Chennai doctors design app that works as hearing aid [Chennai]

Publication info: The Times of India (Online) [New Delhi] 09 Dec 2013.

Full text: CHENNAI: There are apps to play with, there are apps to learn. And now comes an app that helps those with hearing problems. Doctors at the Madras ENT Research Foundation (MERF), along with some European experts, have designed 'Listen App' that works as a hearing aid compatible with a mobile phone. What's more, it works on Bluetooth.

Nearly 6% of the Indian population has different degrees of hearing loss, but only 10% of them have access to a hearing aid. The mobile phone app aims to bridge this gap.

MERF Institute of Speech and Hearing principal Dr Ranjith Rajeswaran said the reason that many people do not use a hearing aid is lack of accessibility, affordability and sustainability. "But with this application, anyone who has a hearing impairment can have access to a hearing aid at a fraction of the cost," he said. He added that the software comes with a music player and television option which would be compatible in movie theatres.

The software was launched at the closing day of a five-day workshop on vocal arts and sciences which was aimed at training speech pathologists in helping voice professionals and singers preserve their voice. Singer T N Seshagopalan, who was the chief guest of the programme, pointed out that there is lack of awareness about voice culture among singers in India, and efforts should be taken to conserve the voice which is the backbone of their career.

The programme also saw the launch of another application, the Classroom App, designed for school children who have a hearing problem. "Almost 80% of school children perform poorly in academics as they have problems listening in class. With this application, they will not be distracted as other environmental noises get filtered through the hearing device and only the teacher's voice that comes through a microphone gets amplified," said MERF founder Dr Mohan Kameshwaran. Studies have shown that an assistive listening device of this kind has the capacity to improve the academic performance of a child by 60% in 10 months, said the doctor.

Siemens Medical Instruments Pte. Ltd.; Patent Application Titled "Method for Operating a Hearing Apparatus" Published Online

Publication info: Electronics Newsweekly (Nov 6, 2013): 7117.

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors BARTHEL, ROLAND (FORCHHEIM, DE); OTTE, CLEMENS (MUENCHEN, DE); RASS, UWE (NUERNBERG, DE); STEINKE, FLORIAN (MUENCHEN, DE), filed on April 17, 2013, was made available online on October 24, 2013.

Full text: 2013 NOV 6 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors BARTHEL, ROLAND (FORCHHEIM, DE); OTTE, CLEMENS (MUENCHEN, DE); RASS, UWE (NUERNBERG, DE); STEINKE, FLORIAN (MUENCHEN, DE), filed on April 17, 2013, was made available online on October 24, 2013.

The assignee for this patent application, patent application serial number united state, is Siemens Medical Instruments Pte. Ltd.

Reporters obtained the following quote from the background information supplied by the inventors: "Field of the Invention

"The invention relates to a method for operating a hearing apparatus, in which an operating parameter of the hearing apparatus is determined and smoothed by a filter. The invention further relates to a hearing apparatus having a signal processing apparatus, wherein at least one operating parameter of the signal processing apparatus can be adjusted and smoothed by a filter.

"The term hearing apparatus is understood here to mean any auditory stimulus-producing device which can be worn in or on the ear, in particular a hearing device, a headset, earphones or suchlike.

"Hearing devices are wearable hearing apparatuses which are used to provide hearing assistance to the hard-of-hearing. In order to accommodate the numerous individual requirements, various designs of hearing devices are available such as behind-the-ear (BTE) hearing devices, hearing device with external earpiece (RIC: receiver in the canal) and in-the-ear (ITE) hearing devices, for example also concha hearing devices or completely-in-the-canal (ITE, CIC) hearing devices. The hearing devices listed as examples are worn on the outer ear or in the auditory canal. Bone conduction hearing aids, implantable or vibrotactile hearing aids are also available on the market. With these devices the damaged hearing is stimulated either mechanically or electrically.

"The key components of hearing devices are principally an input transducer, an amplifier and an output transducer. The input transducer is normally a sound receiver e.g. a microphone and/or an electromagnetic receiver, e.g. an induction coil. The output transducer is most frequently realized as an electroacoustic transducer, e.g. a miniature loudspeaker, or as an electromechanical transducer, e.g. a bone conduction receiver. The amplifier is usually integrated into a signal processing unit. This basic configuration is illustrated in FIG. 1 using the example of a behind-the-ear hearing device. One or more microphones 2 for picking up ambient sound are incorporated into a hearing device housing 1 to be worn behind the ear. A signal processing unit 3 which is also integrated into the hearing device housing 1 processes and amplifies the microphone signals. The output signal from the signal processing unit 3 is transmitted to a loudspeaker or receiver 4, which outputs an acoustic signal. The sound may be transmitted to the device wearer's eardrum by way of an acoustic tube which is fixed in the auditory canal by an ear-mold. Power for the hearing device and in particular for the signal processing unit 3 is supplied by a battery 5 which is also integrated in the hearing device housing 1.

"The signal processing unit contains operating parameters, which are dependent on the microphone signals. For instance, the strength of a noise filtering is varied as a function of noise intensity or an additional directional microphone with a given strength is activated as a function of an acoustic environment.

"These operating parameters therefore vary temporally with the acoustic environment. In order to prevent frequent sudden changes in parameter values, it is usual to smooth the temporal curve of the parameter values by a suitable filter.

"One example of this is a smoothing average value filter, such as the exponentially weighted smoothing average value. In order to achieve a smoothing with such a filter, the data to be smoothed relating to the entire window width in which the smoothing is to take place, must be provided in the storage device of the signal processing unit. With conventional operating conditions, for instance a sampling rate of 24 kHz and a window width of 3 s, significant data quantities accumulate which, on account of the limited storage capacity of conventional signal processing apparatuses, may rapidly lead to capacity problems.

"U.S. patent publication No. 2010/0232633 A1 discloses a method for recording operating parameters of a hearing device, in which input data is classified in accordance with its association with value ranges. A digit assigned to the respective value range is incremented for each input value, so that a histogram is obtained which reproduces the distribution of the input values."

In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent application: "It is accordingly an object of the invention to provide a method for operating a hearing apparatus and a hearing apparatus which overcome the above-mentioned disadvantages of the prior art methods and devices of this general type, which enable a smoothing of temporally varying operating parameter values of a hearing apparatus with as little storage space requirements as possible.

"With an inventive method, the input value is classified for each input value, in other words each unsmoothed value, in accordance with its association with a plurality of predetermined classes and a counter assigned to the respective class, which belongs to the input value, is increased. In the simplest case, the counter value of the counter can in this way be incremented by one, other increments which vary if necessary from step to step can however also be used. The counter with the greatest counter value is then determined and an operating parameter value assigned to the counter with the greatest counter value is output as an output variable of the filter.

"Such a smoothing method manages with significantly less storage compared with algorithms known from the prior art. Instead of having to store the input data relating to the entire window width, only the storage space for the counter assigned to the respective classes is required so that the method is in particular suited to use under the relatively limited conditions of hearing apparatuses.

"In a first variant of the method, only the operating parameter value assigned to the counter with the greatest counter value is then output as an output variable if the counter exceeds a predetermined threshold value. Alternatively, the operating parameter value output last is retained as an output variable. The choice of threshold value essentially determines here the window width of the smoothing algorithm.

"It is expedient in this case, when exceeding the threshold value, by one of the counters after outputting the output variable, to set all counters to zero so that the smoothing effect is retained and the storage space is limited.

"In the embodiment illustrated up to now, the method is in particular suited to smoothing operating parameters of the hearing apparatus, which already exist in a discretized form. This may be for instance the evaluation of the acoustic surroundings of the hearing apparatus according to a number of discrete classes (conversational situation, background music and suchlike).

"The method is however also suited to handling non-discrete, real-valued operating parameters. In this case, the classes are preferably represented by cohesive intervals across predetermined, non-discrete value ranges, in order to achieve a discretization in the first step of the method which enables a particularly storage-efficient processing.

"It is further expedient here to scale all counter values by a predetermined factor .lamda. with 0.ltoreq..lamda..ltoreq.1 prior to increasing the counter value. Such a scaling limits the growth of the counter values and thus indirectly determines the window width of the smoothing algorithm. The scaling further influences the extent to which values present in the past determine the current output variable of the filter so that the characteristics of the filter can be adjusted particularly easily by choosing .lamda.

"Instead, as in the initially described variant, of simply incrementing the counter by one for each class which can be assigned an input value, a more complex method of counting is preferably selected here. All counter values are herewith increased by an amount which is dependent on a distance of the input value from a center point of the interval corresponding to the respective class.

"In other words, an input value in this variant of the method not only influences the counter of the class to which it directly belongs, but also the counter of adjacent classes. This results in an additional smoothing and improves the robustness of the algorithm.

"It is particularly expedient here to increase the counter value vj of a class j of the classes, which is assigned an interval with the center point bj, by (1-.lamda.)max(0,1-(|yi-bj|)/.sigma.)) for each input value yi of the operating

parameter, wherein .sigma. represents a predetermined influence radius.
"Classes, the interval center point of which are further away from the input value than the amount of .sigma., are therefore not influenced so that the smoothing properties of the filter can be set by choosing .sigma.
"Overall, an algorithm is created, which, with a constantly low storage requirement, can smooth real-valued data across any window width both in a discretized and also non-discrete manner, and is in this way robust compared with outliers and transient events.
"The invention further relates to a hearing apparatus of the type cited in the introduction, a signal processing apparatus of which has a filter and is designed, in order to smooth the operating parameter for each input value, to classify the input value in accordance with its association with a plurality of predetermined classes and to increase a counter assigned to the respective class, which belongs to the input value, to determine the counter with the greatest counter value and to output an operating parameter value assigned to the counter with the greatest counter value as an output variable of the filter. As already explained with the aid of the inventive method, a robust and storage-efficient smoothing of the operating parameters of the hearing apparatus can herewith be achieved.
"Other features which are considered as characteristic for the invention are set forth in the appended claims.
"Although the invention is illustrated and described herein as embodied in a method for operating a hearing apparatus and a hearing apparatus, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings. BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING
"FIG. 1 is a schematic layout of a hearing apparatus according to the prior art; and
"FIG. 2 is a schematic representation of a course of an exemplary embodiment of a method according to the invention."
For more information, see this patent application: BARTHEL, ROLAND; OTTE, CLEMENS; RASS, UWE; STEINKE, FLORIAN. Method for Operating a Hearing Apparatus. U.S. Patent Application Serial Number united state, filed April 17, 2013, and posted October 24, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3647&p=73&f=G&l=50&d=PG01&S1=20131017.PD.&OS=PD/20131017&RS=PD/20131017
Keywords for this news article include: Algorithms, Electronics, Signal Processing, Siemens Medical Instruments Pte. Ltd..

Atypical vertical sound localization and sound-onset sensitivity in people with autism spectrum disorders

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Publication info: Journal of Psychiatry & Neuroscience : JPN 38.6 (Nov 2013): 398-406.

Abstract (Abstract): Background: Autism spectrum disorders (ASDs) are associated with auditory hyper- or hyposensitivity; atypicalities in central auditory processes, such as speech-processing and selective auditory attention; and neural connectivity deficits. We sought to investigate whether the low-level integrative processes underlying sound localization and spatial discrimination are affected in ASDs.

Full text: Headnote

Background: Autism spectrum disorders (ASDs) are associated with auditory hyper- or hyposensitivity; atypicalities in central auditory processes, such as speech-processing and selective auditory attention; and neural connectivity deficits. We sought to investigate whether the low-level integrative processes underlying sound localization and spatial discrimination are affected in ASDs. Methods: We performed 3 behavioural experiments to probe different connecting neural pathways: 1) horizontal and vertical localization of auditory stimuli in a noisy background, 2) vertical localization of repetitive frequency sweeps and 3) discrimination of horizontally separated sound stimuli with a short onset difference (precedence effect). Results: Ten adult participants with ASDs and 10 healthy control listeners participated in experiments 1 and 3; sample sizes for experiment 2 were 18 adults with ASDs and 19 controls. Horizontal localization was unaffected, but vertical localization performance was significantly worse in participants with ASDs. The temporal window for the precedence effect was shorter in participants with ASDs than in controls. Limitations: The study was performed with adult participants and hence does not provide insight into the developmental aspects of auditory processing in individuals with ASDs. Conclusion: Changes in low-level auditory processing could underlie degraded performance in vertical localization, which would be in agreement with recently reported changes in the neuroanatomy of the auditory brainstem in individuals with ASDs. The results are further discussed in the context of theories about abnormal brain connectivity in individuals with ASDs.

Introduction

People with autism spectrum disorders (ASDs) display im- paired social interaction and communication skills and a pat- tern of rigid and repetitive behaviour, according to the DSM- IV criteria.1 In addition, ASDs are associated with both hyposensitivity and hypersensitivity to sensory stimuli.2--4 These are not considered primary features of ASDs in the DSM-IV, but they are included as criteria in the DSM-5 (www.dsm5.org). Given the impaired verbal communication skills of people with ASDs, the questions of whether and how auditory processing is affected and of how this relates to the underlying neural substrate are highly relevant. This is also evi- denced by a rapidly increasing interest in auditory and speech perception in individuals with ASDs.5--7 Findings indicate that children with ASDs have enhanced pitch perception, difficulty understanding speech in noisy environments and a reduced likelihood of orienting toward auditory social stimuli.8--13

Auditory brainstem responses have longer and less con- sistent latencies in individuals with ASDs.14 The primary auditory cortex in people with ASDs and auditory hypersen- sitivity show a stronger response to pure tone pip stimuli.15 Studies investigating speech-in-noise perception have shown that people with ASDs have more difficulty than controls understanding speech in noise with (spectro)temporal dips.10 This effect, a weaker comodulation masking release16 in peo- ple with ASDs, was also found in a later study, suggesting that controls were better able to integrate information over temporally separated intervals than participants with ASDs.11 Spatial attention has been shown to be affected and accompa- nied by abnormal event-related brain potentials in people with ASDs in a spatial hearing experiment.17 Recent post- mortem investigations of the brainstem olivary complex (part of the auditory pathway) in decedents who had ASDs re- vealed a greatly reduced size of the medial superior olive (MSO), with lower numbers of stellate and fusiform neurons and, to a lesser degree, reduced size of the other nuclei of the superior olivary complex (SOC).18,19 These are, to the best of our knowledge, the only histological studies investigating these structures in decedents who had ASDs, and unfortu- nately patient and control brains were not perfectly matched for sex and level of functioning.

Nevertheless, they provide an interesting perspective on auditory processing in brains affected by ASDs.
These and other abnormalities reported across a broad range of processes in the auditory domain6,7 suggest that the pathophysiology of ASDs may not be exclusively confined to higher-level (top--down) cognitive processing, but may al- ready be present at the level of primary sensory (bottom--up) processing. The concept of more pervasive neural deficits is closely related to the hypothesis of abnormal connectivity throughout the brain in people with ASDs.20--23 Two specific theories of deficient connectivity focus on deficits in temporal binding21 (reduced ?-band synchronization between local brain networks) and the ratio of excitation to inhibition in the brain.23 Functional and structural imaging studies have also suggested abnormal subcortical connectivity in people with ASDs.24--26 Recent investigations seem to point toward a com- bination of short-range overconnectivity and long-range underconnectivity in people with autism.27 This "connectivity hypothesis" of ASDs claims that the social and cognitive ab- normalities may be explained by poor long-range connectiv- ity between distant regions of the brain and excessive short- range connectivity within and between nearby regions.22 This hypothesis has recently been called into question, as motion- related artifacts may have contributed to findings in func- tional connectivity studies.28--30

The auditory pathway in the human brain is relatively well understood31 and, as such, offers a good opportunity to obtain better understanding of ASDs at the neural level. This is par- ticularly promising for the neural mechanisms underlying sound localization, as the roles and neural connectivities of the different auditory brainstem nuclei in localization are to a large degree described and understood.32,33 We reasoned that global connectivity deficits and abnormal brainstem develop- ment could profoundly and predictably affect sound localiza- tion. We performed 3 behavioural experiments, which are out- lined in the sections that follow; an overview is given in the Appendix (Table S2, available at cma.ca/jpn). While we cannot unambiguously map behavioural measurements to these neural mechanisms, any observed atypicalities would provide a new perspective on auditory processing in individuals with ASDs and could be a starting point for future research.

Horizontal and vertical localization of noise stimuli within background noise

Horizontal localization relies predominantly on the detection of interaural time differences (ITDs), originating from the different distances of the ears to the sound source, and interaural level differences (ILDs), caused by frequency-dependent masking by the head.32 For low frequencies, ITD detection is the primary mechanism. It relies on coincidence detection of spikes travel- ling along the ipsilateral and contralateral auditory nerve fibres. Hence, ITD detection critically depends on the accurate timing of inputs at the ears.34--36 For higher frequencies, starting from about 2 kHz, ILD detection by excitatory--inhibitory (EI) and inhibitory--excitatory (IE) cells becomes the primary mechan- ism.37 These cells are sensitive to the ILD at their best frequency. As ITD and ILD detection integrate binaural information, they rely on intact long-range neural connectivity between the brain- stem nuclei of the left and right pathways.

Sound-source location in the vertical plane is determined from the spectral shape properties of the acoustic input that arise from the complex geometry and associated direction- dependent filtering of the pinna.32 Vertical localization at lat- eral locations38 does not rely on integrating binaural informa- tion, but is primarily a "within-stream" monaural process that is thought to rely on short-range connectivity within auditory nuclei (i.e., within tonotopic maps).34,35 It has been shown that abnormalities in this processing stream can be sensitively demonstrated by adding competing background noise to increase the difficulty of the localization task.39

We designed an experiment to investigate whether hori- zontal and vertical localization performance are affected in people with ASDs and whether difficulties in signal/noise separation add to this.

Vertical localization of sweep stimuli

To investigate impaired temporal integration in participants with ASDs, we performed a localization experiment with repetitive frequency-modulated sweeps of different repeti- tion periods. The instantaneous spectral properties of sweeps are narrowband, but as the moving centre frequency covers all audible frequencies, a fast sweep can be temporally inte- grated by the brain to provide sufficient spectral information for vertical sound

localization.40 The sweep experiment al- lowed us to systematically vary the temporal integration window across sweeps by varying their speeds and thus al- lowed us to test our hypothesis that healthy control partici- pants can integrate spectral information over a longer win- dow than participants with ASDs.

Precedence effect

When the same sound originates from 2 locations with a short temporal delay, there is a temporal window within which the brain will fuse the sounds into a single source; this phenomenon is known as the precedence effect.41,42 In most cases the fused sound will appear to originate from a point between the actual sound locations and weighted by the stimulus delay. The time difference up to which this effect oc- curs (about 5--50 ms) is at least an order of magnitude larger than the maximum ITD caused by the distance between the ears (about 650 μs). The precedence effect can be interpreted as an aspect of temporal integration sensitivity. We hypothe- sized that a shorter temporal integration window in partici- pants with ASDs would result in a shorter time window for the precedence effect in this group than in healthy controls.

Methods

Participants

Measurements were performed in adults with ASDs and healthy controls. We obtained written informed consent from all participants. The study was approved by the local ethical committee (CMO regio Arnhem-Nijmegen). We recruited high-functioning participants with ASDs from referrals to the department of psychiatry at the Radboud Uni- versity Nijmegen Medical Centre and from participants in a previous study.43 People with ASDs were included if they had a clinical diagnosis of autistic disorder or Asperger syndrome according to DSM-IV1 criteria and if they had no comorbid Axis I disorders. Clinical diagnoses were established by expe- rienced clinicians on the basis of a careful developmental his- tory and psychiatric evaluation. Clinical diagnoses were con- firmed by administering a structured interview, the Autism Diagnostic Interview-Revised (ADI-R),44 among the parents or caretakers of participants. We recruited healthy control par- ticipants from the Donders Institute database. We tested the nonverbal intelligence of participants using Raven's Ad- vanced Progressive Matrices (APM). Participants were in- cluded if they were between 18 and 35 years old. We excluded individuals who reported hearing impairment, severe neuro- logic impairment or severe psychiatric comorbidity.

The sweep localization experiment was performed in the groups described above; participants were asked to come back for the noise localization and precedence experiments. Since not all participants were still available, new healthy control participants were included in these experiments.

Experimental setup

Experiments were performed in a dark 3 ×3 ×3 m room with reflection-dampening walls, preventing echoes above 500 Hz. Stimuli were presented from 1 of 58 identical speakers (Visaton SC 5.9) mounted on a motorized hoop measuring 2.5 m in diameter that could rotate around the earth-vertical axis at a precision better than 0.1°. Speakers were mounted on the hoop at 5° increments, from --55° to 85° on the front half, and from --52.5° to 87.5° on the back half, thus allowing for a 2.5° resolution in the elevation direction. The participant was seated comfortably in a modified chair, with his or her head in the centre of the hoop. Two fixed background speakers were positioned at a height of 1.5 m on both sides of the frontal wall (see the Appendix, Fig. S1). Stimuli were generated offline using MATLAB (Mathworks) at a sampling rate of 48.828kHz, had 5ms sinusoidal onset and offset envelopes, and were presented from a real-time processor (RP2.1, Tucker-Davis Technologies, System 3). Custom-made ampli- fiers that allowed for a per-trial attenuation drove the speak- ers on the hoop; an off-the-shelf amplifier (Philips FA569) drove the background speakers. The experiment was con- trolled by custom-written software running on a standard personal computer (Dell).

Two sets of single-turn magnetic-field coils attached along the edges of the side walls (horizontal) and floor and ceiling (vertical) generated the oscillating magnetic fields for the search-coil method at 60 kHz and 80 kHz, respectively. The participant wore a lightweight spectacle frame with a pickup coil attached on its nose bridge, allowing precise measurement of the head orientation at a resolution better than 0.1°. A laser diode attached to

the spectacle frame in the centre of the pickup coil projected onto a small (1 cm2) plate fixed at about 30 cm in front of the head, providing the participant with a convenient head-fixed visual pointer. To convert measurements on the horizontal and vertical channels into azimuth and elevation head orientation angles, we used a visual calibration procedure in which the participant pointed at target light-emitting diodes (LEDs) throughout the relevant region of measurement within the frontal hemifield. Head orientation was expressed in az- imuth and elevation coordinates, defined as the angles with the medial and horizontal planes, respectively.45

Noise localization experiment

In each trial, we presented a white noise background (0.2--20 kHz) with a sound pressure level (SPL) of of 62 dB from the fixed speakers for a duration of 2500 ms. After a random delay of 450--700 ms from white noise onset, 1 of the speakers on the hoop played a broadband target stimulus consisting of quasi--white noise (0.2--20 kHz) looped with a 20ms period (sounding like a buzzer) for a total duration of 150 ms including 50 ms on/offset envelopes. Target locations were selected pseudorandomly from a flat distribution within --75° and 75° azimuth and --45° and 60° elevation. In- tensity varied between --20 and 0 dB in steps of 5 dB with re- spect to the background stimulus. In addition, we included control localization trials without the background noise and at the maximum target intensity.

We instructed participants to aim the visual pointer at a fixation LED (middle of the frontal wall) at the start of the trial and then to quickly aim it in the direction of the target sound stimulus and to maintain fixation for about a second. We included 29 trials per sound level, yielding a total of 174 trials.

Sweep experiment

Stimuli consisted of repeated full-range (0.2--24.4 kHz) fre- quency sweeps, generated using the voltage-controlled oscilla- tor function in the signal processing toolbox in MATLAB. Sweeps had durations of 1, 2, 4, 8, 16 and 32 ms and were re- peated to produce stimuli that all had a total duration of 150ms. All stimuli were presented at 0 azimuth, with eleva- tions between --45° and 60° and with no background sound. Participants received the same visual pointing instructions as they did for the noise localization experiment. There were 132 trials.

Precedence experiment

In the precedence experiment, we presented a 100 ms white noise stimulus at an SPL of 62 dB from both background speakers (located at --45° and 45° azimuth and 0° elevation) with a delay of 0--40 ms in either the left or right channel. Par- ticipants were instructed to push a button if they heard 2 sounds ("2 onsets"). There were 150 trials.

Statistical analysis

Prior to further analysis, we extracted head movement par- ameters (representing pointer position) for the localization and sweep experiments from the measured data. A custom developed toolbox46 automatically detected responses using velocity and acceleration criteria. Some detected intervals needed manual adjustment. The head orientation at the end of the participant's response was the response angle used for further analysis.

We parameterized participant performance in the local- ization experiments with 2 measures: the response gain, which is the slope of a linear fit of response angles to stimu- lus angles, and the Pearson linear correlation coefficient be- tween stimulus and response data. We substituted trials without a response by setting the azimuth and elevation co- ordinates to zero. In the correlation computation, we only included trials where the participant made a response. If the participant responded in fewer than 3 trials for a given con- dition, the correlation was set to zero. This only occurred for the lowest intensity category in the noise localization ex- periment. We assessed group level effects using repeated- measures analysis of variance (ANOVA) with a significance threshold of ? = 0.05. We calculated statistics using SPSS version 19 (IBM Corporation).

In the precedence experiment, we applied logistic regres- sion to model the responses per participant. From the

regres- sion coefficients, we computed the point where 2 sounds were reported in 50% of the cases as the threshold. We as- sessed group differences using a 2-tailed, 2-sample t test with a significance threshold of ? = 0.05.

Results

The characteristics of the included participants are shown in Table 1. Ten participants with ASDs and 6 controls partici- pated in all experiments. One patient with an ASD was ex- cluded owing to neurologic abnormalities and 1 was ex- cluded owing to hearing impairment. Two controls and 1 patient with an ASD were excluded because they had not performed the task correctly. For 9 participants it was not possible to obtain ADI-R data because no parent or care- taker was available. One participant had a score below the cut-off on the social interaction scale, 2 scored below the cut-off for stereotypical behaviour and 4 did not meet the onset cut-off. The clinical picture, however, was very typical in all of these cases. All other ADI-R scores were above the cut-off in all domains.

Figure 1 shows all responses from the noise localization experiment of an example participant from either group, sorted by different signal-to-noise ratios (SNRs). Note that azimuth performance in both participants is very reliable up to the point starting below --15 dB, where the participants had great difficulty hearing the stimulus. In contrast, elevation performance decreased more gradually for all SNRs. This pattern is consistent with earlier findings obtained from healthy controls.39

The group analyses show that azimuth localization had very good trial-to-trial reproducibility for SNRs of --10 dB and higher in both the ASD and control groups, with both gain and correlation decreasing for the low SNRs (Fig. 2A). Differences between the ASD and control groups and interac- tions with SNRs were not significant (all $p > 0.10$). For the elevation response components, both gain and correlation were significantly lower for the ASD than the control group (Fig.2B, C; gain: $F_{1,18} = 6.45$, $p = 0.021$, partial $\eta^2 = 0.26$; corre- lation: $F_{1,18} = 8.28$, $p = 0.010$, partial $\eta^2 = 0.32$). The group ×SNR interaction after Greenhouse--Geisser (GG) correction was significant for gain ($F_{5,90} = 4.00$, $p_{GG} = 0.019$, partial $\eta^2 = 0.18$), but not for correlation ($p_{GG} = 0.637$). We used GG correc- tion, as both ANOVAs violated the sphericity assumption for repeated-measures ANOVA (Mauchly test of sphericity $p < 0.001$ in both tests).

Figure 3A summarizes the results for the sweep localiza- tion experiments. The data show the response gains and cor- relations in the elevation direction as a function of sweep duration of 1--32 ms. Participants with ASDs showed signifi- cantly lower correlation scores than controls (Fig. 3B, $F_{1,36} = 5.70$, $p = 0.022$, partial $\eta^2 = 0.14$; Mauchly test of sphericity $p = 0.05$). The difference in gain was not significant ($p = 0.13$). Group ×period interactions were not significant for either gain or correlation (both $p > 0.10$).

Figure 4A shows the measured psychometric curve from an example participant in the ASD and control groups dur- ing the precedence experiment, in which the relative fraction of perceived double stimuli is plotted against speaker delay. For short delays, the participant reported hearing a single sound in all trials, whereas 2 sounds were reported for the longest delays. In the group results (Fig. 4B), the average 50% response point was 30.1 ±standard deviation (SD) 4.2 ms for healthy control listeners and 24.2 ±7.1 ms for listeners with ASDs; this difference was significant ($t_{14.7} = -2.26$, $p = 0.039$, Cohen $d = 1.0$; equal variances not assumed).

To investigate whether performance in the noise localization and precedence experiments were related, Figure 5 shows both measures per participant. Performance in the 2experiments sig- nificantly correlated across all participants ($r = 0.47$, $p = 0.037$).

See the Appendix for an exploration of age, which was not included in the analyses, as an explanatory variable.

Discussion

Horizontal and vertical localization of noise stimuli within background noise

In the noise localization experiment, participants with ASDs and healthy controls performed equally well in horizontal plane localization for all employed SNRs. The similarity in performance between the groups confirms that both healthy controls and participants with ASDs had few problems hear- ing the stimuli for SNRs above --

20 dB and were attentively performing the task.

Interestingly, participants with ASDs performed markedly worse at vertical localization in this experiment. In contrast to horizontal localization,33 vertical localization is predominantly a monaural process, especially for lateral targets.38 A possible ex- planation for the impairment in performance is abnormal con- nectivity within the cochlear nuclei and the inferior colliculi, which are believed to be involved in elevation detection.47,48 A sharp reduction in the number of fusiform neurons in the MSO in patients with ASDs has been reported in the litera- ture.18,19 It has been suggested that similar neurons in the cochlear nucleus play a role in elevation processing47and orient- ing toward elevated sources.49,50 The efferent fibres from these neurons project to the inferior colliculus and the medial genicu- late body.51 A reduction in the number of fusiform neurons in the cochlear nucleus could, therefore, impair downstream relay- ing of elevation information from the cochlear nucleus.

We observed a significant group ×SNR interaction for the vertical response gain in this experiment. The curves in Fig- ure 2B suggest that the between-group effect of gain could be multiplicative rather than additive, which could potentially explain the interaction. Although the results are compatible with impaired vertical localization at a low SNR in partici- pants with ASDs (a shift of the curve to the left), we cannot, therefore, unambiguously attribute the significant interaction to such an effect.

Vertical localization of sweep stimuli

Like in the noise localization experiment, we also observed that participants with ASDs performed worse on vertical lo- calization in the sweep localization experiment. The differ- ence between groups appeared largest for the fastest sweeps, although the group ×period interaction was not significant. It has been shown previously that the fast sweeps contain ad- equate spectral information and should therefore be the easi- est stimuli to localize in the vertical plane.40 The apparent lack of a between-group difference that is specific to the slower sweeps suggests that there is no difference in the length of the spectrotemporal integration window, but rather that fun- damental elevation processing is affected in people with ASDs (as in the noise localization experiment).

Precedence effect

Participants with ASDs showed a weaker precedence effect than controls. Previously reported thresholds for the prece- dence effect vary greatly with stimulus type and response task. A threshold of 22 ms has been reported for 100 ms noise bursts,42,52 although in that experiment the criterion was "equal loudness of lead and lag," instead of the "double on- set" criterion that we used in the present study. Larger values (30--50 ms) have been reported for speech.42 In light of these previous findings, the thresholds reported in the present study seem plausible. The shorter threshold in participants with ASDs could hint at a reduced ability to integrate infor- mation over time and thus appears to be consistent with the temporal binding hypothesis.21 Moreover, the time scale of the precedence effect falls exactly in the hypothesized time- scale of temporal binding deficit21 (i.e., in the 10--40 ms range of the ?-band frequencies).

General discussion

We will briefly consider how the results we discussed could relate to the theory of abnormal connectivity in people with ASDs.22,27 With respect to vertical localization, connectivity theories of ASDs would suggest local overconnectivity,20 and this seems plausible, as either under- or overconnectivity would likely have a detrimental effect on performance. Find- ings of reduced sizes of the relevant nuclei in people with ASDs and reduced sizes of their neuronal populations, how- ever, could point to reduced connectivity.18,19 As binaural pro- cessing is fundamental for the precedence effect, factors con- tributing to the shorter temporal window may include reduced long-range connectivity between the left and right pathways. Hence, the combination of the localization and precedence experiments is compatible with this part of the connectivity hypothesis. The significant correlation between performance in the noise localization and precedence experi- ments (Fig. 5) suggests that both effects may indeed originate from the same root cause at the neuronal level.

The hypothesis of reduced temporal binding in people with ASDs21 may provide an explanation for a weaker prece- dence effect in this population. Note, however, that there was no indication of deficient coincidence detection in azimuth processing in the first experiment. This indicates that tem- poral binding may indeed be affected, but that this may be more appropriately viewed as having consequences at longer time scales, perhaps in more complex neural systems, rather than a direct problem in neural timing.

Fusiform cells in the auditory brainstem have been described as pyramidal cells as well, and this may hint at a relation be- tween our findings and reported abnormalities in development of other brain areas. Pyramidal cells of smaller size have been observed in layers III, V and VI of Brodmann areas 44 and 45.53 These neurons are involved in longer-range cortical and subcor- tical projections. In the same layers of the fusiform gyrus, neur- ons were found to be smaller and fewer in number.54 In this con- text it should also be noted that, as it seems likely that neuronal atypicalities are present throughout the brain, changes in corti- cal processing could provide complementary or alternative ex- planations for impaired task performance.

It has been speculated19 that the reduced number of fusi- form and stellate cells may be caused by neuroblasts failing to migrate to the SOC or that they may not survive after fail- ing to form connections to the cochlear nuclei. A potentially interesting aspect of these data, although the authors did not mention this, is that in people with ASDs, the number of MSO neurons seems to increase with age until adulthood, whereas in controls, the number seems constant over the age range covered. A delayed development trajectory of the brain is one of the main features of theories on ASDs;55 a potential developmental aspect in the neural structure of the auditory pathway suggests that investigating sound localization in children may prove worthwhile.

Limitations

With the broadband stimuli that we used in the present study, it is not possible to disentangle the ITD and ILD detec- tion mechanisms that contribute to horizontal localization. Follow-up studies could use stimuli with only low- or high- frequency content to distinguish between the 2 mechanisms. Group sizes were relatively small in the experiments inves- tigating localization in noise and in the precedence experi- ment. For this reason it was not possible to perform analyses on performance differences among participants in the ASD group. It may be fruitful to investigate subgroups and correl- ations of localization task performance with other diagnostic measures in future research.

Conclusion

We observed 2 abnormalities in auditory processing in people with ASDs: participants with ASDs performed worse than con- trols on vertical sound localization, and the temporal window for the precedence effect was shorter in participants with ASDs than controls. The functional abnormality in vertical localiza- tion may be a reflection of a reduction in structural connectivity that has been reported in the literature18,19 and is consistent with the hypothesis of reduced long-range connectivity.20,27 The tem- poral binding hypothesis of ASD21 could explain the shorter temporal window in which the precedence effect occurs.

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J Psychiatry Neurosci 2013;38(6):398-406.
Submitted Sept. 5, 2012; Revised Jan. 14, Mar. 20, 2013; Accepted Mar. 20, 2013.
DOI: 10.1503/jpn.120177
Competing interests: C. Kan is on the ADHD Advisory Board at Eli Lilly and has received royalties for 2 Dutch books on autism. J.K.Buitelaar declares an internal grant from the University Medical Centre, Radboud University. No other competing interests declared.
Contributors: E. Visser, M. Zwiers, A.J. van Opstal and J.K. Buitelaar designed the study. E. Visser, C.C. Kam and L. Hoekstra acquired the data, which E. Visser, M. Zwiers, A.J. van Opstal and J.K. Buitelaar analyzed. E. Visser, M. Zwiers and A.J. van Opstal wrote the article, which all authors reviewed and approved for publication.

Suhami Associates ltd; Patent Issued for Cellphone Managed Hearing Eyeglasses

Publication info: Telecommunications Weekly (Oct 9, 2013): 1075.
ProQuest document link

Abstract: [...]it can also replace many of the functions of the cellular phone.

Links: Check LinkSource for Full Text

Full text: 2013 OCT 9 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- A patent by the inventor Suhami, Avraham (Petah Tikva, IL), filed on March 27, 2012, was published online on September 24, 2013, according to news reporting originating from Alexandria, Virginia, by VerticalNews correspondents.
Patent number 8543061 is assigned to Suhami Associates ltd (Petah Tikva, IL).
The following quote was obtained by the news editors from the background information supplied by the

inventors: "A Hearing Aid enhances hearing by amplifying voices detected by a sensitive microphone, while bringing an individual's reduced hearing response at various audible frequencies, to the level of hearing of a normal person, which is defined roughly as the ability to hear sounds on an absolute scale of 0 to 25 dB. The modified sound is then delivered into the user's ear canal.

"Hearing Aids also use various algorithms to suppress noise, echo and eliminate receiver-to-microphone acoustic feedback.

"Hearing devices may be situated behind-the-ear (BTE), in-the-ear (ITE) or completely-in-the-ear canal, (CIC).

"In recent years the use of cellphones in relaying voice messages from one person to another has increased enormously. The advent of cellular phones has caused many problems for the hearing impaired people wearing one of the hearing aids in or behind the ear, starting from the electromagnetic interferences between the two devices that are in close distance one from the other and the physical encumbrance caused by placing the cellphone over the hearing aid. Several solutions to these problems have been devised, including the use of inductive communication between the cellphone and the hearing aid device through the use of telecoils or resolving the causes of interferences. However to the best of our knowledge no radical solution to the hearing impaired people in the cellular phone age has been suggested nor implemented.

"One of the technological problems of the (BTE), (ITE) or (CIC) type hearing aids is the determination of the direction of the sound reaching the ear; precise determination of the direction of sound enables to eliminate unwanted sources of sound and greatly improve SNR. This problem is currently dealt by using directional microphones that alleviate the problem (see U.S. Pat. No. 3,770,911). Some previous art solutions have suggested using two microphones and measuring the phase delay between them for determining the sound direction, however if the two microphones are very close the determined direction is not accurate. There have been several applications to put several microphones on the eyeglasses temples (see U.S. Pat. No. 3,247,330, U.S. Pat. No. 4,773,095; U.S. Pat. No. 7,192,136; U.S. Pat. Nos. 7,031,483; 7,609,842, 20090252360) for finding the direction of sounds however the technological implementations of these devices have been unsuccessful. There are also no cellphones that, working collaboratively with 'hearing eyeglasses', eliminate unwanted directional or non-directional sound."

In addition to the background information obtained for this patent, VerticalNews journalists also obtained the inventor's summary information for this patent: "The invention describes a Hearing Aid device composed of a cellphone and eyeglasses where some of the programs are carried out by components embedded onto the temples of eyeglasses and some programs by components which are inherently part of cellphones. The combined device improves the intelligibility of voice messages arriving both through the cellphone speaker, the connected earphones and directly through the free air. The user can call diverse programs suitable for different situations, by using inertial sensors embedded either in the eyeglasses or are inherently part of the cellphone.

"It has to be realized that the core architecture of the classical hearing aid is to detect voice, 'correct' it, and deliver it to the ear of the hearing impaired person.

"A cellphone, in principle can do all these functions, with some reservation though. It can detect voice, directly or through the cellular network, it can determine interactively with the hearing impaired person his hearing profile, it has the computing power to 'boost' certain intensities, and eliminate certain sources of noise and when its speaker is juxtaposed to the ear, it can deliver the 'corrected' sound to the ear of the hearing impaired person.

"There are things that the cellphone cannot do though. In its current architecture, it cannot differentiate between directional sound and surround sound and eliminate unwanted sound and mainly, it cannot be worn all the day connected to the ear.

"Here is where the eyeglasses come. They can be worn inconspicuously all the time, and components embedded on its temples may carry out many of the functions that neither the cellular phone nor the miniscule behind or in the ear hearing aids can. In fact it can also replace many of the functions of the cellular phone.

"The design of the device presented in this application goes half way.
"It comprises a cellphone in its current architecture and eyeglasses where electronic sensors, processors, device conditioners and transceivers are embedded on its temples and can interact with the cellphone through its ports using coded audio instructions. Together they provide to a hearing impaired person, hearing loss corrected speech and sound, arriving either directly or by wireless communications.
"Hearing impaired people communicate with other people directly or using line and wireless communication devices, telephones and cellphones. Intelligibility of a received message is conditional to a faithful reconstruction of the parts of the message that are missing, due to the hearing losses. Amplifying the received message across the board, at all frequencies, is the basic tool that improves intelligibility. When the hearing losses are minimal, amplification may be sufficient. However amplifying both relevant speech and noise may not achieve much. Therefore reduction noise as much as possible is the next goal. In our system we try to substantially eliminate noise using two strategies. One strategy is by letting the hearing impaired person, to limit his 'listening cone' to cover only the space covered by his interlocutor(s). If the noise is omnidirectional, this tool by itself will reduce noise by up to two orders of magnitude. If the noise, on the other hand, is coming from the same direction as his interlocutor, this strategy may not achieve much. Setting a 'listening code' requires at least 4 microphones around the head of the person; consequently this strategy requires to place the microphones on the eyeglasses worn by the user. To increase the accuracy of the limited listening code and the ability to change it quickly in real time, powerful DSPs, that continuously compute cross-correlations between the various microphones, are installed on both temples of the eyeglasses.
"The second strategy we use for reducing noise, is to follow speech components in time with a time resolution of 1-2 milliseconds and try to locate the natural 'pauses' between phonemes, syllables and words. As noise is, with high degree of probability, present both during 'pauses' and during speech segments, subtracting the noise frequencies amplitudes from the following speech frequencies, improves the SNR during speech. This strategy is applicable both to the sound detected by the microphones situated on the eyeglasses temples as it is applicable to the microphone of the cellular phone. The cellphone controls the processors on the temples by emitting high frequency audio instructions in the form of ringtones not heard by most persons.
"The next tool we have, in our endeavour to improve intelligibility of the detected speech is to compensate for the loss of hearing of selected audio notes, mostly at low and high frequencies at each ear. These losses may be measured by the user himself using his cellphone, and the required amplifications at selected frequencies, applied both to the speech detected by the microphones situated on the eyeglasses and at the incoming calls by wireless, before being sent to the respective left and right speakers of the eyeglasses and the cellphone speaker and earphones.
"Next, it is essential to differentiate between the voice of the user and that of other people in order to refrain from amplifying the user's voice and sending it to the respective speakers, thereby starting a regenerative audio loop. This identification of the user's voice may be achieved by cross-correlating the voice segments detected by the microphones at the two opposite sides of the mouth and eliminating those voice segments that are fully correlated. In addition the voice segments detected by the microphones of the eyeglasses or the cellphone, may be compared to the preloaded voice signature of the user, where high correlation approves the identity of the user and therefore are prevented to reach the respective speakers.
"Current Hearing Aid devices, suffer from deficiencies some of which are due to the limited space of several cm.sup.3, into which all the components, including the microphone, the receiver and the batteries, have to be squeezed in. An example is trying to find the direction of sound with two microphones that are 1 cm apart. The limited space, also dictates the use of power-limited data processors that are not powerful enough to perform complex comparisons fast enough.
"In this context it is important to stress the need to process speech rapidly, in order to combine it with speech arriving directly to the ear through the free air, so that the ear will seamlessly integrate the two. Digital hearing

loss compensation comprising spectral decomposition with filters, non-linear amplification depending on the hearing threshold and spectral reconstruction ought to be carried out preferably in milliseconds or less, in order to enable the audio signals emitted by the receiver to be integrated with the sound reaching the ear directly through free air, without much delay.

"The noise subtraction schemes should also abide by the same constraint of speed; they should be able to define and subtract 'noise' from speech, preferably within several milliseconds from the detection by the microphone of said sound wavefront. This kind of quick reaction requires fast and powerful 32 bit DSPs that are hard to squeeze into the miniscule behind-the-ear hearing aids. RF Transceivers embedded on the eyeglasses enable two way communications with the digital world and communication between the temples of the eyeglasses.

"Consequently placing the required powerful DSPs and batteries much larger than the miniscule Zn-air batteries, on the eyeglasses temples, is a major advantage.

"Current 'Hearing Aids' are individualized devices optimized for certain situations by different programs. Change of programs need professional adjustments, requiring frequent visits to the hearing clinic. In this context too, the ability to change programs using the cellphone is a major advantage.

"We also maintain that there is no single solution to hearing impairment. The various situations encountered with different interlocutors and/or sound sources in different locations, are hard to accommodate with one 'ingenious' device. Detecting automatically, the various situations and allocations and maximizing Speech intelligibility accordingly although feasible, is not part of the functionality of the current invention. Different programs are needed to maximize speech intelligibility, in a quiet or noisy room of different sizes, in a Park or in a concert hall. One-on-one dialog is different from Listening to everyone talking at the same time in a meeting. Listening to music at home is different than Listening in a concert hall. Given the breadth of situations, our system opted for letting the user to make the selection between programs, depending on the situation he is in. In our architecture change of programs is done by the user, using his cellular phone by emitting the proper instruction using coded ringtones detected by the microphones embedded on the eyeglasses frames. Some functions like selecting the apertures of the 'Listening cone' may be executed with a number of 'taps' on the 'tap' sensors located on both temples. The selection is then acknowledged by a short message delivered through the receiver of the hearing aid. Large memories are placed on each temple of the eyeglasses to accommodate programs that best satisfy the various situations.

"The Ringtones emitted by the user's cellphone serve a dual purpose, to generate bands of tones of different pitch and timbre of varying intensities for determining the threshold of hearing, and also generate sequences of sounds for controlling the various functions of the system. The coded audio instructions embedded into Ringtones when detected by the microphones of the eyeglasses or that of the cellphone are interpreted by the embedded microcontrollers which then instruct to execute the various functions. A side advantage of relaying instructions to the system by audio is that some people may also relay instructions by just 'whistling' from a distant location. External commands may also be transmitted by the wireless Bluetooth transceiver of the cellphone and detected by the Bluetooth transceiver installed on the eyeglasses.

"The ability to record his own hearing responses, using his cellphone Ringtones, enables the user to do so in real life situations, which is very different from determining a threshold of hearing using pure tones delivered through earphones in a booth of an audio clinic.

"In this context it is important to realize that the 'structure' of the ear changes the spectrum of the sound reaching the inner ear; while higher frequencies are amplified, the lower ones are weakened. Moreover these changes are dependent on the direction of the sound reaching the ear. Consequently, it has to be realized that the 'hearing threshold' measured in the audio clinic with pure tones, is only a first approximation when it comes to improve the hearing ability in real life situations, where sounds arrive from different directions. The correction implemented in hearing aids usually consists in amplifying the various frequencies in different amounts, given

the 'hearing threshold' measured in the clinic, so that the resultant frequency response is that of a 'normal person'. We maintain that this procedure is grossly incorrect; the correction should be different when for example the sound is coming from someone in front of you, from the side or from a 'surround sound' system with 6 loudspeakers in a room.

"Another aspect of defining a suitable 'threshold of hearing' is the intelligibility aspect, which takes in account the brain perception of speech. A person will 'hear' a sound's higher harmonics although he may not hear the fundamental frequency and will substitute the unheard frequency in trying to decode a word that should have contained the unheard or unresolved frequency. This substitution will help the brain 'understand' the word.

"An additional aspect of measuring the 'hearing threshold' is the 'masking' effect, where a note at certain frequency may be masked from being 'heard' if another note at a near frequency but higher energy, is present within a 'short' time window. Thus for example a 250 Hz note followed within 200 millisecond by a 350 Hz note of the same amplitude (double the energy) will prevent the 250 Hz note of being heard. These and other brain related effects make the 'hearing threshold' measured with pure tones in a noiseless booth with earphones that discard the amplification effects of the ear pinna, less of an objective measurement of hearing loss. Consequently we maintain that the 'threshold of hearing' should not be measured with pure tones only but with complex Ringtones that include in addition to the fundamental notes also several of their harmonics. As the hearing mechanism is energy cumulative, the loudness of the complex notes for testing the 'hearing threshold' should at least be 200 msec long.

"Therefore the different 'thresholds of hearing' should be measured in the field and stored for use in these very different situations.

"We foresee at least 5 different 'thresholds of hearing' for each ear: when the sound is coming from the front, from a side or from all around the person, from earphones or from a cellphone juxtaposed to the ear. Consequently at least 10 'hearing thresholds' should be measured, stored and used as a base for amplification in similar situations.

"Measuring the hearing threshold with the cellular phone is beneficial not only for oneself for correcting incoming calls, before reaching the ears, but may also be used for correcting outgoing calls, given the threshold of hearing of the receiving party. The threshold of hearing may be measured and recorded either by oneself or from remote through a Q&A session for finding the hearing threshold of the party at the other end of the line. Thus, when transmitting a call, the specific correction needed for the receiving party to better understand the call, can be inserted into the transmission. Consequently, the 'Hearing correction' should figure side by side with the cellphone number of a party if this person is interested to receive calls better suited to his hearing quality.

"In a preferred embodiment the Hearing Eyeglasses components embedded in each of the eyeglasses temples include a Codec, a Microcontroller, a DSP, a large Flash memory, a Bluetooth RF transceiver, a rechargeable battery, an efficient receiver, 3 microphones and several MEMS sensors, all commercial off-the-shelf components. The microcontrollers situated in the temples may communicate between them by NFC (Near Field Communication) or by wire embedded in the temples of the eyeglasses or by a loose micro-cable connecting the back tips of the temples.

"The main modes of operation are 'Speech' and 'Surround sound' which are further divided into 'Noisy' or 'Quiet' selections and further depending on the size of the space where the sound source and the 'hearing' person are located. In addition some specific sources of sound may be selected, in order to optimize the characteristics of the 'sound source' to those of the user's hearing impairment. Such specific 'sound source' selections may for example include close family members with whom the user has frequent conversations. Their voice signatures may be recorded and stored for use in preferential processing of their calls. Voice signatures that are useful for making incoming calls more intelligible comprise, the adjustment of the dynamic range of the largely logarithmic compression of speech and accentuation of certain frequencies. These and other features may be analyzed given previous calls of certain frequent callers, such as family members, and preferential features specific to the

caller such as amplification of certain frequency bands and optimal loudness range may be stored and applied when calls from said persons are received.

"4 microphones 'around' the head are used to determine the direction of the 'Sound source' in a 'Noisy' environment. Fast cross-correlations between pairs of 4 microphones determine the relative'LEAD' or 'LAG' of the sound waves; in other words the differences in the time of arrival of the sound to the microphones. For example a maximal cross-correlation of (1) or (-1) means that the sound source is located on a plane perpendicular to the line connecting the two microphones. This is the case of a one-on-one frontal conversation. In this case the audio levels detected by both microphones are equal, while the volume is inverse proportional to the square of the distance. However the cross-correlations between the front and back microphones will 'LEAD' or 'LAG' depending on their relative locations 'LEAD' or 'LAG' will determine the 'altitude' of the source of sound relative to the plane determined by the four microphones around the head.

"In the 'Surround Sound' mode which is applicable when Listening to music at home or in a concert hall, the 'pause' period is not only harder to automatically define, but it is also wrong as in a 'pause' period, noise made by the crowd, may increase. In this case a user signaling is required, by activating one of the external signaling devices mentioned above, in order to define 'noise' only when the user thinks it to be proper.

"Two LED illuminators placed on the front of the temples and activated by a 'touch' sensor, are directed forward and illuminate a limited area in front of the eyeglasses; they serve several purposes in dark areas and may be used for example to illuminate the scene being photographed by the eyeglasses camera or to read in the dark, whether in an airplane or in bed or for indicating the eyeglasses location by generating an audio code, for example when triggered by a proper whistle or ringtone. One of the LED illuminators may be in the NIR wavelength for illuminating a scene being photographed in the dark, without drawing attention.

"The large flash memory connected to the microcontroller allows to record and store all the available programs that may be implemented depending the situation and place where the Hearing Eyeglasses are utilized to improve hearing. It may also be used to store conversations whether face-to-face or through the cellphone or store Audio programs detected by the FM receiver. The two 3-axis gyroscopes on the temples, sense the mutual positions of the eyeglasses temples and shut the battery whenever the eyeglasses are posed horizontally with the temples crossed over the frames.

"In the 'sleep' mode a limited number of components on the eyeglasses wake-up periodically for a short time and listen for short external coded signals. In the case that a properly coded audio or wireless signal is received and authenticated, the hearing eyeglasses emits a sound signal and a flashing light by a LED. These signals help find the location of misplaced eyeglasses. The search signal may also be a proprietary whistle, previously recorded, digitized and stored in the memory."

URL and more information on this patent, see: Suhami, Avraham. Cellphone Managed Hearing Eyeglasses. U.S. Patent Number 8543061, filed March 27, 2012, and published online on September 24, 2013. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=30&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1486&f=G&l=50&co1=AND&d=PTXT&s1=20130924.PD.&OS=ISD/20130924&RS=ISD/20130924

Keywords for this news article include: Audiology, Electronics, Ear Diseases, Hearing Loss, Otolaryngology, Microcontroller, Hearing Disorders, Sensation Disorders, Suhami Associates ltd, Nervous System Diseases, Neurologic Manifestations.

I may lack hearing, but not ambition

Author: Gounden, Yuven.

Publication info: Accountancy SA (Oct 2013): 56.

Abstract: Leigh Burton was always encouraged by her parents, regardless of her hearing disability, to complete a degree that would enable her to support herself and allow her, as a woman, to be financially independent. Her career of choice was that of a Chartered Accountant (CA (SA)). Burton always saw how much her father enjoyed his career and this motivated her to follow the same route as him. She is one of the first deaf CAs(SA) to qualify in South Africa. A further motivation for choosing this career is her love of travel. And travel she did indeed. Visiting exotic destinations such as the Caribbean, Mauritius, Singapore, Indonesia, Australia, London and the US gave her a sense of fulfillment.

Full text: Headnote

A deaf CA(SA) shares how qualifying was her ticket to the world.

leigh Burton was always encouraged by her parents, regardless of her hearing disability, to complete a degree that would enable her to support herself and allow her, as a woman, to be financially independent. Her career of choice was that of a Chartered Accountant [CA(SA)]. Leigh always saw how much her father enjoyed his career and this motivated her to follow the same route as him. Leigh is one of the first deaf CAs(SA) to qualify in South Africa.

A further motivation for choosing this career is Leigh's love of travel. And travel she did indeed. Visiting exotic destinations such as the Caribbean, Mauritius, Singapore, Indonesia, Australia, London and the United States gave her a sense of fiilfilment.

"I also wanted to complete a qualification that had international recognition and would allow me to travel all over the world if need be since one of my passions is travel. I have always enjoyed numbers and shared this passion with my father who is also a CA(SA)."

It is said that when one sense is lost the others are doubled. It seems that this rings true of Leigh and it also enhanced her sixth sense, making her more receptive to lessons in life and to what teachers and mentors had to offer. This Johannesburg based 30-something young lady was not short of role models - and she took on their advice and philosophies with gusto!

"My biggest role model throughout my life has been my father and I strive every day to live up to the ideals and values he upholds. I also wouldn't be where I am today without the support of my mother. She has great strength and has always showed unwavering belief in me. My mother has always focused on giving me a sense of independence.

"During my school years, two people had a profound effect on the person that I am today. They were my guidance councillors, Mr. Ken Hovelmeier and Mrs. Maureen Groch, who taught me to never doubt myself and that even with my hearing disability I could achieve my dreams and be all that I wanted to be. That moulded my belief to not use my disability as an excuse or 'cop out' in life".

Leigh attended the mainstream private schools Kingsmead College for Girls and St. Stithians Collegiate and she excelled in her studies. This was extrapolated to Wits University where she faced many challenging situations: the biggest being her ability to filter the messages from the 'noise' from her hearing aid. However, with great support from the Accounting Department at Wits, this did not deter her insatiable desire to excel - and excel she did! When she wrote her board examination, she found that the South African Institute of Chartered Accountants (SAICA) gave her lots of support and this helped her to qualify as a CA(SA).

"Kicking off my career at Deloitte Johannesburg brought me into contact with a great family of mentors and

friends. Alan Munitich, a Deloitte partner, played a pivotal role in my career at Deloitte right through articles and also in my role as a manager. He shared great passion for his work and for enjoyment of life as well as travel. Alan was also a great support in all facets of my work at Deloitte. I know that even though time has passed since I started my career in commerce that I can always phone Alan for a chat and advice. I must also mention Grant Krog [former partner] and Ryan Duffy [partner], who exerted a positive and strong motivational influence on me."

Leigh's area of speciality is tax and financial consulting, which can be a demanding area to work in. In her capacity as a financial/ tax consultant she assists in all aspects of taxation for all taxpayer types ranging from the calculation of Income Tax, Secondary Tax on Companies (now Dividend Withholding Tax), Provisional Tax, Employees Tax, VAT and Capital Gains Tax. Other responsibilities include assisting with SARS audits and liaising with SARS directly to clear any queries or disputes pertaining to any year of assessment. Additional responsibilities include the provision of accounting and financial services, comprising preparation of annual financial statements, completion of annual returns and other statutory returns including registering of new entities, and liaison with auditors. Ad hoc duties include monitoring clients' investment portfolios and administration of share trusts, obtaining exchange control approval for non-resident clients where necessary.

Can a person with a hearing disability handle such an intimidating portfolio?

"Anything is possible. If you want to be a CA(SA) go out and achieve that goal. Nothing is stopping you, not even your disability. It may take a bit longer than most people but that doesn't matter when you cross that goal line. Always remember to believe in yourself and know that you are capable of anything."

When she is not crunching numbers, Leigh relishes surfing the social media platforms, and keeping abreast of the changes in the technological world. Leigh believes that Twitter and Facebook are just two examples of the many social media platforms that are changing the face of how we interact with people, not only on a personal level, but also in business. Leigh is of the opinion that social media is definitely a big player in our lives today. She also enjoys taking time out in the gym, socialising with her friends, planning holidays and catching up on good reads when she has spare time.

Leigh encourages young people to pursue a career as a CA(SA).This is sound advice considering that South Africa has a shortage of about 5 000 CAs(SA).

"In as much as the career of a CA(SA) is challenging it is also very rewarding. My advice to youngsters would be if being a CA(SA) is your dream never give up pursuing it until you get it. The world is definitely your oyster once you have your CA(SA) qualification."

It is clear that Leigh did not perceive her disability as an obstacle. Instead she chose to rise above her circumstances and to pursue her goals with enthusiasm. Leigh epitomises the adage that 'the sky is the limit'.

Author: Yuven Gounden.

Siemens Medical Instruments Pte. Ltd.; Patent Issued for Hearing Apparatus with Low-Interference Receiver Control and Corresponding Method

Publication info: Telecommunications Weekly (Sep 11, 2013): 1151.
ProQuest document link

Abstract: According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventors Nikles, Peter (Erlangen, DE); Ruckerl, Gottfried (Nurnberg, DE); Schatzle, Ulrich (Forchheim, DE), filed on April 16, 2008, was published online on August 27, 2013.

Full text: 2013 SEP 11 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventors Nikles, Peter (Erlangen, DE); Ruckerl, Gottfried (Nurnberg, DE); Schatzle, Ulrich (Forchheim, DE), filed on April 16, 2008, was published online on August 27, 2013.

The assignee for this patent, patent number 8520881, is Siemens Medical Instruments Pte. Ltd. (Singapore, SG).

Reporters obtained the following quote from the background information supplied by the inventors: "Hearing devices are portable hearing apparatuses which are used to supply the hard-of-hearing. To accommodate the numerous individual requirements, different configurations of hearing devices such as behind-the-ear hearing devices (BTE), in-the-ear hearing devices (ITE), e.g. including conch hearing devices or completely-in-the-channel hearing devices (CIC), are provided. The hearing devices designed by way of example are worn on the outer ear or in the auditory canal. Furthermore, bone conduction hearing aids, implantable or vibrotactile hearing aids are also available on the market. In such cases the damaged hearing is stimulated either mechanically or electrically.

"Essential components of the hearing devices include in principle an input converter, an amplifier and an output converter. The input converter is generally a receiving transducer, e.g. a microphone and/or an electromagnetic receiver, e.g. an induction coil. The output converter is mostly realized as an electroacoustic converter, e.g. a miniature loudspeaker, or as an electromechanical converter, e.g. a bone conduction receiver. The amplifier is usually integrated into a signal processing unit. This basic configuration is shown in the example in FIG. 1 of a behind-the-ear hearing device. One or a number of microphones 2 for recording the ambient sound are incorporated in a hearing device housing 1 to be worn behind the ear. A signal processing unit 3, which is similarly integrated into the hearing device housing 1, processes the microphone signals and amplifies them. The output signal of the signal processing unit 3 is transmitted to a loudspeaker and/or receiver 4, which outputs an acoustic signal. The sound is optionally transmitted to the ear drum of the device wearer via a sound tube, which is fixed with an otoplastic in the auditory canal. The power supply of the hearing device and in particular of the signal processing unit 3 is provided by a battery 5 which is likewise integrated into the hearing device housing 1.

"The pulse-density modulation (PDM) or pulse-width modulation (PWM) is frequently used to control the loudspeaker and/or receiver of a hearing device for instance. The digital control is advantageous in that the stage of the digital-analog converter can be dispensed with in the case of digital hearing devices. Digital control circuits also have a significantly higher efficiency rate than analog control circuits. By contrast, analog control circuits are less prone to interference, i.e. they occupy a frequency spectrum which is restricted to an acoustic signal with a small harmonic wave part. The very strongly developed harmonic waves in the case of digital control nevertheless interfere with the wireless transmission of data between hearing devices and the transmission between a hearing device and an external accessory (remote controller, wireless programming device, wireless relay device etc.).

"One possible solution to this problem could lie in the following compromise: The receiver is controlled analogously in the case of hearing devices with wireless transmission and in the case of hearing devices without the wireless function, a power-saving digital control takes place. Hearing devices with wireless transmission may however thus not profit from the power-saving digital control."

In addition to obtaining background information on this patent, VerticalNews editors also obtained the inventors' summary information for this patent: "The object of the present invention thus consists in enabling a power-saving digital control of the loudspeaker of the hearing apparatus, also especially for digitally operating hearing apparatuses. A corresponding method for operating a hearing apparatus is also to be provided.

"This object is achieved in accordance with the invention by a hearing apparatus with a transmission facility for wireless data transmission in a main frequency band, a loud speaker and a control facility for controlling the

loudspeaker with a control signal, with the frequency spectrum of the control signal having a significant notch in one range of the main frequency band.

"Provision is also made in accordance with the invention for a method for operating a hearing apparatus by wirelessly transmitting data in a main frequency band and controlling a loudspeaker of the hearing apparatus with a control signal, with the frequency spectrum of the control signal having a significant notch in one range of the main frequency band.

"By separating the signals for the data transmission and for the control of the loudspeaker in the frequency range, alternate interferences hardly occur any more so that a hearing apparatus, which is designed for wireless data transmission, can also digitally control the internal receiver and/or loudspeaker.

"The control signal of the control facility is preferably pulse-density modulated or pulse-width modulated. An inductive loudspeaker which operates as a low pass can thus be controlled by a digital signal processing circuit without considerable signal processing outlay.

"The data transmission through the transmission facility can take place in a broadband fashion in several frequency bands and the frequency spectrum of the control signal can have a significant notch in the range of each of the frequency bands in each instance. The principle according to the invention can thus also be applied to a broadband transmission of high data rates.

"The transmission facility can also comprise a band pass filter, which essentially only allows frequency parts to pass, which lie in the main frequency band or in the main frequency band and in the range of multiples thereof. The interference resistance of the wireless transmission can herewith be additionally increased.

"In a special embodiment, the hearing apparatus according to the invention can be configured as an in-the-ear hearing device, even if the current consumption there and the space available are extremely limited. The minimal space available forces the receiver, which is generally a magneto-acoustic converter, very close to the receiver coil. The position and alignment with each device is also individual with in-the-ear hearing devices. In any case, the receiver induces more or less large interference signals into the receiver coil. The signal-to-noise ratio there is thus generally clearly impaired. The poor signal-to-noise ratio could be improved by an increased transmission power, which can however only be achieved by an enormous energy requirement. Therefore the inventive solution involving spectrally separating the control signal for the receiver from the transmission signal for the wireless data transmission is even more welcome.

"According to a further embodiment, a hearing system with two hearing devices is provided in accordance with the invention, which each have the design of the hearing apparatus described above, with the transmission facilities of both hearing devices allowing a bidirectional, wireless data transmission and a data transmission in one direction taking place in a different frequency band to a data transmission in the other direction. A real bidirectional connection can thus be made available with synchronized directional transmissions."

For more information, see this patent: Nikles, Peter; Ruckerl, Gottfried; Schatzle, Ulrich. Hearing Apparatus with Low-Interference Receiver Control and Corresponding Method. U.S. Patent Number 8520881, filed April 16, 2008, and published online on August 27, 2013. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=39&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1919&f=G&l=50&co1=AND&d=PTXT&s1=20130827.PD.&OS=ISD/20130827&RS=ISD/20130827

Keywords for this news article include: Broadband, Electronics, Digital Control, Data Transmission, Signal Processing, Siemens Medical Instruments Pte. Ltd..

Distortion product otoacoustic emission level maps from normal and noise-damaged cochleae

Author: Meinke, Deanna;Clavier, Odile;Norris, Jesse;Kline-Schoder, Robert;Allen, Lindsay;Buckey, Jay

Publication info: Noise & Health 15.66 (Sep-Oct 2013): 315-25.

Abstract: Distortion product otoacoustic emission (DPOAE) level mapping may be useful for detecting noise-induced hearing loss (NIHL) early. Employing DPOAE mapping effectively requires knowledge of the optimal mapping parameters to use for detecting noise-induced changes. The goal of this project was to show the map regions that differ most between normal and noise-damaged cochlea to determine the optimal mapping parameters for detecting NIHL. DPOAE level maps were generated for the $2f_1-f_2$ and the $2f_2-f_1$ DPOAEs for 17 normal hearing male subjects and 19 male subjects with NIHL. DPOAEs were measured in DPOAE frequency steps of approximately 44 Hz from 0.5 kHz to 6 kHz using constant f_2/f_1 ratios incremented in 0.025 steps from 1.025 to 1.5 using both unequal-level (L1,L2 = 65,55 dB sound pressure level (SPL)) and equi-level (L1,L2 = 75,75 dB SPL) stimulus paradigms. Maximal responses for the $2f_2-f_1$ emission at L1,L2 = 65,55 dB SPL were found at lower ratios compared to previous studies. The map regions where NIHL eliminated or reduced DPOAE magnitude were identified. DPOAE level mapping using higher-level, equi-level primaries produced significantly more detectable emissions particularly for the $2f_2-f_1$ emission. The data from this study can be used to optimize DPOAE level mapping parameters for tracking noise-exposed subjects longitudinally.

Full text: Introduction

The ability to detect noise-induced hearing loss (NIHL) early and implement preventive strategies would reduce the social and economic burdens attributed to this disorder. Distortion product otoacoustic emission (DPOAE) level mapping is a potential new approach to detect NIHL and monitor individuals for early signs of cochlear damage from hazardous noise exposure over time. The Knight and Kemp, [1],[2] DPOAE level and phase mapping approach has been used in rabbits to display DPOAE data with normal cochlear status and after noise exposure. [3] These researchers suggested that DPOAE level/phase mapping may provide a sensitive indicator of cochlear damage due to evidence of a strong DPOAE place-fixed component in rabbits with normal cochlear function and in rabbits with NIHL where DPOAEs exist. To date, there are limited human data using the Knight and Kemp, [1],[2] DPOAE level mapping approach in normal and noise-damaged cochleae, perhaps due to the time-intensive nature of the testing paradigm and the customized testing protocols needed to collect comprehensive data sets.

Time-intensive DPOAE level mapping has been utilized to investigate differences in DPOAEs for 20 male subjects with normal hearing and 10 subjects with NIHL. [4] The experimental paradigm used an f 2 /f 1 fixed-ratio approach incremented in 0.025 steps between 1.025 and 1.5 in response to three equi-level primary tone sweeps (L1,L2 = 80,80; 75,75 and 65,65 dB SPL). The extended DPOAE frequency range encompassed 0.5-6.0 kHz in DPOAE frequency steps of 44 Hz. Both wave- and place-fixed emissions were evident for the 2f 1 -f 2 emission and place-fixed emissions were evident for the 2f 2 -f 1 emission in both normal and NIHL subjects with measurable emissions. The outcomes did not support the hypothesis that an increase in place-fixed DPOAEs may occur due to potential changes in cochlear structural irregularities caused by hazardous noise exposure as evidenced in the prior rabbit study. However, in this initial study, DPOAE levels differed for the NIHL group as compared to the normal hearing group in regions that extended beyond the conventional 2f 1 -f 2 optimal f 2 /f 1 ratio of 1.2. These initial data suggested that DPOAE level mapping might provide a more comprehensive evaluation of cochlear function that could be useful in the assessment of NIHL. Investigating this potential application was severely limited by the duration of the initial mapping protocol (45 min/DPOAE level map), which required a high degree of cooperation and tolerance from the subjects. More efficient and flexible

instrumentation, test protocols, and analysis techniques were needed.

New technology developed for the present study allows for comprehensive maps to be completed within a clinically reasonable time (maps can be completed in times ranging from 5 min to 25 min depending on the number of points desired), but the optimal parameters to use to collect mapping data for the early detection of NIHL are not known. The objective of this study was to determine the DPOAE frequencies and ratios on a DPOAE level map most affected by noise exposure, and to use this information to develop DPOAE level mapping protocols designed for the early detection and monitoring of cochlear damage from hazardous noise exposure. To accomplish this, mapping data from 17 normal hearing male subjects were compared to data from 19 men with NIHL. We hypothesized that some map regions would show minimal differences and could be omitted from future mapping protocols and that higher-level primaries (e.g., L1,L2 = 75,75) would produce more detectable emissions in the NIHL group. We also hypothesized that the technology developed for this study, combined with the data from the normal and noise-exposed study groups, would yield mapping protocols to assess NIHL that could be completed within a clinically acceptable amount of time.

Methods

Participants

DPOAE level maps were recorded from male subjects aged 18 to 50 years from the University of Northern Colorado geographical community, which includes veteran/military service members. Inclusion criteria for all subjects included a negative otologic history, no history of neurological disorders, normal otoscopy and normal middle ear status (based upon normative values for static admittance, equivalent ear canal volume and tympanometric peak pressure between -150 daPa to +50 daPa). Additional subject inclusion criteria were dependent upon the experimental grouping; either "normal hearing non-noise exposed" (NHNN) or "NIHL noise exposed." (NIHL) Pure-tone air-conduction thresholds were used to classify the subjects into each experimental group: (1) NHNN where thresholds were <20 dBHL for 250-8000 Hz bilaterally and (2) NIHL defined as thresholds <20 dBHL at 250-500 Hz and <60 dBHL for 1000-6000 Hz. Only one ear was used for the study and right versus left ear was randomized at the time of enrollment for the NHNN group and in cases of bilateral NIHL.

Noise exposure status was determined by an extensive occupational and non-occupational noise exposure case history survey and interview. Subjects classified as NHNN reported either no past or present noise exposures or only rare exposures in the past. Subjects classified as NIHL reported routine and consistent participation in noise hazardous activities in the past and in some cases, ongoing noise exposure at the time of the study enrollment. The use of hearing protection during noise exposed activities varied across subjects and activities, and was typically used either inconsistently or not at all by the majority of NIHL subjects. Trained audiology graduate research assistants and the first author obtained consent, and conducted the case history interviews and experimental testing. The study was approved by the University of Northern Colorado Institutional Review Board.

Audiometry and acoustic-immittance testing

Pure-tone audiograms were obtained manually at 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz using a Hughson-Westlake procedure performed with an acoustically calibrated Grason Stadler GSI 16 audiometer and TDH-50P supra-aural earphones. [5] Testing was completed in a Tracoustics single-walled sound booth meeting ANSI S3.1-1999 (R2008), [6] permissible ambient noise levels.

Normal tympanometry patterns (Type A) and pressure equalization (-150 to +50 daPa) were verified for the test ear prior to conducting DPOAE measurements using routine acoustic-immittance measurements with a Maico EroScan Pro (i.e., the 226-Hz tympanogram).

Distortion Product Otoacoustic Emission Level Mapping

DPOAE level maps were collected using the hardware and software developed specifically for this research project in collaboration with Creare Inc., (Hanover, NH). The prototype hearing assessment system

specifications are provided in Appendix A.[SUPPORTING:1]

Experimental DPOAE level maps were collected with the human subjects awake and seated in a recliner within the single-walled sound booth after receiving instructions to remain as quiet and still as possible. Subjects were permitted to read or operate electronic games/devices with the audio disabled during the testing. All data were collected during a single 1.5 h experimental session. Rest periods were offered between the two mapping level protocols; however, no subjects requested removal of the probe or a change of position necessitating probe removal and reinsertion. DPOAE probes were sealed in the ear canal using the standard-sized rubberized tube-phone ear tips.

The researchers subjectively determined an adequate seal in the ear canal by visualization, tug-test for resistance, and subjective feedback from the subject. To assist with proper probe placement, a frequency sweep (chirp) was presented in the ear canal before the DPOAE testing. The results from three chirps (500 Hz to 5000 Hz) at 65 dB SPL were averaged, smoothed, and displayed to the research assistant. In the case of a poor seal, the probe was reseated and the chirps were repeated. Every effort was made to assure an adequate first seal and the final acoustic sweep test was stored as a baseline reference for future DPOAE level-mapping testing. If the probe did need to be reinserted, the baseline acoustic frequency-sweep spectrum could be used as a reference and the probe could be adjusted until the sweeps were consistent with baseline measures. For this cross-sectional study, however, the probes did not need to be reseated and baseline acoustic frequency-sweeps were consistent between mapping primary tone stimulus levels (L1,L2 = 65,65 and 75,75).

DPOAEs were measured in DPOAE frequency steps of approximately 44 Hz for both the 2f 1 -f 2 and 2f 2 -f 1 emissions from 0.5 kHz to 6 kHz using constant f 2 /f 1 ratios incremented in 0.025 steps from 1.025 to 1.5. Over this parameter space, f 2 ranged from 0.258 kHz to 18.023 kHz while f 1 ranged from 0.388 kHz to 12.016 kHz. This produced a map composed of 5160 points. Using a total of 4 averages per point, each map required 25 min to complete. DPOAE level maps were collected for two primary tone levels: 65,55 dB SPL (consistent with conventional DP-Grams), and 75,75 dB SPL. There was no evidence of artifactual distortion at levels above -20 dB SPL when these high-level primary stimuli were measured in an artificial ear (Brüel and Kjaer Model 4157, Nærum, Denmark).

[Figure 1] provides a general description of the plotting to orient the reader to the data presentation. The 2f 1 -f 2 and 2f 2 -f 1 DPOAEs were shown within the same area plot, consistent with the Knight and Kemp, [1] and Martin, [3] data presentations. The 2f 1 -f 2 DPOAE was plotted in the upper half of the panel and was contiguous with the 2f 2 -f 1 emission in the lower half of the same panel frame [Figure 1]. Emission levels were mapped (z-axis) by aligning vertically on the y-axis the DP (distortion product) frequency (~500 Hz to 6000 Hz) and in ascending ratio order on the x-axis for both the 2f 1 -f 2 and 2f 2 -f 1 DPOAEs [Figure 1]a. This 3-dimensional approach (DP Frequency, DP Level and f 2 /f 1 ratio) was then color coded for DPOAE level [Figure 1]b in 0.8 dB SPL color gradients and converted to a 2-dimensional plot [Figure 1]c. DPOAE level data were plotted using warmer colors (reds, yellows) for high-level emissions and cooler colors (light green, light blue) for low-level emissions. DPOAEs that most likely reflect noise floor (NF) values were plotted as a dark blue color. The color range was set from -20 dB to 30 dB SPL. Values in the map either lower or higher than these bounds were displayed using the value for the lower or upper bound limit respectively.{Figure 1}

When the DP level was plotted as in [Figure 1]c, the map tended to show a concentration of higher level DPs at the lower DP frequencies, which were also contaminated by higher NF levels. To illustrate this more clearly, the data were also presented as a signal-to-noise ratio (SNR) map. In this case, the DP minus NF was plotted, rather than just the DP level [Figure 1]d. The color range was set from 0 dB to 30 dB for SNR and values either lower or higher than these bounds were displayed using the value for the lower or upper bound limit respectively.

The trajectory of the more commonly referenced f 2 frequency is provided in [Figure 1]c for 3 kHz and 6 kHz, since this is a region typically damaged by hazardous noise exposure. These plots span a larger frequency

space and utilize a larger frequency increment (44 Hz versus 12 Hz) when compared with the Knight and Kemp's, [2] report's figures.

Statistical analysis

Each map was a matrix of 129 frequencies and 40 ratios (5160 DPOAEs). To create average maps, the individual DP levels (for a level map) and the individual DP minus NF values (for an SNR map) were averaged point-by-point across subjects within an experimental group. For the average SNR maps, the percentage of overall points greater than or equal to 3 dB SNR, 6 dB SNR and 9 dB SNR were calculated for each group. The percentage of points at or above the 3 cut-off values (>3 dB, >6 dB and >9 dB) were compared between the NHNN and NIHL groups using the non-parametric statistics (Kruskal-Wallis test). To compare the average NHNN and NIHL maps, the maps were first median filtered, and then compared point-by-point using a one-way ANOVA with an alpha of 0.05. A compensation for multiple comparisons was not used, since the objective of the point-by-point comparison was to outline areas on the map with the highest likelihood of showing significantly different DPOAE levels between the NHNN and NIHL groups. The goal was to create a map of the points where the two average SNR maps differed significantly, with the understanding that some of these points might represent type I errors. This overall approach provides a way to define the areas of the map most likely to show differences between a NHNN and NIHL group, which is needed to provide the greatest opportunity to detect subtle early changes in mapping for noise-exposed individuals.

Results

Subjects

A total of 36 male subjects participated in the study (NNHN n = 17; NIHL n = 19). The mean age of the NHNN group was 28.2 years +- 8.8 years. The NIHL group was slightly older with a mean age of 35.7 years +- 9.3 years. Unpaired Student's t-testing reveals a statistically significant age difference between the two groups using an alpha of 0.05 (P = 0.018).

Pure-tone audiometry

All subjects had measureable thresholds between 250 Hz and 8000 Hz. Average audiometric thresholds for test ears in NHNN and NIHL groups are provided in [Figure 2]. The NHNN group was comprised of 53% right and 47% left ears while the NIHL group was comprised of 37% right and 63% left ears. The average thresholds from 250 Hz to 8000 Hz for the NIHL group were significantly poorer than the NHNN group (P <0.01).{Figure 2}

DPOAE equal-ratio level and signal-to-noise ratio maps

Qualitative observations: General

[Figure 3] provides a single subject example of a level and SNR map for a NHNN subject. [Figure 4] provides an example for a NIHL subject. The maps for the individual subjects were unique, but on average patterns of DPOAE response were evident. [Figure 5] shows the average level and SNR maps for the NHNN and NIHL groups.{Figure 3}{Figure 4}{Figure 5}

A qualitative review of the DPOAE level maps revealed obvious visual differences between the experimental groups. The NHNN group had more high-level DPOAEs, a wider band of ratios in the 2f 1 -f 2 area where DPOAEs were detected, and a larger area where 2f 2 -f 1 DPOAEs were detected compared to the NIHL group.

Qualitative observations: Amplitude features

The DPOAE level data are consistent with a band of maximal response centered at the f 2 /f 1 frequency ratio of 1.2 across DP frequencies for all subjects at both L1,L2 = 65,55 and 75,75. This is consistent with the findings of Harris et al., at L1,L2 = 65,55. [7]

The 2f 2 -f 1 emissions were present over a smaller area of the map as illustrated in [Figure 5]. For the NHNN group, the optimal 2f 2 -f 1 emission for 65,55 level maps occurred at an f 2 /f 1 ratio of 1.025 and for the 75,75 map, a ratio of 1.075.

At both stimulus levels, there was visual evidence of a low-frequency color band (reds) or vertical stripe at the

lowest DP frequencies [Figure 5]a, c, e and g, which was not apparent in the SNR map. This color band did not occur when the system was tested using a cavity indicating that low frequency physiologic noise was the likely source of the response observed in the level maps. The SNR maps further suggest that the low-frequency response is dominated by noise.

Quantitative observations: Amplitude maps

For the NHNN subjects at L1,L2 = 65,55 dB SPL, the highest DPOAE level response occurs near the f 2 /f 1 ratio of 1.275 for the lowest DP frequencies (<2000 Hz) but occurs near a ratio of 1.15 for the highest DP frequencies (>5000 Hz). At primary levels of 75,75 dB SPL, the highest response occurs at ratios of about 1.3 at low DP frequencies, and 1.15 at highest DP frequencies. This is similar to the DP frequency/ratio function reported by Harris et al. [7] Higher-level DP amplitudes corresponded with higher SNRs at the same ratio and DP frequency. When the primary tone levels were increased to L1,L2 = 75,75 dB SPL [Figure 5]e and f the averaged response region was enhanced with higher level emissions for the 2f 1 -f 2 region and a broad response for the 2f 2 -f 1 region of the map. The higher DP levels at low frequencies were also correlated to relatively high SNR levels for the 2f 1 -f 2 emission at ~ 1.2 ratios, but not at other ratios or for the 2f 2 -f 1 emission [Figure 5]e and f. This would indicate the presence of DPOAEs around the 1.2 ratio, but not at other ratios (despite the high levels shown at all ratios at low frequencies on the map), at low frequencies (<2000 Hz).

For subjects with NIHL, lower level amplitude 2f 1 -f 2 DPOAE responses (L1,L2 at 65,55 dB SPL) were evident at all DP frequencies for the 1.2 ratio region when compared to NHNN subjects. The range of ratios that exhibit a response is narrower as well. For both groups, the region of relative higher DPOAE levels was near 3-4 kHz, which correlates to an f 2 range of ~4.5-6 kHz when referencing an f 2 /f 1 of 1.2. There was little or no response evident for the 2f 2 -f 1 region of the map when using moderate level primary tones. Stimulation with high level primary tones of L1,L2 = 75,75 dB SPL elicited higher level DPOAE responses in impaired ears. For high level primary tones, a broader frequency and ratio region of response for the 2f 1 -f 2 and the 2f 2 -f 1 emissions became evident at the DP frequencies of 3-4 kHz.

Analysis

SNR

SNR averages for each group were analyzed to determine relative areas of the map with significant levels of emissions. [Figure 6] shows the results for each experimental group and for each emission type. Each plot shows the cumulative number of points with an SNR at or above 3 dB, 6 dB and 9 dB as a function of primary tone level and experimental group for each emission type. [Table 1] summarizes the statistical significance of the differences.{Figure 6}{Table 1}

For the NHNN group, approximately half the points in the upper portion of the map have an SNR of at least 3 dB and 25% of all points are above 9 dB SNR indicating a high probability of DPOAE presence for the L1,L2 = 65,55 dB SPL protocol. In contrast, the NIHL group shows fewer points when referencing a SNR of 3 dB (46% versus 62% for NHNN) and less than half as many as for the NHNN group with an SNR of 9 dB. At L1,L2 = 75,75 dB SPL stimulus levels, both group show increases in the number of points with higher SNR values, but with the same relative differences evident between the two groups.

In general, the number of points with SNR of 3 dB or more is 30-50% less on the lower half of the map (2f 2 -f 1) than the upper half of the map (2f 1 -f 2), for either group. The difference between the two stimulus level protocols is more striking for the 2f 2 -f 1 emission. Indeed, for either group, the number of points with 9 dB SNR or higher quadrupled when increasing stimulus levels from 65, 55 dB to 75, 75 dB SPL (from 6.5% to 30% of the measurements for the NHNN group, and from 3.5% to 15% for the NIHL group). [Table 1] provides the P values when the NHNN and NIHL results are compared using the Kruskal-Wallis test. The percentage of points at each SNR threshold was significantly lower ($P < 0.05$) for the NIHL group for all comparisons, except for values >3 dB at 65,55 for the 2f 2 -f 1 emission. The most significant differences were seen for the percentage of points >9 dB

at L1,L2 = 75,75 for the 2f 2 -f 1 emission.

The box and whisker plots [Figure 6] illustrate the variability within the NHNN and NIHL groups. Although the medians for the NHNN and NIHL groups were significantly different at each cut-off level (>3 dB, >6 dB, or >9 dB), the interquartile range overlapped at all SNR cut off levels.

Statistical comparison of averaged DPOAE level maps

To reduce noise within the averaged DPOAE level maps, the data points were spatially averaged using a 3 ×3 median filter and then a one-way ANOVA was applied to each DPOAE level in the map. The results are plotted in [Figure 7].{Figure 7}

For the 2f 1 -f 2 DPOAE elicited with a moderate level primaries (65,55 dB SPL), the area of differentiation occurred at ratios between 1.125 and 1.275 at DP frequencies ranging between 1 kHz and 5 kHz, with the largest differences occurring between 2.5 kHz and 4.5 kHz. This correlates to an f 2 frequency range of about 3-6.8 kHz at a 1.2 ratio. For the 75,75 dB SPL protocol, a larger region of significance was evident. In addition, one small area of difference between the two groups appeared at the higher frequencies, where DP values are greater than 5 kHz and at ratios between 1.25 and 1.3 (corresponding to f 2 values of 8-9.5 kHz at these ratios).

For the 2f 2 -f 1 DPOAE there was minimal evidence of significant differences at the 65,55 dB SPL primary tone levels; however, at the L1,L2 = 75,75 dB SPL stimulus level there were lobes of responses that differed significantly between the two experimental groups. Areas of particular significance occur at DP frequencies ranging between 4 kHz and 5 kHz at small ratios as well as above 5.5 kHz at ratios ranging between 1.025 and 1.35.

Technical development

As part of this study, the technology was further developed to minimize the time required for each individual map. A new DPOAE mapping system using a dedicated digital signal processor and CODEC (analog-to-digital and digital-to-analog encoder/decoder) to generate and process each measurement was designed and built. The updated system also records both the lower side-band, 2f 1 -f 2 , and upper side-band, 2f 2 -f 1 , emissions simultaneously. This resulted in a time reduction of almost 50% as a single stimulus captures two points in equal level maps. This improved system developed by Creare Inc., (Hanover, NH) can compute a map at a rate of 0.24 s/stimulus, which is 140% of the theoretical limit. This is a marked improvement over the ~0.48 s/stimulus in the system used at the Jerry Pettis Memorial Veterans Medical Center (JPMVMC) for previously published maps, and the 0.3 s/stimulus for the system used to generate the maps in the present study.

This reduction brings the time to complete a map from approximately 25 min with the research prototype used for the present study, to approximately 12 min for an equal level stimulus (e.g., L1,L2 = 75,75 dB SPL) and 16 min for an unequal stimulus (e.g., L1,L2 = 65,55 dB SPL). (Unequal stimulus maps require additional time because the 2f 2 -f 1 emissions are measured with L1,L2 = 55,65 dB SPL and therefore cannot be measured at the same time as the 2f 1 -f 2.)

Discussion

DPOAE level mapping offers potential for detecting and tracking NIHL, but the appropriate parameters to use and the areas of the DPOAE level map that change the most with noise exposure have yet to be defined. In this study, we performed DPOAE level maps on 17 individuals without a history of noise exposure and compared those results to maps from 19 individuals with mild-moderate NIHL. The results show that: (a) both DPOAE levels, and the range of ratios where DPOAEs are detected, are reduced in the NIHL group for both the 2f 1 -f 2 and 2f 2 -f 1 emissions, (b) higher level primaries (L1,L2 = 75,75 dB SPL) increase the number of measureable emissions with an SNR of 3, 6 or 9 dB or greater in both groups, (c) the DPOAE ratios and frequencies that elicited the largest DPOAE SNRs were also generally the same ones that were significantly different between the NHNN and NIHL groups, (d) the 2f 1 -f 2 emission is reduced significantly for both L1,L2 = 65,55 dB SPL and 75,75 dB SPL primary levels for the NIHL group, (e) the 2f 2 -f 1 emission is reduced significantly in NIHL,

but the changes are evident only when using L1,L2 = 75,75 primary tone levels, (f) the optimal ratio for the 2f 2 -f 1 emission at L1,L2 = 65,55 dB SPL is smaller than has been described previously and (g) displaying DPOAE level map data plotted as a function of SNR, rather than as DPOAE level, improves map interpretation at lower DPOAE frequencies (<2000 Hz).

Overall DPOAE level mapping results

As expected, DPOAE levels were significantly reduced in the NIHL group for both experimental protocols. The overall DPOAE levels, as well as the range of f 2 /f 1 ratios where emissions were detectable, were reduced. This effect was likely due predominately to the history of noise exposure in the NIHL group. Although the NIHL group was statistically significantly older than the NHNN group; the mean age differed by only 7 years. Currently, there is no definitive support for the premise that age alone significantly affects DPOAEs amplitude. [8] There are no age-corrections applied to the clinical interpretation off DPOAE magnitude measurements. Although the reduction in DPOAE levels in subjects with NIHL is not surprising, these data suggest that there may be potential benefit in examining more than just the optimal DPOAE level at a single ratio when monitoring individuals for changes over time. Low-level 2f 1 -f 2 emissions and the 2f 2 -f 1 emission may disappear early on due to noise exposure. This hypothesis needs to be more fully explored in a longitudinal study.

One benefit of the DPOAE level map is that it presents a large amount of DPOAE data in a color pattern, so that the map image provides a visual snapshot of cochlear function between the DP frequencies of 0.5 kHz and 6.0 kHz across a wide range of stimulus ratios. This form of data presentation allows for more detailed data collection and analyses than standard DP-Grams, and also allows for a quick visual comparison of maps from a given individual. The results from this study show that the DPOAE SNR map, shown in combination with a DPOAE level map, improves the interpretation of the measurements, revealing areas where higher noise levels dominate the response.

Effect of primary tone level

Stover et al. [9] suggested that moderate-level primaries in the 50-60 dB SPL range are optimal for distinguishing normal-hearing versus mild to moderately hearing impaired ears when comparing to conventional pure-tone audiometry. The data from this study show that higher primary tones produce higher amplitude emissions in both the noise-exposed and non-noise exposed group. Since DPOAE level mapping takes time, testing at multiple primary tone levels may be feasible for a research application, but impractical for field use in hearing conservation programs. Helleman et al. [10] also suggested that higher level primary tones may be advantageous in terms of minimizing the effect of background noise when DPOAE monitoring was implemented as part of an occupational hearing conservation program. The data from this study show that higher level primaries provide higher SNRs in both the NHNN and NIHL groups, and are especially important for the measurement of DPOAEs in a mild-moderately NIHL impaired ear. Therefore, the higher-level primaries may be more useful for DPOAE level mapping studies in these populations. Although, since lower-level primaries are generally believed to be more sensitive to cochlear damage compared to higher level primaries, lower-level primaries may still be useful in individuals with normal DPOAE levels at baseline.

2f 2 -f 1 emissions

DPOAE level maps provide data on both 2f 1 -f 2 and 2f 2 -f 1 emissions; however, it is not clearly established if measuring the 2f 2 -f 1 emission adds value in detecting NIHL. Results from this study show significant changes in the 2f 2 -f 1 region when comparing the NHNN to the NIHL group. This difference was only apparent at the higher primary tone levels. These data suggest that when using the mapping for longitudinal tracking, the 2f 2 -f 1 emission area may be useful in detecting early cochlear changes due to hazardous noise exposure. This finding also provides further evidence that "coherent linear reflection" emission sources are useful in the detection of NIHL. [3],[4]

The data also revealed that the optimal 2f 2 -f 1 emission occurred at an f 2 /f 1 ratio of 1.025 at L1,L2 = 65,55 dB SPL, which is a smaller ratio value than has been seen in other studies. This may be because none of the

cited works other than Fitzgerald and Prieve, [11] tested at such a low ratio and their results yielded the lowest ratio at which they did test. Although Fitzgerald and Prieve tested ratios as low as 1.025, they selected a single ratio that maximized the emission over a range of primary level combinations, and not specifically L1,L2 = 65,55. In addition, previous studies used DPOAE level to determine the optimal ratio, [11],[12],[13],[14] whereas the present study relies on both DPOAE levels and SNR to determine the optimal ratio in part because of the very short averaging time used in the protocol.

Technical factors for DPOAE level mapping

One factor limiting the use of DPOAE level maps as a clinical tool is the amount of time each map takes. As part of this study, the technology was developed to minimize the time required for each individual map. Testing time can be shortened further by using data from this study to reduce the number of points in each map. The data obtained in this study established the outlines of a smaller-sized map containing the most useful information [Figure 7]. Another approach to reducing test time is to use a flexible map protocol that allows for longer averaging times at some frequencies and ratios, and shorter times at frequencies not contaminated by noise. This could lead to an adaptive clinical DPOAE mapping protocol wherein frequencies, ratios and averaging time are optimized to maximize the response of the ear while maintaining a reasonable clinical testing time of about 5-10 min. Further, research and development will be required to design an efficient and clinically relevant DPOAE mapping protocol.

Analytical considerations

Using a point-by-point ANOVA after median filtering has limitations when applied to these data (e.g., multiple comparisons). As mentioned previously, this approach was undertaken in order to determine the areas with the highest likelihood of illustrating differences in DPOAE levels between the NHNN and NIHL groups as the mapping technology and protocol are being developed. This serves a different purpose than quantifying exact differences between groups. It is also recognized that DPOAE level maps are highly individualized, and consequently group comparisons are further confounded. As the mapping technology is advanced, more sophisticated statistical analysis can be undertaken to longitudinally monitor for individual changes in DPOAE level maps over time using fewer data points.

Conclusions

DPOAE level mapping provides a comprehensive overview of the changes in DPOAE magnitude for both the 2f 1 -f 2 and the 2f 2 -f 1 emissions in NIHL. DPOAE level mapping using higher level, equi-level primaries (75,75) provides more measureable DPOAEs in both the NHNN and NIHL groups than the lower level, unequal-level primaries (65,55). On average, the changes in DPOAE level maps in the NIHL group are concentrated in particular map areas and this knowledge could be used to design more efficient mapping protocols. Using SNR to display map results provides additional information for an improved interpretation of the mapping data, particularly at lower DPOAE frequencies in humans. Advances in the technology for acquiring DPOAE level maps have been made, which allow DPOAE level maps to be collected in clinically-acceptable times (5-10 min). DPOAE level mapping may offer a novel approach for differentiating and monitoring changes in cochlear function due to hazardous noise exposures.

Acknowledgments

We thank Dr. Brenda Lonsbury-Martin, Dr. Glen Martin and Barden Stagner for their support and assistance in developing and validating the instrumentation and software used in this research. We appreciate the work of Abigail Fellows, Ashley Huerta, Amber Powner, Kathy Pritzl and numerous personnel at Creare Inc. who supported the project.[15]

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Teacher's good vibrations

Author: Foley, Peter.

Publication info: The Queensland Times [Ipswich, Qld] 27 Aug 2013: 10.
ProQuest document link

Abstract: The Baha sound processor is attached to the skull and converts sound waves to vibrations in the cochlear that are read by the brain.

Links: Check LinkSource for Full Text

Full text: CHRISTINE New jokes that there are times she wishes she could switch it off but she seriously couldn't live without her Baha.

Mrs New has a Baha (Bone Anchored Hearing Aid) and it has helped her to keep teaching.

The Amberley District State School prep teacher has been an early childhood teacher for 34 years.

The Baha sound processor is attached to the skull and converts sound waves to vibrations in the cochlear that are read by the brain. Mrs New has had hearing aids for about 20 years after losing her hearing through infection and has a Baha on her right side.

"I got my first hearing aid in my early 30s and then went to two hearing aids and then I went to the Baha and I still wear a behind the ear hearing aid on the other side," she said. "The reason I needed it is that because of infection I could no longer wear a hearing aid.

"This is a little bit different to the cochlear implant because the cochlear is still working but at the start, it's like you're listening inside a bubble, but it's quite subtle and it's a better sound in your head."

Having the Baha helps her keep working where noises - especially voices - fly thick and fast.

"It helps in the classroom," she said. "I can work out which child's talking to me and what they're saying."

But after teaching preschool, prep and grades one, two and three, are there times she'd like to turn off her hearing aids?

"Yes," she said with a laugh. "And sometimes when you go home. You shouldn't do it because you don't take your ears off when you go home - but sometimes you feel like doing it.

"But it's best if you wear your hearing aids all the time during the day so you learn to filter out the sounds you don't want to hear; that's what the natural ear does."

She has been upfront about the Baha with her students who were keen to know all about it.

"A couple of them asked me whether I was a robot," she said. "They've made robots and put a Baha on the back of its head."

Hearing Awareness Week

Held this week, it aims to raise community awareness of hearing impairment and ways to protect your hearing. It gives the 22% of Australians 15 and over who have a hearing impairment a chance to share their experience and help to create a greater understanding of their needs.

Credit: Peter Foley

Widex A/s; Agency Reviews Patent Application Approval Request for "Hearing Aid with an H-Bridge Output Stage and a Method of Driving an Output Stage"

Publication info: Telecommunications Weekly (Aug 14, 2013): 439.

ProQuest document link

Abstract: Due to the low-pass filtering effect of the loudspeaker coil, no audible switching noise will emanate from the loudspeaker when driven in this way, provided the switching period of the bit stream is well above the reproduction frequency limit of the loudspeaker. [...]a digital bit stream may control a loudspeaker directly.

Links: Check LinkSource for Full Text

Full text: 2013 AUG 14 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- Widex A/s has been issued patent application serial number 845721, according to news reporting originating out of Washington, D.C., by VerticalNews editors.

The patent's inventors are ANDERSEN, Henning Haugaard (Birkerod, DK); KNUDSEN, Niels Ole (Humlebak,

DK).
This patent application was filed on March 18, 2013 and was made available online on August 1, 2013.
From the background information supplied by the inventors, news correspondents obtained the following quote:
"This application relates to hearing aids. More specifically, it relates to hearing aids comprising digital output stages for driving acoustic output transducers. The invention further relates to a method for driving a digital output stage of a hearing aid.
"In this context, a hearing aid is defined as a small, battery-powered device, comprising a microphone, an audio processor and an acoustic output transducer, configured to be worn in or behind the ear by a hearing-impaired person. By fitting the hearing aid according to a prescription calculated from a measurement of a hearing loss of the user, the hearing aid may amplify certain frequency bands in order to compensate the hearing loss in those frequency bands. In order to provide an accurate and flexible amplification, most modern hearing aids are of the digital variety.
"Contemporary digital hearing aids incorporate a digital signal processor for processing audio signals from the microphone into electrical signals suitable for driving the acoustic output transducer according to the prescription. In order to save space and improve efficiency, some digital hearing aid processors use a digital output signal to drive the acoustic output transducer directly without performing a digital-to-analog conversion of the output signal. If the digital signal is delivered to the acoustic output transducer directly as a digital bit stream with a sufficiently high frequency, the coil of the acoustic output transducer performs the duty as a low-pass filter, allowing only frequencies below e.g. 15-20 kHz to be reproduced by the acoustic output transducer. The digital output signal is preferably a pulse width modulated signal, a sigma-delta modulated signal, or a combination thereof.
"An H-bridge is an electronic circuit for controlling inductive loads such as electric motors or loudspeakers. It operates by controlling the direction of a flow of current through a load connected between the output terminals of the H-bridge by opening and closing a set of electronic switches present in the H-bridge. The switches may preferably be embodied as semiconductor switching elements such as BJT transistors or MOSFET transistors. This operating principle permits a direct digital drive output stage to be employed in order to enable a suitably conditioned digital signal to drive a loudspeaker directly, thus eliminating the need for a dedicated digital-to-analog converter and at the same time reducing the power requirements for the output stage.
"A sigma-delta modulator is an electronic circuit for converting a signal into a bit stream. The signal to be converted may be digital or analog, and the sigma-delta modulator is typically used in applications where a signal of a high resolution is to be converted into a signal of a lower resolution. In this context, a sigma-delta modulator is used for driving the H-bridge output stage in the hearing aid.
"The diaphragm of a loudspeaker has a resting or neutral position assumed whenever no current flows through the loudspeaker coil and two extreme positions assumed whenever the maximal allowable current flows in either direction through the loudspeaker. By applying a sufficiently fast-changing bit stream from an H-bridge represented by positive and negative voltage impulses to the loudspeaker terminals, any position between the two extreme diaphragm positions of the loudspeaker may be attained. The higher the number of positive impulses in the bit stream is, the more the loudspeaker diaphragm will move towards the first extreme position, and the higher the number of negative impulses in the bit stream is, the more the loudspeaker diaphragm will move towards the second extreme position. Due to the low-pass filtering effect of the loudspeaker coil, no audible switching noise will emanate from the loudspeaker when driven in this way, provided the switching period of the bit stream is well above the reproduction frequency limit of the loudspeaker. Thus, a digital bit stream may control a loudspeaker directly.
"From EP-B1-1716723 is known a digital output stage for a hearing aid, said output stage comprising a sigma-delta converter and an H-bridge for driving an acoustic output transducer for a hearing aid. The output stage is denoted a three-state output stage because it is capable of delivering a bit stream consisting of three individual

signal levels to the acoustic output transducer. In the following, these levels are denoted '+1', '-1' and '0', where '+1' equals the maximum positive voltage across the acoustic output transducer, '-1' equals the maximum negative voltage across the acoustic output transducer, and '0' equals no voltage. This utilizes the fact that a positive voltage pulse makes the diaphragm of the acoustic output transducer move in one direction, and a negative voltage pulse makes the diaphragm of the acoustic output transducer move in the other direction. By delivering a clocked bit stream consisting of '+1'-levels and '-1'-levels interspersed with '0'-levels as voltage pulses to the acoustic output transducer, any position deviation within the confinements of the mechanical suspension of the acoustic output transducer diaphragm may thus be obtained, as the loudspeaker coil acts as an integrator of the voltage pulses. The digital output stage of the prior art generates the '0'-level by applying a '+1'-level and a '-1'-level simultaneously to both terminals of the acoustic output transducer.

"This way of generating the '0'-level for the acoustic output transducer has the advantages of being very easy to implement, as no extra components are needed to provide the '0'-level, and to save power, as the '0'-level uses no extra current and the provision of three separate levels effectively doubles the possible voltage swing across the acoustic output transducer. However, it also has some inherent drawbacks, which will be explained in greater detail in the following.

"The '+1'-levels and '-1'-levels both generate differential voltages over the wires and terminals of the acoustic output transducer. This is not the case with the '0'-level. With the '0'-level, both wires carry the same voltage simultaneously, and since this is a rapidly switching voltage it radiates more common mode signal to its immediate surroundings. This radiation results in increased crosstalk to nearby surroundings, such as telecoils or wireless transmission receiver coils typically present in the hearing aid. Since this crosstalk has frequencies above 1 MHz, it does not possess a problem to the telecoil, since a telecoil is configured to convey frequencies below 8-10 kHz. The wireless receiver coil, however, suffers a very considerable reduction in signal-to-noise ratio from the capacitive interference resulting from this crosstalk phenomenon, often to a degree where reliable signal reception becomes impossible.

"This capacitive interference emanates mainly from electrically exposed parts of the output circuit, primarily the wires connecting the output pads of the electronic circuit chip of the hearing aid to the input terminals of the acoustic output transducer. It is not possible to shorten these wires further for mechanical reasons, but some reduction in the capacitive coupling between these wires and sensitive electronic circuits in the vicinity may be achieved by twisting the wires and keeping them physically close together.

"The voltage pulses are presented to the output transducer at a frequency of 1-2 MHz, and the resulting noise components may thus disturb the operation of electronic circuits sensitive to capacitive interference at high frequencies. In cases where the afflicted electronic equipment incorporates a wireless remote control for the hearing aid the problems caused by electromagnetic interference are exceptionally severe, as the effective operating range of the wireless remote control is limited considerably by the capacitive interference emanating from the output stage and masking the remote control signals from proper reception.

"WO-A1-03/047309 discloses a digital output driver circuit for driving a loudspeaker for a mobile device such as a hearing aid or a mobile phone. The digital driver circuit comprises an input, a modulator and a three-level H-bridge and is integrated into the loudspeaker enclosure in order to shield the driver circuit from electromagnetic interference and to keep the wires connecting the driver output to the loudspeaker short. The driver circuit further comprises a feedback circuit connected to the loudspeaker for regulating the supply voltage for the driver circuit.

"An output driver integrated into a loudspeaker in the way described in WO-A1-03/047309 is not interchangeable with dynamic standard loudspeakers of the kind used in hearing aids. If, for example, a hearing aid housing and circuitry may be adapted for use with a range of different loudspeakers having different impedance values, e.g. for treating different degrees of hearing loss, a loudspeaker having an integrated output driver would not be well suited for this configuration. In cases where this type of flexibility is desired, long wires

between the output stage terminals of the hearing aid circuit and the terminals of the loudspeaker of the hearing aid are unavoidable. An extra set of long wires for the signal from the loudspeaker to the feedback circuit would also be required by the prior art output driver, which would further increase capacitive interference noise."
Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent application: "The invention, in a first aspect, provides a hearing aid comprising an input transducer, an analog-to-digital converter, a digital signal processor, a three-level output modulator connected to a three-level output driver, a first voltage source, a second voltage source, a common voltage node and an acoustic output transducer, wherein the output driver comprises an H-bridge output stage configured to control the connection of a first and a second terminal of the acoustic output transducer, the H-bridge being configured to connect the first voltage source to the first terminal of the acoustic output transducer and the common voltage node to the second terminal of the acoustic output transducer when the output modulator generates a first level, to connect the second voltage source to both the first and the second terminal of the acoustic output transducer when the output modulator generates a second level, and to connect the first voltage source to the second terminal of the acoustic output transducer and the common voltage node to the first terminal of the acoustic output transducer when the output modulator generates a third level.
"It is a feature of the present invention to devise an output stage for a hearing aid having an output converter capable of providing the benefits of a three-stage output converter without having the capacitive noise and interference problems associated with output converters of the prior art, regardless of having long wires connecting the output stage to the loudspeaker of the hearing aid.
"The invention, in a second aspect, provides a method of driving an output stage of a hearing aid, said method comprising providing a single-bit digital signal representing an audio signal to be reproduced by the hearing aid, providing a first voltage source for generating a first voltage, providing a second voltage source for generating a second voltage, providing an acoustic output transducer, converting the single-bit digital signal into a three-level control signal comprising a positive level, a negative level, and a zero level, connecting the first voltage source to a first terminal of the acoustic output transducer, and connecting a second terminal of the acoustic output transducer to ground, whenever the control signal produces a negative level, connecting the first voltage source to the second terminal of the acoustic output transducer, and connecting the first terminal of the acoustic output transducer to ground, whenever the control signal produces a positive level, and connecting the second voltage source to both the first terminal and the second terminal of the acoustic output transducer whenever the control signal produces a zero level. BRIEF DESCRIPTION OF THE DRAWINGS
"The invention will now be described in further detail with respect to the drawings, where
"FIG. 1 is a schematic of an output stage for a hearing aid according to the prior art,
"FIG. 2 is a schematic of an output stage for a hearing aid according to an embodiment of the invention,
"FIG. 3 is a schematic illustrating a first condition in the output stage of FIG. 2,
"FIG. 4 is a schematic illustrating a second condition in the output stage of FIG. 2,
"FIG. 5 is a schematic illustrating a third condition in the output stage of FIG. 2,
"FIG. 6 is a graph illustrating a typical input signal to the output stage of FIG. 2, and
"FIG. 7 is a schematic of a hearing aid with an output stage according to an embodiment of the invention."
For the URL and additional information on this patent application, see: ANDERSEN, Henning Haugaard; KNUDSEN, Niels Ole. Hearing Aid with an H-Bridge Output Stage and a Method of Driving an Output Stage. U.S. Patent Application Serial Number 845721, filed March 18, 2013, and posted August 1, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3141&p=63&f=G&l=50&d=PG01&S1=20130725.PD.&OS=PD/20130725&RS=PD/20130725
Keywords for this news article include: Audiology, Widex A/s, Electronics, Ear Diseases, Hearing Loss, Electromagnet, Otolaryngology, Digital To Analog, Hearing Disorders, Sensation Disorders, Nervous System Diseases, Neurologic Manifestations.

Widex A/S; Patent Issued for FSK Receiver for a Hearing Aid and a Method for Processing an FSK Signal

Publication info: Telecommunications Weekly (Aug 14, 2013): 1030.
ProQuest document link

Abstract: [...]a receiver is usually embodied as a tiny coil configured to pick up electromagnetic base band (i.e. unmodulated) audio frequency signals from a telecoil transmitter surrounding the hearing aid comprising the receiver. [...]external equipment enables communication with the hearing aid in various ways. [...]e.g. a cable connection may be provided for the purpose of programming the hearing aid, an FM-receiver may be connected for use in public address situations where a speaker is wearing a microphone with a wireless FM transmitter, and a Bluetooth.RTM. receiver may be used for streaming audio signals from a mobile telephone or the like.

Full text: 2013 AUG 14 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- A patent by the inventors Andersen, Henning Haugaard (Birkerod, DK); Kilsgaard, Soren (Smorum, DK), filed on May 11, 2010, was published online on July 30, 2013, according to news reporting originating from Alexandria, Virginia, by VerticalNews correspondents.

Patent number 8498434 is assigned to Widex A/S (Lynge, DK).

The following quote was obtained by the news editors from the background information supplied by the inventors: "This application relates to hearing aids. More specifically, it relates to hearing aids comprising wireless receivers. Still more specifically the invention relates to hearing aids comprising frequency-shift-keying (FSK) receivers.

"A common signal source in a hearing aid is one or more microphones picking up acoustic sound signals occurring in the vicinity of the hearing aid. Another common signal source in hearing aids is a telecoil receiver. Such a receiver is usually embodied as a tiny coil configured to pick up electromagnetic base band (i.e. unmodulated) audio frequency signals from a telecoil transmitter surrounding the hearing aid comprising the receiver.

"State-of-the-art hearing aids are usually designed to accept more than one signal source for advanced functionalities for the purpose of amplifying, conditioning and reproducing them by virtue of the hearing aid circuitry.

"Some behind-the-ear (BTE) hearing aids have means for connecting external equipment to the hearing aid circuitry, such as FM-receivers, Bluetooth.RTM. receivers, cables etc. Such external equipment enables communication with the hearing aid in various ways. Thus e.g. a cable connection may be provided for the purpose of programming the hearing aid, an FM-receiver may be connected for use in public address situations where a speaker is wearing a microphone with a wireless FM transmitter, and a Bluetooth.RTM. receiver may be used for streaming audio signals from a mobile telephone or the like.

"Some newer hearing aid types also comprise internal wireless receivers. Most of these wireless receiver types draw their power directly from the hearing aid battery. Prolonged use of wireless receivers known in the art may lead to rapid depletion of the hearing aid battery necessitating frequent battery changes and adding to the cost of operation of the hearing aid. Receiver types having integral power supplies comprising a separate battery add to the weight, size and complexity of the receiver. A more power-efficient wireless receiver would thus be of great benefit to hearing aid users.

"Power-efficiency may, e.g., be enhanced by reducing the total power consumption of the receiver circuitry. However, this should be performed without impairing the noise performance of the receiver, which would lead to reduced signal quality. Provided that signals to be transmitted are in a digital format, an FSK transmitter-receiver configuration, well-known to persons skilled in the art, is generally preferred.

"FSK signals may be demodulated in several different ways, each having different advantages, topologies and complexity. The demodulators can be subdivided into several categories: FM to AM demodulator types (e.g. Slope, Foster-Seeley and Ratio), PLL demodulators, Zero-crossing demodulators and Quadrature demodulators.

"One quadrature demodulator type well known in the art comprises a local oscillator and two signal branches denoted the in-phase branch and the quadrature branch, respectively, the received signal being splitted into an in-phase (I) component and a quadrature (Q) component. In the (binary) quadrature signal, one component is assigned binary zero, and the other component is assigned binary one. As the two signal components I and Q are mutually exclusive, a digital bitstream consisting of ones and zeroes is generated whenever the transmitter is active. Both branches are connected to a CPU, which completes the demodulation process. Generally, each branch comprises a multiplier, a filter and a decision device. The multiplier in the in-phase branch is connected directly to the local oscillator, whereas the multiplier in the quadrature branch is connected to a 90.degree. phase-shifted version of the local oscillator. The information in the frequency-shift-keyed signal is then decoded and utilized according to its intended purpose.

"Such an FSK demodulator is, for instance, described in U.S. Pat. No. 4,987,374, in the name of Burke. This demodulator comprises a local oscillator feeding a first and a second branch, each branch comprising a mixer and a detection stage. The mixer in the first branch mixes the incoming signal with the direct signal from the local oscillator, and the mixer in the second branch mixes the incoming signal with a 90.degree. phase-shifted version of the signal from the local oscillator.

"FSK receivers according to the prior art work satisfactorily in a multitude of applications. However, if the available power is only small, as is the case in hearing aids, the effective transmission range is very short, and reception errors, e.g. due to noise present in the signal, may severely corrupt the quality of the received signal.

"More confident means of detecting the signals for the purpose of improving the noise-immunity of an FSK receiver without a significant increase in power consumption is thus desired."

In addition to the background information obtained for this patent, VerticalNews journalists also obtained the inventors' summary information for this patent: "The invention, in a first aspect, provides a wireless FSK receiver for use in a hearing aid, said receiver comprising a first amplifier stage, a limiter stage, a plurality of phase detection stages, the number of phase detection stages being greater than two, and a lookup table, said first amplifier stage being connected to the input of said a limiter stage, the output of said limiter stage being split up into a first plurality of respective inputs said plurality of phase detection stages, each phase detection stage comprising a local oscillator, a mixer stage, a filter stage, and a comparator stage, respectively, the input of each phase detection stage forming a first input of the respective mixer stage, each of the respective local oscillators being connected to a second input of the respective mixer stage, the output of each mixer stage being connected to an input of the respective filter stage, the output of each of the filter stages being connected to an input of the respective comparator stage, the output of each of the comparator stages being connected to an input of said look-up table, the output of said lookup table forming an Arc tan 2-value from a set of arguments produced by said plurality of phase detection stages, wherein the frequency of each of the local oscillators is tuned to the carrier frequency of an FSK signal and wherein the phase angles of the local oscillators of the phase detection stages are mutually staggered by 180.degree./n, where n is the number of local oscillators.

"By increasing the number of demodulator branches from two to three, four, five, or more branches, the total bit-resolution, i.e. the number of discrete symbols sent per data bit, of the FSK receiver according to the invention is comparatively increased. Utilizing state of the art microelectronic technology, the increased power

consumption resulting from the addition of more demodulator branches has been found to be acceptable in spite of the added complexity of the receiver. A more effective, yet power-efficient approach to FSK receiver design is thus achieved. Wireless FSK receivers comprising from five to ten demodulator branches are considered to provide the most optimum balance between noise-immunity, circuit complexity, and total receiver power consumption.

"The invention, in a second aspect, provides a wireless FSK receiver and a method for processing a wireless FSK signal for providing a signal for a hearing aid, including the steps of receiving said FSK signal, amplifying said FSK signal, limiting the amplified FSK signal, splitting the amplified, limited FSK signal into a plurality of signal branches, the number of branches being greater than the number of distinctly detectable phase angles to be received, detecting the phase of the FSK signal in each branch of the plurality of signal branches, calculating a logical signal vector based on the detected phase of the FSK signal in each of the plurality of signal branches, summing the signal vectors of the plurality of signal branches, deriving information from the FSK signal based on the result of the summation, and presenting the derived information to the hearing aid, wherein the step of detecting the phase of the FSK signal in each branch of the plurality of signal branches includes the steps of creating a mixed signal by mixing the FSK signal with the signal from a local oscillator, band-limiting the mixed signal using a low-pass filter, comparing the mixed, band-limited signal to a fixed, predetermined level, and generating a logical value based on the comparison.

"The invention, in a third aspect, provides a hearing aid comprising a wireless frequency-shift-keying (FSK) receiver, said receiver comprising an antenna, a first amplifier stage, a limiter stage, a plurality of parallel phase detection stages and a lookup table block, wherein each phase detection stage comprises a local oscillator, a mixer stage, a filter stage, and a comparator stage, respectively, the outputs of each of the respective comparator stages being connected to the input of the look-up table block, characterized in that the number of phase detection stages is greater than two.

"Further features and advantages appear from the dependent claims."

URL and more information on this patent, see: Andersen, Henning Haugaard; Kilsgaard, Soren. FSK Receiver for a Hearing Aid and a Method for Processing an FSK Signal. U.S. Patent Number 8498434, filed May 11, 2010, and published online on July 30, 2013. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=28&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1361&f=G&l=50&co1=AND&d=PTXT&s1=20130730.PD.&OS=ISD/20130730&RS=ISD/20130730

Keywords for this news article include: Widex A/S.

Listening Effort With Cochlear Implant Simulations

Author: Pals, Carina; Sarampalis, Anastasios; Baskent, Deniz.

Publication info: Journal of Speech, Language and Hearing Research (Online) 56.4 (Aug 2013): 1075-1084.
ProQuest document link

Abstract: Fitting a cochlear implant (CI) for optimal speech perception does not necessarily optimize listening effort. This study aimed to show that listening effort may change between CI processing conditions for which speech intelligibility remains constant. Nineteen normal-hearing participants listened to CI simulations with varying numbers of spectral channels. A dual-task paradigm combining an intelligibility task with either a linguistic or nonlinguistic visual response-time (RT) task measured intelligibility and listening effort. The simultaneously performed tasks compete for limited cognitive resources; changes in effort associated with the

intelligibility task are reflected in changes in RT on the visual task. A separate self-report scale provided a subjective measure of listening effort. All measures showed significant improvements with increasing spectral resolution up to 6 channels. However, only the RT measure of listening effort continued improving up to 8 channels. The effects were stronger for RTs recorded during listening than for RTs recorded between listening. The results suggest that listening effort decreases with increased spectral resolution. Moreover, these improvements are best reflected in objective measures of listening effort, such as RTs on a secondary task, rather than intelligibility scores or subjective effort measures.

Full text: Headnote

Purpose: Fitting a cochlear implant (CI) for optimal speech perception does not necessarily optimize listening effort. This study aimed to show that listening effort may change between CI processing conditions for which speech intelligibility remains constant.
Method: Nineteen normal-hearing participants listened to CI simulations with varying numbers of spectral channels. A dual-task paradigm combining an intelligibility task with either a linguistic or nonlinguistic visual response-time (RT) task measured intelligibility and listening effort. The simultaneously performed tasks compete for limited cognitive resources; changes in effort associated with the intelligibility task are reflected in changes in RT on the visual task. A separate self-report scale provided a subjective measure of listening effort.
Results: All measures showed significant improvements with increasing spectral resolution up to 6 channels. However, only the RT measure of listening effort continued improving up to 8 channels. The effects were stronger for RTs recorded during listening than for RTs recorded between listening.
Conclusion: The results suggest that listening effort decreases with increased spectral resolution. Moreover, these improvements are best reflected in objective measures of listening effort, such as RTs on a secondary task, rather than intelligibility scores or subjective effort measures.

Key Words: cochlear implants, listening effort, dual task, reaction time, computer simulation, hearing, speech perception

Cochlear implants (CIs) are implantable auditory prostheses that partially restore hearing to people with profound hearing impairment. To accomplish this, a sound processor translates the incoming acoustic signal to electrical pulse trains, which are transmitted to the auditory nerve by an electrode array inserted in the cochlea. From the early days of CI research, the primary focus has been on improving the ability to understand speech (e.g., Fishman, Shannon, &Slattery, 1997; Fu, 2002; Manrique et al., 1999; Pfingst, Zwolan, &Holloway, 1997; Skinner et al., 1994; Wilson et al., 1991). In this context, CI benefit has typically been measured using speech intelligibility tests. Research on hearing impairment, however, has shown that cognitive measures (e.g., the response times on a verbal sentence verification test [Baer, Moore, &Gatehouse, 1993], the dual-task paradigm [e.g., Anderson Gosselin &Gagné, 2011; Sarampalis, Kalluri, Edwards, &Hafter, 2009], and pupillometry [Zekveld, Kramer, &Festen, 2010]) can provide an additional layer of information to complement intelligibility measures. The additional performance information these measures provide has been linked to ease of listening (e.g., Baer et al., 1993), or listening effort (e.g., Anderson Gosselin &Gagné, 2011), which was the focus of the present study.

Research on effort in general is based on the historical work of Broadbent (1958), Baddeley and Hitch (1974), and Kahneman (1973), each of whom proposed a shared, limited cognitive resource, later commonly referred to as working memory, that can be allocated to various tasks, as necessary. A more recent version of Baddeley's theory proposes a phonological loop for storing and manipulating incoming auditory information, a visuospatial sketchpad for visual information, an episodic buffer that stores and retrieves information from long-term memory, and a central executive that coordinates the execution of complex tasks (Baddeley, 2012). An effortful task requires a large proportion of the resources relevant to the task or a considerable involvement of the

central executive, or both. Listening effort can then be defined as the proportion of limited cognitive resources engaged in interpreting the incoming auditory signal. It has been suggested that the presence of noise or distortions in a speech signal increases cognitive demand and thus listening effort (Schneider &Pichora-Fuller, 2000; Stenfelt &Rönnberg, 2009). Spectral degradation of a speech signal, such as in CI processing or CI simulations, has been shown to tax top-down cognitive processes involved in speech perception (Baskent, 2010, 2012). Thus, we argue that, especially when the fitting of a CI is less than optimal, interpreting the impoverished signal requires substantial cognitive resources, making listening for CI users effortful.

If minimizing listening effort is to be taken into consideration when fitting CIs, it is essential to have a measure that reliably reflects listening effort. Traditionally, the fit of CIs and the benefit of new processing strategies have been determined using speech intelligibility measures. Baer et al. (1993) have shown, however, that a benefit of processing strategy measured in response times on a verbal task, which they linked to ease of listening, was more pronounced than the benefit expressed in improved intelligibility. This suggests that other measures may be more suitable for reflecting benefits in listening effort. Supporting this idea, Rabbitt (1968, 1991) has shown that a degraded bottom-up auditory signal, while not affecting the ability to repeat each word of a list at the moment it is heard, can have a significant effect on later recall of the words. This performance on the memory task is a measure of working memory load, which can be interpreted to reflect listening effort. Sarampalis et al. (2009) have shown, in normal-hearing participants, that hearing-aid-like noise reduction strategies can result in an improvement in performance on a secondary task, even when no improvement in speech intelligibility is seen. This finding implies that a hearing device feature, such as noise reduction, though it may be deemed not beneficial when assessed only with an intelligibility test, may in fact be beneficial due to a reduction in listening effort. Other studies in hearing aid research also suggest that signal-processing benefits may sometimes be better reflected by tests of listening effort (Lunner, Rudner, &Rönnberg, 2009; Rudner, Foo, Rönnberg, &Lunner, 2009; Sarampalis et al., 2009).

The hypothesis of the current study was that listening effort may change independently from speech intelligibility for different processing settings of the CI, and therefore an advantage in effort may not be accurately reflected by speech intelligibility measures. This hypothesis was tested using speech stimuli, which were generated using a noise-band vocoder to simulate CI processing. The use of simulations allowed intelligibility to be systematically manipulated by changing the spectral resolution (i.e., number of processing channels). Normal-hearing participants listened to the CI-simulated sentences and repeated what they heard, thus providing speech intelligibility data for each level of processing. The variations in listening effort resulting from the different processing conditions were assessed using a dual-task paradigm chosen based on Sarampalis et al. (2009). In a dual-task paradigm, a primary and a secondary task are performed simultaneously. If the tasks are similar, they compete for resources, and an increase in effort associated with the primary task will thus be reflected in decreased performance on the secondary task (Broadbent, 1958; Rabbitt, 1966). For more complex cognitive tasks, dual-task interference is less straightforward. However, simple psychometric tasks, such as an image-judgment task, appear to show most interference when performed simultaneously with such complex tasks (Hegarty, Shah, &Miyake, 2000).

In the current study, the primary task was a speech intelligibility task using the CI-simulated stimuli. The measure chosen to reflect listening effort was the response times (RTs) on a visual secondary task. This choice was based on the argument that one of the central cognitive resources relevant to speech understanding is speed of processing (Kramer, Zekveld, &Houtgast, 2009), and thus a secondary task using this resource will reflect effort associated with the primary speech intelligibility task. The secondary task of choice would need to be affected by effort associated with the speech task, while not affecting performance on the speech task itself. For this reason, we used two different secondary tasks in this experiment, which we expected to show different degrees of interference with the speech task: a rhyme-judgment task (e.g., Baddeley &Salamé, 1986; Wilding &White, 1985) and a simplified, two-dimensional version of the mental-rotation task (Caissie, Vigneau, &Bors,

2009; Hegarty et al., 2000; Hoyek, Collet, Fargier, &Guillot, 2012). Rhyme judgment and mental rotation tap verbal and visuospatial speed of processing, respectively (Heydebrand, Hale, Potts, Gotter, &Skinner, 2007). Research has shown the rhyme-judgment task to be a predictor of speech understanding (Heydebrand et al., 2007; Lunner, 2003), which suggests that this task relies at least partly on the same cognitive resources as speech perception, and thus we expected it to show strong interference with the primary task. The mental-rotation task showed no correlation with speech comprehension (Heydebrand et al., 2007), and for this reason, we expected it to interfere less with the primary task.

In addition to the dual-task paradigm, which was used as an objective measure of effort, listening effort was measured on a subjective multidimensional self-report scale. Although self-report measures of subjective effort are easy to administer, it is not certain whether they reflect the proportional demand on cognitive resources (Wickens, 1992). Objective measures of effort, such as the dual-task paradigm, are specifically designed to reflect cognitive demand and may therefore be more sensitive to small changes in listening effort. However, such measures are less practical to use in, for example, a clinical setting. Although both subjective and objective measures are used to quantify listening effort, studies combining both often report no statistical relation between the two (AndersonGosselin &Gagné, 2011; Feuerstein, 1992; Zekveld et al., 2010), suggesting that objective and subjective measures of listening effort may tap different aspects of listening effort and may be complementary.

Method

Participants

Twenty-three normal-hearing young adults were recruited for participation in this study, four of whom were excluded during data analysis because of missing values in their data sets (either due to problems with the digital voice recorder or inconsistent filling out of the subjective workload questionnaire). The remaining 19 ranged in age from 19 to 25 years (average age about 22 years). Three were male, 16 were female. All participants were native Dutch speakers, and they reported having no dyslexia or other language impairment. Prior knowledge of Japanese or similar scripts was an exclusion criterion based on the stimuli used in one of the secondary tasks. Normal hearing was confirmed by pure-tone thresholds (below 20 dB HL at audiometric frequencies between 250 and 6000 Hz). All participants were given sufficient explanation about the experiment and voluntarily signed an informed consent form prior to data collection and were reimbursed for their time and effort.

Speech Stimuli

The stimuli used for the intelligibility task were full sentences, eight to nine syllables in length, of on average 1.8-s duration. Using sentences rather than single words would allow for a full secondary task trial, from stimulus presentation until response, to be completely contained within the presentation of one auditory stimulus. The sentences of the VU corpus (Vrije Universiteit, Amsterdam, the Netherlands; Versfeld, Daalder, Festen, &Houtgast, 2000), of the female speaker set, were used. These are digitally recorded (sampled at 44.1 kHz) and organized in 39 balanced lists, each list consisting of 13 Dutch sentences. The sentences were processed using a noise-band vocoder (Dudley, 1939), implemented in MATLAB, to simulate CI processing (Shannon, Zeng, Kamath, Wygonski, &Ekelid, 1995). The experimental variable in the listening task was the spectral resolution of the simulated speech, manipulated by using different numbers of spectral channels in the vocoder. Normalhearing listeners can usually understand CI-simulated speech quite well with four to eight channels (Baskent, 2006; Friesen, Shannon, Baskent, &Wang, 2001). On the basis of these studies, the conditions for the listening task were chosen to cover the range from nearly unintelligible to perfectly intelligible: 2-, 4-, 6-, 8-, 12-, 16-, and 24-channel CI simulations and a control condition using unprocessed speech stimuli. The filter bandwidths and cutofffrequencies varied depending on the number of channels. The bands were chosen such that they corresponded to evenly spaced regions in the cochlea; this was achieved by calculating the -3 dB cutofffrequencies using Greenwood's frequency-to-place mapping formula (Greenwood, 1990). For some

examples of -3 dB cutofffrequencies, see Figure 1.

The vocoder processing was implemented as follows: First, the original acoustical signal was separated into a number of spectral bands (the analysis bands) as determined by the experimental condition, using sixth-order Butterworth bandpass filters. From each analysis band, the slow-changing envelope was extracted by means of half-wave rectification and filtering with a third-order low-pass Butterworth filter with -3 dB cutofffrequency of 160 Hz. A set of noise-band carriers (the synthesis bands) was constructed by similarly dividing white noise into spectral bands using sixth-order Butterworth bandpass filters. For this experiment, the center frequencies and bandwidths of the analysis bands were the same as those of the synthesis bands in order to simulate matching frequency-to-place mapping of the CI electrode array (Baskent &Shannon, 2007; Greenwood, 1990). The CI simulationswere then constructed bymodulating each synthesis band with the envelope extracted from the corresponding analysis band and then adding these modulated noise bands together to form the final stimulus.

Visual Stimuli

The stimuli for the secondary tasks were rhyme words for one task and Japanese characters for the other. The reason for using Japanese phonetic symbols was to ensure that the stimuli for the mental-rotation task were linguistically meaningless to the participants. The words used in the rhymejudgment task were monosyllabic Dutch words, vetted for their pronunciation by a native speaker of Dutch. The 75% most frequently occurring words, as determined by the CELEX lexical databases of Dutch (Baayen, Piepenbrock, &Gulikers, 1995), were used in the experiment. The words in the display were clearly visible, one above another, centered on a computer monitor in big, black capital letters on a white background, each letter approximately 7 mm wide and 9 mm high, with a 12-mm vertical white space between the words. The Japanese characters used for the mental-rotation task were taken from the hiragana, one of the two syllabaries in use in Japanese. For those pairs of characters that can easily be mistaken as the same when rotated by 90° (for example: and), only one of the two characterswas used. The characters in the display were clearly visible, positioned side by side, and centered on a computer monitor in black on a white background, each character approximately 3 cmwide and 3 cmhigh, with a 4-cm horizontal white space between the characters, as illustrated in Figure 2.

Equipment

The participants were seated in a soundproof booth, in front of a wall-mounted computer screen at approximately 50-cm distance. A computer program, implemented using the Psychophysics Toolbox Version 3 for MATLAB and run on an Apple Macintosh computer, coordinated the presentation of both the auditory stimuli for the primary task and the visual stimuli for the secondary task. The verbal responses on the primary listening task were recorded for later scoring on a PalmTrack 24-bit digital audio recorder (Alesis, LP). The key-press responses and the RTs on the secondary task were automatically logged by the experimental program. The digital audio stimuli were sent via the AudioFire 4 external soundcard (Echo Digital Audio Corporation) to open-back HD600 headphones (Sennheiser electronicGmbH&Co.KG), to be presented to the participant diotically. The participants were instructed to adjust the volume to a comfortably loud, clearly audible level, within the range of 65-75 dB SPL. The calibration was done using the processed stimuli, measuring root-mean-square sound pressure with integration time constant of 1 s.

Procedure

Listening effort was measured objectively with a dualtask paradigm, consisting of a listening task (primary) and two different visual decision-making tasks (secondary); and subjectively with a multidimensional subjective rating scale.

Listening task. The primary task was designed to measure the participant's intelligibility score for sentences of varying spectral resolution. This task was presented three times for each of the eight levels of spectral resolution: once as a single task and once combined with each secondary task. The presentation order of these 24 conditions was randomized for each participant. Blocks of presentations for the single-task listening conditions consisted of one list of 13 sentences. For the dual-task conditions, no more than one RT

measurement could be recorded during the presentation of each sentence. Therefore, each block of presentations included a total of 26 sentences. This way it was possible to gather a sufficient amount of RT data recorded during the presentation of an auditory stimulus for statistical analysis. The interval between the onsets of the sentences was timed 8 s apart, and the average duration of the sentences was approximately 2 s. The intelligibility task was to listen to the processed sentences and repeat out loud what was heard. The participants were encouraged to guess if they were not sure what they heard. Their responses were recorded for offline scoring by a native Dutch speaker. The percentage of correctly identified words served as a measure of intelligibility.

Visual tasks. The visual decision-making tasks were designed to measure RTs, from stimulus onset until a key was pressed by the participant. In the rhyme-judgment task, a randomly chosen pair of words was displayed, one above the other, on the computer monitor. The participant's task was to indicate whether the two words rhymed or not by pressing one of two buttons on the keyboard. In the mentalrotation task, a randomly chosen pair of Japanese characters was displayed side by side on the monitor, one of which was rotated by 90°. The location of the rotated character (leftor right) and the direction of the rotation (clockwise or counterclockwise) were randomly determined by MATLAB, with equal probabilities for each possible combination. On this task, participants indicated whether the two characters were the same (except for the rotation) or different by pressing one of the same two buttons used in the rhyme-judgment task.

The rest of the procedure was the same for both visual tasks. The stimulus combination was chosen at random, with a 50% chance for a pair that required a "yes" answer. The stimuli were presented until a key was pressed in response or for a maximum of 2.7 s, after which the next trial would begin. Consecutive stimuli were separated by an interstimulus interval during which a fixation cross would appear in the center of the screen for the participants to focus on. The duration of this interval was pseudorandomly varied between 0.5 and 2.0 s, based on a uniform distribution. If no key was pressed, the trial was logged as a "miss." This variation ensured that the participants were unable to predict when a stimulus would appear and that in dual-task conditions the timing of the auditory and visual stimuli varied.

Subjective rating scale. For subjective assessment of listening effort, the NASA Task Load Index (TLX) was used (Hart &Staveland, 1988). The NASA TLX is a multidimensional scale that measures a range of aspects contributing to perceived workload: mental demand, physical demand, temporal demand, performance, effort, and frustration (Hart &Staveland, 1988). The total score is the weighted mean of the scores from the different dimensions. The weights are determined after the experiment by pairwise comparison. For all possible pairs of dimensions, the participants are asked to indicate which of two contributed most to the overall workload of the tasks. This procedure of weighting the ratings is designed to reduce intersubject variability resulting from differences in individual interpretation of workload and its factors.

Results

The average speech intelligibility scores are depicted in Figure 3. In each panel, the scores are plotted separately for listening task only, listening task combined with rotation task, and listening task combined with rhyme-judgment task. In the leftpanel of Figure 3, the intelligibility scores are plotted in units of percentage correct, as a function of spectral resolution. In the right panel of Figure 3, the scores are plotted in rationalized arcsine units (RAU; Studebaker, 1985), as a function of spectral resolution. The conversion to RAU was performed to allow a closer examination of the effects near ceiling; RAU scores are easier to interpret because, unlike with proportional scores, the variance is independent of the mean, and thus differences in percentage scores on different parts of the scale (e.g., the difference between 50% and 60% is not comparable to the difference between 90% and 100%) are not comparable, whereas differences in RAU are. Because the maximum possible value in RAU depends on the number of items in a task, the RAU scores were calculated based on an average number of words per list (80 words) and a proportion of words repeated correctly for each task. This ensures that a score of 100% correct always corresponds to the same RAU value, in this case,

117.83. The leftpanel of Figure 3 shows that, in terms of percentage correct, speech intelligibility appears to reach a plateau at six channels. The right panel shows that there might still be some improvement in intelligibility between six and eight channels. To examine these effects and differences between percentage correct and RAU scores, we carried out further analyses on both sets of scores.

Two repeatedmeasures analyses of variance (ANOVAs) were performed with task and spectral resolution as factors (with three and eight levels, respectively), one on the percentage correct scores and one on the RAU scores. Both ANOVAs showed a significant main effect of spectral resolution-percentage correct, $F(7, 126) = 396.84$, $p < .001$; RAU, $F(7, 126) = 412.89$, $p < .001$-and a significant interaction between task and spectral resolution-percentage correct, $F(14, 252) = 2.11$, $p = .012$; RAU, $F(14, 252) = 1.85$, $p = .033$. A post hoc analysis using Tukey's honestly significant difference test (HSD) indicated that the sole cause of the significant interaction was a significant difference in intelligibility between the mental-rotation task and the single task for the four-channel condition, while there was no significant difference between the single task and the rhymejudgment task. To confirm that there was no difference in performance between the two dual tasks, we performed twoway ANOVAs for these two tasks over the eight levels of spectral resolution, again for both the percentage correct scores and the RAU scores. These ANOVAs showed no significant interaction between task and processing. From this, we concluded that there was no significant difference between the two dual tasks in terms of speech intelligibility. Therefore, we then grouped the data for the two dual tasks together to examine the differences between listening conditions. As expected, speech intelligibility with two channels was very low, with about 13% of the words identified correctly. Increasing the number of channels to four provided a dramatic improvement in intelligibility; participants scored on average 70% correct. For six channels, speech intelligibility was near perfect, on average 98% correct. The significance of these differences was determined using Tukey's HSD, which showed that there were significant improvements in intelligibility from two to six channels of CI simulations and that further increases in spectral resolution resulted in no significant improvement in intelligibility. This was true for both the percentage correct scores and the RAU scores.

Upon examining the RTs from individual participants, we discovered a reduction over time, regardless of the listening conditions, suggesting training effects. Figure 4 shows the mean dual-task RT data as a function of presentation order, with each visual task in a separate panel. Despite each participant being presented with the listening conditions in a different, randomized order, the fit lines in these figures do show that there were strong learning effects during the course of the experiment. In order to reduce the betweensubject variance introduced by these training effects, they were modeled and compensated for using the following procedure. First, an exponential function was fitted to the overall mean RT data for each of the two secondary tasks. The proportion of variance accounted for (R2) by these fits was 0.975 for the rhyme-judgment task and 0.841 for the mental-rotation task. The horizontal asymptote of the exponential fit line is interpreted as the value on which the RT converges when all training effects have stabilized. For each individual participant, the learning effects were then compensated for by subtracting the deviation from the asymptote predicted by the fit line for each condition on the basis of the order of presentation. These manipulations of the data had no visible effect on the shape of the RT data as a function of spectral resolution. They did, however, considerably reduce the variance; for the raw RT data, standard deviations of the mean RTs per level of spectral resolution ranged from 0.35 to 0.63 s; compensating for learning effect reduced the standard deviations to values between 0.15 and 0.27 s. Further analyses of the RTs were performed on the data corrected for learning effects.

The first two panels of Figure 5 show the RT data (adjusted for learning effects) for the rhyme-judgment task and the mental-rotation task. Because wrong answers may be the result of a strategy or accidental button press, these RTs may be unrealistically short and thus distort the data. Therefore, RTs for trials on which a wrong answer was given were leftout of the analysis. In both panels, the mean RTs are shown for trials presented during listening (dashed line) and for trials presented between the auditory stimuli (dotted line). The overall mean RTs, recorded during and between auditory stimuli grouped together, are represented by the solid

line. These two plots show that the reduction in RTs from two to eight channels was greater for trials presented during a sentence than for trials presented in between. A three-way repeated measures ANOVA, with the factors task, visual stimulus timing, and spectral resolution, indicated that the interaction between stimulus timing and processing was indeed significant, $F(7, 126) = 18.37$, $p < .01$. The results of the ANOVA also showed a significant main effect of processing on RT, $F(7, 126) = 28.78$, $p < .01$. Comparison between mean RTs for consecutive processing conditions using Tukey's HSD showed a significant decrease in RT for listening conditions up to eight channels. Interesting to note is that there were significant RT improvements even for conditions in which speech intelligibility had reached a plateau.

The third panel in Figure 5 shows the mean NASA TLX scores for the listening task performed alone and with both secondary tasks. Both dual tasks were consistently judged more effortful than the single-task conditions. It can also be seen from the figure that the NASA TLX scores, like the RTs, decrease as the number of channels CI simulations increases, at least for low numbers of channels. However, the decrease in effort between six- and eight-channel CI simulations for NASA TLX scores was not significant. A twoway ANOVA of the NASA TLX scores showed significant main effects of spectral resolution as well as task, which we attribute to the difference between the single and dual task. An ANOVA performed only on the NASA TLX data for the two dual tasks did not show a significant effect of task. Because there was no significant difference between the two dual tasks, we averaged the mean RTs over both dual tasks to further examine them. The mean RTs for consecutive listening conditions were compared using Tukey's HSD, which showed a significant decrease in NASA TLX scores for listening conditions up to six channels.

Discussion

The hypothesis of the present study was that, with different settings of CI processing, listening effort may change differently from speech intelligibility. Furthermore, the conventional speech intelligibility tests may not be sufficient to capture these effects accurately. To explore this hypothesis, listening effort was assessed using an objective and a subjective measure. These measures were then compared with speech intelligibility scores to examine whether they were sensitive to differences in listening effort between conditions in which no improvement in intelligibility was seen. The participants were presented with speech stimuli processed to simulate CI output with different levels of spectral resolution and asked to repeat back what they heard. This was the primary task of the dual-task paradigm used, and this task resulted in speech intelligibility scores for each level of spectral resolution. Two different secondary tasks-a rhymejudgment task and a mental-rotation task-served to provide an objective measure of the listening effort associated with each level of processing, in the form of RTs on a visual decision-making task performed simultaneously with the intelligibility task. In addition to this, a multidimensional workload questionnaire was administered after each task to serve as a subjective measure of listening effort.

The results of the primary speech intelligibility task, in line with the findings of previous research (e.g., Baskent, 2006; Friesen et al., 2001), showed an increase in intelligibility with increased spectral resolution. The present study closely reproduced the speech intelligibility results reported by Friesen et al. (2001) for normal-hearing listeners presented with CIsimulated English sentences in quiet. In both studies, amarked increase in intelligibility was observed between two- and six-channel CI simulation. Intelligibility appeared to reach about 98% for six spectral channels, and further increases in spectral resolution produced no significant improvement.

The main interest of the present study was listening effort. The results from the subjective workload questionnaire, the NASA TLX, showed consistently higher scores for dual task compared with single task. This is not surprising because the NASA TLX is designed to measure overall task load, and a dual task can be considered to be cognitively more demanding than a listening task alone (Wickens, 2008). For all three tasks (the single listening task, the rhymejudgment dual task, and the mental-rotation dual task) the NASA TLX showed a significant decrease in workload from two to six spectral channels. For an increased number of

spectral channels beyond six, no significant decrease in subjective workload was found. The results of the two visual decision-making dual tasks showed that, although both speech intelligibility and NASA TLX scores improved only from two up to six spectral channels, RTs on both secondary tasks improved significantly from two up to eight channels. In other words, the RT measures captured an improvement, or benefit, of increasing spectral resolution from six to eight spectral channels that the intelligibility task and the NASA TLX did not capture.

One can argue whether the benefit captured by a decrease in RTs is indeed due to reduced listening effort. Recall that what we call "listening effort" is the proportion of a shared, limited cognitive resource that is allocated to the listening task. The larger the effort, the larger is this proportion assigned to the listening task, and thus the less of this resource is available to perform another task simultaneously. The RTs recorded between presentations of auditory stimuli showed a significantly shallower effect of spectral resolution than the ones recorded during presentation of auditory stimuli (Figure 5). This observation supports the idea that the effects of simulated CI processing present in the RT data are indeed caused by changes in demands on shared resources due to these differences in processing. In short, the observed pattern suggests that the reduced RTs are caused by a decrease in listening effort associated with the increase in spectral resolution. The literature shows that effects of effort are rather elusive, and effects in RT, though significant, can be as small as about 50 ms (e.g., Baer et al., 1993; Sarampalis et al., 2009). Although the results show a significant effect in RT only for conditions with constant intelligibility between six and eight channels, this effect was observed for both secondary tasks; therefore, we are convinced that it is a persistent and repeatable effect. Although both intelligibility and subjective workload measures are likely to reflect changes in listening effort to some degree, as these two measures showed a pattern similar to that of the RT measures, they appear to be less sensitive to changes in listening effort; they showed no significant improvement between six and eight spectral channels, whereas the RT measures did.

The NASA TLX scores do not show the same sensitivity to changes in listening effort as the RT measures. This difference in sensitivity between the NASA TLX and the RT measures can be explained in two ways. As mentioned in the beginning of this article, several studies combining objective and subjective measures have reported no statistical relation between the two (Anderson Gosselin &Gagné, 2011; Feuerstein, 1992; Zekveld et al., 2010). Anderson Gosselin and Gagné (2011) suggested that these different types of measures reflect different aspects of listening effort. They referred to the distinction between "effort" and "ease" made by Feuerstein (1992) and suggested that whereas performance on the secondary tasks reflect effort, a subjective self-report measure reflects ease. Another possible explanation attributes this difference to the "performance" dimension in the NASA TLX. Rubio, Diaz, Martin, and Puente (2004) compared different subjective workload measures and concluded that, of the three measures they compared, the NASA TLX showed the highest correlation with performance. This could explain why the NASA TLX results in the present study follow the intelligibility results more closely and, like the intelligibility measures, are less sensitive to changes in listening effort.

In the present study, the rationale for using two different visual RT tasks, one linguistic in nature and one purely visual, was based on the hypothesis that these two types of secondary tasks tap different aspects of working memory, the phonological loop and the visuospatial sketchpad (Baddeley, 2012; Heydebrand et al., 2007), and thus might be affected differently by the primary intelligibility task. We originally expected that this could result in different patterns of the RT outcomes for the two tasks as a function of spectral resolution or differences in interaction with the primary speech perception task. Against our expectation, the patterns of average RTs for the two secondary tasks looked very similar, and there was indeed no significant interaction between the type of secondary task and spectral resolution. Furthermore, neither task affected the performance on the primary task. One possible explanation for these similarities between the two tasks could be that, because of the nature of the Dutch language, most rhyming word pairs were orthographically similar, whereas most nonrhyming pairs were

dissimilar. Therefore, although we assumed the task to be purely linguistic, it was possible for the participants to adopt a visual strategy. Alternatively, mental rotation is such a complex operation that it is not limited to the visual modality but rather requires central processing as well (Ruthruff, Miller, &Lachmann, 1995). Thus, even though the task used in this study was a simplified version of the classical mental-rotation task, it could well be affected by a concurrent task in a different modality-such as a listening task. Regardless of the nature of the secondary task, both versions showed effects of listening effort where speech intelligibility scores and subjective effort scores did not.

Overall, we take the findings of the present study to mean that decreased spectral resolution, as manipulated by reducing the number of vocoder channels in CI simulations, results in increased listening effort, which is reflected in longer RTs on a secondary task. Supporting our observations, Lindenberger and Baltes (1994) hypothesized that, in a manner similar to the interference between tasks in a dualtask paradigm, interpreting degraded sensory input may require an increased allocation of cognitive resources, leaving fewer resources available for other cognitive tasks at hand. Schneider and Pichora-Fuller (2000) referred to this as the "information degradation hypothesis." Further support for such coupling between degraded speech and the increased cognitive resources needed for its processing was presented by Pichora-Fuller, Schneider, and Daneman (1995), who have shown that effects of age on cognitive performance can, at least partially, be explained by a decrease in sensory function; older listeners were found to have more trouble recalling lists of spoken items, whereas for both young and old listeners, decreasing the signal-to-noise ratio of auditory stimuli reduced their ability to store the items in memory. This finding suggests that a reduction in signal quality increases cognitive demand similarly in both young and old listeners. Two more recent studies showed increased cognitive demand as a result of decreased spectral resolution with both CI simulations and CI users (Baskent, 2012; Chatterjee et al., 2010).

In short, auditory processing, working memory, and speed of processing seem to interactively affect both speech understanding and the resources available for additional tasks (Lunner, 2003). In this light, changes in the effort needed to interpret the auditory signal can be reflected in both measures of working memory performance and speed of processing, such as the RTs on a secondary task used in this study. In their study, Sarampalis et al. (2009) showed a benefit of noise reduction strategies reflected both in better working memory performance and faster RTs, even for conditions in which noise reduction provides no benefit in speech intelligibility. The current study shows similar results: A significant decrease in RTs was found as the number of channels for CI simulations increased from six to eight, although this produced no significant increase in intelligibility.

To summarize, the present study used a dual-task paradigm in which normal-hearing participants were asked to simultaneously perform a speech intelligibility task using CI-simulated speech stimuli with different numbers of spectral channels and a visual RT task. The results showed that RTs decreased with an increasing number of channels, even for some conditions that showed no more improvement in speech intelligibility. This finding suggests that it is possible to further improve the listening experience for CI users, even when no improvement is observed in speech intelligibility. Currently, there is no clinical test that can show such benefits of different programs.

This line of research will help identify processing features and strategies for improving listening effort for CI users and help develop a method for measuring listening effort in a clinical setting to assist in improving CI fitting to optimize listening effort. Considering that a large proportion of Dutch CI users report increased listening effort with a CI compared with preimplantation (van Hardeveld, 2010), such optimization would be beneficial to a large population. The dual-task paradigm used in this study is not yet suitable for measuring listening effort in one individual, because of large individual variance and training effects, and is thus not suitable for use in clinical settings. However, it has proven to be sensitive enough to show effects of listening effort across a group of participants and hence presents a useful method that can be used in research settings, such as in developing

new signal-processing algorithms.

Acknowledgments

This research was supported by Cochlear Ltd, Dorhout Mees, Stichting Steun Gehoorgestoorde Kind, the Heinsius Houbolt Foundation, a Rosalind Franklin Fellowship from the University of Groningen, the Netherlands Organization for Scientific Research (NWO, VIDI Grant 016.096.397), and the Cochlear Implant Center Northern Netherlands and is part of the research program Communication Through Hearing and Speech.

We gratefully acknowledge Thomas Lunner for his insightful suggestions concerning this research; Thomas Stainsby and Ruben Benard for their comments on earlier versions of this article; and Frits Leemhuis, Annemieke ter Harmsel, Nico Leenstra, and Marije Sleurink for their help in seeing this project through.

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received March 3, 2012
Revision received August 21, 2012
Accepted November 1, 2012
DOI: 10.1044/1092-4388(2012/12-0074)

Roles of Voice Onset Time and F0 in Stop Consonant Voicing Perception: Effects of Masking Noise and Low-Pass Filtering

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.4 (Aug 2013): 1097-1107.
ProQuest document link

Abstract: The contributions of voice onset time (VOT) and fundamental frequency (F0) were evaluated for the perception of voicing in syllable-initial stop consonants in words that were low-pass filtered and/or masked by speech-shaped noise. It was expected that listeners would rely less on VOT and more on F0 in these degraded conditions. Twenty young listeners with normal hearing identified modified natural speech tokens that varied by VOT and F0 in several conditions of low-pass filtering and masking noise. Stimuli included /b/-/p/ and /d/-/t/ continua that were presented in separate blocks. Identification results were modeled using mixed-effects logistic regression. When speech was filtered and/or masked by noise, listeners' voicing perceptions were driven less by VOT and more by F0. Speech-shaped masking noise exerted greater effects on the /b/-/p/ contrast, while low-pass filtering exerted greater effects on the /d/-/t/ contrast, consistent with the acoustics of these contrasts. Listeners can adjust their use of acoustic-phonetic cues in a dynamic way that is appropriate for challenging listening conditions; cues that are less influential in ideal conditions can gain priority in challenging conditions.

Full text: Headnote

Purpose: The contributions of voice onset time (VOT) and fundamental frequency (F0) were evaluated for the perception of voicing in syllable-initial stop consonants in words that were low-pass filtered and/or masked by speech-shaped noise. It was expected that listeners would rely less on VOT and more on F0 in these degraded conditions.
Method: Twenty young listeners with normal hearing identified modified natural speech tokens that varied by VOT and F0 in several conditions of low-pass filtering and masking noise. Stimuli included /b/-/p/ and /d/-/t/ continua that were presented in separate blocks. Identification results were modeled using mixed-effects logistic regression.
Results: When speech was filtered and/or masked by noise, listeners' voicing perceptions were driven less by VOT and more by F0. Speech-shaped masking noise exerted greater effects on the /b/-/p/ contrast, while low-pass filtering exerted greater effects on the /d/-/t/ contrast, consistent with the acoustics of these contrasts.
Conclusion: Listeners can adjust their use of acoustic-phonetic cues in a dynamic way that is appropriate for challenging listening conditions; cues that are less influential in ideal conditions can gain priority in challenging conditions.
Key Words: speech perception, noise, voicing contrast, bandwidth

Consonant voicing contrasts are very common in the world's languages (Ladefoged &Maddieson, 1996), and

the perception of acoustic cues underlying these contrasts has been explored thoroughly for normal-hearing listeners and other listeners in quiet conditions. Much less is known about how voicing is perceived by individuals who rely on low-frequency hearing (e.g., individuals with hearing impairment [HI]) or individuals listening in background noise. It is clear that perception of voicing remains accurate across a wide range of signal degradations, including highor low-pass filtering (Miller &Nicely, 1955), masking noise (Miller &Nicely, 1955; Phatak &Allen, 2007; Phatak, Lovitt, &Allen, 2008; Wang &Bilger, 1973), hearing impairment (Bilger &Wang, 1976), spectral degradation (Shannon, Zeng, Kamath, Wygonski, &Ekelid, 1995; Xu, Thompson,&Pfingst, 2005), or cochlear implantation (Friesen, Shannon, Baskent, &Wang, 2001). It is thus often stated that the amount of "information transfer" is high for the voicing feature relative to other consonant features. This finding is so consistent that some studies dispense with potential voicing confusions in the very design of the experiment (Dubno &Levitt, 1981). Despite this generalized high level of success, the constraints that face listeners in noise and/or those who rely on low-frequency hearing (e.g., listeners with hearing loss) are likely to change the means by which voicing is perceived-that is, the voice information could be recovered via different cues in varied listening conditions. In the current study, we show that in some degraded conditions, the role of voice onset time (VOT) decreases and the role of fundamental frequency (F0) increases for the perception of wordinitial voicing in stop consonants.

Cues for Voicing in Stop Consonants

Although perception of voicing in word-initial stop consonants has been largely attributed to VOT (i.e., the duration between consonant release and the onset of voicing for the following vowel; Lisker &Abramson, 1964), F0 plays a role as well. F0 is higher after voiceless stops than after voiced stops (House &Fairbanks, 1953), and this difference generally lasts roughly 100 ms into a vowel (Hombert, 1975). Although F0 is not a very potent cue for stop sounds with canonical voiced or voiceless VOTs (Abramson &Lisker, 1985), it can exert potent influence under certain conditions, such as for sounds with ambiguous VOTs (Abramson &Lisker, 1985; Haggard, Ambler, &Callow, 1970). When F0 contour conflicts with VOT, reaction time is slowed (Whalen, Abramson, Lisker, &Mody, 1993), suggesting that listeners are sensitive to F0 information even when identification curves suggest otherwise.

Another acoustic cue that may be useful to voicing perception is F1. Word-initial stop sounds are followed by transitioning formants, the first of which begins at a low frequency (e.g., 300 Hz) and ascends to its target frequency for the following sound. As VOT grows longer, that rising transition becomes increasingly devoiced, resulting in a higher F1 frequency at the onset of voicing; long VOT values yield higher F1 onsets, whereas low F1 onsets are characteristic of short VOT values (Lisker, 1975). An exception to this trend is for high vowels (e.g., /i/, /u/), whose voicing-related F1 perturbations are minimal because F1 begins and ends at low frequencies; F1 is thus not thought to aid the voicing contrast in high vowel environments. In this experiment, we focused on the contributions of VOT and F0 and hence relied on the /i/ vowel to provide an environment in which VOT perception could be measured without confounding changes in F1.

Both low-pass filtering and masking noise should affect VOT and F0 disproportionately. The aspiration noise that characterizes the VOT cue contains considerable energy in the high-frequency regions, particularly for the /t/ consonant (see Figure 1). Eliminating high-frequency energy from the signal would render the aspiration less audible while maintaining lower frequency harmonics in the vowel that drive F0 perception. Competing noise should more effectively mask the VOT than the vowel because the aspirated portion of the word is less intense than the vowel portion; the F0 is recovered from the vowel and should thus be relatively less affected by the noise.

The Effect of Low-Pass Filtering

Exploring the effect of limited bandwidth in terms of a low-pass filter (LPF) has particular relevance for understanding the experience of people with HI. High-frequency hearing loss can render some phonetic cues inaudible, potentially compelling listeners with HI to rely on different cues than those used by people with normal

hearing. Furthermore, the lack of access to high-frequency auditory filters is likely to compromise temporal resolution because the wideband highfrequency filters are considerably superior in the temporal domain compared with the narrow-band low-frequency filters (Eddins, Hall, &Grose, 1992). For example, noise gap detection thresholds become smaller as bandwidth grows wider (Eddins &Green, 1995; Eddins et al., 1992; Grose, 1991). For this reason, it is likely that listeners who rely solely on low-frequency energy have poorer ability to use temporal cues (such as VOT) but remain receptive to residual information that should include F0.

Role of F0 in Noise

Previous research has shown that F0 is a useful cue for listening to speech in noise (Brokx &Nooteboom, 1982; McAdams, 1989). When the F0 contours of masked sentences are flattened or inverted around the mean, intelligibility decreases (Binns &Culling, 2007) and self-reported difficulty increases (Laures &Weismer, 1999), particularly when the masker is competing speech. It is likely that the F0 contour can help direct listeners' attention to the timing of target words to aid in intelligibility (Cutler &Foss, 1977). Although the utility of a natural F0 contour is well established at the sentence level, relatively little is known about the contributions of F0 contour to the intelligibility of individual segments or phonetic features. Fogerty and Humes (2012) showed that the flattening of F0 contours or the removal of F0 information (i.e., whisper-like speech) resulted in deficits for both vowels and consonants. Therefore, although vowels are the primary periodic element in the speech signal, consonant sounds stand to benefit from natural F0 contours as well.

Objectives and Hypothesis

The present study was designed to test whether F0 would become a more prominent cue for voicing in wordinitial stop consonants in conditions of low-pass filtering and/or masking by speech-shaped noise. Unlike aspiration noise that characterizes the VOT cue, F0 should be perceptible even without high-frequency information. F0 has been previously shown to be a beneficial cue for listening to sentences in noise, but its use at the segmental level has not been fully understood. We hypothesized that in the aforementioned degraded signal conditions, listeners' voicing judgments would be driven more heavily by F0 and less by VOT.

Method

Participants

Participants included 20 adult listeners (15 women; mean age = 24.3 years) with normal hearing, defined as having pure-tone thresholds ≤20 dB HL from 250 to 8000 Hz in both ears (American National Standards Institute, 2010). All participants were native speakers of American English and were screened for self-reported unfamiliarity with tonal languages (e.g., Mandarin, Cantonese, Vietnamese) to ensure that no participant entered with a priori increased bias toward using F0 as a lexical or phonetic cue. Informed consent was obtained for each participant, and the experimental protocol was approved by the institutional review board at the University of Maryland. Participants were reimbursed for their participation.

Stimuli

Two sets of stimuli were created using modified natural speech. The words "Pete," "beat," "teen," and "Dean," spoken by a male native speaker of English, were recorded in a double-walled sound-treated room with a 44.1 kHz sampling rate. We sought to measure the contribution of VOT without the added complementary cue of F1, so a high vowel /i/ was used for all consonant environments. Stimuli varied by VOT (in seven or eight steps for /b/-/p/ and /d/-/t/, respectively) and F0 (in eight steps). Following the method used by Andruski, Blumstein, and Burton (1994), onset portions of words with /b/ or /d/ onsets were progressively replaced with equivalently long portions of onset aspiration from /p/ or /t/, respectively, in 10-ms increments from the onsets (bound at the closest zero crossing) to create continua of VOT. Thus, the vowel from each stimulus item came from the /b/- or /d/-initial tokens. For the /d/-/t/ continuum, the VOT range spanned from 0 ms to 70 ms, and the range for the /b/-/p/ continuum spanned from -10 ms (prevoicing) to 50 ms, as suggested by previous studies (Abramson &Lisker, 1970; Lisker &Abramson, 1964).

Intensity of items in the /b/-/p/ series varied within 2.7 dB, and all items in the /d/-/t/ series varied within 1 dB;

overall root-mean-square intensity was affected by VOT step because lower intensity aspiration noise progressively replaced higher intensity phonated vowel onsets. Volume was calibrated such that the end-point "voiced" stimulus of each series in the optimal (full-spectrum, in quiet) condition was 65 dBA.

The F0 contour of each stimulus was manipulated using the pitch synchronous overlap-add method in Praat (Boersma &Weenink, 2011). Steps in the F0 continuum were interpolated in eight steps along a log scale ranging from 94 to 142 Hz, which reflects the general range for male speech, as indicated by previous work (Abramson &Lisker, 1985; Ohde, 1984; Whalen et al., 1993). F0 was kept steady over the first two pitch periods of the vowel and fell (or rose) linearly until returning to the original contour at the 100-ms point in the vowel (the time indicated by Hombert, 1975). Following the 100-ms timepoint, all F0 contours were equal within each continuum.

Masking noise. Speech-shaped noise (SSN) was extracted offline from the iCAST program (Fu, 2006). Its spectrum was strongest in the 200-600 Hz region and decreased by roughly 6 dB per octave (see Figure 1). This noise was chosen to reflect the long-term average spectrum (LTAS) of conversational speech rather than the LTAS of our stimuli (the presence of only one vowel in our stimuli would yield a LTAS of only very limited utility with regard to everyday experience). Stimulus timing within the noise was roved so that there was 280-360 ms of noise before the stimulus and 380-450 ms of noise after the stimulus. To present varying signal-to-noise ratios (SNRs), noise levels varied while speech signals were kept at constant amplitude within each condition. Noise levels were set relative to the vowel onset so that SNR was not affected by intensity differences stemming from VOT continuum steps or by syllable type (stop-final or nasal-final). As most studies do not reference one particular point in a syllable to calculate SNR, caution is encouraged when comparing SNR levels in the current study with those from other publications. For example, the SNR at vowel onset for "Pete" is roughly 4 dB greater than that calculated from the entire word, resulting in greater masking to reach equivalent SNR.

Low-pass filtering. Stimuli were low-pass filtered using the Hann band filter function in Praat (Boersma &Weenink, 2011), illustrated by the filter responses in Figure 2. Cutofffrequencies of 4 kHz, 2 kHz, and 1 kHz were used to investigate various degrees of residual acoustic information. Filtering was done after the addition of background noise to model the order of signal degradations encountered by a listener with HI. Therefore, the level of noise (and, hence, the overall signal) for conditions at poorer SNRs was more intense than those at better SNRs, and signals with higher LPF cutoffs were more intense that those with lower LPF cutoffs. It should be noted that although the vowels and final consonants in all speech stimuli were degraded by the masking noise and filtering, these segments were already identified by the visual word choices.

Conditions

The levels of low-pass filtering and SNR in this experiment were chosen to measure specific effects highlighted in Table 1.

The arrangement of conditions was inspired by preliminary experiments (Table 1, top row) that suggested that either 0 dB SNR or a 1 kHz LPF permitted use of the VOT cue, but the combination of these factors promoted the use of F0 nearly exclusively. The combination of the 1 kHz LPF and the 0 dB SNR condition could be improved by either ameliorating the LPF settings or making the SNR more favorable. Thus, questions following this pilot testing included the following: (a) What LPF cutoffis necessary to facilitate the use of VOT when the SNR is 0 dB (middle row)? and (b) What SNR is needed to facilitate the use of VOT when the LPF is 1 kHz (bottom row)? Each of these conditions was tested for the /b/-/p/ stimuli and for the /d/-/t/ stimuli, resulting in a total of 16 conditions (note that some conditions are used for multiple comparisons but were tested just once).

Procedure

All testing was conducted in a double-walled soundtreated booth. Stimuli were presented in the free field through a single TannoyReveal studiomonitor loudspeaker (frequency response: 65 Hz-20 kHz, ±3 dB) at a distance of 1-2 ft, placed in front of the listener at eye level. Listeners responded to these stimuli by clicking a

button on a computer screen labeled with two word choices (either Pete-beat or teen- Dean). There was no time limit on their response, and they were permitted to enable stimulus repetitions up to three times; stimulus repetitions were very rare.

Conditions were defined by SNR and LPF cutoff(e.g., [0 dB SNR, 4 kHz], [10 dB SNR, 1 kHz]; see Table 1). There were 56 items (7 VOT ×8 F0) for the /b/-/p/ blocks and 64 items (8 VOT ×8 F0) for the /d/-/t/ blocks; stimuli within each block were presented in random order. Each block was presented five times, which resulted in well-defined psychometric functions along the stimulus parameters. Each participant began with at least one block of the optimal (quiet, no LPF) condition before hearing any masked-LPF conditions. Because of the large number of conditions, participants generally did not volunteer enough time to complete five blocks of each condition; condition selection and ordering was constrained within participants' scheduling availability. Listeners heard a variable subset of the conditions (that were not necessarily limited to one contrast), depending on their scheduling availability; most completed between 5 and 10 different conditions. The final data set included at least 10 listeners for each condition, for a total of over 800 tested blocks. Each repetition of a single block took roughly 3-5 min.

Before performing the group analyses, we used Sigmaplot 9.01 (Systat, 2004) to initially fit individual listeners' response functions to a simple logistic model. When listeners' data for a particular condition did not reach satisfactory convergence to the model, one or two more repetitions of that condition were conducted to smooth the function to allow a better fit. This was done for 5 of 20 listeners in some of the more challenging conditions (i.e., those where signal degradations were harsh enough to inhibit consistent use of the cues).

Analysis

Listeners' responses were fit using generalized linear (logistic) mixed-effects models (GLMMs). This was done in the R software interface (R Development Core Team, 2010), using the lme4 package (Bates &Maechler, 2010). A random effect of participant was used, and the fixed effects were the stimulus factors described above (Consonant Place, VOT, F0, LPF, SNR). The binomial family link function was used. The models included each main factor and all possible interactions (the four-way interactions were significant, necessitating the inclusion of all nested factors and interactions). The goal of these models was similar to that used by Peng, Lu, and Chatterjee (2009) and by Winn, Chatterjee, and Idsardi (2012); the models tested whether the coefficient of the resulting parameter estimate for an acoustic cue was different from zero and, crucially, whether the coefficient was different across conditions of LPF and SNR levels. Changes in this coefficient represent changes in the log odds of voiceless perceptions resulting from the condition or cue level change. Following previous studies (Morrison &Kondaurova, 2009; Winn et al., 2012), we interpreted the factor estimate from the GLMM as an indication of the strength of the factor (i.e., a higher estimate indicates higher perceptual weight).

Results

Averaged group responses to the continua of VOT and F0 are displayed in the tiled grids in Figures 3, 4, and 5. Grayscale intensity represents the proportion of voiced responses. Listeners who solely used VOT to distinguish these contrasts would yield grids with rows of different grayscale intensity, whereas listeners who solely used F0 would yield grids with columns of different grayscale intensity; each grid reflects the use of both cues in varying proportions. Sharper grayscale contrasts in successive rows and columns are akin to steeper psychometric functions.

Three GLMMs were used to describe listeners' responses for each of the three planned comparisons. Model terms along with the intercept and parameter estimates are given in Tables 2, 3, and 4. Simplified parameter estimates from the GLMMs are summarized in the supplemental table of coefficients (see online supplemental materials) and are illustrated in Figure 6.

In the first comparison (initial exploration of LPF and noise; Figure 3; Table 2), there were significant main effects of VOT, F0, SNR, and LPF (all ps <.001). Alveolar consonants were less likely to be heard as voiced (consistent with acoustics of these consonants;Lisker&Abramson, 1964). F0 was a stronger cue for the /d/-/t/

contrast (p <.001). The effect of VOT was significantly reduced when the signal was either low-passed (p <.001 for both contrasts) or in noise (p <.001 for both contrasts) and significantly reduced further in the presence of both filtering and noise (p <.001). The effect of F0 was significantly stronger for both contrasts when the signals were masked by noise (p <.001); when signals were low-passed, F0 became stronger only for the /b/-/p/ contrast. When the signal was both low-passed and in noise, the use of F0 significantly increased for both contrasts compared with either degradation alone (p <.001).

In the second comparison (effects of LPF in 0 dB SNR noise; Figure 4; Table 3), the effect of VOT significantly decreased for both contrasts with each successive reduction in LPF cutoff(p <.001), with the exception of the 1 kHz condition, which was not significantly different from the 2 kHz condition. The use of VOT for the /d/-/t/ contrast was greater than that for the /b/-/p/ contrast when the full spectrum was available, but in any LPF condition, there was a significant advantage for the /b/-/p/ contrast for the use of VOT (all ps <.001). The effect of F0 was significantly stronger for the /d/-/t/ contrast in all low-pass filtered conditions (p <.001 for 4 kHz and 2 kHz; p <.05 for 1 kHz). The effect of F0 for the /b/-/p/ contrast did not significantly increase in any LPF condition.

In the third comparison (effects of SNR with a 1 kHz LPF; Figure 5; Table 4), the use of VOT significantly decreased with each successive reduction in SNR for both contrasts (all ps <.001). The use of F0 increased for the /b/-/p/ contrast for 5 and 0 dB SNR (both ps <.001), while it increased for the /d/-/t/ contrast in all conditions with noise (all ps <.001).

A question that remains from the results presented thus far is whether a listener can achieve the same or similar level of accuracy for voicing recognition via F0 as with VOT. Because the analyses presented thus far do not speak to correctness per se, a final analysis was conducted to evaluate the identification of stimuli where both the VOT and F0 cues cooperated at typical "voiceless" or "voiced" values. Figure 7 illustrates performance levels for these end-point stimuli by listeners in all conditions. Voicing was correctly identified with 80% accuracy or greater in all conditions except for /b/ in the 1 kHz LPF with 0 dB SNR noise condition. The cue estimate for VOT showed a significant positive correlation with accuracy for end-point accuracy (r = .76 for /b/-/p/, r = .74 for /d/-/t/; p <.05 for each). The cue estimate for F0 showed a significant negative correlation with end-point accuracy for the /d/-/t/ contrast (r = -.68, p <.05) but did not show a significant correlation with accuracy for the /b/-/p/ contrast. Thus, although listeners were able to mostly compensate for the degraded VOT cue via the F0 cue, they performed better when relying on VOT.

Discussion

In this experiment, listeners perceived voicing contrasts in signals that were low-pass filtered and/or masked by SSN. These two signal degradations generally yielded a decline in the use of VOT that was accompanied by an increase in the use of F0. Thus, as acoustic degradations compromised the availability of the VOT cue, listeners did not simply guess at the words-they recruited appropriate information from a different acoustic cue. The one condition common to all three comparisons (0 dB SNR, 1 kHz LPF; the most challenging condition) was theoretically the most challenging in the experiment. It was distinct because while the use of VOT decreased, the use of F0 was less than the use of F0 for some other, more favorable masked and/or filtered conditions. For the most challenging condition, it appears that the acoustic signal is so degraded that even F0 is difficult to perceive in a useful way.

Speech-shaped masking noise and low-pass filtering had disproportionate effects on the /b/-/p/ and /d/-/t/ contrasts. To the extent that voicing perception can be framed as detection of aspiration noise, these disproportionate effects can be explained by the acoustics of labial and alveolar stop sounds in this study. The use of cues for labial sounds was influenced more by the level of masking noise, presumably because the spectrum of SSN competes more directly with the /p/ burst and aspiration (see Figure 1). Low-pass filtering the sounds had little effect on the use of cues for labial sounds, presumably because the spectrum of the /p/ aspiration contains sufficient low-frequency components that remain after filtering. Conversely, the use of VOT

for the /d/-/t/ contrast was heavily reduced by low-pass filtering. Consistent with earlier literature on the acoustics and perception of /t/ (Régnier &Allen, 2008), the audibility of energy above 4 kHz is essential for the perception of /t/ aspiration; all conditions that used a LPF of 4 kHz or lower saw dramatic reductions in VOT use along with increased use of F0 for alveolar sounds, even for modest SNRs. Table 5 shows that the SNR advantage of /p/ compared with /t/ is evident in the lower frequency regions (i.e., from 0 to 4 kHz), whereas in higher frequency regions (i.e., between 4 and 8 kHz), /t/ has an advantage (all relative to the masking noise used in this experiment). The pronounced asymmetry in energy at the upper and lower regions for labial and alveolar aspiration noise helps to explain differences in cue weighting across these two places of articulation and accords with previous reports of individual consonant advantages in SSN (Phatak &Allen, 2007).

Other types of noise may have different effects than those shown in this study. With the entire spectrum available and audible, the SNR of stimuli in white noise may affect the /t/-/d/ contrast more heavily than the /p/-/b/ contrast. Amplitude-modulated noise or competing speech might momentarily provide a favorable SNR for these cues via a dip in amplitude concurrent with the onset of the target words; there is no reason to think that modulation would differentially affect /p/ versus /t/. It should be noted that listeners with hearing loss are less able to capitalize on shortterm valleys of a masker (Carhart &Tillman, 1970; Festen &Plomp, 1990) and, thus, may not recover segmental information in such conditions.

Although listeners were able to reliably identify the voicing of the most natural (i.e., "end-point") stimuli (Figure 7), it is not yet known whether the signal degradation requires listeners to use greater cognitive resources to perceive voicing. Given listeners' general tendency to rely on VOT rather than on F0 (Abramson &Lisker, 1985), conditions driven by F0 could have been more difficult than those driven by VOT, despite similar accuracy scores. Accuracy for end-point stimuli in this experiment was significantly correlated to the strength (i.e., factor estimate) of VOT. Thus, scores in phoneme identification tasksmay tell only part of the story; similar scores could have arisen because of different perceptual strategies. Pupillometry during speech perception tasks suggests that extra effort is required to maintain equal intelligibility of speech in the presence of different types of maskers (Koelewijn, Zekveld, Festen, &Kramer, 2012) or if listeners have hearing loss (Kramer, Kapteyn, Festen, &Kuik, 1997). It is not yet known whether alternative phonetic cue-weighting strategies would elicit similar signs of increased listening effort.

In this experiment, the role of F1 was minimized via the use of the high vowel /i/. Jiang, Chen, and Alwan (2006) showed that F1 can play a role in the perception of voicing in noise for non-high vowels, confirming a prediction by Hillenbrand, Ingrisano, Smith, and Flege (1984). It is not yet known whether F1 or F0 is more dominant in compensating for degradations of VOT in masked and/or filtered conditions.

The motivation for this experiment was to model potential listening strategies that could arise when a person experiences HI. Because HI is more complex than a simple LPF, the results of this study should be interpreted with caution. There are suprathreshold deficits in the spectral and temporal domains that might limit a listener's ability to utilize either of the acoustic cues explored in this study. These deficits are frequently attributed to poor frequency resolution and/or temporal fine structure coding (Bernstein &Oxenham, 2006; Lorenzi, Gilbert, Carn, Garnier, &Moore, 2006). Turner and Brus (2001) showed that although the amplification of low-frequency energy (including F0) provided benefit for listeners with HI, this benefit was smaller than that observed for those with normal hearing.Grant (1987) suggested that listeners with HI are not able to detect subtle F0 contrasts and would therefore benefit fromF0 contours only if they were exaggerated by roughly 1.5-6 times those observed in natural speech. Thus, it remains unclear whether listeners with cochlear hearing loss can capitalize on F0 cues in noise to the same extent as the participants in this study. Further difficulties might be experienced by older listeners, who have been shown to experience deficiencies in auditory temporal processing in basic psychophysical tasks (Gordon-Salant &Fitzgibbons, 1993, 1999) and tasks involving perception of temporal phonetic cues in isolated words (Gordon-Salant, Yeni-Komshian, Fitzgibbons, &Barrett, 2006) and in sentence contexts (Gordon-Salant,Yeni-Komshian,&Fitzgibbons, 2008).

The use of F0 as a segmental cue in this study may partly explain the benefit of a natural F0 contour of sentences presented in noise (Binns &Culling, 2007; Laures &Weismer, 1999; Miller, Schlauch, &Watson, 2010). It is not known whether the segmental use of F0 cues in this study would generalize to longer utterance contexts, where F0 contrast is likely constrained by other sources of variability (e.g., intonation) and phonetic reduction. It should be noted that the current experiment used a two-alternative forcedchoice task that assessed only voicing perception in single words; it is likely that these stimuli would be confused with other consonants (but perhaps not with consonants of different voicing) if a larger response set were used. Conversely, the influence of sentence context and other top-down factors may compensate for the added difficulty of an open response set (McClelland, Mirman, &Holt, 2006).

Emergent models of phonetic perception and categorization increasingly acknowledge the integration of multiple covarying acoustic cues in the speech signal (McMurray &Jongman, 2011; McMurray, Tanenhaus, &Aslin, 2002; Toscano &McMurray, 2010). The presence of multiple cues for voicing can at least partly explain why voicing is such a robust feature in phoneme identification tasks in adverse listening conditions like low-pass filtering and masking noise. Listeners are capable, without any explicit instructions, of increasing reliance on residual cues in a speech signal when otherwise stronger cues have been degraded.

Acknowledgments

This work was supported by National Institutes of Health (NIH) Grants R01 DC 004786 (awarded to Monita Chatterjee) and 7R01DC005660-07 (awarded to David Poeppel and William J. Idsardi). Matthew B. Winn was supported by the University of Maryland Center for Comparative and Evolutionary Biology of Hearing Training Grant (NIH Grant T32 DC000046-17; principal investigator Arthur N. Popper). We are grateful to Ewan Dunbar for his assistance with the statistical analysis.

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Editor: Sid Bacon
Associate Editor: Marjorie Leek
Received March 18, 2012
Revision received August 30, 2012
Accepted December 28, 2012
DOI: 10.1044/1092-4388(2012/12-0086)

Task Difficulty Differentially Affects Two Measures of Processing Load: The Pupil Response During Sentence Processing and Delayed Cued Recall of the Sentences

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.4 (Aug 2013): 1156-1165.
ProQuest document link

Abstract: In this study, the authors assessed the influence of masking level (29% or 71 % sentence perception) and test modality on the processing load during language perception as reflected by the pupil response. In addition, the authors administered a delayed cued stimulus recall test to examine whether processing load affected the encoding of the stimuli in memory. Participants performed speech and text reception threshold tests, during which the pupil response was measured. In the cued recall test, the first half of correctly perceived sentences was presented, and participants were asked to complete the sentences. Reading and listening span tests of working memory capacity were presented as well. Regardless of test modality, the pupil response indicated higher processing load in the 29% condition than in the 71 % correct condition. Cued recall was better for the 29% condition. The consistent effect of masking level on the pupil response during listening and reading support the validity of the pupil response as a measure of processing load during language perception. The absent relation between pupil response and cued recall may suggest that cued recall is not directly related to processing load, as reflected by the pupil response.

Full text: Headnote
Purpose: In this study, the authors assessed the influence of masking level (29% or 71 % sentence perception) and test modality on the processing load during language perception as reflected by the pupil response. In

addition, the authors administered a delayed cued stimulus recall test to examine whether processing load affected the encoding of the stimuli in memory.
Method: Participants performed speech and text reception threshold tests, during which the pupil response was measured. In the cued recall test, the first half of correctly perceived sentences was presented, and participants were asked to complete the sentences. Reading and listening span tests of working memory capacity were presented as well.
Results: Regardless of test modality, the pupil response indicated higher processing load in the 29% condition than in the 71 % correct condition. Cued recall was better for the 29% condition.
Conclusions: The consistent effect of masking level on the pupil response during listening and reading support the validity of the pupil response as a measure of processing load during language perception. The absent relation between pupil response and cued recall may suggest that cued recall is not directly related to processing load, as reflected by the pupil response.
Key Words: speech recognition, speech recall, pupil response, processing load, text reception threshold (TRT)
Challenging listening conditions imposed by back- ground noise or hearing loss can impair the ability to perceive parts of spoken information. There is ample evidence that such speech perception difficulties increase the reliance on cognitive and linguistic processes during conversation (Kramer, Zekveld, &Houtgast, 2009; Shinn-Cunningham &Best, 2008; Zekveld, George, Kramer, Goverts, &Houtgast, 2007) and, thus, result in increased listening effort (see, e.g., Kramer, Kapteyn, Festen, &Kuik, 1997; Kramer et al., 2013; McCoy et al., 2005; Sarampalis, Kalluri, Edwards, &Hafter, 2009; Zekveld, Kramer, &Festen, 2010, 2011).
In recent years, many researchers acknowledged the need to examine the effects of background noise and hearing loss on both speech perception performance measures and on measures reflecting the effort ox processing load required during listening (Edwards, 2007; Mackersie &Cones, 2011; Piquado, Isaacowitz, &Wingfield, 2010). Examination of both types of measures is important because the effects of signal characteristics and individual factors like hearing impairment and cognitive abilities may affect both aspects of speech perception differently. Researchers have applied various measures of processing load, including physiological measures like the pupil response, functional magnetic res- onance imaging (fMRI), and event-related potentials (Just, Carpenter, &Miyake, 2003). In the current study, we used the pupil response to examine the effects of masking on processing load during listening and reading.
The task-related pupil response reliably reflects the cognitive processing demands of tasks in multiple domains (Beatty, 1982; Janisse, 1977). The pupil dilates when cog- nitive load increases (see, e.g., Granholm, Asarnow, Sarkin, &Dykes, 1996). The pupil responds to memory load (Beatty, 1982), as well as to processing load, when listening to speech (Piquado et al., 2010; Schluroff, 1983; Stanners, Headley, &Clark, 1972; Wright &Kahneman, 1971). Task-evoked changes in pupillary dilation are phasic changes time-locked to the onset of stimuli requiring cognitive processing. In addition, research indicates that the response is closely related to the reticular formation and locus coeruleus in the brain stem (Aston-Jones &Cohen, 2005).
In recent studies (Koelewijn, Zekveld, Festen, &Kramer, 2012; Kramer et al., 1997, 2013; Zekveld, Kramer, &Festen, 2010, 2011), we examined the pupil response during listening to speech presented against a background of noise. The re- sponse proved to be sensitive to speech intelligibility, type of masking noise, age, hearing loss, and cognitive abilities. Additionally, the results acquired thus far indicate that this measure validly reflects processing load. For example, if the intelligibility level is manipulated by varying the signal-to- noise ratio (SNR), the pupil response is affected such that, with increasing speech comprehension difficulty, the pupil response is increasing. In the current study, we aimed to further validate this application of pupillometry. We assessed whether equivalent differences in task-difficulty level in a visual and an auditory sentence perception test had similar effects on the task-evoked pupil response.
Also, we assessed the effect of task difficulty (i.e., masking level) and test modality on the recall of sentences correctly perceived in the listening and reading tests. Several researchers (Heinrich, Schneider, &Craik, 2008;

Kjellberg, Ljung, &Hallman, 2008; McCoy et al., 2005; Rabbitt, 1991) have suggested that the processing resources required during listening may affect recall of the perceived stimuli. They argued that higher levels of background noise and poorer hearing acuity require extra processing resources. As a result, fewer processing resources are available for stimulus encoding, which negatively influences recall of the spoken information. The data observed by McCoy et al. (2005), Surprenant (1999, 2007), Kjellberg et al. (2008), Rabbitt (1968, 1991), and Heinrich et al. (2008) indeed showed that more challenging listening conditions reduced stimulus recall, even if it was likely that the stimuli were correctly perceived by the participants.

Researchers have applied various methods in these studies. Kjellberg et al. (2008) did not find a relation between listening condition and stimulus recall when sentences, rather than words, were presented. In some of the studies, word identification was not directly assessed and, thus, not con- trolled for (McCoy et al., 2005) or not 100% correct (Murphy, Craik, Li, &Schneider, 2000; Surprenant, 2007). As de- scribed by Kjellberg et al. (2008) and Surprenant (1999), impaired stimulus perception could also affect recall by degrading the stored physical representation of the stimuli (i.e., dual code model). If stimulus perception is controlled for by asking participants to repeat each stimulus, the dual code model is a less likely explanation for the effect of noise on recall (Kjellberg et al., 2008).

In the current study, we obtained a physiological measure of processing load (i.e., pupil response) during the perception of partly masked speech (as assessed by the Speech Reception Threshold [SRT] test; Plomp &Mimpen, 1979) or text (as assessed by a visual equivalent of the SRT test, the Text Reception Threshold [TRT] test; Zekveld et al., 2007). The primary aim of the current study was to further validate the pupil response as a measure of processing load by com- paring (a) the processing load evoked while someone is listening to speech in noise with (b) the load evoked by the visual TRT test. If the pupil response reflects processing load, equivalent difficulty changes in both tasks (i.e., 29% vs. 71% sentence perception) should similarly affect the pupil response during perception. Additionally, we created a cued recall test by visually presenting the first half of sentences that were correctly perceived in the TRT and SRT tests. Participants were asked to complete the sentence from memory. We aimed to assess whether the difficulty level in the listening and reading tests would affect delayed recall of the correctly perceived sentences. The final aim was to assess the relation between several cognitive variables (read- ing and listening span tests [RSpan and LSpan, respectively]), the processing load during performance of the SRT and TRT tests (pupil response), and cued recall test performance. Therefore, we additionally administered complex, relevant working memory tasks: the RSpan and LSpan tests (Daneman &Carpenter, 1980).

In numerous studies, researchers have demonstrated the association between cognitive abilities, such as those relevant for the TRT and RSpan tests, and speech perception performance in challenging conditions (see, e.g., Kramer et al., 2009; Rönnberg, Rudner, Foo, &Lunner, 2008). Researchers have proposed several hypotheses regarding the relation between cognitive abilities and the processing load during sentence perception (see, e.g., Ahern &Beatty, 1979, 1981; van der Meer et al., 2010; Verney, Granholm, &Marshall, 2004). First, persons with high cognitive ability may exploit more resources during the task, resulting in higher performances and more cognitive processing load regardless of task difficulty (see, e.g., Zekveld, Kramer, &Festen, 2011). Second, participants with large capacity may allocate this additional capacity only when the task is difficult (see, e.g., van der Meer et al., 2010). Third, processing efficiency could be larger for persons with high cognitive ability, re- sulting in less processing load, regardless of task difficulty (see, e.g., Heitz, Schröck, Payne, &Engle, 2008). Consistent with several studies-Kramer et al. (1997); Zekveld, Kramer, and Festen (2010, 2011); and Koelewijn et al. (2012)-we expected that more challenging listening and reading conditions would be associated with larger processing load, as indicated by a larger pupil response. Because both the SRT and TRT tests require the completion of partly masked sentences, the tests likely tap into similar linguistic processes. Therefore, we did not expect an inter- action effect between test modality (auditory or visual) and task performance (percent correct sentence perception) on the pupil response. In line with multiple other studies-Pichora- Fuller,

Schneider, and Daneman (1995); Heinrich et al. (2008); McCoy et al. (2005); and Piquado, Cousins, Wingfield, and Miller (2010)-we expected that cued recall performance would be lower in the conditions in which sentence perception performance was lower. Furthermore, consistent with other studies-Zekveld, Kramer, and Festen (2011); Zekveld, Rudner, Johnsrude, Heslenfeld, and Rönnberg (2012); Tun, Wingfield, and Stine (1991); and Kjellberg et al. (2008)-we expected that the processing load as reflected by the pupil response would be larger for participants with good TRT performances and smaller for those with high-quality RSpan and LSpan performances.

Main Experiment

Method

Participants

Twenty-four students (15 women and nine men) with normal hearing participated. Their ages ranged from 18 to 27 years, with a mean age (Magc) of 22 years (SD = 2.9 years). They were recruited among students of the Vrije Universiteit (VU University), Amsterdam, the Netherlands. All partici- pants were native Dutch speakers who reported normal or corrected-to-normal vision, no dyslexia, and no history of neurological disease. None of the participants wore glasses or eye makeup during the tests, and seven participants used contact lenses during the tests. The project was approved by the Ethics Committee of the VU University Medical Center. All participants provided written informed consent.

Stimuli and Tests

Near vision screening. Near vision was screened with a visual acuity Snellen equivalent (Bailey &Lovie, 1980). During the screening, a word chart is digitally presented at 40 cm, and participants are asked to read the words aloud. The words are presented with decreasing font size on each line, ranging from 80 points to 2 points. The smallest font size that the participant was able to read had to be <8 points for inclusion in the current study (i.e., at least 18 points below the smallest point size used in the tests).

Pure-tone audiometry. We measured participants' pure- tone hearing thresholds to ensure that the thresholds in both ears were <20 dB HL at the octave frequencies be- tween 125 and 8000 Hz.

SRT test. In each SRT test, 36 short, everyday Dutch sentences, as developed by Versfeld, Daalder, Festen, and Houtgast (2000) and recorded by a female speaker, were presented in background-interfering speech. Sentences from this set are pronounced clearly, at a natural rate. An example sentence (translated into English) is, The shop is within walking distance. The sentences were equalized regarding intelligibility (see Versfeld et al., 2000, for more details).

The speech uttered by the female speaker was masked with speech uttered by a male speaker (a stream of single sentences played without intermissions). The sentences in the masking speech were different from those used in the target speech but were chosen from the same set (Versfeld et al., 2000). The masking speech was spectrally shaped in order to obtain the same long-term average frequency spectrum as the target female speech. For each sentence, the audio file containing the single-talker masker was started at a random time point; the presentation of the masker started 3,000 ms before speech onset, and masker offset was 4,000 ms after speech offset. After masker offset, an answer prompt (a 1-s, 1 -kHz tone presented at 70 dB SPL) indicated that the listener was allowed to give his or her verbal response. This paradigm allowed measurement of the baseline pupil size during the time in which participants were listening to the mask alone and prevented the target pupil response from being con- founded by the pupil response to the previous sentence and to the act of responding. Participants were asked to report each sentence aloud and to repeat each word in case they had not understood the entire sentence. Also, they were instructed to say, "I haven't understood anything," in case they were not able to perceive any of the target words. The experimenter scored whether the sentence was reproduced completely correctly. We varied the SNR by adapting both the speech and the masker levels while keeping the overall intensity fixed at 70 dB SPL. We presented the first sentence at an SNR below threshold (-12 dB SNR) and then repeatedly presented it while increasing the SNR by 4-dB steps until the participant was

able to reproduce the entire sentence correctly. Each of the following sentences was presented once at an SNR deter- mined by the adaptive procedure. Two adaptive procedures were applied: a l-up-2-down procedure estimating the SNR required for perceiving 29% of the presented sentences cor- rectly (SRT29%) and a 2-up-l-down procedure estimating the SNR required for 71% sentence perception (SR l ı : see Levitt, 1971). The SRT was the mean SNR of Sentences 5-36. The data of the first four sentences were not included in the analyses (Plomp &Mimpen, 1979).

TRT test. The TRT test is conceptually equivalent to the SRT test in that it measures the ability to perceive degraded verbal information. In the TRT test, 36 partly masked written sentences (Versfeld et al., 2000) were presented on a PC screen set 40 cm from the participant (Zekveld et al, 2007). Sentences did not overlap with those used in the SRT test. Text was masked with a bar pattern. First, we created a bitmap image that was proportionally filled with black bars, depending on the required percentage of unmasked text. Then, we stretched the bitmap image to the fixed dimensions of the field in which the words appeared. For each trial, the bar pattern consisted of bars of equal thickness. Between trials, we varied the percentage of unmasked text by changing the thickness of the presented bars.

The colors of the text, background, and bar pattern mask were equiluminant (i.e., 21 cd/m2). This specification prevented a confounding of the pupil response by illumina- tion differences between text stimuli presented with different degrees of masking. The field background color was gray, the text color was orange, and the mask color was green.

Similar to the SRT test, at the start of each trial, the mask became visible for 3,000 ms. Then, the text appeared "behind" it in a word-by-word fashion, with one word presented at a time. The display duration of each word was equal to the duration of the utterance of each word in the corresponding audio file (Versfeld et al., 2000). The mask remained visible for 4,000 ms after the last word of each sentence disappeared. The disappearance of the mask acted as a response prompt for the participants, who were asked to report each sentence aloud. Similar to the SRT test, either a l-up-2-down or a 2-up-l-down adaptive procedure was applied, targeting 29% or 71% sentence readability, respec- tively (TRT29% and TRTyi»,,.). The step size applied in the TRT test was a 6% change of the percentage of unmasked text. The TRT was the mean percentage of unmasked text of Sentences 5-36.

RSpan test. In the RSpan test (Daneman &Carpenter, 1980), short (five-word) sentences were visually presented. Half of these were nonsense sentences (e.g., The table sings a song); the other half made sense (e.g., The friend told a story). The Dutch sentence material and test were developed to be equivalent to the Swedish version described by Andersson, Lyxell, Rönnberg, and Spens (2001; see Besser, Koelewijn, Kramer, Zekveld, &Festen, in press). First, three sets of three sentences were presented, followed by three sets of four sentences, three sets of five sentences, and three sets of six sen- tences. Immediately after each sentence, participants verbally indicated whether the sentence made sense. After each set of sentences, participants were prompted to recall, in serial order, either the first or the last word of each sentence. The experimenter recorded the number of words correctly recalled, regardless of order.

LSpan test. The LSpan test is an auditory version of the reading span test (Besser, Koelewijn, et al, in press); a list of different but equivalent sentences were auditorily pre- sented. Sentences were spoken by a female speaker and pre- sented in silence, binaurally over headphones at 70 dB SPL. Participants performed the same task as in the RSpan test. In contrast to our procedures for the RSpan test data, we acquired pupillometric data during the LSpan test for purposes that surpass the scope of this article. These data are not included in the analyses of the current study.

Surprise cued recall test. Of those sentences that were completely correctly reproduced by the participant in the SRT29%, SRT71o/o, TRT29 ;,- and TRT71% tests, 40 sentences (10 sentences per test) were randomly selected. The first half of the sentence (e.g., the first three words of a six-word sentence or the first four words of a seven-word sentence) was presented visually. For example, for the sentence, De stad telt twee miljoen

inwoners (The city has two million inhabitants), the cue would be, De stad telt (The city has). Participants were asked to complete the sentences from memory. In most cases, the cue did not contain a clause or a semantically or syntactically meaningful unit. Sentences selected from the four tests were shown in random order. Participants were not forewarned of the memory test and were instructed to complete the sentence even if they were not able to recall the sentence from memory. Both the percentage of correctly added words and the percentage of entirely correctly completed sentences were scored. The rationale for obtaining both scores was that they may reflect partly different abilities: Whereas entirely correctly com- pleting a sentence is based on correct recall from memory, the word scores (the number of single words correctly added) likely depend, to a higher extent, on the participant's ability to use the first half of the sentence as linguistic context in which to infer the probable sentence ending. The two types of scores may relate differently to the other variables col- lected in the current study.

Pupillometry. The pupil size and location of the left eye were measured with a SensoMotoric Instruments pupillometer (2D Video-Oculography, Version 4; Berlin, Germany). The system uses infrared video-based technology, and data were sampled at 50 Hz. The spatial resolution of the pupillometer was 0.03 mm.

For details of the pupil data selection, cleaning, and data reduction, see Zekveld et al. (2010). In the SRT and TRT tests, the baseline pupil size was determined for each sentence by averaging the pupil size in the 1.0 s preceding speech or text onset. The procedure applied to remove eye- blink artifacts from the pupil data started with the calcu- lation of the average pupil diameter between the start of the baseline and the answer prompt, separately for each trial. Pupil diameter values below 3 SDs of this average diameter were classified as blinks. Eye blinks were replaced by linear interpolation starting four samples before and ending eight samples after a blink. We excluded those traces in which more than 15% of the data were missing due to eye blinks and those traces containing artifacts due to eye movements.

The data of the deblinked traces were smoothed by a 5-point moving average filter and then were averaged over trials, for each condition and participant. The maximum number of traces per SRT and TRT condition was 32 be- cause we did not analyze the data of the first four sentences of each test. On average, 29 traces were included in each condition. Then, we determined (a) the peak pupil dilation (peak dilation amplitude) relative to the baseline pupil size, (b) the peak latency relative to sentence onset, and (c) the mean dilation (relative to baseline) between the start of the sentence and the response prompt. See Zekveld et al. (2010, Figure 1) for a graphical presentation of these measures.

Procedure and Equipment

Test administration took place in a sound-treated room. Auditory stimuli were presented via Sony MDR V900 headphones. During the SRT tests, participants maintained focus at a fixation dot positioned 4 m away on a white wall. The test session started with the acquisition of the pure- tone audiogram and near vision screening. Then, either the LSpan test (for half the participants) or the RSpan test (for the other half) was presented. Next, half the participants started with the TRT tests and subsequently performed the SRT tests, and the other half started with the SRT tests and subsequently performed the TRT tests. The order of the 29% and 71% correct conditions was additionally balanced over participants. Both the TRT and SRT tests started with a practice test of 13 sentences. Subsequently, participants performed the RSpan or the LSpan task (i.e., the one they had not yet performed at the start of the test session), and the test session was finished after the surprise cued recall test. The cued recall test was always performed at least 15 min after completing the last TRT or SRT test. Sentences were presented only once to each participant. The assignment of sentence lists to conditions was balanced across participants. The duration of the test session was 2 hr with a 5-min break halfway through the session.

Before starting the first test in which pupil data were collected, and before participants were seated behind their respective PC monitors, we positioned the pupillometric equipment, and we measured pupil size in maximum illu- mination (230 lux [lx]) and in complete darkness. The room illumination was adapted individually such that

the pupil size was around the middle of its dynamic range at the start of the experiment. This prevents floor-and-ceiling effects in the pupil response and makes the response independent of the baseline pupil size (Beatty &Lucero-Wagoner, 2000; Hyönä, Tommola, &Alaja, 1995; Janisse, 1977). The mean room illumination was 84 lx (SD = 35 lx).

Analyses

For the behavioral data, descriptive statistics of the test results were calculated. We performed a within-subjects analysis of variance (ANOVA) to test the effects of test (SRT or TRT) and percent correct condition (29% or 71%) on the pupil response data and cued recall. We performed a correlation analysis to assess the associations between the RSpan and LSpan performances, the pupil response during the TRT and SRT tests, and cued recall.

Results

Behavioral Data

All participants had normal hearing; the mean pure- tone hearing thresholds at 125, 500, 1000, 2000, 4000, and 8000 Hz were <20 dB HL for both ears (M = 6.6 dB HL, SD = 3.5 dB HL).

The mean SRT29% was -15.8 dB SNR (SD = 1.9 dB SNR), and the mean SRT71»,0 was -9.5 dB SNR (SD = 2.2 dB SNR). The mean TRT29% was 63.2% unmasked text (SD = 7.8%), and the mean TRT71% was 80.8% unmasked text (SD = 13%). The mean RSpan was 22.0 (SD = 4.5), and the mean LSpan was 26.4 (SD = 3.6). The mean number of correctly reported sentences was 9.7 (SD = 1.4) in the 29% conditions, out of the total 32 sen- tences included in the analyses, which corresponds to an average performance level of 30% of the sentences. This number equaled 22.1 (SD = 1.4) in the 71%> conditions, corresponding to 69%. of the sentences. The SRT, RSpan, and LSpan performances were similar to those observed in other studies that examined comparable groups of partici- pants (see, e.g., Besser, Koelewijn, et al, in press; Koelewijn et al., 2012).

Pupil Data

Figure 1, Panel A shows the peak and mean pupil dilation, and Panel ? shows the latency of the peak dilation in the SRT and TRT tests, separately for the 29% and 71% correct conditions. Panel A indicates that the pupil response was larger in the 29% correct conditions and larger in the SRT tests than in the TRT tests.

For both the peak and mean pupil dilation data, the ANOVA showed main effects of test as follows: peak dilation, i*U, 23) = 34.7, ρ <.001, partial η2 = .60; mean dilation, i^l, 23) = 29.7,ρ <.001, partial η2 = .56. Also, the ANOVA showed main effects of the percent correct condition as follows: peak dilation, i^l, 23) = 4.9,ρ <.05, η2 = .18; mean dilation, i^ l, 23) = 6.5,ρ <.05, partial η2 = .22. For both dependent variables, the Test χ Percent Correct Condition interaction effect was not statistically significant. No signif- icant effects of the two factors on the latency of the peak dilation were found.

The baseline pupil diameter was determined while participants listened to the interfering talker (SRT test) or watched the bar pattern mask (TRT test). Table 1 shows the mean baseline pupil size for the two tests separately for the two performance levels; the baseline pupil size was larger in the SRT test than in the TRT test. An ANOVA with independent factors test (TRT vs. SRT) and percent correct condition (29% vs. 71%) showed a main effect of test on the baseline pupil size, i*U, 23) = 200.3, ρ <.001, η2 = .90.

Cued Recall Test

Figure 2 shows the percentage of words and sentences that were correctly completed in the cued recall test. Cued recall performance was higher for the sentences that were presented in the more difficult SRT and TRT conditions (29% performance level). The results of the ANOVA on the word scores did not show statistically significant effects of test and percent correct, although a trend was observed for the effect of percent correct condition, F(1,23) = 3.36, ρ = .08, partial η2 = .13. The results of the ANOVA on the sentence scores indicated a main effect of percent correct condition (29% vs. 71%), i*(l, 23) = 5.8,ρ <.05, partial η2 = .20, but no statistically significant effect of test (SRT vs. TRT) and no Test x Percent Correct Condition interaction.

Post Hoc Experiment: Effect of Test Setup on Pupil Response

Figure 1 (Panel A) and Table 1 show that the pupil response and the baseline diameter were larger in the SRT test than in the TRT test. The SRT and TRT tests differ in various aspects, among which the modality (auditory vs. visual stimuli) and the equipment/test setup (i.e., in the TRT test, watching the stimuli presented on a PC screen; in the SRT test, focusing at a fixation dot on the wall) are important factors. To interpret the differences in the pupil response between the two tests, it is important to distinguish between the potential effects of those differences by assessing the sole effect of focusing on a PC screen (TRT test) versus focusing on a fixation positioned on a wall (SRT test) with- out the confounding influence of modality differences be- tween the tests. Therefore, we assessed the pupil response during the SRT test in a different group of participants while they were focusing either (a) on a fixation dot presented on a PC screen or (b) on the wall.

Method

Twenty-four participants (18 female and six male; Magc = 22.0 years, SD = 2.7 years) twice performed the SRT test, estimating the SNR required for completely correctly perceiving 50% of the sentences (1-up-l-down procedure). This post hoc experiment was part of a larger study that re- quired estimation of the SNR required for 50% sentence intelligibility. In one test, the setup was similar to that applied in the SRT test described in the Method subsection of the Main Experiment section, with participants focusing on a fixation dot positioned on a wall at 4 m distance. In the other test, participants were seated 40 cm behind a PC screen and focused on a fixation dot displayed in the middle of the screen. The order of the two conditions was balanced across participants. The other test characteristics (e.g., the stimuli) and the measurement of the pupil response were the same as those described for the Main Experiment.

Results

Figure 3, Panel A shows the peak and mean pupil response for both test setups (participants focusing on a fixation dot on the wall vs. a fixation dot on the PC screen), and Panel ? shows the latency of the peak dilation for the two settings. Panel A suggests that the peak of the pupil response was smaller when participants focused at a fixation dot positioned on the PC screen as compared to the peak dilation while focusing on a fixation dot on the wall.

We performed three paired-samples t tests to assess the effect of test setting on the peak pupil dilation, the mean dilation, and the latency of the peak dilation. The difference in the peak dilation amplitude between the two settings was statistically significant, $r(23) = -2.6$, Bonferroni cor- rected $\rho < .05$. Effects of test setup on the mean dilation and peak latency were not statistically significant.

The mean baseline pupil size in the SRT test that was performed while participants focused on the fixation dot on the wall was 4.4 mm (SD = 0.8 mm). It was 3.3 mm (SD = 0.5 mm) while participants focused on the fixation dot pre- sented on the PC screen. A paired-samples t test indicated that the baseline pupil size was significantly larger when partici- pants focused on the fixation dot on the wall, $t(23) = -10.2$, $\rho < .001$.

The results of the post hoc experiment indicate that the relatively large pupil responses in the SRT test, as com- pared with those in the TRT test, are likely partially ex- plained by differences in test setup between the two test types. Furthermore, the baseline pupil size was substantially smaller when participants focused on the screen than when they focused on the wall, thereby suggesting that the dif- ferences in the baseline pupil size between the SRT and TRT tests were likely the result of the different test setups.

Correlation Analyses Main Experiment

We assessed the Pearson correlation coefficients among SRT, TRT, LSpan, RSpan, cued recall, and the pupil response (peak dilation amplitude in the SRT and TRT tests). To restrict the number of statistical tests, we used the average TRT (averaged over the 29% and 71% correct conditions) and did not include the mean pupil dilation in the analysis because the peak and mean pupil dilation were highly associated in all conditions (Pearson correlation coefficients between .84 and .91). Also, we did not include the latency of the peak dilation because this variable did not show the expected effect of task difficulty. Further, we averaged the cued recall

data over tests and conditions, separately for the word and sentence scores. The results are presented in Table 2. Note that the results of the statistical tests performed on the correlation coefficients should be interpreted cau- tiously because we did not correct the significance level of the statistical tests for the total number of tests (i.e., 30) performed.

No statistically significant correlations were observed among the TRT, SRT, LSpan, RSpan, and cued recall data on the one hand, and the peak pupil dilation on the other hand. The peak dilation amplitude in some of the conditions were positively associated with one another (see Table 2), indicating that participants who had a large pupil response in one condition also had relatively large responses in other conditions.

Discussion

The main result of the current study was that manip- ulation of the performance level in the SRT and TRT tests (29% vs. 71% correct sentence perception) affected the pupil response such that for both the TRT and SRT tests, the peak and mean dilation were smaller (i.e., less processing load) in the 71% correct conditions (see Figure 2). In several previous studies (Koelewijn et al., 2012; Kramer et al., 1997, 2013; Zekveld, Kramer, &Festen, 2010, 2011), we ob- served similar intelligibility effects on the pupil response in the SRT test. Also, it is interesting to observe this effect for the TRT test. As expected, we did not observe an inter- action effect between test modality (TRT vs. SRT) and percent correct. Thus, similar difficulty differences (29% vs. 71% correct) in both tests equally affected the pupil response, which supports the validity of the pupil response as a measure of cognitive processing load.

In addition, we hypothesized that the processing load as reflected by the pupil response would be larger for participants with good TRT performances and smaller for those with good RSpan and LSpan performances. Although researchers have found that RSpan and TRT are important predictors of speech perception (see, e.g., Akeroyd, 2008; Besser, Zekveld, Kramer, Rönnberg, &Festen, 2012; Rönnberg et al., 2008; Rönnberg, Rudner, Lunner, &Zekveld, 2010), the present data do not indicate associations among TRT, RSpan, LSpan, and the peak pupil responses in the SRT and TRT tests. The absence of any significant associations among these variables may be influenced by the relatively small and homogenous sample included in the study. Because con- trasting findings regarding the relation between cognitive abilities and processing load have been found in 1MRI studies (see, e.g., Osaka et al., 2003; Prat &Just, 2011), more research into this relation with a larger group of participants would be valuable.

Further, in line with Pichora-Fuller et al. (1995), Heinrich et al. (2008), McCoy et al. (2005), and Piquado, Cousins, et al. (2010), we expected cued recall performance to be lower in the conditions in which sentence perception performance was lower and cognitive processing load was higher. In contrast, the current findings indicate that par- ticipants were better able to recall sentences that were pre- sented in the more difficult TRT and SRT tests (i.e., the conditions targeting 29% correct sentence perception; see Figure 2). In the current study, all sentences presented in the cued recall test were completely correctly perceived in the TRT or SRT test. By definition, in the SRT and TRT tests targeting 29% correct sentence perception, fewer sentences were perceived correctly than in the 71% correct conditions, which may have enhanced the ability to encode the sentences in the 29% correct condition (cf. the list-length effect; Strong, 1912). However, it is currently unknown whether the list- length effect also applies to sentence lists (Kinnell &Dennis, 2011). In some previous studies (Heinrich et al., 2008; Murphy et al., 2000; Pichora-Fuller et al., 1995; Piquado, Cousins, et al., 2010; Schneider, Daneman, Murphy, &Kwong See, 2000; Surprenant, 1999, 2007), stimulus per- ception was not correct, may have been imperfect in all conditions, or was not directly assessed and thus not con- trolled for, which could have impaired stimulus recall. Furthermore, in most previous studies, the authors used different types of stimuli, such as discourse passages (Schneider et al., 2000) or words (Heinrich et al., 2008; McCoy et al., 2005; Murphy et al., 2000). Additional differ- ences between the current and previous studies include the type of masker used to distort the speech, cued recall versus free recall (used in previous studies), the lower overall performance levels (in the current study), and the fact that participants performed an incidental (in the

current study) instead of intentional recall test. In other fields of research, such as the reading of texts (Gao, Stine-Morrow, Rim Noh, &Eskew, 2011; Walker, Jones, &Mar, 1983), similar findings have been reported, with more difficult (but successful) perception- enhancing recall. However, researchers who have addressed the "levels of processing" approach (Craik &Lockhart, 1972) have found inconsistent effects of noise on recall (see, e.g., Smith &Broadbent, 1981). Thus, in the current study, stim- ulus recall was better for the more difficult listening and reading conditions. In addition, no correlation between pupil response and recall was observed. Therefore, we suggest that processing load may not directly affect cued recall of sentences-at least, not when applying the specific recall tests that were used in the current study.

The lower recall performances of the sentences presented in the 71% as compared with the 29% correct conditions cannot be explained by differences in sentence characteristics between the conditions because the allocation of sentences to conditions was balanced across listeners. However, both sentence perception and cued recall may have depended more on the internal linguistic context (entropy) of the correctly repeated sentences in the 29% correct con- ditions than in the 71% correct conditions, which may have caused the relatively high recall performances for the sen- tences presented in the 29% conditions. A higher dependence on the linguistic entropy in the 29% correct conditions would be reflected by a relatively low /-factor (see Boothroyd &Nittrouer, 1988) for the sentences perceived correctly in these conditions. To test this hypothesis, we calculated the /-factor of each sentence based on the data collected in the current study, separately for the TRT and SRT tests. Independent t tests performed separately for the TRT and SRT tests showed that the average /-factor of the sentences perceived correctly in the 29% conditions did not differ significantly from those perceived correctly in the 71% correct conditions; thus, it is unlikely that linguistic entropy confounded the present data.

The peak and mean dilation (see Figure 2, Panel A) and the baseline pupil size (see Table 1) were larger in the SRT tests than in the TRT tests. The SRT and TRT tests differ in several respects, including stimulus modality and test setup. The post hoc study showed that both the pupil response (Figure 3, Panel A) and the baseline pupil diameter were smaller when participants looked at a fixation dot presented on the screen instead of on the wall. The relatively small baseline pupil size was probably due to the higher illumination level while the participant was seated behind the screen compared with the overall illumination level in the room. The effect of test setup on the peak dilation in the SRT test was relatively small (i.e., around 0.05 mm) as compared with the difference in pupil response between the TRT and SRT tests (i.e., around 0.15 mm). Furthermore, as described by Janisse (1977) and Beatty and Lucero-Wagoner (2000), the baseline pupil size does not affect the pupil response if it is around the middle of its dynamic range, as was the case in the current study. Therefore, we assume that other factors, such as the act of reading, also affected the relatively small pupil response in the TRT test. In addition, the data may indicate that reading masked text is easier than listening to masked speech. Further, in the SRT test, the speech was masked with meaningful, interfering speech, whereas in the TRT test, a meaningless bar pattern masked the text. The higher pupil response in the SRT test may have been asso- ciated with the higher similarity between the target and the masker as compared with the TRT test. If speech is masked by a meaningless masker such as stationary noise, the pupil response is lower (e.g., around 0.13 mm in 71% correct conditions; Koelewijn et al., 2012; Zekveld et al., 2010) and, therefore, more similar to the pupil response evoked in the TRT test as compared with the response to speech masked by an interfering speaker. The results indicate that researchers must take care to minimize differences in tasks and stimuli if they want to directly compare the responses between tests.

The TRT test performances were relatively low (i.e., a relatively high percentage of unmasked text was required for achieving 29% and 71% readability performance) as compared with previous studies (see, e.g., Besser, Zekveld, et al., 2012; Zekveld et al., 2007). In the current study, we adapted the colors of the TRT stimuli to prevent confound- ing the pupil response with illumination differences between the stimuli presented with different degrees of masking. The resulting nonoptimal colors for reading the text likely caused these relatively

low performances.

In conclusion, both masking level and test modality affected the pupil response: The pupil response was larger in more difficult conditions and in the SRT test as compared with the TRT test. The lack of a Masking Level χ Test Modality interaction effect support the validity of the pupil response as a measure of processing load. One unexpected result of this study was that participants were better able to recall stimuli that were presented in the more difficult conditions, regardless of test modality. Our findings indi- cate that stimulus recall is not directly related to cognitive processing load as reflected by the pupil response. Finally, the pupil response was sensitive to test setup, with smaller pupil responses when participants were seated behind a PC screen than when they were seated in front of a wall.

Acknowledgments

The first author was supported by a grant from The Netherlands Organisation for Scientific Research (Veni 451-10-031). We thank J. H. M. van Beek for his technical assistance in the development of the test and data-analysis software.

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Editor: Craig Champlin
Associate Editor: Brent Edwards
Received February 13. 2012
Revision received July 19. 2012
Accepted December 24. 2012
DOI: 10.1044/1092-4388(2012/12-0058)

The Contribution of Matched Envelope Dynamic Range to the Binaural Benefits in Simulated Bilateral Electric Hearing

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.4 (Aug 2013): 1166-1174.
ProQuest document link

Abstract: This study examined the effects of envelope dynamic-range mismatch on the intelligibility of Mandarin speech in noise by simulated bilateral electric hearing. Noise-vocoded Mandarin speech, corrupted by speech-shaped noise at 5 and 0 dB signal-to-noise ratios, was presented unilaterally or bilaterally to 10 normal-hearing listeners for recognition. For unilateral conditions, the right ear was presented with the 8-channel noise-vocoded stimuli generated using a 15-dB envelope dynamic range (DR). To simulate the envelope DR mismatch between the 2 ears, the left ear was presented with the 8-channel noise-vocoded stimuli generated using a 5-, 10-, or 15-dB envelope DR, respectively. Significant binaural summation benefits for Mandarin speech recognition were observed only with matched envelope DR between the 2 ears. With reduced DR, the performance of tone identification was more consistent in the steady-state speech-shaped noise than that of sentence recognition. Consistent with previous findings, the present results suggest that Mandarin speech-perception performance of bilateral electric listening in noise is affected by the difference of envelope DR between the 2 implanted ears, and the binaural summation benefits are maximized when DR mismatch is minimized between the 2 implanted ears.

Full text: Headnote

Purpose: This study examined the effects of envelope dynamic-range mismatch on the intelligibility of Mandarin

speech in noise by simulated bilateral electric hearing.
Method: Noise-vocoded Mandarin speech, corrupted by speech-shaped noise at 5 and 0 dB signal-to-noise ratios, was presented unilaterally or bilaterally to 10 normal-hearing listeners for recognition. For unilateral conditions, the right ear was presented with the 8-channel noise-vocoded stimuli generated using a 15-dB envelope dynamic range (DR). To simulate the envelope DR mismatch between the 2 ears, the left ear was presented with the 8-channel noise-vocoded stimuli generated using a 5-, 10-, or 15-dB envelope DR, respectively.
Results: Significant binaural summation benefits for Mandarin speech recognition were observed only with matched envelope DR between the 2 ears. With reduced DR, the performance of tone identification was more consistent in the steady-state speech-shaped noise than that of sentence recognition.
Conclusions: Consistent with previous findings, the present results suggest that Mandarin speech-perception performance of bilateral electric listening in noise is affected by the difference of envelope DR between the 2 implanted ears, and the binaural summation benefits are maximized when DR mismatch is minimized between the 2 implanted ears.
Key Words: bilateral electric hearing, electric hearing, dynamic range, binaural benefits
(ProQuest: ... denotes formulae omitted.)
A substantial amount of evidence exists supporting the hearing benefits of binaural cochlear implants (CIs) in terms of better speech recognition in challenging environments (see, e.g., Buss et al, 2008; Gantz et al., 2002; Litovsky, Parkinson, Arcaroli, &Sammeth, 2006; Loizou et al., 2009; Schleich, Nopp, &D'Haese, 2004), sound localization (see, e.g., Litovsky, Johnstone, et al., 2006; Neuman, Haravon, Sislian, &Waltzman, 2007; Schoen, Mueller, Helms, &Nopp, 2005), language acquisition and learning (see, e.g., Caselli, Rinaldi, Varuzza, Giuliani, &Burdo, 2012), and quality of life (see, e.g., Litovsky, Parkinson, et al., 2006; Summerñeld et al., 2006). The binaural benefits for CI speech perception in noise have been receiving an increased level of interest, with researchers examining the head-shadow effect, the binaural summation effect, and the binaural squelch effect (see reviews in Brown &Balkany, 2007; Tyler, Dunn, Witt, &Preece, 2003). The head-shadow effect has probably the largest impact on binaural CI hearing, and the difference in speech recognition thresholds (SRTs) for the two monaural listening conditions (i.e., one condition with the CI closer to the noise sources and the other condition with the CI on the shadowed side) ranges between 4 and 7 dB (see, e.g., Gantz et al., 2002; Tyler et al., 2003). The benefit of the binaural summation effect (i.e., presenting the identical stimulus bilaterally) is mainly attributed to the redundancy of information in the stimuli presented at the two ears. The summation benefits observed from listeners with bilateral CIs are relatively larger (e.g., 1.5-2.9 dB in SRTs; Schleich et al., 2004) than those observed from normal- hearing (NH) listeners (it was suggested to be approximately 1 dB in Bronkhorst &Plomp, 1989). Although the benefit of the binaural squelch effect is rarer and is sensitive to the test conditions, a few studies suggested that some bilateral CI users obtained this benefit (see, e.g., Gantz et al., 2002).
More recently, several studies in which experimenters focused on how the unilateral performance affected binaural benefits (e.g., Litovsky, Parkinson, et al., 2006; Yoon, Li, Kang, &Fu, 2011; Yoon, Liu, &Fu, 2011) showed that significant binaural benefits in bilateral CIs depend on com- parable performance across the two implanted ears. In general, subjects having very dissimilar unilateral speech- understanding performance gain little in terms of binaural advantages. However, only a small number of studies exam- ined the possible origins of the performance mismatch between ears. Garadat, Litovsky, Yu, and Zeng (2010) studied the effects of "dead regions'" for the performance difference be- tween the two implanted ears and suggested that customized programming for bilateral CI processors based on knowledge about dead regions could enhance performance in adverse listening situations. Yoon, Liu, andFu (2011) showed that the CI insertion-depth difference between ears might contribute to mismatched unilateral performance, thereby decreasing binaural benefits. Chen, Wong, Tahmina, Azimi, and Hu (2012) investigated the impact of mismatched spectral resolu- tion between implanted

ears on the recognition of Mandarin tones and sentences and concluded that matched spectral resolution maximized binaural summation benefits for Mandarin speech perception by simulated bilateral electric hearing. In the present study, we examined another likely source of unilateral performance discrepancy-the dynamic range (DR) of the temporal envelope-in the context of Mandarin speech perception in noise by simulated bilateral electric hearing. Our rationale for the present work was that, because of the two different maps used to convert acoustic signal units to electric current units, electric current signals have different DRs across the two implanted ears, which may contribute to the unilateral CI performance discrepancy.

Researchers have extensively used acoustic simulations (Dormán, Loizou, &Rainey, 1997; Shannon, Zeng, Kamath, Wygonski, &Ekelid, 1995) involving NH subjects in CI re- search to study the effects of various factors on speech per- ception by unilateral and bilateral CIs; they have done so because it is advantageous to avoid the impact of patient- specific confounding factors (e.g., insertion depth, neural surviving pattern, etc.) that exist in clinical populations. In general, the vocoding processing used in the CI simulations mimics the way sound is processed in CI devices, with the exception that the final mapping stage is usually ignored. In consequence, without the logarithmic compression, the DRs of the temporal envelopes in acoustic simulations could be much larger than those generated by the clinical devices. In several studies (see, e.g., Fu &Shannon, 1999; Loizou, Dormán, &Fitzke, 2000; van Hoesel, Böhm, Battmer, Beckschebe, &Lenarz, 2005; Zeng &Galvin, 1999; Zeng et al., 2002), researchers examined how DR compression could affect the performances of the vocoding processing in CI simulations and of real CI listening. Fu and Shannon (1999) used peak or center clipping to reduce the DR of the input speech signals, and they measured the effects of reduced DR on phoneme recognition by CI users in quiet and in noise. Zeng and Galvin (1999) showed that, in quiet, reduced DR had little impact on phoneme recognition; however, in noise, phoneme recognition was significantly degraded by the re- duction of the DR. Zeng et al. (2002) examined how to best convert the acoustic signals to optimize the DR of electric currents in CI listeners. Van Hoesel et al. (2005) assessed the effects of amplitude-mapping adjustment on speech intelli- gibility with unilateral and bilateral CI patients by reducing the stimulation level (also referred to as the "DR") of standard monaural amplitude-mapping function when used bilater- ally. They found a modest but statistically significant decrease in performance when stimulation level was lowered in quiet and in noise. In their CI simulation study, Loizou et al. (2000) used a six-channel sinusoid vocoder and compressed the amplitudes of the sine waves in a systematic fashion to sim- ulate the effects of a reduced DR between 6 and 24 dB on speech understanding. The major drawback of their approach is that the minimum envelope amplitude both before and after compression across all spectral channels was always set to the quantization noise floor value (i.e., the value of 1 in the pulse- code modulation wave file format often used in CI simula- tions). As a result, (a) in most cases, the DR of the input acoustic signals was clearly overestimated and (b) the arbi- trarily set minimum value of the output envelope amplitude was not accurate and could lead to undesirable signal distor- tions. To address these issues, in our present study, we used an approach that dynamically set the minimum envelope ampli- tude both before and after compression across all spectral channels.

Among the three types of binaural benefits (i.e., head shadow, binaural summation, and binaural squelch), the head-shadow effect is mainly from the physical phenomenon that the head would attenuate some frequency components of the interfering noise signals and prevent these components from reaching the other side of the head. In other words, the head would produce a shadow; for this reason, the head- shadow effect does not involve central auditory processing. Yoon, Shin, and Fu (2012) showed that binaural spectral mismatch did not appear to have a negative impact on the head-shadow effect, and Garadat et al. (2010) showed that spectral holes in the higher frequency range would have a negative impact on the head-shadow effect because these holes undermine the spectral cues underlying the head- shadow effect. The hypothesized result of the envelope DR mismatch is that the mismatch might have a negative impact on the head-shadow effect. For instance, in the lis- tening scenario where speech is presented from the front of the head and noise from the right, usually

the left ear will have a signal-to-noise ratio (SNR) advantage over the right ear because the head shadow attenuates the low-frequency sound by 3-6 dB and attenuates the high-frequency sound by about 20 dB (Tyler et al, 2003). There are three scenarios for the envelope DR between the two ears: The left is better than the right, the left is similar to the right, or the left is worse than the right. For the left ear to take advantage of the improved SNR, the envelope DR of the left ear cannot be significantly worse than that of the right ear because the reduced DR undermines the spectral contrast, which needs to meet a certain threshold for phoneme recognition (see, e.g., Loizou et al., 2000). In other words, if the DR of the left ear is considerably worse than that of the right ear, the head-shadow effect would be seriously reduced. The binaural summation and squelch effects rely on the redundancy and integration of the speech information from the two ears and involve central processing. The binaural summation effect occurs when both ears are presented with similar speech information (i.e., diotic listening), leading to the increment of the perceived loudness. The hypothesized impact of the envelope DR mismatch on the summation effect is that the mismatch would have a negative impact on the summa- tion effect because the summation effect requires similar speech information from the two ears for the central process- ing. The binaural squelch effect refers to the advantage asso- ciated with bilateral listening when compared to monaural listening with the shadowed ear. On the basis of the results from Yoon et al. (2012), the hypothesized impact of the en- velope DR mismatch on the squelch effect is that the mis- match would have a negative impact on the squelch effect because the squelch effect might require similar speech in- formation from the two ears for central processing. To ac- curately measure the effects of the envelope DR mismatch on the head-shadow and squelch effects, researchers need to conduct spatial-hearing experiments such as those involving head-related transfer functions (HRTFs; e.g., Garadat et al., 2010; Yoon et al., 2012). In the present study, we focused on the binaural summation benefits.

We assessed the effects of envelope DR mismatch in the present study by using vocoded Mandarin speech to simulate unilateral and bilateral CIs. The binaural listening experi- ments were designed to answer the question of how envelope DR mismatch would affect the intelligibility of Mandarin speech in steady-state noise by bilateral electric hearing. From the results of previous studies in which the authors used English speech materials (see, e.g., Litovsky, Parkinson, et al, 2006; Yoon, Li, et al., 2011; Yoon, Liu, &Fu, 2011), we hypothesized that, compared to the conditions with un- matched DR across the two implanted ears, those conditions with matched DR would yield more pronounced binaural summation benefits for Mandarin speech perception in noise. As to the binaural Mandarin tone identification and its re- lationship with sentence recognition, on the basis of our earlier studies on spectral-resolution mismatch in Chen et al. (2012) as well as those results on tone recognition in quiet by Fu, Zeng, Shannon, and Soli (1998), we hypothesized that (a) DR mismatch may have less effect on tone identification than on sentence recognition and (b) factors other than tone identification might account more for the variance of Mandarin sentence recognition performance in noise.

Method

Subjects and Materials

Ten (five male and five female) NH native Mandarin- Chinese listeners participated in the experiments. The subjects' ages ranged from 18 to 28 years, and the majority of subjects were graduate students at The University of Hong Kong. Subjects were compensated for their participation in the study.

The Mandarin tone materials included six single-vowel syllables (/a/, loi, Id, Ii I, lui, and /ü/) in each of the four Mandarin tones (1: flat and high, 2: rising, 3: falling and rising, and 4: falling) produced by two adult native Mandarin- Chinese (one male and one female) speakers in a sound- treated booth, resulting in a total of 48 vowel tokens (i.e., two speakers x six vowels x four tones) for Mandarin tone identification. The Mandarin sentence materials included sentence lists taken from the database of Mandarin Hearing in Noise Test (MHINT; see Wong, Soli, Liu, Han, &Huang, 2007, for more details). All sentences were produced by a native Mandarin-Chinese male speaker, with fundamental frequency (F0) ranging from 75 to 180 Hz. Both Mandarin sentences and vowels were recorded at a sampling rate of 16 kHz, and their waveforms were then adjusted to have the

same root-mean-square (rms) values. The duration of the vowel tokens was normalized (Fu &Zeng, 2000). We used steady-state, speech-shaped noise (SSN) to corrupt the target speech materials at 5 and 0 dB SNR levels before the vocoding processing, and we chose the SNR levels to avoid the ceiling effect.

Amplitude Envelope Dynamic-Range Compression

The amplitude values of the temporal envelopes were extracted in the vocoding processing (see the Signal Processing section, below) and then were linearly compressed within a predetermined DR. The basic mechanism for ampli- tude envelope DR compression in the present study is similar to that developed in Loizou et al. (2000)-that is, experi- menters use a linear transform to convert the range of the input amplitude envelope to a smaller range of the output amplitude envelope. However, the main differences lie in (a) how the minimum envelope amplitude of the input signal is determined and (b) how the linear transform is designed.

To determine the minimum and maximum amplitude values of the temporal envelopes in the spectral channels (denoted as X,,,,·,, and Xmax, respectively), we computed the histograms for the amplitudes of the temporal envelopes using the 240 sentences in the MHINT database. Xmax was selected to include 99% of all sorted amplitude counts, and Xmin was selected to include 1% of all sorted amplitude counts in ascending order. The amplitude envelope compression was conducted as follows: Let x and v denote the input and output amplitude envelopes, respectively. The compressed output amplitude envelope v was computed as

... (1)

where χ is the mean of the input amplitude envelope x, and ? is a constant (i.e., the compression factor) chosen in order for the output amplitude envelope to fall within a certain DR-that is,

... (2)

where Ymax and Ymill indicate the maximum and minimum output amplitude values, respectively. It is clear that the mean value of the output amplitude envelope equals the mean value of the input amplitude envelope (i.e., v = χ), regard- less of the value of DR selected; in contrast, the approach in Loizou et al. (2000) yielded different vs for different DR values. Combining Equations (1) and (2), the compression factor ? can be obtained as

... (3)

To summarize, we performed the compression of the amplitude envelope by first computing the ? value given the DR value using Equation (3), and then ? was used in Equa- tion (1) to map the input amplitude envelope x to the output amplitude envelope v. Figure 1 shows the relationship be- tween the values of the averaged targeted DR and the values of the compression factor a, computed from the 240 sentences taken from the MHINT database. It is noted that when a equals 0 in Equation (1), the compressed amplitude envelope becomes a direct current signal with a constant value of χ (i.e., v = x), and the DR is 0 dB; alternatively, when ? equals 1 in Equation (1), the output amplitude envelope keeps the original DR of the input amplitude envelope. Figure 2 shows the histograms for the DR values of the amplitude envelopes of the eight spectral channels computed from the 240 vocoded MHINT sentences for different values of a, which takes the value of 1/13, 1/5, and 1/3 in Figures 2A, 2B, 2C, and 2D, respectively. Figure 2D shows that the input amplitude envelopes across the eight spectral channels have a DR be- tween around 40 to 80 dB, showing a nearly normal distri- bution with a mean value around 60 dB; similarly, the output amplitude envelopes have a mean DR value of around 5,10, and 15 dB in Figures 2A, 2B, and 2C, respectively. Figure 2 also shows the plots (i.e., dotted lines) of fitting the histograms of the envelope DR values using normal-distribution functions with parameter values of mean (μ) and standard deviation (σ).

Signal Processing

An eight-channel noise vocoder was used in the vocod- ing processing in this study. We did this because Friesen, Shannon, Baskent, and Wang (2001) showed that, despite the relatively large number (16-22) of electrodes available, most CI users receive only a limited number (i.e., up to eight) of channels of spectral information. In implementing the eight- channel noise vocoder, the corrupted Mandarin speech materials were first processed through a pre-emphasis high- pass filter (2000-Hz cutoff) with a 3-dB/octave rolloff and then

were band-pass filtered into eight frequency bands be- tween 80 and 6000 Hz using sixth-order Butterworth filters. We used the equivalent rectangular bandwidth scale (Glasberg &Moore, 1990) to allocate the eight channels with the specific bandwidth (see Table 1). The temporal envelope of each spectral channel was extracted by full-wave rectification fol- lowed by low-pass filtering using a second-order Butterworth filter with a cutoff frequency of 160 Hz. The envelope of each frequency band was then compressed to the pre-set DR (e.g., a = 1/5 for compressing the envelope DR to 10 dB; see Figure 2B) and was used to modulate a white-noise signal, followed by band-limiting using the same Butter- worth band-pass filters. The envelope-modulated noises of each band were finally summed up, and the level of the syn- thesized speech was adjusted to yield the same rms value as that of the original speech.

To simulate DR mismatch across the two implanted ears, the right ear was presented with the eight-channel noise-vocoded stimuli that were compressed into 15-dB DR, whereas the left ear was presented with the eight-channel noise-vocoded stimuli that were compressed into 5-, 10-, and 15-dB DR, respectively. Note that the 15-dB DR was used because researchers have found that the electrical DR was about 15 dB for CI listeners (Zeng et al., 2002). The three processing conditions described above are referred to as R15_L5, R15_L10, and R15_L15, respectively, where R and L denote the right and left ears, respectively. As the control condition, we implemented the condition R15_L0, which presented only to the right ear the eight-channel noise- vocoded stimuli that were compressed into 15-dB DR.

Note that, because the amplitude of the white noise was not constant, using white noise as the carrier signal might introduce undesirable change to the DR of the envelope- modulated noise in each frequency band, although the en- velope DR prior to modulating the white-noise signal (i.e., the DR of envelope .!') was controlled following Equations (1) and (3). However, we did not expect the simulations in this study to accurately predict CI listeners' speech perception perfor- mance with various DRs; rather, we wanted to explore the effects of DR mismatch on binaural summation benefits of speech intelligibility in simulated bilateral electric hearing. In contrast, because of the constant amplitude of the sinu- soidal carrier signal, a sinusoid vocoder may be selected in future studies. Further investigation is warranted, in which researchers compare the effects of envelope DRs on speech intelligibility between noise-vocoded and sinusoid-vocoded speech.

Procedure

The experiment was performed in a soundproof booth, and stimuli were played to listeners through a set of Sennheiser HD 250 Linear II circumaural headphones at a comfort- able listening level. Prior to the test, in order to become familiar with the vocoded stimuli and the testing procedure and conditions, each subject participated in a 20-min practice session and listened to the noise-vocoded speech with both matched and unmatched DRs in the temporal envelopes across the two ears. Each subject participated in eight testing conditions (i.e., two SNR levels x four processing conditions) in both Mandarin sentence recognition and tone identifica- tion tests. The order of the eight testing conditions was ran- domized across subjects. For the Mandarin sentence test, a total of 20 Mandarin sentences were used per condition, and none of the sentences were repeated across various testing conditions. The subjects were instructed to write what they heard on the response sheets, and they were allowed to repeat the stimuli only once. The subjects were also instructed to guess when they were unsure about what they heard. For the Mandarin tone test, each condition consisted of two presentations of each vowel stimulus spoken by a male talker and a female talker, and each subject listened to a total of 96 randomized vowel stimuli (i.e., two repetitions x two speakers χ six vowels χ four tones) per condition. The Mandarin tone responses were collected with custom soft- ware through the use of a computer display of response alternatives and a mouse as a response key. The subjects were allowed to use a repeat key as many times as they wished to repeat the presentations of the test stimuli during the tone test. We calculated the percent correct score for each condition by dividing the number of words or tones correctly identified by the total number of words or vowel stimuli presented, respectively. Subjects were given a 5-min break every 30 min during the test.

Results

Figure 3A shows the mean percent correct scores of Mandarin sentence recognition for all conditions at different SNRs. We determined statistical significance by using the percent correct score as the dependent variable and using SNR levels and processing conditions as the two within- subjects factors. Two-way analysis of variance (ANOVA) with repeated measures indicated a significant effect of SNR level, i*U, 9) = 601.7, ρ <.0005; a significant effect of DR, F(3, 27) = 12.0, ρ <.0005; and a nonsignificant SNR Level x Dynamic Range interaction, F(3, 27) = 1.63,;; = .206. Sig- nificant improvement in intelligibility was observed when lis- teners had access to the binaural vocoded stimuli with the same envelope DR (i.e., condition R15_L15) across the two ears, compared with the binaural stimulation with unmatched en- velope DR (i.e., conditions R15_L10 and R15_L5). For in- stance, the improvement with the R15_L15 stimuli relative to the R15_L5 stimuli ranged from 15 percentage points at 5 dB SNR to 9 percentage points at 0 dB SNR. Furthermore, post hoc pairwise comparisons revealed a significant binaural benefit only for the condition R15_L15 (ρ <.05), compared with the condition R15_L0, in which the vocoded stimuli were presented unilaterally to the right ear. When the enve- lope DRs were not matched between the ears (i.e., conditions R15_L10 and R15_L5), there was no performance improve- ment with bilateral stimulation over condition R15_L0.

The results from the tone identification are shown in Figure 3 ? and are not quite similar to those observed from sentence recognition in Figure 3A. A two-way ANOVA with repeated measures indicated a nonsignificant effect of SNR level, i*U, 9) = 1.51, = .255; a (weakly) significant effect of envelope DR, F(3, 27) = 6.04, ρ = .04; and a nonsignifi- cant SNR Level x Envelope Dynamic Range interaction, F(3, 27) = 0.50, ρ = .685. Furthermore, post hoc pairwise comparisons revealed a significant binaural benefit only for the condition R15_L15 (ρ <.05) at 0 dB SNR, compared with the condition R15_L0, in which the vocoded stimuli were presented unilaterally to the right ear. Again, when the envelope DRs were not matched across ears (i.e., conditions R15_L10 and R15_L5), there were no significant binaural benefits over unilateral hearing (i.e., condition R15_L0) at both 5 and 0 dB SNR.

Discussion and Conclusions

A prominent feature of the proposed compression scheme is that the probability distribution of the input-amplitude DR is more or less retained in the output-amplitude DR. As can be seen in Figure 2, the nearly normal distribution shown in subplot D for the original DR is mostly kept intact in subplots ? and C (for the compressed DRs of 10 and 15 dB, respectively), except that the mean and standard deviation values are reduced accordingly due to the compression; sub- plot A shows that the DR distribution for the compressed DR of 5 dB is skewed toward lower values and slightly deviates from the normal distribution. In contrast, the compression scheme in Loizou et al. (2000) used arbitrarily set minimum values of input and output amplitudes; as a consequence, as shown in Figure 3 of that article, the DR values of the com- pressed envelope amplitudes heavily tilted toward lower numbers, which might lead to artificially introduced distor- tion in the test stimuli, thereby underestimating the speech recognition performance. It is worthwhile to point out that both compression schemes used in the present study and Loizou et al. (2000) are based on linear transforms, which differ from the logarithmic compression typically used in CIs. In order to match the loudness growth between electric stim- ulation and acoustic stimulation (Zeng &Shannon, 1992), CI processing typically uses logarithmic compression, as the loudness growth in acoustic stimulation of the auditory sys- tem features a power function of physical intensity of the sound. Because our simulation study used acoustic stimula- tions involving the typical peripheral auditory system, the perceived loudness of the stimuli by NH listeners had a loga- rithmic relationship with the rms values of the stimuli. In other words, a linear transform would be more appropriate for our acoustic simulation study, although there would be differences between the loudness growth in our study and that in electric hearing. To our understanding, a logarith- mic transformation would skew the DR distribution toward higher values, and as a consequence, the DR distribution would deviate away from the nearly normal distribution in the original envelopes. In the acute-testing setup, a loga- rithmic transform might lead to more practice time, but with that exception, we would expect results to be similar to those using a linear transform.

Certainly in future studies, nonlinear compression schemes warrant further investigation.

The findings of this study suggest that Mandarin tone identification may be robust to noise interference (i.e., at least for steady-state noise (SSN) maskers of 5- to 0-dB SNR levels) when the amplitude envelopes are compressed to a smaller DR (e.g., DR =15 dB). Outcomes from other studies have reported the relatively small effect of spectral manipula- tions on Mandarin tone identification performance. For in- stance, Fu et al. (1998) found that when the spectral resolution in the noise-vocoder simulation was altered from η = 1 to η = 4, the identification of Mandarin tones was almost con- sistent-that is, around 60% and 80% with envelope filter cutoff frequencies of 50 and 500 Hz, respectively. Zhou and Xu (2008) simulated the effect of mismatched spectral dis- tribution of envelopes on Mandarin tone recognition using a noise vocoder; they found that spectral shift might not pose a severe problem for tone recognition when the carrier bands are shifted basally relative to the analysis bands by 1-7 mm in the cochlea. To some extent, the present result is consistent with previous findings on the relative robustness of Mandarin tone recognition when compared to performances recogniz- ing other speech components (e.g., phonemes and sentences). Chen et al. (2012) suggested that the smaller effects of noise on Mandarin tone recognition than on speech recognition might be partially due to (a) the favorable local SNRs of vowel segments where lexical tones were located and (b) a higher chance level for tone identification (i.e., 25%) than for con- sonant or vowel recognition. In addition to these factors, we believe that another factor for the relatively unchanged per- formance of Mandarin tone recognition across the three DR conditions may be the severe degradation of the temporal amplitude contour cues used for tone recognition, such that there was very little difference in the availability of this cue across the three reduced DRs tested. Many studies suggested that CI listeners used temporal amplitude contour and peri- odicity cues for tone identification (Fu &Zeng, 2000; Fu et al, 1998; Yuan et al., 2009). The envelope filter cutoff frequency was set to 160 Hz in the present study because researchers have used this setting in other acoustic simulation studies to inves- tigate the performance of Mandarin tone identification (see, e.g., Chen et al., 2012; Zhou &Xu, 2008). Nevertheless, using a relatively low cutoff frequency to extract temporal amplitude envelope means that listeners relied primarily on the limited temporal cues (e.g., tonal amplitude envelope/contour; Fu et al., 1998) for tone identification. Further analysis revealed that when the amplitude envelope was compressed to a smaller DR (e.g., 15 dB), the distinction among the amplitude contours of four Mandarin tones was reduced, which made it difficult for listeners to obtain sufficient amplitude contour information for reliable tone identification. Figure 4 illustrates the am- plitude contours of a recording of the Mandarin Chinese vowel /a/ in quiet and at three DRs: the original range, 15 dB, and 10 dB. It is seen in Figure 4A that the amplitude contours of four lexical tones are notably different, with each repre- senting the F0 contours of four Mandarin tones accordingly. However, when the DR of amplitude envelope was com- pressed to 15 dB and 10 dB in Figures 4B and 4C, respectively, it is clear that the difference among the four amplitude con- tours is not as salient as that observed in Figure 4A (i.e., with the original DR). This diminished distinction among ampli- tude contours at a smaller DR might also partially account for the lower and relatively consistent recognition scores of Mandarin tones in Figure 3B. Note that further study is needed, in which researchers investigate how the periodicity cues and DR would interact with one another to influence the performance of tone recognition.

Furthermore, the reduced DR might also damage the formant representation in vowels and other temporal enve- lope cues beneficial for phoneme recognition (Fu &Zeng, 2000; Fu et al., 1998; Loizou et al., 2000). Hence, comparing the recognition scores in Figure 3 of the current article with those in Figure 1 of Chen et al. (2012), it is not surprising to see that, for the same eight-channel noise-vocoding processing and the same testing materials, the proposed compression scheme reduced the unilateral sentence and tone recognition perfor- mance by about 27%-36% and 14%-24%, respectively, when the amplitude envelope DR was compressed from (the origi- nal) 60 dB to 15 dB.

In conclusion, in the present study we assessed the effects of envelope DR mismatch on the binaural summation benefits for Mandarin speech intelligibility in simulated bi- lateral electric hearing with an improved

DR compression scheme. It is important to note that because this is an NH- based acoustic simulation study that involved "ideal" as- sumptions unlikely to hold in actual patients with bilateral CIs, caution should be used in interpreting the present findings, and a follow-up study with bilateral CI users is needed to verify these results (e.g., the testing conducted was acute and was not performed after long-term experience with the mis- matched DRs, and we do not yet understand how CI users adapt their DR mapping after long-term use; in addition, there are many confounding factors in electric hearing such as the depth of electrode insertion, neuron survival patterns, and current spread). With this in mind, in this article we examine the implications of the present study. Consistent with previ- ous findings on the binaural summation benefits for English materials (see, e.g., Litovsky, Parkinson, 2006; Yoon et al., 2011; Yoon, Liu, &Fu, 2011), as well as those on the effects of spectral resolution mismatch for Mandarin speech materials (Chen et al., 2012), the present results suggest that the sentence perception performance of binaural CI listening in noise is affected by the difference of envelope DRs between the two ears, and binaural summation benefits are maximized with matched DRs in the two implanted ears. In addition, the present study shows that in the context of compressed envelope amplitudes, tone identification in steady-state SSN is steadier than sentence recognition, suggesting that tone identification performance in noise might not predict sentence recognition performance in unilateral and bilateral CIs.

Acknowledgments

This research was supported, in part, by Faculty Research Fund, Faculty of Education, The University of Hong Kong; by Seed Funding for Basic Research, The University of Hong Kong; and by the General Research Fund (GRF), administered by the Hong Kong Research Grants Council.

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Editor: Craig Champlin
Associate Editor: Marjorie Leek
Received August 14. 2012
Revision received October 5. 2012
Accepted December 24. 2012
DOI: 10.1044/1092-4388(2012/12-0255)

Kyoto University; Patent Issued for Method for Designing Audio Signal Processing System for Hearing Aid, Audio Signal Processing System for Hearing Aid, and Hearing Aid

Publication info: China Weekly News (Jul 30, 2013): 1141.
ProQuest document link

Abstract: [...]a digital signal resulting from the AD conversion is first split into a multiple frequency bands by bandpass filters, and then at each frequency band the signal is processed via a digital filter with a gain being increased or decreased according to the auditory characteristics of a hard-of-hearing person.

Full text: 2013 JUL 30 (VerticalNews) -- By a News Reporter-Staff News Editor at China Weekly News -- From Alexandria, Virginia, VerticalNews journalists report that a patent by the inventors Yamamoto, Yutaka (Kyoto, JP); Nagahara, Masaaki (Kyoto, JP), filed on August 3, 2009, was published online on July 16, 2013.
The patent's assignee for patent number 8488823 is Kyoto University (Kyoto, JP).
News editors obtained the following quote from the background information supplied by the inventors: "When viewed worldwide, the number of hard-of-hearing persons is supposed to be increasing. Hearing loss is categorized into conductive hearing loss, sensorineural hearing loss and mixed hearing loss that includes both thereof, depending on a part of disorder in the auditory system. A character given as common to these categories of hearing loss is incapability of or difficulty in sensing a certain frequency band of sounds that a hard-of-hearing person wants to hear.
"The miniaturization and speed-up of digital signal processing processors (DSP) in recent years have enhanced freedom in designing hearing aids, and thus have caused the mainstream of the hearing aids to shift from analog to digital.
"Currently, a method commonly used in audio signal processing for digital hearing aids is a multi-channel method using the conventional signal processing theory. In this method, first, an analog audio signal that comes

in from a microphone is passed through a microphone amplifier, and then is subjected to an AD-conversion process.
"Secondly, a digital signal resulting from the AD conversion is first split into a multiple frequency bands by bandpass filters, and then at each frequency band the signal is processed via a digital filter with a gain being increased or decreased according to the auditory characteristics of a hard-of-hearing person.
"The divided frequency bands are then resynthesized.
"And finally, the signal undergoes a DA-conversion process and then is outputted as an analog audio signal from a speaker by way of a speaker amplifier.
"In relation to this, references related to the present invention include patent literature 1, 2 as cited below. The patent literature 1, 2 below are attributable to the present inventor(s), where the patent literature 1 discloses a method for designing a digital filter according to sampled-data H.infin. control theory, whereas the patent literature 2 discloses a sampling rate conversion device designed according to sampled-data H.infin. control theory.
"[Citation List]
"[Patent Literature]
"Patent Literature 1 Japanese Patent Gazette No. 3,820,331
"Patent Literature 2 Japanese Patent Gazette No. 3,851,757"
As a supplement to the background information on this patent, VerticalNews correspondents also obtained the inventors' summary information for this patent: "The multi-channel method described as above requires an adjustment by which frequency characteristics of the digital filter is tailored to each hard-of-hearing person so as to carry out an audiometry to the hard-of-hearing person and then to increase or decrease the gain on each of the divided frequency bands.
"Adjusting and optimizing a hearing aid to its user with hearing loss involve trial and error, and therefore troublesome.
"An objective of the present invention is to provide a novel technology for designing a hearing aid that is more appropriate to a hard-of-hearing person, an audio signal processing system therefor and a hearing aid therewith.
"The present invention is a method for designing an audio signal processing system for a hearing aid,
"wherein the system comprises
"an AD converter for converting an analog audio input signal (y.sub.c) inputted to the hearing aid into a digital audio input signal;
"a hearing aid digital filter (K(z)) for performing a signal processing on the digital audio input signal outputted from the AD converter; and
"a DA converter for converting a digital signal outputted from the hearing aid digital filter into an analog audio output signal (u.sub.c) to be outputted to a hard-of-hearing person; and
"wherein the hearing aid digital filter (K(z)) is designed according to sampled-data control theory so as to reduce an error (e.sub.c) occurring between a restored analog signal (z.sub.c) obtained by filtering the analog audio output signal (u.sub.c) outputted from the DA converter through an analog filter (P(s)) that has characteristics corresponding to auditory characteristics of the hard-of-hearing person and
"the analog audio input signal (y.sub.c) inputted to the hearing aid.
"In conventional digital hearing aids, as set forth above, the audio signal processing has been performed within the framework of the multi-channel method or methods based on other signal processing theories.
"In contrast, the present inventors have conceived a new idea to contemplate an audio signal processing for a digital hearing aid within the framework of control theory, the idea being completely different from the conventional methods for designing digital hearing aids.
"Here, in the field of control theory, sampled-data control theory has been established for digitally controlling an

analog control object.
"In this context, the present inventors arrived at the conception that a technique of sampled-data control can apply to design of a hearing aid when a sound input/output system including an auditory analog characteristics of a hard-of-hearing person is assumed as an analog control object.
"In other words, it may be said that a hearing aid is a device to recover the auditory perception of a hard-of-hearing person by adjusting a certain frequency band in a sound to the auditory characteristics of the hard-of-hearing person.
"Stated differently, when assuming a signal system in which a hearing aid and auditory characteristics of a hard-of-hearing person are combined, it can be said that the function of a hearing aid is to match a sound that the hard-of-hearing person can recognize through his or her auditory perception with the sound that is inputted to the hearing aid as much as possible, and thus to reduce the error lying between them.
"Therefore, it may be said that an appropriate design of a hearing aid is identical with designing of a digital filter with which a difference (an error) between the sound that is inputted to the hearing aid and the sound that a hard-of-hearing person can recognize through his or her auditory perception is diminished in the sound input/output system that includes the auditory characteristics of the hard-of-hearing person.
"The present invention was achieved based on the above-mentioned conception. According to the present invention, by assuming a signal restoration system by which a restored analog signal is generated by filtering an analog audio output signal outputted from the DA converter through an analog filter having characteristics corresponding to auditory characteristics of a hard-of-hearing person, an appropriate digital filter can theoretically be designed based on existing sampled-data control theory.
"Here, for auditory characteristics of a hard-of-hearing person, either auditory characteristics obtained from a measurement on an individual hard-of-hearing person or auditory perception characteristics that are generally assumable may be used.
"For the aforesaid existing sampled-data control theory, sampled-data H.infin. control theory is preferable. However, it may be other design methods in sampled-data control theory, for example, sampled-data H.sup.2 control theory.
"Moreover, it is preferred that the audio signal processing system further comprises
"an anti-aliasing filter for performing anti-aliasing on a digital audio input signal outputted from the AD converter,

"a downsampler for performing a downsampling on an output from the anti-aliasing filter, and
"an upsampler for restoring a sampling rate that was lowered by the downsampler, wherein
"the hearing aid digital filter is for performing the signal processing on a digital audio input signal outputted from the upsampler.
"By employing the configuration as described above, high frequency sound which is a problem for the conventional hearing aids can be eliminated. That is, a 'high frequency noise having peak property such as the one occurring when hard substances clash' has been a harsh sound in the conventional hearing aids. However, with the above described configuration, after removing the high frequency noise having peak property that causes harsh sounds and then by means of the hearing aid digital filter, an appropriate signal processing can be performed based on the auditory characteristics of the hard-of-hearing person, to give a hearing aid that generates a more natural sound.
"From another viewpoint, the present invention is an audio signal processing system for a hearing aid, the system comprising
"an AD converter for converting an analog audio input signal inputted to the hearing aid into a digital audio input signal,
"a hearing aid digital filter for performing a signal processing of the digital audio input signal outputted from the AD converter,

"a DA converter for converting the digital signal outputted from the hearing aid digital filter into an analog audio output signal to be outputted to a hard-of-hearing person,
"wherein the hearing aid digital filter is designed according to sampled-data control theory so as to reduce the error between
"a restored analog signal obtained by filtering an analog audio output signal outputted from the DA converter through an analog filter that has characteristics corresponding to auditory characteristics of the hard-of-hearing person, and
"the analog audio input signal to the hearing aid.
"From yet another viewpoint, the present invention is a hearing aid including the audio signal processing system.
"According to the present invention, a hearing aid digital filter can be theoretically designed."
For additional information on this patent, see: Yamamoto, Yutaka; Nagahara, Masaaki. Method for Designing Audio Signal Processing System for Hearing Aid, Audio Signal Processing System for Hearing Aid, and Hearing Aid. U.S. Patent Number 8488823, filed August 3, 2009, and published online on July 16, 2013. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=37&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1826&f=G&l=50&co1=AND&d=PTXT&s1=20130716.PD.&OS=ISD/20130716&RS=ISD/20130716
Keywords for this news article include: Asia, Japan, Audiology, Electronics, Ear Diseases, Hearing Loss, Otolaryngology, Digital Filters, Kyoto University, Hearing Disorders, Sensation Disorders, Audio Signal Processing, Nervous System Diseases, Neurologic Manifestations.

Gn Resound A/s; Agency Reviews Patent Application Approval Request for "Hearing Aid with Signal Enhancement"

Publication info: Electronics Newsweekly (Jul 24, 2013): 3893.
ProQuest document link

Abstract: From the background information supplied by the inventors, news correspondents obtained the following quote: "Hearing impaired individuals often experience at least two distinct problems: a hearing loss, which is an increase in hearing threshold level, and a loss of ability to understand high level speech in noise in comparison with normal hearing individuals.

Full text: 2013 JUL 24 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- Gn Resound A/s has been issued patent application serial number 343428, according to news reporting originating out of Washington, D.C., by VerticalNews editors.
The patent's inventors are Gran, Karl-Fredrik Johan (Malmo, SE); Dittberner, Andrew Burke (Antioch, IL).
This patent application was filed on January 4, 2012 and was made available online on July 11, 2013.
From the background information supplied by the inventors, news correspondents obtained the following quote: "Hearing impaired individuals often experience at least two distinct problems: a hearing loss, which is an increase in hearing threshold level, and a loss of ability to understand high level speech in noise in comparison with normal hearing individuals. For most hearing impaired patients, the performance in speech-in-noise intelligibility tests is worse than for normal hearing people, even if the audibility of the incoming sounds is restored by amplification. An individual's speech reception threshold (SRT) is the signal-to-noise ratio required

in a presented signal to achieve 50 percent correct word recognition in a hearing in noise test.
"Today's digital hearing aids that use multi-channel amplification and compression signal processing can readily restore audibility of amplified sound for a hearing impaired individual. The patient's hearing ability can thus be improved by making previously inaudible speech cues audible.
"Loss of capability to understand speech in noise is accordingly the most significant problem of most hearing aid users today. The traditional way of increasing SRT in hearing instruments, is to apply either beamforming or spectral subtraction techniques.
"In the first case, at least one microphone in combination with a number of filters, fixed or adaptive, is used to enhance a signal from the presumed target direction and at the same time suppress all other signals.
"In spectral subtraction techniques, the goal is to create an estimate of the long term noise spectrum and turn down gain in frequency bands where the instantaneous target signal power is lower than the long term noise power. Even though the methods are very different from a technological standpoint, they still have the common goal; enhance the target signal and remove the noise disturbance.
"The methods cannot take listener intent into account and they may remove parts of the audio signal which the listener is trying to focus on."
Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent application: "Below, a new method of enhancement of a desired signal is disclosed. The new method makes use of the human auditory system's capability of concentrating on a desired signal. A new binaural hearing aid system using the new method is also disclosed.
"Listening in complex sound fields is to a large extent facilitated by binaural processing in the auditory system. Due to diffraction effects by the pinna, concha, head and torso and due to reflection effects in reverberant environments, cues are imparted to the sound field, which are highly individual for the given subject.
"The most important cues in binaural processing are the interaural time differences (ITD) and the interaural level differences (ILD). The ITD results from the difference in distance from the source to the two ears. This cue is primarily useful up till approximately 1.5 kHz and above this frequency the auditory system can no longer resolve the ITD cue.
"The level difference is a result of diffraction and is determined by the relative position of the ears compared to the source. This cue is dominant above 2 kHz but the auditory system is equally sensitive to changes in ILD over the entire spectrum.
"It has been argued that hearing impaired subjects benefit the most from the ITD cue as the hearing loss tends to be less severe in the lower frequencies.
"It has been shown that manipulating the relative interaural phase and level of a target signal, i.e. a signal a listener desires to listen to, and of a noise signal, i.e. a signal the listener perceives as disturbing, can improve speech intelligibility significantly. It seems as if the auditory system is indeed adapted to separate signals with different ITD and ILD encoding to perform a natural type of noise reduction to facilitate focusing on the target signal.
"It has been found that if the target signal is presented in anti-phase, i.e. phase shifted 180.degree., and the noise in-phase in the two ears, an increase of the Binaural Masking Level Difference (BMLD) of 13 dB can be achieved compared to when both signals are presented in-phase in the two ears. Depending on the type of noise, an improvement of 20 dB of the BMLD is achievable.
"The reverse situation where noise is presented out of phase and the target is presented in phase yields a slightly lower performance.
"In the new method, at least one of the target signal and the noise signal is estimated, and the at least one estimate is presented to the user of the binaural hearing aid system in such a way that a user's capability of understanding speech in noise is improved.
"For example, a listener may listen to sound with a signal S that the listener desires to listen to and noise N that

the listener finds disturbing, i.e. the sound signal is S+N.

"Based on the sound signal S+N, the desired signal S may be estimated. The estimate is denoted ES. Subtracting two times the estimate ES from the sound signal S+N results in a modified signal: S+N-ES-ES, and since ES is approximately equal to S, modified signal is: N-ES which is approximately equal to -S+N, i.e. the original sound signal wherein the desired signal S has been substantially substituted with signal S phase shifted by 180.degree.. Now, the original signal S+N may be presented to one ear of a user, and the phase shifted signal N-ES, or more accurately S+N-2ES, may be presented to the other ear for improved BMLD and SRT.

"Alternatively, both the desired signal S and the noise N may be estimated and the sum of the estimates ES+EN may be presented to one ear of the user, and the phase shifted sum -ES+EN may be presented to the other ear for improved BMLD and SRT.

"The desired signal S and the noise may be swapped so that the noise estimated is phase shifted instead of the desired signal for improved BMLD and SRT; however with decreased performance compared to phase shifting the desired signal S.

"Noise can be background speech, restaurant clatter, music (when speech is the desired signal), traffic noise, etc.

"The purpose for the method is not to remove any part of the signal but instead present the signals so that the auditory system can perform natural noise reduction and separate the target signal from the noise signal.

"In this way, if for some reason (e.g. the presumed target direction is wrong, or the unit is not able to achieve sufficient target/noise separation, the target signal and the noise signal are swapped; enhancement of the target signal is still obtained, although with slightly decreased performance.

"This would not be possible with traditional noise reduction techniques, since the target signal, which in this case would be assumed to be the noise would be suppressed.

"Thus, a new binaural hearing aid system is provided, comprising

"at least one microphone for provision of respective at least one microphone audio signal in response to sound received at the at least one microphone, a signal separation unit configured to provide an estimate of one of a target signal and a noise signal based on the at least one microphone audio signal, a phase shift circuit configured to phase shift the estimate of one of the target signal and the noise signal, and a phase shift adder connected to provide a phase shifted signal representing sound received at the at least one microphone in which the estimate of one of the target signal and the noise signal has substantially substituted the respective original one of the target signal and the noise signal, and a first receiver for conversion of a receiver input signal into an acoustic signal for transmission towards one of the eardrums of a user of the binaural hearing aid system, and a second receiver for conversion of a receiver input signal into an acoustic signal for transmission towards the other one of the eardrums of the user, and wherein the receiver input of one of the first and second receivers is connected to a signal representing the phase shifted signal, and the receiver input of the other one of the first and second receivers is connected to a signal representing sound received at the at least one microphone.

"Further, a new method is provided of binaural signal enhancement in a binaural hearing aid system, the method comprising the steps of

"providing at least one microphone audio signal in response to sound, and providing an estimate of one of a target signal and a noise signal based on the at least one audio signal, phase shifting the estimate of one of the target signal and the noise signal, and providing a phase shifted signal representing the at least one microphone audio signal in which the phase shifted estimate of one of the target signal and the noise signal has substantially substituted the respective original one of the target signal and the noise signal, and transmitting a signal representing the phase shifted signal towards one of the eardrums of a user of the binaural hearing aid system, and transmitting a signal representing the at least one microphone audio signal towards the other one of the eardrums of the user.

"In the event that the estimate of one of the target signal and the noise signal is equal to the corresponding original one of the target signal and the noise signal, the phase shifted estimate can exactly substitute the respective original signal; however typically, the estimate of a signal will deviate from the original signal and substitution of the original signal with its estimate will typically not lead to substitution of the deviation, and thus the estimate is said to substantially substitute the original signal.

"Throughout the present disclosure, one signal is said to represent another signal when the one signal is a function of the other signal, for example the one signal may be formed by analogue-to-digital conversion, or digital-to analogue conversion of the other signal; or, the one signal may be formed by conversion from another acoustic signal to an electronic signal or vice versa; or the one signal may be formed by analogue or digital filtering or mixing of the other signal; or the one signal may be formed by transformation, such as frequency transformation, etc, of the other signal; etc.

"Further, signals that are processed by specific circuitry, e.g. in a signal processor, may be identified by a name that may be used to identify any analogue or digital signal forming part of the signal path from the source of the signal in question to an input of the circuitry, e.g. signal processor, in question. For example an output signal of a microphone, i.e. the microphone audio signal, may be used to identify any analogue or digital signal forming part of the signal path from the output of the microphone to its input to the signal processor, including pre-processed microphone audio signals.

"The at least one microphone may contain a single microphone; however preferably, the at least one microphone has two microphones. Further, the at least one microphone may have more than two microphones for improved separation of the target signal and the noise signal.

"For improved signal enhancement, the second hearing aid may also comprise at least one microphone for provision of microphone audio signals in response to sound received at the respective microphones. In this case, the transceiver of the first hearing aid is connected for reception of signals representing the microphone audio signals of the second hearing aid, and the signal separation unit is configured to provide the estimate of the target signal and the estimate of the noise signal based on the audio signals of the first and second hearing aids.

"Preferably, the phase shift circuit phase shifts the estimate of the target signal, and preferably, the phase shift ranges from 150.degree. to 210.degree., more preferred the phase shift is approximately equal to 180.degree., and most preferred equal to 180.degree.

"The signal separation unit may be configured to provide the estimates based on spectral characteristics of the audio signals as is well-known in the art of noise reduction. However, according to the new method, the noise estimate is not suppressed in the output presented to the user; rather the target estimate and the noise estimate is presented to the user in a way that improves the user's SRT.

"The signal separation unit may be configured to provide the estimates based on statistical characteristics of the audio signals as is well-known in the art of noise reduction. However, according to the new method, the noise estimate is not suppressed in the output presented to the user; rather the target estimate and the noise estimate is presented to the user in a way that improves the user's SRT.

"The signal separation unit may comprise a beamformer, and the beam former may be configured to provide the estimates based on microphone audio signals of the first and second hearing aids. The beamformer of the signal separation unit is different from conventional beamformers in that the noise estimate is not suppressed in the output presented to the user; rather the target estimate and the noise estimate is presented to the user in a way that improves the user's SRT.

"The beamformer combines the microphone audio signals output by a plurality of microphones of the at least one microphone into a target signal with varying sensitivity to sound sources in different directions in relation to the plurality of microphones. Throughout the present disclosure, a plot of the varying sensitivity as a function of the direction is denoted the directivity pattern. Typically, a directivity pattern has at least one direction wherein

the microphone signals substantially cancel each other. Throughout the present disclosure, such a direction is denoted a null direction. A directivity pattern may comprise several null directions depending on the number of microphones in the plurality of microphones and depending on the signal processing.

"The beamformer may be a fixed beamformer with a directional pattern that is fixed with relation to the head of the user. The beamformer may for example be based on at least two microphones, with a directional pattern that has a maximum in the front direction of the user, i.e. the forward looking direction of the user, and a null in the opposite direction, i.e. the rear direction of the user.

"The beamformer may be based on more than two microphones, and may include microphones of both hearing aids using wireless or wired communication techniques. The increased distance between the microphones may be utilized to form a directional pattern with a narrow beam providing improved spatial separation of the target estimate from the noise estimate. The conventional output of the beamformer may be used as the target estimate, and the noise estimate may be provided by subtraction of the target estimate from the microphone audio signal of one of the microphones of the plurality of microphones.

"When microphones of both hearing aids of the binaural hearing aid system cooperate with the beamformer, the respective microphone signals must be sampled substantially synchronously. Time shifts as small as 20-30 .mu.S between sampling instants of the respective microphone signals in the two hearing aids may lead to a perceivable shift in the beam direction. Furthermore, a slowly time varying time shift between the sampling instants of the respective microphone signals, which inevitably will occur if the hearing aids are operated asynchronously, will result in an acoustic beam that appears to drift and focus in alternating directions.

"Thus, the hearing aids of the binaural hearing aid system may be synchronized as for example discloses in more detail in WO 02/07479.

"The beamformer may comprise adaptive filters configured to filter respective microphone audio signals and to adapt the respective filter coefficients for adaptive beamforming towards a sound source. For example, the beamformer may adapt to optimize the signal to noise ratio.

"An adaptable beamformer makes it possible to focus on a moving sound source or to focus on a non-moving sound source, while the user of the hearing aid system is moving. Furthermore, the adaptable beamformer is capable of adapting to changes in the sound environment, such as appearance of a new sound source, disappearance of a noise source or movement of noise sources relative to the user of the hearing aid system.

"An adaptive beamformer may be designed under the assumption that the signals received at the at least one microphone can be modelled as a combination of a target signal from a pre-determined target direction plus noise:

"y.sub.i(n)=h.sub.i(n)*s(n)+v.sub.i(n)

"where h.sub.i(n) is the impulse response of sound propagation from the source emitting the signal s(n) to the i.sup.th microphone and v.sub.i(n) is the noise signal at the same microphone. The noise can consist of both directional noise and other types of noise such as diffuse noise or babble noise.

"The filter coefficients may adaptively be determined by solving the following optimization problem:

"{ a i (n) } i = 1 4 = arg min { a i (n) } i = 1 4 z (n) 2 ##EQU00001## subject to i = 1 4 a i (n) * h i (n) = h 1 (n) ##EQU00001.2##

"Finding a solution to this optimization could be done adaptively using least mean square, recursive least square, steepest descent or other types of numerical optimization algorithms.

"Once the target and noise estimate has been determined, the signals are presented to the user in such a way that the SRT of the user is improved.

"Preferably, the target estimate is presented in opposite phase, i.e. 180.degree. phase shifted with relation to each other, at the two ears of the user, while the noise estimate is presented in phase at the two ears of the user. Thus, in the first hearing aid, a first adder may be connected to the signal separation unit, and output a sum of the target estimate and the noise estimate provided by the signal separation unit, and the output of the

first adder may be connected to a signal processor for further processing, such as hearing loss compensation, and the output of the signal processor may be connected to an output transducer that outputs a corresponding output to one ear of the user, or the output of the first adder may be connected directly to the output transducer. A second adder may be connected to the signal separation unit, and output a sum of the reverse phases target estimate and the noise estimate provided by the signal separation unit, and the output of the second adder is connected to a transceiver that transmits the output of the second adder to the other hearing aid having a transceiver for reception of the output of the second adder. The output of the transceiver may be connected to a signal processor for further processing, such as hearing loss compensation, and the output of the signal processor may be connected to an output transducer that outputs a corresponding output to another ear of the user, or the output of the transceiver may be connected directly to the output transducer.

"Instead, with somewhat reduced performance in improved SRT of the user, the noise signal may be presented in opposite phase, i.e. 180.degree. phase shifted with relation to each other, at the two ears of the user, while the target estimate is presented in phase at the two ears of the user.

"Preferably, the first hearing aid includes a delay between the adder and the output transducer so that the relative phase of the signals output by the respective output transducers of the first and second hearing aids is maintained.

"The improvement of SRT as a function of the phase shift has a maximum at 180'; however the function is sine-shape with a flat maximum so that the improvement obtained by a phase shift ranging from 150.degree. to 210.degree. is close to the maximum improvement. Thus, the phase shift need not be exactly 180.degree., but preferably has a value within the range from 135.degree. to 225.degree., more preferred from 150.degree. to 210.degree.

"The new binaural hearing aid system may comprise a multi-channel first hearing aid in which the microphone audio signals are divided into a plurality of frequency channels.

"Correspondingly, individual target signal estimates and noise estimates may be provided in each frequency channel of the plurality of frequency channels, or may be provided in one or more selected frequency channels of the plurality of frequency channels, or one or more target signal estimates and noise estimates may be provided for one or more respective groups of selected frequency channels of the plurality of frequency channels, or one target signal estimate and noise estimate may be provided based on all the frequency channels of the plurality of frequency channels.

"The plurality of frequency channels may include warped frequency channels, for example all of the frequency channels may be warped frequency channels.

"The new binaural hearing aid system may additionally provide circuitry used in accordance with other conventional methods of hearing loss compensation so that the new circuitry or other conventional circuitry can be selected for operation as appropriate in different types of sound environment. The different sound environments may include speech, babble speech, restaurant clatter, music, traffic noise, etc.

"The new binaural hearing aid system may for example comprise a Digital Signal Processor (DSP), the processing of which is controlled by selectable signal processing algorithms, each of which having various parameters for adjustment of the actual signal processing performed. The gains in each of the frequency channels of a multi-channel hearing aid are examples of such parameters.

"One of the selectable signal processing algorithms operates in accordance with the new method.

"For example, various algorithms may be provided for conventional noise suppression, i.e. attenuation of undesired signals and amplification of desired signals.

"Microphone audio signals obtained from different sound environments may possess very different characteristics, e.g. average and maximum sound pressure levels (SPLs) and/or frequency content. Therefore, each type of sound environment may be associated with a particular program wherein a particular setting of algorithm parameters of a signal processing algorithm provides processed sound of optimum signal quality in a

specific sound environment. A set of such parameters may typically include parameters related to broadband gain, corner frequencies or slopes of frequency-selective filter algorithms and parameters controlling e.g. knee-points and compression ratios of Automatic Gain Control (AGC) algorithms.

"Signal processing characteristics of each of the algorithms may be determined during an initial fitting session in a dispensers office and programmed into the new binaural hearing aid system in a non-volatile memory area.

"The new binaural hearing aid system may have a user interface, e.g. buttons, toggle switches, etc, of the hearing aid housings, or a remote control, so that the user of the new binaural hearing aid system can select one of the available signal processing algorithms to obtain the desired hearing loss compensation in the sound environment in question.

"The new binaural hearing aid system may be capable of automatically classifying the users sound environment into one of a number of sound environment categories, such as speech, babble speech, restaurant clatter, music, traffic noise, etc, and may automatically select the appropriate signal processing algorithm accordingly as known in the art.

"In accordance with some embodiments, a binaural hearing aid system includes at least one microphone for provision of at least one microphone audio signal in response to sound received at the at least one microphone, a signal separation unit configured to provide an estimate of one of a target signal and a noise signal based on the at least one microphone audio signal, a phase shift circuit configured to phase shift the estimate, a phase shift adder connected to provide a phase shifted signal, wherein in the phase shifted signal, the phase shift of the estimate of one of the target signal and the noise signal substantially substitutes respective one of the target signal and the noise signal, a first receiver for conversion of a first receiver input signal into a first acoustic signal for transmission towards a first eardrum of a user of the binaural hearing aid system, and a second receiver for conversion of a second receiver input signal into a second acoustic signal for transmission towards a second eardrum of the user, wherein a receiver input of one of the first and second receivers is connected to a signal representing the phase shifted signal, and a receiver input of the other one of the first and second receivers is connected to a signal representing the sound received at the at least one microphone.

"In accordance with other embodiments, a method of binaural signal enhancement in a binaural hearing aid system, includes providing at least one microphone audio signal in response to sound, providing an estimate of one of a target signal and a noise signal based on the at least one microphone audio signal, phase shifting the estimate of one of the target signal and the noise signal, providing a phase shifted signal in which the phase shifted estimate of one of the target signal and the noise signal substantially substitutes the respective one of the target signal and the noise signal, transmitting a first signal representing the phase shifted signal towards a first eardrum of a user of the binaural hearing aid system, and transmitting a second signal representing the at least one microphone audio signal towards a second eardrum of the user.

"Other and further aspects and features will be evident from reading the following detailed description of the embodiments. BRIEF DESCRIPTION OF THE DRAWINGS

"The drawings illustrate the design and utility of embodiments, in which similar elements are referred to by common reference numerals. These drawings are not necessarily drawn to scale. In order to better appreciate how the above-recited and other advantages and objects are obtained, a more particular description of the embodiments will be rendered, which are illustrated in the accompanying drawings. These drawings depict only typical embodiments and are not therefore to be considered limiting of its scope.

"FIG. 1 schematically illustrates an exemplary new binaural hearing aid system,

"FIG. 2 schematically illustrates an exemplary new binaural hearing aid system,

"FIG. 3 schematically illustrates an exemplary new binaural hearing aid system,

"FIG. 4 schematically illustrates an exemplary new binaural hearing aid system,

"FIG. 5 schematically illustrates a signal separation unit with an adaptive beamformer based on two microphones,

"FIG. 6 schematically illustrates a signal separation unit based on four microphones, and
"FIG. 7 schematically illustrates an exemplary new binaural hearing aid system."
For the URL and additional information on this patent application, see: Gran, Karl-Fredrik Johan; Dittberner, Andrew Burke. Hearing Aid with Signal Enhancement. U.S. Patent Application Serial Number 343428, filed January 4, 2012, and posted July 11, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3657&p=74&f=G&l=50&d=PG01&S1=20130704.PD.&OS=PD/20130704&RS=PD/20130704
Keywords for this news article include: Audiology, Algorithms, Electronics, Ear Diseases, Hearing Loss, Gn Resound A/s, Otolaryngology, Hearing Disorders, Signal Processing, Sensation Disorders, Nervous System Diseases, Neurologic Manifestations.

What you can expect from your hearing aids

Publication info: Daily Record [Wooster, Ohio] 23 July 2013: D.8.
ProQuest document link

Abstract: If your hearing loss has progressed to the degree that you need hearing aids, a critical factor in their success is your understanding and acceptance of realistic expectations of their capabilities.

Full text: If your hearing loss has progressed to the degree that you need hearing aids, a critical factor in their success is your understanding and acceptance of realistic expectations of their capabilities. Hearing instruments -- regardless of brand or type of technology -- can never replace normal hearing in all listening situations. Expecting results that cannot be achieved will only lead to frustration and dissatisfaction. If you know what to expect, you'll be free to enjoy the improvements that hearing aids can make in your life. Here are some guidelines which should help you and your provider agree on a set of realistic expectations for you.
-- The extent to which the lost hearing function can be restored through amplification is based on the severity and duration of your hearing loss. The degree and extent of hearing loss is determined by using calibrated equipment called an audiometer.
-- The more severe your hearing loss, the larger the hearing aid must be to provide room for a larger amplifier and components.
-- Crowded social gatherings and restaurants are examples of noisy conditions where even a person with "normal hearing" has trouble hearing conversations. As a person's hearing deteriorates, so also does the ability of a hearing aid to correct for hearing loss in these types of situations. Your provider's goal is to select an appropriate circuit for your hearing aid that will deliver a natural loudness throughout your entire listening range without getting too loud or too quiet.
-- In difficult listening situations normal hearing listeners rely on using speech reading cues and focusing their attention on the speaker. These listening skills are even more important for the hearing aid user when faced with these circumstances.
-- In quiet, many hearing aid users can achieve a performance level equal to normal hearing. But as the difficulty of the listening task increases, the gap between a person with normal hearing and a person with hearing loss widens. The more severe the hearing loss, the wider the gap.
-- With properly fitted hearing aids, you should be able to hear many normal sounds that you may not otherwise be able to hear clearly, such as the voice of your clients or the words of a loved one. You may also begin to

hear sounds you have forgotten were a part of your world, such as the hum of the motor on your refrigerator or the buzz of your fluorescent lights.
-- Hearing aids in the conventional non-linear and digital categories should prevent normally loud sounds from becoming uncomfortable.
-- Depending on the degree and severity of your loss, hearing aids may allow you to hear speech more clearly in some noisy situations.
-- You'll need time to get used to your new hearing aids to learn how to achieve maximum performance from them.
-- Hearing aids will not restore your hearing to normal. Science has not been able to match the human hearing mechanism.
-- Hearing aids will not "filter out" background noise, despite some advertising claims. Some hearing aids have circuitry that will avoid boosting the volume of some types of background noise, but this can also remove some of the speech you want to hear. This is usually a benefit, however, providing a more comfortable listening experience and better sound quality in some types of noise situations.
-- Hearing aids should allow you to understand speech more clearly, with less effort, in a variety of listening situations.
-- Hearing aids should keep others from noticing your hearing loss.
--We have the same goal as you: to find a way to help you reach the best possible hearing improvement. Using the best testing and assessment equipment science has to offer, and the availability of hearing aids from 27 worldwide manufacturers, we pledge to do our best to meet a set of mutually agreed-upon objectives and expectations.
Provided by Premiere Hearing.

GETTING AN EARFUL

Author: Dimond, Valerie.

Publication info: Sarasota Herald Tribune [Sarasota, Fla] 23 July 2013: E.6.
ProQuest document link

Abstract: Consumers are often unaware that hearing devices work differently for different people, says Ed Ogiba, president the Hearing Loss Association of Sarasota, a consumer education and advocacy group. HOW TO SHOP People often feel dissatisfied with their hearing aids because they were fitted by someone too focused on the sale, instead of the patient's needs, says Bradenton audiologist Victoria Moore of Hearing Aid Systems Inc. Hearing instrument specialists and audiologists are both legally certified to fit patients with hearing aids -- but there are important differences between them, she adds.

Full text: Finding the right hearing device takes time -- and money
Second of two parts.
Venice resident Judi Picha, 73, knows her way around a hearing aid.
She has been using them since she was a teenager, and says keeping a detailed list of what does and doesn't work is key.
"I wrote down everything that I did not like, so when I had my visit I could describe accurately what was wrong, versus saying, 'They don't work for me,'" says Picha. "Also I learned to keep the aids in for several weeks, so my brain could adjust to the new sound. It takes patience."

Today Picha has a cochlear implant that includes a T-coil. She says T-coils are kind of like having your own personal loudspeaker.

"It brings the sound right to one's ear, and I hear just about every single word when I use it," says Picha, who activates hers every Sunday at church. "Often I hear someone my hearing husband cannot hear well, because they are so soft-spoken."

Consumers are often unaware that hearing devices work differently for different people, says Ed Ogiba, president the Hearing Loss Association of Sarasota, a consumer education and advocacy group.

"You have to start by getting the right audiologist," Ogiba says. "We recommend that you look for audiologists that sell the top six: Oticon, Phonak, Resound, Siemens, Starkey, Widex."

These brands, he says, are consistently recommended by leading audiologists who speak at the HLAS monthly meetings.

Joan Mastrandrea of Sarasota learned her lesson through experience, after buying the cheapest pair of hearing aids she could find for a few hundred dollars. Frustrated and disappointed with their performance, she eventually gave up on hearing aids and went without until she found a good pair last year.

"I was too cheap to pay for good ones back then," says Mastrandrea, 82, who was fitted with new aids by Sarasota audiologist Lyndsey Nalu.

"I never knew the difference until I joined the Hearing Loss Association," says Mastrandrea. "I assumed that all people who sold hearing aids have the same education. I was wrong."

HOW TO SHOP

People often feel dissatisfied with their hearing aids because they were fitted by someone too focused on the sale, instead of the patient's needs, says Bradenton audiologist Victoria Moore of Hearing Aid Systems Inc.

Hearing instrument specialists and audiologists are both legally certified to fit patients with hearing aids -- but there are important differences between them, she adds.

"Audiologists have to go through years of university training and 1,450 hours of clinical practice. Hearing aid specialists only need a high school diploma and six months of training," Moore says.

It's also important to make sure you are being seen as an individual, and not a dollar sign.

"A good audiologist will want your lifestyle inputs," says Ogiba. If not, "You're going to end up with what they sell, not what you need."

Ogiba notes that today's aids come with a variety of styles, sizes and programs that can be customized to different needs.

"You want someone who won't just throw out that same brand at every customer that walks in," says audiologist Brad Ingrao, also from Hearing Aid Systems Inc.

And don't be enticed by a certain brand based on someone else's experience.

"Uncle Harry's hearing is different from yours," Ogiba says.

He believes you should follow the audiologist's advice -- many patients don't -- and get the recommended device, which could mean wearing one that's larger than you expected. Ogiba says the social stigma people attach to hearing aids is the most common reason people complain -- because they want the most discreet model on the shelf.

"This is one of the biggest issues for people in the market for an aid," he says. "Performance increases progressively with an aid's size, but so does the first-time wearer's perceived stigma issue."

On the other hand, today's smaller aids can be very good, says Ingrao, modeling a miniature hearing aid that virtually disappears inside his ear. As technology advances, he says, smaller models are performing better all time.

"Hearing devices aren't like your grandparents' hearing aids," says Moore. "They've come a long way."

When you buy your hearing aids, your provider should be scheduling that first follow-up appointment before you leave the office, Ingrao says. And "understand your contract," he adds -- especially

if you live in different places throughout the year.
If you buy hearing aids in Ohio and you need service in Sarasota, you may need to pay an additional service fee to the audiologist you visit here. Find out.
"The other alternative is to mail your hearing aid to the original place where you purchased it," says Moore.
ABOUT THAT PRICE
The bottom line is to find what works, because hearing aids are an investment that doesn't come cheap.
The average cost of a quality hearing aid starts at around $3,000 -- for one ear.
"It can hit you like a thunderbolt. Medicare doesn't cover it. Health insurance plans don't cover it," Ogiba says.
Moore says military veterans,
federal employees and some with
unionized jobs do have hearing aid coverage.
And funding for hearing aids and implants is available to those who can't afford them through a new program, Help Us Hear (HUH), says Jennifer Moss, executive director of the Ear Research Foundation at Silverstein Institute in Sarasota.
The collaborative effort includes support from HLAS, Sarasota Memorial Healthcare Foundation, Audiology Management Group, hearing equipment manufacturers and private donors.
"We were getting calls all the time about cost issues," says Moss, noting that so far 16 people have seen benefits from the program.
In Florida, people who purchase hearing aids are entitled to a refund of the purchase price, minus 5 percent, within 30 days. So once you do get fitted, Ogiba suggests getting acquainted with your new equipment right away. "Wear it every waking hour -- really put it to the test," he says. "If you miss the movies, get your butt to the movies two to three days a week in that 30-day period."
What you get when you get those T-coils
A T-coil is a tiny wireless receiver inside a hearing aid or cochlear implant that vastly improves sound quality wherever a hearing loop system is installed.
"My patients that have T-coils love them," says Sarasota audiologist Lyndsey Nalu at Adept Audiology.
Sound travels through a microphone or a sound board hooked up to an amplifier and connected to an induction loop. The loop runs along the border of the room -- or designated area -- and delivers the sound via magnetic signal directly to the person's T-coil, filtering out ambient or background noise.
"This makes the signal far clearer than that picked up by a hearing device without a T-coil," Nalu says.
Edward Ogiba, president of the Hearing Loss Association Sarasota says hearing loops can now be found in dozens of places around Sarasota, Bradenton and Venice, including the Van Wezel, Players Theater, Sarasota Orchestra, churches, libraries and medical offices.
"This county has more loops in theaters than anywhere else in the country -- 18 playhouses are looped and more houses of worship than anywhere in the country," says Ogiba, a T-coil user who is lobbying to get more places on board.
An audiologist may need to activate your T-coil before it can be used. After that, it turns on and off by flipping a tiny switch or remote control. Some kick in automatically if they detect a hearing loop system.
If you have a hearing aid without a T-coil, Nalu says, you may be able to have one installed for $50 to $250 -- if your device isn't too tiny.
"Most of the very small in-the-ear and behind-the-ear devices cannot accommodate a T-coil," she explains. "I have found that most individuals would prefer hearing devices with a T-coil, even if it means they are slightly larger in size."
-Valerie Dimond
Credit: VALERIE DIMOND , Correspondent
Illustration

Caption: Audiologist Carmelo Ortega conducts a test at the Silverstein Institute in Sarasota. STAFF PHOTO / DAN WAGNER; A spectrum of hearing instrumentation from hearing aids to cochlear implants is displayed at the Silverstein Institute in Sarasota.STAFF PHOTODAN WAGNER; "You have to start by getting the right audiologist. We recommend that you look for audiologiststhat sell the top six: Oticon, Phonak, Resound, Siemens, Starkey, Widex."-- Ed Ogiba, president, Hearing Loss Association of Sarasota

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GN ReSound A/S; Agency Reviews Patent Application Approval Request for "Hearing Aid with Improved Magnetic Reception during Wireless Communication"

Publication info: Telecommunications Weekly (Jul 10, 2013): 625.
ProQuest document link

Abstract: [...]this way of solving the problem prevents the user of the hearing aid from using a remote control to adjust the hearing aid and also prevents transmission of signals to the other hearing aid in a binaural hearing aid system. [...]there is a need for a hearing aid that allows use of the telecoil, or another magnetically sensitive transducer, as an input source of the hearing aid and simultaneous RF-transmission without the RF-transmission causing interference in the signal output by the hearing aid in response to the output signal of the telecoil or another magnetically sensitive transducer.

Full text: 2013 JUL 10 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- GN ReSound A/S has been issued patent application serial number 330524, according to news reporting originating out of Washington, D.C., by VerticalNews editors.

The patent's inventors are Pedersen, Brian Dam (Ringsted, DK); Nijsse, Gerard ('S-GRAVENHAGE, NL).

This patent application was filed on December 19, 2011 and was made available online on June 27, 2013.

From the background information supplied by the inventors, news correspondents obtained the following quote:

"The present application relates to a hearing aid with a telecoil, or another magnetically sensitive transducer, and an RF transceiver for wireless communication, e.g. via a wireless network, such as for wireless interconnection of two hearing aids in a binaural hearing aid system, and wireless interconnection of hearing aids with other devices, such as a remote control for a hearing aid, a fitting instrument, a mobile phone, a headset, a door bell, an alarm system, a broadcast system, etc, etc."

Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent application: "Magnetic pick-up coils, often referred to as telecoils or T-coils (from 'Telephone Coils'), in hearing aids allow audio sources to be electro-magnetically, i.e. non-acoustically, connected to a hearing aid, which is intended to help the wearer filter out background noise. They can be used with telephones, FM systems (with neck loops), and induction loop systems, also called 'hearing loops', that transmit sound to hearing aids from public address systems and TVs. Hearing loops are widely used in churches, shops, railway stations, and other public places.

"A telecoil consists of a metal core (or rod) around which ultra-fine wire is coiled. Telecoils generate an electrical signal in response to a varying magnetic field.

"Although a telecoil constitutes a wide-band receiver, interference is unusual in most hearing loop situations. Interference can manifest as a buzzing sound, which varies in volume depending on the distance between the wearer and the source. Sources are electromagnetic fields, such as CRT computer monitors, older fluorescent lighting, some dimmer switches, many household electrical appliances and airplanes.

"In addition, an RF-transceiver of the hearing aid may also generate interference. During normal operation, power consumption of hearing aid circuitry is very low. In an example, a hearing aid has a current consumption

of 1 mA during normal operation.

"Typically, an RF transceiver in a hearing aid consumes a comparatively large amount of power during transmission or reception. For example, the current consumption of the RF transceiver circuitry may increase from 50 .mu.A to 30 mA during transmission or reception by the RF transceiver. Therefore, turning the RF transceiver on or off generates a large current transient in the hearing aid circuitry, and during the duration of the current transient, a varying magnetic field with large magnetic field gradients is generated.

"The magnetic field gradients are picked up by the telecoil and induce a disturbing signal in the electronic telecoil signal output by the telecoil, e.g. residing in a hearing loop. The disturbing signal interferes with the desired signal in a disturbing and bothering way for the wearer of the hearing aid.

"The characteristics of the current transients generated in the hearing aid changes over time, e.g. as a function of the degree of depletion of the hearing aid battery, the number of previous charging cycles having been applied to the battery, the type of battery currently in use, etc.

"Conventionally, this interference problem has been solved by turning the RF transceiver off whenever the telecoil is selected as an input source for inputting the electronic telecoil signal to the processor of the hearing aid, for example when the user desires to listen to signals of a hearing loop. However, this way of solving the problem prevents the user of the hearing aid from using a remote control to adjust the hearing aid and also prevents transmission of signals to the other hearing aid in a binaural hearing aid system.

"Thus, there is a need for a hearing aid that allows use of the telecoil, or another magnetically sensitive transducer, as an input source of the hearing aid and simultaneous RF-transmission without the RF-transmission causing interference in the signal output by the hearing aid in response to the output signal of the telecoil or another magnetically sensitive transducer.

"In the new hearing aid, interference from the RF-transceiver of the hearing aid is prevented by substitution of the output signal of the magnetically sensitive transducer disturbed by current transients generated when the RF-transceiver is turned on or off with an estimated output signal, wherein the estimate is based on parts of the output signal that have not been disturbed by turning the RF-transceiver on or off.

"Thus, a new method of removing interference from a hearing aid audio signal is provided, comprising the steps of:

"converting a varying magnetic field into an audio signal,

"generating a hearing loss compensated output signal based on the audio signal,

"converting the hearing loss compensated output signal to an auditory output signal that can be received by the human auditory system,

"controlling turn-on and turn-off of an RF transceiver of the hearing aid,

"forming an estimate of the audio signal that is within a time period comprising an event that the RF transceiver changes state between on and off, wherein the estimate is formed based on the audio signal obtained outside the time period, and

"generating the hearing loss compensated output signal based on the estimate of the audio signal that is within the time period.

"The method may further comprise at least one of the following steps:

"(a) forming an estimate of the audio signal before the time period, the estimate of the audio signal before the time period being based on a part of the audio signal input to the processor after the time period, and wherein the hearing loss compensated output signal is also based on the estimate of the audio signal before the time period, and

"(b) forming an estimate of the audio signal after the time period, the estimate of the audio signal after the time period being based on a part of the audio signal input to the processor before the time period, and wherein the hearing loss compensated output signal is also based on the estimate of the audio signal after the time period.

"Further, a new hearing aid is provided, comprising

"a magnetically sensitive transducer for conversion of a varying magnetic field into an audio signal,
"a processor configured to generate a hearing loss compensated output signal based on the audio signal,
"an output transducer for conversion of the hearing loss compensated output signal to an auditory output signal that can be received by the human auditory system, e.g. an acoustic output signal,
"an RF transceiver for wireless communication, and
"a communication controller that is configured to turn the RF transceiver on and off, and wherein,
"the processor is further configured to generate the hearing loss compensated output signal based on an estimate of the audio signal within a time period comprising an event that the RF transceiver changes state between on and off, and wherein the estimate is based on a part of the audio signal input to the processor outside the time period.
"The processor may also be configured to generate the hearing loss compensated output signal based on an estimate of the audio signal before the time period, the estimate of the audio signal before the time period being based on the audio signal that is input to the processor after the time period.
"The processor may also be configured to generate the hearing loss compensated output signal based on an estimate of the audio signal after the time period, the estimate of the audio signal after the time period being based on the audio signal that is input to the processor before the time period.
"When the communication controller turns the RF transceiver on or off, the processor receives information that the RF transceiver is turned on or off so that the processor can substitute the audio signal with an estimated signal within an appropriate time interval.
"Typically, the auditory output signal is an acoustic signal that is transmitted towards the ear drum of the wearer of the hearing aid; however, the auditory output signal may also be an electronic signal for electronic stimulation of the auditory system of the user, for example using a cochlear implant.
"Throughout the present disclosure, the term 'audio signal' may be used to identify any analogue or digital signal forming part of the signal path from the output of the magnetically sensitive transducer to an input of the signal processor.
"The magnetically sensitive transducer may be any transducer capable of converting a varying magnetic field into an audio signal, such as a telecoil, GMR sensor (Giant MagnetoResistance sensor), Hall sensor, etc.
"The hearing aid may also include an input transducer, preferably a microphone, or an array of microphones, for conversion of an acoustic sound signal into an electronic transducer signal.
"In a digital hearing aid, the electronic transducer signal and the audio signal are digitized by respective AD-converters.
"The signal processor, such as a digital signal processor or DSP, may be configured to process a selected one of, or a selected combination of, the audio signal and the electronic transducer signal in accordance with a selected signal processing algorithm into a processed output signal for compensation of hearing loss, for example including a compressor for compensation of dynamic range hearing loss.
"The time period includes the time during which the current transient disturbs or distorts the audio signal, and typically, the time period starts at turn-on or turn-off of the RF-transceiver. Within the time period, the audio signal is substituted by an estimated signal calculated from the audio signal outside the time period, e.g. preceding the time period, or succeeding the time period, or a combination. In a digital hearing aid, the samples of the audio signal are substituted by estimated samples calculated from samples of the audio signal outside the time period, such as samples preceding the time period, or samples succeeding the time period, or a combination of samples preceding and samples succeeding the time period.
"Thus, the estimate may be based on extrapolation of the audio signal input to the processor outside the time period, e.g. the estimate may be based on extrapolation of the audio signal input to the processor before the time period, i.e. forward prediction; or, the estimate may be based on extrapolation of the audio signal input to the processor after the time period, i.e. backward prediction; or, the estimate may be based on a combination of

extrapolation of the audio signal input to the processor before and after the time period, respectively, i.e. both forward and backward prediction.

"Obviously, backward prediction requires delaying the signal, parts of which are to be estimated, in order for the signal after the time period to be available for estimation of the signal within the time period.

"Samples in the time period may be estimated using Linear Predictive Coding based on samples preceding the time period, or samples succeeding the time period, or a combination of samples preceding and samples succeeding the time period.

"The estimates may be weighted with a window, such as a Hanning window. Windowing minimizes formation of artefacts in the auditory output signal of the hearing aid by transition from the audio signal itself to an estimate of the audio signal.

"Other estimates may be calculated using other formulas, such as Warped Linear Predictive Coding, Polynomial extrapolation, etc.

"The estimate may also be calculated in the frequency domain, for example based on calculation of the Fast Fourier Transform of the audio signal input to the processor before the time period, i.e. forward prediction in the frequency domain; or, the estimate may be based on calculation of the Fast Fourier Transform of the audio signal input to the processor after the time period, i.e. backward prediction in the frequency domain; or, the estimate may be based on a combination of calculation of the Fast Fourier Transform of the audio signal input to the processor before and after the time period, respectively, i.e. both forward and backward prediction in the frequency domain.

"In order to further smooth the transition from real samples of the audio signal to estimated samples, one or more consecutive samples immediately preceding the time period, or one or more consecutive samples immediately succeeding the time period, or both, may also be substituted with estimated samples, wherein the original undisturbed signal samples are included in the estimates.

"For example, the most recent undisturbed signal sample occurring immediately before turn-on or turn-off of the RF transceiver may be substituted by an estimate calculated from samples occurring after the time period in a weighted combination with the undisturbed audio signal sample itself in order to gradually change from the undisturbed audio signal itself to an estimate of the audio signal.

"Likewise, the first undisturbed signal sample occurring after turn-on or turn-off of the RF transceiver may be substituted by an estimate calculated from samples occurring before the time period in a weighted combination with the undisturbed signal sample itself in order to gradually change from an estimate of the audio signal to the undisturbed audio signal itself.

"The hearing aid including the processor may further be configured to process the signal in a plurality of frequency channels.

"An estimate of the audio signal may be provided in at least one frequency channel of the plurality of frequency channels, such as in one or more selected frequency channels, such as in all of the frequency channels.

"The plurality of frequency channels may include warped frequency channels, for example all of the frequency channels may be warped frequency channels.

"In accordance with some embodiments, a hearing aid includes a magnetically sensitive transducer for conversion of a varying magnetic field into an audio signal, a processor configured to generate a hearing loss compensated output signal based on the audio signal, an output transducer for providing an auditory output signal based on the hearing loss compensated output signal, an RF transceiver for wireless communication, and a communication controller that is configured to turn the RF transceiver on and off, wherein the processor is further configured to generate the hearing loss compensated output signal based on an estimate of the audio signal within a time period comprising an event that the RF transceiver changes state between on and off, and wherein the estimate is based at least on a part of the audio signal input to the processor outside the time period.

"In one or more embodiments, the estimate may be based on extrapolation of the part of the audio signal input to the processor outside the time period.
"In one or more embodiments, the part of the audio signal may be input to the processor before the time period.
"In one or more embodiments, the part of the audio signal may be input to the processor after the time period.
"In one or more embodiments, the part of the audio signal on which the estimate is based may have a duration that is at least twice as long as the time period.
"In one or more embodiments, the estimate may be formed using Linear Predictive Coding.
"In one or more embodiments, the estimate may be formed using Warped Linear Predictive Coding.
"In one or more embodiments, the estimate may be formed using windowing.
"In one or more embodiments, the windowing may comprise a Hanning window.
"In one or more embodiments, the processor may also be configured to generate the hearing loss compensated output signal based on an estimate of the audio signal before the time period, the estimate of the audio signal before the time period being based on a part of the audio signal that is input to the processor after the time period.
"In one or more embodiments, the processor may also be configured to generate the hearing loss compensated output signal based on an estimate of the audio signal after the time period, the estimate of the audio signal after the time period being based on a part of the audio signal that is input to the processor before the time period.
"In one or more embodiments, the processor may further be configured to process the audio signal in a plurality of frequency channels, and wherein the estimate of the audio signal may be provided in at least one of the plurality of frequency channels.
"In accordance with other embodiments, a method of removing interference from a hearing aid audio signal includes converting a varying magnetic field into an audio signal, generating a hearing loss compensated output signal based on the audio signal, providing an auditory output signal based on the hearing loss compensated output signal, controlling turn-on and turn-off of an RF transceiver of the hearing aid, forming an estimate of the audio signal that is within a time period comprising an event that the RF transceiver changes state between on and off, wherein the estimate is formed based at least on the audio signal obtained outside the time period, and generating the hearing loss compensated output signal based on the estimate of the audio signal that is within the time period.
"In one or more embodiments, the estimate may be formed utilizing Linear Prediction Coding.
"In one or more embodiments, the hearing loss compensated output signal may also be based on an estimate of the audio signal before the time period, the estimate of the audio signal before the time period being based on a part of the audio signal input to the processor after the time period.
"In one or more embodiments, the hearing loss compensated output signal may also be based on an estimate of the audio signal after the time period, the estimate of the audio signal after the time period being based on a part of the audio signal input to the processor before the time period.
"Other and further aspects and features will be evident from reading the following detailed description of the embodiments. DESCRIPTION OF THE DRAWING FIGURES
"The drawings illustrate the design and utility of embodiments, in which similar elements are referred to by common reference numerals. These drawings are not necessarily drawn to scale. In order to better appreciate how the above-recited and other advantages and objects are obtained, a more particular description of the embodiments will be rendered, which are illustrated in the accompanying drawings. These drawings depict only typical embodiments and are not therefore to be considered limiting in the scope of the claims. The embodiments will be described in more detail with reference to the drawings, wherein
"FIG. 1 shows a block diagram of a hearing aid with a telecoil and an RF-transceiver,
"FIG. 2 shows a plot of signals in the hearing aid of FIG. 1, and

"FIG. 3 illustrates audio signal estimation."
For the URL and additional information on this patent application, see: Pedersen, Brian Dam; Nijsse, Gerard. Hearing Aid with Improved Magnetic Reception during Wireless Communication. U.S. Patent Application Serial Number 330524, filed December 19, 2011, and posted June 27, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3936&p=79&f=G&l=50&d=PG01&S1=20130620.PD.&OS=PD/20130620&RS=PD/20130620
Keywords for this news article include: Audiology, Electronics, Ear Diseases, Hearing Loss, GN ReSound A/S, Otolaryngology, Hearing Disorders, Sensation Disorders, Wireless Technology, Wireless Communication, Nervous System Diseases, Neurologic Manifestations.

Mechanized scaling with ultrasonics: Perils and proactive measures

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Publication info: Journal of Indian Society of Periodontology 17.4 (Jul-Aug 2013): 423-428.
ProQuest document link

Abstract: Mechanized scaling for plaque removal is a routine procedure in the practice of periodontics. Though it appears innocuous by itself, there are retinues of hazards associated with it on various organ systems in the body. Some of these unwanted effects and measures to avoid or ameliorate the same are elaborated here. Exposure to ultrasonic scaling is inevitable before any other treatment procedure. Aerosol contamination, vibrational hazards, thermal effects on the dental pulp, altered vascular dynamics, disruption in electromagnetic device, diminished hearing and dental unit waterline contamination are some of the probable off-shoots a patient has to bear. Uses of barrier devices, proper attention to usage of equipment, protection for ear and water treatment are few of solutions for the same. Though documented evidence for the existence of all effects is lacking, it is never the less significant for the overall safety of the patient. A conscientious clinician should therefore inculcate the available steps to overcome the hazards of ultrasonic scaling.

Full text: Introduction
The periodic removal of supra and sub-gingival plaque is essential for controlling inflammatory periodontal diseases. [1] Mechanized instruments use the water-cooled instrument tip vibrating at high frequency for eradication of bacterial deposits from teeth and periodontal pockets. The two categories of mechanized instruments are ultrasonic and sonic handpieces. [2] Though they are indispensable tools of periodontics, they are not without their set of perils. Thus, some of the inherent problems associated with the use of ultrasonic scalers and the practical solutions for the same are elaborated here.
Indoor Air Pollution
Health problems related to poor indoor air quality are often related to contaminants, which include bioaerosols, non-viable particulates and volatile organic chemicals. [3] Many routine dental procedures produce aerosol and splatter composed of varying combinations of water, tissue and tooth dust, blood and saliva. At a minimum distance of 50 cm from patient undergoing ultrasonic scaling about 33% of blood borne aerosols were isolated in a recent study. [4]
Micik et al. defined dental aerosols as particles smaller than 50 μm with any particles larger than 50 μm being described as splatter. [5] Aerosol particles of 50 μm or smaller remain airborne for a longer period and enter the

nasal passages with penetration deep into the respiratory tree creating health concern. All aerosol particles may contain blood elements with attached viral particles, such as human immunodeficiency virus and hepatitis B virus. [6] Other diseases known to be spread through airborne route are pneumonic plague, tuberculosis, influenza, legionnaire's disease and severe acute respiratory distress syndrome. [7]

Reduction of Indoor Air Pollution

Recommendations by American Dental Association (ADA) and Prevention and Occupational Safety and Health Administration support the use of a "spray-wipe-spray" technique. Use of a surface disinfectant with documented evidence of bactericidal, tuberculocidal and virocidal activity is recommended. All areas within six feet radius of the operation should be cleaned. [7]

The dental team should not rely on a single precautionary strategy.

In the reduction of dental aerosols, the first layer of defense is personal protection barriers such as masks, gloves and safety glasses. For masks to be protective, they must filter effectively aerosol particles of 50 μm or less with minimal marginal leakage. [8]

The second layer is antiseptic pre-procedural rinse with a mouthwash such as chlorhexidine.

The third layer of protection is the routine use of a high volume evacuator (HVE).

An additional fourth layer would be the use of a device to reduce aerosol contamination that escapes the operating area, such as a high efficiency particulate air filter (HEPA). Extra-oral HVE covered with a towel can filter out blood-borne aerosols. [4]

According to the ADA and centers for disease control a room ceiling equipped with HEPA will be 99.97% efficient in removing all particles 0.3 μm or larger in diameter. [3]

The advantages and disadvantages of commonly used protective measures are given in [Table 1]. [7]{Table 1}

Vibration Hazards

It is well-recognized that the large amplitudes produced by pneumatic drills will cause "white finger" or "acrocyanosis." This is a disruption in the blood flow to the fingers, caused by the vibration that is passed from the drill through to the hand. [9]

A study was undertaken on 120 subjects comprising of 60 dentists and hygienists exposed to vibrations, from high-speed hand pieces and ultrasonic scalers and a control group of 60 dental assistants and medical nurses. [10] They were assessed for manual performance, tactility, strength, etc., In this study, it was found that the vibrations could produce a reduction in strength and tactile sensitivity and performance. It was stated that vibrating tools are used for an average of 75 min a day highlighting the need for the reduction of exposure time.

Reduction of Hazards From Vibration

Prolonged operation of an ultrasonic scaler may cause alteration of blood and nerve supplies to the operator finger. In this respect, adequate standardization of instruments and procedures is essential including:

Adequate training of the clinician in the use of the ultrasonic scalerAvoidance of heavy contact loadsAn indication of the displacement amplitude of the scaling probe tip and the direction of its oscillation. [11]

Research is needed to aid in the development, design and production of an ultrasonic hand piece that will eliminate any vibration hazards to the operator. [9]

Thermal Hazards

If the ultrasonic scaler is perfectly coupled at the probe/enamel interface then about 37% of ultrasonic energy would leave the metal and enter the tooth. However, this does not occur because:

The dimensions of the probe tip are much smaller than the wavelength of sound at these frequenciesThere is usually a thin layer of water imposed between the probe and the tooth.If heavy contact pressures are used the coupling will then be improved, increasing the amount of ultrasound entering the tooth. One of the major sources of damage to the tooth is the result of frictional heating between the probe and the enamel, especially if there is inadequate or no water cooling. However, the presence of water may act as a matching layer allowing uniform ultrasound energy to enter the tooth. [11]

A study has shown that temperature rise in the tooth caused by heating can cause damage to the pulp and dentine. An increase above 11C was shown to invariably destroy the pulp and a 17C increase produced pulp death. [12] However, a recent work suggests that an increase of 11.2C produces no damage on the pulp tissues. [13]

Down-Regulation of Thermal Hazards

Consistent use of the unit on the highest power setting will increase the potential for thermal damage without necessarily increasing the efficiency. [14] Temperature sensitivity can be controlled by slightly reducing the water flow or in the case of units with self-contained lavage warm water can be added to the container. When soft-tissue sensitivity is perceived as a problem and local anesthetics are not viable treatment choice, long acting topical anesthetic solutions have been used successfully for sub-gingival debridement. [2]

A study was designed to compare the temperature rise in dentin during ultrasonic scaling using either ultrasonic handpiece irrigation, intermittent bulb irrigation or no irrigation. A single clinician applied light forces, ultrasonic device was set to a fixed power setting and water flow was adjusted to 15 ml/min to reduce the number of study variables. Ultrasonic coolant temperature increases with duration of instrumentation and reaches a plateau, which is affected by power setting and irrigation volume. Bulb syringe irrigation and ultrasonic device water spray significantly reduced heat generation from ultrasonic scaling to physiologically tolerable levels. [15]

Thus, most studies conclude that powered scaling should not be considered without irrigation and the flow rate in the region of at least 20-30 ml/min. [9]

Thrombogenic Hazards

During dental treatment, the oscillating tip of ultrasonic scaler will be in contact with the tooth. It may be possible that the tooth acts as a waveguide conducting the vibrational energy from the scaler toward the apex of the root. If sufficient energy reaches the root, then it could pose a thrombogenic hazard to the blood vessels passing through the apical foramen into the pulp. This may lead to a potential loss of tooth vitality. [16]

A study conducted in vivo on mice to assess the effect of a wire vibrating at a frequency of 20 kHz placed against an intact blood vessel resulted in the production of platelet emboli and the formation of thrombi. [17]

This work was repeated with a commercially available ultrasonic scaler, which demonstrated similar findings. [9]

Thus, ultrasound transmissions into the tooth may result in potential damage to the structures such as blood vessels both within and around the teeth.

Alleviation of Thrombogenic Hazards

A probe tip operating at displacement amplitude of 44 μm directed perpendicular to the tooth surface under heavy contact pressure only resulted in displacement amplitude at the root tip of 1-2 μm. Thus, thrombogenic hazard may result when the longitudinal oscillations are directed perpendicular to the tooth surface. Thus, changing the direction of the oscillating tip so that it is parallel to the tooth reduces the vibration at the root apex to a barely detectable levels. [11]

Interruption of Electronic Devices

The electromagnetic device of vital importance is the cardiac pacemaker. The cardiac pacemaker is a tissue implanted electrical transmitter designed to regulate the rhythm of the heart. Two types are used, competitive (fixed rate type) and non-competitive (demand type), the former discharging at a fixed rate while the latter only discharges if the rate becomes irregular. [18]

The handpiece of the ultrasonic scaler produces an electromagnetic field and the severity of interference is dependent on the strength of this field. [9] The electromagnetic field produced by magnetostrictive ultrasonic scalers may interfere with the pacemaker discharge rate, resulting in a serious life-threatening hazard to the patient. [19] It has been suggested that any effects, which have been observed may be the result of a non-competitive type of pacemaker switching over to a fixed mode during the period of interference. [18] Work investigating the magnetostrictive scaler stated that interference can be caused if the pacemaker lead comes within 37.5 cm of the scaler. [20] No reports of interference caused by piezoelectric scaler have been reported.

[19]

Avoidance of Interference with Electromagnetic Devices

An elaborate medical history for every patient is prerequisite to rule out the presence of cardiac pacemakers. Consultation with the patient's physician and cardiologist is a must in patients with pacemakers. A safe distance of 50 cm or more is a must in these patients. [21] Magnetostrictive ultrasonic scalers should not be used on patients with a pacemaker. [22]

Auditory Hazards

Lesions of hearing apparatus can be chronic or acute. Acute acoustic trauma is caused by a high intensity noise stimulus such as an explosion or gunfire. The onset is painful and may be reversible or irreversible. Chronic acoustic trauma is caused by prolonged exposure to lower intensity sound irritant and is painless. The damage is irreversible because cochlear hair cells cannot regenerate. Although a certain amount of gradual hearing loss is considered normal as a part of ageing (presbycusis), prolonged exposure to excessive noise can greatly add to hearing loss.

The cognitive sound frequency for human ear is 20-20,000 Hz. Sounds below this range are infrasonic and those above are ultrasonic. The important speech frequency falls between the ranges of 250 Hz and 4000 Hz. A high-intensity, high-frequency noise can damage the high frequency receptors. [22]

Kilpatrick proposed a number of sounds in the dental office that may be hazardous to dentists hearing: High-speed turbineHigh-volume aspiratorUltrasonic scalerMixing devices for stone, amalgam, etc.Music playing loudly and continuously. [23]

Damage to operator hearing is possible through airborne sub-harmonics of the ultrasonic scaler. For the patient, damage can occur through the transmission of ultrasound through tooth contact to the inner ear through the bones of the skull. [9]

Degree of risk to the individual dentists depends on several factors.

Intensity of noiseFrequency spectrum of noiseDuration of exposure each dayDistance from the sourceIndividuals age, physical condition and susceptibilityType of procedureThe intensity of noise emitted from hand pieces differs from manufacturer to manufacturerPrevious exposure to damaging noise resulting in permanent injury to hearingWorking environment: Materials in the dental operatory, i.e., smooth cement walls and floors reflect noise almost completely, whereas draperies absorb noise considerably. [24] Hearing loss is expressed in terms of hearing threshold shifts in decibels (dB) as determined by audiometry. Permanent threshold shifts due to moderate noise levels, such as those encountered in dentistry would be detectable after years of exposure. [25]

In United Kingdom, the noise at work regulations state that a maximum exposure of 85 dB is permissible daily during an 8-h working period. This was ascertained using a formula given in the regulations. [26]

A study was undertaken to measure the noise levels made by different dental handpieces and equipment in dental practices and laboratories. Noise levels were measured in four dental practices and three dental laboratories. In the dental clinics, almost all noise produced by the dental instruments did not exceed the maximum permissible level of 85 dB. The only instrument that seemed to emit noise that was higher than 85 dB was the ultrasonic scaler in one of the dental clinics. [24]

Möller et al. reported temporary threshold shifts (TTS) in hearing in eight out of 20 subjects following a 5-min ultrasonic scaling procedure. [27] Unilateral changes of 10-20 dB in the frequency range of 3-10 kHz were demonstrated in these patients, three of whom had bilateral tinnitus. Both tinnitus and TTS are commonly accepted as early predictors of noise-induced hearing loss (NIHL). The liberal use of dental ultrasonic instruments may therefore pose a potential hazard to the hearing of the patient. [28]

A longitudinal study of 10 years duration on general practitioners and general dental practitioners concluded that dentists are at higher risk of hearing impairment although not generalized. [29]

Thus, ultrasonic scaler has been shown to cause no permanent harm to hearing through airborne noise.

Transmission of ultrasound through the bone may potentially damage the inner ear; although, this has not been demonstrated. Work is needed to identify if hearing loss is a problem for patients who receive regular ultrasonic scaling. [9]

Attenuation of auditory hazards

As NIHL is not a treatable condition it can only be partly relieved by rehabilitative means, prevention therefore assumes a great importance. [24]

Theoretically there are five methods of prevention of NIHL:

Exclusion from noise exposure of those who are most susceptible to NIHLTo reduce the exposure timePersonal evaluation: Technicians should have baseline otologic and audiometric examination to determine the current hearing status. Annual retests should be carried out to detect any degree of change taking placeReduction in noise level may be achieved by regular maintenance of equipment and early repair or replacement of defective items. The working room should be made more acoustically satisfactory by minimizing the hard surfacesPersonal protection with the use of ear muffs or plugs. Ear plugs are inserted into the ear canal, whereas ear muffs cover the entire external ear by means of a sealed cup. In general, plugs provide less noise attenuation than muffs and are useful in the noise levels from 100 dB to 105 dB. Muffs subdue noise levels from 110 dB to 115 dB. [30]Root Surface Removal by Ultrasonics

Evidence shows that ultrasonic and sonic scalers are effective in plaque and calculus removal, surface alterations including scratches, gouges and nicks increase exponentially as the ultrasonic power is increased from medium to high. Studies also reveal that as instrument contact time, tip to tooth angle and instrument pressure is increased, the likelihood of root surface damage is also increased. [31],[32] A growing body of evidence suggests that forceful instrumentation of the root surface to achieve cementum removal may be unnecessary and harmful. Cemental thickness can be assessed using fluorescence microscopy, contact microradiography and toluidine blue staining after the injection of labeling agents. [33] In fact, overzealous root planning removes important protein components such as bone morphogenetic proteins and slows down critical fibrous attachment from bone to root. [34]

Increasing the power setting from low to high may actually increase the loss of root substance from 11.37 +- 3.64 mm to 23.37 +- 15.76 mm. [35]

Diminution of Root Substance Removal

Defect volume and defect depth created by magnetostrictive and piezoelectric scalers are influenced by the combination of working parameters such as lateral force and tip angulations. Instrument power setting has to be low or medium to minimize tooth substance removal. 30B severe root damage at 40 s instrumentation occurred under most combination of lateral force tip angulation and power settings. Therefore, minimal forces, correct angulations and optimum power setting are mandatory to prevent the root surface damage. [2] Though, it is reported that thinner tips cause more recession the data are not conclusive to preclude the usage of these tips. [36] Rather than creating a glassy smooth root surface, Thompson believes that velvety smooth, clean surfaces with a resulting decrease in root sensitivity is most conducive to tissue healing. [34]

Dental Unit Waterline Contamination

Water recovered from dental units connected to municipal water supplies may contain millions of bacterial colony forming units per millimeter. Biofilms have been shown to be a primary source of contaminated water delivered by dental units. [37] The medical risk from the microbial contamination of water is the most significant to immunosuppressed individuals. Patients and clinicians temporarily compromised by infection and stress may also be at risk of infection. [2] This water can spread infection by the dispersed contaminated aerosols. [38]

A survey was undertaken by Williams et al. wherein DUWL samples were collected from 116 three-way syringe lines, 54 high-speed hand-pieces and 12 scaler lines from about 150 operatories at 54 sites in Washington, Oregon and California. Samples from 12 scalers showed a similar pattern of severe microbial contamination (mean 19,800 CFU/ml, SD = 37,300). Sections of functioning DUWL showed complete biofilm layers lining the

inner surface. [39]

Prevention of Duwl Contamination

The ADA has called for dental researchers and dental manufacturers to design equipment and measures to reduce waterline contamination. The announced goal was to match the standards for kidney dialysate, or 200 CFU/ml. [40]

The various approaches to risk reduction of DUWL contamination are: [41]

Anti-retraction valves and retrograde aspiration of oral fluids

Anti-retraction valves will limit re-aspiration and are most efficacious when fitted immediately distal to the handpiece. Autoclaving the hand-pieces after use and flushing of units for 30 s at the end of the day will augment the action of the anti-retraction valve and should help to eliminate any aspirated liquid. Back flow from dental units to the mains water supply may occur and it is necessary to install check valves to prevent this from occurring.

Filtration

Using filters on the dental waterline to eliminate bacteria from the water entering the handpiece, especially to reduce the planktonic bacteria. Therefore, disposable filters are recommended, which must be changed daily. Filters should be inserted just distal to the point of entry of water into the hand-piece for maximum efficiency. A pore size of 0.2 microns is recommended.

Flushing

ADA recommends that waterlines should be flushed through for several minutes at the start of each clinic day. Flushing for 20 min, which would be impractical in most dental surgeries, will reduce the bacterial count to zero. However, the persistent nature of contamination is demonstrated when 30 min later, shedding of bacteria from the biofilm returns the total colony counts to within pre-flush range.

Biocides and chemical disinfectants

Biocides have been used in an attempt to remove the biofilm and eliminate the planktonic bacterial count. These include chlorhexidine gluconate, povidone-iodine, ethanol, hypochlorite, peroxide and glutaraldehyde. The intrinsic resistance of the biofilm ecosystem has hampered their value.

Chlorination

Chlorine, as sodium hypochlorite, is the most commonly employed biocide in water treatment plants and has proven efficacy in cold water hospital systems. Independent reservoir clean water systems can be used to deliver chlorine flushes to the dental waterline. The system can be "shocked" or hyper-chlorinated intermittently with high doses of 50 ppm chlorine every 6 months.

Peroxide, ozone and ultraviolet light

Hydrogen peroxide and ozone are compounds that can be introduced continuously into waterlines. UV treatment of water has been used alone or in conjunction with ozone and other biocides for the control legionellae and reduction of endotoxins in water. A major advantage of these systems is that they avoid introducing chemical disinfectants into the effluent water system with the potential for pollution and destructive effects on wildlife.

Independent clean water systems

A separate pressurized clean water reservoir system filled with sterile water plumbed to the mains connections to the municipal water provides sterile water. The total volume of water consumed per day as an irrigant is in the range of 1-2 L/dental unit; thus, the use of small reservoir is sufficient. Reservoirs should be used preferably with sterile water or boiled water that is allowed to cool in a sterile sealable container. Letting the system to drain down to dry and purging with air or ethanol will help to prevent the biofilm proliferation due to desiccation.

Autoclavable systems

A fully autoclavable assembly of water reservoirs, silicon multi-lumen DUWL tubing and fittings to be sterilized between patients could be used for surgical procedures.

Conclusion

Considering the ethical issues of treating a patient under absolute safety it is the responsibility of every practitioner to pay heed to the above adverse effects and apply stringent measures to counteract the same.

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Patents; Patent Application Titled "Method of Signal Processing in a Hearing Aid System and a Hearing Aid System" Published Online

Publication info: Computers, Networks & Communications (Jun 13, 2013): 2468.

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors WESTERMANN, Adam (Sydney, AU); BUCHHOLZ, Jorg Matthias (Sydney, AU); DAU, Torsten (Copenhagen, DK), filed on January 14, 2013, was made available online on May 30, 2013.

Full text: 2013 JUN 13 (VerticalNews) -- By a News Reporter-Staff News Editor at Computers, Networks &Communications -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors WESTERMANN, Adam (Sydney, AU); BUCHHOLZ, Jorg Matthias (Sydney, AU); DAU, Torsten (Copenhagen, DK), filed on January 14, 2013, was made available online on May 30, 2013.

No assignee for this patent application, patent application serial number 740417, has been made.

Reporters obtained the following quote from the background information supplied by the inventors: "The present invention relates to a method of signal processing in a hearing aid system. The invention, more specifically, relates to a method of noise suppression in a hearing aid system. The invention further relates to hearing aid systems having means for noise suppression.

"In the context of the present disclosure, a hearing aid should be understood as a small, microelectronic device designed to be worn behind or in a human ear of a hearing-impaired user. A hearing aid system may be monaural and comprise only one hearing aid or be binaural and comprise two hearing aids. Prior to use, the hearing aid is adjusted by a hearing aid fitter according to a prescription. The prescription is based on a hearing test, resulting in a so-called audiogram, of the performance of the hearing-impaired user's unaided hearing. The prescription is developed to reach a setting where the hearing aid will alleviate a hearing loss by amplifying sound at frequencies in those parts of the audible frequency range where the user suffers a hearing deficit. A hearing aid comprises one or more microphones, a microelectronic circuit comprising a signal processor, and an acoustic output transducer. The signal processor is preferably a digital signal processor. The hearing aid is enclosed in a casing suitable for fitting behind or in a human ear.

"It is well known that people with normal hearing can usually follow a conversation despite being in a situation with several interfering speakers and significant background noise. This situation is known as a cocktail party environment. As opposed hereto hearing impaired people will typically have difficulties following a conversation in such situations.

"In the article by Allen et al.: 'Multimicrophone signal-processing technique to remove room reverberation from speech signals', Journal Acoustical Society America, vol. 62, no. 4, pp. 912-915, October 1977, a method for suppression of room reverberation, from the signals recorded by two spatially separated microphones, is disclosed. To accomplish this the individual microphone signals are divided into frequency bands whose corresponding outputs are cophased (delay differences are compensated) and added. Then the gain of each resulting band is set based on the cross correlation between corresponding microphone signals in that band. The reconstructed broadband speech is perceived with considerably reduced reverberation.

"US-A1-20080212811 discloses a signal processing system with a first signal channel having a first filter and a second signal channel having a second filter for processing first and second channel inputs and producing first and second channel outputs, respectively. Filter coefficients of at least one of the first and second filters are adjusted to minimize the difference between the first channel input and the second channel input in producing the first and second channel outputs. The resultant signal match processing of the signal processing system gives broader regions of signal suppression than using Wiener filters alone for frequency regions where the interaural correlation is low, and may be more effective in reducing the effects of interference on the desired speech signal.

"One problem with the above mentioned systems is that noise from interfering speakers is not efficiently suppressed.

"It is therefore a feature of the present invention to overcome at least this drawback and provide a more efficient method for suppression of noise from interfering speakers.
"Hereby speech intelligibility for the hearing impaired can be improved in the otherwise very difficult situation of following a conversation despite several interfering speakers.
"It is another feature of the present invention to provide a hearing aid system incorporating means for suppression of noise from interfering speakers."
In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent application: "The invention, in a first aspect, provides a method for processing signals in a hearing aid system comprising the steps of: providing a first signal representing the output from a first input transducer in a first hearing aid of the hearing aid system; providing a second signal representing the output from a second input transducer of the hearing aid system; transforming the first and second signal from the time domain and to the time-frequency domain hereby providing a third and fourth signal, respectively; calculating a value representing the interaural coherence between the third and fourth signal hereby providing a fifth signal; deriving a first gain value for the hearing aid system based on the fifth signal; applying the first gain value in the amplification of the third signal in the first hearing aid hereby providing a sixth signal; transforming the sixth signal from the time-frequency domain and to the time domain hereby providing a seventh signal for further processing in the hearing aid system; and wherein the relation determining the first gain value as a function of the value representing the interaural coherence comprises three contiguous ranges for the values representing the interaural coherence, where the maximum slope in the first and third range are smaller than the maximum slope in the second range and wherein the ranges are defined such that the first range comprises values representing low interaural coherence values, the third range comprises values representing high interaural coherence values, and the second range comprises values representing intermediate interaural coherence values.
"This provides an improved method for suppression of noise from interfering speakers in a hearing aid system.
"The invention, in a second aspect, provides a hearing aid system comprising at least one hearing aid, two microphones, analogue-to-digital converter means, time-frequency transforming means, interaural coherence calculation means, first gain calculation means adapted for suppressing interfering speakers, digital processing means adapted for alleviating a hearing deficit of the user wearing the hearing aid system, digital-to-analogue converter means, and output transducer means for providing an acoustical signal, wherein the first gain calculation means is adapted for using a relation determining a first gain value as a function of a value representing the interaural coherence comprising three contiguous ranges for the values representing the interaural coherence, where the maximum slope in the first and third range are smaller than the maximum slope in the second range, and wherein the ranges are defined such that the first range comprises values representing low interaural coherence values, the third range comprises values representing high interaural coherence values, and the second range comprises values representing intermediate interaural coherence values.
"The invention, in a third aspect, provides a hearing aid system comprising a hearing aid and an external device, said hearing aid having a microphone, analogue-to-digital converter means, time-frequency transforming means, interaural coherence calculation means, first gain calculation means adapted for suppressing interfering speakers, digital processing means adapted for alleviating a hearing deficit of the user wearing the hearing aid system, digital-to-analogue converter means, and output transducer means for providing an acoustical signal, and said external device having an acoustical-electrical input transducer means and link means for transmitting data derived from the input transducer to the hearing aid, wherein the first gain calculation means is adapted for using a relation determining a first gain value as a function of a value representing the interaural coherence comprising three contiguous ranges for the values representing the interaural coherence, where the maximum slope in the first and third range are smaller than the maximum slope

in the second range, and wherein the ranges are defined such that the first range comprises values representing low interaural coherence values, the third range comprises values representing high interaural coherence values, and the second range comprises values representing intermediate interaural coherence values.

"Further advantageous features appear from the dependent claims.

"Still other features of the present invention will become apparent to those skilled in the art from the following description wherein the invention will be explained in greater detail. BRIEF DESCRIPTION OF THE DRAWINGS

"By way of example, there is shown and described a preferred embodiment of this invention. As will be realized, the invention is capable of other different embodiments, and its several details are capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive. In the drawings:

"FIG. 1 illustrates highly schematically selected parts of a hearing aid system according to an embodiment of the invention;

"FIG. 2 illustrates highly schematically a binaural hearing aid system according to an embodiment of the invention;

"FIG. 3 illustrates a computer simulation of the interaural coherence distribution and corresponding gain value, in a hearing aid system according to an embodiment of the invention, where the hearing aid system is worn by a user in a large room with a distant speaker;

"FIG. 4 illustrates a computer simulation of the interaural coherence distribution and corresponding gain value, in a hearing aid system according to an embodiment of the invention, where the hearing aid system is worn by a user in a large room with a nearby speaker;

"FIG. 5 illustrates a computer simulation of the interaural coherence distribution and corresponding gain value, in a hearing aid system according to an embodiment of the invention, where the hearing aid system is worn by a user in a large room with both the distant and the nearby speaker; and

"FIG. 6 illustrates highly schematically a binaural hearing aid system, including an external device, according to an embodiment of the invention."

For more information, see this patent application: WESTERMANN, Adam; BUCHHOLZ, Jorg Matthias; DAU, Torsten. Method of Signal Processing in a Hearing Aid System and a Hearing Aid System. U.S. Patent Application Serial Number 740417, filed January 14, 2013, and posted May 30, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3996&p=80&f=G&l=50&d=PG01&S1=20130523.PD.&OS=PD/20130523&RS=PD/20130523

Keywords for this news article include: Patents, Microelectronics, Digital To Analog, Signal Processing.

Phonak Ag; "Hearing Assistance System and Method" in Patent Application Approval Process

Publication info: Telecommunications Weekly (Jun 12, 2013): 736.
ProQuest document link

Abstract: According to these systems, the wireless link not only serves to transmit audio signals captured by the wireless microphone, but in addition, also serves to transmit control data obtained from analyzing the audio signals in the transmission unit to the receiver unit(s), with such control data being used in the receiver unit to adjust, for example, the gain applied to the received audio signals according to the prevailing ambient noise and

the issue of whether the speaker is presently speaking or not.

Links: Check LinkSource for Full Text

Full text: 2013 JUN 12 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- A patent application by the inventors Callias, Francois (Fontaines, CH); El- Hoiydi, Amre (Neuchatel, CH); Richard, Claude (Fribourg, CH), filed on April 22, 2010, was made available online on May 30, 2013, according to news reporting originating from Washington, D.C., by VerticalNews correspondents.

Patent application serial number 642708 is assigned to Phonak Ag.

The following quote was obtained by the news editors from the background information supplied by the inventors: "The invention relates to a system and a method for providing hearing assistance to at least one user, wherein audio signals from an audio signal source, such as a microphone for capturing a speaker's voice, are transmitted via a wireless link to a receiver unit acting as an audio receiver for an ear-worn device, such as a hearing aid.

"Presently, in such systems, the wireless audio link usually is an FM (frequency modulation) radio link. According to a typical application of such wireless audio systems, the receiver unit is connected to or integrated into a hearing instrument, such as a hearing aid, with the transmitted audio signals being mixed with audio signals captured by the microphone of the hearing instrument prior to being reproduced by the output transducer of the hearing instrument. The benefit of such systems is that the microphone of the hearing instrument can be supplemented or replaced by a remote microphone which produces audio signals which are transmitted wirelessly to the FM receiver, and thus, to the hearing instrument. In particular, FM systems have been standard equipment for children with hearing loss in educational settings for many years. Their merit lies in the fact that a microphone placed a few centimeters from the mouth of a person speaking receives speech at a much higher level than one placed several feet away. This increase in speech level corresponds to an increase in signal-to-noise ratio (SNR) due to the direct wireless connection to the listener's amplification system. The resulting improvements of signal level and SNR in the listener's ear are recognized as the primary benefits of FM radio systems, as hearing-impaired individuals are at a significant disadvantage when processing signals with a poor acoustical SNR.

"A typical application of such wireless audio systems is at school, wherein the teacher uses a wireless microphone for transmitting the captured audio signals via the transmission unit to receiver units worn by the students. Since the receiver units and the respective hearing aids are usually owned by the students, the receiver units may be of different types within a class.

"Another typical application of wireless audio systems is the case in which the transmission unit is designed as an assistive listening device. In this case, the transmission unit may include a wireless microphone for capturing ambient sound, in particular from a speaker close to the user, and/or a gateway to an external audio device, such as a mobile phone; here the transmission unit usually only serves to supply wireless audio signals to the receiver unit(s) worn by the user.

"Examples of analog wireless FM systems particularly suited for school applications are described, for example, in European Patent Application EP 1 863 320 A1 and International Patent Application Publication WO 2008/138365 A1. According to these systems, the wireless link not only serves to transmit audio signals captured by the wireless microphone, but in addition, also serves to transmit control data obtained from analyzing the audio signals in the transmission unit to the receiver unit(s), with such control data being used in the receiver unit to adjust, for example, the gain applied to the received audio signals according to the prevailing ambient noise and the issue of whether the speaker is presently speaking or not.

"In applications where the receiver unit is part of or connected to a hearing aid, transmission is usually carried out by using analog FM technology in the 200 MHz frequency band. In recent systems the analog FM transmission technology is replaced by employing digital modulation techniques for audio signal transmission.

An example of such a digital system is available from the company Comfort Audio AB, 30105 Halmstad, Sweden under the trademark COMFORT DIGISYSTEM.RTM.

"A specific example of an analog wireless FM system particularly suited for school applications is described in International Patent Application Publication WO 2008/074350 A1, wherein the system consists of a plurality of transmission units comprising a microphone and a plurality of analog FM receiver units and wherein only one of the transmission units has an analog audio signal transmitter, while each of the transmission units is provided with a digital transceiver in order to realize an assistive digital link for enabling communication between the transmission units. The assistive digital link also serves to transmit audio signals captured by a transmission unit not having the analog transmitter to the transmission unit having the analog transmitter from where the audio signals are transmitted via the analog FM link to the receiver units.

"U.S. Pat. No. 7,778,432 B2 relates to a wireless network for communication of binaural hearing aids with other devices, such as a mobile phone, using slow frequency hopping, wherein each data packet is transmitted in a separate slot of a TDMA frame, with each slot being associated to a different transmission frequency, wherein the hopping sequence is calculated using the ID of the master device, the slot number and the frame number. A link management package (LMP) is sent from the master device to the slave devices in the first slot of each frame. The system may be operated in a broadcast mode. Each receiver is turned on only during the transmission during time slots associated to the respective receiver. The system has two acquisition modes for synchronization, with two different handshake protocols. Eight LMP messages are transmitted in every frame during initial acquisition, and one LMP message is transmitted in every frame once a network is established. Handshake, i.e., bi-directional message exchange, is needed both for initial acquisition and acquisition into the established network. During acquisition, only a reduced number of acquisition channels is used, with the frequency hopping scheme being applied to these acquisition channels. The system operates in the 2.4 GHz ISM band. A similar system is known from U.S. Pat. No. 8,229,146 B2.

"International Patent Application Publication WO 2008/135975 A2 relates to a communication network, wherein the receiver wakes up for listening to the preamble of a data packet and goes to sleep again, if no valid preamble is received.

"U.S. Patent Application Publication 2007/0086601 A1 relates to a system comprising a transmission unit with a microphone for transmitting a speaker's voice to a plurality of hearing aids via a wireless digital link, which may be unidirectional or bi-directional and which may be used for transmitting both audio data and control data to the hearing aids.

"U.S. Pat. No. 7,529,565 B2 relates to a hearing aid comprising a transceiver for communication with an external device, wherein a wireless communication protocol including a transmission protocol, link protocol, extended protocol, data protocol and audio protocol is used. The transmission protocol is adapted to control transceiver operations to provide half duplex communications over a single channel, and the link protocol is adapted to implement a packet transmission process to account for frame collisions on the channel.

"European Patent Application EP 1 560 383 A2 relates to a Bluetooth system, wherein the slave device, in a park mode or in a sniff mode, periodically wakes up to listen to transmission from the master and to re-synchronize its clock offset.

"U.S. Patent Application Publication 2007/0259629 A1 relates to the transmission of audio signals from a main device, such as a mobile phone, to a peripheral device, such as a headset, in order to establish a wireless personal area network by using an ultra-wide band link, wherein very short pulses of 1 ns or less duration, corresponding to transmission band width of about 500 MHz, are transmitted. In order to reduce power consumption, the transceivers are operated in an interpulse duty cycling mode. In order to better match the peak current consumption from the battery during powered-on times of the interpulse duty cycling to the average current drawn from the battery, a capacitive element is charged when pulses are not being transmitted or received and is then discharged to power the transceiver when pulses are being transmitted or received. It is

also mentioned that such system may be used with devices like a microphone and a hearing aid.
"In U.S. Pat. No. 5,083,095, which relates to a hearing aid having a microphone preamplifier using a junction field effect transistors (JFET), in order to enhance power supply rejection, it is mentioned that, due to the internal impedance of the power source, in connection with the relatively low power supply voltage, the power output stage may contribute a signal which, due to the high current drawn through the power supply impedance, is equal to or greater than the wanted signal. It is also mentioned that such ripple signals may be reduced by placing a capacitor across the power leads or by placing a large resistor between the power lead and the stage to be isolated, with a capacitor across the normal leads of that stage. It is also mentioned that the drawback of such solutions employing a RC-filter is the relatively large capacitor required therefore.
"U.S. Patent Application Publication 2008/0232623 A1 relates to a hearing aid which is recharged via the direct audio input by a battery included in a wireless communication device attached to the hearing aid via the direct audio input, with the transceiver of the communication device likewise being powered by that battery.
"U.S. Pat. No. 6,737,838 B2 relates to a DC/DC up/down converter, wherein first a supply voltage is converted to a lower voltage through a step-down DC/DC converter (buck converter) and then, during specific phases of work also the higher voltage is generated from the lower voltage using the same coil in a step-up converter (boost converter) architecture.
"Conventional radio receiver units ('boots') for hearing aids typically use FM-modulation in the VHF frequency band (169 to 220 MHz) and are connected to the hearing aid through a 3-pin plug-in interface having an audio signal pin, a power pin and a common ground pin, wherein the radio receiver boot is powered by the hearing aid battery. The hearing aid typically is provided with a so-called audio shoe, provided by the hearing aid manufacturer, for connection to the standard 3-pin interface. Typically, the batteries of the hearing aid provide for a supply voltage between 1 and 1.5 V, wherein a typical current consumption of, for example, a BTE hearing aid is between 1 and 2 mA. A digital transceiver operating in the 2.4 GHz band typically needs a supply voltage of 1.5 to 3 V and requires a typical current of 25 mA."
In addition to the background information obtained for this patent application, VerticalNews journalists also obtained the inventors' summary information for this patent application: "It is an object of the invention to provide for a hearing assistance system employing a digital audio link, wherein the receiver unit is powered by the battery of an ear-worn device comprising the stimulation means and wherein noise signals due to current ripples should be avoided. It is also an object of the invention to provide for a corresponding hearing assistance method.
"According to the invention, these objects are achieved by a hearing assistance system and a hearing assistance method as described herein.
"The invention is beneficial in that, by providing the receiver unit with a capacitor connected in parallel to the transceiver for supplying the transceiver during listening or transmission operation with current and for being recharged by the power supply of the ear-worn device, when the transceiver is sleeping and with a controlled current source for controlling the current flowing from the power source to the transceiver and the capacitor in a manner so as to prevent changes in that current which are expected to add an audible noise signal to the audio signals supplied to the stimulation means, the transceiver can be operated in a duty cycling mode for reducing power consumption, while nevertheless noise signals, which otherwise would be caused by the fast changes in the current consumed by the transceiver when switching between the sleeping state and the active listening/transmission state and vice-versa, can be prevented. By using a capacitor to provide for the necessary current peaks in the current consumed by the transceiver, the controlled current source is able to keep the current supplied by the power source close to the average current consumed by the transceiver.
"Preferably, the controlled current source is adapted to adjust the current flowing from the power source to the transceiver and the capacitor to a constant target current value selected according to the estimated quality of the audio link (or according to the estimated average current consumption of the transceiver). The current

flowing from the power source to the transceiver may be kept within -0% . . . +20% at the target value. In case of a change of the estimated quality of the audio link, the current may be adjusted to a new target current value corresponding to the changed quality of the audio link with a time constant of at least 0.05 sec. The target current value preferably is selected as the estimated average current to be consumed by the transceiver plus a safety overhead to account for transient changes in link quality. The link quality may be estimated from an output signal of the transceiver indicative of the packet level error rate and/or the bit level error rate of the received audio signals.

"Preferably, the controlled current source is adapted to monitor the voltage across the transceiver in a manner so as to keep it below a given threshold. To this end, dummy discharge of the capacitor may be caused. According to one example, the receiver unit may comprise a shunt circuit connected in parallel to the capacitor. The shunt circuit may comprise a load resistance, which is periodically switched on by the controlled current source. It can also be a circuit operating in an independent manner, as to prevent the voltage across the transceiver to go over a maximum value and/or to prevent the voltage across the current source to fall below a minimum value. Alternatively or addition, the transceiver may be forced to carry out dummy listening operation.

"These and further objects, features and advantages of the present invention will become apparent from the following description when taken in connection with the accompanying drawings which, for purposes of illustration only, show several embodiments in accordance with the present invention. BRIEF DESCRIPTION OF THE DRAWINGS

"FIG. 1 illustrates the variety of audio components which can be used with a system according to the invention;

"FIG. 2 is a schematic view of a use of a first example of a system according to the invention;

"FIG. 3 is a schematic view of a use of a second example of a system according to the invention;

"FIG. 4 is a schematic view of a use of a third example of a system according to the invention;

"FIG. 5 is a schematic block diagram of an example of a system according to the invention;

"FIG. 6 is a more detailed example of the audio signal path in the transmission unit of the system of FIG. 5;

"FIG. 7 is a more detailed block diagram of an example of the receiver unit of the system of FIG. 5;

"FIG. 8 is an example of the TDMA frame structure of the signals of the digital audio link used in a system according to the invention;

"FIG. 9 is an illustration of an example of the protocol of the digital audio link used in a system according to the invention in the connected state;

"FIG. 10 is an illustration of an example of how a receiver unit in a system according to the invention listens to the signals transmitted via the digital audio link;

"FIG. 11 is a schematic block diagram of an example of a receiver unit according to the invention including a controlled current source;

"FIG. 12 is a more detailed block diagram of an example of the receiver unit of FIG. 11;

"FIG. 13 are plots, from top to bottom, of the current consumed by a transceiver of the receiver unit of FIGS. 11 and 12, the transceiver supply voltage and the current consumed by the current controlled source, respectively, as a function of time;

"FIG. 14 is a block diagram of an alternative example of the receiver unit of FIG. 11;

"FIG. 15 shows a sequence of five phases of the current flow during operation of the receiver unit of FIG. 14;

"FIG. 16 is a block diagram of an another alternative example of the receiver unit of FIG. 11;

"FIG. 17 shows a sequence of five phases of the current flow during operation of the receiver unit of FIG. 16;

"FIG. 18 is a block diagram of a controller to be used in the receiver units of FIGS. 14 &16; and

"FIG. 19 are plots of examples of current profiles through the coil during a working period for various input and output voltages."

URL and more information on this patent application, see: Callias, Francois; El- Hoiydi, Amre; Richard, Claude. Hearing Assistance System and Method. U.S. Patent Application Serial Number 642708, filed April 22, 2010,

and posted May 30, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3994&p=80&f=G&l=50&d=PG01&S1=20130523.PD.&OS=PD/20130523&RS=PD/20130523
Keywords for this news article include: Patents, Phonak Ag, Wireless Technology, Wireless Communication.

Evaluation of a Pinna Compensation Algorithm for Sound Localization and Speech Perception in Noise

Author: Kuk, Francis; Korhonen, Petri; Lau, Chi; Keenan, Denise; Norgaard, Magnus.

Publication info: American Journal of Audiology (Online) 22.1 (Jun 2013): 84-93.
ProQuest document link

Abstract: This study was designed to evaluate the effect of a pinna compensation (PC) algorithm on localization performance in the horizontal plane and speech intelligibility in noise. Nine and 18 experienced hearing aid users with bilaterally symmetrical sensorineural hearing loss participated in the localization study and the speech-in-noise study, respectively. Performance was evaluated unaided, aided with a behind-the-ear (BTE) hearing aid with an omnidirectional microphone (Omni), and aided with the same hearing aid with the PC algorithm (Omni+PC). Localization performance was measured using 12 loudspeakers spaced 30° apart on a horizontal plane. Speech-in-noise performance was measured with speech presented from 0°or 180°. A single-blinded, repeated measures design was used. Significant improvement in localization accuracy was found when comparing the Omni+PC condition to the Omni condition. Also, the Omni+PC condition improved the signal-to-noise ratio by 2.4 dB when compared to the Omni condition when speech was presented from the front in a diffuse noise background. Use of the PC algorithm improved localization on the horizontal plane and speech-in-noise performance. These results support use of the PC algorithm in BTE hearing aid fittings. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: This study was designed to evaluate the effect of a pinna compensation (PC) algorithm on localization performance in the horizontal plane and speech intelligibility in noise.
Method: Nine and 18 experienced hearing aid users with bilaterally symmetrical sensorineural hearing loss participated in the localization study and the speech-in-noise study, respectively. Performance was evaluated unaided, aided with a behind-the-ear (BTE) hearing aid with an omnidirectional microphone (Omni), and aided with the same hearing aid with the PC algorithm (Omni+PC). Localization performance was measured using 12 loudspeakers spaced 30° apart on a horizontal plane. Speech-in-noise performance was measured with speech presented from 0°or 180°. A single-blinded, repeated measures design was used.
Results: Significant improvement in localization accuracy was found when comparing the Omni+PC condition to the Omni condition. Also, the Omni+PC condition improved the signal-to-noise ratio by 2.4 dB when compared to the Omni condition when speech was presented from the front in a diffuse noise background.
Conclusion: Use of the PC algorithm improved localization on the horizontal plane and speech-in-noise performance. These results support use of the PC algorithm in BTE hearing aid fittings.
Key Words: pinna compensation, localization, hearing-in-noise, spectral cues
The latest hearing industry statistics reported the use of behind-the-ear (BTE) hearing aids (HAs) reaching

69.9% (Strom, 2012). This renewed popularity of BTEs is mostly fueled by the increased cosmetic acceptance of miniature thin-tube and thin-wire receiver-in-the-canal (RIC) and receiver-in-the-ear (RITE) devices. At the same time, algorithms to improve the precision of fitting have also resulted in a higher performance of BTE HAs. One such example is the use of pinna compensation (PC) algorithms that preserve or enhance some spectral characteristics of the pinna. This study examined the efficacy of one such algorithm.

One of the benefits of having binaural hearing (or HAs) is the ability to use the interaural level difference (ILD) and interaural time difference (ITD) of a sound perceived between the two ears as a means to localize its location (Kuhn, 1977; Wightman &Kistler, 1992). The spectral difference of the sound source when it is presented in front or from the back of a listener also provides a cue for localization. The ability to localize a sound source is important for safety (e.g., traffic) and functional reasons (e.g., turning to the direction of the speaker in a crowd). Localization gives listeners the ability to construct auditory scenes of their surroundings, which reinforces their sense of space and their relationship with the auditory objects in their surroundings (Stern, Brown, &Wang, 2006).

The spectral cue that is used for front-back localiza- tion is provided by the pinna. The pinna casts a shadow to sounds that originate from the back and has the effect of a linear filter with a frequency response determined by the direction of the sound source relative to the pinna. When sounds are presented directly from the back, the pinna reduces their intensity by ~ 5 dB between 2 kHz and 8 kHz at the ear canal opening. These spectral changes provide front-back localization cues (e.g., Blauert, 1997). The use of in-the-ear (e.g., ITE; ITC, or in the canal; and CIC, or completely in canal) style HAs preserves this pinna shadow (e.g., Best, Kalluri, McLachlan, Valentine, Edwards, &Carlie, 2010; D'Angelo, Bolia, Mishler, &Morris, 2001; Van den Bogaert, Carette, &Wouters, 2011; Westennann &Topholm, 1985) and has been demonstrated to partly preserve front-back localization. The use of BTE HAs with an omnidirectional microphone placed on top of the pinna reduces or modifies the pinna shadow. This is because an omnidirectional microphone is equally sensitive to sounds from all directions (measured in a free field). Although some directivity is achieved when the BTE is worn on the ear due to diffractions of the head, this directional sensitivity is typically less than what is achievable with a directional microphone (Dillon, 2001). This difference in front-to-back sensitivity could be sufficient to offset any cues that the pinna provides and could lead to increased front-back confusion.

Indeed, it has been shown in several studies that the use of BTE HAs increases the rate of front-back localization reversals when compared to ITE (Orton &Preves, 1979; Westermann &Topholm, 1985), CIC (Best et al, 2010), or more recently, in-the-pinna (ITP) (Van den Bogaert et al, 2011) HAs. If aided localization is an important issue to consider in an HA, it would be logical to correct for the absence of the pinna shadow so that, despite the use of a BTE HA, the wearer would still have the natural pinna localization cues for front-back differentiation. This is especially necessary given the recent interest in the use of RIC/RITE-style HAs.

It is possible to compensate for the difference in spectral cues that result from the difference in microphone location by electronically shaping the input that originates from the back. Such is the basis of PC algorithms. The natural attenuation of sounds coming from behind can be created by adjusting the polar pattern of the microphone system so it is in a directional mode >2000 Hz while leaving the lower frequency bands in an omnidirectional mode. This would simulate the pinna attenuation for the higher frequency sounds arriving from the back without affecting the lower frequency sounds. For sounds arriving from the front, the PC algorithm should yield an identical output as an omnidirectional microphone for all frequencies. Because a PC algorithm attenuates sounds from the back much like the action of a directional microphone, one would also infer that a directional BTE HA could provide enhancement in localization over its omnidirectional counterpart.

Keidser et al. (2006) examined the effect of compres- sion, noise reduction, and directional microphones on localization performance on a horizontal plane in 12 listeners with hearing impairment using a 360° loudspeaker array. Three directional microphone modes were examined: cardioid microphones in both ears, figure-8 microphone in one ear and cardioid in opposite ear, and omnidirectional in one ear and cardioid in opposite ear.

Although the effects of compression and noise reduction on localization were insignificant, the impact of a directional microphone was significant in all three modes. A reduction in front-back confusion was reported with use of the directional micro- phone over time. The same findings were also confirmed in a later study using a hypercardioid directional microphone in 21 listeners with hearing impairment (Keidser, Carter, Chalupper, &Dillon, 2007). Similarly, Mueller, Kegel, Schimmel, and Dillier (2012) created virtual environments to evaluate sound localization with BTE HAs and reported that a cardioid directional microphone reduced front-back confusion over that of an omnidirectional microphone or noise reduction algorithm.

Although a directional microphone (having directivity in all frequencies) could improve front-back localization, it may not be necessary to have directional attenuation across all frequencies in order to achieve PC. Partial directionality, especially that >2000 Hz, may be all that is needed. Keidser, O'Brien, Hain, McLelland, and Yeend (2009) compared the horizontal localization ability of 21 listeners with hearing impairment using a BTE HA programmed in four directional schemes: (a) omnidirectional across all frequencies, (b) omnidirectional <1000 Hz and hypercardioid >1000 Hz (partial-1, with a directivity index or DI of 0 dB at 1000 Hz rising to 4 dB >2000 Hz), (c) omnidirectional <2000 Hz and hypercardioid >2000 Hz (partial-2, with a DI of 0 dB at 2500 Hz rising to 2 dB at 4000 Hz), and (d) hypercardioid directionality in all frequencies (from 5 dB in the lows to 4 dB at -5000 Hz). Five different stimuli each covering a different range of frequencies were used to study the effects of directionality and stimulus characteristics on localization. Keidser et al.'s data showed that the partial-1 directionality condition improved front-back localization for mid- and high-frequency stimuli but not for low-frequency stimuli. No significant effect was observed on left/right localization. Unlike the partial directionality, the use of a full-band directional microphone had a small positive effect on front-back localization but a negative effect on left/right localization.

Other commercial PC algorithms have been marketed, although a detailed technical description often was not available. Phonak (2004) reported that its Real Ear Sound (RES) algorithm restored the pinna shadow by creating a polar pattern with a DI of 1 to 2 dB from 1500 Hz to 6000 Hz and 0 to -3 dB from 250 Hz to 1000 Hz. This is - 1 dB poorer than the unaided DI <1000 Hz and 1 dB better than the unaided DI >4000 Hz. A study reported by Phonak (2004) showed that the RES reduced the rate of front-back confusion by an average of 38%. In the study, 18 adults with hearing impairment were tested using a 12-loudspeaker array and a 500-ms speech-shaped noise as the stimulus.

However, the same observation was not replicated in an external study using 4- to 8-year-olds as the test participants. Marriage, Gardner, Stone, and Moore (2007) examined the impact of the RES feature on horizontal localization (front- back and left-right) in a group of 15 children with hearing impairment using only two loudspeakers (for either front- back or left-right evaluation). A 1-s duration pink noise was used as the stimulus to compare performance between the omnidirectional microphone and the RES conditions. No difference in front-back or left/right localization scores was noted between the conditions. A training session with feedback was also provided subsequently; nonetheless, no effect of training was noted.

Recently, Widex introduced its PC algorithm, called the Digital Pinna (DP). The DP is designed as a directional microphone with partial directionality >2000 Hz, resembling a hypercardioid polar pattern. The DP resembles the unaided in-situ directivity <1500 Hz and achieves a DI of 4 dB >2000 Hz. This DI is higher than the unaided in-situ DI (which is ~2 dB >2000 Hz) and could potentially facilitate front-back localization on the horizontal plane. Furthermore, because the PC algorithm attenuates sounds that originate from the back, much like a directional microphone, it is reasonable to expect that the DP would also improve the signal-to-noise ratio (SNR) of the listening environment over its omnidirectional microphone counterpart. It is also estimated that the magnitude of the SNR improvement should at least approximate the SNR improvement as one changes the microphone position from a BTE HA to an ITE/ITC HA. Pumford, Seewald, Scollie, and Jenstad (2000) showed that the SNR benefit offered by an ITE HA over a BTE HA was -2.4 dB in a diffuse noise condition.

Thus, we conducted the current study to validate the benefits of the DP. Specifically, we compared the potential

improvement in front-back localization and speech-in-noise performance between the DP (i.e., an omnidirectional microphone with a PC algorithm) and an omnidirectional microphone without such an algorithm.

Experiment #1: Localization in Horizontal Plane

Method

Participants

Based on data collected in a pilot study, we estimated that a sample size of eight participants was required to demonstrate that the PC algorithm can improve front-back localization with a power >0.8 (significance level a = 0.05). We recruited a total of nine adults (6 females and 3 males) from the Widex Office of Research in Clinical Amplification's research center. Their ages ranged from 65 to 81 years (x = 73 yrs, crs = 6). All participants were native English speakers, and all had mild-to-moderate sensorineural hearing losses. The averaged insert thresholds for the left and right ears are shown in Figure 1. The mean pure-tone averages (at 0.5 kHz, 1 kHz, and 2 kHz) were 39.8 dB HL for the left ear and 40.6 dB HL for the right ear. All participants had a <20-dB threshold difference between ears at any audiometric test frequency. Six of the nine participants were experienced HA wearers, with an average of 6.5 years HA use. Two participants wore BTE HAs and four wore custom HAs (ITE, CIC, ITC). Details of the participants, including the makes, models, and styles of their HAs, are provided in Table 1. Participants were explained the purpose of the research study, their tasks, and their benefits before signing an informed consent. They were financially compensated for their participation in the study.

HAs and Fitting

All participants were fitted bilaterally with Widex Clear440 Passion model HAs using Widex Compass (v. 5.1) fitting software. The Widex Clear440 Passion is an HA with wireless connectivity between the two HAs. However, all wireless functionality was disabled during this study. This RIC HA features 15-channel slow-acting amplitude com- pression and has a frequency response between 100 Hz and 7800 Hz (American National Standards Institute, 2003). The sampling frequency of the analog-to-digital converter stage is 32 kHz. Among the features of this device are noise reduction, adaptive feedback cancellation, and impulse noise management. The noise reduction algorithm was deactivated during the testing. The feedback cancellation algorithm remained in its default setting.

For Experiment 1, we compared two HA programs: omnidirectional microphone alone (Omni) and omnidirectional microphone with the PC algorithm (Omni+PC). The latter was commercially known as the DP feature. The PC algorithm was designed to achieve a hypercardioid polar pattern >2000 Hz without altering the in-situ directivity <2000 Hz. Figure 2 shows a comparison of the DI of the unaided, Omni, and Omni+PC conditions as measured on a KEMAR manikin in an anechoic chamber. Note that the DI of the DP feature exceeded that of the unaided condition by at least 2 dB across all frequencies >2000 Hz. The partici- pant's in-situ hearing thresholds were measured at 500 Hz, 1 kHz, 2 kHz, and 4 kHz, with the study HAs coupled to instant-fit eartips. Two participants (S4, S6) were provided with a closed vent, five participants (SI, S2, S3, S7, S9) were provided with a 1.7-mm vent, and two participants (S5, S8) were provided with open fit tips.

We conducted a feedback test to estimate the feedback path and to limit the maximum available gain before feedback. The appropriateness of the fitting was verified by examining the simulated real-ear output and predicted aided thresholds on the fitting software to ensure accuracy and efficiency. An acceptable fitting required that the predicted aided thresholds be <20 dB HL below 3 kHz and <30 dB HL at 4 kHz. Predicted aided thresholds were within 5 dB of the measured sound-field thresholds (Kuk, Ludvigsen, Sonne, &Voss, 2003). Simulated real-ear output and not actual real-ear output was measured because it was previously demonstrated that the sensation level (difference between threshold and output) shown on the fitting software was within + 2 dB of the measured real-ear output in >80% of cases (Kuk, 2012).

Test Setup

All testing was conducted in a double-walled sound- treated booth (Industrial Acoustics Company, Inc.) with

internal dimensions of 3 m x 3 m x 2 m (W x L x H). Localization performance was measured using a 12-loudspeaker array that was evenly distributed on a horizontal plane around the listener. The spacing between adjacent loudspeakers was 30°. The loudspeakers used were KRK-ST6 2-way passive studio monitors. The loudspeakers were individually calibrated using a sound level meter (Quest model 1800) placed 1 m in front of the loudspeaker within the booth. A speech-shaped noise was presented from each loudspeaker at an intended output level of 68 dB(C). Loudspeakers with an output deviation from this 68 dB(C) noise were electrically compensated to within +1 dB.

Afterward, the frequency response of each loudspeaker was measured at 1/3-octave intervals while using a white noise stimulus. Loudspeakers with substantial deviation from the other loudspeakers were not included for use. The 12 loudspeakers used had maximum deviations (among 12 loudspeakers) within +2.1 dB at 250 Hz, +1.6 dB at 500 Hz, +0.6 dB at 1000 Hz, + 1.1 dB at 2000 Hz, + 0.6 dB at 4000 Hz, and +1.1 dB at 8000 Hz. During testing, the listeners were seated 1 m from the loudspeakers in the center of the array facing the front loudspeaker. The listeners were instructed to keep their heads fixated toward the front loudspeaker. A foam headrest was placed behind the participants' head to help reduce head movement. In addition, the test administrator monitored the participants visually during the test to ensure that there was no head movement during stimulus presentations. A touch-screen computer display (17" Planar PT 1700 MU) was placed on a small computer table in front of the participants so that they could register their responses.

The target stimulus was presented from one of the 12 loudspeakers in a random order. The participant's task was to indicate the perceived location of the target sound by touching the position of a circle on the touch-screen monitor. The location of the participant's response on the circle was recorded by the computer. Thus, it was possible to register a perceived location between two loudspeakers. Stimuli were automatically presented at the participant's pace in a random order. The test software was implemented using Visual Basic programming language for the Windows XP operating system. During the course of the study, monthly calibration of all test equipment was conducted in addition to daily calibration checks.

Stimulus

The target stimulus was a steady-state 300-ms high- pass (2000 Hz) filtered noise burst that was generated by filtering a white-noise signal using an 18th-order Butterworth filter. Signal generation was carried out using Adobe Audition 1.0 audio editing software. The stimuli were presented using an Echo Audiofirel2 twelve-channel digital audio interface. Signals were amplified using a Niles SI-1230 power amplifier.

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The participants' localization performance was evaluated under three test conditions: unaided, Omni, and Omni+PC. The test conditions were counterbalanced across participants. Stimuli were presented at a 30-dB sensation level (SL), or in cases where this was too loud, at the most comfortable listening (MCL) level. Each signal azimuth was presented a total of three times during each test trial.

Results

Performance Measures

The binaural localization cues (ILD, ITD) are virtually identical for sounds that originate from sources that are located at an equal distance from the listener's ear. This makes it impossible to judge the true location of a sound source as the signals originating from two different sources can create the identical auditory events. The typical errors in the horizontal plane that arise from this are front-back or back-front errors mirrored around the axis of the ears. Therefore, when assessing localization performance that extends across the whole horizontal plane (i.e., 360°), the root-mean-square (RMS) error frequently used for assessing localization may not be a consistent metric across all source angles. Thus, we reported individual localization perfor- mance as the percentage of correct responses within +15° from the source direction.

Figure 3 shows the averaged localization scores across all stimulus azimuths for all participants under the three test conditions. In the unaided condition, the participants responded correctly for 21.6% of the stimulus

presentations. In the aided conditions, the participants responded correctly for 17.9% of the stimulus presentations with Omni and for 26.9% with Omni+PC. A one-way repeated measures analysis of variance (ANOVA) was used to examine the effect of test condition. The results showed a significant effect of test condition, F(2, 16) = 3.62, p = 0.05, rf = 0.31, power = 0.6. Post hoc analysis with Bonferroni adjustment indicated that Omni+PC performed significantly better than Omni,/? = 0.01, effect size = 1.12, power = 0.8. Figure 4 shows a scatter plot comparing the individual localization scores between the unaided and Omni+PC conditions. In order to provide some insights on the potential influence of the participants' previous HA experience on localization, we used triangles to represent those participants who previously wore BTE HAs, circles for those who wore custom HAs (i.e., ITC, CIC), and squares for those who had never worn HAs. The localization scores ranged from 8.3% to 30.6% in the unaided condition and from 16.7% to 55.6% in the Omni+PC condition. Six of the nine participants had individual localization performance higher with the Omni+PC condition than with the unaided condition. No correlation was observed between the unaided localization performance and aided localization performance with Omni+PC (R2 = 0.09). Likewise, Figure 5 shows a compar- ison of the localization scores between the Omni and Omni+PC conditions. Omni+PC yielded higher localization performance than Omni for seven of the nine participants. The participants' previous HA styles did not suggest or provide any indication for aided localization performance with Omni+PC.

Front-Back Localization

We analyzed localization performance by focusing on the measured localization data for sounds originating from the three front (330°, 0°, 30°) and the three back (150°, 180°, 210°) loudspeakers. We analyzed the instances in which the participants identified these stimuli correctly as originating from the frontal hemisphere (270°... 90°) or the rear hemisphere (90°... 270°). Figure 6 shows the front- back localization scores averaged across all participants. Localization scores for sounds presented from the front were 59.3% with Omni and 70.4% with Omni+PC. Localization scores for sounds presented from the back were 30.4% with Omni and 60.0% with Omni+PC. The unaided localization scores were 71.1% for sounds presented from the front and 50.4% for sounds presented from the back.

A two-way repeated measures ANOVA was used to examine the effect of test condition (unaided, Omni, Omni+PC) and the effect of hemisphere (front, back). Results showed that the effect of test condition was significant, F(2, 16) = 7.02, p = 0.006, rf = 0.46, power = 0.9, whereas the effect of hemisphere was not significant, .Ffl, 8) = 3.19, p = 0.11, r\2 = 0.28, power = 0.4. The interaction effect between test condition and hemisphere also was not significant, F(2, 16) = 0.65, p = 0.53, rf = 0.07, power = 0.1. Post hoc analysis indicated that only Omni+PC performed significantly better than Omni for localization from the back, p = 0.02, effect size = 0.92, power = 0.7. No significant difference was observed between the unaided and the other two test conditions (p >0.05).

Experiment #2: Speech Understanding in Noise

Method

Participants

A total of 18 native English-speaking adults (11 females and 7 males) between 63 and 82 years (x=72, crs = 5.9) participated in this experiment. The nine participants who participated in Experiment 1 were among the 18 participants. A power analysis based on the first nine participants suggested that 23 participants were needed to demonstrate the SNR advantage of the PC algorithm with a power of 0.8 (significance level a = 0.05). The study was terminated after data collection was completed on the 18th participant when it was clear that the criterion for statistical significance was exceeded. All listeners had mild-to-moderate sensorineural hearing losses. The mean pure-tone average for left and right ears was 41.5 dB HL (crs = 4.8). Figure 7 shows the averaged insert earphone thresholds for the left and right ears.

Thirteen of the 18 participants were experienced HA wearers, with an average 7.8 years (crs = 4.5) of HA use. Three participants wore BTE HAs, 10 participants wore custom products (i.e., ITE, CIC, ITC), and five

participants did not wear any HAs. Details on the participants, including the makes, models, and styles of their HAs, are provided in Table 2.

HAs

The same HA that was used in Experiment 1 was also used in this experiment.

Test Setup

Participants' speech-in-noise performance was mea- sured with the Hearing In Noise Test (HINT; Nilsson, Soli, &Sullivan, 1994). All testing was conducted in the same double- walled sound-treated booth described previously. Test loudspeakers were positioned at 1 m from the participant at 0°, 90°, 180°, and 270°. Presentation of the HINT stimuli was controlled by a custom computer program implemented using Visual Basic for the Windows XP operating system.

Stimuli

A continuous speech-shaped noise that matched the spectrum of the male talker used in the HINT was presented at a fixed level of 68 dB SPL (C, slow). The level of the speech signal was adjusted in 4-dB steps for the first four sentences and 2-dB steps for the 5th to 20th sentences. The ratio of the average speech level (from the 5th to 20th sentence) and the noise level defined the reception threshold for speech (RTS).

Procedure

Speech-in-noise performance was measured under two stimulus conditions. In the first condition, the speech stimuli were presented from a loudspeaker at 0°, and the continuous speech-shaped noise was presented from the three loud- speakers at 90°, 180°, and 270°. This condition examined the potential SNR benefit provided by the PC algorithm as it attenuated sounds arriving from the back of the listener.

In the second condition, the speech stimuli were presented from the loudspeaker at 180°, and the continuous speech-shaped noise was presented from the three loud- speakers at 0°, 90°, and 270°. This condition examined the potential negative effect of the PC algorithm in reducing audibility for sounds >2 kHz when speech was presented from the back of the listener and noise was presented from the front and sides.

Results

The average RTS measured for stimuli presented from 0° or 180° are reported in Figure 8. Note that the concomitant speech-shaped noise was presented from the other three azimuths (90°, 270°, and 18070°). When speech was presented from the front and noise from the sides and back (speech 0°, noise 90°, 270°, and 180°), the RTS required for 50% performance was 4.5 dB in the unaided condition, 5.0 dB in the Omni condition, and 2.6 dB in the Omni+PC condition. A one-way repeated measures ANOVA compar- ing the absolute RTS of the three conditions was significant, $F(2, 34) = 6.65$, $p = 0.004$, $rf = 0.28$, power = 0.9. Post-hoc analysis with Bonferroni adjustment showed that Omni+PC was significantly better than the Omni and unaided conditions, $p < 0.005$, effect size >0.7, power >0.8.

Wien speech was presented from 180° and noise from the sides and front (speech 180°, noise 90°, 270°, and 0°), the RTS required for 50% performance was 6.8 dB in the unaided condition, 3.8 dB with Omni, and 4.6 dB with Omni+PC. A one-way repeated measures ANOVA compar- ing the absolute RTS of the three conditions was significant, $F(2, 34) = 16.86$, $p < 0.001$, $rf = 0.49$, power = 0.9. Post hoc analysis with Bonferroni adjustment showed that Omni and Omni+PC were significantly better than the unaided condition, $p < 0.005$, effect size >0.76, power >0.85. No significant difference was found between the Omni and the Omni+PC conditions ($p = 0.092$).

Discussion

The present study examined the effect of the PC algorithm on horizontal localization and speech-in-noise performance. First, laboratory data showed that the PC algorithm used in the HA study improved the overall localization accuracy in the horizontal plane from an omnidirectional microphone by 9.0% when collapsed across all azimuths and by 30.0% when comparing stimuli presented from the back. The PC algorithm also improved localization performance over the unaided condition by almost 10% for sounds presented from the

back. Second, the data showed that the PC algorithm reduced the RTS by 2.4 dB when compared to an omnidirectional microphone and by 2.0 dB when compared to the unaided condition when speech was presented in a diffuse noise background.

Front-Back Localization

The current study showed significant improvement in localization performance when comparing the omnidirectional microphone alone to the omnidirectional microphone with PC. The improvement did not seem to be affected by the style of HAs that the participants wore before the study (see Figures 4 and 5). The finding of a 30% reduction in front- back confusion compared favorably to the 27% improvement from the partial-1 directionality reported in the Keidser et al. (2009) study. The differences between this study and Keidser et al.'s study were differences noted in the DI between 1000 Hz and 2000 Hz, the loudspeaker set-up, the stimuli used, and the experience of the participants. Whereas Keidser et al.'s partial-1 condition had significant DI between 1000 Hz and 2000 Hz, the PC algorithm used here had close to 0 dB DI <2000 Hz. In addition, Keidser et al. used a 20-loudspeaker array with five stimuli each covering a different range of low, mid, and high frequencies. They were also significantly longer (750 ms to 2 s) than the stimulus used in this study. A 12-loudspeaker array system and only one 300-ms high-pass noise >2000 Hz were used in this study. Stimulus frequency and stimulus durations are known to affect the absolute localization performance (Irving &Moore, 2011).

A key difference in findings between the Keidser et al. study (2009) and this study was the time frame in which the effect of PC was realized. In the Keidser et al. study, no immediate benefit of the PC algorithm was seen at the initial visit: The benefit was reported only after 3 weeks of use of the algorithm. This suggests that an acclimatization period was needed to realize the benefit. On the other hand, the benefits seen with the DP feature in the current study were immediate. The participants demonstrated the improved front-back localization performance at the initial fitting of the study HA. It is unclear why the effect of the PC algorithm used in the current HA was more immediate: The slight difference in DI between the two HAs would not have led to such a difference. Perhaps the longer stimuli used in the Keidser et al. study made it easier for participants to localize, but they were less sensitive for the listeners to distinguish between HA conditions.

This study also confirmed that aided localization with an omnidirectional microphone was poorer than unaided localization for sounds presented from the rear, which was poor to begin with (-50%, Figure 6). Thus, it is gratifying to note that the aided performance with the Omni+PC condition was even slightly better than the unaided condi- tion. This may originate from a PC algorithm that has a higher DI (-3-4 dB) than the DI of the typical unaided ear (-2 dB). The higher DI provided a greater spectral contrast between signals presented to the front and to the back. Following this line of reasoning, one may expect a full-band hypercardioid directional microphone with a high-frequency DI of 6 dB to result in an even better front-back localization performance than the DP algorithm used in this study. Although Keidser et al. (2009) compared the localization performance between a full-band directional microphone, the partial-1 directional microphone, and the unaided condition, the high frequency DI for their full-band directional microphone condition was limited to the same 3^1 dB as the partial-1 directionality. Thus, their study was unable to answer if a higher high-frequency DI would lead to better front-back localization. Additional studies are necessary to examine the relationship between front-back localization and high-frequency DI.

Open-Ear Fitting

It is known that a directional microphone loses its directivity as the vent diameter of the HA/earmold increases. The loss is more noticeable in the low and mid frequencies than in the high frequencies. Indeed, in an open-ear fitting with a full-band directional HA, the DI <2000 Hz can be reduced to an unaided level (Dillon, 2001). This means that the effective DI of an open-fit full-band directional HA would primarily be concentrated at frequencies >2000 Hz, similar to that of the pinna shadow. The difference may be the magnitude of the DI in the high frequencies between the two. Although the DI in the high frequencies varies between 4 dB and 6 dB for a two-port, full-band directional microphone, the DI varies between 2 dB and 4 dB when it is implemented as a PC

algorithm. This has several implica- tions. First, it means that the SNR advantage of an open-fit directional HA could be similar to that of a BTE HA with a PC algorithm such as the Omni+PC microphone condition used in this study. For example, the 2.4-dB SNR benefit with the PC algorithm measured in the current study was similar in magnitude to Kuk, Keenan, Sonne, and Ludvigsen's study (2005a), which reported an average of 2-dB SNR improvement of an open-fit directional microphone over its omnidirectional counterpart. The DI of the full-band directional microphone used in the Kuk et al. study (2005a) was reportedly ~6 dB in the high frequencies. Second, if the effective DI of an open-ear directional microphone is similar to that of the PC algorithm, one may consider designing a dedicated directional microphone specifically for open-ear BTE fittings. In this case, the directional microphone may have an omnidirectional polar pattern <2000 Hz and a hypercardioid polar pattern >2000 Hz (similar to the PC used here). Because of the omnidirectional polar pattern in the lower frequency, no amplification is needed to offset the loss in the low-frequency output that is typically seen in a directional microphone (Ricketts, 2001). This will eliminate the extra circuit noise generated from amplifying the low frequencies. Thus, the results of this study, along with the reports that open-ear fitting improves vertical localization (Bryne &Noble, 1998), would support the use of partial directionality in an open-ear fitting HA for sound localization and speech-in-noise performance. This possibility needs to be validated.

Speech Intelligibility in Diffuse Noise

The PC algorithm improves speech intelligibility in a diffuse noise field by 2.4 dB, but it could also attenuate desirable sounds that originate from the back. The impact of the latter was not shown in the current study, where the difference in RTS between the Omni and Omni+PC condi- tions was 0.8 dB (and statistically nonsignificant). The nonsignificant effect could be due to use of the HINT and testing in a noise background. In a noise background, the impact of the noise on the elevation of SNR may be more dominant over the impact of the reduced sensitivity of the microphone to sounds originating from the back. This could mask the impact of a directional microphone for sounds that originate from the back. On the other hand, such "masking" effect would likely not be present in a quiet situation. Previously, Kuk, Keenan, Lau, and Ludvigsen (2005b) reported a 7.2% reduction of phoneme recognition scores with a fixed directional microphone when speech was presented from behind at 65 dB SPL in quiet. However, it needs to be pointed out that the directional microphone used in the Kuk et al. study had a DI of 6 dB across frequencies and would have produced greater attenuation of sounds originating from the back than the PC algorithm used in the current study. Additional studies with speech presented from the back in quiet are needed to fully assess the impact of the PC algorithm on speech intelligibility presented from the back.

Conclusion

The primary purpose of this study was to evaluate the use of an omnidirectional microphone with PC on front-back localization and speech-in-noise performance. The results demonstrated that the PC algorithm improved horizontal localization and speech-in-noise performance without significant loss in speech intelligibility for sounds arriving from the back.

Sidebar

Disclosure Statement

The hearing aid feature studied in the current manuscript was developed by Widex. The authors of the current manuscript are employees of Widex.

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Editor: Larry Humes
Received July 24. 2012
Revision received September 25. 2012
Accepted October 8. 2012
DOI: 10.1044/1059-0889(2012/12-0043)

Effects of Signal Level and Spectral Contrast on Vowel Formant Discrimination for Normal-Hearing and Hearing-Impaired Listeners

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Publication info: American Journal of Audiology (Online) 22.1 (Jun 2013): 94-104.
ProQuest document link

Abstract: The aim of this study was to determine whether increasing the overall speech level or the individual spectral contrasts of vowel sounds can improve vowel formant discrimination for listeners both with and without normal hearing. Thresholds of vowel formant discrimination were examined for the F2 frequencies of 3 American English vowels for listeners with and without normal hearing. Spectral contrasts of the F2 were enhanced by 3, 6, and 9 dB. Vowel stimuli were presented at 70 and 90 dB SPL. The thresholds of listeners with hearing impairment were reduced significantly after spectral enhancement was implemented, especially at 90 dB SPL, whereas normal-hearing listeners did not benefit from spectral enhancement. These results indicate that a combination of spectral enhancement of F2 and high speech level is most beneficial to improve vowel formant discrimination for listeners with hearing impairment. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: The aim of this study was to determine whether increasing the overall speech level or the individual spectral contrasts of vowel sounds can improve vowel formant discrimination for listeners both with and without normal hearing.
Method: Thresholds of vowel formant discrimination were examined for the F2 frequencies of 3 American English vowels for listeners with and without normal hearing. Spectral contrasts of the F2 were enhanced by 3, 6, and 9 dB. Vowel stimuli were presented at 70 and 90 dB SPL.
Results: The thresholds of listeners with hearing impairment were reduced significantly after spectral enhancement was implemented, especially at 90 dB SPL, whereas normal-hearing listeners did not benefit from spectral enhancement.
Conclusion: These results indicate that a combination of spectral enhancement of F2 and high speech level is most beneficial to improve vowel formant discrimination for listeners with hearing impairment.

Key Words: speech perception, hearing loss, speech enhancement

Listeners with hearing impairment (HI) have greater difficulty in speech perception than normal-hearing (NH) listeners (Henry, Turner, &Behrens, 2005; Leek, Dormán, &Summerñeld, 1987). Because poor communication performance for listeners with HI is often caused by reduced audibility of speech signals, a common method of compensating for hearing loss is to increase the intensity of speech sounds beyond audibility levels for listeners with HI (Humes, Dirks, Bell, &Kincaid, 1987). However, reduced frequency selectivity is often associated with sensorineural hearing loss and contributes to difficulty in speech perception for listeners with HI (Needleman &Crandell, 1997). Therefore, another compensatory method is to selectively enhance the spectral and temporal features that are important for speech perception (i.e., increase the spectral contrast of speech stimuli; Bunnell, 1990; Lyzenga, Festen, &Houtgast, 2002; Stone &Moore, 1992). The primary purpose of this study was to investigate whether increasing the speech level or enhancing the spectral contrasts of vowel sounds can improve vowel formant discrimination for listeners with HI.

A number of studies have suggested that vowel sounds are perceptually categorized by their characteristic spectral properties, such as the resonant peaks in the vowel spectrum (Hillenbrand, Getty, Clark, &Weeler, 1995). These peaks, called formants-especially the first two formants, FI and F2-are primary acoustic cues for vowel identification and categorization. Small changes to vowel formant frequency may result in a perceptual shift from one vowel category to another. Therefore, it is important to understand how sensitive the human auditory system is to differences in formant frequency. The threshold for vowel formant discrimination is defined as the smallest detectable difference of a single formant frequency. Many factors have been shown to significantly affect formant discrimination for NH listeners, including vowel category, level of linguistic context, and speech level (Liu, 2008; Liu &Kewley-Port, 2004).

To date, studies of vowel formant discrimination for listeners with HI are limited, providing equivocal results. Coughlin, Kewley-Port, and Humes (1998) and Richie, Kewley-Port, and Coughlin (2003) measured formant discrimination for four American English vowels presented at conversational levels (60-70 dB SPL) and relatively high sound levels (95 dB SPL) for NH and HI listeners. Results suggested that, for the listeners with HI, formant discrimi- nation improved significantly from low to high levels, especially for F2 frequency, in which the listeners with HI had hearing loss. These two studies argued that this improvement was due to the better audibility at high levels. However, the listeners with HI still had markedly higher thresholds than the NH listeners for F2 at 95 dB SPL, indicating that increased audibility alone was not sufficient for the listeners with HI to achieve NH performance.

Conversely, Liu and Kewley-Port (2007) reported that formant discrimination of F2 at a well-audible level (95 dB SPL) for listeners with HI was worse than at 70 dB SPL in three phonetic contexts: isolated vowel, syllable, and sentence. They argued that this reverse-level effect on formant discrimination was due to the reduced frequency selectivity and upward spread of masking on F2 produced by FI. Additionally, Liu and Kewley-Port concluded that in the earlier studies (Coughlin et al., 1998; Richie et al., 2003), F2 was not audible at low levels and became well audible at high levels, whereas in their study, F2 was audible at both the low and high levels. Together, these studies with listeners with HI suggest that formant discrimination was significantly affected not only by audibility, but also by other factors associated with hearing loss such as reduced frequency selectivity.

In addition to the studies that measured vowel formant discrimination of listeners with HI, other studies examined just-noticeable differences in F2 transition of listeners with HI, with a main focus on the effect of upward spread masking of FI on F2 discrimination (Danaher, Osberger, &Pickett, 1973; Danaher &Pickett, 1975; Van Tassell, 1980). Pickett and colleagues (Danaher et al, 1973; Danaher &Pickett, 1975) found that discrimination of F2 transitions in synthetic vowels was improved for listeners with moderate-to-severe flat or sloping hearing losses as FI was removed from the stimuli, indicating that the upward spread of masking from FI interfered with the F2 discrimination of the listeners with HI. In a later study, Van Tassell (1980) reported that as a group, listeners with HI performed similarly in F2 transition discrimination for stimuli with and without FI

presented, although the listeners with HI showed great individual variability. These studies indicate that the presence of low-frequency components (e.g., Fl) generates masking on F2 perception. Thus, spectral enhancement of F2 in the present study may increase the F2 representation to overcome the upward spread of masking by Fl.

Based on these findings of F2 discrimination (Coughlin et al, 1998; Danaher et al, 1973; Danaher &Pickett, 1975; Liu &Kewley-Port, 2007; Richie et al., 2003; Van Tassell, 1980), we proposed that the enhancement of specific acoustic features of vowels may improve discrimination for listeners with HI rather than only increasing overall vowel intensity. One such solution is to enhance spectral contrasts. Vowel formants are represented with much lower spectral contrast in the dysfunctional auditory system of humans (Liu &Kewley-Port, 2007) and animals (Miller, Calhoun, &Young, 1999b) as compared to the normal auditory system. Several studies have suggested that vowel identification improves as the spectral contrast of vowel formants are increased for both NH and listeners with HI, indicating the importance of spectral contrast for vowel perception (Leek et al, 1987; Liu &Eddins, 2008). Increasing the spectral contrasts of F2 and F3 improved the spectral representation of vowels and partially restored sensitivity to the F2 frequency in the responses of the HI auditory nerve (Miller, Calhoun, &Young, 1999a). Thus, spectral enhancement of vowel formants may be able to compensate for the spectral smearing that is caused by sensorineural hearing loss. Spectral enhancement may also improve vowel formant discrimination for listeners with HI.

In the present study, we increased the spectral contrasts of F2 for individual vowels. This is in contrast to the high- pass amplification of the F2 and F3 frequency ranges that are commonly used in hearing aid technology by both manufacturers and traditional prescriptive fitting methods (Mueller, 2005). When high-pass amplification is applied, the spectral valley between Fl and F2 could be increased, obscuring the spectral representation and worsening listener performance (Miller et al., 1999a). Thus, in this study, we enhanced the spectral contrasts of F2 by increasing the amplitude of F2 but not changing the spectral valleys near F2. If the spectral enhancement of selective formant peaks is found to improve speech perception for listeners with HI, this strategy may have potential implications in signal processing algorithms for amplification devices.

Altogether, the main purpose of this study was to investigate whether acoustic manipulation, via increase of the overall speech level or spectral contrast, is able to improve vowel formant discrimination for NH and HI listeners. We manipulated three factors: speech level (70 and 90 dB SPL), spectral enhancement of F2 (original and enhancement by 3, 6, and 9 dB), and F2 frequency of three English vowels (/a, x, i/).

Method

Stimuli

Three American English isolated vowels, /a, x, i/, were used as stimuli. The three original vowels were recorded in an /hVd/ context from a young American English female talker and served as the base stimuli for spectral enhancement. Isolated vowels were obtained by truncating the initial /hi and the final /d/, including the onset and offset formant transition, such that only the central vowel nucleus remained. The central 200-ms portions of the /hVd/ syllable that included only vowels in isolation were selected as the base stimuli for spectral enhancement and formant frequency shifts. Because previous studies (Coughlin et al., 2008; Liu &Kewley-Port, 2007; Richie et al., 2003) reported that listeners with HI primarily had difficulty discriminating differences of F2 frequency, the present study focused on formant discrimination of F2. The average F2 frequency of the three vowels over the entire vowel duration was 1442 Hz for /a/, 2078 Hz for /se/, and 2563 Hz for /i/.

There were four conditions of formant enhancement: unenhanced (original), and 3-, 6-, and 9-dB enhancement of F2. The left panel of Figure 1 illustrates the spectra of the original Ixl vowel (solid line) and the /ee/ vowel with 9-dB F2 enhancement (dashed line). The spectral enhancement of F2 was manipulated as follows: first, a three-dimensional (3-D) spectrogram (Amplitude x Time x Frequency) of the original vowel was obtained by analysis using STRAIGHT (Kawahara, Masuda-Kastuse, &Cheveigne,, 1999); second, at each time frame of the spectrogram, the valleys below Fl, between Fl and F2, and between F2 and F3 were defined as Vl, V2, and

V3, respectively. For the enhanced F2 conditions, only amplitudes at the frequencies between the valleys next to F2 (e.g., V2 and V3) were enhanced. The level of the F2 peak was amplified by 3, 6, and 9 dB, and the levels of the components between V2 and F2 and between F2 and V3 were linearly interpolated in a log scale. For example, the amplitude at the midpoint of V2 and F2 was amplified for 4.5 dB for the 9-dB enhancement conditions. Thus, there were four vowels with and without F2 enhancement serving as standard vowels for formant frequency shifts for each vowel category.

Stimuli were generated with different amounts of formant-frequency shift based on each standard vowel with the corresponding spectral enhancement. The procedure for shifting F2 frequency is briefly described below (for more details, see Liu &Kewley-Port, 2004). For each time frame of the 3-D spectrogram (Kawahara et al., 1999), as shown in the right panel of Figure 1, the F2 peak was shifted by flattening the frequency range corresponding to the formant shift at the spectral valley lower than the F2 frequency (V2) and replacing the original amplitude values with the shifted peak at the high-frequency valley (V3). In other words, the F2 shift was manipulated between the two spectral valleys, V2 and V3. This was also the same frequency range of the F2 enhancement. The F2-shifted vowels had the same amplitude of formant peaks (e.g., Fl, F2, and F3) as the standard vowel. The F2 values were shifted systematically from 0.5% to 20% of F2 frequency, with a step size of 0.5%, resulting in 40 formant-shifted vowels. This F2-shifted spectrogram was loaded into STRAIGHT and was used for vowel resynthesis. Thus, for each vowel, there were four sets of 40 F2-shifted vowel stimuli, with each set corresponding to one F2 enhancement condition. Additionally, a vowel /s/ was recorded from a middle-aged female speaker, different from the female speaker who recorded the three test vowels. The vowel /s/ served as the standard vowel for a 15-min training session before the test sessions. Like the test vowels, the F2 of the vowel /s/ was shifted from 0.5% to 20% of F2 frequency, with a 0.5% step size with the same formant shift method described above.

The stimuli with and without spectral enhancement were presented with 10-ms rise-fall ramps at two levels: 70 and 90 dB SPL. Sound pressure levels of vowel sounds were measured at the output of the ER-2 insert earphones via an NBS-9A 2-cc coupler that was connected to the microphone of a Larson-Davis (Model 2800) sound-level meter set to the linear weighting scale.

Study Participants

Six HI listeners with moderate sensorineural hearing loss at high frequencies and six NH listeners participated in this study. Participants were 18-55 years old; NH and HI listeners had mean ages of 23 and 37, respectively. All were native speakers of American English with normal middle-ear function. As shown in Figure 2, the audiometric thresholds of the listeners with HI were no more than 65 dB HL within the range of 250^000 Hz except participant SI at 4000 Hz. The NH listeners had pure-tone thresholds <15 dB HL at octave intervals between 250 and 8000 Hz (American National Standards Institute, 2010). All procedures were approved by the Institutional Review Board of the University of Texas at Austin. All listeners consented to participate in the study.

Procedure

Speech stimuli, sampled at 12207 Hz, were presented to the right ears of the listeners, who were seated in a sound- treated IAC (Industrial Acoustics Company) booth, via calibrated ER-2 insert earphones. Stimulus presentation was controlled by a series of TDT (Tucker-Davis Technologies) modules, including an enhanced real-time processor (RP2.1), a programmable attenuator (PA5), and a headphone buffer (HB7). Thresholds were measured using a three-interval, forced-choice procedure with a two-down, one-up tracking algorithm, estimating 71% correct responses (Levitt, 1971). There were 24 experimental conditions (3 formant frequencies x 4 spectral enhancements x 2 speech levels), the order of which was randomized.

For each trial, the standard vowel was presented in the first interval, followed by a standard vowel and a formant- shifted vowel randomly ordered in the second and third test intervals. The listener's task was to indicate which of the two test intervals contained the vowel that was different from the standard vowel via a

button press on an LCD monitor with an interface that simulated a handheld button box. The inter stimulus interval (ISI) was 400 ms. A light located above each interval button illuminated simultaneously with each presentation of the vowel stimulus. For each block, the F2 shift was started at 10% of the F2 frequency and was adjusted in a 1% step size for the first three reversals and then 0.5% thereafter. The threshold for each block of 60 trials was based on the average F2 shift at the last even number of reversals in the adaptive track, without counting the first three.

Across all conditions and listeners, a threshold of a given block was computed as a mean of 10 reversals. The threshold for each condition was taken as the average for two blocks. An additional block was conducted if thresholds for the two blocks differed by >1% of the F2 frequency (e.g., two steps of formant shifts). Across all of the listeners, this occurred an average of eight times out of a total of 24 experimental conditions. Listeners completed a 15-min training session using the vowel /s/ before the test session to gain familiarization with the procedure. The training and test sessions lasted ~5 hr, with each session lasting 90-120 min. The experimental design and process was manipulated using SykoFizX software application (TDT, Inc.).

Results

Overall Performance

Thresholds are expressed as Weber fractions (ÀF/F). Average thresholds across NH (left) and HI (right) listeners are plotted in Figure 3 as a function of F2 frequency for the four enhancement conditions and two speech levels. A four-factor (within-subjects factors: spectral enhancement, formant frequency, and speech level, and between-subjects factor: listener group) analysis of variance (ANOVA) of the thresholds was conducted. Thresholds were significantly affected by listener group, $F(1, 10) = 8.239$, $p <0.05$; formant frequency, $F(2, 20) = 7.722$, $p <0.05$; and spectral enhancement, $F(3, 30) = 20.299$, $p <0.05$, but not by speech level, $F{ 1, 10) = 0.158$, $p >0.05$. Of the six two-factor interactions, four were significant (Group x Formant Frequency, Group x Spectral Enhancement, Formant Frequency x Spectral Enhancement, and Speech Level x Spectral Enhancement; all $p <0.05$). Of the four three-factor interactions, only the Group x Speech Level x Spectral Enhancement interaction was significant ($p <0.05$).

Because the two listener groups differed significantly in overall performance (see Figure 3), and the interaction effect of group and spectral enhancement was significant, we conducted separate analyses for the NH and HI listeners. The effects of spectral enhancement and speech level are reported in the following two subsections for NH and HI listeners, respectively.

Effects of Spectral Enhancement and Speech Level for NH Listeners

Overall, as shown in Figure 3, neither spectral enhancement nor speech level produced an improvement for the NH listeners. A three-factor (spectral enhancement, formant frequency, speech level) repeated measures ANOVA with threshold (ÀF/F) as the dependent variable showed that NH listeners were not affected by speech level, $F(1, 5) = 0.098$, $p >0.05$; spectral enhancement, $F(3, 15) = 1.482$, $p >0.05$; or formant frequency, $F(2, 10) = 0.924$, $p >0.05$. None of the two-way interactions for NH listeners was significant (all $p >0.05$), but the three-way interaction of spectral enhancement, formant frequency, and speech level was significant, $F{6, 30) = 2.506$, $p <0.05$.

Effects of Spectral Enhancement and Speech Level for Listeners With HI

A similar ANOVA for the listeners with HI showed significant effects of spectral enhancement, $F(3, 15) = 20.206$, $p <0.05$, and formant frequency, $F(2, 10) = 6.370$, $p <0.05$, but no significant effect of speech level, $F(1, 5) = 0.116$, $p >0.05$. Of the two-factor and three-factor interactions, the interaction of speech level and spectral enhancement was significant, $F(3, 15) = 6.941$, $p <0.05$, as was the interaction of formant frequency and spectral enhancement, $F(6, 30) = 2.652$, $p <0.05$. Post hoc Tukey tests suggested that for the listeners with HI, thresholds were improved by spectral enhancement of 3, 6, and 9 dB (all $p <0.05$). Because the interaction effects of spectral enhancement and speech level or formant frequency were significant, we examined the simple main effect of spectral enhancement for each speech level and for each formant frequency, described in

the next two paragraphs.

In order to measure the simple main effect of spectral enhancement under each speech level for the listeners with HI, two-way (spectral enhancement and formant frequency) repeated measures ANOVAs were completed for 70 and 90 dB SPL, respectively. At 70 dB SPL, there was a significant effect of spectral enhancement, $F(3, 15) = 6.557$, $p < 0.05$, and formant frequency, $F(2, 10) = 5.565$, $p < 0.05$, on formant thresholds; there was no significant interaction effect of spectral enhancement and formant frequency, F{6, 30) = 1.397, $p > 0.05$. The average thresholds improved by 17% for 3-dB F2 enhancement, 24% for 6-dB F2 enhancement, and 34% for 9-dB F2 enhancement compared to the thresholds of original vowels. Post hoc Tukey tests indicated that thresholds for 6- and 9-dB enhancement were significantly better than thresholds of original vowels (both $p < 0.05$). For 90 dB SPL, spectral enhancement, $F(3, 15) = 17.015$,/? < 0.05, and formant frequency, $F(2, 10) = 4.421$, $p < 0.05$, showed a significant effect on formant discrimination; the interaction of spectral enhance- ment and formant frequency did not, $F(6, 30) = 1.544$, $p > 0.05$. Thresholds improved by 46% for 3-dB F2 enhancement, 60% for 6-dB F2 enhancement, and 71% for 9-dB F2 enhancement relative to the thresholds of original vowels. Post hoc Tukey tests reported that performance was significantly improved for all three spectral enhancement conditions compared to performance of the original condi- tion (all $p < 0.05$).

Similarly, in order to measure the main effect of spectral enhancement under each formant frequency, we conducted two-factor (spectral enhancement and speech level) repeated measures ANOVAs for the three formant frequencies. At all three formant frequencies, thresholds were significantly affected by spectral enhancement (all $p < 0.05$), but not by speech level (all $p > 0.05$). The interaction effect of speech level and spectral enhancement was significant for the F2 of /ae/ and /i/ (both $p < 0.05$), but not for the F2 of /a/. Post hoc Tukey tests suggested that thresholds of any of the three spectrally enhanced conditions were significantly lower than thresholds for the original conditions of the three formant frequencies (all $p < 0.05$). As shown in Table 1, individual variability of formant discrimination performance due to spectral enhancement was observed for the listeners with HI, possibly due to the different configurations and severities of hearing loss across them. It should also be noted that for the listeners with HI, an increase of speech level did not improve formant discrimination of original vowels with no F2 enhancement (see Figure 3). For instance, for original vowels with no spectral enhancement, thresholds degraded by 34% at 90 dB SPL compared to thresholds at 70 dB SPL, whereas for 3-dB, 6-dB, and 9-dB F2 enhancement, an increase of speech level from 70 to 90 dB SPL improved formant discrimination by 14%, 31%, and 42%, respectively. These results imply that benefits from 70 to 90 dB SPL, if any, were conditional upon F2 amplitude.

As described in the statistical results above, vowel formant discrimination was not affected by speech level but was significantly affected by the interaction of spectral enhancement and speech level. To reveal the simple main effect of speech level under each spectral enhancement condition, we completed two-factor (speech level and formant frequency) repeated measures ANOVAs for the vowels with original spectrum, and 3-dB, 6-dB, and 9-dB F2 enhancement, respectively. Results showed no significant effect of speech level at any of the F2 enhancement conditions: original, F(I, 5) = 2.005, $p > 0.05$; 3 dB, .Fifi, 5) = 0.321, $p > 0.05$; 6 dB, F(1, 5) = 0.648, $p > 0.05$; and 9 dB, .Ffl, 5) = 2.158, $p > 0.05$. In addition, no significant interaction effects of speech level and formant frequency were found for any of the F2 enhancement conditions: original, $F(2, 10) = 0.853$, $p > 0.05$; 3 dB, $F(2, 10) = 2.440$, $p > 0.05$; 6 dB, $F(2, 10) = 0.428$, $p > 0.05$, and 9 dB, $F(2, 10) = 0.575$, $p > 0.05$.

NH Listeners Versus Listeners With HI

As reported earlier, the HI listeners' overall perfor- mance was significantly worse than that of the NH listeners. In addition, we conducted three-factor (within-subjects factors: formant frequency and spectral enhancement; between-subject factors: listener group) ANOVAs at 70 and 90 dB SPL, respectively, indicating significantly worse performance for the listeners with HI than their NH peers (both $p < 0.05$). To determine if the increase of speech level and spectral enhancement of F2 could improve HI listeners' thresholds to NH listeners' level, we conducted a two-factor (formant frequency and listener group) ANOVA: the 9-dB F2 enhancement condition at

90 dB SPL that provided the greatest benefits for listeners with HI (e.g., the dashed line in the lower right panel of Figure 3) versus the original, unenhanced vowels at 70 dB SPL for NH listeners (e.g., the solid line in the upper left panel of Figure 3). The NH listeners showed significantly lower thresholds than the listeners with HI, Ffl, 10) = 5.054, p <0.05, suggesting that increasing speech level and spectral contrast were not able to help the listeners with HI reach the same level of performance as the NH listeners.

Discussion

The purpose of this study was to examine whether enhancing a crucial spectral prominence of vowel stimuli would improve NH and HI listeners' abilities to discriminate differences in F2 frequency. As shown in the left panels of Figure 3, the NH listeners did not show any significant improvement from increasing speech levels or spectral enhancements of F2. This is not surprising, because NH listeners do not have the reduced amplitude and secondary distortion associated with hearing loss. NH listeners only need 3- to 4-dB peak-to-valley contrasts for Fl and F2 to identify vowels with >80% accuracy (Leek et al., 1987). Given that peak-to-valley contrasts of F2 for the three original vowels in this study were >6 dB, spectral contrasts of F2 of the original vowels were well resolved for NH listeners such that F2 enhancement did not benefit NH listeners to discriminate formant frequency difference.

On the other hand, the listeners with HI did show marked benefits (see the right panels of Figure 3) when F2 amplitude was enhanced at both 70 and 90 dB SPL, indicating the importance of spectral contrasts of formant peaks on vowel perception (Leek et al, 1987; Liu &Eddins, 2008). In order to examine audibility and presentation of the vowel F2 peaks for the listeners with HI, excitation patterns of the vowels /se, i, a/ with the original spectra and F2 enhancements at 70 and 90 dB SPL were computed following Moore and Glasberg's (2004) excitation pattern model. Excitation patterns were also calculated for the NH listeners.

In general, as shown in Figures 4 and 5, spectral peaks at high frequencies (e.g., F2 and F3) were smeared in the excitation patterns for the listeners with HI, likely due to the loss of frequency selectivity, whereas spectral peaks of F2 and F3 were well represented in the excitation patterns for the NH listeners (see Figure 6). As shown in Figure 4, a 9-dB F2 enhancement resulted in an enhanced representation of F2 in the excitation pattern for listeners with a mild-to- moderate hearing loss (e.g., S6). On the other hand, for listeners with a moderate-to-severe hearing loss (e.g., SI), F2 may not be audible, and the spectral peaks were severely smeared for the original vowels /il and /se/ at 70 dB SPL, whereas F2 with the 9-dB enhancement may increase the F2 internal presentations and F2 audibility (see Figure 5). Thus, spectral enhancement of F2 peaks resulted in an enhanced internal representation and/or better audibility of F2 for the listeners with HI, especially those with severe hearing loss, thus improving their F2 discrimination.

However, vowel formant discrimination did not improve by simply increasing the overall speech level from 70 to 90 dB SPL with no F2 enhancement, suggesting that the difficulty of listeners with HI is accounted for not only by audibility, but also by reduced frequency selectivity (Needleman &Crandell, 1997). As indicated in Figures 4 and 5, the internal F2 presentations became more smeared by an increase in speech level from 70 to 90 dB SPL for the listeners with HI, whereas the upward spread of masking from Fl may increase as speech level increased, possibly accounting for the slightly worse vowel formant discrimination at 90 dB SPL. This is consistent with previous studies (i.e., only increasing speech level may not significantly compensate for spectral smearing of formant peaks for listeners with HI; Liu &Kewley-Port, 2007). However, it should be noted that Coughlin et al. (1998) and Richie et al. (2003) reported that formant discrimination was improved from low (e.g., 60/70 dB SPL) to high (e.g., 95 dB SPL) levels. The differential effects of speech level on vowel formant discrimination among these studies could be due to the audibility and internal representations of F2 peaks. That is, in the studies of Coughlin et al. and Richie et al., F2 was audible at high levels but not at low levels, and F2 was represented in the excitation patterns of their listeners with HI (for details, see Figure 6 of Liu &Kewley-Port, 2007).

In the present study, F2 audibility became better at the high speech level; however, F2 representation was

severely smeared (see Figures 4 and 5), suggesting that increased audibility of F2 may improve formant discrimination only when F2 was represented well internally for listeners with HI. Moreover, in this study, HI listeners' performance improved by 14%^42% from 70 to 90 dB SPL as spectral enhancement of F2 was implemented, possibly due to better audibility of F2 peaks. For example, the F2 peak with a 9-dB enhancement was audible for the listener with moderate-to-severe hearing loss (e.g., SI; see Figure 5) at 90 dB SPL, but not at 70 dB SPL for vowels Iii and /se/. Altogether, these results suggest that both audibility and representation of formant peaks were critical to vowel perception for listeners with HI.

In the present study, the vowel stimuli with F2 enhancement were presented at the same level with the original vowels, resulting in an increase of the F2 spectral contrasts and a slight attenuation of the Fl amplitude (see Figures 4-6). Such acoustic changes may reduce the upward spread masking of Fl on the F2 and enhance the F2 representation (e.g., higher spectral contrasts of F2, resulting in better sensitivity to F2 frequency discrimination). This is consistent with the behavioral and physiological findings in other studies (Danaher et al, 1973; Danaher &Pickett, 1975; Miller et al, 1999a).

In the studies of F2 transition discrimination, listeners with HI performed better for stimuli with Fl removed than for stimuli with Fl present (Danaher et al., 1973; Danaher &Pickett, 1975). When the F2 and F3 peaks were amplified with no change in the Fl area, termed contrast-enhanced frequency shaping, the neural representation of the F2 frequency for the auditory nerve with noise-induced hearing loss was also enhanced (Miller et al, 1999a). The reduction of the Fl masking effect may also interpret individual variability regarding improvement of formant discrimination spectral contrasts among the listeners with HI. That is, the masking effect of FI on F2 discrimination was greater for the listeners with a sloping high-frequency hearing loss compared to the listeners with a flat hearing loss such that the spectral enhancement of the F2 resulted in greater improvement in formant discrimination for the sloping high- frequency hearing loss (Danaher et al, 1973; Danaher &Pickett, 1975). For example, as shown in Table 1 and Figure 2, Listener S5 had a relatively flat hearing loss and showed less benefits than Listeners SI and S4, who had a sloping high-frequency hearing loss. However, individual variability of listeners with HI may also be related to their hearing loss severity. For instance, Listeners S4 and S6 had similar hearing loss configurations, yet Listener S4 had greater improvement of formant discrimination than Listener S6 with relatively more severe hearing loss. More research is needed to investigate the effect of hearing loss configuration and severity on the spectral enhancement benefits of vowel formant discrimination.

The findings of this study are also consistent with behavioral and physiological studies in speech processing regarding spectral enhancement for the dysfunctional auditory system (Bunnell, 1990; Lyzenga et al., 2002; Miller et al., 1999a; Stone &Moore, 1992). Bunnell (1990) manipulated spectral enhancement by applying filters in speech spectrum with different filter weights such that three sets of speech stimuli were produced in terms of spectral contrasts: normal, reduced, and enhanced. Results showed that stop consonant identification with spectral enhancement increased moderately (-5% in average) for listeners with HI compared to original speech sounds. Similarly, a 16-channel bandpass filter bank with each filter bandwidth close to the bandwidth of auditory filters of NH listeners was imple- mented by Stone and Moore (1992) to enhance spectral contrasts of speech sounds. Results of sentence recognition in noise indicated that there was no significant improvement in speech perception for the listeners with HI; however, listeners reported both higher quality and higher intelligibility of speech with spectral enhancement. Enhanced spectral contrasts of speech sounds combined with noise suppression also resulted in improvement of sentence recognition for listeners with simulated hearing loss (Lyzenga et al, 2002). Miller et al. (1999b) reported that the rate and temporal tonotopic representation of the F2 frequency in the abnormal auditory nerve was improved by amplifying the F2 spectral contrasts and F3 peaks.

Results of the present study indicate that spectral enhancement of vowel formant peaks may improve HI listeners' sensitivity to formant frequency changes. Given that thresholds of vowel formant discrimination were significantly related with vowel identification (e.g., lower thresholds of formant discrimination, better vowel identifi- cation; Kewley-Port, Bohn, &Nishi, 2005), improvement of vowel formant discrimination may help

listeners with HI achieve greater accuracy in vowel identification. In addition, researchers have recently reported that vowels play a critical role in sentence recognition for young and elderly listeners with normal and impaired hearing (Fogerty, Humes, &Kewley-Port, 2010, 2012; Fogerty &Kewley-Port, 2009), implying that enhanced acoustic features of vowel sounds (e.g., spectral contrasts) may improve listeners' sentence recognition. Overall, the present study and previous studies with spectral enhancement suggest that spectral enhancement of prominent peaks in speech spectrum may improve phonetic perception, speech recognition, or speech quality for listeners with HI. These findings could have implications for future hearing aid design as well as other assistive listening devices. On the other hand, the best performance of listeners with HI with a combined increase of speech level and spectral enhancement still could not reach the level of NH listeners, indicating that spectral enhancement may not be compen- sated solely by only an increase of the peak-to-valley contrasts, but perhaps also some other method, such as manipulation of formant bandwidth and/or spectral tilt. However, it should also be noted that spectral enhancement may result in changes of speech quality. More research is needed to study whether listeners with HI can benefit in vowel discrimination and identification from spectral enhancement.

Acknowledgments

A portion of the data was presented at the 158th Acoustic Society of America Meeting in San Antonio, TX. This study was funded by the University of Texas at Austin Undergraduate Research Fellowship to the first author. Special thanks are given to Craig Champlin for his comments on an earlier version of this manuscript.

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Editor: Larry Humes
Received July 27. 2012

Revision received October 30. 2012
Accepted October 31. 2012
DOI: 10.1044/1059-0889(2012/12-0044)

Masking Release and Modulation Interference in Cochlear Implant and Simulation Listeners

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Publication info: American Journal of Audiology (Online) 22.1 (Jun 2013): 135-46.
ProQuest document link

Abstract: To examine the effects of temporal and spectral interference of masking noise on sentence recognition for listeners with cochlear implants (CI) and normal-hearing persons listening to vocoded signals that simulate signals processed through a CI (NH-Sim). NH-Sim and CI listeners participated in the experiments using speech and noise that were processed by bandpass filters. Depending on the experimental condition, the spectra of the maskers relative to that of speech were set to be completely embedded with, partially overlapping, or completely separate from, the speech. The maskers were either steady or amplitude modulated and were presented at +10 dB signal-to-noise ratio. NH-Sim listeners experienced progressively more masking as the masker became more spectrally overlapping with speech, whereas CI listeners experienced masking even when the masker was spectrally remote from the speech signal. Both the NH-Sim and CI listeners experienced significant modulation interference when noise was modulated at a syllabic rate (4 Hz), suggesting that listeners may experience both modulation interference and masking release. Thus, modulated noise has mixed and counteracting effects on speech perception. When the NH-Sim and CI listeners with poor spectral resolution were tested using syllabic-like rates of modulated noise, they tended to integrate or confuse the noise with the speech, causing an increase in speech errors. Optional training programs might be useful for CI listeners who show more difficulty understanding speech in noise. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: To examine the effects of temporal and spectral interference of masking noise on sentence recognition for listeners with cochlear implants (CI) and normal-hearing persons listening to vocoded signals that simulate signals processed through a CI (NH-Sim).
Method: NH-Sim and CI listeners participated in the experiments using speech and noise that were processed by bandpass filters. Depending on the experimental condition, the spectra of the maskers relative to that of speech were set to be completely embedded with, partially overlapping, or completely separate from, the speech. The maskers were either steady or amplitude modulated and were presented at +10 dB signal-to-noise ratio.
Results: NH-Sim listeners experienced progressively more masking as the masker became more spectrally overlapping with speech, whereas CI listeners experienced masking even when the masker was spectrally remote from the speech signal. Both the NH-Sim and CI listeners experienced significant modulation interference when noise was modulated at a syllabic rate (4 Hz), suggesting that listeners may experience both modulation interference and masking release. Thus, modulated noise has mixed and counteracting effects on speech perception.
Conclusion: When the NH-Sim and CI listeners with poor spectral resolution were tested using syllabic-like rates of modulated noise, they tended to integrate or confuse the noise with the speech, causing an increase in speech errors. Optional training programs might be useful for CI listeners who show more difficulty

understanding speech in noise.

Key Words: cochlear implants, hearing loss, speech perception

Typical environmental noises such as background conversations are temporally varying in frequency and amplitude. Listeners with normal hearing (NH) can take advantage of gaps in these fluctuating maskers. They are able to "listen in the dips" of temporally varying noise to extract information about the speech signal, thereby experiencing improvement in speech recognition (e.g., Bernstein &Grant, 2009; Festen &Plomp, 1990; Jin &Nelson, 2006). Such performance improvement in the presence of fluctuating compared to steady-state noise conditions is known as masking release. Previous studies have reported that NH listeners' speech recognition scores could improve by as much as 80 percentage points when noise was modulated versus steady (Jin &Nelson, 2006).

However, significant masking release reduction or no masking release has been found in cochlear implant (CI) users or in NH listeners identifying vocoded speech that simulates speech processed by a CI device (NH-Sim; Fu &Nogaki, 2004; Kwon, Perry, Wilhelm, &Healy 2012; Nelson &Jin, 2004; Nelson, Jin, Carney, &Nelson, 2003; Qin &Oxenham, 2003; Stickney, Zeng, Litovsky, &Assmann, 2004). For example, Nelson and colleagues (Nelson &Jin, 2004; Nelson et al, 2003) compared the performance of three listener groups (NH, CI, and NH-Sim) for sentence recognition in the presence of different masking noises, including steady-state noise and gated noise modulated at different frequencies. They found that the NH listeners showed significant masking release even at high levels of noise (-8 and -16 dB signal-to-noise ratios [SNRs]), whereas the NH-Sim and CI listeners showed limited or no masking release at more favorable SNRs (+8 and +16 dB SNRs).

Typically, robust and redundant speech cues (both spectral and temporal) help NH listeners to segregate relevant speech signals out of a noise mixture and to integrate the signals into a continuous perceptual stream. However, when spectral cues are reduced, via CI processor, for example, a broadband modulated noise might seem perceptually quite similar to the speech: Its frequency components are overlapped with those of speech, and the rate of fluctuation of noise and speech are similar. Without fine-grained spectral information in speech, listeners might rely more on temporal cues to process consonants and vowels. In the presence of modulated noise, such temporal information in speech is obscured by the noise modulations, and NH-Sim and CI listeners may experience modulation interference rather than (or in addition to) masking release (Kwon &Turner, 2001). As a result, little to no masking release has been observed from these groups of listeners.

One thing in common found from the previous studies of speech perception in noise was the positive SNRs used for CI or NH-Sim listeners (e.g., Fu &Nogaki, 2004; Kwon &Turner, 2001; Nelson et al, 2003; Qin &Oxenham, 2003; Stickney et al., 2004). Because these listeners were listening to impoverished spectral speech cues, they were tested at favorable (positive) SNRs in which the signal and noise are more similar in level in order to avoid a floor effect (Nelson et al., 2003). At those positive SNRs, CI or NH-Sim listeners may confuse the modulated noise with the speech and will not be able to take advantage of "dip listening" (Ihlefeld, Deeks, Axon, &Carlyon, 2010).

When the characteristics of a noise are quite different from those of speech, the negative effect of masking interference on CI or NH-Sim listeners might be negligible. In studies of spatial masking, when speech and noise were presented from different locations, NH listeners as well as CI and NH-Sim listeners showed spatial release from masking (Ihlefeld et al. 2010; Loizou et al., 2009). Furthermore, Kwon et al. (2012) showed that when the envelopes of modulated noise were less temporally overlapped with those of speech signals, ~50% of CI participants were able to benefit from the dips of modulated noise, resulting in significant masking release. These results suggest that if speech and noise are perceptually segregated, CI listeners would be able to experience masking release.

In the current study, we investigated differences in the masking of speech experienced by NH-Sim and CI listeners for maskers that overlap with speech in audio frequency and modulation rate. The purpose of the current study was to examine the conditions in which temporal and spectral interference affect sentence

recognition for NH-Sim and CI listeners, and to determine whether masking release might be seen in CI listeners when the spectrum of speech are distinct from that of noise.

We asked two research questions. First, do NH-Sim and CI listeners experience similar systematic increases in masking as the frequencies contained in a broadband masker overlap more closely with the speech signal? To answer this question, both speech and noise were processed by series of bandpass filters. Depending on the experimental condition, the spectra of the maskers relative to that of speech were set to be completely embedded, partially overlapping more (PO-more), partially overlapping less (PO-less), or completely separate from the speech (remote). We hypothesized that NH-Sim listeners would show a systematic reduction in masking of a speech signal as the masker overlapped less with the speech, but that CI listeners may not show such a clear relationship.

Second, under what conditions do NH-Sim and CI listeners experience masking release or modulation interference? Previous investigations indicated that the modula- tion index of speech is -3 Hz to 4 Hz, which corresponds to the syllable rate in speech (Drullman, Festen, &Plomp, 1994; Houtgast &Steenken, 1985). We hypothesized that, if NH- Sim and CI listeners rely more on the temporal envelope cues of speech, then masking interference may be strongest when the noise is amplitude modulated at these rates. Although studies on both NH-Sim and CI listeners (Ihlefeld et al., 2010; Kwon &Turner, 2001; Nelson et al., 2003; Qin &Oxenham, 2003) examined the effect of modulation rate on speech perception, no clear answers were reported. We hypothesized that NH-Sim and CI listeners would show no masking release but might show masking interference when the noise is amplitude modulated at a rate approaching the syllable rate. Furthermore, the masking interference associated with the rate effect may occur even when the speech is spectrally remote from the noise because CI listeners are not able to segregate speech from noise even when they are spectrally remote (Stickney et al, 2004).

Experiment 1: Sentence Recognition of NH-Sim Listeners

Method

Participants

Ten undergraduate or graduate students (5 male and 5 female) participated in the experiment. They were 19 to 32 years of age and were Native American English speakers. Their hearing was <20 dB HL at audiometric frequencies of 250, 500, 1000, 1500, 2000, 3000, 4000, 6000, and 8000 Hz (American National Standards Institute, 2010).

Stimuli

Both Institute of Electrical and Electronics Engineers sentences (IEEE, 1969) spoken by a female speaker and white noise were filtered through 16 filter bands whose cutoff frequencies were set based on the work of Fu and Nogaki (2004). Bandpass filters (4th-order Butterworth) were used. The output of each bandpass-filtered stimulus was numbered in order from 1 to 16: Band #1 contained the lowest frequency components, ranging from 200 Hz to 272 Hz, and Band #16 contained the highest frequency components, ranging from 5768 Hz to 7000 Hz. Table 1 shows the low and high cutoff frequencies of each of the 16 bandpass filters.

The speech temporal envelopes were extracted from the 10 lower individual speech bands, 1-10, by low-passing the bands of speech through a 4th-order Butterworth filter at a cutoff frequency of 160 Hz. Our previous study (Nie &Nelson, 2009) showed that low-pass filtered natural IEEE sentences at a cutoff frequency of 2000 Hz were equally intelligible as those sentences with a full spectrum to NH listeners and listeners with hearing impairment. In the pilot study (Nie &Nelson, 2009), the 10-band CI simulation satisfied our criterion of a >50% key word identification in NH listeners. The speech envelopes from the 10 bands were half-wave rectified and imposed on the white noise filtered through the same band. Each band carrying speech temporal envelopes was refiltered through the same bandpass filter to eliminate the spectral spread resulting from imposing envelopes on noise. The 10 bands of noise carrying a speech envelope were added to formulate the vocoded-speech stimuli.

White noise was bandpassed and then superimposed with sinusoidal amplitude modulation (SAM) to be presented as background noise. The spectra of the background noise were set to completely embedded, partially overlapping (PO), adjacent and not overlapping, or remote, with that of the speech. Table 2 shows spectral components of the noise bands for each noise condition. For the completely embedded condition, the individual noise bands 5 through 10 were combined into one noise band. There were two partially overlapping conditions: PO-more and PO-less, and their noise band components were 7-12 and 9-14, respectively. The noise band components of the adjacent condition included Bands 11-16. For the remote condition, the individual noise bands 13-16 were combined. Each SAM noise condition was modulated at five modulation rates: 0 Hz (unmodulated noise), 4 Hz, 16 Hz, 32 Hz, and 64 Hz. Total numbers of conditions per listener were 26: 5 noise-band conditions x 5 modulation rates plus 1 quiet condition.

Procedure

Both speech and noise stimuli were processed by a customized MATLAB code with a sampling rate of 22050 Hz and were presented via a SoundMAX card controlled by a Pentium 4 computer. The speech stimuli were presented at 70 dB A for the low-pass spectrum monaurally to the right ear when no background noise was present; when background noise was present, the speech stimuli were presented at 70 dB A and the noise was at an SNR of 10 dB. The SNR was determined by the difference between the level of the speech pass-band (i.e., 70 dB A) and the level of the pass-band of the background noise.

In each test condition (in quiet and in noise with different noise spectrum at different modulation rates), two randomly chosen lists of 10 sentences were presented to the participants. After each sentence was presented, participants wrote down on the response sheet what they heard and then pressed the "Enter" key on the computer keyboard to listen to the next sentence. Each participant's response was scored for the percentage of correct key words identified. The total number of key words from two IEEE lists was 100. If participants responded in homophones of key words, they were scored correct for these corresponding key words. No correct feedback was provided.

The order of experimental conditions was randomized across the 10 participants. In addition, the order of sentence presentation within each list was randomized. Participants took 4-6 hr in total to complete the speech experiment, which was broken into 1- to 2-hr listening sessions. Participants undertook the sessions on different days. Practice listening was given at the beginning of the first session of the speech experiment. For the practice session, two randomly chosen IEEE lists were presented to the participants. One of the two practice lists was presented without background noise (quiet condition); the other one was presented with background noise of Bands 13 through 16 (remote condition) modulated at 64 Hz.

Results

Figure 1 shows the percentage correct key word identification for the NH-Sim listeners. The scores varied greatly from one listener to another for the same conditions. For instance, the NH-Sim listeners correctly identified 53%-80% of the key words, with an average of 64.7%, in the quiet condition and 10%-54% of the key words, with an average of 20%, when the noise spectrum was completely embedded in the speech spectrum. Repeated measurement analysis of variance (ANOVA) on conditions with background noise revealed significant differences in the spectral (band) condition; that is, as the spectrum of the background noise approached or overlapped more with the spectrum of speech, listeners identified fewer key words, $F(A, 36) = 100.851$, $p < 0.001$. However, different amplitude modulated (AM) rates of the modulated bandpass noise did not result in significant improvement in speech understanding, $F(4, 36) = 1.707$, $p = 0.170$. Speech perception with modulated noise did not improve from that with steady-state noise, indicating no masking release. The interaction between the spectral separation (i.e., between speech and noise) and modulation rate was not significant, $F(16, 144) = 0.809$, $p = 0.673$.

Further pair-wise comparisons with Bonferroni adjust- ment were performed on the factor of spectral separation between noise and speech. The key word identification score of each noise-speech spectral separation was

significantly higher than those scores obtained in the smaller noise-speech spectral separations (allp <0.05). That is, with the five noise- speech spectral separations, from small to large-embedded, PO-more, PO-less, adjacent, and remote-the speech under- standing score significantly improved progressively.

As no difference in key word identification was found between AM-rate separations, the scores from different AM- rate separations in the same noise-speech spectral (band) separation were averaged to yield a single score for each noise-speech spectral separation. Pair-wise comparisons from the repeated measurement of ANOVAs conducted based on these averaged scores and the scores in the quiet condition showed that the performance in the quiet condition was significantly better than the performance in the conditions where the noise was present, except the remote condition.

Overall, the NH-Sim listeners showed two findings. First, they experienced a systematic increase in masking (decrease in speech recognition) as the masker was more spectrally overlapping with the speech signal. No masking was seen from the spectrally remote masker. Second, they showed neither masking release nor modulation interference from the modulated maskers in any noise-speech spectral separation condition at any modulation rate, suggesting that the large majority of the masking experienced was based on the spectral content of the speech and noise signals, with minimum effect of the envelopes of the maskers.

Experiment 2: Sentence Recognition of CI Listeners

We conducted a similar experiment with the CI listeners to confirm whether the findings of the NH-Sim listeners would cany over to actual users of CIs. We hypothesized that because CI listeners are more reliant on temporal envelopes, they may experience more modulation interference than the simulation listeners. Further, because of current spread from the CI devices, we hypothesized that CI listeners may experience masking from noises that were presumed to be spectrally remote from the speech signal.

Method

Participants

Seven postlingually deafened adult listeners with CI participated in this experiment. A detailed description of the CI listeners is shown in Table 3. Their mean age was 48 years, ranging from 21 to 73 years, and their average length of deafness before implantation was 26 years, ranging from 18 to 42 years. All listeners had worn their CIs for >2 years (M = 6 years, range = 13 years).

Stimuli

In order to create different degrees of spectral interference for the CI listeners, both speech and noise were spectrally filtered and were used to construct experimental conditions with various spectral distances between the speech signals and noise. In order to have the frequency components of the speech signals for CI listeners similar to those of the vocoded-speech for NH-Sim listeners (see Table 1), IEEE sentences were low-pass filtered at 2149 Hz, which is the high cutoff frequency of bandpass noise #10 used for the vocoded-speech. However, if the CI listeners did not achieve speech recognition scores of at least 50% in quiet, the low- pass cutoff frequency was changed to 3205 Hz, which is the high cutoff frequency of Band #11. This allowed those CI listeners to have more spectral information of the speech available. Two out of the seven CI listeners (CI 3 and 5) required the wider speech spectrum to achieve 50% correct in quiet. Because there was no significant modulation effect on speech recognition in the NH-Sim listeners, and previous studies by Nelson and colleagues (Nelson &Jin, 2004; Nelson et al., 2003) using speech materials with a full spectrum showed no significant performance difference between 16 Hz and higher modulation rates for CI listeners, three noise modulation rates-0, 4, and 16 Hz-were used to shorten the length of experiment time for the CI listeners. Similar to the noise conditions used for the NH-Sim listeners, a series of bandpass-filtered noises were created to design four noise conditions: embedded (noise completely embedded within the speech band), PO-more (partially overlapping more), PO-less (partially overlapping less), and remote (not overlapping) relative to the speech spectrum. The low and high cutoff frequencies for each noise condition are shown in Table 4.

Procedure

Six out of the seven CI listeners wore implants bilaterally. Throughout the experiment, they were asked to use only one device that works better and that he or she relies on more in everyday life. The other device was turned off. One CI listener, CI 6, used a single device without a hearing aid on the other side. Thresholds through each listener's CI device in the sound field were measured for filtered noises with identical spectra of speech and each masking noise (i.e., embedded, PO-more, PO-less, and remote) in order to confirm that speech and noise were fully audible to the CI listeners. Noises were presented monaurally via a loudspeaker located at 45° azimuth and 0° elevation, and in 1-meter distance to the ear with the CI device.

For the speech recognition test, the loudspeaker was set at the same azimuth and distance to the listeners' CI device as those set in the masking-noise threshold test. The level of speech was 70 dB A. When background noise was present, the noise was at a +10 dB SNR. In each condition, two randomly chosen lists of 10 sentences were presented to the participants. Participants were seated in a sound booth and were asked to repeat back what they heard after each sentence was presented. An examiner outside the booth was able to hear the verbal responses via a talk-back system and marked the key words that were repeated correctly on an answer sheet. After each response, the examiner pressed the "Enter" key on the computer keyboard to present the next sentence. Each participant was scored for the percentage of correct key words identified. The same scoring method used for the NH-Sim listeners was applied to calculate identification scores for each condition. No correct feedback was provided to the participants.

Conditions were randomized across the participants, as was the order of the 10 sentences within each list. Practice listening was given at the beginning of the first session of the speech experiment. First, CI listeners were presented with full-spectrum speech (unprocessed speech) in quiet to make sure their best speech recognition score was at least 70%. Second, they listened to low pass filtered speech at 2149 Hz in quiet. If the CI listeners were able to identify the key words at least 50%, this high cutoff frequency was employed to process speech stimuli. If CI listeners could not reach 50% key word identification, the cutoff frequency was increased to 3205 Hz, as described earlier. Once the appropriate cutoff frequency was set for each CI listener, another practice run was played in the remote noise condition with noise modulation of 16 Hz.

Results

Table 5 shows detection thresholds for individual CI listeners in each band of noise whose spectrum was similar to the speech or noise conditions. Detection thresholds for speech and each noise condition were measured in order to ensure that both speech and noise were audible to the CI listeners. Thresholds ranged from 19 dB SPL to 38 dB SPL, which were below the presentation levels for speech and noise.

Figure 2 shows the average scores of percentage correct key word identification for the CI listeners as a function of different listening conditions. In quiet, CI listeners understood 85% of full-spectrum speech on average, ranging from 72% to 100%. When the stimuli were low-pass filtered at 2149 Hz (for CI 1, 2, 4, and 7) or at 3205 Hz (for CI 3 and 5), the average performance in quiet was 68%, ranging from 54% to 86%. To compare speech recognition scores in quiet with those in noise, a one-way ANOVA was carried out with five levels of spectral listening conditions: embedded, PO-more, PO-less, remote, and quiet. Because there was no AM modulation applied to the quiet conditions, only speech recognition scores in steady-state noise (0 Hz modulation) at each spectral distance condition were analyzed. A significant overall spectral separation effect was revealed, $F(A, 30) = 19.017$, $p < 0.001$. Bonferroni post hoc tests showed that CI listeners' performance in the remote condition was significantly worse than in quiet ($p = 0.023$) and significantly better than in the rest of the noise conditions (all p values <0.026). The tests also indicated better performance in quiet than in all other spectral separation conditions (all p values <0.023). The results suggest that CI listeners' speech understanding is adversely affected by the presence of noise, even when the noise is spectrally remote from speech.

Two-way repeated-measures ANOVAs (Spectral Separation x AM Rate) with sentence recognition scores as the dependent variables showed significant effects of both spectral, $F(3,18) = 22.48$, $p < 0.001$, and AM-rate differences, $F(2, 12) = 19.86$, $p < 0.001$. However, there was no significant interaction between the two factors,

F(6, 36) = 1.39, p >0.05. Bonferroni post hoc tests for the effect of spectral separation between speech and noise revealed that the performance of the CI listeners in the remote noise condition was significantly better than those in three other noise conditions, embedded, PO-more, and PO-less (p <001). Interestingly, speech understanding scores were not significantly different (p >0.05) when the spectrum of noise was either completely embedded with or partially overlapping (PO-more and PO-less) the speech bandwidth. This suggests that the internal spectral masking was greater than what would be expected by the physical spectral characteristics of the noise (the distance from the speech signals), which might be due to the fact that CI listeners experienced significant spectral interaction between the masker and speech.

Examining the effect of AM rate, Bonferroni post hoc tests showed that the CI listeners' sentence recognition was significantly poorer in noise modulated at 4 Hz than in steady noise (0 Hz) or in noise modulated at 16 Hz regardless of spectral separation. This is illustrated in Figure 2, showing the lower performance across noise spectra at 4 Hz compared to the performance at 0 Hz and 16 Hz.

In general, the CI listeners showed evidence of modulation interference when the masker was modulated at 4 Hz, which is a rate similar to the syllabic rate of the speech stimuli. Further, the CI listeners showed significant masking even in the presence of spectrally remote or slightly over- lapping noises, indicating significant internal current spread of speech and noise spectra.

Comparison Between NH-Sim and CI Listeners

To examine performance differences between the two listener groups, we compared the results of Experiments 1 and 2. First, a one-way (listener group) ANOVA with speech recognition scores in quiet as the dependent variable showed that there was no significant listener group difference in quiet, i*U,15) = 0.565, p >0.05, which indicates that the NH-Sim and CI listeners were able to understand the low- pass filtered speech equally well in quiet.

To examine performance differences between the NH- Sim and CI listeners in noise, a three-way repeated-measures ANOVA was carried out with two within-subject factors (Spectral Separation x AM Rate) and one between-subject factor (listener group). Only the noise conditions used for both listener groups were included in the analysis (four spectral separations: embedded, PO-more, PO-less, and remote, and three AM rates: 4 Hz, 16 Hz, and steady state). Figure 3 shows the performance of both the NH-Sim and CI listeners as a function of noise conditions at each AM rate (the top panel for 0 Hz, the middle for 4 Hz, and the bottom for 16 Hz). Overall, the CI listeners performed significantly worse than the NH-Sim listeners in the presence of noise (between-subject factor) regardless of the modulation rate, *F('l,15) = 8.312, p <0.05. In addition, significant effects of spectral separation, F(3, 45) = 86.079, p <0.001, and AM rate, F(2, 30) = 17.723, p <0.001, were found. A Bonferroni post hoc test showed that when noise was modulated at 4 Hz, listeners performed worse compared to their performance in steady and 16-Hz modulated noise (all p values <0.001). Listeners' performance in steady noise was not significantly different from that in the modulated noise at 16 Hz (p >0.813). There were no significant two- or three-way interactions among the three factors (p >0.05). This result suggests that noise modulated at a syllabic rate (4 Hz) caused both the NH-Sim and CI listeners greater difficulty under-standing speech than a steady noise or a noise with faster modulations.

The nonsignificant interaction between the AM rate and listener group was somewhat unexpected. Based on the previous separate analysis for the NH-Sim group and for the CI group, the CI listeners were significantly affected by the AM rate difference (with 4-Hz modulated noise showing a negative effect on performance), whereas the NH-Sim listeners were not. This ambiguous finding might be due to the fact that the NH-Sim listeners were originally tested with more AM-rate conditions. To test this assumption, we conducted a two-way repeated-measures ANOVA on the performance of the NH-Sim group, including only the conditions that were the same as those for the CI group. The results showed that there was a significant effect of modulation rate, F(2, 18) = 5.23, p = 0.016, and spectral separation, ^(3, 27) = 80.07, p <0.01. A Bonferroni post hoc test revealed a significant difference in the NH-Sim listeners' performance between 4 Hz and 16 Hz (p = 0.025), but

not between steady and 4 Hz or 16 Hz (allp values >0.05). Thus, we conclude that both the CI and the NH-Sim listeners were somewhat negatively affected by the 4-Hz AM rate, resulting in modulation interference, although the interference was stronger for the CI group than for the NH-Sim group. On the other hand, there was no performance difference between the 16-Hz modulated noise and the steady noise conditions for both listener groups, which suggests neither masking release nor modulation interference for the faster AM rate.

Modulation of the noise seemed to affect CI users in a manner somewhat different from the simulation listeners. Figure 4 shows the average performance difference between modulated noise (either 4 Hz or 16 Hz) and steady-state noise (0 Hz) for the NH-Sim (upper panel) and the CI listeners (lower panel) as a function of the noise conditions. The difference >0 indicates masking release (i.e., the score in modulated noise exceeds the score in steady noise), whereas the difference <0 suggests modulation interference, with the performance in modulated noise poorer than that in steady noise. For NH-Sim listeners, the performance differences in most noise conditions except remote at 4 Hz were <0, showing masking interference. At 16 Hz, the difference for NH-Sim listeners was >0, indicating some masking release. For CI users, the performance differences in 4-Hz modulated noise were mostly <0 and were always poorer than those in 16-Hz modulated noise. This suggests that at the 4-Hz modulation rate, CI listeners seem to be experiencing modulation interference, especially when compared to their performance at 16 Hz.

Discussion

Effect of Noise on NH-Sim and CI Listeners

The purpose of the current study was to investigate the possible contribution of temporal and spectral interference to sentence recognition in modulated noise for NH-Sim and CI listeners. Both speech and noise were processed via various sets of bandpass or low-pass filters (Fu &Nogaki, 2004) to create different spectral distances between the target speech and noise. The amplitudes of noise masker were also modulated at different rates to examine whether a certain modulating rate might cause more interference than others. Overall, the results suggest that even when the NH-Sim and CI listeners are equated for their speech understanding in quiet, there are important differences between the two groups in noise conditions. For example, sentence recogni- tion of the CI listeners was significantly poorer than that of the NH-Sim listeners in all types of noise, even though their performances were equivalent in quiet, suggesting that there is considerable spectral spread for "real" CI listeners that is not captured in NH-Sim listeners. Syllabic rates of modulation had negative modulation interference effects on both listener groups, with more noticeable interference for the CI listeners. When speech and masker noise were spectrally separated, the NH-Sim listeners were not adversely affected by the noise, which resulted in similar performance in quiet and in spectrally remote noise. When the noise and target speech were spectrally overlapped, greater spectral over- lapping of vocoded speech and masker resulted in a larger and systematic decrease in speech understanding. The NH- Sim listeners did not show significant masking release when the noise masker was amplitude modulated (seen in Figure 3). Furthermore, the various AM rates on masker did not result in much increased difficulty in understanding vocoded speech, suggesting that the amplitude modulation itself might not substantially interfere with the temporal envelope cue for vocoded speech. However, it should be noted that there was large intersubject variability for listeners' understanding vocoded speech in noise, similar to that seen by others (Fu &Nogaki, 2004; Nelson et al., 2003). The CI listeners were significantly affected by noise even when the spectrum of noise was remote from that of speech, which was different from the NH-Sim listeners, whose performance did not drop in the remote condition. The sentence recognition scores of the CI listeners dropped even further when the noise spectrum was overlapped with the speech spectrum. For the three overlapping noise conditions-embedded, PO-more, and PO-less-the CI listeners' performance remained poor and approximately the same. It should be noted, however, that a potential limitation of the current study might have affected generalization of the findings to the CI population.

In order to examine the effect of spectral interference of noise on speech perception when spectral distances

between noise and speech signal were varied, we decided to use speech stimuli that were low-pass filtered at 2149 Hz or 3205 Hz instead of full-spectrum speech, which is a more natural and realistic listening condition. Overall for CI users, the AM rate of the modulated noise had an effect, stronger than their NH-Sim counterparts. Their 4-Hz modulated noise performance was significantly lower than both steady ($p < .001$) and 16 Hz ($p = .005$) noise, with no difference between steady and 16-Hz modulated noise. Overall, no masking release was observed. In fact, within a given spectral condition (remote, overlapping), performance in steady noise was often better than that in modulated noise, indicating some modulation interference. In particular, performance in 4-Hz AM noise (shown in filled bars with zero or negative masking release) was the poorest.

Clinical Implications for CI Listeners

One of the common findings from the studies of CI users is individual variability in their speech recognition scores regardless of speech materials or noise conditions (e.g., Fu &Galvin, 2008; Gifford, Shallop, &Peterson, 2008; Kwon et al., 2012), which was also found in the current study. Table 6 shows the performance of individual CI listeners in several conditions: quiet with full-spectrum speech and low-pass filtered speech, remote noise for the three AM conditions, and embedded noise for the same AM conditions. Note that CI 2 and CI 6, who performed best in quiet conditions (both full-spectrum and low-pass filtered speech), understood sentences better in most of the noise conditions than the rest of the CI listeners. CI 7 performed almost as well in quiet but scored poorer in noise. Among the remaining CI listeners, CI 3 and 4 had the worst scores in quiet; however, their recognition scores in the noise conditions were not consistently lower than the others. Overall, the current findings of individual variability suggest that a CI listener's performance in quiet does not always predict how much he or she is affected by noise in real life (as suggested by Smoorenberg, 1992).

Unlike the NH-Sim listeners, the CI users were significantly affected by the noise even when its spectrum was distant from the speech spectrum, as in the remote condition (see Figure 2). As suggested before, this might be due to channel interactions between speech and noise, which is a peripheral effect of the remote masker. It could also be possible that such a spectrally distinct noise masker may interfere with the central processing of a speech signal. This central masking could result from the listener's reduced ability to separate the target and masker due to the high degree of target-masker similarity, sometimes also referred to as informational masking (Arbogast, Mason, &Kidd, 2002; Brungart, 2001).

It has been reported that CI users may have an effective number of four to eight channels, even though more channels are built in the speech processor (Fishman, Shannon, &Slattery, 1997; Friesen, Shannon, Baskent, &Wang, 2001; Gamham, O'Driscoll, Ramsden, &Saeed, 2002). Thus, the temporal envelopes of the speech represented at the central auditory system may be perceived as more similar to those of the masker for CI users than for the simulation listeners. The central/informational masking was demonstrated in the Stickney et al. (2004) study, where CI listeners did not show better speech recognition when the talker of single-talker maskers was different from the signal talker. If this is true, then peripheral manipulations on the current commercial CI devices such as developments in signal processing algorithms or mapping strategies might not be enough to reduce the negative effect of background noise on speech perception of CI listeners. Perhaps, specific auditory training such as speech-in-noise training or targeted speech training in modulated maskers could be recommended based on listeners' individual needs (Fu &Galvin, 2008).

Previous studies reported that auditory training was helpful for listeners with hearing impairment to detect/ recognize simple stimuli such as musical tones (Galvin et al, 2007; Gfeller et al, 2002) and to understand speech recog- nition in difficult listening conditions (Fu &Galvin, 2008). Furthermore, behavioral changes due to auditory training seem to be correlated with training-related neurophysiologi- cal changes (Tremblay et al, 1998). Further studies need to be conducted to develop and verify an effective training method for CI users listening in modulated noise, in order to improve their segregation of speech from modulated back- ground noise. In the meanwhile, clinicians may recommend commercially available computer-based training such as Computer Assisted Speech Training (Fu, Galvin, Wang, &Nogaki, 2005), Listening and Auditory Communication

Enhancement (Sweetow &Henderson-Sabes, 2004), or a word-based auditory training program (Humes, Burk, Strauser, &Kinney, 2009), to CI users who have more difficulty understanding speech in noise. These programs have been shown to alleviate their stress levels in unfavorable listening conditions and to improve their understanding of speech in general.

Conclusion

CI users show more spectrally based masking than do their NH-Sim counterparts. Noise that was thought to be spectrally remote from the speech signal nevertheless interfered with CI listeners' perception of bandpass speech signals. Even when noise was designed to be spectrally remote from the speech signal, the presence of the noise (modulated or unmodulated) produced masking in CI listeners but not in simulation listeners. This can be presumed to result from the current spread of the speech and noise signals, and could be one reason why even the presumably remote masker showed some modulation interference for the CI users. In the simulation listeners, performance in the remote masker was equivalent to that in the quiet low-pass speech, and no modulation interference is seen. Presumably, then, the simulation listeners could still segregate the speech from the remote noise, and the envelope of the modulated remote noise did not cause interference or confusion with the use of the speech envelope.

Both NH-Sim and CI listeners show some evidence of modulation interference when listening to speech in modu- lated noise, with modulation interference showing up more strongly in CI users than in their NH-Sim counterparts. This interference happened whether the noise was spectrally embedded, overlapping, or remote from the speech signal. This could be an important factor in understanding the lack of masking release in these listeners, and could add to our understanding of their poor performance in background noise. When listeners have poor spectral resolution and they are tested using syllabic-like rates of modulated noise even at favorable SNRs, they apparently tend to be disrupted by the modulated noise, resulting in increased speech processing errors.

Acknowledgment

Portions of this project were supported by a Texas Speech- Language Hearing Foundation grant to the first author, the Doctoral Dissertation Fellowship at the University of Minnesota to the second author, and the National Institute on Deafness and other Communication Disorders (DC008306) to the third author.

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Editor: Larry Humes
Received August 21, 2012
Revision received January 13. 2013
Accepted January 17. 2013
DOI: 10.1044/1059-0889(2013/12-0049)

Sertoma club tackles hearing health

Author: Gitt, Tammie.

Publication info: McClatchy - Tribune Business News [Washington] 01 June 2013.
ProQuest document link

Abstract: People with properly equipped hearing aids can flip a switch on the hearing aid and the hearing aid effectively becomes a loudspeaker in the ear and filters out the background noise.

Full text: June 01--ENOLA -- Maureen Royer of the Carlisle Area Sertoma Club saw a recent Harrisburg Senators game as an opportunity to advance the club's mission of raising awareness of hearing issues.
It was, however, fireworks night. Fireworks can top 130 decibels, according to the American Speech-Language-Hearing Association. Hearing loss starts with anything over 85 decibels.
Royer saw irony as opportunity, handing out earplugs at the club's information table.
Nearly everyone knows someone affected by hearing loss, Royer said. One in five Americans experience some form of hearing loss.
"The hearing we have today won't get better," Royer said. "It will only get worse."
The next opportunity for the clubs to proclaim their message comes at the Celebrate Sound: Don't Walk in Silence fun walk on June 29.
Celebrate Sound is a national fundraiser co-sponsored by Sertoma and its sister nonprofit, Hearing Charities of America. The walk raises awareness about communication disorders, educates people about hearing health and promotes activities that can improve the quality of life for those with hearing issues.
Royer said the 18 clubs in the East and West Central Penn districts will hold walks on the same day in Harrisburg, York and Lancaster.
Capitol Area Sertoma, Carlisle Area Sertoma, Hearts-N-Hands Sertoma-Mechanicsburg, Middletown Hearts-N-Hands and West Shore Sertoma clubs are working together on the Harrisburg walk. Royer said this is the first time the clubs have held a joint event with a singular focus.
The walk will start at 9 a.m. June 29, at Adams-Ricci Community Park in Enola. Sertoma member RJ Harris, the morning show host at WHP 580, will be the emcee for the event.
Registration for the walk is $20. People can visit the website, mycelebratesound.com/Carlisle to register or make a donation. Royer said people can also participate as "virtual walkers" by donating $20, who would still

receive the free T-shirt.
Royer said the goal of the Harrisburg area teams is to raise $12,000.
Half of the proceeds from the walk will go back to the club to use in the community and the other half will go to the national Sertoma headquarters to fund national projects.
Local projects may include looping public meeting rooms. A looped room has an inductive coil installed and connected to the public address system. People with properly equipped hearing aids can flip a switch on the hearing aid and the hearing aid effectively becomes a loudspeaker in the ear and filters out the background noise.
The club also gives scholarships to students from local high schools who intend to pursue careers in hearing-related fields such as audiology and special needs education. Royer said they have given away about $40,000 since 1998.
Credit: The Sentinel, Carlisle, Pa.

Take Our Advice

Publication info: The Gazette [Colorado Springs, Colo] 11 May 2013: 38.
ProQuest document link

Abstract: For those of us old enough to have experienced the British Invasion (The Beatles, The Rolling Stones, The Kinks and, of course, The Who), hearing troubles are likely a combination of age and the ear-damaging decibels that came through Marshall amplifiers, those early Walkmen or cranking the volume past 60 percent! If your problem is inner-ear damage, you'll go through a series of hearing tests and evaluations to find which type of aid will work best and which you can most easily adjust to.

Full text: Dear Amy: Ever since we broke off our serious relationship, I've realized how much I compromised to please this woman and how I practically changed myself during the course of our relationship. She has moved away, we're on good terms now, and she's seeing someone new. I think she learned her lesson from our relationship and changed. I still have strong feelings for her. In all honesty, I really want her back. -- Regrets
Dear Regrets: Your former girlfriend seems to have changed because she has changed -- she has changed her love object and her address, for instance. She is no longer controlling you because she is no longer with you. This could be why she seems so patient and reasonable to you -- she has a new person to bend to her will and whim. Chasing an ex who is with someone else is considered to be in poor taste. Consider objectively the possibility she hasn't changed at all but that you miss her anyway.
Realize that's OK, and normal, and then put yourself in healthy situations to meet new people.
Dear Amy: My boyfriend of several years claimed he wanted to get married and then said he wanted to live together first, even though I object to doing so.
He then said, after a breakup, that he was ready to get married and was prepared to propose. A proposalfree year and a half passed, and I asked him directly why he had done that. He held steadfast to needing to live together, and I finally agreed to it a month ago, gave my landlord notice and told my kids.
Today he texted that he no longer thinks that we should live together. He refuses to talk face to face and will not return my calls. What is the best thing to say to him at this point? -- Confused
Dear Confused: This guy will not take your calls -- but he's really doing you a favor, because you should not be talking to him. Do not communicate with him again. Talk to your landlord, apologize to your kids and restart your life.
--

Send questions to Ask Amy,
Chicago Tribune, TT500, 435 N.
Michigan Ave., Chicago, IL 60611
or email askamy@tribune.com.

Q u e s t o n :

I'm turning 60, and maybe all those rock 'n' roll concerts I went to are finally taking their toll on my hearing. I think I need a hearing aid, but I don't want to look like my grandmother. Any advice? -- Adele, C., Boulder

Answer: Oh, yes. For you -- and all the rock 'n' rollers in their 60s and 70s -- the answer to "Tommy, can you hear me?" finally might be YES, because of the amazing breakthroughs audiologists are making these days.

For those of us old enough to have experienced the British Invasion (The Beatles, The Rolling Stones, The Kinks and, of course, The Who), hearing troubles are likely a combination of age and the ear-damaging decibels that came through Marshall amplifiers, those early Walkmen or cranking the volume past 60 percent! Almost 10 million folks ages 45 to 65 report problems with their hearing, but we believe there's a lot more.

Fortunately, hearing aids are now coming in loud and clear, with five digital types: behind the ear; on the ear (s m a l l e r than behind the ear); in the ear; in the ear canal (barely visible); and comple tely in the ear canal (invisible). They work off p r o g r a m - mable computer chips that can differentiate between speech and background noise and can filter out the background. Amazing! And they don't look anything like your grandma's earpiece.

So, get thee to a specialist. If your problem is inner-ear damage, you'll go through a series of hearing tests and evaluations to find which type of aid will work best and which you can most easily adjust to. Be patient and persistent. Take various models for a test drive. The process of choosing the right hearing aid may take some time. But the rewards of being able to comfortably participate in the noisy world around you more than make up for the hassles you may have.

--

Mehmet Oz, M.D., is host of "The
Dr. Oz Show," and Mike Roizen,
M.D., is Chief Medical Officer at the
Cleveland Clinic Wellness Institute.
Submit your health questions at
www.doctoroz.com.

Dear Helo se: For my granddaughter's birthday, my daughter hosted a painting party for several little girls she had invited. She went to a crafts store and bought small, individual canvases for each child. Then she covered the outside patio table with some newspaper and set up each little girl at the table with a canvas in front of her. When the little girls were done, my daughter had them sign the back of the canvas. When the canvases were dry, she framed them, and on the back of each masterpiece she wrote the date and occasion. -- Judy Malik, Seguin, Texas

Darl ng! Fun idea for folks of any age. -- Heloise

Dear Helo se: To keep strawberries fresh longer, evenly space them in an airtight container with pieces of paper towel between each layer and place in the refrigerator. -- E.G. in Conn.

Strawberr es are a favor te of mine. To easily hull strawberries, poke a straw all the way through the strawberry, from the bottom up. For my strawberry gelatin cake recipe, as well as Heloise's Red Velvet Cake and War Cake, send $5 and a long, selfaddressed, stamped (66 cents) envelope to: Heloise/Cake, P.O. Box 795001, San Antonio, TX 78279-5001. -- Heloise

Dear Helo se: My husband is on oxygen. Clear tubing
is difficult to see on our floor, so I cut about a half-inch of neon orange duct tape and wrapped it around the tubing about every 8 to 10 inches. Easier to see it and less danger of getting feet tangled up and possibly

falling. -- Wanda in Texarkana, Ark.
Dear Helo se: I use a leather glove on my hand so lids can't slip during removal. -- James in Oregon
Somet mes the l ds on jars or other containers can be a pain (literally) to remove. Tap the side of the lid with a wooden spoon to help break the air seal. When in desperation, my favorite thing to do is to let someone else open it. -- Heloise
--
Send hints via post to Heloise, P.O. Box 795001, San Antonio, TX
78279-5001 or via email
to heloise@heloise.com.

Petrosquamosal sinus in the temporal bone as a cause of pulsatile tinnitus: a radiological detection

Author: Liu, Zhaohui;Chen, Chengfang;Wang, Zhenchang;Gong, Shusheng;Xian, Junfang;Liang, Xihong

Publication info: Clinical Imaging 37.3 (2013): 561-3.
ProQuest document link

Abstract: We report a newly evidenced cause of venous pulsatile tinnitus--the petrosquamosal sinus in the temporal bone. We also present the case of a 45-year-old woman who presented with an incapacitating objective pulsatile tinnitus in the left ear for 10 years. The radiology evidenced a petrosquamosal sinus in the air cells of the left temporal bone. The symptoms of pulsatile tinnitus disappeared completely after surgical treatment.

Full text: 1 Introduction

Pulsatile tinnitus is the perception of a rhythmical noise that is synchronous with the heartbeat. It frequently induces anxiety and depression in patients. Sometimes, it becomes an unbearable sound that even drives patients to commit suicide [1] . Because the treatment is based on the cause of pulsatile tinnitus, accurate diagnosis is imperative.

Pulsatile tinnitus is a multifactorial disease and can be categorized into vascular and nonvascular. In the present study, we reported the first case of pulsatile tinnitus as a result of petrosquamosal sinus. The petrosquamosal sinus was surgically treated, and the pulsatile tinnitus disappeared.

2 Case report

A 45-year-old woman complained of objective pulsatile tinnitus in the left ear, which started 10 years ago. The tinnitus was enhanced in physical activity or in a stooping position of the body and decreased in rotation of the head to the left or by external compression of the ipsilateral vascular structures. Otoscopic examination revealed no abnormal findings.

Dual-phase contrast-enhanced CT was performed from the vertex to approximately the sixth cervical level. The venous phase CT showed a petrosquamosal sinus that originated at the junction of the transverse and sigmoid sinuses and traveled in the left temporal bone. The form of bifurcation was demonstrated at the anterior end of the petrosquamosal sinus, without anterior communications. A dehiscent cortical plate around the petrosquamosal sinus and an extensive pneumatized temporal bone filled with air were also found (Fig. 1). Digital subtraction angiography (DSA) confirmed the presence of the petrosquamosal sinus. The manifestation of the petrosquamosal sinus on DSA resembled that on computed tomography (CT) (Fig. 2), but the petrosquamosal sinus was not demonstrated on magnetic resonance imaging (MRI). Dual-phase contrast-enhanced CT, MRI, and DSA did not evidence any known cause of pulsatile tinnitus.

The petrosquamosal sinus was treated by surgery. Briefly, a postauricular incision was made and an anterior skin flap was raised over the mastoid. A superiorly based mastoid periosteal flap was created and pedicled on the temporal muscle to expose the mastoid cortex. The petrosquamosal sinus in temporal bone was skeletonized. Temporal muscle and fascia were placed on the surface of the petrosquamosal sinus. The repair was then covered with the superiorly based periosteal flap. The skin was closed, and a compressive mastoid dressing was placed. The pulsatile tinnitus disappeared completely after surgery and did not reappear during 33 months of follow-up.

3 Discussion

Although the petrosquamosal sinus usually declines in size in fetuses of 60 mm in length and disappears by the time of birth [2] , it sometimes may persist after birth. Previous anatomical and radiological studies have described this venous channel in occasionally healthy people [3-5] . However, petrosquamosal sinus has not been reported as a cause of pulsatile tinnitus in previous studies. Because the petrosquamosal sinus was located close to the inner ear and coexisted with a dehiscent cortical plate and an extensive pneumatized temporal bone in the patient of the present study, we hypothesized it might be the cause of the tinnitus. This hypothesis was also supported by the clinical examination and surgical treatment.

Although the petrosquamosal sinus presented in the embryonic period, the tinnitus occurred in the patient at 35 years old. We suspect that the cortical plate between the petrosquamosal sinus and the air cells of the temporal bone may be complete before the presence of pulsatile tinnitus. The complete cortical plate is considered as an insulation characteristic and may impede the noise from flowing in the petrosquamosal sinus to transmit to the air cells [6,7] . A dehiscent cortical plate caused by long-term impacting effect of blood flow on the cortical plate may destroy this insulation characteristic. The noise from blood flow can be easily transmitted to the air cells through the dehiscent cortical plate. Large air cells filled with air can increase the resonance of noise by prolonging, amplifying, and filtering the sound being transmitted to the cochlea [6,7] .

Pulsatile tinnitus has numerous causes and can be divided into vascular and nonvascular. To date, about 20 causes of vascular pulsatile tinnitus have been reported [6-17] . The majority of patients have a treatable underlying cause which can be detected in about 70% of them radiologically [8] . Therefore, detailed imaging studies are recommended. Radiological investigations of pulsatile tinnitus include dual-phase contrast-enhanced CT, inner ear MRI, and DSA at our institution. Dual-phase contrast-enhanced CT serves as an initial survey for pulsatile tinnitus because it can provide highly detailed images of the temporal bone and the vascular anatomy. MRI should then be performed for detection of possible neoplasm or vascular malformation. Although arterial phase CT and MRI can screen dural arteriovenous fistulas in patients with pulsatile tinnitus [9,10] , DSA remains the gold standard for this disease [18] . In our case, although the petrosquamosal sinus can also be confirmed on DSA, the relationship between the petrosquamosal sinus and the temporal bone can only be evaluated on contrast-enhanced CT.

In conclusion, this newly described treatable cause of pulsatile tinnitus, namely, the petrosquamosal sinus in the temporal bone, is a rare venous variation. It should be included in the differential diagnosis of pulsatile tinnitus in clinical practice. Contrast-enhanced CT is recommended as the primary diagnostic tool with the suspicion of the disease. The surgical treatment of such a lesion is an effective and safe method.

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What's New and Notable in Hearing Aids: A Friendly Guide for Parents and Hearing Aid Wearers

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Publication info: Volta Voices 20.3 (May/Jun 2013): 24-29,6.
ProQuest document link

Abstract: Audiologists should properly select good candidates for frequency-lowering technologies, program this technology appropriately for the individual's needs, and verify the benefit the wearer receives through the use of probe microphone measures (ask your audiologist about probe microphone measures if you are unaware of this important hearing aid assessment tool).\n Because the microphone is positioned closely to the mouth of a parent or teacher, the speech signal captured by the system's microphone is typically much higher in volume level than the surrounding background noise. Studies have shown that hearing aid and cochlear implant users receive great benefit from dynamic digital RF systems when compared to traditional/classic and dynamic FM systems (Thibodeau, 2013; Wolfe et al., in press).

Full text: Sometimes, it seems that hearing aid technology changes as quickly as computer technology. By the time you get a new one, there's something else on the horizon that will make your "new" hearing aids seem outdated. However, there are some great things happening that will likely stick around for quite a while. Investing in new hearing aids or maybe even your first pair can be overwhelming. Today, some advanced technology features, which were formerly only available in expensive, high-end hearing aids, are now available in economy-level hearing aids. This article discusses several new hearing aid technologies and suggests

questions that you may want to ask your hearing health providers when you select your next set of hearing aids.

Access to HighFrequency Information

Audibility of high-frequency sounds is essential for developing speech and language. The ability to hear high-frequency speech sounds is crucial for understanding speech as well as the rules underlying language and grammar, such as plurality, possessives and subject-verb agreement. Furthermore, research has shown that when children with hearing loss cannot adequately hear sounds above 4,000 Hz, they will have to be exposed to three times as many words as children with typical hearing to learn new vocabulary and concepts due to the reduced acoustic bandwidth caused by the hearing loss (Pittman, 2008). The "Familiar Sounds Audiogram" shown in Figure 1 illustrates the large number of consonants that reside in the high frequencies. Unfortunately, hearing aids have typically been limited in their ability to provide sufficient audibility for high-frequency sounds. The speech sounds on the audiogram are placed in the pitch and intensity range at which the sounds are typically heard. You can see that high-frequency sounds like Ik/, If/, Is/, and /th/ occur in the highfrequency range (3,000-8,000 Hz) and at very soft levels. These sounds are important to understand plurality, possessives, and for overall clarity of speech.

Hearing loss is frequently poorer in the high frequencies relative to the low frequencies. In response to the aforementioned difficulties, hearing aid manufacturers have developed several approaches to improve audibility and understanding of high-frequency speech and environmental sounds.

Traditionally, hearing aids have been unable to provide sufficient amplification for sounds beyond 4,000 to 6,000 Hz. This constraint was primarily attributed to a limitation of the hearing aid receiver (the term used to refer to the miniature speaker of the hearing aid), which simply could not provide adequate amplification of high-frequency sounds. Additionally, the hearing aid would often produce acoustic feedback (i.e., whistling, squealing) with attempts to amplify high-frequency sounds.

Recently, several manufacturers have introduced "extended bandwidth" hearing aids, which promote improved receivers that sufficiently amplify sounds to 8,000 Hz and beyond. Although this technology is promising, there is a paucity of studies showing significant improvements in speech recognition with the use of extended bandwidth amplification. Research studies addressing technologies designed to enhance access to high-frequencies will be discussed following the proceeding discussion on frequencylowering technology.

Rather than attempting to extend the limits of the hearing aids frequency response, some manufacturers have developed hearing aids with frequency-lowering technology. Frequency lowering can be achieved by linear frequency transposition (LFT), non-linear frequency compression (NLFC), or spectral envelope warping (SEW). A brief explanation of each follows.

Linear frequency transposition (LFT) (Figure 2B) takes high-frequency sounds, transfers them down into a lower frequency range, filters the transposed sound and then mixes it in with the amplified lowfrequency sounds, where the patient has better hearing, so that the high-frequency and low-frequency sounds are overlaid on one another.

Non-linear frequency compression (NLFC) (Figure 2C) takes high-frequency information above a designated frequency range, referred to as the crossover frequency, and compresses it into a lower range as determined by a pre-set frequency compression ratio. Sounds below the crossover frequency are not compressed, and low-frequency and high-frequency sounds are not mixed with one another.

Spectral envelope warping (SEW) (Figure 2D) is designed to capture a high-frequency sound information and replicate it at a lower frequency. Similar to LFT, the bandwidth of the high-frequency sound information is not altered, SEW moves the high-frequency of sound to a lower frequency range, where the low-frequency and high-frequency sounds are overlaid on one another. However, in contrast to LFT, SEW also amplifies the high-frequency sound and presents it at its original frequencies as well (Rodemerk et al., n.d.; Simpson, 2009).

All of the aforementioned frequency-lowering strategies possess potential advantages and limitations, and there

are no published research studies showing one approach to be superior to another. However, published studies have shown that each of these different frequency-lowering technologies can improve audibility and speech understanding of high-frequency speech sounds for children and adults with severe to profound hearing loss (Auriemmo et al., 2008; Glista et al., 2009; Kuk et al., 2010; Simpson et al., 2005; Galster et al. 2011). Additionally, Wolfe and colleagues (2010; 2011) determined that NLFC improves audibility for and recognition of high-frequency speech sounds for children with moderate highfrequency hearing loss, and they showed that performance with NLFC improved with experience (i.e., acclimatization) with the frequency-lowering technology. As such, several weeks of NLFC use may be necessary before benefit is fully realized. More recendy, Wolfe and colleagues (submitted, 2013) compared aided thresholds and speech recognition for a group of children who had mild hearing loss and used hearing aids with NLFC and extended bandwidth. NLFC provided better access to low-level high-frequency sounds as well as better recognition of high-frequency speech sounds when compared to hearing aids with extended bandwidth.

As previously mentioned, there can be disadvantages associated with frequencylowering technology. In particular, if the frequency-lowering is too aggressive, then speech and environmental sounds may become distorted resulting in poor sound quality and a reduction in speech understanding. Audiologists should properly select good candidates for frequency-lowering technologies, program this technology appropriately for the individual's needs, and verify the benefit the wearer receives through the use of probe microphone measures (ask your audiologist about probe microphone measures if you are unaware of this important hearing aid assessment tool). Further, the benefits of frequency-lowering technology should be validated with behavioral testing and feedback from parents, speech therapists, and teachers. Researchers have suggested several different practices to effectively fit and verify frequencylowering technology as well as to determine candidacy for these technologies (Glista &Scollie, 2009; Kuk, 2013; Simpson, 2009; Wolfe et al., 2010, 2011).

Hearing Aid Noise Reduction Technologies

One of the most pressing difficulties of persons with hearing loss is an inability to effectively understand speech in the presence of noise. Studies have shown that around 40% of adult wearers continue to be unsatisfied with their ability to hear in noise after being fitted with hearing aids (Kochkin, 2010). Numerous research studies have shown that children with hearing loss experience even more difficulty understanding speech in noise when compared to their peers with typical hearing or adults with hearing loss (McCreery et al., 2010; Stelmachowicz et al., 2001). Hearing aid manufacturers have developed numerous technologies to improve performance in noise, including directional microphones, digital noise reduction (DNR), wind noise reduction, and dereverberation algorithms.

Directional microphone technology typically employs two or more microphones to amplify sounds coming in from the front as prescribed, while limiting or reducing amplification for sounds coming from the sides and back. This approach assumes that the wearer will face the signal of interest in a noisy environment, and consequently, the speech will be enhanced and the surrounding noise will be reduced. Numerous research studies have shown that directional microphones improve speech understanding in noise more than any other technology currently built into hearing aids (although directional microphones do not provide as much improvement in speech understanding in noise as remote microphone radio frequency systems - also commonly known as FM systems - which are an assistive technology that may be used with hearing aids to provide the most improvement in speech recognition in noise (Schäfer &Thibodeau, 2004)). As a result, directional technology is routinely recommended for adult hearing aid wearers.

In contrast, there are conflicting recommendations regarding the use of directional microphones in children (Bagatto et al., 2010; King, 2010; McCreery et al., 2012; Ricketts et al., 2010). For instance, the Ontario guideline for fitting hearing aids for children discourages the use of directional microphones for children, while the Australian guideline recommends the use of directional hearing aids for children (Bagatto et al., 2010; King, 2010). The hesitation associated with directional microphone use in infants centers around the concern that

directional amplification may limit a child's access to important sounds that arrive from behind him/her. We know that incidental listening, the term used to describe a child's tendency to listen to speech that, is not directed specifically to him or lier, is responsible for a great deal of a child's vocabulary and social development. In fact, Dr. Carol Flexer has estimated that as much as 90% of what a child learns during the first few years of life comes from incidental listening (Cole &Flexer, 2010). Could directional microphones, which inherently limit access to sounds arriving from behind a child, interfere with incidental listening? There has not been enough research examining directional hearing aid use in young children to fully answer that question yet.

It should be noted that many contemporary hearing aids feature what is often referred to as adaptive directionality, in which the hearing aid amplifies sound from all directions equally (e.g., omni-directional) in quiet environments and automatically switches to directional mode in noisy environments. In fact, some hearing aids even go a step further and remain in omni-directional mode if the primary signal arriving from behind the user is speech. With this approach, the risk of missing out on important speech signals arriving from behind or from the side of a hearing aid wearer is limited. It is likely that there are differences in adaptive directional algorithms from one manufacturer to another, and consequently, there is not enough evidence to determine whether they are suitable for children.

Although directional microphones may improve speech recognition in noise, it is probably prudent to refrain from their use until a child is old enough to consistently orient toward the signal of interest and provide verbal feedback about the potential perceived advantages and limitations of directional amplification. Hopefully, ongoing research and development will clarify the question of whether young children should use adaptive directional amplification and possibly even result in a hearing aid that limits the potential disadvantages of directional amplification for children.

Digital noise reduction (DNR) is another hearing aid noise technology designed to improve performance in noisy environments. DNR analyzes the sound arriving to the hearing aid, determines whether it is speech or noise, and reduces the aided gain when background noise is the dominant input. Research conducted with adult hearing aid users has shown that DNR significantly improves listening comfort in noise, and wearers consider DNR to be one of the most important features in their hearing aids (Powers et al., 2006; Kochkin, 2010). Other studies have indicated that DNR provides at most a modest improvement, and in many cases, no change in speech understanding in noise (Bentler, 2005; Peeters 2009). Most studies have shown no degradation in speech recognition in noise for adults using DNR. Like directional technology, DNR is routinely recommended for adult hearing aid wearers.

As with directional hearing aids, we are still examining the appropriateness of DNR for young children. Research with pediatric hearing aid users has essentially shown that DNR does not degrade or improve speech recognition in noise (Bentler et al., 2010; McCreery et al., 2010). Bender and colleagues (2010) did show that DNR may improve listening comfort for children in noisy situations. They also showed that children's novel word learning abilities were improved with the use of DNR, a fact they attributed to a decrease in the cognitive processing load afforded by improved listening comfort associated with DNR. Taken collectively, these findings suggest that DNR may be quite beneficial for children and should be considered for use with pediatric hearing aid wearers (McCreery et al., 2010; Stelmachowicz et al., 2010).

However, it is important to remember that not all hearing aids work alike, and it is possible that some DNR algorithms may reduce gain for speech. It is imperative that the audiologist verify that gain is not reduced when speech is present. Contemporary hearing aid testing equipment typically allows for this type of verification. The interested audiologist is referred to an excellent review by McCreery and colleagues on electroacoustic assessment of hearing aids with DNR (McCreery, Gustafson, &C Stelmachowicz, 2010). Once the audiologist does determine that DNR does not reduce gain when speech is present, DNR should be considered for pediatric hearing aid wearers.

Binaural Processing

There is a reason we have two ears. In people with typical hearing, the ears work together to better understand speech in noisy environments as well as to determine the direction from which a sound originates. For instance, we can tell that a sound originates from our right side, because it is a little louder and arrives a little earlier at the right ear than the left. Hearing aids are now capable of sharing information with one another in an attempt to preserve the natural differences that exist between sounds arriving at the two ears and mimic the way the natural auditory system works.

Furthermore, some hearing aids work together so that a wearer may adjust the volume or a program on one hearing aid and the change automatically happens at the other hearing aid. Some hearing aids also have the capability of allowing the user to hear the sound from a telephone in both ears simultaneously when the phone is placed next to one of the hearing aids. Finally, some advanced hearing aids share information between their microphones in order to allow for "super directionality." As shown in Figures 3B and 3C, beamforming achieved by two hearing aids working together can be much more precise than either hearing aid working alone.

Streaming Accessories

Almost every major hearing aid manufacturer now has a way to wirelessly link your hearing aids with your personal technology (from phones to computers to TVs). Some companies use "streamers" (a device you wear around your neck to allow you to interface between the hearing aids and the accessory) to wirelessly connect to your personal products, while other manufacturers have developed hearing aids that allow you to wirelessly connect without an interface device. Some manufacturers also offer a wireless microphone accessory, which can pick up an important voice and wirelessly send it to the hearing aids directly or via the streamer. This type of technology is great for noisy environments such as a restaurant, because the voice of a parent (or spouse) can be captured by the microphone and sent directly to the hearing aids of the child (or significant other). Smartphone technology is also paving the way to allow you to use an app to control your hearing aids. This is an everevolving technology, so ask your hearing professional about the best option for your lifestyle.

Digital Modulation (DM) Radio Frequency (RF) Systems

Personal remote microphone radio frequency (RF) systems have been around for a long time, and have long been recognized as the most effective means to improve speech recognition in noisy places. In short, these systems possess a microphone/transmitting unit that captures the signal of interest and sends it by way of a radio signal to small receivers that are coupled to the user's hearing aids or cochlear implant sound processors. Because the microphone is positioned closely to the mouth of a parent or teacher, the speech signal captured by the system's microphone is typically much higher in volume level than the surrounding background noise. The transmitting device may also be plugged into a computer, MP3 player, classroom smart board, etc., to directly capture and send that audio signal of interest to the receivers.

Historically, these types of systems have used an analog frequency modulated (FM) RF signal to transmit the signal of interest. Recently, manufacturers have started introducing digitally-modulated RF systems, which are similar to Bluetooth* technology used in several recreational and business applications. Digital RF systems are able to provide a higher level of analysis and control over the signal that is captured by the microphone and eventually delivered to the receiver. Furthermore, these systems typically use a carrier frequency that "hops" from frequency to frequency many hundred times per second, a characteristic that makes digital RF systems less susceptible to interference from nearby RF devices (Wolfe et al., in press). Studies have shown that hearing aid and cochlear implant users receive great benefit from dynamic digital RF systems when compared to traditional/classic and dynamic FM systems (Thibodeau, 2013; Wolfe et al., in press).

Waterproof /Water Resistant

Perhaps it's just icing on the cake, but besides all of the great technology that allows individuals to hear better in a variety of settings, several hearing aid companies have now made some of their products water-resistant. Some even claim you can swim with them. It is important to consider how the warranty works if you do choose to participate in water activities with the hearing aids on. Some are not "waterresistant" per se, but have a

special coating inside the electronics that helps repel moisture - especially good if you (or your child) are susceptible to excessive sweating or have wax problems. If you know that you have this specific concern, let your provider know so they can request that special coating is applied to your hearing aid as it may not be standard in all cases.

In summary, hearing aid technology has improved significantly over the past few years. Although it is not perfect, contemporary technology can improve the communication abilities of most everyone with hearing difficulties. If you are struggling with your hearing, you should consult your audiologist to determine whether new technology may alleviate your communication difficulties. Your hearing is too important to struggle through life with inferior technology. Additionally, make certain you see a licensed audiologist who is experienced with providing new technology for patients in your age range (or the range of your child). The best technology in the world can be worthless if it is not selected and fitted appropriately to meet the wearer's needs. Remember, we should work together to use new technology so that each person with hearing loss reaches his/her full potential. Your hearing is worth it!

Sidebar

Sara Neumann is placing Alyceea's hearing aid following a hearing aid check.

Sidebar

Does my child (do I) have access to the fall spectrum of speech sounds? What type of hearing aid technology is avaiUhle to help me or my child hear high-frequency sounds of speech? What types of signs should I fookfor to indicate my child (I) have access to high-frequency speech sounds? What type of signs should I look far to indicate that frequency-lowering technology may be distorting the speech my child (I) hears?

Ask your audiologist

Sidebar

Should my child (I) be using microphones and digital noise reduction in her hearing aids? Should my child (I) have a special "noise program" or should my child (I) use an adaptive program? How will we know if it works? What technology would you recommend for my child to opti mize her listening abilities in noise

Ask your audiologist

Sidebar

Q Will my hearing aids work wirelessly? What are the different ways that they can do that? How may I use th technology to improve my hear ing in situations in which I struggle Do my hearing aids allow wireless streaming? Are additional accessories available to help me (my child) in difficult listening situations (e.g., tele phone, TV, restaurants, etc.)? What is the additional cost, and what type of advantages do they offer?

Ask your audiologist

Sidebar

Q Should I consider use of a personal digital RFsystem?

Are my hearing aids waterproof or water-resistant? What is the best way to care for them?

Ask your audiologist

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This article anda full list of references is available at ListeningandSpokenLanguage.org/ ParentGuideHA.aspx.

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Digital hearing aids

Author: Roizen, Michael; MD; and Mehmet Oz.

Publication info: Telegraph - Herald [Dubuque, Iowa] 14 Apr 2013: E.3.
ProQuest document link

Abstract: Fortunately, hearing aids are now coming in loud and clear, with five digital types: behind the ear; on the ear (smaller than behind the ear); in the ear; in the ear canal (barely visible); and completely in the ear canal (invisible).

Full text: Question: I'm turning 60 next week, and maybe all those rock'n'roll concerts I went to are finally taking their toll on my hearing.
I think I need a hearing aid, but I don't want to look like my grandmother. Any advice? - Adele, C., Boulder, Colo.
Answer: Oh, yes. For you - and all the rock'n'rollers in their'60s and'70s - the answer to "Tommy, can you hear me?" finally might be yes, because of the amazing breakthroughs audiologists are making these days.
Fortunately, hearing aids are now coming in loud and clear, with five digital types: behind the ear; on the ear (smaller than behind the ear); in the ear; in the ear canal (barely visible); and completely in the ear canal (invisible).
They work off programmable computer chips that can differentiate between speech and background noise, and

can filter out the background.
Be patient and persistent. Take various models for a test drive. The process of choosing the right hearing aid could take some time.
Email your questions to Oz and Roizen at youdocsdaily@sharecare.com.

STOP THAT NOISE!

Author: Nickens, T Edward.

Publication info: Field & Stream 117.11 (Apr 2013): 68-69.

Abstract: Wearing some type of hearing protection now-whether you go with plugs or muffs-is an investment in your future sanity. 1 / Mack's Ultra SoftFoam Earplugs $4 FOR 10 * MACKSEARPLUGS.COM THE LOWDOWN With a noise reduction rating (NRR) of up to 32 decibels, these ubiquitous plugs make highrepetition shooting safe and comfortable. WHO SHOULD BUY Any shooter who is looking for a big step up from drugstore foam plugs but doesn't want the bulk of a full muff. 3 / Caldwell Platinum Series G3 Earmuffs $80 * BATTENFELD TECHNOLOGIES.COM THE LOWDOWN Many midpriced earmuffs use cut-offtechnology that cycles on and offwhen presented with a loud noise, resulting in gaps in hearing.

Full text: Headnote

We test and rate four types of hearing protection, so you can find one that matches your shooting style and your wallet

After a youth misspent by scoffing at hearing protection, I have learned my lesson: For what my digital hearing aids cost, I could cram an iPad and an English double gun into my ears. So be smart and wear one of the four types of hearing protection featured here, which run the gamut from dirt-cheap to hmm-that's-a-bit-of-cash (in that order). Any will preserve your hearing, and the more expensive devices can vastly improve your enjoyment in the field and on the shooting range. Take it from me: Wearing some type of hearing protection now-whether you go with plugs or muffs-is an investment in your future sanity.

1 / Mack's Ultra SoftFoam Earplugs

$4 FOR 10 * MACKSEARPLUGS.COM

THE LOWDOWN With a noise reduction rating (NRR) of up to 32 decibels, these ubiquitous plugs make highrepetition shooting safe and comfortable. The low-pressure polyurethane memory foam compresses easily and re-forms in the ear canal for a tight fit that blunts sounds. Covered with a skin of slick material, they are easier to insert and more comfortable to wear than bargain-basement PVC stopples.

HITS They are easy to use and inexpensive, and they work.

MISSES Proper insertion takes two hands and more time than you have when ducks are coming in. Once inserted, they render you practically deaf.

WHO SHOULD BUY The hunter who needs the least costly solution-but everyone should carry them as backups. I keep foam earplugs stashed in jacket pockets, blind bags, and gun cases.

2 / E.A.R. Inc. Insta-Mold Earplugs

$65 * EARINC.COM

THE LOWDOWN E.A.R. Inc. providers make these custom earplugs on the spot at outdoor expos and can be scheduled for fittings at your local gun range. Here's how it's done: Hypoallergenic silicone is injected into the ear canal, which hardens into a pliable mold in less than 10 minutes. The mold is removed, trimmed, allowed to

cure for an hour, and coated with a lubricant. Done. Insta-Molds are super comfortable and provide an aesthetically subtle and very effective sound barrier (about 30dB NRR).
HITS Excellent wind protection and no clanking against the gunstock, as full muffs can do. They are available with acoustic filters that allow normal conversation.
MISSES It takes some practice to get the knack of inserting the somewhat corkscrew-shaped plugs.
WHO SHOULD BUY Any shooter who is looking for a big step up from drugstore foam plugs but doesn't want the bulk of a full muff.
3 / Caldwell Platinum Series G3 Earmuffs
$80 * BATTENFELD TECHNOLOGIES.COM
THE LOWDOWN Many midpriced earmuffs use cut-offtechnology that cycles on and offwhen presented with a loud noise, resulting in gaps in hearing. Not these. Like many higher-end muffs, the G3s use compression technology to dampen muzzle blasts (21dB NRR), whereas low-level sounds are clearly amplified. I found these muffs very comfortable to wear. On the shooting range and in the duck blind, normal conversation and other ambient sounds came through loud and clear.
HITS They use AAA batteries, which can be found just about anywhere.
MISSES The ear cups occasionally banged on the gunstock. They picked up a little wind noise in a stiffbreeze.
WHO SHOULD BUY Anyone who wants good electronic muffs but not the typical price tag. These are a steal for the money.
4 / ProEars Stalker Gold Electronic Earmuffs
$330 * PROEARS.COM
THE LOWDOWN These muffs are packed with features-compression technology, circuit boards in each ear cup, twin 360-degree microphones, and hybrid analog-digital technology-that combine to produce ample hearing protection (25dB NRR), high-fidelity sound reproduction, and a significant boost in amplification. There's also a 3.5mm jack that allows users to plug in two-way radios for field communication-or an iPhone, if you must.

HITS The slim-profile design stays clear of gunstocks. Leather ear cups reduce sweat, which is common when wearing vinyl cups.
MISSES Uses harder-to-find N-style medical batteries. An external batteryon lamp would be nice.
WHO SHOULD BUY Shooters who need top-end quality for frequent high-volume situations, such as at the range or dove field-and anyone already experiencing some degree of hearing loss.
THE TEST
First, I wore each device and mounted shotguns and rifles with varying stock designs to test for ease of use and any issues with stock clearance and cheek weld. Then I set a window box fan on its medium setting and moved around in the artificial breeze to gauge how wind might affect each device. And of course, there was the shooting: I used each device in dove fields, in duck blinds, in a treestand, and at the shooting range. -T.E.N.

Effects of Noise Suppression on Intelligibility: Experts' Opinions and Naïve Normal-Hearing Listeners' Performance

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.2 (Apr 2013): 404-415.
ProQuest document link

Abstract: In this study, the authors investigated how well experts can adjust the settings of a commercial noise-reduction system to optimize the intelligibility for naive normal-hearing listeners. In Experiment 1, 5 experts

adjusted parameters for a noise-reduction system while aiming to optimize intelligibility. The stimuli consisted of speech presented in car- cabin noise or babble at 5 different signal-to-noise ratios (SNRs). In Experiment 2, the effects of processing with these settings were measured with 10 listeners undertaking an intelligibility test. In Experiment 3, the intelligibility of a broad range of settings was investigated with another 10 listeners to determine whether the experts' chosen settings could have been improved. Low Cronbach's alphas indicated that parameter settings varied considerably within and across experts. For very low SNRs, mean proposed settings differed from those for higher SNRs. The different settings had no significant effects on intelligibility for naive normal- hearing listeners. At high SNRs, the settings proposed by experts were found to deteriorate intelligibility. Superior intelligibility for naive normal-hearing listeners was achievable from settings other than the ones proposed by the experts. While attempting to enhance noisy speech, experts may propose settings that deteriorate intelligibility for naive normal-hearing listeners. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: In this study, the authors investigated how well experts can adjust the settings of a commercial noise-reduction system to optimize the intelligibility for naive normal-hearing listeners.
Method: In Experiment 1, 5 experts adjusted parameters for a noise-reduction system while aiming to optimize intelligibility. The stimuli consisted of speech presented in car- cabin noise or babble at 5 different signal-to-noise ratios (SNRs). In Experiment 2, the effects of processing with these settings were measured with 10 listeners undertaking an intelligibility test. In Experiment 3, the intelligibility of a broad range of settings was investigated with another 10 listeners to determine whether the experts' chosen settings could have been improved.
Results: Low Cronbach's alphas indicated that parameter settings varied considerably within and across experts. For very low SNRs, mean proposed settings differed from those for higher SNRs. The different settings had no significant effects on intelligibility for naive normal- hearing listeners. At high SNRs, the settings proposed by experts were found to deteriorate intelligibility. Superior intelligibility for naive normal-hearing listeners was achievable from settings other than the ones proposed by the experts.
Conclusion: While attempting to enhance noisy speech, experts may propose settings that deteriorate intelligibility for naive normal-hearing listeners.
Key Words: noise suppression, opinion-based intelligibility, performance-based intelligibility

Signal processing methods for the enhancement of poor-quality speech audio are currently found in a range of commercial applications, such as hearing aids, mobile phones, and digital audio workstations (DAWs). Many of these relate to the reduction or suppression of unwanted noise (see Loizou, 2007, for review). It has been found that these methods typically reduce or at best make little difference to intelligibility (Hu &Loizou, 2007a; Ludvigsen, Elberling, &Keidser, 1993), although occasional improvements in intelligibility are reported (Arehart, Hansen, Gallant, &Kalstein, 2003; Tsoukalas, Mourjopoulos, &Kokkinakis, 1997).

Most noise reduction systems come with large parameters sets. From studies that consider the effects of parameter changes (Boll, 1979; Lim, 1978; Ludvigsen et al, 1993; Tsoukalas et al, 1997), it emerges that the choice of settings may influence intelligibility. Little information is available on how one might determine settings that optimize intelligibility. Adjusting the parameters is left to experts: the dispenser of the hearing aid, the forensic audio specialist, or the engineer developing the algorithm. Typical intelligibility studies measure a listener's ability to reproduce the speech correctly, but such measurements are time-consuming. This makes them infeasible for evaluating parameter setting in practical settings. Various authors (Goldsworthy &Greenberg, 2004; Ludvigsen et al, 1993; Ma, Hu, &Loizou, 2009) have tried to predict the intelligibility of noise-reduced noisy speech with existing physical intelligibility metrics but found that these metrics gave poor predictions. Others (Loizou &Ma, 2011; Taal, Hendriks, Heusdens, &Jensen, 2011) have developed metrics

especially designed for predicting the intelligibility of noise-reduced speech. But it is not yet clear whether these new metrics can be used to find parameter settings that optimize intelligibility; so currently the task of finding the best settings for a noise-reduction algorithm is left to experts.

Little is known about experts' abilities to estimate the intelligibility of noisy speech after noise reduction. Studies that have investigated whether opinions can be relied on have focused on speech in noise without noise reduction (Beck &Speaks, 1993; Cienkowski &Speaks, 2000; Cox &McDaniel, 1989; Fabry &Van Tasell, 1990; Magnusson, Karlsson, Ringdahl, &Israelsson, 2001; McDaniel &Cox, 1992; Rankovic &Levy 1997; Studebaker, Bisset, Van Ort, &Hoffnung, 1982) or on filtered speech (Fabry &Van Tasell, 1990; Purdy &Pavlovic, 1992; Rankovic &Levy, 1997). The outcomes of these studies suggest that these opinions can be measured reliably (Beck &Speaks, 1993; Cox &McDaniel, 1989). High correlations with intelligibility measures (Cienkowski &Speaks, 2000; Magnusson et al., 2001; Purdy &Pavlovic, 1992; Rankovic &Levy, 1997; Studebaker et al, 1982) or with physical metrics (Fabry &Van Tasell, 1990; Magnusson et al, 2001) have been observed. Purdy &Pavlovic (1992) have shown that opinions have validity. In some studies (McDaniel &Cox, 1992; Studebaker et al, 1982), it has been reported that opinions are sensitive to differences in intelligibility caused by different hearing aids. However, all of these studies considered situations where the same listeners provided both the opinions and the intelligibility measures. With noise reduction, experts tend to decide on the settings that are subsequently used by naive listeners. For example, in forensic applications, an audio specialist can decide to apply noise reduction, while the processed audio may later be heard by transcribers or jury members. With mobile phones, it is the engineer designing the device that usually decides on the settings that are experienced by users. To our knowledge, no studies have investigated whether these experts' opinions can be relied on.

Despite the numerous studies showing congruence between opinions and intelligibility measures, there are reasons to question the experts' abilities to find settings optimal for intelligibility. It has been reported that noise reduction can improve the perceived quality of speech but deteriorate intelligibility at the same time (Arehart et al, 2003; Hu &Loizou, 2007a, 2007b). Consequently, speech quality cannot be used as a cue to find settings optimal for intelligibility. Additionally, noise reduction can reduce listening effort in conditions where intelligibility is invariant (Sarampalis, Kalluri, Edwards, &Hafter, 2009). Hence, listening effort may also be a fallible cue for experts trying to optimize intelligibility.

It could be argued that the failure of noise reduction to improve intelligibility could be caused by the fact that experts are unable to provide optimal parameter settings for a given audio environment. To investigate this argument, we report the results of three experiments that contrast expert opinions on the intelligibility of noise-reduced noisy speech with corresponding intelligibility scores obtained with naive normal-hearing listeners. For the current work, such listeners were preferred over listeners with hearing impairment. The application of noise reduction appears to be widespread, and the work of our experts focused on speech processing in general. In Experiment 1, experts were asked to set the parameters of a commercial noise-reduction system to values that, according to their opinion, optimized intelligibility. In Experiment 2, speech recordings processed with these settings were evaluated with intelligibility measurements obtained from naive normal-hearing listeners. In Experiment 3, intelligibility was measured with a broad range of parameter settings, verifying whether the settings chosen by the experts optimized intelligibility.

Experiment 1: Opinions on Optimal Parameter Settings

Method

Participants. Five experts provided parameters settings. Four had a background in electrical engineering; one was an experimental psychologist involved in speech enhancement research. The mean and standard deviation of their ages was 30 and 7 years, respectively. All were male and experienced listeners. They were selected on the basis of their experience in speech processing and familiarity with different speech enhancement algorithms. None reported hearing difficulties. For three of them, the normal status of their hearing was later confirmed by measurement of their pure-tone hearing thresholds (International Organization for Standardization,

2004). These were below 20 dB at octave frequencies ranging from 0.125 to 8 kHz.

Materials, stimuli, and procedure. The noise-reduction system was a commercial program adding functionality to a DAW, also known as a plug-in. The system operated on the basis of multiband compression and had eight parameters. The first parameter controlled the frequency resolution, reflecting the frame size of the fast Fourier transform. The second and third parameters controlled the user's estimates of the noise threshold and signal level, respectively. These parameters were combined with an automated noise estimation procedure that measured changes in magnitudes and phases over time in order to find a time-varying noise threshold for each frequency band. The time constant for the noise estimate was approximately 2 s. A fourth parameter allowed fine-tuning of the estimated noise floor by a common over- or underestimation factor.

Once a decision had been made as to which components in a frame and subband were noise, a fifth parameter specified the maximum attenuation applied to these components. The smoothness of the noise reduction was controlled by the sixth and seventh parameters, specifying the rate at which noise was reduced over time and across frequencies, respectively. The final, eighth, parameter activated additional smoothing of the noise estimation over time.

We judged that the parameters controlling the maximum noise attenuation and the one controlling the noise threshold (excluding the fine-tuning) gave the most audible differences. In addition, their adjustments were particularly recommended in the system's user manual. Consequently, the fifth and second parameters were chosen as targets in our experiments, and are here labeled X and Y, respectively. X could be changed between 0 and 40 dB; possible values of Y ranged from 0% to 100%. All other parameters were fixed to their default values. This reduced the complexity of the experts' task and of the problem space encountered in the subsequent experiments. The fast Fourier transform frame size was set to 512 points. The fine-tuning of the noise threshold and signal level were fixed at 2 and 2.5 dB, respectively. Spectral and temporal smoothing were set at 100 Hz and 140 ms per 60 dB, respectively. Additional smoothing of the noise estimation was always switched on.

Stimuli were generated using MATLAB release 2008a with a 16-kHz sampling rate and 16-bit depth. During the experiment, stimuli were presented diotically over Sennheiser HDA200 headphones connected to an RME Fireface 800 D/A converter.

Each stimulus consisted of three concatenated Institute of Electrical and Electronics Engineers (IEEE) sentences (Rothauser et al., 1969; Smith &Faulkner, 2006), randomly selected and mixed to random fragments of car-cabin noise (Hilkhuysen, Gaubitch, Brookes, &Huckvale, 2012) or babble (Varga &Steeneken, 1993). The latter noise is a recording of 100 people speaking in a canteen, in which individual voices are slightly audible. For each noise type, five signal-to-noise ratios (SNRs) were used. For car-cabin noise, the SNRs were -21 to -9 dB in 3 dB steps; with babble noise, the SNRs were -12 to 0 dB in 3 dB steps. According to the Speech Intelligibility Index (American National Standards Institute, 1997), the SNRs used for the two noises should give rise to comparable intelligibilities. The five SNRs will be addressed as "very low," "low," "medium," "high," and "very high," independent from the noise type.

After loading a particular stimulus in the DAW, the experts activated the plug-in. Using looped playback, they were asked to set the sliders of X and Y to values that according to their opinions gave optimal intelligibility. Both sliders could be adjusted in real time, that is, experts heard the effect of a change in a parameter as its value was modified. Besides adjusting the two parameters, they were allowed to bypass the noise suppressor and to adjust the presentation level to their liking. Given their expertise, it was assumed that they were able to adjust the stimulus level to optimal intelligibility; these levels were not monitored. Experts could listen to each stimulus as often as they wanted or needed to find proper settings.

Throughout this article, a set of experimental conditions excluding replications will be addressed as the experimental kernel. The five noise levels for each of the two noise types gave rise to an experimental kernel with 10 different experimental conditions. Stimuli within this kernel were presented in random order.

Presentation of the kernel was repeated five times using different sets of sentences. Consequently, each expert provided settings for a total of 50 different stimuli, which took about 3 hr excluding regular breaks.

Results

Figure 1 shows the relation between the settings proposed by all experts for the parameters X and Y in all experimental conditions. Circles and squares denote settings proposed for speech in car-cabin noise and babble, respectively. The size of the markers represents the SNR of the stimulus, with a larger size denoting a higher SNR. Markers are spread along both axes: A wide range on each parameter was used. There appears to be some trade-off between settings: High values for X are never combined with high values for Y. However, at times, experts recommended low values for both. Consequently, the correlation between the settings of X and Y is low ($r = -0.14$, $\rho < .05$). Although significantly different from zero, the correlation was judged to be low enough to inspect each parameter with a separate 5x5x2x5 analysis of variance (ANOVA) for repeated measurements, including the factors Expert χ Repetition χ Noise Type χ SNR.

Among all main effects used to predict X only, the Expert effect attained significance, $F(4, 10.3) = 5.34$, $\rho < .05$. Besides this significant main effect, the following interactions reached statistical significance: Expert χ SNR, ^(16, 8.4) = 3.83, ρ <.05; Repeat χ Noise Type, F{4, 16) = 3.14,77 <.05; and Noise Type χ SNR, F(4, 16) = 3.82,/? <.05. The Expert χ SNR interaction was significant as a result of Expert 4. He proposed settings around 9 dB at very low SNR and substantial higher settings close to 19 dB at all other SNRs. A lower setting at very low SNR was less pronounced for the other experts. The Repeat χ Noise Type interaction was also the result of settings made at very low SNR. At subsequent repetitions of the experimental kernel, X was set to lower values in very low SNR conditions. At the other SNRs, settings varied less across repetitions.

The Noise Type χ SNR interaction is specified in Table 1, showing the mean settings of X for each combination of noise type and SNR, averaged across experts and repetitions. Except for the car-cabin noise at very low SNR, settings of X are close to 13 dB. In an a posteriori Duncan test, we found that only the average setting of 9 dB proposed for the car-cabin noise at very low SNR differed significantly from any other condition except from babble noise at very low SNR. All other paired comparisons were nonsignificant.

The ANOVA predicting Y showed significant main effects only for Expert, $F(4, 4.7) = 6.33$, $\rho < .05$; and SNR, $F(A, 16) = 3.09$, $\rho < .05$. All interactions and other main effects did not attain significance. Table 1 also shows the mean settings of Y for the different levels of SNR averaged across all other factors. The results of an a posteriori Duncan test indicated that only the average setting of 40% at very low SNR differed significantly from other SNRs, except from medium SNR. None of the other paired comparisons attained significance. The average setting for the low to very high SNR equaled 48%.

In the current study, the experimental kernel was repeated five times. Given the significant effects of the Expert and Repeat factors, intra- and interexpert reliabilities were calculated. To address intra expert reliability, a matrix for each expert and parameter was constructed in which the rows and columns indicated the 10 experimental conditions and five sessions, respectively. Matrix entries represented the settings that a particular expert proposed for the corre- sponding experimental condition and repetition. The corre- lation matrices of the repetitions formed the basis of the calculation of standardized Cronbach's alphas. These are displayed in Table 2. Intraexpert reliability was highest for Expert 4, with values of 0.8 and 0.7 on Parameters X and Y, respectively. Experts 1 and 5 showed negative reliabilities on Parameter X. Expert 1 additionally showed a negative reliability with Parameter Y. Such negative reliabilities indicate that the mean correlation between repetitions is negative, for example, for the settings of X supplied by Expert 5, the average correlation equaled -0.13. The 95% confidence intervals, obtained by bootstrapping, include values above 0.7 for Expert 4 on both X and Y and for Expert 5 on Y only. For all other combinations of experts with parameters, these confidence intervals cover values at or below 0.7.

The last row in Table 2 displays the interexpert reliabilities. Calculations were based on matrices with rows and columns representing the 10 experimental conditions and five experts, respectively. Cells contained the mean

setting for each condition and expert averaged across repetitions. The resulting standardized Cronbach's alphas were 0.2 and 0.6 for the settings of X and Y, respectively. The 95% confidence interval of X includes values above 0.7.

Discussion

Settings showed a partial perceptual trade-off between the two parameters. Experts avoided simultaneous high settings on X and Y. All other combinations were proposed. Consequently, the correlation of two parameters remains low, justifying their presence in the plug-in. The low correlation also warrants an independent analysis of the settings.

In general intraexpert reliabilities were poor. Only Experts 4 and 5 reached Cronbach's alphas of 0.7 and above. Lower values are usually interpreted as unacceptable (Nunnally, 1978). The other three experts showed poor intraexpert reliabilities, indicating that their settings for equivalent experimental conditions differed across repetitions. Experts 1, 2, and 5 even showed negative reliabilities, implying that the same experimental condition gave rise to both higher-than-average settings and lower-than-average settings in different repetitions.

One explanation for the low reliabilities could be that optimal settings were independent from the noise types and SNRs used here. The calculation of Cronbach's alpha is based on the assumption that different experimental conditions require different settings to optimize intelligibility. Only then will it be possible to obtain the substantial correlations between repetitions essential for acceptable reliabilities. A possible cause for the poor reliabilities is that changes in settings have little consequence for intelligibility. This will be investigated in Experiments 2 and 3.

Both ANOVAs showed significant effects of expert, indicating that participants held diverse opinions on the best settings. Given the reliability scores, one could question participants' expertise and wonder whether a group of forensic audio engineers or audiologists may have been more consistent. However, the experts included in this study are representative of the group of researchers typically involved in the development of speech enhancement algorithms. Their poor interexpert reliability could indicate that they were uncertain about which settings to propose.

Following classical test theory that forms the basis of the Cronbach's alpha statistic, each setting proposed is the result of a true intended setting plus some random error. Assuming that the random errors are independent and defining "best" in terms of least squared error, the best estimate of the intended setting will be the mean across repetitions and experts. On average, experts opted for different values in some experimental conditions. For both noise types, the mean setting for Y was significantly lower at the very low SNRs (40%) compared with most other SNRs (48%). X was set to a lower value for speech in car-cabin noise at the very low SNR (9 dB) compared with the other SNRs (13 dB). This suggests a preference to apply less noise reduction when intelligibility was very poor, perhaps because experts were trying to preserve the available information in the signal. In Experiment 2, the effects of the mean expert settings on intelligibility were evaluated by observing the performance of naive normal-hearing listeners.

Experiment 2: Performance-Based Intelligibility With Mean Opinion-Based Settings

Method

Participants. Experiment 2 involved 10 listeners. The mean and standard deviation of their ages were 25 and 7 years, respectively. They were recruited from the Psychology Subject Pool of University College London. All had pure- tone hearing thresholds of 20 dB HL or less at octave frequencies ranging from 0.125 to 8 kHz as measured with circumaural headphones (International Organization for Standardization, 2004). All listeners were native speakers of British English, had never participated in intelligibility experiments or been exposed to the speech materials before, and were paid for their efforts.

Materials. In Experiment 2, the DAW and the plug-in were used to generate noise-reduced stimuli. Stimulus presentation and response collection were accomplished with an application written in MATLAB. Stimuli were played back on an RME Fireface 400 D/A converter connected to Sennheiser HDA-200 headphones. The

presentation levels of the stimuli were calibrated using a 0.5-in. microphone (Brüel &Kjier 4192) placed in a 2-cc coupler (Brüel &Kjíer 4153), polarized with a microphone power supply (Brüel &Kjíer 2804) and connected to a spectrum analyzer (Onno Soki cf-350z). Speech and noise materials were equivalent to the ones used in Experiment 1.

Stimuli and design. Looking at signals processed by the plug-in, we found that the noise estimator stabilized after about 2 s. Therefore, while generating a stimulus, we embedded a target sentence into two sentences that were different from the target sentence. This triplet was mixed with a random fragment of noise with duration equal to the duration of the sentence triplet. To create a noise-reduced stimulus, the noise-perturbed triplet was subsequently processed by the commercial noise-reduction plug-in installed on the DAW. This step was omitted for the unprocessed speech condition. In a next step, the first and third sentences in the triplet were deleted. Because the shortest sentence used in this study had a duration of 2.55 s, initial embedding followed by extraction of the target sentence allowed the noise estimator to stabilize before processing of the target sentence.

The noise types and SNRs were equivalent to the ones previously used in Experiment 1. Noise-reduced stimuli were generated with the mean settings determined in Experiment 1. X and Y settings of 13 dB and 48%, respectively, were applied to speech at all SNRs and both noise types. The X value of 13 dB corresponds to the mean proposed setting across all conditions excluding the settings for car-cabin noise at very low SNR. Similarly, the value of 48% for Y corresponds to the mean setting across all conditions excluding the settings proposed for the lowest SNRs. This combination of parameter settings will be referred to as seti3,4S. In Figure 1, these settings are represented by a cross of dashed lines. Many markers are located near the center of this cross, indicating that the experts had proposed similar parameter combinations several times. Because the experts proposed different settings at very low SNRs, two additional experimental conditions were included. For speech in car- cabin noise at a very low SNR, an additional condition with X and Y set at 9 dB and 40%, respectively, was added (seteno). These settings correspond to the mean settings proposed for speech in car-cabin noise at a very low SNR. A cross of dotted lines in Figure 1 marks this parameter combination. For speech in babble at a very low SNR, Y was additionally set at 40%, while the setting for X was kept at 13 dB (seti3,4o). which are the mean settings proposed by the experts for this condition. In Figure 1, this setting is marked by the crossing of the dotted horizontal line with the dashed vertical line. The smallest markers representing lowest SNRs are at times distant from the mean settings. But assuming that the proposed settings contain random errors, these mean settings are the best estimates of the intended settings.

Consequently, the kernel experimental design excluding repetitions had the following 22 conditions: Noise (car, babble) χ SNR (very low, low, medium, high, very high) χ Suppressor (off, seti3,4S) + Noise (car) χ SNR (very low) χ Suppressor (set9,4o) + Noise (babble) χ SNR (very low) χ Suppressor (seti3,4o)· This kernel was repeated 10 times using different sets of sentences from the first 220 IEEE sentences divided into 10 groups of 22 target sentences each. For each listener, target sentences within a group were randomly combined with the experimental conditions. Across listeners, sentence groups were presented according to a Latin square design.

Procedure. Data collection took place in a sound-attenuated booth. Listeners performed two tasks: an intelligibility test and a scoring task. In the intelligibility test, a stimulus was presented diotically over headphones. To ensure that the speech was presented above hearing thresh- olds, we made certain that the naive listeners had no control over the presentation levels. Speech Intelligibility Index calculations predicted that in the absence of noise, the speech presented within the range of 42-78 dB SPL would be fully intelligible to a listener with a flat hearing loss of 20 dB HL. Following these calculations, speech was presented at a constant level of 51 dB SPL, while noise levels varied according to the required SNR. The low level of the speech ensured that even at the lowest SNRs with the highest noise levels, the stimulus was still presented at a comfortable level. After listening to a sentence, participants were asked to repeat it verbatim. Each stimulus was presented only once, and participants were encouraged to guess in the situations where the sentence was not

fully intelligible. Their verbal responses were audio-recorded.

During the scoring task, participants listened to the recorded responses given by previous participants. The first participant listened to recordings obtained in a pilot experiment, and the responses of the last participant were scored by an additional, eleventh, listener who did not perform the intelligibility task. During scoring, the five key words available in each sentence making up the stimuli were displayed on a computer screen, and the response was played back to the participant. Each participant could listen to each response as many times as needed to determine whether it contained the key words. They ticked the correct key words on the computer screen by using a mouse. While scoring, participants could adjust the presentation level to their liking. A particular set of sentences was scored only once it had been presented to the participant as an intelligibility test. Hilkhuysen et al. (2012) found that scoring by normal- hearing participants is as reliable as scoring by experimenters. Full data collection consisting of providing information about the study, taking informed consent, measuring the audiogram, responding to the stimuli, and scoring of the responses usually took about 75 min per participant.

Statistical analysis. To obtain intelligibility measures for various listening conditions, we calculated the base-two logarithm of the ratio of the number of correct and number of incorrect key words. Hilkhuysen et al. (2012) labeled the resulting quantity performance level with units in Berksons (Bk). A one-unit decrease in performance level signifies that for a fixed number of correct key words, the number of incorrect key words has doubled. Using Berksons instead of percentage correct scores gives a more linear relation between intelligibility and SNR. On a percentage scale, psychometric functions are usually S-shaped and exhibit floor and ceiling effects for intelligibilities near 0% and 100%. At these ends, it becomes difficult to detect differences between functions. The linearization allows a better inspection of subtle differences even at the extremes of the percentage scale. Classic linear statistical models, such as ANOVA, are less appropriate for percentage scores because they can predict values outside the 0%-100% word correct range and falsely assume that sample variance is independent from the absolute percentage (Hilkhuysen et al., 2012). Additionally, ANOVAs are inappropriate for unbalanced designs (Max &Onghena, 1999; Quené &Van Den Bergh, 2004), created here by including set9 4o and set 13,40 only at very low SNRs. Multilevel logistic regression as proposed by Goldstein (1995) and Hox (2010) overcomes these limitations. This technique, also known as mixed-effects logistic regression (Agresti, 2007), is a generalization of traditional linear regression. It takes into account the binary character of the data as well as the fact that the same listener provided observations under all experimental conditions.

Results

Figure 2 displays the psychometric functions. To facilitate comparison of performance levels with the more commonly used percentage scale, we display the correspond- ing percentage values on the right axis. The marker for the single condition with seteno coincides with the marker for unprocessed car-cabin noise at -21 dB SNR. The marker representing the measurement with set 13,40 is covered by the marker for intelligibility of speech in babble at -12 dB SNR processed with set 13,4g. Most filled markers are located below the corresponding open markers, suggesting a trend toward deleterious effects of noise reduction with set 13,4s on speech intelligibility.

A plot of performance level versus the repetition number of the kernel experimental design (not shown here) showed an improvement of about 0.5 Bk in performance over the first six repetitions and a decrease of less than 0.1 Bk during the remaining repetitions. To address and compensate for these effects-likely caused by learning-we included in the logistic regression the factor Repeat, representing the repetition number of the kernel experimental design. For this factor, a linear and a quadratic component centered on the sixth repetition were included.

The results of the mixed-effects logistic regressions, one for each noise type, are displayed in Table 3. Row 1 indicates the estimated performance level for unprocessed speech at medium SNR during the sixth repetition of the kernel experiment, with car-cabin noise and babble performance estimated at -0.2 and -0.4 Bk, respectively.

These values do not differ significantly from zero, meaning that the SNRs in the reference condition resulted in performance levels that do not differ significantly from 0 Bk (50%). Rows 2 to 5 indicate the effects of changing the SNR from medium to very low, low, high, and very high levels, respectively, while the other factors remain at their reference levels. Changing the SNR evidently influences intelligibility for both noises: All coefficients differ significantly from zero. Row 6 specifies the effect of applying noise reduction with seti3,4S parameters while all other factors are at reference levels. Although the corresponding coefficients for car-cabin noise and babble are negative, values do not differ significantly from zero. In other words, for speech in noise at medium SNR during the sixth repetition of the kernel, no significant effects of noise reduction on intelligibility were found. Rows 7 to 10 specify the additional effects of noise reduction with seti3,4S at other SNRs. At high SNR, the coefficients of -0.8 and -0.9 Bk for car-cabin noise and babble, respectively, differ significantly from zero. Added to the -0.2 Bk effects of noise reduction observed in the reference condition, the total effect of noise reduction in the high SNR condition is -1.0 Bk for both noise types. At very high SNR in babble, noise reduction also significantly reduced intelligibility by -0.9 Bk. The total effect of noise reduction added to its effect in the reference condition again results in a total performance shift of-1.0 Bk. At very high SNR in car-cabin noise, no significant effect of noise reduction was observed. For both noise types, regression coefficients at the very low and low SNRs do not differ significantly from zero. In summary, noise reduction with seti3, 4S caused significant reductions in intelligibility of 1 Bk at high SNR for both noises and at the very high SNR of babble noise. At all other SNRs, noise reduction had no significant effect on intelligibility.

The experimental design included two additional parameter settings that were applied only at very low SNR. Their effects relative to the effects previously discussed for seti3,4s are specified in Row 11. For speech in car-cabin noise at the very low SNR, changing the settings from seti3,4S to set9,4o gave rise to a nonsignificant increase in performance of 1.2 Bk. For noise-reduced speech in babble at very low SNR, changing seti3,4S to seti3,40 had no effect on intelligibility. Rows 12 and 13 specify the effects of learning. In both noise types, the linear component reached significance, but only with car-cabin noise did the quadratic component attain significance.

Discussion

Noise reduction with the settings proposed by the experts had little effect on intelligibility. For nine out of the 12 conditions, the experts' attempts to enhance the noisy speech had no significant effect. At very low SNRs, their mean settings differed from their settings at other SNRs. However, these different settings had no significant effect on the intelligibility for the naive normal-hearing listeners. From the performances observed with set9,40 and seti3,40, we deduce that the application of noise reduction to speech in car-cabin noise and babble with these settings has no impact on intelligibility.

For three out of 12 conditions, the mean settings proposed by experts deteriorated the intelligibility for our naive normal-hearing listeners. In these cases, noise reduc- tion doubled the number of incorrect words for a fixed number of correct words.

The outcomes of Experiments 1 and 2 are remarkable. At very low SNRs, experts suggested different settings to other SNRs, although there were no significant consequences for intelligibility. At high SNRs in both noise types and at a very high SNR in babble, mean proposed settings that were also proposed by individual experts deteriorated intellig- ibility. One interpretation of this result would be that experts cannot be relied on to choose optimal settings for noise reduction. At least in the conditions where intelligibility deteriorated, experts should have opted for no enhancement. However, one could argue that the experts were instructed to apply noise reduction and that refraining from its application was not a valid response in this task. It could be that they opted for optimal settings in the sense of those that were the least detrimental. This possibility was considered in Experiment 3, where intelligibilities for naive normal-hearing listeners were measured over a broad range of parameter settings. Because the deteriorating effect of noise reduction on intelligibility was observed for both noise types at high SNRs, these levels were specifically tested.

Experiment 3: Performance-Based Intelligibility Across a Broad Range of Settings

Method

Participants. Ten listeners different from those who participated in Experiment 2 were included in Experiment 3. The criteria for inclusion were equivalent to Experiment 2. In Experiment 3, the mean and standard deviation of the listeners' ages was 25 and 5 years, respectively.

Materials, stimuli, design, and procedure. Materials and generation of the stimuli were similar to Experiment 2. Compared with the previous experiment, the number of parameter sets tested was extended. For both parameters of interest, four equally spaced settings were used. X was set to 0, 13, 26, or 39 dB. Values of Y were at 0%, 33%, 66%, or 99%. Each of the four values of X was combined with the four levels of Y, leading to 16 combinations. These will be addressed as setij, with i and j indicating levels of X and Y, respectively. Additionally, the intelligibility of unprocessed speech was measured, giving rise to a total of 17 different types of processing applied, represented by the factor Process. Intelligibility was measured for two noise types: car-cabin noise and babble. To obtain a feasible experimental design, we took measurements only at the high SNR, corresponding to -12 dB SNR for car-cabin noise and -3 dB SNR for babble. The kernel experimental design contained Process (17) χ Noise Type (2), for a total of 34 conditions. As done previously, these conditions were randomized within a listening task using a set of 34 different IEEE sentences. The kernel was presented 10 times using different sets of IEEE sentences.

When the X and Y parameters were both set at high values, the signal level dropped considerably. To prevent masking of the speech by the listeners' hearing thresholds, we raised the presentation level of the stimuli 9 dB compared with Experiment 2, resulting in a level of 60 dB SPL for unprocessed speech. Because all stimuli with a fixed speech level had a high SNR, none of the stimuli were uncomfor- tably loud.

Intelligibility tests were interleaved with scoring tasks. Acquiring informed consent, measuring the participant's audiogram and collecting the data took between 2 and 2.5 hr per participant, including a break halfway through the data collection.

Results

Figure 3 shows the measured intelligibilities expressed in Berksons as functions of Parameter X. Each curve represents measurements at a fixed level of Parameter Y, as labeled on the right of each curve. Figure 3 suggests that when one of the parameters is set at zero, changing the other has little consequence for intelligibility, which is close to that of unprocessed speech. However, when both parameters are set at nonzero values, intelligibility deteriorates when the setting of any one parameter is increased. The significance of these visual impressions was tested in two mixed-effects logistic regressions that included the observations either in car-cabin noise or in babble. Lowest and highest perfor- mance was observed for the first and seventh repetition of the kernel experimental design, respectively, over which range performance increased by 0.5 Bk. To account for eventual learning, we included linear and quadratic components centered on the seventh repetition in the regression equations. Consequently, the models included the following factors: a random Subject factor; Noise Type and Processing as fixed categorical factors; and Repetition as a covariate. The intelligibility of unprocessed speech during the seventh repetition of the kernel experimental design was taken as reference. The main outcomes of the mixed-effects logistic regression are represented in Table 4. The left side describes the results for speech in car-cabin noise at high SNR. Unprocessed noisy speech forms the reference condition. In general, settings with either X or Y set at zero, such as setoo,oo, setoo,33, set00,99, set26,oo, and set395oo, did not result in significant shifts in intelligibility relative to the reference condition. Exceptions are set00,66 and set13 0o· Similar to settings where both parameters had nonzero values, noise reduction with set00,66 and set 13,00 deteriorated intelligibility relative to unprocessed speech. The linear and quadratic components of the Repeat factor did not reach significance; hence, no significant learning occurred.

On the right side of Table 4, effects of different parameter settings for the intelligibility of speech in babble are shown. Again, performance in unprocessed babble at the high SNR forms the reference condition. When both

parameters were set at nonzero values, intelligibility dete- riorated significantly, as previously found with car-cabin noise. But in contrast to the previous findings, set00,66 and set 13,00 had no effects on the intelligibility of speech in babble. No significant learning could be shown, that is, the linear and quadratic components of the Repeat factor did not attain statistical significance.

Discussion

To inspect whether the mean parameter settings proposed by the experts were the least detrimental, we evaluated intelligibility for naive normal-hearing listeners across a broad range of settings and with various parameter combinations. We found that in general, only settings of either X or Y close to zero resulted in intelligibility similar to that of unprocessed speech. When both parameters had values differing much from zero, intelligibility deteriorated. From these results, we conclude that in Experiment 1, our experts did not provide settings that optimized intelligibility. It could be argued that this conclusion is the result of an artifact introduced by averaging individual settings. For example, suppose that some experts always proposed settings of X close to zero, combined with high values for Y, whereas other experts suggested high values of X combined with low values of Y. Then averaging across experts would result in mean settings for X and Y that both have middling values. The outcome of Experiment 3 would then suggest that although individual settings would have little effect on intelligibility, the average settings would be deleterious. This line of thought is further explored in Figure 4.

The contour plots in Figure 4 visualize the shifts in intelligibility for various combinations of settings relative to unprocessed speech. Each contour plot was generated by interpolating the intelligibility for the different settings evaluated in Experiment 3. Two constellations of bold lines indicate the settings for speech in car-cabin noise and babble at high SNR as provided by Experts 2 and 5 in Experiment 1. These experts showed poor intraexpert reliabilities in Table 2. The lines connect the five repetitions to their average setting on X and Y. Each constellation shows that the proposed settings spanned a broad range of values for X as well as for Y. Such unstable behavior contributed to their poor intraexpert reliabilities. However, the deteriorations in intelligibility for the settings proposed during the repetitions are stable within a range of 0.6 Berkson per expert and similar to the effects observed with the settings averaged across experts and repetitions. These findings suggest that poor intraexpert and interexpert reliabilities could be the result of the fact that different combinations of settings have similar intelligibility. Although the two experts caused similar amounts of degradation in intelligibility, they did so with different combinations of settings. Although less pronounced, comparable findings hold for the other three experts. Of the 30 sets of parameters for speech at high SNR as proposed by these three experts in Experiment 1, only five sets resulted in intelligibility shifts of less than -0.5 Bk. Hence, we see little evidence to believe that averaging across repetitions and experts increased the detrimental effects of noise reduction on intelligibility.

General Discussion

The current results suggest that experts are unable to set the parameters of a commercial noise reduction system to values that optimize intelligibility. None of the settings considered in listening tests improved intelligibility, but some settings different from the ones proposed by the experts were less detrimental. Processing with the experts' settings resulted at times in lower intelligibilities for naive normal- hearing listeners than the unprocessed noisy speech. At times, experts proposed settings that reduced intelligibility by more than 1 Bk. From these findings, we conclude that when attempting to improve the intelligibility of noisy speech with noise reduction, experts may actually deteriorate its intelligibility.

This study was designed to investigate whether experts are able to propose settings leading to optimal intelligibility. Explaining why experts sometimes suggest settings that deteriorate intelligibility could be a research goal for a follow-up study. At this point, we can only speculate about the possible causes.

One explanation is that listeners are poor in estimating intelligibility in general. Such an explanation goes against findings by many authors (Beck &Speaks, 1993; Cienkowski &Speaks 2000; Fabry &Van Tasell, 1990;

Magnusson et al., 2001; McDaniel &Cox, 1992; Rankovic &Levy, 1997; Studebaker et al., 1982) that report good abilities, in particular at high SNRs (Cox &McDaniel, 1989; Gray &Speaks, 1978). In the current study, opinions on intelligibility failed specifically at high SNRs. But there are other differences between the current study and previous studies that may account for the difference in outcomes. Whereas in the current study, intelligibility was estimated by experts and measured with naive listeners, in the previously mentioned studies, intelligibility was estimated and measured with the same listeners. Maybe the intelligibilities estimated in those studies were valid only for each individual listener. Different listeners were used in this study because we expect that in most applications of noise reduction, experts are providing settings for others. If it is the case that experts provide nonoptimal settings for naive listeners, we would expect an even stronger effect for noise reduction applied in audiology. Audiologists need to provide hearing aid settings for listeners with diverse hearing impairments and can rely even less on their own hearing. Follow-up studies could focus on parameter settings for noise reduction as available in hearing aids.

Other differences between the current study and previous research concern the method used to obtain the opinions. In most previous studies, listeners had to rate the intelligibility of various stimuli (Beck &Speaks, 1993; Cienkowski &Speaks, 2000; Fabry &Van Tasell, 1990; McDaniel &Cox, 1992; Rankovic &Levy, 1997), reporting good abilities in particular at high SNRs (Cox &McDaniel, 1989; Gray &Speaks, 1978). In other studies (Magnusson et al, 2001; Studebaker et al., 1982), listeners had to select the most intelligible in a paired comparison task. Here the experts had to adjust two sliders to settings that, according to their opinion, led to optimal intelligibility. Possibly they considered only a subset of all possible combinations of X and Y. Although adjusting sliders may be common in most applications of noise reduction, experts may be able to generate more valuable opinions with more formal tasks, such as intelligibility ratings or paired comparisons, as used in previous studies involving opinions.

Given the deleterious effects found, experts appear to use the wrong cues while attempting to optimize intelligibility with noise reduction. We consider speech quality and listening effort as potential fallible cues. At higher SNRs, intelligibility and speech quality improve (Arehart, Kates, Anderson, &Harvey, 2007). Hence, across SNRs, speech quality provides an informative cue to estimate intelligibility. But this cue may fail when used to estimate intelligibility after noise reduction. Outcomes from Hu and Loizou (2007a, 2007b) imply that noise reduction can improve speech quality and deteriorate intelligibility at the same time. Hence, if our experts optimized speech quality in an attempt to improve intelligibility, this could have led to the results found.

Listening effort could make another fallible cue for estimating intelligibility after noise reduction. Effort typically is inversely related with intelligibility. Increasing the SNR of noisy speech diminishes listening effort and augments intelligibility (e.g., Houben, van Doorn-Bierman, &Dreschler, 2013; Howard, Munro, &Plack, 2010). Noise reduction can alter this relation. Sarampalis et al. (2009) found that at a fixed level of intelligibility, noise reduction diminished listening effort. Our experts may have minimized listening effort while attempting to increase intelligibility. Such a strategy may appear legitimate if intelligibility is preserved at least, but such was not the case in the current study. At high SNRs, experts tolerated reductions in performance from 1.7 Bk (76%) down to 0.7 Bk (62%).

Low intra- and interexpert reliabilities revealed that the settings proposed by the experts were unstable. We previously mentioned that if the experimental conditions required similar settings, such poor reliabilities should be expected. From Figure 4, an additional explanation emerges. Curves denoting equal intelligibility suggest that there is not one optimal pair of settings giving the highest intelligibility but that different settings can lead to equivalent intelligibilities. The fact that numerous settings instead of one were optimal may have contributed to the low intra- and interexpert reliabilities.

Lack of expertise may also have contributed to the poor reliabilities. We hold that our experts were representative of those involved in the development of noise-reduction algorithms. They had ample experience in speech audio processing, and all knew that noise reduction tends to decrease intelligibility. Yet our experts suggested

settings that incidentally reduced intelligibility. Outcomes could be different if forensic audio specialists or audiologists had supplied the settings.

The fact that none of the settings seemed to improve intelligibility could be seen as a weakness of this study. Urged to improve intelligibility, our experts may have opted for settings that had at least some perceptual effect. The findings may have been different if the noise-reduction algorithm had settings that improved intelligibility. But in our opinion, the approach taken here fits well to typical applications of noise reduction. We are not aware of guidance that experts can call on to make best use of noise reduction. We think that the findings reported here underline the need for physical intelligibility metrics that predict intelligibility after noise reduction. Various authors (Loizou &Ma, 2011; Taal et al, 2011) have proposed such metrics, but at this moment, it is not clear whether these metrics can be used to optimize the settings of noise-reduction algorithms. A valid metric should be able to reveal the consequences for intelligibility of a noise-reduction system designed to improve speech quality or minimize listening effort. Additionally, such a metric would allow the inspection of a much broader range of listening conditions and parameter settings than feasible in listening experiments. Given the abundance of parameter combina- tions, it may well be possible that contemporary single- microphone noise-reduction algorithms are able to improve intelligibility once provided with settings that are appropriate for a particular listening condition.

Acknowledgments

This work was executed within the Centre for Law Enforcement Audio Research, funded by the United Kingdom Home Office.

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Editor: Sid Bacon
Associate Editor: Pam Souza
Received October 24. 2011
Revision received March 12. 2012
Accepted July 8. 2012
DOI: 10.1044/1092-4388(2012/11-0286)

Amplitude Rise Time Does Not Cue the /ba/-/wa/ Contrast for Adults or Children

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.2 (Apr 2013): 427-440.
ProQuest document link

Abstract: Previous research has demonstrated that children weight the acoustic cues to many phonemic decisions differently than do adults and gradually shift those strategies as they gain language experience. However, that research has focused on spectral and duration cues rather than on amplitude cues. In the current study, the authors examined amplitude rise time (ART; an amplitude cue) and formant rise time (FRT; a spectral cue) in the /ba/-/wa/ manner contrast for adults and children, and related those speech decisions to outcomes of nonspeech discrimination tasks. Twenty adults and 30 children (ages 4-5 years) labeled natural and synthetic speech stimuli manipulated to vary ARTs and FRTs, and discriminated nonspeech analogs that varied only by ART in an AX paradigm. Three primary results were obtained. First, listeners in both age groups based speech labeling judgments on FRT, not on ART. Second, the fundamental frequency of the natural speech samples did not influence labeling judgments. Third, discrimination performance for the nonspeech stimuli did not predict how listeners would perform with the speech stimuli. Even though both adults and children are sensitive to ART, it was not weighted in phonemic judgments by these typical listeners. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: Previous research has demonstrated that children weight the acoustic cues to many phonemic decisions differently than do adults and gradually shift those strategies as they gain language experience. However, that research has focused on spectral and duration cues rather than on amplitude cues. In the current study, the authors examined amplitude rise time (ART; an amplitude cue) and formant rise time (FRT; a spectral cue) in the /ba/-/wa/ manner contrast for adults and children, and related those speech decisions to outcomes of

nonspeech discrimination tasks.
Method: Twenty adults and 30 children (ages 4-5 years) labeled natural and synthetic speech stimuli manipulated to vary ARTs and FRTs, and discriminated nonspeech analogs that varied only by ART in an AX paradigm.
Results: Three primary results were obtained. First, listeners in both age groups based speech labeling judgments on FRT, not on ART. Second, the fundamental frequency of the natural speech samples did not influence labeling judgments. Third, discrimination performance for the nonspeech stimuli did not predict how listeners would perform with the speech stimuli.
Conclusion: Even though both adults and children are sensitive to ART, it was not weighted in phonemic judgments by these typical listeners.
Key Words: speech perception, children, adults, amplitude rise time
When a person speaks, the actions of the larynx and vocal tract shape all forms of structure in the resulting speech signal: spectral, temporal, and amplitude. It would seem that all those forms of structure would contribute equally to phonemic decisions, but decades of speech perception research have shown otherwise. Listeners attend to, or weight, the various kinds of structure in the signal differently depending on many factors, including what their first language experience was; what the decision is that needs to be made; and what the other phonetic, syntactic, and lexical properties of the signal are.

Children's Weighting Strategies

Another factor that affects how acoustic structure in the speech signal gets weighted is the age of the listener. For example, it has been found that young children (ages 3-7 years) weight formant transitions more than adults when making judgments about the sibilants /s/ and /J*/ in the syllable-initial position but weight static fricative noises less than adults in these same decisions (Mayo, Scobbie, Hewlett, &Waters, 2003; Nittrouer, 1992; Nittrouer &Miller, 1997; Nittrouer &Studdert-Kennedy, 1987; Siren &Wilcox, 1995). Complementary to those results, research also has found that children weight formant transitions more in decisions concerning the voicing of syllable-final stops, but they weight the duration of the vocalic syllable portion less than adults (Greenlee, 1980; Krause, 1982; Nittrouer, 2004; Wardrip-Fruin &Peach, 1984). Finally, children rely on formant transitions to the same extent as adults in decisions regarding place of articulation for syllable-initial, voiceless stops but are poorer at using the burst or aspiration noise in those decisions (Parnell &Amerman, 1978). In this case, formant transitions are weighted strongly by adults in place decisions regarding stop consonants; thus, there likely is no way for that weighting to be any stronger. In a similar manner, adults weight formant transitions strongly in decisions regarding place for weak fricatives (Harris, 1958), and it has been found that children weight formant transitions in those decisions to a similar extent as adults (Nittrouer, 2002). Taken together, the evidence across these studies reveals that children generally pay more attention to the time-varying spectral structure of formant transitions than do adults and pay less attention to durational cues and static spectral structure. In other words, children's weighting strategies differ from those of adults. These strategies change for children-at least, for those children who are learning language typically-as they gain experience with language, a trend that has been termed the developmental weighting shift (Nittrouer, Manning, &Meyer, 1993).

Researchers have collected evidence supporting the developmental weighting shift largely employing the methods used in studies of categorical perception, but with two acoustic cues varying across stimuli instead of just one. In this type of study, one cue is set to vary in equal-sized acoustic steps along a continuum. In sibilant labeling experiments, for example, researchers have used single-pole noises to model the sibilants, and the center frequencies of those noises have spanned a range from one appropriate for an /J/ noise to one appropriate for an /s/ noise. Each of those noises was then combined with each of two vocalic segments: one with formant transitions appropriate for a syllable-initial /J/ and one with transitions appropriate for a syllable-initial /s/. All stimuli resulting from those combinations were presented to listeners multiple times for labeling, and the proportion of one labeling category was plotted as a function of noise frequency, separately for each

vocalic segment. Outcomes for one such experiment (Nittrouer, 1992) are shown in Figure 1, for adults (top panel) and 3-year-olds (bottom panel). Estimates of the perceptual weighting of the sibilant noises and formant transitions can be gathered from the shapes of the functions and the separation between them: The steeper the functions, the more weight that was assigned to the sibilant noises. The greater the separation between functions, the more weight that was assigned to the formant transitions. One can infer from Figure 1 that children paid less attention to the fricative noises than did adults (the labeling functions are shallower) and paid more attention to formant transitions than did adults (the functions are more separated). This method of collecting data was used in the present study.

Weighting Strategies or Auditory Sensitivity

In spite of the robust evidence supporting the suggestion that children weight acoustic cues to phonemic contrasts differently than do adults, the following question can be asked: Are children simply less sensitive to some acoustic properties in the speech signal than are adults? Perhaps children's weighting strategies actually reflect their underlying auditory capacities; perhaps children make linguistic decisions on the basis of what acoustic structure is most salient to them. That specific question has already been addressed in two studies that tried to relate children's labeling of speech stimuli to their discrimination thresholds for nonspeech analogs of those speech stimuli. One experi- ment compared outcomes for adults and for 3-year-olds (Nittrouer, 1996), and the other compared outcomes for adults and for 5- and 7-year-olds (Nittrouer &Crowther, 1998). Similar results were reported in both cases: Slightly greater acoustic differences were needed between two stimuli in order for children to report that those stimuli were different, but those outcomes could not explain labeling results. One reason was that children's difference limens were greater than those of adults for all acoustic properties examined, even the spectral glides used to model the formant transitions that children so strongly weight in speech perception. In addition, children's difference limens were sufficiently small for each property that it seemed unlikely that sensitivity could be a factor in children's weighting strategies. For example, 5- and 7-year-olds in Nittrouer and Crowther's (1998) experiment had a mean difference limen of 83 Hz, which was larger than the 39 Hz found for adults. However, in the sibilant labeling experiments, step size for the sibilant noises was 200 Hz, so children's sensitivity to the frequency of those noises was considered adequate to dismiss a lack of sensitivity as a possible explanation for their weaker weighting of the noises. Overall, no correspondence was found between the specific properties for which children had diminished sensitivity (compared to adults) and their weighting strategies.

A similar lack of correspondence between auditory sensitivity to acoustic properties and processing of speech signals has been observed for populations other than typically developing children. For example, in several studies, researchers have investigated potential relationships between sensitivity to acoustic properties and recognition of phone- mic segments related to those properties for children with dyslexia (e.g., Bishop, Carlyon, Deeks, &Bishop, 1999; Mody, Studdert-Kennedy, &Brady, 1997; Nittrouer, 1999). None of these studies found a clear connection. A particularly elegant demonstration of this kind of finding was provided by Rosen and Manganari (2001). Those investiga- tors expanded on a report by Wright and colleagues (1997), which showed that children with dyslexia demonstrated enhanced backward masking compared with typically read- ing peers. Using that report as a starting point, Rosen and Manganari were able to replicate the finding of greater backward masking for nonspeech stimuli in teenagers with dyslexia, compared with typically reading peers. However, no evidence was found that the enhanced backward masking deleteriously affected recognition of syllable-initial pho- nemes, as would have been expected if that auditory deficit accounted for the phonological problems of children with dyslexia. Thus, evidence of poor performance on a psy- choacoustic task using nonspeech stimuli could not predict recognition of a phonemic contrast related to that task.

Another line of investigation has consistently failed to find evidence of a link between auditory sensitivity to acoustic properties in the speech signal and the processing of the speech signal itself. Empirical evidence from second- language learners shows that listeners may be sensitive to change in an acoustic property but

nonetheless fail to base phonemic decisions on that property if linguistic experience has not promoted the use of that particular property. For example, Miyawaki et al. (1975) examined sensitivity to third formant glides, which on their own are not heard as speechlike, and labeling of stimuli along a /ja/-to-/la/ continuum, which is based on those third formant glides. Three groups of listeners participated: (a) native English speakers, (b) native Japanese speakers who were experienced second-language users of English, and (c) native Japanese speakers who were inexperienced second-language users of English. Japanese does not have a /ja/ /la/ distinction. The results showed that the Japanese listeners were just as sensitive to the third formant glides as the English speakers, but they did not pay attention to that property when it was integrated into speech signals to the extent that native English speakers did. Consequently, they were unable to label the speech stimuli appropriately. Thus, a disassociation was again demonstrated between auditory sensitivity for an acoustic property and how that property is weighted in speech perception. Some effect of English experience was found, however, suggesting that adults can modify their weighting strategies for speech.

In the current experiment, sensitivity to the acoustic properties manipulated in the speech stimuli was explored to determine whether it can explain patterns of perceptual weighting for those speech stimuli. Although findings regarding how well listeners can discriminate acoustic cues in nonspeech signals generally cannot predict how well those listeners integrate those cues into phonetic decisions, it still must be the case that sensitivity to a cue is a basic requisite for being able to use that cue. As in earlier studies that addressed this question, nonspeech stimuli were used in the current study because it is extremely difficult to assess sensitivity to acoustic cues in speech signals, if speech signals are used. It is a quintessential characteristic of speech perception that once a cue is integrated into a speechlike percept, listeners can no longer isolate that cue for the purpose of judging its auditory qualities (see, e.g., Mann &Liberman, 1983; Remez, Pardo, Piorkowski, &Rubin, 2001).

The Case for Examining the Weighting of Amplitude Cues

The work on developmental shifts in weighting strategies for speech have thus far examined only temporal and spectral cues, but there is good reason to want to explore potential shifts in the weighting of amplitude cues, as well. Cochlear implants provide a veridical representation of amplitude structure in the speech signal, but degraded spectral structure. Thus, it would be useful to examine whether listeners-both adults and children-attend to amplitude structure when it cues a phonemic contrast. In addition, the possibility has been raised that children with reading problems might be poorer at recovering amplitude structure from the speech signal than their normal-hearing peers (Goswami, Fosker, Huss, Mead, &Szucs, 2011; Goswami et al., 2002), sparking further interest in how strongly typically developing children weight amplitude structure in their phonemic decisions. For these reasons, we selected for study a phonological contrast that involves a distinction in the rate of amplitude change-namely, the stop-glide manner contrast of /ba/ versus /wa/.

For both of these syllables, the vocal tract is initially closed (or tightly constricted) at the lips. As the syllable progresses, that lip constriction need only be opened for the syllable to be produced. Rate of change in lip opening is responsible for the acoustic differences between stops and glides, with two properties primarily affected: (a) the rate of formant change and (b) the rate of amplitude change at syllable onset. The first and second formants increase in frequency as the vocal tract is opened, and the overall amplitude of the signal increases. The spectral cue involving formant transitions is different in this case from that examined in earlier studies of developmental shifts in cue weighting because it does not involve variation in direction of change; instead, it involves variation only in rate of change. In earlier studies, the starting or ending frequencies of formant transitions, as well as direction of change, varied across stimuli as a function of consonant place. For /ba/ and /wa/, formant frequencies are similar at syllable onset and steady-state regions, but the time required to move from one to the other differs. Consequently, the nature of the cue is different than in earlier studies, so it is not possible to predict beforehand whether children will weight this cue more, similarly, or less than adults do. Several studies have already examined adults' weight- ing strategies for this manner contrast. For example, Nittrouer and Studdert-Kennedy (1986) manipulated the amplitude rise time (ART) of natural /ba/ and /wa/

syllables such that tokens of each were given the structure of the other while preserving original formant structures. The results showed that adults based their phonemic decisions almost entirely on the rate of formant change; the effect of ART was small. However, there was one confound in using natural speech samples to examine weighting strategies for these syllables that may have influenced outcomes, and that was fundamental frequency (fO): It also differs at syllable onset for these tokens. Because the vocal tract is completely closed prior to the start of a /ba/ syllable, subglottal pressure is greater at voicing onset in these syllables than in /wa/ syllables, where air continues to flow through the narrow lip constriction. As a result, fO is higher in frequency at constriction release in /ba/ than in /wa/. That factor was not controlled in Nittrouer and Studdert-Kennedy's experiment, but it was in a subsequent experiment. Walsh and Diehl (1991) used synthetic speech tokens in which fO remained consistent and replicated Nittrouer and Studdert-Kennedy's findings, thus minimizing the probability that the outcomes of that earlier study were due to differences in fO. Nonetheless, in the current experiment, we examined potential effects of fO by using both natural and synthetic stimuli. In addition, in the current experiment, we made use of new methods of switching gross amplitude envelopes among natural tokens and of imposing envelope structure on synthetic syllables in order to ensure that these envelopes were what they were described to be.

The Current Experiment

In all, the current experiment had three objectives. The first objective was to examine how adults and children weight ART and rate of formant transitions (hereafter referred to as formant rise time [FRT]) in this stop-manner contrast. To meet this objective, we selected adults and children as participants. The second objective of this study was to determine whether fO influences these decisions. We accom- plished this objective by including two kinds of speech stimuli: (a) natural tokens that retained natural variability in fO and (b) synthetic tokens in which fO was held constant across stimuli. The third objective of this study was to measure sensitivity to ART for nonspeech stimuli for the same listeners from whom the phonemic labeling results were obtained in order to evaluate the extent to which auditory sensitivity to this property accounts for the extent to which it is weighted in the stop-glide decision.

Method

Listeners

Participants were 20 adults between 18 and 40 years of age and 30 children ranging in age from 4;3 (years;months) to 5; 11. The mean age of children was 5;2 (SD = 0;7). None of the listeners (or, in the case of children, their parents) reported any history of hearing or speech disorder. All listeners passed hearing screenings consisting of the pure tones of 0.5, 1, 2, 4, and 6 kHz presented at 25 dB HL to each ear separately. Parents of the 4- and 5-year-olds reported that their children were free from significant histories of otitis media, defined as six or more episodes during the first 3 years of life. Children were given the Goldman Fristoe Test of Articulation-Second Edition (Goldman &Fristoe, 2000) and were required to score at or better than the 30th percentile for their age in order to participate. Children's scores ranged from the 30th percentile to greater than the 87th percentile (M = 59, SD = 18). Adult participants were given the Reading subtest of the Wide Range Achievement Test (4th edition; Wilkinson &Robertson, 2006), and all demonstrated better than a 12th grade reading level.

Equipment and Materials

We recorded stimuli using a Shure KSM studio microphone, a Tube MPStudio V3 amplifier, and an Echo Gina 3G digital audio converter, using Adobe Audition software. All testing took place in a soundproof booth, with the computer that controlled stimulus presentation being located in an adjacent room. Hearing was screened with a Welch Allyn TM262 audiometer using TDH-39 headphones. Stimuli were stored on a computer and presented through a Creative Labs Soundblaster card, a Samson headphone amplifier, and AKG-K141 headphones. This system has a flat frequency response and low noise. Custom-written software controlled the presentation of the stimuli. The experimenter recorded responses with a keyboard connected to the computer.

For the labeling tasks, two drawings (on 8" χ 8" cards) were used to represent each response label: for /ba/, a picture of a baby, and for /wa/, a picture of the ocean (water). When introducing these pictures, the experimenter explained to the listener that the pictures were being used to represent the response labels because babies babble by saying /ba/-/ba/ and babies call water /wa/.

For the discrimination tasks, a 4" χ 14" cardboard response card with a line dividing it into two 7-in. halves was used with all listeners during testing. On one half of the card were two black squares, which represented the "same" response choice; on the other half were one black square and one red circle, which represented the "different" response choice. Ten other cardboard cards (4" χ 14", not divided in half) were used for training with children. On six cards were two simple drawings, each of common objects (e.g., hat, flower, ball). On three of these cards, the same object was drawn twice (identical in size and color), and on the other cards, two different objects were drawn. On four cards were two drawings each of simple geometric shapes: two with the same shape in the same color and two with different shapes in different colors. We used these cards to ensure that all children knew the concepts of "same" and "different."

A game board with 10 steps was also used with children. The children moved a marker to the next number on the board after each block of stimuli (10 blocks in each condition). Cartoon pictures were used as reinforcement and were presented on a color monitor after completion of each block of stimuli. A bell sounded while the pictures were being shown and so served as additional reinforcement for responding.

Stimuli

Five sets of stimuli were created: for labeling tasks, one set of natural speech stimuli and two sets of synthetic speech stimuli; for discrimination tasks, two sets of nonspeech stimuli.

Natural speech stinudi. Three types of stimuli were created from recordings of /ba/ and /wa/ syllables: (a) syllables with original, unprocessed temporal envelopes; (b) syllables with temporal envelopes transposed within the same category of syllable (/ba/ or /wa/); and (c) syllables with temporal envelopes switched between the two types of syllable (/ba/ and /wa/).

Recording and measurements. A male speaker was recorded producing 10 tokens each of /ba/ and /wa/ in random order, and these tokens were digitized at a 44.1-kHz sampling rate with 16-bit resolution directly onto a hard drive. Five tokens of each were selected, matching duration as closely as possible. Acoustic measurements were made of each token, using TF32 software (Milenkovic, 2004). For these measurements, the vowel was defined as the whole vocalic portion of the syllable, from the release of closure for /ba/ or the release of constriction for /wa/. Six measurements were made:

1. FO was measured for the first three pitch periods after vowel onset.
2. Fl, F2, and F3 were measured for the first two pitch periods after vowel onset.
3. Fl, F2, and F3 were measured at the start of vowel steady state, defined as the point where F2 no longer rose more than 10 Hz from one pitch period to the next, and was calculated using 26-pole linear predictive coding (LPC) analysis at each pitch period.
4. Vowel duration was measured from vowel onset to the end of the vowel, which was defined as the zero crossing where energy from the formants higher than Fl was fully attenuated.
5. FRT was measured from vowel onset to the start of the vowel steady state.
6. ART was measured, using the following procedure: The amplitude peak of the syllable was found and root-mean-square (RMS) amplitude was calculated over the five pitch periods with the amplitude peak as the center, using WavEd software (Neely &Peters, 1992). RMS was then computed for individual pitch periods preceding the amplitude peak. The first pitch period with an RMS value >80% of the peak value was labeled as the end of the amplitude rise. ART was calculated as the duration between vowel onset and the end of the amplitude rise.

Table 1 lists the values for each of these measures.

Temporal envelope manipulation. Before the gross temporal envelope (GTE) was interchanged (either transposed or switched) between tokens, prevoicing was removed from the /w/ tokens and the burst was removed

from the /b/ tokens to eliminate those as cues for the stop-glide distinction. These tokens are referred to as "unprocessed" in this article. There were three subsequent steps in the process of interchanging the GTE from a model token onto a target token in order to create transposed and switched stimuli.

First, the GTE was removed from the target token so that a new envelope could be applied without interaction from the envelope of that target. A process of pitch period normalization was used in which every individual sample in one pitch period was scaled by the same amount so the maximum amplitude peak across all pitch periods was uniform. To find the individual pitch periods of the target, autocorrelation functions with 40-ms windows starting at the beginning of each pitch period were used, in a three-step process, as follows: First, measuring from the start of one pitch period, the start of the next pitch period was estimated to be between 5.6 and 14.3 ms later, assuming fO to be between 70 and 180 Hz, which is typical for a male speaker. Second, the peak of the autocorrelation function within that window was used to constrain further where the start of the next pitch period would be. Third, the nearest positive-going zero crossing was identified as the exact start. After every pitch period was identified, each was scaled separately.

The second step in the GTE-interchanging process was extracting the GTE from a second, or model, token. Because of variations of fO and utterance length across tokens, there could be no temporal alignment of individual pitch periods in the separate model tokens. Therefore, the GTE from each model token was measured by half-wave, rectifying the original signal and low-pass filtering using a cutoff frequency of 20 Hz.

The third step in the GTE-interchanging process was overlaying the extracted GTE of the model onto the normalized target using a pointwise multiplication. Prior to the multiplication, the longer of the two signals was truncated at the end to match the length of the shorter signal. Because tokens had been selected to be similar in length, truncation involved only a pitch period or two, when necessary. After doing this, we measured the ART of the target with the new envelope using procedures already described to ensure that the envelopes of the transposed or switched tokens matched those of the tokens that served as models. For two tokens, slight deviations were found. In those cases, individual pitch periods were adjusted so the ART of the target matched the model ART precisely.

The transposed stimuli were created in round-robin fashion: /ba/1 was the model imposed on /ba/ 2 as the target, /ba/ 2 was the model imposed on /ba/ 3 as the target, and so forth. The same procedure was used with the /wa/ stimuli. The switched stimuli were created so that /ba/ 1 was the model and /wa/1 was the target and vice versa, /ba/ 2 was the model and /wa/ 2 was the target and vice versa, and so forth.

These manipulations resulted in a total of 30 stimuli of six types: Five unprocessed /ba/ tokens, five transposed /ba/ tokens (with envelopes from different /ba/ tokens), five switched /ba/ tokens (with /wa/ envelopes), five unprocessed /wa/ tokens, five transposed /wa/ tokens (with envelopes from different /wa/ tokens), and five switched /wa/ tokens (with /ba/ envelopes). During every block of testing, two tokens of each type were played, creating blocks of 12 stimuli. Ten blocks were presented. Each time the software selected a token of a particular type to play, it did so randomly, but it did not replace that token into the pool until each token in the pool had been played. This process resulted in each stimulus being played a total of four times during testing, so 20 responses were collected to each type. In all, 120 stimuli were presented (6 types χ 5 tokens χ 4 repetitions).

Synthetic speech stimuli, two sets. Onset and steady- state formant values averaged across the /ba/ and /wa/ tokens were used to determine parameter settings for a nine-step /ba/-/wa/ continuum using a Klatt synthesizer (Sensyn). The tokens were all 370 ms in duration, with an fO of 100 Hz throughout. Starting and steady-state frequencies of the first two formants were the same for all stimuli, even though the time to reach steady-state frequencies varied. Fl started at 450 Hz and rose to 760 Hz at steady state. F2 started at 800 Hz and rose to 1150 Hz at steady state. F3 was kept constant at 2400 Hz. FRT varied along a nine-step continuum from 30 ms to 110 ms, in 10-ms steps.

Controlling ART required that the signals be pro- cessed in MATLAB because there is no way to reliably control amplitude in Klatt-based speech synthesizers. The amplitude of voicing (AV) parameter is designed to simulate

the amplitude of the voicing source before the signal is filtered by the vocal tract. However, that parameter interacts with filter parameters (i.e., those associated with formants) such that there is no direct correspondence between the AV setting and signal level at output. In this experiment, AV was set to a constant value of 60, and MATLAB was used to overlay ART after synthesis. The envelope created by MATLAB started at 0 dB and rose to the maximum amplitude at the end of the rise time, which varied along a seven-step continuum from 10 ms to 70 ms in 10-ms steps. Still one more adjustment needed to be made because Sensyn imposes a brief rise time of its own, even if AV is set to be constant across the stimulus. That unavoidable rise time would interact with the envelope created in MATLAB, if not corrected. Thus, an extra 10-ms frame was appended to the start of the file with identical parameters to those of the first frame, and then that frame was deleted from each file after stimuli were created.

The procedures described above were combined to make two sets of stimuli, one that varied in FRT and one that varied in ART. For the FRT stimulus set, the most /ba/-like ART (10 ms) and the most /wa/-like ART (70 ms) were applied to each stimulus along the nine-step /ba/-/wa/ FRT continuum, resulting in 18 FRT stimuli (9 FRTs χ 2 ARTs). For the ART stimulus set, stimuli were created with the most /ba/-like FRT (30 ms) and most /wa/-like FRT (110 ms). Then the seven ARTs were applied to each stimulus, resulting in 14 ART stimuli (2 FRTs χ 7 ARTs). Figure 2 shows synthetic stimuli for which FRT and ART signaled phonemic identity in a consistent manner (top panel) and stimuli for which they were set to signal phonemic identity in a contradictory manner. Inspection of the waveforms confirms that ART was implemented as described. During testing, stimuli were played 10 times each in blocks of however many stimuli there were, so that listeners heard a total of 180 FRT and 140 ART stimuli in two separate conditions.

Nonspeech stimuli for discrimination, two sets. For the discrimination task, two types of stimuli were created: (a) one set that was more speechlike in quality and (b) one set that was not speechlike at all, but nonetheless served as an analogue of the first set. As in Miyawaki et al.'s (1975) study, it was considered possible that listeners would be sensitive to ART when it is not heard as part of a speech signal, but fail to attend to it in making the phonemic judgment. Evidence for that position would be obtained if listeners recognized smaller differences in ART with the completely nonspeech signals than they did with the more speechlike signals.

The more speechlike set of stimuli was synthesized with Sensyn, using steady-state formants. The frequencies were 500 Hz for Fl, 1000 Hz for F2, and 1500 Hz for F3. These frequencies are typical values for modeling the resonances of a male vocal tract with a quarter wavelength resonator, although they do not represent any English vowel. The fO was 100 Hz. Total duration was 370 ms. Onset amplitude envelopes (similar to the envelopes used for the other synthetic speech stimuli) were overlaid onto these signals. ART ranged from 0 to 250 ms in 25-ms steps, resulting in 11 stimuli. The other set of stimuli consisted of sine waves synthesized using TONE (Tice &Carrell, 1997), with the same duration, formant frequencies, and ARTs as the formant stimuli, resulting in 11 stimuli. The stimulus with the 0-ms ART was always the standard (A), and every stimulus (including the standard) was played as the comparison (X). During testing, each stimulus was compared to the standard 10 times, so that listeners heard a total of 110 formant stimuli and 110 sine wave stimuli.

Summary. Five sets of stimuli were presented in this experiment, in five separate tasks: one labeling task with natural speech stimuli, two labeling tasks with synthetic speech stimuli (FRT and ART), and two discrimination tasks (one with formant stimuli and one with sine wave stimuli).

Procedure

All procedures were approved by the The Ohio State University Institutional Review Board. Adults were tested in a single session of 45 min, and 4- and 5-year-olds were tested in two sessions of 45 min each over 2 days. The screening procedures (hearing screening and the Wide Range Achievement Test or Goldman Fristoe Test of Articulation) were administered first. The five test conditions were ordered so that one of the synthetic /ba/-/wa/ labeling tasks was first, followed by one of the discrimination tasks. The labeling task with the natural /ba/-/wa/ stimuli was always presented third, followed by the other discrimination task and, finally, the other synthetic

/ba/-/wa/ labeling task. As a result, there were four possible orders of presentation. Adults completed all tasks in the single session, and children completed the first three tasks in the first session and the last two tasks in the second session.

Labeling tasks. For the /ba/-/wa/ labeling tasks, the experimenter introduced each picture separately and told the listener the name of the syllable associated with that picture. Ten live-voice practice trials were presented in which the listener pointed to the picture and named it after the experimenter said a syllable (five times for each syllable). Having listeners both point to the picture and say the syllable ensured that they were correctly associating the syllable and the picture. Then the listener heard the five unprocessed exemplars of /ba/ and /wa/ over headphones and was instructed to respond in the same way. Listeners were required to respond to nine of the 10 exemplars correctly to proceed to testing. For synthetic /ba/-/wa/ stimuli, training was also provided for the endpoints corresponding to the most /ba/-like (30 ms FRT, 10 ms ART) and /wa/-like (110 ms FRT, 70 ms ART) stimuli. Listeners heard five presentations of each endpoint and had to respond to nine out of the 10 correctly in order to proceed to testing. Feedback was provided for up to two rounds of training, and then listeners were given up to two rounds without feedback to reach criterion. If listeners were not able to respond to nine of 10 endpoints correctly by the third round, testing for that condition was not done. During testing in each of the three stimulus conditions, listeners needed to respond with 80% or better accuracy to the endpoints in order to have their data included in the analysis.

Different dependent measures were analyzed for the natural and synthetic stimuli. For natural stimuli, the percentage of stimuli of each type given the label of the original (target) syllable served as the dependent variable. Arcsine transformations were used for statistical analysis because results were close to 100%. For synthetic stimuli, the plan was to use each listener's labeling responses to construct cumulative normal distributions of the proportion of /wa/ responses across each continuum. Lines could then be fit using probit analysis (Finney, 1971). From these probit functions, slopes and distribution means (i.e., phoneme boundaries) can be computed. These procedures were followed for the FRT continua, which showed typical distributions. However, responses to the ART continua did not show the usual cumulative normal distributions. Thus, instead of fitting probit functions, the percentage of /wa/ responses across each continuum served as the dependent variables.

Discrimination tasks. For the discrimination tasks, an AX procedure was used. In this procedure, listeners compare a stimulus, which varies across trials (X), with a constant standard (A). For both the sine wave and formant stimuli, the A stimulus was the one with a 0-ms ART. The interstimulus interval between standard and comparison was 450 ms. The listener responded by (a) pointing to the picture of the two black squares and saying "same" if he or she judged the stimuli as being the same or (b) pointing to the picture of the black square and the red circle and saying "different" if he or she judged the stimuli as being different. Both pointing and verbal responses were used because each served as a check on the reliability of the other.

Before any testing with the acoustic stimuli was done with children, they were shown the drawings of the six same and different objects and were asked to report whether the two objects on each card were the same or different. Then they were shown the cards with drawings of same and different geometric shapes and were asked to report whether the two shapes were the same or different. Finally, children were shown the card with the two squares on one side and a circle and a square on the other side and were asked to point to same and to different. Adults were simply shown the card with the two squares on one side and a circle and a square on the other side and were asked to point to same and to different. Before testing with stimuli in each condition, all listeners were presented with five pairs of stimuli that were identical and five pairs of stimuli that were maximally different, in random order. Listeners were asked to report whether the stimuli were the same or different and were given feedback. Next, these same training stimuli were presented, and listeners were asked to report whether they were the same or different, only without feedback. Listeners needed to respond correctly to nine of the 10 training trials without feedback in order to proceed to testing. During testing in each of the two stimulus

conditions, listeners needed to respond correctly to at least 16 of these physically same and maximally different stimuli (80%) to have their data included in the final analysis.

The discrimination functions of each listener formed cumulative normal distributions, and probit functions were fit to these distributions. From these fitted functions, distribution means were calculated and served as difference thresholds. These thresholds were the 50% points on the discrimination functions.

Results

All 20 adults were able to meet the training and testing criteria to have their data included in the study for all five tasks. All 30 children met the inclusion criteria for the labeling task with natural syllables. For the two labeling tasks with synthetic syllables, 27 of the 30 children met the inclusion criteria for the FRT continua, and 29 of the 30 children met the inclusion criteria for the ART continua. The two discrimination tasks were more difficult for children: Only 12 of the 30 children met the inclusion criteria for the formant stimuli. Those 12 and an additional five children met the inclusion criteria for the sine wave stimuli. These attrition rates suggest that young children have difficulty discerning acoustic stimuli that differ only on amplitude structure, and that is especially true if the stimuli are speechlike.

Labeling Task With Natural Stimuli

Figure 3 shows the percentage of original responses for adults and children for the unprocessed, transposed, and switched /ba/ and /wa/ stimuli. Adults and children responded to the unprocessed and transposed stimuli with the original response (/ba/ for /ba/ and /wa/ for /wa/) 99.33% to 100% of the time. The switched /wa/ stimuli (/wa/ with /ba/ envelopes) were also heard as /wa/ nearly all of the time: 100% for adults and 99% for children. Only one child was affected by the change in ART for the switched /wa/ stimuli, hearing 20% of them as /ba/. Switched /ba/ stimuli (/ba/ with /wa/ envelopes) showed many more /wa/ responses, especially from children. Two of the 20 adults (10%) and 13 of the 30 children (43%) responded to switched /ba/ with more than 10% /wa/ responses.

Table 2 shows results from two-way analyses of variance (ANOVAs), with age as the between-subjects factor and stimulus type (unprocessed, transposed, or switched) as the within-subject factor, for /ba/ and /wa/ stimuli separately. For stimuli created from the original /ba/ syllables, the main effects of stimulus type and age were statistically significant, as was the Stimulus Type χ Age interaction. The largest amount of variance was explained by stimulus type (η2 = .39). Because a significant interaction was found, we conducted one-way ANOVAs with age as the factor for each of the three stimulus types separately to locate the source of that interaction. Only switched /ba/ showed a significant effect, F(1, 48) = 9.14, ρ - .004. These statistical findings support the claim that the only natural stimuli that were not labeled entirely according to formant trajectories were the switched /ba/ syllables. Labeling of these stimuli was influenced slightly by ART, and that influence was greater for children than for adults. Stimuli created from the original /wa/ syllables were labeled entirely according to formant trajectories, by adults and children alike.

Labeling Task With Synthetic Stimuli

Figure 4 shows results for the FRT continua (top panel) and the ART continua (bottom panel) for adults (squares, solid lines) and children (circles, dashed lines). Looking first at results for the FRT continua, on the top panel, it appears that adults and children responded similarly. When these labeling functions are compared with those in Figure 1, which is reprinted from a sibilant-vowel study, responses for both groups resemble those of adults in that earlier study, where functions were steep. This pattern indicates that listeners responded largely on the basis of the cue manipulated along the continuum represented on the x-axis. In this case, that was FRT. However, functions from this experiment were less separated on the basis of the second cue (ART in the current experiment) than were those of the adults in the experiment depicted in Figure 1. This pattern indicates that the second cue in this experiment was not weighted strongly.

To examine results for this FRT continuum more closely, we performed two-way ANOVAs on the slopes and phoneme boundaries, with age and ART as main effects. For slopes, the main effects of age and ART were not

significant, but the Age χ ART interaction was, F(1, 45) = 4.71,/? = .035, η2 = .10. This outcome reflects the fact that adults' labeling functions had similar slopes across ARTs, and children's labeling function for the /wa/ ART had a slope similar to that of adults. However, children's labeling function for the /wa/ ART (filled circles) is slightly shallower, and that likely accounts for the significant interaction. As with natural stimuli, children were slightly affected by the /wa/ ART, even when stimuli had clear /ba/ FRTs. For phoneme boundaries, the effect of ART was significant, F(1, 45) = 17.74,/? <.001, η2 = .28, but neither age nor the Age χ ART interaction was significant. These outcomes mean that listeners responded differently to stimuli with /ba/ and /wo/ ART, but the effect was similar for children and adults. It was not large for either group.

The results for the ART continua (see bottom panel of Figure 4) are striking: Listeners appear to have assigned no weight at all to ART when the formants were /wa/-like (filled symbols). Adults also did not weight ART strongly when the formants were /ba/-like (open symbols), but children did, to a small degree. About 25% of the stimuli with /ba/ FRT and the longest ART were labeled as /wa/ by children. This matches the result found for natural tokens, where some children labeled some switched /bo/ syllables as /wa/, as well as the result found for the FRT continuum with the /wa/ ART, where children's function was shallower than others because some stimuli at the /ba/ FRT endpoint were labeled as /wa/.

Because responses were all so close to 0% and 100% for these synthetic ART stimuli, it was not possible to compute probit functions. Instead, we computed the percentage of /wa/ responses across all steps on the ART continuum for the /ba/ and /wa/ FRT continua separately. We conducted a two-way ANOVA with age as the between-subject s factor and FRT as the within-subject factor. Arcsine transforms were used. The effect of age was significant, F(1, 47) = 6.87, ρ - .012, η2 = .13, as was the effect of FRT, F(1, 47) = 1,591.26,ρ <.001, η2 = .97. The Age χ FRT interaction was also significant, F(1, 47) = 25.93, ρ <.001, η2 = .36. These results confirm that listeners in both groups weighted FRT heavily in their phonemic decisions and that children showed some small weighting of ART, which adults did not do.

From these labeling results, it is clear that all listeners weighted FRT strongly in their stop-glide decisions. Neither adults nor children weighted ART strongly at all. Of course, the question arises as to whether listeners are sensitive to this acoustic structure or not.

Discrimination Tasks

Figure 5 shows discrimination functions for sine wave (filled symbols) and synthetic (open symbols) stimuli for adults (squares) and children (circles). It appears that both adults and children were sensitive to ART. One striking aspect of these results is that children appear to have been more sensitive to changes in ART than adults, but that impression needs to be tempered by the fact that many children were not able to meet criteria to participate at all, indicating they were not able to judge ART in these nonspeech stimuli. Thus, the children included in the data shown here represent only those children who could perform the task with these stimuli and, on average, they appear to have been slightly more sensitive to ART than were adults.

We performed a two-way ANOVA with age as the between-subjects factor and stimulus type as the within-subject factor on distribution means from adults and the 12 children who met criteria for participation with both types of stimuli. We found that the effect of age was significant, F(1, 30) = 4.95, ρ - .034, η2 = .14, as was the effect of stimulus type, F(1, 30) = 48.63, ρ <.001, η2 = .62. The Age χ Stimulus type interaction was not significant. Thus, we can conclude that listeners were more sensitive to ART for sine wave stimuli than for formant stimuli, the more speechlike sounds. The children who met criteria for participating with these nonspeech stimuli were more sensitive to ART than were adults.

Finally, we compared labeling results for children who could and could not meet criteria to participate in the discrimination tasks with nonspeech stimuli to determine whether there were any differences in speech labeling between these groups. We conducted two-way ANOVAs on dependent measures for each set of speech stimuli, with group (children who could or could not meet criteria with the nonspeech stimuli) as the between-subjects factor and stimulus type as the within-subject factor. For no set of speech stimuli was either a

significant effect of group or a Group χ Stimulus type interaction found. Therefore, it may be concluded that children who were unable to perform the discrimination tasks with nonspeech stimuli performed indistinguishably from children who could perform those tasks on speech labeling. Mean scores for the Goldman Fristoe Test of Articulation were also submitted to statistical analysis, and no significant difference was observed.

Discussion

The purpose of this study was to examine the labeling of stimuli differing in manner class (stops vs. glides) by adults and children. This purpose was motivated by three factors: (a) a desire to extend work on developmental changes in perceptual weighting strategies for speech, (b) an interest in constructing a base from which the question can be explored of how listeners with cochlear implants might process the amplitude structure provided by those implants, and (c) suggestions that children with dyslexia might have difficulty processing amplitude structure in the speech signal (Goswami et al., 2002, 2011). Three specific objectives were addressed by the current study. The first objective was to examine whether adults and young children differ in terms of how they weight the acoustic cues to the stop-glide contrast. Outcomes revealed that adults and children alike based their decisions about whether syllables started with stops or glides almost entirely on the rate of formant change. That similarity across age groups matches earlier findings showing that when adults heavily weight formant transitions in phonemic decisions, children demonstrate the same strategies. In general, children weight formant transitions strongly in phonemic decisions, so when adults do the same, their strategies match. However, earlier findings exploring age- related changes in weighting strategies for speech signals typically involved phonemic contrasts in which the direction of formant transitions differed across categories. The current experiment extends those findings by revealing that when the primary acoustic difference is rate of formant change, adults and children alike weight that property greatly.

One age-related difference was observed, however- and that happened when the cues conflicted, as was the case for switched /ba/ syllables. In that case, adults were able to attend to the formant cue only. Children, on the other hand, were slightly affected in their labeling decisions by ART. The suggestion has previously been made that children are obliged to integrate acoustic structure for speech signals, even when that structure provides conflicting information about phonemic identity (Nittrouer &Crowther, 2001). That suggestion may explain outcomes for this current study because the children were deleteriously affected when rate of formant transition and rate of amplitude change cued different phonemic decisions. Even at that, however, the effect was found only if the rate of formant change was rapid; it was not found for the switched /wa/ syllables, where the rate of formant change was gradual. In any event, responses of listeners in both age groups were overwhelmingly based on the rate of formant frequency change.

The second objective of the current study was to determine whether fO in natural stimuli might be used by listeners in making decisions about this manner contrast. This objective was accomplished by using both natural, modified stimuli in which fO retained its original value and synthetic stimuli that shared a consistent fO. Response patterns matched for the two types of stimuli, so no evidence was found to indicate that listeners give any weight at all to fO in this particular phonemic decision.

The third objective was to determine whether sensi- tivity to the acoustic property of ART, as measured for nonspeech sounds, could explain the extent to which listeners weight that property in making the stop-glide distinction. A disassociation between sensitivity and weighting of acoustic properties has been observed in experiments with adults who are second-language learners and in experiments with children. In the current experiment, a similar disassociation was observed: Adults and children-at least, the children who were able to perform the task-showed mean dis- crimination thresholds of less than 50 ms, so they were highly sensitive to variation in ART, yet they did not use this acoustic property in their phonemic decisions. Thus, further evidence was found to support the position that measured sensitivity to acoustic properties reveals little about the role that those properties may play in phonemic decisions. Here, as elsewhere, evidence of separate organi-

zational strategies for speech and nonspeech stimuli is seen. Both kinds of signals require some perceptual organization of sensory elements, but the extent to which that organiza- tion is explained by primitive versus schema-based principles varies for speech and nonspeech signals (Bregman, 1990; Remez, 2008). Furthermore, the specific schémas under- lying perception differ for speech and nonspeech signals (Nittrouer &Tarr, 2011; Remez, Rubin, Berns, Pardo, &Lang, 1994). As a result, the ability to make decisions about the auditory qualities of nonspeech signals predicts little about how the properties of those signals will be used in the perception of speech. In the current study, even more evidence of the disassociation between the perception of nonspeech and speech signals is provided by the fact that the children who could not perform the discrimination task with nonspeech signals showed the same outcomes in their labeling of speech stimuli as the children who could perform the discrimination task. Thus, it may be concluded that a demonstration that a specific property is used in speech perception predicts little about whether listeners will necessarily be able to judge its auditory qualities when it is presented in a nonspeech context.

In sum, the current experiment demonstrates that neither adults nor children use ART in making decisions about whether they heard /ba/ or /wa/. Instead, these listeners weighted FRT strongly in making this decision. Although formant transitions specify this manner distinction differently from the way formant transitions specify place of consonant constrictions (i.e., rate of change vs. direction/ extent of change), it should perhaps not be surprising that adults and children weighted the cue similarly. In either case, formant transitions involve the relatively slowly modulating changes of vocal tract resonances. Evidence from experi- ments with sine wave speech has revealed that adults and children are comparable in their abilities to comprehend those signals, which replicate the slowly modulating changes of vocal tract resonances (Nittrouer &Lowenstein, 2010; Nittrouer, Lowenstein, &Packer, 2009). This evidence is complementary to the idea that it is precisely formant transitions that first capture children's attention when perceiving speech (e.g., Nittrouer, 2006). According to this account, children's perceptual attention gradually shifts away from being highly and almost singly focused on formant transitions in the speech signal and starts to incorporate other phonemically informative kinds of acoustic structure. Where children with dyslexia are concerned, several studies have demonstrated that they depend even more than age- matched control subjects on formant transitions in making phonemic judgments (Boada &Pennington, 2006; Johnson, Pennington, Lowenstein, &Nittrouer, 2011). That outcome is reflected in the results of Goswami et al. (2011), who found that the children with dyslexia placed their /ba/-/wa/ phoneme boundaries at briefer FRTs than did children who read typically. The common interpretation of this sort of finding is that children with dyslexia are delayed in shifting their perceptual weight away from formant transitions and toward other kinds of acoustic structure (see, e.g., Boada &Pennington, 2006; Nittrouer, 1999).

Of course, finding that samples of some listener populations fail to weight ART in making decisions regarding this manner contrast does not necessarily mean that all other populations of listeners will similarly disregard it. The current study demonstrates that adults and children with age-appropriate speech perception failed to attend to ART, and research by Goswami and colleagues (2011) showed that children with dyslexia do not attend to this property either. However, there is one other population of listeners for whom the question needs to be explored of how well amplitude structure supports phonemic decisions: listeners with cochlear implants. The processing strategies of cochlear implants affect the quality of the signal properties delivered. Where formants are concerned, change over time is represented only when frequencies cross channels, so small changes in formant frequencies are missing. Because children typically depend so strongly on the time-varying spectral structure of the speech signal, it is important to determine how well they might be able to use amplitude structure instead when spectral structure is impoverished in this way. Cross-linguistic studies of weighting strategies have revealed that listeners depend on acoustic cues that are most relevant in their native language. For example, adults whose native language is English rely on the length of the vocalic portion before vocal tract closure in decisions regarding the voicing of final obstruents (Chen, 1970; Peterson &Lehiste, 1960; Raphael, 1972). However, listeners whose native language either does not include syllable-final obstruents or does not

make a length distinction based on voicing fail to weight this acoustic property strongly (Crowther &Mann, 1992, 1994; Flege &Wang, 1989). Nonetheless, individuals can modify their weighting strategies as they gain experience with a new, second language (Miyawaki et al, 1975). Thus, the hypotheses could be posed that perhaps adults who receive cochlear implants modify existing weighting strategies once they get those implants, and perhaps children with implants develop strategies that involve weighting ART strongly. Future investigations will need to explore those hypotheses.

In summary, the current study was undertaken to reexamine the acoustic and perceptual bases of labeling decisions for stimuli differing according to a stop-glide manner distinction. The results showed that adults and children alike based these decisions on the rate of formant frequency change, and hardly at all on ART.

Acknowledgments

This work was supported by National Institute on Deafness and Other Communication Disorders Grant ROI DC000633. We thank Ellen Hambley for her help with subject testing. We also acknowledge Amanda Caldwell's help in reading an earlier draft of this article.

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Editor: Sid Bacon
Associate Editor: Marjorie Leek
Received March 7. 2012
Revision received July 7. 2012
Accepted August 14. 2012
DOI: 10.1044/1092-4388(2012/12-0075)

THE QUEST FOR QUIET

Author: Childs, Craig.

Publication info: Muse 17.4 (Apr 2013): 6-12.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: Headnote
A WRITER SEEKS SILENCE IN A NOISY WORLD.

THE CITY'S ROAR

On many visits to Manhattan, I have found myself poking around the city trying to find a moment of quiet. Once I located a hint of it in Central Park during a windless, late-night snowfall. There I stood absolutely still in the lemon glow of the city, a sky full of snow. The city still roared from all sides, a thousand noises combined into one. I counted that distant, mild roar as quiet. It was a welcome relief from the more pressing noises of the daytime city.

During the day, though, heavy traffic tends to run around 85 decibels (dB). Eight straight hours of that noise level could permanently bend the hairs that carry sound through your inner ear. The average subway ride comes to around 112 dB, somewhere between a shouted conversation and a power saw going off near your head.

An audiology researcher in Berkeley, California, tested the sound of his local transit system and found that sound levels were as high as those at a rock concert (around 120 dB). On top ofthat, he noted, many passengers were wearing earbuds. By listening to music loud enough to cover the outside noise, they were going far past the limits on volume and time-exposure that lead to permanent damage and hearing loss.

Hearing is something that, once lost, people cannot get back. Each ear contains about 17,000 "hair cells" that turn vibrations into signals to the brain. Too much noise causes permanent damage to these hairs.

Because of the loud world Americans live in, hearing loss has become an epidemic in the United States. A 2012 study at Johns Hopkins University found that one in three adults has trouble hearing. Loud music, loud workplaces, and loud living environments are all part of the problem. Hearing loss is reported in 8.5 percent of people in their 20s and 17 percent of those in their 30s.

But when it comes to health problems caused by sound, hearing loss is only the tip of the iceberg. Scientists have found that rats that hear a frequent buzzer sound for weeks on end develop high blood pressure. Even after five weeks of buzzing, these rats are still darting back and forth across their cages, while rats in quieter cages have lower blood pressure and don't pace so nervously.

For humans, six hours of exposure to 90-decibel sound significantly raises the heart rate - and leaves it there for up to an hour after the noise is gone. Many studies have found a link between noise exposure and heart attack risk. In 2005 research in Berlin hospitals revealed that people living in loud environments are at a 50 percent greater risk of having a heart attack.

Among school kids, noise may make it harder to learn. In a 2005 study, researchers from the University of London tested children in 89 schools and concluded that kids who are exposed to high levels of aircraft noise have delayed reading skills.

Lorraine Maxwell, a sound researcher at Cornell University, says, "When children are in schools or housing situations where airplanes take off every 30 seconds or truck traffic is going by, those kids are constantly subjected to noise [that] neither they nor their teacher nor their parents can control. For them, long-term memory is interrupted. They stop paying attention. It requires too much energy. We call it cognitive fatigue."

Maxwell has been looking at classrooms for decades, and she believes that learning problems and physical illnesses are tied directly to noise. "We see children's blood pressure rising over time," Maxwell says. "When they are removed from that environment, or if the airport changes its flight pattern, then they recover."

THE COCKTAIL PARTY

Noisiness is subjective - in other words, it's a matter of opinion. It's a combination of decibels, tone, pitch, and annoyance. It ranges from the piercing warning of heavy machinery to a mouse pattering through the wall behind your head when you are trying to sleep. Noise is simply what you do not want to hear.

Quiet - although you can define it as little or no noise - is subjective too.

I was in New York, looking for what I thought was the perfect quiet: no clanking or roaring. I finally chose a rainy Sunday morning on Wall Street, figuring there would be no traffic and no noise. Just to get there, though, I had to hop on a train that was like sticking my head inside a bullhorn. The ride took 20 minutes. After just 10 more

minutes at 110 dB, I would have been at the limits that make the Occupational Safety and Health Administration warn, YOU'RE GOING DEAF!

I got off at an empty station. It was about five o'clock in the morning; there was not a soul to be seen. The train rumbled away, its mechanical racket replaced by a buzz of electricity from the fluorescent lights and tubes in the ceiling.

When clicks and squeals from the next train began coming down the tracks, I pushed my way out through the turnstiles and took the stairs into an early morning rain. There were no cars, no people, just the buildings standing tall and gray. The only sound was a steady fizz of rain on the street. The average rainfall comes in at 50 dB, a volume you could listen to forever without damage or distraction. Relieved by the sound, I snapped open my umbrella and walked into the thin, wet light of dawn.

We often think hearing is less important than sight. But in fact we are hearing just as much as we are seeing, if not more. We just don't always know it.

"Why do we need hearing when we've got vision?" asks Bill Yost, a psychoacoustic researcher at Arizona State University. "If you talk to people who are [born] blind and deaf - never heard or never saw in their lives - and ask them if they could have a sense they would like restored, they usually say hearing."

What the deaf are missing is an "auditory scene," something the hearing brain is constantly paying attention to. With hearing alone, you can tell how far away a garbage truck is, or how close you are to someone who's speaking. Picking up on sound reflections, you can actually listen to shapes and sizes, and whether a space is open or closed.

Your ear turns a flood of incoming sound into a coded message that travels through nerve cells to the brain. Then the brain analyzes this code to create a sound picture of the environment. First, the twists and turns of the outer ear magnify the sound's qualities, setting off the miniature tuning forks of the inner-ear bones. Sound then flows across hair cells in the inner ear like wind through tall grass, and the brain reads this wind. In a way, you see the air with your ears.

The human ear can tell apart 1,500 different pitches. The cells that move information from the ears into the brain are the fastest in the body, making hearing the most real-time sense we have.

Yost says, "The auditory system is always computing information, because what I said just a second ago is gone, so the brain has got to keep track of that over time."

When we throw our sensitive, attentive ears into a loud, modern environment, the result can be maddening. You might think you are tuning out most noise, but the simple fact is you are not. "There's the cocktail party effect," Yost says. "You want to [pay attention] to one voice, but it's difficult because of all the other sounds being generated."

"Listening is not the same as hearing," Yost says. "We get lots of information traveling through the auditory nervous system, but whether we are paying attention to it, listening to it - there's a whole other issue."

THE ANECHOIC CHAMBER

I searched for quiet places from city to city, but kept finding noise. I visited an elevator in Minneapolis (ominous motor sound) and dry sewage tunnels under Tucson (street sounds muffled through manhole covers). It seemed no matter where I went, quiet always came with a "but": quiet but for jet noise, quiet but for a refrigerator hum, quiet but for a distant motor.

I wondered if I would ever find such a thing as silence - not just a lack of noise, but a complete absence of sound. Eventually I arrived at what's called an anechoic ("ann-eh-KO-ick") chamber in the basement of a building at the University of California, Berkeley.

This soundless chamber is overseen by a retired audiologist named Erv Hafter, who took me inside. Hafter carefully explained that an anechoic chamber is not an infinitely silent place. As far as he knows, no such thing exists on Earth. He said there are movements in the ground, vibrations, jackhammers, even distant earthquakes.

The room, covered top to bottom and side to side with foam-core filters, absorbed all noise except for what was aimed directly at me - in this case, Hafter's voice. I could not stop staring at his mouth as he talked. It was as if he were speaking down a tube. I could hear his spit. Between words came a brief and eerie deadness.
Hafter went to the large airlock door. "I'll just shut you in. Take as much time as you need." He closed the door, and I stood in silence, listening for earthquakes in China.
Used for sound experiments, the chamber is lined with speakers and trunks of electrical cables. The floor is a springy net of wire. The wires strained, sounding like violin strings under my feet as I slowly paced the room's edges. Without the usual sound waves bouncing this way and that, I could not hear where I was. My ears were fighting with my other senses: my eyes said I was in a closed space, but my ears said I was floating in an infinite emptiness.
An audiologist doing sound research with babies once told me anechoic chambers always make them cry. He said, "You have a perfectly quiet, normal 10-monthold, happy as álark, maybe even half asleep; you bring them into an anechoic chamber, and they go berserk."
I pulled the chains on four light bulbs, plunging the room into total darkness. It felt like my senses were suddenly cut off, a sensation that would have driven a 10-month-old stark raving mad.
With my vision taken away, I focused on what I could hear, which at first was nothing. The tiny bones in my ears relaxed. I began to hear the soft thrum of my heart. Then came a fainter noise, a hiss. It was not as sharp as the ringing in some people's ears called tinnitus, which is the result of damaged hearing. I thought it was an air duct, but no air comes or goes from an anechoic chamber.
I tilted my head one way and the other, trying to fix on the sound's location. I realized it was in my head. It was, I believe, the sound of blood flow echoing through my skull, like sand pouring across velvet.
I lasted 45 minutes. Then I pulled the chain on each light, popped open the heavy door, and emerged. I took an elevator up, pushed through the outside doors, and stepped onto campus as if coming up for air. It was like getting my senses back, the relief of jet noise and thousands of bustling students.
THE SOUND OF SILENCE
It takes technology to make the quiet of an anechoic chamber. Not even the bottom of a cave is as quiet. This is also the kind of silence that noise-canceling headphones are aiming for.
Walk through an airport, and you will notice people wearing these devices to find their own slice of silence, like portable anechoic chambers. Noise-canceling headphones work by picking up the frequencies of outside sounds and emitting different sound waves that cancel out those frequencies. They essentially put a dome around your head so that you don't have to turn up your music so loud it leaves your ears ringing.
But is masking all outside sounds really the answer to our noisy world? Brent Edwards, head of research for Starkey Laboratories, the largest hearing-aid company in the United States, says no. "Your ears are a constant monitoring system for everything around you," Edwards says.
Even working with top technology, Edwards says, he cannot create a device that breaks down sounds into separate parts, or finds their locations, as well as the human ear does.
"I like the fact I cart hear so much going on," he says. "Our cognitive system has built up an alert mechanism from when mankind had to worry about tigers sneaking up on them in the forest. When there is constant sound around you, that kind of indicates that it is not a threat, nothing you need to pay attention to, and you tend to ignore it. You tend not to even know it's there. When it changes, that is when you are alerted."
Still, I wanted silence. I wanted the anechoic chamber but without the chamber. No walls, no ceiling, no airplanes rumbling by at 30,000 feet, no faroff highway noise, no sound.
In the Gran Desierto of Sonora, Mexico, I searched for this next level of quiet. On the west side of the desert, sand dunes stretch across the horizon. The tallest dunes rise 800 feet, like liquid mountains.
At first, it seemed all I could find in these dunes was a bone-scraping wind. It hardly paused, swirling and scribbling across the sand, a never-ending orchestra of sound. After several straight days it became a bit

maddening. My mouth was salted with blowing sand.
Then one night the wind stopped. It was as if the world suddenly held its breath. I left my camp and climbed to the slender crest of a dune, listening to the last breezes snaking away. I was nearly in the center of 4,000 square miles of sand, with an almostfull moon illuminating the dunes. I clapped my hands and listened for an echo. The sand absorbed most of the sound, reflecting just enough so I could hear the clap riding away. I hooted loud, listened to my voice fleeing across the sand.
And then I was still. I listened.
It sounded perfect enough to finally call it a night.

Sidebar

Heavy traffic in New York City has a volume of about 85 decibels.

Sidebar

In noisy spaces, our brains struggle to focus on just one sound at a time.

Sidebar

Anechoic chambers are engineered to be as silent as possible.

Sidebar

Finally! Not a sound to be heard except your own thoughts. And the flapping of vultures.
Does quiet calm you down or drive you bonkers? Shout or whisper your answer at www.musemagkids.com/townhall.

AuthorAffiliation

Craig Childs has contributed to NPR's Morning Edition and written for publications including the New York Times and Pacific Standard magazine. He and his family live off the grid near Cohrado's West Elk Mountains.

Taking of Marine Mammals Incidental to Specified Activities; U.S. Marine Corps Training Exercises at Air Station Cherry Point

Publication info: The Federal Register / FIND 78. 061. (Mar 29, 2013).

Abstract (Abstract): Notice; proposed incidental harassment authorization; receipt of application for letter of authorization; request for comments.
RIN Number: "RIN 0648-XC486"
Citation: "78 FR 19224"
Page Number: "19224"
"Notices"
SUMMARY: We have received an application from the U.S. Marine Corps (Marine Corps) requesting an incidental harassment authorization (Authorization) to take marine mammals incidental to various training exercises at Marine Corps Air Station (MCAS) Cherry Point Range Complex, North Carolina for a period of one year.

Full text: Source: DEPARTMENT OF COMMERCE (DOC)
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Notice; proposed incidental harassment authorization; receipt of application for letter of authorization; request for comments.
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SUMMARY: We have received an application from the U.S. Marine Corps (Marine Corps) requesting an incidental harassment authorization (Authorization) to take marine mammals incidental to various training exercises at Marine Corps Air Station (MCAS) Cherry Point Range Complex, North Carolina for a period of one year.
The Marine Corps' activities are military readiness activities pursuant to the Marine Mammal Protection Act (MMPA), as amended by the National Defense Authorization Act (NDAA) for Fiscal Year 2004. Per the MMPA, we are requesting comments on our proposal to issue an authorization to the Marine Corps to incidentally harass by Level B harassment only, bottlenose dolphins (Tursiops truncatus), during the training exercises that would occur within the proposed effective period of May 20, 2013 through May 19, 2014. We are also requesting comments on our intent to promulgate regulations governing the take of marine mammals over a 5-year period incidental to the activities described in this notice.
DATES: Comments and information must be received no later than April 29, 2013.
ADDRESSES: Comments on the application should be addressed to P. Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3225. The mailbox address for providing email comments is ITP.Cody@noaa.gov. Please include 0648-XC486 in the subject line. We are not responsible for email comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 25-megabyte file size.
Instructions: All submitted comments are a part of the public record and we would post to http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.
To obtain an electronic copy of the application, write to the previously mentioned address, telephone the contact listed here (see FOR FURTHER INFORMATION CONTACT), or visit the internet at: http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.
The following associated document is also available at the same internet address: The Marine Corps' Environmental Assessment (EA) titled, "Environmental Assessment MCAS Cherry Point Range Operations," for their federal action of supporting and conducting current and emerging training operations. Their EA evaluates the effects of the proposed training operations on the human environment including impacts to marine mammals and their 2009 Finding of No Significant Impact (FONSI) for the activities.
This notice and the referenced document present detailed information on the scope of our federal action and resultant environmental impacts for purposes of the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 et seq.) (i.e., potential impacts to marine mammals from issuing the proposed Authorization including measures for mitigation, and monitoring). We solicit and would consider comments submitted in response to this notice when determining whether to prepare additional NEPA analysis. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.
FOR FURTHER INFORMATION CONTACT: Jeannine Cody, Office of Protected Resources, NMFS, (301) 427-8401.
SUPPLEMENTARY INFORMATION:
Background
Section 101(a)(5)(D) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.) directs the Secretary of Commerce to authorize, upon request, the incidental, but not intentional, taking of small numbers of marine mammals of a species or population stock, by United States citizens who engage in a

specified activity (other than commercial fishing) within a specified geographical region if, after notice of a proposed authorization to the public for review and public comment: (1) We make certain findings; and (2) the taking is limited to harassment.

We shall grant authorization for the incidental taking of small numbers of marine mammals if we find that the taking will have a negligible impact on the species or stock(s), and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). The authorization must set forth the permissible methods of taking; other means of effecting the least practicable adverse impact on the species or stock and its habitat; and requirements pertaining to the mitigation, monitoring and reporting of such taking. We have defined "negligible impact" in 50 CFR 216.103 as " * * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Section 101(a)(5)(D) of the MMPA establishes a 45-day time limit for our review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of small numbers of marine mammals. Within 45 days of the close of the public comment period, we must either issue or deny the authorization and must publish a notice in the Federal Register within 30 days of our determination to issue or deny the authorization.

The National Defense Authorization Act of 2004 (NDAA; (Public Law 108-136)) amended section 101(a)(5)(A) of the MMPA by removing the small numbers and specified geographic region provisions; revising the definition of harassment as it applies to a military readiness activity; and explicitly requiring that our determination of "least practicable adverse impact" include consideration of: (1) Personnel safety; (2) the practicality of implementation; and (3) impact on the effectiveness of the military readiness activity.

The NDAA's definition of harassment as it applies to a military readiness activity is: (i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Summary of Request

We received a request from the Marine Corps on January 28, 2013, requesting that we issue we issue an Incidental Harassment Authorization (Authorization) for the take, by Level B harassment only, of small numbers of Atlantic bottlenose dolphins (Tursiops truncatus) incidental to air-to-surface and surface-to-surface training exercises conducted around two bombing targets within southern Pamlico Sound, North Carolina, at MCAS Cherry Point. We received a complete and adequate application requesting Authorization on March 19, 2013. To date, we have issued two, 1-year Authorizations to the Marine Corps for the conduct of the same activities from 2010 to 2012 (75 FR 72807, November 26, 2010; 77 FR January 3, 2012). This is the Marine Corps' third request for an Authorization. We intend to proceed to rulemaking after a final determination is made on whether or not to issue this Authorization. This document also serves as Notice of Receipt of a request for rulemaking and subsequent Letter of Authorization.

Project Purpose --The Marine Corps plan to conduct weapon delivery training at two bombing targets: Brant Island Target (BT-9) and Piney Island Bombing Range (BT-11). Training at BT-9 would involve air-to-surface (from aircraft to in-water targets) and surface-to-surface (from vessels to in-water targets) warfare training, including bombing, strafing, special (laser systems) weapons; surface fires using non-explosive and explosive ordnance; and mine laying exercises (inert). Training at BT-11 would involve air- to-surface exercises to provide training in the delivery of conventional (non-explosive) and special (laser systems) weapons. Surface-to-surface

training by small military watercraft would also be executed here. The types of ordnances proposed for use at BT-9 and BT-11 include small arms, large arms, bombs, rockets, missiles, and pyrotechnics. All munitions used at BT-11 are inert, practice rounds. No live firing occurs at BT-11. Training for any activity may occur year-round. Active sonar is not a component of these specified training exercises; therefore, we have not included a discussion of marine mammal harassment from active sonar operations within this notice.

Description of the Specified Activity

The Marine Corps is requesting authorization to harass bottlenose dolphins from ammunition firing conducted at two bombing targets within MCAS Cherry Point. The authorization would be valid for a period of one year from the date of issuance. The bombing targets are located at the convergence of the Neuse River and Pamlico Sound, North Carolina.

BT-9 is a water-based target located approximately 52 kilometers (km) (32.3 miles (mi); 28 nautical miles (nm)) northeast of MCAS Cherry Point. The BT-9 target area ranges in depth from 1.2 to 6.1 meters (m) (3.9 to 20 feet (ft)), with the shallow areas concentrated along the Brandt Island Shoal (which runs down the middle of the restricted area in a northwest to southeast orientation). The target itself consists of three ship hulls grounded on Brant Island Shoals, located approximately 4.8 km (3.0 mi) southeast of Goose Creek Island. Inert (non-explosive) ordnance up to 454 kilograms (kg) (1,000 pounds (lbs) and live (explosive) ordnance up to 45.4 kg (100 lbs) trinitrotoluene (TNT) equivalent, including ordnance released during strafing, are authorized for use at this target range. The target is defined by a 6 statute-mile diameter prohibited area designated by the U.S. Army Corps of Engineers, Wilmington District (33 CFR 334.420). Non-military vessels are not permitted within the prohibited area, which is delineated by large signs located on pilings surrounding the perimeter of the BT. BT-9 also provides a mining exercise area; however, all mine exercises are simulation only and do not involve detonations. BT-9 standard operating procedures limit live ordnance deliveries to a maximum explosive weight of 100 lbs TNT equivalent. The USMC estimates that it could conduct up to approximately 1,554 aircraft-based and 322 vessel-based sorties, annually, at BT-9. The standard sortie consists of two aircraft per bombing run or an average of two and maximum of six vessels.

BT-11 is a 50.6 square kilometers (km^2) (19.5 square miles (mi^2)) complex of land- and water-based targets on Piney Island. The BT-11 target area ranges in depth from 0.3 m (1.0 ft) along the shoreline to 3.1 m (10.1 ft) in the center of Rattan Bay (BA, 2001). The in-water stationary targets of BT-11 consist of a barge and patrol (PT) boat located in roughly the center of Rattan Bay. The barge target is approximately 41.1 by 12.2 m (135 by 40 ft) in dimension. The PT boat is approximately 33.5 by 10.7 ft (110 ft by 35 ft) in dimension. Water depths in the center of Rattan Bay are estimated as 2.4 to 3 m (8 to 10 ft) with bottom depths ranging from 0.3 to 1.5 m (1 to 5 ft) adjacent to the shoreline of Piney Island. A shallow ledge, with substrate expected to be hard-packed to hard bottom, surrounds Piney Island. No live firing occurs at BT-11; all munitions used are inert, non-explosive practice rounds. Only 36 percent of all munitions fired at BT-11 occur over water; the remaining munitions are fired to land based targets on Piney Island. The USMC estimates that it could conduct up to approximately 6,727 aircraft-based and 51 vessel-based sorties, annually, at BT-11.

All inert and live-fire exercises at MCAS Cherry Point ranges are conducted so that all ammunition and other ordnances strike and/or fall on the land or water based target or within the existing danger zones or water restricted areas. A danger zone is a defined water area that is closed to the public on an intermittent or full-time basis for use by military forces for hazardous operations such as target practice and ordnance firing. A water restricted area is a defined water area where public access is prohibited or limited in order to provide security for government property and/or to protect the public from the risks of injury or damage that could occur from the government's use of that area (33 CFR 334.2). Surface danger zones are designated areas of rocket firing, target practice, or other hazardous operations (33 CFR 334.420). The surface danger zone (prohibited area) for BT-9 is a 4.8 km (3.0 mi) radius centered on the south side of Brant Island Shoal. The surface danger zone for BT-11 is a 2.9 km (1.8 mi) radius centered on a barge target in Rattan Bay.

According to the application, the Marine Corps is requesting take of marine mammals incidental to specified activities at MCAS Cherry Point Range Complex, located within Pamlico Sound, North Carolina. These activities include gunnery; mine laying; bombing; or rocket exercises and are classified into two categories here based on delivery method: (1) Surface-to-surface gunnery and (2) air-to-surface bombing. Exercises may occur year round, day or night (approximately 15 percent of training occurs at night).

Surface-to-Surface Gunnery Exercises

Surface-to-surface fires are fires from boats at sea to targets at sea. These can be direct (targets are within sight) or indirect (targets are not within sight). Gunnery exercise employing only direct fire is the only category of surface-to-surface activity currently conducted within the MCAS Cherry Point bombing targets. An average of two and maximum of six small boats (7.3-26.0 m; 24-85 ft), or fleet of boats, typically operated by Special Boat Team personnel, use a machine gun to attack and disable or destroy a surface target that simulates another ship, boat, swimmer, floating mine or near shore land targets. Vessels would travel between 0-20 knots (kts) (0-23 miles per hour (mph)) with an average of two vessels actually conducting surface-to-surface firing activities. Typical munitions would be 7.62 millimeter (mm) or .50 caliber (cal) machine guns; and/or 40 mm grenade machine guns. This exercise is usually a live-fire exercise, but at times blanks would be used so that the boat crews could practice their ship handling skills. The goal of training is to hit the targets; however, some munitions may bounce off the targets and land in the water or miss the target entirely. Additionally, the personnel would use G911 concussion hand grenades (inert and live); however, these are not aimed at targets, as the goal is to learn how to throw them into the water.

Table 1 includes the estimated amount of munitions expended at BT-9 and BT-11 in 2011 and 2012. Historically, boat sorties have been conducted at BT-9 and BT-11 year round with equal distribution of training effort throughout the seasons. Live fires constitute approximately 90 percent of all surface-to-surface gunnery events. The majority of sorties originated and practiced at BT-9 as no live fire is conducted at BT-11. The Marine Corps has indicated a comparable number of sorties would occur throughout the IHA timeframe. There is no specific schedule associated with the use of ranges by the small boat teams. However, exercises tend to be scheduled for 5-day blocks with exercises at various times throughout that timeframe. There is no specific time of year or month training occurs as variables such as deployment status, range availability, and completion of crew specific training requirements influence schedules.

Table_1--Aircraft_and_Boat_Sorties,_by_Mission_Type,_Conducted_in_2011_and_2012				
	BT-9		BT-11	
Mission_type	2011	2012	2011	2012
Air-to-Surface	1,554		4,251	
Surface-to-Surface	223	322	105	106
Total	1,777		4,356	

A number of different types of boats are used during surface-to-surface exercises depending on the unit using the boat and their mission and include versions of Small Unit River Craft, Combat Rubber Raiding Craft, Rigid Hull Inflatable Boats, Patrol Craft. They are inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion. Boat crews approach, at a maximum of 20 kts (23 mph), and engage targets simulating other boats, swimmers, floating mines, or near shore land targets with 7.62 mm or .50 cal machine guns; 40 mm grenade machine guns; or M3A2 concussion hand grenades (approximately 200, 800, 10, and 10 rounds respectively). Vessels typically travel in linear paths and do not operate erratically. Other vessels may be

located within the BTs; however, these are support craft and do not participate in munitions expenditures. The purpose of the support craft is to remotely control High Speed Maneuvering Surface Targets (HSMSTs) or to conduct maintenance on electronic equipment located in the towers at BT-9. Support craft are typically anchored or tied to marker pilings during HSMST operations or tied to equipment towers. When underway, vessels do not typically travel faster than 12-18 kts (13.8-20.7 mph) or in an erratic manner.

Air-to-Surface

Air-to-surface training involves ordnance delivered from aircraft and aimed at targets on the water's surface or on land in the case of BT-11. We provide a description of the types of targets used at MCAS Cherry Point in the previous section. There are four types of air-to-surface activities conducted within the MCAS Cherry Point BTs: mine laying; bombing, gunnery, or rocket exercises which are carried out via fixed- or rotary-wing aircraft.

Mine Laying Exercises

Mine warfare includes the strategic, operational, and tactical use of mines and mine countermine measures. Mine warfare is divided into two basic subdivisions: (a) The laying of mines to degrade the enemy's capabilities to wage land, air, and maritime warfare, and (b) the countering of enemy-laid mines to permit friendly maneuver or use of selected land or sea areas (DoN, 2007). MCAS Cherry Point would only engage in mine laying exercises as described below in the waters around BT-9. No detonations of any mine device are involved with this training.

During mine laying, a fixed-wing or maritime patrol aircraft (P-3 or P-8) typically drops a series of about four inert mine shapes in an offensive or defensive pattern, making multiple passes along a pre-determined flight azimuth, and dropping one or more shapes each time. Mine simulation shapes include MK76, MK80 series, and BDU practice bombs ranging from 25 to 2,000 pounds in weight. There is an attempt to fly undetected to the area where the mines are laid with either a low or high altitude tactic flight. The shapes are scored for accuracy as they enter the water and the aircrew is later debriefed on their performance. The training shapes are inert (no detonations occur) and expendable.

Bombing Exercises

The purpose of bombing exercises is to train pilots in destroying or disabling enemy ships or boats. During training, fixed wing or rotary wing aircraft deliver bombs against surface maritime targets at BT-9 or BT-11,day or night, using either unguided or precision-guided munitions. Unguided munitions include MK-76 and BDU-45 inert training bombs, and MK-80 series of inert bombs (no cluster munitions authorized). Precision-guided munitions consist of laser-guided bombs (inert) and laser-guided training rounds (inert). Typically, two aircraft approach the target (principally BT-9) from an altitude of approximately 914 m (3,000 ft) up to 4,572 m (15,000 ft) and, when on an established range, the aircraft adhere to designated ingress and egress routes. Typical bomb release altitude is 914 m (3,000 ft) for unguided munitions or above 4,572 m (15,000 ft) and in excess of 1.8 km (1 nm) for precision-guided munitions. However, the lowest minimum altitude for ordnance delivery (inert bombs) would be 152 m (500 ft).

Onboard laser designators or laser designators from a support aircraft or ground support personnel are used to illuminate certified targets for use when using laser guided weapons. Due to target maintenance issues, live bombs have not been dropped at the BT-9 targets for the past few years although these munitions are authorized for use. For the effective IHA timeframe, the Marine Corps would not use live bombs. Live rockets and grenades; however, have been expended at BT-9.

Air-to-surface bombing exercises have the potential to occur on a daily basis. The standard sortie consists of two aircraft per bombing run. The frequency of these exercises is dependent on squadron level training requirements, deployment status, and range availability; therefore, there is no set pattern or specific time of year or month when this training occurs. Normal operating hours for the range are 8 a.m. to 11 p.m., Monday through Friday; however, the range is available for use 365 days per year.

Gunnery Exercises

During gunnery training, fixed- and rotary-wing aircraft expend smaller munitions targeted at the bombing targets with the purpose of hitting them. However, some small arms may land in the water. Rotary wing exercises involve either CH-53, UH-1, CH-46, MV-22, or H-60 rotary-wing aircraft with mounted 7.62 mm or .50 cal machine guns. Each gunner expends approximately 800 rounds of 7.62 mm and 200 rounds of .50 cal ammunition in each exercise. These may be live or inert.

Fixed wing gunnery exercises involve the flight of two aircraft that begin to descend to the target from an altitude of approximately 914 m (3,000 ft) while still several miles away. Within a distance of 1,219 m (4,000 ft) from the target, each aircraft fires a burst of approximately 30 rounds before reaching an altitude of 305 m (1,000 ft), then breaks off and repositions for another strafing run until each aircraft expends its exercise ordnance allowance of approximately 250 rounds. In total, about 8-12 passes are made by each aircraft per exercise. Typically these fixed wing exercise events involve an F/A-18 and AH-1 with Vulcan M61A1/A2, 20 mm cannon; AV-8 with GAU-12, 25 mm cannon.

Rocket Exercises

Rocket exercises are carried out similar to bombing exercises. Fixed- and rotary-wing aircraft crews launch rockets at surface maritime targets, day and night, to train for destroying or disabling enemy ships or boats. These operations employ 2.75-inch and 5-inch rockets. Generally, the average number of rockets delivered per sortie is approximately 14. As with the bombing exercise, there is no set level or pattern of amount of sorties conducted.

Munitions Descriptions

We refer the reader to Tables 2 and 3 for a complete list of the ordnance authorized for use at BT-9 and BT-11, respectively. There are several varieties and net explosive weights (for live munition used at BT-9) can vary according to the variety. All practice bombs are inert and used to simulate the same ballistic properties of service type bombs. They are manufactured as either solid cast metal bodies or thin sheet metal containers. Since practice bombs contain no explosive filler, a practice bomb signal cartridge (smoke) is used for visual observation of weapon target impact. Practice bombs provide a low cost training device for pilot and ground handling crews. Due to the relatively small amount of explosive material in practice bombs (small signal charge), the availability of ranges for training is greatly increased.

When a high explosive detonates, it is converted almost instantly into a gas at very high pressure and temperature. Under the pressure of the gases thus generated, the weapon case expands and breaks into fragments. The air surrounding the casing is compressed and shock (blast) wave is transmitted into it. Typical initial values for a high-explosive weapon are 200 kilobars of pressure (1 bar = 1 atmosphere) and 5,000 degrees Celsius (9,032 degrees Fahrenheit). There are five types of explosive sources used at BT-9: 2.75-inch Rocket High Explosives, 5-inch Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. No live munitions are used at BT-11.

_____Table_2--Description_of_Munitions_Used_at_BT-9
Ordnance_____Description_____Net_explosive_weight
MK-76_Practice_Bomb__25-pound_teardrop-shaped_cast___(of_signal
(inert)_____metal_bomb,_with_a_bore_tube____cartridge)_varies,
_____for_installation_of_a_signal____maximum_0.083800
_____cartridge_____lbs.
BDU-33_Practice_Bomb_Air_Force_MK_76_practice_bomb___same_as_above.

(inert)
BDU-48_Practice_Bomb_10-pound_metal_cylindrical_bomb_same_as_above.
(inert)_____body_with_a_bore_tube_for
_____installation_of_a_signal
_____cartridge
BDU-45_Practice_Bomb_500-pound_metal_bomb_either_____(of_signal
(inert)_____sand_or_water_filled._Two_____cartridges,_total
_____signal_cartridges._____0.1676_lbs.
BDU-50_Practice_Bomb_500-pound_metal_bomb_either_____same_as_above.
(inert)_____sand_or_water_filled._Two
_____signal_cartridges.
MK-81_Practice_Bomb__250-pound_bomb_____0.
(inert)
MK-82_Practice_Bomb__500-pound_bomb_____0.
(inert)
MK-83_Practice_Bomb__1,000-pound_bomb_configured_____0.1676_lbs.
(inert)_____like_BDU_45
MK-84_Practice_Bomb__2,000-pound_bomb_configured_____0.1676_lbs.
(inert)_(special_____like_BDU_45
exception_use_only)
2.75-inch_(inert)____Unguided_2.75_inch_diameter_____0.
_____rocket
5-inch_Zuni_(inert)__Unguided_5_inch_diameter_rocket_0.
5-inch_Zuni_(live)___Unguided_5-inch_diameter_rocket_15_lbs.
2.75wp_(inert)_____2.75-inch_rocket_containing_____0.
_____white_phosphorous
2.75HE_____High_Explosive,_2.75_inch_____4.8_lbs.
_____rocket
0.50_cal_(inert)_____Machine_gun_rounds_____0.
7.62_mm_(inert)
20_mm_(inert)
25mm_(inert)

30_mm_(inert)
40_mm_(inert)
25_mm_HE_(live)_____High_Explosive_Incendiary,_Live_0.269_lbs.
_____machine_gun_rounds
Self_Protection_____Aerial_flare_____0.
Flare
Chaff_____18-pound_chaff_canister_____0.
LUU-2_____30-pound_high_intensity_____0.
_____illumination_flare
Laser_Guided_____89-pound_inert_training_bomblet_0.
Training_Round
(LGTR)_(inert)
_____Table_3--Description_of_Munitions_Used_at_BT-11
Ordnance_____Description
MK76_Practice_Bomb_____25-pound_teardrop-shaped_cast_metal
_____bomb_body,_with_a_bore_tube_for
_____installation_of_a_signal_cartridge.
BDU_33_Practice_Bomb_____Air_Force_designation_for_MK_76
_____practice_bomb.
BDU_48_Practice_Bomb_____10-pound_metal_cylindrical_bomb_body
_____with_a_bore_tube_for_installation_of_a
_____signal_cartridge.
BDU_45_Practice_Bomb_____500-pound_metal_bomb_body_either_sand
_____or_water_filled._Configured_with
_____either_low_drag_conical_tail_fins_or
_____high_drag_tail_fins_for_retarded
_____weapons_delivery._Two_signal
_____cartridges_installed.
MK_81_Practice_Bomb_____250-pound_inert_bomb
MK_82_Practice_Bomb_____500-pound_inert_bomb.
2.75-inch_____Unguided_2.75_inch_diameter_rocket.
5-inch_Zuni_____5_inch_diameter_rocket.

WP-2.75-inch_____White_phosphorous_7-pound_rocket.
0.50_cal_____Inert_machine_gun_rounds.
7.62_mm
5.56_mm
20_mm
30_mm
40_mm
TOW_____Wire_guided_56-pound_anti-tank
_____missile.
Self_Protection_Flare_____Aerial_flare.
SMD_SAMS_____1.5-pound_smoking_flare.
LUU-2_____30-pound_high-intensity_illumination
_____flare.
Laser_Guided_Training_Round_(LGTR)_____89-pound_inert_training_bomblet.

The amounts of all ordnance to be expended at BT-9 and BT-11 (both surface-to-surface and air-to-surface) are 1,225,815 and 1,254,684 rounds, respectively (see Table 4 and 5).

_____Table_4--Amount_of_Live_and_Inert_Munitions_That_Would_Be_Expended_at_BT-9,
_____Annually
Proposed_munitions__*1_____Proposed_total___Proposed_number__Net
_____No._of_rounds____of_explosive_____explosive
_____rounds_having_an_weight
_____impact_on_the____(lb)
_____water
Small_Arms_Rounds_Excluding_.50___525,610_____N/A_____N/A.
cal
.50_Cal_____568,515_____N/A_____N/A.
Large_Arms_Rounds--Live_____5,000_____40mm_HE:_5,000___0.1199.
Large_Arms_Rounds--Inert_____117,051_____N/A_____N/A.
Rockets--Live_____48_____2.75"_Rocket:_48_4.8
_____20_____5"_Rocket:_20____15.0.
Rockets--Inert_____876_____N/A_____N/A.
Bombs_and_Grenades--Live_____0_____G911_Grenade:____0.5.

_____N/A
Bombs_and_Grenades--Inert_____4,199_____N/A_____N/A.
Pyrotechnics_____4,496_____N/A_____N/A.
Total_____1,225,815_____N/A.
____*1_Munitions_may_be_expended_from_aircraft_or_small_boats.
_____Table_5--Amount_of_Inert_Munitions_That_Would_Be_Expended_at_BT-11
Proposed_munitions__*1_____Proposed
_____total_No.
_____of_rounds
Small_Arms_Rounds_Excluding_.50_Cal_____610,957
.50_Cal_____366,775
Large_Arms_Rounds_____240,334
Rockets_____5,592
Bombs_and_Grenades_____22,114
Pyrotechnics_____8,912
Total_____1,254,684
____*1_Munitions_may_be_expended_from_aircraft_or_small_boats.

Description of Marine Mammals in the Area of the Specified Activity

Forty marine mammal species occur within the nearshore and offshore waters of North Carolina; however, the majority of these species are solely oceanic in distribution. Only one marine mammal species, the bottlenose dolphin, has been repeatedly sighted in Pamlico Sound, while an additional species, the endangered West Indian manatee (Trichechus manatus), has been sighted rarely (Lefebvre et al, 2001; DoN 2003). The U.S. Fish and Wildlife Service oversees management of the manatee; therefore, we would not include a proposed authorization to harass manatees and we will not discuss this species further in this notice.

No sightings of the endangered North Atlantic right whale (Eubalaena glacialis) or other large whales have been observed within Pamlico Sound or in vicinity of the bombing targets (Kenney, 2006). No suitable habitat exists for these species in the shallow Pamlico Sound or bombing target vicinity; therefore, whales would not be affected by the specified activities. Thus, we will not discuss them further in this notice. Other dolphins, such as Atlantic spotted (Stenella frontalis) and common dolphins (Delphinus delphis), are oceanic in distribution and do not venture into the shallow, brackish waters of southern Pamlico Sound.

The specified activity has the potential to affect only one marine mammal species under our jurisdiction: the bottlenose dolphin. We refer the public to Waring et al. (2011) for general information on this species which is presented below this section. The publication is available at http://www.nmfs.noaa.gov/pr/pdfs/sars/ao2011.pdf. We present a summary of information on the species below this section.

Bottlenose Dolphin

California sea lions are not listed as threatened or endangered under the Endangered Species Act (ESA; 16 U.S.C. 1531 et seq.), however, they are categorized as depleted (and thus strategic) under the MMPA.

Four out of the seven designated coastal stocks for bottlenose dolphins may occur in North Carolina waters at

some part of the year: the Northern Migratory stock (NM; winter); the Southern Migratory stock (SM; winter); the Northern North Carolina Estuarine stock (NNCE; resident, year round); and the more recently identified Southern North Carolina Estuarine stock (SNCE; resident, year round).

Dolphins encountered at the BTs likely belong to the NNCE and SNCE stock; however, this may not always be the case. NMFS' 2011 stock assessment report provides further detail on stock delineation.

NMFS provides abundance estimates for the four aforementioned migratory and resident coastal stocks in its 2011 stock assessment report. The best available abundance estimate for the NNCE stock is the combined abundance from estuarine (Read et al., 2003) and coastal (aerial survey data dating from 2002) waters. This combined estimate is 1,387 (Waring et al., 2011). Similarly, the best available abundance estimate for the SNCE stock is the combined abundance from estuarine and coastal waters. This combined estimate is 2,454 (Waring et al., 2011). The best abundance estimate for the NM stock, resulting from 2002 aerial surveys, is 9,604 (Waring et al., 2011). Using the same information, the resulting best abundance estimate for the SM stock is 12,482 (Waring et al., 2011).

From July 2004 through April 2006, the Services Southeast Fisheries Science Center conducted 41 aerial surveys to document the seasonal distribution and estimated density of sea turtles and dolphins within Core Sound and portions of Pamlico Sound, and coastal waters extending one mile offshore (Goodman et al, 2007). Pamlico Sound was divided into two survey areas: western (encompassing BT-9 and BT-11) and eastern (including Core Sound and the eastern portion of restricted air space R-5306). In total, 281 dolphins were sighted in the western range. To account for animals likely missed during sightings (i.e., those below the surface), Goodman et al. (2007) estimate that, in reality, 415 dolphins were present. Densities for bottlenose dolphins in the western part of Pamlico Sound were calculated to be 0.0272 per square kilometer (km^2) in winter and 0.2158 per km^2 in autumn. Dolphins were sighted throughout the entire range when mean sea surface temperature was 7.60 [degrees] C to 30.82 [degrees] C (45.6 to 87.5 [degrees] F), with fewer dolphins sighted as water temperatures increased. Like in Mayer (2003), dolphins were found in higher numbers around BT-11, a range where no live firing occurs.

In 2000, Duke University Marine Lab (DUML), conducted a boat-based mark-recapture survey throughout the estuaries, bays and sounds of North Carolina (Read et al., 2003). This summer survey yielded a dolphin density of 0.183/km^2 (0.071 mi^2) based on an estimate of 919 dolphins for the northern inshore waters divided by an estimated 5,015 km^2 (1,936 mi^2) survey area. Additionally, from July 2002-June 2003, the USMC supported DUML to conduct dolphin surveys specifically in and around BT-9 and BT-11. During these surveys, one sighting in the restricted area surrounding BT-9 and two sightings in proximity to BT-11 were observed, as well as seven sightings in waters adjacent to the BTs. In total, 276 bottlenose dolphins were sighted ranging in group size from two to 70 animals with mean dolphin density in BT-11 more than twice as large as the density of any of the other areas; however, the daily densities were not significantly different (Maher, 2003). Estimated dolphin density at BT-9 and BT-11 based on these surveys were calculated to be 0.11 dolphins/km^2, and 1.23 dolphins/km^2, respectively, based on boat surveys conducted from July 2002 through June 2003 (excluding April, May, Sept. and Jan.). However, the Marine Corps choose to estimate take of dolphins based on the higher density reported from the summer 2000 surveys (0.183/km^2). Although the aerial surveys were conducted year round and therefore provide for seasonal density estimates, the average year-round density from the aerial surveys is 0.0936, lower than the 0.183/km^2 density chosen to calculate take for purposes of this MMPA authorization. Additionally, Goodman et al. (2007) acknowledged that boat based density estimates may be more accurate than the uncorrected estimates derived from the aerial surveys.

In Pamlico Sound, bottlenose dolphins concentrate in shallow water habitats along shorelines, and few, if any, individuals are present in the central portions of the sounds (Gannon, 2003; Read et al., 2003a, 2003b). The dolphins utilize shallow habitats, such as tributary creeks and the edges of the Neuse River, where the bottom depth is less than 3.5 m (Gannon, 2003). Fine-scale distribution of dolphins seems to relate to the presence of

topography or vertical structure, such as the steeply-sloping bottom near the shore and oyster reefs, which may be used to facilitate prey capture (Gannon, 2003). Results of a passive acoustic monitoring effort conducted from 2006-2007 by Duke University researchers validated this information. Vocalizations of dolphins in the BT-11 vicinity were higher in August and September than vocalization detection at BT-9, an open water area (Read et al., 2007). Additionally, detected vocalizations of dolphins were more frequent at night for the BT-9 area and during early morning hours at BT-11.

Unlike migrating whales which display strong temporal foraging and mating/birthing periods, many bottlenose dolphins in Pamlico Sound are residents and mate year round. However, dolphins in the southeast U.S. do display some reproductive seasonality. Based on neonate stranding records, sighting data, and births by known females, the populations of dolphins that frequent the North Carolina estuarine waters have calving peaks in spring but calving continues throughout the summer and is followed by a smaller number of fall births (Thayer et al., 2003).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kiloHertz (kHz) (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks have a dominant frequency range of 110 to 130 kHz and a source level of 218 to 228 decibels (dB) re: 1 [mu]Pa (peak-to-peak) (Au, 1993) and 3.4 to 14.5 kHz at 125 to 173 dB re 1 [mu]Pa (peak-to-peak) (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fish, specifically sea trout (Salmo trutta) and Atlantic salmon (Salmo salar), in some regions (i.e., Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutierrez and Stienessen, 2004; Cook et al., 2004).

Potential Effects on Marine Mammals

As mentioned previously, with respect to military readiness activities, Section 3(18)(B) of the MMPA defines "harassment" as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

The Marine Corps concluded that Level B harassment to marine mammals may occur incidental to munitions firing noise and pressure at the bombing targets. These military readiness activities would result in increased noise levels, explosions, and munitions debris within bottlenose dolphin habitat. In addition, we also considered the potential for harassment from vessel and aircraft operation. Our analysis of potential impacts from these factors, including consideration of the Marine Corps' analysis in its application, is outlined in the following sections.

Anthropogenic Sound

Marine mammals respond to various types of anthropogenic sounds introduced in the ocean environment.

Responses are highly variable and depend on a suite of internal and external factors which in turn results in varying degrees of significance (NRC, 2003; Southall et al., 2007). Internal factors include: (1) Individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; (2) past exposure of the animal to the noise, which may lead to habituation or sensitization; (3) individual noise tolerance; and (4) demographic factors such as age, sex, and presence of dependent offspring. External factors include: (1) non-acoustic characteristics of the sound source (e.g., if it is moving or stationary); (2) environmental variables (e.g., substrate) which influence sound transmission; and (3) habitat characteristics and location (e.g., open ocean vs. confined area). To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to ambient noise levels and the species' hearing sensitivity range. That is, if the frequency of an introduced sound is outside of the species' frequency hearing range, it cannot be heard. Similarly, if the frequency is on the upper or lower end of the species hearing range, the sound must be louder in order to be heard.

Marine mammal responses to anthropogenic noise are typically subtle and can include visible and acoustic reactions such as avoidance, altered dive patterns and cessation of pre-exposure activities and vocalization reactions such as increasing or decreasing call rates or shifting call frequency. Responses can also be unobservable, such as stress hormone production and auditory trauma or fatigue. It is not always known how these behavioral and physiological responses relate to significant effects (e.g., long-term effects or individual/population consequences); however, individuals and populations can be monitored to provide some insight into the consequences of exposing marine mammals to noise. For example, Haviland-Howell et al. (2007) compared sighting rates of bottlenose dolphins within the Wilmington, NC stretch of the Atlantic Intracoastal Waterway (ICW) on weekends, when recreational vessel traffic was high, to weekdays, when vessel traffic was relatively minimal. The authors found that dolphins were less often sighted in the ICW during times of increased boat traffic (i.e., on weekends) and theorized that because vessel noise falls within the frequencies of dolphin communication whistles and primary energy of most fish vocalizations, the continuous vessel traffic along that stretch of the ICW could result in social and foraging impacts. However, the extent to which these impacts affect individual health and population structure is unknown.

A full assessment of marine mammal responses and disturbances when exposed to anthropogenic sound can be found in our proposed rulemaking for the Navy Cherry Point Range Complex (74 FR 11057, March 16, 2009). That rulemaking was made final on June 15, 2009 (74 FR 28370). In summary, sound exposure may result in physiological impacts, stress responses, and behavioral responses which could affect proximate or ultimate life functions. Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The ultimate life functions are those that enable an animal to contribute to the population (or stock, or species, etc.).

I. Physiology-Hearing Threshold Shift

In mammals, high-intensity sound may rupture the eardrum, damage the small bones in the middle ear, or over stimulate the electromechanical hair cells that convert the fluid motions caused by sound into neural impulses that are sent to the brain. Lower level exposures may cause a loss of hearing sensitivity, termed a threshold shift (TS) (Miller, 1974). Incidence of TS may be either permanent, referred to as permanent threshold shift (PTS), or temporary, referred to as temporary threshold shift (TTS). The amplitude, duration, frequency, and temporal pattern, and energy distribution of sound exposure all affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, generally, so does the amount of TS and recovery time. Human non-impulsive noise exposure guidelines are based on exposures of equal energy (the same SEL) producing equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH 1998). Until recently, previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall et al., 2007). Three newer studies, two by Mooney et al. (2009a, 2009b) on a single bottlenose dolphin either exposed to playbacks of Navy MFAS or octave-band

noise (4-8 kHz) and one by Kastak et al. (2007) on a single California sea lion exposed to airborne octave-band noise (centered at 2.5 kHz), concluded that for all noise exposure situations the equal energy relationship may not be the best indicator to predict TTS onset levels. Generally, with sound exposures of equal energy, those that were quieter (lower sound pressure level [SPL]) with longer duration were found to induce TTS onset more than those of louder (higher SPL) and shorter duration (more similar to noise from AS Cherry Point exercises). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter et al., 1966; Ward, 1997). Additionally, though TTS is temporary, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). However, these studies highlight the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts.

PTS consists of non-recoverable physical damage to the sound receptors in the ear, which can include total or partial deafness, or an impaired ability to hear sounds in specific frequency ranges; PTS is considered Level A harassment. TTS is recoverable and is considered to result from temporary, non-injurious impacts to hearing-related tissues; TTS is considered Level B harassment.

Permanent Threshold Shift

Auditory trauma represents direct mechanical injury to hearing related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory trauma is irreversible and considered to be an injury that could result in PTS. PTS results from exposure to intense sounds that cause a permanent loss of inner or outer cochlear hair cells or exceed the elastic limits of certain tissues and membranes in the middle and inner ears and result in changes in the chemical composition of the inner ear fluids. In some cases, there can be total or partial deafness across all frequencies, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges. There is no empirical data for onset of PTS in any marine mammal, and therefore, PTS-onset must be estimated from TTS-onset measurements and from the rate of TTS growth with increasing exposure levels above the level eliciting TTS-onset. PTS is presumed to be likely if the hearing threshold is reduced by >/= 40 dB (i.e., 40 dB of TTS). Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals.

Temporary Threshold Shift

TTS is the mildest form of hearing impairment that can occur during exposure to a loud sound (Kryter, 1985). Southall et al. (2007) indicate that although PTS is a tissue injury, TTS is not because the reduced hearing sensitivity following exposure to intense sound results primarily from fatigue, not loss, of cochlear hair cells and supporting structures and is reversible. Accordingly, NMFS classifies TTS as Level B Harassment, not Level A Harassment (injury); however, NMFS does not consider the onset of TTS to be the lowest level at which Level B Harassment may occur (see III. Behavior section below this section).

Southall et al. (2007) considers a 6 dB TTS (i.e., baseline hearing thresholds are elevated by 6 dB) sufficient to be recognized as an unequivocal deviation and thus a sufficient definition of TTS onset. TTS in bottlenose dolphin hearing have been experimentally induced. For example, Finneran et al. (2002) exposed a trained captive bottlenose dolphin to a seismic watergun simulator with a single acoustic pulse. No TTS was observed in the dolphin at the highest exposure condition (peak: 207 kPa [30psi]; peak-to-peak: 228 dB re: 1 microPa; SEL: 188 dB re 1 microPa ^{2} -s). Schludt et al. (2000) demonstrated temporary shifts in masked hearing thresholds in five bottlenose dolphins occurring generally between 192 and 201 dB rms (192 and 201 dB SEL) after exposure to intense, non-pulse, 1-s tones at, 3kHz, 10kHz, and 20 kHz. TTS onset occurred at mean sound exposure level of 195 dB rms (195 dB SEL). At 0.4 kHz, no subjects exhibited threshold shifts after SPL exposures of 193dB re: 1 microPa (192 dB re: 1 microPa ^{2} -s). In the same study, at 75 kHz, one dolphin

exhibited a TTS after exposure at 182 dB SPL re: 1 microPa but not at higher exposure levels. Another dolphin experienced no threshold shift after exposure to maximum SPL levels of 193 dB re: 1 microPa at the same frequency. Frequencies of explosives used at MCAS Cherry Point range from 1-25 kHz; the range where dolphin TTS onset occurred at 195 dB rms in the Schlundt et al. (2000) study.

Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). For example, Nachtigall et al. (2003) measured TTS in a bottlenose dolphin and found an average 11 dB shift following a 30 minute net exposure to OBN at a 7.5 kHz center frequency (max SPL of 179 dB re: 1 microPa; SEL: 212-214 dB re:1 microPa ^{2} -s). No TTS was observed after exposure to the same duration and frequency noise with maximum SPLs of 165 and 171 dB re:1 microPa. After 50 minutes of exposure to the same 7.5 kHz frequency OBN, Natchigall et al. (2004) measured a 4-8 dB shift (max SPL: 160dB re 1microPa; SEL: 193-195 dB re:1 microPa ^{2} -s). Finneran et al. (2005) concluded that a sound exposure level of 195 dB re 1 [mu]Pa2-s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

II. Stress Response

An acoustic source is considered a potential stressor if, by its action on the animal, via auditory or non-auditory means, it may produce a stress response in the animal. Here, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS) or the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer, 2005). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipids for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones, predominantly cortisol in mammals. The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal's life history stage (e.g., neonate, juvenile, adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. The stress response may or may not result in a behavioral change, depending on the characteristics of the exposed animal. However, provided a stress response occurs, we assume that some contribution is made to the animal's allostatic load. Any immediate effect of exposure that produces an injury is assumed to also produce a stress response and contribute to the allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield, 2003). If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, we assume that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there can be no behavioral change.

III. Behavior

Changes in marine mammal behavior in response to anthropogenic noise may include altered travel directions, increased swimming speeds, changes in dive, surfacing, respiration and feeding patterns, and changes in vocalizations. As described above, lower level physiological stress responses could also co-occur with altered behavior; however, stress responses are more difficult to detect and fewer data exist relative to specific received levels of sound.

Acoustic Masking

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when sounds in the

environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

Southall et al. (2007) defines auditory masking as the partial or complete reduction in the audibility of signals due to the presence of interfering noise with the degree of masking depending on the spectral, temporal, and spatial relationships between signals and masking noise, as well as the respective received levels. Masking of sender communication space can be considered as the amount of change in a sender's communication space caused by the presence of other sounds, relative to a pre-industrial ambient noise condition (Clark et al., 2009). Unlike auditory fatigue, which always results in a stress response because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response, depending on the degree and duration of the masking effect. Masking may also result in a unique circumstance where an animal's ability to detect other sounds is compromised without the animal's knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case, the change in behavior is the lack of a response that would normally be made if sensory impairment did not occur. For this reason, masking also may lead directly to behavior change without first causing a stress response. Projecting noise into the marine environment which causes acoustic masking is considered Level B harassment as it can disrupt natural behavioral patterns by interrupting or limiting the marine mammal's receipt or transmittal of important information or environmental cues. To compensate for masking, marine mammals, including bottlenose dolphins, are known to increase their levels of vocalization as a function of background noise by increasing call repetition and amplitude, shifting calls higher frequencies, and/or changing the structure of call content (Lesage et al., 1999; Scheifele et al., 2005; McIwem, 2006).

While it may occur temporarily, we do not expect auditory masking to result in detrimental impacts to an individual's or population's survival, fitness, or reproductive success. Dolphins are not confined to the BT ranges; allowing for movement out of area to avoid masking impacts. The Marine Corps would also conduct visual sweeps of the area before any training exercise and implement training delay mitigation measures if a dolphin is sighted within designated zones (see Proposed Mitigation Measures section). As discussed previously, the Marine Corps has been working with DUML to collect baseline information on dolphins in Pamlico Sound, specifically dolphin abundance and habitat use around the BTs.

Assessment of Marine Mammal Impacts from Explosive Ordnances

MCAS Cherry Point plans to use five types of explosive sources during its training exercises: 2.75-inch Rocket High Explosives, 5-inch Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. The underwater explosions from these weapons would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. The shock wave and blast noise are of most concern to marine animals. In general, potential impacts from explosive detonations can range from brief effects (such as short term behavioral disturbance), tactile perception, physical discomfort, slight injury of the internal organs and the auditory system, to death of the animal (Yelverton et al., 1973; O'Keeffe and Young, 1984; DoN, 2001).

Explosives produce significant acoustic energy across several frequency decades of bandwidth (i.e., broadband). Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band. The effects of an underwater explosion on a marine mammal depend on many factors, including the size, type, and depth of both the animal and the explosive charge; the depth of the water column; and the standoff distance between the charge and the animal, as well as the sound propagation properties of the environment. The net explosive weight (or NEW) of an explosive is the weight of TNT required to produce an equivalent explosive power. The detonation depth of an explosive is particularly important due to

a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss). Marine Corps conservatively estimates that all explosives would detonate at a 1.2 m (3.9 ft) water depth. This is the worst case scenario as the purpose of training is to hit the target, resulting in an in-air explosion.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. The maximum firing time is 10-15 second bursts. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics, the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. For all metrics, the cumulative impact area of an event consisting of a certain number of bursts is merely the product of the impact area of a single burst and the number of bursts, as would be the case if the bursts are sufficiently spaced in time or location as to insure that each burst is affecting a different set of marine wildlife.

Physical damage of tissues resulting from a shock wave (from an explosive detonation) is classified as an injury. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000) and gas containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible to damage (Goertner, 1982; Hill 1978; Yelverton et al., 1973). Nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Severe damage (from the shock wave) to the ears can include tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear.

Non-lethal injury includes slight injury to internal organs and the auditory system; however, delayed lethality can be a result of individual or cumulative sublethal injuries (DoN, 2001). Immediate lethal injury would be a result of massive combined trauma to internal organs as a direct result of proximity to the point of detonation (DoN, 2001). Exposure to distance explosions could result only in behavioral changes. Masked underwater hearing thresholds in two bottlenose dolphins and one beluga whale have been measured before and after exposure to impulsive underwater sounds with waveforms resembling distant signatures of underwater explosions (Finneran et al., 2000). The authors found no temporary shifts in masked-hearing thresholds, defined as a 6-dB or larger increase in threshold over pre-exposure levels, had been observed at the highest impulse level generated (500 kg at 1.7 km, peak pressure 70 kPa); however, disruptions of the animals' trained behaviors began to occur at exposures corresponding to 5 kg at 9.3 km and 5 kg at 1.5 km for the dolphins and 500 kg at 1.9 km for the beluga whale.

Generally, the higher the level of impulse and pressure level exposure, the more severe the impact to an individual. While, in general, dolphins could sustain injury or mortality if within very close proximity to in-water explosion, monitoring and mitigation measures employed by the Marine Corps before and during training exercises, as would be required under any Authorization issued, are designed to avoid any firing if a marine mammal is sighted within designated BT zones (see Proposed Mitigation and Monitoring section). No marine mammal injury or death has been attributed to the specified activities described in the application. As such, and due to implementation of the proposed mitigation and monitoring measures, bottlenose dolphin injury, serious injury or mortality is not anticipated nor would any be authorized.

Inert Ordnances

The potential risk to marine mammals from non-explosive ordnance entails two possible sources of impacts: elevated sound levels or the ordnance physically hitting an animal. The latter is discussed below in the Munition Presence section. The USMC provided information that the noise fields generated in water by the firing of non-explosive ordnance indicate that the energy radiated is about 1 to 2 percent of the total kinetic energy of the

impact. This energy level (and likely peak pressure levels) is well below the TTS-energy threshold, even at 1-m from the impact and is not expected to be audible to marine mammals. As such, the noise generated by the in-water impact of non-explosive ordnance will not result in take of marine mammals.

Training Debris

In addition to behavioral and physiological impacts from live fire and ammunition testing, we have preliminarily analyzed impacts from presence of munition debris in the water, as described in the Marine Corps' application and 2009 EA. These impacts include falling debris, ingestion of expended ordnance, and entanglement in parachute debris.

Ingestion of marine debris by marine mammals can cause digestive tract blockages or damage the digestive system (Gorzelany, 1998; Stamper et al., 2006). Debris could be either the expended ordnance or non-munition related products such as chaff and self protection flares. Expended ordnance would be small and sink to the bottom. Chaff is composed of either aluminum foil or aluminum-coated glass fibers designed to act as a visual smoke screen; hiding the aircraft from enemy radar. Chaff also serves as a decoy for radar detection, allowing aircraft to maneuver or egress from the area. The foil type currently used is no longer manufactured, although it remains in the inventory and is used primarily by B-52 bombers. Both types of chaff are cut into dipoles ranging in length from 0.3 to over 2.0 inches. The aluminum foil dipoles are 0.45 mils (0.00045 inches) thick and 6 to 8 mils wide. The glass fiber dipoles are generally 1 mil (25.4 microns) in diameter, including the aluminum coating. Chaff is packed into about 4-ounce bundles. The major components of chaff are silica, aluminum, and stearic acid; all naturally prevalent in the environment.

Based on the dispersion characteristics of chaff, concentrations around the BTs would be low. For example, Hullar et al. (1999) calculated that a 4.97-mile by 7.46-mile area (37.1 km^2) would be affected by deployment of a single cartridge containing 150 grams of chaff; however, concentration would only be about 5.4 grams per square nautical mile. This corresponds to fewer than 179,000 fibers per square nautical mile or fewer than 0.005 fibers per square foot.

Self-protection flares are deployed to mislead or confuse heat-sensitive or heat-seeking anti-aircraft systems. The flares are magnesium pellets that, when ignited, burn for a short period of time (less than 10 seconds) at 2,000 degrees Fahrenheit. Air-deployed LUU-2 high-intensity illumination flares are used to illuminate targets, enhancing a pilot's ability to see targets while using Night Vision Goggles. The LUU-2B Flare has a light output rating of 1.8 x 10(6) candlepower and at 1,000 feet altitude illuminates a circle on the ground of 500 meters. The LUU-2 is housed in a pod or canister and is deployed by ejection. The mechanism has a timer on it that deploys the parachute and ignites the flare candle. The flare candle burns magnesium at high temperature, emitting an intense bright white light. The LUU-2 has a burn time of approximately 5 minutes while suspended from a parachute. The pyrotechnic candle consumes the flare housing, reducing flare weight, which in turn slows the rate of fall during the last 2 minutes of burn time. At candle burnout an explosive bolt is fired, releasing one parachute support cable, which causes the parachute to collapse.

Ingestion of debris by dolphins is not likely, as dolphins typically eat fish and other moving prey items. We solicited information on evidence of debris ingestion from two marine mammal veterinarians who have performed many necropsies on the protected species of North Carolina's waters. In their experience, no necropsies of bottlenose dolphins have revealed evidence of munition, parachute, or chaff ingestion (pers. comm., Drs. C. Harms and D. Rostein, November 14, 2009). However, it was noted evidence of chaff ingestion would be difficult to detect. In the chance that dolphins do ingest chaff, the filaments are so fine they would likely pass through the digestive system without complication. However, if the chaff is durable enough, it might act as a linear foreign body. In such case, the intestines bunch up on the line restricting movement of the line resulting in an obstruction. The peristalsis on an immovable thin line can cause intestinal lacerations and perforations (pers. comm., C. Harms, November 14, 2009). This is a well-known complication in cats when they ingest thread and which occurs occasionally with sea turtles ingesting fishing line. The longevity of chaff filaments,

based upon dispersion rates, is unclear. Chaff exposed to synthetic seawater and aqueous environments in the pH range of 4-10 exhibited varying levels of degradation suggesting a short lifespan for the outer aluminum coating (Farrell and Siciliano, 1998). The underlying filament is a flexible silica core and composed of primarily silica dioxide. While no studies have been conducted to evaluate the effects of chaff ingestion on marine mammals, the effects are expected to be negligible based upon chaff concentration in the environment, size of fibers, and available toxicity data on fiberglass and aluminum. Given that the size of chaff fibers are no more than 2 inches long, tidal flushing reduces concentration in the environment, and chaff degradation rate, the chance of chaff ingestions is unlikely; however, if swallowed, impacts would be negligible.

Given that there is no evidence that dolphins ingest military debris; dolphins in the Sound forage on moving prey suspended in the water column while expended munition would sink; the property and dispersion characteristics of chaff make potential for ingestion discountable; and that Pamlico Sound is a tidal body of water with continuing flushing, we have preliminarily determined that the presence of training debris would not have an effect on dolphins in Pamlico Sound.

Although sometimes large, expended parachutes (e.g., those from the flares) are flimsy and structurally simple. Thus, we have preliminarily determined that the probability of entanglement with a dolphin is low. There are no known reports of live or stranded dolphins entangled in parachute gear; fishing gear is usually the culprit of reported entanglements. The Service's Marine Mammal Stranding Network (Network) has established protocol for reporting marine mammals in peril. Should any injured, stranded or entangled marine mammal be observed by USMC personnel during training exercises, the sighting would be reported to the Network within 24 hours of the observation.

Vessel and Aircraft Presence

The marine mammals most vulnerable to vessel strikes are slow-moving and/or spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., right whales, fin whales (Balaenoptera physalus), and sperm whales (Physeter macrocephalus)). Smaller marine mammals such as bottlenose dolphins (the only marine mammal that would be encountered at the BTs) are agile and move more quickly through the water, making them less susceptible to ship strikes. We are not aware of any vessel strikes of bottlenose dolphins in Pamlico Sound during training operations. Therefore, we do not anticipate that Marine Corps vessels engaged in the specified activity would strike any marine mammals and no take from ship strike would be authorized in the proposed Authorization.

Behaviorally, marine mammals may or may not respond to the operation of vessels and associated noise. Responses to vessels vary widely among marine mammals in general, but also among different species of small cetaceans. Responses may include attraction to the vessel (Richardson et al., 1995); altering travel patterns to avoid vessels (Constantine, 2001; Nowacek et al., 2001; Lusseau, 2003, 2006); relocating to other areas (Allen and Read, 2000); cessation of feeding, resting, and social interaction (Baker et al., 1983; Bauer and Herman, 1986; Hall, 1982; Krieger and Wing, 1984; Lusseau, 2003; Constantine et al., 2004); abandoning feeding, resting, and nursing areas (Jurasz and Jurasz 1979; Dean et al., 1985; Glockner-Ferrari and Ferrari 1985, 1990; Lusseau, 2005; Norris et al., 1985; Salden, 1988; Forest, 2001; Morton and Symonds, 2002; Courbis, 2004; Bejder, 2006); stress (Romano et al., 2004); and changes in acoustic behavior (Van Parijs and Corkeron, 2001). However, in some studies marine mammals display no reaction to vessels (Watkins, 1986; Nowacek et al., 2003) and many odontocetes show considerable tolerance to vessel traffic (Richardson et al., 1995). Dolphins may actually reduce the energetic cost of traveling by riding the bow or stern waves of vessels (Williams et al., 1992; Richardson et al., 1995).

Dolphins within Pamlico Sound are continually exposed to recreational, commercial, and military vessels. Richardson et al. (1995) addresses in detail three responses that marine mammals may experience when exposed to anthropogenic activities: tolerance; habituation; and sensitization. More recent publications provide variations on these themes rather than new data (NRC, 2003). Marine mammals are often seen in regions with

much human activity; thus, certain individuals or populations exhibit some tolerance of anthropogenic noise and other stimuli. Animals will tolerate a stimulus they might otherwise avoid if the benefits in terms of feeding, mating, migrating to traditional habitats, or other factors outweigh the negative aspects of the stimulus (NRC, 2003). In many cases, tolerance develops as a result of habituation. The NRC (2003) defines habituation as a gradual waning of behavioral responsiveness over time as animals learn that a repeated or ongoing stimulus lacks significant consequences for the animals. Contrarily, sensitization occurs when an animal links a stimulus with some degree of negative consequence and as a result increases responsiveness to that human activity over time (Richardson et al., 1995). For example, seals and whales are known to avoid previously encountered vessels involved in subsistence hunts (Walker, 1949; Ash, 1962; Terhune, 1985) and bottlenose dolphins that had previously been captured and released from a 7.3 m boat involved in health studies were documented to flee when that boat approached closer than 400 m, whereas dolphins that had not been involved in the capture did not display signs of avoidance of the vessel (Irvine et al., 1981). Because dolphins in Pamlico Sound are continually exposed to vessel traffic that does not present immediate danger to them, it is likely animals are both tolerant and habituated to vessels.

The specified activities also involve aircraft, which marine mammals are known to react (Richardson et al., 1995). Aircraft produce noise at frequencies that are well within the frequency range of cetacean hearing and also produce visual signals such as the aircraft itself and its shadow (Richardson et al., 1995, Richardson &Wuersig, 1997). A major difference between aircraft noise and noise caused by other anthropogenic sources is that the sound is generated in the air, transmitted through the water surface and then propagates underwater to the receiver, diminishing the received levels to significantly below what is heard above the water's surface. Sound transmission from air to water is greatest in a sound cone 26 degrees directly under the aircraft. Reactions of odontocetes to aircraft have been reported less often than those of pinnipeds. Responses to aircraft include diving, slapping the water with pectoral fins or tail fluke, or swimming away from the track of the aircraft (Richardson et al., 1995). The nature and degree of the response, or the lack thereof, are dependent upon nature of the flight (e.g., type of aircraft, altitude, straight vs. circular flight pattern). Wuersig et al. (1998) assessed the responses of cetaceans to aerial surveys in the northcentral and western Gulf of Mexico using a DeHavilland Twin Otter fixed-wing airplane. The plane flew at an altitude of 229 m at 204 km/hr. A minimum of 305 m straight line distance from the cetaceans was maintained. Water depth was 100-1000m. Bottlenose dolphins most commonly responded by diving (48 percent), while 14 percent responded by moving away. Other species (e.g., beluga whale (Delphinapterus leucas), sperm whale) show considerable variation in reactions to aircraft but diving or swimming away from the aircraft are the most common reactions to low flights (less than 500 m).

Anticipated Effects on Habitat

Detonations of live ordnance would result in temporary modification to water properties. As described above, an underwater explosion from these weapon would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. However, these would be temporary and not expected to last more than a few seconds. Because dolphins are not expected to be in the area during live firing, due to monitoring and mitigation measure implementation, they would not be subject to any short term habitat alterations.

Similarly, no long term impacts with regard to hazardous constituents are expected to occur. MCAS Cherry Point has an active Range Environmental Vulnerability Assessment (REVA) program in place to monitor impacts to habitat from its activities. One goal of REVA is to determine the horizontal and vertical concentration profiles of heavy metals, explosives constituents, perchlorate nutrients, and dissolved salts in the sediment and seawater surrounding BT-9 and BT-11. The preliminary results of the sampling indicate that explosive constituents (e.g., trinitrotoluene (TNT), cyclotrimethylenetrinitramine (RDX), and hexahydro-trinitro-triazine (HMX), as described in Hazardous Constituents [Subchapter 3.2.7.2] of the MCAS Cherry Point Range

Operations EA, were not detected in any sediment or water sample surrounding the BTs. Metals were not present above toxicity screening values. Perchlorate was detected in a few sediment samples above the detection limit (0.21 ppm), but below the reporting limit (0.6 ppm). The ongoing REVA would continue to evaluate potential munitions constituent migration from operational range areas to off-range areas and MCAS Cherry Point.

While it is anticipated that the specified activity may result in marine mammals avoiding certain areas due to temporary ensonification, this impact to habitat and prey resources is temporary and reversible and considered in further detail earlier in this document, as behavioral modification. The main impact associated with the proposed activity would be temporarily elevated noise levels and the associated direct effects on marine mammals, previously discussed in this notice.

Summary of Previous Monitoring

The Marine Corps complied with the mitigation and monitoring required under the previous authorizations (2010-2012). In accordance with the 2010-11 IHA, USMC submitted a final monitoring report, which described the activities conducted and observations made. USMC did not record observations of any marine mammals during training exercises. The only recorded observations--which were of bottlenose dolphins--were on two occasions by maintenance vessels engaged in target maintenance. No marine mammals were observed during range sweeps, air to ground activities, surface to surface activities (small boats), or ad hoc via range cameras. Table 6 details the number of sorties conducted, by air and water, at each target. The number of sorties conducted does not relate to the total amount of munitions expended, as the training requirements for the specific military unit conducting the sortie determine the munitions loading for the air platform or watercraft during each sortie. In addition, munitions expenditures may be determined by the loading specifications of the specific aircraft and vessels used in the training exercise.

Table_6--Sorties_Conducted_at_BT-9_and_BT-11		
Mission_type	BT-9	BT-11
Air-to-surface	1,554	4,251
Surface-to-surface_(water-to-water)	223	105
Total	1,777	4,356

The total amount of ordnance expended at BT-9 and BT-11 under the 2010-11 IHA was 878,625 and 693,612 respectively (Table 7). These amounts represent 98 and 62 percent of the estimated annual maximum ordnance expenditures. The amounts of ordnance expended at the BTs account for all use of the targets. There are five types of explosive sources used at BT-9: 2.75-inc Rocket High Explosives, 5-inch Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. No explosive munitions are used at BT-11. Based on this information, the Marine Corps did not exceed the authorized level of take.

Table_7--Ordnance_Usage_at_BT-9				
	Total_rounds		Percentage_of	
			maximum	
Munitions_expenditures	BT-9	BT-11	BT-9	BT-11
Small_arms,_excluding_.50_cal	355,718	363,899	68	72
.50_cal	410,815	246,255	160	75

Large_arms_(Live)_____480_(all_40____N/A_____4_____N/A				
_____mm)				
Large_arms_(Inert)_____108,811_____79,531____117_____33				
Rockets_(Live)_____48_(all_2.75___N/A_____20_____N/A				
_____in)				
Rockets_(Inert)_____185_____2,018_____26_____44				
Bombs/Grenades_(Live)_____0_____N/A_____0_____N/A				
Bombs/Grenades_(Inert)_____2,086_____1,697_____51_____8				
Pyrotechnics_____482_____212_____11_____2				
Total_____878,625_____693,612___98_____62				

The Marine Corps will submit a monitoring report for the 2012 training season which expired on December 31, 2012, to us no later than March 31, 2013.

Proposed Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(D) of the MMPA, we must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and the availability of such species or stock for taking for certain subsistence uses.

The NDAA of 2004 amended the MMPA as it relates to military-readiness activities and the ITA process such that "least practicable adverse impact" shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. The training activities described in the Marine Corp's application are considered military readiness activities.

The Marine Corps, in collaboration with us, has worked to identify potential practicable and effective mitigation measures, which include a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the "military-readiness activity". These proposed mitigation measures are listed below.

(1) Range Sweeps: The VMR-1 squadron, stationed at MCAS Cherry Point, includes three specially equipped HH-46D helicopters. The primary mission of these aircraft, known as PEDRO, is to provide search and rescue for downed 2^{d} Marine Air Wing aircrews. On-board are a pilot, co-pilot, crew chief, search and rescue swimmer, and a medical corpsman. Each crew member has received extensive training in search and rescue techniques, and is therefore particularly capable at spotting objects floating in the water.

PEDRO crew would conduct a range sweep the morning of each exercise day prior to the commencement of range operations. The primary goal of the pre-exercise sweep is to ensure that the target area is clear of fisherman, other personnel, and protected species. The sweep is flown at 100-300 meters above the water surface, at airspeeds between 60-100 knots. The path of the sweep runs down the western side of BT-11, circles around BT-9 and then continues down the eastern side of BT-9 before leaving. The sweep typically takes 20-30 minutes to complete. The PEDRO crew is able to communicate directly with range personnel and can provide immediate notification to range operators. The PEDRO aircraft would remain in the area of a sighting until clear if possible or as mission requirements dictate.

If marine mammals are sighted during a range sweep, sighting data will be collected and entered into the US Marine Corps sighting database, web-interface, or report generator and this information would be relayed to the

training Commander. Sighting data includes the following (collected to the best of the observer's ability): (1) Species identification; (2) group size; (3) the behavior of marine mammals (e.g., milling, travel, social, foraging); (4) location and relative distance from the BT; (5) date, time and visual conditions (e.g., Beaufort sea state, weather) associated with each observation; (6) direction of travel relative to the BT; and (7) duration of the observation.

(2) Cold Passes: All aircraft participating in an air-to-surface exercise would be required to perform a "cold pass" immediately prior to ordnance delivery at the BTs both day and night. That is, prior to granting a "First Pass Hot" (use of ordnance), pilots would be directed to perform a low, cold (no ordnance delivered) first pass which serves as a visual sweep of the targets prior to ordnance delivery to determine if unauthorized civilian vessels or personnel, or protected species, are present. The cold pass is conducted with the aircraft (helicopter or fixed-winged) flying straight and level at altitudes of 200-3000 feet over the target area. The viewing angle is approximately 15 degrees. A blind spot exists to the immediate rear of the aircraft. Based upon prevailing visibility, a pilot can see more than one mile forward upon approach. The aircrew and range personnel make every attempt to ensure clearance of the area via visual inspection and remotely operated camera operations (see Proposed Monitoring and Reporting section). The Range Controller may deny or approve the First Pass Hot clearance as conditions warrant.

(3) Delay of Exercises: An active range would be considered "fouled" and not available for use if a marine mammal is present within 1000 yards (914 m) of the target area at BT-9 or anywhere within Rattan Bay (BT-11). Therefore, if a marine mammal is sighted within 1000 yards (914 m) of the target at BT-9 or anywhere within Rattan Bay at BT-11 during the cold pass or from range camera detection, training would be delayed until the marine mammal moves beyond and on a path away from 1000 yards (914 m) from the BT-9 target or out of Rattan Bay at BT-11. This mitigation applies to both air-to-surface and surface-to-surface exercises.

(4) Range Camera Use: To increase the safety of persons or property near the targets, Range Operation and Control personnel monitor the target area through tower mounted safety and surveillance cameras. The remotely operated range cameras are high resolution and, according to range personnel, allow a clear visual of a duck floating near the target. The cameras allow viewers to see animals at the surface and breaking the surface, but not underwater.

A new, enhanced camera system has been purchased and will be installed on BT-11 towers 3 and 7, and on both towers at BT-9. The new camera system has night vision capabilities with resolution levels near those during daytime. Lenses on the camera system have focal lengths of 40 mm to 2200 mm (56x), with view angles of 18 [degrees] 10' and 13 [degrees] 41', respectively. The field of view when zoomed in on the Rattan Bay targets will be 23 ft wide by 17 ft high, and on the mouth of Rattan Bay itself 87 ft wide by 66 ft high.

Again, in the event that a marine mammal is sighted within 1000 yards (914 m) of the BT-9 target, or anywhere within Rattan Bay, the target would be declared fouled. Operations may commence in the fouled area after the animal(s) have moved 1000 yards (914 m) from the BT-9 target and/or out of Rattan Bay.

(5) Vessel Operation: All vessels used during training operations would abide by the Service's Southeast Regional Viewing Guidelines designed to prevent harassment to marine mammals (http://www.nmfs.noaa.gov/pr/education/southeast/).

(6) Stranding Network Coordination: The USMC would coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during training activities or within 24 hours after completion of training.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that we must set forth "requirements pertaining to the monitoring and reporting of such taking". The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for IHAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of

taking or impacts on populations of marine mammals that are expected to be present.

Proposed Monitoring

The Marine Corps proposes to conduct the following to fulfill the necessary monitoring and reporting that would result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals expected to be present within the action area:

(1) Protected Species Observer Training: Pilots, operators of small boats, and other personnel monitoring for marine mammals would be required to take the Marine Species Awareness Training (Version 2), maintained and promoted by the Department of the Navy. This training would make personnel knowledgeable of marine mammals, protected species, and visual cues related to the presence of marine mammals and protected species.

(2) Weekly and Post-Exercise Monitoring: Post-exercise monitoring would be conducted concomitant to the next regularly scheduled pre-exercise sweep. Weekly monitoring events would include a maximum of five pre-exercise and four post-exercise sweeps. The maximum number of days that would elapse between pre- and post-exercise monitoring events would be approximately three days, and would normally occur on weekends. If marine mammals are observed during this monitoring, sighting data identical to those collected by PEDRO crew would be recorded.

(3) Long-term Monitoring: The Marine Corps has awarded DUML duties to obtain abundance, group dynamics (e.g., group size, age census), behavior, habitat use, and acoustic data on the bottlenose dolphins which inhabit Pamlico Sound, specifically those around BT-9 and BT-11. DUML began conducting boat-based surveys and passive acoustic monitoring of bottlenose dolphins in Pamlico Sound in 2000 (Read et al., 2003) and specifically at BT-9 and BT-11 in 2003 (Mayer, 2003). To date, boat-based surveys indicate that bottlenose dolphins may be resident to Pamlico Sound and use BT restricted areas on a frequent basis. Passive acoustic monitoring (PAM) is providing more detailed insight into how dolphins use the two ranges, by monitoring for their vocalizations year-round, regardless of weather conditions or darkness. In addition to these surveys, DUML scientists are testing a real-time passive acoustic monitoring system at BT-9 that will allow automated detection of bottlenose dolphin whistles, providing yet another method of detecting dolphins prior to training operations. Although it is unlikely this PAM system would be active for purposes of implementing mitigation measures before an exercise prior to expiration of the proposed Authorization, it could be operational for future MMPA incidental take authorizations and would be evaluated for effectiveness at the appropriate time.

(4) Reporting: The Marine Corps would submit a report to us within 90 days after expiration of the Authorization or, if a subsequent incidental take authorization is requested, within 120 days prior to expiration of the Authorization. The report would summarize the type and amount of training exercises conducted, all marine mammal observations made during monitoring, and if mitigation measures were implemented. The report would also address the effectiveness of the monitoring plan in detecting marine mammals.

General Notification of Injured or Dead Marine Mammals

The Marine Corps would systematically observe training operations for injured or disabled marine mammals. In addition, the Marine Corps would monitor the principal marine mammal stranding networks and other media to correlate analysis of any dolphin strandings that could potentially be associated with MCAS Cherry Point training operations.

Marine Corps personnel would ensure that we are notified immediately or as soon as clearance procedures allow if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any training operations. The Marine Corps would provide us with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

In the event that an injured, stranded, or dead marine mammal is found by Marine Corps personnel that is not in the vicinity of, or found during or shortly after operations, the Marine Corps personnel would report the same

information as listed above as soon as operationally feasible and clearance procedures allow.

General Notification of a Ship Strike

In the event of a vessel strike, at any time or place, the Marine Corps shall do the following:

* Immediately report to us the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown);
* Report to us as soon as operationally feasible the size and length of the animal, an estimate of the injury status (e.g., dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status;
* Report to us the vessel length, speed, and heading as soon as feasible; and
* Provide us a photo or video, if equipment is available.

Estimated Take by Incidental Harassment

The following provides the Marine Corps' model for take of dolphins from explosives (without consideration of mitigation and the conservative assumption that all explosives would land in the water and not on the targets or land) and potential for direct hits and our analysis of potential harassment from small vessel and aircraft operations.

Acoustic Take Criteria

For the purposes of an MMPA incidental take authorization, three levels of take are identified: Level B harassment; Level A harassment; and mortality (or serious injury leading to mortality). The categories of marine mammal responses (physiological and behavioral) that fall into harassment categories were described previously in this notice. A method to estimate the number of individuals that will be taken, pursuant to the MMPA, based on the proposed action has been derived. To this end, we use acoustic criteria that estimate at what received level Level B harassment, Level A harassment, and mortality (or serious injury) of marine mammals would occur. The acoustic criteria for underwater detonations are comprehensively explained in our proposed and final rulemakings for the U.S. Navy's Cherry Point Range Operations (74 FR 11057; 74 FR 28370). We summarize them here:

Criteria and thresholds for estimating the exposures from a single explosive activity on marine mammals were established for the Seawolf Submarine Shock Test Final Environmental Impact Statement (FEIS) ("Seawolf") and subsequently used in the USS Winston S. Churchill (DDG 81) Ship Shock FEIS ("Churchill") (DoN, 1998 and 2001). We adopted these criteria and thresholds in final rule on the unintentional taking of marine animals occurring incidental to the shock testing which involved large explosives (65 FR 77546; December 12, 2000). Because no large explosives (greater than 1000 lbs NEW) would be used at Cherry Point during the specified activities, a revised acoustic criterion for small underwater explosions (i.e., 23 pounds per square inch [psi] instead of previous acoustic criteria of 12 psi for peak pressure over all exposures) has been established to predict onset of TTS.

I.1. Thresholds and Criteria for Injurious Physiological Impacts

I.1.a. Single Explosion

For injury, NMFS uses dual criteria, eardrum rupture (i.e. tympanic-membrane injury) and onset of slight lung injury, to indicate the onset of injury. The threshold for tympanic-membrane (TM) rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture). This value is stated in terms of an Energy Flux Density Level (EL) value of 1.17 inch pounds per square inch (in-lb/in2), approximately 205 dB re 1 microPa ^{2} - sec.

The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 26.9 lbs), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-msec (DoN, 2001). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury. This analysis assumed the marine species populations were 100 percent small animals. The criterion with the largest potential impact

range (most conservative), either TM rupture (energy threshold) or onset of slight lung injury (peak pressure), will be used in the analysis to determine Level A exposures for single explosive events.

For mortality and serious injury, we use the criterion corresponding to the onset of extensive lung injury. This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. For small animals, the threshold is given in terms of the Goertner modified positive impulse, indexed to 30.5 psi-msec. Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 30.5 psi-msec index is a complicated calculation. To be conservative, the analysis used the mass of a calf dolphin (at 26.9 lbs) for 100 percent of the populations.

I.1.b. Multiple Explosions

For multiple explosions, the Churchill approach had to be extended to cover multiple sound events at the same training site. For multiple exposures, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (detonation); this is consistent with the treatment of multiple arrivals in Churchill. For positive impulse, it is consistent with the Churchill final rule to use the maximum value over all impulses received.

I.2. Thresholds and Criteria for Non-Injurious Physiological Effects

To determine the onset of TTS (non-injurious harassment)--a slight, recoverable loss of hearing sensitivity, there are dual criteria: an energy threshold and a peak pressure threshold. The criterion with the largest potential impact range (most conservative), either the energy or peak pressure threshold, will be used in the analysis to determine Level B TTS exposures. We refer the reader to the following sections for descriptions of the thresholds for each criterion.

I.2.a. Single Explosion--TTS-Energy Threshold

The TTS energy threshold for explosives is derived from the Space and Naval Warfare Systems Center (SSC) pure-tone tests for TTS (Schlundt et al., 2000; Finneran and Schlundt, 2004). The pure-tone threshold (192 dB as the lowest value) is modified for explosives by (a) interpreting it as an energy metric, (b) reducing it by 10 dB to account for the time constant of the mammal ear, and (c) measuring the energy in 1/3-octave bands, the natural filter band of the ear. The resulting threshold is 182 dB re 1 microPa ^{2} -sec in any 1/3-octave band.

I.2.b. Single Explosion--TTS-Peak Pressure Threshold

The second threshold applies to all species and is stated in terms of peak pressure at 23 psi (about 225 dB re 1 [mu]Pa). This criterion was adopted for Precision Strike Weapons (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico (NMFS, 2005). It is important to note that for small shots near the surface (such as in this analysis), the 23-psi peak pressure threshold generally will produce longer impact ranges than the 182-dB energy metric. Furthermore, it is not unusual for the TTS impact range for the 23-psi pressure metric to actually exceed the without-TTS (behavioral change without onset of TTS) impact range for the 177-dB energy metric.

I.3. Thresholds and Criteria for Behavioral Effects

I.3.a. Single Explosion

For a single explosion, to be consistent with Churchill, TTS is the criterion for Level B harassment. In other words, because behavioral disturbance for a single explosion is likely to be limited to a short-lived startle reaction, use of the TTS criterion is considered sufficient protection and therefore behavioral effects (Level B behavioral harassment without onset of TTS) are not expected for single explosions.

I.3.b. Multiple Explosions--Without TTS

For multiple explosions, the Churchill approach had to be extended to cover multiple sound events at the same training site. For multiple exposures, accumulated energy over the entire uninterrupted firing time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (detonation); this is consistent with the treatment of multiple arrivals in Churchill. Because multiple explosions could occur within a

discrete time period, a new acoustic criterion-behavioral disturbance without TTS is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower noise levels than those that may cause TTS.

The threshold is based on test results published in Schlundt et al. (2000), with derivation following the approach of the Churchill FEIS for the energy-based TTS threshold. The original Schlundt et al. (2000) data and the report of Finneran and Schlundt (2004) are the basis for thresholds for behavioral disturbance without TTS. During this study, instances of altered behavior sometimes began at lower exposures than those causing TTS; however, there were many instances when subjects exhibited no altered behavior at levels above the onset-TTS levels. Regardless of reactions at higher or lower levels, all instances of altered behavior were included in the statistical summary. The behavioral disturbance without TTS threshold for tones is derived from the SSC tests, and is found to be 5 dB below the threshold for TTS, or 177 dB re 1 microPa ^{2} -sec maximum energy flux density level in any 1/3-octave band at frequencies above 100 Hz for cetaceans.

II. Summary of Thresholds and Criteria for Impulsive Sounds

The effects, criteria, and thresholds used in the assessment for impulsive sounds are summarized in Table 8. The criteria for behavioral effects without physiological effects used in this analysis are based on use of multiple explosives from live, explosive firing at BT-9 only; no live firing occurs at BT-11.

_____Table_8--Effects,_Criteria,_and_Thresholds_for_Impulsive_Sounds
Effect_____Criteria_____Metric_____Threshold_____Effect
Mortality_____Onset_of_____Goertner_modified___indexed_to_30.5_____Mortality.
_____Extensive_____positive_impulse____psi-msec_(assumes
_____Lung_Injury_____100_percent_small
_____animal_at_26.9_lbs)
Injurious_____50_percent____Energy_flux_density_1.17_in-lb/in__*2___Level_A.
Physiological_Tympanic_____(about_205_dB_re_1
_____Membrane_____microPa__*2_-sec)
_____Rupture
Injurious_____Onset_Slight__Goertner_modified___indexed_to_13_psi-__Level_A.
Physiological_Lung_Injury___positive_impulse____msec_(assumes_100
_____percent_small
_____animal_at_26.9_lbs)
Non-injurious_TTS_____Greatest_energy_____182_dB_re_1_microPa_Level_B.
Physiological_____flux_density_level___*2_-sec
_____in_any_1/3-octave
_____band_(>_100_Hz_for
_____toothed_whales_and
_____>_10_Hz_for_baleen

_____whales)--for_total
_____energy_over_all
_____exposures
Non-injurious_TTS_____Peak_pressure_over__23_psi_____Level_B.
Physiological_____all_exposures
Non-injurious_Multiple_____Greatest_energy_____177_dB_re_1_microPa_Level_B.
Behavioral____Explosions____flux_density_level___*2_-sec
_____Without_TTS___in_any_1/3-octave
_____(>_100_Hz_for
_____toothed_whales_and
_____>_10_Hz_for_baleen
_____whales)--for_total
_____energy_over_all
_____exposures_(multiple
_____explosions_only)

Take from Explosives

The Marine Corps conservatively modeled that all explosives would detonate at a 1.2 m (3.9 ft) water depth despite the training goal of hitting the target, resulting in an above water or on land explosion. For sources that are detonated at shallow depths, it is frequently the case that the explosion may breech the surface with some of the acoustic energy escaping the water column. The source levels presented in the table above have not been adjusted for possible venting nor does the subsequent analysis take this into account. Properties of explosive sources used at BT-9, including NEW, peak one-third-octave (OTO) source level, the approximate frequency at which the peak occurs, and rounds per burst are described in Table 9. Refer to Table 10 for distances to our harassment threshold levels from these sources.

_____Table_9--Source_Weights_and_Peak_Source_Levels
Source_type_____New_____Peak_OTO_SL_____Frequency_of_____Rounds
_____Peak_OTO_SL_____per_burst
2.75-inch_Rocket_4.8_lbs_____223.9_dB_re:_____[approx.]_1500___1
_____1[mu]Pa_____Hertz_(Hz)
5-inch_Rocket____15.0_lbs_____228.9_dB_re:_____[approx.]_1000___1
_____1[mu]Pa_____Hz
30_mm_____0.1019_lbs_____212.1_dB_re:_____[approx.]_2500___30
_____1[mu]Pa_____Hz
40_mm_____0.1199_lbs_____227.8_dB_re:_____[approx.]_1100___5

_____1[mu]Pa_____Hz
G911_Grenade_____0.5_____213.9_dB_re:_1___[approx.]_2500___1
_____[mu]Pa_____Hz
_____Table_10--Distances_to_Our_Harassment_Thresholds_From_Explosive_Ordnances
_____Behavioral_____TTS_____Level_A_____Mortality
_____disturbance____(23_psi)_____(13_psi-msec)__(31_psi-ms)
_____(177_dB
_____energy)
2.75-inch_____N/A_____172_m_(564_ft)_47_m_(154_ft)__27_m_(89_ft)
Rocket_HE
5"_Rocket_HE___N/A_____255_m_(837_ft)_61_m_(200_ft)__39_m_(128_ft)
30mm_HE_____209_m_(686_ft)_N/A_____10_m_(33_ft)___5_m_(16_ft)
40mm_HE_____144_m_(472_ft)_N/A_____10_m_(33_ft)___5_m_(16_ft)
G911_Grenade___N/A_____83_m_(272_ft)__21_m_(33_ft)___10_m_(33_ft)

To calculate take, the distances to which animals may be harassed were considered along with dolphin density. The density estimate from Read et al. (2003) was used to calculate take from munitions firing. As described in the Description of Marine Mammals in the Area of the Specified Activity section, this density, 0.183/km ^{2} , was derived from boat based surveys in 2000 which covered all inland North Carolina waters. Note that estimated density of dolphins at BT-9 and BT-11, specifically, were calculated to be 0.11 dolphins/km^2 , and 1.23 dolphins/km^2 respectively (Maher 2003), based on boat surveys conducted from July 2002 through June 2003 (excluding April, May, Sept. and Jan.). However, the USMC chose to estimate take of dolphins based on the higher density reported from the summer 2000 surveys (0.183/km ^{2}). Additionally, take calculations for munition firing are based on 100 percent water detonation, although the goal of training is to hit the targets, and no pre-exercise monitoring or mitigation. Therefore, take estimates can be considered conservative.

Based on dolphin density and amount of munitions expended, there is very low potential for Level A harassment, serious injury, and mortality and monitoring and mitigation measures are anticipated to further negate this potential. Accordingly, we are not proposing to issue these levels of take. As portrayed in Table 9, the largest harassment zone (Level B) is within 209 m of a detonation in water; however, the Marine Corps has implemented a 1,000 m "foul" zone for BT-9 and anywhere within Raritan Bay for BT-11. In total, from firing of explosive ordnances, the USMC is requesting, and NMFS is proposing to issue, the incidental take of 25 bottlenose dolphins from Level B harassment (Table 11).

_____Table_11--Number_of_Dolphins_Potentially_Taken_From_Exposure_to_Explosives
_____Based_on_Threshold_Criteria
Ordnance_type__Level_B--_____Level_B--TTS___Level_A--_____Mortality
_____behavioral_____(23_psi)_____Injurious_____(30.5_psi)
_____(177dB_re_____(205_dB_re

_____1microPa__*2_-_____1microPa__*2_-	
_____s)_____s_or_13_psi)	
2.75"_Rocket___N/A_____4.97_____0.17_____0.06	
HE	
5"_Rocket_HE___N/A_____3.39_____0.09_____0.03	
30mm_HE_____2.55_____N/A_____0.05_____0.00	
40mm_HE_____12.60_____N/A_____0.16_____0.01	
G911_Grenade___N/A_____0.87_____0.03_____0.01	
Total_____15.15_____9.23_____0.5_____0.11	

Take from Direct Hit

The potential risk of a direct hit to an animal in the target area is estimated to be so low it is discountable. A Range Air Installation Compatible Use Zone (RAICUZ) study generated the surface area or footprints of weapon impact areas associated with air-to-ground ordnance delivery (USMC 2001). Statistically, a weapon safety footprint describes the area needed to contain 99.99 percent of initial and ricochet impacts at the 95-percent confidence interval for each type of aircraft and ordnance utilized on the BTs. At both BT-9 and BT-11 the probability of deployed ordnance landing in the impact footprint is essentially 1.0, since the footprints were designed to contain 99.99 percent of impacts, including ricochets. However, only 36 percent of the weapon footprint for BT-11 is over water in Rattan Bay, so the likelihood of a weapon striking an animal at the BT in Rattan Bay is 64 percent less. Water depths in Rattan Bay range from 3 m (10 ft) in the deepest part of the bay to 0.5 m (1.6 m) close to shore, so that nearly the entire habitat in Rattan Bay is suitable for marine mammal use (or 36 percent of the weapon footprint).

The estimated potential risk of a direct hit to an animal in the target area is extremely low. The probability of hitting a bottlenose dolphin at the BTs can be derived as follows: Probability = dolphin's dorsal surface area * density of dolphins. The estimated dorsal surface area of a bottlenose dolphin is 1.425 m^2 (or the average length of 2.85 m times the average body width of 0.5 m). Thus, using Read et al. (2003)'s density estimate of 0.183 dolphins/km^2 , without consideration of mitigation and monitoring implementation, the probability of a dolphin being hit in the waters of BT-9 is 2.61 x 10^{-7} and of BT-11 is 9.4 x 10^{-8} . Using the proposed levels of ordnance expenditures at each in-water BT (Tables 4 and 5) and taking into account that only 36 percent of the ordnance deployed at BT-11 is over water, as described in the application, the estimated potential number of ordnance strikes on a marine mammal per year is 0.263 at BT-9 and 0.034 at BT-11. It would take approximately three years of ordnance deployment at the BTs before it would be likely or probable that one bottlenose dolphin would be struck by deployed inert ordnance. Again, these estimates are without consideration to proposed monitoring and mitigation measures.

Take from Vessel and Aircraft Presence

Vessel movement is associated with surface-to-surface exercises, as described in the Specified Activities section above, which primarily occurs within BT-11. The USMC is not requesting takes specific to the act of maneuvering small boats within the BTs; however, NMFS has analyzed the potential for take from this activity. The potential impacts from exposure to vessels are described in the Vessel and Aircraft Presence section above. Interactions with vessels are not a new experience for bottlenose dolphins in Pamlico Sound. Pamlico Sound is heavily used by recreational, commercial (fishing, daily ferry service, tugs, etc.), and military (including the Navy, Air Force, and Coast Guard) vessels year-round. The NMFS' Southeast Regional Office has developed marine mammal viewing guidelines to educate the public on how to responsibly view marine

mammals in the wild and avoid causing a take (http://www.nmfs.noaa.gov/pr/education/southeast). The guidelines recommend that vessels should remain a minimum of 50 yards from a dolphin, operate vessels in a predictable manner, avoid excessive speed or sudden changes in speed or direction in the vicinity of animals, and not to pursue, chase, or separate a group of animals. The Marine Corps would abide by these guidelines to the fullest extent practicable. The Marine Corps would not engage in high speed exercises should a marine mammal be detected within the immediate area of the BTs prior to training commencement and would never closely approach, chase, or pursue dolphins. Detection of marine mammals would be facilitated by personnel monitoring on the vessels and those marking success rate of target hits and monitoring of remote camera on the BTs (see Proposed Monitoring and Reporting section).

Based on the description of the action, the other activities regularly occurring in the area, the species that may be exposed to the activity and their observed behaviors in the presence of vessel traffic, and the implementation of measures to avoid vessel strikes, we determined that it is unlikely that the operation of vessels during surface-to-surface maneuvers will result in the take of any marine mammals, in the form of either behavioral harassment, injury, serious injury, or mortality.

Aircraft would move swiftly through the area and would typically fly approximately 914 m from the water's surface before dropping unguided munitions and above 4,572 m for precision-guided munitions bombing. While the aircraft may approach as low as 152 m (500 ft) to drop a bomb this is not the norm and would never be done around marine mammals. Regional whale watching guidelines advise aircraft to maintain a minimum altitude of 300 m (1,000 ft) above all marine mammals, including small odontocetes, and to not circle or hover over the animals to avoid harassment. Our approach regulations limit aircraft from flying below 300 m (1,000 ft) over a humpback whale (Megaptera novaeangliae) in Hawaii, a known calving ground, and limit aircraft from flying over North Atlantic right whales closer than 460 m (1509 ft). Given that Marine Corps aircraft would not fly below 300 m on the approach, would not engage in hovering or circling the animals, and would not drop to the minimal altitude of 152 m if a marine mammal is in the area, we believe it unlikely that the operation of aircraft, as described above, will result in take of bottlenose dolphins in Pamlico Sound in any manner.

Negligible Impact Analysis and Preliminary Determination

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

The NDAA's definition of harassment as it applies to a military readiness activity is: (i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

We propose to authorize take by Level B harassment for the proposed training operations. Acoustic stimuli generated during training operations may have the potential to result in the behavioral disturbance of some marine mammals. There is no evidence that planned activities could result in injury, serious injury, or mortality within the specified geographic area for the requested authorization. The required mitigation and monitoring measures would minimize any potential risk for serious injury or mortality.

Pursuant to our regulations implementing the MMPA, an applicant is required to estimate the number of animals that will be "taken" by the specified activities (i.e., takes by harassment only, or takes by harassment, injury, and/or death). This estimate informs the analysis that we must perform to determine whether the activity will have a "negligible impact" on the species or stock. We have defined "negligible impact" in 50 CFR 216.103 as:

"an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number and manner of takes, alone, is not enough information on which to base a negligible impact determination. We must also consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat.
The Marine Corps has been conducting gunnery and bombing training exercises at BT-9 and BT-11 for several years and, to date, no dolphin injury, serious injury, or mortality has been attributed these military training exercises. The Marine Corps has a history of notifying the NMFS stranding network when any injured or stranded animal comes ashore or is spotted by personnel on the water. Therefore, stranded animals have been examined by stranding responders, further confirming that it is unlikely training contributes to marine mammal injuries or deaths. Due to the implementation of the aforementioned proposed mitigation measures, no take by Level A harassment or serious injury or mortality is anticipated nor would any be authorized in the IHA. We are proposing; however, to authorize 25 Level B harassment takes associated with training exercises.
The Marine Corps has proposed a 1000 yard (914 m) safety zone around BT-9 despite the fact that the distance to NMFS explosive Level B harassment threshold is 228 yards (209 m). They also would consider an area fouled if any dolphins are spotted within Raritan Bay (where BT-11 is located). The Level B harassment takes allowed for in the IHA would be of very low intensity and would likely result in dolphins being temporarily behaviorally affected by bombing or gunnery exercises. In addition, takes may be attributed to animals not using the area when exercises are occurring; however, this is difficult to calculate. Instead, we look if the specified activities occur during and within habitat important to vital life functions to better inform its negligible impact determination.
Read et al. (2003) concluded that dolphins rarely occur in open waters in the middle of North Carolina sounds and large estuaries, but instead are concentrated in shallow water habitats along shorelines. However, no specific areas have been identified as vital reproduction or foraging habitat. Scientific boat based surveys conducted throughout Pamlico Sound conclude that dolphins use the areas around the BTs more frequently than other portions of Pamlico Sound (Maher, 2003) despite the Marine Corps actively training in a manner identical to the specified activities described here for years.
As described in the Affected Species section of this notice, bottlenose dolphin stock segregation is complex with stocks overlapping throughout the coastal and estuarine waters of North Carolina. It is not possible for the Marine Corps to determine to which stock any individual dolphin taken during training activities belong as this can only be accomplished through genetic testing. However, it is likely that many of the dolphins encountered would belong to the NNCE or SNCE stock. These stocks have a population estimate of 1,387 and 2,454, respectively. We are proposing to authorize 25 takes of bottlenose dolphins in total; therefore, this number represents 1.8 and 1.0 percent, respectively, of those populations. This species is not listed as threatened or endangered under the ESA
Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, we preliminarily find that the specified USMC AS Cherry Point BT-9 and BT-11 training activities will result in the incidental take of marine mammals, by Level B harassment only, and that the total taking from will have a negligible impact on the affected species or stocks.
Subsistence Harvest of Marine Mammals
Marine mammals are not taken for subsistence uses within Pamlico Sound; therefore, issuance of an IHA to the USMC for MCAS Cherry Point training exercises would not have an unmitigable adverse impact on the

availability of the affected species or stocks for subsistence use.
Endangered Species Act (ESA)
No ESA-listed marine mammals are known to occur within the action area. Therefore, there is no requirement for NMFS to consult under Section 7 of the ESA on the issuance of an Authorization under section 101(a)(5)(D) of the MMPA. However, ESA-listed sea turtles may be present within the action area.
On September 27, 2002, NMFS issued a Biological Opinion (BiOp) on Ongoing Ordnance Delivery at Bombing Target 9 (BT-9) and Bombing Target 11 (BT-11) at Marine Corps Air Station, Cherry Point, North Carolina. The BiOp, which is still in effect, concluded that that the USMC's proposed action will not result in adverse impacts to any ESA-listed marine mammals and is not likely to jeopardize the continued existence of the endangered green turtle (Chelonia mydas), leatherback turtle (Dermochelys coriacea), Kemp's ridley turtle (Lepidochelys kempii), or threatened loggerhead turtle (Caretta caretta). The proposed IHA will not result in effects beyond those considered in the 2002 BiOp and NMFS does not anticipate the need for further Section 7 consultation for the Authorization or the underlying activities proposed by the Marines. No critical habitat has been designated for these species in the action area; therefore, none will be affected.
National Environmental Policy Act (NEPA)
On February 11, 2009, the Marine Corps issued a Finding of No Significant Impact for its Environmental Assessment (EA) on MCAS Cherry Point Range Operations. Based on the analysis of the EA, the Marine Corps determined that the proposed action will not have a significant impact on the human environment. We adopted the Marine Corps' EA and signed a Finding of No Significant Impact on August 31, 2010. We have again reviewed the proposed application and preliminarily determined that there are no substantial changes to the proposed action or new environmental impacts or concerns. Therefore, we have determined that a new or supplemental EA or Environmental Impact Statement is likely unnecessary. Before making a final determination in this regard, we will review public comments and information submitted by the public and others in response to this notice. The EA referenced above is available for review at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.
Dated: March 26, 2013.
Helen M. Golde,
Acting Director, Office of Protected Resources, National Marine Fisheries Service.
[FR Doc. 2013-07305 Filed 3-28-13; 8:45 am]
BILLING CODE 3510-22-P

Tracking the brain's noise filter

Author: #BB# FROM THE LAB.

Publication info: The Southland Times [Invercargill, New Zealand] 14 Mar 2013: 11.
ProQuest document link

Abstract: W ith the start of university and international cricket happening in Dunedin in the past two weeks, a lot of partying has made the news. One of the things that...

Full text: W ith the start of university and international cricket happening in Dunedin in the past two weeks, a lot of partying has made the news. One of the things that has always amazed me about parties is how we can tune-in to a single conversation, while filtering out the music, clinking of glasses and other conversations.
But this ability is surprisingly difficult for people with hearing impairments, even if they have hearing aids. They

often find it difficult to pay attention to a single sound and filter out the noise. My father complains that his hearing aids actually seem to make it worse, because he can hear even more irrelevant noise. His solution is to take his hearing aids out, but that just removes him from the conversation. And that doesn't sound very nice to me.
The "cocktail party problem" is the name scientists have given to our ability to tune-in to just one speaker at a noisy gathering, and it has puzzled scientists for more than 60 years. Exciting new neuroscience research suggests that the brain is able to recognise and filter out irrelevant noise, even before it comes to our attention.
Study participants simultaneously watched two videos of people telling a story and were asked to concentrate on only one of them. While participants were doing this, the researchers recorded their brain activity. With the assistance of some sophisticated kit and clever mathematical computation, researchers were able to track the information from the two videos as it travelled through the subjects' brains. They found evidence that both stories were heard. That is, the actual sounds of each story entered the brain in the same way.
This makes sense because we can hear all the sounds at a party, but only pay attention to some of them.
Researchers then looked at regions of the brain that are known to be involved with "higher order" functions. These are the things that we sometimes think of as uniquely human, such as using and understanding language. These areas of the brain showed only the activity patterns of the story that the subjects were asked to pay attention to. The brain activity patterns coming from the irrelevant story simply did not exist at these higher levels. This is the first-ever evidence that we may be able to direct the flow of information into our brains.
Now that scientists know the places in the brain that only the important information gets to, they can map the pathway that it takes. More importantly, they can now ask what happens to the unimportant information. Why doesn't it get to the same place? How is it filtered out? And why is the filter broken in some people? Dr Christine Jasoni is director of the Otago Neuroscience Programme, a senior lecturer in anatomy at the University of Otago, and president of the Otago Institute of Arts and Sciences, the Otago/Southland branch of the Royal Society of New Zealand.
Credit: #BB# FROM THE LAB

Design and evaluation of tinnitus synthesis methods: From spectral to spatial matching

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Publication info: American Journal of Otolaryngology 34.2 (2013): 121-32.
ProQuest document link

Abstract: Purpose
This study was designed to investigate methods to help patients suffering from unilateral tinnitus synthesizing an auditory replica of their tinnitus.
Materials and methods
Two semi-automatic methods (A and B) derived from the auditory threshold of the patient and a method (C) combining a pure tone and a narrow band-pass noise centred on an adjustable frequency were devised and rated on their likeness over two test sessions. A third test evaluated the stability over time of the synthesized tinnitus replica built with method C, and its proneness to merge with the patient's tinnitus. Patients were then asked to try and control the lateralisation of this single percept through the adjustment of the tinnitus replica level.
Results
The first two tests showed that seven out of ten patients chose the tinnitus replica built with method C as their

preferred one. The third test, performed on twelve patients, revealed pitch tuning was rather stable over a week interval. It showed that eight patients were able to consistently match the central frequency of the synthesized tinnitus (presented to the contralateral ear) to their own tinnitus, which leaded to a unique tinnitus percept. The lateralisation displacement was consistent across patients and revealed an average range of 29dB to obtain a full lateral shift from the ipsilateral to the contralateral side.

Conclusions

Although spectrally simpler than the semi-automatic methods, method C could replicate patients' tinnitus, to some extent. When a unique percept between synthesized tinnitus and patients' tinnitus arose, lateralisation of this percept was achieved.

Full text: 1 Introduction

Subjective tinnitus (i.e. perception of a sound without any external or internal auditory stimulation [1]) is a highly prevalent otoneurological symptom for which there is currently no causally oriented treatment [2] . In the USA up to 16 % of the general population has been found to suffer from frequent tinnitus [3] . Although most people can become accustomed to a tinnitus percept, clinical subjective tinnitus can significantly alter one's quality of life [4] . In the most recent pathophysiological models, tinnitus was no longer considered to originate in the cochlea but was rather seen to be a consequence of neuroplastic changes in the central auditory and non auditory pathways occurring as a consequence of sensory deprivation after cochlear damage [5,6] . Indeed, the clinical patterns of tinnitus were similar to those observed in chronic pain following amputation [7,8] , where conditioning techniques using virtual reality (VR) have been shown both to be theoretically interesting and effectively useful [9] . Hypothetically, if the patients manage to transfer their subjective auditory perception to a real sound similar to their tinnitus percept, it could allow them to take control of the tinnitus-like percept they manipulate, see and hear.

The aim of the presented study was to build a tinnitus avatar that would be further exploited in a therapeutic protocol, where the patient would be invited to manipulate his/her tinnitus avatar in a virtual reality environment [10] . This implies creating a "virtual tinnitus" that could be manipulated in the virtual environment. In order to reproduce a realistic sensation, the virtual tinnitus needs to "imitate" the patient's tinnitus behaviour. Although tinnitus can be perceived inside or outside the head, the majority of tinnitus is unilateral (with a predominance for the left ear) or bilateral [11,12] . To limit the number of different factors, only patients with an unilateral tinnitus were recruited in the presented study.

In headphone listening conditions, a sound source played over headphones can be externalized using head related transfer function (HRTF) but can also move "inside the head" by an action of source lateralisation. In normal headphone listening conditions, diotic signals give rise to a unique auditory event located in the centre of the head. Increasing the gain of one of the signals "pushes" the sound image towards the corresponding ear. If dichotic signals, differing in pitch, are presented, then the fusion does not occur any more and two separate auditory events are heard respectively in the right and left ear. Lackner [13] conducted an experiment on six patients that were suffering from tinnitus resulting from cortical and peripheral damages. The central frequency of their tinnitus was matched with an external sound played in the contralateral ear (opposite ear of the ear where the tinnitus is located - stated as ipsilateral ear). For four of them, the internal and the external signals fused and therefore resulted in a unique percept. Changing the gain of the external signal changed the perceived position of this percept. This experiment was done using only one pure frequency tone that reproduced part of the tinnitus spectrum.

The tinnitus sensation is complex to characterize because only the patient suffering from tinnitus can recreate a similar sound with synthetic signals that do not necessarily "sound" like his/her sensation. The tools can only help him/her in this recreation. Nageris et al. [12] reported judiciously that the variability of the measured tinnitus

pitch was dependent on different factors such as: test procedure, homogeneity of the population sample and origin of the tinnitus. Indeed, different signals and methods have been carried out to characterize tinnitus dominant pitch. Although the repeated within-session pitch matching was shown to be comparable with that of external tones matching, tinnitus pitch matching was shown to vary significantly across sessions [14-16] . In most studies, tinnitus characterisation would consist of adjusting a pure tone frequency to match the dominant pitch of the perceived tinnitus [12-15,17-20] . Different procedures have been used to help the patient to create a replica of their tinnitus, avoid octave error and work on the reliability of their results. In [13] , patients used a method of adjustment where the frequency of the external tone was swept by the experimenter. Tyler and Conrad-Armes [14] advised to use either method of adjustment or adaptive method by "bracketing" the tinnitus pitch. Mitchell et al. [19] and Penner and Klafter [18] worked on pure tone matching using a frequency adaptive forced-choice-double-staircase procedure. Moore et al. [20] used a bracketing method centred on a previously defined frequency. Most of these methods are time-consuming therefore tiring for the patient (Tyler suggested repeating the procedure at least seven times to have a final result) and, most of the time, needs an external examiner to manage the frequency change. Furthermore, the reliability of tinnitus matching with a single pure tone might be inappropriate to represent the timbre of tinnitus [21] . In order to better portray the complex tinnitus sensation, Norena [16] then Roberts [22] proposed a method to estimate the various components contributing to the global tinnitus sensation. In [16] , ten subjects were asked to rate successively the similarity of their tinnitus against a collection of pure tones ranging from 500 Hz to 14 kHz. A combination of these tones weighted by their respective ratings forms what the authors named "the internal spectrum of perceived tinnitus". It was observed that this estimated internal spectrum roughly followed the frequency profile of the auditory threshold with the main components falling into the hearing loss area. Using a similar approach, Roberts et al. [22] proposed to characterize the tinnitus spectrum using eleven sound clips with a central frequency ranging from 0.5 kHz to 12 kHz. For each subject, the bandwidth of these eleven sound clips (pure tone, 5 % of the centre frequency (CF) at ?10 dB, 15 % of CF at ?10 dB) was chosen according to a self-described tinnitus timbre as being respectively "tonal", "ringing" or "hissing". The tinnitus spectrum was modelled through the individual rating of these eleven sounds with the tinnitus as the comparison using the Borg CR100 scale [23] . Conducted with 32 subjects, the study also revealed that the tinnitus spectrum spanned the region of the hearing loss [22] . In these two methods the patients had to adjust manually defined frequency tones. Conclusions from Norena et al. and Roberts et al. suggest that an automatic or semi-automatic tinnitus synthesis method could be derived from the measurement of the subject's auditory threshold shift. The tinnitus matching process could then be simplified and reliable, if the tinnitus sensation is stable.

In the presented study, three methods of creating a credible auditory image (tinnitus avatar) of the patient's perceived tinnitus were investigated. The reliability was then investigated by a test-retest of the synthesized tinnitus built with one of the methods. Finally, if the combination of synthesized tinnitus and the patient's tinnitus gave rise to a unique percept, then the apparent lateralisation of this percept was investigated.

2 Materials and methods

In the following section, the three methods as well as the three subjective test procedures are presented. The study received the approval of the local ethical committee (Comité de Protections des Personnes Ile de France VIII, Boulogne Billancourt, France).

2.1 Tinnitus synthesis methods

Three adaptive subject-driven methods have been devised to create an acoustic replica of the patient's tinnitus. The devised methods were based on a combination of two complex stimuli respectively composed of a sinusoidal component and a filtered noise component. This combination was meant to allow the patient to tune between different tinnitus sensations, often reported in the literature as sounding "tonal" or "ringing", "hissing", "whooshing", etc.

All tinnitus synthesis methods presented below used the contralateral ear to drive the tinnitus matching. This

choice was in line with the CIBA recommendation that advocates the use of the contralateral ear for pitch matching if the tinnitus is unilateral [15] .

2.1.1 Auditory threshold measurement

The tinnitus synthesis methods A and B described below were based on the estimated auditory threshold curve of the patient. Consequently, audiograms of the patients have been systematically measured for both ears before inviting them to tune their respective avatar with the different methods.

An audiogram program has been designed to estimate the hearing curve of the patient using an ascendant method. Sequences of one-second fixed-frequency pure tone separated by one second of silence were presented to the patient with a step increase of 3 dB until he/she indicated hearing the sound by pressing the space-bar of the keyboard. The stimulated ear and the frequency were randomly chosen. Once the sound was detected, another tone was presented to the patient until all the measurements were done. The hearing threshold was measured from 125 Hz to 16 kHz. Measured frequencies corresponded to the frequency distribution defined in ISO 389-1 [24] complemented with the frequency distribution defined in ISO 389-5 [25] norms in order to cover the range from 125 Hz to 16 kHz. From 125 Hz to 8 kHz, frequencies were roughly distributed in 1/3 octave band. From 8 kHz to 16 kHz, frequencies were distributed in 1/6 octave band.

2.1.2 Semi automatic methods A and B

The assumption behind the design of method A and B was based on Norena's conclusion that the tinnitus' internal spectrum mirrors the frequency profile of the auditory loss of the ipsilateral ear, i.e. the ear where the tinnitus was located. For both methods, the synthetic tinnitus was a combination of two complex stimuli. The first stimulus was composed of a series of sinusoids and the second was a broadband filtered noise. The frequency content of the tinnitus was automatically built and the only task of the patient was to determine the relative gain of the sinusoid aggregate stimulus and of the noise stimulus (one slider controlling the balance between both components). A global gain slider allowed for the matching of the overall signal level to the tinnitus loudness.

2.1.2.1 Method A

The two components were sculpted in frequency to follow the auditory threshold curve (in dB SPL) of the ipsilateral ear. The frequencies of the sinusoids were those used in the auditory threshold measurement procedure. Their relative gains fitted the corresponding auditory thresholds. The frequency envelope of the filter applied to the noise stimulus component was derived from the same auditory threshold curve using linear interpolation between the different measured frequencies. Method A took the ipsilateral auditory threshold curve as the basis of the tinnitus reproduction. Different typologies of hearing loss were equally considered. Indeed, method A weighted equivalently a unilateral notch present on the ipsilateral ear, and a symmetrical hearing impairment.

2.1.2.2 Method B

In method B, it was hypothesized that the analysis of the auditory threshold asymmetry between the two ears may be used as an indicator of the tinnitus' internal spectrum. Accordingly, the tinnitus avatar spectrum built with method B aimed at mirroring this asymmetry. The relative weight of the sinusoids and the noise filter envelope were built upon the auditory thresholds difference (in dB) between the ipsilateral and the contralateral ears. As for method A, the frequency profile was fixed and the patients were only asked to adjust a slider controlling the level balance between the two components and a global gain slider to match the overall signal level to the loudness of the tinnitus.

2.1.3 "Manual method" C

Method C was close to single pitch matching. Pitch matching has often been based on adaptive procedure or bracketing, with fixed discretized frequency, sometimes managed by instructor. In this case, the patients were asked to span the frequency range to find the matching frequency. The synthetic tinnitus was composed of two stimuli: a pure tone and a 1/6 octave band noise centred on a single and adjustable frequency. The band-pass filter was either implemented using a bi-quadratic parametric filter or in the Fourier domain, using a 1/6 octave

band rectangular window. Patients were invited to synthesize the tinnitus avatar by adjusting the central frequency common to both components, their relative gains and a global level.

2.2 Test session 1

This first test session was intended to gather preliminary observations about the different tinnitus synthesis methods. Objective data was collected about the different control parameters tuned by the patients together with their spontaneous comments about the task, the overall similarity of the created tinnitus avatars and the preferred tinnitus avatar (i.e. the one that sounds the most like their tinnitus). The whole session lasted from forty-five minutes to one hour.

2.2.1 Patients

Ten patients (two females, eight males) aged between 26 and 60 (mean 41) and reporting tonal and stable unilateral tinnitus (five left and five right) were involved in a tinnitus avatar synthesis session where they could create their tinnitus avatar using the three methods A, B and C successively.

2.2.2 Apparatus

Both the audiogram and tinnitus matching procedures were performed on a Mac Book Pro equipped with an external RME Fireface 400 sound card set at 44.1 kHz sampling rate. The methods were implemented using MAX/MSP software. Audiogram measurements and test session 1 were performed with Koss R80 headphones. The total electro-acoustic chain comprising the computer, the sound card and the headphones was calibrated using a B&K artificial ear in order to derive the dB FS to dB SPL conversion curve.

For each synthesis method, a simple graphical user interface (GUI) was designed to help the patient to tune the different method parameters. The GUI consisted of different virtual sliders represented on the screen, which the patient controlled with the mouse.

Once the patient was satisfied with the tinnitus matching, an excerpt of 10 seconds was saved in an audio sound file in order to allow for its subjective evaluation in the different test sessions. Sound files were encoded with 24 bits dynamic range and 44.1 kHz sampling rate. In order to better exploit the dynamic of the sound files, signals were amplified before being recorded so as to approach an RMS level of ?10 dB FS. The corresponding gain was saved and compensated for when playing back the sound file, in order to restore the tinnitus avatar to its original level.

2.2.3 Procedure

The session started with the measurement of the auditory threshold curve of the patient on both ears using the procedure described in Section 2.1.1 . Immediately after, the patient proceeded with the creation of his/her tinnitus avatars using the three tinnitus synthesis methods A, B and C (described in Section 2.1.2 and Section 2.1.3) successively. For all patients, the order of the methods was kept the same. Before starting a given method, the patient received explanations about the GUI and the significance of each tuning parameter (virtual sliders controlled with the mouse). Once the tinnitus matching was accomplished, a short sound file excerpt of the tinnitus avatar was automatically recorded. The patient was invited to have a short debriefing with the experimenter, to give oral feedback or any free comments about the task itself or about the global or detailed resemblance between his/her tinnitus and the recently created avatar.

As a last step, after having accomplished the matching using the three creation methods, the patient was invited to compare the three tinnitus avatars and to indicate which was the most similar to his/her tinnitus. To do so, the patient listened alternatively to the three avatar sound files, and was free to switch from one to the other. As during the matching process, the avatars were played back on the contralateral ear. However the patient could not change the playback level, which was set according to what he/she had tuned during the matching step. Once the most resembling tinnitus avatar was chosen, the patient was asked to comment on his/her choice.

2.3 Test session 2

The time interval between the first and second sessions was between two and five months.

The second session was dedicated to the subjective assessment of the tinnitus avatars synthesized during the

first session. As exposed in Section 2.1 , the different synthesis methods were devised to portray individual specificities of the tinnitus spectrum. In order to verify whether these methods actually succeeded in their goals, the patients were invited to compare the likeness of their own tinnitus avatars with that of non-individual avatars such as those that were created by the other patients. Although necessarily based on subjective judgements, and despite a small number of patients, the goal was to obtain some objective quantification of the suitability of the different proposed tinnitus synthesis methods.

2.3.1 Patients

This session involved a subset of five patients who participated in the first session (two females, three males, mean age = 46, age range 34-60) reporting tonal and stable unilateral tinnitus (three left and two right).

2.3.2 Apparatus

The equipment was the same that the one used in test session 1, described in 2.2.2 .

2.3.3 Procedure

Two different tests were organised within the same session, the total duration of which was about thirty minutes. For both tests, twelve stimuli including individual and non-individual tinnitus avatars were presented to each patient. They consisted of a subset of the tinnitus sound files collected during the first session. Three of these stimuli were the individual avatars that the patient had built during the first session with methods A, B and C. The nine others were non-individual, and corresponded to the tinnitus avatars that were respectively built and selected as their best by the other nine patients of the first session. It should be noted that the stimuli corpus presented was different for each patient. Ten stimuli were common to all (the ten best avatars including the patient's own best). Accordingly, they did not necessarily originate from the same synthesis method. Two stimuli were patient specific, i.e. they corresponded to the two other individual avatars that the patient built during the first session but did not select as his/her best.

2.3.3.1 Visual Analogue scale (VAS)

Each stimulus was played back in loop in the contralateral ear and the patient was free to listen to it as long as he/she wanted. The patient was first asked to adjust the level of the tinnitus avatar in accordance to his/her tinnitus. The level was initialized to ?150 dB and the patient could adjust it with a vertical slider represented on a GUI. In order to avoid sound distortion of the avatar and hearing injury, the level was constrained to stay below an upper limit of 0 dB FS (107 dB SPL at 1 kHz) otherwise the tinnitus avatar was simply muted. This precaution was especially important when a patient was adjusting the level of a non-individual tinnitus avatar as his/her hearing threshold may differ from that of the patient who designed it. After matching its level, the patient was asked to rate the level of resemblance of the tinnitus avatar with his/her tinnitus on a VAS (from 0 = completely different to 100 = identical). The adjustment of the signal level and the similarity judgment were made using two vertical faders represented on a GUI. The twelve tinnitus avatars were successively scored using the same procedure. The three avatars created by the patient were presented first followed by the non-individual tinnitus avatars. The patient was not aware of the identity and origin of the tinnitus avatars.

2.3.3.2 Pairwise Comparison test

The twelve stimuli were used in a forced choice pairwise comparison. All stimuli were played back in loop in the contralateral ear using the level tuned by the patient during the VAS test. For each pair the patient could switch freely at any time between both stimuli, but was no longer allowed to modify the level. The patient was invited to select which stimulus from the pair was the most similar to his/her tinnitus. As a full pairwise comparison method with twelve stimuli would have led to a rather tedious task (66 pairs), we restricted the number of pairs. For each patient the three individual avatars were compared to each other (3 pairs), and the three individual avatars were also compared to the other nine non-individual tinnitus avatars (27 pairs), which led to a total of 30 pairs. For each patient the global "preference" score of the different stimuli was obtained by adding the number of times it was chosen, divided by the number of times it was involved in a pairwise comparison (11 times for individual avatars and 3 times for the non-individual ones).

2.4 Test session 3

A third test session investigated, on the one hand, the reproducibility and stability of the tinnitus avatar over a one-week interval and, on the other hand, whether the patient's tinnitus and the tinnitus avatar merged together and gave rise to a unique percept. Based on the observations and results of the first two test sessions (see section 3.1 and 3.2 for details), the preferred method was chosen to be method C. Only this method was used in this third test session.

2.4.1 Patients

A new set of twelve patients (six females and six males) aged from 24 to 69 (mean 45 years) were involved in this third test session. They all reported unilateral tinnitus (six right and six left).

2.4.2 Apparatus

The equipment was similar to the test sessions 1 and 2, apart from the headphones. Test session 3 was performed using BeyerDynamic 990 open headphones which were used during the therapeutic application [10] . The calibration was adapted accordingly.

2.4.3 Procedure

The procedure was conducted in two phases, separated by a one-week interval.

2.4.3.1 First phase

The auditory threshold curve of the patients was first measured on both ears using the audiogram method described in Section 2.1.1 . The patients were then invited to a training task where they had to match two sinusoidal tones in pitch and loudness. A reference tone of fixed frequency was played in the ipsilateral ear. A variable frequency tone was played in the contralateral ear. The task of the patients was to match the pitch and loudness of the variable tone to that of the reference tone by moving sliders integrated in a graphical user interface situated in front of them. The training was repeated for five tones with increasing frequency (500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz). Once the training was completed, the patients were invited to create a tinnitus avatar (hereafter called C1) with method C as described in Section 2.1.3 .

2.4.3.2 Second phase

One week later, the patients were asked to create a new version (hereafter called C2) of their tinnitus avatar following the same procedure as in the first phase. This was also preceded by a frequency-matching training phase. After creating the new tinnitus avatar, the patients were invited to evaluate the similarity of the C1 and C2 tinnitus avatar versions with their tinnitus. Each avatar was presented to the contralateral ear, and the patients were not allowed to modify its level. The evaluation was performed with two methods.

In the first evaluation method, the patients had to evaluate the similarity of each tinnitus avatar version with their tinnitus using a VAS from 0 ("very different") to 100 ("identical").

In the second evaluation method, the two avatars were compared to each other. The patient could freely switch from one tinnitus avatar version to the other as many times as they wanted. The two versions were denoted "A" and "B" and the patients were not aware of their respective identity. Using a 7-point horizontal scale (from left to right: "A much more similar to the tinnitus than B", "A more similar to the tinnitus than B", "A and B are equivalent", "B more similar to the tinnitus than A", "B much more similar to the tinnitus than A"), the patients were asked to judge the similarity according to three criteria: "global similarity", "pitch similarity", "loudness similarity".

A final test was performed in which the patients were asked to choose their preferred tinnitus avatar version (C1 or C2) and check if the combination of the tinnitus avatar with their tinnitus was merging into a unique percept. The patients were then successively invited to tune the tinnitus avatar gain in order to localize the tinnitus image at five different lateral directions (an apparent direction towards the contralateral side, an apparent position in between the median plane and the contralateral ear - approximately on the same sagittal plane as the eye, an apparent direction in the median plane, an apparent position in between the median plane and the ipsilateral ear and, an apparent direction towards the ipsilateral side). Each direction tuning was repeated twice.

3 Analysis

Results from the three test sessions are shown in the following sub-sections. Characteristics of the avatars are analysed in pitch and loudness. The scores of the different avatar ratings are displayed in cumulated distributions. For the test sessions 1 and 2, cumulative distribution values were calculated for each method and compared to each other. A cumulative distribution "smaller" than another means that the distribution is concentrated on higher scores and thus indicates a better merit of the corresponding method. A non-parametric statistical analysis, the Kolmogorov-Smirnov unilateral test was conducted on score distributions.

3.1 Characteristic of the avatars

From the results of test session 1, spectral parameters of the avatars synthesized by the patient with each method are described in Table 1 . The last row of the table displays the tinnitus considered as preferred by the patient after matching the three avatars.

Fig. 1 shows the spectral profiles of the three different tinnitus avatars synthesized by two patients together with the respective auditory threshold frequency curves of their ipsilateral and contralateral ears. The avatar built with method C had its central frequency defined by the patient. Its central frequency often reached very high values. This observation is in line with previous studies showing that tinnitus matched high frequency tones in up to 88% of subjects in a population displaying high frequency sensorineural hearing loss [26] . For three patients (P4, P9, P10) this frequency was even over 12 kHz. Indeed, in contrast with previous studies [22,27] , the frequency range was not capped at a maximum of 12 kHz in order to stay coherent with the automatic methods A and B, which have built a tinnitus avatar spectrum encompassing the whole frequency range. When comparing the central frequency of the synthesized tinnitus avatars that were built with method C by the ten patients, it was seen that all but one stayed within the same octave band and five out of seven even stayed within an interval of more or less one sixth of an octave. For methods A and B, the avatar spectra were derived from the patient's auditory thresholds. The avatar built with method A followed the hearing loss of the ipsilateral ear; a greater loss implies a higher signal amplitude. As the patient's hearing loss arose mostly at high frequency, method A built stimuli with a spectral profile strongly predominant at high frequencies. Apart from patient P10, all patients exhibited quasi symmetrical loss between ispilateral and contralateral ears. Therefore this high frequency predominance vanished in method B due to the fact that its frequency profile was based on the difference between the ipsilateral ear and the contralateral ear auditory thresholds. Consequently, the tinnitus profile built upon method B tended to emerge at mid frequencies, while the high frequencies remained below the auditory threshold. This tendency was corroborated by the comments of the patients who often judge the tinnitus avatar A as being higher in pitch, or even harsher than tinnitus avatar B. Interestingly, the only patient who selected the tinnitus avatar synthesized with the differential method B exhibited a pronounced auditory threshold asymmetry (cf. patient P10 in Fig. 1).

To evaluate the loudness of the tinnitus sensation, the level of the avatar is expressed in dB SL with respect to the auditory threshold of the contralateral ear (where the avatar was played). As seen in Table 1 , on average, the tinnitus avatar was tuned so that its spectral profile emerged only a few dB (<10 dB) above the contralateral auditory threshold (method A: mean 6 dB (±9.74), method B: mean 6 dB (±7.16), method C: mean 9 dB (±17.62)), as found in [14,20] . However, Table 1 shows that for some avatars, especially those built with method C, the level was much higher or even sometimes lower than the auditory threshold of the contralateral ear. This may come from the fact that the auditory threshold has been sampled only on a limited set of frequencies (every 1/6 octave). In method C, the pitch could be continuously tuned over the entire frequency range. Thus, the correction applied to convert dB FS into dB SL could be inaccurate for the frequencies in between the measured ones, especially in the interpolated frequency regions exhibiting a steep slope. The same phenomenon could have occurred with the noise component of the avatars built with method A and B.

Although the averaged level ratio between the sinusoid component and the noise component was almost balanced for method A and for method B, important variability was observed among patients (method A: mean

?1 dB (±32.38), method B: mean 14 dB (±33.80)). For method C, the noise component was maintained at a very low level, or even muted, especially for the five first patients P1 to P5 (see [Table 1]), that described the noise component with too much low frequency content, and for whom the mean S/N was +48 dB (±33.28). It was suspected that the bi-quadratic filter used to create the band-pass noise was not sharp enough, which could have led to a high risk of the emergence of low frequencies over their contralateral auditory threshold. As a consequence, for the five next patients P6 to P10, the filter was then replaced by a 1/6 octave band rectangular window centred on the same frequency as the sinusoidal component. For patients P6 to P10, who used this more selective band-pass filter, the mean level difference between the sinusoidal and the noise component was reduced to 18 dB (±6.65).

3.2 Choice of the avatar

At the end of session 1, the patients had to choose the avatar that matched best their tinnitus. Out of ten patients, seven selected the tinnitus avatar synthesized with method C as the best matching one, whilst two selected the method A and one selected the method B ([Table 1]).

In session 2, five patients who participated in the first session had to rate individual and non-individual avatars on a VAS and, comparatively by pairs. The idea behind the inclusion of non-individual avatars was to check whether the patients would actually rank higher their own avatars compared to non-individual ones. The global score obtained for the individual tinnitus avatars built with method A, B and C was averaged over five individual judgments, whereas the score for the non-individual avatars was averaged over forty-five (9 ×5). [Fig. 2] displays the distribution of the VAS scores obtained for the different individual avatars A, B and C and the non-individual avatars. In the forced choice pairwise comparison procedure, a preference score was derived by scoring each stimulus of a given pair with '1' if preferred and '0' if not. A global score was obtained for each synthesis method by adding the scores over all pairs and normalising this value by the number of pairs in which it was presented. For both, VAS and pairwise comparison test results, method C obtained better scores than method B (see [Fig. 2]). The cumulative distribution of method C scores was "smaller" than that of method B (Kolmogorov-Smirnov test, $P < .002$), which reflects a better ranking. The cumulative distribution of individual tinnitus avatars built with method C was significantly smaller than that of individual tinnitus avatars built with method A ($P < .02$) for the pairwise comparison test. In contrast, the score distributions of method A and C were not significantly different for the VAS test. However, the cumulative distribution of method C was smaller than that of non-individual tinnitus avatars ($P < .01$), which was not the case of method A ($P = .15$). In other words, when patients judged method C, they preferred their individual tinnitus avatar to non-individual avatars, which was not the case for the other methods A or B.

The non-individual tinnitus avatars included in the test session 2 were the best matching tinnitus avatars chosen by the ten patients of the first test, which means that seven of them belonged to method C (see [Table 1]). The cumulative distribution of the VAS score for individual tinnitus avatars built with method C was compared with the one for non-individual tinnitus avatars restricted to those built with method C. The Kolmogorov-Smirnov unilateral test concluded that the cumulative distribution of the tinnitus avatars C was still smaller than the cumulative distribution of the non-individual tinnitus avatars ($P = .04$). In the pairwise comparison test, the cumulative distribution of the tinnitus avatars built with method C was only marginally smaller than that of non-individual avatars ($P = .08$). As observed before with the analysis of the VAS scores, this tendency was likely to come from the fact that non-individual avatars were mainly built with method C (seven out of ten), and that all these tinnitus avatars were homogeneously tuned in frequency.

With both evaluation methods, the scores of the individual tinnitus avatars synthesized with method C were shown significantly higher than the scores obtained with non-individual avatars. This revealed a superior ability of method C to preserve the individual characteristics of the patient's tinnitus. However, when the non-individual avatars were restricted to those built with method C, this difference tended to vanish (only significant in the VAS test), and may have resulted from the homogeneous frequency tuning observed among all tinnitus avatars built

by the patients involved in these test sessions.

3.3 Stability over time

Test session 3 concentrated on evaluating the likeness of avatars created with method C over two sessions. Two ratings were used: absolute scale (VAS) and comparison of the two created avatars.

3.3.1 VAS judgements of C1 and C2

Fig. 3 displays the individual VAS scores of the two tinnitus avatar versions created by each patient within a one week interval. The distribution of the individual scoring differences between the first and the second tinnitus avatars was also compared to a normal distribution to investigate the patient's consistency in tuning his/her tinnitus.

The Kolmogorov-Smirnov test showed that the distribution of individual score differences was significantly lower than would be expected with a normal distribution (P <.02), which indicates that each patient showed a preference for the most recently tuned tinnitus avatar, rating it higher than that tuned a week earlier.

3.3.2 Preference judgement of C1 and C2

In order to gain a better insight into the perceptual dimensions that could explain the scoring, the patients were invited to rate their preference by comparing C1 and C2 (i.e. the tinnitus avatars that matched their tinnitus better) on a 7-point scale (from "A much more similar to the tinnitus than B" to "B much more similar to the tinnitus than A"). The test was repeated three times, each time with a different instruction, judging the similarity to their tinnitus according to a "global likeness", a "spectral likeness", or an "intensity likeness". From this data, a preference score was derived on a scale ranging from ?3 (first avatar much more similar) to +3 (second avatar much more similar). The cumulative distribution of these preference scores was then compared to a normal distribution. Fig. 4 displays the individual responses of the patients together with the cumulative distribution curves of the preference scores derived from the test. According to the Kolmogorov-Smirnov test, the distribution of the preference score for the global likeness was not significantly different from a normal distribution (P = .48), the distribution of the preference score for the spectral likeness was marginally smaller than the normal distribution (P = .04), and the preference score for the intensity likeness was significantly smaller than the normal distribution (P = .003). There was no significant global preference towards the most recent avatar, however, when orienting the judgment on the spectral matching and on the intensity matching there was a significant preference towards the most recent tinnitus avatar, especially for the intensity matching.

3.3.3 Frequency tuning consistency between the two tinnitus avatars

The objective consistency of the patients' frequency tuning between the two tinnitus avatars were then compared. Fig. 5 displays the histogram of the central frequency ratio between the second and the first avatars, expressed on a 1/6 octave band logarithmic scale. Values are mainly clustered around 0, corresponding to a ratio of 1 between the two central frequencies (+/? 1/6 octave), and 6 corresponding to a central frequency of the second avatar one octave above the central frequency of the first avatar (+/? 1/6 octave). This means that most of the patients tuned the second avatar either very close to the first one (+/? 1/6 octave) or one octave above (+/? 1/6 octave). This tendency suggests that patients were relatively consistent in their frequency tuning, although they may have been confused with octave interval difference.

3.4 Spatial fusion and percept lateralisation

Out of twelve patients in the test session 3, eight reported that their tinnitus and the avatar were actually merging into a unique percept, while the remaining four patients reported that the tinnitus avatar and the tinnitus were always heard as separate entities whatever the level of the tinnitus avatar.

Fig. 6 displays the results of the lateralisation test in which the patients were invited to tune the gain of the tinnitus avatar to control the apparent spatial location of their tinnitus. The gain was expressed relative to the level tuned to match the perceived loudness of their tinnitus.

Interestingly, the four patients for whom no merging percept could be found all showed large inconsistency in the pitch tuning between their two avatars (one octave or more difference). This could either indicate that they

did not succeed in matching the dominant pitch of their tinnitus or that the method C did not allow them to convincingly portray their tinnitus spectrum. For the eight other patients, the slope of the lateralisation displacement as a function of the tinnitus avatar level was shown to be close to linear and was consistent over the different patients. A linear fit across the individual curves revealed that a range of 29 dB was required to obtain a full lateral shift from the ipsilateral to the contralateral side. It was also interesting to observe the negative intercept: ?6.3 dB (±3.6 dB for 95 % confidence interval). In other words, when the patients were asked to tune the tinnitus avatar level so as to obtain an auditory image in the median plane (0°), this level was significantly below the level they had tuned for the equal loudness judgment.

4 Discussion

The first part of the study intended to determine whether a tinnitus avatar synthesis method based on an automatic spectrum profile reconstruction would succeed in faithfully portraying the internal spectrum of the perceived tinnitus. Method A and B were inspired by previous studies conducted on the internal characterization of tinnitus spectra. In [16,22] , patients were invited to match the loudness and rate the likeness of a series of elementary sound clips to their tinnitus. These sound clips were either pure tones or narrow band-pass noises centred on frequencies regularly spanning the region from 500 Hz to 14 kHz. In both studies, the subjective likeness of these sound clips was shown to roughly follow the auditory threshold of the subject. Methods A and B, devised so as to avoid any frequency-tuning task from the patient, systematised the relationship between the auditory threshold and the tinnitus spectrum. Unfortunately, from the scores collected in both test sessions 1 and 2, it can be concluded that, in their current state, methods A and B did not succeed in convincingly portraying the tinnitus' internal spectrum of the ten patients that have tried them. The attempt of method B to build the tinnitus avatar upon the asymmetry of the hearing threshold profiles did not show any evidence of merit. Method C which proposed a simpler stimulus profile centred on a single frequency, performed comparatively better. Although the stimulus proposed by method C was often judged to lack of complexity and to match only the dominant pitch of the tinnitus, the stimuli built by methods A and B did not automatically render a timbre comparable to the internal tinnitus spectrum.

However, a different approach may improve their behaviour. In the study of Roberts et al. [22] , for instance, it was observed that the likeness matches of pure tones or band-pass noise centred on increasing frequencies show a roll-off above 12 kHz. This property could be taken into account to weight the spectral profile of the sinusoid aggregate and the filtered noise components accordingly. Furthermore, methods A and B were using the defined frequency tones chosen for the audiogram to build the avatar. These predominant frequencies might not match the tinnitus frequency. The frequency steps of method C were not continuous but they were much smaller than one sixth of an octave (from 1 Hz step at 250 Hz to 80 Hz step at 17 kHz, with 5 Hz step at 1 kHz and 25 Hz step at 4 kHz), which allowed the patient to adjust the tone frequency with precision.

Methods A and B were derived from the hearing loss profile of the ipsilateral ear. In some studies, it has been a matter of debate whether the tinnitus' internal spectrum extends over the region of the auditory loss, or if it shows preponderance at or near its edges [20,27-29] . In Sereda's study, the hearing loss profile was determined by regression of the audiometric data. The edge of the hearing loss was defined as the break point of the regression where the audiometric data passed from clinically normal (< 20 dB HL) to impaired (> 20 dB HL). In the presented study, although some of the avatars were falling in the hearing loss (considering Sereda's definition) of the ipsilateral ear of the patient, others had their central frequency at the edge of near the edge of hearing loss. An alternative method could then propose to build the auditory profile according to the frequency derivative of the auditory threshold, in order to focus on the edges of the region of auditory loss. Such a method was implemented during this study but too few patients could test it to allow for its evaluation. However, this method would not have satisfied all patients as four of the patients had normal hearing threshold and no edge or slope or hearing loss could be established.

Test session 3 provided information on the consistency and stability of the tinnitus avatars tuned with method C,

within a one week interval. It was shown that the frequency tuning was fairly consistent between the two sessions, although the pitch of the second session was often tuned one octave (+/? 1/6 octave) above. Several studies [12,14,15,20] pointed out that procedure is important for pitch reproduction stability and octave error, especially because tinnitus matching often involves high pitch matching. Indeed, the human ability to recognize pitch interval was generally considered to degrade rapidly for pure tones above 4-5 kHz, although recent studies have shown that robust pitch information could be conveyed by complex sounds composed of harmonics that are all above 6 kHz [30] . To avoid octave error, Moore proposed a procedure that directed the patient close to the frequency region of the tinnitus. In [20] , the patient listened to defined tones from 0.25 to 8 kHz with one-octave interval and had to indicate the closest tone to his/her tinnitus. The matching task was starting from the selected frequency. However, even with this precaution, octave errors have been listed. In Moore's study, an external administrator was adjusting the frequency to carry out the characterisation of the tinnitus pitch. In our procedure, the patient was allowed and invited to freely span the all frequency range before starting to concentrate on one particular region. Even though a training task was introduced asking the patient to match two external tones in pitch (one tone had fixed frequency), it was not sufficient. The patient should be invited to check whether a pitch one octave higher would match his/her tinnitus' dominant pitch better. Then, the frequency region where the patient searches his/her tinnitus pitch should be limited.

Method C also seemed a good candidate to allow fusion between the tinnitus avatar and the tinnitus. Lackner demonstrated this phenomenon for four patients using pure tones, suggesting that the tinnitus reacted like an external sound [13] . In our study, such merging was observed for the majority of the patients (eight patient out of twelve) using a complex sound, provided that they were consistent in pitch matching. For those patients, it was also possible to steer the lateralisation of this percept by controlling the level of the tinnitus avatar only displayed in the contralateral ear. If confirmed, this would mean that the sub-cortical localisation process is preserved. For instance, the average slope of the lateralisation displacement as a function of the tinnitus avatar level was similar to that reported for the lateral displacement as a function of interaural level difference for normal hearing in dichotic conditions, i.e. 24 dB for a full lateral displacement from left to right [31] .

More intriguing was the significant negative offset of the lateralisation curve (?6.3 dB). Indeed, on average, the median position was obtained with a tinnitus avatar level significantly lower than the equal loudness level. One hypothesis is that this comes from the loudness interaction principle for interaural interaction between the two ears. It has been shown that when an intermittent sound (here the avatar) matches the loudness of a continuous sound (the tinnitus), the loudness of the continuous sound decreases [32] . Although further studies are needed to confirm this observation, it suggests a new approach to characterize the subjective intensity of the tinnitus, where its value would be obtained indirectly from a localisation task rather than a direct loudness evaluation might be relevant. Indeed, a task directly focusing on the tinnitus loudness may bring a general over-estimation as the subjective intensity may be emphasized through an attentional process [33] .

5 Conclusion

The present study aimed at synthesizing an auditory replica of a patient's tinnitus. The attempt to design methods that automatically build the tinnitus' spectral content upon the frequency profile of the patient's auditory threshold did not succeed in convincingly portraying the patient's tinnitus. At least, in their current state, these methods performed less well than a more conventional method based on the combination of a pure tone and a band-pass noise centred at an adjustable single frequency. Although lacking spectral complexity, such a simple tinnitus avatar already shows interesting perceptual properties, provided that the patient is able to match the central frequency consistently. Indeed, a consistent spectral matching, between the patient's tinnitus and the tinnitus avatar played back into the contralateral ear, elicits the spatial fusion between the subjective tinnitus and the external stimulus. Furthermore, adjusting the level of the tinnitus avatar in the contralateral ear can control the apparent lateralisation of this unique percept.

Acknowledgments

This research was supported by a Tinnitus Research Initiative Grant (PB 07 01) and by AMPLIFON France. S. Bertet received a grant from Fondation "Les Gueules Cassées". The authors wish to thank Paul Avan for useful comments on an earlier version of the manuscript.

PATIENT	ID	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Sex	F	M	M	M	M	M	M	F	M	M	Age
34	36	42	40	54	29	47	60	26	42	Tinnitus ear	R
R	L	L	L	R	R	R	L	L	A-METHOD	S/N (dB)	10
?90	0	?3	11	28	12	11	4	7	T (dBSL)	18	1
9	?9	4	8	2	6	0	26	B-METHOD	S/N (dB)	7	?13
?19	?6	?2	90	20	3	6	56	T (dBSL)	17	4	13
?1	5	1	3	?4	0	14	C-METHOD	Freq (Hz)	11970	11680	5156
14980	12187	17265	2792	10722	14433	13261	S/N (dB)	97	26	10	58
47	19	28	12	12	20	T (dBSL)	49	26	9	?14	8
0	5	?5	11	2	Preferred method	C	C	C	A	C	C

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Research on Method for Hearing Loss Simulation

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Publication info: International Journal of Advancements in Computing Technology 5.6 (Mar 2013): 845-851.
ProQuest document link

Full text: Headnote

Abstract
In order to improve the efficiency of hearing-aids arithmetic research, a method for hearing loss simulation is proposed. This method is divided into three main steps: frequency shaping, amplitude compression and full phase low-pass filtering. According to the patient's audiogram, frequency shaping can change the amplitude-frequency characteristics of speech, and then form the speech which is audible for hearing loss patients. Amplitude compression is used to compress the dynamic range of patients with sensorineural hearing loss. According to the hearing and pain threshold of hearing impaired subjects, the speech is piecewisely compressed. Especially, patients with hearing loss greater than 70dB may have total loss of their inner hair cell function. For this case, a method which passed the speech through the full phase low-pass filter is adopted. In the comparison test with hearingimpaired subjects, the method for hearing loss simulation has precisely simulated the characteristic of hearing loss for these patients. So this method can be used as an auxiliary method for hearing aids arithmetic research.

Keywords: Hearing Aids, Hearing Loss Simulation, Frequency Shaping, Full Phase Filter

(ProQuest: ... denotes formulae omitted.)

1. Introduction

Simulation technology is widely used in various fields[1,2,3]. Now it is rapidly growing in healthcare professions generally, both for teaching and conveying understanding of disability and disease conditions[4]. The necessary components for the development of such simulations in hearing healthcare-a sufficient understanding of the functional consequences of hearing loss and the technical capability to simulate them-are currently available for improved patient and family counseling, hearing conservation, and professional training.

Firstly, an effective simulation system can provide a realistic demonstration of both the communicative and psychosocial effects of hearing impairment. By listening to speech through the simulated loss, family members would immediately appreciate the importance of lip-reading and speaking clearly in assisting with and improving communication. They would also gain an understanding of the benefits that come with various hearing aid options. Such counseling would enable family members to partake more directly in hearing health decisions. Secondly, one mission of hearing conservation is to educate people about the risks of hearing damage and the protective measures available for minimizing that risk. An accurate and credible demonstration of hearing loss could be an effective motivator in industrial and military hearing conservation as well as public education programs. In these applications, a suitably designed and flexible hearing loss simulator would allow users to switch instantly between normal hearing and any degree of hearing loss. Thirdly, using simulations, students in audiology and deaf-education programs could gain valuable understanding by experiencing the disabilities with which they will work as clinicians and teachers. They would have the opportunity to explore different degrees

and types of hearing loss and to experience the effects of hearing aid options, either in the controlled conditions of a teaching laboratory or in the world outside the lab. Mainstream classroom teachers with deaf or hard-of-hearing students could likewise benefit from demonstrations of difficulties in communication and ways to improve it.

On both psychoacoustic discrimination tasks and speech-reception tests, results from impaired listeners are reasonably well-matched by normal-hearing subjects listening through a simulation that includes only threshold shiftand recruitment[5,6]. In 2006, Sensimetrics Corporation has developed HeLPS (the Hearing Loss and Prosthesis Simulator), a flexible and powerful nonimmersive simulation system designed specifically for audiologic use[7].

Although various hearing loss simulations have been developed over the years, none considers the dead regions at high frequencies as a defining characteristic for hearing loss simulation. Based on researches above mentioned, a method for the simulation of hearing loss is proposed. This method is divided into three main steps: frequency shaping, amplitude compression and full phase low-pass filtering. After the comparison test with hearing-impaired subjects, the method for hearing loss simulation can be used as an auxiliary method for hearing aids arithmetic research.

2. Method for Hearing Loss Simulation

The test speech was processed by three steps: frequency shaping, amplitude compression and low-pass filtering. Frequency shaping was used to simulate the hearing loss of patients according to the real patient's pure tone testing. Amplitude compression was used to restrict the patient's test speech energy according to the dynamic range of patient. Finally, low-pass filtering was used. Before the speech was given to patients, the full phase low-pass filter was adopted. The CF (Cut-offfrequency, CF) of the low-pass filter is set according to the edges of dead regions for hearing-impaired subjects, which ensured that there was no component above the CF within the test signals. This setting was only provided for patients who had dead regions in the high frequency region.

2.1 Frequency shaping

Loudness recruitment is the necessary characteristic for many hearing losses. For those losses that exhibit abnormal loudness growth, loudness recruitment must be included in the simulation. In the paper, frequency shaper is adopted. The principle of frequency shaping is to change the amplitude-frequency characteristics of speech, and then form the speech which is audible for hearing loss patients according to the patient's audiogram. Generally, the audiogram is tested according to 11 frequency points, so this experiment supposed that the hearing level between these frequency points varies linearly. The detailed steps are:

(1) According to the audiogram, the hearing levels $G(f)$ between two testing frequency point are set linearly.

(2) Then the FFT $X (f)$ of the original signal $x(n)$ is calculated, and the hearing levels within the corresponding frequency regions is subtracted from $X (f)$ to obtain $Y(f)$.

(3) Finally, the IFFT is performed on $Y(f)$ to get the frequency-shaped signal $y(n)$.

2.2 Amplitude compression

Many hearing impaired people with sensorineural hearing loss have a reduced dynamic range. Sometimes, the loud speech is acceptable for normal-hearing people, but for some hearingimpaired subjects it is too noisy and uncomfortable. So for high intensity speeches, it does not need to be amplified but to be limited. The hearing range of normal people is about 0~120 dB. Here, 0dB denotes the hearing threshold, while 120dB denotes the paint threshold. Normally, speech pressure level of 90dB makes people uncomfortable.

The typical linear amplitude compression curve is shown in Figure 1. From the figure, when the input signal energy Pin is lower than the threshold Pth, the output signal energy is the same as the input signal energy. The amplitude compression only acts when the input signal energy is higher than Pth. When it exceeds the paint threshold, the output signal energy will remain unchanged. Suppose g is the output gain, the relationship between the output signal $y(n)$ and the input signal $x(n)$ is:

... (1)
The relationship between the output energy and the input energy is F
... (2)
The calculation method for the output gain g is:
... (3)
2.3 Full phase digital filter
High-frequency hearing loss is the most common clinical hearing impairment, which may result from cochlear anatomy, auditory physiology, noise, ototoxic drugs, and age[8,9]. The hearing loss in about 90% children and young people is related with high frequency between 4 kHz and 8 kHz. When hearing losses in one region are higher than 70 dB, this region is called as 'dead region' which means a certain region of the cochlea with nonfunctioning inner hair cells[10]. For this issue, the full phase low-pass filter is adopted. Individuals with no dead regions should obtain a benefit from high-frequency amplification, whereas individuals with dead regions may show no benefit from high-frequency amplification[11,12]. Full phase filter can effectively improve the degradation performance caused by the data truncation. Full phase filter considers all data truncation problem, and then process them respectively. Finally, the processing results are synthesized to obtain the output signal. This method effectively suppresses the spectral leakage problem caused by the data truncation, which make the filter process more continuous. So comparing with traditional filter design method, the full phase low-passing filter has the steep transition zone, big stop-band attenuation and good pass-band ripple. Especially, the full phase characteristic makes each channel signal have no phase distortion after filtering, and then more accurately maintain the amplitude and phase information of the original signal in each channel. Furthermore, the design process is easy to realize.
Similar to traditional method, full phase DFT is also based on frequency sampling. But this design method can more precisely control the frequency response of sampling points. The design steps are[13]:
(1) According to the design requirement, the ideal frequency response ( ) g H w of the zerophase FIR is selected. By zero-phase conditions, its amplitude frequency characteristics are even symmetry with ω=0, π, 2π.

(2) According to the requirements of the CF accuracy and implementation complexity, the length M =2N-1 of full phase DFT digital filter ( ) N h n is set.
(3) ( ) g H w is equally spaced sampled between the interval of [0 ,2π]. Here, the frequency sampling point ω is equal to 2πk/ N (k =0,1,...,N-1) , so the filtering response is:
... (4)
(4) The zero-phase filter ( ) N h n is:
... (5)
3.Simulations
3.1 Subjects
Six hearing-impaired adults, one woman and five men (age: 18-64 years), participate in the study. They were experienced hearing aid users and recruited from the Medical School of Southeast University. Relevant information about all the subjects is provided in Table 1. Their hearing threshold levels, measured via the Interacoustics AD226 audiometer, are shown in Table 1. In addition, six normal-hearing students, two woman and four men (age:20-30 years), also participate in the study. Subjects are not paid for their participation in the experiments. The participation of the subjects in these experiments is in accordance with the 'Guiding principles for research involving human or animal subjects'.
Although there were only six patients in the test, their causes for hearing loss were representative. As shown in Table 1, subject 1 and subject 5 were presbycusis, so their hearing level was gradually decreasing in both ears. The cause for subject 3 was the near constant exposure to the high noise levels, so his level had a V-notch at 6000Hz. The hearing level of drug-induced deafness had a steep drop for both ears, which was in accordance

with that of subject 2. The curve of hearing-impaired patients with congenital or hereditary hearing loss was relatively flat, which was suitable for subject 4 and subject 6. Furthermore, subject 2 and subject 3 had steeply sloping hearing losses.

3.2 Simulations for signal processing

The content of the test speech is "na shi li zh.ng shang y.u d. y. zh.ng shu, b. zh. d. zh., b. zh. d. gan". Every process procedure which simulates the hearing loss of the subject 3 is shown in Figure 2.

3.3 Pure-tone test

Figure 3 shows thresholds for the 6 hearing-impaired subjects for 11 pure-tone signals between 125 and 8000 Hz. Each subject has moderate-to-severe high-frequency hearing loss, with varying degrees of hearing impairment in the low and middle frequencies. Six normal hearing subjects' broadband thresholds were matched to each of the six hearing-impaired subjects' quiet thresholds. To illustrate the precision of the threshold matching, comparisons between normal-hearing listeners and hearing-impaired listeners are shown in Figure 3. The root mean square errors between the normal listener's 11 broadband thresholds and the corresponding hearing-impaired listener's quiet thresholds are also included in each panel.

4.Conclusion

The paper was designed to improve client/family understanding of both hearing loss and available treatment options. The method is divided into three main steps: frequency shaping, amplitude compression and full phase low-pass filtering. Results in pure tone test between normal hearing subjects and hearing-impaired subjects are almost the same. So this method can be a valuable demonstration tool for audiologists working in family counseling, aural rehabilitation, hearing conservation, or professional education.

5.Acknowledgements

The work was supported by the National Natural Science Foundation of China under Grant No. 61273170 and No. 61201326, the Natural Science Fund for Higher Education of Jiangsu Province under Grant No. 12KJB510021 and Changzhou Science and technology Support Program (Industrial) under Grant No. CE20120101.

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The use of fractal tones in tinnitus patient management

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Publication info: Noise & Health 15.63 (Mar 2013): 96-100.
ProQuest document link

Abstract: A variety of noises have been employed for decades in an effort to facilitate habituation, mask, or suppress tinnitus. Many of these sounds have reportedly provided benefit, but success has not been universal. More recently, musical stimuli have been added as a sound therapy component. The potential advantages of using such stimuli, in particular fractal tones, in combination with amplification are discussed in this paper.

Full text: Introduction
Knowledge of tinnitus has progressed over the past two decades from considering tinnitus as a symptom of an ear disorder to the current belief that the generation of tinnitus perception and tinnitus distress, is a function of the brain. This concept has been validated not only by the fact that surgical destruction of the auditory nerve does not necessarily remove the perception of tinnitus, [1],[2],[3] but also by an increasing number of neuroimaging investigations [4],[5],[6] demonstrating widespread activation of neural structures. It is also believed that a key factor in many, if not most, instances of tinnitus is reorganization (neural plasticity) and an increase in central nervous system activity (gain) as a consequence of peripheral attenuation. [7],[8] In fact, the vast majority of individuals with chronic tinnitus show at least some degree of hearing loss. [9] Several investigations have demonstrated hyperactivity within auditory pathway structures such as the dorsal cochlear nucleus and the inferior colliculus. [10],[11],[12]
Attempts have been made to restore this missing acoustic stimulation, at least partially, via amplification,

filtering, or other means in order to overcome the lack of appropriate stimulation from the ear to the damaged frequency regions in the auditory cortex. Numerous studies have demonstrated various degrees of benefit provided by amplification. [13],[14],[15] There are a number of reasons why hearing aids might be effective in providing relief from tinnitus. Among them are the beliefs that greater neural activity may allow the brain to correct for abnormal reduced inhibition due to outer hair cell damage; an enriched sound environment provided by amplification may minimize maladaptive cortical reorganization; amplification of ambient noise may partially mask tinnitus and is likely to reduce the contrast from tinnitus perception to quiet; and fatigue and stress created by the requirement of extra listening effort may be reduced thus allowing more resources to be allocated to tinnitus coping mechanisms. All of these may facilitate habituation. Furthermore, since the majority of tinnitus sufferers have at least some degree of hearing loss and advances in digital technology allowing for open fittings have expanded the lower range of amplification candidates, hearing aids are frequently a common choice for relief. In the recent Kochkin et al., 2011 study, [16] of nine tinnitus treatment methods assessed (hearing aids, music, medication, relaxation exercises, counseling, non-wearable sound generators, herbs and dietary supplements, wearable sound generators, and psychological counseling), the most substantial tinnitus amelioration was achieved with hearing aids (34%), followed by the use of music (30%). None of the other treatments achieved an efficacy rating of more than 10%.

There are three distinct goals for sound therapy. The ultimate objective is to completely suppress the tinnitus, while a less gratifying, but still effective (and realistic) goal is to facilitate habituation (the process of adapting to a stimulus thorough repeated exposure). With habituation, either the perception of the tinnitus, or the reaction to the tinnitus is greatly, if not fully, diminished. [17] The third option is to provide total or partial masking. [18] Total masking occurs when an external sound is perceived as being louder than the tinnitus, rendering it inaudible when in the presence of the masking stimuli. Partial masking occurs when the loudness of the tinnitus is reduced, but not eliminated by the masker. In addition, masking may divert the patient's attention. Masking employs a narrow band of noise centered around the perceived pitch of the tinnitus in an attempt to provide relief by either completely or partially obscuring the patient's perception of the tinnitus. However, many advocates of behavioral retraining therapies consider full masking of tinnitus to be counterproductive, since for long-term habituation to occur, the stimulus has to be perceived during training. [17] In addition, masking can interfere with hearing or produce too much distraction. Furthermore, it may only work for a tonal type tinnitus, because if a noise is employed, either broadband or narrow band (in order to limit the overall loudness), it may sound too similar to a "hissing" tinnitus. However, perhaps the greatest limitation of masking is that it typically cannot be constantly or permanently sustained. Therefore, while noise was once considered the most common form of acoustic tinnitus management, other auditory stimuli that can mask or mingle with tinnitus are now being increasingly recommended, utilized, and researched for their long-term benefits.

Sound therapy is not universally effective. However, the actual benefit from sound therapy remains somewhat elusive. Meta analyses have been conducted on the use of sound therapy. In the Cochrane review [19] six trials (553 participants) were analyzed. They concluded that no significant change was seen in the change in loudness or the overall severity of tinnitus following the use of sound therapy compared to other interventions such as patient education, relaxation techniques, tinnitus coping strategies, counseling, tinnitus retraining and exposure to environmental sounds. The authors stated that "the lack of quality research in this area, in addition to the common use of combined approaches (hearing therapy plus counseling) in the management of tinnitus are, in part, responsible for the lack of conclusive evidence." Other studies. [20],[21] (primarily from the psychology literature) have indicated a small, but significant benefit from the addition of sound therapy to other approaches. At least one author [22] has indicated that "virtually all sound therapies are combined with some form of counseling." Thus, differences in the benefits reported from sound therapies may relate, at least in part, to the effectiveness of counseling, and it is certainly possible that personality characteristics of the patient and perceived psychoacoustic characteristics of the tinnitus may play a yet undefined role.

The purpose of this paper is to propose the use of music, and specifically, unfamiliar music in the form of fractal tones, as a sound therapy tool and to analyze the rationale and considerations that one might contemplate in selecting specific musical stimuli for sound therapy.

Music is considered a reasonable acoustic stimulus for sound therapy since many of the most commonly reported problems occurring as a consequence of tinnitus relate to increased stress and difficulties relaxing, concentrating, and sleeping. [23] A recent study was conducted examining the relative impact of stress and noise exposure (one of the most frequent causes of tinnitus) on the probability of having tinnitus. The authors reviewed over 2,000 tinnitus patients and concluded that while exposure to both noise and stress were important for the probability and level of tinnitus discomfort, stress was the more important factor in determining whether a patient would transition from being mild or severely impacted. [24] It has also been reported that long-term stress and coping strategies were the strongest predictors of tinnitus, even stronger than traditional risk factors such as hearing loss, age, gender, and hyperacusis. [25]

The use of music for setting and altering moods, arousing, and relaxing, is certainly not new. Music is commonly employed in homes, work environments, celebrations, advertisements, romances, movies, athletic locker rooms, shopping malls, and hospitals to soothe, relax, energize and engage. Additionally, music has been actively, and increasingly, employed as a therapeutic treatment for a number of physical and psychological ailments. [26] Advances in neuroscience and neural imaging have provided a greater understanding of the effects of musical stimuli on the brain and human behavior, including stress. Knowledge about the site of stimulation, neural interactions, and transfer of neural transmitters help explain the behavioral consequences, both positive and negative, of exposure to music. Listening to music can result in physiological changes correlated with relaxation and stress relief. [27] One reason music is believed to be helpful in reducing stress is because of the wide range of neural structures that are activated including the cerebellum, frontal lobe, limbic system, and auditory cortex. Each of the areas has been identified as being involved in tinnitus perception. [28],[29]

Moreover, music is an easy stimulus to alter and certain "rules" have been established about patterns of musical elements, such as slow onset, slower tempo, lower pitch, degree of repetition, and lack of emotional content that, if followed, can produce a desired calming, rather than alerting, effect. [30],[31],[32] Studies have shown that listening to certain types of musical stimuli induces relaxation and heightened concentration in some individuals, but not in others. [33] Active listening tends to arouse, passive listening tends to soothe. Active listening may distract, passive listening may allow for increased relaxation. It has been recommended that music used for tinnitus management should evoke positive feelings, should be void of vocals, should not contain pronounced bass beats, should be pleasant, but not too interesting or compelling (though for short-term relief attention capturing music can be beneficial), should induce relaxation while reducing tinnitus audibility (best for long-term relief), and should be played at low levels where music blends with tinnitus. [34],[35] Other suggestions indicate that if music is to be relaxing, it should have a tempo near or below resting heart rate (60-72 beats/min); have a fluid melodic movement, contain a variety of pitches, be self-selected, not have rapid amplitude changes, [36] and contain an element of uncertainty. [37] In addition, the fact that sounds (including music) affects people in different ways, due to inherent, learned (and cultural) preferences, should be taken into consideration.

While music was identified as a preferred "masker" for tinnitus in 1988, [38] perhaps the first widespread employment of music for tinnitus relief was proposed by Davis, et al., [39],[40],[41] and commercialized by Neuromonics. This approach incorporates a counseling component and a sound therapy component consisting of four pre-recorded music passages that are filtered in accordance with the individuals' hearing loss and delivered via an MP3 player coupled to high fidelity, non-occluding earphones. Many of the principles mentioned above (for example, a relatively slow tempo with no sudden changes in amplitude) to induce relaxation have been utilized in the selection of the pre-recorded musical passages. More recently, Okamoto et al., [42]

proposed a very different music therapy. It differs from the Neuromonics approach in that it removes (notches) the music out of the frequency regions associated with the tinnitus rather than increasing the intensity in accordance with the hearing loss. In addition, rather than using pre-selected music, it allows the listeners to select music based on their own preference.

While success has been reported success for both approaches, there are potential limitations. In the Neuromonics approach, the patient has only limited choices in the stimuli. This may become a liability if the patient becomes bored or bothered by the repetition of the music. For both therapies, the use of previously recorded music may have an undesired impact on stress reduction because familiar music could evoke memories and potentially negative emotions [34] or create unwanted distraction. From a practical perspective, since somewhat visually obtrusive headphones (including cords) are currently used in these approaches, some individuals may not be able to use the processor at times where headphones may be considered inappropriate, such as during work. This restriction could perhaps be resolved with the future use of wireless technology.

Another potential limitation is that while the Neuromonics processor modifies the musical signal to compensate for hearing loss, it only provides this stimulation during the limited time it is worn each day (2-4 h is suggested). It does not provide amplification of external stimuli to compensate for the hearing impairment. As stated earlier, current theories suggest that tinnitus generation may result from the peripheral attenuation of auditory input. [11] This attenuation provokes an increase in central auditory system activity from the dorsal cochlear nucleus through the auditory cortex, as well as a coupling with the limbic system (particularly the hippocampus and amygdala) via collateral connections from the thalamus and other structures. [4] Stimulation of the thalamus results in release of neurotransmitters, including adrenaline, to produce an autonomic nervous system response associated with stress. [43]

An alternative approach that incorporates the benefits and rules of music but avoids these potential limitations is the use of fractal tones. Auditory fractal tones utilize harmonic, but not predictable relationships, and are generated by a recursive process where an algorithm is applied multiple times to process its previous output. [44] The tones (which sound somewhat like wind chimes) are pleasant, but are not associated with music that the listener may hold in memory. They create a melodic chain of tones that repeat enough to sound familiar and follow appropriate musical rules, but vary enough to not be predictable. In addition, the algorithm ensures that no sudden changes appear in tonality or tempo.

The potential application of fractal tones delivered via high-fidelity hearing aids was explored in an experiment to determine if the presence of various acoustic stimuli, including fractal tones, would (1) be perceived as relaxing to tinnitus patients, (2) reduce short term tinnitus annoyance, and (3) lower subjective tinnitus handicap and reaction scores in a 6 month field trial. [45] The experimental protocol allowed for a comparison of fractal tones alone, fractal tones combined with amplification, broadband (white) noise alone, white noise mixed with amplification, and fractal tones along with amplification and white noise.

Results indicated that fractal tones were effective in promoting relaxation and reducing annoyance from tinnitus. Similar results were also reported by others. [46],[47] Both fractal tones and white noise reduced tinnitus annoyance (white noise to a greater degree than the fractal tones, likely due to greater masking effects), but the fractal tones were preferred by subjects for longer term use for reasons discussed below. In addition, while the majority of subjects selected slower tempos for relaxation and long-term wear, this choice was not unanimous. This underscores the benefit of providing the individual listener with choices. [48] Individual preferences for certain types of acoustic stimuli were also emphasized in the Henry et al., [49] study in which they reported most, but not all, of their participants clearly preferred certain stimuli over others.

The Sweetow and Sabes results [45] agreed with the Henry et al., [49] data in that their subjects showed a preference for stimuli that were modulated in both the spectral and temporal domains. In the latter study, subjects were presented with a variety of noises and environmental sounds that were filtered and modulated. They found that most, but not all, of their subjects had clear preferences for certain stimuli over others, and

most preferred were those that were modulated or temporally varying as opposed to steady state (i.e., pure tones, or filtered or broad band-noise) signals. Modulated signals are characteristic of fractal and other musical stimuli. Reavis, et al., [50] indicated that electrical and acoustic suppression was achieved most effectively using dynamically modulated signals. Their results confirmed the conclusions of others. [51],[52] that temporally patterned sounds such as amplitude and frequency modulated signals may produce highly synchronized and robust cortical responses as opposed to steady state sounds, which produce mostly onset and offset responses in the cortex, and thus may be a more attractive stimulus for this cortical effect. Zeng et al. [53] also suggested that the temporal characteristics of an electrically generated signal are critical to suppression. Sounds that are too slow produce bursts of activity and those that are too fast show no synchronization, but within a specific range the neurons fire synchronously to the sound stimulus and can produce synchronized, robust neural activity in the auditory cortex. It is possible that there are also optimal properties for an acoustical signal designed for tinnitus relief, though this has yet to be verified.

Preferences for modulated stimuli (as opposed to steady-state signals) for tinnitus relief, may be part of the reason why noise masking has fallen out of favor among some practitioners as an acoustic tinnitus treatment, in addition to the fact that noise does not have the inherent value of inducing relaxation. Interestingly, in the Sweetow and Henderson-Sabes study, noise (similar to the faster tempo fractal tones) reduced short-term annoyance more than other stimuli. The likely cause for this finding was that the steady state noise and faster rhythm provided for more masking because of the shortening (or complete lack) of inter-stimulus intervals. However, only two of the participants opted to have the noise only as a program during the 6 month wearing of the hearing aids, and none of them selected the noise only condition as their preferred setting. This too, may be related to the belief that noise may lack the inherent stress-reducing and relaxation inducing characteristics of music. Thus, the combination of tinnitus annoyance reduction and increased relaxation may be an important factor in long-term acceptance.

Although fractal music differs from conventional music in terms of its familiarity, similar preferences for using music for relaxation and tinnitus sound therapy appear to apply. This includes the finding that sudden variations in amplitude can be disconcerting and counterproductive for sound therapy, lower pitches were found to be more relaxing than higher pitches, and slower tempos were preferred over faster tempos. In addition, subjects preferred major chords rather than minor chords. [45] Subjects in the Hann, et al., [34] investigation compared four well-known baroque musical passages, Bach's Air in G, which is also one of the pre-recorded musical passages contained in the Neuromonics protocol, Albinoni's Adagio, and two of Vivaldi's Four Seasons. Their conclusion was that the major mode was the common musical element for preference. This is consistent with the elements of music most associated with a positive emotional response. [30],[31]

Presenting musical stimuli via hearing devices offer some obvious advantages. For example, the hearing deficit can be compensated for by applying the algorithm of the hearing aids to the fractal tones, a potential advantage over pre-recorded CDs. In addition, modern hearing aids are less conspicuous than wearing headphones, particularly those requiring a wired connection to a MP3 player. However, if musical, or other acoustical stimuli are going to be incorporated into hearing aids (so-called combination devices) one must consider whether the limitations of the devices themselves, in particular, bandwidth and dynamic range, create restrictions. Previous investigations [49] may shed some light on this question. In this study, the majority of subjects preferred the amplitude modulated sounds over the filtered white noise sounds even though the latter stimuli contained several tracks extending to 14 KHz, well beyond the capability of modern hearing aids. Thus, the bandwidth limitations of current hearing aids may not be a critical drawback. Hearing aids have inherent restrictions on dynamic range since their primary purpose is amplifying speech (as opposed to MP3 players or other recording devices). Rather than producing a potential decrement to sound therapy for tinnitus, Hann et al., [34] suggest that minimizing the dynamic range is actually a desirable component of sound therapy for tinnitus patients. Considering the fact that hearing impaired patients have loudness recruitment, and many further suffer from

hyperacusis, it makes sense that certain tinnitus patients do not wish to be exposed to high intensities. The use of hearing aids with low compression knee points may be of benefit because they will provide additional amplification for very quiet environments, while still offering separate regulation for gain and output for high input intensities.

Conclusions

Musical stimuli may provide a different, and in some cases, superior option for sound therapies. The use of amplification, combined with flexible music-like signals containing relaxation inducing properties may be a further asset to tinnitus management procedures.

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No cochlear dead regions detected in non-pulsatile tinnitus patients: An assessment with the threshold equalizing noise (sound pressure level) test

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Publication info: Noise & Health 15.63 (Mar 2013): 129-33.
ProQuest document link

Abstract: One of the hypotheses on the etiology of non-pulsatile tinnitus in normal or hearing impaired patients is the existence of sharp edged cochlear dead regions (DR) flanking normal functioning hair cells. The lack of inhibition of DR on the neighboring neurons may lead to hyperactivity. Currently the Threshold Equalizing Noise test (TEN test) is the reference test to clinically assess cochlear DR. To identify cochlear DR in patients with non-pulsatile tinnitus with and without hearing loss using the TEN (sound pressure level)-test. Data were obtained from adult patients with non-pulsatile tinnitus visiting the Tinnitus Clinic of the University Hospital Antwerp. The TEN (SPL)-test was performed to assess the presence of cochlear DR for test frequencies ranging from 0.5 to 8 kHz. A total of 55 ears of 33 subjects (15 male; 18 female) with non-pulsatile tinnitus were included in the study. Subjects were divided into subgroups based on the audiometric configuration of hearing loss: Flat configuration (N = 23), high-frequency gently sloping (N = 10) and high-frequency steeply sloping (N = 22). In forty-eight ears there was no evidence of cochlear DR. In seven ears the results were inconclusive. This occurred in patients with high-frequency steeply sloping audiogram configurations. The present study does not support the TEN (SPL) test as a reliable tool for the detection of cochlear DR in a tinnitus population.

Full text: Introduction
A dead region (DR) can be defined as a region in the cochlea where the inner hair cells (IHCs) along the basilar membrane and/or neurons are non-functioning or missing, resulting in the absence of basilar membrane vibration transduction to the brain at those places. [1],[2] This does not mean that a particular tone is not audible. A tone producing peak vibration at a particular place on the basilar membrane can be detected by off-place or off-frequency listening provided that the stimulus is sufficiently loud. The tone will not be detected at its usual place on the basilar membrane but at an adjacent place where the IHCs are functioning more effectively. [2],[3] The extent of a DR can be defined in 2 manners: Either by distance along the basilar membrane,

described by the characteristic frequencies related to this place (e.g., a DR extending from 4000 to 10 000 Hz), or by the characteristic frequency (CF) of IHCs or neurons adjacent to the DR. [2] The presence of a DR can result in several problems such as abnormal pitch perception, [4] rapid loudness growth, [5] and distorted perception of pure tones. [6] In order to diagnose cochlear DRs, the Threshold Equalizing Noise (TEN) test was developed. [7] In this test a broadband masking noise (the TEN) is used which is spectrally shaped so that all auditory output filters contain an equal noise power. This means that, for subjects with normal hearing thresholds, the masked threshold for a pure tone is the same for all frequencies over the range of 250-10 000 Hz. More specifically, the TEN level is specified as the level in a one-Equivalent Rectangular Bandwidth N (ERB N) (132 Hz) wide band centered at 1000 Hz, where ERB N stands for the average of the auditory filter as determined for young normal-hearing subjects at moderate sound levels. [2] For example, if the TEN noise is presented at a dial level of 70 (corresponding to 70 dB/ERB), then thresholds, for normal hearing subjects, across a wide frequency range, measured in this noise should also be 70 dB SPL. [Figure 1] [2] illustrates the principle of the TEN test. Looking at the top panel, the solid curve represents the basilar membrane vibration pattern for a pure tone with a CF of. [1] 5 kHz, expressed by the maximum vibration at that frequency. The shaded area reflects the presence of a high-frequency DR starting at approximately 1.07 kHz. To measure absolute thresholds for frequencies below 1.07 kHz, 40 dB of basilar membrane vibration is needed (long-dashed line). As indicated by the short-dashed line, the absolute threshold value of a 1.5 kHz tone (which falls within the DR) is 67 dB. A threshold is measurable because of the intact IHC's adjacent to the DR (= off-frequency listening). In the bottom panel a TEN of 70 dB/ERB N is added masking the 1.5 kHz tone at 67 dB. To make the tone audible again the level has to be increased so that basilar vibration just below the 1.07 kHz DR slightly exceeds 70 dB. A level of 97 dB is required in order to achieve audibility of the tone again. A normal hearing subject with no DR would have a masked threshold of approximately 70 dB. This figure shows that for the person with a DR, the masked threshold was 30 dB higher than the unmasked threshold (97 dB vs. 67 dB) and that the masked threshold was 27 dB higher than in the case where there was no DR (97 dB vs. 70 dB). This last remark demonstrates the two criteria that need to be fulfilled to determine a DR: (1) at least 10 dB of masking is required and (2) the masked threshold should be at least 10 dB higher than normal. [2] There are currently two commercially available TEN test versions: the TEN sound pressure level test (TEN-SPL) and the TEN hearing loss level test (TEN-HL). [2] They differ in 3 ways: Frequency range tested, amplitude characteristics of the TEN noise and the calibration. The TEN (SPL) test is calibrated in dB SPL and covers a frequency range of 250-10 000 Hz. The TEN (HL) test is the modified version of the TEN (SPL), calibrated in dB HL which is easier to interpret as the audiometer is also calibrated in dB HL. The frequency range of the TEN (HL) is narrowed to 250-4000 Hz and the TEN noise contains a lower crest factor. The present study aims to investigate whether cochlear DRs are more prevalent in patients suffering from tinnitus. Tinnitus, the perception of sound in the absence of an external acoustic sound source, poses a clinical problem for millions of people around the world. [8] The understanding of the pathological mechanism of tinnitus generation remains in the stage of hypothesis and conjecture. One of the hypotheses on the etiology of non-pulsatile tinnitus is the existence of sharp edged cochlear DRs flanking normal functioning hair cells. The lack of inhibition of DRs on the neighboring neurons may lead to hyperactivity. Previous studies showed that tinnitus in the absence of measurable hearing loss at all frequencies or at the tinnitus frequency does not exclude cochlear/neural damage. [9] Previously the detection of DRs was reported in eight out of eleven subjects with normal hearing and non-pulsatile tinnitus, [10] providing evidence for the theory that deafferentiation is also possible in tinnitus subjects with audiometrically normal hearing thresholds. In the present study we used the TEN (SPL) test in order to assess cochlear DRs in an adult population with non-pulsatile tinnitus and various audiometric configurations.{Figure 1}

Methods

Subjects

Thirty-three patients presenting with non-pulsatile tinnitus in the University Hospital Antwerp (UZA) underwent the standard otorhinolaryngologic (ORL) and audiometric protocol for tinnitus. In addition, the TEN (SPL) test was performed in tinnitus ears only. The group consisted of fifteen male and eighteen female patients with a mean age of 51.7 +- 16.2-years-old (range 20-73). Twenty-two patients suffered from bilateral tinnitus while eleven patients perceived a unilateral tinnitus in either the right or left ear.

Pure-tone audiometry

All patients received visual inspection of the eardrum by an ORL-specialist. In addition, tympanometry was normal in all subjects so middle ear pathologies were excluded. According to current clinical standards (ISO 8253-1, 1989), air conduction threshold were measured at 125, 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz using a 2-channel Interacoustics AC-40 audiometer in a soundproof booth. Bone conduction thresholds were measured at 250, 500, 1000, 2000, 3000 and 4000 Hz. All the patients included in this study had a normal hearing or a sensorineural hearing loss (SNHL) as the air-bone gap never exceeded 10 dB HL. For all the analyses only those ears in which tinnitus was perceived were included in this study. Tinnitus ears were divided into 3 categories in accordance with Demeester et al., (2009): A flat configuration, a high-frequent gently sloping (HFGS) configuration and a high-frequent steeply sloping (HFSS) configuration. To be categorized as a flat configuration, the difference between the mean thresholds of 250/500 Hz, the mean of 1 kHz/2 kHz thresholds, and the mean of 4 kHz/8 kHz should be less than or equal to 15 dB. A HFGS configuration is defined as an audiogram where the difference between the mean of 500 Hz/1 kHz thresholds and the mean of 4 kHz/8 kHz thresholds is greater than 15 dB but less than 29 dB. Finally, a HFSS configuration is present when the difference between the mean of 500 Hz/1 kHz thresholds and the mean of 4 kHz/8 kHz is 30 dB or more. [11] Of all tinnitus ears, 24 were categorized with a flat, 10 with a HFGS, and 21 with a HFSS configuration.

Tinnitus analysis

A Dutch validated version of the Tinnitus Questionnaire (TQ), [12] was completed by the majority of patients (four patients did not complete the questionnaire). The TQ was originally published by Goebel and Hiller. [13] who described the TQ as a global index of tinnitus-related distress. Based on the total score on the TQ, patients are assigned to a distress category: Slight (0-30 points: Grade 1), moderate (31-46 points: Grade 2), severe (47-59 points, grade 3) and very severe (60-84 points, grade 4).

Secondly, patients had to score their tinnitus loudness on a Visual Analogue Scale (VAS) going from 0 (no tinnitus) to 10 (tinnitus extremely loud). Finally, tinnitus pitch and intensity were determined through tinnitus analysis using pitch matching and loudness matching procedures.

Threshold equalizing noise (SPL) procedure

The TEN (SPL) test was performed in all fifty-five tinnitus ears using an original TEN (SPL) CD played by a CD player (Sony CDP-XE270) and presented through a TDH-39 supra-aural earphone. First, the audiometer was connected to the CD player output plug. Input channel 1 on the audiometer was selected on the left side, and channel 2 was selected on the right side. The first track on the CD, a calibrating tone, was played continuously and both volume unit (VU) meters were adjusted to read 0 dB. Absolute thresholds were measured using a final 2 dB-step size to determine the threshold. Subsequently, the TEN was presented with a level of 70 dB and the masked thresholds were measured in a similar way. In case the absolute thresholds of a patient were 60 dB SPL or worse, the level of the TEN was raised. Therefore, the TEN provided at least 10 dB of masking at all times. A DR was considered present if the following criteria were both met. [7]

The masked threshold is at least 10 dB worse than the absolute thresholdThe masked threshold is at least 10 dB worse than the masking noise (TEN)The results were categorized as positive (DRs present), negative (no DRs present) or inconclusive. Several situations can cause inconclusive results. Firstly, it may be impossible to produce 10 dB of masking in patients with severe or profound SNHL because the maximum output of the audiometer is reached. Therefore, the intensity of the TEN will not cause sufficient masking. Secondly, when the

TEN level was considered as too loud by the patient, the level was lowered and did not provide sufficient masking, leading to inconclusive results. Finally, absolute and/or masked thresholds could not be measured in some patients with profound hearing loss at certain frequencies because of output limitations of the audiometer.

Results

The audiometric results are represented graphically in [Figure 2] where mean absolute hearing thresholds of patients with a flat (N = 24), a HFGS (N = 10) and HGSS (N = 21) are shown. A full tinnitus analysis was performed on 31 ears of 21 patients (10 with bilaterally tinnitus, 11 with unilateral tinnitus). [Table 1] shows the results of the tinnitus analysis after pitch matching as well as the tinnitus type (pure tone or noise-like). In addition, [Table 2] shows the scores for VAS and TQ. The majority of patients experienced a high-pitched tinnitus and mostly a noise-like character. The tinnitus loudness was scored on a VAS by nineteen of the thirty-three patients (of which in 11 patients with bilateral tinnitus, the VAS was also scored bilaterally). Tinnitus intensity was measured in 26 patients and 29 patients completed the TQ of which eight patients were categorized with a degree 1, 10 with a 2 nd degree, 9 with a 3 rd and 2 with a 4 th degree. Because of time shortcomings in the daily clinical practice, all (TQ, VAS and tinnitus analysis) were not always done completely. Therefore, [Table 1] and [Table 2] do not contain data of all ears of all patients on which the TEN (SPL) was applied. In patients suffering from bilateral tinnitus, the TEN (SPL) test was performed in both ears. In patients with unilateral tinnitus, TEN (SPL) was performed in the affected ear only. [Figure 3] shows the mean masked threshold per frequency in 70 dB SPL of TEN (or more in subjects where the unmasked threshold exceeded 60 dB SPL). The mean masked thresholds were 10 dB SPL or more better than the 'normal' masked threshold (which would be 70 dB SPL in 70 dB TEN) for all frequencies meaning that the tone was audible even at a level much lower than the TEN level. As one of the criteria for a DR states that the masked threshold should be at least 10 dB worse than the unmasked threshold, no DRs were found in these patients. Therefore, the outcome of most TEN (SPL) tests were negative. Nevertheless, four patients showed inconclusive results at certain frequencies. In one patient with a symmetric HFSS audiogram configuration and bilateral non-pulsatile tinnitus, the unmasked threshold could not be measured bilaterally upwards from 2 kHz because of audiometer output limitation as the unmasked threshold exceeded 120 dB HL. In three other patients with a HFSS configuration (two patients with bilateral tinnitus and one with unilateral tinnitus), the unmasked threshold were measured but the TEN noise could not be set loud enough to provide sufficient masking. Therefore the results in these patients remained inconclusive for a DR located in the high frequencies. An oversight of inconclusive results along with the reason of inconclusiveness is given in [Table 3].{Figure 2}{Figure 3}{Table 1}{Table 2}{Table 3}

Discussion

It has been suggested that tinnitus is often accompanied by severe (IHCs damage in certain cochlear regions, even in the absence of measurable hearing loss. [9],[10] Severe IHC damage causes deafferentiation and therefore DRs in the cochlea. In the present study tinnitus patients with different audiometric configurations and hearing thresholds (going from normal hearing to profound hearing loss) were tested for DRs by use of the TEN (SPL) test. In the study of Weisz et al., (2006) a normal hearing student population suffering from tinnitus was tested of which eight out of eleven subjects were identified with a DR. [10] In another study, in which the TEN (HL) test was applied, 15% of tinnitus patients with normal hearing sensitivity had positive TEN results, indicative for a DR. [14] In our normal hearing subjects with tinnitus (N = 16 ears), no DRs were identified. It has been reported earlier that it is more likely that IHC damage/loss is involved in subjects where the hearing loss exceeds 55 to 60 dB. [15] Furthermore, it has been found that a DR is more prevalent in subjects with a hearing loss exceeding 55 to 60 dB SPL. [3],[14] In addition, severe high-frequency hearing loss or high frequency steeply sloping audiograms are more associated with DRs and positive TEN findings. Several studies found a greater prevalence of DRs in subjects with a steep slope. [3],[16] The present study was not able to confirm these findings as also those ears with a HFSS audiogram configuration (N = 22) showed negative TEN results.

However, as mentioned earlier and elucidated in [Table 3], in four patients with a HFSS configuration, unmasked or masked thresholds could not be obtained in seven tinnitus ears because of audiometer output limitations. Here the TEN findings remained inconclusive. The problem of the amount of inconclusive results of the TEN (SPL) test has been previously reported by Hornsby and Dundas (2009) where in 80% of the ears inconclusive results were found for at least one frequency and 30% at three frequencies or more. [3] Vinay and Moore (2007) also noted that it is more likely to have inconclusive results when the audiometric thresholds exceed 85 dB HL. [14] The TEN (HL) test can be presented at higher levels without distortion and might therefore reduce the amount of inconclusive results. [2] Nevertheless, in the present study, the TEN (SPL) was deliberately chosen over the TEN (HL) because of the wider frequency range. Furthermore, as tinnitus analysis showed that most patients included in this study, perceived a high pitched tinnitus, we were especially interested in the cochlear preservation at those frequencies. Thirty-two ears of the patients included in the present study, were characterized as a HFGS (N = 10) or a HFSS (N = 22) configuration. As mentioned before, patients with high-frequency steeply sloping audiometric configurations are more likely to have a DR in that area. Such results were not found by the current study. As the present study aimed to assess the TEN (SPL) as a clinical tool for the explanation of tinnitus, the question arises whether cochlear DRs are necessary for a tinnitus percept. It has been shown that immediately after acute (impulse) noise trauma in military personnel, 88% of the soldiers perceived a noise-induced tinnitus. [16] The presence of cochlear DRs was determined by the use of psychophysical tuning curves (PTCs), which is considered as a more reliable tool by some authors. [17] It has been shown that immediately after acute impulse noise trauma in military personnel 70% of the soldiers had DRs, 50% of which recovered partially or completely (narrowing or disappearing of the DR zone) after some time. The high prevalence of DRs after noise trauma may be involved in noise-induced tinnitus. However, the fact that some patients with tinnitus had no DRs and some patients with DRs had no tinnitus supports the hypothesis that the presence of a DR is neither necessary nor sufficient to induce tinnitus. [16] These findings fit the suggestion that OHCs might be of more importance than IHCs in the generation of tinnitus as in a previous study in a group of normal hearing tinnitus patients 85% demonstrated abnormal transient otoacoustic emissions, of which only 15% abnormal TEN (HL) findings. [18] In conclusion, tinnitus is a common phenomenon in modern society. While the etiology of tinnitus remains elusive in many cases, research is needed in order to identify a possible causative factor. One of the hypotheses on non-pulsatile tinnitus is the presence of cochlear DR leading to central hyperactivity. If DR can be identified by use of the TEN test, the present study does not support the concept that DR are necessary for tinnitus. Therefore, the use of the TEN test as a diagnostic tool in a tinnitus population might be of limited value. The authors would like to point out that the present study does not designate the TEN test to be unreliable as a whole but as a result of the present findings the TEN test does not provide a useful tool in the diagnostics of tinnitus patients. Further research with the TEN test in tinnitus patients is necessary in order to confirm these findings.

Acknowledgments

This research was supported by the Stavros Niarchos Foundation and a TOP-BOF project of the University Antwerp.

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Noisy Classroom Simulation Aids Comprehension in Hearing-Impaired Children

Publication info: Targeted News Service [Washington, D.C] 11 Feb 2013.
ProQuest document link

Full text: The University of Washington issued the following news release:
Children with hearing loss struggle to hear in noisy school classrooms, even with the help of hearing aids and other devices to amplify their teacher's voice. Training the brain to filter out background noise and thus understand spoken words could help the academic performance and quality of life for children who struggle to hear, but there's been little evidence that such noise training works in youngsters.

A new report (asadl.org/jasa/resource/1/jasman/v133/i1/p495_s1) showed about a 50 percent increase in speech comprehension in background noise when children with hearing impairments followed a three-week auditory training regimen. The effect was still evident when the children were tested three months after the training ended.

The findings are among the first to demonstrate that auditory training with noise can work in children. Other studies show that similar regimens help hearing-impaired adults.

The training involves repeated exposure to speech masked by noise, and is intended to teach the brain how to receive information and process it more efficiently. This could help hearing-impaired children who struggle to keep up in noisy classrooms.

"It's not a fair playing field with their normal-hearing peers," said Jessica Sullivan (https://sites.google.com/a/uw.edu/pahlab/home/bio), lead author and a University of Washington assistant professor of speech and hearing sciences. "They have the best technology, but it's not enough - they still miss things."

People with normal hearing usually filter out background noise seamlessly. If a loud truck rumbles by, they can still understand a conversation because their brains work quickly to fill in sounds that they might have missed. But people with hearing loss take in sound more slowly, and brain regions that process hearing aren't as adept at filling in muffled information.

In Sullivan's study, published in the January issue of the Journal of the Acoustical Society of America (http://asadl.org/jasa/), hearing-impaired youngsters ages 6 to 17 attended seven one-hour sessions spread across three weeks. They listened to a series of sentences, such as "We saw two brown bears" or "Grandmother gave Bob red beans," masked by staticky background noise intended to simulate a clattering classroom scene.

During the sessions, Sullivan gradually made the regimen more demanding by ratcheting up the number of words in the sentences, the noise volume and the time between hearing the sentence and identifying what words were said. The children had to give correct answers 80 percent of the time before advancing to the next level of difficulty.

Three months after the training, the participants still showed improvements in word recognition over the noise. Sullivan also found that auditory training with a crackling noise - called "interrupted" because white noise was interspersed with fleeting five- to 95-millisecond silences - increased hearing comprehension more than using continuous white noise. Children in the interrupted noise group showed about a 50 percent increase in speech intelligibility compared with their hearing at the beginning of the experiment.

"The maintenance of the improvement is a truly significant finding," Sullivan said. "It indicates that new hearing and listening strategies have been developed to detect speech despite noise."

The next step in the research is to see how the regimen works for other people, such as adults and cochlear-implant users, and to other types of noise, including real-world settings.

Co-authors are Linda Thibodeau and Peter Assmann of the University of Texas at Dallas, where the study was conducted. The study was funded by the National Institute on Deafness and Other Communication Disorders (http://www.nidcd.nih.gov/Pages/default.aspx).

TNS MGD130212-4200066 StaffFurigay

Speech Perception in Noise by Children With Cochlear Implants

Author: Caldwell, Amanda; Nittrouer, Susan.

Publication info: Journal of Speech, Language and Hearing Research (Online) 56.1 (Feb 2013): 13-30.
ProQuest document link

Abstract: Common wisdom suggests that listening in noise poses disproportionately greater difficulty for listeners with cochlear implants (CIs) than for peerswith normal hearing (NH). The purpose of this studywas to examine phonological, language, and cognitive skills that might help explain speech-in-noise abilities for children with CIs. Three groups of kindergartners (NH, hearing aid wearers, and CI users) were tested on speech recognition in quiet and noise and on tasks thought to underlie the abilities that fit into the domains of phonological awareness, general language, and cognitive skills. These last measures were used as predictor variables in regression analyses with speech-in-noise scores as dependent variables. Compared to children with NH, children with CIs did not perform as well on speech recognition in noise or on most other measures, including recognition in quiet. Two surprising results were that (a) noise effects were consistent across groups and (b) scores on other measures did not explain any group differences in speech recognition. Limitations of implant processing take their primary toll on recognition in quiet and account for poor speech recognition and language/phonological deficits in childrenwithCIs. Implications are that teachers/clinicians need to teach language/phonology directly and maximize signal-to-noise levels in the classroom.

Full text: Headnote

Purpose: Common wisdom suggests that listening in noise poses disproportionately greater difficulty for listeners with cochlear implants (CIs) than for peerswith normal hearing (NH). The purpose of this studywas to examine phonological, language, and cognitive skills that might help explain speech-in-noise abilities for children with CIs.

Method: Three groups of kindergartners (NH, hearing aid wearers, and CI users) were tested on speech recognition in quiet and noise and on tasks thought to underlie the abilities that fit into the domains of phonological awareness, general language, and cognitive skills. These last measures were used as predictor variables in regression analyses with speech-in-noise scores as dependent variables.

Results: Compared to children with NH, children with CIs did not perform as well on speech recognition in noise or on most other measures, including recognition in quiet. Two surprising results were that (a) noise effects were consistent across groups and (b) scores on other measures did not explain any group differences in speech recognition.

Conclusions: Limitations of implant processing take their primary toll on recognition in quiet and account for poor speech recognition and language/phonological deficits in childrenwithCIs. Implications are that teachers/clinicians need to teach language/phonology directly and maximize signal-to-noise levels in the classroom.

Key Words: cochlear implants, speech perception, children, speech recognition in noise and quiet

(ProQuest: ... denotes formulae omitted.)

Recognizing speech in noisy conditions has always been viewed as presenting special difficulty for listeners with hearing loss. Before cochlear implants (CIs), when hearing aids (HAs) were the only means of amplification, this difficulty could be explained largely by the fact that abnormal cochlear function is associated with broadened auditory filters (e.g., Glasberg &Moore, 1986; Leek,Dorman,&Summerfield, 1987). Phonemically relevant spectral structure, such as formant frequencies, is poorly represented with broadened filters (e.g., Revoile, Pickett, &Kozma-Spytek, 1991). As a result, perceptual segregation of that spectral structure from background noise is difficult (Baer, Moore, &Gatehouse, 1993; Bernstein&Brungart, 2011; Boothroyd,Mulhearn, Gong, &Ostroff, 1996; Fu, Shannon, &Wang, 1998). The development of CIs as a treatment for severe to profound hearing loss has done nothing to improve this particular problem because processing strategies in these devices are designed to deliver only spectrally broad signals to the auditory system (e.g., Rubinstein,

2004).

CIs have, however, improved speech recognition in quiet for listeners with severe to profound hearing loss, with average isolated word recognition scores for adults of 40% to 50% correct (Firszt et al., 2004) and some individual implant users scoring much higher; however, listeners using CIs continue to struggle in noisy situations (e.g., Zeng &Galvin, 1999). In addition to the problems introduced by processing strategies that provide only a broad representation of phonemically relevant spectral structure, a lack of temporal fine structure contributes to the difficulty these listeners experience segregating a target signal from background noise (Lorenzi, Gilbert, Carn, Garnier, &Moore, 2006). From these constraints on the kinds of signal structure available through implants, it is easy to appreciate why listeners with CIs might struggle to recognize speech in noisy environments. There are, however, factors other than the constraints on signal structure affecting bottom-up auditory processes that influence how well listeners recognize speech in noisy backgrounds.

Top-Down Linguistic Effects

A listener's knowledge of linguistic structure and the ability to bring that knowledge to bear on speech perception affect how well one recognizes speech in noise. Several metrics have been developed to quantify the contributionmade by these top-down influences. In particular, Boothroyd (Boothroyd, 1968;Boothroyd&Nittrouer, 1988) developed such a metric, known as the j factor, and it has been used on data for listeners fromage 4 years to elderly (Nittrouer &Boothroyd, 1990). When it comes to word recognition, this metric is built on the principle that the probability of recognizing a word is related to the probabilities of recognizing the separate constituents of that word, a relationship that can be represented by this equation:

... (1)

where pw is the probability of recognizing the word; pp is the probability of recognizing each part, or phoneme; and n is the number of phonemes in the word. Of course, a listener's lexical knowledge influences word recognition such that the probability of recognizing a word does not depend on the recognition of each phoneme separately, as would be the case for nonsense items. Therefore, Equation 1 can be changed as follows:

... (2)

where j is the number of independent channels of information required for recognition and is between 1 and n.Equation 2 can now be rewritten to provide the metric of the effective number of information channels needed to recognize a word:

... (3)

According to this formula, j is a dimensionless factor that serves as an index of how strongly lexicality influences word recognition. The smaller j is, the greater the effect of lexicality on recognition. This effect is the combination of having the requisite lexical knowledge and of being able to bring that knowledge to bear on recognition. Nonetheless, early investigations of top-down linguistic constraints on speech perception typically assumed normal language knowledge and instead focused on measuring the extent towhich listeners use that knowledge in perception (Hirsh, Reynolds, &Joseph, 1954; Miller, Heise, &Lichten, 1951; Pollack, Rubenstein,&Decker, 1959). Studies with other populations, however, are reminders that the first component of the effect cannot be assumed. Listeners such as second-language learners are perfectly capable of using linguistic constraints during perception, if functioning intheir first language, but lack adequate familiarity with linguistic and phonological structure in their second language. As a result, speech perception under difficult listening conditions, such as noisy environments, is hard for these listeners (Bradlow&Pisoni, 1999; Cutler, Garcia Lecumberri, &Cooke, 2008; Flege, MacKay, &Meador, 1999; Pinet &Iverson, 2010; Rogers, Lister, Febo, Besing, &Abrams, 2006; von Hapsburg, Champlin, &Shetty, 2004). When evaluating speech perception in noise for clinical populations, it is possible that a lack of linguistic knowledge might similarly explain some part of any observed deficit that is found for those listeners.

Lessons From Individuals With Dyslexia

One population other than listeners with hearing loss that demonstrates particular difficulty recognizing speech

in noise consists of individuals with reading problems. In 1983, Brady, Shankweiler, and Mann showed that children with dyslexia recognized words in noise more poorly than their peers with normal hearing (NH), even though recognition scores in quiet were comparable across groups. This finding was attributed to poor phonological category formation on the part of the childrenwith dyslexia, and work since then has supported that suggestion (e.g., Serniclaes, Ventura, Morais, &Kolinsky, 2005; Vance &Martindale, 2011). Other studies have found that individuals with reading problems have difficulty creating categories from sensory inputs, regardless of whether they are related to speech (Ahissar, Lubin, Putter-Katz, &Banai, 2006; Nittrouer, Shune, &Lowenstein, 2011). In turn, this problem has been identified as a source of the speech-perception-in-noise difficulties exhibited by this group. The ability to make strong predictions about what kinds of structures to expect makes perception resistant to noisemasking (Ahissar, 2007). Fromthis perspective, the problems dyslexic children encounter listening to speech in noise could be described as strictly top-down effects: Because of their weakly defined phonological categories, they are ill equipped to predict the structures that would be in the noise. This explanation could similarly explain the finding that second-language learners have greater difficulty recognizing speech in noise than first-language learners: Because second-language listeners have more weakly specified phonological categories as well, they would also be less capable of predicting phonological form through the interfering noise. In any event, it is unlikely that the deficits that listeners with dyslexia exhibit when it comes to listening to speech in noise are due to problems at the auditory periphery.

Ziegler and colleagues (Ziegler, Pech-Georgel, George, Alario, &Lorenzi, 2005; Ziegler, Pech-Georgel, George,&Lorenzi, 2011) conducted two studies with a slightly different population (individuals with specific language impairments) and found that these listeners did indeed have more difficulty than typically developing children understanding speech in a variety of noises. However, the children with language impairment showed masking release for fluctuating, rather than stationary, noise comparable in magnitude to that of typically developing children. Because that kind of masking release is a peripheral effect, their enhancedmasking per se is unlikely due to auditory deficits at the periphery.

Another deficit often attributed to children with dyslexia is one described as a temporal processing deficit (Gaab, Gabrieli, Deutsch, Tallal, &Temple, 2007; Merzenich et al., 1996; Tallal, 1980; Tallal, Miller, &Fitch, 1993; Tallal &Piercy, 1973, 1974). This proposed deficit is commonly viewed as a problem in how the auditory system handles rapidly changing acoustic structure, and the proposed effect is that it hinders the ability of children with dyslexia to develop highly refined phonological categories. Consequently, it could be a source of their problems in understanding speech in noise. One kind of phonetic contrast that has been used to demonstrate temporal processing deficits in children with dyslexia is voice onset time (VOT): Children with reading problems have exhibited shallower labeling functions for stimuli along VOT continua than children without such deficits (Breier et al., 2001; Godfrey, Syrdal-Lasky, Millay, &Knox, 1981; Manis et al., 1997). VOT is a particularly good property to use in investigations of whether children with hearing loss who use CIs have difficulty forming phonemic categories, similar to the problems found for children with dyslexia. This temporal structure should be well represented in implants because processing strategies recover envelopes in a number of channels and code this information onto the electrodes. Thus, this acoustic cue of VOT could offer a test of whether there is an underlying problem with category formation for children with CIs.

Children Who Use CIs

Given all that is known about what it takes to recognize speech in noisy backgrounds, it comes as no surprise to find that children with CIs have been found to have more trouble than other children doing so (Davidson, Geers, Blamey, Tobey,&Brenner, 2011). Peripheral processes that allow listeners with normal cochlear function to separate target signals from background noise are impaired in these children, because of the signal-processing limitations of the devices. Some of the perceptual and cognitive processes that seemto influence speech recognition in noisy environments from a top-down direction are also impaired, likely adding to these listeners' problems understanding in noise. Children with CIs do not have phonemic categories that are as well formed as

their peers with NH (Geers &Hayes, 2011; Johnson &Goswami, 2010), a factor that could inhibit their abilities to predict the signal. Although implants are associated with tremendous improvements in spoken language abilities for children with hearing loss over what they are capable of without them (Tomblin, Spencer, Flock, Tyler, &Gantz, 1999), these children continue to show impaired abilities. Compared to their peers with NH, children with CIs continue to struggle at recognizing language structure in general (Niparko et al., 2010; Nittrouer, 2010) and at building vocabularies (Hayes, Geers, Treiman, &Moog, 2009; James, Rajput, Brinton, &Goswami, 2009; Nittrouer, 2010). These broader language deficits would reasonably be expected to affect the abilities of children with CIs to recognize speech in noise. Finally, children with CIs have demonstrated impaired abilities in processes fitting under the heading of cognitive skills, in particular working memory (Burkholder &Pisoni, 2003; Cleary, Pisoni, &Geers, 2001; Pisoni, Kronenberger, Roman, &Geers, 2011). Deficits in cognitive skills have not specifically been implicated in problems recognizing speech in noise.However, it can be assumed that difficulties forming and retaining amemory of what was heard could influence outcomes.

The Current Study

Before this study was conducted, it was anticipated that children with CIs would show poorer speech perception in noise than children with NH, or even children with enough residual hearing to use HAs. The study we report here was undertaken mainly to examine factors that might account for variability among children with CIs in theirabilities to recognize speech innoise, thus improving researchers' collective understanding of this deficit. In particular, three measures of phonological awareness were obtained, along with a measure of speech perception in noise. The three measures of phonological awareness spanned a range of developmental aptitude, thus increasing the likelihood that maximum variability among participants would be found. Such variability is necessary for performing powerful regression analyses. Other factors examined as potential predictors of children's abilities to recognize speech in noise included their abilities to form phonemic categories based on a temporal property (VOT). Examining children's labeling of stimuli along aVOTcontinuumprovided an estimate of howwell these children can use rapidly changing acoustic structure of a sort likely to be available through an implant. It also permitted insight into how well deaf children with CIs can form categories when given access to the sensory information on which those categories are based. Also evaluated in the current study were children's language comprehension, vocabulary size, short-term memory, and speed of perceptual processing. All participants with hearing loss, and most with NH, in this study were part of a longitudinal investigation and had been tested repeatedly at regular intervals since infancy. This fact made them a particularly good sample to study, because no evidence to suspect secondary handicaps that might interfere with the development of spoken language has been found for any child in the longitudinal study.

Method

Participants

Fifty-four children who had just completed kindergarten came to The Ohio State University during the summer of 2010 to participate in this study. Of these, 35 had permanent sensorineural hearing loss with three-frequency pure-tone averages greater than 50 dB hearing level in the better ear. Twenty-seven of those children had severe to profound sensorineural hearing loss and wore one or two CIs. Eight had moderate hearing loss and wore bilateral HAs. Another 19 children had NH. Pure-tone audiometric measurements made at the time of testing confirmed these category descriptions. All children except for four in the NH group had participated in a longitudinal study from 12 to 48 months of age (Nittrouer, 2010). All children with hearing loss in the study received intervention services focused on spoken language development starting shortly after their hearing loss was identified.

Demographic Measures

Demographic information for the three groups is provided in Table 1. Range of age at the time of testing was 73-85 months for children with NH, 72-83 months for children with HAs, and 73-94 months for children with CIs. One child with CIs had to repeat kindergarten, which explains the greater age range for that group.

Socioeconomic status was indexed using a two-factor scale on which both the highest educational level and the occupational status of the primary income earner in the home are considered (Nittrouer &Burton, 2005). Scores for each of these factors range from 1 to 8, with 1 being the lowest and 8 being the highest. Values for the two factors are multiplied together, resulting in a range of possible scores from1 to 64. In general, a score of 30 represents a household in which the primary income earner has a 4-year university degree and a job such as a midlevel manager or a teacher. Scores of 20 represent households in which the primary income earner has a high school diploma and works in a service industry, in construction, or as a skilled craftsman. The scores obtained for these children suggest they all had reasonably rich language environments in the home.

The bottom four rows of Table 1 show demographic information for the children with hearing loss. All children with hearing loss had been identified before 2 years of age, and most had been identified before 1 year. The childrenwith CIs had received those implants early, which for 21 of the 27 children meant before age 2. Consequently, these children had considerable experience using their implants. Eighteen of the children with implants wore two. Thirteen children with implants had worn an HA on the opposite ear (i.e., bimodal experience) for a period of a year or more.

Equipment

All testing took place in sound-attenuated rooms. All stimuli used in testing were presented via a computer with a Creative Labs Soundblaster digital-to-analog card using a 44.1-kHz sampling rate with 16-bit digitization and a RolandMA-12C-powered speaker for audio presentation, placed 1min front of the child at a 0° azimuth. The phonological awareness tasks were presented in audiovisual format using a 1,500-kbps data rate and 24-bit digitization for video presentation. Presentation for speech recognition in noise was audio only.

All test sessions were video-recorded using a Sony HDR-XR550V video recorder so that scoring could be done later. Children wore Sony FM transmitters in specially designed vests that transmitted speech signals to the receivers. Those receivers provided direct line input to the hard drives of the cameras to ensure good sound quality for all recordings.

General Procedure

Children arrived in Columbus, Ohio, the night before testing started. Four to six children attended each camp. They were tested individually in six separate sessions over a 2-day period. Each test session consisted of several tasks that lasted no longer than 1 hr. Children had a minimum of 1 hr between test sessions. Several kinds of measures were collected to assess children's abilities to recognize words and constituent phonemes in noise and to evaluate the factors that likely affect those recognition abilities. All procedureswere approved by the institutional review board of The Ohio State University.

Stimuli and Task-Specific Procedures

Speech in noise. Eighteen word lists from Mackersie, Boothroyd, and Minniear (2001) were used. Each list consisted of 10 phonetically balanced CVC words. Noise with a flat spectrum was generated using a randomnoise generator. Six word lists were presented at each of three signal-to-noise ratios (SNRs): -3 dB, 0 dB, and +3 dB. These levels were chosen because they have been used often in earlier work investigating speech recognition in noise by children, both typically developing and with dyslexia (Brady et al., 1983; Nittrouer et al., 2011; Nittrouer &Boothroyd, 1990). Although the same 18 lists were presented to all children, the SNR at which each list was presented varied randomly across children. The order of presentation of lists, and so ofSNRs, also varied randomly, with the stipulation that two lists could not be presented at the same SNR consecutively. During presentation, the level of the words was held constant at 68 dB SPL, and the level of noise varied. After testing in noise was completed with these 18 word lists, the same words were presented in quiet for recognition. Dependent measures were the percentages of correct words and phonemes.

The j factor (Boothroyd &Nittrouer, 1988) was used to index the contribution of lexical effects to word recognition. The j factor is not reliable when percentages of phonemes or words recognized correctly are below 5% or above 95%. In this study, these factors were not available for some children with HAs or CIs in some

SNRs because they scored below 5% correct on either phonemes or words. Using the j factor permitted the examination of whether any potential group differences observed for recognition scores might be due to differences in the extent to which children made use of lexical effects during speech perception.

In a separate session, the CIDW-22 word lists (Hirsh et al., 1954) were presented in quiet. These lists consist of 50 words each and are commonly administered in clinical settings. There are four lists, and the lists presented to individual children varied. These additional materials were used to gauge how ecologically valid the Mackersie et al. (2001) materials are for use with children.

Phonological awareness. Three tasks assessing phonological awareness were used in order to cover a broad range of developmental skill levels. The syllable counting task required children to count the number of syllables in each word. Because this task assesses sensitivity to syllable structure, it is considered developmentally easier than the other two tasks, both of which assessed sensitivity to phonemic structure. In the initial consonant matching task, children heard two words and needed to judge whether they started with the same sound or not. The final consonant choice taskwas considered to be the hardest because it measured the skill expected to be acquired latest. In this task, children heard and repeated a target word and then heard three more words. Children had to select which of those words ended in the same sound as the target. This task was the most difficult because the ability to perform such tasks with final segments develops later than the ability to do them with initial segments (Stanovich, Cunningham, &Cramer, 1984), and because children had to hold four words in a memory buffer. Items for each task are shown in Appendixes A through C.

Specially written software controlled presentation of all stimuli, and the experimenter entered responses directly into the computer. Practice was provided prior to testing on each task. The percentage of correct answers in each task served as the dependent measures. In addition, incorrect answers were recorded and reviewed later for any evidence that children might be implementing a response strategy other than the one required to perform the task correctly. An example of such an alternative response strategywould be if a child responded on the basis of semantic relations between items.

VOT. Children's abilities to label stimuli along aVOT continuum were examined as a way to gauge their general abilities to form phonemic categories when signal structure is available to them. Consonant voicing contrasts are generally more resistant than many other kinds of consonant contrasts to hearing loss (e.g., Boothroyd, 1984), and children with CIs have been found to make these distinctionsmore readily than theymake other consonant contrasts (Giezen, Escudero, &Baker, 2010). The stimuli used here had been used in earlier studies and were found to evoke sharp labeling functions from children, even those with phonological processing problems (Nittrouer, 1999, 2011) or hearing loss (Nittrouer&Burton, 2005). These stimuli are synthetic replicas of da and ta, consisting of 270-ms vocalic portions. The first formant (F1) has a 40-ms transition at the beginning, going from a starting frequency of 200 Hz to a steady-state frequency of 650 Hz. The second and third formants (F2 and F3) change over the first 70 ms. The second formant starts at 1800 Hz and falls to a steady-state frequency of 1130 Hz. The third formant starts at 3000 Hz and falls to a steadystate frequency of 2500 Hz. The fourth and fifth formants (F4 and F5) are constant throughout the stimuli at 3250 Hz and 3700 Hz, respectively. The fundamental frequency (f0) is 120 Hz for the first 70 ms and then falls linearly through the rest of the stimulus to an ending frequency of 100 Hz. A nine-step continuum was created from these vocalic portions by cutting back the onset of voicing in 5-ms steps from 0 to 40 ms. Before voicing started, no source excited F1, but aspiration noise excited the higher formants. Two 10-ms portions of natural release bursts were used, both fromthe samemale speaker: One came from a production of da and one from ta. Appending these bursts to the start of the stimuli had the effect of creating a nine-step continuumwith effective VOTs of 10 ms to 50 ms.

Practice was provided with natural tokens of da and ta and then with the endpoint stimuli from the synthetic continuum. These endpoints consisted of the token with the briefest VOT paired with the da burst and the token with the longest VOT paired with the ta burst. Children needed to respond correctly to nine out of 10

presentations of the endpoints in order to proceed to testing.

Language comprehension. Children's abilities to comprehend spoken language were assessed using the Auditory Comprehension subtest of the Preschool Language Scales, Fourth Edition (Zimmerman, Steiner, &Pond, 2002). This task requires the child to demonstrate an understanding of spoken language by performing specific commands given by the examiner. It is particularly sensitive to children's abilities to comprehend syntactic structures. Standard scores were used as dependent measures.

Vocabulary. Expressive vocabulary was assessed with the Expressive One-Word Picture Vocabulary Test (Brownell, 2000). This task requires the child to provide the words that label a series of pictured items shown one at a time on separate pages. Standard scores were used as dependent measures.

Short-termmemory. For the short-termmemory task, words were presented over the speaker at a level of 68 dB SPL. Ten lists consisting of the same six words were presented, with the order of words varied across each list randomly by the program. The six words were ball, coat, dog, ham, pack, and rake. These words and this task have been used with children before (e.g., Nittrouer &Miller, 1999) and are known to be appropriate for children. Words in each list were presented with an onset-toonset rate of 1 s. After all words were presented, pictures of each item in random order, but not matching that of the audio presentation order, appeared at the top of the computer touch screen. The child's task was to touch each picture in the order heard. As the child touched a picture, it moved down and into place to the right of the picture of the just previously touched word. After all words were touched, the pictures were at the bottom of the screen, in order from leftto right according to how the child recalled hearing them. The computer program recorded the child's responses and compared them to the order in which words were actually presented.

Before testing, training was done using the letters F, H, Q, R, S, and Y, with the same procedures described above for testing. After training on how to do the task with those letter stimuli, the test words were introduced by presenting them over the speaker one at a time and showing them one at a time. All six pictures were then displayed, and the child had to select the picturematching each word presented in isolation to proceed to testing. After testing with the 10 lists, this procedure was repeated. Data were eliminated from the analysis if the child could not respond with perfect accuracy to the six words presented in isolation. The percentage of items out of 60 (10 lists of six words each) for which order was accurately recalled was used as the dependent measure.

Speed of perceptual processing. For a measure of processing speed, we used the Object Naming subtest of the Comprehensive Test of Phonological Processing (Wagner, Torgesen, &Rashotte, 1999). This task consisted of two pages of pictures arranged in four rows of nine pictures each. The child's task was to name the pictures, in order, as quickly as possible. The time required to name all 36 items was obtained from the videotape of the test session, and the sum across the two trials was used as the dependent measure.

Results

Data were screened to check for homogeneity of variance across groups and for linearity. Arcsine transformations of percentage correct word and phoneme recognition scores were used in inferential tests. An alpha level of .05 was applied, but precise p values are given when $p < .10$. When $p > .10$, results are described as not significant.

Speech Recognition

External and internal validity. Figure 1 shows mean percentage correct recognition for phonemes (top panel) and words (bottom panel) at each SNR and in quiet for each group, with standard errors of the means as error bars. In addition to these group results for the Mackersie et al. (2001) words presented in noise and in quiet, other group results are shown for comparison. For word recognition in noise, results for the same stimuli presented at the same SNRs to 14 typically developing 7-year-olds with NH from Nittrouer et al.'s (2011) study are shown next to mean scores for children with NH from this current study at each SNR. A two-way repeated-measures analysis of variance (ANOVA) on scores for children with NHin the twostudies, with study as the

between-subjects factor and SNRas the within-subject factor, revealed only a main effect of SNR, $F(2, 62) = 63.26$, $p < .001$. Neither the main effect of study nor the SNR ×Study interaction were significant, meaning $p > .10$. This outcome provides reassurance that participants with NHwere likely representative of children with NH.

Mean percentage correct recognition scores for phonemes and words presented in quiet are also shown for the CID W-22 word lists. These scores are from the children in the current experiment. For all groups of children, phoneme and word recognition scores appear to be similar for the Mackersie et al. (2001) words and the CID W-22 words, and a series of paired-sample t tests carried out on phoneme and word scores for each group separately failed to reveal any statistically significant differences for any group. Thus, the words used in the current test of speech perception in noise are neither harder nor easier than what children are routinely asked to recognize in such tests.

Group differences.We examined potential group differences for recognition of the Mackersie et al. (2001) words in quiet and in noise. For recognition in quiet, we performed one-way ANOVAs with post hoc contrasts. For both phonemes and words, the overall effect of listener group was significant: phonemes, $F(2, 51) = 30.33$, $p < .001$, and words, $F(2, 51) = 31.10$, $p < .001$. In both cases, contrasts between children with NH and children in both of the other two groups were significant ($p < .001$), both with and without Bonferroni adjustments, but contrasts between children with HAs and CIs were not. Thus, one can conclude that children with NH had better recognition in quiet than children with eitherHAs or CIs. In quiet, recognition was similar for children with hearing loss, regardless of whether they wore HAs and CIs.

The results of two-way repeated-measures ANOVAs performed on scores obtained for words presented in noise are shown in Table 2. Effects of SNR and group membership were both significant, for both phoneme and word scores. The Group ×SNR interaction was close to significant for phonemes ($p = .058$) and was significant for words ($p = .028$). For both phoneme and word scores, post hoc contrasts showed differences between children with NH and the two hearing loss groups ($p < .001$), both with and without Bonferroni adjustments. The contrast of scores between children with HAs and CIs was not significant for phoneme scores but was significant for word scores ($p = .040$), without a Bonferroni adjustment; with the adjustment, the contrastwas not significant.

There is one potential flaw in viewing performance strictly according to how well children recognized phonemes and words in noise: Differences were observed across groups for recognition in quiet. Consequently, scores for recognition in noise were influenced not only by the presence of that noise but by general speech recognition abilities as well. To control for the effects of how well children could recognizewords in quiet, wecomputed percentages of phonemes and words recognized correctly in noise for only those phonemes and words recognized correctly in quiet. For phonemes, this approach meant that recognition in noise was matched to recognition in quiet, based on specific words and locations of phonemes within thosewords.Figure 2 shows groupmeans for these scores, and Table 3 shows results of ANOVAs performed on these conditional phoneme and word scores. Overall, values and patterns of scores in Figure 2 closely resemble those of Figure 1. Statistical outcomes were similar, but the Group ×SNR interactions were not significant for these conditional scores. Again, post hoc contrasts showed differences in scores for children with NH and those of the two hearing loss groups ($p < .001$), for both phonemes and words, and again, no significant difference was found between children with HAs and those with CIs for phoneme scores, but for word scores, the contrast was significant ($p = .047$) without a correction for multiple contrasts; with a Bonferroni adjustment, the effect was no longer significant.

Lexical effects. Mean j factors for each group at each SNR are shown in Table 4. These factors were computed only on data fromchildren who had recognition scores between 5% and 95% correct for both phonemes and words. All children with NH had scores within this range at all three SNRs, but some children with hearing loss did not achieve 5% correct recognition at one or more SNRs. These reported j factors are similar to those

reported by Nittrouer and Boothroyd (1990) for children between 4 and 6 years of age: +3 dB SNR = 2.51 and 0 dB SNR = 2.45. Children were not tested at -3 dBSNRinthat study.

A two-way repeated-measures ANOVA run on the current data showed a significant effect of SNR, $F(2, 58) = 3.15$, $p = .05$, but neither the group effect nor the Group ×SNR interaction was significant. Simple effects analyses conducted on these values revealed a significant difference only between j factors for -3 dB versus +3 dB SNR ($p = .049$), although the comparison of -3 dB versus 0 dB was close to significant ($p = .058$). The comparison of j factors for 0 dB versus +3 dB SNR was not significant; thus, one can conclude that similar lexical effects were found for children in all groups. A slight trend was found toward reduced lexical effects at the poorest SNR.

Summary. Speech recognition diminished as SNR becamepoorer, and children with hearing loss did not perform as well as children with NH, regardless of whether they wore HAs or CIs. These differences could not be attributed to differences in lexical effects across groups. Significant differences were not observed between children with HAs and CIs for phoneme recognition in noise; however, for word recognition, contrasts reached statistical significance without Bonferroni corrections. Because the group of children withHAs was small, it is possible that a true difference between these groups may exist and was missed in these analyses. A difference in speech perception in noise for children with HAs and CIs could have been predicted because CIs do not preserve all the kinds of signal structure available through HAs. Because of the possibility of a group difference between children with HAs and those with CIs, results from children with HAs were not included in subsequent analyses; instead, analyses focused on potential differences between children with NH and those with CIs.

Other Measures

VOT. Labeling functions for the synthetic VOTstimuli are shown in Figure 3. Functions are very similar in location and slope for children with NH and those with CIs, and t tests done on phoneme boundaries and slopes all failed to reveal significant differences between children withNHand those with CIs. Thus, one can conclude that these children with CIs exhibited typical abilities for categorizing speech stimuli that are distinguishable based on the temporal cue of VOT.

General language. The top two rows of Table 5 show mean standard scores, standard deviations, outcomes of t tests, and effect sizes in the form of Cohen's ds for both auditory comprehension and expressive vocabulary measures. For both measures, children with NH performed better than children with CIs. These differences were significant, with large effect sizes.

Cognitive skills. The middle two rows of Table 5 show mean scores and other statistics for measures of cognitive skills. Children with NH performed better on both tasks than children with CIs. These differences were significant, but with effects of only moderate size.

Phonological awareness. The bottom three rows of Table 5 show mean scores and other statistics for the three measures of phonological awareness. Children with NH performed better than children with CIs on all three, but effects were greater for the two measures of phonemic awareness than the one measure of syllabic awareness. That likely reflects the fact that CIs preserve the amplitude structure affiliated with syllabic structure in the speech signal but are poor at conveying many of the acoustic cues associatedwith phonemes. In particular, spectral structure arising from the vocal tract filter is lacking.

A review of incorrect responses failed to reveal any evidence that any strategy other than the one designated by the task was used by any child for responding.

Regression Analyses

Separate linear regressions with one predictor variable in each analysis were performed with each of two dependent measures of speech recognition in noise. The twomeasures of speech recognition used in these analyses were the conditional (upon correct recognition in quiet) phoneme and word recognition scores. These scores were selected for use on the basis of principled grounds (they seem most valid), but in fact outcomes were no different when the nonconditional percentage-correct scores were used. The mean across the three

SNRs for each measure (phoneme and word recognition) was computed for each child. The predictor variables used were each of the seven measures shown in Table 5. These linear regressions were performed with scores for children with NH and those with CIs combined, as well as for each group separately. Standardized beta coefficients are shown in Table 6.

When we looked at scores for all children, we found that the predictor variables that explained significant proportions of variance in phoneme and word recognition were the language measures and the measures of phonemic awareness. The highest standardized beta coefficient obtainedwas for word recognition and the final consonant choice task (b = .782). Short-term memory also explained a significant proportion of variance for word recognition (b = .405), but the magnitude of that effect was smaller than for any general language or phonemic awareness measure. When we examined beta coefficients for each group separately, we noted that the only one that explained a significant proportion of variance for either group was the one for the initial consonant matching task and word recognition for children with NH (b = .594).

The pattern of finding significant beta coefficients when children in both groups are considered together, but finding no significant coefficients when they are considered separately, means that the two groups differ in performance for both variables (predictor and dependent), but there was not a continuous effect within the groups. Figure 4 illustrates this pattern for word recognition and final consonant choice, the analysis that resulted in the largest beta coefficient when all children were included. The pattern found here is one of two distinct groups defined by scores on each of the measures but no indication of a relationship between scores for either group. In fact, several children with NH performed similarly to children with CIs on the final consonant choice task but were more accurate at recognizing words in noise.

Factors Affecting Performance of Children With CIs

We again used the conditional phoneme and word recognition scores as dependent variables to examine potential effects of factors related to hearing loss and cochlear implantation in the children with CIs. First, we obtained standardized beta coefficients using age of identification, age at first implantation, and age at second implantation (for the 18 children who had two implants) as predictor variables. Of these, only age at first implantation revealed significant effects for phoneme recognition (b = .424, t = 2.341, p = .027), but not for word recognition, (b = .362, t = 1.945, p = .063). Thus, being younger at the time of the first implant was associated with better outcomes for speech recognition in noise: Roughly 18% of the variance in phoneme recognition scores was explained by age at first implant.

Next, we examined the effects of having one or two implants and of having had or not had some period of bimodal experience. Only one child was still wearing an HA and a CI at the time of testing. That child was not included in the analyses of one or two implants because she did not fit neatly into either group.Mean conditional phoneme and word recognition scores are shown in Table 7, and t tests were performed on these scores. The effect of having one or two implants was not significant (p >.10). The effect of having had some period of bimodal experience was not significant either; however, a trend toward better word recognition (t = 2.038, p = .052) was found for the group with some period of bimodal experience.

Finally, we examined scores for phoneme and word recognition in quiet for children with CIs. Because their performance was not close to 100% accurate in quiet, as was the case for children with NH, the abilities of children with CIs to recognize speech in noise were highly constrained by their abilities to recognize speech in quiet. Thus, it seemed important to determine what explained those quiet recognition abilities. Stepwise linear regressions were performed, with the percentages of phonemes and words recognized correctly in quiet serving as dependent variables. Predictor variables included the seven measures that have been considered thus far (shown in Table 5), as well as age of first implantation, because that was found to explain a significant proportion of variance for phoneme recognition in noise.

The results of these analyses are shown in Table 8. For both phoneme and word recognition in quiet, expressive vocabulary scores explained a large proportion of variance, such that the better a child's vocabulary

was, the better the child's recognition in quiet was. Scores on the initial consonant matching task were also found to explain significant proportions of variance in phoneme and word recognition scores. However, the interesting aspect of this result is that the direction of relationship was opposite to what would be expected: Higher scores on the initial consonant task were associated with lower scores on phoneme and word recognition in quiet.

Discussion

We undertook this study to examine factors that were considered likely candidates to help explain speech recognition in noise by children who use CIs.We fully anticipated before the study was conducted that children with CIs would perform more poorly than children with NH on measures of speech recognition in noise, and that was indeed found to be the case. However, only small Group ×SNR interactions were obtained, and only when scores not contingent on performance in quiet were used in statistical analyses. Those patterns of result suggest that noise effects on recognition were either similar or only slightly greater for children with CIs than for children with NH. This finding could be interpreted as indicating that-at least for children-the limitations on the kind of signal delivered by CIs take the greatest toll on speech recognition in quiet. Adding noise to the signal appears to have comparable effects for all children, regardless of hearing status.

That situation differs from the one presumed to exist for adults. It is commonly believed that noise has more deleterious consequences for implant users than for listeners withNH(e.g., Carroll, Tiaden,&Zeng, 2011), but perusal of the literature fails to provide strong evidence of this position. Few studies have quantified phoneme or word recognition scores in various levels of noise for adults with NH and those with CIs (cf. Zeng &Galvin, 1999). One report that gave scores derived from real words showed close to a 40-percentage-point drop in phoneme recognition scores between 25 dB SNR (which is effectively listening in quiet) and 0 dB SNR for implant users and listeners with NH alike (Hochberg, Boothroyd,Weiss, &Hellman, 1992). Those recognition scores match what is typically found for listeners with NH (e.g., Boothroyd &Nittrouer, 1988) and for listeners with CIs (e.g., Friesen, Shannon, Baskent, &Wang, 2001) at those noise levels. Consequently, it could be that the processing limitations imposed by CIs have their primary effects on recognition in quiet even for adults, and noise effects are consistent in magnitude for listeners with NH and those who use CIs. Be that as it may for adults, the current study suggests that it is likely the case for children.

Of course, these results spark the question of why childrenwithCIs are somuch poorer at recognizing speech than children with NH, even in quiet. Some of the explanationmust surely be that implants provide only a sparse signal representation, lacking many of the acoustic properties, especially spectral ones, traditionally thought to underlie phonetic perception. At the same time, children with CIs demonstrate a variety of language deficits, including those of vocabulary, phonological awareness, and comprehension of language structures. Although the source of those difficulties may very well be traced to the impoverished signals provided through implants, the language and phonological deficits would nonetheless be expected to feed back and have negative effects of their own on speech recognition. As Ahissar (2007) suggested, highly refined language knowledge allows listeners to make predictions about the structure that is likely to be in the signal; conversely, the absence of such knowledge inhibits recognition. This phenomenon presumably would be just as applicable to perception in quiet as in noise, especially if the signal is degraded due to processing limitations.

Nonetheless, children with CIs performed significantly more poorly than children with NH when it came to recognizing speech in noise. This difference between groups was strongly related to group differences in language and phonological awareness measures, but no evidencewas found to suggest that recognition scores in noise were explained by the language and/or phonological awareness measures for children with CIs: No withingroups effects were found. Only one measure (initial consonant matching) was found to explain a significant proportion of variance for recognition in noise, but only for the children with NH.

Given the trends observed in this study, one can conclude that the difficulties in recognizing speech in noise experienced by children with CIs differ from those of children with dyslexia. Children in the latter group

recognized speech perfectly well in quiet and exhibited problems only for recognition in noise. Thus, there is a clear and disproportionately large effect of noise on recognition abilities for children with dyslexia, compared to that experienced by children with NH and without dyslexia. Children with CIs showed deficits for speech recognition in quiet and an effect of noise similar in magnitude to what was observed for children withNH. The implication of these findings is that improved processing strategies for CIs, if and when they are developed, should be expected to have positive effects on recognition in both quiet and noise for children with CIs. In fact, if processing strategies that preserve phonemically relevant spectral structure in the signal and/or temporal fine structure were to be developed, children with CIs could reasonably be expected to acquire better language and phonological skills as well. That prediction follows fromthe fact that results fromthe VOT continua revealed that these children are perfectly capable of forming well-defined phonological categories, as long as they have access to the signal properties on which those categories are based. Until such time as improved processing strategies can be implemented in CIs, teachers and clinicians will need to continue providing extra support to these children to help them acquire the language and phonological skills they need to succeed in academic settings. Care should be given to maximize signal-to-noise levels for these children, as well.

Acknowledgments

This work was supported by Grant R01 DC006237 from the National Institute on Deafness and Other Communication Disorders to Susan Nittrouer. We thank Daniel Burry, Joanna Lowenstein, Eric Tarr, and Puisan Wong for help with stimulus development and data collection, and Caitlin Rice for help with manuscript preparation.

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Editor: Sid Bacon
Associate Editor: Emily Tobey
Received December 8, 2011
Accepted June 1, 2012
DOI: 10.1044/1092-4388(2012/11-0338)

Appendix

(ProQuest: Appendix omitted.)

Auditory Brainstem Response to Complex Sounds Predicts Self-Reported Speech-in-Noise Performance

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.1 (Feb 2013): 31-43.
ProQuest document link

Abstract: To compare the ability of the auditory brainstem response to complex sounds (cABR) to predict subjective ratings of speech understanding in noise on the Speech, Spatial, and Qualities of Hearing Scale (SSQ; Gatehouse &Noble, 2004) relative to the predictive ability of the Quick Speech-in-Noise test (QuickSIN; Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2004) and pure-tone hearing thresholds. Participants included 111middle- to older-age adults (range = 45-78) with audiometric configurations ranging from normal hearing levels to moderate sensorineural hearing loss. In addition to using audiometric testing, the authors also used such evaluation measures as the QuickSIN, the SSQ, and the cABR. Multiple linear regression analysis indicated that the inclusion of brainstem variables in a model with QuickSIN, hearing thresholds, and age accounted for 30% of the variance in the Speech subtest of the SSQ, compared with significantly less variance (19%) when brainstem variables were not included. The authors' results demonstrate the cABR's efficacy for predicting self-reported speech-in-noise perception difficulties. The fact that the cABR predicts more variance in self-reported speechin- noise (SIN) perception than either the QuickSIN or hearing thresholds indicates that the cABR provides additional insight into an individual's ability to hear in background noise. In addition, the findings underscore the link between the cABR and hearing in noise.

Full text: Headnote

Purpose: To compare the ability of the auditory brainstem response to complex sounds (cABR) to predict subjective ratings of speech understanding in noise on the Speech, Spatial, and Qualities of Hearing Scale (SSQ; Gatehouse &Noble, 2004) relative to the predictive ability of the Quick Speech-in-Noise test (QuickSIN; Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2004) and pure-tone hearing thresholds.
Method: Participants included 111middle- to older-age adults (range = 45-78) with audiometric configurations ranging from normal hearing levels to moderate sensorineural hearing loss. In addition to using audiometric testing, the authors also used such evaluation measures as the QuickSIN, the SSQ, and the cABR.
Results: Multiple linear regression analysis indicated that the inclusion of brainstem variables in a model with QuickSIN, hearing thresholds, and age accounted for 30% of the variance in the Speech subtest of the SSQ, compared with significantly less variance (19%) when brainstem variables were not included.
Conclusion: The authors' results demonstrate the cABR's efficacy for predicting self-reported speech-in-noise perception difficulties. The fact that the cABR predicts more variance in self-reported speechin- noise (SIN) perception than either the QuickSIN or hearing thresholds indicates that the cABR provides additional insight into an individual's ability to hear in background noise. In addition, the findings underscore the link between the cABR and hearing in noise.

Key Words: central auditory processing, brainstem, speech-in-noise perception, clinical audiology, speech perception, electrophysiology, aging

Older adults often report difficulty hearing in background noise. Providing appropriate assessment and management for these individuals can be challenging for the audiologist and other clinicians. Historically, the traditional audiologic assessment included pure-tone threshold and word recognition measures; more challenging assessments, such as repeating sentences in competing background noise, were reserved for the assessment of central auditory processing. Researchers gave little thought to addressing the older adult's most challenging concern-hearing speech in noise (SIN). The use of clinical measures of SINperception, such as the Quick Speech-in-Noise test (QuickSIN; Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2004), the Bamford-Kowal-Bench Speech-in-Noise test (BKBSIN; Bench, Kowal, &Bamford, 1979), the Hearing in Noise Test (HINT; Nilsson, Soli, &Sullivan, 1994), and theWords-in-Noise test (WIN;Wilson, Abrams, &Pillion, 2003), has been more prevalent in the last decade. These measures classify performance into degrees of hearing

handicap in noise, providing clinicians the information needed to make specific recommendations for hearing enhancement in noise (e.g., directional microphones, FM systems). Although these tests are useful, particularly when counseling patients, it remains challenging for clinicians to predict actual performance in difficult, real-world listening situations. Any assessment requiring a voluntary response is affected by cognitive factors, which can be compromised in the elderly (Dennis &Cabeza, 2007; Salthouse, 1985)-the group that most often seeks out assistance for hearing difficulties. What is needed, then, is an objective measure that is unaffected by cognitive status and can be used to predict real-world SIN performance.

An objective measure requires no response from the patient. Such measures, including auditory brainstem responses, otoacoustic emissions, and acoustic reflex thresholds, are routinely used for hearing screening and diagnosis in babies and other difficult-to-test patients (Hall, 2007). An objective measure for predicting SIN perception in the older adult population would require evaluation of more complex processing than that offered by simple stimulus detection and would be sensitive to agerelated changes in central auditory system function. Researchers have documented the effects of aging on temporal resolution in the auditory system (Anderson, Parbery- Clark, White-Schwoch, &Kraus, 2012), which can generally be attributed to overall slowing of neural processing. This slowing may arise from a number of factors including, but not limited to, delayed neural recovery time (Walton, Barsz, &Wilson, 2008), decreased inhibition (Caspary, Ling, Turner, &Hughes, 2008), and increased temporal jitter (Pichora-Fuller, Schneider, MacDonald, Pass, &Brown, 2007). Evidence of neural slowing has been documented in the auditory cortex (Iragui, Kutas, Mitchiner, &Hillyard, 1993; Matilainen et al., 2010; Tremblay, Billings, &Rohila, 2004) and brainstem (Anderson, Parbery-Clark, Yi,&Kraus, 2011; Finlayson, 2002; Vander Werff& Burns, 2011). Neural slowing can affect precise encoding of temporal speech features, accounting in part for the older adult's difficulty with hearing in background noise (Tremblay, Piskosz, &Souza, 2002; Walton, 2010).

The auditory brainstem response to complex sounds (cABR) provides an objective means for evaluating the brainstem's ability to accurately encode timing and frequency information and also reflects neural slowing in older adults (Parbery-Clark, Anderson, Hittner, &Kraus, 2012; VanderWerff& Burns, 2011). The cABR's high reliability in individuals lends itself to clinical uses such as assessment and documentation of treatment outcomes (Hornickel, Knowles, &Kraus, 2012; Russo, Hornickel, Nicol, Zecker,&Kraus, 2010; Song, Nicol,&Kraus, 2011a, 2011b). The use of complex stimuli provides more sensitivity than do clicks or tone bursts to subtle differences in impaired populations, relative to normal controls (Song, Banai, Russo, &Kraus, 2006), thus highlighting the potential for the cABR to provide an effective means of assessing central auditory system function. In a previous study, we documented that accurate neural timing is an important factor in SIN performance in older adults (Anderson et al., 2011). In the present study, weexamined the utility of the cABR for predicting self-reported SIN perception in older adults, using a clinically available software platform.

To achieve our objective of finding an efficacious measure of real-world performance, we compared the sensitivity of monaural, binaural, and binaural-in-noise presentation protocols for assessing differences in SIN perception. The monaural protocol has proved useful to clinicians assessing language-based learning impairments in children (Banai et al., 2009), but we included the binaural protocol in case the monaural presentation failed to elicit a robust, replicable response in older adults. The binaural-in-noise presentation was used to simulate speech processing in degraded conditions. We did not include a monaural-in-noise protocol because pilot testing revealed that the individuals tested did not have a sufficiently replicable response for peak identification. Our aim was to determine which of these protocols was most predictive of self-reported SIN perception.

We also developed a stimulus-compensation protocol to reduce the effects of peripheral hearing loss on the cABR in individuals with hearing loss. This protocol created an amplified waveform based on individual hearing loss in each participant.We compared responses to these three presentation conditions using amplified and unamplified stimuli and anticipated that the use of amplified stimuli would minimize expected effects of audibility

loss (e.g., loss of detectable response peaks) in individuals with a hearing loss.

We used the Speech, Spatial, andQualities of Hearing Scale (SSQ; Gatehouse& Noble, 2004) because we wanted a measure that reflects self-reported performance rather than behavioral performance obtained in the clinic or laboratory. Specifically, by virtue of it being a self-report measure, the SSQ provides clinicians with important information about self-perception of the ability to perceive speech in noise, a common clinical complaint in older adults. The SSQ was developed in response to recognized limitations of the traditional audiological battery for predicting listening ability in challenging environments, such as rooms with multiple talkers and other noise sources. The SSQ covers a range of hearing contexts, asking individuals to rank perceived hearing difficulty ranging from easier one-on-one conversations in a quiet setting to conversing in a large, noisy restaurant.Gatehouse and Noble administered the SSQ to 153 patients with hearing loss prior to hearing aid fitting and concluded that the SSQ elicits new dimensions of hearing (e.g., attention switching, spatial hearing), thus providing a measure of complex and dynamic aspects of hearing in noise not captured by traditional assessment tools. Since its development, the SSQ has been used to document the benefit of using one versus two hearing aids (Most, Adi-Bensaid, Shpak, Sharkiya, &Luntz, 2012; Noble &Gatehouse, 2006), the advantages of directional microphones for speech intelligibility in noise (Wilson, McArdle, &Smith, 2007), and the benefit of cochlear implant algorithms (Vermeire, Kleine Punte,&Van de Heyning, 2010), as well as to obtain an individual self-assessment of speech understanding in noise abilities (Agus, Akeroyd, Noble, &Bhullar, 2009; Helfer&Vargo, 2009). The SSQis a reliable instrument: Researchers administering tests 6 months apart (Singh&Pichora-Fuller, 2010) obtained test.retest correlations from both one-on-one interviews (r = .83) and mailed questionnaires (r = .65).

We predicted that the cABR, a highly reliable and objective measure of spectral and temporal resolution, would be a better predictor of real-world SINperformance than would clinical measures requiring patient responses. We expected that the effects of aging.including delayed neural recovery, decreased inhibition, and increased temporal jitter.would result in delayed onset and offset timing as well as decreased overall morphology and sharpness of the response to the stimulus onset.

Method

Participants

We recruited 111 participants (64 women, 47 men; ages 45.78; Mage = 61.1) from the Chicago area. We obtained audiometric thresholds at octave intervals (interoctave at 3000 and 6000 Hz) from 125.12,000 Hz. The participants included individuals with hearing levels ranging from normal hearing to moderate hearing loss, with the exclusion of any participant who had hearing thresholds greater than 40 dB HL (below 4000 Hz) or greater than 60 dB (from 4000 to 8000 Hz). Pure-tone averages (500.4000 Hz) ranged from 2.5 dB HL to 44.5 dB HL (M= 17.29, SD=8.7; seeFigure 1). Inaddition, no participant had air-bone gaps greater than 10dBat 2 ormore frequencies in either ear, nor had neurological disorders, asymmetric pure-tone thresholds (defined as >15 dB difference at 2 or more frequencies between ears), delayed Wave V latencies for the click-evoked auditory brainstem response (defined as a latency >6.8 ms at 80 dB SPL presented at a rate of 31.4 Hz), interauralWaveVlatency differences greater than 0.2 ms, or nonreplicating onsets or offsets in the cABR. Finally, exclusionary criteria included IQ scores <85 on the vocabulary and matrix design subtests of the Wechsler Abbreviated Scales of Intelligence (WASI; Zhu&Garcia, 1999) and scores <22 (from participants who were age.60) on the Montreal Cognitive Assessment (M°CA; Nasreddine et al., 2005), a screening for cognitive impairment. Participantswere compensated for their time and procedures were approved through the Northwestern University Institutional Review Board.

SIN

Self-Reported SIN Perception

Participants answered questions on the SSQ about hearing performance in various environments using a 10-point Likert scale, ranging from one-on-one listening in a quiet environment to listening to multiple talkers in a

background of other talkers. In addition tomeasuring the ability to understand speech, the questionnaire also measures an individual's self-perception of localization abilities and judgment of sound quality. Because we are primarily interested in speech understanding, we restricted our analysis to the Speech subscale. We mailed the questionnaires to our participants and asked them to fill them out prior to coming to their appointments so that their answers would not be influenced by our testing. The Speech subscale has higher reliability (r = .83) than do the three combined subscales (r = .65) in mailed formats (Singh &Pichora-Fuller, 2010).

Clinical Measure of SIN Perception

We assessed SIN performance with the QuickSIN because of its widespread clinical use and its superior ability to separate performance between groups of participants with normal hearing and groups of participants with hearing impairment compared with other tests containing sentences, such as theBKB-SIN orHINT (Wilson et al., 2007). Four sets of six sentences were presented binaurally at 70 dB HL in a background of four-talker babble noise (three females and one male) through insert earphones (ER-2; Etymotic Research). The first set of sentences was presented at +25 dBsignal-to-noise ratio (SNR), with the SNR decreasing by 5 dB for each subsequent sentence down to 0 dB SNR. Five key words in each sentence were marked as correct or incorrect. The total number of key words repeated correctly in each set of six sentences was subtracted from 25 to obtain the SNR loss in dB, defined as the difference between the individual's SIN threshold and the average SIN threshold (Killion et al., 2004). The SNR loss scores were averaged over the 4 lists to obtain the final SNR loss. A lower SNR loss score indicated better SIN performance.

Electrophysiology

Stimulus. The stimulus was a 40-ms [da] syllable synthesized in KLATT (Klatt, 1980). The stimulus began with a noise burst and was followed by a consonant-to-vowel transition.The fundamental frequency (F0) of the stimulus rose linearly from 103 Hz to 125 Hz. The formant trajectories were as follows: The first formant rose from 220 Hz to 720 Hz, the second and third formants decreased from 1700 Hz to 1240 Hz and from 2580 Hz to 2500 Hz, respectively, and the fourth (3600 Hz) and fifth (4500 Hz) formants remained constant for the duration of the stimulus. The stimulus did not include the steady-state vowel of the syllable, but it was perceived as a consonant-vowel syllable. This stimulus has been used in previous studies examining rate (Krizman, Skoe, &Kraus, 2010), sex differences (Krizman, Skoe, &Kraus, 2012), reading disorders (Banai et al., 2009), and maturation (Johnson, Nicol, Zecker, &Kraus, 2008). Figure 2 displays the stimulus and the grand average response.

An amplified stimulus was used for individuals who had hearing loss greater than 20 dB at any frequency from 125 Hz to 4000 Hz or greater than 25 dB at 6000 Hz or 8000 Hz. Using the National Acoustics Laboratory-Revised algorithm (NAL-R; Byrne &Dillon, 1986), we selectively amplified stimulus frequencies based on individual hearing thresholds in MATLAB (MathWorks).

For individuals with normal hearing, we presented the unamplified [da] stimulus at a rate of 10.9Hz through electromagnetically shielded insert earphones (ER-3A; NatusMedical) at 80.3 dB SPL in the following three conditions: Monaurally (right ear) in quiet, binaurally in quiet, and binaurally in pink noise (+10 dB SNR). For participants with hearing loss, we presented both the amplified and the unamplified [da] stimuli for each of the three conditions (monaurally in quiet, binaurally in quiet, and binaurally in pink noise), making a total of six conditions. We chose the right ear for monaural presentation because right-ear stimulation produces more robust frequency encoding and earlier latencies than does stimulation to the leftear (Hornickel, Skoe,&Kraus, 2009).We presented the [da] stimuli in alternating polarities tominimize stimulus artifact and the cochlear microphonic (Gorga, Abbas, &Worthington, 1985; Russo, Nicol, Musacchia, &Kraus, 2004), an approach that emphasizes the envelope following response (Aiken&Picton, 2008; Campbell, Kerlin, Bishop, &Miller, 2012; Skoe &Kraus, 2010).

Recording.We recorded responses using the Biologic Navigator Pro System (Natus Medical). Prior to each recording, we calibrated the click and [da] stimuli to 80 dB SPL using a Brüel &Kjæ r 2238 Mediator sound level

meter coupled to an insert earphone adapter. We sampled the SPL for each stimulus over 60 s to obtain the average SPL. Responses were recorded via a vertical electrode montage of four Ag-AgCl electrodes (central vertex [Cz] active, forehead ground, and linked earlobes reference) for the binaural recordings and three electrodes (same as described above, with only the right earlobe as reference) for the monaural recordings.We used a criterion of ±23 mV for online artifact rejection. Two blocks of 3,000 artifact-free sweeps were collected in each condition for each participant and averaged using an 85.3-ms window, including a 15.8-ms prestimulus period. The responses were sampled at 12 kHz and were online bandpass-filtered from 100 Hz to 2000 Hz (12 dB/octave).

Data Analysis

We conducted data analysis using established MATLAB routines (Johnson et al., 2008; Krizman et al., 2010). A second observer manually identified and confirmed the onset peak and trough (labeled V and A) and the offset peak (labeled O; see Figure 2). Peaks that were not detectable were marked as missing data points and were excluded from the analysis. To obtain a measure of sharpness of the neural response, we calculated the slope between the onset peak (V) and trough (A). We also obtained a measure of the overall response morphology and neural fidelity to the stimulus by cross-correlating the stimulus and response waveforms, yielding a stimulus-toresponse correlation value. These measures (onset latency and slope, offset latency, and response morphology) were obtained for all six conditions and were labeled as follows:

Monaural

Onset latency: Vlat

Onset slope: VAslope

Offset latency: Olat

Response morphology: STRr

Binaural

Onset latency: Bi_Vlat

Offset slope: Bi_VAslope

Offset latency: Bi_Olat

Response morphology: Bi_STRr

See Table 1 for means and standard deviations of all cABR variables for the monaural, binaural, and binauralin-noise conditions.

Statistical Analysis

To determine the effectiveness of the amplification algorithm, we performed paired t tests between responses to amplified and unamplified stimuli for onset latency (Vlat), offset latency (Olat), VAslope, and morphology STRr.We performed linear regressions, with the average SSQ score (14 items on the speech subscale) entered as the dependent variable and QuickSIN scores, pure-tone average (PTA; average of thresholds from 500-4000 Hz), Age, Vlat, Olat, VAslope, and STRr entered in that order. Using the "Enter" method of multiple linear regression, we specified the order of variable entry to prevent brainstem variables from accounting for the variance that might have otherwise been ascribed to QuickSIN, PTA, and Age. We compared the outputs of the linear regressions for monaural versus binaural presentation conditions to determine the most efficacious protocol.

In all models, we checked residuals for normality to ensure that the linear regression analysis was appropriate for the data set (Kolmogorov-Smirnov Test; M = 0, SD = 0.97, p = .355). We ran collinearity diagnostics with satisfactory variance inflation factor (highest = 2.02) and tolerance (lowest = 0.494) scores, indicating the absence of strong correlations between two or more predictors.

Results

Amplification Algorithm

Monaural presentation. We applied the amplification algorithm in the 50 of 111 cases in which hearing loss

exceeded our criteria for normal thresholds. Stimulus amplification in the monaural presentation resulted in greater onset and offset peak detectability (amplified: 47 of 50 detectable onsets and 44 of 50 detectable offsets vs. unamplified: 38 of 50 detectable onsets and 35 of 50 detectable offsets; Related-Samples McNemar Test: VAslope, p = .031; Olat, p = .004). Comparisons of responses to the unamplified versus amplified stimuli in individuals with hearing loss revealed that VAslope was sharper in the amplified versus unamplified stimuli, t(37) = 2.887, p = .0006: Mamplified = -0.29, Munamplified = -0.25. Although Olat was slightly earlier for the amplified stimuli, the differences were not significant, t(34) = 0.384, p = .703:Mamplified = 48.83ms,Munamplified = 48.91ms. The STRr values did not differ between conditions, although the r value was slightly higher in the amplified condition, t(49) = 0.837, p = .437: Mamplified = 0.113, Munamplified = 0.106. The final number of participants with hearing loss with detectable onsets and offsets was 44. The final total of participants (those with normal hearing and those who were hearing impaired) with detectable onsets and onsets was 104. All individuals with normal hearing had detectable onsets and offsets. Figure 3 compares the average waveforms of participants with hearing loss in response to amplified versus unamplified stimuli.

Binaural presentation. The response to the binaural presentation was robust, with detectable onset peaks in all responses to amplified or unamplified stimuli and little difference in detectability of the offset peaks (amplified: 48 of 50 detectable offsets vs. unamplified: 44 of 50 detectable offsets; Related-Samples McNemar Test: Olat, p = .219). The greatest effects were seen for the onset, with Bi_Vlat earlier and Bi_VAslope sharper in responses to amplified versus unamplified stimuli-Bi_Vlat, t(49) = 3.662, p = .001;Mamplified = 6.62 ms, Munamplified = 6.74 ms; Bi_VAslope, t(49) = 5.250, p <.001,Mamplified = -0.45,Munamplified = -0.37. The Bi_Olat and Bi_STRr values did not differ significantly between conditions: Bi_Olat, t(43) = 1.213, p = .234, Mamplified = 49.17 ms, Munamplified = 49.35 ms; Bi_STRr: t(49) = 0.529, p=600,Mamplified=0.093,Munamplified=0.097. All individuals with normal hearing had detectable onsets and offsets.

Binaural-in-noise presentation. The response to the binaural-in-noise presentation was degraded compared with the responses in binaural quiet and monaural presentations. We found little difference between responses to amplified or unamplified stimuli with equivalent detectability of the onset peaks (36 of 50 detectable onsets to both amplified and unamplified stimuli) and offset peaks (amplified: 36 of 50 detectable offsets vs. unamplified: 39 of 50 detectable offsets; Related-Samples McNemar Test: Bin_Olat, p = 1.00). There were no significant differences between amplified and unamplified measures (Bin_Vlat: p >.1; Bin_VAslope, Bin_Olat, and Bin_STRr: p >.5). We also observed a loss of replicability in the responses of individuals with normal hearing (N = 60; 47 of 60 and 51 of 60 detectable onsets and offsets, respectively).

Multiple Linear Regression

Monaural presentation. Results of multiple linear regression analysis indicated that our selected brainstem variables predicted a greater amount of variance in selfassessed SINperception on theSSQin middle- to older-age adults than did PTA, QuickSIN, and Age. We chose to use the "Enter" method of linear regression, which specifies the order of variables entered into the model. By entering the cABR variables last, we ensured that the cABR variables did not use up the variance that might have otherwise been attributed to PTA, QuickSIN, or Age. Our model (PTA, QuickSIN, Age, Vlat, Olat, VAslope, and STRr, entered in this order) is a good fit for the data, F(6, 103) = 5.982, p <.001, with an R2 value of .306. Only the brainstem variables of Olat and STRr significantly contributed to the variance. Table 2 provides standardized (b) and unstandardized (B) coefficients and levels of significance for the independent variables. In order to disambiguate the contributions of brainstem variables from other measures, we reran the regression hierarchically with PTA, QuickSIN, and Age on the first step and brainstem variables on the second step. The variables on the first step contributed significantly to the variance in SSQ, F(2, 103) = 5.721, p = .001, with an R2 value of .148. The addition of brainstem variables in Step 2 produced a significant change to the variance, R2 change = .158, F(3, 103) = 5.413, p = .001. Table 3 provides standardized coefficients (b), changes in R2, and levels of significance for the variables in Models 1 and 2.

Binaural presentation. Results using the binaural presentation indicated again that selected brainstem variables predicted a greater amount of variance in self-assessed SIN perception on the SSQ than did PTA, QuickSIN, and Age. Our model ("Enter" method: PTA, QuickSIN, Age, Bi_Vlat, Bi_Olat, Bi_VAslope, and Bi_STRr, entered in this order) is a satisfactory fit for the data, $F(6, 103) = 2.608$, $p = .017$, with an R2 value of .170. Only the Bi_STRr significantly contributed to the variance of the model. Table 4 provides standardized (b) and unstandardized (B) coefficients and levels of significance for the independent variables. We reran the regression hierarchically with PTA, QuickSIN, and Age on the first step and brainstem variables on the second step. Again, the variables on the first step contributed significantly to the variance in SSQ, $F(2, 103) = 5.721$, $p = .001$, with an R2 value of .148. However, we found that the addition of brainstem variables in Step 2 did not produce a significant change to the variance, R2 change = .073, $F(3, 103) = 1.964$, $p = .107$. Table 5 provides standardized coefficients (b), changes in R2, and levels of significance for the variables in Models 1 and 2.

Binaural-in-noise presentation. The lack of detectable peaks in individuals with either normal hearing or hearing loss resulted in a total number of 56 of 111 participants who had both detectable onsets and onsets, because some of the participants who had detectable onsets did not have detectable offsets and vice versa. Results of the linear regression indicated that the model including PTA, QuickSIN, Age, Bin_Vlat, Bin_Olat, Bin_VAslope, and Bin_STRr variables was not satisfactory for predicting SSQ, $F(6, 55) = 1.778$, $p = .117$, $R2 = .224$. The results of the binaural-in-noise presentation should be interpreted with caution, however as we did not have the recommended number of participants for performing a linear regression analysis (98; see Green, 1991).

Correlations. Tables 6 and 7 display intercorrelations among the SSQ and the independent variables-monaural cABRvariables in Table 6 and binaural cABRvariables in Table 7. The following variables were related to SSQ: PTA, QuickSIN, Age, monaural onset latency (Olat), and monaural and binaural morphology (STRr and Bi_ STRr). No significant correlations were noted between the SSQ and the binaural-in-noise cABR variables. Scatter plots demonstrating relationships among SSQ and Olat (monaural presentation), QuickSIN, and PTA are presented in Figure 4.

Summary. Brainstem variables (particularly the offset latency and stimulus-to-response correlation) significantly contribute to the variance in self-perception of SIN ability; in fact, they contribute greater variance than either hearing thresholds or QuickSIN scores. The monaural presentation protocol predicted greater variance than did the binaural protocol (Hotelling's t/Stegler's Z: $t103 = 2.05$, $Z = 2.00$, $p < .05$). In individualswith hearing loss, the use of amplified stimuli produced more detectable peaks, sharper onset slopes, and greater overall morphology (stimulus-to-response correlations) than did the use of unamplified stimuli.

Discussion

Our results demonstrate the important role of subcortical function in SIN performance as perceived by the listener. In our model, offset latency and overall morphology of the response waveform made significant contributions to the predictions of self-assessed SIN ability. Our study also revealed that using an amplified stimulus for the cABR produced more replicable waveforms in individuals with hearing loss, thereby reducing the number of participantswho needed to be excluded fromthe analysis. Themonaural protocolwasmost efficacious for predicting SIN perception, likely because ceiling effects in the binauralin- quiet presentation produced robust responses in almost all participants, limiting its ability to differentiate between good and poor SIN perceivers. Onthe other hand, floor-like effects were apparent in the binaural-in-noise presentation in which the noise degraded the neural responses in many participants to such a degree that useful information from the response was limited.

What are the mechanisms underlying the offset latency's importance for successful communication in background noise? Detection of stimulus offsets and onsets contributes to the activation of duration-tuned neurons in the inferior colliculus and at higher levels of the auditory system(Brand, Urban,&Grothe, 2000; Faure, Fremouw, Casseday, &Covey, 2003). Researchers have posited that duration selectivity results from temporal interaction of excitatory and inhibitory inputs that are offset in time (for review, see Sayegh, Aubie,&Faure,

2011). Activation of inhibitory transmitters is essential for duration tuning; for example, when pharmacological inhibitory antagonists are applied, duration tuning is abolished (Casseday, Ehrlich,& Covey, 2000). Caspary et al. (2008) documented the reduction of inhibitory transmitters in the midbrains of older mammals. Taken together, these results suggest that imprecise duration tuning is one of the consequences of aging; in fact, deficits in duration discrimination for tones and gaps in noise have been observed in older versus younger adults (Fitzgibbons &Gordon-Salant, 1994). In addition, duration-tuned neurons are tuned in frequency andamplitude, so that responses of these neurons are highly specific. Therefore, duration-tuned neurons may act as spectrotemporal filters (Sayegh et al., 2011), providing the precise encoding necessary for understanding speech in noise.

The other brainstem factors contributing to variance in SIN perception-reduced onset slope and poorer stimulus-to-response correlation (representing decreased morphology)-can result from temporal jitter or loss of neural synchrony that accompanies aging. The SIN performance of young adults with normal hearing when they listen to temporally jittered speech decreases to the levels expected of older adults (Pichora-Fuller et al., 2007), providing a potential explanation for the older adults' listening-in-noise difficulties.We did not, however, find the expected relationships between age and onset latency (Olat), onset slope (VAslope), and morphology (STRr). The lack of relationship between these variables and age might be explained by the restricted age range in our study, which did not include anyone younger than 45 years. Because onset latencies can be delayed in adults as young as 47 years (Parbery-Clark et al., 2012), the relationship between age and latency might have been obscured by an age-related delay in all of our participants.

Even though the QuickSIN's contribution to the SSQ variance was less than that of the cABR, the QuickSIN and other clinical tests of SIN perception remain an important part of the audiological protocol. In the first author's experience, patients often express satisfaction that their actual difficulty has finally been evaluated after being tested with the QuickSIN.We are not recommending that these tests be dropped from the protocol; rather,we suggest that clinicians beaware of the limitations of a strictly behavioral protocol. Cognitive factors, such as memory or attention, will affect tests results, such as those of the QuickSIN (Parbery-Clark, Skoe, Lam, &Kraus, 2009; Shinn-Cunningham &Best, 2008), and memory and/or attention may be compromised in some older adults (Pichora-Fuller, 2003). Therefore, the clinician should consider the QuickSIN and other SIN test results in the context of the patient's overall function and his or her stated difficulties.

If one accepts that an objective measure of SIN perception is warranted in the assessment of older adults, how can the cABR be incorporated into clinical practice? The protocol for obtaining the measures described in this article requires approximately 20 min (including time for electrode application). While we acknowledge that a typical audiologist cannot routinely extend the assessment time by 20 min, the cABR nevertheless can be considered for inclusion when an individual's reports of hearing difficulty are not reflected in the traditional battery of speech and pure-tone tests. In Figure 5 we provide two examples of cABRs from participants who have good and poor SSQ scores, respectively. While the individual with a better SSQ score has poorer hearing thresholds and QuickSIN score, he has earlier onset and offset latencies, a sharper slope, and better cABR morphology. We envision the use of such measures as informing the clinician of the need to assess suprathreshold auditory function; in the future, a clinicianmight rely on normative values to assess auditory function in an individual patient. For example, the cABR may benefit patientswho are having inordinate difficulties adjusting to their hearing aids, thus helping clinicians determine whether problems with central auditory processing are interfering with patients' ability to benefit from amplification and whether auditory training or assistive listening devices are indicated (for review, see Anderson& Kraus, in press). Because the cABR is highly reliable and consistent over time (Song et al., 2011b), its uses are interpretable on an individual level, suggesting a use for monitoring changes. The cABR has been used to document training benefits in children (Russo, Nicol, Zecker, Hayes, &Kraus, 2005) and young adults (Song, Skoe, Banai, &Kraus, 2012), but more work is needed to determine the cABR's efficacy for predicting and assessing training benefit in older

adults.

We chose to use the SSQ rather than a more direct measure of SINperception, suchas theQuickSIN, because we wanted to address individual self-perception of ability, which is what generally motivates someone to seek help for hearing difficulties. In addition, the SSQ is an approximation of overall, day-to-day SIN performance, as opposed to a one-time test in a clinic. The linear regression model used in this study predicted 30% of the variance in the SSQ, leaving much of the variance attributed to unknown factors. Personality characteristics and occupations likely affect individual answers on the SSQ. The person who works in a noisy area with high communication demands will answer questions differently than would the older, retired individual who spends much of his or her time at home watching television. If we had selected a standardized clinical or laboratory SIN perception measure as our predicted variable, we expect that our model might have predicted more variance because the dependent variable would be somewhat freer of the influence of personality and lifestyle biases. It should be noted that our data set is not typical for patients of an audiologic clinic, in thatmost of themcameto our laboratory to participate in research, not because they were seeking treatment or advice for hearing problems. Nevertheless, many of our participants were motivated to participate in the study because they had noticed some trouble when listening in noise and wanted to participate in a research study before seeking clinical consultation. In the future, we plan to extend this analysis to a clinical population of individuals seeking treatment for hearing loss.

Other factors, such as cortical processing, cognitive function, aging, and general life experiences, would also add to the predicted variance of our model. The auditory cortex can make use of degraded or limited signals and translate them into meaningful input, as is noted in individuals with auditory neuropathy (Kraus et al., 2000) or those who wear cochlear implants (Psarros et al., 2009). Therefore, cortical processing likely contributes significantly to SIN perception. Although age did not significantly contribute to the variance in the SSQ in our data set, it has been established that age-related declines in cognitive function affect clinical and laboratory measures of SIN perception (Gordon-Salant &Fitzgibbons, 1997; Humes, 2007; Pichora-Fuller &Souza, 2003). The ability to compensate for loss of acoustic or linguistic redundancy in unfavorable environments is compromised by age-related decreases in prefrontal lobe function, thus affecting memory, attention, and inhibition of unwanted background noise (Wong, Ettlinger, Sheppard, Gunasekera,&Dhar, 2010). These changes affect performance on clinical measures of SIN perception; for example, workingmemory is related to QuickSIN scores in both young (Parbery-Clark et al., 2009) and older (Parbery- Clark, Strait, Anderson, Hittner, &Kraus, 2011) adults with normal hearing.

Even though SIN perception difficulties are frequently found in older adults, age did not significantly contribute to our model. Deficits in SIN perception are present as early as middle age (ages 45-54; Helfer &Vargo, 2009); therefore, in our data set, self-perception of speech in noise in all of our participants may have been affected by aging to some extent. Finally, life experiences, such as years ofmusical training, offset age-related declines in SIN perception (Parbery-Clark et al., 2011). Therefore, a comprehensivemodel must necessarily include cortical, cognitive, and life experiences in addition to the subcortical and peripheral measures used in this study. Our future work will evaluate interactions among peripheral, central (brainstem and cortical), cognitive, and lifeexperience variables using structural equation modeling.

Conclusion

The cABR provides an objective means for assessing the central processes contributing to SINperception. Our results demonstrate evidence in the cABR of a possible link between neural slowing, as evidenced by delayed offset, reduced morphology, and diminished SIN perception. In the future, this objective test may play a role in the audiological protocol, particularly in patients whose reported hearing difficulties, whether aided or unaided, are greater than would be predicted from traditional audiological measures; therefore, the clinical use of the cABR merits further study. Our analysis also contributes to the understanding of the biological mechanisms underlying SIN perception.

Acknowledgments

This work was supported by an NUCATS Institute CTI Pilot Grant Proposal, National Institutes of Health Grant T32 DC009399-01A10, and by the Knowles Hearing Center. We thank the participants who graciously participated in our testing. We also thank Sarah Drehobl, Jane Hornickel, Trent Nicol, and Karen Chan for their critical review and comments on the article and Sarah Anderson for her assistance with the statistical analysis. We acknowledge the work of Erika Skoe and Sumitrajit Dhar in developing the MATLAB routine and stimulus compensation protocol.

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Editor: Sid Bacon
Associate Editor: Paul Abbas
Received January 31, 2012
Accepted June 5, 2012
DOI: 10.1044/1092-4388(2012/12-0043)

Factors Affecting the Processing of Intensity in School-Aged Children

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Publication info: Journal of Speech, Language and Hearing Research (Online) 56.1 (Feb 2013): 71-80.
ProQuest document link

Abstract: Thresholds of school-aged children are elevated relative to those of adults for intensity discrimination and amplitude modulation (AM) detection. It is unclear how these findings are related or what role stimulus gating and dynamic envelope cues play in these results. Two experiments assessed the development of sensitivity to intensity increments in different stimulus contexts. Thresholds for detecting an increment in level were estimated for normal-hearing children (5- to 10-year-olds) and adults. Experiment 1 compared intensity discrimination for gated and continuous presentation of a 1-kHz tone,with a 65-dB-SPL standard level. Experiment 2 compared increment detection and 16-Hz AM detection introduced into a continuous 1-kHz tone, with either 35- or 75-dB-SPL standard levels. Children had higher thresholds than adults overall. All listeners were more sensitive to increments in the continuous than the gated stimulus and performed better at the 75- than at the 35-dB-SPL standard level. Both effects were comparable for children and adults. There was some

evidence that children's AM detection was more adultlike than increment detection. These results imply that memory for loudness across gated intervals is not responsible for children's poor performance but that multiple dynamic envelope cues may benefit children more than adults.

Full text: Headnote

Purpose: Thresholds of school-aged children are elevated relative to those of adults for intensity discrimination and amplitude modulation (AM) detection. It is unclear how these findings are related or what role stimulus gating and dynamic envelope cues play in these results. Two experiments assessed the development of sensitivity to intensity increments in different stimulus contexts.
Method: Thresholds for detecting an increment in level were estimated for normal-hearing children (5- to 10-year-olds) and adults. Experiment 1 compared intensity discrimination for gated and continuous presentation of a 1-kHz tone,with a 65-dB-SPL standard level. Experiment 2 compared increment detection and 16-Hz AM detection introduced into a continuous 1-kHz tone, with either 35- or 75-dB-SPL standard levels.
Results: Children had higher thresholds than adults overall. All listeners were more sensitive to increments in the continuous than the gated stimulus and performed better at the 75- than at the 35-dB-SPL standard level. Both effects were comparable for children and adults. There was some evidence that children's AM detection was more adultlike than increment detection.
Conclusion: These results imply that memory for loudness across gated intervals is not responsible for children's poor performance but that multiple dynamic envelope cues may benefit children more than adults.
Key Words: children, psychoacoustics, hearing, development

Studies of auditory intensity discrimination in children have introduced a wide range of possible developmental trends. For example, Berg and Boswell (2000) reported adultlike performance by 3 years of age, whereas others have reported a protracted period of development up to or beyond 10-12 years of age (e.g.,Maxon &Hochberg, 1982). One procedural factor that could play an important role in the variability across studies is the use of gated versus continuous stimuli (Berg &Boswell, 2000;Werner &Marean, 1996). For a gated stimulus, the listener must retain a memory of the loudness associated with each interval and compare percepts across intervals separated in time. In the case of a continuous stimulus, on the other hand, the task can be performed based on detecting a within-interval change in loudness.Detecting an intensity increment in an ongoing sound does not require the listener to compare the loudness associated with stimuli in separate intervals, potentially reducing the memory requirements of the task. This study sought to clarify the role of memory in the development of intensity discrimination in school-aged children.

For intensity discrimination tasks with two or more gated intervals, performance in adults is thought to rely on two types of memory: sensory and context coding (Durlach &Braida, 1969). Sensory memory is a vivid, modalityspecific memory which lastsÈ10-20 s after stimulus exposure and decays in a logarithmic fashion (Cowan, 1988; Laming &Scheiwiller, 1985). Context coding, on the other hand, is associated with a more stable memory trace, in which some sensory detail is lost; it is based on a comparison of the target stimulus with previously presented stimuli. Berliner and Durlach (1973) measured intensity discrimination in adults for pairs of tones as a function of the intertone delay, with the level of the standard tone either fixed or roved in an unpredictable way on a trialby- trial basis. They found that the delay between pairs of tones in a trial had a larger effect when the standard level was roved than when it was fixed. This result is consistent with the idea that the decay of sensory memory has a large effect when level rove requires the listener to compare stimuli within a trial. In the absence of rove, however, listeners seem to rely in part on context coding, which reduces their susceptibility to memory decay.

Performance on a wide range of memory tasks improves over childhoodand into early adolescence (Gathercole, 1998), including tasks relying on sensory memory. For example, Keller and Cowan (1994) showed a difference

between 6- to 7-year-olds and adults in a task relying on sensory memory for tone pitch. That study involved two stages of testing. In the first stage, pairs of tones separated by 2 s were presented, and their frequency separation was adjusted to estimate the frequency difference (Df) associated with 84% correct. In the second stage, the Df for each listener was fixed, and the duration of the intertone interval was adjusted to estimate points on the psychometric function associated with 84% and 71% correct. The 84% threshold was near 2 s for all listeners, as expected based on the first stage of testing.The71%threshold, however,was significantly shorter for the 6- to 7-year-olds than the adults. This result was interpreted as reflecting a more rapid decay of sensory memory for pitch in young children than adults. In a subsequent study, Gomes et al. (1999) showed an analogous effect by using mismatch negativity, supporting the idea that maturation in the persistence of sensory memory for pitch is independent of attention or strategy. Although there are fundamental differences in sensory memory for pitch and loudness (e.g., more rapid decay in memory for loudness; Clement, Demany, &Semal, 1999), it is possible that sensorymemory for loudness follows a similar developmental time course to that observed for pitch.

In addition to maturation of sensory memory, development in the ability to carry out context coding could limit the performance of young children in intensitybased psychoacoustic tasks. Context coding is an active process, requiring attention, reliance on accumulated knowledge, and the use of specific listening strategies (Durlach &Braida, 1969). These factors have been implicated in the development of short-term memory, generally (Chi, 1976; Cowan, Saults, &Elliott, 2002), and they could play a significant role in performance of gated intensity discrimination. Further, immature sensory memory could reduce the attentional resources available for cognitive processing (Gomes et al., 1999), including resources associated with context coding.

Expressed in 10 log(DI/I), intensity discrimination in adult listeners is on the order of 4.5 dB better for continuous than gated stimuli (Green, Nachmias, Kearney, &Jeffress, 1979; Viemeister &Bacon, 1988). Although this effect is not completely understood, one possibility is that it is related to the introduction of dynamic cues that reduce reliance on memory for loudness. The effect of stimulus gating on intensity discrimination in children is not known, but it is possible that the maturation of auditory memory for loudness could affect children's performance differently for gated and continuous stimuli. Some support for this hypothesis is garnered by reports that 3-year-olds are nearly adultlike at detecting increments in a continuous 55-dB-SPL, two-octave band of noise (Berg &Boswell, 2000), whereas intensity discrimination for a gated pure tone continues to develop well into childhood (Fior &Bolzonello, 1987; Jensen&Neff, 1993; Maxon&Hochberg, 1982).

Detection of amplitude modulation (AM) that is sufficiently low in rate to be temporally resolved by the auditory system is similar to intensity increment detection, in that both tasks are based on changes in stimulus level over time. As the rate of modulation increases, sensitivity toAMfor a gated noise carrier declines (Viemeister, 1979), a result that is interpreted in terms of temporal resolution. Hall and Grose (1994) reported that although 4- to 10-year-old children are less sensitive to AM of a noise carrier than adults, thresholds worsen as a function of increasing AM rate similarly in the two groups. In other words, the time constant associated with AM detection is similar in young school-aged children and adults. In conjunction with developmental effects for intensity discrimination, this observation is consistent with the hypothesis that both intensity discrimination and AM detection are limited by sensitivity to changes in intensity, with no additional developmental effects in temporal processing of AM.

Wojtczak and Viemeister (1999) demonstrated a strong relationship between increment detection and AMdetection in adults. That study measured increment detection and detection of low-rateAMwith a continuous pure tone at several stimulus levels. Increment-detection thresholds, in units of 10 log(DI/I), were linearly related to AM-detection threshold, in units of 20 log(m), wheremis a value 0-1 that represents modulation depth. This finding suggests that AM may be detected based on the discriminability of stimulus intensities at different points in the stimulus envelope and not so much based on the dynamic transitions between these intensities. That is, envelope fluctuation itself may not be important in the detection of AM, apart from considerations related to

temporal resolution. In contrast to this view, several groups have proposed that dynamic envelope changes are of critical importance to both AM detection and the detection of a level increment (Gallun &Hafter, 2006; Oxenham, 1997). In Gallun and Hafter (2006), adults detected an intensity increment imposed in the temporal center of a relatively long-duration tonal pedestal. Sensitivity was reduced by the introduction of AMmaskers that were either at the target frequency or more than two octaves above the target frequency. These results were shown by Gallun and Hafter (2006) to be consistent with the use of dynamic transition cues, modeled using a modulation filterbank. In that modeling approach, detection was based on the outputs of bandpass filters acting on the stimulus envelope. Regardless of the exactmechanismresponsible, the results of Wojtczak and Viemeister (1999) and Gallun and Hafter (2006) support the view that AM detection and increment detection are closely related and likely rely on similar processes.

The present set of experiments sought to clarify the factors responsible for relatively poor intensity discrimination in school-aged children compared with adults. The first experiment assessed the role of stimulus gating in the development of intensity discrimination abilities by comparing performance for gated stimuli and for continuous presentation of the standard tone. If memory for loudness is a major contributor to the developmental effect observed for gated stimuli, then presenting the pedestal continuously should be more beneficial for child listeners than adult listeners. The second experiment tested the hypothesis that intensity discrimination and AM detection are limited by the same factors in children and adults. If this is incorrect and children benefit more from dynamic cues than adults-as they might if memory for loudness were a limiting factor-then this would be reflected in relatively better AM detection than intensity discrimination for children. An ancillary goal of this experimentwas to evaluate the effect of level of the standard tone in the developmental effect observed for intensitybased tasks. Intensity discrimination for a pure tone improves as a function of signal level in adults, a result often attributed to spread of excitation and greater numbers of auditory channels providing cues to changes in intensity at higher presentation levels (e.g., Florentine &Buus, 1981). Some data indicate a maturation in the level effect for intensity discrimination (Maxon &Hochberg, 1982), with relatively greater benefit of increasing stimulus level in younger children. However, it is unknownwhether presentation level affects increment detection and AM detection in an analogous way for children and adults.

Experiment 1

Method

Listeners. Child listeners were 5.2 to 9.0 years of age (M= 7.1 years), including 10 boys and six girls. Adult listeners were 19.8 to 51.7 years of age (M = 29.9 years), including five men and six women. All had normal hearing, defined as thresholds of 15 dB HL or better at octave frequencies 250-4000 Hz (American National Standards Institute [ANSI], 2010).

Stimuli. Stimuli were generated using a real-time processor (RP2, Tucker-Davis Technologies [TDT]), with dynamic parameters and experimental procedures controlled by MATLAB. Sounds were played out at a rate of 12.2 kHz(RP2,TDT), routed through a headphone buffer (HB7, TDT) and presented diotically with circumaural headphones (Sennheiser, HD650).

The stimulus was a 1-kHz pure tone, played at a level of 65 dB SPL in the standard (no-signal) intervals, and the listener's task was to indicate the interval associated with a level greater than 65 dB SPL. The increment was 500 ms in duration, including 25-ms raised-cosine ramps, and it was defined in units of 10 log(DI/I). In the continuous condition, the standard tone played throughout a threshold estimation track, and the increment was gated on in the signal interval. In the gated condition, either the standard or the standard plus increment was gated on for 500 ms.

Procedures. Trialswere presented as a three-alternative forced choice. Although a three-alternative task could tax the listener'smemorymore than a one- or two-alternative task, this procedure is often used in studies with children because it does not require a sophisticated understanding of the perceptual features of the target signal. Rather than describing the qualities of the signal, the instructions are just to select the interval that

sounds different from the other two, a task that is easily understood by almost all typically developing school-aged children. A 2-down 1-up stepping rule was used to estimate threshold, defined as the 71% correct point on the psychometric function (Levitt, 1971). Increment intensity was initially adjusted in 4-dB steps, reduced to 2 dB after the second track reversal, and tracks continued until eight reversals had been obtained. A threshold estimate was the average increment at the last six track reversals. Three such estimates were obtained and assessed for variability. If the initial three estimates spanned a range of 3 dB or more, then a fourth was collected. All thresholds in a condition were completed in a single block, and conditions were completed in random order. All estimates were averaged to compute the final threshold estimate for each listener in each condition. Listeners viewed an animated sequence marking the listening intervals, entered their responses on a touchscreen, and received only positive feedback. All methods were approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

Results

Figure 1 shows the distributions of intensity discrimination thresholds for each group (as indicated on the abscissa) and each condition (as indicated above each panel). Median values are plotted with horizontal lines, boxes span the 25th-75th percentiles, vertical lines indicate the 10th-90th percentiles, and circles showthe minimum and maximumthresholds. Visual inspection of this figure indicates that thresholds were higher in children than adults and higher for the gated than the continuous stimulus but that the effect of gating was uniform across subject groups. This was confirmed with a repeated-measures analysis of variance (ANOVA), incorporating two levels of group (child, adult) and two levels of condition (continuous, gated). There was a significant main effect of group, $F(1, 25) = 18.20$, $p < .001$, and of condition, $F(1, 25) = 241.65$, $p < .001$, but no interaction,$F(1, 25) = 0.62$, $p = .440$.

Both groups were affected equally by gating when thresholds were represented in units of 10 log(DI / I). Intensity discrimination thresholds can be represented a number of different ways, however (Grantham &Yost, 1982; Green, 1988). The question of howbest to characterize psychophysical intensity discrimination has received significant attention in the literature, with different studies supporting the use of 10 log(DI/I), 20 log(Dp/p), and DL (e.g., Buus&Florentine, 1991; Moore, Peters,&Glasberg, 1999; Shepherd &Hautus, 2007).1 Statistical analyses indicated that the interaction between group and condition was not statistically significant when thresholds were expressed in terms of 10 log(DI/I) or 20 log(Dp/p). The interaction was significant, however,when units of DLwere used, $F(1, 25) = 10.90$, $p = .003$, with a larger effect of group for gated than for continuous stimuli. There are reasons to prefer units of 10 log(DI/I) over units of DL in the present data set. Box's test indicated that covariance matrices were not significantly different across data sets in units of 10 log(DI/I),$M = 1.39$, $p = .739$, but theywere different when assessed in units of DL,$M = 10.34$, $p = .025$. On the basis of this observation, units of 10 log(DI/I) were used to characterize intensity discrimination in the remainder of this article.

Figure 2 shows intensity discrimination thresholds for individual child listeners, plotted as a function of age. Mean adult data are shown at the far right of the graph, with error bars spanning ±1 SD. Symbol style reflects the stimulus condition, as defined in the legend, and vertical lines connect data points of individual listeners. In addition to the significant difference in thresholds across groups, there was also modest evidence of a developmental trend within the child group. Using a one-tailed significance criterion, the correlation with child age was significant for thresholds in the gated condition ($r = -.50$, $p = .023$) and for thresholds in the continuous condition ($r = -.45$, $p = .041$). The finding of a robust correlation between thresholds in these two conditions ($r = .77$, $p < .001$) suggests that individual differences may be a more important determinant of sensitivity than listener age. This possibility receives additional support from the finding of a significant partial correlation between thresholds in the gated and continuous conditions after controlling for child age ($r = .70$, $p = .002$, one-tailed). There was no correlation between the gated-continuous difference and child age ($r = -.09$, $p = .36$, one-tailed), indicating that there was no development in the ability to benefit from continuous stimulus presentation

within the child group.

Discussion

Intensity discrimination thresholds for a 500-ms 1-kHz tone are better for adults than school-aged children.Thresholds as a function of child age tended to improve over the range tested here (5-9 years), but this effect was modest. Robust correlations in the child data across conditions indicated consistent individual differences that are not accounted for by age. This finding suggests that although sensitivity improves over the age range tested here, there are individual differences in the time course of this development. This would be consistent with our previous data on pure-tone intensity discrimination in this age range (Buss, Hall, &Grose, 2006) and with the observation that particularly large individual differences are often observed at ages associated with rapid development (Werner &Gray, 1998).

Presenting the stimuli in gated intervals rather than in the context of a continuous stimulus elevates thresholds, but this effect is comparable for adults and children when results are represented in units of 10 log(DI/I). Previous work on intensity discrimination in adult listeners has demonstrated better performance for continuous than gated stimuli, with differences of 4.6 dB (Viemeister &Bacon, 1988) and 4.2 dB (Green et al., 1979) under conditions comparable to those of this study. These effects are similar to the average gated-continuous differences obtained with adults (4.9 dB) and children (5.4 dB) in this experiment.

There are several possible explanations for the gated- continuous difference in adult listeners (reviewed by Turner, Zwislocki, &Filion, 1989). One is that presenting the stimulus continuously leads to loudness adaptation, such that there is better ability to encode a subsequent increase in intensity. There is no reason to believe that loudness adaptation differs in school-aged children and adults (Baruch, Botte, &Scharf, 1993). Therefore, adaptation is unlikely to introduce age effects in the tasks of this experiment. Another explanation for the gated-continuous difference is the extra memory requirement associated with a gated stimulus (Durlach&Braida, 1969). Results of this study do not support the hypothesis that memory for loudness, necessary for across-interval comparisons, limits the performance of children more than that of adults. This leaves open the possibility that the neural representation of intensity in the central auditory system is more variable in children than in adults, a hypothesis considered by Buss et al. (2006).

Experiment 2

The goal of Experiment 2 was to assess the parallel between the developmental effects observed for intensity discrimination andAMdetection. In adult listeners,Wojtczak andViemeister (1999) demonstrated a linear relationship between increment detection and the detection of lowrate AM, with performance improving in both tasks as the presentation level is increased. This result suggests that the perceptual cues supporting performance of these two tasks may be highly related. It was hypothesized that the same relationship would hold for child listeners. This prediction is based on the finding in Experiment 1 that children benefit to a comparable degree as adults from the introduction of dynamic cues for intensity discrimination with the use of continuous, rather than gated, stimuli.

Method

Listeners. Child listeners were 5.4 to 9.5 years of age (M= 7.1 years), including eight boys and eight girls. Adult listeners were 17.9 to 43.1 years of age (M = 25.0 years), including five men and six women. All had normal hearing, defined as thresholds of 15 dB HL or better at octave frequencies 250-4000 Hz (ANSI, 2010). One of the child listeners had previously participated in Experiment 1.

Stimuli. Stimulus generation and presentation followed the procedures described for Experiment 1 (above), with the exception that stimuli were presented monaurally to the leftear. In the increment-detection conditions, the standard stimulus was a continuous 1-kHz pure tone played at a level of 35 or 75 dB SPL, and the listener's task was to indicate the interval associated with an intensity increment, defined in units of 10 log(DI/I). Each increment was 500 ms in duration, including onset and offset ramps. Ramps were 15.6-ms raised cosines, resembling the onset of the first period of modulation in the AM-detection task.

For amplitude modulation detection, modulation was achieved by multiplying a 1-kHz tone with a raised 16-Hz sinusoid, and the result was scaled to either 35 or 75 dB SPL. Modulation began and ended at envelope values associatedwith the standard intensity, with no further smoothing or ramping. In all cases, modulation began with a positive slope (i.e., approximately sine phase), such that the first envelope maximum occurred approximately 15.6 ms after modulation onset (onequarter of a period of 16-Hz AM). Target modulation lasted for approximately 500 ms and was embedded in a continuous tone. This listener's task was to indicate the interval associated with the amplitude-modulated stimulus. Modulation depth was defined in units of 20 log(m).

Procedures. Procedures closely followed those of Experiment 1. Thresholds were obtained in blocks by condition. At least three estimates were obtained in each condition, and a fourth was taken when the first three spanned a range of 3 dB or more. Conditions were completed in random order.

Results

Thresholds are plotted in Figure 3, with individual child listeners' results plotted as a function of age. The mean adult thresholds are plotted at the far right of each panel, with error bars spanning ±1 SD. Symbols reflect the level of the standard, as indicated in the legend, and data for each child are connected with a vertical line. The two panels show results for increment detection (top) and AM detection (bottom).

Increment detection is considered first. For both levels, mean thresholds for child listeners were poorer than those for adults. This difference was, on average, 3.0 dB for the 35-dB level and 2.8 dB for the 75-dB level. This is comparable to the 3.5-dB difference across groups observed in Experiment 1 for the continuous stimulus presented at 65 dB SPL. Age group differences were assessed by using a repeated-measures ANOVA, with two levels for each of two variables: level (low, high) and group (child, adult). This analysis confirmed a main effect of group, $F(1, 27) = 29.06$, $p = .001$. There was also a main effect of level, $F(1, 27) = 111.33$, $p < .001$, but there was no interaction between group and level, $F(1, 27) = 0.04$, $p = .849$. This result indicates that the detection advantage associated with the higher level standard was not significantly different in child and adult listeners, with an across-group average difference of 4.2 dB-SPL between the 35- and 75-dB-SPL thresholds. The data were examined for effects of age within the child group by performing an analysis of covariance (ANCOVA), with level as a between-listener variable and child age as a within-listener variable. The effect of age and the Level X Age interaction failed to reach significance (p . .138).

The bottom panel of Figure 3 shows results of the AMdetection task. Thresholds for child listeners were poorer than adults' thresholds at both standard levels, with mean differences of 3.9 dB and 2.6 dB for the 35- and 75-dB-SPL levels, respectively. Age-group differences were assessed by using a repeated-measures ANOVA, with two levels for each of two variables: level (low, high) and group (child, adult). There was a main effect of group, $F(1, 27) = 6.48$, $p = .017$, and amain effect of level,$F(1, 27) = 148.98$, $p < .001$, but no interaction between group and level, $F(1, 27) = 0.61$, $p = .443$. As in increment detection, children performed more poorly than adults, but they benefited from increasing the level of the standard stimulus to the same degree. The average difference between thresholds for the 35- and 75-dB-SPL stimulus levels was 10.7 dB. The data were examined for effects of age within the child group by performing an ANCOVA. The effect of age and the Level X Age interaction failed to reach significance in this analysis (p . .394).

Figure 4 shows individual listener's incrementdetection thresholds plotted as a function of their AMdetection thresholds. Symbols indicate the level of the standard stimulus, as defined in the legend. Data for the two groups are plotted in separate panels. Lines were fitted to the data in each group by minimizing the sum of the squared error. The solid lines in both panels are the best fit to adult data, and the dotted line is the best fit to child data. The slopes fitted to these data are similar across groups, with values of M = 0.37 for adult data and M = 0.32 and for child data. This is somewhat lower than the value of 0.44 reported by Wojtczak and Viemeister (1999) for adults tested under comparable stimulus conditions. The y-intercept differs across groups. For adult data, the intercept is .0.33 dB, and for child data, it is 0.45 dB. These age effects are similar to those observedwhen lines are fitted to group mean data.

We assessed the significance of differences in line fits to adult and child data by fitting child data using the parameters that characterize adult data and then examine the residuals. Therewas no significant association between residuals and thresholds in theAM-detection task, $F(1, 30) = 1.47$, $p = .234$, indicating that the slope of the data was well fitted by the adult slope estimate. The mean of the residuals was significantly different from zero, $t(31) = 5.80$, $p < .001$, however, reflecting the fact that the intercept fitted to adult data was not an optimal fit to the child data. These results can be interpreted as showing that the developmental effect is relatively greater for increment detection than for 16-Hz AM detection in the context of continuously presented stimuli.

Discussion

Increment-detection thresholds measured in this experiment improved with level of the standard. For adults, mean thresholds were -6.2 and -10.4 dB at 35 and 75 dB SPL, respectively. For children, these values were -3.3 and -7.6 dB, respectively. These level effects can be compared with those reported by Rabinowitz, Lim, Braida, and Durlach (1976), who compiled data of 15 studies that measure intensity discrimination as a function of stimulus level for a 1-kHz tone. On the basis of that review, the average expected change in thresholds between 35 and 75 dB SPL is on the order of 2.5 dB. This is less than the approximately 5-dB change found by Wojtczak and Viemeister (1999) and the 4.6-dB change obtained in this study. Threshold improvement with increasing level has been described as the near miss to Weber's lawbecause sensitivity to intensity increments is not constant relative to the level of the standard. It is widely accepted that the near miss is due to greater spread of excitation at higher stimulus levels and, hence, a wider range of frequencies providing cues to changes in intensity (e.g., Florentine &Buus, 1981). These results suggest that whereas school-aged children performmore poorly overall, they benefit fromthese additional cues to the sameextent as adult listeners.

Previous data on the effect of stimulus level for intensity discrimination have shown that younger listeners tend to perform particularly poorly for low-level stimuli, such that the age effect is largest at the lowest presentation levels. Berg and Boswell (2000) measured increment detection for two-octave bands of noise in 1- to 3-year-olds and adults, and they found a greater age effect at lowthan at high presentation levels. Maxon and Hochberg (1982) found an analogous result for gated intensity discrimination of a 500-Hz tone. In a comparison of results across a group of 4- to 12-year-olds, the age effect was largest at the lowest stimulus level, equated in dB SL. However, this age effect was dominated by the pronounced effect of level for the youngest group of listeners (4-year-olds); level effects were nearly identical for 6- to 12-year-olds. Data from this and previous studies are consistent with the conclusion that level effects reach maturity between 4 and 6 years of age.

Like increment detection, AM-detection thresholds improved with increasing level in both groups, with an average difference of 10.7 dB between thresholds at the 35- and 75-dB-SPL presentation levels. This result is consistent with previous literature on adults (Kohlrausch, 1993; Wojtczak &Viemeister, 1999). As for increment detection, AM detection was worse for child listeners than for adult listeners, with a mean group difference of 3.3 dB. These results can be compared with those of Hall and Grose (1994), who reported a significant age effect for AM detection. In that study, the stimulus was a continuous 75-dB-SPL Gaussian noise, bandpass filtered between 200 and 1200 Hz, and modulation was achieved through multiplication with a raised sinusoid. AM-detection thresholds improved as a function of age: the child-adult difference was approximately 3.6 dB for 6- to 7-year-olds, the mean age of listeners in the present experiment. That age effect for a noise carrier is consistent with these results for a pure-tone carrier.

The relationship between AM detection and intensity discrimination for a continuous tone in the child data follows the same general trend as described previously in adult data-better sensitivity to AM is associated with better sensitivity to intensity increments (Wojtczak &Viemeister, 1999). There is evidence that AM detection may be less prone to developmental age effects, however, reflected in the offset in the intercept of the line relating these two variables. One reason for this could be related to the number of opportunities to hear a dynamic change in stimulus intensity; the AM-detection task provides multiple opportunities to detect dynamic changes in intensity, whereas the increment-detection task is associated with dynamic changes only at increment onset

and offset. This explanation suggests that envelope fluctuation itself may be an important factor in children's AM detection, as contrasted with comparisons of stimulus intensities at different points in the stimulus envelope. The ability to benefit from multiple dynamic envelope transitions could be related to the benefit of "multiple looks," which is described in studies of temporal integration (Viemeister &Wakefield, 1991). There is some indication that children experience more temporal integration than adultswhen detecting a 1625-Hz tone (He, Buss, &Hall, 2010), and it is possible that integration of multiple looks in AM detection follows a similar trend.

General Discussion and Conclusion

At the outset of this study, it was hypothesized that children's intensity discrimination thresholds could be limited by memory to a greater extent for gated than for continuous stimuli. These limits could include immaturities in sensory memory, the ability to carry out context coding, or some combination of these factors. As previously observed in adults, intensity discrimination was better when the standard played continuously than when it was gated on and offin each listening interval. This benefit was seen to a comparable degree in the data of both adults and school-aged children. Because the continuous presentation introduces a within-interval cue, this result suggests that development of memory for loudness across intervals is not responsible for children's poor performance with gated stimuli. One possibility is that both sensorymemory and context coding for intensity are mature in school-aged children. Another possibility is that such differences do exist but that other factors dominate the results of the present experiments. For example, whereas continuous presentation alleviates demands on the listener's memory for loudness, the listener must select from among three possible signal intervals. Near threshold, the ability to identify the target interval is improved by comparing cue strength across intervals. Development could affect the accuracy of this comparison. In either case, our results imply that the large variability in developmental data for intensity discrimination (Experiment 1 of this article; Buss, Hall, &Grose, 2009) cannot be attributed to the use of gated versus continuous stimuli.

One generalization that might be drawn from the results of the first experiment is that dynamic, withininterval cues for intensity discrimination have a similar effect on children and adults. This conclusion is not fully consistent with results of the second experiment, however. For a continuous stimulus, detection of 16-Hz AM was relatively better in children than adults when compared with increment detection. That is, the more dynamic envelope changes characterizing the AM stimulus were easier for the children to detect than the relatively more stationary intensity increment. Therefore, a comparable gated-continuous difference across age groups (Experiment 1) is consistent with the adultlike ability to benefit from dynamic envelope cues, but the relatively good performance onAMdetection in children (Experiment 2) seems to indicate maturation of that ability.

One way to resolve this apparent conflict is to propose a different process for exploiting onset cues present for increment detection and modulation cues present for AM detection. There is a linear relationship in the data obtained for these measures within listener groups (Experiment 2, Figure 4;Wojtczak &Viemeister, 1999), but there could nonetheless be important differences in the cues underlying these two tasks. Modeling work using the modulation filterbank speaks against this possibility, supporting the idea that increment detection and AM detection are based on the same underlying cues. However, this modeling has typically used relatively brief signals (e.g., <100 ms; Gallun &Hafter, 2006), and it is unclear whether these results would hold for longer duration stimuli (e.g., the 500 ms used in the present experiments). Better performance in AM detection might occur if children benefit to a greater degree than adults from multiple looks for dynamic envelope features. Increment detection in a continuous stimulus provides a pair of dynamic cues (an onset and offset), whereasAMdetection for a 16-Hz rate provides eight such pairs of cues in a 500-ms listening interval. It has been proposed that integration of cues across modulation periods for continuous stimuli may not be optimal in adults because of temporal stimulus uncertainty regarding the onset of modulation (Sheft& Yost, 1990); one possibility is that children are more prone to overintegration than adults, leading to a larger benefit for stimuli with ongoing AM. Greater integration of dynamic envelope cues in children is broadly consistent with the finding of greater temporal integration for detection of tones in children under some conditions (He et al.,

2010).However, additional data onthe temporal integration of AM would be required to confirm this interpretation.

Acknowledgments

Thiswork was supported by National Institute onDeafness and Other Communication Disorders Grants R01 DC000397 and R01 DC007391. A subset of data was presented at the 29th Midwinter Research Meeting of the Association for Research in Otolaryngology in Baltimore, Maryland (February 2006).

Footnote

1Units of DL are equivalent to 10 log([I +DI]/I).

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Editor: Sid Bacon
Associate Editor: Majorie Leek
Received January 1, 2012
Accepted June 29, 2012
DOI: 10.1044/1092-4388(2012/12-0008)

Patents; Agency Reviews Patent Application Approval Request for "Feedback Control in a Listening Device"

Publication info: Telecommunications Weekly (Jan 16, 2013): 801.
ProQuest document link

Abstract: Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent: "When an actuation element on a listening device (e.g. a hearing aid) located at or behind the ear of a user is activated by the user's hand, it is expected that the hand will be removed as soon as the user has performed the intended action, e.g. changed to a desired program or modified another setting, e.g. volume.

Full text: 2013 JAN 16 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- A patent application by the inventors PEDERSEN, Michael Syskind (Smorum, DK), filed on June 26, 2012, was cleared for further review on January 3, 2013, according to news reporting originating from Washington, D.C., by VerticalNews correspondents.

Patent application serial number 533293 has not been assigned to an institution or company.

The following quote was obtained by the news editors from the background information supplied by the inventors: "The following account of the prior art relates to one of the areas of application of the present application, hearing aids.

"Two different ways exist for changing programs/volume in a hearing aid. This is illustrated in FIG. 1. One way is to use a button at the hearing aid (FIG. 1a). The other way is to wirelessly change the program/volume through an external device such as a remote control (FIG. 1b). The difference is that the local acoustics around the hearing aid changes while the hand is near the ear (pressing an activation element on the hearing aid, FIG. 1a), but the local acoustics is unlikely to change in the other case where the hand is far from the hearing aid (on the remote control, FIG. 1b). When the local acoustics changes, the feedback path will change. This may result in howling.

"EP 2 148 525 A1 describes a hearing instrument comprising a codebook of plausible feedback channel impulse responses (or any equivalent representation) and to make them available for selection and use by a signal processing unit in the appropriate listening situation, e.g. by storing them in a memory of the hearing instrument."

Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent: "When an actuation element on a listening device (e.g. a hearing aid) located at or behind the ear of a user is activated by the user's hand, it is expected that the hand will be

removed as soon as the user has performed the intended action, e.g. changed to a desired program or modified another setting, e.g. volume. In this situation, the feedback cancellation filter update algorithm is preferably adapted to not react on the acoustic changes caused by the manual operation of the activation element, because the acoustics is expected to change back to normal after a short while (where 'normal' typically will be the situation a (possibly short) while before the activation by the user of the actuation element, i.e. while the user's hand is approaching the hearing aid). When the program change (or other modification of a setting of the hearing aid) is done wirelessly, no local acoustic changes are expected, and the hearing aid feedback cancellation filter estimation should be adapted to its normal update routine. The present invention is related to the physical change of the local acoustic environment caused by a user's operation of an activation element on the listening device, rather than to the functional effect of the operation of the activation element in the listening device (e.g. a program change, a volume change, etc.).

"An object of the present application is to provide an improved control mechanism for an adaptive filter.

"Objects of the application are achieved by the invention described in the accompanying claims and as described in the following.

"A Listening Device:

"In an aspect of the present application, an object of the application is achieved by a listening device adapted for being located in or at an ear of a user and comprising an input transducer for converting an input sound to an electric input signal; and an output transducer for converting a processed electric signal to an output sound; a forward signal path being defined there between and comprising a signal processing unit for processing the electric input signal or a signal derived therefrom and providing a processed output signal; a manually operable user interface located at or on the listening device allowing a user to control a function of the listening device; a feedback estimation system for estimating a feedback path from the output transducer to the input transducer, the feedback estimation system comprising an adaptive filter, the adaptive filter comprising a variable filter part, and an algorithm part comprising an adaptive algorithm, the variable filter part being adapted for providing a transfer function to a filter input signal and providing a filtered output signal, the transfer function being controlled by filter coefficients determined in the algorithm part and transferred to the variable filter part, the feedback estimation system further comprising an update control unit adapted for controlling the adaptive algorithm including the transfer of filter coefficients to the variable filter part, wherein the update control unit is adapted to monitor the manually operable user interface and to provide that an activation of the manually operable user interface is used for influencing the control of the adaptive algorithm.

"This has the advantage of providing a scheme for handling the risk of howl during manual operation of a listening device adapted for being located at or in an ear of a user.

"The term 'used for influencing the control of the adaptive algorithm' is in the present context taken to include the delay or omission or change of an action related to the adaptive algorithm that would otherwise have been performed in the listening device (had the user not activated the user interface). The 'control of the adaptive algorithm' may e.g. relate to the timing of the calculation or re-calculation of filter coefficients (and/or to change of the adaptation rate of the adaptive algorithm) and/or to the transfer of filter coefficients from the algorithm part to the variable filter part.

"In an embodiment, the listening device comprises an analysis path (in parallel to the forward signal path) comprising functional components for analyzing the input signal (e.g. determining a level, a modulation, a type of signal, an acoustic feedback estimate, etc.). In an embodiment, some or all signal processing of the analysis path and/or the signal path is conducted in the frequency domain. In an embodiment, some or all signal processing of the analysis path and/or the signal path is conducted in the time domain.

"The listening device comprises an adaptive acoustic (and/or mechanical) feedback suppression system. Feedback suppression may be achieved by subtracting an estimate of the feedback signal within the listening device. It has been proposed to use a fixed coefficient linear time invariant filter for the feedback path estimate

[Dyrlund, 1991]. This method proves to be effective if the feedback path is steady state and, therefore, does not alter over time. However, the feedback path of a listening device, e.g. a hearing aid, does vary over time and some kind of tracking ability is often preferred. Adaptive feedback cancellation has the ability to track feedback path changes over time. It is also based on a linear time invariant filter to estimate the feedback path but its filter weights are updated over time [Engebretson, 1993]. The filter update may be calculated using stochastic gradient algorithms, including some form of the popular Least Mean Square (LMS) or the Normalized LMS (NLMS) algorithms. They both have the property to minimize the error signal in the mean square sense with the NLMS additionally normalizing the filter update with respect to the squared Euclidean norm of some reference signal. Various aspects of adaptive filters are e.g. described in [Haykin].

"In an embodiment, the manually operable user interface comprises a touch sensitive activation element. A touch sensitive element can e.g. comprise any switch element for selecting one of two or more options, e.g. a push button, a touch (sensitive) screen, a rotating wheel, a mechanical switch, a proximity sensor, etc.

"In an embodiment, the listening device is adapted to provide that the feedback estimate is used to minimize or cancel feedback from the output transducer to the input transducer. In an embodiment, such adaptation is implemented by a combination unit for combining (e.g. a summation unit) the feedback path estimate with (e.g. subtracting from) an input signal, e.g. from a microphone or microphone system, of the listening device.

"In an embodiment, the update control unit is adapted to control the timing of the calculation of filter coefficients and/or the transfer of filter coefficients to the variable filter part. In an embodiment, the update control unit comprises a timing unit that controls when new filter coefficients are to be calculated. In an embodiment, the update control unit comprises a timing unit that controls when newly calculated (or stored) filter coefficients are transferred to the variable filter part of the adaptive filter. When the manually operable user interface has been activated, the timing unit is adapted to influence the timing of the calculation of the filter coefficients and/or their transfer to the variable filter (based on the event of occurrence of the activation, and e.g. for a predefined time thereafter).

"In an embodiment, the update control unit is adapted to inhibit or delay the calculation of filter coefficients and/or the transfer of filter coefficients to the variable filter part with a predefined time (after activation of the manually operable user interface). In an embodiment, the delay is adapted to be sufficiently large to allow the acoustic situation (including the feedback path from the output to the input transducer of the listening device) after user's activation of the manually operable user interface to be normalized, e.g. based on an estimated average value. In an embodiment, the delay is larger than 1 s, such as in the range from 1 s to 5 s, e.g. around 2 s. In an embodiment, the delay is larger than 5 s.

"In an embodiment, the update control unit is adapted to modify the adaptation rate of the adaptive algorithm. In an embodiment, the adaptation rate is decreased when an activation of the manually operable user interface is detected in the listening device. In an embodiment, the adaptation rate is governed by a step size of the algorithm. In an embodiment, the step size of the algorithm is decreased when an activation of the manually operable user interface is detected. In an embodiment, the step size is set to zero when an activation of the manually operable user interface is detected and held at zero for a predefined (delay) time, where after it is returned to its original value or to a default value or to a value determined by the chosen program, if the activation of the manually operable user interface resulted in a program change. In an embodiment, the step size is frequency dependent, e.g. in that feedback estimation is performed fully or partially in the frequency domain. In an embodiment, the calculation of updated filter coefficients is performed in a number of frequency bands, whereas the filtering is performed in the time domain (cf. e.g. FIG. 3c).

"In an embodiment, the listening device, e.g. the update control unit, comprises a memory wherein one or more default feedback path estimates is/are stored, and wherein the update control unit is adapted to select a default feedback path estimate from the memory and to transfer corresponding filter coefficients to the variable filter part when the manually operable user interface has been activated. In an embodiment, the default feedback

path estimate comprises a channel impulse response, a complex-valued transfer function, or a set filter coefficients. In an embodiment, the one or more default feedback path estimates is/are determined and stored in the listening device in advance of its normal operation, e.g. in a fitting procedure. Alternatively or additionally, the one or more default feedback path estimates is/are determined during normal operation of the listening device. Different default feedback path estimates may be stored for different programs of the listening device corresponding to different listening situations (e.g. music, telephone, speech in noise, 'cocktail party', etc.). Preferably, changes to the feedback path estimate over time are monitored. During a stable time period, where little or no large changes to the feedback path estimate occurs, a value (e.g. an average value) of the feedback path estimate is stored in a memory of the listening device as a default feedback path estimate. In an embodiment, the 'stable' feedback path stored in memory is determined off-line, e.g. during a fitting session of the listening device. In an embodiment, a number of the last determined feedback path estimates (F.sub.x(n), n being time) (e.g. corresponding filter coefficients) are stored in a memory. In an embodiment, a difference between the current feedback estimate (F.sub.x(n)) and the immediately preceding feedback estimate (F.sub.x(n-1)) is determined, e.g. as |F.sub.x(n)-(F.sub.x(n-1)|.sup.2. In an embodiment, an average value (e.g. a running average) of the previous feedback path estimates is stored in the memory. In an embodiment, the older estimates are weighted less than the newer estimates, e.g. according to the recursive formula F.sub.st,p(n)=.alpha.F.sub.x(n-1)+(1-.alpha.)F.sub.x(n), where F.sub.st,p is the stored previous feedback estimate, n is a time index and .alpha. is a constant between 0 and 1. The smaller the value of .alpha., the more weight on the latest values of the feedback estimate, and the larger the value of .alpha., the more weight on the historic values of the feedback estimate. In an embodiment, .alpha. is smaller than 0.5, such as smaller than 0.3, such as smaller than 0.2, such as in the range from 0.05 to 0.2. In an embodiment, a difference between the current feedback estimate (F.sub.x(n)) and the stored feedback estimate (F.sub.st(n-1)) is determined, e.g. as |F.sub.x(n)-(F.sub.st(n-1)|.sup.2. In an embodiment, the current feedback estimate is an average over a number of the latest feedback estimates. In an embodiment, a difference between the current feedback estimate (F.sub.st,c) and the preceding feedback estimate (F.sub.st,p) is determined, e.g. as |F.sub.st,c-F.sub.st,p|.sup.2. In an embodiment, one of the stored feedback path estimates is defined as a default feedback path estimate. This may be the case, if the difference between the current feedback estimate and the previous feedback estimate (e.g. the stored previous feedback estimate or the immediately preceding feedback estimate) is larger than a predetermined value (e.g. more than 50% larger or more than 100% larger) AND if the user interface is activated within a predetermined time of the last determined feedback path estimates (e.g. .ltoreq.0.1 s after, or .ltoreq.1 s after, or .ltoreq.5 s after). In an embodiment, after a user interface activation event, a choice between a number Nd of available stored default feedback path estimates is performed by choosing the feedback path estimate that provides the lowest prediction error, e.g. MIN .epsilon.[|y-Fd.sub.x*u|.sup.2], or, when normalized, MIN .epsilon.[|y-Fd.sub.x*u|.sup.2/|y|.sup.2], where .epsilon. is the expected value operator, y is the current input signal (e.g. ER in FIG. 2, 3), Fd.sub.x is a default feedback estimate x, and u is the current output signal (e.g. REF in FIG. 2, 3), and where x is varied over the Nd available feedback paths.

"Any operating parameter or function of the listening device may in principle be influenced by the manually operable user interface. In an embodiment, a function of the listening device that may be controlled via the manually operable user interface is a program shift or a volume change.

"In an embodiment, the listening device is a portable device, e.g. a device comprising a local energy source, e.g. a battery, e.g. a rechargeable battery.

"In an embodiment, the listening device comprises a hearing aid, a headset, an active ear protection device or a combination thereof.

"In an embodiment, the listening device is adapted to provide a frequency dependent gain to compensate for a hearing loss of a user. In an embodiment, the signal processing unit is adapted for running algorithms for

enhancing an input signal and providing a processed output signal. Various aspects of digital hearing aids are described in [Schaub; 2008].

"In an embodiment, the output transducer comprises a receiver (speaker) for providing an acoustic signal to the user.

"The listening device comprises an input transducer for converting an input sound to an electric input signal. In an embodiment, the listening device comprises a directional microphone system adapted to provide a resulting directional microphone characteristic of the system, e.g. for separating two or more acoustic sources in the local environment of the user wearing the listening device and/or for attenuating one acoustic source relative to another acoustic source. In an embodiment, the directional system is adapted to detect (such as adaptively detect) from which direction a particular part of the microphone signal originates. This can be achieved in various different ways as described in the prior art.

"In an embodiment, the listening device comprises an antenna and transceiver circuitry for wirelessly receiving a direct electric input signal from another device, e.g. a communication device or another listening device. In an embodiment, the listening device comprises a (possibly standardized) electric interface (e.g. in the form of a connector) for receiving a wired direct electric input signal from another device, e.g. a communication device or another listening device.

"In an embodiment, the communication between the listening device and the other device is in the base band (audio frequency range, e.g. between 0 and 20 kHz). Preferably, communication between the listening device and the other device is based on some sort of modulation at frequencies above 100 kHz. Preferably, frequencies used to establish communication between the listening device and the other device is below 50 GHz, e.g. located in a range from 50 MHz to 50 GHz.

"In an embodiment, the listening device further comprises other relevant functionality for the application in question, e.g. compression, noise reduction, etc.

"Use:

"In an aspect, use of a listening device as described above, in the 'detailed description of embodiments' and in the claims, is moreover provided. In an embodiment, use is provided in a system comprising audio distribution, e.g. a system comprising a microphone and a loudspeaker in sufficiently close proximity of each other to cause feedback from the loudspeaker to the microphone during operation by a user. In an embodiment, use is provided in a system comprising one or more hearing instruments, headsets, ear phones, active ear protection systems, etc., e.g. in handsfree telephone systems, teleconferencing systems, public address systems, karaoke systems, classroom amplification systems, etc.

"A method:

"In an aspect, a method of operating a listening device, the listening device comprising an input transducer for converting an input sound to an electric input signal; and an output transducer for converting a processed electric signal to an output sound; a forward signal path being defined there between and comprising a signal processing unit for processing the electric input signal or a signal derived therefrom and providing a processed output signal; a manually operable user interface located at or on the listening device allowing a user to control a function of the listening device is furthermore provided by the present application.

"The method comprises estimating a feedback path from the output transducer to the input transducer using an adaptive algorithm for determining filter coefficients for a variable filter; transferring filter coefficients to the variable filter thereby providing an estimated feedback path transfer function; monitoring the activation of the manually operable user interface; controlling the adaptive algorithm, including the transfer of filter coefficients to the variable filter, depending on the activation of the manually operable user interface.

"It is intended that the structural features of the device described above, in the 'detailed description of embodiments' and in the claims can be combined with the method, when appropriately substituted by a corresponding process and vice versa. Embodiments of the method have the same advantages as the

corresponding devices.
"A Computer Readable Medium:
"In an aspect, a tangible computer-readable medium storing a computer program comprising program code means for causing a data processing system to perform the steps of the method described above, in the 'detailed description of embodiments' and in the claims, when said computer program is executed on the data processing system is furthermore provided by the present application. In addition to being stored on a tangible medium such as diskettes, CD-ROM-, DVD-, or hard disk media, or any other machine readable medium, the computer program can also be transmitted via a transmission medium such as a wired or wireless link or a network, e.g. the Internet, and loaded into a data processing system for being executed at a location different from that of the tangible medium. In an embodiment, the data processing system comprises the signal processing unit of the listening device described above, in the 'detailed description of embodiments' and in the claims.
"A Data Processing System:
"In an aspect, a data processing system comprising a processor (e.g. the signal processing unit of the listening device described above, in the 'detailed description of embodiments' and in the claims) and program code means for causing the processor to perform the steps of the method described above, in the 'detailed description of embodiments' and in the claims is furthermore provided by the present application.
"A Listening system:
"In a further aspect, a listening system comprising a (first) listening device as described above, in the 'detailed description of embodiments', and in the claims, AND an auxiliary device is moreover provided. In an embodiment, the system comprises two or more auxiliary devices. In an embodiment, the listening system is portable.
"In an embodiment, the system is adapted to establish a communication link between the listening device and the auxiliary device to provide that information (e.g. control and status signals, possibly audio signals) can be exchanged between them or forwarded from one to the other.
"In an embodiment, the auxiliary device is an audio gateway device adapted for receiving a multitude of audio signals (e.g. from an entertainment device, e.g. a TV or a music player, a telephone apparatus, e.g. a mobile telephone, or a computer, e.g. a PC, a telecoil, a wireless microphone, etc.) and adapted for allowing a user to select and/or combine an appropriate one of the received audio signals (or combination of signals) for transmission to the listening device.
"In an embodiment, the auxiliary device comprises a remote control function with a user interface adapted for allowing a user to modify settings of the first listening device.
"In an embodiment, the auxiliary device is another (second) listening device. In an embodiment, the second listening device is a listening device as described above, in the 'detailed description of embodiments', and in the claims. In an embodiment, the listening system comprises two listening devices adapted to implement a binaural listening system, e.g. a binaural hearing aid system. In an embodiment, the listening system, comprises a binaural listening system, e.g. a hearing aid system, AND a further auxiliary device, e.g. an audio gateway device and/or a remote control device.
"Further objects of the application are achieved by the embodiments defined in the dependent claims and in the detailed description of the invention.
"As used herein, the singular forms 'a,' 'an,' and 'the' are intended to include the plural forms as well (i.e. to have the meaning 'at least one'), unless expressly stated otherwise. It will be further understood that the terms 'includes,' 'comprises,' 'including,' and/or 'comprising,' when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will also be understood that when an element is referred to as being 'connected' or 'coupled' to

another element, it can be directly connected or coupled to the other element or intervening elements may be present, unless expressly stated otherwise. Furthermore, 'connected' or 'coupled' as used herein may include wirelessly connected or coupled. As used herein, the term 'and/or' includes any and all combinations of one or more of the associated listed items. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless expressly stated otherwise."
For the URL and additional information on this patent application, see: PEDERSEN, Michael Syskind. Feedback Control in a Listening Device. U.S. Patent Serial Number 533293, filed June 26, 2012, and posted January 3, 2013. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3488&p=70&f=G&l=50&d=PG01&S1=20121227.PD.&OS=PD/20121227&RS=PD/20121227
Keywords for this news article include: Patents, Algorithms, Electronics, Signal Processing, Information Technology, Information and Data Processing.

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iHear Medical, Inc.; Patent Issued for Hearing Device with Semipermanent Canal Receiver Module

Publication info: Telecommunications Weekly (Jan 9, 2013): 1118.
ProQuest document link

Abstract: News editors obtained the following quote from the background information supplied by the inventors: "Brief Description of Ear Canal Anatomy and Physiology "The ear canal 10 (FIG. 1) is generally narrow and tortuous and is approximately 26 millimeters (mm) long from the canal aperture 11 to the tympanic membrane 15 (eardrum).

Full text: 2013 JAN 9 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- From Alexandria, Virginia, VerticalNews journalists report that a patent by the inventor Shennib, Adnan (Oakland, CA), filed on August 12, 2010, was cleared and issued on December 25, 2012.
The patent's assignee for patent number 8340335 is iHear Medical, Inc. (Oakland, CA).
News editors obtained the following quote from the background information supplied by the inventors: "Brief Description of Ear Canal Anatomy and Physiology
"The ear canal 10 (FIG. 1) is generally narrow and tortuous and is approximately 26 millimeters (mm) long from the canal aperture 11 to the tympanic membrane 15 (eardrum). The lateral-part 12 is referred to as the cartilaginous region due to the underlying cartilaginous tissue 19. The cartilaginous region 12 of the ear canal 10 deforms in shape and moves in response to the mandibular (jaw) motions, which occur during talking, yawning, eating and also when sleeping over the ear. Hair and earwax (cerumen) are primarily present in this cartilaginous region 12. The medial part, proximal to the tympanic membrane, is rigid and referred to as the bony region 13 due to the underlying bone tissue 7. The skin in the bony region is very thin (relative to the skin in the cartilaginous region) and is far more sensitive to touch or pressure. A characteristic bend roughly occurring at the bony-cartilaginous junction 8 separates the cartilaginous region 12 and the bony region 13. The dimensions and contours of the ear canal vary significantly among individuals.
"A cross-sectional view of the typical ear canal (not shown) reveals generally oval shape with a long diameter in the vertical axis and a short diameter in the horizontal axis. Canal dimensions vary significantly along the ear canal and among individuals. FIG. 2 shows an alternate view of the ear canal 10 (top-down) indicting the narrowness of the contoured ear canal. This view shows the challenge of placing a contiguous hearing device

entirely in the ear canal, particularly for placement in the bony region 13. Even with smaller receivers fitting in the bony region 13, frequent insertions leads to skin irritation, pain and lacerations. For this reason among others, canal placements have been largely limited to the cartilaginous region. Placement of a device entirely in the bony region is not possible with state of the art components due to component size limitations and to difficulty in accessing a hearing device placed deeply and entirely in the bony region alone. Nevertheless, placement of a speaker in the bony region is desired to achieve acoustic advantages including reduction of occlusion effect, less distortion, less receiver vibrations, improved high frequency reception, and other non-acoustic benefits such as reduced receiver exposure to earwax, water and moisture.

"Physiological debris is primarily produced in the cartilaginous region 12 of the ear canal, and includes cerumen (earwax), sweat, and oils produced by the various glands underneath the skin in the cartilaginous region. Debris is naturally extruded from the ear canal by the process of lateral epithelial cell migration which starts from the tympanic membrane laterally towards the lateral (outer) par of the ear canal. There is no cerumen production or hair in the bony part of the ear canal thus less exposure to debris for parts placed in the bony region. The ear canal ends medially (inner direction) at the tympanic membrane 15 is which is connected to the ossicular bone chain and more specifically to the malleus handle 17. Externally and lateral to the ear canal are the concha 5 and the auricle 6 which are important for collecting sound and frequency shaping it into the ear canal.

"Several types of hearing losses affect millions of individuals. Hearing loss naturally occurs as we age beginning at higher frequencies (above 4000 Hz) and increasingly spreads to lower frequencies with age.

"The Limitations of Conventional Canal Hearing Devices

"The limitation of current canal hearing devices is well described in US patent applications U.S. Pat. No. 6,473,513 and U.S. Pat. No. 6,137,889 incorporated herein by reference. These limitations include the well know occlusion effect (speaking into a barrel effect), dexterity limitation for placing a device deep in the ear canal, device size for fitting a miniature device with all standard components including a microphone, circuitry, battery and a receiver (speaker) into ear canals, particularly small and contoured ones. A major limitation is the propensity of a completely-in-the-canal (CIC) device to feedback when set at high volume settings due to the proximity of internal components and the mechanical coupling within the integrated device package. Integrated CIC and in-the-canal (ITC) devices in general, such as in U.S. Pat. No. 5,701,348 are typically not offered to those with severe impairment due to feedback concerns for the high gain requirements.

"The Limitation of Current Extended Wear Hearing Devices

"Extended wear devices recently conceived and developed are disclosed in U.S. Pat. No. 7,424,124, U.S. Pat. No. 7,310,426, U.S. Pat. No. 7,298,857, U.S. Pat. No. 7,215,789, U.S. Pat. No. 6,940,988 and U.S. Pat. No. 6,473,513. They attempt to circumvent the limitation of conventional canal hearing devices, mainly by placing a device deep in the ear canal in close proximity to the tympanic membrane thus reducing the level of amplification needed to deliver sound to the tympanic membrane. A major limitation of prior art extended wear device is the high contraindication leading o the exclusion of approximately 50% of potential wearers according to industry reports. The high contraindication rate is mostly due to size and shape limitation of the ear. These devices also suffer from limited longevity, rarely reaching 4 months, due to the contamination and damage to the continuously worn device from earwax and moisture accumulation in the ear canal. The long term sealing of the extended wear devices prevents moisture from periodically drying out as would normally occur in the unoccluded ear canal. The cost of prior art extended wear devices is high and prohibitive to most consumers.

"In contrast, daily wear canal devices have the advantage of being removed daily to periodically maintain the device such as drying it out, replace the battery when needed and allow the ear canal to rest and dry out. On the other hand, an extended wear canal device has the distinct advantage of deeper canal placement thus 'invisible' with reduced stigma. However, as mentioned before, it is not possible to insert an integrated device package in many ears, particularly in small and contoured ear canals. Providing articulation with respect to the receiver portion (for example U.S. Pat. No. 7,424,124) helps in dealing with the insertion but also presents

known problems such as jackknifing and lack of visualization during the insertion process. For example, one inserting the device cannot know how deep the receiver portion is in the bony region, since receiver viewing is entirely blocked by the lateral portion of the hearing device.

"It is well known that moisture and contamination are mainly present in the cartilaginous part of the ear unlike the boy region, which is relatively 'clean'. However, the cartilaginous region is far less sensitive to frequent touch and pressure, unlike the bony region which is easily prone to damage and irritation, particularly from frequent device insertions. These paradoxical constrains have prevented the hearing aid industry from providing an 'invisible' hearing device that is easy to insert, comfortable to wear, long-lasting, cost effective for the user, and easy to maintain.

"It is a principal objective of the present invention to provide a more optimal combination of features including; (1) delivering sound deeper in the bony region within exceptional proximity to the eardrum, (2) provide extended wear in the bony region without resorting to daily insertions and removals therein, (3) provide easy access for device maintenance, and (4) provide moisture relief for the device and the canal.

"Another objective is to provide a more space efficient design of a canal device that fits a greater range of ears including small and contoured ones, thus reducing the contraindication rate experienced by current designs.

"A further objective of the invention is to provide an acoustically non-occluding hearing device by selectively occluding the bony region while providing occlusion-relieve venting and moisture drying in the ear canal.

"The terms 'short-term' and 'daily wear' are used interchangeably, and so are the terms 'semi-permanent' and 'extended-wear'. 'Short-term' and 'extended-wear' are relative terms and intended here to contrast one another. Extended-wear refers herein to continuous wear exceeding 1 month, and preferably exceeding 4 months as enabled by the present invention. Short term generally refers to daily wear as known in conventional hearing devices and further defined herein as any wear of less than 1 month. The words 'speaker' and 'receiver' are used interchangeably throughout the application."

As a supplement to the background information on this patent, VerticalNews correspondents also obtained the inventor's summary information for this patent: "The present invention provides a modular canal hearing device positioned entirely in the ear canal having a receiver module (also referred to as speaker module) that is separate and is inserted in the bony region semi-permanently. A separate main module is subsequently placed laterally in the cartilaginous part of the ear canal and is removable separately from the ear canal for maintenance while the receiver module remains therein for relatively an extended period. The receiver module comprises a receiver (speaker) and a retainer for retaining the speaker module and providing acoustic sealing to prevent feedback. The receiver module also comprises a wireless coupler for wirelessly receiving power and/or audio signals from the main module. The receiver module is passive and activated by wireless near-field coupling when the main module is inserted in the ear canal in proximity thereto.

"The placement of the receiver module in the bony region is semi-permanent thus minimizes insertion frictions in the bony region, known to be extremely sensitive to touch and pressure. The receiver module being extremely small and separate from the rest of the device allows for improved fit, manipulation, visualization and navigation into and out of the ear canal. The receiver module is not encumbered by the presence of large components associated with an integrated hearing device. Similarly, the main module is smaller by excluding a receiver assembly, thus easier to insert and manipulate into and out of the ear canal.

"The receiver module is placed in proximity to the tympanic membrane resulting in superior sound and energy efficiency. The main module comprises a microphone, a battery, a sound processor/amplifier (electronic circuit), and in the preferred embodiment an inductive coupling coil for transmitting audio signals wirelessly to the receiver module. The receiver module remains immobile during its semi-permanent wear in the ear canal. The immobility of the receiver module allows for rapid acclimation of the sensitive bony region to the receiver module as a foreign object. In contrast, the main module is positioned in the cartilaginous region, which is robust and far less sensitive to frequent touch and motion of the device including from mandibular movements. When the main

module is removed, the receiver module remains in the ear canal with its acclimated skin undisturbed.
"The main module and the receiver module are electromechanically isolated, either by an air gap or by the incidental contact of the coupling elements. At least one coupling element, if connecting, must be flexibly connected to provide vibration isolation to control feedback. Vibration-caused feedback is well known in hearing aid design and particularly for CICs, thus they are limited in their application to less severe hearing impairments. The present invention eliminates such vibration coupling and also prevents the transfer of motion from the main module to the receiver module (for example due to jaw movements, sleeping on the ear, yawning, etc.), thus eliminating skin rubbing and irritation in the bony region where the receiver module resides.
"The main module is placed preferably entirely in the ear canal with the lateral end at or past its aperture, beyond the concha region. In other embodiments, the main module may extend to the concha region for improved access for persons of limited dexterity. The receiver module being in the bony region is less prone to contamination from physiologic debris (i.e, cerumen) present in the cartilaginous area thus can be worn for extended wear exceeding 4 months. By eliminating frequent insertions, cumulative scooping of earwax is minimized. Earwax contamination of receiver sound port is a common problem that plagues canal hearing devices, leading to exceptionally high repair and return rates.
"Deep placement of the invented device allows for invisible and hassle-free wear, features highly sought after by hearing impaired individuals. Placement of the microphone inside the ear canal or within the concha area provides natural sound pick-up by taking advantage of natural ear acoustics. The combined effect of receiver placement near the eardrum and microphone placement in the ear leads to significantly improved sound quality including less distortion, less apparent noise, less wind noise, improved frequency response, and improved speech perception by preserving localization of sound, particularly in noisy conditions.
"The receiver module is preferably inserted by a hearing professional such as an ENT physician, an audiologist or a hearing specialist to provide proper inspection and cleaning of the ear canal and for the safe placement of the receiver module deep in the bony region within exceptional proximity of the eardrum. The receiver module is preferably placed within 4-10 mm from the eardrum. The main module is designed for self-insertion and self-removal, since it is more accessible and with less concern for damage to the ear canal. The modules comprise compressible retainers, which are preferably generic and assorted in size and shape to fit a variety of ear canals without resorting to custom manufacturing as with conventional canal devices. In the preferred embodiments, the main device is remotely controlled for activation and or adjustment as well known in the field of hearing aid design.
"The main module can be removed relatively frequently as needed to maintain the device or the ear canal. For example to replace the battery, replace a disposable cover, replace a sound filter, clean the device, recharge the battery if rechargeable, drying the device, or to simply rest and aerate the ear canal. The receiver module may be designed for self-insertion but preferably after sizing and trial fit by a hearing professional to ensure proper size, fit, and medical considerations of the ear, particularly in the bony region.
"In the preferred embodiment, the receiver module remains in the bony region continuously for extended wear exceeding four months while the main module is removed daily or as needed for device and ear canal maintenance.
"In one aspect, the present invention provides a modular hearing device for inconspicuous wear in the ear canal, comprising: a speaker module for placement medially in the ear canal in the bony region and in proximity to the eardrum, said speaker module comprises a speaker assembly for delivering amplified sound to the tympanic membrane, a skin contacting retainer concentrically positioned over said speaker assembly for retaining said receiver assembly entirely in said ear canal, and a receive coil for wireless reception of electromagnetic signal representing audio signals; and a main module laterally positioned primarily in the cartilaginous region of the ear canal, comprising a microphone, a power source and a transmit coil for wireless transmission of said electromagnetic signal representing audio signal to said receive coil within said speaker

module, said main module is separately removable from the ear canal while said speaker module remains therein when said main module is removed; and wherein said speaker module is activatable by the presence of said main module when placed inside the ear canal in proximity thereto.
"In some embodiments, the retainer provides acoustic attenuation of at least 20 decibels between said speaker assembly output and microphone input within the audiometric frequency range between 500 and 4000 Hz. In some embodiments, the power source is a primary battery or a rechargeable battery. In some embodiments, the said receive coil and/or transmit coil comprise a flexible connection for providing vibration and motion isolation between said speaker module and said main module when said receive and transmit coils are in contact. In some embodiments, the receive coil and/or transmit coil comprise means for vibration dampening at the coupling interface therebetween."
For additional information on this patent, see: Shennib, Adnan. Hearing Device with Semipermanent Canal Receiver Module. U.S. Patent Number 8340335, filed August 12, 2010, and issued December 25, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=38&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1862&f=G&l=50&co1=AND&d=PTXT&s1=20121225.PD.&OS=ISD/20121225&RS=ISD/20121225
Keywords for this news article include: iHear Medical Inc.

Tonotopic reorganization and spontaneous firing in inferior colliculus during both short and long recovery periods after noise overexposure

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Publication info: Journal of Biomedical Science 20 (2013).
ProQuest document link

Abstract: Doc number: 91
Abstract
Background: Noise induced injury of the cochlea causes shifts in activation thresholds and changes of frequency response in the inferior colliculus (IC). Noise overexposure also induces pathological changes in the cochlea, and is highly correlated to hearing loss. However, the underlying mechanism has not been fully elucidated. In this study, we hypothesized that overexposure to noise induces substantial electrophysiological changes in the IC of guinea pigs.
Results: During the noise exposure experiment, the animals were undergoing a bilateral exposure to noise. Additionally, various techniques were employed including confocal microscopy for the detection of cochlea hair cells and single neuron recording for spontaneous firing activity measurement. There were alterations among three types of frequency response area (FRA) from sound pressure levels, including V-, M-, and N-types. Our results indicate that overexposure to noise generates different patterns in the FRAs. Following a short recovery (one day after the noise treatment), the percentage of V-type FRAs considerably decreased, whereas the percentage of M-types increased. This was often caused by a notch in the frequency response that occurred at 4 kHz (noise frequency). Following a long recovery from noise exposure (11-21 days), the percentage of V-types resumed to a normal level, but the portion of M-types remained high. Interestingly, the spontaneous firing in the IC was enhanced in both short and long recovery groups.
Conclusion: Our data suggest that noise overexposure changes the pattern of the FRAs and stimulates

spontaneous firing in the IC in a unique way, which may likely relate to the mechanism of tinnitus.

Links: Check LinkSource for Full Text

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Background

Tinnitus is a condition normally associated with hearing loss, and involves the perception of sound without the corresponding stimulus [1-3]. The reorganization of the frequency topographic map (FTM) has shown to be a direct outcome from hearing loss [4-7]. This could be associated with an increase of spontaneous firing in the brain auditory center [8-9]. It is accepted that such reorganization and spontaneous firing [1-10] are likely involved in the mechanism of tinnitus.

Previous studies have determined that the auditory system contains a topographic representation of tone frequency. The inner hair cells of the cochlea are tonotopically organized, resulting in each inner hair cell having tonotopic connections, through its associated ganglion cells, to cells in the cochlear nucleus [11]. Interestingly, topographic plasticity in the adult central auditory system has been well documented using a wide variety of techniques that result in partial ablation within the periphery of the auditory system. These techniques include mechanical disruption of the organ of Corti [5-6] and spiral ganglion [7-12], administration of cochleotoxic drugs [4-14], and exposure to high intensity sounds [15-16].

The documented changes in the inferior colliculus (IC) included: expanded lesion-edge frequency representations, shifts in characteristic frequencies that cause the expanded lesion edge frequency representations within affected frequency-response areas (FRA) [7-12], reduced levels of sideband inhibition at the particular frequency causing hearing loss [12-17], and reduced inhibition response from multi-units [4]. The changes within the IC occurred immediately after lesions developed and continued for several weeks to several months. For example, hearing loss greater than 10 dB, induced by noise exposure, caused instantaneous changes in the primary auditory cortex [15].

At a single-unit level, tonotopic re-organization of the IC is related to a shift in the characteristic frequency (CF). The shift included a distinct staircase pattern [18] along the dorsoventral axis. Following noise exposure, the original stepwise frequency-depth function changed significantly. In some distortions, only two or three "steps" appeared. The V-type, which is most common in the IC [7-19], translated to double peaks or multi-peaks in the FRA. Non V-type FRAs included two or three frequency peaks [16]. The CF thresholds significantly increased with the time following noise exposure, partially accounting for the occurrence of tinnitus [15]. Furthermore, previous reports have shown that auditory neural hyperactivity appears in the auditory cortex, IC, and cochlear nucleus, occurring simultaneously with tinnitus [1-20]. Yet, the mechanisms of tinnitus, which are associated with hearing loss, have not been clearly identified in these models.

To understand these complex mechanisms associated with tinnitus, narrow-band noise was utilized to induce cochlear damage in guinea pigs. We have measured the FRAs, spontaneous firing of single units in the IC, and

cochlear damage in a single cell level, following noise overexposure of one day (short recovery) and 11-21 days (long recovery), respectively. Our data provide a new perspective in understanding the mechanism of noise induced tinnitus.

Methods

All procedures were approved by the Department of Otolaryngology at The First Affiliated Hospital of Chinese PLA General Hospital and followed all required guidelines. Care and use of the animals in this study was also approved by the Institutional Animal Care and Use Committee of the Chinese PLA General Hospital. Nineteen healthy guinea pigs of both sexes with normal auricular reflex, weighing between 227 g and 525 g were used. The animals were randomly divided into three groups. Short recovery group (7 animals) was evaluated 24 hours after noise exposure and long recovery group was evaluated 11-21 days after exposure (6 animals). In the control group, six healthy animals were used. This timeframe (11-21 days) was consistent with previous studies, which showed that compound action potential (CAP) thresholds were fractionally recovered two weeks after noise-exposure [3-22].

ABR thresholds

The auditory brainstem response (ABR) was also measured. Specifically, guinea pigs were anesthetized with xylazine (0.1 mg/kg) and ketamine (30 mg/kg). Subdermal electrodes were inserted at the vertex and pinna. A speaker was positioned directly above the mid-line of the animal's head at a height of 12 cm. Tone-pips (0.5-ms on rise/fall time, at 30/sec) at 2, 4, 8, and 16 kHz were used as sound stimuli. The response signal was amplified, filtered, and averaged using the Intelligent Hearing System software (ISEN Tech and Trading, Ltd. Beijing, China) [23].

Conditions for noise exposure

During this procedure, the animals were not anesthetized and thus were fully awake, undergoing a bilateral exposure to noise, which was produced from a signal machine (Model 33220A, Agilent Technologies, Inc., UK), intensified by a power amplifier (Model 2706, Brüel &Kjær Sound &Vibration Measurement A/S, Denmark), and transmitted to the surrounding speakers (Model D1002, Beijing First Radio Equipment Factory, Beijing, China). The acoustic overexposure stimulus was a 1/3 octave narrow band noise (i.e. white noise filtered by 1/3 octave band filter) at 4 kHz and 120 dB, measured by a sound level meter (Model 2209, Brüel and Kjær Sound and Vibration Measurement A/S, Denmark), and lasted 4 hours within a sound insulated room. The speakers were placed 4 cm in front of the head of an unrestrained guinea pig within small cells in a subdivided cage (1 animal/cell). Noise calibration, targeting SPL, was performed immediately before each exposure session. It should be noted that sound pressure levels varied by <1 dB across the cages.

Surgery procedure

Before the surgery, a dosage of 0.7 ml/100 g urethane was injected intraperitoneally for anesthetic purposes. The level of anesthesia was monitored in accordance with breathing state and blink reflex during the experiment. If the blink reflex occurred, one third of the concentration of the first dose of urethane was added to maintain a state of unconsciousness. The animals were given a preoperative subcutaneous injection of a dosage of 0.05 ml/100 g atropine to reduce respiratory secretion and to prevent respiratory tract obstruction during the experiment. Oxygen was administered through a customized mask while conducting the experiment. The animal body temperature was maintained by an electric blanket (Model 050100C0001B, FHC Inc. Bowdoin, ME, USA). After the guinea pigs were anesthetized, they were placed in the stereotaxic apparatus. The scalp, temporal muscle, and connective tissue were removed and the skull was exposed. A 10 cm long flat head screw was fixed on the top of the skull using glue and reinforced by dental cement (Model: 200805, Dental Division in Shanghai Medical Equipment, Ltd., Shanghai, China). An area which is 2 mm behind lambda, and 2.5 mm to the right side of the midline, was marked as a circle center with a radius of 2.5 mm. The skull included in the radius of the circle was removed by a micro-drill and the dura mater was removed.

Generation of stimuli

Digital signals generated with 200 kHz sampling rate were used as the sound stimuli. After analog conversion (RX6; Tucker-Davis Technologies, USA) [24-25], the stimuli were applied to the anesthetized animals through the speakers (Electrostatic speaker 1, TDT Co., USA) which were placed next to each ear 20 cm from lambda in a free field. The rise/fall time of pure tone was 5 ms [17]. The stimulation sequences included two steps: 1) A sweep sequence was used for the determination of CF and minimum threshold of the IC neurons, followed by random sweep sequences including 561 pure tones (50 ms duration) at an interval of 250 ms between each tone pip; in this set-up, the frequency ranged from 1 kHz to 60 kHz with 5.9 octaves, and sound intensities were randomly ranged from 10 to 60 dB SPL with 11 linear steps on the intensity curves. 2) Repetitive stimulation sequences were used for determination of neuronal discharge patterns at CF 40 dB above threshold; this was repeated 100 times with a stimulation interval of 600 ms and duration of 200 ms.

Single neuron recording

Extracellular electrophysiological recordings were performed in an anechoic chamber where the anesthetized guinea pigs were fixed in place with both ears in a natural unblocked state, which allowed all data obtained in the IC to be binaural. The speakers were placed next to each ear 20 cm from lambda. Single tungsten electrodes (Model 575300, A-M Systems, Sequim, WA, USA), with tip diameters of 50 microns, were controlled by micro-thrusters. Each electrode track through the IC was continued until a reduction in field potential amplitude was observed. The electrode was then immediately withdrawn and repositioned and a new track was started. The raw signal was sampled at 25 kHz, amplified (X 5000; A-M systems, Sequim, WA, USA), and filtered (0.3 ~ 3 kHz; Tucker-Davis Technologies, TDT Co., Alachua, FL, USA). The FRA, CF and threshold at CF of a single IC neuron were determined audio-visually after a sweep sequence was used. Spontaneous activities of the IC neuron were identified during this recording process, following the criteria: firing rate ≥5 spikes/s, duration ≥10 s. Data were analyzed with OpenSorter software 2.5.0 (Tucker-Davis Technologies, TDT Co., Alachua, FL, USA). The typical IC neurons with spontaneous activities were detected according to the FRAs and the post stimulus time histogram (PSTH) as described previously [10-19].

Nuclear DNA staining of cochlear hair cell

DNA fluorescent dye Hoechst 33342 (Sigma, St. Louis, USA) was used for the nuclear staining of the Organ of Corti [26]. Hoechst was prepared as 0.04% (wt/vol) stock solution using distilled water and stored in the dark at 4°C. For staining, the stock solution was diluted to 1:200 by phosphate buffered saline (PBS, Beijing Puboxin BioTech Ltd., Beijing, China). After signal recording in IC cells, the animal was sacrificed. The temporal bone was removed along with the opening of the oval window and round window of the ear. A solution of 4% paraformaldehyde was repeatedly infused into the cochlea through both windows. Then the cochlea was quickly dissected from the surrounding bones, and the basilar membrane was isolated, being placed in Hoechst staining solution for 10 minutes in the dark at room temperature. The specimen was washed in the PBS and mounted using 50% glycerol (Beijing Puboxin BioTech Ltd., Beijing, China) on a slide. The fluorescence excitation wavelength for Hoechst 33342 was 337 nm, and the corresponding emission wavelength was 430 nm. Imaging was performed using an Olympus confocal microscope (FluoView FV1000, Olympus China Ltd., Beijing, China), which can be used to count the number of hair cells in the randomly selected areas.

The total number of nuclei in either inner or outer hair cells was counted from three 1-mm sections in length located within the cochlea duct. For the control group, we used 12 cochleae from six guinea pigs. Similarly, for the long recovery group, 12 cochleae from six animals were also examined. The three sites were chosen at 14.5-15.5, 10.5-11.5, and 4.0-5.0 mm from the basal end of the basilar membrane, respectively. The nucleus condition was determined through visual inspection under microscopy.

Statistical analysis

All results were presented as mean ±standard error (mean ±SE). Comparisons of constituent proportions among the three groups (FRA) were made using PASW Statistics 18.0 software and SPSS 13.0 software (SPSS Inc. IBM Co. Armonk, New York, USA). Comparisons between groups were performed through

Student's t-Test, and $P < 0.05$ was considered significant.

Results

ABR thresholds in noise exposure group

Prior to noise exposure, the average auditory brainstem response (ABR) threshold was screened using 2, 4, 8, and 16 kHz. One day after noise overexposure, the ABR thresholds were raised at all the above frequencies compared to pre-exposure levels ($P < 0.01$ from 13 animals). The specific data are listed in Figure [figure omitted; refer to PDF] .

Figure 1

ABR Thresholds of auditory brainstem response before and after noise exposure (NE).

ABR Thresholds of auditory brainstem response before and after noise exposure (NE). Statistical data representative of ABR (auditory brainstem response) thresholds before and one day after noise exposure ($n = 13$ from 13 animals) in guinea pigs. Four frequencies were tested: 2 kHz, 4 kHz, 8 kHz, and 16 kHz. *Significant difference from pre-NE group at the same frequency ($P < 0.01$).

[figure omitted; refer to PDF]

Nuclear changes of inner and outer hair cells of the cochlea following noise exposure

During the long recovery after noise overexposure, we found significant portions of fragmentation or disappearance of the nuclei within both outer and inner hair cells of the cochlea, as compared to control; for inner hair cells, irregular shape and disorganized alignment of the nuclei were observed (Figure [figure omitted; refer to PDF] A-D). Furthermore, it appears that there are more considerable nuclear disruptions in the 1st and 2nd turn of the cochlea compared to the 3rd turn, suggesting more high frequency damages (in 1st and 2nd turns) than low frequency damage (3rd turn). It has been noted that Figure [figure omitted; refer to PDF] A is a typical picture represented for 1st, 2nd, or 3rd turn in control cochlea (no NE), because in our confocal settings, there was no marked difference among the images taken from these cochlear sections. Thus, Figure [figure omitted; refer to PDF] A was used as a general image taken from the 1st to 3rd turns.

Figure 2

Representative confocal microscopy (x 40) of fluorescence stained nuclei within inner and outer hair cells in the cochlea of guinea pigs, 11 days after noise exposure (120 dB, 4 hours).

Representative confocal microscopy (x 40) of fluorescence stained nuclei within inner and outer hair cells in the cochlea of guinea pigs, 11 days after noise exposure (120 dB, 4 hours). A : Normal levels are observed in the nuclei of inner and outer hair cells of the control subject. The nuclei were arranged normally and no disruption or fragmentations were found. **B** : The image location is in the third turn of the cochlea after noise exposure, where signs of fragmentation equally occurred throughout both inner and outer hair cells. **C** : In the second turn of the cochlea, after noise exposure, more disruption and fragmentation appears to occur in the inner and outer hair cell nuclei compared to the third turn of the cochlea. **D** : The first turn in the cochlea, after noise exposure, exhibited severe disruption and fragmentation compared to the second and third turns in the inner and outer hair cell nuclei.

[figure omitted; refer to PDF]

As shown in Figure [figure omitted; refer to PDF] , the number of cochlea nuclei in the after-noise exposure (NE) group was significantly reduced compared to pre-NE group (213.1 ±3.5 *vs.* 242.5 ±2.1 for inner hair cells; 615.9 ±12.5 *vs.* 720.9 ±12.5 for outer hair cells; $n = 12$, $P < 0.05$).

Figure 3

The number of nuclei in the cochlea in inner (A) and outer (B) hair cells.

The number of nuclei in the cochlea in inner (A) and outer (B) hair cells. Before noise exposure (NE) *vs.* after NE ($n = 12$ from 6 animals; * $P < 0.05$).

[figure omitted; refer to PDF]

Composition change of FRA

The description of the FRA follows the methods of Hernandez et al. [19]. The FRA types of recorded neurons from all guinea pigs we used were similar to those previously reported [19]. The majority of FRAs have a single peak, the V-type, as defined by Hernandez et al. [19]. In order to compare the V-type to other types, the double peak or multi-peak type was defined as M-type, and the elongated narrow rectangular band was defined as N-type (Figure [figure omitted; refer to PDF]). As shown in Figure [figure omitted; refer to PDF] , during a short recovery period after noise overexposure, the percentage of V-type was significantly lower than the normal group (61.1 ±2.4% *vs.* 86.6 ±4.7%, n = 6-7, P <0.01). During the long recovery period, the percentage of V-type shifted back towards normal (76.6 ±7.8% *vs.* 86.6 ±4.7%, n = 6, n.s.). The percentage of M-type is significantly increased during both short (19.3 ±5.4%, n = 7, P <0.05) and long recovery groups (16.7 ±6.7%, n = 6, P <0.05) compared to the normal group (6.0 ±3.1%, n = 6). However, the percentage of N-type remained constant in both short and long recovery periods (Figure [figure omitted; refer to PDF]).

Figure 4

Representative graphs of frequency response patterns that are the basis of FRA types.

Representative graphs of frequency response patterns that are the basis of FRA types. (A) V-type, **(B)** M-type, **(C)** and N-type FRAs created by testing neuronal responses through electrode measurement. Variables included sound frequency and intensity.

[figure omitted; refer to PDF]

Figure 5

The percentage of FRA types including V-, N- and M-types in normal, short recovery, and long recovery groups.

The percentage of FRA types including V-, N- and M-types in normal, short recovery, and long recovery groups. # P <0.05 compared to normal groups in V-type (n = 6 from 6 animals for normal and n = 7 from 7 animals for short recovery). * P <0.05 compared to normal groups in M-type (n = 6 from 6 animals for normal, n = 7 from 7 animals for short recovery, and n = 6 from 6 animals for long recovery).

[figure omitted; refer to PDF]

Changes of characteristic frequency (CF) over depth

As shown in Figure [figure omitted; refer to PDF] A, the neuronal CF increased with the increasing depth of the tungsten electrode insertion along the dorsoventral axis of the IC in normal groups (114 neurons from 6 animals). Interestingly, we have observed that for the short recovery group, there is a noticeable gap at 4 kHz (161 neurons from 7 animals, Figure [figure omitted; refer to PDF] B, P <0.01, neurons with 4 kHz gap in short recovery group *vs.* neurons with 4 kHz gap in normal group, post hoc contrast). However, this gap was partially reduced in the long recovery group (74 neurons from 6 animals, P <0.01, neurons with 4 kHz gap in long recovery group *vs.* neurons with 4 kHz gap in normal group; P <0.05 neurons with 4 kHz gap in long recovery group *vs.* in neurons with 4KHz gap in short recovery group, post hoc contrast) (Figure [figure omitted; refer to PDF] C).

Figure 6

Function curves providing a correlation between CF (characteristic frequency) and protrusion depth within the IC.

Function curves providing a correlation between CF (characteristic frequency) and protrusion depth within the IC. A : A normal distribution can be observed within the control CF map. CF and depth have a positive trend, resulting in higher frequencies the deeper the protrusions within the IC. **B** : Short recovery group shows more of a randomized pattern with dispersed responses above and below 4 kHz creating a gap specifically at that frequency. **C** : Long recovery group exhibited the same type of gap at 4 kHz, but at a reduced level showing signs of recovery.

[figure omitted; refer to PDF]

Changes of IC neurons with spontaneous firing

Representative FRA with typical spontaneous firing activity (A), corresponding spontaneous firing curve (B), and the percentage of neurons with spontaneous firing activity in different groups (C) are illustrated in Figure [figure omitted; refer to PDF] . Spontaneous activities in the neuron were identified following the criteria: firing rate ≥5 spikes/s, duration longer than 10 s. Thus, any firing rate lower than 5 spikes/s was regarded as the absence of spontaneous activities. Specifically, in Figure [figure omitted; refer to PDF] C, the percentage of IC neurons with spontaneous firing activity in the short recovery group was significantly increased compared to normal group (31.6 ±3.6% *vs.* 15.3 ±3.0%, n = 6-7, P <0.05). The percentage of IC neurons showing spontaneous activity in the long recovery group was also higher than normal group (40.5 ±13.8% *vs.* 15.3 ±3.0%, n = 6, P <0.05). There was no statistical difference between the short and long recovery groups.

Figure 7

Spontaneous firing activities in IC neurons.

Spontaneous firing activities in IC neurons. A : Representative FRA showing typical spontaneous firing. **B** : A typical spontaneous firing curve over time in an IC neuron. **C** : The percentage of neurons with spontaneous firing activity in normal (114 neurons from 6 animals), short recovery (161 neurons from 7 animals) and long recovery groups (74 neuron from 6 animals). *Significant difference from normal group (P <0.05).

[figure omitted; refer to PDF]

Discussion

In this study, noise exposure caused two pathological consequences: one is FRA constituent proportions which were noticeably changed; the other is the IC cells which showed higher spontaneous firing activities. We also observed that average ABR thresholds at 4 kHz, 8 kHz, and 16 kHz were ~10 dB higher in the acute noise exposure group. In addition, images of nucleus staining in the hair cells clearly showed extensive disruption and fragmentations in both inner and outer hair cells in the 1st and 2nd turns after NE. However, we are not clear whether the cells were undergoing inflammation or apoptosis. Thus, we only speculate that the cells could possibly be in these stages, which requires further studies.

Consistent with previous studies, narrow-band frequency noise, or pure tone could cause a diffused elevation of CAP thresholds in adjacent frequencies which are normally higher than the exposure frequency. This may be due to the basalward shift of damage to inner and outer hair cells located on the basilar membrane [2-28]. According to Seki's study, hearing loss of more than 10 dB can cause changes of auditory central CF maps in cats [12-17]. Moreover, in our study, the underlying causes of the histogram changes (Figure [figure omitted; refer to PDF]) may be complex. FRA constituent proportions' changes may be induced by elevation of ABR thresholds. After noise exposure, the neuronal output of the cochlea decreased proportionally along with the increased numbers of damaged inner hair cells [17]. Mechanistically, inner hair cells can accurately convert nano level ciliary beats, caused by sound waves, to electrical energy [29]. Outer hair cells can process the space-time coding through a conversion from mechanical energy to the electrical energy generated by the inner hair cells [29]. Therefore, damage to outer hair cells caused changes of space-time coding for output sound, resulting in a decreased cochlear signal output. Thus, the inhibition/excitation balance of IC neurons became disrupted and new sound space-time coding was reconstructed.

We have found that FRA constituent proportions noticeably changed after noise exposure, which is consistent with previous studies [12-17]. Specifically, the aforementioned change was most notable in the short recovery group regarding V- and M-type. The long recovery following noise exposure allowed for the continuous restructuring of FRA types back to normal levels, resulting in reduced differences among proportions of FRA types between normal and long recovery groups. This suggests that IC neurons show signs of self-repair during a prolonged time period. These changes in tuning curves are possibly correlated to the fundamental cause of tinnitus or hyperacusis (oversensitivity) [30], which will be the focus of further research.

In the function curves of CF and depth in our experiments, there is a marked gap at 4 kHz measured in the short recovery group as shown in the CF *vs.* depth map. The reduced gap observed in the long recovery group

implied the presence of self-repair processes 11-21 days following noise exposure. Although, when compared to chronic tinnitus, the period of 11-21 day is relatively short, it provides a sufficient timeframe to measure the pathological changes in hearing during this period. Note that the noise overexposure frequency was set at 4 kHz, which correlated with this gap. A former study showed that the maximal inhibitory frequency is normally lower than the major frequency at which tinnitus occurs [31]. Our research suggests that the noise of 4 kHz caused a significant shift at 4, 8 and 16 kHz in ABR thresholds.

Increased spontaneous firing rates and the reorganization of the tonotopic map closely follow sensory deafferentation. This also provides an objective signal for tinnitus when associated with hearing loss [32]. It has been reported that after tone-induced (6 kHz) hearing loss in cats, increased synchrony was largely restricted to regions of the auditory cortex where reorganization of the tonotopic map occurred (6 - 10 kHz) compared to non-reorganized regions [8].

In this study, we observed that the FTM reorganization was more noticeable in the short recovery group than the long recovery group. Both groups also had higher spontaneous firing activities than normal. The reorganization of the FTM is obvious in either recovery period when the increased spontaneous firing activity occurs, suggesting that the firing is a relatively dependent event with FTM reorganization. Interestingly, spontaneous rates are increased in animals with tinnitus [33]. Other research has shown that neural tinnitus can continue for life-long periods after recovery from noise-induced damage, whereas CAP thresholds recover only partially weeks after noise-exposure [3-29]. Therefore, we speculate that these enhancements in spontaneous firing within the IC neurons relate to tinnitus models previously described [34]. The mechanism of increased spontaneous firing after noise exposure has not yet been fully understood. However, it is likely related to hyperactivity of the auditory nuclei in the brain stem, or a reduction in the normal suppressive activity of the central auditory cortex on peripheral auditory nerve activity as indicated in previous research [35]. It is possible that the disruption of inhibition/excitation balance in IC may arise from noise induced damage to both inner- and outer-hair cells, resulting in increased spontaneous activities in the IC neurons.

Conclusion

Our research has determined the response of FRAs following noise overexposure. IC neurons during both short and long recovery periods show increased spontaneous firing activity after noise overexposure, when compared to the normal group. In addition, we found that the spontaneous firing and FTM reorganization are two correlated events. Noise induced damage in both inner- and outer- hair cells should be related to these two phenomena. Our results may be useful to develop potential treatments for related hearing diseases.

Competing interests

No conflicts of interest, financial or otherwise, are declared by the authors.

Authors' contributions

FW, LZ, YS, WG performed the experiments, LZ, FW analyzed experimental data, FW, BH and LL designed the project, LL and DH sponsored and supervised the experiments, LZ, FW and EMR wrote the paper, LZ and EMR made figures, LZ supervised the paper submission, editing, and revision. All authors read and approved the final manuscript.

Acknowledgments

We acknowledge the assistance of Dr. Alan R. Palmer, Brad Rose, Huizhan Liu, Yuqian Liu for research support. We also thank Allison Hallman, Yongjin Zhu, and William Roberts for their assistance.

Grants

This study was supported by National Natural Science Foundation of China (NSFC #30872863), Michigan OU General Fund G110, and Ohio State University College of Medicine Start-up Fund 013000 (USA).

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Oticon A/s; "Diminishing Tinnitus Loudness by Hearing Instrument Treatment" in Patent Application Approval Process

Publication info: Telecommunications Weekly (Dec 26, 2012): 842.
ProQuest document link

Abstract: "According to a first aspect of the present invention, the above identified technical object is achieved by a listening device for a hearing impaired person being subjected to a tinnitus at a tinnitus frequency range that comprises the following components: an input transducer configured to provide an electric input signal comprising audio, a detector coupled to the input transducer and configured to determine whether the electric input signal is a broadband signal or not and to provide a detection signal in response and a controllable filter for filtering the electric input signal that is coupled to the detector and the input transducer and configured to output a filtered electric input signal such that a component of the electric input signal in the tinnitus frequency range is attenuated, if the detection signal indicates that the electric input signal is a broadband signal, and to output an unfiltered electric input signal such that a component of the electric input signal in the tinnitus frequency range is not attenuated, if the detection signal indicates that the electric input signal is not a broadband signal.

Full text: 2012 DEC 26 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- A patent application by the inventors PONTOPPIDAN, Niels Henrik (Smorum, DK), filed on June 5, 2012, was cleared for further review on December 13, 2012, according to news reporting originating from Washington, D.C., by VerticalNews correspondents.

Patent serial number 489264 is assigned to Oticon A/s.

The following quote was obtained by the news editors from the background information supplied by the inventors: "A hearing impaired person using a hearing instrument for compensating his/her hearing impairment can additionally be bothered by a tinnitus. A conventional approach for treating tinnitus is to emit a sound through the hearing instrument that either compensates the tinnitus noise by means of a destructive interference or that disturbs the source of the tinnitus, such as hair cells or subsequent auditory functionality, in generating the tinnitus. Such a conventional approach is, for instance, described in U.S. Pat. No. 6,047,074. This publication suggests treating tinnitus with a programmable hearing aid that includes a signal processing chain responsible for producing a useful signal by acting on an input signal in a manner to correct a hearing impairment of a wearer of the hearing aid.

"In the publication 'Listening to tailor-made notched music reduces tinnitus loudness and tinnitus-related auditory cortex activity', Proceedings of the National Academy of Sciences of the United States of America (PNAS), 107 (3): 1207-1210, 2010, authors H. Okamoto et al. describe a causal treatment approach of treating a tinnitus by targeting the tinnitus percept more directly. According to the described new approach, a chronic tinnitus patient is exposed to self-chosen music, which was notched to contain no energy in the frequency range surrounding the patient's tinnitus frequency. For instance, a frequency band of one octave width centered at the individual tinnitus frequency was removed from a music energy spectrum via a digital notch filter."

In addition to the background information obtained for this patent application, VerticalNews journalists also obtained the inventors' summary information for this patent: "It is an object of the present invention to provide a listening device offering an improved tinnitus treatment possibility. It is furthermore an object of the present invention to provide a corresponding operating method of operating a listening device and a corresponding computer program.

"According to a first aspect of the present invention, the above identified technical object is achieved by a listening device for a hearing impaired person being subjected to a tinnitus at a tinnitus frequency range that comprises the following components: an input transducer configured to provide an electric input signal comprising audio, a detector coupled to the input transducer and configured to determine whether the electric input signal is a broadband signal or not and to provide a detection signal in response and a controllable filter for filtering the electric input signal that is coupled to the detector and the input transducer and configured to output a filtered electric input signal such that a component of the electric input signal in the tinnitus frequency range is attenuated, if the detection signal indicates that the electric input signal is a broadband signal, and to output an unfiltered electric input signal such that a component of the electric input signal in the tinnitus frequency range is not attenuated, if the detection signal indicates that the electric input signal is not a broadband signal.

"The present invention includes the recognition that, on the one side, the introductorily mentioned conventional approach of treating a tinnitus by emitting a sound is, in the outcome, merely a symptom management. A conventional approach of treating a tinnitus results at best at a temporary partial elimination of the tinnitus noise, namely for the time when the signal is emitted; however, the emission of a signal does not heal the tinnitus itself. If the known hearing aid stops emitting the sound, the tinnitus will keep on bothering the hearing impaired person. On the other side, the causal treatment approach described by Okamoto et al. requires the hearing impaired person to listen to the prerecorded music over and over again in order to sustainably reduce tinnitus loudness.

"In contrast, the listening device of the first aspect of the present invention automatically achieves a sustainable

reduction of tinnitus loudness by detecting that the electric input signal is a broadband signal and by dampening a frequency component of the electric input signal in the tinnitus frequency range. If the listening device detects that the electric input signal is not a broadband signal, the filter will not filter the electric input signal but let it pass substantially unmodified, in particular unfiltered. Thereby, the listening device automatically promotes a reversing of maladaptive auditory cortex reorganization in the ear/ears of the hearing impaired person.
"The listening device can be any hearing instrument, hearing aid, headset, earphone and in-the-ear (ITE) listening component, a completely-in-canal (CIC) listening component, a behind-the-ear (BTE) listening component, or a receiver-in-the-ear (RITE) listening component. The listening device can furthermore be an analog, a digital or an analog-digital hybrid listening device.
"The term 'tinnitus frequency range' of a user is in the present context to mean a frequency range around a central tinnitus frequency f.sub.t which is perceived by a user as comprising the disturbing frequencies associated with tinnitus. The tinnitus frequency range (including the central tinnitus frequency can e.g. be determined for a given user by playing a number of narrow-band sounds (e.g. pure tones or harmonic series with missing fundamentals that span small frequency range) centered at different frequencies over the human audible frequency range (e.g. between 20 Hz and 20 kHz) and have the user identify the frequency (or frequencies) that is perceived as closest to the disturbing tinnitus sounds. In an iterative procedure, the distances in frequency between the sounds played for the user can be diminished to successively more precisely identify one or more tinnitus frequency ranges (and thus corresponding central tinnitus frequency/ies). In an embodiment, more than one distinctly different (non-overlapping) tinnitus frequency ranges of a user is defined.
"In an embodiment, the component of the electric input signal in the tinnitus frequency range that is attenuated defines a 'tinnitus filtering range' (e.g. between respective minimum and maximum tinnitus filtering frequencies, e.g. corresponding to 3 dB cut-off frequencies of a band-pass filter).
"The term 'a broadband signal' is in the present context taken to mean a signal having a bandwidth that is larger than the component of the electric input signal in the tinnitus frequency range that is attenuated. A broadband signal is e.g. defined as a signal that has a bandwidth larger than one third octave, e.g. larger than one octave, relative to a centre frequency f.sub.t of the tinnitus frequency range. In an embodiment, the bandwidth of the broadband signal is larger than 500 Hz, such as larger than 1 kHz, such as larger than 2 kHz. The filtering characteristic of the controllable filter is adapted to the tinnitus frequency range of the hearing impaired person that wears the listening device. This can mean that the controllable filter dampens a frequency component in the electric input signal that has a frequency identical to the frequency/frequencies of the individual tinnitus noise. However, if it is determined that a treatment of the tinnitus can be improved if other or additional components in the electric input signal that have a frequency other than the frequency of the individual tinnitus noise are dampened, the controllable filter is adjusted such that these components of the electric input signal are dampened. Thus, the filtered electric input signal can be target filtered such that a frequency band of a certain range centered at the individual tinnitus frequency is dampened from the broadband electric input signal. In another approach, the filtered electric input signal can also be a filtered signal, whose frequency components that directly surround the individual tinnitus frequency remain substantially unchanged and that other frequency components at a certain distance to the individual tinnitus frequency are dampened. However, it is preferred that the controllable filter dampens such a component of the electric input signal, whose frequency is substantially identical to the individual tinnitus frequency/frequencies. Measurement results have shown that such target filtering offers a more effective treatment of tinnitus loudness.
"The controllable filter dampens the component of the electric input signal such that the amplitude of the component of the filtered electric input signal is reduced compared to the amplitude of the component of the electric input signal prior to be subjected to the filter. It is preferred that the controllable filter is configured to completely remove the component, if the detection signal indicates that the electric input signal is a broadband

signal. However the advantageous effects of the controllable filter in the listening device can also be achieved, if the component is substantially reduced. For instance, the controllable filter is a notch filter, such as a digital notch filter or an analogue notch filter. Alternatively, the dampening is performed by an analysis-synthesis filter bank whose respective bands are set to zero or to another dampening value.

"It shall be understood that in case that it is detected that the electric input signal is not a broadband signal and an unfiltered electric input signal is provided by the controllable filter correspondingly, such unfiltered electric input signal can be subjected to further filter means that the listening device can optionally comprise. The primary function of the controllable filter is to attenuate the relevant component of the electric input signal, if the electric input signal is a broadband signal. The controllable filter can be embedded in a filter bank of the listening device, if present, the filter bank configured to fulfill filter function that are conventional within the scope of listening devices, such as noise filtering etc. However, the controllable filter can alternatively be arranged separately in the listening device.

"The wording tinnitus is to be understood to follow its standard definition in the technical field of acoustic signal processing.

"In a preferred embodiment, the detector comprises a classifier for determining whether the electric input signal is a broadband signal or not. The classifier is configured to classify the electric input signal in one of a plurality of classes comprising at least: broadband music, broadband noise, such as car noise or other environmental noise, non-broadband own voice and non-broadband speech. In a preferred embodiment, the controllable filter outputs a filtered electric input signal, whose component in the tinnitus frequency range is attenuated, if the detector classifies the input signal as one or more of broadband music or broadband noise (such as car noise or other environmental noise). If, on the other hand, the electric input signal is classified as non-broadband own voice or as non-broadband speech, the controllable filter outputs a substantially unmodified electric input signal, that is to say: the controllable filter does not process the electric input signal but rather forwards it substantially unmodified to a component connected downstream of the controllable filter.

"In order to perform the classification, the classifier can comprise estimation means for estimating in which class the electric input signal is to be classified. Such estimation means can perform the estimation on a regular basis known from the prior art, cf. e.g. US 2003/0144939 A1 or US2006/0179018 A1.

"In a preferred embodiment, the detector is configured to provide the detection signal indicating that the input signal is a broadband signal only, if the electric input signal has not been classified as own voice or as speech. If own voice or speech is contained in the acoustic input signal, filtering the electric input signal with a controllable filter could harm the intelligibility of the signal eventually presented to the hearing impaired person wearing the listening device. Thus, if the signal is classified as voice of speech, the controllable filter does not filter the electric input signal. As the classifying can be based on estimation, the electric input signal could both be identified as being a broadband signal and as containing own voice and speech. In this case, no filtering shall take place. Level detection in hearing aids is e.g. described in WO 03/081947 A1 or U.S. Pat. No. 5,144,675. A speech detector is e.g. described in WO 91/03042 A1. Own voice detection is e.g. dealt with in US 2007/009122 A1 and in WO 2004/077090 A1.

"In a particular preferred embodiment, the listening device comprises an activator coupled to the controllable filter and to the detector, which is configured to activate and deactivate the controllable filter in dependence of the detection signal. For instance, if the detection signal yields that the input signal is a broadband signal, the activator activates the filter such that the electric input signal is converted into a filtered electric input signal. If, in the other case, the detection signal yields that the electric input signal is a non-broadband signal or, respectively, that the electric input signal contains own voice or speech, the activator deactivates the controllable filter, such that the controllable filter does not process the electric input signal but rather forwards it substantially unmodified to a component of the listening device connected downstream to the controllable filter.

"In another preferred embodiment, the listening device comprises a user interface configured to provide a user

submitted tinnitus treatment user signal to the activator, wherein the activator is configured to activate and deactivate the controllable filter in dependence of the detection signal and the tinnitus treatment user signal. This embodiment takes into account that the hearing impaired person wearing the listening device may want to decide whether or not the controllable filter shall output a filtered electric input signal or not, as the filtered electric input signal can lead to an output signal to be presented to the hearing impaired person that differs from an output signal which has been derived from an unfiltered electric input signal. Thus, the hearing impaired person can, for instance, decide that the controllable filter only operates at certain time periods during the day.
"In another preferred embodiment, the listening device additionally comprises a programmable timer configured to provide a timer signal to the activator, wherein the activator is configured to activate and deactivate the controllable filter in dependence of the detection signal and the timer signal. This embodiment can be combined with the embodiment described above that comprises a user interface. For a certain tinnitus therapy, it can be advantageous that the controllable filter is only activated at a certain times of the day and/or, respectively, for a maximum amount of time per day or, respectively, per hour or any other time unit. In an embodiment, the activator can receive the detection signal, the timer signal and a user signal and only activates the controllable filter, if all of the three aforementioned signals yield that the controllable filter should be activated, that is to say: The detection signal yields that the input signal is a broadband signal, the user signal indicates that the hearing impaired person wishes that the tinnitus therapy takes place and the timer signal allows for operation of the controllable filter. If one of the aforementioned three signals yields contrary, the controllable filter is not activated but deactivated and outputs an unfiltered electric input signal such that a component of the electric input signal in the tinnitus frequency range is not dampened.
"In case the tinnitus frequency range of the user is relatively broad (or comprises a number of different (non-overlapping) frequency ranges spaced over a relatively broad frequency range), e.g. comprises more than one octave of frequencies, the listening device may be adapted to split the tinnitus therapy into a number of separate treatments (separate in time), each concentrating on a specific frequency range, each frequency range being e.g. smaller than one octave. The listening device is then adapted to provide the number of separate treatments at different points in time, e.g. in a repetitive pattern, so that that only one of the number of frequency ranges is stimulated (treated) at a given time.
"It is preferred that the programmable timer is configured to determine the amount of operation time during which the controllable filter outputs the filtered electric input signal and to ensure that the operation time does not exceed a predetermined limit, wherein the predetermined limit is programmed to the timer. The predetermined limit can, for instance, analogously be formulated as '2 h per day' or '10 min per hour', 'total of 100 hours maximum' and so on. Such setting of a predetermined time limit may in an embodiment be set during fitting by a Health Care Professional (HCP) of the listening device to a particular user's needs. In another embodiment, the setting of a predetermined time limit may be controlled by the user of the listening device via a user interface, e.g. a button or a remote control.
"In an embodiment, the listening device is adapted to allow a user to activate a traditional tinnitus treatment (e.g. comprising playing audio pieces masking noises, delivering pleasant sounds, etc.). In the fitting process the Hearing Care Professional (HCP) may define the 'treatment' schedule providing tinnitus treatment according to the present invention to a predefined period per day, e.g. 2 hours per day. If, however, the user of the listening device (e.g. via a user interface) requests the traditional tinnitus treatments with a certain frequency and/or a certain duration during daily use, the listening device may be adapted to monitor such behavior and to increase or decrease the frequency or duration of the treatments (between certain maxima and minima, e.g. set by a HCP during fitting of the device to the user in question) based on said monitored behaviour.
"In another preferred embodiment, the listening device additionally comprises a memory coupled to the controllable filter and configured to store one or more individual frequency values representing the tinnitus frequency range, wherein the controllable filter is configured to adapt its filter characteristic according to the

stored frequency values. Thus, after production, the listening device does not have to be a priori exactly adapted to the designated user, but can be adapted to the individual tinnitus appearance during a fitting process. Such fitting process can result in a spectral characterization of the hearing impaired person's tinnitus and in determined frequencies that shall be removed by the controllable filter. Thus, by determining the one or more individual frequency values during the fitting process, the listening device for the hearing impaired person can be adjusted to the individual tinnitus appearance.

"The listening device of the first aspect of the present invention is not limited to only treat a tinnitus, but can also, in a preferred embodiment, compensate other hearing deficiencies of a hearing impaired person and generally improve intelligibility of the incoming acoustic signal.

"In another preferred embodiment, the listening device comprises a signal processor connected downstream of the controllable filter and configured to process either the filtered or the unfiltered electric input signal according to a processing algorithm and to output a processed electric signal. It is further preferred that the listening device comprises an output transducer connected downstream of the signal processor and configured to convert the processed electric signal to an analog output signal to be presented to the hearing impaired person. In an embodiment, the output transducer comprises a number of electrodes of a cochlear implant or a vibrator of a bone conducting hearing device. In an embodiment, the output transducer comprises a receiver (speaker) for providing the stimulus as an acoustic signal to the user.

"The input transducer is e.g. adapted to convert an acoustic input signal to an electric input signal comprising audio. The input transducer can comprise one or more microphones. The input transducer can alternatively or additionally comprise a wireless receiver for receiving an electromagnetic signal and extracting (e.g. demodulating the received signal to provide) an audio signal therefrom. The wirelessly received signal may be transmitted to the listening device from any appropriate device comprising a transmitter of an audio signal, e.g. a microphone, a telecoil, another listening device (e.g. a contralateral listening device of a binaural system), a communication device (e.g. a cellphone), an audio gateway for receiving a number of audio signals and transmitting a selected one (or a mixture of several selected signals) to the listening device (e.g. controlled by the user of the listening device), etc. The wireless transmission may be based on any communications technology of relevance to a portable listening device, e.g. near-field or far-field electromagnetic communication, light communication, etc.

"According to a second aspect of the present invention, the above identified technical object is achieved by a method of operating a listening device for a hearing impaired person being subjected to a tinnitus at a tinnitus frequency range, wherein the method comprises steps of receiving an electric input signal comprising audio, determining whether the electric input signal is a broadband signal or not and providing a detection signal in response and forwarding the electric input signal to a controllable filter and outputting a filtered electric input signal such that a component of the electric input signal in the tinnitus frequency range is attenuated, if the detection signal indicates that the electric input signal is a broadband signal, or outputting an unfiltered electric input signal such that a component of the electric input signal in the tinnitus frequency range is not attenuated, if the detection signal indicates that the electric input signal is not a broadband signal.

"The operating method of the second aspect of the present invention principally shares the advantages of the listening device of the first aspect of the present invention. In particular, the operating method has preferred embodiments that correspond to the additional optional features of the listening device of the first aspect of the invention described above. For instance, it is preferred that the method comprises the step of classifying the electric input signal into one of the classes: broadband sound, broadband music, broadband noise, non-broadband own speech, non-broadband voice and performing the filtering step, only if the electric input signal is a broadband signal and not a non broadband voice or speech signal. The method preferentially also comprises the step of receiving a user signal and performing the filtering step only, if the user signal yields that the hearing impaired person wishes the tinnitus treatment to be commenced. It is furthermore preferred that the method

comprises a step of monitoring the time period during which a filtered electric input signal is generated and to prevent further filtering of the electric input signal, if it is determined that a predefined maximum of time has been exceeded. The received electric signal comprising audio is e.g. received from a wireless receiver (or transceiver) or from an acousto-electric transducer such a as a microphone or a microphone system (e.g. comprising a number on microphones and e.g. providing as an output a directional signal).
"According to a third aspect of the present invention, the above identified object is achieved by a computer program for operating a listening device, the computer program comprising program code means for causing the listening device to carry out the steps of the method of the second aspect of the present invention, when the computer program is run on a computer controlling the listening device.
"The computer program of the third aspect of the invention may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems."
URL and more information on this patent application, see: PONTOPPIDAN, Niels Henrik. Diminishing Tinnitus Loudness by Hearing Instrument Treatment. U.S. Patent Serial Number 489264, filed June 5, 2012, and posted December 13, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=3692&p=74&f=G&l=50&d=PG01&S1=20121206.PD.&OS=PD/20121206&RS=PD/20121206
Keywords for this news article include: Tinnitus, Broadband, Oticon A/s, Electronics, Electromagnet, Otolaryngology, Hearing Disorders, Signal Processing, Sensation Disorders, Nervous System Diseases, Neurologic Manifestations.

Appeals court to hear deaf student's complaint

Author: England-Nelson, Jordan

Publication info: Orange County Register [Santa Ana, Calif] 20 Dec 2012.
ProQuest document link

Abstract (Abstract): "At the end of the day, (the student is) emotionally very tired from all the intense concentration" and "come(s) home mentally exhausted from trying to listen," a court order reads. "She reports that she will laugh at school when she sees others laughing and worries about looking stupid if others realize she did not catch the joke."
"It's much more complex than the cost issue," says Jack Clarke, the attorney representing Tustin Unified. "I can't speak in specifics about any particular student, but we believe that by complying with federal law we have not discriminated against any student in the district."
The original hearing of the case, which took place in 2009, examined whether the district had denied the plaintiff a "free and appropriate public education" as required by the Individuals with Disabilities Education Act. Citing another case as precedent, the judge affirmed that schools are not required to provide "every special service necessary to maximize each handicapped child's potential."

Full text: A hearing-impaired Tustin high school student has asked that her complaint against the Tustin Unified School District be re-examined.

The girl says the district's refusal to provide speech-to-text transcription in real time constitutes discrimination. Two judges have already sided with Tustin Unified, holding that the school is not required by law to provide the service. Now the case has been brought before the 9th Circuit Court of Appeals.

Although the girl is deaf, a cochlear implant allows her to communicate by listening and speaking, rather than using sign language. The electronic device stimulates the auditory nerve to provide a sense of sound, but does not restore normal hearing, as it does not filter out background noise that hearing people do naturally. As it stands, the girl - whose name is not given in the suit because she was a minor at the time it was filed - finds it difficult to follow what is happening in class, particularly during student discussions.

"At the end of the day, (the student is) emotionally very tired from all the intense concentration" and "come(s) home mentally exhausted from trying to listen," a court order reads. "She reports that she will laugh at school when she sees others laughing and worries about looking stupid if others realize she did not catch the joke."

Despite her difficulty in classes, the student generally earns average to above-average grades in school, according to court records.

The high school has offered to provide an FM system, which involves a wireless microphone that beams a signal to an ear piece worn by the student. The girl dislikes the FM technology because the microphone picks up static and side conversations when the teacher moves around the classroom, and she didn't want to force students to pass around a microphone in class.

The service that the girl has requested in her appeal is called communication access real-time translation, or CART. The technology costs $100-$150 an hour and involves a person listening in on the class and transcribing what is said.

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The act only provides basic and low-level protections, said David Gray, the Tustin student's lawyer. He said the previous judges did not take into sufficient consideration the Americans with Disabilities Act, which he says ensures greater equality of opportunity for disabled individuals than the Individuals with Disabilities Education Act.

"If you have someone in a wheel chair, you give him a ramp to get up the steps -- you don't make him crawl," Gray said by phone.

Gray's client first asked for captioning service as she was entering ninth-grade. She is now a senior, and would no longer directly benefit from a reversal of the judges' decision.

"The hope is to get some clear legal precedent so the next kid coming up from middle school will have a clear definitive answer for this," said Gray.

STUDENT

STUDENT

Publication date: Dec 20, 2012

Year: 2012

Products October 15, 2012

Publication info: Lodging Hospitality (Dec 10, 2012).

Full text: AMENITIES

Olive Branch Botanicals offers a line of bathroom amenities that the company says are softer and gentler and provide a more ecological approach to skin and body care and includes a respect for the environment.

RECYCLING CONTAINERS

Witt Industries expanded its line of GeoCube indoor recycling containers with a larger, 36-gallon capacity model, the addition of a recycle blue color as an option on all sizes, an improved bag holder retainer band and a new combination top for cans and paper. Also, the decals to identify the recycling stream for its cube has been changed to a new, more readable typeface design.

SELF-SERVICE YOGURT

Donper America introduced a new yogurt machine hotels can use for buffet areas, breakout sessions, free evening meals and other occasions. The model BH7480 is a freestanding unit that dispenses two flavors with a twist option housed in a slim-design stainless steel compartment. The machine is air-cooled, eliminating the need for it to connect to water and glycol systems.

CARPET

Bloom is a new carpet collection from Aqua Hospitality Carpets and Zeftron, a premium branded nylon 6 fiber system. The line is available in three nature-themed styles-Flora, Pure Petal and Just Leafy-and six colorways ranging from neutral earthtones to natural brights. Available in both broadloom and tile, the collection is suited for guestrooms, corridors and lobby areas.

HEARING AID

The Silent Servant Hotel Kit from Silent Call Communications is a complete package to meet the needs of guests who are deaf or hard of hearing while meeting applicable ADA regulations. The kit includes a receiver with built-in alarm clock, smoke detector with transmitter, sound monitor for the telephone, doorbell transmitter on a bracket, bed vibrator and a snap-on phone amp.

LAVATORY SYTEM

Bradley Corp. introduced the Advocate AV-Series Lavatory System, which it says is the first lavatory unit to include a sink, soap, faucet and dual-sided hand dryer in one unit. In addition to user convenience and functionality, the all-in-one design ensures all waste water goes down the drain, not on the floor or down the walls. Available in two- or three-user models, the lavatory is also ADA compliant, says the company.

SHOWERHEADS

Oxygenics has expanded its line of self-pressurizing showerheads to include four series. The Spa Series features the Evolution hand-held, rotating-head, multi-feature spray. The Power Series has the Power Massage Combo that offers 35 different sprays and a dual showerhead. The Rain Series is a wide (up to 10 inches) showerhead that has up to 54 power nozzles on each unit. The Classic Series includes simple and affordable models.

CLOCK RADIO

Sunbeam's new Elite CR1003 clock radio designed specifically for hotels is a "talking" product with a wide array of other features but is simple to operate, says the company. Features include voice, nap timer, USB charger, radio seek, iPod dock and white noise. It also has what Sunbeam calls a foolproof alarm setting system that incorporates an audible voice that instructs and confirms guest alarm settings. The unit also has a large, bright LCD display with easy-to-read time and clearly marked "alarm on/off" and "alarm time" indicators.

HAND DRYER

TRI-Umph is a new addition to American Specialties' Roval Collection of hand dryers. The company says the automatic high-speed dryer is a super-hygienic, fast-drying and competitively priced option for commercial washrooms. The unit's ergonomic design allows users to dry their hands in a natural position without water splash-back or water falling to the floor and creating a hazard. Its filter system is comprised of three layers of filter: HEPA, carbon and anti-microbial.

GUEST INTERNET SYSTEM

Eleven Wireless, provider of a cloud-based guest Internet platform, launched ElevenOS software, which is a new framework for advanced bandwidth management that includes package tiering, in-session upgrades, sharing across multiple guest devices and easy provisioning and prioritization for groups and conferences.

CLOUD-BASED PMS

At the recent HITEC trade show, Hotel Concepts-Brilliant introduced iTesso, a scalable, customizable and integrated cloud-based property management system, distribution platform and central reservations system. It also can be deployed as a direct connection between a hotel CRS and the global distribution system or as a distributed multi-property PMS with links to third-party CRS. The software is based and hosted on the Microsoft Azure cloud infrastructure.

TOOTHBRUSH HOLDER

The Stand and Stow toothbrush holder from Lightbulb LLC is a hotel amenity that provides guests with a clean place to stand their toothbrushes in the bathroom and a convenient place to store the brushes when they leave. A customization program from the company allows hotels to place their logos on the item.

HOSPITALITY LEGAL ISSUES

The fourth edition of Managing Legal Issues in the Hospitality Industry from Research and Markets Ltd. shows hotel owners and operators how to effectively and proactively manage the legal environment in their lodging properties. New to this edition are discussions of payment card industry compliance, revised ADA regulations, information on social media and more.

WIRELESS PA SYSTEM

The Loudmouth Wireless PA System from Ritron, Inc. allows hotels to use existing portable two-way radios, base stations or mobile radios to deliver live voice messages at a distance of up to two miles away, making the system suitable for general paging or announcements, weather emergencies, security announcements and more. The company says the system installs easily and virtually anywhere with no trenching or extensive wiring required.

STACKABLE SEATING

The Piper Chair from MTS Seating is contemporary and comfortable and takes stackable banquet seatings to "an elegant new level," says the company. The multi-contoured seat shell provides the comfort. The chair is stackable up to 10 high and comes with a 12-year structural frame warranty.

IPAD CHECK-IN

The xPress Check-In app from Northwind allows hotels to use iPads and other tablets for personalized mobile check-in and check-out services with seamless remote access to Northwind's Maestro Property Management Suite. Using the app, guest service agents can provide curbside service, upsell and change room assignments in real-time, complete group check-in and room blocking, remotely encode magstripe and RFID room keys, capture credit card info with PCI compliance and more.

SUSTAINABLE FURNITURE

The Plank Collection of furniture, developed by Pfeiffer Lab for furniture manufacturer Council, is made of Perennial Wood, a product made in the U.S. from domestically harvested Southern pine. The manufacturer says the wood undergoes a proprietary process that transforms its cell structure, leaving no toxic substances and providing a physical barrier that resists damage from outdoor elements for decades.

UPRIGHT VACUUM

The SC9050B lightweight commercial upright vacuum from Sanitaire features a more durable design in a lightweight, easy-to-maneuver frame, says the company. The frame is made of magnesium, which is 75% lighter than steel and 33% lighter than aluminum. A new design allows users to place their foot on the vacuum hood and release the vacuum from the upright position without the use of the foot pedal.

FLATWORK IRONER CLEANER

Tingue, Brown &Co. introduced a heavy-duty Continuous Belt Cleaner for flatwork ironers. Using an abrasive mesh strip design, the cleaner accesses difficult-to-reach areas directly under the ironer to remove large amounts of dirt, lint, grime, wax and other contaminants that accumulate over time.

AMENITY COLLECTION

Lather Hotel partnered with luxury bath and body brand Mistral to introduce the Mistral Verveine hotel amenity collection. The products draw on organic shea butter to soften, natural olive oil to hydrate and condition and the scent of verbena to energize and soothe, says the company. The collection includes shampoo, conditioner, shower gel, body lotion, body soap, face soap, bath salts, shea butter and hand cream.

LOCKING TECHNOLOGY

Enhancements to VingCard's RFID locking technology promise to nearly double the reading speed for its Classic RFID, Signature RFID and Signature RFID Remotus designs. In addition, the company says the new platform enables the RFID locks to read keycards from more than twice as far.

MATTRESSES

Jamison Bedding's new Town &Country mattress line comes in four models including one- and two-sided designs. ArmorPur technology repels water- and oil-based liquids and stains. It safeguards the bed from mold, mildew, algae, bacteria, odor-causing microbes and microbial deterioration.

CLEANING CHEMICALS

Signet Cleaning Chemical Service combines cleaning chemicals from Diversey with the delivery service of Cintas. The co-branded product line includes floor, hard surface and manual warewashing cleaners. The delivery service eliminates the need to carry inventory and provides properly diluted chemicals at the push of a button.

Publication date: Dec 10, 2012

Year: 2012

Frequency Dependence of Binaural Interaction in the Auditory Brainstem and Middle Latency Responses

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Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 190-8.
ProQuest document link

Abstract: The primary purpose of this investigation was to determine the relative frequency representation of binaural function in the brainstem and cortex of adults. The secondary purpose was to compare adult responses to previously reported infant responses. Simultaneous auditory brainstem responses and auditory middle responses were recorded monaurally and binaurally in 20 young women. The binaural (BIN) response was subtracted from the summed monaural waves (L+R) to obtain the binaural interaction components (BIC) from waves V (peak A) and Pa (BIC-Pa). Amplitude ratios were calculated as BIC/L+R. Repeated-measures

analyses of variance evaluated responses to frequency (500 Hz vs. 4000 Hz), wave condition (L+R vs. BIN), and wave class (auditory brainstem response vs. auditory middle response). Waveforms were present for all conditions. The L+R responses were larger than the BIN responses, 500 Hz produced larger amplitudes than 4000 Hz, and Pa was larger than wave V. The largest response, overall, was the Pa(L+R) response to 500 Hz. For amplitude ratios, BIC-Pa/Pa(L+R) was larger than Peak A/[V(L+R)]. More neural resources are devoted to binaural function in the cortex than in the brainstem, andmore resources are devoted to lower frequencies than to higher frequencies. The adult data confirm that previously recorded infant data reveal binaural immaturity. Longitudinal data should characterize developmental characteristics of binaural function.

Full text: Headnote

Purpose: The primary purpose of this investigation was to determine the relative frequency representation of binaural function in the brainstem and cortex of adults. The secondary purpose was to compare adult responses to previously reported infant responses.
Methods: Simultaneous auditory brainstem responses and auditory middle responses were recorded monaurally and binaurally in 20 young women. The binaural (BIN) response was subtracted from the summed monaural waves (L+R) to obtain the binaural interaction components (BIC) from waves V (peak A) and Pa (BIC-Pa). Amplitude ratios were calculated as BIC/L+R. Repeated-measures analyses of variance evaluated responses to frequency (500 Hz vs. 4000 Hz), wave condition (L+R vs. BIN), and wave class (auditory brainstem response vs. auditory middle response).
Results: Waveforms were present for all conditions. The L+R responses were larger than the BIN responses, 500 Hz produced larger amplitudes than 4000 Hz, and Pa was larger than wave V. The largest response, overall, was the Pa(L+R) response to 500 Hz. For amplitude ratios, BIC-Pa/Pa(L+R) was larger than Peak A/[V(L+R)].
Conclusion: More neural resources are devoted to binaural function in the cortex than in the brainstem, andmore resources are devoted to lower frequencies than to higher frequencies. The adult data confirm that previously recorded infant data reveal binaural immaturity. Longitudinal data should characterize developmental characteristics of binaural function.

Key Words: electrophysiology, adults, hearing, infants, physiology, acoustics, development

Binaural hearing allows people to understand speech in noisy backgrounds and to localize the direction of sounds in the environment. Deficits in binaural processing, however, can accompany aging, hearing loss, and some pathological conditions, all of which can reduce a person's communication ability. A better understanding of binaural processing may lead to improvements in communication for people who have binaural deficits. Binaural function has been studied extensively with psychoacoustics but not with physiological measures; the physiological measures provide the ability to determine function at various levels in the brainstem and cortex. Electrophysiological studies of binaural function have been done primarily with the auditory brainstem response (ABR) and, to a lesser extent, with auditory middle latency responses (AMLR) and auditory late latency responses (ALLR) responses (for a review, see Fowler, 2004). This study focuses on the electrophysiological measures of binaural interaction in the ABR and AMLR.

The first evidence of binaural interaction was provided in the ABR by Jewett (1970). Binaural stimulation of the auditory brainstem pathways produced a larger response than did monaural stimulation, but not twice as large, suggesting that the right and leftauditory pathways interacted in the brainstem. Dobie and Berlin (1979) formalized a method for investigating the difference, which they called the binaural interaction component (BIC) of the ABR. The BIC was defined as the amplitude difference between the summation of the leftand right responses (called the L+R or predicted binaural amplitude) and the binaural response amplitude (the BIN or true binaural response). The subtraction is done in one of two ways: Either the L+R response is subtracted from

the BIN response (e.g., Dobie &Berlin, 1979) or the BIN is subtracted from the L+R response (e.g., Fowler &Leonards, 1985; McPherson &Starr, 1993). The BICs from the two subtractions are mirror images, but the characteristics measured from each are not necessarily the same across studies.

The ABR has five waves, indicated by Roman numerals, and extends from the eighth nerve to the lateral lemniscus (Moller &Jannetta, 1983). The ABR-BIC waveform is centered around the generators of Waves IV-VI, which are thought to arise from the superior olivary complex to the lateral lemniscus (Moller&Jannetta, 1983). Binaurally innervated neurons within this pathway limit the amplitude of the binaural response as a cumulative effect of neural interactions involving excitations and suppressions within the auditory neural pathways. For click stimuli, the ABR-BIC amplitude indicates a 16%-25% reduction of the predicted (L+R) response (Dobie &Norton, 1980; McPherson, Tures, &Starr, 1989), thus suggesting overall suppression in neurons that are shared between the leftand right auditory brainstem pathways. These binaural neurons are localized between the trapezoid body and the lateral lemniscus (Polyakov &Pratt, 1994).

The BIC can be elicited from AMLR and ALLR as well, but less is known about the origins of the latter responses. The AMLR, of concern in the present study, consists of Na-Pa-Nb, which occur from 12 to 75 ms after click stimulation and arise from the thalamocortical radiations and primary auditory cortex. The click-evoked AMLR-BIC is associated with Na-Pa-Nb in adults (Dobie &Norton, 1980; McPherson &Starr, 1993; McPherson et al., 1989) and in infants (Cone-Wesson, Ma, &Fowler, 1997; McPherson et al., 1989). Click-evoked AMLR BICs indicate that binaural responses are nearly half the size of the predicted response (Dobie &Norton, 1980; McPherson et al., 1989), suggesting that more cortical resources are devoted to binaural processing in the cortex than in the brainstem. Comparable studies using tonal signals in adults have not been reported.

The binaural interaction components in the ABR and AMLR are currently being used for a variety of clinical purposes. For example, Delb, Strauss, Hohenberg, and Plinkert (2003) used the BIC to identify auditory processing deficits in children, whereas Leigh-Paffenroth, Roup, and Noe (2011) used the AMLR-BIC to evaluate adults with equal sensitivity but different auditory function between ears. He, Brown, and Abbas (2010) used the BIC to determine in a cochlear implant user the amount of current spread in the cochleae of both ears. Gordon, Valero, and Papsin (2007) used the binaural interaction component of the ABR to measure brainstem plasticity in young children who were fit with binaural cochlear implants with variable time delays between the fittings. These uses suggest the need for a better understanding of the BIC, including the responses to stimulus frequency.

Very few studies have investigated the effects of signal frequency on the BIC of either the ABR or the AMLR. In the ABR, the BIC has been recorded with tonal signals across the frequency range from 1000 to 6000 Hz in adults (Fowler, 1989; Fowler &Broadard, 1988; Fowler &Leonards, 1985; Ito, Hoke, Pantev, &Lutkenhoner, 1988) and with both 500 and 4000 Hz in infants (Cone-Wesson et al., 1997). In the AMLR, the BIC has been recorded with tonal stimuli from 500 Hz in adults (Zhou &Durrant, 2003) and with 500 and 4000 Hz in infants (Cone-Wesson et al., 1997). Cone-Wesson et al. (1997) concluded that the ABR-BIC and MLR-BIC elicited with tonal signals were immature in infants, but comparable data from adults have not been reported for verification of that supposition. Accordingly, the purpose of this investigation was to determine the relative frequency representation of binaural function in the brainstem and auditory cortex of adults and to compare the results with the frequency representation described in the previously reported responses in infants (Cone-Wesson et al., 1997).

Method

This study was approved by the University ofWisconsin- Madison Institutional Review Board, and all participants signed an informed consent prior to being enrolled in the study. Twenty young adult women (Mage = 24 years, range = 21-34 years) served as participants; only women were recruited for homogeneity across participants. Each participant passed a hearing screening at 20 dB HL for octave frequencies ranging from 250 Hz to 8000

Hz, a tympanometric screening using the norms of Margolis and Heller (1987), and acoustic reflexes present at both 500 and 4000 Hz at 90 dB HL. Participants were required to have no current or chronic history of middle-ear pathology. All testing was completed in a sound-treated booth that met standard requirements for ambient noise (American National Standards Institute, 1991). Stimuli were calibrated prior to testing each test day.We used a Quest Model 1800 Precision Impulse Integrating sound level meter (SLM) with a Model OB-300 1/3-1/1 octave filter set to calibrate 500-Hz stimuli and 4000-Hz stimuli to maintain a 100-dB peak sound pressure level (peSPL). The SLM was calibrated with an acoustic calibrator (Quest CA-22), then the insert earphones were calibrated.

ABR and AMLR were recorded simultaneously (Biologic EP, Version 5.64, Model 92). Stimuli were 500- and 4000-Hz tone bursts with a 2-ms rise-fall time and a 1-ms plateau in a Blackman-shaped envelope. Stimuli were presented at 100 dB peSPL and at a rate of 11.1 stimuli per second. Gold-cup surface electrodes (Grass, E5GH) were placed at the vertex (Cz) for the positive input, at the nape of the neck for the negative input, and on the forehead for ground. Impedance was <3,000 ohms and was balanced within 1,000 ohms across electrodes. Physiological filters were set to pass activity from 10 to 3000 Hz (3-dB down points) with a slope of 12 dB per octave.

Each participant was tested in one 3-hr session, with breaks as necessary. Participants reclined in a comfortable chair for the evoked potential tests and were asked to remain awake and quiet for the tests. Participant wakefulness was verified after each bank of 6000 sweeps by the examiner talking to the participant. The beginning stimulus frequency (500 or 4000 Hz) was alternated for successive participants. Two thousand stimuli were presented in each condition in the sequence of monaural right, monaural left, and binaural stimuli, and each sequence was repeated twice, for a total of 6,000 sweeps each.

Data were manipulated and analyzed offline. The leftand right monaural responses were added to yield the L+R response, after which the BIN was subtracted from the L+R response to yield the BIC. The BIC was considered present only if an independent observer and the second author both agreed on its presence. Latency and peak-totrough amplitudes were measured for waveforms in each of the replications in all stimulus conditions. For the ABR waveform conditions, wave V and Peak A were measured; for theAMLRconditions,wave Pa andBIC-Pawere measured. Amplitude ratios for peak A/V(L+R) and BIC-Pa/Pa(L+R) were calculated to control for amplitude differences in the parent waveforms.

For the statistical analysis, the latency and amplitude data used were the average of the three replications. Latencies, amplitudes, and amplitude ratios were analyzed with repeatedmeasures analysis of variance (RMANOVA; SPSS Version 20) with significance defined at the $p < .05$ level.

Results

The parent waveforms and the BIC were evident in all participants for both ABR and AMLR conditions and for both stimulus frequencies. A typical response to the 4000-Hz stimulus from a participant is shown in Figure 1, with the components of interest labeled. For the ABR, the peak Awas present in 100% of the BICs for both stimulus frequencies, whereas the peak B was present in 50% of BICs for 500 Hz and 60% of BICs for 4000 Hz. Hence, for the remainder of the study, we considered only peak A for the ABR-BIC.

Tables 1 and 2 contain the mean data (and SDs) for the latencies and amplitudes, respectively, for the wave components of interest (L+R, BIN, peak A, and BIC-Pa). As expected, the mean latencies for wave Vand Pa were longer in all conditions (monaural, binaural, L+R, and BIC) for 500 Hz than for 4000 Hz. The mean amplitudes of the wave V and Pa in the L+R and BIN conditions were greater for the 500-Hz stimuli than for the 4000-Hz stimuli. Overall, the largest BIC was the BIC-Pa elicited with the 500-Hz stimuli.

The latencies of waves V and Pa were analyzed with a three-way RM ANOVA to determine the significance of differences between class of potential (ABR V and AMLR Pa), stimulus frequency (500 Hz and 4000 Hz), and waveform condition (L+R and BIN); results are shown in Table 3. The only significant differences were between frequencies and between the wave classes. As expected, latencies were longer for waves elicited by 500 Hz

than 4000 Hz, and latencies were longer for the AMLR Pa than for the ABR wave V. The difference in latency between the L+R and BIN potentials was not significant, and interaction was significant.

The amplitudes of the L+R and BIN conditions for waves V and Pa for both frequencies are shown in Figure 2. Overall, the amplitudes for ABR wave V (leftpanel) are smaller than the amplitudes for AMLR wave Pa (right panel). The AMLR wave Pa in the L+R condition had the largest amplitude overall, and the difference in amplitudes between L+R and BIN conditions was large for the wave Pa in comparison with the wave V. The results were analyzed with a three-way RM ANOVA to determine the significance of differences between class of potential (ABR and AMLR), stimulus frequency (500 and 4000 Hz), and waveform condition (L+R and BIN); the results are shown in Table 4. The only significant main effect was waveform condition, with the L+R being larger than the BIN condition. Main effects for the stimulus frequency (responses to 500 Hz were greater than responses to 4000 Hz) and class of potential (Pa amplitude was larger than Vamplitude) were of marginal significance as a result of interactions between variables. The interactions are depicted in Figure 3. Panel A illustrates the interaction between frequency and wave condition. Whereas the 500-Hz frequency produced larger amplitudes than did the 4000-Hz frequency, the amplitude difference between the two frequencies was larger for the L+R condition (0.22 mV) than for the BIN condition (0.03 mV). Panel B illustrates the interaction between wave class and frequency, which indicates that amplitudes for Vand Pa are more similar (and larger) for 500 Hz than for 4000 Hz, as a result of reduced amplitudes for wave Vat 4000 Hz. Panel C illustrates the interaction between wave class and wave condition and indicates that in the L+R condition, wave Pa is much larger than wave V, whereas amplitudes for the two waves are similar for the BIN condition. In summary, the largest amplitudes were recorded for the Pa wave in the L+R condition with the 500-Hz stimulus frequency.

The BIC amplitudes and amplitude ratios (given in Table 2) are shown in Figure 4. In the figure, Panel A shows the absolute values for the BIC amplitudes, and Panel B shows the amplitude ratios. For both panels, the gray bars represent responses to 500 Hz, and the black bars represent responses to 4000 Hz. The pattern of responses is similar for the amplitudes and amplitude ratios. The amplitudes and the amplitude ratios were significantly correlated in three out of four cases (peak A at both frequencies and BIC-Pa at 4000 Hz), so the RM ANOVAwas confined to the amplitude ratios. The RM ANOVA indicated a significant difference for the class of potential, $F(1, 19) = 8.035$, $p = .011$, with the ratio for BIC-Pa being larger than the ratio for ABR peak A. There was a trend ($p = .074$) only for the interaction between wave class and stimulus frequency, suggesting that the BIC-Pa ratio was larger for 500 Hz than for 4000 Hz, whereas the ABR peak A ratio was not different for the two stimulus frequencies.

Discussion

The purpose of this study was to increase understanding of the way that binaural information is coded in the brainstem and auditory cortex as indicated by the BIC from the simultaneously recorded ABR and AMLR. All of the participants had the parent waveforms and the BIC for all stimulus and wave conditions. The AMLR provided BIC waveforms that were larger than those of the ABR, and the 500-Hz tone bursts provided larger BIC waveforms than did the 4000-Hz tone bursts. The results, therefore, are consistent with proportionately more resources being devoted to binaural function in the cortex than in the lower brainstem and suggest that more binaural resources are devoted to the lower frequencies than to the higher frequencies. The following discussion is divided into sections on class of potential, stimulus frequency, and comparison of adult and infant responses (Cone-Wesson et al., 1997) elicited by 500-Hz and 4000-Hz tone bursts.

Gender of the participants is not identified in most BIC studies in adults (e.g., Dobie &Norton, 1980; Ito et al., 1988; McPherson et al., 1989; McPherson &Starr, 1993) or infants (Cone-Wesson et al., 1997). When gender is identified in the participants (e.g., Zhou &Durrant, 2003), it is not analyzed. Participants in the Kelly-Ballweber and Dobie (1984) study were all men. Gender effects are not expected because the binaural interaction data are expressed as ratios, which normalize any amplitude differences across participants. Hence, to date, there are no demonstrated effects of gender on the BIC, and gender is not discussed below.

ABR Versus AMLR

Although no studies in adults can be directly compared with the findings in the present study, some observations can be made about the trends across studies. No previous studies evaluated adults with frequency-specific stimuli in both the ABR and AMLR paradigms, so comparisons can be made only with studies using click stimuli. McPherson and Starr (1993) recorded the ABR and AMLR individually with clicks at levels roughly equivalent to those used in the present study. McPherson et al. (1989) recorded ABR and AMLR simultaneously using click stimuli in adults and infants, but stimulus levels were substantially lower than those in the present study. Although both studies (McPherson &Starr, 1993; McPherson et al., 1989) reported wave V amplitudes from peak to trough, both studies reported amplitudes of P(30) and N(40) individually. In contrast, the present study measured both wave Vand wave Pa from peak to trough. Consequently, the comparisons to the studies by McPherson and colleagues use the summation of their P30 and N40 to approximate the Pa amplitude for comparisons to the present study.

In the present study, the tone bursts of 500 Hz and 4000 Hz produced wave V(L+R) amplitudes of 1.10 and 0.7 mV for 500 and 4000 Hz, respectively. For the same potential evoked with clicks, McPherson and Starr (1993) reported an amplitude of 0.984 mV, and McPherson et al. (1989) reported an amplitude of 0.960 mV-values that are between those elicited by the tone bursts. Dobie and Norton (1980) reported a wave V(L+R) amplitude of approximately 1.05 mV with a BIC peak A amplitude of about 0.40 mVor a ratio of about 0.25 (estimated from their graphs). The BIC peak A amplitude ratios for the present study were about 0.33 for both tone bursts, which were larger than any of the ratios reported for click stimuli (16%-25%).

The previous studies plus the present study are consistent in reporting that the AMLR BIC is substantially larger than the ABR BIC as a result of the L+R condition producing much larger amplitudes than the BIN condition (Dobie &Norton, 1980; McPherson &Starr, 1993; McPherson et al., 1989). The amplitudes of Pa(L+R) for clicks are approximately 1.73 mV and 1.55 mV (McPherson et al., 1989 and McPherson &Starr, 1993, respectively) and 1.55 mV and 1.44 mV for 500 Hz and 4000 Hz, respectively, in the present study; the values are quite consistent, considering differences in stimuli and recording parameters across studies. The BIC amplitude ratios in the present study also compare generally with the click-evoked AMLR BIC amplitude ratios that are near 50% in the two studies by McPherson and colleagues. The amplitude ratios in the present study were similar for 4000 Hz at 0.56 and somewhat larger for 500 Hz at 0.71. Thus, the 4000-Hz response is more like the click response than the 500-Hz response.

The data discussed above suggest substantial differences between the representations of binaural function in the cortex compared to the brainstem. The larger amplitudes for the BIC-Pa compared with the ABR peak A, as well as the larger BIC-Pa amplitude ratios compared with the ABR peak A ratios, confirm that the binaural responses command more neural resources in the cortex than in the brainstem, as previously reported with click stimuli (Dobie &Norton, 1980; McPherson &Starr, 1993; McPherson et al., 1989); the present findings extend those concepts to tonal signals and further suggest that low-frequency sounds command more neural resources than do higher frequency sounds. Further details concerning the frequency specificity of these responses are discussed below.

Frequency Differences

The BIC occurred in all participants for both stimulus frequencies in the present study as it does in most studies that use tonal signals presented at stimulus levels that are at least moderate. One unique finding in the present study was that at 4000 Hz, the BIN wave V was larger than the L+R wave V. The amplitude difference was 0.05 mV, with the BIN amplitude being the larger of the two. This difference was in the presence of SDs that were 0.25 mV for the BIN condition and 0.28 mV for the L+R condition, suggesting that this finding is probably a statistical anomaly resulting from the variability of the amplitude measurements. The computer additions and subtractions of the actual waveforms produce point-by-point comparisons between the involved responses. In contrast, the amplitudes of the individual components are measured from peak to following trough and do not

always coincide preciselywith the computerderived waveform differences.

Fowler and Leonards (1985) compared ABR BIC amplitudes resulting from stimulation with 1000 and 4000 Hz in participants with normal hearing and in those with highfrequency sensorineural hearing loss. Of interest here are the stimulus conditions at 100 dB peSPL for the listeners with normal hearing. Wave V(L+R) amplitudes were 0.86 mV for 1000 Hz and 0.78 mV for 4000 Hz, and the amplitude of peak A was larger at 1000 Hz than at 4000 Hz. At 4000 Hz, the amplitudes for the V(L+R) were slightly larger in the present study than those in Fowler and Leonards, but that is likely a result of the lower high-pass physiological filter used in the present study. Fowler (1989) evaluated binaural interaction with 1000-Hz and 3000-Hz tone pips and reported that wave V(L+R) amplitudes were larger for the lower frequency with amplitudes of 1.35 mV for 1000 Hz and 0.98 mV for 3000 Hz; ABR BIC peak A and amplitude ratios [A/V(L+R)] also were larger for the lower frequency. Despite the differences in recording and stimulus parameters, these three studies present the same pattern; the amplitudes of wave V(L+R) and peak A as well as the amplitude ratio associated with the lower frequencies consistently had the larger amplitude.

In a study with tonal signals with different parameters, Ito et al. (1988) recorded the binaural difference potential of the ABR to tonal signals from 1000 Hz to 6000 Hz and reported that the response amplitudes declined as the stimulus frequency increased. The present study extended the lowest stimulus frequency used for the ABR BIC to 500 Hz, thus confirming that the lower frequency stimuli provide larger BICs. These data are consistent with the supposition that the lower frequencies excite a wider frequency spread on the basilar membrane, which recruits a larger neural pool and results in the larger response amplitudes for the lower frequencies as compared with higher stimulus frequencies.

In the Ito et al. (1988) study, the click produced the largest amplitude overall, but the lowest frequency usedwas 1000 Hz, and 500 Hz is expected to produce a larger amplitude than did 1000 Hz. Ito et al. attributed the large amplitude of the click-evoked response to elicitation of the greatest amount of synchrony, but the stimulation of neural units over a wide frequency range also must have been a factor. Although higher frequency stimuli may elicit more synchronous responses than lower-frequency signals, the higher-frequency signals do not generally produce the larger BIC amplitudes. However, the signal parameters in the Ito et al. study were quite different from those in the two Fowler studies and, therefore, may explain at least some of the differences.

One other study (Zhou &Durrant, 2003) evaluated the binaural interaction in the AMLR with tone bursts in adults. The one signal parameter that was comparable to the stimuli in the present study was 500 Hz, which produced a binaural Pa amplitude ratio of 48%. That ratio is smaller than the ratio recorded as 0.71 in the present study, but the different signal parameters may account for some of the differences between studies.

Finally, some studies have investigated the frequencyspecific contributions to the ABR-BIC but with clicks in noise or filtered clicks as stimuli. DeVries and Decker (1988) used clicks in high-pass masking noise filtered at 500- 4000 Hz to evaluate the effects of frequency on the binaural interaction component of the ABR. Although they reported that the 500-Hz high-pass masked click produced the largest response, no statistically different results were found in their data. Polyakov and Pratt (1999) used filtered clicks but recorded responses using a three-channel Lissajous trajectory (3-CLT) to localize different components of the binaural interaction. They reported that some components were preferentially sensitive to high frequencies but also responded to lower frequencies. Additional studies using the same stimuli and similar recording parameters across participants will be necessary to confirm the effects of stimulus frequency on the binaural AMLR.

Adults Versus Infants

Maturation of binaural responses has been studied in several studies with click stimuli but in only one study with frequency-specific stimuli in neonates (see Cone-Wesson et al., 1997, for a complete description of those authors' methods). That study used some similar stimulus and recording configurations as in the present study to elicit the BIC simultaneously from ABR and theAMLRin neonates of both genders. Neonates were considered normal if their weight was 2800-4000 g, Apgar scores were >8 at 1 min and 5 min, the neonates had no risk

factors for hearing loss, and a normal ABR was obtained at 65 dB peSPL (Cone-Wesson et al.). A comparison between the results from 500- and 4000-Hz stimuli (rise-fall of 2 ms, plateau of 1 ms) in the two studies provides an opportunity to evaluate maturational changes in the BIC. Cone-Wesson et al. (1997) reported that not all infants had the BIC; the ABR peak A was present in 82% at 500 Hz and 74% at 4000 Hz, whereas the AMLR BIC-Pa was present in 62%at 500 Hz and 52%at 4000 Hz. In contrast, all of the adult participants in the present study had the BIC for both the ABR and AMLR, confirming that absence of binaural responses in some infants is consistent with immaturity. The tone pips were presented at 105 peSPL for the infants and 100 peSPL for the adults; these different levels suggest that the infants received approximately 10 dB higherlevel stimuli than did the adults. Based on Stapells, Picton, and Smith (1982), 100 pSPL is approximately 94 dB peSPL because of the different methods of calibration. Higher signal levels are consistently associated with more BICs, so the number of responses in the infants is a conservative estimate of the maturational stage of the binaural system at term birth.

Characteristics of the infants' and adults' responses also can be evaluated for signs of maturity. The mean amplitudes of the parent and BIC waveforms for the infants who had responses (Cone-Wesson et al., 1997) and the adults in the present study are depicted in Panel A of Figure 5, and the amplitude ratios are shown in Panel B. In the figure, the top panels include data from the 500-Hz stimuli, and the bottom panels include data from the 4000-Hz stimuli, whereas the leftpanels show data from the ABR and the right panels show data from the AMLR. The amplitudes of the parent waveforms are larger for the adults (black bars) than for the infants (gray bars) for both stimuli and both waveform classes. For the BIC, the ABR peak A is also similar for both frequencies for the infants and adults, but the BIC-Pa is substantially larger in the adults for both frequencies. Finally, the BIC amplitude ratios present a different pattern from that of the parent waveforms; the amplitude ratios are larger for the infants in all conditions except the Pa-BIC at 4000 Hz, for which it is equal for adults and infants. This overall pattern of the BIC suggests immaturity of the parent waveforms as well as for the BIC in the AMLR as described by Cone- Wesson et al. These differences confirm the immaturity of infants' binaural function, especially for the high brainstem/ cortical levels where the AMLR is generated. Longitudinal studies will be necessary to categorize the development of the waveforms throughout maturation.

The binaural system as described by the present study is only one of many ways in which the binaural system can be, and has been, studied electrophysiologically. A range of different stimuli and different response classes is necessary to provide a fuller analysis of binaural interaction. The short tone bursts with fairly rapid onset times were chosen for the present study because they were appropriate stimuli for both ABR and AMLR, and they facilitated an analysis of the processing that one type of signal undergoes between the brainstem and cortical levels. Similarly, clicks have been used for this purpose and can also be used for ALLRs if the goal is to evaluate widespread areas of the cortex, although different stimulation rates and physiological filters would be needed (e.g., McPherson et al., 1989). Other uses of short-duration stimuli (clicks and tone bursts) for binaural function include explorations of time and intensity trading (e.g., Furst, Eyal, &Korczn, 1990; Zhou &Durrant, 2003). The binaural masking level difference (MLD) is another type of binaural interaction; electrophysiological measures of the MLD require longer stimulus durations for the maximum benefit; an example can be found in Fowler and Mikami (1992), in which auditory late latency potentials were elicited with 500-Hz tone bursts with 5-ms riseand- fall times and a 25-ms plateau to record MLDs up to 14 dB. Even longer tonal signals (2000 ms) have been used to measure binaural beats in the cortical event-related potentials (Pratt et al., 2009). These studies exemplify only a few of the wide variety of stimuli and responses that researchers use to evaluate the binaural system.

Acknowledgments

This article is based on a thesis written by Jennifer Horn, supervised by Cynthia G. Fowler, in partial fulfillment of the requirements for a master of science degree at the University of Wisconsin-Madison in 1997.

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Editor and Associate Editor: Larry Humes
Received February 11, 2012
Accepted May 20, 2012
DOI: 10.1044/1059-0889(2012/12-0006)

Acceptable Noise Level and Psychophysical Masking

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Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 199-205.
ProQuest document link

Abstract: Individuals with low acceptable noise levels (ANLs) accept more noise than individuals with high ANLs. To determine whether ANL is influenced more by afferent or efferent cortical responsiveness, the authors measured differences in temporal masking responses between individuals with low versus high ANLs. If listeners with low ANLs have masked thresholds similar to those of listeners with high ANLs, low ANLs may be due to reduced afferent responsiveness affecting both the masker and signal. If, however, listeners with low ANLs have masked thresholds better than that of listeners with high ANLs, there may be a physiological basis for improved selective attention via stronger efferent inhibition of the "unwanted" sound. Participants were 19 listeners with normal hearing between the ages of 19 and 35. Ten listeners had low ANLs and 9 had high ANLs. All participants were compared using tone-in-noise simultaneous, forward, and backward masking tasks. Results revealed no observed differences in masked thresholds between the low versus high ANL group. The low ANL group, however, required significantly more threshold runs to achieve criterion necessary for threshold determinations. Findings suggest that low ANLs are associated with reduced afferent cortical responsiveness and, possibly, decreased sustained attention.

Full text: Headnote

Purpose: Individuals with low acceptable noise levels (ANLs) accept more noise than individuals with high ANLs. To determine whether ANL is influenced more by afferent or efferent cortical responsiveness, the authors measured differences in temporal masking responses between individuals with low versus high ANLs. If listeners with low ANLs have masked thresholds similar to those of listeners with high ANLs, low ANLs may be due to reduced afferent responsiveness affecting both the masker and signal. If, however, listeners with low ANLs have masked thresholds better than that of listeners with high ANLs, there may be a physiological basis for improved selective attention via stronger efferent inhibition of the "unwanted" sound.
Method: Participants were 19 listeners with normal hearing between the ages of 19 and 35. Ten listeners had low ANLs and 9 had high ANLs. All participants were compared using tone-in-noise simultaneous, forward, and backward masking tasks.
Results: Results revealed no observed differences in masked thresholds between the low versus high ANL group. The low ANL group, however, required significantly more threshold runs to achieve criterion necessary for threshold determinations.
Conclusions: Findings suggest that low ANLs are associated with reduced afferent cortical responsiveness and, possibly, decreased sustained attention.
Key Words: acceptable noise level, masking, cortical responsiveness

Nabelek, Tucker, and Letowski (1991) developed a procedure for quantifying a listener's reaction to background noise while listening to speech. This measure has become known as the acceptable noise level (ANL; Nabelek, Tampas, &Burchfield, 2004), which is defined as the difference between the most comfortable level (MCL) for running speech and the maximum background noise level (BNL) that a listener is willing to accept or "put up with" while listening to running speech discourse. The higher the ANL, the less background noise the individual is willing to accept. Studies conducted by Nabelek and colleagues (Nabelek, Freyaldenhoven, Tampas, &Burchfield, 2006; Nabelek et al., 1991, 2004) showed that asANL increases, the chances of success in hearing aid use are reduced. A common finding with ANL is a large intersubject variability. This variability is not accounted for by intrasubject characteristics such as gender (Rogers, Harkrider, Burchfield, &Nabelek, 2003), age (Nabelek et al., 2006), audiometric thresholds (Nabelek et al., 1991), middle ear characteristics, or activity levels of the medial olivocochlear bundle system (Harkrider &Smith, 2005). Nor is ANL related to a speech performancein- noise task (Crowley &Nabelek, 1996; Nabelek et al., 2004, 2006). Although authors of earlier studies suggested that ANL is not dependent on type of noise (see, e.g., Nabelek et al., 1991), authors of subsequent studies (see, e.g., Johnson, Ricketts, &Hornsby, 2009) found that increasing the bandwidth of white noise increases the ANL, assuming that speech and noise are measured using the same frequency weighting. Studies by Harkrider and Tampas (2006) and Tampas and Harkrider (2006) compared physiological responses from individuals with low versus high ANLs using transientevoked otoacoustic emissions, auditory brainstem responses, middle latency responses (MLRs), and long latency responses (LLRs). The two groups showed physiological differences in responses from higher level regions of the central nervous system. Specifically, individuals with low ANLs had smaller peak-to-peak amplitudes of certain MLR and LLR waveforms versus individuals with high ANLs. Thus, differences in these responses between the two groups suggest that more central regions of the auditory system (at least, those beyond the superior olivary complex) may mediate acceptance of background noise. Tampas and Harkrider (2006) also found that listeners with low versus high ANLs generally have less change in component amplitude with changes in stimulus intensity, suggesting that listeners with low ANLs have either reduced afferent cortical responsiveness to sound or stronger efferent inhibition to unwanted background noise than do listeners with high ANLs. Stronger inhibition may be a factor in selective attention for auditory signals (see, e.g., Dempster, 1992; Harnishfeger &Bjorkland, 1994). A behavioral masking study may shed light on which of these alternatives is more correct. If, indeed, listeners with low ANLs

have less afferent cortical auditory responsiveness, then their masked thresholds should be similar to that of listeners with high ANLs, in that the reduced afferent responsiveness would affect both masker and signal. If, however, listeners with low ANLs have a physiological basis for improved selective attention, then their masked thresholds should be better than those of listeners with high ANLs because the stronger efferent inhibition of "unwanted" sound should allow the listeners with low ANLs to more easily detect the tonal target.

In the past, researchers suggested that simultaneous masking is peripheral in origin, whereas backward masking is mediated by higher order regions (Deatherage &Evans, 1969; Duifhuis, 1973; Elliott, 1962; Soderquist, Carstens, &Frank, 1981). The regions of the auditory system that mediate forward masking are still not known. The notion that forward masking is mediated more peripherally in the auditory system generally is accepted but not proven. Prolonged vibration or "ringing" effects of the basilar membrane may account for the persistent masking effect on the signal after offset of the masker (Moore, 1997). Other reasons might be that short-term adaptation in the central auditory system decreases its responsiveness just after the end of the masker-or, perhaps, the persisting neural-evoked activity is still there, somewhere along the auditory pathway higher than the auditory nerve, and it masks the signal (Moore, 1997). Backward masking thresholds are subject to greater individual differences for children and adults with normal hearing (Buss, Hall, Grose, &Dev, 1999) than those that are typically seen for simultaneous and forward masking. Likewise, large individual variability is seen when measuring ANL in an otherwise homologous population (see, e.g., Harkrider &Smith, 2005; Nabelek et al., 2006; Rogers et al., 2003). Because both ANL and backward masking appear to be mediated centrally and have high intersubject variability, different backward masking thresholds might be found between listeners with low versus high ANLs, whereas performance in forward and simultaneous masking may be similar between the two groups. To date, no known studies in the literature have investigated masking in relation to ANL.

In the current study, we used three psychophysical masking paradigms to investigate possible differences in responsiveness between listeners with low ANLs and listeners with high ANLs. We hypothesized that if afferent cortical responsiveness explained differences in ANLs, then performance between the two groups should be similar for all masking conditions. If efferent cortical responsiveness contributed to differences in ANLs, masking thresholds in all three conditions should be better for listeners with low versus high ANLs due to the benefit of selective attention from a stronger inhibitory system.

Method

Participants

Participants were volunteers with normal hearing (ages 19- 35 years) who were recruited from the student population at the University of Tennessee in Knoxville. Potential participants were excluded if they had hearing thresholds less than 15 dB HL (American National Standards Institute [ANSI] S3.6-2010) at octave frequencies between 250 Hz and 8000 Hz, bilaterally. Participants also were disqualified if, during an initial interview, they reported a history of ear infections, neurological disease, language impairment, attention-deficit/hyperactivity disorder, drug or alcohol dependency, mental illness, or any other central nervous system disorder. Of the initial 44 participants who volunteered, we included in the study only those participants who fell within low (≤ 6 dB) or high (≥ 16 dB) ANL groups. We did this in an attempt to obtain more distinct group differences (Harkrider &Tampas, 2006; Tampas &Harkrider, 2006).We excluded participants with mid ANLs (n = 20). Thus, the final study group consisted of 19 participants, 10 of whom had low ANLs and nine of whom had high ANLs. (Two additional participants with low ANLs and three additional participants with high ANLs were unable to complete the project.) The University of Tennessee Institutional Review Board approved all experimental protocols.

Procedure

ANL behavioral assessment. Participants completed the tests in an audiometric (Acoustic Systems) test booth that meets ANSI standards for permissible noise levels (ANSI S3. 1-1999/2008). The speech stimulus was a recorded monologue of a male speaker (Arizona Travelogue, Cosmos Inc.), and the competing background

noise was multitalker babble from the revised Speech Perception in Noise (SPIN) test (Bilger, Neutzel, Rabinowitz, &Rzeczkowski, 1984). We presented the target and noise via a compact disc with two tracks routed through an audiometer (GSI-61 clinical audiometer) that meets ANSI standards for audiometers (ANSI S3.6-2010), and then we routed both signals through the right insert earphone (Etymotic, ER-3A). In this manner, we measured ANL monaurally in the right ear, consistent with the presentation of temporal masking signals in the current study. To establish the MCL and BNL, we used a method of adjustment and bracketing that was based on procedures adapted from previous ANL studies (Franklin, Thelin, Nabelek, &Burchfield, 2006; Harkrider &Tampas, 2006; Nabelek et al., 1991; Tampas &Harkrider, 2006). We chose initial starting levels for finding MCL and BNL, and step sizes, to maximize efficiency of data collection while maintaining repeatability and reliability.

During each assessment, the participant signaled the examiner outside the booth to adjust stimuli levels. Instructions were presented verbally and in written mode to participants. Initially, the MCL for the participant was obtained. The level of the male speech was presented first at an attenuator setting of 40 dB HL on the audiometer and then was increased in 10-dB steps until prompted by the participant to reduce the level. Thereafter, the level of the male speech was adjusted up and down, first in steps of 5 dB and then in steps of 2 dB, until the MCL was established.

To establish the BNL, the level of the multispeech babble noise was adjusted, this time while the running speech was fixed at the MCL. The male discourse and noise were presented simultaneously. The participant was instructed to signal the examiner upon reaching the maximum level of background noise that he or she was willing to put up with while listening to the male discourse. The level of the multispeech babble was presented initially at 30 dB below the speech presentation level (at MCL) and then was increased in 10-dB steps until the participant indicated that it was above the level he or she could put up with for a long time while following the male discourse. Then, the level of the babble was adjusted down in 10-dB steps until the participant indicated that it was below the level that he or she could put up with for a long time while following the discourse. Finally, the level of the background noise was adjusted again up and down in 5-dB steps, and then in 2-dB steps, to the most noise that the participant was willing to put up with while still following the discourse and not becoming tense or tired. This level was marked as the participant's BNL.

We measured ANL by computing the difference between the MCL and BNL. Two complete ANL measurements (or trials) were conducted; thus, for each participant, we obtained two MCLs and two BNLs. For each participant, if the ANLs obtained from the two trials varied by more than 4 dB, the participant was reinstructed, and a third trial was obtained (Freyaldenhoven, Plyler, Thelin, &Hedrick, 2007; Freyaldenhoven, Thelin, Plyler, Nabelek, &Burchfield, 2005). The closest two ANL measures were averaged for each participant. A third trial was necessary for only two of 19 participants, emphasizing the previously documented test / retest reliability of ANL.

Masking procedures. Participants sat in a sound-treated booth (Industrial Acoustics Corporation [IAC]) that meets ANSI standards (ANSI S3.1-1999) for permissible noise levels. Each participant was asked to detect a brief tone in a background noise (masker) presented to his or her right ear (see, e.g., Hartley, Wright, Hogan, &Moore, 2000). All stimuli were generated digitally. The signal and the noise were passed through a separate computer-controlled attenuator and then were routed to the right-side headphone (Sennheiser HD 580). The stimuli were gated with a cosine-squared function that produces 10-ms rise and fall times (see, e.g., Wright et al., 1997). The tonal signal was a 1000-Hz tone with an overall duration of 20 ms as measured from the onset to the offset. The masker was a narrow-band noise that extended from 600 Hz to 1400 Hz, and its overall level was 70 dB SPL as measured in a 6-cc coupler (Bruel &Kjaer DB0161), with an all-in-all duration of 300 ms (see, e.g., Wright et al., 1997). There were three different masking conditions:

1. Simultaneous masking: The signal was temporally centered in the masker (Buss et al., 1999).
2. Backward masking: The 20-ms tone onset was initiated at 0, 20, or 40 ms before the onset of the 300-ms

noise (Wright et al., 1997).
3. Forward masking: The tone onset was initiated at 0, 20, 40, or 80 ms after the offset of the masker (Wright et al., 1997).
Temporal patterns of stimuli presentations are shown in Figure 1. The effect of forward masking for a broadband noise masker decays as the time interval between masker and signal is increased. There is little masking effect seen beyond a 200-ms signal delay (Jesteadt, Bacon, &Lehman, 1982). Soderquist et al. (1981) found no masking effects beyond 125 ms but did find relatively large masked threshold shifts when the signal-masker interval was less than 40 ms. In another study, Nishimura, Nakagawa, Sakaguchi, Hosoi, and Tonoike (2003) investigated forward masking at the level of the auditory-evoked N1m component. Results showed that the N1m amplitude was smallest for a signal delay of 40 ms. At shorter signal delays, the N1m amplitude actually increased, suggesting an integration of signal and masker neural activity. For signal delays greater than 40 ms, the N1m amplitude increased with increasing signal delay, as would be expected if masking occurred because of neural adaptation caused by the masker (Nishimura et al., 2003). Therefore, to include in the current study forward masking conditions that might be attributable to either temporal integration or neural adaptation mechanisms, we chose masker-signal delays at, above, and below 40 ms. These delays were varied at four conditions: 0 ms, 20 ms, 40 ms, and 80 ms.
Conversely, the signal-masker interval that elevates signal thresholds in backward masking seldom surpasses 25 ms (Fastl, 1976) but can reach 100 ms (Elliott, 1962). Nevertheless, in Soderquist et al. (1981), the greatest backward masking effects were found between 0 ms and -40 ms relative to the onset of the masker. For this reason, we chose signal-masker intervals of 0 ms, 20ms, and 40 ms in the backward masking paradigm. The noise level remained constant during threshold evaluation for all paradigms.
Data reported byWright et al. (1997) andMarler, Champlin, and Gillam (2001) show improvements in backward masking thresholds over the course of their study sessions, potentially complicating data interpretation. In an attempt to avoid a learning effect in the participants of the current study, we kept practice sessions and experimental sessions brief. Further, we compared performance within each participant across experimental sessions to document possible learning effects.
We obtained tone detection thresholds with a twoalternative, forced-choice (2AFC) procedure with a two-down, one-up tracking paradigm to estimate the 71% correct point on the psychometric function (Levitt, 1971). Data collection occurred online through the use of a commercially available software program (Psycho-Sig, Tucker-Davis Technologies). Because all listeners had normal hearing, the starting level for the adaptive procedure was fixed at 80 dB. Initial step size was 5 dB, with a final step size of 2 dB after two reversals. Runs were terminated after eight reversals, with threshold computation performed on the last six reversal points. The run standard deviation is the standard deviation across the last six reversal points. The listener was asked to listen for the signal tone and to indicate in which time interval the signal tone was presented.
During the task, the listener sat facing a computer screen. The two time intervals in which the signal tone might be present were represented on a computer screen as two blinking squares, one square for each time interval. One interval contained the noise only, and the other interval contained the tone. When the first interval of masker or masker + signal was presented, the left-most square would change shape as if pressed. Likewise, when the second interval of masker or masker + signal was presented, the right-most square would change shape as if pressed. After the second interval presentation, the participant used a mouse click to select which square (or interval) contained the signal tone. Because of the nature of the 2AFC task, the participant has to select an interval to proceed with the test, regardless of whether he or she hears the tone.
Response analysis. An individual threshold (or run) with a standard deviation of greater than 4.25 dB was discarded. These particular runs were discarded because wide tracking excursions within a run probably indicate that the participant lost concentration or, by chance, tracked too low, with many trials expended with signal level below threshold. In either case, we felt that such runs should be rejected as unreliable in the current

study. Three to six runs with individual standard deviations less than 4.25 were collected for each of the eight masking conditions. The value of 4.25 was selected on the basis of previous masking data using the paradigm of the current study, in which the largest standard deviations for a given run were 4.0 dB to 4.3 dB (Bacon &Grantham, 1989; Grantham &Bacon, 1991). For every condition, the average of the three to six runs was the masked threshold for that condition. Standard deviations were then computed across the runs used in threshold determination. All thresholds (runs) for each participant were obtained over two to three sessions; we did this to avoid participant fatigue. The order of obtaining thresholds (runs) for each condition was determined randomly. This method follows that of previous investigators examining masking (Bacon &Grantham, 1989; Grantham &Bacon, 1991).

Results

Masking Thresholds and Standard Deviations

The group means of all thresholds (in dB SPL) for each of the eight masking conditions are shown in Table 1. Average standard deviations across runs used to compute thresholds are shown in Table 2. A one-factor analysis of variance (ANOVA) was carried out on simultaneousmasking thresholds, where the factor was group (low vs. high ANL). The ANOVA revealed no significant difference between the two ANL groups, $F(1, 17) = 0.002$, $p = .966$.

We compared backward masking thresholds using a twofactor, repeated measures ANOVA. The factors were group and gap duration (repeated measures on 0 ms vs. 20 ms vs. 40 ms). Mauchly's test of sphericity was significant for the factor gap duration; therefore, degrees of freedom were corrected and reported using Greenhouse-Geisser estimates of sphericity for gap duration. (If the results of Mauchly's test of sphericity were significant in subsequent statistical analyses, the remaining statistical analyses were reported using Greenhouse-Geisser corrections.) The analysis showed a predictable significant main effect for gap duration, $F(1.451, 24.670) = 29.144$, $p < .001$, such that masking thresholds decreased as the duration of the gap increased. The analysis revealed neither a significant group difference, $F(1, 17) = 0.089$, $p = .769$, nor a significant Group ×Gap Duration interaction, $F(1.451, 24.670) = 0.220$, $p = .761$.

Forward masking thresholds also were compared through the use of a two-factor, repeated measures ANOVA. The factors were group and gap duration (repeated measures on 0 ms vs. 20 ms vs. 40 ms vs. 80 ms). Results showed a predictable main effect of gap duration, $F(2.011, 34.195) = 136.163$, $p < .001$, such that masking thresholds decreased as the duration of the gap increased. The ANOVA revealed neither a significant group difference, $F(1, 17) = 0.026$, $p = .874$, nor a significant Group ×Gap Duration interaction, $F(2.011, 34.195) = 0.628$, $p = .541$.

Discarded Runs

Mean discarded runs by masking condition for each of the two ANL groups are shown in Table 3. A one-factor ANOVA was carried out on the number of discarded runs collapsed across all masking conditions and durations, where the factor was group (low vs. high ANL). The ANOVA revealed a significant difference between the two ANL groups, $F(1, 17) = 8.241$, $p = .011$, such that individuals with low ANLs had more discarded runs than did individuals with high ANLs. To determine which masking conditions contributed to this significant group difference, three additional one-factor ANOVAs were computed for each masking condition. The factor was group (low vs. high ANL). The analyses revealed no difference between groups for the simultaneous masking condition, $F(1, 17) = 1.286$, $p = .273$; a difference between groups for the backward masking condition, $F(1, 17) = 5.614$, $p = .030$; and a difference between groups for the forward masking condition, $F(1, 17) = 5.752$, $p = .028$.

Discussion

Several reports have suggested that central structures of the auditory system contribute to the mediation of ANL (see, e.g., Harkrider &Tampas, 2006; Horne, 2010; Tampas &Harkrider, 2006). In a similar way, backward masking effects are likely mediated by structures above the brainstem, whereas it has been suggested that

simultaneous and forward masking effects are mediated more peripherally (see, e.g., Deatherage &Evans, 1969; Duifhuis, 1973; Elliott, 1962). Because listeners with low ANLs have smaller changes in central auditory evoked potential amplitudes with changes in stimulus intensity (Tampas &Harkrider, 2006), the authors hypothesized that these individuals have either less responsive cortical neurons or greater central efferent inhibition than do individuals with high ANLs. If listeners with low ANLs have reduced cortical auditory responsiveness, then their masked thresholds should be similar to those of listeners with high ANLs because the reduced responsiveness would be to both masker and signal. However, if listeners with low ANLs had a biological basis for stronger inhibition (or selective attention), then their masked thresholds should have been better across all masking conditions than those of listeners with high ANLs. Results of the current study indicated similar masking thresholds across the groups, supporting the hypothesis that listeners with low ANLs have reduced cortical auditory responsiveness.

There was a significant difference between the two ANL groups, and this difference manifested itself through the number of discarded runs that were omitted due to high standard deviations. The low ANL group required the completion of significantly more runs to obtain the targeted standard deviation per run (4.25 dB) for both forward and backward masking conditions. Temporal masking tasks require a steady effort that is related to attentional factors (Helzer, Champlin, &Gillam, 1996). Therefore, the number of trials needed to reach the criterion might be influenced by the listeners' focused or sustained attention to the masking task. The low ANL listeners in the current study may have been less attentive to the masking stimuli and, possibly, less conservative in their responses.

The differences in discarded runs between the low and high ANL groups may be related to central nervous system activation. For example, results from auditory evoked potential studies have shown that listeners with low ANLs have central auditory regions that are (a) less responsive to changes in auditory stimulation and/or (b) have greater cortical inhibition than those of listeners with high ANLs (Harkrider &Tampas, 2006; Tampas &Harkrider, 2006). Results from the current study suggest that listeners with low ANLs subjectively may be able to tolerate more noise not because of stronger cortical inhibition (i.e., they do not necessarily have better selective attention) but, rather, because of weaker afferent cortical activation. Less responsiveness may translate into less focused or less sustained attention-rather than better selective attention-by listeners with low ANLs.

In addition, results from the current study relate to the results of studies in which the authors found minimal correlation between ANL and speech performance-in-noise tasks (Crowley &Nabelek, 1996; Nabelek et al., 2004, 2006), suggesting that acceptance of background noise and perception of speech in noise are related but not identical phenomena. Results from the current study suggest that ANL may not merely reflect peripheral signal-to-noise ratio measures as those that might be measured from outputs of internal filters. Instead, ANL appears to be a more centrally mediated phenomenon.

In conclusion, the lack of significant differences in masking thresholds between the two ANL groups for any masking condition suggests that differences in ANLs are not due to temporal processing or selective attention abilities. Instead, differences in acceptance of background noise while listening to speech may be due-at least, in part-to overall afferent cortical responsiveness. These results are based on behavioral (not physiological) data, so there may have been variables other than cortical responsiveness that could have influenced the results. For example, the significantly larger number of discarded runs for the low versus high ANL group may suggest that, relative to individuals with high ANLs, reduced afferent cortical responsiveness is associated with reduced focused attention or reduced sustained attention in individuals with low ANLs. Because no explicit measures of attention were tested in the current study, additional research is needed to clarify how ANL measures and components of attention are related.

Acknowledgments

We thank Patrick N. Plyler for valuable comments on this article.

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Editor: Sheila Pratt
Associate Editor: Brad Rakerd
Received July 3, 2011
Revision received December 4, 2011
Accepted May 30, 2012
DOI: 10.1044/1059-0889(2012/11-0021)

Stimuli and Normative Data for Detection of Ling-6 Sounds in Hearing Level

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Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 232-41.
ProQuest document link

Abstract: The purpose of this work was to develop and evaluate a calibrated version of the Ling-6 sounds for evaluation of aided detection thresholds. Stimuli were recorded, and data from calibration values in dB HL were developed. Aided performance was characterized in adults and children. Stimuli were recorded, prepared, and transferred to a CD for testing. Initial testing was completed on 29 normally hearing young adults to determine typical responses in dB SPL and reliability. Corrections to dB HL were determined for each stimulus. Twenty-seven adults and 5 children with hearing losses were tested. Average normal sound field thresholds were 1 dB HL. Aided thresholds for adults varied with unaided hearing level and were better for low-frequency sounds. Adults and children performed differently, possibly because of greater hearing aid gain for children. Stimulus preparation and shaping resulted in a recorded, calibrated set of Ling-6 stimuli that provide flat normal thresholds in hearing level for normally hearing listeners. Typical performance ranges may vary with hearing level and prescription. More data are required to fully characterize this trend in the pediatric population.

Full text: Headnote

Purpose: The purpose of this work was to develop and evaluate a calibrated version of the Ling-6 sounds for evaluation of aided detection thresholds. Stimuli were recorded, and data from calibration values in dB HL were developed. Aided performance was characterized in adults and children.
Method: Stimuli were recorded, prepared, and transferred to a CD for testing. Initial testing was completed on 29 normally hearing young adults to determine typical responses in dB SPL and reliability. Corrections to dB HL were determined for each stimulus. Twenty-seven adults and 5 children with hearing losses were tested.
Results: Average normal sound field thresholds were 1 dB HL. Aided thresholds for adults varied with unaided hearing level and were better for low-frequency sounds. Adults and children performed differently, possibly because of greater hearing aid gain for children.
Conclusions: Stimulus preparation and shaping resulted in a recorded, calibrated set of Ling-6 stimuli that provide flat normal thresholds in hearing level for normally hearing listeners. Typical performance ranges may vary with hearing level and prescription. More data are required to fully characterize this trend in the pediatric population.

Key Words: amplification or hearing aids, children, adults, efficacy, outcomes

Intervention for permanent childhood hearing impairment typically follows four stages: screening, assessment, intervention, and outcome evaluation (American Academy of Audiology, 2003). For families choosing an oral-aural approach, intervention may include the fitting and use of hearing aids and/or cochlear implants as well as intervention for communication development. Therapists, including speechlanguage pathologists and auditory-verbal therapists, may be trained to screen for appropriate aided hearing prior to therapy sessions using the Ling-5 or Ling-6 sound test (Ling, 1989). The Ling-6 sounds include /m/, /u/, /a/, /i/, /X/, and /s/ and were chosen to span the range of speech frequencies typically occupied by running speech. In addition, the vowels /u/, /a/, and /i/ span the vowel quadrangle in the English language (Stevens, 1998). Preceding a therapy session, these sounds may be delivered using the therapist's voice, and the child's ability to detect and/or recognize each sound may be monitored. This rapid check is done to confirm that the hearing devices are functional and to assist the therapist in estimating the child's aided speech sound detection, identification, and discrimination abilities.

Because the Ling sounds are commonly assessed by therapists who are clinical partners in providing intervention services, some audiologists also adopt the Ling-6 sound test in a variety of ways. Hearing aid fitting protocols for adults and children may include the use of Ling-6 sounds at the device validation stage as a rapid measure of speech sound reception (Cox, Mendel, &Bell, 2011; Smiley, Martin, &Lance, 2004). Anecdotal reports include either administration of the sounds as is done by therapists or measurement of aided detection thresholds by presenting each sound with the clinician's voice via a clinical audiometer. Users of this test have noted the need to define whether the test is used to evaluate speech sound detection, discrimination, or identification and the relative advantages and disadvantages of each type of evaluation (Smiley et al., 2004). The work described in this article was focused on the use of Ling-6 sounds for the evaluation of speech sound detection. A detection task was chosen to facilitate future work with infants, who may be able to perform an aided audiogram as an outcome measure. The present work focuses mainly on adults in this early evaluation of this procedure.

Aided Detection Thresholds in Device Evaluation

Aided detection thresholds have been used for various purposes in hearing aid fitting.Within historical comparative methods for hearing aid fitting, both unaided and aided sound field thresholds were measured at many frequencies and used to calculate the functional gain of the hearing aid under consideration (Skinner, 1998). Functional gain was used when shaping the hearing aid frequency response in lieu of electroacoustic hearing aid analysis. In modern practice, this time-consuming process for verification and shaping of hearing aid gain has largely been replaced by faster and more accurate electroacoustic procedures. In previous studies, authors have proposed a variety of factors that may limit the validity of functional gain measures, including head and body movement during testing, hearing aid noise floor, hearing aid response differences between speech and nonspeech test signals, off-frequency listening for participants with steeply sloping hearing losses, and interactions of compression attack and release times with stimulus onsets and/or offsets (Hawkins, 2004; Kuk, Keenan, Lau, &Ludvigsen, 2004; Scollie &Seewald, 2002; Stelmachowicz, Hoover, Lewis, &Brennan, 2002). These factors have led some authors to suggest that electroacoustic hearing aid analysis is a more appropriate tool for estimating hearing aid gain and frequency response, compared with functional gain measures (Hawkins, 2004; Stelmachowicz et al., 2002).

cochlear implants, or bone-anchored hearing devices are sometimes obtained, even for a small number of stimuli, as an outcome measure to determine the lowest level of sound that may be detectable (Bass-Ringdahl, 2010; Davidson et al., 2009; Hodgetts, Hakansson, Hagler, &Soli, 2010; Tharpe, Fino-Szumski, &Bess, 2004). This procedure is done to evaluate the fitting, and although it does not include computation of functional gain for shaping purposes, it may include comparison of unaided versus aided conditions as a benefit measure. This validation procedure has been deemed as having higher clinical utility when the hearing device cannot be assessed electroacoustically (e.g., bone-conducted or bone-anchored devices) or when information about whether a listener can detect aided sound is of clinical interest (Stelmachowicz et al., 2002). With either of these goals, interpretation of aided thresholds is difficult without knowledge of a "target" or "appropriate" aided threshold, which may vary with hearing threshold levels and/or hearing technology. Very little recent data exist, particularly regarding aided thresholds for speech stimuli with contemporary hearing devices. Typical performance with modern devices may be of interest for several reasons. First, contemporary devices may have increased wearable gain for low-level stimuli as a result of more effective feedback controls, increased processing bandwidth, and more frequency use of multichannel wide dynamic range compression, compared with early-era digital and linear analog devices. These changes may result in lower levels of sound being detected by the user. Second, modern prescriptive and fitting methods better account for the use of wide dynamic range compression and the different listening needs and preferences of adults and children (Keidser, Dillon, Flax, Ching, &Brewer, 2011; Scollie et al., 2005). For these reasons, characterization of typical

performance in users of modern hearing technologies, fitted using modern techniques, was of interest in this study.

Rationale for Current Study

In this article, we describe a set of stimuli and procedures for performing aided threshold evaluations, in dB HL, using prerecorded Ling-6 stimuli. The rationale for this study is fourfold. First, the Ling-6 stimuli span the speech frequencies by using only six test stimuli. Therefore, the use of Ling-6, rather than warbled tones or other narrowband stimuli, could probe a broad frequency range while requiring fewer measurements. Second, the Ling-6 stimuli are well understood by clinicians and have high face validity. Third, the Ling-6 stimuli are natural speech tokens and therefore support aided threshold evaluation with modern signal processing. Recent hearing aid efficacy studies have used aided Ling-6 thresholds as an outcome measure, with results indicating that this measurement is sensitive to frequency-specific differences between aided conditions (Glista et al., 2009; Wolfe et al., 2010, 2011). Finally, we speculated that clinical interpretation of detection thresholds for Ling-6 sounds would be supported if calibrated in the hearing level (HL) scale. Considering these arguments, the purpose of this study was to develop Ling-6 stimuli with calibration in dB HL and to characterize typical aided outcomes for these stimuli by using testing procedures that are feasible for use with commonly available clinical equipment.

Method

Pilot Stimuli and Procedure

The Ling-6 stimuli were spoken by a woman who was a native speaker of English. She was seated within a doublewalled IAC sound booth. Recordings were made with a pedestal microphone (AKG Acoustics) located approximately 30 cm from the talker's mouth and routed to a pre-amplifier (USBPre). Digitization was performed via sound card, and recordings were made with commercially available software (Spectraplus). The talker was instructed to produce each sound in isolation, with neutral vocal effort. The following orthographic representation of the Ling sounds was provided for her reference: "AH as in operate, EE as in beep, OO as in shoe, SH as in shoe, SS as in stop, MM as in man." Ten repetitions of each sound were recorded, and the token with the most neutral pitch contour and best sound quality was chosen and uploaded into editing software (Goldwave). Stimuli were excised from the original recordings and edited to preserve the naturally produced token as much as possible and to be approximately 1 s in duration (range: 0.89-1.25 s) and peak intensity (0.5 full-scale deflection). These edits required the shortening of only /X/ and /s/, which had naturally produced durations of about 1.5 s each. When shortening was required, the stimulus was clipped at a zero crossing, and an offset ramp in volume was imposed to prevent offset transients. The spectral characteristics of these stimuli are presented in Figure 1. The edited stimuli were embedded in a computer-assisted threshold search procedure, which used a two-alternative forced-choice adaptive tracking paradigm to assess sound field detection thresholds. Response choices were "heard it" and "didn't hear it." Thresholds on the adaptive track were estimated from the last four reversals, using a 5 dB step size and a 50% criterion. Sound field levels from this task were quantified in dB SPL, by calculating the reference calibration levels minus the attenuation levels at threshold.

Pilot Evaluation

Ten young adults (3 men, 7 women, ages 21-35 years) were recruited to participate in a pilot evaluation of these stimuli. Participants reported no hearing difficulties, had normal otoacoustic emissions, and had pure-tone audiometric thresholds in both ears at normal levels (at or below 15 dB HL) from 250 through 8000 Hz. Binaural sound field thresholds were measured twice for each participant. All measures were made in a double-walled sound booth. Noise levels within the booth met standards for maximum permissible ambient noise levels (MPANL) for the ears not covered condition, for testing at frequencies between 125 and 8000 Hz (Frank, 2000). Mean sound pressure levels at threshold ranged from 0 to 22 dB SPL across the Ling-6 sounds and formed a U-shaped curve across stimulus peak frequency similar to that of a minimum audible field curve. For example, the highest sound pressure levels at threshold were observed for the lowest frequency and highest frequency

stimuli (/m/ and /s/, respectively). These values were taken as interim reference equivalent threshold sound pressure levels (RETSPL; American National Standards Institute [ANSI], 2004) for these specific stimuli.

Clinical Stimuli and Procedure

On the basis of the pilot results, the levels of the stimuli were adjusted to approximate the pilot RETSPL per stimulus. As recommended by ANSI, a calibration tone was constructed that exceeded the peak levels of the highest level stimulus (ANSI, 2004). As well, a calibration noise was constructed that produced a target output level in the sound field, assuming that the field was calibrated for binaural listening at zero degrees azimuth. The intended purpose of the tone and noise was to permit replicable use of the CD, by providing the researchers with a tool to set the audiometer's input sensitivity for the CD on repeated uses, and to verify the sound field levels produced over time. Calibrated levels were monitored daily during data collection for this study, with the requirement of meeting calibration targets within 2 dB each day that data were collected.

The resulting calibration and Ling-6(HL) stimuli were placed on a CD for use with manual audiometric procedures via a clinical audiometer (GSI-61). The VU meter was adjusted to place the calibration tone at zero prior to use of the CD, and pilot testing with normally hearing listeners was attempted. However, recall that a 22 dB range existed among the stimuli in the pilot evaluation. Those that had been most attenuated within the resulting stimulus set could not be heard by the tester during manual audiometry. Therefore, a revised version was constructed that used minimal digital attenuation of stimuli, anticipating that a manual correction would be applied to convert the results to HL (see Appendix A). Specifically, the stimuli were adjusted by up to 5 dB, with values chosen to support the use of 5 dB step sizes in both manual audiometry and in correction factors. The RETSPL for each stimulus was compared with the RETSPL of /a/, which had the lowest detection thresholds. Stimulus levels were adjusted relative to this to the nearest 5 dB step. Any changes greater than 5 dB were saved for manual correction. For example, the /u/ stimulus had a pilot RETSPL greater than that of the /a/ stimulus and so was increased by 3 dB. In contrast, the /m/ stimulus had a pilot RETSPL that was 17 dB greater than that of the /a/ stimulus and so was adjusted by 2 dB, assuming that a correction factor would be applied for the remaining 15 dB. The root-mean-square digital levels of the resulting stimuli were within 12 dB of one another, which more readily allowed the tester to hear the stimulus during testing, compared with the first version.

Normative data for this version of the CD were gathered from a second group of normally hearing listeners, and clinical results were gathered on a group of adults with hearing impairment, as described below. Tracks on the CD included a calibration tone, a calibration noise, and six tracks of stimuli. Each stimulus track included 64 repetitions of the Ling-6 sound for use with conventional audiometric procedures. In the text below, this CD is referred to as the Ling-6(HL) test.

Participants

Twenty-nine normally hearing young adults (mean age: 24 years; age range: 20-28 years; 25 women and 4 men) participated in an evaluation of the Ling-6(HL) test. These participants reported no history of hearing problems and passed a hearing screening from 250 to 8000 Hz at 25 dB HL. Otoscopic examinations revealed no blockage of the external ear. Twenty-seven adults with hearing loss also participated (mean age: 68 years; age range: 21-87 years; 11 women, 16 men). Seventeen of these participants were regular users of hearing aids, all binaurally. Their hearing losses ranged from mild to moderate by pure-tone average (mean three-frequency pure-tone average [PTA]: 43 dB HL; PTA range: 31-60 dB HL). Audiometric slopes ranged from zero to 90 dB between 4000 and 500 Hz (mean slope: 40 dB). Figure 2 shows the mean and individual audiometric thresholds for the better ear of each participant. In addition, to illustrate the application of this test, we evaluated five children from a typical clinical caseload. These children ranged in age from 6 to 9 years and had moderate hearing losses in the better ear. One child had conductive hearing loss, and the remainder had sensorineural losses.

Hearing Aid Fitting Procedure

Adult participants were fitted with a pair of laboratory hearing aids, which were commercially available devices with multichannel wide dynamic range compression, no frequency lowering processing, and omnidirectional microphones. Venting was incorporated into earmolds on a case-by case-basis and ranged from 1 mm to 3.5 mm. All other features of the devices, such as digital noise reduction, were disabled during testing. Feedback cancellation was required and enabled for five participants. Hearing aids were fitted using the fifth version of the Desired Sensation Level (DSL 5) method (Bagatto et al., 2005), which includes a prescription for use with adults (Scollie et al., 2005), and verified using probe microphone measures of the Real Ear Aided Response (REAR) for running speech at 55 and 65 dB SPL and for 85 dB warbled tones, using a commercially available system (Audioscan Verifit VF-1). For the group as a whole, 81% of participants were fitted to within 5 dB of target at 4000 Hz in both ears. Five participants with steeply sloping hearing loss could not be fitted to within 5 dB of target, although most were fitted closely to target through 2000 Hz. This fitting profile is similar to those in a recently published study of clinically typical and beneficial fittings using the DSL 5 adult prescription (Polonenko et al., 2010).

The children in this study were tested while wearing their own hearing aids of varying makes and models. The hearing aids had been fitted using the DSL 5 method (Bagatto et al., 2005). These hearing aids were prescribed and verified by an experienced pediatric audiologist using simulated REAR measures, individually corrected using measured Real Ear to Coupler Differences. The fit to targets of each hearing aid was within 5 dB of targets for running speech at 65 dB SPL and for warble tones at 90 dB SPL.

Data Collection in dB HL

Each participant's detection thresholds were measured for each Ling-6(HL) stimulus with manual administration using 5 dB step sizes and a two-down, one-up bracketing procedure. Testing was completed within a double-walled audiometric booth (IAC) with a loudspeaker, placed at zero degrees azimuth, connected to an audiometer (GSI-61). Participants were seated in a height-adjustable chair with their heads located in a marked point within the booth. Each test was completed twice within one session. Participants with normal hearing were tested with ears uncovered, and they listened binaurally. Participants with hearing loss were tested in the binaurally aided condition. Testing was completed within the same booth used for pilot data, which exceeded the standards for MPANL for ears uncovered.

Results

Normative Values and Test-Retest Reliability

All twenty-nine normally hearing listeners completed the protocol, including the evaluation of test-retest reliability. Threshold values for each Ling-6(HL) stimulus were averaged across the two tests, and a final correction factor was determined that resulted in average thresholds near 0 dB HL across frequencies. Across stimuli and participants, corrected threshold values ranged from -12.5 to 15 dB HL. Table 1 displays the average corrected threshold per sound, as well as the 95% confidence interval for normal detection of each sound. In general, the upper limit of normal performance for this test was approximately 15 dB HL. Mean test-retest for this participant group was 2 dB across participants and stimuli and was one audiometric step size (5 dB) or less for all but two of 174 thresholds (99%) measured in the normally hearing group. The upper limit of the 95% confidence interval for test-retest difference was between 5 and 8 dB across stimuli (Table 1). Correlations between test and retest ranged from 0.71 to 0.90 in this group.

Characterization of Aided Results in Adults

As with the normally hearing listeners, adults with hearing loss completed two administrations of the Ling-6(HL) detection test but performed the test while wearing hearing aids. Test and retest aided thresholds were within 5 dB for all listeners and all stimuli. Test-retest correlations ranged from 0.89 to 0.97 across stimuli. Therefore, aided thresholds were averaged across test and retest for all participants in this group. The aided thresholds ranged from 0 to 47.5 dB HL. This range includes scores that fall outside the normal range of test performance, indicating that not all listeners had normal speech sound-detection abilities even though they were binaurally

aided. It is possible that the outcome of normalized versus nonnormalized aided detection thresholds might interact with the degree of unaided hearing loss, as normalization for all degrees of hearing loss is not a goal of the adult-based prescriptive method used in these fittings (Scollie et al., 2005). To determine the relation between unaided hearing levels and aided detection thresholds, we computed correlation coefficients between the magnitude of the unaided hearing loss and the aided Ling-6(HL) results. These correlations were computed both for each audiometric frequency in the better ear and also for the overall hearing loss, computed as the better ear four-frequency pure-tone average (BE4FPTA) of thresholds at 500, 1000, 2000, and 4000 Hz. The results, shown in Table 2, indicate several considerations that are important for interpreting test results. First, consider the predictive ability of the unaided pure-tone thresholds. In general, unaided thresholds are good predictors of performance when they are similar in frequency to the peak energy regions of the stimulus. For example, unaided thresholds at 250 and 500 Hz were the best two predictors of aided thresholds for /m/, /u/, and /i/. As shown in Figure 1, these stimuli had their highest spectral peaks in the low-frequency region. This trend occurred also for most stimuli, with /a/ correlated with low-and mid-frequency thresholds, and /s/ correlated with unaided hearing across frequencies, to 4000 Hz. However, both /X/ and /s/were also correlated with unaided hearing thresholds in the lower frequencies. This correlation might indicate that audibility of low-frequency energy in these fricatives contributed to detection, although the design of this study precludes direct evaluation of this. It may be the case that further sampling, a greater range of audiograms, or experiments with filtered stimuli would be necessary to determine the frequencyimportance function of these stimuli for detection. Another possible predictor of aided performance is the magnitude of hearing loss, represented here as the BE4FPTA. This predictor was also significantly, although more modestly, correlated with aided detection thresholds. Taken together with the frequency-specific results, this indicates that the magnitude and configuration of hearing loss are associated with aided detection thresholds with Ling-6(HL) stimuli. This result means that participants with better unaided hearing detected the Ling-6(HL) stimuli at lower levels than did listeners with poorer hearing, even in the aided condition. This relationship is depicted in Figure 3, which displays aided Ling-6(HL) thresholds for each stimulus and listener, against the listeners' unaided hearing levels by pure-tone average. Each Ling-6(HL) stimulus is indicated by a specific symbol in Figure 3, grouped with vowels and nasal stimuli on the leftpanel and fricatives on the right. Data from both listeners with normal hearing and listeners with aided hearing loss are shown. All data are plotted against the BE4FPTA, to facilitate visual comparison between nasals, vowels, and fricatives on a common scale. Confidence intervals for typical aided detection results are indicated for each group of stimuli (vowels and nasals versus fricatives) by solid lines. The derivation of these intervals is discussed further below.

For vowel and nasal stimuli, listeners with normal hearing had detection thresholds of about 15 dB HL or better. Adults with aided hearing loss performed both within or poorer than the normal range, depending on their degree of hearing loss. Adults with unaided thresholds of 30 dB HL or better had aided thresholds within the normal range and not significantly correlated with the BE4FPTA. Mean aided Ling-6(HL) thresholds for this group were 9.3 dB HL (SD = 5.12 dB). For listeners with hearing loss between 30 and 50 dB HL, average aided detection thresholds were poorer (M= 17.7 dB HL; SD = 7.2 dB) but not significantly correlated with varying unaided hearing levels. Above 50 dB HL, results indicated a significant trend for increasing aided nasal and vowel thresholds as hearing thresholds increased ($n = 40$, $r = .495$, $p = .001$). These participants detected nasal and vowel sounds at 25 dB HL on average (SD = 8.6 dB).

Detection thresholds for fricatives are shown as closed symbols in Figure 3. Results for the fricatives were somewhat poorer, with aided thresholds not within the normal hearing range but rather within a range of 15 to 50 dB HL. Aided detection thresholds were significantly associated with unaided better ear pure-tone averages for the fricatives ($n = 54$, $r = .522$, $p < .001$).

Correlations between better ear pure-tone average and each group of stimuli (nasals and vowels versus fricatives) were used to generate confidence intervals (solid lines in Figure 3). The BE4FPTAwas selected as

the predictor rather than frequency-specific thresholds, as it permits comparison of performance across stimuli using a single criterion. Accordingly, confidence intervals were computed as the mean aided Ling-6(HL) threshold in the range from 0 to 30 dB HL BE4fPTA, with a two standard deviation interval around the mean. Above 50 dB HL BE4fPTA, the range was computed as a linear regression of aided Ling-6(HL) thresholds versus unaided thresholds, with regressed values surrounded by two standard deviations. Between 30 and 50 dB HL BE4fPTA, the two previously described confidence intervals are joined by straight lines. This implies that aided threshold levels for the Ling-6(HL) stimuli may be related to the hearing loss of the listener, perhaps as a result of device-fitting differences for lesser versus greater hearing losses. This issue will be addressed in more detail below.

Illustrative Cases With Children

Aided detection of the Ling-6 sounds may assist pediatric audiologists in determining whether a child has auditory access to speech across a wide range of frequencies. In children, two other factors may also impact typical results. First, infants and younger children typically respond to a slightly suprathreshold minimum response level (MRL) rather than responding at true threshold for audiometric tasks (Sabo, Paradise, Kurs-Lasky, &Smith, 2003; Widen et al., 2000). Responses for young children on a Ling-6(HL) detection task may also be at MRL rather than at true threshold. Recall that average normal thresholds for the Ling-6(HL) stimuli were between 0 and 15 dB HL. The upper limit of the normative adult range may therefore differ from the upper limit of normal hearing commonly used to interpret visually reinforced audiometry (VRA) results for younger children (i.e., 25 dB HL; Sabo et al., 2003). Second, children who use hearing aids may be provided with more gain than would be given for an adult with the same audiogram, using recent versions of some prescriptive formulae (Keidser et al, 2011; Scollie et al., 2005). This may allow children who use hearing aids to detect the Ling-6(HL) sounds at a lower level than was typical of the adult data presented in this study. To illustrate this second issue, we examined five pediatric cases in the course of normal clinical practice. As described above, these children were between the ages of six and nine years of age and wore hearing aids fitted to within 5 dB of the DSL 5 child target. Aided Ling-6(HL) thresholds were measured with good withintest reliability by using standard audiometric procedures, as judged by the clinician. The results from these children are shown alongside adult data in Figure 3. It is evident that these children had lower (better) aided thresholds than were measured for adults with similar degrees of hearing loss. Two factors may have contributed. First, the DSL 5 child prescription requires more gain than does the DSL 5 adult prescription. Therefore, the children wore devices with approximately 7 dB more gain for a 50 dB HL audiogram (Scollie et al., 2005). Second, three of the children used frequency compression hearing aids. One of these children had aided detection thresholds for /s/ and /X/ at 15 dB HL or better despite having unaided high-frequency thresholds in the severe range. This result for DSL 5 child fittings using frequency compression is consistent with results in published studies using a non-HL version of this Ling-6 test (Glista et al., 2009). Finally, the best-performing child had a flat moderate conductive hearing loss and aided thresholds well below 0 dB HL for all six stimuli. Further data would be required to determine whether this type of result is consistently associated with aided conductive hearing loss.

Discussion

This article presents a set of prerecorded Ling-6 stimuli, implemented on a CD, with clinical calibration procedures and normative data for use as a speech sound detection test in the sound field. Data on a sample of adults with hearing loss and illustrative cases of children with hearing loss provide preliminary characterization of test performance as an aided outcome measure. These results indicate that typical performance on this test varies with the unaided hearing loss and the prescription type. These factors will be discussed in more detail below.

Test-retest reliability for both normally hearing listeners and for listeners with hearing aids was within one audiometric step size for the majority of test cases in this study. This is consistent with reports of aided sound field thresholds using warbled tone stimuli to assess listeners with nonlinear hearing aids (Kuk et al., 2004) and

either similar to or slightly better than well-recognized reports in which aided thresholds were measured on adults and children with hearing loss (Hawkins, Montgomery, Prosek, &Walden, 1987; Humes &Kirn, 1990; Stuart, Durieux-Smith, &Stenstrom, 1990). In general, the procedures used across these studies were similar, and they are similar to those used in the current study. Two differences warrant discussion. First, the data presented by Kuk and colleagues (2004) were gathered within a sound booth that had been modified to include absorptive fabric panels to further reduce standing waves, and the listener's head was resting against a headrest to minimize head and body movement. To represent clinical conditions during testing, we did not incorporate these procedures into the current study. Second, the stimuli used in the present study are broader in bandwidth than the warbled tones used in the previous studies cited above. The broader bandwidth could reduce the effects of standing waves, which may be an advantage for test-retest reliability. The broader bandwidth also prevents this test from being highly frequency specific and prevents their use in characterizing aided hearing on a frequency-by-frequency basis, compared with testing with narrowband stimuli, such as pure tones. Test performance was characterized in a sample of adults with hearing loss, all of whom were fitted with a modern, commercially available hearing aid with multichannel wide dynamic range compression. The hearing aids were fitted using the DSL 5 method and verified in the ear canal of each participant using a probe tube microphone system. With these fittings, adults with better ear pure-tone averages of up to 30 dB HL achieved aided thresholds in the upper half of the normal range for the low-frequency stimuli in this test. For losses above this or for high-frequency stimuli, aided detection was not within the normal range and was related to the degree of hearing loss, characterized either by frequency-specific thresholds or by the overall magnitude of the hearing loss. This is consistent with the prescriptive goals and calculations of the DSL 5 method, which prescribes aided listening levels for adults that are significantly lower than those prescribed for children (Scollie et al., 2005). Clinically, this means that expected aided performance on this test ranges between about 0 and 50 dB HL, depending on the frequency content of the stimulus and the unaided hearing loss and gain of the hearing aid. Adult performance was compared with illustrative cases of five older children who were tested while wearing their own hearing aids. These devices had also been fitted using the DSL 5 method, which prescribes more gain for children with early childhood hearing losses than is prescribed for adults with acquired losses. Specifically, DSL 5 uses a modified normalization algorithm for children, in which gain targets attempt to normalize audibility if the input is above the compression threshold (Scollie et al., 2005). Accordingly, the children had lower aided thresholds than did the adults, and their scores fell largely within the normal range. The current data set on children serves to illustrate that adults and children may have different test performance if they are fitted with a prescription that uses age-dependent gain. In addition, some of these children used frequency-lowering hearing aids, which may have been a factor in their aided thresholds for the higher-frequency stimuli. The current data set on children is not adequate to fully characterize typical children's responses across hearing loss or technology type, and further work on this is recommended.

Considering the results presented here, it appears that the Ling-6(HL) stimuli support reliable estimation of sound field speech sound detection thresholds in several participant groups, using clinically available equipment such as a CD player and commercial audiometer. This test may support reliable test results across time and tester, compared with a live voice administration during aided threshold testing, although this was not studied directly in this research. Limitations of either the test or our current knowledge of the test include the following: First, the performance of this test is not yet fully characterized on children who use hearing aids, particularly children in the developmental range for testing with VRA. The use of a VRA-based protocol for assessing aided Ling sound detection in infants and toddlers has been suggested in previous reports (Winter &Kuk, 1998). However, the test-retest, normative, and clinically typical test performance for VRA is unique (Hawkins, 2004; Sabo et al., 2003; Widen et al., 2000). We would therefore expect that a VRA procedure with the Ling-6(HL) stimuli would require specific evaluation to determine normative properties, clinical patterns of outcome, and appropriate application with test azimuths other than those used in this study. Second, the relative advantages

or disadvantages of using Ling-6 sounds rather than warbled tones or narrow bands of noise for aided detection threshold evaluation is not addressed by the current study. Third, recalling that all data used here were measured using zero degrees azimuth, normative test properties with other azimuths have not yet been assessed. Fourth, the variation and importance of frequency content across the Ling-6 stimuli is not fully exploited by a detection task such as is presented here. Consider the spectral properties of the four low-frequency stimuli (/m/, /u/, /a/, /i/) in this set (Figure 1) against the typical test performance in hearing aid users (Figure 3). These stimuli have similar peak spectral levels yet different spectral properties. This detection test would likely have been driven by the primary spectral peaks between 200 and 500 Hz, where the stimuli have similar peak levels. This is consistent with the results, in which aided detection thresholds across these stimuli occupy essentially the same range in the aided adult listeners. Therefore, is testing all six stimuli necessary? This may be an important clinical consideration regarding test time. It also highlights the different test considerations when Ling-6 stimuli are used either for a detecion task or for a more complex task such as speech sound discrimination or identification (Smiley et al., 2004). Whereas the former may be related to peak levels, the latter may be affected by other properties of the stimuli, including formant structure. Literature on vowel recognition indicates that audibility, frequency, frequency change, and frequency ratios of formats likely affect vowel identification (Hillenbrand, Getty, Clark, &Wheeler, 1995; Monahan &Idsardi, 2010). The present work addresses the use of the Ling-6 stimuli for detection purposes in decibel hearing level but does not address the suprathreshold tasks of discrimination or identification. Finally, the results presented here were gathered using the DSL 5 fitting method and nonlinear hearing aids. It is possible that typical performance with other fitting methods or technologies may vary from the results shown here.

The clinical use of the Ling-6(HL) detection test requires use of the calibration tone to adjust the input sensitivity of the audiometer to the correct level and verification that the target calibration levels are achieved using a sound level meter. These requirements are typical of CD-based tasks that are routed to audiometers. If they are, use of the correction factors shown in Appendix A may be appropriate. As with other tests that are used across a variety of sound fields (e.g., Cox &Gray, 2001), site-specific verification of the corrections on a sample of otologically normal listeners is recommended either to ensure that the corrections are appropriate or to develop site-specific corrections. Although correction factors are perhaps inconvenient, the advent of computer-assisted audiometers may facilitate automation of such corrections in the future.

Appropriate clinical applications of this version of the Ling-6 stimuli may include measurement of aided speech sound detection thresholds as a measure of hearing device outcome. This application is not a replacement for electroacoustic hearing aid analysis, specifically real ear measurement, as a method for ensuring that the gain and frequency shaping of a hearing aid is appropriate for a particular hearing aid user. Real ear measurement is more precise and provides more detailed and robust information about hearing aid response across frequency and level, compared with measures of either functional gain or aided thresholds. Therefore, aided Ling-6(HL) detection thresholds use may have greatest utility (a) for devices that cannot be evaluated with real ear measurements (e.g., cochlear implants, bone-anchored or -conducted hearing devices, middle ear implants); or (b) when confirmation that the listener is receiving the aided signal is of clinical interest (e.g., for children, when measurement of aided thresholds is done to validate that aided speech sounds are detected by the child). This latter use is best considered an outcome measure as opposed to a verification measure. Either of these applications may assist in postfitting evaluations or provide information for further discussion with patients, caregivers, teachers, or speech-language pathologists. The score sheet presented in Appendix B displays the normal range measured in this study, based on the 95% confidence intervals measured for each group of listeners, and allows plotting of unaided and/or aided detection thresholds on a case-by-case basis.

Acknowledgments

The development of this test was financially supported by the Natural Sciences and Engineering Research Council/Canadian Institutes of Health Research Collaborative Health Research Program, the Canadian

Language and Literacy Research Network Summer Studentship program, and the Hearing Foundation of Canada. Ongoing support for clinical evaluation of the test in children is provided by the American Academy of Audiology New Investigator Award (2012-2013) and in partnership with the Network of Pediatric Audiologists of Canada and Sheila Moodie. The Ontario Research Foundation's support of the National Centre for Audiology Translational Research Unit supported this project through access to participants. The authors thank Richard Seewald for comments on an earlier version of this article and KellyMattingly for assistance with figure preparation.

An audio CD is available with the stimuli used in this study, along with support documents that provide instructions and scoring sheets. Contact Phonak (www.phonak.com) for more information.

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Editor and Associate Editor: Larry Humes
Received April 17, 2012
Revision received June 14, 2012
Accepted June 24, 2012
DOI: 10.1044/1059-0889(2012/12-0020)

Appendix

(ProQuest: Appendix omitted.)

An Evidence-Based Systematic Review of Directional Microphones and Digital Noise Reduction Hearing Aids in School-Age Children With Hearing Loss

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Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 295-312.
ProQuest document link

Abstract: The purpose of this evidence-based systematic review was to evaluate the efficacy of digital noise reduction and directional microphones for outcome measures of audibility, speech recognition, speech and language, and self- or parent-report in pediatric hearing aid users. The authors searched 26 databases for experimental studies published after 1980 addressing one or more clinical questions and meeting all inclusion criteria. The authors evaluated studies for methodological quality and reported or calculated p values and effect sizes when possible. A systematic search of the literature resulted in the inclusion of 4 digital noise reduction and 7 directional microphone studies (in 9 journal articles) that addressed speech recognition, speech and language, and/or selfor parent-report outcomes. No digital noise reduction or directional microphone studies addressed audibility outcomes. On the basis of a moderate level of evidence, digital noise reduction was not found to improve or degrade speech understanding. Additional research is needed before conclusions can be drawn regarding the impact of digital noise reduction on important speech, language, hearing, and satisfaction outcomes. Moderate evidence also indicates that directional microphones resulted in improved speech recognition in controlled optimal settings; however, additional research is needed to determine the effectiveness of directional microphones in actual everyday listening environments.

Full text: Headnote

Purpose: The purpose of this evidence-based systematic review was to evaluate the efficacy of digital noise reduction and directional microphones for outcome measures of audibility, speech recognition, speech and language, and self- or parent-report in pediatric hearing aid users.
Method: The authors searched 26 databases for experimental studies published after 1980 addressing one or more clinical questions and meeting all inclusion criteria. The authors evaluated studies for methodological quality and reported or calculated p values and effect sizes when possible.
Results: A systematic search of the literature resulted in the inclusion of 4 digital noise reduction and 7 directional microphone studies (in 9 journal articles) that addressed speech recognition, speech and language, and/or selfor parent-report outcomes. No digital noise reduction or directional microphone studies addressed audibility outcomes.
Conclusions: On the basis of a moderate level of evidence, digital noise reduction was not found to improve or degrade speech understanding. Additional research is needed before conclusions can be drawn regarding the impact of digital noise reduction on important speech, language, hearing, and satisfaction outcomes. Moderate evidence also indicates that directional microphones resulted in improved speech recognition in controlled optimal settings; however, additional research is needed to determine the effectiveness of directional microphones in actual everyday listening environments.
Key Words: children, evidence-based systematic review, digital noise reduction, directional microphones, amplification

The negative perceptual consequences of background noise on speech understanding have been established across numerous studies with children (Elliott, 1979; Johnson, 2000). Children with and without hearing loss experience greater degradation in speech recognition than do adults in background noise (McCreery et al.,

2010; Stelmachowicz, Pittman, Hoover, &Lewis, 2001); furthermore, children with hearing loss may experience even greater degradation in speech understanding than do their peers with normal hearing (Crandell, 1993; Finitzo-Hieber &Tillman, 1978). Interference from background noise not only influences speech understanding but can also have substantial effects on learning and academic achievement, including reading and mathematics (Shield &Dockrell, 2003, 2008). Classroom noise levels are frequently observed to exceed recommended levels of noise and reverberation, often reaching levels that are likely to degrade speech recognition and make learning more difficult. Whereas the recommended signal-to-noise ratio (SNR) for educational environments is +15 dB to +30 dB, SNRs in most classrooms are only between -6 dB and +6 dB (Knecht, Nelson, Whitelaw, &Feth, 2002; Nelson, Bougatsos, &Nygren, 2008). Frequency modulation (FM) systems can be coupled with hearing aids (HAs) to limit the effects of background noise on speech understanding and learning in classrooms (Lewis &Eiten, 2011); yet, FM systems may not be practical in all listening situations, such as learning environments like classroom discussions with multiple talkers of interest. When FM systems are impractical or not available, HA features such as directional microphones and digital noise reduction (DNR) may help to minimize the negative perceptual consequences of background noise. Directional microphones and DNR are HA features that were developed to minimize the negative effects of background noise for HA users. DNR includes a wide range of signal processing strategies designed to classify the input to the HA as primarily speech input or noise input, and then reduce gain when the input to the HA is predominantly noise. DNR can be implemented using a wide range of algorithms, including modulation detection and complex filtering. Significant differences in the implementation of DNR between manufacturers and within manufacturers' different products make general predictions about the effect of DNR and related outcomes difficult (Hoetink, Körössy, &Dreschler, 2009).

Directional microphones also have been developed to limit the negative effects of noise on speech understanding and comfort. Directional microphones maintain amplification for sounds originating in front of the listener while limiting amplification for sounds arriving from the sides and behind the listener. Spatial processing is accomplished by having multiple microphones at different locations on the HA or a single microphone with multiple ports. Directional microphones can be assigned to a specific program in the HA, which requires the listener to switch the device to a directional setting for situations with background noise. More recently, manufacturers have developed directional microphone systems that switch automatically from omnidirectional to directional response when the input to the HA has spectral, modulation, and/or level characteristics consistent with background noise. This process often relies on a similar classification signal processing to DNR. Directional microphones can also be fixed, where the direction pattern of the microphones does not change, or be adaptive, where the directional pattern of the microphone changes in response to the location of a speech or noise source in the environment. The advent of programmable directional microphone and DNR settings, as well as adaptive features that change automatically in response to the environment, create novel challenges for clinicians who must decide whether these features should be activated as well as how to verify any impact their use may have on audibility. Recent data support the idea that school-age children can reliably change their HA program in response to changes in the environment (Scollie, 2010), but the efficacy and effectiveness of adaptive signal processing features have yet to be determined.

Although research with pediatric HA users is becoming more prevalent, most DNR research to date has been conducted in the adult population. In general, adult DNR studies reveal that speech recognition typically is not affected by DNR (Bentler, 2005). However, adults can experience improved ease of listening in noise with DNR compared to conditions without DNR (Boymans &Dreschler, 2000; Ricketts &Hornsby, 2005). For example, Mueller, Weber, and Hornsby (2006) documented that while DNR did not change speech recognition for adults, DNR did result in listeners being able to tolerate a higher acceptable noise level in comparison to conditions without DNR. The lack of improvement or degradation in speech understanding for adults with DNR is not surprising given that most algorithms use modulation detection to reduce gain only for periods of the signal

where only noise is present (Kates, 2008). Some DNR algorithms may selectively reduce gain only in frequency regions where noise is the primary signal; however, the spectral characteristics of speech and noise in realistic environments often overlap significantly. Therefore, when both speech and noise are present in the environment, many DNR algorithms do not make significant changes to the signal in order to preserve the audibility of speech (Peeters, Kuk, Lau, &Keenan, 2009). Even if DNR were active when both speech and noise were present in the environment, any reduction in gain would be applied to the combined speech in noise signal, making it unlikely that SNR improvements would be sufficient to improve speech understanding. Therefore, as with adults, the primary objective for using DNR with children should be to maintain speech understanding while limiting the negative impact of background noise on listening effort, cognitive processing, and the child's listening comfort. In cases where DNR does result in decreased speech audibility, the negative effect on speech recognition would likely be greater for children than what would be expected with adults, as children require more audibility to reach the same levels of speech recognition as adults (Stelmachowicz et al., 2001).

Unlike DNR, directional microphones have the potential to improve the SNR for the listener, particularly in situations where the signal of interest and noise sources are spatially separated (Boymans &Dreschler, 2000; Gravel, Fausel, Liskow, &Chobot, 1999). The benefits of directional microphones for improving speech understanding in noise for adults who use HAs have been previously documented in three systematic reviews (Agence d'évaluation des technologies et des modes d'intervention en santé [AETMIS], 2003; Amlani, 2001; Bentler, 2005). Whereas the magnitude of improvement observed with directional microphones varied across studies, reviews by AETMIS (2003), Amlani (2001), and Bentler (2005) all reported that overall directional microphones did provide a statistically significant improvement in speech recognition across studies with adults. In general, the largest improvements in speech recognition were observed for experimental conditions where the stimuli are presented in front of the listener and the noise source was fixed behind the listener. The presence of reverberation, diffuse noise sources, or other more realistic acoustic conditions resulted in smaller improvements in speech recognition in adults.

Although existing studies can provide clinicians with support for using these advanced HA signal processing strategies with adults, the findings are difficult to generalize to children in school-age populations due to the ongoing development of auditory, speech, and language skills coupled with the unique, acoustically complex environments in which they must access auditory information. Changes in audibility that result from DNR and directional microphones may have different effects on children than those previously reported with adult listeners. Since children experience greater degradation in speech understanding from background noise than adults, the degree to which the negative consequences of background noise can be limited may have a greater impact on children than has been observed in adults. Additionally, differences in listening behavior between adults and children have the potential to affect the degree to which similar results can be observed with children. Unless the talker of interest and sources of noise are stationary, improvements in the SNR with directional microphones are predicated on the ability to orient the head toward the signal of interest. Ching and colleagues (2009) evaluated listening behavior in infants and young children with normal hearing and hearing loss in simulated realistic listening situations. These children looked at the speaker of interest more than 40% of the time, which suggests that young children are able to orient toward a speaker in realistic environments, but may not do so consistently.

Evidence-based systematic reviews (EBSRs) and guidelines of HA signal processing for children are necessary to provide objective, nonbiased summaries of empirical evidence and recommendations for HA selection and clinical management based on empirical evidence. The American Academy of Audiology Pediatric Amplifications Guidelines Task Force has announced a soon-to-be published evidence-based guideline that will likely include information on directional microphones and DNR. Currently available pediatric HA articles, clinical guidelines, and protocols (American Academy of Audiology Task Force, 2003; Bagatto, Scollie, Hyde,

&Seewald, 2010; King, 2010; Scollie, 2010) are not based on systematic reviews of the evidence. Additionally, as pointed out by Scollie (2010), current clinical guidelines provide conflicting recommendations regarding the use of HA features with children. Whereas Bagatto and colleagues (2010) recommended decisions about selecting HA features be conducted on an individual basis using clinical judgment, King (2010) recommended that features such as directional microphones and DNR be routinely used with children. Therefore, the purpose of the current EBSR is to systematically review the current research evidence regarding the effect of directional microphones and DNR on relevant hearing, speech, and satisfaction outcomes for school-age children with hearing loss.

Beginning in 2010, ASHA's National Center for Evidence- Based Practice in Communication Disorders began a systematic search of the current, peer-reviewed research to determine the impact of several HA signal processing features on select communication outcomes in school-age children, including: directional microphone response, noise reduction, amplitude compression, and frequency lowering. The results of the literature search are presented in a series of three EBSR reports. This review focuses on the impact of directional microphone response and noise reduction; two additional reviews address frequency lowering and amplitude compression. This series of EBSRs is intended to inform clinical decisions pertaining to the selection and management of the aforementioned HA technology for school-age children.

We developed clinical questions for this review in consideration of the population, intervention, comparison, and outcome. Our population of interest is school-age children, and our intervention comparisons include the use of DNR in HAs versus the use of HAs without DNR and omnidirectional response as compared to directional microphone response. Four categories of outcome measures have been suggested to evaluate the efficacy of HA features with children: audibility, speech recognition, speech and language outcomes, and subjective measures (Hogan, 2007). Audibility, the ability to hear sounds directly, impacts an individual's ability to recognize, learn, and interpret speech. Audibility outcome measures are objective measures of speech audibility, including sound-field testing, real ear measures (gold standard), real-ear-to-coupler difference, Articulation Index (AI; ANSI S3.5-1969) scores, and Speech Intelligibility Index (SII; ANSI S3.5-1997) scores. Because children with hearing impairments are more likely to have limited exposure to audible speech (Arlinger, 2001), they are at increased risk for language difficulty in areas such as vocabulary acquisition (e.g., Briscoe, Bishop, &Norbury, 2001; Pittman, 2008), which is important in developing context for academic subject areas (e.g., Maynard, Pullen, &Coyne, 2010; Myers &Botting, 2008; Scarborough, 1998). Speech recognition outcome measures are objective measures of speech stimuli identification, including phoneme, nonword, word, and sentence materials. The accurate perception of speech underlies the development of spoken and written language skills (Bavin, Grayden, Scott, &Stefanakis, 2010; DesJardin, Ambrose, Martinez, &Eisenberg, 2009). Speech and language outcome measures include standardized measures of communication development. Ultimately, the impact of hearing ability on social interaction becomes a primary focus and is often captured by self-report or parent-report questionnaires. The impact of these outcomes on school-age children fitted with hearing devices is an important consideration for audiologists who provide services to that population.

Two clinical questions were developed as the focus of this EBSR:

1. What are the effects of DNR technology as compared to HAs without DNR on audibility outcomes, speech recognition outcomes, speech and language outcomes, and HA self-report or parent-report outcomes for schoolage children with hearing loss?
2. What are the effects of directional microphone response as compared to omnidirectional response on audibility outcomes, speech recognition outcomes, speech and language outcomes, and HA self-report or parent-report outcomes for school-age children with hearing loss?

Method

Literature Search

We obtained articles for this series of reviews from a literature search of HA processing features. The fourth

author, experienced in conducting systematic literature searches (e.g., Frymark et al., 2010), developed a search strategy. We searched 26 databases (e.g., PubMed, CINAHL, PsycINFO, ERIC) from January to April 2010 using keywords related to hearing loss, children, and amplification (e.g., hearing aid, hearing instrument, amplification, child, frequency compression). A full list of the searched databases and search terms are included in a concurrent review within this series, McCreery, Venediktov, Coleman, and Leech (2012). We examined reference lists of all full-text articles retrieved from the initial search to identify additional relevant articles. One author looked for articles citing the studies accepted for inclusion (see McCreery et al., 2012) and searched in the EBSCO database for literature published by 26 prolific authors. The overarching search for the series of reviews was initially completed from January to April 2010; however, given the size and scope of the review series as well as the lapse of time with report of results, the search was updated to include studies published through July 2011.

Study eligibility was based on the following inclusion criteria: (a) experimental or quasi-experimental research designs addressing one or more of the clinical questions; (b) studies written in English that were published in a peerreviewed journal after 1980; (c) studies including school-aged children between the ages of 5 and 17 years with documented conductive, mixed, or sensorineural hearing loss; (d) studies using wearable HAs and signal processing approaches that are currently available in commercial HAs; and (e) studies providing comparative data on HAs with and without the target technological features. Studies including participants outside of the target age range were excluded unless the mean age fell within the target age range or if the data could be split for separate analyses. Operational definitions of signal processing strategies and outcomes are included in McCreery et al. (2012). Two authors independently applied the inclusion criteria to determine study eligibility based on abstracts. A second independent review of preliminarily accepted full-text articles was completed by the same authors to determine final inclusion. We calculated interrater reliability using the kappa statistic (k) and percent agreement. Interrater disagreements were resolved by consensus or the advisement of the first author, who also reviewed the final list of included and excluded literature for accuracy and completeness. Landis and Koch's (1977) labels describing relative strength of agreement were applied to k statistics: <.00 = poor, .00-.20 = slight, .21-.40 = fair, .41-.60 = moderate, .61-.80 = substantial, and .81-1.00 = almost perfect.

Critical Appraisal

Individual studies. Full-text versions of each included study were independently reviewed by the second and third authors, who have educational training and previous experience (e.g., Gosa, Schooling, &Coleman, 2011; Roush, Frymark, Venediktov, &Wang, 2011); these authors appraised experimental research for quality. Each author rated the quality of the study on up to seven appraisal criteria using an adaptation of the ASHA levels-of-evidence scheme (Cherney, Patterson, Raymer, Frymark, &Schooling, 2008; Fey et al., 2010; Mullen, 2007). The levels-of-evidence scheme was developed by the ASHA National Center for Evidence-Based Practice in Communication Disorders along with the ASHA Advisory Committee for Evidence-Based Practice and was piloted prior to its adoption in 2008. The scheme was adapted for evaluation of within-subject repeated measures designs with special consideration for threats to internal validity arising from these study designs (Portney &Watkins, 2009) and with input from the first author regarding the applicability of each appraisal point to HA research. We calculated interrater reliability using κ (weighted as appropriate) and percent agreement. Neither rater had an extensive audiological background; therefore, they requested the knowledge and experience of the first author as necessary to provide background information to clarify any instances of uncertainty during the quality appraisal process. Individual studies received one point for each appraisal criterion met, and quality ratings were determined for each study on the basis of the total number of points. Appraisal points were awarded for (a) an adequate description of study protocol (i.e., sufficient detail provided for replication), (b) assessor blinding, (c) an adequate description of random sampling of participants, (d) randomization to condition or sequence of conditions, (e) counterbalancing of the order of conditions (applicable only to within-subject designs), (f) reporting of p values (or the provision of data to calculate that statistic), and

(g) reporting of effect sizes and their confidence intervals (or the provision of data to calculate those statistics).
Body of evidence. We used the Cincinnati Children's Hospital Medical Center body of evidence grading scheme (Cincinnati Children's Hospital Medical Center, 2011a) to evaluate the strength of the evidence for the body of literature for each clinical question. This scheme was selected because it considers several important domains: hierarchy, bias, quantity, magnitude of effect, and consistency of evidence (Coleman, Talati, &White, 2009), and offers a clear and objective approach to evaluating bodies of evidence. The second and third authors independently evaluated the quality of individual studies using the Cincinnati Children's Hospital Medical Center Controlled Clinical Trial Appraisal worksheet (Cincinnati Children's Hospital Medical Center, 2011b) to arrive at a quality level for each study. Interrater agreement was calculated using k and percent agreement. These two authors then independently evaluated the body of evidence for each clinical question using the Cincinnati Children's Hospital Medical Center evidence grading worksheet to arrive at a grade of high, medium, or low. A high grade of evidence is based on a high-quality systematic review, more than one high-quality randomized controlled trial or more than five high-quality nonrandomized controlled trials or cohort studies. If a body of evidence was graded as high, it suggests that future research is not likely to change confidence in the answer to the clinical question. A moderate grade was based on a high-quality randomized controlled trial or multiple high- or low-quality systematic reviews, randomized and nonrandomized controlled trials, cohort studies, or more than five case-control studies. Moderate evidence suggested that future research is likely to have an important impact on answers to the clinical question. A low grade of evidence indicated that there is consensus but no research to answer the question. A grade was not assignable if there was insufficient evidence to answer a clinical question. Questions and interrater disagreements were resolved by consensus or advisement of the first author.

Data Extraction and Analysis

With the advisement of the first author, a list of disciplinespecific data extraction points was developed. The second and third authors summarized these critical features of each study, including study design, characteristics of the population, previous HA usage, test HA features, HA settings (including volume control and equalization), study protocol, outcome measures, findings, and limitations. The first author reviewed summaries for accuracy and completeness. This information is located throughout the text and tables of this review.

Effect size, r, was calculated for all studies providing sufficient data. In studies providing raw data in which the independent variable was dichotomous and the dependent variables were continuous, the point-biserial correlation coefficient (rpb) effect size was calculated using an online calculator (Lowry, 2010). If raw data were not presented, an approximated effect size, r, was calculated from F-statistics with corresponding degrees of freedom (dfs; Garbin, n.d.) or from paired t values and df (Rosenthal &DiMatteo, 2001). The number of participants in each study was entered into an online calculator (Garbin, n.d.) to calculate the confidence interval (CI) surrounding each effect size. Effect sizes favoring the experimental technology (i.e., HAs with DNR or a directional microphone response) investigated in each study were assigned a positive value, whereas effect sizes favoring the control condition (i.e., HAs with DNR deactivated or an omnidirectional response) were assigned a negative value. The magnitude of the r effect sizes was interpreted as follows: small (.10 to .29), moderate (.30 to .49), and large (above .50; Cohen, 1992). P values were calculated in several studies in which raw data were provided but statistical significance for our sample of interest was not reported. We used the Wilcoxon signed ranks test due to the small number of participants.

We discuss the statistical significance of included study findings throughout the text of this review. A finding was considered to be statistically significant if the confidence interval surrounding the effect size did not include the null value and/or if the p value was less than or equal to .05. For each clinical question, we further analyzed results to determine whether any data trends were apparent that suggested an impact of study design or study quality on the results.

Results

Study Selection

Of the 376 studies identified, 168 were eliminated during the abstract review and an additional 171 were subsequently excluded after review of the full text. Of the 37 remaining studies, 14 were eliminated after further scrutiny. This process resulted in a total of 23 articles, nine of which are included in this review. Reasons for exclusion were that the study did not directly address a clinical question for this or another review in the series, did not provide sufficient data for analyses, or reported the use of a technology no longer available in commercial HAs. See McCreery et al. (2012) for a flow chart depicting this process.

Ten studies from nine articles were included in this review. Four studies (Auriemmo et al., 2009; Pittman, 2011a, 2011b; Stelmachowicz et al., 2010) provided data to address Clinical Question 1 (DNR) and seven studies (Auriemmo et al., 2009; Gravel et al., 1999; Hawkins, 1984; Kuk, Kollofski, Brown, Melum, &Rosenthal, 1999; Ricketts, Galster, &Tharpe, 2007, Experiments 1 and 3; Wouters, Litière, &van Wieringen, 1999) addressed Clinical Question 2 (directional microphones). One study (Auriemmo et al., 2009) investigated both directional microphone response and DNR.

Interrater Reliability

Overall interrater reliability for the inclusion/exclusion process indicated substantial agreement and moderately high percent agreement between raters (k = .67, 87.9%). The interrater reliability for the critical appraisal of individual studies and bodies of evidence was also calculated using the k statistic (weighted as appropriate) and percent agreement. Perfect interrater agreement (k = 1.00, 100%) was obtained for three appraisal criteria: blinding, sampling, and random allocation to condition/sequence. Interrater agreement was moderate for the counterbalancing and effect size appraisal criteria (k = .60, 80%; k = .62, 90%, respectively) and substantial for the statistical (p value) reporting criterion (k = .48, 70%). Interrater reliability was poor (k = 0) for one appraisal criterion, protocol description, despite a high percent agreement between raters (i.e., 80%). The skewed distribution of responses created a paradox in which the k statistic was very low despite a fair percentage of agreement (see Feinstein &Cicchetti, 1990, for further explanation). Interrater reliability and percent agreement for individual study quality determinations, conducted as a step in the process of grading the body of evidence for each question, was substantial (k = .62, 90%). Individual ratings are included in the supplementary materials associated with this article.

DNR

Clinical Question 1: What is the effect of DNR technology as compared to HAs without DNR on audibility outcomes, speech recognition outcomes, speech and language outcomes, and HA self- or parent-report outcomes on school-age children with hearing loss?

Four studies (Auriemmo et al., 2009; Pittman, 2011a, 2011b; Stelmachowicz et al., 2010) that included a total of 65 participants met the inclusion criteria for this clinical question. Participants ranged in age from 5 to 12.8 years and presented with mild to moderately severe hearing loss. The majority of participants had a sensorineural hearing loss and were experienced HA users. Additional details are presented in Table 1. Four different HA models with varying DNR algorithms were identified across the four studies and included the Widex Diva SD9M/19M, Siemens Explorer 500, Starkey Destiny (Model 1200), and a test HA with modulation-based DNR algorithm and Wiener filter. Researchers in two studies (Auriemmo et al., 2009, Stelmachowicz et al., 2010) provided speech recognition outcomes, two (Pittman 2011a, 2011b) provided speech and language outcomes, and one (Auriemmo et al., 2009) also provided HA self- or parentreport outcomes. Additional details regarding HA features and experimental procedures are located in the appendix. As a result of the heterogeneity (e.g., differences in specific outcome measures used, differences in severity of hearing loss, differences in compression thresholds and stimulus input levels) and small number of included studies for each clinical question, effect sizes were not averaged across studies.

Speech recognition outcomes. Speech recognition outcomes consisted of nonsense syllable, word, and

sentence recognition scores measured at several SNRs. Auriemmo et al. (2009) tested word recognition in quiet and at +5, 0, and -10 dB SNR. Stelmachowicz et al. (2010) measured recognition of nonsense syllables, words, and sentences at SNRs of 0, +5, and +10 dB. As shown in Table 2, two (of five) effect sizes yielded a small magnitude of effect (favoring DNR); however, no statistically significant mean differences in speech recognition were reported between conditions with DNR compared to those without DNR in either study at any SNR.

Speech and language outcomes. As reported in Table 3, Pittman, in two studies (2011a, 2011b), examined language outcomes for children with hearing loss using DNR. Pittman (2011b) measured children's ability to appropriately categorize words heard in noise while completing a simultaneous visual task with DNR activated versus deactivated. In Pittman (2011a), children's ability to learn novel words was investigated by exposing children to nonsense words presented in noise with DNR activated versus deactivated. In both studies, effect sizes were small and nonsignificant with the exception of one finding, in which the p value just reached significance ($p = .047$) and favored HAs with DNR for novel word learning in older children (11-12 years; Pittman, 2011a). The magnitude of this effect was large.

HA self-report or parent-report outcomes. Auriemmo et al. (2009) used the parent version of the Abbreviated Profile of Hearing Aid Performance (PA-PHAP; Kopun &Stelmachowicz, 1998) to assess parents' perceptions of their child's response to a range of listening situations after each 6-week trial with the HA with DNR versus without DNR. Parents did not report any significant difference between HA conditions on the PA-PHAP. Children in this study also were asked to respond to a directional subscales questionnaire (Ricketts, Henry, &Gnewikow, 2003) designed to evaluate the child's perceived amount of difficulty hearing in different listening environments. The children did not report any significant differences between settings with DNR and those without DNR for the "sound front" scale; however, significant differences ($p = .03$) were reported for the "sound back" scale, which favored the setting with DNR enabled.

Trend analysis by study design and quality. Individual study quality scores ranged from 4/7 to 5/7 across the four studies. All of the studies were within-subject, repeated measures designs, and three studies counterbalanced conditions, further distinguishing them as crossover designs. In the fourth study, Pittman (2011b) randomized participants to a sequence of conditions, also reducing the potential for order effects. None of authors of these studies reported use of random sampling, and only one indicated that assessors were blinded. However, researchers in all four studies did provide adequate protocol descriptions and reported or provided sufficient information to calculate statistical significance (see Table 4). Results from these studies were analyzed to determine whether variations in study quality or study design were associated with variations in effect size. However, because there were only minimal discrepancies among the included studies in quality and design, no conclusions were possible. The ability of users to control the volume of the HA, although not included as an appraisal point, may significantly impact study findings. Study authors indicated that volume control was deactivated in all but one study (Auriemmo et al., 2009), which did not provide information regarding the volume control.

Overall quality of body of evidence for DNR. The authors of one low-quality RCT (Pittman, 2011b) and three lowquality controlled clinical trials (Auriemmo et al., 2009; Pittman, 2011a; Stelmachowicz et al., 2010) provided information to address Clinical Question 1. Findings from these studies were generally consistent and suggested that DNR did not have a significant impact on speech recognition, speech and language, or parent /child report outcomes. Using the Cincinnati Children's Hospital Medical Center grading scheme, this constitutes a moderate body of evidence, which means that further research is likely to impact the answer to this clinical question.

Directional Microphones

Clinical Question 2: What is the effect of directional microphone response as compared to omnidirectional response on audibility outcomes, speech recognition outcomes, speech and language outcomes, or HA self-report or parent-report outcomes for school-age children with hearing loss? Seven studies were found to

address this clinical question (Auriemmo et al., 2009; Gravel et al., 1999; Hawkins, 1984; Kuk et al., 1999; Ricketts et al., 2007 [Experiment 1, Experiment 3]; Wouters et al., 1999). These studies included a total of 97 participants (ages 4.8-17 years) with hearing loss severity ranging from mild to severely profound. As shown in Table 1, the majority of participants were experienced HA users with a sensorineural hearing loss. Experimental directional response systems included adaptive automatic or fixed systems that used either dual microphones or a single two-port directional microphone. Additional details pertaining to the HA features and experimental procedures are presented in the appendix. All seven studies included speech recognition outcomes and three (Auriemmo et al., 2009; Kuk et al., 1999; Ricketts et al., 2007, Experiment 1) also included HA self- or parent-report outcomes.

Speech recognition outcomes. Speech recognition outcomes were reported for word or sentence recognition accuracy at set SNRs as well as SNRs necessary to achieve 50% accurate speech recognition (see Table 5). Effects of directionality are heavily dependent on the azimuth of the signal and noise in relation to the listener. Therefore, results are discussed in the context of the signal/noise azimuth.

Presentation of signal to front and noise to back. Two studies (Auriemmo et al., 2009; Kuk et al., 1999) assessed accuracy of word recognition for directional response and omnidirectional response at several positive and negative SNRs. Although Kuk et al. did not provide sufficient information to calculate effect sizes, p values were reported revealing statistical significance across all SNRs and favored use of HAs with a directional response over the participants' own omnidirectional HAs ($p < .05$). Auriemmo et al. reported large and statistically significant findings at SNRs of 0 dB ($r = .56$, 95% CI [.14, .81], $p < .05$) and -10 dB ($r = .67$, 95% CI [.31, .86], $p < .05$) in favor of the directional HAs. Findings in quiet and at +5 SNR failed to reach statistical significance; however, the magnitude of the effect at +5 SNR was moderate. Two studies (Gravel et al., 1999; Hawkins, 1984) measured SNRs necessary to achieve 50% accuracy on tests of word or sentence recognition. All p values from these two studies were statistically significant and favored directional response over omnidirectional response ($p < .05$); yet only one of the three effect sizes was significant. Gravel et al. (1999) reported a large and statistically significant effect size for words and sentences combined ($r = .86$, 95% CI [.67, .94], $p < .0001$). Hawkins (1984) examined the effects of omnidirectional and directional microphones in both monaural and binaural conditions. Neither condition produced a statistically significant effect size, although the magnitude of effect was moderate in the monaural condition and large in the binaural condition.

Presentation of signal to front and noise to side. In one study, Wouters and colleagues (1999) presented stimuli to the front (0°) of participants and noise to the side (90°) and measured the SNR necessary to achieve 50% accuracy on tests of word and sentence recognition. Effect sizes ranged from small ($r = .22$) to large ($r = .63$) for words or sentences presented in several types of noise. However, the statistical significance of these effects could not be determined because confidence intervals were not reported or calculable. All p values were statistically nonsignificant.

Presentation of signal to front in diffuse noise. Ricketts and colleagues (2007) simulated several classroom environments within which three different experiments were conducted. Only data from Experiments 1 and 3 provided information to determine the effect of directional response with stimuli and noise coming from various directions. In Experiment 1, omnidirectional and directional response was measured in five simulated conditions: "teacher front," "teacher back," "desk work," "discussion," and "bench seating." The azimuths of stimuli and noise for each condition are provided in Table 5. The SNRs necessary to achieve 50% accuracy on a sentence recognition test were recorded. An overall effect size, calculated across all five listening conditions, was large and statistically significant and favored directional response ($r = .58$, 95% CI [.25, .79], $p < .0017$). Post-hoc analysis revealed a statistically significant interaction of listening condition and directionality. "Teacher front," "desk work," and "discussion" conditions were statistically significant and favored directional response ($p < .05$). "Teacher back" was statistically significant and favored omnidirectional response ($p < .0375$). "Bench seating" was not statistically significant. In Experiment 3, omnidirectional and directional response were

measured in a "multiple talkers" condition in which the stimuli were directed to the front, back right, or back leftof the participant and noise was presented from four speakers in corners of the room. The overall effect size for this condition was large and statistically significant and favored omnidirectional response (r = -.79, 95% CI [-.90, -.58], p <.0012). Post hoc analysis revealed a significant interaction between stimuli source and directionality. No statistically significant differences were noted between directional and omnidirectional responses when the stimuli were presented to the front of the listener; although, significant differences (p <.01) favoring omnidirectional response were present when the stimuli were presented to the back leftand back right of participants.

Summary of speech recognition outcomes. The overall findings indicate that directional microphones were more effective for speech recognition when the signal was presented directly in front (0° azimuth) of the listener and when the noise was presented directly behind the listener (180° azimuth). Use of omnidirectional microphones, however, resulted in better speech recognition when the signal deviated away from the front of the listener.

HA self-report or parent-report outcomes. In three studies (Auriemmo et al., 2009; Kuk et al., 1999; Ricketts et al., 2007, Experiment 1), researchers evaluated HA self- or parent-report outcomes in the children's daily environments using subjective questionnaires administered to children, parents, and/or teachers. No effect sizes were calculable for these studies; however, p values were reported in Auriemmo et al. (2009) and Ricketts et al. (2007). The p values reported in the Kuk et al. study were based at a .10 significance level, and, therefore, could not be interpreted as significant at the .05 level. The Kuk et al. findings suggested that overall students favored the use of directional microphones over their own omnidirectional HAs for the majority of listening situations. No differences were found for the following situations: group discussion, teacher moving, and talking while hanging coats. Auriemmo and Ricketts and their coauthors found no statistically significant differences between directional and omnidirectional response for children or parents.

Trend analysis by study design and quality. As depicted in Table 4, individual study quality scores ranged from 2/7 to 5/7. All of the studies were within-subject, repeated measures designs. Three (Auriemmo et al., 2009; Gravel et al., 1999; Ricketts et al., 2007, Experiment 1) were designed to control for order effects by counterbalancing conditions and were therefore classified as crossover studies, whereas in another study, Hawkins (1984) controlled for order effects by randomizing participants to a sequence of conditions. Authors of all studies reported or provided sufficient data to calculate statistical significance, and the majority of studies provided an adequate description of protocol and sufficient data to calculate effect sizes. For many studies, researchers did not indicate assessor blinding, random sampling, randomization and/or counterbalancing procedures. The results of these studies were further analyzed to determine whether study design or quality impacted findings. Despite multiple similarities in study design and quality among select studies, no overall conclusions can be drawn; effect sizes were unavailable or the significance of the effect size was questionable for some of the studies. Although not included in the study critical appraisal, potential confounding variables including volume control settings, frequency response, and use of different devices are important to consider when evaluating study findings. With the exception of two studies in which sufficient information was not provided (Kuk et al., 1999; Wouters et al., 1999), studies did equalize the frequency response between omnidirectional and directional conditions. Only one study (Hawkins, 1984) reported that volume control was fixed for both conditions; all other studies did not provide this information. One important confound noted by Kuk et al. (1999) was the use of different devices to assess omnidirectional and directional response. Outcomes from directional microphone HAs were compared to outcomes with the children's own omnidirectional HAs.

Overall quality of body of evidence for directional microphones. The body of evidence to answer this clinical question consisted of one low-quality randomized controlled trial (Hawkins, 1984) and six low-quality controlled clinical trials. Findings from these studies were generally consistent across similar signal/noise listening configurations. This constitutes a moderate level of evidence that suggests that future research is likely to impact the answer to the clinical question.

Discussion

The purpose of the current EBSR was to evaluate the impact of DNR and directional microphone technology on a range of communication outcomes for school-age children with hearing loss who use HAs. Our aim in this review as well as the findings from two additional reviews in this series was to inform clinical decisions pertaining to the selection and management of these technologies in the school-age population. DNR and directional microphones are both designed to minimize the negative perceptual consequences of background noise on comfort and perception. Because school-age children listen and learn in environments with significant levels of competing background noise (Knecht et al., 2002), these technologies have the potential to benefit children with hearing loss. We identified four studies that evaluated DNR and seven studies that evaluated directional microphones were identified and analyzed as part of the review.

DNR

DNR is a signal processing strategy designed to reduce the negative perceptual consequences of background noise by lowering the gain of the HA when the input signal is classified as noise. Because DNR typically relies on gain reduction, speech recognition can at best be maintained and may potentially be degraded if the processing significantly alters the audibility of the speech signal (Stelmachowicz et al., 2010). The results of two studies included in this EBSR on the effect of DNR on speech recognition with school-age children with mild to moderately severe hearing loss (Auriemmo et al., 2009; Stelmachowicz et al., 2010) indicated that mean speech recognition was not improved or degraded with DNR. Although the younger group of children (ages 5-8 years) in Stelmachowicz et al. (2010) showed considerable individual variability in speech recognition in conditions with and without DNR, none of the participants showed constant patterns of improvement or degradation across nonsense syllables, monosyllabic words, or sentences. Auriemmo et al. (2009) also included parent and child ratings of listening difficulty, which were found to improvewith DNR for the children's ratings only when sound was located behind them. Although such a finding would be anticipated with directional microphones, it is unexpected for a condition with only DNR activated because DNR adjusts the SNR in a nonlocalized manner. Results from these two studies support the conclusion that the DNR algorithms used in these two studies did not improve or degrade speech recognition in school-age children, but did result in a reduction in the difficulty rating for sounds from behind the listener. These findings are generally congruent with previous studies of the impact of DNR on speech recognition and sound quality in adults with hearing loss.

The author of two other studies included in this EBSR (Pittman, 2011a, 2011b) examined the influence of DNR on complex listening tasks, including word categorization and novel word learning tasks. The outcomes in these two studies were categorized as speech and language outcomes because the tasks were dependent on perceptual and cognitive processes important for spoken and written language development, in addition to speech recognition. For the word categorization study (Pittman, 2011b), participants heard words that were to be categorized as person, food, or animal while also completing a complex connect-the-dots visual task. No improvement or degradation in word categorization was observed when comparing conditions with and without DNR for children with hearing loss. In another study, Pittman (2011a) analyzed the effect of DNR on novel word learning at 0 dB SNR. Whereas there was no improvement or degradation in word learning for 8- to 9-year-old children with hearing loss, 11- to 12-year-olds experienced an enhancement in word learning in the DNR condition only. The age-related differences in DNR benefit were attributed to the higher overall nonword recognition scores in the older group; the process of novel word learning in part is dependent on the accuracy of speech recognition. Because speech recognition in noise has rarely shown improvement with DNR in previous studies, an enhancement in novel word learning may be unlikely to occur if the effect is dependent on DNR improving perception. Collectively, these two studies suggest that DNR does not negatively impact complex listening and word learning tasks and has the potential to improve performance in some conditions and age groups of children. Although word categorization and novel word learning have not been specifically explored in DNR studies with adult listeners, investigators have reported positive outcomes for reduced listening effort at

very poor SNRs (Sarampalis, Kalluri, Edwards, &Hafter, 2009) and acquisition of novel speech contrasts (Marcoux, Yathiraj, Côté, &Logan, 2006) for DNR with adults. While further research is needed to specify the underlying mechanisms that result in reduced effort and improved performance on complex tasks in the absence of observable benefits for speech perception, the limited data to date suggest that DNR will not negatively impact learning processes in school-age children. Given the documented negative consequences of noise on academic and learning outcomes in children (Shield &Dockrell, 2008), the use of DNR in classroom settings may help to minimize potential problems.

Overall, a moderate level of evidence from four studies of DNR with school-age children identified in the current review suggest that DNR does not affect speech recognition or complex listening tasks and may result in reduced ratings of difficulty for specific situations (sounds behind the listener) and improved novel word learning in older (11- to 12-year-old) children. Evidence that DNR does not result in reduced outcomes in conjunction with its potential for improvements in sound quality, listening effort, and complex listening and learning tasks provides preliminary support for the use of DNR with school-age children. Further studies of DNR should attempt to replicate the findings from these studies with different DNR algorithms because the characteristics and implementation of DNR vary considerably across manufacturers and devices (Hoetink et al., 2009). The four studies of DNR in the current review also included only children with mild to moderately severe hearing loss. Children with greater degrees of hearing loss may have more limited audibility and experience greater degradation in outcomes with background noise that could lead to different results with DNR.

Three of the four studies addressing this clinical question used the desired sensation level (DSL; Scollie et al., 2005) fitting prescription to determine HA gain and output. Auriemmo and colleagues (2009) used a proprietary approach. Differences in audibility for different fitting prescriptions across studies may limit the generalizability of these findings and ability to compare results across studies using different prescriptive methods. The use of proprietary fitting approaches without quantification of aided audibility prevents accurate predictions regarding the magnitude and pattern of differences that might be observed for different outcome measures in children with hearing loss.

The state of the evidence in any given area of research is suggested to move through several distinct phases including exploratory, efficacy, effectiveness, and cost-effectiveness (see Robey, 2004, for further discussion of stages of research). The DNR studies included in this review were all in the efficacy stage of research, meaning that research was conducted in a controlled manner to maximize the internal validity of the findings. As efficacy has not been established for speech recognition and speech and language outcomes, additional efficacy research examining these outcomes, as well as the effect of DNR on users' self-reported ease of listening and performance on complex listening tasks, is needed to establish the benefit of DNR. Also, as advancements in DNR algorithms are achieved, additional efficacy research on all outcomes will continue to be necessary. Longitudinal studies with children using DNR may provide insight into the effects of experience and acclimatization, and long-term impacts on language and learning processes. Research that addresses these questions would help clinicians to determine the appropriateness of this technology for children because preference ratings have been found to favor DNR for adult listeners in previous studies (Ricketts &Hornsby, 2005). Once efficacy has been established, additional research may focus on effectiveness and cost-effectiveness research.

Directional Microphones

We identified seven studies with school-age children and adolescents that compared an omnidirectional microphone, which is equally sensitive to sounds regardless of their location relative to the listener, to directional microphones for school-age children. Speech recognition in noise was consistently improved when the signal of interest was in front of the listener (Auriemmo et al., 2009; Gravel et al., 1999; Hawkins, 1984; Kuk et al., 1999; Ricketts et al., 2007), but was poorer for conditions where the signal of interest was behind the listener (Ricketts et al., 2007). Improvements for speech originating in front of the listener were observed across

a wide range of SNRs, stimuli, and configurations of noise: diffuse noise as in Ricketts et al. (2007) and fixed noise behind the listener in Gravel et al. (1999). Because speech recognition is improved when the talker of interest is in front of the listener and is either maintained or degraded for conditions when the talker of interest is beside or behind the listener, the benefit of directional microphones for schoolage children is dependent on the ability of the child to orient toward the signal of interest. This ability to orient is particularly important in classroom situations where the speaker of interest may move or change, such as a teacher moving through the classroom or during a class discussion with multiple talkers; it may be dependent on the age of the listener. Ricketts and Galster (2008) demonstrated that school-age children with hearing loss were able to accurately orient toward the signal of interest in classroom settings, indicating that amplification can be maintained using directional microphones in classroom environments. These findings suggest that directional microphones may be beneficial for school-age children in classrooms in situations where an FM system would be impractical, including classroom discussions with multiple talkers of interest.

Despite improvements in speech recognition across multiple studies, no significant differences were observed for subjective measures of sound quality for directional versus omnidirectional responses (Auriemmo et al., 2009; Ricketts et al., 2007, Experiment 1). This disparity is counterintuitive considering the importance of speech understanding to communication in everyday situations. However, there are several potential explanations for this difference between objective measures of speech recognition and subjective ratings of satisfaction and sound quality:

1. The amount of improvement from directional microphones in real-world environments may be much smaller than the improvements in a controlled speech recognition task in a laboratory, an explanation that has been mentioned in systematic reviews of directional microphones for adults (Amlani, 2001).
2. Because directional microphones maintain amplification for whatever signal the child is oriented toward, the benefits of directional microphones may be less apparent to the users because they may use visual cues to orient toward the signal of interest throughout the day, which studies with adults have demonstrated can influence the degree of observed directional benefit in the laboratory (Wu &Bentler, 2010).
3. Although in at least one study (Auriemmo et al., 2009) researchers used a questionnaire (from Ricketts et al., 2003) that contained items that specifically probed listening situations that would be expected from directional microphones, the overall difference between speech recognition and subjective satisfaction outcomes in the current review may reflect the need for different tools to assess the benefits of this technology in real-world environments and more realistic laboratory outcome measures.

Another important consideration regarding the use of directional microphones in real-world environments is the influence that reduced sensitivity from sounds arriving from the sides or behind the child may have on their ability to use overhearing. Akhtar (2005) suggested that overhearing may be an important mechanism to support novel word learning in young children. By definition, incidental learning through overhearing involves the child's ability to hear and attend to stimuli that may not be directly in front of them. Children with hearing loss are at risk for delays in the acquisition of new vocabulary compared to their peers with normal hearing (Pittman, 2008). Preliminary data from Moeller (2010) suggests that children with hearing loss may face additional challenges using overhearing to support novel word learning compared with children with normal hearing. Although studies that directly evaluate how directional microphones may affect overhearing have not been conducted, potential limitations on children's ability to learn new vocabulary could limit the efficacy of this technology with young children.

Most of the studies relating to this clinical question used a version of the DSL (Scollie et al., 2005) prescriptive formula to prescribe HA gain and output for their participants. Two studies (Auriemmo et al., 2009; Kuk et al., 1999) used a proprietary prescriptive approach other than DSL and one study (Wouters et al., 1999) used POGO. The DSL is the most widely used prescriptive method for children, but the extent to which results obtained with one specific prescriptive formula can be generalized to other approaches cannot be determined.

As mentioned previously, the use of manufacturer proprietary prescriptive approaches without documenting audibility over a range of input levels limits the ability to determine whether differences in outcomes are related to audibility or the signal processing contrast of interest.

The included studies contribute to a moderate level of evidence that suggests efficacy for the use of directional microphones in school-age children in well-controlled laboratory environments when the sound is directed to the front of the child; however, methodological weaknesses limit our ability to confidently form conclusions without further research. Despite the need for additional high-quality efficacy research, the state of research for directional microphone studies is progressing through a later stage of efficacy and into the realm of effectiveness. Effectiveness research investigates the impact of an intervention when it is implemented in realistic situations, and, often, in typical daily environments. One study (Ricketts et al., 2007) investigated efficacy in several simulated environments, where the configuration of speech and noise signals more realistically approximated classrooms and other important environments. Authors of three studies (Auriemmo et al., 2009; Kuk et al., 1999; Ricketts et al., 2007, Experiment 1) also included real world HA satisfaction measures. The equivocal findings from these later stage investigations highlight the need for additional late efficacy and effectiveness studies that use real world or simulated environments and outcomes. Also, since most HA manufacturers incorporate multiple signal processing techniques into the same device, children may be using DNR and directional microphones simultaneously, whereas most of the current research focuses on the independent effects of these technologies. Future efficacy and effectiveness research should investigate how these strategies may interact to affect listening and satisfaction outcomes.

Limitations of the Current Review

Several limitations of this systematic review should be considered. First, the search criteria for this review were restricted to studies available in English, which likely reduces the quantity of relevant information that could have otherwise been included. Also, although the exclusion of unpublished findings and findings published in non-peer-reviewed journals was intentional to ensure that all included studies were previously vetted in a peer-review process, it has been suggested that this practice increases the likelihood of publication bias and may overrepresent positive treatment effects (McAuley, Tugwell, &Moher, 2000). In addition to the studies discussed in this review, the reader should consider research that was published after completion of the specified dates of this literature search. It is anticipated that future updates to this review will capture evolving research findings. Finally, due to the limited number of studies and differences in technologies and outcome measures used, the effect sizes obtained in this EBSR were not pooled. It is expected that as additional research becomes available, meta-analysis of the findings will be possible, reliable, and meaningful.

Conclusion

When making clinical decisions, clinicians should always use their own expertise to consider the needs and desires of the client in addition to the quality of research evidence, expert consensus opinion, potential benefits/harms, and costeffectiveness. DNR processing did not improve or degrade speech understanding in school-age children in two studies included in the current review, and outcomes during complex learning tasks were largely unaffected by DNR. There was limited evidence from one study suggesting a potential impact on HA satisfaction; however, additional research is needed to evaluate different DNR processing schemes as well as the influence of these features on comfort and ease of listening in realistic listening situations. Based on these preliminary results from a moderate body of evidence, DNR algorithms that do not reduce the audibility of speech could be used to increase listener comfort in school-age children. Research with younger children and greater degrees of hearing loss are needed before broader evidence-based recommendations can be made.

Based on a moderate body of evidence, HAs with a directional microphone response were found to improve speech recognition in noise in controlled situations where the target signal is located in front of the listener. However, decreased performance with directional response was noted in one article (Ricketts et al., 2007) when the target signal was located to the side or behind the listener, which highlights the importance of counseling

and the ability of the listener to orient toward the target signal for the benefits of this technology to be fully realized. Equivocal real-world satisfaction ratings also call attention to the need for additional research in this area to better understand the use of this technology in typical daily environments. Directional microphones have the potential to improve speech understanding in background noise in specific configurations of talker and background noise. Given the number of potential acoustic environments that a school-age child might experience in home, academic, and social situations, directional microphones may be beneficial in some situations and equivocal or detrimental in others. Therefore, recommendations regarding directional microphones with school-age children should be based on the child's ability to change the directional setting and the specific acoustic environments encountered by the child.

Acknowledgments

This evidence-based systematic review was supported by ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP). We thank Laura Cannon for updating the literature search and the following individuals for comments on an earlier version of this article: Patricia Stelmachowicz, Brenda Hoover, Ruth Bentler, Tracy Schooling, Tobi Frymark, and Rob Mullen. No author had any paid consultancy or any other conflict of interest with this document, and all authors agreed to declare no competing interests.

Sidebar

This systematic review was conducted under the auspices of the American Speech-Language-Hearing Association; however, this is not an official position statement of the Association.

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Editor and Associate Editor: Larry Humes
Received March 13, 2012
Revision received July 2, 2012
Accepted July 8, 2012
DOI: 10.1044/1059-0889(2012/12-0014)

Appendix

Appendix
HA and Procedural Details

An Evidence-Based Systematic Review of Frequency Lowering in Hearing Aids for School-Age Children With Hearing Loss

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Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 313-328.
ProQuest document link

Abstract: We developed 1 clinical question for this review, which addressed the comparison of hearing aids using frequency lowering compared to conventional processing amplification for outcomes of audibility, speech recognition, speech and language, and self- or parent-report for children with hearing loss. We systematically searched 26 databases for studies addressing a clinical question and meeting all inclusion criteria. We evaluated studies for methodological quality and reported or calculated effect sizes when possible. The literature search resulted in the inclusion of 5 studies. We implemented several different frequencylowering strategies across studies; 2 studies used nonlinear frequency compression, 2 used frequency transposition, and 1 used frequency compression with dynamic consonant boost. Whereas methodological limitations of the included studies preclude the formulation of strong conclusions, findings were generally positive across frequency-lowering strategies and outcomes. Additional high-quality research is needed in this area.

Full text: Headnote

Purpose: We developed 1 clinical question for this review, which addressed the comparison of hearing aids using frequency lowering compared to conventional processing amplification for outcomes of audibility, speech recognition, speech and language, and self- or parent-report for children with hearing loss.

Method: We systematically searched 26 databases for studies addressing a clinical question and meeting all inclusion criteria. We evaluated studies for methodological quality and reported or calculated effect sizes when possible.

Results: The literature search resulted in the inclusion of 5 studies. We implemented several different frequencylowering strategies across studies; 2 studies used nonlinear frequency compression, 2 used frequency transposition, and 1 used frequency compression with dynamic consonant boost.

Conclusions: Whereas methodological limitations of the included studies preclude the formulation of strong conclusions, findings were generally positive across frequency-lowering strategies and outcomes. Additional high-quality research is needed in this area.

Key Words: children, evidence-based systematic review, frequency compression, frequency transposition, nonlinear frequency compression, dynamic consonant boost, frequency lowering, amplification

Headnote

Appendix

HA and Procedural Details

The primary goal of providing early and appropriate amplification for children is to provide access to the acoustic cues needed to support the acquisition of speech and language abilities. Although children who receive amplification and early intervention before 6 months of age generally have better communicative outcomes than cohorts who are identified or fit with hearing aids (HAs) after 6 months of age (e.g., Nelson, Bougatsos, &Nygren, 2008), children who receive early amplification still exhibit delays compared to their peers with normal hearing. Further, Moeller and colleagues (2007) found that children who received amplification before 6 months of age had significantly delayed phonological development for the fricative class of phonemes, despite acquiring other classes of speech sounds later than, but at a rate similar to, children with normal hearing. The authors attributed delayed fricative acquisition to the limited bandwidth of conventional processing (CP) HAs. Additional research supports the notion that early phonological delays may impact the acquisition of morphosyntax (Moeller et al., 2010) as well as having implications for speech perception in school-age children with hearing loss. Stelmachowicz, Pittman, Hoover, and Lewis (2001) demonstrated that audibility of a frequency range from 2 to 4 kHz was important for perception of fricatives in male speakers and a range from 2 to 8 kHz in female and child speakers. Given that hearing amplification is typically restricted to approximately 5 kHz (Stelmachowicz, Pittman, Hoover, Lewis, &Moeller, 2004), children with hearing loss may not adequately perceive high-frequency sounds such as /s/ and /z /, especially when listening to female speakers or their own productions. Several studies have examined the impact of extending bandwidth into the 9-10 kHz region. These studies suggest that extended bandwidth may improve word learning (Pittman, 2008; Pittman, Lewis, Hoover, &Stelmachowicz, 2005; Stelmachowicz, Lewis, Choi, &Hoover, 2007) and perception of important fricative sounds, such as /s/, which serve multiple linguistic functions in language (Stelmachowicz et al., 2001). Providing amplification for frequencies above 6 kHz is also supported by studies that showed improved speech recognition (Hornsby, Johnson, &Picou, 2011), listener preference (Ricketts, Dittberner, &Johnson, 2008), and acceptable noise level (Johnson, Ricketts,&Hornsby, 2009) in adult listeners.

The most obvious strategy for providing a broader bandwidth through HAs would be to develop HAs that can provide better high frequency audibility. Killion and Tillman (1982) reported on a HAwith bandwidth that extended up to 16 kHz, demonstrating that extended bandwidth hearings aids were technologically feasible. However, the extended bandwidth in that system had a limited output that would have only been appropriate for listeners with mild hearing losses. Despite this potential, the bandwidth of most digital HAs has been limited to

approximately 5 kHz. Evidence of incremental improvements in HA bandwidth has started to surface (Kreisman, Mazevski, Schum, &Sockalingam, 2010), but numerous barriers to extending the bandwidth of amplification up to 10 kHz in digital HAs have prevented more substantial progress. In regard to determining bandwidth, the Nyquist theorem states that in order to adequately capture the signal, the sampling rate must be at least two times higher than the frequency desired in the input signal. Therefore, to capture inputs up to 10 kHz, a 20 kHz minimum sampling rate is needed (Kuk &Baekgaard, 2009). The extension of bandwidth into higher frequencies can also constrain low-frequency amplification and output power as well as increase distortion and acoustic feedback (Boothroyd &Medwetsky, 1992; Kuk &Baekgaard, 2009). The relatively low level of speech energy at high frequencies means that greater gain is required at higher frequencies to achieve consistent audibility. Moore, Stone, Fullgrabe, Glasberg, and Puria (2008) documented that only approximately 40% of adults with mild to moderate high-frequency hearing loss could achieve audibility at 10 kHz due to the limited speech energy at frequencies above 4 kHz and the significant gain requirements for making those softsounds audible. An alternative to extending HA bandwidth is to use signal processing to lower the output frequency of the speech spectrum to overcome HA design and speech energy limitations at higher frequencies. Multiple signal processing approaches, collectively known as frequency lowering, shiftor compress high-frequency sounds into a lower frequency range, thus making previously undetectable high-frequency sounds perceptible to the hearing-impaired listener. Several different approaches to frequency lowering are currently available in wearable HAs such as nonlinear frequency compression (NLFC), frequency transposition (FT), and dynamic speech recoding systems that use a combination of frequency compression (FC) and temporal consonant enhancement, such as dynamic consonant boost (DCB). In NLFC, inputs to the HA above a specified start frequency are lowered in frequency by a specific compression ratio, preserving the frequency of signals below the start frequency (Glista et al., 2009). HAs with FT extract a spectral peak above a start frequency down one octave to preserve harmonic relationships in the input signal (Auriemmo et al., 2009). Devices that use FC with DCB compress the entire input spectrum of the HA and also provide additional gain to sounds with the temporal and spectral characteristics of fricative phonemes. Unlike extending the bandwidth of the HA, frequency lowering involves alteration of the distribution of speech energy as a function of frequency, which has raised concerns about potential negative impacts due to distortion of acoustic cues necessary for speech recognition and speech and language learning. Whereas audibility of highfrequency sounds has been demonstrated to be important for supporting speech and language development, novel word learning, and speech perception in children, questions remain about whether those developmental processes can be facilitated with frequency-lowering strategies.

Prior to the advent of cochlear implants, frequencylowering strategies were developed to be implemented with individuals with severe to profound hearing loss and limited potential for aided audibility (Braida et al., 1979). The resulting frequency-lowering strategies applied significant signal processing to the entire speech spectrum to maximize audible speech energy, often leading to significant distortion of acoustic speech cues. The initial use of frequency lowering across the entire speech spectrum was necessary for these listeners with extremely limited residual hearing to maximize the potential for making the speech spectrum audible. Consequently, early studies of frequency lowering using techniques of vocoding (Lippmann, 1980; Posen, Reed, &Braida, 1993) or slow playback (Beasley, Mosher, &Orchik, 1976; Bennett &Byers, 1967) demonstrated limited improvement and even degradation in speech intelligibility with hearing impaired users. Subsequent expansion of the candidacy recommendations for pediatric cochlear implantation has reduced the number of individuals with profound hearing loss who utilize HAs and has thus resulted in a greater proportion of HA users with mild to severe hearing loss. Consequently, the focus of the implementation of frequencylowering strategies has shifted to address the audiological and communication goals of these individuals who typically have adequate low- to mid-frequency audibility. More specifically, newer frequency-lowering algorithms, including NLFC (Glista et al., 2009) and FT (Kuk, Keenan, Korhonen, &Lau, 2009), are applied over a more limited frequency range, typically in the

high frequencies, with the goal of extending audibility to frequencies greater than the bandwidth of CP HAs. Because these more recent strategies are often applied only at higher frequencies, the significant spectral distortion that occurred with noise vocoders and slow playback systems is likely reduced. As a result, current frequency-lowering strategies, applied in a population of children with lesser degrees of hearing loss, may show more favorable results than previous approaches.

Studies of frequency-lowering devices are becoming more prevalent in both the pediatric and adult populations. Studies of frequency lowering with adults have shown mixed results depending on the subjects' degree of hearing loss and specific outcome measures used to establish benefit (Bohnert, Nyffeler, &Keilmann, 2010; Glista et al., 2009; Simpson, Hersbach, &McDermott, 2005, 2006). The effects of frequency lowering for children have the potential to be different than in adult studies for several important reasons. First, previous studies have demonstrated that children show larger improvements in speech understanding as the bandwidth of HAs is extended to higher frequencies (Stelmachowicz et al., 2004). The extent to which frequency lowering increases the audibility of high-frequency speech cues may result in more consistent improvements in speech understanding in children than have been observed in adults. Alternatively, children's speech understanding is more susceptible to spectral distortion than adults (Eisenberg, Shannon, Martinez, Wygonski, &Boothroyd, 2000), who are more easily able than children to use their knowledge of phonology and language to support speech understanding under conditions of significant distortion. Manufacturer data suggest that frequency lowering may be activated in as much as 80% of one company's pediatric HA fittings (Jones &Launer, 2010), supporting the need for an evidence-based systematic review (EBSR) to help clinicians understand the potential effects of this technology on outcome measures of HA efficacy in school-age children with hearing loss.

The purpose of this EBSR is to document the current, peer-reviewed research evidence pertaining to the use of frequency-lowering HA signal processing features in schoolage children with hearing loss. This review is part of a series of three reviews of current HA signal processing approaches for children. Other reviews in this series address directional microphone response/noise reduction and amplitude compression.

The clinical question was formulated for this review in consideration of the population, intervention, comparison, and outcome. The population under review is school-age children with hearing loss. The intervention is HAs with frequency-lowering signal processing, and the comparison is HAs without frequency lowering. Outcomes of audibility, speech recognition, speech and language, and self- or parentreport (subjective measures) are all important to consider in HA research (Hogan, 2007). There is an inherent relationship between these outcomes such that the level of audibility achieved will impact an individual's ability to recognize speech, an individual's ability to recognize speech will affect his or her expressive and receptive speech and language skills, and the degree to which the HA is able to improve audibility and speech recognition will likely influence the individual's satisfaction with the device. Ideally, one would hope to affect change in all four of these outcome areas, but research may demonstrate that a given HA signal processing strategy impacts one outcome category more or less than another. This research is valuable to understand the strengths and limitations of a hearing device. Audibility outcomes are objective measures of speech audibility (e.g., sound-field testing, real ear measures, articulation index scores [ANSI S3.5-1969], and Speech Intelligibility Index [SII] scores [ANSI S3.5-1997]. Speech recognition outcomes include objective measures of speech stimuli identification at the phoneme, nonword, word, and sentence level. Speech and language outcomes consist of formal and informal measures of receptive and expressive speech and language skills (e.g., Goldman-Fristoe Test of Articulation-Second Edition; Goldman &Fristoe, 2000; mean length of utterance). Finally, self- and parent-report outcomes include subjective measures such as satisfaction surveys and listening questionnaires.

Robey (2004) suggested that clinical research moves through five distinct phases beginning with exploratory research (Phases I and II) and progressing to efficacy (Phase III) and effectiveness research (Phase IV) prior to the investigation of cost-effectiveness (Phase V). Exploratory research typically comprises case studies and discovery-oriented small studies, whereas efficacy research usually includes controlled laboratory trial research.

Effectiveness research is often conducted in typical environments to determine the extent to which therapeutic benefit is attainable in realistic situations; cost-effectiveness research typically consists of cost-benefit analysis and is usually targeted to regulators, policy makers, and legislative bodies. In consideration of the known research literature associated with frequency-lowering signal processing and the current availability of this technology, we anticipated that the majority of research would fall into the efficacy phase of research. As such, the following clinical question was formulated for this EBSR: What are the effects of frequency-lowering technology as compared to standard HA bandwidth on audibility outcomes, speech recognition outcomes, speech and language outcomes, and HA self-report or parent-report outcomes for school-age children with hearing loss?

Method

Literature Search

This review is based on a systematic literature search conducted with a combined search strategy of several HA signal processing strategies. In addition to frequency lowering, the search also pulled studies addressing directional microphone response, noise reduction, and amplitude compression. The results of studies addressing these other HA signal processing features are discussed in separate reviews within this series (i.e., directional microphone/digital noise reduction and amplitude compression). The search strategy was developed by the fourth author, who has experience in conducting systematic literature searches (e.g., Frymark et al., 2010). We initially searched 26 databases (e.g., PubMed, CINAHL, PsycINFO, ERIC) for peer-reviewed literature published from 1980 to April 2010 using key words related to hearing loss and children (e.g., hearing aid, hearing instrument, amplification, child, frequency compression). In addition, we searched reference lists of all full-text articles to identify articles for potential inclusion and conducted specific searches based on prolific authors and accepted articles. After an extensive time lapse prior to publication, we updated the literature search in July 2011 to capture the most recently published information. Specific details pertaining to the literature search and update, including a list of databases, key words, and search dates, can be found in McCreery, Venediktov, Coleman, and Leech (2012).

The inclusion criteria required studies to have an experimental or quasi-experimental design, to address the clinical question, and to have been published in English. The sample must have included children between the ages of 5 and 17 years with a documented hearing loss. Studies including participants outside of the target age range were excluded unless the mean age fell within the target age range or if the data could be split for separate analyses. To be included, study authors must have provided comparative data of outcomes with and without the target HA feature using wearable devices and using signal processing approaches that were currently available in commercial HAs. Operational definitions are included in McCreery et al. (2012). The second and third authors independently read abstracts and full-text articles to determine articles for final inclusion. Interrater reliability was calculated using the kappa statistic (k) and percent agreement, and disagreements were resolved by consensus or with the advisement of the first author (R.W.M.). Landis and Koch's (1977) labels describing relative strength of agreement were applied to k statistics: <.00 = poor, .00-.20 = slight, .21-.40 = fair, .41-.60 =moderate, .61-.80 = substantial, and .81-1.00 = almost perfect.

Critical Appraisal

Individual studies. The second and third authors critically and independently appraised the quality of each accepted article using up to seven appraisal criteria modified from the ASHA levels-of-evidence scheme (Cherney, Patterson, Raymer, Frymark, &Schooling, 2008; Fey et al., 2010; Mullen, 2007). This scheme was developed by the ASHA National Center for Evidence-Based Practice in Communication Disorders along with the ASHA Advisory Committee for Evidence-Based Practice. It was piloted prior to its adoption in 2008. The scheme was adapted for evaluation of within-subject repeated measures designs in consideration of the common threats to internal validity (Portney &Watkins, 2009). The first author provided input regarding the appropriateness of the scheme as it pertained to HA research. The raters both had previous experience (e.g.,

Gosa, Schooling, &Coleman, 2011; Rousch, Frymark, Venediktov, &Wang, 2011) and training evaluating the methodological quality of scientific literature. The appraisal criteria were as follows: (a) an adequate description of study protocol (i.e., sufficient detail provided for replication), (b) assessor blinding, (c) an adequate description of random sampling of participants, (d) randomization to condition or sequence of conditions, (e) counterbalancing of the order of conditions (applicable only to within-subject designs), (f) reporting of p values (or the provision of data to calculate that statistic), and (g) reporting of effect sizes and their confidence intervals (or the provision of data to calculate those statistics). One point was awarded for each appraisal criterion fully met. Interrater reliability was calculated using k (weighted as appropriate) and percent agreement. Neither rater had an extensive audiological background. As such, the knowledge and experience of the first author was requested in instances of uncertainty to clarify background audiological concepts.

Body of evidence. The strength of the body of evidence available to address the clinical question posed in this review was evaluated using an evidence grading scheme developed by the Cincinnati Children's Hospital Medical Center (2011a). This scheme considers domains of hierarchy, bias, quantity, magnitude of effect, and consistency of evidence, all considered to be important for evaluating bodies of evidence (Coleman, Talati, &White, 2009), and provides an objective and straightforward grading system. The second and third authors independently evaluated the quality of individual studies using the Cincinnati Children's HospitalMedical Center controlled clinical trial appraisal worksheet (Cincinnati Children's Hospital Medical Center, 2011b) to arrive at a quality level for each study. Agreement was calculated using k and percent agreement. Next, the two raters independently evaluated the body of evidence for the clinical question using the Cincinnati Children's Hospital Medical Center evidence grading worksheet (Cincinnati Children's Hospital Medical Center, 2011a). Evidence was graded high, medium, low, or grade unassignable. A high grade of evidence was based on a high quality systematic review, more than one high quality randomized controlled trial or more than five high quality nonrandomized controlled trials or cohort studies. Highly graded bodies of evidence indicate that further research is not likely to change the level of confidence in the answer to the clinical question. A moderate grade is based on a high quality randomized controlled trial or multiple high or low quality systematic reviews, randomized and nonrandomized controlled trials, cohort studies, or more than five casecontrol studies. Moderate evidence suggests that further research is likely to have an important impact on the answer to the clinical question. Low evidence is based on local or published consensus but not research evidence. The grade was unassignable if there was insufficient evidence and lack of consensus. Questions and interrater disagreements were resolved by consensus or under the advisement of the first author.

Data Extraction and Analysis

The second and third authors summarized the critical features of each study including study design, characteristics of the population, previous HA usage, test HA features, study protocol, outcome measures, findings, and limitations. The first author reviewed summaries for accuracy and completeness. This information is located throughout the tables and text of this review.

Effect size, r, was calculated for all studies providing sufficient data. For studies providing raw data, the pointbiserial correlation coefficient, rpb, was determined using an online calculator (Lowry, 2010). Effect size, r, was also approximated for several studies providing F statistics or paired t values and corresponding degrees of freedom (df; Garbin, n.d. [online calculator]; Rosenthal &DiMatteo 2001, respectively). The confidence interval surrounding each effect was determined from the sample size and effect size estimate using another online calculator (Garbin, n.d.). Effect sizes favoring the experimental technology (i.e., frequency lowering) investigated in each study were assigned a positive value, whereas effect sizes favoring the control condition (i.e., HAs with inactivated or unavailable frequency lowering) were assigned a negative value. Effect size magnitudes were labeled small, medium, or large according to the scale suggested by Cohen (1992) such that r = .10 is a small effect, r = .30 is a medium effect, and r = .50 is a large effect. The p values were calculated in several studies in which raw data were provided but statistical significance for our sample of interest was not

reported. The Wilcoxon signed ranks test was used due to the small number of participants.

We discuss the statistical significance of included study findings throughout the text of this review. A finding was considered to be significant if the confidence interval surrounding the effect size did not include the null value and/or if the p value (provided by the author or calculated as indicated above) was less than or equal to .05. For each clinical question, results were further analyzed to determine if any data trends were apparent which may suggest an impact of study design or study quality on the results.

Results

Study Selection

Of the 376 citations retrieved, we rejected 168 after reading the abstract, 171 after reading the full text, and 14 after detailed analysis (see McCreery et al., 2012, for flow chart and reasons for rejection).We fully accepted 23 articles for inclusion in the series of EBSRs; six articles (five studies) pertained to frequency lowering, and the remaining studies addressed either directional microphones/digital noise reduction or amplitude compression and are discussed in separate reviews. The authors of one study (Wolfe et al., 2010) included in this review provided follow-up data in a separate article (Wolfe et al., 2011).

Interrater Reliability

Interrater reliability for sifting articles for inclusion or exclusion was substantial (k = .67; percent agreement = 87.9%), and all interrater disagreements were resolved by consensus. Interrater reliability for the critical appraisal of individual studies and the body of evidence was also calculated using the k statistic (weighted as appropriate) and percent agreement for each of the seven appraisal points based on the raters' agreement across the five studies. These values ranged from substantial agreement ("effect size," k = .62; 80%) to perfect agreement ("assessors blinded," "sampling," "allocation," "counterbalancing," k = 1.00; 100%) with the exception of two appraisal points related to the adequacy of study protocol description and availability/calculability of p values for which interrater reliability was poor (k = 0; 80%). For the first appraisal point, raters agreed that there was an adequate description of study protocol for four of the five studies. For the remaining study, the authors disagreed on the adequacy of the protocol description and resolved by consensus that the study provided an inadequate description. For the appraisal point regarding the reporting or calculation of p values, the raters agreed that the p value was reported or calculable in four of five studies. The one p value disagreement was resolved via consensus to have been reported or calculable as well. The raters arrived at full independent agreement (k = 1.00; 100%) when identifying the individual study quality levels as the first step in determining the grade of the body of evidence. Individual rater responses are included in the supplementary materials associated with this article.

Study Findings

We obtained five studies that addressed the clinical question posed for this review. Two sets of researchers (Auriemmo et al., 2009; Smith, Dann, &Brown, 2009) studied the use of FT, two (Glista et al., 2009; Wolfe et al., 2010, 2011) investigated NLFC, and one (Miller-Hansen, Nelson, Widen, &Simon, 2003) used FC with DCB. As a result of the heterogeneity (e.g., differences in specific outcome measures used, differences in severity of hearing loss, differences in compression thresholds and stimulus input levels) and small number of included studies for each clinical question, effect sizes were not averaged across studies.

Frequency Compression With DCB

Miller-Hansen and colleagues (2003) used FC with DCB and collected audibility outcomes for 19 children and speech recognition outcomes for 16 children who had previous outcome data with CP HAs. This study was a repeated measures design with a quality appraisal score of 2/7 (see Table 1 for full list of appraisal criteria and quality scores). As noted in Table 2, children were experienced HA users and had hearing losses ranging from mild-moderate to profound. Outcome measures were obtained 1 month post-fitting of the frequency-lowering device and compared to previous measures with the children's CP HAs. Whereas effect sizes were not calculable for any outcomes in this study, aided thresholds significantly favored the use of the

frequencylowering device over CP at 500, 1000, and 2000 Hz ($p < .0001$); word recognition outcomes also favored the use of frequency lowering ($p = .006$).

Frequency Transposition

Two studies (Auriemmo et al., 2009; Smith et al., 2009) investigated the effect of FT as found in the Widex Inteo 9 and 19 HAs compared to CP in the same or a previously worn device. Both studies were repeated measures design studies with quality appraisal scores of 2/7 (see Table 1). The children in these studies ranged from 6 to 14 years of age with sloping sensorineural hearing losses. They were all experienced HA users (see Table 2). In Auriemmo et al. (2009), speech recognition, speech production, and self-report outcome measures were collected for the study HAs in CP and FT settings at baseline and/or after 3- or 6-week acclimatization and training periods. In the study by Smith and colleagues (2009), speech recognition and speech production outcome measures were obtained after 12 and 24 weeks, respectively, for the study aids in FT mode as compared to the children's previous performance with their own CP HAs.

Speech recognition outcomes. Auriemmo and colleagues (2009) reported no statistically significant differences for a nonsense syllable test presented at 30 dB HL and 50 dB HL between FT and CP at baseline and after 3 weeks of training with each type of processing. There was a significant difference ($p < .05$) between scores after 6 weeks of training in the FT program compared to CP at baseline and after 3 weeks of training at 30 dB HL for consonant recognition and after 3 weeks of training compared to CP at baseline for vowel recognition. Additionally, scores after 6 and 3 weeks of training with the FT settings were significantly better than scores with FT at baseline for consonant and vowel recognition at 30 dB HL (see Table 3). Smith et al. (2009) found statistically significant differences ($p \leq .01$) on tests of word and phoneme perception for participants using frequency lowering after 12 weeks over previous scores with CP HAs.

Speech and language outcomes. Both Auriemmo et al. (2009) and Smith et al. (2009) investigated differences in speech production outcomes after use of FT. Smith et al. noted significant differences ($p = .01$) in the children's scores on the Goldman-Fristoe Test of Articulation-Second Edition (Goldman &Fristoe, 2000) after 24 weeks of HAs with FT as compared to their previous scores without FT. Children in the Auriemmo et al. study also demonstrated significantly better ($p < .05$) production of /s/ and /z/ in reading and conversation after 6 weeks of auditory training with FT as compared to their previous productions after 3 weeks of training without FT.

Self- or parent-report outcomes. Investigators of both studies (Auriemmo et al., 2009; Smith et al., 2009) addressed HA self-report, teacher-report, or family-report outcomes for children using frequency-lowering devices. No measures of effect size were reported or calculable for either study. In Auriemmo et al. (2009), significant differences on subjective questionnaires favoring FT were reported after 6 weeks of training ($p < .05$) compared to 3 weeks of training with CP. Also, the majority of children reported a preference for the FT setting over the default HA setting when listening to bird songs, music, and female discourse. Smith et al. (2009) investigated family perceptions of HA benefit. Only four of the six families responded to the researcher-generated questionnaire. Of those who responded, all reported increased responses to specific high-frequency sounds, observed some degree of change in their child's speech production, and noted that their child heard better during one-on-one conversations. Some families also noted that their child requested repetition less frequently.

Frequency Compression

Outcomes using NLFC were reported in two studies (Glista et al., 2009; Wolfe et al., 2010, 2011). Glista et al. (2009) used a repeated measures design and received a quality appraisal score of 2/7. Wolfe et al. (2010, 2011) randomized and counterbalanced study conditions and was therefore classified as a crossover design with a quality appraisal score of 5/7 (see Table 1). Children in these studies were between the ages of 6 and 17 years and demonstrated sloping sensorineural hearing loss that was either moderately severe to profound (Glista et al., 2009) or mild-moderate to moderately severe (Wolfe et al., 2010, 2011; see Table 2). The

acclimatization period ranged from 3 weeks to 1.3 years in Glista et al. and 6 weeks in each condition in Wolfe et al. Both studies provided audibility and speech recognition outcomes, and Glista et al. also provided self- or parent-report outcome measures.

Audibility outcomes. Glista et al. (2009) and Wolfe et al. (2010, 2011) provided audibility outcomes consisting of aided thresholds using tones and/or high frequency speech sounds (i.e., /s/ and /sh/) for both NLFC and CP conditions. Effect sizes were calculable for Wolfe et al.; all were large and significant (they ranged from r = .60, 95% CI [.13, .85] to r = .82, 95% CI [.53, .94]; see Table 4). These findings favored the use of NLFC over CP conditions. Wolfe et al. (2011) also provided follow-up data at 6 months which revealed no significant change from audibility measures after 6 weeks of use. Although effect sizes were not available for the study by Glista et al., aided thresholds for at least one phoneme, /s/ or /sh/, were significantly ($p < .05$) better for 2 of 10 participants with NLFC as compared to CP. Group level statistical analysis was not completed for the child data in isolation from the adult data; results of a repeated measures analysis of variance (ANOVA) completed with combined adult and child data revealed a significant main effect of processor type, favoring NLFC over CP. Glista et al. included age group as a between-subjects variable and did not indicate a main effect of age. Further, results from the multiple linear regression analysis indicate that age group was not significantly correlated to the results.

Speech recognition outcomes. Both studies provided efficacy data pertaining to speech recognition outcomes; however, effect sizes were available only in Wolfe et al. (2010, 2011). Wolfe et al. measured discrimination of plurals and several phonemes in tokens, that is, /asa/, /ada/, /afa/, /aka/, /asha/, and /ata/, as well as performance on a speech-in-noise test. A large and statistically significant effect was noted on the University of Western Ontario Plurals Test (Glista &Scollie, 2012), favoring NLFC (r = .81, 95% CI [.51, .93]). Two tokens, /asa/ and /ada/, revealed large and statistically better outcomes for NLFC over CP (r = .57, 95%CI [.03, .85], $p < .05$; r = .56, 95% CI [.07, .83], $p < .05$, respectively). Effect sizes were not calculable for tokens /ada/, /afa/, /aka/, or /asha/, and effect sizes were not significant for tokens /ata/ and /asa/ at 6000 Hz. None of these tokens were statistically significant. Performance on the Bamford-Kowal-Bench Speech-in-Noise Test (Etymotic Research, 2005) was neither clinically nor statistically significant. There were no statistically significant differences on any speech recognition outcomes at 6 month follow-up with the exception of a large and significant improvement in discrimination of tokens /ada/ (r = .68, 95% CI [.26, .88], $p < .01$) and /asa/ (r = .62, 95%CI [.13, .87], $p < .05$) filtered at 6000 Hz for the frequencylowering condition compared to results at 6 weeks. Glista and colleagues (2009) measured participants' scores on a speech recognition test using a HA with NLFC activated or deactivated. Group-level analysis was not performed for child data in isolation; a repeated measures ANOVA completed with adult and child data combined revealed that speech recognition scores were significantly higher in the NLFC condition as compared to the CP condition for consonant and plural stimuli. However, scores were not significantly different for vowels. Age group was included as a betweensubjects variable, and it was not indicated that there was a main effect of age. The authors' results of the multiple linear regression indicated no significant correlation of age group on the results for consonant recognition but a significant correlation for plural recognition. Those findings revealed that the children in the study received greater benefit associated with the NLFC condition for the plural recognition task than adults. Visual depiction of the child data support that, on average, children's speech recognition scores were higher in the NLFC condition than the CP condition for consonant and plural stimuli, although the statistical significance and magnitude of this effect are unclear. As noted in Table 4, individual analysis of the child data indicated a statistically significant ($p < .05$) difference in speech recognition scores favoring NLFC for consonants and plurals for 4/10 participants and 7/11 participants, respectively. There was not a statistically significant difference between the processing types for any children with the vowel stimuli.

Self- or parent-report outcomes. No effect sizes or p values were reported or calculable in either study; however, Glista et al. (2009) noted that 64% of children preferred the NLFC device over CP, 9% preferred CP

over NLFC, and 27% preferred neither of the processing conditions.

Trend Analysis by Study Design and Quality

Table 1 depicts the specific appraisal points met or unmet for each study as well as the total quality score. Repeated measures designs were used in four studies. One study used a crossover design (Wolfe et al., 2010, 2011). In that study, participants were randomly allocated to the sequence of conditions and counterbalanced. Study quality scores ranged from 2/7 (Auriemmo et al., 2009; Glista et al., 2009; Miller-Hansen et al., 2003; Smith et al., 2009) to 5/7 (Wolfe et al., 2010, 2011). Although the majority of these studies did provide an adequate description of study protocol and provided measures of statistical significance (or sufficient data to calculate statistical significance), studies did not collect a random sample of participants and in many instances did not randomize to a sequence of conditions or counterbalance to avoid practice effects or blind assessors. The findings were further analyzed to determine whether there were any apparent effects of study design and study quality on results. Visual inspection does not suggest that differences in study quality were responsible for trends in the results. Auriemmo et al. (2009) explained that counterbalancing was not used due to the ethical implications of providing the children with new technology and subsequently removing it as would be necessary in a crossover design. Glista et al. (2009) used a withdrawal study in order to eliminate uncertainty that significant findings in favor of the experimental treatment were erroneously attributed to practice or acclimatization effects. The methods used to quantify high-frequency audibility varied across studies. For example, Glista and colleagues completed a test for cochlear dead regions in their participants to optimize audibility of frequency-lowering settings, whereas Auriemmo et al. did not attempt to provide amplification above 3000 Hz. These decisions could have resulted in differences in high-frequency audibility between the different frequency-lowering strategies. Another consideration is that confounding variables within a study may significantly impact the results. Potential confounds noted in this review included unequal amounts of total training time provided in the frequency lowering and CP conditions in Auriemmo et al. and the use of different HA devices (children's own HAs were used to assess CP) in Miller-Hansen et al. (2003).

Overall Quality of Body of Evidence

This body of evidence consists of one low-quality randomized controlled trial (Wolfe et al., 2010, 2011) and four low-quality controlled clinical trials. Findings across these studies were generally consistent and favored the use of frequency lowering over CP amplification for outcomes assessed. This body of evidence is graded moderate, which suggests that further research is likely to have an important impact on conclusions regarding this clinical question.

Discussion

We included five studies in the current review that examined outcome measures for HAs with frequency lowering. Two of the included studies evaluated FT (Auriemmo et al., 2009; Smith et al., 2009), two studies evaluated NLFC (Glista et al., 2009; Wolfe et al., 2010, 2011), and one study evaluated FC with DCB (Miller-Hansen et al., 2003). Overall, studies of frequency lowering reported equivalent or positive results across studies and outcome measures.

Frequency Compression With DCB

Limited evidence from the one study (Miller-Hansen et al., 2003) that reported outcomes for FC with DCB indicated significantly improved audibility and speech recognition outcomes for children using this technology compared to their previous performance with CP HAs. This study suggests that the 1-month acclimatization period was sufficient for children to adapt successfully to these devices. It is unclear whether additional acclimatization would continue to result in significantly improved audibility and speech recognition outcomes. A notable limitation of this study is the use of two different devices (i.e., the experimental frequency compression device and the children's own CP HAs) to assess the two different conditions. We cannot be certain that the study findings were a result of frequency compression and not a result of other uncontrolled differences between the two devices. Also, lack of a control group and lack of counterbalancing reduce the internal validity

of the study and ability to control the influence of maturation on speech recognition outcomes. Further, the magnitude of the effect of FC with DCB is unknown because effect sizes were not presented and we were unable to calculate effect sizes from available data. Additional research with FC with DCB is necessary in order to draw meaningful conclusions regarding the impact of this technology for children with hearing loss.

Frequency Transposition

Evidence from two studies (Auriemmo et al., 2009; Smith et al., 2009) addressed the use of FT in theWidex Inteo 9 and 19 HAs. Neither study provided sufficient data comparing audibility outcomes with FT to outcomes with CP amplification for statistical analysis; however, visual analyses of four audiograms in Auriemmo et al. (2009) depicting sound-field thresholds with FT and without FT in the right and leftears clearly suggest lower thresholds for all participants in both ears with FT. Neither study provided speech recognition, speech and language, or self- or parent-report outcomes.

Although no differences in speech recognition were noted in Auriemmo et al. (2009) after 3 weeks of training in each condition, significant differences were noted for consonant recognition after 6 weeks of training in the FT condition compared to outcomes after 3 weeks in the CP amplification condition. Further, scores after 3 weeks and 6 weeks of training with FT were significantly better than baseline FT scores. Similarly, Smith and colleagues (2009) noted a significant difference between phoneme perception scores in favor of FT following a 12-week acclimatization period in comparison with scores associated with previous use of CP amplification. Findings from Auriemmo et al. and Smith et al. suggest that length of acclimatization may have a significant impact upon speech recognition outcomes and warrants further systematic evaluation. Unfortunately, the lack of a control group and counterbalancing in both of these studies does not allow us to rule out practice, training, or maturational effects. Also, the duration of the training was a confounding variable because unequal amounts of training were provided in each condition. We cannot be certain that study findings reflect differences caused by FT and not additional auditory training. Auriemmo et al. noted that auditory training alone was unlikely to have been responsible for the findings because outcomes on a nonsense syllables test were similar at time of fitting with the default condition and after 3 weeks of training.

Speech and language outcomes are consistent with speech recognition findings from both studies. Smith et al. (2009) noted significantly higher scores on an articulation test after 24 weeks of FT use as compared to previous scores associated with the use of CP amplification. Auriemmo et al. (2009) noted significantly better production of /s/ and /z/ in the study participants after 6 weeks of training with FT as compared to previous scores after 3 weeks of training with CP amplification. As with speech recognition outcomes, practice effects, training, and maturation (i.e., the passage of time between the two speech and language measurement periods in each condition), all threats to internal validity and potential confounding variables, such as differences in the length of training between CP and FT, may account for the significant difference in findings.

Limited evidence from one study (Auriemmo et al., 2009) indicated a child preference for FT after 6 weeks of acclimatization compared to CP amplification. In the study by Smith and colleagues (2009), families noted improvements in children's auditory functioning with FT. The lack of effect sizes for the majority of these findings limits the characterization of the magnitude of the effect of FT in these studies. Because blinding was not used in these studies, results of subjective preference measures should be viewed with caution. Without blinding children, parents, and teachers to the experimental processing, positive effects may be related to expectations of improvement related to labeling, and negative effects may be moderated by the same expectations. Such effects have been documented in HA outcomes research with adults (Bentler, Niebuhr, Johnson, &Flamme, 2003) and can significantly impact listeners' perceptions and expectations about benefit.

Frequency Compression

Authors of two studies (Glista et al., 2009; Wolfe et al., 2010, 2011) investigated the use of NLFC on audibility and speech recognition outcomes in children (and adults: Glista et al., 2009) with hearing loss. Although significant findings were reported for audibility outcomes and consonant and plural speech recognition

outcomes in Glista et al. (2009), these findings included both adult and child data combined. Additional statistical analyses indicated that there was not significant variability between adult and child findings for /s/ and /sh/ detection and consonant recognition, and that the variation in plural recognition resulted from larger improvement with NLFC for children as compared with adults. However, it is uncertain whether statistical analysis of the child data in isolation would have sufficient power to produce a statistically significant result or a large effect size. Individual audibility and speech recognition data from Glista et al. indicated that some, but not all, participants had significantly better outcomes with the use of NLFC.Wolfe et al. (2010, 2011) reported statistically significant findings favoring the use of NLFC for all tested thresholds (4000-8000 Hz) and phonemes /s/ and /sh/. Additionally, significant speech recognition outcomes were noted, favoring NLFC for plurals and some speech tokens (/asa/, /ada/, /ata/), but not for sentences in noise. The magnitudes of these effects were all medium to large. Unlike the previous study designs discussed, Wolfe et al. used a counterbalanced crossover design with equal (6 week) acclimatization periods for each condition, thereby eliminating the concern for practice, order, training, and maturation effects noted in previous studies.

Implications of Findings

The purpose of frequency-lowering strategies is to increase the audibility of the high frequencies to minimize the negative consequences of limited HA bandwidth. The authors of the studies included in this review evaluated three different frequency-lowering strategies and overall contribute to a moderate body of evidence, suggesting that additional research evidence may have an important impact on conclusions regarding the use of this technology. Across frequencylowering strategies, audibility, as measured by aided puretone thresholds and /s/ and /sh/ detection thresholds, was consistently improved by frequency lowering. Aided detection of pure tones in quiet has limited utility for predicting audibility for speech in realistic listening environments (Stelmachowicz &Lewis, 1988) because thresholds are measured at levels significantly below the average level of speech sounds as processed by hearing aids. Improvements in the detection of fricative sounds would be expected to translate more directly into measurable improvements in speech recognition. Therefore, if clinicians are interested in documenting changes in audibility with frequency lowering, differences in the detection of specific phonemes or phonemic contrasts may be a more valid approach than aided pure tone thresholds in sound field. Specifically, aided pure tone thresholds are likely to be strongly affected by other signal processing systems in the HA, such as amplitude compression or feedback management. Additionally, the researchers who examined NLFC (Glista et al., 2009; Wolfe et al., 2010, 2011) and FC with DCB (Miller-Hansen et al., 2003) used a version of the desired sensation level (DSL; Scollie et al., 2005) prescriptive formulas to verify the gain and maximum output of the HA, which is widely used in pediatric HA fitting. In both of the studies of FT, investigators used the manufacturer's proprietary prescriptive approach (Sensogram). Differences in prescriptive formulae for the types of frequency lowering included in the current review could have resulted in variations in audibility that were related to the prescriptive approach rather than the frequency lowering. Discrepancies in the prescriptive approach make comparisons across studies and types of frequency lowering difficult to attribute to frequency lowering alone. Additionally, generalization to other prescriptive approaches is also not possible.

For studies in the current review, speech recognition outcomes were also generally more favorable with the use of frequency lowering as compared to CP amplification; however, due to methodological weaknesses in the majority of studies, we cannot be sure that the benefit is truly a result of the frequency lowering or that it is clinically significant. The authors of one study (Wolfe et al., 2010, 2011) that was of relatively higher methodological quality did show meaningful and statistically significant benefit of NLFC for some, but not all, speech recognition subtests. These differences across stimuli may have been impacted by varying degrees of sensitivity to the morphosyntactic cues, such as plurality. Specifically, since frequency-lowering strategies are most likely to facilitate detection and understanding of highfrequency speech sounds (such as /s/ and /z/), the largest benefits of these strategies should be realized in tests that are sensitive to morphology at the word level. Speech recognition tests that provide more opportunities to identify plurals, such as the University ofWestern

Ontario Plurals Test (Glista &Scollie, 2012), allow direct assessment of morphology at word level contrasts that are likely to be affected by frequency lowering. Speech recognition tests that include sentence-level syntactic cues, such as the Bamford-Kowal-Bench Speech-in-Noise Test (Etymotic Research, 2005), or do not contain a sufficient number of high-frequency phonemes (Phonetically Balanced Kindergarten words; Haskins, 1949) may not accurately reflect the impact of frequency lowering on all aspects of speech understanding. Additionally, sentences may provide listeners with semantic and syntactic cues that support speech recognition even when acoustic cues are limited. Because current frequency-lowering strategies are applied primarily to the high frequencies where speech energy may be limited, standardized estimates of audibility such as the SII (ANSI S3.5-1997) do not predict large improvements in the overall speech recognition score if the audibility of high-frequency bands is enhanced. The limitations of the SII for predicting speech recognition was highlighted in work by Gustafson and Pittman (2010), who reported variability in speech recognition for adults and children with normal hearing between conditions with varying bandwidth but matched for audibility on the SII. Given the significance of high-frequency audibility for the development of phonological (Moeller et al., 2007) and morphosyntactic (Moeller et al., 2010) skills as well as novel word learning (Pittman, 2008), the limitations in enhancing the audibility of high-frequency sounds for speech recognition should not be interpreted as being insignificant to a child's development.

Speech and language outcomes were reported only in the two studies that investigated FT (Auriemmo et al., 2009; Smith et al., 2009). As previously indicated, we cannot conclude that the improvements noted in these outcomes were a result of FT because maturation and practice effects were not addressed by appropriate control conditions. Whereas measures of audibility and speech recognition are more directly linked (i.e., less impacted by factors external to hearing) than speech and language measures to HA signal processing, speech and language measures are also important to investigate because these outcomes have enormous impacts on a child's academic abilities and social well-being.

Measures of user satisfaction are also critical in HA research because the perceptual benefits of amplification do not always correspond to increased listener satisfaction. For example, in studies of digital noise reduction with adult listeners, speech recognition was not altered by the signal processing, but significant improvements in ratings of sound quality were observed (Ricketts &Hornsby, 2005). Limited findings provided in several studies included in this review suggest that many children prefer frequency-lowering devices to CP amplification and that subjective improvements in hearing are noted by many children and their families with the use of frequency lowering.

Directions for Future Research

The current research with frequency-lowering signal processing strategies is in the efficacy phase of research, meaning that the outcomes were primarily measured in controlled laboratory environments. The frequency-lowering strategy of interest in these studies was the independent variable; other signal processing variables generally were controlled for or deactivated. These studies all implemented repeated measure designs to compare children's outcomes related to CP amplification to outcomes associated with frequency-lowering amplification. Although one study (Wolfe et al., 2010, 2011) controlled for potential order effects by counterbalancing amplification conditions, the majority of studies did not. Future efficacy research in this area should carefully control for order effects by randomization and counterbalancing to ensure that all results can be attributed to the use of frequency lowering and not accounted for by practice or, in studies of extended duration, maturation. As the length of the acclimatization period and differences in individual participant characteristics appear to influence outcomes, additional research to determine ideal candidacy and training/acclimatization periods may be warranted. Future research should also include measures of effect size in order to evaluate the magnitude of the impact of frequencylowering strategies compared to CP amplification.

Once the efficacy of different frequency-lowering strategies is established with additional research, subsequent research may focus on comparative efficacy and effectiveness research. Comparative efficacy research will be

necessary to determine whether one type of frequency lowering is more beneficial than others, which includes consideration of the influence of the hearing characteristics of the child or other external variables. Also, since most HAs incorporate more than one signal processing strategy into the same device, efficacy and effectiveness research will be needed to investigate how audibility, speech recognition (especially morphosyntax), speech and language, and satisfaction outcomes are affected by the interaction of multiple signal-processing strategies (e.g., directional microphones, wide dynamic range compression, and FT) in real-world environments.

Although several of the studies included in the current review examined the influence of acclimatization on speech recognition outcomes (Auriemmo et al., 2009; Smith et al., 2009; Wolfe et al., 2010, 2011), variations in the time course and degree of improvement over time suggest that factors related to the acclimatization process should be examined. Immediate improvements in audibility are anticipated to support long-term benefits for speech recognition and speech and language outcomes. Therefore, the influence of acclimatization on speech and language outcomes should also be examined, preferably using control groups or other methodological approaches to minimize the influence of maturational and practice effects on outcomes. Two studies that included measurements at two different time intervals (Auriemmo et al., 2009; Wolfe et al., 2010) demonstrated that initial improvements in speech recognition outcomes were either maintained or increased after varying periods of experience (with or without additional auditory training) with the signal processing. Until further research into the time course of improvements related to frequency lowering can be reported, clinicians should anticipate that improvements in outcomes may be observed as listening experience increases over time.

The studies included in the current review also include a heterogeneous sample of hearing impaired children with variations noted in age as well as severity of hearing loss, extent of experience with CP amplification, length of exposure to aided audibility, and other variables that could influence the degree to which frequency-lowering benefits may be observed. These differences across studies are not conducive to developing consistent candidacy for frequency lowering in general or for the three specific implementations of frequency lowering used in different studies. The extent to which these and other variables influence outcomes with frequency lowering should be explored to assist clinicians in making decisions about whether or not frequency lowering is appropriate and, if so, what parameters should be selected to optimize audibility.

Limitations

There are several limitations to the current review. One is the inclusion criterion, which restricted accepted articles to those reporting on a signal processing strategy that is currently implemented in commercial HAs. This restriction eliminated studies that used frequency vocoding and outdated forms of FT, which may have provided a historical background of the earlier outcomes of frequency lowering. In addition, only studies that were published in English were included, which likely reduced the total number of studies that could have been evaluated. Also, the decision was made to accept only studies published in a peer-reviewed journal in order to ensure that all studies received initial vetting and to reduce the likelihood of including biased studies; however, it has been suggested that the exclusion of nonpublished research may introduce publication bias into the systematic review. Because research on this topic continues to be conducted and published, the reader is encouraged to consider all literature published after the systematic search conclusion dates specified in this EBSR. We expect that future updates to this review will capture additional published research. The results of the systematic review were not pooled in a meta-analysis due to the variations across frequency-lowering strategies and the limited number of effect sizes available. Direct comparisons between types of frequency lowering were not possible due to multiple methodological differences between studies as well as the fact that studies of FT used the manufacturer's proprietary prescriptive approach, whereas studies of NLFC and FC with DCB used the DSL prescriptive approach to determine HA gain and maximum output levels. Differences in audibility between prescriptive approaches that are unrelated to frequency lowering confound potential comparisons across frequency-lowering strategies for all of the outcomes in the current review.

Conclusion

Based on a moderate body of evidence, current research provides preliminary support for the use of frequency-lowering strategies for school-age children with sloping hearing loss of at least moderate degree in the high frequencies. The majority of research in this area contains methodological limitations that restrict our ability to draw strong conclusions; however, outcomes were generally positive across outcome measures. Additional research is needed in order to draw confident conclusions regarding the use of frequency lowering. For example, individual variation in observed benefit from frequency-lowering strategies, as reported in one study, may reflect differences in audibility. Given the potential heterogeneity of outcomes across school-age children, clinicians should use clinical outcomes to monitor children's auditory development milestones and aided speech recognition to support clinical decisions about the implementation of frequency lowering with their pediatric patients. Future research should attempt to resolve issues surrounding candidacy for frequency-lowering strategies as well as the timeframe and extent of any acclimatization that may occur.

Acknowledgments

This evidence-based systematic review was supported by ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP). We thank Laura Cannon for updating the literature search and the following individuals for comments on an earlier version of this article: Patricia Stelmachowicz, Brenda Hoover, Ruth Bentler, Tracy Schooling, Tobi Frymark, and Rob Mullen. No author had any paid consultancy or any other conflict of interest with this document, and each author agreed to declare no competing interests.

Sidebar

This systematic review was conducted under the auspices of the American Speech-Language-Hearing Association; however, this is not an official position statement of the Association.

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*References marked with an asterisk indicate studies included in the EBSR.

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Editor and Associate Editor: Larry Humes
Received March 13, 2012

Revision received July 2, 2012
Accepted July 8, 2012
DOI: 10.1044/1059-0889(2012/12-0015)

The Effects of Aging on Auditory Processing and Cognition

Author: Tun, Patricia A; Williams, Victoria A; Small, Brent J; Hafter, Ervin R.

Publication info: American Journal of Audiology (Online) 21.2 (Dec 2012): 344-50.
ProQuest document link

Abstract: To briefly summarize existing data on effects of aging on auditory processing and cognition. A narrative review summarized previously reported data on age-related changes in auditory processing and in cognitive processes with a focus on spoken language comprehension and memory. In addition, recent data on effects of lifestyle engagement on cognitive processes are reviewed. There is substantial evidence for age-related declines in both auditory processes and cognitive abilities. Accumulating evidence supports the idea that the perceptual burden associated with hearing loss impacts the processing resources available for good comprehension and memory for spoken language, particularly in older adults with limited resources. However, many language abilities are well preserved in old age, and there is considerable variability among individuals in cognitive performance across the life span. The authors discuss how lifestyle factors and socioemotional engagement can help to offset declining abilities. It is clear that spoken language processing in adulthood and old age is affected by changes in perceptual, cognitive, and socioemotional processes as well as by interactions among these changes. Recommendations for further research include studying speech comprehension in complex conditions, including meaningful-connection spoken language, and tailoring clinical interventions based on patients' auditory processing and cognitive abilities along with their individual socioemotional demands.

Full text: Headnote

Purpose: To briefly summarize existing data on effects of aging on auditory processing and cognition.
Method: A narative review summarized previously reported data on age-related changes in auditory processing and in cognitive processes with a focus on spoken language comprehension and memory. In addition, recent data on effects of lifestyle engagement on cognitive processes are reviewed.
Results: There is substantial evidence for age-related declines in both auditory processes and cognitive abilities. Accumulating evidence supports the idea that the perceptual burden associated with hearing loss impacts the processing resources available for good comprehension and memory for spoken language, particularly in older adults with limited resources. However, many language abilities are well preserved in old age, and there is considerable variability among individuals in cognitive performance across the life span. The authors discuss how lifestyle factors and socioemotional engagement can help to offset declining abilities.
Conclusions: It is clear that spoken language processing in adulthood and old age is affected by changes in perceptual, cognitive, and socioemotional processes as well as by interactions among these changes. Recommendations for further research include studying speech comprehension in complex conditions, including meaningful-connection spoken language, and tailoring clinical interventions based on patients' auditory processing and cognitive abilities along with their individual socioemotional demands.
Key Words: aging, cognition, speech

As most older adults know all too well, aging is associated with changes and challenges in many areas. Research has provided ample evidence for age-related changes in sensory abilities (Gordon-Salant, Frisina,

Popper, &Fay, 2010), cognitive abilities (Craik &Salthouse, 2007), and socioemotional processes (Urry &Gross, 2010), yet much remains to be understood about how these myriad changes interact in the individual.We will discuss briefly each of these areas in turn and provide recommendations for directions of future research and clinical implementation.

Age-Related Changes in Auditory Processing

As adults age, changes occur that can influence auditory processing. Age-related changes within the auditory system from both animal and human studies have been well documented and show degradations in anatomic, physiologic, and audiologic structures and functions (e.g., Chisolm, Willott, &Lister, 2003; Frisina &Walton, 2001; Schneider, 1997; Stach, Hornsby, Rosenfeld, &DeChicchis, 2009; Willott, 2001). Starting with the most peripheral anatomic structures, there are minimal age-related changes in the outer and middle ear, such as loss of stiffness in the cartilaginous portion of the external auditory meatus and increased prevalence of arthritis of middle ear joints (Schneider, 1997; Weinstein, 2000). Age-related changes in the outer or middle ear structures do not produce significant hearing deficits in older individuals; however, changes in the inner ear and neural pathways are known to have dramatic effects on auditory processing (Chisolm et al., 2003; Schneider, 1997; Schneider &Pichora-Fuller, 2000).Within the cochlea, a loss of outer and inner hair cells and ganglion cells is observed. There are also overall blood supply changes that can reduce audiologic functionality by affecting the three arteries that innervate the auditory system, along with a decrease in vascularization in the layers of the stria vascularis. This decrease in vascularization causes degenerative changes by limiting blood flow and possibly affecting metabolic processes that maintain the various cochlear potentials (Schneider, 1997; Schuknecht, 1993). Evidence of age-related changes is noted beyond the cochlea, throughout the brainstem and into the auditory cortex. A loss of neural synchrony is considered another influential change that occurs as age affects auditory processing (Schneider &Pichora-Fuller, 2000). Depending on stimulus parameters, such as frequency, intensity, or spatial location, auditory neurons are either excited or inhibited. Older adults show a lack of inhibition (Tremblay, Piskosz, &Souza, 2003; Willot, 1996) and decrease in excitatory synchronization (Anderson &Kraus, 2010; Schneider &Pichora-Fuller, 2000), resulting in the degradation of neural coding throughout the central auditory nervous system (e.g., Frisina, 2001; Lister, Maxfield, Pitt, &Gonzalez, 2011; Tremblay et al., 2003).

In summary, there are progressive degenerations of sensory, strial, neural, and supportive cells within the cochlea and a reduction of neural inhibition and synchrony abilities as a result of aging that lead to deficits in functionality. Loss of pure-tone sensitivity with age is one of the most extensively documented age-related decreases in functionality. Many have described the typical hearing loss configurations of the aging adult (e.g., Chisolm et al., 2003; Schuknecht &Gacek, 1993; Willott, 1991), where the higher frequencies are more affected and continue to decline with increased age. Although pure-tone detection quantifies the audibility component of hearing loss, and audibility is a major predictor of auditory processing difficulties (Houtgast &Festen, 2008; Humes, 1996; Sommers &Humes, 1993), there are, however, physiological, histological, and psychoacoustic studies that have shown a weak relationship between real-life auditory processing and pure-tone sensitivity (Houtgast &Festen, 2008; Killion, 2002; Plomp, 1978; Schneider, 1997; Wilson &McArdle, 2008).

Under the umbrella of perceptional processing and in addition to declines in pure-tone sensitivity, other factors that are thought to influence auditory processing difficulties and also are known to decline with age include frequency and intensity discrimination, temporal resolution, and binaural processing. Impaired frequency discrimination has been observed by the broadening of auditory filters (Glasberg, Moore, Patterson, &Nimmo-Smith, 1984; Patterson, Nimmo-Smith, Weber, &Milroy, 1982; Sommers &Humes, 1993) and an increase in frequency difference limens (Abel, Krever, &Alberti, 1990; Konig, 1957; Moore &Peters, 1992) that lead to decreased frequency selectivity. Indeed, the ability of the auditory system to differentiate the spectral components of a complex sound into its component frequencies is reduced for older listeners. Additionally, older individuals with hearing loss exhibit impaired intensity discrimination, resulting in poor intensity resolution and

increased intensity difference limens (Schneider &Pichora-Fuller, 2000). Similarly, impaired temporal resolution has been demonstrated by elevated gap detection, gap discrimination, and duration discrimination thresholds in older listeners independent of hearing loss (e.g., Fitzgibbons &Gordon-Salant, 1994; Moore &Peters, 1992). Decreased temporal resolution may also influence the observed reduction in binaural processing in older adults. Here, older adults show impaired binaural release from masking, where interaural time and level differences are used to locate and separate the signals (Koehnke &Besing, 2001; Pichora-Fuller &Schneider, 1998).

Because of these perceptual declines, older adults have greater difficulty localizing sound sources and discriminating spectral and temporal transitions in a signal. Such declines in peripheral auditory processing significantly impact the ability to understand speech in difficult listening environments (Baer &Moore, 1993; Helfer, 1991; Koehnke &Besing, 2001; Patterson et al., 1982; Schneider, 1997). With these difficulties, older listeners struggle with processing complex signals, such as rapid speech presented in background noise and reverberation (Bergman et al., 1976; Helfer, 1991). Indeed, the most common complaint of older listeners is difficulty understanding speech, particularly in less than optimal listening situations. Older listeners, independent of hearing loss and with similar thresholds, vary in their ability to understand speech in the presence of noise; therefore, a more advantageous signal-to-noise ratio is needed to reach a given level of performance (Helfer, 1991; Helfer &Freyman, 2008; Killion, 2002; Wilson &McArdle, 2008). Adverse listening conditions that add perceptual difficulty and reduce performance in these situations have been demonstrated experimentally with time-compressed speech (e.g., Tun, 1998; Wilson, Preece, Salomon, Sperry, &Bornstein, 1994), speech embedded in background noise (e.g., Helfer &Freyman, 2008; Pichora-Fuller, Schneider, &Daneman, 1995), and reverberated speech (e.g., Moncur &Dirks, 1967; Wilson et al., 1994). Older listeners' performance in these adverse listening conditions shows large individual differences that cannot be fully explained by perceptual deficits.

Although the perceptual predictor variables, such as the above-described declines in perceptual processing (i.e., audibility, temporal and intensity discrimination, frequency resolution, and binaural processing), are the major predictor of performance by older listeners (Houtgast &Festen, 2008; Humes, 1996), there are still undefined secondary influences. Emerging evidence shows that the perceptual and cognitive systems form a highly integrated information-processing system (Arlinger, Lunner, Lyxell, &Pichora-Fuller, 2009; Lin, 2011; Lindenberger &Baltes, 1994; Pichora-Fuller, 2007; Schneider &Pichora-Fuller, 2000), and the remaining variance not explained by the age-related changes in the perceptual domain provides support that cognitive factors are also influencing older adults' auditory processing abilities (Akeroyd, 2008; Arlinger et al., 2009; Houtgast &Festen, 2008; Humes, 2005; Rabbit, 1991; Schneider &Pichora-Fuller, 2000). We now turn to age-related changes in cognitive processes that may impact auditory processing.

Age-Related Changes in Cognitive Processes

Although there is substantial variation across individuals, aging is commonly associated with declines in cognitiveprocessing resources in the areas of attention (McDowd &Shaw, 2000), working memory, and executive function (Baddeley, 2002; Verhaeghen &Cerella, 2002; West, 1996), as well as with a general decline in mental processing speed (Salthouse, 1996). All of these abilities play a critical role in speech processing, and so we might expect age-related declines to interact with the changes in auditory processing described above in a way that affects the older listener's ability to comprehend and remember spoken language (Benichov, Cox, Tun, &Wingfield, 2011). Speech places a substantial burden on attention and working memory processes. Unlike written text, speech processing is carried out online in real time, with words coming in at a rapid rate of 120 to 180 words per minute, without opportunity for the listener to go back and review previous material. To comprehend speech, the listener must attend to the incoming speech signal in order to recognize phonemes and access lexical items, as well as carry out syntactic and semantic operations while holding previous information in memory. Ultimately, new information must be integrated with knowledge in long-term memory to create a coherent representation of the spoken message. Considering the complexity of this task, the level of

success that older adults achieve in everyday speech comprehension is impressive in light of a large body of research demonstrating age-related declines in attentional capacity and working memory or the ability to simultaneously hold information in a buffer while performing manipulations on it (Baddeley, 2002; Engle, 2002). In addition, declines in general cognitive processing speed have been considered virtually a hallmark of the aging process, beginning in young adulthood and continuing in a fairly linear fashion across the life span (Salthouse, 1996). Finally, to add to the complexity of processing speech in everyday environments, the older listener often must cope with background noise and distraction, or dividing attention between listening and other activities. There is evidence that these conditions may be especially challenging for the older listener, because of changes in the executive functions, such as dividing attention, switching attention, and inhibiting distraction (Baddeley, 2002; Hasher &Zacks, 1988; Logie, 2011; Miyake et al., 2000; Tun &Lachman, 2010). Neuroimaging research has confirmed age differences in brain activity during such activities, particularly in areas of prefrontal cortex (DiGirolamo et al., 2001), as well as hearing-related differences in patterns of brain activation (Peelle, Troiani, Wingfield, &Grossman, 2010). The precise links with behavior remain to be determined, but such structural and functional changes provide a mechanism for linking sensory and cognitive changes with age.

On the positive side, there is at the same time encouraging evidence from neuroscience for plasticity of the brain well into old age (e.g., Kramer &Erickson, 2007). Also, language skills such as vocabulary and speech comprehension are among those abilities that tend to be well preserved in old age (Tun, Benichov, &Wingfield, 2010). Thus, an important challenge for current researchers is to combine findings from research in audiology, cognitive aging, and cognitive neuroscience to better understand how these cognitive changes impact older listeners. Ultimately, the goal is to learn how to build on older adults' preserved abilities in order to optimize communication in their everyday listening environments.

To meet these challenges, researchers will need to move beyond the typical measures that have represented the gold standard for assessing abilities: for example, we will need to go beyond simply measuring accuracy of word recognition in order to examine comprehension of meaningful spoken language. This includes examining sentences and more extended discourse presented in the sort of "open-set" conditions that reflect listening in daily life. Tests of sentence or passage processing can provide qualitative information about how well younger and older listeners process information at different levels ranging from detail to gist. Also, measuring free recall (Tun, 1998; Tun &Wingfield, 1994) may provide a more sensitive index of differences in performance than comprehension questions (Schneider, Daneman, Murphy, &Kwong See, 2000). Including measures other than accuracy, which provides a dichotomized "success-failure" view of spoken language processing, will increase the sensitivity to detect nuances and qualitative changes in strategies and patterns of processing (cf. Stine-Morrow, Miller, Gagne, &Hertzog, 2008). For example, use of an auditory moving window technique that allows listeners to self-pace across the course of a sentence has revealed age differences in the pattern of how listeners allot processing time to different linguistic elements (Titone, Prentice, &Wingfield, 2000). Response latencies can be especially useful, as speed of processing is a critical dimension in speech understanding (Tun, 1998; Tun, Wingfield, Rosen, &Blanchard, 1998). This is especially true in the case of older listeners with slower central processing speeds, who may experience particular difficulties when speech rates are rapid (Gordon-Salant &Fitzgibbons, 1995; Wingfield, McCoy, Peelle, Tun, &Cox, 2006; Wingfield, Tun, &Rosen, 1995). Because the listener has little control over the rate of incoming speech information, it is important that he or she does not fall behind in comprehension, compounding difficulties with storing and retrieving information. Unfortunately, studies have shown that when speech is syntactically complex, older hearingimpaired adults may have particular difficulty maintaining comprehension speed, as reflected in latencies (Tun, Benichov, &Wingfield, 2010) as well as accuracy (Wingfield et al., 2006).

A critical issue for future work is the question of listening effort, as fatigue is a common complaint among those with hearing loss. Self-ratings can provide one index of perceived effort (Larsby, Hallgren, Lyxell, &Arlinger, 2005). However, there is increasing recognition that the increased perceptual effort associated with hearing loss

can have important consequences downstream on comprehension and memory processes, even when speech is intelligible (Heinrich, Schneider, &Craik, 2008; McCoy et al, 2005; Pichora-Fuller et al., 1995; Rabbitt, 1968; Wingfield, Tun, &McCoy, 2005). This may be compounded by background noise, which presents a special challenge to those with hearing loss (Gordon-Salant &Fitzgibbons, 1995; Schneider, Pichora-Fuller, &Daneman, 2010) as well as for older listeners, who may have particular difficulty inhibiting meaningful competing speech (Larsby et al., 2005; Tun,O'Kane,&Wingfield, 2002; Tun&Wingfield, 1999).

Finally, the field is becoming increasingly aware of people's need to listen while carrying out other activities in daily life, so an important consideration is how greater perceptual effort may impact other tasks. Recent studies have shown how hearing loss may be accompanied by larger costs in secondary task performance (Tun, McCoy, &Wingfield, 2009) and how signal processing in a hearing aid might affect performance on a secondary task (Sarampalis, Kalluri, Edwards, &Hafter, 2009). The latter study addressed a long and checkered history of active noise reduction (NR) in hearing aids, where there is little evidence of improved speech reception despite positive reports from listeners. Sarampalis et al. suggested that redundancy between NR and internal neural processes could produce both of those effects, with the idea being that by doing for a listener what he or she normally does for him or herself, the NR could free up cognitive effort for application to secondary tasks.

Lifestyle Engagement and Hearing-Related Cognitive Impairment

Although the results described above generally point to decrements in cognitive performance among older adults with hearing loss, it is important to note that much of this work has primarily examined group means, or average performance across cross-sectional samples. Increasingly, however, there is an awareness that "one size does not fit all" in many areas and certainly not in the area of spoken language processing in older adults. Although the declines cited previously have been found for groups, there is very large variability between individuals, as well as among different types of ability within a given individual (e.g., preservation of vocabulary and verbal abilities in spite of declines in episodic memory). This presents a challenge to researchers in characterizing a typical trajectory of performance, but it also allows great latitude in how individuals can compensate for declines in one area by optimizing strengths in another (Baltes, 1997). There are also a number of lifestyle and behavioral factors that may serve to offset age-related declines in cognitive abilities. These include education (e.g., Tun &Lachman, 2008; but see Zahodne et al., 2011), which may provide a cognitive reserve (Stern, 2009; Stern et al., 2005); physical exercise (Kramer &Erickson, 2007); and cognitively challenging activities (Hertzog, Kramer, Wilson, &Lindenberger, 2008; Schooler, 2007; Tun &Lachman, 2010). In this next section, we will consider in more detail the role of social engagement in the cognitive health of older adults. This influence is particularly relevant for older adults with hearing loss, who may be especially challenged in social situations as hearing loss compounds social isolation with age (Jerger, Chmiel, Wilson, &Luchi, 1995).

Several studies have suggested that older adults who are socially engaged exhibit superior cognitive performance (Bassuk, Glass, &Berkman, 1999; Hughes, Andel, Small, Borenstein, &Mortimer, 2008; Seeman et al., 2010) and are at a reduced risk of dementia (Fratiglioni, Paillard-Borg, &Winblad, 2004), as compared with their less engaged counterparts. For example, Hughes and colleagues (2008) found that satisfaction with social support and social network was consistently related to change in cognitive performance. Persons who indicated greater satisfaction with support had better overall cognitive functioning as well as fewer longitudinal declines in memory performance. However, one of the challenges of this area of research is the issue of determining whether declines in social activities precede declines in cognitive performance or whether persons who are declining cognitively relinquish social activities. Recently, Small and colleagues (Small, Dixon, McArdle, &Grimm, 2012) examined this issue by using latent-change-score models (McArdle, 2009). These allow comparisons between models that correspond to changes in social activities preceding changes in cognitive performance and the reverse. Unlike some other studies that have used these models (e.g., Lövdén, Ghisletta, &Lindenberger, 2005), the results indicated that changes in cognitive performance largely preceded changes in

social activities, such that persons who were declining on measures of verbal speed and memory were more likely to give up social activities.

Thus, hearing loss has the potential to negatively influence an older adult's cognitive performance both directly and indirectly. The evidence from experimental manipulations indicates that degrading speech can lead to poorer cognitive performance (e.g., Wingfield et al., 2005; Wingfield &Tun, 2007). Moreover, the negative impact can also be observed indirectly, through changes in the types of stimulating activities in which older adults participate and lower quality of life (Carabellese et al., 1993; Meadow-Orlans, 1985). As a result, the level of social complexity or engagement that has been associated with better cognitive performance may be reduced for older adults with hearing difficulties. In turn, these more impoverished environments may be associated with declines in cognitive functioning. Additional research that couples changes in auditory processing, environmental engagement, and cognitive functioning is necessary to tease out these associations.

Summary

In this brief review, we have summarized some of the perceptual, cognitive, and socioemotional changes associated with the aging process. Fortunately, there is increasing recognition of the opportunities afforded by compensating for age-related declines with lifestyle and activity changes, even in old age. An important challenge for researchers is to bridge the gaps that currently exist between audiology and cognitive science in order to optimize spoken communication in our rapidly aging population.

Recommendations

On the basis of the findings summarized here, we would make the following recommendations for researchers and clinicians:

1. Cognitive abilities, such as working memory, speed of processing, and executive function, should be considered, as well as sensory abilities that impact speech processing.
2. Data from large numbers of adults across the adult life span should be collected by using both cross-sectional and longitudinal research designs.
3. Among the same subjects, simple and complex stimuli should be used to obtain behavioral and nonbehavioral measures (e.g., electrophysiological, neuroimaging), to holistically evaluate the complexity of aging on speech processing.
4. Through the use of self-reported measures, factors such as listening effort, quality of life, and perceived handicap should be obtained.
5. As life is lived in complex and demanding environments, research studies need to extend testing conditions to include distraction by different kinds of noise and competing speech and to simulate situations in which there is a need to divide attention and carry out other concurrent secondary tasks.
6. Measures of speech processing should be extended beyond word recognition to include sentences and meaningful discourse, including open-set materials typically found in everyday listening. Also include measures of comprehension and memory and measures of processing speed (e.g., reaction times, latencies). All of these will improve the ecological validity of the data collected.
7. Individual differences in preserved abilities that can be used to compensate for declines (cognitive, social, personality or motivational, and so forth) should be built on.
8. Clinical interventions need to be tailored on the basis of patients' auditory processing and cognitive abilities along with their individual socioemotional demands. Such interventions might include specific parameters for assistive hearing technologies (e.g., NR in hearing aids), more intensive counseling, and auditory training or rehabilitation. The interventions would be designed to encourage maintenance of stimulating social interactions to offset any potential social isolation.

Acknowledgments

Research on cognitive aging cited includes, in part, work funded by the National Institute on Aging Grant 19714. The Rehabilitation Research and Development Service, Department of Veterans Affairs, supported the work by

Victoria A. Williams. The contents of this article do not represent the views of the Department of Veterans Affairs or the United States Government.

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Editor and Associate Editor: Larry Humes
Received June 4, 2012
Revision received August 14, 2012
Accepted August 19, 2012
DOI: 10.1044/1059-0889(2012/12-0030)

The Influence of Reduced Audible Bandwidth on Asynchronous Double-Vowel Identification

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.6 (Dec 2012): 1750-1764.
ProQuest document link

Abstract: In this study, the authors sought to determine whether reduced audible bandwidth associated with hearing loss contributes to difficulty benefiting from an onset asynchrony between sounds. Synthetic double-vowel identification was measured for normal-hearing listeners and listeners with hearing loss. One vowel (Target 2) was 250 ms in duration, and one (Target 1) varied in duration. The vowels had the same offset, and an onset asynchrony between the vowels ranged between 0 and 200 ms. Listeners identified both vowels in their perceived order. The scoring metrics used were as follows: Target 1 correctly identified in the correct position, Target 2 correctly identified in the correct position, ordered double-vowel identification, and unordered double-vowel identification. The same experiment was conducted with vowels low-pass filtered at 900 Hz simulating reduced audible bandwidth. For all scoring metrics, increases in onset asynchrony led to better vowel identification. Listeners with hearing loss benefited less from onset asynchrony than normal-hearing listeners only for Target 2 identification. Filtering the vowels reduced onset asynchrony benefit for all scoring categories and for both groups. Results implicate reduced audible bandwidth in difficulties of listeners when using onset asynchrony for sound segregation. Therefore, listeners with a reduced audible bandwidth may have communication difficulties in natural environments. [PUBLICATION ABSTRACT]

Full text: Headnote

Purpose: In this study, the authors sought to determine whether reduced audible bandwidth associated with hearing loss contributes to difficulty benefiting from an onset asynchrony between sounds.
Method: Synthetic double-vowel identification was measured for normal-hearing listeners and listeners with hearing loss. One vowel (Target 2) was 250 ms in duration, and one (Target 1) varied in duration. The vowels had the same offset, and an onset asynchrony between the vowels ranged between 0 and 200 ms. Listeners identified both vowels in their perceived order. The scoring metrics used were as follows: Target 1 correctly identified in the correct position, Target 2 correctly identified in the correct position, ordered double-vowel identification, and unordered double-vowel identification. The same experiment was conducted with vowels low-pass filtered at 900 Hz simulating reduced audible bandwidth.
Results: For all scoring metrics, increases in onset asynchrony led to better vowel identification. Listeners with hearing loss benefited less from onset asynchrony than normal-hearing listeners only for Target 2 identification. Filtering the vowels reduced onset asynchrony benefit for all scoring categories and for both groups.
Conclusion: Results implicate reduced audible bandwidth in difficulties of listeners when using onset asynchrony for sound segregation. Therefore, listeners with a reduced audible bandwidth may have communication difficulties in natural environments.
Key Words: onset asynchrony, double-vowel, hearing loss, audibility
The auditory system accomplishes sound segregation through a sophisticated process in which the components of the combined stimulus that impinge upon the ear are analyzed and either grouped as belonging to the same source or segregated as parts of different sources. Speech perception in noise is likely to involve auditory grouping processes because the ear might separate noise from speech based, in part, on their acoustic differences (cf.Bregman, 1990;Darwin&Carlyon, 1995).Doublevowel experiments have demonstrated that listeners with sensorineural hearing loss often experience difficulty with this process, showing deficits in the

ability to segregate sounds based on onset asynchrony (e.g., Lentz &Marsh, 2006) and deficits in the ability to distinguish sounds from within themixture (e.g., Arehart, King, &McLean-Mudgett, 1997; Arehart, Rossi-Katz, &Swensson-Prutsman, 2005). The influence of sensorineural hearing loss on onset asynchrony as a sound-segregation cue has received only limited attention, and it is unclear what auditory mechanisms are responsible for the decreased onset asynchrony benefit in listeners with hearing loss. The goal of this study was to establish whether one factor that is often associated with hearing loss, reduced audible bandwidth, leads to deficits in sound-segregation abilities.

Double-vowel identification is a popular method of studying the sound-segregation process in normal-hearing listeners and listeners with hearing loss (e.g., Arehart et al., 1997; Assmann&Summerfield, 1989; Summerfield &Culling, 1992;Summers&Leek, 1998).During a doublevowel experiment, two synthetic vowels are presented concurrently to a listener, and the listener identifies one or both vowels. By using this paradigm the experimenter can study sound segregation using stimuli modeled after speech sounds yet also independently vary a number of stimulus parameters for each vowel (such as the duration, formant frequencies, and fundamental frequency). In this way, double-vowel experiments allow investigation of sound segregation through the manipulation of specific acoustic parameters. Inferences about sound segregation can be made based on changes in performance associated with the acoustic manipulations.

A compelling cue to sound segregation, onset asynchrony, has been demonstrated to facilitate sound segregation using double-vowel experiments. In particular, onset differences between two vowels lead to better vowel identification than when the vowels have synchronous onsets. Summerfield and Culling (1992) showed that the masked detection threshold of a target vowel decreasedmorewhen a masker vowel had a temporally asynchronous onset than when it was simultaneous with the target. Using double-vowel stimuli, Lentz and Marsh (2006) demonstrated improvements in identifying a constituent vowel of a double-vowel stimulus when the vowels had simultaneous offsets but increasingly asynchronous onsets. Hedrick and Madix (2009) also demonstrated benefits due to onset asynchrony for double vowels and implicated vowel identity in the benefits received, with specific vowel pairs leading to greater benefits than others. To date, Lentz and Marsh (2006) provide the only double-vowel experiment that has evaluated the impact of hearing loss on benefits received from onset asynchrony.Their results illustrated that although listeners with hearing loss receive benefits from onset asynchrony, the benefits are diminished compared to normal-hearing listeners.

Few nonspeech psychophysical studies have evaluated the effect of hearing loss on the ability to take advantage of onset asynchrony. Lentz, Leek, and Molis (2004) tested spectral-shape discrimination (i.e., profile analysis) using asynchronous pure-tone stimuli, and Grose and Hall (1996) tested comodulation-masking release using asynchronous narrow bands of noise. Both studies demonstrated little influence of hearing loss on the pattern of thresholds as a function of the onset asynchrony between the various stimulus components. These experiments suggest that hearing loss does not impair the ability to group or segregate nonspeech sounds based on onset asynchrony, a result that is in direct contrast with the findings of Lentz and Marsh (2006), who used speechlike stimuli. One major difference across the experiments is that the stimulus components were fully audible (though presented at different sensation levels) to listeners in both groups in the experiments of Lentz et al. (2004) and Grose and Hall (1996). In contrast, some of the stimulus components would have been attenuated by the subjects' hearing loss in the double-vowel experiment of Lentz andMarsh (2006), and so the stimuli in that study had narrower internal bandwidths for the listeners with hearing loss than for the listeners with normal hearing. This leaves open the possibility that the ability to fully represent onset asynchrony could be affected by an inability to hear all stimulus components. Although Lentz and Marsh (2006) ruled out the contribution of audibility on their results using an excitation-pattern analysis, the role of reducing the number of stimulus components was not explicitly tested. Further evaluation is needed to establish whether the ability to benefit from onset asynchrony is altered by a reduced audible bandwidth.

Psychophysical literature suggests that reduced audible bandwidth may detrimentally impact the ability to

benefit from onset asynchrony. First, listeners with hearing loss have more difficulty detecting amplitude modulation imposed on broadband noise (e.g., Bacon &Viemeister, 1985; Takahashi &Bacon, 1992) and detecting gaps in broadband noise stimuli (e.g., Fitzgibbons &Gordon-Salant, 1987; Grose, Eddins, &Hall, 1989). Second, when broadband stimuli are filtered, poorer temporal acuity is measured. Bacon and Viemeister (1985) measured temporal modulation transfer functions (TMTFs) using low-pass filtered stimuli. The TMTFs for the normal-hearing listeners with low-pass filtering were similar to TMTFs measured in listeners with hearing loss. Eddins, Hall, and Grose (1992) also measured elevated gap detection thresholds for narrower-bandwidth stimuli, particularly in higher frequency regions. Together, these studies suggest that reducing audible bandwidth limits the temporal information available to listeners.

Because such strong bandwidth effects are reported for temporal processing tasks, one might expect to see deficits in the ability to use onset asynchrony in listeners with sloping hearing loss, due to the limited bandwidth associated with the filtering characteristics imposed by the hearing loss. Although it is anticipated that listeners with hearing loss will experience deficits in their ability to benefit from onset asynchrony (see Lentz &Marsh, 2006), it is not clear whether these deficits are related explicitly to a loss of audible components, which would most greatly impact listeners with sloping hearing losses. To establish whether loss of audible components contributes to difficulties taking advantage of onset asynchrony, the current experiment measures asynchronous doublevowel identification in normal-hearing listeners and listeners with hearing loss using low-pass filtered and unfiltered synthetic vowels.

Method

Participants

Seven normal-hearing listeners, ranging in age from 23 to 64 years with a mean age of 45.0 years, and seven listeners with hearing loss, ranging in age from 22 to 65 years with a mean age of 47.7 years, participated. Normalhearing listeners had pure tone audiometric thresholds no greater than 20 dB HL between 250 and 3000 Hz and no greater than 25 dB HL between 4000 and 8000 Hz. Listeners with hearing loss were selected to have mildto- moderately severe sloping hearing losses with a pure tone average at 1, 2, and 4 kHz of 35 dB HL or greater and no greater than 75 dBHLat 3000 Hz. Hearing losses were bilateral and symmetric, with the site of lesion presumed to be cochlear in origin based on air- and boneconduction thresholds. The right ears were tested for the listeners with normal hearing, whereas the better ear was tested for listeners with hearing loss. Audiometric thresholds for all test ears together with the participants' ages are reported in Table 1. Listener NH7 was the first author of this study. All procedures were approved by the Institutional Review Board at Indiana University.

Stimuli

Stimuli used were steady-state synthesized vowels modeled after the Standard English vowels /æ , i, e, 3, a/. Table 2 lists the formant frequencies for each vowel, which matched those described by Arehart et al. (1997). For reference, spectra of the individual vowel sounds are plotted in Figure 1.

Vowels were synthesized using an implementation of theKlatt synthesis software (Klatt, 1980) by H. Timothy Bunnell at a sampling rate of 16000 Hz and then resampled in MATLAB at 24414 Hz for playback. The vowels were synthesized at two different fundamental frequencies, 126 Hz and 141 Hz, and were generated to be 550 ms in duration. When isolated single vowels were presented, they were shortened to 250 ms in duration and included 10-ms rise/fall times. Vowels were calibrated so that their unfiltered rms power was equivalent to 90 dB SPL. Vowels then were presented to listeners either in their original state (unfiltered), or after low-pass filtering. For the filtered conditions, each vowel was low-pass filtered at 900 Hz, using a 12th order Butterworth filter having a slope of 72 dB per octave. The cutofffrequency was chosen to be 900 Hz so that each individual vowel did not have energy above the first formant (see Table 2), giving each vowel similar formant information regardless of whether it was presented to a listener with hearing loss or not. Although the filtering reduced the total power of the vowels, the spectrum level of components below 900 Hz remained unchanged.

Once the individual vowels were synthesized, double vowels were made by adding two vowels of the same fundamental frequency (126/126 Hz or 141/141 Hz) together.1 One of the vowels, Target 1, was 250, 275, 350, or 450 ms in duration. The second vowel, Target 2, was always 250 ms in duration. To make the double vowel, the 550-ms single vowels were shortened to the appropriate duration and gated using 10-ms raised cosine on and offramps. Target 1 and Target 2 were added together such that both vowels had synchronous offsets. In those cases when the duration of Target 1 was longer than that of Target 2, an onset asynchrony between the two vowels was produced (25, 100, or 200 ms). For example, Figure 2 shows a waveform schematic of a double-vowel pair with Target 1 at 450 ms and Target 2 at 250 ms (an onset asynchrony of 200 ms).

A high-pass masking noise was presented with all vowel stimuli so that listeners with normal hearing could not use information related to upward spread of excitation (see Bacon &Viemester, 1985).2 This Gaussian noise was generated with a cutofffrequency of 4800 Hz for the unfiltered conditions and 1080 Hz for the filtered conditions. The spectrum level of the noise was approximately 26 dB. This noise did not limit the ability to hear any of the formants in the double vowel; it simply limited the ability of normal-hearing listeners to use additional high-frequency spread of excitation in the task. The noise began at the beginning of each experimental session and played continuously throughout the entire session. However, each time the listener switched from unfiltered vowel identification to filtered vowel identification, the appropriate noise was used.

The vowels were digitally generated off-line and were summed with the digitally generated high-pass noise before being played through one channel of a 24-bit digitalto- analog converter, TDTSystemIIIRP2.1 (Tucker Davis Technologies,Alachua, FL), at a sampling period of 4.096 ×10-5 s (sampling rate is about 24414 Hz). The output of the RP2.1 was fed into a programmable attenuator (TDT PA5), which was adjusted to appropriately calibrate the stimuli, and then to a headphone buffer (TDT HB6). The outputwas then fed into one earphone of a Sennheiser HD 250 II Linear headset.

Procedure

The experiment consisted of two separate phases: double-vowel and single-vowel identification. Although double-vowel identification provides the basis for establishing the benefits of onset asynchrony, single-vowel identification was measured for two reasons. First, singlevowel identification provided a familiarization phase to all listeners and allowed a determination of whether all vowelswere identifiable under unmasked, unfiltered conditions. Second, possible training effects that may have occurred throughout the duration of the experiment were assessed using single vowels.

Double-vowel identification. During the doublevowel phase of the experiment, 25 pairs of vowels were presented. Each vowel was paired with each other vowel once as Target 1 and once as Target 2, and each vowel also was paired with itself (5 vowels ×5 vowels = 25 vowel pairs). The order in which the vowel pairs were presented was randomly selected, with each possible pair heard only once in the 25-vowel sequence.

Double-vowel data were collected using a randomized blocked design in which the 25 vowel pairs were presented for a given filter cutofffrequency (900 Hz or unfiltered), fundamental frequency (126/126 Hz or 141/ 141 Hz), and onset asynchrony (0, 25, 100, or 200 ms). The filter cutofffrequency was first selected at random, and then the eight different experimental conditions were tested within each cutofffrequency with these eight different conditions referred to as a block. Within a block, the fundamental frequencywas chosen randomly, and then each onset asynchrony was tested in random order within a fundamental frequency. Data were collected by alternating between a block of unfiltered vowels and a block of filtered vowels, so that data were collected for a total of 16 conditions (2 filter conditions ×2 fundamental frequencies ×4 onset asynchronies). Listeners were tested on each of the 16 conditions a total of eight times. Within each condition, percent-correct scores were calculated based on 25 vowel pairs. The first three sets of 25 double vowels were treated as training (i.e., 6 blocks: 3 unfiltered and 3 filtered blocks), and the last five scores were averaged together and used as a final percent-correct estimate (125 trials per condition).

Listeners were seated in a sound-attenuating room during the experimental sessions. They were asked to

identify the two vowels in the order in which they occurred (unless the onset asynchrony was 0 ms and then no order judgment was possible). At the beginning of each set of 25 double vowels, subjects were given the opportunity (but were not required) to listen to the 250-ms single vowels for practice. On each trial, two sets of possibleword identifiers (top rowforTarget 1 and lower rowfor Target 2) were presented as button labels on the monitor in front of the subject. The identifiers (had, heed, head, herd, and hod) were used to represent the phonetic symbols (/æ , i, e, 3, a/). Following presentation of the stimulus, subjects used a mouse click to choose the buttons corresponding to the two vowels that were presented. Subjects were allowed to modify their initial responses and then were required to click a "confirm" button before continuing to the next trial. Each rowcontained all of the possible five identifiers; using two separate sets of identifiers for the first and second vowel encouraged independent judgments of the two vowels. No feedback was provided during the double-vowel presentations.

Because scores were obtained for identifying two asynchronous vowels, multiple different scoring scenarios were available. As such, percent-correct scores were obtained for the following vowel identification measurement scenarios: Target 1 identification (first vowel identified in the first position), Target 2 identification (second vowel identified in the second position), ordered double-vowel identification (Targets 1 and 2 identified in the appropriate positions), and unordered double-vowel identification (Targets 1 and 2 identified irrespective of position). For reference, Target 2 identification is the measurement that replicates the scoring convention of Lentz and Marsh (2006). Percent-correct scores are expressed in terms of rationalized arcsine units (RAU) to stabilize the error variance (Studebaker, 1985).

Single-vowel identification. During the training phase of the experiment (the first three replicates of double vowels) and at least five times throughout the experimental sessions, performance on single vowels was evaluated to ensure that subjects remained familiar with the vowel identities and that they maintained stable performance throughout the experiment.During the training sessions, unfiltered single-vowel identification was assessed prior to and after each block of unfiltered vowels. Filtered single-vowel identification was also assessed prior to and after each block of filtered vowels. In this way, listeners received training on the single vowels twice for each fundamental frequency for each training block. By the completion of the training phase subjects were required to achieve at least 88% on the unfiltered single vowels to continue participating in the study.One listenerwith hearing loss did not meet this criterion and so was excluded from further testing. Once the training sessions were completed, single-vowel identification was assessed only periodically (about four times throughout the experiment) to ensure stable performance.

Single vowels were tested by presenting each of the five vowel tokens a total of five times (25 vowels in isolation). Responses were collected in the samemanner as for the double-vowel paradigm, with the monitor screen presenting the responses in the context of key words (had, heed, head, herd, and hod) on the screen. However, rather than requiring two responses from the subject, only one response was required. Unfiltered single vowels were always tested following blocks of unfiltered double vowels, and filtered single vowels were always tested following blocks of filtered double vowels. For these single vowel conditions, listeners received feedback regarding the identity of the single vowel. Both groups of listeners had similar scores on the single vowels, but listeners with normal hearing did performslightly better. On average, listeners with normal hearing and hearing loss scored 110 RAU (98% correct) and 98 RAU (93% correct), respectively, on the unfiltered single vowels. Filtering decreased performance: Normal-hearing listeners achieved scores of 66 RAU (65% correct), whereas listeners with hearing loss scored 65 RAU (64% correct). Despite the severe form of filtering applied, listeners still achieved scores that were well above chance (20 RAU). A one-way t test for each listener was conducted on the final four percent-correct scores obtained during the initial training period and the final four percent-correct scores collected during the experimental sessions. These tests showed no significant improvement in unfiltered single-vowel identification.

Results

Figure 3 plots scores inRAUas a function of onset asynchrony collapsed across fundamental frequency for each vowelmeasurement scenario for normal-hearing listeners (filled symbols) and listeners with hearing loss (unfilled symbols). Data obtained from filtered and unfiltered conditions are also plotted as black circles and gray triangles, respectively. For reference, chance performance corresponds to 20 RAU (20% correct) for Target 1 and Target 2 identification, -4 RAU (4% correct) for ordered double-vowel identification, and 2 RAU (7% correct) for unordered double-identification. Average scores were at least 10 RAU above chance for all conditions tested, with scores increasing as onset asynchrony increased for both groups of listeners. This result demonstrates that onset asynchrony is an effective way of improving performance on a double-vowel task. In general, listeners with hearing loss have poorer scores than normal-hearing listeners when the vowels are unfiltered, but data of both groups tend to overlap in the filtered conditions. The patterns of benefit differ somewhat across the different vowel measurement scenarios and will be discussed in more detail below. For each of the four measurement scenarios, statistical effects were assessed using separate repeatedmeasures analyses of variance (ANOVAs), in which group membership was a between-subject factor and onset asynchrony (0 ms when tested, 25, 100, and 200 ms) and filtering (unfiltered or low-pass filtered) were treated as within-subject factors. These statistics were conducted by collapsing across fundamental frequency, which had only a small effect on scores (< 2 RAU).3 The statistical results are reported in Table 3. The statistical results that are consistent across all vowel measurement scenarios are discussed first, and the differences across the measurement scenarios are discussed in turn.

Across all vowel measurement scenarios, theANOVAs reveal that filtering and onset asynchrony are significant main effects. The main effect of onset asynchrony indicates that onset asynchrony leads to improvement in performance in double-vowel identification, as observed in Figure 3. The main effect of filtering is due to lower scores in the filtered conditions compared to the unfiltered conditions.Not surprisingly, filtering the vowels so that only F1 information is present leads to poorer performance.

Two of the three two-way interactions are also significant across all scenarios. The Filtering ×Group interaction reflects a greater effect of filtering on performance for the normal-hearing listeners than for the listeners with hearing loss. Looking back to Figure 3, one can see that the normal-hearing listeners outperformthe listeners with hearing loss when the vowels are unfiltered, but performance is similar for the twogroups in the filtered conditions. The filtering effectively removes the differences in performance that are typically observed between normal-hearing listeners and listeners with hearing loss.

The Filtering ×Asynchrony interaction indicates that the effect of onset asynchrony is greater for the unfiltered stimuli than for the filtered stimuli. This interaction is illustrated in Figure 4, with benefit (score in RAUat 25 ms subtracted from the score in RAU at 200 ms) collapsed across groups plotted versus vowel measurement scenario for the filtered and unfiltered conditions. As Figure 4 shows, filtering the double-vowel stimuli led to an overall reduced benefit received from onset asynchrony in all measurement scenarios (dark gray vs. light gray bars). Both groups of listeners received benefit fromonset asynchrony for both filtered and unfiltered vowels, although the benefits received for filtered vowels were smaller. Prior to filtering, normal-hearing listeners had an average benefit from onset asynchrony collapsed across all measurement scenarios of 26 RAU, and listeners with hearing loss had an average benefit of 23 RAU. After filtering, both normal-hearing listeners and listeners with hearing loss received smaller benefits, an average of 9 and 11 RAU, respectively. Consequently, we can conclude that a limited audible bandwidth can be expected to detrimentally impact sound segregation based on onset asynchrony.

Many of the significant factors involving group membership were significant for some but not all measurement scenarios. First, the main effect of group was significant for only two of the vowel measurement scenarios (ordered and unordered double-vowel identification). By examining Figure 3, we can see that there are differences in performance between groups for the unfiltered conditions (circles) but not the filtered conditions (triangles). The difference between the groups for the unfiltered conditions tended to be largest in ordered and

unordered double-vowel identification. The differences between the groups in the unfiltered conditions were too small in Target 1 and Target 2 identification to yield statistically significant effects.

Second, an interaction between onset asynchrony and group is revealed for unordered vowel identification. These measurement-specific benefits are illustrated in Figure 5,which plots the benefits due to onset asynchrony (200 ms scores - 25 ms scores) collapsed across filter conditions for each group of listeners. Figure 5 shows that for Target 1 identification and ordered double-vowel identification, the observed benefits are similar between normalhearing listeners and listeners with hearing loss. However, unordered vowel identification has a different magnitude of benefits for the two groups of listeners: 15 RAU for listeners with hearing loss versus only 8 RAU for normalhearing listeners.Here, listeners with hearing loss receive more benefit from onset asynchrony than the normalhearing listeners. Interestingly, this is the only measurement scenario in which some listeners with hearing loss approached chance performance for the filtered conditions (although average scores were about 14 RAUpoints above the floor of 2 RAU). Scores for HI1 and HI3 at the 0-ms onset asynchrony and under filtered conditions were 8 and 5 RAU points above the floor, respectively, but all other listeners had scores at least 12 RAU points above the floor. Even if floor effects were present at the 0-ms onset asynchrony, the interpretation would be that the onset asynchrony benefit is underestimated for the listeners with hearing loss, and in these conditions listeners with hearing loss had greater benefit than normalhearing listeners.

On the other hand, ceiling effects may have contributed to a reduced benefit from onset asynchrony for the normal-hearing listeners in ordered double-vowel identification. Figure 3 indicates that normal-hearing listeners had identification scores much higher than those of the listeners with hearing loss. The presence of Target 1 presented simultaneously with Target 2 could limit maximal performance, and it seems likely that listeners would not be able to achieve the same scores as in quiet, particularly so because the vowels have the same fundamental frequencies.

A decrease in benefit received by listeners with hearing loss for Target 2 identification is revealed in the three-way interaction involving group, filtering, and onset asynchrony. The three-way interaction reflects a result that listeners with hearing loss receive less benefit from onset asynchrony than normal-hearing listeners in the unfiltered conditions but not in the filtered conditions. This interaction is illustrated in Figure 6, which plots the benefits received by both groups of listeners in Target 2 identification. This pattern in unfiltered vowel identification replicates the results of Lentz andMarsh (2006),who only measured unfiltered vowel identification (for Target 2). Their results indicated a reduced benefit of onset asynchrony for listeners with hearing loss. However, it is notable that this effect of group is not evident in any of the other vowel measurement scenarios.

Generally, introducing an onset asynchrony between the two vowels leads to better vowel identification for both groups of listeners, but benefits also differ depending on the vowel measurement scenario. Figures 3-5 demonstrate that Target 1 identification is associated with the largest benefits due to onset asynchrony, whereas benefit for Target 2 identification and unordered double-vowel identification tend to be lower than in the other two vowel measurement scenarios. Large benefits for Target 1 identification are likely due to temporal unmasking effects, as increases in onset asynchrony lead to a portion of the vowel that does not overlap with a competing stimulus, making it much easier to identify than a vowel that is always presented simultaneously with a competing sound (e.g., Target 2). The smaller benefits for Target 2 identification probably occur because increases in onset asynchrony do not lead to an unmasking of Target 2-it is always presented under competition. Different amounts of benefit for unordered double vowel identification are likely to be related to different factors than for Target 2, possibly ceiling effects for unfiltered double-vowel identification. In general, however, onset asynchrony leads to an improvement in vowel identification scores for doublevowel stimuli. The amount of improvement depends on hearing status and vowel measurement scenario and is likely due to both masking and audibility.

Taken together, the effects of onset asynchrony can be summarized as follows:

1. Benefits due to onset asynchrony were observed for both groups of listeners and were present for both filtered and unfiltered vowels.
2. Filtering reduced the benefits due to onset asynchrony for both groups of listeners.
3. Listeners with hearing loss received similar benefits to normal-hearing listeners in Target 1 and ordered vowel identification. For unordered double-vowel identification, listeners with hearing loss received greater benefit from onset asynchrony. For Target 2 identification, the listeners with hearing loss experienced less benefit due to onset asynchrony in the unfiltered conditions but similar benefits to normalhearing listeners in the filtered conditions.
4. Benefits from onset asynchrony were greatest for Target 1 identification and smallest for bothTarget 2 identification and unordered double vowel identification.

Discussion

Benefit From Onset Asynchrony: Role of Bandwidth

For filtered and unfiltered vowels, the presence of an onset asynchrony leads to increases in performance for both groups of listeners. Filtering the vowels reduces the received benefit, which suggests that the ability to hear all stimulus components influences the ability to take advantage of onset asynchrony. However, filtering reduced the benefit in all vowel measurement scenarios, whereas listeners with hearing loss exhibited a reduced ability to take advantage of onset asynchrony only in Target 2 identification. As such, reduced audible bandwidth might play a role in reduced benefit from onset asynchrony, particularly for listeners with severe hearing loss, but other factors related to hearing loss also influence the pattern of data seen in the listeners tested here.

All vowel measurement scenarios exhibited large reductions in onset-asynchrony benefit with the size of the reduction varying across scenarios-ranging from 20 RAU for Target 1 identification and 7 RAU for Target 2 identification. The patterns of benefit across measurement scenarios for each specific vowel are generally similar to the patterns observed for the unfiltered vowels: Target 1 identification and ordered double-vowel identification scoring methods led to the greatest benefit due to onset asynchrony (see Figures 4 and 5). Because the filtered and unfiltered conditions reflect similar patterns of benefit across the different vowel measurement scenarios, the processes that underlie benefits due to onset asynchronymay be the samefor filtered and unfiltered vowels. The reduced benefits for the filtered vowels, however, imply that listeners must hear all stimulus components to receive the greatest benefit due to onset asynchrony. As Figure 4 illustrates, the reduced audible bandwidth impacts benefits across all measurement scenarios, in contrast to the milder form of reduced audibility experienced by listeners with hearing loss.

In general, the reduction in onset asynchrony benefit for both normal-hearing listeners and listeners with hearing loss under filtered conditions emphasizes the importance of hearing all stimulus components so that they may receive a large benefit from onset asynchrony. This result confirms our hypothesis based on psychophysical data revealing an influence of stimulus bandwidth on the measurements of temporal acuity (Bacon &Viemeister, 1985; Eddins et al., 1992). Further, we can conclude that a wide audible bandwidth leads to a large benefit from onset asynchrony. Decreases in this bandwidth (either due to hearing loss or environmental factors) are likely to reduce the benefit a person may receive from the onset asynchrony sound-segregation cue. Loss of the high-frequency components could be particularly problematic, as temporal resolution has been demonstrated to be better at high frequencies compared to low (e.g., Snell, Ison, &Frisina, 1994). Should this result generalize to other speech stimuli, one could argue that providing amplification across the widest frequency bandwidth possible would allow a listener with a sloping hearing loss to gain the most benefit from temporally based sound-segregation cues.

At this point, however, it is not clear whether it is the attenuation of all harmonics or only the formants that lead to this result. Note that low-pass filtering the vowels at 900 Hz eliminates both high-frequency harmonics and the high-frequency formants (F2-F5). It might be that attenuating the formants only (and not all of the

harmonics) leads to the reduced benefit from onset asynchrony, as the locations of the spectral or formant peaks play a significant role in vowel identification (e.g., Peterson &Barney, 1952). In the end, listeners with hearing loss experience attenuation of both formants and harmonics, and so we cannot differentiate between these two mechanisms using listeners with hearing loss or simple lowpass filtering.

One interesting aspect of these data is that filtering the vowel stimuli reduced the onset asynchrony benefit for all listeners in all vowel measurement scenarios, but listenerswith hearing loss showed reduced benefit only in Target 2 identification. If the limited audible bandwidth of the listeners with hearing loss was the only factor that diminished benefit from onset asynchrony, then it would have been expected that listeners with hearing loss would have exhibited this deficit in all vowel measurement scenarios. Although it appears that reduced audible bandwidth has a role to play in reduced sound-segregation abilities experienced by listeners with hearing loss, other suprathreshold factors are likely implicated; these are discussed in the next section.

Benefit From Onset Asynchrony: Role of Competition

The result that listeners with hearing loss experienced reduced benefit from onset asynchrony in Target 2 identification could be related to the greater susceptibility to masking by listeners with hearing loss. In Target 2 identification, the vowel being identified is always presented under competition, and so perhaps the greater susceptibility of masking experienced by listeners with hearing loss impacts the size of the benefits received for these stimuli. Notably, the studies of Lentz et al. (2004) and Grose and Hall (1996) did not measure onset asynchrony perception under competition, which might explain why listeners with hearing loss experienced similar effects of onset asynchrony as normal-hearing listeners in those experiments.

The role of competition can be observed by comparing the vowel identification benefits across the different vowel measurement scenarios (see Figures 4 and 5). As mentioned earlier, the largest benefit received is for Target 1 identification. These large benefits might be facilitated by an environmental release from masking of Target 1 concomitant with the increase in onset asynchrony. There is evidence that Target 2 does not fully mask Target 1 when they are synchronous (scores are not near chance for double-vowel identification at the 0-ms onset asynchrony); however, increases in onset asynchrony would lead to portions of Target 1 that are presented without a competing sound. These portions (even as short as 25 ms) could have provided a great deal of information to listeners regarding the identity of the first target, especially in cases where the two vowels are easily confusable. As onset asynchrony increases, the unmasked portion of Target 1 increases, and listeners could become more and more accurate in identifying that vowel. Thus, for Target 1 identification, the unmasking associated with onset asynchrony is likely to have contributed to the large benefits seen for thismeasurement scenario.

With regard to Target 2 identification, benefits are likely smaller because of masking of Target 1 on Target 2. In contrast to Target 1, Target 2 was always presented under simultaneously (but not necessarily fully) masked conditions. Increases in onset asynchrony would not have led to unmasked portions of the vowel. Thus, benefits received for longer onset asynchronies in the Target 2 identification are not related to a temporal unmasking. Here, Target 2 is partially masked because a conflicting representation of formant peaks in that excitation pattern associated with the Target 1 vowelmakes itmore difficult to identify. In this case, onset asynchrony benefits could be related to "higher-level" factors, such as reduced uncertainty regarding the identity of the two vowels, reduced uncertainty regarding the order of the two vowels, or improvements in sound-segregation abilities at the greater onset asynchronies.

To begin to establish whether masking may have a role to play in performance and the benefits due to onset asynchrony for Target 2 identification, we looked more closely at the patterns of vowel identification at two onset asynchronies and qualitatively compared those patterns to excitation patterns based on the simultaneous presentation of two vowel sounds. Because this result was observed only for unfiltered vowels, this is the only condition explored here.

Figure 7 plots the identification score of each individual vowel for Target 2 identification in the unfiltered

conditions and shows that the patterns of individual vowel identification vary substantially between the normalhearing listeners and the listeners with hearing loss. For example, at the 25-ms and the 200-ms onset asynchronies, the /i/ was easily identifiable for the normalhearing listeners butwas themost difficult for the listeners with hearing loss to identify. As Figure 1 illustrates, F2 and F3 of the /i/ are both above 2000 Hz, and they may have been be rendered inaudible by the losses of some of the listeners used here. Onset asynchrony provided relatively moderate benefits for /i/ within both groups, but there was a larger improvement in scores for the normalhearing listeners than for the listeners with hearing loss. On the other hand, the /e/ was relatively difficult for the listeners with normal hearing but relatively easy for the listeners with hearing loss to identify. Here, listeners with hearing loss received greater onset asynchrony benefits compared to normal-hearing listeners.

To establishwhethermasking effects might have contributed to the group differences in performance and onset asynchrony benefit, Figure 8 plots the difference between the excitation pattern of the competing vowel and excitation pattern of the double vowel.4 This calculation allows an estimate of how much of the vowel of interest is represented in the double vowel. In a sense, these excitation pattern differences represent the amount of spectral contrast available to the listener when one vowel is masked by another.

Using this type of analysis, two particular patterns are expected for vowels that are easily identified. First, the formant peaks of the vowel of interest should be prominent once the competing vowel is subtracted from the sum. As listeners typically use the formant peaks for vowel identification, a representation with strong formant peaks would be associated with high scores. Second, we would also expect that the same formant peaks would be present across the different competing sounds. Listeners would be expected to perform better on tasks that have consistent cues across experimental trials. So, if F1 is present only for two competing vowels and F2 is present for the other two competing vowels, then identification performance might be difficult for listeners, as listeners may not know a priori whether to listen for F1 or F2. Further, the formant information should not be redundant across the various vowels. For example, if F1 is only available for one vowel, it could be easily confused with another vowel having similarly limited formant information. Hedrick and Madix (2009) suggested that vowels that are less confusable from others are more likely to receive large benefits due to onset asynchrony. Consequently, we expect that consistent, unambiguous, formant information would be associated with large benefits due to onset asynchrony.

Excitation pattern differences are plotted in Figure 8 for a normal-hearing simulation (leftpanels) and a hearing-loss simulation (right panel). For reference, the frequencies of the first three formants are indicated on the panels as filled circles.The leftpanels ofFigure 8 illustrate that across the different vowels, most vowels have a fairly robust representation even in the summed representation for the normal-hearing listeners.Take /i/, for example (second panel on left): Both F1 and F3 have robust peaks that are prominent in the presence of all competing sounds. Itmay not be surprising then, that the /i/ is easily identified by the normal-hearing listeners when presented under competition (see Figure 7). This robust representation might also allow listeners to receive strong benefits from onset asynchrony when identifying this vowel. In contrast, the /e/, which is more difficult to identify, has robust formant peaks, but the location of those formant peaks are not as consistent across the competing sounds (see middle panel, left). When presented with /i/, F1 and F2 are available, but when presented with /3/, only F3 is robust. Further, some of the /e/ representations may be confused with the representations of other vowels (e.g., /æ / when paired with /i/, /3/, and /a/). Consequently, the onset asynchrony may not always disambiguate the vowels, possibly leading to a reduced benefit.

On the other hand, the right panels of Figure 8 illustrate that listeners with hearing loss are at a distinct disadvantage compared to normal-hearing listeners due to their reduced frequency selectivity. The general amount of spectral contrast available to them is greatly reduced, at times being less than half that available to normalhearing listeners. The scale of the y-axis has been kept the same as for the normal-hearing listeners to illustrate the magnitude of this effect. The most notable effect of hearing loss is that many of the vowel sounds

do not have robust representations of all formants in the double vowel. The /a/ is an exception (bottom right panel), as the F1/F2 region is robust across the various competing vowels, but when compared with the /a/ as presented to normal-hearing listeners, the strength of the F1 peak is reduced for all double-vowel combinations. It is notable that listeners with hearing loss had the greatest ease in identifying the /a/ at the 25- and 200-ms onset asynchronies (see Figure 7). Onset asynchrony also improved identification of this vowel to a greater degree for normalhearing listeners than for listeners with hearing loss, perhaps because the F1/F2 region is not confusable with the spectral representation of other vowels for the listeners with hearing loss. On the other hand, the /æ / does not have a consistent representation across the competing vowels. When the /æ / is paired with /i/, F1 and F2 are robustly available (though not as robustly as for normalhearing listeners). However, when /æ / is paired with /a/ and /3/, only F3 is well available and consistent across the two competing vowels. It is not surprising, then, that the /æ / has relatively poor performance in the Target 2 identification measurement scenario and also leads to a relatively small benefit of onset asynchrony. The pattern present for /e/ is quite similar, as the peaks associated with the greatest spectral contrast are quite varied across the competing sounds. The /i/ is also likely difficult for these listeners because only F1 is robustly available to them (due to their reduced audibility and frequency selectivity, the F2 and F3 spectral information is diminished). The /i/ can therefore be easily confused with other vowels in certain combinations (e.g., the /e/ when presented with /a/ or /æ / and the /3/ when presented with /a/).

Hedrick andMadix (2009) suggested that vowels that are less confusable from others are more likely to receive large benefits due to onset asynchrony. For normal-hearing listeners, the /i/ and /3/ are the most distinct from the other vowels and therefore benefit more from onset asynchrony. For listeners with hearing loss, the /i/ and /3/ are not nearly as distinct: Figure 8 indicates that both vowels have similar spectral contrast in a low-frequency region, and even though F2 and F3 are quite different for these two vowels, there may not be sufficient spectral contrast available to listeners in these frequency regions. Because these twovowels have poorer representations, they do not lead to large benefits due to onset asynchrony. The reduced frequency selectivity of listeners with hearing loss, then, impacts the patterns of vowel-specific identification and the amount of benefit that listeners are able to receive from the onset asynchrony.

Summary and Conclusions

In summary, low-pass filtering of double vowels leads to a reduced benefit from onset asynchrony differences in double-vowel identification. This result indicates that limiting the bandwidth of the double vowel impairs the ability to use onset asynchrony as a sound-segregation cue for listeners with normal hearing and those with cochlear hearing loss. Listeners with hearing loss received less onset asynchrony benefit than the normal-hearing listeners for Target 2 identification when the vowels were unfiltered, but they received similar benefits due to onset asynchrony in the other three vowel measurement scenarios. The fact that onset asynchrony benefit was similar between the two groups in three of the four vowel measurement scenarios suggests that masking of Target 1 on Target 2 could contribute to the reduced benefit received for identifying the second target.

Once the vowels were filtered, the benefits received from onset asynchrony were similar for normal-hearing listeners and listeners with hearing loss in all vowel measurement scenarios, including Target 2 identification. The filtering provided similar amounts of information to both listener types. Taken together, these results implicate reduced audible bandwidth for the group differences observed for Target 2 identification, and excitation pattern analyses support the idea that reduced frequency selectivity impacts the ability to benefit fromonset asynchrony differences.

Acknowledgments

We thank Jumana Harianawala, Shen Yi, and Melissa Papesh for assistance with programming and data collection. Larry Humes, Diane Kewley-Port,William Shofner, and Rachael Holt provided valuable comments during the development and writing of this work.

Footnote

1Although fundamental frequency differences between the two vowels were not evaluated in this study, the vowels were synthesized at two fundamental frequencies for potential comparison with future data.

2The high-pass noise was included for two major reasons. First, upward spread of excitation occurs for both normal-hearing listeners and listeners with hearing loss, but listeners with hearing loss are limited due to poor auditory thresholds at high frequencies. Listeners with normal hearing have the potential to use the spread of excitation generated by highfrequency formants to assist with identification of individual vowels, but listeners with hearing loss, especially those with sloping losses, frequently do not have this opportunity. The high-pass noise limits the chance that normal-hearing listeners could use these frequency regions to provide any additional information to accomplish the task. Second, because we are specifically testing whether bandwidth impacts onset asynchrony benefits, presenting a high-pass noise ensures that listeners are presented with similar bandwidth information.

3On average, vowels synthesized at the 126-Hz fundamental frequency yielded scores that were 1.5 RAU better than vowels synthesized at the 141-Hz fundamental frequency. These differences were the same magnitude for both groups of listeners.

4Excitation patterns were constructed using the auditory filters reported by Glasberg and Moore (1990) and MATLAB code provided by Jens Appell. Excitation patterns for each individual vowel and each double vowel were generated (excluding double vowels in which the constituent vowels were the same). To simulate the reduced frequency selectivity for the listeners with hearing loss, the bandwidths of the filters (in equivalent rectangular bandwidth) were doubled. Average audiometric thresholds were also included, as the excitation values were limited to those that exceeded audiometric thresholds (as obtained via interpolation). These excitation patterns also included the high-pass noise to more faithfully represent the spectral contrast available to the listener in the experiment.

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received February 4, 2011
Revision received July 11, 2011
Accepted April 19, 2012
DOI: 10.1044/1092-4388(2012/11-0033)

Perceptual Acclimatization Post Nonlinear Frequency Compression Hearing Aid Fitting in Older Children

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.6 (Dec 2012): 1765-1787.
ProQuest document link

Abstract: In this study, the authors evaluated the effect of frequency compression hearing aids on speech perception ability and the time course and magnitude of acclimatization-related changes. Participants included children ages 11-18 years. Speech perception ability was evaluated over well-controlled baseline, treatment, and withdrawal study phases. Study-worn hearing aids were individually fitted to all participants. The authors evaluated speech perception ability using outcomes of speech detection (/s/ and /S/ sounds), /s-S/ discrimination, and plural and consonant recognition. Indices of change were discussed on a case-by-case basis across all study phases. Significant treatment effects were measured for all cases, on at least one measure, with some listeners displaying significant acclimatization trends following a trial of frequency compression. Findings suggest that frequency compression provided varying outcomes, both in benefit and acclimatization, across listeners. For some, a period of acclimatization was necessary before change could be measured. For others, performance remained stable over the time course under evaluation, suggesting that some but not all children will experience improved speech recognition ability after a period of frequency compression hearing aid use.

Full text: Headnote

Purpose: In this study, the authors evaluated the effect of frequency compression hearing aids on speech perception ability and the time course and magnitude of acclimatization-related changes.
Method: Participants included children ages 11-18 years. Speech perception ability was evaluated over well-controlled baseline, treatment, and withdrawal study phases. Study-worn hearing aids were individually fitted to all participants. The authors evaluated speech perception ability using outcomes of speech detection (/s/ and /S/ sounds), /s-S/ discrimination, and plural and consonant recognition.
Results: Indices of change were discussed on a case-by-case basis across all study phases. Significant treatment effects were measured for all cases, on at least one measure, with some listeners displaying significant acclimatization trends following a trial of frequency compression.
Conclusion: Findings suggest that frequency compression provided varying outcomes, both in benefit and acclimatization, across listeners. For some, a period of acclimatization was necessary before change could be measured. For others, performance remained stable over the time course under evaluation, suggesting that some but not all children will experience improved speech recognition ability after a period of frequency compression hearing aid use.
Key Words: hearing aids, hearing device evaluation, children, single-subject design
(ProQuest: ... denotes formula omitted.)
Rehabilitation for listeners with hearing impairment (HI) often includes the provision of amplification via hearing aids.When conventional hearing aids are not able to provide audibility of high-frequency speech sounds, frequency-lowering signal processing is a clinically available treatment option. In this study, we evaluated the time course of acclimatization to a frequency-lowered signal over several months of realworld use.
For adult listeners with severe-to-profound highfrequency hearing loss, the gain needed to provide audibility of high-frequency speech sounds does not always translate into better speech perception performance. Several studies suggest that amplification at frequencies where hearing impairment is severe provides little to no speech perception benefit (Ching, Dillon, &Byrne, 1998; Ching, Dillon, Katsch, &Byrne, 2001; Hogan &Turner, 1998). Others have suggested that providing high-frequency information to listeners with highfrequency hearing loss can significantly improve speech perception, especially in noisy listening environments (Plyler &Fleck, 2006; Turner &Henry, 2002). However, individual variability in these studies suggests that some listeners receive speech perception benefit from amplified high-frequency sound, whereas others do not. For the pediatric

population, both age and hearing loss have been shown as significant predictors of speech recognition measured in both quiet and noise (Scollie, 2008; Stelmachowicz, Hoover, Lewis, Kortekaas, &Pittman, 2000). Listeners with high-frequency cochlear dead regions may experience a lack of benefit with high-frequency audibility (see review in Moore, 2004); this may vary across listeners and has largely been studied in the adult population (Cox, Alexander, Johnson, &Rivera, 2011). Studies including both adults and children have suggested that hearing aids with frequency-lowering technology could be considered for listeners with significant dead regions (Vickers, Moore, &Baer, 2001) and/or for listeners with severe high-frequency hearing loss (Glista, Scollie, Bagatto, et al., 2009; Robinson, Stainsby, Baer, &Moore, 2009).

Some clinically available types of frequency-lowering hearing aid technology include nonlinear frequency compression and frequency transposition. Studies suggest that these frequency-lowering technologies may benefit adults and children with high-frequency hearing loss, and that benefit varies across individuals (see review by Simpson, 2009). In general, frequency compression splits the incoming hearing aid signal into two channels. The high-frequency channel is compressed into a narrower bandwidth. This results in sound being lowered in frequency within the high-frequency channel (Simpson, Hersbach, &McDermott, 2005). Research suggests that frequency compression provides speech perception benefit for someadults and children with high-frequency hearing loss (Bohnert, Nyffeler, &Keilmann, 2010; Glista, Scollie, Bagatto, et al., 2009; Simpson et al., 2005; Simpson, Hersbach, &McDermott, 2006; Wolfe et al., 2010). In previous studies of frequency compression, researchers have examined varying degrees/configurations of highfrequency hearing impairment, fitting approaches, and listening environments. Research suggests that candidacy may be affected by both audiometric configuration and age group, with both children (versus adults) and listeners who have greater high-frequency hearing loss being more likely to receive benefit (Glista, Scollie, Bagatto, et al., 2009).

Auditory Acclimatization Post Hearing Aid Fitting

For listeners with longstanding severe-to-profound high-frequency hearing losses, frequency-lowering hearing aids may provide access to new high-frequency cues, albeit presented at lower frequencies. When the auditory system receives this new acoustic information, some time for learning-induced reorganization may be required to accommodate novel sounds. This adjustment period has been defined as auditory acclimatization (Arlinger et al., 1996), as reported in the Eriksholm Workshop on Auditory Deprivation and Acclimatization (1996): "Auditory acclimatization is a systematic change in auditory performance with time, linked to a change in the acoustic information available to the listener. It involves an improvement in performance that cannot be attributed purely to task, procedural or training effects" (p. 87S).

The role of auditory acclimatization post hearing aid fittings has been a topic of interest in the literature for many years. The evidence presented in the older research is mixed. In several studies, researchers concluded that the acclimatization effect is minimal and may vary according to measurement technique, practice effects, and/or changes made to hearing aid gain within a study (Bentler, Niebuhr, Getta,&Anderson, 1993; Flynn, Davis, &Pogash, 2004; Humes, Halling, &Coughlin, 1996; Saunders &Cienkowski, 1997; Surr, Cord, &Walden, 1998; Turner, Humes, Bentler, &Cox, 1996). Alternatively, several studies have reported change in benefit over time in the range of 0% to 10%, with some individuals demonstrating larger improvement (Arlinger et al., 1996; Cox, Alexander, Taylor, &Gray, 1996; Gatehouse, 1992, 1993; Horwitz &Turner, 1997; Kuk, Potts, Lee,Valente,&Picirrillo, 2003; Silman, Silverman, Emmer, &Gelfand, 1993; Yund, Roup, Simon, &Bowman, 2006). In all of the studies noted above, experimenters tested adult subjects, with one exception-the study by Flynn and colleagues, in which the authors concluded that that the trend in improved speech perception over time likely related to fine-tuningmodificationsmade over the course of the study rather than an acclimatization effect. Overall, individual variability in acclimatization post hearing aid use may relate to factors including hearing loss severity/configuration, age, cognitive ability, hearing aid experience, hearing aid style, and the complexity of the hearing aid signal-processing scheme (Bentler et al., 1993; Cox et al., 1996; Gatehouse, 1992; Horwitz &Turner, 1997; Saunders &Cienkowski, 1997; Yund et al., 2006).

Data regarding adult-child differences in post hearing aid acclimatization patterns are not readily available, although auditory learning studies in listeners with normal hearing indicate that maturation of auditory learning continues to develop through adolescence (Huyck &Wright, 2011). These studies are consistent with maturation of auditory evoked potentials, in which maturation may occur by age 6 years or continue to approximately age 12, depending on the methodology (Pang&Taylor, 2000; Ponton, Eggermont,Kwong, &Don, 2000;Wunderlinch&Cone-Wesson, 2006). Overall, research suggests that maturation related to auditory processing skills, such as speech recognition, may continue into adolescence. This evidence is consistent with the idea that children may not show the same acclimatization patterns as adults. In addition to maturation effects, generalization of auditory learning may be both task and stimulus dependent (Wright &Zhang, 2009). In general, frequency resolution abilities tend to mature earlier (Hartley,Wright, Hogan, &Moore, 2000) and generalize outside of trained tasks (Wright&Zhang, 2009), compared with temporal abilities.

Auditory Acclimatization and Frequency Lowering

Current research suggests that acclimatization may play a role in speech perception performance with frequency-lowering technologies. Wolfe and colleagues (2010, 2011) formally evaluated the long-term effects of frequency compression in children ages 5-13 with moderate to moderately severe hearing loss at 6 weeks and 6 months post fitting. Results varied across the different speech measures used in the study. Aided detection results improvedwith frequency compression and remained stable over the 6-month time course. Recognition of wordfinal plurality improved with frequency compression; however, high performance levels limited measurement of long-term acclimatization effects. Nonsense syllable recognition was significantly better at the 6-month period when compared with conventional processing and after 6 weeks of frequency compression use. Last, frequency compression offered improved speech recognition in noise after several weeks to several months of use. Because there was no control group, Wolfe and colleagues could not determine whether the improvement in recognition of speech sounds over time should be attributed to a learning effect, acclimatization, or both. The authors pointed out the possibility that improvements measured over time may have been, in part, due to linguistic and/or cognitive maturation, on the basis of the study length and the children's ages (Wolfe et al., 2011). Additional studies on the effects of frequency lowering with children have suggested that benefit may vary with acclimatization time (Auriemmo et al., 2009; Glista, Scollie, Bagatto, et al., 2009; Glista, Scollie, Polonenko, &Sulkers, 2009; Wolfe et al., 2010). Further research is needed to examine the time course of acclimatization effects on perceptual benefits of frequency-lowering technology.

The Current Study

This study was designed to examine the time course of acclimatization to frequency-lowering hearing aids. We recruited a group of older HI children and followed them for 6 months of hearing aid use. We selected this age range of children to minimize expected maturational confounds.We chose this age range on the basis of studies related to the maturation of auditory evoked potentials (described above) in the absence of direct evidence related to adult-child differences in post-hearing-aid acclimatization patterns. Speech perception measures were administered on 10 different testing appointments spanning baseline, treatment, and withdrawal phases. We used a single-subject design; each participant acted as his or her own control. In this study, we evaluated the effect of nonlinear frequency compression hearing aids on speech perception ability and the time course and magnitude of acclimatization-related changes following a real-world trial.

Method

Participants

Recruitment of six participants ages 11-18 years took place at the University of Western Ontario (UWO) H. A. Leeper Speech and Hearing Clinic, local audiology clinics, and through an educational audiologist. Participants who met the inclusion criteria for the study were enrolled in a sequential manner; recruitment efforts were limited to a smaller number of participants, facilitating a single-subject design. The feasibility of collecting data from a larger number of participants was limited due to challenges encountered when conducting repeated

outcome measurement over an extended time course. No participant was excluded on the basis of task performance or degree of benefit. For binaurally aided participants, audiometric inclusion criterion were as follows: a bilateral sensorineural hearing impairment, sloping to at least a moderately severe high-frequency pure-tone average (HF-PTA) hearing level averaged across 2000 Hz, 3000 Hz, and 4000 Hz.

Participants were required to be full-time users of digital behind-the-ear (BTE) hearing aids prior to entering the study. Five of the participants wore binaural hearing aids and had high-frequency losses that were symmetrical within 10 dB on the basis of HF-PTA. One participant with an asymmetrical hearing loss was monaurally aided in the better ear (Case 6). On average, the participants beganwearing hearing aids at age 3.75 years, as per parental report. Details pertaining to previously worn hearing aid type, fit-to-targets, and FM usage are reported in Table 1. A data-logging feature tracked hearing aid usage over the course of the study on all studyworn hearing aids. All participants were assessed as full-time hearing aid users (i.e., achieving continuous usage during school hours) prior to beginning data collection. TheUWOResearchEthicsBoard approved this study for health sciences research involving human subjects.

Pure-tone air conduction thresholds were measured bilaterally at all octave and interoctave frequencies between 250 Hz and 8000 Hz for each participant using a Grason-Stadler 61 audiometer. Air conduction threshold testing was completed in a double-walled soundtreated booth using Etymotic Research ER-3A insert earphones coupled to each participant's personal earmolds. We measured hearing thresholds at the beginning and end of the study; all participants demonstrated hearing levels within 10 dB of baseline over the course of the study. Participants were evaluated for cochlear dead regions (DRs) through use of the threshold equalizing noise (TEN-HL) test; results were interpreted through use of published criteria (Malicka, Munro, &Baker, 2010; Moore, 2004; Moore, Glasberg, &Stone, 2004). Refer to Table 1 for demographic and TEN test results. This test supports measurements up to 4000 Hz. Suspected DRs are reported according to TENtest results; in some cases, no DRs were measured (denoted with "none") or hearing threshold levels were beyond the range of the TEN-HL test (denoted with "INC"). Participants are listed from least to greatest HF-PTA.

Hearing Aid Fitting

Device fitting followed protocols from the Desired Sensation Level (DSL) method Version 5.0 (Bagatto et al., 2005; Scollie et al., 2005) as implemented within the Audioscan Verifit VF1. Each participant was fitted with study-worn hearing aids: Phonak Naida IX SP BTE hearing aids coupled to integrated FM receiver boots (MicroLink ML10i); these devices were worn for the entire duration of the study with the gain/advanced features of the devices held constant throughout.We disabled the volume control (VC), digital noise reduction (DNR), and automatic program selector features in the main listening program. Prescriptive targets were matched using simulated real-ear measures incorporating individual real ear to coupler difference (RECD) values.We selected a coupler-based verification strategy to reduce room noise/reverberation effects and concerns with feedback during real-ear procedures; this promoted test environment consistency and replicable measures across the repeated fitting appointments. Aided measurements of speech at 55 dB SPL, 65 dB SPL, 70 dB SPL, and 75 dB SPL, and for a 90 dB SPL puretone signal were completed during fitting appointments. Hearing aids were adjusted so that the best possible match to targets would be provided. When required, participant-driven gain adjustments took place, and only prior to beginning the baseline condition. Reported fit-to-targets data reflected measurement made at the settings worn for this study including any participantrequested gain adjustments. Table 1 includes a summary of the fit-to-targets per child, indexed as the highest frequency at which prescriptive targets could be met within 5 dB for a 70 dB SPL input level. The baseline condition began once this fitting process was completed.

Following the baseline condition, frequency compression parameters were individually adjusted according to a previously established protocol (Glista&Scollie, 2009; Glista, Scollie, Bagatto, et al., 2009), described briefly here. Gain and amplitude compression were held constant to match those of the baseline fitting. Better-ear hearing thresholdswere used in the selection of frequency compression settings. The settings were then applied

binaurally; in this study, we did not investigate the use of asymmetrical settings. Verification of frequency compression used filtered speech passages available in the Audioscan Verifit VF-1. These passages are shaped to include low-frequency energy, a notched mid-frequency area, and a 1/3 octave band of high-frequency speech energy. This high-frequency band is clinician-selectable, and it centered on frequencies at 3150 Hz, 4000 Hz, 5000 Hz, or 6300 Hz. When tested with frequency compression offversus on, the clinician can observe the frequency location and audibility of the speech band (Bentler, 2010; Glista &Scollie, 2009). We measured the bands centered on 4000 Hz and 6300 Hz at an input level of 70 dB SPL and assessed whether they were audible. We enabled and adjusted frequency compression until they were audible or until the limits of adjustment were reached (refer to Table 1 for case-specific results). This type of measurement does not take into account the bandwidth of frication sounds. For this reason, fittervocalized sustained fricatives (/s/ and /S/) were used in aided response measurements through the Verifit "livespeech" mode. This allowed an evaluation of the frequency overlap of the frication bands. Fitting adjustments were made to minimize /s-S/ overlap, if possible, in an attempt to provide a fitting that minimized the risk of /s-S/ confusion.

Outcome Measures

We administered four aided behavioral outcome measures: (a) speech sound detection, (b) plural recognition, (c) /s-S/ discrimination, and (d) consonant recognition. The first three measures assessed detection or discrimination of high-frequency speech sound (for sensitivity in the frequency range of the processor), and the fourth assessed recognition of a broad range of speech sounds (to provide a more generalizable assessment of speech sound recognition). Test stimuli were presented monaurally to the better-hearing ear according to preference and HF-PTAvalues. For discrimination and consonant recognition tasks, we varied presentation levels between 55 dB SPL and 70 dB SPL re: the 2cc coupler across cases to ensure testing above chance performance in the baseline condition, but presentation levels were held constant thereafter. The plural recognition task was presented at 55 dB SPL on the basis of procedures from previous studies (Glista, Scollie, Bagatto, et al., 2009; Wolfe et al., 2010). The speech sound detection task was adaptive by level. Counterbalancing was used during outcome measure presentation, per test session. Calibration was performed in the coupler using a hearing aid programmed to have no gain.

Outcome measures were implemented in custommade experimental software, executed from a personal computer. A computer monitor, positioned in front of each participant, displayed response choices that the participant selected via the use of a mouse. Signals, in the form of .wav files, were routed from the computer to a custom-made programmable attenuator (CM108AH audio chip and LM1973 audio attenuator) and a clinical audiometer (GSI-61). Signals from the audiometer were presented through a modified direct-audio-input (DAI) connector cord connected to the hearing aid.

Speech sound detection. We measured aided detection thresholds for speech sounds using an adaptive, computer-controlled version of the Ling Test (Ling, 1988; Tenhaaf &Scollie, 2005). Stimuli, spoken by a female talker, were presented in isolation through the use of a starting presentation level of 70 dB SPL. Threshold values were estimated as the average level of four reversals to a 50% detection criterion. A 10-dB step size was used in the first reversal, followed by a 4-dB step size for all subsequent reversals. These parameters of the adaptive testing procedure remained constant throughout testing. The detection procedure was administered twice for each phoneme across all testing phases. Phonemes were tested in a random order per administration.

Traditionally, the Ling Test is composed of six sounds: /m/, /a/, /i /, /u/, /S/, and /s/. To facilitate measurements of aided detection, sensitive to changes in highfrequency audibility, two mid/high-frequency sounds were included: /S/ and /s/. A 1/3 octave band spectral analysis of the stimuli is provided in Figure 1a. Spectral peaks reside at approximately 6000 Hz for /s/ and 2500 Hz for /S/. Aided thresholds measured with these two sounds have been used in previous studies of frequency lowering (Glista, Scollie, Bagatto, et al., 2009). In general, this test measures the lowest level at which isolated speech sounds can be heard. When presented in a repeated

measures paradigm, this test can provide information concerning a change in hearing level across different hearing aid conditions (i.e., with and without frequency compression). Depending on the hearing level of the listener and/or activation of frequency compression, it is possible that a listener could hear the phonemes in a distorted and/or alternate form. In the case of steeply sloping, severe-to-profound high-frequency hearing loss, audibility of /s/ or /S/ may be limited to only the lower shoulder of the frication band; this means that resulting measured detection thresholds would likely reflect partial audibility of the sound(s) tested.

Plural recognition. The UWO Plurals Test (Glista &Scollie, 2012) assesses participants' ability to use the fricatives /s/ and /z/ as bound morphemes. For this task, we chose stimuli similar to those used in previous research to test sensitivity to high-frequency audibility in children who use hearing aids (Stelmachowicz, Pittman, Hoover, &Lewis, 2002). Stimuli include the singular and plural forms of 15words: ant, balloon, book, butterfly, crab, crayon, cup, dog, fly, flower, frog, pig, skunk, sock, and shoe. The testing paradigm included the use of computer-controlled software to automate stimulus presentation, presentation of a closed set of responses, and scoring. A 1/3 octave band analysis of the concatenated words and the extracted fricative portion at the end of each word is displayed in Figure 1b. The mean spectral peak of the fricative portion resides at approximately 5000 Hz. Stimulus files were automatically generated via a computer in random order and including two repetitions, generating a score out of 60 items per measurement. Stimuli were mixed with a speech-shaped noise at a +20-dB signal-to-noise ratio (SNR). The noise was included to mask low-level stimulus offset cues that could have served as a surrogate cue for plural identification. Participants were instructed to pay attention to the stimuli rather than to the noise. Tester observation inferred that the inclusion of low-level noise did not appear to influence the ability of the children to focus on the stimuli of interest. A closed response set was presented on a computer monitor using pictures (from articulation cards; Super Duper Publications [Webber, 1998a, 1998b, 1999, 2000, 2003]) and a corresponding orthographic display. Each response set included the singular and plural form of each target word. Participants were instructed to choose which picture best described what he or she heard.

The UWO Plurals Test has been included in other studies designed to assess the effects of frequency compression hearing aid technology (Glista, Scollie, Bagatto, et al., 2009; Wolfe et al., 2010). Literature on the development and evaluation of this test proposes its use in evaluating the detection of high-frequency fricative sounds in a word-final position. Results obtained in listeners with normal hearing and in listeners with hearing impairment (aided conditions) indicated reliable repeated outcome measurement (Glista &Scollie, 2012).

/s-S / discrimination. An aided discrimination task, developed at UWO, was included in the test battery to facilitate the measurement of /s-S/ discrimination. This consisted of six consonant-vowel (CV) syllables including high-frequency fricatives coupled to three vowels ranging in articulator dimension (i.e., front-back, high- low). The stimulus set included nonsense CV pairs /si-Si/, /sa-Sa/, and /su-Su/, spoken by three adult female talkers. Stimuli were presented in a three-alternative forcedchoice paradigm, and participants were instructed to choose the "oddball" item. Each discrimination score included 54 items (18 items ×3 repetitions). Items were randomized and run in a single block at each testing session. Due to the nature of frequency compression hearing aid processing, frequency compression can result in sounds being presented at lower frequencies and/or with an altered spectral shape (when compared with conventional processing). These effects are of particular interest when considering discrimination of /s-S/ with frequency compression because it can modify the spectral shape of /s/, making it appear closer to that of /S/. Results measured with the /s-S/ discrimination may be influenced by factors including degree of hearing loss, previous exposure to partial or full cues of /s/ and /S/ sounds with conventional amplification, and strength of frequency compression settings.

In the development of this task, we chose the /s/ and /S/ sounds to form recordings made in a double-walled sound booth using a studio-grade AKG condenser microphone (C 4000 B). The microphone was connected to a preamplifier and analog-to-digital converter (USBPre) and desktop computer. Recorded files were digitized at a sampling rate of 44100 Hz, using 16-bit resolution. We used the SpectraPLUS FFT Spectral Analysis System to

store the resulting file. All stimuli were recorded several times, and final test items were chosen for similarity and neutrality of intonation for each /s-S/ pair.We introduced stimulus-specific variability to minimize the ability to use idiosyncrasies of a specific stimulus for recognition rather than spectral cues, per se. Variation in the spectral energy of the fricatives was achieved through the pairing of consonants with three different vowels (Boothroyd &Medwetsky, 1992). In addition, multiple talkers and repetitions of each utterance were included.
We analyzed the CV spectra to determine differences in the spectral energy of /s/ versus /S/ (using Praat software). Specifically, we measured the centroid frequency, or center of gravity of the frication noise (Forrest,Weismer, Milenkovic, &Dougall, 1988), by extracting the fricative portion of the CV stimuli using 1/3 octave bands analysis (SpectraPLUS; see Figure 2). Centroid values range from 8.03 kHz to 10.37 kHz for CVs beginning with /s/, and from 3.81 kHz to 5.98 kHz for CVs beginning with /S/. The spectral peak is estimated at approximately 10 kHz for CVs beginning with /s/ and at approximately 3 kHz for CVs beginning with /S/. These findings are consistent with those reported in the literature describing the spectral peak frequency of female speech: The spectral energy of an /s/ sound peaks at approximately 6- 9 kHz for female speech, whereas the spectral energy of /S/ peaks over a range of approximately 3-6 kHz (Boothroyd& Medwetsky, 1992; Pittman, Stelmachowicz, Lewis, &Hoover, 2003).
Consonant recognition. To measure consonant recognition, we used the University of Western Ontario Distinctive Features Differences Test (UWO-DFD; Cheesman &Jamieson, 1996), developed with four talkers and 21 nonsense disyllables, including / b, tS, d, f, g, h, dZ, k, l,m, n, p, r, s, S, t, 8, v, w, j, and z/.We presented all items in a fixed, word-medial context (i.e., LCIl). Participants were instructed to select the target nonsense word from an orthographic display on a computer monitor. Presentation of stimuli, recording of responses, scoring, and presentation of results were all under computer control. The final task included 84 items, comprised of tokens spoken by two female talkers and two male talkers. Each phoneme was therefore presented four times in a random order across speakers. We included the UWO-DFD in this study to provide both a general measure of the participant's abilities to identify consonant sounds and an indication of the types of confusion errors made across the different testing conditions. Previous studies found consonant identification tasks to be sensitive to changes in the patterns of consonant confusions introduced by frequency-lowering technologies (Robinson, Baer, &Moore, 2007; Robinson et al., 2009). This test was included in previous research evaluating aided speech sound recognition in child and adult listeners (Glista, Scollie, Bagatto, et al., 2009; Jenstad, Seewald,Cornelisse,&Shantz, 1999; Scollie, 2008; Scollie et al., 2010).
Study Design and Data Collection Sequence
Case series evaluation was conducted as a withdrawal design, including outcome measures administered repeatedly for two test conditions: evaluation of conventional processing and evaluation of frequency compression. The experiment was sectioned into three phases: (a) Baseline (with conventional processing), (b) Treatment (with frequency compression), and (c) Withdrawal (with conventional processing). Across all conditions, study participants were blind to the status of hearing aid processing. Experimenter bias was minimized through the use of fully automated, computer-controlled testing.
We employed a single-subject design to evaluate change at the level of the individual; this approach was used in prior research on acclimatization effects post hearing aid use (Gatehouse, 1992). This type of research design requires experimental control and rigor, as does group-level design, although the specific experimental parameters differ and are specific to singlesubject design (Logan, Hickman, Harris, &Heriza, 2008). In single-subject design, each participant serves as his or her own control, thus allowing researchers the opportunity to measure significant changes in performance at the individual level (Gast, 2010). Achieving this level of control was of particular interest in this study because each participant presented with different hearing loss degrees/configurations, thus requiring different frequency compression settings. In addition, previous studies (Simpson, 2009) have reported large between-subject variability in results obtained with frequency-lowering hearing aids. The use of change indices within singlesubject design can facilitate measurement of small,

consistent variations in performance level within a testing condition. Such findings may not be as apparent at the group level. Although this type of design offers a way of evaluating clinical significance, the extent to which findings can be applied to HI listeners beyond this study is limited.

Baseline phase. The volume control was disabled during this phase (and all other phases of the study). A minimum of two testing sessions were scheduled for all tasks during the baseline phase. A stopping criterion enabled evaluation of stable performance without frequency compression prior to introducing treatment. Confidence intervals (CIs) were used briefly to judge whether performance across adjacent testing sessions was significantly different; lack of change across adjacent sessions was interpreted as stable performance. The goal of this design was to allow practice and acclimatization time without frequency compression and start the treatment phase once stable baseline performance was achieved.

Treatment phase. This phase included six test sessions-four sessions of outcome measurement completed every 2 weeks, followed by two sessions at monthly intervals. Frequency compression processing was enabled for the first test session and remained enabled without modification across the entire treatment phase. Strict adherence to the intended biweekly/monthly timeline could not be achieved for all participants due to illness and/or scheduling factors. On average, we allotted a 16-week treatment phase to all participants (range = 14.1-17.0 weeks). This time period is consistent with that reported in the literature (i.e., 12-18 weeks) investigating acclimatization effects in aided speech perception (Gatehouse, 1992, 1993; Horwitz &Turner, 1997).

Withdrawal phase. We included a final test session to evaluate performance without frequency compression following acclimatization to frequency compression. We achieved this by disabling the frequency compressor on the final day of testing. All participants wore the study aids with frequency compression enabled until the time of this withdrawal appointment. On average, withdrawal testing was completed 3.5 weeks (range = 1.0-7.4 weeks) after finishing the treatment condition of the study. Details pertaining to the study design and individual results were disclosed to the participants upon completion of the withdrawal phase. The study-worn aids were then offered to all participants free of charge, with the option of reenabling frequency compression and/or incorporating other fitting alterations. All participants chose to keep the study-worn aids with frequency compression enabled; the sole change requested was enabling of the VC.

Results

Analysis Strategies

Analyses focused on significant change, both positive and negative, in speech perception performance at the individual level within and across study conditions. Analyses included the use of CIs calculated across change indices (Morgan &Morgan, 2009; Portney &Watkins, 2000) and a within-condition approach (Gast, 2010), as described below. Within-condition analyses are traditionally found in single-subject research to analyze the direction of change within a testing condition. All analysis strategies were chosen to facilitate measurement of small, consistent change at the individual level. Indices of change included (a) increased or decreased performance within the baseline condition, (b) overall difference in performance between baseline and treatment, (c) increased or decreased performance during the treatment condition (denoting acclimatization trends), and (d) differences between adjacent scores at the boundaries of the baseline and treatment or treatment and withdrawal conditions. Error pattern analyses were performed for three of the four indices of changes, according to results obtained on the UWO-DFD test. Case-specific results are presented in the order in which they appear in Table 1.

Change within the baseline condition. For each child, CIs were calculated around scores corresponding to each testing session within the baseline condition. This facilitated an evaluation of change across adjacent testing sessions and the use of a stopping criterion. Intervals were computed from the mean baseline score, which is ±1.96 ×the SD of test-retest scores for repeated measures including plural recognition, /s-S/ discrimination, and detection measures (Portney &Watkins, 2000). For the consonant recognition measure, the SD was calculated from the binomial theorem (Thornton &Raffin, 1978). The length of the baseline condition was determined on a

case-by-case basis and according to the following stopping criterion: demonstration that (a) the mean score of the adjacent testing session fell within this CI or (b) the mean score for the adjacent testing session fell below the CI. These simplified CIs (related to test-retest) assisted the tester in deciding when a participant should advance to the treatment phase; this strategy differed from those described below.

We used a CI, derived around the entire baseline phase, to evaluate change attributable to treatment. This interval was calculated as the upper limit of a CI around the mean scores across the baseline phase. CIs were calculated around mean scores according to the binomial theorem for all recognition- or discrimination-based tasks and using a CI of ±5 dB for detection tasks. This yielded a CI around detection scores larger than the mean baseline test-retest error for this task. Significant change attributable to frequency compression use was observed when two ormore consecutive treatment scores fell outside these CIs; this is consistent with established procedures and takes into account that treatment effects are not always stable over a prolonged period of testing (Morgan &Morgan, 2009).

Change within the treatment condition. Additional analyses were performed on scores within the treatment condition in a two-step process for each measure and child; this second step was completed only when the first step yielded a significant result. First, we evaluated the relative change in performance level by subtracting the median value of the last three testing sessions from that of the first three testing sessions; we used median values, rather than mean values, to limit degree of influence from outliers (Gast, 2010). Second, we performed linear and nonlinear regression analyses to further evaluate the acclimatization trend. Data sets displaying a gradual change over time were fitted linearly; results were deemed significant when the slope of the line was significantly different from zero. Data sets displaying improvement after a specific period of time (i.e., S-shaped curves) were fitted with a sigmoidal function using XLfit curve-fitting software (ID Business Solutions, 2009):

... (1)

whereDdescribes the bottom plateau of the curve, Vmax describes the range of performance values the curve takes, n describes the slope factor, and Km describes the x value at which the middle y value is attained. Nonlinear analyses were deemed significant when raw data points were strongly correlated to those predicted ($p < .05$). Trends are plotted for significant cases only (see Figures 3 through 8) and are summarized in Table 2.

Change between adjacent scores: Baseline to treatment or treatment to withdrawal. To evaluate an initial treatment effect, we derived CIs around the final baseline scores; these extended into the treatment phase to include the initial treatment score. We calculated CIs around mean scores according to the binomial theorem for all recognition/discrimination-based tasks and using a CI of ±5 dB for detection tasks. A significant treatment effect (benefit/decrement) was reported when the initial treatment score fell outside the interval. To evaluate the withdrawal effect, we derived CIs around the final treatment score; these extended to include the withdrawal score. Intervals were calculated through use of the binomial theorem for all recognition- or discrimination-based tasks and using a fixed CI of ±5 dB for detection tasks. A significant withdrawal effect (benefit or decrement) was reported when the final score with frequency compression disabled fell outside this treatment CI.

Error pattern analysis.We used raw scores obtained on the UWO-DFD test to generate tables of "difference" confusion matrices, across participants and for the latter three of the changes indices (see the Appendix). The first column of matrices display change in consonant confusions due to initial activation of frequency compression; scores are a result of subtracting final baseline scores from initial treatment scores. The second column displays change within the treatment condition (i.e., acclimatization effects); scores are a result of subtracting initial treatment scores from final treatment scores. The final column displays change due to withdrawal of treatment; scores reflect subtraction of the withdrawal scores from the final treatment scores. Stimuli appear in alphabetic order according to the response options presented to the participants. Interpretation of results falling along the diagonal are as follows: Positive numbers indicate less errors with frequency compression enabled (first and last columns), or an improvement with frequency compression over time (second column only), and negative numbers indicate frequency compression decrement. The opposite can be

interpreted for results falling offthe diagonal: Positive numbers indicate more errors with frequency compression enabled, and negative numbers indicate fewer errors without frequency compression (compared with either frequency compression or across time). Because of the small sample of results displayed for each participant, this discussion focuses on changes in confusion identification greater than 50% (i.e., a difference value of three or four).

Case Study 1

Case Study 1 is an example of a child who received little benefit from frequency compression and who performed at ceiling on most tests regardless of hearing aid condition. Figure 3 shows the results for the first case, displayed for each measure as a function of time. The vertical lines within each panel delineate the baseline, treatment, and withdrawal phases. Shaded areas represent the CIs. Results without and with frequency compression are plotted as open and filled symbols, respectively. Note that the ordinates for the upper panels (measured in percent correct) and lower panels (measured in dB SPL) indicate performance and threshold measures, respectively. An asterisk and/or a trend line indicates significant effects. Also included in this figure is an audiogram showing the child's hearing thresholds.

Overall, Case Study 1 had high performance scores for the recognition and discrimination tasks across test sessions. Significant initial frequency compression benefit was measured on the /s/ detection task only, which is an adaptive task with the highest frequency stimulus in this battery. Electroacoustically, there was little room for improvement with frequency compression because the conventional processing condition was able to match targets to 4000 Hz. Participant comments made during the treatment phase included that of new audibility of warning signals at school and during use of personal listening devices; the participant viewed these new sounds in a positive manner.Asignificant withdrawal effect was measured for consonant recognition and detection of /s/ relative to the final score for the treatment condition. No significant trends were observed within the treatment condition, suggesting limited acclimatization (see Table 2), although ceiling performance limited our ability to measure further change on many measures. Error pattern analyses (see the Appendix) revealed that this participant had initial difficulty identifying /8/ and /v/ sounds with frequency compression; /8-v/ recognition improved with acclimatization.

Case Study 2

Case Study 2 is an example of a child who received significant benefit from frequency compression in addition to nonlinear acclimatization trends but had initial decrement on some measures. Figure 4 displays all results for Case Study 2. Significant initial benefit with frequency compression was measured for the plural recognition task, whereas significant initial decrement was measured for /s-S/ discrimination and /S/ detection. Significant overall treatment benefit was found on the plural and consonant recognition tasks, whereas significant overall treatment decrement was found for the /S/ detection task. Significant changes occurred when frequency compression was withdrawn, with poorer performance on /s-S/ discrimination and better performance on /S/ detection. Acclimatization trends were observed for consonant recognition, /s-S/ discrimination- and detectionbased tasks with significant nonlinear acclimatization trends for consonant recognition, and /s-S/ discrimination (see Table 2). Error pattern analyses (see the Appendix) suggest consonant confusions between affricate and fricative sounds; however, no clear patterns of error change can be observed across study conditions. Approximately 10 weeks with treatment was required to demonstrate significant consonant recognition improvement. One interesting aspect of this acclimatization pattern is the initial decrement observed with /s-S/ discrimination, which resolved with increased experience with frequency compression.

Interpretation of this case is difficult given the mixed pattern of results. Electroacoustically, the 6300-Hz region of speech was audible with frequency compression but not without. Therefore, sounds with energy in this region (e.g., /s/) may have become audible, which would explain the improved performance in detection word-final plurality and in detection of /s/. However, for detection of an /S/ sound and /s-S/ discrimination, verification evidence suggests that audibility of the 4000-Hz region was present both with and without frequency

compression. Therefore, the participant was required to change her discrimination of /s/ and /S/ froma sound versus silence cue to those of newly audible cues. It appears that she did so following 8-10 weeks of experience with the new processor, but this came at the cost of poorer detection thresholds for /S/. Looking at consonant recognition from a broader perspective, these various beneficial and unfavorable effects combined to provide an overall benefit to consonant recognition after 8-10 weeks of acclimatization to the new processor. The participant did not report any difficulty understanding speech over the course of the study. Overall, the results presented for Case 2 suggest more benefit than detriment with frequency compression.

Case Study 3

This case study describes a child who showed significant acclimatization post hearing aid fitting with frequency compression; however, a withdrawal effect was not measured for this participant. Figure 5 displays all results for Case 3. Significant initial benefit was measured for detection of /s/. Significant overall treatment benefit was measured for plural recognition and /s/ detection. When frequency compression was removed, no significant changes were measured. This may have been due to results approaching the significance level on the plurals task and to fairly small changes on /s/ detection overall. As well, performance on the discrimination task was at ceiling across all phases of the experiment. Error pattern analyses (see the Appendix) suggest that this participant experienced many different consonant identification errors over the course of the study; errors are not confined to specific distinctive features. However, acclimatization effects are noted for /r-v/ and /r-w/ confusions (i.e., identification improved over time) and on /z- dZ/ confusions (i.e., more errors were made over time).

Within the treatment condition, significant acclimatization-related changes were measured for plural and consonant recognition and for detection tasks. A significant nonlinear trend was observed for plural recognition along with a linear trend for consonant recognition (see Table 2). Therefore, two different acclimatization trends are present in the data sets for Case Study 3: gradual improvement over time on the consonant recognition task and improvement after 6 weeks of acclimatization on the plural recognition task.

Case Study 4

The child in Case Study 4 had the largest degree of benefit from frequency compression in the study, along with prominent patterns of acclimatization. Prior to beginning testing, this child requested a significant amount of adjustments to the initial fitting due to loudness, which contributed to gain reduction at approximately 2000Hz and above, consistent with reported fit-to-targets (see Table 1). TEN test results suggested the presence of cochlear dead regions at 2000 Hz and above; therefore, gain adjustments may have been driven by perceived distortion in sound quality and excessive loudness for sounds in the dead region (complaints related to average and loud conversational speech, spoken by school peers). These reports are consistent with those in the literature of listener-perceived sound quality at frequencies where dead regions are present (Moore, 2004). In addition to participant-driven gain reductions, we also created a noise management program (second to the main study worn listening program) to assist with hearing aid use in noisy environments; this program had the same frequency response as that of the testing program but included noise reduction digital signal processing. Figure 6 displays all results for Case Study 4. Significant initial frequency compression benefit was measured for plural recognition. Significant overall frequency compression benefit was found on the plural recognition, /s-S/ discrimination, and detection of /s/ and /S/. Significant decrements occurred when frequency compression was withdrawn-on all measures except the consonant recognition task; therefore, withdrawal effects were measured for tasks where frequency compression benefit was also noted and for tasks measuring the effects of speech perception related to /s/ and /S/ sounds. In addition, significant acclimatization trends were observed. A linear increase in performance with time was measured for plural recognition and detection based-tasks along with a nonlinear trend for /s-S/ discrimination (see Table 2). Error pattern analyses (see the Appendix) suggest improved consonant identification with frequency compression for some of the affricate, fricative, and other consonant sounds. Specifically, identification of /d/ improved with initial activation of frequency compression,

/tS-k/ confusion improved over time, and identification of /S/ and /8/ sounds improved with acclimatization time. Two unique acclimatization trends are present in the data presented for Case Study 4: gradual improvement over time for plural recognition and detection-based tasks and improvement after a specific period of acclimatization (i.e., approximately 6 weeks) for the discrimination task. Given this participant's history and extensive dead regions, enabling frequency compression likely would have provided novel sounds. For this reason, an acclimatization periodmay have allowed this listener to associate these novel cueswith specific phonemes (to be able to recognize and discriminate sounds). The significant withdrawal effect reported across four out of the five tasks suggests that benefit change over time can be attributed to novel speech cues introduced with frequency compression as opposed to practice effects.

Case Study 5

Case Study 5 is an example of a child who received significant benefit after acclimatizing to frequency compression. Across measures, this child's within-session variability was larger than that of other children, resulting in larger CIs. Figure 7 displays all results for Case 5. Significant initial and overall frequency compression benefit was measured for the discrimination task; a significant acclimatization effect occurred at approximately 8 weeks. Overall frequency compression decrement was measured for both detection tasks. When frequency compression was withdrawn, /s/ detection was significantly poorer. This participant did not comment on differences in sound quality or perceived speech perception ability over the course of the project. It is unclear why this participant experienced a performance decrement with frequency compression on the detection tasks. Hearing threshold levels, screened on more than one occasion, ruled out the presence of threshold shift.

Significant acclimatization-related improvement was measured in plural and consonant recognition as well as for /s-S/ discrimination (see Table 2). A large improvement in /s-S/ discrimination ability was observed after approximately 8weeks. Error pattern analyses (see theAppendix) suggest an initial decrement in identifying /tS/ and /f/ sounds, with /f/ largely being confused with /s/. Initial improvement in /z-v/ identification with frequency compression is also noted. Over time, /tS/, /dZ/, /s/, and /8/ identification improved with frequency compression. Improvement in /s/ identification was largely due to less /s-S/ confusions over time.Withdrawing frequency compression resolved /s-f / confusion but introduced greater difficulty identifying /d /.

Case Study 6

The child in Case Study 6 received little benefit from frequency compression and performed relatively poorly on all speech perceptionmeasures. Recall that this adolescent had the most hearing loss of all cases and was a longstanding wearer of monaural amplification due to lack of benefit amplification in her poorer ear. Although the study aidprovided greater range of sounds thanwas audible with her previous aid, speech audibility was very limited in the high frequencies. The chosen frequency compression setting was among the strongest available in the clinical software, yet neither the 4000-Hz bands nor the 6300-Hz bands were made audible (see Table 1). Aided measurements of /S/ indicated that the lower shoulder of the /S/ frication band was above threshold only when frequency compression was applied, whereas the /s/ frication band was well below threshold regardless of frequency compression activation/deactivation. Therefore, this case illustrates outcomes associated with a less-than-optimal fitting, even with frequency compression, due to limitations in fitting arising from profound hearing loss and device limitations.

Figure 8 displays all results for Case Study 6. Significant initial and postacclimatization frequency compression benefit was measured on the discrimination task. On the basis of the measurements of aided speech bands and aided live /S/ and /s/, this may relate to hearing a partial cue for /S/ and differentiating it from an inaudible or very soft/s/ when using frequency compression, versus hearing neither sound when frequency compression was not active. This type of discrimination was previously observed in studies of childrenwithmoderately severe to profound hearing losses (Kosky &Boothroyd, 2003). Within the first half versus last half of the treatment condition, we observed small but significant acclimatization-related improvements for plural identification,

consonant recognition, and /s-S/ discrimination (see Table 2). However, the acclimatization trend across the treatment period did not reveal a significant linear or nonlinear pattern and was not accompanied by a significant withdrawal effect (this result pattern is detailed below in the Discussion section). Error pattern analyses (see the Appendix) are difficult to interpret for this participant, as they are scattered across many different consonants and are nonuniform; this is thought to be due, in part, to the degree of hearing loss presented in Case Study 6. Initial improvement in identification of /b/ is noted with frequency compression, and greater /r-w/ confusions are noted over the treatment condition. Overall, this adolescent experienced significant frequency compression benefit in /s-S/ discrimination. The small but significant acclimatization-related improvements experienced during a trial with frequency compressionwere not large enough to result in significant benefits when compared to baseline or posttrial testing without frequency compression.

Discussion

In this experiment, we evaluated treatment effectiveness and auditory acclimatization effects attributable to frequency compression hearing aid signal processing. Performance with frequency compression varied across speech perception measures and participants. In general, a unique pattern of results was measured for each participant, with some participants demonstrating large changes in speech perception ability with frequency compression hearing aids and others demonstrating little change. Significant frequency compression benefit following an acclimatization period was observed for five of the six participants on any one measure. This pattern of results was more often observed when speech perception effects were measured through the use of high-frequency fricative sounds (i.e., using /s/ and /S/ stimuli). One participant (Case Study 3) did not demonstrate posttrial changes on anymeasure, and his performance was generally at ceiling acrossmeasures and processors. Frequency compression benefit, when it occurred, had a magnitude of up to 20% for tasks scored in percentage and up to 10 dB for aided thresholds. A frequency compression decrement of 12 dB was measured for one participant, even when the same participant derived benefit in other measures. We investigated acclimatization effects over 4 months in older children and adolescents in an effort to minimize maturational effects; however, improvements measured over time could have been due, in part, to maturation.

Treatment Effectiveness

Treatment effects described by outcome measure can be summarized as follows. For the plural recognition task, frequency compression benefit was measured for three participants: For one participant, benefit was measured right away, another demonstrated benefit only after an acclimatization period, and the third demonstrated an initial improvement in plural recognition that further improved with acclimatization time. For the consonant recognition task, none of the participants demonstrated initial benefit with frequency compression hearing aids; overall or posttrial benefit was measured for two of the participants. Benefit was measured on the /s-S/ discrimination task for three of the participants, with all three demonstrating overall benefit and two demonstrating initial and/or posttrial benefit; initial/posttrial performance decrement was measured for one participant on this task. Finally, on the detection tasks, benefit on either the /s/ or /S/ task was measured initially and/or posttrial for five of the six participants, with slightly more participants demonstrating improved /s/ detection ability when compared with /S/ detection; an initial performance decrement, resulting in posttrial benefit, was measured for one participant on the /S/ detection task. Overall, these results may indicate that detection measures appear to require less acclimatization time to show treatment effectiveness compared with discrimination or recognition measures. Further research would be required to evaluate this speculation.

Auditory Acclimatization

For two participants (Case Studies 2 and 4), postacclimatization benefit from frequency compression was accompanied by significant improvements over the treatment interval, suggesting that a period of acclimatization was needed for these listeners to benefit from the processor. These same participants did not show improvements during their baseline trial without frequency compression, suggesting that benefit observed over time was specific to audibility changes from frequency compression rather than from new sound from the

study aids versus their previous fittings.

Frequency compression-related decrement was most apparent for the child with the flattest audiometric configuration (Case Study 2). Results suggest that the child in Case Study 2 had more difficulty detecting /S/ and discriminating /S/ from /s/ when frequency compression was activated. Although this participant learned to differentiate between /s/ and /S/ and demonstrated improved consonant discrimination and error patterns, her ability to identify /S/ was best without frequency compression. We cannot fully explain this pattern of results, which speaks to the fact that frequency compression may introduce adverse speech perception effects for some listeners. A different setting may have resulted in different outcomes, but investigation of performance with an alternative frequency compression setting was beyond the scope of this study.

Two unique acclimatization patterns were measured in this study: gradual improvement over time (i.e., a linear trend) and improvement after a specific period of acclimatization (i.e., a nonlinear trend). The latter pattern, resembling an S-shaped curve, mainly occurred for the /s-S/ discrimination task (Case Studies 2, 4, and 5). An S-shaped pattern may be associated with the nature of the discrimination task and/or the novel cues presented with frequency compression. Specifically, this task requires the participant to be able to not only detect novel sounds but also differentiate between them. In some cases, only one sound may have been novel to the participant (e.g., new audibility of /s/ only), and the amount of frequency shifting may have differed for /s/ versus /S/. Differentiating between /s/ and /S/ in the presence of highfrequency hearing loss may be more difficult when the previously learned cues (e.g., the frequency location of a frication band) have been frequency lowered. This type of change likely requires the listener to relearn cues associated with a specific phoneme. The literature suggests brain plasticity as a possible underlyingmechanism for auditory acclimatization (Palmer, Nelson, &Lindley, 1998;Willott, 1996); the literature also suggests that frequency discrimination tasks are highlyamenable to auditory learning effects that generalize across tasks (Wright &Zhang, 2009). Because the peak frequency is an important cue for fricative recognition (Dubno &Levitt, 1981), we may speculate that learning the new frequency locations of /s/ and /S/ may be required for some users of frequency-lowering strategies. Brain plasticity may be required to excel on such a task, requiring the listener to learn to represent and integrate new acoustic information. Furthermore, some participants with S-shaped data patterns for the discrimination task required 6-10 weeks of acclimatization time prior to measurement of significant frequency compression benefit. In other cases (e.g., Case Study 6), participants demonstrated significant initial benefit, which remained stable over the treatment phase.

We also noted other interesting acclimatization results. In some cases, participants scored more poorly on some measures with conventional processing following the frequency compression trial (even though they did not benefit from frequency compression) versus the baseline trial. A possible explanation includes perceptual adjustment to speech cues, to the point that listening without frequency compression was disadvantageous. In other cases, significant improvements measured during treatment with frequency compression were followed by equally good scores with frequency compression withdrawn. A possible explanation for absent withdrawal effectsmay be a carryover effect in which the participants learned to use cues during the treatment phase of the study and were able to apply this learning even without the frequency-compressed signal (i.e., in the withdrawal phase). One possible mechanism for a carryover effect could be neural reorganization. Alternatively, it could be that the increased bandwidth of the study aids (versus their own aids) caused an acclimatization effect that was not specific to frequency compression. Although we took multiple measures during the baseline trial to guard against this confound, it is not possible to entirely rule out the potential for further acclimatization to conventional processing beyond the baseline phase in all cases.

Test Battery and Trial Length

The test battery used in this study was chosen to be sensitive to the effects of frequency-lowering hearing aids, both for high-frequency sounds and across a wide range of consonants. Stimuli containing fricative sounds such as /s/ and /S/ were of particular interest in this study because both contain high-frequency energy and because

the nonlinear nature of the frequency compressor used here provides more lowering for /s/ than for /S/, leading to the possibility of overlap of the two fricatives. The test battery contains stimuli spoken by different speakers, which resulted in minor spectral differences across tasks (see Figures 1 and 2), and spectral stimuli that are consistent with those reported in the literature (Boothroyd &Medwetsky, 1992; Pittman et al., 2003). The use of frequency compression processing alters the spectral shape of individual fricatives by lowering and narrowing the frication band. This depends on how the frequency compression was set; stronger settings provided more lowering effects. It is possible that frequency compression can alter the nature of fricatives substantially, resulting in their being perceived as a different phoneme or perhaps as a nonrecognizable sound. Certainly, some such effects were noticed in the consonant confusion matrices. These effects arose from a task in which listeners used a closedset response and were, therefore, forced to designate a phonemic response. Results from the consonant recognition test suggest that the participants experienced many different speech sound confusions in addition to the hypothesized /s-S/ confusion. Other types of confusions noted in this study include, but were not limited to, /8-v/, /r-w/, /s-f/, and /tS-k/. Some consonant confusion errors were present in the baseline fitting, some were a result of the introduction of frequency compression, and some resolved over time.We did not evaluate whether listeners would misidentify some phonemes if they had been given an open-set task, although this would be an interesting question for further research. Other factors to consider in test battery construction include the use of adaptive measures. One participant in this study performed at ceiling on all measures but /s/ detection, which was not only an adaptive task but also the highest frequency stimulus and was, therefore, highly sensitive to the effects of frequency lowering. These ceiling effects were not anticipated. The tasks themselves are difficult either due to the high-frequency content of the stimuli in combination with participants' hearing losses (detection and discrimination measures), low presentation level (plurals task), or low context (consonant recognition). Factors explaining the higher-than-anticipated scores may include the older ages of these adolescent participants- although many adolescents were tested on similar tasks by Glista et al. (2009)-or more recently developed hearing technologies that include broader bandwidth in both processing and output than the aids used by Glista et al. Ceiling performance with frequency compression hearing aids was reported previously (Wolfe et al., 2011).

Comparison With Other Studies of Frequency Lowering

Certain findings reported in the present study differ from those previously reported. Simpson and colleagues (2006) investigated frequency compression outcomes in seven adult participants with steeply sloping losses. The participants in the Simpson et al. study did not receive frequency compression benefit after a brief or absent acclimatization period. The authors of that study concluded that frequency compression for steep losses may use a strong degree of frequency lowering and that, perhaps, this may require additional adaptation time and/or training efforts (Simpson et al., 2006). In the present study, we found evidence to support this speculation in some (but not all) listeners; however, due to the small number of participants included in this study, further research is needed to investigate this correlation. A longer acclimatization period was needed to achieve significant frequency-lowered benefit for recognition tasks when compared withdetection tasks; these findings are consistent with those reported in studies of children by Auriemmo et al. (2009) andWolfe et al. (2011). Similarly, in a study including adult listeners, Kuk, Keenan, Korhonen, and Lau (2009) discussed the need for an adaptation period with frequency-lowering hearing aid technology, given the possibility that some wearers may not immediately accept the sound quality of such devices. Factors that may explain differences between the results reported in this study and those reported by Simpson et al. include the use of pediatric participants, more recently developed hearing instruments, and the use of a different fitting method. Further research would be required to determine the individual role of each of these factors.

In a previous study on frequency transposition, error pattern analyses revealed improved identification for some consonants, in addition to the introduction of different confusions (Robinson et al., 2007, 2009). Specifically, errors confusing /s/ with /S/ increased with the introduction of frequency lowering; New confusions remained

despite a 5-week period of experiencewith the study hearing aids. Robinson and colleagues (2009) speculated that the lack of overall benefit measured with frequency loweringmay have related, in part, to the relatively short trial period. Alternatively, findings from the current study suggest that speech sound confusions introduced with frequency lowering may resolve over time, for some listeners, and with a prolonged acclimatization period. It is difficult to compare these two studies directly, given the difference in fittings methods, participant ages, and processing schemes evaluated. Further research is needed to directly compare outcomes with different forms of frequency-lowering technologies.

In summary, this experiment provided case-specific evidence of auditory acclimatization to newly audible high-frequency sounds for some of the child listeners (ages 11-18 years) and in the presence of a well-controlled adaptation period. A unique pattern of results was measured across cases, suggesting that treatment and/or acclimatization effects measured within this study cannot be generalized outside of case-specific findings. Given the low incidence of permanent childhood hearing loss and the lower incidence of precipitous hearing losses within this group, the study of acclimatization effects through the use of strategies such as single-subject design allowed a systematic exploration of outcome in this group. Because the exact limits of candidacy for frequency lowering are not yet known, we sampled across a range of high-frequency hearing losses. In this sample, we had some participants who received little or no benefit from this technology and others who received significant benefit that sometimes required a period of acclimatization in order to take effect. These results are consistent with those of Glista et al. (2009), who reported a significant association between the degree and configuration of highfrequency hearing loss and candidacy for frequency compression, as well as those of Wolfe et al. (2011), who reported improvement of frequency compression benefit over time. In the present study, we measured the time course of acclimatization (when it did occur) by sampling outcomes at frequent intervals. From this design, we observe that acclimatization trends (when they occur) take two forms: (a) gradual linear changes and (b) sudden nonlinear changes that occur after a period of 6-10 weeks. Presence or absence of speech perception change varied not only across people but also across outcome measures. On the basis of this, we concluded (a) that individual determination of candidacy, fitted settings, and outcomes of frequency compression are warranted in clinical practice and (b) that further research is required to determine limits of candidacy and an optimal test battery for use in evaluation of outcome. Furthermore, research is needed with new frequency-lowering strategies to determine optimalmethods for fitting, particularly in cases of asymmetrical hearing losses, the construction of optimal outcome batteries, and evaluations of whether participant variables such as developmental status and hearing-loss profile affect benefit and/or acclimatization.

Acknowledgments

This work was supported by Canadian Institutes of HealthResearchGrant 200710CGD-188045-172173, Masonic Help2Hear Foundation, and Phonak AG. Special thanks to David Lee and Steve Beaulac for their assistance on this project, and to Andrea Pittman, Chris Lee, Meg Cheesman, and Richard Seewald for their comments on the project in various stages of development and writing.

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Editor: Sid Bacon
Associate Editor: Pam Souza
Received June 30, 2011
Revision received November 14, 2011
Accepted April 25, 2012
DOI: 10.1044/1092-4388(2012/11-0163)

Appendix
(ProQuest: Appendix omitted.)

Audiovisual Perception of Congruent and Incongruent Dutch Front Vowels

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.6 (Dec 2012): 1788-1801.
ProQuest document link

Abstract: Auditory perception of vowels in background noise is enhanced when combined with visually perceived speech features. The objective of this study was to investigate whether the influence of visual cues on vowel perception extends to incongruent vowels, in a manner similar to the McGurk effect observed with consonants. Identification of Dutch front vowels /i, y, e, Y/ that share all features other than height and lip-rounding was measured for congruent and incongruent audiovisual conditions. The audio channel was systematically degraded by adding noise, increasing the reliance on visual cues. The height feature was more robustly carried over through the auditory channel and the lip-rounding feature through the visual channel. Hence, congruent audiovisual presentation enhanced identification, while incongruent presentation led to perceptual fusions and thus decreased identification. Visual cues influence the identification of congruent as well as incongruent audiovisual vowels. Incongruent visual information results in perceptual fusions, demonstrating that the McGurk effect can be instigated by long phonemes such as vowels. This result extends to the incongruent presentation of the visually less reliably perceived height. The findings stress the importance of audiovisual congruency in communication devices, such as cochlear implants and videoconferencing tools,

where the auditory signal could be degraded.

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Purpose: Auditory perception of vowels in background noise is enhanced when combined with visually perceived speech features. The objective of this study was to investigate whether the influence of visual cues on vowel perception extends to incongruent vowels, in a manner similar to the McGurk effect observed with consonants.

Method: Identification of Dutch front vowels /i, y, e, Y/ that share all features other than height and lip-rounding was measured for congruent and incongruent audiovisual conditions. The audio channel was systematically degraded by adding noise, increasing the reliance on visual cues.

Results: The height feature was more robustly carried over through the auditory channel and the lip-rounding feature through the visual channel. Hence, congruent audiovisual presentation enhanced identification, while incongruent presentation led to perceptual fusions and thus decreased identification.

Conclusions: Visual cues influence the identification of congruent as well as incongruent audiovisual vowels. Incongruent visual information results in perceptual fusions, demonstrating that the McGurk effect can be instigated by long phonemes such as vowels. This result extends to the incongruent presentation of the visually less reliably perceived height. The findings stress the importance of audiovisual congruency in communication devices, such as cochlear implants and videoconferencing tools, where the auditory signal could be degraded.

Key Words: audiovisual speech perception, vowels, McGurk effect

(ProQuest: ... denotes formulae omitted.)

Perception of spoken language is not an auditory phenomenon only; it is also heavily influenced by visually perceived pronunciation information. The influence of visual cues on speech perception has been shown for a variety of speech tokens such as consonants (see, e.g., Massaro, 1987; for an overview, see Massaro, 1989; Massaro &Cohen, 1990) and vowels (Robert-Ribes, Schwartz, Lallouache &Escudier, 1998; Traunmüller &Öhrström, 2007) and for conditions such as hearing impairment (Baskent&Bazo, 2011; Grant,Walden,&Seitz, 1998; Miller &D'Esposito, 2005). This interaction is so strong that when the auditory and visual components are incongruent, they may fuse into a single percept that is different from both the original auditory stimuli and the original visual stimuli-also known as the McGurk effect (McGurk &MacDonald, 1976). For spoken man- machine interaction devices and video applications, such knowledge of audiovisual integration is crucial. For example, the precision with which the auditory and visual information are aligned in videoconferencing tools follows directly from research on audiovisual integration of temporally mismatching stimuli (McGrath &Summerfield, 1985; Miller &D'Esposito, 2005). Also, appropriate audiovisual alignment is especially important for users of rehabilitative communication devices such as cochlear implants and hearing aids. Because the auditory signals are less well transmitted, listeners with hearing impairment rely heavily on the visual cues (Baskent &Bazo, 2011; Champoux, Lepore, Gagneú, &Théoret, 2009; Rouger,Fraysse, Deguine&Barone, 2008).When auditory information is correctly aligned with visual information, listeners-especially those with hearing impairment- profit significantly from the visual information for understanding speech (Baskent &Bazo, 2011). However, when audiovisual information is not correctly aligned, disruptive interactions may be observed in addition to the loss of positive interaction. Disruptive interactions of audiovisual information have been shownwiththeMcGurkeffect for consonants but are not as extensively investigated for the case of vowels. However, it was recently shown that the contribution of vowels to the auditory intelligibility of speech is significant and could, in some listening situations, be even higher than the contribution of consonants (Cole,Yan, Mak, Fanty,&Bailey, 1996; Kewley-Port, Burkle, &Lee, 2007). Kewley-Port et al. (2007) argued that listeners with hearing impairment are evenmore dependent on the correct perception of vowels because, in most cases of hearing impairment, high frequencies (which are associated with consonants) are lost more readily than are lowfrequencies (which are associated

with vowels). Thus, correct alignment is shown to be important for audiovisual interaction devices, and although vowels are shown to be important for speech intelligibility, research has focused on audiovisual incongruence with consonants. As vowels are of higher intensity and have longer duration than consonants, the effect of visually incongruent information-for example, as in cochlear implant or hearing aid users-might be different for vowels than for consonants. In the present study, therefore, we investigated the perceptual processes that play a role in the audiovisual perception of vowels- more specifically, the Dutch high- and mid-high-front vowels ([i, y, e, Y], as in the Dutch words biet, fuut, beet, and hut, respectively)-with congruent and incongruent audiovisual features.

Onthe basis of acoustic information, the first formant (F1) and second formant (F2) of a particular vowel are most crucial for its recognition (for an overview, see Rosner &Pickering, 1994). Regarding the vowels of interest of the present study, the F1 is generally associated with the height feature, and the F2 is generally associated with the backness feature (Ladefoged, 1982; Rosner &Pickering, 1994). Furthermore, the literature suggests that F2 is also related to the lip-rounding feature for some vowels (Lisker&Rossi, 1992;Valkenier&Gilbers, 2008).Masking one of the formants by noise leads to perceptual confusions. By establishing confusion matrices for different levels of white noise, Pickett (1957) showed that the shared features of the vowels explain the relatively structured confusions that were observed. In short, height-by virtue of the perception of F1-is the most robust acoustic feature, followed by backness (F2).

In addition to the acoustic cues, visual cues also influence the perception of high-front vowels. Robert-Ribes et al. (1998) quantified the facilitatory influence of visual cues on the French high- and mid-high-front vowels [i, y] and [e, L] by using congruent audiovisual stimuli presented with white noise at different levels. In most cases, the visual and auditory cues are complementary (Massaro &Stork, 1995); for instance, lip rounding is a strong visual cue, whereas height is a strong auditory cue. Similarly, Miller and Nicely (1955) showed that most features of consonants that were easy to identify from a talker's face were hard to identify from hearing them, and vice versa. Summerfield (1987) labeled and described those findings as complementarity in audiovisual processing. Complementarity of the two modalities improves the perception of congruent audiovisual stimuli, especially when the auditory input is deteriorated (e.g., in background noise). However, if the audiovisual stimuli are incongruent, fusions may occur, such as in the McGurk effect (McGurk&MacDonald, 1976). In short, when a visual [ga] stimulus1 was concurrently presented with an auditory [ba] stimulus, the resulting perception was that of /da/.2 The McGurk effect is extensively investigated on different pairs of consonants. However, research has not yet established the limits and themagnitude of the fusion effect in the vowels that are acoustically more stable. One reason for this could be that such an investigation is relatively difficult to do in English, where the most visually distinctive feature-lip rounding-is not an independent distinctive feature of vowels. In other languages with an independent lip-rounding feature, however, an experiment can be conceived that uses vowels that share all perceptual features but rounding. In Swedish, for example, Traunmüller and Öhrström (2007) found a shiftin the auditory response from theSwedish high unrounded front vowel /e/ to the high rounded front vowel /L/, when an auditory [e] stimulus was shown concurrently with a visual [y] stimulus. However, this effectwasnot generalizable, as it was observed only with a subgroup of participants who were more prone toward using visual speech cues.

The aim of the present study was to establish the extent to which the acoustic and visual domains influence audiovisual vowel perception, both in quiet and in background noise. In addition to congruent audiovisual vowel perception, taking advantage of the lip-rounding feature of Dutch vowels, we investigated the perceptual fusion using incongruent audiovisual stimuli. If the visual and acoustic features are complementary, as argued by Robert- Ribes et al. (1998), the visually more salient (i.e., prominent) feature (i.e., lip rounding) leads to a stronger McGurk effect than the visually less salient one (i.e., height). For this purpose,wemeasured confusions (similar to the measurements done in Traunmüller &Öhrström, 2007, and Robert-Ribes et al., 1998) with the Dutch high- and mid-high-front vowels of [i, y, e, Y]. These vowels allowed vowel pairs thatwould differ only in

height or lip rounding. Hence, in the incongruent stimuli, conditions of audio and video input that differed in height only and/or rounding only could be tested.Contrary to the findings of Traunmüller and Öhrström (2007)-who analyzed the data for the subset of participants who were more prone toward using visual cues-we included all participants without a pre-selection.We induced a visual bias-that is, an increased reliance on visual information in audiovisual perception-for all participants by systematically adding noise to the auditory channel. The advantage in doing so is that the results can now be generalized to not only the subgroup of perceivers who are more prone toward visual cues but also to the entire group of normalhearing listeners and their audiovisual speech perception in suboptimal listening conditions.

Method

Subjects

Sixteen native speakers of Standard Dutch (11 men [Mage = 24.8 years, SD = 1.9]; 4 women [Mage = 23.8 years, SD = 0.5]) participated in the experiment. The data of one participant were not reliable because some data points were missing; therefore, we excluded all data of this participant from analysis. All participants reported normal hearing and normal-to-corrected vision. Participation was voluntary, with the possibility of withdrawing at any time during the study. Participants were fully informed about the study, and their written consent was obtained prior to data collection.

Stimuli

Selection of speech material and speech context. In order to give an impression of the Dutch vowel system, Figure 1 shows the vowel triangle of the Dutch vowels. The vowel triangle was created with the formants as determined with Praat (Boersma, 2001) from vowels produced in isolation by a 31-year-old female speaker of Standard Dutch. In the present study, we investigated the audiovisual perception of the Dutch high- and mid-high-front vowels [i, y, e, Y], which are represented as shaded circles in Figure 1. These vowels were selected because (a) lip-rounding and height features of these vowels cross in the acoustic as well as the visual domain and (b) there are no other confounding features. (For a more extensive analysis and justification of the selected vowels, see the Appendix.)

The vowels [i, y, e, Y] were recorded in the context of [c V c], where [c] represents a voiceless velar fricative (such as in the Dutch word acht). This choice was based on the argument by Traunmüller and Öhrström (2007) that velar consonants hardly affect the visibility of vowel features because the lips and the jaw do not need to be in a particular position. The voiced velar plosive [g], as was used in the Traunmüller and Öhrström study, does not exist in the Dutch language. Also, the use of the voiceless velar plosive [k] would lead to (semantically) meaningful Dutch words. As the context of the voiceless velar fricative c produces phonologically allowed nonsense words for all Dutch vowels, this seemed to be the most appropriate context structure.

Recording and editing of speech material. The stimuli were recorded in a quiet room with bright natural daylight against a white background. The speaker was a 22-year-old female native speaker of the standard variety of Dutch.The stimuliwere recordedwith a Samsung HMX-H106-SP video recorder placed approximately 3 m from the speaker, who was standing against the white background with audio sampled at a rate of 48000 Hz. Recordings were made from the front of the speaker's face, including the entire face and neck and with the mouth at one third from the bottom of the display screen on the computermonitor. The total frame size on the computermonitor was 513 cm2, and the size of themouth was approximately 3 cm2. The front portion of the tongue was visible for the high vowels (see Table 1).

For each vowel, two utterances were selected where the head movement was minimal, and the experimenters agreed on successful pronunciation of the target vowel. The duration of the video files of the selected stimuli were cut to equal duration of 1 s, with approximately 0.3 s neutral face at the start and end of the video. The long-term root-mean-square (RMS) levels of the audiorecordings were normalized with Praat. Steady low-pass filtered noise of varying intensities (SLN) was produced by low-pass filtering white noise (filter order = 1, resulting in a slope of -6 dB/oct in filter response). SLN was added to the stimuli (which were kept at constant

intensity), resulting in stimuli with signal-to-noise ratios (SNRs; calculated on RMS levels) of 30 dB (almost quiet), 0 dB, -6 dB, -12 dB, and -18 dB. Audio presentation level of processed stimuli was calibrated to a comfortable level of approximately 70 dBA (varying with variations in stimulus intensity).

Those prepared recordings were used as control conditions and served as a starting point for the creation of the stimuli of the experimental conditions. In the experimental conditions, the audio tracks with added noise were recombined with differing video tracks to create incongruent audiovisual stimuli in three conditions: (a) fully crossed, (b) incongruent lip rounding, and (c) incongruent height. In the fully crossed condition, vowel pairs differed in both height and rounding. In the incongruent lip-rounding and incongruent height conditions, vowel pairs differed in rounding only or in height only, respectively. This resulted in 328 stimuli of 1 s each (8 video vowel tokens + 8 audio vowel tokens ×5 noise levels + 16 incongruent audiovisual vowel stimuli ×5 noise levels ×3 conditions + 8 congruent audiovisual vowel stimuli ×5 noise levels). Thus, two different stimuli of each type were presented per condition in the control conditions (video, audio, and congruent audiovisual), and four different stimuli of each type were presented per condition in the incongruent experimental conditions.

Experimental procedure. An identification task was carried out in a sound-attenuated booth over headphones. Each participant was tested on the full set of control and experimental stimuli. Stimuli were presented and responseswere collected usingE-PrimeVersion 2.0 software (Psychology Software Tools) via a MacBook (aluminum unibody, Spring 2008 edition) running Windows XP SP2 via Boot Camp. The participants were seated facing (and about 70 cm away from) a 13.3-in. flat-panel LED display (resolution 1280 pixels ×800 pixels, vertical angle of view 18°, horizontal angle of view 26°). Participants wore Sennheiser HD 600 headphones that were directly connected to the MacBook sound card output.

The actual data collection was preceded by a short introduction with task instruction and symbol explanation (we did this to familiarize the participants with the possible responses and accompanying keys). The participants were informed that auditory, visual, and audiovisual stimuli were to be presented. The test instruction was to continuously look at the screen and to indicate by keypress what was perceived.

The test consisted of two blocks of approximately 15 min, with a short break in between. The stimuli were presented with all conditions and all stimuli randomized over both blocks. For each trial, the participant could start the presentation of the target stimulus by keypress. Afixation-cross appeared in themiddle of the screen for 1 s, after which the stimulus was presented. In the audio-only condition, the screen was black. After presentation of the stimulus, the response alternatives were shown on the monitor. The possible answers consisted of all rounded and unrounded Dutch high- and mid-high-front vowels: /y, Y, L, i, I, e/ plus the vowels /u, o, a/. These vowels were indicated on the screen with the grapheme that is normally written in Dutch with a common Dutch word to clarify the intended vowel sound. No limitation was imposed on response time.

Methodology of analysis. Perceptual confusions were measured, and confusion matrices were formed to depict patterns of perceptual change.However, in order to determine the significance of perceptual change, the experimenter must quantify the data differently, which we did by using error rates, as described below. Error rates were calculated for each experimental condition (c) by subtracting the accuracy (acc; the mean correct responses) from the highest possible error score of 1 (multiplied by 100 to obtain percentages), where acc was calculated as

... (1)

whereNTRIALS (c) was the number of trials for condition c andNCORRECT (pp,c) was the number of correct responses for participant pp in condition c.We used either the visual or the auditory stimulus as a truth reference in order to determine NCORRECT. As a means to determine the interaction effects in the audiovisually congruent conditions, we predicted error rates for multisensory responses (ep) from the accuracy scores for the auditory-only and visualonly conditions as

... (2)

where acc(A) was the accuracy score for the audio-only condition and acc(V) was the accuracy score for the

visualonly condition, and acc(A) ×acc(V) was the probability that both were correct. This way, we omitted effects of statistical facilitation and only determined the possible effects of multisensory interaction.

We used a second measure, relative transmitted information score (TREL), to analyze the availability of speech features in different noise conditions (for an overview and explanation, see van Son, 1994). TREL was the ratio between the transmitted information, T, and the maximum rate of transmission, TMAX, in percentages, such as

... (3)

where

... (4)

and

... (5)

HSTIM and HRESP were mean logarithmic products (entropies) for stimulus and response, respectively, and HCM was the entropy of the confusion matrix, calculated by

... (6)

where p(i, j) was the probability of observing response j for stimulus i in a two-dimensional vector or confusion matrix (HCM) and was replaced by either p(i) (HSTIM) or p(j) (HRESP) for a one-dimensional vector.

TREL was calculated per feature; the analysis was performed on matrices representing either rounded and unrounded stimuli and responses, or high and mid-high stimuli and responses. The relative rate of transmission represented the ratio of the responses that can be predicted from the stimuli (Miller &Nicely, 1955).

Results

Complementarity in Congruent Audiovisual Vowels

Table 2 shows the confusion matrices aggregated over all noise levels for the congruent conditions. Note that the visual-only [Y] was more likely to be perceived as /y/ than as / Y/. All other single-channel stimuli were perceived as mostly correct. Error rates (see Figure 2) and transmitted information scores (see Figure 3) were calculated for every noise condition separately. Also, the multisensory error rates as predicted from the auditory and visual error rates are presented. Figure 2 shows the error rates for the audio-only (filled triangles), video-only (filled squares), audiovisual congruent (filled circles), and audiovisual as predicted (ep; open circles) conditions as a function of noise level. Vowel discrimination benefited from combined audiovisual input, which is reflected in slightly lower error rates in the congruent audiovisual condition than ep, the multisensory error rates as predicted from the auditory and visual error rates (Friedman's test, c2 = 2.67, pone-sided = .051).A post hoc comparison showed that the difference was significant for the SNR levels -6 dB, -12 dB, and -18 dB (pairwise Wilcoxon, pone-sided <.05, adjusted for Bonferroni correction).

Visual Influence in Incongruent Audiovisual Vowels

Because the responses to incongruent stimuli can be evaluated with respect to the audio as well as the video input, we calculated two error rates for each incongruent condition. The leftand right panels of Figure 4 show the error rates with regard to the auditory and visual parts of the input, respectively. The error rates for the audiovisual congruent condition are the same in both panels because the visual and auditory stimuli were the same in this condition. The figure shows that both the auditory and the visual error rates are higher in the three incongruent conditions (open symbols) than in the congruent condition (filled symbols). In all conditions, the auditory perception deteriorates with increasing noise level, which is reflected by upward slopes. In contrast, the visual perception improves with increasing noise, reflected by a similar, but inverse and less profound, pattern with regard to the visual error rates.

Table 3 shows the results of Friedman's test (a)when the visual error rate of an incongruent condition was compared with the congruent condition or the visual-only condition and (b)when the auditory error rate of an incongruent condition was compared with the congruent condition or the audio-only condition. Table 3 also shows the levels for which the post hoc Wilcoxon test is significant (after correction for Bonferroni).

For all incongruent conditions, the overall auditory and the overall visual error rates are significantly different

from the four reference levels (Friedman, p <.001, post hocWilcoxon's test, adjusted p <.05 for all comparisons except for visual error rate for incongruent liprounding compared with visual-only for -6 dB, -12 dB, and -18 dB). For all but one of the conditions, the error rates in the experimental condition are significantly higher than the reference levels; namely, the overall auditory error rate in the incongruent height (and, thus, congruent lip-rounding) condition is significantly lower than the audio-only error rate.

The auditory error rates in the incongruent liprounding condition and the incongruent lip-rounding and height condition are significantly different from the auditory error rates in both the audiovisual congruent and the audio-only conditions for the 0 dB, -6 dB, -12 dB, and -18 dBSNRlevels (p <.01). The auditory error rates in the incongruent height condition are significantly higher than the audiovisual congruent error rates for the SNR of -18 dB (p <.05) and are significantly lower than the audio-only error rates for the SNR of -18 dB (p <.05).

Transmitted Information Scores

The transmitted information scores provide more detailed insight into the error rates, as they show what part of the information was or was not available when analyzed for different features. Figure 3 shows the transmitted information scores for lip-rounding (leftpanel) and height (right panel) for the audio-only, video-only, and audiovisual congruent conditions. Highest profit from visual inputwas in noise; the audiovisually transmitted information for lip-rounding is significantly higher than the auditorily or visually transmitted lip-rounding information for SNRs of -6 dB, -12 dB, and -18 dB (Friedman c2 = 42 and 23, respectively, p <.001;Wilcoxon, adjusted p <.05). Furthermore the lip-rounding is better transmitted visually than auditorily at SNRs of -12 dB and -18 dB (Friedman c2 = 7, p <.01;Wilcoxon, adjusted p <.001). The height information is better transmitted auditorily and audiovisually than visually for all SNR levels (Friedman c2 = 59 and 66, respectively, p <.001; Wilcoxon, adjusted p <.05).

McGurk Effect in Incongruent Audiovisual Vowels

In incongruent conditions, fusions of features were expected to occur-namely, features from the visual and auditory input are recombined into a perceived vowel that was not presented in either one of the channels. We originally expected fused percepts that combine the auditorily salient height feature and the visually salient rounding feature. In the present study, apart from these expected fusions, unexpected ones were also found, as seen in the confusion matrices aggregated over all noise levels (see Table 4), where the shaded numbers represent the expected fusions. All fusions that seemto be a trend in the data are reported in this section, and the unexpected findings (that are a trend) are explained in theDiscussion section. Furthermore, the effect of noise on the number of fusions is analyzed. An increased reliance on visual information in audiovisual perception was induced by adding noise to the auditory channel. In order to quantify this effect, we present the major fusions; these are the fusions that occur most often per category, whether they were predicted or not. Namely, if reliance on visual cues as a result of noise in the auditory domain leads to increased audiovisual integration, a significant increase in number of fusions is expected. The major fusions are plotted in Figure 5 as a function of noise. Later in the text of this article, test results for the increase (or decrease) of these fused responses is reported (see end of this section).

Table 4A shows the responses in the fully crossed condition. In this condition, fusions occurred when the vowels [iA, eA, yA, YA] were presented with the vowels [YV, yV, eV, iV] (where superscript "A" or "V" denotes that the phoneme was presented through the auditory {A} or visual {V} channel). Although we expected to find the fused responses /y, Y, i, e/, respectively, the observed fusions led predominantly to perceived /y, L, i, I/ instead. The peak of the observed fusions was found at a SNR of -18 dB for [iA] with [YV] and at SNR of -12 dB for the other three stimulus pairs.

Next, Table 4B shows the responses for the liprounding incongruent condition. We expected increased visual responses because the auditory and visual height information are combined with the visually salient liprounding feature. Next to this expected result, we found that [YA] presented with [eV] was sometimes perceived as /I / (ranging from 9% at 30 dB SNR to 40% at -6 dB SNR). Also, [eA] presented with [YV] was sometimes perceived

as /L/ (ranging from 34% at 30 dB SNR to 70% at -12 dB SNR).
Finally, Table 4C shows the responses for the incongruent height condition. We expected increased auditory responses because the auditory and visual rounding information are combined with the auditorily salient height feature. Next to this expected result, we found an increase in /I/ responseswhen [iA]was presented with [eV] (ranging from 0% at 30 dB SNR to 56% at -18 dB SNR).
The major fusions are shown in Figure 5 as a function of noise. For each crossed condition, a separate bar gives the percentage of fusions ranging from 1.5% fused responses for [yA] with [eV] in clean speech to 86% fused responses for [eA] with [yv] in -12dB. For all pairs, the percentage of fused responses increases with increasing noise up to SNR of -12 dB. For all pairs but [iA] with [YV], the increased percentage of fused responses is turned around with SNR of -18 dB. A Friedman test with noise level as factor revealed that the amount of fused responses is significantly different for different noise levels: Friedman c2(4) = 202, p <.001.Apost hocWilcoxon analysis revealed that the amount of fusions significantly changed for each increase in noise. The amount of fusions increased for SNRs of 0 dB, -6 dB, and -12 dB and decreased for SNR of -18 dB (adjusted p <.01 for all comparisons).

Discussion

In the present study, we used congruent and incongruent Dutch front vowels as audiovisual stimuli, presented in steady low-pass filtered noise, to investigate to what extent visual cues influence the perception of vowels. The noise, by degrading the auditory input and forcing the participants to relymore on the visual input, served the purpose of producing robust perceptual interactions between the audio and visual cues.
Robert-Ribes et al. (1998) showed, for the case of vowels, that visual and auditory features are complementary (see also Summerfield, 1987)-namely, the feature whose auditory discrimination is hardest can be perceived better through vision, and vice versa. When the information is incongruent, the auditory and visual features were expected to interact in a way that can be explained by the ease of perception in either of the two channels. For incongruent stimuli, this would yield perceived vowels that combined the most salient auditory cue with the most salient visual cue. This would, in turn, lead to fusions of vowel features, similar to the McGurk effect previously observed with consonants.

Complementarity in Congruent Audiovisual Vowels

We reproduced the findings of Robert-Ribes et al. (1998) for Dutch vowels. Our results showed complementarity of the features in the auditory and visual channels; the transmitted information for lip-rounding, for example, was higher in the congruent audiovisual condition than the transmitted information for lip-rounding in the audio-only or video-only condition (see Figure 3). Also, for low SNR, the perception of congruently presented audiovisual vowels was better than the score that was predicted on the basis of vowels perceived through either of the single channels (see Figure 2).

Visual Influence in Incongruent Audiovisual Vowels

Themain interest of the present study was the perception of audiovisually incongruent vowels. Because vowels are shown to contribute significantly to intelligibility of speech (Kewley-Port et al., 2007), correct perception of vowels can be decisive for speech understanding. Yet, this can be disrupted as a result of misalignment of the auditory and visual signals-for example, in modern audiovisual communication devices. Until now, research on audiovisual incongruency has focused on consonants; this research needs to be extended to vowels.
In this study,we showed that the auditory processing of vowels was influenced by incongruent visual information that was reflected by an increase in auditory error rates in comparison to the audiovisual congruent condition (see Figure 4). The increased auditory error rate was highest for both conditions when the auditory stimulus was presented with incongruent lip-rounding; however, incongruently presented height also led to a change in the response distributions. Thus, apart from the beneficial influence that congruent visual information has on the perception of speech (Baskent &Bazo, 2011)-and, more specifically, vowels (in addition to this study, see also Robert-Ribes et al., 1998)-incongruent visual vowel information is disadvantageous for the correct perception of

vowels. Even when the visual input is not very salient (i.e., height), incongruent presentation can disrupt the perceptual process, especially when the auditory signal is less well transmitted. If processing speed in audiovisual devices can be improved by passing half the auditory information, one can think of special conditions where ignoring the visually salient lip-rounding information in the audio channel of technical devices would improve the alignment by improving the processing speed. This could aid the correct perception of vowels and, hence, speech, as the information is transmitted through the channel through which it is saliently perceived.

McGurk Effect in Vowels With Incongruent Lip-Rounding

For the incongruent conditions where both visual and auditory error rates were higher than the audiovisual congruent error rates, the perceived vowel was neither the auditorily presented one nor the visually presented one. This was the case in both conditions with incongruent lip-rounding. The confusion matrices for those conditions showed fusions of vowel features (known as the McGurk effect). As was hypothesized, the fusions consisted mainly of vowels in which the height of the auditory vowel was combined with the rounding of the visual vowel (see shaded cells in Table 4). Exceptions to this were the following: In the incongruent lip-rounding and height condition, [YA] that was presented with [iV]was perceived as /I/, and [eA] that was presented with [yV]was perceived as /L/. Similarly, the incongruent lip-rounding condition showed a recombination of [YA] that was presented with [eV] into / I / percepts and [eA] that was presented with [YV] into /L/ percepts. Although wepresent themas exceptions, the responses can be interpreted as natural fusions. As explained in the Appendix, the vowel [Y] was used instead of [L] because [Y] belongs to the same viseme category as [y]. Although both [L] and [Y] are called "mid-high vowels," their first formant frequencies (F1s) are not identical (Adank, Hout, &Smits, 2004). F1 of [Y] ismore similar to the F1 of [I] than to the F1 of [i] or [e]. Also, the F1 of [e] is more similar to the F1 of [L] than to the F1 of [Y] or [y]. Therefore, the results are not intrinsically different from McGurk-like fusions, especially considering the fact that height is most salient in the auditory channel. Namely, an audiovisual vowel is perceived with the rounding of the visually presented vowel and with the F1 closest to the auditorily presented vowel.

McGurk Effect in Vowels With Incongruent Height

Contrary to our expectations, we also found significant visual influence when height was presented incongruently in the auditory and visual channels. Height is not a very visible feature because tongue placement is hidden behind lip articulation. Therefore, we expected results similar to those of the congruent stimuli-that is, [YA] presented with [yV] would then lead to the auditory height perception of /Y/ and the visual rounding perception of /y/, resulting in a perceived / Y/. Indeed, the visual influence of congruent lip-rounding was additive or complementary; auditory identification improved with regard to the audio-only condition. However, next to this positive influence, we also found a detrimental influence; both auditory and visual identification degraded (i.e., resulted in higher error rates) with regard to the audiovisual congruent condition, which implies that neither the visual nor the auditory input was effectively perceived.

The confusion matrices show that the detrimental effect in both modalities was due to two effects of nonnormal perception /fusions (see Table 4C). First, [yA] that was presented with [YV] led to the perception of either /y/ or / Y/, where we expected a congruency effect leading to predominantly /y/ responses. The perception of /Y/ combined the auditory and visual perception of liprounding with the visual height despite the fact that the visual height was less well transmitted visually than auditorily at all SNR levels (see Figure 3). Second, an increase in the number of /I/ perceptions was found when [iA] was presented with [eV]. This was not a purely auditory effect, as auditory [i] that was presented on its own did not often result in /I / percepts (see Table 2A). It must be noted, however, that also in the three control conditions, / I / responses were given to both [i] and [e] stimuli. The effect can partly be explained as follows: [I, i, e] belong to the same viseme category of short unrounded vowels (van Son, Huiskamp, Bosman, &Smoorenburg, 1994). Adank et al. (2004) showed that the mean F1 values for those vowels (pronounced by 10 female speakers) are 442 Hz, 399 Hz, and 294 Hz for [e], [I], [i],

respectively. Therefore, the perceived /I/ combines the audiovisual lip-rounding with a vowel having the height (F1) in between the height of the presented vowels [e] and [i] despite the fact that height is best transmitted auditorily at all SNR levels. It turns out that the incongruent visual inputwas sometimes preferred over themore reliably transmitted auditory information (see confusions in Table 4C).

It can be concluded that in special cases,where perceptual features are crossed, fusions occur in incongruently presented vowels, similar to the McGurk effect commonly observed in consonants. Vowels are longer in duration and higher in energy than consonants, and the results show evidence that these intrinsic differences do not prevent the cognitive system from binding information from the different modalities, especially when the auditory signal is less reliable. Further research could reveal audiovisual interactions between vowels and consonants. Audiovisual interactions of long vowels and short consonants could lead to partial incongruence, the effect of which is unknown. Also, the interaction of auditory and visual streams of information for peoplewho are hard of hearing might differ from the results found in this study and, thus, needs further investigation. Namely, longstanding hearing loss might lead to a different phonological system (e.g., a few of the participants with cochlear implants in the study conducted by Schorr, Fox, Wassenhove, and Knudsen [2005] gave [ta] responses to the three different stimuli /ka, pa, ta/, indicating that the phonological system is broadened for these participants with regard to these phonemes), which could result in interactions different from the ones found here. Insight into the interaction of auditory and visual information streams in different conditions may help provide a better understanding of the problems that people experience with misalignment of the auditory and visual channels and where the focus should be with regard to alignment.

The Influence of Saliency on the McGurk Effect

The influence of saliency on the amount of fused responses can be related to the transmitted information scores. It was shown that the amount of fused responses increases significantly for increasing noise levels up to SNR of -12 dB. The auditory transmitted information scores for height decrease gradually, with noise increasing to SNR of -12 dB, and, hence, the reliance on visual information increases; transmitted information for liprounding is better through the visual than through the auditory channel for SNR of -6 dB and below. Furthermore, it was shown that the amount of fused responses significantly decreases for -18 dB SNR with respect to -12 dB SNR. This can similarly be related to the steep drop in transmitted information for height-and, hence, the identifiability of the height feature. Thus, when noise increases, the reliance on visual information increases accordingly, which leads to fused responses provided that the auditory height is perceived correctly.

Conclusions

In summary, we have demonstrated that the audiovisual information leads to complementarity in congruent vowels. Furthermore, we have shownthat incongruent visual input influences the perception of stimuli, although visual information alone may not be sufficient to disambiguate between vowels. Finally, we have shown that this knowledge is not always used optimally, as listeners sometimes used less salient information from one modality even when more salient information was available fromthe other modality.The finding that even the visually less salient height feature influences auditory identification stresses the importance of appropriate audiovisual alignment in communication devices, such as cochlear implants and/or videoconferencing tools, especially when the auditory signals are degraded and listeners rely heavily on visual cues (Champoux et al., 2009; Rouger et al., 2008). For those types of applications, the addition of visual information is of great help; however, if misaligned with auditory information, it may distort the perception of speech.

Acknowledgments

The first authorwas supported by Stichting Technologische Wetenschappen (STW) Grant DTF 7459 and is supported by Samenwerkingsverband Noord Nederland (SNN) Grant 221. The fourth author is supported by a Rosalind Franklin Fellowship from the University of Groningen and by VIDI Grant 016.096.397 from the Netherlands Organization for Scientific Research (NWO) and the Netherlands Organization for Health Research and Development (ZonMw).

This work was based on the second author's minor thesis, which was completed at the Research School of Behavioral and Cognitive Neurosciences, University of Groningen, the Netherlands. We thank Maeike Kiers for helping us to record the speech material and Dörte Hessler for her advice regarding the stimuli creation. Also, we thank Rob van Son for his insightful comments on the statistical analysis.

Footnote

1In this notation, square brackets are used for phones or specific utterances.

2In this notation, slashes indicate perceived vowel quality or perceived vowel class.

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Editor: Sid Bacon
Associate Editor: Charissa Lansing
Received August 15, 2011
Revision received February 3, 2012
Accepted April 26, 2012
DOI: 10.1044/1092-4388(2012/11-0227)

Appendix

Appendix. Detailed analysis and justification of the selected vowels.

The high and mid-high front vowels [i, y, e, Y] were selected because lip-rounding and height features of these vowels cross in the acoustic as well as the visual domain with no other confounding features, as explained

below in detail:
1. With regard to the acoustic features, height and diphthongization were aimed to be matched in pairs of vowels. The Dutch vowels [i, y] are high vowels and [e, I, Y, L] are mid-high vowels (Adank et al., 2004; Pols, Tromp, &Plomp, 1973; van Hout, Adank, &van Heuven, 2000). Van Hout et al. (2000) found that expert listeners judged the vowels [e] and [L] in standard Dutch as relatively monophthongal, although they are conventionally described as diphthongs (Gussenhoven, 1999) or near-diphthongs (Rietveld &van Heuven, 2009). Therefore the vowels [i, y] and [e, I, Y, L] make appropriate candidates for the forming of vowel pairs that are either different from or equal to one another in height.
2. With regard to the visual features, the rounded vowels [y] and [Y] belong to the viseme category of "short rounded front vowels," whereas [L] belongs to "long rounded front vowels" (Van Son et al., 1994). The vowels [e, I, i] belong to the viseme category of "unrounded front vowels." Therefore, the vowels [y, Y] and [I, i, e] make appropriate candidates for the forming of vowel pairs that are either different from or equal to one another in rounding.
3. The crossing of features in the acoustic and visual domains was necessary for analyzing the responses to the incongruent vowel stimuli-that is, where a feature can conflict in the auditory and visual domains without other conflicting features. Using crossing of features as a criterion, it was most appropriate to use [e] and [i] as monophthongal and unrounded vowels (mid-high and high, respectively) and [Y] and [y] as monophthongal and rounded vowels (mid-high and high, respectively; see Table 1). As an example, complete crossing can now be achieved by combining the auditory vowel [e] with the visual vowel [y] (crossed on both the rounding and height features, whereas all other features are kept equal).

The Consonant-Weighted Envelope Difference Index (cEDI): A Proposed Technique for Quantifying Envelope Distortion

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.6 (Dec 2012): 1802-1806.
ProQuest document link

Abstract: The benefits of amplitude compression in hearing aids may be limited by distortion resulting from rapid gain adjustment. To evaluate this, it is convenient to quantify distortion by using a metric that is sensitive to the changes in the processed signal that decrease consonant recognition, such as the Envelope Difference Index (EDI; Fortune, Woodruff, &Preves, 1994). However, the EDI relies on the entire duration of the signal, including portions irrelevant to consonant recognition. This note describes a computationally efficient method of automatically segmenting speech in time according to the syllable structure. Our technique uses the 1st derivative of the envelope as a basis. Peaks located in the derivative were used to generate a weighting function for the computation of a metric of signal distortion. The weighting function significantly improved the variance explained in consonant recognition scores over previous methods. However, only 3.2% of the variance was explained in the revised model. This technique was effective in focusing the analysis of distortion on specific segments of the signal. Use of the technique has implications for speech analysis. The difference in the amplitude envelope of consonants is not a robust model of the effect of hearing aid compression on consonant recognition.

Full text: Headnote

Purpose: The benefits of amplitude compression in hearing aids may be limited by distortion resulting from rapid

gain adjustment. To evaluate this, it is convenient to quantify distortion by using a metric that is sensitive to the changes in the processed signal that decrease consonant recognition, such as the Envelope Difference Index (EDI; Fortune, Woodruff, &Preves, 1994). However, the EDI relies on the entire duration of the signal, including portions irrelevant to consonant recognition.
Method: This note describes a computationally efficient method of automatically segmenting speech in time according to the syllable structure. Our technique uses the 1st derivative of the envelope as a basis. Peaks located in the derivative were used to generate a weighting function for the computation of a metric of signal distortion.
Results: The weighting function significantly improved the variance explained in consonant recognition scores over previous methods. However, only 3.2% of the variance was explained in the revised model.
Conclusion: This technique was effective in focusing the analysis of distortion on specific segments of the signal. Use of the technique has implications for speech analysis. The difference in the amplitude envelope of consonants is not a robust model of the effect of hearing aid compression on consonant recognition.
Key Words: envelope, consonant, speech, distortion, syllable
(ProQuest: ... denotes formula omitted.)
Amplitude compression is widely used in hearing aids to provide audibility without making loud sounds uncomfortable. A negative consequence of amplitude compression is distortion of the temporal envelope (e.g., Jenstad &Souza, 2005), which consists of slow changes in level over time useful for speech understanding. In previous work (Jenstad &Souza, 2005, 2007; Souza, Hoover, &Gallun, 2012), envelope distortion was measured using theEnvelope Difference Index (EDI; Fortune, Woodruff,&Preves, 1994). The EDI is the mean absolute difference in envelope between two signals. For amplitude compression, there is an approximate threshold of EDI = 0.2, above which consonant recognition, in both nonsense syllables and sentences, decreases (Jenstad &Souza, 2007). This information can be used in the design and prescription of hearing aid compression parameters as an upper limit of acceptable envelope distortion.
A limitation to the conventional EDI when used with vowel-consonant-vowel (VCV) stimuli is that the calculation included portions of the vowels that were unlikely to contribute to consonant recognition.We hypothesize that calculating the EDI from the entire duration of the speech token included envelope distortions irrelevant to consonant recognition. By restricting the analysis to the portion of the token that is thought to contribute to information transmission, we expect to improve the predictive power of the EDI for levels of signal distortion typical of hearing aid compression.
In order to focus our analysis on the consonant, we must make choices about what portions of the signal contribute to consonant recognition. In running speech, this issue is complex (see, e.g., Drullman, Festen, &Plomp, 1994). In more strictly controlled stimuli, such as VCVs, we can reasonably assume that the signal amplitudes at the onset of the initial vowel and the offset of the final vowel contribute minimally-or not at all-to the recognition of themedial consonant.These onsets and offsets can be greatly affected by compression (e.g., overshoot at a vowel onset). We would like to reduce the influence of these regions to our measure of consonant distortion by decreasing the weighting of amplitude changes in regions far from the medial consonant.
Current techniques for automatically parsing syllables attempt to identify vowels at syllable nuclei using peaks in the temporal envelope (de Jong &Wempe, 2009; Wang &Narayanan, 2007). Although this is a robust approach, it is not suitable for our purposes because it is temporally imprecise and is susceptible to amplitude compression. Temporal imprecision results from the use of very low envelope filter cutoffs and correlations over time to improve the accuracy of syllable identification in spontaneous speech. Our restricted set of VCV stimuli allows for the use of a less complex method. However, our test stimuli are subjected to amplitude compression, which flattens the temporal envelope and can introduce artificial peaks when gain is reduced (reviewed in Souza, 2002). Because we need to parse speech stimuli that may be heavily compressed, existing techniques

relying on locating peaks in the temporal envelope are not appropriate.

Instead of relying on peaks in the temporal envelope, we propose relying on peaks in the first derivative of the temporal envelope. These peaks, both positive and negative, correspond to transitions into and out of pauses in speech, and to the opening and closure of articulators during transitions between consonants and vowels. This is a modification of existing techniques, resulting in a representation of syllables that is temporally precise, informative of both syllable onsets and offsets, and robust to the temporal envelope distortions introduced by amplitude compression.

Algorithm for Syllable Segmentation

The proposed algorithm, the consonant-weighted Envelope Difference Index (cEDI), identifies syllables in a speech signal by selecting consecutive positive and negative peaks from the first derivative of the temporal envelope. Figure 1 (Panel A) demonstrates the algorithm output at various stages for an input signal with two syllables. The waveform for the syllable [ama] is shown by the light etching. The envelope (dark solid line) is extracted by using rectification and low-pass filtering. The result is down-sampled, and the first derivative (medium-dark line) is computed. Peaks in the derivative (vertical dashed lines) are identified that occur at magnitudes greater than a threshold parameter. The highest magnitude peak is selected in alternating directions. These peaks represent the transitions in the envelope from low to high or high to low amplitude, corresponding to the onset and offset of vowels in each syllable. Panel B in Figure 1 is discussed in the Analysis of Consonant Distortion section below.

Method

The cEDI was evaluated by retrospectively applying it to a subset of previously collected data. Details are available in Souza, Hoover, and Gallun (2012). Briefly, 10 listeners (Mage = 25.1 years) with normal hearing (thresholds <25 dB HL)were presentedwithVCVstimuli, whichwereprocessed to reduce spectral cues so that recognition relied primarily on the low-frequency temporal envelope. The stimuli included the consonants /b, d, g, p, t, k, f, q, s, X, v, 8, z, Z,m, n/ spoken with the vowel /a/ by four American English talkers (Turner, Souza, &Forget, 1995). Each stimulus waveform was band limited to 176-7168 Hz and was converted into signal correlated noise (SCN; Schroeder, 1968) by filtering into four bands (crossover frequencies 440, 1130, and 2800 Hz), multiplying each sample of the four time-domain waveforms randomly by either +1 or -1, and filtering the four resulting signals into their respective input bandwidths. Amplitude compression was applied to the stimuli using a hearing aid simulator (GennEM v1.0; Armstrong, 1997) in four conditions determined in a preliminary analysis to produce a range of EDI. The compression ratio and release time for each condition are listed in Table 1, as well as the mean EDI for each condition. Listeners were seated in a sound-treated booth, and data were collected with a touch-screen monitor. Sounds were presented at 65 dB SPL using Etymotic Reseach ER-2 insert earphones. Listeners were instructed to select, from a grid of consonants, the one most similar to the sound presented in a 16-alternative, forced-choice paradigm.

Analysis of Consonant Distortion

In order to measure only the envelope changes that could affect consonant recognition, we first identified the segment of each token surrounding the consonant, as follows (see Figure 1, Panel A). TheVCVwas rectified using half-wave rectification and was low-pass filtered using a fifth-order Butterworth filter with a 50-Hz cutofffrequency. The resulting envelope signal was down-sampled to a sampling rate of 450 Hz. The first derivative of the envelope was computed by the difference between consecutive samples. Peaks greater than a threshold slope parameter of m = ±0.41 were labeled. From this set, four peaks were selected as the onset and offsets of the nuclei in each syllable. The peaks were selected using the following logic: For each syllable, the greatest positive peak is the onset until a negative peak is reached, then the most negative peak is the offset until a positive peak is reached, indicating the next syllable. The identified locations were inspected manually to ensure that the algorithm was successful in all cases.

A window function was computed from the selected peaks, and this window was applied as a scaling function in

theEDI computation, resulting in a consonant-weighted metric: cEDI. The window was formed independently for each consonant and talker, based on the syllable landmarks identified from peaks in the derivative of the envelope. The window was a cosine-squared ramp from 0 before the first peak to 1 at the midpoint in time between the first and the second peak, then back to 0 from the midpoint between the third and the fourth peak to the fourth peak. An example window is shown by the thin line in the upper panel of Figure 1.

The computation of the cEDI is as follows:

... (1)

The absolute value of the difference between the compressed and uncompressed envelopes (Env1 and Env2, normalized) is averaged over each sample (N) and divided by two (Fortune et al., 1994).The computation of the cEDI multiplies each envelope by the window computed above, w(n), prior to normalization. A window of 1 for all ns was used when calculating the EDI by the conventional method.

The bottom panel of Figure 1 shows the uncompressed (solid line) and compressed (dotted line) envelopes for /ama/. The gray vertical bars in the lower panel of Figure 1 showthe difference values included in the conventional EDI, and the darker vertical bars in the lower panel of Figure 1 show the difference values included in the cEDI,which result fromthe application of the window function. The window reduced the contribution of the initial vowel onset and final vowel offset, which are regions distorted by compression, yet unlikely to contribute to consonant recognition, and not likely to affect the EDI proximal to the consonant transition regions.

Results

The effect of distortion on temporal envelope cues was quantified by using the conventional EDI, as reported previously, and by using the cEDI. Figure 2 shows the correlation between the EDI and cEDI for each stimulus waveform in the study. Results from normal hearing listeners recognizing the spectrally reduced and compressed consonants are shown in Figure 3. Mean consonant recognition was reduced in Condition 3, $t(9) = 2.6$, $p = .028$, and Condition 4, $t(9) = 4.0$, $p = .003$, in which envelope distortion from compression was the greatest. To evaluate our prediction that focusing the analysis of distortion on the consonant portion of the signal would improve its correlation to behavioral performance, we used both the EDI and cEDI in a linear model of consonant recognition. A stepwise linear regression was used with three factors: (a) a metric of distortion (EDI or cEDI), (b) the consonant, and (c) an interaction between consonant and distortion metric. Both the EDI and cEDI accounted for a small but significant portion of the variance in consonant recognition (EDI, $r2 = .019$, $p = .028$; cEDI, $r2 = .032$, $p = .004$), and the cEDI accounted for more of the variance. The consonant and consonant interaction factors were not significant for either model.

Discussion

Comparison of EDI and cEDI

The results confirm our hypothesis that focusing the analysis of distortion in a signal on the consonant would improve the relationship between distortion and consonant recognition. As demonstrated in Figure 2, the cEDI gives a broader range of values for the same compressed signals comparedwith the conventional EDI. This indicates that the cEDI is more sensitive to the effects of compression on consonant cues in the temporal envelope than the conventional EDI. As a result, more of the variance in consonant recognition is accounted for with the cEDI. However, the total amount of variance explained remains an unremarkable 3.2%. While it is an improvement over the EDI, the cEDI fails to capture the changes to the temporal envelope that are perceptually salient to the listener. A model based on a frequency analysis of the temporal envelope, such as the Spectral Correlation Index (SCI), may be a better approach to quantify the effect of envelope distortion (Gallun &Souza, 2008). Future work will apply the syllable parsing presented here to a model of signal distortion based on the spectrum of the envelope.

Syllable Analysis

The algorithm for automatically parsing syllables presented in this article was highly successful when applied to VCV stimuli. The technique located the peaks corresponding to every VC and CV transition in the set of 16

consonants for all 4 talkers. A single threshold value was needed for the entire set of signals when uncompressed.The techniquewas also successful in parsing the compressed signals, but high levels of compression required the selection of a lower threshold value for some consonants. The central two points identified by the algorithm, which indicate the location of the consonant, were not affected by compression. Because of the success of the algorithm under heavy compression, we are confident that itwill be useful in a broad range of applications.

Future Directions

The technique for syllable segmentation developed for this article has applications beyond segmenting the two-syllable speech signals analyzed here. Future work will apply the technique to longer utterances, so that a comparison can be made between short-time, phonemic metrics, such as SCI (Gallun& Souza, 2008), and metrics that require a long duration input, such as the Speech Intelligibility Index (SII; American National Standards Institute, 1997). Such comparisons can be made regardless of the source of envelope distortion (e.g., reverberation, noise reduction). Preliminary data indicate that the algorithmsuccessfully locates syllable boundaries in continuous speech.We plan to use these boundaries as a guide to performing short-time signal analyses on continuous signals for comparison to longer durationmetrics. The use of the first derivative of the envelope also may provide an advantage over existing techniques for syllable analysis in speech signal processing, or in such applications as automatic speech recognition (Bartels &Bilmes, 2007).

Acknowledgments

This work was supported by National Institutes of Health Grant DC0060014 and by Veterans Health Administration Rehabilitation Research and Development Service Grant C4963W.

Footnote

1An appropriate threshold can be determined from the peak slope value observed or the expected total number of transitions.

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Editor: Sheila Pratt
Associate Editor: Catherine Palmer
Received September 16, 2011
Accepted March 5, 2012
DOI: 10.1044/1092-4388(2012/11-0255)

Acoustics of Clear Speech: Effect of Instruction

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.6 (Dec 2012): 1807-1821.
ProQuest document link

Abstract: This study investigated how different instructions for eliciting clear speech affected selected acoustic measures of speech. Twelve speakers were audio-recorded reading 18 different sentences from the Assessment of Intelligibility of Dysarthric Speech (Yorkston &Beukelman, 1984). Sentences were produced in habitual, clear, hearing impaired, and overenunciate conditions. A variety of acoustic measures were obtained. Relative to habitual, the clear, hearing impaired, and overenunciate conditions were associated with different magnitudes of acoustic change for measures of vowel production, speech timing, and vocal intensity. The overenunciate condition tended to yield the greatest magnitude of change in vowel spectral measures and speech timing, followed by the hearing impaired and clear conditions. SPL tended to be the greatest in the hearing impaired condition for half of the speakers studied. Different instructions for eliciting clear speech yielded acoustic adjustments of varying magnitude. Results have implications for direct comparison of studies using different instructions for eliciting clear speech. Results also have implications for optimizing clear speech training programs.

Full text: Headnote
Purpose: This study investigated how different instructions for eliciting clear speech affected selected acoustic measures of speech.
Method: Twelve speakers were audio-recorded reading 18 different sentences from the Assessment of Intelligibility of Dysarthric Speech (Yorkston &Beukelman, 1984). Sentences were produced in habitual, clear, hearing impaired, and overenunciate conditions. A variety of acoustic measures were obtained.

Results: Relative to habitual, the clear, hearing impaired, and overenunciate conditions were associated with different magnitudes of acoustic change for measures of vowel production, speech timing, and vocal intensity. The overenunciate condition tended to yield the greatest magnitude of change in vowel spectral measures and speech timing, followed by the hearing impaired and clear conditions. SPL tended to be the greatest in the hearing impaired condition for half of the speakers studied.
Conclusions: Different instructions for eliciting clear speech yielded acoustic adjustments of varying magnitude. Results have implications for direct comparison of studies using different instructions for eliciting clear speech. Results also have implications for optimizing clear speech training programs.
Key Words: clear speech, instructions, acoustics
Speech clarity has been a topic of significant research interest over the past few decades. Following Smiljanic and Bradlow (2009), the term clear speech refers to a speaking style wherein talkers voluntarily adjust their conversational or habitual speech to maximize intelligibility for a communication partner. Talkers may use clear speech in a variety of situations, such as when conversing in a noisy environment or when talking to someone who has a hearing impairment. Clear speech is further recommended for use as a therapy technique for speakers with dysarthria (Beukelman, Fager, Ullman, Hanson, &Logemann, 2002; Dromey, 2000; Hustad &Weismer, 2007), for use in military aviation training programs (Huttunen, Keränen, Väyrynen, Pääkkönen, &Leino, 2011), and for use in aural rehabilitation training programs (Schum, 1997). Identifying variables responsible for the improved intelligibility typically associated with clear speech also may help to improve signal processing technologies for auditory prostheses (i.e., Krause &Braida, 2009; Picheny, Durlach, &Braida, 1985, 1986; Uchanski, Choi, Braida, &Reed, 1996; Zeng &Liu, 2006). Thus, clear speech research has real-world implications for optimizing clear speech training programs and for developing technologies for use with populations who have difficulty understanding speech. In addition, the construct of clear speech figures prominently in certain speech production theories (Lindblom, 1990; Perkell, Zandipour, Matthies, &Lane, 2002). The increase in intelligibility from conversational to clear speech has been termed the clear speech benefit, and the magnitude of this effect is known to vary widely across studies. That is, with the exception of a few investigations that used listeners with particular kinds of hearing impairment or simulated hearing impairment, the average clear speech benefit in a given study reportedly ranges from 3% to 34% (Smiljanic &Bradlow, 2009; Uchanski, 2005). Variables contributing to cross-study variation in the overall clear speech benefit are not well understood. As noted in a following section, differences in instruction or cues for eliciting clear speech may be a contributing factor.

In a variety of studies, researchers have sought to determine the acoustic basis of the improved intelligibility typical of clear speech.The following reviewhighlights findings from studies reporting acoustic measures that were of interest to the present investigation, including vowel formant frequency characteristics, speech durations, and vocal intensity. More comprehensive reviews may be found in Smiljanic and Bradlow (2009) as well as Uchanski (2005).

Vowel space area, calculated from midpoint or steady-state values of F1 and F2, indexes the size of an individual's vowel articulatory-acoustic working space (Turner, Tjaden, &Weismer, 1995). The relationship between vowel space and intelligibility for neurologically normal talkers is suggested by studies reporting larger vowel space areas for talkers who are inherently more intelligible in conversational speech (Bradlow, Torretta, &Pisoni, 1996; Hazan &Markham, 2004). Some dysarthria studies have also suggested a relationship between vowel space area and intelligibility (e.g., Hustad &Lee, 2008; H. Liu, Tsao, &Kuhl, 2005; Tjaden &Wilding, 2004). An expanded vowel space area for clear versus conversational speech has been widely reported (Bradlow, Krause, &Hayes, 2003; Ferguson &Kewley-Port, 2002, 2007; Johnson, Flemming, &Wright, 1993; Moon &Lindblom, 1994; Picheny, Durlach, &Braida, 1986). There are exceptions, however. Goberman and Elmer (2005) did not find significant vowel space expansion for clear speech produced by speakers with dysarthria secondary to Parkinson's disease. Krause and Braida (2004) also reported minimal vowel space area

expansion when neurologically normal talkers were trained to produce clear speech at normal or conversational speech rates. Picheny et al. (1986) further suggested a tendency for midpoint formant frequencies for lax vowels, and the derived lax vowel space area, to change more dramatically for clear speech as compared with tense vowels, although this trend has not been strongly supported in more recent studies (Krause &Braida, 2004).

Ferguson and Kewley-Port (2007) used a novel approach to investigate acoustic changes likely responsible for improved intelligibility of clearly produced /bVd/ words. Static and dynamic spectral measures of vowel production for speakers exhibiting a large clear speech benefit (big-benefit talkers) were contrasted with measures for speakers exhibiting no clear speech benefit (no-benefit talkers). Clear speech for big-benefit talkers was characterized by greater vowel space area expansion, a greater overall increase in F1, and higher F2 values for front vowels when compared with clear speech produced by the no-benefit talkers. Vowel formant dynamics did not differ for the big-benefit and no-benefit talkers, nor did Tasko and Greilick (2010) find clarityrelated differences in F1 or F2 diphthong transitions. However, other studies have reported that vowel formants are more dynamic in clear speech as compared with conversational speech (Ferguson &Kewley-Port, 2002; Moon &Lindblom, 1994; Wouters &Macon, 2002). Perceptual studies using speech resynthesis have also suggested the importance of dynamic spectral cues for accurate vowel identification (e.g., Assmann &Katz, 2005; Hillenbrand &Nearey, 1999).

Slowed speaking rate is probably the most widely reported characteristics of clear speech (Bradlow, Krause, &Hayes, 2003; Picheny et al., 1986; Smiljanic&Bradlow, 2008). The slower than normal speaking rate typical of clear speech further tends to be associated with a reduced articulation rate, increased segment durations, and longer, more frequent pauses (Bradlow et al., 2003; Picheny et al., 1986; Uchanski et al., 1996). Although many studies have reported a slowed speech rate for clear speech, speakers can be trained to produce clear speech at a normal or conversational speech rate (Krause &Braida, 2004). This observation might be taken to suggest that a reduced rate, lengthened segment durations, and longer, more frequent pauses do not contribute to the improved intelligibility typically associated with clear speech. However, the fact that Krause and Braida (2004) found that the increase in intelligibility for clear speech produced at a normal speech rate was not as great as the increase in intelligibility for clear speech produced at a typically slower than normal rate suggests the contribution of temporal adjustments to the clear speech benefit. Other studies have also suggested that an increased number of pauses accompanying clear speech benefits intelligibility (S. Liu &Zeng, 2006).

Finally, clear speech studies reporting vocal intensity measures have found that clear speech is generally accompanied by at least some increase in vocal intensity (e.g., Dromey, 2000; Goberman &Elmer, 2005; Picheny et al., 1986). As noted by Uchanski (2005), the contribution of increased vocal intensity to the clear speech benefit is not attributable to improved audibility, as the relevant perceptual studies have equated clear and conversational speech for overall SPL. Rather, other speech production changes accompanying an increased vocal intensity, such as the use of more canonical vocal tract shapes, may help to explain improvements in intelligibility.

Although research conducted over the past few decades has made a great deal of progress in advancing our knowledge of clear speech,many important questions still need to be addressed. One is the extent to which the instruction or cue for eliciting clear speech impacts both production and perception (Smiljanic &Bradlow, 2009). To date, clear speech has been elicited using a variety of instructions or cues, including "speak clearly" (Ferguson, 2004; Ferguson &Kewley-Port, 2007), "hyperarticulate" or "overenunciate" (Dromey, 2000; Moon &Lindblom, 1994), or "speak to someone with a hearing impairment or non-native speaker" (Bradlow et al., 2003; Smiljanic &Bradlow, 2008). Other studies have used a combination of these instructions (e.g., Picheny et al., 1985; Rogers, DeMasi, &Krause, 2010; Tasko &Greilick, 2010). Studies comparing different cues for increasing vocal loudness (e.g., Darling &Huber, 2011; Huber &Darling, 2011; Sadagopan &Huber, 2007) and studies investigating different cues or instructions for slowing speech rate (VanNuffelen,De Bodt,Vanderwegen,

&Wuyts, 2010) have suggested that speech output differs depending on the nature of the instruction or cueing provided to talkers. It seems reasonable to hypothesize that clear speech output also may differ depending on the cue or instruction used to elicit this speech style.

The question of whether different instructions or cues for eliciting clear speech result in equivalent articulatory-acoustic and perceptual changes is nontrivial. Differences in clear speech instruction could help to explain cross-study variation in production characteristics as well as cross-study differences in the magnitude of the clear speech benefit. Knowing the speech production adjustments associated with a particular clear speech instruction further has the potential to assist in optimizing clear speech training programs for dysarthria or aural rehabilitation. As an initial step in addressing this multifaceted issue, the current study examined the impact of three clear speech instructions on selected acoustic measures of speech for a group of healthy adult talkers. Instructions included "speak clearly" (clear condition), "overenunciate" (overenunciate condition), and "talk to someone with a hearing impairment" (hearing impaired condition). These cues or instructions were selected for several reasons. First, all instructions have been used in separate, previously published studies and are reasonably distinct from one another (Bradlow et al., 2003; Dromey, 2000; Ferguson, 2004; Johnson et al., 1993; Moon &Lindblom, 1994). In addition, these cues are probable candidates for use in clear speech training programs, and it was of interest to determinewhether instructions likely to be used therapeutically would elicit similar types or magnitudes of acoustic change.

Method

Participants

A total of 12 neurologically healthy speakers (six men and six women) ranging from 18 to 36 years of age (M = 24, SD = 6 years) were recruited from the student population at the University at Buffalo to serve as participants. Participants were judged to speak Standard American English as a first language and reported no history of hearing, speech, or language pathology. All speakers passed a pure tone hearing screening, administered bilaterally at 20 dB HL at 500, 1000, 2000, 4000, and 8000 Hz (American National Standards Institute [ANSI], 1969). In addition, no speaker had received university training in linguistics or communicative disorders and sciences.

Speech Sample

For each of the 12 speakers, 18 different sentences, varying in length from five to 11 words, were selected from the Assessment of Intelligibility of Dysarthric Speech (AIDS; Yorkston&Beukelman, 1984). Sentences were audio-recorded as part of a larger speech sample, which also included /hVd/ words. Each sentence set was selected to include three to five occurrences of the tense vowels /A, i, æ, u/ and the lax vowels /I, e, u, Ã/. Vowels also were selected to occur in content words and in syllables receiving primary stress. In addition to measures of duration and intensity discussed below, spectral characteristics of vowels were of primary interest, following Ferguson and Kewley-Port (2007).

Speakers read the sentences in four conditions, including, habitual, clear, hearing impaired, and overenunciate. These conditions were selected for several reasons. First, other clear speech studies have elicited adjustments in clarity by instructing speakers to "overenunciate/ hyperarticulate" (overenunciate condition), "talk to someone with a hearing loss" (hearing impaired condition) or "speak clearly" (clear condition) (e.g., Bradlow et al., 2003; Ferguson, 2004; Johnson et al., 1993; Moon &Lindblom, 1994; Smiljanic &Bradlow, 2008). When selecting instructions from among those utilized in previous studies, care also was taken to choose distinctive instructions. Thus, only "talk to someone with a hearing impairment" but not "talk to a non-native speaker" was included for study. In addition, these cues were deemed to be reasonable candidates for use in clear speech training programs, especially "overenunciate" and "speak clearly," and it would seem important to know whether training program instructions would elicit similar types or magnitudes of acoustic change.

For the habitual condition, speakers were simply instructed to read the sentences. Thus, the habitual condition is similar to "conversational" or "citation" speech in other clear speech studies. Speakers subsequently were

asked to read the sentences "while speaking clearly" (clear), allowing each participant to determine what this phrase meant (see Ferguson, 2004). Speakers also were instructed to "speak as if speaking to someone who has a hearing impairment" (hearing impaired condition) and to "overenunciate each word" (overenunciate condition). The order of these latter two conditions was alternated among participants such that the order of conditions for six participants was habitual, clear, hearing impaired, and overenunciate, and the order of conditions for the remaining six participants was habitual, clear, overenunciate, and hearing impaired. Participants were engaged in casual conversation for a few minutes between recordings for each condition to minimize carry-over effects. The clear condition was always recorded immediately following the habitual condition. This order of conditions was followed so that speakers could interpret the instructions to "speak clearly" without the prior influence of hearing the instructions to "overenunciate" or "talk to someone with a hearing impairment."

Procedure

Data collection took place in a sound-attenuated booth. A head-mounted CountryMan E6IOP5L2 Isomax condenser microphone was used to record the acoustic signal. A mouth-to-microphone distance of 6 cm was maintained throughout the recording for each speaker. The microphone signal was preamplified using a Professional Tube MIC Preamp, low-pass filtered at 9.8 kHz and digitized to a computer at a sampling rate of 22 kHz using TF32 (Milenkovic, 2002). Prior to recording each participant, a calibration tone of known intensity was also recorded. The calibration tone was later used to calculate vocal intensity from the acoustic speech signal (see Tjaden &Wilding, 2004). Stimuli were presented using MicrosoftPowerPoint and were read from a computer screen.Written instructions for each condition were presented both visually on the computer screen and verbally at the beginning of recording, as well as a quarter, half, and three quarters of the way throughout each condition. For each speaker, four random orderings of sentences were created such that sentences were produced in a different order for the four speaking conditions.

Prior to performing the acoustic analysis, audio files were recoded by a research assistant not involved in the study so that the investigators performing the acoustic measures were blinded to the identity of each speaking condition. The purpose of this procedure was to help control for possible experimenter bias when performing the acoustic analysis.

Table 1 summarizes acoustic measures of interest. These measures were selected from among those reported in previous clear speech studies (Bradlow et al., 2003; Ferguson &Kewley-Port, 2002, 2007; Moon &Lindblom, 1994; Picheny et al., 1986). Because it was expected that the various clear speech instructions would elicit articulatory adjustments, as inferred from the acoustic signal, and possibly different magnitudes of adjustment, ameasure of segmental articulation was included. The current focus on vowels is consistent with that of Ferguson and Kewley-Port (2007). Similarly, a measure of vocal intensity was obtained because it was speculated that the instruction to "speak to someone with a hearing impairment" might elicit a relatively greater adjustment in vocal intensity than other instructions. Finally, global speech timing was included for study because a reduced speaking rate has been so widely reported in clear speech research. Given that the instructions selected for study might be used in clear speech training programs for dysarthria, and that speaking rate reduction is often desirable in the treatment of dysarthria, it was of interest to determine whether the various clear speech instructions would elicit different magnitudes of speaking rate adjustment. Each of the acoustic measures is discussed in more detail below. All acoustic analyses were performed using TF32 (Milenkovic, 2002).

Segmental acoustic measures. Vowel segment durations were obtained using a combination of the waveform and wideband (300-400 Hz) digital spectrographic displays. Vowel durationwas computed from the first glottal pulse of the vocalic nucleus to the last glottal pulse as indicated by energy in both F1 and F2 (Tjaden, Rivera, Wilding, &Turner, 2005; Turner et al., 1995). For each speaker and condition, vowel segment durations were averaged for tense (A, i, æ, u) and lax (I, e, u, Ã) vowel categories. These averages were subsequently used in

the statistical analyses for segment durations.

Linear predictive coding generated formant trajectories for F1 and F2 also were computed over the entire duration of each vowel of interest. Computer-generated tracking errors were inspected for errors and manually corrected as needed. Using MicrosoftExcel, F1 and F2 values were extracted at three time points corresponding to 20%, 50%, and 80% of vowel duration (Hillenbrand, Getty, Clark, &Wheeler, 1995). Average midpoint formant frequencies (50% point) for each speaker and condition were used to calculate a variety of static measures of vowel production, including vowel space area, F1 range, F2 range, intravowel distance, and tense-lax spectral distance.

Using Heron's formula (see Goberman &Elmer, 2005; Turner et al., 1995), a separate vowel space area was calculated for tense vowels /A, i, æ, u/ and lax vowels /I, e, u, Ã/, yielding a tense vowel space area and lax vowel space area for each speaker and condition for use in the statistical analysis. Because tongue height and tongue advancement broadly correspond to adjustments in F1 and F2, respectively (Kent &Read, 2002), F1 range and F2 range also were calculated to supplement measures of vowel space area. Following procedures used by Ferguson and Kewley-Port (2007), F1 and F2 ranges were computed using midpoint formant frequencies from the four tense vowels that form the extremes or border of the articulatory-acoustic working space /A, i,æ , u/. F1 range was determined by calculating the absolute difference between average F1 values for /i / and /u/, and average F1 values for /æ / and /A/. Similarly, F2 range was determined by calculating the absolute difference between average F2 values for /i / and /æ /, and average F2 values for /A/ and /u /. Separate F1 and F2 ranges were calculated for each speaker and condition for use in the statistical analysis.

As illustrated in Figure 1, a measure termed intravowel distance (ID) was calculated to index the amount of change in F1 ×F2 space for a given vowel in the clear, hearing impaired, and overenunciate conditions relative to the habitual condition. Relatively greater IDs suggest that a given vowel is more amenable to condition effects. Thus, the ID measure is not unlike the Euclidean distance fromhabitual centroid measure reported by Turner et al. (1995). As shown schematically in Figure 1, ID was determined by calculating the length of the line between a vowel's habitual F1 ×F2 coordinate and the corresponding F1 ×F2 coordinate for that vowel in the clear, hearing impaired, and overenunciate conditions. In Figure 1, the habitual F1 ×F2 coordinates for /u / and /u/ are indicated with open circles labeled with the appropriate phonetic symbol. Squares in Figure 1 correspond to F1 ×F2 coordinates for each vowel in the clear, hearing impaired, and overenunciate conditions. Solid lines represent IDs. Thus, for each speaker and vowel, three ID measures were obtained. IDs were calculated to describe vowels contributing to adjustments in vowel space area and were not included in the parametric statistical analysis.

Previous studies have suggested that clear speech impacts dynamic characteristics of vowel production (Ferguson &Kewley-Port, 2002; Moon &Lindblom, 1994; Wouters &Macon, 2002). Thus, following procedures established by Ferguson and Kewley-Port (2007), formant frequency values at the 20% and 80% points were used to calculate the dynamic measure, lambda (l), using the formula |F180 - F120| + |F280 - F220|. For each speaker and condition, lambda measures were calculated for each vowel and then averaged across tense and lax vowel categories, yielding a mean lambda measure for tense vowels and a mean lambda measure for lax vowels for use in the statistical analysis.

The measure tense-lax spectral distance between the four vowel pairs, /æ -e/, /i-I /, /u-u/ and /A-Λ/, was calculated to provide an index of the relative spectral distinctiveness of tense-lax vowel pairs. This measure is illustrated in Figure 1 by the dashed line, which indicates the Euclidean distance in F1 ×F2 space for the tense-lax vowel pair /u/ and /u/. Several additional measures also were derived to further characterize the degree of acoustic contrast for the four tense-lax vowel pairs. These measures included duration ratios and lambda ratios. These ratios were calculated separately for each of the four tense-lax vowel pairs for use in the statistical analysis. Thus, average lax durations were divided by average tense durations, yielding four duration ratios per speaker and condition. Similarly, average lax lambda values were divided by average tense lambda values,

yielding four lambda ratios per speaker and condition.

Global timing. Measures of total utterance duration, run duration, and syllable counts were obtained for use in calculating speaking rate and articulation rate in syllables per second. Pause durations and pause frequencies were also measured. A pause was defined as a silent period of 200 ms or greater between words (Turner &Weismer, 1993).

Standard acoustic criteria were used to identify onsets and offsets for total utterance durations and run durations. A run was defined as a stretch of speech separated by interword pauses (Turner &Weismer, 1993). Total utterance durations were calculated by summing all run durations and pauses within a sentence. Sentence or run onsets beginning with obstruents were defined as the leftedge of the release burst or fricative noise (Klatt, 1975). The onset of a nasal was indicated by a reduction in intensity in the higher frequencies (Kent &Read, 2002). Onsets for vowels, liquid, and glides were defined as the leftedge of the first glottal pulse, as indicated by energy in both F1 and F2. Similar criteria were applied when determining offsets.

Speaking rate for each sentence in syllables per second was calculated by dividing the number of syllables produced by total utterance duration (in milliseconds) and then multiplying by 1,000. For each sentence, articulatory rate (syllables per second) was calculated by dividing the number of syllables produced by the total duration of all runs (in milliseconds) composing a sentence and multiplying by 1,000 (Turner &Weismer, 1993). For each speaker and condition, measures of speaking rate, articulation rate, pause duration, and pause frequency were averaged across sentences for use in the statistical analysis.

Vocal intensity. Following procedures from previous studies, the average root-mean-square (RMS) voltage of each run was converted to dB SPL in reference to each speaker's calibration tone (Tjaden &Wilding, 2004). For each speaker and condition, a measure of average intensity was determined by averaging SPL across all runs. These averages were used in the statistical analysis.

Measurement Reliability

Acoustic measures were performed by the first author, with measurement questions resolved by conferral with the second author. The second author also performed ongoing accuracy checks for a randomly selected sample of approximately 10% of stimuli (i.e., n = 2 sentences) for each speaker and condition at the initial time of measurement. One set of sentences from each speaking condition (i.e., approximately 10% of stimuli) was selected from four different speakers for use in determining measurement reliability following the same procedures utilized for performing the initial measures. Absolute measurement errors and Pearson product-moment correlations were used to index reliability. The correlation between the first and second set of segment duration and run duration measures was 0.96 (M absolute difference measure = 0.008 s, SD = 0.016 s) and 0.99 (Mabsolute difference measure = 0.02 s, SD = 0.08 s), respectively. The correlation between the first and second set of spectral measures was 0.99 (Mabsolute difference measure = 20.0 Hz, SD = 60.0 Hz), and the correlation between the first and second set of SPLs was 0.95 (Mabsolute difference measure = 0.23 dB, SD = 0.69 dB).

Data Analysis

Descriptive statistics in the form of means and standard deviations were calculated for all acoustic measures. Parametric statistical analyses (i.e., analysis of variance) were performed for tense vowel space area, lax vowel space area, tense segment duration, lax segment duration, F1 range, F2 range, tense-lax spectral distance, SPL, lambda (l), duration ratios, lambda ratios, speaking rate, and articulation rate. Pause frequency and pause duration data were characterized using descriptive statistics because pauses occurred fairly infrequently. Using SAS Version 9.1.3 statistical software, a multivariate linear model was fit to each dependent variable in this repeated measures design. For all dependent variables, models included the main effect of condition (habitual, clear, hearing impaired, overenunciate). The analyses for tense-lax spectral distances, lambda ratios, and duration ratios also included a vowel main effect as well as a Condition ×Vowel interaction, as potential differences among the four tense-lax vowel pairs were of interest. To control for gender differences in

dependent measures, a variable representing gender also was included in each analysis. To account for the within-subject dependence structure, each multivariate linear model assumed that the distribution of the error terms for each subject was multivariate normal with zero mean and an unstructured covariance structure (Brown &Prescott, 1999). Post hoc pairwise comparisons were performed using a Bonferroni correction for multiple comparisons. All tests were two-sided, and a significance level of $p < .05$ was used in all hypothesis testing. Finally, for convenience, the clear, hearing impaired, and overenunciate conditions are collectively referred to as the nonhabitual conditions throughout the Results and Discussion.

Results

Vowel Space Area

Figures 2 and 3 report average F1 ×F2 coordinates and the associated vowel space areas for male and female speakers, respectively. The statistical analysis indicated a significant condition effect for both tense, $F(3, 10) = 28.65$, $p < .0001$, and lax, $F(3, 10) = 17.9$, $p = .0002$, vowel space areas. For tense vowels, post hoc comparisons indicated greater vowel space areas for the clear ($p=.0002$), hearing impaired ($p=.0007$), and overenunciate ($p < .0001$) conditions when compared with the habitual condition. Tense vowel space area in the overenunciate condition was also significantly greater than in the clear condition ($p = .001$). For lax vowels, post hoc comparisons indicated larger vowel space areas for clear ($p = .006$), hearing impaired ($p = .001$), and overenunciate ($p = .0003$) conditions compared with habitual.

For tense and lax vowels, the finding of greater vowel space area in the nonhabitual conditions as compared with habitual held for 12 and 10 speakers, respectively. In addition, the overenunciate condition was associated with the greatest tense and lax vowel space areas for 10 and nine speakers, respectively. The remaining speakers exhibited the greatest vowel space areas in the hearing impaired condition.

Because previous studies have suggested that lax vowels are more susceptible to the effects of speaking style than tense vowels (Picheny et al., 1985), the mean percent increase in vowel space area for the nonhabitual conditions relative to the habitual condition was calculated. As reported in Table 2, on average, lax vowels exhibited a greater percent change in vowel space area for the nonhabitual conditions when compared with the habitual condition, particularly for female speakers.

Figure 4 reports data for F1 and F2 range in the form of box and whiskers plots. Data for F1 are reported in the upper panel, and data for F2 are reported in the lower panel. For F1 range there was a significant effect of condition, $F(3, 10) = 15.97$,$p=.0004$. Post hoc analyses further indicated that F1 range was greater in all three nonhabitual conditions as compared with habitual ($p \leq .008$) but did not differ for pairs of nonhabitual conditions. This trend of a greater F1 range in the nonhabitual conditions relative to habitual held for 11 of 12 speakers. As illustrated in Figure 4, descriptive statistics further indicated that, on average, F1 range was greatest in the overenunciate condition, followed by the hearing impaired, clear, and habitual conditions.Results were similar for F2 range. That is, the statistical analysis indicated a main effect of condition, $F(3, 10) = 21.13$, $p = .0001$. Post hoc analyses further indicated that F2 range was greater in all three nonhabitual conditions as compared with habitual ($p \leq .001$), and this trend held for 11 of 12 speakers. In addition, F2 range was significantly greater in the overenunciate condition versus the clear condition ($p = .001$). Finally, as illustrated in Figure 4, descriptive statistics indicated that on average, F2 range was greatest in the overenunciate condition, followed by the hearing impaired, clear, and habitual conditions.

Intravowel Distance

Table 3 summarizes findings for ID. This table reports the number of speakers exhibiting the greatest ID for a given vowel comprising the tense and lax vowel categories within each condition. Thus, the first row of Table 3 indicates that for the clear condition, five speakers exhibited the greatest ID for /i /, six speakers exhibited the greatest ID for /u/, one speaker exhibited the greatest ID for /æ /, and no speakers exhibited the greatest ID for /A/. The implication is that in the clear condition, the tense vowels /i / and /u / were most amenable to adjustment in F1 ×F2 space as compared with /æ / and /A/. Of the tense vowels, Table 3 further suggests that

the majority of speakers produced the greatest IDs for /i, u/. For lax vowels, although not as robust, Table 3 suggests that speakers tended to produce the greatest IDs for /I, u/ within a given condition. Thus, these lax vowels tended to be more susceptible to condition effects than other lax vowels.

Vowel Spectral Change Measure (Lambda)

Descriptive statistics for lambda are reported in Table 4. The main effect of condition was significant for both tense, $F(3, 10) = 3.90$, $p = .04$, and lax, $F(3, 10) = 5.79$, $p = .01$, vowels. Post hoc comparisons for tense vowels were not significant. However, Table 4 indicates a trend for greater tense lambda values in the overenunciate and hearing impaired conditions as compared with the habitual and clear conditions. Moreover, six speakers had the greatest lambda values in the overenunciate condition, and four speakers had the greatest lambda values in the hearing impaired condition.

Post hoc tests for lax vowels indicated significantly greater lambda values, or more dynamic vowels, for the hearing impaired ($p = .02$) and overenunciate ($p = .04$) conditions when compared with habitual, as well as for the overenunciate condition versus the clear condition ($p = .01$). Consistent with these post hoc analyses, eight speakers had the largest lax lambda values in the overenunciate condition, and three speakers had the greatest lambda measures in the hearing impaired condition.

Segment Durations

Descriptive statistics for segment durations are reported in Table 4. The statistical analyses indicated a significant condition effect for both tense, $F(3, 10) = 41.84$, $p < .0001$, and lax, $F(3, 10) = 17.9$, $p < .0001$, vowel durations. For tense vowels, post hoc comparisons indicated that speakers significantly increased vowel durations for the hearing impaired ($p = .0006$) and overenunciate ($p = .0002$) conditions when compared with the habitual condition. Tense vowels were also longer in the overenunciate condition when compared to the clear condition ($p < .0001$). Post hoc comparisons for lax vowels indicated longer vowels for the hearing impaired ($p = .0001$) and overenunciate ($p < .0001$) conditions as compared with the habitual condition. The overenunciate ($p < .0001$) and hearing impaired ($p = .005$) conditions were also associated with longer vowels compared with the clear condition. Inspection of individual speaker data revealed that all but two speakers followed the trend of increased tense and lax vowel durations for the clear, hearing impaired, and overenunciate conditions relative to habitual.

Distinction of Tense-Lax Vowel Pairs

Figure 5 illustrates spectral distances for tense (filled circles) and lax (unfilled circles) vowel pairs for speaker M07 (upper panel) and M04 (lower panel). Greater distances or longer lines in Figure 5 indicate greater distinction of vowel pairs in F1 ×F2 space. For each of the four vowel pairs, the statistical analysis indicated no significant difference among conditions. However, inspection of individual speaker data indicated that for /æ -e/, /i-I /, and /u-u/, anywhere from six to eight speakers increased spectral distances for the nonhabitual conditions compared with habitual. For the /A-Ã/ tense- lax pair, however, nine of 12 speakers reduced tense- lax spectral distances in the clear condition, and five speakers increased tense-lax spectral distances in the hearing impaired and overenunciate conditions. Interestingly, for every vowel pair, M04-data for which are plotted in the lower panel of Figure 5-reduced all but one tense-lax spectral distance for the nonhabitual conditions compared with habitual.

Table 5 reports descriptive statistics for duration ratios and lambda ratios. Ratios approaching 1.0 indicate reduced distinction. For both measures, ratios did not differ significantly across conditions. Indeed, duration ratios in Table 5 for a given vowel pair vary only a small amount across conditions, although it is notable that average duration ratios for the tense-lax pair /A-Ã/ tend to approach 1.0 in the nonhabitual conditions, indicating relatively less temporal distinction, whereas duration ratios for the tense lax pair /i-I / suggest a trend toward increased temporal distinction in the nonhabitual conditions. Inspection of average lambda ratios in Table 5 further suggests a trend for all tense-lax vowel pairs to exhibit increased dynamic distinction in most of the nonhabitual conditions, as lambda ratios tend to move away from 1.0 in the nonhabitual conditions relative to

habitual. The main effect of vowel pair was significant for duration ratio, $F(3, 33) = 5.13$, $p = .005$, and lambda ratio, $F(3, 33) = 13.67$, $p < .0001$. Although this main effect was not of particular interest, it serves to demonstrate that vowel pairs behaved differently with respect to ratio measures.

Articulation Rate and Speaking Rate

Table 6 reports descriptive statistics for global measures of speech timing. For articulation rate, the statistical analysis indicated a significant condition effect, $F(3, 10) = 78.46$, $p < .0001$. Post hoc comparisons indicated slower articulation rates for the clear ($p = .001$), hearing impaired ($p < .0001$), and overenunciate ($p < .0001$) conditions when compared with habitual. Articulation rates were also reduced for the overenunciate condition when compared with the clear ($p < .0001$) and hearing impaired ($p = .01$) conditions. Findings for speaking rate were identical to those for articulation rate. Inspection of individual speaker data further indicated that nine of 12 speakers followed the trend of having the fastest articulation and speaking rates in the habitual condition followed by the clear, hearing impaired, and overenunciate conditions. In addition, 11 of the 12 speakers had a slower articulation rate and speaking rate in the overenunciate condition when compared with the clear and hearing impaired conditions.

Pause Frequency and Duration

Pause frequency and pause duration data also are reported in Table 6, which indicates that speakers used the greatest number of pauses in the overenunciate condition. This trend held for nine of 12 speakers. Table 6 further indicates longer average pause durations in the nonhabitual conditions as compared with the habitual condition.

SPL

Figure 6 reports mean sentence-level SPL and SDs. The statistical analysis indicated a significantmain effect of condition, $F(3, 10) = 3.80$, $p = .04$. No post hoc comparisons were significant. However, inspection of individual speaker data further indicated that six of 12 speakers increasedmean vocal intensity by approximately 1-2dBfor the hearing impaired condition compared with the habitual condition, and three speakers increased mean vocal intensity by approximately 1-2 dB for the overenunciate condition relative to the habitual condition.

Discussion

Different clear speech instructions were associated with differentmagnitudes of acoustic change for measures of vowel production, speech timing, and vocal intensity. The instruction to "overenunciate" tended to elicit the greatest adjustments in vowel production and speech timing, followed by "speak to someone with a hearing impairment." For half of the speakers studied, this latter condition also elicited the greatest adjustments in vocal intensity. Finally, "speak clearly" elicited the smallest acoustic adjustments relative to the habitual condition. Results and their implications are considered below.

Static and Dynamic Measure of Vowel Production, Speech Timing, and SPL

In agreement with previous clear speech studies (Bradlow et al., 2003; Ferguson &Kewley-Port, 2002, 2007; Moon &Lindblom, 1994; Picheny et al., 1985), speakers in the present study significantly increased tense and lax vowel space areas for all nonhabitual conditions relative to the habitual condition. Descriptive statistics further indicate that both tense and lax vowel space areas were consistently maximized in the overenunciate condition, with analyses for F1 and F2 ranges suggesting that speakers achieved adjustments in vowel space area by producing greater excursions in both tongue height and tongue advancement, with a trend toward the greatest excursions for the overenunciate condition.

To further explore whether particular vowels were more amenable to the effects of clear speech instructions than others, and by inference those vowels contributing to vowel space area change in the nonhabitual conditions, ID measures were calculated to measure each vowel's shiftin F1 ×F2 space across conditions. In general, more speakers tended to produce the greatest ID measures for the high vowels /i, I, u, and u/ in the clear, hearing impaired, and overenunciate conditions. Given the fact that all speakers increased tense and lax vowel space area in the nonhabitual conditions, findings for ID measures suggest that shifts in high tense and

lax vowels contributed most to vowel space expansion.

In addition to clarity-related changes in midpoint vowel formant frequencies, tense and lax lambda measures-corresponding to the amount of spectral change in F1 and F2 between 20% and 80% of vowel duration and by inference within-vowel variation in tongue height and advancement-also differed significantly among conditions. Findings were similar to those for vowel space area in that lambda measures were significantly greater in the nonhabitual conditions compared with habitual. Moreover, both tense and lax lambda measures were greatest in the overenunciate condition (Table 4).

The different clear speech instructions also yielded different magnitudes of change in measures of speech timing, with the greatest change in the form of longer segment durations, longer pauses, greater numbers of pauses as well as slow articulation and speech rates for the overenunciate condition, followed by the hearing impaired, clear, and habitual conditions. Although previous clear speech studies have reported much greater numbers of pauses than reported in the current study (Krause &Braida, 2004; Picheny et al., 1985), the criterion for determining pauses used in these studies was much shorter (i.e., 10 ms) than that used in the current study, as well as in other studies (i.e., 200 ms or greater). Finally, on average, mean SPL for nonhabitual conditions only increased by 1-2 dB compared with that in the habitual condition. Half of the speakers produced a 3- to 6-dB increase in average SPL for the hearing impaired condition, however, and three speakers increased mean SPL by approximately 1-2 dB in the overenunciate condition relative to habitual. These SPL adjustments are less consistent than previously reported (Dromey, 2000; Moon &Lindblom, 1994; Picheny et al., 1985). However, as noted by Smiljanic and Bradlow (2009), an increased vocal intensity or increased vocal effort might not necessarily be expected for clear speech, as talkers presumably use clear speech to maximize intelligibility rather than vocal loudness.

The fact that the various clear speech instructions yielded different magnitudes of change in vowel space area, F1 and F2 range, lambda, and speech timing suggests caution in directly comparing these kinds of measures in studies that use different cues or instructions for eliciting adjustments in speech clarity. Results also have implications for clear speech training programs. That is, findings from the present study suggest that the cue "overenunciate" may prove most effective in a clear speech training program for increasing lingual excursion and thus vowel space area as well as vowel spectral dynamics. This cue also may be most effective for eliciting reductions in speech and articulation rate, at least relative to the other clear speech instructions studied. In contrast, the cue "speak to someone with a hearing impairment" would appear to be more effective than "overenunciate" or "speak clearly" in a clear speech training program that aims to increase average vocal intensity. Given the fact that only about half of the speakers increased vocal intensity in the hearing impaired condition, however, it is not necessarily expected that a clear speech training program would yield consistent changes in vocal intensity. Future studies are needed to investigate these suggestions. Additional studies also are needed to determine the extent to which the different magnitudes of acoustic change reported in the current study are perceptually relevant. Astrong prediction is that clear speech instructions associated with relatively greater acoustic change would also be associated with a relatively larger clear speech benefit.

An explanation for why the various clear speech instructions or cues elicited different amounts of acoustic change may be related to the nature of the speech modifications suggested by each cue. Given that the clear condition consistently yielded the smallest acoustic adjustments, it would appear that the general instruction "speak clearly" may not adequately inform a speaker about how to adjust speech output. Ferguson (2004) also suggested that some speakers may require more specific instructions than "speak clearly" to maximize the benefits of clear speech. In contrast, the cues to "overenunciate" or "speak to someone with a hearing impairment" appear to have provided speakers with more focused information as to how to modify speech. The instruction to overenunciate appeared to direct speakers' attention to segmental articulation and speech durations, and the instruction "talk to someone with a hearing impairment" appeared to direct speakers' attention-for at least approximately half of the speakers-to vocal intensity as well as segmental articulation and

speech duration, albeit to a lesser extent than "overenunciate."

Tense-Lax Vowel Distinctiveness

Chen (1980) reported that repeated productions of a given vowel (i.e., vowel clustering) become closer in F1 ×F2 acoustic working space in clear speech, thus creating greater spectral distinction among vowel categories. More recent studies have shown that this type of spectral distinctiveness among neighboring vowels is important for intelligibility (H. Kim, Hasegawa-Johnson, &Perlman, 2011; Neel, 2008). Vowel clustering of the nature reported by Chen (1980) and H. Kim et al. (2011) was not computed in the present study due to the number of occurrences of each vowel (N = 3-5) per condition and the connected speech context. Instead, distinctiveness of tense-lax vowel pairs was examined via spectral distance in F1 ×F2 space measures, duration ratios, and lambda ratios.

Although there was a trend for the four tense-lax vowel pairs to exhibit increased dynamic distinction in the non-habitual conditions, measures of spectral and temporal distinctiveness for tense-lax vowel pairs did not differ significantly among conditions. Apparently, speaking-condition related enhancement in distinctiveness for tense-lax vowel pairs is subtle-a finding also supported by Y. Kim (2011) in a recent study investigating the impact of increased vocal intensity on spectral distinctiveness of tense-lax vowel pairs. However, vowel distinctiveness in the present studywas notwhollyunaffected by clear speech instructions. That is, as noted by Smiljanic and Bradlow (2009), results for vowel space area as well as F1 and F2 range suggest enhanced spectral distinctiveness among both tense vowels and lax vowels.

Interestingly, one speaker (M04) reduced almost all spectral distances for tense-lax vowel pairs in the nonhabitual conditions. Inspection of M04's duration and lambda ratios suggested that this speaker did tend to enhance tense-lax vowel contrast in the nonhabitual conditions with duration or dynamic spectral cues, but the magnitude of the enhancement was modest. Informal listening to M04's sentences further suggested only subtle perceptual differences among conditions. More formal perceptual judgments are warranted, but M04's data support the hypothesis that spectral and temporal acoustic contrast in clear speech is perceptually important.

Clear Speech and Articulatory Effort

Perkell and colleagues (2002) reported that clear speech was associated with greater peak movement speeds, longer movement durations, and greater movement distances. Although there is no widely accepted metric of articulatory effort, Perkell et al. (2002) interpreted these adjustments as evidence of increased articulatory effort for clear speech much in the same way that an increased SPL has been interpreted to reflect increased respiratory-phonatory effort (see Fox et al., 2006). It has further been suggested that acoustic adjustments associated with clear speech, such as increased intensity, lengthened sound segments, expanded vowel space areas, increased formant transition extents, increased formant transition slopes, and greater spectral distances, are associated with changes in the duration and/or velocity of articulatory movements (Moon &Lindblom, 1994; Perkell et al., 2002).

In the present study, greater movement distances for the nonhabitual conditions are suggested by increased vowel space areas, F1 and F2 ranges, lambda values, and IDs. The nonhabitual conditions also yielded changes in segment durations, articulation rate, and speaking rate. To the extent that these types of acoustic changes for the nonhabitual conditions may be a reflection of or byproduct of articulatory effort, the implication is that speakers used the greatest articulatory effort when instructed to overenunciate. Relatedly, results for SPL suggest a trend for increased respiratory- phonatory effort in the hearing impaired condition, for approximately half of the speakers.

Caveats and Future Directions

Several factors should be kept in mind when interpreting results of the present investigation. First, speakers included for study were healthy, young adults who spoke Standard American English with a dialect characteristic of the western New York region. Whether findings can be generalized to other ages, dialects, and languages is unknown. In addition, only neurologically healthy speakers were studied. Results may not translate

in a straightforward manner to clinical populations, such as patients with dysarthria, for whom clear speech is used therapeutically. Future studies evaluating the effects of different clear speech instructions for a variety of populations, including dysarthria, are of importance.

As a result of the ordering of conditions, the cumulative effect of the clear condition on the following nonhabitual conditions is unknown. However, in an effort to minimize carry-over effects across conditions, participants were engaged in a few minutes of conversation in between conditions. We also acknowledge that there was not a training component associated with the various clear speech instructions, nor was feedback provided regarding the adequacy with which speakers were able to produce clear speech. Thus, results should not be directly extrapolated to clear speech training programs or real-world clear speech situations in which listener feedback is available. Another factor to consider is the potential impact of clear speech instruction on measures of speech production that were not of interest in the present study. For example, clear speech has been shown to affect consonant production characteristics (Maniwa, Jongman, &Wade, 2009) as well as f0 (Bradlow et al., 2003), although Uchanski (2005) noted a fair amount of cross-speaker variability in the impact of clear speech on this latter measure. Future studies can now build on the present investigation to improve our understanding of how clear speech instruction affects a broader range of speech production measures. Studies also are needed to determine the perceptual consequences of different clear speech instructions. Finally, because many studies continue to use a hybrid of instructions to elicit clear speech (Bradlow et al., 2003; Picheny et al., 1985; Smiljanic &Bradlow, 2008), additional studies are needed to determine how a combination of clear speech definitions affects both speech production and perception.

Acknowledgments

This research was supported by National Institute onDeafness and Other Communication Disorders Grant R01DC004689. Portions of this study were presented at the November 2010 Convention of the American Speech-Language-Hearing Association.

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Editor: Anne Smith
Associate Editor: Karen Forrest
Received June 15, 2011
Revision received November 21, 2011
Accepted March 7, 2012
DOI: 10.1044/1092-4388(2012/11-0154)

Suhami Associates Ltd; Agency Reviews Patent Application Approval Request for "Cellphone Managed Hearing Eyeglasses"

Publication info: Telecommunications Weekly (Nov 28, 2012): 325.
ProQuest document link

Abstract: [...]it can also replace many of the functions of the cellular phone.

Full text: 2012 NOV 28 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- Suhami Associates Ltd has been issued patent application serial number 430728, according to news reporting originating out of Washington, D.C., by VerticalNews editors.
The patent's inventors are Suhami, Avraham (Petah Tikva, IL).
This patent application was filed on March 27, 2012 and was cleared for further review on November 15, 2012.
From the background information supplied by the inventors, news correspondents obtained the following quote:
"A Hearing Aid enhances hearing by amplifying voices detected by a sensitive microphone, while bringing an individual's reduced hearing response at various audible frequencies, to the level of hearing of a normal person, which is defined roughly as the ability to hear sounds on an absolute scale of 0 to 25 dB. The modified sound is then delivered into the user's ear canal.
"Hearing Aids also use various algorithms to suppress noise, echo and eliminate receiver-to-microphone acoustic feedback.
"Hearing devices may be situated behind-the-ear (BTE), in-the-ear (ITE) or completely-in-the-ear canal, (CIC).
"In recent years the use of cellphones in relaying voice messages from one person to another has increased enormously. The advent of cellular phones has caused many problems for the hearing impaired people wearing one of the hearing aids in or behind the ear, starting from the electromagnetic interferences between the two devices that are in close distance one from the other and the physical encumbrance caused by placing the cellphone over the hearing aid. Several solutions to these problems have been devised, including the use of inductive communication between the cellphone and the hearing aid device through the use of telecoils or resolving the causes of interferences. However to the best of our knowledge no radical solution to the hearing impaired people in the cellular phone age has been suggested nor implemented.
"One of the technological problems of the (BTE), (ITE) or (CIC) type hearing aids is the determination of the direction of the sound reaching the ear; precise determination of the direction of sound enables to eliminate

unwanted sources of sound and greatly improve SNR. This problem is currently dealt by using directional microphones that alleviate the problem (see U.S. Pat. No. 3,770,911). Some previous art solutions have suggested using two microphones and measuring the phase delay between them for determining the sound direction, however if the two microphones are very close the determined direction is not accurate. There have been several applications to put several microphones on the eyeglasses temples (see U.S. Pat. No. 3,247,330, U.S. Pat. No. 4,773,095; U.S. Pat. No. 7,192,136; U.S. Pat. Nos. 7,031,483; 7,609,842, 20090252360) for finding the direction of sounds however the technological implementations of these devices have been unsuccessful. There are also no cellphones that, working collaboratively with 'hearing eyeglasses', eliminate unwanted directional or non-directional sound."

Supplementing the background information on this patent application, VerticalNews reporters also obtained the inventors' summary information for this patent: "The invention describes a Hearing Aid device composed of a cellphone and eyeglasses where some of the programs are carried out by components embedded onto the temples of eyeglasses and some programs by components which are inherently part of cellphones. The combined device improves the intelligibility of voice messages arriving both through the cellphone speaker, the connected earphones and directly through the free air. The user can call diverse programs suitable for different situations, by using inertial sensors embedded either in the eyeglasses or are inherently part of the cellphone.

"It has to be realized that the core architecture of the classical hearing aid is to detect voice, 'correct' it, and deliver it to the ear of the hearing impaired person.

"A cellphone, in principle can do all these functions, with some reservation though. It can detect voice, directly or through the cellular network, it can determine interactively with the hearing impaired person his hearing profile, it has the computing power to 'boost' certain intensities, and eliminate certain sources of noise and when its speaker is juxtaposed to the ear, it can deliver the 'corrected' sound to the ear of the hearing impaired person.

"There are things that the cellphone cannot do though. In its current architecture, it cannot differentiate between directional sound and surround sound and eliminate unwanted sound and mainly, it cannot be worn all the day connected to the ear.

"Here is where the eyeglasses come. They can be worn inconspicuously all the time, and components embedded on its temples may carry out many of the functions that neither the cellular phone nor the miniscule behind or in the ear hearing aids can. In fact it can also replace many of the functions of the cellular phone.

"The design of the device presented in this application goes half way.

"It comprises a cellphone in its current architecture and eyeglasses where electronic sensors, processors, device conditioners and transceivers are embedded on its temples and can interact with the cellphone through its ports using coded audio instructions. Together they provide to a hearing impaired person, hearing loss corrected speech and sound, arriving either directly or by wireless communications.

"Hearing impaired people communicate with other people directly or using line and wireless communication devices, telephones and cellphones. Intelligibility of a received message is conditional to a faithful reconstruction of the parts of the message that are missing, due to the hearing losses. Amplifying the received message across the board, at all frequencies, is the basic tool that improves intelligibility. When the hearing losses are minimal, amplification may be sufficient. However amplifying both relevant speech and noise may not achieve much. Therefore reduction noise as much as possible is the next goal. In our system we try to substantially eliminate noise using two strategies. One strategy is by letting the hearing impaired person, to limit his 'listening cone' to cover only the space covered by his interlocutor(s). If the noise is omnidirectional, this tool by itself will reduce noise by up to two orders of magnitude. If the noise, on the other hand, is coming from the same direction as his interlocutor, this strategy may not achieve much. Setting a 'listening code' requires at least 4 microphones around the head of the person; consequently this strategy requires to place the microphones on the eyeglasse worn by the user. To increase the accuracy of the limited listening code and the ability to change

it quickly in real time, powerful DSPs, that continuously compute cross-correlations between the various microphones, are installed on both temples of the eyeglasses.

"The second strategy we use for reducing noise, is to follow speech components in time with a time resolution of 1-2 milliseconds and try to locate the natural 'pauses' between phonemes, syllables and words. As noise is, with high degree of probability, present both during 'pauses' and during speech segments, subtracting the noise frequencies amplitudes from the following speech frequencies, improves the SNR during speech. This strategy is applicable both to the sound detected by the microphones situated on the eyeglasses temples as it is applicable to the microphone of the cellular phone. The cellphone controls the processors on the temples by emitting high frequency audio instructions in the form of ringtones not heard by most persons.

"The next tool we have, in our endeavour to improve intelligibility of the detected speech is to compensate for the loss of hearing of selected audio notes, mostly at low and high frequencies at each ear. These losses may be measured by the user himself using his cellphone, and the required amplifications at selected frequencies, applied both to the speech detected by the microphones situated on the eyeglasses and at the incoming calls by wireless, before being sent to the respective left and right speakers of the eyeglasses and the cellphone speaker and earphones.

"Next, it is essential to differentiate between the voice of the user and that of other people in order to refrain from amplifying the user's voice and sending it to the respective speakers, thereby starting a regenerative audio loop. This identification of the user's voice may be achieved by cross-correlating the voice segments detected by the microphones at the two opposite sides of the mouth and eliminating those voice segments that are fully correlated. In addition the voice segments detected by the microphones of the eyeglasses or the cellphone, may be compared to the preloaded voice signature of the user, where high correlation approves the identity of the user and therefore are prevented to reach the respective speakers.

"Current Hearing Aid devices, suffer from deficiencies some of which are due to the limited space of several cm.sup.3, into which all the components, including the microphone, the receiver and the batteries, have to be squeezed in. An example is trying to find the direction of sound with two microphones that are 1 cm apart. The limited space, also dictates the use of power-limited data processors that are not powerful enough to perform complex comparisons fast enough.

"In this context it is important to stress the need to process speech rapidly, in order to combine it with speech arriving directly to the ear through the free air, so that the ear will seamlessly integrate the two. Digital hearing loss compensation comprising spectral decomposition with filters, non-linear amplification depending on the hearing threshold and spectral reconstruction ought to be carried out preferably in milliseconds or less, in order to enable the audio signals emitted by the receiver to be integrated with the sound reaching the ear directly through free air, without much delay.

"The noise subtraction schemes should also abide by the same constraint of speed; they should be able to define and subtract 'noise' from speech, preferably within several milliseconds from the detection by the microphone of said sound wavefront. This kind of quick reaction requires fast and powerful 32 bit DSPs that are hard to squeeze into the miniscule behind-the-ear hearing aids. RF Transceivers embedded on the eyeglasses enable two way communications with the digital world and communication between the temples of the eyeglasses.

"Consequently placing the required powerful DSPs and batteries much larger than the miniscule Zn-air batteries, on the eyeglasses temples, is a major advantage.

"Current 'Hearing Aids' are individualized devices optimized for certain situations by different programs. Change of programs need professional adjustments, requiring frequent visits to the hearing clinic. In this context too, the ability to change programs using the cellphone is a major advantage.

"We also maintain that there is no single solution to hearing impairment. The various situations encountered with different interlocutors and/or sound sources in different locations, are hard to accommodate with one

'ingenious' device. Detecting automatically, the various situations and allocations and maximizing Speech intelligibility accordingly although feasible, is not part of the functionality of the current invention. Different programs are needed to maximize speech intelligibility, in a quiet or noisy room of different sizes, in a Park or in a concert hall. One-on-one dialog is different from Listening to everyone talking at the same time in a meeting. Listening to music at home is different than Listening in a concert hall. Given the breadth of situations, our system opted for letting the user to make the selection between programs, depending on the situation he is in. In our architecture change of programs is done by the user, using his cellular phone by emitting the proper instruction using coded ringtones detected by the microphones embedded on the eyeglasses frames. Some functions like selecting the apertures of the 'Listening cone' may be executed with a number of 'taps' on the 'tap' sensors located on both temples. The selection is then acknowledged by a short message delivered through the receiver of the hearing aid. Large memories are placed on each temple of the eyeglasses to accommodate programs that best satisfy the various situations.

"The Ringtones emitted by the user's cellphone serve a dual purpose, to generate bands of tones of different pitch and timbre of varying intensities for determining the threshold of hearing, and also generate sequences of sounds for controlling the various functions of the system. The coded audio instructions embedded into Ringtones when detected by the microphones of the eyeglasses or that of the cellphone are interpreted by the embedded microcontrollers which then instruct to execute the various functions. A side advantage of relaying instructions to the system by audio is that some people may also relay instructions by just 'whistling' from a distant location. External commands may also be transmitted by the wireless Bluetooth transceiver of the cellphone and detected by the Bluetooth transceiver installed on the eyeglasses.

"The ability to record his own hearing responses, using his cellphone Ringtones, enables the user to do so in real life situations, which is very different from determining a threshold of hearing using pure tones delivered through earphones in a booth of an audio clinic.

"In this context it is important to realize that the 'structure' of the ear changes the spectrum of the sound reaching the inner ear; while higher frequencies are amplified, the lower ones are weakened. Moreover these changes are dependent on the direction of the sound reaching the ear. Consequently, it has to be realized that the 'hearing threshold' measured in the audio clinic with pure tones, is only a first approximation when it comes to improve the hearing ability in real life situations, where sounds arrive from different directions. The correction implemented in hearing aids usually consists in amplifying the various frequencies in different amounts, given the 'hearing threshold' measured in the clinic, so that the resultant frequency response is that of a 'normal person'. We maintain that this procedure is grossly incorrect; the correction should be different when for example the sound is coming from someone in front of you, from the side or from a 'surround sound' system with 6 loudspeakers in a room.

"Another aspect of defining a suitable 'threshold of hearing' is the intelligibility aspect, which takes in account the brain perception of speech. A person will 'hear' a sound's higher harmonics although he may not hear the fundamental frequency and will substitute the unheard frequency in trying to decode a word that should have contained the unheard or unresolved frequency. This substitution will help the brain 'understand' the word.

"An additional aspect of measuring the 'hearing threshold' is the 'masking' effect, where a note at certain frequency may be masked from being 'heard' if another note at a near frequency but higher energy, is present within a 'short' time window. Thus for example a 250 Hz note followed within 200 millisecond by a 350 Hz note of the same amplitude (double the energy) will prevent the 250 Hz note of being heard. These and other brain related effects make the 'hearing threshold' measured with pure tones in a noiseless booth with earphones that discard the amplification effects of the ear pinna, less of an objective measurement of hearing loss. Consequently we maintain that the 'threshold of hearing' should not be measured with pure tones only but with complex Ringtones that include in addition to the fundamental notes also several of their harmonics. As the hearing mechanism is energy cumulative, the loudness of the complex notes for testing the 'hearing threshold'

should at least be 200 msec long.
"Therefore the different 'thresholds of hearing' should be measured in the field and stored for use in these very different situations.
"We foresee at least 5 different 'thresholds of hearing' for each ear: when the sound is coming from the front, from a side or from all around the person, from earphones or from a cellphone juxtaposed to the ear. Consequently at least 10 'hearing thresholds' should be measured, stored and used as a base for amplification in similar situations.
"Measuring the hearing threshold with the cellular phone is beneficial not only for oneself for correcting incoming calls, before reaching the ears, but may also be used for correcting outgoing calls, given the threshold of hearing of the receiving party. The threshold of hearing may be measured and recorded either by oneself or from remote through a Q&A session for finding the hearing threshold of the party at the other end of the line. Thus, when transmitting a call, the specific correction needed for the receiving party to better understand the call, can be inserted into the transmission. Consequently, the 'Hearing correction' should figure side by side with the cellphone number of a party if this person is interested to receive calls better suited to his hearing quality.
"In a preferred embodiment the Hearing Eyeglasses components embedded in each of the eyeglasses temples include a Codec, a Microcontroller, a DSP, a large Flash memory, a Bluetooth RF transceiver, a rechargeable battery, an efficient receiver, 3 microphones and several MEMS sensors, all commercial off-the-shelf components. The microcontrollers situated in the temples may communicate between them by NFC (Near Field Communication) or by wire embedded in the temples of the eyeglasses or by a loose micro-cable connecting the back tips of the temples.
"The main modes of operation are 'Speech' and 'Surround sound' which are further divided into 'Noisy' or 'Quiet' selections and further depending on the size of the space where the sound source and the 'hearing' person are located. In addition some specific sources of sound may be selected, in order to optimize the characteristics of the 'sound source' to those of the user's hearing impairment. Such specific 'sound source' selections may for example include close family members with whom the user has frequent conversations. Their voice signatures may be recorded and stored for use in preferential processing of their calls. Voice signatures that are useful for making incoming calls more intelligible comprise, the adjustment of the dynamic range of the largely logarithmic compression of speech and accentuation of certain frequencies. These and other features may be analyzed given previous calls of certain frequent callers, such as family members, and preferential features specific to the caller such as amplification of certain frequency bands and optimal loudness range may be stored and applied when calls from said persons are received.
"4 microphones 'around' the head are used to determine the direction of the 'Sound source' in a 'Noisy' environment. Fast cross-correlations between pairs of 4 microphones determine the relative'LEAD' or 'LAG' of the sound waves; in other words the differences in the time of arrival of the sound to the microphones. For example a maximal cross-correlation of (1) or (-1) means that the sound source is located on a plane perpendicular to the line connecting the two microphones. This is the case of a one-on-one frontal conversation. In this case the audio levels detected by both microphones are equal, while the volume is inverse proportional to the square of the distance. However the cross-correlations between the front and back microphones will 'LEAD' or 'LAG' depending on their relative locations 'LEAD' or 'LAG' will determine the 'altitude' of the source of sound relative to the plane determined by the four microphones around the head.
"In the 'Surround Sound' mode which is applicable when Listening to music at home or in a concert hall, the 'pause' period is not only harder to automatically define, but it is also wrong as in a 'pause' period, noise made by the crowd, may increase. In this case a user signaling is required, by activating one of the external signaling devices mentioned above, in order to define 'noise' only when the user thinks it to be proper.
"Two LED illuminators placed on the front of the temples and activated by a 'touch' sensor, are directed forward and illuminate a limited area in front of the eyeglasses; they serve several purposes in dark areas and may be

used for example to illuminate the scene being photographed by the eyeglasses camera or to read in the dark, whether in an airplane or in bed or for indicating the eyeglasses location by generating an audio code, for example when triggered by a proper whistle or ringtone. One of the LED illuminators may be in the NIR wavelength for illuminating a scene being photographed in the dark, without drawing attention.
"The large flash memory connected to the microcontroller allows to record and store all the available programs that may be implemented depending the situation and place where the Hearing Eyeglasses are utilized to improve hearing. It may also be used to store conversations whether face-to-face or through the cellphone or store Audio programs detected by the FM receiver. The two 3-axis gyroscopes on the temples, sense the mutual positions of the eyeglasses temples and shut the battery whenever the eyeglasses are posed horizontally with the temples crossed over the frames.
"In the 'sleep' mode a limited number of components on the eyeglasses wake-up periodically for a short time and listen for short external coded signals. In the case that a properly coded audio or wireless signal is received and authenticated, the hearing eyeglasses emits a sound signal and a flashing light by a LED. These signals help find the location of misplaced eyeglasses. The search signal may also be a proprietary whistle, previously recorded, digitized and stored in the memory."
For the URL and additional information on this patent application, see: Suhami, Avraham. Cellphone Managed Hearing Eyeglasses. U.S. Patent Serial Number 430728, filed March 27, 2012, and posted November 15, 2012.
Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=1916&p=39&f=G&l=50&d=PG01&S1=20121108.PD.&OS=PD/20121108&RS=PD/20121108
Keywords for this news article include: Brain, Electronics, Microcontroller, Suhami Associates Ltd, Central Nervous System.

Publication date: Nov 28, 2012

Year: 2012

Seeing facial motion affects auditory processing in noise

Author: Gilbert, Jaimie L; Lansing, Charissa R; Garnsey, Susan M

Publication info: Attention, Perception and Psychophysics 74.8 (Nov 2012): 1761-1781.
ProQuest document link

Abstract: Speech perception, especially in noise, may be maximized if the perceiver observes the naturally occurring visual-plus-auditory cues inherent in the production of spoken language. Evidence is conflicting, however, about which aspects of visual information mediate enhanced speech perception in noise. For this reason, we investigated the relative contributions of audibility and the type of visual cue in three experiments in young adults with normal hearing and vision. Relative to static visual cues, access to the talker's phonetic gestures in speech production, especially in noise, was associated with (a) faster response times and sensitivity for speech understanding in noise, and (b) shorter latencies and reduced amplitudes of auditory N1 eventrelated potentials. Dynamic chewing facial motion also decreased the N1 latency, but only meaningful linguistic motions reduced the N1 amplitude. The hypothesis that auditory-visual facilitation is distinct to properties of natural, dynamic speech gestures was partially supported. [PUBLICATION ABSTRACT]

Full text: Headnote

Published online: 16 October 2012

Abstract Speech perception, especially in noise, may be maximized if the perceiver observes the naturally occurring visual-plus-auditory cues inherent in the production of spoken language. Evidence is conflicting, however, about which aspects of visual information mediate enhanced speech perception in noise. For this reason, we investigated the relative contributions of audibility and the type of visual cue in three experiments in young adults with normal hearing and vision. Relative to static visual cues, access to the talker's phonetic gestures in speech production, especially in noise, was associated with (a) faster response times and sensitivity for speech understanding in noise, and (b) shorter latencies and reduced amplitudes of auditory N1 eventrelated potentials. Dynamic chewing facial motion also decreased the N1 latency, but only meaningful linguistic motions reduced the N1 amplitude. The hypothesis that auditory-visual facilitation is distinct to properties of natural, dynamic speech gestures was partially supported.

Keywords Evoked potentials . Multisensory processing . Speech perception

Everyone experiences difficulty understanding speech at some point, especially in noisy environments or in the presence of a hearing loss. The natural setting for speech communication is in a face-to-face environment where people can both hear the speech and see the face of the talker. Considerable evidence has shown that performance on speech perception tasks improves when information from both auditory and visual modalities is available (Bergeson, Pisoni &Davis 2003; Bernstein, Auer &Takayanagi 2004; Grant &Seitz, 1998; Kaiser, Kirk, Lachs, &Pisoni, 2003; Kim &Davis, 2004; Schwartz, Berthommier, &Savariaux, 2004; Sumby &Pollack, 1954). However, evidence is conflicting about what aspects of the visual speech signal contribute to the auditory-visual facilitation.

From the classic McGurk paradigm (McGurk &MacDonald, 1976), it is well known that visual information influences auditory perception. Facial perception may differ from visual perception of other kinds of objects (see, e.g., Bentin, Allison, Puce, Perez &McCarthy 1996). For instance, a smile on the face may influence how a talker is perceived (Otta, Lira, Delevati, Cesar, &Pires, 1994), and perceivers may look to parts of the face other than the mouth, such as the eyes, before and after a speech utterance (Lansing &McConkie, 2003). In addition, visual motion may elicit special processing (see, e.g., Ahlfors et al., 1999; Bavelier et al., 2001). Results from Schwartz et al. (2004) have suggested that a dynamic nonspeech visual cue (a dynamic rectangle) did not facilitate auditory-visual speech, and that facilitation required a dynamic visual speech gesture. However, results from Bernstein et al. (2004) suggested that, on the contrary, a variety of visual stimuli- including the full face of the talker, a static rectangle, a dynamic rectangle, and a dynamic Lissajous figure-all facilitated auditory-visual speech perception.

Another important consideration for auditory-visual speech perception is the quality of the acoustic environment, which affects speech audibility, and may thus influence the use of observable visual information from the face of the talker. For individuals with normal hearing, auditory-visual facilitation may not be measurable in ideal listening conditions, due to near-ceiling-level performance when auditory information is all that is available. However, recent studies have demonstrated that auditory-visual speech in quiet listening conditions is processed differently than auditory-only speech. The amplitude of the N1 component of the event-related brain potential (ERP) was reduced in response to matching, congruent, and synchronous auditory-visual speech syllables, in comparison to responses to auditory-only speech syllables (Pilling, 2009; vanWassenhove, Grant, &Poeppel, 2005), and also in comparison to the sum of responses to auditory-only and visual-only speech syllables (Besle, Fort, Delpuech, &Giard, 2004). There is also some evidence that in quiet conditions, congruent auditory-visual speech can be processed faster than auditory-only speech (Pilling, 2009; van Wassenhove et

al., 2005).

When the audibility of the speech signal is reduced, the N1 response to auditory-only speech syllables is slower and reduced in amplitude (Martin, Kurtzberg, &Stapells, 1999; Martin, Sigal, Kurtzberg, &Stapells, 1997). Environments with reduced audibility, such as speech in noise, provide an opportunity for the visual speech signal to contribute to perception (Sumby &Pollack, 1954). Questions remain, though, about how auditory-visual speech is processed in noise. Modifications to an acoustic signal presented in noise have been demonstrated to alter the neural response pattern in aggregate neural responses recorded in guinea pig auditory cortex (Cunningham, Nicol, King, Zecker, &Kraus, 2002). Unrelated competing stimuli have also been shown to influence a click-evoked neural response (Weihing, Daniels, &Musiek, 2009). In the present experiments, we employed ERPs measured in humans in response to auditory- visual stimuli in order to investigate the influence of different types of visual signals on the processing of acoustic speech syllables in white noise.

The goals of the present experiments were (1) to investigate the neural correlates of auditory-visual facilitation in noise and (2) to test whether neural processing of auditory-visual cues would vary with the type of visual cue. Detailed information about when and how auditory-visual integration occurs in individuals with normal hearing sensitivity is necessary to the development of theories and applications for those whose perceptual processes may be different because of sensory deprivation from deafness during a critical period or because their sensory stimulation is delivered by a cochlear implant.

Three separate experiments were conducted. In Experiment 1, we tested the hypothesis that audibility and type of visual cue affect the identification of /ba/ and /ga/ in a speededresponse task. Experiments 2 and 3 investigated the hypotheses that audibility and type of visual cue, respectively, influenced the neural correlates of auditory-visual facilitation, as measured by the N1 component of the evoked auditory response. Behavioral data (accuracy and response time measures) were collected for all three experiments. The behavioral findings from Experiments 2 and 3 replicated the results observed in Experiment 1, so those are presented in detail only for the first experiment.

Experiment 1

Method

Participants

A group of 16 participants (eight female, eight male) between the ages of 18 and 25 were recruited. All spoke American English as their native language, reported that they were righthanded, and had normal or corrected-to-normal visual acuity. On the basis of self-report, the participants had no significant history of hearing, language, or reading problems or neuropathology. In addition, all of the participants completed an automated hearing test procedure with calibrated headphones within the laboratory sound booth. This automatic procedure (Home Audiometer Hearing Test software, Version 1.83; www.audiometer.co.uk) calculates a hearing threshold level, and it was tested on lab personnel to verify its accuracy as compared to a traditional hearing test conducted in a hearing clinic. Using the automated, calibrated procedure, all of the participants had pure-tone thresholds of 30 dB HL or better at 500, 1000, 2000, 3000, 4000, and 6000 Hz. Participants demonstrated a range of lipreading proficiency (2 %-44 %) on the basis of words-correct scoring (Bernstein, Demorest, &Eberhardt, 1994; Demorest &Bernstein, 1991, 1992), with average performance (M 0 27 %, SD 0 12 %) similar to the previously reported mean of 20.8 % of words correct (Demorest &Bernstein, 1991). The lipreading screening results indicated that the participants represented a diverse group in terms of their proficiency to extract words from visual-only speech gestures. Written informed consent was obtained, and the participants received monetary compensation or fulfilled a course requirement as partial compensation for their time.

Stimuli

Audio-video recordings were made of two different talkers (one male and one female) producing five exemplars of the speech syllables /ba/ and /ga/. These syllables were selected to contrast the perception of a gesture with a high degree of visibility (/ba/) with the perception of one with limited visibility (/ga/). Recordings were made in

a quiet room with a Canon XL1 HD digital camcorder at 30 frames per second, with an MS condenser microphone. The talkers' faces were illuminated with a Lowell Caselight 5 5400 K. Video recordings were also made of the same individuals chewing gum or displaying a fixed natural smile. The productions of speech and nonspeech facial movements began and ended with a neutral face position.

Auditory stimuli Speech stimuli (16-bit sample size, 44.1- kHz sampling rate) were extracted from the audio-video recording in quiet and equated in average root-mean square (RMS) level. The acoustic characteristics of the speech syllables are detailed in Table 1 (/ba/) and Table 2 (/ga/). In addition, the stimuli were mixed with white noise (bandwidth of 0-22050 Hz), with the level of the noise adjusted to an average RMS value that was equal to that of the speech stimuli, 9 dB more intense than the speech stimuli, or 18 dB more intense than the speech stimuli. Thus, two auditory signals were presented overlapping in time-the speech signal and the white noise, with the white noise preceding the onset of the speech stimulus and continuing after the speech offset. As this was an initial foray into investigations of the neural correlates of auditory-visual speech perception in noise, specifically by measurement of the N1 ERP, we decided to start by observing effects that occurred in broadband white noise. Broadband white noise was selected to ensure that differences in responses were related to the properties of the syllable and not to differential characteristics of the masker. This selection also had the advantage of allowing for comparisons between the present findings and previous research that had also employed broadband noise, in investigations of auditory-visual speech perception (Bernstein et al., 2004; Kim &Davis, 2004; Sumby &Pollack, 1954) and neural activity (Cunningham et al., 2002), and importantly, in a study differentiating activity related to two separate acoustic onsets (Kaplan-Neeman, Kishon-Rabin, Henkin, &Muchnik, 2006). The stimuli were presented at signal-to-noise ratios (SNRs) of 0, -9, or -18 dB. These particular SNRs were chosen on the basis of the results of Sumby and Pollack (1954); the 0- to -18-dB SNR range encompasses differences seen on a function of SNR for the percent difference (between auditoryonly and bisensory presentation) of speech intelligibility scores (see Sumby &Pollack, 1954, Fig. 3). For the present experiments, SNRs were determined by holding the level of the speech constant at a presentation level of approximately 60 dB SPL and adjusting the level of the noise.

Visual stimuli Four types of visual stimuli were presented: (a) a static rectangle, (b) a static smiling image of the talker's face, (c) a full-motion video of the talker's face producing a chewing motion, and (d) a full-motion video of the talker's face producing the dynamic speech gestures to vocalize /ba/ or /ga/. The video display (600 ×800 pixels [h ×w] in the center of the computer screen) presented the complete face of the talker, in frontal view from above the neck to the top of the head, at a rate of 29.97 frames per second (fps). The first frame of each video was presented for 1,000 ms before the video played, and the last frame was presented for 500 ms. Dynamic video motion (talking or chewing) began after the initial 1,000-ms presentation of the first frame of a neutral face.

Experimental stimuli Auditory and visual stimuli were paired to create the experimental test stimulus conditions. Auditory speech (in quiet or mixed with noise) was presented with a static rectangle to form the auditory-withrectangle (AR) condition (Fig. 1), with a static smiling face to form the auditory-with-static-face (ASF) condition (Fig. 2), with dynamic chewing motion on the face to form the auditory-with-dynamic-nonspeech-facial-motion (ADF) condition (Fig. 3), and with visual speech gestures to form the auditory-visual speech (AVS) condition (Fig. 4). The visual-only (VO) condition (Fig. 5) consisted of visual speech gestures presented in the absence of an auditory stimulus or presented with white noise only. In the AVS condition, auditory speech was always paired with the speech gesture that had produced that particular exemplar. The stimuli for each talker consisted of five exemplars per syllable. The initial video frame (or the static image) was presented for 1,000 ms prior to motion onset. The onset of the initial image coincided with the onset of the white noise, such that at least 1,000 ms separated the onset of the noise and the onset of speech sounds (Kaplan-Neeman et al., 2006). Motion for the video stimuli began following this 1,000-ms static presentation. However, as speech requires prearticulatory motion, the onset of auditory speech did not occur exactly 1,000 ms following the beginning of

the trial. For all of the experimental stimuli, the auditory speech signal began at the same time as it would have, had the participant been viewing the combined auditory-plus-visualspeech condition.

Experimental design

Experimental trials were organized into ten blocks (two per visual cue condition), each consisting of 80 trials and lasting approximately 8 min. In each block, one of the possible visual cues was paired with auditory stimuli in each of the four possible acoustic environments (quiet or 0, -9, or -18 dB SNR), with equal numbers of presentations of /ba/ and /ga/ in each acoustic environment. The orders of trials in each acoustic environment and of the two syllables were randomized within blocks. Across blocks, all possible combinations of visual cue and acoustic environment (quiet and noise levels) were presented. The order of blocks using different visual cues was presented in a new randomized order for each participant, with the exception that the visual-only (without sound) condition was always presented last, to mitigate the development and use of visual-only strategies for auditory-visual conditions.

Productions of the stimuli from two talkers were tested (one male, one female). Each participant received stimuli in all experimental conditions, but saw and heard stimuli produced by only one of the talkers, with half seeing the female and half the male talker. The participants were asked to press a button to respond to a yes/no question after each trial. The yes/no design allowed for the application of signal detection theory. To control for the possibility of variability in the task demands for perceiving the different syllables, half of the participants were asked, "Do you think it was /ba/?" and the other half were asked, "Do you think it was /ga/?" Participants were instructed to respond as quickly and as accurately as possible. Responses were measured for 2 syllables (/ba/, /ga/) ×4 acoustic environments (quiet, 0 dB SNR, -9 dB SNR, -18 dB SNR) ×5 visual cues (AR, ASF, ADF, AVS, VO), with 20 trials per cell, for a total of 800 trials for each participant.

Procedure

Written instructions and practice items were provided prior to the experimental trials. The instructions and the task ("Do you think it was . . .") were designed to avoid biasing attention toward a single modality. Practice items allowed participants to ask any questions about the task prior to beginning data collection. Auditory stimuli were presented via an insert earphone (ER-3A, Etymotic Research) to the right ear. Visual stimuli were presented on a cathode ray tube (CRT) computer monitor with 1,280 ×1,024 pixel resolution, using 32-bit color quality with a 75-Hz refresh rate. Participants were seated such that the distance between their eyes and the monitor was approximately 85 cm, with chair height adjusted so that their eye heights were approximately level with the center of the monitor.

Each trial within a block was followed by a screen reminding the participant to respond to the trial (1,500-ms duration). Participants were instructed to respond as quickly and as accurately as possible, by pressing buttons for either a "yes" or a "no" answer on a Cedrus response pad (Model RB-830). Subsequently, a screen appeared with a fixation cross centered in the middle of the screen to indicate that the participant should prepare for the next trial. The interval of the fixation cross ranged between 1,000 and 2,000 ms and was randomly varied by Presentation software (Version 10.0, Build 07.03.06; www.neurobs.com). Participants were encouraged to take breaks to reduce fatigue. Following the experimental blocks, participants completed a lipreading screening measure (Bernstein, Demorest, Coulter &O'Connell 1991; Eberhardt, Bernstein, Demorest, &Goldstein, 1990) consisting of 20 Central Institute for the Deaf (CID) everyday sentences (Davis &Silverman, 1978) spoken by a male talker, digitized from the Bernstein and Eberhardt (1986) corpus. The purpose of screening lipreading performance was to ascertain that the participants' lipreading proficiencies were consistent with that of the general population on average (Demorest &Bernstein, 1991), and that a range of proficiency on extracting words from visual-only speech information was represented.

Data analyses

Signal detection theory (Green &Swets, 1966) was applied in order to analyze response sensitivity and bias across experimental conditions. A hit was defined as a correct response, indicating that the target syllable was

identified when the target syllable was in fact presented (e.g., the task "Do you think it was /ba/?", acoustic stimulus /ba/, and response "yes"). A false alarm was defined as an incorrect response, indicating that the target syllable was identified when the other syllable was presented (e.g., the task "Do you think it was /ba/?", acoustic stimulus /ga/, and response "yes"). Repeated measures analyses of variance (ANOVAs) were performed for each measure. In this and all following experiments, significance for omnibus ANOVAs was determined at the p <.01 level with Huynh-Feldt corrections (uncorrected degrees of freedom will be reported), and significance for follow-up testing was defined at the p <.05 level with Bonferroni corrections (with the alpha level set to the value of .05 divided by the number of comparisons). The between-subjects factors Talker (male, female), Target Syllable Task (Do you think it was /ba/?, Do you think it was /ga/?), and Sex of the Participant were initially included in this and all following analyses for all experiments. However, since these factors failed to reach significance, they are excluded from all results reported in all experiments. Effect sizes are reported in terms of f according to Cohen's (1988) power tables, and are categorized as small (f 0 .10), medium (f 0 .25), or large (f 0 .40). All significantmain effects in all three experiments had large effect sizes.

Results

Response sensitivity was better overall in noise when visible speech gestures were present than when nonspeech visual cues were present. The participants demonstrated a bias to answer "no" in response to /ba/ presented in noise at both 0 and -9 dB SNR, and also when it was presented with nonspeech visual cues. Response times were slower overall in the most intense noise environment tested in this experiment (-18 dB SNR), but the effect of noise was significant only with nonspeech visual cues. When acoustic syllables were presented with visual speech gestures, the -18-dB SNR did not slow down response times.

Accuracy: Signal detection analysis

Sensitivity as measured by d' was reliably affected by both visual cue type [F(4, 56) 0 99.87, p <.001, f 0 .70] and acoustic environment [F(3, 42) 0 196.09, p <.001, f 0 .80]. The participants' ability to distinguish the signal from the noise decreased as the noise level increased when no visible speech gestures were available. A significant Visual Cue ×Acoustic Environment interaction [F(12, 168) 0 78.11, p <.001] revealed that sensitivity decreased especially at the most challenging noise level in the absence of visible speech gestures (Fig. 6). Sensitivity decreased significantly at -18 dB SNR as compared to -9 dB SNR only in the AR, ASF, and ADF visual cue conditions. In these nonspeech visual cue conditions, sensitivity was also decreased significantly at -9 dB SNR, as compared to the quiet listening conditions.

The analysis of response bias revealed a difference between the two syllables [F(1, 14) 0 18.46, p = .001, f 0 .70], with participants being more likely to respond "no" for /ba/ trials [/ ba/, M 0 1.44, SD 0 0.77; /ga/, M 0 0.92, SD 0 0.37]. A significant Syllable ×Visual Cue interaction [F(4, 56) 0 8.31, p <.001] revealed a significant bias to answer "no" for /ba/ in the AR, ASF, and ADF presentation conditions. We also found a reliable Syllable ×Acoustic Environment interaction [F(3, 42) 0 7.08, p = .004], because participantswere biased to respond "no" to /ba/ relative to /ga/ at 0 and -9 dB SNR. The three-way Visual Cue ×Acoustic Environment ×Syllable interaction was also significant [F(12, 168) 0 3.72, p = .005]. Follow-up testing revealed similar response bias β statistics across syllables in the 0- and -9-dB SNR acoustic environments in the nonspeech visual cue presentation conditions. This pattern of results suggests that participants were more likely to respond "yes" and "no" equally when visible speech gestures were presented or when the task could be completed using information from one sensory modality (auditory- only in quiet, or visual-only at -18 dB SNR). With nonspeech visual cues at 0 and -9 dB SNR, perhaps when the information from both modalities was salient, there was a bias to respond "no" to /ba/.

Response time

The results for response times were similar when analyzing all responses and when analyzing only correct (hit) responses. The statistics from all responses are reported to provide an analysis with more-similar ns across conditions. We found significant main effects of both visual cue [F(4, 60) 0 38.84, p <.0001, f 0 .70] and acoustic

environment [F(3, 45) 0 112.74, p <.0001, f 0 .80] on response times. Response times were significantly faster when visual speech gestures were presented (for AVS, M 0 823.14 ms, SD 0 260.47 ms; for VO, M 0 789.29 ms, SD 0 266.56 ms) than when they were not (for AR, M 0 1,141.28 ms, SD 0 313.88 ms; for ASF, M 0 1,109.45 ms, SD 0 316.29 ms; for ADF, M 0 1,118.13 ms, SD 0 425.90 ms).

Across acoustic environments, responses were faster in both the quiet condition (M 0 879.01 ms, SD 0 250.49 ms) and the 0-dB SNR condition (M 0 907.70 ms, SD 0 261.84 ms) than in the two highest-noise-intensity conditions. Responses were also faster at -9 dB SNR (M 0 946.38 ms, SD 0 272.36 ms) than at -18 dB SNR (M 0 1,251.95 ms, SD 0 465.55 ms).

A significant Visual Cue ×Acoustic Environment interaction [F(12, 180) 0 54.22, p <.0001] revealed that responses were slower in the -18-dB than in the -9-dB SNR environment only when visual speech cues were absent (Fig. 7). Acoustic environment also interacted with syllable [F(3, 45) 0 7.99, p = .0007], but differences in the response times to syllables at the same SNR did not reach significance. A faster response time to /ga/ (M 0 1,215.69 ms, SD 0 444.42 ms) than to /ba/ (M 0 1,288.21 ms, SD 0 485.84 ms) at -18 dB SNR approached significance, but the difference did not survive the Bonferroni corrections. The significance of the Acoustic Environment ×Syllable interaction in the omnibus ANOVA may have been confounded by a marginally significant Visual Cue ×Acoustic Environment ×Syllable interaction in the omnibus ANOVA [F(12, 180) 0 2.25, p = .0115 (significance set at p <.01 for the omnibus ANOVA)]. In testing comparisons, a marginally significant difference was found, with responses being faster to /ga/ than to /ba/ at -18 dB SNR with static smiling face (ASF) visual cues [F(1, 15) 0 10.72, p = .0051 (significance set at p <.05 with ten comparisons tested; therefore, p <.005 with Bonferroni corrections)].

Discussion

The measures of response sensitivity and response time were improved in noisy acoustic environments when participants saw visible speech gestures, as compared to seeing nonspeech visual cues. In the most intense noise environment tested (noise level at 78 dBA SPL, or a -18-dB SNR), response times were somewhat faster to /ga/ than to /ba/, mainly when a nonspeech visual cue, the static smiling face, was presented. Since place of articulation is not a robust acoustic cue for perceiving consonants in noise (Miller &Nicely, 1955), people may need help from visual cues when determining consonant identity in noisy environments. The slower responses for /ba/ when accompanied by a static face suggest that listeners rely on visual cues especially for sounds that are produced with articulatory motion that is visible on the face, such as /ba/, and do so less for sounds with less visible articulation.

An alternative explanation for syllable differences is the role of an upward spread of masking with broadband white noise. Formant frequencies, especially F2, were generally higher for /ga/ than for /ba/ (see Tables 1 and 2), suggesting that in greater levels of noise, more masking would occur for /ga/. However, it is unlikely that an upward spread of masking impacted our results, as response times were generally faster for the syllable that would have been more masked. In addition, no syllable differences were evident in the d' sensitivity analyses; if more masking had occurred for /ga/, there should have been differences in both sensitivity and response time measures. Individuals also differ in their susceptibility to masking effects (Neff& Dethlefs, 1995), such that differential effects of the upward spread of masking on the syllables might not be consistent across participants. The data suggest instead that the manipulation of the type of visual cue was a key factor in the observed participant behaviors.

No consensus exists in the literature regarding the influence of nonspeech visual cues on behavioral measures of speech perception such as detection and identification. Bernstein et al. (2004) found lower detection thresholds with auditory-visual presentations, regardless of whether the visual stimuli consisted of speech gestures or static/ dynamic geometric shapes. In contrast, Schwartz et al. (2004) found better identification of voiced plosives only when the visual stimuli consisted of the visible speech gestures, not when they consisted of a dynamic geometric shape. In the present experiment, behavioral measures of response sensitivity and

response time were also improved only by visible speech gestures, not by the nonspeech visual cues of a chewing motion, a static face, or a static rectangle.

The production of some speech sounds involves preparatory motion as a talker moves from a resting state to articulation of an isolated phoneme, and also during coarticulation in natural, continuous speech. When visual precues such as this were included in Bernstein et al.'s (2004) experiments, there was an advantage for speech gestures over nonspeech visual cues, consistent with the results obtained here and by Schwartz et al. (2004). Kim and Davis (2004) reported that dynamic visual speech gestural movement was necessary for an auditory-visual advantage in a two-interval forced choice task, but the advantage went away when the speech gesture was reversed temporally, suggesting that the local temporal correlation between visual and auditory speech cues was also important.

The results from Experiment 1 indicated that only visual speech gestures led to an improvement in behavioral measures of response sensitivity and response time. The influence of visible speech gestures on measures of behavioral performance was most noticeable in the -9- and -18-dB SNR acoustic environments. However, performance did not differ between the AVS and VO presentation conditions, suggesting that visual information alone was sufficient to accomplish this yes/no behavioral task in these acoustic environments, with simple speech stimuli that were highly contrastive in visual saliency. The influence of visual information at earlier stages in the processing of these stimuli, as reflected in the ERPs, was investigated in the following experiments.

Experiment 2

The aim of Experiment 2 was to investigate the processing of auditory-visual stimuli, as measured by the N1 ERP response, in quiet and at different SNRs. ERP responses to auditory syllables (presented in quiet and in white noise) were compared when accompanied by either a dynamic chewing face or a visual speech gesture. The selection of the ADF and AVS visual cue conditions provided the opportunity to evaluate the effect of audibility with speech as compared with nonspeech visual motion.

Method

Participants

A new group of 16 participants (eight female, eight male) participated in Experiment 2. The participant eligibility criteria were the same as those for Experiment 1. As in Experiment 1, participants denied any hearing problems and had pure-tone thresholds of 30 dB HL or better at 500, 1000, 2000, 3000, 4000, and 6000 Hz, as measured in the laboratory by the automated, calibrated hearing test procedure. Participants again varied in their ability to extract words from visual-only speech, with a range of 8 %-40 % words correct (M 0 22 %, SD 0 10 %) on a lipreading test (Demorest &Bernstein, 1991).

Stimuli

The auditory and visual stimuli were a subset of those used in Experiment 1. In particular, only the ADF and AVS visual cue conditions were used.

Experimental design

The amplitude and latency of the N1 potential, along with the accuracy and response times for behavioral responses, were measured. Sixteen conditions were created in a 2 visual cues (ADF, AVS) ×4 acoustic environments (quiet, 0 dB SNR, -9 dB SNR, -18 dB SNR) ×2 syllables (/ba/, / ga/) design with 100 trials per condition, for a total of 1,600 trials per participant. The experimental trials were organized into blocks lasting approximately 10 min, with eight blocks per experimental session. Each block consisted of one visual cue condition accompanying randomized acoustic environments and syllables, with equal numbers of presentations of /ba/ and /ga/. The between-subjects factors [Talker (male, female), Target Syllable Task ("Do you think it was /ba/?", "Do you think it was /ga/?"), and Sex of the Participant] were identical to those of Experiment 1. Eight participants were presented with stimuli produced by the male talker, of which four responded to the question "Do you think it was / ba/?", and of these four participants, two were male, one of whom received the ADF

condition first, and the other received the AVS condition first.

Procedure

The procedures were similar to those of Experiment 1, with the addition of electroencephalograph (EEG) recording, a lab visit, and a second experimental session. ERPs were recorded via Ag-AgCl electrodes snapped onto a cap (Easy Cap Modular EEG-Recording Caps, EASYCAP; www.easycap.de/easycap/), using InstEP IWave software (Version 5.21) with Grass Model 12 Neurodata Acquisition System amplifiers (Grass Instrument Co.,WestWarwick, RI). The scalp recording locations (referred to as the Channel factor in the analyses), based on the 10-10 international electrode system (Chatrian, Lettich, &Nelson, 1985, 1988), were Fz, Cz, Pz, F3, F4, C3, C4, C5, C6, CP5, CP6, FC3, FC4, CP3, CP4, P3, and P4. The recording parameters were set to a bandpass of 0.01-30 Hz; the data sampling rate was 200 Hz. Recordings were referenced to the leftmastoid online and later re-referenced to the averaged mastoid locations (A1, A2). Bipolar electrode pairs above and below the right eye and just lateral to each eye were used to monitor eye blinks and saccades. Recording electrode impedances were below 5 kΩ, and the ground electrode was below 10 kΩ.

Participants completed a lab visit to verify eligibility and to become familiarized with the setup procedures required for recording the ERPs. Data were collected across two sessions, with all conditions (ADF and AVS at each SNR) presented at both sessions in order to reduce the chances that the results would differ across sessions for spurious reasons. All other procedures were identical to those for Experiment 1.

Data analyses

Waveform analysis ERP waveforms were time-locked to the acoustic stimulus onset (i.e., burst release). Single-trial epochs, with a 100-ms baseline before the burst and 500 ms after it, were extracted and first submitted to an eye movement correction program (Gratton, Coles, &Donchin, 1983), and then to an artifact rejection procedure. Trials were rejected and excluded from the analysis if the amplitude in any recording (EEG) channel exceeded a criterion value of ±100 μV. N1 waveforms were analyzed for peak amplitude and latency within an 80- to 200-ms time window. Peaks were identified via an automatic detection program that selected the time and value of the largest amplitude-for instance, in the case of a double peak. After the data analysis, a digital smoothing filter (bandpass 0-15 Hz) was applied to the averaged waveforms for plotting.

Statistical analyses N1 amplitudes and latencies were submitted to separate repeated measures ANOVAs: 2 visual cues (ADF, AVS) ×4 acoustic environments (quiet, 0 dB SNR, -9 dB SNR, -18 dB SNR) ×2 syllables (/ba/, /ga/) ×17 electrodes (Fz, Cz, Pz, F3, F4, C3, C4, C5, C6, CP5, CP6, FC3, FC4, CP3, CP4, P3, P4). The results were similar for all trials and for only correct (hit) trials. The results reported here reflect the analyses performed on all trials.

Results

Behavioral responses

Response sensitivity and response times showed the same pattern as in Experiment 1, with the presence of visual speech cues mitigating the effects of noise in the acoustic environment (see Figs. 8 and 9). As this subset of conditions replicated the findings from Experiment 1, these will not be discussed in further detail. Instead, the focus of this discussion will be the new information revealed in the analysis of the ERPs.

Event-related potentials

Visual inspection of grand mean waveforms revealed that N1 responses were absent at -18 dB SNR, so this condition was excluded from further analysis. The probable reason for the absence of these waveforms in the most difficult listening condition is that the speech was not reliably audible in this level of noise (e.g., Martin et al., 1999; Martin et al., 1997). The artifact rejection criteria led to excluding 2.29 % of all trials (1 %-4 % within each condition, approximately equally distributed across conditions) from the analysis. The between-subjects factors Talker, Target Syllable Task, and Sex of the Participant failed to reach significance. Thus, data were collapsed over those factors and compared for each syllable, in three acoustic environments, with two types of visual cues. Plots of the N1 response for /ga/ in the ADF (chewing) condition across scalp locations are shown

in Fig. 10; plots of the N1 response in different conditions recorded at the Cz electrode are shown in Fig. 11.
N1 amplitude Significant main effects occurred for visual cue [F(1, 15) 0 52.59, p <.0001, f 0 .80], acoustic environment [F(2, 30) 0 36.36, p <.0001, f 0 .80], and channel [F (16, 240) 0 16.12, p <.0001, f 0 .40]. N1 amplitudes were smaller in the AVS condition (M 0 -1.80 μV, SD 0 2.29 μV) than in the ADF condition (M 0 -4.33 μV, SD 0 2.16 μV). With respect to the acoustic environment, amplitudes were largest in quiet conditions (M 0 -4.05 μV, SD 0 2.63 μV), were reliably smaller at 0 dB SNR (M 0 -2.93 μV, SD 0 2.44 μV), and were smallest at -9 dB SNR (M 0 -2.21 μV, SD 0 2.26 μV). The amplitudes of the effects of both visual cue and noise level were largest over central and lefthemisphere scalp locations, with the greatest amplitudes at electrode C3. At each electrode location, amplitudes were smaller in the AVS condition than in the ADF condition, but the Visual Cue ×Channel interaction was significant [F (16, 240) 0 9.75, p <.0001], likely due to a decrease in the amplitude difference across visual cue conditions at more frontal and right locations-for instance, F4 and C6. Similarly, although the amplitude at each of the 17 electrodes decreased as noise level increased, a significant Acoustic Environment ×Channel interaction occurred [F(32, 480) 0 4.33, p = .0005]. Channel amplitude differences were greater between quiet and 0 dB SNR than between 0 and -9 dBSNR; amplitude differences across acoustic environments were decreased at posterior and lateral electrode locations-for instance, Pz and C6. In summary, N1 amplitudes decreased when the visual cue was a speaking face relative to when it was a chewing face, and also decreased as noise was introduced to the acoustic environment and increased in intensity, regardless of visual cue type.
N1 latency Significant main effects of visual cue [F(1, 15) 0 44.31, p <.0001, f 0 .80], acoustic environment [F(2, 30) 0 74.17, p <.0001, f 0 .80], syllable [F(1, 15) 0 30.78, p = .0001, f 0 .80], and channel [F(16, 240) 0 8.96, p <.0001, f 0 .40] on N1 latencies emerged. Latencies were faster in the AVS condition (M 0 127.56 ms, SD 0 28.83 ms) than in the ADF condition (M 0 144.89 ms, SD 0 25.20 ms), as well as fastest in quiet (M 0 119.38 ms, SD 0 18.52 ms), slower at 0 dB SNR (M 0 138.30 ms, SD 0 23.19 ms), and slowest at -9 dB SNR (M 0 151.01 ms, SD 0 32.21 ms). Latencies for /ba/ (M 0 129.20 ms, SD 0 25.76 ms) were 14 ms faster on average than latencies for /ga/ (M 0 143.25 ms, SD 0 29.23 ms). Latencies were faster at posterior electrode locations, with the fastest latency at midline Pz.
Several significant interactions occurred for N1 latencies. Visual cue interacted with both acoustic environment [F(2, 30) 0 5.98, p = .0081] and channel [F(16, 240) 0 5.38, p <.0001]. Acoustic environment also interacted with syllable [F(2, 30) 0 6.81, p = .0052]. In the ADF presentation condition, all three acoustic environments were significantly different from each other, with the fastest latencies in quiet and the slowest at -9 dB SNR. In the AVS presentation condition, the quiet condition was significantly faster than both noise conditions, with no difference between the noisy environments. Latencies were faster in the AVS condition than in the ADF condition across all channels, but the latency difference between conditions was reduced at frontal locations-for instance, Fz, F3, and F4. For each syllable, latencies were significantly slower in progressively poorer acoustic environments. Latencies for /ba/ were significantly shorter than latencies for /ga/ in both noise conditions, but not in quiet.
In sum, N1 latencies were faster when visual speech gestures accompanied the auditory stimuli, and also faster when the quality of the acoustic environment improved. However, when speech gestures were visible, the presence but not the intensity level of the noise affected latencies, particularly for the /ba/ syllable. Overall, latencies were faster for /ba/ than for /ga/, but only in noise. In the quiet condition, we found no difference in latencies between the syllables.

Discussion

The literature reports (e.g., Martin et al., 1999; Martin et al., 1997) that the N1 response is present in response to consonant- vowel syllables, provided that acoustic speech energy is audible. In the present experiment, no N1 waveforms were measurable at -18 dB SNR, suggesting that this level of noise masked the acoustic speech information. This was true in both the chewing (ADF) and AVS conditions, suggesting that the N1 waveform

reflects auditory processing of audible speech. Thus, the changes in N1 morphology to each individual acoustic speech syllable with different visual cues could be attributed to the influence of visual information on auditory processing. However, the effect of the quality of the auditory environment, which in this experiment was degraded with white noise, also interacted with the influence of visual information. N1 latencies were significantly slower at -9 than at 0 dB SNR with the dynamic chewing gesture; the N1 latencies for auditory-visual speech did not differ significantly between these two environments. This finding suggests that the processing speed for auditory-visual speech (acoustics with the matching articulatory gesture) may be less sensitive to effects of increasing the noise level. This finding was based on data collapsed across syllables, and syllable differences for the latency measures occurred in the direction predicted by an upward spread of masking (i.e., comparatively reduced audibility of /ga/ predicting smaller amplitudes and slower latencies than were found for /ba/). However, voice onset times were also later for /ga/ than for /ba/, which may have contributed to the relatively slower N1 latencies for /ga/. However, pertinent to our experimental motivation, the results indicated differential effects of the visual cue on processing of the acoustic stimuli in quiet and in noise. Modifications to a signal presented in noise can be related to a change in underlying neural activity that occurs during processing. For example, previous research (Cunningham et al., 2002) has demonstrated that modifications to the acoustic signal (increasing the stop gap duration and increasing the burst intensity) for syllables presented in noise led to a change in the neural substrates (an increase in the onset amplitude measures of the aggregate neural responses). In the present Experiment 2, we modified (reduced) the audibility of auditory-visual stimuli that contained facial motion. The results showed that the morphology of the far-field scalprecorded brain potential N1 in response to auditory-visual stimuli changed in relation to the quality of the acoustic environment, and that these changes were observable in quiet and in noise at a -9-dB SNR. In Experiment 3, we investigated changes in the underlying neural substrates, as measured by the N1 response that occurred with modifications to the type of visual cue-that is, with and without facial motion.

Experiment 3

The goal of Experiment 3 was to identify changes in the processing of auditory speech syllables that are associated with different visual inputs. The response associated with visual-only speech was also recorded, as a control condition to verify that responses in the other presentation conditions reflected auditory processing.

Method

Participants

A group of 16 new participants (eight female, eight male) were recruited for Experiment 3. The eligibility criteria for participation were the same as for Experiments 1 and 2. Again, no participant reported any difficulty hearing, and when tested on the in-laboratory, automated, calibrated hearing test, all had pure-tone thresholds of 30 dB HL or better at 500, 1000, 2000, 3000, 4000, and 6000 Hz. The participants represented a diversity in their ability to recognize visual-only words, with a range in performance of 9 %- 58 % of words correct (M 0 28 %, SD 0 12 %) on a lipreading screening (Demorest &Bernstein, 1991).

Stimuli

The auditory, visual, and experimental (paired) stimuli were identical to those for Experiment 1, but only two acoustic environments were tested: quiet and -9 dB SNR.

Experimental design

The N1 potential, response time, sensitivity, and bias were recorded for 5 visual cues (AR, ASF, ADF, AVS, VO) ×2 acoustic environments (quiet, -9 dB SNR) ×2 syllables (/ba/, / ga/), with 100 trials per cell, for a total of 2,000 trials per participant. Ten experimental blocks (two per visual cue) were presented per session, each of approximately 10 min duration, for two sessions, with each block presenting stimuli in one visual cue condition. The order of presentation of the trials with different acoustic environments was randomized within each block. The order of the visual cue conditions was randomized, such that each participant received a different order, with the exception that the visual-only condition was always presented last, as in Experiment 1.

Procedure and data analyses

The procedures and data analyses were the same as were outlined for Experiment 2.

Results

Behavioral responses were again recorded and analyzed. The effects of the visual cue condition replicated the findings from Experiment 1 in the quiet and -9-dB SNR acoustic environments (see Figs. 12 and 13). Due to the consistency of these findings with prior experiments, only the ERP results will be highlighted.

Event-related potentials

Waveform analyses were performed as for Experiment 2. The artifact rejection criteria (detailed in the Exp. 2 Method) led to the exclusion of 2.23 % of the trials in Experiment 3 (1 %-3 % of trials per condition, approximately equally distributed across conditions). Grand mean waveforms time-locked to the acoustic burst were extracted; the plots of the N1 response in all conditions across scalp locations are shown in Fig. 14. As expected, no measurable peaks were observed in the VO condition; that is, EEG activity time-locked to the release of the acoustic burst did not result in an N1 potential when only visual information was presented. This substantiates that the N1 peaks observed with the visual and auditory pairings reflect processing of the auditory stimulus. The AR and ASF conditions produced virtually identical results, so to simplify the analyses reported here, the AR condition was excluded from the ANOVAs, so that discussion will focus on the ASF, ADF, and AVS results. Plots of the N1 response to the AVS, ADF, and ASF presentation conditions, as recorded at the Cz electrode, are shown in Fig. 15.

N1 amplitude Again we found significant main effects of visual cue [F(2, 30) 0 14.91, p = .0001, f 0 .70], acoustic environment [F(1, 15) 0 69.66, p <.0001, f 0 .80], and channel [F(16, 240) 0 22.34, p <.0001, f 0 .40]. N1 amplitudes were again reduced when visual speech gestures were available. For nonspeech facial cues, the amplitudes were on average -4.06 μV (SD 0 2.31 μV), with a static smiling face, and -4.21 μV (SD 0 1.97 μV), with a chewing face, and these two conditions did not differ from each other [F(1, 15) 0 0.40, p = .5391]. In contrast, the average amplitude in the AVS condition was -2.56 μV (SD 0 1.76 μV), which was smaller than those for both the static smiling face [F(1, 15) 0 17.44, p = .0008] and the chewing face [F(1, 15) 0 18.89, p = .0006]. Thus, amplitude was reduced when speech gestures were visible. As expected, amplitude was also reduced in noise (M 0 -2.84 μV, SD 0 1.83 μV) as compared to quiet (M 0 -4.38 μV, SD 0 2.19 μV). Overall, the amplitude was greatest over leftcentral electrode locations-for instance, Cz, C3, and FC3. The effects of visual cue and acoustic environment described above were evident at each electrode location, but amplitudes were particularly reduced at frontal lateral electrode locations (e.g., F3, F4, C5, C6) for visual cues [F(32, 480) 0 7.40, p <.0001], and at posterior electrode locations (e.g., Pz, P3, P4) for acoustic environments [F(16, 240) 0 11.24, p <.0001]. To summarize the main points of the amplitude results, N1 peak amplitudes were significantly reduced with visual speech gestures, and also with noise.

N1 latency We found significant main effects of visual cue [F(2, 30) 0 199.00, p <.0001, f 0 .80], acoustic environment [F(1, 15) 0 269.57, p <.0001, f 0 .80], syllable [F(1, 15) 0 49.27, p <.0001, f 0 .80], and channel [F(16, 240) 0 4.46, p = .0054, f 0 .40]. Latencies were shortest in the AVS condition (M 0 126.83 ms, SD 0 29.51 ms), next shortest in the ADF condition (M 0 139.61 ms, SD 0 32.36 ms), and longest in the ASF condition (M 0 169.92 ms, SD 0 25.01 ms). Follow-up testing revealed the latencies in all three visual cue conditions to be significantly different from each other. Latencies were delayed by approximately 40 ms in noise as compared to quiet (quiet, M 0 125.14 ms, SD 0 27.06; noise, M 0 165.77 ms, SD 0 28.12). The latency of the N1 for /ba/ was approximately 10 ms faster (M 0 140.72 ms, SD 0 34.38 ms) than the latency for /ga/ (M 0 150.19 ms, SD 0 33.49). The fastest latencies occurred at right posterior electrode locations Pz and P4.

Significant Visual Cue ×Acoustic Environment [F(2, 30) 0 10.25, p = .0006], Syllable ×Channel [F(16, 240) 0 3.94, p = .0008], and Visual Cue ×Acoustic Environment ×Channel [F(32, 480) 0 3.23, p = .0005] interactions also emerged. Within each visual cue type, latencies in quiet were significantly faster than those in noise. In quiet, the latency in the ASF condition was significantly slower than the latencies in both the ADF and AVS

conditions, which did not differ from one another. The same was true in noise, except that we also found a significant difference between the latencies for ADF and AVS. Latencies were slower for /ga/ than for /ba/ across all channels, but this difference was minimal at frontal locations Fz, F3, and F4.

In sum, N1 latencies were slowest with a static smiling face, faster with a chewing face, and fastest with visible speech gestures. Latencies were also faster in quiet than in noise and for /ba/ than for /ga/. In quiet, there was no significant difference in latencies for the two dynamic visual cues. However, in noise, latencies were significantly faster with visual speech gestures than with a chewing gesture.

Discussion

Previous arguments in the literature have suggested that the magnitude of the neural response can be used to determine whether the relationship between visual and auditory speech involves an alerting mechanism (Baier, Kleinschmidt &Müller 2006; Besle et al., 2004). Baier et al. argued that neural activity as measured in an fMRI procedure increased when there was a learned association between the auditory and visual stimuli, and decreased when the stimuli were not associated. Besle et al. argued that the auditory-visual facilitation associated with an alerting mechanism should result in an N1 amplitude increase. Therefore, they interpreted their findings of decreased N1 amplitudes with auditory-visual speech as evidence against an alerting mechanism.

The results from the present experiment suggest an alternative interpretation. In Experiment 3, a decrease in N1 amplitudes occurred only when both the auditory and visual stimuli presented linguistic information (the AVS condition). However, faster N1 latencies occurred with either the chewing gesture or the visible speech gesture-that is, with dynamic facial cues. Therefore, we hypothesized that the speed of the neural response, not the magnitude, may be related to a learned association between facial movement and acoustic speech, such that facial motion serves as an alerting mechanism for acoustic speech. In complex environments, humans have difficulty suppressing the visual information in a bimodal auditory-visual stimulus, demonstrating visual dominance (Sinnett, Spence, &Soto-Faraco, 2007). Due to the high ecological significance of speech, seeing facial motion may prime, or alert, the auditory system to be ready to respond. This alert would be activated prior to determining whether the facial motion is actually informative about temporally co-occurring auditory stimuli. This would explain why both uninformative chewing and informative speech gestures speeded up the N1 response to an auditory syllable. The meaningfulness of the visual cue appears to influence the magnitude of the neural response rather than its timing, since N1 amplitudes were decreased only with a linguistically informative congruent visual gesture. A possible alternative interpretation may be that the visible speech gesture introduced another channel of information, leading to the reduction in amplitude. Paulmann, Jessen, and Kotz (2009) proposed that the magnitude of an ERP response is related to how many channels present information. In discussing results for the P200 and N300 (in a gender/talker identification task), they reported reduced amplitudes for three channels of information (a visual static picture of a face conveying an emotional valence, an auditory semantically meaningful sentence, and congruent prosody) as compared to two channels of information (semantic content removed from the multimodal stimulus), which in turn was reduced as compared to responses to the emotional valence of the face alone. Combined with the results from the present experiment, meaningfulness, or linguistic significance, appears to be a factor requiring further investigation for its role in multisensory processing.

General discussion

Perhaps the most important of the new findings obtained in the experiments reported here is the observed dissociation between the amplitude and latency of N1 responses to spoken syllables paired with different kinds of visual cues. Latency was sensitive to any kind of facial motion (at least, to both of the two different kinds of facial motion used in these experiments) and not to its meaningfulness, while amplitude was sensitive to the meaningfulness of the facial motion. Latency also appeared to be more sensitive to effects of audibility, evidenced in syllable differences, with slower latencies for /ga/, which would be more susceptible to upward

spread of masking than would /ba/. The present study shows that auditory N1 morphology is affected by visual cues in noisy environments, whereas previous studies had examined these effects only in quiet (e.g., Pilling, 2009; van Wassenhove et al., 2005). Behavioral measures of response sensitivity and response time were improved with auditory-visual speech in the most challenging SNR tested in this experiment, as compared to responses to acoustic speech paired with three types of nonspeech visual cues. Linguistically familiar gestures, when presented with acoustic speech, influenced auditory processing by speeding up the N1 latency and decreasing N1 amplitude. Processing of auditory-visual speech, as measured by the N1 component, was distinct from processing of acoustic speech with the nonspeech visual cues tested in this study. However, processing was also influenced by a nonspeech dynamic facial stimulus (chewing), in that faster N1 latencies also occurred with this visual cue in a quiet listening condition. In noisy acoustic environments, N1 latencies were faster with visible speech gestures than with chewing gestures.

Quality of the acoustic environment

Reduced audibility influenced the morphology of the N1 response to auditory-visual signals in a manner similar to that demonstrated by Martin et al. (1999; Martin et al., 1997) for auditory-only speech. Thus, auditory-visual processing was influenced by the quality of the acoustic environment-that is, slower and with reduced amplitude in noise. The results from the present experiments revealed an advantage for auditory-visual speech in noise as compared to other experimental stimuli, in both behavioral measures of task performance and the associated neural correlates. Comparisons were made at each SNR level, however, and when speech was presented in a noisy environment, accurate auditory-visual speech perception may have required less effort than is required with auditory-only speech (Fraser, Gagné, Alepins, &Dubois, 2010).

Dynamic facial visual cues

In the present experiments, latency facilitation occurred with both types of dynamic facial cues, but amplitude decrease occurred only with auditory-visual speech. Van Wassenhove et al. (2005) theorized that the latency reduction with auditory- visual speech is related to predictive coding of sensory information, as well as to the saliency and redundancy of visual information. They developed the hypothesis that visible articulation that naturally precedes acoustic speech activates an internal prediction that is compared to later incoming acoustic information. Faster latencies would be the result of an earlier match between the prediction and new information. The data reported in the present study support this theory, as latencies were faster with visible speech gestures. However, the results of the present study also suggest an extension of this theory. As was discussed previously in relation to Experiment 3, faster N1 latencies occurred with chewing gestures than with static facial images. We hypothesize that a precue or a learned association between facial motion in general and acoustic speech may be involved in priming the auditory system to respond, thus leading to faster latencies. As van Wassenhove et al. would argue, the increased saliency or redundancy of the visual speech gesture could account for the additional latency decrease demonstrated with noise for the present Experiment 3. However, only visual information with linguistic content- speech gestures-would lead to a match between visual and auditory information and decreased amplitudes from less effortful processing. A chewing gesture could be considered a mismatch between visual and auditory information, resulting in greater N1 amplitudes for chewing gestures than for speech gestures.

Ponton, Bernstein, and Auer (2009) discussed the possibility of both integrative and modulatory effects of visual signals in auditory-visual processing. They suggested that different effects arise from parallel processing of features related to the visual speech (integrative) and of features not related to the visual speech (modulatory). The present results are consistent with this distinction. The decreased amplitudes observed with auditory-visual speech could be interpreted as an integrative effect of processing both acoustic speech and articulatory gesture. The faster latencies observed with dynamic facial motion could be interpreted as a modulatory effect of visual information not related to the speech gesture.

Considerations for the ERP results

Multiple components The N1 is probably not a unitary response, but may instead consist of several subcomponents (Näätänen &Picton, 1987), which may be differentially affected by visible speech gestures, the temporal relation between visible speech gestures and acoustic speech, and multisensory interaction/integration effects. For example, Puce, Epling, Thompson, and Carrick (2007) have discussed two components occurring within the N1 response time window, one of which they identified as being sensitive to auditory information (the N140), and the other to visual motion (the N170). The timing of the N1 peak in the averaged waveforms in Experiment 3 (average latencies across electrodes at 170 ms for a static face, 140 ms for nonspeech facial motion, and 127 ms for auditory-visual speech), together with its susceptibility to decreased audibility (i.e., its absence in the loudest noise and in the visualonly condition) suggests that it consisted primarily of a response to the auditory stimulus rather than to the motion itself. However, it is possible that the decrease in N1 amplitude in the auditory-visual speech condition was due to an increase in the contribution from the slightly later neurons responding to visual information, since spreading the activity over a wider time range would lead to a decrease in amplitude in the averaged waveforms.

Auditory-visual stimuli have been found to influence other ERP components both earlier and later than the N1. Auditory brainstemresponses to auditory-visual speech occurringwithin approximately 30 ms have been shown to have slower latencies and smaller amplitudes than those for auditory-only speech (Musacchia, Sams, Nicol, &Kraus, 2006). Changes over visual areas during a 40- to 90-ms time window have been demonstrated for bimodal relative to unimodal nonspeech object stimuli (Giard &Peronnet, 1999). The P50 component has been reported to be altered when both auditory and visual nonspeech stimuli are attended (Talsma, Doty, &Woldorff, 2007). Earlier-occurring components may also influence the morphology of later components, with auditory-visual effects perhaps culminating during the N1 time window. One effect that earlier components can have is to cause a desynchronization of neural activity, resulting in degraded morphology of later-occurring peaks, which could have contributed to the apparent absence of a P2 peak following the N1 in our waveforms at all but the most frontal sites.

Neural oscillatory phase It is possible that the observed differences in N1 latency and/or amplitude could be due to shifts in the phase of the neuronal oscillations thatmake up the EEG. Recent evidence has demonstrated that the phase of alpha activity at the onset of a visual stimulus affects aspects of the averaged ERP response to those stimuli (Mathewson, Gratton, Fabiani, Beck, &Ro, 2009). It has also been hypothesized that a predictable temporal lag between auditory and visual stimuli modifies the phase of neural oscillations (Schroeder, Lakatos, Kajikawa, Partan, &Puce, 2008). In the experiments reported here, the time lags between visual motion onset and the acoustic burst were equated for the chewing and speaking faces. If detecting facial motion leads to a shiftin the EEG phase, that could contribute to the earlier N1 latency observed in both the speaking and chewing face conditions. Since no conditions with nonfacial visual motion were included, we cannot conclude that only facial motion leads to such an effect, but our hypothesis is that individuals with normal hearing and normal vision are sensitive to the temporal relations between facial motion and acoustic speech, due to a lifetime of experience associating movements of the face with speech.

Increase of inhibitory activity Evidence from human fMRI studies (Wright, Pelphrey, Allison, McKeown, &McCarthy, 2003) and monkey local-field potential studies (Ghazanfar, Maier, Hoffman, &Logothetis, 2005) has suggested that bimodal stimuli produce both increases in neural activity in some brain regions and decreases in other regions, as compared to unimodal stimuli. It is possible that an increase in activity in some regions may reflect increased inhibitory activity, and increased inhibition of N1 generators is one possible mechanism for the decrease in N1 amplitudes seen in Experiments 2 and 3 for auditory-visual speech only.

Relation to buttonpress response The behavioral measures tapped into processing at a different time than the N1 ERP component. It took an additional 500-800 ms after the N1 peak for the perceiver to make a decision and press a button. The difference in the timing between the two kinds of measures provides part of the explanation for why response times were faster for /ga/ but N1 latencies were faster for / ba/. The faster neural

processing of /ba/ may be related to (1) earlier and/or more salient visual cues for /ba/ than for /ga/, and/or (2) the greater audibility of /ba/ because it is less masked by broadband white noise than /ga/ is. In contrast, faster response times for /ga/ may be related to a bias to wait for a visual cue for /ba/, since it normally has clear visual cues, and not to wait with /ga/, because it normally has weaker visual cues. This interpretation was supported by signal detection analyses that revealed that the buttonpress responses were affected by overall response biases as well as by sensitivity to the properties of the stimuli.

The N1 latency measure proved to be more sensitive to the effects of visual motion on speech processing than did the behavioral responses. The fact that N1 latencies were faster for both chewing and speech facial gestures than for a static facial image suggests that facial motion in general may serve to alert the speech-processing system that speech sounds are imminent. This was not revealed by the behavioral response times, which were faster only when speech was accompanied by a speaking face, again suggesting that the two kinds of measures tapped into different subsets of the processes involved in recognizing the auditory-visual stimuli. Physiological measures allow for an evaluation of processing without the ceiling or floor effects that can occur with behavioral measures. For instance, behavioral measures did not reveal any difference between auditory-visual speech and visual-only speech, presumably because the visual cues were sufficient to make the decision required by the task. In contrast, an N1 response was recorded for auditory-visual speech, but not for visual-only speech. The strength of behavioral measures is in determining how processing is related to the final percept and response, for example, in how well a person may be able to communicate. The evaluation of both early processing in physiological measures and later processing with a behavioral action or response would be helpful for determining at which point an obstacle or deficit in perception occurs, which could be crucial to identifying an appropriate treatment methodology.

Implications for auditory-visual speech perception development

Sensory and language experience early in life impacts neurological development and processing (Bavelier et al., 2001; Capek et al., 2009; Neville et al., 1998; Ponton &Eggermont, 2001; Sharma, Dorman, &Spahr, 2002): If auditory stimulation is not received within a sensitive period, sensory processing follows a different developmental path, as measured by the P1 auditory evoked potential (see Sharma, Nash, &Dorman, 2009, for a review). Children with hearing loss have different experience not only with auditory sensory stimulation, but also with associating auditory and visual sensory stimulation. It is unknown how auditory-and thus auditory-visual integration-deprivation would influence the development of multisensory neural processing.

Even with early identification and treatment, children with hearing loss will lack experience associating auditory and visual stimuli very early in life. Infants with normal hearing demonstrate sensitivity to auditory-visual integration processes within the first few months of life (Burnham &Dodd, 2004; Lewkowicz, 2000; Patterson &Werker, 2003). Children with hearing loss who had received a cochlear implant after 30 months of age did not consistently report fused auditory-visual percepts in a McGurk stimuli task (Schorr, Fox, van Wassenhove, &Knudsen, 2005). This suggests that auditory-visual integration deprivation during a critical period affects the ability to associate these multimodal stimuli, as measured by a behavioral response. In contrast to their normal-hearing peers, children with cochlear implants relied more upon the visual information when perceiving conflicting auditory-visual stimuli (Schorr et al., 2005). It is probably not the sensitivity to visual speech cues that is affected by a unimodal auditory sensory impairment, but rather the ability to associate and integrate information from both auditory and visual sensory modalities, which may develop differently or not at all. Individuals who lack this early multisensory experience might not demonstrate the decrease in N1 latencies shown by the normally hearing participants in our studies when viewing a facial chewing motion.

For children with hearing loss who utilize aural communication, the development of auditory skills with a sensory device has obvious importance. However, the value of associating auditory and visual information, particularly in poorquality acoustic environments, should not be overlooked. Adults with hearing loss demonstrate changes in auditory processing in better acoustic environments than do adults with normal hearing (Oates, Kurtzberg,

&Stapells, 2002; Whiting, Martin, &Stapells, 1998). Correspondingly, visual information may affect auditory processing in better acoustic conditions for individuals with hearing loss than for individuals with normal hearing.

Limitations

The scope of the present experiments did not allow for an investigation of all possible characteristics of the visible speech gesture. Dynamic nonfacial stimuli were not tested. The stimuli were selected according to the hypothesis that facial images would influence processing to a greater degree than would nonfacial images. The results indicated that the relevant facial feature is motion. Syllable differences in the timing measures also suggest that future research should employ spectrally shaped maskers to investigate the processing of syllables with equal degrees of masking/audibility. Because the white noise was exactly the same for both syllables, it is clear that the differences are related to the syllable and not to the processing of different noise sources. Future studies may examine differential effects of spectrally shaped, high-pass, low-pass, or other types of noise. The present findings relate only to competition from a broadband white noise. Continued investigation will be required to elucidate the roles of audibility and visibility in understanding syllable differences. The present experiments have demonstrated the effect of type of visual cue within a particular speech syllable, with decreased N1 amplitudes being associated with meaningful speech gestures. Further research should investigate the extension of these results to a larger, more diverse set of syllables and also to more complex speech.

Conclusions

The present experiments are unique in examining, in combination, the effects of reduced audibility and the influence of the features of visual cues on the N1 ERP corresponding to auditory processing in noise. The results indicated that the N1 response measured in these experiments was an auditory response, because it was not generated in response to visualonly stimuli and was influenced by reduced audibility in a manner similar to auditory-only speech (Martin et al., 1999; Martin et al., 1997). The processing of acoustic speech with reduced audibility was associated with slower latencies and decreased amplitudes, regardless of the type of visual cue presented. However, with visible speech gestures, latencies did not differ between the 0- and -9-dB SNR environments in Experiment 2. Thus, evidence from the present experiments suggests that concurrently seeing visible speech gestures while listening to acoustic speech in noise may make auditory processing less sensitive to an increase in noise intensity.

The results from the present study provide partial support for the hypothesis that auditory-visual facilitation is unique to the properties of the speech gesture. The neural correlates of auditory-visual speech perception differed from the measures in response to the other types of experimental stimuli tested. No difference was seen between a static geometric shape and a static facial image, indicating that seeing a face in itself does not influence auditory processing to a greater degree than does seeing a geometric shape. Two types of facial motion were associated with faster N1 latencies. As we noted above, a dynamic nonfacial stimulus was not included among the presentation conditions. However, the results revealed that one aspect of the influence of visible speech gestures on auditory speech (faster N1 latency) may not be specific to speech gestures, but instead may generalize to all facial motion. A distinct effect of visible speech gestures on auditory processing was seen in decreased N1 amplitudes.

Our empirical data support the hypothesis that auditory- visual perception of speech in noise is a distinct process related to the special characteristics of visible speech gestures; however, speech gestures are very complex, and the present experimental stimuli could not be used to evaluate all possible features of the visual speech gesture. Specifically, the influence of visual motion must continue to be investigated. In addition, hypotheses regarding a priming or alerting mechanism due to a reliable temporal lag between visual and auditory stimuli should be tested further. The impact of auditory deprivation on the future ability to integrate auditory and visual cues needs to be considered in order to maximize the auditory-visual benefit for clinical

populations-for instance, individuals with cochlear implants.

The interaction of auditory and visual cues influences speech perception processes. Auditory-visual facilitation was seen in both behavioralmeasures and the neural correlates of speech perception, particularly in noise. In adults with normal hearing and vision, the neural correlates of sensitivity to integrating facial motion, and especially facial speech motion, with acoustic speech may be measured in both quiet and noise. People are sensitive to associations between auditory and visual stimuli beginning at a very young age (see, e.g., Burnham &Dodd, 2004; Lewkowicz, 2000; Patterson &Werker, 2003). Auditory (re)habilitation treatment methodologies for all age groups must take into account the speech perception benefit that may be received from learning to associate and integrate auditory and visual cues.

Author note J.L.G. is currently affiliated with the University of Wisconsin, Stevens Point. This research was conducted as part of the dissertation requirements for the first author and was supported in part by funds from the University of Illinois Research Board. Portions of this research have been presented at meetings of the American Speech- Language-Hearing Association and the American Auditory Society.

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Publication date: Nov 2012

Year: 2012

Increased Inner Ear Susceptibility to Noise Injury in Mice With Streptozotocin-Induced Diabetes

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Publication info: Diabetes 61.11 (Nov 2012): 2980-6.
ProQuest document link

Abstract: We aimed to investigate the pathophysiology of diabetes-associated hearing impairment in type 1 diabetes using mice with streptozotocin-induced diabetes (C57BL/6J; male). Hearing function was evaluated 1, 3, and 5 months after induction of diabetes (five diabetic and five control animals per time point) using auditory-evoked brain stem responses (ABRs). Mice (four diabetic and four control) were exposed to loud noise (105 dB) 5 months after induction of diabetes. ABRs were measured before and after noise exposure. Cochlear blood flows were measured by laser-Doppler flowmeter. Spiral ganglion cells (SGCs) were counted. Vessel endothelial cells were observed by CD31 immunostaining. Chronologic changes in the ABR threshold shift were not significantly different between the diabetic and control groups. However, vessel walls in the modiolus of the cochleae were significantly thicker in the diabetic group than the control group. Additionally, recovery from noise-induced injury was significantly impaired in diabetic mice. Reduced cochlea blood flows and SGC loss were observed in diabetic mice cochleae after noise exposure. Our data suggest that diabetic cochleae are more susceptible than controls to loud noise exposure, and decreased cochlear blood flow due to sclerosis of the vessels and consequent loss of SGCs are possible mechanisms of hearing impairment in diabetic patients.

Full text: Headnote

We aimed to investígate the pathophysiology of diabetesassociated hearing impairment in type 1 diabetes using mice with streptozotocin-induced diabetes (C57BL/6J; male). Hearing function was evaluated 1, 3, and 5 months after induction of diabetes (five diabetic and five control animals per time point) using auditory-evoked brain stem responses (ABRs). Mice (four diabetic and four control) were exposed to loud noise (105 dB) 5 months after induction of diabetes. ABRs were measured before and after noise exposure. Cochlear blood flows were measured by laser-Doppler flowmeter. Spiral ganglion cells (SGCs) were counted. Vessel endothelial cells were observed by CD31 uranunostaining. Chronologic changes in the ABR threshold shift were not significantly different between the diabetic and control groups. However, vessel walls in the modiolus of the cochleae were significantly thicker in the diabetic group than the control group. Additionally, recovery from noise-induced injury was significantly impaired in diabetic mice. Reduced cochlea blood flows and SGC loss were observed in diabetic mice cochleae after noise exposure. Our data suggest that diabetic cochleae are more susceptible than controls to loud noise exposure, and decreased cochlear blood flow due to sclerosis of the vessels and consequent loss of SGCs are possible mechanisms of hearing impairment in diabetic patients. Diabetes 61:2980-2986, 2012

At present, >278 million people worldwide have a disabling hearing impairment (1). Hearing impairment leads to difficulty in conversation, music appreciation, orientation to alarms, and participation in social activities. Hearing loss is typically classified as conductive, sensorineural, or mixed. Conductive hearing loss results from pathologic changes to either the external or the middle ear structures blocking the sound waves from reaching the fluids of the inner ear. Sensorineural hearing loss results from pathologic changes of inner ear structures such as the cochlea or the auditory nerve and impedes transmission of neural impulses to the auditory cortex of the brain. Sensorineural hearing loss can be congenital or can be acquired because of prolonged exposure to loud noises, ototoxic substances, ear diseases, or systemic disease such as hypertension, hyperlipidemia, and diabetes (2,3). However, the impact of diabetes on hearing impairment has not been as well recognized until recently in comparison with the known microvascular complications affecting the renal, visual, and peripheral nervous systems.

Jordao (4) first reported the association between diabetes and hearing loss in 1857. Since then, a number of clinical studies have been conducted to investigate the possible relation of diabetes and hearing loss, with inconsistent conclusions (5-9). Some reported negative results (10,11). Recently, using a large population-based dataset, Bainbridge, Hoffman, and Cowie concluded that diabetes is an independent risk factor for hearing loss (12). In addition, interactions between noise exposure and diabetes were reported (13,14). Histopathological studies on the temporal bones of patients with diabetes reported thickened vessels of the stria vascularis, atrophy of the stria vascularis, and loss of outer hair cells (OHCs) in the cochlea (15,16). Thickening of the cochlear modiolar vessel walls (17) and microangiopathic involvement of the endolymphatic sac and/or basilar membrane vessels (18) were also reported as characteristic diabetes-related changes in the cochlea. These reports suggested that microangiopathy was a common change in the cochlea of the patients with diabetes, in addition to the changes in the renal, visual, and peripheral nervous systems.

Studies in animal models have also shown an association between diabetes and hearing loss. A longitudinal study on diabetic rats (WBN/Kob) showed hearing impairment compared with age-matched Wistar rats (19). In middleaged mice, type 2 diabetes induced by a high-fat diet led to significant hearing impairment over a period of 6 months. Although mice with streptozotocin (STZ)-induced type 1 diabetes showed only a slight hearing impairment in a normal quiet setting (20), recovery of hearing function after noise exposure was impaired in STZ rats (21).

Morphologically, loss of OHCs (19,22-25) and inner hair cells (IHCs) (22) has been reported in diabetic rodent models. Changes in intermediate and marginal cells of the stria vascularis (19,22,23), degeneration of spiral ganglion cells (SGCs) (19,25), and thickening of the basement membranes of capillaries in the stria vascularis

(26) have also been reported. However, another study did not find any of these changes in diabetic rats (27). To date, although there are a number of studies investigating hearing function and cochlear morphology in diabetic rodents, reports on the pathophysiology underlying diabetes-associated hearing impairment are still inconsistent. Therefore, we conducted this study to elucidate the mechanisms by which diabetes affects the cochleae. We assessed physiological and morphological alterations in the cochleae over time in mice with STZinduced diabetes. We then tested the hypothesis that diabetes may primarily affect the inner ear by increasing its sensitivity to environmental stress. This we tested by comparing the sensitivity to noise-induced hearing loss in normal mice versus mice with STZ-induced diabetes.

RESEARCH DESIGN AND METHODS

Aitimele «ad induction of diabetes. Thirty-eight C57BL'6J mice (8 weeks old; male) were used in this study. All animal procedures were approved by the Institutional Animal Care and Use Committee guidelines of Kobe University Graduate School of Medicine. Animals were maintained on a normal diet under standard animal house conditions. Mice in the diabetic group were injected with STZ (100 mg/kg body wt i.p. in 100 µ?. sterile citrate buffer, pH 4.5; Sigma Chemical Co, St Louis, MO) on two consecutive days (28). Mice in the control group were injected with physiological saline. Mice with venous blood glucose levels of >306 mg/dL, in samples obtained from the tail and measured by Glutest-Ace (Sanwa Kagaku Kenkyusho, Nagoya, Japan), were considered diabetic. Body weight and venous blood glucose levels were measured at baseline (pretreatment) and 1, 3, and 5 months after STZ or physiological saline injection.

Experimental protocol. Animals were randomly assigned to control or diabetic groups. They were then divided into the following subgroups: 1 -month group (diabetes, ? = 5; control, ? = 5), 3-month group (diabetes, ? = 5; control, ? = 5), 5-month group (diabetes, ? = 5; control, ? = 5), and noise-exposed group (diabetes, ? = 4; control, ? = 4). Mice were followed for 5 months after STZ injection because mortality rate was 20% at 6 months after STZ injection in the preliminary experiment

In each subgroup, hearing function was measured by auditory-evoked brain stem responses (ABRs) at baseline (pretreatment). The hearing function of mice in the 1-, 3-, and 5-month groups was also measured using ABRs at 1, 3, or 5 months after injection of STZ or physiological saline. After the last ABR measurements, cochlear blood flow was measured. Then mice were immediately killed and cochleae were removed. The mice in the noise-exposed group were exposed to loud noise 5 months after injection of STZ or physiological saline. In the noise-exposed group, ABR was performed immediately before the exposure and 1, 3, 5, 7, and 14 days after the noise exposure. After completion of ABR, cochlear blood flow was measured and cochleae were removed.

Hearing measurement*. ABR was measured in both ears of each animal. Prior to measurements, animals were anesthetized with midazolam (10 mg/kg i.p.), medetomidine (37.5 µ?/kg i.p.), and butorphanol tartrate (0.5 mg/kg i.p.). ABR measurement was performed using waveform storing and stimulus control with Scope software on the PowerLab system (PowerLab2/26; AD Instruments, Castle Hill, Australia), and electroencephalogram (EEG) recording was performed with the extracellular amplifier AC PreAmplifler (P-55; Astro-Med, West Warwick, RI). Sound stimuli were produced by a coupler-type speaker (ESlspc; Bio Research Center, Nagoya, Japan) inserted into the external auditory canal of mice. Tone burst stimuli, with a 0.2 ms rise/fall time (cosine gate) and 1-ms ñat segment at frequencies of 4, 8, 16, and 32 kHz, were generated, and the amplitude was specified by a sound generator and attenuation Real-Time Processor and Programmable Attenuator (RP2.1and PA5; TuckerDavis Technologies). Sound-level calibrations were performed using a Sound Level Meter (NA-42; Rion, Tokyo, Japan). For recording, stainless steel needle electrodes were placed at the vertex and ventrolateral to the left and right ears. Generally, ABR waveforms were recorded for 12.8 ms at a sampling rate of 40,000 Hz using 50- to 5,000-Hz band-pass filter settings; waveforms from 256 stimuli at a frequency of 9 Hz were averaged. ABR waveforms were recorded in 5-dB sound pressure level (SPL) intervals down from a maximum amplitude until no waveform could be visualized.

Noise exposure. Animals were exposed in pairs, in separate cages, to oneoctave band noise (OBN) centered at

4 kHz, at 105-dB SPL for 2 h (temporary threshold shift [TTS] model), in a ventilated sound-exposure chamber. The sound chamber was fitted with speakers (HFD-261-8 and LE-M94; ???, Kobe, Japan) driven by a noise generator (SF-06, Rion, and DEQ2496, Boehringer, Willich, Germany) and power amplifier (DA-250D, TOA). The stimulus intensity varied by a maximum of 3 dB across measured sites within the exposure chamber. During noise exposure, noise levels were monitored with a sound level meter (NL20; Rion), a preamplifier, and a condenser microphone. The microphone was positioned within the cage at the approximate level of the animal's head

Measurement of cochlear blood flow. The left tympanic bulla of the mice was exposed and opened under deep anesthesia. With a laser-Doppler flowmeter (TBF-LN1; Unique Medical, Tokyo, Japan), cochlear blood flow was measured using a 0.5-mm-diameter laser-Doppler probe placed over the lateral wall of the cochlea. The operating principle of the laser-Doppler flowmeter has previously been described in detail (29,30). Blood flow of the stapedial artery was also measured. Blood flow ratio was determined as the laser-Doppler output of the cochlear lateral wall divided by that of the stapedial artery.

Histological preparations. After measurement of cochlear blood flow under deep anesthesia, the temporal bones were immediately removed and transferred into 4% paraformaldehyde in 0. 1 mol/L PBS (pH 7.4). Under a dissecting microscope, the round and oval windows and the cochlear capsule near the apex were opened, followed by gentle local perfusion of 4% paraformaldehyde from the apex. The tissues were kept in fixative at 4°C for 24 h. After overnight fixation, cochleae were decalcified with 10% ethylenediaminetetraacetic acid disodium salt dihydrate (pH 7.0; Muto Pure Chemicals, Tokyo, Japan) at room temperature for 2 days. Cochleae were dehydrated through a graded ethanol series and xylene, embedded in paraffin, and then sectioned at 3.0 μ?? in the midmodiolar plane.

Morphological analysis. The slides containing cochlea sections were stained with hematoxylin-eosin (?-E) (hematoxylin from Muto Pure Chemicals; eosin from Wako Pure Chemicals Industries, Osaka, Japan) to study the structure. The specimens were examined with a laboratory microscope (BX51; Olympus, Tokyo, Japan).

Inununohistochemical staining for CD31. The paraformaldehyde-flxed, paraffin-embedded specimens were deparafflnized and rehydrated through a graded xylene and alcohol series. The sections were then placed in a citratebuffered solution (pH 6.0) and heated at 100°C in a microwave oven for 10 min. Endogenous peroxidase was blocked with 3% hydrogen peroxide, and nonspecific binding was blocked with 10% normal rabbit serum for 15 min. The sections were then incubated with the polyclonal anti-CD31 antibody (DIA 310, diluted 1:20; Dianova, Hamburg, Germany) at room temperature for 30 min, washed in PBS, and incubated with biotmylated anti-Rat IgG (diluted 1:200; Vector Laboratories, Burlingame, CA). Antibody binding was visualized with the Elite ABC kit (Vector Laboratories). Diaminobenzidine was used for coloration, and nuclei were counterstained with hematoxylin.

Evaluation of cochlear vessels. The sections stained by immunohistochemistry for CD31, which labels the endothelial cells of blood vessels, were used to study the morphological changes of cochlear vessels. Three midmodiolar sections separated by 30 μ?? were selected in each temporal bone, with the average defined as the data for the animaL Perpendicular cross-sections of the spiral modiolar artery were used to study the cochlear vessels. The most perpendicularly sectioned vessel was selected for observation in each subject The cochlear specimens were examined with a light microscope system (BZ8100; Key enee, Osaka, Japan) and saved as digital images. For measurement the area of vessel walls, the CD3 I-positive area was measured using a VH Analyzer VH-H1A5 (Keyence) and calculated with reference to methods previously described (31). The vessel wall area (VWA) and vessel wall length (VWL) per vessel crosssection were determined using the following formulae: VWA = T-Lu and VWL = (outer length of lines delimiting VWA + inner length of lines delimiting VWA)/2, where ? is the total cross-sectional area of each vessel and Lu is the luminal area Vessel wall thickness in each vessel was expressed as VWA/VWL.

Spiral ganglion cell count. In the current study, the cochlea was divided into three half turns (basal, upper basal,

and apical). Morphometric assessments of SGCs were performed for each cochlear tum on the H-E-stained sections. The cochlear specimens were observed and photographed with a BZ-8100 light microscope, and digital images were saved. The areas of Rosenthal canal and the cochlear turn were quantified by measuring their cut surfaces using VHH1A5. All neurons meeting the size and shape criteria to be considered type 1 SGCs within each profile of Rosenthal canal were counted for each cochlear turn. The SGC density was determined as the number of cell nuclei per 10,000 μp?2 Rosenthal canal. We calculated the SGC density as previously described (32) in three midmodiolar sections 30 μp? apart from each cochlea with the average defined as the data for the animal.

Statistical analysis. The overall effect on ABR threshold shifts, vessel wall thickness, ABR threshold shifts after noise exposure, cochlear blood flow, and SGC density was assessed by a nonpaired t test (STATA 11.1; STATA, College Station, TX). A ? value <0.05 was considered statistically significant All data are represented as means ±SE.

RESULTS

Body weight and blood glucose levels in control and diabetic mice. Changes in body weight and blood glucose levels during the study are shown in Fig. 1. Body weight increased steadily in control mice throughout the 5-month observation period. In contrast, diabetic mice showed little gain in weight Body weights of the diabetic animals were significantly decreased compared with those of controls at 1, 3, and 5 months of the experiment (Flg. LA). Blood glucose levels in the control group did not change throughout the experimental period. The blood glucose levels were significantly higher in the diabetic group than in the control group throughout the experiment (Fig. LB). Of animals injected with STZ, 91.4% (32 per 35, including preliminary experiments) showed elevations in blood glucose sufficient for diabetes classification.

Time course of ABR threshold shift through the 5-month observation. The diabetic group showed slightly higher ABR threshold elevations compared with controls, but these differences did not reach statistical significance throughout the experiment at all ABR frequencies (4, 8, 16, and 32 kHz) except at 4 kHz at 1 month (Fig. 2). ABR threshold was elevated in both the diabetic and control groups as they grew older throughout the observation period

Histological changes in cochleae. At 5 months after injection, the CD31 -positive staining area in vessel walls at the modiolus of the cochlea was significantly broader in the diabetic mice than in controls (Fig. 3A and E), indicating that vessel walls in the modiolus of the cochleae were thickened in the diabetic group. A significant difference was observed in the mean vessel wall thickness between the diabetic group and the control group (2.29 vs. 1.68 μ??, ? = 0.002) (Fig. 3(7). There was no difference in the lateral cochlear wall including stria vascularis between diabetic and normal cochleae at 1, 3, and 5 months after injection. IHCs and OHCs were well preserved in both diabetic and control mice.

Time course of ABR threshold shifts after exposure to noise. Compared with baseline, ABR thresholds at frequencies of 4, 8, and 16 kHz shifted markedly at day 1 after noise exposure for both control and diabetic mice (Fig. 4). In general, ABRs (4 and 8 Hz particularly) in diabetic mice after exposure showed a delayed recovery of TTS components and a significant increase in permanent threshold shift. ABR thresholds in the control group recovered to baseline by day 7 at 4 and 8 kHz. At 4 kHz, recovery from TTS was significantly delayed in the diabetic group compared with the control group at days 5, 7, and 14 (Fig. 44). At 8 kHz, recovery from TTS was also significantly delayed in the diabetic group compared with the control group at days 7 and 14 (Fig. AB). At 16 and 32 kHz, ABR threshold shifts in the diabetic group showed a tendency toward delayed recovery from TTS compared with the control group, but this difference did not reach statistical significance (Fig. AC and D).

Cochlear blood flow. A significant difference was observed in the blood flow ratio of cochleae in diabetic and control groups (12.8 and 21.1%) at 14 days after noise exposure (Fig. 5). Cochlear blood flow after noise exposure was significantly decreased in the diabetic group compared with the control group (P = 0.005). In

contrast, there was no significant difference in the blood flow ratio of cochleae between diabetic and control groups at 1, 3, and 5 months after injection (data not shown).

Lose of SGCs. Loss of the type 1 SGCs was observed in all portions of the cochlea in the diabetic group at 14 days after noise exposure. Figure 6 shows the representative sections of Rosenthal canal in the apical turn of the cochlea of the control group (Fig. 6?) and diabetic group (Fig. 65). The average numbers of SGCs in the diabetic and control groups 14 days after noise exposure were 20.2/10,000 and 28.8/10,000 μ??2 in the apical turn, 29.7/10,000 and 36.8/ 10,000 μ??2 in the upper-basal turn, and 23.5/10,000 and 30.4/ 10,000 μ??2 in the basal tum, respectively (Fig. 6C). The numbers of SGCs after noise exposure were significantly decreased in all portions of the cochleae in the diabetic group in comparison with the control group. In contrast, the average numbers of SGCs in the diabetic and control groups without noise exposure were 28.8/10,000 and 30.1/10,000 μp?2 in the apical turn, 32.6/10,000 and 33.7/10,000 μ??2 in the upper-basal turn, and 33.9/10,000 and 33.3/10,000 μ??2 in the basal turn, respectively. There was no significant difference between the diabetic and control groups without noise exposure. The lateral wall of cochleae including the stria vascularis, IHCs, and OHCs were well preserved in both the diabetic group and controls after noise exposure.

DISCUSSION

In the current study, ABR thresholds shifted with aging in both the diabetic and control groups. This was as expected because the C57Biy6 mice used in the current study are well-known to develop sensorineural hearing loss much earlier in life than other mice (33-35). However, no significant differences in aging-related hearing impairment were observed between the diabetic and control mice, in accordance with a previous study using the STZ-induced diabetes model in CBA/CaJ mice (20) but in contrast with findings from the rat model of chronic pancreatitis and spontaneous diabetes (19). Most interestingly, we showed that recovery from noise-induced injury was significantly impaired in an experimental diabetes model, consistent with a previous report using the STZ-induced diabetes rat model (21).

These results are quite compatible with the clinical features of hearing loss in human patients with diabetes, as patients with a long history of severe diabetes do not necessarily suffer from hearing impairment. Moreover, several studies have reported that patients with diabetes are prone to noise-induced hearing loss. One cross-sectional study suggested that diabetic workers were more prone to developing severe noise-induced hearing loss (13). Another survey observed significant interactions between firearm noise exposure and hearing loss in diabetic patients at 3 kHz (36). Automobile company workers with high fasting blood glucose levels showed significantly higher hearing thresholds at 4 kHz than workers with normal fasting glucose levels (14). These studies and ours suggest that patients with diabetes are potentially more susceptible to noise-induced hearing loss. The current study suggests that this may be attributed to impaired recovery from noise injury. As a result of accumulated damage from noise as well as other factors such as ototoxic agents and infections, hearing impairment may become relevant among people with diabetes.

Pathologically, endothelial dysfunction is a common mechanism for renal and other chronic vascular complications in diabetes (37). Therefore, it is noteworthy that in the current study thickening of the modiolar vessel walls was the most characteristic morphological change in the diabetic mice. Thickening of the wall of the modiolar artery has also been observed in the temporal bone in a patient with diabetes (17). The cochlea is supplied with its blood flow by the spiral modiolar artery and the cochlear branch of the vestibule cochlear artery, which are terminal branches of the inner ear artery (38). We therefore hypothesized that the morphological changes observed in the modiolar vessels might induce circulatory disturbances in diabetic cochleae.

To test this hypothesis, we studied the blood flow in mouse cochlea. Indeed, cochlear blood flows in diabetic mice appeared lower than those in normal mice. While there was no significant difference in the blood flow in cochleae between diabetic and control mice 5 months after injection under normal conditions, the difference in cochlear blood flow between the two groups became obvious after noise exposure. Blood flow is influenced by

depth of anesthesia or systemic blood pressure. Thus, it is difficult to determine the baseline of cochlear blood flow. Assessments of dynamic responsiveness for vasoconstrictor or dilator applied to the round window have been reported (39) as a method for measuring the vascular conductance. In this study, to exclude the influence of systemic blood pressure we applied the blood flow ratio (blood flow of cochlear lateral wall to blood flow of stapedial artery). The cochlea is supplied principally by the inner ear artery (labyrinthine artery), which is a branch of the anterior inferior cerebellar artery (38), while the stapedial artery, a branch of the internal carotid artery, supplies the middle ear and the surrounding bone of the cochlea Because the stapedial artery and the anterior inferior cerebellar artery do not communicate directly with each other (40), laserDoppler output of the stapedial artery can be considered to reflect systemic blood pressure. Reduced cochlear blood flow has significant implications for metabolic homeostasis in the cochlea because cellular metabolism clearly depends on adequate supply of O2 and nutrients as well as elimination of waste products (41). Hence, the reduction in cochlear blood flow induced by intense noise exposure might cause the impairment of recovery from TTS in diabetic mice.

Noise exposure causes sensory cell death and auditory nerve death resulting from metabolically initiated changes including formation of free radical species (41,42). Ischemia in the cochlea itself has been shown to lead to hair cell death via apoptosis and cause delayed cell death in the SGCs (41). However, in the current study, diabetic mice exhibited significant loss of SGCs in the cochlea after noise exposure, while IHCs and OHCs were preserved. A recent report indicates that noise exposure causes acute loss of afferent nerve terminals and delayed loss of the SGCs even when hair ceUs are well preserved (43). Taken together, these results suggest that deterioration of walls of the modiolar vessel supplying the SGCs combined with ischemic changes and loss of cochlear synaptic terminals induced by noise exposure causes death of SGCs resulting in irreversible impairment of hearing.

In conclusion, the current study suggests that diabetic cochleae are more susceptible than controls to loud noise exposure. Long-term diabetes status leads to thickening of modiolar vessel walls and reduced cochlear blood flow after noise exposure. Disrupted microcirculation may cause loss of SGCs and irreversible hearing impairment. One limitation of the current study is low sample size. However, the authors believe that the trend is clear from the quantitative results and anatomical changes. Further studies should be performed to develop new strategies for prevention and treatment of hearing impairment in patients with diabetes.

ACKNOWLEDGMENTS

This work was supported by Grant-in-Aid for Young Scientists (B) (23791896 to T.F. and 20791191 to H.T.) and Grant-in-Aid for Scientific Research (C) (23592482 to D.Y.) from the Ministry of Education, Culture, Sports, Science, and Technology of Japan.

No potential conflicts of interest relevant to this article were reported.

T.F. researched data, contributed to discussion, and prepared the manuscript. D.Y. and S.K. researched data, contributed to discussion, and reviewed and edited the manuscript. S.H. and H.T. contributed to discussion. K.-i.N. contributed to discussion and reviewed and edited the manuscript. T.F. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Parts of this study were presented in abstract form and as a poster at the 34th Annual Midwinter Research Meeting of the Association for Research in Otolaryngology, Baltimore, Maryland, 19-23 February 2011.

The authors thank H. Matsunaga, Department of Otolaryngology-Head and Neck Surgery, Kobe University Graduate School of Medicine, for excellent technical assistance.

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Received 30 December 2011 and accepted 14 May 2012.
DOL· 10.2337/dbl 1-1845

Publication date: Nov 2012

Year: 2012

Alterations of the CIB2 calcium- and integrin-binding protein cause Usher syndrome type 1J and nonsyndromic deafness DFNB48

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Publication info: Nature Genetics 44.11 (Nov 2012): 1265-71.
ProQuest document link

Abstract: Sensorineural hearing loss is genetically heterogeneous. Here, we report that mutations in CIB2, which encodes a calcium- and integrin-binding protein, are associated with nonsyndromic deafness (DFNB48) and Usher syndrome type 1J (USH1J). One mutation in CIB2 is a prevalent cause of deafness DFNB48 in Pakistan; other CIB2 mutations contribute to deafness elsewhere in the world. In mice, CIB2 is localized to the mechanosensory stereocilia of inner ear hair cells and to retinal photoreceptor and pigmented epithelium cells. Consistent with molecular modeling predictions of calcium binding, CIB2 significantly decreased the ATP-induced calcium responses in heterologous cells, whereas mutations in deafness DFNB48 altered CIB2 effects on calcium responses. Furthermore, in zebrafish and Drosophila melanogaster, CIB2 is essential for the function and proper development of hair cells and retinal photoreceptor cells. We also show that CIB2 is a new member of the vertebrate Usher interactome. [PUBLICATION ABSTRACT]

Full text: Headnote

Sensorineural hearing loss is genetically heterogeneous. Here, we report that mutations in CIB2, which encodes a calcium- and integrin-binding protein, are associated with nonsyndromic deafness (DFNB48) and Usher syndrome type 1J (USH1J). One mutation in CIB2 is a prevalent cause of deafness DFNB48 in Pakistan; other CIB2 mutations contribute to deafness elsewhere in the world. In mice, CIB2 is localized to the mechanosensory stereocilia of inner ear hair cells and to retinal photoreceptor and pigmented epithelium cells. Consistent with molecular modeling predictions of calcium binding, CIB2 significantly decreased the ATP-induced calcium responses in heterologous cells, whereas mutations in deafness DFNB48 altered CIB2 effects on calcium responses. Furthermore, in zebrafish and Drosophila melanogaster, CIB2 is essential for the function and proper development of hair cells and retinal photoreceptor cells. We also show that CIB2 is a new member of the vertebrate Usher interactome.

We previously mapped to chromosome 15q23-q25.1 a locus associated with type 1 Usher syndrome (USH1H) that segregated in two families and a locus associated with autosomal recessive nonsyndromic hearing

impairment (ARNSHI) (DFNB48) that segregated in five families1,2. Subsequently, we identified 52 additional families with DFNB48 (Supplementary Figs. 1 and 2). Here, we report that, in affected subjects in 54 Pakistani families with DFNB48, we found a homozygous mutation (c.272T>C, p.Phe91Ser) of CIB2 (Figs. 1 and 2a and Supplementary Fig. 3), and, in two families with DFNB48 (DEM4025 and DEM4225), we identified a c.297C>G (p.Cys99Trp) CIB2 mutation that cosegregated with deafness (Figs. 1 and 2a). Hence, mutation of CIB2 is one of the major causes of ARNSHI within the Pakistani population (Supplementary Tables 1 and 2). In addition, a c.368T>C transition in CIB2 (p.Ile123Thr) cosegregated with ARNSHI in a Turkish family with DFNB48, family 802 (Figs. 1 and 2a). SNPs linked to CIB2 were genotyped in unrelated affected individuals homozygous for the c.272T>C and c.297C>G mutations, and the flanking haplotypes were consistent with a founder effect for both alleles (Supplementary Tables 3 and 4).

The CIB2 gene lies distal to the critical interval of the USH1H locus that was defined by linkage analysis in family PKDF125 (ref. 2). As expected, no mutations in exons of CIB2 were found in affected members of family PKDF125. However, affected individuals in another family with USH1, PKDF117 (Fig. 1c), were found to be homozygous for the c.192G>C (p.Glu64Asp) mutation in CIB2. This new locus is designated USH1J. Thus, USH1J and deafness DFNB48 are caused by allelic mutations. The four recessive mutations of CIB2 cosegregate with deafness or deaf-blindness, whereas carriers have normal hearing. No carriers of the c.192G>C and c.368T>C mutations were found in 676 and 724 ancestry-matched control chromosomes, respectively (Supplementary Table 4). Heterozygosity for the c.272T>C and c.297C>G mutations was identified in 1 and 5 representative samples, respectively, from unaffected Pakistani individuals (868 control chromosomes) but was not found in 192 individuals represented in the Coriell Human Diversity panel, in the 1000 Genome Project database or in 5,400 individuals listed in the National Heart, Lung, and Blood Institute (NHLBI) Exome Sequencing Project variant database (see URLs; Supplementary Table 4). Polyphen-2 (ref. 3) and MutationTaster4 predicted that the CIB2 mutations are deleterious (Supplementary Table 5).

CIB2 belongs to a family of calcium- and integrin-binding proteins containing three or four EF-hand domains that change conformation upon binding of calcium and presumably mediate intracellular calcium signaling5,6. Human CIB2 encodes three alternatively spliced isoforms, all of of which are affected by the four mutations identified in USH1J and deafness DFNB48 (Fig. 2a). The CIB1 protein is 38% identical and 59% similar to CIB2, and its crystal and nuclear magnetic resonance (NMR) structures7,8 were used to model the effects of mutations in USH1J and deafness DFNB48 (Fig. 2b,c). Three of the affected residues, which are conserved, Glu64, Phe91 and Cys99 (Supplementary Fig. 4), are in a region implicated in interaction with the C-terminal unstructured, negatively charged tail of αIIβ integrin7,8. The substitutions at these residues may weaken the interaction of CIB2 with integrin (Fig. 2b,c, Supplementary Fig. 5 and Supplementary Table 5), affecting integrin activation9 and possibly the efficiency of calcium sequestration by CIB2, as a result of potentially subtle changes in subcellular localization. In the absence of integrin, Arg33 forms a salt bridge with Glu64 (Fig. 2b). However, in the presence of integrin, Arg33 and Glu64 do not form a salt bridge as a result of the different conformation of CIB2 (Fig. 2c). The p.Glu64Asp alteration might change the energetic cost of accommodating the integrin C-terminal tail, thereby affecting binding affinity or kinetics. Phe91 lines the effector-binding pocket, and the p.Phe91Ser alteration might therefore disrupt effector binding. Similarly, substitution at Trp99 may alter the effector-binding pocket or calcium binding by the second EF-hand domain. In contrast, the p.Ile123Thr alteration is located within the second CIB2 EF-hand domain neighboring Thr122, a Ca2+-coordinating residue. Our molecular modeling predicts that the p.Ile123Thr alteration increases the affinity of calcium binding (Fig. 2b,c).

To experimentally explore the effects of these CIB2 mutations on intracellular calcium signaling, we used ratiometric Ca2+ imaging to measure ATP-induced inositol triphosphate (IP3)-dependent calcium responses10 in transiently transfected COS-7 cells. Cells expressing wild-type CIB2 had a 40% decrease in ATP-induced Ca2+ release compared to cells transfected with empty vector (Fig. 2d and Supplementary Fig. 6). The

inhibitory effect of CIB2 on calcium responses could be due to its calcium-buffering ability6 or, similar to CIB1 and CaBP1, could be due to CIB2 interaction with IP3 receptors10-13. None of the four missense mutations resulted in notable changes in CIB2 distribution (data not shown). However, the p.Cys99Trp alteration abolished the ability of CIB2 to decrease Ca2+ release, whereas the p.Ile123Thr alteration enhanced this inhibition (Fig. 2d). These observations are consistent with modeling predictions of the effects of CIB2 mutations on the calcium-binding affinity of CIB2.

CIB2 is widely expressed in human and mouse tissues, including in the inner ear and retina (Supplementary Fig. 7). Transcriptome analysis showed a 57-fold enrichment of Cib2 mRNA in mouse cochlear hair cells at postnatal day (P) 7 compared to supporting cells (SHIELD; see URLs). Cib2 immunoreactivity was first observed at P2 in the organ of Corti and vestibular organs and was limited to supporting cells in the developing organ of Corti up until P8 (Supplementary Fig. 8a,b). Cib2 was observed in the cytoplasm of adult supporting cells, in the inner hair cell (IHC) and outer hair cell (OHC) cuticular plate and along the length of stereocilia (Fig. 3a-d and Supplementary Fig. 8a-k). Cib2 staining was often more intense at shorter row stereocilia tips than in the neighboring stereocilia of a longer row (Supplementary Table 6), where it may be involved in calcium signaling that regulates mechanoelectrical transduction14. In P25 vestibular hair cells, Cib2 was also localized along the length of stereocilia and was concentrated in patches toward the tips of stereocilia (Fig. 3e,f). Gene gun transfection of auditory and vestibular hair cells with a Cibib2-GFP expression vector resulted in targeting and concentration of Cibib2-GFP in stereocilia tips (Fig. 3g-j). Notably, Cibib2-GFP was also more concentrated at the tips of shorter row stereocilia.

Many members of the USH interactome bind to myosin VIIa and whirlin15,16. We show that CIB2 can multimerize and that it interacts with whirlin, which is localized at the tips of stereocilia17, and myosin VIIa (Fig. 4 and Supplementary Fig. 9). No interaction of CIB2 was found with the other reported USH proteins. Thus CIB2 is a member of the USH interactome (Supplementary Fig. 10). To explore whether myosin VIIa or whirlin are necessary for CIB2 localization at hair cell stereocilia tips, we immunostained organs of Corti from homozygous shaker-1 (Myo7a4626SB) and whirler (Whrnwi) mice using antibody to CIB2. We observed no mislocalization of Cib2 in stereocilia of homozygous Myo7a- or whrn-mutant mice (Supplementary Figs. 8i-p and 11), indicating that, in vivo, myosin VIIa and whirlin are not required for localization of Cib2 in mouse inner ear hair cell stereocilia.

We next probed the function of Cib2 in the sensory cells of the ear and eye, which we studied in zebrafish, where cib2 (NM_200706.1) is expressed throughout development (Supplementary Fig. 12a). Using specific cib2-targeting morpholinos, we knocked down cib2 in embryos (Supplementary Figs. 12b and 13). We categorized the phenotypes at 72 hours post-fertilization (h.p.f.) into class 1 (normal appearance), class 2 (tail defect), class 3 (tail defect, microphthalmia and blood pooling) and class 4 (hypopigmentation, microphthalmia, tail defect and delayed development) (Fig. 5a,b). Approximately 80% of 5-d-old morphants did not respond to acoustic stimuli or were unable to remain upright while swimming (Fig. 5c). Scanning electron microscopy (SEM) revealed a marked decrease in the number of hair cell patches (neuromasts) in morphants (Fig. 5d-k). However, among class 1 and 2 morphants, we found some neuromasts with hair cell bundles (Fig. 5f-i and Supplementary Fig. 14). To assess the functional status of neuromast hair cells in the lateral lines, we briefly exposed larvae to FM1-43, a styryl pyridinium dye that enters the hair cells via partially open MET channels at rest18-21, or its fixable analog, AM1-43. Controls showed prominent fluorescent neuromasts at the head and lateral line regions (Fig. 5l). Morphants had few or no fluorescent neuromasts at 96 h.p.f. (Fig. 5l). We measured the microphonic potentials of these neuromasts, and, consistent with FM1-43 dye uptake, we observed a reduction in extracellular receptor potentials in morphant embryos relative to scrambled morpholino-injected controls (Fig. 5m-o), which could be a result of nonfunctional or degenerating MET components in lateral-line hair cells. Thus, Cib2 function is essential for development, maintenance and/or function of the mechanosensory hair cells in zebrafish.

In the mammalian inner ear, an optimal intracellular Ca2+ concentration is critical for MET, adaptation, frequency tuning, hair bundle twitching, outer hair cell electromotility and afferent synaptic transmission22-32. Ca2+ concentrations in stereocilia depend on mobile calcium buffers, a mitochondria belt beneath the cuticular plate, and PMCA, a Ca2+-ATPase14,22,33-35. Hair cell bundles of both cochlear and vestibular organs differentially express various calcium-binding proteins, including calmodulin, calretinin, parvalbumin and calbindin-D28K33,36-42, and mobile buffers that help maintain an optimal Ca2+ concentration. On the basis of stereocilia tip localization of Cib2, one may hypothesize that Cib2 temporarily sequesters calcium entering the stereocilia through MET channels until this calcium exits the stereocilia through PMCA35,43-46 or is taken up by mitochondria beneath the cuticular plate. Another plausible function of Cib2, which is not mutually exclusive, is the maintenance of calcium homeostasis in the hair cell body, which, in turn, may modulate OHC electromotility28,29,47. Furthermore, Cib2 is also concentrated in the cuticular plate region of hair cells, where an ATP-gated IP3-dependent intracellular Ca2+ store is located12. Similar to CaBP1, Cib2 may interact directly with IP3 receptors10, modulating purinergic responses in OHCs12. The analysis of hair cell physiology in a Cib2-mutant mice would help clarify and distinguish between some of these hypotheses.

To gain insight into the function of Cib2 in the mammalian eye, we determined the localization of Cib2 in the mouse retina. Cib2 immunoreactivity was observed in inner and outer segments of photoreceptor cells, as well as in the retinal pigmented epithelium (RPE). Diffuse immunoreactivity was also observed in the inner (IPL) and outer (OPL) plexiform layers and in the ganglion cell layer (Supplementary Fig. 15).

The Drosophila genome encodes one CIB-related gene, CG9236, which codes for a protein similar to human CIB2 (59% identical and 71% similar). CG9236 (referred to here as cib2) is expressed in several tissues, including the adult eye48. Calcium levels control many aspects of Drosophila phototransduction49,50. To further assess Cib2 function, we measured phototransduction activity with electroretinograms (ERGs) following cib2-knockdown through RNA interference (RNAi). cib2RNAi flies showed significantly reduced photoresponse amplitude (Fig. 6a,b) and impaired responses to flicker stimuli at high frequencies (Fig. 6c,d). cib2RNAi flies failed to reliably follow individual pulses by ~40 Hz, whereas controls only exhibited this behavior by ~70 Hz (Fig. 6c). The response amplitudes of cib2RNAi flies to individual flicker stimuli also approached noise levels at lower frequencies than those of controls (Fig. 6d). Finally, cib2RNAi flies failed to sustain an adequate photoresponse during prolonged stimulation, even at a low frequency of 1.7 Hz (Fig. 6e,f). Collectively, these data indicate that cib2 in Drosophila is necessary to achieve a strong, sustained photoresponse and to track fast light stimuli, phenotypes consistent with transiently elevated intracellular Ca2+ concentrations49,50.

Because calcium dysregulation is associated with retinitis pigmentosa and light-induced retinal degeneration50, we analyzed photoreceptor morphology in cib2RNAi flies. Control and cib2RNAi flies showed no obvious eye dysmorphology when raised under 12-h light:12-h dark conditions (Fig. 6g). However, cib2RNAi flies exhibited significant photoreceptor degeneration when raised under constant light for 5 d (Fig. 6g). Thus, cib2 is required for proper phototransduction and prevention of light-dependent retinal degeneration. These physiological and morphological phenotypes are consistent with the presence of an elevated intracellular Ca2+ concentration49,50, which inhibits the phospholipase C activity that normally activates cation- permeable TRP channels opening in response to light51. High levels of intracellular calcium are also known to inactivate TRP channels and thereby reduce the photoresponse51. Several previous studies have indicated that proper calcium regulation and phototransduction are necessary to maintain photoreceptor integrity, and defects in calcium regulation render individuals particularly sensitive to light-induced photoreceptor degeneration49,50.

In summary, CIB2 mutations underlie USH1J and nonsyndromic deafness DFNB48. Because Cib2 is concentrated in stereocilia and interacts with myosin VIIa and whirlin and Cib2 morphants have reduced hair cell microphonic potential, we speculate that human CIB2 participates in calcium regulation in the mechanotransduction process. Our studies reveal that, as in humans, Drosophila Cib2 is critical for proper photoreceptor maintenance and function and that CIB2 has conserved roles in calcium homeostasis.

URLs. NHLBI Exome Sequencing Project variant database, http://evs.gs.washington.edu/EVS/; SHIELD, https://shield.hms.harvard. edu/viewgene.html?gene=Cib2; Primer3, http://frodo.wi.mit.edu/; 1000 Genome Project, browser.1000genomes.org/; Polyphen-2, http://genetics.bwh.harvard.edu/pph2/index.shtml; MutationTaster, http://www.mutationtaster.org/; Project HOPE, http://www.cmbi.ru.nl/hope/modeling; Yasaraasaraasaraasaraasara, http://www.yasara.org/.

Methods

Methods and any associated references are available in the online version of the paper.

Note: Supplementary information is available in the online version of the paper.

Acknowledgments

We thank the families for their participation and cooperation. We also thank G.N. Sarangdhar, R. Rachel, T. Jaworek, V. Ponferrada and K. Gul for technical assistance and R.J. Morell, J. Schultz, D. Drayna, A. Swaroop and A.J. Griffith for critique of the manuscript. We thank T.M. Leisner (University of North Carolina at Chapel Hill) for the generous giftof antibodies to CIB. Genotyping services were provided to S.M.L. by the Center for Inherited Disease Research (CIDR). CIDR is fully funded through a federal contract (N01-HG-65403) from the US National Institutes of Health (NIH) to Johns Hopkins University. Z.M.A. is a recipient of a Research to Prevent Blindness Career Development Award. This work was also supported by funding from the Higher Education Commission and the Ministry of Science and Technology (Islamabad, Pakistan) to Sheikh Riazuddin and W.A., the International Center for Genetic Engineering and Biotechnology (Trieste, Italy) under project CRP/PAK08-01 contract 08/009 to Sheikh Riazuddin, the Cincinnati Children's Hospital Research Foundation (CCHMC) Intramural Research Funds to Saima Riazuddin and Z.M.A., a National Science Foundation grant (IOS-1050754) to E.K.B., US National Institute on Deafness and Other Communication Disorders (NIDCD/NIH) research grants R01 DC03594 and DC011651 to S.M.L., R01 HL092544 to L.V.P., R01 DC009645 to M.T., R01 DC008861 to G.I.F., R01 DC012564 and R00 DC009287 to Z.M.A., and R01 DC011803 and R01 DC011748 to Saima Riazuddin, and intramural funds from the NIDCD (DC000039-15) to T.B.F.

AUTHOR CONTRIBUTIONS

Z.M.A., Saima Riazuddin and T.B.F. conceived and designed the study. Saima Riazuddin and Z.M.A. performed linkage, RT-PCR and mutational analyses, cloned isoforms and provided bioinformatics evaluations. I.A.B. and S.L. conducted immunocytochemistry and quantification analyses on the inner ears of wild-type and mutant mice, performed transfection assays using sensory epithelial explants and interpreted results. A.P.J.G. performed coimmunoprecipitation assays, immunocytochemistry of CIB2 in retinas and myo7a-mutant mice. K.L. and P.B.A.-E. analyzed linkage data and screened controls. S.B., A.W., M. Ayub, M. Ansar and W.A. enrolled Pakistani families. G.I.F., A.A.I. and G.P.S. performed calcium imaging in COS-7 cells, scanning electron microscopy imaging of zebrafish embryos and recording of microphonic potentials. E.K.B. and S.P.N. designed and conducted ERG studies in flies. R.Y. performed morpholino microinjections, FM1-43 dye uptake experiments, RT-PCR and startle response measurements. T.C. and D.T. generated the cib2-mutant flies and conducted light stress analysis and light microscopy imaging of fly eyes. R.S.H. performed molecular modeling. R.A.A., S.A., J.A., S.N.K. and Sheikh Riazuddin ascertained Pakistani families, obtained clinical data and performed linkage and mutational analyses. L.V.P. provided the Cib1-mutant mice. M.T. and A.S. enrolled the Turkish families and performed linkage analysis. S.M.L. supervised the work at the Baylor College of Medicine, G.I.F. supervised the work at the University of Kentucky, and T.B.F. supervised the work at the NIDCD/NIH and helped with data interpretation. Saima Riazuddin, T.B.F. and Z.M.A. wrote the manuscript; G.I.F., E.K.B., T.C., I.A.B. and S.M.L. edited the manuscript. All authors contributed to the final version of the manuscript.

COMPETING FINANCIAL INTERESTS

The authors declare no competing financial interests.

Published online at http://www.nature.com/doifinder/10.1038/ng.2426.

Sidebar

ONLINE E METHODS

Subject and clinical evaluations. This study was approved by institutional review boards (IRBs) at the National Centre of Excellence in Molecular Biology (NCEMB), (FWA00001758), the US National Institutes of Health (Combined Neuroscience IRB; OH-93-N-016), the Cincinnati Children's Hospital Research Foundation (2009-0684; 2010-0291), the Baylor College of Medicine, the University of Miami and Quaid-i-Azam University. Written informed consent was obtained from adult subjects and the parents of minor subjects. The degree of hearing impairment was assessed by pure tone air conduction audiometry at frequencies ranging from 250 to 8,000 Hz. Vestibular function was evaluated by tandem gait and Romberg testing. Funduscopic and ERG examinations were performed by an ophthalmologist on 14 affected individuals from families with deafness DFNB48 and two affected individuals from the family with USH1J (PKDF117) to detect the absence or presence of frank retinopathy1,2. Peripheral blood samples or buccal swabs for genomic DNA extraction were collected from participating subjects.

Genetic linkage and mutation analysis studies. Using genomic DNA from affected members of two families with USH1 and five families with DFNB48 (Supplementary Table 2), we sequenced ~100 bp of adjacent intronic sequence flanking all exons of the 16 candidate genes. CIB2-directed primer sequences are listed in Supplementary Table 7. Methods for direct sequencing and mutational analyses were described previously53. Control DNA samples from ancestry-matched Pakistani, Turkish, Coriell Human Diversity and Caucasian populations were sequenced for CIB2 mutations.

Molecular modeling. Two homology models of the CIB2 protein were constructed; the templates were the high-resolution crystal structure of human CIB1 (PDB 1XO5)5 and the solution structure of a Ca2+-CIB1 complex with the cytoplasmic domain of the integrin αIIβ subunit (PDB 2LM5)8 (Fig. 2b). The SWISS-MODEL server54 was used for modeling, and energy minimization and analysis were performed with Yasara (see URLs). We also used the Project HOPE web server to further determine the effects of missense mutations on the structure of CIB2 (ref. 55).

Calcium imaging. COS-7 cells were transfected with various DsRed-tagged constructs using Lipofectamine 2000 (Invitrogen) and 3-4 μg of DNA per ~1 ml of serum-free Opti-MEM medium (Invitrogen). After 20-28 h, cells were loaded with 18 μM ratiometric Ca2+ indicator, Fura-2 AM (Molecular Probes), for 1-1.5 h at room temperature. Fura-2 fluorescence was observed in L-15 medium at room temperature with sequential 340- and 380-nm illuminations at a rate of 0.78-0.81 image pairs per second. The 340- to 380-nm fluorescence (F340/F380) ratio images were calculated, and pixel values were converted to intracellular Ca2+ concentration using the calibration curve obtained with the Fura-2 Calibration kit (Molecular Probes). Calcium responses were evoked by application of 1 μM ATP for 50 s through a puffpipette of ~1 μm in diameter that was situated ~25 μm from the cells (Supplementary Fig. 6). The number of dishes used for every construct was 4 or greater, and the number of transfected cells for every construct was over 40.

Qualitative and relative quantitative RT-PCR analysis. For PCR-based expression analyses, we used cDNA panels (Clontech) produced from tissues obtained from 19- to 69-year-old humans and from 8- to 12-week-old mice. Gene-specific primers were used for exons 1 and 5 of Cib2. For relative quantitative analysis of Cib2, the PCR primer-binding sites were located in exons 4 and 5, and the TaqMan probe spanned the junction of exons 4 and 5.

Expression constructs encoding fluorescently tagged protein. We used PCR-ready adult human eye cDNA (Clontech) to clone the full-length isoform of CIB2 into vectors encoding GFP and tdTomato (Clontech) tags (Supplementary Fig. 16). Mouse full-length Cib2 cDNA was PCR amplified from P1 to P5 inner ear cDNA. For expression plasmids, both strands of the cDNA inserts were verified with Sanger sequencing. Full-length and deletion constructs for mouse whirlin have been described previously17.

Antibody validation. To validate antibody to CIB2 (H00010518-A01, Abnova), we performed a colocalization

assay using COS-7 cells transfected with constructs expressing CIB2-GFP, DsRed-CIB1, GFP-CIB3 and GFP-CIB4 (Supplementary Fig. 16). COS-7 cells were transfected by electroporation (Neon, Invitrogen) and were incubated overnight at 37 °C with 5% CO2. Cells were then fixed with 4% paraformaldehyde (EMS) for 20 min, permeabilized for 15 min in 0.2% Triton X-100 and blocked by incubation in 2% BSA and 5% normal goat serum for 30 min. All solutions were made with 1× PBS. COS-7 cells were incubated for 2 h with antibody to CIB2 diluted with blocking solution to a concentration of ~5 µg/ml. After washes, Alexa Fluor 568-conjugated goat antibody to rabbit IgG (Molecular Probes) diluted 1:500 was incubated with cells for 20 min at room temperature. Samples were mounted using ProLong Gold Antifade Reagent (Molecular Probes), and images were captured on an LSM780 confocal microscope equipped with a 63× 1.4 numerical aperture (N.A.) objective (Zeiss Microimaging).

Immunostaining. C57BL6/J, shaker-2 (Myo15ash2/sh2) and whirler (Whrnwi/wi) mutant mice were handled according to the US NIH protocol 1263-09. Inner ears were dissected and immunostained as described17 with slight modifications. Tissue was fixed in 4% paraformaldehyde in 1× PBS (with Ca2+ and Mg2+) overnight at 4 °C. All other reagents, including antibody to CIB2 used at a 1:200 dilution and Alexa Fluor 488-conjugated IgG (Invitrogen), were diluted in 1× PBS supplemented with 2 mM EDTA. Samples were mounted with ProLong Gold Antifade Reagent and imaged using an LSM780 system. The sensory epithelium of the retina was dissected from adult CD1 mice, stained with the antibody to CIB2 and imaged using an LSM700 system.

The fluorescence intensity of CIB2 labeling at the stereocilia tips of P13 and P31 C57BL/6J, P11 Whrnwi/+ and P31 Myo7a4626SB/+ mice was measured using ImageJ software. The region of interest covered the tips of either the first (tallest) or second row of stereocilia from individual stereocilia bundles of inner hair cells. The integrated intensity of fluorescence was measured within these regions at the focal planes where stereocilia tips were in best focus. The values obtained were then divided by the number of stereocilia within the corresponding region to determine the labeling intensity per stereocilium. The amounts of CIB2 labeling at different stereocilia rows were compared using an unpaired t test.

Helios gene gun transfection. P2 to P3 organ of Corti and vestibular sensory epithelial explants of C57BL/6, shaker-2 and whirler mutant mice were cultured for 1 d in DMEM supplemented with 7% FBS (Invitrogen) at 37 °C with 5% CO2 and were transfected with construct encoding CIB2-GFP using a Helios gene gun as described56. After 24-48 h, cultures were fixed in 4% paraformaldehyde overnight at 4 °C and were stained with rhodamine phalloidin as described17. Then, samples were mounted with ProLong Gold Reagent and imaged using an LSM780 system.

Coimmunoprecipitation assays. HEK 293 cells (ATCC) were maintained using DMEM supplemented with 10% FBS, glutamine and penicillin-streptomycin (Invitrogen). Cells were plated at 80% confluency for 24 h at 37 °C in 5% CO2. On the day of transfection, 10 µg of each DNA was transfected into cells using the Fugene HD kit (Promega). After 48 h, cells were homogenized with a sonicator (Fisher Scientific) at intensity setting 2 for 10 s in buffer A (50 mM Tris-HCl, pH 7.5, 100 mM NaCl and 1% NP-40) containing a protease inhibitor mixture (Roche). Protein A-Sepharose CL-4B beads were incubated for 4 h with 5 µg of antibody to GFP and were washed three times with PBS containing 0.1% Triton X-100. Lysates were incubated for 16 h with the beads and were centrifuged at 10,000g for 3 min. Beads were washed with buffer A three times and boiled in 2× SDS sample buffer.

Zebrafish morpholino injections and fluorescent staining. Embryos were injected with a specific translation-blocking morpholino to zebrafish cib2 (7.5 ng; Supplementary Table 7), a splice-junction site-specific morpholino (10 ng) or a control morpholino (scrambled sequence) at the one-cell stage as described57. Fluorescent labeling of lateral-line neuromasts with 3 µM AM1-43 was performed as described21.

Startle response assays. Five-day-old cib2 morphants and control larvae were placed in 10-cm diameter dishes and allowed to acclimate for 10 min before being tested. The startle reflex was recorded on video using a digital camera after larvae were stimulated with a series of taps on the edge of the dish, as previously described58.

Zebrafish imaging by SEM. zcib2 morphants and control, mock-transfected larvae were fixed in 2.5% glutaraldehyde in 0.1 M cacodylate buffer supplemented with 2 mM CaCl2 for 1-2 h at room temperature. Specimens were dehydrated in a graded series of ethanol baths, dried at the critical point from liquid CO2, sputter coated with platinum (5.0 nm, controlled by a film- thickness monitor) and observed with a field-emission SEM (S-4800).

Recording of microphonic potential in zebrafish. Zebrafish larvae were anesthetized using 0.01% MS-222 (Tricaine, Sigma) dissolved in a normal bath solution containing 120 mM NaCl, 2 mM KCl, 10 mM HEPES, 2 mM CaCl2 and 0.7 mM NaH2PO4 at pH 7.3, supplemented with 150 nM tetrodotoxin (Sigma) to reduce muscle twitching. Larvae were secured on glass-bottom dishes with nylon fibers. Microphonic potentials were recorded at room temperature (22 °C) using borosilicate glass electrodes with 5-6 MΩ resistance that were placed near the apical edges of the lateral-line neuromasts. We recorded from posterior neuromasts that had seemingly healthy hair cells. Kinocilia tufts were deflected with a stiffglass probe driven by a piezoelectric actuator (PA 8/12, Piezosystem Jena) with sinusoidal stimuli of 2-μm peak-to-peak amplitude at 100 Hz. Microphonic potentials were recorded with an Axopatch 200B amplifier (Molecular Devices) in a current-clamp mode, further amplified by 10× (SIM983, Stanford Research) and low-pass filtered at 1-2 kHz. Each recording represents an average of 1,000 responses.

Drosophila genetics and morphogenesis studies. Transgenic lines carrying a UAS-driven hairpin RNA interference (RNAi) construct for CG9236 (ref. 59) on chromosomes 2 and 3 were obtained from the Vienna Drosophila RNAi Center (VDRC). These flies were crossed to a recombined chromosome carrying three transgenes-pWIZ, upstream activating sequence (UAS)-Dicer2 and long-GMR-GAL4: pWIZ is an RNAi line that has diminished expression of the white gene, thus reducing autofluorescent pigmentation60; Dicer2 increases the efficiency of RNAi-mediated knockdown59; and long-GMR-GAL4 drives UAS-dependent gene expression specifically in all differentiated cells in the eye61. Flies were maintained on standard agar, cornmeal and molasses medium at 25 °C. For the light-induced degeneration studies, flies were raised in standard polystyrene fly vials 30 cm from a 25-W fluorescent light bulb for 5 d. Photoreceptor morphology was monitored in live flies using a water immersion, cornea neutralization epifluorescence procedure that has previously been described62. We verified photoreceptor morphology using 2-μm plastic sections of dissected retinas that were counterstained with toluidine blue (Sigma) as previously described63. Ten to 12 flies were examined per experimental group, and light-dependent degeneration assays were conducted 3 times.

ERG recordings in Drosophila. Flies were immobilized with CO2, mounted on a coverslip with pink dental wax (Electron Microscopy Sciences) and adapted to the dark. The recording electrode (a cotton wick containing 0.9% NaCl connected to a silver wire) was positioned on the surface of the eye, and the indifferent electrode (silver wire) was placed in the abdomen. Recordings were acquired at 10,000 Hz. White light stimuli (with an intensity of 1.70 ×10-14 photons per cm2 per second) were delivered through an optical fiber connected to a light-emitting diode (LED). Data were analyzed in MATLAB (MathWorks). All data were smoothed with (filter(ones(1,windowsize)/ windowsize,1,data)), with windowsize = 1,000 measurements for 5-s stimuli, windowsize = 100 measurements for 300-ms stimuli and windowsize = 10% of cycle length for frequency measurements. To establish the amplitude, the absolute voltage difference between baseline and maximal responses was averaged over approximately 20 pulses per fly. To establish the response amplitude to individual flicker frequencies, each cycle's maximum response and following minimum response were established, and the absolute value of their difference was averaged for pulses 11-23. Sustainability was tested with a train of 150 300-ms pulses at 1.7 Hz. Noise levels are given on the basis of baseline data.

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Received 26 April; accepted 6 September; published online 30 September 2012; doi:10.1038/ng.2426

Publication date: Nov 2012

Year: 2012

The use of the kurtosis metric in the evaluation of occupational hearing loss in workers in China: Implications for hearing risk assessment

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Publication info: Noise & Health 14.61 (Nov 2012): 330-42.
ProQuest document link

Abstract: This study examined: (1) the value of using the statistical metric, kurtosis [β(t)], along with an energy metric to determine the hazard to hearing from high level industrial noise environments, and (2) the accuracy of the International Standard Organization (ISO-1999:1990) model for median noise-induced permanent threshold shift (NIPTS) estimates with actual recent epidemiological data obtained on 240 highly screened workers exposed to high-level industrial noise in China. A cross-sectional approach was used in this study. Shift-long temporal waveforms of the noise that workers were exposed to for evaluation of noise exposures and audiometric threshold measures were obtained on all selected subjects. The subjects were exposed to only one occupational noise exposure without the use of hearing protection devices. The results suggest that: (1) the kurtosis metric is an important variable in determining the hazards to hearing posed by a high-level industrial noise environment for hearing conservation purposes, i.e., the kurtosis differentiated between the hazardous effects produced by Gaussian and non-Gaussian noise environments, (2) the ISO-1999 predictive model does not accurately estimate the degree of median NIPTS incurred to high level kurtosis industrial noise, and (3) the inherent large variability in NIPTS among subjects emphasize the need to develop and analyze a larger database of workers with well-documented exposures to better understand the effect of kurtosis on NIPTS incurred from high level industrial noise exposures. A better understanding of the role of the kurtosis metric may lead to its incorporation into a new generation of more predictive hearing risk assessment for occupational noise exposure.

Full text: Introduction

Experimental and epidemiological data from animal and human noise exposures indicates that the current noise exposure criterion (International Standard Organization; ISO-1999:1990) [1] underestimates the amount of noise induced hearing loss (NIHL) acquired by workers exposed to complex industrial noises. These results emphasize the inadequacy of current methods of measuring and evaluating noise exposures for the purpose of hearing conservation. The difficulty lies in our inability to identify the necessary and sufficient metrics that need to be measured in order to be able to estimate hearing loss from continued long-term exposure. Current hearing risk assessment as embodied in the ISO-1999:(1990) [1] document are based on data for NIHL and high level noise exposures acquired several decades ago using what by today's standards would be considered primitive technology. At the time the demographic data were incorporated into ISO-1999, energy metrics were the only metrics that could be measured from a noise environment with noise survey equipment. Thus, in the ISO-1999 document, all noise exposures are quantified by a single metric, that is a time-integrated pressure squared or energy metric incorporating a spectral weighting. However, the energy metric of time-integrated pressure squared, with or without spectral weighting (A-scale), is insufficient to characterize complexFNx01 non-Gaussian (non-G) industrial noise exposure. Thus, there is a need to better understand how to measure and evaluate noise exposures to better predict potential NIHL for hearing conservation purposes.

Temporal characteristics of noise exposure are known to affect hearing, [2],[3],[4],[5],[6],[7],[8] yet temporal variables are not incorporated into noise energy metrics, where infinite number of very different noise exposures can all have the same equivalent noise level (Leq). Noise metrics sensitive to temporal variation need to be incorporated into current measures. One metric sensitive to temporal noise characteristics is the kurtosis statistic. Kurtosis, β (t), is defined as the ratio of the fourth-order central moment to the squared second-order moment of the amplitude distribution. Kurtosis is a metric that can be used to quantify the departure from normality. For a normal distribution β (t) = 3 whereas distributions that are outlier prone have values of β (t) =>3. Examples of the former are Gaussian (G) noises or unvoiced fricatives (/s/, /f/, /sh/) while examples of the latter are running speech, impulse/impact noise, and complex noises. Complex noises are common in industrial environments where they consist of combinations of impact and continuous G noise, i.e., they are non-G. All the variables that characterize a non-G noise (e.g., transient peaks, inter-transient intervals, transient durations, crest factor etc.,) have an effect on the kurtosis value. This is necessary since there is no agreed upon method to predict the hazard to hearing in individuals resulting from complex occupational noise exposures, [9],[10],[11],[12],[13],[14] That is, a valid and reliable method is needed in the construction of a noise dose resposne relation (DRR) for hearing conservation purposes. The main reason for this is the absence of published data on human NIHL that include sufficient numbers of workers with well-documented exposures. After many years of research, the question remains as to how current standards, developed from the results of steady-state exposures, and quantified by weighted energy alone, predict NIHL to complex noise environments. Studies which have shown both support for and against the equal energy hypothesis (EEH) that forms the basis of current hearing risk assessment for noise exposure, suggest that an energy approach is not sufficient to characterize a complex noise exposure.

If we can place the predictive value of both energy and kurtosis on a sound scientific footing we may be able to develop a very precise approach to the measurement and evaluation of noise environments. While there is currently no consensus on how to incorporate complex noise characteristics into predicting hearing hazard, [9],[10],[11],[12],[13],[14] our own animal studies have shown that the kurtosis [β(t)] metric may be a reasonable candidate to adequately predict the risk of hearing loss from complex noise. [5],[6],[7],[8] These studies demonstrate that: (1) kurtosis ordered the extent of hearing and sensory cell loss from a variety of complex noise exposures, i.e., for a fixed energy level, the noise-induced trauma increased as the kurtosis increased; (2)

non-G exposures are more hazardous than G exposures of equivalent energy and the hazard is identified by the kurtosis, and (3) the EEH applies to exposures of the same class as defined by the kurtosis. This single result represents a significant advance in our understanding of the EEH and its application to noise standards. The kurtosis statistic can be used to estimate the deviation of a distribution from the G, and can be computed on a filtered wave form to obtain a frequency specific kurtosis β(f) or on the unfiltered time-domain signal to obtain an overall kurtosis β(t). The kurtosis β(t) can then be associated with the Leq while β(f) can be associated with a frequency specific spectral energy Leq(f). It is possible that kurtosis may effectively discriminate the risk of hearing and sensory cell loss for noise exposures with equal energy but different temporal characteristics, a fundamental problem with current hearing conservation programs. If the human data that are collected reinforce our animal model data then a new approach to measuring industrial noise for hearing conservation purposes may be developed. [5],[6],[7],[8]

Significant limitations of both the ISO-1999 and American National Standard Institute [1] models of noise-induced permanent threshold shift (NIPTS) have been associated with their inability to accurately estimate NIPTS to non-G noise. Both the National Institute of Occupational Safety and Health (NIOSH) [15] and the Committee on Hearing, Bioacoustics, and Biomechanics [11] working groups have acknowledged this and have recommended that such data be acquired. The NIOSH [15] document "Criteria for a Recommended Standard: Occupational Noise Exposure, Revised Criteria" for instance, emphasized the lack of data on the effects of temporal variables especially when the noise environment is non-G. The NIOSH [15] also acknowledged the need to improve the way in which current noise exposure standards (ISO-1999) predicts the probability of acquiring a NIPTS and the magnitude of NIPTS incurred from a given noise exposure. The ISO-1999 document, which incorporates field studies of NIPTS and studies of age-related hearing loss has also been criticized by the NIOSH [15] for data that is based on "mixed quality" which "constrain the ability to establish a widely accepted hearing risk assessment for impulsive and other sounds."

Compounding the issue above is the relative lack of research and conflicting results in the literature which attempt to evaluate the predictions of ISO-1999 for median NIPTS in workers exposed to diverse industrial noise environments. A few studies have evaluated the accuracy of how ISO-1999 quantifies risk of NIPTS based on a retrospective analysis of the 1968-1972 Occupational Noise and Hearing Survey (ONHS). [16],[17],[18] Some caution must be exercised however, when comparing the noise exposure and thresholds measures from the ONHS population to current populations since the ONHS database was developed using audiometric and noise measuring instrumentation available over 30 years ago.

Prince [17] cautioned against using the ISO-1999 model for populations exposed to "intermittent or highly variable exposure conditions" since the model assumes that workers were exposed to steady-state noise. Some studies have reported that the ISO-1999 model "underestimated" the risk or amount of NIPTS in workers exposed to high level industrial noise [16],[17],[19],[20],[21],[22] whereas Dobie [18] using the ONHS data reported reasonable agreement between the high frequency median NIHL estimates with the predictions of ISO-1999.

Experimental animal data have challenged the validity of the ISO-1999 and ANSI S3.44 database and have indicated that non-G noise is more hazardous to hearing than G noise of the same spectrum and SPL. [5],[6],[7],[8],[10],[12],[13] Human demographic data [9],[17],[18],[19] also challenge these measures. Considering that many industrial noise environments are non-G (e.g., impacts or noise bursts, intermittent and/or time-varying) and that energy metrics (e.g., Leq) are suitable for G noise, there is a need to evaluate alternative metrics or combination of metrics which have been found to be appropriate for assessing non-G noise environments.

Our current study was a clear extension of our animal experiments. [5],[6],[7],[8] It allows us to test our findings in a human population to better understand: (1) the predictive accuracy of the ISO-1999 model for estimating median NIPTS in workers predictably exposed to a variety of industrial noise environments, and (2) how to

measure and evaluate noise exposures for the purpose of hearing conservation, i.e., evaluate the kurtosis metric as an indicator of hazard resulting from the temporal features of industrial noise environments. To accomplish these objectives, we compared the ISO-1999 approach for determining median NIPTS estimates with actual recent epidemiological data obtained on 240 highly screened workers exposed to high-level noise in Chinese industry.

FNx01In this study the term "complex noise" refers to non-Gaussian noise, which in the course of the work cycle is interrupted, intermittent and time varying in level.

Methods

Study design

A cross-sectional approach was used in this study. The four main study procedural elements were: (1) select workplaces based upon consistent noise and employment characteristics; (2) select and recruit subjects based upon strict quality criteria (i.e., health history and stable employment criteria); (3) obtain shift-long temporal wave forms of the noise that workers were exposed to for evaluation of noise exposures on selected subjects; and (4) obtain audiometric testing on all selected subjects. The details of each approach are addressed below.

Workplace selection for inclusion in the study

Workplace selection for this study was based upon criteria designed to assure necessary G and non-G noise exposure and a sufficient subject pool meeting subject criteria. Each workplace included in the study had: (1) a workforce that was stable over a number of years; (2) work processes and machinery that were stable for a number of years; (3) sufficiently high G and non-G noise exposure work areas, and (4) no use of hearing protective devices (HPD) by workers prior to the recent use of HPDs mandated in the last one-two years of employment. These selection criteria were designed to facilitate accurate cumulative noise exposure assessments over each worker's career. In these industries, workers are employed in high level noise environments which include a wide range of energy [L Aeq8h = 85 to <94dBA]; kurtosis level [($\beta(t)$ = 3-196; mean = 30.5, s.d = 26.1], and exposure duration (1-30 year's). Industries were selected that were known to produce some of the highest noise levels with corresponding high levels of kurtosis. Most of the noise environments in these industries consist of what we have defined as complex noise i.e., refers to non-G noise that in the course of a work cycle, may be intermittent, interrupted and of variable level.

Subject selection and recruitment

A total of 240 workers were selected from two industries in Shiyan, Hubei province of China. Two hundred seven subjects (36.02.1 +- 4.93 years old, 125 males and 82 females) were exposed to complex noise (non-G; median [$\beta(t)$ >4] for 14.9 +- 5.9 years. The remaining 33 subjects (36.5 +- 5.08 years, 20 males and 13 females) were exposed to a continuous noise (G; median $\beta(t)$ <4) for 16.04 +- 6.2 years. All candidate subjects were required to complete a noise exposure and health questionnaire modified from Dobie [23] which was followed by a face-to-face interview for quality control (to clarify and affirm responses). Subject criteria were designed to assure that observed hearing loss is directly attributed to the measured industrial noise exposures and not related to other medical problems. The ideal subject is one whose high-level noise exposure was limited to that experienced on the job and who has been employed at that same job for his entire employment history.

The duration of the workers exposure to noise without the use of HPD's was determined from the noise exposure questionnaire and interview. The subjects in this study used HPDs only in the last one-two years of employment. All subjects met strict criteria. They must have consistently worked within the same job category and work (noise exposure) area for their entire current employment, and were excluded from the study for any of the following reasons: (1) prior employment (with a different employer) in a high noise environment; (2) military service or shooting activities; (3) reported hearing complaints; (4) present auditory symptoms; (5) family history of hearing loss; (6) history of ear disease; (7) use of ototoxic drugs; and (8) history of diabetes. As self reports of prior noise exposure and hearing problems can be unreliable, personnel medical and employment history records were reviewed in conjunction with questionnaire responses and interviews in evaluating whether

potential participants were acceptable. These criteria helped to ensure that the observed change in the subjects hearing threshold level during his/her employment in the target industries were primarily attributable to the subject's age, length of time in noise, and the noise measured during the study. A review of their work history records on file was performed to ensure that their current position is their first job with high-level noise exposure.

Compounding the problem of predicting NIHL over a working lifetime are the use of HPD, changes in production technology, and worker job instability. While the implementation of hearing conservation programs is an important and necessary practice, each worker's occupational exposure is attenuated in an unpredictable fashion, interfering with the effective estimation of noise exposure over time for experimental studies. Similarly, worker mobility and changes in machinery within a job also make historic noise estimation difficult. These issues have been addressed in this study.

Real-time sound recording: Collection and analysis of noise exposure waveforms

Personal noise dosimeters (Hangzhou Aihua Instruments Co. AWA5610B, class II) were used to collect noise exposure levels on individuals. The dosimeters were equipped with a microphone (Aihua, Hangzhou, AWA14421) fixed on the collar of each subject. The dynamic range of the dosimeters was 40 to 140 dB (A). The noise dosimeters could work continuously for fifteen hours. Leq(A) was recorded and calculated every two seconds. Prior to any measurements each dosimeter was calibrated using a 94 dB SPL, 1 kHz tone (Aihua Instruments, Model AWA6221B calibrator). Noise data collected in the dosimeter were transferred to an IBM-compatible computer. The eight-hour continuous equivalent, A-weighted sound pressure level [Leq(A) 8h] was calculated for each measurement. The workers were divided into groups based on the type of noise exposure, factory, workshop, type of work and type of machine they were using.

In the continuous G noise environment, four or five workers in each group were selected for shift-long personal noise exposure level measurements using the dosimeter over a workday lasting eight or ten hours. In the complex noise environment (non-G), subjects were measured over the course of one entire work shift. The Leq(A) 8h for each subject in a group was averaged to produce a group mean daily noise exposure level [dB(A) SPL]. The statistical metric "kurtosis", which quantifies the 'peakedness' of an amplitude distribution was determined for the G and non-G noise exposure using a digital recorder (Kenwood, MGR-A7) connected to a dosimeter (Aihua, AWA5610B) to collect real-time samples of each subject's noise exposure in each industrial plant. Recordings were made at the level of the subject's ear. Full-shift (~8 hrs) noise for individual was recorded using MGR-A7 with 16 bit resolution at a 48 kHz sampling rate and fed to an IBM computer for subsequent analysis. The kurtosis of the noise was computed over consecutive 40-second time windows of each full-shift noise record using MATLAB software and the mean or median values were used to establish the kurtosis values for each series of noise records.

A detailed analysis of the temporal noise record that workers were exposed to and their audiograms was made to compare the actual NIHL in each worker with the predictions in ISO-1999. Noise environment characterization was achieved through: (1) full-shift noise signatures measured for each subject, (2) multiple subjects from each job category, and (3) historical review of each included job category to assure that no major changes in work organization or machinery used have taken place. Thus we were able to account for within and between worker variability for each job and construct a reasonably stable measure of noise exposure over the historical period covered by selected workers. Complete work shift noise waveforms were recorded for all subjects. Each subject had personal noise exposure data collected twice within the course of one month. The second record was used to make a rough estimate of exposure variability. Each shift-long personal noise exposure evaluation included two types of noise monitoring equipment. The first is a standard noise dosimeter (AWA 5610B) adapted to an output line of the microphone (AWA 14421). The second digital recorder (Kenwood MGR-A7), adapted to a precision dosimeter (AWA 5610B), obtained a full waveform record of the subject's noise exposure over a single work shift (~ eight hour) period. Both the dosimeter and recorder was calibrated

before and after each sampling with a sound calibrator (AWA6221A) according to the manufacturer's instructions.

The microphone was placed on the collar of each subject at the beginning of an eight-hour work shift and collected at the end of the shift. Since the reliability of the noise data depends on the subject's cooperation in the proper use of the recorder, each subject was informed about the purpose of measurement and the importance of wearing it continuously for the full measurement period. The importance of the accuracy of noise data in assessing the need for noise control and the consequences of tampering with the microphone (shouting into it or knocking it on doors, etc.) was explained. With few exceptions, noise records were artifact free. Such artifacts will affect the value of kurtosis in the analysis window and skew the analytical results. Thus the recorded noise data needs to be preprocessed prior to analysis to eliminate these artifacts.

An artifact detecting and eliminating program was used to automatically track and delete artifact segments in the recorded noise data. Data were entered from the subject's history/medical questionnaire into a database using Epidata 3.1 software. The duplicated database was checked for errors and sent into an SPSS (version 13) software package for subsequent analysis.

Software was developed for analyzing the eight-hour long noise waveforms collected on each subject. The software is designed to extract: (1) the frequency and time domain kurtosis, a statistical metric shown to correlate with NIPTS, [5],[6],[7],[8] and (2) the joint peak-interval histogram from complex noise environments. Conventional level and spectral metrics are also extracted in a variety of formats. These metrics taken together provide considerable temporal information that complements the energy and spectral metrics when the latter are insufficient to determine the hazard of a noise exposure.

Audiometric testing

Each subject had two audiometric examinations within one month. The second audiogram was used as a check on the initial measurements. Any discrepancy of more than 10 dB at any frequency necessitated additional testing and investigation and possible rejection of the subject. All audiometric testing took place immediately following a two-day respite from the industrial environment. These examinations included air-conduction pure-tone audiometry at. 5, 1, 2, 3, 4 and 6 kHz in each ear. In addition, an otologic examination and tympanometry testing were conducted to rule out conductive hearing impairment in each ear. Pure-tone audiometric thresholds were measured with an automatic microprocessor clinical audiometer (MADSEN ITERA) calibrated to appropriate ISO standards [24] and equipped with TDH-39 headphones mounted in MX-41/AR cushions. These tests were conducted in an audiometric sound suite with background sound pressure levels at or below the OSHA maximum allowable octave-band levels for audiometric test rooms. Prior to their day of testing each subject was instructed to avoid all sources of loud noise (e.g., loud music, gunfire, machinery, etc.) for the 48 hours prior to testing.

Statistical analysis

The median NIPTS for each noise exposed group was compared to the ISO-1999 predicted median NIPTS using a one-way analysis of variance (ANOVA) with repeated measures on one factor (frequency) and post-hoc paired comparisons (Fisher Protected Least Significant Difference Test). A statistical significance level of $P < 0.05$ was adopted for all analyses. Post hoc testing which showed the differences between the NIPTS for the noise exposure and ISO prediction to be significant ($P < 0.05$) is indicated by an asterisk (FNx01) in [Table 1]. The median difference statistic determined median NIPTS. The predicted ISO-1999 threshold for each subject was determined using the equation described in the ISO-1999 document (ANSI S3.44-1996, Section 6.3) [1] as described below. Statistically significant effects of frequency were expected and found in all of the analyses because of the frequency-specific nature of the audibility curve and the noise exposure stimulus which caused greater NIPTS at some frequencies. For this reason, main effects of frequency are not addressed in the presentation of the results.{Table 1}

Evaluation of ISO-1999 median NIPTS estimates

A database composed of the worker's shift-long temporal noise waveform and associated audiometric results was developed and compared to the ISO-1999 predictions for median NIPTS. Hearing threshold levels at each test frequency (2, 3, 4 and 6 kHz) were adjusted by subtracting averaged hearing threshold levels in age and gender matched population adapted from ISO 1999:1990 Annex B (derived from an audiometric survey of the US population in 1960 to 1962). [25] Threshold results at 0.5 and 1 kHz were not reported since very little if any NIPTS was observed at these frequencies from the noise exposure conditions reported in the present study. Furthermore, NIOSH [15] recommended that 0.5 kHz no longer be tested in hearing conservation practice. Consistent with NIOSH reports, binaural average thresholds were determined for all subjects across the test frequencies. Median thresholds were then calculated for each noise exposed group.

The subjects were exposed to only one occupational high level complex noise and had a limited (past one-two years) or no history of hearing protection. Thus we were assured that the observed hearing loss was directly attributed to the measured industrial noise exposures. Subjects were partitioned into separate groups for three noise exposure level ranges (L Aeq = 85- <88; 88- <91; 91- <94), and two exposure durations (<10 years and >10 years). For each exposure condition defined by exposure level and duration, subjects were further partitioned into one of two groups based on the kurtosis level [β(t) <10 or >10] of the noise. A similar analysis was performed on the entire subject population (N = 240) exposed to noise levels ranging from L Aeq = 85 to <94 and exposure durations ranging between 1-30 years. For this analysis, the subjects were partitioned into one of two groups based on the kurtosis level [β(t) <4 or >4] of the noise. By partitioning the subjects into groups represented by β(t) <4 and >4, we attempted to compare the effect produced by G [β(t) <4], and non-G [β(t) >4] noise on median NIPTS for several exposure conditions. The predicted ISO-1999 thresholds for each subject was determined using the equation described in the ISO-1999 document (ANSI S3.44-1996, Section 6.3) for exposure times between 10 and 40 years [i.e., median potential NIPTS N 0.50 = [μ + vlog (Θ/Θ0)] (L A8hn - L 0)2] and less than 10 years [i.e., median potential NIPTS (N 0.50;Θ,<10 = log (Θ +1)/log(11)N 0.50;Θ,= 10). This calculation was also made to derive the ISO-1999 predictions for median NIPTS for each noise exposure condition classified by the L Aeq8h and exposure duration. This approach allowed us to compare the ISO-1999 model prediction estimates for median NIPTS for each exposure condition to the median NIPTS incurred by the subjects for the same exposure condition. This was done to determine the accuracy of the ISO predictions for a variety of noise exposure conditions at each kurtosis level, e.g., [β(t) = <10 and >10], and G [β(t) = <4], and non-G (β(t) = >4]. This approach allowed us to better understand the: (1) relative contribution of the temporal features (i.e., kurtosis) of the noise exposure on NIPTS, and (2) degree of correspondence between the ISO-1999 prediction estimates for median NIPTS and that incurred for different group exposure conditions classified by L Aeq8h , duration and kurtosis level. The median NIPTS group results for subjects in each noise condition (i.e., defined by L Aeq8h , and exposure duration) were determined for both the mean and median noise exposure kurtosis level range of β(t) = <10 and >10, and β(t) = <4 and >4. The mean and median noise exposure kurtosis level range metrics were both evaluated to better understand their relative degree of correspondence for median NIPTS for: (1) two different kurtosis level ranges [e.g., β(t) = <10 and >10, and β(t) = <4 (G) and >4 (non-G)] and, (2) the ISO-1999 prediction estimate with epidemiological data obtained on 240 subjects divided among several noise exposure conditions. It should be noted that the different nature of each statistic (i.e., mean vs. median) is reflected in the differences reported for median NIPTS in (1) and (2). This analysis was performed using both the mean and median kurtosis statistic of the noise level to evaluate each statistic on (1) and (2) above.

Results

Evaluation of ISO-1999 median NIPTS estimate predictions

[Figure 1] (Panels G1-G11) compares the ISO-1999 median NIPTS predictions with the median NIPTS incurred by subjects for the variety of noise exposures indicated by L Aeq range (L Aeq = 85- <88, L Aeq = 88- <91, and L Aeq = 91- <94) and duration (<10 or >10 years). For each exposure condition, subjects were divided into two

groups based on the mean and median kurtosis levels [β(t) = <10 and/or >10] of the noise. In a few exposure conditions only one kurtosis level was reported due to a lack of subjects. A similar analysis shown in [Figure 2] (Panel G12) compares the ISO-1999 median NIPTS predictions with the mean and median NIPTS incurred by the total population of 240 subjects for L Aeq = 85 - <94 and 1-30 years exposure duration. This population was divided into two groups based on the median kurtosis level of the noise [β(t) = <4 (G) or >4 (non-G)]. Summary data for the groups defined in [Figure 1] and [Figure 2] are represented in [Table 1]. For all noise exposures where comparisons between the ISO-1999 median NIPTS predictions and high kurtosis noise [β(t) = >10] exposed groups could be made, the ISO predictions significantly (P <0.05) under estimated the NIPTS for both the median (5 out of 5 group comparisons; panels G2-G6) and mean (4 out of 5 group comparisons; panels G7-G10) kurtosis groups. Similarly, for all noise exposures where comparisons between the ISO-1999 median NIPTS predictions and low kurtosis noise [β(t) = <10] exposed groups could be made, the ISO predictions significantly (P <0.05) underestimated the NIPTS for both the median (4 out of 5 groups; panels G1-G4) and mean (1 out of 2 groups; panel G7) kurtosis groups. Post hoc testing showed the differences to be significant (P <0.05) across most of the test frequencies as indicated by an asterisk (FNx01) in [Table 1].

The results in [Figure 1] and [Table 1], which show that the ISO-1999 predictions underestimated the median NIPTS by up to ~ 15 dB in workers exposed to the industrial noise exposure conditions in this study, was reasonably consistent in the two lower noise level exposure groups (L Aeq = 85- <88; and L Aeq = 88- <91) across the test frequencies. In the higher noise level group (L Aeq = 91- <94), the ISO-1999 predictions underestimated the median NIPTS by up to ~10-15dB at 2 and/or 6 kHz with similar results occurring at 3 and 4 kHz. The extent by which the ISO model underestimated the group median NIPTS was slightly greater (Mean = 2.1 dB) for the higher median kurtosis noise level [β(t) = >10; Mean = 8.8 dB] than for the lower median kurtosis noise level [β(t) = <10; Mean = 6.7 dB] across the test frequencies. A similar result was observed for the mean kurtosis statistic, i.e., the extent by which the ISO model underestimated the group median NIPTS was greater (Mean = 6.8 dB) for the higher mean kurtosis noise level [β(t)>10; mean = 9.8 dB] than the lower mean kurtosis noise level [β(t) <10; mean = 3.0 dB]. The ISO median NIPTS predictions were more closely aligned (average of ~5 dB across the test frequencies) with the median NIPTS for the mean kurtosis than the median kurtosis statistic across the exposure conditions in this study. [Figure 2] (Panel G12) and [Table 1] show the median NIPTS results for the entire population (N = 240) divided by kurtosis level for G[β(t) = <4] and non-G [β(t) = >4] noise exposures ranging by level (L Aeq = 85 - <94) and duration (1-30 years). The ISO-1999 predictions significantly [F(2,643) = 10.60, P <0.05] underestimated the median NIPTS at 2, 4, and 6 kHz for the high kurtosis level [β(t) = >4] group but not for the low kurtosis level group [β(t) = <4]. The ISO-1999 model: (1) consistently underestimated the mean and median NIPTS for each kurtosis level group across the test frequencies, and (2) was more closely aligned with the mean and median NIPTS incurred by the lower [β(t) = <4; mean = 2 dB] than higher [β(t) = >4; mean = 4.5 dB] kurtosis level group across the test frequencies, i.e., the ISO-1999 model underestimated the mean and median NIPTS by up to 10 dB for the higher kurtosis level group [β(t) = >4] across the test frequencies.{Figure 1}{Figure 2}

The effect of kurtosis level on NIPTS

The effect of kurtosis level on NIPTS for β(t) = <10 and >10, and for β(t) = <4 (G) and >4 (non-G) is shown in [Figure 1] (Panels G1-G11) and 2 (Panel G12), respectively. Summary data for the groups defined in [Figure 1] and [Figure 2] are represented in [Table 1] and [Table 2]. The results show that the median NIPTS increased by an average of 3 dB (range 0-11 dB) as the median kurtosis level increased from β(t) <10 to >10 and by an average of 8.1 dB (range 3-13 dB) as the mean kurtosis level increased from β(t) <10 to >10 across the test frequencies among the noise exposed groups. This kurtosis level effect was reasonably consistent and most pronounced for the lower L Aeq exposure groups (L Aeq = 85- <88; and L Aeq = 88- <91) than for the higher noise level group (L Aeq = 91- <94). This effect was not statistically significant (P = 0.05) for the median β(t) = <10 and >10 group comparisons (4 out of 4; Panels G2, G3, G4, G6). However, the amount of median NIPTS

was significantly greater for the higher mean kurtosis level [β(t) = >10] than lower mean kurtosis level [β(t) = <10] in the exposed groups where comparisons could be made (2 out of 2) across the test frequencies (2-6 kHz) and at the test frequencies of 3, 4 and 6 kHz [e.g., Panel G7- L Aeq = 85- <88 and exposure duration >10 years; F(2,79) = 8.02, P <0.05; and Panel G9- L Aeq = 88- <91 and exposure duration >10 years F(2,137) = 18.04, P <0.05]. The range in median NIPTS for the β(t) = <10 and >10 kurtosis level groups between the 10% and 90% percentile was ~ 10-50 dB across the test frequencies and was most pronounced for those frequencies having the greatest amount of NIPTS (e.g., 3, 4, and 6 kHz).{Table 2}

A comparison of the median NIPTS for the groups exposed to the two kurtosis levels β(t) = <4 and >4 and ISO-1999 predictions is shown in [Figure 2] and [Table 1] and [Table 2]. The median NIPTS increased by ~ 2-4 dB (mean = 2.4 dB) as the kurtosis level of the noise exposure increased from β(t) <4 to >4 across the test frequencies. This effect was not significant (P = 0.05) for the kurtosis level [β(t) = <4 to >4] group comparison. The high frequency median NIPTS (average of 3, 4 and 6 kHz) increased by 2.8 dB as the kurtosis level increased from β(t) = <4 (G) to >4 (non-G) for the noise level range represented by L Aeq = 85- <94 [Table 2]. The range in median NIPTS for the β(t) = <4 and >4 kurtosis level groups between the 10% and 90% percentile was ~ 15-40 dB across the test frequencies and was most pronounced for those frequencies with the greatest amount of NIPTS (e.g., 3, 4, and 6 kHz).

The effect of noise exposure level and duration on NIPTS

The mean high frequency NIPTS (3, 4, and 6 kHz) incurred among different subjects as a function of exposure duration range (1 <D <10, 10 <D <20, 20 <D <30) for the three exposure levels is illustrated in [Table 3]. Summary data of the results in [Figure 1] and [Figure 2] shown in [Table 1] also represent the effect of exposure duration (<10 and >10 years) on median NIPTS across the test frequencies. The results show the characteristic pattern for development of NIHL over time, i.e., NIHL develops most rapidly in the first 10 years, and then decelerates with additional exposure to noise. [15],[23] For the two lower level noise ranges, the median high frequency NIPTS increased by an average of 6.9 dB for L Aeq = 85- <88, and by 3.9 dB for L Aeq = 88- <91 as exposure duration increased from 1 <D <10 to 20 <D <30. In contrast, there was a negligible increase in NIPTS as exposure duration increased over this range for the higher noise level group (L Aeq = 91- <94), i.e, may be attributed to the large variance in NIPTS in high frequency median NIPTS (up to ~50 dB) at similar durations for each exposure level. The distribution of median NIPTS among exposure levels and durations was also large e.g., the average difference between the 10% and 90% percentile was 26 dB (range from 14-33 dB). The range in median NIPTS between the 10% and 90% percentile for the same noise exposure duration was reasonably consistent (3 dB) among the three noise exposure level groups. In contrast, the range in median NIPTS between the 10% and 90% percentile for the same noise exposure level was somewhat larger (11 dB) among the three exposure durations.{Table 3}

Discussion

The role of the kurtosis metric for hearing risk assessment

The results from the present study indicated that the kurtosis metric is an important variable in determining the hazards to hearing posed by a high-level industrial noise environment for hearing conservation purposes, i.e., the kurtosis differentiated between the hazardous effects produced by G and non-G noise environments. This finding suggests that an energy metric (Leq) alone should not be used to predict NIPTS (as applied in the ISO model) since it appears to be insensitive to the effects of the temporal characteristics of a noise exposure known to be important in affecting hearing. This conclusion is based on the results which showed that the: (1) median NIPTS increased (mean = 8.1 dB; range 3-13 dB) as the mean kurtosis level increased [β(t) <10 to >10], and (2) amount of median NIPTS was significantly greater (P <0.05) for the higher mean kurtosis level [β(t) = >10] than lower mean kurtosis level [β(t) = <10] at the test frequencies of 3, 4 and 6 kHz in the exposed groups where comparisons could be made (2 out of 2). Collectively, the findings from this study in humans, concomitant with the results from our experiments with animals, [5],[6],[7],[8],[12] suggest that the use of an

energy metric (Leq) in combination with the kurtosis [β(t)] of the amplitude distribution of a noise environment can be used to more accurately estimate the hazards to hearing from the diversity of complex noise environments found in industry. These results are supported by recent studies [26],[27] in humans which have demonstrated the value of the kurtosis in hearing risk assessment to noise. In a study by Zhao et al. (2010), [26] the kurtosis metric was shown to more accurately assess the risk of developing high frequency NIHL in workers in Chinese industry exposed to high level G and non-G noise, e.g., the noise exposure SPL combined with a kurtosis correction term to match a dose-response relationship in those exposed to a G and non-G noise environment served as a "good metric for assessment of risk for NIHL". By introducing the kurtosis variable into the temporal component of the cumulative noise exposure calculation, the two dose response curves (for G and non-G exposed groups) were made to overlap, essentially yielding an equivalent noise-induced effect for the two study groups, i.e., the kurtosis statistic quantified the deviation of the complex noise from the G. Goley et al., [27] who applied the approach by Zhao et al., [26] using human data to data collected in our auditory research laboratories in the chinchilla, showed that the kurtosis correction term improved the predictive accuracy (e.g., from r = 0.46 for L Aeq8h to r = 0.67 for the kurtosis corrected constant) of the kurtosis metric on NIHL.

The results above indicate the need to develop and analyze a larger database of workers with well-documented exposures to better understand the effect of kurtosis on NIHL incurred from high level industrial noise exposures for hearing risk assessment. If we can place the predictive value of both energy and kurtosis on a sound scientific footing we may be able to develop a very precise approach to the measurement and evaluation of noise environments.

Considering the results from this study, a data acquisition and analysis strategy which incorporates the kurtosis level of the noise should be designed to take into account the diversity of industrial exposure conditions which contribute to NIHL. This is necessary since current occupational noise measurement practice relies primarily on measures such as an A-weighted Leq measure that completely ignores the temporal characteristics of complex industrial noise environments. Unfortunately there is at present no other generally accepted metric or combination of metrics to be used as an alternative to weighted energy. The NIOSH has supported research designed to investigate the effects of complex noise on hearing in an animal model. However, while the parametric approach used in these studies has given us insights into the relative importance of the noise variables in causing hearing loss, it has not had an impact on exposure criteria because we do not know how to apply this information to the industrial environment or even to what extent it applies. Other attempts have been made to develop metrics [28] that would be highly correlated with hearing loss from any industrial noise environment. However, to date the ideal metric remains elusive.

Evaluation of ISO-1999 median NIPTS estimates

The results from the present study indicated that the: (1) ISO-1999 predictive model significantly ($P < 0.05$) underestimated (up to ~ 15 dB across most test frequencies) the amount of median NIPTS in almost all noise exposed groups (9 out of 10) with both high median and mean kurtosis levels [$\beta(t) = >10$ and $\beta(t) = >4$]; (2) ISO-1999 predictive model significantly ($P < 0.05$) underestimated (up to ~ 10-15 dB at 2 and/or 6 kHz) the amount of median NIPTS in the majority of noise exposed groups (5 out of 7) with both low median and mean kurtosis levels [$\beta(t) = <10$], and (3) the ISO-1999 median NIPTS predictions were more closely aligned (average of ~5 dB across the test frequencies) with the median NIPTS for the mean kurtosis than the median kurtosis statistic across the exposure conditions in this study. The different nature of each statistic (i.e., mean and median) is reflected in the differences for median NIPTS reported between the predicted ISO estimates and that incurred by the noise exposed groups.

The results in the present study noted above are consistent with several studies which reported the ISO model to underestimate the amount of NIPTS. For example, hearing thresholds of railway workers were reported to exceed ISO-1999 predictions by 9 dB over 2 and 4 kHz. [20] Carlsson et al., [21] who conducted an audiometric

analysis in 1200 noise-exposed workers in Sweden, reported that in seven out of nine subgroups, the audiometric curves fell above 0.1 fractile of the ISO model and in only two groups they were at or below 0.1 fractile predicted with the ISO model. The NIOSH, [29] who compared the excess of risk of hearing impairment (binaural average >25 dB HL) expected to result from 40 years of occupational noise exposures of 80, 85, and 90 dBA (8 hour TWA) among 60-year old workers, also found that the ISO-1999 underestimated the amount of risk compared to other methods. Furthermore, comparisons between the jute weaving NIPTS data from Carlsson et al., [19] with the NIPTS predictions by ISO-1999 for this data showed a close correspondence during the first 10 years of exposure with significant differences (i.e., the ISO predictions underestimated the Carlsson et al., data [21] appearing after 15-20 years of exposure for the 50 th and 75 th percentile. In a recent study by Leensen et al., [22] an analysis of hearing thresholds in over 29,000 construction workers in Dutch industry indicated a similar relationship to ISO-1999 predictions for exposure duration greater than 10 years. However, the ISO model was not consistent with the population data during the first 10 years of exposure, i.e., pure-tone average at 3, 4, and 6 kHz was ~ 10 dB poorer than that predicted by ISO-1999. Leensen et al., [22] also found that construction workers employed for less than ten years had greater hearing losses than expected based on the interpolation of ISO-1999. The median values of worker NIPTS however, was similar to the ISO predictions for exposure times between ten and 40 years. Recent studies, [30],[31] which have attempted to evaluate the ISO-1999 database, commonly used to compensate for age-related hearing loss (i.e., to determine NIPTS), revealed the following results: (1) there was a greater amount of NIPTS in men (65-74 years) than that observed in the 1999-2006 National Health and Nutrition Examination Survey (NHNES) i.e., prevalence of hearing impairment was lower in the 1999-2006 NHNES in comparison to the 1959-1962 database, [25] and (2) using the 1999-2002 NHNES (N = 3,527), occupational noise exposure was significantly associated with several non-occupational noise factors (e.g., smoking, educational level, leisure time and firearm noise), [31] The implication of the findings above suggest that: (1) the use of the use of the 1999-2006 NHNES database (instead of ISO-1999) would result in greater NIHL in unscreened older male adults, and (2) an overestimation of NIHL may occur using the ISO-1999 age-correction database if non-occupational noise factors (e.g., smoking, educational level, leisure time and firearm noise) are not considered.

Susceptibility to noise-induced hearing loss

The results reported in this study illustrate characteristic differences in individual susceptibility to noise exposure reflected in very little to large median NIPTS of up to 50 dB (pure tone average for 3, 4, and 6 kHz) for comparable noise exposure conditions. This finding is consistent with that reported by Taylor et al., [19] who examined hearing loss in a group of forge operators who had worked in the same factory for up to 40 years i.e., workers exposed to the same constant noise (99 or 102 dB) for long periods of time (1-54 years) showed as much as 70 dB difference in auditory threshold between the least and most affected workers with NIHL. In the ISO-1999 model the distribution of median NIPTS is also large e.g., for men working at 100 dB (A) noise for 30 years the difference between 10% and 90% percentile of hearing loss is 60 dB HL. In our present study, differences between 10% and 90% percentile of median NIPTS were also large and greatest (up to ~50 dB) at the higher test frequencies where the amount of NIPTS was most pronounced. Even in controlled laboratory experiments the range of hearing loss in chinchillas exposed to the same high level noise show a range of variability that is similar to variability found in demographic studies. [5],[6],[7] The large variability in NIHL has been attributed to the variation in acoustic transfer characteristics of the external auditory meatus, [32] contribution of the stapedius reflex to protection from noise exposures, [33],[34] and/or genetic factors. [35],[36] Recently, gene expression differences induced by a noise exposure were demonstrated in mice. [35] Other intrinsic factors such as gender, race, hypertension, diabetes, and external factors [36],[37],[38],[39] which include ototoxicity, leisure noise exposure, smoking, and use of HPD, have been reported. These potential factors, combined with the parameters of the noise exposure itself (e.g., Leq, duration, interrupted, intermittent, and time varying) contribute, in varying ways, to the probability of developing NIHL and the magnitude of NIHL

among individuals exposed to equal acoustic energy exposures. In light of the results from this present study, another potential factor to consider is the kurtosis level of the noise exposure, i.e., the median NIPTS increased as the kurtosis level of the noise exposure increased.

Conclusion

The results from the varied exposure conditions in the present study suggest that: (1) the kurtosis metric is an important variable in determining the hazards to hearing posed by a high-level industrial noise environment for hearing conservation purposes, i.e., the kurtosis differentiated between the hazardous effects produced by G [β(t) = <4] and non-G [β(t) = >4] noise environments, and noise environments with high and low mean and median kurtosis levels [β(t) = <10 and >10], and (2) the ISO-1999 predictive model is not as accurate estimating the amount of median NIPTS incurred from high level kurtosis industrial noise as it is to low level kurtosis industrial noise. This conclusion is supported by the findings which showed: a) that the ISO-1999 model was more closely aligned with the group exposed to the G [β(t) = <4] than to the non-G [β(t) = >4] industrial noise, e.g., the ISO model significantly (P <0.05) underestimated the median NIPTS for the high level kurtosis group at 2, 4 and 6 kHz, b) the extent by which the ISO model underestimated the group median NIPTS which was greater (Mean = 6.8 dB) for the higher mean kurtosis noise level [β(t) = >10; mean = 9.8 dB] than the lower mean kurtosis noise level [β(t) = <10; mean = 3.0 dB] among the noise conditions across the test frequencies, and c) the ISO model significantly (P <0.05) underestimated the amount of median NIPTS in the majority (14 of 17) of comparisons with noise exposed groups having both high [β(t) = >10] and low [β(t) = <10] mean and median kurtosis levels.

The inherent large variability in NIPTS among subjects, in combination with the relatively small sample sizes in a few noise exposure groups, emphasize the need to develop and analyze a larger database of workers with well-documented exposures to better understand the effect of kurtosis on NIPTS incurred from high level industrial noise exposures. This will enable us to determine if the kurtosis metric provides more value in identifying high level complex industrial noise exposures that have the potential to increase risk of NIHL, than the traditional energy based approach for hearing conservation. A better understanding of the role of the kurtosis metric in NIHL may lead to its incorporation into a new generation of more predictive hearing risk assessment for noise exposure provided that human exposure and hearing loss data can continue to be acquired from suitably designed epidemiological studies.

Acknowledgments

This work was supported by Grant No. 1-R01-OH-002317 from the National Institute for Occupational Safety and Health. Cincinnati, Ohio. The assistance of Roger P. Hamernik (Director, Auditory Research Laboratories, SUNY Plattsburgh) is greatly appreciated.

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Publication date: Nov 2012

Year: 2012

Dandiya music making more revellers deaf

Author: Porecha, Maitri

Publication info: DNA : Daily News & Analysis [Mumbai] 26 Oct 2012.

Abstract: According to the guidelines, the noise level in a residential area should not exceed 55db up to 10pm and 45db after 10pm.

Full text: A couple of days ago, 28-year-old Sneha (name changed) requested her neighbour, who is a ear specialist, to check her ears, as she was having difficulty hearing for about a week. She believed that a little cleaning would resolve the issue. But when the doctor examined Sneha, he found that her inner ear was severely damaged.

"Sneha is an avid dandiya player. Constant exposure to high-decibel music has caused the problem," said Dr Pradeep Uppal, the Thane-based ENT surgeon.

Sneha's is not an isolated case. From information available, during the dandiya season every year, ENT specialists get such cases complaining of hearing loss in at least one of the ears. This has gotten worse recently, say anti-noise pollution activists. Noise levels touched 100 decibels (db) this time, which is close to the sound impact from firecrackers burned during Diwali.

According to the guidelines, the noise level in a residential area should not exceed 55db up to 10pm and 45db after 10pm. In silence zones (around schools and hospitals) this must not go over 50db before 10pm and 40db after 10pm.

Doctors say that persons exposed to noise levels in the range of 60-70db over a period of time could suffer hearing loss. "Sudden loud noise can cause a hole in the eardrum, which is treatable with medication and surgery. But sustained noise over a period of time can also result in sensorineural deafness, which is a gradual loss of hearing. This is the most common problem among teenagers who are Navratri revellers," said Dr Uppal. (The ear consists of three main parts - the outer ear, the eardrum and the inner ear or cochlea.)

A frequent complaint by revellers during the nine-day celebration is a constant ringing in the ears. "Such reverberating sound is caused because of the damage to sensitive hair cells inside the ear. Often, patients don't come to us immediately as they do not attribute hearing loss to the noise," said Dr Hetal Marfatia-Patel, professor in the ENT department at KEM hospital.

Doctors suggest some protective steps. "Plug your ears with cotton while walking on the streets, as a sudden explosion of firecrackers can damage the ear permanently," Dr Marfatia-Patel said. "Partial loss of hearing loss is also rampant. In other countries people also use special noise filter plugs that don't hinder the sound, but reduce the loudness. Unfortunately, such specialized ear plugs are not available in India yet."

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Credit:Maitri Porecha

Publication date: Oct 26, 2012

Year: 2012

USF Researchers Identify Gene Linked to Old Age Hearing Loss

Publication info: Targeted News Service [Washington, D.C] 25 Oct 2012.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: The University of South Florida issued the following news release:

University of South Florida researchers have identified a genetic biomarker for age-related hearing loss, a major breakthrough in understanding and preventing a condition of aging that affects 30 million Americans and greatly diminishes their quality of life.

In a nine-year study that was a collaboration between USF's Global Center for Hearing &Speech Research and the National Technical Institute for the Deaf at the Rochester Institute of Technology, researchers were able to identify the first genetic biomarker for presbycusis. The genetic mutation carried by those who ultimately suffer from age-related hearing loss is linked to speech processing abilities in older people.

Their findings are published in the journal Hearing Research. The study was authored by USF College of Engineering professors Robert Frisina Jr. and Robert Frisina Sr., the founders of the Global Center for Hearing &Speech Research, and David Eddins, a USF associate professor of communication sciences and disorders and chemical and biological engineering.

In collaboration with the House Ear Institute in Los Angeles, the researchers discovered a gene that produces a key protein in the inner ear - the cochlea - called glutamate receptor metabotropic 7 (GRM7). The GRM7 protein is intimately involved in converting sound into the code of the nervous system, in the cochlea, which is then sent to the parts of the brain used for hearing and speech processing.

Now having identified the gene, the researchers said people can be tested and takes steps earlier in life - such as avoiding loud noises, wearing ear protection and avoiding certain medicines known to damage hearing - to protect their hearing.

"This gene is the first genetic biomarker for human age related hearing loss, meaning if you had certain configurations of this gene you would know that you are probably going to lose your hearing faster than someone who might have another configuration," said Robert Frisina Jr.

The Frisinas launched their study of genetics' role in hearing loss nine years ago in hopes of identifying the cause of one of the most common forms of permanent hearing loss. Clinically, age-related hearing loss has been defined as a progressive loss of sensitivity to sound, starting at the high frequencies, inability to understand speech, the lengthening of the minimum discernible temporal gap in sounds, and a decrease in the ability to filter out background noise. Researchers now know the causes of presbycusis are likely a combination of multiple environmental and genetic factors.

"Age-related hearing loss is a very prevalent problem in our society. It costs billions of dollars every year to manage and deal with it. It's right up there with heart disease and arthritis as far as being one of the top three chronic medical conditions of the aged," said Robert Frisina Jr.

DNA analyses were conducted and completed at the University of Rochester Medical School and the Rochester Institute of Technology.

The study involved 687 people who underwent three hours of extensive examination of their hearing capabilities, including genetic analyses and testing of speech processing.

Interestingly, the gene mutation played out differently in women than in men, the researchers found. While the variation had a negative impact for men, it did the opposite for women, who actually had better than average hearing in their elder years. That discovery supports a 2006 finding by the Frisina research group that the hormone aldosterone plays a role in hearing capabilities.

To read the full study, click here.http://www.sciencedirect.com/science/article/pii/S0378595512002092

TNS MJ88-121025-4084706 StaffFurigay

Publication date: Oct 25, 2012

Year: 2012

Siemens Medical Instruments Pte. Ltd; Researchers Submit Patent Application, "Hearing Aid Device with a Directional Microphone System and Method for Operating a Hearing Aid Device Having a Directional Microphone System", for Approval

Publication info: Electronics Business Journal (Oct 24, 2012): 9991.
ProQuest document link

Abstract: [...]the mode of working of the signal processing unit can be adapted to both the individual hearing loss of a hearing aid device wearer and the current audio conditions in which the hearing aid device is being operated.

Full text: 2012 OCT 24 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Business Journal -- From Washington, D.C., VerticalNews journalists report that a patent application by the inventors HAIN, Jens (Kleinsendelbach, DE); JUNIUS, Dirk (Moehrendorf, DE); MULLER-WEHLAU, Matthias (Erlangen, DE); PAPE, Sebastian (Erlangen, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012.
The patent's assignee for patent serial number 437046 is Siemens Medical Instruments Pte. Ltd.
News editors obtained the following quote from the background information supplied by the inventors: "Field of the Invention
"The invention relates to a hearing aid device with a directional microphone system. The device which has a directional microphone system with at least a first microphone, from which a first microphone signal is emitted, a second microphone, from which a second microphone signal is emitted, and a delay unit (T). For the purpose of generating a directivity, the second microphone signal or a fourth microphone signal derived therefrom is delayed in the delay unit by an internal time delay and is associated with the first microphone signal or a third microphone signal derived therefrom; a cross-correlation analysis unit, at which the first or the third microphone signal and the second or the fourth microphone signal arrive, determines a value of a cross correlation of the two microphone signals; a control unit adjusts the time delay depending on a value of the cross correlation of the two microphone signals.
"The invention further relates to a method for operating such a hearing aid device in order to provide directional microphone functionality.
"A hearing aid device according to the invention is understood to mean any device which delivers an output signal that can be discerned by a user as an acoustic signal, or which contributes to the delivery of such an output signal, and which features means that serve to or help to compensate for an individual hearing loss suffered by the user. In particular, such devices here comprise hearing devices which can be worn on the body or on the head, in particular on or in the ear, and which can also be wholly or partially implanted. However, such devices also comprise those whose primary purpose is not to compensate for hearing loss, e.g. devices in the field of entertainment electronics (televisions, Hi-Fi systems, MP3 players, etc.) or communication devices (mobile telephones, PDAs, headsets etc), but which nonetheless provide means for compensating for an individual loss of hearing.
"In order to provide binaural support for a user, use is normally made of a hearing aid device system comprising two hearing aid devices, in particular hearing devices, which can be worn on or in the ear. In addition to at least

one hearing aid device that can be worn on or in the ear, a hearing aid device system can also comprise at least one further device, e.g. an external processor unit that can be worn on the body of the user. The external processor unit can be used for remote control of the hearing aid device or hearing aid device system, for example, but can also perform other functions such as analysis of the acoustic audio environment, for example.

"A hearing aid device normally comprises an input converter for picking up an input signal. The input converter is designed as a microphone, for example, which picks up an acoustic signal and converts it into an electrical signal. However, input converters can also be units which feature a coil or an antenna and which pick up an electromagnetic signal and convert it into an electrical signal. Furthermore, a hearing aid device normally comprises a signal processing unit for processing and frequency-dependent amplification of the electrical signal. For the purpose of signal processing in the hearing aid device, provision is made for a preferably digital signal processor (DSP), whose mode of working can be influenced by means of programs or parameters that can be transferred to the hearing aid device. Consequently, the mode of working of the signal processing unit can be adapted to both the individual hearing loss of a hearing aid device wearer and the current audio conditions in which the hearing aid device is being operated. The electrical signal which has been changed thus is then supplied to an output converter. This is normally designed as a headphone, which converts the electrical output signal into an acoustic signal. However, other embodiments are also possible here, e.g. an implant-type output converter that is connected directly to an auditory ossicle and causes the latter to vibrate.

"European published patent application EP 0 064 042 A1 and U.S. Pat. No. 4,425,481 describe a hearing aid device comprising a classifier which analyzes the microphone signal entering the hearing aid device and automatically recognizes the audio conditions in which the hearing aid device is currently situated. Depending on the audio conditions that are recognized, the parameters relating to signal processing in the hearing aid are automatically adjusted.

"A modern hearing aid device usually comprises a directional microphone system, by means of which in particular the articulation can be improved in various audio conditions, e.g. during a conversation in an environment where interference noise is present. A directional microphone system conventionally comprises at least two microphones, whose outputs are connected together and whose output signals are associated in order to achieve directivity. Depending on the interconnexion of the microphones, in particular on an internal signal delay between the two microphone signals, it is possible to adjust different directional characteristics. The AI-DI (articulation index directivity index) is normally used as a measure for the directivity. In order to achieve the desired directivity for a directional microphone system, an internal base time delay between the microphone signals must be carefully adjusted for each new hearing aid device. This is usually done using so-called KEMAR measurements for a specific wearing position of the respective hearing aid device, wherein a reference signal is presented from a frontal direction. The base time delay is normally adjusted so as to optimize reception of an acoustic signal arriving from the front (relative to the direction of view) and to maximize suppression of an acoustic signal arriving from the opposite direction (from behind).

"U.S. Pat. No. 5,757,933 describes a hearing aid device which features a directional microphone system comprising two electrically interconnected microphones, wherein different directional characteristics can be adjusted depending on a signal delay between the generated microphone signals.

"Two problems occur in respect of the adjustment of the base time delay: firstly the base time delay depends largely on the effective distance of the two microphones relative to an acoustic source, and secondly the effective base time delay is also frequency-dependent due to the frequency-dependent diffraction and reflection of the sound. The frequency-dependent base time delay is normally determined using KEMAR measurements, but is to a large extent dependent on the reflection properties of the audio environment of the hearing aid device.

"The first problem is highly relevant for universal (instant fit) hearing aid devices having fixed tube length or cable length between the respective hearing aid device and an associated otoplastic. As a result of the

predetermined tube length or cable length, the positions of the individually worn hearing aid devices vary more than in the case of a conventional adaptation, because in the case of the latter the acoustician can manually adapt the tube length to the individual ear of the respective user, thereby ensuring that the ideal position is achieved. The greater the deviation of an angle a between a connection line of the microphone openings and the horizontal plane, for a hearing aid device worn by a user, from the angle a that was determined on the KEMAR during the development process for the optimal wearing position, the more ineffective the directivity of the directional microphone system, i.e. the AI-DI decreases.

"The second problem occurs irrespective of the wearing position concerned. Individual factors such as haircut or shape of the head and pinna influence the frequency-dependent group delay and therefore adversely affect the performance of the directional microphone system.

"United States Patent Application Publication No. US 2002/0041696 A1 describes a hearing aid device comprising a directional microphone system as per the preamble of claim 1 and a method for operating such a hearing aid device as per the preamble of claim 10.

"U.S. Pat. No. 7,340,068 B2 describes a device and a method for determining wind noise, in which provision is made for generating a first time-dependent correlation signal consisting of values of a cross-correlation function between a first and a second microphone signal, and a second time-dependent correlation signal consisting of values of an autocross-correlation function of either the first or the second microphone signal."

As a supplement to the background information on this patent application, VerticalNews correspondents also obtained the inventors' summary information for this patent: "It is accordingly an object of the invention to provide a hearing aid device and method with direction microphone processing which overcome the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides for a device and a method that achieves superior performance of a directional microphone system for a hearing aid device, irrespective of the individual wearing position of the hearing aid device.

"With the foregoing and other objects in view there is provided, in accordance with the invention, a hearing aid device with a directional microphone system, comprising:

"a first microphone configured to output a first microphone signal and a second microphone configured to output a second microphone signal;

"a delay unit configured for generating a directivity by delaying the second microphone signal or a fourth microphone signal derived therefrom by an internal time delay and associating with the first microphone signal or with a third microphone signal derived therefrom for the purpose of generating a directional microphone signal;

"a cross-correlation analysis unit connected to receive the first or the third microphone signals and to receive the second or the fourth microphone signals, and configured for determining a value of a cross correlation of the two microphone signals;

"a classifier for determining an audio condition in which the hearing aid device is currently situated; and

"a control unit for adjusting the time delay in dependence on the value of the cross correlation of the two microphone signals, wherein the time delay is adjusted depending on the audio condition.

"There is also provided, in accordance with the invention, a method of operating a hearing aid device provided with a directional microphone system having a first microphone, from which a first microphone signal is output, and a second microphone, from which a second microphone signal is output, the method which comprises:

"generating a directivity by delaying the second microphone signal or a fourth microphone signal derived therefrom in a delay unit by an internal time delay and associating with the first microphone signal or a third microphone signal derived therefrom;

"determining a value of a cross-correlation of the two microphone signals; and determining audio conditions in which the hearing aid device is currently situated; and

"adjusting the internal time delay depending on the value of the cross-correlation of the two microphone signals

and depending on the current audio conditions.

"The fundamental idea of the invention is that of using a cross-correlation analysis to determine the time delay with which an acoustic signal arrives at the microphones, in particular at the microphone opening that is assigned to the respective microphone in the housing of the hearing aid device. The internal time delay for at least one microphone signal that is generated by one of the two microphones is then applied depending on the external delay that was determined by the correlation analysis.

"By virtue of the invention, the internal delay can be adapted to the individual external delay that is dependent on the wearing position. Optimized directivity can therefore be adjusted with reference to the individual wearing position. Even if the individual wearing position deviates from the ideal wearing position, a high performance of the relevant directional microphone system, in particular a high AI-DI, is achieved.

"The novel hearing aid device according to the invention also comprises a classifier for determining the audio conditions in which the hearing aid device is currently situated, wherein the adjustment of the time delay takes place depending on the audio conditions. Determining the effective distance of the microphones of the directional microphone system concerned is particularly efficient if the location of the acoustic source, from which an acoustic signal emerges and is captured by the microphones, in relation to the microphones is known. This can be assumed in certain audio conditions. In the audio conditions 'conversation background quiet', for example, it is assumed that the hearing aid device wearer is facing the conversation partner. This is therefore an ideal moment for determining the effective distance between the microphones. In addition to the audio conditions 'conversation background quiet', this however also applies to other audio conditions, e.g. 'television'.

"A cross-correlation function is advantageously used to determine the time delay with which an acoustic signal arrives at the microphones. It is generally used in the signal analysis to describe the correlation of two signals x(t) and y(t) at different time displacements t between the two signals. It shows e.g. maxima in the case of time displacements which correspond to the group delay from the measurement location of the signal x(t) to the measurement location of the signal y(t). Propagation time differences from a signal source to both measurement locations can also be established in this way. In the case of a time delay .tau., the cross-correlation function of the microphone signals has a maximum which corresponds to the propagation time of the acoustic signal between the two microphones (specifically: between the two microphone openings in the housing of the hearing aid device). This time delay is designated as effective time delay .tau..sub.eff. By virtue of the cross-correlation function, it is therefore easily possible to determine the effective external propagation time, between the two microphones, of an acoustic signal that arrives from a frontal direction (as seen by the user) at the hearing aid device which is worn in an individual position.

"The internal time delay between the microphone signals is advantageously not adjusted on the basis of a single instance of determining the cross-correlation function of the two microphone signals, and hence on the basis of a single calculation of the effective time delay .tau..sub.eff. Instead, the cross-correlation function and hence the effective time delay .tau..sub.eff are advantageously determined more than once within a specific time period. A resulting effective time delay .tau..sub.eff, res is preferably determined therefrom by means of a histogram analysis. Stable results can be achieved in this way. For the purpose of histogram analysis, the time displacement .tau. is divided into specific time segments and, for each time segment, the frequency with which the effective time delay .tau..sub.eff occurs in this time segment is determined. The resulting effective time delay .tau..sub.eff, res is then derived from that time segment in which the determined effective time delays .tau..sub.eff are most frequent.

"In the case of a hearing aid device that can be worn behind the ear, comprising a directional microphone system which has a front and a back microphone, the internal (base) time delay of the microphone signal that is generated by the back microphone is advantageously adjusted so as to be identical to the effective time delay .tau..sub.eff or resulting effective time delay .tau..sub.eff, res that was determined in the manner described above. This is the base time delay, by means of which an acoustic signal arriving directly from behind (as seen

by the hearing aid device wearer) is largely erased (cardioid radiation pattern). In order to vary the direction of maximal signal suppression, it is nonetheless also possible to set a time delay that differs from the base time delay. Using a directional microphone system comprising two microphones, it is thus possible to set a super-cardioid, hyper-cardioid or even figure-of-eight radiation pattern, for example.

"As described in the introduction, the external time delay is frequency-dependent as a result of diffraction and reflection effects. According to a preferred embodiment of the invention, provision is therefore made for determining an internal time delay which is also time-dependent. This can easily be achieved by first supplying the microphone signals that are output from the microphones to a filter bank in each case. This results in the microphone signals being split into frequency bands. The internal time delay is then determined separately for the respective frequency band. The influence of diffraction and reflection effects can be largely suppressed in this way.

"In order to prevent systematic errors in the calculation of the effective time delay, and hence in the adjustment of the internal time delay, the calculated effective time delay or resulting effective time delay is first subjected to a validation check before the internal time delay is adapted. In particular, erroneous values relating to the effective time delay can be determined in the case of a reverberant environment or an incorrect spatial orientation of the relevant hearing aid devices. In order to prevent erroneous adjustment of the internal time delay, e.g. threshold values can be specified for the calculated effective time delay, wherein the internal time delay is not adapted if a threshold value is exceeded. In the case of a hearing aid device system comprising two hearing aid devices worn on the head, a further possibility consists in performing a comparison of the effective time delays that are determined in the two hearing aid devices. If these time delays differ excessively, this indicates audio conditions that are not suitable for the adjustment according to the invention.

"In a preferred embodiment of the invention, there is no sudden switch from the previously used internal time delay to the newly calculated internal time delay, and instead a more gradual transition between the two time delays takes place (fading). Switching-related artifacts are thereby avoided.

"In summary, the invention offers the following advantages: a. By virtue of using statistical methods (histogram analysis), an individually adapted and hence more effective directivity is achieved. b. Frequency-dependent diffraction and reflection effects are taken into consideration, and therefore high directivity is achieved over the entire frequency range concerned. c. By virtue of a hearing aid device that is adjusted according to the invention, the speech understanding in varying audio environments is significantly improved.

"Other features which are considered as characteristic for the invention are set forth in the appended claims.

"Although the invention is illustrated and described herein as embodied in a hearing aid device comprising a directional microphone system and method for operating a hearing aid device comprising a directional microphone system, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."

For additional information on this patent application, see: HAIN, Jens; JUNIUS, Dirk; MULLER-WEHLAU, Matthias; PAPE, Sebastian. Hearing Aid Device with a Directional Microphone System and Method for Operating a Hearing Aid Device Having a Directional Microphone System. U.S. Patent Serial Number 437046, filed April 2, 2012, and posted October 11, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=4176&p=84&f=G&l=50&d=PG01&S1=20121004.PD.&OS=PD/20121004&RS=PD/20121004

Keywords for this news article include: Audiology, Electronics, Hearing Loss, Cardio Device, Otolaryngology, Medical Devices, Machine Learning, Signal Processing, Emerging Technologies, Siemens Medical Instruments

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Publication date: Oct 24, 2012

Year: 2012

Siemens Medical Instuments Pte. Ltd.; "Hearing Aid Device and Method for Operating a Hearing Aid Device" in Patent Application Approval Process

Publication info: Electronics Newsweekly (Oct 24, 2012): 1191.
ProQuest document link

Abstract: "Published German patent application DE 10 2009 032 238 A1 discloses a method for monitoring the adjustment of a hearing device, containing a filter bank for the spectral selective amplification and volume compression of audio signals, to a hearing loss of a hearing device wearer.

Links: Check LinkSource for Full Text

Full text: 2012 OCT 24 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- A patent application by the inventors PAPE, Sebastian (Erlangen, DE); SERMAN, Maja (Erlangen-Buckenhof, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012, according to news reporting originating from Washington, D.C., by VerticalNews correspondents.
Patent serial number 437042 is assigned to Siemens Medical Instuments Pte. Ltd.
The following quote was obtained by the news editors from the background information supplied by the inventors: "Field of the Invention
"The invention relates to a hearing aid device and to a method for operating a hearing aid device.
"U.S. patent publication No. 2011/004 468 A1 discloses a hearing aid device and a method for operating a hearing aid. The hearing aid has an input converter for receiving an input signal and converting the signal into an electrical input signal. A signal processing unit is provided for processing and frequency-dependent amplification of the electrical input signal and for generating an electrical output signal. An output converter converts the electrical output signal into an output signal which can be perceived by a user as an acoustic output signal. A sound detector facility is provided for identifying sounds in a speech signal going into the hearing aid device. A device is provided for briefly increasing the amplification above a normal amplification for at least one frequency range, in which an identified sound contains signal components.
"Published, European patent application EP 1 175 125 A2, corresponding to U.S. Pat. No. 5,706,352, relates to a degree of amplification and filter circuit and discloses an adaptive filter circuit for use in a hearing device by a person with a hearing impairment having a predetermined frequency range. The filter circuit includes a variable filter and an amplifier, which have a bandwidth which corresponds to the predetermined frequency range of the hearing impairment.
"Published German patent application DE 10 2009 032 238 A1 discloses a method for monitoring the adjustment of a hearing device, containing a filter bank for the spectral selective amplification and volume compression of audio signals, to a hearing loss of a hearing device wearer. This publication describes a maximum possible amplification in the upper frequency bands by the hearing device and a feedback whistling, which, with unfavorable designs or with leakages, already uses the ear mold in the case of minimal amplifications, which are too minimal for adequate amplification of the fricative energies.

"Tight boundaries with respect to the maximum amplification which can be achieved with a hearing aid device are generally set by the required, small size of the device and the minimal distance between the input converter (in particular microphone) and output converter (in particular receiver). The extremely bothersome feedback whistling occurs in the case of excessively high amplification. The feedback tendency of a hearing aid device is frequency-dependent and applies in most cases to the upper range of the frequency range which can be transferred by a hearing aid device.

"With many hearing-impaired persons, there is therefore the problem that specific frequency ranges can no longer be adequately perceived even with coverage with a hearing device. With the perception of speech, this results in specific sounds, in particular consonants which contain signal components in the high-frequency signal spectrum with respect to speech, not being understood correctly. So-called fricatives, which are named according to their type of articulation, are particularly affected, for instance 's', 'sch', 'v', or 'z'.

"In order to compensate for the hearing loss, it is known to transpose the relevant frequency ranges into other frequency ranges which can be better perceived. When implementing a frequency transposition of this type, a distinction is essentially made between two methods: with the frequency shift, a frequency range (e.g. 4 kHz-6 kHz) is moved into another frequency range (e.g. 2 kHz-4 kHz). Contrary to this, in the case of compression, the frequency of the output signal is produced by multiplying the frequency of the input signal with a factor (e.g. 0.75). Nevertheless a frequency compression frequently does not take place starting with 0 Hz, but instead firstly above a determined (knee point) frequency, e.g. 2 kHz.

"A method of frequency transposition in a hearing aid device as well as a hearing aid device for implementing a frequency transposition are known from published, European patent application EP 1 441 562 A2.

"The frequency transposition has two fundamental disadvantages: on the one hand damage to the original spectral composition of specific consonants and other sounds and on the other hand, relating to the perception, the ability to distinguish between different fricatives, is significantly spectrally impaired.

"Methods of speech signal processing are known from the prior art, by which the vowels or consonants can be identified in a speech signal. For instance, German utility model DE 691 05 154 T2 discloses a method of this type, in which a speech signal spectrum is analyzed in order to determine peak values and average values, which are compared with specific threshold values in order to identify vowels and consonants.

"U.S. patent publication No. 2009/0112 594 A1 discloses a method in which a distinction is made between pre and postvocalic consonants based on acoustic models.

"Unpublished, German patent application DE 103 08 483 A1, corresponding to U.S. Pat. No. 7,010,133, discloses a method for automatically setting the amplification in a hearing aid device, with which during operation, a speech signal level and an interference signal level is determined in several frequency bands of an input signal. The amplification is automatically set as a function of the determined signal level and the signal frequency. Amplification parameters are determined in this way by including a loudness model and a speech intelligibility model.

"International patent publication WO 00/05923, corresponding to U.S. Pat. No. 6,768,801, discloses a hearing aid having improved speech intelligibility by frequency-selective signal processing and a method for operating a hearing aid of the type."

In addition to the background information obtained for this patent application, VerticalNews journalists also obtained the inventors' summary information for this patent: "The object of the invention is to improve the understanding of speech in the case of hearing losses, in which specific frequency ranges can no longer be perceived with high sound levels.

"According to a first aspect, the invention proposes a hearing aid device that has at least an input converter for receiving an input signal and converting the signal into an electrical input signal, a signal processing unit for processing and frequency-dependent amplification of the electrical input signal and for generating an electrical output signal, an output converter for converting the electrical output signal into an output signal which can be

perceived as an acoustic output signal by a user, and a sound detector facility for identifying the sounds in a speech signal going into the hearing aid device. Facilities are provided for briefly increasing the amplification above a normal amplification for at least one frequency range, in which an identified sound contains signal components. Facilities are provided for setting the normal amplification of an electrical input signal in dependence on the signal frequency. The amplification is restricted to a permanently possible maximum amplification at least in a specific frequency range. The amplification can be set such that this exceeds the normal amplification or the permanently possible maximum amplification at least essentially for the duration of the identified sound. The amplification can be set such that this exceeds the normal amplification or the permanently possible maximum amplification at most for a duration which lies below a setting time of a feedback whistling.

"According to a second aspect, the invention proposes a method for operating a hearing aid device having at least an input converter for receiving an input signal and converting the signal into an electrical input signal, a signal processing unit for processing and frequency-dependent amplification of the electrical input signal and for generating an electrical output signal, and an output converter for converting the electrical output signal into an output signal which can be perceived as an acoustic output signal by a user. Sounds are identified in a speech signal going into the hearing aid device. The amplification is briefly increased above a normal amplification for at least one frequency range in which an identified sound contains signal components. The normal amplification of an electrical input signal is set as a function of the signal frequency. The amplification is restricted to a permanently possible maximum amplification at least in one specific frequency range. The amplification exceeds the normal amplification or the permanently possible, maximum amplification at least essentially for the duration of the identified sound. The amplification exceeds the normal amplification or the permanently possible, maximum amplification at most for a duration which lies below a setting time of a feedback whistling.

"A hearing aid device according to the invention is understood to mean each device which provides an output signal which can be perceived as an acoustic signal by a user or contributes to providing such an output signal and which has means for compensating for an individual hearing loss of the user. In particular, this is a hearing device which can be worn on the body or on the head, in particular on or in the ear, or can be wholly or partially implanted. Such devices are however also included, the predominant purpose of which does not lie in compensating for a hearing loss, for instance electronic entertainment devices (televisions, hifi systems, MP3 players etc), or communication devices (mobile telephones, PDAs, headsets etc.) which nevertheless have means for compensating for an individual hearing loss.

"A hearing aid device generally includes an input converter for receiving an input signal. The input converter is embodied for instance as a microphone which receives an acoustic signal and converts the same into an electrical input signal. Units are however also considered as input converters which comprise a coil or an antenna and which receive an electromagnetic signal and convert the same into an electrical input signal. Furthermore, a hearing aid device usually includes a signal processing unit for processing and frequency-dependent amplification of the electrical input signal. A preferably digital signal processor (DSP), the mode of operation of which can be influenced by programs or parameters which can be transmitted to the hearing aid device, is used for signal processing in the hearing aid device. As a result, the mode of operation of the signal processing unit can adjust both to the individual hearing loss of a hearing aid device wearer and also to the current audio situation, in which the hearing aid device is currently operated. The thus changed electrical input signal is finally fed to an output converter. This is generally embodied as a receiver, which converts the electrical output signal into an acoustic signal. Nevertheless, other embodiments are also possible here, e.g. an implantable output converter, which is directly connected to an auditory ossicle and prompts the same to vibrate.

"With a hearing aid device, the amplification is set such that the individual hearing loss of a user is compensated. The amplification needed for this is usually dependent on the signal frequency. Physical

boundaries are however set with respect to the maximum adjustable amplification, the boundaries on the one hand resulting from the technical possibilities of the hearing aid device used and on the other hand being used to prevent feedback. Feedback occurs in most cases in the upper frequency range which can be transmitted by a hearing aid device. Many hearing aid device wearers unluckily have significant hearing loss in this frequency range, for the compensation of which a high amplification would be necessary. To prevent feedback, the amplification is therefore set in a relevant frequency range such that the relevant hearing device can still be operated in a stable fashion, even if the amplification needed to compensate for the individual hearing loss can no longer be achieved. Furthermore, with the so-called power devices, which enable very high amplification by avoiding acoustic feedback, upper boundaries are set for the amplification on account of the mechanical stability of the devices.

"According to the invention, aside from the usual components (input converter, signal processing unit, output converter) the hearing aid device has a sound detector facility for identifying sounds, in particular components, in a speech signal going into the hearing aid device.

"A sound is generally a noise or a tone, caused by the human or animal voice. In general linguistics, a sound in the narrower sense is a defined acoustic wave produced with the flow of breath (phonation flow) when the organs of speech are in a specific position. The generation and perception of sounds forms the subject matter of phonetics. A speech sound and/or phone is understood there as the smallest, phonetic unit of the spoken language.

"Within the meaning of the invention, a consonant is generally understood to mean a sound, the articulation of which contains a narrowing of the vocal tract, so that the flow of breath is wholly or partially blocked and results in audible turbulences. Consonants are sounds overcoming obstacles. In particular, within the meaning of the invention consonants are not restricted to the consonant letters (B, C, D, F etc).

"With an identified sound, in particular a consonant or fricative, which has signal components in a frequency range in which the amplification needed to compensate for the individual hearing loss can no longer be permanently achieved, the invention now provides to briefly increase, in particular for the duration of the sound, the amplification above the permanently possible amplification. As a result, it is possible for the hearing aid device wearer to better perceive the sound and thus better understand the overall speech.

"In conjunction with the invention, it is insignificant whether the desired amplification cannot be permanently achieved, because this would exceed the permanently possible maximum output power of the final amplifier in the relevant frequency range, or whether the amplification was restricted in order to prevent feedback to protect the mechanical stability of the relevant device. With respect to the final amplifier, it is namely possible to briefly increase the output power above the permanently possible maximum output power without herewith causing damage. With respect to the feedback problem or the mechanical stability, a brief exceedance of the permanently maximum permissible amplification is also unproblematic, since, e.g. the unwanted feedback whistling requires a certain setting time, rather than rendering the same bothersomely noticeable. The duration of a sound nevertheless lies below this setting time.

"In a preferred embodiment of the invention, provision is made to split the electrical input signal into several parallel frequency bands (channels) and the signal processing in the hearing aid device in the signal processing unit takes place at least partially in parallel in the individual frequency bands. Advantageously as a function of an identified sound, the amplification is then increased above the normal amplification at least for a specific frequency band, if the desired amplification cannot be achieved permanently on account of the already cited reasons and the identified sound contains signal components in the relevant frequency band.

"The invention is advantageous in that, contrary to a frequency compression, the clarity of speech is not impaired to any degree.

"Other features which are considered as characteristic for the invention are set forth in the appended claims.

"Although the invention is illustrated and described herein as embodied in a hearing aid device and a method

for operating a hearing aid device, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."
URL and more information on this patent application, see: PAPE, Sebastian; SERMAN, Maja. Hearing Aid Device and Method for Operating a Hearing Aid Device. U.S. Patent Serial Number 437042, filed April 2, 2012, and posted October 11, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=4173&p=84&f=G&l=50&d=PG01&S1=20121004.PD.&OS=PD/20121004&RS=PD/20121004
Keywords for this news article include: Electronics, Signal Processing, Siemens Medical Instuments Pte. Ltd..

Publication date: Oct 24, 2012

Year: 2012

Siemens Medical Instruments Pte. Ltd.; Patent Application Titled "Hearing Device with Reduced Acoustic Wind Sensitivity" Under Review

Publication info: Electronics Newsweekly (Oct 24, 2012): n/a.
ProQuest document link

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors MEISTER, Bernd (Erlangen, DE); RITTER, Hartmut (Neunkirchen Am Brand, DE); WEISTENHOFER, Christian (Bubenreuth, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012.

Full text: 2012 OCT 24 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors MEISTER, Bernd (Erlangen, DE); RITTER, Hartmut (Neunkirchen Am Brand, DE); WEISTENHOFER, Christian (Bubenreuth, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012.
The assignee for this patent application, patent serial number 437050, is Siemens Medical Instruments Pte. Ltd.

Reporters obtained the following quote from the background information supplied by the inventors: "Field of the Invention
"The present invention relates to a hearing device with reduced acoustic wind sensitivity.
"Hearing devices are used to supply hearing-impaired persons with acoustic ambient signals which are processed and amplified to compensate for and/or treat the respective hearing impairment. A hearing device includes in principle one or more input converters, a signal processing facility with an amplification facility and/or an amplifier and an output converter. The input converter is generally a receiving transducer, e.g. a microphone and/or an electromagnetic receiver, such as an induction coil. The output converter is generally implemented as

an electroacoustic converter, e.g. miniature loudspeaker, or as an electromechanical converter, such as a bone conduction receiver. It is also referred to as a receiver. The output converter generates output signals, which are routed to the ear of the patient and generate an audio perception in the case of the patient. The amplifier is generally integrated into the signal processing facility. The power supply to the hearing device takes place by means of a battery arranged in the hearing device housing. The essential electronic components of a hearing device are generally arranged on a printed circuit board as an interconnect device or are connected thereto.
"Hearing devices are known in various basic housing configurations. With ITE hearing devices (In-The-Ear) a housing which contains all the functional components including a microphone and a receiver, is for the most part worn in the auditory canal. CIC hearing devices (Completely-In-Canal) are similar to the ITE hearing devices, but are however worn completely in the auditory canal. With BTE hearing devices, (Behind-The-Ear) a housing with components such as a battery and signal processing facility is worn behind the ear and a flexible acoustic tube, also referred to as tube, guides the acoustic output signals of a receiver from the housing to the auditory canal. RIC-BTE hearing devices (Receiver-In-Canal Behind-The-Ear) equate to the BTE hearing devices, but the receiver is worn in the auditory canal and instead of an acoustic tube, which routes acoustic signals to an earpiece, a flexible cable or a wire-carrying tube, also referred to as receiver tube or receiver connecting means, guides electrical signals to a receiver which is attached to the front of the receiver tube.
"In addition to optical properties, such as a small installation size or an agreeable shape, the acoustic properties determine the quality of a hearing device. The acoustic properties are significantly benefited by means of the high quality input converter, output converter and a good signal processing facility. A further determining factor is the sensitivity to wind. Wind which blows across the hearing device and/or forms due to movement of the hearing device wearer, often results in interference noises which are amplified again by the hearing device and disturb the hearing device wearer in terms of his/her hearing perception and possibly hamper understanding of the spoken language for instance. A favorable embodiment and position of the microphone openings relative to the head and auricle of the hearing device wearer or covers on the hearing device housing form part of the known countermeasures. Furthermore, electronic measures, such as filtering or reducing the amplification factor, enable the influence of wind noises to be reduced. Inspite of these measures, there still exists the need to reduce the acoustic wind sensitivity of hearing devices further or by way of alternative solutions."
In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent: "It is accordingly an object of the invention to provide a hearing device which overcomes the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides for a hearing device with reduced acoustic wind sensitivity.
"With the foregoing and other objects in view there is provided, in accordance with the invention, a hearing device, comprising: functional parts of a hearing device; and a surface formed with a shark skin structure.
"One significant reason for the occurrence of interference or wind noises if wind blows over the surface of a hearing device is that as of a specific wind speed, e.g. measured in meters per second, a laminar flow passes into a turbulent flow. This process can also be described such that a fluid flows in layers which do not mix and the fluid is increasingly disturbed by turbulences, i.e. swirling or transverse flows as of a specific flow speed. Turbulences can be detected in a wind tunnel for instance. If this swirling appears in the region of the microphones and/or the microphone inlet openings of a hearing device, they produce noise which can be perceived as bothersome by a hearing device wearer, or the one possible wanted signal, i.e. speech, is overlayed and the perception of the wanted signal is negatively influenced. The occurrence of turbulences can be identified using measuring technology for instance by a deterioration of the signal-to-noise ratio, whereby the ratio of wanted signal to noise signal decreases more significantly from a characteristic wind speed, for instance by an order of magnitude, than with wind speeds which are lower than the characteristic wind speed, subsequently also referred to as the characteristic wind speed or limiting wind speed. The object of the invention of specifying a hearing device with reduced acoustic wind sensitivity can therefore also be described

such that the critical wind speeds are to be moved toward higher speeds.
"The basic idea behind the invention is a hearing device, the surface of which includes a shark skin structure. The skin of a shark consists of thousands of small scales with recesses and elevations. The sharp and pointed shapes of the scales form small channels in the direction of swimming movement of the shark. Dividing the water flow into the smallest regions prevents water particles of the water flow from connecting, forming swirls and then also disturbing the surround water flow. This principle can also be applied to air as a surrounding medium. The technical implementation of the principle of operation of shark skin and the principle realizability of such structures is known from the prior art, for example, from Fraunhofer Mediendienst, special edition 05-2010, issue 4 'Shark skin for airplanes, ships and wind power systems', published by Fraunhofer Gesellschaft, Munich, Germany. There, the use in these fields of application substantially aims at a reduction in the water and/or air resistance. Further details and differences when using shark skin structures in hearing devices are described below.
"The shark skin structure of a surface of a hearing device preferably includes scales, which have a length between 0.1 .mu.m and 0.1 mm and a height which is less than the length.
"The dimensions of the scales, from which the shark skin structure is composed, influence the wind speed from which a laminar wind flow changes into a turbulent flow. The specified region represents a preferred size range.
"In accordance with the invention, the scales have channel-type recesses and rib-type elevations, which are parallel to one another and define a longitudinal axis.
"Furthermore, in accordance with the invention, when the hearing device is being worn, at least directional components of the longitudinal axis of the scales are aligned parallel to an axis, which is defined by the straight line of sight of a hearing device wearer.
"The best effect in terms of increasing the critical wind speed is generally then achieved if the longitudinal axis of the scales is parallel to the vector of the wind speed. In the event of a hearing device which is worn behind the ear of a hearing device wearer, wind, e.g. when walking, will blow past the hearing device predominantly in parallel with the auricle, i.e. in the straight line of sight of a hearing device wearer, so that an alignment of the longitudinal axis of the scales parallel to the straight line of sight of the hearing device wearer is advantageous. Since on account of the curved surface of a hearing device, not all longitudinal axes of the scales can be aligned in the straight line of sight of the hearing device wearer, at least one component is to be aligned in this direction.
"The surface with the shark skin structure preferably only includes points which are not in contact with the skin of the hearing device housing when the hearing device is being worn.
"The shark skin structure with its elevations and channels could bring about an unpleasant wearing sensation if it rests on the skin of a hearing device wearer. To prevent this, the shark skin structure should only include points which are not in direct skin contact. Such points are for instance on the upper side of the hearing device housing or on the upper side of a hearing device hook.
"The scales are favorably embedded in a varnish. A varnish in which small scales with the described properties are embedded, enable the shark skin structure to be attached to curved surfaces.
"It is conceivable that the shark skin structure is embodied on the surface of a film.
"This method is advantageous in that the shark skin structure can be applied to the hearing device with simple means, for example by means of adhesion.
"It is particularly advantageous that the shark skin structure is impressed into the in particular glass fiber-reinforced, surface of the hearing device.
"Modern injection molding methods enable textures in the micrometer range, with which hearing device housings with a shark skin structure can be cost-effectively produced for instance with high quality. Further methods of impressing a shark skin structure into a hearing device housing or a hearing device hook are high-precision laser drilling methods. A hard or hardened surface lends itself to a stable surface structure, such as

can be achieved for instance by means of glass fiber reinforcement.
"A preferred embodiment of the invention provides that the material which embodies the shark skin structure is biocompatible.
"In this context, the term biocompatible is to be understood to mean that the material which embodies the shark skin structure does not have a negative influence on the hearing device wearer, in particular does not irritate the skin of the hearing device wearer chemically. A biotolerant material is suitable for the purpose, and a bioinert material is preferred.
"Other features which are considered as characteristic for the invention are set forth in the appended claims.
"Although the invention is illustrated and described herein as embodied in a hearing device with reduced acoustic wind sensitivity, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."
For more information, see this patent application: MEISTER, Bernd; RITTER, Hartmut; WEISTENHOFER, Christian. Hearing Device with Reduced Acoustic Wind Sensitivity. U.S. Patent Serial Number 437050, filed April 2, 2012, and posted October 11, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=4171&p=84&f=G&l=50&d=PG01&S1=20121004.PD.&OS=PD/20121004&RS=PD/20121004
Keywords for this news article include: Electronics, Signal Processing, Siemens Medical Instruments Pte. Ltd..

Publication date: Oct 24, 2012

Year: 2012

Siemens Medical Instruments Pte. Ltd.; Patent Application Titled "Method for Improving the Comprehensibility of Speech with a Hearing Aid, Together with a Hearing Aid" Under Review

Publication info: Electronics Newsweekly (Oct 24, 2012): 7258.
ProQuest document link

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors PAPE, Sebastian (Erlangen, DE); SERMAN, Maja (Erlangen-Buckenhof, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012.

Full text: 2012 OCT 24 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors PAPE, Sebastian (Erlangen, DE); SERMAN, Maja (Erlangen-Buckenhof, DE), filed on April 2, 2012, was cleared for further review on October 11, 2012.
The assignee for this patent application, patent serial number 437041, is Siemens Medical Instruments Pte. Ltd.

Reporters obtained the following quote from the background information supplied by the inventors: "The

invention relates to a hearing aid together with a method for operating a hearing aid with an input transducer for receiving an input signal and converting it into an electrical input signal, a signal processing unit for processing the electrical input signal and effecting frequency-dependent amplification of it, and for generating an electrical output signal, and an output transducer for converting the electrical output signal into an output signal which the user can perceive as an acoustic output signal.

"Due to the required small size of the devices and the small distance between the input transducer (in particular a microphone) and the output transducer (in particular an earpiece), the maximum amplification which can be achieved with a hearing aid is generally subject to narrow limits. In particular, if the amplification is too high an extremely disturbing feedback whistle arises. The feedback susceptibility of a hearing aid is frequency-dependent, and mostly affects the upper end of the frequency range which a hearing aid can transmit.

"For many of those with damaged hearing, the problem thus arises that even when they are equipped with a hearing aid they can no longer adequately perceive certain frequency ranges. In the perception of speech this leads to certain sounds not being correctly understood, in particular consonants which in terms of speech have signal components which are in the high frequency signal spectrum. This particularly affects the so-called fricatives, which are named after the way they are articulated, for example 's', 'sh', 'v' or 'z'.

"A known way of compensating for the loss of hearing described is to transpose the frequency ranges affected into other frequency ranges, which can be better perceived. In performing a frequency transposition of this type, two main methods are distinguished: in the case of frequency displacement, a frequency range (e.g. 4 kHz-6 kHz) is shifted into another frequency range (e.g. 2 KHz-4 kHz). In contrast to this, in the case of frequency compression the frequency of the output signal is produced by multiplying the frequency of the input signal by a factor (e.g. 0.75). Often however, frequency compression is not effected with 0 Hz as the starting point, but only above a certain frequency (the knee point) e.g. 2 kHz.

"Methods for frequency transposition in a hearing aid, and a hearing aid for carrying out a frequency transposition, are known from the publication, European patent application EP 1 441 562 A2.

"Frequency transposition, in particular frequency shifting, has two main disadvantages: on the one hand in respect of the spectrum, corruption of the original spectral composition of certain consonants and other sounds and, on the other hand, the ability to distinguish different fricatives--which affects their perception--is significantly impaired.

"From the prior art, methods of speech signal processing are known by which the vowels or consonants can be recognized in a voice signal. For example, German utility model DE 691 05 154 T2 discloses a method of this type with which a voice signal spectrum is analyzed for the purpose of determining peak and average values, which are compared with certain threshold values to recognize vowels and consonants.

"Also, a method is known from U.S. patent publication No. 2009/0112594 A1 whereby pre-vowel consonants and post-vowel consonants are distinguished on the basis of acoustic models.

"U.S. Pat. No. 5,014,319 describes a hearing aid in which a frequency analysis device classifies sounds and, for a frequency transposition, determines a transposition factor appropriate for the frequencies occurring in the sounds. In order to avoid the frequency transposition suppressing individual speech sounds, so that useful information is then lost, a device for the reconstruction of speech components is provided in this hearing aid. For this purpose, the start of each individual speech sound which is recognized is stored, and the residue which remains is in each case discarded. The actual frequency transposition is then achieved by outputting these speech start-sounds over an extended time."

In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent: "It is the objective of the present invention to improve the comprehension of speech in the case of a hearing loss where certain frequency ranges can no longer be perceived even at high volumes.

"With the foregoing and other objects in view there is provided, in accordance with the invention a hearing aid.

The hearing aid includes an input transducer for receiving an input signal and converting the input signal into an electrical input signal, a signal processing unit for processing and frequency-dependent amplification of the electrical input signal and for generating an electrical output signal, an output transducer for converting the electrical output signal into an output signal which can be perceived by a user as an acoustic output signal, facilities for performing a frequency transposition and for generating a transposed signal, facilities for detecting specific features of the electrical input signal, and filtering facilities, for filtering the transposed signal, whereby the filtering is performed in dependence on the specific features which have been detected in the electrical input signal.

"A hearing aid in accordance with the invention is to be understood as any device which supplies an output signal which can be perceived by a user as an acoustic signal, or contributes to the supplying of such an output signal, and which provides facilities which act as or contribute towards compensation for an individual loss of hearing in the user. In particular, this will be a hearing aid which can be worn on, or can be wholly or partially implanted in, the body or the head, in particular on or in the ear. However, it also includes devices whose primary purpose is not to compensate for a hearing loss, for example electronic entertainment devices (TVs, hi-fi systems, MP3 players etc.), or communication devices (mobile telephones, PDAs, headsets etc.) which do however provide measures for compensating for an individual loss of hearing.

"In general, a hearing aid incorporates an input transducer for receiving an input signal. The input transducer will, for example, be in the form of a microphone which receives an acoustic signal and converts it into an electrical input signal. However, it is also possible to regard as the input transducer units which have a coil or an antenna and which receive an electromagnetic signal and convert it into an electrical input signal. Furthermore, a hearing aid conventionally incorporates a signal processing unit for processing and effecting frequency-dependent amplification of the electrical input signal. For the purpose of signal processing in the hearing aid, use will be made of a signal processor, preferably digital (a DSP), whose method of working can be influenced by programs or parameters which can be transmitted to the hearing aid. This enables the signal processing unit's way of working to be adapted, both for the individual loss of hearing of a hearing aid wearer and also for the current hearing situation in which the hearing aid is currently being operated. The electrical input signal which has been modified in this way is finally fed to an output transducer. This is generally in the form of an earpiece which converts the electrical output signal to an acoustic signal. However, here again other forms of embodiment are possible, e.g. an implantable output transducer which is directly linked to the auditory ossicles and which excites vibrations in them.

"The basic idea of the invention consists in detecting specific features of the electrical input signal and in filtering the transposed signal as a function of the specific features detected in the input signal. For this purpose, the inventive hearing aid provides appropriate facilities for detecting specific features of the electrical input signal, and filtering facilities for the purpose of filtering the transposed signal. The objective of this is to detect certain characteristics of the input signal which could be lost due to the frequency transposition and to restore them, at least partially, in the transposed signal.

"In the case of one preferred form of embodiment, the specific features of the electrical input signal which are detected are, in particular, characteristic features of a speech signal which the input signal includes. These are, in particular, characteristic features of certain speech components, such as for example characteristic features of certain sounds, consonants or fricatives. In addition, however, it is possible to detect specific features of other signals included in the input signal, for example of music, and for filtering to be effected as a function of these features. Quite generally, the objective of the invention is retrospectively to retrieve, at least partially, features of the input signal which are specific, i.e. particular or characteristic, which are lost as a result of the frequency transposition, by filtering facilities.

"In the case of one form of embodiment of the invention, the specific feature of an electrical input signal, in particular of a speech signal included in the electrical input signal, which is detected is the distribution of the

input signal power against frequency. This can be based, for example, on a spectral analysis of the input signal, whereby the signal level is determined for each frequency in the input signal over a certain frequency range. The objective of the filtering of the transposed signal which follows is then to achieve a similar power distribution in the output signal, in which the corresponding power maxima and minima lie at an altered frequency, in accordance with a frequency transposition rule.

"Another form of embodiment of the invention provides for the detection of the maxima and/or minima of the electrical input signal, as a function of the frequency, as its specific features. Here too, the number and positions of the maxima and minima are then mapped onto the transposed frequency range by appropriate setting of the filtering facilities.

"The advantages of the invention are shown particularly clearly in the case of a hearing aid with filtering facilities for distributing the electrical input signal into several frequency bands (channels), in which the processing and the frequency-dependent amplification of the electrical input signal are effected at least partially in parallel in the individual frequency bands, and with facilities for the transference of at least one signal which is present in a first frequency band into a second frequency band in the course of the frequency transposition. In particular in the case of this channel-dependent or channel-by-channel frequency shift, as applicable, which in practice represents the method used for preference rather than frequency compression, the resulting power distribution or the distribution of the maxima and minima in the output signal, as appropriate, can deviate greatly from that of these variables in the original signal. As a result--if the invention is not used--when the input signal contains a speech signal the comprehension of this speech is in particular made significantly more difficult.

"In the case of one particularly preferred form of embodiment of the invention, a hearing aid in accordance with the invention incorporates a sound detection device for the purpose of detecting specific features of the electrical input signal, by which sounds, in particular consonants or fricatives, can be recognized in the electrical input signal and the filtering can be effected as a function of a sound which has been recognized. The specific features of the electrical input signal which are detected in accordance with the invention are then characteristic features of these sounds, in particular a characteristic shape of the frequency spectrum, the power distribution etc.

"In general terms, a sound is a noise or tone produced by a human or animal voice. In general speech science, a sound in the more narrow sense is a defined sound wave produced by a flow of breath (phonation airstream) with a particular adjustment of the speech organs. The generation and perception of sounds is the subject of phonetics. A speech sound, or phone, is here regarded as the smallest phonetic unit of spoken language.

"In the sense of the invention, a consonant is to be understood generally as a sound, the articulation of which includes a narrowing of the vocal passage, so that the airstream from the breath is totally or partially blocked and audible turbulences (air eddies) are produced. Consonants are sounds which overcome a hindrance. In particular, in the sense of the invention consonants are not restricted to the consonant letters (B, C, D, F etc.).

"Because the invention is intended, in particular, to contribute to improving the comprehensibility of speech, it is possible to restrict the application of the invention to periods of time in which there is a speech signal. The invention then detects the spectral power distribution of a recognized sound, or the distribution of the maxima and minima in the signal level, as applicable, and maps this onto the appropriate distribution in the transposed signal.

"With one preferred form of embodiment of the invention, the inventive hearing aid incorporates facilities for the transformation of the input signal, or of a signal derived from this, into the frequency domain, whereby the signal processing takes place at least partially in the frequency domain. In the frequency domain it is more easily possible, in particular, to recognize sounds, in particular consonants or fricatives, than when the signal processing is in the time domain. Also, some specific features of the input signal can be detected more easily in the frequency domain than in the time domain.

"Further, with one preferred form of embodiment of the invention, the filtering facilities effect the filtering in the

time domain. In particular, narrow-band filters at the end of the signal processing performed by a relevant hearing aid can contribute to the mapping of a spectral distribution characteristic of certain sounds or fricatives, as applicable, into the restricted frequency range of the output signal.
"Other features which are considered as characteristic for the invention are set forth in the appended claims.
"Although the invention is illustrated and described herein as embodied in a method for improving the comprehensibility of speech with a hearing aid, together with a hearing aid, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."
For more information, see this patent application: PAPE, Sebastian; SERMAN, Maja. Method for Improving the Comprehensibility of Speech with a Hearing Aid, Together with a Hearing Aid. U.S. Patent Serial Number 437041, filed April 2, 2012, and posted October 11, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=4175&p=84&f=G&l=50&d=PG01&S1=20121004.PD.&OS=PD/20121004&RS=PD/20121004
Keywords for this news article include: Electronics, Signal Processing, Siemens Medical Instruments Pte. Ltd..
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Publication date: Oct 24, 2012

Year: 2012

Restoration of auditory evoked responses by human ES-cell-derived otic progenitors

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Publication info: Nature 490.7419 (Oct 11, 2012): 278-82.
ProQuest document link

Abstract: Deafness is a condition with a high prevalence worldwide, produced primarily by the loss of the sensory hair cells and their associated spiral ganglion neurons (SGNs). Of all the forms of deafness, auditory neuropathy is of particular concern. This condition, defined primarily by damage to the SGNs with relative preservation of the hair cells, is responsible for a substantial proportion of patients with hearing impairment. Although the loss of hair cells can be circumvented partially by a cochlear implant, no routine treatment is available for sensory neuron loss, as poor innervation limits the prospective performance of an implant. Using stem cells to recover the damaged sensory circuitry is a potential therapeutic strategy. Here we present a protocol to induce differentiation from human embryonic stem cells (hESCs) using signals involved in the initial specification of the otic placode. We obtained two types of otic progenitors able to differentiate in vitro into hair-cell-like cells and auditory neurons that display expected electrophysiological properties. Moreover, when transplanted into an auditory neuropathy model, otic neuroprogenitors engraft, differentiate and significantly improve auditory-evoked response thresholds. These results should stimulate further research into the development of a cell-based therapy for deafness. [PUBLICATION ABSTRACT]

Full text: Headnote

Deafness is a condition with a high prevalence worldwide, produced primarily by the loss of the sensory hair cells and their associated spiral ganglion neurons (SGNs). Of all the forms of deafness, auditory neuropathy is of particular concern. This condition, defined primarily by damage to the SGNs with relative preservation of the hair cells1, is responsible for a substantial proportion of patients with hearing impairment2. Although the loss of hair cells can be circumvented partially by a cochlear implant, no routine treatment is available for sensory neuron loss, as poor innervation limits the prospective performance of an implant3. Using stem cells to recover the damaged sensory circuitry is a potential therapeutic strategy. Here we present a protocol to induce differentiation from human embryonic stem cells (hESCs) using signals involved in the initial specification of the otic placode. We obtained two types of otic progenitors able to differentiate in vitro into hair-cell-like cells and auditory neurons that display expected electrophysiological properties. Moreover, when transplanted into an auditory neuropathy model, otic neuroprogenitors engraft, differentiate and significantly improve auditory-evoked response thresholds. These results should stimulate further research into the development of a cell-based therapy for deafness.

Hair-cell-like phenotypes and sensory neurons, with different degrees of functional maturation, have been obtained from mouse stem populations4-10. After transplantation, some cell types have shown engraftment but none have shown evidence of functional recovery10-15. Although useful for research purposes, these products are unsuitable for a therapeutic application and appropriate cell types of human origin have remained elusive so far. Neuroprogenitors isolated from mature human cochleae display limited proliferative and differentiating potential16, hESC-derived neural crest cells may differentiate into sensory neurons by exposure to bone morphogenetic protein (BMP) but lack true otic characteristics17,18. Recently, we isolated a population of bipotent stem cells from the human fetal cochlea (human fetal auditory stem cells, hFASCs), with the ability to produce hair-cell-like cells and neurons19. However, although hFASCs can be expanded in vitro for approximately 25 population doublings, they eventually undergo replicative senescence. Hence, there is a need for a reliable, renewable source of human otic progenitors, with the ability to produce both cell types for sensory replacement.

Fibroblast growth factor (FGF) signalling is necessary and sufficient for the induction in vivo of the otic placode, the primordium of the hearing organ20,21. As the ligands involved in placode signalling in the mouse have been identified as FGF3 and FGF10 (refs 22, 23), we proposed that exposure to these factors would trigger otic differentiation of hESCs. Initial experiments with embryoid bodies confirmed FGF3 and FGF10 induction of otic features (Supplementary Fig. 1a). Wetherefore focused on developing a method devoid of this initial cellaggregation step, which is prone to high variability. Undifferentiated colonies of hESCs were dissociated for plating as a monolayer on laminin-coated flasks (see Supplementary Methods). Under these conditions, treatment with FGF3 and FGF10 induced the placodalmarkers PAX8 and PAX2, either in the presence of knockout serum replacement or under defined conditions using Dulbecco's Modified Eagle's Medium (DMEM) with Ham's F12 and N2/B27 (DFNB) medium (Supplementary Methods and Supplementary Figs 1b and 2). Global analyses of gene expression was performed using Affymetrix GeneChip arrays and, after normalization (see Supplementary Methods), samples were mined in two different ways. We first used the Gene Set EnrichmentAnalysis (GSEA) tool24 to look for genes that were enriched in the entire list of probe sets, without establishing a priori cut offof differential expression (Supplementary Tables 1 and 2). This analysis showed that a set of otic markers was significantly enriched in the FGFtreated samples when compared with the undifferentiated hESCs (normalized enriched score (NES), 0.568; family-wise error rate (FWER) P50.046) or cells grown in DFNB (NES, 0.707; FWER P50.019) (Supplementary Table 1).A second type of analysis assessed genes differentially expressed using predefined criteria for fold-change cut offand statistical

significance (see SupplementaryMethods).Atotal of 1,424 genes (represented by 2,124 probe sets) was differentially upregulated in the FGF samples when compared to undifferentiated hESCs, whereas 423 genes (505 probe sets) were unregulated in theFGF-treated versus theDFNB controls (Supplementary Tables 3 and 4). Conversely, 2,368 genes (3,231 probe sets) were downregulated in the FGF samples versus hESCs, and 482 genes (607 probe sets) were downregulated versus DFNB (Supplementary Tables 5 and 6). In a gene ontology analysis, the gene ontology terms 'sensory organ development' (Expression Analysis Systematic Explorer (EASE) P value score in FGF versus hESC, P53.92310215; FGF versus DFNB, P50.022); 'ear development' (FGF versus hESC, P54.47 31028; FGF versus DFNB, P50.014) and 'ear morphogenesis' (FGF versus hESC, P53.08 x1026; FGF versus DFNB, P50.0497) were highly enriched in the FGF-treated cells in both comparisons, and 'mechanoreceptor differentiation' and 'auditory receptor differentiation' were highly enriched in FGF versus hESC (see Supplementary Tables 7-10). Both bioinformatics analyses therefore suggested that the FGF treatment was generating a global change of transcription compatible with the induction of otic progenitors.

We also used immunostaining to examine the co-expression of PAX8 and SOX2, to define the otic progenitors at a cellular level. Otic progenitors grew as colonies after the inductive phase. Initial immunolabelling showed a relatively large proportion of doublepositive cells in the FGF-treated condition (,78%), in contrast to the relatively moderate upregulation of otic transcripts detected with the arrays. However, a subset of cells expressed very high levels of PAX8 and SOX2, and these were assessed with an automated microscopy platform (InCell Analyzer 1000) that enabled quantification of the number of positive cells and their relative intensity (Fig. 1 and Supplementary Fig. 3). When a stringent threshold was selected (75th intensity percentile per cell line and antibody; see Supplementary Methods) 18.3%60.8 (6 s.e.m.) of the cells expressed high levels of PAX8 and SOX2 (PAX8hiSOX2hi) after FGF treatment (against 0% obtained without the growth factors, P ,0.001), whereas 18%62 cells were PAX8hiFOXG1hi (compared to 4%64 cells for the control, P,0.001). PAX8hiSOX2hiFOXG1hi cells also expressed the otic markers PAX2, nestin, SIX1 and GATA3 (Fig. 2h and Supplementary Figs 4 and 5a). It is likely that this subset of PAX8hiSOX2hiFOXG1hi-expressing cells represents the otic progenitors. The reproducibility of the protocol was tested across the hESC lines H7, H14 and Shef3, which all gave comparable results (see Fig. 1 and Supplementary Fig. 3). FGF3 and FGF10 induced two morphologically distinct types of otic colonies (Fig. 2a-h). One cell population showed a flat phenotype, with large cytoplasm and formed epithelioid islands (Fig. 2a-d), whereas the second was small, with denser chromatin, and presented cytoplasmic projections (Fig. 2e, f). Given their morphological appearance, we have operationally named them otic epithelial progenitors (OEPs) and otic neural progenitors (ONPs), respectively. The relative proportion of these progenitors was dependent on the cell line, plating density and the degree of cell separation (single cells versus cell clusters) (Supplementary Figs 5 and 6 and Supplementary Methods). Progenitor colonies were purified using sequential dissociation (see Supplementary Methods), yielding moderately homogenous cultures of the desired cell colony type, and were expanded in OSCFM (otic stem cell full media; see Supplementary Methods).

The differentiation potential of OEPs and ONPs was tested in 'neuralizing' and 'hair-cell' culture conditions developed previously using hFASCs19 (see Supplementary Methods). OEPs produced haircell- like cells as defined by the simultaneous expression ofATOH1 and BRN3C, or BRN3C and MYO7A (,45%) (Supplementary Fig. 7). A small subset differentiated a rudimentary apical bundle, expressing espin (Supplementary Fig 8). These hair-cell-like cells also expressed an outward K1 current, the inward rectifier K1 current IK1 and an inward Ca21 current (ICa) (Supplementary Fig. 9). Under neuralizing conditions, they produced a small proportion (,9%) of sensory neurons (Supplementary Fig. 7). Conversely, ONPs were committed to produce neurons. Under neuralizing conditions, almost all cells developed a bipolar morphology and were positive for BRN3A and b-tubulin III, as well as for b-tubulin III and NF200. They also expressedNEUROD1, ISL1 and NTRK2, a delayed-rectifierK1 current (IK), an Na1 current (INa), and elicited single action potentials

(Supplementary Fig. 9). No hair-cell differentiation was obtained from ONPs under neuralizing or hair-cell culture conditions. Detailed results are given in Supplementary Information.

The properties of ONPs in vivo were studied by transplanting them into ouabain-treated gerbils, a model of neuropathic deafness25. Application of ouabain directly to the round window selectively damages the type I SGNs, preserving the hair cells and the organ of Corti26 (Supplementary Fig. 10). After ouabain application, only a small number of SGNs survived (6.4%; see Supplementary Table 11). Most of the surviving cells (,87%) were peripherin-positive type II neurons, therefore less than 1% of the original population of type I neurons remained (SupplementaryTable 11 and Supplementary Fig. 13). Staining for myosin VIIa and the presence of distortion product otoacoustic emissions (DPOAEs) confirmed that the organ of Corti had not been damaged (Supplementary Figs 10 and 11). DPOAEs are sounds produced as a consequence of electromechanical feedback from the outer hair cells and can be used to check their physiological integrity.

ONPs derived from Shef1 hESCs constitutively expressing either enhanced green fluorescent protein (eGFP) or tomato fluorescent protein were expanded in OSCFM, dissociated with trypsin and delivered directly into the modiolus, approaching the cochlea through the round window. One set of animals was transplanted 3 to 5 days after ouabain application (n513), and another was transplanted 2 weeks after the ototoxic drug (n55). As no functional or histological differences were encountered between the two groups (P.0.05; Supplementary Fig. 12), they were analysed together. Two to three weeks after transplantation, five out of six animals had surviving, transplanted cells grafted in the modiolus, forming an ectopic spiral ganglion (Fig. 3a, b). Cells in the marginal sides of the ectopic ganglion had undergone differentiation as judged by b-tubulin III staining (Fig. 3b) and displayed neural projections, targeting the organ of Corti (Fig. 3c, d). Animals were then monitored for 10 weeks post tranplantation. Histological analysis after 10 weeks post transplantation showed that the ectopic ganglion was still present and that cells had also migrated into the Rosenthal's canal (Fig. 3e). Transplanted cells expressed the 3A10 neurofilament-associated antigen and NKAa3 (ATP1A3), a marker of type I neurons and afferent fibres in the inner ear27 (Supplementary Fig. 14). Notably, projections from the transplanted cells that reached the organ of Corti were targeting the hair cells, and fibres positive forNKAa3 and GluA2 were found next to the basal pole of the inner hair cells, suggesting the presence of synaptic connections (Fig. 3g). Moreover, fibres form the transplanted cells were visualized leaving the modiolus towards the brainstem (Fig. 3f). In the cochlear nucleus of three gerbils we found red fluorescent protein (RFP)-positive fibres also stained for synaptophysin, suggesting synaptic connections with the central auditory path (Fig. 3h, i). Transplanted ONPs contributed significantly to restore neuronal density (Fig. 3j; P,0.01). Although 112.5611.9 TUJ11 cells permm2 (6s.e.m.) were present in the ouabain-treated, untransplanted ears, 546.4630.6 TUJ11 cells per mm-2 were found after transplantation. From these, 94.960.3% were also GFP- (or tomato)-positive, confirming their exogenous nature (Supplementary Table 12). The number of projections detected in the brainstem was considerably lower than the number of transplanted cell bodies identified in the ganglion. Although this could be explained by the limited sorting of fluorescent protein into the long afferent fibres, the pathfinding of the central innervations requires further future exploration. No tumours were detected in any of the transplanted animals at any stage throughout the experiment.

Functional performance was determined by measuring auditoryevoked response (ABR) thresholds. These were established based on the wave ii-wave iii (P2-N3 waveform) amplitude28. These waves are generated by the cochlear nucleus and the superior olivary complex cells, and reflect neural connections with the central auditory pathway29. After ouabain application, auditory function was severely impaired, with thresholds rising from 20 dB sound pressure level (SPL) to almost 80 dB SPL, the maximum intensity tested. Frequency discrimination was also abolished. The amplitudes of wave ii-wave iii complexes were almost negligible at any of the frequencies explored at the maximum intensity of 80 dB SPL (Fig. 4d). ABRs were recorded at 1- to 2-week intervals.Control animals (n58) showed no sign of functional recovery throughout the experiment, with a mean auditory threshold after 10 weeks of 75.1462.3 dB (6s.e.m.); similar to the 76.3761.8 dB obtained after ouabain

treatment.However, in the transplanted animals (n518), there was a detectable improvement in the ABR thresholds (Fig. 4a, b) starting approximately 4weeks post transplantation,with the mean auditory threshold lowered (improved) to 50.464.5 dB by 10weeks post transplantation. Furthermore, the mean auditory threshold shift, calculated as the difference between the threshold at 10weeks post transplantation versus the one before ouabain treatment, was of 5361.7 dB in the control animals, compared to 28.663.6 dB in the transplanted cohort (P50.0002; Fig. 4c). This represents an overall functional improvement of approximately 46%. The range of recovery went from modest to almost complete (see Supplementary Fig. 15), which is remarkable considering the technical challenges involved in the procedure. Tonotopical processing was also partially restored (Fig. 4d). A trend in the increment of wave ii-wave iii amplitudes was detected at each frequency explored, with amplitudes being significantly different at 22, 26 and 30 kHz, when compared to the untransplanted animals (P,0.05). When compared to the amplitudes before the ouabain application, the improvement was approximately 43%. Latencies were mostly similar to the ones before ouabain (Fig. 4e). The only significant difference was detected at 30 kHz (before ouabain, 4.5860.2 ms, n56; post transplantation, 5.960.4 ms, n55; P,0.05), suggesting that some maturation was still taking place at this stage. Finally, there was a significant correlation between the increment of neural density by transplanted cells and the lowering of the ABR threshold (R250.3867, P,0.05; Fig. 4f).

Our developmentally informed protocol produced hESC-derived auditory hair cells and neurons that closely resembled phenotypes obtained from hFASCs, providing validation of their cochlear characteristics. This was supported further by the restoration of ABR thresholds on transplantation of otic progenitors into a deaf adult mammal. The ability to reinstate auditory neuron functionality paves the way for a future cell-based treatment for auditory neuropathies. It may also, in combination with a cochlear implant, offer a therapeutic solution to awider range of patients that currently remain without viable treatment.

METHODS SUMMARY

hESCs lines used (H7, H14, Shef1, Shef3, Shef1-eGFP and Shef1-tomato), with a normal karyotype, were maintained on mouse embryonic fibroblast feeders (MEFs) under standard conditions. Although experiments with embryoid bodies and initial monolayer experiments were carried out in the presence of KOSR, we later adopted a chemically defined medium. This serum-free, chemically defined basal culture media included a 1:1 mixture of Dulbeco's Modified Eagle's Medium (DMEM):Ham's F12 and N2/B27 supplements. In most experiments, FGF3 and FGF10 were used at 50 ng ml-1. Laminin (R&D Systems) was used at 5 mg cm-2. Antibodies, polymerase chain reaction (PCR) primers and microarray analysis are detailed in the Supplementary Methods. To induce hair-cell differentiation, progenitors were transferred to gelatin-coated dishes and cultured with DFNB supplemented with all-trans retinoic acid (10-6 M; Sigma) and epidermal growth factor (EGF) (20 ng ml-1) for 2 to 4 weeks. To induce neuronal differentiation, cells dissociated with trypsin were plated on gelatin-coated dishes and incubated in DFNB with basic FGF (20 ng ml-1) and Sonic hedgehog (Shh-C24II, 500 ng ml-1; R&D Systems). On the third day, culture was supplemented with neurotrophin 3 (NTF3, 10 ng ml-1; Petropech) and brain-derived neurotrophic factor (BDNF, 10 ng ml-1; Petropech). Shh-C24II was removed on the fourth or fifth day, whereas the neurotrophins remained for the length of the incubation, normally between 7 and 14 days. Conditions for electrophysiological recordings are detailed in the Supplementary Methods. The auditory neuropathy model was generated by applying 1mM ouabain directly into the round-window niche of adult gerbils. Either 3 days or 2 weeks later, hONPs expressing eGFP or tomato fluorescent protein, were injected into the modiolus. Functional recovery was monitored weekly by measuringABRs andDPOAEs, for up to 10 weeks. Cochleae were taken, fixed and processed for analysis. Details of the hearing test and histological preparation are provided in the Supplementary Methods.

Full Methods and any associated references are available in the online version of the paper.

Received 31 July 2010; accepted 16 July 2012.
Published online 12 September 2012.

Sidebar

METHODS

Human ES-cell culture. hESC lines H7, H14, Shef1 (including the derivatives Shef1-GFP and Shef1-tomato) and Shef3 with a normal karyotype were maintained on inactivated mouse embryonic fibroblast (MEF) feeder cells in knockout Dulbecco's modified Eagle's medium (Invitrogen) supplemented with 20% knockout serum replacement (KOSR), 1% nonessential amino acids, 2mM L-glutamine (all from Invitrogen), 0.1mM b-mercaptoethanol (Sigma) and 4 ng ml-1 of basic fibroblast growth factor (bFGF; R&D systems).

Differentiation through formation of embryoid bodies. To induce the formation of embryoid bodies, undifferentiated hESCs were dissociated into small clumps with collagenase IV (Invitrogen) and transferred into non-adherent bacterial petri dishes containing hESC culture media (minus bFGF) supplemented with either FGF3 (50 ng ml-1) and FGF10 (250 ng ml-1) or EGF (20 ng ml-1) and IGF1 at (50 ng ml-1). This resulted in the formation of free-floating embryoid bodies. Cultures were maintained in a humidified chamber in a 5% CO2 and air mixture at 37 uC. The embryoid bodies were cultured for 6 days and then allowed to attach onto tissue culture dishes coated with 0.1% gelatin. After 10 days, the cultures with EGF and IGF1 were supplemented with 10 ng ml-1 bFGF for a further 6 to 8 days. FGF3 and FGF10 cells remained exposed to the growth factors throughout the experiment. All growth factors and supplements were obtained from R &D Systems or Invitrogen.

Induction of otic progenitors directly as monolayers. Undifferentiated hESCs were dissociated with 0.025% Trypsin-EDTA (Sigma) and the cell suspension passed through either a 70- or 100-mm cell strainer (BD Labware). The 70-mm strainer gave primarily a single-cell suspension, whereas the 100-mm strainer retained a few 2-to-3-cell clumps. Cells were plated at different densities onto laminin-coated plastic (5 mg cm22; R&D systems,). Gelatin-coated dishes were also used, but the adhesion of cells proved to be very poor. Cells were incubated with chemically defined DFNB medium (DMEM high glucose: F12 mixed 1:1, with N2 and B27). This basal medium was supplemented, from the moment of plating, with either FGF3 (50 ng ml-1) and FGF10 (50 ng ml-1) and allowed to differentiate for 10 to 12 days or with EGF and IGF1 plus bFGF as described above for embryoid bodies formation. The medium was replaced completely every 2 days. During the first few days post plating, a high level of cell death is customary.

Colony enrichment and induction of differentiation into hair-cell-like cells and sensory neurons. To enrich for OEPs, cells surrounding the epithelial colonies were lifted with a quick incubation in 0.025% Trypsin-EDTA, helped by mechanical scrapping under a microscope with a pipette tip. Once colonies edges started to curl (see Fig. 2c, d), cells were rinsed away. A second, prolonged trypsin step allowed the collection of epithelial colonies that remained attached.

To induce differentiation into hair-cell-like cells, we followed the protocol developed with hFASCs19. Dissociated cells were transferred to gelatin-coated dishes and cultured with DFNB supplemented with all-trans retinoic acid (1026 M; Sigma) and EGF (20 ng ml-1) for 2 to 4 weeks.

To enrich for ONPs, surrounding cells were scraped offunder the microscope using a 10-ml pipette tip bent at the end. Small colonies were then allowed to grow further for another 2 to 3 days, before being dissociated by trypsin. The use of these methods gave a fairly homogenous culture for the desired cell colony type.

To induce differentiation into auditory sensory neurons, dissociated cells were plated on gelatin-coated dishes and incubated in DFNB with bFGF (20 ng ml-1) and Sonic hedgehog (Shh-C24II, 500 ng ml-1; R&D Systems). On the third day, culture was supplemented with neurotrophin 3 (NTF3, 10 ng ml-1; Petropech) and brain-derived neurotrophic factor(BDNF, 10 ng ml-1; Petropech). Shh-C24II was removed on the fourth or fifth day, whereas the neurotrophins remained for the length of the incubation, normally between 7 and 14 days.

For proliferative expansion, progenitors were cultured in otic stem cell full media (OSCFM; DFNB plus 20 ng ml-1 bFGF, 50 ng ml-1 IGF1 and 20 ng ml-1 EGF).

RNA isolation and gene expression analysis. Total RNA was isolated using Trizol (Invitrogen) and was reverse

transcribed into cDNA using Superscript III (Invitrogen). PCR was performed using standard protocols with Hotstar Taq polymerase (Qiagen).
Forward and reverse primer sequences, from the 59 to 39 direction, were as follows: PAX2, GAGCGAGTTCTCCGGCAAC and GTCAGACGGGGACGAT GTG; PAX8, ACCCCCAAGGTGGTGGAGAAGA and CTCGAGGTGGTGCT GGCTGAAG; GAPDH, GTCCACTGGCGTCTTCACCA and GTGGCAGTGA TGGCATGGAC; SOX2, ATGCACCGCTACGACGTGA and CTTTTGCACC CCTCCCATTT;FGF3,TTGGAGATAACGGCAGTGGAandCTCCAGGTTAT CCGGGCTCT; PDS, AGCAGAGACAGGTCATGGCA and ATCCGACAGGA ACTGCAGCT; harmonin, AGCTGGTCATCAATGAACC and AGATGGAA TATCCATTGATCCG; POU4F3 (also known as BRN3C), TGCAAGAACC CAAATTCTCC and GAGCTCTGGCTTGCTGTTCT; GATA3, GTACAGC TCCGGACTCTTCCC and CTGCTCTCCTGGCTGCAGACA; MYO7A, CACATCTTTGCCATTGCTGAC and AGAAGAGAACCTCACAGGCAT; NEUROD1, GCCCCAGGGTTATGAGACTATCACT and CCGACAGAGC CCAGATGTAGTTCTT; ATOH1, CTCAGCCCCAGCTTCTGC and AAAC AACGACCATCGCAGAG; HPRT, AATTATGGACAGGACTGAACGTC and CGTGGGGTCCTTTTCACCAGCAAG; POU4F1 (also known as BRN3A), GGCCCACCTCAAGATCCCGG and AGTTTCTCGGCGATGGCGGC; NTRK2 (also known as TRKB), GAGCATCATGTACAGGAAAT and CTTGATGTT CTTCCTCATGT; ISLET1, CAACAAACAAAACGCAAAAC and AAGTCAA ACACAATCCCGA.
Relative quantification of expression was performed using SYBR Green and the following primers: RPLPO, GAAGGCTGTGGTGCTGATGG and CCGGAT ATGAGGCAGCAGTT; PAX8, CTTGGCAGGTACTACGAGAC and GCAAAC ATGGTAGGGTTCTG; PAX2, CTTTAAGAGATGTGTCTGAGGG and CCT GTTCTGATTTGATGTGCT. DCts were calculated against the ribosomal protein RPLPO andDDCts values compared against the levels expressed by undifferentiated hESCs. Undirected differentiation of embryoid bodies was induced by allowing the cells to aggregate in the presence of hES media (minus bFGF) supplementedwith 5% FCS. Reactionswere carried out in triplicate and values represent themean from2 to 4 independent experiments. Three different hESC lines were tested.
Affymetrix microarrays. Gene-expression profiles were obtained from hESC lines H14, Shef1 and Shef3 by hybridizing samples from undifferentiated, FGF3-and-FGF10-treated and DFNB-treated cells to Gene Chip HG-U133 Plus 2.0 arrays. Cells were cultured under differentiating conditions for 14 days before RNA was isolated. Normalization and initial analysis were done using puma (http://www.bioconductor.org). The chosen method is particularly robust and accurate when working with small sample sizes and the potentially high variability commonly found in human samples. Merging of the expression values from each experimental condition independently obtained from the three different cell lines was carried out using a hierarchical mixture of Gaussian distributions. The combined value for each transcript is the most probable value that represents the mixture of the two classes based on the uncertainty associated to each transcript at probe level. Analysis for the specific enrichment of otic markers was done using the Gene Set Enrichment Analysis (GSEA) tool24. This is a powerful algorithmthat determines whether a set of genes is randomly distributed in a ranked list or primarily found at the top or bottom by calculating an enrichment score. This approach is based on the principle that a particular 'signature' of genes expressed together is highly informative, even if some individual genes change only by a small percentage (for example, 20%). This is because it identifies a structure of correlation within the genes rather than isolated outliers. A set of known pluripotency markers was run in parallel as a referential control. For the second analysis, probe sets were counted as differentially expressed if their expression changed by $1.5-fold (log2 0.5849) and their probability of positive log ratio (PPLR statistic) was .0.8 for upregulated or ,0.2 for downregulated probe sets. Pathway and gene ontology (GO) enrichment analyses were carried out on these differentially expressed gene lists using the Database for Annotation, Visualization, and Integrated Discovery (DAVID; http://david.abcc.ncifcrf.gov/ home.jsp). Functional annotation was used to reveal biological processes highly represented in a probe set list and the significance or likelihood of their enrichment

expressed using the EASE score threshold (with P,0.05).

Immunolabelling. Cells and sections were fixed in cold 4% paraformaldehyde in PBS for 10 minutes, permeabilized and blocked in 0.1% Triton X-100, 5% normal donkey serum in PBS for 20 minutes at room temperature (20-25 uC) and then incubated with the primary antibody in the same buffer. Antibodies used in this study have been widely used and well characterized. These antibodies were against SOX2 (1:100, rabbit polyclonal, Millipore); nestin (1:100, mouse monoclonal, Abcam); PAX8 (1:100, goat polyclonal, Abcam); PAX2 (1:100, rabbit polyclonal, Abcam), GATA3 (1:50, mouse monoclonal, Santa Cruz), FOXG1 (1:50, rabbit polyclonal, Abcam), SIX1 (1:100, mouse monoclonal clone 3C7, Sigma), ATOH1 (1:100, rabbit polyclonal, Abcam); BRN3c (1:100, mouse polyclonal, Abnova), espin (1:100, rabbit polyclonal, Sigma); b-tubulin III (TUJ1) (1:100, mouse monoclonal, Covance); NF200 (1:100, rabbit polyclonal, Sigma), Synaptophysin (1:150, mouse monoclonal, Millipore), 3A10 (1:50, mouse monoclonal clone, DSHB, Iowa), BRN3a (1:100, rabbit polyclonal, Chemicon), NKAa3 (1:75, goat polyclonal, Santa Cruz) and GluR2 (1:100, mouse monoclonal clone L21/32, Millipore). As GFP and tomato fluorescent protein can become downregulated after transplantation, their signal was amplified using either anti-GFP (1:100, rabbit polyclonal, Torrey Pines Biolabs) or anti-RFP (1:100, rabbit polyclonal, Abcam) antibodies. The myosin VIIA antibody was a giftfrom C. Petit. Specific labelling was visualized with secondary donkey anti-mouse, anti-goat or anti-rabbit antibodies conjugated to either Alexa Fluor 488 or Alexa Fluor 568. Controls were carried out by replacing the primary antibody with unspecific mouse or rabbit immunoglobulin-G (IgG). Nuclei were counterstained with DAPI (49,6-diamidino-2-phenylindole; Sigma).

Images were acquired using a Zeiss Axiophot microscope using Axio Vision software. For conventional quantification, several hundred cells were scored from random fields from two to five independent experiments. Statistical comparisons of means were made using analysis of variance (ANOVA; two-way ANOVA followed by the Bonferroni post test). For all statistical tests P,0.05 was used as the criterion for statistical significance.

Quantification using the InCell Analyzer. The hESC lines H7, H14 and Shef3 were seeded at 1,500 cells per well of a 96-well clear flat-bottom plate (655090; Greiner Bio-one) in either FGF or DFNB media. Images of several thousand stained cells from three independent wells were acquired using an automated microscopy platform (InCell Analyzer 1000, GE Healthcare). Forty random fields were acquired in each well using a 320 objective. Images were analysed using Developer Toolbox 1.7 software (GE Healthcare).

Nuclei were counted as positive at two different thresholds of fluorescent intensity; these were set independently for each cell line and plate. The first threshold was set according to the fluorescent intensity distribution histogram of the cells in the control (no primary antibody) wells: cells were counted as positive, green or red, if the nuclei intensity was greater than the 99th intensity percentile point in channel 2 (green) or 3 (red), respectively. Similarly, a second threshold was set to count very highly positive cells. This was determined from the fluorescent intensity distribution of the cells grown in FGF; cells were counted as highly positive if the nuclei intensity was greater than the 75th intensity percentile point in this condition. Significance was determined using Chi-square with Yates' correction.

Electrophysiology. Membrane currents fromundifferentiated cells, and differentiating hair-cell-like cells and sensory neurons were measured using the whole-cell patch-clamp technique with an Optopatch (Cairn Research) or axopatch 200B (Molecular Devices) amplifiers. Recordings were carried out at room temperature (20-25 uC) from cells cultured between 9 and 19 days under either 'hair cell' or 'neuralizing' conditions, or soon after completing the induction with FGF3 and FGF10 (undifferentiated). Current clamp recordings of neuron-like cell-voltage responses were performed at body temperature (35-37 uC). The extracellular solution contained (in mM): 135 NaCl, 5.8KCl, 1.3CaCl2, 0.9MgCl2, 0.7 NaH2PO4, 5.6 D-glucose, 10HEPES-NaOHand 2 sodiumpyruvate.Amino acids and vitamins for Eagle's minimal essential medium (MEM) were added from concentrates (Fisher).ThepHwas adjusted to 7.5.Cells were viewed using an uprightmicroscope (Leica) and continuously superfused with the above extracellular solution. Patch pipettes weremade fromsoda glass

capillaries (3-4MV) and coated with surf wax. The pipette filling solution contained (in mM): 131KCl, 3MgCl2, 1EGTA-KOH, 5Na2ATP, 5 Hepes-KOH and 10 sodium phosphocreatine (pH 7.3).
Data were acquired using pClamp software and a Digidata analogue-to-digital converter (Molecular Devices). Data were filtered at 2.5 or 5 kHz, sampled at 5 or 50 kHz and stored on computer for off-line analysis using Clampfit and Origin (OriginLab) software. Membrane capacitance (Cm) was 3064 pF (n543, range from 9 to .100 pF) and residual series resistance was 7.860.7MV, resulting in voltage-clamp time constants of 244640 ms. Membrane currents were elicited by applying voltage steps in 10-mV nominal increments or decrements from the holding potential of -84mV or -104mV (for IK, ICa and INa) or -64mV (for IK1).
Recordings and reported currents were corrected off-line for linear leakage, typically calculated between -84mV and -74mV (undifferentiated cells: 0.460.1 ns, n56; hair-cell-like cells: 2.360.8 ns, n514, neuron-like cells: 1.760.6 ns, n515). Membrane potentials were corrected for the voltage drop across the residual series resistance (Rs) and for a liquid junction potential of -4mV. Statistical comparisons of means were made using ANOVA (one-way ANOVA followed by the Tukey post-test). For all statistical tests P,0.05 was used as the criterion for statistical significance. Mean values are quoted6s.e.m. in text and figures.
Transplantation and cochleae processing. Animal experiments were approved by the Sheffield University Ethical Review Committee and carried out under a Home Office Project License conforming to UK legislation. Anaesthesia in young, adult gerbils (3-8 months old) was induced with ketamine and xylazine, and maintained with isoflurane during the surgical intervention. Before the deafening procedure, auditory function was measured as described below. Under sterile conditions and using a retro-auricular approach, the bulla from the leftear was exposed and a small hole opened on its surface. Twenty microlitres of a 1-mM ouabain solution (Sigma) were applied to the round-window niche, incubated for 30 min and then absorbed with a small cotton wick. The right cochlea was leftundisturbed and used as a control in each animal. Opening in the bulla was sealed with a bit of fascia and Vetbond (3M), the surgical wound closed with sutures and the animal allowed to recover for 3 days.
Before cell transplantation, auditory function was measured to ascertain the efficacy of the deafening protocol. Bulla was exposed as before and the roundwindow niche re-opened. A small hole was drilled into the modiolus by going through the round-window membrane, using a 30G needle or a KFlex dental file (no. 25). Human ONPs, expanded in OSCFM, were dissociated and collected to a density of 1.53104 cells per ml in DMEM. About 3 ml (4-5 3104 cells) were injected into the central modiolus using a stainless steel NanoFil syringe (WPI) with a 33G tungsten bevelled needle. Control animals underwent an identical intervention, but were transplanted with DMEM only. To prevent rejection, gerbils were given daily injections of cyclosporine A (15mgkg21 day21; Sandoz).
At selected time points, animals were killed and fixed by transcardiac perfusion with 4% paraformaldehide in PBS. Cochleae were removed, post-fixed overnight and decalcified by immersion in 0.125MEDTA for approximately 2 weeks. Tissue was embedded in Cryo-M-Bed (Bright) and sectioned in a cryostat.
Spiral ganglion cell densities. Cells present after ouabain treatment and after transplantation, and expressing the appropriated markers were counted in the apical, mid and basal turns in 7 to 27 randomly selected mid-modiolus sections fromeach cochlea. The area was measured using ImageJ and densities calculated as cells permm2. Statistical comparisons of means were made usingANOVA. For all statistical tests P,0.05 was used as the criterion for statistical significance. Mean values are quoted 6 s.e.m. in text and figures.
ABRs and DPOAEs. ABR testing was conducted in an isolated laboratory room. Prior to testing, the gerbils were sedated with ketamine and xylazine and placed on a heating pad. The ABRs were recorded using System 3 digital signal processing hardware and software (Tucker Davis Technologies (TDT)). ABR stimuli were presented using two enhanced real-time processors (RP2.1), a programmable attenuator (PA-5) to control the stimulus levels and closed-field magnetic speakers (CF1). The CF1 speaker presented the ABR stimuli through a 10-cm tube that allowed its delivery directly into the ear canal. The ABR responses were recorded using 27GA

subdermal needle electrodes (Rochester Electro-Medical) connected to a low impedance headstage (RA4LI) and medusa preamplifier (RA4PA) before sending them to a medusa base station signal processor (RA16). Click stimuli were presented at a rate of 20 s21, ranging from 80 dB SPL to 20 dB SPL in 10-dB decrements. For tone ABRs, 5-ms pure-tone pips (ranging from 6 kHz to 38 kHz in 4-kHZ increments) were presented at an intensity of 80 dB SPL. The ABR waveforms were produced through differential voltage recordings from electrodes placed at the vertex (recording electrode) and ipsilateral mastoid (reference electrode), with the ground electrode placed on the lower back. Each ABR waveform represented the average response to 500 stimulus presentations. The amplitude between the wave ii positive peak and wave iii negative peak were measured for each dB SPL, and the ABR thresholds were determined as the stimulus level that evoked a voltage that was 2 s.d. above the mean background noise level.

DPOAE testing was conducted in the same room, and gerbils were prepared for the procedure as they were for ABRs testing. DPOAEs were recorded using the same TDT workstation under different settings. The instrumentation used to present theDPOAEstimuli consisted of a single ear probe unit to direct the stimuli into the ear canal by the Etymotic ER-10B1 low noise microphone system that provided 20 dB of gain, and a microphone amplifier (MA-3) that provided an additional 20 dB of gain to the DPOAE responses prior to digital conversion. The sampling rates to generate stimuli and digitize the responses were 100 kHz. The DPOAEs were generated by simultaneously presenting two sinusoids differing in frequency into the ear canal of the gerbil (the lower frequency was labelled f1 and the higher frequency was labelled f2). The amplitude of the distortion product at the frequency defined by 2f12f2 was then measured by recording the pressure in the ear canal. The stimuli were selected for DPOAE testing from 6 kHz to 42 kHz with 4-kHz increments. The sound levels for the f1 and f2 primaries were calibrated to 65 dB SPL and 60 dB SPL, respectively, using an ACOustical interface system (ACO Pacific) with a 2-cc calibration syringe.

All ABR and DPOAE stimuli were created using TDT SigGen and recordings conducted using TDT BioSig software. Statistical comparisons of means were made using either the unpaired Student's two-tailed t-test for two data sets, or for comparisons of multiple data sets, using ANOVA (two-wayANOVA followed by the Bonferroni post test). For all statistical tests P,0.05 was used as the criterion for statistical significance. Mean values are quoted 6 s.e.m. in text and figures.

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Supplementary Information is available in the online version of the paper.
Acknowledgements This work was supported primarily by grants from Action on Hearing Loss (RNID) to M.N.R. Other support included Deafness Research UK (M.N.R and W.M.), the Wellcome Trust (088719, W.M.), Medical Research Council (P.W.A, H.D.M. and M.N.R) and ESTOOLS (P.W.A). S.L.J. was supported by aWellcome Trust VIP award and the RNID. W.M. and S.L.J. are Royal Society university research fellows. Confocal images were taken at the Light Microscopy Facility of the Department of Biomedical Sciences, University of Sheffield. We are grateful for the advice of M. Mulheran and I. Russell on the tests of auditory function, provided at the earlier stages of this project, and to the assistance of P. Gokhale on the use of the InCell Analyzer. M.N.R. acknowledges the support and encouragement of his late parents, Noemí Luján-Ceballos and Juan Carlos Rivolta.
Author Contributions W.C., N.J., L.A., S.J.E and J.K.T. collected and/or assembled, analysed and interpreted data. S.L.J., S.K. and W.M. collected and/or assembled, analysed and intepreted electrophysiology data. M.M. carried out biocomputational analysis of gene-array data. P.W.A. and H.D.M. provided study material and administrative support. M.N.R. was responsible for conceiving and designing the study, for obtaining financial support, collecting and/or assembling, analysing and interpreting data, for manuscript writing, and for final approval of the manuscript.
Author Information Microarray datasets have been deposited at the NCBI Gene Expression Omnibus and they can be retrieved with accession number GSE36754. Reprints and permissions information is available at www.nature.com/reprints. The authors declare no competing financial interests. Readers are welcome to comment on the online version of the paper. Correspondence and requests for materials should be addressed to M.N.R. (m.n.rivolta@sheffield.ac.uk).

Publication date: Oct 11, 2012

Year: 2012

Tomorrow's people

Author: Kingston, Anne

Publication info: Maclean's 125.41 (Oct 10, 2012): 78.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: Headnote
Brain caps that let us speak via our thoughts, cochlear implants that bestow super hearing: the body of the future will transcend human limits. And it's not far away.
[PHOTO OMITTED]
PHOTO CAPTION: Homo evolutis: Biomedicine is changing so fast it represents a new kind of human evolution

PHOTO CREDIT: Getty Images; Photo Illustration by Levi Nicholson

A century ago, the design of 21st-century man was unimaginable to anyone but sci-fi writers, and even they didn't go far enough. No one foresaw a species able to prevent pregnancy with a pill. Or able to snake a wire up an artery to restore bloodflow. No one anticipated the sub-species of "Real Housewives"--women bronzed in tanning beds, filled with silicone and injected with a poisonous toxin to smooth wrinkles.

Such interventions are but a prelude to the human-design innovation to come, predicts Juan Enríquez, founding director of Harvard Business School's Life Sciences Project. We've been given glimpses of that future: the thriving field of regenerative medicine is using stem cells to regrow old organs--and build brand new ones. Cancer patients have received new windpipes built from their own cells; spinal columns are being augmented with polymers. At the Massachusetts Institute of Technology, Edward Boyden's lab has successfully downloaded a mouse's memory to a computer, raising all sorts of possibilities for externalizing human memory. Scientists are isolating "high-performance" genes such as ACE, linked to the ability to adapt to high altitudes, and 577R, which is found in most Olympic power athletes. Meanwhile, neuroprosthetics are redefining "bionic man" with artificial limbs powered via little more than a bit of electric current and the person's thoughts.

Man's instinct to re-engineer is hard-wired, Enríquez says in an interview with *Maclean's* . "We've transformed poisonous berries into beautiful heirloom tomatoes," he says. "We've taken wolves and made them into various species of dogs; we've taken corn and made it a completely unnatural plant--grains the same size and colour." And now, in making the human body itself the platform for innovation, we're propelling the evolution of the species itself. In *Homo Evolutis: A Short Tour of Our New Species,* an ebook he co-authored with Steve Gullans, Enríquez writes that *Homo sapiens* have already evolved into "Homo evolutis," defined as "a hominid that takes direct and deliberate control over the evolution of his species, her species and other species."

The result, Enríquez says, will be an explosion of various species of varying genetic composition. And soon. Our children or grandchildren, he says, could take different enough biological forms from us to be considered another species entirely.

In conversation, Enríquez dials back his timeline slightly. "Though it takes centuries for entire species populations to separate, you are going to start to see clusters, looking like very different types of things." The history of genetically modified food offers a model, he says: "Over 20 years, plant life in one place is completely different from another. Grain harvested in Canada is very different than grain harvested in parts of Europe." New natural selection will hinge on money and government policy: "Some countries will veto procedures like stem cell and gene therapies; others will push for them," he says. "And you'll get every type of variety in between."

Evolution isn't linear, he says, noting we've been conditioned by the human timeline pioneered in Ernst Haeckel's black-and-white silhouette drawings--"something climbing out of the primordial ooze that becomes a monkey, then a human, then a human sitting at a computer." Rather, evolution branches like a tree. "You tend to get various versions coexisting," he says, noting we've already seen 30 *Homo sapiens* iterations.

Thousands of loosely connected pieces are accelerating the process: "How we drug ourselves, the kind of information we put in our brain, what we eat, technology." The rise in autism is an example. Enríquez theorizes it could stem from rapid evolution of the human brain, as the average person is barraged by more data in a day than people living a century ago absorbed in a lifetime.

The upshot will be societal shifts more seismic than those of both the industrial and digital revolutions, he predicts. As for specifics, he's mum. "You have to be really arrogant to say, 'I know what humans are going to be like in 500 years,' " he says. History shows that genetic flux influences societal values. Enríquez uses the example of blue eyes, which didn't exist until 10,000 years ago, when they emerged by way of the Black Sea, resulting from a mutation in the OCA2 gene that turned off the mechanism producing brown melanin pigment. "If you told me 11,000 years ago that it turns out people are going to have blue eyes and it's going to be really

successful and get people modelling contracts and mates I would have said, 'Ha!' Which is totally wrong."
One safe bet is hominids of the future being as smooth as seals, with character-defining scars a thing of the past. "The focus now is duplicating the capacity humans had in utero to heal without scars," says Gail Naughton, CEO of San Diego-based Histogen Inc., and a pioneer in the tissue-implementation field. "Scarring is unwanted cosmetically, but medically, too, it's very harmful in that it reduces the function of organs or bone cartilage."
"Certainly we're going to make people live longer, healthier, happier lives," says MIT scientist and engineer Robert Langer, renowned for developing "smart" implantable microchips that target drugs directly at tumours. He cites three areas of huge potential: nanoparticles that can target drugs to tumours; "smart" delivery microchips that release drugs by remote control; and drugs that can turn genes on and off, which could bring an end to fatal conditions like Huntington's. Langer hopes to see prototypes up and running in five years.
Such innovation is forcing a reappraisal of what it is to be human. Neural mapping technology, for example, allows people to transcend corporeality. A "brain cap" permits paraplegics or those with "locked-in syndrome" due to conditions such as ALS communicate by wearing a cap that interfaces with a computer. Users think of a letter of the alphabet, and it's transmitted to the screen.
"The notion of who's handicapped and not will be turned on its head," Enríquez says, pointing to Oscar Pistorius, the South African double-amputee sprinter who, running on carbon blades, competed at the 2012 London Olympic Games and then won gold at the Paralympic Games.
Cochlear implants are another example of a technology used to heighten function beyond what's traditionally "normal." Hearing has evolved over tens of thousands of years, Enríquez says, while hearing devices are evolving over months. "So it's not totally inconceivable that in 20 years, people without cochlear implants won't be hired by symphony orchestras because people who have them hear so much more--and in tones others can't hear." And that could lead to technology and medication once designed to achieve "normalcy," like cochlear implants and even ADHD drugs, being employed for heightened performance.
Custom-ordering genomes like the "super Olympian" 577R is another prospect, though not immediately, Enríquez says. "Gene technology is not going to be invented or financed or structured because somebody wants to become an Olympic athlete, but rather to solve a life-threatening condition," he says. "Once that is standard, it is not inconceivable that people will take it and put it into conditions that are bothersome but not fatal. After that, they'll put it into aesthetic conditions." (Even so, he points out, receiving a 577R isn't going to automatically render someone an Olympian. "That requires unbelievable discipline.")
The deployment of reconstructive surgical methods developed in the First World War into cosmetic procedures in subsequent decades offers an analogy to the evolution of science and technology. The current ravages of war are providing funding impetus, with the Pentagon investing more than $300 million into research on regrowing muscle and skin to treat burn injuries and transplant technology for lost limbs. We're already seeing the science marshalled to end wrinkly skin and hair loss. Naughton's company, Histogen, for instance, is developing skin serums and is in clinical trials with a "hair-stimulating complex," an injection designed to grow hair that has a potential market of 300 million. They're hoping to receive regulatory approval in Asia in 2015 and in the U.S. in 2016.
Just as the Old Masters explored the body as it was known then, so too are a new breed of artists focusing on representing this new body. Australian Lucy McRae, the first self-styled "body architect," is working with biologist Sheref Mansy on a "swallowable parfum." Once absorbed, the "digestible scented capsule" will transform skin into an atomizer, McRae explains in a press release. The scent's potency will vary from person to person, "determined by each individual's acclimatization to temperature, stress, exercise, or sexual arousal." McRae's past projects include an ultra-thin electronic tattoo lit up by touch, developed with Philips North America.
"Philips has been exploring design around the human body and emotion for years," says spokeswoman Amy

Shanler. McRae's project was a test case, "It doesn't imply Philips will go into the tattoo business," says Shanler, "but it does help us understand how people feel about having electronics in or on their body, which can be applied to the health care area."

Commercial applications of the various emerging technologies are easy to imagine. The cosmetics industry, for instance, is taking cues from biomedicine's use of the body as a self-medicating vessel--Dennis Paphitis, founder of Australian skin care brand Aesop, recently announced plans to create a sunscreen ingested as a pill. So it isn't surprising that biotech research has already yielded a new species of rich people. Enríquez, also a venture capitalist, is co-founder of Synthetic Genomics Inc., based in La Jolla, Calif., a company that funded the creation of the first synthetic bacterial cell. Langer's work has been used in more than 100 million patents worldwide. Then there's the emergence of outfits like the Ontario Brain Institute, which connects innovative research with investors. It currently has high hopes for Sense Intelligent, an Android-compatible app that helps deaf people experience sound using "Google glasses," set for release next year. Sounds are captured, filtered and visualized, explains Alison Fenney, the entrepreneurship and management training coordinator, so that wearers "learn to interpret speech, music and ambient noise, and perfect their own speech."

Enríquez expresses doubt that mankind is prepared for this *Brave New World-Frankenstein-The Matrix* mash-up. "I don't think we're ready ethically, politically, morally," he says. Yet speciation is crucial for survival. "We can survive in different niches. Single versions of a species tend to go extinct. There is nothing that says because you're big and strong you're going to evolve. Those who adopt and adapt do." Having different versions of hominids, as strange as it sounds, is actually a very smart way of increasing the odds of hominid survival. "That doesn't mean all will survive," he says, "but it does mean you're not betting everything on 17 black."

Langer expects progress to be hindered by "science challenges, regulatory challenges, money challenges." One breakthrough creates another hurdle, he says. "You make people live longer, and there's Alzheimer's." Brain downloading gives rise to the threat of brain hacking. "Every time you solve one big problem, there's another big problem. That's how you have to think about it. There's always something."

Publication date: Oct 10, 2012

Year: 2012

Let's Break the Silence on Hearing Loss

Author: Roufs, Kathleen S

Publication info: The Chronicle of Higher Education (Oct 8, 2012): n/a.
ProQuest document link

Abstract: Many faculty members with hearing loss just bear up in silence, in a silent world. One academician suggested that she did not feel free to discuss her hearing loss until she became a department head and had tenure. Another said he felt a total lack of sensitivity to the issue among the faculty and administrators with whom he interacts.

Full text: It's high time that we helped our hearing-impaired colleagues move out of their isolated worlds.

"I think my avoidance of social contexts with my colleagues is interpreted as social withdrawal, reticence, or disinterest, rather than what it mostly is: embarrassment that I cannot follow conversations in a crowded

environment. So, I 'beg off' or not show up."

That comment was made by one of 84 faculty members who said, in a study conducted last year at the University of Minnesota-Twin Cities, that they had experienced some degree of hearing loss. The hypothesis was that many faculty members with hearing loss just bear up in silence, in a silent world, and the study confirmed it. In fact, that number is probably quite low. We have no way of knowing how many hearing-impaired faculty members did not respond to the survey, but if their number reflects that of the general population (as one would expect), it would be closer to 500.

One academician suggested that she did not feel free to discuss her hearing loss until she became a department head and had tenure. Another said he felt a total lack of sensitivity to the issue among the faculty and administrators with whom he interacts.

Although we may all know about support services for students with hearing loss, and where to find those resources, support for faculty with hearing loss, for many, is not commonly a priority. How faculty members responded in the study confirmed that too many educators are coping silently with hearing impairments.

With the exception of those who wore obvious hearing devices, 63 percent of the respondents said that none of their colleagues were aware of their hearing loss. This leads one to surmise that many faculty members--like the study participant who said, "I would never reveal my hearing loss to colleagues"--simply do not disclose their condition, even to those with whom they work.

Two-thirds of hearing losses among the study participants occurred after the age of 46, suggesting that age-induced hearing loss is a reality for many. It is both alarming and heartbreaking to think that faculty members with hearing loss fear they will be judged by their hearing limitations, rather than their intellectual contributions. As one respondent said, "I'm pretty good at lip reading and faking it."

We need to put "find solutions for hearing-impaired faculty members" on our institutional agendas. As our faculty members are graying (the number of professors age 65 and older more than doubled from 2000 to 2011), the number with hearing loss is growing. Approximately 17 percent of American adults admit to some degree of hearing loss, and there is a direct correlation with age: The National Institute on Deafness and Other Communication Disorders reports that 18 percent of people 45 to 64 years old, 30 percent of those 65 to 74 years old, and 47 percent of those 75 years old or older are hearing impaired.

What should we do? As individuals, once we know that faculty members with hearing loss are among us, we should adopt some simple behavioral changes to begin to include them more fully in academic life. For example, when interacting with a hearing-impaired person whose back is to you, tap the person on the shoulder to get his or her attention. Don't talk with your hand over your mouth. Make eye contact with the person when you are speaking. Don't expect the person to participate in gatherings with background noises (hearing-impaired people frequently say they can only pretend to follow conversations in noisy spaces). And don't mumble.

The stigma associated with hearing loss is one reason for educators' reluctance to talk about it. But another common reason is that faculty members worry about costing their departments money if they request assistance in combating their hearing challenges.

"It boils down to resources," said one study participant, echoing the sentiments of many others. "If I bring this up, is the department then obligated to spend money on resources for me? If resources are spent to assist me with hearing loss, then will others feel resentment towards me?" Yet this is a largely unfounded fear, since money to assist the hearing impaired typically comes from the disability-services or human-resources departments. What's more, many of the institutional accommodations that can be made are not all that expensive. For example:Remodeled and new construction could include induction looping, a relatively inexpensive, invisible system of transmission made for telecoil-equipped hearing aids and cochlear implants. Loops work by receiving sound, filtering the background noise, and relaying the sound directly to the hearing devices. The University of Minnesota at Duluth is looping classrooms and lecture halls as the spaces are

upgraded or constructed. The loops conform to Americans With Disabilities Act requirements for hearing disabilities; require little, if any, maintenance; and entail no additional headphones or neckpieces. Classrooms and meeting rooms could be made more conducive to better hearing with simple acoustical modifications such as using carpet, cloth drapes, fabric-covered room dividers, and other "soft" surfaces. Seating could be arranged to allow faculty members with hearing loss to engage more effectively by accommodating situations like one-sided hearing loss, and by encouraging closer interaction between the faculty member and students or colleagues to improve hearing comprehension. Telephone systems could offer options from simple amplification to devices that translate the conversation into readable captions, either on the phone or on a computer screen. Rectangular conference tables could be replaced with oval ones to allow better eye contact and easier lip reading for all participants.

Jane E. Brody, the Personal Health columnist for The New York Times, wrote earlier this year, "Hearing loss, a disability currently untreated in about 85 percent of those affected, may be the nation's most damaging and costly sensory handicap." She's right, and it's high time that we helped our colleagues move out of their silent worlds.n

Kathleen S. Roufs is emeritus director of advising and retention at the University of Minnesota at Duluth.

Credit: By Kathleen S. Roufs

Illustration

Michael Morgenstern for The Chronicle; Caption: Let's Break the Silence on Hearing Loss 1

Publication date: Oct 8, 2012

Year: 2012

Anatomy and physiology of the senses

Author: Hendry, Charles; Farley, Alistair; McLafferty, Ella

Publication info: Nursing Standard 27.5 (Oct 3-Oct 9, 2012): 35-42.
ProQuest document link

Abstract: This article, which forms part of the life sciences series, examines the sensory systems of the body. Sensory organs may be categorised as general or special. Sensory systems enabling sight, hearing, smell and taste may be classified as special. Sensory systems enabling proprioception, touch, and thermal and pain perception may be classified as general. This article describes the anatomy and physiology of the sensory systems, examining structures associated with vision and hearing, equilibrium and sensation. Common disorders of vision and hearing are also considered, including glaucoma, cataract, age-related hearing impairment and conductive hearing impairment.

Full text: Headnote

The synthesis of art and science is lived by the nurse in the nursing act

Josephine G Paterson

Abstract

This article, which forms part of the life sciences series, examines the sensory systems of the body. Sensory organs may be categorised as general or special. Sensory systems enabling sight, hearing, smell and taste may be classified as special. Sensory systems enabling proprioception, touch, and thermal and pain perception may

be classified as general. This article describes the anatomy and physiology of the sensory systems, examining structures associated with vision and hearing, equilibrium and sensation. Common disorders of vision and hearing are also considered, including glaucoma, cataract, age-related hearing impairment and conductive hearing impairment.

Keywords
Glaucoma, hearing impairment, life sciences, sense organs, vision

Sense organs can be categorised as either general or special. Sense organs concerned with taste, smell, vision and hearing may be described as special sense organs. General sense organs are related to tactile, thermal, pain and proprioceptive sensations and are important for the sensory functioning of the body.

Special sense organs

The eye: structure and function

The main function of the eye is to focus light on the retina (Watson 2011). The visual cortex, in the occipital lobe of the brain, is responsible for processing visual information (Tortora and Derrickson 2009).

The eye is a spherical structure, surrounded by fat (Watson 2011) (Figure 1). It has a number of protective structures, including the eyelids, which cover the eye during sleep and protect the eyes from bright sunlight. Modified sebaceous glands in the eyelids, called lacrimal (tear) glands, lubricate the eye. The action of blinking washes tears over the surface of the eye, removing small particles (Waugh and Grant 2010). The eyelashes and eyebrows protect the eyes from foreign objects, such as dust particles, microbes, perspiration and direct sunlight.

The eyeball is composed of three layers:

* The fibrous tunic.
* The vascular tunic.
* The retina.

The fibrous tunic The outer layer of the eyeball is known as the fibrous tunic. It is made up of the anterior cornea and the posterior sclera. The cornea is transparent and covers the coloured or pigmented part of the eye, called the iris. The cornea is curved, and is part of a series of structures that enable light to be focused on the retina (Tortora and Derrickson 2009).

The sclera is white and gives the eyeball its shape (Watson 2011). The scleral venous sinus (canal of Schlemm) is an opening at the junction of the cornea and the sclera. This canal is important, because it drains aqueous humour, found in the anterior chamber between the lens and the cornea. The aqueous humour drains through the trabecular meshwork, found near the ciliary body, into the canal of Schlemm, returning to the venous circulation. If the scleral venous sinus becomes partially or fully blocked, increased intraocular pressure associated with glaucoma can occur. Degenerative changes with age and narrowing of the angle between the cornea and the iris cause the canal of Schlemm to become blocked.

The conjunctiva is a mucous membrane lining the eyelids. It covers the anterior part of the sclera and is continuous with the corneal epithelium covering the cornea (Watson 2011). Lacrimal glands protect the eye by producing tears. Tears maintain the moistness of the conjunctiva, protecting, cleaning and lubricating the eyeball (Thibodeau and Patton 2012). Tears consist of water, salts, mucus and lysozymes (bactericidal enzymes) (Tortora and Derrickson 2009). Tears empty into small ducts in the medial angle of the eye, which open into a lacrimal sac before joining the nasal cavity via the nasolacrimal duct (Seeley et al 2007).

The vascular tunic The middle layer of the eyeball is formed from the vascular tunic and consists of the choroid, ciliary body and coloured iris.

The choroid contains many blood vessels that nourish the retina. It also contains melanin, which absorbs stray light rays, preventing reflection and scattering of light in the eyeball. An area of the choroid at the front of the eye becomes the ciliary body. The ciliary body contains the ciliary processes and the ciliary muscle. The ciliary processes secrete aqueous humour. Extending from the ciliary processes are the zonular fibres (suspensory

ligaments) that attach to the lens. The ciliary muscles act on the zonular fibres, either contracting or relaxing, to change the shape of the lens, adapting it for near and distance vision (Tortora and Derrickson 2009).
The iris lies between the cornea and the lens. It is attached to the ciliary processes. Melanocytes, which produce melanin, are found in the iris. The amount of melanin present in the iris, which is genetically controlled, determines its colour. The iris consists of circular and radial smooth muscle fibres, which are responsible for controlling the amount of light that enters the pupil (Thibodeau and Patton 2012). These muscle fibres are said to be antagonistic because they have the opposite action to one another. The circular fibres contract while the radial muscles relax in bright light, constricting the pupil. The radial muscles contract while the circular fibres relax in dim light, dilating the pupil.
The retina The inner layer of the eyeball is called the retina, which consists of a pigmented layer and a neural layer. The pigmented layer is made up of melanin and lies between the choroid and the neural layer. Its function is the absorption of stray light rays. The neural layer of the retina has many layers and is important in the processing of visual information before sending nerve impulses into axons that form the optic nerve. There are three layers of retinal neurones: the photoreceptor layer, bipolar cell layer and ganglion cell layer.
Light passes through the ganglion and bipolar cell layers and two synaptic layers before it reaches the photoreceptor layer. Photoreceptors are specialised cells and are important in the process of converting light rays into nerve impulses. There are two types of photoreceptors - rods and cones - with each retina having approximately six million cones and 120 million rods (Tortora and Derrickson 2009). Rods are the receptors for greyscale and night vision, and cones are the receptors for day and colour vision (Thibodeau and Patton 2012). Three types of cones exist - blue, green and red - and are scattered throughout the central portion of the retina, which allow different colours to be distinguished (Thibodeau and Patton 2012).
Visual information passes from the photoreceptors, through the outer synaptic layer to bipolar cells and then from bipolar cells through the inner synaptic layer to ganglion cells. The axons of ganglion cells extend to the optic disc and leave the eyeball as the optic nerve. The optic disc is found at the point where the optic nerve leaves the eyeball and the main arteries and veins for the eye are brought together (Tortora and Derrickson 2009). The optic disc has no rods or cones, so it is termed the blind spot.
Near the centre of the back of the retina is the macula lutea, which is an oval, yellowish area providing central vision (Watson 2011). A small depression on the centre of the macula lutea is called the fovea centralis. This area contains the greatest concentration of cones of any area in the retina, making this the area of highest visual acuity or resolution (Thibodeau and Patton 2012).
The lens The lens is transparent and has no blood vessels. It lies behind the iris and pupil. The lens divides the inside of the eyeball into two cavities: the anterior cavity and the vitreous chamber (Tortora and Derrickson 2010). The anterior cavity contains anterior and posterior chambers. The anterior chamber lies between the cornea and the iris and the posterior chamber lies behind the iris and in front of the zonular fibres and lens. Both chambers are filled with aqueous humour, a transparent watery fluid that nourishes the lens and cornea. Aqueous humour filters out of blood capillaries in the ciliary processes and enters the posterior chamber, where it flows forward between the iris and the lens through the pupil and into the anterior chamber. The aqueous humour leaves the anterior chamber and empties into the scleral venous sinus and into the blood. Aqueous humour is usually replaced every 90 minutes (Tortora and Derrickson 2010).
The vitreous chamber lies between the lens and the retina. Inside the vitreous chamber is the vitreous humour, a transparent jelly-like substance that holds the retina flush to the choroid giving the retina an even surface for the reception of clear images. Vitreous humour is formed during embryonic development and is not replaced during the individual's lifespan. Phagocytic cells ingest debris in the vitreous humour to maintain clarity in this chamber. The pressure in the eyes, called the intraocular pressure - usually about 16mmHg - is mainly produced by aqueous humour, but partly by vitreous humour. The intraocular pressure maintains the shape of the eyeball and prevents it from collapsing (Tortora and Derrickson 2009).

The visual pathway Light is the stimulus that results in vision. Light enters the eye through the pupil and is refracted so that it is focused on the retina. Refraction makes it possible for light from a large area to be focused on a small area of the retina (Watson 2011). Refraction or bending of light occurs as light passes through the cornea, aqueous humour, lens and vitreous humour on its way to the retina.

Parallel light rays, striking a convex lens, are bent towards a focal point - the point at which refracted light rays meet - on the retina. If the object is less than seven metres away, the curvature of the lens must be increased to enable the focal point to remain on the retina. This function of the eye is termed accommodation. Far vision is achieved with the lens in its resting position (Watson 2011). When viewing distant objects the ciliary muscle of the ciliary body is relaxed and the lens is flatter because it is stretched in all directions by taut zonular fibres. When viewing a close object, the ciliary muscle contracts, pulling the ciliary body towards the lens. This action releases tension on the lens and zonular fibres. The lens therefore becomes more convex, which increases its focusing power and the convergence of light rays (Tortora and Derrickson 2009). Images focusing on the retina are inverted and undergo right to leftreversal. However, the brain learns early in life to co-ordinate visual images with the correct orientation of objects being viewed (Tortora and Derrickson 2009).

Photoreceptor cells on the retina respond to light stimuli by producing nervous impulses. Photoreceptors synapse with neurones in the bipolar and ganglion layers of the retina. Nerve signals leave the retina and exit the eye via the optic nerve. The optic nerve from each eye meets at the optic chiasma, which lies in front of and above the pituitary gland (Waugh and Grant 2010). In the optic chiasma, nerve fibres from the nasal side of each retina cross over to the temporal side, while nerve fibres from the temporal side of each retina remain on the same side. In this way, both cerebral hemispheres receive sensory input from each eye (Thibodeau and Patton 2012).

After leaving the eye, the optic nerves enter the brain and travel to the visual cortex in the occipital lobe of the cerebrum, where visual interpretation of the nervous impulses generated by light stimuli in the rods and cones of the retina result in vision (Waugh and Grant 2010).

Binocular vision occurs when light rays from an object strike corresponding points on two retinas. When a person stares straight ahead at a distant object, the incoming light rays aiming directly at both pupils are refracted to comparable spots on the retinas of both eyes. Moving closer to the object, the eyes need to move medially for the light rays from the object to strike the same points on both retinas. The term convergence is used to describe this medial movement of both eyeballs. The nearer the object the greater the degree of convergence required to maintain binocular vision (Tortora and Derrickson 2009).

Binocular or stereoscopic vision allows objects to be seen in three dimensions. Each eye sees an object slightly differently. Although the visual fields overlap somewhat, the lefteye sees more of an object on the leftside, while the right eye sees more of an object on the right side. The views from each eye are merged in the cerebrum, so that the image viewed by both eyes comes together and only one object is perceived. Binocular vision allows for greater depth and distance perception (Waugh and Grant 2010).

The ear: structure and function

The ear has a role in hearing and the maintenance of equilibrium (balance). It is divided into three anatomical areas:

* The external ear.
* The middle ear.
* The inner ear.

The external ear is made up of the pinna and the external auditory meatus (Figure 2). The pinna is situated at the side of the head. It surrounds the opening of the external auditory meatus, which is a curving tube about 2.5cm long, extending into the temporal bone and ending at the tympanic membrane or eardrum. The tympanic membrane separates the external ear from the middle ear. The external auditory meatus contains numerous short hairs and ceruminous glands that produce a waxy material called cerumen or earwax. Hairs and cerumen

prevent dust and foreign objects from entering the ear. They also protect the skin in the auditory meatus from water, microbes and insects (Tortora and Derrickson 2009). Cerumen can sometimes accumulate in the meatus and hinder hearing by blocking sound waves (Thibodeau and Patton 2012). Excessive earwax often falls out unaided. If it impairs hearing then eardrops may be prescribed to soften the wax. Occasionally it may be necessary to use ear irrigation to wash the wax out (NHS Choices 2012).

The middle ear is a small cavity lined with epithelium. It is a hollow in the temporal bone, filled with air that enters and exits via the auditory tube (Watson 2011). The auditory tube that links the pharynx and the middle ear allows air pressure on both sides of the tympanic membrane to equalise.

There are three small bones in the middle ear, called the auditory ossicles. These are the malleus (hammer), incus (anvil) and stapes (stirrup). The handle of the malleus is attached to the internal surface of the tympanic membrane (Tortora and Derrickson 2009), with the incus lying between the malleus and the stapes, thereby acting as a bridge between the two bones. The stapes presses against a membrane that covers a small opening in the vestibule called the oval window, which separates the middle ear from the inner ear. Another window, the round window, can be found in the vestibule and is covered by the secondary tympanic membrane (Tortora and Derrickson 2009).

Sound waves entering the ear cause the tympanic membrane to vibrate. The ossicles convey vibrations from the tympanic membrane to the inner ear (Watson 2011). Movements arising from the vibrating tympanic membrane are transmitted and magnified by the ossicles as they pass through the middle ear. Movement of the stapes against the oval window causes movement of fluid called perilymph within the inner ear. The inner ear consists of the bony labyrinth and the membranous labyrinth (Watson 2011).

The outer bony labyrinth encloses the inner membranous labyrinth (Tortora and Derrickson 2009). The activation of specialised mechanoreceptors known as hair cells in the inner ear generate nerve impulses that result in hearing and equilibrium. Anatomically, the inner ear consists of three spaces in the temporal bone, assembled in a complex maze, hence the term 'bony labyrinth'. These spaces are filled with a watery fluid called perilymph and are divided into the vestibule, semicircular canals and cochlea (Seeley et al 2007).

The vestibule is adjacent to the oval window between the semicircular canals and cochlea; a membranous sac is suspended in the perilymph and follows the shape of the bony labyrinth, much like a tube within a tube. This is the membranous labyrinth, which is filled with thicker fluid called endolymph.

The specialised mechanoreceptors for equilibrium are located in the three semicircular canals and the vestibule. Inside each canal is a dilated area called the ampulla that contains a specialised receptor, the crista ampullaris, which generates an impulse whenever its head is moved. Sensory cells in the crista ampullaris have hair-like extensions that are suspended in the endolymph and are stimulated when movement of the head causes the endolymph to move, thus causing the hairs to bend and generate a nerve impulse.

Nerves from other receptors, for example the utricular and saccular nerves in the vestibule, join those from the semicircular canals to form the vestibular nerve, which joins with the cochlear nerve to form the vestibulocochlear nerve. Nervous impulses passing through this nerve reach the cerebral cortex.

The cochlea is concerned with hearing. It is a spiral tube that makes two and three-quarter turns around a central pillar bone called the modiolus. The cochlea is divided lengthways into three separate tunnels by the basilar and vestibular membranes, which stretch from the modiolus to the outer wall. The two outer tunnels are known as the scala vestibuli and the scala tympani. These tunnels are filled with perilymph and join at the top of the modiolus. The middle tunnel is called the cochlear duct and is filled with endolymph (Watson 2011). The organ of Corti, which is the structure that transduces (converts) pressure waves caused by sound waves to neurological impulses, lies in the cochlea. It is surrounded by endolymph filling the membranous cochlea, which is a tube in the bony cochlea. Specialised hair cells on the organ of Corti generate nerve impulses when bent by the movement of endolymph, which is set in motion by sound waves.

Mechanism of hearing Sound waves are collected by the pinna and transported through the external auditory

canal where the waves strike the tympanic membrane causing it to vibrate (Seeley et al 2007). This causes the three auditory ossicles and the oval window to vibrate, which in turn causes vibration of perilymph in the cochlea. Vibration of perilymph gives rise to vibration of endolymph, which in turn produces movement of the hair cells that extend into it. Movement of these hair cells generates nerve impulses and the signal is carried in the cochlear nerve. Nerve impulses travel via the vestibulocochlear nerve carrying the information to the auditory cortex in the temporal lobe of the brain, where it is appreciated and interpreted as sound (Watson 2011).

Physiology of equilibrium There are two types of equilibrium, static and dynamic. Static equilibrium refers to the maintenance of body position (mainly the head) relative to the force of gravity. Body movements that stimulate the receptors for static equilibrium include tilting the head and linear acceleration or deceleration, such as when the body is being moved in a car that is speeding up or slowing down. Dynamic equilibrium is the maintenance of body position (mainly the head) in response to rotational acceleration or deceleration.

The vestibular apparatus includes the saccule, utricle and semicircular ducts. The walls of the saccule and utricle each contain a small, thickened region called a macula. The two maculae that are perpendicular to one another are the receptors for static equilibrium. They provide information on the position of the head in space and are essential for maintaining appropriate posture and balance. The maculae also detect linear acceleration and deceleration.

The semicircular ducts function in dynamic equilibrium. The ducts lie at right angles to one another. The two vertical ducts are the anterior and posterior semicircular ducts, and the horizontal duct is the lateral semicircular duct. This arrangement helps in the detection of rotational acceleration or deceleration. When the head is moved the attached semicircular ducts and hair cells move with it. However, endolymph that is not attached lags behind. Hair cells bend as they drag through the stationary endolymph. This mechanism produces receptor potentials that, in turn, generate nerve impulses that pass along the vestibular branch of the vestibulocochlear nerve (Tortora and Derrickson 2009). Eventually nervous impulses passing through this nerve reach integrating centres within the medulla oblongata and pons for interpretation.

Smell, taste and touch

Odour receptors

The chemoreceptors responsible for olfaction (the sense of smell) are found in a small area of epithelial tissue in the upper area of the nasal cavity. Each receptor, known as an olfactory cell, has specialised cilia that sense different chemicals and cause the cell to react by producing a nerve impulse. Olfactory receptors detect chemicals dissolved in the watery mucus that lines the nasal cavity. Although olfactory receptors are particularly sensitive they adapt readily, thereby losing their responsiveness. This means that cells rapidly lose the ability to respond to continuing olfactory stimulus. This is the result of fatigue and inhibition of action potentials (Thibodeau and Patton 2012). Olfactory cells lose their sensitivity to specific odours by up to 50% in the first second (Tortora and Derrickson 2009, Waugh and Grant 2010). This loss of responsiveness results in odours being obvious at first, but fading after a short time (Thibodeau and Patton 2012). The nerve impulses for smell follow the olfactory nerve to the olfactory bulb and then on to the olfactory tract, which can be found under the frontal lobe. Smells are interpreted in different olfactory areas in the temporal lobe. A sense of smell is almost always necessary to be able to detect taste.

Taste receptors

The organs of taste (gustation) are the taste buds. They contain supporting cells and chemoreceptors called gustatory cells, which produce nerve impulses interpreted by the brain as taste. Two types of papillae exist on the surface of the tongue: one type contains taste buds while the other helps to distinguish food textures (Thibodeau and Patton 2012). Chemoreceptor cells are stimulated by chemicals dissolved in saliva. Flavours result from a combination of taste bud and olfactory receptor stimulation. Taste impulses are carried by the VII and IX cranial nerves and are interpreted in the temporal lobe with the corresponding smell impulse. The five

primary tastes experienced are sweet, sour, salty, bitter and umami (savoury) (Thibodeau and Patton 2012).

Sensation: the somatosensory system

Sensory nerve endings may be found in the skin, muscles, tendons, joints and internal organs throughout the body. Although they are found in almost every part of the body, most are found in the skin. Types of sensation include pain, pressure, propioception, temperature, touch and vibration.

Sensory nerve endings have a number of similar, significant functional characteristics regardless of their size, type or location. First, they must be able to sense a stimulus or change in the strength of a particular stimulus in the environment. The stimulus is then said to have met the threshold to induce a nervous impulse. Second, the impulse is transmitted over a nervous system pathway to the brain. Third, the sensation is interpreted and recognised in the brain. As different receptor cells have a unique form and function, they respond to differing stimuli, enabling the experience of different sensations (Table 1).

Other general sensations include itching, which occurs in response to the stimulation of free nerve endings by specific chemicals, including bradykinin and histamine released during local inflammatory responses. It is thought that the sensation of tickling is triggered by free nerve endings (Tortora and Derrickson 2010). A free nerve ending is described as a simple, common sensory receptor composed of bare dendrites (Tortora and Derrickson 2009, Thibodeau and Patton 2012). However, this tickling sensation will only occur if touched by someone other than oneself.

Pain is a protective mechanism that indicates the potential for damage from harmful or noxious elements. The receptors for pain are called nociceptors and are free nerve endings located in every tissue of the body except the brain. Some encapsulated receptors (dendrites enclosed by a connective tissue capsule) called polymodal nociceptors can be activated by a variety of stimuli, including intense thermal, mechanical, chemical or pain stimuli (Tortora and Derrickson 2009). Chemicals such as prostaglandins, kinins, potassium ions, lactic acid and histamine are released by intracellular structures in response to irritation or injury of the tissues, which stimulate polymodal nociceptors (Tortora and Derrickson 2009). Pain may continue even after a pain-producing stimulus is removed as a result of pain-mediating chemicals lingering after injury.

Proprioceptive sensations enable people to know where their head and limbs are in space. Therefore, people are able to carry out several functions without sole reliance on vision.

Common disorders of vision and hearing

Glaucoma

Glaucoma is commonly associated with a rise in intraocular pressure that causes damage to the optic neurons. It results from inadequate drainage of aqueous humour from the anterior chamber of the eye and occurs when drainage of aqueous humour is impeded, resulting in elevated intraocular pressure. This in turn raises the pressure on the optic nerve and can cause physical damage and loss of peripheral vision if leftuntreated. Risk factors for development of glaucoma include (Boyd-Monk 2007):

*Family history of glaucoma.

*Raised intraocular pressure.

*Myopia (short-sightedness).

*Hyperopia (long-sightedness).

*History of eye trauma or eye surgery.

*Advancing age in susceptible individuals.

*Long-term use of topical or systemic corticosteroids.

Types of glaucoma Primary, open-angle glaucoma, where the disease progresses gradually, is the most common type of glaucoma. Irreversible damage can occur to the optic disc if the condition is not detected early and managed appropriately. Cupping of the optic disc occurs where there is enlargement of the natural cup shape of the optic disc, leading to the gradual loss of peripheral vision. These changes are indicative of impaired flow of aqueous humour. Blockage to the flow of aqueous humour generally occurs in the sieve-like

channels of the trabecular meshwork found in the canal of Schlemm.

Primary, open-angle glaucoma is often detected during routine eye examination and is usually asymptomatic in the early stages. However, some people may experience intermittent pain over the eyebrow area or see haloes around light sources (Gould 2006, Mehta and Burton 2007).

Treatment consists of topical drug therapy, which is aimed at slowing production of aqueous humour and/or increasing drainage of aqueous humour, therefore reducing intraocular pressure. Other procedures can be performed if drug therapy does not control intraocular pressure, including non-invasive argon laser trabeculectomy, which is used to open the channels of the trabecular meshwork. This procedure is temporary and may need to be repeated. Eventually a surgical trabeculectomy may be undertaken, creating a new outlet for the aqueous humour to drain from the eye.

Closed-angle glaucoma is a surgical emergency. It occurs when the lens enlarges and displaces the iris, pushing it forward. This narrows or closes the angle between the iris and cornea. The patient presents with symptoms of sudden onset of blurred vision and extreme eye pain. Other signs and symptoms of closed-angle glaucoma include red eye, headache, nausea and vomiting as a result of eye pain, and intraocular pressure as high as 50mmHg (Harries et al 2009).

Immediate treatment includes instillation of mitotic eye drops, which reduce the size of the pupil and increase the flow of aqueous humour. Steroidal eye drops may also be instilled to reduce the acute inflammatory response. Eye drops such as timolol may also be administered, which is thought to decrease the production of aqueous humour (British National Formulary 2012).

Intravenous acetazolamide that stops aqueous humour production may be administered with an infusion of mannitol, which shrinks the vitreous humour (Boyd-Monk 2007). Once the acute episode of closed-angle glaucoma is under control, the patient will undergo surgery for a non-invasive peripheral iridotomy. This involves an opening being made into the iris to allow aqueous humour to flow from behind the iris into the anterior chamber.

Cataract

When the lens becomes opaque, a cataract has formed. Most cataracts form as a result of normal age-related, degenerative changes (Batterbury et al 2009). As the lens becomes opaque it appears cloudy and distorts the passage of light through the lens. Glare from the cataract can result in decreased visual acuity in bright light (Mehta and Burton 2007). Typical signs and symptoms of cataract formation include (Alexander et al 2006):

* Reduction in visual acuity affecting distance vision more than near vision.
* General dimming of vision because of a reduction in the amount of light reaching the retina.
* Increase in the number of refractive errors as a result of reduced elasticity of the lens.
* Increase in dazzle and glare in bright light.
* Haloes visible around lights at night.
* Monocular diplopia (double vision).
* Change in colour and depth perception.

The mainstay of treatment is cataract surgery, in which the lens is removed and replaced by an intraocular lens implant, usually under local anaesthetic.

Hearing impairment

Presbycusis Otherwise known as age-related hearing loss, presbycusis is the most common type of sensorineural hearing impairment. Loss of hearing is thought to result from loss of hair cells and nerve fibres in the organ of Corti near the oval window, where high-pitched sound is converted to nerve impulses. Hearing loss is more noticeable in relation to high-pitched sounds and consonants (Lueckenotte 2000). Excessive cerumen accumulation in the ear will exaggerate presbycusis.

The process is bilateral and starts from the age of 40. High levels of background noise result in a reduction in the ability to hear. The loss of hearing acuity makes it more difficult to locate the direction of sounds.

Conductive hearing impairment Changes in the outer or middle ear that impair the conduction of sound inwards can lead to conductive hearing impairment. This may be caused by impacted earwax, foreign bodies, benign tumour of the middle ear, otitis media or otosclerosis. Typical symptoms are loss of hearing and a softspeaking voice, the latter being the result of the individual hearing their voice conducted by bone and perceiving it as being loud. Treatment of any underlying problem generally improves hearing (Huether 2010).

Conclusion

The structure and function of the eye and ear have been examined in this article. The means by which these sensory organs interpret visual objects and audible sounds have also been discussed. The relationship between the sensory receptors for smell and taste, and the importance of interpretation of sensory information, has been examined. Polymodal nociceptors are important in the detection of noxious stimuli that can result in harm to the body. A good understanding of the special and general senses allows nurses to select and use appropriate evidence-based interventions when caring for patients with sensory deficits NS

Sidebar

Hendry C et al (2012) Anatomy and physiology of the senses.
Nursing Standard. 27, 5, 35-42. Date of acceptance: May 5 2012.

Review

All articles are subject to external double-blind peer review and checked for plagiarism using automated software.

Online

Guidelines on writing for publication are available at www.nursing-standard.co.uk. For related articles visit the archive and search using the keywords above.

Sidebar

POINTS FOR PRACTICE

* Describe the advice people require to maintain healthy eyes.
* Describe the advice people require to maintain healthy ears.
* Explain the pre-operative and post-operative care of a patient who has had cataract surgery.
* Outline the information you would give a patient who has recently been given a hearing aid.

GLOSSARY

Fovea centralis

A small depression on the macula lutea, which has the highest concentration of cone cells of any area in the retina.

Lacrimal apparatus

The system that produces, secretes and drains tears.

Lysozymes

The bactericidal enzymes present in tears.

Macula lutea

The area of keenest vision, which is located in the centre of the retina.

Ossicles

The three small bones in the ear called the malleus, incus and stapes, responsible for transmission of vibrations through the tympanic membrane to the cochlea.

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Publication date: Oct 3-Oct 9, 2012

Year: 2012

The sound environment in an ICU patient room--A content analysis of sound levels and patient experiences

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Publication info: Intensive & Critical Care Nursing 28.5 (Oct 2012): 269-79.
ProQuest document link

Abstract: This study had two aims: first to describe, using both descriptive statistics and quantitative content analysis, the noise environment in an ICU patient room over one day, a patient's physical status during the same day and early signs of ICU delirium; second, to describe, using qualitative content analysis, patients' recall of the noise environment in the ICU patient room. The final study group comprised 13 patients. General patient health status data, ICU delirium observations and sound-level data were collected for each patient over a 24-hour period. Finally, interviews were conducted following discharge from the ICU. The sound levels in the patient room were higher than desirable and the LAF max levels exceed 55dB 70-90% of the time. Most patients remembered some sounds from their stay in the ICU and whilst many were aware of the sounds they were not disturbing to them. However, some also experienced feelings of fear related to sounds emanating from treatments and investigations of the patient beside them. In this small sample, no statistical connection between early signs of ICU delirium and high sound levels was seen, but more research will be needed to clarify whether or not a correlation does exist between these two factors.

Full text:

Patient nr.	Sex	Age	Diagnosis	ICU lengths of stay (days)
1	M	63	Pneumonia	5
2	M	63	Sepsis	9
3	F	81	Thrombosis	3
4	M	57	Pneumonia	3
5	M	57	Aortic aneurysm	1
6	F	60	Pain treatment	1
7	M	67	Aortic aneurysm	1
8	F	86	Rectal cancer surgery	1
9	M	77	Pulmonary embolism	1
10	F	51	Guillain-Barré	33
11	M	77	Aortic aneurysm	4
12	F	63	Whipples surgery	1
13	F	60	Pancreatitis	65

Table 1 - Subject demographics.

Patient ID	Ventilator	Enteral nutrition	Midazolam	Propofol	Opioids
1	X	2	X	X	3
4	X	X	X	X	5
X	X	X	6	X	X

7	X	8	X	9	X
X	X	10	X	X	X
X	11	12	13	X	X

Table 2 - Ventilator treatment, enteral nutrition, midazolam, propofol and opioids at the time of sound measurement. The "X" means that the patient has received the treatment some time during the ICU stay.

Patient ID	Early signs of ICU delirium	Disturbing sounds [b]	% Of the time that LAFmax exceeded 55dB	dB (LAeq)	dB (LAFmax)
1	2	Not disturbed	[a]	[a]	[a]
3	0	Not disturbed	79%	55	89
5	0	Not disturbed	78%	53	101
7	0	Not disturbed	82%	52	88
11	7	Not disturbed	82%	53	97
2	2	Technical equipment Patients in the same room Staff	79%	54	88
4	8	Staff	83%	54	88
6	1	Sounds in dreams Staff	79%	51	87
8	3	Patient in the same room	87%	52	84
10	6	Technical equipment	77%	53	94
12	0	Patient in the same room Staff Technical equipment	89%	53	93
9	8	No sound memories	86%	53	94
13	7	No sound memories	68%	51	82

Table 3 - Number of early signs of ICU delirium, disturbing sounds, percent of the time that LAFmax exceeded 55dB, LAeq and LAFmax for each patient.

ID	Never fully awake	No clear sentences	Did not rest peacefully	No calm and peaceful look	No period with calm sleep	Do not responds adequately
1	X	2	X	X	3	4
X	X	X	X	5	6	X
7	8	X	X	X	9	X
X	X	X	X	10	X	X

X	11	X	X	12	13	X

Table 4 - Number of patients (*n* =13) showing according the "early signs of ICU delirium" protocol. The "X" means that a nurse has observed the sign sometimes during the 24 hours of measurement.

ID	Tense body position	Between conscious-ness and wakeful ness	Waking with anxiety	Difficulties in answering	Mumbling speech	Fearful look	Tense, watchful look	No eye contact	Apathetic look	Passive behaviour
1	X	2	3	4	X	X	X	X	5	6
7	8	9	X	X	X	10	X	X	X	11

Table 5 - Number of patients (*n* =13) showing according to the "early signs of ICU delirium" protocol. The "X" means that a nurse has observed the sign sometimes during the 24 hours of measurement.

Categories	Subcategories
Sounds related to the setting	Calm and peaceful
Too quiet	Hearing sounds from outside
Sounds related to the staff	No memories of sounds related to the staff
Aware but not disturbed by the staff's presence	No possibility of escaping
Conversations about the own treatment and care	Sounds related to the other patients in the same room
Aware but not disturbed	Involuntary listeners
No possibility of shutting off the unwanted sound	Scaring and frightening sounds
Sounds related to the technical equipment	Lacked memories of sounds related to technical equipment
Frightening thoughts about the meaning of the sound	Safe and friendly
Sounds as a part of dreams	Sounds integrated into dreams

Table 6 - Overview of categories and subcategories in relation to sound experiences.

Implications for clinical practice

This study illustrates the need to improve the physical environment in the ICU patient room.

It also indicates that intervention strategies are needed that include:

* Acoustical improvements
* Reduction of noise
* Reducing the volumes of technical alarms

On-going research seeks to describe and understand the existing conditions of the ICU patient room and find connections between noise and health. However, until the phenomenon is better understood nurses in ICU must work with the tools available. It is vital for the nurses caring for persons in ICU to have proficient knowledge of the patients' experiences of sounds and noises.

Introduction

The high level of noise in hospital intensive care units (ICUs) is a well-documented reality and previous studies have shown mean levels of between 55-66dB LAeq (equivalent continuous level) during the daytime in patients'

rooms, with maximum levels reaching 80dB LAFmax (maximum level with time weighting FAST) (Akansel and Kaymakci, 2008; Bailey and Timmons, 2005; Christensen, 2007; Ryherd et al., 2008; Tsiou et al., 1998). This far exceeds the recommendations in the World Health Organisation (WHO) "guidelines for community noise", stating that for good sleep, the sound level should not exceed 30dB (LAeq) both for continuous background noise and individual noise (WHO, 1999). The highest noise levels in the ICU are related to the staff conversation, continuous treatment and the use of advanced technical equipment (Akansel and Kaymakci, 2008; Xie et al., 2009).

Noise as a concept is often defined as any sound that is unwanted, undesirable or without musical quality (Hilton, 1985). This means that sound and noise are complex phenomena and how they are experienced depends on the sound level, the nature of the sound and the subjective experience which is influenced by a number of aspects such as cultural and social factors, individual personality and attitudes (Belojevic et al., 2003). Unfortunately, most research has focussed on sound levels and few studies describe the patients' own experience of noise and sounds in the ICU. There are some examples of studies where patients have mentioned the sound environment. In one qualitative study, some patients described the environment as chaotic, with a lot of noise, beeps and rattling sounds (Lof et al., 2006) and in a questionnaire study the patients themselves scored noise from other patients in the same room as the most disturbing (Akansel and Kaymakci, 2008). Additionally, in another qualitative study patients reported that the noise made it impossible for them to sleep (Granberg et al., 1998). It is unclear to what degree the sounds and noises influence the ICU patient. We know from other areas that hospital noise influences the immune, the cardiovascular and the endocrine systems negatively (Christensen, 2002; Hagerman et al., 2005; Ising and Braun, 2000). We also know that the sounds and disturbing noise in ICUs affect the sleep cycle in a negative way (Honkus, 2003). It is therefore also probable that patients in ICUs suffer from physical and psychological disorders in some way. Unfortunately these effects are poorly investigated.

One of these distressing patient disorders that may be related to the sound environment is the high rate of intensive care delirium (ICU delirium) amongst patients in ICUs (Van Rompaey et al., 2008). ICU delirium denotes a state of acute confusion and change in cognition or a perceptual disturbance that develops over a short period (hours to days) and fluctuates over time (Granberg et al., 1996; Delirium and Cognitive Impairment Study Group, 2010 (www.icudelirium.org)). Two different states of delirium have been identified, hyperactive delirium, characterised by agitation, restlessness and emotional instability and hypoactive delirium, characterised by apathy and lack of responsiveness (Girard et al., 2008; Granberg-Axell et al., 2001; Liptzin and Levkoff, 1992). Patients have reported that noise or a sudden loud sound triggered the development of so-called unreal experiences (Granberg et al., 1999). ICU delirium is a severe condition that must be taken seriously since various studies have shown that it is a predictor of higher mortality and a longer ICU stay (Ely et al., 2001a, 2004; Girard et al., 2008; Thomason et al., 2005). Many physical risk factors have been identified but the main cause of ICU delirium remains unknown (Ouimet et al., 2007). The unique sound environment with high levels that fluctuate over time, potentially affecting the patient's biorhythm, might be a precipitating factor, but knowledge is limited and more research is needed. In summary, it is obvious that the patients' perceptions of sound in ICUs are not just a matter of sound levels but also depend on the sonic characteristics and individual circumstances at the particular moment. It is therefore of great importance to elucidate the phenomenon of sound as a whole, including the patient's own experiences together with measured sound levels. Moreover, there is a lack of knowledge regarding the negative effects of the high sound level and disturbing noises in the ICU, particularly when it comes to ICU delirium.

This study had two aims: first to describe, using a quantitative approach, the noise environment in an ICU patient room during one day, a patient's physical status during the same day and early signs of ICU delirium; second, to describe, using a qualitative approach, patients' recall of the noise environment in an ICU patient room.

Method

Participants and settings

This study is to be seen as a pre-study for the planning and design of a larger study where the aim is to investigate the relationship between sound (objective and subjective) and the occurrence of ICU delirium and/or other factors of interest. The present study was carried out in a general medical-surgical ICU in a county/regional hospital located in South-Western Sweden, which treats adults and sometimes children but not infants. Between 700 and 800 patients are admitted annually and the unit is the only ICU in the hospital. The mean acute physiology and chronic health evaluation II (APACHE II) (Knaus et al., 1985) score for the unit is 17.0 (2009). The unit was built to accommodate 13 beds and was often filled to capacity but at the time of the study treatment was limited to eight patient beds. This means that the study setting should be considered a high-tech environment with a heavy workload putting pressure on the professionals working there. The patient rooms were shared rooms for two or three patients. The nursing staff consisted of 70 registered nurses (RNs) with a one-year special education in intensive care and 30 enrolled nurses (ENs). One RN and one EN normally work together, where the former is responsible for the planning, delivery and evaluation of the nursing care. Generally two patients are allocated to each pair. The ICU has one chief physician and two other anaesthetists responsible for the intensive care treatment. In addition there are junior physicians working emergency duty hours.

Nineteen patients were recruited using convenience sampling. Exclusion criteria were head injury, known hearing impairment and dementia. Patients for whom surgery was planned were invited in advance to participate in the study by a ward nurse during a planned pre-operative assessment visit. In cases of acute admission to the ICU, the patients were recruited by their allocated ICU nurse. In cases where the patient was unable to communicate, the allocated ICU nurse asked the patients' next of kin for vicarious informed consent. The patient was then asked for his/her personal informed consent after the acute phase when he/she was no longer influenced by drugs or the medical condition. Data were destroyed if the patient declined to participate or died.

The Regional University Ethics Research Committee approved the study.

Data collection

Multiple categories of data were simultaneously collected for each patient over a 24-hour period: (1) general patient health status data, (2) notes of signs of possible ICU delirium (observations) and (3) sound level data. All three categories of data were quantitative as described in the Aims section of this paper. This 24-hour period was chosen because both day and night sound was of interest and the particular day chosen was judged to be an "ordinary ICU day". Finally, (4) qualitative interviews were conducted with the patients following discharge from the ICU. See Fig. 1.

(1) General patient health status

Data were collected from protocols describing nursing treatment and observations together with medical documentation comprising data concerning the fulfilment of the patient's physiological needs (e.g. blood pressure, breathing and heart rate, regimen for sedation and ventilation, etc.). In addition, data concerning the patient's ordinary physiologically monitored measurements and medications were printed and collected for further analysis.

(2) ICU delirium observations

Structural observations were made every hour using a protocol for registrations of early signs of the development of ICU delirium. The protocol, developed by Granberg-Axell et al. (2001), is based on observations of ICU patients in connection with and following extubation/decanulation, according to the Statistical Manual of Mental Disorders Criteria (DSM-IV). The protocol has not yet been analysed regarding validity or reliability since is not an assessment tool for diagnosing ICU delirium but is designed as an aid to help nurses to be aware of and register early signs of ICU delirium. The protocol was chosen as the purpose was to register changes of

behaviour every hour without waking the patient. This time period was chosen as it is known that delirium can fluctuate over time (Granberg et al., 1999). The registrations concerned the patient's motor activity, mimicry, wakefulness/contact and whether the patient was calm or anxious and was able to communicate. The observations were carried out by an EN or the RN who was allocated to the patient and were made continuously over 24 hours (both as frequency and/or as an on-going occurrence). Demographic data such as gender, age, current pharmacological treatment, cause of treatment and length of ICU stay were registered.

(3) Sound level data

Parallel with the registrations and collection of protocols, measurements of dB(A)sound pressure levels with a one-minute average interval were carried out using a Bruel &Kjaer 2260 sound level meter. The data were analysed using B &K Evaluator software and the A-weighted equivalent levels sampled during 24 hours (LAeq24h) and A-weighted maximum levels (LAFmax) are given in this paper. The "A" implies that a frequency filter, "A-weighting network", was used. This filter reduces the contribution of low frequency sound energy, increasing its similar to the response of the human ear (Speaks, 1999). The recording device was close to the patient's beds and took place over the same 24-hour periods as the patient's physical status data collection and ICU delirium observation.

(4) Qualitative follow-up interviews

The final part of the data collection process was a tape-recorded unstructured interview held after the patient had moved out of the ICU. The interviews were carried out at a time and place that the patients themselves determined. The open-ended interview questions focussed on memories of sounds and of the ICU environment in general (Fig. 1).

Data analysis

Content analysis is an established method used in the analysis of textual material and aims to provide new insights and clarify and describe an actual target as broadly as possible (Krippendorff, 2004). It can be used as both a qualitative and a quantitative method. Qualitative content analysis focusses on the subjective interpretation of the content of the text (Hsieh and Shannon, 2005) and is a systematic process of coding and identifying themes or patterns, whilst the purpose of quantitative content analysis is to code text data and describe the findings by means of statistics.

In this study data were subjected to both qualitative and quantitative content analysis. Descriptive analyses of demographic variables (age, length of stay (LOS)) are presented. Because of the small sample data are presented descriptively using non-parametric statistics (medians) except for the sound levels which were analysed using parametric statistics (means). Level of significance was set to 0.05. To analyse possible relationships between sound levels (LAFmax and LAeq) and number of early signs of ICU delirium, the Spearman correlation test was used. The Statistical Package for the Social Sciences for Windows 18.00 (SPSS Inc., Chicago, IL, USA) was used for all analyses.

The interviews were analysed using qualitative conventional manifest content analysis (Hsieh and Shannon, 2005) and followed the process of organising and integrating texts into emerging codes, subcategories and categories. First, the whole interview text was read through several times open-mindedly and considered before an overall view of the text was reached. From this careful reading, key words or concepts were identified and organised as codes, that is, words and phrases related to the purpose of the study. The codes were then sorted into subcategories and categories, according to differences and similarities. Finally definitions for each category were developed.

Results

All data were collected between May 2007 and July 2008. Of the 19 patients who participated in the study, three died in the ICU, one refused to participate further and two could not be contacted for an interview. The sound measurements of one patient are missing (pat nr 1) due to technical problems. The final study group consisted of 13 patients, six women and seven men, with a median age of 63 years (range 51-86). The median LOS in the

ICU was three days (Table 1). One of the patients suffered from tinnitus (nr 5) and one needed a hearing aid in one ear (nr 3).

Findings from the measurement day

The data concerning ventilator treatment, enteral nutrition regimens, sedation and opioids for each patient for the sound-measurement day are presented in Table 2. Sedation denotes treatment with benzodiazepines or propolipids and opioids means pharmacological treatment with morphine, fentanyl or similar compounds. Enteral nutrition means that the patient was fed through a tube and that the nutrition was connected to a pump next to the bed. Six of the patients stayed only one day in the ICU (Table 1), meaning that these patients described their experiences from the sound measurement day. As the other seven patients had an ICU LOS of between three and 66 days their sound experiences could be from the measurement day but also from any of the other days spent in the ICU.

Table 3 presents the results from the sound measurements and a summary of the number of early signs of ICU delirium for each patient. The overall mean sound level for all the 12 patients over the 24-hour period was 53dB (LAeq) (SD=1.11) with maximum levels ranging from 82 to 101dB (LAmax) and minimum levels ranging from 31 to 47dB (LAmin). LAF max levels exceeded 55dB 68-89% of the time (Table 3).

Four patients showed seven or more early signs of ICU delirium, according to the early signs of delirium protocol (Table 3) and Tables 4 and 5 present all the 13 patients' signs in more detail. No patient exhibited a behaviour that indicated hyperactive delirium, such as plucking behaviour, motor restlessness or aggression. A majority of the patients (nine patients) were fully awake at some time during the day and responded adequately to the staff's requests (10 patients) and a majority (12 patients) also had periods of calm sleep. In the statistical analysis we found no connection between high number of early signs of ICU delirium and high sound levels (LAeq p =0.63, r =-0.15 and LAmax p =0.99, r =-0.004).

Findings from the interview data

Table 3 presents a summary of the disturbing sounds mentioned by each interviewee. Two (nr 9 and nr 13) did not recall anything concerning sounds or other events from their time in the ICU. Five were not disturbed by noise, but remembered sounds in different ways. The interviews are presented in categories and subcategories (underlined in the text) (Table 6).

Sounds related to the setting

The environment in the patient room was experienced as *calm and peaceful* by some of the interviewees and quiet enough for them to rest and sleep at night. But the environment could also be too calm. In one case, one of the interviewees described how, on some occasions, he woke up in the middle of the night and found the room *too quiet* and this silence really scared him. When he woke up, he could not orientate himself at all and he did not know where he was or what time it was, nor could he contact the staff since he was intubated and tired. He did not see the staff and no one saw that he was awake. At that moment he felt very lonely and abandoned.

Only two patients recalled *hearing sounds from outside* . They heard sounds both from a helicopter landing and explosions related to a building project. Neither of these two interviewees was disturbed by these sounds.

Sounds related to the staff

Two of the patients said that they had *no memories of sounds related to the staff* . However, a majority of the interviewees recalled low sounds as something necessary and continuous and that they were *aware but not disturbed by the staff's presence* . Even in cases when they did not actually see the staff, they could hear them quietly moving about, carrying out their duties and talking to one another, which made the interviewees feel safe and secure. This background noise also sometimes helped the patient to distinguish between day and night since the sound level from the staff decreased at night. However, there were times when the interviewees were disturbed by sounds related to the staff. In these cases they felt helpless and they realised that they had *no possibility of escaping* from the noise. On some of these occasions the sound level was important, for example when nurses with distinctive voices talked or laughed. In other cases there were other factors that made the

sound disturbing and uncomfortable, for example when the conversations were too quiet to understand but loud enough to hear. One patient described the experience as follows:
(nr 4)"Then sometimes when you lie there, half asleep.... the staff stand in the door way and joking with each other, then I thought, are they talking about me or.?"
Some of the sounds that the patients recalled from the ICU concerned dialogues and *conversations about their own treatment and care* . For example, one of the interviewees remembered how she heard fragmentary discussions and conversations about her blood pressure which was too low and ongoing treatment, but she was too tired to ask anything. Other interviewees remembered how the staff talked directly to them, asking if they needed anything or wanted help. One patient recalled how the physician once stopped the anaesthesia for a short period and told him what had happened and about the treatment, which he really appreciated.

Sounds related to other patients in the same room.

All the interviewees shared rooms with one or two other patients and the space was divided only by thin fabric curtain. It was impossible not to hear what was going on and the patients who recalled such episodes often commented in the interview about the sounds coming from the patients beside them. Some were simply *aware but not disturbed by the sounds* and they only noticed the appearance of the others. Thus, sometimes they became *involuntary listeners* , whether they wanted to or not. Two patients described how several times they heard parts of conversations concerning the other patient in the room. These dialogues made them both curious and frustrated since they had to listen to stories without beginnings or ends. These stories gave rise to many thoughts and speculations but they had no one to talk to about them. The illness of the interviewees complicated the situation since they were tied to the bed with cables and sometimes a ventilator. In cases when there was a lot of noise around, they had *no possibility of shutting off the unwanted sound* . They found some of this disturbing noise extremely annoying and irritating. The interviewees had to listen to coughing, snoring and screaming patients and no one offered them a radio or ear protection. One of the participants said:
(nr 8) "but it was so annoying, this noise all the time, and I couldn't sleep to escape the noise, it was impossible, it was so loud it was impossible"
In addition to the annoying sounds, *some sound was experienced as scaring and frightening* . One interviewee, who was awake and doing relatively well, lay next to a critically ill patient during the night and day she spent in the ICU. She had to listen to all the discussions about the progression of the other patient's illness and hear the staff carry out advanced treatment. For example, she heard several physicians come in and perform a tracheotomy, just behind the curtain. This is what she heard:
(nr 12) "and then, once, he obviously got so bad that a lot of surgeons came in, I don't know how many there were, and they didn't speak in low voices, they spoke loudly and a lot to each other about all these things and illnesses, I know a little about healthcare so... I put my fingers in my ears, I didn't want to listen. Then I heard one of the surgeons say: but then we have to do a tracheotomy, then we have to do a tracheotomy...and, (whispering), I thought; now they will cut his throat here in the ICU. Yup, they put on operating clothes and they stood there and discussed things loudly, they didn't consider whether anyone was awake."
She thought it was awful to lie there, surrounded by all that noise, and felt helpless and fearful. None of the staff came to her and explained anything or offered her another room and it did not occur to her to ask herself.

Sounds related to the technical equipment

Even if most interviewees *lacked memories of sounds related to technical equipment,* some were well aware of the sound from the machines. Some sounds were very unexpected and experienced as disturbing and annoying, for example the alarms from the food pump, the infusion drip and the ventilator. Sometimes these sounds also negatively affected their night sleep. When they heard these unfamiliar sounds, especially at the beginning, many had *frightening thoughts about the meaning of the sound* . One of the interviewees was scared to death when she was listening to the sound from the ventilator and thought that the alarm indicated that it was about to stop and she would be unable to breathe. Furthermore some sounds were combined with physical

contact which made these noises more annoying, for example the automatic blood pressure measurement and the treatment with continuous positive air pressure (CPAP). One participant remembered:
(nr 10)"...yes, it was another sound that disturbed me, when they came in and checked my temperature, it was so annoying, when they came in with this new machine, and just pushed it in to my ear...(sound)...And it makes a noise...I thought that it was terrible... And then they use some sort of capsule or whatever it is, and then: "no, it must be wrong" and then they put it in the other ear, or so..."
After a whilst, when they got used to the environment, the patients became increasingly familiar with the different sounds. If they recognised the various alarms and sounds and if they knew that the staff took care of the machines they sometimes found the sounds both *safe and friendly* .

Sound as a part of dreams

One of the interviewees remembered sounds but they were all *integrated into her dreams* . There were no really frightening sounds, but they were disturbing and unfamiliar and she was unable to protect herself from the noise, even if she tried. One of the sounds she heard and mentioned several times was a clicking sound. This is her description:
(nr 6) "and then all the time, I heard these clicks... from someone... it was a slide projector or. they came back, over and over again."
She never received any explanation of what the sound was or where it came from.

Summary

The results from the interviews describe the variety and complexity of the various sounds in an ICU patient room. Sometimes a similar sound could be experienced as disturbing on one occasion and safe and comforting on another, for example sounds from the chatting staff or from the patient beside them. It was also obvious that all sounds were experienced subjectively and that the patients had both positive and negative experiences of the sound environment. The positive sounds, such as those from a quiet working staff, created feelings of safety, security and familiarity, whilst the negative sounds, such as those from a sick patient behind the curtain or noisy technical equipment created feelings of fear, helplessness and anxiety.

Discussion

The sound environment in the ICU and its effects on the patients is a complex area and our results further illustrate that many factors influence both the level of disturbance and the patient's experience. One factor is the noise levels in the patient room. The results of our study show a LAeq noise level of between 51dB and 55dB LAeq, which is somewhat lower than previous investigations in similar environments (Akansel and Kaymakci, 2008; Ryherd et al., 2008) but still high. This also far exceeds that recommended by the WHO (WHO, 1999). Another interesting result is the fact that the LAFmax level exceeded 55dB between 77% and 89% of the measured time for 11 of the 12 patients who were measured. This is alarming since it means that there are very few minutes per day in which the patient gets peace and quiet. The two patients (nr 8 and 12) who had the highest levels, 87% and 89% of the time respectively also mentioned in the interview that they were disturbed by different sounds. Three early signs of ICU delirium were observed in one of them (nr 8). These two patients had a LOS of only one day so what they recalled was from the measurement day.
We did not see any correlation in this study between ICU delirium and number of high sound levels, but that does not mean that there is no such relationship. First, the sample is small, this study is to be seen as a pre-study, and second, ICU delirium often develops over time, hours or days, and here we only registered early signs of ICU delirium continuously during one day. The signs these patients showed, or did not show, could be the result from another day or night with or without high sound levels. Thirdly, there are many other risk factors already identified as predisposing to ICU delirium (Ouimet et al., 2007) and this must be taken into account. Thus a larger study is needed to exclude possible confounders. The next important step will therefore be to follow a higher number of patients for a longer period, with reference to ICU delirium in connection with high sound levels and disturbing sounds.

Previous studies have shown that the hospital personnel themselves produce the majority of the noise in the ICU (Akansel and Kaymakci, 2008; Xie et al., 2009). In this study, the interviewees had few negative things to say about the sounds related to the staff even if some gave examples of negative experiences. It is important to remember that patients, especially those in the ICU, are completely dependent on the staff. Being a patient treated in an ICU, means being under the control of another and the presence of the staff can be simultaneously both comforting and disturbing. Almerud et al. (2007) describes how the patients in an ICU try not to bother the staff, but strive to please and that coping in some way depends on compliance with the current rules. The present findings point to the importance of an involved staff, sensitive to the patients' needs. Education about the effects of acoustic noise is also needed, since a previous study has shown that such knowledge is limited amongst ICU staff (Christensen, 2005). The results from the interviews, show the connections between specific events involving high noise levels and disturbance, for example when the staff speak loudly or unexpectedly loud alarms and loud treatments occur. But as often as the disturbance seems to be related to events with high noise levels, it is just as common for other factors to influence the possibility of sleep, rest and calm. Such things for example, were patients snoring, coughing and vomiting in the same room. These annoying sounds made the whole stay very uncomfortable for the patient and some of them also created feelings of insecurity, fear and helplessness. It was also obvious that noise related to the next-door patient together with noise from technical equipment were two of the most annoying and disturbing elements, which is consistent with other recent quantitative and qualitative studies (Akansel and Kaymakci, 2008; Almerud et al., 2007). The sound environment in the ICU is unique since most patients there are suffering from severe critical illness or injuries and require advanced and noisy treatment both day and night as well as high levels of staff activity. These treatments and caring activities produce noises, both loud and disturbing, some of which were mentioned in the interviews, for example the suctioning procedure (90dBA) (Jang et al., 2004) and the continuous positive airway pressure treatment (CPAP) (57-70dBA) (Cavaliere et al., 2008). As one of the interviewees narrated, "light" surgery is also sometimes performed in the patient room. Such conditions strongly suggest the need for specific interventions and much more must be done to protect the neighbouring patient. The goal of intensive care must be to create a basis for recovery; not only through advanced technical and pharmacological treatment but also through providing a healing environment (La Torre, 2006; Lower et al., 2002), including peace and quiet. Single rooms, of course, would be the best option, but if that is not possible, a reduction in the noise level in the rooms is necessary. This can be achieved through making the ceilings and walls sound absorbent, but also through action plans concerning staff behaviour (Monsen and Edell-Gustafsson, 2005). Second, technical equipment must be designed to be silent (Edworthy and Hellier, 2006; Meredith and Edworthy, 1995). It is unacceptable for machines to be positioned just behind the patient's head and produce high noise levels and loud alarm signals.

Limitations

The sound experience is related both to the sound levels and individual conditions at a specific time. It was therefore important for us to elucidate the research question using both a quantitative and a qualitative approach. The comparison of ICU delirium and high sound levels might be seen as a pre-study in view of the small sample, whilst the sound level measurements and the qualitative part provides an acceptable description of what it is like to lie in an ICU patient room. To achieve good reliability the texts of the interviews were coded by two of the authors, first by LJ and then "reproduced" by BL. Reproducibility, or "intercoder reliability" measures the consistency of shared understanding held by two or more coders and is necessary to ensure the quality of a content analysis (Krippendorff, 2004).

ICU delirium remains unrecognised in 66% to 84% of patients whether they are in an ICU, hospital ward, or emergency department (Delirium and Cognitive Impairment Study Group, 2010 (www.icudelirium.org)). The "early signs of ICU delirium" protocol, which is under development, has some limitations since it has not yet been analysed for validity or reliability. However, it captures the signs of a developing ICU delirium early on and is an efficient and easy protocol to work with. It is designed primarily to help nurses recognise and identify signs

of delirium early since they work at the bedside. The protocol is easy to administer and can be seen as a complement to other protocols such as the confusion assessment method for the ICU (CAM-ICU) (Ely et al., 2001b). The CAM-ICU screens for signs of ICU delirium only at a specific moment and moreover, the patients have to respond to specific questions, which can sometimes be hard. The "early signs of ICU delirium" protocol was developed from a study by Granberg-Axell et al. (2001), where patients in an ICU were strictly observed for several days. All the patients had been mechanically ventilated but they were only observed during the weaning process or the days after extubation. Both mechanically ventilated patients and non-ventilated patients were included in this study. It is therefore important to take into account that some of the signs, for example "no eye contact", can be connected to the sedative treatment as well as to ICU delirium. Another weakness of the protocol is that it is meant to be completed by the nurses in the patient room. Sometimes the nurses have a great deal to do and there might be a risk that they will not always have the time to identify the signs and/or complete the protocol.

Conclusion

The sound level in the patient room in an ICU is too high and the LAF max levels exceed 55dB 70-90% of the time. However, it is not only the high level of sound that is a problem for the patients. Sounds from to the neighbouring patient and from advanced medical treatments and technical equipment are experienced as disturbing and can create feelings of helplessness, excluding the possibilities of finding peace and calm which are essential for recovery and well being. In this small sample, no statistical connection was seen between early signs of ICU delirium and high sound levels, but more research in this area is needed. This knowledge is of great importance both in connection with the development of new ICU units and for the staff who work in them.

Conflict of interest

The author(s) declare that they have no competing interests.

Acknowledgements

We would like to express our thanks to the patients that shared their experiences with us and Timothy Hsu for his kind assistance in this study.

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Publication date: Oct 2012

Year: 2012

New Sentence Recognition Materials Developed Using a Basic Non-Native English Lexicon

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.5 (Oct 2012): 1342-1355.
ProQuest document link

Abstract: The objective of this project was to develop new sentence test materials drawing on a basic non-native English lexicon that could be used to test speech recognition for various listener populations. These materials have been designed to provide a test tool that is less linguistically biased, compared with materials that are currently available, for sentence recognition for non-native as well as native speakers of English. One hundred non-native speakers of English were interviewed on a range of 20 conversational topics. Over 26 hr of recorded non-native English speech were transcribed. These transcriptions were used to create a lexicon of over 4,000 unique words. The words from this lexicon were used to create the new materials based on a simple syntactic sentence structure frame. Twenty lists of 25 sentences were developed. Each sentence has 4 keywords, providing 100 keywords per list. Lists were equated for rate of occurrence of keywords in lexicon, high-frequency count (total number of affricates and fricatives), number of syllables, and distribution of syntactic structure. Listeningin- noise results for native-English-speaking, normal-hearing listeners indicated similar performance across lists. The Basic English Lexicon materials provide a large set of sentences for native and non-native English speech-recognition testing.

Full text: Headnote
Purpose: The objective of this project was to develop new sentence test materials drawing on a basic non-

native English lexicon that could be used to test speech recognition for various listener populations. These materials have been designed to provide a test tool that is less linguistically biased, compared with materials that are currently available, for sentence recognition for non-native as well as native speakers of English.
Method: One hundred non-native speakers of English were interviewed on a range of 20 conversational topics. Over 26 hr of recorded non-native English speech were transcribed. These transcriptions were used to create a lexicon of over 4,000 unique words. The words from this lexicon were used to create the new materials based on a simple syntactic sentence structure frame.
Results: Twenty lists of 25 sentences were developed. Each sentence has 4 keywords, providing 100 keywords per list. Lists were equated for rate of occurrence of keywords in lexicon, high-frequency count (total number of affricates and fricatives), number of syllables, and distribution of syntactic structure. Listeningin- noise results for native-English-speaking, normal-hearing listeners indicated similar performance across lists.
Conclusion: The Basic English Lexicon materials provide a large set of sentences for native and non-native English speech-recognition testing.
Key Words: sentence testing, speech in noise, non-native English speaker
Over the past few decades, the study of second language (L2) speech perception has emerged as an expanding research area, the results of which have implications for a range of disciplines, including linguistics, speech science, audiology, and education. More recently, there has been an increased interest regarding the speech perception of listeners attending to speech in their non-native language in adverse listening conditions, such as in noise, which mimic real-life communication situations (e.g., Bradlow &Alexander, 2007; Cutler, Garcia Lecumberri, &Cooke, 2008; Pinet &Iverson, 2010; Shi, 2010; Smiljanic &Bradlow, 2011; vanWijngaarden, Steeneken,&Houtgast, 2002). This interest comes at a time when the U.S. population continues to becomemore diverse (U.S. Census Bureau, 2010). The increasingly diverse populace requires that speech-language pathologists and audiologists alike meet the demands of clients who have communication disorders and primarily communicate in English but do not speak English as their first language (Adler, 1990; Ballachanda, 2001a, 2001b). To properly assess communication disorders for this population as well as to eventually provide evidence-based practice for these clients, it is necessary to have a better understanding of speech perception of the non-impaired (i.e., those with normal audiometric thresholds, normal speech and/or language), non-native listener.

One facet that has hindered speech perception research with non-native speakers of English is the lack of test materials specifically designed to test the nonnative English speaking population. The currently available test materials have typically been developed with other listener groups in mind (e.g., native listeners or children). They are often limited in the number of unique sentences or keywords that can be manipulated in experimental conditions. The existing test materials may thus be inappropriate for use with non-native adult listeners and can often lead to researchers developing their own project-specific materials. Creating novel stimuli is time consuming and may not allow for direct comparisons of the findings across various studies (see Bent and Bradlow, 2003, and Bradlow and Alexander, 2007, for discussions of such issues). With these issues in mind, the goal of the current project was to create a new, large set of test materials for sentence recognition that would be appropriate for both native- and nonnative English speakers. These materials could then be used to investigate speech perception as well as to assess hearing abilities in the laboratory and clinics. Our long-term research goals, of which the new test materials are a crucial component, are to gain insight into the interaction of auditory and linguistic factors in shaping first and second language speech perception processes. As a part of this agenda, we have developed these sentences in the hope that they will aid in examining applied and theoretical issues regarding native and non-native speech processing.

This article describes the development of the new Basic English Lexicon (BEL) sentence recognition materials. Although these materials share some facets with existing sentence lists (e.g., Bamford-Kowal-Bench [BKB] and Speech Perception in Noise Test [SPIN]), they are distinguished by two important features. First, they are based

on a basic English lexicon derived from naturalistic interactions with non-native speakers. We use "basic" here to indicate vocabulary used by nonnative talkers in conversations discussing everyday topics. Second, they comprise a large set of original sentences (500 total with 2,000 keywords). These design features should allow for less linguistically biased speech recognition and hearing assessments of both native and non-native listener groups as well as for testing of multiple experimental conditions.

Speech recognition can be studied using many different components of speech, including phonemes, words, and sentences. Though research using each of these stimuli sheds light onto speech processing at distinct levels of linguistic structure, we opted to focus on the development of sentence materials since they reflect ecologically valid speech structures encountered in realworld listening environments (Villchur, 1982).A potential problem with using sentence materials for experimental and clinical testing is that once listeners hear the sentence, they become familiar with the test material. Presenting the listener with the same material again can bias recognition scores because the listener can rely partially on memory to complete the task (Yund &Woods, 2010). A limited number of sentences has proven to be challenging for researchers conducting experiments with multiple experimental conditions or with smaller populations that are difficult to recruit (e.g., hearingimpaired, cochlear-implant, and non-native English speaking listeners). An even more challenging problem when testing non-native speakers of English is that they may be unfamiliar with the vocabulary used within the sentences, and the sentence structure may be difficult for them to process. This may lead them to replace the target words with words that are more familiar to them or that make sense within the sentence even though it was not the signal they heard. The lack of familiarity and the inexperience with the various levels of L2 linguistic structure can thus further bias non-native listeners' recognition scores. It is therefore crucial to use sentence recognition materials that will aid researchers and clinicians in separating perception difficulties that are linguistically driven from those that are auditorily driven in non-native listener groups.

Many researchers have turned to the BKB (Bench, Kowal, &Bamford, 1979) sentence lists (or a revised version of these sentences) when testing non-native speakers of English (e.g., Crandell &Smaldino, 1996; Mayo, Florentine, &Buus, 1997; Nakamura &Gordon-Salant, 2011; Pinet&Iverson, 2010;Van Engen, 2010). TheBKB sentence lists are composed of 21 lists of 16 sentences (1,050 keywords in total) and were originally developed using a lexicon from hearing-impaired British children to assess their auditory abilities. Bent and Bradlow (2003), for instance, used four lists from the revised BKB (Bamford &Wilson, 1979) lists to conduct English speech-perception testing for non-native speakers. There were 144 unique keywords across the four lists of sentences. After perception testing was completed, the non-native speakers of English performed a word familiarity test to determine how familiar the listeners were with the keywords. Listeners rated their familiarity on a 7-point scale ranging from 1 (I don't know this word) to 7 (I know this word). Additional words that previously have been shown to be less familiar with nonnative speakers of English (Bradlow &Pisoni, 1999) were also included to allow the entire spectrum of the 7-point scale to be used. Results indicated that listeners ranked approximately 80% of the keywords as a 7 on the familiarity scale and very few keywords were rated below a 5 on the 7-point scale. This suggests that the listeners were familiar with and at least recognized the majority of the test words. These results highlight that, at a minimum, a portion of the BKB sentences are a good alternative when testing speech perception of nonnatives (see appendix in Bent &Bradlow, 2003). However, the BKB sentences, which were aimed at testing children, include vocabulary and syntactic structures that are simpler than what non-native adults encounter in daily interactions.

Another set of test materials that are commonly used in speech perception research (e.g., Mayo et al., 1997; Tabri, Chacra, &Pring, 2011), SPIN sentences, were designed to separate differences in performance due to acoustic-phonetic versus "linguistic-situational" information. SPIN sentences are scored based on the listener's response to the perception of one noun that is in the final word position. In half of the sentences, the final word is highly predictable based on the beginning of the sentence (e.g., "A bear has a thick coat of fur"), whereas the other half of the sentences contain a final word that is not predictable based on the beginning of the sentence

(e.g., "They knew about the fur"). When SPIN sentences were created, the familiarity of the final words was controlled by using words from the Thorndike and Lorge lists (1944). These sentences were designed for use with a clinical population and initially included 250 lowpredictability and 250 high-predictability sentences (a total of 250 keywords in which the same items were used for both sentence types). Later, Bilger, Nuetzel, Rabinowitz, and Rzeczkowski (1984) reported that only eight of the original 10 lists were equivalent in difficulty for a clinical population (a total of 200 keywords per sentence type), and these lists have become known as the Revised SPIN sentences. The Revised SPIN sentences have been used for non-native English sentencerecognition testing (Mayo et al., 1997), even though many of the final keywords may not be familiar to non-native speakers of English (e.g., "flock," "mast," "rim," "mist," "notch"). Though Mayo et al. (1997) reported that highly proficient bilinguals perform near native performance in quiet for the recognition of SPIN sentences, Bradlow and Alexander (2007) developed an alternative list of 120 sentences (60 high- and 60 low-predictability sentences) that used vocabulary (e.g., "paper," "bird," "trees," "mother") that would be more familiar to a broader range of proficiency levels for non-native speakers of English. To test the familiarity of the keywords for the high-predictability sentences, non-native English speakers were asked to fill in the blank for the final key word of the sentences they tested. Sentences that were most consistently completed were included in testing. Bradlow and Alexander developed these lists to investigate non-native listeners' ability to benefit from either semantic contextual cues or exaggerations of acoustic-phonetic cues. As already mentioned, an important caveat with using the SPIN materials (and the alternative lists provided by Bradlow and Alexander) is that the amount of materials available to test the subject is limited. This is challenging when there are multiple experimental conditions or a limited number of subjects available for testing across experiments. These projects also highlight the fact that in order to obtain meaningful data, researchers currently must resort to developing their own materials for specific experiments, which is both time consuming and costly.

Though the existing materials aided in providing us with important insights into sentence recognition for various populations, we undertook the task of developing new sentence materials that would more directly address the unique requirements posed by speakers of English as a second language. In doing this, we focused on the following features: first, designing a greater number of sentence materials to enable difficult-to-recruit listeners to complete tasks under multiple experimental conditions; second, developing sentence materials using the lexicon derived from the actual non-native speakers' spontaneous productions; third, creating sentences in which the majority of non-native speakers of English would be familiar with the vocabulary items; last, constructing sentences with a simple English structure to make the task less difficult for non-native listeners and older listeners. To this end, we collected a large non-native English lexicon from the naturalistic speech of 100 non-native English speakers. Using this lexicon, we created 500 sentences. This carefully designed set of 500 sentences aims to fill a gap in the resources available to researchers and clinicians for conducting studies and assessments with native and non-native speakers of English. In addition, high-quality recordings of the new materials are available. The development of the BEL sentence materials is described below.

Method

Basic Lexicon Development Procedures

The central consideration in developing the sentence materials was to use only lexical items with which a large number of non-native listeners, who may have limited knowledge of the English lexicon and syntax (among other L2 features), would be familiar. Native speakers, of course, would have familiarity with these more basic vocabulary items as well. For the purposes of ensuring the use of the lexical items that L2 speakers were likely to know in these materials, we adopted a novel approach in collecting the basic lexicon. Rather than using second language learning textbooks or assuming that certain items would be known to L2 learners, we conducted interviews with 100 non-native speakers of English. We focused on relatively proficient L2 learners with diverse language backgrounds who reside in the United States and are representative of the larger U.S. demographic. These materials are, therefore, most appropriate for aU.S. non-nativeEnglish listener population.

The 100 participants were part of the Queens College and the broader Queens County community. Queens is the easternmost of the five New York City boroughs. It has over 2 million residents, approximately half of whom were born outside of the United States. Approximately 138 languages are spoken in Queens (New York State Comptroller, 2000).

Conversations were elicited using 20 predetermined topics (see Table 1). On average, 40 participants discussed each topic (with a range of 29-53 participants per topic). Topics were designed to obtain a large lexicon while limiting the scope of the conversation. Also, many conversational topics were closely related to other topics. The specific number and types of topics we chose were necessary to generate a large amount of vocabulary while at the same time trying to increase vocabulary repetition across participants. Research assistants, who were native speakers of American English, began the conversations by reading short, scripted introductions based on each topic. Several open-ended questions were used to prompt conversation. These questions were mainly used for those participants who were less talkative. For many participants, dialogue flowed naturally, and scripted questions were not necessary.1 On average, each participant discussed eight conversational topics and spoke for approximately 2 min per topic. In total, 795 short conversations, totaling more than 26 hr of conversational speech, were digitally recorded using handheld SONY IC recorders with an attached lapel microphone. All procedures were approved by the Institutional Review Board at Queens College of the City University of New York. Participants were provided with a written statement regarding the research project. Written consent was not obtained as anonymity was maintained for all participants. Payment was not provided for this portion of the research project.

The next step in creating the lexicon involved orthographically transcribing the participants' speech during the interviews. Each conversation was transcribed by one transcriber and checked for reliability by a second transcriber. Words that could be identified clearly from their pronunciation and identified by the context in which they were used were included as lexical items. Even though some non-native productions differed from the native targets, we opted to include them because at this point we were concerned not with the accuracy of their pronunciation but rather with their active knowledge of these lexical items. Crucially, both transcribers had to agree that the words used revealed familiarity with the meaning and appropriate use in the sentence. From these data, a lexicon was created for each individual talker, including all the words used by that talker. Each lexical item was labeled for syllable count and part of speech. On average, each participant used 385 unique words per recording session. The first time a word was used, it was considered unique. All words (including every word spoken) used across all talkers were then combined into a master lexicon. In the master lexicon, each word was marked for the frequency with which it occurred (i.e., the number of times repeated) across all participants. The final lexicon included more than 200,000 spoken words, with 4,062 unique words (excluding function words) spoken with varying rates of occurrence. The words from the master lexicon were used as the vocabulary to develop the test sentences.

Background Information for Speakers Used to Create Lexicon

All participants completed a questionnaire modeled after the Northwestern University Subject Database questionnaire (Chan, 2012) developed by the Department of Linguistics at Northwestern University. Questions addressed the speakers' demographic information, language background, English experience, and so forth. Results from the questionnaire revealed that participants had a wide range of linguistic and educational backgrounds, English experience, and English proficiency levels. Of the 100 non-native English speakers, 55 participants were women, and 45 were men. Participants ranged between 18 and 73 years in age (M = 32 years, SD = 13 years). The participants represented 28 different nationalities and 16 native languages (see Tables 2 and 3, respectively). Sixty-nine of the participants spoke two languages (native language and English), 29 spoke three languages, and two spoke four languages. Not all 100 participants reported responses for their race and ethnicity; however, 70 of the participants reported being non-Hispanic or Latino, while 28 participants identified as Hispanic or Latino. Of those participants who reported their race, 50 identified as Asian, while 45

identified as White. The majority of our participants spoke Spanish, Mandarin, or Korean as their native language. It was important for us to have a very diverse group of cultures and native language backgrounds so that our sentence materials would not be biased toward one ethnic group or one native language background. The language background of our participants reflects demographic projections by the U.S. Census Bureau that between the years of 2000 and 2050, the Hispanic population in the United States will increase by 188%, while the Asian population will increase by 213%. Individual background information of the 100 participants is provided in Supplemental Material Table 1.

The average age at which participants began learning English was 12.8 years old (range = 8-39 years old). Participants had an average of 5.4 years of formal English language classes in their home country (range = 0-18 years). Forty-six participants had no formal English education; four began their English education in primary school, 15 in secondary school, 22 in college, and 13 in graduate school. Fifty-nine participants were full-time students (it should be noted that, of these, many were "nontraditional" undergraduates; Queens College has, for example, many students returning to school to change careers or who began college later in life), 16 identified as white-collar workers (including a microbiologist, a lawyer, an accountant, and an occupational therapist), 23 identified as blue-collar workers (including an electrician, a waiter, and a room attendant), and two were retired.

Sentence Development

A second major concern in developing these new materials was the need for the non-native listeners to be familiar with the syntactic structure in which the lexical items or keywords occurred. To ensure the relative simplicity of the syntactic structures and consistency across sentences, we used a predetermined syntactic frame to create the sentences. The basic syntactic frame that was used to develop the sentences consisted of the following obligatory and optional (in parentheses) word categories: (D), (A), N or Pro, (Adv), V, (Adv), (P), (D), (A), (N), where D = determiner, A = adjective, N = noun, Pro = pronoun, Adv = adverb, V = verb, and P = preposition. No complex syntactic frames with, for example, embedded or preposed dependent clauses, or with complementizer phrases, were included. In addition, only two members of the category could be coordinated using the form ofXand X, such as Noun and Noun. Grammaticality, meaning, and the number of keywords (i.e., the words within the sentence that serve as the targets for the sentence-recognition materials; these are shown in Table 4 and Supplemental Material Table 2 using capital letters) determined how many and which of the optional categories were included. There were 12 variants of the basic structure that were the most common and accounted for 70% of the BEL sentences. An example of the 12 variants is shown in Table 4. The remaining 20% of the sentences, though less common, were also similar types of variants of that original syntactic frame. Using the original syntactic frame provided us with sentences approximately equal in length (in terms of the number of total words) and complexity and an equal number of keywords. All keywords were derived from the master lexicon (described above). The complete list of the 500 sentences, each composed of five to seven words with four keywords, can be found in Supplemental Material Table 2.

Once 500 sentences were written, 16 native speakers of English (11 women, 5 men; mean age = 31 years old) were asked to read the sentences. They were asked to flag any sentences that were confusing, odd, did not make sense, or did not sound like a typical English sentence. Two lab members (including the first author) reviewed comments from the 15 native-English-speaking readers. Although all comments were taken into consideration, only those sentences that more than one reader critiqued were edited. An example of a native-reader critique was, "It sounds more natural to start this sentence with 'My Uncle' rather than 'The Uncle.'" A more substantive comment was made with respect to the following sentence: "The ARMY and GENERAL FOUGHT a BATTLE" (in which the keywords of the sentence are capitalized). Three separate readers commented that the combination of "the ARMYand GENERAL" sounded unnatural. This sentence was eventually edited to "The STRONG ARMY WON the BATTLE." More than one native-Englishspeaking reader critiqued 40 of the 500 sentences. All 40 sentences were edited or rewritten to address the readers' concerns. Subsequently, a group of 15 non-native English speakers (10 men, 5 women; mean age = 45 years old) were

asked to read the revised sentences. The average age at which these readers began learning English was 22 years old. The native languages of these readers included German, Igbo, Mandarin, Polish, and Spanish. These readers were also asked to flag any sentence that did not make sense to them or any sentence in which they did not understand the vocabulary used. All comments by these readers were taken into consideration. Words were replaced for any sentence that even one reader indicated he or she was not familiar with or if the reader indicated the sentence did not make sense. The majority of comments non-native readers made indicated difficulty with the whole meaning of the sentence and how it related to the real world, or at times the non-native readers pointed out incorrect use of grammar (which in actuality was correct).

One example of an original sentence with which several non-native readers had difficulty is "The FISH SWAM SLOWLY in the BOWL," which received comments such as "I don't understand the word 'bowl' used here" and "This sentence sounds strange." The sentence was edited to "The FISHSWAMSLOWLYin the LAKE." The common term "fishbowl" makes the use of "bowl" in this context seem natural to a native speaker. However, if a non-native speaker is unfamiliar with the term "bowl," most likely understood as kitchenware, the use of this word in this context would seem very strange. Another example included the original sentence "The COOK MADE FLAT NOODLES." Three non-native readers stated the following comments: "I don't understand 'flat' in this sentence"; " 'Cook' doesn't make sense in this sentence"; and "It should be 'cooker' instead of 'cook.'" The sentence was edited to "The CHEF MADE FRESH NOODLES." The use of "cook" as a noun is seemingly common to a native speaker of English but potentially confusing to a non-native as "cook" is often initially learned as a verb. In addition, although "flat" is a fairly easy adjective, its use with food may be a bit atypical. The substitution of "fresh" was chosen since this word is more commonly associated with food. A final example of a comment made by one reader that did not result in the sentence being edited was in response to the following sentence: "She WASHED and DRIED her CURLY HAIR." The non-native reader commented, "It should be 'hairs' instead of 'hair.'" No changes were made since this was an erroneous grammar edit, and the reader did not have difficulty understanding the meaning or vocabulary used within the original sentence. In total, 85 sentences were modified.

BEL Sentence List Development

The final 500 sentenceswere divided into 20 different test lists (each including 25 sentences and 100 keywords) based on vocabulary (including the rate of occurrence of each word in the master lexicon), syntactic structure (distributing different types of structures across lists), syllable counts, and high-frequency speech information (i.e., the distribution of fricative and affricate sounds to account for perception difficulties for listeners with high-frequency hearing loss). Function words were not included in the affricate and fricative count. Each list of 20 sentences contained 100 target words. Across the 2,000 keywords, 939 unique keywords were used. Ideally we desired that all 2,000 keywords be unique, that is, never repeated across any of the sentences. Having zero repeatability of keywords was a desired criterion because hearing a specific key word in one listening condition could prime a listener to correctly repeat that sameword in another potentially more degraded listening condition. However, in reality with our constraints of using only vocabulary from our non-native elicited English lexicon, this criterion was, in fact, impossible. There were only a limited number of words we could use without repeating to generate a large number of sentences with four keywords that were also grammatically and semantically correct. This is a problem not specific to our sentences alone, however; it is a common problem both in BKB sentences (in which the developers of these sentences also had similar constraints that they were creating their stimuli based on naturally produced speech of hearing-impaired children) and the Harvard IEEE sentences (IEEE Subcommittee, 1969) (which did not necessarily have a lexicon restraint, but the developers were faced with trying to create 720 sentences with 3,600 total keywords). The amount that the keywords do repeat across our sentences is in alignment with these popular sentence lists in that 47% of our keywords are unique, whereas 47% and 52%of keywords are unique in the BKB and IEEE lists, respectively.

Recordings

Two native-English female talkers (26 and 27 years old) and one native-English male talker (age 34) each recorded the complete set of 500 sentences in a soundtreated room. Sentences were digitally recorded at a 44.1 kHz sampling rate with 16-bit resolution. A custom-designed software program created in MaxMSP (Cycling, 74' Version 5.0, 2008) using an Apple iMac computer connected to a MOTU Ultralite mK3 digital-analog convertor and a Shure SM81 cardioid condenser microphone with pop filter attached, placed 12 in. (parallel) from the talkers' lips, were used to record the sentences. The talkers were instructed to speak naturally. The text for each sentence was presented to the talker via a 27-in. Apple LED cinema display that could be visualized clearly through the double-paneled window of the sound-treated room. The talkers could also see a VU meter that indicated the target talking sound level. The 500 recordings were digitally edited using Sound- Studio to remove silence at the beginning and at the end of each sentence. Some sentences were rerecorded because of speech disfluencies or extraneous noises in the recording. All files were then root-mean-square (RMS) equalized, using Praat (Boersma &Weenink, 2011), to the same pressure level of 0.1 Pa. The length (in seconds) of each wave file for all three talkers is reported in Supplemental Material Table 2. All sentence recognition testing reported in this article was conducted using the recordings obtained by the first female talker. No experimental testing has been conducted using the other two talkers at this point. All of the highquality audio recordings are available for use by request to the first author.

Listening Test Procedure

To determine whether the 20 lists we created contained sentences and lexical items that were equally easy or difficult to recognize and that performance across lists would be correlated under identical listening conditions, we asked native speakers of English to listen to the sentences in noise.We decided to focus initially on native speakers of English in order to obtain data about the relative difficulty across sentence lists on a more homogeneous participant pool (and therefore at this time, data for non-native speakers of English and hearingimpaired listeners will not be included). Seventeen normal-hearing native-English-speaking listeners (mean age = 23 years, SD = 4 years; 6 men, 11 women) participated. The Institutional Review Board at Queens College of the City University of New York approved all listening test procedures. Listeners were paid for their participation and provided written informed consent. Prior to participation, all listeners had an otoscopic evaluation to ensure clear ear canals. All listeners had normal hearing thresholds (<20 dBHL) bilaterally tested with standard clinical audiological procedures (American Speech-Language-Hearing Association, 2005) at octave frequencies between 250 and 8000 Hz on a twochannel Grason Stadler clinical audiometer and TDH headphones.

Listeners were seated in a comfortable chair in a double-walled, sound-treated room. Stimuli were passed to an MOTU Ultralite mK3 digital-analog convertor, passed through a HeadAmp 6 Pro headphone amplifier, and output to Etymotic ER1 insert earphones with disposable foam insert eartips (13 mm) attached. Each listener was presented with all 500 sentences, separated into 20 different lists of 25 sentences. The presentation order of the lists was randomly selected. The level of the target sentences was fixed at 65 dB SPL, measured using a GRAS Sound and Vibration IEC Ear Simulator coupled to a preamplifier. Sound pressure levels were based on the average RMS pressure of the sentence files. The sentences were presented in the presence of noise (16 bit, 22 kHz sampling rate) spectrally matched to the long-term average spectra (LTAS) of the 500 test sentences. The noise was generated using MATLAB by passing a Gaussian white noise through a Finite Impulse Response filter with a magnitude response equal to the LTAS of the 500 sentences spoken by the first female talker. The level of the competing noise was fixed at 70 dB SPL, providing a signal-to-noise ratio (SNR) of -5 dB. The target speech and noise masker stimuli were mixed in real time with custom software created using MaxMSPrunning on an Apple iMac computer.One target sentence was played on each trial, and a random portion of the 60-s noise masker was presented 1 s longer than the target sentence (500 ms prior to the beginning of the sentence and 500 ms at the end of the sentence).

Listeners were first presented with eight sentences (from the Revised BKB sentence materials) spoken by the

same female talker used to record our target sentences. This allowed listeners a practice period listening in noise and familiarizing themselves with the talker's voice and the task before the experimental testing began. Listeners were presented the practice sentences at 5, 0, and -5 dB SNR. The number of sentences presented at eachSNRvaried depending on the participant's performance (i.e., if listeners were having difficulty with the task, they were allowed extra sentences at the easier SNR before moving to the more difficult SNR; otherwise, the first three sentences were presented at 5 dB SNR, the next three at 0 dB SNR, and the last four sentences at -5 dB SNR). Listeners came in on two separate occasions to complete all of the testing. All listeners completed their second test session within 7 days of the first test session, and on average the two test sessions were separated by 4 days. Subjects completed 10 lists per day.

Listeners were asked to repeat the sentences that they heard. Specifically, they were instructed to repeat any word that they heard, regardless of whether the sentence made sense or they had missed portions of the sentence. Listeners' responses were scored online by an examiner seated outside of the double-walled soundtreated room. Listeners' responses were also digitally recorded using a handheld Sony digital-voice recorder with an external lapel microphone. The recordings were scored for reliability purposes by a second examiner. Scores that were not in agreement between the two examiners were reassessed by a third examiner, and a score was agreed on.

Results

The specific question we addressed with this listening test was whether the word recognition success was similar across the 20 lists we created. In other words, we wanted to know whether the 20 lists were equally easy or difficult to recognize and that performance across lists was correlated under identical listening conditions. As reported earlier, all online scoring was reliability checked, and agreement between the two testers occurred in 96% of the total trials. A third examiner was used to determine the final score in the event of scorer disagreements. Average data and standard deviations from the 17 listeners are presented in Table 5 along with the distribution of syllable count, high-frequency count, and rate of occurrence of keywords within the lexicon used to equally divide the sentences across lists. A repeated measures analysis of variance (ANOVA) was used to test differences in performance across lists. The ANOVAwas significant at the $p < .05$ level, $F(19) = 11.15$, $p < .001$. To determine significant differences between the lists, we used post hoc pairwise comparisons based on estimated marginal means with a Bonferroni adjustment for multiple comparisons. These results indicated that 17 of the 20 lists were not significantly different from each other in difficulty with respect to mean performance for each list. Three of the lists were significantly different (List 9 yielded significantly lower scores compared with all lists except Lists 4 and 15, and Lists 18 and 20 yielded significantly higher scores compared with Lists 4, 8, 9, 14, and 15 and Lists 4, 7, 8, 9, 13, 14, and 15, respectively) than the other lists (p values ranging from <.001 to .044).

Redistribution of Sentence Lists 9, 18, and 20

We redistributed the sentences within Lists 9, 18, and 20 in an attempt to equate the difficulty of these three lists. Sentences were redistributed based on the performance of the 17 native-English-speaking listeners and the content of each sentence (syllable count, highfrequency count, syntactic structure, and rate of key word occurrence within the developed lexicon). That is, we used sentence performance to redistribute sentences that listeners performed consistently poorly on with sentences that many listeners consistently performed well on within Lists 9, 18, and 20, while maintaining similar distributions for syllable count, high-frequency count, syntactic structures, and rate of key word occurrence according to the overall design features. The distribution was based on modeling sentence recognition performance for each list, which resulted in mean performance scores based on the other 17 lists.

Perception Testing After Revision of Lists 9, 18, and 20

An additional 20 native-English speaking listeners (mean age = 23 years, SD = 5 years; 3 men, 17 women) with normal audiometric thresholds were tested on the recognition of all 500 sentences (20 lists). Average data and

standard deviations from the 20 listeners are presented in the last two columns of Table 5. Table 6 illustrates mean and median performance, standard error, and the lower and upper bound of a 95% confidence interval for performance for each list.

We conducted a repeated measures ANOVA to assess differences in mean performance across the 20 lists. The repeated measures ANOVA was significant at the $p < .05$ level, $F(19) = 4.409$, $p < .001$. To determine which list pairs had significantly different performance scores, we used post hoc pairwise comparisons based on estimated marginal means with a Bonferroni adjustment for multiple comparisons, which indicated that four list pairs were significantly different at the $a = .05$ level. List Pairs 11 and 14 ($p < .001$), 11 and 15 ($p = .008$), 14 and 16 ($p = .009$), and 15 and 16 ($p = .010$) were significantly different from each other (significant differences for list pairs are shown in Table 7).

To determine whether performance across lists was correlated under identical listening conditions, we calculated correlations between performance scores. Bivariate correlations for all 20 lists indicated that performance scores for the largemajority of list pairs were significantly correlated. The performance scores of the two groups of listeners (those that listened to the original 20 lists and those that listened to the 20 lists with Lists 9, 18, and 20 revised) were used for these computations. Therefore, the sample size for these correlationswas 37 for Lists 1-8, 10-17, and 19. A sample size of 20 was used for the correlations including Lists 9, 18, and 20. Pearson coefficients for all 210 list pairs are shown in Table 8.

General Discussion

The spontaneous speech of 100 non-native English speakers was used to create 500 new sentences for speech-recognition testing aimed at both native and non-native listeners. Though linguistic biases can never be removed from open-set speech recognition testing for non-native speakers of English, these materials were designed to provide a less linguistically confounding test tool. Twenty new test lists were created with 25 sentences each, providing 2,000 scoreable keywords. Recognition performance of native-English speaking, normal-hearing listeners at a fixed SNR of -5 dB indicated that overall the lists were equally difficult, and the majority of performance scores between lists were significantly correlated.

There has been tremendous progress understanding non-native speech perception in adverse listening conditions in recent years (e.g., Bradlow &Pisoni, 1999; Cutler et al., 2008); however, there are currently no standards for determining whether poor speech recognition scores obtained by non-native listeners on Englishlanguage speech recognition tests are due to their linguistic inexperience with the English language or various auditory impairments. It has been suggested by many (e.g., Gelfand, 2009; Nakamura &Gordon-Salant, 2011) that one way to deal with this issue is to test non-native speakers of English in their native language. To this end, new derivations of the Hearing in Noise Test were created in eight languages (Soli&Wong, 2008). This work is helping to fill a much-needed void in speech-in-noise assessments conducted in languages other than English. However, there are several disadvantages to this approach for testing in theUnited States. First, all clinics would need to be equipped with speech-recognition tests in the various languages. Second, test materials may not be available in a listener's native language. Third, the examiner would need to be fluent (or at least highly proficient) in the test language in order to score the listener's responses or at a minimum have access to a trained interpreter who could score the responses. Last, we argue that it is imperative to consider those listeners who communicate predominantly in English but are non-native speakers of the language (e.g., someone born and reared outside of the United States but who now works, shops, dines, and so forth in an English-speaking community). For these listeners, their communication disorder is most likely being experienced predominantly in English because they are using English, not their native language, throughout the course of their day. Therefore, evaluating speech recognition in English, rather than their native language, may be functionally more relevant.

As a first step in assessing list equivalency for the new recognition materials, we conducted perception testing on native-English speakers with normal hearing. We opted to focus on native speakers of English in order to

gain an insight into the relative difficulty across sentence lists on a more homogeneous subject pool. The use of normal-hearing, monolingual English speakers allowed us to probe whether there were any materialand/ or signal-related variations within the sentences or recordings that could cause significant differences in performance across lists.

Correlations between performance on one list compared with performance on a different list showed that out of 210 list pairs, 87% of the correlations were significant at an alpha of .05 or greater (see Table 8), indicating equal perceptual ease or difficulty across the majority of lists. The sample size used for correlations for Lists 9, 18, and 20 was smaller (n = 20) than the sample size used for the remaining lists (n = 37). When these lists were not included in the analyses, significant correlations between list pairs increased to 92%. These data can be used when deciding on lists for research designs that maximize the equivalency across lists.

It is important to note that the original SPIN sentences, though equivalently difficult for normal-hearing listeners, were not found to be equivalent in difficulty for hearing-impaired listeners (Bilger et al., 1984). This resulted in a reduced number of revised materials that provided equal difficulty across lists for those listeners with hearing loss. However, we opted not to test nonnative English listeners or hearing-impaired listeners in this initial phase. Both groups are heterogeneous by nature, and for a proper analysis with these types of listeners, a large sample size is needed that is beyond the scope of this article. The BEL sentences remain to be tested on a clinical population and a large non-native English speaking population. Until these data are collected, we cannot confirm that all 20 lists are equally difficult for these listener groups. However, throughout the development of these sentences, the demands of hearingimpaired and older listeners were taken into account.We evenly distributed thenumber of high-frequency phonemes (fricatives plus affricates) across lists to account for perception difficulties for those listeners with high-frequency hearing loss (see Hedrick, 1997; Zeng &Turner, 1990). We also kept the length of the sentences within seven words to help make these lists a potential test tool for older listeners or other populations with cognitive or memory limitations that may lead to greater difficulty recalling longer strings of words (see Wingfield, Poon, Lombardi,&Lowe, 1985). It is our hope that these considerations will allowus to use theBELsentences for perceptual testing with diverse listener groups.However, itmay be that after more data are collected, a revised version of the BEL sentences will be needed for use with specific clinical populations.

A possible shortcoming of the BEL sentences is that all non-native speakers used to create the lexicon were residents of Queens, New York. Therefore, their vocabulary could be specific to American English speakers and non-natives living in urban areas. However, during the creation of the sentences, we tried to avoid words that participants used that were specific to the New York City metropolitan area, such as "subway" or "transit." We also intentionally asked our talkers to elaborate on experiences within their home country in the hope that this would broaden the range of vocabulary used. We believe that the resulting lexicon from which we derived keywords for BEL sentences reflect more general knowledge and experiences that would be common to many U.S. residents.

Planned future work in our laboratories includes the collection of a large set of normative data from 100 nonnative speakers of English for all 20 lists. The findings from this project extension will be able to directly address some of the issues raised above. As expected, our pilot data show a large variability between participants, as a result of differences in linguistic history and English experience. It is important to note, though, that a similar pattern of mean performance between lists was observed for non-native listeners compared with the native results reported above.

Finally, it is important to keep in mind that the perception data reported were collected using only one talker (SR). No experimental testing has been completed with the other two talkers, although recordings are available for all three talkers. The data reported above are specific to the acoustics of talker SR's recordings, and it cannot be assumed that the reported results will be replicated with the other talkers. Out of our three talkers, SR had the slowest rate of speech (see Supplemental Material Table 2), which may aid in non-native speech

perception. Furthermore, all perception testing was conducted at one level of distortion (-5 dB SNR). It is possible that at other SNRs or in other types of background noise (e.g., informational maskers), list equivalency may vary from that reported above. Healy and Montgomery (2007) suggested that sentences that are more or less difficult with respect to recognition in noise tend to retain their relative level of intelligibility even when overall performance level changes significantly and for different levels of listener ability. They caution, however, that sentences may not retain their relative level of intelligibility when sentence intelligibility is compared across different types of signal distortion. It is therefore crucial to make these sentences available to be tested in other experimental paradigms such that we can gain more insight into the various talker-, listener-, and signal-related factors that affect word recognition for these materials.

Conclusions

The goal of this project was to develop new sentence materials that could be used to test speech recognition for various listener populations. In our approach, we were guided by two major considerations: one, to use lexical items and syntactic structures appropriate for use with non-native listeners and, two, to generate a large set ofmaterials that could be used inmultiple experimental conditions and with difficult-to-recruit listener populations. We were able to address these considerations by deriving a large basic lexicon fromecologically valid communicative situations (i.e., spontaneous dialogues) with non-native speakers and embedding these lexical items in simple syntactic frames. The resulting set of materials consists of 20 lists of 25 sentences for a total of 2,000 target keywords. The development of these test materials was a major methodological goal of the present study. An important finding reported in this article is that native- English listeners found these lists to be equivalent in difficulty. Although these results provide important knowledge about the test materials in this stage of the project development, we are hopeful that similar results will be obtained for non-native and other clinical populations when tested using the BEL sentences.

Acknowledgments

This work was supported in part by the Grant Program for Projects on Multicultural Affairs from the American Speech-Language-Hearing Association and the Undergraduate Research/Mentor Experience at Queens College. This project could not have been completed without the tremendous commitment from the undergraduate and graduate students in the Speech and Auditory Research Lab at Queens College and the UTsoundLab at the University of Texas at Austin. The authors are especially thankful to Stacey Rimikis for her incredible dedication to this project. Portions of this project were presented at the 2010 American Speech-Language-Hearing Association convention in Philadelphia, PA; the 160th meeting of the Acoustical Society of America in Cancun, Mexico, in 2010; and the 2011 New York State Speech-Language-Hearing Association convention in Saratoga Springs, NY. A preliminary report of this project was published by Lauren Calandruccio in The ASHA Leader (October 12, 2010, edition).

Footnote

1As an example, the scripted introduction and the follow-up questions for the topic of consumption and consumerism are provided: "Many Americans love to shop. As a culture, we tend to buy too much and spend way too much money. We are also getting a bad reputation for wasting too much." Following this introduction, the below scripted questions might be used as prompts: (1) How important is shopping in [home country]? (2) Do people typically only buy what they need, or do they shop for fun? (3) Do you enjoy shopping? Why/why not? (4) After you've paid all your bills, what do you do with money you have leftover? (5) Do you see a problem with people buying too much stuff? How does this affect the economy? The environment? (6) Do people in [home country] usually shop with credit cards or cash? Do you usually use a credit card or cash? Why?

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received September 16, 2011
Revision received January 27, 2012
Accepted February 21, 2012
DOI: 10.1044/1092-4388(2012/11-0260)

Publication date: Oct 2012

Year: 2012

The Effect of Technology and Testing Environment on Speech Perception Using Telehealth With Cochlear Implant Recipients

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.5 (Oct 2012): 1373-1386.
ProQuest document link

Abstract: In this study, the authors evaluated the effect of remote system and acoustic environment on speech perception via telehealth with cochlear implant recipients. Speech perception was measured in quiet and in noise. Systems evaluated were Polycom visual concert (PVC) and a hybrid presentation system (HPS). Each system was evaluated in a sound-treated booth and in a quiet office. For speech in quiet, there was a significant effect of environment, with better performance in the sound-treated booth than in the office; there was no effect of system (PVC or HPS). Speech in noise revealed a significant interaction between environment and system. Subjects' performance was poorer for PVC in the office, whereas performance in the sound-treated booth was not significantly different for the two systems. Results from the current study were compared to results for the same group of subjects from an earlier study; these results suggested that poorer performance at remote sites in the previous study was primarily due to environment, not system. Speech perception was best when evaluated in a sound-treated booth. HPS was superior for speech in noise in a reverberant environment. Future research should focus on modifications to non-sound-treated environments for telehealth service delivery in rural areas.

Full text: Headnote

Purpose: In this study, the authors evaluated the effect of remote system and acoustic environment on speech perception via telehealth with cochlear implant recipients.
Method: Speech perception was measured in quiet and in noise. Systems evaluated were Polycom visual concert (PVC) and a hybrid presentation system (HPS). Each system was evaluated in a sound-treated booth and in a quiet office.
Results: For speech in quiet, there was a significant effect of environment, with better performance in the sound-treated booth than in the office; there was no effect of system (PVC or HPS). Speech in noise revealed a significant interaction between environment and system. Subjects' performance was poorer for PVC in the office, whereas performance in the sound-treated booth was not significantly different for the two systems. Results from the current study were compared to results for the same group of subjects from an earlier study; these results suggested that poorer performance at remote sites in the previous study was primarily due to environment, not system.
Conclusions: Speech perception was best when evaluated in a sound-treated booth. HPS was superior for speech in noise in a reverberant environment. Future research should focus on modifications to non-sound-treated environments for telehealth service delivery in rural areas.
Key Words: cochlear implants, telehealth, telepractice, speech perception, Polycom

With the help of technological advances in cochlear implants (CIs) and expanding candidacy criteria over the last 2 decades, a significant number of CI recipients have achieved open-set speech perception (Battmer, Reid,&Lenarz, 1997;Gifford, Dorman, Shallop, &Sydlowski, 2010; Parkinson et al., 2002). Speech perception can be evaluated using a wide range of stimuli in quiet and in noise to track progress over time. Speech-perception testing is a routine part of clinical CI recipient appointments and is typically performed in a sound-treated booth using calibrated speech material at a predetermined sound pressure level (SPL; Gifford, Shallop, &Peterson, 2008; Luxford and the Ad Hoc Subcommittee, 2001). CI recipients may undergo speech-perception testing, in addition to other programming and objective tests, 6-10 timeswithin the first year of device use, with additional testing required annually for monitoring progress with the CI. As with most specialty areas in health care, clinical CI programs are often located in more densely populated regions; therefore, the ability to return for

necessary follow-up appointments can be challenging for CI recipients who live far from a CI center. Telehealth services may be more feasible and cost effective for patients who live a significant distance from the CI center. Telehealth services have become more widespread in recent years, allowing the remote exchange of health information across various disciplines, including medicine, psychiatry, dentistry, and speech-language pathology and audiology (American Speech-Language-Hearing Association, 2005; Fricton &Chen, 2009; Geoffroy et al., 2008; Reynolds, Vick, &Haak, 2009). Telehealth services have primarily been provided using the Internet and/or videoconferencing technology to extend health services, as well as nonclinical information such as research and education, to geographical areas where needed services may be limited (Bickett-Weddle, Aquilino, &Roth, 2008; De Las Cuevas, Arredondo, Cabrera, Sulzenbacher, &Meise, 2006). As with any interactive technology, and especially when disseminating protected health information across the Internet, it is essential to use technology that meets clinical service delivery standards. As the use of telehealth becomes more prevalent, evidence from research is needed to set minimal guidelines for the appropriate use of this technology and to quantify the impact of technology and remote locations on the quality of services provided.

Telehealth for CI recipients has been successfully applied to intraoperative testing (Shapiro, Huang, Shaw, Roland, &Lalwani, 2008), programming (McElveen et al., 2010; Ramos et al., 2009), and objective tests (Hughes et al., 2012); however, researchers investigating speech perception via telehealth have found additional challenges (Hughes et al., 2012). Because speech-perception scores are used to track progress in CI recipients, accurate and consistent administration is necessary in order for telehealth to be used routinely for service delivery. It is also important to evaluate speech perception with materials that are used in a clinical setting; these materials include a variety of stimuli, such as monosyllabic words, sentences in quiet, and sentences in noise.

Ribera (2005) evaluated the remote use of the Hearing in Noise Test (HINT) with normal-hearing listeners using Meeting Point (Version 4.6) and ViGO videoconferencing. Results revealed that administration and scoring of the HINT via a remote connection was equivalent to face-to-face administration and scoring. Although the study results revealed that the remote application of the HINT was acceptable, it was performed with normalhearing listeners seated in a sound-treated booth. Acoustic differences between sound-treated booths and alternative test environments (e.g., an office setting, with less stringent requirements for noise and reverberation) could have a much larger impact on listeners with a CI, affecting the consistency of results obtained in the same setting and the comparability of results across different settings.

McElveen et al. (2010) and Ramos et al. (2009) evaluated speech perception in CI recipients by using maps created over a remote connection comparedwithmapsmade in the traditional face-to-face condition. The McElveen et al. study found no significant difference in Consonant- Nucleus-Consonant (CNC) and HINT scores across the two mapping applications. Ramos et al. also found no significant differences in performance on disyllabic word scores in their study. In both studies, however, speechperception testing was performed in the standard faceto- face setting after a remote-mapping session, not over an Internet or videoconference connection at a remote location. These studies have demonstrated that creating CI maps over the Internet equates to similar speech-perception outcomes as those from maps made in a standard face-to-face manner. However, it is necessary to determine whether all CI measures, including speech perception, can be administered via telepractice for consistent and comparable documentation of outcomes with the CI. Because a wide range of speech materials are used to assess speech recognition with CI recipients, investigating remote applications of the HINT and other speech stimuli with varying amounts of linguistic content is important.

In a study by Hughes et al. (2012), the authors conducted a comprehensive set of CI measures using Polycom (Clary Business Machines Co., Pleasanton, CA) videoconferencing and a secure socket layer virtual private network (SSLVPN) using an ABA study design. CI measures of map levels, electrode impedance, psychophysical thresholds, and electrically evoked compound action potentials (ECAPs) were equivalent across test settings (remote vs. face-to-face). However, speech perception in quiet and in noise was poorer when using

the Polycom videoconference technology in a non-soundtreated room at the remote site, compared with the traditional face-to-face condition in a sound-treated booth. It was unclear whether speech perception scoreswere poorer in the remote condition because (a) speech-perception materials were transmitted over a videoconference link from the experimenter site, which may have negatively affected the speech signal provided to the recipient at the remote end (e.g., limited transmission quality, Internet bandwidth, and compressed audio); (b) ambient noise and reverberation were higher at the remote site because of nonstandard test environments; or (c) a combination of both equipment and environment effects. It is important to investigate these differences before speechperception testing can be routinely used for telepractice with CI recipients. In the current study, we investigated the relative contribution of equipment and environment on speech perception tested in the remote condition for individuals with CIs.

One standard to help guide acceptable test conditions for remote applications is that from the American National Standards Institute (ANSI) for Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms (ANSI S3.1-1999). ANSI advises that audiometric test roomsmeet specific SPLs in order to permit testing to a 0-dB hearing threshold level (HL). These standards include maximum allowable SPLs at octave frequencies from 125 Hz to 8000 Hz; however, ANSI does not specify allowable SPLs for speech-perception testing. It has been shown that excessive roomnoise and reverberation negatively affect speech perception, especially for individuals with hearing loss (Beutelmann &Brand, 2006; Poissant, Whitmal, &Freyman, 2006). It is unfortunate that sound-treated spaces are usually not available in rural communities where speech-perception testing may be conducted via remote methods. Investigating the most favorable testing configuration may help optimize speech-perception testing in conditions where soundtreated booths are not accessible.

Finally, little is known about the perceptual effects of transmitting speech through the Internet or videoconferencing equipment for CI recipients or other individuals with hearing loss. Ribera (2005) suggested that transmitted speech material over a network does not compromise the signal presented to listeners at the remote end; however, subjects in that study had normal hearing and were seated in an acoustically controlled sound booth. It is unclear whether results would be similar for CI recipients using videoconferencing technologies. Videoconferencing technologies are limited by the amount of audio information that they can transmit over Internet protocol (IP) bandwidth restrictions (Polycom VSX 7000 Product Reference Guide, 2003, p. 14). Because of bandwidth limitations, audio information presented through a videoconference link is first compressed (encoded) to reduce the used bandwidth for delivery to the recipient site. At the recipient site, the signal is then decoded before introduction to the listener. Several factors may affect the signal during this process, including limited frequency response of the system (human ear is 20 Hz-22 kHz; most technologies have more limited bandwidth), low bit rates, muting or interruption of sound, artifacts from noise sources, and packet (data) loss from compression (Orto&Karapetkov, 2011; Ribera, 2005). These factors may affect the acoustic representation of the signal for the listener at the remote end, likely resulting in either a delay or distortion of the signal. Acoustic degradation related to the transmission system or processing may have an even more detrimental impact on listeners with a CI because they are listening with a compromised auditory system. More information is needed regarding audio transmission with Polycom and other telehealth technologies to determine the effect on speech perception for CI recipients.

The objective of this study was to evaluate systems for telehealth administration of speech-perception stimuli to CI recipients at a remote location as well as differences in test environments. The literature suggests that testing system, environment, or both may have a negative effect on CI recipients' performance in the remote condition (Hughes et al., 2012; Ribera, 2005). Because differences in performance may necessitate a standard for clinical telehealth services, these effects should be explored. The first goal of this study was to evaluate two different systems for administration of speechperception materials to a remote location. Previous research suggested that Polycom with visual concert (PVC) transmission may negatively affect a speech signal (Hughes et al., 2012); therefore, for the current study, we designed a custom-made hybrid presentation system (HPS) to

eliminate bandwidth restrictions by presenting speech stimuli directly from a speaker at the subject location. The second goal of the study was to evaluate the effect of testing room environment (quiet office vs. soundtreated booth). Hughes et al. (2012) suggested that remote-site speech-perception scores in that study may have been negatively affected by ambient noise and reverberation from testing in a non-sound-treated room. We evaluated CI recipients using a range of stimuli, including monosyllabic words, sentences in quiet, and sentences in noise. We evaluated speech perception in four different conditions to assess the effects of system and environment: (a) PVC in a sound-treated booth, (b) HPS in a sound-treated booth, (c) PVC in a quiet office, and (d) HPS in a quiet office.

Our objective was to evaluate speech perception in conditions that would be hypothetically the most ideal (HPS in a sound booth) versus the most realistic for telehealth applications (PVC in a quiet office). Itwas hypothesized that CI recipients' speech-perception scores across all measures would be best in theHPS + sound booth condition because this represents the quietest environment, with no audio compression or bandwidth restrictions.We used stimuli of varying linguistic complexity from monosyllabic words to sentences in noise to evaluate the effect of these variables across a continuum of stimuli that would be used clinically with CI recipients.We compared the results of this study with the results from the same group of subjects who participated in the Hughes et al. (2012) study to investigate discrepancies between speech-perception results and remote environments used for testing in that study.

Method

Subjects

Sixteen adult and pediatric subjects participated in this study (14 unilateral and two bilateral CI recipients; Mage = 48 years; range = 12-87 years). Demographic information for each subject is outlined in Table 1. All subject recruitment and informed consent were performed by personnel from the Boys Town National Research Hospital (BTNRH) Cochlear Implant Research Laboratory. The goal was to enroll subjects with at least 1 year of experience with the CI before participating in the study; however, one subject had only 5 months of device use (mean duration of use = 6 years; range = 5 months- 14 years). All subjects except R3/F11 also participated in the Hughes et al. (2012) study. This study was approved by the BTNRH Institutional Review Board under Protocol 03-07-XP.

Equipment Setup

Testing was performed at BTNRH with the subject in the CI laboratory and the experimenter in a small conference room on a separate floor. Each subject participated in four listening conditions, which are described below. For all conditions, we used a Polycom unit with a tabletop pod microphone for bi-directional video and audio communication between the subject and the experimenter. A Polycom Video Station Experience (VSX) 7000 was used in the conference room with the experimenter, while a Polycom High Definition Experience (HDX) 7000 was used at the subject location to allow communication between the subject and the experimenter at all times.

Figure 1 illustrates the two systems evaluated in this study. The first system (see Figure 1, top), also used by Hughes et al. (2012), was a Polycom VSX/HDX 7000 with a visual concert (PVC). A visual concert is an interface that enables users to connect a computer to a Polycom system in order to present high-resolution graphics and audio presentations from a media player (e.g., computer, DVD player) to listeners at a far site. Before the subject arrived, a direct call (which is much like making a typical telephone call) was made from the subject's Polycom unit to the experimenter's Polycom. The two Polycom systems were connected through the use of a dedicated web-streaming and videoconferencing network with an encrypted 3-megabytes-per-second (mbps) bandwidth; therefore, all testing was conducted over a secure connection. The visual concert, connected to a Latitude D630 laptop computer and the Polycom at the experimenter location, allowed for the direct introduction of speechmaterial (.wav files) across the dedicated network to the Polycom speakers at the subject site (bypassing the tabletop microphone). Using a 512-kbps call rate, speech stimuli were transmitted across

the videoconference link to the subject location. Stimuli were presented at the subject location through the use of Mitsubishi SP-322V speakers that accompanied the Mitsubishi display monitor for the Polycom system (Mitsubishi Electric Corporation, Tokyo, Japan).

Polycom technology is a widely available product used for videoconferencing. As stated above, however, it transmits video and audio information in a compressed format. Video content for this study (for communication purposes only) was transmitted at a dimension of 1024 ×768 kbps. Transmission of the speech stimuli was performed with the Polycom Siren 14/G 722.1C technology. This is a standard wideband audio compression algorithm with an upper frequency range of 14 kHz, transmitted at bit rates of 24-48 kbps (Polycom VSX 7000 Product Reference Guide; p. 14). It should be noted that because this study was performed over a dedicated network, it avoided most Internet traffic that may occur over other existing connections (e.g., a bridge network shared by many sites causing additional Internet bandwidth limitations and loss of signal information during transmission). Therefore, PVC in this study likely reflects the "best-case scenario" for the administration of speech-perception materials to CI recipients using available Polycom videoconferencing technology.

The second system evaluated was a custom-made HPS (see Figure 1, bottom), which was designed to eliminate bandwidth and compression issues associated with the transfer of speech materials across a videoconference/ network link.With HPS, custom software installed on laptops at both the experimenter and subject sites allowed for speech materials to be played directly from a high-quality speaker at the subject location. This application allowed the experimenter (in the conference room) to control/command the software at the subject site, using an Internet connection. The stimulusdelivery application was developed within the interactive sound synthesis and processing language Max/MSP (Cycling '74, San Francisco, CA). The transfer of commands, including stimulus choice, playback volume, and transport (play, stop) configuration from the experimenter to subject software, was accomplished with Open Sound Control (OSC; Berkeley, CA; Wright, 2005). OSC is used for interactive control over existing highspeed networking technologies (it is not limited by a local Internet system).OSC is a binary format that transfers packets of data that the experimenter and subject programs can decode using User Datagram Protocol (UDP). To accomplish this, we linked the two computers to one another using a dedicated send-and-receive network port. The experimenter used her computer to control the subject's computer, allowing the experimenter to select and play speech material using uncompressed 16-bit .wav files that resided on the computer's internal hard drive at the subject location. Finally, the .wav files were converted to the analog domain by means of a dedicated digital audio convertor (E-MU 0202 USB; E-MU Creative,Milpitas, CA) and thenwere played back through a Focal CMS 40 nearfield studio speaker (Focal-JM Lab Company, Saint-Jean-Bonnefonds, France). This allowed the speech material to be played directly from the focal speaker at the subject site, eliminating transmission of the material over an Internet or videoconference link.

Acoustic Measurements

Speech perception was tested in two environments: a sound-treated audiometric booth and an office. We evaluated the background noise and reverberation characteristics of both environments to determine the effect of testing environment on speech perception. As stated, a sound-treated booth is typically used for clinical assessment of speech perception, whereas an office setting is more typical of the environment that would be available for remote testing.

A single set of octave-band background noise measurements were made in the two listening conditions (quiet office and sound-treated booth). Measurements, which were taken with a Type 1 integrating sound-level meter (Larson Davis Model 824; PCB Piezotronics, Depew, NY), included octave bands from 125 Hz to 8000 Hz and 5-min Leq broadband noise, which is the average (over a 5-min period) A-weighted SPL in each environment. The office was a 9'×7' room with a 12' ceiling; it contained a desk spanning two walls, overhead cabinets, a storage closet, carpeting, and no windows. Noise sources included a desktop PC, laser printer, overhead lights, and fluorescent-strip desk lighting. The office was located within the Cochlear Implant Research Laboratory;

therefore, hallway traffic was not an issue. Acoustic measurements in the office were taken at a quiet time during the day when the external airborne and impact noise could be minimized. For all subsequent measurements and experimental testing, the internal noise sources that could be eliminated in the office (i.e., computer, printer, overhead lights) were turned off, excluding the fluorescent strip lights, which were kept on during testing. Thus, these measurements represent the best-case scenario for ambient background noise in a quiet office. The single-walled, sound-treated booth was adjacent to the office used in this study. It measured 9' ×9' with a 6'7μ ceiling. The booth contained a table, recliner chair, and large television (not used in this study). The doors to the sound booth and office were closed during testing and calibration.

In addition to octave-band background noise measurements, measurements of reverberation time (T30), early decay time (EDT), and clarity of speech (C50) were conducted in the test environments because it has been shown that excessive reverberation affects speech understanding in rooms (Bradley, 1986; Peutz, 1997). T30 is the time required in seconds for a sound to decay (or decrease in level) by 60 dB after the sound source has stopped (a smaller T30 is more favorable). EDT represents the decay time for the first 10 dB of the T30 value (faster is better). C50 is a measurement of speech clarity in dB; experimenters determine C50 by measuring the ratio of energy in the first 50 ms to the energy arriving after 50 ms, thus measuring the prominence of the direct sound within a reverberant environment. The higher the dB value, the clearer the speech signal will sound among the reverberation. Considering speech perception was of primary concern in the current experiment, and considering the ratio of earlyto- late energy is known to affect speech understanding (Bistafa &Bradley, 2000), C50 was used because it is a good correlate to the effects of room acoustics on the intelligibility of speech (Bradley, Reich,&Norcross, 1999).

Measurements were conducted by obtaining monaural impulse responses (IRs) in each space. IRs were measured using a 50-s logarithmic sinusoid-sweep excitation signal with a 24-bit resolution analog-to-digital (A/D) conversion and 48-kHz sampling rate. To generate the impulse, we convolved the recorded sweep in the time domain using an appropriate time-inverse filter with a -6 dB/octave equalization to compensate for the logarithmic frequency-time spacing of the excitation signal. This method is described by Farina (2000) and allows for the recording of IRs with a very high signal-to-noise ratio (SNR).A single loudspeaker (Focal,CMS-40) served as the sound source, and a small-diaphragm measurement microphone (Earthworks, M23; Milford, NH) was used. EDTand T30 were calculated from the IRs in accordance with ISO 3382 (International Organization for Standardization, 1997).

Procedures

Each subject participated in speech-perception testing in four listening conditions while using his or her everyday speech-processor settings. Speech-perception measures consisted of one list of the CNC monosyllabic words in quiet (Peterson &Lehiste, 1962), two lists from the HINT measured in quiet (Nilsson, Soli, &Sullivan, 1994), and two lists from the Bamford-Kowal-Bench Sentences-In-Noise (BKB-SIN; Bench,Kowal,&Bamford, 1979; re-recorded in American English by Etymotic Research, 2005) per listening condition. Sentence lists were presented in a randomized order and were not repeated across any of the four listening conditions; in addition, we used the pairing recommendations for the CNC and BKB-SIN to ensure equivalency across test conditions (Etymotic Research, 2005; Skinner et al., 2006).

Calibration of the speech-perception materials was performed for both PVC and HPS outputs using a Radio Shack sound-level meter. All tests were administered at 60 dB SPL (A). The subject was instructed to repeat what he or she heard and to take a guess if unsure. Subjects' responses were scored by the experimenter observing via the Polycom link. The subject could view the experimenter at all times through the Polycom videoconference link. The four listening conditions (which are described below) were performed in a randomized order. Testing was performed in 1 day (approximately 2 hr), and breaks were provided to the subject during the setup and calibration of each condition (about 15 min).

Condition 1: PVC in the quiet office. For this condition, the subject was in the office described above. The

subject was seated approximately 1 m from the speaker of the Polycom unit. Speech materials were administered from the PVC at the experimenter site (in the conference room) using the dedicated network port to the PVC speakers at the subject's location. This condition is similar to the speech-perception testing that was conducted by Hughes et al. (2012), in which speech perception was tested in a non-sound-treated room using PVC transmission to a remote site.

Condition 2: PVC in the sound-treated booth. This condition was administered in the same manner as PVCin the quiet office described above; however, subjects were seated in an acoustically controlled sound-treated booth rather than in the office. For ease of testing at the subject location, the Polycom system, focal speaker, computer for HPS playback requirements, and video recorder were mounted on an Anthr°Cart (Tualatin, OR) specifically designed for this study. The cart was transported to the sound-treated booth or the office, depending on the test order.

Condition 3: HPS in the quiet office. The Polycom system was used only for communication between the subject and the experimenter, whereas the HPS custommade program was used for playing the speech stimuli from the focal speaker at the subject location. During administration of the tests, the experimenter muted the Polycom tabletop microphone at the experimenter site to eliminate the introduction of unwanted background noise to the subject. The subject was seated approximately 1 m from the focal speaker.

Condition 4: HPS in the sound-treated booth. Testing was conducted using HPS administration of speech stimuli to subjects seated in an acoustically controlled sound booth 1 m from the focal speaker.

Results

Acoustical Measurements

Figure 2 displays the broadband acoustical measurements for the sound-treated booth and quiet office (external noise sources off); this figure also includes an average (± 1 SD) of the octave-band measurements from the three remote sites2 used in Hughes et al. (2012; referred to as remote avg on the graph). We performed this comparison to determine whether differences existed between the testing environments in the current study and in Hughes et al. (2012). A Kruskal-Wallis one-way analysis of variance (ANOVA) revealed a significant difference in octave-band noise between the testing sites ($H = 11.29$, $df = 2$, $p = .004$). A pairwise multiple comparison (Dunn's method) revealed significantly higher noise levels for the quiet office than for the sound-treated booth ($p < .05$). Also, octave-band noise levels were significantly higher for the average of the three remote sites from Hughes et al. (2012) than for those of the sound-treated booth ($p < .05$). The office environment was not significantly different from the remote sites from Hughes et al. (2012). The octave-band background noise for only the sound-treated booth was below the recommendations of ANSI S3.1 (1999) for all frequencies used for audiometric testing.

Figure 2 also illustrates the Leq 5-min measurements for the current study and remote average (± 1 SD) from Hughes et al. (2012). In the quiet office, with all noise sources (computer, printer, lights) turned on, the environment measured 42.1 dB (A). When the noise sources (except for the fluorescent strip lighting) were eliminated, the Leq was reduced by 10.4 dB to 31.7 dB (A). Leq for the sound-treated booth was 27.8 dB (A)-3.9 dB quieter than the all offLeq for the office setting. The average Leq for the remote sites in Hughes et al. was 43.2 dB (A), which was most similar to the office all on condition. There is no standard to which we can compare these measurements; however, speech materials were presented at 60 dB SPL (A), which was approximately 28 dB SPL above the office all offmeasurement, 31.7 dB (A) (recall that testing was conducted in the all offcondition).

Figure 3 shows the reverberation results for the sound-treated booth, office, and remote average (± 1 SD) from Hughes et al. (2012). Only T30 is included from Hughes et al. as that study did not evaluate C50 or EDT. One-way ANOVA results evaluating T30 across the three environments revealed a statistically significant difference in reverberation time, $F = 49.31$, $df = 2$, $p < .001$. A pairwise multiple comparison (Holm-Sidak) indicated that T30 was significantly higher for the office (i.e., more reverberant) than for the sound-treated booth ($p < .001$),

was higher for the remote sites than for the sound-treated booth ($p < .001$), and was higher for the remote sites than for the office ($p < .001$). One-way ANOVA results revealed a statistically significant effect of room for EDT ($H = 9.89$, $df = 1$, $p < .001$) and C50 ($H = 9.80$, $df = 1$, $p < .001$) for the current study. Post hoc analyses (Dunn's method) showed a significantly higher C50 value for the sound-treated booth than for the office ($p < .05$) as well a longer EDT in the office than in the sound-treated booth ($p < .05$). As expected, the sound-treated booth was a quieter and less reverberant space than the office setting. Even though noise sources were eliminated for optimal listening in the office, T30, C50, and EDT results indicate that the sound-treated booth was much more favorable for speech understanding.

Speech Perception

Figure 4 shows mean results (±1 SD) across the four listening conditions (two systems and two environments) for the four speech-perception measures in the current study. For all statistical analyses involving speech-perception data, we analyzed the differences between recognition of CNC words and CNC phonemes using a repeated-measures multivariate analysis of variance (MANOVA) because word and phoneme scores were derived from the same task and were not independent observations. Results for CNC words and HINT sentences were analyzed separately from BKB-SIN sentences because the former were measures of percent correct in quiet, whereas the BKB-SIN sentences were measures of noise that were obtained through use of an adaptive paradigm to determine the SNR for 50%- correct recognition.

The overall effect of test environment (quiet office vs. sound-treated booth) on recognition of CNC words and phonemes was significant, $F(2, 14) = 13.719$, $p = .001$, Wilks' $L = 0.338$, $h2\ p = .662$. The effect of system (PVC vs.HPS) onCNCwords and phonemes was not significant, $F(2, 14) = 2.381$, $p = .129$, Wilks' $L = 0.746$, $h2\ p = .254$, reflecting no difference in CNC word or CNC phoneme recognition between the PVC and HPS systems. Further analysis of the effect of environment on words and phonemes indicated that the effect of room was significant for recognition of both CNC words, $F(1, 15) = 25.142$, $p < .001$, $h2\ p = .626$, and CNC phonemes, $F(1, 15) = 28.725$, $p < .001$, $h2\ p = .657$. Specifically, CNC word and phoneme recognition were both higher (better) in the sound-treated booth than in the office.

The effect of environment and system on HINT sentences in quiet and on BKB sentences in noise was assessed through the use of ANOVA. For HINT sentences in quiet, the effect of environment was significant, $F(1, 15) = 8.96$, $p = .009$, $h2\ p = .374$, with better sentence recognition in the sound-treated booth than in the office. The effects of system, $F(1, 15) = 0.603$, $p = .449$, $h2\ p = .039$, and the two-way interaction between system and test environment, $F(1, 15) = 0.435$, $p = .520$, $h2\ p = .028$, were not significant, suggesting that system did not impact HINTsentence recognition and that the main effect of environment was observed for both systems, respectively.

For BKB sentences in noise, there was a significant Environment ×System interaction, $F(1, 15) = 22.563$, $p = .002$, $h2\ p = .469$, indicating that the pattern of BKB sentence recognition in noise for each test environment was dependent on the system. Specifically, there was no difference between PVC and HPS systems in the soundtreated booth, but BKB sentence recognition in noise was significantly better (lower SNR) for HPS in the office than for PVC in the office (a 2.1-dB difference). Results for the BKB-SIN with HPS in the office (10.5 dB) were not significantly different from either presentation system in the sound-treated booth (10.2 dB for PVC and 10.6 dB for HPS). Results suggest that PVC in the office yielded the poorest results for speech-innoise testing.

It was of interest to analyze performance differences between the testing environments in the current study and those in Hughes et al. (2012). Recall that it was unclear whether test system or environment yielded poorer speech-perception results in the earlier study. Although Hughes and colleagues used conference rooms for testing (with no modifications), the testing environments in the current study were an office with noise sources minimized as much as possible and a soundtreated booth. To facilitate a comparison between the speech-perception results from Hughes et al. and those of the current study, speech perception was analyzed from a subset of 14 subjects who participated in both studies. Subjects not included in this comparison were R3/F1

(because that subject did not participate in Hughes et al.) and F10/F11 (who was tested with bilateral CIs in the current study but was tested with only a single CI in Hughes et al.). In the Hughes et al. study, two measures were made at the remote visit through the use of PVC; the average of the two measures was used for the comparisons made here. From the current study, we used scores from PVC in the office and PVC in the sound-treated booth and compared them with the average of the two remote PVC scores from Hughes et al. PVCwas used for the comparison because only that system was used for both studies.

To analyze the effect of environment on speech perception, three analyses were completed: (a) PVC data for the remote site (Hughes et al., 2012), (b) PVC in the sound-treated booth (current study), and (c) PVC in the quiet office (current study). Results are displayed in Figure 5. Overall, there was a significant effect of environment on the CNC scores, $F(4, 52) = 15.317$ $p < .001$, Wilks' $L = 0.202$, $h2\ p = .551$. Further analysis of each dependent variable revealed significant effects of environment on scores for both CNC words, $F(2, 26) = 11.283$, $p = .001$, $h2\ p = .465$, and CNC phonemes, $F(2, 26) = 24.792$, $p < .001$, $h2\ p = .656$. To examine the pattern of significant differences across locations while controlling for Type 1 error rate, we completed post hoc comparisons using Fisher's least significant difference (LSD). Post hoc results revealed significantly higher CNC word and phoneme recognition for PVC in the sound-treated booth (63% words, 79% phonemes) and for the office (56% words, 76% phonemes) than for the remote sites (48.2%words, 69.5%phonemes; $p < .001$). The differences between sound-treated booth and office were not significant forCNC words or phonemes. The effect of location on HINT sentences in quiet was assessed using a repeatedmeasures ANOVA. The main effect of location was significant, $F(2, 26) = 19.033$, $p < .001$, $h2\ p = .594$. Post hoc testing revealed no significant difference between sound-treated booth and office, with both conditions resulting in significantly higher speech perception than the remote sites used in Hughes et al.

We tested the effect of location on BKB-SIN results (see Figure 5, bottom right) using a repeated-measures ANOVA. The main effect for location was significant, $F(2, 26) = 9.016$, $p = .001$, $h2\ p = .410$. Post hoc testing revealed that sentence recognition in noise was better (lower SNR) for the sound-treated booth than for the quiet office ($p < .001$) or remote sites ($p < .001$), which were not significantly different from each other ($p = .312$). Overall, the effect of location on speech recognition with thePVCsystemwas consistent across stimulus type. This effect varied depending on whether the task was completed with or without the addition of competing noise. For speech perception in ambient acoustic conditions, both the sound-treated booth and the office resulted in higher performance than did the remote sites used in the earlier study, whereas for speech recognition with the addition of multitalker babble, the sound-treated booth was superior to both the office and remote sites.

Discussion

Research has determined that traditional CI measures, such as electrode impedance, programming, and ECAP testing, can be conducted via telehealth with equivalent results as a standard face-to-face appointment (Hughes et al., 2012; McElveen et al., 2010; Ramos et al., 2009). However, our previous investigation of telehealth with CI recipients revealed poorer speech perception in the remote condition (Hughes et al., 2012). The goal of the current study was to investigate whether poorer speech-perception scores were due to bandwidth problems associated with the type of system used to transmit speech stimuli over the Internet, or because of the acoustic environment used for testing (or a combination of both).Testing was conducted for a variety of speech stimuli in quiet and in noise.

Results from the current study revealed no significant effect of system (PVC or HPS) when subjects were tested on speech in quiet (CNCs andHINTs).When tested on these same stimuli, subjects performed best in the sound-treated booth, compared with the quiet office (see Figure 4). Background and reverberation measurements support these findings. The sound-treated booth was a quieter, less reverberant space that resulted in better speech perception scores compared with the office environment. Even when efforts were made to eliminate background noise in the office, CI recipients still experienced a decrease in speech

perception, compared with performance in the sound-treated booth.

For testing in the presence of background noise (BKB-SIN), results indicated that a combination of system and environment may be a significant determinant of subjects' performance (see Figure 4). When in the office (which is a more reverberant environment), subjects performed more poorly with PVC transmission of the speech stimuli (a 2-dB decrease in performance) compared with HPS. In the sound-treated booth, however, there was no significant difference in performance using either system. A 2-dB difference can have a large impact on speech recognition in noise; this difference indicated that subjects may have been more sensitive to changes in the SNR when testing was performed with PVC in the office compared with when testing was performed with HPS in the office. It is likely that a combination of reverberation and background noise, as well as compression and bandwidth limits from the PVC, were more detrimental than testing with the background noise alone (as in the HPS condition). This result suggests that HPS may be a superior system to use for remote testing-at least, when testing speech in noise in reverberant environments.

A comparison of this study with that of Hughes et al. (2012) reveals similar findings related to the effects of testing environment. Speech perception with PVC transmission was compared for a subset of subjects participating in both studies (see Figure 5). Subjects performed best in the sound-treated booth for all speech measures, as expected. For testing in quiet (CNCs and HINTs), scores for the remote sites in Hughes et al. were significantly poorer than the scores for both the sound-treated booth and the office; however, there was no significant difference in scores between those of the sound-treated booth and those of the office. Recall that in the analysis of the current study, however, speech perception in quiet was significantly better for the soundtreated booth than for the quiet office. Although the magnitude of the difference in speech perception between the sound-treated booth and the office did not change (6% higher on average in sound-treated booth), the additional comparison of results from Hughes et al. (2012) resulted in a nonsignificant difference between sound-treated booth and quiet office for the PVC subset. This was because a larger difference was needed to reach statistical significance for the larger number of factors that were being compared.

When comparing speech in noise (BKB-SIN) results for the two studies, the trend in subjects' scores was similar to testing in quiet, with the best performance (lower SNR) for the sound-treated booth and poorest performance (higher SNR) for testing at the remote sites in Hughes et al. (2012). Results revealed that scores were significantly better for the sound-treated booth compared with the office as well as for the sound-treated booth compared with the remote sites; however, in the current study, performance in the office was not significantly different from performance at the remote sites. It is likely that a combination of reverberation and fluctuating ambient environment noise (e.g., heating and ventilating systems, hallway traffic) made both the office and the remote sites equally challenging listening environments, especially for speech-in-noise testing, because the SNR was effectively higher than for the sound booth.

Results from the current study and Hughes et al. (2012) reveal that the sound-treated booth provided themost optimal environment for testing, as was expected. As discussed, sound-treated booths are not typically available in rural communities. In an effort to evaluate spaces that are available in rural areas, we analyzed speech-perception scores in three different test environments: a sound-treated booth, a quiet office, and remote sites without any noise modifications. Results determined that speech-perception scores do improve when noise sources can be eliminated in a testing suite (see Figure 5); however, this modification alone is not enough to provide an adequately controlled environment for scores that are equal to those obtained in a sound-treated booth. Results of the current study do suggest that HPS, when used for speech-in-noise testing, may help eliminate the negative effects of background noise.

Recall that the HPS was designed to eliminate the transfer of speech material across a videoconference link. Our previous investigation of speech perception through telehealth suggested that Polycom technology may have negatively affected speech presented to CI listeners at remote sites (Hughes et al., 2012). With Polycom, audio information is compressed before being sent to a user at a far-site location; therefore, it was hypothesized

that HPS would be superior technology for testing by eliminating this transfer. There was, however, no difference in speech-perception scores for testing conducted in quiet for HPS or PVC. It appears that HPS was superior only when used for testing speech in noise in a reverberant environment. The reader should keep in mind that testing with the PVC in the current study was done through a dedicated network,which likely reduced Internet traffic and muting, loss of sound, or packet loss that would traditionally be experienced over busier open networks with PVC. The dedicated network may have provided an avenue for less compression of the speech stimuli in this study. A dedicated network was not used in the earlier study, which may have contributed to the poorer results (in addition to the increased reverberation and background noise at the testing sites). The HPS system was superior for testing in noise and could easily be used across any Internet network system. However, it is not a commercially available system and would require user setup, which may be difficult without a prerequisite background using these technologies. PVC is commercially available and more user friendly, although it can be expensive to purchase. In our previous investigation, Polycom systems were readily available at rural health centers and at universities in Nebraska and South Dakota (Hughes et al., 2012).

Another alternative to investigate for testing speech perception for telehealth purposes is direct administration of a speech stimulus to the recipient's speech processor; this process is termed direct connect. Ideal administration would be through the manufacturer software, eliminating the need for additional equipment and software at a remote site. Direct administration of speech stimuli is currently not available for commercial use in the United States. This approach could (a) potentially bypass the background noise and reverberation in the environment and (b) prevent the need for a sound-treated booth in rural communities. This option, however, is limited in clinical utility because the microphone functionality and front-end processing would not be assessed with this approach. Direct administration is less representative of real-life listening than acoustic presentation of speech as through traditional test methods, although it could be argued that traditional test methods (e.g., in the sound-treated booth) are also not representative of realworld listening conditions.

The test-retest reliability of speech-perception scores obtained in a non-sound-treated clinical space may be worth investigating. The purpose of testing in a sound-treated booth is to have a quiet and controlled environment for speech-perception scores to be compared and monitored over time and, potentially, even across clinics. Often, testing is performed with pre-recorded stimuli or in the presence of background noise in an attempt to re-create more realistic listening environments, particularly when CI recipients' scores are reaching ceiling levels in quiet or when patients report difficulties hearing in real-world situations. However, if experimenters could perform testing in a clinical space while monitoring and controlling fluctuating noise sources (e.g., electronics, lights, and heating/air conditioning units), such as in this study, clinical spaces could function as a more realistic test environment. Regular clinic rooms could then be used for telehealth administration of speech perception stimuli, provided that the effects of background noise and reverberation in the environment are considered. Further research investigating modifications to clinical spaces in remote areas-including the use of acoustic modifications to reduce reverberation and background noise-may lead to scores equivalent to those obtained in a sound-treated booth.

Finally, it is worth investigating the appropriateness of traditional clinical testing methods in which CI recipients are seated directly in front of a speaker in a sound-treated booth. Although sound-treated booths provide a consistent environment across sessions for monitoring progress and outcomes with the CI, the resulting test scores are often inflated compared with subjective reports of performance in real life. In previous studies, researchers have determined that listeners perform more poorly with lower SNRs and softer presentation levels (Firszt et al., 2004; McCreery et al., 2010). For CI recipients, a reduced SNR and softer presentation level equates to even more difficulty in speech recognition and understanding. Perhaps modifications to standard testing protocols, as suggested by Firszt et al. (2004), should be more strongly considered for clinical CI standards. A standard that incorporates considerations for face-to-face appointments as well as telehealth encounters would be ideal.

This study has expanded our knowledge regarding the feasibility of testing speech perception through telehealth with CI recipients. The variability of tests conducted outside of sound-treated booths should be quantified through further investigation. The use of acoustic treatments also may offer realistic options for creating an environment with characteristics that are equivalent to testing in the sound-treated booth. Future research should focus on evaluating speech perception in telehealth applications with the same accuracy as in a face-to-face visit. As technology for CIs continues to evolve, it is imperative that practitioners expand their ability to reach patients and provide them with adequate and accessible clinical services. Telehealth is an efficient way to reach patients who have difficulty accessing clinical CI services.

Acknowledgments

This study was supported by the National Institute on Deafness andOther Communication Disorders (NIDCD)Grants 3R01DC009595-01A1S1 (awarded to M. L. Hughes) and P30DC04662 (awarded to W. Jesteadt). The content of this project is solely the responsibility of the authors and does not necessarily represent the official views of NIDCD or the National Institutes of Health. We thank Suman Barua and Jennifer Bournique for assistance with data collection as well as the subjects for their time and participation.

Footnote

1R3/F1 is a single bilaterally implanted subject; subject numbers are designated on a per-implant basis.

2In Hughes et al. (2012), subjects visited one of three remote testing sites closest to their home. Rooms at the remote sites were small conference rooms equipped with videoconferencing technology, not sound-treated booths.

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Editor: Sid Bacon
Associate Editor: Paul Abbas
Received December 29, 2011
Accepted February 22, 2012
DOI: 10.1044/1092-4388(2012/11-0358)

Publication date: Oct 2012

Year: 2012

Patents; Patent Application Titled "Fitting of Sound Processors Using Improved Sounds" Under Review

Publication info: Computer Weekly News (Sep 27, 2012): 500.
ProQuest document link

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors Blamey, Peter John (South Yarra, AU), filed on August 2, 2010, was cleared for further review on September 13, 2012.

Links: Check LinkSource for Full Text

Full text: 2012 SEP 27 (VerticalNews) -- By a News Reporter-Staff News Editor at Computer Weekly News -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors Blamey, Peter John (South Yarra, AU), filed on August 2, 2010, was cleared for further review on September 13, 2012.
No assignee for this patent application, patent serial number 388268, has been made.
Reporters obtained the following quote from the background information supplied by the inventors: "Sound processors, including hearing aids, ALDs, and consumer audio devices such as headsets, headphones, mobile phone handsets, and MP3 players are being used more frequently in noisy environments by people with normal or near-normal hearing as well as people who are hard of hearing. Under these circumstances, hearing can be enhanced by adjusting the loudness, frequency-shaping, and dynamic properties of the sounds produced by the devices to suit the needs and preferences of the individual listener. In the case of hearing aids, these services are typically provided by audiologists and/or audiometrists in a clinical setting. Some of these types of

adjustments are commonly available in consumer audio devices by means of analogue volume controls and tone controls.

"The majority of these devices now use digital signal processing which enables a much wider variety of adjustments and customisations to suit the individual needs and preferences of users. At the same time, devices are becoming smaller and do not have the physical space available for the complex controls that would be necessary to make a wide variety of adjustments. One way to make adjustments is to use an applications program running on a computer and download the customised solution to the device to be used in stand-alone operation. This is typical for hearing aids, but not for ALDs and consumer audio devices that tend to use analog volume and tone controls. The fitting software for modern hearing aids may manipulate tens or even hundreds of parameters that control the operation of the hearing aid, and are downloaded to the device after fitting is complete. The adjustment typically requires a skilled audiologist, audiometrist, or hearing aid fitter. Digital sound processing for other consumer audio devices can also be configured by software running on a computer and subsequently downloaded to the device. This configuration is typically made by the manufacturer prior to sale of the device and tailors the device to the needs of the average user, rather than customising it for an individual. Sometimes an individual may choose from a number of preconfigured customizations (for example in the case of an ALD).

"The sound processing device fitting methods described above suffer from the disadvantage that either a skilled fitter is required to operate the fitting software (as in the case of a hearing aid), or a single 'average' fitting or small number of preconfigured customizations is too limited to be well suited to each individual.

"Furthermore, conventional hearing aid fitting methods require specialised equipment such as an audiometer to measure hearing thresholds and other hearing characteristics, and hearing aid test boxes to measure and set the hearing aid gain and/or output using a hearing aid prescription based on the audiogram. The sounds used for measurements of hearing and hearing aid gain are usually pure tones, narrow-band noises, or other synthetic sounds such as speech-shaped noise or broadband harmonic complexes. These sounds do not occur in natural contexts and are often unfamiliar and unpleasant for people to listen to. The listener may find it difficult to perform tasks such as setting the sounds to a comfortable level because the sounds themselves have unpleasant or 'uncomfortable' characteristics no matter how loud or soft they may be.

"Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

"Throughout this specification the word 'comprise', or variations such as 'comprises' or 'comprising', will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps."

In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent: "The present invention is a simplified method of fitting a hearing aid or other audio device that uses sounds that will sound pleasant to the listener during the fitting process. In the following, the sounds are sometimes described as 'musical notes' or 'notes' where each note is comprised of two or more tones with frequencies that are harmonics of a fundamental frequency and having a common amplitude envelope characterised by a rise time, a sustained section, and a relatively long decaying fall in amplitude. Each note is a recorded or synthesized sound with well-controlled amplitude and frequency characteristics in order to provide precise frequency-specific measures of hearing. The invention comprises: a method and apparatus to present notes to the listener for the purpose of measuring hearing characteristics and preferences; and a method and apparatus for customizing the device using the measured hearing characteristics. The notes are presented to the listener acoustically directly from the sound processing device.

They may be recorded or generated and fed electrically via a direct input to the sound processing device, or may be generated or stored within the sound processing device itself. The customisation method includes listening to one or more notes and adjusting their level in response to simple instructions such as 'adjust the sound until it is comfortable' or 'adjust the sounds until they are all equally loud'. After adjustment of the musical notes by the listener, the device is configured by a suitable automated protocol to optimize the sound quality for the listener.

"According to a first aspect the present invention provides a method for customizing a sound processing device for an individual listener. The method comprises:

"Presenting one or more notes via a sound processing device to a listener, each note comprising a collection of two or more harmonically related tones, spectrally positioned about the frequency of interest, and having a temporal envelope consisting of a rise time, sustain time, and decay time;

"Obtaining the listener's input regarding the loudness of each delivered sound and adjusting the levels of the sounds; and

"Inputting the adjusted levels of the sounds into an automated process to configure and tune the sound processing device for the listener.

"According to a second aspect the present invention provides a system for customizing a sound processing device for an individual listener. The system comprises:

"a computing device configured to control presentation of one or more notes to a listener, each note comprising a collection of two or more harmonically related tones, spectrally positioned about the frequency of interest, and having a temporal envelope consisting of a rise time, sustain time, and decay time, and including a visual display and user input device for the control of the customization process;

"a sound processing device to output notes to the listener;

"an optional programming interface device to connect the sound processing device to the computing device so that the sound processing device may be controlled by the computing device; and

"a software program running on the computing device to control the presentation and adjustment of the level of the notes, and automatically configure the sound processing device based on the adjusted levels of the notes.

"According to a third aspect, the present invention provides a computer program product for customizing a sound processing device for an individual listener. The computer program product comprises:

"computer program code for presenting one or more notes via a sound processing device to a listener, each note comprising a collection of two or more harmonically related tones, spectrally positioned about the frequency of interest, and having a temporal envelope consisting of a rise time, sustain time, and decay time;

"computer program code for obtaining the listener's input regarding the loudness of each delivered note and adjusting the levels of the notes; and

"computer program code for inputing the adjusted levels of the notes into an automated process to configure and tune the sound processing device for the listener.

"The computing device may be a personal computer, mobile phone handset or other suitable device.

"The sound processing device may be a hearing aid, an assistive listening device, or a mobile phone handset.

"The adjustment of levels may be to set each note to a comfortable level or to balance the loudness of a set of notes at different frequencies of interest so that they are equally loud.

"In one preferred embodiment of the invention, simplified fitting software runs on a personal computer. The simplified fitting software controls the presentation of a sequence of musical notes to the listener and records the listener's responses to balance the loudness of the musical notes. The musical notes are generated by the sound processing device itself under the control of the fitting software. In some embodiments, the notes are generated by creating a square wave, filtering the square wave with a bandpass filter to select harmonics or tones only in a narrow frequency range, and modulating the amplitude of the selected harmonics with an amplitude envelope to create a sound similar to a musical note. The envelope in preferred embodiments may be

fixed, or in other embodiments may be alterable. Notes with different frequency characteristics are created by changing the filter cut-off frequencies. The personal computer is connected to the sound processing device by a wired or wireless programmer interface. The simplified fitting software uses the listener's responses to configure and program the sound processing device to optimise its performance for the individual listener.
"In a second preferred embodiment of the invention, the functions of the personal computer are performed by a mobile phone handset.
"In a third embodiment of the invention, the mobile phone handset is the customizable device as well as being the computing device that executes the simplified fitting software.
"In some embodiments, the tones comprising the musical note may be spaced apart in frequency by a fixed amount, regardless of the frequency of interest. Alternatively, the tones comprising the musical note may be spaced apart in frequency by an amount which varies with the frequency of interest, for example the spacing of the tones may be proportional to the frequency of the tones.
"In some embodiments, the tones comprising the musical note may be generated directly instead of being derived from a filtered square wave as described above.
"The advantages of some embodiments of the present invention may include: The use of natural sounding musical notes for the characterisation of hearing instead of pure tones and noises that sound unnatural and unpleasant to some people, thus improving the validity of the hearing measurements; The presentation of notes directly through the sound processing device so that no compensation is required for individual acoustic differences between devices or between listeners; Rapid and convenient access to well-fitted hearing aids for users in remote locations or in countries where audiology services are rudimentary or non-existent; Rapid and convenient access to well-fitted sound processing devices of all types for users with normal or impaired hearing without the need for specialised equipment or skilled operators; An effective method of individual customization of sound processing devices requiring complex adjustments without increasing the size and complexity of the devices themselves; and a method to allow users to refine the customization of sound processing devices for themselves.
"The simplified fitting method may be used as part of an online audiology system such as of the type disclosed in PCT/AU2010/000161, the contents of which are incorporated herein by reference, in a conventional audiology practice, in a retail environment, or in an online consumer environment.
"The enhancement provided by the invention may be an improvement in speech intelligibility, sound quality, comfort and naturalness of the amplified or processed sound in quiet and/or noisy environments."
For more information, see this patent application: Blamey, Peter John. Fitting of Sound Processors Using Improved Sounds. U.S. Patent Serial Number 388268, filed August 2, 2010, and posted September 13, 2012.
Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=2417&p=49&f=G&l=50&d=PG01&S1=20120906.PD.&OS=PD/20120906&RS=PD/20120906
Keywords for this news article include: Patents, Software.

Publication date: Sep 27, 2012

Year: 2012

Theology student's hearing loss shared by millions in U.S.

Author: Hernandez, Martha L

Publication info: McClatchy - Tribune Business News [Washington] 24 Sep 2012.

Abstract: [...]occupational hearing loss is the most common work-related injury in the United States, according to the U.S. Centers for Disease Control and Prevention.

Full text: Sept. 24--Nidia Cruz's classmates noticed something was wrong with her: The 21-year-old could not always hear them -- especially when she wasn't looking at them.

Cruz, who is pursuing a bachelor's degree in theology at the Rio Grande Bible Institute, was in middle school back in her hometown of Mexico City when she first realized she couldn't sit at the back of the class anymore. She needed to be at the very front -- the closer to the teacher, the better.

Earlier this year, though, Cruz had her hearing formally evaluated for the first time and learned the true extent of her condition: She was, medically speaking, hard of hearing, and she needed a hearing aid.

Breaking the news to her was Dr. Edieberto Palacios, a physician who said he is one of only three audiologists in the Rio Grande Valley.

"He described my condition," an amazed Cruz said in Spanish. "He told me everything I was going through without me telling him."

Cruz's condition is not rare. About 40 million people in the United States have been diagnosed with a hearing impairment, and among them just 1 in 10 seek treatment.

Palacios said a stigma attached to hearing aids tends to dissuade patients from using them.

"I cannot count how many times I've seen viejitos, they come in their walkers, got dentures, got glasses, they have medical assistance (and they are deaf), but God forbid someone sees them with a hearing aid," Palacios said.

TRENDS AND DATA

Hearing impairment can be hereditary -- it runs in Cruz's family, for instance -- but it also can be acquired by exposure to loud noise or other medical conditions.

Palacios said hearing loss is increasing in "the younger population" because of MP3 players, and the condition is more prevalent in men because of their exposure to loud noises like gunfire and motorcycles, and "on the job, they work in a factory with machines."

Indeed, occupational hearing loss is the most common work-related injury in the United States, according to the U.S. Centers for Disease Control and Prevention. Approximately 22 million U.S. workers are exposed to hazardous noise levels at work, and an additional 9 million are exposed to ototoxic -- or ear-damaging -- chemicals. All told, an estimated $242 million is spent annually on worker's compensation for hearing-loss disability.

TREATMENT

Among the 40 million diagnosed with hearing loss in the U.S., the vast majority are like Cruz: not deaf, but hard of hearing. For them, the solution is a hearing aid, Palacios said.

For seniors, it's important to seek help as soon as they notice hearing loss. If they wait until they can hardly hear, adapting to the hearing aids will be harder.

Hearing aids will improve a senior's life, but for younger patients, they're crucial because impaired hearing diminishes a child's capacity to learn to speak -- and to learn in general.

Cruz, who is here with a student visa, is putting herself through school with scholarships, the little money that her family provides and work-study.

She is wearing a hearing aid in each ear that Palacios lent to her temporarily, but she needs to find the money to acquire what she really needs: Hearing aids that can filter sounds and not just amplify them.
To reach her dream of finishing her education, learning English and working bilingually in a church, she said she'll need to be able to hear.
But she's confident God will bring her the aid she needs.
--
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Publication date: Sep 24, 2012

Year: 2012

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Author: Hernández, Martha L

Publication info: The Monitor [McAllen, Tex] 23 Sep 2012.
ProQuest document link

Links: Check LinkSource for Full Text

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Among the 40 million diagnosed with hearing loss in the U.S., the vast majority are like Cruz: not deaf, but hard of hearing. For them, the solution is a hearing aid, Palacios said.

For seniors, it's important to seek help as soon as they notice hearing loss. If they wait until they can hardly hear, adapting to the hearing aids will be harder.

Hearing aids will improve a senior's life, but for younger patients, they're crucial because impaired hearing diminishes a child's capacity to learn to speak -- and to learn in general.

Cruz, who is here with a student visa, is putting herself through school with scholarships, the little money that her family provides and work-study.

She is wearing a hearing aid in each ear that Palacios lent to her temporarily, but she needs to find the money to acquire what she really needs: Hearing aids that can filter sounds and not just amplify them.

To reach her dream of finishing her education, learning English and working bilingually in a church, she said she'll need to be able to hear.

But she's confident God will bring her the aid she needs.

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Illustration

CAPTION: 1

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Nidia Cruz, right, high fives Yozy Aguirre following a theology class Tuesday at the Rio Grande Bible Institute in Edinburg. Cruz's classmates noticed that she has some hearing problems and they are trying to find a way to help their classmate.

Credit: The Monitor

Publication date: Sep 23, 2012

Year: 2012

Bernafon AG; Patent Issued for Hearing Aid Adapted to a Specific Type of Voice in an Acoustical Environment, a Method and Use

Publication info: Computer Weekly News (Sep 20, 2012): 2319.

ProQuest document link

Abstract: "A Hearing Aid "An object of the disclosure is achieved by a hearing aid comprising a microphone for converting an ambient sound signal to an electric sound signal, a voice detector adapted to determine if a voice is present in said electric sound signal and a frequency analyzer to determine a fundamental frequency of a voice present in said electric sound signal, a signal processor adapted to process said electric sound signal--or an electric signal derived from it--dependent upon adjustable processing parameters, a memory comprising corresponding sets of processing parameters and fundamental voice frequencies, a decision unit to select and forward from the memory to the signal processor a set of processing parameters in accordance with a fundamental frequency determined by the frequency analyzer.

Links: Check LinkSource for Full Text

Full text: 2012 SEP 20 (VerticalNews) -- By a News Reporter-Staff News Editor at Computer Weekly News -- From Alexandria, Virginia, VerticalNews journalists report that a patent by the inventor Hockley, Neil (Berne, CH), filed on January 16, 2009, was cleared and issued on September 4, 2012.

The patent's assignee for patent number 8259972 is Bernafon AG (Berne, CH).

News editors obtained the following quote from the background information supplied by the inventors: "Many hearing impaired people have difficulties understanding different voices. Most amplification techniques (including generic fitting rationales) are developed around an average long term spectrum of speech (e.g. NAL NL1 (National Acoustic Laboratories, AU), DSL m[i/o] (Desired Sensation Level, The University of Western Ontario CDN), etc.) of a male voice without regards to any characteristics of the individual speaker's voice. Recorded speech tests used for the verification of the hearing aid fitting typically do not take into account any individual variations, i.e. an average is used. Anecdotally, in the clinic, the male voice is often reported by end users of hearing aids to be easier to understand than a female or a child's voice.

"US 2004/0190740 describes a time and frequency dependent method of adjusting the amplification of a hearing aid to a particular speech signal in a noisy environment. The method is based on determining the levels of speech and noise signals in a plurality of frequency bands and subsequent `automatic` adjustment of the electrical signal dependent thereon.

"U.S. Pat. No. 6,453,284 describes a system for tracking individual voices in a group of voices by estimating the fundamental frequencies of each of the voices present. The system involves the use of a recurrent neural network to track the multiple voices over time. The system can e.g. be implemented in a digital hearing aid for selective amplification of an individual's voice.

"EP 1 530 403 describes the definition of various groups of acoustical signals and the automatic determination of the type of acoustic signal present in a given situation and the adaptation of a corresponding fitting signal to the HA."

As a supplement to the background information on this patent, VerticalNews correspondents also obtained the inventor's summary information for this patent: "The present disclosure deals with the problem that people with a hearing aid device may have difficulties to understand different types of voices, e.g. female and child voices. "If the hearing instrument could detect different voiced vocal patterns and then apply different dedicated settings (gain, compression and directionality, etc.) then this would aid in the perception of speech for these different voices and for the different environments where these individuals are found (e.g. a grandchild's birthday party).

"An object of embodiments of the present disclosure is to seek to improve the perception of different voices in a given acoustical environment for a wearer of a hearing aid. It is a further object to seek to improve the perception of the voices of children and females, e.g. in social situations. Children can be especially difficult to understand due to the acoustics of their voices and possibly also their developing speech and language skills. Many people (especially grandparents) miss out on a lot of the thoughts and observations of their grandchildren. It is an object of the disclosure to compensate for that.

"The primary idea of embodiments of the present disclosure is to detect the fundamental frequency of a voice in a given acoustical environment and to apply different settings to the hearing aid dependent thereof so as to best accommodate the perception of this voice by the wearer of the hearing aid.

"A Hearing Aid

"An object of the disclosure is achieved by a hearing aid comprising a microphone for converting an ambient sound signal to an electric sound signal, a voice detector adapted to determine if a voice is present in said electric sound signal and a frequency analyzer to determine a fundamental frequency of a voice present in said electric sound signal, a signal processor adapted to process said electric sound signal--or an electric signal derived from it--dependent upon adjustable processing parameters, a memory comprising corresponding sets of processing parameters and fundamental voice frequencies, a decision unit to select and forward from the memory to the signal processor a set of processing parameters in accordance with a fundamental frequency determined by the frequency analyzer. Alternatively, instead of or in addition to the fundamental frequency, one or more formant frequencies can be used to define the type of voice.

"This has the advantage of allowing a modification of parameters of a hearing aid program for a signal processing unit for adapting an electrical sound signal to a specific hearing profile and acoustic environment to be modified according to the type of voice present in the actual acoustic environment and to thereby optimize the perception of that voice for the wearer of the hearing aid.

"The term `a set of processing parameters for processing the electrical sound signal` is to be understood as comprising at least one parameter, e.g. a parameter of a program of a digital signal processor for processing an input signal comprising a signal originating from an acousto-electric transducer (e.g. a microphone) to adapt the signal to a specific hearing profile and/or acoustic environment (e.g. a parameter influencing the amplification in a particular frequency band/range, or a set of parameters defining a part of or a full gain profile, compression, noise reduction, directionality, etc.). The term `a set of processing parameters` may alternatively cover a piece of program code or an algorithm of a hearing aid program.

"The terms `hearing aid` and `hearing instrument` are used interchangeably in the present application to indicate a listening device that is adapted to provide a (e.g. customized) frequency dependent gain of an input sound signal to improve a listeners perception of the input sound.

"In an embodiment, a number of the parameters of a hearing aid program can be modified during the normal course of that hearing aid program. In an embodiment, the hearing instrument is adapted to have different gain tables assigned within a single program. This makes the adaptation more smooth and less noticeable for the end-user, because it is NOT necessary to stop the current program and load a new program to the signal processor from a non-volatile memory of the hearing instrument. In an embodiment, a specific CHILD-gain map, optimized to a voice from a child, and a specific FEMALE-gain map, optimized to a voice from a female, can be automatically selected for a program adapted for a specific acoustic environment or situation (e.g. with other voices present in the background, discussion with no other voices present (other than the discussion partner(s)), etc.). This has the advantage that a user does not have to change the current program because the necessary modification can occur automatically within the framework of the current program. In the present context, the term `program` is intended to cover the settings of a hearing aid (e.g. gain, compression, directionality, noise reduction, frequency transposition, etc.), which can be adjusted to particular hearing situations (e.g. TV-watching, conversation, work, party, etc.) and the change of which typically involve reloading of software from a non-volatile memory to the working memory of the signal processor. In other words, the focus on a specific `type` of person (e.g. male, female or child) within a given acoustic environment can in a particular embodiment advantageously be handled within the same program. With reference to FIG. 5, the lookup table containing corresponding values of fundamental and/or formant frequencies and processing parameters for the signal processor are stored in a memory (MEM), from which they can be loaded into the signal processor (DSP) and replace the current values, without reloading the whole program. In this embodiment, only the predefined

parameters, which depend on the fundamental frequency, are occasionally changed by loading the currently appropriate parameters from the memory (MEM) to the signal processor, whereas the rest of the parameters for the current program are left unaltered (in the processor). In an embodiment, parameters for a given hearing aid program p(x), e.g. for face to face (f2f) conversation, p(f2f), comprises a number Q of parameters, P.sub.f2f1, P.sub.f2f2, . . . , P.sub.f2fq, P.sub.f2fq+1, . . . , P.sub.f2f2q, P.sub.f2f2q+1, . . . , P.sub.f2f3q, P.sub.f2f3q+1, . . . , P.sub.f2fQ, where the first 3q parameters depend on the fundamental frequency F.sub.0 of the voice being listened to and comprise three sets of q parameters, each being optimized to a different range of fundamental frequencies (e.g. for listening to a MALE (P.sub.f2f1, P.sub.f2f2, . . . , P.sub.f2fq), FEMALE (P.sub.f2fq+1, . . . , P.sub.f2f2q), and CHILD (P.sub.f2f2q+1, . . . , P.sub.f2f3q) voice, respectively), and of which only one set is used in the processor at a time. A signal from the frequency analyzer can--dependent upon the actually determined fundamental frequency--decide which of the three sets of parameters are to be used at a given time. The change between the three sets of parameters, which are stored in a rapidly accessible memory (e.g. a RAM or cache memory or other dynamic memory, cf. e.g. MEM in FIG. 5) of the hearing aid (e.g. the signal processor), can be performed in a shorter time than if a whole new program with totally new parameters (P.sub.x1-P.sub.xQ, x designating a specific listening situation for which a separate program exists) should be read into the signal processor from a memory (e.g. a non-volatile memory, e.g. an EPROM or other permanent memory) with a slower access time. Typically, the number q of parameters (P.sub.x1, . . . , P.sub.x3q), which can be easily exchanged, is smaller (e.g. q in range from 1 to 5 or in the range from 5 to 20) than the number Q-3q of parameters (P.sub.x3q+1, . . . , P.sub.xQ), which are independent of the fundamental frequency (e.g. Q-3q in the range from 20 to 100 or in the range from 50 to 200 or more). In an embodiment, the ratio of Q to n*q, where n is the number of sets of parameters depending on the fundamental frequency that can be easily exchanged (above, n=3), is larger than 1, such as larger than 2, such as larger than 5, such as larger than 10. In an embodiment, the sets of q parameters that are adapted to be rapidly exchanged in the processor represent different gain profiles each optimized e.g. for a MALE, a FEMALE or a CHILD speaker).

"The primary information that is intended to be detected by the frequency analyzer is the fundamental frequency of an individual's vocalizations. The meaning of the term `fundamental frequency` (F.sub.0) is understood to follow its established definition in speech acoustics. This is the smallest frequency at which the vocal folds vibrate. Higher harmonics (n*F.sub.0) of the fundamental frequency are typically also produced (n=2, 3, 4, . . .). The frequencies, at which the vocal tract resonates, are called the formant frequencies F.sub.i, i=1, 2, 3, . . . (cf. e.g. Yost, W. A. &Nielsen, D. W. (1985), Fundamentals of Hearing, Holt, Reinhart, &Winston New York N.Y., page 190). The formant frequencies are produced by the fundamental frequency and/or those higher harmonics thereof, whose frequency are close to a resonance frequency of the vocal tract. The formants provide information by which we are able to perceive the differences between vocalized speech sounds, e.g. vowels. If the fundamental frequency is known, characteristics of a vocalization can be predicted. The formant frequencies are determined by the size, length and shape and the ends of the vocal tract. Because the dimensions of the vocal tract differ from person to person, the formant frequencies vary correspondingly. For example, the average length of the vocal tract of a male is about twice that of a child and 1.2 times that of a female. This leads to generally higher child and female formant frequencies than those of a male.

"In a particular embodiment, the frequency range of interest .DELTA.f considered by the hearing aid is e.g. between 5 Hz and 20 kHz, such as between 10 Hz and 10 kHz. In an embodiment, the frequency range of interest is split into a number of frequency bands FB.sub.i (i=1, 2, . . . , n.sub.b), e.g. n.sub.b=8 or 16 or 64 or more (where each band may be individually processed). In an embodiment, the listening system comprises a filter bank splitting the electrical input signal into a number of signals, each comprising a particular frequency band FB.sub.i (i=1, 2, . . . , n.sub.b), where n.sub.b can be any relevant number larger than 1, e.g. 2.sup.n, where n is an integer .gtoreq.1, e.g. 6.

"In a particular embodiment, the decision circuit provides a control signal adapted to select a set of processing

parameters dependent upon the determined fundamental frequency.

"In a particular embodiment, the decision unit--dependent upon the control signal--is adapted to forward the selected set of processing parameters to the signal processor with a predetermined time delay TD. This has the advantage of enabling an individualized change from one parameter set (e.g. gain profile) to another.

"In a particular embodiment, the decision unit is adapted to provide that the time delay TD is dependent on the detected fundamental frequency F.sub.0. In other words, an algorithm or formula for allocating a time delay to a specific fundamental frequency is provided.

"In a particular embodiment, the decision unit is adapted to provide that a predefined set of default parameters are loaded after a predetermined time delay in case no voice is present. This has the advantage that the hearing aid can be automatically adapted to a situation of `silence` in case it has previously been adapted to a specific type of voice or speaker.

"A voice detector is a unit that detects whether a voice is present in an acoustic input signal and outputs a corresponding control signal. In an embodiment, the voice detector analyzes the electric (possibly digitized) representation of an acoustic input signal, e.g. the electrical input signal as provided by a microphone having converted the acoustical input signal to an electrical input signal. One of the characteristics of voiced speech is the presence of a series of harmonic frequencies. A simple voice detector detects the possible presence of synchronous energy and harmonic structures of vowels in the ambient sound signal (when converted to an (possibly digitized) electric sound signal). The control signal (voice OR no voice) from the voice detector can in its simplest form be used to switch from a `speech`-mode (initializing a hearing aid program optimized for speech understanding) to a non-speech or comfort mode (initializing a hearing aid program optimized for comfortable listening) of the hearing aid.

"In a particular embodiment, the voice detector is adapted to operate with a predefined VD-update frequency. In an embodiment, the voice detector is updated at least every 10 s, such as at least every 5 s, such as at least every 1 s, such as at least every 0.5 s. Preferably a compromise is made between speed of adaptation (relatively high update frequency) and stability (relatively low update frequency to avoid unintentional updates due to short temporary changes in the acoustic environment).

"A frequency analyzer is a unit that determines a fundamental frequency of an electrical signal comprising a voice. Various fundamental aspects of frequency analyzers are discussed in A. M. Noll, Short-Time Spectrum and 'Cepstrum' Techniques for Vocal-Pitch Detection, The Journal of the Acoustical Society of America, Volume 36, Number 2, February 1964 and in A. M. Noll, Cepstrum Pitch Determination, The Journal of the Acoustical Society of America, Volume 41 Number 2, 1967.

"In an embodiment, the frequency analyzer is controlled by a voice detector. In an embodiment, the frequency analyzer is activated by a detection of a voice by the voice detector.

"In a particular embodiment, the frequency analyzer is adapted to operate with a predefined FA-update frequency. In an embodiment, the frequency analyzer is updated only when a voice is present (e.g. as indicated by the voice detector). In an embodiment, the frequency analyzer is updated with a frequency equivalent to that of the voice detector. In an embodiment, the frequency analyzer is updated more often than once every 10 s, such as more often than once every 1 s.

"In a particular embodiment, the voice detector is adapted to determine a dominant voice among a multitude of voices.

"The term `a dominant voice` is in the present context taken to mean the loudest voice, e.g. determined by direct measurement of the sound pressure level of the speech signals in an environment.

"In a particular embodiment, the dominant voice is determined on the basis of average sound level pressure (in a predefined frequency range, e.g. in one or more selected frequency bands, e.g. in all bands).

"In an embodiment, the `voice detector` and the `frequency analyzer to determine a fundamental frequency of a voice` are integrated into the same functional unit.

"In a particular embodiment, the corresponding sets of processing parameters and fundamental voice frequencies include sets of processing parameters corresponding to predefined average fundamental frequencies for male, female and child voices. Relevant ranges of average fundamental frequencies for the actual voice types can e.g. be determined by experiment.

"In an embodiment, the average male fundamental frequency is defined in the range from f.sub.11 to f.sub.12. In an embodiment, f.sub.11 is larger than or equal to 85 Hz. In an embodiment, f.sub.12 is smaller than or equal to 165 Hz. In an embodiment, the average male fundamental frequency is defined in the range from 85 Hz to 165 Hz.

"In an embodiment, the average female fundamental frequency is defined in the range from f.sub.21 to f.sub.22. In an embodiment, f.sub.21 is larger than or equal to 165 Hz. In an embodiment, f.sub.22 is smaller than or equal to 240 Hz. In an embodiment, the average female fundamental frequency is defined in the range from 165 Hz to 240 Hz.

"In an embodiment, the average child fundamental frequency is defined in the range from f.sub.31 to f.sub.32. In an embodiment, f.sub.31 is larger than or equal to 240 Hz. In an embodiment, f.sub.32 is smaller than or equal to 540 Hz. In an embodiment, the average child fundamental frequency is defined in the range from 240 Hz to 540 Hz.

"In an embodiment, a default set of parameters (e.g. equal to parameters for a specific group or a dedicated DEFAULT set) is used if the fundamental frequency determined is not within the ranges of the predefined groups, or if no well defined fundamental frequency can be determined. Such set of parameters can e.g. be loaded after a predefined time delay TD.sub.DEFAULT after the loss of a `valid` fundamental frequency (e.g. depending on the update frequency (VD-update) of the voice detector, e.g. a predefined number of T.sub.UPDATE (the time between subsequent updates), e.g. 2 or 5 or 10 times T.sub.UPDATE, or e.g. after a predefined time, e.g. 10 s or 20 s or 30 s.

"It is intended that the features of the method of adapting a hearing aid described below (in the detailed description and in the claims) for a hearing aid can be combined with the hearing aid outlined above (when appropriately defined as structural features).

"A Method of Adapting a Hearing Aid

"It is intended that some or all of the features described above, in the detailed description, or in the appended claims for a hearing aid can be combined with embodiments of the method outlined in the following.

"A method of adapting a hearing aid to a voice in an acoustical environment is furthermore provided, the method comprising a) converting an acoustical sound signal into an electrical sound signal; b) determining whether a voice is present in said electric sound signal; c) determining the fundamental frequency of the electrical sound signal, if a voice signal is present; d) classifying the voice based on the determined fundamental frequency and a predefined set of fundamental voice frequencies; e) selecting a set of parameters for processing the electrical sound signal based on the determined voice class and predetermined corresponding sets of processing parameters and voice classes; and f) forwarding the selected set of processing parameters to a signal processor for processing the electrical sound signal--or a signal derived from it--and generating a processed signal

"In an embodiment, at least some of the predefined sets of fundamental voice frequencies include overlapping neighboring frequency ranges.

"In an embodiment, a predefined set of processing parameters comprises at least one parameter for modifying gain, compression, and/or directionality, etc. to improve the perception of speech for the wearer of the hearing aid.

"In an embodiment, the corresponding sets of processing parameters and fundamental voice frequencies defining different voice classes include sets of processing parameters corresponding to predefined ranges of average fundamental frequencies for male, female and child voices. In an embodiment, the relevant ranges of

average fundamental frequencies for the voice types in question are determined by experiment.

"In an embodiment, the average male fundamental frequency is defined in the range from f.sub.11 to f.sub.12. In an embodiment, f.sub.11 is larger than or equal to 85 Hz. In an embodiment, f.sub.12 is smaller than or equal to 155 Hz. In an embodiment, the average male fundamental frequency is defined in the range from 85 Hz to 155 Hz.

"In an embodiment, the average female fundamental frequency is defined in the range from f.sub.21 to f.sub.22. In an embodiment, f.sub.21 is larger than or equal to 165 Hz. In an embodiment, f.sub.22 is smaller than or equal to 255 Hz. In an embodiment, the average female fundamental frequency is defined in the range from 165 Hz to 255 Hz.

"In an embodiment, the average child fundamental frequency is defined in the range from f.sub.31 to f.sub.32. In an embodiment, f.sub.31 is larger than or equal to 250 Hz. In an embodiment, f.sub.32 is smaller than or equal to 540 Hz. In an embodiment, the average child fundamental frequency is defined in the range from 250 Hz to 540 Hz.

"In an embodiment, if the dominant voice is classified as a child's voice, the corresponding set of processing parameters comprise at least one parameter for automatically switching the hearing aid into full directional mode, and/or for applying more gain at relatively higher frequencies for relatively soft to medium input levels, and/or for increasing noise reduction.

"In an embodiment, the method further comprises a learning mode defining different classes i (i=1, 2, . . . , n) of voices and corresponding fundamental frequency ranges [f.sub.i1;f.sub.i2]. In an embodiment, the fundamental frequency ranges corresponding to different classes of voices are adapted to individual voice types, e.g. the voices of a person's family or of persons frequently engaged, e.g. in a working environment. This training aimed at automatic program selection can e.g. be implemented using a neural network based on a self organising map, cf. e.g. US 2006/0179018.

"In a particular embodiment, a total set of processing parameters for a specific hearing aid program comprises a total number Q of parameters, including a number n*q of parameters that depend on the fundamental frequency of the input signal and a number Q-n*q parameters that are independent thereof and wherein the n*q parameters represent n subsets of q parameters each being optimized for a particular one of n possible voice classes, so that only Q-(n-1)*q parameters are used in the signal processor at a given time for a specific hearing aid program.

"In a particular embodiment, a subset of q parameters out of the n*q parameters can be exchanged in the total set of Q-(n-1)*q parameters currently being processed by the signal processor without reloading all Q-(n-1)*q parameters. This has the advantage that the HA-program can be automatically adapted to a particular type of voice (selected among a number of predefined types of voices) without having to reload the whole program (e.g. all parameters necessary for characterizing the program).

"In an embodiment, the number of class types n is 2 (e.g. ADULT, CHILD) or 3 (e.g. ADULT, CHILD, OTHER or MALE, FEMALE, CHILD) or 4 (e.g. MALE, FEMALE, CHILD, OTHER).

"In a particular embodiment, at least some of the q parameters govern or influence the gain in at least a part of the frequency range of interest (a number of frequency bands), e.g. corresponding to the relatively higher frequencies, e.g. frequencies within the frequency range of interest larger than a low-to-high frequency f(L->H). In an embodiment, f(L->H) is around 1,000 Hz or around 1,500 Hz or around 2,000 Hz or around 2,500 Hz or around 4,000 Hz. In a particular embodiment, at least some of the q parameters govern or influence gain and/or directionality and/or compression and/or noise reduction.

"Use of a Hearing Aid

"Use of embodiments of a hearing aid as described above, in the detailed description or in the appended claims or obtainable by embodiments of a method as described above, in the detailed description or in the appended claims is furthermore provided.

"A Software Program and a Computer Readable Medium:
"A software program for running on a digital signal processor of a hearing aid comprising a signal processor is furthermore provided, the software program, when executed on the digital signal processor, implementing at least some of the steps of the method described above, in the detailed description and in the claims. Preferably at least one of steps b) to f) of the method is implemented in the software program. In an embodiment, the hearing aid is a hearing aid as described above, in the detailed description and in the claims.
"A medium having instructions stored thereon is furthermore provided. The stored instructions, when executed, cause a signal processor of embodiments of a hearing aid as described above, in the detailed description or in the appended claims to perform at least some of the steps of the method as described above, in the detailed description and in the claims. Preferably at least one of steps b) to f) of the method is included in the instructions. In an embodiment, the medium comprises a non-volatile memory of a hearing aid. In an embodiment, the medium comprises a volatile memory of a hearing aid.
"As used herein, the singular forms 'a,' 'an,' and 'the' are intended to include the plural forms as well, unless expressly stated otherwise. It will be further understood that the terms 'includes,' 'comprises,' 'including,' and/or 'comprising,' when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will be understood that when an element is referred to as being 'connected' or 'coupled' to another element, it can be directly connected or coupled to the other element or intervening elements maybe present. Furthermore, 'connected' or 'coupled' as used herein may include wirelessly connected or coupled. As used herein, the term 'and/or' includes any and all combinations of one or more of the associated listed items."
For additional information on this patent, see: Hockley, Neil. Hearing Aid Adapted to a Specific Type of Voice in an Acoustical Environment, a Method and Use. U.S. Patent Number 8259972, filed January 16, 2009, and issued September 4, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=37&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1829&f=G&l=50&co1=AND&d=PTXT&s1=20120904.PD.&OS=ISD/20120904&RS=ISD/20120904
Keywords for this news article include: Software, Algorithms, Bernafon AG, Neural Networks.

Publication date: Sep 20, 2012

Year: 2012

Sound bites

Author: Bouton, Katherine

Publication info: International Herald Tribune [Paris] 20 Sep 2012: 7.
ProQuest document link

Abstract (Abstract): "No one told me it was going to be this noisy," says a young woman who is going deaf in Nina Raines's play "Tribes." If you have a hearing aid, the world is, paradoxically, far noisier than it is for a person with normal hearing. The human ear is a miraculous thing. It can filter out the roar of the crowd in a stadium while homing in on the voice of the person in the next seat. A hearing aid can't do that. The only way to really filter out noise is simply to turn it off.

I'm the first to acknowledge that noise has its place. What would "Bring In da Noise, Bring In da Funk" have been without the clatter of those tapping feet? Who wants to go to a sports event where the crowd is silent? The stomp of a tyrannosaurus in Sensurround, the excited din of a good party, the audible energy of a city. Noise is an integral part of any of these. But it can still be noisy without being literally deafening.

We need to quiet things down a bit for everyone, but especially for those who are already deafened. Webster's defines noise as sound "that lacks agreeable musical quality or is noticeably unpleasant." That's a subjective definition. What's music to your ears is almost always noise to mine.

Full text: Even for those with normal hearing, dining and talking are becoming mutually exclusive.

"No one told me it was going to be this noisy," says a young woman who is going deaf in Nina Raines's play "Tribes." If you have a hearing aid, the world is, paradoxically, far noisier than it is for a person with normal hearing. The human ear is a miraculous thing. It can filter out the roar of the crowd in a stadium while homing in on the voice of the person in the next seat. A hearing aid can't do that. The only way to really filter out noise is simply to turn it off.

Americans are increasingly aware of the dangers of noise, the single largest cause of hearing loss, but we are less aware of the way it further handicaps those of us who already have hearing loss.

I began to lose my hearing in my early 30s, for reasons no one has been able to determine. My hearing loss is progressive, and in 2002 I finally gave in to the inevitable and got hearing aids. I bought new ones -- at $3,000 apiece, with little or no insurance reimbursement -- every two or three years as my hearing deteriorated. Three years ago, when a hearing aid no longer helped in my worse ear, I got a cochlear implant, the height of hearing technology. I hear well enough now that I'm unlikely to get run over by a car coming up behind me. But, like the hearing aid in my other ear, the implant is nowhere near as good as a human ear -- either for hearing or for filtering out what I don't want to hear.

In a noisy environment like a restaurant, a person with normal hearing will still be able to hear his companion. But in that same environment, a hearing-impaired person will hear chairs scraping, dishes clanking, waiters shouting, all of it bouncing off the high ceilings, the bare walls, the chic metallic tables and chairs -- an anxiety-provoking wall of noise. Worst of all is the background music, sometimes competing with a different sound track throbbing in the kitchen.

Recently I had dinner with my husband and sister (both with normal hearing) and my daughter, son and niece, all 20-somethings, in a popular restaurant. It was my birthday and I had a great time, enjoying my family and the good food, but I didn't hear one word said at the table. My daughter occasionally texted me a shorthand version of the conversation.

When my hearing loss was more moderate, I'd simply take off my hearing aid if it got too loud, setting it on the edge of the plate or on the table. But that can lead to unfortunate results. The ex-husband of a friend once popped his into his mouth, thinking it was a piece of bread. The best solution is to eat with just one or two other people, both facing you, so that you can supplement the sounds you hear with what you see. That's enough to keep a social conversation going. If I really must hear what the other person is saying, I schedule the meeting in an office or at home.

Even for those with normal hearing, dining and talking are becoming mutually exclusive. Noise is the second most common complaint about restaurants, according to Zagat, following poor service. The first thing that anyone asked me when I said I was writing a book about hearing loss was whether I could recommend a quiet restaurant.

Noise causes hearing loss, and hearing loss itself is bad for your health. There are 48 million hearing-impaired Americans. Those affected include teenagers, people ages 19 to 44 (the most common period for the onset of hearing loss), and the elderly. Hearing loss is itself associated with depression, dementia and even heart

disease.
Some researchers speculate that what we think of as age-related hearing loss is merely the accumulated damage of a lifetime of noise. Studies in Sudan and Easter Island in the '60s and '80s, respectively, have found populations where age-related hearing loss seemed nonexistent or limited. Though there may be genetic explanations, there was a marked difference between the hearing of Easter Islanders who had lived only on the island and those who had spent some years on the industrialized mainland.
I'm the first to acknowledge that noise has its place. What would "Bring In da Noise, Bring In da Funk" have been without the clatter of those tapping feet? Who wants to go to a sports event where the crowd is silent? The stomp of a tyrannosaurus in Sensurround, the excited din of a good party, the audible energy of a city. Noise is an integral part of any of these. But it can still be noisy without being literally deafening.
We need to quiet things down a bit for everyone, but especially for those who are already deafened. Webster's defines noise as sound "that lacks agreeable musical quality or is noticeably unpleasant." That's a subjective definition. What's music to your ears is almost always noise to mine.
a former editor at The New York Times, is the author of "Shouting Won't Help: Why I -- and 50 Million Other Americans -- Can't Hear You."

Publication date: Sep 20, 2012

Year: 2012

Siemens Medical Instruments Pte. Ltd.; Patent Application Titled "Method and Device for Estimating Interference Noise, Hearing Device and Hearing Aid" Under Review

Publication info: Electronics Newsweekly (Sep 12, 2012): 3877.
ProQuest document link

Abstract: According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors Rosenkranz, Tobias (Erlangen, DE), filed on February 16, 2012, was cleared for further review on August 30, 2012.

Full text: 2012 SEP 12 (VerticalNews) -- By a News Reporter-Staff News Editor at Electronics Newsweekly -- According to news reporting originating from Washington, D.C., by VerticalNews journalists, a patent application by the inventors Rosenkranz, Tobias (Erlangen, DE), filed on February 16, 2012, was cleared for further review on August 30, 2012.
The assignee for this patent application, patent serial number 397859, is Siemens Medical Instruments Pte. Ltd.

Reporters obtained the following quote from the background information supplied by the inventors: "Field of the Invention
"The present invention relates to a method for estimating interference noise by providing a value for the power density of a total signal, containing a useful signal and the interference noise to be estimated, in a current time window, comparing the value of the total signal with an estimated value, multiplied with an amplification factor, of interference noise from a time window prior to the current time window and using the smaller of the two values from the comparison as a preliminary estimated value for the interference noise in the current time window. The present invention additionally relates to a device for estimating interference noise in an input device for the provision of the value for the power density of the total signal and a recursive minimum estimation

device for the comparison of the value of the total signal with the estimated value of the previous time window. The present invention furthermore relates to a hearing device with such a device for estimating interference noise. A hearing device in the present context is understood to be any sound-emitting device that can be worn in or on the ear, in particular a hearing aid, a headset, headphones and the like.

"Hearing aids are wearable hearing devices used to help people who are hard of hearing. Hearing aids are made available in various designs, including behind-the-ear (BTE) hearing aids, receiver in the canal (RIC) hearing aids and in the ear (ITE) hearing aids, for example also concha hearing aids and in the canal hearing aids (ITE, CIC), in order to meet the wide range of different user requirements. The hearing aids mentioned as examples are worn on the external part of the ear or in the auditory canal. However other aids to hearing, including bone conduction aids to hearing and implantable and vibrotactile aids to hearing, are also available in the market. The damaged hearing is stimulated either mechanically or electrically with these devices.

"The primarily important components of a hearing aid are in principle an input transducer, an amplifier and an output transducer. The input transducer is generally a sound receiver, for example a microphone, and/or an electromagnetic receiver, such as, for example, an induction coil. The output transducer is usually realized as an electroacoustic transducer, for example a miniature loudspeaker, or as an electromechanical transducer, for example a bone vibrator. The amplifier is ordinarily integrated into a signal processing unit. This design in principle is illustrated in FIG. 1 using the example of a behind-the-ear hearing aid. One or more microphones 2 are installed in a hearing aid housing 1 to be worn behind the ear. The microphones 2 are to receive sound from the environment. A signal processing unit (SPU) 3, which is likewise integrated into the hearing aid housing 1, processes and amplifies the microphone signals. The output signal from the signal processing unit 3 is transmitted to a loudspeaker or bone vibrator 4, which outputs an acoustic signal. The sound may be transmitted to the eardrum of the hearing aid wearer via an acoustic tube secured in the auditory canal by means of an ear mold. The power supply for the hearing aid and in particular for the signal processing unit 3 comes from a battery (BAT) 5 that is likewise integrated in the hearing aid housing 1.

"In many applications, especially in the case of hearing aids and cellular telephones, the wanted signal, which is usually speech, is often affected by interference noise. While stationary interference noise generally does not cause much of a problem for known speech enhancement systems, non-stationary interference noise is usually more of a challenge. Single-channel (that is to say only a single microphone is used), model-based speech enhancement systems, which are also expected to suppress highly non-stationary interference noise, are particularly affected. Such single-channel speech enhancement systems can make the listener's life easier by appropriately attenuating interference noise.

"Single-channel interference noise reduction is typically performed by what are known as Wiener filters. When creating a Wiener filter, it is necessary at least to estimate the interference noise power spectral density (PSD). Conventional speech enhancement systems customarily presuppose that the interference noise tends to be stationary, that is to say the characteristic of the interference noise changes only slowly over time. The interference noise characteristics can accordingly be estimated during breaks in speech, which, however, demands robust voice activity detection (VAD).

"More sophisticated methods operate according to the 'minimum statistic' or 'minimum tracking' principle. They are able to update the interference noise estimate even during voice activity and thus do not need VAD. The minimum statistic method breaks noisy speech down into sub-bands and searches for minima in these sub-bands within a certain period of time. Due to the highly dynamic nature of the voice signal, the minima should correspond to the noise spectral power density if the noise or interference noise is sufficiently stationary. The minima are used as input variables for the generation of an amplification factor in the relevant frequency band. The method fails, however, if the interference noise is too non-stationary. This means that its performance plummets in highly non-stationary environments (for example chat in a cafeteria). Reference is made in respect of interference noise reduction by means of what are known as 'recursive minimum tracking' and 'minimum

statistic' to the book by Eberhard Hansler and Gerhard Schmidt titled 'Acoustic Echo and Noise Control: A Practical Approach', Wiley-Interscience-Verlag, 2004 and to the article by R. Martin titled 'Noise Power Spectral Density Estimation Based on Optimal Smoothing and Minimum Statistics', IEEE Transactions on Speech and Audio Processing, 2001, 9 (5), pages 504 to 512.

"Speech enhancement techniques known as 'codebook-based' techniques have recently been developed. These techniques make use of prior knowledge about speech and interference noise. The principal idea behind them is to estimate the spectral envelope and the wide-band signal powers (amplification factors) of speech and interference noise from the noise-affected signal. Typical spectral envelopes of speech and different categories of interference noise are stored in codebooks. The first step in estimation is to take a pair (one speech entry and one interference noise entry) of spectral envelopes from the corresponding codebooks. The optimal amplification factors (that is to say the wide-band speech power and the wide-band interference noise power) are estimated by maximizing a specific optimization criterion. One criterion, for example, is that the sum of the speech and interference noise codebook entries corresponds as far as possible to the current noise-affected signal. In a second step, either the pair (together with the associated estimated amplification factors) that corresponds with the highest probability to the current noise-affected spectrum is selected or each pair is weighted with the probability that it corresponds to the current noise-affected sound spectrum and all of the pairs thus weighted are added together. By this means estimated values are obtained for the speech and interference noise components of the noise-affected sound spectrum. These estimated values are used as input variables for a subsequent interference noise reduction operation, for example using a Wiener filter. This estimation method is carried out in short time windows (for example 8 ms) so that rapid changes in the interference noise characteristic can be tracked virtually without delay. A minimum statistic estimator can track such changes only with a delay in the range of a few seconds.

"Such a codebook-based algorithm is known from the article by T. Rosenkranz titled 'Noise Codebook Adaptation for Codebook-Based Noise Reduction', in Proceedings of the International Workshop on Acoustic Echo and Noise Control (IWAENC), Tel Aviv, August 2010.

"There are, however, also three serious disadvantages to the codebook-based approach. Firstly, interference noise estimation is limited to a predefined set of codebook entries. These entries represent spectral envelopes, so they are smoothed along the frequency axis. This means that sharp spectral peaks, for example, are not modeled. Secondly, the ability of the codebook-based approach to respond to changes in interference noise without delay means that the estimate fluctuates strongly. The estimate of the wide-band level is quite naturally not perfect and consequently fluctuates relatively strongly about the true value, which leads to unpleasant artifacts in the signal produced after interference noise removal. Thirdly, this codebook-based approach cannot cope with any categories of noise for which it has not been trained."

In addition to obtaining background information on this patent application, VerticalNews editors also obtained the inventors' summary information for this patent: "It is accordingly an object of the invention to provide a method and device for estimating noise signals which overcome the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides for a method and a device with which it is possible to estimate even unfamiliar interference noise as quickly as possible.

"With the foregoing and other objects in view there is provided, in accordance with the invention, a method for estimating interference noise, the method comprising:

"providing a value for the power density of a total signal, containing a wanted signal and the interference noise to be estimated, in a current time window;

"comparing the value of the total signal with an estimated value, multiplied by an amplification factor, of interference noise from a time window prior to the current time window;

"using the smaller of the two values in the comparing step as a preliminary estimated value for the interference noise in the current time window;

"providing a codebook estimated value for the interference noise in the current time window; and
"using the greater of the preliminary estimated value and the codebook estimated value as the estimated value for the interference noise in the current time window.
"In other words, the objects of the invention are achieved, according to the invention, by a method for estimating interference noise in which a codebook estimated value is provided for the interference noise in the current time window and in which the greater of a preliminary estimated value and the codebook estimated value is used as the estimated value for the interference noise in the current time window.
"With the above and other objects in view there is also provided, in accordance with the invention, a device for estimating interference noise which comprises:
"an input device to provide a value for the power density of a total signal, containing a wanted signal and the interference noise to be estimated, in a current time window;
"a recursive minimum estimation device to compare the value of the total signal with an estimated value, multiplied with an amplification factor, of interference noise from a time window previous to the current time window and to output the smaller of the two values from the comparison as a preliminary estimated value for the interference noise in the current time window;
"a codebook estimation device to provide a codebook estimated value for the interference noise in the current time window; and
"a logic device connected to the recursive minimum estimation device and to the codebook estimation device and configured to determine the larger of the previous estimated value and the codebook estimated value as the estimated value for the interference noise in the current time window.
"The 'recursive minimum tracking' and the 'codebook-based interference noise estimation' techniques are thus combined according to the invention in an advantageous manner in order to achieve improved reduction of non-stationary interference noise. The aforementioned disadvantages of recursive minimum searching and the disadvantages of codebook-based estimation as such are thereby essentially eliminated.
"The value for the total signal and the estimated value for interference noise are preferably spectral values. Signal processing in the method according to the invention is then performed in the spectral range.
"It is particularly favorable for the method to be applied in multiple frequency channels in parallel. The input signal is for this purpose advantageously broken down into the various spectral components in a filter bank.
"It is also advantageous for the estimated value for the interference noise in the current time window to be smoothed with the estimated value from the previous time window. This is favorable insofar as it does not result in any excessive jumps in the noise reduction.
"It is also particularly advantageous if the codebook estimated value can temporarily be set to zero. The equivalent effect can be achieved by switching off the codebook estimation device. This makes the entire algorithm less sensitive to whether the interference noise is known or not.
"In an advantageous application, the method for estimating interference noise outlined above is used to reduce interference noise. It is again particularly advantageous here for such a method for reducing interference noise to be used to operate a hearing aid or to be implemented in a hearing aid. This enables hearing aid wearers in particular to benefit from the improved, combined interference noise reduction method.
"The aforementioned device for estimating interference noise can be integrated into a hearing device. In a most preferred embodiment, this hearing device is implemented as a hearing aid.
"Other features which are considered as characteristic for the invention are set forth in the appended claims.
"Although the invention is illustrated and described herein as embodied in a method and device for estimating an interference noise, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and

advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."
For more information, see this patent application: Rosenkranz, Tobias. Method and Device for Estimating Interference Noise, Hearing Device and Hearing Aid. U.S. Patent Serial Number 397859, filed February 16, 2012, and posted August 30, 2012. Patent URL: http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetahtml%2FPTO%2Fsearch-adv.html&r=2929&p=59&f=G&l=50&d=PG01&S1=20120823.PD.&OS=PD/20120823&RS=PD/20120823
Keywords for this news article include: Algorithms, Electronics, Bone Research, Signal Processing, Siemens Medical Instruments Pte. Ltd..
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Publication date: Sep 12, 2012

Year: 2012

STUDY: HEARING IMPAIRED EARS HEAR DIFFERENTLY IN NOISY ENVIRONMENTS

Publication info: US Fed News Service, Including US State News [Washington, D.C] 11 Sep 2012.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: WEST LAFAYETTE, Ind., Sept. 10 -- Purdue University issued the following news release:
The world continues to be a noisy place, and Purdue University researchers have found that all that background chatter causes the ears of those with hearing impairments to work differently.
"When immersed in the noise, the neurons of the inner ear must work harder because they are spread too thin," said Kenneth S. Henry, a postdoctoral researcher in Purdue's Department of Speech, Language and Hearing Sciences. "It's comparable to turning on a dozen television screens and asking someone to focus on one program. The result can be fuzzy because these neurons get distracted by other information."
The findings, by Henry and Michael G. Heinz, an associate professor of speech, language and hearing sciences, are published as a Brief Communication in Nature Neuroscience. The work was funded by the National Institutes of Health and the National Institute on Deafness and Other Communication Disorders.
"Previous studies on how the inner ear processes sound have failed to find connections between hearing impairment and degraded temporal coding in auditory nerve fibers, which transmit messages from the inner ear to the brain," said Heinz, who studies auditory neuroscience. "The difference is that such earlier studies were done in quiet environments, but when the same tests are conducted in a noisy environment, there is a physical difference in how auditory nerve fibers respond to sound."
Hearing loss, suffered in varying degrees by 36 million American adults, means there is damage to sensory cells in the cochlea and to cochlear neurons as well. The cochlea is the part of the inner ear that transforms sound into electrical messages to the brain.
In this study, the researchers measured a variety of physiological markers in chinchillas, some with normal hearing and others with a cochlear hearing loss, as they listened to tones in quiet and noisy environments. Chinchillas are used because they have a similar hearing range to humans, and background noise is used in the study to simulate what people would hear in a crowded room.
"The study confirmed that there is essentially no change, even for those with hearing loss, in terms of how the

cochlear neurons are processing the tones in quiet, but once noise was added, we did observe a diminished coding of the temporal structure," Henry said.
The researchers focused on coding of the temporal fine structure of sound, which involves synchrony of neural discharges to relatively fast fluctuations in sound pressure. Both coding of fast fine structure information and coding of slower envelope fluctuations are critical to perception of speech in everyday listening environments.
"When noise was part of the study, there was a reduction in how synchronized the neurons were with the temporal fine structure," Henry said.
The auditory system filters sound into a number of channels that are tuned to different frequencies, and those channels vary based on their frequency tuning. In a normal system, the channels are sharp and focused, but they get broader and more scattered with hearing impairment.
"Now that we know a major physiological effect from hearing loss is that the auditory nerve fibers are particularly distracted by background noise, this has implications for research and clinical settings," said Heinz, who also has a joint appointment in biomedical engineering. "For example, most audiology testing, whether it is lab research or hearing-loss screenings, takes place in a quiet environment, but testing noisy, more realistic backgrounds is necessary to truly understand how the ear is processing sound. This also could influence the design of hearing aids and assistive technologies.
"Designers are often working on improving the temporal coding of the signal, but this research suggests that a primary focus should be on improving noise-reduction algorithms so the hearing aid provides a clean signal to the auditory nerve. Other ways people can reduce background noise include induction-loop hearing systems, which are used in churches and other public settings to provide a cleaner signal by avoiding room noise."
Next, the researchers plan to expand the study to focus on more real-world noises and coding of slower envelope information in sound.
"Additional study is certainly needed, and there are others who are also looking at the role the central nervous system plays, too," Henry said. "But ultimately, we found that hearing loss degrades temporal coding of sounds in background noise in the cochlea, the most peripheral level of auditory processing." For any query with respect to this article or any other content requirement, please contact Editor at htsyndication@hindustantimes.com

Publication date: Sep 11, 2012

Year: 2012

Study: Hearing Impaired Ears Hear Differently in Noisy Environments

Publication info: Targeted News Service [Washington, D.C] 10 Sep 2012.
ProQuest document link

Links: Check LinkSource for Full Text

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"Designers are often working on improving the temporal coding of the signal, but this research suggests that a primary focus should be on improving noise-reduction algorithms so the hearing aid provides a clean signal to the auditory nerve. Other ways people can reduce background noise include induction-loop hearing systems, which are used in churches and other public settings to provide a cleaner signal by avoiding room noise."

Next, the researchers plan to expand the study to focus on more real-world noises and coding of slower envelope information in sound.

"Additional study is certainly needed, and there are others who are also looking at the role the central nervous system plays, too," Henry said. "But ultimately, we found that hearing loss degrades temporal coding of sounds in background noise in the cochlea, the most peripheral level of auditory processing."

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TNS cp -120911-JF78-4021042 StaffFurigay

Publication date: Sep 10, 2012

Year: 2012

Otoacoustic Emissions and Evoked Potentials in Infants after Breast-Feeding Jaundice: Hearing Dysfunction in Breast-Feeding Jaundice

Author: Poblano, Adrián; Ballesteros, Norma; Arteaga, Carmina; Flores, Blanca; Flores, Teodoro

Publication info: Neuroscience and Medicine 3.3 (Sep 2012): 270-274.
ProQuest document link

Abstract: We study hearing in a group of infants with Breast-feeding jaundice (BFJ) by means of Transient-evoked otoacoustic emissions (T-EOE) and Brainstem auditory evoked potentials (BAEP) searching for relationship between bilirubin serum levels and auditory dysfunction. Eleven infants born at-term with BFJ were selected for the study. We studied also 11 control age-and gender matched healthy at-term infants without signs of jaundice. T-EOAE studies were performed between 5-7 days after birth, and 3 months later. BAEP studies were performed once. BFJ group infants exhibited lower amplitudes in T-EOE than infants in the control group. These differences disappear at the 3-month evaluation. In BAEP, we observed a significant latency delay of waves I and V in Breast-feeding jaundice group infants. All infants in both groups demonstrated reproducible wave V response at 30 decibels. No significant correlation values were observed between bilirubin serum levels and T-EOE and BAEP variables. Our data suggest that BFJ can result in transient periph-eral and central auditory dysfunction. Dysfunction is reversible after treatment of infants with BFJ. [PUBLICATION ABSTRACT]

Full text: Headnote

ABSTRACT

We study hearing in a group of infants with Breast-feeding jaundice (BFJ) by means of Transient-evoked otoacoustic emissions (T-EOE) and Brainstem auditory evoked potentials (BAEP) searching for relationship between bilirubin serum levels and auditory dysfunction. Eleven infants born at-term with BFJ were selected for the study. We studied also 11 control age-and gender matched healthy at-term infants without signs of jaundice. T-EOAE studies were performed between 5-7 days after birth, and 3 months later. BAEP studies were performed once. BFJ group infants exhibited lower amplitudes in T-EOE than infants in the control group. These differences disappear at the 3-month evaluation. In BAEP, we observed a significant latency delay of waves I and V in Breast-feeding jaundice group infants. All infants in both groups demonstrated reproducible wave V response at 30 decibels. No significant correlation values were observed between bilirubin serum levels and T-EOE and BAEP variables. Our data suggest that BFJ can result in transient periph-eral and central auditory dysfunction. Dysfunction is reversible after treatment of infants with BFJ.

Keywords: Breast-Feed Jaundice; Hyperbilirubinemia; Hearing; Neonates; Transient-Evoked Otoacoustic Emissions; Brainstem Auditory Evoked Potentials

1. Introduction

Previous research has shown the relationship between neonatal hyperbilirubinemia and sensorineural hearing loss [1,2]. The majority of investigations have been per-formed by means of Brainstem auditory evoked re-sponses (BAEP) in High-risk newborns (HR-NB). These infants have been followed throughout several years after birth to confirm hearing loss [3-6]. Observations have suggested repeatedly that hearing dysfunction is a mani-festation of injury situated in the auditory neural pathway along the brainstem. However, one paper had situated the injury also in the peripheral cochlear system [7].

Breast-feeding jaundice (BFJ) provides a fair model to study the peripheral and central auditory alterations after pure neonatal hyperbilirubinemia, because this is differ-ent from hyperbilirubinemia in HR-NB. The majority of infants with BFJ are born at term with adequate weight and without other risk factors for auditory damage, such as asphyxia, intracranial hemorrhage, or others. Thus, the aim of our study was to study hearing function in a group of infants with BFJ by means of Transient-evoked oto-acoustic emissions (T-EOE) and BAEP with the hypothesis that there is a relationship between bilirubin serum levels and peripheral and central auditory dysfunction. In order to test our hypothesis, we employed T-EOE as an index for cochlear toxicity, and BAEP as an index of auditory brainstem neurotoxicity.

2. Materials and Methods

2.1. Subjects

Healthy infants born at General Hospital "Dr. Darío Fernández" readmitted with jaundice to the Department of Pediatrics during their first week of life with diagnoses of BFJ were selected for the study. Inclusion criteria in-cluded the following: jaundice in Kramer zone ≥2; bilirubin levels >15 mg/dL; age at birth between 37 and 41 of gestational weeks; weight >2750 g; 5-min Apgar score >7, and without other risk factors for hearing damage. All of the infants were exclusively breastfed. Mothers of the patients noted jaundice at home, and it was not accompanied by decreased activity or poor feed-ing. None newborn had any laboratory evidence of hemolytic disease as evidenced by anemia, reticulocyto-sis, or another abnormality. Infants were screened for neurological, and auditory dysfunction [8,9], and for perinatal factors associated with an increased risk of hy-perbilirubinemia including, maternal diabetes mellitus, high blood pressure, administration of oxytocin during labor, as well as central nervous system bleeding or in-jury, or infection. At time of readmission to the hospital, the infants were evaluated for clinical signs of acute bilirubin encephalopathy manifested as changes in level of consciousness, tone/movement, poor feeding, abnor-mal cry, opistho-tonus and/or seizures, and alterations in brainstem function. Other causes of hyperbilirubinemia including scalp bruising, dehydration and sepsis were investigated. Laboratory studies included complete blood counts, electrolytes, glucose, and cultures. Cranial Ultra-sonographic studies were performed in all newborns to rule-out other brain pathologies. Bilirubin determinations and T-EOE were performed in the first days after jaun-dice was recognized to identify and treat possible neuro-development deviations; T-EOE were repeated 3 months later. BAEP determinations were performed rapidly after T-EOE examination once. We studied 11 infants with BFJ (four males and seven females) and 11 control healthy newborn infants who were age-and gender matched at the time of study without signs of jaundice. Results of each study were blinded to the researchers who revised BAEP and T-EOE determinations for group pertinence. The Research and Ethics Committees of the Hospital and of the Institute approved the protocol. In-formed consent was obtained from parents of infants and is contained in signed forms according to the principles expressed in the Declaration of Helsinki.

2.2. Bilirubin Determinations

Samples were obtained by peripheral venipuncture. All specimens were protected from light after they were drawn, and these were analyzed immediately. Total bilirubin concentration was determined spectrophotomet-rically, and unbound bilirubin concentration was meas-ured by the peroxidase method using a clinical analyzer (UB analyzer, Arrows Co., Osaka, Japan). Samples with high unbound bilirubin >0.5 μg/dL were measured for concentration of direct bilirubin by diazo method [10].

2.3. Transient-Evoked Otoacoustic Emissions (T-EOE)

Responses were recorded with the ILO-88 (Otodynamic Ltd, London, UK), during a sleep session. Studies were conducted in a sound-proofed room. Prior to the Oto-acoustic emission study, ear canals were checked with an otoscope to confirm permeability of external auditory channel. We use a miniature acoustic probe fitted into the infant ear channel. The probe incorporates a small mi-crophone and ear-speaker. Stimuli consisted of 80 deci-bel (dB) HL (Hearing level) click stimulation of 100 μsec delivered at a repetition rate of 11/sec. Signal was amplified and filtered between 350 and 6400 Hz. Two hundred fifty stimuli were averaged. Analysis time was 20

millisec. Contralateral ear masking with white noise 20 dB below stimulus intensity was administrated simultaneously. Adequate T-EOAE responses were identified based on reproducibility of ≥75%. The detection thresh-old of T-EOAE was measured by stimulating the ear with decreasing click intensities in 20-dB steps. Each ear was tested separately [11].

2.4. Brainstem Auditory Evoked Potentials (BAEP)

BAEP were recorded and analyzed following standard international recommendations [12]. BAEP determinations were performed after a feeding sleep in a sound-proof room. Each subject was tested with BAEP using an ATI system (Buenos Aires, Argentina). Three gold-disk electrodes were placed on the scalp, with nega-tive electrode on ipsilateral mastoid, positive on vertex, and neutral on contralateral mastoid. Interelectrode impedances were ≤2 kilo-ohms. Electrical activity among electrodes was amplified and averaged over a 10 millisec time base. Stimulus was administrated through a Tele-phonics TDH-49 earphone (Telephonics Co., Huntington, NY, USA). Stimuli were presented monoaurally at a rate of 11/sec. Initial presentation intensity was 70-dB HL and decreased by 20-dB steps to determine neurophysi-ologic threshold of response. Contralateral ear masking with white noise 20 dB below stimulus intensity was administrated simultaneously. Stimuli were delivered mono-aurally and consisted of 100 μsec alternating clicks. Band pass filters were set between 100 and 3000 Hz, and stimulus average was 2024 clicks. The process was repeated at least once to ensure reproducibility of response. Latencies of waves I, III, and V were measured by manual cursor placement at leftand right ear re-cordings separately; I-III, III-V, and I-V interpeak inter-vals were calculated automatically by computer software; a normal hearing threshold was determined if the repro-ducible wave V response was present at last at 30 dB level.

2.5. Data Analysis

We calculates average and Standard deviation (SD) of quantitative variables and percentages of qualitative variables. We report BAEP data from the ear producing the faster I-V conduction time as published previously elsewhere [13,14], because in this way we avoid sub-clinical hearing conductive alterations. Comparisons between both groups were performed by two-tailed Student t test. We performed Pearson correlation analysis between total, indirect, and direct bilirubin serum levels and T-EOE and BAEP variables. The level of statistical significance a-priori chosen was $p \leq 0.05$. Calculations were performed with the SPSS 14.0 (SPSS Inc., Chicago, IL, USA) computer program [15].

3. Results

Clinical characteristics of infants in each group are shown in Table 1; no significant differences in compared variables between groups were observed. The infants age at which mother requested attention ranged between 5 and 7 days after birth (median, 6 days). Average bilirubin determinations in BFJ-group infants are presented in Ta-ble 2.

Averages of response amplitude by ear determined by T-EOE at birth and 3 months later are shown in Table 3; in the neonatal period, there were significant differences in both ear responses between groups, with BFJ-group infants exhibiting lower amplitudes than infants in the control group. However, these differences disappear at the 3-month evaluation when hyperbilirubinemia was resolved.

Average of main waves (I, III, and V) and interwave intervals (I-III, III-V, and I-V) in BAEP determinations are presented in Table 4; we observed a significant la-tency delay of waves I and V in BFJ-group infants. However, all infants in both groups demonstrated repro-ducible wave V response at 30 dB, suggesting adequate hearing and thus no second BAEP study was performed in infants. We did not observe cases of auditory neu-ropathy. No significant correlation values were observed between total, indirect, and direct bilirubin serum levels and T-EOE, and BAEP variables.

4. Discussion

In this paper, we showed that BFJ in low-risk at-term infants results in both auditory peripheral and central dysfunctions as reflected in T-EOE and BAEP alterations. We also observed that these auditory and

neurophysi-ologic alterations could be reversible after rapid man-agement and resolution of the hyperbilirubinemia. How-ever, we could not demonstrate our hypothesis about signifycant correlation between bilirubin serum levels and peripheral and central auditory dysfunction.

Several in-vitro studies showed that bilirubin-induced neuronal toxicity involves changes in energy metabolism, alteration in membrane function, decreased membrane potential, alteration in enzyme function, and inhibition of protein synthesis [16,17]. It also appears from these pre-viously cited in-vitro studies that immature cells are more sensitive to bilirubin toxicity than differentiated cells, supporting clinical experience demonstrating that premature neonates are more susceptible to bilirubin-induced neurotoxicity than at-term infants. However, our data also suggest that the auditory responses of otherwise healthy at-term infants could be injured by hyper-bilirubinemia.

Various clinical factors, such as hypothermia, hypoxia, acidosis, hypercarbia, asphyxia, sepsis, intraventricular hemorrhage, and hemolysis, have been postulated to ex-plain the occurrence of bilirubin neurotoxicity at much lower levels of serum total bilirubin [1]. These factors are thought to increase the risk of kernicterus by affect-ing serum bilirubin-albumin binding, bilirubin entry into the brain, or tissue uptake of bilirubin. For example, one study identified a degree of acidosis with low serum al-bumin levels that occurred prior to the maximum un-bound bilirubin level and that was present in newborns with kernicterus [18]. On the other hand, a study of fol-low-up of at-term or near-term infants with BFJ reported transient neurologic abnormalities. These abnormalities resolved following management with phototherapy and exchange transfusions, and bilirubin level did not corre-late with the long-term prognosis [19]. Results from this study are partially in agreement with our data.

One of the tools commonly utilized to investigate bilirubin-induced neurotoxicity in neonates is BAEP test. BAEP has been studied in high-risk pre-term newborns as a non-invasive auditory neurophysiologic assessment of bilirubin neurotoxicity. Many observations confirm the higher frequency of auditory alterations in newborns after hyperbilirubinemia, such a delay of wave I, III and V latencies or the absence of response at higher intensi-ties of auditory stimulation [3-6]. This is in indirect agreement with our observations, because we observed a wave I and V delay. Other studies have shown correla-tion between indirect bilirubin serum levels and BAEP alterations [20]; however we are unable to confirm this correlation in our observations. Other studies have dem-onstrated that BAEP alterations are reversible after blood exchange [21]. However, we were unable to confirm this observation, because our infants with BFJ were not blood ex-changed and all our infants in both, control and BFJ groups presented response at 30 dB. Thus, there was no reason for subsequent appointment 3 months later for an additional BAEP study.

Otoacoustic emissions have been used to screen hear-ing alterations after neonatal hyperbilirubinemia. T-EOE has been employed as a first step in rapid screening of infant auditory performance. Study investigators usually carry out a BAEP examination after an abnormal T-EOE [2,7]. Researchers have observed a decrease in the re-sponse amplitude of T-EOE such as that which we ob-served in our BFJ-group infants, or an increased number in absences of response after auditory stimulation.

Recently, Jangaard et al. did not observed an increased frequency in cerebral palsy, developmental delay, autism, and hearing loss in a population of infants born at-term or near-term with other neurologic risk-factors other than hyperbilirubinemia (≥19 mg/dL) [22]. This result is also in indirect agreement with our observations, because we observed no case of hearing loss. However, because we measured T-EOE and BAEP variables quantitatively, we were able to detect subclinical effects of transient hyper-bilirubinemia in the peripheral and central auditory sys-tem of infants with BFJ, that were not observed by the other work team.

We did not observe cases of auditory neuropathy in our sample, but this may be explained of our small sam-ple size [23]. An alternative explanation may be that auditory neuropathy after neonatal hyperbilirubinemia is a complex alteration that requires other risk-factors than only high bilirubin serum levels for the production of auditory alterations. However, our infants must be fol-lowed, because language delay has been reported as a possible complication after neonatal hyperbilirubinemia [24].

Our research possesses some limitations; thus, our re-sults must be considered as tendencies, not strong conclusions. The sample is small, despite its being highly selected and age-gender-matched to a control group. Therefore, in the future a greater number of at-term in-fants with BFJ must be studied. Moreover, follow-up time was brief, notwithstanding follow-up of these in-fants will continue with these as out-patients in the Pedi-atrics Department to determine whether minimal auditory dysfunction or language alteration during child develop-ment can be a result of the BFJ episode during the neo-natal period of life.

5. Conclusion

Our data suggest that BFJ can result in peripheral and central auditory dysfunction. The dysfunction is reverse-ble; thus, early identification and treatment of infants with BFJ is mandatory to prevent possible auditory com-plications.

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Received November 11th, 2011; revised May 28th, 2012; accepted June 29th, 2012

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Publication date: Sep 2012

Year: 2012

Performance, fatigue and stress in open-plan offices: The effects of noise and restoration on hearing impaired and normal hearing individuals

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Publication info: Noise & Health 14.60 (Sep 2012): 260-72.
ProQuest document link

Abstract: Hearing impaired and normal hearing individuals were compared in two within-participant office noise conditions (high noise: 60 L_{Aeq} and low noise: 30 L_{Aeq}). Performance, subjective fatigue, and physiological stress were tested during working on a simulated open-plan office. We also tested two between-participants restoration conditions following the work period with high noise (nature movie or continued office noise). Participants with a hearing impairment (N = 20) were matched with normal hearing participants (N = 18) and undertook one practice session and two counterbalanced experimental sessions. In each experimental session they worked for two hours with basic memory and attention tasks. We also measured physiological stress indicators (cortisol and catecholamines) and self-reports of mood and fatigue. The hearing impaired participants were more affected by high noise than the normal hearing participants, as shown by impaired performance for tasks that involve recall of semantic information. The hearing impaired participants were also more fatigued by high noise exposure than participants with normal hearing, and they tended to have higher stress hormone levels during the high noise compared to the low noise condition. Restoration with a movie increased performance and motivation for the normal hearing participants, while rest with continued noise did not. For the hearing impaired participants, continued noise during rest increased motivation and performance, while the movie did not. In summary, the impact of noise and restorative conditions varied with the hearing characteristics of the participants. The small sample size does however encourage caution when interpreting the results.

Full text: Introduction

There are concerns about the effects of noise on cognitive performance and health in open-plan offices (see reviews). [1],[2],[3] These concerns are strengthened by experimental studies which indicate that noise (such as irrelevant speech) impairs performance [4],[5],[6] and increases stress. [7] In a previous study from our laboratory we also found effects of realistic office noise on cognitive performance. [8]

There are good reasons to expect that the impacts of noise in an open-plan office vary not only with the types of noise and the layout of the office, but also with the characteristics of the individuals exposed to noise. One important individual difference variable is hearing status. In Sweden more than 10% of the population have some hearing impairment and among those more than half are of working age. [9] No studies to our knowledge have systematically addressed how individuals with a hearing impairment fare (physiologically and psychologically) in open-plan offices. For example, it appears that no research has considered whether hearing impaired individuals' work performance is disrupted by background speech or how stressful they experience a noisy background to be.

If noise has a negative effect on office workers, one important strategy is to find ways to attenuate the negative outcomes. Jahncke et al. [8] showed that a 7 minute break from work in office noise promotes restorative experiences in university students with normal hearing. Restorative effects are typically seen after a break as

less fatigue, reduced psychophysiological activity (e.g. blood pressure, stress hormones) and/or increased cognitive/attentional performance.

The aim of the present study was to investigate whether open-plan office noise affects performance and stress, and whether these effects differ between hearing impaired and normal hearing individuals. In addition we investigated the restorative effects of 14 minutes break with two different restorative conditions.

Hearing impairment and performance in Noise

Most studies concerning individuals with hearing impairment have focused on performance and listening effort in tasks involving speech processing. The results show that background noise has a larger effect for the hearing impaired than for normal hearing individuals in these tasks (for a review, see. [10]) Furthermore, both subjective and objective measures indicate that background noise forces the hearing impaired to exert more effort in speech recognition tasks than is necessary for individuals with normal hearing. [11],[12] To the extent that the task involves speech perception (e.g. taking a phone call), background noise thus is therefore likely to be more detrimental for the hearing impaired than for individuals with normal hearing.

It is not apparent whether this stronger effect from background noise for the hearing impaired also applies to non-auditory tasks. By itself, a hearing loss may be favorable when performing visual tasks in office noise, as the noise is not as prominent or intelligible for the hearing impaired as it is for individuals with normal hearing. On the other hand, most individuals with a serious hearing impairment use a hearing aid, which may amplify the sound to a normal hearing level. However, the hearing aid may also distort the speech signal, [13] which may lead to more distraction for the hearing impaired. Recruitment, which refers to the finding that the same increase in signal strength gives a larger increase in perceived loudness in a non-normal ear than in the normal ear [14] may also play a part here by leading to the perception of sharp onsets of sound that capture attention away from focal task processing much like an auditory deviant. [15] Therefore, for the hearing impaired, as compared to the normal hearing individuals, there may be an additional demand of resisting attentional capture which may cause disruption of or less efficient, focal task processing. In the present study we included noise with temporal variations of speech, phones ringing, and office clatter etc. from working life (i.e. a recording from an actual open-plan office) to test whether the hearing impaired individuals are more distracted in a situation with louder noise than are individuals with normal hearing.

Hearing impairment, fatigue and stress

Babisch [16] reviewed findings concerning stress hormones in relation to research on the cardiovascular effects of noise. Interestingly there are some studies showing specific effects of noise on stress that are related to hearing and noise sensitivity. For example, Melamed and Bruhis [17] performed a field study on industrial workers and have shown that the workers had increased urinary cortisol levels after a day without wearing hearing protection compared with when using them (i.e. a difference of 30-33 dB).

Persson-Waye et al. [18] have also showed that after two hours of cognitive work in low-frequency noise (i.e., ventilation noise), normal hearing individuals that reported themselves as highly sensitive to noise maintain higher cortisol levels than individuals that report less sensitivity to noise. Therefore, higher cortisol levels could be expected in individuals who are highly sensitive to sounds because of a hearing impairment. However, to the authors' knowledge no studies have been reported that demonstrate such a relationship.

Restoration

The study of restoration in different contexts has been guided by different theoretical approaches that entail different outcomes over time. [19],[20],[21] There are lack of studies that investigate low-cost ways to provide well-being and efficiency at work. [22] One way to promote restoration has been to use film-clips or pictures of nature [23],[24] that can easily be used during a break in an office environment. [8] For a review of the psychological benefits of nature experiences see Bowler et al. [25] However, from reported research on restorative environments, it cannot be well specified how long the restorative period should be to improve performance and how varying sound conditions might influence the effectiveness of the restorative period. We

attempted to address this in the present study. In a previous study Jahncke et al. [8] tested two cognitive tasks in an attempt to tap fatigue effects: the response inhibition task (SART) and a cognitive inhibition task (Proactive interference), but failed to show any effects of a seven minute rest on task performance. The authors argued that this may be due to ceiling effects. In the present study we attempt to make the response inhibition task more difficult. We also include another task, mental arithmetic, which has been shown to be cognitively fatiguing to perform. [26] Performance on this task may therefore be more sensitive to the benefits of a restorative break. In addition, we double the rest period to 14 minutes.

Hypotheses

Our hypotheses are

Hypothesis 1: Within each of the two hearing groups, there will be an effect of noise on (a) cognitive processing resulting in depreciation in cognitive performance with high noise, (b) stress hormones resulting an increase in hormones associated with stress in the context of high noise, and (c) self ratings of sleepiness and lack of motivation, whereby sleepiness and lack of motivation will increase with work in the high noise compared to the low noise condition.

Hypothesis 2: There will be an interaction between noise and hearing level on the dependent measures. The hearing impaired individuals are expected to have more difficulties (i.e. task performance will be reduced, stress hormone levels will increase and they will be more fatigued) in high noise compared to normal hearing individuals because they are possibly more sensitive and distracted by high sounds. In low noise however, normal hearing individuals may have more difficulties than the hearing impaired because the noise might be more prominent for them at this level.

Hypothesis 3: Participants will restore from fatigue (measured as performance on cognitive tasks, self-ratings and cortisol levels) to differing degrees as a function of restoration conditions. More precisely, we expect a nature movie without sound (positive stimuli) to be more restorative than noise (negative stimuli).

Methods

Design

We used a 2 ×2 mixed factorial experiments, with one between-participants factor (hearing level) and one within-participant factor (noise condition). We also had two different between-participants restorative conditions at the end of the high noise sessions. The participants either watched a nature movie with no sound or listened to office noise without a movie (between-participants manipulations). During the low noise session all participants sat in quiet during the restorative period, to assure the same session length in both noise conditions.

Participants

The participants in the study were 20 hearing impaired (nine females; median age = 53) and 18 normal hearing individuals (eight females; median age = 48). The participants with hearing impairment were recruited from the Swedish association of the Hard of Hearing Persons (HRF) and we only included those in the age span 20-65 years old. Those who reported having severe tinnitus and/or Menières disease were excluded. In the next step we recruited matched normal hearing participants following the criteria of the same gender, age (accepted with small age variation), occupation and education as the hearing impaired individuals. Out of the 38 participants, 20 had earlier worked with office tasks, and 10 had some experience with open-plan offices. Participants' hearing abilities were screened [see [Figure 1]a and b for the means of the audiograms for the hearing impaired and normal hearing group]. The standard deviation across all values was 24.83 for the hearing impaired and 5.28 for the normal hearing participants. The criterion to be included in the hearing impaired group was a mean hearing loss of 28 dB or more over the frequencies 500, 1000, 2000 and 4000 Hz, which did not give any overlap between the two groups. The participants with hearing-aids were told to have them turned on during the experiments. Participants were informed of the nature of the study before participating and they were randomly assigned to the two sequence orders of the two noise conditions. Participation in all sessions of the experiment

was compensated with 990 Swedish crowns.{Figure 1}

Research setting

The research was carried out in an office laboratory (63 m 2) at the University of Gävle. The room was designed to simulate a neutral open-plan office including windows to a white room with simulated outdoor lighting. Ambient conditions in the indoor environment were kept approximately constant throughout the experiments. The room temperature at the work place varies in-between 20.7-21.6C during the experimental sessions. The airflow was 20 l/s for each person in the experiment, and the CO 2 concentration was always well below 1000 ppm. Luminance was set to 480-520 lx incident on the height of the seating in each workstation and met the current recommendations in Sweden for work with computers. [27] The luminance in the room outside the window was set to 1950 lx measured at the middle of the window.

The workstations were separated by 1.43 m high screens. Each cubicle was 1.24 m wide. At each end of the set of cubicles a pane of glass was installed to better avoid direct sounds from the loudspeakers to the participants sitting close by. Behind the participants on each side were also 3.60 m wide ×1.80 m high screens to better avoid direct sounds from the loudspeakers behind.

Noise conditions

We recorded the noise used in the experiment in an actual open-plan office in Sweden. From the multi-channel recording, one hour of office noise was extracted, edited and reproduced in the test room with eight loudspeakers, two at each wall, and one subwoofer. In the high noise condition, additional phone and sound signals were added to the office noise. The phone signals consisted of different mobile tunes and stationary telephones ringing. The speech signals were conversations recorded from radio, from which we cut away one of the voices to simulate telephone conversations. The high noise was reproduced with an equivalent A-weighted sound level of 60 L Aeq in the room. In the low noise condition the added phone and sound signals were excluded and the noise was low pass filtered, which reduced L Aeq in the room by 12 dBA. The sound level was further attenuated to reach 30 L Aeq. The one hour office noise tape was looped once, and the sound signals in the latter hour were rotated 180 degrees to equalize noise exposure throughout the room.

The sound level measurements showed the same L Aeq in the first and second hour of the reproduced office noise. The statistical distribution of sound pressure levels was similar in the high and low noise conditions except that the equivalent levels differed by 30 dB. The Speech Transmission Index (STI) was the same for the high noise condition (60 dB) in this study, as for the high noise condition (51 dB) in the earlier study by Jahncke et al. [8] The STI values in the low noise condition (30 dBA) were lower than in the low noise condition (39 dB) by Jahncke and colleagues. The speech noise in the low noise condition was now so close to the hearing threshold that it was not possible to hear the weakest speech sounds.

Restoration conditions

After two hours of work in office noise the participants went through a restoration period for 14 minutes. Two different restorative conditions were tested after the high noise condition: half of the participants saw a movie with clips of nature environments in quiet and half of the participants were exposed to continued office noise. In the low noise condition, all participants sat in quiet during the restorative period. In the analysis of restoration effects only the movie and office noise conditions were compared, as the quiet condition differed from these to conditions also with respect to the preceding noise condition.

Measures

Cognitive performance

We used several different cognitive tasks to measure the effects of the noise and restoration manipulations. A response inhibition- and an arithmetic test (further described below) were included to measure fatigue/restoration and were performed three times: in the beginning (pretest), after 2 hours of work (Post work), and after the restoration period at the end of the experimental sessions (Post rest). The other cognitive tasks were included twice to measure change across time in noise, except for the reading comprehension task that

was included once per session because of the time it took to perform [see [Figure 2] for an overview of the task order]. The same presentation order of dependent measures was used for all participants to control for the timing between task and noise. As we were not trying to make an evaluation of each specific test, we were ready to take the confounding between when and which task was performed in return for a reduced error term.{Figure 2}

Response inhibition

Response inhibition was measured with the Sustained Attention to Response Test (SART), which taps the ability to inhibit a physical response and/or sustain attention. [28] Digits from one to nine were presented repetitively and the participants were told to respond with a key press to all numbers except three target numbers (i.e., 2, 5 and 9). A digit was presented on the computer screen once every 1000 ms and remained for 1000 ms. Each trial consisted of 140 digits where 15% were targets (i.e., number 2, 5, 9) to which the response was to be inhibited. The following scores were considered: (1) the sum of errors of commission (i.e., the number of times the response to the targets was not successfully inhibited); (2) the sum of errors of omission (i.e., the number of times a response was not made to a number which should have been responded to), and (3) reaction time (i.e., the mean response time in milliseconds for all numbers except the target numbers).

Arithmetic's

This task was a computational task with ten single-digit numbers, which were presented one by one on the screen. The operation to perform (+ or -) was presented between the numbers. The participants controlled the presentation speed. When all the ten numbers were presented the participants typed in the answer. [29] In total there were 16 sets and the scores were the sum of correct answers and the time it took to complete the arithmetic task.

Math

This was a simple addition task whereby participants were required to add double-digit (e.g. easy task; 44+38) and triple-digit numbers (e.g. difficult task; 122+435). Each experimental block consisted of 15 double-digit and 15 triple-digit expressions. The answer time was set at 20 seconds for each math expression. The task always started with a difficult expression that was followed by an easy expression and so on. The scores were the sum of correct answers (divided in the easy task and the difficult task) and the mean response time for the expressions (also divided in the easy task and the difficult task).

Word memory

Memory for words was measured with a Proactive interference (PI) task, which taps the ability to inhibit information that once was relevant for recall but has since become irrelevant for the task. [30] The participants learned words from eight lists with ten words each. The separate lists were composed of words drawn from the same category. After a given list of ten words had been presented, participants were required to free recall the words from the most recent list and ignore (suppress) words from earlier lists. We used the following categories: "fish and other water living creatures", "fruits and vegetables", "animals", "cloths and accessories", "kitchen- and gardening tools", "countries" and "cities in Sweden". The words were presented on the computer screen every 1000 ms and remained for 1000 ms. The orders of the categories within each experimental session were counterbalanced between participants. The following four scores were considered: (1) PI points: the sum of words recalled from the correct list; (2) PI pro: the sum of error words (i.e. from earlier lists); (3) PI lacking answers: the sum of words not remembered; and (4) PI other errors: the sum of error words (i.e. new words not coming from earlier lists).

Reading comprehension

The texts for the reading task were taken from the Swedish National University Aptitude Test. One sentence at a time was presented and the participant decided when the next sentence should be presented by clicking the space button. In 25 of the 43 sentences one word was missing and the participants were given a choice between four alternatives. Sometimes the information for the correct choice was in the text that no longer was

on the screen, sometimes the information appeared on the screen simultaneously. The scores were the sum of correct answers and the time it took to complete the reading task.

When all the text was read, two variations of memory questions were posed. In the first set the participant was presented with a sentence and was asked to judge whether the sentence was taken from the text read or not. In some of these sentences an important word from the original text had been changed and in other sentences there was no similarity with the original text. Scores were the sum of correctly marked sentences. In the second set there were questions about the information stated explicitly in the text, (e.g. years, book titles, places, names). Scores were the sum of correctly marked details.

Search task

In this task participants had to locate a specific object among different information channels. The information was organized in a table. The seven columns contained information about price, location, area, year etc. The twenty rows kept together the information about a given object (e.g. a person, a house or a country). The participants were asked to find the object that met a set of criteria, either by using two columns (easy) or four columns (difficult). Therefore this task taps processes required to search through and understand the contents of a table with information, while successively updating and memorizing which information is most correct according to the target criterion. Each experimental block consisted of the twelve questions (e.g. six easy questions and six difficult questions) and time was limited to one minute per question before a new question was presented. The scores were the sum of correct answers (divided into the easy task and the difficult task) and the time it took to complete the search task (also divided into the easy task and the difficult task).

Serial recall

In this task with numbers, the participants were told to remember a string of eight one digit numbers (i.e. 1-8) and then recall them in the correct order. Each number was presented for 400 milliseconds followed by a pause of 350 milliseconds before the next number was presented. After the eight digits were presented an answer box appeared on the computer screen with the numbers 1-8 in random order. The participants then had to organize the numbers in the correct order. Each block consisted of 27 lists and only numbers written at their correct positions were scored correct. We also scored lists that were complete (e.g. when all the eight digits were assigned their correct positions).

Self ratings of fatigue

Perceived sleepiness and motivation were measured with the Swedish Occupational Fatigue Inventory (SOFI) developed by Åhsberg, Gamberale and Kjellberg. [31] The questions are based on a factor analysis where five components were established for 25 items describing feelings of cognitive- and physical fatigue. Only the three components describing cognitive fatigue were selected for this study. Lack of energy was measured with the words "worn out" and "exhausted", Lack of motivation with the words "passive" and "uninterested", and Sleepiness with the words "sleepy" and "the number of yawns for the last ten minutes" on a scale ranged from 1 = not at all to 4 = a lot.

Stress hormones

Urinary catecholamine's

The urine samples were collected directly when all participants arrived to the laboratory (Pre work), in the middle of the work period (Mid work; after 1 hour 30 minutes) and at the end of the experimental session (Post rest; after 3 hours). For each participant, the exact time after the bladder had been emptied by voluntary voiding was noted, the total urine volume was measured, and 40 ml of urine was mixed in 100 ml glass bottles containing 0.5 ml 2 M HCL as a preservative. Samples were stored in a freezer at - 20C until subsequent preparation. The samples were thawed within 2 months and purified according to the BIO-RAD method (Urinary Catecholamine's by HPLC, Reagent Kit, Catalogue Number 195-5841/N) and assayed following standard methods for high performance liquid chromatography. The amounts of the catecholamines Norepinephrine and Epinephrine were expressed as ng/h/kg body weight. The analyses were carried out by a professional blind to

the experimental conditions at the University of Gävle.

Salivary cortisol

Saliva samples were obtained with Salivette tubes (Sarstedt, Landskrona, Sweden) at four times during the experimental session: Pre work, after approximately 1 hour of work, Post work and Post rest [[Figure 2] for an overview of the experimental session]. It is however, unclear how to handle the timing of the measurements of the peak response in cortisol as there might be a time lag before the reaction is measurable. [32] The radio immunoassays (RIA) of the samples were carried out in the Stress Research Institute at Stockholm University by a professional blind to the experimental conditions.

Procedure

Data collection took place at a simulated office at the University of Gävle. Participants went through a practice session for one hour, several days in advance of the first experimental session. The practice session was meant to reduce possible training effects on the cognitive tasks. The experimental sessions only took place on Tuesdays and Wednesdays. The experimental sessions were run between four and seven pm and for each participant, one day separated the two sessions. The procedure for one experimental session is presented in [Figure 2].

After the first urine and saliva samples, the participants completed the SOFI and performed the first block of fatigue tasks in quiet. After the fatigue tasks they preceded through the first block of cognitive tasks while one of the two different noise conditions (low noise, or high noise) was played back. The session order of the noise conditions was counterbalanced but not the cognitive tasks between the experimental sessions. The Search task and Word memory task were counterbalanced between participants within one session to reduce the risk of an order effect because of the different task categories. After 1.5 hours of work the participants left the simulated office for the second urine sample. Back in the laboratory the second block of cognitive tasks started. Next, the second fatigue block started and the noise was turned off. In the beginning of this block a saliva sample was collected and the SOFI was again completed.

The next phase was the restoration period wherein the participants were instructed to put their headphones on. In the high noise condition the participants either watched a nature movie with no sound or listened to office noise (without any film) during the restoration period. The participants were randomly assigned to one of the two restoration conditions. In the low noise condition all participants sat in quiet for 14 minutes to keep the same session length. After the restoration period the participants put off their headphones and went through the last fatigue block in silence. The whole procedure took about three hours to complete and one to eight participants were tested at each occasion.

Statistical analyses

Because of failures to follow instructions 3 participants were excluded from the analyses of the noise effects, leaving 34 participants for further analysis. One participant was excluded from the analyses of the restoration effects due to equipment malfunctioning during the restoration period. There are further data missing for the following number of participants in these measures: SART (1), Reading comprehension (2), Search task (9), SOFI (4), Norepinephrine (3), and Epinephrine (3) due to lack of answers and equipment malfunctioning. A General Linear Model (SPSS version 18) with repeated measures (mixed) design was used for the analysis of noise and fatigue effects. When Mauchly's test indicated significant non-sphericity in the variance-covariance matrix for the within-subject analyses, the Greenhouse-Geisser adjusted degrees of freedom and corresponding P-values are reported for the F-tests.

Results

Results are reported first for effects during work, and then for the effects of restoration. For both sections the presentation order begins with the effects on cognitive performance, then on psychophysiological stress and then finally on self-ratings of fatigue.

Noise effects on cognitive performance during work

In the design, noise conditions (high and low) was a within-participant variable. However, given evidence that the performance measures showed strong transfer effects (i.e. interactions of performance and session order), we defaulted to treat noise conditions as a between-persons variable with the high and low noise levels in the first experimental session as a between-participants variable.

Math

There were no significant effects of noise or hearing on the number of correct answers in the math tasks. This might be due to a ceiling effect since few participants had more than three errors. Further, the analysis showed no significant main effect of noise on speed. Therefore, there is no support for Hypothesis 1 (a) - that mathematical performance was impaired by noise level.

However, there was an interaction between noise and hearing on performance speed. As shown in [Figure 3]a both the hearing impaired- and normal hearing groups appeared to work faster in the easy tasks in high noise than in low noise. In the difficult tasks [Figure 3]b the hearing impaired appeared to work faster in high noise than in low noise, whereas the normal hearing groups performed at about the same speed in both high and low noise. An ANOVA with noise condition and hearing (2 ×2) as between-participants factors and time and difficulty (2 ×2) as within-participant factors showed the Noise ×Hearing ×Difficulty interaction to be significant ($F (1, 30) = 4.62$, $P < 0.05$, partial [eng, Lapp] $2 = 0.13$). The interaction contradicts Hypothesis 2 because the hearing impaired worked faster in high noise than the normal hearing individuals. Also for the easy tasks the results were not in line with Hypothesis 2, as both hearing groups were faster in high noise.{Figure 3}

Word memory

The analysis showed no significant main effect of Noise on the measures of word memory. This contradicts Hypothesis 1 (a) which predicts impaired performance during the higher noise level. Further, as shown in [Figure 4], the hearing impaired participants appeared to do worse (had more omissions) in the word memory task (PI) during high noise, than in the low noise condition, whereas the opposite was true for the group with normal hearing. However, the ANOVA only showed a trend towards Hearing ×Noise interaction $F (1, 30) = 3.30$, $P = 0.079$, partial [eng, Lapp]$2 = 0.10$. The results thus showed a trend in line with Hypothesis 2, indicating that the hearing impaired had more difficulties in high noise compared to normal hearing individuals.{Figure 4}

Reading comprehension

In contradiction to Hypothesis 1 (a) there were no main effects of noise on any of the reading scores. Again, only when hearing status was considered, an effect of noise level was seen.

As shown in [Figure 5] the participants with a hearing impairment appeared to remember more sentences in low noise compared to those in high noise, while the normal hearing group showed the opposite effect. This was confirmed by the ANOVA, which showed a significant interaction between Hearing and Noise on memory for the contents (points for correctly marked sentences), $F (1, 28) = 4.70$, $P < 0.05$, partial [eng, Lapp] $2 = 0.14$. Further, memory for specific details in the text (points of correctly marked details) showed a similar pattern, but in this case there was only a tendency toward a Hearing ×Noise interaction, $F (1, 28) = 3.28$, $P = 0.081$, partial [eng, Lapp] $2 = 0.11$. These results were in line with Hypothesis 2 showing that the hearing impaired had more difficulties in high noise than the normal hearing individuals.{Figure 5}

Search task and serial recall

There were no statistically significant effects of Noise on the Search task and for Serial recall performance. The participants had only a few correct answers in the difficult part of the Search task which suggests a floor effect.

Noise effects on acute psychophysiological stress during work

Since there are large individual variations in stress hormone levels, the analyses of the physiological measures were only conducted with noise as a within-participant comparison. The mean cortisol level was gradually lowered between the three measurement occasions both in the low and the high noise conditions, $F (1.31, 39.27) = 33.82$, $P < 0.001$, partial [eng, Lapp]$2 = 0.53$, [Figure 6]a and b. There was no main effect of noise, but in low noise the hearing impaired and normal hearing participants had approximately the same cortisol levels at

all measurement occasions, whereas in high noise the hearing impaired group had higher levels than the group with normal hearing. This was reflected in the ANOVA as a tendency towards a Time ×Noise ×Hearing interaction, F (1.37, 41.23) = 3.06, P = 0.075, partial [eng, Lapp] 2 = 0.093. In summary, we found no significant support for Hypothesis 1 (b) but a tendency towards higher stress levels during high noise exposure for the hearing impaired participants in line with Hypothesis 2.{Figure 6}

Norepinephrine levels declined over time, F (1.28, 33.19) = 10.18, P <0.002, partial [eng, Lapp] 2 = 0.28. However, there was no significant main effect of noise on the level of catecholamines over time and no interaction between noise and hearing. No support thus was found for Hypotheses 1 (b).

Noise effects on self ratings of fatigue during work

In this section the focus is only on the noise effects which were measured Pre work and Post work. In the section concerning restoration we also include measures from Post rest (after the period of restoration).

In the first step we analyzed the SOFI ratings with session order and hearing (2 ×2) as between-participant factors and noise and time (2 ×2) as within-subjects factors. The analysis revealed a significant main effect of time on all the scales, sleepy, F (1, 29) = 43.67, P <0.001, partial [eng, Lapp] 2 = 0.60; the amount of yawning, F (1, 29) = 11.48, P <0.01, partial [eng, Lapp] 2 = 0.28; worn out, F (1, 29) = 52.83, P <0.001, partial [eng, Lapp] 2 = 0.65; exhausted, F (1, 29) = 42.38, P <0.001, partial [eng, Lapp] 2 = 0.59; passive, F (1, 29) = 54.72, P <0.001, partial [eng, Lapp] 2 = 0.65; and uninterested, F (1, 29) = 62.26, P <0.001, partial [eng, Lapp] 2 = 0.68; indicating an increase of sleepiness, lack of energy and loss of motivation over time [Table 1]. However, the participants were more sleepy, tired and were less motivated over time during both high and low noise exposure, which contradicts Hypothesis 1 a of a main effect of noise level.{Table 1}

Further, the hearing impaired participants and the normal hearing participants rated themselves at about the same level of sleepiness during the low noise exposure. During the high noise exposure the hearing impaired were more sleepy than the normal hearing group [Figure 7], yielding a significant Noise ×Hearing interaction on the rating of the amount of yawning, F (1, 29) = 5.56, P <0.05, partial [eng, Lapp] 2 = 0.16.{Figure 7}

Unexpectedly, participants became more uninterested (unmotivated) over time in low noise than when they were in high noise, which resulted in a significant Time ×Noise interaction on the ratings of being uninterested, F (1, 29) = 4.43, P <0.05, partial [eng, Lapp] 2 = 0.13. Note also that the mean values indicated that the normal hearing participants were less motivated than the hearing impaired during both noise conditions [Table 2]; however, this Time ×Noise ×Hearing interaction was not significant.{Table 2}

In summary, the hearing impaired participants were more tired during high noise exposure than the normal hearing participants, which is in line with Hypothesis 2.

Effects of restoration on cognitive performance

As a first step we analyzed if the participants had a drop in arithmetic performance from Pre work to Post work during high noise to establish that the participants were in a state of need for cognitive restoration. Although discrepancies were found in performance between session orders, the overall pattern showed decreased quality and increased speed during work in high noise exposure. The ANOVA showed that the Time ×Session order interaction was significant for both correct answers; F (1, 29) = 5.05, P <0.05, partial [eng, Lapp] 2= 0.15, and performance speed; F (1, 29) = 9.23, P <0.01, partial [eng, Lapp] 2= 0.24.

As a second step we analyzed whether there was a difference in performance between a restorative period with movie or noise from Post work to Post rest. As shown in [Figure 8]a the normal hearing participants performed better (correct answers) after restoration with a movie, while their performance declined after continued noise exposure. As shown in [Figure 8]b, the opposite pattern emerged for the hearing impaired participants with decreased performance with movie and improved performance with noise. An ANOVA with Restorative condition, Hearing and Session order (2 ×2 ×2) as between-participants factors and Time (2) as a within-participant factor, showed that the Restorative condition ×Time ×Hearing interaction was significant; F (1, 25) = 7.64, P <0.02, partial [eng, Lapp] 2= 0.23. In summary, only the normal hearing participants followed Hypothesis

3, with increased performance after restoration with the movie and decreased performance with noise.{Figure 8}

Effects of restoration on acute psychophysiological stress

No effect of restoration was found on the urinary catecholamines and salivary cortisol, yielding no support for Hypotheses 3. However, see the effects of time on the urinary catecholamines and salivary cortisol under the section "Noise effects on acute psychophysiological stress" above.

Effects of restoration on self ratings of fatigue

As stated previously the participants were sleepy prior to the restorative period, as the participants showed a significant increase in sleepiness, a significant decrease in energy, and a significant loss of motivation from Pre work to Post work during both high and low noise exposure.

As shown in [Figure 9]a, the normal hearing participants had a loss in motivation (i.e. passiveness) after a restorative period in noise and an increase in motivation after they had watched the movie. However, the hearing impaired showed the opposite pattern with an increase in motivation after a restorative period in noise and a decrease with movie [Figure 9]b. An ANOVA with Restorative condition, Hearing and Session order (2 ×2 ×2) as between-participants factors and time (2) as a within-participant factor showed that the Time ×Hearing ×Restorative condition interaction was significant for lack of motivation (passiveness); $F(1, 24) = 5.50$, $P < 0.05$, partial [eng, Lapp] $2 = 0.19$.{Figure 9}

For the other SOFI-variables there was a session-order interaction, which made us leave those analyses from further consideration.

In summary, only the normal hearing participants followed Hypothesis 3, with increased motivation after restoration with the movie and loss in motivation with noise.

Discussion

Effects of noise on cognitive performance

There were no main effects of noise level on any of the tasks (i.e. Math, Memory for words, Reading, Search task and Serial recall), contradicting Hypothesis 1 a. The high noise level tested was 60 L Aeq , which is in the region of a normal speech level. However, when exploring the effects of hearing status, we found an interaction between hearing and noise level in line with Hypothesis 2 for two of the tasks. The hearing impaired participants were more affected by high noise than the normal hearing, as shown by decreased performance in memory for the contents of a text, and a tendency for decreased performance in the memory for words test. Possibly, noise at 60 L Aeq was distracting for the hearing impaired as they presumably are more sensitive for noise.

An interesting result was also that the normal hearing participants worked better overall during high noise than low noise. One plausible explanation may be their motivational and arousal level. For example, Yerkes and Dodson's [33] theory predicts a need of a higher level of arousal for optimal performance on easy tasks than more difficult tasks (i.e. the "task difficulty hypothesis"). If most of the tasks we employed were perceived as quite easy to the participants they most probably needed arousing stimuli (i.e. noise) to perform well. In line with this, Suedfeld and Loewen [34] have showed that feelings of arousal can increase with noise. The subjective ratings also showed that the participants had significantly higher motivation in high noise than low noise, although sleepiness increased over time. However, there are some difficulties with these theories, particularly in specifying the optimum level of arousal.

One notable result was that the easy math tasks benefited from a higher noise level. In this task (i.e. adding two digit numbers) both hearing impaired and normal hearing participants worked faster in high noise than in low noise. In the more difficult math task (i.e. adding three digit numbers) the hearing impaired participants worked faster in high noise, while the normal hearing participants worked at about the same speed in high and low noise. This benefit is in line with a previous study by Loed, Holding and Baker [35] which showed that background noise can increase performance of simple arithmetic's (i.e. speed in work completion) when performed during the afternoon. The present experiment was also conducted during the afternoon, therefore,

the results appear to be consistent with an arousal explanation.

Another question that arises is why there was no interaction between noise level and hearing status for two of the tasks (i.e. Serial recall and Search task). The lack of an interaction with noise level may be explained by earlier studies showing that some tasks are not vulnerable to a variation in noise intensity; rather performance is impaired by the changing properties of the sound. [36] However, the tasks shown to be impaired by noise intensity when hearing status was considered (i.e. memory for contents of a text, memory for words), need more complex semantic processing and involvement of long term memory (e.g. processing of word meaning, rehearsal of solutions). This is in line with an earlier study [8] that also showed word memory (i.e. semantic memory) to be impaired by office noise level but not, for instance, serial recall. The present results therefore support the finding that only some tasks are impaired by office noise. [37] One important objective for future studies will be to decompose tasks into their component processes and then test the impact of different noise sources on those constituent processes.

Effects of noise on acute stress

The participants showed a significant decline in cortisol in both noise conditions over time, consistent with the decline that occurs as a part of normal circadian variation. However, there was a tendency for the hearing impaired participants to show higher stress levels over time in high noise compared to low noise. The same pattern of decline over the experimental session in both noise conditions was also evident in the norepinephrine, measured from urine. In summary, we found no main effect of noise on stress hormones, contradicting Hypothesis 1b. The results merely showed a weak tendency in line with Hypothesis 2 demonstrating that the hearing impaired participants were more stressed by the high noise condition compared to the normal hearing participants.

Effects of noise on self-ratings of fatigue

In both noise conditions there was an increase of sleepiness and loss of motivation over time. However, there was no main effect of noise level on fatigue, contradicting Hypothesis 1b. Instead there was an interaction between noise and hearing status in line with Hypothesis 2. During low noise both hearing groups were at about the same level of sleepiness. However, during high noise the hearing impaired were expected to be more tired than the normal hearing participants.

Restoration

The participants felt sleepier, less motivated and less energetic from Pre work to Post work, and their performance quality decreased in the arithmetic task during the work period. Thus, the results meet the criteria for analyzing cognitive restoration (i.e. an antecedent condition indicating fatigue).

It was shown that the normal hearing participants' performance and motivation improved with the nature movie, and declined after continued noise exposure. This supports earlier findings [8] that normal hearing participants restore better with a nature movie than with noise. However, for the hearing impaired participants of the present study, the opposite pattern emerged. Both their performance and motivation decreased after restoration with the nature movie, and improved after noise exposure. This is difficult to explain, but one possible explanation is that continued noise exposure might have counteracted their possibilities to slow down, relax, and feel how sleepy they were.

Further, no restorative effects were found on the salivary cortisol and urinary catecholamines. The stress hormones showed a decline over time in accordance with the normal circadian rhythm.

In summary, Hypothesis 3 only held for the normal hearing participants' performance and motivation. They showed significantly increased performance and motivation after restoration with the movie and decreased performance and motivation with noise. The hearing impaired contradicted Hypothesis 3 with the opposite pattern.

A comparison with our previous experiment

Jahncke et al, [8] reported an experiment with open-plan office noise, cognitive performance, restoration and

subjective ratings that in many respects is comparable to the experiment reported here. However, there are some discrepancies in the results, which may or may not be due to differences in the sounds employed, in the cognitive tests employed and/or the characteristics of the participants. For instance the participants in the previous study were young (mean age = 26 years) students at the University of Gävle, while the participants in the study reported here were older (mean age close to 50 years) and had less formal schooling and had different occupations. To probe whether this difference had any impact on the difference in results between the two experiments, a follow up statistical comparison was made between the results on a comparable test (i.e. serial recall) from participants in Jahncke et al,[8] and participants from the present study. This analysis showed that normal hearing participants in the study of Jahncke et al,[8] that were students, performed better in low noise than the normal hearing participants in the present study, $t(53) = 2.27$, $P < 0.05$, although the low noise in Jahncke et al, [8] was 39 L Aeq as compared to 30 L Aeq in the present study. It should be noted that serial recall is rather insensitive to sound level. [36]

The baseline difference in performance level between the normal hearing groups, in the two experiments, may be one of the explanations as to why the results of the present study differ from the results of the earlier study by Jahncke and colleagues. It is however, difficult to further explain the discrepancies in our findings.

Limitations

It should be acknowledged that this study was small in scale and that we had additional problems with missing data. There is therefore a risk that the conclusions are underpowered. The lack of interactions especially may have been seriously influenced by the small N in our samples. It is possible that different results may have been found in a larger sample, especially when considering how much variation there may be in the hearing impaired group.

Further, we cannot tell whether we would have observed an increase in fatigue if we had not conducted our study from 4-7 pm. This for most office work would be towards the end of the working day and another choice of time frame might have changed the results. However, we choose to conduct these studies during the afternoon as this is more appropriate for measuring the stress hormones, as we expect a decrease in stress hormone levels in the afternoon. If the stress hormones are measured when a daily increase is expected we could not rule out whether the increase is due to noise or the circadian rhythm.

According to the stress hormones, most of the tasks employed were most probably perceived as quite easy to the participants. This could explain why we did not see any main effect of noise on the stress hormones in our study.

It can also be questioned if it is of real-life relevance to watch a nature movie with no sound as a tool to be used in real office life. Outside the experimental studies it is probably of better practical use to take a walk in a real nature environment during the break. Further, we are not able to say whether it is the silence, the nature, or both that are important as our stimuli contained both these features. This is something for future research to examine further.

Conclusion and Practical Implications

The results of this study showed that the hearing impaired were more distracted by high noise than the normal hearing, as indicated by decreased performance in the tasks requiring recall of semantic information. However, they were not distracted when they performed the two tasks (Serial recall and Search task) that are underpinned by processes, which previously have shown to be insensitive to noise level.

The hearing impaired individuals were also more fatigued by a higher noise exposure than people with normal hearing and they tended to have higher stress hormone levels during high noise compared to the low noise. The present study however, cannot disentangle whether the effects reported are a result of hearing impairment or a result of the use of hearing aids. The participants might also have used different types of hearing aids, which can differ in performance and suitability for our test conditions. [38]

An important finding in this study is that it is not just the types of noise and layout of the office that affect

employees. The impact also varies with the hearing characteristics of the persons exposed to noise and the tasks they perform. Therefore, special consideration needs to be made to the individual prerequisites. For example, it is rarely possible for hearing impaired persons to decrease the negative impact from surrounding noise by turning off the hearing aids, when the work requires a readiness for phone calls and communication with colleagues. Therefore other solutions might be needed (e.g. quiet rooms) to be able to enhance performance and wellbeing for these individuals.

There should also be further concerns for designing sound environments that can promote daily restoration at workplaces, as indicated by an earlier study of Jahncke et al. [8] The present study showed that a break with a nature movie improved the normal hearing participants' performance in arithmetic's, and that continued noise exposure during the break decreased their performance. These results underscore the need to address the issue of how to enhance restorative qualities within the noisy environments of our daily surroundings.

Acknowledgments

This research was funded by AFA Insurance and by the University of Gävle and was conducted in partial fulfillment of the requirements for a doctoral degree. We would like to thank Staffan Hygge and Terry Hartig for helpful advice in planning and conducting this study. We are also grateful to Kenth Dimberg at the University of Gävle for analyzing the urine samples and Lars Holmberg at the Stress Research Institute, Stockholm University for analyzing the saliva samples. We also thank Örjan Johansson and Johan Odelius at Luleå University of Technology for their help with the recordings and arrangements of the office noise used in this experiment and to Valtteri Hongisto and David Oliva for their help with analyzing the STI of speech in the office noise recordings. We also thank Anders Kjellberg, John Marsh, Patrik Sörqvist and the anonymous reviewers for helpful comments on this manuscript, the Swedish Association of Hard of Hearing People (HRF) for generous support, and Ecophon and S-line office for their donations to furnish the simulated open- plan office.

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Publication date: Sep 2012

Year: 2012

Clinical Trial Results with the MED-EL Fine Structure Processing Coding Strategy in Experienced Cochlear Implant Users

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Publication info: ORL : Journal for Oto - Rhino - Laryngology and Its Related Specialties 74.4 (Sep 2012): 185-98.
ProQuest document link

Abstract: Objectives: To assess the subjective and objective performance of the new fine structure processing strategy (FSP) compared to the previous generation coding strategies CIS+ and HDCIS. Methods: Forty-six adults with a minimum of 6 months of cochlear implant experience were included. CIS+, HDCIS and FSP were compared in speech perception tests in noise, pitch scaling and questionnaires. The randomized tests were performed acutely (interval 1) and again after 3 months of FSP experience (interval 3). The subjective evaluation included questionnaire 1 at intervals 1 and 3, and questionnaire 2 at interval 2, 1 month after interval 1. Results: Comparison between FSP and CIS+ showed that FSP performed at least as well as CIS+ in all speech perception tests, and outperformed CIS+ in vowel and monosyllabic word discrimination. Comparison between FSP and HDCIS showed that both performed equally well in all speech perception tests. Pitch scaling showed that FSP performed at least as well as HDCIS. With FSP, sound quality was at least as good and often better than with HDCIS. Conclusions: Results indicate that FSP performs better than CIS+ in vowel and monosyllabic word understanding. Subjective evaluation demonstrates strong user preferences for FSP when listening to speech and music.

Full text: Original Paper
ORL 2012;74:185198 DOI: 10.1159/000337089
Received: July 21, 2011
Accepted after revision: November 28, 2011
Published online: July 18, 2012
Clinical Trial Results with the MED-ELFine Structure Processing Coding Strategy in Experienced Cochlear Implant Users
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crimination. Comparison between FSP and HDCIS showed that both performed equally well in all speech perception tests. Pitch scaling showed that FSP performed at least as well as HDCIS. With FSP, sound quality was at least as good and often better than with HDCIS. Conclusions: Results indicate that FSP performs better than CIS+ in vowel and monosyllabic word understanding. Subjective evaluation demonstrates strong user preferences for FSP when listening to speech and music.
Introduction
A sound stimulus can be decomposed into amplitude, frequency and phase signals using the Hilbert transform [1]. Thus, we can regard a signal as being a constant amplitude, fine structure carrier, which is amplitude-modulated by an envelope signal. In speech and other acoustic signals, the fine structure varies continuously and carries
Key Words
Fine structure processing [H11554] Cochlear implant [H11554] Coding strategy [H11554] Speech perception [H11554] Music [H11554] Pitch [H11554] CIS+ [H11554] OPUS
AbstractObjectives: To assess the subjective and objective performance of the new fine structure processing strategy (FSP) compared to the previous generation coding strategies CIS+ and HDCIS. Methods: Forty-six adults with a minimum of 6 months of cochlear implant experience were included. CIS+, HDCIS and FSP were compared in speech perception tests in noise, pitch scaling and questionnaires. The randomized tests were performed acutely (interval 1) and again after 3 months of FSP experience (interval 3). The subjective evaluation included questionnaire 1 at intervals 1 and 3, and questionnaire 2 at interval 2, 1 month after interval 1. Results: Comparison between FSP and CIS+ showed that FSP performed at least as well as CIS+ in all speech perception tests, and outperformed CIS+ in vowel and monosyllabic word dis-
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important information such as pitch and timbre. In normal hearing, the neural response to low frequencies reflects both the envelope and the fine structure information of the signal, whereas in the neural response to higher frequencies beyond around 5 kHz, the envelope is mainly represented [2].
In normal-hearing subjects, when presenting signals that are limited to a number of independent channels as used in cochlear implants (CIs) today, the primary information carrier for (western) speech is the envelope, whereas for music it is the fine structure [3, 4] . Smith et al. [3] also found that interaural time delays in the fine structure are more strongly determining perceived stimulus site than interaural time delays in the envelope, although the speech signal coded in the envelope still dominates perception.
All continuous-interleaved-sampling (CIS) and n-ofm-based coding strategies that have been in use in CIs during the last 1520 years rely mainly on envelope information [5] . In general, users of these coding strategies show good to very good speech perception in quiet, moderate speech perception in noise and poor to moderate music appreciation [6] . Specifically, the transmission of tonal speech information, such as prosodic contour or speaker gender, as well as music perception and appreciation is poor in CI users compared to normal-hearing listeners [79].
Thus, the quintessential performance characteristics of these coding strategies are in agreement with the results found by Smith et al. [3]. The observation that envelope information alone is suitable for supporting very good speech understanding but only moderate music appreciation suggests that these strategies do not provide sufficient fine structure information required for a better performance in music perception.
This notion is supported by results from users of electric-acoustic stimulation (EAS), an approach to cochlear implantation first described by von Ilberg et al. [10] that has become widely accepted. In EAS, individuals with a ski slope type hearing loss are treated by combining a CI and a hearing aid in the same ear. The CI electrode is shorter than usual and covers the cochlea only partially and thus provides the mid- to high-frequency range. Low frequencies are amplified by the hearing aid, given the residual hearing could be preserved during CI surgery. In individuals with little to no low-frequency hearing loss, amplification may not be required at all. In contrast to regular CI users, EAS recipients enjoy acoustic hearing in the low frequencies, and thus have access to both envelope and fine structure information.
Results reported in users of EAS demonstrate improved speech perception in noise and improved music appreciation [11]. Therefore, EAS users perform better in exactly those conditions where standard CI users experience the most difficulty. These results are in line with Smith et al. [3], in that they further demonstrate how essential the fine structure component is for sound perception. The major difference between EAS and regular CI with complete cochlear coverage is the presence of fine structure information in the low-frequency region. Therefore, the results from EAS also suggest that improved temporal coding in the low frequencies could enhance CI performance.
To improve the transmittance of fine structure information, the fine structure processing (FSP) coding strategy was developed by MED-EL (Innsbruck, Austria). FSP is intended to better enable users to perceive pitch variations and timing details of sound. The FSP as well as the HDCIS (high-definition CIS) coding strategies are available in the MED-EL OPUS 1 and OPUS 2 processors.
This paper reports and discusses the results of a multi-centre clinical trial investigating the effect of the FSP strategy on auditory perception in CI users compared to the HDCIS and the CIS+ strategies available in the TEMPO+ speech processor, the predecessor of the OPUS audio processors. The objective of this study was to test if the FSP strategy was superior or non-inferior to the HDCIS strategy and if the FSP and HDCIS coding strategies were superior or non-inferior to the CIS+ strategy.
Methods

Subjects

Forty-six adult subjects, who had received a PULSARCI 100 CI unilaterally, were enrolled into the MED-EL fine structure clinical trial (24 female, 22 male). They were recruited from 13 centres across Germany. All subjects were postlingually deafened, except for 1 subject who had an onset of progressive hearing loss at 2 years of age. However, we considered this subject to fulfil the inclusion criteria of postlingual deafness since the progressive hearing loss allowed the use of natural hearing during the early stages of speech and language development. Subjects had a minimum of 6 months of experience with the CIS+ coding strategy, and had to score better than 40% on Freiburg monosyllables to be able to complete the speech perception tests included in this study design. Aetiologies of hearing loss were: progressive (4), otosclerosis (2), trauma (1), sudden hearing loss (1), noise trauma (1), NF2 (1), Ushers syndrome (1), viral infection (1), Mnires disease (1), progressive hearing loss and flu infection (1), cholesteatoma (1), middle ear infection (1), genetic (suspected, 1) and other (1). In 28 subjects, the aetiology was unknown. The subjects mean age at hearing loss was 46 years (range: 271). Their mean age at implan-

Table 1. O verview of tests conducted for each coding strategy

CIS+ (TEMPO+)
HDCIS (OPUS 1)
FSP (OPUS 1)

tation was 54 years (range: 2076) and their mean age at testing was 56 years (range: 2077) with a mean CI experience of 1.4 years (range: 731 months).

Subjects were required to have at least 10 active electrodes as defined at the most recent fitting before the beginning of the study. Five subjects had 10, 11 subjects had 11, and 30 subjects had 12 electrodes activated. Subjects were also required to have an overall stimulation rate 615,600 pps for CIS+ with the TEMPO+ speech processor. Most comfortable loudness levels of active electrodes had to be below compliance level.

Devices and StrategiesSubjects came into the study using their clinically fitted TEMPO+ speech processor and were switched over to the OPUS 1 audio processor. The OPUS 1 allows either the slightly modified CIS+ speech coding (HDCIS) or the new FSP coding strategy. HDCIS operates equivalently to the CIS+ strategy in the TEMPO+ speech processor [12]. Just like CIS+, HDCIS is an envelope-based strategy, where the envelope of the sound signal in a certain frequency range is sampled, using a constant-rate pulse train that bears no relationship to the temporal structure of the sound signal. Thus, frequency is presented only using the place cue, in other words, presented only via the location of the stimulated electrode contact in the cochlea. Beyond the usual envelope modulations in CIS-like strategies that mainly transmit fundamental frequency, the temporal fine structure of the sound signal is not represented.

In contrast to fixed-rate envelope-based coding strategies like HDCIS where the timing of stimulation is not an information carrier, FSP works in both time and place. The timing of stimulation is used to code the temporal structure of the sound signal particularly in the low- to mid-frequency range. This is achieved by using channel-specific sampling sequences (CSSS) [13] . A CSSS is a series of stimulation pulses that is started at each positive-going zero-crossing in a channels band-pass filter output. In FSP, the length of these sequences is related to the band-pass filters upper corner frequency. Thus, the instantaneous repetition rate of these sequences equals the instantaneous fine structure frequency of the signal in the respective frequency range. In the FSP strategy, CSSS is typically used on the lower (i.e. apical) 23 channels, which means that depending on the band-pass filter arrangement, the temporal fine structure is coded using CSSS for frequencies up to 300500 Hz and the lower cut-off frequency is reduced from 250 Hz used for the CIS+ and HDCIS strategies [14] to between 70 and 100 Hz [14, 15] for FSP. For the current study, the clinical settings in the fitting software for the

lower cut-off frequency were used: i.e. 100 Hz for FSP and 250 Hz for CIS+ and HDCIS.
On the remaining channels, tonotopic frequency coding is
achieved using virtual channels, which are pitch percepts that are intermediate to the pitch percepts created by stimulating single electrodes in isolation [16, 17]. Just like HDCIS, FSP uses bandpass filters with a bell-shaped frequency response [18]. This allows a smooth transition of stimulation from one electrode to the adjacent apical or basal electrode as frequency decreases or increases. As an example, stimulation amplitude on the more apical electrode will decrease and stimulation amplitude on the more basal electrode will increase, as input frequency increases. It was found in a study by Nobbe et al. [18] that this filter design in conjunction with sequential stimulation is as efficient in creating intermediate pitches (and thus virtual channels) as simultaneous stimulation.

Study Design

All subjects were fitted with the OPUS 1 behind-the-ear audio processor at the acute test interval (test interval 1). During test interval 1, they were assessed using the CIS+ (TEMPO+), the HDCIS (OPUS 1) and the FSP (OPUS 1) speech coding strategies on sentences in noise, monosyllables in noise, and vowels in noise. Subjects also completed a questionnaire (questionnaire 1). In this questionnaire, the subjects compared the HDCIS and FSP strategies on the OPUS 1, toggling between the two programmes to make a comparative judgement. Finally, subjects completed a pitch scaling test, comparing the HDCIS and FSP strategies on the OPUS 1.

Subjects then wore the OPUS 1 audio processor using FSP. After 1 month (test interval 2), they completed a postal questionnaire (questionnaire 2) comparing listening experience with the OPUS 1 (FSP) to that with the TEMPO+ (CIS+). After 3 months of OPUS 1 experience with FSP (test interval 3), which allowed sufficient time for the subjects to become accustomed to the new coding strategy, subjects returned to the clinic to be reassessed using the same test protocol as for test interval 1 (see table1 for an overview of tests, coding strategies and test interval combinations).

The study received all necessary ethics board approvals and subjects signed an informed consent before their enrolment in the study. Subjects were reimbursed for travel expenses and received a compensation payment after finishing the study. If a subject decided to prematurely terminate the study, then he/she received a proportionate compensation payment.

Questionnaires

In questionnaire 1, subjects were asked to compare their hearing impression of music and speech with the FSP and HDCIS strategies, which were tested in a randomized order. The stimuli were presented via headphones (Sennheiser HD570). Subjects listened to two pieces of music a well-known German nursery rhyme (Hnschen klein, same melody as Little John) and Mozarts Little Night Music as well as to a male-female dialogue in quiet and in noise. Twenty-four questions were competitive on a 5-step scale; these were included to test the hypothesis of FSP being equal to or better than the HDCIS strategy. For the 5-step scale questions, categories 35 were considered to be equal to or better than. The analyses of these questions are shown on a percentage scale demonstrating the proportion of subjects scoring in categories 35 in order to test the hypothesis. Questionnaire 1 furthermore included 6 questions on timbre of sound and pitch of the voice. These questions were not of a competitive nature;

Speech tests (intervals 1 and 3) + + + Questionnaire 1 (intervals 1 and 3) + + Questionnaire 2 (interval 2) + + Pitch scaling (intervals 1 and 3) + +

their only purpose was to obtain an additional idea of the quality of the different strategies, i.e. they were not used to measure the efficacy of strategies.

In questionnaire 2, which was a postal questionnaire, subjects were asked to retrospectively compare their

hearing with the FSP strategy (OPUS 1) to the hearing they had when using the CIS+ strategy (TEMPO+). The rationale behind administering questionnaire 2 after 1 month was based on the assumption that subjects could still remember their experience with the TEMPO+ speech processor, i.e. with the CIS+ strategy, and could therefore retrospectively answer competitive questions between FSP and CIS+. It was furthermore expected that subjects would have had sufficient time to adjust to the new coding strategy to give a reasonable opinion about it. Questionnaire 2 consisted of 24 questions, with 18 questions of a competitive nature with a 5-step answering scale ranging from much better to much worse. The other 6 questions (Q5, Q2024) were descriptive measurements about telephone use, music perception and music listening habits. Individual questions from both questionnaires are included in
figure 1 ac and figure 2 ac.

Speech Perception Tests

For testing of speech perception, the OLSA sentence test [1921], the Freiburg monosyllable test [22], and a vowel test [23] were used. The OLSA is a closed-set adaptive sentence test consisting in total of 40 lists with 30 sentences each. The speech level was constant at 70 dB SPL, and the noise level (OLSA noise) was varied in order to determine the speech-to-noise ratio (SNR) that resulted in a 50% correct speech reception threshold for each individual. The initial SNR was 10 dB in all subjects. One list of the OLSA tests was administered in each condition. The SNRs used in the vowel and monosyllable tests were determined from the results of a training phase preceding all speech perception tests. In this training phase, two lists of the OLSA test were administered, and the speech reception threshold resulting from the second list was used as the SNR in the vowel tests. The SNR used in the monosyllable test was then determined by adding 10 dB to the SNR in the vowel test. Two lists of monosyllables with 20 words each and 10 runs of the vowel test were performed in each condition. Speech perception testing was carried out in free field with both the speech and the noise presented from a loudspeaker at a distance of 1 m from the subjects head at 0 azimuth. The order of the speech perception tests as well as of the coding strategies in all tests was randomized.

Pitch Scaling

Pitch scaling was performed using pure tones with frequencies between 110 and 1,245 Hz (110, 139, 156, 185, 220, 262, 311, 370, 440, 523, 622, 740, 880, 1,047, 1,245 Hz). The tones were 500 ms in duration and had on- and off-ramps of 50 ms. Each stimulus in the pitch scaling test consisted of a reference tone followed by a test tone. The reference tone had a frequency of 370 Hz. The test tone presented one of the above-mentioned frequencies (including 370 Hz). The interval between the reference tone and the test tone was 300 ms in duration.

Subjects were asked to indicate the magnitude of the difference in pitch between the reference tone and the test tone on an open scale, which did not provide any units or end points. Rather, each subject could establish his/her own numerical units and end points. The middle of the scale was marked with the digit 0 (zero). Subjects were asked to allocate negative pitch differences (i.e. stimuli where the pitch of the test tone was lower than the pitch of the reference tone) left of the middle, and positive pitch differences right of the middle.

Six runs, each consisting of one complete set of test tone frequencies, were performed for the FSP and the HDCIS coding strategies. Thus, for each coding strategy, each test tone frequency was presented 6 times. The order of test tone frequencies was randomized in each run and the order of coding strategies was randomized across runs.

The tones were presented at a comfortable loudness level via headphones. The headphones used (Sennheiser HD570) were big enough to completely and tightly enclose the behind-the-ear processors. In order to eliminate the effect of loudness on pitch, all tones were balanced in loudness prior to pitch scaling. A paired comparison procedure was applied whereby the level of each test stimulus was adjusted to produce equal loudness to the reference stimulus. The resulting levels were used without roving throughout the scaling. Some of the test tone frequencies are below the lower frequency range limit used in the HDCIS strategy (250 Hz, see above) so that

the level of these test tones needed to be increased considerably in order to produce equal loudness to the reference tone. In order to account for this, an audibility criterion was defined; if the level of the test tone of a certain frequency was larger than the level of the reference tone by more than 15 dB, then that frequency was considered inaudible and was not included in the pitch scaling.

Statistical AnalysisQuantitative data are expressed as median or mean, with either range (minimum and maximum) or standard deviation. Qualitative data are presented as absolute and relative frequencies. Quantitative data were checked for normal distribution using the Kolmogorov-Smirnov test.

For the statistical analysis of pitch scaling test results, the open scale of each subject was transformed into a normalized scale to make the pitch scaling comparable between subjects and coding strategies. Normalization was performed by dividing each pitch judgement by the maximum absolute number used by the subject in the scaling. After normalization for each subject, mean pitch judgements and standard deviation values were calculated from the 6 judgements for each test tone frequency and coding strategy. To characterize pitch scaling as a function of coding strategy in each subject, the audible frequency range and the perceived pitch range were calculated for each coding strategy. The audible frequency range is the distance in hertz between the lowest test tone frequency and the highest test tone frequency used with a certain coding strategy in the test. Thus, the audible frequency range is the complete frequency range used in the test (1101,245 Hz) minus those frequencies that were found to be

Fig. 1.

a Results of questionnaire 1 at test interval 3: questions relating to music, melody, singing voice and instruments. b Results of questionnaire 1 at test interval 3: questions relating to voice quality, male/female voices and dialogue in background noise.

c Results of questionnaire 1 at test interval 3: questions relating to timbre and pitch.

Color version available online

How do you judge FSP in comparison to HDCIS?

68.9

Q1: Music Mozart overall hearing impression

Q3: Music Mozart melody recognition Q4: Music Mozart instrument/singing voice recognition

Q5: Music Mozart overall preference Q6: Music Childrens song overall hearing impression

Q8: Music Childrens song melody recognition Q9: Music Childrens song instrument/singing voice recognition

Q10: Music Childrens song overall preference

FSP is equal or better FSP is worse

88.9

71.1

64.4

73.3

91.1

77.8

66.7

0 10 20 30 40 50

Percentage

60 70 80 90 100

a

How do you judge FSP in comparison to HDCIS?

FSP is equal or better FSP is worse
Q11: Speech overall quality of the voice
73.3
Q12: Speech overall quality of the own voice
75.6
Q13: Dialogue the quality of a female voice
71.1
Q14: Dialogue the quality of a male voice
84.1
Q17: Dialogue female speech melody
75
Q18: Dialogue male speech melody
77.3
Q19: Dialogue understanding of the male voice (auditory example)
77.3
Q20: Dialogue understanding of the female voice (auditory example)
70.5
Q22: Dialogue with background noise the quality of a female voice
66.7
Q23: Dialogue with background noise the quality of a male voice
75.6
Q26: Dialogue with background noise female speech melody
77.8
Q27: Dialogue with background noise male speech melody
80
Q28: Dialogue with background noise male voice
82.2
Q29: Dialogue with background noise female voice
71.1
Q30: Dialogue with background noise the background sound
77.8
0 10 20 30 40 50
Percentage
60 70 80 90 100
b
Q2: Music Mozart timbre of sound
How do you judge FSP in comparison to HDCIS?much darker darker equal brighter much brighter
Q7: Music Childrens song timbre of sound
Q15: Dialogue the female pitch
Q16: Dialogue the male pitch
Q24: Dialogue with background noise the female pitch
Q25: Dialogue with background noise the male pitch
0 10 20 30 40 50
Percentage
60 70 80 90 100
c

1
Fine Structure Processing Coding Strategy in Experienced CI Users
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Color version available online
How do you judge FSP in comparison to CIS+? FSP is equal or better FSP is worse
Q1: Speech understanding in quiet female voice
93.3
Q2: Speech understanding in quiet male voice
91.1
Q3: Speech understanding in background noise male voice
86.4
Q4: Speech understanding in background noise female voice
82.2
Q10: Speech understanding in a group situation male voice
82.6
Q11: Speech understanding in a group situation female voice
84.8
Q12: Speech understanding when watching TV
82.6
Q13: Speech understanding when listening to the car radio
90.9
Q14: Speech understanding when listening to passengers in the car
86.7
0 10 20 30 40 50
Percentage
60 70 80 90 100
a
How do you judge FSP in comparison to CIS+? FSP is equal or better FSP is worse
Q15: Listening to music known music
93.3
Q16: Listening to music unknown music
90.9
Q17: Melody known music
91.1
Q18: Single musical instrument known music
93.3
Q19: Naturalness of sounds
91.1
0 10 20 30 40 50
Percentage
60 70 80 90 100
b
How do you judge FSP in comparison to CIS+? FSP is equal or better FSP is worse
Q6: Speech understanding on the phone known male voice
84.8
Q7: Speech understanding on the phone unknown male voice

81.5
Q8: Speech understanding on the phone known female voice
87.5
Q9: Speech understanding on the phone unknown female voice
74.1
0 10 20 30 40 50 60 70 80 90 100
c
Percentage
Fig. 2. a Results of questionnaire 2 at test interval 2: questions relating to speech understanding in quiet, background noise and group situations. b Results of questionnaire 2 at test interval 2: questions relating to music listening, melody and naturalness of sounds. c Results of questionnaire 2 at test interval 2: questions relating to speech understanding (male/female voices) when using the telephone.

inaudible in the loudness balancing procedure. The perceived pitch range is the difference between the highest normalized pitch judgement and the lowest normalized pitch judgement for a certain coding strategy.
Two different statistical tests were applied to show both superiority and non-inferiority according to the study design. The methodology is described in the following two paragraphs.
Effects of coding strategy on speech perception and pitch scaling were assessed using the Sasabuchi test or the Schuirmann test [24] to show non-inferiority of FSP versus HDCIS and non-inferiority of FSP and HDCIS versus CIS+. When the Kolmogorov-Smirnov tests showed that data were normally distributed, the ratio of means design, Sasabuchi tests and relative test bounds of [H9254] = 0.8 were chosen. When the Kolmogorov-Smirnov tests indicated that data were not normally distributed, the difference of means log scale design, Schuirmann tests and relative test bounds of [H9254] = 0.8 were chosen.
To test superiority of FSP versus HDCIS and superiority of FSP and HDCIS versus CIS+ paired sample t tests or Wilcoxon signed-rank tests were used. Whether parametric (paired t test) or non-parametric (Wilcoxon signed-rank test) tests were used depended on the results of normality testing using Kolmogorov-Smirnov tests.

Effects of coding strategy on hearing quality as tested using questionnaires 1 and 2 were assessed using the binomial test to compare the frequency distributions between FSP and HDCIS.
In all statistical tests, significance was defined as p ! 0.05. Equiv Test TM 1.0 (Cork, Ireland, http//www.statsol.ie) was used for all non-inferiority testing. Non-inferiority testing was conducted by the Institute of Medical Statistics, Informatics, and Health Economics of the Medical University of Innsbruck. SPSS for Windows 14.0 (Chicago, Ill., USA, http//www.spss.com) was used for all other analyses.
Results
Hearing Quality
Results for questionnaires 1 and 2 are shown in figure 1 ac and figure 2 ac. In each graph, the content of the questions is indicated on the vertical axis or in the title of the graph. Questionnaire 1 was completed at both, test interval 1 (acute fitting) and test interval 3 (after 3 months of FSP use). Data reported on are from test interval 3, as these would more realistically reflect hearing quality judgements, following some device experience.
Relative frequencies for 23 of the 24 competitive assessment questions of questionnaire 1 are shown in figure 1 a and b. One question was not included in figure 1 a and b as 97.8% of responses were missing. With respect to music, depending on the question and the music being presented (see Methods for details), 64.491.1% of the subjects rated the FSP strategy to be better than or equal to HDCIS. With respect to speech, again depending on the sound sample being used, 66.784.1% of the subjects rat-

ed FSP to be better than or equal to HDCIS. On all questions, binomial tests showed that the proportion of subjects who have judged FSP 6 HDCIS was significantly higher than (or in some cases at least equal to) the proportion of subjects who preferred HDCIS (p ! 0.05).

Results of the 6 questions on timbre of sound and pitch of the voice are shown in figure 1 c. For these questions, the originally German answer categories are shown in English. However, please note that there is no clear translation of the German answer categories dunkel (viel dunkler and dunkler) and hell (viel heller und heller). Both Langenscheidts dictionary (eWrterbcher 4.0, Revision 14, http://www.langenscheidt.de) and the LEO dictionary (http://dict.leo.org/) translate the term dunkel as dark, deep and dull and the term hell as bright, light and clear. We decided to use the translation dark for dunkel and bright for hell. For these questions on timbre and pitch, it could not be defined if a brighter sound was to be preferred over a darker sound and vice versa. These questions were not of a competitive nature and were thus only included to obtain an additional idea of the quality of the different strategies. Across all questions, more subjects found FSP to sound brighter and clearer than HDCIS than there were subjects finding FSP to sound darker and more dull.

After 1 month of at-home experience, subjects completed a postal questionnaire (questionnaire 2), which asked them to compare listening experiences with the OPUS 1 to those with the TEMPO+. All subjects returned this questionnaire. Some results of questionnaire 2 are shown in figure 2 ac. The open question noting different music styles subjects listened to is not depicted in these graphs as it presents no valuable information in regard to the upgrade to the new FSP coding strategy. With respect to speech understanding (fig.2 a), depending on the question, 82.293.3% of the subjects rated FSP 6 CIS+. For questions relating to music (fig.2 b), 90.993.3% of the subjects rated FSP 6 CIS+. Binomial tests on all competitive assessment questions showed that the proportion of subjects who judged FSP 6 CIS+ was significantly higher than the proportion of subjects who preferred CIS+ (p ^ 0.001).

Telephone Use

Thirteen subjects did not use the telephone; as a result, 33 (71.7%) subjects answered questions about telephone use. As this subgroup is not a representative sample of all study participants, these questions were only analysed descriptively. On average, subjects preferred FSP over CIS+ on all telephone use questions (fig.2 c). 84.8% of the

Mean pitch range HDCIS: 78.2 (38.2 SD)
100
HDCIS
FSP
Normalized scale (range: 100 to +100)
50
0 110 139 156 185 220 370 440 523 622 740 880 1,047 1,245
262
311
Mean pitch range FSP: 115.8 (47.1 SD)
50
100
Mean frequency range HDCIS: 990.5 Hz (16.2 SD)
Mean frequency range FSP: 1,076.8 Hz (29.1 SD)
Frequency

Fig. 3. Mean pitch scaling values as a function of frequency. The line with the circles shows pitch scaling for HDCIS, whereas the line with the triangles shows pitch scaling for FSP. Where the line is shown dashed, the

frequency range is not applicable to all subjects. With HDCIS, 8 subjects could recognize tones down to 220 Hz, for 37 subjects the lowest frequency was 262 Hz. With FSP, for 7 subjects the lowest frequency was 110 Hz and 5 subjects could perceive the difference between tones down to 139 Hz. For the majority of the subjects (33) 185 Hz was the lowest frequency. Error bars represent standard deviations of the pitch range.
subjects reported that they understood a known male communication partner as well or better with FSP in comparison to CIS+ (worse: 15.2%). 81.5% of the subjects reported that they understood an unknown male communication partner as well or better with FSP in comparison to CIS+ (worse: 18.5%). 87.5% of the subjects reported that they understood a known female communication partner as well or better with FSP in comparison to CIS+ (worse: 12.5%). 74.1% of the subjects reported that they understood an unknown female communication partner better or much better with FSP in comparison to CIS+ (worse: 25.9%).

Music Listening

36.4% of the subjects listened to music on a daily basis, and 45.4% listened to music 12 times a week. Music with the OPUS 1 sounded natural and pleasant for 39.1% of the subjects, 52.2% reported that music sounded unnatural but still pleasant; while 8.7% reported that music sounds unnatural and unpleasant to them. 64.4% of the subjects reported that music sounds broad, full, resonant and complete (translation of voll from http://dict.leo.org/) with FSP in comparison to
CIS+ (equal: 20%, worse: 15.5%). 48.9% of the subjects reported that they perceived the timbre of music to be brighter with FSP in comparison to CIS+ (equal: 26.7%, darker: 24.4%).

Pitch Scaling

Again, data reported here were from test interval 3, as these more realistically reflect pitch-scaling judgements, following some device experience. Applying the audibility criterion mentioned above (see Methods section), the lowest perceivable frequency was lower using FSP (110 Hz) in comparison to the lowest frequency when using HDCIS (220 Hz) (fig.3). There was no difference in audibility for the highest tested frequency. In the range of perceivable frequencies, both strategies produced increasing pitch with increasing frequency. The mean audible frequency range was higher with FSP (1,076.8 8 29.1 Hz) than with HDCIS (990.5 8 16.2 Hz). A Schuirmann test confirmed non-inferiority at a significant level (p ^0.001). A Wilcoxon signed-rank test revealed a statistically significant difference in median test results between the two groups (p ^ 0.001), indicating that subjects could hear a wider range of frequencies with the FSP strategy.

100
100
90
90
80
80
70
70
60
60
Correct (%)
50
p = 0.007
50
dB

40
p = 0.001
40
30
30
p <0.001
20
20
p = 0.008
10
10
0
0
10
10
FSP HDCIS CIS+
FSP HDCIS CIS+
FSP HDCIS CIS+
Vowels
Monosyllables
OLSA
Fig. 4. Speech perception scores at test interval 3. Subjects were tested with the OLSA, Freiburg monosyllable and vowel tests using the FSP, HDCIS and CIS+ coding strategies.

The mean perceivable pitch range was higher with FSP (115.8 8 47.1) than with HDCIS (78.2 8 38.2). Non-inferiority of FSP was demonstrated (p ^ 0.001) and a paired t test showed a statistically significant difference in mean test results between the two coding strategies (p ^ 0.001). This indicates that with the FSP strategy, subjects could perceive a significantly larger range of pitches than with HDCIS. Further analysis showed that this was due to differences at the lower pitch end. The mean lowest pitch score was lower with FSP (52.8 819.6) than with HDCIS (18.6 8 17.3). Again, non-inferiority was demonstrated (p ^ 0.001), and a Wilcoxon signed-rank test revealed a statistically significant difference in mean test results between the two strategies (p ^0.001). The mean highest pitch scores were 74.0 8 15.2 for FSP and 71.7 8 11.4 for HDCIS. Non-inferiority was shown (p ^ 0.001), whereas a Wilcoxon signed-rank test revealed no statistically significant difference in mean test results between the two strategies (p = 0.111).

Speech Perception Testing

Data of speech perception tests are shown in figure 4 . Data were analysed for test interval 3 (3 months device experience), as this was the defined end point of the clinical investigation, showing data with some device experience.

At test interval 3, vowel scores were similar for FSP (64.4 8 10.9%) and HDCIS (65.4 8 12.5%) [p ^ 0.001 (non-inferiority) and p = 0.577 (superiority)]. Those for FSP were significantly higher than those for CIS+ (59.6 8 11.2%) [p ^ 0.001 (non-inferiority) and p = 0.007 (paired t test superiority)]. HDCIS vowel scores were significantly higher than CIS+ scores (p = 0.001). Mono-syllable scores showed the same behaviour for FSP and HDCIS [FSP: 44.8 8 19.03%; HDCIS: 42.3 8 18.8%; p ^ 0.001 (non-inferiority) and p = 0.139 (superiority)] and were also significantly higher for FSP than for CIS+ (38.9 8 17.8%) [p ^ 0.001 (non-inferiority) and p !0.001 (paired t test superiority)]. HDCIS monosyllable scores were significantly higher than CIS+ scores (p = 0.008). In the OLSA test, speech reception thresholds were slightly lower for FSP (3.0 8 6.7 dB) and HDCIS (2.9 8 7.0 dB) than for CIS+ (3.4 8 7.7 dB); however, none of these differences was statistically significant (fig.4).

Discussion
Before discussing the results, it should be noted here that although the OPUS 1 audio processor was used in the study (as this was the only audio processor available at study start), the results can be extrapolated to the OPUS 2 audio processor, as the FSP and HDCIS coding strategies are identically implemented in both processors.
Furthermore, it is to note that all tests used in this study were based on the German language which might raise the question about the applicability of our results in regard to CI patients speaking different languages, such as English. When extrapolating speech test results of German-speaking CI users to languages with radically different sound systems or phonetic structures, such as some African languages, which use an egressive air-stream for the production of their typical click sounds [25] , or many tonal languages (e.g. Mandarin), in which pitch changes are used to change word meaning, difficulties might occur as these linguistic devices are not found in German. In contrast, the English language, for example, has strong similarities in the consonant and vowel systems (e.g. German: 15 vowels and 3 diphthongs, and English: 12 vowels and 5 diphthongs) [26, 27] as well as in the use of tense and lax vowels. This strong overlap between the phonetic inventories of English and German means that listeners in both languages have access to highly similar phonetic cues. This allows the conclusion that speech data from one language can also be applied to the other language, i.e. our research results are also applicable to English-speaking CI users as well as CI users of various different languages.
The Effects of Coding Strategy on Hearing QualityFor the 5-step scale questions of questionnaire 1, categories 35 were considered to be equal to or better than a significantly higher proportion of subjects fell within this category range (fig.1 a, b), indicating that the FSP strategy provides an equal or better listening percept on a subjective level in a number of listening conditions. Statistical analysis showed that, for all questions, the proportion of subjects judging FSP to be equal to, or better than, HDCIS was significantly larger than the proportion of subjects rating HDCIS better. This type of analysis is important to provide a more subjective overview of listening experiences during daily listening activities. FSP is designed to provide the listener with a better music percept due to the additional access to lower pitch and frequency, and this is indeed reflected in the outcomes of the questionnaire.
The other 6 questions (questions 2, 7, 15, 16, 24 and 25;
fig.1 c) turned out to be more difficult to interpret. Mostly they were related to the perception of timbre. The choice options could be best translated as preferring either a darker sound or a brighter sound when relating to Klangfarbe or sound colour. Although there is no direct English translation, Klangfarbe might best be described as timbre. Among the group analysing the data, there was much discussion (and variance) as to the meaning of the outcomes on this portion of the survey. Some expected a darker sound to be richer, conveying more low-frequency information and were thus surprised by the outcome with a trend towards brighter sound. Others thought that brighter might translate to clearer, better listening, as this could be seen as a more positive word than darker. In the end, it was agreed that the authors should not overinterpret these results, as it is difficult to assess what the subjects really intended to report, given that we have differences in opinion on this. The responses to these questions provide qualitative information regarding perception of sound and were thus not used to test any hypothesis.
All 6 questions about telephone use, music perception and music listening preferences in questionnaire 2 were analysed separately from its remaining 18 competitive questions. The relative frequency analysis on the competitive questions regarding speech and music shows that the preference for the FSP coding strategy was significantly greater than for CIS+ (fig.2 a, b). 83.9% of the subjects listened to music at least once or twice a week, if not every day, which is in contrast to research by Veekmans et al. [28] on CIS+ users where only 17% of 23 users listened to music at all. A surprisingly large number (39.1%) reported music to sound both natural

and pleasant. This contrasts Veekmans CIS+ data, where 63% noted that music was pleasant noise without melody, and suggests that providing fine structure elements to the coding strategy allows users to now perceive music as more pleasant and natural, and perhaps more music-like. This is supported by the fact that subjects found music to sound fuller and brighter with FSP. The questions regarding telephone use were descriptively analysed since not all (71.7%) subjects reported using the telephone. A large number of subjects did use the telephone to some degree (71.7%), which reflects the same experience in a study by Anderson et al. [29], where 71% of respondents reported using the telephone after receiving their CI. FSP may bring about better understanding, as in the current study, there were improvements on understanding of familiar (male: 84%, female: 87%) and unfamiliar speakers (male:

81%, female: 74%). This is in comparison to the Anderson study, where 65% understood familiar speakers and 46% unfamiliar speakers well. Of those who used the telephone, most showed a preference for the FSP coding strategy (fig.2c).

All in all, the results of the questionnaires 1 and 2 indicate that most subjects found FSP to perform equal to, or better than, CIS+ with a large variety of sound signals and in a large variety of environments. In no question did FSP perform worse than HDCIS. The results regarding music are of particular interest since FSP is designed to provide better frequency information in the low frequencies. These results suggest that in contrast to earlier assessments of music appreciation with a CI [30, 31] , FSP coding, which provides more information on pitch frequency and possibly depending on the sound also on the first few harmonics, may enhance the music listening experience. This is verified by the large number of subjects who reported that even though music might sound unnatural (which can be expected), it still sounds pleasant suggesting access to the fine structure of sound, over and above the envelope of sound, has somewhat improved the music listening experience. In all, 91% of subjects reported that after using FSP, music is now pleasant to listen to with their CI, exceeding by far the numbers reached with CIS, ACE and SPEAK as reported in a study by Brockmeier et al. [32]. More recent studies confirm our results of an improved music perception. Arnoldner et al. [14] investigated speech and music perception in 14 postlingually deafened adults und used the MED-EL MUSIC test to assess specific musical skills and subjective judgements. Results showed that subjects performed better with the OPUS processor using FSP compared to the TEMPO+ using CIS in 2 out of 3 tests (rhythm and number of instruments). Similarly, Lorens and his research group [33] tested 60 children using a visual analogue scale to assess user satisfaction regarding music stimuli. In the visual analogue scale at interval II (34 months of HDCIS experience only, none with FSP) subjects rated FSP better than CIS+ by 27.1%, HDCIS better than CIS+ by 31.5% and no significant difference between FSP and HDCIS. At interval III (34 months of FSP experience only), subjects rated FSP better than CIS+ by 32.4%, HDCIS better than CIS+ by 22.3% and again no significant differences between HDCIS and FSP. Thus, we can conclude that our outcomes in adults also concur with findings in children.

The Effects of Coding Strategy on Pitch Scaling

The results from the questionnaires are complemented by the results of the pitch scaling experiments. With the FSP strategy, pitch scaling showed a significantly greater access to lower frequencies (lowest audible frequency for FSP: 110 Hz vs. for HDCIS: 220 Hz) and a significantly lower pitch percept (lowest perceived pitch for FSP: 58.1 vs. 12.8 for HDCIS) (fig.3). This difference of pitch scaling results between FSP and HDCIS/CIS+ coding strategies cannot only be attributed to the fine structure processing but also to the lower cut-off frequency for FSP at 100 Hz compared to 250 Hz for CIS+ and HDCIS strategies. As expected, no significant difference in audible frequency or perceived pitch was found at the upper end of the tested frequency range. Here, no technical difference exists between FSP and HDCIS, i.e. both strategies provide envelope information only, so

that no difference was to be expected.

Thus, the results show that the FSP strategy provides the listener with better pure-tone hearing for frequencies lower than 220 Hz indicating that the FSP strategy meets its principal design goal, i.e. better frequency coding in the lower frequencies. This obviously gives the listener greater access to pitch which could provide better access to the fundamental frequency (F0). Better F0 could improve speech perception in a variety of listening conditions and improve access to music via melody recognition, which is in line with the results of the questionnaires discussed above. Interestingly, however, an experiment by Krenmayr et al. [34], in which they compared two different fine structure strategies, demonstrated that the pitch of a stimulus does not only depend on its F0 but also on the presentation of acoustic properties in stimulation patterns. They furthermore concluded that fine structure enables CI users to perceive lower pitches than purely enveloped-based coding strategies such as CIS/CIS+.

The Effects of Coding Strategy on Speech Perception

Results showed that subjects performed similarly with FSP and HDCIS but significantly better with FSP and HDCIS than with CIS+ on vowels and monosyllables (tables 2 and 3). Improved vowel and monosyllabic word scores support the claim suggested by results of the questionnaires (see above) that FSP may indeed provide better everyday listening outcomes for users than the CIS+ strategy. Our improved speech perception results in quiet are in line with multiple other studies showing a benefit of FSP in speech understanding in children and adults [14, 33, 3537]. However, whereas sentence perception in noise was not significantly different with FSP and HDCIS

Table 2. R esults for speech understanding scores (vowels, monosyllables, OLSA adaptive sentences in noise) at 3-month test intervals (test interval 3)

Speech understanding at test interval 3	vowels			monosyllables			OLSA		
	FSP	HDCIS	CIS+	FSP	HDCIS	CIS+	FSP	HDCIS	CIS+
Mean	64.40	65.38	59.62	45.00	42.78	38.94	2.95	2.86	3.26
Median	64.00	65.00	61.00	45.00	45.00	37.50	1.50	2.10	1.60
Standard deviation	10.85	12.53	11.15	18.85	18.90	17.78	6.71	6.98	7.65
Minimum	46.00	33.00	33.00	7.50	7.50	7.50	7.30	7.60	8.20
Maximum	88.00	99.00	90.00	82.50	85.00	77.50	20.30	19.60	25.00

Table 3. R esults for speech understanding scores (vowels, mono-syllables, OLSA adaptive sentences in noise) at test interval 3: p values

Test	Non-inferiority and superiority of FSP	FSP vs. HDCIS	FSP vs. CIS+
Vowels	Non-inferiority of FSP	0.001*	0.001*
	Superiority of FSP	0.577	0.007*
Monosyllables	Non-inferiority of FSP	0.001*	0.001*
	Superiority of FSP	0.139	<0.001*
OLSA	Non-inferiority of FSP	0.001*	0.001*
	Superiority of FSP	0.734	0.330

* p <0.05: results indicating statistical significance.

from CIS+ in our study, study outcomes by Vermeire et al. [37] as well as other research groups [14, 33, 36] demonstrated statistically significant improvement of speech understanding in noise with FSP compared to the CIS or CIS+ coding strategy. It is to note, however, that the follow-up time in both Vermeires [37] and Riss [36] studies was 12 months, which indicates that subjects might need more time to get fully accustomed to the FSP coding strategy and to learn to use the cues that are available with FSP to greater benefit in speech

understanding in noise.
Interestingly, the HDCIS speech perception test results in our study were quite similar to those of the FSP coding strategy. When considering the results from questionnaire 1 (comparing FSP and HDCIS, with a significant preference for FSP) and questionnaire 2 (comparing FSP and CIS+, with a significant preference for FSP), this
comes as a surprise considering that CIS+ and HDCIS are essentially the same coding strategy. Perhaps speech perception measures are not sensitive enough to the changes that come with increased lower frequencies. This could suggest that there are subtle changes that affect everyday listening that cannot be measured in a laboratory setting and suggests that the development of improved test methods is important. In addition, these results may again indicate that subjects need a longer follow-up time with FSP in order to get used to this coding strategy and to show greater differences between FSP and previous coding strategies.
Conclusions
Results from this clinical study demonstrate that users of FSP as implemented in the OPUS processor performed as well or even better when compared to their scores with CIS+ or HDCIS. These results also show that CIS users should have no decrement in performance when they transition to the FSP coding strategy. Subjects performed significantly better on vowel and monosyllabic word perception tests with the OPUS processor than with the TEMPO+. The study demonstrated a significantly lower pitch perception and significant user preference for FSP in questionnaire 2. Coupled with improved rating of music appreciation as well as finding regular music listening habits among subjects, these results not only suggest the superiority of the new FSP coding strategy, but also indicate that the addition of the time code in FSP does indeed offer an important new direction in overcoming the limitations of traditional CI coding strategies.

Acknowledgements
The authors would like to acknowledge the following clinics that provided subjects for this study: Klinik und Poliklinik fr Hals-, Nasen- und Ohrenkrankheiten, Universittsklinikum Wrzburg, Wrzburg; Hals-Nasen-Ohren Klinik, Klinikum rechts der Isar der TU Mnchen, Munich; HNO- und Poliklinik, Klinikum Grosshadern; Hals-Nasen-Ohrenklinik der Ruhr-Universitt Bochum, St Elisabeth Hospital, Bochum; Zentrum der Hals-Nasen-Ohrenheilkunde der Universitt, Klinikum JW. Goethe-Universitt, Frankfurt; Katholisches Klinikum Koblenz Marienhat, Koblenz; Klink- und Poliklinik fr HNO-Heilkunde, Universittsklinikum Carl Gustav Carus, Dresden; Klinik fr
Hals-Nasen-Ohrenheilkunde, HELIOS Klinikum Erfurt GmbH, Erfurt; Poliklinik: Plastische Operationen, Universittsklinik fr Hals-, Nasen- und Ohrenheilkunde, Essen; Klinik und Poliklinik fr Hals-, Nasen- und Ohrenheilkunde, Universittsklinikum Hamburg-Eppendorf, Hamburg; Hals-, Nasen-, Ohrenheilkunde, Medizinische Hochschule Hannover, Hannover; Institut fr Phoniatrie und Pdaudiologie, Universittsklinikum Jena, Jena; Klinik fr Hals- Nasen- und Ohrenheilkunde, Medizinische Fakultt, Otto-von-Guericke-Universitt Magdeburg, Magdeburg; HNO Klinik Otto Krner, Universtitt Rostock, Rostock; Universitts-HNO-Klinik, Tbingen; Hals-, Nasen-, Ohrenheilkunde, Universittsklinikum Ulm, Ulm. This clinical investigation was sponsored by MED-EL GmbH.
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Mller et al.

Publication date: Sep 2012

Year: 2012

Advanced Bionics, LLC; Patent Issued for System and Method for Fitting a Hearing Prosthesis Sound Processor Using Alternative Signals

Publication info: Computer Weekly News (Aug 16, 2012): 1422.
ProQuest document link

Abstract: At high rates of stimulation, the behavior of the electrically stimulated auditory system can mimic that of the normally healthy ear in that perception of constant amplitude stimuli cannot be maintained over time by all patients. [...]the need arises, in setting the levels in cochlear implant processors, for using either actual speech stimuli, or stimuli that mimic the nature of speech."

Full text: 2012 AUG 16 (VerticalNews) -- By a News Reporter-Staff News Editor at Computer Weekly News -- From Alexandria, Virginia, VerticalNews journalists report that a patent by the inventors Segel, Philip A. (Englewood, CO); Overstreet, Edward H. (Valencia, CA); Kruger, Tracey L. (Valencia, CA); Mishra, Lakshmi N. (Valencia, CA), filed on April 8, 2011, was cleared and issued on July 31, 2012.
The patent's assignee for patent number 8233989 is Advanced Bionics, LLC (Valencia, CA).
News editors obtained the following quote from the background information supplied by the inventors: "The present invention relates to hearing prostheses, and more particularly to an improved technique for programming, or fitting, a cochlear implant system to a particular patient.
"Cochlear prostheses produce sensations of sound in deaf patients by direct electrical stimulation of the auditory nerve. In modern, multichannel cochlear prostheses, several different sites are stimulated at various distances along the cochlea to evoke the different pitches of sound perception that are normally encoded by nerve activity originating form the respective sites. The patterns of electrical stimulation are derived from acoustic signals picked up by a microphone and transformed by a so-called speech processor that is programmed to meet the particular requirements of each patient. Several different schemes for processing the acoustic signal and transforming it into electrical stimuli have been developed and are well-described in the scientific literature and various patents. For purposes of the present invention, these schemes--also known as speech processing strategies--can generally be considered as either sequentially, partially-simultaneously or fully-simultaneously speech processing strategies.
"The conventional setting of electrical stimulation levels in sound processors for cochlea implant systems--a process generally referred to as 'fitting' the speech processor to a patient--has involved the stimulation of single channels (comprised of monopolar or bipolar stimulation pathways) employing stimuli that do not resemble the stimulation patterns inherent in the on-going speech signal. See, e.g., U.S. Pat. No. 5,626,629, incorporated herein by reference. Typically, during such fitting process, gated-bursts of some fixed burst duration and constant amplitude are delivered to the patient. This procedure of obtaining psychophysical measurements is

often quite laborious. The patient's task is to set a level where sound is barely audible, and then set a level where sound is comfortably loud.

"Disadvantageously, after going through the time-consuming and laborious cochlear-implant-fitting process, when the patient's microphone is enabled and speech stimuli are delivered to all channels, either sequentially, partially-simultaneously or fully-simultaneously, the psychophysically set levels bear little resemblance to the final parameters set in the patient's sound processor. Adjustments to the overall level of stimulation as well as other parameters tend to be required to mold the psychophysically derived parameters into a viable program that appropriately maps the perceived speech stimuli to electrical stimuli that may be delivered directly to the patient's cochlea. Hence, essentially two fitting procedures are typically required--one to set the psychophysical levels, and a second to make adjustments to such levels.

"A further complication in setting levels in a sound processor is the fact that in cochlear-implant systems, which employ narrow pulse widths (e.g., 10.7 microseconds) and high rates of stimulation, obtaining single-channel measurements for estimates of comfortable loudness is not practical. At high rates of stimulation, the behavior of the electrically stimulated auditory system can mimic that of the normally healthy ear in that perception of constant amplitude stimuli cannot be maintained over time by all patients. Thus, the need arises, in setting the levels in cochlear implant processors, for using either actual speech stimuli, or stimuli that mimic the nature of speech."

As a supplement to the background information on this patent, VerticalNews correspondents also obtained the inventors' summary information for this patent: "The present invention addresses the above and other needs by using alternative stimuli, i.e., stimuli other than the constant amplitude stimuli used in prior fitting schemes, to set the parameters of a cochlear implant system. The use of such alternative stimuli advantageously allows the entire fitting process to be completed in a very short time period, and generally eliminates the need for secondary adjustments.

"In accordance with one aspect of the present invention, modulated pulse trains with selectable degrees of amplitude modulation are delivered during the fitting process. These novel stimuli are delivered to the cochlear processor either in rapid sequential fashion, partially simultaneous fashion, or full simultaneous fashion to groups of channels within the speech processor. In this context, a 'group' of channels may contain n channels, where n is an integer that may be as few as one channel or as large as the number of channels within the speech processor of the cochlear implant system. Advantageously, such modulated pulse trains mimic the time varying nature of speech stimuli sufficiently so as to allow the setting of the sound processor parameters in a single step without further adjustments.

"In accordance with another aspect of the invention, various speech-like stimuli may be inputted during the fitting process in order to set the parameters of the sound processor. Such speech-like stimuli include, but are not necessarily limited to: (1) shaped bands of noise whose overall bandwidth is adjustable; (2) modulated bands of noise whose center frequencies are adjustable; (3) complex tonal stimuli whose spectra and various amplitude components are adjustable; or (4) speech tokens whose spectra and amplitude envelopes are well described.

"In accordance with an additional aspect of the invention, modulated stimuli, in some embodiments, may be delivered directly through the band-pass filters of the sound processor via the fitting system rather than through an auxiliary port. The perceived loudness of such stimuli may then be adjusted as needed, e.g., according to prior known psychophysical procedures.

"In accordance with yet another feature of the invention, in one embodiment, the modulated stimuli comprise white noise that is generated internal to the speech processor. Such white noise is then applied directly through the band-pass filters of the sound processor and processed through a multiplicity of channels in parallel so that stimuli resulting from the white noise are delivered to a selected group of electrodes, where the perceived loudness of the stimuli are adjusted as needed to a desired threshold level.

"Advantageously, in some embodiments of the invention, the stimuli used by the invention during the sound processor setting procedure may be generated through a software module that may be incorporated into the cochlear implant processor fitting system, e.g., the CLARION.RTM. CII Bionic Ear.RTM. System, or the HiRes90K.RTM. System, available commercially from Advanced Bionics Corporation, of Sylmar, Calif., or other commercially-available cochlear implant systems.

"In operation, at least some embodiments of the invention may adjust the level of the delivered stimuli according to known perceptual loudness contours derived from normal hearing individuals (minimal audible field) or from known acoustic phenomena, such as the long-term spectrum of speech. Thus, e.g., stimuli may be delivered at the electrical equivalent of the long-term spectrum of speech, at a level representing the detection abilities of normal hearing individuals, or at any point in between."

For additional information on this patent, see: Segel, Philip A.; Overstreet, Edward H.; Kruger, Tracey L.; Mishra, Lakshmi N.. System and Method for Fitting a Hearing Prosthesis Sound Processor Using Alternative Signals. U.S. Patent Number 8233989, filed April 8, 2011, and issued July 31, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=24&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1166&f=G&l=50&co1=AND&d=PTXT&s1=20120731.PD.&OS=ISD/20120731&RS=ISD/20120731

Keywords for this news article include: Electronics, Legal Issues, Advanced Bionics LLC, Amplitude Modulation.

Publication date: Aug 16, 2012

Year: 2012

Audiological issues and hearing loss among Veterans with mild traumatic brain injury

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Publication info: Journal of Rehabilitation Research and Development 49.7 (2012): 995-1004.
ProQuest document link

Abstract: The authors examined the prevalence, severity, etiology, and treatment of audiology problems among Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) Veterans with mild traumatic brain injury (TBI). A retrospective chart review was performed of 250 Veterans with mild TBI. Results of a comprehensive second-level mild TBI evaluation and subsequent visits to audiology were evaluated. They found the vast majority (87%) of Veterans reported some level of hearing disturbance and those involved in blast injuries reported a higher incidence of hearing disturbance than those with other injury etiologies. Strategies to address perceived stigma associated with hearing loss may increase attendance at follow-up visits. Additionally, while only a third of audiograms were found to be abnormal, advanced testing resulted in a significant percentage of the population being diagnosed with auditory dysfunction.

Full text: Headnote

Abstract-We examined the prevalence, severity, etiology, and treatment of audiology problems among

Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) Veterans with mild traumatic brain injury (TBI). A retrospective chart review was performed of 250 Veterans with mild TBI. Results of a comprehensive second-level mild TBI evaluation and subsequent visits to audiology were evaluated. We found the vast majority (87%) of Veterans reported some level of hearing disturbance and those involved in blast injuries reported a higher incidence of hearing disturbance than those with other injury etiologies. Audiology referrals were given to 75 Veterans and 37 attended. At this visit, Veterans reported tinnitus (75.7%) and hearing loss (59.8%). Nearly half (48.6%) of Veterans were diagnosed with conductive hearing loss, sensorineural hearing loss, or central auditory dysfunction. An additional 24.3% of Veterans had subclinical levels of auditory dysfunction. Our study has highlighted the increased prevalence of hearing loss among OIF/OEF Veterans and, thus, the need for appropriate referrals and treatment. Strategies to address perceived stigma associated with hearing loss may increase attendance at follow-up visits. Additionally, while only a third of audiograms were found to be abnormal, advanced testing resulted in a significant percentage of our population being diagnosed with auditory dysfunction.
Key words: adult, audiology, auditory dysfunction, blast injuries, brain injuries, hearing, hearing loss, mTBI, tinnitus, Veterans, wounds and injuries.
Abbreviations: C&P = Compensation and Pension, CAP = central auditory processing, CAPD = central auditory processing disorder, dBHL = decibels hearing loss, DPOAE = distortion product otoacoustic emission, IED = improvised explosive device, NSI = Neurobehavioral Symptom Inventory, OAE = otoacoustic emission, RPG = rocket-propelled grenade, SD = standard deviation, TBI = traumatic brain injury, VA = Department of Veterans Affairs, VHA = Veterans Health Administration.

INTRODUCTION

A dramatic increase in the use of explosive devices in Operation Enduring Freedom and Operation Iraqi Freedom is responsible for a significant shiftin the types of injuries experienced among soldiers. Between 2003 and 2005, 68 percent of combat injuries were blast related [1]. Head and neck injuries have increased in proportion relative to previous conflicts, and 78 percent of these injuries were consequential to explosions caused by devices such as improvised explosive devices (IEDs), land mines, mortars, bombs, or grenades [2]. Mild traumatic brain injury (TBI) can result from these types of blast-related injuries [3], and their prevalence in modern combat has increased dramatically. An estimated 20 percent, or 300,000 of the 1.6 million soldiers deployed to Iraq and Afghanistan, have mild TBI [4]. Individuals with mild TBI can present clinically with cognitive, physical, or behavioral problems [5]. Individuals also often present with complaints of anxiety, depression, apathy, and mood swings [5].

In conjunction with the increase in mild TBI, blast-related injuries also result in auditory and vestibular issues. Because the human ear is designed to be sensitive to changes in pressure, it is the most susceptible organ to damage from the pressure created by a blast wave [6]. Previous studies have found that 62 percent of blast-related TBI patients admitted after the onset of Operation Iraqi Freedom complained of hearing loss and 38 percent reported tinnitus [7]. Hearing problems were also found to be present in TBI patients who had not experienced a blast, with 44 percent complaining of hearing loss and 18 percent reporting tinnitus [7]. A study of 12,521 Veterans with TBI found that 34.6 percent of the cohort self-reported auditory impairment and an additional 9.9 percent reported both auditory and visual impairment. Of these, Veterans who experienced blast-related injuries were found to have the highest rate of self-reporting both auditory and visual impairment [8].

Ear and hearing injuries may significantly affect the daily lives of soldiers, both in and out of combat. Permanent hearing loss has been reported to contribute to psychosocial and physical health problems, such as depression, decreased social and emotional function, personal relationships, and decreased cognitive function [9-11]. While studies have examined the link between TBI and hearing loss, the mild TBI population specifically has not been widely studied. A previous study of 36 American adults with a history of mild TBI found that when compared with the normative values, these individuals performed significantly worse on the Dichotic Word Listening Task [12].

Additionally, more than one-third of individuals with a mild TBI were found to fail at least one condition of a dichotic word recall task [13]. However, these studies do not include information about clinical testing and results.

METHODS

A retrospective chart review of 250 Veterans with mild TBI was performed at a single, midwestern Department of Veterans Affairs (VA) medical center. Individuals with a confirmed diagnosis of mild TBI between June 15, 2007, and July 15, 2009, were identified by local physicians based on TBI reports to the Veterans Health Administration (VHA) Support Service Center and considered for inclusion. Patients with moderate/severe TBI, a prior history of ear disease or hearing loss, or non-VA care for hearing loss were excluded.

Veterans with mild TBI and hearing problems were identified using the VA's comprehensive second-level TBI evaluation. Veterans are referred for a comprehensive second-level evaluation after receiving an initial positive mild TBI screening. The initial screening is administered by a healthcare provider and consists of four questions regarding exposure to a mild TBI event(s), immediate symptoms, and current symptoms. Further information regarding the VHA's mild TBI screening process is described by Donnelly et al. [14]. The comprehensive TBI evaluation [14-15] is designed to identify the presence or absence of mild TBI and examines items such as demographics, injury etiology, number and degree of blasts exposed to, distance from blasts, and the Neurobehavioral Symptom Inventory (NSI) [16]. The NSI consists of 22 TBI symptoms, including hearing difficulty, and asks patients to rate the degree to which the symptom disturbs them. Items are rated on a 5-point scale ranging from "not at all" (0 = none: rarely if ever present; not a problem at all) to "almost always" (4 = very severe: almost always present and I have been unable to perform at work, school, or home due to this problem; I probably cannot function without help). Degree of blasts consists of primary, secondary, tertiary, and quaternary blast injuries. Primary blast injuries consist of pressure waves created by the blast. Secondary injuries are due to penetrating trauma caused by shrapnel. Tertiary blast injuries are the result of people being thrown into the ground or a fixed object. Quaternary injuries are any illness or disease not due to primary, secondary, or tertiary causes (e.g., burns, crush injuries, toxic inhalation) [17].

Detailed data were collected from electronic medical records by using a data collection tool developed for this study. Information was extracted from the comprehensive second-level TBI evaluation and from subsequent referrals to audiology (including all audiology follow-up appointments). Data elements collected from the medical record of audiology encounters included family history, demographics, hearing complaints, number of visits, noise exposure, examinations received, diagnoses, and treatment. Degree of hearing loss was measured as decibels hearing loss (dBHL) on an audiogram, where any threshold above 25 dBHL at any frequency was considered a hearing loss. Furthermore, 26-40 dBHL was mild, 41-54 dBHL was moderate, 55-69 dBHL was moderately severe, 70-89 dBHL was severe, and 90 dBHL+ was profound. Abnormal findings for tympanometry were considered ±100 daPa middle ear peak air pressure, <0.3 mL or >1.7 mL for static compliance. In instances where otoacoustic emissions (OAEs) were performed, one of two methods was used. Diagnostic testing was performed with the Bio-logic Scout OAE device (Natus Medical Inc; San Carlos, California) from 750 to 8,000 Hz using Boys Town criteria (65 and 55 dB for level 1 and level 2, respectively). A screening test was performed with the Bio-logic AuDX Pro (Natus Medical Inc), from 1,500 to 6,000 Hz. For diagnostic testing, results were deemed to be abnormal if an emission was absent at any or all frequencies. An absent response was defined as less than 6 dB emission to noise-floor ratio, as well as an emission amplitude greater than -10 dB, replicated. For screening OAEs, results were documented as either "pass" or "refer" using the default pass/refer criteria and were considered abnormal if a "refer" finding was noted at any or all frequencies, replicated. For acoustic reflex thresholds, findings were abnormal if they were unexpectedly absent or elevated based on pure tone findings. The exact central auditory tests given varied depending on the Veterans' history and report, as well as their performance throughout testing, but generally included at least one test from each of the following categories: auditory temporal processing (Random Gap Detection Test, Gaps in Noise Test),

auditory temporal patterning (Pitch Pattern and Duration Pattern Sequence tests), dichotic listening (Dichotic Digits, Competing Words and Competing Sentences subtests of SCAN-A and Competing Sentences Test), monaural low-redundancy speech (low-pass filtered speech testing, QuickSINTM Speech-In-Noise Test, Words in Noise, Filtered Words and Auditory Figure-Ground subtests of SCAN-A), and binaural interaction (masking level difference). Speech recognition tests were most often CID-W22 recorded word lists, but sometimes may have been performed with a monitored live voice. If immittance, OAE, or central auditory processing (CAP) test findings were found to be abnormal despite the presence of normal hearing on the audiogram, a "subclinical hearing loss" designation would be given. Descriptive statistics used include chi-square for dichotomous variables and analysis of variance for continuous variables. All analyses were conducted using SAS 9.2 software (Cary, North Carolina).

RESULTS

A total of 240 patients met inclusion criteria. Of the original 250 Veterans, 1 was excluded after being identified as having moderate/severe TBI, 5 had a prior history of ear disease or hearing loss, and 4 received care outside the VA for hearing loss. A total of 75 Veterans received an audiology referral, with 37 presenting for an examination (Figure).Figure.Study cohort flowchart. mTBI = mild traumatic brain injury, VA = Department of Veterans Affairs.

At the time of the comprehensive second-level evaluation, the average age of the 240 Veterans was 27.9, with 73 percent of the population under the age of 30. The majority of Veterans were white (71.25%), single (64.17%) males (92.08%) who were currently employed or a student (69.58%) and had a high school diploma or less (62.92%) (Table 1).

Comprehensive Second-Level Evaluation

During the comprehensive second level-evaluation, when asked to rate "hearing difficulty" (from the NSI) experienced since injury, 87 percent of the Veterans reported some degree of disturbance of daily living due to hearing difficulty (NSI greater than zero). Overall, Veterans reported a moderate level of hearing difficulty disturbance (mean ±standard deviation [SD] = 1.86 ±1.0) with 40.4 percent reporting moderate, 24.2 percent reporting severe, and 3.3 percent reporting very severe difficulty. Men reported greater hearing difficulty disturbance than women (mean NSI = 1.9 vs 1.3, respectively; $p < 0.05$) as did whites compared with minorities (mean NSI = 1.9 vs 1.5, respectively; $p < 0.05$). No significant associations were found between age, marital status, education, or employment and reported hearing difficulty disturbance.

More than half the cohort, or 64.2 percent (n = 154), reported at least one blast exposure, 106 of whom were injured solely from blast injuries. Among those Veterans who were only involved in blast injuries, 78 had identified the most intense type of blast injury they experienced during the second-level evaluation as 85.9 percent primary blast (n = 67) and 14.1 percent secondary blast (n = 11). Also among Veterans only involved in blast injuries, 97 reported the type of blast they were exposed to as IED only (36.1%, n = 35), rocket-propelled grenades (RPGs) only (6.2%, n = 6), bomb only (4.1%, n = 4), mortar only (3.1%, n = 3), or a combination of multiple blast exposures (e.g., IED and RPGs; 50.5%, n = 49).

Some level of hearing difficulty (NSI symptom score greater than zero) was reported by a greater percentage of Veterans incurring a blast-related injury (92.5%) compared with fall (84.0%), vehicle (80.0%), and mixed etiology (any combination of accident types; 87.5%) (Table 2). However, the average NSI hearing difficulty score did not differ statistically among these groups. The average reported NSI hearing difficulty and percentage reporting hearing difficulty did not differ by degree of blast exposure (primary, secondary, tertiary) among patients incurring a blast-only mild TBI (n = 106) or by number of visits to audiology (Table 2).

Referrals to Audiology Clinic

Seventy-five Veterans with mild TBI (31.3%) received referrals to the audiology clinic. Referral to audiology did not differ by age, sex, marital status, education, employment, or race/ethnicity; however, Veterans receiving a referral to audiology reported significantly more severe hearing difficulty than those not receiving a referral (2.2

vs 1.7, respectively; p <0.01). Of Veterans who indicated that they experienced hearing difficulty on the NSI (symptom score greater than zero), 34.9 percent were referred (n = 73) while 65.1 percent were not given a referral (n = 136; p <0.005). Examination of physician notes from the comprehensive mild TBI evaluation found hearing loss (81.3%), balance and dizziness problems (70.7%), tinnitus (56.0%), and earaches (9.3%) to be the most commonly reported symptoms of those referred to audiology (n = 75).

Evaluations in Audiology Clinic

Of the 75 Veterans with mild TBI given a referral to audiology, 37 (49.3%) attended. Veterans who did not attend their examination reported similar levels of hearing difficulty during the second-level evaluation as those who attended their appointments (2.18 vs 2.16, respectively). No significant differences existed between those attending or not attending when compared by age, sex, marital status, education, employment, or race/ethnicity. However, those attending their audiology appointment had a greater number of referrals given at the time of the second-level comprehensive examination (mean ±SD = 3.54 ±1.48) than those who did not attend their audiology visit (mean ±SD = 2.79 ±1.44; p <0.05). Patients who did not attend were most frequently a "no-show" on one or more occasions for unknown reasons (52.6%, n = 20). Documented reasons for not attending included a scheduled Compensation and Pension (C&P) examination (7.9%, n = 3), appointment refusal (5.3%, n = 2), redeployment (5.3%, n = 2), and cerumen buildup (2.6%, n = 1). An additional nine Veterans (23.7%) did not schedule or attend an appointment for unknown reasons.

The main complaints during the audiological examination were tinnitus (75.7%, n = 28) and hearing loss (59.5%, n = 22). Frequencies of tests performed and abnormalities are summarized in Table 3. Of the 37 visits, audiograms were noted in the examination of 35 (94.6%), word recognition tests in 26 (70.3%), and CAP disorder (CAPD) tests in 6 (16.2%). Audiogram tests resulted in abnormal findings for 12 of these Veterans (34.3%). Tympanometry and distortion product OAE (DPOAE) examinations were both noted in 21 visits (56.8%) and were abnormal at a rate of 23.8 percent and 81.0 percent, respectively. Additionally, acoustic reflex thresholds were noted for 11 patients (29.7%) and were abnormal at a rate of 18.1 percent. Acoustic reflex decay was noted for one patient (2.7%) and was not abnormal. No tympanic membrane perforations were noted.

Of the 37 Veterans who had audiology clinic visits, hearing loss occurred in varying degrees (Table 4). Veterans with abnormal findings that differed between each ear were considered to be part of the category representing the more severe level and/or form of hearing difficulty. Based on audiograms, seven Veterans (18.9%) were found to have mild hearing loss (26-40 dB), four (10.8%) moderate hearing loss (41-54 dB), and one (2.7%) moderate-severe hearing loss (55-69 dB). Overall, 10 Veterans (27.0%) were diagnosed as having sensorineural hearing loss, 6 (16.2%) were diagnosed with CAPD, and 2 (5.4%) were found to have conductive hearing loss. Furthermore, nine Veterans (24.3%) experienced subclinical levels of auditory dysfunction.

Follow-up and treatment plans varied and were not noted for all individuals. Referrals were given to 19 (51.4%) patients. They included 10 ear, nose, and throat referrals; 5 CAPD referrals; 3 neuropsychological testing referrals; 2 C&P referrals; and 1 neurology referral. It was suggested that nine (24.3%) patients receive a tinnitus evaluation while a hearing aid, wax removal, mental hygiene, and hearing protection were suggested for one patient each (2.7%). Treatment plans were unavailable or undocumented in four (10.8%) examinations.

DISCUSSION

Audiology issues are highly prevalent among Veterans with mild TBI. In our study, 87 percent of Veterans with mild TBI reported some level of hearing difficulty while more than 64 percent of Veterans reported at least a moderate level of hearing difficulty. Overall, 31.3 percent of our cohort received a referral to audiology. Of those who complained of hearing loss, 65.1 percent were not given a referral. Because of the complicated medical needs of those with mild TBI, the significant percentage of Veterans experiencing hearing difficulties may not have received a referral because more pressing issues presented at the time of their comprehensive second-level examination. Previous studies have found that in such patients, ear and balance deficits are commonly

overlooked [1]. However, without a referral at this time, patients may not otherwise seek treatment. These findings highlight the need for clinicians to pay particular attention to hearing complaints among mild TBI patients and for more comprehensive screening methods and proper referral methods to be developed.

Men reported greater difficulty hearing than women. In support of this, our study found that a significantly greater percentage of men were involved in blast-related mild TBI. White Veterans were also found to report significantly greater hearing difficulty and increased percentages of hearing complaints than non-white Veterans for unknown reasons.

Of particular interest, 50.7 percent (n = 38) of Veterans who were referred did not attend their audiology clinic appointment. One possibility for low attendance at audiology appointments is the stigma attached to both hearing loss and hearing aids. Previous studies have found that perceived stigma has an influence on decision-making processes that occur during initial acceptance of hearing loss, testing, and use of hearing aids [18]. Additionally, this stigma is not exclusive to men and is perceived by younger women as well [19]. Efforts to reduce the stigma surrounding hearing loss may increase the number of Veterans who return for follow-up visits after the comprehensive evaluation. Although the effect of hearing loss on the Veteran population is lesser known, its effects in the general population and the elderly are well documented. Because hearing loss increases with aging, these Veterans may also experience symptomatic hearing loss at younger ages than expected. Conceivably, the Veteran population, with an active role both in the workplace and home life, may also experience a significant loss of quality of life because of unmanaged hearing loss. Impaired hearing may restrict both employment and recreational activity. Furthermore, the effects of hearing loss are only further compounded by the effect of mild TBI on an individual's health overall.

Unexpectedly, Veterans who did attend their audiology appointment received about 25 percent more referrals at the comprehensive second-level examination than those who did not attend. This result was not consistent with our hypothesis that patients with many health concerns may prioritize their visits. Instead, some of these patients may be more likely to visit all their appointments because they are already spending a greater amount of time at the healthcare facility.

A third of audiograms resulted in abnormal findings. We were unable to find any previous studies that examined the mild TBI population; however, our results are similar to previous studies that found TBI patients (TBI injury severity unreported) to have decreased hearing sensitivity on audiograms [7,20]. Pure sensorineural hearing loss was found to be the most common type of hearing loss among Veterans, as in previous studies [7]. While previous studies have found that tympanic membrane perforation is the most common ear-related blast injury, we found no tympanic membrane perforations in this mild TBI population [6,21].

To better assist patients, physicians need to be aware of the services that are provided by audiologists; otherwise, referrals will not be made. Close to two-thirds of the Veterans who were tested in our cohort were found to have "normal hearing" per the audiogram. Yet, the high prevalence of testing beyond the audiogram in our cohort found abnormalities in a significant number of these Veterans. DPOAE testing within our sample also produced a large group diagnosed with subclinical hearing loss. This finding suggests that blasts and other mild TBI etiologies may cause damage that is not detected by an audiogram and strongly indicates that audiological testing should not stop after the audiogram.

Because dizziness, loss of balance, hearing complaints, sound sensitivity, and tinnitus are not only possible symptoms of TBI but also symptoms of otologic pathology, the audiologist is an important team member for management of the blast-injured and/or TBI populations [22]. Blast-related auditory deficits can occur throughout the auditory system, from the outer ear to the cortex, which can result in a variety of complex symptoms [23]. Audiologists can offer a variety of treatment and management options for audiological and vestibular dysfunction. Additionally, audiologists must be aware that although a patient who complains of hearing loss in this population may present a normal audiogram, further testing may result in identifying auditory dysfunction.

The use of additional testing, such as CAPD testing that helps to identify CAP deficits, allows for patient-specific management [22]. Once the nature and severity of specific deficits are identified, appropriate guidance for management can be offered. Education and counseling on deficit-specific compensatory and communication strategies should also be offered. Unfortunately, the results of a 2007 questionnaire given to randomly selected members of the American Academy of Audiology found that audiologists have very limited knowledge of this additional testing [24]. Hence, it is not surprising that many VA audiology clinics are not providing these services [22]. More training is needed for audiologists with regards to this type of testing, and more research is needed on CAP and management in the adult TBI population [22].

When hearing loss occurs, the VA offers premium amplification choices and has many assistive listening devices available to suit nearly all hearing impaired Veterans. In the current study, 20 percent of the Veterans with hearing loss exhibited a mild sensorineural hearing loss. Open-fit devices are ideal for mild to moderate high frequency hearing losses and are appealing to a younger population because of cosmetics and Bluetooth compatibility. For those with more severe atypical losses, many VA centers offer cochlear implants and bone-anchored hearing devices. Counseling on hearing conservation and preservation as well as various auditory training exercises may be offered. Auditory training may take several forms, including clinician-directed (Auditory Process Training), self-directed (Auditory Process Training 3), and computer-based (Listening and CommunicationEnhancement).

Tinnitus was the number one complaint of Veterans tested in this current study (73.7%). Many options for tinnitus management are currently available, including counseling, sound generators, hearing aids, and other devices. The method currently endorsed by the VA is progressive tinnitus management, developed at the National Center for Rehabilitative Auditory Research, which is located at the Portland VA Medical Center in Portland, Oregon [25-26]. This is a hierarchal program designed to be maximally efficient and address the needs of all tinnitus patients [27]. Resources for this program are abundant and free to all VA audiologists and Veterans.

Our study is limited by small sample sizes and its retrospective chart review nature. Prevalence of hearing difficulty was self-reported by Veterans during the comprehensive second-level evaluation. Thus, results may be affected by a patient's subjectivity. As previously stated, many patients diagnosed with mild TBI have several medical concerns and, for some Veterans, receiving treatment for hearing difficulties may not have been among their most crucial needs. This could have resulted in both fewer referrals and poor attendance in audiology clinic even after receiving a referral. Lastly, our study was limited by the number of Veterans who attended their audiology follow-up appointment.

It would be interesting to further compare our findings and diagnoses with those of other sites and audiology clinics, which may not perform the same level of testing. Future research may also consider comprehensively comparing testing methods by location, because this would dramatically help the progression toward a standardization of care for these individuals. A longitudinal study following this population would also be beneficial, because it may provide evidence of accelerated hearing loss in those who went undiagnosed.

CONCLUSIONS

The discovery that the vast majority (87%) of our cohort reported some level of hearing difficulty on the NSI is an alarming indication of the prevalence of hearing issues among Veterans with mild TBI. Also notable is that the majority of Veterans who indicated hearing difficulty were involved in blast-related accidents, specifically IEDs and multiple blasts. The relatively low referral rates to audiology within the cohort elicit a need for further exploration, because hearing difficulty could result in significantly decreased quality of life.

Hearing loss and tinnitus were commonly reported problems. We found that tympanometry and audiogram testing were often not enough to come to a complete diagnosis of the patient's ailments. In particular, DPOAE and acoustic reflex threshold examinations both produced abnormal findings in several patients considered normal after initial hearing testing. Sensorineural hearing loss, conductive hearing loss, and subclinical levels of

hearing loss were prevalent among the population. We found varying treatment methods, but referrals to ear, nose, and throat and tinnitus evaluations were the most common. Further evaluation of testing methods and standardization of treatment among mild TBI patients experiencing hearing loss are needed.

ACKNOWLEDGMENTS

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Financial Disclosures: The authors have declared that no competing interests exist.

Funding/Support: This study was supported by the VA Office of Research and Development, Health Services Research and Development Service (grant IIR 07-188-3).

Additional Contributions: We would like to thank Salma Ahmed and Bridget O'Brien for their assistance in the initial chart review. Mr. St. Andre is now with the Health Research and Educational Trust, Chicago, Illinois.

Institutional Review: This study was approved by the local Human Subjects Institutional Review Board.

Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the VA or the U.S. Government.

Sidebar

Submitted for publication January 2, 2011. Accepted in revised form September 14, 2011.

This article and any supplementary material should be cited as follows:

Oleksiak M, Smith BM, St. Andre JR, Caughlan CM, Steiner M. Audiological issues and hearing loss among Veterans with mild traumatic brain injury. J Rehabil Res Dev. 2012;49(7):995-1004.

http://dx.doi.org/10.1682/JRRD.2011.01.0001

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http://dx.doi.org/10.1682/JRRD.2011.01.0001

Publication date: 2012

Year: 2012

Performance on tests of central auditory processing by individuals exposed to high-intensity blasts

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Publication info: Journal of Rehabilitation Research and Development 49.7 (2012): 1005-25.
ProQuest document link

Abstract: Thirty-six blast-exposed patients and twenty-nine non-blast-exposed control subjects were tested on a battery of behavioral and electrophysiological tests that have been shown to be sensitive to central auditory processing deficits. Abnormal performance among the blast-exposed patients was assessed with reference to normative values established as the mean performance on each test by the control subjects plus or minus two standard deviations. Blast-exposed patients performed abnormally at rates significantly above that which would occur by chance on three of the behavioral tests of central auditory processing: the Gaps-In-Noise, Masking Level Difference, and Staggered Spondaic Words tests. The proportion of blast-exposed patients performing abnormally on a speech-in-noise test (Quick Speech-In-Noise) was also significantly above that expected by

chance. These results suggest that, for some patients, blast exposure may lead to difficulties with hearing in complex auditory environments, even when peripheral hearing sensitivity is near normal limits. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract-Thirty-six blast-exposed patients and twenty-nine non-blast-exposed control subjects were tested on a battery of behavioral and electrophysiological tests that have been shown to be sensitive to central auditory processing deficits. Abnormal performance among the blast-exposed patients was assessed with reference to normative values established as the mean performance on each test by the control subjects plus or minus two standard deviations. Blast-exposed patients performed abnormally at rates significantly above that which would occur by chance on three of the behavioral tests of central auditory processing: the Gaps-In-Noise, Masking Level Difference, and Staggered Spondaic Words tests. The proportion of blast-exposed patients performing abnormally on a speech-in-noise test (Quick Speech-In-Noise) was also significantly above that expected by chance. These results suggest that, for some patients, blast exposure may lead to difficulties with hearing in complex auditory environments, even when peripheral hearing sensitivity is near normal limits.

Key words: audiometric evaluation, auditory dysfunction, auditory processing disorder, blast, central auditory processing, evoked potential, hearing loss, rehabilitation, traumatic brain injury, Veterans.

Abbreviations: ABR = Auditory Brainstem Response, DD = Dichotic Digits, DPOAE = distortion product otoacoustic emission, EP = evoked potential, FP = Frequency Patterns, GIN = Gaps-In-Noise, GSI = Grason-Stadler, HL = hearing level, LLR = long latency response, MLD = Masking Level Difference, mTBI = mild traumatic brain injury, N0S0 = signal in phase with noise, N0Sp = signal out of phase with noise, NCRAR = National Center for Rehabilitative Auditory Research, OIF/OEF/OND = Operation Iraqi Freedom/Operation Enduring Freedom/Operation New Dawn, PTAHF = puretone average (high frequency), PTALF = pure-tone average (low frequency), PTSD = posttraumatic stress disorder, QuickSIN = Quick Speech-In-Noise, SD = standard deviation, SNR = signal-to-noise ratio, SPL = sound pressure level, SSW = Staggered Spondaic Words, TBI = traumatic brain injury, VA = Department of Veterans Affairs, WRAMC = Walter Reed Army Medical Center, WRS = word recognition score.

INTRODUCTION

The recent conflicts in Afghanistan and Iraq (Operation Iraqi Freedom/Operation Enduring Freedom/Operation New Dawn [OIF/OEF/OND]) have resulted in unprecedented rates of exposure to high-intensity blasts, often resulting in traumatic brain injury (TBI) among members of the U.S. military. The Department of Veterans Affairs (VA) 2011 TBI Comprehensive Evaluation Summary [1] estimated the prevalence of TBI in the OIF/OEF/ OND Veteran population at 7.8 percent. While the typical focus of auditory evaluation is on damage to the peripheral auditory system, the prevalence of brain injury among those exposed to high-intensity blasts suggests that damage to the central auditory system is an equally important concern for blast-exposed persons. Discussions with clinical audiologists and OIF/OEF/OND Veterans Service Office personnel suggest that a common complaint voiced by blast-exposed Veterans is an inability to understand speech in noisy environments, even when peripheral hearing is within normal or near-normal limits. Such complaints are consistent with damage to neural networks responsible for higher-order auditory processing [2].

The auditory structures most vulnerable to axonal injury are the lower- and mid-brain stem nuclei, the thalamus, and the corpus callosum. Damage may include swelling, stretching, and shearing of neural connections, as well as inflammatory changes in response to tissue injury [3]. There also may be a loss of synaptic structures connecting nuclei in the central auditory system, resulting in distorted or missing information transmitted to cortical centers [4-5]. The interhemispheric pathways connecting auditory areas of the two cerebral hemispheres run through the posterior half of the corpus callosum [6]. The corpus callosum is a structure that

may be particularly vulnerable, as it has been shown to be damaged even in non-blast-related head injury [7-8]. Axonal damage to this part of the corpus callosum would be expected to interfere with auditory and speech processing, as well as other bilaterally represented auditory cortical functions. Furthermore, recent modeling work has revealed that the blast wave itself can exert stress and strain forces on the brain that are likely to cause widespread axonal and blood vessel damage [9]. Such impacts would not necessarily create changes visible on a medical image, but could still impair function by reducing neural transduction time, efficiency, or precision of connectivity. This wide diversity of potential damage and sites of injury also suggests that the profile of central auditory damage is likely to vary considerably among patients. For this reason, the first step in the diagnosis and treatment of blast-related dysfunction is the identification of which brain functions have been impaired.

TESTS OF CENTRAL AUDITORY FUNCTION

Behavioral tests are mainstays of central auditory test batteries, and many have been shown to be both sensitive and specific to particular brain injuries. It may also be important, however, to include evoked potential (EP) measures (electrophysiological tests) of neural function [10] to complement the behavioral tests. The Auditory Brainstem Response (ABR) is a commonly used test that evaluates the integrity of the auditory nerve and brainstem structures, whereas measures from the auditory evoked late response reflect cortical processing [11]. Long latency responses (LLRs), which are sensitive to impaired neuronal firing and desynchronization of auditory information, are useful tools for the assessment of cognitive capability. Prolonged latencies in LLRs would suggest interruptions in neural transmission within or between cortical networks. This could be due to reduced cortical neuron availability or diminished neural firing intensity. In addition, longer neural refractory periods can result in reduced amplitudes of event-related potentials.

The purpose of the current study was to determine whether performance on a battery of behavioral and electrophysiological tests of central auditory function differs between individuals who have recently experienced a high-explosive blast and those who have not. The study involved five behavioral and two electrophysiological tests designed to encompass aspects of central processing from the brainstem to the cortex. The selection of tests was based on the need to assess several important and potentially vulnerable aspects of auditory processing of complex sounds. These functions include the precise coding and preservation of temporal firing patterns that support speech understanding, pitch perception, and localization of sounds in the environment.

MATERIALS AND METHODS

Participants

The blast-exposed group was drawn from a group of patients who, upon returning to the (former) Walter Reed Army Medical Center (WRAMC) for medical treatment after deployment in Iraq or Afghanistan, were identified by medical staffas being exposed to at least one highexplosive blast within 1 year preceding study enrollment. All participants in this group had a notation in their medical record of exposure to a blast. A subject interview was conducted in order to obtain standard demographic information, a medical history, and an audiological history (including exposures to potentially damaging noise). No participants with greater than a mild TBI (mTBI) diagnosis were approached for enrollment, and no participants with hearing losses greater than 50 dB hearing level (HL) (pure-tone average of 0.5, 1.0, and 2.0 kHz) were included. All testing of blast-exposed patients was carried out in the Army Audiology and Speech Center at WRAMC.

A control group of subjects who had not been exposed to a blast were recruited and tested at the National Center for Rehabilitative Auditory Research (NCRAR), Portland VA Medical Center (Oregon). The goal of testing this group was to establish normative data and statistical cutoffs for abnormal performance on these specific tests in a group of appropriately age- and hearing- matched control subjects. Recruitment of the control group followed testing of the patient group, which allowed statistical matching of the groups with respect to age, sex, and audiometric configuration.

Subject Interview and Audiometric Evaluation

In addition to the subject interview, medical records of participants were reviewed by the research team at WRAMC. Each military servicemember admitted to WRAMC from deployment who has been exposed to a blast is evaluated by the TBI team to assess the presence and severity of TBI. This evaluation consists of screening tests and subsequent detailed neuropsychological testing, if indicated. The diagnosis of TBI, and severity, are based on these tests as well as information concerning loss of consciousness, duration of any posttraumatic amnesia, alteration of consciousness, and imaging studies, when appropriate. The diagnoses of mTBI or no TBI were extracted from the medical records for each experimental subject in this study. No patients were included in this study with a diagnosis of moderate or severe TBI.

Each subject underwent a comprehensive audiometric evaluation to establish configuration, severity, and probable site of lesion of any hearing loss. Pure-tone airand bone-conduction audiometry as well as clinical speech assessments (Quick Speech-In-Noise [QuickSIN] sentence recognition and NU-6 word recognition tests) were measured using a Grason-Stadler (GSI) GSI-61 audiometer (Eden Prairie, Minnesota) and Sennheiser HDA 200 headphones (Old Lyme, Connecticut). Immittance audiometry was conducted with the GSI Tympstar, and distortion product otoacoustic emissions (DPOAEs) were collected at WRAMC using the GSI Audera and at NCRAR using the Mimosa Acoustics HearID systems (Champaign, Illinois). DPOAEs were collected at frequencies between 0.5 and 12.0 kHz. All test equipment at the two data collection sites was exactly the same (with the exception of the otoacoustic emission testing as part of the audiometric evaluation). All testing was carried out with the subject seated or reclining comfortably in a quiet room or a sound-treated audiometric booth.

Behavioral Tests of Central Auditory Function

The behavioral tests used in the study were recorded versions played over a Sony CD player (Tokyo, Japan) connected to the GSI-61 clinical audiometer [12-13]. Before presentation to subjects, the test levels were calibrated using the recorded calibration tones on each test. Tests were presented at 50 dB sensation level (i.e., 50 dB above the level at which speech is detectable) unless the subject indicated discomfort at the prescribed levels, in which case small adjustments in level were permitted. Responses were made verbally or by button press, depending on the requirements of the test. Subjects were given frequent rest breaks as needed. The behavioral testing took approximately 2 hours and was carried out over two experimental sessions.

Temporal Pattern Perception

Delay or disruption in the transmission of auditory information throughout the auditory pathways would likely result in temporal processing deficits [14-15]. Musiek et al. investigated patients' temporal patterning abilities using the Frequency Patterns (FP) test [14], which is thought to be sensitive to lesions in the right cortex, the corpus callosum, and the brainstem [16-17]. It is resistant to mild hearing loss [18].

Musiek and Pinheiro developed this test of the ability to report sequences of three tone bursts that are presented to each ear independently [16]. Their procedures for this test were followed in this study. In each of the sequences, two tone bursts are the same frequency, while the third tone is a different frequency. Subjects were instructed to verbally repeat back the words "high" and "low" for the test items and were not allowed to hum or sing the responses. Three practice items were presented prior to the test. The right ear was tested first, followed by the leftear. If a subject incorrectly labeled any of the three tone bursts, that item was considered incorrect. Also, if the subject reversed the order of an item, that item was considered incorrect. Each ear was tested with 15 items. If all except one of the first 15 items were correct or incorrect, the testing stopped. Otherwise, the full 30-item test was administered.

Auditory Temporal Resolution

Temporal resolution was tested using the Gaps-In- Noise (GIN) gap-detection task [13], which produces an estimate of the briefest temporal gap a listener can detect in a continuous noise stimulus. This test is also sensitive to lesions of the cortex and corpus collosum. Previous studies have found that up to 40 percent of patients with brain damage had abnormal gap-detection thresholds [15,19]. This test has been shown to have

moderate sensitivity for identifying subjects with central auditory lesions and has high test-retest reliability [13]. The GIN test consists of a series of 6-second broadband noise segments. Each noise segment contains zero to three silent intervals (gaps). These gap durations are 2, 3, 4, 5, 6, 8, 10, 12, 15, and 20 ms and are pseudorandomized in occurrence and location within the noise segment. Following the protocol of Musiek et al. [13], subjects were instructed to listen for tiny "pops" or "clicks" that may or may not occur during the noise segments and to push a button to indicate that they heard the gaps. Subjects were instructed to respond immediately each time they heard a gap. Late responses were scored as misses. If there was any question about how many times a subject pressed the response button during a noise segment, the test was paused so the tester could verify the number of responses with the subject. A short practice list was presented only to one ear, with gaps that ranged from 8 to 20 ms. Each ear was tested separately, and the right ear was tested first. The test score was the percent correct responses at each gap duration, and a threshold was estimated based on the smallest gap for which the subject scored greater than 50 percent (gap detected on at least four of the six presentations), with all longer durations receiving a score greater than 50 percent.

Binaural Processing and Sound Localization

Temporal precision of neural firing is also involved in binaural processing and localization of sound in space. The Masking Level Difference (MLD) test evaluates the integrity of the earliest sites of binaural comparison and sensitivity to interaural phase in the brainstem, as well as cortical areas sensitive to spatial representations. The MLD is a well-established psychophysical measure that has also been developed as a clinical test [20-21]. This measure of brainstem integrity is obtained by comparing the ability to detect a signal in the presence of noise that is either in phase or out of phase at the two ears. Without an intact binaural comparison system (which is located at the level of the brainstem), the two conditions are functionally equivalent, but with an intact system, threshold differences >12 dB are typically observed for lowfrequency pure tones.

Binaural thresholds for a 500 Hz pure tone presented either in phase or out of phase between the two ears were determined in the presence of a binaural masking noise presented in phase. Several different signal-to-noise ratios (SNRs) were tested for the signal in phase with noise (N0S0), the signal out of phase with noise (N0Sp), and the noise with no tone present (catch trial). The subjects were instructed to listen for the beeps in the presence of the noise and say "yes" if they heard the beeps and "no" if they did not hear the beeps. This test does not contain practice items, but the test was paused if the subject needed additional time to respond. The MLD is the difference in decibel SNR for signal thresholds for the inphase and out-of-phase conditions.

Dichotic Listening: Dichotic Digits

Because of potentially compromised axonal and synaptic structures and diminished neural conduction, higher-level tasks such as dichotic listening may be affected in individuals exposed to high-explosive blasts. The Dichotic Digits (DD) test assesses dichotic listening ability using number identification with dichotic presentation of the stimuli [22]. The test is sensitive to lesions in the primary (left) cortex and in the corpus callosum. Musiek et al. found lateral effects when using this test, mostly in the leftears of subjects with brain pathology [14]. This test has good sensitivity to central auditory nervous system pathology, is relatively resistant to mildto- moderate high frequency cochlear hearing loss, and has high test-retest reliability [14].

Following the procedures outlined by Musiek, two digits were presented to one ear and two digits were presented to the other ear [22]. The test began with a practice that contained three test items. The subject was instructed to repeat back all digits, and order was not scored. The test contained 20 test items of four digits in each, and the individual digits were marked as a miss if the subject gave an incorrect response or failed to respond. Subjects were encouraged to guess rather than not respond at all.

Dichotic Listening: Staggered Spondaic Words

The Staggered Spondaic Words (SSW) test examines the ability to segregate and interpret competing speech presented to the two ears [23]. It is thought to be sensitive to lesions of the corpus callosum and cortex [24]. Deficits on the SSW test, including diminished left-ear responses, would suggest interhemispheric transfer

deficits at the level of the corpus callosum. This test is useful in this patient population as it is resistant to the effects of peripheral hearing impairment [25] and has evidence of strong reliability and validity [26].
The SSW test consists of 40 pairs of "spondaic words," and each spondaic word ("spondee") contains two syllables spoken with equal emphasis on both syllables. Furthermore, each syllable of the spondee contains a complete word, an example of which is the spondee "hotdog." On each of the 40 trials, one spondee is presented to the leftear and one is presented to the right ear in such a way that the second syllable of the first spondee presented to one ear overlaps in time with the first syllable of the second spondee presented to the other ear [23]. Scoring is based on the identification of the parts of the words presented in isolation and in competition, as well as the total number of errors. Each SSW item is made up of two spondaic words that are presented in a way that creates four test conditions: (1) right noncompeting syllables, (2) right competing syllables, (3) leftcompeting syllables, and (4) leftnoncompeting syllables. Four practice items are presented prior to beginning the test. The test began with the first spondee presented to the right ear and the second spondee presented to the leftear. Subsequent items rotated between right ear spondee first and leftear spondee first throughout the 40 test items. Subjects were instructed to repeat back the words in the exact order they heard them presented. To score this test, we marked any incorrect words in the four test conditions as a miss and added up by test condition. In addition, if a subject repeated all of the words but in an incorrect order, the test item was marked as a reversal but the individual words were considered correct in the final count per test condition. The subject was allowed to take as much time as needed to respond to each item. Scores consisted of total errors as well as number of errors for each competing and noncompeting condition.

Evoked Potential Tests of Central Auditory Function

Both testing sites used the same equipment and the same protocols that, once established, were loaded at both sites so that the protocol settings would be exactly matched to minimize errors. Verification of the equipment was accomplished by site visits of NCRAR audiologists to the WRAMC group. This enabled two individuals to be tested at both sites, further confirming the equivalence of measurement in the two locations. The EP testing took approximately 2 hours, including setup time.

Auditory Brainstem Response

The ABR has been used to help estimate the integrity of cochlear structures and central auditory pathways from the auditory nerve to the superior olivary complex. The ABR is characterized by five or six peaks in the response waveform that occur at particular times after sound presentation. Both latency and amplitude of the peaks and relationships among the peaks are important measures of brainstem function.
The ABR was elicited using 100 μs clicks with rarefaction phase presented through ER-3A (300) insert earphones at 80 dB normal HL at a rate of 17 clicks per second for each ear independently (Etymotic Research, Inc; Elk Grove Village, Illinois). Using a Cadwell Sierra Wave EP system (Kennewick, Washington), ABRs were recorded from scalp electrode Cz (top of head) referenced to contralateral and ipsilateral mastoid electrodes, with the ground electrode placed at Fpz (forehead). Electrode placements were measured according to the International 10-20 system [27]; impedances were maintained at <5 k (at 30 Hz); impedance differences were £2 k. At least 2,000 accepted trials for each run were averaged and then repeated. If needed, a third waveform was collected to ensure repeatability. The filter settings were 100 and 3,000 Hz. ABR waveforms were averaged and analyzed by selecting visible waves I through V. The following components of the ABR were recorded, measured, and analyzed: (1) absolute latencies of one or more of the five constituent waves, (2) interpeak latencies, (3) interaural latency differences for all peaks, (4) absolute amplitudes of all visible waves, and (5) wave V/I amplitude ratios.

Long Latency Responses

In general, an averaged LLR wave is composed of contributions from multiple structures and can reflect attention, cognitive, discriminative, and integrative functions of the brain. Putative neural generators for auditory LLRs include thalamic projections to the auditory cortex, primary auditory cortex, supratemporal plane,

temporalparietal association cortex, frontal cortex, reticulothalamus, and medial septal area. LLRs consist of a series of positive and negative peaks that occur from 70 to 500 ms after onset of the stimulus. For this study, the following major peaks and troughs of the LLR were measured and evaluated: in order of latency, these components are labeled N100 (N1), P160/200 (P2), N200 (N2), and P300 (P3). The first three LLR peaks are primarily exogenous: they are affected strongly by characteristics of the auditory stimuli. In contrast, the event-related P300 is an endogenous potential that is related to cognition, attention, auditory discrimination, memory, and semantic expectancy.

The four-channel Cadwell Sierra Wave EP system was used to record LLRs from gold-cup or silver-silver chloride surface electrodes affixed to the subject's head at Cz (top of head), C3 (leftside of head, approximately midway between ear and top of head), and C4 (right side of head, approximately midway between ear and top of head). A reference electrode was placed on the subject's nose. An electrode placed at Fpz (forehead) served as the common (ground) for all preamplifiers. Eye-blink (electrooculographic or myographic) activity was monitored using the fourth channel, with an electrode located superiorly and inferiorly to the lefteye. Ocular artifacts greater than 60 μV were rejected automatically. The gain of each electroencephalography channel was 100,000. The low-frequency cutoffof the bandpass filter for all LLR recordings was 1 Hz; the high-frequency cutoffwas 30 Hz.

The LLR was elicited from each ear independently using an "oddball paradigm." During each averaging epoch, the "frequent" (standard or common) signal, a 500 Hz tone, was presented 80 percent of the time at 75 dB sound pressure level (SPL). A 1,000 Hz "oddball" (deviant or rare) signal was presented at pseudorandom intervals 20 percent of the time at 75 dB SPL. Subjects were asked to count the higher-pitched (1,000 Hz) tones silently to themselves. The rise time of tonal stimuli was 10 ms, the plateau 50 ms, and the fall time 10 ms, using a Blackman envelope. Each test run was terminated when 50 to 60 acceptable oddball responses had been averaged. The final LLR comprised an average of 2 repeatable runs for a total of at least 100 individual responses to the deviant signal. The latency and amplitude from baseline of N100, P160/P200, N200, and P300 waves were analyzed.

RESULTS

Participants

Of the 55 blast-exposed patients who were consented at the Army Audiology and Speech Center at WRAMC, 36 completed all of the behavioral testing and 19 completed all of the electrophysiological testing. The lesser number of participants in the electrophysiological testing was due to persistent equipment failures (that resulted in a complete loss of data) rather than fatigue or discomfort. All but two of the patients who completed the electrophysiology testing also completed the behavioral testing. Each of the blast-exposed patients had been examined by the WRAMC TBI team, and 17 were diagnosed as having no TBI, while 19 were diagnosed with mTBI. The members of the blast-exposed group who completed the behavioral testing comprised a group that had an age range of 20 to 54 (mean of 32.8 years) and 32 males and 4 females.

Twenty-nine control subjects who had not been exposed to a blast were recruited and tested at the NCRAR. All control subjects completed both the behavioral and electrophysiological test batteries. The age range of the control group was from 19 to 54 (mean of 32.1 years) and consisted of 26 males and 3 females.

Subject Interview

All but five of those blast-exposed patients who completed the behavioral testing also completed the medical history survey. Of the patients who completed the survey, 41.9 percent (13/31) reported having been exposed to more than 1 blast and 29 percent (9/31) reported being exposed to more than 10 blasts. Fifty-five percent (17/31) had serious bodily injuries as a direct result of the blast, suggesting that they were in close proximity to the blast, which is consistent with the reports that those patients gave of their blast exposure. Because the experience was too recent for an official diagnosis to be made, it was not possible to determine which of the blast-exposed participants had posttraumatic stress disorder (PTSD). Nonetheless, 13 of the 31 blast-exposed

patients who completed the medical history interview answered that they had PTSD.

Two of the questions concerned whether or not participants had experienced any hearing changes following blast exposure. While only 39 percent (12/31) of those surveyed reported greater difficulties hearing in quiet after their exposure, 78 percent (25/32) reported greater difficulties hearing speech in noisy environments.

Audiometric Evaluations

Each subject completed a full audiometric evaluation. Figure 1 shows the mean pure-tone air-conduction thresholds for the two groups of subjects. All subjects had acoustic reflex thresholds, acoustic reflex decay test results, tympanograms, and DPOAEs within normal limits (at least 6 dB above the noise floor). A repeated-measures analysis of variance was carried out on the audiometric thresholds (in decibels HL) with frequency (0.5, 1.0, 2.0, 4.0, and 8.0 kHz) and ear (left, right) as within-subjects factors and group membership (blast-exposed vs control) as a between-subjects factor. Greenhouse-Geisser corrections were applied to the analyses where indicated, in order to account for unequal variance across dependent variables. This resulted in noninteger degrees of freedom in some cases.

Test ear was not a significant factor ($F(1,63) = 2.81$, $p = 0.10$), but test frequency was significant ($F(2.27,252) = 14.08$, $p < 0.001$) as was group membership ($F(1,63) = 15.10$, $p < 0.001$). There was also a significant interaction between test frequency and group membership ($F(4,252) = 3.07$, $p = 0.04$). Examination of the mean audiometric data at each frequency revealed that the threshold differences across groups were usually in the range of 3 to 6 dB, although some were higher, with the largest differences occurring for 4.0 and 8.0 kHz in the leftear. Those differences were 12 and 13 dB, respectively. In all cases, the effect was consistently in the direction of greater impairment for the blast-exposed group. Although statistically significant, these small differences seldom exceeded the range of test-retest reliability for clinical audiograms and do not reach the level that is generally thought to account for differences between groups on the behavioral and electrophysiological tests used [20,24].

Table 1 shows the mean word recognition scores (WRSs) for the leftand right ears, as well as the SNR values for the QuickSIN measurements made with leftear stimulation, right-ear stimulation, and presentation of the identical QuickSIN stimuli to both ears. Three of the blast-exposed patients did not complete the WRS testing, and four did not complete the QuickSIN. To determine whether abnormal performance was statistically more likely in the blast-exposed group, we categorized individuals as performing "normally" or "abnormally" based on comparison of each score with a cutoffvalue calculated from the scores of the control group. Cutoffvalues, shown in Table 1, correspond to two standard deviations (SDs) above the mean of the control group.

Using the control data to determine the range of normal performance for a group of subjects with this age, hearing, and sex composition, we found that 12 percent (4/33) of the blast-exposed group and 10 percent (3/29) of the control group were "abnormal" on the WRS when tested at either the leftor right ear. This difference was not statistically different from a distribution that would have arisen by chance, on the basis of a nonparametric chi-square test ($c2 = 0.049$, $df = 1$, $p = 0.83$).

A similar analysis of the QuickSIN, however, found that 39 percent (12/31) of the blast-exposed patients performed abnormally on one or more of the measures, while only one control subject was outside the normal range. These rates of abnormal performance are significantly different from expected based on random variation ($c2 = 10.98$, $df = 1$, $p < 0.01$).

The lack of a significant difference on the WRS suggests that speech understanding per se was unaffected (as was the ability to undergo basic auditory testing), whereas the significant difference on the QuickSIN suggests that the ability to understand speech in complex auditory environments (in this case, multitalker babble) may be impaired for at least some of the blast-exposed participants. Further light was shed on this difference between the groups by examining the results of the central auditory test battery.

Behavioral Central Auditory Processing Tests

Table 2 shows means, SDs, and ranges of performance on the five behavioral tests by the blast-exposed and

control subjects. Abnormal performance was determined by comparing each subject's score to a cutoffdefined as plus (or minus, where appropriate) two SDs from the mean of the control group. Figure 2(a) displays the percentage of subjects within each group who performed abnormally on one or more of the subtests listed in Table 2. Nonparametric chi-square tests were used to determine whether or not the proportion of the blastexposed group performing outside the normal range was statistically different from the proportion of control subjects performing outside the normal range.

Performance on Frequency Patterns

Table 2 shows mean accuracy, SD, and range of performance for both test groups on the FP test, for the leftand right ears. For the right ear, the mean accuracy for the control subjects was 93.10 ±14.14 percent and mean accuracy for the blast-exposed group was 85.18 ±20.89 percent. For the leftear, the mean accuracy for the control subjects was 93.67 ±11.21 percent and mean accuracy for the blast-exposed group was 84.35 ±23.54 percent. The difference between these means was not significantly different for either ear ($p > 0.05$). Using a cutoffof 71 percent for the left-ear test and 65 percent for the right-ear test, 19 percent (7/36) of the blastexposed patients and 7 percent (2/29) of the control subjects exhibited abnormal performance when tested at either the right or leftear. This difference was not statistically significant ($c2 = 2.12$, $df = 1$, $p = 0.15$).

Performance on Gaps-In-Noise

Table 2 shows approximate gap thresholds estimated from performance on the GIN test, for the leftand right ears. For the right-ear test, mean threshold for the control group was 3.79 ±1.29 ms and mean threshold for the blast-exposed group was 6.03 ±3.20 ms, which was a statistically significant difference ($F(1,64) = 12.39$, $p = 0.001$). A cutoffof 6 ms indicated that 31 percent (11/36) of the blast-exposed participants had approximate gap thresholds in the abnormal range, and none of the control subjects performed abnormally ($c2 = 10.66$, $df = 1$, $p = 0.001$). For the leftear, mean threshold for the control group was 4.28 ±2.10 ms and mean threshold for the blast-exposed group was 6.44 ±3.12 ms, which was a statistically significant difference ($F(1,64) = 10.33$, $p < 0.01$). A cutoffof 8 ms indicated that 22 percent (8/36) of the blast-exposed participants had approximate gap thresholds in the abnormal range, and one of the control subjects performed abnormally ($c2 = 4.75$, $df = 1$, $p < 0.05$). Figure 3(a) shows that 39 percent (14/36) of the blastexposed group had abnormal performance on the GIN test for either ear, as compared with 3 percent for the control group (1/29). The difference was statistically significant ($c2 = 11.37$, $df = 1$, $p < 0.01$).

Performance on Masking Level Differences

Average data for the MLD test are shown in Table 2. The average MLD for the control group was 13.59 ±2.80 dB, and the average MLD for the blast-exposed group was 13.28 ±3.74 dB. This difference was not statistically significant ($F(1,64) = 0.136$, $p = 0.71$). The N0Sp condition, which is the SNR needed to detect a signal presented with a 180° phase reversal between the two ears, had an average threshold for the control subjects of - 24.83 ±2.70 dB and an average threshold for the blastexposed group of -23.00 ±3.66 dB. This difference was statistically significant ($F(1,64) = 5.03$, $p < 0.05$). The N0S0 condition, which is the SNR needed to detect a signal presented diotically (no binaural differences), had an average threshold for the control subjects of -11.24 ±2.36 dB and an average threshold for the blast-exposed subjects of -9.72 ±3.54 dB. This difference was also statistically significant ($F(1,64) = 3.97$, $p = 0.05$).

Based on the SDs, cutoffvalues were set at 8 dB for the MLD, -7 dB for N0S0, and -19 dB for N0Sp. None of the control subjects had thresholds outside the normal range on either of the component measures, while 17 percent (6/36) of the blast-exposed were abnormal on N0S0 ($c2 = 5.33$, $df = 1$, $p < 0.05$) and 11 percent (4/36) were abnormal on N0Sp ($c2 = 3.43$, $df = 1$, $p = 0.06$). For the MLD, 20 percent (7/36) of the blast-exposed subjects had MLD values of £8 dB, while only 3 percent (1/29) of the control subjects had MLDs in the abnormal range ($c2 = 3.81$, $df = 1$, $p = 0.05$). Considering both the component subtests and the MLD score, 33 percent (12/36) of the blast-exposed were abnormal on one or more of the measures, while only 3 percent (1/29) of the control subjects had one or more scores in the abnormal range ($c2 = 8.97$, $df = 1$, $p = 0.003$).

Performance on Dichotic Digits

Performance on the DD test was well within the normal range for nearly all of the subjects and at or near perfect performance for many. As shown in Table 2, for the right ear, the mean accuracy for the control subjects was 97.67 ±3.47 percent and mean accuracy for the blastexposed group was 96.60 ±3.97 percent. For the leftear, the mean accuracy for the control subjects was 94.31 ±5.97 percent and mean accuracy for the blast-exposed group was 94.24 ±5.17 percent. These differences were not statistically significant ($p > 0.25$). Using a cutoffof 91 percent for the right ear and 82 percent for the leftear, 11 percent (4/36) of the experimental subjects performed abnormally for either the right or leftear, as opposed to 14 percent (4/29) of control subjects. This difference was not statistically significant ($c2 = 0.11$, $df = 1$, $p = 0.74$).

Performance on Staggered Spondaic Words

Table 2 shows that the mean number of total errors for the control group on the SSW was 4.14 ±3.03, while the mean for the blast-exposed group was 10.44 ±6.52. This difference was statistically significant ($F(1,64) = 23.05$, $p < 0.001$). The cutoffvalue for normal performance was 10 errors, based on mean and SD of the control group. Only 3 percent (1/29) of the control subjects had 310 errors, while 36 percent (13/36) of the blastexposed subjects had between 10 and 29 total errors. In the leftcompeting condition, 31 percent (11/36) of the blast-exposed subjects performed abnormally (38 errors) compared with 3 percent (1/29) of the control subjects. In the right competing condition, 39 percent (14/36) of the blast-exposed subjects performed abnormally compared with 0 percent (0/29) of the control subjects. Overall, 3 percent (1/29) of the control subjects and 44 percent (16/36) of the blast-exposed subjects performed abnormally on one or more of the subtests of the SSW. This difference was statistically significant different ($c2 = 13.98$, $df = 1$, $p < 0.001$).

Total Number of Tests in Abnormal Range

Figure 2(b) shows the proportion of subjects in each group who produced abnormal performance on any of the five behavioral tests. Of the blast-exposed subjects, 75 percent (27/36) had abnormal performance on at least one test, as opposed to only 24 percent (7/29) of the control subjects. Of the 36 blast-exposed subjects, 17 (44%) showed abnormal performance on two or more of the behavioral tests, while 3 of 29 (10%) control subjects were abnormal on two or more tests and only one was abnormal on three tests. No subject had abnormal performance on all five behavioral tests. There was a statistically significant difference between groups in terms of the number of abnormal test results ($c2 = 17.50$, $df = 4$, $p = 0.002$).

Evoked Potentials

EP measurements were carried out on 19 blastexposed subjects and 29 control subjects. Two repeatable ABR and LLR recordings were collected and averaged for each subject. Traces were analyzed independently by three audiologists, using the software provided with the Cadwell Sierra Wave equipment. Disagreements concerning the peak locations within a trace were reconciled either by agreement of two of the three audiologists or by consultation with a highly experienced EP researcher (R. L. Folmer). In the final analysis, two blast-exposed subjects were excluded from the ABR and LLR results and one control subject was excluded from the ABR results because of unacceptable levels of artifact during the EP recording, which made the waveforms indistinguishable. All traces were baseline corrected. As the equipment was not designed for audiological testing, ABR latencies also needed to be corrected to account for the length of the insert earphone tubes used in order to correspond to standard clinical latencies (a shiftof ~0.9 ms).

Average peak latencies and amplitudes for the ABR are shown in Table 3 for the blast-exposed and control groups. Peak-to-peak amplitudes were calculated as the amplitude difference between the highest peak and the following valley. If either peak or valley for waves I, III, and V were indistinguishable, values from that wave were excluded from the calculations in Table 3, as indicated by the variable numbers of subjects included in each average (n). Consistent with previous reports in the EP literature, amplitude data were more variable than latencies.

Grand averaged waveforms for the ABR measurements are shown in Figure 3 for both right and leftears as

either ipsilateral or contralateral to the stimulus ear. Figure 3(a) includes the average of the control subjects (n = 29), while Figure 3(b) displays waveforms from the blastexposed subjects (n = 19). These waveforms and the values in Table 3 were quite similar between blast-exposed and control groups, and the average peak latencies and amplitudes did not differ significantly between groups.

In contrast to the ABR waveforms, the later auditory components demonstrated different results for the two groups. The grand averaged waveforms shown in Figure 4 indicate responses to the right and to the leftear, for both the rare and the common stimuli. The mean data and SDs shown in Table 4 reflect the peak latencies and amplitudes in the grand average waveforms. Recall that baseline correction was applied to the amplitude to show the similarities between ears and the common and rare test conditions. Amplitude values are displayed in microvolts from baseline. A significant difference was seen between groups for the P300 latency in the right ear ($t(42) = 2.65$, $p = 0.01$). There was also a significant group difference for the P300 amplitude in the right ear ($t(42) = -2.26$, $p = 0.03$) and the N100 amplitude in the leftear ($t(38) = 2.21$, $p < 0.05$) for the rare stimulus condition.

Viewed as a whole, results from the EP testing indicate similar performance between the blast-exposed and control groups (as well as within groups) for the earlier components (ABR and N100), with significant differences emerging for later components (P300, particularly the right ear), reflecting higher processing stages in the auditory system and cognitive centers of the brain. These findings are consistent with Segalowitz et al. [28] and Alberti et al. [29], who also reported lower amplitudes and longer latencies for auditory P300 components in subjects with mTBI. Lew et al. also observed smaller amplitude and longer latency auditory P300s from patients with histories of severe brain injury compared with nondisabled control subjects [30]. When the individual values for the blast-exposed patients were compared with the range of expected values based on the control data, however, significantly abnormal latencies and/or amplitudes were not observed, based on the criterion of plus or minus two SDs from the mean.

DISCUSSION

Effects of Individual Factors: Number of Blast Exposures, mTBI, PTSD

Recall that some of the experimental subjects reported they had experienced multiple blast events, while others only reported one such event. Of the 31 subjects who were willing to respond to questions about their blast-exposure experience(s), 13 reported more than one blast exposure and 18 reported only one exposure. An analysis of the rate of abnormal performances comparing these two subgroups across all of the subtests examined, as well as the total number of abnormal test results, did not result in any significant differences. Similarly, a medically driven diagnosis of mTBI (by the WRAMC TBI team) was also examined as a potential additional factor beyond blast exposure and did not reveal any significant differences between the 19 subjects who were diagnosed with mTBI and the 17 who were not. If such a diagnosis can be assumed to indicate injury severity among the blast-exposed experimental subjects tested here, that diagnosis was not reflected in significant correlations with abnormal performance on these central auditory tests. The diagnosis of TBI also was not significantly correlated with age, pure-tone average (low frequency) (PTALF) thresholds at 0.5, 1.0, and 2.0 kHz, or with puretone average (high frequency) (PTAHF) thresholds at 1.0, 2.0, and 4.0 kHz. Nor was there a significant correlation between a diagnosis of mTBI and the number of tests on which performance was abnormal.

Those who completed the questionnaire and reported PTSD (13/31) were no more likely to perform abnormally on the GIN, MLD, DD, or FP tests ($p > 0.50$), nor was the total number of abnormal test results significantly associated with a report of PTSD. Performance on the SSW, on the other hand, was significantly associated with a report of PTSD, with 85 percent (11/13) of those reporting PTSD performing abnormally on at least one of the subtests compared with 22 percent (5/23) of those not reporting PTSD ($c2 = 13.30$, $df = 1$, $p < 0.001$). While the MLD and the N0Sp subtest of the MLD were not significantly related to a report of PTSD, the same was not true of the N0S0 subtest, on which 38 percent of those reporting PTSD (5/13) performed abnormally, but only 4

percent (1/23) of those not reporting PTSD performed outside the normal range ($c2 = 6.96$, $df = 1$, $p < 0.01$). Confirmation of the relationship between a report of PTSD and difficulties detecting signals in noise was revealed by the results of the QuickSIN test, on which 62 percent (8/13) of those reporting PTSD had SNR loss values in the abnormal range, as opposed to only 5 percent (1/19) of those who did not. Note that four participants did not complete the QuickSIN, none of whom reported PTSD.

Effects of Individual Factors Beyond Blast Exposure: Age and Hearing Loss

Although the incidence of hearing loss among people exposed to a high-explosive blast varies considerably (see Helfer et al. [31] for review), the most recent published estimate based on military medical records is about 52 percent with permanent sensorineural loss [32- 33]. In order to be eligible to participate, however, subjects in this study all had to have average PTALF thresholds at 0.5, 1.0, or 2.0, kHz of <50 dB HL. Indeed, those tested generally had only mild losses (except sometimes at 4.0 kHz). PTALF thresholds were 23.33 dB or better in both ears for all blast-exposed subjects, and WRS scores were 88 percent or better at the right ear and 80 percent or better at the leftear. The fact that we were able to identify subjects who had such minor documented hearing loss is perhaps remarkable given the noise levels from a blast, as well as other likely noise exposures associated with military service. It is not totally unexpected, however, given that earplugs are issued and may be worn in environments in which blasts are encountered. Other mitigating factors can include the type of helmet worn, the physical environment (reverberant vs open field), the type of explosive, and the orientation of the ear to the blast wave.

Correlations among the behavioral test results, age, and the average PTAHF thresholds at 1.0, 2.0, and 4.0 kHz were conducted on the combined subject pool (both control and blast-exposed) in order to examine the potential impacts of these factors on performance. Age and hearing loss (as measured by the PTAHF) were significantly correlated ($R(65) = 0.30$, $p = 0.01$). PTAHF was significantly negatively correlated with the MLD test ($R(65) = -0.276$, $p = 0.03$) and with the total number of errors on the SSW test ($R(65) = 0.398$, $p = 0.001$).

To examine other factors that might explain the relationships between PTSD and abnormal test performance, PTALF for the leftand right ears, PTAHF for the leftand right ears, WRS for the leftand right ears, and age were all compared for those participants exposed to blasts who did and did not report PTSD. Age was not significantly different between the groups ($F(1,35) = 0.622$, $p = 0.44$), nor was PTAHF for either ear (right ear: $F(1,35) = 1.29$, $p = 0.26$; leftear: $F(1,35) = 0.494$, $p = 0.49$). WRS was marginally significantly different for both ears, however, as was PTALF (right ear PTALF: $F(1,35) = 11.56$, $p < 0.01$; right ear WRS: $F(1,31) = 4.03$, $p = 0.05$; leftear PTALF: $F(1,35) = 6.47$, $p < 0.05$; leftear WRS: $F(1,35) = 4.01$, $p = 0.05$).

Correlations Among Behavioral Measures

Total number of errors on the SSW test was significantly correlated with average estimated threshold on the GIN test ($R(65) = 0.338$, $p = 0.006$) and negatively correlated with average performance on the FP test ($R(65) = -0.276$, $p = 0.03$). Performance on the FP test was negatively correlated with average estimated threshold on the GIN test ($R(65) = -0.391$, $p = 0.001$). No other score correlations were significant.

Correlations were also calculated for abnormal versus normal performance across the five behavioral tests. Abnormal performance on the GIN test was significantly correlated with abnormal performance on the SSW test ($R(65) = 0.29$, $p = 0.03$) and with abnormal performance on the FP test ($R(65) = 0.27$, $p = 0.04$). No other correlations reflecting abnormal performance between tests were significant. The generally low correlations among the central auditory processing tests confirm that these tests, selected specifically to try to test various levels of the auditory system, do reflect separate auditory functions.

Control Group Performance Compared with Established Norms

The behavioral tests used in this study were developed to assess central auditory processing abilities in a number of different groups of patients. The normative studies typically included fairly young nondisabled subjects from many different backgrounds. Etiologies considered in many of those studies included concussive head injuries incurred during sports activities and motor vehicle crashes. People with other brain

injuries/pathologies, such as strokes or tumors, have also been included as experimental groups in these studies. In contrast to the experimental group studied in this research, those subjects typically had known, localized regions of brain injury. The experimental subjects evaluated in this study did not have confirmed pathologies that could be identified, but had in common exposure to the debilitating effects of a high-explosive blast during their deployments in Iraq and/or Afghanistan. Their suspected brain injuries were evaluated functionally, using criteria such as length of unconsciousness. Some were wearing protective gear when they were exposed to a blast, and they would likely have received rapid, extensive, and capable posttraumatic care. The control group was included in this study because of possible differences in demographics between subjects who provided the published normative values and the experimental subjects studied here-in particular, hearing loss extent and configuration and age. By using age-, sex-, and hearing-loss matched control subjects, some potentially important differences between the groups, unrelated to blast-exposure history, were avoided. It should be noted that, because performance by the control group served as the "norm" against which performance of the experimental subjects was judged, a definition of a cutoffscore determined as the mean plus or minus two SDs would result in one or two control subjects identified as performing abnormally. However, the relevant comparison is how many of the experimental group performed outside the normative values established in this study. This was a more conservative comparison than if the published norms had been used. For all tests, the control group of subjects assessed here provided a more stringent requirement for labeling performance as abnormal.

Which Central Auditory Tests Were Most Likely to Reveal Abnormal Performance?

Figure 2(a) shows graphically which tests of central auditory function were most likely to reveal abnormal performance in subjects who had been exposed to a blast. The GIN test and the SSW both revealed substantial rates of abnormal performance relative to the age- and hearing- matched controls. These results suggest that one or both of these two tests could be useful in determining whether or not central auditory functions were impaired in a given blast-exposed patient. The MLD test also showed a significant rate of abnormal performance among the blast-exposed patients, especially when the component subtests are also considered. Finally, the QuickSIN, although not formally included in the central auditory test battery, appears to provide useful data for the clinician interested in identifying nonperipheral factors affecting hearing ability.

Although none of the tests of auditory EPs used in this study revealed significant rates of abnormal performance for the blast-exposed patients, there were several late potentials that revealed significant differences between the mean values associated with the two groups. Future work should examine whether or not it would be possible to develop stimuli that could be used to reveal abnormal values for an individual patient.

Do Results of Central Tests Point to Site of Lesion?

The tests used in this study were selected to assess at least two brain areas that are heavily involved in auditory processing of simple and complex sounds and that are likely to reflect damage to auditory structures and neural projections. The three tests that revealed the largest effects of blast exposure were the GIN test, the SSW test, and the MLD test. The first two have been shown to reflect damage to the cortex and corpus callosum, and the latter tests the function of the auditory brainstem. The significant correlation between blast exposure and abnormal performance on the SSW and GIN tests suggests that the cortex and corpus collosum may be involved when there is exposure to a high-intensity blast. Differences in the mean values for the late electrophysiological responses but not for the ABR also support the involvement of cortical rather than early brainstem structures. The patterns of abnormal performance revealed for the MLD and its component subtests suggest that later brainstem structures may be involved, but the data are too sparse to draw strong inferences. These data do suggest that it is at least possible, however, that blast exposure may affect either brainstem or cortical level function, with variability as to the degree to which each area is involved. As mentioned previously, it is also essential to remember that the configuration of damage is almost certain to vary among blast-exposed individuals based on the specific conditions of the exposure (or exposures).

Within the blast-exposed group, individuals who had been diagnosed with mTBI demonstrated very little difference on these tests from those without such a diagnosis. This finding indicates that impairments in central processing, whether due to auditory or other factors, should be suspected after blast exposure, even in the absence of a formal diagnosis of mTBI. In addition, subjects who had been exposed multiple times to a blast did not show significantly different performance from subjects who only reported one blast exposure. This result should be taken with a degree of skepticism, however, as number of blast events was not a major classification factor in this experiment. Further work on the effects of multiple versus single blast exposures is obviously an important target for future research. Finally, significant correlations were revealed between abnormal performance on central auditory tests and a report of PTSD. This potentially important relationship should be examined in a study specifically designed to examine PTSD as a factor in auditory function.

Are Blast-Exposed Individuals Likely to Have Central Auditory Processing Disorder?

While it is tempting to interpret the results of this study in terms of the clinical diagnosis of central auditory processing disorder, we would strongly advise against doing so. The purpose of the study was to determine whether patients who were recently exposed to highexplosive blasts showed evidence of central auditory dysfunction as determined from a battery of established central tests, and to a significant extent, they did. However, the patients tested were all hospitalized for major injuries to areas other than the brain. The potential importance of this fact should not be ignored, as it is associated with other factors that could have affected performance, most notably the possibility that the subjects were taking significant doses of medications for non-auditory-related injuries. Attempts to determine the extent of medications used by these subjects that might affect performance on auditory tests were largely unsuccessful.

Despite this note of caution, however, it is also the case that none of the experimental subjects performed poorly on all tests, suggesting that performance was not impaired on all behavioral testing, but rather on several specific measures. If performance was impaired by overall vigilance or memory deficits, then it would be expected that two tests sharing similar presentation methods and response characteristics would produce similar results. It is instructive to note, then, that the DD and SSW tests produced markedly different rates of abnormal performance despite quite similar task demands. Specifically, both required the participant to hear and repeat back four items, two of which were presented to each ear. The difference is that the DD uses digits, which are closed-set and practiced from an early age, while the SSW uses an open set of compound words that require the participant to switch from attending to one ear to dividing attention between ears, and then to switch to attending to the other ear. The data collected here are not sufficient to determine which of these factors was driving performance and how these factors relate to blast exposure. It is a strong indication, however, that the basic ability to perform an auditory task was not responsible for the high rate of abnormal performance among the blastexposed patients.

CONCLUSIONS

Performance on these central tests was not strongly correlated with a diagnosis of mTBI, suggesting that blast exposure is, of itself, a separate disordered state, not necessarily dependent on TBI. That is, the effects of a highexplosive blast on the central systems-in this case, the auditory system-may be quite different, and potentially more subtle, than the impaired functions of the brain observed in those with TBI. In light of the many complaints of auditory difficulties expressed to audiologists by Veterans who report an exposure to blasts during their deployments, it is critical to determine how central auditory function, and performance on tests such as those used here, is affected after some amount of healing time has passed for these individuals.

The blast-exposed individuals tested here were mostly young (mean age 32.8 yr) and, because of their status as warfighters, would be highly physically fit. Except for their injuries from war, these were very healthy individuals. Many of these servicemembers were exposed to more than one high-explosive blast during their tours of duty, and they often experienced other injuries, such as amputation, which for many was the immediate reason for their treatment at WRAMC. Individuals who had been diagnosed with mTBI, and therefore might be

considered more seriously impaired by the blast exposure, did not on the whole perform worse on these tests than those who were not diagnosed with TBI. Even without obvious significant brain involvement resulting from their blast exposure, the performance of these young warfighters on central auditory tests indicate that a substantial number of them might be suffering from disorders associated with central auditory processing. Because of the frequency of auditory complaints voiced by these individuals, it might be prudent to include one or more tests of central auditory function in their postdeployment screenings and perhaps also for all preseparation screenings for soldiers leaving military service.

Clinic time is valuable, and it is unlikely that several tests of central auditory processing could be included in routine audiometric evaluations. However, the results of this study indicate that performing the SSW, GIN, and/or MLD tests, either alone or in combination, can provide valuable insight into the likelihood of impairment to central auditory functions and may alert clinicians to the need for further assessments.

ACKNOWLEDGMENTS

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Administrative, technical, or material support: R. L. Folmer, S. A. Fausti, M. R. Leek.

Financial Disclosures: The authors have declared that no competing interests exist.

Funding/Support: This material was based on work supported by the VA Rehabilitation Research and Development Service (Merit Review awards B5067R [PIs: Leek, Fausti] and C7755I [PIs: Gallun, Leek]), a Senior Research Career Scientist award (grant C4042L [PI: Leek]), VA Career Development II awards (grants C4963W [PI: Gallun] and C7067W [PI: Lewis]), and the VA Rehabilitation Research and Development NCRAR (Center of Excellence award C4844C).

Institutional Review: The study was approved by Institutional Review Boards at the Portland VA Medical Center and the (former) WRAMC.

Participant Follow-Up: The authors do not plan to notify study subjects of the publication of this article because of lack of contact information.

Additional Contributions: We particularly express our gratitude and admiration to the warfighters who participated in this research at the (former) WRAMC. Drs. Frank Musiek and Richard Wilson generously provided essential testing materials. Dr. David Lilly contributed to the design of the study.

Disclaimer: The opinions and assertions presented are private views of the authors and are not to be construed as official or as necessarily reflecting the views of the VA or the Department of Defense.

Sidebar

Submitted for publication March 6, 2012. Accepted in revised form June 5, 2012.

This article and any supplemental material should be cited as follows: Gallun FJ, Diedesch AC, Kubli LR, Walden TC, Folmer RL,

Lewis MS, McDermott DJ, Fausti SA, Leek MR. Performance on tests of central auditory processing by individuals exposed to high-intensity blasts. J Rehabil Res Dev. 2012;49(7):1005-24.

http://dx.doi.org/10.1682/JRRD.2012.03.0038

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http://dx.doi.org/10.1682/JRRD.2012.03.0038

Publication date: 2012

Year: 2012

Blast exposure and dual sensory impairment: An evidence review and integrated rehabilitation approach

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Publication info: Journal of Rehabilitation Research and Development 49.7 (2012): 1043-58.
ProQuest document link

Abstract: Combat exposures to blast can result in both peripheral damage to the ears and eyes and central damage to the auditory and visual processing areas in the brain. The functional effects of the latter include visual, auditory, and cognitive processing difficulties that manifest as deficits in attention, memory, and problem solving-symptoms similar to those seen in individuals with visual and auditory processing disorders. Coexisting damage to the auditory and visual system is referred to as dual sensory impairment (DSI). The number of Operation Iraqi Freedom/Operation Enduring Freedom Veterans with DSI is vast; yet currently no established models or guidelines exist for assessment, rehabilitation, or service-delivery practice. In this article, we review the current state of knowledge regarding blast exposure and DSI and outline the many unknowns in this area. Further, we propose a model for clinical assessment and rehabilitation of blast-related DSI that includes development of a coordinated team-based approach to target activity limitations and participation restrictions in order to enhance reintegration, recovery, and quality of life. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract-Combat exposures to blast can result in both peripheral damage to the ears and eyes and central damage to the auditory and visual processing areas in the brain. The functional effects of the latter include visual, auditory, and cognitive processing difficulties that manifest as deficits in attention, memory, and problem solving-symptoms similar to those seen in individuals with visual and auditory processing disorders. Coexisting damage to the auditory and visual system is referred to as dual sensory impairment (DSI). The number of Operation Iraqi Freedom/Operation Enduring Freedom Veterans with DSI is vast; yet currently no established models or guidelines exist for assessment, rehabilitation, or service-delivery practice. In this article, we review the current state of knowledge regarding blast exposure and DSI and outline the many unknowns in this area. Further, we propose a model for clinical assessment and rehabilitation of blast-related DSI that includes development of a coordinated team-based approach to target activity limitations and participation restrictions in order to enhance reintegration, recovery, and quality of life.

Key words: auditory training, blast exposure, blast injury, central auditory processing disorder, dual sensory impairment, rehabilitation, traumatic brain injury, veteran, visual processing disorder, visual training

Abbreviations: AV = audiovisual, CI = confidence interval, DSI = dual sensory impairment, ERP = event-related potential, FM = frequency modulation, HI = hearing impairment, HL = hearing level, NSI = no sensory impairment, OIF/OEF = Operation Iraqi Freedom/Operation Enduring Freedom, PTSD = posttraumatic stress disorder, TBI = traumatic brain injury, VA = Department of Veterans Affairs, VHA = Veterans Health

Administration, VI = visual impairment, WHO-DAS II = World Health Organization Disability Assessment Schedule II.

INTRODUCTION

Rehabilitation research on dual sensory impairment (DSI) is fairly sparse and has primarily focused on deaf-blind individuals [1] or aging individuals with gradual onset peripheral hearing loss and vision loss (see Saunders and Echt [2]). Little or no research has been conducted to examine the effect of, and rehabilitation for, DSI associated with military operations. Combat exposures can result in both peripheral damage to end organs (ears and eyes) and in central damage to the auditory and visual processing areas in the brain. Hearing protection, eye protection, Kevlar helmets, and body armor have considerably decreased the occurrence of peripheral injuries [3]; however, a current major concern is damage to the central auditory and visual systems resulting from blast exposure [4-5], which can cause sensory processing deficits that broadly manifest as difficulties understanding speech and difficulties reading [6-7]. More specifically, auditory complaints include difficulty listening in the presence of background noise, following oral instructions, and understanding rapid or degraded speech [8]. Visual complaints pertinent to reading include difficulties with blur, text navigation and search, fluency and reading speed, sustained reading, and reading comprehension [9]. In many cases, individuals with these auditory and visual difficulties have clinically normal or almost normal hearing and visual acuity [10].

Vast numbers of servicemembers have returned from Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) with blast-related injuries [11], such that blast-related mild traumatic brain injury (TBI) has been referred to as the "signature wound" of the current conflicts [12]. There are four different mechanisms through which blast injuries arise: primary, secondary, tertiary, and quaternary. Primary blast injuries are caused by the over- and underpressurization of air generated by the blast itself; secondary injuries are caused by flying debris; tertiary injuries result from the body being thrown by the blast wave; and quaternary injuries are associated with factors such as inhalation of toxic fumes, burns, and crush injuries [13]. Although the brain is vulnerable to primary, secondary, and tertiary injuries, for the purpose of this review we are interested in the damage from primary injuries, which, as shown by magnetic resonance imaging, cause diffuse axonal injury, contusions, and subdural hemorrhage [14]. Diffuse axonal injury results when axons are sheared or stretched, contusions occur when the brain moves within the skull to cause bruising of the brain parenchyma, and subdural hemorrhage occurs when the movement of the brain in the skull is sufficient to tear the surface veins. Diffuse axonal injury is seen most commonly in the corticomedullary junction, the internal capsule, and the upper brain stem and corpus callosum. Contusions are most common in the inferior, lateral, and anterior frontal and temporal lobes, and hemorrhaging is seen in the frontal and parietal convexities [14]. The functional effects of these blast effects include visual, auditory, and cognitive processing difficulties that manifest as deficits in attention, memory, and problem solving-symptoms similar to those seen in individuals with visual and auditory processing disorders [15].

In this article, we review the current state of knowledge regarding blast exposure and DSI and also outline the many unknowns regarding assessment, rehabilitation, and clinical service models for addressing blast-related DSI.

METHODS

We conducted a literature review of published peer-reviewed empirical studies and reviews using "vision" or "visual" and/or "hearing" or "auditory," "sensory," and "dual sensory" as primary search terms, coupled with "loss," "impairment," "dysfunction," "processing disorder," "training," "rehabilitation," "traumatic brain injury," "blast," "blast exposure," and "blast injury" as search terms in PsychInfo, Medline, Cochrane Database of Systematic Reviews, and Google Scholar. We focused identified selections to the objective of describing what is known about blast exposure and DSI, as well as identifying gaps in knowledge, to provide a synthesized content review of (1) the effects of blast exposure on the auditory and visual systems; (2) the prevalence and effects of

DSI; and (3) the implications for definition, assessment, and rehabilitation practice.

RESULTS AND DISCUSSION

Damage to Auditory System

Unlike the typical sensorineural hearing loss that comes about from long-term exposure to high-intensity noise, blasts cause conductive, mixed, and sensorineural hearing losses arising from the sudden and vast change in air pressure [4,16]. Specifically, blasts can rupture the tympanic membrane, damage the ossicular chain, tear inner and outer hair cells away from the support cells, and rupture the reticular laminar in the cochlea [17]. These injuries and their associated effects on hearing and communication are relatively well understood, and routine rehabilitation, such as surgery for ossicular damage and provision of amplification for sensorineural hearing loss, can be offered. While amplification is far from being a perfect solution to cochlear damage, at least the shortcomings and benefits of hearing aids and other assistive devices are recognized.

Of greater concern, perhaps, are the many OIF/OEF Veterans reporting hearing difficulties in the absence of conventionally defined hearing loss. The number of individuals with these complaints is unknown; however, studies suggest the numbers are substantial. In 2007, Lew et al. noted that 26 of 42 individuals with a blast-related TBI reported hearing difficulties but that 11 percent of the 26 had normal pure-tone sensitivity [18]. More recent data suggest the numbers may be considerably higher [19]. Specifically, it was determined that 65.9 percent of 12,521 Veterans judged to have deployment-related TBI and who reported being exposed to blast complained of auditory difficulties. Although the audiometric status of these individuals was not stated, we can estimate from other studies that between 35 and 54 percent had permanent sensorineural hearing loss [17-18,20] and a further 7 percent had ruptured tympanic membranes [3], suggesting that about 20 percent of those reporting hearing difficulties had normal or almost-normal audiometric thresholds. Saunders and Abrams suggested that clinicians note an equally high number of Veterans who perceive hearing difficulties and yet have normal or almost normal auditory acuity [21]. Saunders and Abrams conducted a survey of Department of Veterans Affairs (VA) audiologists to determine how often they encounter OIF/OEF Veterans who complain of difficulties hearing and yet have normal or almost-normal pure-tone sensitivity. Of the VA audiologists, 92 percent reported encountering at least one such individual per month in their clinic, with 53 percent encountering between one and three per month and 39 percent encountering four or more per month.

Recent data from a study comparing blast-exposed servicemembers with a control group of non-blast-exposed Veterans matched on age, sex, and degree of hearing impairment (HI) on a variety of auditory measures suggest that these reports of hearing difficulties in the presence of normal or near-normal hearing sensitivity are a result of damage to the central auditory system [22]. Specifically, the blast-exposed servicemembers performed more poorly than the controls on three measures of central auditory function: the Staggered Spondaic Word Test, the Gaps-in-Noise test, and masking level differences. They also found reduced P300 amplitudes and increased P300 latencies to an infrequently presented (20% of trials) 1,000 Hz target tone in an "oddball" paradigm among the blast-exposed servicemembers, whereas auditory brainstem responses and earlier components of the wave form (e.g., N100 peak and N1-P2 peak-to-trough values) did not differ between the groups. This reflects normal function between the auditory nerve and brainstem but some degree of deficit for the attention-driven P300 wave. Indeed, each of the measures differentiating the blast-exposed servicemembers from the non-blast-exposed controls likely reflects lesions in central cortical areas of the brain, many of which are associated with temporal processing. Gallun et al. hypothesized that damage to the fragile neural connections is associated with pressure differentials occurring in the brain as the blast wave passes through [22]. Similar findings of temporal processing deficits among individuals with non-blast-related TBI have been reported. Specifically, Bamiou et al. compared the auditory processing abilities of eight insular stoke patients with eight neurologically normal controls [23]. Each of the stroke patients showed deficits in temporal resolution and sequencing, while the controls performed at normal levels. Likewise, Griffiths et al. reported that following stroke, a patient reported he could no longer recognize familiar tunes unless they comprised long,

slow notes [24]. Psychophysical testing revealed that the patient performed more poorly than nondisabled controls when the tones were played rapidly but that he performed similarly to the controls when the presentation rate was slow. Similarly, the patient was unable to conduct a binaural sound movement task. On the other hand, the patient's performance did not differ from that of controls on tests of pure-tone sensitivity and frequency modulation (FM) detection. Data from other non-Veterans with TBI show auditory deficits on other behavioral auditory tests. Paré et al. showed patients with mild TBI to have auditory working memory deficits as demonstrated by poorer digit span performance than nondisabled controls immediately after their injury and at 3-month follow-up [25]. Kwok et al. reported that patients with a mild TBI performed more poorly than nondisabled controls immediately after injury and at 1-month follow-up on neuropsychological tests that included measures of both auditory and visual information processing (i.e., divided attention assessed with the Symbol Digit Modalities Test, sustained attention assessed with the Digit Vigilance Test, verbal recognition assessed with the Chinese Auditory Verbal Learning Test, and verbal fluency assessed with the Verbal Fluency Test) [26]. These individuals also had poorer sustained attention immediately after injury and at 1- and 3-month follow-ups.

Like Gallun et al. [22], other studies have revealed electrophysiological abnormalities accompanying TBI among Veterans [27] and non-Veterans alike [28-29]. More specifically, Lew et al. found that patients with TBI had significantly lower P300 amplitude and longer P300 latencies for auditory event-related potentials (ERPs) than non-TBI controls [27], and Segalowitz et al. found university students with mild TBI to have lower P300 amplitudes and latencies on oddball vigilance task ERPs [28], while Gaetz and Weinberg reported that patients with persistent postconcussive syndrome had delayed P300 to both visual and auditory stimuli [29].

Damage to Visual System

A substantial percentage of OIF/OEF servicemembers exposed to blast that did not sustain overt ocular trauma self-report visual difficulties despite good eye health and visual acuity [5,7,30-31]. Akin to the effects of blast exposure on the auditory system, the visual pathways, cranial nerves, and other neurologic substrates responsible for visual function may also sustain damage consequent to blast [7,9,14]. Visual abnormalities detected in servicemembers with closed-head primary blast-injury most commonly include photosensitivity, oculomotor (i.e., version, vergence, accommodation) dysfunctions, and visual field losses [7,9]. Additional deficits, perhaps more subtle in their presentation, have been documented and include decrements in spatial contrast sensitivity, color discrimination [7], reduced speed and accuracy of scanning [32], spatial perceptual deficits [9], and impaired visual processing speed and attention [33]. The potential effects of blast-related TBI on vision are multiple, consistent with the diffuse injury affected across visual system structures, and variable across individuals and blast-exposures [34].

The deficits in visual function described may adversely affect performance of activities of daily living such as mobility and reading, which in turn limit engagement in education, vocation, and leisure. Slowed visual processing and reaction times, visual field losses, visual-spatial perceptual and attention deficits, particularly in visually complex environments, may challenge safe ambulation (e.g., bumping into objects and/or people) and driving [33,35]. Reports indicate the most prevalent visual complaint of blast-injured Veterans is difficulty reading [36-37], particularly reading continuous text [7]. Difficulties that challenge reading ability include blurred vision, double vision, visual discomfort or fatigue, skipping words or lines of text, reduced reading speed, inefficient search for critical information, difficulty with sustained reading, and deficient reading comprehension [34,36]. In a sample of 125 Polytrauma Network Site outpatient Veterans, 63 percent reported difficulty with reading [36]. Stelmack et al. indicated that a reading problem was identified during the eye examinations of 18 out of 36 TBI clinic Veteran patients; however, average visual acuity was equivalent to 20/20 [37].

The centrality of visual acuity to definitions of visual function and visual impairment (VI) may limit the routine clinical detection of visual deficits in blast-exposed patients with normal or near-normal visual acuities [38-39]. As part of a recent national survey of approximately 440 VA optometrists, we sought to determine how often

these eye clinic providers encounter OIF/OEF Veterans who present with visual difficulties but who demonstrate normal or almost-normal visual acuities. The majority of the respondents reported encountering such patients on a monthly basis. Of VA optometrists, 83 percent reported seeing at least one or more such patients per month in their clinic, with 63 percent seeing one to three per month and 20 percent seeing more than four each month. The extent to which Veterans' visual difficulties consequent to blast-exposure are under-reported or unrecognized is not known [7].

Singly or in combination, the visual efficiency and visual processing deficits described adversely affect safety, independence, work, education, and quality of life. Importantly, visual deficits and dysfunctions do not exist in isolation, but coexist alongside a number of frequently associated comorbidities (e.g., posttraumatic stress disorder [PTSD], depression [37]) and injuries including cognitive effects. For instance, taken together, limitations in visual efficiency and visuocognitive information processing compound effects of blast on everyday function as is evident in mobility, reading, and reading comprehension difficulties [7,33-34,37]. Several reports, moreover, stress that unaddressed vision problems in this population may impede individual rehabilitation progress generally and particularly to the extent that aspects of rehabilitation are visually dependent [34,36].

Dual Sensory Impairment

Prevalence

Studies examining the prevalence of DSI in the general population estimate that between 7 and 21 percent of adults has some degree of DSI [40-43], with the varying prevalence depending on the population and age group investigated. We are aware of only one published study that estimates the prevalence of DSI among the Veteran population to be in the range of 5.0 to 7.4 percent [44]. Smith et al. reported the prevalence of DSI among individuals aged 44 to 64 years old to be 0 percent (confidence interval [CI]: 0%-3.6%), increasing to 26 percent (CI: 17.4%-34.6%) for individuals over 85 years old. This study was based on a retrospective chart review of 400 randomly selected charts of Veterans receiving healthcare at the Mountain Home VA Medical Center (Mountain Home, Tennessee) and likely reflects age-related HI and VI. The prevalence of DSI among blast-injured OIF/OEF Veterans is unknown, although a recent study has shed some light on the matter. Lew et al. conducted a retrospective chart review of 175 OIF/OEF Veterans with TBI who had been admitted to a Polytrauma Rehabilitation Center [45]. They documented four subgroups of patients based on the presence or absence of HI and VI: HI alone, VI alone, HI and VI (DSI), and no sensory impairment (NSI). HI was defined as being present if the patient had one or more thresholds of 26 dB hearing level (HL) or poorer at any octave frequencies between 250 Hz and 8 kHz. VI was defined based on acuity of worse than 20/63 in the better eye or with hemianopsia of ≤20°. Of the 175 charts reviewed, 62 patients had completed both hearing and vision evaluations from which the presence or absence of sensory impairments could be identified. Of these 62 patients, 12 (19%) had HI alone, 21 (34%) had VI alone, 9 (15%) had NSI, and 20 (32%) had DSI defined using the clinical metrics just described. Of particular interest, however, are those many individuals with blast-related injuries who report hearing and vision difficulties encountered by VA audiologists and optometrists and yet do not have measured impairment¡Xat least when conventional clinical assessment procedures are used. These numbers are unknown. Lew et al. determined that of 12,521 Veterans reporting blast exposure and judged to have TBI, 34.6 percent reported both auditory and visual difficulties and only 24.2 percent reported neither auditory nor visual difficulties [19]. Lew et al. reported that 11 percent of blast-exposed Veterans and 4 percent of non-blast-exposed Veterans reported hearing loss but had no measureable impairment [18], and Brahm et al. found that 75.9 percent of blast-exposed and 75.0 percent of non-blast-exposed Polytrauma Network Site outpatients with mild TBI reported visual complaints, but 98.2 and 100.0 percent, respectively, had visual acuity of 20/60 or better [46]. These findings indicate that reports of hearing and vision dysfunction in the presence of peripherally normal or almost-normal hearing and vision are quite common.

Effect

Studies comparing single sensory impairment versus DSI have historically focused on older samples of

individuals, and thus the extent to which these inquiries are applicable to the younger population of blast-exposed Veterans is not known. However, examination of the effect of DSI on other patient groups with differing etiologies may serve to guide future research directions specific to DSI in younger blast-exposed Veterans. Studies of older populations have shown that individuals with DSI report poorer health, greater activity limitations, less social participation, more depression, and greater cognitive and functional decline than those with a single sensory impairment or NSI. For example, Crews and Campbell examined questionnaire data of 9,447 individuals obtained during the 1994 Second Supplement on Aging study [47]. The presence of HI was ascertained by a positive response to one of the following items: "deafness in one ear," "deafness in both ears," or "any other trouble hearing;" VI was determined through a positive response to the item "trouble seeing even with glasses." In this study, 58.0 percent of individuals reported NSI, 24.4 percent reported HI alone, 9.4 percent reported VI alone, and 8.2 percent reported DSI. Compared with individuals with NSI, those with HI were 1.7 times more likely to have fallen in the last 12 months, those with VI were 1.8 times more likely to have fallen, and those with DSI were 3.0 times more likely to have fallen. Similar statistics exist for the probability of reporting confusion (HI: 1.4, VI: 2.2, DSI: 2.8), difficulty bathing (HI: 1.4, VI: 2.8, DSI: 3.8), difficulty dressing (HI: 1.5, VI: 2.1, DSI: 3.6), difficulty preparing meals (HI: 1.5, VI: 3.5, DSI: 4.7), and difficulty using a telephone (HI: 3.6, VI: 4.9, DSI: 9.1). Interestingly, the contrasts between groups were not as great for socially based activities. For example, 73.9 percent of individuals with NSI reported visiting friends, while the numbers were 70.9 percent for those with HI, 66.8 percent for those with VI, and 63.4 percent for those with DSI. Similar numbers existed for telephoning friends (NSI: 83.9%, HI: 75.7%, VI: 79.8%, DSI: 72.1%), going to movies (NSI: 30.7%, HI: 25.8%, VI: 21.1%, DSI: 19.5%), and eating out (NSI: 66.0%, HI: 65.9%, VI: 56.3%, DSI: 55.8%). Likewise, Raina et al. examined data of 16,613 individuals older than 66 years who completed the 1991 Health and Activity Limitation Survey [48]. The data showed that individuals with DSI reported the most restrictions conducting instrumental activities of daily living (e.g., shopping, housework, personal care, meal preparation), followed by those with VI alone and then those with HI alone. Those with more severe sensory disabilities were more likely to report restrictions in ability to conduct instrumental activities of daily living and were less likely to have decision-making control and to be happy with their lives. Increased rates of depression with DSI have also been documented. Chou and Chi reported that individuals with DSI were 2.21 times more likely to be depressed than individuals with NSI [49]. The rates for single sensory impairment were 1.49 and 2.05 for HI alone and VI alone, respectively. Chia et al. conducted a study of the effects of DSI that differ from those described earlier, because rather than relying on self-reports of DSI, they assessed hearing and vision using clinical test procedures [50]. They examined 2,015 individuals aged 55 to 98 years from the Blue Mountains Eye Study at year 5 of longitudinal study participation. Of these, air and bone conduction thresholds at octave frequencies from 0.25 to 8 kHz and monocular distance LogMAR visual acuity and cataract examinations were available from 1,836 participants. Participants also completed the Australian-adapted version of the 36-item Short Form Health Survey [46]. Of the participants, 40 percent had HI alone (pure tone average >25 dB HL), 9.3 percent had VI alone (acuity >20/40), and 6 percent had DSI. They found that the individuals with DSI had significantly poorer physical function, general health perceptions, vitality, and mental and social well-being than individuals with a single sensory impairment or NSI.

These studies illustrate that the effects of DSI generally exceed the effects of single sensory impairment, presumably because the individual with DSI cannot compensate for the single sensory impairment with the second sense [2]. For example, it has been long established that supplementing a degraded auditory signal with visual information results in considerable benefit for speech understanding [51-52], resulting in improvements in speech understanding of 50 percent over auditory-alone conditions [53]. The explanation lies in the complementary nature of the information available from the auditory and visual signals [54-55]. Walden et al. also showed that such complementarities apply to benefit obtained from amplification, such that visual cues provide place-of-articulation information, while amplification provides place, manner, and voicing cues [56].

Individuals with DSI are at a further disadvantage for understanding speech in that subtle, nonverbal cues, such as gestures, facial expressions, and body posture, are also lost. For instance, tone of voice provides information about mood and intent, facial expressions and posture can reveal the emotions of the speaker, gestures often provide information that supplement the verbal content, and eye contact provides an emotional link between the speaker and the listener. Consequently, while the literal content of the speech may be understood, the subtle paralinguistic information that enhances communication may be lost.

The interrelationships between the auditory and visual systems are not limited to lipreading. There is considerable evidence of overlap, both neuroanatomically and functionally. For instance, Cappe and Barone showed that in primates, the core of the auditory cortex receives direct inputs from both somatosensory and visual areas [57], while Wang et al. report that single neurons from a primary sensory cortex measured in a monkey can integrate visual sensory information [58]. From a functional standpoint, Recanzone demonstrated that spatial perception of the location of an auditory signal can be altered by providing a visually mismatched cue simultaneous with the auditory cue [59], while Jacquin-Courtois et al. showed that prism adaptation in patients with visual and auditory unilateral neglect could increase auditory responses on the side of neglect [60]. In other words, the effects of prism adaptation extended from the visual system to the auditory system.

Musacchia et al. recently provided biological evidence that HI alone leads to degraded audiovisual (AV) integration abilities [61]. In their study, older adults with near-normal hearing and with mild-to-moderate hearing loss were presented with a synthetic syllable under auditory alone, visual alone, and AV conditions at a fixed sensation level. Peak P1 and N1 latencies and amplitudes were measured for each condition. The normal-hearing subjects showed significantly earlier latencies and subadditive P1 amplitudes in the AV condition over the auditory and visual conditions combined. The subjects with HI showed similar trends, but the differences were not significant. The authors concluded that this demonstrates diminished AV integration in individuals with HI. The implications of this for individuals with DSI are considerable in that it suggests the disadvantages over single sensory impairment will be multiplicative. Interestingly, the study of blast-exposed Veterans with TBI by Lew et al. showed that HI was the strongest predictor of VI, and vice versa, suggesting that these impairments may derive from a common source [19]. Studies to further elucidate these relationships and potential multiplicative effects are needed.

In sum, DSI affects many aspects of function: physical, psychological, and psychosocial. While substantially less is known about the functional effects of combined auditory and visual processing in blast-injured servicemembers and Veterans, they nevertheless represent critical considerations for the coordination of comprehensive and collaborative interdisciplinary care. The continuing paucity of research to clinically define DSI, develop clinical protocols for consistent and objective assessment, determine optimal approaches for rehabilitation, and develop integrated audiological and vision services represents a notable challenge to the field. These issues are further discussed later.

Clinical Definition

It is customary to classify medical disorders into degrees of severity. The value of such is that it provides a basic understanding of the activity limitations and participation restrictions an individual will encounter as a result of his or her impairment, it can help clinicians select appropriate interventions for the impairment, and it provides a metric from which to track change-either disease progression or improvement following intervention [62]. HI and VI are unfortunately, and problematically, diagnosed and treated in isolation [2]. HI is classified based on unaided ability to hear, while VI is classified using best-corrected vision. HIs are based primarily on threshold measures (pure-tone sensitivity), while definitions of VI center on the ability to resolve high-contrast spatial detail (acuity) and on visual fields. With this in mind, it is not surprising that a unified classification for DSI does not exist. In fact, the notion of conceptualizing DSI in an integrated and complimentary fashion, rather than as two distinct and independent phenomena incidentally presenting in the same individual, is relatively recent.

We acknowledge that developing a DSI classification system would be complex, since it would require an

understanding of the relative effect of the two impairments. However, if achieved, this system would assist in the development of algorithms for selecting optimal interventions and rehabilitation strategies, so that, for instance, evidence-based decisions could be made regarding provision of differing interventions for someone with a mild HI coupled with severe VI versus someone with moderate HI and mild VI. A classification system of this sort would be prescriptive and thus would have to move from the traditional model of single-discipline definitions of sensory impairment reliant on hearing sensitivity and visual acuity indicators to integrated functional hearing and vision (dual sensory) assessments with demonstrated relevance to everyday functional capacities. Standardized tools to assess dual sensory function are prerequisite to moving to a system that provides comprehensive dual sensory care. Until such tools exist, a unified classification system is unlikely.

Assessment

As discussed earlier, assessment of sensory disorders is primarily focused on measurement of impairment (e.g., the extent to which thresholds change, the eardrum moves, and the eye can resolve high-contrast spatial detail). There are tools, such as tests of functional hearing (speech) or functional vision (reading), that assess the effects of sensory (dys)function on the everyday skills and abilities of the person, and there are questionnaires that measure perceived effects resulting from the functional limitations; however, these tools are less widely used in the clinic than those that measure impairment. To understand the effects of DSI and to target rehabilitation efforts, we propose the development of dual sensory assessment tools.

Evidence exists to suggest that blast injury causes damage to areas of the brain involved in auditory and visual processing. Tools for assessing central processing again focus on a single sense. There is also evidence that TBI can cause deficits in multisensory integration [63], such as limitations in the way the brain processes and combines information from each sense and the environment to assemble a unified picture, which might be noted in a task requiring the combination of auditory information with the articulatory gestures of the lips and face to improve recognition of speech in a noisy environment [64]. Successful multimodal integration results in responses to multimodal stimuli that are faster than would be predicted from response times to single-sensory stimuli [65] and that produce larger neural responses than single-sense inputs [66]. In its extreme, disrupted multisensory integration is thought to cause symptoms of autism-spectrum disorders [67] and schizophrenia [68], but in less extreme forms, it can manifest as learning difficulties; distractibility; impulsiveness; sensitivity to touch, sounds, and light; and abnormal activity levels (high or low). Many of these symptoms have been noted among blast-injured Veterans and are often attributed to PTSD. Tools to reliably differentiate PTSD from processing difficulties associated with mild TBI would be a valuable addition to the clinical battery. Toward this end, Peskind et al., using brain fluorodeoxyglucose positron emission tomography, reported that Veterans with mild TBI from multiple blast exposures had decreased cerebral metabolic rate of glucose in the cerebellum, vermis, pons, and medial temporal lobe, as well as subtle impairments in verbal fluency, cognitive processing speed, attention, and working memory, compared with 12 cognitively nondisabled volunteers from the community [69]. These deficits are similar to those seen in patients with cerebellar lesions and, thus, may indicate either a physical basis for PTSD or a method for differentiating PTSD from mild TBI.

Selection and development of assessment tools should be focused on those that measure activity limitations (i.e., difficulties that arise because of an impairment, such as an inability to hear speech clearly in a noisy location or to read a book in a dimly lit room) and participation restrictions (i.e., problems that arise from activity limitations, such as withdrawing from social activities). This approach differs from current practices of using unimodal tools that measure either hearing-specific or vision-specific function or performance. These tools would need to be equally sensitive to effect domains of auditory and visual dysfunction so as to comprehensively and realistically capture the functional sensory capacity of individuals with DSI in an integrated fashion. Given that uptake of information from our surroundings is not usually limited to one sensory modality, we hope that ecologically valid measures for assessing DSI in an integrated fashion will be developed. The availability of such tools is especially important for understanding the effects of DSI among blast-exposed

Veterans, who often have little or no HI and/or VI as conventionally assessed and defined.

A number of performance-based tests of everyday function have been developed for assessment of activity limitations, for example, the Direct Assessment of Functional Status Scale [70], the Cognitive Performance Test [71], the Revised Observed Tasks of Daily Living [72], and Timed Instrumental Activities of Daily Living [73]. These tests require the participant to perform a number of everyday tasks using real-life materials in the laboratory or clinic. The participant's ability to perform each step of the task is scored. If such measures are to be used to assess DSI, it would be necessary to confirm that each is sensitive to HI alone and VI alone, as well as to DSI. Unfortunately, none of these measures were developed with a single sensory impairment or DSI in mind, they are not standardized for use in clinical or rehabilitation settings, and there are no normative data available from large populations. Furthermore, the tasks are weighted toward use of vision more heavily than hearing; therefore, for assessment of DSI, those currently available would have to be considerably altered.

Self-report questionnaires or interviews are the most practical way to assess participation restrictions; indeed, there is growing consensus that assessment of daily function requires self-report measures as well as performance-based measures [74]. There are many sense-specific tools for evaluating the activity limitation and participation restrictions associated with HI and VI, such as the Abbreviated Profile of Hearing Aid Benefit [75], the Hearing Handicap Inventory for the Elderly [76], the Low Vision Visual Functioning Questionnaire [77], and the National Eye Institute Visual Functioning Questionnaire [78]. However, such questionnaires have limited utility for understanding the effects of DSI, since they focus on a single sensory impairment only. A questionnaire of potential utility for understanding the effects of DSI is the World Health Organization Disability Assessment Schedule II (WHO-DAS II), which provides a profile of functional abilities and effect of impairments in six domains: Understanding and Communicating, Getting Around, Self-Care, Getting Along with People, Life Activities, and Participation in Society. The WHO-DAS II was developed as a tool for identifying the needs of individuals with varying impairments, matching patients to interventions, tracking functioning over time, and measuring clinical outcomes and treatment effectiveness; thus, conceptually it is a highly appropriate tool for assessing DSI.

There is value in using both performance-based measures and self-report measures, because both have important strengths and weaknesses. Self-report measures are revealing because they provide the patient's perspective on, and personal experience of, the problem under investigation. On the other hand, self-report data are influenced by the patient's interpretation of questions, the accuracy of the patient's recall of information, the patient's emotional and psychological state (e.g., fatigue, motivation), and the patient's perception of what he or she believes the examiner wants to hear [79]. Correlations between degrees of reported and measured sensory loss are low [80], and discrepancies exist between self-report and objective ratings [81-82]. Performance measures, on the other hand, avoid these issues, but they may lack construct validity and/or pertinence to a particular individual's lifestyle and daily activities. Furthermore, interventions yielding improvements in performance (particularly laboratory-based performances) but little or no change in self-perceived ability may be limited in terms of their potential for translation and integration into clinical practice (i.e., poor patient adherence or persistence due to limited perceived utility).

Rehabilitation

The major challenge for rehabilitation of DSI associated with blast injury is that traditional forms of rehabilitation for HI and VI (providing hearing aids and eyeglasses) are not applicable, because individuals tend to have normal to near-normal auditory and visual acuity. Indeed, the Veterans Health Administration (VHA) does not currently have established evidence-based approaches to rehabilitation for blast-related DSI associated with TBI. Current practices adopted by audiologists to address auditory difficulties include providing mild-gain hearing aids, personal FM systems, and auditory training programs [21]. There is good rationale for the use of each. Personal FM systems have been used successfully to manage auditory processing problems in children [83-84] and adults [85]. By placing the microphone of the FM close to the source of the wanted signal and then

transmitting via radio frequency transmission to a receiver worn by the listener, there are significant improvements in the signal-to-noise ratio of speech in noisy and reverberant environments. It is believed that by enhancing the speech signal, more resources are made available for use in higher-level auditory processing. Auditory training has been shown to be successful for children with language learning disorders [86-87], for improving satisfaction and performance of adult hearing aid users [86-88], and for enhancing the memory of older adults [89]. An accumulating body of literature shows that auditory training has the potential to change neural function, as demonstrated by changes in electrophysiological metrics such as increased P300 amplitude and decreased latency to speech signals [87,90] and changes in the amplitude and latencies of the N1-P2 complex [91-92]. Auditory training has also been shown to transfer from trained tasks to improved speech syllable identification [93], sentences in quiet [94] and in noise [88], high context sentences [95], and perceived hearing disability and handicap [88,95].

Rehabilitation practices commonly used by optometrists to address visual difficulties associated with blast injury and normal or near-normal visual acuity include refraction and the provision of optical interventions, including tints and filters to assist with photosensitivity and prisms to expand visual field, as well as nonoptical interventions, such as education regarding lighting, increasing contrast, and decreasing visual clutter. Vision therapy is used at times, most typically to address convergence insufficiency and accommodative infacility. Vision therapy, depending on the disorder(s) to be addressed, often requires at least 12 or more weekly or biweekly office therapy sessions that may be inconvenient, costly, and more time-consuming than home-based visual therapies. Stelmack et al. indicated that, in fact, spectacles were the primary (78%) visual treatment prescribed for patients with TBI seen at one VA site in contrast with much lower provision of vision therapy (14%) [37]. A recent national survey of VA optometrists specific to treatment of visual complaints in OIF/OEF Veterans showed that 84 percent provided spectacles, 61 percent provided prisms and filters, and 39 percent provided vision therapy; however, 16 percent indicated uncertainty as to the efficacy of their rehabilitation efforts in ameliorating their patients' deficits. A variety of training approaches have been applied to visual efficiency and visual information processing decrements in a variety of patient populations. Vision therapy protocols are a family of behavioral optometry approaches that address primarily visual efficiency anomalies in version, vergence, and accommodation and, to a lesser degree, in information processing disorders. Multicenter clinical trial-based evidence regarding efficacy, however, is limited, including specific to neurorehabilitation optometric approaches to the visual dysfunction seen in populations with TBI [9]. Nevertheless, a handful of studies suggest responsiveness of populations with TBI to training interventions. For instance, Freed and Hellerstein found that a small sample of patients with mild TBI receiving optometric rehabilitation that included vision therapy demonstrated greater visual system recovery based on visually evoked cortical potential testing than age-, sex-, and head size-matched controls [96]. Han et al. reported that computer-presented eye movement training resulted in improved reading-related eye movements, and this remediation was associated with decreased reports of reading dysfunction among adults with acquired brain injury, including those with TBI [97]. Similarly, brain-plasticity grounded vision restoration training of residual visual function has resulted in visual field (re)expansion [98]. Practice-related improvements in the functional or useful field of view in nondisabled adults is thought to result from enhancements in visual perceptual processing and attention, including speed, identification, discrimination, and attention abilities [99-100]. These studies demonstrate that visual training can improve visual function associated with visual processing deficits, and investigators such as Scalf et al. present neuroimaging data elucidating the neural correlates of these improvements [99].

It is conceivable that devices can be developed that use incoming visual and auditory inputs to enhance visual and auditory cues or that tactile information be collected to enhance limited auditory and visual input. Such approaches would potentially enhance multisensory integration processes. A system of this nature is being developed by Jacobs et al. at the National Center for Rehabilitative Auditory Research (Portland, Oregon), in which mutual information obtained from a camera focused on the face of a speaker will be combined with that

obtained by a hearing aid in the ear of the listener [101]. Using sophisticated algorithms, these data can be used to extract signal from noise and, thus, to attenuate the noise and improve the signal-to-noise ratio. Crossdisciplinary development of new patient-centered technologies is crucial for optimal development of new devices for DSI.

The goal of cross-disciplinary rehabilitation is to address DSI within the context of the whole individual, taking into account the DSI as well as other co-impairments so that strategies to optimize residual capacities, accommodate losses, and teach compensatory strategies can be devised. Accordingly, rehabilitation efforts will entail tailoring environmental and technologic and training and/or retraining rehabilitative interventions to maximize functional independence. Innovative, integrative, and new models of assessment and care are needed. Educating emerging and future audiology and vision providers in multisensory team-based processes of care is a critical first step.

The ultimate goal of rehabilitation is to restore full participation in society and quality of life and ensure individuals have the full capacity to participate in education, vocation, independent living, social activities, relationships, and recreation. While quality of life is often considered in assessment of outcomes, reintegration is rarely assessed. According to the VHA Handbook (1172.04), reintegration is the resumption of age, sex, and culturally appropriate roles in the family community and workplace. In a meta-analytic evaluation of the methodological quality of research on cognitive rehabilitation after TBI, Cicerone et al. reported that of 32 randomized clinical trials, only 4 measured treatment effects on participation and only 1 on quality of life [102]. Given the prevalence of DSI in blast-exposed Veterans, evidence for impaired community integration following TBI [103], and the challenges that vision and hearing difficulties pose in everyday life [2], assessment of reintegration and quality of life in returning OIF/OEF servicemembers should be considered critical metrics when VA is evaluating the success of its rehabilitation programs. This is because while performance-based assessments, such as reading and speech discrimination, are clearly important to everyday function, they do not necessarily capture patient-centered outcomes, such as return to job, activity, and independent living and life satisfaction overall.

CONCLUSIONS

Providers are faced with numerous challenges regarding blast-related DSI that include definition of the problem, quantification and assessment of its effects, selection of rehabilitation strategies, and the development of a service-provision model. Further, awareness of DSI resulting from blast-exposure is relatively recent, and thus, it is not known whether the limited knowledge about DSI in the aging population is even applicable to this younger population of Veterans whose reported functional difficulties are similar but whose DSI etiology, reserve capacities, lifestyle, and needs are quite different.

We recommend the assessment and rehabilitation approach to blast-related DSI depicted in the Figure and emphasize the necessity of engaging in an interdisciplinary team-based approach to rehabilitation. The model depicted in the Figure uses the International Classification of Functioning, Disability and Health [104], which shifts the focus from causes to effects along a common metric of health and disability, to guide assessment, classification, and rehabilitation and to illustrate the interrelationships between them. Specifically, blast injuries to brain, ears, eyes, and other parts of the body lead to HIs and VIs. The severity of these injuries depends on a number of variables, including blast intensity and number of exposures. In blast-related DSI, visual and auditory processing are affected and relative degree of these processing impairments directly influences functional vision and hearing performance. Functional vision and hearing effects manifest as activity limitations and participation restrictions, which will impair reintegration, recovery, and quality of life. An interdisciplinary clinical team approach to rehabilitation that incorporates technology, vision and auditory training, and environmental modifications to accommodate and compensate for impairments is thus necessary to optimize societal reintegration and attainment of preinjury quality of life.

ACKNOWLEDGMENTS

Author Contributions:
Study concept and design: G. H. Saunders, K. V. Echt.
Drafting of manuscript: G. H. Saunders, K. V. Echt.
Critical revision of manuscript for important intellectual content: G. H. Saunders, K. V. Echt.
Financial Contributions: The authors have declared that no competing interests exist.
Funding/Support: This material is based on work supported by the VA Rehabilitation Research and Development Service (grants 4844C and C4850C).
Additional Contributions: The authors would like to thank Terri Pogoda, PhD, for her valuable input on an earlier version of the manuscript.
Disclaimer: The contents of this article do not necessarily represent the views of the VA or the U.S. Government.

Sidebar

Submitted for publication August 20, 2010. Accepted in revised form May 3, 2011.
This article and any supplementary material should be cited as follows:
Saunders GH, Echt KV. Blast exposure and dual sensory impairment: An evidence review and integrated rehabilitation approach. J Rehabil Res Dev. 2012;49(7):1043-58. http://dx.doi.org/10.1682/JRRD.2010.08.0157
ResearcherID: Gabrielle H. Saunders, PhD: F-4768-2012

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http://dx.doi.org/10.1682/JRRD.2010.08.0157

Publication date: 2012

Year: 2012

Preliminary studies on differential expression of auditory functional genes in the brain after repeated blast exposures

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Publication info: Journal of Rehabilitation Research and Development 49.7 (2012): 1153-62.
ProQuest document link

Abstract: The mechanisms of central auditory processing involved in auditory/vestibular injuries and subsequent tinnitus and hearing loss in Active Duty servicemembers exposed to blast are not currently known. The authors analyzed the expression of hearing-related genes in different regions of the brain 6 h after repeated blast exposures in mice. Preliminary data showed that the expression of the deafness-related genes otoferlin and otoancorin was significantly changed in the hippocampus after blast exposures. In summary, mice exposed to repeated blasts showed injury to the auditory cortex and significant alterations in multiple genes in the brain known to be involved in age- or noise-induced hearing impairment.

Full text: Headnote

Abstract-The mechanisms of central auditory processing involved in auditory/vestibular injuries and subsequent tinnitus and hearing loss in Active Duty service members exposed to blast are not currently known. We analyzed the expression of hearing-related genes in different regions of the brain 6 h after repeated blast exposures in mice. Preliminary data showed that the expression of the deafness-related genes otoferlin and otoancorin was significantly changed in the hippocampus after blast exposures. Differential expression of cadherin and protocadherin genes, which are involved in hearing impairment, was observed in the hippocampus, cerebellum, frontal cortex, and midbrain after repeated blasts. A series of calcium-signaling genes that are known to be involved in auditory signal processing were also found to be significantly altered after repeated blast exposures. The hippocampus and midbrain showed significant increase in the gene expression of hearing loss-related antioxidant enzymes. Histopathology of the auditory cortex showed more significant injury in the inner layer compared to the outer layer. In summary, mice exposed to repeated blasts showed injury to the auditory cortex and significant alterations in multiple genes in the brain known to be involved in age- or noise-induced hearing impairment.

Key words: auditory functional genes, auditory process, blast injury, cadherin, hearing loss, neurotrauma, otoancorin, otoferlin, protocadherin, tinnitus.

Abbreviations: cDNA = complementary DNA, TBI = traumatic brain injury.

INTRODUCTION

Battlefield blast exposure is reported to cause auditory impairment in a large population of military personnel deployed to Iraq and Afghanistan [1-2]. Auditory/vestibular injuries from blast traumatic brain injury (TBI) can cause increased incidence of tinnitus and hearing loss, which worsens over time if not treated [1-4]. Shock waves generated from explosive blasts are reported to be destructive to both gas- and fluid-filled structures of the body, including the lungs, intestines, brain, eyes, nose, and middle ear [5-9]. Blast-induced damage to the auditory system can be the consequence of either direct exposure of the auditory canal to blast shock waves or TBI and impairment in the central auditory processing involving different brain regions after blast exposure. The literature on the neurobiological mechanisms of hearing impairment and development of tinnitus from blast TBI is limited.

A number of genes and their protein products have been reported to be involved in both age- and noise-related hearing loss [10-15]. Cadherin and protocadherin mutations were linked to digenic inheritance of deafness and have specific functional roles in noise-induced hearing loss [13- 14,16-17]. Other groups of proteins involved in deafness are otoferlin and otoancorin, which are also reported to have major roles in auditory functions, including central auditory processing [18-21]. Another large class of molecules involved in auditory signaling is centered on the calcium regulating proteins, which are known to have broad functions in age- and noise-related hearing loss or protection [18,22-26]. The significance of reactive oxygen species and heat shock proteins in

age- and noise-related auditory impairments are also reviewed in detail [10,27-34].

Recent research on age- or noise-related hearing loss preferred mice as a suitable animal model because of the vulnerability of mice to sound compared to other rodents [15,35]. We have developed a preclinical mouse model of repeated blast exposures using an air-blast shock tube that closely mimics the repeated exposure to improvised explosive devices, grenades, or firing weapons used in the battlefield or breacher's studies [36-37]. The newly developed repetitive blast animal TBI model showed significant levels of neuropathology and neurobehavioral deficits after repeated blast exposures at 20.6 psi [36]. Using this mouse model of repeated blast exposures, we sought to determine differential expression of auditory-related genes in various regions of the brain by complementary DNA (cDNA) microarray analysis.

METHODS

Animal Blast Exposure Model

Experiments were performed in male mice (C57BL/ 6J, age 8-10 weeks, Jackson Laboratory; Bar Harbor, Maine). Groups of isoflurane (4%) anesthetized animals (n = 6 for sham and n = 6 for blast) were exposed to repeated blast exposures (20.6 psi), as reported previously, using a shock tube [9,36,38-39]. At a 6 h time point after the last blast exposure, three animals each from sham and blast groups were euthanized, and the brain tissue was collected after necropsy and separated into various regions as described earlier [39]. Different regions of the brain samples were immediately snap frozen and stored at -80°C until use. Remaining animals (n = 3) in each group were sacrificed at 24 h after the last blast exposure and used for histopathology.

Preparation of RNA

Total RNA was isolated using Trizol reagent (Invitrogen Life Technology; Carlsbad, California) following the manufacturer's protocol. RNA quality and quantity were determined by using an Agilent 2100 Bioanalyzer (Agilent Technologies; Santa Clara, California).

cDNA Microarray Analysis

Microarray analysis was performed using Agilent 60-mer mouse genome 44K oligo microarrays (Agilent Technologies). We labeled 5 mg of purified RNA with a commercially available kit (Agilent Low Input Quick Amp) by polymerase chain reaction amplification (Bio-Rad Laboratories; Hercules, California). Samples were fragmented and hybridized against universal mouse reference RNA (Stratagene; La Jolla, California) with a kit from Agilent. A 2-Color Microarray-Based Gene Expression Analysis (version 6.5) protocol was used for labeling and microarray processing. An Agilent G2565CA fluorescence scanner was used to quantitate the slides, and the resultant data were extracted using software (Agilent Feature Extraction, version 10.7.1). For filtering and normalization of the data, GeneSpring 10.1 software (Agilent) was used.

Statistical Analysis

The statistical analysis of the microarray data was performed with GeneSpring 10.1 software. Changes in the level of expression of various genes after blast exposure in comparison to sham controls were identified by Welsh's t-test statistical method (p-values <0.05) in conjunction with multiple correction test (Benjamini-Hochberg) with 5 percent false discovery rate. To account for the small sample size, we used the reference design and filtered for genes with signal intensities that are twice the standard deviation of the background intensity levels. We determined that by performing gene-by-gene t-tests, for a samples size of 3 and 5 percent false discovery rate and a standard deviation of 0.5, the power is 75 percent. We also applied pathway and gene ontology analyses that offer extra power because it is statistically unlikely that a larger fraction of false positive genes end up in one specific pathway.

Histopathology of Auditory Cortex

Histopathology was performed in blast-exposed and sham control mice (n = 3 in each group), as described previously [36]. Brain sections were silver stained and microscopically examined for neurodegeneration exclusively in the auditory cortex region, and the severity of injury was scored as mild (+), moderate (++) and severe (+++).

RESULTS

Expression of Auditory-Related Genes in Hippocampus After Repeated Blast Exposures

The hippocampus of mice exposed to repeated blasts showed significant changes in the expression of multiple genes that are reported to be involved in age- or noiseinduced hearing loss (Table 1). Otoancorin, a gene defective in autosomal recessive deafness, showed a significant increase (3.4-fold), while otoferlin, which is essential for glutamate exocytosis at the auditory ribbon synapse, showed a 1.8-fold decrease in the expression after repeated blast exposures. The expression of calcium binding protein 2 showed a 1.6-fold increase, whereas calcitonin-related polypeptide expression showed a 1.9-fold decrease after blast exposures. The expression of antioxidant enzyme superoxide dismutase 3 showed a 2.0-fold increase in the hippocampus of mice exposed to repeated blasts. The expression of heat shock protein 8 and heat shock transcription factor 5 showed significant increase in the hippocampus after repeated blast exposures. Protocadherin alpha 4 expression showed a 1.3-fold decrease after blast exposures.

Expression of Auditory-Related Genes in Cerebellum After Repeated Blast Exposures

The cerebellum of mice exposed to repeated blasts showed a 1.2-fold increase in protocadherins alpha 4 and beta 20 expression (Table 2). The expression of S100 calcium binding protein A7A showed a 1.4-fold increase, while multiple calcium channel proteins and calcium binding protein 2 expression showed a 1.1 to 1.2-fold decrease in the cerebellum after repeated blast exposures. Heat shock protein 8 expression also showed a 1.1-fold decrease after blast exposures.

Expression Profile of Auditory-Related Genes in Frontal Cortex After Repeated Blast Exposures

The expression of calcium signaling-related molecules showed significant increase in the frontal cortex of mice exposed to repeated blasts, including calpain 3 (1.5-fold), S100 calcium binding protein A3 (1.4-fold), calcium/ calmodulin-dependent protein kinase kinase 1 (1.2-fold), and calcium binding domain 4A alpha polypeptide 7 (1.4- fold) (Table 3). Protocadherin beta 11 and calreticulin expression showed significant decrease (2.2- and 1.2-fold, respectively) in the frontal cortex of mice exposed to repeated blasts.

Expression of Auditory-Related Genes in Midbrain After Repeated Blast Exposures

The changes in the expression of auditory-related genes in the midbrain of repeated blast-exposed mice are shown in Table 4. Expression of cadherin-like 24 showed a 1.8-fold increase, while expression of cadherin 12 and protocadherin 8 showed significant decrease (1.7- and 1.4-fold, respectively) after the blast exposures. Multiple calcium signaling molecules, including calpain 9 (2.1-fold), S100 calcium binding protein A3 (1.2-fold), and calcium activated potassium channel beta 3 (2.1-fold), showed significantly increased expression in the midbrain after repeated blast exposures. At the same time, the expression of calcium binding protein 7 (2.2-fold), calcium channel voltage dependent L type alpha 1D subunit (1.6-fold), and calcium/ calmodulin-dependent protein kinase 2 gamma (1.1-fold) showed significant decrease after repeated blast exposures. The midbrain of repeated blast-exposed mice also showed significant decrease in the expression of heat shock protein 2 (1.3-fold), nicotinic alpha polypeptide 7 cholinergic receptor (1.5-fold), and stanniocalcin 2 (1.3-fold).

Histopathology of Auditory Cortex After Repeated Blast Exposures

To investigate whether blast exposure induces pathology of the auditory cortex, neuropathology analysis of the brain of repeated blast-exposed mice was performed by silver staining. As shown in the Figure, a significant level of neurodegeneration occurred in the auditory cortex at 24 h after repeated blast exposures. The pathology index in the inner layer of auditory cortex (Figure(b2)) was scored as + to ++, while the pathology index of the outer layer (Figure(a2)) was - to + compared to the respective sham controls.

DISCUSSION

Previous studies showed a significant level of neuropathology and neurobehavioral changes, with ~20 percent mortality rate after repeated blast exposures in mice at 20.6 psi [36]. The pathology was more evident in the prefrontal cortex and cerebellum of repeated blast-exposed mice. More recent results showed regional-specific changes in acetylcholinesterase activity in various regions of the brain after repeated blast exposures, indicating

that the effects of blast exposure is heterogeneous in the brain [39]. The majority of the neurobiological changes in the brain were significant at 6 h after the last blast exposure [36]. Based on these observations, we analyzed the changes in the gene expression profile in different regions of the brain at 6 h after blast exposures in the present study.

The expression of otoferlin, which is known to be present in the brain and is essential for glutamate exocytosis at the auditory ribbon synapse and reported to be defective in a recessive form of human deafness, showed significant decrease in the hippocampus of mice exposed to repeated blasts [19-20,40-42]. In contrast, otoancorin, another hearing- related gene defective in autosomal recessive deafness and known to mediate the contact between the apical surface of sensory epithelial cells and acellular gels of the inner ear and the tectorial and otoconial membranes for proper auditory processing, showed significant increase in the hippocampus after repeated blast exposures [21,43]. Significant increase in the expression of otoancorin in the hippocampus after repeated blast exposures seems to be a compensatory mechanism to increase the sensitivity of hearing following injury to the auditory system and needs to be investigated in detail as a potential mechanism involved in the development of tinnitus.

Cadherins and protocadherins are another set of genes that showed differential expression in various regions of the brain after repeated blast exposures. Cadherin and protocadherin mutations are reported to be involved in noise-induced hearing loss [13-14,16-17,44]. The altered expression profile of cadherins and protocadherins in different regions of the brain after repeated blast exposures may impair central auditory processing. The functional significance of these gene modifications in the blast-induced impairment of central auditory processing has to be studied in detail to exploit them for therapeutic applications.

Molecules involved in calcium influx and calciumdependent proteins/enzymes are predominant signal transducers in auditory neurons [22-23,45-48]. The frontal cortex and midbrain of blast-exposed mice showed significant increase in the expression of calcium-dependent cysteine proteases and calpain 3 and 9, respectively (Tables 3 and 4). Calpains are essential for initiation and promotion of cell death, and treatment with calpain inhibitors are known to prevent the hearing loss induced by aminoglycoside ototoxicity [45]. The hippocampus of blast-exposed mice showed a significant decrease in the expression of calcitonin-related peptide, a suggested peptide therapeutic treatment for hearing loss (Table 1) [22,48]. The cerebellum and midbrain regions showed significant decrease in the expression of voltage-dependent calcium channel genes after repeated blast exposures, while multiple calcium binding proteins showed differential expression in the hippocampus, cerebellum, frontal cortex, and midbrain after repeated blast exposures (Tables 1-4). It is known that L-type voltagegated calcium channels are involved in the pathogenesis of acoustic injury in the cochlea, and treatment with calcium channel blockers can reduce the damage to the auditory neurons [26].

Other types of molecules involved in calcium regulation, such as calreticulin and calmodulin-dependent protein kinase expression, showed significant decrease in the frontal cortex and midbrain of blast-exposed mice, respectively (Tables 3 and 4) [23,47]. Interestingly, two calcium binding proteins, calretinin and parvalbumin, that were upregulated in the cerebellum at 24 and 48 h after blast exposures by proteomic analysis were not found to be altered in cDNA microarray analysis at 6 h after blast exposures.* One possible reason for this difference is that calretinin and parvalbumin expression might be regulated at the translational level after blast exposures, which needs to be investigated further. Second, cDNA microarray analysis at 24 and 48 h after blast exposures needs to be done to find any significant changes in calretinin and parvalbumin gene expression. Western-blotting of the hippocampal region at 6 h after blast exposures showed significant increase in calretinin, further supporting the idea that blast exposure possibly modulates the protein expression at the translational level. The differential expression of calcium-dependent proteins/receptors in the brain after repeated blast exposures could be the consequence of increased/decreased calcium buffering in the auditory neurons. Thus, these results suggest that repeated blast exposures lead to an imbalance in the regulation of calcium homeostasis in different regions of the brain that can directly influence the central auditory processing and lead

to auditory impairment.

Heat shock proteins or factors are one of the bestcharacterized families of protective proteins that are usually upregulated after stress, offering cellular protection and survival [10,27-28]. Repeated blast exposures in mice showed significant increase in the expression of heat shock protein 8 and factor 5 in the hippocampus, while cerebellum and midbrain showed significant decrease in heat shock protein 8 and heat shock protein 2, respectively (Tables 1, 2, and 4). The functional significance of heat shock proteins in hyperthermia and noise overstimulation is well documented [10,28]. The differential expression of heat shock proteins in the brains of repeated blast-exposed mice needs to be investigated further. Additionally, repeated blast exposure in mice showed significant reduction in the expression of the cholinergic receptor nicotinic alpha polypeptide 7 in the midbrain, suggesting a possible role of these receptors in aberrant central auditory processing (Table 4). The nicotinic receptor of cochlear hair cells has been proposed by others as a potential therapeutic target in acoustic trauma [11,49].

The functional role of reactive oxygen species and the protective efficacy of antioxidants in noise-induced hearing loss are well documented [32,50-51]. Repeated blast exposure in mice showed significant increase in the expression of antioxidant enzymes, superoxide dismutase 3, and glutathione peroxidase 4 in the hippocampus and midbrain, suggesting a protective mechanism in central auditory processing (Tables 1 and 4). The influence of glutathione peroxidase and superoxide dismutase in noiseinduced hearing loss has also been reported [12,31,33-34]. Reactive oxygen species showed an increase in the brain following repeated blast exposures [36].

Neuropathology analysis of the auditory cortex of repeated blast-exposed mice showed significant injury (Figure). The injury level was more on the medial contralateral side of the brain than the ipsilateral side. The neuropathology of the auditory cortex is in line with the significant level of auditory-related gene expression changes in the brain of blast-exposed mice. It is not clear whether the neuropathology is responsible for the changes in gene expression or vice versa. It has been reported that blast-induced mild to moderate TBI leads to neurobiological and behavioral changes with multifocal axonal injury [52-53]. In these reports, neuropathological changes were observed at 7 and 14 d after blast exposure, although gene expression changes were observed at day 1, indicating that molecular changes contributes to the neuropathology. In our studies, neuropathology was prominent at 24 h after repeated blast exposures, but changes in gene expression were observed much earlier, suggesting that molecular changes can occur earlier as a direct effect of blast exposures. Preliminary data on brain DNA damage after blast exposure using comet assay showed breakage of DNA after repeated blast exposures. Studies with rats exposed to low-levels of explosive blast showed terminal dUTP nick end labeling-positive cells in the white matter in day 1 without any changes in day 7 [54].

Changes in many hearing-related genes after blast exposure in the brain indicate that these genes play specific roles in central auditory processing. The gene expression changes may be the consequence of initial protection against blast-induced central auditory processing and later as injury mechanism of central auditory processing. Gene expression changes can vary with respect to blast overpressure or number of blasts and may also depend on the severity of injury. The contribution of the shock waves transmitting through the auditory canal or directly through the skull in central auditory processing impairment is currently being investigated in the laboratory by using ear protection. Unraveling the functional role of these genes in central auditory processing and how they cross-talk with each of the brain regions to perform sound perception, hearing, speech recognition, and longterm memory will help us to understand how exactly their modulation plays a role in central auditory processing impairments. The linkage of these gene modulations to concurrent neuropsychiatric changes after blast exposure is also important to understand the complex neurobiological mechanisms of blast affecting central auditory processing and aid in rehabilitation.

CONCLUSIONS

In summary, preliminary results indicate that repeated blast exposures in mice showed significant alterations in

multiple genes that are reported to be involved in age- or noise-related hearing loss at 6 h after blast exposure. The repeated blast exposure also showed significant neuropathology at 24 h in the auditory cortex, suggesting that blast exposure damages central auditory processing systems. Gene expression changes occur at early time points after blast exposure and may not be the consequence of apoptotic or necrotic changes in the brain. The gene expression profile showed differential pattern in various regions of the brain of mice exposed to repeated blasts. Otoferlin and otoancorin, which are involved in deafness, showed significant alteration in the hippocampus after repeated blast exposure. Similarly, cadherins and protocadherins, which are involved in noise-induced hearing loss, showed significant changes in all the brain regions tested. The expression profile of calcium- regulating proteins/receptors in various brain regions also showed differential expression, indicating an imbalance in calcium homeostasis after repeated blast exposures. The heat shock proteins and antioxidant enzyme expressions also showed significant changes in various regions of the brain after repeated blast exposure, indicating possible protective effects. The differential expression of multiple auditory-related genes in various regions of the brain after repeated blast exposures in mice needs to be investigated further to draw specific biochemical pathways involved in the functional significance of central auditory processing in blast-induced auditory dysfunction and tinnitus.

ACKNOWLEDGMENTS

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Financial Disclosures: The authors have declared that no competing interests exist.

Funding/Support: This material was unfunded at the time of manuscript preparation.

Additional Contributions: Collaborative help from COL Paul Bliese, Dr. Joseph Long, and Blast-Induced Neurotrauma Branch members is greatly acknowledged.

Institutional Review: Experiments were performed in compliance with the Animal Welfare Act and other Federal statutes and regulations relating to animals and experiments involving animals and adhered to principles stated in the Guide for the Care and Use of Laboratory Animals with an approved Institutional Animal Care and Use Committee protocol.

Disclaimer: The contents, opinions, and assertions contained herein are private views of the authors and are not to be construed as official or reflecting the views of the Department of the Army or the Department of Defense.

Sidebar

Submitted for publication September 30, 2011. Accepted in revised form February 7, 2012.

This article and any supplementary material should be cited as follows:

Valiyaveettil M, Alamneh Y, Miller S, Hammamieh R, Wang Y, Arun P, Wei Y, Oguntayo S, Nambiar MP. Preliminary studies on differential expression of auditory functional genes in the brain after repeated blast exposures. J Rehabil Res Dev. 2012;49(7):1153-62.

http://dx.doi.org/10.1682/JRRD.2011.09.0182

Footnote

*Arun P, Valiyaveettil M, Biggemann L, Alamneh Y, Wei Y, Oguntayo S, Wang Y, Long JB, Nambiar MP. Modulation of hearing related proteins in the brain and inner ear following repeated blast exposures. Intervent Med Appl Sci. Forthcoming.

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http://dx.doi.org/10.1682/JRRD.2011.09.0182

Publication date: 2012

Year: 2012

Oticon A/S; Patent Issued for Active Noise Cancellation in Hearing Devices

Publication info: Telecommunications Weekly (Aug 8, 2012): 276.

Abstract: [...]it is an advantage that the processed electric audio signal is combined with the active noise cancellation signal, since by providing the combined signal to the output transducer, all noise signals that have entered the ear canal by either a hearing device vent, by leakage between the hearing device and the ear canal wall, through an input transducer etc. will be cancelled or reduced.

Full text: 2012 AUG 8 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventors Jorgensen, Ivan (Smorum, DK); Rasmussen, Karsten Bo (Smorum, DK); Petersen, Svend Oscar (Smorum, DK), filed on July 15, 2008, was cleared and issued on July 24, 2012.

The assignee for this patent, patent number 8229127, is Oticon A/S (Smorum, DK).

Reporters obtained the following quote from the background information supplied by the inventors: "Previously active noise cancellation (ANC) systems and hearing aids have not been used in combination. ANC and hearing aids work in opposite ways, since a hearing aid amplifies sound and ANC attenuates sound. But by combining a hearing aid and an ANC in a suitable way as in this invention, it is possible to obtain the advantages and technical effects of both systems.

"WO05052911 relates to a hearing aid which can perform active noise cancellation. The hearing aid includes a signal processor which produces a compensation/cancellation signal that can attenuate acoustic signals that bypasses the signal path of the hearing aid and enters the ear canal.

"DE 1033219 also relates to a hearing aid which can perform active noise cancellation. The active noise cancellation is performed by processing signals from one or more microphones and loudspeakers arranged in the hearing aid vent. The microphone signals are transmitted to a filter unit in order to attenuate unwanted acoustic signals.

"WO06003618 relates to an earplug with a circuit for active noise cancellation. When a noise signal is received in the earplug, a cancelling signal is processed by means of the circuit to cancel the noise signal.

"U.S. Pat. No. 6,567,524 concerns a hearing protective earplug with an audio communication terminal for obtaining speech signals of high quality while attenuating noise. The earplug performs noise attenuation automatically adapted to the noise conditions and communication modes.

"U.S. Pat. No. 6,181,801 and U.S. Pat. No. 6,021,207 relate to a communications earpiece which receives audio signals, wired and wireless, respectively, sent from an external device such as a mobile phone. Ambient sounds are used for noise cancellation. The communications earpiece can be used by both hearing impaired and non-hearing impaired users.

"When a hearing device user is in a noisy environment, it is advantageous that the hearing device can perform active noise cancellation. But it is a problem of the prior art that when the hearing device operates as active noise cancellation, sound signals, both the undesired and the desired, will be attenuated due to the active noise cancellation. This may not always be desirable.

"It therefore remains a problem to provide a hearing device which improves active noise cancellation (ANC) and thus may provide a better audible signal to the user."

In addition to obtaining background information on this patent, VerticalNews editors also obtained the inventors' summary information for this patent: "Disclosed is a hearing device system comprising at least one hearing aid circuitry and at least one active noise cancellation unit, the at least one hearing aid circuitry comprises at least one input transducer adapted to convert a first audio signal to an electric audio signal; a signal processor connected to the at least one input transducer and adapted to process said electric audio signal by at least

partially correcting for a hearing loss of a user; an output transducer adapted to generate from at least said processed electric audio signal a sound pressure in an ear canal of the user, whereby the generated sound pressure is at least partially corrected for the hearing loss of the user; the at least one active noise cancellation unit being adapted to provide an active noise cancellation signal adapted to perform active noise cancellation of an acoustical signal entering the ear canal in addition to said generated sound pressure; wherein the hearing device system further comprises a combiner unit adapted to combine the processed electric audio signal with the active noise cancellation signal, to obtain a combined signal and to provide the combined signal to the output transducer.

"Consequently, it is an advantage that the processed electric audio signal is combined with the active noise cancellation signal, since by providing the combined signal to the output transducer, all noise signals that have entered the ear canal by either a hearing device vent, by leakage between the hearing device and the ear canal wall, through an input transducer etc. will be cancelled or reduced.

"The interference between the noise signals that have entered the ear canal and the cancellation signal in the combined signal occurs in the residual space defined between the hearing device in the ear canal and the tympanic membrane.

"It is an advantage that all undesired sound signals will be attenuated, when the active noise cancellation (ANC) system is active.

"Typically, a hearing device vent channel is included in hearing devices for user comfort, since a vent enables sound pressure equalization between the ambient space surrounding the hearing device user and the residual space in the ear canal, at low frequencies. But the vent allows sound signals from the surroundings to enter into the ear canal even when the hearing aid circuitry is turned off, and this may be very unpleasant and annoying for the user.

"In the hearing device of the present invention the ANC system may attenuate sound signals constantly, even when the hearing aid functionality is turned off, and therefore the user may avoid noise from all undesired sound signals.

"Traditionally, if a hearing aid circuitry is operated as an ANC, the hearing aid circuitry will consequently reduce, attenuate or block out audio signals. The user of the hearing device may therefore loose desired audio signals, since they may be attenuated as the undesired audio signals. Therefore it is an advantage of the present invention that the hearing device may comprise both a hearing aid circuitry with hearing aid functionality and an ANC system with noise cancelling abilities.

"A further advantage of using both ANC and a hearing aid circuitry is that noise contributions from a specific frequency range may be reduced. A conventional hearing aid circuitry can not reduce acoustic signals more than what is achieved by turning off the amplification in a particular frequency band. But when combining a hearing aid circuitry and an ANC system, the ANC makes it possible to reduce the amplification to an even lower level or lower response than the 'occluded' response, which is the sound pressure level in the residual space, when at least a part of the hearing device is inserted into the ear canal and the gain turned off.

"An example to illustrate this: if in the occluded response the frequency range from 700 to 1100 Hz is dominated by a noise signal of 80 dB SPL (sound pressure level), and the frequency range above 1100 Hz is dominated by a desired signal, i.e. speech, at 60 dB SPL, then a conventional hearing device would need to amplify the signals above 1100 Hz with 30 dB to get 10 dB SNR (signal-to-noise ratio). If the ANC reduced the direct sound by 15 dB, then the occluded response from 700 to 1100 Hz would be 65 dB SPL, and then the hearing device would only need to amplify the bands above 1100 Hz with 15 dB gain instead of 30 dB gain to get 10 dB SNR. Or alternatively if the hearing device amplifies 30 dB, then the SNR becomes 25 dB. Additionally, an improved dynamic range is achieved, since the dynamic range is the ratio between noise and the most powerful signal.

"In one embodiment the hearing device system may further comprises an audio streaming control unit adapted to receive, and optionally process, a second audio signal from an audio streaming device. Alternatively, the

hearing device system may comprise an audio streaming device for generating the second audio signal.
"Consequently, it is an advantage that the hearing device system may comprise both a hearing aid circuitry, active noise cancellation and means for receiving an audio signal from an audio streaming device. Noise, such as background noise from e.g. cars, aircrafts etc, can be a problem to hearing device users. When a user is in a noisy environment, the hearing device may perform active noise cancellation, and at the same time it may be advantageous for the user to listen to music, radio etc from the audio streaming device. In some embodiments, the combiner unit may thus further be adapted to combine the, optionally processed, second audio signal with the active noise cancellation signal.
"The noise cancellation performed by the ANC system will together with the streamed audio signal result in an improved signal-to-noise ratio (SNR) for the user, since unwanted audio noise will be cancelled or reduced while a desired audio signal is streamed directly to the output transducer(s), e.g. loud speaker(s), in the ear canal(s) of the user.
"The audio streaming device may be such as a radio transmission, a music player such as a MP3 player, a mobile phone, audio transmission from a TV and/or the like.
"The audio streaming device may e.g. be wirelessly connected or wire-connected to the hearing device.
"The hearing aid circuitry may be fully functional when the ANC system is active. The hearing aid circuitry may also be in a condition where the audio streaming device transmits audio signals to the hearing device, so that the user can listen to e.g. music.
"The user may choose to listen to e.g. music when there is much noise in the surroundings, but the user may also choose to listen to music, radio, TV etc. even though there is not any noise in the surroundings. It is understood that the audio streaming device may be used for any purpose at any time, e.g. listening to music, mobile phone usage etc.
"Furthermore, it is understood that the hearing device may be used by hearing impaired users and/or non-hearing impaired users. If the hearing device is used by a hearing impaired user, the signal processor is adapted to process all received audio signals, both from the input transducer(s) and from the audio streaming device, according to the user's hearing loss. In addition to this, the ANC system will cancel noise from the surroundings.
"Applications for hearing-impaired users may be: hearing aid circuitry and ANC, hearing aid circuitry, ANC and audio streaming device in order to improve SNR.
"If the hearing device is used by a non-hearing impaired user, the ANC system will cancel noise from the surroundings, and the user may use the audio streaming device for mobile phone usage, listening to music, radio etc.
"Applications for non-hearing impaired users may be: ANC, ANC and audio streaming, security personal, headset(s) in the ear(s), for people in noisy environment,
"In one embodiment a hearing device system is disclosed wherein the at least one active noise cancellation unit may be analogue.
"An advantage of this embodiment is that the analogue ANC will cancel, reduce or attenuate the direct sound, which is the sound through the hearing device vent and possible leakage between the ear mould and the ear canal, and this will result in a reduced comb filter effect. The comb filter effect occurs when a delayed version of a signal is added to the signal itself, which causes constructive and destructive interference. The comb filter effect occurs in digital hearing devices, because the delay through the digital hearing device processing path and the direct sound through the vent will result in acoustic interference, since some frequencies are cancelled out due to same level and opposite phase of direct sound through the vent and the delayed sound through the digital hearing device.
"Another way to solve the problem of the comb filter effect would be by reducing the vent size, but a side effect of reducing the vent size is that occlusion is increased. When the hearing device user speaks there will be a

build-up of low frequency sound conducted via the skull and head tissue to the residual space in the ear canal behind the hearing device. This build-up of sound produces the so-called occlusion effect.
"So by using the effect of the ANC to reduce the direct sound though the vent and thereby reducing the comb filter effect, reduction of vent size may not be necessary and occlusion may thereby be avoided.
"Furthermore, if a digital hearing aid circuitry is operated as an ANC system, the delay through the electronics should be very low due to the sound parsed through the vent, because the delay in the signal processing should be comparable with the delay of sound entering through the vent in order for the noise cancellation to take place. In an analogue ANC system there is a low delay, which is an advantage for achieving a well-functioning ANC system. So by having an analogue signal path as in this embodiment, the delay will be low.
"In some embodiments the hearing device system may further comprise a digital feed-back cancellation unit. In one embodiment, the digital feedback cancellation unit is adapted to adjust gain in the active noise cancellation filter.
"The gain in the ANC filter may need to be adjusted according to the openness, vent size and/or leakage ('effective vent') of the individual hearing device in a specific ear, and these parameters can be dynamically changing. The digital feed-back cancellation (DFC) is a dynamic system that continuously estimates the feed-back path of the hearing aid circuitry, which is the transfer function through the output transducer into the vent, out of the vent and through the input transducer.
"An advantage of this embodiment is that the transfer function contains information about how open the vent is and may therefore be used to update the gain of the ANC filter.
"This application may be used for ANC systems like analogue feed-forward ANC systems, analogue feed-back ANC systems, digital feed-forward ANC systems, digital feed-back ANC systems and/or combinations thereof.
"In one embodiment a hearing device system is disclosed which further may comprise a digital feed-back cancellation unit adapted to adjust the filter characteristics of the active noise cancellation filter.
"An advantage of this embodiment is that the filter characteristics, such as frequency response, of the ANC filter may be adjusted according to the DFC. This application may also be used for ANC systems like analogue feed-forward ANC systems, analogue feed-back ANC systems, digital feed-forward ANC systems, digital feed-back ANC systems and/or combinations thereof.
"Typically, in conventional hearing devices an adaptive and adjustable system is obtained by implementing an extra microphone, a so called error microphone, which can receive and communicate 'error signals' in the hearing device. By implementing a DFC system, which may adjust and adapt gain and/or filter characteristics in the ANC filter, an error microphone in the hearing device may be omitted.
"It is to be understood that any suitable kind of acoustical feedback path estimator may be implemented in order to obtain the feedback estimation and cancellation.
"In one embodiment the hearing device system may further comprise an output automatic gain control (AGC) unit. In a conventional hearing aid the vent limits how powerful the sound pressures generated by the output transducer may be at low frequencies. The maximum output from the output transducer will easily be reached at low frequencies, e.g. 90-95 dB at 200 Hz and 100-115 dB at 1 kHz. Consequently, it is an advantage of this embodiment that by implementing an AGC in the hearing device, it may be ensured that the output transducer does not cut at powerful sound pressures in the low frequency region, and at the same time a high dynamic region is retained at high frequencies.
"In one embodiment the hearing device system may further comprise a pulse width modulation unit adapted to perform pulse width modulation of the combined signal.
"In one embodiment the hearing device system may further comprise a pulse density modulation unit adapted to perform pulse density modulation of the processed electric audio signal.
"An advantage of these embodiments is that pulse width modulated signals and pulse density modulated signals allow the exploitation the benefits of class C/D operation, thus providing increased efficiency and low

power consumption.
"Further embodiments are disclosed in the dependent claims.
"According to one aspect a method of improving noise cancellation in a hearing device system, the method comprising the steps of converting a first audio signal to an electric audio signal by an input transducer; processing the electric audio signal by at least partially correcting for a hearing loss of the user by a signal processor; generating from at least said processed electric audio signal a sound pressure in an ear canal of the user by an output transducer, whereby the generated sound pressure is at least partially corrected for the hearing loss of the user; providing an active noise cancellation signal adapted to perform active noise cancellation of an acoustical signal entering the ear canal in addition to said generated sound pressure by at least one active noise cancellation unit; wherein the method further comprises the step of combining the processed electric audio signal with the active noise cancellation signal by a combiner unit to obtain a combined signal and providing the combined signal to the output transducer.
"The present invention relates to different aspects including the hearing device described above and in the following, and corresponding methods, devices, and/or product means, each yielding one or more of the benefits and advantages described in connection with the first mentioned aspect, and each having one or more embodiments corresponding to the embodiments described in connection with the first mentioned aspect and/or disclosed in the appended claims."
For more information, see this patent: Jorgensen, Ivan; Rasmussen, Karsten Bo; Petersen, Svend Oscar. Active Noise Cancellation in Hearing Devices. U.S. Patent Number 8229127, filed July 15, 2008, and issued July 24, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=37&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1848&f=G&l=50&co1=AND&d=PTXT&s1=20120724.PD.&OS=ISD/20120724&RS=ISD/20120724
Keywords for this news article include: Oticon A/S, Electronics, Signal Processing.

Publication date: Aug 8, 2012

Year: 2012

Sound Bites

Author: Bouton, Katherine

Publication info: New York Times , Late Edition (East Coast) [New York, N.Y] 03 Aug 2012: A.21.
ProQuest document link

Abstract: Three years ago, when a hearing aid no longer helped in my worse ear, I got a cochlear implant, the height of hearing technology. [...]in that same environment, a hearing-impaired person will hear chairs scraping, dishes clanking, waiters shouting, all of it bouncing off the high ceilings, the bare walls, the chic metallic tables and chairs -- an anxiety-provoking wall of noise.

Full text: "NO one told me it was going to be this noisy," says a young woman who is going deaf in Nina Raines's play "Tribes." If you have a hearing aid, the world is, paradoxically, far noisier than it is for a person with normal hearing. The human ear is a miraculous thing. It can filter out the roar at Madison Square Garden

while homing in on the voice of the person in the next seat. A hearing aid can't do that. The only way to really filter out noise is simply to turn it off.

Americans are increasingly aware of the dangers of noise, the single largest cause of hearing loss, but we are less aware of the way it further handicaps those of us who already have hearing loss.

I began to lose my hearing in my early 30s, for reasons no one has been able to determine. My hearing loss is progressive, and in 2002 I finally gave in to the inevitable and got hearing aids. I bought new ones -- at $3,000 apiece, with little or no insurance reimbursement -- every two or three years as my hearing deteriorated. Three years ago, when a hearing aid no longer helped in my worse ear, I got a cochlear implant, the height of hearing technology. I hear well enough now that I'm unlikely to get run over by a car coming up behind me. But, like the hearing aid in my other ear, the implant is nowhere near as good as a human ear -- either for hearing or for filtering out what I don't want to hear.

In a noisy environment like a restaurant, a person with normal hearing will still be able to hear his companion. But in that same environment, a hearing-impaired person will hear chairs scraping, dishes clanking, waiters shouting, all of it bouncing off the high ceilings, the bare walls, the chic metallic tables and chairs -- an anxiety-provoking wall of noise. Worst of all is the restaurant's background music, sometimes competing with a different sound track throbbing in the kitchen.

Earlier this week I had dinner with my husband and sister (both with normal hearing) and my daughter, son and niece, all 20-somethings, in a popular Brooklyn restaurant. It was my birthday and I had a great time, enjoying my family and the good food, but I didn't hear one word said at the table. My daughter occasionally texted me a shorthand version of the conversation.

When my hearing loss was more moderate, I'd simply take off my hearing aid if it got too loud, setting it on the edge of the plate or on the table. But that can lead to unfortunate results. The ex-husband of a friend once popped his into his mouth, thinking it was a piece of bread. The best solution is to eat with just one or two other people, both facing you, so that you can supplement the sounds you hear with what you see. That's enough to keep a social conversation going. If I really must hear what the other person is saying, I schedule the meeting in an office or at home.

Even for those with normal hearing, dining and talking are becoming mutually exclusive. Noise is the second most common complaint about restaurants, according to Zagat, following poor service. The first thing that anyone asks me when I say I'm writing a book about hearing loss is whether I can recommend a quiet restaurant. Booths, tablecloths and carpeted floors are a good start. A corner table helps. Sit with your back to the wall.

Noise causes hearing loss, and hearing loss itself is bad for your health. There are 48 million hearing-impaired Americans, over 15 percent of the population. Those affected include teenagers (nearly 20 percent of whom experience some level of hearing loss), people ages 19 to 44 (the most common period for the onset of hearing loss), and the elderly. Hearing loss is itself associated with depression, dementia and even heart disease.

Some researchers speculate that what we think of as age-related hearing loss is merely the accumulated damage of a lifetime of noise. Studies in Sudan and Easter Island in the '60s and '80s, respectively, have found populations where age-related hearing loss seemed nonexistent or limited. Though there may be genetic explanations, there was a marked difference between the hearing of Easter Islanders who had lived only on the island and those who had spent some years on the industrialized mainland.

I'm the first to acknowledge that noise has its place. What would "Bring In da Noise, Bring In da Funk" have been without the percussive clatter of those tapping feet? Who wants to go to a sports event where the crowd is silent? The stomp of a tyrannosaurus in Sensurround, the excited din of a good party, the bustle of a popular restaurant, the audible energy of a city. Noise is an integral part of any of these. But it can still be noisy without being literally deafening.

We need to quiet things down a bit for everyone, but especially for those who are already deafened. Webster's

defines noise as sound "that lacks agreeable musical quality or is noticeably unpleasant." That's a subjective definition. What's music to your ears is almost always noise to mine.

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KATHERINE BOUTON Katherine Bouton, a former editor at The New York Times, is the author of the forthcoming book "Shouting Won't Help: Why I -- and 50 Million Other Americans -- Can't Hear You."

Illustration

Drawing (Drawing by Aesthetic Apparatus)

Publication date: Aug 3, 2012

Year: 2012

Neuroanatomical correlates of tinnitus revealed by cortical thickness analysis and diffusion tensor imaging

Author: Aldhafeeri, Faten M; Mackenzie, Ian; Kay, Tony; Alghamdi, Jamaan; Sluming, Vanessa

Publication info: Neuroradiology 54.8 (Aug 2012): 883-92.
ProQuest document link

Abstract: Tinnitus is a poorly understood auditory perception of sound in the absence of external stimuli. Convergent evidence proposes that tinnitus perception involves brain structural alterations as part of its pathophysiology. The aim of this study is to investigate the structural brain changes that might be associated with tinnitus-related stress and negative emotions. Using high-resolution magnetic resonance imaging and diffusion tensor imaging, we investigated grey matter and white matter (WM) alterations by estimating cortical thickness measures, fractional anisotropy and mean diffusivity in 14 tinnitus subjects and 14 age- and sex-matched non-tinnitus subjects. Significant cortical thickness reductions were found in the prefrontal cortex (PFC), temporal lobe and limbic system in tinnitus subjects compared to non-tinnitus subjects. Tinnitus sufferers were found to have disrupted WM integrity in tracts involving connectivity of the PFC, temporal lobe, thalamus and limbic system. Our results suggest that such neural changes may represent neural origins for tinnitus or consequences of tinnitus and its associations.[PUBLICATION ABSTRACT]

Full text: Neuroradiology (2012) 54:883892 DOI 10.1007/s00234-012-1044-6

FUNCTIONAL NEURORADIOLOGY

Neuroanatomical correlates of tinnitus revealed by cortical thickness analysis and diffusion tensor imaging

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Jamaan Alghamdi &Vanessa Sluming

Received: 23 February 2012 /Accepted: 25 April 2012 /Published online: 22 May 2012 # Springer-Verlag 2012

AbstractIntroduction Tinnitus is a poorly understood auditory perception of sound in the absence of external stimuli. Convergent evidence proposes that tinnitus perception involves brain structural alterations as part of its pathophysiology. The aim of this study is to investigate the structural brain changes that might be associated with tinnitus-related stress and negative emotions.

Methods Using high-resolution magnetic resonance imaging and diffusion tensor imaging, we investigated grey matter and white matter (WM) alterations by estimating cortical thickness measures, fractional anisotropy and mean diffusivity in 14 tinnitus subjects and 14 age- and sex-matched non-tinnitus subjects.

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Results Significant cortical thickness reductions were found in the prefrontal cortex (PFC), temporal lobe and limbic system in tinnitus subjects compared to non-tinnitus subjects. Tinnitus sufferers were found to have disrupted WM integrity in tracts involving connectivity of the PFC, temporal lobe, thalamus and limbic system. Conclusion Our results suggest that such neural changes may represent neural origins for tinnitus or consequences of tinnitus and its associations.
Keywords Tinnitus . Cortical thickness . DTI . MRI . Brain
Introduction
Tinnitus is a disruptive auditory perception of sound in the absence of any acoustic stimuli [1]. Statistics from the Royal National Institute for Deaf People (London, UK) indicated that 13 million people in the Western Europe and the USA seek medical assistance regarding their tinnitus [2]. Experiencing tinnitus chronically has negative associations such as anxiety, depression and attention deficits, all of such disorders making tinnitus more complex than experiencing only a sound [1]. This has raised the demand for finding a cure for tinnitus; although there are pharmaceutical treatments for tinnitus on the market, none are curative and many have side effects [3]. The big challenge in finding a cure for tinnitus is embodied in the fact that there is no consensus regarding the neurophysiological substrates of tinnitus. Even though many studies on animals [4] and humans [5] have been conducted, the exact neuro-physiological mechanism of tinnitus is still poorly understood.

Table 1 Inclusion/exclusion criteria for tinnitus patients
Inclusion/exclusion criteria
1. Hearing loss should be no worse than 40 dB HL at 2 kHz and 60 dB HL at 4 kHz
2. No conductive hearing loss3. Newman THI for new and existing tinnitus patients 384. Symmetrical hearing loss <15 dB asymmetry up to 4 kHz5. No severe health problems, no head injuries or no known neurological disorders (acoustic neuroma)
Functional neuroimaging studies on humans have provided evidence for a distributed cortical network associated with tinnitus perception. Abnormal functioning in auditory areas [6] and non-auditory areas such as the limbic system [5], amygdala [7] and prefrontal cortex (PFC) [8] were reported in studies involving tinnitus sufferers. Brain structural studies have added valuable information regarding the structural alterations as part of tinnitus pathophysiological mechanism. Grey matter (GM) reduction was reported in the subcallosal region [9], the inferior colliculus and hippocampus [10] and the PFC [11]. Reduced integrity of the brain white matter (WM) that connects the auditory cortex with the PFC has been reported only in a single study [12]. It seems, to some extent, that certain brain regions are involved in tinnitus perception, including the auditory cortex, limbic system and PFC.
In the current study, we investigated cortical thickness alterations utilising cortical thickness analysis (CTA) which relies on an unbiased computational algorithm [13]. We have also investigated brain WM integrity by diffusion tensor imaging (DTI) in tinnitus sufferers compared to normal healthy controls. To the best of our knowledge, this is the first study investigating morphological alterations in the cortical thickness measurement estimation in tinnitus population and also the first one combining CTA with DTI on the same population compared to normal controls. We hypothesised that tinnitus sufferers would demonstrate both cortical thickness

alterations and disrupted brain WM integrity, particularly in regions involved in sound perception, emotions and attention. We used user-independent, semi-automated computational algorithms to avoid any errors that might arise from different observers when measuring cortical thickness. Our study aims to determine brain GM and WM changes that are associated with tinnitus, thus, improving current and future treatment strategies.

Experimental procedure

Subjects

This study has an ethical approval from Sefton Research Ethics, Liverpool, UK. Between November 2009 and March 2011, 14 patients suffering from tinnitus have been recruited from audiology clinics at Aintree University Hospitals NHS Foundation Trust, Liverpool, UK. Patients inclusion criteria are summarised in Table 1. For comparison, 14 healthy volunteers were recruited. All volunteers were assessed by an audiologist to ensure that they all have normal hearing thresholds (HT). Patients and volunteers characteristics are listed in Table 2. To exclude acoustic neuroma, all subjects were scanned using a high-resolution magnetic resonance imaging (MRI) sequence on the internal auditory meatus. After detailed explanation of the experimental procedure and reading the a priori-provided information sheet, all subjects gave written informed consent. All scans were sent to the Walton Centre NHS Foundation Trust and reported by radiologists. None of subjects from both groups have had neurological disorders.

Image acquisition

For CTA, three-dimensional (3D) high-resolution structural MR volumes were acquired using the Symphony1.5-T whole-body MRI imaging system (Siemens, Magnetom, Erlangen, Germany). The acquisition parameters were field of view of 256 mm, flip angle of 8, slice thickness of 1 mm and matrix size of 256256 mm, giving a voxel size of 111 mm. TR and TE were 1,660 and 3.04 ms, respectively.

For DTI, a single-shot echo-planar imaging sequence (TR08,000 ms, TE0111 ms) was used. Diffusion gradients were applied in 60 directions (b01,000 s/mm2) together with 5 non-diffusion acquisitions (b00 s/mm2). For each

Table 2 Patients and controls characteristics

Characteristics Controls (n014)

Tinnitus (n014)

Age (years)

Range 3060 3060 Mean SD 46.58.76 49.58.28 GenderMale 9 8Female 5 6Tinnitus duration (years) 6.088.47

Average Newman score (mean SD) 58.414.05

Fig. 1 Cortical thickness overlaid on the volume map. The colour bar shows thickness in millimetres

DTI scan, 50 axial slices were acquired, with a slice thickness of 2.5 mm and no slice gapping.

Image analysis

CTA

Image analysis was performed using the BrainVoyager QX software package version 2.2 (Brain Innovation, Maastricht, The Netherlands). T1-weighted images were corrected for inhomogeneities to improve brain segmentation. All anatomical data were transformed to ACPC and then to Talairach (TAL) standard space as a preparatory step for the preprocessing pipeline of the CTA. TAL images were transformed into 0.50.50.5-mm resolution using sinc interpolation. Then, brains were peeled from surrounding head tissue using the advanced segmentation tools implemented in BV. Cerebellum and subcortical structures were removed, and tissue contrast and homogeneity were enhanced using sigma filter. WMGM boundary and GMcerebrospinal fluid (CSF) boundary were segmented and then polished by computing the magnitude map which is based on the calculated gradient maps of the binary segmentation results. Cortical thickness volume maps were calculated for every subject (Fig. 1). Because it is not possible to do group study based on cortical thickness volume maps, reconstructed folded cortical representation for each subject was created. To improve the spatial correspondence between different subjects and different populations, the reconstructed folded cortical

representations (meshes) for each subject and each hemisphere were cortically aligned
matching the macro-anatomical structures such as gyri and sulci. Cortical thickness was then calculated for each cortically aligned mesh for each subject. Whole brain, corrected for multiple comparison applying false discovery rate (FDR) at $p<0.05$, and a priori-defined regions of interest (ROIs) approaches were applied in this study using the brain atlas provided by BrainVoyager QX [13], which contained four defined lobes: frontal, temporal, occipital and parietal lobes. From these four lobes, we only investigated the bilateral frontal and temporal lobes (see Fig. 2). ROIs included (bilaterally): superior frontal gyri, middle frontal gyri, inferior frontal gyri, superior temporal gyri, middle temporal gyri, inferior temporal gyri, anterior cingulate cortex, cingulate gyri, posterior cingulate cortex and primary auditory cortex (BA41) (see Fig. 3). The selection of lobes and ROIs were based on previous functional MRI and voxel-based morphometry (VBM) studies on tinnitus [10, 11, 14]. We hypothesised that tinnitus sufferers will exhibit brain structural deficits in brain regions involved in hearing, emotions and attention. On that basis, we have selected the PFC and the temporal lobe at lobule level and then we went into deeper analysis to include their gyri in addition to the limbic system.

Statistical analyses for the CTA were performed using SPSS v. 20 (SPSS Inc., Chicago, IL, USA). Using SPSS, we performed analysis of covariance (ANCOVA) with thicknesses as dependant variables, tinnitus versus controls as independent variable and age, tinnitus duration and tinnitus severity measured by the Newman score as covariance. ANCOVA allowed us to measure differences between groups while statistically controlling other factors such as age, tinnitus duration and severity which could have an impact on the results.

DTI

The DTI dataset were corrected for eddy current distortion and motion using FDT (FMRIBs toolbox) as part of the FMRIB Software Library (FSL), Oxford, UK (available free

Fig. 2 ROIs. This figure shows the selected lobes in both hemispheres, the frontal lobe (red) and the temporal lobe (blue)

between the HT in the right and left ear (t00.5, p00.6).

Fig. 3 ROIs. This figure shows the a priori-hypothesised ROIs in both hemispheres (this figure illustrates the right hemisphere for visualization only). ROIs included (bilaterally) the superior frontal gyrus (SFG), middle frontal gyrus (MFG), inferior frontal gyrus (IFG), superior temporal gyrus (STG), middle temporal gyrus (MTG), inferior temporal gyrus (ITG), primary auditory cortex (PAC), anterior cingulate cortex (ACC), cingu-late gyrus (CG), posterior cingulate gyrus (PCG) and parahippocampal gyrus (PHG)

online at http://www.fmrib.ox.ac.uk/fsl/

Web End =http://www.fmrib.ox.ac.uk/fsl/ , release 4.1.3). The brain extraction tool was used to remove extra-cerebral tissues such as the skull and eyes. For the fractional anisotropy (FA) and mean diffusivity (MD) calculations, DTI images were imported to BrainVoyager QX software package version 2.2 (Brain Innovation, Maastricht, The Netherlands). Firstly, DT images were co-registered on a high-resolution 3D volume acquired on the same session applying the 12-parameter affine alignment. Then, a volume diffusion-weighted dataset was created for each subject using sinc interpolation. FA and MD maps were then calculated in native space after applying brain mask to remove noise outside the brain. As a preparatory step for group analysis, FA and MD maps were transformed into ACPC, then TAL spaces. Statistical analysis was performed on two approaches: whole brain analysis applying FDR corrected for multiple comparisons and thresholded p value of <0.005 with a minimum cluster of 10 contiguous voxels. Significant clusters from ANCOVA RFX were labelled with reference to JHU-ICBM-DTI WM labels, part of the FSL atlas tools (see Fig. 4). Age, tinnitus severity and duration were considered as covariants.

Results

Demographics

There were no differences between tinnitus sufferers and controls in the mean age (t01.4, p00.17) and HT (right

ear, t00.7, p00.6; left ear, t00.2, p00.75). There was no significant difference within the tinnitus group

CTA

Whole brain analysis using FDR with $p<0.05$ corrected for multiple comparisons did not reveal any significant difference in the cortical thickness between tinnitus and control groups.

Predefined ROIs

Significant cortical thickness reduction in the bilateral temporal and frontal lobes was found in tinnitus patients when compared with controls (see Table 3).

The results of the regional ROI analysis are presented in Table 4. In the right hemisphere, there were significant cortical thickness reductions in the tinnitus group compared

Fig. 4 Main WM tracts with which significant clusters from group comparisons labelled with

Table 3 Patients versus controls ANOVA of the frontal and temporal lobes

Thicknesses are displayed as the mean standard error (SE) in millimetres

Lobe Patients (mean SE) Controls (mean SE) p value

Right frontal lobe 2.70.078 30.075 0.045 Right temporal lobe 2.90.071 3.20.06 0.004 Left frontal lobe 2.80.09 2.90.07 0.03 Left temporal lobe 2.90.07 3.10.07 0.025

to the control group in the superior, middle and inferior frontal gyri, anterior cingulate cortex, cingulate gyrus, superior, middle and inferior temporal gyri and right primary auditory cortex (BA41).

In the left hemisphere, significant cortical thickness reduction was found in the inferior frontal gyrus, cingulate gyrus extending to the posterior segment of this gyrus and superior temporal gyrus in the tinnitus group compared to the non-tinnitus controls (Fig. 5).

CTA correlations

No correlations were found between cortical thickness in the frontal and temporal lobes and other measures in either

tinnitus or control groups (age, HT) and between thickness in the frontal and temporal lobes and tinnitus severity or duration in the tinnitus group.

For tinnitus sufferers, significant negative correlation was found between the HT and cortical thickness of the right primary auditory cortex (r00.7, p00.01 and 0.006 for the HT in the RE and the LE, respectively). No correlation was found between Newman Tinnitus Handicap Inventory (THI) score and cortical thickness measures in any ROIs. In the left hemisphere, no correlation between HT in both ears and cortical thickness measures was found. GM volume did not correlate with any of these measures in the tinnitus group. There was no significant correlation between behavioural measures, CTA of any ROI and GM volume in the control subjects (Fig. 6).

Table 4 Patients versus controls ANCOVA of cortical thickness of the a priori-defined ROIs

Region Patients(mean SE)

Controls (mean SE)

p value TAL coordinates (x, y, z)

Right hemisphere

Superior frontal gyrus 2.60.3 2.90.4 0.05 12, 10, 58 Middle frontal gyrus 2.70.36 3.10.45 0.027 46, 29, 24 Inferior frontal gyrus 2.80.51 3.20.57 0.061 47, 17, 6 Anterior cingulate cortex 2.30.27 2.60.14 0.003 5, 44, 4 Cingulate gyrusa 2.60.2 2.70.2 0.012 10, 24, 26 Posterior cingulate gyrus 2.40.53 2.60.25 0.23 6, 55, 24 Parahippocampal gyrus 3.40.24 3.40.36 0.8 14, 4, 11 Superior temporal gyrusa 2.60.36 3.040.41 0.028 48, 5, 1 Middle temporal gyrus 2.80.34 3.30.43 0.004 46, 56, 4 Inferior temporal gyrus 3.20.52 3.60.73 0.11 44, 30, 15 Primary auditory cortex (BA41) 2.30.31 2.90.7 0.043 41, 30, 10 Left hemisphereSuperior frontal gyrus 2.70.06 2.80.05 0.13 10, 58, 15 Middle frontal gyrus 2.70.07 2.80.07 0.34 32, 28, 33 Inferior frontal gyrus 2.70.06 30.06 0.02 8, 56, 17 Anterior cingulate cortex 2.60.12 2.90.11 0.07 12, 21, 5 Cingulate gyrusa 2.70.048 2.90.046 0.05

17, 1, 43
Posterior cingulate gyrus 2.70.15 3.10.13 0.012 2, 44, 26 Parahippocampal gyrus 3.20.02 3.40.032 0.32 18, 2, 16 Superior temporal gyrusa 2.60.06 2.90.06 0.02 57, 8, 5 Middle temporal gyrus 2.60.1 2.90.09 0.15 59, 5, 12 Inferior temporal gyrus 3.10.16 3.50.15 0.17 57, 11, 19 Primary auditory cortex (BA41) 2.40.09 2.60.08 0.07 38, 24, 12
Thicknesses are displayed as the mean SE in millimetres
aSignificant findings in bilateral structures

Fig. 5 Two examples of cortical thickness maps of the right hemisphere. The left one shows the cortical thickness map of a healthy control and the right shows the tinnitus thickness map
DTI (Tables 5 and 6; Figs. 7 and 8)
DTI correlations
No significant correlations were found between FA, MD and age, HT in both groups and THI in tinnitus patients.
Discussion
Results of the present study revealed the following: (1) tinnitus patients have both cortical thickness reductions and reduced integrity of the WM in the right PFC vicinity,(2) tinnitus patients relative to controls showed reduced thickness and disrupted connectivity of the bilateral temporal lobes, including the right auditory cortex, (3) tinnitus subjects versus controls subjects ANCOVA revealed reduced cortical thickness in the limbic system and (4) reduced WM integrity of the corpus callosum (CC) was observed in tinnitus subjects compared to controls subjects.
Cortical thickness reductions in the PFC (superior and middle frontal gyri) have been reported in post-traumatic stress disorder (PTSD) sufferers [15], adding another similarity between PTSD and tinnitus perception to those discussed by Fagelson [16] and Moller et al. [17]. Attention deficits were also found to be associated with cortical thickness reductions in the dorsolateral PFC (DLPFC) [18]. A deficit in the PFC WM integrity has been reported in major depressive disorder [19, 20] and attention deficit hyperactivity disorder (ADHD) [21], symptoms of which are comparable to the negative associations experienced by patients suffering with tinnitus. The nature of that disruption the WM was a decrease in the FA and an increase in the MD in the orbitomedial segment of the PFC in ADHD sufferers. Similarly, our findings revealed reduced FA of the inferior fronto-occipital fasciculus that connects the frontal and the occipital lobes. Functional alterations in the PFC have been stated in many neuroimaging studies involving tinnitus patients [8, 14, 22]. The theoretical neurophysiological model of tinnitus which was proposed by Jastreboff [23]
considers the PFC as one of the major compartments of the model that should be involved to perceive tinnitus. This postulation is structured on the fact that tinnitus sufferers have reported cognition, memory and attention deficits [1, 24], all of such functions being organised by the PFC [25]. Hence, the cortical thickness reduction and the disrupted connectivity of the PFC with other cortical neocortical regions might not be due to attention-related deficits only, but rather it might be associated with the negative emotions experienced by tinnitus sufferers as well. The PFC, specifically the DLPFC, has a major role in working memory functions [26]. Tinnitus patients were reported to have impairments in the working memory [27]. Thus, we believe that the reduction in the cortical thickness and cortical connectivity in such region in our tinnitus group compared to the controls might be an underlying neurodegenerative mechanism of tinnitus perception and its negative associations. Although some studies have reported structural changes in tinnitus sufferers by means of VBM [9, 10], only Leaver et al. [11] have found structural changes in the
Fig. 6 Scatter plot showing the correlation analysis between cortical thickness alterations and hearing thresholds (HT) in both right ear (RE) and left ear (LE) in the right primary auditory cortex in the tinnitus group

Table 5 ANCOVA RFX of the FA, controls >patients

Statistical threshold set at p<0.005 uncorrected for multiple comparisons with a minimum cluster of 10 contiguous voxels
Region Peak voxels in TAL coordinates t p value
x y z
Right hemisphere
PFC
Inferior fronto-occipital fasciculus (medial frontal gyrus, BA9)
4 55 14 4.2 0.0003
CC
Body 3 15 25 3.4 0.001 Splenium 3 38 14 3.6 0.001 Left hemisphereSuperior longitudinal fasciculus 42 37 12 4.5 0.0001 ILF 37 52 11 4.3 0.0002 Anterior thalamic radiation 26 31 1 3.9 0.0005

ventromedial PFC, while others found these differences in auditory and non-auditory areas such as the thalamus.

The primary auditory cortex which lies on the temporal lobe has been strongly linked to tinnitus perception as it is considered the provider of tinnitus signal [1]. Many theorists believe that tinnitus perception is conditioned by a dysfunction in the auditory cortex [23, 28]. Functional neuroimaging studies on the tinnitus population have reported abnormal functioning of the auditory cortex [29, 30]. Structural MRI studies have revealed GM reduction in the auditory cortex [10] and reduced volume of Heschls gyrus in the tinnitus population [31]. Findings from the present study which demonstrate cortical thickness reduction in the right primary auditory cortex (part of which is Heschls gyrus) are in agreement with the previously reported findings. The inferior longitudinal fasciculus (ILF), which also demonstrated reduced integrity in the tinnitus sufferers group, connects the occipital lobe with the anterior region of the temporal lobe. The functional role of the ILF is believed to arbitrate the fast transfer of visual signals between visual areas, anterior temporal region, parahippocampal gyrus and amygdala as a projection or back-projection processes [32]. From the latter, it has been suggested that the ILF is

responsible for the enhancement of emotionally significant visual stimuli via mediating the transfer of back visual signals from the amygdala to the early visual areas. Disrupted integrity of such connectivity between these regions combined with altered GM morphology might be responsible for the negative emotional aspects of tinnitus. Jastreboff [1] has suggested the involvement of the limbic system in tinnitus perception which he evidenced from negative emotions complained by tinnitus sufferers.

In accordance with the involvement of the limbic system connectivity as revealed by disrupted integrity of the ILF, CTA have revealed altered topography of the limbic system in tinnitus sufferers compared to the controls. Negative emotions such as depression and anxiety, which are under the control of the limbic system, are commonly reported to be associated with tinnitus perception [1]. Abnormal functioning in the limbic system has been demonstrated in several neuroimaging studies on tinnitus sufferers [5, 8]. However, such patterns of activations are believed to represent, indirectly, a neural plasticity associated with tinnitus. With regard to structural alterations that are thought to be associated with tinnitus, Muhlau et al. have reported GM reduction in the subcallosal region which is part of the

Table 6 ANCOVA RFX MD controls >patients
Statistical threshold set at p<0.005 uncorrected for multiple comparisons with a minimum cluster of 10 contiguous voxels
Region Peak voxels in TAL coordinates t p value
x y z
Right hemisphere
Anterior thalamic radiation 3 18 6 3.5 0.002 Left hemisphereInferior fronto-occipital fasciculus 31 33 2 3.7 0.0007

Fig. 7 ANCOVA RFX FA controls >patients. Statistical threshold set at p<0.005 uncorrected for multiple comparisons with a minimum cluster of 10 contiguous voxels. IFOF inferior fronto-occipital fasciculus, CC corpus callosum, SLF superior longitudinal fasciculus, ILF inferior longitudinal fasciculus

emotional circuit and has a major role in the behavioural responses to environmental stimuli [9].
Although it was not predicted, the body and the splenium of the CC demonstrated reduced FA in tinnitus patients compared to the controls. The CC is the largest tract of WM fibres that connect the two hemispheres. Reduced WM integrity of the CC was reported in sufferers of emotional and cognitive deficits such as bipolar disorder [33], ADHD [34] and PTSD [35]. The importance of the CC is embodied in interhemispheric and intrahemispheric communication and the consequent integration of cognitive, emotional and motor functions. It was proposed that there is a mirror negative image of each hemispheric region on the opposing hemisphere, and the CC interconnects these homologous areas in normal functioning brain [36, 37]. In other words, if a certain region in a given hemisphere has been excited to perform a function, fibres of the CC will act to inhibit functional asymmetry in opposite homotopic region. Split-brain studies reported that those patients have shown conceptual difficulties similar to patients with right hemisphere damage. The deficits due to right hemisphere damage were related to attention and cognition [36, 38], similar also to tinnitus associations. The reason for that is the absence of inhibition from the left to the right hemisphere, although of the normal functioning of the right hemisphere. With regard to the tinnitus pathophysiological mechanism, the reduced integrity of the CC might cause an imbalance between the two hemispheres in terms of simultaneous excitation and inhibition [36, 39]. Therefore, tinnitus signal may arise as a consequence of such improper functioning. The role of interhemispheric connectivity in
tinnitus perception has not yet been identified and future studies are needed to unmask the involvement of the connectivity of the two hemispheres in tinnitus pathophysiological mechanism.
Correlation analysis has revealed an association between HT and cortical thickness alterations in the tinnitus group compared to the controls. Tinnitus sufferers with hearing deficits (high HT) tend to have more cortical thickness reduction compared to tinnitus subjects with low HT (no hearing deficits) in the right primary auditory cortex. The insignificant correlation between HT, FA and MD might be due to the fact that not all of our subjects had hearing loss, although mild hearing deficits were present. Even in sensorineural hearing loss sufferers, the MD was not found be correlated with the severity of hearing impairment, although the FA did [40]. We expected to find a correlation between age, cortical thickness alterations, FA and MD on the basis of previous studies [41, 42] in both groups, but several correlations failed to reach significance. This might be due to the fact that we did not include a wide age range as we only recruited subjects from 30 to 60 years of age. Tinnitus severity measured by the Newman THI showed no statistically significant correlation with cortical thickness, FA, MD and HT. The Newman THI instrument is based on subjective self-reporting of tinnitus impact on daily life. It depends on personal reaction to tinnitus sound, understanding of the term severity and other personal factors [43].
The cortical thickness measurement reflects the status of the GMWM boundary and the cortical mantle itself. Thus, cortical thinning may indicate changes in myelination, neuronal density, GMWM boundary and synaptic truncating
Fig. 8 ANCOVA RFX FA patients >controls contrast. Statistical threshold set at p<0.005 uncorrected for multiple comparisons with a minimum cluster of 10 contiguous voxels. Increased FA in the tinnitus group compared to the nontinnitus group in the right inferior longitudinal fasciculus

[44, 45]. Scientists have identified the cerebrum cortical thickness based on their cellular types, density and neuronal arrangements; therefore, cortical thickness alterations may represent a deviation from their normal cytoarchitecture. Possibly, reduction in the cortical thickness may reflect GM reduction and vice versa. Narr et al. [45] have revealed a strong association between GM concentrations and cortical thickness. On the other hand, the underlying causes of reduced FA in WM tracts do vary as it may reflect loss of connectivity between brain cortical regions, demyelination or dysmyelination of the neuronal axons, changes in WM organisation and changes in WM fibres architecture [46]. The underlying causes of increased FA are unknown; however, it is believed that some factors contribute to FA increase. These factors include increased myelination, deficits in axonal structure or decreased axonal diameter [47].

CTA and DTI provided an evidence of the GM and WM changes associated with tinnitus. The use of semi-automated CTA implemented in the BrainVoyager software made the results user-independent. Thus, this approach reduced the errors that might arise from observer correction of anatomical variations in manual segmentation approaches. CTA by using MRI can be an objective diagnostic test for tinnitus since all the available tools to diagnose subjective tinnitus are self-reported, opening a remarkable future research filed. Gathering results from the current study and previous structural studies on tinnitus patients which revealed GM reduction in different regions, it is revealed that tinnitus perception is associated with structural alterations. Tinnitus sufferers showed significant cortical thickness reductions and disrupted cortical connectivity in regions involved in attention, memory, emotions and auditory functions. Further volumetric studies investigating possible volume deficits in subcortical structures such as the amygdala, PFC and hippocampus or other structural studies investigating possible alterations in the GM and WM are needed to unmask the pathogenesis of tinnitus. Lack of these studies makes it difficult to highlight the conclusive findings about tinnitus perception from a neuroscience point of view. Nonetheless, results from the current study motivate further studies investigating cortical thickness measurements and cortical connectivity in tinnitus. Modelling a recognisable pattern of cortical thickness in tinnitus patients (as in Fig. 5) might be possible if further studies continue from the current study, and definitely, this would help in the diagnosis and treatment of tinnitus.

Limitations

Our study, although it gave an evidence of the involvement of GM and WM integrity in tinnitus, is limited by the relatively small number of tinnitus patients recruited which might explain why we could not see differences when applying the FDR statistical approach (another limitation) which is more conservative but have more statistical significance. The third limitation is embodied in the automatic segmentation process performed by the BrainVoyager. During segmentation, the source of error arises from a possible misclassification of some voxels. In other words, a given voxel may belong to GM and classified as CSF due to limited resolution and, therefore, partial volume effect is encountered. Further CTA and DTI studies on tinnitus sufferers including a larger sample size are needed to investigate the possible role of cortical connectivity and structural alterations in tinnitus pathophysiology.

Conclusion

In summary, the key in finding the ultimate cure for tinnitus relies on understanding the pathophysiological mechanism of its induction. Although many studies, including the current one, have been done on tinnitus, there is no globally agreed definite mechanism. Our study provides the first evidence on alerted cortical topography combined with disrupted cortical connectivity in tinnitus patients. Based on the results from previous neuroimaging studies and ours, it can be said that certain brain regions are more likely to be involved functionally and structurally in tinnitus perception. These regions include the auditory cortex, PFC, limbic system, CC and temporal regions. Future studies are needed to exploit the CTA technique on a larger tinnitus population including pre-treatment and post-treatment sufferers to have more insight into the pathophysiology of tinnitus.

Conflict of interest We declare that we have no conflict of interest.

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Publication date: Aug 2012

Year: 2012

Surefire, LLC; Patent Issued for Hearing Aid Extension

Publication info: Telecommunications Weekly (Aug 1, 2012): 303.

Abstract: According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventor Smith, Richard C. (Costa Mesa, CA), filed on October 8, 2007, was cleared and issued on July 24, 2012. [...]it is desirable to provide an improvement to hearing aids and the like that enhances the comfort and effectiveness thereof."

Full text: 2012 AUG 1 (VerticalNews) -- By a News Reporter-Staff News Editor at Telecommunications Weekly -- According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventor Smith, Richard C. (Costa Mesa, CA), filed on October 8, 2007, was cleared and issued on July 24, 2012.

The assignee for this patent, patent number 8224005, is Surefire, LLC (Fountain Valley, CA).

Reporters obtained the following quote from the background information supplied by the inventors: "Hearing aids for enhancing the ability of the hearing impaired to hear are well known. Hearing aids have a microphone, an amplifier, a battery, and speaker. The microphone picks up ambient sound, such as voices. The amplifier increases the intensity of at least selected portions of the sound so that it can more easily be heard. The battery provides power to the amplifier. The speaker converts an electronic signal from the amplifier into sound at the user's ear.

"Some hearing aids include a filter that tends to reject non-voice sounds. The use of a filter helps make voice more intelligible by at least partially eliminating sound that can interfere with voice. As those skilled in the art will appreciate, some sounds can interfere with voidce in a manner that makes voice more difficult to hear and understand.

"Some hearing aids are analog devices and some hearing aids are digital devices. Analog hearing aids use analog electronic circuitry to amplify and/or filter sound. Digital hearing aids use digital circuitry to amplify and/or filter sound. The use of digital circuitry can provide enhanced control over the hearing aid's ability to reject unwanted sounds.

"Some hearing aids have the microphone, amplifier, battery, and filter located behind the ear and are therefore referred to as behind-the-ear (BTE) hearing aids. Such hearing aids also have a portion that is in the ear. The portion in the ear contains the speaker. The speaker can be located in the conchae or the ear canal.

"Some hearing aids are disposed entirely within the ear and are known as in-the-ear (ITE) hearing aids. A portion of the hearing aid can be located within the conchae and another portion of the hearing aid can be located within the ear canal. Typically, the microphone, amplifier, battery, and filter of ITE hearing aids are located in the conchae and the speaker is located within the ear canal.

"Some hearing aids are disposed entirely within the ear canal and are known as completely-in-the-canal (CIC) hearing aids. The microphone, amplifier, battery, speaker, and filter are all disposed in the ear canal of the user.

"Generally, at least a portion of the speaker is disposed in the ear canal regardless of the type of hearing aid. The entire speaker and other components of the hearing aid can be disposed either completely or partially in the ear canal.

"Although such contemporary hearing aids have proven generally suitable for their intended purposes, they possess inherent deficiencies which detract from their overall desirability and effectiveness. For example, the speaker and any other components of a contemporary hearing aid that are to be disposed in the ear canal are commonly contained within a rigid plastic housing. The rigid plastic housing can press upon and/or abrade sensitive tissues of the ear canal. This can result in irritation and/or damage to these tissues. Further, contemporary hearing aids do not deliver sound sufficiently close to the eardrum so as to be as effective as

desired. Further, contemporary hearing aids are undesirably subject to loosening and even falling out of the ear.

"Further, the rigid plastic housing does not typically seal well against the ear canal, thus allowing unfiltered ambient sound to reach the eardrum. The unfiltered ambient sound includes noise that would otherwise have been mitigated by the hearing aid's filter. This noise makes voice less intelligible and thereby adversely affects the effectiveness of the hearing aid.

"Improper sealing of the hearing aid with respect to the ear canal can also allow amplified sound to escape from the ear canal and be picked up with the hearing aid's microphone. This can result in positive feedback that causes a squeal. The squeal can be very loud to the hearing aid wearer and is extremely annoying.

"As such, although the prior art has recognized, to a limited extent, problems associated with the use of hearing aids, the proposed solutions have, to date, been ineffective in providing a satisfactory remedy. Therefore, it is desirable to provide an improvement to hearing aids and the like that enhances the comfort and effectiveness thereof."

In addition to obtaining background information on this patent, VerticalNews editors also obtained the inventor's summary information for this patent: "Systems and methods are disclosed herein to enhance the comfort, effectiveness, and performance of hearing aids and the like. More particularly, an embodiment of an extension for a hearing aid can comprise a layer of resilient material that is configured to cover at least an inner portion of a hearing aid and that is configured to be inserted into a user's ear canal and can also comprise a strap that is configured to hold the extension onto the hearing aid.

"An embodiment can comprise a hearing aid assembly comprising a hearing aid having at least a portion that is configured to be disposed within a user's ear canal and can also comprise an extension attached to the hearing aid. The extension can comprise a layer of resilient material that is configured to cover at least an inner portion of a hearing aid and that is configured to be inserted into a user's ear canal and can also comprise a strap that is configured to hold the extension onto the hearing aid.

"An embodiment can comprise a completely-in-the-canal (CIC) hearing aid assembly comprising a completely-in-the-canal (CIC) hearing aid and an extension. The extension can comprise a layer of resilient material that is configured to cover at least an inner portion of a hearing aid and that is configured to be inserted into a user's ear canal and can also comprise a strap configured to hold the extension onto the hearing aid.

"An embodiment can comprise an extension for a hearing aid, wherein the extension comprises means for covering at least an inner portion of a hearing aid and also comprises means, such as a strap, for holding the extension onto the hearing aid.

"An embodiment can comprise a method for making an extension for a hearing aid, wherein the method comprises injection molding a resilient material so as to form a layer of resilient material that is configured to cover at least an inner portion of a hearing aid and forming a strap to the resilient material. The strap can be configured to attach the extension to the hearing aid. The strap can be formed either separately form the extension or integrally therewith.

"An embodiment can comprise an extension for a wireless receiver, wherein the extension comprises a layer of resilient material configured to cover at least an inner portion of a hearing aid and configured to be inserted into a user's ear canal and a strap configured to hold the extension onto the hearing aid.

"Benefits include more comfortable use of hearing aids and the like. Comfort is enhanced because the resilient layer cushions sensitive tissue of the ear canal. Flanges can further enhance comfort. The extension, particularly the flanges thereof, can enhance the fit of the hearing aid so as to make the hearing aid substantially less likely to loosen and/or fall out.

"Benefits also include more effective use of hearing aids as the like. The resilient layer and/or the flanges better seal the ear canal so as to substantially inhibit the leakage of ambient noise around the hearing aid and into the ear, as well as to similarly substantially mitigate the leakage of amplified sound around the hearing aid and to

the microphone thereof in a manner that cause squealing. The extension can also deliver sound closer to the eardrum so as to enhance the effectiveness of a hearing aid or the like.
"This invention will be more fully understood in conjunction with the following detailed description taken together with the following drawings."
For more information, see this patent: Smith, Richard C.. Hearing Aid Extension. U.S. Patent Number 8224005, filed October 8, 2007, and issued July 24, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=38&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1855&f=G&l=50&co1=AND&d=PTXT&s1=20120717.PD.&OS=ISD/20120717&RS=ISD/20120717
Keywords for this news article include: Surefire LLC.
Our reports deliver fact-based news of research and discoveries from around the world. Copyright 2012, NewsRx LLC

Publication date: Aug 1, 2012

Year: 2012

Siemens Medical Instruments Pte. Ltd.; Patent Issued for Method and Apparatus for Monitoring a Hearing Aid

Publication info: China Weekly News (Jul 17, 2012): 1237.
ProQuest document link

Abstract: According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventors Joeng, Lilyana (Singapore, SG); Koo, Wee Haw (Singapore, SG); Lim, Meng Kiang (Singapore, SG); Lim, Poh Chye (Singapore, SG), filed on February 13, 2009, was cleared and issued on July 3, 2012.

Full text: 2012 JUL 17 (VerticalNews) -- By a News Reporter-Staff News Editor at China Weekly News -- According to news reporting originating from Alexandria, Virginia, by VerticalNews journalists, a patent by the inventors Joeng, Lilyana (Singapore, SG); Koo, Wee Haw (Singapore, SG); Lim, Meng Kiang (Singapore, SG); Lim, Poh Chye (Singapore, SG), filed on February 13, 2009, was cleared and issued on July 3, 2012.
The assignee for this patent, patent number 8213627, is Siemens Medical Instruments Pte. Ltd. (Singapore, SG).
Reporters obtained the following quote from the background information supplied by the inventors: "Field of the Invention
"The invention relates to a system, to a portable transceiver and to a method for monitoring a hearing aid, and to a hearing aid which is suitable for this purpose.
"For people in the vicinity of a hearing-aid wearer, there is often a problem that they often cannot know whether and what the hearing-aid wearer is perceiving or has perceived acoustically. It is often unclear at this stage whether a hearing-aid wearer has perceived anything at all. Children or older people in particular are frequently unable to indicate what they have heard. It is just as difficult for them to provide information as to whether they are perceiving their environment as quiet or loud, or full of interference noise. It is frequently possible to detect whether a hearing-aid wearer has perceived something acoustically only by gestures or the facial expression of the hearing-aid wearer.
"The effects on the hearing perception which are caused by an individual hearing loss or a suitable hearing aid supply can be made audible by simulation both to those with normal hearing and to those affected by a hearing

disability. Multichannel dynamic expansion systems make it possible to simulate the hearing impression which is produced by an individual hearing loss or by a hearing aid supply, by use of channel-dependent amplification in a plurality of channels, with an additional dependency on the respective input level. This simulation process is also referred to as auralization. By way of example, auralization provides a person with normal healthy hearing with an acoustic impression of the hearing perception of a person with individual hearing loss.

"The parameters which are specific for an individual hearing loss or for a specific hearing loss category for the dynamic expansion systems are determined by audiometric measurements. The hearing losses which occur are highly varied and cover very different characteristics. Examples of these aspects are reduced time resolution and frequency resolution or so-called recruitment, which describes the change in the volume perception of those with hearing disabilities.

"In the case of hearing losses, it is useful from many points of view to offer the person in the vicinity of a person with a hearing disability auralization of the effect of the hearing disability. For example, for this purpose, simulation can be used to give an impression to the relatives with normal hearing of the hearing impression of the person with a hearing disability with and without assistance by the respective hearing aid. A person with normal hearing can use this to test or simulate the effect of hearing-aid assistance for a hearing-aid wearer, at least to a limited extent.

"One precondition for auralization is an audiometric measurement and creation of an individual audiogram. Measurements such as these can be carried out only by specialists, for example hearing-aid device audiologists and doctors. The corresponding systems can, furthermore, be used only by experts and are also financially worthwhile only for them.

"In order to simulate the hearing capability of a person, in particular of a person with a hearing disability, it is known from German patent DE 101 10 945 for the hearing capability of this person to be recorded first of all. To do this, the hearing capability is tested in a plurality of realistic environmental situations. These situations are preferably simulated in a room which is configured to be suitable for this purpose, the so-called measurement room. Characteristic variables of the audiogram are derived from the tests, characterizing the hearing capability of the relevant person as comprehensively as possible. In order to provide third parties, for example relatives of the person, with an impression of the hearing capability of the relevant person, test signals are then produced in which the noises in realistic situations are modified corresponding to the recording audiogram such that this gives a person with normal hearing the same hearing impression which the (unmodified) noise would cause in a person with a hearing disability.

"However, the measurements are carried out exclusively in laboratory conditions, so that individual noise environments that actually occur and occur in the respective environment of the person with the hearing disability can be considered only inadequately.

"European patent EP 1 353 529 discloses a simulation apparatus in which simulation data for a plurality of typical hearing loss categories and for a plurality of hearing aid models can be transferred from one user to another via a data network. This allows both the recording of audiometric data with the user and the auralization of the effects associated with this on the hearing perception as well as the selection of a suitable hearing aid and its matching and demonstration for the person affected to be offered via the Internet. The affected person can thus carry out tests relating to his hearing capability in the home environment, but with a quality which is restricted by the hardware available to him.

"However, the measurements are possible exclusively with access to a computer and a data network. Furthermore, the measurement results must in each case be transmitted to a computer system and must be evaluated there before they can be used for auralization. Conclusions relating to the hearing impression in real-time conditions and in any given life situations, for example outside the range of the computer, are thus not possible.

"A further difficulty is that hearing aids may have different hearing programs for different noise environments.

Switching can be carried out between the different hearing programs either automatically by the hearing aid or manually by the hearing-aid wearer. The various possible hearing programs result in an additional multiplicity of variation options. These would have to be taken into account for auralization if a respectively currently appropriate hearing impression of the respective environmental situation is intended to be given taking into account the operation of the hearing aid.

"The number of variations to be simulated is additionally enormously increased if adaptive filters and amplifiers are used in the hearing aid. Realistic simulation, matching all the stated conditions, in real time is therefore very difficult with the known apparatuses and methods.

"International patent disclosure WO 2006/074655 A1, corresponding to U.S. patent publication No. 20070269065, discloses a hearing-aid system containing a hearing aid and a portable module for monitoring the hearing aid. The portable module can receive data from the hearing aid representing the signal processing parameters of the hearing aid in real time. This allows remote monitoring of the hearing aid.

"Despite the known options for monitoring by auralization, monitoring of the effect of hearing-aid assistance on a hearing-aid wearer in real time and at any desired locations has therefore not been possible until now."

In addition to obtaining background information on this patent, VerticalNews editors also obtained the inventors' summary information for this patent: "It is accordingly an object of the invention to provide a method and an apparatus for monitoring a hearing aid which overcome the above-mentioned disadvantages of the prior art methods and devices of this general type, which allows monitoring of the effect of hearing-aid assistance on a hearing-aid wearer in real time and at any desired location.

"With the foregoing and other objects in view there is provided, in accordance with the invention a hearing aid system. The system includes a hearing aid having a microphone for detecting an acoustic input signal and converting the acoustic input signal into an electrical output signal, a receiver for producing an acoustic output signal being dependent on the electrical output signal of the microphone, and a transmitter for transmitting a monitoring signal, which is dependent on the electrical output signal of the microphone. The system further includes a portable transceiver having a receiver for receiving the monitoring signal, and a signal processing device for processing the monitoring signal received and is coupled to the receiver. The signal processing device produces an indication signal in dependence on the monitoring signal received.

"One fundamental idea of the invention is to provide a system for monitoring a hearing aid containing the hearing aid and a portable transceiver. The hearing aid contains a transmitter which transmits a monitoring signal, which is dependent on an electrical output signal of the microphone of the hearing aid. The portable transceiver contains a receiver for reception of the monitoring signal as well as a signal processing device for processing of a received monitoring signal, with the signal processing device using the received monitoring signal to produce an indication signal which allows monitoring of the hearing assistance by the hearing aid.

"Further fundamental ideas of the invention contain a specification of a correspondingly configured hearing aid, a correspondingly configured transceiver and a corresponding method.

"The indication signal makes it possible to monitor a signal state or an operating state of the hearing aid. An important feature of this is that the indication signal is dependent on a monitoring signal which is normally available only in the interior of the hearing aid. The monitoring signal is characteristic of the assistance effect of the hearing aid, which normally has an effect which can be perceived only by the hearing-aid wearer. For example, it can indicate an operating state of the hearing aid, such as the currently active hearing program, or a signal state within the hearing aid, such as a filter or gain setting, or it can reflect the audio signal produced by the hearing aid. If the monitoring signal reflects the audio signal produced by the hearing aid, then this will have already passed through the signal processing by the hearing aid. The change in the audio signal by the hearing aid therefore need no longer be simulated externally, and, instead, the modified audio signal is available directly.

"The transmission of the monitoring signal to the transceiver and the processing to form the indication signal

results in information being available externally as well about the state of the hearing aid, in order to monitor the hearing aid. The indication signal can therefore be used to monitor the operation of the hearing aid and the effect of the hearing assistance without this requiring any reaction or response from the hearing-aid wearer. Since the transceiver is in the form of a portable appliance, monitoring such as this can be carried out at any desired locations. Since, furthermore, the transceiver is not dependent on data network access to a database or a computer, but itself carries out the processing of the monitoring signal directly, this results in only negligibly short time delays.

"In one advantageous refinement of the invention, the production of the indication signal by the signal processing device includes a restriction of the received monitoring signal, such that the restriction simulates the restriction of the hearing capability of a person with hearing loss. If an electrical signal which corresponds essentially to the acoustic signal recorded by the microphone of the hearing aid, after amplification by the hearing aid and shortly before transmission to the receiver, is now used as the monitoring signal, then the hearing impression or the hearing perception as produced in the case of the hearing-aid wearer can be simulated by the indication signal. This allows the hearing perception of the hearing-aid wearer to be auralized for people with normal hearing, by the transceiver.

"The auralization with the aid of the transceiver allows people in the vicinity of the hearing-aid wearer to monitor at any time whether the hearing-aid wearer is receiving acoustic signals which have been amplified in a usable form by the hearing aid and allow hearing or understanding. All that is necessary to do this is to output the indication signal by a loudspeaker or headset, as an acoustic signal. Furthermore, people in the vicinity can also monitor at any time whether the acoustic signal amplified by the hearing aid is being adversely affected or distorted by excessive noise or other interference factors.

"In a further advantageous refinement of the invention, the monitoring signal is obtained at a signal input of the receiver of the hearing aid. The signal that has been amplified by the hearing aid and is emitted through the receiver of the hearing aid to the hearing-aid wearer is thus actually the one available to the transceiver after reception of the monitoring signal. This signal, as a monitoring signal, represents a particularly worthwhile basis for signal processing, in particular the auralization, by the transceiver.

"In a further advantageous refinement of the invention, the production of the indication signal by the signal processing device includes the determination of a gain which is a function of an audio frequency of the received monitoring signal. This allows the frequency-dependent gain of the hearing aid to be recorded or made available in the transceiver. The gain spectrum can vary in particular in the case of hearing aids with adaptive gain or adaptive filters, and as a result of hearing program switching operations as well. The determination of this spectrum by the transceiver allows comparison with a predetermined nominal value at any time, for example with an audiogram of the hearing-aid wearer in the course of so-called 'audiogram matching'.

"In a further advantageous refinement of the invention, the production of the indication signal by the signal processing device includes the determination of an interference noise level of the received monitoring signal. In the case of hearing aids, operating states also occur in which noise or background noise is amplified more than proportionally. In consequence, it is possible for hearing perception of the hearing-aid wearer to be greatly distorted or interfered with, while a person with normal hearing would not perceive any increased amount of interference noise. Since, by use of the indication signal, the transceiver provides a person with normal hearing with information relating to the interference noise level occurring in the hearing aid, it allows this person to carry out a comparison of the actual hearing impression in the respective situation. The person with normal hearing can in this way monitor the operation of the hearing aid. This person can on the one hand ask the hearing-aid wearer to make a hearing program change, and on the other hand this person can take account of the restricted or disturbed hearing perception of the hearing-aid wearer.

"In a further advantageous refinement of the invention, the transceiver has a data memory for recording the monitoring signal. The recordings can be used to analyze the operation of the hearing aid or the state of the

current hearing perception capability of the hearing-aid wearer subsequently, for example by a doctor or a hearing-aid audiologist.
"In a further advantageous refinement of the invention, the recording is started by a user. The hearing-aid wearer or a person in the vicinity can thus start the recording in particular in problem situations, in which the hearing aid provides only defective or restricted hearing assistance. Problem situations such as these can be analyzed retrospectively with the aid of the recording.
"In a further advantageous refinement of the invention, the recording is carried out as a function of the received monitoring signal. For example, the hearing aid can use the monitoring signal to transmit the signal for starting the recording, in order in this way to have the capability to initiate the recording itself. This allows a recording to be made as a function of an internal state or operating state of the hearing aid.
"In a further advantageous refinement of the invention, the recording is started as a function of a hearing program change which is signaled by the monitoring signal. This allows situations to be analyzed retrospectively which are related to a hearing program change or could be the reason for this.
"Other features which are considered as characteristic for the invention are set forth in the appended claims.
"Although the invention is illustrated and described herein as embodied in a method and an apparatus for monitoring a hearing aid, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.
"The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings."
For more information, see this patent: Joeng, Lilyana; Koo, Wee Haw; Lim, Meng Kiang; Lim, Poh Chye. Method and Apparatus for Monitoring a Hearing Aid. U.S. Patent Number 8213627, filed February 13, 2009, and issued July 3, 2012. Patent URL: http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=35&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1711&f=G&l=50&co1=AND&d=PTXT&s1=20120703.PD.&OS=ISD/20120703&RS=ISD/20120703
Keywords for this news article include: Asia, Audiology, Singapore, Electronics, Data Network, Hearing Loss, Otolaryngology, Signal Processing, Siemens Medical Instruments Pte. Ltd..

Publication date: Jul 17, 2012

Year: 2012

Endangered and Threatened Wildlife and Plants; Two Foreign Macaw Species

Publication info: The Federal Register / FIND 77. 130. (Jul 6, 2012).
ProQuest document link

Abstract (Abstract): Proposed rule; 12-month finding.
CFR Part: "50 CFR Part 17"
RIN Number: "RIN 1018-AY33"
Citation: "77 FR 40172"
Document Number: "Docket No. FWS-R9-ES-2011-0101: 450 003 0115"

Page Number: "40172"
"Proposed Rules"
SUMMARY: We, the U.S. Fish and Wildlife Service (Service), propose to list as endangered the military macaw (Ara militaris) and the great green macaw (Ara ambiguus) under the Endangered Species Act of 1973, as amended (ESA). We are taking this action in response to a petition to list these parrot species as endangered or threatened under the ESA. This document also serves as the completion of the status review and as the 12-month finding. We seek information from the public on the proposed listing for these species.

Links: Check LinkSource for Full Text

Full text: Source: DEPARTMENT OF THE INTERIOR (DOI)
United States Fish and Wildlife Service (FWS)
Proposed rule; 12-month finding.
CFR Part: "50 CFR Part 17"
RIN Number: "RIN 1018-AY33"
Citation: "77 FR 40172"
Document Number: "Docket No. FWS-R9-ES-2011-0101: 450 003 0115"
Page Number: "40172"
"Proposed Rules"
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DATES: We will consider comments and information received or postmarked on or before September 4, 2012.
ADDRESSES: You may submit comments by one of the following methods:
* Federal eRulemaking Portal: http://www.regulations.gov. Follow the instructions for submitting comments on Docket No. FWS-R9-ES-2011-0101.
* U.S. mail or hand-delivery: Public Comments Processing, Attn: FWS-R9-ES-2011-0101; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042-PDM; Arlington, VA 22203.
We will not accept comments by email or fax. We will post all comments on http://www.regulations.gov. This generally means that we will post any personal information you provide us (see the Information Requested section below for more information).
FOR FURTHER INFORMATION CONTACT: Janine Van Norman, Chief, Branch of Foreign Species, Endangered Species Program, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Room 420, Arlington, VA 22203; telephone 703-358-2171. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800-877-8339.
SUPPLEMENTARY INFORMATION:
Executive Summary
I. Purpose of the Regulatory Action
On January 31, 2008, the Service received a petition dated January 29, 2008, from Friends of Animals, represented by the Environmental Law Clinic, University of Denver, Sturm College of Law, requesting that we list 14 parrot species under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.). As part of a court-approved settlement agreement, the Service agreed to submit a determination as to whether the petitioned action is warranted, not warranted, or warranted but precluded by other listing actions for the military macaw (Ara militaris) and the great green macaw (Federal Register by June 30, 2012. This action

complies in part with this settlement agreement and is authorized by the ESA.

II. Summary of the Major Provisions of the Regulatory Action in Question

We are proposing to list as endangered the military macaw (Ara militaris) and the great green macaw (Ara ambiguus). We are proposing this action primarily because of the effects of habitat loss, fragmentation, and degradation; small and declining population size; poaching; and regulatory mechanisms that are inadequate to ameliorate these threats on these birds throughout their ranges.

III. Costs and Benefits

Section 4(b)(1)(A) of the ESA directs that determinations as to whether any species is an endangered or threatened species must be made "solely on the basis of the best scientific and commercial data available." Further, this action is not a "significant" regulatory action under Executive Order 12866. Therefore, we have not analyzed its costs or benefits.

Background

Section 4(b)(3)(B) of the ESA (16 U.S.C. 1531 et seq.) requires that, for any petition to revise the Federal List of Endangered and Threatened Wildlife and Plants that contains substantial scientific or commercial information that listing the species may be warranted, we make a finding within 12 months of the date of receipt of the petition ("12-month finding"). In this finding, we determine whether the petitioned action is: (a) Not warranted, (b) warranted, or (c) warranted, but immediate proposal of a regulation implementing the petitioned action is precluded by other pending proposals to determine whether species are endangered or threatened, and expeditious progress is being made to add or remove qualified species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Section 4(b)(3)(C) of the ESA requires that we treat a petition for which the requested action is found to be warranted but precluded as though resubmitted on the date of such finding, that is, requiring a subsequent finding to be made within 12 months. We must publish these 12-month findings in the Federal Register .

In this document, we announce that listing these two species as endangered is warranted, and we are issuing a proposed rule to add these two species as endangered to the Federal List of Endangered and Threatened Wildlife. Prior to issuing a final rule on this proposed action, we will take into consideration all comments and any additional information we receive on the proposed rules. Such information may lead to a final rule that differs from this proposal. All comments and recommendations, including names and addresses of commenters, will become part of the administrative record.

Previous Federal Actions

Petition History

On January 31, 2008, the Service received a petition dated January 29, 2008, from Friends of Animals, represented by the Environmental Law Clinic, University of Denver, Sturm College of Law, requesting that we list 14 parrot species under the ESA. The petition clearly identified itself as a petition and included the requisite information required by the Code of Federal Regulations (50 CFR 424.14(a)). On July 14, 2009 (74 FR 33957), we published a 90-day finding in which we determined that the petition presented substantial scientific and commercial information indicating that listing may be warranted for 12 of the 14 parrot species. In our 90-day finding on this petition, we announced the initiation of a status review to list as endangered or threatened under the ESA the following 12 parrot species:

(1) Blue-headed macaw (Primolius couloni),

(2) Crimson shining parrot (Prosopeia splendens),

(3) Great green macaw (Ara ambiguus),

(4) Grey-cheeked parakeet (Brotogeris pyrrhoptera),

(5) Hyacinth macaw (Anodorhynchus hyacinthinus),

(6) Military macaw (Ara militaris),

(7) Philippine cockatoo (Cacatua haematuropygia),

(8) Red-crowned parrot (Amazona viridigenalis),
(9) Scarlet macaw (Ara macao),
(10) White cockatoo (Cacatua alba),
(11) Yellow-billed parrot (Amazona collaria), and
(12) Yellow-crested cockatoo (Cacatua sulphurea).

We initiated the status review to determine if listing each of the 12 species is warranted, and initiated a 60-day public comment period to allow all interested parties an opportunity to provide information on the status of these 12 species of parrots. The public comment period closed on September 14, 2009.

On October 24, 2009, and December 2, 2009, the Service received a 60-day notice of intent to sue from Friends of Animals and Wild Earth Guardians for failure to issue 12-month findings on the petition. On March 2, 2010, Friends of Animals and Wild Earth Guardians filed suit against the Service for failure to make timely 12-month findings within the statutory deadline of the Act on the petition to list the 14 species (Friends of Animals, et al. v. Salazar, Case No. 10-CV-00357 (D.D.C.)). Pursuant to a court-ordered settlement agreement entered in this case, the Service agreed to specific time frames for submitting to the Federal Register a determination as to whether the petitioned action is warranted, not warranted, or precluded by other listing actions. In compliance with the settlement agreement, we published status reviews for the crimson shining parrot (Prosopeia splendens), yellow-crested cockatoo (Cacatua sulphurea), white cockatoo (Cacatua alba), and Philippine cockatoo (Cacatua haematuropygia) on August 9, 2011 (76 FR 49202); the red-crowned parrot (Amazona viridigenalis) on October 6, 2011 (76 FR 62016); the yellow-billed parrot (Amazona collaria) on October 11, 2011 (76 FR 62740); and the blue-headed macaw (Primolius couloni) and grey-cheeked parakeet (Brotogeris pyrrhoptera) on October 12, 2011 (76 FR 63480).

For the remaining four species that are the subject of this settlement agreement (the military macaw, the great green macaw, the scarlet macaw, and the hyacinth macaw), the Service agreed to submit 12-month findings on the petitioned action to the Federal Register by June 30, 2012. This Federal Register document complies with the settlement agreement with respect to the military macaw and great green macaw. We will announce the 12-month findings for the remaining two parrot species for which a 90-day finding was made on July 14, 2009 (74 FR 33957) in subsequent Federal Register notices.

Information Requested

We intend that any final actions resulting from this proposed rule will be based on the best scientific and commercial data available. Therefore, we request comments or information from other governmental agencies, the scientific community, or any other interested parties concerning this proposed rule. We particularly seek clarifying information concerning:

(1) Information on taxonomy, distribution, habitat selection (especially breeding and foraging habitats), diet, and population abundance and trends (especially current recruitment data) of these species.
(2) Information on the effects of habitat loss and changing land uses on the distribution and abundance of these species.
(3) Information on the effects of other potential threat factors, including live capture and hunting, domestic and international trade, predation by other animals, and any diseases that are known to affect these species.
(4) Information on management programs for parrot conservation, including mitigation measures related to conservation programs, and any other private, nongovernmental, or governmental conservation programs that benefit these species.
(5) The potential effects of climate change on these species and their habitats.

Please include sufficient information with your submission (such as full references) to allow us to verify any scientific or commercial information you include. Submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination. Section 4(b)(1)(A) of the ESA directs that determinations as to whether any species is

an endangered or threatened species must be made "solely on the basis of the best scientific and commercial data available."

Public Hearing

At this time, we do not have a public hearing scheduled for this proposed rule. The main purpose of most public hearings is to obtain public testimony or comment. In most cases, it is sufficient to submit comments through the Federal eRulemaking Portal, described above in the ADDRESSES section. If you would like to request a public hearing for this proposed rule, you must submit your request, in writing, to the person listed in the FOR FURTHER INFORMATION CONTACT section by August 20, 2012.

Species Information for the Military Macaw

Taxonomy

The military macaw (Ara militaris, Linnaeus 1766) is in the Psittacidae family and is also known as "guacamaya verde," "parava," and "ravine parrot." Three subspecies of military macaw have been proposed and are recognized by some: Ara militaris bolivianus (Reichenow 1908), Ara militaris mexicanus (Ridgway 1915), and Ara militaris militaris (Linnaeus 1766). Avibase, a database of all birds of the world maintained by Bird Studies Canada, and the Integrated Taxonomic Information System (ITIS) both recognize these subspecies (http://www.itis.gov and http://avibase.bsc-eoc.org/avibase.jsp, accessed August 30, 2011). The range of A. m. bolivianus is thought to be in Bolivia and Argentina. The range of A. m. mexicanus is thought to be restricted to Mexico. However, the taxonomic status of Ara militaris remains unclear.

Because it is a strong flyer (it has been observed traveling up to 20 kilometers (km) (12 miles [mi]) per day) and it is a semi-migratory species, the physical similarities suggest that seemingly isolated populations may be in contact (Juniper and Parr 1998, p. 423), and therefore their populations may be connected genetically.

For the purpose of this rule, all populations or subspecies of this species essentially face similar threats or threats of similar magnitude, are all generally in the same region, and all have quite small populations, generally fewer than 100 individuals. Absent peer-reviewed information to the contrary and based on the best available information, we recognize all populations of military macaws as a single species. For the purpose of this proposed rule, we are proposing to list the military macaw, including all subspecies, as endangered.

Species Description

The military macaw is an extremely vocal species; it is described as being very noisy and is known to shriek (Birdlife International (BLI) 2011, p. 1). It is a large macaw (70 centimeters or 27.5 inches in length) and is quite vibrant in color. It has dark lime-green feathers mixed with blue flight feathers that are olive-colored underneath. Its forehead is red, and it has a bare white facial area and a black bill. Its lower back is blue; its tail is red and blue. The farthest south population, in Bolivia, which extends into Argentina, exhibits reddish brown on their throats and cheeks (Juniper and Parr 1998, p. 423). This species is often confused with the great green macaw. The great green macaw (Ara ambiguus) is very similar in appearance to the military macaw, but the military macaw has more prominent blue tinge on its hind neck, is smaller, and has darker plumage. These two species are separated geographically.

Habitat and Life History

Military macaws nest both in tree cavities and cliffs. Parrots that nest in cavities in cliff walls such as the military macaw (Bonilla-Ruz et al. 2007, p. 730) also nest colonially (in groups). Cliff cavities in ravines used by this species have been documented 25 and 30 meters (m) (82 to 98 feet (ft)) above ground (Arcos-Torres and Solano-Ugalde 2008, p. 70). Tree cavities used by this species have been observed to be 18 m (60 ft) above ground and 75 cm (29.5 inches) deep (Baker 1958, p. 98). This species has also been observed to use secondary cavities, such as abandoned woodpecker holes, particularly in dead pine trees (Strewe and Navarro 2004, p. 50). They alternate nesting and foraging areas based on food availability (Bonilla-Ruz undated, p. 1). Nesting appears to be synchronous with the peak fruiting season, which occurs during April and May (Huatatoca pers. comm. in Arcos-Torres and Solano-Ugalde 2008, p. 70). The military macaw is a social

species that congregates in small flocks and is often observed in mated pairs. Its clutch size is usually two to three eggs. They begin to reproduce between 3 and 4 years of age (Mexican National Commission for Protected Areas [CONANP] 2006 in Bonilla-Ruz undated, p. 2). Aggregated nesting is believed to be due to the lack of suitable disbursed nest sites, which may also explain why they are concentrated in certain sites (Salinas-Melgoza et al. 2009, p. 306).

This species prefers the lower montane wet forests of the Andes. It inhabits remaining fragmented forested area in the Neotropics. However, in the northernmost part of its range, in Mexico, it is associated with seasonally dry, semi-deciduous tropical forest, deciduous tropical forest, and slopes of pine-oak forest (Bonilla-Ruz 2006, p. 45; Rivera-Ortiz et al. 2006, p. 26).

The military macaw is a seasonal migrant, based on food and nutrient availability. In some areas, it has been observed using clay licks to obtain sodium and possibly other minerals, which is a common activity in some parrot species (Lee 2010, p. 58). Its diet varies seasonally. It has been observed feeding on several plant species. Some of the plant species it was observed feeding on include: Brosimum alicastrum (Maya nut, ramon), Bunchosia montana (no common name (ncn)), Bursera aptera (ncn), Bursera schlechtendalii (ncn), Celtis caudate (ncn), Cedrela species (cedar fruits), Cyrtocarpa procera (Chupandilla), Ficus species (figs), Hura crepitans (ochoo, arbol del diablo, acacu, monkey's dinner-bell, habillo, ceiba de leche, sand-box tree, possum wood, dynamite tree, ceiba blanca, assacu, posentri), Hura polyandra (arbol del diablo, haba, jabillo, tetereta), Melia azedarach (Chinaberry tree), Neobuxbaumia tetetzo, (cardon, higos de teteche, tetetzo), Orbignea guacoyula (a type of palm), Plumeria rubra (Frangipani), Tecoma stans (yellow trumpetbush), Tillandsia makoyana (ncn), and Tillandsia grandis (ncn) (Huellega 2011, p. 9; Moschione 2007, in Navarro et al., 2008, p. 2; Contreras-Gonzalez et al. 2006, p. 387; Renton 2004, p. 12; Juniper and Parr 1998, p. 422). Seeds were found to be 39 percent of this species' diet. They have also been observed feeding on bromeliad stems (species unknown) and cacti (species unknown). In Mexico, in the northern part of its range, military macaws have been observed in desert habitat, although they tend to have lower reproductive success in this habitat type (Rivera-Ortiz et al. 2008, p. 261). In desert habitat, which is suboptimal, it has been observed consuming edible flowers (species unidentified). Despite the low seasonal abundance of food, deserts offer some refuge from poaching due to the inhospitable dry climate, which can act as a deterrent to poachers (Rivera-Ortiz et al. 2008, p. 261).

Range, Observations, and Population Estimates

The military macaw is distributed in highly fragmented, small populations in Mexico and South America. Its range extends from northern Mexico southward into Ecuador, Peru, Colombia, Venezuela, Bolivia, and the southern tip of Argentina (see Figure 1 or http://www.birdlife.org/ for an approximation of its range and distribution). The species has been described as patchily distributed throughout the eastern foothills of the Andes Mountains (Snyder et al. 2000, p. 125). It occurs in altitudes up to 1,600 m (5,249 ft) (Strewe and Navarro 2004, p. 50; Strewe and Navarro 2003, p. 33; Snyder et al. 2000, chapter 7, pp. 102, 124-125). Although it has a large distribution (276,000 km ^{2} (106,564 mi^2)), its populations are localized. Most populations are now estimated to have fewer than 100 individuals (Renton 2004, pp. 12-14). However, in 2004, one population in Colombia was estimated to be 156 individuals (Florez and Sierra 2004, p. 3). This species may have occurred in Guatemala in the past, but it is no longer found there (Gardner 1972 in Snyder et al. 2000, p. 125). Overall, its populations are fragmented and becoming more isolated (Rivera-Ortiz 2008, p. 256).

See Illustration in Original Document.

The species inhabits tropical semi-deciduous forests along the Pacific and Atlantic slopes through Central and South America. The best available information indicates there are reasonably healthy but small populations in El Cielo and Sierra Gorda Biosphere Reserves in Mexico, Madidi and Amboro National Parks, Pilon Lajas Biosphere Reserve and Apolobamba National Integrated Management Area in Bolivia, and Manu Biosphere Reserve and Bahuaja Sonene National Park in Peru, and a small but stable remnant population in Tehuacan-

Cuicatlan Biosphere Reserve, Oaxaca, Mexico (Hosner et al. 2009, p. 222; Arizmendi 2008, p. 3; Rivera-Ortiz 2008, p. 256; Renton 2004, p. 14).

Argentina

Argentina is the southernmost part of this species' range, and here the species has never thought to have been abundant (Navarro et al. 2008, p. 1). In fact, this species was initially thought to be extirpated (locally extinct) in Argentina, but recent surveys have found small populations of this species in at least two locations in the northern province of Salta. There are anecdotal reports of this species crossing the Itau River (Navarro et al. 2008, p. 3), which borders Bolivia and Argentina. Between 2005 and 2007, approximately 100 individuals were observed in the Salta Province (Coconier et al. 2007, p. 59). These areas include: Finca Itaguazuti, and the Acambuco Provincial Flora and Fauna Reserve (8,266 hectares [ha] or 20,426 acres [ac]) in the Tartagal Mountains and which borders Bolivia (BLI 2011b; Navarro et al. 2008, p. 1; Coconier et al. 2007, p. 59). In 2008, flocks of between 4 and 40 individuals of this species were observed in three ravines in the Salta Province. These locations were the Agua Fresca (Cool Water) Ravine north of Campo Cauzuti, El Limon Ravine (which had the largest population), and the Carapari River Ravine. These are believed to be established populations, rather than flocks crossing over from Bolivia (Navarro et al. 2008, p. 1).

Bolivia

In Bolivia, the military macaw is regularly observed in five national parks (Hennessey 2010, pers. comm.). This species exists in the Andean foothills in Bolivia in forested areas extending from the northern Tambopata National Reserve to the southern Pilon Lajas Reserve (Hennessey et al. 2003, p. 319). These parks are in the general vicinity of the border of southern Peru and northern Bolivia (Hosner et al. 2009, p. 222; Navarro et al. 2008, p. 2; Hennessey et al. 2003, p. 322). They are part of the Greater Madidi-Tambopata Landscape (known as "Parque Nacional Madidi" or GMTL). Within the GMTL, there are thought to be reasonably healthy populations of this species in the Apolobamba National Integrated Management Area, Amboro and Madidi National Parks, and Pilon Lajas Biosphere Reserve (Hennessey 2011 pers. comm.; Hosner et al. 2009, p. 225). The GMTL is 110,074 km ^{2} (42,500 mi^2) in size, and encompasses one of the largest areas of intact montane forest in the tropical Andes (WCS 2009, p. 2). This area is a high conservation priority due to its large number of endemic bird species (Hennessey et al. 2003, p. 319). Pilon Lajas consists of primary evergreen tropical lowland forest, foothill forest, and lower montane forest. Pilon Lajas was recognized as a Biosphere Reserve and Indigenous Territory by the Bolivian Government in 1992; however, it did not have any actual protections in place until 1994. This area in the past has been managed via a partnership with Veterinarians Without Frontiers (CEPF 2000, p. 28).

In 2008, this species was observed at Serrania Sadiri in Madidi National Park, La Paz Department, Bolivia (Hosner et al. 2009, p. 225). Serrania Sadiri is found just inside Madidi National Park. Here, flocks of between 2 and 36 individuals have been observed (Hosner et al. 2009, p. 228). The Pilon Lajas Biosphere Reserve is primarily in La Paz Department, but slightly overlaps into the Beni Department. Here, this species is described as uncommon (Hennessey 2003, p. 329). It was observed in Parapetiguasu-Taremakua, and Parapetiguas-Uruwigua in Santa Cruz, Cordillera Province, and at Altamachi and Madidi in Cochabamba, Ayopaya Province (MacLeod 2009, pp. 42-43). In summary, within Bolivia, there are many small populations of this species in areas that provide suitable habitat for this species (primarily large forest patches under some form of protection) (Herzog 2011 pers. comm.).

Colombia

In the late 1990s, there were approximately five disjunct populations in the central Andes mountains (Snyder et al. 2000, p. 125). In Colombia, groups of 50 individuals have been observed, and in one case, a population was estimated to have 156 individuals (Florez and Sierra 2004, pp. 2-3). In most cases, the presence of these groups is related to cliff formations favorable for nesting (where they are less accessible to poachers), and where deforestation is having less of an impact (Florez and Sierra 2004, pp. 2-3; Rodriguez and Hernandez-

Camacho 2002, p. 203). In Colombia, this species inhabits a wide range of altitudes and areas with various degrees of alteration (Florez and Sierra 2004, pp. 1-3; Juniper and Parr 1998). In Colombia, this species has been observed between altitudes of 700 and 1,600 m (2,297 to 5,249 ft) (Florez and Sierra 2004, pp. 1-3; Salaman et al. 2002, pp. 167, 187). Populations have been observed in Guajira peninsula, Las Orquideas, Tayrona National Park, Serrania de Perija, Serrania de San Lucas, San Salvador Valley, Sierra Nevada De Santa Marta, La Guajira Department, and Cueva de los Guacharos National Park (Strewe and Navarro 2003, p. 32). In 1998, this species was observed in flocks of up to 12 individuals at Villa Iguana and Alto Cagadero in Serrania de los Churumbelos (Salaman et al. 2007, pp. 33, 38, 47, 89). It has been observed in palm stands in the San Salvador valley during the breeding season (December--July) (Strewe and Navarro 2003, p. 33). At Cueva de los Guacharos National Park, flocks of up to 16 have been observed (Strewe and Navarro 2003, p. 32).

There are two small, stable populations of military macaws at Sierra Nevada de Santa Marta (Sierra meaning mountain range) and Churumbelos, Cauca, with approximately 50 mature birds at each site (Fundacion ProAves 2011a). In 2004, Florez and Sierra estimated that the population in the cliffs of the Cauca River was 156 individuals and contained 54 breeding pairs and 26 nests (2004, p. 3). However, this population is subjected to impacts from poaching and deforestation (Florez and Sierra, 2004, pp. 3-4), so the population now may be smaller. These researchers also noted that many chicks fall from the cliff nests and die. A new population was recently reported at two locations in the Catatumbo-Bari National Park on the Colombian-Venezuelan border (Avendano in litt). There are no recent records in northern Antioquia (Paramillo), Serrania de San Lucas, or Perija ranges (Fundacion ProAves 2011a, pp. 28-29).

In the Frio Valley of Colombia, this species is reported to only be present during the breeding season (Strewe and Navarro 2004, p. 50). Several nests were found here in forest fragments. A population at El Congo Reserve was intensively studied in 2001. One nest was located 12 m (39 ft) above ground in a Ceiba tree, within open primary forest on a steep slope at 900 m (2,953 ft). A breeding population of 12 pairs, with groups of up to 28 was observed in December 2000. However, here it is still threatened in the valley by habitat loss and domestic trade (two cases noted in 2001) (Strewe and Navarro 2004, p. 50), and the population may now be decimated.

Ecuador

In Ecuador, this species is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 72). This species has been observed in the areas of Sumaco and Zamora-Chinchipe in Ecuador (Snyder et al. 2000, p. 125) and at Kichwa River Reserve (Reserva Kichwa Rio), within the Gran Sumaco Guacamayos Biosphere Reserve (Arcos-Torres and Solano-Ugalde 2008, p. 72). Most records of military macaw in Ecuador during the 1980s and 1990s found groups of up to 20 individuals (Ridgely and Greenfield 2001); however, lately most records have not exceeded 8 individuals (Arcos -Torres and Solano-Ugalde 2008, p. 72) except for a breeding colony of 16 individuals that was observed in the Reserva Kichwa Rio (Arcos-Torres and Solano-Ugalde 2008, pp. 70, 72). Prior to 1980, it was observed in the upper Upano River Valley (Ridgely 1980 p. 244). In 2006, 200 ha (494 ac) were turned into the Narupa Reserve, where this species has been observed recently (Fundacion ProAves et al. 2010, p. 42). Additionally, in 2010, a pair of military macaws was observed in northern Ecuador in the Sumaco region (Olah and Barnes 2010, p. 19).

Mexico

There are at least four populations of military macaws that are believed to exist in Mexico, each consisting of between 30 and 90 individuals (Rivera-Ortiz et al. 2008, p. 256). Those populations are discussed below. Identification of these populations is difficult for two reasons. First, this species is thought to primarily breed and forage in remote areas that are difficult to access, and second, it is a semi-migratory species that follows seasonal food sources, so flocks move to other areas seasonally. In Mexico, there are reasonably healthy but small populations in the following areas:

* Tehuacan-Cuicatlan Biosphere Reserve (at the border of Puebla and Oaxaca States),

* Mineral de Nuestra Senora Reserve (Sinaloa State),
* El Cielo Biosphere Reserve (Tamaulipas State),
* Sierra Gorda Biosphere Reserve (Queretaro State), and
* Sierra Manantlan Biosphere Reserve (Jalisco State).

See Illustration in Original Document.

In Mexico, there may also be isolated populations of military macaws in other States. Figure 2 shows the current and historical distribution of the military macaw in Mexico (Arizmendi 2008, p. 4). Other States where it may exist include Colima, Durango, Guerrero, Michoacan, Morelos, Nayarit (in the Valley of Flags or "Valle de Banderas"), Nuevo Leon, San Luis Potosi, and Zacatecas, although in some cases, there are no recent records of the species in several of the previously mentioned States (Bonilla-Ruz 2011 pers. comm.; Nova-Munoz 2006, p. 20; Inigo-Elias 1999, 2000 in Almazan-Nunez 2006, p. 20). Areas where it has been recently documented are described below.

Chihuahua

Researchers believe there is a remaining population in the Sierra Madre Occidental Mountains (north-central Mexico) in Otachique (Cruz-Nieto et al. 2006, p. 14). In 2005, 25 nests were observed (Cruz-Nieto et al. 2006, p. 14). This canyon is approximately 700 m (0.5 miles) wide by 14 km (8.6 miles) in length and consists of mature pines, firs, and oaks. Some gallery temperate forest remains in this area.

Jalisco

This species is found sporadically in the western foothills of Sierra del Cuale and Sierra Cacoma in Jalisco on the western coast of Mexico (Renton 2004, pp. 13-14). Here, it was observed in 2004, near a freshwater lake, Cajon de Pena (26 by 9 km (16 by 5.6 mi) in size), which was constructed in 1976. It is found in the Chamela-Cuixmala Biosphere Reserve (132,000 ha or 32,617 ac), which is managed by Mexico's Instituto de Ecologia of the National Autonomous University of Mexico (UNAM) and nongovernmental organizations (NGOs). Patches of semi-deciduous forest in this area form corridors between existing protected areas, such as the Chamela-Cuixmala and the Sierra Manatlan Biosphere Reserves (Renton 2004, p. 14). These patches likely have served as critical ecological links for this species.

Oaxaca

This species has recently been the focus of research in Sabino Canyon, Oaxaca. Sabino Canyon is in the Tehuacan-Cuicatlan Biosphere Reserve (Reserva de la Biosfera Tehuacan Cuicatlan) in central Mexico. In 2001, this species was observed in two canyons within this reserve. In both ravines, 20 pairs were observed nesting (Salazar-Torres 2001, p. 18). Here, this species nests in the canyon cliff walls in crevices that can be as high as 250 m (820 ft). Between 2002 and 2004, approximately 100 individual military macaws were observed (Bonilla-Ruz et al. 2007, p. 729). During 2007-2008, at least 67 birds were observed during the month of August (Rivera-Ortiz et al. 2008, p. 256; Rivera-Ortiz et al. 2007, p. 26). This area is thought to be a fairly new site for this species (Rivera-Ortiz et al. 2007, p. 28). The known nesting site locations within the reserve increased from five to nine during the study period (Rivera-Ortiz et al. 2007, p. 28). Currently in the Sabino Canyon, the population of military macaws is thought to be between 90 and 100 individuals (Arizmendi 2008, p. 15). This is a large reserve, which was created in 1998. It spans 490,187 ha (1,211,278 ac) and is located within the Mixteca Oaxaquena Province between the cities of Puebla and Orizaba. It is approximately 150 km (93 mi) southeast of Mexico City (http://www.parkswatch.org, accessed July 11, 2011) and approximately 2 hours from Tehuacan, Oaxaca, Mexico. Large mountain ranges delineate the boundaries of the reserve, and six rivers are within the protected area's boundaries.

Sinaloa

This species exists in Mineral de Nuestra Senora de la Candelaria Ecological Preserve, 12 km (7.4 mi) southeast of the town of Cosala in Sinaloa, Mexico (Rubio et al. 2007, p. 52; Bonilla-Ruz et al. 2006, p. 45). Its area is 1,256 ha (3,104 ac) and consists of dry tropical forest. In 2002, this area was designated as a protected

area by the State of Sinaloa Decree.

Sonora

Between 2008 and 2009, it was observed at the Northern Jaguar Reserve in east-central Sonora (Flesch 2009, pp. 5, 12), and was described as a rare summer resident here. In this area, this species was recently observed in small flocks in cliff areas (Flesch 2008, pp. 35-36). In 2005, it was observed in the Rio Aros canyon and upper Rio Yaqui valley in an area known as the Yaqui Basin (O'Brien et al. 2006, pp. 4, 28). Flesch suggests that the species is likely to occur only in cliffs near stands of tropical vegetation (full citation 2008, p. 27).

Tamaulipas

Historically, in Mexico's eastern State of Tamaulipas, flocks of approximately 60 individuals were noted almost daily in the area of Gomez Farias, Mexico (Sutton and Pettingill 1942, p. 14). The Gomez Farias region is on the eastern slope of the Sierra Madre Oriental mountain range, known locally as the "Sierra de Guatemala." This area is in the general vicinity of the state-protected El Cielo Biosphere Reserve, where this species is still known to occur (Arvin 2001, p. 8). The University of Texas, Brownsville maintains a research station, Rancho del Cielo, within the 145,687-hectare (360,000-acre) reserve. The research station supports locally driven scientific research and community development (University of Texas, Brownsville, unpaginated). Activities conducted by the research station have positive impacts on this species by attracting researchers and the birding community, preserving and protecting habitat, and creating awareness in the area.

Peru

There are populations in Manu Biosphere Reserve, Tambopata National Reserve, and Bahuaja Sonene National Park in Peru. The two latter parks border one another in the southern Peruvian Amazon region (ParksWatch 2002, p. 1). This species has been observed around the Pongo de Mainique of the Urubamba River and on the upper Tambopata River (Snyder et al. 2000, p. 125). Recently, it was observed in the Madre de Dios department in the southeastern Peruvian Amazon (Lee 2010, p. 14). Flocks of 40 to 50 individuals have been observed in Atalya at Madre de Dios (Snyder et al. 2000, p. 125). The species has been observed seasonally in small numbers in the area of the Huallaga River Canyon (JGP Consultants 2011 pp. 1, 5, 8).

Venezuela

Within Venezuela, it has been documented primarily within protected areas. In this country, little information about the species exists (Rodriguez et al. 2004, pp. 375-376). Here it persists in the Andes in the Central Coastal Cordillera and Sierra de Perija (Rodriguez et al. 2004, pp. 375, 378, 379). It has been found on the north slopes of El Avila, Guatopo, Henri Pittier National Park, the State of Cojedes, Cerro La Mision, and Sierra de Perija National Park (Desenne and Strahl 1994 and Fernandez-Badillo et al. 1994 in Snyder et al. 2000, p. 125). A new population of this species was recorded at two localities at the Catatumbo-Bari National Park at the Colombian-Venezuelan border (Avendano in litt). Moist forests exist as four distinct enclaves within the Catatumbo Valley, in both northwestern Venezuela and northeastern Colombia. This extends the species' previously known range from the east slope of the Serrania de Perija southwards (Avendano in litt).

Summary of Range

According to several recent surveys, the military macaw exists in small populations ranging from a few pairs to approximately 100 individuals. It is found primarily in protected areas in Mexico, Colombia, Bolivia, and to a lesser extent, in Ecuador, Peru, Venezuela, and Argentina (see Figure 1), where large areas of suitable habitat remain. The population in the Pilon Lajas Biosphere Reserve, Bolivia, may serve as a link to other populations of this species to the northwest and to the south (Hennessey et al. 2003, pp. 330-331). Recent records of this species usually, but not always, find this species in protected areas (Flesch 2009; MacLeod 2009; Flesch 2008; Florez and Sierra 2004; Rodriguez 2004; Renton 2004; Hennessey et al. 2003). These records find this species in areas such as protected parks where there are large remaining areas of suitable habitat for nesting, feeding, and breeding (see Figure 1).

Most current, available records of this species pertain to populations in Bolivia and Mexico, and to a smaller

extent in Peru and Colombia. We do not know how this species is distributed outside of parks and protected areas other than what has been described in this status review, but it is likely that the species is primarily restricted to protected areas for the following reasons:
(1) It is a large species that requires habitat containing large trees or cliffs for nesting, both of which are limited, and large areas of suitable habitat for nesting, feeding, and breeding.
(2) This species requires a variety of specific plant species throughout the year for feeding, which likely only remain in enough abundance in protected areas.
(3) The species persists in areas where they are less accessible to poaching because they are located farther from roads.
(4) In some cases there are conservation awareness programs in place in these protected areas.
(5) Protected areas often offer some measure of protection from threats to the species.

Summary of Population Estimate

There are various but imprecise population estimates for this species. One report estimates the population to be fewer than 10,000 individuals (Arizmendi 2008, p. 3). BLI reports that the population is estimated to be between 10,000 and 19,999 mature individuals with a decreasing trend (BLI 2011, p. 1). We believe that the population is significantly fewer than 10,000 based on recent documented observations of this species, most of which are described in this status review. Researchers in Colombia agree with our supposition (Botero-Delgadillo and Paez 2011, p. 13). Published literature (referenced in this document) has documented small flocks ranging from approximately 16 to 156 individuals distributed in disjunct locations in Mexico, Argentina, Ecuador, Venezuela, Peru, Colombia, and Bolivia. In situations where species are rare or have small populations, the number of observations made per survey may be very small and the number of sites limited, and, therefore, estimates and projections may not be accurate (Pollack 2006, p. 891; Marsden 1999, pp. 377-390).
The current total population number is unclear; however, based on these recent records, we believe that the population is substantially fewer than 10,000 individuals for the following reasons:
* It is unlikely to exist in large numbers other than in the areas documented, or it exists in small flocks of similar numbers in undocumented areas.
* It is unlikely to persist in viable populations in areas outside of protected parks, which contain large forested areas that contain suitable habitat.
* There is little evidence or documentation of substantial flocks. Because this is a loud, charismatic species, it is logical to assume that where this species exists, at least in substantial flocks, there is documentation or evidence of the species publicly available.
* The areas where this species exists are likely known because the species tends to return to the same area to nest. It has been recorded to use one area for approximately 30 years (Florez and Sierra 2004, p. 3).
* This species may exist in other areas where it has not been documented, but if so, it is likely to exist in very small flocks, based on the best available scientific and commercial information.

We estimate that the population is closer to between 1,000 and a few thousand remaining individuals. However, with this status review, we are requesting information from range countries, species experts, local NGOs, and the public about this species regarding where it exists and current population estimates.

Conservation Status

There are various protections in place for this species at the international, national, and local levels. At the international level, this species is listed as vulnerable by the International Union for Conservation of Nature (IUCN) (2011). However, this status under IUCN conveys no actual protections to the species.

CITES

The military macaw is protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which is one of the most important means of controlling international trade in animal and plant species affected by trade. CITES is an international agreement through which member countries, called

Parties, work together to ensure that international trade in CITES-listed animals and plants is not detrimental to the survival of wild populations by regulating their import, export, and reexport. All of the range countries for this species are Parties to CITES (CITES 2009, p. 1). Almost all psittacines (parrots), including the military macaw, were included in CITES Appendix II in 1981 (CITES 2008a, p. 1). This species was transferred to Appendix I of CITES in 1987, because populations were declining rapidly due to uncontrolled trapping for the international pet bird trade (CITES 1989a, pp. 1-7). An Appendix-I listing includes species threatened with extinction whose trade is permitted only under exceptional circumstances, which generally precludes commercial trade.

WBCA

The import of the military macaw into the United States is also regulated by the Wild Bird Conservation Act (WBCA) (16 U.S.C. 4901 et seq.), which was enacted on October 23, 1992, in an effort to ensure that exotic bird species are not harmed by U.S. trade. The purpose of the WBCA is to promote the conservation of CITES-listed exotic birds by ensuring that all imports into the United States are (1) sustainable and (2) not detrimental to the species. Permits may be issued to allow imports of listed birds for scientific research, zoological breeding or display, or as a personal pet when certain criteria are met. The Service may approve cooperative breeding programs and subsequently issue import permits under such programs. Wild-caught birds may be imported into the United States if the Service approves a management plan for their sustainable use. At this time, the military macaw is not part of a Service-approved cooperative breeding program and does not have an approved management plan for wild-caught birds.

Argentina

There is only a small population remaining in Argentina, in the northern province of Salta. This species is considered to be a critically endangered species by the Government of Argentina (Navarro et al. 2008, p. 1). It is protected through national legislation (Law 22.421 and Decree 691/81), administered by the Direccion Nacional de Fauna y Flora Silvestres. Law 22.421 addresses the Conservation of Fauna, enacted in 1981. Decree 691/81 addresses the protection and conservation of wild fauna and is implemented through law 22.421.

Bolivia

In Bolivia, this species is listed as vulnerable. The 1975 Law on Wildlife, National Parks, Hunting and Fishing (Decree Law No. 12,301 1975, pp. 1-34) has the fundamental objective of protecting the country's natural resources. This law governs the protection, management, utilization, transportation, and selling of wildlife and their products. It also governs the protection of endangered species; habitat conservation of fauna and flora; and the declaration of national parks, biological reserves, refuges, and wildlife sanctuaries.

Colombia

In Colombia, various protections are in place. Colombia categorizes this species as "vulnerable" (Salaman et al. 2009, p. 21). A vulnerable species is considered to be one that is not in imminent danger of extinction in the near future, but it could be if natural population trends continue downward and deterioration of its range continues (EcoLex 2002, p. 10).

A conservation project focusing on the coffee zone of the middle Rio Frio is ongoing and its goal is to create a conservation corridor connecting natural habitats and shade-grown coffee plantations (Strewe and Navarro 2004, p. 51). The establishment of the private nature reserve, Buena Vista, was the first step to conserve the foothill forest ecosystems. This was done in close cooperation with a local organization, Grupo Ecologico Defensores de la Naturaleza--Campesinos de Palomino, (Strewe and Navarro 2003, pp. 34-35). The Pro-Sierra Nevada de Santa Marta Foundation (FPSNSM) maintains a permanent monitoring station at Buena Vista nature reserve. FPSNSM is working toward sustainable development projects in cooperation with local communities, national park units, and coffee-grower committees in the region. This includes educational campaigns to limit hunting. Habitat management takes place on private lands in the lowlands and foothills of the San Salvador valley to reduce the pressure on the remaining natural forest habitats, including a reforestation program using

native tree species. Additionally, forest reserves have been established as part of a network of private nature reserves in the valley (Strewe and Navarro 2003, p. 35-36).

Ecuador

In Ecuador, this species is considered endangered, "en peligro de extincion" (Arcos-Torres and Solano-Ugalde 2008, p. 69). Here, this species is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 72).

Mexico

In Mexico, the military macaw is protected as endangered under Mexico's Wildlife Protection Act, and this species has been highlighted as a priority species for conservation in the Mexican Parrot Conservation Plan (Rivera-Ortiz et al. 2008, p. 256; Renton 2004, p. 12). Its official list of endangered and threatened bird species is termed the Norma Oficial Mexicana 059 (NOM-059-ECOL).

Peru

In Peru, this species is listed as vulnerable and its protections fall under the jurisdiction of the National Institute of Natural Resources (Instituto Nacional de Recursos Naturales, INRENA). Peru's Supreme Decree No. 034-2004-AG (2004, p. 276,855) prohibits hunting, take, transport, and trade of protected species, except as permitted by regulation.

Venezuela

In Venezuela, this species is listed as endangered (Rodriguez et al. 2004, p. 376).

NGO Involvement

In the 1980s, conservationists realized the value of identifying areas or habitat in terms of numbers of endemic bird species. BirdLife International, in partnership with countries, other nongovernmental organizations (NGOs), and various other partners, developed the Important Bird Area (IBA) program, which is a worldwide initiative to identify and protect critical areas for bird conservation. IBAs are areas that regularly contain significant numbers of one or more globally threatened species or other species of global conservation concern. One of the criteria in identifying important regions for bird conservation is the distribution of restricted-range and globally threatened species such as the military macaw. As of 2007, more than 8,500 IBAs had been identified worldwide (Garcia-Moreno et al. 2007, p. 1). The military macaw has triggered the IBA criteria for 37 IBAs (BLI 2011, pers. comm.) Note that this does not mean this species always occupies these areas; rather, the species has been identified in these areas.

A number of locally based and international conservation organizations have developed programs in connection with protected areas within this species' range such as ecotourism associated with clay licks (Lee 2010, pp. 167-168). The Wildlife Conservation Society (WCS) is implementing a range of projects aimed at strengthening the management of Greater Madidi-Tambopata Landscape in Bolivia. Its program is based on three main categories: (1) Park management, (2) natural resources management, and (3) scientific research (Parks Watch 2005a, p. 35). In the Greater Madidi-Tambopata Landscape, where the WCS is monitoring populations of the military macaw (WCS 2009, p. 8), the area encompasses one of the largest swaths of intact montane forest in the Tropical Andes in northern Bolivia and southern Peru. It is 110,074 km^2 (42,500 mi^2) and includes five protected areas.

A Colombian-based NGO, Fundacion ProAves, is also working to protect this species and its habitats. Fundacion ProAves developed a conservation plan for 2010 to 2020 for several parrot species, including the military macaw (Botero-Delgadillo and Paez 2011, p. 7). However, it is unclear if or when it will be adopted by the Government of Colombia.

In Mexico, several NGOs are participating in the conservation and management of this species. In 1989, a strong citizen movement began to conserve the 383,567-ha (947,815-ac) Sierra Gorda Biosphere Reserve by establishing the local group, Grupo Ecologico Sierra Gorda. In collaboration with the local community, this group has taken action to effectively protect bird communities as well as other groups of wildlife in this area. Strategies include environmental education, the establishment of private reserves, and payment for environmental services

in a 25,000-ha (61,776-ac) area of this reserve (Pedraza-Ruiz, 2008 p. 1). The Chamela-Cuixmala Biosphere Reserve is managed by Mexico's Instituto de Ecologia of the National Autonomous University of Mexico (UNAM) and local NGOs. Other NGOs are working with communities to obtain macaw feathers from aviaries so that indigenous people will not hunt the macaws for their feathers (Renton 2004, p. 14). In the Sinaloa area, the Universidad Autonoma de Sinaloa has been active in conservation of this species since 1998 (Rubio et al. 2007, p. 52). This university conducts research, and conducts outreach activities to foster knowledge and conservation of this species at the Mineral de Nuestra Senora de la Candelaria Ecological Preserve.

Evaluation of Threat Factors

Introduction

Throughout the range of this species, the factors impacting this species are generally very similar. The current primary factors affecting the military macaw are habitat loss and degradation, and poaching (Gastanaga et al. 2011, entire; Strewe and Navarro 2004, p. 50). Habitat loss is primarily due to conversion of the species' habitat (generally forests) to agriculture and other forms that are not optimal for the military macaw (Donald et al. 2010, p. 26; Florez and Sierra 2004, p. 3). Conversion of habitat to soy plantations is now considered to be one of the principal causes of Amazon deforestation (Bonilha 2008, p. 17). Because this species has a small and fragmented population, poaching, while apparently uncommon, remains a concern (Botero-Delgadillo and Paez 2011, p. 13).

This status review focuses primarily on where this species has been documented, in parks and other areas with protected status and the peripheral zones. In some cases, we will evaluate the factor by country. In other cases, we may evaluate the factor by a broader region, if we do not have adequate information specific to a particular country about this species. This is because often threats are the same or very similar throughout the species' range. For particular areas in which we lack information about the species, we request additional information from the public during this proposed rule's comment period (see DATES, above).

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The military macaw has a large but fragmented distribution (276,000 km^2 (106,564 mi^2)), and not all locations where the military macaw exists are known. Habitat destruction and modification is one of the main threats to the military macaw; significant amounts of this species' habitat have been converted such that its habitat is no longer suitable and no longer provides adequate shelter (nesting sites) and food sources, and these causes of habitat loss are likely to continue. Between 2000 and 2005, of all the continents, South America had the largest net loss of forested area, experiencing a loss of 4.3 million ha (10.6 million ac) per year (FAO 2006 in Mosandl et al. 2008, p. 38). In some countries, extractive activities for nontimber forest products occur, such as the removal of palm trees (Arecaceae family) to obtain hearts of palm (ParksWatch 2011; http://www.tropicalforestresearch.org). Currently, the military macaw exists in many parks and other areas that have protected status (Coconier et al. 2009, p. 63; Arizmendi 2008, p. 4; Rodriguez et al. 2004, p. 78; Renton 2004, p. 12). Studies have found that compared with the surrounding areas, conditions inside the parks were significantly better than their surrounding areas (Bruner et al. 2001, p. 125). One study found that in 40 percent of tropical parks, land that had formerly been under cultivation and that was incorporated into park boundaries had recovered. This subsequently led to an actual increase in vegetative cover. The study found that 83 percent of parks were successful at mitigating encroachment (Bruner et al. 2001, p. 125). This was confirmed in a more recent study that found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (Oliveira et al. 2007, p. 1,235). However, this species still faces habitat loss, even in protected areas.

We are limiting our analysis to areas where there is readily available information about this species. For instance, there is very little information available about this species in Argentina and Venezuela (Coconier et al. 2009; Navarro et al. 2008, p. 1; Coconier et al. 2007; Rodriguez et al. 2004). However, in both of these countries, the species faces similar threats (such as the lack of suitable habitat) as in other countries (Rodriguez

et al. 2004, p. 373). The largest populations of this species, discussed in detail in the Range, Observations, and Population Estimates section, appear to be in Mexico and Bolivia. Even in these countries, its populations are small and its distribution is fragmented. In other countries within its range such as Colombia, Peru, and Ecuador, it exists in smaller populations, and Argentina and Venezuela have even smaller and possibly negligible populations. Additionally, the military macaw may have occurred in Guatemala in the past, but it is no longer found there (Gardner 1972 in Snyder et al. 2000, p. 125). We invite experts and the public to provide any additional information they may have about the species in these countries, which we will consider and incorporate into the decision making process for our final determination on this proposed action.

Argentina

In Argentina, habitat destruction, particularly deforestation for agricultural expansion for soy plantation, and timber extraction have significantly increased in recent years (Devenish 2009, p. 60; Chebez et al. in litt. in Navarro et al. 2008, pp. 7, 9; DiPaola et al. 2008, pp. 1, 8; FAO 2007, p. 42). The species was thought to no longer exist in Argentina, which is the southernmost part of its range, but recent surveys found small populations of this species in at least two locations in the Salta Province (Navarro et al. 2008, p. 1). The primary threat to forested areas in Argentina is the expansion of agriculture, particularly soy, into remaining habitat such as the Chaco plains in the Andes mountain range (Centro de Accion Popular Olga Marquez de Aredez (CAPOMA) 2009, p. 6). The practice of drying swamps through channeling is common in northern Argentina, particularly for producing soybeans, which have an increasing demand in the global market. The current rate of deforestation stands at 25,000 ha (61,776 ac) per year resulting from land converted to agricultural use (Devenish 2009, p. 60). The area converted to soy production increased from as little as 3 percent in the 1970s to 40 percent of the total crop area in 2003, covering 14 million ha (34.6 million ac) (Devenish 2009, p. 60). Conversion of lands to soy production is favored by the current political and economic climate, both at the global and national levels (Devenish 2009, p. 60). With regard to other types of land use, the area used for cattle ranching has decreased, but exotic tree plantations have doubled (Devenish 2009, p. 60).

In addition, pipeline routes and associated roads are being established in this area in connection with oil, gas, and mineral exploration (Navarro et al. 2008, pp. 7, 9). Road building operations greatly facilitate access to large, previously inaccessible forested areas (Fimbel et al. 2001, pp. 511-512). The area occupied by permanent facilities including pipelines and refineries is relatively small, but oil development areas cover large tracts of land. Oil development can have significant negative impacts on nearby habitat through construction of roads and other buildings, discharge of contaminants, and oil spills and leaks (Rhee et al. 2004, chap. 6, p. 31). Although some of this species' habitat is protected, its habitat continues to shrink in Argentina. In the area of Acambuco, where the military macaw has been observed, the designation of Acambuco Reserve as a provincial reserve provides some protective measures. The purposes of this reserve, in part, are to preserve its genetic resources, to preserve the environment surrounding catch basins of its rivers, and to guarantee the maintenance of the biodiversity living in the reserve. However, in the Salta Province, this species is primarily found in areas that are unprotected, with the exception of the Acambuco Reserve. In summary, significant amounts of this species' habitat have been converted such that its habitat is no longer suitable, and these causes of habitat loss are likely to continue.

Bolivia

Madidi National Park experiences threats representative of threats to this species' habitat in Bolivia, and this is one of the key areas where this species likely has a viable population in Bolivia. Thus, we focused our analysis on this park. The National Service of Protected Areas (SERNAP) has authority over Bolivia's parks and protected lands. Approximately 53 percent (57.2 million ha; 141.3 million ac) of Bolivia's total area is forested (FAO 2011, p. 118). Of this area, 38.9 million ha (96.1 million ac) are within the Bolivian Amazon and constitute 5 percent of the total Amazon forest (Locklin and Haack 2003, p. 774). As of 2005, Bolivia had 12 national parks, including 6 with integrated management natural areas, 1 with indigenous territory (or communal lands),

and 4 national reserves; 2 biosphere reserves; and 3 integrated management natural areas, totaling 16,834,380 ha (41,598,659 ac) (ParksWatch 2005, p. 2). A discussion of typical threats in Bolivia's parks follows. The region suffers from chronic and intense poverty levels, which affect more than 90 percent of the population (Instituto Nacional de Estadistica de Bolivia (INE) 2005). The result is intense conflict between development and conservation. In Madidi National Park, the three greatest threats to the nature preserve are the construction of a highway within the park, drilling for oil, and a planned hydroelectric dam. Other activities that are impacting or are likely to impact this park are illegal logging, gold mining, and uncontrolled tourism (ParksWatch 2011b, pp. 1-15; Chavez 2010, pp. 1-2).

Deforestation and Logging

The forests of Bolivia have mainly been subjected to selective logging (Salo and Toivonen 2009, p. 610; Fredericksen 2003, p. 10), which has been done at very low levels and with low human pressures (Pacheco 2006, p. 206), allowing them so far to remain largely intact. In the five national parks where the military macaw is regularly observed, there are some protections in place for the species' habitat (Hennessey 2010, pers. comm.). However, logging still occurs within the range of this species (ParksWatch 2011b, p. 1). Large tracts of primary forest remain in Bolivia, but it is likely that some of these will be subjected to logging (Fredericksen 2003, p. 13) due to slash-and-burn activities by indigenous communities, and because forest products are one of Bolivia's primary exports (Byers and Israel 2008, p. vi). The use of slash-and-burn practices on steep and erodible slopes has considerably affected the area's hydrological regime, particularly near the city of Santa Cruz. In many areas of human settlement, soil erosion is compounded by logging, nutrient depletion, and weed invasion.

As of 2006, 89 timber companies held the rights to 5.8 million ha (14.3 million ac) of logging concessions (Pacheco 2006, p. 208). The Bolivian Forestry Law of 1996 (Forestry Law 1700) requires the preparation and approval of management plans and adherence to best management practices ((BMPs) (Nter et al. 2011, p. 292; Fredericksen 2003, p. 10). For instance, harvesters must pre-map harvestable trees (which have minimum diameter limits), protect seed trees, and set aside areas that are designated as protected or not harvestable (Nter et al. 2011, p. 292). Management issues still need to be addressed, including sufficient regeneration time for commercial species (Fredericksen 2003, p. 10). However, Bolivia continues to attempt to balance the use of its natural resources with competing priorities. For example, the Pilon Lajas Management Plan divided the reserve into specific zones to combine indigenous community rights with conservation initiatives (Hennessey et al. 2003, p. 320). Despite national laws and regulations, activities such as illegal timber extraction continue to spread unabated (World Bank 2006, p. 8; U.S. Forest Service 2007, p. 2; Pacheco 2006, p. 208; TRAFFIC 2006, p. v).

Roads

There are increasing demands for road infrastructure within Bolivia for many reasons. It is one of the poorest countries in South America (MacLeod 2009, p. 6; INE 2005), and the government would like to improve its economy (ParksWatch 2011b, p. 13). The construction of the Apolo-Ixiamas Road is one way of facilitating access to its natural resources. A road has been proposed that would bisect the Madidi National Park and Natural Integrated Management Area, opening vast, currently inaccessible tropical forest areas to colonization and resource extraction (ParksWatch 2011b, pp. 1-2; Fleck et al. 2006, p. 13). This can promote illegal logging, and facilitate access to previously inaccessible forested areas (Fimbel et al. 2001, pp. 511-512). The construction of roads through this park has been a source of controversy for several years (http://conservation-strategy.org/en/project/economics-road-through-madidi-national-park, accessed October 6, 2011). The current status of the road and whether it will be constructed around the park or through the park remains unclear. However, regional development plans are often implemented without consideration of impacts on natural resources (WCS 2009, p. 4). Plans to connect Bolivia and Peru to Brazil's expanding markets and expand the energy industry (oil and gas) will affect fragile areas of high biodiversity (WCS 2009, p. 4). Roads constructed in

the past have also been problematic. In the late 1990s, roads through Serrania Sadiri spurred an increase in unsustainable logging of the area's mahogany trees, which were the most valuable tree at the time (World Land Trust 2010, p. 1).

Hydroelectric Power

Possibly one of the greatest threats in the Madidi National Park is the proposed Bala Hydroelectric Dam Project at the Beni River in the Bala Gorge, where the Beni River goes through the Bala Mountain Range (WCS 2011, p. 2). El Bala Hydroelectric Dam, as proposed, could flood much of Madidi National Park and the adjacent biosphere reserve and indigenous territory Pilon Lajas, which is an area of about 2,000 km^2 (4,942 mi^2) (Chavez 2010, pp. 1-2; Bolivia Supreme Decree 24191). Construction of dams can have severe impacts on ecosystems (McCartney et al. 2001, p. v). For example, a dam blocks the flow of sediment downstream. During construction of dams, disturbance to soils at the construction site is one of the largest concerns. This leads to downstream erosion and increased sediment buildup in a reservoir. Although the current status of this dam is unclear, it is clear that the Government of Bolivia is intent on becoming more self-reliant, in part through creating its own sources of energy through hydroelectric dams.

Oil Exploration

In October 2010, the Bolivian Government approved Supreme Decree 0676, which directly affects the Madidi National Park and the Biosphere Reserve and Indigenous land called Pilon Lajas (http://www.oecoamazonia.com/en/news/bolivia/171-bolivia-transforma-parque-na-amazon; accessed September 13, 2011) by extending gas and oil exploration and development. Oil exploration in the region would not only affect the pristine nature of the Madidi National Park and Pilon Lajas, but also the subsistence of the indigenous people living in the area (http://www.amazonfund.eu/art-oil-madidi.html, accessed September 13, 2011). The exact effects of oil exploration to this species are still unclear.

Other Pressures

In Madidi National Park, there is limited legal hunting, but in the areas surveyed, this species was described as common and not exploited (Hosner et al. 2009, p. 226). Nine villages or communities are within the national park, and 22 are in the integrated management natural area. Of the 31 communities, three are located in the Andean plateau zone. In the lowlands, two of the communities occupy the zone of valleys around the municipality of Apolo. Madidi's buffer zone has an additional 11,000 indigenous inhabitants (Fleck et al. 2006, p. 29). Timber extraction still occurs here (WorldLand Trust 2010, p. 1). In 2010, an additional 25,090 ha (62,000 ac) of pristine tropical rainforest in Bolivia were protected, following a decision by an indigenous community to create a tourism refuge in the Sadiri rainforest (WorldLand Trust 2010, p. 1). Landless Andean farmers make a living in the lowlands, and they at times expand the agricultural frontier, increasing the risk of disease transmission between domestic animals and wildlife, bringing crops and domestic animals closer to wildlife predators, and increasing hunting pressure in surrounding forests (WCS 2009, p. 4). Harvest of nontimber forest products such as palm hearts (in the Arecaceae or Palmaceae family), jatata (Geonoma species), pachiuva (Socratea exorrhiza), and jipijapa (Carludovica palmata) for subsistence (Fredericksen 2003, p. 13) also occurs.

In summary, threats to the species' habitat in Bolivia include unsustainable land use practices, illegal logging, road building, and exploration activities for oil extraction, which are contributing to the erosion of Bolivia's ecosystems (MacLeod 2009, p. 6; ParksWatch 2005, p. 1). Large tracts of primary forest remain in Bolivia, but it is likely that many of these will be subjected to logging and other pressures, such as extraction of nontimber forest products, particularly because forest products contribute to Bolivia's national exports (Byers and Israel 2008, p. vi). The Government of Bolivia is attempting to balance improving its economy with conservation initiatives, and some of its development initiatives may negatively impact this species' habitat. Despite protections in place, this species' habitat in Bolivia continues to experience these threats, and we expect these pressures to continue into the future.

Colombia

In the past, human colonization, development, and exploration within the range of the species in Colombia were limited due to the exceptionally steep and high terrain of the Andes (Salaman et al. 2002, p. 160). However, researchers reported in 2004 that the Cauca River Canyon in northeastern Colombia, an area containing military macaws, was extensively deforested (Florez and Sierra 2004, p. 3). The main threats in the lowlands are the expansion of agriculture, particularly by small farmers in the middle altitude areas, and extractive activities such as hunting (including the removal of birds to sell as pets) and wood harvesting (Salaman et al. 2007, p. 89). As resources become scarcer in the lowlands, these pressures move upland. Associated with these farming practices is the use of livestock and the erosion caused by livestock grazing on steep slopes, as well as erosion due to cultivation.

Until recently, forest cover was largely continuous in Colombia, but deforestation has increased dramatically (FAO 2010, pp. 22, 106; FAO 2002). Deforestation rates in lowland moist forest on the foothills of the eastern Andes of Colombia are rapidly accelerating. Deforestation has increased from 1.4 percent (1961-1979) to 4.4 percent (1979-1988), and is correlated with increasing human population density (Salaman et al. 2007, p. 89; Vina and Cavelier 1999, p. 31). Primary forest habitats throughout Colombia have undergone extensive deforestation. Vina et al. (2004, pp. 123-124) used satellite imagery to analyze deforestation rates and patterns along the Colombian-Ecuadorian border (in the Departments of Putumayo and Sucumbios, respectively), finding that between 1973 and 1996, a total of 829 km^2 (320 mi^2) of tropical forests within the study area were converted to other uses. This corresponds to a nearly one-third total loss of primary forest habitat, or a nearly 2 percent mean annual rate of deforestation within the study area.

Since the 1970s, the Colombian Government has encouraged road construction and colonization projects. The goal is to create links to the vast and undeveloped Amazonian region, and to open up the Llanos and Amazonian lowlands for utilization of their natural resources (Salaman et al. 2007, pp. 10, 89; Salaman et al. 2002, p. 160). In recent years, this species' habitat has come under increased pressure with the completion of the Mocoa-Bogota highway, the proposed Puerto Asis-Florencia road, and the discovery and exploitation of petroleum and precious metals. All of these factors contribute to an escalation in human encroachment and associated impacts that degrade this species' habitat (Salaman et al. 2007, p. 10). The few remaining forest connections between the upper and lower slopes are under pressure, even where they are minimally protected. Five main routes link the lowlands from Colombia's high Andean interior. Infrastructure development on the eastern slope of the Andes in Colombia, as well as adjacent Ecuador, has also caused significant human population pressures and has led to much habitat degradation. Increased and improved access roads have led to the conversion of mature tropical forests for pasture lands, petroleum products exploitation, and coca plantations (Salaman et al. 2007, p. 89). These road projects to link Colombia with Venezuela and Ecuador along the entire eastern base of the Andes have contributed to additional deforestation.

Serrania de los Churumbelos National Park

Currently, the Serrania de los Churumbelos forest is almost entirely intact, and land is owned by the government and uncolonized (Salaman et al. 2007, pp. 10, 91-92). This mountain range has largely avoided the degree of human impact that other regions have suffered. However, this is changing rapidly due to mineral exploration (petroleum and precious metals) and natural resources (timber and rich organic soils for agriculture) demands. The Serrania de los Churumbelos could become the focus of large-scale deforestation and colonization in the near future (Salaman et al. 2007, p. 89). Parque Natural Nacional Cueva de los Guacharos provides some protection to the forests in this region although it is a small park (approximately 5,000 ha or 12,355 ac) and even here, illegal encroachment occurs (Salaman et al. 2007, p. 89).

Catatumbo-Bari National Park

The primary threat in the Catatumbo-Bari National Park (at the Colombian-Venezuelan border) is deforestation and impacts associated with coca plantations surrounding the Park (Fundacion ProAves 2011, Avendano in litt).

Coca cultivation has fluctuated for the past several years. Over a 4-year study period, it contained about 100 ha (247 ac) of coca (United Nations Office on Drugs and Crime, undated report, p. 33). A new population of this species was recently recorded at two locations in this park (Avendano in litt). One population in the Cauca valley (fewer than 50 mature birds) could be affected by the construction of a dam (155 m (508.5 ft) in height) that could affect its sole breeding cliff. However, this dam is still in the planning stages (Fundacion ProAves 2011 pers. comm., September 4, 2011).

Ecuador

Ecuador is experiencing the highest deforestation rate in South America (Mosandl et al. 2008, p. 37). Forested habitat within many parts of Ecuador has diminished rapidly due to logging, clearing for agriculture, and road development (Youth 2009, pp. 1-3; Mosandl et al. 2008, p. 37; Sierra 1999, p. 136; Dodson and Gentry 1991, pp. 283-293). Between the years 1990 and 2005, Ecuador lost a total of 2.96 million ha (7.31 million ac) of primary forest, which represents a 16.7 percent deforestation rate, and a total loss of 21.5 percent of forested habitat since 1990 (Butler 2006b, pp. 1-3; FAO 2003b, p. 1). Much of the primary moist forest habitat has been replaced with pastures and scattered trees (Collar et al. 1992, p. 533), and forest habitat loss continues in Ecuador. Very little suitable habitat now remains for the species here, and remaining suitable habitat is highly fragmented (Bass et al. 2010, p. 2; Snyder et al. 2000, p. 122). In the area where this species exists, near the Gran Sumaco Biosphere Reserve, there are several oil reserves (Celi-Sangurima 2005, p. 22). However, specific impacts to this species as a result of oil exploration or extraction activities are unknown.

The colony in Kichwa River Reserve is currently in an area designated as protected, although it is unclear what these protections entail. In this area, the local community group Macaw Rio is interested in conducting ecotourism. Although this colony has persisted for about 150 years (Huatatoca, in litt.), it likely will be affected by logging and the resulting deforestation on nearby land. Researchers suggest that the apparent lack of this species in Ecuador is possibly related to lack of suitable sites for the formation of breeding colonies, or lack of knowledge about sites that may be located in inaccessible areas (Arcos-Torres and Solano-Ugalde 2008, p. 72). We know of no specific threats to the species in the Kichwa River Reserve, other than those associated with small population sizes, which is discussed under Factor E, below.

Mexico

Mexico has suffered extensive deforestation (conversion of forest to other land uses) and forest degradation (reduction in forest biomass through selective cutting, etc.) over the past several decades (Commission for Environmental Cooperation (CEC) 2010, pp. 45, 75). In recent decades, Mexico's deforestation has been rapid (Blaser et al. 2011, pp. 343-344). Between 1990 and 2000, Mexico lost forest (factoring in natural regeneration of degraded forest and planting of forest in areas that previously did not have forest) at a net rate of 344,000 ha (850,043 ac) per year (FAO 2010, p. 21). During 1990-2010, Mexico lost approximately 6 million ha (15 million ac) of forest, and had one of the largest decreases in primary forests worldwide (FAO 2010, pp. 56, 233). Although Mexico's rate of forest loss has slowed in the past decade, it still continues. The current rate of net forest loss in Mexico is 155,000 ha (383,013 ac) per year, with an estimated 250,000-300,000 ha (617,763-741,316 ac) per year degraded (Government of Mexico (GOM) 2010b, in Blaser et al. 2011, p. 344; FAO 2010, p. 233).

Currently, Mexico has 64.8 million ha (160.1 million ac) of forest (Food and Agriculture Organization (FAO) 2010, p. 228), and 50 percent of these forests are considered degraded. Projections of lost forested area by the year 2030 in Mexico are between 10 percent to nearly 60 percent of mature forests lost, and approximately 0 to 54 percent of regrowth forests lost (CEC 2010, pp. 45, 75). Deforestation via forest conversion to agricultural uses remains a major driver of land transformation in Mexico (CEC 2008, p. 24). Agricultural production is projected to double within the country by 2030 (CEC 2010, pp. 34, 70). Although some of this increase in production is expected to be due to an increase in productivity on previously converted land, total agricultural land area in Mexico is projected to increase by 6,300 to 41,400 ha (15,568 to 102,302 ac) by 2030 (CEC 2010,

p. 75).

In the range of the military macaw, such as the tropical forest along the Pacific coast of Mexico, high rates of deforestation have occurred; slash-and-burn agriculture still occurs along with grazing. In 2002, it was estimated that the species had suffered a 23 percent habitat loss within its range in Mexico using a Genetic Algorithm for Rule-set Prediction (GARP) analysis tool (Rios-Munoz 2002, pp. 24, 32). GARP analysis essentially uses ecological characteristics of known species locations in order to determine its likely distribution.

A 3-year study documented loss of habitat, particularly trees used by macaws, in the Tehuacan-Cuicatlan Biosphere Reserve, Sabino Canyon. In their study, researchers found a total of 170 individual plants of species consumed by military macaws in the pine forests in an area of 1,500 m^2 (16,146 ft^2) in 2005 (Arizmendi 2008, p. 43). By January 2008, eleven (6.5 percent) of these trees had been logged. In the transitional forest between dry and pine (in an area of 1,000 m^2 or 10,764 ft^2), 134 plants were documented in 2005, and by January 2008, fifteen (11.90 percent) of them had been logged. Arizmendi suggested that these activities are carried out by local communities, and suggested that a local environmental education campaign be implemented. A reduced number of trees limits the availability of adequate food resources across the landscape. With fewer trees remaining, the area cannot support the same number of individuals of the species and therefore causes a further reduction in the population. Macaws were not found in deforested areas, even where an important food source, Hura polyandra, was left as shade for cattle (Rivera-Ortiz et al. 2008, p. 256). As further support, in Jalisco, most of the sites where macaws were present had little or no habitat loss (note that none of the sites in Jalisco where military macaws were located were in protected areas). No macaws were located in sites with more than 30 percent habitat loss, even though these sites may have had abundant trees.

Mining

At the Mineral de Nuestra Senora reserve in Cosala, where this species occurs, mining activities are occurring (Rubio et al. 2007, p. 52; Bonilla-Ruz et al. 2006, p. 45). This reserve is 12 km (7.5 mi) southeast of Cosala in Sinaloa, Mexico. This reserve was created after a joint effort in 1999 between the state, municipal government, and the Autonomous University of Sinaloa. The Autonomous University of Sinaloa conducted technical studies to propose the area as a nature reserve. The university also conducted conservation projects here which focused on the "Ecology and Conservation of the Military Macaw" and "Environmental Education and Ecotourism." In 2002, the Mineral de Nuestra Senora reserve was formally designated. Since then, parrot populations and their habitat here both within and outside the preserve have been affected by mining activities taking place in the area (Rubio et al. 2007, p. 52). In early 2005, mining efforts began on underground development and drilling (Scorpio Mining 2011, p. 2). The current effect of mining on the species is unclear.

Peru

There is little to no current published information with respect to specific threats to this species in Peru (Gastanaga et al. 2011, entire; BLI 2011, p. 2; JGP 2011, entire; Lee 2010, entire; Cowen 2009, entire; Terborgh 2004, entire; Brightsmith 2004, entire). It exists in several parks which convey some measures of protection (Oliveira et al. 2007, p. 1235; Terborgh 2004, p. 35). Peru's protected areas are managed by the General Department of Natural Protected Areas, INRENA, under the authority of Law No. 26834, Law of Natural Protected Areas, promulgated in 1997. The Peruvian national protected area system includes several categories of habitat protection. Habitat may be designated as any of the following:

(1) Parque Nacional (National Park, an area managed mainly for ecosystem conservation and recreation);

(2) Santuario (Sanctuary, for the preservation of sites of notable natural or historical importance);

(3) Reserva Nacional (National Reserve, for sustainable extraction of certain biological resources);

(4) Bosque de Proteccion (Protection Forest, to safeguard soils and forests, especially for watershed conservation);

(5) Zona Reservada (Reserved Zone, for temporary protection while further study is under way to determine their importance);

(6) Bosque Nacional (National Forest, to be managed for utilization);
(7) Reserva Comunal (Communal Reserve, for local area use and management, with national oversight); and
(8) Cotos de Caza (Hunting Reserve, for local use and management, with national oversight) (BLI 2008, p. 1; Rodriguez and Young 2000, p. 330).
Because the designations of national parks, sanctuaries, and protection forests are established by supreme decree that supersedes all other legal claim to the land, these areas tend to provide more habitat protection than other designations. All other protected areas are established by supreme resolution, which is viewed as a less powerful form of protection (Rodriguez and Young 2000, p. 330).
This species has been documented in the Tambopata National Reserve, which is a 275,000-ha (679,540-ac) conservation area created by the Peruvian Government in 1990. The main purpose was to protect the watersheds of the Tambopata and Candamo rivers. This area protects some of the last pristine lowland and premontane tropical humid forests in the Amazon. Within the Tambopata National Reserve, there have been isolated human settlements along stretches of the Malinowski River and where it flows into the Tambopata River. Fewer than 5,000 people inhabit the Tambopata National Reserve's border area to the north. They make a living of slash-and-burn agriculture, small-scale gold mining, timber extraction, and hunting and fishing. One area of Tambopata, including a buffer zone, was recently described as a "crisis zone" (Lee 2010, p. 169). It has been described as being at high risk to illegal settlement, timber extraction, and mining (Lee 2010, p. 169).
Populations of this species are thought to be in the Manu Biosphere Reserve and the Bahuaja Sonene National Park in Peru (WCS 2007, p. 1; Herzog in litt. 2007; Terborgh 2004, pp. 40-41). Problems here are primarily due to human population growth (Terborgh 2004, pp. 40-41). Five indigenous groups reside in the Manu Biosphere Reserve--they are both legal and illegal settlers (Terborgh 2004, pp. 40-41). An ecological research station has been in place since 1973 in Manu National Park (Terborgh 2004, entire), which also adds some protection to the species. Research has shown that often simply by having a long-term research presence there, this serves to reduce poaching (Campbell et al. 2011, p. 2). Unlike parks in the United States, in countries such as Peru, parks and protected areas were formed around the indigenous tribes that live there (Terborgh 2004, p. 51), and the management and purpose of the parks often include protection of the rights of indigenous human communities. This philosophy of park protection and mandates of parks is different from in the United States, where humans are viewed as visitors to the parks, rather than permanent residents (Terborgh 2004, p. 51). In Manu Biosphere Reserve, another potential threat is oil exploration. Both Shell and Mobil Oil have conducted oil exploration activities in this area (Terborgh 2004, p. 55; ParksWatch 2002, pp. 5, 7). Within Bahuaja, as of 2002, there were no human establishments within its boundaries (ParksWatch 2002a, p. 1). However, activities that could affect the military macaw in this area include gold mining, illegal logging, extraction of forest resources, and an increase in farming (ParksWatch 2002b, p. 1).
Venezuela
There is little published information about the species in Venezuela (BLI 2011, p. 2; Rodriguez 2004, entire). Here it exists in the Andes in the Central Coastal Cordillera, and Sierra de Perija (Rodriguez et al. 2004, pp. 375, 378, 379). It has been found on the north slopes of El Avila, Guatopo, Henri Pittier National Park, Ceroo La Mision, Sierra de Perija National Park (Desenne and Strahl 1994 in Snyder et al. 2000, p. 125; Fernandez-Badillo et al. 1994 in Snyder et al. 2000 p. 125). Most of its range in Venezuela is within protected areas, but threats still exist in the protected areas here (Snyder et al. 2000, p. 125). In 2000, Snyder et al. noted that Sierra de Perija was being deforested for narcotics, land speculation, and cattle (p. 125). A population of this species was recently recorded for the first time at two localities at the Catatumbo-Bari National Park in the Colombian-Venezuelan border, extending the previous species' range from the east slope of the Serrania de Perija southwards (Avendano in litt).
Summary of Factor A
Habitat loss, human encroachment, and conversion to agriculture are the main threats acting on the species

throughout its range. These threats are exacerbated by an inability by range country governments to adequately manage and monitor the species (see discussion under Factor D, below). South America had the largest net loss of forest area of all continents between 2000 and 2005 (Mosandl et al. 2008, p. 38), with a net loss of 4.3 million ha per year. Although specific, detailed information about this species' remaining occupied habitat status is not available for each country, we know that much of this species' habitat has been lost through conversion of land to farming, forestry, or other activities (Bonilha 2008, p. 17; Etter et al. 2006, p. 369; Renton 2004, p. 13). Conversion of habitat to soy plantations is now considered to be one of the principal causes of Amazon deforestation. Deforestation may already have destroyed as much as 1.2 million ha (3 million ac) in the Amazon. This, combined with pressures of capture for the pet trade, has severely impacted the wild population of military macaws. Studies have shown that over time, resident bird diversity generally declines as forest fragments become smaller (Turner 1996, pp. 202, 206).

As with most parrots, the military macaw requires large areas of suitable habitat, including large trees or other nesting cavities for nesting, feeding, and roosting as well as food sources. Logging is a common form of habitat loss that affects this species (Bonilla-Ruz 2006, p. 45). Deforestation via conversion of land to agricultural use is a threat to military macaws because it directly eliminates forest habitat, removing the trees that support the species' nesting, roosting, and dietary requirements. It also results in fragmented habitat that isolates military macaw populations, potentially compromising the genetics of these populations through inbreeding depression and genetic drift (Lande 1995, pp. 787-789; Gilpin and Soule 1986, p. 27). We do not know the exact extent of deforestation in the range of the military macaw. However, the best available information indicates that deforestation continues to occur and affect the species throughout its range, despite protections that are in place.

Currently the population of military macaws is extremely small (likely a few thousand individuals), those populations are severely fragmented, and its suitable habitat is becoming increasingly more scarce. Therefore, based on the best available scientific and commercial information, we find that the present or threatened destruction, modification, or curtailment of habitat or range is a threat to the military macaw now and in the future.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The trade in wild parrots is common in some areas of South America (Gastanaga et al. 2011, entire; Cantu-Guzman et al. 2008, entire). In its Red List assessment, the IUCN indicates that the two major threats to the military macaw are habitat loss and capture for the domestic pet trade (IUCN 2011, p. 1). Many reports indicate that poaching for the pet trade is still a problem for parrot species, particularly in poorer countries (Herrera and Hennessey 2007, entire; Dickson 2005, p. 548). For perspective, in the United States, captive-bred specimens of this species were recently found offered for sale for $699 (Basile 2010, p. 2). In 2006, four military macaws were advertised for sale with an average sale price of $850 (Cantu-Guzman et al. 2008, p. 72). Although the scope of the illegal trade in the military macaw is unknown, poaching can be a lucrative and relatively risk-free source of income (Dickson 2005, p. 548).

A high percentage of birds die during the process of capturing from the wild, transporting, and selling them. Younger birds die at a higher rate than adult birds, and the younger birds are more desirable. Because most of these activities are illegal, it is difficult to accurately determine the actual mortality rate, but estimates vary between 31 and 90 percent (Weston and Memon 2009, p. 79; Cantu-Guzman et al. 2007, pp. 7, 20, 22, 55, 60). Wild harvest can destroy pair bonds, remove potentially reproductive adults from the breeding pool, and have a significant effect on small populations (Kramer and Drake 2010, p. 11). Military macaws mate for life, are long-lived, and have low reproductive rates. These traits make them particularly sensitive to the impacts of their removal from the wild (Lee 2010, p. 3; Thiollay 2005, p. 1,121; Wright et al. 2001, p. 711). These activities adversely affect a species' population numbers (Pain et al. 2006, p. 322).

Although poaching continues to occur for the pet trade, it has been found to be significantly lower at protected

sites (Pain et al. 2006, pp. 322-328; Wright et al. 2002, p. 719). Other reports have found that national or local protection, particularly when local communities are actively involved in conservation efforts, can successfully reduce nest take (Pain et al. 2006, p. 328; Chassot et al. 2006, pp. 86-87). Gonzalez (2003, pp. 437-446) found evidence of poaching, particularly during nesting seasons, in the Pacaya-Samiria National Reserve, a protected area in the Loreto Department, Peru, during his 1996-1999 study. However, he also found that poaching decreased during the 1998 harvest season (Gonzalez 2003, p. 444), which he attributed to increased numbers of birds confiscated by regional authorities, which may have subsequently discouraged poaching (also see Factor D, below).

A related factor is the destruction of trees in this species' habitat due to poaching. This species primarily depends on tree-cavity nests as its habitat. Not only does nest poaching negatively affect this species by reducing the population size and the number of birds available to reproduce, it also in some cases destroys this species' habitat. Several studies have found that poachers will cut down trees to remove nests. A study conducted in the late 1990s found that in some cases in Peru, poachers cut down the nesting tree in order to access the nestlings (Gonzalez 2003, p. 443). They also were observed "hacking" open the nest cavities to remove chicks (Bergman 2009, pp. 6-8; Low 2003, pp. 10-11). An average of 21 nests was destroyed per poaching trip (Gonzalez 2003, p. 443). Nest destruction was also reported by Bergman in Ecuador in 2009 (pp. 6-8).

The military macaw was listed in CITES Appendix II, effective June 6, 1981, and was transferred to CITES Appendix I, effective October 21, 1987. Most of the international trade in military macaw specimens consists of live birds. Data obtained from the United Nations Environment Programme--World Conservation Monitoring Center (UNEP-WCMC) CITES Trade Database show that during the nearly 6 1/2 years that the military macaw was listed in Appendix II, a total of 1,034 military macaw specimens were reported to UNEP-WCMC as (gross) exports. Of those 1,034 specimens, 1,019 were live birds and 15 were feathers. In analyzing these data, it appears that several records may be over-counts due to slight differences in the manner in which the importing and exporting countries reported their trade. It is likely that the actual number of military macaw specimens in international trade during this period was 973, including 958 live birds and 15 feathers. Fourteen of the live birds were captive-bred, and the others were reported with the source unknown. Exports from range countries included: 364 live birds from Bolivia; 320 from Mexico; 11 from Ecuador; 4 from Venezuela; and 1 from Argentina.

During the more than 22 years following the transfer to Appendix I (October 21, 1987 through December 31, 2009, the last year for which complete data are available), the UNEP-WCMC database shows a total of 1,523 military macaw specimens as (gross) exports, including 1,226 live birds, 190 scientific specimens, 105 feathers, 1 body, and 1 trophy (UNEP-WCMC trade database, accessed July 12, 2011). As noted above, it appears that some records may be over-counts due to differences in the manner in which the importing and exporting countries reported their trade. It is likely that the actual number of live military macaws in international trade during the 22-year period was 1,119. Of those 1,119 birds, 840 were captive-bred or captive-born, and 119 were reported as wild. The source of the remaining live birds is unknown. Exports from range countries included: 54 live birds from Mexico; 10 from Argentina; 4 from Venezuela; 2 from Colombia; and 1 from Peru. Annual quantities exported ranged from a low of 14 live birds during 2006, to 122 live birds (including 80 exported from South Africa) in 2009. Since 2004, none of the exports from range countries has been reported as wild origin.

Argentina, Bolivia, Ecuador, and Mexico

In Argentina, Ecuador, and Venezuela, there is little to no information available about overutilization. International trade has diminished, but local trade continues to occur. In Bolivia, a report published in 2009 indicated that of 17,609 birds (including military macaws) documented in the market studied in Department of Santa Cruz (not far from the range of this species), 64 percent of the birds were found to be adults captured in

the wild. Ninety percent (24,707) of the birds were found to be from the Department of Santa Cruz. A total of 2,604 individuals were from the Department of Tarija, 176 from the Department of Beni, 20 from Peru, and 12 from Brazil (Herrera and Hennessey 2009, p. 233). The report indicated that most parrots (some of which were military macaws) were locally sold, and found that 23,306 were in the city of Santa Cruz, and 4,156 were sent to Cochabamba.

In Mexico, the military macaw is reportedly one of the most sought-after species in the illegal pet bird trade (Cantu-Guzman et al. 2007, p. 38), and poaching remains a concern. In 1995-2005, it was the fifth most seized Mexican psittacine species by Mexico's Environmental Enforcement Agency, becoming the fourth most seized psittacine species in 2007-2010 (p. 52). As an example, at a sinkhole in El Cielo Biosphere Reserve; a population of approximately 50 birds was decimated by poaching in the 1980s (Aragon-Tapia in litt. 1989 in Snyder et al. 2000, p. 125). In many areas, it nests in relatively inaccessible cavities on cliff walls, which provides some protection against the pressures of nest poaching. However, nest poaching is a severe threat in Jalisco and Nayarit, where the species nests in tree cavities (Contreras-Gonzalez et al. 2009, p. 43; Renton in litt. 2007 and Bonilla in litt. 2007 in BLI 2011, pp. 1-2). Between 2005 and 2006 in Mexico, five military macaws were found for sale, and the average price was $373 (Cantu-Guzman et al. 2007, p. 76).

Local residents in Argentina indicated that young chicks are removed "for foreigners" but also noted that it is extremely difficult due to the difficulty in accessing the species' preferred nesting sites and the aggressiveness of the macaws (Navarro et al. 2008, pp. 7, 9). Additionally, in Mexico and Ecuador, indigenous communities have used military macaw feathers for ceremonial and medicinal practices. However, NGOs are working with these communities to obtain macaw feathers from aviaries so that the indigenous people will not hunt the macaws (Renton 2004, p. 14).

Colombia

This species and other Ara macaws are occasionally hunted by indigenous people in Colombia. In one study, in the Catatumbo-Bari National Park, hunting was found to be concentrated around the 15 indigenous communities within the 160,000-ha (395,369-ac) park (Avendano 2011). In 2004, in a cliff-nesting location along the Cauca River, Colombia, threats to this species included poaching and loss of foraging trees (Florez &Sierra 2004, pp. 2-3). They found that at the Cauca River site, it was common for some people to remove hatchlings from the nests and sell between 20 to 30 chicks per year on the black market (p. 3). To counteract these activities, a local awareness campaign was initiated (Florez &Sierra 2004, pp. 2-3). As a result of this project, 3,000 Hura crepitans trees (a species used by the military macaw) were planted by the local communities, and the awareness campaign appeared to be effective. Researchers do not believe that hunting pressure is a serious short-term threat. However, local education and awareness programs generally need to be ongoing and long-term for them to be effective, and the local communities need to be aware of the benefits of conserving species in the wild, as well as have alternative sources of income (i.e., income other than that derived from poaching).

Peru

A recent study in Peru examined nest poaching and illegal trade of parrots, including the reasons for poaching, and the methods, seasons, and locations where the sale and actual poaching of parrots occurred. This study found that this species is still being poached in the wild (Gastanaga et al. 2011, pp. 79-80), even in protected areas and despite national protections in place. During the 2007-2008 study, eight military macaws were found for sale in two out of eight markets surveyed in Peru (p. 79). Seven of these birds were found in the Amazonian lowland city, Pucallpa (p. 80). The study also found that where protections and enforcement have been implemented such as in Cusco, there were no parrots for sale in markets. This indicates that although it still continues, poaching is becoming less frequent due to involvement by NGOs, minimal international demand for the species, and enforcement by authorities.

Summary of Factor B

Among birds, parrots are the group most subject to commercial trade (Hutton et al. 2000, p. 14). Parrots have suffered a disproportionate number of extinctions, in part due to their desirability as pets. Conservation efforts by the various entities working to ensure long-term conservation of the military macaw may result in its population slowly increasing; however, it is likely that the population is still declining. Even though the military macaw is listed as an Appendix-I species under CITES and laws have been established within the range countries to protect this species, we are still concerned about the illegal capture of this species in the wild. Despite regulatory mechanisms in place and restricted international trade, poaching is lucrative and continues to occur. Additionally, because each population of military macaws is small, with usually fewer than 100 individuals, poaching is likely to have a significant effect on the species. Based on the best available scientific and commercial information, we find that overutilization for commercial, recreational, scientific, or educational purposes is a threat to the military macaw throughout its range.

C. Disease or Predation

Disease

Studies of macaws indicate that this species is susceptible to many bacterial, parasitic, and viral diseases, particularly in captive environments (Kistler et al. 2009, p. 2,176; Portaels et al. 1996, p. 319; Bennett et al. 1991). Viral diseases seem to be more prevalent and subsequently more studied in parrots than bacteria and parasites. Psittacines are prone to many viral infections such as retrovirus, pox virus, and paramyxo virus, and captive-held birds seem particularly susceptible (Gaskin 1989, pp. 249, 251, 252). A highly fatal disease, Pacheco's parrot disease, is also caused by a virus (Simpson et al. 1976, p. 218). After infection from this virus, death occurs suddenly without apparent sign of sickness other than some mild nasal discharge and lethargy (Simpson et al. 1976, p. 211). However, as transmission of this disease is mainly through nasal discharge and feces, it is less likely to happen in open habitat in the wild than in a confined aviary, particularly because in the wild this species has been observed to alternate nest sites based on food availability (Chosset et al. 2004, pp. 35-39). Another disease, proventricular dilatation disease (PDD), may be one of the worst diseases known to affect parrots (Kistler et al. 2008, p. 2). PDD has been documented in several continents in more than 50 different parrot species and in free-ranging species in at least five other orders of birds (Kistler et al. 2008, p. 2). It is not clear if some diseases observed in birds in captivity also occur in the wild with the same frequency. However, because the populations of military macaws are small and widely distributed, disease is less of a concern because diseases tend to be more easily transmitted between individuals within close range, and wild birds disperse and are not constantly in close proximity. Also, captive conditions in aviaries make birds more susceptible to disease where the stress of confinement combined with inadequate diet can reduce the ability of birds to fight disease.

We have no evidence of significant adverse impacts to wild populations of military macaws due to disease. Disease is a normal occurrence within wild populations. There is no indication that disease occurs to an extent that it is a threat. Based on the best available scientific and commercial information, we find that disease is not a threat to the military macaw in any portion of its range now or in the future.

Predation

Eggs and chicks are more susceptible to predation than adult macaws (Arizmendi 2008, p. 44). Chicks and eggs are particularly susceptible to predation by snakes (Arizmendi 2008, p. 44), but military macaws select their nests where they are likely to have a high level of reproductive success. Because military macaws generally construct their nests in high locations such as canyon cliffs, snake predation is less of a concern because snakes need tree canopy or vines to climb in order to gain access to eggs and chicks.

Other predators known to consume this species' eggs include iguanas, red-tailed hawks (Buteo jamaicensis), turkey vultures (Carthates aura), and some mammals (Arizmendi 2008, p. 44). In the Sabino canyon, iguanas were observed near the nesting sites. Researchers suggested that a predator control program here would benefit the macaws (Arizmendi 2008, p. 45). Macaws frequently exhibit alarmed behavior when red-tailed

hawks and turkey vultures approach their nests (Arizmendi 2008, p. 44). In Argentina, a flock of parrots was attacked by a pair of peregrine falcons (Falco peregrinus), which also nest in ravines (Navarro et al. 2008, p. 6). However, although parrots and falcons can be combative, the peregrine falcon, which normally consumes small mammals and birds, is not thought to be a natural predator of the military macaw (Bradley et al. 1991, p. 193). Due to its large size and careful nest site selection, the military macaw is less susceptible to predation by both land and aerial predators (Florez and Sierra 2004, pp 2-3). However, even limited predation is still a concern in part because removal of potentially reproductive adults from the breeding pool can have a significant effect on small populations by destroying macaw mating pair bonds (Kramer and Drake 2010, p. 11). Additionally, studies on similar species in similar Andean habitats indicate that vulnerability to predation by generalist predators increases with increased habitat fragmentation and smaller patch sizes (Arango-Velez and Kattan 1997, p. 140). Because each population of military macaws is small, with usually fewer than 100 individuals, and because this species mates for life, even low levels of predation are likely to have a significant effect on the species.

Summary of Factor C

Diseases associated with military macaws in the wild are not well documented. Although there is evidence that diseases occur in parrots in the wild, we found no information that diseases affect this species to the degree that they are negatively impacting this species in the wild. Because the populations are distributed across such a large area, these populations have a built-in resiliency against impacts from disease if one population is affected by a disease outbreak. Conversely, although disease in the wild is not a concern, predation does remain a concern; there is evidence that predation on this species occurs often enough that it can have a significant impact. Because of the species' small and declining population size, tendency to mate for life, low reproductive capacity, and existence in isolated habitat fragments, even minimal predation renders the species more vulnerable to local extirpations. Therefore, we find that predation, compounded by ongoing habitat loss and poaching, is a threat to the military macaw.

D. The Inadequacy of Existing Regulatory Mechanisms

Regulatory mechanisms to protect a species could potentially fall under categories such as regulation of trade, wildlife management, parks management, or forestry management. We are primarily evaluating these regulatory mechanisms in terms of parks because this is where this species generally occurs. Regulatory mechanisms could be at the local, national, or international levels.

International Wildlife Trade (CITES)

A specimen of a CITES-listed species may be imported into or exported (or reexported) from a country only if the appropriate permit or certificate has been obtained prior to the international trade and it is presented for clearance at the port of entry or exit. The Conference of the Parties (CoP), which is the decision making body of the Convention and comprises all its member countries, has agreed on a set of biological and trade criteria to help determine whether a species should be included in Appendix I or II. The military macaw is listed in Appendix I. For Appendix-I species, both an export permit or reexport certificate must be issued by the country of export and an import permit from the country of import must be obtained prior to international trade. An export permit for species listed in either Appendix I or II may only be issued if the country of export determines that:

* The export will not be detrimental to the survival of the species in the wild (CITES Article III(2) and Article IV);
* The specimen was legally obtained according to the animal and plant protection laws in the country of export;
* For live animals or plants, that they are prepared and shipped for export to minimize any risk of injury, damage to health, or cruel treatment; and
* For Appendix I species, an import permit has been granted by the importing country.

Except in specific scenarios for approved captive-breeding programs, the import of an Appendix-I species requires the issuance of both an import and export permit. Import permits are issued only after the importing country determines that it will not be used for primarily commercial purposes (CITES Article III(3)) and that the

proposed recipient of live animals or plants is suitably equipped to house and care for them. Thus, with few exceptions, Appendix-I species cannot be traded for commercial purposes.

The CITES Treaty requires Parties (member countries) to have adequate legislation in place for its implementation. Under CITES Resolution Conference 8.4 (Revised at CoP15) and related decisions of the CoP, the National Legislation Project evaluates whether Parties have adequate domestic legislation to successfully implement the Treaty (CITES 2011a). In reviewing a country's national legislation, the CITES Secretariat evaluates factors such as:

* Whether a Party's domestic laws prohibit trade contrary to the requirements of the Convention,
* Whether a Party has penalty provisions in place for illegal trade, and if they have designated the responsible Scientific and Management Authorities, and
* Whether a Party's legislation provides for seizure of specimens that are illegally traded or possessed.

The CITES Secretariat has determined that the legislation of Argentina, Colombia, Mexico, and Peru is in Category 1, meaning they meet all the requirements to implement CITES. Bolivia, Ecuador, and Venezuela were determined to be in Category 2, with a draft plan, but not enacted (http://www.cites.org, SC59 Document 11, Annex p. 1). This means the Secretariat determined that the legislation of Bolivia, Ecuador, and Venezuela meet some, but not all, of the requirements for implementing CITES. Based on the decrease in reported international trade, CITES and the range countries for this species have effectively controlled legal international trade of this species. Therefore, we find CITES is an effective mechanism for preventing overexploitation for international trade in this species.

Parks and Habitat Management

We are focusing our evaluation of the potential threats to this species primarily to parks for the following reasons. Most suitable habitat, primary forest, only remains in these protected areas. The best available information suggests that this species is now mostly found in protected areas such as parks, in part because this is where suitable habitat remains for the species. Additionally, the majority of the information available regarding the potential threats to the species pertains to the parks, where the species is usually found. Our rationale is supported by Cowen, who noted that encounter rates for large macaw species were generally higher in primary forests (2008, p. 15), which tend to be located in areas with protected status. Throughout this species' range, we found that many of the threats that occur to this species are the same or similar. Threats generally consist of various forms of habitat loss or degradation. Each range country for this species has protections in place, but for reasons such as limited budgets and limited enforcement capabilities, the laws and protections are generally not able to adequately protect the species. Our analysis of regulatory mechanisms is discussed essentially on a country-by-country basis, beginning with Bolivia, and is summarized at the end.

Research has found that tropical parks have been surprisingly effective at protecting ecosystems and species within boundaries designated as parks or other protected status despite underfunding and pressures for resources (Oliveira et al. 2007, p. 1,235; Bruner et al. 2001, p. 126; Terborgh 1999, entire). Bruner's study found that protected areas are especially effective in preventing land clearing. It found that in 40 percent of parks, land that had formerly been under cultivation and that was incorporated into park boundaries had actually recovered. This subsequently led to an increase in vegetative cover. The study also found that 83 percent of parks were successful at mitigating encroachment (Bruner et al. 2001, p. 125). It concluded that the conditions inside the parks were significantly better than in their surrounding areas (Bruner et al. 2001, p. 125). Oliveira et al. found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (2007, p. 1,235). However, despite these protections, this species has experienced threats such that their populations are now so small (generally fewer than 100 in each population) that any pressure now has a more significant effect. Parks, without management, are often insufficient to adequately protect the species. Conditions in specific parks are discussed below.

Argentina

In 2007, Argentina enacted a law mandating minimum standards for the environmental protection of native forests (Ley de Bosques). However, the federal government has not fully enforced the law, and provincial governments are not in full compliance with it (DiPaola et al. 2008, p. 2). Argentina lacks adequate protections of its natural environments; there is a lack of environmental awareness and commitment from the government to adequately protect its resources (FAO 2007, pp. 43-44, 59-60). Provinces usually allow landowners to decide whether to maintain forest cover or deforest the land. The absence of a serious land use planning strategy, particularly during the past 20 years, has led to significant habitat degradation (FAO 2007, p. 60). The threat to native forests has remained particularly high in the Salta Province. As a result, a coalition of indigenous communities and nongovernmental organizations filed for injunctive relief in Argentina's highest court to attempt to combat deforestation (DiPaola et al. 2008, p. 2). In this case, the court mandated deforestation activities to be halted pending the completion of a cumulative environmental impact study. The decision forced the Salta Province to comply with the deforestation moratorium imposed by the Forestry Law, and pressured the Province to comply with the other key provision of the law by completing an environmental land use plan (DiPaola et al. 2008, p. 2). Although the Forestry Law is in place and the court case has set a precedent for compliance with this law, the area where this species occurs in Argentina to the best of our knowledge remains largely unprotected (Navarro et al. 2008, pp. 7, 9). However, we do not know how this area is affected by these activities, nor what regulatory mechanisms are in place here with respect to this species and its habitat.

Bolivia

This species primarily inhabits the parks and protected areas in Bolivia's Andean region (Herzog 2011, pers. comm.). National parks are intended to be strictly protected; however, some areas where the species occurs are also designated as areas of integrated management, which are managed for both biological conservation and the sustainable development of the local communities. Bolivia attempts to balance natural resource uses; however, it is one of the poorest countries in South America (MacLeod 2009, p. 6; CIA World Factbook, accessed December 6, 2011), and subsequently has competing priorities. As of 2005, Bolivia had 5 national parks, 6 national park and integrated management natural areas, 1 national park and indigenous territory (or communal lands), 4 national reserves, 2 biosphere reserves, and 3 integrated management natural areas (ParksWatch 2005, p. 1). These make up Bolivia's National System of Protected Areas ((SNAP) Servicio Nacional de Areas Protegidas). Below are the designations and their relevant categorizations of protections (eLAW 2003, p. 3).

(1) Park, for strict and permanent protection of representative ecosystems and provincial habitats, as well as plant and animal resources, along with the geographical, scenic and natural landscapes that contain them;

(2) Sanctuary, for the strict and permanent protection of sites that house endemic plants and animals that are threatened or in danger of extinction;

(3) Natural Monument, to preserve areas such as those with distinctive natural landscapes or geologic formations, and to conserve the biological diversity contained therein;

(4) Wildlife Reserve, for protection, management, sustainable use, and monitoring of wildlife;

(5) Natural Area of Integrated Management, where conservation of biological diversity is balanced with sustainable development of the local population; and

(6) "Immobilized" Natural Reserve, a temporary (5-year) designation for an area that requires further research before any official designations can be made and during which time no natural resource concessions can be made within the area (Supreme Decree No. 24,781 1997, p. 3).

The foundation of Bolivia's laws is largely based on Bolivia's 1975 Law on Wildlife, National Parks, Hunting, and Fishing (Decree Law No. 12,301 1975, pp. 1-34), which has the fundamental objective of protecting the country's natural resources. This law governs the protection, management, utilization, transportation, and selling of wildlife and their products; the protection of endangered species; habitat conservation of fauna and flora; and the declaration of national parks, biological reserves, refuges, and wildlife sanctuaries, regarding the

preservation, promotion, and rational use of these resources (Decree Law No. 12,301 1975, pp. 1-34; eLAW 2003, p. 2). Later, Bolivia passed an overarching environmental law in 1992 (Law No. 1,333 1992), with the intent of protecting and conserving the environment and natural resources. Studies have shown that protected areas have been successful in providing protection from poaching, logging, and other forest damage, especially when compared to unprotected areas (Lee 2010, p. 3; Killeen et al. 2007, p. 603; Oliveira et al. 2007, p. 1,234; Asner 2005, p. 480; Ribeiro et al. 2005, p. 2; Gilardi and Munn 1998, p. 641). However, pressures on the parks' resources are increasing; these are described below.

Within the Greater Madidi-Tambopata Landscape, activities that could negatively affect this species occur, and there are competing priorities within these protected areas. Madidi is divided into three contiguous areas, with two different management categories: A strictly protected National Park in two sections which total 1,271,000 ha (3,140,709 ac), and a natural integrated management area with 624,250 ha (1,542,555 ac), where conservation and sustainable development of the local communities is the main purpose (Conservation Strategy Fund (CSF) 2006, p. 29). The most significant activities that are having a negative impact or could in the future in this area are the construction of a highway within Madidi, mining for natural resources such as gold, drilling for oil, and a planned hydroelectric dam (ParksWatch 2011b, p. 8; http://www.amazonfund.eu/art-oil-madidi.html, accessed September 13, 2011; Chavez 2010, pp. 1-2). There is limited legal hunting of this species occurring here, but in the areas surveyed, this species was described as common and not exploited (Hosner et al. 2009, p. 226). Timber extraction still occurs in some areas (World Land Trust 2010, p. 1). In the rainforest and foothill forest of Serrania Sadiri within Madidi, roads in the late 1990s spurred a rise in the unsustainable logging of the area's mahogany trees, which were the most valuable tree at the time (World Land Trust 2010, pp. 1-2). Within the Apolobamba protected area, uncontrolled clearing, extensive agriculture, grazing, and "irresponsible" tourism are ongoing (Auza and Hennessey 2005, p. 81). Habitat degradation and destruction from grazing, forest fires, and timber extraction are ongoing in other protected areas, such as Tunari National Park (Department of Cochabamba), where suitable habitat exists for this species (De la Vie 2004, p. 7).

Bolivia's national policy is to decentralize decision making, and responsibility for land planning and natural resource management is increasingly shifting to local and regional governments (Wildlife Conservation Society (WCS) 2009, pp. 2-5). However, the decentralization process is occurring without sufficient personnel, staff training, and operational funds. There is little information as to the actual protections that Bolivia's laws and protected areas confer to military macaws, despite the laws in place at the national level for its wildlife. Threats to the species and its habitat include unsustainable land use practices, illegal logging, mining, road building, oil extraction, illegal animal trade, and hunting, which are all still occurring within this species' habitat (MacLeod 2009, p. 6; WCS 2009, pp. 2-5). The mechanisms in place are inadequate at reducing the threat of habitat destruction and human disturbance within these protected areas.

Colombia

The Colombian Government has enacted and ratified numerous domestic and international laws, decrees, and resolutions for managing and conserving wildlife and flora. Colombia currently has 54 areas that have protected status (El Sistema Nacional de Areas Protegidas (SINAP); National Natural Parks of Colombia 2011). Of those, 33 have been declared Important Bird Areas (IBAs). The protected area designations are as follows: National parks (parques nacionales), flora and fauna sanctuaries (santuarios de fauna y flora), flora sanctuaries (santuarios de flora), nature reserves (reserva natural), and unique natural areas (area natural unica) (Law 165 of 1994). Small populations of this species occur in several reserves and protected areas in Colombia (Strewe and Navarro 2003, p. 32). These protected areas in Colombia offer various degrees of protection to the species.

In 2003, conservation priorities were identified for its bird species, a conservation corridor was designed, and a habitat conservation strategy within the San Salvador valley was developed (Strewe and Navarro 2003, p. 29). The private Buena Vista Nature Reserve was established and protects approximately 400 ha (988 ac) of tropical

wet lowland forest and wet premontane forest on the northern slope of the Sierra Nevada. It encompasses extensive primary forests along an altitudinal gradient of 600 to 2,300 m (1,968 to 7,545 ft) and forest patches and secondary forest at elevations between 450 to 600 m (1,476 to 1,968 ft). The reserve is adjacent to the Sierra Nevada de Santa Marta National Park and the Kogi-Malayo Indian reserve (Strewe and Navarro 2003, p. 29).

Resource management in Colombia is highly decentralized. Colombian environmental management has been divided between the national and regional levels since the 1950s. Governmental institutions responsible for oversight appear to be under resourced (ITTO 2006, p. 222) and unable to adequately manage species such as the military macaw. Resources are managed within local municipalities by one of 33 "Autonomous Regional Corporations" known as CARs (Corporaciones Autonomas Regionales) (Blackman et al. 2006, p. 32). CARs are described as corporate bodies of a public nature, endowed with administrative and financial autonomy to manage the environment and renewable natural resources, implemented through Law 99 of 1993 (p. 32). Each department (analogous to U.S. state designations) within Colombia is managed by a separate local entity. These corporations grant concessions, permits, and authorizations for forest harvesting (ITTO 2006, p. 219). As of 2005, 40 percent of Colombia's public resources were managed by local municipalities, making Colombia one of the most decentralized countries in terms of forestry management in Latin America (Blackman et al. 2006, p. 36). Monitoring of resource use and forest development authorized by these corporations is conducted mostly by local nongovernmental organizations. The International Tropical Timber Organization (ITTO) considers the Colombian forestry sector to be lacking in law enforcement and on-the-ground control of forest resources, with no specific standards for large-scale forestry production, no forestry concession policies, and a lack of transparency in the application of the various laws regulating wildlife and their habitats (ITTO 2006, p. 222). Consequently, there is currently no effective vehicle for overall coordination of species management for multijurisdictional species such as the military macaw. Fundacion ProAves developed a conservation plan for 2010 to 2020 for several parrot species, including the military macaw (Botero-Delgadillo and Paez 2011, p. 7). However, it is unclear if or when it will be adopted by the Government of Colombia.

Additionally, despite protections, forest loss continues almost unabated in the mountains of the Sierra Nevada, demonstrating that formal protections and regulatory mechanisms are inadequate. In this area, El Congo Reserve currently may be the only secure nesting site for the military macaw, but it is too small (40 ha; 99 ac) to conserve viable populations.

Efforts are occurring in Colombia to protect and monitor its species, although they do not appear to be adequate to combat the threats to this species. One management tool that Colombia has recently developed is a bird-watching strategy in these protected areas to monitor and report on bird species such as the military macaw, in conjunction with ecotourism (National Natural Parks of Colombia 2011). Despite the efforts in place, there is a lack of information available about the status of this species and its habitat in Colombia. There is no clear information about the status of the species in Colombia; particularly its population trend. We are unable to determine that this conservation strategy will sufficiently mitigate threats to the military macaw, nor are we able to find that the regulatory mechanisms in place in Colombia are adequate. The species population is small in Colombia, and threats to its habitat still exist.

Ecuador

In Ecuador, the military macaw is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 72). It has been observed in the areas of Sumaco and Zamora-Chinchipe (Youth 2009, p. 1; Snyder et al. 2000, p. 125) and recently at Kichwa River Reserve (Reserva Kichwa Rio), within the Gran Sumaco Biosphere Reserve Guacamayos (Arcos-Torres and Solano-Ugalde 2008, p. 72). This species is categorized as endangered "en peligro de extincion" (Arcos-Torres and Solano-Ugalde 2008, p. 69) in Ecuador. It is protected by Decree No. 3,516 of 2003 (Unified Text of the Secondary Legislation of the Ministry of Environment) (EcoLex 2003b, pp. 1-2 and 36). This decree summarizes the laws governing environmental policy in Ecuador and provides that the

country's biodiversity be protected and used primarily in a sustainable manner.
Habitat destruction is ongoing and extensive in Ecuador (Mosandl et al. 2008, p. 37; Butler 2006b, pp. 1-3; FAO 2003b, p. 1). Unsustainable forest harvest practices likely continue to impact the military macaw's habitat. In 2004, Ecuador Law No. 17 (Faolex 2004, pp. 1-29) amended the Forest Act of 1981 (Law No. 74) to include five criteria for sustainable forest management: (i) Sustainable timber production; (ii) the maintenance of forest cover; (iii) the conservation of biodiversity; (iv) co-responsibility in management; and (v) the reduction of negative social and environmental impacts (ITTO 2006, p. 225; Aguilar and Vlosky 2005, pp. 9-10). In 2001, the Ecuadorian government worked with the private sector to develop a system of monitoring and control of forest harvest practices. However, in 2003, the Supreme Court of Ecuador declared the control system unconstitutional, and new control systems were being developed (ITTO 2006, p. 225). Approximately 70 percent of the forest products harvested are harvested illegally, or are used as fuel wood, or are discarded as waste (ITTO 2006, p. 226; Aguilar and Vlosky 2005, p. 4). Because the extractive harvesting industry is not monitored, the extent of the impact is unknown; however, the best available information indicates that habitat degradation negatively affects this species in Ecuador.
The Ecuadorian government recognizes 31 different legal categories of protected lands (e.g., national parks, biological reserves, geo-botanical reserves, bird reserves, wildlife reserves, etc.). The colony in Kichwa River Reserve Macaw receives some legal protections by being in a Reserve. However, a study published in 2002 concluded that although 14 percent of Ecuador is categorized as national reserve network (Sierra et al. 2002, p. 107), the system does not provide adequate protection for its ecosystems. As of 2006, the amount of protected land (both forested and nonforested) in Ecuador totals approximately 4.67 million ha (11.5 million ac) (ITTO 2006, p. 228). However, only 38 percent of these lands have appropriate conservation measures in place to be considered protected areas according to international standards (i.e., areas that are managed for scientific study or wilderness protection, for ecosystem protection and recreation, for conservation of specific natural features, or for conservation through management intervention) (IUCN 1994, pp. 17-20). The ITTO, as of 2006, considered ecosystem management and conservation in Ecuador, including effective implementation of mechanisms that would protect the military macaw and its habitat, to be lacking (ITTO 2006, p. 229).
Although this colony has persisted for about 150 years (Huatatoca, pers. comm. in Arcos-Torres and Solano-Ugalde 2008, p. 72), it may be affected by logging and the resulting deforestation on nearby land (Arcos-Torres and Solano-Ugalde 2008, p. 72). The best available information indicates that on-the-ground enforcement of Ecuador's laws, oversight of the local jurisdictions, and implementing and regulating activities are ineffective in conserving the military macaw and its habitat in Ecuador. Researchers suggest that the apparent lack of this species in Ecuador is related to lack of existing suitable sites (large areas containing appropriate feeding, nesting, and breeding habitat) for the formation of breeding colonies. The governmental institutions responsible for natural resource oversight in Ecuador appear to be under-resourced, and to our knowledge, there is a lack of law enforcement on the ground. Despite the creation of a national forest plan, the best available information indicates there is a lack of capacity to implement this plan due to inconsistencies in application of regulations, and discrepancies between actual harvesting practices and forestry regulations. These inadequacies have facilitated logging, clearing for agriculture, subsistence farming, and road development. Habitat conversion and alteration are ongoing within Ecuador, including within protected areas.
Mexico
Threatened and endangered species are regulated under the general terms of the General Law of Ecological Balance and Environmental Protection (Ley General del Equilibrio Ecologico y Proteccion al Ambiente (LGEEPA)), the General Wildlife Law (Ley General de Vida Silvestre (LGVS)), and also under CITES (CEC 2003, unpaginated). NOM-059-ECOL-2001 establishes a list of wildlife species classified as either in danger of extinction (endangered), threatened, under special protection, or probably extinct in the wild (Government of Mexico 2002, p. 6). All use of endangered and threatened species requires a special permit from the Secretariat

of the Environment and Natural Resources (Secretaria del Medio Ambiente y Recursos Naturales (SEMARNAT). SEMARNAT's main goal is to protect, restore, and conserve its ecosystems and natural resources. Under Mexico's General Wildlife Law, the use of these protected species, including the military macaw, may be authorized only when priority is given to the collection and capture for restoration, repopulation, and reintroduction activities (Comision Nacional Para El Conocimiento y Uso de la Biodiversidad 2009, unpaginated; CEC 2003, unpaginated).

International trade of Mexico's wildlife is also managed by SEMARNAT. In 2008, Mexico passed Article 60_2 to amend its General Wildlife Law. The article bans the capture, export, import, and reexport of any species of the Psittacidae (parrot) family whose natural distribution is within Mexico (Cantu and Sanchez 2011, p. 1). It allows for authorizations for removal of individuals from the wild to be issued only for conservation purposes, or to accredited academic institutions for scientific research. However, it does not appear to be adequate based on recent investigations of trade of Mexico's native parrot species.

The military macaw falls under the jurisdiction of several other laws in Mexico. The 2003 General Law on Sustainable Forest Management (Ley General de Desarrollo Forestal Sustenable (LGDFS)) governs forest ecosystems in Mexico, including military macaw habitat. This law formalizes the incorporation of the forest sector in a broader environmental framework. Under this law, harvesting of forests requires authorization from SEMARNAT. It also requires that harvesting forests is based on a technical study and a forest management plan (GOM 2010, p. 24). A number of additional laws complement the 2003 law in regulating forest use. The LGEEPA regulates activities for protecting biodiversity and reducing the impact on forests and tropical areas of certain forest activities; the LGVS governs the use of plants and wildlife found in the forests; the General Law on Sustainable Rural Development (Ley General de Desarrollo Rural Sustentable) provides guidance for activities aimed at protecting and restoring forests within the framework of rural development programs; and the Agrarian Law (Ley Agraria) governs farmers' ability to use forest resources on their land (Anta 2004, in USAID 2011, unpaginated).

Another law regulating portions of the military macaw's habitat is the National System of Protected Natural Areas (Sistema Nacional de Areas Naturales Protegidas (SINANP)). These protected natural areas are created by presidential decree, and the activities in them are regulated under the LGEEPA, which requires that the protected natural areas receive special protection for conservation, restoration, and development activities (Comision Nacional de Areas Naturales Protegidas (CONANP) 2011, unpaginated). These natural areas are categorized as: Biosphere Reserves, National Parks, Natural Monuments, Areas of Natural Resource Protection, Areas of Protection of Flora and Fauna, and Sanctuaries (CONANP 2011, unpaginated). The military macaw is known to occur in several protected areas.

Conservation strategies in Mexico rely heavily on natural protected areas, and biosphere reserves comprise most of the designated protected area in the country (Figueroa and Sanchez 2008, pp. 3324, 3234). The military macaw occurs in or near at least four biosphere reserves. Although some areas where this species occurs have protected status, Figueroa and Sanchez (2008, entire) found that, for example, the Sierra Gorda Biosphere Reserve was ineffective (as opposed to effective or weakly-effective). This study specifically evaluated the effectiveness of Mexico's protected areas for preventing land use and land cover change. It assessed the effectiveness of national protected areas (NPAs) by quantifying (1) the rate of change and (2) the total extent of change, between 1993 and 2002, as well as (3) the percentage, in 2002, of areas transformed by human use; transformed areas included agriculture, cultivated and induced pastures, human settlements, and forestry plantations. The rate of change of transformed areas inside each NPA was also compared with that estimated for an equivalent area surrounding the NPA. They selected 69 federal decreed NPAs (out of 160 NPAs decreed in Mexico) that were 1,000 ha (2,471 ac) or larger, which is the minimum area for conserving ecosystems in Mexico (Figueroa and Sanchez 2008, p. 3,225; Ordonez and Florez-Villela 1995, p. 11). The study found that, overall, only approximately 54 percent of protected areas, including 65 percent of biosphere

reserves, were effective.

Peru

In Peru, this species is listed as vulnerable under Supreme Decree No. 034-2004-AG (2004, p. 276855), and its protections fall under the jurisdiction of the National Institute of Natural Resources (Instituto Nacional de Recursos Naturales, INRENA). This Decree prohibits hunting, take, transport, and trade of protected species, except as permitted by regulation. The military macaw is thought to occur in at least three areas with protected status in Peru. The Peruvian national protected area system includes several categories of habitat protection (refer to Factor A. National reserves, national forests, communal reserves, and hunting reserves are managed for the sustainable use of resources (IUCN 1994, p. 2). The designations of national parks, sanctuaries, and protection forests are established by supreme decree that supersedes all other legal claim to the land and, thus, these areas tend to provide some form of habitat protection (Rodriguez and Young 2000, p. 330). However, limited information is available with respect to the status of this species in Peru. We do not know if the occurrence of the military macaw within protected areas in Peru actually protects the species or mitigates threats to the species, and to what extent these protections are effective.

Venezuela

In Venezuela, the military macaw is thought to exist in two parks: El Avila National Park and Henri Pittier National Park. Very limited information about the status of this species is available in Venezuela. Henri Pittier National Park (107,800 ha; 266,380 ac) was declared the first national park in Venezuela in 1937. Henri Pittier National Park is the largest national park of the Cordillera de la Costa (Coastal Mountain Range) region. The principal threats to this park include fire, human encroachment, solid waste buildup, pollution, hunting, and limited resources for effective park management (ParksWatch 2011g, unpaginated). In many cases, the intensity of threats has increased. Prior to 1994, a team of government representatives, NGOs, universities, and aviculturists in Venezuela had developed both an action plan for the conservation of parrots and a book containing information on parrot biology (Morales et al. 1994, in Snyder 2000, p. 125). However, currently, it is unclear what conservation initiatives are occurring.

El Avila National Park (81,800 ha; 202,132 ac in size), is located along the central stretch of the Cordillera de la Costa Mountains in northern Venezuela. The most immediate threats to the park are forest fires and illegal settlements, which occur primarily near Caracas (ParksWatch 2011f, unpaginated). ParksWatch notes that the areas closest to the city have experienced more problems in the more isolated northern slope and eastern sector of El Avila. Other threats in this park include the presence of nonnative plants and poaching.

Summary of Factor D

In Argentina, Ecuador, Peru, and Venezuela, we recognize that conservation activities are occurring, and that these activities may have a positive effect on the species at the local population level. Parrots, in general, are long-lived with low reproductive rates, traits that make them particularly sensitive to poaching and other threats such as habitat loss (Lee 2010, p. 3; Thiollay 2005, p. 1,121; Wright et al. 2001, p. 711). Removal of a few birds from a population of 100 can have a greater effect than removal of a few birds from larger populations. The primary threats to this species historically have been the loss of habitat and capture for the pet trade (Strewe and BLI 2011, p. 1; Navarro 2003, p. 33). Since regulatory mechanisms such as CITES and the WBCA have been put into place, particularly since 1992, much of the legal international trade in the military macaw has declined (see Factor B discussion, above; UNEP-WCMC CITES trade database, accessed September 6, 2011). However, those pressures prior to the military macaw's listing under CITES and the WBCA contributed significantly to the decline in population numbers for this species. Since then, the species' habitat has become fragmented, its range has reduced, and its populations have more difficulty finding suitable habitat.

Each of these countries has enacted laws to protect its wildlife and habitat. However, we are unable to conclude that the regulatory mechanisms in place are adequate. The populations of this species in these four countries likely range from fewer than 100 to a few hundred individuals. There are numerous threats acting on this

species; its populations have severely declined. In some cases, the actual causes of decline may not be readily apparent and a species may be affected by more than one threat in combination. Habitat conservation measures within these range countries do not appear to sufficiently mitigate future habitat losses. Habitat loss and degradation continue to occur within these countries; the best available information does not indicate that the existing regulatory mechanisms have mitigated these threats in the range of this species. Because these populations of this species are very small in these countries, any impact is likely to have a significant impact on the species; therefore, we are unable to conclude that regulatory mechanisms in place for this species and its habitat are adequate.

Bolivia, Colombia, and Mexico have enacted various laws and regulatory mechanisms for the protection and management of this species and its habitat. Although information available is limited, the best evidence suggests that the military macaw exists in small populations in several large protected areas within these countries. As discussed under Factor A, the military macaw prefers primary forests and woodlands and complex habitat that offers a variety of food sources. Its suitable habitat has been severely constricted due to deforestation. In these three countries, there is clear evidence of threats to this species due to activities such as habitat destruction and degradation, poaching, construction of roads, and mining, as well as decreased viability due to small population sizes, despite the regulatory mechanisms in place. We acknowledge that research and conservation programs are occurring in these countries. However, based on the best available information, we find that the existing regulatory mechanisms for these countries are either inadequate or inadequately enforced in order to protect the species or to mitigate ongoing habitat loss and degradation, poaching, and the severe population decline of this species. Habitat conservation measures within these range countries do not appear to sufficiently mitigate future habitat losses.

Based on the best available information, we are unable to conclude that the existing regulatory mechanisms currently in place sufficiently mitigate threats to the military macaw throughout its range. Therefore, we find that the existing regulatory mechanisms are inadequate to mitigate the current threats to the continued existence of the military macaw throughout its range now and into the future.

E. Other Natural or Manmade Factors Affecting its Continued Existence

Small Population Size

Small, declining populations can be especially vulnerable to environmental disturbances such as habitat loss (O'Grady 2004, pp. 513-514). In order for a population to sustain itself, there must be enough reproducing individuals and habitat to ensure its survival. Conservation biology defines this as the "minimum viable population" requirement (Grumbine 1990, pp. 127-128). This requirement may be between 500 and 5,000 individuals depending on variability, demographic constraints, and evolutionary history. The military macaw occurs in relatively small populations (ranging from a few pairs to approximately 100 individuals, with the total population size that is likely no greater than a few thousand). The military macaw relies on specific habitat to provide for its breeding, feeding, and nesting. Historically, the military macaw existed in much higher numbers in more continuous, connected habitat. Its suitable habitat is becoming increasingly limited, and its suitable habitat is not likely to expand in the future.

The combined effects of habitat fragmentation and other factors on a species' population can have profound effects and can potentially reduce a species' respective effective population by orders of magnitude (Gilpin and Soule 1986, p. 31). For example, an increase in habitat fragmentation can separate populations to the point where individuals can no longer disperse and breed among habitat patches, causing a shift in the demographic characteristics of a population and a reduction in genetic fitness (Gilpin and Soule 1986, p. 31). This is especially applicable for a species such as the military macaw that was once wide-ranging. It has lost a significant amount of its historical range due to habitat loss and degradation. Furthermore, as a species' status continues to decline, often as a result of deterministic forces such as habitat loss or overutilization, it will become increasingly vulnerable to other impacts. If this trend continues, its ultimate extinction due to one or

more stochastic (random or unpredictable) events becomes more likely. The military macaw's current occupied and suitable range is highly reduced and severely fragmented. The species' small population size, its reproductive and life-history traits, and its highly restricted and severely fragmented range increase this species' vulnerability to other threats.

Climate Change

Consideration of ongoing and projected climate change is a component of our analysis under the ESA. The term "climate change" refers to a change in the mean, variability, or seasonality of climate variables over time periods of decades or hundreds of years (Intergovernmental Panel on Climate Change (IPCC) 2007, p. 78). Forecasts of the rate and consequences of future climate change are based on the results of extensive modeling efforts conducted by scientists around the world (Solman 2011, p. 20; Laurance and Useche 2009, p. 1,432; Nunez et al. 2008, p. 1; Margeno 2008, p. 1; Meehl et al. 2007, p. 753). Climate change models, like all other scientific models, produce projections that have some uncertainty because of the assumptions used, the data available, and the specific model features. The science supporting climate model projections as well as models assessing their impacts on species and habitats will continue to be refined as more information becomes available. While projections from regional climate model simulations are informative, various methods to downscale projections to more localized areas in which the species lives are still imperfect and under development (Solman 2011, p. 20; Nunez et al. 2008, p. 1; Marengo 2008, p. 1). The best available information does not indicate that climate change is impacting this species such that it is a threat. After reviewing the best available information, we do not find that changes in climate are impacting this species such that climate change is a threat.

Summary of Factor E

A species may be affected by more than one threat acting in combination. Impacts typically operate synergistically, particularly when populations of a species are decreasing. Initial effects of one threat factor can later exacerbate the effects of other threat factors (Gilpin and Soule 1986, pp. 25-26). Further fragmentation of populations can decrease the fitness and reproductive potential of the species, which will exacerbate other threats. Lack of a sufficient number of individuals in a local area or a decline in their individual or collective fitness may cause a decline in the population size, despite the presence of suitable habitat patches. Within the preceding review of the five factors, we have identified multiple threats that may have interrelated impacts on this species. For example, the species' behavior of not nesting in areas where depredation or disturbance is likely may mean that a nest site is "abandoned" before nesting is even attempted. Thus, the species' productivity may be reduced because of any of these threats, either singularly or in combination. The most significant threats are habitat loss and poaching, particularly because the species has such a small and fragmented population, and it requires a large range and variety of food sources. These threats occur at a sufficient scale so that they are affecting the status of the species now and in the future.

In addition, the species' current range is highly restricted and severely fragmented. The species' small population size, its reproductive and life-history traits, and its highly restricted and severely fragmented range increase the species' vulnerability to adverse natural events and manmade activities that destroy individuals and their habitat. The susceptibility to extirpation of limited-range species can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too fragmented such that it may no longer be demographically or genetically viable (Harris and Pimm 2004, pp. 1612-1613). Therefore, we find that the species' small population size, in combination with other threats identified above, is a threat to the continued existence of the military macaw throughout its range now and in the future.

Finding and Status Determination for the Military Macaw

We find that this species is endangered based on the above evaluation, and we propose to list this species as endangered due to the threats described above that continue to act on this species. Within the preceding review of the five factors, we identified multiple threats that may have interrelated impacts on the species. For example,

the productivity of military macaws may be reduced because of the effects of poaching and habitat loss, which are expected to continue to act on the species in the future. In cases where populations are very small, species mate for life, and birds produce small clutch sizes, these effects are exacerbated. The susceptibility to extirpation of species with small and declining populations can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too fragmented such that it may no longer be demographically or genetically viable (Harris and Pimm 2004, pp. 1,612-1,613). This species exists generally in very small and fragmented populations, usually in areas with some form of protected status in Mexico, Bolivia, Peru, and Colombia, and to a limited extent Ecuador, Venezuela, and Argentina. Its life-history traits (such as mating for life and small clutch size) make it particularly susceptible to extinction because its populations are so small. Based on our review of the best available scientific and commercial information pertaining to the five factors, we found that many of these threats are similar throughout the species' range. In four of the countries (Argentina, Ecuador, Peru, and Venezuela), the populations are extremely small, and very little information about the status of the species is available in many parts of its range. It is not necessarily easy to determine (nor is it necessarily determinable) which potential threat is the operational threat. However, we believe that these threats, either individually or in combination, are likely to occur at a sufficient geographical scale to significantly affect the status of the species. Additionally, although we do not have precise genetic information about populations throughout this species' range, it is likely that there is some genetic transfer between populations. We believe this based on its demonstrated ability to fly long distances in search of food sources (Chosset and Arias 2010, p. 5). The most significant threat, habitat loss and degradation, is prevalent throughout this species' range. Its suitable habitat has severely contracted, and habitat loss is likely to continue into the future. We do not find that the factors affecting the species are likely to be sufficiently ameliorated in the foreseeable future. Therefore, we find that listing the military macaw is warranted throughout its range, and we propose to list the military macaw as endangered under the ESA.

Species Information for the Great Green Macaw

Taxonomy

The great green macaw (Ara ambiguus or ambigua, Linnaeus, 1766; Bechstein, 1811) is in the parrot (Psittacidae) family. It is known by various common names such as lapa verde, Buffon's macaw, Guacamayo verde mayor, Guara verde, and Papagayo de Guayaquil. It occurs as two subspecies. The nominate subspecies, Ara a. ambiguus, occurs from Honduras to north-west Colombia. The subspecies A. a. guayaquilensis occurs in western Ecuador (Rodriguez-Mahecha et al. 2002, p. 116; Fjeldsa et al. 1987, pp. 28-31). There are believed to be only around 100 individuals of A. a. guayaquilensis in two areas in Ecuador. This subspecies has a smaller bill with greener underside of the flight and tail feathers than the nominate subspecies (Juniper and Parr 1998, p. 423). Avibase and ITIS both recognize these subspecies (http://www.itis.gov and http://avibase.bsc-eoc.org/avibase.jsp, accessed November 3, 2011).

There is no universally accepted definition of what constitutes a subspecies, and the use of the term subspecies varies among taxonomic groups (Haig and D'Elia 2010, p. 29). To be operationally useful, subspecies must be discernible from one another (i.e., diagnosable) and not merely exhibit mean differences (Patten and Unitt 2002, pp. 28, 34). This element of diagnosability, or the ability to consistently distinguish between populations, is a common thread that runs through all subspecies concepts. All populations or subspecies of Ara ambigua essentially face similar threats, all are generally in the same region (Central and northern South America), and all have small populations. For the purpose of this proposed rule and based on the best available information, we recognize all populations of great green macaws as a single species.

Description

This species ranges between 77 and 90 cm (30 and 35 inches) in length and has a red frontal band above a large black bill, bare facial features with black lines, blue flight feathers on the superior feathers and olive inferior feathers, blue lower back, and orange tail (Juniper and Parr 1998, pp. 423-424). It is the second largest

New World macaw. This species is not sexually dimorphic, meaning there are no differences in appearance between males and females of the same species. The great green macaw is very similar in appearance to the military macaw, but the military macaw has more prominent blue coloring on its hind neck, has darker plumage, and is smaller. These two species are also separated geographically.

Range, Observations, and Population Estimates

The great green macaw is patchily distributed in a 100,000-km^2 (38,610-mi^2) area (BLI 2011). In addition to occupying humid tropical forests primarily in Central America (Costa Rica, Honduras, Nicaragua, and Panama), there are small remnant populations in western Ecuador, as well as northern Colombia (Berg et al. 2007, p. 1; Chassot et al. 2006, p. 7). Although there may be some interaction between populations, the great green macaw is fragmented into seven isolated populations throughout its distribution due to habitat loss (Monge et al. 2009, pp. 159, 174).

Deforestation has reduced this species' habitat and concentrated its population into primarily five areas: the border of Honduras and Nicaragua, the border of Nicaragua and Costa Rica, the Darien region of Panama and Colombia, and two very small populations in Ecuador (Hardman 2010, p. 8; Monge et al. 2009, p. 159). Population estimates were made in the 1990s and early 2000s. The global population is now likely less than 2,500 mature individuals (or less than 3,700 with juveniles included) (Monge et al. 2009, pp. 213, 256); however, the actual population is far from clear. In 1993, the population estimate was 5,000 individuals; in 2000, the population was estimated to be between 2,500 and 10,000 birds (BirdLife International 2009a; Rodriguez-Mahecha 2002a). Although historical observations are useful for assessing the range of the species, they may also be biased because surveys may not have sampled randomly. Thus, historical population estimates of this species may not be accurate. Although the population in Costa Rica is increasing, the population continues to be very small (Monge et al. 2010, p. 16), and researchers believe that the global population of this species is decreasing (Botero-Delgadillo and Paez 2011, p. 91). Specific information about the range and population estimate for each country is discussed below.

See Illustration in Original Document.

Colombia

Historically in Colombia, it was found in the north of the Serrania de Baudo and the West Andes and east to the upper Sinu valley (Snyder et al. 2000, pp. 121-123). In the late 1990s, this species was observed in Los Katios National Park, around Utria National Park in Serrania de Baudo (Salaman in litt. 1997), and the Choco area of western Colombia (Angehr in litt. 1996 in Snyder et al. 2000, pp. 121-123; Ridgley 1982). This species' potential geographical range is 51,777 km^2 (19,991 mi^2), which includes two core areas in Sierra Nevada de Santa Marta and in the center of Antioquia Department of Columbia (Salaman et al. 2009, p. 21; Monge et al. 2009, unpaginated; Quevado-Gill et al. 2006, p. 15). The total Columbian population is currently unclear, but it is now believed to primarily exist in Los Katios National Park, which borders the Darien region in Panama. It was also recently observed in the area of Sabanalarga, Antioquia (Quevado-Gill et al. 2006, p. 15). Even though the largest population is thought to be in the northern Darien border region with about 1,700 adults, researchers believe this is an estimate without a strong basis (Botero-Delgadillo and Paez 2011, p. 91). The populations in Colombia are highly localized, and this number could be an overestimate (Botero-Delgadillo and Paez 2011, p. 91).

Costa Rica

The great green macaw historically inhabited forests along the Caribbean lowlands of Costa Rica (Chosset et al. 2004, p. 32). The population has increased in that area since 1994, when there was an estimate of 210 birds. The population appears to have fluctuated; in 2004, it was estimated that a maximum of 35 pairs were breeding in northern Costa Rica (Chosset et al. 2004, p. 32). A survey conducted in 2009 reported an population estimate of 302 in Costa Rica (Monge et al. 2009, p. 12); another estimate was that there was a total of 275 birds in Costa Rica in 2010 (Chassot 2010 pers. comm. in Hardman 2010, p. 11).

Approximately 67,000 ha (165,561 ac) of great green macaw breeding territory now remains in Costa Rica (Chun 2008, p. v), which is less than 10 percent of its original suitable habitat (Monge et al. 2010, p. 15; Chosset et al. 2004, p. 38). Potential great green macaw breeding habitat, excluding Ecuador, is defined by the density of almendro trees, which this species uses for its primary feeding and nesting substrate. Based on the assumption that great green macaw breeding pairs require 550 ha (1,359 ac) of non-overlapping habitat, Chun postulated that northern Costa Rica could support about 120 breeding macaw pairs (2008, p. 110). Chun notes that even the forested areas identified as individual "patches" through a geographic information system (GIS) program do not necessarily represent areas of forest with continuous canopy cover (indicating complex, fairly undisturbed habitat that is likely to contain nutritional needs for this species). Although these patches of forest are technically connected at some level, they are for the most part highly porous and discontinuous, and no analysis was performed to filter out stands that might be porous or discontinuous. There are some areas in its potential range that are above the elevation threshold for almendro trees, and do not meet the criteria for suitable habitat.

Ecuador

In Ecuador, there may be only potentially one viable population. This population exists in the Cerro Blanco Protected Forest, which is 6,070 ha (15,000 ac) outside of Guayaquil in Guayas Province (Villate et al. 2008, p. 19). This population is believed to be approximately 10 individuals; an estimate of 60 to 90 individuals in Ecuador may be optimistic (Horstman pers comm. in Hardman 2010, p. 12). This is a decline from 1995, when the population was estimated to be approximately 100 birds in the Esmeraldas Province (Waugh 1995, p. 10). Between 1995 and 1998, some individuals were observed in the Playa de Oro area along the Santiago River (Jahn 2001, pp. 41-43). In 2002, Ecuador's population was estimated to be between 60 and 90 individuals (Monge et al. 2009, p. 256), but the population was reported to be rapidly decreasing. In 2005, the species was described as being found in scattered forest remnants in coastal Ecuador from Guayas to Esmeraldas Province (Horstman 2005, p. 3).

In addition to the small population in the Cerro Blanco Protected Forest, recently reported to be about 11 individuals, there may be another small group in the Rio Canande Reserve, which is humid tropical forest, in the Esmeraldas province in coastal northern Ecuador (Horstman pers comm. in Hardman 2010, p. 12). Rio Canande Reserve (1,813 ha or 4,478 ac) is one of eight reserves managed by another NGO, the Jocotoco Foundation. The most recent population census in Ecuador was conducted in the provinces of Esmeraldas, Santa Elena, and Guayas. Five individuals were recently observed in the Bosque Protector Chongon Colonche; one macaw was observed at the Hacienda El Molino, near the Cerro Blanco Protected Forest; and two macaws were seen at Rio Canande (Horstman 2011, p. 16). The Cordillera (mountain range) de Chongon-Colonche is on the central pacific coast of Ecuador, located in the provinces of Guayas and Manabi. Some individual great green macaws have also been observed at Hacienda Gonzalez (40 km or 25 mi) northwest of Guayaquil; however, these individuals may be part of the same population found in Cerro Blanco. In summary, the majority of individuals are believed to be in Esmeraldas Province, and very small numbers remain in the Chongon-Colonche mountain range, Guayas.

Honduras

In 1983, the great green macaw was common in lowland rain forests in the Moskitia (Mosquitia) area and eastern Olancho (Marcus 1983, p. 623). The region known as the Moskitia includes both eastern Honduras and northern Nicaragua. Historically, the species was reported to occur in the areas of Juticalpa and Catacamas in Olancho (Marcus 1983, p. 623). The species has been observed daily in the Platano River area in flocks of more than 10 individuals and almost daily in the Patuca River area, usually in pairs (Barborak 1997 in Snyder et al. 2000, pp. 121-123). In August 1992, it was recorded on the Patuca River at Pimienta upstream from Wampusirpe (Wiendenfeld in Monge et al. 2009, p. 242). Currently, it exists in the Rio Platano Biosphere Reserve (800,000 ha or 1,976,843 ac), which has been described as one of the most important reserves in

Central America (Anderson et al. 2004, p. 447).

Nicaragua

In Nicaragua, the great green macaw is found primarily in lowland, tropical, and rain forest, as well as pine barrens, primarily in the Bosawas Reserve in the north and around the Indio-Maiz and San Juan rivers in the south (Stocks et al. 2007, p. 1503; Martinez-Sanchez 2007; Chassot 2004, p. 36). The name Bosawas is derived from three significant geographic landmarks that delineate the reserve's core zone limits: The Bocay River, Mount Saslaya, and the Waspuk River. The Bosawas protected area contains habitat that is vital to the species. In the buffer zone of the Indio-Maiz Biological Reserve, great green macaw nesting locations have been identified. The Indio-Maiz Biological Reserve is located in Nicaragua just across the San Juan River at the northern border of Costa Rica, and is nearly 264,000 ha (652,358 ac) in size. The Nicaragua and Costa Rica macaw populations intermix; macaws have been observed crossing the San Juan River, which separates Nicaragua and Costa Rica. As of 2006, in the Quezada, Bijagua, Samaria, and La Juana communities, five macaw nests had been located during surveying. Recently, 35 active nests had been documented in the Indio-Maiz Biological Reserve (Monge et al. 2010, p. 16).

In 1999, Powell et al. estimated that the Nicaraguan great green macaw population could be 10 times the size of the population in Costa Rica. In 2008, a population viability analysis was conducted that indicated the size of the great green macaw population in Nicaragua was 661 individuals (Monge et al. 2010, p. 21). In 2009, a population census was conducted, during which 432 macaws were observed. The researchers suggest that the "average population" in Nicaragua is 532 (Monge et al. 2010, p. 13). This 2009 study yielded an estimated population of 871 individuals in Costa Rica and Nicaragua combined (Monge et al. 2010, p. 21).

Panama

In Panama, the great green macaw is believed to inhabit the following areas: Bocas del Toro, La Amistad, northern Veraguas, Colon, San Blas, Darien, and Veraguas South (Monge et al. 2009, unpaginated). The species has been described as locally fairly common near Cana, Alturas de Nique, in 2005 (Angehr in litt. 2005). As of 2009, the historical distribution in Panama was described as not well known due to lack of information (Monge et al. 2009, p. 68). The most viable population is believed to be in Darien National Park, Panama, which borders Colombia (Monge et al. 2009, p. 68; Angehr in litt. 1996 in Snyder et al. 2000, pp. 121-123; Ridgley 1982). Researchers believe the Darien area may contain the largest overall population of the great green macaw. However, there is little recent information to confirm this (Monge et al. 2009, p. 68). Darien National Park is the largest national park in Panama, and one of the largest tropical forest protected areas in Central America (TNC 2011, p. 1). The Darien region encompasses nearly 809,371 ha (2 million acres) of protected areas, including Darien National Park and Biosphere Reserve, Punta Patino Natural Reserve, Brage Biological Corridor, and two indigenous reserves (TNC 2011, p. 1). La Amistad, an area which may have a fairly viable population, connects suitable habitat in Panama such as Cerro Punta, Rio Platano, and the Darien region, and connects the remote hills of Bocas del Toro Province with habitat in Costa Rica. La Amistad is approximately 200,000 ha (500,000 acres) in area.

Summary of Population Estimate

The global population of great green macaws is estimated to be fewer than 2,500 mature individuals, or no more than 3,700 individuals (Monge et al. 2009, p. 213; Jahn in litt. 2005, 2007, unpaginated). Based on the best available information from experts, the total population is likely between 1,000 and 3,000 individuals (Botero-Delgadillo and Paez 2011, p. 91; Monge et al. 2009, p. 213; Monge et al. 2009b, p. 68). In Ecuador, the population is estimated to be likely fewer than 80 individuals (Horstman 2011, p. 17). In 2009, a census was conducted in Costa Rica and Nicaragua (Monge et al. 2010, p. 13). A total of 173 individuals were observed in the Costa Rican study area, and 432 individuals were observed in the Nicaraguan study area during the breeding season (Monge et al. 2010, p. 22), with the areas of Monico, Romerito, and Bartola having the highest estimated abundance at the time of each census. The population of the great green macaw for Costa Rica is

currently estimated to be approximately 302 individuals, and the population for Nicaragua is roughly estimated to be 532 individuals (Monge et al. 2010, p. 22). Horstman and Jahn both state that the estimate for Ecuador may be optimistic (in litt.). Species with strict habitat requirements such as the great green macaw are particularly subject to population size overestimation, because they are unlikely to be randomly distributed within the habitat (Jetz et al. 2008, p. 116). Thus, additional surveys are needed and ground-truthing (gathering data regarding where the species is located) is essential to obtain accurate population estimates for this species.

Habitat and Life History

The great green macaw inhabits humid lowland foothills and deciduous forests generally below 600 m (1,968 ft), but also may occur between 1,000 and 1,500 m (3,281 and 4,921 ft) depending on suitable habitat, which is primarily based on the presence of almendro (Dipteryx panamensis) trees. The type of habitat preferred by the great green macaw is an ecosystem where the almendro tree and Pentacletra macroloba (oil bean tree) dominate (Chassot et al. 2006, p. 35). This species' nests have been found in Carapa nicaraguensis (caobilla), Enterolobium schomburgkii (guanacaste blanco), Goethalsia meiantha, Prioria copaifera (cativo), and Vochysia ferruginea (botarrama) trees (Chosset and Arias 2010, p. 14; Powell et al. 1999). Nests have been observed in large trees, with cavities that are nearly 20 m (66 ft) above ground (Rodriguez-Mahecha 2002, p. 119). Great green macaws have been observed to use the same nesting cavity for many years if they are undisturbed, although they may alternate nest sites each year (Chun 2008, p. 102). Reproductive capability is generally reached between ages 5 and 6 years (Chassot et al. 2004, p. 34). The great green macaw mates for life, and nests in deep cavities (usually of almendro trees) from December to June (Chassot et al. in Villate et al. 2008, p. 19; Monge et al. 2002, p. 39). The incubation time is 26 days and the nesting period is 12 to 13 weeks (Rodriguez-Mahecha et al. 2002, p. 119). After the breeding season, individuals disperse from the lowlands towards higher forests in the mountains in search of food (Powell et al. 1999 in Chosset et al. 2004, p. 38). The great green macaw has been observed in flocks of up to 18 individuals, and has been observed traveling long distances on the Caribbean slope. Macaws are strong fliers and are known to travel hundreds of kilometers (Chosset and Arias 2010, p. 5; Chosett et al. 2004, p. 36). During a study in the late 1990s, macaws fitted with radio transmitters demonstrated that macaws migrate seasonally based on food availability, and were found to travel between 40 and 58 km (25 to 36 mi) while in search of food (Chosset et al. 2004, p. 35).

Diet

The great green macaw has been observed feeding on fruits of 37 tree species (Berg et al. 2007, p. 2; Chassot et al. 2006, p. 35). While it is closely associated with the almendro tree, its diet varies based on location. In Ecuador, it was observed feeding on the following tree species: Cordia eriostigma (totumbo), Cynometra sp. (cocobolo), Ficus trigunata (matapalo), Ficus sp. (higueron), Psidium acutangulum (Guayaba de monte), Chrysophyllum caimito (caimito), and Vitex gigantea (tillo blanco or pechiche) (Berg et al. 2007, p. 2; Waugh 1995, p. 7). In other parts of its range, it has also been observed feeding on Cavanillesia platanifolia (no common name [NCN]), Cecropia litoralis (pumpwood or trumpet tree), Centrolobium ochroxylum (amarillo de guayaquil), Cochlospermum vitifolium (buttercup tree), Lecythis ampla (sapucaia), Leucaena trichodes (NCN), Odroma pyramidalis (NCN), Pseudobombax guayasen (NCN), Pseudobombax millei (beldaco), Rafia species (believed to be palms), Sloanea spp., Symphonia globulifera (NCN), and Terminalia valverdeae (guarapo) (Berg et al. 2007, p. 6). One preferred plant species, Cynometra bauhiniifolia (NCN), produced more food than nine other species (Berg et al. 2007, p. 1). In another study, two of the most important sources of food for the great green macaw, in addition to the almendro tree, were found to be Sacoglottis trichogyna (titor, rosita, or manteco) and Vochysia ferruginea (NCN) (Herrero-Fernandez 2006, p. 9; Chassot et al. 2006, p. 35). S. trichogyna fruits were observed to be its preferred food when D. panamensis was scarce or unavailable in Costa Rica (Chassot et al. 2004, p. 34).

Almendro Trees

The great green macaw is closely associated with almendro trees for feeding and nesting in the majority of its range (Chun 2008, p. iv; Chosset et al. 2004, p. 34). Because the great green macaw is highly dependent on the almendro tree, we are describing almendro tree habitat, its life history, and factors that affect its habitat. The almendro tree (also known as the tropical almond or mountain almond tree) is a member of the pea family (Fabaceae; Papilionoideae) and bears compact, single-seeded drupes. The seeds are encased in a thick woody endocarp that has been observed to persist on the forest floor for up to 2 years (Hanson 2006, p. 68). This tree species is only located in southern Nicaragua, Costa Rica, Panama, and Colombia, where it grows primarily in the lowlands of the Atlantic plains. They require an annual rainfall of 3 to 5 m (approximately 10 to 16 ft) (Schmidt 2009, p. 14) for optimal growth. A 2008 study reported that nearly 90 percent of all great green macaw nests identified in northern Costa Rica are located within hollowed cavities of large almendro trees (Chun 2008, p. 109). Additionally, almendro trees were found to provide 80 to 90 percent of both the macaw's food and nesting needs. Great green macaw pairs tend to select nesting trees that are surrounded by relatively dense stands of reproducing almendro trees (Chun 2008). Almendro tree fruit sustains the adults, chicks, nestlings, and fledglings over the course of the breeding and development season, which coincides with the peak production of almendro fruit (November through March).

Likely pollinators of the almendro tree are bees within the genera Bombus, Centris, Melipona, Trigona, and Epicharis (Thiele 2002 in Hanson 2006, p. 3; Flores 1992, pp. 1-22; Perry et al. 1980, p. 310). These trees are referred to as "emergent" because they are the tallest trees in the forest. Almendro trees can grow to over 46 m (150 ft) and reach a diameter of 1.5 m (4.92 ft). Three hundred-year-old trees have been documented, but research suggests that the almendro tree has a maximum potential age of 654 years (Fichtler et al. 2003 in Schmidt 2009, p. 15).

Wood from the almendro tree is heavy, is commercially valuable, and yields the highest prices on local markets (Rodriguez and Chaves 2008, p. 5). It is used for furniture, floorings, bridges, railroad ties, boats, marine construction, handicrafts, veneers, industrial machinery, sporting equipment, springboards, and agricultural tool handles (Schmidt 2009, p. 16). Almendro outsells every other tree species on the Costa Rican timber market (Grethel and Norman 2009 in Schmidt 2009, p. 77; Rodriguez and Chaves 2008, p. 5). It was listed in Appendix III of CITES in Costa Rica in 2003, and in Nicaragua in 2007 (http://www.cites.org). A species is unilaterally listed in Appendix III by a country in the native range of that species, at the request of that country. Article II, paragraph 3, of CITES states that "Appendix III shall include all species which any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the cooperation of other parties in the control of trade." For the export of specimens of an Appendix-III species, the Management Authority in the country of export needs to determine that the specimens were not obtained in contravention of that country's laws. In addition to CITES protections, a recent decision by the fourth Chamber of Costa Rica's Supreme Court in 2008 required the Ministry of Environment and Energy (MINAE, or Ministerio de Ambiente y Energia) to abstain from the use, exploitation, or extraction of almendro trees (Chun 2008, p. 113).

Recent research found that this tree species is much more restricted to lowland habitat than previously described; it is predicted to occur between 45 and 125 m (147 to 410 ft) in elevation, in part based on its soil requirements (Schmidt 2009, p. iv; Chun 2008, p. 109). The almendro tree is best adapted to areas with high levels of rainfall and acidic clay soils with good drainage below elevations of 500 m (1,640 ft), such as the Atlantic lowlands of Costa Rica (Schmidt 2009, p. iv). Almendro trees require at least 2000 millimeters (mm) (79 inches) of rainfall per year for optimal growth (Schmidt 2009, p. 69).

Great green macaw breeding pairs are believed to require a home range of 550 ha (1,359 ac) (Chun 2008, p. 105). Because the great green macaw requires such a large range and is strongly associated with almendro trees, range countries such as Nicaragua and Costa Rica have developed conservation plans for the almendro tree. Almendro trees commonly occur at a density of less than one adult tree per hectare (Hanson et al. 2008 in

Schmidt 2009, p. 14; Hanson et al. 2006, p. 49). The highest density recorded was 4 trees per hectare (Chaverri and Lopez 1998). In one area of Costa Rica that was surveyed for almendro trees, of 140,178 ha (56,728 ac) surveyed, 20 percent exhibited densities of 0.50 almendro trees per hectare or more, and 50 percent had densities of 0.20 trees per ha or more (Chun 2008, p. 103).

Due to their important role in the ecosystem, particularly with respect to the great green macaw, conservation efforts have focused on the almendro tree. These trees not only provide habitat to many wildlife species such as the great green macaw, but they also play a significant role in the ecosystem. One conservation strategy for the great green macaw is to protect 30,159 ha (74,493 acres) of primary, secondary, and mangrove forest that remains in this species' nesting habitat. Another conservation strategy has been to establish almendro tree plantations. Due to its open crown structure, almendro has a relatively translucent canopy that produces only moderate shade, which allows for the production of shade canopy crops such as pineapple and cacao (Schmidt 2009, p. 19). These almendro plantations are being researched for several reasons, particularly due to the almendro tree's ability to resist decay, its ability to capture carbon dioxide, and its role in the ecosystem (Schmidt 2009, p. 11). Additionally, almendro trees have been identified as the most promising species for long-term carbon sink reforestation projects in Costa Rica (Redondo-Brenes 2007, p. 253; Redondo-Brenes and Montagnini 2006, p. 168).

In Ecuador, the great green macaw is not dependant on almendro trees, although the great green macaw still inhabits humid lowland areas (Juniper and Parr 1998, p. 424). In this habitat, the great green macaw prefers Lecythis ampla (salero) in the Esmeraldas rainforest, Cynometra bauhiniaefolia (cocobolo) as a primary food source, and pigio (Cavanillesia platanifolia) as a nest tree (Horstman pers. comm. 2011).

Conservation Status

There are various protections in place for the great green macaw at the international, national, and local levels. At the international level, this species is listed as endangered on the IUCN Red List due to continuous loss of habitat, hunting, and poaching of this species for the pet trade (IUCN 2011). IUCN's Red List classifies species as endangered (extinction probability of 20 percent within 20 years) or critically endangered (extinction probability of 50 percent within 10 years) based on several criteria, including limited or declining ranges or populations. However, the status under IUCN conveys no actual protections. This species is listed in Appendix I of CITES. Appendix I includes species threatened with extinction that are or may be affected by international trade, and are generally prohibited from commercial trade. Refer to the discussion above for the military macaw for additional information about CITES. The great green macaw's conservation status in each country is discussed below and in more detail under Factor D.

Colombia

The great green macaw is listed as Vulnerable on Colombia's Red List (Renjifo et al. 2002, p. 524). It has protected status in Los Katios National Park, Utria National Park, Paramillo National Park, and Farallones de Cali National Natural Park (Rodriguez et al. 2002, pp. 120-121). The largest population of the great green macaw is believed to exist in the Darien Endemic Bird Area (EBA) 023, which encompasses southern Panama and northwestern Colombia. However, there are no reliable population estimates for this area (Botero-Delgadillo and Paez 2011, p. 91; Jahn in litt. 2004). Colombia developed a National Action Plan for the Conservation of Threatened Parrots (Plan Nacional de Accion para la Conservacion de los Loros Amenazados), and it was in effect until 2007. The ProAves Foundation, an NGO in Colombia, has been active in parrot conservation since 2005. Other than NGO involvement, it is unclear what proactive, effective protections are in place for this species.

Costa Rica

The great green macaw is considered to be endangered in Costa Rica (Monge et al. 2010; Herrero 2006, p. 6; Executive Order No. 26435-MINAE). Several intense conservation initiatives are underway for this species in Costa Rica. In 2001, a committee was formed to investigate a corridor for the conservation of this species'

habitat. As a result, the San Juan-La Selva Biological Corridor was formed to connect the Indio Maiz Biological Reserve in southeastern Nicaragua with the Central Volcanic Cordillera Range in Costa Rica. This links Costa Rica's La Selva Biological Station in the north to the Barra del Colorado Wildlife Reserve and National Park and Protective Zone of Tortuguero on Costa Rica's Caribbean coast. In addition, the conservation team lobbied for the establishment of the Maquenque National Wildlife Refuge to protect the macaw's breeding habitat (Hardman 2010, p. 10; Chun 2008, p. 98). This corridor makes up a part of the larger MesoAmerican Biological Corridor, which has been proposed to connect protected habitat from the Yucatan Region in southern Mexico and Belize to the Darien National Park in Panama (http://www.greatgreenmacaw.org/BiologicalCorridor.htm, accessed October 25, 2011).

The San Juan-La Selva bi-national corridor links existing protected wild areas. There is also an extended part to the northwest that includes the El Castillo area. The goal of this initiative is to provide linkages to 29 protected areas involving 1,311,182 ha (3,240,001 ac) (Chassot et al. 2006, p. 85). Because macaws are known to move hundreds of kilometers (Chosset and Arias 2010, p. 5), these linkages should allow for this species to better access different habitats so that it is able to meet its nutritional and nesting requirements. In addition to containing key conservation sites for the great green macaw, the corridor connects the vast expanse that includes Punta Gorda Natural Reserve, Cerro Silva Natural Reserve, and Fortaleza Inmaculada Concepcion de Maria Historic Monument (Chassot et al. 2006, p. 85). The corridor also provides connections among unprotected forest patches in Costa Rica in addition to providing connections to protected areas. Many of these areas may not be pristine habitat; some areas are either inhabited by humans or used by local communities to extract resources. However, there are conservation awareness programs in place throughout the corridor, and the great green macaw is being intensely managed and monitored in the San Juan-La Selva Biological Corridor.

Ecuador

This species is categorized as critically endangered in Ecuador (Monge et al. 2009, p. 256), primarily due to deforestation and hunting pressures. In Ecuador, the only potentially viable population is believed to exist in the Cerro Blanco Protected Forest, which is 6,070 ha (15,000 ac) in size. The Guayaquil subspecies of the great green macaw (Ara a. guyaquilensis) is thought to be in imminent danger of extinction (Berg 2007, p. 1). In 2008, the National Preservation Strategy for the Great Green Macaw in Ecuador was described at the Great Green Macaw Population Viability Assessment and Habitat Conservation Workshop held in Costa Rica; however, funding is still lacking for many of the initiatives in Ecuador that have been prescribed as necessary for the conservation of this species.

Honduras

The great green macaw is categorized as endangered in Honduras (List of Wildlife Species of Special Concern, Resolution No. Gg-003-98 APVS). In 1990, the government of Honduras prohibited the capture and sale of wildlife, including the great green macaw in Honduras. Currently, this species exists in the Rio Platano Biosphere Reserve (which consists of 800,000 ha or 1,976,843 ac). The official designation of the Biosphere as a reserve is to protect and conserve biodiversity; however, this designation has not halted deforestation within the protected area (UNESCO 2011, p. 1; ParksWatch 2011; Wade 2007, p. 65). Additionally, as of 2009, there were 23 areas in Honduras identified as Important Bird Areas (IBAs) (Devenish et al. 2009, p. 1) that may provide additional protections to this species in part by serving as ecotourism sites which can increase conservation efforts in the areas. For additional information on IBAs, see the discussion above for the military macaw.

Nicaragua

Nicaragua follows the IUCN categorization for this species (Castellon 2008, pp. 13, 19; Lezama-Lopez 2006, p. 90). The great green macaw exists in the Indio-Maiz Biological Reserve, which has had protected status since 1990, although threats to the species still exist in this Reserve (Herrera 2004, pp. 5-6). Nicaragua is also

participating in the bi-national conservation strategy for this species (Monge et al. 2009, pp. 11, 16).

Panama

There is little information available regarding the status of this species in Panama (Monge et al. 2009, p. 67); however, Panama follows the IUCN categorization for this species (Devenish et al. 2009, p. 294). The great green macaw is believed to be in Darien National Park (Monge et al. 2009, p. 68). Panama's wildlife law of 1995, Law No. 24, establishes the standards for wildlife conservation.

NGO Involvement

There are many nongovernmental organization (NGO), private, and government efforts to protect this species, although not all of the projects and NGOs are identified in this document. NGOs have conducted collaborative efforts, such as training workshops, that are community-focused and aimed at the conservation of habitat. In Nicaragua, Fundacion Cocibolca is active in this species' conservation. The NGO first signed an agreement with Nicaragua's Natural Resources Ministry (MARENA) in 1996, at which time the conservation group was the first NGO to have been granted responsibility to manage a national protected area in Nicaragua (http://www.marena.gob.ni; accessed November 9, 2011; http://www.planeta.com, accessed November 9, 2011). The Nicaraguan conservation organization, Fundacion del Rio, works in the buffer zone of the Indio-Maiz Biological Reserve, which borders the San Juan River (Villate 2008, p. 39). In 1999, this NGO began an environmental education program in this buffer zone to promote awareness of the great green macaw and its habitat. In another area, as a result of conservation efforts, the local government of El Castillo declared this species the official municipal bird, and the city established sanctions to those intending to harm this species (Chassot et al. 2008, p. 23).

Since 2001, Fundacion del Rio and the Tropical Science Center in Costa Rica have coordinated a binational campaign focused on promoting the awareness of the ecology of the great green macaw in the lowlands of the San Juan River area (Chassot et al. 2009, p. 9). Between 2002 and 2005, at least 11 workshops on great green macaw biology and preservation were held within communities of the buffer zone of Indio-Maiz Biological Reserve in Costa Rica (Chassot et al. 2006, p. 86). Some examples of projects initiated by NGOs include installation of nest boxes to increase nest availability and community heritage festivals that are focused on the great green macaw. Some NGOs are providing training to local communities to monitor populations, and some researchers are studying this species via satellite transmitters to determine the species' home range and specific habitat used (Chosset et al. 2004, p. 35). In Costa Rica and Nicaragua, 20 communities are participating in monitoring and protection activities of the great green macaw (Chosset and Arias 2010, p. 3). The primary objectives of the campaign have been to improve awareness by conducting workshops on the importance, threats, and conservation of the great green macaw and its habitat; to strengthen natural resources management by environmental authorities of both Nicaragua and Costa Rica, focusing on the local and international biological corridors; and to organize joint activities (Chassot et al. 2006, p. 83).

In Colombia, the NGO, ProAves, has made great progress in forming partnerships at the local, regional, and international levels to carry out bird conservation initiatives (Chassot et al. 2008, p. 23; Quevado-Gill et al. 2006, p. 18). Additionally, reforestation efforts have occurred (Monge et al. 2009, p. 263). These efforts have focused primarily within the reserves of the Colombian Civil Society Association Network (Quevado-Gill et al. 2006, p. 17). Conservation efforts and these workshops have been important because they have trained the community in sustainable development by linking local agricultural activities to the protection of natural resources (Quevado-Gill et al. 2006, p. 17).

Three NGOs are active in the conservation of this species in Ecuador: Pro-Forest Foundation in Guayas Province, Fundacion Natura, and the Jocotoco Foundation at the Rio Canande Reserve in Esmeraldas Province. The Pro-Forest Foundation (Fundacion ProBosque) was created in 1992, through a decree of the Ecuadorian Ministry of Agriculture. Its mission is to protect areas with an emphasis in reforestation, agroforestry, investigation, environmental education, ecotourism programs, all in order to support the conservation of

biodiversity.

In Panama, the Asociacion Nacional para la Conservacion de la Naturaleza (ANCON) began conservation work in 1991. The project has jointly worked on conservation efforts with Panama's Instituto Nacional de Recursos Naturales Renovables (INRENARE). ANCON has worked on training park rangers, marking and patrolling paths and park boundaries, acquiring property around parks and tree nurseries, and improving agricultural techniques (TNC 2011, p. 2).

Additionally, members from several NGOs participated in the great green macaw conservation workshop held in the 2008. The purpose of the workshop was to bring together experts, to determine the priorities for the conservation of the species, and to develop a plan for its conservation (Monge et al. 2009, entire). We acknowledge the substantial effort underway by various NGOs in the range countries of this species to protect it and its habitat. Despite many efforts in place, the populations of the great green macaw continue to face many threats to its habitat.

Evaluation of Threat Factors

Introduction

Section 4 of the ESA (16 U.S.C. 1533) and implementing regulations (50 CFR 424) set forth procedures for adding species to, removing species from, or reclassifying species on the Federal List of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the ESA, a species may be determined to be endangered or threatened based on any of the following five factors:

(1) The present or threatened destruction, modification, or curtailment of its habitat or range;

(2) Overutilization for commercial, recreational, scientific, or educational purposes;

(3) Disease or predation;

(4) The inadequacy of existing regulatory mechanisms; and

(5) Other natural or manmade factors affecting its continued existence.

In making this finding, information pertaining to the great green macaw in relation to the five factors in section 4(a)(1) of the ESA is discussed below. In considering what factors might constitute threats to a species, we must look beyond the exposure of the species to a particular factor to evaluate whether the species may respond to that factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat, and, during the status review, we attempt to determine how significant a threat it is. The identification of factors that could impact a species negatively may not be sufficient to compel a finding that the species warrants listing. The information must include evidence sufficient to suggest that these factors, singly or in combination, are operative threats that act on the species to the point that the species may meet the definition of endangered or threatened under the ESA.

This status review focuses primarily on where this species has been documented, which is generally in parks and other areas with protected status and the peripheral zones. In some cases, we will evaluate the factor by country. In other cases, we may evaluate the factor by a broader region or context, for example, if we do not have adequate information specific to a particular country about this species. This is because often threats are the same or very similar throughout the species' range. If we do not have information about the species in a particular area, we will state this and request information during this proposed rule's comment period (see DATES, above).

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Throughout the range of this species, the factors impacting the great green macaw are generally very similar. The main factors affecting this species are habitat loss and degradation, and poaching (McGinley et al. 2009, p. 11; Berg et al. 2007; Chassot et al. 2006; Quevado-Gill et al. 2006, p. 16; Guedes 2004, p. 280). Both Central and South America continue to experience high levels of deforestation (FAO 2010, p. xvi). Habitat loss is primarily due to conversion of the species' habitat (generally forests) to agriculture and other forms that are not optimal for this species (Chosset and Arias 2010, p. 3; Monge et al. 2009, entire).

Almendro habitat, this species' primary food and nesting source, has declined significantly (Schmidt 2009, p. 16), particularly since the 1980s. Almendro and other tree species used by the great green macaw have been selectively cut down and removed from this species' habitat. Selective logging is the practice of removing one or two generally large, mature trees and leaving the rest. Throughout the range of the great green macaw, its habitat has declined primarily due to competition for resources and human encroachment (Guedes 2004, p. 279; Rodriguez-Mahecha and Hernandez-Camacho 2002; Chassot and Monge 2002 in Rothman 2008, p. 509). Its habitat has continuously been clear-cut and converted to agriculture or human establishments, which is discussed in more detail below.

Logging

Tree species used by macaws tend to be large, mature trees with large nesting cavities. The practice of selective logging can severely impact macaws because this practice often targets the old, large trees that the macaws depend upon for nesting. In selective logging, the most valuable trees from a forest are commercially extracted (Asner et al. 2005, p. 480; Johns 1988, p. 31), and the forest is left to regenerate naturally or with some management until being subsequently logged again. Johns (1988, p. 31), looking at a West Malaysian dipterocarp forest, found that mechanized selective logging in tropical rainforests, which usually removes a small percentage of timber trees, causes severe incidental damage. He found that the extraction of 3.3 percent of trees destroyed 50.9 percent of the forest. Timber companies operating under a selective logging system can cause considerable damage to the surrounding forest, both to trees and soil. Selective logging can cause widespread collateral damage to remaining trees, subcanopy vegetation, and soil, and the practice impacts hydrological processes, erosion, fire, carbon storage, and plant and animal species (Chomitz et al. 2007, pp. 117, 119; Asner et al. 2005, p. 480). Forests that were selectively logged 15 years before exhibited an open structure with skeletons of incidentally killed trees, serious gulley erosion, and vegetation on waterlogged sites that had been compacted by heavy vehicles (Edwards 1993, p. 9). Because selective logging targets large, mature trees, this practice can have a disproportionate impact on hole-nesters, such as macaws. Additionally, the availability of food sources for frugivores (fruit-eaters, such as the great green macaw) is reduced because the trees that contain nutritional sources are no longer there.

Selective logging is particularly devastating in the case of the great green macaw, as the species is closely associated with the almendro tree, which it needs for both food and shelter. The almendro tree's wood is of great commercial value due to its strength and durability for flooring, roofing, and irrigation systems (Madriz-Vargas 2004, p. 8). Because this tree species is quite high in commercial value, it has been selectively logged. Concern for this tree species was significant enough that the species was added to CITES Appendix III in Costa Rica and Nicaragua. Listing species in Appendix III enhances conservation measures enacted for the species by regulating international trade in the species, particularly by preventing trade in illegally acquired specimens. In general, shipments containing CITES-listed species receive greater scrutiny from border officials in both the exporting and importing countries. The elimination of almendro trees is possibly the most severe threat for the species in its range countries with the exception of Ecuador, where the decrease in availability of other tree species used by the great green macaw is a concern.

Unsustainable logging practices that destroy the forest canopy also reduce habitat available to the great green macaw. The great green macaw's primary nesting habitat, the almendro tree, is slow growing and may take centuries to reach sufficient size to harbor cavities (Schmidt 2009, p. 15). Although the nest cavities that the macaws prefer (deep and dry) may take 10 to 20 years to form, these nests can last for several decades (Chun 2008, p. 101). Not only have amounts of available suitable habitat decreased, but the spatial distribution of its habitat has also changed, making foraging more difficult and requiring more energy expended. Even in undisturbed forests, suitable tree cavities are usually limited. As a result, each loss of a nest site can represent the loss of potentially many future chicks that could have been raised in each tree cavity.

Agriculture

Habitat degradation, particularly due to conversion of forest habitat to agriculture or plantations, is a major factor affecting great green macaws. The clearing of forests and buffer zones for the development of plantations for bananas, oil palms, cacao, coffee, soybeans, and rice destroys great green macaw nesting sites and exposes chicks to poaching for the pet trade (Botero et al. 2011, p. 92; Monge et al. 2009, pp. 26, 29, 43, 54; Waugh 1995, p. 2). By 2005, the world's tropical forests biome had decreased to less than 50 percent tree cover (Donald et al. 2010, p. 26), in part due to the above activities. Tropical forest fragmentation due to these activities continues to be a concern. A discussion of habitat loss and degradation for each country follows.

Colombia

Very little information is available about the great green macaw's status in Colombia (Botero-Delgadillo and Paez 2011, pp. 86, 90; Monge et al. 2009; Jahn in litt. 2004). A large population is believed to exist in Los Katios National Park, which borders the swampy and sparsely-populated Darien region in Panama; however there are no recent reported observations of the species in this area. Population surveys need to be conducted (Botero-Delgadillo et al. 2011, pp. 88, 90; Monge et al. 2009). At least 40 percent of the great green macaw's original distribution area in northwestern Colombia was deforested by 1997 (Etter 1998 in Jahn in litt. 2004). Threats to this species in Colombia have been identified as: Agriculture (particularly illegal coca cultivation); agroindustrial farms; large forest plantings of exotic trees; wood extraction; development of infrastructure; and hunting, capturing, harvesting of this species (Botero-Delgadillo and Paez 2011, pp. 91-92). Threats specific to Los Katios National Park are illegal deforestation and hunting (UNEP-WCMC 2009, p. 1). In 2009, the threats in this park were so severe that the park was added to UNESCO's List of World Heritage Sites in Danger (http://whc.unesco.org/en/list/711, accessed January 17, 2012).

Deforestation

Colombia has experienced extensive deforestation in the last half of the 20th century as a result of habitat conversion for human settlements, road building, agriculture, and timber extraction (FAO 2010, p. 233; Armenteras et al. 2006, p. 354). A 23-year study, conducted from 1973 to 1996, found that these activities reduced the amount of primary forest cover in Colombia by approximately 3,605 ha (8,908 ac) annually, representing a nearly one-third total loss of primary forest habitat (Vina et al. 2004, pp. 123-124). More than 70 percent of rural land of Colombia located in former forestlands is now devoted to cattle grazing (Etter and McAlpine 2007, pp. 89-92). Beginning in the 1980s, habitat loss increased dramatically as a result of influxes of people settling in formerly pristine areas (Perz et al. 2005, pp. 26-28; Vina et al. 2004, p. 124). More recent studies indicate that the rate of habitat destruction is accelerating (FAO 2010, p. xvi). Between the years 1990 and 2005, Colombia lost approximately 52,800 ha (130,471 ac) of primary forest annually (Butler 2006a, pp. 1-3).

Primary forest habitats such as those used by the great green macaw throughout Colombia have undergone extensive deforestation. Vina et al. (2004, pp. 123-124) used satellite imagery to analyze deforestation rates and patterns along the Colombian-Ecuadorian Border (in the Departments of Putumayo and Sucumbios, respectively) and found that between 1973 and 1996 a total of 829 km^2 (320 mi^2) of tropical forests within the study area were converted to other uses. This corresponds to a nearly one-third total loss of primary forest habitat, or a nearly 2 percent mean annual rate of deforestation within the study area. Habitat loss and degradation, including conversion of this species' habitat to other forms of use such as agriculture, plantations, or harvesting of this species' plant food sources, continue to occur and affect the quality of this species' habitat. In addition to the direct detrimental effect of habitat loss, there are several indirect effects of habitat disturbance and fragmentation, such as road building (Brooks and Strahl 2000, p. 10). Roads increase human access into habitat, facilitating further exploitation, erosion, and habitat destruction (Chomitz et al. 2007, p. 88; Hunter 1996, pp. 158-159). Research has documented that road building and other infrastructure developments in areas that were previously remote forested areas have increased accessibility and facilitated further habitat destruction and human settlement (Etter et al. 2006, p. 1; Alvarez 2005, p. 2,042; Cardenas and Rodriguez-Becerra 2004,

pp. 125-130; Vina et al. 2004, pp. 118-119; Hunter 1996, 158-159). A study conducted on the effects of habitat fragmentation on Andean birds within western Colombia determined that 31 percent of the historical bird populations in western Colombia had become extinct or locally extirpated by 1990, primarily as a result of habitat fragmentation from deforestation and human encroachment (Kattan and Alvarez-Lopez 1996, p. 5; Kattan et al. 1994, p. 141). Greater exposure of soil to direct sunlight leads to factors such as drier soils and also creates a different growing environment. For example, the creation of roads changes the habitat by altering the distance of nesting and feeding habitat to the forest "edge," increasing the amount of light exposure, and creating stress on (breeding) individuals in part due to noise and visual stimuli (Benitez-Lopez et al. 2010, p. 1,308).

Coca Cultivation

Ongoing coca cultivation has had a significant impact on forest cover in Colombia (Armenteras et al. 2006, p. 355; Fjeldsa et al. 2005, p. 205; Page 2003, p. 2; Alvarez 2002, pp. 1,088-1,093). Colombia is one of the leading producers of coca, the plant species that provides the main ingredient of cocaine. Between 1998 and 2002, cultivation of illicit crops increased by 21 percent each year, with a parallel increase in deforestation of formerly pristine areas of approximately 60 percent (Alvarez 2002, pp. 1,088-1,093). Much of Colombia's coca is grown by farmers because it generates more income than any other crop (Butler 2006, pp. 1-2). Illegal drug crops are cultivated within the great green macaw's range (BLI 2011, pp. 1-2). Large-scale coca production has moved into the extensive rainforests of the Choco state, which is considered to be a biodiversity hotspot in northwest Colombia, in the range of the great green macaw.

A 1990 United Nations study estimated that coca growers can make about $4,000 U.S. dollars per hectare (Tammen 1991, p. 12 in Page 2003, pp. 15-16). A farmer can only earn about $600 per hectare growing an alternative crop such as coffee, which is the most often-cited potential substitute crop for coca (Page 2003, pp. 15-16). Page notes that production of coffee and tea requires 3 to 4 years from planting to first harvest and then can only be harvested once per year, while coca can be harvested 8 months after it is planted and can be harvested every 90 days thereafter. The coca bushes themselves do not require much care, and can be cultivated on plots of land that are much smaller than those required for crops other than coca (Tammen 1991, p. 6 in Page 2003, p. 16). Finally, not only do coca crops displace native habitat and species assemblages that are important for the great green macaw, but they also deplete the soil of nutrients, which hampers regeneration following abandonment of fields (Van Schoik and Schulberg 1993, p. 21).

Drug eradication efforts in Colombia have further degraded and destroyed primary forest habitat by using nonspecific aerial herbicides to destroy illegal crops (BLI 2007d, p. 3; Alvarez 2005, p. 2,042; Cardenas and Rodriguez Becerra 2004, p. 355; Oldham and Massey 2002, pp. 9-12). For example, in 2006, eradication efforts were undertaken on over 2,130 km^2 (822 mi^2) of land, which included spraying of 1,720 km^2 (664 mi^2) and manual eradication on the remaining land. These eradication efforts occurred over an area 2.7 times greater than the net cultivation area (UNODC et al. 2007, p. 8). Herbicide spraying has introduced harmful chemicals into great green macaw habitat and has led to further destruction of the habitat by forcing growers to move to new, previously untouched forested areas (Alvarez 2007, pp. 133-143; BLI 2007d, p. 3; Alvarez 2005, p. 2042; Cardenas and Rodriguez Becerra 2004, p. 355; Oldham and Massey 2002, pp. 9-12; Alvarez 2002, pp. 1,088-1,093).

The ecological impacts of coca production are significant. Farmers clear forest to plant coca seedlings. Not only does each acre of crop production result in the clearing of roughly 1.6 ha (4 ac) of forest, this practice also results in secondary effects such as the pollution of land and local waterways with the chemicals used to process coca leaves, including kerosene, sulfuric acid, acetone, and carbide (Butler 2006, pp. 1-2).

Costa Rica

Most of the research on this species has been conducted in Costa Rica, where a very small population of this species remains. Despite Costa Rica's progress in conservation of this species, the historical breeding area for

this species in Costa Rica has been reduced by 90 percent (Villate et al. 2008, p. 19; Chosset et al. 2004, p. 38). In 2004, approximately 30 reproductive pairs remained in the wild in Costa Rica (Madriz-Vargas 2004, p. 4). Up until the 1960s, Costa Rica's human population was growing by approximately 4 percent annually (World Bank 2011, unpaginated; Chun 2008, p. 6). Logging in the 1960s and 1970s decimated this species' habitat (Hardman 2010, p. 8). In the 1980s, the area near Puerto Viejo de Sarapiqui experienced severe deforestation and conversion to banana and pineapple plantations. By 1996, 52,000 ha (128,495 ac) of lowland forest had been converted to banana plantations (Brewster 2009, p. 8). The loss of forested area in the north has primarily been due to the production of livestock, forestry products, sugar cane, and (in more recent years) pineapple (Villate et al. 2008, p. 15).

In the mid-1980s, policies changed from granting incentives for livestock and cattle ranching to reforestation for forest management. However, these incentives led initially to the clearing forests for conversion to exotic species plantations. As a result, forestry in Costa Rica (and Panama) has been dominated by the use of exotic species such as Tectona grandis (teak) or Gmelina arborea (melina) (Schmidt 2009, p. 10). This trend changed in 1986, with the Forestry Act 7472. In the 1990s, the focus changed, and the government began to create incentives for small farm owners to establish and maintain native tree species plantations (Piotto et al. 2003, p. 427). By 1992, a project was implemented to improve the use of forested areas; however, it estimated that by that time only 5 percent of original forest area remained intact (Chassot et al. 2001 in Villate et al. 2008, p. 15). Reforestation projects began initially through an agreement between Costa Rica and Germany. The program was implemented by the Agribusiness Association and Forestry Producers (APAIFO) and the Cooperation for Forestry Development San Carlos (CODEFORSA).

In Costa Rica's border zone with Nicaragua, Landsat TM satellite images from 1987, 1998, and 2005 showed a fragmented landscape with remnants of natural ecosystems, which has implications for the conservation of this species. The images identified several classes of cover and land use (natural forest, secondary forest, water, agriculture and pasture, banana and pineapple plantations, and bare ground) (Chassot et al. 2009, pp. 8-9). These researchers noted that the annual rate of deforestation was 0.88 percent for the 1987-1998 period, and 0.73 percent for the 1998-2005 period, even considering recovery of secondary forest. The researchers also noted that in the area studied, deforestation rates were higher than national averages for the same time span (Chassot et al. 2009, p. 9).

In the 1990s, plans to form the San Juan-La Selva Biological Corridor began in response to the significant decrease in habitat available to the great green macaw and its decline in population numbers. In 1993 and 1994, about 1,000 km^2 (386 mi^2) were identified as important nesting areas for this species in Costa Rica. In 2002, the San Juan-La Selva Biological Corridor, an area of 60,000 hectares (148,263 ac), was established to protect the nesting sites and migration flyway of the great green macaw in Costa Rica, up to the Nicaragua border (Guedes 2004, p. 280). Although this corridor is in place, recent reports indicate that habitat degradation and other factors continue to affect the great green macaw (Monge et al. 2009, p. 121).

To its credit, Costa Rica was the only country in Central America that had a positive overall increase in forest area during the period 2000-2005 (FAO 2010, p. 19; FAO 2007). Intense efforts are underway in Costa Rica to conserve and recover this species, in part by addressing habitat degradation. In some areas, the commercial use of the almendro tree is now being replaced by synthetic material due to conservation efforts focused on the great green macaw. In some areas, landowners are being paid to protect and "adopt" almendro trees, and several ecotourism projects have developed using these trees and the macaws as part of the ecotourism attraction. As of 2009, 12 nesting trees had protection agreements (Brewster 2009, p. 10). Still, habitat degradation continues to impact the great green macaw (Villate et al. 2008, p. 14), and even trees that are designated as protected are either cut down or targeted for poaching (Chun 2008). Logging still occurs in the remnant forests of both the northern zone of Costa Rica and southeast Nicaragua (Chassot and Arias 2011, p. 1; Monge et al. 2009, pp. 128-129). Logging, while it may be illegal, has also been documented in the buffer

zone of the Indio-Maiz Biological Reserve (Monge et al. 2006, p. 10). The buffer zone is within the breeding range of the great green macaw and likely affects the species' viability. Additionally, both primary and regrowth forest in the San Juan-La Selva Biological Corridor continue to be threatened by timber extraction and agricultural expansion (Chassot and Arias 2011, p. 1; Monge et al. 2009, pp. 128-129).

Mining

A gold mining project may also affect conservation efforts for the great green macaw in Costa Rica. In 2001, the Ministerio del Medio Ambiente y Energia (MINAE) granted the mining concession (Resolution R-578-2001--MINAE) in San Carlos to clear nearly 202 ha (500 ac) of old-growth rainforest for the project (Villate 2009, p. 57; http://www.infinito.co.cr and http://www.nacla.org, both accessed November 15, 2011). The Crucitas mining project is located in the Northwest Corridor of San Juan-La Selva, a few miles from the San Juan river (which separates Costa Rica from Nicaragua). The Crucitas area is part of a major zone for bird conservation initiatives, partly implemented by BLI, that includes both the Water and Peace Biosphere Reserve and the San Juan-La Selva Biological Corridor (Chassot et al. 2009, p. 9), including the El Castillo extension. It is reported that 72 percent of the area that had been proposed for implementation of the project is forested and contains almendro tree (and consequently great green macaw) habitat. The company proposed to clear cut the area in order to establish the open pit mine.

In adjacent Nicaragua, the area of influence of the mining project is also part of the buffer zone of the two reserves: San Juan River Biosphere Reserve and the Indio-Maiz Biological Reserve. These areas contain features of endemism and species compositions that are unique (Sistema Nacional de Areas de Conservacion (SINAC) 2007 in Villate et al. 2008, p. 58). Although Crucitas is not part of the current nesting area of the great green macaw, it is only about 10 km (3 mi) southeast of the historical distribution of the species. The mining activities are likely to affect the current population of the great green macaw by impacting its habitat as well as ongoing conservation efforts. The project lies within a geographical area that is of critical importance to the conservation of this species. Additionally, the removal of more primary forest cover would further reduce the ability to maintain connectivity along the San Juan-La Selva Biological Corridor, which continues to be subjected to fragmentation (Villate 2008, p. 58). As of November 2010, a court ruled that the open-pit gold mine was improperly permitted
(http://centralamericadata.biz/en/article/home/Crucitas_Mining_Concession_Cancellation_Confirmed, accessed January 12, 2012). However, prior to the court ruling, 121 ha (300 ac) of primary forest had already been cleared (http://www.santuariolapas.com/profile_003.html, accessed December 14, 2011). The ultimate impacts and outcome of the mining project are unclear; however, the species is and will continue to be impacted by pressures for resources that affect its habitat.

Ecuador

Although the population of great green macaw is reported to be stable and slowly increasing in the Cerro Blanco Protected Forest, it is an extremely small population (Monge et al. 2009, p. 256). There are likely fewer than 100 individuals remaining in Ecuador. In this part of its range, three tree species are noted as crucial for the survival of the species: Lecythis ampla (salero) and Cynometra bauhiniaefolia (cocobolo) as primary food sources, and Cavanillesia platanifolia (pigio) as a nest tree (Horstman 2011, p. 17). Logging, poaching, and illegal land settlements continue to occur in the great green macaw's range and are threats to the population in Ecuador, particularly in the Cerro Blanco Protected Forest (http://www.worldlandtrust-us.org, unpaginated; World Wildlife Fund 2011, p. 5; Horstman 2011, p. 12). Between 1960 and 1980, the human population in Ecuador grew from 4 to 10.2 million, which resulted in more than 90 percent of Pacific lowland and foothill forest below 900 m (2,953 ft) being converted to agriculture (Dodson and Gentry 1991, p. 279). Much of the species' habitat was converted to plantations of bananas, oil palms, cacao, coffee, soybeans, and rice (ELAW 2005, p. 1; Dodson and Gentry 1991, p. 279).

In 2002, the Government of Ecuador authorized the conversion of 50,000 ha (123,553 ac) of tropical forest in

the Choco region of western Ecuador into oil palm plantations (ELAW 2005, pp. 1-2). As of 2005, 374 ha (924 ac) of native forests were being cut daily (Horstman 2005, p. 8). Clearing forests for this monoculture crop has threatened thousands of endemic species and introduced dangerous pesticides to local ecosystems (Cardenas 2007, p. 43). For example, in Esmeraldas Province, pesticides are used intensively in a 36,000-ha (88,958-ac) area of oil palm plantations (ELAW 2005, pp. 1-2). Local villages cite problems from the pesticides and effluents from the processing plants.

Logging, poaching, and illegal land settlement are occurring in the Cerro Blanco Protected Forest, Ecuador (ProForest Foundation (Fundacion ProBosque), undated, p. 3). The Food and Agriculture Organization of the United Nations (FAO) reported in 2010 that in Ecuador, "planted forests are predominantly composed of introduced species," such as rubber plantations and other nonnative species (FAO 2010, p. 93), which do not provide appropriate habitat and nutritional needs for the great green macaw. Despite these activities, due to the efforts of the ProForest Foundation--the NGO in charge of the reserve--the population in the Cerro Blanco forest preserve is reported to be stable (Horstman 2011, p. 17). The Cerro Blanco forest preserve is a small area that is being managed particularly for this species. It is jointly owned by the ProForest Foundation and a cement company, Holcim, as mitigation for its nearby limestone quarries. Reserve managers are converting former cattle pasture to native tree farms, which they use to help restore dry tropical forest in other locations, including a corridor to nearby patches of forested areas (Horstman 2009 pers. comm.). Despite the conservation efforts in place, logging, poaching, and illegal land settlement continue to affect the population in the Cerro Blanco Protected Forest (Horstman 2011, p. 17; Fundacion Pro-Bosque, undated, p. 3). A conservation strategy for this species recommends that a ban be instituted on the cutting and commercialization of the three tree species described above that were noted as crucial for the great green macaw's survival (Monge et al. 2009, pp. 256-258). However, deforestation, encroachment, and habitat degradation activities such as these continue (Horstman 2011, p. 17).

Another threat to the macaw's population in this reserve is the rapid expansion of the city of Guayaquil. Squatter settlements develop on the city's outskirts and encroach the forest (Fundacion ProBosque undated, p. 3). Illegal settlements are a problem, and squatter communities have attempted to take over property within Cerro Blanco. The local NGO conducts educational awareness programs to mitigate these activities. An example of awareness campaign activities is educating the local communities about the effect on their water supply when they destroy forested areas (Horstman pers. comm. in Hardman 2010, p. 13). However, pressures to this species' habitat continue to impact the species.

Honduras

In Honduras, threats have included illegal trafficking of this species and deforestation due to agriculture, cattle grazing, and logging (Devenish et al. 2009, p. 256). The threat of deforestation is particularly important because a recent study found that 87 percent of Honduras is only suitable for forest (Larios and Coronado 2006, p. 13) due to its generally mountainous terrain. There is very little information available on the status of this species in Honduras, particularly scientific literature (Monge et al. 2009, p. 122). Only six papers on avian diversity and avian population surveys in Honduran forests were published between 1968 and 2004 (Anderson et al. 2004, p. 456). However, we do know that the threats in Honduras are similar to those in other countries within the range of this species (McCann et al. 2003, pp. 321-322), and the most significant threat is deforestation. In 2008, the Departamento de Areas Protegidas y de Vida Silvestre (DAPVS) in Honduras estimated that 80,000 ha (197,684 ac) of natural areas were being destroyed annually (DAPVS 2008 in Devenish et al., 2009 p. 256).

The great green macaw is believed to exist in the Rio Platano Biosphere Reserve within the watershed of the Platano River (Monge et al. 2009, p. 8). The area is also known as the "Mosquitia Hondurena," which is 500,000 ha (1,235,527 ac) in size. The reserve serves as protection to the 100 km (62 mi) long Platano River watershed, in addition to protecting parts of the Paulaya, Guampu, and Sicre rivers (Devenish 2009, p. 256). Several indigenous tribes such as the Miskito, Tawahka, Pech, Garifunas, and "Mestizos" use this area for their

traditional livelihoods. Although this reserve was designated as a World Heritage Site, pressures to the reserve area for its resources continue (TNC 2011, unpaginated). In 2011, the Rio Platano Biosphere Reserve was added to the list of World Heritage Sites in danger due to encroachment (UNEP-WCMC 2011, p. 1).

In the Rio Platano Biosphere Reserve of Honduras, the unregulated extraction of timber and mass production of bananas has caused an alarming decline of great green macaw populations (Devenish et al. 2009, p. 256). The deforestation in Honduras is occurring as a result of an increase in the human population, which requires clearing areas for home development as well as wood products (Devenish et al. 2009, p. 256). The annual human population growth rate as of 2011 was estimated to be 1.09 percent (U.S. Department of State 2011, unpaginated). Palacios and Brus Laguna, towns on the coast approximately 5 km (3.1 mi) from the park on either side of the reserve, are likely contributing to the pressures such as agriculture and logging that are occurring illegally in the reserve.

Nicaragua

In Nicaragua, great green macaws face reductions in populations due to illegal extraction of timber and agricultural expansion (McGinley et al. 2009, pp. 13, 33, 35; Jeffrey 2001, pp. 1-5). Overall, there is a lack of information about the status of the great green macaw population and its habitat in Nicaragua (Monge et al. 2010; Monge et al. 2009, pp. 52-53). However, a population of the great green macaw is known to occur in the Indio-Maiz Biological Reserve, located in Nicaragua just across the San Juan River at the northeastern border of Costa Rica (Monge et al. 2009, p. 51), where suitable habitat for this species remains. This reserve, which is believed to be one of the few strongholds for the great green macaw, is nearly 264,000 ha (652,358 ac) in size. It is likely that the Indio-Maiz Biological Reserve contains extensive forest areas with high densities of almendro trees (Chun 2008, p. 94), and therefore is critical to this species' survival. Chun suggests that many areas in Nicaragua may exceed the minimum great green macaw nesting requirement of 0.20 trees per hectare within the breeding territory. Although the Indio-Maiz Biological Reserve is considered one of Nicaragua's best preserved forested areas and has limited access, its buffer zone has recently been under assault from activities such as loggers in search of lumber and illegal farming of Elaeis guineensis (African palm) trees for biofuel (Chosset and Arias 2010, p. 3; Ravnborg et al. 2006, p. 2). As resources become more scarce in the buffer zones, illegal activities push farther into the lesser disturbed and lesser accessible areas. Despite the existence of this protected area, deforestation continues to occur.

Deforestation is one of the major threats to biodiversity in this region; one steadily increasing form is the conversion of forest into agricultural or pasture lands (Chassot et al. 2006, p. 84). In Nicaragua, between 1990 and 2005, 1.35 million ha (3.34 million ac) of forested areas were converted to agriculture or were deforested due to other reasons such as logging (FAO 2010, p. 232; FAO 2007). Much of Nicaragua has protected status. In 2005, approximately 36 percent of Nicaragua's forested area was designated as protected or in some form of conservation status (FAO 2007). Additionally, in 2007, there were 72 protected areas in Nicaragua's National System of Protected Areas (Castellon 2008, p. 19). However, 88 percent of Nicaragua's area designated as forest is privately owned (FAO 2010, p. 238), and, therefore, is not protected. Additionally, much of the logging that occurs is illegal and is not monitored (Pellegrini 2011, p. 21; Richards et al. 2003, p. 283).

As an example, the Bosawas Reserve is one of the areas believed to contain great green macaws as well as suitable habitat for a viable population. It was designated a reserve in 1979, in response to the advance of the agricultural frontier (Cuellar and Kandel 2005, p. 9). However, during the 1980s, the area was not managed; it was the battleground for the armed conflict between the Sandinistas and the Contras (Cuellar and Susan Kandel 2005, p. 9). In October 1991, Bosawas was declared a National Natural Resource Reserve through Executive Decree No. 44-91. Despite its designation as a protected area, encroachment and habitat degradation still occur (McCann et al. 2003, p. 322). In Bosawas, indigenous tribal communities have rights to use the forests under the Autonomy Statute of 1987 (Cuellar and Kandel 2005, p. 11). As of 1998, the indigenous population was approximately 9,200 in or near the Bosawas reserve (Stocks et al. 2007, p. 1497). In

2005, the Nicaraguan government granted land titles to 86 indigenous Miskitu and Mayangna groups in Bosawas and contiguous indigenous areas (Stocks et al. 2007, p. 497). Generally, these indigenous communities manage the forests well and want to maintain their traditional way of life. However, "mestizo" communities were encouraged to settle in the area that is now the reserve's buffer zone during the period when lands were being converted to plantations. Both the mestizo and indigenous communities depend on access to land to ensure their livelihoods. However, the mestizo communities convert primary forest to agricultural or livestock uses (Cuellar and Kandel 2005, p. 13), while the indigenous communities have less impact on the ecosystem. Land rights disputes are common in these areas, and land use rights are often unclear. The Government of Nicaragua is attempting to manage these issues (Pellegrini 2011, p. 21), but conflict and practices that degrade the great green macaw's habitat persist both in the Bosawas Reserve and in other areas within the range of the species.

One of the factors contributing to deforestation in this area is a high rate of poverty (Pacheco et al. 2011, p. 4). Nicaragua is the poorest country in Central America (CIA World Factbook 2011). In part, due to the high rate of poverty, the great green macaw continues to face threats to its habitat. Communities living within the range of the great green macaw practice unsustainable activities, such as conversion of habitat to agriculture or logging, which contribute to deforestation of the species' remaining habitat in Nicaragua (McGinley 2009, p. 36; Castellon 2008, pp. 21, 30; Richards et al. 2003, p. 282). Much of the Indio-Maiz Biological Reserve is described as being intact and unlogged (Chun 2008, p. 116). Despite this, some loggers cross the border into Nicaragua to harvest the almendro tree (Schmidt 2009, p. 16; Chassot et al. 2006, p. 84). Anecdotal reports indicate that Costa Rican loggers pay Nicaraguan farmers about $15 for each almendro tree, bring the logs to Costa Rica, and sell them for about $1,450 in Costa Rica (Arias 2002, p. 4). Because incomes in the Bosawas region of Nicaragua were found to average under $800 per family per year (Stocks et al. 2007, p. 1,498), the almendro trees are quite valuable. Consequently, a bi-national biological corridor between Nicaragua and Costa Rica was proposed in an attempt to prevent the extinction of the almendro tree (Chassot et al. 2006, p. 84). Although this corridor exists and efforts are in place (refer to discussion under Factor D, below) to mitigate border issues (Hernandez et al., undated, pp. 1-14) in this region, habitat degradation continues.

Panama

In Panama, this species is believed to primarily exist in the Darien region, which borders northern Colombia (Angeher 2004, in litt.). Deforestation was estimated to exceed 30 percent of the species' original range in Panama (Angehr 2004, in litt.). Although there is limited information available on the threats affecting great green macaw populations in Panama, deforestation is known to occur within this species' range (Monge et al. 2009, p. 68; Angehr 2004, in litt.). Conflict regarding land rights of indigenous communities has become one of the most critical issues in the Darien region. The most significant threats to tropical forests in Panama overall include road construction and road improvement, especially in the Darien region, and agricultural expansion, particularly in the Darien and Bocas del Toro regions, which results in increased access to forests (Parker et al. 2004, p. V-2). Roads have been found to be one of the leading causes of global biodiversity loss (Benitez-Lopez et al. 2010, p. 1,307). The construction of the Pan-American Highway and other roads are affecting the Darien forest area (TNC 2011, p. 1). When roads are constructed, they increase access to previously inaccessible areas. This leads to more pressures on the forested areas, such as conversion to agriculture, competition for resources (such as the extraction of plant species that may be consumed by the great green macaw), and more logging.

A 2006 report indicated that the advance of the agricultural frontier and "spontaneous colonization" occurring at a rate of 50,000 to 80,000 ha (123,500 to 197,700 ac) per year is rapidly shrinking Panama's forests and protected areas (McMahon et al. 2006, p. 8). Prior to its formal designation in 1990, La Amistad National Park, which spans the border between Costa Rica and Panama, experienced impacts from cattle ranching, timber extraction, burning, and illegal settlements (UNEP-WCMC 2011, p. 7). Trails, encroachment, roads, grazing,

and hunting continue in this area and affect this species' habitat (TNC 2012, unpaginated; UNEP-WCMC 2011, p. 7) . Soil and water resources have been depleted due to traditional agricultural practices and inadequate conservation measures. Indigenous production systems, with their low-intensity land use, long rotation periods, and plentiful forests for hunting and gathering, are increasingly becoming unsustainable due to economic pressures. The indigenous production systems are being replaced by farming systems that emphasize monoculture without rotation, which leads to depleted soils and encourages greater expansion of the agricultural frontier. These threats are heightened by rural poverty that drives populations in search of areas with a relatively intact natural resource base with high levels of globally significant biodiversity (Pacheco et al. 2011, pp. 4, 18). Watershed degradation from deforestation and unsustainable land use has accelerated soil erosion, sedimentation, and pollution. As a result of competition for resources, many farmers and indigenous people have emigrated to the Darien and Bocas del Toro provinces, where the great green macaw is believed to exist in larger numbers than in other parts of the species' range. Unsustainable land practices, the lack of capacity by both public and private stakeholders to encourage sustainable land use, infrastructure development, and the lack of management plans further exacerbate the degradation of this species' habitat.

Darien forests are under pressure from the expanding agricultural frontier and related colonization (TNC 2011, p. 1; McMahon 2006, p. 8). The region's human population is growing at a rate of about 5 percent a year. Loss of forest cover is often linked to agricultural expansion, which often follows new or improved roads, and which results in increased access to forests. Slash-and-burn agriculture has resulted in huge tracts of deforested land. Other factors that affect the stability of great green macaw populations include the National Authority for the Environment's (ANAM) inability to fund programs for protected areas and buffer zones, and the extraction of other minerals and building materials, whether legal or illegal (Angehr et al. 2009, p. 291). Logging and mining is legally restricted in the area; however, logging still occurs outside the Darien reserve, and the practice encroaches the remaining forest cover in the buffer zone. Problems in or adjacent to protected areas include illegal clearing for development, agriculture, and cattle grazing; road construction; and extraction of minerals or construction materials (Devenish et al. 2009b, p. 291).

The presence of gold mines in the Darien Region, particularly the Cerro Pirre area, was also indicated to be a threat to the species. Significant mining activities in this area were conducted prior to the 18th century. The clearing of forests to create roads for mining facilitates the transport of materials and personnel in and out of the mining zones (Robbins et al. 1985, pp. 200, 202). Roads exacerbate deforestation practices such as logging and conversion to agriculture or other land uses, as well as colonization. This area is now an ecotourism site; as of 1985, there is now second-growth forest recovery from the gold mines that had been abandoned during the 18th century. It does not appear that mining in this area still occurs, and, therefore, mining is not currently impacting the species.

Summary of Factor A

The global population of great green macaws is decreasing due to the threats identified above that continue to exert pressure on the species. The loss of much of the older forested areas has reduced high-quality habitat for this species to relatively small and isolated patches throughout its range; however, suitable habitat remains in some protected areas in Central and South America. Habitat degradation poses a significant threat throughout the range of the great green macaw, which is especially vulnerable to the effects of isolation and fragmentation because it tends to mate for life, it has a small clutch size and specialized habitat requirements, and its populations are small and decreasing.

The great green macaw is naturally associated with unfragmented, mature, forested landscapes, and is considered a habitat specialist that selects areas of contiguous mature forest in Central America and parts of northern South America (Monge et al. 2009; Madriz-Vargas 2004, p. 7). This species requires large areas for its feeding requirements and is not well adapted to fragmented landscapes. Deforestation results in fragmented forests with high ratios of edge to forested area, and the original biodiversity upon which this species depends is

lost. Greater exposure of soil to direct sunlight leads to factors such as drier soils and also creates a different growing environment. Because there are few remaining older, complex forest stands providing adequate habitat for breeding, feeding, and nesting, great green macaw populations are in decline. The great green macaw is threatened by the impacts of both past and current habitat loss, including ongoing habitat modification that results in poor quality and insufficient forest habitats, habitat fragmentation, and isolation of small populations. The ability of the great green macaw to repopulate an isolated patch of suitable habitat following decline or extirpation is particularly unlikely due to the species' large home range requirements, and this is exacerbated by its small overall population size and the large distances between the remaining primary forest fragments. Despite the existence of the bi-national corridor in Nicaragua and Costa Rica and a multitude of conservation efforts, we find that the present or threatened destruction, modification, or curtailment of habitat is a threat to the great green macaw now and in the future.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Because this species has an extremely small and fragmented population, poaching, while apparently uncommon, remains a concern (Botero-Delgadillo and Paez 2011, p. 13; Monge et al. 2009, pp. 26, 40, 106). Removal of this species from the wild has a significant detrimental effect on this species because this species tends to mate for life and only produces 1 or 2 eggs annually. The species has been heavily poached in the wild historically and is still trafficked for the pet trade in Honduras and Nicaragua (Anderson 2004, p. 453; http://www.lafeberconservationwildlife.com/?p=1714, accessed December 14, 2011). Although there are no known current reports of poaching in all parts of its range, poaching was raised as a concern at the 2008 workshop held in Costa Rica on this species (Monge et al. 2009, various). After regulatory mechanisms such as CITES and the WBCA were put into place, particularly since 1992 when the WBCA went into effect, much of the legal trade in the great green macaw declined (see discussion of military macaw for more information about WBCA) (UNEP-WCMC CITES trade database, accessed September 6, 2011). The great green macaw was listed in CITES Appendix II, effective June 6, 1981, and was transferred to Appendix I, effective August 1, 1985. Most of the international trade in great green macaw specimens consists of live birds.

Data obtained from the United Nations Environment Programme-World Conservation Monitoring Center (UNEP-WCMC) CITES Trade Database show that during the 4 years the great green macaw was listed in Appendix II, 26 live great green macaws were reported to UNEP-WCMC as (gross) exports. In analyzing the data, it appears that several records may be overcounts due to slight differences in the manner in which the importing and exporting countries reported their trade. It is likely that the actual number of great green macaw specimens in international trade during this period was 22 live birds. All of the live birds were reported with the source "unknown." Exports from range countries included six live birds from Panama and five live birds from Nicaragua (UNEP-WCMC 2011).

During the more than 24 years following the transfer to Appendix I (August 1985 through December 2009, the last year for which complete data reported are available), the UNEP-WCMC database shows 786 live birds in international trade. However, it is likely that the actual number of live great green macaws in international trade during this period was 701 (U.S. CITES Management Authority 2012). Of these, 647 were reported to be captive-bred or captive-born, 5 were reported as wild, and 15 were reported as "pre-Convention." The source of the remaining live birds is unknown. Exports of live birds from range countries included 17 from Costa Rica, 10 from Ecuador, 12 from Nicaragua, and 6 from Panama. Note also that some of these birds may be personal pets that are counted more than once.

The pressures historically to remove this species from the wild for the pet trade, in part due to its high commercial value, have contributed significantly to the decline in population numbers for this species. Poaching continues to occur in this species' range countries, particularly in Nicaragua (Castellon 2008, pp. 20, 25; Kennedy 2007, pp. 1-2; BLI 2007, p. 1). The majority of information available for Central America regarding poaching and the sale of parrot species was focused in Nicaragua (Herrera-Scott 2004, pp. 1-2). A study

published in 2004 assessed the origin and local sale and export of parrots and parakeets in Nicaragua (Herrera-Scott 2004, pp. 1-2), and focused on the buffer zone of the Indio-Maiz Biological Reserve, a critical area for the great green macaw. The study followed the marketing chain from rural areas to the capital city. Most of the wildlife trade was found to occur in Managua. As of 2000, poaching was still occurring in the buffer zone of the Indio-Maiz Biological Reserve (Herrera-Scott 2004, p. 6). An estimated 7,205 parrots were sold during that year (Herrera-Scott 2004, p. 1). The legal export of wildlife species from Nicaragua in general decreased significantly between 2002 and 2006 (McGinley 2009, p. 16). Despite the decrease in legal trade, in 2007, a number of parrot species could be still found for sale along roads to tourists (Kennedy 2007, pp. 1-2; BLI 2007, p. 1) Nicaragua is the poorest country in Central America and the second poorest in the Hemisphere, and has widespread underemployment and poverty (CIA World Factbook 2011, unpaginated; FAO 2011, p. 1). Approximately 17 percent of its population lives in extreme poverty (Castellon 2008, p. 21). Many of Nicaragua's citizens live in rural areas where they usually earn a living from agriculture and fishing, and the sale of a parrot can significantly increase their earnings. As mentioned above under the Factor A discussion, incomes in the Bosawas region of Nicaragua were found to average under $800 per family per year as of 2007 (Stocks et al. 2007, p. 1,498). The great green macaw was found for sale at an average of $200 to $400 U.S. dollars (USD) (Fundacion Cocibolca in BLI 2007, p. 1) For perspective, in the United States, captive-bred specimens can sell for up to $2,500 USD (Basile 2009, p. 6). The high commercial value, especially in relation to the average family income, indicates that it is still worthwhile to poach and sell this species. Due to the extreme poverty in Central America, particularly in Nicaragua, and due to the high commercial value of great green macaws, poaching continues to be a significant concern for this species.

Poaching can be intertwined with habitat destruction (Factor A). Some poachers still cut down trees to obtain nestlings (Hardman 2011, p. 13; Chun 2008, p. 105). This practice of cutting down trees to remove nestlings is particularly devastating to small populations reliant upon certain types and sizes of nesting trees. Not only are poachers removing vital members of the population, they are destroying a nest site that may have taken a breeding pair several years to find and cultivate. One study looked at 51 nest sites that had been identified between 1994 and 2003 (Chun 2008, p. 105). The study evaluated potential habitat by examining the presence and density of almendro trees by aerial survey. It examined portions of two protected areas--the San Juan-La Selva Biological Corridor and the Maquenque National Wildlife Refuge (Chun 2008, p. 117). Of 51 nest sites, 10 trees had been cut by the end of the survey period. In some cases, the nests had been deliberately cut even after the tree had received protection status and had been distinguished as a nesting tree with a plaque. Nest destruction has also been reported in Ecuador (Bergman 2009, pp. 6-8), where it is estimated to have an extremely small population. Another study confirmed this practice, although this was a different parrot species, and found an average of 21 nests was destroyed per poaching trip (Gonzalez 2003, p. 443).

Poaching for the pet bird trade can destroy pair bonds, remove potentially reproductive adults from the breeding pool, and have a significant effect on small populations (Kramer and Drake 2010, pp. 511, 513). This is in part because this species mates for life, is long-lived, and has low reproductive rates. These traits make them particularly sensitive to the effects of poaching (Lee 2010, p. 3; Thiollay 2005, p. 1121; Wright et al. 2001, p. 711). In some areas in Costa Rica, there were no recent reports of nest poaching due to conservation efforts (Villate et al. 2008, p. 23). However, despite conservation efforts in place, the conservation workshop for Ara ambiguus held in 2008 indicated that poaching of this species is still a concern throughout its range (Monge et al. 2009, pp. 18, 26, 29, 40).

Summary of Factor B

Conservation efforts by various entities working to ensure the long-term conservation of the great green macaw may result in its population slowly increasing (Monge et al. 2010, pp. 12-13). However, overall, the best available information indicates that the population is still declining (Botero-Delgadillo and Paez 2011, p. 91; Monge et al. 2009). The species still faces threats such as habitat loss and poaching. Often, there is a lag time

after factors have acted on species (i.e., poaching and habitat loss) before the effect is evident (Sodhi et al. 2004, p. 325). Even though the great green macaw is listed as an Appendix-I species under CITES and commercial international trade is now significantly reduced, there is still concern about the illegal capture of this species in the wild. This species is desirable as a pet, and its native habitat is in impoverished countries, where the sale of an individual bird can significantly increase a person's income. Despite regulatory mechanisms in place, poaching is lucrative and still occurs. Additionally, because each population of great green macaws is small, with possibly between 10 to 500 individuals (Monge et al. 2010, pp. 21, 22), poaching is likely to have a significant effect on the species. The populations are distributed widely throughout the range of the species (see Figure 3) and are highly fragmented, and the amount of interaction between populations is unknown but likely infrequent. Based on the best available information, we find that overutilization, particularly due to poaching, is a threat to the great green macaw throughout its range now and in the future.

C. Disease or Predation

Diseases associated with great green macaws in the wild are not well documented (De Kloet and Dorrestein 2009, p. 571; Herrero 2006, pp. 15-19; Tomaszewski et al. 2001, p. 533). Studies of macaws have demonstrated that they are susceptible to many bacterial, parasitic, and viral diseases, particularly in captive environments (Kistler et al. 2009, p. 2,176; Portaels et al. 1996, p. 319; Clubb and Frenkel 1992, p. 119; Bennett et al. 1991; Wainright et al. 1987, pp. 673-675). However, most studies are conducted on captive macaws. Some of the diseases known to affect macaws are discussed below.

Pacheco's Parrot Disease

Pacheco's parrot disease is a systemic disease caused by a psittacid herpes virus (PsHV-1) (Tomaszewski et al. 2006, p. 536; Abramson et al. 1995, p. 293; Panigrahy and Grumbles 1984, pp. 808, 811). It is an acute, rapidly fatal disease of parrots, and sudden death is sometimes the only sign of the disease; however, in some cases, birds may show symptoms and may recover to become carriers (Tomaszewski et al. 2006, p. 536; Abramson et al. 1995, p. 293; Panigrahy and Grumbles 1984, p. 811). This disease and the presence of PsHV-1 has been known in both captive and wild-caught macaws (Tomaszewski et al. 2006, pp. 538, 540, 543; Panigrahy and Grumbles 1984, p. 809); however, we found no information indicating that this disease impacts the great green macaw in the wild.

Psittacosis

Psittacosis (chlamydiosis), also known as parrot fever, is an infectious disease that could affect this species and is caused by the bacteria Chlamydophila psittaci. An estimated one percent of all birds in the wild are infected and act as carriers (Jones 2007, unpaginated). C. psittaci is transmitted through carriers who often show no signs of the disease. It is often spread through the inhaling of the organism from dried feces (Michigan Department of Agriculture 2002, p. 1), but may also pass orally from adults to nestlings when feeding via regurgitation or from the adult male to the adult female when feeding during incubation (Raso et al. 2006, pp. 239). Wild birds may not show clinical signs. This may be explained by a naturally occurring balanced host-parasite relationship (Jones 2007, unpaginated; Raso et al. 2006, pp. 236, 239-240).

Proventricular Dilatation Disease

Proventricular dilatation disease (PDD), also known as avian bornavirus (ABV) or macaw wasting disease, is a serious disease reported to infect psittacines. Macaws are among those commonly affected by PPD (Abramson et al. 1995, p. 288), although it is a fatal disease that poses a serious threat to all domesticated and wild parrots worldwide, particularly those with very small populations (Kistler et al. 2008, p. 1; Abramson et al. 1995, p. 288). This contagious disease causes damage to the nerves of the upper digestive tract, so that food digestion and absorption are negatively affected. The disease has a 100-percent mortality rate in affected birds, although the exact manner of transmission between birds is unclear. In 2008, researchers discovered a genetically diverse set of novel ABVs that are thought to be the cause (Kistler et al. 2008, p. 1). The researchers developed diagnostic tests, methods of treating or preventing bornavirus infection, and methods for screening for the anti-

bornaviral compounds (Kistler et al. 2008, pp. 1-15). However, we found no information that this disease affects wild great green macaws.

Psittacine Beak and Feather Disease

Psittacine beak and feather disease (PBFD) is a common circovirus that has been documented in over 60 psittacine species; all psittacines may be potentially susceptible (Rahaus et al. 2008, p. 53; Abramson et al. 1995, p. 296). This virus, which originated in Australia, affects both wild and captive birds, causing chronic infections resulting in either feather loss or deformities of the beak and feathers (Rahaus et al. 2008, p. 53; Cameron 2007, p. 82). PBFD causes immunodeficiency and affects organs such as the liver and brain, and the immune system. Suppression of the immune system can result in secondary infections due to other viruses, bacteria, or fungi. The virus can exist without obvious signs (de Kloet and de Kloet 2004, p. 2,394). Birds usually become infected in the nest by ingesting or inhaling viral particles. Infected birds develop immunity, die within a couple of weeks, or can become chronically infected. No vaccine exists to immunize populations (Cameron 2007, p. 82). We found no information on this disease in great green macaws.

We have no evidence of significant adverse impacts to wild populations of great green macaws due to disease; disease is a normal occurrence within wild populations. A review of the best available information indicates that disease does not occur to an extent that it is a threat to this species, particularly because the populations are widely dispersed, which provides an element of resiliency to the overall population. We conclude, based on the best available scientific and commercial information, that disease is not a threat to the great green macaw now or in the future.

In addition, we have no information indicating that predation threatens the great green macaw. This is the second largest New World macaw, and the best available information does not indicate that predation (other than poaching) is a factor that negatively affects this species. While predators undoubtedly have some effect on fluctuations in great green macaw numbers, there is no evidence to suggest that predation has caused or will cause long-term declines in the great green macaw population. Therefore, we have determined that this factor does not pose a threat to the great green macaw, now or in the future.

D. The Inadequacy of Existing Regulatory Mechanisms

Regulatory mechanisms affecting this species that we evaluate could potentially fall under categories such as wildlife management, parks management, or forestry management. We are primarily evaluating these regulatory mechanisms in terms of nationally protected parks because this is where this species generally occurs. A summary of the status of forest policies, regulatory mechanisms, and laws in the range countries of the great green macaw is below. The most authoritative source for assessing the state of forests is the United Nations Food and Agriculture Organization's Forest Resources Assessment (Chomitz et al. 2007, p. 42). FAO's 2010 study found that each range country for this species has a national forest law, policy, or program in place, and Table 1 indicates the year it was last evaluated. However, the study found that few forest policies at the subnational level (such as jurisdictions equivalent to states in the United States) exist in these countries.

_____National_forest_____National_forest_program					
_____policy					
Country_____Exists___Year_____Exists___Year_____Status					
Colombia_____Yes_____1996_____Yes_____2000_____Under_revision					
Costa_Rica_____Yes_____2000_____Yes_____2001_____Under_revision					
Ecuador_____Yes_____2002_____Yes_____2002_____In_implementation					
Honduras_____Yes_____1971_____Yes_____2004_____In_implementation					

Nicaragua_____Yes_____2008_____Yes_____2008_____In_implementation
Panama_____Yes_____2003_____Yes_____2008_____Unclear
Table_1._Adapted
from_FAO_Global
Forest_Resource
Assessment_2010,
pp._302-303.
_____Forest_law_national
Country_____National--type_____Year_____Subnational
_____exists
Colombia_____Incorporated_in_other___1974_____No.
_____law
Costa_Rica_____Specific_forest_law_____1996_____No.
Ecuador_____Specific_forest_law_____1981_____No.
Honduras_____Specific_forest_law_____-_____No.
Nicaragua_____Specific_forest_law_____2003_____Yes.
Panama_____Specific_forest_law_____1994_____No.
Table_1._Adapted
from_FAO_Global
Forest_Resource
Assessment_2010,
pp._302-303.

In 2007, FAO noted that many countries (in the range of the great green macaw) had enacted new forest laws or policies within the past 15 years, or had taken steps to strengthen their existing legislation or policies. Among countries that had enacted new forest legislation were Costa Rica, Honduras, Nicaragua, Panama, Colombia, and Ecuador (FAO 2007, p. 43). Despite the existence of these laws and policies, the populations of the great green macaw are still negatively affected by habitat loss, encroachment, and, to a lesser extent, poaching.

Parks and Habitat Management

Throughout this species' range, we found that many of the threats that occur to this species are the same or similar. Threats generally consist of various forms of habitat loss or degradation (see Factor A discussion, above). Each range country for this species has protections in place, but for reasons such as limited budgets and limited enforcement capabilities, the laws and protections are generally not able to adequately protect the species. Our analysis of regulatory mechanisms is discussed essentially on a country-by-country basis, beginning with Colombia, and is summarized at the end.

Colombia

Colombia has enacted numerous laws to protect species and their habitats. This species exists predominantly

in areas that are protected, and Colombia has several laws that pertain to protected areas. Some of these laws include:

* Natural Resources and Decree Law number 2811/74.
* Decree 1974/89: Regulation of Article 310 of Decree 2811, 1974, on integrated management districts of natural renewable resources.
* Law number 99/93: Creates the Ministry of the Environments and the National Environmental System.
* Law number 165/94: Biological Diversity Treaty.
* Decree 1791/96: Establishment of the Forest Use Regime.

A list of legislation that applies to protected areas in Colombia is available at http://www.humboldt.org.co/ingles/en-politica.htm and at http://www.regulations.gov in Docket No. FWS-R9-ES-2011-0101. A discussion of Colombia's regulatory mechanisms with respect to the great green macaw follows.

The great green macaw is listed as vulnerable on Colombia's Red List (Renjifo et al. 2002, p. 524). Resolution No. 584 of 2002 provides a list of Colombian wildlife and flora that are considered "threatened." Colombia defines threatened as those species whose natural populations are at risk of extinction if their habitat, range, or the ecosystems that support them have been affected by either natural causes or human actions. Threatened species are further categorized as critically endangered, endangered, or vulnerable. Colombia defines a critically endangered species as one that faces a very high probability of extinction in the wild in the immediate future, based on a drastic reduction of its natural populations and a severe deterioration of its range. An endangered species is one that has a high probability of extinction in the wild in the near future, based on a declining trend of its natural populations and a deterioration of its range. A vulnerable species is one that is described as not in imminent danger of extinction in the near future, but it could be if natural population trends continue downward and deterioration of its range continues (EcoLex 2002, p. 10).

Colombian Law No. 99 of 1993 created the Ministry of the Environment and Renewable Natural Resources and the National Environmental System (SINA). SINA sets out the principles governing environmental policy in Colombia, and provides that the country's biodiversity is protected and used primarily in a sustainable manner (Humboldt Biological Resources Research Institute 2011, unpaginated; EcoLex 1993, p. 2). SINA is a set of activities, resources, programs, and institutions that allow the implementation of environmental principles. Consistent with the Constitution of 1991, this management system was intended to be decentralized. However, an environmental assessment study conducted for the World Bank in 2006 found that Colombia's current decentralized system is inadequate as implemented (Blackman et al. 2006, p. 15). Although Law 99 assigns the role of leading and coordinating environmental management in Colombia to the Ministry of Environment (Ministerio del Medio Ambiente, MMA), Colombia's Autonomous Regional Corporations (CARs) have the role of implementing environmental laws (Blackman et al. 2006, pp. 39-40, 42). CARs have responsibility for both management of natural resources and economic development (Ministry of Environment et al. 2002).

In 2006, an analysis of the effectiveness of Colombia's CARs was conducted for the World Bank. In Blackman et al.' s analysis, they reported that many individuals both inside and outside the government felt there was a lack of effectiveness of SINA. For example, Colombia's efforts to eradicate the coca trade has not been effective at reducing the amount of coca being cultivated (Page 2003, p. 2; also see Factor A). In addition to not adequately addressing the coca cultivation, which destroys the great green macaw's habitat, aerial fumigations of the coca crop have destroyed banana fields and polluted the environment (Page 2003, p. 2) (see Factor A discussion, above). The effectiveness of these regional management groups varied; the study found that the effectiveness was correlated with the CARs' age, geographic size, and level of poverty (Blackman et al. 2006, p. 16). Due to the decentralized structure, CARs were found to be ineffective at environmental management in Colombia (Blackman et al. 2006, p. 14).

This species' habitat occurs to some extent in areas designated as protected by SINA, including five national parks (Rodriguez-Mahecha 2002a). Two parks are particularly significant: Katios National Park and Utria

National Park. Although this species likely exists in at least these two parks (Botero-Delgadillo and Paez 2011, p. 92), no protective measures have been actually implemented to curb human impacts on the species' habitat by the indigenous and farming residents within these protected parks (Botero-Delgadillo and Paez 2011, p. 92). Cultivation of plants for cocaine production is known to occur within the boundaries of Katios National Park. The cultivation of illegal crops (particularly coca) poses additional threats to the environment beyond the destruction of montane forests (Balslev 1993, p. 3). Coca crop production destroys the soil quality by causing the soil to become more acidic, depletes the soil nutrients, and ultimately impedes the regrowth of secondary forests in abandoned fields (Van Schoik and Schulberg 1993, p. 21; also see Factor A discussion, above). As of 2007, Colombia was the leading coca producer (United Nations Office of Drugs and Crime (UNODC) et al. 2007, p. 7). Since 2003, cocaine coca cultivation has remained stable at about 800 km^2 (309 mi^2) of land under cultivation (UNODC et al. 2007, p. 8). This activity continues to degrade and destroy great green macaw's habitat. With respect to Utria National Park, little to no information is known about the status of the species in this area (Botero-Delgadillo and Paez 2011, p. 91). Although it is extremely remote, human communities reside within and around the park, and continue to use the resources within the park.

Despite Colombia's numerous laws and regulatory mechanisms to administer and manage wildlife and their habitats, the great green macaw continues to face many threats to its habitat. There is little information available about the species (Botero-Delgadillo and Paez 2011, p. 90), and the most recent information indicates that no conservation action has been proposed for this species (Botero-Delgadillo and Paez 2011, p. 88). On-the-ground enforcement of existing wildlife protection and forestry laws, and oversight of the local jurisdictions implementing and regulating activities, are ineffective at mitigating the primary threats to the great green macaw. As discussed under Factor A (above), habitat destruction, degradation, and fragmentation continue throughout the existing range of the great green macaw. Therefore, we find that the existing regulatory mechanisms currently in place are inadequate to mitigate the primary threats of habitat destruction to the great green macaw in Columbia.

Costa Rica

In Costa Rica, there are more than 30 laws related to the environment (Peterson 2010, p. 1). A list of the environmental laws in Costa Rica is available at: http://www.costaricalaw.com/costa-rica-environmental-laws.html. As deforestation is the most significant factor affecting the great green macaw, some laws applicable to the conservation of the great green macaw are:

* Law No. 2790 Wildlife Conservation Law ("Ley De Conservacion De La Fauna Silvestre," July 1961).
* Law No. 7317 Wildlife Conservation Law ("Ley De Conservacion De La Vida Silvestre," December 1992).
* Law 7554 Law of the Environment ("Ley Organica del Ambiente," October 1995).
* Law No. 7575 Forestry Law ("Ley Forestal," February 1996).
* Law 7788 Biodiversity Law (In 1998, the National System of Conservation Areas (SINAC) was created through this law (Canet-Desanti 2007 in Villate et al. 2008, p. 24).

In the early 1990s, Costa Rica had one of the highest deforestation rates in Latin America (Butler 2012, p. 3). Forest cover in Costa Rica steadily decreased from 85 percent in 1940, to around 35 percent today, according to the FAO's State of the World's Forests (Butler 2012, unpaginated; FAO 2010, pp. 227, 259; FAO 2007). Historically, clearing for agriculture, particularly for coffee and bananas, in addition to cattle pastures was the main reason for Costa Rica's rainforest destruction. During the 1970s and early 1980s, vast expanses of rainforest had been burned and converted to cattle pastures. Today, although deforestation rates of natural forest have dropped considerably, Costa Rica's remaining forests still experience illegal timber harvesting (in protected areas) and conversion to agriculture (in unprotected zones) (Butler 2012, unpaginated; Monge et al. 2009, p. 121; FAO 2007). Despite its abundance of conservation legislation, Costa Rica has undergone significant periods of deforestation (Butler 2012, unpaginated; FAO 2007, p. 38), which have had a severe effect on the great green macaw.

Almendro Tree Protection

In Costa Rica and Nicaragua, the great green macaw is highly dependent on the almendro tree. Almendro trees are found only on the Atlantic coast from southern Nicaragua down through Costa Rica and Panama and into Colombia, primarily at altitudes below 900 m (2,953 ft). This tree species is now protected by law in Costa Rica; cutting any almendro tree over 120 cm (47.2 in) or less than 70 cm (27.6 in) in diameter is prohibited (Rainforest Biodiversity Group 2008, p. 1). The remaining Costa Rican populations of almendro trees are concentrated in the northeastern corner of the country from the San Juan River south to Braulio Carrillo National Park (Hanson 2006, p. 3). Although little forest remains undisturbed in this region, many almendro trees were left standing in fragments or pastures, partly due to the extremely dense nature of the tree's wood and the difficulty in cutting down these trees.

As a result of the great green macaw's dependence on almendro trees, conservation efforts for the great green macaw have focused on this tree species. A decree was enacted in 2001 to limit extraction of the almendro tree. Harvest was temporarily suspended until a study could be conducted to evaluate the status of this primary food and nesting source in relation to the great green macaw (Chosset et al. 2002, p. 6). According to Costa Rican legislation (Decree No 25167-MINAE), the removal or logging of almendro trees had been illegal in the area between the San Carlos and Sarapiqui Rivers (Madriz-Vargas 2004, p. 9). The objective of the restrictions placed on extraction of almendro trees was to increase the number of nesting sites for the great green macaw and to prevent the tree from becoming extinct; however, forest clearings continued to occur at an alarming rate due to the lack of resources to protect biological reserves (Madriz-Vargas 2004, p. 8). For example, researchers reported in 2003 that of the 60 great green macaw nests identified since the great green macaw conservation project was initiated in 1994, 10 had been cut down by forest engineers working in forest management plans (Monge and Chassot 2003, p. 4). In 2008, Costa Rica's Supreme Court stated that MINAE must abstain from the continuation or initiation of the use, exploitation, or extraction of the almendro tree (Chun 2008, p. 113). In Costa Rica, fines for those who cut down almendro trees have been proposed as a measure, although penalties reportedly have not been instituted (Botero-Delgadillo and Paez 2011, p. 92).

Great Green Macaw Conservation

In the two core areas where the great green macaw exists in Costa Rica, conservation activities are underway, and the breeding populations are being closely monitored. Quebrada Grande is a community-operated, 119-ha (294-ac) reserve in the center of great green macaw habitat. Additionally, the National Green Macaw Commission was formed in 1996 to protect and manage this species' habitat. This commission was formed in response to the severe decline of the great green macaw population, and included 13 government agencies, NGOs, and the Sarapiqui Natural Resources Commission (CRENASA). This conservation effort was formalized by Executive Order No. 7815-MINAE of 1999. The group served as an advisory body to MINAE regarding environmental issues in the northern zone of Costa Rica that affect the great green macaw (Chassot and Monge 2008 in Villate et al. 2008, p. 22). Conservation efforts are still in progress; in 2008, a workshop was held to bring together species experts and government officials to identify priorities and goals in order to conserve the species (Monge et al. 2009, entire).

Additionally, a corridor was created in 2001, with the goal of maintaining connectivity and biodiversity between protected areas in southeastern Nicaragua, the Protected Conservation Area Arenal Huetar North (ACAHN), and Conservation Area of the Central Volcanic Cordillera (ACCVC) in Costa Rica. The primary purpose was to promote the creation of protected wilderness and encourage habitat protection necessary to preserve and increase the great green macaw population (Villate et al. 2008, p. 24).

In 2005, the Maquenque National Wildlife Refuge (MNWR) was established primarily to protect breeding habitat for the great green macaw. Approximately 43,700 ha (107,985 ac) of land identified as potential great green macaw breeding habitat lies within the boundaries of MNWR (Chun 2008, p. 113). This region was targeted because it contains several large nesting trees used by great green macaw breeding pairs. MNWR protects

foraging habitat that may be critical during the great green macaw's breeding season. MNWR is within the larger San Juan La Selva (SJLS) Biological Corridor, and its goal is specifically to connect protected areas in southern Nicaragua to those in central Costa Rica (Chun 2008, p. 98). However, even in this refuge, habitat degradation continues to occur. A Ramsar (the Convention on wetlands) report on this refuge (which is a Ramsar site), indicated that the main threats there are agricultural and forestry activities, which are most prevalent near the Colpachi and Manati lagoons (Ramsar 2012, p. 1).

In summary, as of 2002, less than 10 percent of the great green macaw's original range was estimated to exist in Costa Rica (Chosset et al. 2002, p. 6). The great green macaw greatly depends on the almendro tree as its primary food and nesting resource. However, due to Costa Rica's complex deforestation history, the great green macaw remains imperiled primarily due to habitat fragmentation, degradation, and habitat loss. In 2004, a maximum of 35 pairs were estimated to be breeding in northern Costa Rica (Chosset et al. 2004, p. 32), and the population in this country appears to have increased since a conservation program and regulatory mechanisms have been in place. Costa Rica's population was estimated to be approximately 300 birds in 2010 (Chassot 2010 pers. comm. in Hardman 2010, p. 11; Monge et al. 2010, pp. 13, 22). Despite the apparent increase in the population in Costa Rica, the population is extremely small and has experienced significant decline in available habitat over the past 60 years.

Habitat Degradation

In addition to the historical loss of habitat, the species continues to face threats such as habitat degradation. This species requires a complex suite of plant species over the course of a year for its nutritional needs. Pressures to its habitat such as logging, encroachment, habitat degradation, and likely other factors continue within this species' range. Despite conservation efforts in place, such as conservation awareness programs, research, and monitoring, the population has declined significantly over time and is still only estimated to be approximately 300 individuals. Because this species mates for life and has a small clutch size, the loss of any one individual can have a significant effect on the population. Costa Rica has implemented many environmental laws in conjunction with conservation efforts to protect species, particularly the great green macaw and its habitat. The situation of this species is still precarious, and any of the threats acting on the species, such as habitat loss and degradation, poaching, or other unknown factors, could have a significant effect on the population in Costa Rica because it is so small, and because of its life-history characteristics. The existing regulatory mechanisms, as implemented, are insufficient in Costa Rica to adequately ameliorate the current threats to this species.

Ecuador

As of 2006, the Ecuadorian government recognized 31 various legal categories of protected lands (e.g., national parks, biological reserves, geobotanical reserves, bird reserves, wildlife reserves, etc.). The amount of protected land (both forested and non-forested) in Ecuador as of 2006 was approximately 4.67 million ha (11.5 million ac) (ITTO 2006, p. 228). However, only 38 percent of these lands had appropriate conservation measures in place to be considered protected areas according to international standards (i.e., areas that are managed for scientific study or wilderness protection, for ecosystem protection and recreation, for conservation of specific natural features, or for conservation through management intervention) (ITTO 2009, p. 1). Moreover, only 11 percent had management plans, and less than 1 percent (13,000 ha or 32,125 ac) had implemented those management plans (ITTO 2006, p. 228).

In 2004, the Ecuadorian Minister of the Environment signed a ministerial decree forming the National Strategy for the In-Situ Conservation of the Guayaquil Macaw (Ara a. guayaquilensis) into law (ProForest 2005, p. 3). The strategy included the following components to be implemented within 10 years. Aspects of this conservation plan, which focuses on the Cerro Blanco Protected Forest, a stronghold for great green macaw, include:

* Applied investigation for the conservation of the species;

* Management of the conservation areas where the presence of the Guayaquil macaw has been confirmed, incorporating new areas that are critical for conservation of the species, and providing connecting corridors between the areas;
* Reforestation with appropriate tree species in its habitat;
* Incentives and sustainable alternatives for communities and private property owners within its range; and
* Conservation of the Guayaquil macaw.

Despite the existence of this strategy, the great green macaw still faces significant threats in Ecuador (Horstman 2011, p. 12). There are likely fewer than 100 individuals of this subspecies remaining in Ecuador. Ecuador recognizes that threats exist to its natural heritage, not only to this species, but to all of its wildlife. In 2008, Ecuador approved Article 71 of its Constitution which states, "Nature has a right to integrally respect its existence as well as the maintenance and regeneration of its vital cycles, structures, functions and evolutionary processes." Article 73 also mandates, "measures of precaution and restriction for all activities that could lead to the extinction of species, the destruction of ecosystems, or the permanent alteration of natural habitats." Ecuador has made significant strides in conservation. Ecuador's Article 103 of Book IV on Biodiversity decreed that: "It is prohibited, on any day or time of the year, to hunt species, whether birds or mammals, that constitute wildlife and that are listed in Appendix 1 of the present Record that are qualified as threatened or endangered. Hunting is likewise prohibited in certain areas or zones while the bans are in effect" (Monge et al. 2009, p. 256; Unified Text of the Secondary Legislation of the Ministry of the Environment). Despite the recent advances made in conservation efforts, Ecuador has gone through periods of devastating habitat loss and degradation, which affected the great green macaw's habitat such that it only remains in two fragmented and small areas. It is unclear how sustainable the remaining habitat is, particularly because this species has specialized feeding requirements and requires a large range to provide its nutritional needs.

The National Strategy for the In-Situ Conservation of the Guayaquil Macaw was revised in 2009. As a result, the first national census of great green macaw was conducted in Ecuador in late 2010 (Horstman 2011, pp. 16-17). The Cerro Blanco Protected Area has been managed by the Pro-Forest Foundation, an NGO, for approximately 20 years (Horstman 2011, unpaginated). Horstman indicated that at the Cerro Blanco Reserve, the resident population of approximately 15 macaws travels widely outside of the 6,475-ha (16,000-ac) reserve (http://blogs.discovery.com/animal_news/2009/11/help-for-ecuadors-great-green-macaws.html, accessed October 28, 2011). Horstman, who has worked in this area since the early 1990s, indicated the need to establish a conservation corridor between Cerro Blanco and adjacent patches of suitable forest, and most are less than 40.5 ha (100 ac) in size. During the past 20 years, at least 2,000 ha (4,942 ac) have been reforested (Monge et al. 2009, p. 9). Although reforestation projects have occurred, encroachment is still occurring (Horstman 2011, p. 12). Despite conservation efforts and regulatory mechanisms in place, there is still limited funding available for conservation efforts. Encroachment and other forms of habitat degradation continue to occur within its habitat (see Factor A discussion, above). Therefore, we find that the regulatory mechanisms are inadequate to ameliorate the loss and degradation of great green macaw habitat in Ecuador.

Honduras

The National Conservation and Forestry Institute (ICF) (formerly the Protected Areas and Wildlife Department, established in 1991) is responsible for regulating natural resources and management of protected areas. The National Protected Areas System includes 17 national parks created between 1980 and 2007. As of 2009, there were 79 protected areas (Triana and Arce 2012, p. 1). In 1991, the Protected Areas and Wildlife Department (which is now the National Conservation and Forestry Institute (ICF)) was designated to manage natural resources and protected areas (Devenish et al. 2009, p. 257; Decree no. 74-91, 1991). Prior to 1991, wildlife was managed by the Honduran Department of Wildlife and Ecology (RENARE).

Decree 98-2007, the Forest Law of Honduras, repealed Decree 163-93 of 1993, which contained the Law on Incentives for Forestation, Reforestation, and Forest Protection. The Forest Law sets forth the purposes of the

law, and regulates the use of forestry areas, the rational and sustainable management of forestry resources, protected areas, and wildlife. The law contains definitions and created a series of administrative agencies charged with the implementation of forestry regulations, including the National Forestry Consultative Council. This law also formed the National Forestry Research System and the National Institute for Forestry Conservation and Development (211 provisions; pp. 1-17).

Before the 2007 Forest Law was approved, at least 38 laws governed the sector, creating a confusing policy framework. The situation is further complicated because in many cases, forest tenure (ownership, tenancy, and other arrangements for the use of forests) is unclear. Although most forest is officially state-owned (FAO 2007), states have little practical authority over forest management, and individuals exercise de facto ownership.

Corruption is a barrier to legal logging because it facilitates illegal operations and creates obstacles to legal ones (Pellegrini 2011, p. 18; Rodas et al. 2005, p. 53). Bribes are extorted from certified community forestry operations, and, reportedly, without bribes, transport of legal wood becomes impossible (Pellegrini 2011, p. 18; Rodas et al., 2005, p. 53).

The new 2007 Forest Law was supported by environmental groups, but its implementation was delayed. The law included the abolition of the Honduran Forest Development Corporation (COHDEFOR) (which received unanimous support), more resources for enforcement, and harsher penalties against those who commit forest-related crimes. Previously, the director of COHDEFOR and other political leaders were owners or employees of logging companies, an apparent conflict of interest (Pellegrini 2011, p. 20). Also at that time, the army was involved in enforcement. Out of the resources that were spent for the forestry sector, the military absorbed 70 percent without producing any evidence that enforcement had improved (Pellegrini 2011, p. 20).

Currently in Honduras, the great green macaw is believed to exist in eastern Honduras in suitable habitat distributed from Olancho to the Rio Platano Biological Reserve, the Tawahka Biological Reserve, and Patuca National Park (Monge et al. 2009, p. 39). Its range encompasses both unprotected and protected areas; however, timber exploitation occurs even in areas designated as protected. This practice has created conflicts in protected areas such as the Rio Platano Biosphere Reserve, an area that is considered critical for its conservation (Lopez and Jimenez 2007, p. 26). Demand for mahogany, which has been one of the most extracted species in the area (Lopez and Jimenez 2007, p. 26), has also put pressure on this species' habitat. Selective logging creates openings in forest canopies and changes the ecosystem dynamics and composition of plant species. Income from logging is higher than that earned for crops and cattle, making logging far more lucrative for locals. However, after areas are logged, they become more accessible and are then often converted to uses such as crops and cattle grazing.

Indigenous communities have rights to use many protected areas. Article 107 of the Honduran Constitution protects the land rights of indigenous people. It is the duty of the government to create measures to protect the rights and interests of indigenous communities in the country, especially with respect to the land and forests where they are settled (Article 346). As an example of land use by Honduran indigenous communities, between 15 and 40 percent of the total value of consumption for two indigenous Tawahka communities was found to be derived directly from the forest (Godoy et al. 2002, p. 404). Struggle over land rights is a difficult issue for indigenous communities in Honduras. Logging and mining are some of the biggest threats not only to the great green macaw, but also to the indigenous communities. Indigenous cultures generally have a low impact on the forests (Stocks et al. 2007, pp. 1,502-1,503). Because indigenous communities want their lands protected for their traditional way of life, NGOs are working with these communities to protect reserves in Honduras, which should ultimately benefit the great green macaw.

In 1996, the Rio Platano Biosphere Reserve was placed on the "World Heritage Site in Danger" list, but it was removed from the list in 2007, due to a significant improvement in conservation efforts by NGOs. Several NGOs are working in this area including the Mosquitia Paquisa (MOPAWI) and the Rio Platano Biosphere Project (UNEP-WCMC 2011, p. 5). However, investigations in 2010 and 2011 indicate that there are still problems

within the reserve (UNESCO 2011, pp. 1-3). UNESCO, as recently as 2011, conducted a survey in the Rio Platano Reserve and found illegal activity within the core zone (UNESCO 2011, pp. 1-3). Clearing of land for cattle grazing and illegal fishing and hunting along the river is ongoing. The area is protected by policy by the Department of Protected Areas and Wildlife, State Forestry Administration in Honduras. The reserve management plan, implemented in 2000, included zoning and specific plans for conservation issues. One of the goals of the reserve's conservation plan is to integrate local inhabitants with their environment in part via sustainable agricultural practices. This practice has been found to be a good tool in forest conservation (Pellegrini 2011, pp. 3-8). The reserve plan established buffer zones, cultural zones, and nucleus zones. Indigenous communities living in the reserve and buffer zone are allowed to use the resources within the reserve. The integration of indigenous populations plays a large part in the success of the conservation plan, both inside the reserve and outside the reserve in the buffer and peripheral zones (Pellegrini 2011, p. 3; Stocks et al. 2007, p. 1502-1503). This reserve also receives some funding from the World Wildlife Fund and other private organizations, which assists in the management of the reserve. However, there are currently no park guards or any official entity actively patrolling or guarding the reserve to enforce restrictions.

There is a complex history concerning the balance of land rights of indigenous communities and preservation of habitat for species such as the great green macaw. In Honduras, there is a gap between forestry policy objectives and the state of forestry. The policy frameworks exist to manage timber extraction, but tools are not implemented (Pellegrini 2011, p. 1). COHDEFOR had been responsible for forestry development and enforcement of laws. The Honduran government began to decentralize COHDEFOR beginning in 1985 (Butler 2012, unpaginated) due to its ineffectiveness. As of 2001, the management of Honduran forests was administered by the Administracion Forestal del Estado (AFE, Government Forestry Administration), Corporacion Hondurena de Desarrollo Forestal (COHDEFOR Honduran Forestry Development Corporation) (Moreno and Marineros 2001, p. 2). Land use planning occurs at the national level; however, identifying the best use of areas has not been implemented (Pellegrini 2011, p. 17). In addition, estimates of illegal logging are approximately 80 percent of the total volume extracted for broadleaf and 50 percent for coniferous species (Richards et al. 2003, p. 1).

Honduras is making progress in managing its forested resources. In 2010, Honduras implemented Agreement number 011-2010 (Ecolex 2011), the Forestry Reinvestment Fund and Plantation Development, and its goal is to recover areas degraded or denuded forests. In 2010, Honduras also put into place Decision No. 31/10, the General Regulation of Forestry Law, Protected Areas and Wildlife (Ecolex 2011). This covers the administration and management of forest resources, protected areas, and wildlife. Despite the progress made in Honduras with respect to laws and regulatory mechanisms that affect the great green macaw and other wildlife, the species continues to face habitat loss and degradation in Honduras.

Nicaragua

Nicaragua's General Environmental and Natural Resources Law No. 217, issued in 1996, is considered the legal framework that defines the standards and mechanisms in regard to the use, conservation, protection, and restoration of the environment and natural resources in a sustainable manner. It recognizes the sustainable development concept. By 2004, Nicaragua had enacted 10 environmental laws and was a member of regional and international environmental agreements (Moreno 2004, p. 9). As of 2004, Nicaragua was moving towards the consolidation of a National System of Protected Areas (SINAP) in order to preserve the country's biological wealth (Moreno 2004, p. 9). SINAP consists of National Protected Areas, Municipal Ecological Parks, and Private Wildlife Reserves of "ecological and social relevance at the local, national, and international level, defined in conformance with the law, and designated according to management categories that permit compliance with national policies and objectives of conservation" (McGinley 2009, p. 19; Protected Areas Regulations: Article 3). However, the overall protection and administration of SINAP is hindered by an inability to administer its financial and human resources (McGinley 2009, p. 20). Of the 72 national protected areas, only

23 had approved management plans in 2008, another 19 were in some phase of the approval process, and 30 protected areas had no management plan at all (McGinley 2009, p. 20). Despite protections in place, enforcement has been lacking in protected areas, and poverty continues to be a huge concern in Nicaragua (FAO 2011, pp. 1-2; McGinley et al. 2009, p. 16).

Three assessments of the effectiveness of Nicaragua's laws and regulations with respect to wildlife and forestry laws were recently conducted (Pellegrini 2011; McGinley et al. 2009; Castellon et al. 2008). The first explored the relationship between forest management and poverty (Pellegrini 2011). The research published in 2009 evaluated Nicaragua's Tropical Forests and Biological Diversity (McGinley et al. 2009, entire). The other report evaluated the effectiveness of Nicaragua's wildlife trade policies (Castellon et al. 2008, entire). In Nicaragua, the organization responsible for regulation and control of the forestry sector is the National Forest Institute (INAFOR), which is under the Ministry of Agriculture, Livestock and Forestry (MAGFOR). The other relevant ministry is the Nicaraguan Ministry of Environment and National Resources (MARENA), which supports conservation awareness programs for this species. In early 2003, MARENA created the Municipal Environmental Unit in order to decentralize environmental functions. Although a good legal framework exists in Nicaragua to protect its natural resources, there are still on-the-ground problems that affect this species. For example, in the Indio-Maiz Biological Reserve, one of the strongholds for this species, each forest guard in the control posts along the border of the reserve is responsible for monitoring a stretch of 8 km (5 mi) of the border and an area of 70 km^2 (27 mi^2) (Rocha 2012, pp. 3-6; Ravnborg et al. 2006, p. 6). There are communication and perception problems that are prevalent within the reserve that perpetuate the inability to adequately manage the resources within the reserve. These resources are used both legally and illegally by Costa Ricans who cross the San Juan River and the local communities who live in Nicaragua (Rocha 2012, pp. 3-6).

In 2008, the government of Nicaragua published a report on the status of its wildlife laws and mechanisms (Castellon et al. 2008, entire). It reported the following findings (p. 9):

* Nicaragua's current laws are inadequate to protect and sustain domestic and international trade in CITES species. They are unfocused and lack provisions on habitat degradation and biological productivity.
* Nicaragua does not have a written wildlife trade policy nor laws to underpin sustainable species management in domestic and international trade. The regulatory instruments pertaining to sustainable management of wildlife trade are relevant and coherent and provide a basis for the formulation of such a policy.
* The nonregulatory instruments for measuring the commercial sustainability of wildlife trade are rarely used. The most important of them are: Monitoring, research, education, and information.
* Study of wildlife harvesting shows that the income from trade in harvested species goes principally to external actors, with little or no benefit to rural communities or populations.

The 2008 study also reported that the government of Nicaragua was unable to find a single case in which the application of its laws led to actual fines or penalties for harvesting or trading banned species (McGinley 2009, p. 22). It found that nonregulatory instruments such as monitoring, research, education, and information are poorly used in the oversight of commercial wildlife trade in Nicaragua. (McGinley 2009, p. 22). Despite these findings, a review undertaken by the CITES Secretariat found that the legislation of Nicaragua has been determined to be sufficient to properly implement the CITES Treaty (see discussion below). The country has made an effort to protect its resources, and is attempting to address the management of its natural resources. In addition, specific, targeted conservation measures are occurring. An NGO in Nicaragua, with the support of MARENA, is promoting conservation of this species. They have initiated a campaign to educate communities in part by posting messages on buses on three highly traveled public routes in Managua. For example, one message describes why buying endangered species as pets is not a good idea; rather, they should remain in the wild. Additionally, in 2003, Nicaragua and Costa Rica participated in the First Mesoamerican Congress for Protected Areas. Senior representatives of both countries discussed ways to explore the framework of connectivity between protected areas (Villate et al. 2008, p. 52). As a result, several active conservation

measures for the great green macaw in Nicaragua are underway, such as the development of connected habitat corridors, and the great green macaw conservation workshop was held in 2008. In Nicaragua's Indio-Maiz Biological Reserve, training measures for monitoring the great green macaw have been implemented. For example, technicians associated with Fundacion del Rio have been trained in great green macaw research (Chassot et al. 2006, p. 86). The species' population is only estimated to be 871 individuals in Nicaragua and Costa Rica combined (Monge et al. 2010, p. 21), and pressures continue to occur to the species and its habitat. Despite regulatory mechanisms in place and the existence of many strategies in Nicaragua to combat threats to the species such as deforestation, habitat loss, and poaching for the wildlife trade, these activities continue.
The impoverished rely strongly on forest products (Pellegrini 2011, pp. 21-22). In an attempt to reduce poverty and at the same time conserve forested areas, analyses addressing poverty reduction were conducted prior to 2002. Strategies, described as Poverty Reduction Strategy Papers (PRSPs), recommended approving a forestry law by 2002 (which actually was approved at the end of 2003) and addressing deforestation as a source of ecological vulnerability. As part of its poverty reduction strategy, Nicaragua developed a National Development Plan (Government of Nicaragua 2005 in Pellegrini 2011, pp. 21-22), the goal of which was to strengthen the whole forestry production chain. However, the plan was reported to not have been effectively implemented (Pellegrini 2011, p. 22). The main policy instruments that set the framework for forestry were the Forest Law and the logging ban. The Forest Law establishes the system of forest management (Pellegrini 2011, pp. 21-22). The law includes incentives for sustainable practices; however, Pellegrini noted that it is virtually impossible to take advantage of the law's provisions without support by external organizations such as NGOs (Pellegrini 2011, p. 22; TNC 2007, pp. 3-7).
Nicaragua is focusing efforts on the restoration and protection of forested areas, and its goal was to reduce the deforestation rate from 70,000 ha (172,974 ac) to 20,000 ha (49,421 ac) per year by 2010 (McGinley 2009, p. 28). Recently, the Associated Foresters of Nicaragua (FORESTAN), in cooperation with a local NGO, the Instituto de Investigaciones y Gestion Social (INGES), began an initiative to increase forest cover. Their goal is to incorporate conservation and production areas over 5,000 ha (12,355 ac), and more effectively use commercially valuable tree species while at the same time creating permanent jobs (INGES-FORESTAN 2005 in Sinreich 2009, p. 63). In 2006, a logging ban was put in place. The ban prohibited extraction of six species of wood and any logging operation in protected areas or within 15 km (9 mi) of all national borders, and it put the army in charge of enforcement (Government of Nicaragua 2006 in Pellegrini 2011, p. 23). However, deforestation rates may have increased even after the ban's approval (Guzman 2007, pp. 1-2). Although Nicaragua attempts to manage its natural resources, it has a large challenge due to the pressures for its forest resources in combination with extreme poverty (FAO 2011, p. 1; McGinley et al. 2009, p. 11). Despite these efforts, pressure on the great green macaw's habitat continues.

Panama

In Panama, the great green macaw's stronghold is believed to be in Darien National Park, which borders Colombia (Monge et al. 2009, p. 68; Angehr in litt. 1996 in Snyder et al. 2000, pp. 121-123; Ridgley 1982). The Darien region encompasses nearly 809,371 ha (2 million ac) of protected areas, including Darien National Park and Biosphere Reserve, Punta Patino Natural Reserve, Brage Biological Corridor, and two reserves for indigenous communities (TNC 2011, p. 1). Panama's National System of Protected Areas (SINAP) is managed by the National Environmental Authority (ANAM) and consists of 66 areas, totaling 2.5 million ha (6.18 million ac) (Devenish et al. 2009b, p. 1-2). Of these, 19 have management plans, and 36 have been through a process of strategic planning (ANAM 2006, unpaginated).
ANAM was established in 1998, through the General Environmental Law of Panama (Law 41). ANAM is the primary government institution for forest and biodiversity conservation and management. ANAM plans, coordinates, regulates, and promotes policies and actions to use, conserve, and develop renewable resources of the country. Its mission statement is to guarantee a healthy environment through the promotion of rational

use of natural resources, the organization of environmental management, and the transformation of Panamanian culture to improve the quality of life (Virviescas et al. 1998, p. 2). Law 41 also provides the framework for SINAP. Environmental protection in Panama falls under the jurisdiction of three government agencies, the Institute for Renewable Natural Resources, the Ministry of Agricultural Development, and the Ministry of Health. There are 17 management categories of protected areas that were established through INRENARE's Resolution 09-94. A later law, the Forest Law of 2004, established protections for three types of forest, which covers 36 percent of the country.

There are political and economic pressures to develop many areas (Devenish et al. 2009b, p. 291). Deforestation, in addition to the lack of management, and lease periods for these concessions of 2 to 5 years, have left only an estimated 250,000 to 350,000 ha (617,763 to 864,868 ac) of production forests in Panama (Gutierrez 2001a in Parker et al. 2004, p. I-10). Additionally, many protected areas in Panama lack adequate staff and resources to patrol the areas or enforce regulations (Devenish et al. 2009b, p. 291). In 1986, Panama initiated a national forest strategy (Plan de Accion Forestal de Panama or PAFPAN) supported by FAO; however the plan reportedly did not directly tackle the causes of deforestation. Between 1980 and 1990, concessions for 77,800 ha (192,248 ac) of production forests were awarded to 23 companies, for periods ranging from 2 to 5 years (Parker et al. 2004, p. II-4). In 1994, a new forestry law was approved, which institutionalized forest management. Now, concessions only exist in the Darien Province (Parker et al. 2004, p. II-4). Between 1992 and 2000, the Darien province was one of Panama's provinces that experienced the greatest declines (11.5 percent) in forest cover (Parker et al. 2004, p. 32). However, there are activities in place to combat these pressures. For example, a training program exists to increase capacity in issues such as planning, geographic information systems, sustainable tourism, trail construction and management for park staff, community groups, and other stakeholders in the protected area system.

Darien National Park

Darien National Park extends along about 80 percent of the Panama-Colombia border and includes part of the Pacific coast. The area has been under protection since 1972, with the establishment of Alto Darien Protection Forest. It was declared a national park in 1980. The park is zoned as a strictly protected core zone of over 83,000 ha (205,097 ac). Another zone consists of 180,000 ha (444,789 ac) and contains indigenous Indian populations that have maintained their traditional way of life and culture. Approximately 8,000 ha (19,768 ac) is designated for tourism and environmental education, and the last zone is described as an "inspection zone" which is 40-km (25-mi) wide, and spans the Panama-Colombia border. The Darien forests are threatened from logging, agriculture expansion, burning, and hunting and gathering (TNC 2011, pp. 1-2; Monge et al. 2009, p. 68). Other threats to forest in the region include the development of projects such as dams and highways (Parker et al. 2004, pp. II-7--II-8).

Since 1986, the Asociacion Nacional para la Conservacion de la Naturaleza (ANCON) has been actively involved in conservation of the park in conjunction with INRENARE, the World Wildlife Fund, and other conservation entities. In 1995, a biodiversity conservation project was initiated. The project's goal was to involve local communities in conservation and sustainable use activities, and was funded by the United Nations Environment Programme (UNEP) and the Global Environment Facility. The Nature Conservancy (TNC) is also active in conservation efforts in this area through its Parks in Peril program (TNC 2011, pp. 1-2).

Panama has also initiated reforestation efforts. For example, beginning in the 1960s, Panama began to plant Pinus caribaea (pine species) in degraded areas of the Cordillera of the central region. Additionally, in 1992, a law was passed to provide incentives for the establishment of plantations; however, these were mainly exotic species (Parker et al. 2004, p. III-6). Panama is now implementing reforestation and timber production projects that focus on native species. This initiative is known as the "Native Species Reforestation Project" (Proyecto de Reforestacion con Especies Nativas; PRORENA) (Schmidt 2009, p. 10). Forestry managers have realized that, in some cases, native species are better adapted and perform better than introduced species. Since 2001, the

joint Native Species Reforestation Project between the Smithsonian Tropical Research Institute and the Yale School of Forestry has conducted ongoing research on trees native to Panama. The almendro tree, which is vital to the great green macaw's habitat, has been the subject of research projects in Panama because of its high commercial value (Schmidt 2009, p. 17). Despite efforts to reduce deforestation activities, management problems remain. A study conducted in 2004 suggested that the Forestry Department needs increased autonomy, funding, and staff, and a more appropriate mandate (Parker et al. 2004, pp. 10-11). The study suggested that strengthening the Parks and Wildlife Service through increased staffing and resources would enable them to protect and manage protected areas (Parker et al. 2004, pp. 10-11).

In summary, Panama has a suite of environmental laws in place, and conservation measures are being implemented by the government in collaboration with some NGOs. However, there is very little information available about the great green macaw in Panama (Monge et al. 2009, p. 68), and the information indicates that this species continues to face pressures to its habitat. Despite Panama's participation in conservation initiatives and Panama's regulatory mechanisms in place, there are still significant pressures for resources in the great green macaw's habitat.

International Wildlife Trade (CITES)

The CITES Treaty requires Parties to have adequate legislation in place for its implementation. A complete discussion on CITES is found under Factor D for the military macaw. Within the recent past (since 2000), 261 live great green macaws were reported to have been imported by CITES reporting countries, and none of these live specimens were reported as wild origin (UNEP-WCMC CITES Trade Database, accessed December 8, 2011). Under CITES Resolution Conference 8.4 (revised at CoP15), and related decisions of the Conference of the Parties, the National Legislation Project evaluates whether Parties have adequate domestic legislation to successfully implement the Treaty (CITES 2011a). In reviewing a country's national legislation, the CITES Secretariat evaluates factors such as whether or not a Party:

* Has domestic laws that prohibit trade contrary to the requirements of the Convention;
* Has penalty provisions in place for illegal trade, and has designated the responsible Scientific and Management Authorities; and
* Provides for seizure of specimens that are illegally traded or possessed.

The CITES Secretariat determined that the legislations of Colombia, Costa Rica, Honduras, Nicaragua, and Panama are sufficient to properly implement the Treaty (http://www.cites.org, SC58 Doc. 18 Annex 1, p. 1). These governments were determined to be in Category 1, which means they meet all the requirements to implement CITES. Ecuador was determined to be in Category 2, with a draft plan, but not enacted (http://www.cites.org, SC59 Document 11, Annex p. 1, accessed December 16, 2011). This means the CITES Secretariat determined that the legislation of Ecuador meets some, but not all, of the requirements for implementing CITES. Based on the limited amount of reported international trade for this species, particularly in wild-caught specimens, the range countries, including Ecuador, have effectively controlled legal international trade of this species. Therefore, we find CITES is an adequate regulatory mechanism.

Summary of Factor D

In the range countries for this species, we recognize that conservation activities are occurring, and each country has enacted laws with the intent of protecting its species and habitat. For example, in 2002, the San Juan-La Selva Biological Corridor, an area of 60,000 ha (148,263 ac), was implemented to protect the nesting places and migration flyway of the great green macaw in Costa Rica, as far as the Nicaragua border, where very little is known about the species. However, most of the suitable habitat is restricted to protected areas in clustered locations. Oliveira et al. found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (Oliveira et al. 2007, p. 1,235). Despite regulatory mechanisms established by this species' range countries and despite the species' existence in areas designated as protected, this species has experienced threats such that its populations are now so small that any pressure

has a more significant effect. Parks, without management, are often insufficient to adequately protect the species. The information available with respect to the species' population numbers is extremely limited in its range countries, and the populations of this species in these countries all likely range from a few individuals to a few hundred individuals (Botero-Delgadillo and Paez 2011, p. 91; Monge et al. 2010, p. 22; Monge et al. 2009). The populations are all in relatively disconnected areas. Its suitable habitat has been severely constricted due to deforestation. In all of the range countries, there is clear evidence of threats to this species due to activities such as habitat destruction and degradation, and poaching, and there is decreased viability due to small population sizes, despite the laws and regulatory mechanisms in place. Given that the species' habitat continues to be fragmented and degraded, it is unlikely that any conservation measures are adequately mitigating the factors currently acting on the species.

Based on the best available information, despite protections in place by the respective governments, we find that the existing regulatory mechanisms are either inadequate or inadequately enforced to protect the species or to mitigate ongoing habitat loss and degradation, poaching, and severe population declines. Habitat conservation measures within these range countries do not appear to be sufficient to adequately mitigate future habitat losses. This is due to a suite of factors, such as high rates of poverty in the range of the great green macaw and subsequent pressures for resources, and conflicting management goals (such as economic development and protection of its resources) of its range countries. Therefore, we find that the existing regulatory mechanisms are inadequate to mitigate the current threats to the continued existence of the great green macaw throughout its range.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Small Population Size and Stochastic Events

There have been few quantitative studies of great green macaw populations (Botero-Delgadillo and Paez 2011, p. 91; Monge et al. 2010, p. 12; Monge et al. 2009.). In 2009, the combined estimate for Costa Rica and Nicaragua was 871 individuals (Monge et al. 2010, p. 21), and the estimate for Ecuador was fewer than 100 (Horstman 2011, p. 17). There are no current population estimates for Panama, Honduras, and Colombia, but the global population is believed to be fewer than 3,700 individuals (Monge et al. 2009, pp. 68, 79, 213). Small, declining populations can be especially vulnerable to environmental disturbances such as habitat loss (Harris and Pimm 2008, pp. 163-164; O'Grady 2004, pp. 513-514; Brooks et al. 1999, pp. 1,146-1,147). In Costa Rica, the great green macaw has been eliminated from approximately 90 percent of its former range, and one estimate indicated that there were only 275 birds remaining in 2010 (Chassot 2010 pers. comm. in Hardman 2010, p. 11). Isolated populations are more likely to decline than those that are not isolated (Davies et al. 2000, p. 1456), as evidenced by the Ecuadorian population. Additionally, the great green macaw's restricted range, combined with its small population size and low prospect for dispersal (Chosset et al. 2004, p. 32), makes the species particularly vulnerable to the threat of any adverse natural (e.g., genetic, demographic, or stochastic) and manmade (e.g., habitat alteration and destruction) events that could destroy individuals and their habitats. The government of Costa Rica, in cooperation with Zoo Ave Wildlife Conservation Park, located in Garita de Alajuela, has participated in a captive bird breeding program (Herrero 2006, pp. 2-3) since 1994. Some of the birds produced have been released in protected areas. However, captive breeding is a controversial issue, mainly due to the reintroduction of individuals. One of the concerns is that the reintroduced birds introduce infectious diseases (which may be in dormant phase for a period of time) into the wild (Brightsmith et al. 2006 in Herrero 2006, pp. 2-3).

There are multiple features of this species' biology and life history that affect its ability to respond to habitat loss and alteration, as well as to stochastic environmental events. Due to its current restricted distribution and habitat requirements, stochastic events could further isolate individuals. An example of a stochastic event impacting the species occurred in 2010, and the death of several nestlings was recorded (Chosset and Arias 2010, p. 15). One nestling fell out of a tree, and, in another case, a branch fell on a nestling while it was actually in the nest

and it died (Chosset and Arias 2010, p. 15). Losses such as these can have a significant effect on the population. Additionally, limited available suitable habitat makes it difficult for the species to recolonize isolated habitat patches, which presently exist in a highly fragmented state. This, in combination with the species' nutritional needs, results in the species requiring large home ranges.

Border Conflict

One of the difficulties in the conservation of this species that may not be readily apparent is border conflict. For example, at the border of Nicaragua and Costa Rica, despite cooperation efforts; conflict continues (U.S. Department of State 2012, unpaginated; Berrios 2004, entire). The Nicaraguan-Costa Rican border is one of the most conflict-heavy frontiers in Central America (Lopez and Jimenez 2007, p. 21). Migration issues, navigation rights in border rivers, border delineation, and cultural differences all affect these countries' relations (Lopez and Jimenez 2007, p. 21). Additionally, this area has historically experienced exploitation of its natural resources. Since the beginning of last century, foreign companies have engaged in logging, rubber extraction, and mining (Lopez and Jimenez 2007, pp. 24-25). After these resources were depleted and these activities were no longer profitable, some companies left, leaving behind harmful environmental impacts (Lopez and Jimenez 2007, pp. 24-25). These activities have resulted in polluted rivers, high levels of sedimentation in coastal lagoons, and deforested areas (Lopez and Jimenez 2007, pp. 24-25). These activities all subsequently affect the habitat of the great green macaw.

Deforestation in Nicaragua has a complex history. After a civil war throughout the 1980s, land tenure policies inadvertently encouraged farming techniques that led to deforestation, soil erosion, and general land degradation (Sinreich 2009, p. 11). Later, during the 1990s, COHDEFOR opened up timber extraction opportunities to local community organizations, mainly cooperatives, to help mitigate the economic situation for local people. Licenses allowed the use of fallen wood and timber extraction for sale at local markets. However, a study conducted between 1998 and 2000 found that local groups had extracted an enormous amount of timber and there was no monitoring (Colindres and Rubi 2002). During the period of 1994-1999, although the government offered support to communities in its border regions, tensions continue to affect the Bosawas region of Nicaragua, one of the areas believed to contain a great green macaw population (Lopez and Jimenez 2007, p. 26). Land rights disputes continue to occur in Bosawas, and land use rights are often unclear. Although the government of Nicaragua is attempting to manage these issues (Pellegrini 2011, pp. 21), conflict and practices that degrade the great green macaw's habitat persist both in the Bosawas Reserve and the Indio-Maiz Biological Reserve.

Climate Change

Our analysis under the ESA includes consideration of ongoing and projected changes in climate (see discussion under the military macaw). The 2008 workshop in Costa Rica addressed environmental disasters in the evaluation and assessment of the great green macaw, although climate change was not specifically addressed. Researchers described environmental disasters as events that occur infrequently but that can drastically affect reproduction or survival. Monge et al. reported that in Costa Rica, the number of active nests in 2000 was well below the average of other years. The researchers linked this with the strong El Nino event that occurred during 1997-1998 (Monge et al. 2009, p. 149). The researchers stated that in the last 50 years there were two major El Nino events, and, therefore, one would expect that in 100 years there would be four events of this nature, which could subsequently reduce reproduction by 30 percent (Monge et al. 2009, p. 149). However, this correlation between the low number of active nests and the El Nino event is not strongly supported, nor do we have supporting evidence that this is directly related to climate change. We are not aware of any information that indicates that climate change threatens the continued existence of the great green macaw.

Summary of Factor E

A species may be affected by more than one threat. Impacts typically operate synergistically, and are particularly evident when small populations of a species are decreasing. Initial effects of one threat factor can

exacerbate the effects of other threat factors (Laurance and Useche 2009, p. 1432; Gilpin and Soule 1986, pp. 25-26). Further fragmentation of populations can decrease the fitness and reproductive potential of the species, which can exacerbate other threats. Lack of a sufficient number of individuals in a local area or a decline in their individual or collective fitness may cause a decline in the population size, even with suitable habitat patches. Within the preceding review of the five factors, we have identified multiple threats that have interrelated impacts on this species. Thus, the species' productivity may be reduced because of any of these threats, either singularly or in combination. These threats occur at a sufficient scale such that they are affecting the status of the species now and in the future.

This species' current range is highly restricted and severely fragmented. Each breeding pair requires a large home range to meet its nutritional requirements; it is a large macaw, and its sources of food are becoming scarcer and farther apart, which requires more energy consumption to locate. The susceptibility to extirpation of limited-range species can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too fragmented such that it may no longer be demographically or genetically viable. The species' small and declining population size, reproductive and life-history traits, and highly restricted and severely fragmented range together increase the species' vulnerability to any other stressors. Based on the above evaluation, we conclude that the effects of isolation and its small, declining population size, combined with the threats of continued fragmentation and isolation of suitable forest habitats, pose a threat to the great green macaw.

Finding and Status Determination for the Great Green Macaw

Although precise quantitative estimates are not available, the best available information suggests that populations of great green macaws have substantially declined, and this species likely persists at greatly reduced numbers relative to its historical abundance. The factors that threaten the survival of the great green macaw are: (1) Habitat destruction, fragmentation, and degradation; (2) poaching; (3) inadequacy of regulatory mechanisms to reduce the threats to the species; and (4) small population size and isolation of remaining populations.

The direct loss of habitat through widespread deforestation and conversion of primary forests to human settlement and agricultural uses has led to the fragmentation of habitat throughout the range of the great green macaw and isolation of the remaining populations. The species has been locally extirpated in many areas and has experienced a significant reduction of suitable habitat. The current suitable habitat in Costa Rica is now less than 10 percent of its original suitable habitat (Chosset et al. 2004, p. 38). This species exists generally in small and fragmented populations, and in many cases, the population is so small that intense monitoring and management of the population is underway. The San Juan-La Selva Biological Corridor was established to connect forest patches and join 20 protected areas (Chosset and Arias 2010, p. 5) specifically to preserve habitat for this species.

We have very little information about the species in many parts of its range (Botero-Delgadillo and Paez 2011, p. 91; Monge et al. 2009, p. 68). In 2008, experts from this species' range countries attended a conference to evaluate the viability of its populations and its habitat (Monge et al. 2009, entire). In general, they concluded that populations are viable but they still face threats. The workshop also addressed goals for the conservation of the species; in some parts of its range, conservation efforts are intensive. Based on our review of the best available scientific and commercial information pertaining to the five factors, the threats to the species are generally consistent throughout its range. In many of the range countries, its populations are very small, and specific information about the status of the species is not available in all countries. However, habitat loss and degradation is prevalent throughout this species' range; its suitable habitat has severely contracted, and habitat loss is likely to continue into the future due to pressures for resources. Poaching is known to occur within many parts, if not all parts, of its range. Despite conservation awareness programs, poverty is prevalent within the range of the species, and the species is quite valuable commercially, so poaching continues to occur. We do

not find that the effects of current threats acting on the species are being ameliorated by regulatory mechanisms . Therefore, we find that listing the great green macaw as endangered is warranted throughout its range, and we propose to list the great green macaw as endangered under the ESA.

Peer Review

In accordance with our joint policy with the National Marine Fisheries Service, "Notice of Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities," published in the Federal Register on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate independent specialists regarding this proposed rule. The purpose of peer review is to ensure that our final determination is based on scientifically sound data, assumptions, and analyses. We will send copies of this proposed rule to the peer reviewers immediately following publication in the Federal Register . We will invite these peer reviewers to comment during the public comment period on our specific assumptions and conclusions regarding the proposal to list the military macaw and the great green macaw.

We will consider all comments and information we receive during the comment period on this proposed rule during our preparation of a final determination. Accordingly, our final decision may differ from this proposal.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the ESA include recognition, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness, and encourages and results in conservation actions by Federal and State governments, private agencies and interest groups, and individuals.

The ESA and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife. These prohibitions, at 50 CFR 17.21 and 17.31, in part, make it illegal for any person subject to the jurisdiction of the United States to "take" (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt any of these) within the United States or upon the high seas; import or export; deliver, receive, carry, transport, or ship in interstate commerce in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce any endangered wildlife species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken in violation of the ESA. Certain exceptions apply to agents of the Service and State conservation agencies.

Permits may be issued to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits for endangered species are codified at 50 CFR 17.22. With regard to endangered wildlife, a permit may be issued for the following purposes: For scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities. For threatened species, a permit may be issued for the same activities, as well as zoological exhibition, education, and special purposes consistent with the ESA.

National Environmental Policy Act (NEPA)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), need not be prepared in connection with regulations adopted under section 4(a) of the ESA. We published a notice outlining our reasons for this determination in the Federal Register on October 25, 1983 (48 FR 49244).

Paperwork Reduction Act

This proposed rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). This rule would not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Clarity of the Rule

We are required by Executive Orders 12866 and 12988, and by the Presidential Memorandum of June 1, 1998,

to write all rules in plain language. This means that each rule we publish must:
(a) Be logically organized;
(b) Use the active voice to address readers directly;
(c) Use clear language rather than jargon;
(d) Be divided into short sections and sentences; and
(e) Use lists and tables wherever possible.
If you feel that we have not met these requirements, send us comments by one of the methods listed in the ADDRESSES section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, or the sections where you feel lists or tables would be useful.
References Cited
A complete list of all references cited in this proposed rule is available on the Internet at http://www.regulations.gov or upon request from the Branch of Foreign Species, Endangered Species Program, U.S. Fish and Wildlife Service (see FOR FURTHER INFORMATION CONTACT).
Authors
The primary authors of this proposed rule are Amy Brisendine and Janine Van Norman, Branch of Foreign Species, Endangered Species Program, U.S. Fish and Wildlife Service.
List of Subjects in 50 CFR Part 17
Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.
Proposed Regulation Promulgation
Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:
PART 17--[AMENDED]
1. The authority citation for part 17 continues to read as follows:
Authority: 16 U.S.C. 1361-1407; 16 U.S.C. 1531-1544; 16 U.S.C. 4201-4245; Public Law 99-625, 100 Stat. 3500; unless otherwise noted.
2. Amend SEC 17.11(h) by adding new entries for "Macaw, great green" and "Macaw, military" in alphabetical order under BIRDS to the List of Endangered and Threatened Wildlife to read as follows:
SEC 17.11 Endangered and threatened wildlife.
* * * * *
(h) * * *

_____Species
Common_____Scientific__Historic___Vertebrate__Status_When___Critical_Special
name_____name_____range_____population_____listed_habitat__rules
_____where
_____endangered
_____or
_____threatened
_____* * * * * * *
_____Birds

_____* * * * * * *
Macaw,_____Ara_____Costa_____Entire_____E_____797____NA_____NA
great_____ambiguus____Rica,
green_____Honduras,
_____Nicaragua,
_____and_Panama
_____* * * * * * *
Macaw,_____Ara_____Argentina,_Entire_____E_____797____NA_____NA
military___militaris___Bolivia,
_____Colombia,
_____Ecuador,
_____Mexico,
_____Peru,
_____Venezuela

* * * * *

Dated: May 14, 2012.
Rowan W. Gould,
Director, U.S. Fish and Wildlife Service.
[FR Doc. 2012-16492 Filed 7-5-12; 8:45 am]
BILLING CODE 4310-55-P

Publication date: Jul 6, 2012

Year: 2012

Assessment of cochlear and auditory pathways in patients with migraine

Author: Hamed, Sherifa Ahmad; Youssef, Ahmed Hamdy; Elattar, Amal Mohammad

Publication info: American Journal of Otolaryngology 33.4 (2012): 385-94.
ProQuest document link

Abstract: In this study, we aimed to determine the function of the cochlea and peripheral and central auditory pathways with migraine.
Fifty-eight patients with migraine and 40 healthy subjects were assessed using routine diagnostic audiometry along with transient evoked otoacoustic emissions (TOAEs), distortion product otoacoustic emissions (DPOAEs), and auditory brainstem response (ABR) at high and low repetition rate frequencies.
Nearly two thirds of patients with migraine had one or more abnormalities in electrophysiological testing. Compared with control subjects, patients reported significant lowering of TOAEs amplitude at frequencies of 1 kHz (right: $P = .0003$; left: $P = .002$), 3 kHz (right: $P = .025$), and 4 kHz (right: $P = .019$); prolonged wave III

latency (right: *P* = .009); and I-V interpeak latency (IPL) (left: *P* = .024) at high repetition rate frequencies. Significant correlations were identified between age, duration of illness and frequency of migraine and TOAEs total response and at amplitude of 4 kHz, amplitudes of DPOAEs at 1, 1.5, 2, 3, and 5 kHz and I, III and wave latencies and I-V IPL of ABR at high rate frequencies.

These data suggest that subclinical changes in cochlear function and auditory pathways are associated with chronic migraine. It is possible that migraine could be accompanied by compromise of blood supply of auditory system.

Demographic and clinical characteristics	Patients (n = 58)
Male/female	7/51
Positive family history of migraine	9 (15.52%)
Age, years	20-45 (31.60 ±9.17)
Duration of illness, years	1-20 (8.33 ±4.47)
Type of migraine (MoA)	Common migraine (MA)
46 (79.3%)	Typical migraine
12 (20.7%)	Attacks frequency (number per month)
Low frequency (<4/mo)	30 (51.72%)
High frequency (≥4/mo)	28 (48.28%)
Auditory symptoms	Tinnitus
8 (13.79%)	Phonophobia
12 (20.69%)	Basic audiological evaluation (no. of patients with abnormalities)
PTA	Right ear
7 (12.1%)	Left ear
5 (8.6%)	Tympanometry
Right ear	2 (3.45%)
Left ear	2 (3.45%)
Acoustic reflex	Right ear
8 (13.80%)	Left ear
6 (10.3%)	Speech audiometry (range, mean ±SD)
Right ear	92.00-100.00 (99.52 ±1.85)

Left ear	92.00-100.00 (99.66 ±1.55)

Table 1 - Demographic and clinical characteristics of the studied groups

Electrophysiological variable	Right ear (n = 58)	Left ear (n = 58)
TEAOEs	Overall echo level, kHz	11 (19%)
7 (12.1%)	1.0	28 (48.3%)
32 (55.2%)	1.5	24 (41.4%)
15 (25.9%)	2.0	24 (41.4%)
17 (29.3%)	3.0	30 (51.7%)
26 (44.8%)	4.0	36 (62.1%)
24 (41.4%)	*DPAOEs, kHz*	1.0
13 (22.4%)	26 (44.8%)	1.5
14 (24.1%)	6 (10.3%)	2.0
10 (17.2%)	7 (12.1%)	3.0
9 (15.5%)	5 (8.6%)	4.0
19 (19.3%)	12 (20.7%)	5.0
7 (12.1%)	4 (6.9%)	6.0
8 (13.8%)	11 (19%)	*ABR at 90 dB HL and low repetition rate frequencies (ms)*
Wave 1	9 (15.5%)	10 (17.2%)
Wave III	4 (6.9%)	10 (17.2%)
Wave V	6 (10.3%)	2 (3.4%)
I-III IPL	6 (10.3%)	8 (13.8%)
III-V IPL	15 (25.9%)	1 (1.7%)
I-V IPL	16 (27.6%)	0
ABR at 90 dB HL and high repetition rate frequencies (ms)	Wave 1	11 (19%)
38 (65.5%)	Wave III	15 (25.9%)
13 (22.4%)	Wave V	10 (17.2%)
5 (8.6%)	I-III IPL	32 (55.2%)
5 (8.6%)	III-V IPL	12 (20.7%)
7 (12.1%)	I-V IPL	9 (15.5%)

Table 2 - The number of patients with abnormal OAEs and ABR results

Frequency (kHz)]	Patients (n = 58)	Controls (n = 40)	MoA	MA	*P* value	*P* value	*P* value	Right	Left	Right	Left
Right	Left	Right	Left	Overall echo level (range)	0.00-18.00	0.00-20.00	1.40-19.80	0.00-20.00	0.00-18.10	0.00-20.60	3.90-14.60
6.30-20.00	*P* 1a = .341	*P* 2a = .228	*P* 4a = .884	Mean	11.36	13.25	10.46	12.20	11.34	13.15	11.45
13.59	*P* 1b = .246	*P* 2b = .350	*P* 4b = .770	25th percentile	9.30	11.20	7.80	9.20	9.00	11.20	9.30
12.20	50th percentile	12.60	13.80	10.46	13.40	12.40	13.60	13.50	14.00	*P* 3a = .291	75th percentile
14.38	15.63	13.35	14.90	14.70	15.70	14.30	15.50	*P* 3b = .425	1.0 (range)	-4.00-21.00	-3.00-18.00
-5.00-25.00	-1.00-24.00	-4.00-21.00	-1.00-18.00	-3.00-13.00	-3.00-13.00	*P* 1a = .003	*P* 2a = .040	*P* 4a = .039	Mean	7.00	6.57
10.95	10.73	7.97	7.26	3.55	4.18	*P* 1b = .002	*P* 2b = .029	*P* 4b = .149	25th percentile	1.75	2.00
8.00	6.00	3.00	2.00	0.00	0.00	50th percentile	7.50	6.00	10.00	11.00	9.00
6.00	2.00	4.00	*P* 3a = .001	75th percentile	11.25	11.00	14.50	14.50	13.00	13.00	8.00
7.00	*P* 3b = .004	1.5 (range)	-3.00-22.00	-2.00-23.00	2.00-22.00	0.00-25.00	-3.00-22.00	-2.00-23.00	2.00-21.00	4.00-18.00	*P* 1a = .304
P 2a = .446	*P* 4a = .500	Mean	12.08	11.64	13.27	11.92	12.27	12.03	11.63	10.27	*P* 1b = .827
P 2b = .735	*P* 4b = .217	25th percentile	9.00	8.75	10.00	7.00	8.00	9.00	10.00	7.00	50th percentile

12.00	12.00	13.00	12.00	13.00	12.00	11.00	10.00	*P* 3a = .150	75th percentile	16.75	15.00
17.00	18.00	17.00	15.00	12.00	13.00	*P* 3b = .554	2.0 (range)	-5.00-24.00	-2.00-26.00	0.00-27.00	0.00-24.00
-5.00-24.00	-2.00-26.00	-1.00-22.00	2.00-18.88	*P* 1a = .206	*P* 2a = .574	*P* 4a = .318	Mean	11.54	11.62	13.22	11.84
12.90	11.82	10.18	10.91	*P* 1b = .864	*P* 2b = .880	*P* 4b = .557	25th percentile	8.00	7.75	11.00	6.50
8.00	7.00	7.00	8.00	50th percentile	12.00	12.00	13.00	13.00	13.00	13.00	10.00
12.00	*P* 3a = .099	75th percentile	16.00	15.25	16.00	16.00	16.50	16.00	15.00	13.00	*P* 3b = .597
3.0 (range)	0.00-24.00	-3.00-21.00	-2.00-24.00	-1.00-20.00	0.00-24.00	-2.00-21.00	0.00-21.00	-3.00-10.00	*P* 1a = .025	*P* 2a = .057	*P* 4a = .566
Mean	9.47	7.42	12.59	9.27	9.83	7.79	8.18	6.09	*P* 1b = .150	*P* 2b = .268	*P* 4b = .453
25th percentile	4.00	2.75	8.50	4.00	4.00	2.00	2.00	5.00	50th percentile	9.00	12.00
13.00	9.00	9.00	8.00	8.00	7.00	*P* 3a = .032	75th percentile	15.00	15.25	16.50	13.50
15.00	12.00	12.00	10.00	*P* 3b = .173	4.0 (range)	-4.00-23.00	-4.00-21.00	0.00-24.00	-3.00-18.00	-2.00-23.00	-4.00-21.00
-4.00-14.00	-4.00-15.00	*P* 1a = .019	*P* 2a = .035	*P* 4a = .291	Mean	7.45	6.46	10.73	7.59	8.08	7.26
5.18	3.64	*P* 1b = .410	*P* 2b = .787	*P* 4b = .110	25th percentile	2.00	0.75	8.00	3.00	2.25	2.00
2.00	-1.00	50th percentile	6.00	6.50	11.00	8.00	7.00	8.00	6.00	2.00	*P* 3a = .005

Table 3 - Results of TEOAEs echo level (amplitude changes in dB SPL)
Significance: *P* 1a, b: right and left for patients vs controls; *P* 2a, b: right and left for MoA vs controls; *P* 3a, b: right and left for MA vs controls; *P* 4a, b: right and left for MoA vs MA.

Frequency (kHz)	Patients (n = 58)	Controls (n = 40)	MoA	MA	*P* value	*P* value	*P* value	Right	Left	Right	Left
Right	Left	Right	Left	1.0	1.60-39.42	3.60-38.60	0.30-34.10	7.20-35.70	1.60-39.42	3.60-38.60	16.50-38.50
11.20-34.80	*P* 1a = .156	*P* 2a = .512	*P* 4a = .011	21.31±10.90	21.64±9.14	18.30±7.27	20.17±8.28	19.78±11.14	21.03±9.19	27.73±7.14	24.40±8.90
P 1b = .487	*P* 2b = .699	*P* 4b = .327	*P* 3a = .003	*P* 3b = .234	1.5	1.10-44.80	0.20-41.10	10.00-37.70	6.50-42.50	1.70-44.80	0.20-40.10
1.10-40.10	17.10-41.10	*P* 1b = .640	*P* 2b = .963	*P* 4b = .271	28.08±11.77	26.45±9.77	27.04±7.38	24.63±11.52	27.15±11.67	25.37±9.96	31.97±11.98
31.23±7.58	*P* 1b = .503	*P* 2b = .792	*P* 4b = .068	*P* 3a = .249	*P* 3b = .067	2.0	6.80-43.80	7.70-42.30	10.20-36.20	8.00-35.70	6.80-43.30
7.70-42.30	21.00-34.80	15.90-40.80	*P* 1a = .282	*P* 2a = .771	*P* 4a = .010	29.49±10.41	29.58±8.45	27.40±6.37	27.55±7.20	28.01±10.63	28.87±8.54
35.70±6.84	32.69±7.69	*P* 1b = .286	*P* 2b = .506	*P* 4b = .211	*P* 3a = .005	*P* 3b = .103	3.0	4.90-49.50	14.60-44.70	15.30-39.40	13.40-40.20
4.90-49.50	14.60-44.70	33.70-48.70	29.70-42.00	*P* 1a = .425	*P* 2b = .934	*P* 4a = .0001	33.18±10.26	33.07±8.40	31.57±7.00	30.19±7.87	31.40±10.46
32.38±8.96	40.65±4.58	36.16±4.29	*P* 1b = .152	*P* 2b = .307	*P* 4b = .071	*P* 3a = .0001	*P* 3b = .009	4.0	11.00-47.00	3.10-46.70	9.50-43.80
14.30-47.40	11.00-47.00	3.10-46.70	32.30-41.50	25.00-45.70	*P* 1a = .621	*P* 2a = .344	*P* 4a = .003	33.25±9.25	32.11±9.67	34.40±8.33	35.25±10.00
32.15±9.87	31.32±10.12	37.90±3.29	35.63±6.68	*P* 1b = .203	*P* 2b = .131	*P* 1b = .134	*P* 3a = .076	*P* 3b = .900	5.0	1.40-49.90	5.90-44.10
-3.10-42.30	-5.40-50.80	1.40-49.9	5.90-44.10	27.90-44.20	12.60-39.10	*P* 1a = .160	*P* 2b = .429	*P* 4a = .004	28.94±11.75	30.22±8.96	25.05±10.93
27.41±13.51	27.36±12.28	30.28±8.87	35.59±5.88	29.97±9.91	*P* 1b = .535	*P* 2b = .352	*P* 4b = .932	*P* 3a = .001	*P* 3b = .556	6.0	-3.70-47.80
-1.60-44.00	-13.70-40.10	-3.50-43.60	-3.70-47.80	-1.60-44.00	1.40-37.90	3.00-36.10	*P* 1a = .647	*P* 2b = .941	*P* 4a = .040	23.25±11.61	20.81±12.75

Table 4 - Results of DPOAEs (amplitude changes in dB SPL)
Significance: *P* 1a, b: right and left for patients vs controls; *P* 2a, b: right and left for MoA vs controls; *P* 3a, b: right and left for MA vs controls; *P* 4a, b: right and left for MoA vs MA. Data are expressed as range and mean±SD.

Frequency (kHz)	Patients (n = 58)	Controls (n = 40)	MoA	MA	*P* value	*P* value	*P* value	Right	Left	Right	Left
Right	Left	Right	Left	*ABR at 90 dB HL and low repetition rate frequencies (ms)*	Wave 1	1.44 - 2.00	1.28 - 2.12	1.40 - 1.96	1.40 - 1.88	1.44 - 1.92	1.28 - 2.12
1.48-2.00	1.48-2.00	*P* 1a = .713	*P* 2a = .559	*P* 4a = .249	1.67 ±0.13	1.66 ±0.17	1.69 ±0.19	1.65 ±0.16	1.66 ±0.12	1.66 ±0.16	1.73 ±0.16
1.67 ±0.20	*P* 1b = .877	*P* 2b = .928	*P* 4b = .795	*P* 3a = .694	*P* 3b = .777	Wave III	3.28 - 4.40	3.04 - 4.16	3.48 - 4.60	3.52 - 4.00	3.28 - 4.40
3.24-4.16	3.52-3.96	3.04-3.88	*P* 1a = .266	*P* 2a = .308	*P* 4a = .453	3.71 ±0.20	3.66 ±0.20	3.81 ±0.30	3.74 ±0.15	3.72 ±0.21	3.67 ±0.19
3.68 ±0.13	3.60 ±0.25	*P* 1b = .093	*P* 2b = .153	*P* 4b = .439	*P* 3a = .173	*P* 3b = .127	Wave V	2.76 - 6.20	4.96 - 6.24	5.12 - 6.04	5.12 - 6.80
4.48-6.20	4.96-6.24	2.76-5.88	5.28 - 5.92	*P* 1a = .934	*P* 2a = .708	*P* 4a = .400	5.47 ±0.46	5.58 ±0.26	5.48 ±0.30	5.65 ±0.43	5.52 ±0.28
5.58 ±0.28	5.29 ±0.85	5.55 ±0.19	*P* 1b = .730	*P* 2b = .772	*P* 4b = .639	*P* 3a = .493	*P* 3b = .603	I-III IPL	1.56 - 2.52	1.60 - 2.46	1.30 - 2.48
1.46-2.36	1.56-2.52	1.64-2.46	1.65 - 2.36	1.60 - 2.32	*P* 1a = .438	*P* 2a = .347	*P* 4a = .217	2.02 ±0.21	1.99 ±0.20	1.94 ±0.35	1.99 ±0.29

2.04 ±0.20	1.99 ±0.26	1.95 ±0.22	2.01 ±0.26	*P* 1b = .974	*P* 2b = .986	*P* 4b = .783	*P* 3a = .941	*P* 3b = .849	III-V IP	0.56 - 2.48	1.28 - 3.04
1.44-2.16	1.48-3.72	0.56-2.48	1.28 - 3.04	1.44 - 2.08	1.64 - 2.20	*P* 1a = .435	*P* 2a = .561	*P* 4a = .374	1.80 ±0.27	1.93 ±0.25	1.74 ±0.24
1.96 ±0.57	1.79 ±0.28	1.94 ±0.26	1.86 ±0.23	1.88 ±0.17	*P* 1b = .846	*P* 2b = .896	*P* 4b = .408	*P* 3a = .228	*P* 3b = .665	I-V IPL	2.20 - 4.63
3.36-4.44	3.16-4.32	3.27-5.40	2.20 - 4.63	3.36 - 4.36	3.36 - 4.32	3.56 - 4.44	*P* 1a = .454	*P* 2a = .477	*P* 4a = .901	3.82 ±0.34	3.89 ±0.25
3.73 ±0.39	3.97 ±0.54	3.82 ±0.36	3.89 ±0.25	3.83 ±0.25	3.90 ±0.26	*P* 1b = .630	*P* 2b = .617	*P* 4b = .841	*P* 3a = .458	*P* 3b = .716	*ABR at 90 dB HL and high repetition rate frequencies (ms)*
Wave 1	1.40-4.00	1.28-2.40	1.60 - 1.96	1.52 - 1.92	1.40 - 4.00	1.28 - 2.20	1.44 - 2.08	1.50 - 2.40	*P* 1a = .655	*P* 2a = .631	*P* 4a = .696
1.82 ±0.37	1.85 ±0.20	1.79 ±0.14	1.72 ±0.14	1.82 ±0.41	1.78 ±0.19	1.79 ±0.18	1.82 ±0.24	*P* 1b = .180	*P* 2b = .250	*P* 4b = .564	*P* 3a = .959
P 3b = .213	Wave III	0.12-4.60	3.28 - 4.42	3.64 - 4.24	3.64 - 4.12	0.12 - 4.60	3.28 - 4.24	3.38 - 4.12	3.30 - 4.16	*P* 1a = .009	*P* 2a = .013
P 4a = .141	3.59 ±0.87	3.85 ±0.20	3.94 ±0.20	3.88 ±0.13	3.54 ±0.96	3.86 ±0.19	3.78 ±0.23	3.83 ±0.25	*P* 1b = .531	*P* 2b = .618	*P* 4b = .734
P 3a = .103	*P* 3b = .548	Wave V	3.56 - 6.44	5.06 - 6.60	5.52 - 6.34	5.52 - 6.96	3.56 - 6.44	5.06 - 6.60	5.44 - 6.16	5.57 - 6.04	*P* 1a = .074
P 2a = .074	*P* 4a = .410	5.72 ±0.48	5.82 ±0.28	5.90 ±0.26	5.94 ±0.39	5.70 ±0.53	5.82 ±0.30	5.79 ±0.23	5.79 ±0.16	*P* 1b = .306	*P* 2b = .338

P 4b = .661	*P* 3a = .275	*P* 3b = .241	I-III IPL	1.56 - 5.68	1.64 - 2.52	1.68 - 2.44	1.76 - 2.44	1.56 - 5.68	1.64 - 2.52	1.64 -2. 20	1.76 - 2.32
P 1a = .858	*P* 2a = .717	*P* 4a = .310	2.13 ±0.5 4	2.05 ±0.2 0	2.11 ±0.2 1	2.14 ±0.1 9	2.15 ±0.6 0	2.05 ±0.1 9	2.04 ±0.2 0	2.04 ±0.2 2	*P* 1b = .171
P 2b = .182	*P* 4b = .939	*P* 3a = .420	*P* 3b = .286	III-V IPL	1.20 - 2.32	0.08 - 2.48	1.80 - 2.24	1.80 - 2.28	1.20 - 2.00	0.80 - 2.48	3.72 - 4.32
1.68-2.16	*P* 1a = .354	*P* 2a = .352	*P* 4a = .312	1.94 ±0.2 0	1.92 ±0.3 4	1.97 ±0.1 4	1.98 ±0.1 5	2.62 ±0.5 3	1.91 ±0.3 8	1.96 ±0.1 7	1.93 ±0.1 4
P 1b = .340	*P* 2b = .366	*P* 4b = .766	*P* 3a = .829	*P* 3b = .469	I-V IPL	1.92 - 5.56	2.24 - 4.76	3.70 - 4.52	3.94 - 4.40	1.92 - 4.00	3.56 - 4.76
2.20-4.63	2.24-4.32	P1 = .448	*P* 2a = .430	*P* 4a = .365	3.95 ±0.5 2	3.98 ±0.3 5	4.08 ±0.2 3	4.14 ±0.1 5	4.64 ±0.6 2	4.03 ±0.2 6	3.99 ±0.2 0

Table 5 - Results of ABR at 90 dB HL and low and high repetition rate frequencies

Significance: *P* 1a, b: right and left for patients vs controls; *P* 2a, b: right and left for MoA vs controls; *P* 3a, b: right and left for MA vs controls; *P* 4a, b: right and left for MoA vs MA. Data are expressed as range and mean ±SD.

1

Introduction

Migraine is a common chronic presenting complaint with an estimated prevalence that ranges from 6% to 16% in the general population. It is more frequent in women, with a 1-year prevalence of 17.2% in women and 6% in men [1,2]. Heritability in migraine was estimated to be between 40% and 60% [3]. Migraine is characterized by recurrent episodes of moderate to severe headache that last for 4 to 72 hours, often unilateral, pulsating (throbbing), and associated with photophobia/phonophobia and/or nausea/vomiting. In migraine without aura (MoA), headache is commonly unilateral and pulsating, may be associated with nausea and vomiting, and lasts for 1 or several days, whereas in migraine with aura (MA), headache is preceded by transient focal neurological symptoms as photophobia and phonophobia [4].

Some cochleovestibular symptoms occur commonly in patients with migraine during headache attacks, and some patients exhibit these symptoms between attacks. These symptoms include light-headedness, giddy sensation, dizziness, imbalance, motion intolerance, spontaneous attacks of vertigo, nystagmus, photophobia, and tinnitus [5-7], whereas fluctuating hearing loss, sudden deafness, and permanent hearing loss occur in a small percentage of patients with migraine [5,8-10].

The possibility of auditory dysfunction with migraine is much understudied. Few small-sample-sized studies were done to explore the relationship between chronic migraine and auditory function. Some reported abnormalities in audiometry, auditory brainstem response (ABR), and caloric testing; but in general, results are few and controversial [7,11-14], and the pathophysiology of temporary and permanent auditory manifestations associated with migraine is still incompletely delineated. The flood of information from different studies is important to determine the exact pathologic spectrum of migraine and its long-term consequences.

1.1 Aim of work

The aim of this study was to objectively assess the functions of cochlea and peripheral and central auditory pathways in a group of patients with migraine using routine diagnostic audiometry along with evoked otoacoustic emissions [EOAEs, transient evoked otoacoustic emissions (TEOAEs) and distortion product otoacoustic emission (DPOAEs)] and ABR testing. Otoacoustic emissions are sensitive objective methods to assess cochlear function and monitor dynamic changes in cochlear responsiveness before functional and significant hearing loss occurs from any cause [15,16].

2 Patients and methods

2.1 Patients

This study included 58 adults with migraine and 40 healthy subjects matched for age, sex, socioeconomic status, and educational level as controls for comparison. Headache was classified according to the criteria of the International Headache Society (second edition) [4]. Patients were studied during the attack-free periods with at least 3 days since the last attack. Patients were recruited from the outpatient headache clinic of Assiut University Hospital, Assiut, Egypt. The protocol of the study was approved by the ethical committee of Assiut University, and subjects included gave informed consents before participation. Excluded were subjects with previous history of otological or labyrinthine disorders, systemic or metabolic diseases associated with hearing loss (eg, renal insufficiency, gout, diabetes mellitus, hypertension, hypercholesterolemia/dyslipidemia, hypothyroidism, or active gastrointestinal disease), reported exposure to unsafe noise, use of ototoxic drugs, family history of hearing loss, or clinical evidence of postural hypotension.

2.2 Methods

All patients and control subjects went through full neurological, medical, and audiological history and examination. The frequency of migraine attacks was monitored per month. Accordingly, patients were divided into 2 groups: (*a*) patients with high frequency attaches: those with at least 4/month and (*b*) patients with low frequency attacks: those with less than 4/month. All participants underwent basic audiological evaluation that included initial otoscopic examination, standard pure tone audiometry (PTA), speech audiometry, tympanometry, and acoustic reflex to exclude pathologic conditions of the external or middle ear. Speech audiometry was used to identify the hearing level (HL) at which subjects understood and repeated at least 90% of a set of 10 monosyllables. Immittance testing was done to determine middle ear function using the Amplaid Model 720 immittance bridge (Amplaid, Milan, Italy). Pure tone audiometric thresholds were measured from 0.25 to 8 kHz (0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 kHz), and pure average thresholds for the right and left ears were obtained (Model AC40, version 1.28; Interacoustics, Assens, Denmark). Hearing thresholds were determined in decibel (dB) HL. The examined ears were defined as normal if no absolute threshold level greater than 20 dB was measured over the whole frequency range. Threshold shifts in PTA were considered to be significant if they showed at least 10 dB change in more than 2 consecutive frequencies or if a threshold greater than 20 dB was observed in any audiometric range.

In the same session, TEOAEs and DPOAEs were recorded and analyzed. The TEOAEs were recorded using a commercially available system (ILO88, version 4.2; Otodynamic Ltd, Hatfield, UK). Applied stimuli were rectangular clicks with a duration of 80 microseconds presented at an overall rate of 50/s at a peak sound pressure level (SPL) of 82 dB (±2 dB) using the nonlinear mode. Starting 5 milliseconds after stimulation, 260 responses were amplified, filtered by band passing (0.5-6 kHz), and averaged within a time window of 20 seconds to generate a mean echo response. The noise rejection level was set at the default level of 45 dB SPL. The TEOAEs were considered present when stimulus stability was better than 80% with response reproducibility of more than 50%. The typical noise floor was -12 dB. TEOAEs' global and band response levels (1.0, 1.4, 2.0, 2.8, and 4.0 kHz) were compared between patients and controls. DPOAEs were recorded using computer-based ILO92 (version 1.2; Otodynamic Ltd). Two simultaneous pure tone signals (primaries) were presented to the ear at 2 different frequencies (f1 and f2, where f1 <f2), and 2f1-f2 cubic distortion-product

component was recorded. The 2 stimuli were mixed acoustically and delivered to a probe. The DPOAE amplitude as a function of f2 frequency at a fixed stimulus level (distortion product frequency profiles or DP-grams) was collected. DP-gram recordings were obtained with a frequency ratio f2/f1 fixed at 1.22. Nine pairs of equal level primary frequencies (L1 = L2 = 70 dB SPL) were used at 3 points per octave, spanning f2 frequency range from 1001 to 6006. The 70-dB level of the primary tones was used as this stimulus level most reliably elicits DPOAEs from ears with hearing difficulties. The primary levels of the 2 stimulus tones (f1 and f2) are related by the formula L1 = 39 dB + 0.4 ×L2 (up to an L2 of 70 dB SPL) [15,16]. The DP-gram amplitude across the entire frequency range was determined for each patient. The measurements were done in 2 points per octave from 1- to 6-kHz distortion product. Detection threshold was calculated 3 dB above the noise floor. The ILO92 system performs a statistical test on the noise in the 2f1-f2 frequency area, and only DPOAEs with amplitudes greater than 2 standard deviations above the noise floor were considered valid.

ABR recording was done by a Nicolet Spirit evoked potential system OS/2 version 3 (Nicolet, Madison, WI). Auditory brainstem response was performed using alternating clicks at 0.1 second, time window was 10 milliseconds, and filter settings were 150 Hz to 3 kHz. The stimuli were delivered at 90 dB HL with repetition rate of 11.1 to 51.1 pulses per second. Each response reflected an average of 1500 stimuli presentations. The absolute latencies of waves I, III, and V and I-III, III-V and I-V IPLs were recorded from both ears.

2.2.1 Statistical analysis

Calculations were performed using SPSS, version 12.0 (Chicago, IL). Data were presented as mean ±SD when normally distributed and mean (quartiles) when not normally distributed (TEAOEs). The Kolmogorov-Smirnov test was used to test distributional characteristics. Independent two-sided Student *t* test was used for comparison of the means of normally distributed measures, and Mann-Whitney *U* test was used for comparison of the means when not normally distributed (TEAOEs). Pearson *r* was used to assess correlations for normally distributed data, whereas Spearman methods were used for non-normally distributed data. For all tests, values of $P < .05$ were considered statistically significant.

3 Results

This study included 58 patients (116 ears examined) with migraine with mean age of 31.60 ±9.17 years and duration of illness of 8.33 ±4.47 years. Each patient had headache onset at least 6 months before participation. The majority of patients (79.3%) had MoA, whereas 20.7% had MA. Phonophobia and tinnitus were the auditory symptoms encountered in patients with migraine, with estimated frequencies of 20.69% and 13.79%, respectively. Basic audiological examination revealed that few patients had evidence suggesting conductive hearing problem. Normal middle ear status was confirmed by otoscopy and standard aural immittance procedures. All patients' ears had type (A) tympanograms (except 2 right and 3 left ears) with normal middle ear pressures and normal static compliance. Acoustic reflexes were present bilaterally (but absent in 8 right ears and 6 left ears) at 1 and 2 kHz at presentation levels not exceeding 100 dB HL. According to the standard dichotomous aural criteria, all patients' ears (except 7 right ears and 5 left ears) fell in the normal ear category with auditory thresholds better than 20 dB at 0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 kHz. No statistical difference was identified between the means of hearing thresholds of patients and control subjects. Table 1 showed the demographic and clinical characteristics of the studied groups. Table 2 showed the number of patients with abnormal OAEs and ABR results. Nearly two thirds of patients with migraine had one or more abnormalities in auditory electrophysiological testing. Table 3 showed the results of TEOAEs echo level (amplitude changes in dB SPL). Compared with control subjects, patients with migraine reported significant lowering of TEOAEs amplitudes observed at frequencies of 1 kHz (right: $P = .0003$; left: $P = .002$), 3 kHz (right: $P = .025$), and 4 kHz (right: $P = .019$). Patients with MoA had significant lowering of TEOAEs amplitudes observed at frequencies of 1 kHz (right: $P = .040$; left: $P = .029$) and 4 kHz (right: $P = .035$). Compared with patients with MoA, patients with MA had significant lowering of TEOAEs amplitude observed at frequencies of 1 kHz (right: $P = .001$; left: $P =$

.004), 3 kHz (right: P = .032), and 4 kHz (right: P = .003, left: P = .053). Patients with MA had significant lowering of TEOAEs amplitude that was observed at frequency of 1 kHz (right: P = .039).

Table 4 showed the results of DPOAEs (amplitude changes in dB SPL). Compared with healthy control subjects, patients with MA had significant lowering of DPOAEs amplitudes at frequencies of 1 kHz (right: P = .003), 2 kHz (right: P = .005), 3 kHz (right: P = .0001; left: P = .009), and 5 kHz (right: P = .001). Compared with patients with MoA, patients with MA had significant lowering of DPOAEs amplitudes observed at frequency of 1 kHz (right: P = .01), 3 kHz (right: P = .0001), 4 kHz (right: P = .003), 5 kHz (right: P = .004), and 6 kHz (right: P = .040).

Table 5 showed the results of ABR at 90 dB HL and with low and high repetition rate frequencies. Compared with control subjects, patients with migraine reported prolonged latency of wave III (right: P = .009) and I-V IPL (left P = .024) when ABR was done with high repetition rate frequencies. Patients with MoA had only significant prolongation of latency of wave III on the right side (P = .013). Patients with MA had no significant difference in different ABR parameters compared with healthy subjects and patients with MoA. No sex differences were identified in different OAEs and ABR parameters.

Correlations between audiological variables and demographic and clinical characteristics showed that (1) significant negative correlations were identified between age and right TOAEs total response (-0.381; P = .005) and left TOAEs at 4 kHz (-0.305; P = .031). Significant positive correlations were identified between age and absolute latency of right wave I at repetition rate frequencies (0.321; P = .018), left I-V IPL at high repetition rate frequencies (0.269, P = .054); (2) significant negative correlations were identified between duration of illness and left TOAEs total response (-0.365; P = .009) and amplitudes of the left TOAEs at 4 kHz (-0.297; P = .036); amplitudes of the left DPOAEs at 1 kHz (-0.304; P = .034), 1.5 kHz (-0.307; P = .032), 2 kHz (-0.337; P = .018), 3 kHz (-0.286; P = .046), 5 kHz (-0.315; P = .027), right I-V IPL (0.349; 0.01) at high repetition rate frequencies, left absolute latency of wave III (0.269; P = .047) and left I-V IPL (0.287; P = .036). (3) Significant negative correlations were identified between the frequency of migraine and right TOAEs total response (-0.335; P = .003), amplitude of the left TEOAEs at 4 kHz (-0.345; P = .046), and amplitudes of the left DPOAEs at 3 kHz (-0.281; P = .049) and 5 kHz (-0.365; P = .007). Significant positive correlations were identified between the frequency of migraine and left I-V IPL (0.296, P = .045) at high repetition rate frequencies.

4

Discussion

During the last decades, there has been increasing interest in evaluation and monitoring of human preneural and mechanical elements of the peripheral auditory pathway from different etiologies using OAEs [17-21]. Otoacoustic emissions permit sensitive assessment of cochlear function [15] and objectively monitor dynamic changes in cochlear responsiveness before functional and significant hearing loss occurs from any cause [16]. The outer hair cells (OHCs) are responsible for the cochlear sound amplification and, on the other hand, are capable of moving spontaneously in response to acoustic stimuli generating TEOAEs and DPOAEs. This movement is known as *electromotility* . TEOAEs is known to originate from the activation of the whole cochlea and is superior in middle frequency range. DPOAEs explore large range of frequencies especially in the range between 2 and 4 kHz which are concentrated basely, whereas measurement in the range of low frequencies is less reliable because of noise contamination [22]. OAEs amplitude indicates the summed activity of OHCs. Minimal amounts of cochlear damage may cause measurable changes in OAE responses; and as scattered OHC loss accumulates, OAE amplitude decreases before significant changes in pure tone thresholds [23].

The results of this study showed that a significant number of patients (approximately two thirds) with migraine classified as having normal hearing (HL <20 dB) are at risk of cochlear and peripheral auditory dysfunction evidenced by lowering of TEAOEs amplitude observed at frequencies of 1, 3, and 4 kHz in patients with MoA and MA. The TEAOEs abnormalities were observed at band frequencies but not at overall response levels, indicating that band parameters are more significant than global parameters because of large low-frequency

contribution that is typically present in adult subjects [24,25]. We also reported lowering of DPOAEs in patients with MA at frequencies of 1, 2, 3, and 5 kHz, indicating cochlear and peripheral auditory dysfunctions in these patients [26]. Patients with migraine also had prolongation of wave III latency and I-V IPL of ABR at high repetition rate frequencies, indicating central auditory dysfunction [27]. In partial accordance, in the study of Bolay et al [26], the authors assessed functions of cochlea and its efferents in 53 patients with migraine (106 ears) using TEOAEs and DPOAEs testing. The authors reported significant changes in DPOAEs at 5-kHz frequency and more lowering in DPOAE amplitudes in MA but not in TEOAEs. The authors also observed that contralateral suppression of TEOAE resulted in a significant decrease in amplitudes of TEOAE ($P = .005$) in controls but not in patients, indicating the presence of dysfunction either in the medial olivocochlear complex in the brainstem or at the synaptic transmission between olivocochlear efferents and OHCs in the cochlea. Some authors reported prolonged wave V latency and I-V IPL during the headache attach, indicating transient impairment of the auditory brainstem function [28], whereas others reported prolongation in the waves I, III and V latencies and I-III, III-V and I-V IPLs in 35% of patients with migraine in between the headache attacks [7]. In the study of Dash et al [29], the authors observed that all patients with vertigo had abnormalities in the auditory brainstem-evoked responses in the form of prolonged wave latencies and IPLs, or both.

The results of this and other studies suggest that (*a*) OAEs and/or ABR abnormalities may be the earliest indicator of impending auditory malfunction in migraine and (*b*) disruption of central sensory processing mechanisms during migraine may be one of the mechanisms predisposing to the increase in sensitivity to quiet sounds, resulting in phonophobia and tinnitus [26,30].

The exact pathogenesis of cochlear involvement in migraine is still incompletely understood. Some evidences implicate vascular mechanisms based on the fact that migraine is a disease with a presumed vascular mechanism where the cerebral vascular reactivity is malfunctioning [31]. This is further supported by the following: (1) Some authors reported association of other neurologic phenomena with migraine such as amaurosis fugax, hemiplegia, facial pain, chest pain, and visual aura, suggesting that vasospasm of the cochlear vasculature is the cause of the sudden hearing loss in patients with migraine [5,7,9,26]. (2) Ischemia has been suggested as a cause of transient hearing impairment in association with basilar migraine induced by activation of central nervous system adrenoreceptors by cyclic adenosine monophosphate as well as calcium metabolism alterations [32]. Massive local adrenaline release triggers the release of other β -receptor activators resulting in sterile edema and exudate that can be visualized (via ophthalmoscope) and considered pathognomonic of a migraine attack [33]. This mechanism is further supported by the following findings: (*a*) intraarterial perfusion with adrenaline resulted in blood flow alterations and hearing sensitivity (evaluated by brainstem auditory potentials) in rats; and (*b*) propranolol hydrochloride, a potent β -blocker, has been proven to have a protective action and an effective treatment in migraine-like attacks in rats and to be effective in cessation of hearing fluctuations in patients with migraine with improvement of hearing thresholds [8]. (3) When the cochlea and vestibular end organs were dissected after death of the patient with migraine, sudden deafness, and delayed endolymphatic hydrops, Lee et al [34] found prominent fibrosis in left cochlea consistent with an old infarction. The authors concluded that the sudden left-sided deafness likely resulted from ischemia caused by migraine-associated vasospasm. (4) The cochlea is a vascular region provided with terminal capillary bed. The high metabolic demands of the inner ear and the inherited properties of the cochlea make it unable to form collateral vessels that could restore blood flow in the ischemic regions, resulting in high sensitivity to minimal blood flow reduction [35] and appearance of clinical manifestations even before evidence of macrovascular complication [36]. (5) Recently, we and others reported that patients with chronic migraine are at risk of adverse vascular profile and atherosclerosis [37-40].

We may suggest that cochlear injury and auditory dysfunction with migraine may be attributed to cerebral vasospasm and reduction of blood flow or disturbances of its vasculature caused by intense transitory vasodilatation of the small vessels of the brain with subsequent sterile inflammatory reaction and liberation of

vasoactive mediators (eg, histamine, serotonin, and plasma kinins). One also can speculate that migraine may aggravate atherosclerosis [37-40] and age-related hearing loss [19] and increase hearing impairment caused by daily exposure to noise [30]. This is supported by our findings that hearing dysfunctions were found to be correlated with patients' age, duration of illness, and frequency of migraine attacks.

Despite the importance of the results of this study, there are some limitations: (1) the number of patients is relatively small; and (2) because of the cross-sectional design of this study, the temporal relationship between appearance of auditory dysfunction and migraine attacks is unknown.

5

Conclusions

The results of this study indicate that patients with migraine are at high risk of peripheral and/or central auditory dysfunction. This is important for specialists serving those patients; and also, migraine has to be considered in patients with unknown hearing loss.

Footnote

Author disclosures: none.

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Publication date: 2012

Year: 2012

Abstracts from the 35th Annual Meeting of the Society of General Internal Medicine

Author: Anonymous

Publication info: Journal of General Internal Medicine, suppl. Supplement 27 (Jul 2012): S99-574.
ProQuest document link

Full text: Abstracts from the 35th Annual Meeting of the Society of General Internal Medicine
ABSTRACTS OF SUBMISSIONS ACCEPTED FOR PRESENTATION
SCIENTIFIC ABSTRACTS
2011 VETERANS HEALTH ADMINISTRATION EMERGENCY SERVICES FOR WOMEN (ESW) SURVEY
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BACKGROUND: More women are using Veterans Health Administration (VHA) Emergency Departments (EDs). Women Veterans presenting to VHA EDs may have different needs, and therefore require different resources and processes of care, than their male counterparts. VHA EDs capacities to meet these needs have not been previously assessed. In a research-operations partnership, we surveyed VHA ED capabilities relevant to caring for women Veterans.
METHODS: We surveyed all 120 VHA ED directors between May 24th and June 30th, 2011. We report here primarily on results for gynecologic and sexual assault care and pregnancy testing. Because VHA EDs are known to vary, we compared female-specific capabilities (resources and processes of care) to gender neutral capabilities to ground our analyses. We also assessed capabilities stratified by number of ED encounters by women, total ED
encounters per year, facility complexity, and facility location in large versus small or non-metropolitan areas.
RESULTS: All VHA EDs (100%) completed the survey. Thirty-five percent of VHA EDs have emergent gynecology consultations available at all times compared to 77% having cardiology and 74% urology. An additional 28% of VHA EDs have emergent gynecology consultations available some of the time. Emergency psychiatric consultation for sexual assault is available in 86% of EDs at all times, and 77% are able to arrange follow-up mental health services within 48 hours for this problem. Most (92%) VHA EDs transfer sexual assault victims to other institutions for physical and evidentiary evaluation and treatment. EDs commonly use point-of-care testing (i.e., immediate testing in the ED) for troponin (58%) but not for pregnancy (8%). Similarly, standing ordersets are common for electrocardiogram (88%) and fingerstick glucose (75%) but less common for pregnancy tests (40%). Nurse triage note templates have a designated space for last menstrual period in 33% of the EDs. Basic female-specific supplies, such as speculums and gynecologic examination tables, are available in most, but not all VHA EDs (98% and 88%, respectively). Emergency contraception is available in 87% of VHA EDs and Rho(D) immune globulin in 53%. Seventy-two percent of VHA EDs have pelvic ultrasounds available to ED patients, 39% have this available at all times. VHA EDs with fewer encounters by women, located in small or non-metropolitan areas, and part of less complex VHA healthcare systems have less

capabilities for caring for women.
CONCLUSIONS: While many VHA EDs have capabilities for female-specific care, gaps remain, especially in those with fewer women Veteran encounters. Lack of point of care capability to carry out pregnancy tests, for example, may result in delays in emergency gynecologic and radiologic care to women. Such gaps must be further assessed and addressed if VHA is to provide comprehensive care to women. These data will be used as the basis for developing recommendations for ensuring quality care to women in VHA EDs.

A BRIEF CURRICULAR INTERVENTION TO IMPROVE SCREENING AND BRIEF INTERVENTIONS FOR SUBSTANCE ABUSE IN THE PRIMARY CARE SETTING DOES NOT IMPROVE PERFORMANCE ON A STANDARDIZED PATIENT ASSESSMENT
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BACKGROUND: The need for screening and brief intervention for substance use disorders (SUDs) in primary care settings is widely recognized. Barriers include inadequate provider skills and lack of confidence. The optimal format for curricular interventions to address barriers remains unclear. We implemented a 3 hour Screening, Brief Intervention and Referral to Treatment (SBIRT) curriculum for internal medicine (IM) residents using a Team-based Learning (TBL) format. The TBL format was selected for its adherence to educational principles and active learning. The objective of our study was to evaluate the impact of the curriculum on resident SBIRT skills, knowledge and confidence using a standardized patient (SP) assessment. METHODS: This study took place at an academic residency training program. 54 PGY2 and PGY3 IM residents participated. 26 residents participated in the SP assessment prior to the curriculum (control group) and 29 participated in the SP assessment after the curriculum (experimental group). The SP assessment consisted of 3 twenty-minute encounters with a patient with at-risk alcohol use, alcohol dependence or prescription opioid misuse. SPs evaluated residents on history(HX), information sharing(IS), and patient-physician interaction(PPI) and a single-item to assess overall satisfaction(OS) with the resident. Individual and mean scores for each case were calculated for each of the domains(HX,IS,PPI,OS) and a mean summary score for each domain was calculated for all cases. After the SP assessment, residents completed surveys about their satisfaction with the SP assessment and confidence in performing SBIRT. Residents were surveyed about their satisfaction with the TBL curriculum. T-tests were performed to detect differences between experimental and control groups. RESULTS: There were no statistically significant differences between control and experimental groups on the mean scores for each case in the four domains (HX,IS, PPI,OS) or in the mean summary scores (HX,IS,PPI,OS) for all cases combined. For HX items, residents received 54% of the total points possible (experimental) vs 61% (control; p=.05) and for IS, residents received overall scores of 72% (experimental) vs 67% (control; p=.78). PPI and OS for both groups were rated as good to very good. HX and IS scores were lowest for the prescription opioid misuse case. Resident confidence in screening for drugs [mean=3.93 vs 3.45 (1=strongly disagree, 5=strongly agree), p=.013] and alcohol (mean=4.24 vs 3.66, p=.002), assessing stage of behavioral change (mean=4.21 vs 3.34, p<.001) and making treatment plans for patients with SUDs (mean=3.90 vs. 2.90, p<.001) was significantly higher in the experimental group. Residents in the experimental group were more likely to say they would recommend the SP assessment to a colleague (mean=3.41 vs 2.83, p=.04). Both groups were close to neutral on whether they would recommend the TBL training to a colleague. CONCLUSIONS: A 3 hour TBL session improved resident confidence in their SBIRT skills, but did not improve SBIRT skills as measured by a SP assessment. Resident SBIRT skills in both the experimental and control groups showed room for improvement in all areas (HX,IS,PPI, OS) with a particular need for improvement in handling prescription opioid misuse. Overall satisfaction with SP assessment and the TBL curriculum was

positive. A more intensive curriculum with opportunities to practice skills and receive feedback over time may be required to improve behavioral skills.

A BRIEF STRUCTURED PEER-TO-PEER FEEDBACK INTERVENTION TO IMPROVE THE QUALITY OF RESIDENT DISCHARGE SUMMARIES Krishan Soni; Mia Lozada; Michelle Schneidermann. San Francisco General Hospital, University of California San Francisco (UCSF), San Francisco, CA. (Control ID #1315178)

BACKGROUND: High quality communication is required for safe hospital discharges and is accomplished primarily through the discharge summary.

Clear, concise, and meaningful correspondence between providers is essential and yet, first year medical residents are generally charged with the responsibility of completing discharge summaries with little or no training. While prior studies have shown improvement in discharge summary quality after introducing a didactic curriculum with direct feedback, we are not aware of any curricula that take advantage of peer-to-peer feedback. METHODS: Based on literature review and an internal needs assessment of problems with discharge summaries, we developed an educational curriculum consisting of (1) a didactic session illustrating the quality gaps in discharge summaries at our institution, and best practices for improvement, followed by (2) a one hour session dedicated to directed peer-to-peer feedback for interns to evaluate their own summaries. A discharge summary evaluation tool, focusing on 5 elements of the discharge summary was developed to facilitate peer assessment of discharge summaries. During the peer-to-peer feedback session, interns completed a brief pre-test regarding their confidence with discharge summaries. They exchanged their own discharge summary with a partner and reviewed/evaluated them with the standardized rubric. The larger group congregated and summarized the strengths and weaknesses of their own discharge summaries and focused on areas they would work on in the future, and then completed a brief post-test to assess the experience with the peer-to-peer feedback session. RESULTS: 58 learners participated in this curriculum and completed the pre and post test evaluation form. 29 (50%) of the respondents were medical interns, 13 (22%) were prelim interns from other departments and, 16 (28%) were students. While 69% of respondents thought that completing a discharge summary solidifies their understanding of a patients hospital course, only 22% were satisfied with the quality of their discharge summary. In the post test analysis, 98% of residents agreed or strongly agreed that it is useful to develop and improve skills in writing D/C summaries. 81% of residents thought the peer-to-peer feedback session was comfortable, and 85% thought that it was helpful. CONCLUSIONS: We developed a unique educational innovation involving a peer-to-peer feedback session for PGY1 residents to assess the quality of their own discharge summaries. The peer-to-peer evaluation component was a powerful tool for allowing interns to identify their own strengths and weaknesses in their ability to write concise and accurate discharge summaries. Additionally, the group generated best practices and specific approaches to change their own practice immediately after this session. Having residents provide feedback and teaching to their peers can be a high yield mechanism for promoting learning and retention compared to traditional didactic sessions. This peer-to-peer feedback session could easily be repeated in most academic clinical settings to improve the quality of discharge summaries written by residents.

A COMPARISON OF EVISITS AND OFFICE VISITS FOR SINUSITIS AND URINARY TRACT INFECTIONS AT FOUR PRIMARY CARE PRACTICES Ateev Mehrotra1; Suzanne J. Paone2; Cynthia Carbine2; G. D. Martich2; Grant Shevchik2. 1University of Pittsburgh, Pittsburgh, PA;
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BACKGROUND: There is growing recognition that many physician-patient encounters do not require face-to-face contact. The availability of secure internet portals and personal health records creates the opportunity for online care or structured eVisits. An increasing number of health systems provide eVisits and more health plans reimburse for eVisits (identified via CPT code 99444). While there is growing use of eVisits, little is known about their clinical effectiveness. To fill this gap in knowledge, we compared the care between eVisits and office visits. To complete an eVisit in our healthcare system, patients log onto their secure personal health record and go

through a structured questionnaire with branching logic that reviews their symptoms. This information is sent to their primary care physician who reviews this information and the patients chart and answers on average in ~4 hours. The physician response is via the secure portal, prescriptions are sent electronically to the pharmacy, and the care providers note is automatically put into the healthcare systems electronic health record (EHR). Four commercial health plans in the region reimburse eVisits and for the eVisit a patient pays the typical office visit co-payment.
METHODS: In the EHR for the University of Pittsburgh Medical Center, we used diagnosis codes to identify all eVisits and office visits for urinary tract

infections (UTI) and sinusitis at four primary care practices that occurred between 1/1/10 and 5/31/11. We focused on UTI and sinusitis, because these were common reasons for eVisits and there are published practice guidelines on management. The four practices chosen were the first to adopt eVisits within the system (they are now offered at all practices) and have the highest number of eVisits per month. We abstracted the necessary information (e.g. problem list, prescriptions, tests ordered, follow-up care) from the EHR. RESULTS: We identified 5595 sinusitis visits (9% of which were eVisits) and 3341 UTI visits (3% eVisits). eVisit users were on average only slightly younger (>65yo, eVisits 6% vs. 13% office visits) and employed by self-report (75% vs. 62%). Surprisingly, there was no statistically significant difference in socio-economic status between eVisit and office visit patients (e.g. median household income in zip code<$30,000, 12% vs. 10%). At eVisits, physicians were less likely to order any relevant testing for the condition (e.g. urine culture or urinalysis, 6.5% UTI eVisits vs. 53% UTI office visits). At eVisit physicians were more likely to prescribe antibiotics (e.g. visits with antibiotic prescription, 99% sinusitis eVisits vs. 93% sinusitis office visits). A similar number of patients had any follow-up in the subsequent 3 weeks for the condition (e.g. 9.9% UTI eVisits vs. 11.8% UTI office visits). CONCLUSIONS: At these four primary care practices, eVisits accounted for almost 7% visits for sinusitis and UTI. eVisits attracted patients who were slightly younger and employed. In an eVisit, physicians are more likely to prescribe antibiotics and are less likely to order testing. There was no difference in the need for follow-up. Recognizing we cannot account for differences in diagnosis and severity of illness between the two groups of patients, these results will be helpful to physicians and health systems that are considering eVisits.
A NATIONAL ASSESSMENT OF HEALTH PROFESSIONAL TRAINING AND PIPELINE PROGRAMS IN COMMUNITY HEALTH CENTERS Jaya Aysola1; LeRoi Hicks2. 1Harvard Medical School and Brigham and Women's Hospital, Boston, MA; 2University of Massachusetts Memorial Medical Center, Worcester, MA. (Control ID #1338538)
BACKGROUND: Training and pipeline programs within community health centers (CHCs) are cited as potential solutions to the shortage and maldistribution of primary care providers, yet the impact of such programs is not well understood. We conducted a nationally representative survey of CHCs to examine the effects of such programs on recruitment and retention of primary care providers in shortage areas.
METHODS: We partnered with the National Association of Community Health Centers to develop and pilot a self-administered survey instrument to evaluate the effects of health professional training activities at community health centers. We fielded the online survey to executive directors at a total of 976 federally qualified health centers with an email address in the 2009 Uniform Data System (UDS). Data collection was from March to June 2010, with 390 CHCs (40%) responding. Survey data was then linked to UDS, which provides a range of information on the operations and performance of all community health centers receiving federal funding. Our four predictors were the presence or absence of 1) health professional training programs (providers and/or students) 2) Area Health Education Center programs (AHEC) 3) Student/Resident Experiences and Rotations in Community Health (SEARCH) and 4) Career Ladder/Advancement programs. Our two primary outcomes were

self-reported difficulty in primary care provider recruitment and retention in the past 5 years, with difficulty measured by a scaled response (no/minimal, some, great). We ran both univariate and multivariable ordinal logistic regression models evaluating the associations between our four predictors and outcomes of interest. In our multivariable models, we adjusted for our predictors and several CHC level characteristics, including urban versus rural location, hospital affiliation, and receipt of Title VII funding.
RESULTS: Of the 390 CHCs, 53% were rural, 34.5% reported hospital/ medical school affiliation, 89.6% reported having health professional training programs, 48.5 % reported AHEC programs, 29.7% reported SEARCH programs, and 54% reported Career Ladder programs. The majority of CHCs reported some difficulty in both recruiting and retaining primary care providers in the last 5 years, with 32.6 % reporting great difficulty in recruiting providers and 16.2% reporting great difficulty with retaining
providers. Multivariable analyses demonstrated urban compared to rural health centers were more likely to report no/minimal difficulty in provider recruitment (OR 1.82; 95% CI: 1.14, 2.90; p=.01) and retention (OR 1.94; 95% CI: 1.21,3.12; p=.006). In adjusted analyses, only one of our four predictors, having career ladder programs, was independently associated with both recruitment and retention of primary care providers. Centers with career ladder programs were more likely to report no/minimal difficulty with both recruitment (OR1.93; 95% CI: 1.21, 3.08; p=,006) and retention (OR 2.17; 95% CI: 1.35, 3.49; p=.001) compared to health centers without those programs. CONCLUSIONS: Our findings suggest that career ladder/advancement programs have a significant effect on recruitment and retention of primary care providers in shortage areas. Our study underscores the need for further evaluation of health professional training and pipeline programs in order to expand models that demonstrate effectiveness in improving the primary care workforce in shortage areas.
A NEW MODEL OF RETENTION FOR HEALTH EDUCATION/ BEHAVIORAL INTERVENTIONS: URBAN AFRICAN-AMERICANS IN THE DIABETES EMPOWERMENT PROGRAM Katie Raffel1;
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3Diabetes Research and Training Center, Chicago, IL. (Control ID #1333585)
BACKGROUND: Culturally-tailored diabetes education can improve diabetes self-management and self-efficacy among African-Americans, but attrition is often a barrier to program effectiveness. Attrition from basic diabetes education ranges from 4-57% and is associated with higher HbA1c, blood pressure and BMI as well as increased complications. Despite the importance of retention in health outcomes, research describing minority retention in health education/behavioral interventions is lacking. The Diabetes Empowerment Program combines diabetes education and patient/provider communication training and is culturally-tailored for African-Americans. This program not only improved diabetes self-management but also had notably high retention rates. Despite the intensity of the ten-week program, 70% of the 50 participants attended 80% of the classes. We sought to investigate the programs successful retention in order to address significant gaps in the literature describing minority retention in health education.
METHODS: We conducted four focus groups (n=31) and seven in-depth interviews (n=7) with former participants of the Diabetes Empowerment Program. Interviews and focus groups were conducted by trained interviewers with experience discussing health and communication. Using a structured topic guide, interviewers asked participants to identify and discuss factors influencing their attendance. Each interview/focus group was audio-taped, transcribed verbatim and analyzed using Atlas.ti software. Coding was conducted using an iterative process; each transcription was independently coded by two members of the research team.
RESULTS: Participants discussed multiple program characteristics contributing to successful retention, from which we identified the following key themes: 1. Relevant information: The curriculum was culturally-tailored and practical, incorporating participants traditional diets and community resources and reinforcing information with practical skills training (e.g. touring grocery stores, understanding lab results). 2. Program leadership: Educators were experienced with the local population and in culturally-tailored patient activation. Instructors willingness to

listen and their caring disposition were consistently cited. 3. Social support: Drawing on the African-American tradition of testifying, participants were encouraged to share their stories. The opportunity to be heard and to hear others' experiences was described as relieving, encouraging and educational. 4. Principles of the African-American Helping Tradition: Many participants explained that by sharing their new knowledge and experiences, they hoped to help their peers prevent and manage diabetes. CONCLUSIONS: Based on these results, we suggest a new conceptual model of retention for African-Americans in health education/behavioral interventions. Our model is different from frameworks describing retention in clinical trials, which emphasize contact, scheduling and logistics of research visits. Our results support prioritizing culturally-tailored program design, qualified and openly caring educators and interpersonal support among participants. Our recommended strategies are low-cost and can contribute importantly to interventions in low-resource settings. This understanding of

program factors that improve retention among urban African-Americans with diabetes may be applicable to other health education/behavioral interventions and may help to reduce disparities in disease control and outcomes.

A PROTOCOL FOR ELICITING CLINICAL DECISION SUPPORT OBJECTIVES FOR MEDICAL SPECIALTIES: DEVELOPMENT AND PILOT DEMONSTRATION Douglas S. Bell2; Justin W. Timbie1; Cheryl L. Damberg2; Eric Schneider3; Amber L. Smith2. 1RAND, Arlington, VA; 2RAND, Santa Monica, CA; 3RAND, Boston, MA. (Control ID #1339532)

BACKGROUND: A process for developing meaningful requirements for clinical decision support (CDS) within incentive programs does not exist. We developed a systematic process that combines evidence review with expert opinion to elicit clinically meaningful objectives for CDS from specialists by:1) prioritizing the clinical performance gaps within each specialty and 2) evaluating CDS opportunities that might address the prioritized gaps. METHODS: Our conceptual framework for deriving CDS objectives involved specifying CDS targets that comprised high priority performance gaps for which CDS would be effective and feasible in addressing the gap. We used a two-stage modified Delphi expert panel process to elicit and prioritize the set of CDS targets. In the first stage, experts rated the importance of performance gaps, beginning with a candidate list generated through an environmental scan and supplemented through nominations by panelists. In the second stage, for each of the highest-priority performance gaps, panelists rated the extent to which specific CDS opportunities (existing CDS tools or feasible CDS concepts) would be effective in ameliorating the gap and would be compatible with clinical workflows of the specialty. Each stage consisted of an initial rating (using a web-based program), followed by a moderated discussion of ratings via webmeeting, and a final rating immediately following the discussion. We convened four expert panels representing one medical specialty (oncology), one surgical specialty (orthopedic surgery), one non-surgical procedural specialty (interventional cardiology), and one primary care specialty (pediatrics). All panels except pediatrics focused on a pre-determined, narrow set of clinical conditions. A total of 54 experts completed all ratings. RESULTS: The oncology panel considered 15 of the 22 performance gaps to be high priority and thus potential targets for CDS. Results for the other panels were as follows: 6 of 28 (orthopedics); 11 of 23 (interventional cardiology); and 11 of 28 (pediatrics). Of the high priority performance gaps, many were based on panelists own clinical experience rather than existing performance measures. After considering whether effective and compatible CDS opportunities existed for each performance gap, the final set of high priority CDS targets was reduced to 14 (oncology); 4 (interventional cardiology); and 3 (orthopedics and pediatrics). Order sets were the most common form of CDS found to be effective and compatible (30% of all opportunities), followed by alerts and reminders (26%), and documentation templates (19%). CONCLUSIONS: The protocol successfully elicited high-priority performance gaps having the greatest opportunities for implementation of CDS within four clinically disparate specialties. The staged approach and the use of webmeetings minimized participant burden. Most specialties readily identified high-

priority performance gaps, but only the oncology panel rated a wide range of CDS opportunities highly. The protocol could be replicated across many specialties to produce lists of high-priority CDS targets that could serve as measurable CDS objectives for use in EHR policy actions such as the meaningful use requirements of the Medicare and Medicaid EHR Incentive Programs. Framing objectives as performance gap targets along with specific examples of effective and workable CDS creates enforceable objectives without limiting innovation by developers.

A RANDOMIZED CONTROLLED TRIAL EVALUATING THE EFFECT OF FACILITATED SMALL GROUP SESSIONS ON PHYSICIAN QUALITY OF LIFE, BURNOUT, AND MEANING FROM WORK Colin P. West1,2; Liselotte Dyrbye1; Jeff A. Sloan2; Tait Shanafelt1. 1Mayo Clinic, Rochester, MN; 2Mayo Clinic, Rochester, MN. (Control ID #1339963)

BACKGROUND: Despite the recognized prevalence of burnout, low job satisfaction, and poor quality of life among physicians, few studies have
evaluated interventions to address these issues. Outcome measures from these studies are scarce, and application of validated instruments has been uncommon. In addition, prior studies have been largely observational and limited by volunteer bias. To address these limitations, we conducted a randomized controlled trial of an organizational small group facilitated intervention designed to positively impact physician well-being and job satisfaction, with additional comparison with a cohort of non-study participants.

METHODS: We conducted a randomized controlled trial of a 9-month intervention based on biweekly small group facilitated sessions. Each session lasted 1 hour, and both intervention and control participants received 1 hour of protected time every two weeks during the study, funded by their health care employer. The 17 covered topics included work-life balance, medical mistakes, meaning in work, and resiliency, among other topics relating to the physician experience. Participants completed surveys at baseline and then quarterly for 1 year. Surveys included linear analog self assessment of overall quality of life (QOL), the Empowerment at Work Scale, which includes an assessment of meaning derived from work, and the Maslach Burnout Inventory. The trial groups were compared using generalized estimating equations for repeated measures. In addition, the two study groups were compared with non-study participants from the Mayo Clinic Department of Medicine (DOM) on results from annual well-being surveys in 2010 and 2011 occurring simultaneous with the baseline and 1-year study surveys. RESULTS: N=37 participants were randomized to each arm of the study, with n=34 respondents to each survey in each arm. N=493 DOM faculty comprised the non-study comparison group, with 340 respondents. Overall, data were provided by 408 of 567 (72.0%) DOM faculty. At baseline, no differences were observed between the 3 study groups for any well-being variable. Results at one year are shown in the Table. Compared to non-study participants, those in the intervention arm improved on all 5 variables. The intervention arm also yielded superior average results for each of the 5 outcomes relative to the control arm, although these differences did not reach statistical significance. CONCLUSIONS: Relative to non-study faculty, study participants receiving a small amount of protected time (one hour every other week) experienced substantial reductions in burnout with larger reductions for those in the facilitated small group curriculum. Those in the facilitated small group curriculum also experienced improvement in QOL and meaning from work. These findings are consistent with prior uncontrolled studies of interventions to promote physician well-being. However, further study is needed to define the optimal approach to delivery of these interventions.

Absolute Change in Rates of Poor QOL, Burnout, and High Meaning from Work from Baseline to Year 1.

*All p values comparing intervention versus control>0.05 **All p values comparing all 3 groups <0.01

A RANDOMIZED CONTROLLED TRIAL OF FINANCIAL INCENTIVES TO PROMOTE WEIGHT LOSS AMONG OBESE EMPLOYEES Jeffrey T. Kullgren1; George Loewenstein2; Andrea B. Troxel3; Laurie Norton1; Lisa Wesby3; Jingsan Zhu3; Yuanyuan Tao3; Kevin G. Volpp1. 1Philadelphia VA Medical Center and University of Pennsylvania, Philadelphia, PA; 2Carnegie Mellon University, Pittsburgh, PA; 3University of Pennsylvania, Philadelphia, PA. (Control ID #1339878)

BACKGROUND: Obesity is a leading cause of chronic disease and leads to substantial economic costs in the workplace. Consequently, employers are
Outcome Intervention(n=34)
Control (n=34)*
Non-Study Faculty (n=340)**
Poor QOL -15.2% +0.6% -7.3% High Emotional Exhaustion -20.4% -5.3% +4.3% High Depersonalization -13.3% -8.3% +2.5% Overall Burnout -25.8% -13.8% +4.9% High Meaning from Work +6.3% -6.3% -13.4%

increasingly offering different types of financial incentives to motivate weight loss among obese employees. However, there is little evidence on how to optimally design incentives to promote weight loss in this setting. The objective of this study is to test the relative effectiveness of two novel financial incentive approaches in promoting weight loss among obese employees. METHODS: We developed a partnership with the Childrens Hospital of Philadelphia to recruit 105 employees with a body mass index between 30 and 40 kg/m2 who were interested in losing weight. Participants were given a weight loss goal of 1 pound per week for 24 weeks, provided with access to a website to track their progress, and randomized to one of 3 groups: (1) monthly weigh-ins alone (control group), (2) $100 per month for being at or below their monthly target weight (individual arm), or (3) $500 per month split between groups of 5 participants, who received a larger share when they were at or below their monthly target weight but other group members were not (group arm). The primary outcome is weight loss at 24 weeks. Secondary outcomes include weight loss in a subsequent 12 week observation period without incentives to assess sustainability (i.e., weight loss over the full 36 weeks) and intervention period changes in eating behaviors, physical activity, and participation in weight-related wellness programs. We report here baseline participant characteristics, primary outcome results, and secondary outcome results available through December 2011. Complete data on sustainability will be available by February 2012.
RESULTS: Participants have a mean age of 45.3 years [standard error (SE)1.0] and a mean household income of $94,952 (SE 3,757). Most are female(88.6%), White (62.9%) or African American (29.5%), and have at least a college degree (59.0%). Group arm participants lost more weight (mean 10.7 pounds, SE 1.8) than participants in the control (mean 1.1 pounds, SE 2.0, P=0.0004) and individual (mean 3.7 pounds, SE 1.9, P=0.0079) arms. Group arm participants also experienced a greater increase in cognitive restraint around eating [mean 19.9 (measured on a 0 to 100 scale), SE 4.4] than control (mean 4.6, SE 2.8, P=0.0017) and individual (mean 7.3, SE 2.5, P=0.0087) arm participants. There were no significant differences across arms in changes in emotional eating, uncontrolled eating, physical activity, and weight-related wellness program participation.
CONCLUSIONS: A monthly financial incentive that involved competition within a group was significantly more effective than an individual incentive in promoting weight loss and greater cognitive restraint around eating among obese employees at 24 weeks. Between now and February 2012 we will assess the sustainability of these initial effects. Evidence on the relative effectiveness of different financial incentives will help employers maximize the impact of incentives designed to help obese employees lose weight and modify weight-related behaviors.
A RANDOMIZED CONTROLLED TRIAL OF THE FEASIBILITY OF A PROTECTED SLEEP PERIOD FOR MEDICAL INTERNS IN THE HOSPITAL FOR PROLONGED DUTY KevinG. Volpp1,2; Laurie Norton1,2; Judy A. Shea3,1; Jingsan Zhu1,3; Dylan Small4,1; Mathias Basner5; Adrian Ecker5; David Dinges5; Daniel Mollicone6; Cristina Novak1,2; Lisa Bellini3. 1University of Pennsylvania, Philadelphia, PA; 2Philadelphia VA Medical Center, Philadelphia, PA;
3University of Pennsylvania, Philadelphia, PA; 4University of Pennsylvania, Philadelphia, PA; 5University of

Pennsylvania, Philadelphia, PA; 6Pulsar Informatics, Philadelphia, PA. (Control ID #1340423)
BACKGROUND: In 2008 an Institute of Medicine Report recommended protected sleep periods for medicine trainees on extended overnight shifts, a position reinforced in recent ACGME requirements. We evaluated the feasibility and consequences of mandatory naps during extended duty. METHODS: 4-week blocks at the Philadelphia VA Medical Center (PVAMC) medicine service and at the Hospital of the University of Pennsylvania (HUP) oncology service were randomly assigned to either a standard intern schedule (extended duty overnight shifts of up to 30 hours), or mandatory naps (interns given protected time from 00:30-05:30 to sign out their cell phones and sleep). Study participants were asked to wear wrist actiwatches, complete sleep diaries, and perform daily Psychomotor Vigilance Tests (PVT-B) to measure behavioral alertness.
RESULTS: On 98.3% of intern on call nights, cell phones were signed out to residents as designed. Mean sleep time during the protected period at
PVAMC was 2.6 hours in the intervention months compared with 1.6 in the control months (p-value <0.0001). At HUP, mean sleep time was 2.8 hours in the intervention months and 1.9 hours in the control (p-value <0.0001). Interns with mandatory naps were less likely to have on call nights with no sleep at both sites (PVAMC: 12.5% vs. 26.9%, p-value <0.0001; HUP:11.1% vs. 17.1%, p-value 0.04). In contrast 20.7% of interns during intervention months slept 4-5 hours during the protected period compared with 6.6% during control months at PVAMC (p-value <0.001) and at HUP,27.6% vs. 8.0%, (p-value <0.001). At both HUP and PVAMC, response speed on the PVT-B was significantly faster after on-call nights in the intervention relative to the control group (PVAMC: 4.07 vs. 3.84 per second (s-1), p-value0.021; HUP: 4.04 vs. 3.89 s-1, p-value 0.016), and the number of lapses of attention was lower, albeit not significantly at HUP (PVAMC: 3.88 vs. 5.72, p-value 0.031; HUP: 3.95 vs. 4.73, p-value 0.059).
CONCLUSIONS: This study provides the first evidence that a mandatory program of protected time for sleep on extended duty shifts is feasible with high rates of adherence and that it can produce a significant increase in mean hours slept and an increase in behavioral alertness on mornings after overnight shifts. While there is evidence that obtaining nap sleep (relative to no sleep) during prolonged duty helps reduce fatigue, it remains to be determined whether the gain in sleep time and alertness afforded by a mandatory protected nap reduces fatigue-related errors and accidents involving residents. Protected nap periods are feasible and improve alertness, suggesting they may provide a reasonable alternative to mandated shorter shifts.
A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED SWITCH STUDY OF THE SAFETY, TOLERABILITY, AND EFFICACY OF MILNACIPRAN IN FIBROMYALGIA PATIENTS WHO INADEQUATELY RESPOND TO DULOXETINE Allan Spera2; Lucinda Bateman1; Robert H. Palmer2; Joel M. Trugman2; Jennifer Lin2. 1The Fatigue Consultation Clinic, Salt Lake City, UT; 2Forest Research Institute, Jersey City, NJ. (Control ID #1330962)
BACKGROUND: Fibromyalgia (FM) is characterized by a multitude of symptoms that include chronic widespread pain, fatigue, stiffness, impaired physical functioning, sleep disturbances, cognitive dysfunction, and depressed mood. Since individual patient responses among analgesics often differ, switching therapies with the objective of achieving greater benefit or avoiding certain side effects is common in clinical practice. Milnacipran and duloxetine are both serotonin/norepinephrine reuptake inhibitors approved in the United States for the management of FM. Although these medications are in the same pharmacologic class, their properties differ, which may result in different responses and adverse-effect profiles in some FM patients. This study evaluates the safety, tolerability, and efficacy of milnacipran following a direct switch from duloxetine in FM patients who clinically experience an inadequate response to duloxetine. METHODS: Patients were required to have been taking duloxetine 60 mg/day for 4 weeks at the time of enrollment into this study.
Following a 2-week open-label period with duloxetine 60 mg/day, patients with VAS pain scores 40 and 90 mm (range, 0-100 mm) and dissatisfied with duloxetine were randomized 4:1 to milnacipran 100 mg/ day (n=86) or placebo (n=21) for 10 weeks. The purpose of the small placebo group was to minimize expectation bias rather

than provide a comparator arm, since patients would be discontinuing a treatment that may have been partially efficacious. Patients randomized to milnacipran were directly switched with no tapering or titration periods. The primary efficacy outcome was Patient Global Impression of Change (PGIC) responder status, with PGIC responders defined as patients rating themselves as much improved or very much improved at Week 10. The secondary efficacy outcome was the change from baseline in 1-week recall VAS pain. Additional outcomes included changes from baseline in Fibromyalgia Impact Questionnaire Revised (FIQR), which measures overall FM severity, and Multiple Ability Self-Report Questionnaire (MASQ), which measures self-reported cognitive functioning. Missing data were imputed by the last observation carried forward approach. RESULTS: In the group of patients switched from duloxetine to milnacipran,32.9% were PGIC responders and the mean reduction from baseline in VAS pain was 12.3 mm. In the small group of patients switched to placebo, 23.8%

were PGIC responders and the mean decrease in VAS pain was only 1.3 mm. Patients switched to milnacipran had a mean improvement in FIQR total scores of 7.8 points, representing a 14% improvement (patients switched to placebo improved by only 1.4 points). Patients switched to milnacipran also showed improved cognitive functioning, with a mean improvement in MASQ total score of 2.4 points, while the mean score worsened from baseline by 3.2 points in patients switched to placebo. The most common treatment-emergent adverse events were nausea and dizziness; these occurred in 21% and 15% of patients switched to milnacipran, and in 29% and 5% of patients switched to placebo, respectively.
CONCLUSIONS: These results indicate that members of the same pharmacologic class may have different clinical response profiles and that directly switching FM patients from duloxetine to milnacipran is safe and well-tolerated, and may improve pain and other FM symptoms in patients who inadequately respond to duloxetine.
A REVIEW OF HOMELESSNESS AMONG DISCHARGE DELAYS: MAKING THE CASE FOR MEDICAL RESPITE CARE FOR INDIVIDUALS EXPERIENCING HOMELESSNESS
Jacob Feigal1; Carolyn Bramante1; John Song2,1; Curtis Nordgaard1; Brian Park1. 1University of Minnesota Medical School, Minneapolis, MN; 2University of Minnesota Academic Health Center, Minneapolis, MN. (Control ID #1338108)
BACKGROUND: Homelessness is associated with higher morbidity, mortality, and hospital costs. Medical respite is an emerging care management option that decreases hospital costs and readmissions by combining a 24-hour supportive shelter setting with specialized services for homeless patients with health care needs after hospital discharge. Future efforts to establish respite care centers would benefit from better understanding the health care needs of its target population. Additionally, little research has examined discharge delays of housed versus homeless patients. This study examined medical needs and discharge delays of individuals experiencing homelessness in Minneapolis, Minnesota following discharge from inpatient hospitalization to determine whether respite care could facilitate more expedient and appropriate discharges. METHODS: The study was conducted at Hennepin County Medical Center (HCMC), a 477-bed regional safety net hospital that provides care for much of Minneapolis homeless population. We performed a retrospective cohort analysis of admissions between January 1 and June 30, 2009 at HCMC. Data were abstracted from charts defined by HCMC as discharge delays for external reasons, an operational definition used by the hospitals Utilization Management department to assess eligibility for continued inpatient stay. Using the inpatient electronic medical record, as well as electronic records from Utilization Management, patients were classified as housed, not housed, or unknown based on the federal definition of homelessness. Demographics, reason for admission, interventions, diagnoses, reason for delay, length of delay, and readmissions within 90 days were also abstracted. Analyses were then conducted to evaluate the relationship between housing status and discharge delay. RESULTS: A total of 304 charts included hospitalizations during the study period that were affected by discharge delays; 93 of which belonged to homeless patients. The median number of delay days was significantly longer for homeless than housed patients ($p<0.001$). The charts of 107 patients(43.3%) included psychiatric diagnoses on admission. The median number of delay days remained significantly longer for homeless patients after

controlling for psychiatric diagnoses (p=0.012). For homeless patients, the most common reason for discharge delay was awaiting group home placement (35.6%) while9.9% of delays were due to inability to find shelter placement. Other reasons included awaiting healthcare coverage, medication management, and follow-up requirements. Homeless individuals were less likely to have either public or private insurance than housed patients (p=0.011).
CONCLUSIONS: This study found that homeless patients had longer discharge delays than housed patients after inpatient hospitalizations for both medical and psychiatric reasons. The most common reason for discharge delays of homeless patients was awaiting a group-home bed. Another common reason for delay was inability to find shelter placement. Respite care facilities could potentially expedite discharge in these situations and other situations identified. Respite care could also improve the healing and
recovery of individuals experiencing homelessness, a group that faces many challenges to good health.
A STORY OF CHANGE: THE INFLUENCE OF NARRATIVE ON AFRICAN-AMERICAN PATIENTS WITH DIABETES Anna Goddu1;
Katie Raffel3; Monica Peek1,2. 1University of Chicago, Chicago, IL;
2University of Chicago, Chicago, IL; 3University of Chicago, Chicago, IL. (Control ID #1338420)
BACKGROUND: Identifying culturally-tailored methods to improve diabetes self-care and shared decision-making (SDM) are key areas of research that can improve the health of racial/ethnic minorities. Narrative in the form of storytelling, entertainment, and role-play has shown promise as a means of facilitating behavior change, yet recent models describing its influence have not been fully explicated, and little is known about its effect in diabetes self-care or SDM.
METHODS: The Diabetes Empowerment Program (DEP) is a culturally-tailored intervention to improve self-care and SDM among African-Americans; it has improved patients self-efficacy, self-care behaviors and diabetes control. The DEP incorporates several narrative elements: personal testimonials, role-play, and a film with SDM vignettes. Our study had two aims: 1) To understand how program narrative elements may have affected diabetes-related behavior change, and 2) Whether our results would validate Larkey and Hechts conceptual model, which describes narrative elements as mediated by transportation (i.e. engagement), identification (e.g. with characters), and social proliferation (rehearsal, discussion, support) to influence health behavior change. We conducted four focus groups and seven in-depth interviews with former DEP patients. Using a structured topic guide, trained interviewers asked participants to describe their experience with DEP's narrative elements. Each interview/focus group was audio-taped and transcribed verbatim. Transcripts were independently coded by two researchers using an iterative process and analyzed using Atlas.ti software. RESULTS: 31 patients participated in the focus groups and 7 were interviewed in-depth. 76% were female, and the mean age was 58. The mean income was<$25 k, and the mean number of years with diabetes was 8. Participants reported many narrative elements that influenced their behavior change, from which we identified three central themes. The programs narrative elements: 1) facilitated skills training in diabetes self-care and SDM (when we role playedit broke down my shell. She was teaching us step-by-step); 2) generated relevant teachable moments, making the material more applicable and memorable (somebody might saywhen I started doing this eating properlymy [sugars] went downOkay, I wonder if I did that will mine go down); 3) built strong social support among participants that facilitated program retention and behavioral change (instead of me pushing away from [the education]its an inspiration because you hear what others go through and we get a chance to share). These themes align closely with Larkey and Hechts three social proliferation mediators: rehearsal/reinforcement, discussion/diffusion, and reciprocal support. Participants also described transportation (it had really brought me back) and identification (I saw me there), but these were less prominent themes.
CONCLUSIONS: Our study suggests that the use of narrative can facilitate behavior change among African-Americans with diabetes. The social mediation of narrativesthe discussion and rehearsal of stories, and the support that results from sharing themmay be particularly relevant for this population, especially given their

salience to existing African-American cultural traditions of shared knowledge creation, the use oral testimonials and the helping tradition.

A SURVEY OF PRIMARY CARE CLINICIANS ON USE OF DECISION AIDS AND CONFIDENCE IN SHARED DECISION MAKING SKILLS Leigh H. Simmons1; Lauren Leavitt2,1; Christine Greipp3,1; Karen R. Sepucha2. 1Massachusetts General Hospital, Boston, MA; 2Massachusetts General Hospital, Boston, MA; 3Massachusetts General Hospital, Boston, MA. (Control ID #1339540)

BACKGROUND: Since 2005, primary care clinicians at Massachusetts General Hospital in Boston, MA, have been able to prescribe decision

aids (DAs) to their patients through the electronic medical record. There are 35 video and paper-based DAs available that cover a range of medical conditions such as prostate cancer screening and treatment of knee osteoarthritis. The use of the DAs has increased over time, however, some providers use them often and others never use them. Clinicians were surveyed regarding their perceptions about the use of decision aids and shared decision making in routine clinical practice.

METHODS: A survey was distributed to 361 primary care clinical staff across 15 primary care practices through a survey website. Participants also had the option to receive the survey on paper, via fax. Up to three reminder emails were sent to non-responders. The survey closed after 3 weeks. The survey included 20 questions that examined use of decision aids, perceived barriers to use, and a self-assessment of two key shared decision making skills: risk communication and elicitation of patients goals and preferences. RESULTS: 179 of 361 clinicians (50%) invited to complete the survey responded. Respondents from all 15 primary care sites submitted surveys. The majority of respondents were women (66%) and physicians (85%), with 51% attending physicians, 34% resident physicians, and 14% nurse practitioners. About half of respondents (53%) indicated that they had personally prescribed at least one decision aid (users) and 47% indicated that they had never prescribed a decision aid (non-users). Users were more likely to have watched a video decision aid compared to non-users (63% vs. 23%, $p<0.001$). Users were more likely to feel that the programs definitely helped provide better care for patients (72% vs. 34%, $p<0.001$) and less likely to feel it was difficult to provide decision aids to patients (23% vs. 53%, $p<0.001$) compared to non-users. The most frequent barriers to use of decision aids were not remembering to prescribe (63%) and having few patients who were eligible for the available programs (21%). Very few non-users (2.3%) mentioned concern about increasing visit length as a barrier to using DAs, and only 10% of users felt that using the programs increased the length of their visits. Only 19% of respondents stated that they felt very confident in their ability to communicate risks of treatments and probabilities of outcomes to their patients, and 38% felt very comfortable eliciting patients goals and preferences.

CONCLUSIONS: Many primary care clinicians at Massachusetts General Hospital have experience using decision aids with patients. Potential facilitators for increasing use of decision aids were identified, including provider viewing of the programs to increase familiarity with the content and automation of the prescription process to reduce reliance on clinicians remembering to prescribe programs. The finding that few primary care clinicians felt very comfortable and confident in their shared decision making skills is an impetus for enhancing training in these areas.

A SYSTEM DYNAMIC MODEL OF STROKE REHABILITATION ADHERENCE: HOW MUCH SHOULD WE SPEND TO IMPROVE? David Matchar1,3; Gerald Koh2; John Ansah1; Sean Love1. 1Duke-National University of Singapore Graduate Medical School, Singapore, Singapore; 2National University of Singapore, Singapore, Singapore; 3Duke University Medical Center, Durham, NC. (Control ID #1340283)

BACKGROUND: Despite evidence that rehabilitation following stroke is effective in reducing morbidity and

mortality, rates of use of rehabilitation services is low; in Singapore, a major issue is adherence with recommendations, with approximately 80 percent of referred individuals not attending stroke rehabilitation. Evidence that rehabilitation can reduce long-term disability and attendant costs in general has not provided a compelling policy case for funding a program to improve attractiveness of rehabilitation services. Our objective was to use simulation modeling to provide a vivid demonstration of the potential benefit of various policies to improve uptake of stroke rehabilitation, including a dynamic policy of linking funding to projected cost-effectiveness.
METHODS: A stock and flow model representing the potential sequences of events following a strokeincluding rehabilitation, improvement, or another serious eventwas constructed. The model focused on a major factor in reducing rehabilitation adherence: the attractiveness of services (e.g., convenience and cost). The model provides an estimate of the cost-effectiveness of rehabilitation at different rates of utilization, accounting for the cost of raising levels of utilization. On this a prospective policy is
imposed: to enhance the attractiveness of rehabilitation services through increased levels of government support up to the point at which marginal cost-effectiveness exceeds a prescribed threshold. Based on different hypothetical production functions for service uptake (i.e., relationships between added cost and increased use of rehabilitation service), we examine the value of the policy in terms of social cost-effectiveness. Estimates of model inputs were based on extant population surveys and estimates from the research team.
RESULTS: The model suggests that the proposed policy of improving the attractiveness of rehabilitation services could be constructed in such a way that would allow spending for enhancing rehabilitation services to expand only to the threshold of an acceptable level of health value for money. Depending on the nature of the true production function, and the desire for rapid service expansion and the tolerance for overshoot, a robust policy is feasible.
CONCLUSIONS: Substantial underuse of stroke rehabilitation services provides an excellent opportunity to search for policies that will increase uptake. Modeling helps to provide an evidence-based approach on how to improve uptake of rehabilitation services and quality of life for post-stroke patients.
A YEAR IN REVIEW: IMPLEMENTATION OF A REFUGEE CLINIC AT PENN CENTER FOR PRIMARY CARE
Rachael Truchil; Joseph M. Garland; Matthew H. Rusk. University of Pennsylvania, Philadelphia, PA. (Control ID #1339689)
BACKGROUND: A partnership between a Philadelphia-area refugee resettlement agency and Penn Center for Primary Care, the site of an internal medicine resident clinic, was developed in October 2009. From that partnership a Refugee Clinic was created that opened in October 2010. Now one year after the clinic has been operating we have reviewed our progress and evaluated the clinics compliance with national guidelines for refugee screening so as to improve the clinic in moving forward.
METHODS: A retrospective audit was performed using our electronic medical record and results were compiled and analyzed using Excel. RESULTS: Seventy-five patients were seen during the course of the year, including refugees from five ethnic groups: Bhutanese Lhotshampa, Chin and Karen from Burma, Eritrean, and Russian patients. As per CDC guidelines, our goal is to see all patients within 30 days of arrival in the US. Over the past year we met this goal with 78.7% of the patients we saw, however during the past six months, we met this goal with 97.4% of patients suggesting significant improvement. All patients received a screening complete blood count, QuantiFERON Gold testing for tuberculosis (TB) infection, and hepatitis B serologies. Eosinophilia was common, with 13 patients (17.3%) having an absolute eosinophil count greater than 450. 94% of patients were screened for Strongyloides with three patients testing positive and all received treatment. Serologic testing for Schistosoma infection was positive in 4 of 11 patients tested. One third of patients had positive QuantiFERON Gold testing without symptoms or evidence on chest radiograph of active TB. Rates of immunization for our patients were high with greater than 93% of patients having received MMR, Td or Tdap, and Hepatitis B vaccination (when indicated). Varicella immunity was assessed by history and serology in 96% of patients; all 6

of the non-immune patients were vaccinated. 64% of patients received the seasonal influenza vaccine, 75% of eligible patients received the pneumococcal vaccine, and 16 patients received HPV vaccination. We have also focused attention on making sure the patients seen in clinic received routine age-appropriate preventive health screening. 80.6% of female patients received a Pap test and a lipid profile was checked in 57.3% of patients. Several older patients have required screening colonoscopy, DEXA scans, and mammography. We did not start referring patients for these tests until midway through the year and therefore do not have estimates of number of patients receiving screening.
CONCLUSIONS: Our compliance with CDC guidelines was high but still could be improved upon. In moving forward, we hope to improve upon our rates of routine preventive health screening and have higher rates of vaccination. We also hope to improve treatment rates for latent tuberculosis infection. Finally, we hope to create protocols for the work-up of commonly encountered problems, including eosinophilia, thrombocytopenia, and abdom-

inal pain. We also plan to evaluate the educational value of resident participation in the clinic.
A BROAD ASSESSMENT OF THE ORAL CASE PRESENTATION FROM THE PERSPECTIVES OF INTERNAL MEDICINE FACULTY AND 4TH YEAR MEDICAL STUDENTS Reza Sedighi Manesh1; Michael Elnicki2. 1University of Pittsburgh, Pittsburgh, PA; 2UPMC, Pittsburgh, PA. (Control ID #1333678)
BACKGROUND: The oral case presentation is recognized as a primary mode in which physician-physician communication occurs. It is recognized as an educational goal for trainees by the Clerkship Directors in Internal Medicine (CDIM), the Association of American Medical Colleges (AAMC), and the Accreditation Council for Graduate Medical Educators (ACGME). Nevertheless, many medical schools lack formal teaching of oral presentation skills to medical students. Further, senior trainees lack proper oral presentation skills in the inpatient and outpatient settings. There are limited data regarding how medical students learn skills necessary to present patients and whether teaching of such skills are lacking in medical education curriculum. We had 3 major goals: to further understand the teaching and learning of oral presentation skills, to gain the students perspective in regard to various aspects of the oral case presentation and compare it to that of faculty, and to assess whether students and faculty believe there is a need for formal education in oral presentation skills.
METHODS: We designed and administered a faculty-specific-survey to 44 internal medicine faculty members of the University of Pittsburgh School of Medicine (UPSOM) and a student-specific-survey to 156 fourth year medical students at UPSOM. Both surveys consisted of 10 questions: two free response questions, three or four multiple-choice questions, and four or five 5-point Likert response questions. The questions addressed various aspects of the oral case presentation: ideal time of a presentation in minutes, importance of various attributes of an oral case presentation, and need for formal education. Also, questions addressed the methods of learning and teaching of oral presentation skills by students and faculty. We generated descriptive statistics, used chi-square to compare categorical data, and compared means by t-tests. RESULTS: The survey response rate of faculty and students were 68% (29/44) and 76.2% (119/156), respectively. Faculty and students primarily learned by observing senior students and/or faculty (96.7% vs 96.6%, respectively, p0.1). Faculty and students less commonly learned from textbooks (17.6% vs 10%, respectively, p0.1) and journal articles(7.6% vs 17.6%, respectively, p0.1). Seven faculty members (23%) taught by Lecture and Walk Rounds, 16 (53%) taught by Walk Rounds, 1 taught by Lecture, and 6 (20%) taught by Other methods. Mean response regarding the ideal length of oral presentation of a new patient in minutes by faculty and students were 6.43. Mean response of a need for formal education of oral presentation skills by faculty and students were 41 and 4.20.9 (p0.1), respectively. Forty-six percent of faculty and 38.7% of students believe there is an absolute need (5/5 Likert) for formal education of oral case presentation skills. CONCLUSIONS: Our study addressed each of the aforementioned goals: (1) students primarily learn oral presentation skills from observing senior trainees, and faculty primarily teach students such skills during walk rounds. (2) Students and faculty members opinions

regarding length of an ideal presentation, importance of various attributes of a presentation, and contribution of students presentation skills towards final grade on medicine clerkship were similar. (3) The majority of students and faculty absolutely (5/5 Likert) believe there is a need for formal education in oral presentation skills.

A COMPARISON OF PATIENTS AND PHYSICIANS PERSPECTIVES ON PRESCRIPTION MEDICATION COSTS Leslie Ramirez; Toshiko Uchida; Kenzie A. Cameron; Charlie Zei; Ariane M. Garrett; Anne Henson; Eric D. Christoff; Ami Desai; Erik Orelind; Michael Zielinski; David W. Baker. Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1327007)

BACKGROUND: Patients are shouldering a larger and larger portion of the costs of their medical care. In particular, out-of-pocket costs for
prescription medications have increased substantially in recent years. In an earlier study in our patient population 55% of patients reported being concerned about the costs of their prescription medications. The physicians in our Practice-Based Research Network (PBRN) also expressed concern about patients ability to pay for their medications. The goals of this study included: 1) Comparing patients and physicians perspectives on the magnitude of the problem of prescription medication costs, and 2) Comparing patients and physicians perspectives on the roles of the physician and patient in addressing prescription medication costs. METHODS: This study was conducted by the PBRN at Northwestern University Feinberg School of Medicine known as the Research and Education for Academic Achievement (REACH) Network. We surveyed patients and physicians at 9 of the academic and private practice internal medicine sites in the REACH Network. During the study period, every patient who came for an appointment was given a paper survey to complete after the visit regarding prescription medication costs. Physicians were sent similar surveys by email with paper copies delivered in person to those who failed to complete the email survey. The surveys included both Likert-type and yes/no items about patients and physicians attitudes regarding prescription medication costs. This study was a subset of a larger REACH study regarding prescription medication costs.

RESULTS: Three hundred nine (response rate of 26.2%) patients and 66 (response rate of 88.0%) physicians responded to the surveys. Among patients, 56.1% agreed/strongly agreed that they were concerned about the costs of their prescription medications. In comparison, physicians estimated that 60.5% of their patients were concerned about medication costs. In addition, 25.4% of patients agreed/strongly agreed that they have difficulty paying, while physicians estimated that 28.1% of their patients have difficulty paying for prescription medications. In contrast, 62.9% of patients compared to 87.9% of physicians agreed/strongly agreed that the physician should discuss prescription costs with patients. Finally, 85.8% of patients agreed/strongly agreed that they feel comfortable talking with their doctor about prescription costs, whereas 93.9% of physicians stated they agreed/strongly agreed that they feel comfortable talking with patients about the costs of their prescription medications.

CONCLUSIONS: When compared to patients self-report, physicians in this study were remarkably close in estimating the proportion of patients who were concerned about the costs and had difficulty paying for their prescription medications. In contrast, many fewer patients than physicians felt it was the physicians responsibility to discuss prescription medication costs. Also, in a clinical encounter, patients reported feeling less comfortable discussing medication costs than did physicians. Educational materials and outreach to patients are needed to encourage patients to discuss their concerns about medication costs with their physicians.

A NOVEL CONCEPTUAL MODEL FOR CLINICAL DECISION COMPLEXITY Donna M. Zulman2,1; Susana B. Martins3; Steven Asch2,1; Mary K. Goldstein3,1. 1Stanford University, Stanford, CA; 2VA Palo Alto Health Care System, Menlo Park, CA; 3VA Palo Alto Health Care System, Palo Alto, CA. (Control ID #1336944)

BACKGROUND: Patient complexity is frequently cited as impeding adherence to chronic disease management guidelines. While it is generally assumed that complex patients generate complex management decisions, this relationship has not been rigorously studied. Our objective is to develop a novel conceptual model for clinical

decision complexity, and use data from a clinical decision support (CDS) system to illustrate the models dimensions in the setting of hypertension management.
METHODS: We used a cognitive engineering approach to develop a conceptual model with two major dimensions of clinical decision complexity: Component complexity (the number of information cues associated with a decision) and coordinative complexity (the level of interaction between components) (Figure). We illustrate the dimensions of this model in the setting of hypertension management decisions, using electronic medical record data from a Veterans Affairs hypertension CDS system (ATHENA-HTN). RESULTS: In an analysis of a preliminary sample of 4006 patients with hypertension, common contributors to decision component complexity were older age (67% were>= 65), blood pressure above target (35%), >=3 prescribed anti-hypertensives (23%), diastolic blood pressure <60 mmHg

(10%), and a history of an adverse reaction to an anti-hypertensive (8%). Coordinative complexity arose when multiple, interacting components were present (e.g. among 1417 individuals with blood pressure above target, 17% were over the age of 65 and were on>=3 anti-hypertensives). Coordinative complexity also arose due to the presence of comorbidities with potential disease-disease or medication-disease interactions (mean 4, SD 2.4). For example, 295 (7%) individuals had a condition that constituted a compelling indication for adding a specific anti-hypertensive medication, but also had a condition that constituted a relative contraindication to that same medication
(e.g. a patient with heart failure and COPD had a compelling indication and a relative contraindication for a cardioselective beta-blocker, respectively). CONCLUSIONS: We successfully applied this novel model for decision complexity to hypertension management decisions. Further investigation should examine how best to quantify the dimensions of component and coordinative complexity in order to develop CDS systems that reduce both dimensions. Distinguishing between patient and decision complexity could inform cognitive service reimbursement policies and the development of quality metrics.
A NOVEL METHOD TO TEACH INTERNAL MEDICINE RESIDENTS BEHAVIORAL COUNSELING SKILLS: THE PREVENTIVE MEDICINE EDUCATION PARTNERSHIP (PEP) CURRICULUM. Jennifer Rockfeld; Jennifer Neuman; Anju Dayal; JennyJ. Lin. Mount Sinai School of Medicine, New York, NY. (Control ID #1339067)
BACKGROUND: Most physicians understand the benefits of diet and exercise in the management of many chronic diseases, including obesity, hypertension and diabetes. Despite this awareness, many cite time constraints and lack of training as barriers to providing adequate patient guidance. To address this issue, we developed an evidence-based nutrition and exercise curriculum and created a group visit model for Internal Medicine residents to develop their behavioral counseling skills outside of the usual constraints of a clinic visit.
METHODS: All third year Internal Medicine residents participated in the Preventive Medicine Education Partnership (PEP) curriculum as part of their ambulatory four-week block. Each month, three to six residents underwent a one-hour lecture based on the New York City Department of Health Primary Care Nutrition 101 curriculum as well as three brief lessons on evidence-based exercise recommendations, small group teaching skills and health care literacy. The residents then developed a one-hour lesson plan for their
patients focusing on a low salt diet, a low fat diet, or portion control. They were encouraged to make the session both interactive and appropriate for a low literacy audience. The residents recruited patients from their clinic to participate in three weekly sessions focusing on the topics above. A 30-minute walk and establishment of individual goals followed each session. Residents attitudes toward and confidence in their ability to provide nutrition and exercise counseling were assessed before and after the intervention using an adaptation of a validated survey on a 4-point Likert scale. They also answered qualitative questions at the end of the block to

assess whether the curriculum contributed to their education as a whole. All of the residents responses were anonymous, and students t-test was used to compare pre and post-intervention answers.
RESULTS: Thirty-five third-year residents received the PEP curriculum. Of these, 31 (88%) and 27 (77%) completed the pre and post surveys, respectively. Before and after participation in the PEP program, all residents agreed that all overweight, hypertensive and diabetic patients should be counseled on diet and exercise. The vast majority agreed that it was their responsibility to counsel on diet (97% pre, 93% post) and exercise (94% pre, 93% post). Time constraints and other medical issues of higher priority were cited as barriers to providing adequate counseling. Following participation in the PEP curriculum, residents were more comfortable identifying what is important when providing dietary counseling (mean 2 vs 2.5, $p<0.0046$).

They felt more prepared to follow evidence-based guidelines in counseling their patients about diet (mean 2.1 vs 2.8, $p<0.0001$) and exercise (mean 2.2 vs 2.6, $p<0.0207$) and also were more confident in their ability to improve patients diets (mean 2.3 vs 2.7, $p<0.0054$). All of the residents believed the curriculum should be continued as part of their ambulatory experience. CONCLUSIONS: The PEP curriculum improved residents confidence in their ability to provide evidence based, effective nutrition and exercise counseling. Our findings suggest that a nutrition and exercise curriculum paired with a group visit model is an innovative and potentially successful method to teach residents relevant skills while minimizing the time constraints of the typical clinic environment.

A OBSERVATIONAL STUDY TO MEASURE THE AMOUNT OF TIME NEEDED TO ADMIT A NEW GENERAL MEDICINE PATIENT Kathlyn E. Fletcher1; Alexis M. Visotcky2; Jason M. Slagle3; Matthew Weinger4,3; Sergey Tarima2; Marilyn Schapira5. 1Milwaukee VAMC/Medical College of Wisconsin, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI; 3Vanderbilt University, Nashville, TN;
4Tennessee Valley VAMC, Nashville, TN; 5University of Pennsylvania/ Philadelphia VAMC, Philadelphia, PA.
(Control ID #1324279)
BACKGROUND: Workload is often conceptualized as the numbers of patients for whom a given physician is responsible. However, little information exists about how much work individual patients actually contribute to the workload of a physician. We conducted this study to determine the amount of time internal medicine interns spend on new patient admissions.
METHODS: We conducted a prospective time-motion study on general internal medicine wards at a single tertiary care VAMC, with IRB approval. We consented internal medicine interns and patients admitted by those consented interns. Inclusion criterion for the patients was being admitted to a consented intern. Exclusion criteria were being 1) unable to give consent, 2) admitted after 1 AM; and 3) admitted directly to the ICU. We trained observers to shadow interns during an on call period. We used specialized software on laptop computers to continuously record the tasks performed by interns. We also recorded work performed by the interns for consented patients. We calculated the total time spent on individual patients at 4, 6 and 8 hours after admission. We also calculated the amount of time spent on different types of work (e.g., direct patient care) for each patient. We recorded demographic information for the patients and interns and collected other workload data for the interns such as the number of patients cross-covered and the number of patients on the team at the start of the day. We evaluated the relationship between time spent on patients and possible predictors of time spent by using Pearson's correlations.
RESULTS: Twenty-five of 36 (69%) interns and 26 of 43 (60%) of patients agreed to participate, although 1 patient left AMA prior to data being collected. Mean age of interns was 28.6 (SD 2.4) and mean age of patients was 62.5 (SD 14.2); 98% of the patients were men. Interns spent a mean of 69 31 minutes with each new admission in the first 4 hours after admission, 89 41 minutes after 6 hours and 10787 minutes at 8 hours. In the first 4 hours, interns spent a mean of 32.019.9 minutes (47%) in documentation tasks,16.513.3 minutes (25%) communicating with other healthcare professionals, and 15.9015.03 minutes (22%) at the bedside of each new

patient. The remainder was spent in other activities such as teaching about the patient (2 minutes or 2%). Care for patients occurred episodically, with a mean of 36 tasks devoted to each patient in the first 4 hours of admission. We examined correlations between the number of hours spent on individual patients and other workload parameters. We found that the amount of time that interns predicted that they would spend on the patient was negatively correlated with amount of time they actually spent (r=-0.43, p=0.03). The number of months an intern had been in training was also negatively correlated with the amount of time actually spent (r=-0.38, p=0.06). Team census, intern census and number of patients cross-covered were not significantly correlated with time spent on individual patients.
CONCLUSIONS: We have demonstrated that it is possible to measure the amount of time interns spend on new admissions. These admissions take a significant amount of time. This work is fragmented, and predominantly composed of indirect patient care. Less experienced interns spend more time
than more experienced interns, which reinforces the need for graduated responsibility of patient care.
A PATIENT-CENTERED TEAM APPROACH TO HOME-BASED PRIMARY CARE: A MODEL FOR MULTIDISCIPLINARY PRIMARY CARE AT THE MOUNT SINAI VISITING DOCTORS PROGRAM Cameron R. Hernandez; Meng Zhang; Silvia Chavez; Katherine Ornstein; Theresa Soriano. Mount Sinai Medical Center, New York, NY. (Control ID #1340699)
BACKGROUND: There are at least three million homebound adults in the United States, comprising a costly population at high risk for fragmented care and hospitalization. Mount Sinai Visiting Doctors Program (MSVD), the largest academic home-based primary care program in the U.S., cares for over 1000 homebound patients in Manhattan annually. Despite the programs growth, there continues to be a greater need in the community for primary care services for the homebound than the program is able to meet at its current capacity and structure. In October 2009, MSVD launched a project designed to extend our capacity to care for the most vulnerable homebound patients. Utilizing a patient-centered care team consisting three physicians (two full time equivalents), a social worker, a nurse practitioner, and an administrative assistant, the goal was to extend primary and palliative care services to 50% more homebound individuals per primary care provider while maintaining high quality care.
METHODS: We evaluated the cost-effectiveness of the new multidisciplinary team approach compared to our existing physician-centered model. Additionally, we compared hospitalization rates in 2010, patient satisfaction, and provider burnout for patients receiving team versus standard care. RESULTS: The interdisciplinary team was able to care for 393 patients from 10/1/09 to 11/15/11 which was a 40% increase in each physicians panel size. The wait list to enter MSVD was decreased from over 100 to 40 patients. Wait time until entry into MSVD was decreased from over 12 weeks to 5 weeks. One hundred percent of team patients were seen by one of the team provider post-hospital discharge. Eighty percent of new team patients were evaluated by a social worker. While there was no difference in the number of hospitalization admissions per 1000 patient-days (3.65 team vs. 3.75 non-team) or repeat admissions (10% team vs. 9% non-team) for 2010, the team providers reported less feelings of burnout than non-team providers. Team patients were as satisfied as non-team patients. Team patients had greater recognition of social work and nursing staff. There was 40% increased monthly revenue for one team physician FTE versus one non-team physician FTE. Finally, team patients were cared for at a 15% reduced cost per patient compared to patients receiving standard non-team care at MSVD. CONCLUSIONS: Although we did not find reduced hospitalizations through the use of the team approach, we did find that the program expanded care capacity at no additional cost with no negative impact on quality of care for patients. Home-based primary care programs should continue to explore multidisciplinary approaches to patient care which may be more cost-effective and result in improved patient experience and provider satisfaction, thereby reducing unnecessary healthcare costs.
A POSITIVE DEVIANT ANALYSIS OF SELF-MANAGEMENT STRATEGIES AMONG AFRICAN-AMERICAN AND LATINO PATIENTS WITH DIABETES Ian Huntington1; Ashley Harris2; LeRoi Hicks3. 1Brigham

&Women's Hosp, Boston, MA; 2Brigham &Women's Hospital, Jamaica Plain, MA; 3University of Massachusetts Medical Center and UMass Medical School, Worcester, MA. (Control ID #1340000)
BACKGROUND: Positive deviance is a research method that seeks to identify those people who have achieved an unexpected good outcome despite high risk, and then uncover the individual psychological, environmental, and behavioral factors that are contributing to that success. To our knowledge, this method has yet to be utilized among high-risk diabetes patients. This study focused on those patients with diabetes who had a history of poor disease control but had then made improvements in self-management. METHODS: We examined African-American and Latino patients with Medicaid insurance receiving care at a hospital based outpatient residency

clinic with either residents or faculty as their primary care physicians. Positive deviants (PDs) were defined as having had at least two HbA1c measurements greater than 9% at least 3 months apart and then at least 3 months of HbA1c measurements <7.5%, including the most recent value. We excluded patients who were only on oral agents at the time of poor control, on dialysis, had dementia or had bariatric surgery. Semi-structured interviews were conducted with subjects by co-authors in English (IH) and Spanish (AH). Interview transcripts were recorded, transcribed, and in the case of Spanish language interviews, translated into English for analysis. After coding, we utilized NVivo9 qualitative software to search for themes that occurred frequently in a single interview or across interviews and resulted in categorical nodes, and then grouped them into larger themes. Several interviews were coded by both IH and AH to insure consistency of coding.
RESULTS: Of a total of 490 patients with a HbA1c >9% from 2003-2010, we identified 55 potential subjects who met the above criteria for periods of both poor and improved control. Of these, 14 patients (25%) met further inclusion criteria for being PDs and seven consented for an interview. Two year after data collection, six of the PDs had had HbA1c levels >7.5%. A common theme for the period of poor control was social stressors, including ill parents, a dysfunctional marriage, and homelessness. These stressors caused patients to both deny that they had diabetes and to neglect medications, exercise or dietary self-management. Transitions to improved control were in several cases centered on diabetes health related events which occurred both to the PD and within their families, causing the PDs to take their disease more seriously. For other subjects, it was addressing the significant stressors in their lives. All subjects discussed the sequelae of diabetes (dialysis, vision changes, amputations), and patients were more likely mention these effects if they had family members with that complication. Specific strategies of change included walking more after the transition and diet changes that included removing ill-advised foods from the home and strategies for reducing consumption.
CONCLUSIONS: We found that among traditionally high-risk groups for diabetes complications, the family context of diabetes emerged as an important contributor to the process of change through providing examples of the complications of diabetes and supporting behavioral change; this familial context should be explored by health care providers. Providers should also establish programs to assist high-risk patients with the social factors that may take priority for patients over disease self-management. The difficulty of sustained change is underscored by the rising HgA1c in six of the seven subjects.
A PROFILE OF POORLY CONTROLLED DIABETICS IN SOUTH FLORIDA: THE MIAMI HEALTHY HEART INITIATIVE Olveen Carrasquillo; Elizabeth Patberg; Sonjia Kenya; Yisel Alonzo. University of MIami, Miami, FL. (Control ID #1339706)
BACKGROUND: Given the growing epidemic of diabetes, particularly among Latino populations, there is an impetus to define and implement culturally sensitive interventions aimed at helping to improve health status and the quality of diabetes care in this group. There is increasing consensus that Community Health Workers (CHWs) can have an essential role in narrowing such diabetes and cardiovascular health disparities. However, evidence of their effectiveness from rigorous randomized controlled clinical trails is limited.

METHODS: The Miami Healthy Heart Initiative is clinical trial of poorly controlled Latino diabetic patients randomized to usual care or a one year CHW intervention. Patients are identified from our local public hospital clinic using automated EMR queries followed by opt-out letters and recruitment phone calls. Our primary outcomes are changes from baseline in systolic blood pressure, LDL and HgA1C. Additional outcomes include self-reported medication adherence (Morisky), medication intensification, self-efficacy and self-reported dietary intake (BRFSS) and physical activity (IPAQ). Other measures include acculturation (Marin), health literacy (SAHLSA), and depression (PHQ-9).
RESULTS: To date we have sent recruitment letters to 540 potential patients. Of the 294 subjects that we have been able to contact and whom on screening were study eligible, 79% have agreed to participate. So far we have randomized 178 of our planned 360 patients. Mean age is 56 yrs7 and approximately 30% of our sample is Cuban. The rest of the the study subjects comprise a variety of other Latino ethnicities with no other group representing >15% of the sample. Enrolled participants have a mean SBP of 132 mmHg 18, LDL 99 mg/dl41, and HbA1c of 9.0%.1.7. Most subjects are obese (mean BMI 32.47.7), 44% have low acculturation, but only 12% have low health literacy. Nearly all (70%) have inadequate medication adherence and 48% reported low diabetes related self-efficacy. Although, we are still not adequately powered to make planned statistical comparisons some emerging trends are already evident. For example, the least acculturated Latinos are trending to have better diabetes control than those most acculturated (8.8 1.7 vs 9.4 1.9). Diabetes self-efficacy also seems to be related to poorer glycemic control (8.51.5 vs 9.41.7). In the intervention group, each of our three CHWs is handling a caseload of approximately 30 patients. CHWs have made 8.1 home visits and 14.2 phone calls per patient. Patients have participated in a mean of 2.1 group educational sessions.
CONCLUSIONS: As compared to other communities, poorly controlled Latinos diabetics in MHHI are very ethnically diverse and have relatively high health literacy but similar to others low acculturation status. MMHI is already generating important cross-sectional data of Latino diabetics in Miami. Preliminary findings suggest that existing measures of self-efficacy are valid in this South Florida Latino population. We are also finding evidence of the Latino paradox in our cohort.

A QUALITATIVE INVESTIGATION OF THE DECISION TO INITIATE DO NOT HOSPITALIZE ORDERS AMONGST HEALTH CARE PROXIES OF NURSING HOME RESIDENTS WITH DEMENTIA

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(Control ID #1337596)

BACKGROUND: Approximately 5 million patients with advanced dementia reside in nursing homes in the United States. Advanced dementia is a fatal illness, and routine hospitalization does not necessarily positively impact patients quality of life or health outcomes. Despite this, do not hospitalize (DNH) orders are rare. The demographics of patients with DNH orders have been studied, but little is known about the reasons why some health care proxies choose to initiate DNH orders. The objective of this study was to explore how health care proxies make this decision. METHODS: In this qualitative study, in-depth, in person semi-structured interviews were held with health care proxies (HCPs) of elderly nursing home residents with dementia. An interview guide was developed and tested with nursing home staff. All nursing home residents aged 65 years with an activated HCP were considered eligible. Nursing home staff mailed a letter to all HCPs informing them of the study and allowing them to opt out. HCPs were then contacted and invited to come to the nursing home for an interview. The interviews were audio-taped and transcribed verbatim. Applying grounded theory, transcripts were coded in an iterative process with revision of the interview guide as indicated to prompt for emerging themes. Codes were then organized into pertinent themes. Demographic and clinical characteristics of the nursing home residents were collected from the Minimum Data Set and patient charts.
RESULTS: Of the 31 eligible HCPs, 9 declined to be interviewed, 5 could not be reached and 1 was unable to come for an interview because the resident was hospitalized. The remaining 16 HCPs participated in

approximately 1 hour long interviews. Eight participants had transfer limitations in place, and in most cases had a stipulation allowing for hospitalization in the case of an acute injury. Only 1 participant had an absolute DNH order. The subject of DNH orders elicited a wide variety of responses. Not all HCPs were familiar with the orders; of those that were, their opinions towards the orders were generally strongly positive or negative. All participants, regardless of their opinion of DNH orders, reflected on the challenges of health care decision-making. Major themes that arose included factors that facilitate initiating DNH orders and factors that present barriers to initiating DNH orders. Facilitators included HCP experience in the health care industry, an accurate understanding of the residents prognosis, and a desire to limit resident

distress during hospital transfers. Barriers included a perceived lack of physician involvement in decision-making, a limited understanding of the residents prognosis and a limited understanding of the orders. Other salient themes included misunderstandings about the role of HCPs in decision-making and the personal nature of the decision to limit care. CONCLUSIONS: In this qualitative study of HCP decision-making, we found a number of barriers to initiating DNH orders, some of which appear to be modifiable. Randomized trials are necessary to explore whether interventions to overcome these barriers can increase the number of HCPs who choose to initiate DNH orders.

A RANDOMIZED TRIAL OF PHONE-BASED MOTIVATIONAL INTERVIEWING ON ADHERENCE TO CLOPIDOGREL AFTER A CORONARY STENT AMONG BLACK AND HISPANIC SUBJECTS. Ana M. Palacio1; Leonardo Tamariz1; Hua Li1; Desiree Garay1; Claudia Uribe2; Leslie Hazel-Fernandez2; Olveen Carrasquillo1. 1University of Miami, Miami, FL; 2Competetive Health Analytics, Miami, FL. (Control ID #1336675)

BACKGROUND: Racial/ethnic minorities who receive coronary stents have lower medication adherence to antiplatelet agents. Motivational interviewing (MI) has been effective at inducing behavior change among patients with cardiovascular risk factors. The aim of this study is to compare the efficacy of phone-delivered MI to an educational video at improving medication adherence to clopidogrel among insured minorities.

METHODS: We conducted a randomized trial of Black and Hispanic patients enrolled in a health benefits plan who had recently received a coronary stent. Study patients were randomly assigned to either a telephone based MI intervention or a culturally tailored educational video. The MI intervention consisted of 4 phone-based encounters by trained nurses over 9 months each lasting about 20 minutes made from a centralized location. Outcomes variables collected at baseline and 12-month using surveys and administrative data included self - reported adherence (Morisky score), self reported forgetfulness and carelessness when taking antiplatelet medications and self reported completion of 12 month of therapy (only in 12 month survey). We used ttest and chi-square methods to compare outcomes between groups and used logistic regression to model predictors of self-reported forgetfulness taking medications.

RESULTS: We recruited 339 minorities (58% Hispanics and 42% Black) from 21 different states who had received a new coronary stent. Patients had a mean age of 69.58.8, 52% were males, 78% had an income less than $30,000/yr and only 22% had greater than high school education. At 12 months, as compared to the video group, patients in the MI group had significantly better self reported adherence (lower Morisky score), and were less likely to report being forgetful or careless about taking antiplatelet medications (Table 1). Other important predictors of self-reported adherence at 12 months were low health literacy, black race, and depression ($p<0.01$). Adjusting for these factors as well as socio-demographic characteristics, co-morbidities and baseline Morisky score at baseline did not significantly change our findings. CONCLUSIONS: Among blacks and Hispanics patients, phone-based motivational interviewing resulted in higher self-reported adherenceto clopidogrel after a coronary stent versus a mailed video.A centralized phone-based MI seems to be a promising cost-effective strategy which may help prevent stent re-occlusion among a large geographically diverse sample of minority patients.Analyses of medication adherence using claims data (medication possession ratio) will be

completed by May 2012.
Outcome Motivational interviewing group(n=169)
Video group(n=170)
A SYSTEMATIC REVIEW OF LONGITUDINAL POPULATION-BASED STUDIES ON THE PREDICTORS OF SMOKING CESSATION IN ADOLESCENT AND YOUNG ADULT SMOKERS Semanur Cengelli1,2; Jennifer L. O'Loughlin2,3; Beatrice Lauzon2,3; Jacques Cornuz1,4. 1University of Lausanne, Lausanne, Switzerland; 2Centre de Recherche du CHUM, Montreal, QC, Canada; 3University of Montreal, Montreal, QC, Canada; 4University of Lausanne, Lausanne, Switzerland. (Control ID #1335312)
BACKGROUND: Tobacco use causes more than five million deaths worldwide annually. In Canada in 2009, the prevalence of smoking was 13% among adolescents aged 15-19 years, and 23% among young adults aged 20-24 years. Many young smokers express the desire to quit, but most have a great deal of difficulty doing so. Empirical reviews have generally concluded that smoking cessation programs in youth have limited efficacy. In order to provide a solid knowledge base for future tobacco control interventions, the determinants of self-initiated cessation of duration of at least 6 months in youth need to be better understood.
METHODS: A systematic search of the PubMed and EMBASE databases using smoking, tobacco, cessation, quit and stop as keywords was performed. Limits included articles related to humans, in English, published between January 1984 and August 2010, and study population aged 10-29 years. A total of 4502 titles and 871 abstracts were reviewed independently by 2 and 3 reviewers, respectively. Nine articles were retained for data abstraction. The number of studies that reported a statistically significant association between each determinant investigated and cessation were tabulated, from among all studies that assessed the determinant.
RESULTS: Three of the nine studies retained defined smoking cessation as abstinence of at least 6 months and six studies defined it as abstinence of 12 months. Despite heterogeneity in methods across studies, five factors robustly predicted quitting across studies in which the factor was investigated: not having friends who smoke, not having intentions to smoke in the future, resisting peer pressure to smoke, being older at first use of cigarette and having negative beliefs about smoking. Additional factors are significant in some studies but not others or only once assessed. CONCLUSIONS: The literature on longitudinal predictors of cessation in adolescent and young adult smokers is not well developed. Cessation interventions for this population will remain less than optimally effective until there is a solid evidence base on which to develop interventions.
A1C VARIABILITY AND THE RISK OF DEVELOPING NEW DIABETES FOR THE HEALTHY ADULTS IN JAPAN Osamu Takahashi1,2; Daiki Kobayashi1; Gautam A. Deshpande2; Sachiko Ohde2; Tsuguya Fukui1,2; Paul Glasziou3. 1St.Luke's International Hospital, Tokyo, Japan; 2 St.Luke's Life Science Institute, Tokyo, Japan; 3Bond University, Gold Coast, QLD, Australia. (Control ID #1340192)
BACKGROUND: Recently, the ADA proposed a shift to A1C for the initial diagnosis of diabetes. However, the association of A1Cs variability with developing new diabetes has been little studied. We aimed to evaluate the effect of A1C variability on the risk of developing new diabetes in healthy adults in Japan.
METHODS: Population-based, cohort study from 2005 to 2008 in Tokyo, Japan of healthy adults not taking diabetes medication and with a HbA1c lower than 6.5% at baseline. Based on annual measurement of serum HbA1c we calculated the annual visit-to-visit variability, and used this as a predictor of new onset diabetes in a multivariate logistic regression. RESULTS: At baseline, 14,587 people (50% female) with a mean age of 51 years old (SD: 12 years, range: 23 to 92), a mean fasting plasma glucose (FPG) level of 98.4 mg/dl (SD: 9.3 mg/dl) and a mean HbA1c level of 5.3 % (SD: 0.4 %) had annual check-ups over 4 years. After adjusting for the other potential risk factors new diabetes was predicted by the A1C variability (odds ratio (OR): 10.3 for highest (>=0.16%)) versus the lowest quantile (<0.08 %), 95%CI: 5.9 - 18.0) and by the baseline A1C (OR: 55.2 for A1C of 6.0 - 6.4 % versus A1C of <5.0 %, 95% CI: 13.2 - 230). FPG (OR: 1.1, 95%CI: 1.1 - 1.2) and Smoker (OR:1.8, 95%CO: 1.3 - 2.6) weakly but also significantly related to develop the new diabetes. For predicting the development of diabetes, the

p-value
Not completing 12 months antiplatelet therapy, %
9 17 <0.01
Mean Morisky score 0.180.44 0.460.79 <0.01 Forgetting to takeantiplatelet therapy, %
8 24 <0.01
Being careless about taking antiplatelet therapy, %
7 16 <0.01

combination of the level of AIC at baseline and the variability (Area Under the Curve (AUC) for the ROC=0.94) was superior to the level of A1C at baseline alone (AUC=0.89). (Figure)
CONCLUSIONS: Visit-to-visit variability in A1C independently added to the baseline A1C in predicting the risk of developing new diabetes for the healthy adults.

ARROW PLOTS: AN INNOVATIVE METHOD OF PLOTTING SURROGATE AND CLINICAL OUTCOMES IN META-ANALYSES KoKo Aung1,2; Fanglong Dong4; Robert G. Badgett3,4. 1University of Texas Health Science Center at San Antonio, San Antonio, TX; 2University of Texas School of Public Health, Houston, TX; 3University of Kansas School of Medicine, Wichita, KS; 4University of Kansas School of Medicine, Wichita, KS. (Control ID #1334315)
BACKGROUND: Meta-analyses of health care interventions usually study dichotomous patient-centered clinical outcomes such as mortality. Clinicians titrate medical therapy to a surrogate outcome that is a continuous biomarker. Forest plots in meta-analyses do not, however, show well the relation between a surrogate outcome, baseline risk, and a clinical outcome. The objective of this study is to develop a visual display of quantitative information from meta-analyses to illustrate the link between a purported biomarker, baseline risk, and clinical outcome. METHODS: Differences in outcomes of randomized controlled trials are plotted on two dimensions for two independent variables: changes in a clinical outcome and changes in a surrogate outcome. Arrows begin with the results of the control groups, reflecting baseline risk, and end with the results of the intervention groups. Bayesian meta-analysis is performed and impact of therapy is described with judicial analogies. We illustrate by reanalyzing 3 recent meta-analyses, intensive lowering of LDL-cholesterol (CTT 2010), intensive insulin therapy in hospitalized patients (Kansagara 2011), and intensive glucose lowering treatment in type 2 diabetes (Boussageon 2011). RESULTS: The change in the y-coordinate of each arrow indicates relative risk reduction. The slopes of the arrows represent the relation between change in the biomarker and change in the clinical outcome. For intensive lowering of LDL-cholesterol (Figure), arrows are homogeneous suggesting a consistent association between biomarker and clinical outcome. For diabetes in hospitalized patients, arrows are heterogeneous suggesting inconsistent association between biomarker and outcome. However, two visually identifiable regions suggest association between biomarker and outcome in subpopulations. Intervention may improve clinical outcome in subpopulations with very high baseline glucose or very high baseline risk of mortality. For intensive glucose lowering in type 2 diabetes, arrows are heterogeneous without forming any identifiable homogeneous regions suggesting inconsistent association between biomarker and outcome.
CONCLUSIONS: This data visualization is innovative because two independent variables are dimensioned and Bayesian analyses of regions facilitate interpretation. Arrow plots allow assessment of biomarkers as indicators of therapy response and influence of baseline risk. Further research should develop a statistical measure for homogeneity of slopes of arrows and a method of identifying the thresholds of biomarker and baseline risks that separate benefit from harm.
Figure

ACCEPTANCE OF COMBIVENT RESPIMAT INHALATION SPRAY IN COPD PATIENTS Gary T. Ferguson1; Mo Ghafouri2; Luyan Dai2; Leonard J. Dunn3. 1Pulmonary Research Institute of Southeast Michigan, Livonia, MI; 2Boehringer-Ingelheim Pharmaceuticals, Inc, Ridgefield, CT; 3Clinical Research of West Florida, Inc, Clearwater, FL. (Control ID #1325478)

BACKGROUND: Chronic obstructive pulmonary disease (COPD) medications are preferentially delivered via oral inhalers. Combivent (CVT; ipratropium+albuterol) is currently only available as a metered-dose inhaler (CVT-MDI) that uses a chlorofluorocarbon (CFC) propellant. The Respimat inhaler is a novel, soft-mist inhaler that is CFC propellant-free. In association with the phase-out of CFCs worldwide, the Combivent Respimat Inhalation Spray (CVT-R) has recently been approved for patients with COPD in the USA, and will replace the phasing out MDI device. This study evaluated patient satisfaction+long-term safety of CVTR vs CVT-MDI vs the free combination of ipratropium (Atrovent) HFA and albuterol HFA metered dose inhalers (I+A).

METHODS: The study was a Phase III, 1-year, 3-treatment, open-label, randomized, active-controlled, parallel-group study. After initial screening, patients received CVT-MDI during a 3-4 week baseline period, followed by randomization to 1 of 3 treatments: CVT-R, CVT-MDI, or I+A for 48 weeks. Patients were provided with albuterol MDI rescue medication as needed. Study participants were males and females with COPD, aged 40 years, who were current or ex-smokers (smoking history, 10 pack-years). Treatment compliance was assessed using a patient Daily Diary Card. The primary endpoint was the Performance Domain Score (PDS) evaluated using a modified Patient Satisfaction and Preference Questionnaire (PASAPQ) at Visit 2 (Day 0; before randomization) and at treatment Visits 3-7 (Weeks 3-48). Adverse events (AEs) were recorded at each visit.

RESULTS: 688 patients were enrolled at 55 US sites and 470 were randomized to open-label treatment following baseline treatment with CVTMDI. Baseline demographics were similar for all treatment groups. Overall,

58.7% were male, 93.5% were white, 52.0% were current smokers, and63.0% used pulmonary medication at the time of informed consent. After 48 weeks of treatment, a statistically significantly higher PASAPQ PDS was observed for the CVT-R group vs the CVT-MDI and I+A groups ($P<0.0001$). Patients also indicated that they liked the actuation indicator component of the Respimat device. Improvements in lung function were similar for all groups from Day 1 through Week 48. Time to first COPD exacerbation (TTFE) hazard was slightly longer in the CVT-R group compared to other treatment groups, and the cumulative risk of COPD exacerbation was comparable. There was no significant difference among groups for TTFE leading to hospitalization and exposure-adjusted event rates. Overall, rescue medication use between the groups was not significantly different. Patients in the CVT-R group withdrew from the study in fewer numbers than patients in the I+A group ($P=0.0059$). All patients who received at least 1 dose of study medication were included in the safety analysis. Overall, 78.1% of patients completed the study and 72.0% reported an AE; the percentage of patients with serious AEs was similar in the 3 groups.

CONCLUSIONS: The environmentally friendly CVT-R was statistically superior vs CVT-MDI and I+A with regard to patient satisfaction, and fewer patients dropped out while receiving CVT-R. All 3 treatments showed a similar safety profile. A relative improvement in TTFE with CVT-R suggests that effective drug delivery and/or patient acceptance of the Respimat inhaler may benefit adherence and, therefore, clinical outcomes in patients with COPD.

ACCESS MATTERS: IMPROVED DETECTION OF PREMALIGNANT POLYPS WITH A SCREENING COLONOSCOPY PROGRAM FOR THE UNINSURED Damian Casadesus; Orlando Penaloza; Delaram Moazami; Armen Simonian; Daniel Goldsmith. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1309505)

BACKGROUND: Colonoscopy is an effective screening modality for the early detection of colonic polyps and cancer, but screening rates are low particularly among minorities and the uninsured. In 2008, Capital Health

obtained a clinical grant from the American Cancer Society to perform screening colonoscopies for patients without insurance who were established at the hospitals primary care clinic. The aim of this study is to evaluate the grant program with respect to endoscopic findings and changes in the demographics of patients undergoing colonoscopy.
METHODS: A retrospective review was performed of all patients registered for colonoscopy at the endoscopy suite of Capital Health Regional Medical Center. A pre- and post-implementation analysis was designed to compare 3 groups: 1) all colonoscopies performed in the twenty four months prior to the programs start (pre-program group) 2) all screening colonoscopies performed on uninsured patients in the program during twenty four months period (program group) and 3) all other colonoscopies performed in the same suite during the time of the program (parallel group). A descriptive analysis of demographics, ethnicity and insurance status was performed. The clinical endpoints included rate of polyp detection by screening and the histological description of polyps detected.
RESULTS: There were a total of 3596 colonoscopies performed during this 48 month period, 86 (2.3%) of them were excluded because the data was incomplete. The pre-program group had 1624 colonoscopies, 296 of which were screening colonoscopies, the program group had 339 screening colonoscopies, and the parallel group had 1547 colonoscopies, 292 of which were screening colonoscopies. Implementation of the grant program resulted in more than double the screening colonoscopies performed as compared to the pre-program period (296 vs 631). There was no change in the number of the reimbursed procedures performed in the same suite after initiation of the grant program. The proportion of minority patients undergoing a screening procedure was significantly increased compared to the pre-program group (89/296 vs 280/339; $p<0.001$) and parallel group (136/292 vs 280/339; $p<0.001$). This increase was largely accounted for by a higher proportion of Hispanic and African American patients. The number of patients with polyps was higher in the program group compared with the preprogram and parallel group (42%, 36.8%, and 33.9%, respectively) The total number of polyps and the number of premalignant polyps detected was higher in the program group probably related with the increased number of procedures during the two years period; however, the rate of detection of premalignant polyps did not change among the groups.
CONCLUSIONS: Retrospective analysis of a grant-funded program offering screening colonoscopies to uninsured patients demonstrated a higher rate of screening for an underserved population consisting largely of minority patients. Furthermore, the program resulted in detection of a higher number of premalignant polyps that might otherwise have been undetected. Our experience suggests that targeting health care disparities by insurance status can increase access to preventive services and detect a high number of premalignant lesions.
ACCESS TO PREVENTIVE COUNSELING SERVICES: HEALTH CENTERS VERSUS OTHER PHYSICIAN OFFICES Leiyu Shi2; LydieA. Lebrun1; Quyen Ngo-Metzger1. 1U.S. Department of Health and Human Services, Rockville, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD. (Control ID #1324096)
BACKGROUND: Vulnerable populations seek primary and preventive care from a range of health settings such as health centers (HCs) and physician offices (POs), which include private solo or group practices, free standing clinic/urgicenters, health maintenance organizations, and faculty practice plans. These settings vary in their mission, financial resources, staffing, and patient demographics, and thus, may also differ in the extent to which they are able to operate like a medical home for vulnerable populations. Given the well-known relationship between preventive care and health outcomes, it is important to identify healthcare providers or settings that best promote preventive care for vulnerable populations. The purpose of this study was to compare access to preventive counseling services by HC patients versus patients seen at POs. Racial/ethnic and insurance-related disparities in accessing preventive counseling services were also assessed.
METHODS: Data came from the 2008 National Ambulatory Medical Care Survey (NAMCS), a nationally representative annual survey, which reports on 28,741 visits to non-federal, office-based physicians. In 2008,

the NAMCS also included an oversampling of 104 HCs to provide more reliable data on HC patient visits. Key study variables included: 1) Measures of preventive counseling services: a. health education services for all patients;b. disease management services for patients with a variety of chronic conditions such as asthma, depression, diabetes, hyperlipidemia, hypertension, and obesity; c. asthma education for patients with asthma, d) tobacco use education for patients who smoke, and d. weight control education for patients who are overweight. 2) Measures of health care settings (HCs and POs), taking specific provider and community characteristics into account (e.g., % population below poverty level in patients zip code, % adults with bachelors degree or higher in patients zip code, urban-rural classification). 3) Measures of individual sociodemographics. Individual characteristics such as age, gender, race/ethnicity, education, income, health status, and presence and type of insurance were used as covariates.
RESULTS: Patients seen at HCs were more likely to be racial/ethnic minorities (65%) and have Medicaid (46%) or no insurance (11%) compared to patients seen at POs (26% minorities, 10% Medicaid, 4% uninsured). About 40% of HC patients received health education and counseling services compared to 36% at POs. After controlling for patient sociodemographic and health status characteristics and physician practice characteristics, logistic regressions showed that HC patients were as likely to receive preventive counseling service as patients seen in POs (health education: odds ratio 0.92, CI 0.64-1.33; disease management: odds ratio 0.95, CI 0.34-2.65; asthma education: odds ratio 1.34, CI 0.47-3.81). Furthermore, no adverse racial/ ethnic and insurance-related disparities were noted.
CONCLUSIONS: Patients seen at HCs reported comparable access to preventive counseling services compared to patients seen at POs. No significant racial/ethnic and insurance-related disparities were noted in accessing certain preventive counseling services. As safety-net providers for uninsured and vulnerable populations, HCs provide high levels of accessibility to preventive care services and contribute to overcoming healthcare disparities.

ACUTE RENAL FAILURE POST TWO STAGE ARTHROPLASTY USING ANTIBIOTIC LADEN SPACERS: A SYSTEMATIC REVIEW. Fahd Syed1; Madhumati Rao2. 1Mount Auburn Hospital, Cambridge, MA; 2Tufts Medical Center, Boston, MA. (Control ID #1334962)
BACKGROUND: Two stage arthroplasty is currently the treatment of choice for infected hip and knee joint prostheses. This technique is associated with more than a 90% success rate in terms of eradication of joint space infection (1-3). A number of complications including acute renal failure have been reported following spacer implantation. However, the data on these complications is often limited. Acute renal failure has been reported with the use of vancomycin, gentamicin as well as tobramycin in antibiotic spacers, and has been reported to occur as late as 5 months post implantation(4-8). However,in this instance again, the data regarding this complication are limited. Our aim was to do a systematic review of literature to assess the number of patients who develop acute renal failure post antibiotic spacer implantation. METHODS: Our inclusion eligibility criteria were original studies, both observational and clinical trials as well as case series or case reports and systematic review articles dealing with 2 stage revision arthroplasty (knee and hip), antibiotic loaded spacers, and antibiotic elution from spacers, and post operative complications/systemic complications, in particular acute kidney injury after two stage revision using antibiotic loaded spacers. Abstracts and manuscripts were reviewed by two independent investigators to determine eligibility. Reference lists from all reviewed articles from 1989 to 2011, including relevant narrative reviews were assessed to complete the literature search. Data about materials, methods, and results of each original article included was extracted into a specific form. The materials extracted were compared to each other and conflicting data were re-checked from the original papers and corrected after discussion. RESULTS: 7 out of a total of 297 (2.4 %) patients in whom renal function was

followed up developed acute renal failure. 5 of these were those who had hip spacers and 2 had knee spacers. Different antibiotics and dosages were present in the spacers so it is difficult to establish a relationship between the antibiotic concentration in the spacers and renal dysfunction. In addition to these studies there were 5 cases reported in 4 case reports that had AKI. 2 patients had non oliguric and 1 had oliguric renal failure. 3 of these patients required dialysis. Of these patients 3 had knee spacers and 2 had hip spacers. CONCLUSIONS: Infection itself is a risk factor for the development of renal impairment, which might suggest that patients with infected prostheses are at higher risk, although to date there is little published on this in the literature. With an ageing population it could be expected that the number of patients developing AKI after undergoing hip surgery will increase, the identification of patients at risk of development of AKI will have important prognostic implications. In addition, given that there is no standardization of antibiotic content of the cement used in joint spacers, the study of systemic absorption of the antibiotics used will be important in determining the optimal proportion of antibiotics needed in spacer cement.

ADDRESSING DISPARITIES IN COLORECTAL CANCER SCREENING AT SAN FRANCISCO GENERAL HOSPITAL Claire Horton; Joyce Viloria; Ellen Chen; Hali Hammer. ucsf, San Francisco, CA. (Control ID #1340177)

BACKGROUND: Colorectal cancer [CRC] is the third most common cancer and second leading cause of cancer death in the U.S.1 Approximately 18,000 lives could be saved each year, and 60% of CRC deaths prevented if all U.S. adults over 50 were screened.2 Unfortunately, national rates of CRC screening rates are low [55%], and significant disparities exist for racial minorities. At San Francisco General Hospital, the Family Health Center [FHC] and the General Medicine Clinic [GMC] are on-campus clinics providing general adult primary care. Given limited resources within our safety net system, CRC screening is offered through annual FOBTs in primary care, with referral to colonoscopy for abnormal results. In 2010, 48% of our patients completed CRC screening. 1 U.S. Preventive Task Force.org, accessed December 7, 2010. 2 Cancer statistics, 2007. CA Cancer J Clin. 2007.

METHODS: Beginning in January of 2010, GMC and FHC developed a project to identify and decrease disparities in CRC screening. We performed focus groups to a assess specific barriers to CRC screening in patients with disproportionately low CRC screening rates. Our primary intervention was to develop a panel management system for CRC screening for our two clinics. Two staff members were trained in reviewing registry reports, counseling patients to complete FOBT tests, and providing logistical support for test completion. We also trained staff in colorectal cancer screening counseling, posted screening rates prominently throughout clinic, and involved resident providers in outreach efforts. RESULTS: The racial/ethnic groups with the lowest screening rates were African American and White patients. Marginal housing status, substance abuse, and psychiatric comorbidity were correlated with lower rates of screening. Focus groups identified the following major barriers to performing FOBT testing: confusion about CRC and who was at-risk; inadequate clinic educational efforts; logistical barriers to screening for homeless patients; and cultural beliefs among African-Americans about cancer detection and treatment. To date, the project has resulted in significant increases in CRC screening for all racial/ethnic groups (10% relative improvement over baseline) with a narrowing of screening disparities among racial/ethnic groups. CONCLUSIONS: In two urban safety-net clinics, the lowest rates of CRC screening were seen in Whites, African-Americans, and patients with psychsocial comorbidities. Focus groups helped identify barriers to screening in at-risk groups, and outreach efforts have resulted in improvement for all racial/ethnic groups and a narrowing of healthcare disparities. Next steps include increasing targeted outreach efforts for at-risk groups.

ADHERENCE TO GUIDELINES FOR LOW BACK PAIN IMAGING: COMPARISON OF A TEACHING AND NON-TEACHING CLINIC Claudia P. Taramona Espinoza; Melissa Skupin; Dora Montezuma; Zahrae Sandouk; Sean Drake. Henry Ford Hospital, Detroit, MI. (Control ID #1311087)

BACKGROUND: Acute low back pain (LBP) has a prevalence of 80% and is the fifth most common reason for

clinic visits in the United States. Its evaluation depends mainly on the clinical picture. Numerous studies show that clinicians continue to order routine imaging, despite evidence that it is not beneficial, increases radiation exposure and raises healthcare costs. The American College of Radiology (ACR) published guidelines in 2008 for indications to image based on certain red flags. The objectives of our study were to assess adherence to the ACR guidelines and to compare a teaching and non-teaching clinic.
METHODS: We conducted a retrospective descriptive study. Inclusion criteria were: patients older than 18 with acute (<6 weeks) musculoskeletal LBP, seen in the clinics from March 17, 2008 to June 30, 2011. Exclusion criteria were: non-musculoskeletal LBP, previous LBP work-up, acute on chronic and chronic LBP and patients without a clinic note. A list of medical record numbers and clinic visit dates was retrieved using the ICD-9 billing code of LBP for both an urban teaching and urban non-teaching clinics. Office notes were reviewed. We documented if imaging was ordered and type of imaging, and compared it to the ACR guidelines. Data was analyzed using a chi-square test was used to compare categorical data, and two-sample independent t-tests for continuous data.
RESULTS: We reviewed 1,776 charts (teaching clinic: 954; non-teaching clinic: 822). Patients were excluded for the following reasons: 467 were non-musculoskeletal; 734 were not acute; 149 were previously evaluated; 15 lacked documentation. 404 patients met inclusion criteria: 203 from the teaching clinic; 201 from the non-teaching clinic. The teaching clinic adhered to guidelines 67% of the time, versus 35.3% adherence in the non-teaching clinic ($p < 0.001$). Management was inconsistent with guidelines 23.1% of the time in the teaching clinic, versus 35.8% of the time in the non-teaching clinic ($p=0.005$). For patients who met the ACR criteria but were not imaged, 30.6% were from the non-teaching clinic and 69.4% were from the teaching clinic ($p < 0.01$). For patients who did not meet the imaging criteria, but were still imaged, most were from the non-teaching clinic (73.5% non-teaching, 26.5% resident clinic). The most common red flag was age >70, and it was also the most commonly missed red flag.

CONCLUSIONS: Overall, we found that the teaching clinic adhered to guidelines more than the non-teaching clinic. For patients who were managed inappropriately, the teaching clinic more frequently spared imaging when it was indicated, while the non-teaching clinic more frequently ordered imaging inconsistently with the guidelines. There are several possible explanations for our results. Studies have found that residents are more receptive to using guidelines than supervisors, because they lack experience and research guidelines more often. Supervisors may trust their experience over clinical guidelines. In general, adherence to hospital guidelines is often low to moderate (40-60%). In institutions where residents are not independent decision makers, any implementation plan should combine strategies aimed at both residents and staff physicians. The mindset that more testing means better care must be abandoned in favor of a more evidence-based approach.
ADJUSTING FOR HOSPITALIZED PATIENTS CLINICAL RISK OF URINARY TRACT INFECTIONS: A NECESSARY STEP IN PAY-FOR-PERFORMANCE WHEN COMPARING BY HOSPITAL-ACQUIRED CONDITION RATES. Jennifer Meddings; Heidi Reichert; Mary A.M. Rogers; Laurence F. McMahon. University of Michigan, Ann Arbor, MI. (Control ID #1338627)
BACKGROUND: Hospitals no longer receive more pay to treat certain hospital-acquired conditions (HACs), regardless of a patients risk to develop HACs. Reduced pay for all admissions will occur in 2015 for hospitals with the highest quartile of risk-adjusted HAC rates. Our objective was to develop models to predict a hospitalized patients risk of developing a HAC (using the example of a urinary tract infection, UTI) in order to risk-adjust a hospitals performance by its patients inherent risks of the HAC.
METHODS: Using claims data from the Healthcare Cost and Utilization Project State Inpatient Dataset for 1,792,288 adults discharged from 297 acute care California hospitals in 2009 without a principal diagnosis of UTI, we developed models to predict a patients risk of developing a UTI as a secondary diagnosis using patient characteristics at admission supported by clinical literature as risk factors, such as age, gender and

comorbidities by CMSs hierarchical condition categories. We assessed how hospitals observed UTI rates would be modified by risk-adjustment.
RESULTS: Unadjusted hospital rates (Graph A) of UTIs ranged from 0.8-30.5% (mean 12%). Using a logistic regression model with patient characteristics (c-statistic of 0.77), age, gender and age-gender interactions contributed the most to the models predictiveness (generating a c-statistic of0.66 versus a model with no predictors). Compared to patients admitted for medical diagnoses, patients discharged with surgical diagnosis-related groups had fewer UTIs coded as secondary diagnoses (OR 0.30 for scheduled surgery admits, 0.92 for unscheduled surgery admits). Other conditions at admission associated with significantly higher UTI rates included decubitus ulcers (OR 2.5), ventilator dependence (2.5), shock (2.8), or a urologic or gynecologic diagnosis (1.90). Significant risk factors for UTI with OR 1.1-1.7 included diabetes, renal failure, malnutrition, hip fracture, chronic liver disease, dementia, and other serious neurologic disease. Observed-to-expected ratios for hospitals (Graph B) ranged from 0.35-1.98. Of 74 hospitals in highest quartile of unadjusted UTI rates (Graph A), 23 were reassigned to better quartiles using observed-to-expected ratios (Graph B). CONCLUSIONS: With risk-adjustment by patient characteristics at admission in claims data, 1 in 3 hospitals identified as poor performers by UTI rates would be reassigned as better performers. Age and gender were the most critical patient characteristics for adjustment. It is unclear if lower rates of UTIs coded for surgical patients indicate fewer UTIs occurred versus a coding bias of not listing UTIs when other diagnoses justify equal payment.

ALCOHOL USE AFTER TOBACCO CESSATION: IMMEDIATE CONSEQUENCES Kristin M. Berg1; Megan Piper2; Michael Fiore2; Timothy Baker2; Douglas E. Jorenby2. 1University of Wisconsin Hospitals and Clinics, Madison, WI; 2University of Wisconsin School of Medicine and Public Health, Madison, WI. (Control ID #1333712)
BACKGROUND: While tobacco use has declined in American society,20.6% percent of adults continue to use tobacco. Upwards of 51% percent of American adults consume some alcohol, and studies have shown that use of one substance primes the use of the other. There have been several studies on tobacco cessation and its long-term relationship with alcohol use, but little is known about the immediate consequences of tobacco cessation. METHODS: The Wisconsin Smokers Health Study is a large clinical trial of 1504 participants, designed to compare smoking cessation pharmaco-therapies with each other and placebo in a double-blind, randomized controlled trial. Including participants drinking at least 0.5 drinks daily on average, mean alcohol use pre- and post- quit were compared using students T test for statistical significance. Average daily alcohol use was also compared between groups to determine trends over the 28 day peri-cessation period (2 weeks pre- and 2 weeks post- quit).
RESULTS: Alcohol use in general increases leading up to the planned tobacco quit date. Second, as participants attempt to quit tobacco, they decrease their mean alcohol use by approximately 0.5 drinks daily post-quit ($p<0.05$), with two notable exceptions. Males who do not use cessation pharmacotherapies to assist in their efforts not only demonstrate a lack of change in mean alcohol consumption, but appear to increase alcohol use within 48-72 hours post-tobacco cessation when evaluating daily alcohol trends. Moreover, their alcohol use declines if they relapse to smoking. Females using bupropion as their cessation pharmacotherapy appear to likewise demonstrate no change in their mean alcohol use post-quit, but they do not have the same post-cessation increase in alcohol use as do the males in the placebo group. Third, those participants maintaining abstinence seem to delay and reduce the amount of alcohol consumed in the immediate post-quit period when evaluating daily trends.
CONCLUSIONS: In general, alcohol use significantly decreases in the post-cessation period, possibly indicative of an overall attempt at improved health. However, fluctuations in alcohol use trends in various treatment groups

could indicate underlying factors influencing success rates in this immediate peri-cessation period. These intriguing trends give healthcare professionals an opportunity for counseling and intervention to improve outcomes in their patients seeking tobacco cessation.

AN ANALYSIS TO DETERMINE DRIVERS OF SATISFACTION AND DISSATISFACTION IN THE PATIENT EXPERIENCE OF INPATIENT CONTINUITY OF CARE Ryan Thompson; Elizabeth Immen; Andrea Litvak; Cathleen Ward; Catherine Desroches; David Torchiana; Timothy Ferris. Massachusetts General Hospital, Boston, MA. (Control ID #1340377)

BACKGROUND: The highly specialized nature of tertiary hospital care increasingly requires multiple specialized physicians caring for a single patient. At the same time, ensuring that patient information, management plan, and trusting relationships are shared among the care team remains an essential characteristic of patient-centered care. Given these competing realities, we undertook an effort to improve continuity of care for hospitalized patients, starting with the development of a system to measure patients perception of their care continuity. We describe here our measurement approach, descriptive results, and the aspects of continuity that correlate with both satisfaction and dissatisfaction.

METHODS: We designed our survey to assess a patients perception of continuity at three time points during an inpatient episode of care - ED, ward, and post-discharge. We derived sixteen continuity measurement concepts from the three continuity domains (information, management plan, and relationships) defined in the literature. We then developed and tested 34 Likert-type survey items for 3 distinct surveys (ED, ward, post-discharge); each measurement concept is measured by one to three survey items. Using a random number generator for enrollment, we surveyed consenting patients in-person in the ED and ward, and by telephone post-discharge. We excluded patients who were
clinically or psychologically unstable, or who lacked suitable proxy. The post-discharge survey was not administered to patients discharged to a post-acute facility. Using survey responses re-coded as binary variables based on whether or not the subject selected the top box option, we used regression models to control for age, gender, and insurance type. We calculated measurement concept scores by averaging the top box percentages for survey items associated with each concept. Satisfaction and dissatisfaction with care continuity were assessed by combining multiple survey items which assessed general satisfaction with care.

RESULTS: We enrolled 206 patients through the ED and 834 directly admitted patients between November 2010 and May 2011. Overall, 949 patients completed the inpatient survey (87% of eligible), and 644 patients completed the discharge survey (69% of eligible). Overall unadjusted top box scores with department low-high ranges were 62% for continuity of information (42%, 86%), 75% for management (68%, 90%), and 71% for relationships (58%, 78%). We found that shared decision-making between patient and providers (p=0.01), and patient understanding of provider roles (p=0.01) were associated with greater satisfaction in our patients experience of continuity. Drivers of dissatisfaction were lack of awareness of provider coverage and transitions (p=0.01) and not seeing their longitudinal MGH physician(s) while in the hospital (p=0.01). Two concepts were associated with both satisfaction and dissatisfaction - effective communication about test results and progress in the hospital (p=0.01; p=0.01) and provider responsiveness to patient needs (p=0.01; p=0.05).

CONCLUSIONS: We demonstrated a reliable approach to measuring patient perception of the continuity of their inpatient care. We found significant departmental variability in all three domains of continuity. Our analysis suggests efforts to improve continuity should focus on specific areas most associated with general satisfaction with care.

AN ASSESSMENT OF ELIGIBILITY AND ENROLLMENT INTO CANCER CLINICAL TRIALS AMONG A DISADVANTAGED URBAN POPULATION Tracy Battaglia2; Naomi Y. Ko1; Sarah E. Caron2; Julie C. Fu3; Kathleen T. Finn1; Sandy Allten1; Nectaria Vassilakis1; Lisa Stober1; Lisa A. Kachnic4. 1Boston University School of Medicine, Boston, MA; 2Boston University School of Medicine, Boston, MA; 3Boston University School of Medicine, Boston, MA;

4Boston University School of Medicine, Boston, MA. (Control ID #1337453)
BACKGROUND: Enrollment rates onto cancer clinical trials among adult population remains approximately 2-11% with the majority being whites from high socioeconomic status and educational backgrounds. In order to address the unequal burden of cancer among underserved populations, it is imperative to accrue underrepresented populations onto cancer clinical trials, however, the barriers to minority enrollment must first be better understood. We aim to examine the eligibility and enrollment criteria for disadvantaged populations in cancer clinical trials as the initial step towards increasing minority accrual. METHODS: Boston Medical Center, a Commission on Cancer Accredited and recently designated National Cancer Institute Minority Based Community Clinical Oncology Program, is the largest Safety Net medical institution in New England serving the citys most vulnerable cancer patients. Using the hospital cancer registry to identify incident cases in calendar year 2010 (n= 1,228), we conducted a retrospective review of the electronic medical record (EMR) to identify rates of screening for available cancer clinical trials. Hospital protocol dictates that each patient identified as eligible for an existing cancer clinical trial has documentation in their EMR of screening from a clinical trials nurse. This screening note documents eligibility for enrollment and reasons for ineligibility/non-enrollment. Socio-demographic information was obtained from the cancer registry. Descriptive statistics were used to report our main outcomes: screening rate, eligibility and accrual rate (of those screened), and reasons for not enrolling.
RESULTS: Among 1,228 newly diagnosed cancer patients in calendar year 2010, the mean age was 59 years; 50% female; 47% White, 30% Black, 11% Hispanic, 8% Other and 4% Asian. 99 clinical trials were available for accrual during time period. Overall, we found documentation of screenings for specific cancer trials performed for 543 individual patients, resulting in a 44% screening rate. Each patient may have been screened for multiple trials

(mean 1.6 screens per patient, range 1 to 7 screens) for a total of 854 screenings across all patients. No trial was available for 155 screenings, and 122 screens were excluded due to pending status; among the remaining 577 screenings, we found only 11% (65/577) were deemed eligible for the specific clinical trial. The most commonly noted reasons for not meeting trial-specific eligibility criteria were: disease stage and/or type (33%), prior treatment (27%) and patient co-morbidities (21%). Administrative reasons for ineligibility were mostly (78%) due to sponsor level issues, such as trial on hold. Of the 65 patients who were deemed eligible for clinical trials, 46% (n =31) were enrolled, of which 53% were White, 43% Black and 4% Hispanic. Only 5% declined enrollment when deemed eligible. The most commonly noted reason for declining enrollment was aversion to extra treatment. CONCLUSIONS: Less than half of all newly diagnosed patients had evidence of screening for clinical trial enrollment. The main reason for low screening is lack of available cancer clinical trials. When specific trials are available, only 11% were found to be eligible; the most common reason for ineligibility was disease characteristics and patient co-morbidities. When eligible, a racially representative sample was enrolled. Our findings suggest the need to identify and open clinical trials that are more relevant to our diverse and co-morbid patient population.
AN AUTOMATED TELEPHONE NUTRITION SUPPORT SYSTEM FOR SPANISH-SPEAKING PATIENTS WITH DIABETES Raman R. Khanna1; Pamela J. Stoddard2; Mariana Villagran-Flores3; Paul Bayard3; Joan Thompson3; Ralph Gonzales1. 1University of California, San Francisco, San Francisco, CA; 2Santa Clara Valley Medical Center, San Jose, CA; 3La Clinica de la Raza, Oakland, CA. (Control ID #1336012)
BACKGROUND: Automated telephone-based nutrition support (ATNS) provided through interactive voice response survey software is capable of providing tailored counseling at varying times of day and to limited English proficiency patients, and at a very low cost; but its efficacy is uncertain. Based on a very promising pilot study of ATNS conducted among a medically underserved population living in Cuernavaca, Mexico, we conducted a randomized trial of this system in a predominantly Spanish-speaking safety net population with

type 2 diabetes in the United States.
METHODS: We worked with physicians, dietitians and medical care coordinators at a large community health center in Oakland, California to design an ATNS system which, using Telesage software, called patients approximately twice a week. The ATNS system asked patients to respond (using their telephone key pads) with the number of each of 15 low and high glycemic index foods they had eaten in the previous 24 hours. It then added the number of high glycemic index portions and provided either reinforcement of the current diet or encouragement to choose low glycemic index substitutes depending on the patients total. After designing the intervention, we recruited patients with uncontrolled type 2 diabetes (hemoglobin A1c 8.0) in a randomized, blinded fashion to receive diet and exercise counseling followed by ATNS phone calls either immediately (intervention) or after a period of 3 months (control). We recorded hemoglobin A1c at baseline and at 3 months; the between-group difference in change over 3 months was our primary endpoint. We also recorded other anthropometric and laboratory values at baseline and at 3 months.
RESULTS: We recruited 71 patients between August 2010 and January 2011 and were able to follow up 44 (62%) in that period, with 20 in the intervention group and 24 in the control group. There were no differences between the intervention and control groups at baseline or between patients who did and did not follow up. All patients at baseline had poorly controlled disease, with a median A1c of 8.9 despite taking a median of 2 diabetes medications. Patients in the intervention group received a median of 24 calls (approximately 1.8/week) during the 3 months of follow up; however, they only completed a median of 10 calls (less than 1/week). The median change in A1c from baseline to 3 months was -0.2; in the intervention group it was -0.3 and in the control group it was -0.1; p=0.83 by the Wilcoxon Rank-Sum test. There were no significant differences between the intervention and the control groups in change in blood pressure, body mass index, waist circumference, or cholesterol.
CONCLUSIONS: The ATNS system was easy to set up and cheap to maintain, but despite promising results in the pilot program in Mexico it did not lead to improved Hemoglobin A1c or other metabolic parameters in our US-based study population. Patients completed less than half of the calls that were placed to them by the ATNS system. More work is required to define whether ATNS is effective or appropriate in other populations and at other levels of automated counseling intensity.
AN EDUCATIONAL INTERVENTION TO IMPROVE DISCHARGE SUMMARIES IN A COMMUNITY HOSPITAL
Nicole Gill-Duncan1;
Philippe Leveille1; Dean Luu1; Julie M. Pearson2; Julie Kanevsky1; Daniel Giaccio1. 1Lutheran Medical Center, Brooklyn, NY; 2Lutheran Medical Center, Brooklyn, NY. (Control ID #1330276)
BACKGROUND: The quality of discharge summaries significantly affects the ability of primary care providers to adequately care for patients after hospital discharge. As the pressure on hospitals to decrease length of stay rises, so too does the percentage of patients discharged with significant test results still pending. Relaying information about the hospital course and pending test results to the primary care provider is crucial to ensure patient safety.
METHODS: We developed an assessment tool for rating the quality of discharge summaries. It incorporated ratings of the narrative of the history of present illness and hospital course, as well as scoring the presence of important elements that affect post-hospital care, such as primary and secondary diagnoses, medication reconciliation, and appropriate follow-up. Our educational intervention consisted of two parts. The first was a morning conference teaching residents how to write an effective discharge summary. The second was a noon conference simulation exercise in which a long, detailed description of a hospital course was provided, and residents were asked to write discharge summaries in real time using the guidelines provided in the morning conference. These discharge summaries were then anonymously submitted, and a selection of the best and worst examples were reviewed with the group. Discharge summaries dictated before and after the educational intervention were then compared using the assessment tool. Two members of the research team rated each

discharge summary. The interrater reliability was moderate (Cronbach alpha=0.50). The average absolute difference between the reviewers scores was 21%. Discharge summaries with an absolute difference greater than 30% (fourth quartile) were reviewed by a third reviewer and then all three scores were averaged. Paired t-tests were used to assess the differences in final weighted averages between pre-/ post-test scores.
RESULTS: A total of 104 discharge summaries were assessed from 26 residents. The weighted average score for discharge summaries significantly increased from 52% to 67% after the educational intervention (p<0.01). 70% of the post-intervention discharge summaries were rated as being effective overall (agree or strongly agree), compared to 47% of the pre-intervention discharge summaries. The elements of the discharge summaries that were rated the poorest pertained to medication reconciliation; more than 90% of the summaries from both the pre- and post-intervention groups were missing information on medications that were changed or discontinued. CONCLUSIONS: Our educational intervention improved the quality of hospital discharge summaries written by Internal Medicine residents. Medication reconciliation was rated the poorest. Computer-generated discharge summary forms with specific fields for medication reconciliation may help to improve discharge summaries.

AN EVALUATION OF CONTINUITY CLINIC RE-DESIGN IN AN INTERNAL MEDICINE RESIDENCY PROGRAM Mark L. Wieland1;
Andrew J. Halvorsen2; Rajeev Chaudhry1; Furman S. McDonald3; Kris G. Thomas1. 1Mayo Clinic, Rochester, MN; 2Mayo Clinic, Rochester, MN;
3Mayo Clinic, Rochester, MN. (Control ID #1336566)

BACKGROUND: There have been recent calls for improved internal medicine outpatient training. Charged by participation in the ACGME Education Innovation Project, the Mayo Clinic Internal Medicine Residency Program implemented a continuity clinic re-design in the 2010-11 academic

year. Changes included 1) separation of the inpatient and outpatient experiences, 2) development of outpatient care teams, and 3) additional rotations with concentrated continuity clinic exposure. In order to link these structural processes to outcomes, we assessed the impact of clinic re-design on clinical and educational outcomes.
METHODS: 96 residents in our Primary Care Internal Medicine site participated in this study. The pre-intervention study interval was July 09-June 10; the post-intervention interval was July 10-June 11. Continuity of care was assessed from the perspective of the resident (proportion of visits in which residents see their own patients). Quality of care was assessed through an existing primary care database for diabetes, hypertension and preventive service measures. Patient satisfaction was measured with the ABIM Patient Assessment Module. Residents assessed perceived safety and quality of the care environment through a 13-item survey administered four times per year. Educational outcomes were assessed through an existing electronic evaluation database across multiple domains. We used this database to measure resident satisfaction with clinic, resident performance in clinic, and faculty rating of the clinic experience. Attendance at teaching conferences was tracked via electronic card swipe. Outcomes were assessed for each variable using generalized estimating equations.
RESULTS: Clinical outcomes before and after re-design are depicted in Table 1. Perceived safety and quality of the clinic was higher in the post-intervention year (p-value range 0.026 to <0.0001). Mean attendance at teaching conferences was higher in the post-intervention year (56.7 vs. 63.1, p=<.001). There was no significant difference between study intervals for the remaining educational outcomes.
CONCLUSIONS: Continuity clinic re-design through separation of the inpatient-outpatient experiences and additional structural changes was associated with increased resident panel size but a reduction in continuity of

care with little change in other clinical parameters. Perceived safety and quality in the outpatient setting improved. Attendance at teaching conferences improved while the remaining education outcomes were unchanged. These data provide important information for iterative residency re-design to optimize clinical care, patient continuity, and educational experiences.

Table 1. Clinical outcomes before and after continuity clinic re-design

Domain Pre-Intervention

Post-Intervention

p-value

Panel Size (meanSE) 120.01.0 137.60.9 <.001 Patient Visits (mean

SE)

216.03.8 228.55.4 0.06

Continuity of Care(% of all resident visits) Individual (seeingown panel)

62.9%1.3% 48.1%1.1% <.001

Team (seeing own or team members panel)

67.0%1.2% 63.5%0.8% 0.001

Diabetes Care(% with HgbA1C<8+ LDL<100+BP<140/90, 1567 eligible)

40.2%1.8% 42.2%2.0% 0.40

Microalbumin within one year (1567 eligible)

64.6%1.8% 70.2%1.6% 0.01

Hypertension Care (% with BP<140/90, 4030 eligible)

71.11.1% 72.10.9% 0.40

Preventive Services (% up to date) Mammography (4648 eligible)

55.9%1.1% 49.2%1.3% <.001

Cervical cancer screening (9535 eligible)

68.3%0.8% 67.2%0.7% 0.12

Bone densitometry (1063 eligible)

60.1%2.2% 60.0%2.1% 0.93

Lipid screening (11253 eligible)

76.5%0.7% 76.8%0.6% 0.67

PatientSatisfaction (meanSE, 5-point scale)

4.69.02 4.70.02 0.62

AN EXPLORATORY ANALYSIS OF SUCCESSFUL PEER COACHES: OUR ASSUMPTIONS ABOUT IMPORTANT CHARACTERISTICS MAY NOT BE CORRECT Elizabeth Rogers; Tom Bodenheimer; Danielle Hessler; David Thom. University of California San Francisco, San Francisco, CA. (Control ID #1339936)

BACKGROUND: The training of lay personnel to provide self-management support is proving effective for chronic diseases such as diabetes. However, little has been published about what, if any, characteristics of lay personnel are associated with effective coaching. We sought to understand what characteristics are associated with successful diabetes peer coaches in an urban low-income U.S. population.

METHODS: We carried out a prospective cohort study of diabetic patients from six urban health centers serving a low-income population who participated in a randomized controlled trial to assess the impact of peer health coaching on patient change in glycosylated hemoglobin (HbA1c). The cohort included 25 well-controlled diabetic patients who were trained as peer coaches and 123 poorly controlled diabetic patients who were assigned to coaching. All spoke English or Spanish. We defined level of peer coaching success to be the degree of improvement in patient HbA1c from baseline to 6 months. We used linear regression, to account for clustering by coach, to assess for the association between patient change in HbA1c and baseline coach characteristics of age, gender, number of years with diabetes, body mass index (BMI), HbA1c level, and scores

on two previously validated questionnaires composed of Likert-scale items -Perceived Diabetes Self-Management Scale (PDSMS) and Diabetes Distress Scale (DDS). We also used linear regression to evaluate the association between patient-coach concordance of age, gender, ethnicity, and educational level and patient change in HbA1c over 6 months. All dyads were language-concordant.
RESULTS: Average patient change in HbA1c by coach over the 6-month intervention ranged from an increase in HbA1c of 0.7% to a decrease of2.7%. Higher coach BMI was associated with a greater reduction in patient HbA1c (p=0.01). For example, patients of coaches in the highest BMI tertile had a mean reduction in HbA1c of 1.6% while those with coaches in the lowest BMI tertile reduced their HbA1c by only 0.6%. A lower coach PDSMS score, indicating lower perceived self-management, and a higher DDS score, indicating higher levels of diabetes-associated distress, were both associated with a greater decrease in patient HbA1c (p=0.04 for both associations). Coach age, gender, number of years with diabetes, and baseline HbA1c level did not predict more successful coaching. Patient-coach concordance by gender (60% concordant), ethnicity (63% concordant), and educational level (60% concordant) were not associated with change in patient HbA1C, but age concordance (59% concordant), defined as being no more than 10 years apart in age, was associated with a trend toward greater decrease in patient HbA1c (p=0.09).
CONCLUSIONS: Contrary to our hypothesis, coaches with lower BMI, higher perceived self-management of diabetes, and lower diabetes distress were not more successful in reducing the HbA1c levels of the patients they coached, and in fact they may be less successful. One could hypothesize that those coaches struggling with their own disease management and lifestyle changes may be more open to training and make more empathetic patient connections to prompt improvement in a patients self-management. Coach age, gender, years with diabetes, and HbA1c were not important for successful coaching, but patient-coach age concordance may be. These findings can help guide diabetes peer coach selection in future interventions.
AN UNDERGRADUATE MEDICAL STUDENT GERIATRICS HOME VISIT, REVISITED DURING INTERNSHIP
Gerald D. Denton; Paul Hemmer; Janice Hanson. Uniformed Services University, Bethesda, MD. (Control ID #1332157)
BACKGROUND: Home visits, especially with elderly patients, have been resurgent in medical education, and, when paired with self-reflection and narrative writing, have at least a short-term influence on attitudes towards caring for the elderly. Anecdotal reports indicate durability of at least the

memory of the home visit during medical school experience, but little research supports this.
METHODS: This study had two parts. First, all medical students at the Uniformed Services University (USU) completed a critique on their mandatory Geriatrics Home Visit (GHV) during academic year 2008-9. Second, 18-30 months after their GHV, during the second half of their PGY-1 intern year (2010-11), an electronic survey was provided to these physicians and their colleagues who were graduates of other medical schools. The survey included questions about demographics, home visits during medical school, current attitudes towards care of the elderly, and knowledge of geriatrics. Means and proportion of responses above and below the neutral point for likert-scaled questions were calculated. Qualitative responses were analyzed using constant comparative method. The IRB at USU reviewed this project and granted exempt status.
RESULTS: For the post-GHV critique analysis, 137 of 168 critiques(81.5%) were available for review. The GHV was acceptable to students and changed the way they thought about caring for elderly patients (59% agreed or strongly agreed; mean Likert scale response 3.4/5). Most students felt the GHV was a good way to learn geriatric medicine (56% agreed or strongly agreed; mean Likert scale response 3.4/5). For the PGY-1 intern survey, 14 of the 17 sites where USU graduates were training agreed to participate. 60/133 (45%) of the USU graduates at those sites responded. 124/501(24.7%) of non-USU graduates responded. Overall, 61% performed a home visit during medical school. 88% of PGY-1 interns who performed a home visit as a medical student remembered their patient, and those PGY-1 interns had better attitudinal scores towards care of the

elderly (83.1% vs 58.5%; p=0.003, students t-test). Knowledge scores were similar between PGY-1 interns who did and did not perform a GHV. However, PGY-1 interns who performed a home visit as a medical student had better attitudinal scores towards care of the elderly than PGY-1 interns who did not (84.3% vs 74.9%; p=0.01, students t-test). Qualitative analysis added depth and understanding to the results of both analyses.
CONCLUSIONS: A geriatrics home visit program is an acceptable curricular addition to medical students and is memorable for 18-30 months after the experience. While a geriatric home visit program may not provide a lasting impact on knowledge of geriatrics, PGY-1 intern attitudes towards care of the elderly may be improved. Given the aging of the population and the need for positive attitudes towards care of the elderly, medical schools should consider geriatrics home visits as an addition to their curriculum.
AN ASSESSMENT OF INTERNAL MEDICINE RESIDENT AND MEDICAL STUDENT KNOWLEDGE OF ADDICTION MEDICINE Angel Brown; Victor Kolade; Neha Patel; Lisa Staton. University of Tennessee College of Medicine Chattanooga, Chattanooga, TN. (Control ID #1312234)
BACKGROUND: Approximately 30 million Americans suffer with addiction, and nearly 7 million people misuse prescription medications. Further, addiction complicates the management of co-morbid conditions. There are too few addiction specialists in the United States and generalists are not well versed in addiction disorders; as a result, many patients are not treated adequately. In many medical schools and residency programs, lectures regarding alcohol and drug addiction are limited. The objective of our study was to assess and compare baseline knowledge among medical students and residents in a community-based internal medicine residency program and evaluate the impact of an addiction medicine curriculum on knowledge of substance abuse disorders. We also compared knowledge of medical students and residents from US medical schools to knowledge of international medical school graduates (IMGs).
METHODS: A pretest was administered via the internet and in person to determine baseline knowledge of the subject. Study subjects included internal medicine and transitional year residents, as well as medical students who were enrolled in an internal medicine program at the time of the lecture series. Participants were given four structured sessions, one each week, on the topics of addiction, opioids, alcohol, benzodiazepines and illicit stimulants. An expert panel discussion was also convened. After the completion of the symposium the participants were instructed to complete a posttest online to assess if
learning had occurred. ANOVA was used to compare means. Paired t-test was used to compare before and after scores.
RESULTS: Thirty-six (36) of 44 (81.8%) medical students and medicine residents completed the pretest: internal medicine residents fared the best with an average of 65.4%, while third year internal medicine residents scored an average of 59.2%. Fourth year medical students scored 64%. Second year medicine residents averaged 62.3% and third year medical students averaged62.5%. For all medical students, the average score was 63.3%; for residents, the average score was 62.5%. United States graduates averaged 65.0% correct while the average for international graduates was 58.6%. The differences between groups were not statistically significant. Of the 36 participants, 20 (55.6%) completed both surveys. Posttest scores, average68.75%, were higher than pretest scores, which averaged 61.75%; p=0.003. Among IMGs, the average score rose from 57.5% (pretest: range 35-75%) to72.5% after the seminars (range 50-85%); all 6 participants had higher posttest scores than pretest scores. Among the US trainees, the average score rose was 63.6% on the pretest (range 55-70%) and 67.1% on the posttest (range 45-85%); 8 of 14 (57.1%) participants had higher posttest than pretest scores.
CONCLUSIONS: There is room for improvement in the knowledge base of medical students and residents concerning addiction medicine. Knowledge gains can be demonstrated after structured sessions. Similar studies in larger resident populations may elucidate specific components of the curriculum that are most valuable.
AN ASSESSMENT OF NON-AMERICAN INTERNS' CLINICAL AND LIFE SKILLS: PRELIMINARY DATA Josh Baru; Suja Mathew; Brian P. Lucas; Benjamin Mba. Cook County Hospital, Chicago, IL. (Control ID #1339984)

BACKGROUND: Each year, approximately 25% of medical residency positions are filled by international medical graduates (IMGs). When they begin their training, 80% of these graduates are non-US citizens. Several studies note that non-American IMGs experience unique problems relative to their co-residents such as loneliness, social isolation, concerns related to family members left behind in home countries, a decrease in social status, lack of financial resources and worries about visas/immigration issues. Previous studies have described orientation programs for IMGs, but these have generally focused on acculturation into the healthcare system. In this preliminary study, we explored non-American IMGs comfort and skills in American life as well as the healthcare system.
METHODS: The study group was first-year residents (interns) in the internal medicine residency program at Cook County Hospital (CCH) in Chicago, IL. We also included participants from a pilot study performed at Rush University Medical Center (RUMC). We surveyed the participants within the first 2 months of the 2011 academic year. Surveys were distributed electronically and manually at mandatory teaching conferences. The survey assessed 3 domains: life skills, clinical skills, and communication skills. The survey instrument was created by the research group and was based on consensus opinion and a literature review. All questions were rated on a 7-point Likert scale. We generated summary scores for each intern within each domain and transformed these sums into domain-specific z-scores; 1 z-score unit is equal to 1 standard deviation (SD). We separated participants into American citizens and non-American citizens. We compared the scores for the groups using Students t-test.
RESULTS: 32 (68%) CCH residents completed the survey. 10 residents from the RUMC program were included. 13 participants were American. We found no significant differences in the scores for the clinical or communication skills domains. There were significant differences in life skills as US citizens scored 1.2 SD higher in life skills than non-US citizens (p=0.0001). Specific examples are illustrative. Whereas all 13 American interns strongly agreed with the statement I am comfortable managing a checking/banking account, only 9 (31%) of the non-Americans strongly agreed with it. Similarly, only 8 (28%) non-Americans strongly agreed with the statement I know how to access emergency assistance from local police or fire personnel while 12 (92%) Americans strongly agreed with it. CONCLUSIONS: Our early data of internal medicine residents in 2 urban programs suggests that there are significant differences between non-

American interns life skills upon entering residency in the United States. This data suggests specific goals for orientation programs for IMGs, particularly those that are citizens of other countries. In future work we plan to use factor analysis to refine our instrument. We also plan a citywide sample of internal medicine interns to obtain adequate statistical power to stratify our analysis by potential confounders such as age, sex, and country of origin.
AN ASSESSMENT OF UNDOCUMENTED IMMIGRANTS' ATTITUDES TOWARDS ORGAN DONATION Josh Baru1,2; Carmen Martinez1. 1Cook County Hospital, Chicago, IL; 2Rush University Medical Center, Chicago, IL. (Control ID #1312760)
BACKGROUND: There are approximately 12 million undocumented immigrants living in the United States; 7 million of these are uninsured. Undocumented immigrants can donate organs into the organ pool and, in compliance with the JCAHO and Medicare required request policies, must be asked about their wishes regarding organ donation if they are imminently dying. While they are asked to donate organs, to receive organs they would need to independently cover all expenses. This is an exceedingly rare occurrence. This conflict potentially violates ethical principles of justice and informed consent. The purpose of this study was to determine if undocumented immigrants are aware of this discrepancy and whether they consider it relevant to their decision to donate.

METHODS: The setting is a 500-bed, university-affiliated, safety-net hospital in Chicago, IL. We used a convenience sample of patients older than 18 years old who were admitted to the general medicine wards. Participants were interviewed at the bedside on their first hospital day. Participants were eligible for the study if they spoke English or Spanish, self-identified as undocumented immigrants on the initial screen, and were not aware that they had a condition which would preclude organ donation (e.g., cancer, HIV, or chronic hepatitis). They were excluded if they were incarcerated or cognitively impaired. After the initial screen, study investigators asked participants about willingness to donate. We asked participants if they were insured and then informed them that, if not, they would have to pay for an organ transplant. We then asked participants to guess the costs of solid organ transplantation (heart, liver, and kidney) and informed them of the actual costs. Investigators then reassessed participants willingness to donate and opinions about the importance of this information. Basic demographic characteristics were collected.
RESULTS: 81 patients were screened. 54 were eligible and completed the survey. Spanish was the primary language for all participants. See Table for demographic data. 14 participants (26%; 95% confidence interval [CI], 14-38%) did not know that they would have to pay for an organ if they didn't have health insurance. The cohort grossly underestimated the cost of transplants. Median estimated cost (MEC) for heart transplant was $95 K (Interquartile range [IQR] $45 K-200 K); actual cost is $620 K. MEC for liver transplant was $50 K (IQR $35 K-150 K); actual cost is $525 K. MEC for kidney transplant was $50 K (IQR $30 K-170 K); actual cost is $250 K. Before the intervention, 40 participants (74%; 95% CI, 62-86%) were willing to donate their organs. After the intervention, 42 participants (78%; 95% CI, 66-89%) were willing to donate. 46 participants (85%; 95% CI, 73-93%) felt that this was information that their doctor should tell them.
CONCLUSIONS: This study of a group of undocumented, Spanish-speaking immigrants at a safety-net hospital suggests that being practically unable to receive a transplant does not lead most to opt out of the organ donor pool. Nonetheless, this information is considered important to this group.
Table 1 Demographic characteristics of study population
Characteristics N (%) Country of Origin Mexican Non-Mexican 51 (94) 3 (6) EducationHigh school 48 (89) Related to US Citizen Yes No 34 (63) 20 (37) Children 1 37 (87)
Uninsured 50 (93)
AN ASSOCIATION BETWEEN TIMING OF ADMISSION, MEDICAL TEAM WORKLOAD, AND 30-DAY READMISSION RATE. Yelena Averbukh; William Southern. Montefiore Medical Center, Bronx, NY. (Control ID #1297088)
BACKGROUND: The July effect refers to a drop in the quality of medical care due to trainees changeover at the beginning of academic year in July. Greater teaching team workload is associated with worse patient outcomes, but it is unknown if the association is the same in the early part of the academic year and the later months. To address this we examined the associations between medical team workload, timing of admission during academic year, and 30-day readmission rate.
METHODS: In this retrospective observational study we examined all admissions to the medicine teaching service of an urban academic medical center from 3/1/09 to 6/30/10. Admissions were divided into two groups based on the admission date during either first quarter of the academic year, or during the rest of the year. The two patient groups were compared with respect to demographic characteristics, co-morbidities (Charlson score), severity of illness (Laboratory-based Acute Physiology Score, LAPS), and number of prior admissions. Admissions were further divided into groups as follows: those assigned to busy teams (total admissions >49) and those assigned to less busy teams (total admissions<=49). The primary outcome was 30-day readmission rate. Multivariate logistic regression models were constructed to determine the independent association between teaching team workload and readmission rates, stratified by time of year of admission, after adjustment for demographic and clinical characteristics.
RESULTS: Of 12,118 admissions examined, 2,352 (19.4%) were admitted during the first quarter of the

academic year (July - September) and 9,766(80.6%) were admitted during the rest of the year (October - June). Patients admitted during the first quarter were similar to the patients admitted during the rest of the year with respect to age, gender, race/ethnicity, insurance, and clinical characteristics (LAPS and Charlson score). Patients admitted to busier teams in the first quartile had similar 30-day readmission rate (15.26% vs. 14.93%, p-value 0.82), but greater 30-day readmission rate during the rest of academic year (17.3% vs. 14%, p-value 0.04). After multivariate adjustment for age, LAPS, Charlson score, 90-day prior admissions, patients admitted to more-busy vs. less-busy teams in the first quartile had similar 30-day readmission rate (OR=1.03 (0.82-1.30)). During the rest of the academic year admission to a busier team was associated with increased risk of readmission (OR=1.16 (1.03-1.30)).

CONCLUSIONS: During the first quarter of the academic year admission to a busier team is not associated with increased odd of 30-day readmission. In contrast, during the rest of academic year admission to busier teams is associated with 16% increased odds of 30-day readmission

Odds of 30-day readmission if admitted to More vs. Less busy team, stratified by time of year

Univariate Multivariate*1st Quarter (Jul - Sep) 1.03 (0.82 - 1.29) 1.03 (0.82 - 1.30) 2nd -4th Quarters (Oct - Jun) 1.27 (1.14 - 1.41) 1.16 (1.03 - 1.30)

* Adjusted for age, LAPS, Charlson score, 90-day prior admissions

AN EDUCATIONAL INTERVENTION TO IMPROVE OPIATE PRESCRIBING PRACTICES IN RESIDENT CLINIC Erin Snyder1,2;

Analia Castiglioni1,2; Carlos Estrada1,2; Zhiying You3; Stefan Kertesz3,2; JosephE. Schumacher3. 1University of Alabama at Birmingham, Birmingham, AL;

2Birmingham VA Medical Center, Birmingham, AL; 3University of Alabama at Birmingham, Birmingham, AL. (Control ID #1339197)

BACKGROUND: Prescription of chronic opiates is common in resident continuity clinics. Based on prior research data documenting low comfort and lack of key knowledge among internal medicine residents and faculty, we implemented a multi-pronged educational intervention intended to improve comfort, self efficacy, and knowledge of chronic opiate prescribing. METHODS: Our intervention consisted of development and delivery of 1) educational posters to each resident clinic site including standard recom-

mendations and a guide to urine drug test interpretation, 2) pocket cards to all residents with similar information and 2) two large group lectures. Internal medicine residents and teaching faculty at a single academic medical center were surveyed pre- and post-intervention at intervals 18 months apart (each a convenience sample of persons attending a required educational activity). Using identical questions each time, the survey assessed: a) experience with opiate management (5 items, 4-point Likert), b) comfort with both opiate management (11 items) and tobacco/alcohol counseling (4 items, Likert scale), c) self-efficacy (comparing current practice to ideal practice) and d) knowledge related to typical opiate prescription management (anticipation of correct drug screen results (10 items), and 15 true/false (T/F) questions). Mean scores for the pre-intervention and post-intervention samples were compared, adjusting for gender and training level.

RESULTS: The pre-intervention sample consisted of 48 participants (76% residents, 24% faculty) while the post-intervention consisted of 39 (64% residents, 36% faculty). Pre- to post, overall comfort with opiate management decreased slightly from 32.2 (out of a possible 45, higher scores corresponding to higher comfort) to 29.9 (p=0.09). There was no significant change in self-efficacy (Pre: 27.4 (out of possible 40) vs Post: 28.8 (p=0.13). Prior to our intervention, correct anticipation of standard urine drug screen results was poor, scoring 5.8 (out of 10). Incorrect responses were especially prevalent for fentanyl, demerol, and oxycodone (on this last item, only 10% responded correctly). Post-intervention, knowledge increased to 6.8 ($p<0.01$ unadjusted, and p=0.09 adjusting for gender and training level). Correct anticipation of oxycodone results increased to 41% ($p<0.001$). Knowledge rating on T/F questions increased from 12.1 (out of 15) to 13.3 post-intervention (p=.002,

adjusting for gender and training level).
CONCLUSIONS: A relatively modest intervention consisting of lectures, posters, and pocket cards helped to close key knowledge gaps, but did not improve comfort. This discomfort may be appropriate, however, as our intervention may have alerted learners to previously unrecognized levels of complexity in chronic opiate prescribing.

ANTIBIOTIC PRESCRIBING BY TELEPHONE IN PRIMARY CARE Edward Ewen1; Vincent J. Willey2; Kanchala Vichaichanakul2; Tanmay Khole2; Pranav Dabeer2; Nikhil Loka2; William F. McGhan2; Marci Drees1.

1Christiana Care Health System, Newark, DE; 2University of the Sciences in Philadelphia, Philadelphia, PA.
(Control ID #1333660)
BACKGROUND: Overuse of antibiotics in outpatient settings has been well documented despite numerous randomized controlled trials finding no meaningful clinical benefit of antibiotic treatment for illnesses such as upper respiratory infections (URIs). Because telephone calls between patient and provider are rarely billed, little is known about antibiotic prescribing by telephone and the extent to which this practice contributes to antibiotic overuse is unknown. This study examines the patterns of use and reasons for telephonic antibiotic prescribing in a group of primary care practices.
METHODS: Antibiotic prescription data and telephone notes from 18 primary care practices, including pediatric, internal and family medicine, and women's health, were retrieved from a large, Mid-Atlantic healthcare system outpatient electronic medical record for calendar year 2008. All telephone notes associated with antibiotic prescriptions were reviewed manually and characterized according to antibiotic class, infection type, evidence supporting treatment (empiric or directed by culture/laboratories/imaging), treatment context (new, ongoing, or recurring infection), and temporal relationship to office visits. Antibiotics for chronic use were excluded and practices were categorized as teaching or private. Descriptive statistics were compared using chi-square and Mann-Whitney U tests.
RESULTS: Of 64,105 patients cared for in these practices in 2008, 1790 antibiotics were prescribed by telephone during 1736 calls, for an overall rate of 2.8 per 100 patient-years. The rate of telephonic antibiotic prescribing was greatest in internal and family medicine practices (3.3/ 100 pt-yrs vs 0.6/100 pt-yrs for pediatrics and 0.4/100 pt-yrs for women's health). In addition, private practices prescribed telephonically at more than twice the rate of teaching practices (3.3 vs. 1.4 per 100 pt-yrs, $p<0.001$). The majority of infections were URIs (43.7%) and genito-urinary tract infections (32.6%). These infections were considered new occurrences in 65.7% and recurrent infections in 13.7%. Treatment was directed by cultures, labs, or imaging results in only 13% of prescriptions. Newer macrolides were most commonly prescribed (23.5%) followed closely by quinolones (23.1%). When examining only URIs, broad spectrum antibiotics comprised 74.1% of those prescribed. A total of 796 (44.5%) prescriptions were associated with an office visit within 14 days prior to the telephone call. Patients recently seen in office visits were younger (43.7 [SD 21.5] vs 50.6 [SD 19.9] years, $p<0.001$, more frequently male (25.8% vs 20.9%, $p=0.018$), more often African-American (18.0% vs 12.2%, $p<0.001$), more likely to receive a newer quinolone (moxifloxacin or levofloxacin, 13.3% vs 7.4%, $p<0.001$), and more often received directed therapy (21.4% vs. 6.2%, $p<0.001$) compared to those managed only by telephone.
CONCLUSIONS: Antibiotic prescribing by telephone is relatively common in primary care and significant differences exist in the prescribing rate by teaching and practice type. The majority of prescriptions are generated for the empiric treatment of new onset URIs using broad spectrum antibiotics, and more than half of these patients were not seen in the office within the prior 2 weeks. The frequency and prescribing patterns associated with telephone antibiotic prescribing in this population support the case for further study of its impact on antibiotic resistance.

ANTICOAGULATION MANAGEMENT: DOES FACE-TO-FACE DELIVERED CARE IMPROVE PERCENT

TIME INR IN RANGE OVER TELEPHONE-BASED CARE FOR PATIENTS ON CHRONIC WARFARIN THERAPY? Payam B. Bokhoor1; Lei Xuan2; Eve Glazier3; Shannon M. Ruiz3; Brandon Koretz3; Jason Fish2,3. 1UC Davis, Sacramento, CA; 2UT Southwestern, Dallas, TX; 3UCLA, Los Angeles, CA. (Control ID #1318201)

BACKGROUND: Successful anticoagulant management requires careful monitoring of the international normalized ratio (INR) for those patients on warfarin, with several studies indicating patients have better outcomes when managed by an anticoagulation management service (AMS). Yet, the literature is limited in delineating which patients might benefit most from the different types of AMS configurations. We sought to identify if patients switched from a telephone-based AMS to a face-to-face AMS improved their percent time INR in range as well as to identify those benefiting the most from the switch.

METHODS: Using a retrospective random effects model, we evaluated 209 patients at an academic institution who were transitioned from a telephone-based AMS using venipuncture (non-POCT) to a face-to-face AMS using fingerstick point-of-care testing (POCT). We analyzed 18 months of data: 9 months before and after the switch. To identify any elements of secular trend, we analyzed 132 patients to be switched later over the same 18 months, managed only by non-POCT. Exclusion criteria included patients off of warfarin or hospitalized for greater than one month, or who had two or more consecutive months without data. The primary endpoint was percent time of INR in range (TIR) evaluated as a continuous variable. The independent variable was AMS configuration (POCT versus non-POCT), evaluated as a categorical variable. Additional variables included age, gender, and anticoagulation indication. We also included an interaction term involving diagnosis of atrial fibrillation/atrial flutter (afib) and AMS configuration, evaluated as a categorical variable. RESULTS: There were 231 eligible patients in the intervention group, of which 22 were excluded (4 off of warfarin and 18 with missing data) with a final sample size of 209. The average age was 72.9 (SD 15.7), with 52.6% being female. Half of the patients had afib, with the remaining patients with DVT, PE or CVA (38.8%), Cardiac Valve Replacement (5.7%), coagulation defect (3.4%), CAD or PAD (1.4%), or Pulmonary HTN(0.5%). The average unadjusted TIR was 72.6%. We observed a mean3.3% (95% CI: 1.37, 5.24; p=0.001) increase in TIR in the intervention group after their transition to POCT AMS, controlling for age, gender, and warfarin indication. Using a random effects model with the interaction term, we found that those patients with afib had a mean increase in TIR of1.07% (Interaction Term =-4.49; 95% CI -8.36, -0.62; p=0.02) compared to those patients without afib who had a mean increase of 5.56% (95% CI:2.81, 8.30; p<0.001), controlling for age, gender and warfarin indication.

In the control group, using the same methodology, there was no significant change in TIR during the study period 0.53% (95% CI: -0.24, 3.10; p=0.68). No other variables were significant.

CONCLUSIONS: The POCT AMS led to a greater TIR than the non-POCT AMS. Our research also indicated patients on warfarin for a diagnosis other than afib benefited the most from a POCT AMS, and secular trend did not appear to account for the differences. Further research is needed to better understand which specific components of the POCT AMS led to the improved TIR and why certain patients, typically thought of as complex patients, achieved a greater TIR.

ARE ANGIOTENSIN-CONVERTING ENZYME INHIBITORS (ACEI) AND ANGIOTENSIN-II RECEPTOR BLOCKERS (ARB) A RISK FACTOR FOR CIN? - A HOSPITAL-BASED STUDY Anil Nalubotula; Daniel Gutteridge; Siva K. Talluri; Pramod Kalagara; Daniel Tismal; Vanessa Pauig; Bhavana Siddegowda Bangalore; Marcello F. Schmidt; Radhika Kakarala. McLaren Regional Medical Center, Flint, MI. (Control ID #1333666)

BACKGROUND: Contrast media-Induced nephropathy (CIN) is a major complication in hospitalized patients undergoing procedures using contrast media. CIN is the third most common cause of acute kidney injury (AKI) following hypo-perfusion and nephrotoxic medications, responsible for 11% of hospital-acquired AKI. The

incidence of CIN in the general population (<2%) increases to 20-30% in high-risk patients. Chronic therapy with ACE-I/ARBs has been proposed as a risk factor in some studies but considered protective in others. CIN risk due to ACE-I/ARBs therapy has not been prospectively studied in critically ill and hospitalized patients. The goal of our study is to determine the association of ACE-I/ARB use on CIN incidence in hospitalized patients who had undergone coronary angiogram with or without PCI. METHODS: A retrospective analysis was performed in patients who underwent emergent/non-emergent cardiac catheterization during 2009 at a US community hospital. Patients were excluded if they met any of following criteria: (i) end stage renal disease; (ii) acute kidney injury preceding cardiac catheterization; (iii) hyperkalemia (K>5.5 meq/l); (iv) nephrotoxic agent administration within 3 days before the procedure; (v) pregnancy and (vi) prior cardiac catheterization within one month. CIN was defined as a 25% increase from baseline creatinine within 48 h. Patients were sub-classified based on Mehran CIN score. The association of ACE-I/ARBs with CIN development was evaluated.
RESULTS: Two hundred forty-six patients who underwent cardiac catheterization met the inclusion criteria (55% men, 35% diabetic, 43% anemic, 19% CHF). Of the 246 patients, 50 % (n=123) were taking ACE-I/ARBs. PCI was done in 42% of cardiac catheterization patients (n=100). The median Mehran CIN risk score was similar between ACE-I/ARBs (6.5) and non- ACE-I/ARBs groups (5.0) (P=0.24). There was no significant difference in the incidence of CIN between the two groups (OR: 1.451; 95% CI: 0.677-3.107; P=0.339). A sub-group analysis of 100 patients who underwent PCI revealed CIN development in a total of 8 patients. Of these 8, 75% (n=6) were using ACE-I/ARBs. There was also no statistically significant difference in the incidence of CIN in patients who were using ACE-I/ARBs compared to non-ACE-I/ARBs group (OR: 3.5; CI: 0.68 - 18.63; P=0.131). CONCLUSIONS: We did not find an association between ACE-I/ARB use and CIN. Nevertheless, in patients who underwent PCI, the risk of developing CIN while using ACE-I/ARBs was 3.5 times higher, though not reaching statistical significance. Further randomized controlled trials with more power are required especially in view of the conflicting evidence.

ARE INCOMING INTERNS KNOWLEDGE LEVELS ABOUT CORE CONTINUOUS QUALITY IMPROVEMENT CONCEPTS IMPROVING? Anne Tomolo1; Mamta K. Singh2; Renee H. Lawrence2.
1Atlanta VA Medical Center, Atlanta, GA; 2Cleveland VA Medical Center, Cleveland, OH. (Control ID #1314457)

BACKGROUND: The importance of continuous quality improvement (CQI) for providers skill sets and healthcare systems toolsets is well-recognized and
there is a move to shift such curriculum downstream so that many medical schools offer training experiences related to CQI. However, few studies have evaluated whether exposure and knowledge levels have changed over time. This information is important in terms of shaping residency training related to CQI. We addressed these questions by using data collected on two cohorts of Internal Medicine interns at the beginning of a Practice Based Learning Improvement curriculum in 2005 and 2011.
METHODS: At the beginning of a four-week ambulatory rotation curriculum, interns completed a questionnaire assessing knowledge of core concepts related to CQI in 2005 and 2011. Specifically, learners completed a question about previous experience and answered open-ended (describe or define) questions about the following core concepts: change concept, creating a cause effect diagram, elements of the improvement model, common cause and special cause variation, and why the distinction in types of variation is important. A previously developed coding system was used to score the responses and create a total knowledge score (maximum of 51 points).The coding system scores key variables needed for ideal responses to evaluate short answer definitions for core knowledge concepts (30 variables). The coding system has demonstrated good inter-coder reliability (percent agreement >85%; Lins concordance for total knowledge was 0.98), and face, construct and discriminative validity.
RESULTS: Previous experience was significantly related to cohort year: Of the 34 interns in 2005, 73.5% (n=25) indicated absolutely no experiences with CQI. In contrast, of the 33 interns (missing data for one) in

2011, only 15.2% (n=5) indicated no previous experience and51.5% (n=17) indicated having attended a lecture or teaching session on CQI. However, level of knowledge for the cohorts was not significantly different and was low with the majority of both cohorts scoring zero(70.6%, n=24/34 in 2005 and 73.5%, n=25/34 in 2011). CONCLUSIONS: Despite increasing emphasis upon the inclusion of CQI education in undergraduate medical education these findings suggest that intern baseline knowledge in some core principles of CQI has not changed over six years. Further defining and standardizing core CQI skills sets needed upon graduation from medical school would be helpful. In addition, residency programs may benefit from incorporating a curriculum that includes discussion of CQI core principles early in the training program, particularly prior to participation in Practice-Based Learning and Improvement curriculum that requires the application of these core concepts.

ARE MEDICAL INTERNS MISLED BY DIRECT-TO-CONSUMER PRESCRIPTION DRUG ADVERTISING? A PILOT CASE STUDY Huai Cheng. University of Virginia, Charlottesville, VA. (Control ID #1336251)

BACKGROUND: Direct-to-consumer prescription advertising is epidemic and costly. The claimed benefit and effectiveness of the drug in the advertising is often misleading and not evidence-based. Health care providers have similar exposure to such advertising and may be also influenced to prescribe the drug. Despite critical appraisal of the evidence as part of evidence-based medicine work shops or lectures for medical trainees, how much trainees learn in critcal appraisal of direct-to-consumer prescription advertising has not been well studied. The purpose of this pilot study was to test whether medical interns could correctly recognize the wrongly claimed benefit from a drug advertising figure by a drug company.

METHODS: The study subjects were medical interns who rotated in a 4 week geriatric rotation at a univeristy teaching hospital. During the rotation, they were required to participate in a 4 week evidence-based medicine workshop. The learning objectives of the workshop were provided to medical interns in the begining of the workshop. One was to show them a drug advertising figure and to ask them the following question: Does the combination therapy of drug A and drug B (real drug name with figure was provided to the class) improve cognitive function based on the figure? They were asked to choose one of 4 answeres: yes, probably yes, no, probably no. After the medical interns answered the question, the author (H Cheng) explained the scale of cognitive function assessment in the figure. They were asked to answer the same question again. The title of this figure was Improved cognitive benefits with drug A+drug B. The scale on the X-axis was the duration ranged from 4 to 24 weeks. The scale

(0-4) on the Y-axis appeared impressive with 4 p values ranged from 0.03 to <0.001. The problem was that the cognitive function scale (Severe Impairment Battery) ranged from 1-100, not shown in the figure. Decriptive statistics were used for data analysis.

RESULTS: 44% (72/165) of medical interns from 2007 to 2010 participated in this pilot study. 29% (21/72) said yes, agreeing that the combination therapy of drug A and drug B improves cognitive function; 22% (16/72) said probably yes; 17% (12/75) said no; and 32% (23/72) said probably no. Everybody said no once I explained that the scale of the cognitive function assessment actually ranged from 1-100. They all agreed that the changes of 1-3 in the scale of 1-100 was minimal and the drug advertising figure was misleading. CONCLUSIONS: This pilot study has shown that the incorrectly claimed drug benefit from a drug advertising figure was not recognized by about half medical interns at an univeristy teaching hospital. Whether this could change their prescription behavivor needs to be further studied. Critical appraisal of direct-to consumer prescription drug advertising should be taught to medical interns and perhaps other trainees.

ARE PRIMARY CARE PHYSICIANS READY TO CARE FOR CANCER SURVIVORS? Jeong H. Oh1; Lewis Foxhall2; Karen Basen-Engquist3; Maria Suarez-Almazor1. 1UT MD Anderson Cancer Center, Houston, TX; 2UT MD Anderson Cancer Center, Houston, TX; 3UT MD Anderson Cancer Center, Houston, TX. (Control ID #1309614)

BACKGROUND: Cancer survivorship has sharply risen since the advent of widespread screening practices and

the recent advances in treatment options. Chemotherapy, one of the cornerstones in winning the battle against cancer, has lasting health effects that require medical attention. The purpose of this study was to describe primary care physicians perception of their own knowledge and comfort level ascertaining and managing long-term and late (lasting) effects of chemotherapy in cancer survivors, and their preferences for further Continuing Medical Education (CME) in this area. METHODS: We surveyed a random sample of office-based primary care physicians (PCPs), practicing in Texas with a self-administered cross-sectional fax/mail-based survey instrument. Physicians demographics, cancer diagnosis of survivors, familiarity with lasting effects of chemotherapy, barriers to optimal care, preferences for further CME, and communication patterns with oncologists were obtained. Each item and sub-scale on the survey was summarized using standard descriptive and chi-square statistics, and two-sided precision (95% confidence interval) for a one sample proportion was calculated when appropriate.
RESULTS: Most responses were received by fax (61.2%) and from 128 participants the mean age was 49.8 years, 68.3% were males, 49.2% were general internists and 50.8% were family physicians, and the mean time since their last post-graduate training was 19.4 years. PCPs estimated that cancer survivors constituted 20.6% of all patients seen in the 4 week period prior to the survey,64.0% of the respondents reported they were unfamiliar with the lasting effects of chemotherapy, 75.0% were uncomfortable with screening practices, and 73.7% were uncomfortable with management strategies of these complications. Complexity of chemotherapy agents and their lasting effects was the most significant barrier reported, and Lack of time during patient encounters the least significant barrier. Only 17.6% responded that they had ever been offered any CME opportunity on screening and management of lasting effects of chemotherapy, however 85.6% stated that they would attend such CME if offered. Lecture format in conferences (63.4%) and Printed educational materials by mail(44.6%) were the preferred methods of CME. Most physicians (81.6%) reported that it would be helpful to receive advice/guidelines from oncologists. CONCLUSIONS: Our study suggest that most primary care physicians felt they were unfamiliar with lasting effects of chemotherapy, and reported lack of opportunities for training. These findings underscore the need for additional medical education in this area so that gains achieved in cancer survival are not offset by loss in quality of life, comorbidities, and premature mortality from the same treatment used to save patients lives.
ARE PROGRAM DIRECTORS READY FOR ACGME MILESTONES? Pamela P. Reynolds; Megan Madaras. University of Virginia, Charlottesville, VA. (Control ID #1336313)
BACKGROUND: Supporting a national effort to teach professionalism along the continuum, in 2002 the Accreditation Council on Graduate Medical Education (ACGME) launched its initiative to require program directors (PDs) to focus on 6 core competencies as part of residency training. In 2010 the ACGME announced its Milestones Project, designed to require PDs to document residents' mastery of these competencies prior to graduation. Efforts are now underway to develop curricula and tools that assess residents competencies, including professionalism. This project was designed to determine if PDs at the University of Virginia (UVa) are prepared to implement the Milestones requirements on professionalism.
METHODS: Ten PDs, representing clinical disciplines, were interviewed from January through July 2011 by one of two investigators. A structured interview was followed that asked 9 questions. PDs were asked to define professionalism, describe ACGME requirements for professionalism and discipline specific RRC requirements, whether they have a professionalism curriculum, the importance of role modeling versus didactic teaching on professionalism, whether they formally assess professional behaviors, and agreement or disagreement with behaviors included in a 15-item Medical Professionalism Behavior Assessment Tool (MPB). All interviews were transcribed. The two investigators read all interviews, and analyzed them for specific responses to questions, and common themes across the interviews. RESULTS: All 10 PDs provided a definition of professionalism that included ethical behavior and professional responsibilities. Two (of 10) PDs could state the ACGME's specific requirements for professionalism. Two (of10) PDs could describe additional RRC requirements for

professionalism. Three (of 10) PDs had formal curricula on professionalism that included seminars, lectures, workshops, and journal club case discussions; one also required an advocacy project. All relied on a GME lecture series to provide some of the content of professionalism. All PDs thought role modeling was essential to teaching professionalism, but all thought it was insufficient without structured education on the expectations of professional conduct and formal training on ethics and related issues. Seven (of 10) PDs used 360 evaluations in formative and/or summative evaluations of professionalism. None used a specific professionalism assessment tool. Three (of 10) PDs expressed concern that bad role modeling occurred and all articulated the need for faculty development prior to use of a professionalism assessment tool. All 10 PDs affirmed that the behaviors included in the MPB were appropriate for assessment of residents' professionalism. CONCLUSIONS: PDs at UVa primarily rely on role modeling for teaching professionalism. All PDs believe a curriculum with instruction on the expectations of professionalism is necessary, and that case-based seminars highlighting ethics, conflicts of interest, legal issues in medicine, cultural sensitivity and professional standards would be a valuable addition to residency training. No PD currently provides instruction on the "hidden curriculum" or the "resident as role model". One PD includes skills-based training on cultural sensitivity. While all of the UVa PDs articulate the critical importance of professionalism, most appear unprepared to formally assess residents' professionalism beyond previously described clinical competence.

ARE WE ALL EQUAL? COMPARING STUDENTS PURSUING GENERAL INTERNAL MEDICINE TO THOSE PURSUING OTHER PRIMARY CARE SPECIALTIES Martha Grayson1,4; Dale A. Newton2; Lori Foster Thompson3. 1Albert Einstein College of Medicine, Bronx, NY;
2Brody School of Medicine, Greenville, NC; 3North Carolina State University, Raleigh, NC; 4New York Medical College, Valhalla, NY. (Control ID #1323953)

BACKGROUND: Research examining the factors relevant to medical students career choice commonly combines primary care specialties into one group. While this approach facilitates comparisons between those pursuing primary care and non-primary care specialties, it may mask important differences within the primary care family. The objective of this study was to determine whether students pursuing general Internal Medicine (GIM) differ from their peers interested in Family Practice (FP) and general Pediatrics (PEDS) with respect to anticipated income and the self-reported values driving their career specialty decisions.

METHODS: Fourth-year (M4) students at New York Medical College (NYMC) and Brody School of Medicine at East Carolina University

(ECU) were surveyed annually immediately prior to graduation. This study included 18 consecutive years of M4 data from the students graduating between 1993 and 2010 (response rate=77%). Respondents were asked to indicate their future specialty plans. Those intending to pursue GIM (N= 296), FP (N=358), and PEDS (N=247) were included in the analyses, for a total sample size of N=901 (57% female). Respondents reported their annual expected income five years after completion of residency training. Beginning in 1998, respondents (N=640) were also asked to used a 1 (no influence) to 4 (major influence) scale to rate the degree to which their career decisions were affected by 29 considerations, reflected in items such as allows me to be viewed as a medical authority. Prior factor analysis found that these 29 items clustered into 7 career values: Comprehensive Patient Care, Prestige, Lifestyle, Helping Others, Working with the Poor, Research, and Income. ANCOVA analyses followed by post hoc tests were conducted to examine whether those pursuing GIM placed higher or lower weight on each factor when compared to those pursuing FP and PEDS. We statistically controlled for any effects of school (NYMC, ECU). Differences in anticipated income were also examined.

RESULTS: For three outcome measures, GIM respondents stood out as notably distinct, placing significantly higher value on Prestige and Research and significantly lower value on Helping Others than did both FP and

PEDS (p<.05) respondents. For other outcome measures, GIM tended to cluster with one of the other two primary care specialties, though the particular specialty with which GIM clustered depended on the factor at hand. GIM ratings were similar to PEDS but significantly (p <.05) lower than FP with respect to the importance students placed on Comprehensive Patient Care, Lifestyle, and Working with the Poor when selecting a career specialty. However, in other cases, GIM looked similar to FP, with both GIM and FP diverging significantly from PEDS. Specifically, students aspiring to GIM and FP placed a higher importance on income and they anticipated significantly higher incomes compared to those intending to pursue PEDS (p<.05). CONCLUSIONS: Important differences in income expectations and career values exist between students pursuing GIM and those pursuing other primary care specialties. Although researchers often lump primary care specialties into a common category, this study indicates that a more nuanced view would be appropriate. Awareness of these differences may improve career counseling by medical school faculty and residency program directors in the three primary care fields and ultimately lead to enhanced career satisfaction.

ARE PHYSICIANS ADHERING TO US PUBLIC HEALTH SERVICE SMOKING CESSATION GUIDELINES?

Shibani M. Pokras1; Richard Chapman1; Aaron Galaznik2. 1IMS Consulting Group, Alexandria, VA; 2Pfizer Global Pharmaceuticals, New York, NY. (Control ID #1280040)

BACKGROUND: Recent US Public Health Service (PHS) guidelines urge clinicians to use the 5 As model to treat tobacco dependence. Clinicians should ask and document patients tobacco use at every visit, advise users to quit, assess willingness to quit, assist by offering medication and counseling, and arrange for follow-up. The guidelines urge providers to recommend a combination of counseling and medication, instead of either alone, as there is a strong association between the number of sessions of counseling, when combined with medication, and the likelihood of successfully quitting. We assessed providers agreement with this recommendation and consistency in adherence to the 5As model among patients seen in the last week

METHODS: Our convenience sample consisted of physicians who hosted smoking cessation workshops designed to support patients preparing to quit and ZIP-code matched control physicians who did not participate (using the AMA physician masterfile). Hosts and controls were faxed a post-workshop survey evaluating self-reported adherence to PHS guidelines among patients seen in the past week.

RESULTS: Of 215 host (H) and 2,215 control (C) physicians surveyed, 113(52.6%) and 240 (10.8%) responded, respectively. Mean age overall was51.5y, 24% were female. Hosts were more likely to be non-smokers, to have fewer years practicing, and to have more patients who smoked, and less likely to be solo practitioners (p<0.05 for each). Overall, 83.6% of providers agreed that pharmacotherapy plus multimodal support was a more effective method

to quit smoking than either strategy alone. Significantly more hosts agreed with this statement vs. controls (87.6% vs. 81.7%, p=0.0055). The percentage of physicians who reported completing the following action in >80% of patients seen in the last week were: actively solicited smoking status (ask),34.6% (H:36.3%, C:33.8%); documented discussion of smoking status and treatment strategies (ask), 29.2% (H:32.7%, C:27.5%); initiated the discussion regarding smoking cessation (advise, assess), 27.2% (H:31.9%; C:25.0%); suggested patient consider quitting (assist) supported by (a) counseling:22.9% (H:34.5%, C:17.5%), (b) medication: 30.3% (H:39.8%, C:25.8%), (c) support: 23.8% (H:33.6%, C:19.2%); arranged follow-up, 9.6% (H:14.2%, C:7.5%). Significantly more hosts reported completing each action vs. controls (p<0.05 for each).

CONCLUSIONS: The majority of providers agreed that guideline-recommended combination treatment (medication and counseling) is more effective than either treatment alone, but they were not consistent in recommending each of these components to patients and most frequently recommended pharmacotherapy. Highest adherence to the 5A's model was seen in soliciting smoking status and lowest adherence in arranging for smoking-related follow-up visits. Physicians who had recently hosted smoking cessation workshops reported better adherence to guidelines vs. controls, although no definitive conclusions can be drawn between the groups due to baseline differences and self-selection to participate in these workshops. There was significant

room for improvement in adherence to the 5As model even among hosts of smoking cessation clinics, suggesting the need for greater awareness and training on guidelines to providers.

AS IF HIV WERENT ENOUGH: PERSPECTIVES ON MANAGING MEDICAL COMORBIDITIES IN PEOPLE WITH HIV Anne Monroe; Tashi L. Rowe; Richard D. Moore; Geetanjali Chander. Johns Hopkins University, Baltimore, MD. (Control ID #1340425)

BACKGROUND: Since the introduction of antiretroviral therapy (ART), HIV-positive patients have experienced a dramatic decline in AIDS-related mortality but increasing morbidity and mortality from cardiovascular disease (CVD). An aging population with HIV faces medical comorbidities such as diabetes mellitus (DM) and hypertension (HTN), which must be well-controlled to decrease CVD risk and optimize care. A high level of medication adherence is required for disease control in HIVas well as DM and HTN. The purpose of this study was to explore perceptions of living with HIV complicated by DM or HTN and to elicit barriers to and facilitators of medication adherence.

METHODS: We conducted 6 focus groups, each consisting of 5 or 6 individuals with HIV and DM or HTN on treatment for both conditions. The participants were identified by purposive sampling from the Johns Hopkins HIV Clinic in Baltimore, Maryland. The discussions were audiorecorded and transcribed. Two investigators independently coded transcripts for thematic content using editing style analysis.

RESULTS: There were 35 participants in the sample, of whom 54% were male and 94% were black. Mean age was 50.8 years (standard deviation 5.1) and median body mass index was 28.6 kg/m2 (IQR 24.3, 35.8). The median duration of HIV was 13 years (IQR 5, 18), and most participants had HTN and HIV (65.7%) or DM, HTN, and HIV (25.7%). The thematic domains identified were: 1) perceptions of HIV versus other conditions, 2) attitudes towards medications, and 3) acceptance of HIV and integration of multiple diagnoses into daily life. For perceptions of HIV versus other conditions, many participants identified comorbid conditions as a greater threat than HIV and expressed frustration at not being able to control comorbid conditions: Well you know what? It was told to me [by my doctor] HIVs not going to kill me. High blood pressure is going to kill me . . . thats what I think about the most. For attitudes towards medications, participants discussed perceived ineffectiveness of medications for comorbid conditions and lack of clinical consequences of missed doses: . . . with the high blood pressure medicine . . . my doctor [says], take your high blood pressure [medicine], but then [he says], you aint taking it, cause my pressure be up. I say, Well, let me take it in front of you and then, and then when I come back you will see . . . it still will be high. For acceptance of HIV and integration of multiple diagnoses into daily life, subthemes included: the importance of social support in medication adherence and the use of various reminder systems. For example,

one participant stated, . . . my family and my friends check with me to make sure that Im doing what Im supposed to be doing, keeping my . . . appointments, taking my insulin, taking my HIV drugs, and everything else. CONCLUSIONS: Achieving control of medical comorbidities is an important component of comprehensive HIV care, with particular relevance for patients whose HIV is well-controlled. In contrast with HIV, medication adherence alone may not be sufficient to achieve disease control in DM and HTN. Rather, educational-behavioral interventions to decrease CVD risk in HIV-positive patients must include lifestyle modification and integration of disease management into patients daily lives with social support to achieve treatment goals.

ASKING FOR WHAT SHE NEEDS? PREGNANCY TESTING OR EMERGENCY CONTRACEPTION E. Bimla Schwarz1,2; Sara M. Parisi1; Erin Baldauf1; Rachel B. Rapkin2; Glenn M. Updike2. 1University of Pittsburgh, Pittsburgh, PA; 2University of Pittsburgh, Pittsburgh, PA. (Control ID #1326256)

BACKGROUND: Emergency contraceptive (EC) pills are safe and effective in preventing pregnancy when taken up to 5 days after unprotected sex. Although dedicated EC products have been available in the US since 1998, EC is used relatively rarely and unintended pregnancy remains common in the US. We assessed how often

women seeking pregnancy testing might have benefited from EC and explored characteristics associated with women asking for EC when it was needed.
METHODS: We surveyed women aged 15-45 years who sought EC or walk-in pregnancy testing from a Title X family planning clinic between January 2011 and December 2011. Women were eligible to complete surveys if they had a negative pregnancy test and did not want to be become pregnant at the time of their visit. Surveys were conducted as part of a larger study on use of highly effective reversible contraceptives. Respondents were asked what had prompted their visit to the clinic, how many days since they last had unprotected sex, and how many times they had used EC in the past. They were also asked about their reproductive history and sociodemographic characteristics. We calculated the proportion of women seeking pregnancy testing who might have benefited from same-day use of EC and identified patient characteristics associated with seeking EC when its use was indicated. RESULTS: Two hundred and thirteen women who visited the study clinic completed the survey questions of interest (a response rate of 30%). Respondents were 225 years of age; 70% were black, 17% were white and 13% self-identified as other; 59% had previously been pregnant; 40% had been tested for sexually transmitted infection (STI) in the prior 3 months. Twenty-eight percent (n=59) of respondents were seeking EC and 72% (n= 154) were seeking pregnancy testing. Of those seeking pregnancy testing, 49% might have benefited from same-day use of EC, as they reported a contraceptive emergency (i.e. unprotected sex or sex where the contraceptive method may have failed) within the past 5 days; an additional 4% said that they didnt know how many days it had been since they had unprotected intercourse and might have also benefitted from same-day use of EC. Of those seeking EC, 98% were eligible for same-day use of EC; only one woman (2%) reported it had been more than 5 days since she had unprotected sex. Among women who may have benefited from same-day use of EC, those who asked for EC differed from those who asked only for pregnancy testing in a number of ways. Women who requested EC were older ((mean+SD): 24.3+5.2 vs. 21.4+4.3 years, $p<0.01$), more likely to have experienced an unwanted pregnancy (55% vs. 34%, $p=0.03$), more likely to have had an abortion (46% vs. 19%, $p<0.01$) and more likely to have ever used EC in the past (68% vs. 39%, $p<0.01$). In logistic regression models adjusted for these factors as well as other demographics, previous use of EC was the strongest predictor of whether or not a woman who could have benefited from EC actually asked for it (OR:4.17, 95%CI:1.42-12.24). CONCLUSIONS: A significant portion of women seeking pregnancy tests may benefit from information about and same-day access to EC. Clinicians should ensure that all women seeking pregnancy testing are asked whether they want to be pregnant and how long it has been since unprotected sex. All women at risk of unintended pregnancy should receive timely access to EC.

ASSESSING ORGANIZATIONAL READINESS FOR QUALITY IMPROVEMENT IN A GENERAL INTERNAL MEDICINE FACULTY PRACTICE C. E. Lu; Abigail E. Wilkes; Lisa M. Vinci; Monica Peek; Marshall Chin. University of Chicago, Chicago, IL. (Control ID #1339953)

BACKGROUND: Many change management experts have suggested that the failure to establish sufficient organizational readiness for change accounts for half of all unsuccessful organizational change efforts. However, few studies have explicitly examined what role readiness for change plays within the context of implementing a particular quality improvement intervention. This study examines the organizational readiness for implementing a provider feedback intervention in order to determine whether provider attitudes towards quality improvement may impact their participation in quality improvement interventions.
METHODS: In this study, we define organizational readiness for change as encompassing three domains: perceived need for change, perceived value of the specific quality improvement intervention, and perceived capacity for change. The quality improvement intervention assessed was a roster of providers diabetes patients with select follow-up actions to intensify their care. These rosters were given to academic faculty within the department of general internal medicine that provided care at a primary care clinic within the academic medical center. Organizational readiness for the intervention was assessed using a post-intervention survey and semi-structured interview. Likert scaled questions were analyzed using a Fishers exact test. Qualitative survey

questions and interview responses were analyzed using template analysis.
RESULTS: Most (69%) physicians agreed or strongly agreed that they were effective at helping their patients with diabetes. Less than half of the physicians surveyed (41%) agreed or strongly agreed that the feedback intervention provided them with useful information. Providers were more likely to review the feedback roster if they agreed that the rosters were helpful (p=0.05) and if they agreed that they were effective at helping their patients with diabetes (p=0.03). While we found that many physicians surveyed (43%) found their clinic load to be heavy or very heavy indicating lower capacity for change, this did not seem to correlate with lower tendency to rate the rosters as helpful or review the rosters. Furthermore, while most physicians felt they were effective and the clinic as a whole did well in providing their diabetic patients with appropriate care, most physicians were also able to articulate specific changes needed to improve diabetes care.
CONCLUSIONS: In this study, provider readiness for a particular quality improvement intervention appears to affect their tendency to participate in the intervention. Other factors, such as their personal confidence in their abilities, may also affect their tendency to participate; however, at least for this intervention, provider confidence in their own abilities had the opposite effect expected. Further investigation is needed to determine the role of provider confidence in participation in quality improvement interventions. Further studies are also needed to determine whether such methods could be used at other clinics with other quality improvement interventions, and to further refine methods of assessing readiness for change.
ASSESSING BARRIERS TO UPTAKE OF AVAILABLE SERVICES AND DIABETES EDUCATION AMONGST PATIENTS WITH DIABETES: A QUALITATIVE STUDY IN DELHI, INDIA. Farah N. Khan. UAB, Birmingham, AL. (Control ID #1339125)
BACKGROUND: Diabetes is a growing problem in India, yet little is known about the awareness levels and barriers to care amongst patients with diabetes. The purpose of this qualitative study was to investigate patients knowledge related to diabetes and its complications as well as barriers to care.
METHODS: Semi-structured interviews were conducted with patients with diabetes seen at Dr. Shroffs Charity Eye Hospital (SCEH) in Delhi. The moderators guide incorporated constructs from the Health Belief Model. Interviews were recorded and transcribed. Two independent reviewers used a combined inductive-deductive approach to identify themes.

RESULTS: 23 participants were interviewed; the mean age was 59, nearly half were men (42%), most were married (83%), and 48% had less than 10 years of education. Participants had general knowledge about the severity of diabetes, but did not necessarily perceive personal susceptibility to the complications of diabetes. Cues to action were typically symptom-related. Most patients recognized exercise and diet as key components of diabetes management, but self-efficacy for these behaviors was low. Often patients had difficulty identifying their diabetes related needs based on limited knowledge; when identified, limited education and financial constraints were the main barriers reported.
CONCLUSIONS: This study suggests there is a need for accessible diabetes education programs in India. Further research is needed to elucidate specific barriers to uptake of available healthcare services amongst patients with diabetes in India.
ASSESSING THE NEEDS OF CALIFORNIA HOSPITALS TO IMPROVE THE REPORTING OF PATIENT RACE, ETHNICITY, AND PRIMARY SPOKEN LANGUAGE David Zingmond1; Punam Parikh1; Zahabiya H. Chithiwala1; Scarlett Lin-Gomez2; Daphne Y. Lichtensztajn2; Ninez A. Ponce3; Romana Hasnain-Wynia4; Cheryl Mercado1. 1UCLA, School of Medicine, Los Angeles, CA; 2Cancer Prevention Institute of California, Fremont, CA; 3UCLA School of Public Health, Los Angeles, CA;
4Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1338778)

BACKGROUND: Disparities in health care are documented to be significantly higher among racial/ethnic minority populations. Although California mandates that hospitals collect and report patient race, ethnicity, and primary spoken language, a lack of specific guidelines and standardized practices on what, how, and when these data should be collected has contributed to inconsistent and incomplete data. Implementing standardized methods to collect race, ethnicity, and language data is one strategy to improve quality and elucidate disparities in care, and is recommended by the Institute of Medicine. As part of a multi-step quality improvement program, we performed a baseline assessment of how hospitals collect these data in California. METHODS: A baseline needs assessment hospital survey was developed that explored information on policies and practices regarding patient data collection, including types of data collected, data sources, and the use of a standardized form. The survey also asked about barriers encountered in the collection of these data, data auditing practices, and strategies for improving collection of data on race, ethnicity, language, and place of birth within hospitals. We identified all general acute care hospitals submitting inpatient data to the California Office of Statewide Health Planning and Development (OSHPD), the state agency that is mandated to collect patient-level data. Hospitals were contacted and asked to identify 1 to 2 people appropriate to complete this survey. A long form baseline survey was sent via U.S. post and electronically to these individuals, hospital chief administrators, and hospital registrars. A short form survey was sent to non-respondents. Respondents received a $10 gift card for their participation.
RESULTS: The survey was sent to 367 general acute care hospitals statewide. Fifty-six percent (n=205) hospitals completed the survey. Respondents included admissions/registration, quality improvement, patient services and fiscal personnel, and hospital CEOs. Participating hospitals were generally urban/ suburban, privately-owned facilities. Nearly all hospitals reported collecting race/ethnicity (97%) and spoken language (97%), while only 60% collected place of birth. Five percent of hospitals did not collect any type of patient race or ethnicity information. The majority of hospitals reported using standardized forms to collect race/ethnicity (82%) and spoken language (79%), while only 48% did so for place of birth. Seventy-five percent of hospitals reported auditing patient registration information for completeness. Strategies with the most hospital support to improve the quality and completeness of patient information included collecting data at a patients first visit, offering routine staff training, incorporating questions into existing admissions forms, the development and enforcement of hospital policies regarding data collection, and the availability of a frequently asked questions and answers document to staff. CONCLUSIONS: Hospitals in California are collecting information on patient race, ethnicity, and language as mandated, but variation in data collection exists. Hospitals endorse many reasonable approaches for standard-
ization, but lack information on the accuracy of their data. Future work must focus on methods to assess and improve the collection of these data.
ASSESSING THE ACCURACY AND COMPLETENESS OF RESIDENT SIGOUTS FOR IMPROVING PATIENT HANDOFFS Nadia K. Ali; Salma Baksh; Kristin Chapman; Nancy Law; Sarun Thomas; Ahad Lodhi. Crozer Chester Medical Center, Upland, PA. (Control ID #1330691)
BACKGROUND: A direct consequence of the enactment of the duty-hour standards by Accreditation Council on Graduate Medical Education in 2003 followed by further modifications in 2010 has been an increase in the number of hand-offs taking place. Breakdown in communication has been cited as the leading root cause of sentinel events by The Joint Commission. A transition task force consisting of interns, residents, chief resident and faculty mentor was formed to evaluate the accuracy and completeness of the written signouts created by interns at a teaching community hospital. METHODS: The transition task force used the ANTICIPATE checklist proposed by Vidyarthi et al. as a framework for assessing the accuracy and completeness of the signout. They identified 28 variables that were grouped into 9 categories: demographic data, admitting complaint and diagnosis, medications &allergies, assessment &plan, baseline vital signs and mental status, recent procedures and significant events, follow up plan, primary team contact information and organization of content. Signouts

were obtained from 17 interns (77%) on 4 randomly selected weekdays over a course of 2 weeks. The collected data was corroborated by cross-checking the patient charts. Data was recorded and analyzed using descriptive statistics.
RESULTS: The average intern score for accurate and complete signout was around 60% (16.77 3.05 of 28 points). The categories which achieved accurate completion score of over 80% included organization of content (881) and documentation of recent procedures and significant events (921). The categories that were accurately documented less than 50% included assessment and plan (21%0) and baseline vital signs and mental status (2%3). Medication and allergies received an average score of 56% and Primary team contact information received an average score of 51%. CONCLUSIONS: The study indicates that there is substantial variability in the accuracy and completeness of the interns signouts. Multiple categories of critical significance are deficient indicating the need for standardization of signouts as well as provision of handoffs training to all interns and residents. This study also provides an approach to evaluate the accuracy and completion of signouts for physicians in training. The next step for the transition task force is to create a standardized template and conduct a handoffs workshop for interns and residents.
Table 1: Percentage completion for the different sign-out assessment categories
Assessment Categories Accurately completed (PercentageStandard Deviation)
1 Demographic Data 6229
2 Admitting Complaint &Diagnosis 6430
3 Medications &Allergies 5649
4 Assessment &Plan 210
5 Baseline vital signs and mental status 23
6 Recent procedures &significant events 921
7 Follow-up plan 5646
8 Primary Team Contact information 518
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ASSESSING THE EFFECTIVENESS OF A PATIENT- AND PHYSICIAN-TARGETED INTERVENTION TO ADDRESS PRESCRIPTION MEDICATION COSTS Toshiko Uchida; Charlie Zei; Kenzie A. Cameron; Ariane M. Garrett; Anne Henson; Michael Zielinski; Leslie Ramirez; Erik Orelind; Ami Desai; Eric D. Christoff; David W. Baker. Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1327032)

BACKGROUND: Patients are being required to pay a larger percentage of rising healthcare costs each year. A recent survey conducted by the REACH Practice-Based Research Network affiliated with Northwestern University Feinberg School of Medicine revealed that patients have significant concerns about the costs of their prescription medications, but they seldom discuss ways to reduce these costs with their physicians. In response to these findings, we designed a bundled intervention consisting of an educational brochure targeted to patients and a brief (20-minute) educational seminar delivered to physicians, both focusing on strategies to help patients reduce their prescription medication costs. The current study sought to assess the effectiveness of this patient- and provider-targeted intervention for: 1) increasing the frequency of discussions between patients and physicians about prescription medication costs; and 2) increasing patient use of strategies to help reduce prescription medication costs.
METHODS: We surveyed separate samples of patients at 9 academic and private practice internal medicine sites before and after implementing the bundled intervention. During the study period, every patient who came for an appointment was given a paper survey to complete after the visit. The survey included items about patients concerns about prescription costs and attitudes about discussing prescription medication costs with their physicians. A subset of patients agreed to complete a follow-up questionnaire via phone or web survey approximately two weeks later. These follow-up items related to patients use of various strategies to help

decrease prescription medication costs.
RESULTS: Three hundred nine (response rate 26.2%) patients completed the pre-intervention survey, and 284 patients (response rate 23.4%) completed the post-intervention survey. One hundred ninety-six (68.8%) and 177 (67.3%) of pre- and post-intervention survey respondents completed the follow-up survey, respectively. We observed no difference in the frequency of discussions about prescription medication costs between the pre- and post-tests. However, among patients who did discuss prescription medication costs with their physicians, a significantly larger proportion reported that they (instead of their physician) initiated the discussion in the post-intervention group (70%) compared to the pre-intervention group (42%) (p=0.04). For follow-up questions related to use of various strategies to help reduce costs (e.g., using mail order pharmacies, using pharmacy discount cards, etc.), only use of websites to comparison shop for prescription medications increased (pre 2%, post 16%; p=0.04).
CONCLUSIONS: Combined use of a patient-targeted brochure and a physician-targeted seminar designed to increase patient-provider discussions about prescription medication costs was effective in increasing patient-initiated discussions about such costs. This bundled intervention was also effective in increasing patient use of websites to compare prescription medication costs. The intervention was not effective for increasing patient use of more traditional strategies, such as using mail-order pharmacies or pharmacy discount cards.
ASSESSMENT OF TYPE 2 DIABETES RISK FACTORS AVAILABLE IN THE ELECTRONIC MEDICAL RECORD BY USING ASSOCIATION RULE MINING Jane W. Njeru; Gyorgy J. Simon; M. Regina Castro; Stephen S. Cha; Peter W. Li; Pedro J. Caraballo. Mayo Clinic, Rochester, MN. (Control ID #1336961)
BACKGROUND: The prevalence of diabetes continues to grow worldwide. Identifying individuals at risk is at the core of any prevention efforts. Multiple diabetes prediction models have been developed using clinical and/ or laboratory factors. However, most models are rarely used due to several barriers. New models with novel techniques could provide solutions to these barriers. Association rules mining can discover relationships between unrelated data, and when applied to large databases could help identify new risk factors. In this project we seek to validate the clinical relevance of risk factors selected by association rules mining and compare them against those from previously published models.
METHODS: We used a cohort of 53,393 adults Olmsted County, MN, residents who visited Mayo Clinic between 1999-2004. They all have a glucose value in the electronic medical record (EMR) and no previous diagnosis of diabetes or glucose126 mg/dl. We collected 29 baseline characteristics available as structured data in the EMR including vital signs, medications, diagnoses, and laboratory values. We assessed 5-year incidence of diabetes; 2,349 subjects developed diabetes during the follow up period. We used association rule mining to discover rules that associate risk factors (alone or in combination) with increased risk of diabetes, adjusted for age and time-to-event. This adjustment was performed using the Cox proportional hazard model. For each rule, we calculated its relative risk and statistical significance (Wilcox and Poisson tests). We compared our model with risk factors described in a 2011 systematic review by Collins et al. These risk factors were selected using statistical models other than association rule mining. RESULTS: The association rule mining identified 331 rules with statistically significant increased risk of diabetes (risk factors alone or in combination). Only 16 of the 29 baseline characteristics were included in at least one rule as risk factors. These factors were glucose (n=207), BMI (n=170), triglycerides (n=154), hypertension (n=139), HDL cholesterol (n=88), statins (n=83), ACEI-ARB (n=71), aspirin (n=69), systolic BP (n=50), cholesterol (n=46), beta blockers (n=37), diuretics (n=23), diastolic BP (n=11), tobacco (n=10), ischemic heart disease (n=7) and fibrates (n=5). Each rule had between 1 and 6 risk factors. The relative risk was calculated for each rule and was between 1.34 (beta blockers use) and 3.87 (BMI+HDL+glucose+triglycerides+aspirin+hypertension). Collins et al. reviewed 39 studies with 43 prediction models for incident and prevalent diabetes. These models used a median cohort of 2,562 and a median of 14 candidate risk factors (range 4 to64). The final models included a median of 6 risk factors (range 2 to 11). The most common risk factors included age, family history of diabetes, BMI, hypertension, waist circumference,

gender, ethnicity, glucose level, smoking status, physical activity, systolic blood pressure, triglycerides, HDL, CVD, and HTN and CAD medications. All 16 risk factors in our model have been included in previous models although their definitions may differ; i.e. HTN medications vs. specific class of medications.
CONCLUSIONS: Our novel risk model derived using a large cohort, EMR data, and association rules mining identifies clinically relevant risk factors to predict type 2 diabetes. Further research is needed to better assess this model and its implementation in clinical practice.
ASSOCIATION BETWEEN FOOD INSUFFICIENCY AND MORTALITY: JOINT EFFECT WITH INCOME ON ALL-CAUSE AND CAUSE-SPECIFIC MORTALITY Jennifer Zhu1; Ankit Parikh2; Stuart R. Lipsitz3; Sundar Natarajan4. 1NYU School of Medicine, New York, NY; 2NYU School of Medicine, New York, NY; 3Brigham and Womens Hospital, Boston, MA; 4VA New York Harbor and NYU School of Medicine, New York, NY. (Control ID #1338680)
BACKGROUND: Food insufficiency is the state in which people have an inadequate intake of food due to a lack of resources. It is associated with chronic diseases and poor health outcomes. However, the association between food insufficiency and mortality is not known.
METHODS: Since income may modify the effect of food insufficiency, participants were categorized as: food sufficient middle-income, food insufficient middle-income, food sufficient low-income, and food insufficient low-income. We evaluated the relationship between food insufficiency and mortality among US adults in the Third National Health and Nutrition Examination Survey. Age and sex-adjusted Kaplan-Meier curves characterized survival over time, and a log-rank test was used to test if survival differences existed between groups. The effect of the 4-level food insufficiency income variable on mortality was evaluated using age and sex-adjusted Cox models and multivariate Cox models that also adjusted for race-ethnicity, education, diet, physical activity, smoking, diabetes, obesity, hyperlipidemia, and hypertension. To further elucidate the effect of each variable in the causal pathway on the relationship between the food sufficiency-income variable and mortality, Cox models sequentially incorporated age, sex, race, and risk factors. Low-income food sufficient adults were the referent group in all Cox models.
RESULTS: Of the 13,722 adults surveyed, 62.2% were food sufficient middle-income, 1.1% food insufficient middle-income, 32.8% food sufficient low-income, and 3.8% food insufficient low-income. At 18 years, food

sufficient low-income adults had a higher survival rate compared to food insufficient low-income adults in age and sex-adjusted Kaplan-Meier curves (72% vs. 68%, p<.001). In multivariate Cox models, low-income food insufficient adults had higher all-cause mortality (HR 1.31, CI 1.05-1.63, p=.02) and cancer mortality (HR 1.72, CI 1.07-2.78, p=.03). Cardiovascular mortality did not reach statistical significance (HR 1.26, CI 0.80-2.00, p=.32). In Cox models that excluded variables in the putative causal pathway to mortality, the multivariate HR in low-income food insufficient adults was 1.46 for all-cause mortality (CI 1.19-1.79, p<.001), 1.95 for cancer mortality (CI1.14-3.33, p=.02), and 1.50 for cardiovascular mortality (CI 1.01-2.22, p=.046). In sequential models for all-cause mortality, socioeconomic variables and demographic characteristics had modest effects on the relationship between the food insufficient low-income group and mortality (HR changed from 1.91 to 1.83). However, adding lifestyle and risk factors changed the HR from 1.83 to 1.40. While these sequential adjustments attenuated the effect on mortality, the association between food insufficiency and all-cause mortality, as well as cancer mortality, remained significant even after full adjustment. CONCLUSIONS: Low-income adults who are food insufficient have higher all-cause and cancer mortality than low-income adults who are food sufficient. Cardiovascular mortality is also higher after variables associated with the putative causal pathway to mortality are excluded. Food insufficiency is at the highest level it has ever been since the U.S. Department of Agriculture started collecting data in 1995. Screening for food insufficiency may provide a cost-

effective way for policy makers and health care providers to identify people at high risk of negative health outcomes and intervene by directing people to the appropriate resources.

ASSOCIATION BETWEEN HEALTH LITERACY, PATIENT ACTIVATION, AND GLYCEMIC CONTROL AMONG DIABETIC VETERANS WITH MULTIMORBIDITY LeChauncy D. Woodard; Cassie R. Landrum; Degang Wang; Laura A. Petersen; Aanand D. Naik. Michael E. DeBakey VA Medical Center HSR&D Center of Excellence and Baylor College of Medicine, Houston, TX. (Control ID #1336197)

BACKGROUND: Diabetes is a highly prevalent condition that often coexists with other chronic illnesses. Although the benefits of glycemic control have been widely documented, diabetic patients often have suboptimal control. Prior studies have shown that higher patient activation is associated with better self management and that health literacy is associated with the confidence to make health-related decisions. Both patient activation and health literacy may be particularly important for patients with diabetes, as it is largely a self-managed condition that requires patient involvement in most aspects of care. We examined the interaction of self-reported health literacy and patient activation on glycemic control among diabetic patients with coexisting cardiovascular disease.

METHODS: We administered a survey that included previously validated items on patient activation (Patient Activation Measure) and health literacy (Three-item Health Literacy Measure) to 387 diabetic patients with coexisting hypertension and ischemic heart disease (IHD). We used VA administrative data to screen patients receiving care at a large, urban VA Medical Center from November-December 2010 for our eligibility criteria. We included patients who had 2 outpatient ICD-9 diagnosis codes or 1 inpatient code indicating the study conditions. We also identified patients with IHD using relevant cardiovascular procedure codes. After identifying eligible patients from administrative data, we confirmed the target diagnoses with a medical record review before administering the surveys. Among those who completed surveys, we reviewed medical records to obtain evidence of diabetes control. We used logistic regression to examine the association between achievement of guideline-recommended HbA1c thresholds (RESULTS: 195 individuals (50.4%) returned surveys. Participants were 71% White, 25% Black, 4% Other, 99% male, and had a mean age of68.1 years. 87% of patients had HbA1c levelsCONCLUSIONS: We found that both patient activation and health literacy are associated with achievement of guideline-recommended HbA1c control. Our results suggest that patient activation may play an influential role in achieving the less-stringent HbA1c threshold (

ASSOCIATION BETWEEN PHYSICIANS BELIEFS AND WHETHER THE OPTION OF COMFORT CARE IS OFFERED FOR PATIENTS WITH ADVANCED CRITICAL ILLNESS Yael Schenker1; Greer A. Tiver1; Seo Yeon Hong3; Douglas B. White2.

1University of Pittsburgh, Pittsburgh, PA; 2University of Pittsburgh, Pittsburgh, PA; 3University of Pittsburgh, Pittsburgh, PA. (Control ID #1310165)

BACKGROUND: For patients with advanced critical illness, treatment focused on comfort is an accepted alternative to treatment focused on life-prolongation. Little is known about whether and how physicians present this option to surrogates. The objectives of this study were to assess how comfort care is presented to surrogates and whether physicians beliefs about whether life support should be withdrawn are associated with the presentation of comfort care.

METHODS: We conducted a mixed-methods study of audio-recorded physician-family conferences in 5 ICUs at two academic hospitals from January, 2006 through August, 2008. Participants included 169 family members and 54 physicians who participated in 72 conferences about treatment decisions for patients at high risk of death or severe functional impairment. Transcripts of audio-recorded conferences were coded to identify 1) the presentation of comfort care by the physician, 2) discussion of the risks and benefits of comfort care, and 3) treatment options discussed when comfort care was not offered. Physicians completed a questionnaire indicating the strength of their belief that life support should be withdrawn. We used hierarchical logistic regression to assess the association between the physicians belief that life support should be withdrawn and

the presentation of comfort care as an option.
RESULTS: Audio-recorded conferences took place an average of 10 (SD12) days after admission to the ICU. The inpatient mortality rate was 72%. Using a broad definition of comfort-oriented treatment, comfort care was presented as an option in 56% [95% CI, 44%-67%] of conferences. Few risks and benefits of comfort care were described (mean number of risks per conference was 0.2 (SD 0.5), range 0-2; mean number of benefits 0.9 (SD 1.0), range 0-4). Of the 32 conferences in which comfort care was not discussed, 78% included only discussion of continued unlimited intensive care, 9% included only discussion of limited intensive care, and 13% included discussion of unlimited intensive care and placing some limit on intensive care. In many conferences, intensive care was described as the default option. In clustered multivariate models adjusting for APACHE II score and number of days in the ICU, the only independent predictor of offering comfort care as an option was the strength of the physicians belief that life support should be foregone (OR 1.38 [1.14-1.66], p=.01). CONCLUSIONS: Among a cohort of critically ill patients with a high mortality rate, comfort care was not discussed as an option in nearly half of clinician-family conferences, and the more strongly the physician believed that life support should be continued, the lower the odds that comfort care was offered. These data suggest a previously unrecognized problem with decision making for incapacitated patients with advanced illness: the possibility that physicians personal values may consciously or unconsciously influence whether widely-accepted (and often preferred) end-of-life treatment options are offered. Clinicians should be aware of this potential bias. Researchers should develop and test interventions to ensure that surrogates are able to consider the range of medically-permissible treatment options, including comfort care, when making decisions for loved ones with far advanced illness.
ASSOCIATION BETWEEN RESIDENT ACGME CORE COMPETENCIES AND OUTPATIENT LABORATORY UTILIZATION Jessica R. Singer1; Nancy Chang1; Rafael A. Lantigua1; Steven Shea1,2.
1New York Presbyterian Hospital - Columbia University Medical Center, New York, NY; 2Columbia University, New York, NY. (Control ID #1317386)
BACKGROUND: There is significant variation in laboratory utilization by physicians. This variation matters because there are potential negative consequences for patients, provider organizations and the health care system from under- and over-utilization. Previous studies

have demonstrated that part of the variation in laboratory utilization can be explained by patient-specific factors, physician demographic factors and physician behaviors. Our interest is specifically in the behavioral factors which are potentially modifiable during the formative years of residency training. Previous literature in this area has been limited to attending physician laboratory utilization, self report of behaviors, and focus on inpatient utilization. We aim to determine whether there is an association between Internal Medicine resident physician behaviors, including Accreditation Council for Graduate Medical Education (ACGME) competencies, and laboratory utilization in the outpatient setting.
METHODS: Participants included all 39 first-year Internal Medicine residents at New York Presbyterian Hospital - Columbia University Medical Center (NYPH-CUMC) during the academic year 7/2010-6/ 2011 who had their outpatient continuity practice at the Association of Internal Medicine (AIM) practice. The 4 first-year residents who had their outpatient clinic at other sites were excluded. The AIM practice is a joint resident physician and faculty group practice serving the publicly insured Northern Manhattan community. Laboratory utilization was measured as the total number of outpatient labs ordered by each resident during the academic year adjusted for the residents total number of patient visits that year. Resident behaviors and competencies were measured by supervising inpatient attendings using standardized monthly electronic evaluations of patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, systems-based practice, teaching and teamwork and overall clinical competency. Evaluation scores were scaled from 1 to 9. Spearman rank correlation coefficients were calculated between the outcome and independent variables.

RESULTS: Participants were 46% female. The distribution of laboratory utilization was right skewed with an average of 3.2 (IQR 2.4-4.0) labs ordered per patient visit. The Spearman rank correlation coefficients demonstrated inverse associations between laboratory utilization and patient care (r=-0.13 p=0.40), medical knowledge (r=-0.18 p=0.27), practice-based learning and improvement (r=-0.13 p=0.42), interpersonal and communication skills (r=-0.19 p=0.24), professionalism (r=-0.25 p=0.11), systems-based practice (r=-0.15 p=0.35), teaching and teamwork (r=-0.30 p=0.06), and overall clinical competency (r=-0.22 p=0.18). Correlation coefficients between resident competencies ranged from 0.79 to 0.92 (all p-values <0.001) indicating that there is significant overlap in the competencies as evaluated by attending physicians.
CONCLUSIONS: Better performance on attending rated competencies and behaviors is associated with decreased laboratory utilization in first year residents. Further studies will (1) investigate these relationships in larger sample sizes including second and third year residents to have more power to assess significant associations, and (2) specifically assess whether patterns of utilization on both ends of the spectrum are inappropriate.

ASSOCIATION BETWEEN THE COMMERCIAL CHARACTERISTICS OF PSYCHOTROPIC DRUGS AND THE PROBABILITY OF THEIR OFF-LABEL USE G. Caleb Alexander4,5; Chris Graziul1; Robert Gibbons2,3. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; University of Chicago, Chicago, IL; 4University of Chicago, Chicago, IL; 5University of Chicago, Chicago, IL. (Control ID #1326157)

BACKGROUND: Off-label prescribing, or the use of a medicine for non-FDA approved indications, is especially common for psychotropic therapies and often lacks scientific support. We quantified the association between four commercial characteristics of prescription medicines -product age, therapeutic class age, drug volume, and promotional expenditures - and off-label use of antidepressants, antipsychotics and mood stabilizers from 1998 through 2009.
METHODS: We linked data from the IMS Health National Disease and Therapeutic Index, a nationally representative audit of office-base physicians, with data from FDA@gov and the drug compendium DrugDex, to derive information regarding off-label use. Our primary outcome was the probability that a drug was used for non-FDA approved
indications during a given calendar year. We used mixed-effects regression models with random intercepts for each drug, adding measures of commercial characteristics as fixed effects within this model. RESULTS: We examined agents that represented 981 million [M] drug mentions over the time period examined; this was comprised of 143 M mentions for antipsychotics, 532 M mentions for antidepressants and 306 M mentions for mood stabilizers. From 1998 through 2009, mood stabilizers were the most likely to be used off-label (average annual off-label use of class members ranged from 46%-59%) and anti-depressants were least likely (25%-29%). There was a positive association between the annual proportion of all uses of a therapy that occurred off-label and drug volume (incidence rate ratio [IRR] 1.25, 95% confidence intervals [CI] 1.20-1.31), although the strength of this association differed across the therapeutic classes examined. For each order of magnitude increase in volume of therapy, the fraction of off-label use increased by 42% for antipsychotics, 26% for mood stabilizers, and 18% for anti-depressants. By contrast, there was no statistically significant association between product age (IRR 0.99, CI 0.97-1.00) or class age (IRR 1.01, CI 0.99-1.03) and the probability of off-label use. There was a small, statistically significant association between promotional expenditures and less off-label use (IRR 0.97, CI 0.96-0.98). These associations were similar when examining scientifically unsupported rather than all off-label use.
CONCLUSIONS: Our findings suggest that psychotropic drug volume, rather than product age or therapeutic class age, should be scrutinized to identify settings where the public health impact of unsupported off-label prescribing may be particularly important.

ASSOCIATION OF PATIENT CHARACTERISTICS AND PHYSICIAN SPECIALTY WITH PROSTATE

SPECIFIC ANTIGEN TEST FOLLOW-UP Lipika Samal1,2; Adam Wright1,2; Francine L. Maloney2; Julie Fiskio2; Stuart R. Lipsitz1,2; Gianna Zuccotti1,3. 1Brigham and Women's Hospital, Boston, MA; 2Partners HealthCare, Boston, MA; 3CRICO/Risk Management Foundation, Boston, MA. (Control ID #1336410)
BACKGROUND: Prostate cancer disparities exist, but it is unknown whether the disparities are attributable to differences in initial follow-up of abnormal prostate specific antigen (PSA) tests. Few studies have examined the process of PSA follow-up using data from clinical information systems. METHODS: We queried our clinical information system for PSA test results on adult patients performed at Brigham and Womens Hospital from June 30, 2008 - June 29, 2009. We determined whether abnormal results were followed by either: 1) repeat PSA test, 2) problem list diagnosis (e.g., benign prostatic hyperplasia), 3) a visit with Urology, 4) a visit with Oncology, 5) a procedure such as a biopsy or operation, 6) death, or 7) documentation of patient refusal. Patients with problem list documentation of pre-existing conditions predisposing them to elevated PSA (e.g., prostate cancer) were excluded. Chart review was performed for all failures to follow-up. Data analysis examined the association of patient characteristics and physician specialty with follow-up. We used regression analysis of survival data based on the Cox proportional hazards model to adjust for potential confounders and clustering by patient.
RESULTS: Over a one-year period, we found 1,166 abnormal PSA test results, 97% of which had a follow-up within 1,026 days. Follow-up actions were a repeat PSA test in 27% of cases and a visit in 53% of cases. The median index PSA value was 6.0 (maximum value 11,016). Higher index PSA value ($p=0.001$) and younger patient age were significantly associated with follow-up ($p=0.004$), but race, language preference, and marital status were not. Physician specialty was significantly associated with follow-up. As compared to PSA tests ordered by Internal Medicine, PSA tests ordered by Radiation Oncology were followed-up in a more timely manner ($p=0.002$, see Figure line 5 as compared to line 1) and after adjustment for patient age, index PSA value, and clustering by patient, this difference remained significant ($p=0.002$). Follow-up of PSA tests ordered by Transplant Surgery ($p<0.001$) and tests without a physicians name on the order ($p=0.03$) was less timely than for those tests ordered by Internal Medicine in unadjusted analyses, and the difference between Transplant Surgery and Internal Medicine persisted after adjustment ($p<0.001$).

CONCLUSIONS: We have found that physician specialty is related to timeliness of follow-up in a large sample of PSA tests. In future, queries of clinical information systems may help us to create systems-level solutions to improve timeliness of abnormal test result follow-up.
Servicecat: 1) Internal Medicine, 2) Cardiology, 3) Transplant Surgery, 4) Urology, 5) Radiation Oncology, 6) No name, 7) Other specialty
ASSOCIATIONS BETWEEN ACTIVE TRANSPORT AND CARDIOVASCULAR DISEASE RISK FACTORS IN US ADULTS Gregg L. Furie. 1Yale School of Medicine, New Haven, CT; 2Department of Veterans Affairs, West Haven, CT. (Control ID #1334562)
BACKGROUND: Despite the known cardiovascular health benefits of exercise, many US adults do not obtain recommended amounts of physical activity. Active transport - defined as walking or biking for transportation - could be a valuable source of physical activity, particularly for individuals with low levels of work or recreational physical activity. However, little is known about the health benefits of active transport in the US adult population, and, therefore, whether recommending walking and biking for transportation would be a clinically useful disease prevention strategy. Thus, we investigated the association between active transport and cardiovascular disease risk factors among US adults.
METHODS: We used cross-sectional data from the 2007-2008 and 2009-2010 cycles of the National Health and Nutrition Examination Survey (NHANES). Adults aged 20 years who were not pregnant and reported

unimpaired mobility were classified according to their weekly amount of active transport: no active transport (0 min/wk), low active transport (1-149 min/wk), or high active transport (150 min/wk). Multivariable linear and logistic regression analyses were performed to examine the associations between level of active transport and physical activity-related cardiovascular disease risk factors, including body mass index (BMI), abdominal waist circumference, hypertension, diabetes, and abnormal high-density lipoprotein (HDL) level. Analyses were weighted to account for the complex survey design and adjusted for sociodemographic characteristics, smoking status, and minutes per week of combined work and recreational physical activity.
RESULTS: Of 9,933 adults included in the final sample, 75% engaged in no active transport, 11% engaged in low active transport, and 14% engaged in high active transport. Overall, there were significant inverse associations between level of active transport and BMI, abdominal waist circumference, hypertension, and diabetes. After adjusting for covariates, when compared with no active transport, individuals engaging in low active transport and high active transport had 0.9 kg/m2 (95% confidence interval [CI]=0.5-1.4) and1.2 kg/m2 (95% CI=0.8-1.7) lower mean BMIs, respectively, and 2.2 cm (95% CI=1.2-3.2) and 3.1 cm (95% CI=1.0-4.3) smaller mean waist circumferences, respectively. Odds of hypertension were 24% lower (adjusted odds ratio [OR]=0.76, 95% CI=0.61-0.94) and 31% lower (OR=0.69, 95%
CI=0.58-0.83) among those with low and high levels of active transport. High levels of active transport were associated with 31% lower (OR 0.69, 95% CI=0.54-0.88) odds of diabetes. Active transport was not associated with abnormal HDL level.
CONCLUSIONS: Active transport is associated with lower BMI, smaller waist circumference, and lower odds of hypertension and diabetes in US adults. This association is consistent with the known relationship between physical activity and cardiovascular disease risk factors and supports the utility of recommending active transport as an alternative form of physical activity for patients.
ATTITUDES AND PREFERENCES TOWARD THE PROVISION OF MEDICATION ABORTION IN AN URBAN ACADEMIC INTERNAL MEDICINE PRACTICE Cameron S. Page1; Marji Gold3; Sarah Stumbar2. 1Beth Israel Medical Center, New York, NY; 2Stony Brook University School of Medicine, Stony Brook, NY; 3Albert Einstein College of Medicine, Bronx, NY. (Control ID #1276165)
BACKGROUND: Mifepristone (formerly known as RU-486) became commercially available for early abortion in the US in 2000. This offered Internal Medicine doctors the opportunity to greatly expand abortion access for their patients. A decade later, almost 70% of pregnancy terminations still occur in specialist clinics, with less than 1% of abortions performed by generalists. Our goal was to determine whether patient preference is a reason for the limited uptake of medication abortion among Internal Medicine physicians.
METHODS: The study took place at an urban primary care center with Internal Medicine (IM) and Ob/Gyn clinics. Between December 2008 and July 2009, we approached women in the waiting room of the IM clinic, and invited them to be anonymously interviewed. All consecutive women aged 18 - 45 who presented to the clinic during research sessions were offered participation in the study. A semi-structured 43-item questionnaire was used to inquire about demographic characteristics, pregnancy history, contraceptive practices, and abortion preferences. Support for medication abortion was assessed with a binary yes/no question, followed by the open-ended question, Why do you think this clinic should or should not offer medication abortion? Responses to the open-ended question were coded into one of nine categories. The importance of abortion services was assessed with a question that had three possible responses: very important, somewhat important, and not important.
RESULTS: Of 102 women who met inclusion criteria, 90 completed the survey, yielding a response rate of 88%. 49% were Hispanic, 51% black. The average age was 33. 82% of respondents reported having vaginal intercourse with a man in the past three months. 22.2% were at risk of unintended pregnancy. 47% had had at least one abortion in the past. None of the 77 pregnancy terminations reported were medication abortions. 59% responded Yes to the question, Do you think this clinic should offer medication abortions? and 66% stated that it

was very important or somewhat important to offer this service. Among women who did not support medication abortion, the most common reason given was abortion is morally wrong (71%). Among women who would consider having an abortion in the future, 87% stated that they would be interested in receiving medication abortion from their primary care doctor.
CONCLUSIONS: To our knowledge, this is the first study to examine the abortion preferences of Internal Medicine patients specifically. We found rates of sexual intercourse, unintended pregnancy, and abortion use consistent with national trends. Among our respondents who would consider abortion, a wide majority would like to receive it from their primary care doctor. Our data suggest that patient preference is not a reason for limited uptake of medication abortion among Internal Medicine doctors. Alternate factors, such as physician comfort, should be explored. These data are limited by the small sample size, and a larger study should be done to assess whether these findings are generalizable. The provision of medication abortion by Internal Medicine physicians has the potential to greatly expand abortion access for women.

ATTITUDES REGARDING COLORECTAL CANCER SCREENING TESTS AMONG HISPANIC/LATINO AND NON-HISPANIC BLACK PATIENTS: HOW DO THEY COMPARE? Kenzie A. Cameron1; Vanessa Ramirez-Zohfeld1; Alfred W. Rademaker2; M. Rosario Ferreira1,4; Nancy C. Dolan1,3; Dachao Liu2. 1Northwestern University Feinberg School of Medicine, Chicago, IL; 2Northwestern University Feinberg School of Medicine, Chicago, IL; 3Northwestern Medical Faculty Foundation, Chicago, IL; 4Jesse Brown VAMC, Chicago, IL. (Control ID #1338868) BACKGROUND: Research has explored attitudes toward colorectal cancer (CRC) screening among minority populations; however, such studies often focus exclusively on one racial and/or ethnic population at a time. We sought to explore attitudes toward CRC screening among Hispanic/Latino (H/L) and Non-Hispanic Black (NHB) patients seeking care within the same Federally Qualified Health Center (FQHC) system in a large, urban area.
METHODS: Data were extracted from a larger, ongoing randomized-controlled study to promote colorectal cancer screening. English and Spanish-speaking patients seeking care at one of six FQHCs participated in an interviewer- administered survey that included five attitude questions about stool tests (FOBT and FIT); five related questions were asked regarding attitudes toward colonoscopy. Participants responded on a Likert scale (1= strongly disagree to 4=strongly agree). Independent sample t-tests were used to examine differences in attitude scores among H/L and NHB participants. RESULTS: Among 186 patients, 48.92% identified as H/L and 51.08% as NHB with a mean age of 58.23 years (SD=6.52); 71.50% were female. The groups differed in their attitudes toward the CRC screening tests on only three of the 10 items. Although neither group perceived stool tests as particularly painful, H/L participants reported perceiving a stool test as more painful (M=1.94, SD=1.08) than NHB (M=1.53, SD=0.80; $p<0.01$). H/L participants also perceived a colonoscopy as easier to do (M=3.23, SD=0.94), but as more embarrassing (M=2.68, SD=1.16) than NHB (ease: M=2.76, SD=1.15; $p<.01$; embarrassment: M=2.28, SD=1.17; $p<.05$). No other differences emerged (see Table 1).
CONCLUSIONS: Overall, attitudes toward both stool tests and colonoscopy among the two groups were fairly similar. If the discrepant attitudes reported here are found across multiple samples, these subtle, yet significant differences can inform future prevention efforts. Although a significant difference was seen regarding perceptions of ease of colonoscopy, we are unable to ascertain how participants defined easy to do (e.g., in terms of preparation, access, etc.); making interpretation of this difference difficult. These findings may help to better understand attitudes toward potential screening tests across underserved minority groups and consequently help provide optimal CRC screening counseling in FQHC settings.
Attitude Item Hispanic/Latino M (SD)
Non-Hispanic Black M (SD)
AUTO-IMMUNITY, SUBCLINICAL HYPOTHYROIDISM AND THE RISK OF CORONARY HEART DISEASE AND MORTALITY Tinh-Hai Collet1; Drahomir Aujesky2; Eric Vittinghoff3; Douglas Bauer4,3; Jacobijn

Gussekloo5; Anne R.Cappola6; Wendy P. den Elzen5; Jos Sgarbi7,8; Jacques Cornuz1; Alexandra P. Bremner9; Rui M.B. Maciel7; Henry Vlzke10; John P. Walsh11,12; Nicolas Rodondi2,1. 1University of Lausanne, Lausanne, Switzerland; 2Inselspital, University of Bern, Bern, Switzerland; 3University of California, San Francisco, CA; 4University of California, San Francisco, CA; 5Leiden University Medical Center, Leiden, Netherlands; 6University of Pennsylvania School of Medicine, Philadelphia, PA; 7Federal University of Sao Paulo, Sao Paulo, Brazil; 8Faculdade de Medicina de Marlia, Marlia, Brazil; 9The University of Western Australia, Crawley, WA, Australia; 10University of Greifswald, Greifswald, Germany;
11The University of Western Australia, Crawley, WA, Australia; 12Sir Charles Gairdner Hospital, Nedlands, WA, Australia. (Control ID #1318985)
BACKGROUND: Our recent participant-level meta analysis found that subclinical hypothyroidism (defined as elevated TSH but normal thyroxine levels) was modestly associated with coronary heart disease (CHD) mortality and CHD events, particularly for those with TSH >10 mIU/L. Thyroid auto-antibodies predict the risk of progression from subclinical to overt hypothyroidism, and several guidelines recommend measuring thyroid auto-antibodies to better identify patients who should receive thyroxine replacement. However, it is unknown whether thyroid auto-antibodies predict CHD outcomes associated with subclinical hypothyroidism. We aimed to compare the risks of CHD mortality and CHD events associated with subclinical hypothyroidism in adults with positive vs. negative thyroid auto-antibodies.
METHODS: We searched MEDLINE and EMBASE without language restrictions, and reference lists of retrieved articles to find prospective cohort studies with baseline assessment of thyroid function and auto-antibodies that followed subsequent CHD mortality and CHD events. Individual data on 9,063 participants with 109,017 person-years of follow-up between 1981 and 2005 were supplied from 4 prospective cohorts in Europe, Australia and Brazil. Data on CHD events were available in 4,976 participants from 2 cohorts. Euthyroidism was defined as a TSH 0.45-4.49 mIU/L and subclinical hypothyroidism as TSH between 4.5 and 19.9 mIU/ L with normal thyroxin levels. We used study-specific cutoff values for thyroxin and anti-thyroid peroxidase antibodies (anti-TPO).
RESULTS: Among 9,063 adults (54% of women), 8,418 were euthyroid and 645 had subclinical hypothyroidism (7.1%), of whom 278 (43.1%) had positive anti-TPO. During follow-up, 643 participants died of CHD and 1514 had CHD events. In age and gender-adjusted analyses compared to euthyroid individuals, risks of CHD mortality were similar among those with anti-TPO positive subclinical hypothyroidism (HR=1.23, 95% CI 0.87-1.74) and those with anti-TPO negative subclinical hypothyroidism (HR=1.82, 95% CI 0.74-4.48, p for interaction 0.43). The risks of CHD events were also similar among subclinical hypothyroid subjects with and without anti-TPO antibodies (HR=1.23, 95% CI 0.70-2.18 vs. HR=1.32, 95% CI 0.78-2.23, p for interaction 0.86). Risks of CHD mortality and CHD events increased with higher TSH levels, but did not differ between positive and negative anti-TPO. CONCLUSIONS: Risks of CHD mortality and CHD events associated with subclinical hypothyroidism did not differ according to anti-TPO status. Thyroid autoimmunity does not add prognostic information for subsequent CHD outcomes among adults with subclinical hypothyroidism. The role of the measurement of anti-TPO to target thyroxine replacement should be reevaluated.
BARRIERS AND FACILITATORS TO RECOMMENDED BLOOD PRESSURE MEASUREMENT TECHNIQUE IN COMMUNITY-BASED PRIMARY CARE CLINICS Romsai T. Boonyasai1; Jill A. Marsteller2,1; CherylA. Anderson2,1; Jeanne B. Charleston1,2; Katherine Dietz1; Sarah J. Flynn1; CrystalD. Salcido3; Gary Noronha4,1; Lisa A. Cooper1,2. 1JHU/APL, Baltimore, MD;
2Bloomberg School of Public Health, Baltimore, MD; 3Albert Einstein College of Medicine, Bronx, NY; 4Johns Hopkins Community Physicians, Baltimore, MD. (Control ID #1339987)
BACKGROUND: Blood pressure (BP) measurement in clinical settings often deviates from evidence-based standards, which may lead to suboptimal
Statistical
Significance

A stool test would be easy to do.
3.61 (0.63) 3.65 (0.67) NS
A stool test would be messy.
2.82 (1.09) 2.55 (1.14) NS
A stool test would be painful.
1.94 (1.08) 1.53 (0.80) <0.01
A stool test would be embarrassing.
2.29 (1.17) 2.00 (1.13) NS
A stool test would be scary.
2.08 (1.16) 1.96 (1.15) NS
A colonoscopy would be easy to do.
3.23 (0.94) 2.76 (1.15) <0.01
A colonoscopy would be messy.
2.36 (1.18) 2.38 (1.08) NS
A colonoscopy would be painful.
2.83 (1.08) 2.74 (1.09) NS
A colonoscopy would be embarrassing.
2.68 (1.16) 2.28 (1.17) <0.05
A colonoscopy would be scary.
2.81 (1.13) 2.85 (1.11) NS
1=Strongly disagree; 2=slightly disagree; 3=slightly agree; 4=strongly agree NS=not statistically significant

hypertension treatment. Prior studies have examined barriers to accurate BP assessment, but few have examined what interventions would be practical for clinical settings.
METHODS: This exploratory study was conducted as part of a pragmatic trial aimed at improving hypertension management at 6 urban, community-based primary care clinics. Data were collected in two stages: 1) prior to introducing a standardized BP measurement protocol and automated BP measurement device to intervention sites, we conducted 1-hour semi-structured focus groups with primary care physicians (PCPs, n=37 in 6 groups) and medical assistants (MAs, n=62 in 6 groups) to identify potential barriers to performing recommended techniques. 2) After modifying the intervention based on focus group feedback and introducing it to the clinics, we collected written and photographic observations during scheduled follow-up visits. During these visits we identified implementation issues and engaged in collaborative, solution-oriented problem-solving with clinic staff. We uploaded the transcribed focus group recordings, written diaries from follow-up visits, and photographs to NVIVO for coding and analysis. We used grounded theory to identify principal themes.
RESULTS: Qualitative analysis revealed four barrier themes. First PCPs and MAs expressed concern that performing the recommended BP measurement techniques would interfere with workflow. Second, they identified team dynamics as important barriers to performing recommended procedures. PCPs expressed reluctance to cede BP measurement to MAs, citing concern with reliability of MA-obtained readings and the importance of PCPs personally measuring BP as a means to enhance patient-provider alliance. MAs cited comfort in having PCPs provide back-up for potentially inaccurate measurements. Third, they identified site-specific challenges in the equipment and physical environment, including rooms that lack tables on which to support patients arms during BP measurement and inadequate size of BP cuffs for morbidly obese patients. Fourth, they identified site-specific challenges from clinic organization, including limited staffing at lunchtime and patient stacking at the beginning of clinic sessions. Shared problem-solving with clinic staff identified four

facilitators to adoption of recommended techniques. First, we provided tools to support recommended practices, including detachable arm boards that allow patients to support their arms on the BP measurement device. Second we reorganized MA workflow. In one example, MAs prepared vaccines while patients rest prior to BP measurement. Third, we reorganized duties within PCP-MA teams, and in doing so created efficiencies that allowed for the extra time needed to perform the recommended techniques. Finally, we created patient education materials to explain the process changes and enlist patient support for the intervention. CONCLUSIONS: This work suggests that workflow, team dynamics, physical environment, and clinic organization all pose major barriers to performing guideline-based BP measurement techniques. Collaborative problem solving generated 4 categories of feasible solutions to overcoming these barriers. Future studies could examine if the facilitators to intervention adoption can be disseminated to generalizable settings.

BARRIERS AND FACILITATORS TO IMPLEMENTING A MULTI-MODAL INTERVENTION TO INCREASE HIV TESTING Barbara Bokhour1,2; Stephen R. Henry3; Hemen Saifu3; Gemmae M. Fix1,2; Michael Fletcher3; Matthew B. Goetz3; Herschel Knapp3; Jane Burgess3; Steven Asch4. 1VA New England Healthcare System, Bedford, MA; 2VA New England Healthcare System, Bedford, MA; 3Greater Los Angeles Healtcare System, Los Angeles, CA;
4Palo Alto VAMC, Palo Alto, CA. (Control ID #1340651)

BACKGROUND: HIV testing offers significant benefits yet, many patients remain untested. In the Department of Veterans Affairs, increasing HIV testing is a major initiative, requiring novel approaches to implementing this evidence-based practice. This study examined barriers and facilitators to implementing a multimodal intervention to increase HIV testing. METHODS: We implemented an HIV testing intervention using social marketing, electronic medical rcord clinical reminders (CRs) and performance feedback to facilitate testing at 16 VA medical centers in three regional VA hospital networks. We conducted qualitative formative evaluation at each site, using the PARiHS framework, to understand the context, evidence and facilitation of implementation. Prior to the implementation, we conducted 50 interviews with HIV lead clinicians, primary care lead clinicians, nurse managers and social workers to identify perceived barriers and facilitators to HIV testing. We then conducted 41 follow-up interviews four to six months afterwards to identify which perceived barriers had been addressed by the intervention, which remained problematic, and which interventional factors facilitated an increase in HIV testing rates. RESULTS: Pre-implementation, providers indicated that lack of resources; clinical reminder overload; an onerous written informed consent processes; stigma associated with talking about HIV; concerns about how to communicate positive test results; and concerns about how best to link individuals to care were significant barriers. Concerns for patient welfare, professional responsibility, viewing CRs as helpful and organizational support were key to facilitating testing. Notably, issues of HIV stigma were more prominent in the southern region, with providers referring to trying to discuss HIV testing in the Bible Belt as particularly difficult. Providers noted a need for education for providers and patients about the benefits of HIV testing. Simplifying the consent and testing process was also viewed as critical to increasing testing. Post-implementation interviews indicated that several of these perceived barriers had been addressed; however others endured including concerns about HIV stigma and management of patients who test positive. CONCLUSIONS: Providers found the multi-modal intervention effective in addressing many pre-implementation concerns, including the potential burden of an additional clinical reminder. Several barriers remained and need to be addressed in the future. Addressing organizational and attitudinal barriers can facilitate increasing HIV testing rates in the VA through interventions incorporating clinical reminders, provider education and performance feedback. This study indicates that interventions to implement HIV testing can be successful when utilizing proven quality improvement techniques, addressing providers perceptions of the evidence and taking into consideration the local context of implementation. Attending to concerns about persistent stigma associated with HIV may further help this effort.

BARRIERS TO ADOPTION AND USE OF A NATIONWIDE WEB-BASED PERSONAL HEALTH RECORD AND

PATIENT PORTAL: A QUALITATIVE STUDY OF VAS MYHEALTHEVET Steven R. Simon1,2; Gemmae Fix3,6; Cliona Archambeault5; Max D. Stewart1,2; Keith McInnes3,6; Timothy P. Hogan7,4; Rebecca Grochow1,8.
1VA Boston Healthcare System, Boston, MA; 2Brigham and Women's Hospital, Boston, MA; 3VA Medical Center ENRM, Bedford, MA;
4University of Massachusetts Medical School, Worcester, MA; 5VA Boston Healthcare System, Boston, MA; 6Boston University School of Public Health, Boston, MA; 7VA Medical Center ENRM, Bedford, MA; 8Boston University School of Medicine, Boston, MA. (Control ID #1338859)
BACKGROUND: My HealtheVet (MHV), the VAs personal health record and web-portal, allows patients to track health parameters, view and download elements of their electronic health record, communicate with their providers, and access health education materials. However, low adoption rates prevent this technology from transforming care delivery. Only 3% of VA patients have completed in-person authentication (IPA), necessary for access to key features on the portal. VA primary care clinics are a logical site to engage patients in IPA; however, little is known about how best to intervene. With an overarching goal of developing an intervention to improve adoption and use of MHV, we undertook a qualitative study to identify the barriers to adoption and use of MHV and to characterize current approaches used in primary care to promote enrollment. METHODS: Two researchers observed 3 primary care clinics for a total of 10 hours. We interviewed 4 primary care clinicians and 10 individuals with national roles in MHV (key informants). We conducted 4 patient focus groups - 2 among Veterans (N=11) previously enrolled in MHV and 2 among Veterans (N=12) who had not enrolled - to characterize barriers to MHV adoption and use. We recorded detailed field notes after every encounter, documenting methodological details about data collection; descriptive details about interactions, observations and content; and analytic information such as interpretive ideas linking information across interviews and amongst the types of data collection. We iteratively coded data using an emergent, thematic strategy.

RESULTS: We observed high variability in primary care clinic processes surrounding MHV enrollment, including: presence and involvement of clinical champions; standardization of MHV documentation; and descriptions of MHV. Veterans in all 4 focus groups had Internet access and an interest in MHV; those who had not yet enrolled lacked clarity on what, exactly, MHV is; its relevancy to their health care; and the steps needed to achieve full enrollment. Additionally, many Veterans had encountered problems while trying to enroll in the portal, such as a closed enrollment office, logon errors, and difficulties navigating the user interface. Some primary care providers saw MHV as a nuisance and irrelevant for many of their patients; these clinicians were concerned about time constraints and felt someone else should be helping Veterans to enroll in MHV. In contrast, other providers saw MHV as a way to enhance their practice by facilitating conversations with patients outside of the usual, cumbersome phone system; these clinicians encouraged their patients to enroll in and use the portal. Key informants emphasized the need to publicize the benefits of the patient portal to both Veterans and their clinicians.
CONCLUSIONS: Taken together, the findings from this multi-modal qualitative study reveal a broad spectrum of awareness and understanding of MHV and its potential to influence health care. Discussions with Veterans and clinicians support key informants perceptions that both Veterans and staff will benefit from education and outreach about MHV. Multiple lines of evidence indicate that primary care-based efforts to enroll Veterans in MHV need standardization and improved visibility. These findings will form the basis for the development of primary-care based strategies to foster Veterans adoption and use of the patient portal.
BARRIERS TO POST-HOSPITALIZATION FOLLOW-UP: UNDERSTANDING THE PATIENTS PERSPECTIVE Caroline DeFilippo; Lello Tesema; Ramiro Jervis. Mount SInai Medical Center, New York, NY. (Control ID #1324675)
BACKGROUND: Timely access to primary care follow-up is an important factor in preventing hospital

readmissions. Patients that lack primary care follow-up within four weeks of discharge are more likely to be readmitted. Moreover, resident clinics are often understaffed and have poor continuity of care which may further aggravate poor post hospitalization follow up. As a significant proportion of patients discharged from a hospitalist service have follow up primary care in a resident clinic, our institution undertook a survey of this important patient population. Few studies have looked at the patient perspective to primary care follow up, and none have looked at this in a resident run clinic. While some studies have addressed risk factors associated with poor primary care follow-up, none to our knowledge have addressed the patients views of the role of primary care physician (PCP) after hospitalization.
METHODS: A qualitative and quantitative survey tool was administered to hospitalized patients known to an outpatient primary care clinic staffed primarily by housestaff affiliated with a major medical center. Patients had to have been to the clinic within the past 18 months for a primary care appointment, have an assigned primary care physician, speak English or Spanish and lack cognitive difficulties. Patients consented to have their medical record reviewed and were followed after discharge to see if they attending post-hospitalization appointments.
RESULTS: A total of 50 patients were surveyed over 5 months. The majority of patients felt it was important to follow-up with a physician after hospitalization; however 45% felt they only needed to see a specialist, not their PCP. Qualitative analysis identified the following roles of the PCP: referrals, medications, coordination of care, general check-up and less often follow-up after hospitalization. In addition, patients expressed specific concerns about their clinic experience including lack of continuity with their PCP. Preliminary data suggest that 25% of these patients did not have follow-up appointments with their PCP upon discharge and an additional 25% of patients had appointments and did not attend. The re-hospitalization rate was 20% at 30 days and 28% at 90 days.
CONCLUSIONS: Patients at a large urban tertiary medical center who receive their primary care in a resident run clinic appreciate the importance of post discharge follow up, but a large percentage value sub specialty follow up over primary care. A large number of patients are discharged without
appropriate follow-up care. Future analysis will determine if there is an association between perceived role of the PCP and hospital readmission rates.
BARRIERS TO UTILIZATION OF FREE SPECIALTY CARE IN AN UNINSURED POPULATION Catherine Handy1; Sai Ma2; Lauren Block3; Desiree M. de la Torre4; Anne Langley4; Barbara G. Cook4. 1Johns Hopkins School of Medicine, Baltimore, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 3Johns Hopkins School of Medicine, Baltimore, MD; 4Johns Hopkins Medicine, Baltimore, MD. (Control ID #1321184)
BACKGROUND: Uninsured individuals face many barriers to accessing specialty care. The Access Partnership (TAP) was launched in 2009 by an urban, academic medical center to provide and coordinate free specialty care to qualified uninsured patients. Patients were referred by their primary provider and asked to pay a $20 program entry fee (waived for financial hardship). In the first year, 333 eligible adult patients were referred yet 104 (31%) did not enroll. We sought to understand the barriers to utilization of care within the TAP program to find ways to improve access to specialty care for this population.
METHODS: A cross sectional, qualitative study was done through telephone surveys. Open ended responses were analyzed using word count analysis and categorized as program specific, patient specific, or both.
RESULTS: Eighteen (17%) of non-enrollees were surveyed yielding 23 unique responses. The most commonly cited barriers to joining the program were insufficient program follow up (6 responses) and financial barriers related to the program entry fee (4 responses). Seven responses were related to program-specific barriers and were within the capacity of the program to change. These included insufficient program follow up (6 responses) and unclear eligibility (1 response). Six responses were related to patient-specific barriers. These including work conflicts (2 responses), poor health status and forgetting and not wanting or needing services (1 response each). Ten responses were related to a combination; barriers not within the current design of the program but

potentially within the capacity of the program to change. These barriers included financial barriers posed by the entry fee (4 responses), transportation/mobility issues (2 responses), not understanding the reason for referral (2 responses) and choosing other services (2 responses). CONCLUSIONS: While lowering costs is necessary to improve access to specialty care for underserved patients, it is insufficient. Improving follow up and communication from the program can be used to reduce the program specific barriers. Future work should focus on identifying patients who are less likely to utilize specialty care and improve communication and resource coordination to encourage these patients to follow through with recommended care.

Bubble plot showing degree to which barriers to utilization of care were program specific, patient specific or a combination. Size of bubble reflects number of responses obtained (listed in parentheses).

BETTER MEASURES OF QUALITY FOR PATIENTS HOSPITALIZED WITH ACUTE MYOCARDIAL INFARCTION OR PNEUMONIA LenaM. Chen1,2; John D. Birkmeyer2; Douglas Staiger3; Wenying Zhang2; Justin B. Dimick2. 1VA Center for Clinical Management Research, Ann Arbor, MI; 2University of Michigan, Ann Arbor, MI; 3Dartmouth University, Hanover, NH. (Control ID #1315612)

BACKGROUND: The Centers for Medicare and Medicaid and other large payers have launched numerous initiatives aimed at improving the quality of inpatient medical care. Whether efforts such as public reporting on hospital quality will improve clinical outcomes by steering patients towards higher quality hospitals is uncertain, however. Existing quality measures are generally sub-optimal in identifying hospitals with superior (or inferior) performance. In surgery, composite measures of quality have been found to better predict future outcomes than individual measures. Therefore we assessed how well composite measures of quality predict future hospital mortality for acute myocardial infarction (AMI) and pneumonia (PNA).

METHODS: Using publicly reported performance measures from Hospital Compare and national Medicare data, we examined the ability of two different measures of quality to predict future hospital mortality rates for patients 65 years of age or older with a primary diagnosis of AMI (n=644,967) or PNA (n=1,184,119). For each condition, our quality measures were: 1) mortality rates as reported on Hospital Compare, and 2) a composite measure that was empirically weighted and reliability adjusted, and incorporated volume and mortality. We used each measure separately to place hospitals into quintiles of performance, based on July 2005 to June 2008 data. We then examined the association between hospital rank in 2005-2008 and hospital mortality rates in calendar year 2009.

RESULTS: For AMI and PNA, a composite measure better predicted future hospital mortality rates, compared to Hospital Compare measures. For example, if an AMI patient had chosen a hospital in 2009 using rankings based on the 2005-2008 composite (Hospital Compare) measure, he or she would have had 0.64 (0.72) times the odds of dying in 30 days (CI for odds of dying at best vs. worst hospital quintile based on composite: 0.61-0.66; CI for odds of dying at best vs. worst hospital quintile based on Hospital Compare: 0.69-0.74). If a patient with PNA had chosen a hospital in 2009 using the rankings based on the 2005-2008 composite (Hospital Compare) measure, he or she would have had 0.64 (0.71) times the odds of dying in 30 days (CI for odds of dying at best vs. worst hospital quintile based on composite: 0.62-0.66; CI for odds of dying at best vs. worst hospital quintile based on Hospital Compare: 0.68-0.73). CONCLUSIONS: Composite measures of quality for AMI and PNA are better at predicting future mortality than current measures on Hospital Compare. Incorporating composite measures into public reporting may provide better guidance to patients about which hospitals to choose for their care.

BISPHOSPHONATES - RISKY BUSINESS? Chi-Na Pak1; Jennifer Burkham1,2. 1Santa Clara Valley Medical Center, San Jose, CA; 2Stanford University Hospital, Palo Alto, CA. (Control ID #1311844)

BACKGROUND: Bisphosphonates account for an estimated 80% of all prescribed medications for osteoporosis,

but certain serious conditions have recently been linked to its long-term use. In addition to severe bone and muscle pains, there have been reports of atypical subtrochanteric and diaphyseal femur fractures, osteonecrosis of the jaw, atrial fibrillation, and esophageal cancer associated with its chronic use. Additionally, alendro-nate therapy in postmenopausal women with osteopenia who have no history of clinical fractures or other risk factors for fractures has not been found to be cost-effective and could potentially be harmful. Given these
recent findings, guidelines for the management of osteoporosis is under active review, particularly regarding the appropriate use of bisphosphonates. In an effort to gauge how well the current guidelines are being followed in clinical practice, we studied the percent of patients in our county hospital system, Santa Clara Valley Health and Hospital System in San Jose, California, who are being inappropriately treated with bisphosphonates.
METHODS: Using existing registries of DEXA reports and prescribed medications from the past five years in the Santa Clara Valley Health and Hospital System, an electronic registry was used to pool all patients who have had both a DEXA scan as well as a prescription for bisphosphonates, which came out to 1874 patients. A random number generator was used to select a sample population of 200 from the cohort of 1874. From the sample population, each patients DEXA report was reviewed to see if their T score met diagnostic criteria for osteoporosis, signifying indication for bisphosphonate treatment. If their T score was normal or osteopenic by T score, a chart review was then conducted to look for other indications for bisphosphonate treatment such as fragility fracture found on imaging, documented past fragility fractures, documentation of outside hospital DEXA scans showing osteoporosis, or other documented very high risk factors such as chronic steroid or immunosuppressant use. If any of these other factors were found, then treatment was also considered indicated. If not, then it was determined that bisphosphonate treatment was not clinically indicated. Given our sample size in this descriptive analysis, a confidence level of 95% was used to calculate the confidence interval of 5.38.
RESULTS: We found that 68.5% of patients on bisphosphonates who have had a DEXA met osteoporosis criteria by their T-score and indicated treatment. There were 10% of patients on bisphosphonates who have had a DEXA who did not meet criteria by DEXA but had other indications for treatment upon chart review. Overall, 78.5% of the population were appropriately treated. The percent of people on bisphosphonates who lacked a clear indication for the drug was 21.5% [16.12, 26.88%]. Of this subset, 11.6% were diagnosed with osteoporosis without meeting clinical criteria on chart review and 39.5% were actually diagnosed with osteopenia but still treated with bisphosphonates.
CONCLUSIONS: These results show that many patients are on bisphophonates without documented indication. This suggests a possible gap between knowledge of osteoporosis treatment guidelines and application in clinical practice. It is important to keep providers up to date on changes to osteoporosis treatment guidelines since bisphosphonate use may have more risk implications than previously thought, particularly in those with normal bone density or osteopenia.
BOSTON PATIENT NAVIGATION RESEARCH PROGRAM: THE IMPACT OF NAVIGATION ON TIME TO DIAGNOSTIC RESOLUTION AFTER ABNORMAL CANCER SCREENING Tracy Battaglia1; Sharon Bak1; Timothy Heeren3; Clara Chen3; Richard Kalish2; Stephen Tringale5; James O. Taylor4; Barbara Lottero7; Patrick Egan6; Nisha Thakrar2; Karen Freund1. 1Boston University School of Medicine, Boston, MA; 2South Boston Community Health Center, Boston, MA; 3Boston University School of Public Health, Boston, MA; 4East Boston Community Health Center, Boston, MA; 5Codman Square Health Center, Boston, MA; 6Dorchester House Multi-Service Center, Boston, MA; 7Greater Roslindale Medical &Dental Center, Boston, MA. (Control ID #1317072)
BACKGROUND: There is a need for controlled research studies to assess the impact of patient navigation on cancer outcomes in a vulnerable population. The objective of this study was to evaluate whether patient navigation decreased time to diagnosis for subjects with a breast or cervical cancer screening abnormality.

METHODS: The Boston PNRP program was designed as a clinical effectiveness study of patient navigation as a new standard of care. Boston Patient Navigation Research Program collected baseline data (2004-2005) and intervention data (2007-2008) at 6 community health center sites (CHCs) on all women with cervical or breast cancer screening abnormalities. During the intervention period 3 CHCs were assigned breast

navigators and 3 were assigned cervical navigators, and served as a control site for the other abnormalities. Kaplan-Meier survival curves and proportional hazards regression examined the effect of navigation on time to definitive diagnosis, adjusting for clustering by clinic and adjusting for age, race, language, and insurance. Hazard ratios greater than 1.0 indicate a decrease in time to diagnosis.
RESULTS: We enrolled N=997 subjects in the baseline period and N= 3,041 subjects during the intervention period (n=1,499 navigated, n=1,542 control). 30% were African African, 28% were Hispanic and 34% were white; 32% had no insurance, 38% were publically insured. Among those with a breast screening abnormality, there was a significant decrease in time to diagnosis for navigated subjects who resolved after 60 days (aHR1.4, 95% CI: 1.1-1.9) compared with controls, but no differences for those who resolved before 60 days (aHR1.04, .83 - 1.3). Among those with a cervical screening abnormality, there was a significant decrease in time to diagnosis for all navigated subjects when compared with controls (aHR1.5, 95% CI: 1.4-1.9).
CONCLUSIONS: This clinical effectiveness study documents a benefit of patient navigation on time to diagnosis among a racially/ethnically diverse inner city population cared for in CHCs.
BOTULINUM A TOXIN FOR HEADACHES, A META-ANALYSIS Jeffrey L. Jackson1; Akira Kuriyama2; Yasuaki Hayashino2. 1Zablocki VAMC, Milwaukee, WI; 2Kyoto University, Kyoto, Japan. (Control ID #1337567)
BACKGROUND: Our study objective was to assess the efficacy of botulinum toxin for the prophylactic treatment of headaches in adults. METHODS: We searched Medline, Embase and Cochrane, including RCTs comparing botulinum to placebo or other interventions among adults. Data was abstracted and quality was assessed independently by two reviewers with good inter-rater reliability. We pooled continuous outcomes as standardized mean differences (SMD), also known as effect sizes, using random effects models. By convention, effects less than 0.2 are considered trivial, 0.2-0.5 small, 0.5-0.8 modest and 0.8-1.0 large.
RESULTS: Our search produced 249 articles. Among 31 included trials, 27 compared botulinum to placebo and 4 to other medications (amitriptyline, prednisone, topiramate, valproate). Among placebo controlled trials, 13 evaluated episodic migraine headaches (<15 headaches/month), 8 chronic tension-type headaches (15 days per month), 1 trial evaluated a mixed population of patients with episodic or chronic tension and 5 studied chronic daily headaches (migraine or tension-type headaches occurring more than 14 days per month). Botulinum was more effective than placebo for chronic daily headaches (SMD: -0.33, 95% CI: -0.56 to -0.11, Q=8.24,5 studies, I2=51.5%) and no more effective for episodic migraine (SMD: -0.08, 95% CI: -0.22 to 0.05, Q=30.09, 13 studies, I2=60.1%, p=0.03) or chronic tension-type headaches (SMD: -0.32, 95% CI: -0.69 to 0.05, Q=27.42, 8 studies, I2=74.5%, p<0.005, Figure 2). The single trial with a combination of episodic and chronic tension-type headaches also found no benefit (SMD: -0.11, 95% CI:-0.97 to 0.74). Among fewer trials, botulinum was no better than placebo in producing 50% headache improvement for migraine (5 studies, RR: 0.97, 95% CI:0.86-1.10, Q=2.77, I2=0.0%), chronic tension-type headaches (1 study, RR: 1.11, 95% CI: 0.87-1.43) or chronic daily headaches (2 studies, RR: 1.17, 95% CI: 0.93-1.47, Q=0.76. I2=0.0%). Poor quality, small, single trials found botulinum equivalent to topiramate (SMD: 0.20, 95% CI: -0.36 to 0.76) or amitriptyline (SMD: 0.29, 95% CI: -0.17 to0.76) for chronic migraine and valproate for a trial that included both episodic (n=45) and chronic (n=14) migraines (SMD: -0.20, 95% CI: -0.91 to 0.31). All trials used doses generally inadequate for headache prophylaxis. Botulinum was better than prednisone in a single trial of chronic tension-type headaches (SMD: -2.19, 95% CI: -3.32 to -1.06). CONCLUSIONS: Botulinum is effective for "chronic daily headaches" though ineffective for episodic or chronic tension-type headaches or episodic migraines. The size of the effect is smaller than those found in systematic reviews of tricyclic antidepressants, beta-blockers and anti-

convulsants. The direct comparisons found no differences though all were low quality, small and used inadequate doses of prophylactic medications.
While FDA approved for chronic migraine headaches, there are no clinical trials investigating this specific type of headacheinstead trials evaluated "chronic daily headache" which is a mixture of patients experiencing chronic migraine (68%) or chronic tension (32%) headaches. Given that botulinum is ineffective for chronic tension headaches, it's efficacy for chronic migraines may be underestimated in these studies. Further research is needed to determine the relative efficacy of botulinum compared to other available agents and to confirm its effectiveness for chronic migraine headaches.
BREAST CANCER PATIENTS RECALL OF RECEIVING PATIENT ASSISTANCE SERVICES Jenny J. Lin; Kezhen Fei; Rebeca Franco; Nina A. Bickell. Mount Sinai, New York, NY. (Control ID #1339549)
BACKGROUND: Accuracy of recall is highly variable and recall bias may be more pronounced with the passage of time. As surveys are used to assess utilization and effectiveness of interventions, it is critical to assess factors that affect patient recall, particularly if future funding and services are determined by patients recall of service utilization.
METHODS: We compared newly-diagnosed breast cancer patients recall of receiving patient assistance services at 2 weeks and at 6 months after needs assessment was performed in a patient-assistance randomized controlled trial. All patients received English or Spanish written information about breast cancer treatment and resources; those in the intervention group received information about assistance programs targeted to their specific needs and created an action plan to contact the program. 374 women with new early-stage breast cancer operated at 8 NYC hospitals participating in the RCT were eligible to complete the 6 month follow-up survey. To date, 333 completed the follow-up (89%); 32 completing the baseline survey were unreachable, 7 refused, and 2 were deceased; 164 were assigned to the intervention group. Scales of social support were calibrated to a 100 point scale; SF12 measured physical and emotional health.
RESULTS: Of the 333 women, 210 (63%) had informational needs. At 2 weeks, 96% (202/210) reported receiving breast cancer information but at 6 months, only 69% (140/210) recalled receiving informational material. Of the 140 who recalled getting informational material, 80% had their informational needs met. 100% of women who had their informational needs met, recalled getting informational material, compared to 31% of those who did not get their informational needs met ($p<0.0001$).Age, race, income, education, adjuvant treatment, physical health status and social support did not affect recall. Of the 109 women in the intervention group with psychosocial or practical needs who were told of relevant assistance programs, 67 (61%) contacted the patient assistance program specified in their action plan at 2 weeks. However, at 6 months, only 25/67 (37%) recalled contacting a program. Women who did not recall contacting a program at 6 months were less likely to have had their psychosocial or practical needs met (13% vs 78%; $p<0.0001$). Age, income, race, education, language spoken, social support, adjuvant treatment and physical or emotional health status did not affect recall of programs contacted.
CONCLUSIONS: Nearly all women who receive information about breast cancer and treatment recall getting this information at 2 weeks but this proportion drops substantially by 6 months. Of the women with underlying psychosocial or practical needs, more than half report contacting patient assistance programs within 2 weeks, but by 6 months, only a third of these women recall contacting a program. Womens recall of receipt of patient assistance is strongly related to having had their needs met. Care should be taken when using patient surveys to evaluate the impact and utilization of patient assistance programs due to poor levels of recall.
BREAST CANCER TREATMENT DECISION-MAKING: ARE WE ASKING TOO MUCH OF PATIENTS? Nina A. Bickell; Jennifer C. Livaudais; Rebeca Franco; Kezhen Fei. Mount Sinai School of Medicine, New York, NY. (Control ID #1336437)
BACKGROUND: Physicians are mandated to offer treatment choices to breast cancer patients yet not all patients may feel comfortable with the

responsibility that entails. Prior studies show that breast cancer patients who are not given enough responsibility for treatment decision-making have poorer treatment knowledge and report worse quality of care. In contrast, few studies explore potential adverse consequences for breast cancer patients who feel they are given too much responsibility for treatment decision-making.
METHODS: We sought to describe and compare women by degree of responsibility they felt they had for making decisions about their breast cancer treatment. Our sample includes women with early-stage breast cancer treated surgically at 8 NYC hospitals, recruited for an RCT of patient assistance to improve receipt of adjuvant treatment. In multivariable analyses, we explored the association between treatment decision-making responsibility and a) baseline knowledge of treatment benefit (of surgical and other discussed treatments) and b) regret of treatment decisions after 6 months.
RESULTS: Of 368 women aged 28-89y enrolled at baseline, 72% reported a reasonable amount, 21% too much, and 7% not enough responsibility for treatment decision-making. The majority in the first group were White (53%), earned>$150,000/year (33%), completed college (53%) and had no health literacy problems (50%). In contrast, the majority with not enough responsibility were Black (42%), earned<$50,000/year (58%), did not finish high school (39%), and had health literacy problems (68%). The majority with too much responsibility were Hispanic (68%), earned<$15,000/year (54%), did not finish high school (37%), and also had health literacy problems (62%). Only 29% of women had knowledge of treatment benefits and 40% experienced decision regret at 6 months. Multivariable analysis found that women with too much vs. a reasonable amount of responsibility had less treatment knowledge ([OR] 0.46 [95% CI] 0.21, 0.99; model c=0.7301; p<0.001) and more decision regret at 6 months ([OR] 3.16 [CI] 1.59, 6.29; model c=0.7821; p<0.001). The few women with not enough responsibility also had less treatment knowledge, and more decision regret, though results were not statistically significant in this small group ([OR] 0.74 [CI] 0.23, 2.37 and [OR] 3.26 [CI] 0.93, 11.4).
CONCLUSIONS: Overall, treatment knowledge was low and decision regret common in this group of breast cancer patients. Having not enough or having too much responsibility for treatment decisions adversely impacted treatment knowledge and decision regret. Health literacy problems were common in both groups, suggesting that physicians find alternative ways to communicate with low health literacy patients, and consider using decision-aid tools to enable all patients to obtain adequate treatment knowledge, achieve desired levels of responsibility and reduce decision regret.
BRIEF TOOLS FOR ASSESSING DIETARY QUALITY IN PRIMARY CARE: A PILOT STUDY Melanie Jay1; Christopher Still2; Jamie Seiler2; Nora Henderson1; Stella Savarimuthu1; Iryna Lobach1; Colleen Gillespie1; Adina Kalet1. 1New York University School of Medicine, New York, NY;
2Geisinger Health System, Danville, PA. (Control ID #1336195)
BACKGROUND: Several chronic diseases and conditions including diabetes, hyperlipidemia, obesity and hypertension can be prevented by a healthful diet or managed in part with dietary change. Promoting these behavior changes in primary practice, however, is hampered by the lack of clinically useful, brief, simple, and validated tools for assessing diet and physical activity. The purpose of this pilot study was to identify useful screening questions for targeting dietary change by asking primary care patients to report on the quality of their diets and dietary behaviors and comparing results with the gold standard data from a standardized 24-hour dietary recall.
METHODS: We recruited adult female patients while they waited to see their primary care physician in a public inner city clinic. After the PCP visit, patients were given a questionnaire (self-administered) asking them to report on dietary behaviors and physical activity (30 items) and to rate the quality of their diets (six items) on a four-point Likert-type scale (strongly disagree to strongly agree). Within 1-month of the visit questionnaire, over

a period of two weeks, patients were contacted by phone and asked to provide detailed information in three, 24-hour dietary recalls. The final sample for these analyses was 28 patients with both visit questionnaire and 24-hour recall data. Wilcoxon tests were used to assess associations between visit questionnaire items and the 24-hour recalls.
RESULTS: 49 patients completed the surveys, and all were contacted by telephone. 21 patients either could not be reached, declined to complete 24-hour recalls, or only completed 1 or 2 recalls and were excluded. Among 28 participants who completed 24-hr recall and dietary questionnaire, 35.7% were obese and 60.7% were Hispanic. The mean number of kcal consumed was 1218 kcal. Compared to those who disagreed, patients who agreed with statement I generally eat a healthy diet had fewer kcal (1073 vs. 1465, p=0.06), lower percent saturated fat (7.39 vs. 10.79, p=0.02), lower added sugar(27.87 vs. 45.99, p=0.048), and higher percent calories from protein (16.88 vs.21.93). Patients who agreed with the statement I usually control portions, eat less of what is on my plate had lower kcal (1122 vs. 1595, p=0.06) and lower saturated fat (10.47 vs. 17.7, p=0.06). Patients who agreed with the statement I usually pay attention to fat in my diet and I eat plenty of fruits and vegetables each day also trended towards having healthier diets as measured by the 24-hour dietary recalls. In contrast, the statements I do not eat too much food, I eat enough fruit, and I dont eat too many calories were not associated with healthier diets.
CONCLUSIONS: In this pilot study, we identified four questions that prospectively identified people with healthier dietary behaviors, as validated the gold standard of the 24-hour recall, and therefore may facilitate dietary counseling and targeted interventions. Future studies are needed to clarify these questions operating characteristics and validate them in larger, more diverse patient populations.
BURDEN OF MEDICALLY-RELATED LEGAL NEEDS AMONG PATIENTS SEEKING CANCER CARE SERVICES AT AN URBAN SAFETY NET HOSPITAL Tracy Battaglia1; Rebecca Gupta-Lawrence2; Sarah E. Caron1; Megan Eldridge3; Jessica Schiller2; Tibrine da Fonseca2; Samantha Morton2; Jennifer Rosen4. 1Boston University School of Medicine, Boston, MA; 2Boston Medical Center, Boston, MA; 3Boston Medical Center, Boston, MA; 4Boston University School of Medicine, Boston, MA. (Control ID #1336439)
BACKGROUND: It is well known that underserved populations in the United States bear a disproportionate burden of cancer. It has also been shown that a host of community-specific social, cultural, behavioral and systems barriers to accessing timely quality cancer care exist for these same low-income, racial and ethnic minority populations. Many of these barriers may be legal in nature, requiring solutions residing in laws and their enforcement, an area in which medical providers have little training and also lack resources to address. The burden of legal barriers to accessing cancer care is unknown amongst vulnerable populations.
METHODS: We conducted a cross-sectional survey of women presenting for ambulatory cancer care services at an inner-city safety net hospital to assess legal needs, defined as adverse social circumstances with legal remedies that reside in laws, regulations or policies. We included patients seeking care in three ambulatory cancer practice sites to capture the needs of patients across the entire cancer care spectrum, from screening through diagnosis and treatment. Clinical sites included: a breast health specialty practice where patients are referred for screening and diagnostic services, a medical oncology clinic and a same-day surgery clinic for cancer patients in active treatment. Eligible participants were age 18 and older and able to speak and read English. The Research Assistant-administered survey contained questions regarding 25 specific legal barriers to medical care across the following domains: Income Supports, Housing and Utilities, Employment/Education, Legal Status (Immigration), and Personal &Family Stability and Safety. Descriptive statistics were used to quantify the reported presence of medically-related legal barriers and bivariate associations using T-tests and Chi-square analyses were utilized to compare those with and without reported legal barriers.

RESULTS: Among 104 respondents, 70% were female, 65% were Non-White (48% Black), 43% had income<$20,000 annually and only 34% had private insurance. Overall, eighty (77%) reported concerns with

one or more legal needs in the past month. Compared to those with no reported legal needs, those with reported legal needs were more likely to be Black (54% v. 29%, p=0.05), single, low-income (48% v. 29%, p=0.03), and not own their own home (24% v. 63%, p=0.01). The most common legal needs reported were related to income supports (69%), housing and utilities (51%) and employment/education (32%). Only 35% discussed these legal needs with their health care provider, and among those who did, only 20% utilized resources to address their need.
CONCLUSIONS: This study is the first to provide a comprehensive assessment of the medically-related legal needs of a vulnerable population seeking care across the cancer care spectrum. We have documented a high prevalence of reported legal needs, which are largely unmet in the current healthcare system. Our findings support the need for innovations in cancer care to address legal barriers to care.
CPOE-RELATED MEDICATION ERRORS: ANALYSIS OF 10,000 ERROR REPORT NARRATIVES AND VULNERABILITY TESTING OF CURRENT SYSTEMS Gordon D. Schiff1,3; Andrew C. Seger1,2; Mary Amato2; Diana L. Whitney1; Jennifer Boehne1; Ali Rashidee5; Robert B. Elson6; Ross Koppel4; Adam Wright1,3; David W. Bates1,3. 1Brigham and Women's Hospital, Boston, MA; 2Massachusetts College of Pharmacy &Health Sciences, Boston, MA; 3Center for Patient Safety Research and Practice, Boston, MA; 4University of Pennsylvania, Philadelphia, PA; 5Quantros, Inc, Milpitas, CA; 6MetroHealth Center for Health Care Research and Policy, Cleveland, OH. (Control ID #1338737)
BACKGROUND: Although CPOE has been shown to reduce medication errors, like any new technology it also has potential for introducing new errors. A recent IOM report on HIT safety urges studying problems to analyze their causes and implement prevention strategies. Since 1998 the USP MEDMARX medication error reporting system has collected nearly 2 million reports; in 2003 a coded field was added for CPOE as a contributing cause of the error. As these reports had not been studied previously, we obtained and analyzed the structured and narrative details of these CPOE-related error reports.
METHODS: A team of general internists and pharmacists analyzed MEDMARX CPOE-related error reports using 2 approaches: a) in-depth quantitative and qualitative review of report content, particularly narrative descriptions, and b) by testing vulnerability of leading current CPOE systems to actual error cases by attempting to enter these erroneous orders. We used qualitative analytic software to create a new taxonomy of CPOE errors categorized by type, cause, and prevention strategies. Representative cases were selected to construct use case scenarios based on frequency, severity, generalizability, testability, and correctability.
RESULTS: Of 1.6 million reported errors, 63,040 were reported as CPOE-related. We reviewed and coded 10,000 (15.8%) reports and derived a taxonomy of 73 codes describing error causes, 112 codes describing error effects, and 76 codes describing potential prevention strategies. Leading error causes included multiple electronic systems (1166 cases), problematic use of abbreviations (489), failure to follow procedures/protocol (468), profiling failure/issues (420), lack of computer training/system knowledge (301), hybrid (electronic &paper) systems (202), entry/typing errors (199), medication reconciliation issues (177), and alerts ignored/overridden (143). Leading error effects included missing/incorrect sig (2078), missing/wrong quantity ordered (872), wrong dose or strength (849), wrong schedule (548), duplicate orders (474), wrong formulation/dosage form (360), overdose/potential overdose (355), wrong drug (295), and comments field with conflicting information (254). Testing vulnerability of selected CPOE systems to 21 selected prototypical cases found that of 307 attempted erroneous orders, 174 (57%) could be relatively easily replicated (entered easily or w/ minor workarounds) with no warning or blocking of potentially dangerous orders. Observations of typical users (mostly medical residents) documented multiple instances of error-prone ordering and ignoring of warnings.
CONCLUSIONS: Medication error narrative reports are a rich source of descriptions and insights into medication errors, especially those related
to CPOE. Review of 10,000 CPOE-related errors provided the foundation for a new taxonomy of errors, and

subsequent vulnerability testing revealed that the majority of errors tested could be replicated in current CPOE systems. Selected insights from this analysis include potential for CPOE propagating errors that are perpetuated in recurring orders, potential for facilitation of adjacency/pull down errors, poor integration of CPOE across multiple systems, widespread evidence of alert fatigue/ ignoring with repeated examples of prescribers overriding true positive alerts, and evidence that prescribers often have difficulty entering desired orders leading to potentially dangerous workarounds, in particular description of their intent in free text comments.

CAN TELEPHONE SMOKING CESSATION PROGRAMS REACH AND TREAT HOMELESS SMOKERS? Erin Rogers1,2; Scott Sherman1,2.
1VA NY Harbor Healthcare System, New York, NY; 2New York University School of Medicine, New York, NY.
(Control ID #1336007)

BACKGROUND: Telephone smoking cessation counseling is effective in the general population, but it is not clear how feasible telephone cessation programs are for smokers with housing problems. We compared the feasibility and acceptability of telephone tobacco cessation treatment among non-homeless veterans, homeless veterans residing in long-term VA housing (HUD-VASH), and homeless veterans not residing in HUDVASH housing.

METHODS: These data were collected as part of a six-site VA trial evaluating the implementation of a telephone care coordination program for smokers who use VA mental health services. Mental health providers referred patients to the program. We collected housing status on all referred patients via medical record review at the time of referral. We categorized referred patients as non-homeless if they did not have any medical record documentation of homelessness in the year prior to their referral. We categorized patients as HUD-VASH if there was documentation that they were enrolled in the VAs HUD-VASH housing program at the time of referral. We categorized patients as homeless if they had medical record documentation of homelessness in the year prior to their referral and they were not enrolled in the VAs HUD-VASH program at the time of referral. All referred patients were contacted by phone to offer enrollment in the treatment program. Participants who enrolled were offered self-help materials, smoking cessation medications, and proactive multi-call telephone counseling. We used chi-square analyses to examine the ability of the program to reach and engage non-homeless, HUD-VASH, and homeless patients into treatment.

RESULTS: This report describes the first 1074 patients referred to the program. 912 patients were classified as non-homeless, 87 as HUDVASH, and 75 as homeless. Non-homeless patients and HUD-VASH patients were equally likely to be reached by phone to offer treatment (79% versus 74%; OR=1.32, CI=.80-2.18), but homeless patients were significantly less likely to be reached than non-homeless patients (61% versus 79%; OR=.43, CI=.26-.71). Among patients who were reached by phone, there was no difference in treatment enrollment between non-homeless and HUD-VASH patients (67% versus 64%; OR=1.15, CI=.68-1.97) or between non-homeless and homeless patients (67% versus 61%; OR=1.32, CI=.72-2.44). Among patients who enrolled in treatment, there was no difference in odds of starting telephone counseling between non-homeless and HUD-VASH patients (69% versus 68%, OR=1.04, CI=.35-1.53). However, homeless patients were significantly less likely to begin telephone counseling than non-homeless patients (46% versus 69%, OR=.39, CI=.18-.84). CONCLUSIONS: Telephone program reach and treatment uptake was good in all three patient groups. Veterans in long-term VA housing showed no differences in their ability to use a telephone tobacco cessation program compared to non-homeless patients. Homeless patients were less likely to be reached by the telephone program to offer treatment, although just as likely to enroll when they were reached. Homeless patients who enrolled in treatment were less likely to begin telephone counseling after enrolling. Future research should identify ways to increase the ability of homeless patients to use telephone tobacco cessation programs.

CAN SERUM COBALAMIN SENSIBLY BE DROPPED FROM THE ANEMIA PANEL IN MICROCYTIC INPATIENTS? Sindhu L. Joseph; Kapil Yadav; John Erikson Yap; Swarna Rai; Pramoda Koduru; Brian P. Lucas. John H. Stroger Jr. Hospital of Cook County, Chicago, IL. (Control ID #1338655)
BACKGROUND: Cobalamin (vitamin B12) deficiency is a cause of macrocytic anemia. Yet serum cobalamin levels are often ordered in the diagnostic evaluation of microcytic anemia. This is despite both the low reported prevalence of cobalamin deficiency among patients with microcytic anemia and the fact that such patients must have a combined disorder: cobalamin deficiency plus one known to cause microcytosis. We hypothesized, therefore, that in a large cohort of inpatients with anemia who had cobalamin levels ordered the incidence of cobalamin deficiency would be lower among patients with microcytosis when compared to patients without microcytosis (normo- or macrocytosis). In addition, we hypothesized that patients with microcytic anemia and cobalamin deficiency would have an elevated red cell distribution width (RDW), suggesting a second disorder causing microcytosis METHODS: Our cohort was individual hospitalizations of general medicine patients discharged from Cook County Hospital from July 2009 through June 2010. From this cohort, we identified patients who had a cobalamin level drawn during their hospital stay and who were anemic (hemoglobin less than 12 mg/dl for women and less than 13.5 mg/dl in men) at the time that the cobalamin level was ordered. Trained physician investigators systematically reviewed electronic medical charts to identify the etiology of anemia and determine whether cobalamin deficiency was present. Patients were considered cobalamin deficient if they fulfilled at least 1 out of 3 objective criteria: a serum cobalamin level less than 200 pg/ml, a methylmalonic acid level greater than 376 nmol/l, or receipt of cobalamin replacement therapy.
RESULTS: Among consecutive hospitalizations with anemia during the yearlong study period, 1888 (21% of 9157) had a serum cobalamin level ordered when the patient was anemic and 344 (18% of 1888) when the patient was also microcytic. Cobalamin deficiency was present in 5% of these 1888 hospitalizations overall. This proportion did not vary by whether or not patients were microcytic (chi-squared test, P value=0.9). Of the 16 patients with both microcytic anemia and cobalamin deficiency, all had elevated RDWs (greater than 14.5 %), suggesting combined disorders. Indeed 12 out of the 16 patients had concurrent iron deficiency anemia. However, the proportion of patients with an elevated RDW was nearly as high (97%) among microcytic anemia patients who did not have cobalamin deficiency (Fisher exact test, P value=1.0). CONCLUSIONS: Among anemic inpatients that had serum cobalamin levels drawn, the proportion diagnosed with cobalamin deficiency was low and associated neither with patients MCVs nor RDWs. Despite the selection biases inherent in our methods, our findings suggest that general medicine inpatient physicians should continue to test for cobalamin deficiency when they suspect it as a cause of anemia regardless of whether or not microcytosis is present or the red cell population is disperse in size.
CARE GUIDES: USING TRAINED LAYPERSONS TO IMPROVE CHRONIC DISEASE CARE. A RANDOMIZED CONTROLLED TRIAL. Richard Adair1; Jon Christianson2; Douglas R. Wholey2; KatieM. White2; Heather R. Britt1; Suhna R. Lee2. 1Allina Hospitals and Clinics, Minneapolis, MN; 2University of Minnesota, Minneapolis, MN. (Control ID #1316299)
BACKGROUND: Can we improve care for chronic disease patients while keeping costs down? We tested whether trained laypersons located in clinic waiting rooms, where they could interact face-to-face with patients and providers and build ongoing relationships, could improve care. METHODS: We conducted a randomized controlled trial in 5 primary care clinics diverse in location, patients, and providers. We hired 12 care guides (title chosen by patients). Eligibility for this position was two years of college plus strong social skills and a desire to help others; average salary was $16/h. Most were recent college graduates working in non-medical fields; none had clinical training. The care guides received two weeks' training that included medical ethics and confidentiality, motivational interviewing, the electronic health record (EHR), and basic information about diabetes, hypertension, and heart failure. They were located in small office cubicles in clinic waiting rooms. Their sole task was to help patients who had these diseases and their primary care physicians (PCPs)

work together to reach each patients evidence-based care goals, as defined by national experts. PCPs were asked to refer patients who needed help to care guides for enrollment. Patients who agreed to participate (87%) were given written information about their disease-specific care goals, then randomized in a 2:1 ratio to work with a care guide and their PCP to meet these goals (CG patients), or to work with their PCP in the usual way (UC patients). The end point was percent of care goals unmet at baseline and one year later. Care guides and patients could determine the manner (in person, by telephone) and frequency of their interactions; care guides sent PCPs quarterly EHR progress reports and met informally with them as needed.
RESULTS: A total of 2125 patients were enrolled, 1423 randomized to CG and 702 randomized to UC. Care guides served an average panel of 120 patients/full time position. Most patients had more than one diagnosis (1365 diabetes, 1723 hypertension, 122 heart failure). The groups were well matched for diagnoses, age, sex, insurance status, race, educational attainment, and goals met at baseline (75%). We report interim (6-month) results. In the 1365 patients with diabetes, unmet goals declined 18% in CG patients ($p<.001$) and 1% in UC patients, with a significant difference between the two groups ($p<.001$). In the 705 patients with hypertension without diabetes, unmet blood pressure goals declined 45% in CG patients ($p<.001$) but 51% in UC patients ($p<.001$), with no significant difference between groups. For all randomized patients, unmet goals declined 24% in CG patients ($p<.001$) and 17% in UC patients ($p<.001$), with $p=.065$ for a difference between groups. Data collection for the randomized patients will be carried out for 1 year. CG and UC patients will be compared with 13,647 propensity-score matched patients in similar clinics without care guides, for a subset of goals.
CONCLUSIONS: Trained laypersons integrated into the primary care delivery process can improve care for chronic disease patients, especially those with diabetes, at a relatively low cost.
CESSATION OF ANTIBIOTICS THROUGH USE OF PROCALCITONIN BIOMARKER LEVEL? Quang V. Ton; Sudhir R. Dudekonda; Benjamin Hohmuth. Englewood Hospital Medical Center, Englewood, NJ. (Control ID #1309812)
BACKGROUND: Studies have suggested that serum procalcitonin biomarker levels improve the ability to differentiate between bacterial and nonbacterial infections. Previous trials based in the European health care setting have shown a reduction in antibiotic use through clinical algorithms based on procalcitonin levels. In the United States, procalcitonin biomarker has only been recently made available. We conducted a study to evaluate the relationship of procalcitonin biomarker and subsequent antibiotic administration. We hypothesized that antibiotics will not be discontinued when the procalcitonin level discourages use of antibiotics.
METHODS: We retrospectively reviewed electronic medical records of all patients that had a procalcitonin biomarker level during the first nine months of availability between July 2010 and March 2011 in a single center community hospital. Patient were included if they had a procalcitonin level measured in the emergency department or inpatient setting. Patients were divided into two groups based on procalcitonin levels: discouraged or encouraged use of antibiotics. The discouraged use of antibiotics group included patients who had a procalcitonin level of less than 0.25 ug/L (n=242); while the encouraged use of antibiotics group included patients who had a procalcitonin level of greater than 0.25 ug/L (n=419). The subsequent cessation or continuation of antibiotics was then documented. The specific antibiotic, length of use, and admitting diagnosis were also recorded. Statistical analyses were performed using chi-square analysis for nominal data and unpaired t test (two sided). RESULTS: In the discouraged use of antibiotics group, 78 procalcitonin levels (32.2%) had antibiotics discontinued, while in 164 levels (67.8%) antibiotics were continued. In the encouraged use of antibiotics group, antibiotics were discontinued in 59 levels (14.1%) and continued in 360 levels(85.9%). Clinical adherence with procalcitonin guided therapy was shown in 438 instances (66.3%) while non-adherence was in 223 instances (33.7%) in accordance with procalcitonin levels ($p<0.0001$). Average length of antibiotic use was 4.8 days in the discouraged use of antibiotics group and was 5.9 days in the encouraged use of antibiotics group ($p<0.001$).

CONCLUSIONS: Recent reports from Europe suggest the potential for reduction in antibiotic exposure using clinical algorithms for antibiotic therapy decisions in patients with suspected bacterial infections. Our results suggest that antibiotics are being continued despite procalcitonin levels that should prompt discontinuation of antibiotics. Possible explanations for our findings include lack of procalcitonin algorithms and studies in the United States health care setting. This is one of the first studies to examine clinical adherence in terms of procalcitonin levels and antibiotics in the United States. Further US studies perhaps are needed to alleviate clinician concerns in regards to practice and population differences.

CHANGES IN PATIENT EXPERIENCE IN A PAYMENT-LINKED PATIENT CENTERED MEDICAL HOME DEMONSTRATION PROJECT Asaf Bitton1,2; Gordon Schiff1; Tony Yu1; Daniel Henderson1,4; Stuart R. Lipsitz1; Steven R. Simon1,5; Lydia A. Flier1; Carol Keohane1; David W. Bates1,3. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Harvard School of Public Health, Boston, MA; 4University of Connecticut School of Medicine, Farmington, CT; 5VA Boston HealthCare System, Jamaica Plain, MA. (Control ID #1338719)

BACKGROUND: Patient-centered medical homes (PCMH) pilots are garnering attention for their potential to improve primary care delivery. Linking practice transformation to payment reform may help accelerate this change process, but previous research on the short-term impact of transformation on patient experience has shown mixed results. We examined the impact of a payer-initiated, payment-linked PCMH demonstration on patient experience. METHODS: As part of a multi-modal evaluation, we analyzed data from the first 2 years (2009 and 2010) of a PCMH demonstration initiated by a non-profit commercial insurer in New York. The pilot tested facilitated primary care practice transformation to team-based care linked with comprehensive payment reform in 3 practices with 11,500 health plan patients. The practices received risk-adjusted monthly payments, initial transformation stipends, and significant performance bonus opportunities. Patient experience was surveyed by mail via the Clinical Group-Consumer Assessment of Health Plans (CG-CAHPS) survey, a well-validated measure for outpatient care. We focused on 4 domains: care when needed, physician communication, office staff helpfulness, and global physician rating. Each domain is measured on a 0-100 scale. The survey collects information on patient age, sex, race, education, duration of physician relationship, number of visits in prior year, and self-reported health status. We conducted bivariate analyses comparing patients of PCMH practices to non-PCMH practices, examining means of the domains. We constructed multivariable regression models to assess adjusted differences over time between the PCMH and non-PCMH patients, adjusting for the a priori covariates listed above and accounting for physician-level clustering effects using generalized estimating equations. RESULTS: In 2009 and 2010, 44,626 patients responded to the CG-CAHPS survey, 1689 of whom were linked to a PCMH pilot. Over 47% of the sample was from 2009. Compared to non-PCMH, PCMH patients were older, more likely to be white, and had higher education, according to bivariate analysis. They were significantly less likely to report seeing their physician for more than 5 years, and reported fewer visits per year. In unadjusted analyses, patient experience mean measures were significantly improved in global physician rating in both the PCMH and non-PCMH group. In the two year model adjusted for the significant covariates above, gender, and health status, PCMH ratings in office staff helpfulness improved (84.6 to 85.7), while adjusted means in the non-PCMH group decreased (89.7 to 89.4) (difference in differences=1.4 (SE 0.7), P=0.045). Similar trends toward improvement in the PCMH patients existed in the other domains, though without statistical significance (care when needed: 1.4 (SE 0.9), P=0.14; physician communication: 1.2 (SE 0.8), P=0.11; global rating of physician 0.9 (SE 0.8), P=0.24). CONCLUSIONS: In the first two years of a large PCMH pilot demonstration linked to payment reform, patient experience improved significantly in the office staff interaction domain, and trended toward improvement in other domains. These results are consistent with the pilots transformation focus on team-based care and improving patient interactions and goal-setting. Aligned payment reform efforts to promote and reward this type of transformation may be a valuable tool for primary care delivery reform. Further research is needed to assess whether the changes are sustainable and replicable.

CHANGES IN USE AND GEOGRAPHIC VARIATION IN PERCUTANEOUS CORONARY INTERVENTION (PCI) FOR STABLE ANGINA FOLLOWING PUBLICATION OF THE COURAGE TRIAL Arun Mohan1; Yu-Chu Shen2; David Howard3.
1Emory University School of Medicine, Atlanta, GA; 2Naval Postgraduate School, Monterrey, CA; 3Rollins School of Public Health, Atlanta, GA. (Control ID #1339681)

BACKGROUND: Prior research demonstrates substantial geographic variation in clinical practice that is not associated with health status or patient outcomes. Lack of clarity regarding the best approach to a clinical condition is often cited as a cause of such variation. The COURAGE trial, published in 2007, was a highly publicized, multi-center randomized, controlled trial that found that optimized medical therapy alone was as effective as percutaneous coronary intervention (PCI) plus optimized medical therapy for patients with stable angina. We examine whether overall use and geographic variation in use of PCI for stable angina declined following publication of COURAGE. METHODS: We measured trends in PCI volume in Arizona, California, Florida, Massachusetts, Maryland, and New Jersey using the State Inpatient Discharge databases. These capture a near 100% sample of all inpatient discharges, including discharges for non-elderly patients. We supplemented these data with regional characteristics from the Dartmouth Atlas of Healthcare such as HRR-level inpatient spending for decedents in the last 6 months of life (a generally-accepted measure of regional practice patterns), hospital characteristics, physician availability, and availability of PCI. We examined geographic variation in hospital referral region (HRR)-level PCI volume for stable angina pre- (2006) and post-(2008) publication of the COURAGE trial and compared those to contemporaneous changes in PCI volume for two control conditions not studied in the COURAGE trial, acute myocardial infarction and unstable angina (AMI/UA). Geographic variation was measured in two ways: 1) weighted coefficient of variation (CV), which is the ratio of the standard deviation of the prevalence rates to the mean rate among the HRR, weighted by the population in each HRR, and 2) interquartile ratio (IQR), the ratio of the highest-use HRR to the lowest-use HRR. Multivariate linear and logistic regression was used to examine the impact of age, sex, prevalence of AMI/UA (measure of health status), and non-clinical factors on the use of PCI for stable agina. 72 hospital referral regions which represented 290,950 PCI for stable angina and 350,398 PCI for AMI/UA were included in the analysis. RESULTS: Following the publication of the COURAGE trial PCI volume for stable angina declined 25% (mean=1.2 per 1,000 residents to 0.82, SD=0.68 to 0.48, p=0.002) and decreased 9% for AMI/UA (mean=1.28 to 1.14, SD=0.72 to 0.66, p=0.22). Both the CV (0.62 to 0.63 for stable angina and 0.58 to0.58 for UA/AMI) and the IQR (2.5 to 2.5 for stable angina and 2.3 to 2.5 for AMI/UA) were unchanged. In multivariable regression models, rate of AMI/ UA and spending for decedents in the last 6 months of life were found to be significantly associated with changes in PCI for stable angina ($p<0.05$). Other non-clinical factors were not associated with changes in PCI volume for either stable angina or AMI/UA.
CONCLUSIONS: While use of PCI for stable angina declined after the publication of the COURAGE trial, there was substantial geographic variation in use of PCI for stable angina that existed prior to its publication that did not change following it. Although non-clinical factors explain this finding in part, even this large, well conducted trial with clear implications for the optimal treatment of PCI did not have the desired effect of reducing geographic variation in healthcare utilization for this condition.

CHARACTERISTICS OF CHRONIC KIDNEY DISEASE PATIENTS IN THE TEXAS PANHANDLE Sudha P. Chennasamudram1; Tetyana L. Vasylyeva1; Georges Maliha2; Giron A. Milton3; Sharma Prabhakar4; Roger D. Smalligan2. 1Texas Tech University Health Sciences Center, Amarillo, TX; 2Texas Tech University Health Sciences Center, Amarillo, TX; 3Amarillo Medical Specialists, LLP, Amarillo, TX; 4Texas Tech University health Sciences center, Lubbock, TX. (Control ID #1332270)

BACKGROUND: Chronic kidney disease (CKD) is a growing healthcare problem. It is estimated that over twenty-six million people are affected with CKD in the United States. In addition, about 500,000 patients have

Texas ranks second highest in the prevalence of CKD and costs associated with it in the nation. The goal of this study was to identify the stage at which patients nearing ESRD were referred to nephrologists in the Panhandle region of Texas and to compare these patients with national data available from the Centers for Disease Control and Prevention (CDC). METHODS: A retrospective chart review of CKD patients attending local nephrology clinics in Amarillo, TX was performed (there are no university or public nephrology clinics in the area). Demographic data including age, gender and ethnicity; laboratory values such as serum-creatinine, eGFR, urinary protein excretion, hemoglobin, lipid panel, serum protein and hemoglobin A1c were recorded. Etiology, risk factors for CKD, duration of CKD, medication profile and family history were also collected. Data was compared to the national data from the CDC.
RESULTS: A total of 394 sequential charts were reviewed; 192 men and 192 women. The average age of the patients was 68 (8% 20-44yo, 26% 45-64yo, 66% over 65yo). With regard to etiology of CKD mentioned at initial visit to the nephrologist, the majority had HTN and/or DM. The average HbA1c among diabetic patients was 11. Other mentioned etiologies/comorbidities in approximate decreasing frequency included acute renal failure, coronary artery disease/CHF, polycystic kidney disease, SLE, glomerulonephritis, recurrent infection and obstructive uropathy. Most patients were referred to the nephrology clinic at CKD stage 3 (GFR 30-59).
CONCLUSIONS: Patients in this study had similar causes of CKD in comparison with national CDC data (CDC data: 35% of CKD due to DM, 20% due to HTN). The age distribution of this cohort of Panhandle patients with CKD was significantly older than that in the national database (66% vs 45% (CDC) over 65yo; 26% vs 12% age 45-64; and 8% vs 4% under45). The high average HbA1c among patients in the cohort showed relatively poor glucose control among diabetics. Research has shown that earlier referral to nephrology can slow the progression to ESRD in patients with DM and HTN. It is important to encourage primary care physicians to screen for CKD and aggressively treat the most common contributors to CKD in the USA: DM and HTN. In addition, earlier referral to nephrology may aid in reducing the rate of progression and high associated costs of ESRD in the Panhandle of Texas and the USA in general.
CHARACTERISTICS OF ISOLATED AND SERIAL RE-HOSPITALIZATIONS SUGGEST A NEED FOR DIFFERENT TYPES OF PATIENT-CENTERED STRATEGIES Romsai T. Boonyasai; Huy Do; Jennifer E. Bracey; Regina Landis; Scott Wright. JHU/APL, Baltimore, MD. (Control ID #1339935)
BACKGROUND: Early readmission is considered to be an indicator of healthcare quality as well as of utilization. Characterizing sub-groups among readmitted patients can guide quality improvement efforts. METHODS: We conducted an IRB-approved mixed-methods study of readmitted adults at a 365 bed teaching hospital. 1) We prospectively screened all admissions to identify patients who had been discharged from the hospitalist service within 30 days. 2) A trained research assistant reviewed the index admission and readmission records to collect demographic and health information. 3) Patients were then interviewed using a brief structured questionnaire to ask why they returned to the hospital, whether they felt ready for the index discharge, and whether they had unmet needs after the index discharge. Patients were also asked to rate the patient-centeredness of the index discharge using the Care Transitions Measure and to explain the reason for their rating. 4) We asked hospitalists who had cared for a patient to comment on the preventability of the readmission. 5) We followed patients for 6 months after the index discharge to categorize the episode as an isolated readmission (IR, 1 readmission/6 mos) or part of serial readmissions (SR, >1 readmission/6 mos). All abstracted data and interview responses were transcribed and coded. We used a grounded theory approach to identify principal themes. RESULTS: We identified 82 readmissions involving 76 patients. Median time to readmission was 14.5 days (range 0-30 days). In the 6 months after index discharge, 23 (30.3%) were readmitted once and 53

(69.7%) were readmitted >1 time (range 2-12 times). Only (23.7%) patients rated their index discharge as not patient-centered. Emerging themes related to lack of patient-centeredness include perceptions of poor communication, unmet
expectations (for discharge and for service), and non-improvement of clinical condition. These themes were expressed by both IR and SR patients. Hospitalists provided comments for 66 (80.5%) encounters involving 64 patients. Emerging themes related to the etiology and preventability of readmission include new medical problem, suboptimal quality of care (e.g., fall at skilled nursing facility), care coordination issues (e.g., lack of PCP), disease progression, patient non-adherence, psychiatric illness, and substance abuse. IR patients appeared to be readmitted for suboptimal quality of care and care coordination issues, whereas SR patients were readmitted for disease progression, psychiatric illness and substance abuse.
CONCLUSIONS: Isolated readmissions may be reduced by improving care coordination and quality of care. Communication and expectation management can improve patient-centeredness of discharge processes. Serial rehospitalizations often result from advanced physiologic or psychiatric disease that only complex systems-wide interventions can improve. Hospitals should apply different targeted interventions for IR and SR populations.
CHARACTERISTICS OF PATIENTS SEEN BY AN INPATIENT SUBSTANCE USE DISORDERS CONSULTATION SERVICE Alvanzo Anika; Patti R. Burgee; Diane Moses; Donnie T. Missouri. Johns Hopkins University School of Medicine, Baltimore, MD. (Control ID #1340533)
BACKGROUND: Substance use disorders are common, with an estimated lifetime prevalence of 30% for alcohol and 10% for drug use disorders, respectively. Further, it has been reported that up to 1/5 of hospitalized patients may have a current substance use disorder. The aim of this study is to characterize patients seen by an inpatient Substance Use Disorders Consultation Service. METHODS: Participants were patients seen by the Substance Use Disorders Consultation Service (SUDS) at an urban, mid-Atlantic academic medical center. The SUDS provides consultation services for patients admitted with medical problems related to or exacerbated by use of alcohol and other drugs. Services include provision of recommendations for management of substance withdrawal syndromes, patient education and brief behavioral counseling, and facilitation of linkage to hospital and community-based alcohol and drug treatment programs. Data on patient demographics and substance use was collected at time of SUDS assessment and frequencies and means and standard errors were used to describe the population. Chi square analyses were used for bivariate comparisons of substance use by sex. Between January and June of 2011, there were 564 referrals for SUDS evaluation, representing 477 unique patients. Data is presented for 422 patients with complete substance use information from their first referral to the SUDS.
RESULTS: Patients had a mean age of 49.8 years (SD 10.66) were predominantly men (69.5%) and a majority were either uninsured or receiving Medicaid (57.8%). One quarter of the patients reported polysubstance use, with a range of one to four substances reported. Alcohol was the most common substance reported (60.2%), followed by opiates (26.8%), cocaine (25.6%), marijuana (6.9%) and sedative hypnotics (2.1%). Men were more likely than women to report alcohol use (71.5% vs. 60.6%, p=.029), while more women reported cocaine use (32.0% vs. 22.7%, p=.043) when compared to men. There were no sex differences in polysubstance use.
CONCLUSIONS: Patients referred for inpatient Substance Use Disorders consultation were more likely to be middle aged men reporting use of a single substance, primarily alcohol. Further research should examine the impact of the SUDS on hospital length of stay, substance abuse treatment entry, and 30-day hospital readmission.
CHARACTERIZING LEADERSHIP IN THE MEDICAL HOME TRANSFORMATION: A QUALITATIVE STUDY OF CLINICIAN-LED CHANGE Daniel Henderson1,3; Asaf Bitton1,2; Greg Schwartz1; Elizabeth Stewart4; Carol Keohane1; David W. Bates1,5; Gordon Schiff1. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3University of Connecticut School of Medicine, Farmington, CT;
4National Research Network, Kansas City, MO; 5Harvard School of Public Health, Boston, MA. (Control ID

#1333093)

BACKGROUND: The Patient-Centered Medical Home has emerged as a vehicle for reshaping and reviving primary care, offering hope for providers, patients, and a health care system struggling to control costs. Implementing the model broadly presents substantial challenges, both for the health care system, and the individual clinicians undertaking major change. We sought to understand how physicians lead in this setting. We examined leadership behaviors within physician-led PCMH transformations in three primary care practices. Our aim was to benchmark features with a validated model of transformational leadership, and to explore the association between leadership approaches and initial successes. METHODS: Pursuing a qualitative comparative approach, the research team evaluated three primary care practices 12-18 months into PCMH transformation. Over two days, we observed facilities and operations, conducted structured interviews with staff, and collected artifacts from the sites. These descriptive and qualitative data were compiled, thematically coded, and analyzed. Drawing evidence from this qualitative data pool we classified practice-level approaches to transformation based on a validated framework, the Eight Step Process for Leading Change developed by John Kotter (below). We also identified indicators of success in transformation, and obtained payer-derived scores rating practices on a composite of quality, efficiency, and patient satisfaction. RESULTS: The categorization along the Kotter framework identified many differences in leadership approaches between practices (see table). In addition, practices B and C showed clearer evidence of sustained success than practice A. Site B staff demonstrated satisfaction with success and described individual and team self-efficacy toward a vision. Practice C staff described successes, but focused on the leadership of a single physician. Site A informants tentatively described success, but with negative spillover effects or reversals. Practice B had the highest initial scores but these declined after the transformation began, eventually rebounding partially. By contrast, practice C started with lower scores, but improved rapidly to equal practice Bs. Practice A showed modest improvement of continually lower scores. All three had difficulty sustaining their gains. CONCLUSIONS: This qualitative study identified clear differences between three primary care practices undergoing PCMH adoption on the basis of their fit to a validated model of transformational leadership. The degree to which they matched the framework was associated with measures of better performance for a successful PCMH practice, and these associations were proportionate and plausible, if not entirely specific. These results suggest that leadership may be an important co-factor in the success of PCMH adoption, and deserves continuing study in transforming primary care practices.

Table: Transformation resemblance to framework

Site A

Site B

Site C

Create a sense of urgency I + + Form a powerful guiding coalition I + -Create a vision - + + Communicate a vision I + I Empower others to act on the vision - + -Plan and create short term wins - I I Consolidate improvements and produce morechange

- + I

Institutionalize new approaches - I I

(- clearly inconsistent, I intermediate or indeterminate, + clearly consistent):

CHARACTERIZING HEALTHCARE UTILIZATION AMONG OLDER ADULT LATINOS WITH A HISTORY OF DEPRESSION AND ACCESS TO HEALTHCARE Adriana Izquierdo1; Catherine Sarkisian2,3; Jeanne Miranda4. 1University of California Los Angeles, Los Angeles, CA; 2University of California Los Angeles, Los Angeles, CA; 3VA Greater Los Angeles Healthcare System GRECC, Los Angeles, CA; 4University of California Los Angeles, Los Angeles, CA. (Control ID #1335124)

BACKGROUND: Effective treatments for depression in older adults are available. Older adult Latinos, however,

are less likely to be treated for
depression than older non-Latino whites. Using the largest qualitative dataset collected to date on older Latinos with a history of depression and healthcare access, we aim to characterize how and why this unique population uses healthcare services and treatments for depression management. METHODS: We used data from the qualitative sub-study at 10-year follow-up of participants in the Partners in Care (PIC) study, a RCTof QI programs for depression among people with depression and healthcare access. For the qualitative sub-study, all PIC Latino participants (n=205) were invited to complete 3 semi-structured qualitative interviews over 12 months. We evaluated Latino sub-study participants age50. We developed a descriptive framework to model the pathways along which a patient may proceed as s/he engages in health care services/treatments for depression management. This framework allowed us to identify participants who moved further along the healthcare utilization pathway. To facilitate data management and analysis, we constructed a data matrix (Microsoft Excel 2007) based on the framework; each column represents a step along the healthcare utilization pathway outlined by the framework, each row an individual transcript. For every health care encounter described, we identified meaningful quotations using standard qualitative content-analysis methods and input them into the data matrix. We identified recurring concepts representing contextual factors and participants behaviors and attitudes associated with use, or lack of use, of mental healthcare services/treatments, which we developed into codes. We organized coded quotations into themes, and analyzed the themes for their association with participants' progression along the healthcare utilization pathway. RESULTS: Ninety-five older adult Latinos (77% response) completed at least one qualitative interview (75% female, age range 50-88 years, 265 interviews). Certain themes (e.g., patient activation, patient awareness of depression as a disease, positive past experiences with depression care, perceived provider traits (e.g., empathy, willingness to listen), repeated provider-led outcomes assessment, patient-provider ethnic/gender concordance) facilitated care and were more common in responses among depressed older Latinos who proceeded further along the healthcare utilization pathway. Other themes (e.g., mistrust of provider due to a negative experience and/or general beliefs, absent outcomes tracking) inhibited care and were more likely to be present in responses of those participants who disconnected from care. Some themes (e.g., beliefs about depression, attitudes towards medications, other medical problems, social relationships, media) were associated with variable progression along healthcare utilization pathway.
CONCLUSIONS: Our findings highlight that, even with a history of depression and healthcare access, depressed older Latinos engage in &/or disconnect from using depression services/treatments for myriad reasons at different points in the healthcare utilization process. By describing the reasons associated with patient utilization of and disengagement from mental healthcare services and treatments, our study may help inform the development of future interventions to improve depression care for older depressed Latinos and reduce mental health disparities.
CHECKBOOK: IMPROVING COST AWARENESS THROUGH AUDIT AND FEEDBACK Jason Post; Darcy Reed; Andrew J. Halvorsen; Furman S. McDonald. Mayo Clinic, Rochester, MN. (Control ID #1336601)
BACKGROUND: Rising healthcare costs have created an urgent need to improve physicians education regarding cost and value in healthcare. The ACGME core competency of systems-based practice encompasses cost awareness and risk-benefit analysis, but there has recently been a call to expand this to create a new, seventh core competency of high-value, cost-conscious care. We set out to determine if audit and feedback would improve resident attitude and knowledge regarding costs of commonly ordered tests. METHODS: We developed an electronic audit and feedback tool called Checkbook which provides data on costs and charges for patients cared for at Mayo Clinic-Rochester. This tool allows modeling of healthcare costs and charges by adding or deleting tests and services to the bill. We conducted a pre-post analysis of the effect of Checkbook on residents knowledge and attitudes of healthcare costs. First, we asked 48 first and 48 third year residents to estimate charges for commonly ordered tests and services, and surveyed their attitudes regarding cost.

Residents then used Checkbook to examine

billing data from three hospitalized patients for whom they personally provided care. Residents reflected upon which, if any, tests or services may have been avoidable. Following the Checkbook exercise, residents completed an identical post-test of knowledge and attitudes. Pre and post study results were compared using paired t-tests. RESULTS: Forty-three PGY-1 (89.5%) and 40 PGY-3 (83.3%) residents completed the Checkbook exercise. Post-test data showed improvement in estimates of charge as measured by percentage error for commonly ordered tests and services including electrolyte panel (mean percentage error 83.1% vs13.4%, p<0.0001), serum calcium (17.2% vs 12.0%, p=0.006), chest x-ray (324.6% vs 128.9%, p=0.003), ECG (38.5% vs 9.5%, p=0.001), and a one-night hospital stay (35.0% vs. 3.6%, p=0.01). Less commonly ordered tests such as abdominal CTand head MRI did not show an improvement in accuracy of charge estimate. After using Checkbook, both PGY-1 and PGY-3 residents were more likely to agree that they knew the costs of common tests (PGY-1:2.7% vs. 27%, p=0.003; PGY-3: 9.7% vs. 41.9%, p=0.002) and that they had received adequate education regarding cost of care (PGY-1: 2.7% vs. 51.4%, p=<0.001; PGY-3: 0% vs. 32.3%, p=0.002). PGY-1 residents were more likely to agree that cost influenced their ordering decisions (37.8% vs 67.6%, p=0.005), that their supervising physicians encouraged them to consider cost when ordering tests (24.3% vs 46%, p=0.01), and that they had adequate access to the costs of care that they provide (5.4% vs 54.1%, p<0.001). CONCLUSIONS: This study shows that chart audit and feedback with the aid of a cost/charge calculator reflection tool improves residents knowledge and attitudes regarding costs of care. Previous studies have shown improvement in knowledge of costs using different methods, but to our knowledge this study is the first to demonstrate this using audit and feedback with actual patient cost and charge data. Reflecting upon actual costs of care is an important component of curricula teaching high-value, cost-conscious care.

CHEST RADIOGRAPHS AT PRESENTATION AND CLINICAL OUTCOMES IN A COHORT OF ADULTS HOSPITALIZED WITH COMMUNITY ACQUIRED PNEUMONIA Melissa Simpson1; Joseph Mazza1; John Schmelzer1; Satye Varre1; Liang Hong2; Steven H. Yale1.
1Marshfield Clininc Research Foundation, Marshfield, WI; 2Marshfield CLinic Research Foundation, Marshfield, WI. (Control ID #1336832)

BACKGROUND: Community acquired pneumonia (CAP) is a leading cause of morbidity, mortality, and health care expenditures. Although decreasing in incidence, CAP still accounts for an estimated 28 hospitalizations per 100,000, across all age groups. Diagnosis is symptom based with supporting laboratory and radiographic data. Although chest radiographs are routine, evidence suggests they lack sensitivity for diagnosing CAP. The purpose of this study was to examine the association between chest radiograph findings at the time of presentation and clinical outcomes in a retrospective cohort of 1,126 adults hospitalized for CAP at St. Josephs Hospital (SJH), Marshfield, WI from January 1, 1992 to December 31, 2007.

METHODS: Electronic screening using International Classification of Diseases, 9th Revision (ICD-9) codes 480.0-487.9 identified patients with manual confirmation and chart abstraction. One hundred fifty nine patients had clinical symptoms of CAP but no pulmonary parenchymal abnormalities (chest radiograph negative); 967 patients had CAP and chest radiographs showing pulmonary opacities. Logistic regression was used to analyze associations between chest radiographs and the following clinical outcomes: length of hospitalization, in-hospital mortality, inhospital complications (excluding death), 30 day readmission, and 90 day all-cause mortality (table).

RESULTS: CAP and chest radiographs showing pulmonary opacities. Chest radiograph negative patients were older (p<0.0001), had higher blood pressure (systolic p=0.001, diastolic p=0.02), had a body temperature outside 96.8-100.4F (p=0.04), and were more likely to be nursing home residents (p=0.02). Chest radiograph

positive status was associated with an approximately 5 fold increase in the odds of experiencing an inhospital complication. Chest radiograph results were not associated other outcomes. Among chest radiograph negative patients, 82 (52%) had a repeat radiograph and 38 (24%) developed changes. CONCLUSIONS: This study suggests that chest radiographs have limited prognostic utility for hospitalized patients and should not guide treatment decisions. The association between in-hospital complications and a positive chest radiograph is puzzling given that chest radiograph results were not associated with any other outcomes. Further research should examine other imaging modalities for their utility in prognostication. In our study of CAP, chest radiograph negative patients were older, perhaps contributing to delayed and/or attenuated immune response.
Unadjusted and adjusted odds ratios for the association between chest radgiograph results and clinical outcomes in a cohort of adults hospitalized for community acquired pneumonia
Outcome Chest radiograph negative
Chest radiograph positive
Unadjusted Adjusted
n=159 n=967 OR 95% CI p-value OR 95% CI p-value Mean (sd) length of stay (days) 5.8(5.2) 5.5(5.0) 0.98 0.73-1.31 0.89 1.09 0.81-1.46 0.57 n(%) with in-hospital complication(s) 5(3) 122(13) 4.67 1.70-12.88 0.003 5.18 1.87-14.33 0.002 n(%) died in hospital 10(6) 38(4) 0.61 0.30-1.25 0.18 0.58 0.27-1.22 0.15 n(%) readmitted within 30 days of discharge 11(7) 77(8) 1.17 0.61-2.25 0.64 0.79 0.47-1.34 0.38 n(%) died within 90 days of discharge 21(13) 101(10) 0.77 0.46-1.27 0.3 1.22 0.63-2.35 0.56
CHRONIC DISEASE RISK FACTORS AND ANTICIPATED BEHAVIOR CHANGE FROM GENETIC RISK TESTING IN YOUNG ADULTS Jason L. Vassy1,2; Karen Donelan5,2; Marie-France Hivert3; Kelsey E. O'Brien1; Richard W. Grant4. 1Massachusetts General Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Universit de Sherbrooke, Sherbrooke, QC, Canada; 4Kaiser Permanente Division of Research, Oakland, CA; 5Massachusetts General Hospital, Boston, MA. (Control ID #1326402)
BACKGROUND: Preventive behaviors in young adulthood may decrease the lifetime morbidity from heart disease (HD), type 2 diabetes (T2D), and stroke. However, adherence to diet and exercise guidelines in young adults remains low. Genetic susceptibility testing may identify young adults at increased risk prior to onset of phenotypic risk factors like hypertension and hypercholesterolemia. It is not known whether such testing would motivate behavior change.
METHODS: We conducted a nationally representative Internet survey of young adults aged 25 to 30 years to test the hypothesis that young adults would be motivated by high-risk genetic results to adopt behavior changes. Survey participants were recruited through random digit dialing or address-based sampling. We measured 6 baseline risk factors for HD, T2D, and stroke: non-white race/ethnicity, smoking, poor diet, low physical activity, family history, and obesity. We used a 3-point scale (not at all/somewhat/very) to measure respondents interest in undergoing a genetic susceptibility test for the 3 diseases and a 5-point scale (from Much less likely to Much more likely) to ask whether a hypothetical high-risk genetic result would change their likelihood of improving their physical activity and diet. For those anticipating an improvement, we asked whether this change would occur now vs. 5 years or more from now. We used weighted 2 and t-tests to account for sampling design.
RESULTS: Of 521 survey respondents (completion rate 54%), 40% were non-white, and 30% were obese. Two-thirds expressed interest in genetic testing. Respondents generally reported that high-risk genetic results would increase their

likelihood of improving physical activity and diet (median response Somewhat more likely for both). Of the 6 baseline risk factors, non-white race/ethnicity and current obesity were both associated with greater anticipated likelihood of increasing physical activity ($P<0.05$ for both), whereas less-than-average current physical activity was associated with a lower likelihood of improving diet ($P=0.03$) in response to high-risk genetic test results. Of

the respondents anticipating improvement in physical activity (n=419) or diet (n=411), no risk factor was associated with a greater likelihood of making that change now versus 5 years from now. Indeed, poorer baseline physical activity was associated with delaying physical activity and diet changes (P<0.05 for both behaviors), and poorer baseline diet was associated with delaying dietary changes (P=0.02), compared to better current physical activity and dietary patterns.
CONCLUSIONS: Testing young adults for genetic susceptibility to future lifestyle-related chronic diseases has the potential to motivate behavior changes. However, those with worse baseline health behaviors were least likely to change behavior while still young. These results suggest that to be effective, such testing may need to be coupled with interventions to support behavior change.
CLINICAL SIGNIFICANCE OF RESTING HEART RATE AND INFLAMMATION IN OLDER ADULTS David Nanchen1,2; Jacobijn
Gussekloo3; Simon P. Mooijaart1,4; Rudi G. Westendorp1,5; J. Wouter Jukema6; Peter W. Macfarlane7; Naveed Sattar7,8; David J. Stott7,8; Jacques Cornuz2; Nicolas Rodondi9; Anton J. de Craen1,5. 1Leiden University Medical Center, Leiden, Netherlands; 2University of Lausanne, Lausanne, Switzerland; 3Leiden University Medical Center, Leiden, Netherlands;
4Institute for Evidence-Based Medicine in Old Age, Leiden, Netherlands;
5Leiden University Medical Center, Leiden, Netherlands; 6Leiden University Medical Center, Leiden, Netherlands; 7University of Glasgow, Glagsgow, United Kingdom; 8University of Glasgow, Glagsgow, United Kingdom; 9University of Bern, Bern, Switzerland. (Control ID #1329461)
BACKGROUND: Traditional cardiovascular risk factors have a lower predictive capacity in older people. Thus, resting heart rate might be a promising cardiovascular risk marker in older adults, but previous
results have not led to any clinical utility partly because incertitude remains about the causal role of heart rate in the development of atherosclerosis, or other clinical morbidities such as heart failure, or infection. Particularly, the interrelation between heart rate and inflammation might play a key role in older adults. We aimed to assess the clinical significance of resting heart rate along with inflammation on heart failure, atrial fibrillation and cardiovascular and non-cardiovascular mortality and morbidities in older adults. METHODS: We studied 4084 older adults aged 70-82 years with known cardiovascular risk factors or previous cardiovascular disease, without preexisting heart failure or beta-blockers in the PROSPER study. Over a 3.2-year follow-up period, we compared (non-) cardiovascular mortality and morbidities according to gender-adjusted tertiles of resting heart rate. Inflammation was measured in all participants with C-reactive protein (CRP). RESULTS: In men (women) mean resting heart rate was 55 (60) beat per minute (bpm) for the first tertile, 66 (70) bpm for the second tertile, and 81 (83) bpm for the third tertile, respectively. An elevated resting heart rate (highest vs lowest tertile) was associated with incident heart failure hospitalization (multivariate adjusted hazard ratio [HR] 1.75, 95% confidence interval [CI],1.19-2.59, p for trend across categories =0.001), but not with nonfatal myocardial infarction, stroke or atrial fibrillation. Incident nonfatal infections were also more common (highest vs lowest tertile), with a HR of 1.90, 95% CI, 1.33-2.71, p for trend <0.001. Both non-cardiovascular mortality (HR 1.70, 95% CI, 1.24-2.34, p for trend <0.001) and cardiovascular mortality (HR 1.73, 95% CI 1.22-2.44, p for trend =0.001) were increased in older adults in the highest tertile of heart rate. Further adjustments for inflammation assessed by CRP decreased associations with heart failure to 1.72, 95% CI, 1.16-2.55, p for trend =0.001, and with cardiovascular mortality to 1.60, 95% CI, 1.12-2.28, p for trend =0.005 (Figure).
CONCLUSIONS: In older adults, an elevated resting heart rate predicted first incident heart failure and infection event, but not nonfatal cardiovascular event. Inflammation seems to play only a minor explicative role in the association between resting heart rate and heart failure and cardiovascular mortality in older adults. The specific role of heart rate reduction in cardiovascular prevention management needs further evaluation in older adults.
Figure
JGIM

CLINICIAN-EDUCATORS ARE MORE BURNED OUT AS CLINICIANS THAN AS EDUCATORS: IMPLICATIONS FOR TEACHING (AND PRACTICE). Anne Dembitzer1,2; Colleen Gillespie2; Kathleen Hanley2; Ruth Crowe2; Sondra Zabar2; Nina Yeboah2; Audrey Grask2; Joseph Nicholson2; Adina Kalet2; Mark D. Schwartz1,2. 1NY Harbor VA, New York, NY; 2NYU School of Medicine, New York, NY. (Control ID #1335960)

BACKGROUND: Clinician-educators are the primary teachers of medical students and residents, yet most have not had formal training in medical education. Physician burnout is common and is associated with job turnover and absenteeism, poor morale, and reduced efficiency, and may lead to poorer patient care. As part of a faculty development program (FDP) designed to improve mentoring and teaching skills, we sought to determine the degree of burnout among clinician-educators in an urban, underserved setting, how burnout differed for clinician and educator roles, and the impact of burnout on teaching.

METHODS: 30 clinician-educators (CEs) involved in a FDP completed a survey that included the clinician and educator versions of the Maslach burnout inventory. These scales each assess three features of burnout: Emotional Exhaustion, Depersonalization, and Personal Accomplishment, each classified as low, moderate, or high. They rated their perceived competence in five teaching domains (establishing a learning climate, control of session, assessment/evaluation, instructional skills, and giving feedback). They reported on practice characteristics, career fit, job satisfaction, and commitment to lifelong learning (Jefferson Lifelong Learning Scale). Standardized learners assessed clinician-educators teaching skills in the same five domains in a three-station Objective Structured Teaching Examination (OSTE). Scores were calculated as percentage of items within each domain rated as Done Well (vs. Not or Partly Done).

RESULTS: More than half of the clinician-educator faculty were internists, the rest were pediatricians or family medicine physicians. They spent an average of 24% (SD 11%) of their time teaching or precepting, 55% of their time providing outpatient care (SD 22%), and 20% of their time providing inpatient care (SD 20%). Burnout scores by clinician and educator roles are shown below (Table). Clinician-educators with high emotional exhaustion as clinicians reported lower overall confidence in teaching than did those with only low or moderate emotional exhaustion (one-way ANOVA $F=9.91$, $p=.001$, pairwise comparisons $p<.05$), and this pattern was upheld in the five specific teaching domains as well. Those who reported high depersonalization as clinicians were less confident in teaching than were those with only low or moderate scores (one-way ANOVA $F=4.51$, $p=.020$, pairwise comparisons $p<.05$). Commitment to lifelong learning was lower for those with high clinician-related emotional exhaustion ($F=7.91$, $p=.002$) and high depersonalization ($F=1.967$, $p=.05$), compared to that of those with low or moderate clinician burnout in these areas. Teaching skills in the OSTE did not significantly differ by clinician or educator burnout.

CONCLUSIONS: This sample of clinician-educators in urban, under-served settings had a higher rate of burnout as clinicians than as educators. Burnout as a clinician may impact ones effectiveness as an educator since clinically burned-out faculty had less confidence in their teaching skills and fewer life-long learning habits. This study suggests the need to further investigate how clinician-educators balance the demands and effects of their dual roles.

Burnout scores by clinician and educator roles

Maslach burnout inventory(scored low, medium, high)

Emotional exhaustion % high

CO-MORBIDITY AND COMPLEXITY OF CARE, A WEIGHTY MATTER: FOUR CO-MORBIDITY INDEXES AND PREDICTION OF DEATH, AMBULATORY CARE VISITS, POLYPHARMACY, AND THE PRIMARY CARE CHECKLIST Lillian Min1,2; Neil Wenger4,5; Caroline Blaum1,2; Chris Cigolle1,2; Eve A. Kerr3,1. 1University of Michigan, Ann Arbor, MI; 2VA

Healthcare Systems, Ann Arbor, MI; 3VA Healthcare Systems, Ann Arbor, MI; 4UCLA, University of California, Los Angeles, CA; 5RAND Health, Santa Monica, CA. (Control ID #1334704)

BACKGROUND: Understanding clinical complexity of older ambulatory care patients due to their co-morbidities is crucial to providing high-quality ambulatory care. Co-morbidity indexes measure conditions associated with specific outcomes, assigning greater weights for co-morbidities with the strongest associations with death (Charlson Comorbidity Index, CCI) and expenditures (Medicare Hierarchical Condition Categories, HCC). We previously reported how an unweighted count of 9 conditions was associated with quality of care (ACOVE simple count, ACOVESC). We also developed the Geriatric Complexity of Care (GCC) score, 32 medical, psychosocial and geriatric conditions further sub-classified into severity categories (total 117 categories) common in geriatric ambulatory care. Using an expert panel, the 117 categories were weighted according to the difficulty of providing high-quality primary care for geriatric patients with those conditions. We hypothesized that the GCC (calculated as the total of the difficulty weights for each patients co-morbidities) would predict external (i.e., non-comorbidity) measures of primary care complexity: polypharmacy, primary care visits, and number of ACOVE QIs eligible (the care processes a clinician or medical home would be responsible for).

METHODS: Sample: We reviewed 1 year of ambulatory medical records for 644 patients (age>=75, screened for symptoms of 1+ geriatric condition) in the Assessing the Care of Vulnerable Elders-2 (ACOVE-2) study to obtain the 117 GCC co-morbidity categories. Meaures: We calculated 4 co-morbidity indexes for each patient using weights from the CCI, HCC (ambulatory care sample), ACOVE-SC, and the GCC. For CCI and HCC, we omitted weights for age and gender because multivariable models included these co-variables. Analysis: Using logistic and linear regression, we compared the unadjusted model fit (Area under the Receiver Operating Curve [AUC] and R-squared [R2]) and adjusted effect size (predicted values for top minus bottom quintile, adjusted for age, gender, and functional status) for predicting: (1) 3-year mortality, (2) primary care and specialty ambulatory visits over 1 year, and (3) complexity of care (polypharmacy [14+ long-term medications] and the primary care checklist, calculated as the number of ACOVE QIs each patient was eligible for over 1 year).

RESULTS: Of the 4 co-morbidity indexes, the HCC-weighted score predicted the most variation in mortality (AUC=69.1%) and specialty visits (R2=9.1%) but the GCC was the best predictor of primary care visits (R2=13.6%), polypharmacy (AUC=78%), and the primary care checklist (R2=30.5%). The most complex (top quintile of GCC) patients received more ambulatory medical care (7.0 vs 3.7 primary care visits, 6.2 vs 2.4 specialist visits), polypharmacy (14.3% vs 0% had 14+ medications) and longer ambulatory care checklists (33 vs 25 QIs) compared to the lowest quintile. The effect of GCC on complexity of care outcomes was independent of age, gender, and functional status, even when other indices (CCI, HCC, and ACOVE-SC) were entered into the multivariable models. CONCLUSIONS: Geriatric complexity of care reflects health care needs not represented by simpler and routinely-collected co-morbidity indexes. Future planning of systems with the capacity to provide high quality geriatric ambulatory care should consider targeting complex patients with extra clinic visits and resources (e.g., pharmacy to review additional medication burden).

COMMUNITY HEALTH CENTER PROVIDERS SPANISH LANGUAGE ABILITY AND KNOWLEDGE OF LATINO CULTURE Arshiya A. Baig1; Cara A. Locklin2; Amanda Campbell3; Cynthia T. Schaefer4; Loretta J. Heuer5; Sang Mee Lee6; Marla C. Solomon7; MichaelT. Quinn1; J. Martin Vargas8; Deborah L. Burnet1; Marshall Chin1.

1University of Chicago, Chicago, IL; 2University of Illinois at Chicago, Chicago, IL; 3MidWest Clinicians' Network, Lansing, MI; 4University of Evansville, Evansville, IN; 5University of North Dakota, Fargo, ND; 6University of Chicago, Chicago, IL; 7University of Illinois at Chicago, Chicago, IL; 8Community Action Partnership of Western Nebraska, Gering, NE. (Control ID #1332311)

Personal accomplishment % low

Clinician 53 23 20 Educator 10 0 23 Significance (WilcoxonSigned Ranks Test)

p<.001 p=.001 p=.803

Depersonalization % high

BACKGROUND: Many Latino patients with diabetes receive care at community health centers. However, little is known regarding health center providers Spanish language ability and knowledge of Latino culture. METHODS: We collaborated with the MidWest Clinicians Network and conducted a survey of providers who manage or treat patients with diabetes from member health centers. Providers included advanced practice nurses (APN), certified diabetes educators, certified medical assistants (MA), dietitians, health educators, licensed practical nurses (LPN), physicians, physicians assistants (PA), registered nurses (RN), and social workers. Participants self-reported their ability to speak, understand, read and write Spanish. Providers also rated their knowledge of Latino culture across 8 different domains: role of family, religious beliefs, folk remedies, traditional diet modifications, variations among different Latino cultures, patient-doctor interactions, health barriers for seasonal workers, and culturally tailored care. The composite language ability (Cronbach's alpha 0.94) and cultural knowledge scores (Cronbach's alpha 0.96) were divided into terciles and then dichotomized as high and moderate/low. Participants self-reported ever having received cultural competency training. Participants also reported their access to on-site interpretation services (defined as available 50% or >50% of the time) and cultural competency training (available or not). We assessed overall frequency of language and cultural competency scores and also evaluated differences across provider types using chi-square tests. Availability of interpreter services and cultural competency training were assessed for the providers with low language and cultural knowledge scores.
RESULTS: We received responses from 621 providers (47% adjusted response rate) from 87 health center sites across 10 states. Twenty-nine percent of providers reported never having received cultural competency training. Overall, 12% had high Spanish language scores and 20% had high cultural knowledge scores. Across providers, 8% of APNs, 4% of LPNs, 10% of MAs, 14% of physicians, 16% of PAs, and 2% of RNs reported having high language scores (p=0.10). In terms of cultural knowledge, 23% of APNs, 8% of LPNs, 10% of MAs, 19% of physicians, 24% of PAs, and17% of RNs had high cultural knowledge scores (p=0.27). Of the providers who had low Spanish language scores, 69% had access to interpreter services on-site the majority of the time. Of the providers who had low cultural competency scores, 45% had access to cultural competency training on-site.
CONCLUSIONS: Spanish language ability and cultural knowledge scores were low across all types of providers. Strengthening access to interpreter services and providing cultural competency training may be promising strategies to support health center providers who manage Latino patients.
COMORBID CONDITIONS IN COPD Daniel A. Belletti1; Christopher Zacker1; Jennifer Wogen2. 1Novartis Pharmaceuticals, East Hanover, NJ;
2Medmentis Consulting, Towaco, NJ. (Control ID #1339649)
BACKGROUND: COPD is associated with other risk factors and co-morbid conditions which may complicate COPD management. Primary care treatment patterns of COPD remain largely undocumented despite research suggesting that the majority (63%) of patients with COPD in the US are managed by primary care physicians (PCPs). As PCPs deliver care to many patients with COPD, our study objective was to understand treatment patterns related to 5 specific comorbid conditions addressed in the 2007 Global Initiative for Chronic Obstructive Lung Disease (GOLD) Guidelines.
METHODS: This cross-sectional study was performed via retrospective chart review at 11 primary care sites, using a random sample of from 50-150 patients/site aged 40 through 89 years with a diagnosis of COPD(N= 1517). Data extracted from patient medical records included patient demographics and clinical information (spirometry testing and documented COPD stage, respiratory medications, and co-morbid conditions). Appropriate evaluation or treatment of comorbid conditions was assessed, including glycemic control in diabetic patients, blood pressure (BP) control in hypertensive patients, bone mineral density (BMD) testing for at-risk

patients, and depression screening/treatment for all patients.
RESULTS: Mean patient age was 67.2 (SD+11.3) years, 54% were female, 62% were Caucasian, and 34% were current smokers. Mean duration of COPD was 48 months (range 1-612) . Only 27% of patients had a current FEV1% result documented. 20% were classified as mild (stage I), 13% moderate (stage II), 12% stage III (severe), 3.4% very severe (stage IV). The average number of comorbid
conditions was 2.9 (+/-1.6); 66% had hypertension, 27% diabetes, 26% depression/ anxiety, Comorbid conditions were most prevalent in the severe and very severe categories.(Table 1) Mean number of all medications was 8.1 (+/- 6.7), mirroring the greater number of comorbid conditions present with more severe stages of COPD. (Table 1) Of the patients with the 5 comorbid conditions of interest, about 49% had all of the benchmarks of treatment/evaluation (Figure 1).
CONCLUSIONS: Comorbid conditions are frequently associated with COPD. Concurrent medication use is also higher in those with co-morbid conditions. Comprehensive management of the patient with COPD is complicated by this confluence of conditions, poly- medication use and associated care. Addressing comorbid conditions in COPD remains a critical component of care for primary care.
Avg. # of Medications and Comorbid Conditions by Severity
COPD Stage Avg. # All Medications Avg. # Comorbidities Mild 5.8 2.6Moderate 7.8 2.8Severe 10.4 3.3Very Severe 9.8 3.0 Unkown/Missing 7.7 3.0
COMPARATIVE ANALYSIS OF PRINT AND MULTIMEDIA HEALTH MATERIALS: A SYSTEMATIC REVIEW OF THE LITERATURE Elizabeth A. Wilson1; Gregory Makoul2,3; Elizabeth A. Bojarski1; Katherine R. Waite1; David N. Rapp4; David W. Baker1; Michael S. Wolf1,4. 1Northwestern University, Chicago, IL; 2University of Connecticut School of Medicine, Farmington, CT; 3Saint Francis Hospital and Medical Center, Hartford, CT; 4Northwestern University, Evanston, IL. (Control ID #1338447)
BACKGROUND: Although the prevalence of multimedia educational tools has increased within the context of healthcare, there is little guidance as to what modalities of presentation are most effective. We completed a systematic literature review to evaluate the existing empirical evidence regarding the relative effectiveness of multimedia versus print as modes of dissemination for patient education materials and to examine the development of these materials. METHODS: To examine the impact of type of medium on patient outcomes including preference, comprehension, behavior, and anxiety, we completed a structured literature review utilizing Medline, PsychInfo, and the Cumulative Index to the Nursing and Allied Health Literature (CINAHL), supplemented by reference mining.
RESULTS: Of 738 studies screened, 31 effectively compared equivalent forms of multimedia and print materials. Studies offered 58 opportunities for assessing the effect of medium on various outcomes. In the majority of instances (34 occurrences, 59%), no difference was noted between multimedia and print on patient outcomes. Multimedia was associated with improvements in outcome in 19 instances (33%) and print in 5 (9%). For material development, six studies (19%) assessed readability of materials and 4 (13%) involved patients in tool development. CONCLUSIONS: Multimedia appears to be a promising medium for patient education; however, the majority of studies found that print and multimedia performed equally well in practice. Few studies involved patients in material development or assessed the readability of patient education tools. As such, future research should focus on comparing message-equivalent tools and assessing their effect on behavioral outcomes. Materials should be developed with consideration of universal cognitive constraints and patients input during the development process.
COMPARATIVE EFFECTIVENESS OF HOSPITAL-BASED EDUCATIONAL INTERVENTIONS FOR PATIENTS WITH COPD OR ASTHMA Valerie G. Press1; Vineet Arora2; Lisa M. Shah3; Stephanie Lewis4; Jeffery Charbeneau4; Edward Naureckas5; Jerry Krishnan4.
1University of Chicago Medical Center, Chicago, IL; 2University of Chicago Medical Center, Chicago, IL; 3Johns Hopkins University, Baltimore, MD; 4University of Illinois at Chicago, Chicago, IL; 5University of

Chicago Medical Center, Chicago, IL. (Control ID #1311106)

BACKGROUND: There has been an increasing focus on avoiding preventable readmissions through patient coaching and education. This is particularly salient for inpatients with Chronic Obstructive Pulmonary Disease (COPD), as it is the 3 rd leading cause of 30-day hospital readmissions. However, little is known about how to to improve inpatient self-management skills, especially for medication use, for patients with obstructive lung disease (e.g., COPD, asthma). The primary objective of the study was to test the comparative effectiveness of two interventions that provide hospital-based education on effective inhaler technique for hospitalized patients with COPD or asthma.
METHODS: Adult inpatients with COPD or asthma were randomized to receive either Teach-to-Goal (TTG) or Brief Intervention (BI) education. Participants receiving TTG were provided with a demonstration on inhaler technique and verbal and written instructions and then asked to re-demonstrate their technique (i.e., teachback); this cycle continued until they demonstrated mastery (two rounds). BI participants received verbal and written instructions. Use of metered dose inhaler (MDI) and Diskus devices was assessed using detailed checklists. Misuse was defined as <75% of steps correct. Self-reported inhaler technique confidence was measured using a 5-point Likert scale. Follow-up data were collected at 30-days post-discharge (phone interviews). Overall health-related events (ED visits, hospitalizations and/or deaths), post-discharge were assessed. Chi-squared, Fishers exact, and t-tests were performed using STATA 11. RESULTS: Participants were enrolled and randomized to TTG (n=24) or BI (n=26). The mean age was 54 years, and the majority had COPD (60%), were female (68%) and were African-American (78%). This was a high-risk population with over half (58%) having1 hospitalization in the past year for
COPD or asthma, and nearly half (44%) having had a near-fatal event (ICU admission and/or intubation). While the majority of participants reported being confident with their inhaler technique (MDI 70%, Diskus 94%), most misused their inhalers pre-intervention (MDI 62%, Diskus 78%). The proportion who misused MDIs post-intervention decreased significantly for both TTG and BI groups ($p<0.05$). Further, there was a significantly greater reduction in the prevalence of misuse in the TTG group vs the BI group (50% vs. 30%, $p=0.01$). There was also a nearly significant decrease in misuse for Diskus in the TTG vs. BI group ($p=0.05$). Thirty-nine (78%) participants had 30-day follow-up data; there were 3 deaths and 36 completed follow-up interviews (77% BI, 79% TTG). There were significantly more health-related events in the BI group vs. TTG at 30-days post discharge ($p=0.02$). CONCLUSIONS: Our study demonstrates that providing hospital-based instructions on inhaler technique for patients hospitalized with COPD or asthma can decrease prevalence of inhaler misuse prior to hospital discharge. Further, we demonstrate that TTG may be a superior strategy for improving inhaler technique, and may lead to improved clinical outcomes compared to BI. Finally, high-risk inpatients over-estimate their inhaler technique, emphasizing the need for hospital-based interventions to correct inhaler misuse. Larger, multi-institution comparative studies are needed to evaluate the effects of TTG vs. BI for different patient subgroups (e.g., level of health literacy), the durability of the hospital-based education and associated clinical outcomes.
COMPARATIVE OVERDOSE DEATH RATES BETWEEN ILLICIT AND PRESCRIBED SUBSTANCES Susan Calcaterra1; Ingrid A. Binswanger2. 1University of Colorado, Denver, CO; 2University of Colorado, Denver, CO. (Control ID #1334470)
BACKGROUND: Overdose death rates in the United States (US) vary significantly by drug type. Cocaine and heroin were historically considered leading causes of overdose death in the US. In 2000, prescription opioid overdose deaths surpassed cocaine overdose deaths and are rising at an alarming rate. This trend has been attributed to the widespread use of pain scales, pain as the 5th vital sign, and heavy prescribing for non-

malignant pain. We aimed to describe the death rate from prescription opioid pain relievers as compared to the death rates of other commonly abuse substances, and describe the demographic characteristics of overdose deaths by substance. METHODS: Using the CDC Wonder Database, we reviewed all cocaine (T40.5), heroin (T40.1), psychostimulant (i.e. methamphetamine, T43.6), and prescription opioid poisoning (overdose) deaths (T40.2-T40.4) among 15-64 year olds in the US from 1999-2008. We calculated age-adjusted death rates (number of deaths/100,000 person- years [p-y] and 95%
confidence interval [CI]) for those who died using substance specific ICD-10 codes listed among their causes of death. We calculated death rates by age, gender, and race/ethnicity. We identified the most common underlying causes of death among those who died. Lastly, we categorized all deaths by autopsy status during 2003-2008 to help support the validity of the listed causes of death.
RESULTS: By 2008, prescription opioid overdose deaths were more common than cocaine, heroin, and psychostimulant overdose deaths combined. Deaths increased significantly for heroin, psychostimulants, and prescription opioids from 1999 to 2008. Prescription opioid overdose deaths increased more than three-fold from 1999 to 2008 (2.24/100,000 p-y [95% CI 2.17-2.31] to 7.34/ 100,000 p-y [95% CI 7.22-7.45]). Psychostimulant overdose deaths doubled from 1999 to 2008 (0.37/1000 p-y [95% CI 0.34-0.39] to 0.78/100,000 p-y [95% CI 0.74-0.82]). Cocaine overdose deaths peaked in 2006 (4.29/100,000 py [95% CI 4.20-4.38]), but declined in 2008 (2.84/100,000 p-y [95% CI 2.77-2.92]). Overdose death rates were higher overall in men than woman, and peak death rates were frequently observed among 35-44 year olds. African Americans had the highest death rate due to cocaine (8.00/100,000 p-y [95% CI 7.88-8.11]), American Indians/Alaska Natives had the highest death rate due to psychostimulants (1.45/100,000 p-y [95% CI 1.26-1.64]) and prescription opioids (6.42/100,000 p-y [95% CI 6.03-6.82]), closely followed by non-Hispanic whites, (6.17/100,000 p-y [95% CI 6.12-6.21]). After combining cocaine, heroin, prescription opioid, and psychostimulant overdose deaths, accidental poisonings (X40-49) was the most frequently listed cause of death. Autopsies were performed on 80% of overdose deaths. CONCLUSIONS: While overall overdose death rates due to heroin, cocaine, and psychostimulants have risen since 1999, overdose deaths due to prescription opioids have increased more than three-fold in the last decade. Practice-based interventions to reduce the rising risk of overdose deaths should be tested as a method to decrease the death rates of all substances, not only prescription opioids.
COMPARATIVE EFFECTIVENESS OF ENDOVASCULAR VERSUS OPEN REPAIR OF RUPTURED ABDOMINAL AORTIC ANEURYSM IN THE MEDICARE POPULATION Samuel T. Edwards1;
Marc Schermerhorn2; A. James O'Malley3; Rodney P. Bensley2; Rob Hurks2; Philip Cotterill4; Bruce E. Landon1,3. 1Beth Israel Deaconess Medical Center, Boston, MA; 2Beth Israel Deaconess Medical Center, Boston, MA; 3Harvard Medical School, Boston, MA; 4Center for Medicare and Medicaid Services, Bethesda, MD. (Control ID #1339713)
BACKGROUND: Ruptured abdominal aortic aneurysm (rAAA) is the 13th leading cause of death in the United States and causes up to 9000 deaths annually. The traditional treatment for patients who survive to hospital presentation is open aortic repair (OAR), but perioperative mortality remains over 40%. Endovascular aortic repair (EVAR) has become the dominant mode of treatment for intact AAA, and is becoming increasingly common in the repair of rAAA. In this retrospective cohort study, we sought to compare the perioperative and long-term mortality and perioperative complications of patients who received endovascular versus open repair for rAAA in Medicare patients. METHODS: We examined Medicare beneficiaries 67 years of age or older who were admitted to a US hospital with a primary diagnosis of ruptured abdominal aortic aneurysm (ICD-9 441.3) between 2001 and 2008. We excluded patients with concurrent diagnoses of non-ruptured abdominal aortic aneurysm, thoracic aneurysm, thoracoabdominal aneurysm and aortic dissection and patients with a prior diagnosis of ruptured AAA, or aortic surgery. Treatment was determined using ICD9-CM procedure codes for open aortic repair and endovascular repair. Outcomes consisted of perioperative and long-term mortality, and

perioperative complications including myocardial infarction, pneumonia, acute renal failure, reoperation/conversion to open repair, wound dehiscence, embolectomy and tracheostomy. We also examined discharge disposition, and length of hospital stay. Propensity score models were used to create matched cohorts of patients equally likely to receive endovascular or open repair.
RESULTS: Our cohort consisted of 10998 patients with 1126 receiving EVAR and 9872 receiving OAR. Patients receiving EVAR tended to be older (78.2 v. 77.2 years, p<0.001), and were more likely to have a preexisting diagnosis of AAA (25.6% v. 16.4%, p<0.01). Patients receiving OAR were more likely to require urgent admission (80.5% v. 63.2%, p<

0.01), and less likely be transferred between hospitals before surgery (2.4%v. 6.0%, p<0.01). Propensity matching yielded 1099 patient pairs. Perioperative mortality was 33.7% for EVAR patients and 47.7% for OAR patients and mortality benefit of EVAR persisted to five years. EVAR was associated with a larger mortality benefit with increased age. Patients treated with open repairs suffered a higher rate of most post-operative complications including post operative pneumonia (28.5% vs. 35.9%, p=0.0002), acute renal failure (33.4% vs. 45.4%, p<.0001), embolectomy (3.6% vs. 6.3%, p<0.01), tracheostomy (4.6% vs. 9.9%, p<0.01) wound dehiscence (2.5% vs. 4.6%, p <0.01), mesenteric ischemia(7.6% vs. 14.7%, p<0.01), bowel obstruction (12.74% vs. 17.02%, p<0.01), and colon resection (4.37% vs 8.36%, p<0.01). Conversion to open repair occurred in 4.9% of patients treated with EVAR. Mean length of stay was shorter for EVAR patients (10.8 days vs. 18.1 days, p<0.01), and EVAR patients were more likely to be discharged home(62.8% vs. 40.7%, p <0.01).
CONCLUSIONS: Compared to open repair of ruptured AAA, endovascular repair is associated with lower peri-operative and long-term mortality, fewer in-hospital complications, shorter length of stay and more frequent discharge home. Long-term survival benefit of EVAR persisted to five years, and older patients had a larger survival benefit. Increased use of EVAR for rAAA may lead to decreased mortality for treated ruptured AAA.
COMPARING PHYSICIAN VERSUS PATIENT PERCEPTION OF PHYSICIAN HOSPITAL DISCHARGE COMMUNICATION: A PRELIMINARY STUDY Michael Maniaci; Nancy Dawson. Mayo Clinic in Florida, Jacksonville, FL. (Control ID #1313111)
BACKGROUND: Physician discharge instructions are critical to patient care because they are the link transitioning the hospital care plan to the home. We hypothesized that physician perception of discharge instructions communication is better than patient perception. The results will be used to shape future resident didactics on discharge communication.
METHODS: This observational, survey-based study was done in a 330-bed adult teaching hospital. Surveys were mailed to 100 patients discharged home and 49 internal medicine physicians responsible for those patients care. Each physician had between 1 and 4 of their patients surveyed. Patients and physicians received anonymous 5-item questionnaires concerning physician communication at discharge. Patient surveys inquired about their physicians communication at the specific physician encounter, while physician surveys asked about the physicians overall self-perception of discharge communication skills. Physician responses were separated by physician training levelRESULTS: Completed questionnaires were returned by 59 patients and 40 physicians (26 residents, 14 attendings). All physicians reported a noticeably better perception of communication than patients than the patients: 83% vs. 61% (P=0.027) for spending adequate time reviewing the discharge plan, 98% vs. 80% (P=0.013) for speaking slowly enough to understand, 100% vs. 68% (P<0.001) for using wording that can be easily understood, and 85% vs. 59% (P=0.008) for taking the time to answer questions before discharge. Patients believed more than physicians that further training on patient communication would be beneficial, but this was not statistically significant (41% vs 25%; P=0.13). Attending physicians perceived having more time to review the discharge plan (P=0.025) and answer questions before discharge (P=0.018). Significantly more first-year residents reported that further communication training would be beneficial (P=0.003).

CONCLUSIONS: Patient and physician perceptions of adequate discharge communication in the health care setting differ greatly. While young trainees recognize the constraints of time placed on physician -patient interaction, as experience increases, this recognition decreases. Although all resident levels had a poorer perception than their patients, first-year residents were more perceptive of their communication flaws and more likely to consider further education on effective communication. Based on these preliminary findings, programs should strongly consider didactics for all residents focusing on the basic fundamentals of physician-patient communication.

COMPARING THE PERFORMANCE OF THE S-TOFHLA AND NVS IN A RACIALLY/ETHNIC DIVERSE STUDY POPULATION Vanessa Ramirez-Zohfeld1; Alfred W. Rademaker2; Nancy C. Dolan1,3; M. Rosario Ferreira1,4; Milton "Mickey" Eder5; Dachao Liu2; Michael S. Wolf1; Kenzie A. Cameron1. 1Northwestern University Feinberg School of Medicine, Chicago, IL; 2Northwestern University Feinberg School of Medicine, Chicago, IL; 3Northwestern Medical Faculty Foundation, Chicago, IL; 4Jesse Brown VAMC, Chicago, IL; 5ACCESS Community Health Network, Chicago, IL. (Control ID #1332071)

BACKGROUND: Numerous assessment tools are used to estimate health literacy in healthcare settings, including the Short Test of Functional Health Literacy in Adults (S-TOFHLA) and the Newest Vital Sign (NVS). However, there is a dearth of data on the performance of the NVS when administered within a diverse population and in a language other than English. We compared the performance of the S-TOFHLA with the NVS among both English and Spanish-speaking patients.

METHODS: Data was extracted from a larger, ongoing randomized-controlled study to promote colorectal cancer screening. Participating English and Spanish-speaking patients seeking care at one of six federally qualified health centers serving predominately low-income patients were administered a pre-test which included the S-TOFHLA. After their physician visit they were administered a post test, which included the NVS. Scores on the S-TOFHLA range from 0-100; 0-53 indicates inadequate health literacy, 54-66 marginal health literacy and 67-100 adequate health literacy. Scores on the NVS range from 0-6; 0-1 indicates limited literacy likely, 2-3 limited literacy possible and 4-6 almost always indicates adequate literacy. Spearman correlation coefficients were used to examine the relationship between scores on the S-TOFHLA and NVS. Weighted kappa statistics were used to find the strength of agreement between the scoring categories of the S-TOFHLA and the NVS.

RESULTS: Among 146 patients, 27.40% were men and 72.60% were women with a mean age of 57.79 years (sd=5.97). Hispanic/Latinos comprised 47.26% of study patients while 52.74% identified as non-Hispanic. Fifty-six percent of patients completed the literacy tests in English while 44% completed them in Spanish. Overall, the correlation between the S-TOFHLA and the NVS was 0.73 ($p<0.0001$). There was a stronger correlation for those completing the test in Spanish ($r=0.83$, $p<0.0001$) compared to those completing the tests in English ($r=0.55$, $p<0.0001$). An agreement analysis revealed moderate agreement between the three S-TOFHLA literacy categories and the three NVS categories (kappa=0.36, 95% CI 0.26 - 0.46). Among English test takers, the agreement across the three categories was lower (kappa =0.20, 95% CI 0.11 - 0.30) than for those completing it in Spanish (kappa=0.54, 95% CI 0.37 - 0.71). Of 77 patients classified as having adequate health literacy by the S-TOFHLA, 35.06% were classified by the NVS as having a high likelihood of limited literacy and 32.47% were classified as having limited literacy possible. Of 60 English test takers classified as having adequate health literacy by the S-TOFHLA, 40.00% were classified by the NVS as likely having limited health literacy and 28.33% were classified as having limited literacy possible. Of 17 Spanish test takers who were classified as having adequate health literacy by the S-TOFHLA, 17.65% were classified by the NVS as having a high likelihood of limited literacy and 47.06% were classified as having limited literacy possible.

CONCLUSIONS: Overall, there is moderate agreement between the STOFHLA and the NVS literacy categories; however, the NVS regularly classifies respondents as having more limited literacy than the S-TOFHLA. Agreement is better between the two measures when the tests are taken in Spanish.

COMPARISON OF COMORBIDITY RISK ADJUSTMENT METHODS IN A NATIONAL COHORT OF

VETERANS WITH DIABETES CherylP. Lynch1,2; Mulugeta Gebregziabher1,2; R. Neal Axon1,2; Kelly J. Hunt1,2; Carrae Echols2; Leonard E. Egede1,2. 1Ralph H Johnson Veterans Affairs Medical Center, Charleston, SC; 2Medical University of South Carolina, Charleston, SC. (Control ID #1340373)
BACKGROUND: Adjustment for disease burden or comorbidity risk is essential in health outcomes research. Outcomes models that use administrative data sets, which are generally not collected for research

purposes, may be biased if they do not properly account for comorbidity. Some researchers adjust for comorbidity using an ICD-9-CM adaptation of the Charlson Comorbidity Index (Deyo-Charlson), Elixhauser or their categorical form, while others include diagnostic indicators of individual comorbidities in their model (Quan approach). However, it is unclear which is optimal for risk adjustment. Therefore, we examined these three approaches to determine the most optimal comorbidity risk adjustment with applications to data from a national, longitudinal cohort of veterans with diabetes.
METHODS: We investigated Deyo-Charlson, Elixhauser and Quans comorbidity measures using three modeling approaches: as a continuous predictor, as a categorical form (0=none, 1=one, 2=two, 3=three or more) and as a list of all diagnostic indicators of disease. We considered three types of outcomes (binary, continuous, time to event). Generalized linear mixed models (GLMM) were fitted for glycemic control, assessed by HbA1c (binary and continuous) and Cox regression was used for modeling mortality with comorbidity as the main covariate. We examined area under the receiver operating characteristics curve (AUC) and goodness-of-fit criteria to determine the optimal comorbidity modeling approach. AIC values were standardized by the total sample size used to fit each model. RESULTS: Application of comorbidity measures to a national cohort of 892,223 veterans with diabetes (followed from 2002 to 2006) showed that modeling comorbidity, irrespective of index, in a categorical form (AIC=8.77, R2=0.42, AUC=0.95) leads to greater risk adjustment than modeling it as a continuous predictor (AIC=8.79, R2=0.41, AUC=0.92). In GLMM with continuous HbA1c, a list of diagnostic indicators of disease (Quan approach) consistently exhibited the best goodness-of-fit. In GLMM with binary HbA1c, a better fit was observed when a list of diagnostic indicators (AIC=12.5, R2=0.95, AUC=0.61) or four categories (AIC=12.4, R2=0.61, AUC=0.95) modeled comorbidity compared to including a score (AIC=12.9, R2=0.61, AUC=0.95). Results were similar for mortality outcome. CONCLUSIONS: How we model comorbidity leads to different levels of risk adjustment irrespective of the type of comorbidity index used. A robust approach seems to categorize the count of diagnostic indicators from ICD-9 codes. Researchers need to consider alternative scenarios of modeling previously validated comorbidity scores when adjusting for risk in outcomes research, especially with more widespread use of ICD-10 codes.
COMPARISON OF TAILORED VERSUS MAINSTREAM PRIMARY CARE DELIVERY FOR HOMELESS PERSONS: A NEW, VALIDATED PATIENT ASSESSMENT TOOL Stefan Kertesz1,2;
David E. Pollio2; Cheryl Holt4; Jocelyn L. Steward2; Adam Gordon6; Theresa W. Kim3; Erin Stringfellow3; Erika Austin1; Joya Golden5; Nancy Johnson1; Lori L. Davis2. 1Birmingham VAMC, Homewood, AL; 2U. Alabama, Birmingham, AL; 3Boston Health Care for the Homeless, Boston, MA; 4U. Maryland, Baltimore, MD; 5VA Greater Los Angeles, Los Angeles, CA; 6VA Pittsburgh Health Care System, Pittsburgh, PA. (Control ID #1332698)
BACKGROUND: Tailoring primary care (PC) service delivery for homeless patients may result in more positive experiences with care. Some organizations tailor services for the homeless through co-located medical, mental, &social services, homeless-dedicated medical staff, a homeless mission focus, outreach to streets and shelters, or including formerly homeless persons in leadership. As no consumer assessment surveys were specifically designed for homeless patients, we developed a Primary Care Quality survey for the Homeless (PCQ-H) and compared PCQ-H scores from sites that differed in the degree of homeless-specific service tailoring.

METHODS: Based on 60 interviews with homeless patients and expert clinicians, the PCQ-H survey was designed to assess 11 areas (access, coordination, cooperation, evidence-based care, accountability, patient control, continuity, shared knowledge, respect, substance abuse/mental illness, homeless-specific needs). A multidisciplinary team crafted 78 items (Likert, 1-4) and administered them to random samples of clients from a highly tailored 25-year old Health Care for the Homeless Program (HT: n=182), 2 mainstream VA sites with no (Main 1, n=150) or some (Main 2, n=101) tailoring, and a new tailored VA program (VA-HT, n=41). We used confirmatory factor analysis, item-scale and inter-scale correlations to select 50 items for the present analysis. To assess the effect of service tailoring on patient assessment of care, we first compared scores across sites adjusting for demographics, economic status, chronic and street homelessness, alcohol/drug use, psychiatric symptoms, medical status, and general health. Since ratings of care tended to the favorable end of the Likert scale, we also created a binary indicator of more than the median number of unfavorable or negative responses to items on each scale (e.g. agreeing that I have had to walk out because getting care was too much trouble) and compared the proportion of negative responses across site.
RESULTS: We found 4 overarching scales: Patient-Clinician Relationship (PCR), Access/Coordination (A/C), Perceived Cooperation (COOP) and Homeless-Specific Needs (HSN). There was good model fit (RMSEA=0.069; CFI=0.957), internal reliability (all alphas>0.76), and convergence with Safrans Primary Care Assessment Survey (PCAS) (rs 0.26-0.31, all p<.001). In adjusted analyses, the highly tailored program exceeded the 2 VA sites for PCR (p<.01), COOP (p<.01), and HSN (p<.05). Unfavorable response patterns were 10-25% more prevalent (in absolute terms) for the 2 mainstream VA sites for PCR, COOP and HSN, compared to both tailored sites (all p<.05 in raw &adjusted analyses).
CONCLUSIONS: The PCQ-H appears to provide a valid measure of homeless patients satisfaction with primary care. Homeless patients rate their relationship to their provider, cooperation among caregivers, and care for homeless-specific needs more highly when primary care services are highly tailored. Whether such results are attainable across diverse settings remains to be seen.

COMPARISON OF ELECTRONIC CARESETS TO GUIDE VENOUS THROMBOEMBOLISM RISK ASSESSMENT Larissa Verda; William Trick; Ashima Sahni; Abhimanyu Saini; Samrat Khanna; Monica Muppidi; Shane Borkowsky; Krishna Das. John H Stroger Jr Hospital of Cook County, Chicago, IL. (Control ID #1331870)
BACKGROUND: Hospital acquired venous thromboembolism (VTE) is a significant cause of mortality in hospitalized patients. National quality organizations and expert panels recommend a VTE risk assessment and risk-based prophylaxis for every inpatient. Point scoring systems used in risk stratification have been associated with errors in risk stratification and choice of VTE prophylaxis. Thus, the optimal tool for assessing VTE risk remains unknown. The aim of this study was to compare electronic caresets that differed regarding the extent of clinical guidance provided at the time of VTE risk assessment. METHODS: We performed a cross-sectional study at a 464-bed public teaching hospital. We integrated two separate risk assessment tools into VTE prophylaxis electronic caresets within admission orders. One assessment tool provided detailed guidance on VTE risk factors (RF-G), the other provided no specific guidance (No-G); both of them directed clinicians to categorize the patients VTE risk into three levels (low, moderate/high, very high). Providers were allowed to exit the careset without completing the risk assessment in order to facilitate the admission process. Patients admitted to the medicine service were randomly assigned to one of three inpatient care teams (i.e., firms). We randomly assigned one VTE risk assessment tool to each firm; thus, two firms were exposed to the RF-G tool, and the other firm used the No-G tool. Medical patients were randomly selected and their charts abstracted by four expert housestaff reviewers trained through literature review, case discussion and participation in guideline development; they exhibited excellent agreement in determining VTE risk (=0.8). Reviewers assessed VTE risk blinded to the teams determination and then recorded the primary teams VTE risk assessment. We compared

the level of agreement between the reviewers vs. the RF-G and No-G groups.
RESULTS: We reviewed 344 patient admissions. AVTE risk assessment tool was completed by the housestaff for 135 patients (39%). Physicians using the RF-G tool arm were more likely to complete the VTE prophylaxis risk assessment careset than those using the No-G tool (44% vs 30%, P<0.01). By expert reviewer assessment, the distribution of risk levels between the RF-G and No-G groups were similar. However, the No-G clinical teams were more likely to assign patients to low or very high risk categories compared to the RFG determinations (Table); the distributions among the three categories were significantly different (P<0.01). Agreement between the expert review and clinical team assessments was significantly higher for the RF-G arm compared to the No-G arm (90% vs 63%, P<0.05). Overall, in 14 of 19 cases of disagreement, the clinical team underestimated VTE risk compared to experts. CONCLUSIONS: Clinical determination of VTE risk improved when an assessment tool at the point of care provided risk factor guidance within a venous thromboembolism prophylaxis careset. Although only 40% of physicians completed the electronic risk assessment tool, they were more likely to complete it when risk factor guidance was included.
Risk-factor guidance (RF-G) N=102
No guidance (No-G) N=33
Team N (%)
Reviewer N (%)
Low risk 7 (7) 3 (3) 7 (21) 0 (0) Moderate/highrisk
91 (89) 95 (93) 22 (67) 31 (94)
Very high risk 4 (4) 4 (4) 4 (12) 2 (6)
CONTINUITY CLINIC MAKEOVER: AN AMBULATORY EDUCATION NEEDS ASSESSMENT FOR RESIDENTS PRACTICING IN AN URBAN SAFETY-NET CLINIC Ryan Laponis; Claire Horton; Katherine Julian; Sharad Jain; Reena Gupta. University of California San Francisco, San Francisco, CA. (Control ID #1340074)
BACKGROUND: Educating residents in resource-poor primary care clinics that care for a large volume of vulnerable patients can provide
many positive experiences, but also present barriers to high-quality resident education. While some barriers (high patient volume, low support staff ratios) may be unavoidable, others could be addressed by clinician-educators to enhance the educational experience for resident providers. Using mixed method inquiry, we sought to identify areas needing improvement to meet resident educational goals.
METHODS: We surveyed all second and third year internal medicine residents (primary care and categorical) whose continuity clinic was based at the San Francisco General Hospital General Medicine Clinic during the 2010-2011 academic year using the Veterans Health Administration Learners' Perceptions Surveya 76-item instrument with established reliability and validity that measures satisfaction on a Likert-like scale (1 =poor, 5=excellent) in 6 domains: faculty interactions (14 items); the learning (16), working (12), clinical (14), and physical (6) environments; and personal/professional experience (14). We further explored the resident experience of items with a mean score <4 by conducting four resident focus groups (primary care and categorical) led by the ambulatory chief resident and captured responses by transcription. We used iterative thematic analysis to identify emergent themes.
RESULTS: 16 of 32 (50%) residents participated in the survey. Of the 76 survey items, 35 averaged a score below 4: 14% of items in the faculty interactions domain, 56% in the learning environment, 50% in the working environment, 71% in the clinical environment, 50% in the physical environment and 36% in personal/professional experience. 15 of 32 (47%) residents participated in one of four focus groups. Exploration of the transcripts yielded 4 themes: 1. Need for longitudinal clinical mentorship (For my most complicated patients, I need a go to [preceptor] sometimes, its really complicated and re-presenting [to a different attending every visit]just doesnt work); 2. Increased direct observation and feedback ([I would like] a much more

structured set up where [the same preceptor] just walks in and watches us[monthly]); 3. More time for panel management (We are learning things on our own in a time constrained environment and the only time you can do it is when you are in clinicit is not realistic to do panel management while you are on an inpatient rotation); 4. Learning clinic efficiency and time management skills ([I] Feel like I never have enough time [to get through clinic] and when I graduate, I will have to see even more patients [per clinic session]).
CONCLUSIONS: Residents identify multiple domains in which their safety-net continuity clinic experience can be educationally enhanced. Interventions that increase longitudinal clinical precepting, enhance direct observation and feedback, and teach panel management skills may improve resident satisfaction with continuity clinic experiences and increase retention in primary care careers.
CONTROLLED TRIAL OF A COMBINED DECISION AID+ PATIENT NAVIGATOR INTERVENTION TO INCREASE COLORECTAL CANCER SCREENING AMONG MEDICAID PATIENTS IN NORTH CAROLINA
Lucia A. Leone1; Daniel S. Reuland2,3; Carmen L. Lewis2,3; Mary Ingle5; Brian Erman3; Annette DuBard4; Michael Pignone2,3. 1University of North Carolina, Chapel Hill, NC; 2University of North Carolina, Chapel Hill, NC; 3University of North Carolina, Chapel Hill, NC; 4NC Community Care Networks, Raleigh, NC; 5Community Care of the Lower Cape Fear, Wilmington, NC. (Control ID #1324456)
BACKGROUND: Screening rates for colorectal cancer (CRC) among Medicaid patients are lower than those for the general population despite insurance coverage for tests. The goal of this study was to test, in a controlled trial, an intervention to improve CRC screening rates consisting of a mailed decision aid followed by telephone support from an offsite, payer-based patient navigator.
METHODS: The study was conducted in cooperation with Community Care of North Carolina (CCNC), the quality improvement organization for Medicaid in NC. We selected one of fourteen CCNC regions for our study. Within this region, we selected six practices for the intervention and matched them with six control practices. Practices were selected to allow for a mix with regards to size, geographic location (urban vs. rural) and

presence of residents. Eligible patients at each practice were age 50 and older, not up-to-date with CRC screening based on Medicaid claims data, and currently covered by Medicaid, but not Medicare. A CCNC patient outreach coordinator was trained to serve as a patient navigator for the study. Training included an overview of CRC screening plus motivational interviewing techniques focused on helping patients overcome screening barriers. We mailed a packet containing a decision aid DVD, written survey, and a letter from the patient's physician encouraging screening to all eligible patients in intervention practices. The patient navigator called patients beginning one month after the packet was mailed and attempted to contact each person at least 3 times. Patients who had not returned the mailed survey, had the option to complete it over the phone prior to receiving counseling from the navigator. Our primary outcome was completion of a CRC screening test within six months of enrollment as determined by Medicaid claims data. We compared screening test completion rates among intervention participants with those from the matched control practices, using intent to treat analysis. Other study outcomes were measures of intervention reach based on navigator logs and survey data.
RESULTS: Based on claims data, we identified 240 eligible patients who were not up-to-date with CRC screening from intervention practices (overall screening rate among age-eligible patients was 35.6%) and 174 eligible patients from control practices (overall screening rate of 46.0%). At six months, 9.2% (n=22) of intervention patients had received CRC screening during the intervention period based on claims, compared to7.5% (n=13) of control patients. The rate difference was 1.7 percentage points (95% CI: -3.6, 7.0) After excluding anyone who declined participation or self-reported as ineligible, 207 patients remained in the

intervention group at follow-up. Of those, 26.6% (n=55) completed the decision aid survey and 40% (n=22) of survey completers reported watching some or all of decision aid. The patient navigator discussed CRC screening with 25.6% (n=53) of the 207 intervention patients at least once by phone.
CONCLUSIONS: A mailed decision aid plus phone-based patient navigator intervention had limited reach and was not able to increase CRC screening among older Medicaid patients compared with control. Higher-intensity interventions, such as practice-based navigators, may be needed to better reach challenging patients and improve screening rates among vulnerable populations such as this one.
COPING SKILLS ASSOCIATED WITH INTERNAL MEDICINE RESIDENT BURNOUT: A MULTI-CENTER SURVEY STUDY Jessica Cohen1; Ravi K. Gopal2; Jonathan Ripp1. 1Mount Sinai School of Medicine, New York, NY; 2University of Colorado, Denver, CO. (Control ID #1334764)
BACKGROUND: Job burnout is common among internal medicine (IM) residents and may lead to depression, poor academic performance and self-reported suboptimal patient care. Potential predictors of burnout include excessive work hours, loan debt burden and some personality traits. Little is known about the relationship between coping techniques and job burnout in IM residents. This study attempts to determine whether an association exists between coping mechanisms and IM resident burnout. METHODS: Two academic medical centers, the Mount Sinai School of Medicine and the University of Colorado, administered a survey to IM residents once late in the academic year between April 2010 and June 2011. Likert scale survey measures included job burnout, personality traits and coping mechanisms. Burnout was defined using the most commonly identified definition of the Maslach Burnout Inventory, a previously validated instrument. The validated Brief COPE scale was used to assess both adaptive and maladaptive coping responses to stressful conditions. Combining both centers into one cohort, we conducted chi-square tests to identify statistically significant differences in proportions ($P<0.05$) of burnout across survey items.
RESULTS: Of 259 eligible residents from both institutions, 154 (59%) completed the survey. Sixty-six percent (101/154) of these residents met criteria for burnout. Residents with burnout more frequently used ("a lot") self-distraction (25 v. 3; 25% v. 6%; P=0.034) and self-blame (15 v. 5; 15% v. 9%;P=0.050) as coping mechanisms when compared with residents who were burnout free. Residents with burnout also more commonly used ("at all") behavioral disengagement (25 v. 3; 25% v. 6%;P=0.051) and venting (71 v. 30; 71% V. 57%; P=0.012) as coping mechanisms when compared with residents who were burnout free. There were no significant associations between resident burnout prevalence and other coping mechanisms such as humor, religion, substance use, support network, planning, acceptance or denial.
CONCLUSIONS: In keeping with previous studies of IM residents, we found a high prevalence of burnout late in the academic year. The correlations we observed between burnout and coping mechanisms suggest that burnt out residents use different techniques to manage stressful conditions. Further investigation utilizing a longitudinal design to measure burnout incidence can make use of our findings to identify whether these potentially adverse coping strategies predict the development of burnout. A better understanding of the relationship between burnout and coping may help identify those at risk and inform potential future interventions.
CORRELATES OF SELF-REPORTED HYPERTENSION IN PATIENTS WITH AIDS IN THE ERA OF HIGHLY ACTIVE ANTI-RETROVIRAL THERAPY (HAART) Katherine Krauskopf1;
Mark L. Van Natta2; Alex Federman1; Andrea D. Branch1; Curtis L. Meinert2; Douglas A. Jabs3,1. 1Mount Sinai School of Medicine, New York, NY; 2The Johns Hopkins University Bloomberg School of Public Health, Baltimore, MD; 3Mount Sinai School of Medicine, New York, NY. (Control ID #1336248)
BACKGROUND: Cardiovascular (CV) disease is among the most common non-AIDS comorbidities developed by patients with HIV on treatment. While multiple factors contribute to its development in this population (including chronic inflammation and HAART), hypertension (HTN) represents a significant, modifiable risk factor. It is therefore important to identify distinct clinical predictors and risk factors for HTN in this population. This

study evaluated risk factors for prevalent and incident HTN in a large cohort of HIV-infected individuals, including retinal vascular measurements that are associated with incident HTN in the general population.
METHODS: We analyzed standardized interview data from the Longitudinal Study of Ocular Complications of AIDS (LSOCA). LSOCA is a large, prospective study beginning in 1998 of AIDS patients 13 years of age attending 19 AIDS ophthalmology centers for a routine examination. Outcomes were self-reported HTN at study entry and 3- or 6-month follow-up. Predictors of HTN included traditional risk factors, AIDS duration, severity and disease control, and HIV treatment history. Secondary analysis was performed in LSOCA participants without an ocular opportunistic infection (OOI) to determine associations between central retinal vascular measurements (central retinal artery equivalent [CRAE] and central retinal vein (central retinal vein equivalent [CRVE]) and HTN. The unadjusted associations of risk factors with HTN were assessed using the t-test or the chi-square test. Multiple logistic regression was used to assess adjusted associations of predictors with prevalent self-reported HTN. Cox regression was used to assess associations of predictors with incident self-reported HTN during follow-up among those without self-reported HTN at enrollment. All models were adjusted for socio-demographics, components of metabolic syndrome (hyperlipidemia and diabetes), and hepatitis C co-infection.
RESULTS: Of the 2,359 participants, 80% were male, 60% 40-59 years old, 36% Black, and 14% Hispanic. Prevalence of self-reported HTN was 20% (95% confidence interval [CI]: 18-21). In adjusted analysis, prevalent HTN was associated with Black race (odds ratio [OR]: 1.99, 95% CI: 1.53-2.61], older age [OR: 1.07 per year, 95% CI: 1.06-1.09], and higher weight [OR 1.25 per 10 kg, 95% CI 1.15-1.36), longer time since AIDS diagnosis (OR 1.04 per year, 95% CI 1.00-1.07) and higher CD4+ T cell counts (OR 1.09 per 100 cells/uL, 95% CI 1.03-1.16). HTN incidence was 26/1000 person years (PYs) (95% CI 22-29). Traditional risk factors were also associated with an increased risk for HTN; as were shorter time since AIDS diagnosis (RR 0.95 per year, 95% CI0.91-0.99) and lower peak HIV viral load (RR 0.86 per log copies/ml, 95% CI0.75-0.99). In secondary adjusted analysis, prevalent HTN was associated with narrower CRAE (OR 2.24 1st vs. 4th quartile, 95% CI), as was risk for HTN (RR 5.13 1st vs. 4th quartile, 95% CI 2.58-10.20).

CONCLUSIONS: In this large, prospective study of participants with AIDS, hypertension was relatively prevalent. Risk factors for and clinical indicators of hypertension in this population mirror those in the general population. The results of this study highlight the importance of screening for hypertension as a modifiable CV risk factor among primary care patients with AIDS, including via retinal microvascular evaluation.
COST-EFFECTIVENESS OF PNEUMOCOCCAL CONJUGATE VACCINATION STRATEGIES IN US ADULTS AGED 65 AND OLDER Kenneth J. Smith; Angela Wateska; Mary Patricia Nowalk; Mahlon Raymund; Richard K. Zimmerman. University of Pittsburgh, Pittsburgh, PA. (Control ID #1310720)
BACKGROUND: The 13-valent pneumococcal conjugate vaccine (PCV13) awaits US adult licensure. Its potential role in adults aged 65 years is unclear, particularly since it could prevent nonbacteremic pneumococcal pneumonia, which the presently recommended 23-valent pneumococcal polysaccharide vaccine (PPSV23) has not been consistently shown to do.
METHODS: Using a Markov model, we estimated the cost-effectiveness of vaccination strategies using PCV13 and PPSV23 alone or in combination in 65- and 75-year-old cohorts. For the base case, we assumed no prior vaccination; we also examined prior vaccination and hyporesponsiveness to repeated vaccination scenarios. We estimated age- and comorbidity-specific pneumococcal disease rates, indirect effects on adults from childhood vaccination with PCV13, and costs using CDC Active Bacterial Core surveillance data and US national databases. An expert panel estimated vaccine-related protection. We took a societal perspective and discounted outcomes 3%/yr. One-way and probabilistic sensitivity analyses were performed to test the robustness of results.
RESULTS: The table summarizes incremental cost-effectiveness ratios (ICER) for non-dominated strategies.

PPSV23 strategies were dominated (more costly, less effective) by PCV13 strategies. Results were most sensitive to varying vaccine effectiveness estimates. Probabilistic sensitivity analyses, where parameter values were simultaneously varied, supported baseline results. When we assumed prior vaccination and 80% effectiveness of subsequent vaccinations, base case ICERs increased by 37-78% for single dose strategies and 29-35% for multiple dose strategies. In addition, PCV13 strategies are less favored if greater indirect effects due to childhood vaccination occur.
CONCLUSIONS: Single dose PCV13 strategies may be worth considering for elderly patients. Multiple dose strategies are more expensive, particularly when prior vaccination and the possibility of hyporesponsiveness with repeated vaccination are considered.
Results Table
Cohort age
Strategy ICER (per QALY)
65 PCV13: 65 PCV13: 65, 80 PCV13: 65, 75 PCV13: 65, 75, 85
$11,300 $83,000 $263,000 $272,00075 PCV13: 75 PCV13: 75 85 $62,800 $278,000
ICER=incremental cost-effectiveness ratio QALY=quality adjusted life year
COST-EFFECTIVENESS OF PROCALCITONIN-GUIDED ANTIBIOTIC USE IN COMMUNITY ACQUIRED PNEUMONIA Kenneth J. Smith; Richard K. Zimmerman; Angela Wateska; Mary Patricia Nowalk; Mahlon Raymund; Michael J. Fine. University of Pittsburgh, Pittsburgh, PA. (Control ID #1315469)
BACKGROUND: Although prior randomized trials have demonstrated that procalcitonin (PCT) guided antibiotic therapy effectively reduces antibiotic treatment rates and duration for patients with community acquired pneumonia (CAP), the cost implications of PCT protocols remain unclear.
METHODS: We used a decision model examining hypothetical patient cohorts to estimate the cost-effectiveness of PCT protocols vs. usual care in low-risk patients hospitalized for CAP, taking a third-party payer perspective over the duration of that hospitalization. Since studies show no outcome differences between PCT and usual care strategies, we assumed no length of stay (LOS) or quality of life utility differences in the base case, biasing against PCT use, but relaxed these assumptions in sensitivity analyses. Two PCT protocols were evaluated: 1) PCT levels only at hospital admission, affecting only the decision to begin antibiotic therapy; and 2) PCT levels drawn at admission and on days 3, 5, and 7 as indicated, affecting both prescribing and therapy duration decisions. In clinical trials, PCT protocols decreased absolute antibiotic prescription risk (mean 9.9%) and therapy duration (mean 4.5 days) in CAP patients. Medicare reimbursement for PCT is $38.36. These and other parameter values were varied in sensitivity analyses.
RESULTS: PCT protocols performed only on admission were cost saving compared to usual care if the total per patient cost (including administration) of the antibiotic regimen was>$387 in usual care patients. If PCT was drawn on admission and every two days thereafter while on antibiotic, PCT protocols were cost saving if antibiotic costs were>$23/day; the Figure shows a 2-way sensitivity analysis, varying both antibiotic costs and decreased antibiotic duration. Either PCT protocol was cost saving if total hospital costs decreased>$119 (or LOS decreased >0.18 days) through their use. If PCT use improved quality of life utility through decreased antibiotic side effects or shorter hospitalization, PCT protocols cost<$100,000/QALY if they gained 0.0012 QALYS (~10.5 hours) when oral azithromycin (regimen cost $39) was used, with even more favorable cost-effectiveness ratios when more expensive antibiotic regimens were evaluated. Results favoring PCT use were otherwise robust in sensitivity analyses. CONCLUSIONS: PCT regimens for low-risk patients hospitalized with CAP are likely to be either cost saving or cost-effective compared to usual care in an analysis biased against PCT use. Further pragmatic trials of PCT-guided therapy and other evidence-based antibiotic decision rules in CAP are warranted.
2-Way Sensitivity Analysis
CREATING A POSITIVE LEARNING ENVIRONMENT FOR FEMALE MEDICAL STUDENTS: RESULTS FROM

A LONGITUDINAL QUALITATIVE STUDY Palav Babaria1,2; Sakena Abedin2; David Berg2; Marcella Nunez-Smith2. 1University of California, San Francisco, San Francisco, CA; 2Yale University, New Haven, CT. (Control ID #1339999)

BACKGROUND: Continued high rates of sexual harassment and gender discrimination (SH/GD) amongst female medical students have important implications on medical education and learning. Harassment and belittlement of both male and female students have been associated with

decreased confidence and self-worth, but little is known about how SH/ GD specifically affect the clinical learning environment for third-year female medical students and how these experiences evolve over time. METHODS: A qualitative longitudinal study consisting of in-depth interviews with 12 third-year female medical students after each clinical clerkship. Participants were purposefully selected from a single New England medical school to represent a range of ages, ethnicities, and prior life experiences. Using a grounded theory approach, a diverse coding team analyzed the transcripts to identify recurring themes. The coding team met regularly to review all coded transcripts and resolve any discrepancies. Data was organized using the scientific software, ATLAS.ti 5.0 (Berlin). RESULTS: Four themes emerged, with illustrative quotes, that characterized the effect of gender on the learning environment of participants (1) Gendered experiences affected participants comfort with the medical team, often leading to awkwardness and avoidance; (2) Experiences that were gender-neutral or gender-positive fostered learning and question-asking;(3) Participants often tolerated sexualized or gendered encounters in order to facilitate learning; (4) Over time, participants repeated gendered interactions led to fatigue and disengagement from clinical learning. CONCLUSIONS: Gendered experiences significantly shape the learning environment for third year female medical students, resulting in positive learning environments with increased comfort, engagement and question-asking or negative learning environments with silence, fatigue and disengagement. Educators should attempt to identify these factors and foster improved clinical learning environments for female medical students.

CROSSING THE DIGITAL LINE: MEDICAL TRAINEE AND ATTENDING PHYSICIAN RELATIONSHIPS VIA ONLINE SOCIAL NETWORKS Chapy Venkatesan1; Henry Tran2; Shirley Kalwaney1. 1Inova Fairfax Hospital, Falls Church, VA; 2New York University Langone Medicine Center, New York, NY. (Control ID #1309489)

BACKGROUND: Online social networks such as Facebooktm are very commonly used by medical trainees. However, few studies have examined the content, perceptions, and potential interpersonal issues that may arise between residents and attending physicians via online social networks. The authors sought to quantify and describe the online interactions between medical trainees and attending physicians.

METHODS: From February to April 2010, residents at four academic institutions were asked to complete a 15-question, anonymous web-based survey assessing their online social network behaviors and relationships.. Approximately 25% of respondents were categorical internal medicine residents. Respondents were asked to describe specifically the number, status, and history of online friendships with attending physicians. RESULTS: 130 respondents (90.3%) reported using an online social network. Among these users, 76 (64.4%) reported a friendship with at least one attending physician (mean 7.7 friendships). Respondents did not uniformly use security filters to obscure information or photographs. 45 respondents (46.9%) felt social pressure to accept a request of friendship from an attending. 3 respondents (2.8%) reported online interactions with attending physicians that crossed the line.

CONCLUSIONS: Online friendships between residents and attending physicians via social networks are common. A small percentage of residents report pressure to accept online friendships and experienced negative interactions with attending physicians. National accrediting bodies, GME departments and residency programs need to provide guidance and possibly create policies in order to ensure that the potential problems of

these interactions are mitigated.

CUMULATIVE CHANGES IN USE OF CHRONIC MEDICATIONS: A NEW MEASURE OF PRESCRIBING INTENSITY

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BACKGROUND: Polypharmacy is a major concern in older adults, yet a simple cross-sectional count of medications does not capture the potential
complications (and benefits) that occur when medications are started, stopped, and changed over time. This study explored a novel measure of longitudinal changes in use of chronic medications as a marker of prescribing intensity in elderly veterans.

METHODS: Using a combination of Veteran Affairs (VA) outpatient pharmacy data and VA and Medicare outpatient and inpatient claims data from October 1, 2006 through September 30, 2008, we identified veterans age 65 years or greater who predominantly used VA services and received at least one chronic medication from VA at the beginning of a 1-year study period. Changes in use of chronic medications (drugs supplied for periods of 1 month or longer) were defined as additions (new medications started), discontinuations (medications present at baseline which were no longer filled), disruptions (interruption of refills for>=6 months), intraclass substitution (medication replaced with another drug from the same class) and dose changes. Negative binomial models were used to assess predictors of the rate of medication changes.

RESULTS: Among 834,299 veterans, the mean age was 76 (+/- 7) years. These patients had 5.7 (+/- 2.6) chronic conditions. At baseline, subjects were taking a mean of 4.9 (+/-2.9) medications, and one year later were taking an identical number of medications. However, over this one-year period patients had a mean of 5.3 (+/- 5.1) changes in their chronic medications, including an average of 1.7 additions, 1.5 discontinuations,0.6 disruptions, 1.3 dose changes, and 0.2 intra-class substitutions. Fourteen percent of patients had 10 or more changes in their chronic medications over one year. On multivariate analyses, older patients had fewer medication changes (IRR 0.96 for each 10-year increase in age, 95% CI 0.95-0.96). In contrast, medication changes were more frequent in patients taking more medications at baseline (IRR 1.11 for each additional medication, 95% CI 1.11-1.11) and in patients having more outpatient visits (IRR 1.07 for each additional visit, 95% CI 1.07-1.07). The frequency of medication changes varied substantially between VAs 21 regions. After adjusting for characteristics of patients, medical use, and visit frequency, there was a 27% difference in the rate of medication changes between the regions with the lowest and highest rates of change. CONCLUSIONS: Changes in chronic medications are frequent in elderly veterans. Cumulative measurement of medication changes captures important information about drug regimen complexity and potential problems that are not captured by simple drug counts at discrete time points.

CYSTATIN C-BASED GLOMERULAR FILTRATION RATE: AN IMPROVED PREDICTOR OF MORTALITY

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BACKGROUND: Creatinine (cr) is widely used to track kidney function. However, its utility is limited by partial secretion in renal tubules and dependence on age, gender, race, and muscle mass. Cystatin C (cys) is produced by nucleated cells and is neither secreted nor reabsorbed in nephrons. It is also influenced much less by the aforementioned characteristics. Consequently, it is a reliable marker of renal function and possibly mortality. Yet, it is not known whether clinically relevant glomerular filtration rate (GFR) thresholds, using cys or cr, are superior predictors of mortality in U.S. adults. Identifying the more discriminating marker will allow providers to employ the finest modality to detect and treat kidney disease.

METHODS: GFR was calculated using the standard of care Modification of Diet in Renal Disease cr equation and the new Chronic Kidney Disease Epidemiology Collaboration cys equation. Using the Third National Health

and Nutrition Examination Survey linked mortality data, with follow-up until 2006, we evaluated the relationship between GFR and all-cause mortality using life table analyses and Cox proportional hazards models that incorporated survey weights, strata, and clusters, while adjusting for potential confounders.
RESULTS: Cys and cr measurements were obtained from 7,205 adults. GFR was dichotomized as normal (60 mL/min/1.73 m2) or low (<60 mL/

min/1.73 m2); 74.55% had normal GFR based on cr and cys (NGFRCYCR), 2.58% had low GFR by cr only (LGFR-CR), 12.20% had low GFR by cys only (LGFR-CY), and 10.67% had low GFR by cr and cys (LGFR-CYCR). At 18 years (figure), the proportion surviving was 36.38% in LGFR-CYCR, 44.96% in LGFR-CY, 67.24% in LGFR-CR, and 68.52% in NGFR-CYCR. When directly compared to LGFR-CR, LGFR-CY was better at predicting all-cause mortality [(hazard ratio (HR) 1.53, 95% confidence interval (CI) 1.09-2.15]; LGFR-CYCR was the best (HR 2.34, 95%, CI 1.65-3.32). Further, among adults with normal cr-based GFR, the multivariate-adjusted mortality HR for each unit increase in cys was 7.79 (CI 5.67-10.69); for participants with a low cr-based GFR, the HR was1.62 (CI 1.49-1.78). Finally, the population attributable risk was 5.03% (CI3.72-6.43) in LGFR-CY, 5.86% (CI 4.58-7.20) in LGFR-CYCR, and0.84% (CI 0.02-1.79) in LGFR-CR.
CONCLUSIONS: Using established clinical thresholds, cys-based GFR is superior to cr-based GFR for predicting all-cause mortality and should be the preferred marker or used in combination with creatinine to assess risk. Even when stratified by cr-based GFR, cys is related to mortality in a level-dependent fashion, with a stronger effect among those with normal cr-based GFR. Finally, cys-based GFR has a greater population impact than cr-based assessments.
DOES IMPROVED CONTINUITY OF PRIMARY CARE IMPROVE CLINICIAN-PATIENT COMMUNICATION IN VA? David A. Katz1,2; Kimberly McCoy2; Mary Vaughan Sarrazin2,1. 1University of Iowa Carver College of Medicine, Iowa City, IA; 2VA Medical Center, Iowa City, IA. (Control ID #1326883)
BACKGROUND: Implementation of the Patient Aligned Care Team (PACT) model within the VA aims to improve care coordination and access to first-contact care, but its effects on continuity of care (COC) and on interpersonal dimensions of care are unknown. The aim of this study is to evaluate the association between longitudinal COC with the same primary care provider (PCP) and patients ratings of physician-patient communication during the ongoing PACT initiative.
METHODS: We conducted a retrospective cohort study of 4393 VA outpatients (Region 23) who satisfied the following criteria: 1) were assigned to a PCP and had at least 3 primary care visits to physicians or physician extenders during FY2009-10), and 2) completed the Survey of Healthcare Experiences of Patients (SHEP) following a primary care visit in FY2011. Data from the 2009 Patient Care Management Module were linked to VA outpatient datasets and clinic stop codes were used to identify
primary care visits; telephone contacts, home-based contacts, or contacts with a non-PCP were excluded. Three measures of longitudinal COC, Usual Provider of Continuity (UPC), Modified Modified Continuity Index (MMCI), and Known Provider Continuity (K index), were calculated for each eligible VISN 23 primary care patient (on a scale of 0-1, where 1 is perfect continuity). We grouped COC values into four categories: 1.0 (excellent), 0.75-0.99 (high intermediate), 0.50-0.74 (low intermediate), and <0.50 (poor). Quality of communication was measured using the 4-item CAHPS-HP communication subscale in 3717 patients with complete data. To identify excellent care, we used an all-or-none scoring strategy: when all items within a scale were rated always, the subscale score was assigned a value of 1 (otherwise 0). Patients were also asked to rate whether they participated in shared decision making (SDM)(N=1948 respondents with a treatment choice). Multivariable random effects logistic regression models were used to predict interpersonal communication and shared decision making during FY2011, after controlling for demographics, disability status, chronic medical and psychiatric conditions (Elix-hauser comorbidities plus generalized anxiety disorder and post-traumatic stress disorder), number of primary care clinic visits, usual site of care (modeled as a random effect), and PCP

participation in a PACT Learning Collaborative.
RESULTS: 51, 19, 18, and 12% of outpatients had excellent (UPC=1), high-intermediate (UPC=0.75-0.99), low-intermediate (UPC=0.50-0.74), and low (UPC<0.50) continuity, respectively. In bivariate analysis, 61, 59, 55, and 53% of patients in each continuity category rated their patient-provider communication as excellent, respectively (p=.0002 by Cochran-Mantel-Haenszel test for trend). In multivariable models, only low UPC was associated with a decreased odds of excellent communication (adjusted OR=0.80, 95%CI=0.64-1.0). Similar results were obtained with MMCI and K-index, which account for dispersion of visits across providers. There was no significant association between low UPC and SDM (adjusted OR=0.89, 95%CI =0.66-1.21), but patients with low MMCI tended to be less likely to rate SDM as excellent (adjusted OR=0.71, 95%CI =0.50-1.01).
CONCLUSIONS: Reduced PCP continuity may significantly decrease the quality of patient-provider communication in VA primary care. Innovative models of care that emphasize team-based care need to be monitored for unintended reductions in longitudinal continuity with the patient's PCP.
DAILY DIARY-RECORDED, BUT NOT GLOBAL SELF-REPORTED, ADHERENCE TO WEIGHT MONITORING IS ASSOCIATED WITH REDUCED HEART FAILURE HOSPITALIZATION Christine D. Jones1; George M. Holmes2,5; Darren A. DeWalt3,5; Brian Erman5; Victoria Hawk5; Kimberly Broucksou5; Crystal Cene3,5; Jia-Rong Wu4; David W. Baker7; Dean Schillinger6; Bernice Ruo7; Kirsten Bibbins-Domingo6; Aurelia Macabasco-O'Connell8; Michael Pignone3,5. 1University of North Carolina at Chapel Hill, Chapel Hill, NC; 2University of North Carolina at Chapel Hill, Chapel Hill, NC; 3University of North Carolina at Chapel Hill, Chapel Hill, NC; 4University of North Carolina at Chapel Hill, Chapel Hill, NC; 5University of North Carolina at Chapel Hill, Chapel Hill, NC; 6San Francisco General Hospital, University of California San Francisco, San Francisco, CA; 7Northwestern University, Chicago, IL; 8University of California Los Angeles, Los Angeles, CA. (Control ID #1314646)
BACKGROUND: Heart failure (HF) self-care programs can improve outcomes, but suboptimal adherence to program components may limit effectiveness. Accurately and feasibly measuring adherence can be challenging. We sought to examine the relationship between adherence to daily weight monitoring and HF hospitalization using both self-reported and diary-recorded measures of adherence.
METHODS: We conducted a prospective cohort study among participants who underwent intensive HF self-care training as part of a 4-site randomized trial. All participants received in-person training followed by ongoing telephone-based support and education over 1 year. All partic-

ipants were given digital scales and instructed to weigh themselves daily, record weights in a diary, and mail diaries back to a clinical educator monthly. In addition, participants were instructed about appropriate responses to significant weight changes, including contacting their provider. Self-reported weight monitoring adherence was assessed at 12 months in all participants with the question: How often do you weigh yourself? Patients who indicated weighing daily or more than once daily were categorized as optimally adherent; those who indicated weighing less frequently than daily were categorized as sub-optimally adherent. Diary-recorded weight monitoring adherence was based on return of weight diaries and dichotomized into80% and<80% adherence to daily weight monitoring over the entire follow-up period to reflect optimal and suboptimal adherence, respectively. We evaluated the outcome of HF hospitalization over 1 year; HF hospitalization was determined by a masked adjudication committee. We used negative binomial regression to examine the relationship between self-reported and then diary-recorded weight monitoring adherence with the incidence of HF hospitalization, adjusted for study site, NYHA class, subjective SES, age, gender, race, literacy, HF related quality of life, systolic dysfunction, chronic kidney disease (GFR<60 mL/min), coronary heart disease, beta-blocker use, and ACE inhibitor or ARB use.

RESULTS: Among 303 participants, we identified 74 HF hospitalizations over 12 months. Participants mean age was 61 years, 52% were male, 32% had NYHA Class III or IV at enrollment, and 39% were African American. At 12 months, 83% of participants who completed a survey (241 of 290) self-reported weighing themselves at least daily and 37% of participants (112 of 303) recorded and returned80% of daily weights. We found that patients with daily or greater self-reported weight monitoring adherence had an incidence rate ratio (IRR) of 1.69 (0.46, 6.21) for HF hospitalizations compared to those reporting less than daily weight monitoring; patients with
80% diary-based weight monitoring adherence had an IRR of 0.21 (95% CI 0.11, 0.37) for HF hospitalizations compared to those with< 80% adherence. Sensitivity analyses lowering adherence thresholds yielded little change in results.
CONCLUSIONS: Daily diary-recorded, but not global self-reported, adherence to weight monitoring was associated with fewer HF hospitalizations. The multiple steps involved in diary-recorded weight monitoring adherence (weighing, recording, and mailing diaries) may identify more rigorous adherence to HF self-management skills. Self-care training programs should incorporate objective measures of weight monitoring adherence to ensure optimal clinical outcomes.
DAILY OPIOID USE, BUT NOT RECENT OVERDOSE, PREDICTS PERCEIVED HEALTH STATUS IN HOSPITALIZED OPIOID DEPENDENT PATIENTS Lidia Meshesha1; Judith Tsui1; Jane M. Liebschutz1; Denise Crooks1; Bradley J. Anderson2; Debra S. Herman2; Michael D. Stein2. 1Boston University Medical Center, Boston, MA; 2Butler Hospital, Providence, RI. (Control ID #1322637)
BACKGROUND: Patients entering addiction treatment generally report low perceived health, suggesting health status contribution to motivation for treatment. However, perceived health status, and its predictors, among those not seeking treatment has not been studied. This study examined the association between drug addiction severity and perceived health status in non-treatment seeking persons with opioid dependence admitted to a general medical hospital. METHODS: Baseline data from 113 subjects in a randomized clinical trial of opioid dependent persons hospitalized for medical or surgical indications. Subjects met DSM-IV criteria for opioid dependence and were not currently engaged in addiction treatment. The primary outcome, perceived health status of good, very good, or excellent, was determined by responses to a single question from SF-12 asking subjects to rate their general health, it was then compared to responses of fair or poor health. Primary predictors of interest were past 1 month
frequency of opioid use (daily v. non-daily) and past 6-month accidental overdose. Multivariable logistic regression models assessed associations between perceived health status and substance use related covariates, adjusting for age, gender, race/ethnicity and alcohol use. RESULTS: Participants were 72% male, had a mean age of 40 years (SD12), 40% Caucasian, 32% African-American and 22% Hispanic. Forty-four percent (44%) of patients reported good or better health. In the past 30 days, 88% reported any use of heroin, and 45% endorsed daily opioid use. Individuals who used opioids daily were significantly less likely to report good or better health status (OR=.30, p=.01; 95% CI: 0.12; 0.75) (Table 1). Recent accidental overdose was not significantly associated with health status (OR=2.3, p=.16; 95% CI:0.71; 7.54). Indeed, among the 20% who reported accidental overdose in the past 6 months 60% indicated having good or better health. There were no significant associations between recent cocaine use or injection drug use and perceived health status.
CONCLUSIONS: Non-treatment seeking opioid dependent patients perceived health status was predicted by daily opioid use but not by recent accidental overdose. Since perceptions of poor health status appear to motivate individuals to engage in treatment, changing perceptions of overdose as a potentially lethal health risk among opioid dependent persons merits further exploration.
Logistic Regression Model Predicting Good or Better than Good Health Status (n=113)
Predictor OR (95% CI) z (p =) Daily Opioid Use 0.30* (0.12; 0.75) -2.59 (.01) Past 30-Day Cocaine Use 1.78 (0.76; 4.19) 1.32 (.19) Past 30-Day IDU 0.53 (0.17; 1.60) -1.12 (.26) Accidental OD Prior 6-Mo. 2.31 (0.71; 7.54)

1.39 (.17)
* Adjusted for age, gender, race and alcohol use
DEAFNES AMONG PHYSICIANS AND TRAINEES: A NATIONAL SURVEY. Christopher Moreland1; Darin Latimore2; Ananda Sen3; Nora Arato3; Philip Zazove3. 1The University of Texas HSC - San Antonio, San Antonio, TX; 2The University of California, Davis, Sacramento, CA; 3The University of Michigan, Ann Arbor, MI. (Control ID #1339453)
BACKGROUND: While the deaf and hard of hearing (DHoH) community, a linguistically diverse population, forms a medically underserved minority in the United States (US), many of this communitys members are seeking healthcare professional training, including as physicians, and are entering the healthcare workforce in increasing numbers, with their training facilitated in part by legal support (e.g., from the Americans with Disabilities Act of 1990, or ADA) and technological advances (e.g., electronic stethoscopes connected to hearing aids). Yet little is known about them or the accommodations they receive under the ADA, how these impact their practice, or the patients they serve. The authors designed this study to describe DHoH physicians and trainees characteristics and accommodations used, as well as their current or anticipated future patient characteristics.
METHODS: The authors created an online survey by focus group and expert review. Eligibility criteria for respondents included being a DHoH medical student, resident physician, or practicing physician. Multi-pronged snowball sampling identified 86 potential participants via physicians professional networks, the American Association on Medical Colleges Group on Student Affairs, and medical schools directly; 56 of these individuals agreed to participate in the survey, which was administered July-September 2010. The primary, descriptive measure was the specific accommodations used by survey respondents, as well as frequency of and situations for use. Secondary measures included accommodation satisfaction, career satisfaction, sense of institutional support of accommodations,
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CONCLUSIONS: A culturally tailored patient navigator program can decrease disparities in breast cancer screening that are present in women refugees from Somalia, the Middle East, and Bosnia.
Mammography rates in Refugee women compared to English /Spanish speaking patients
Year Refugee English p-value
Spanish P-value
likelihood of recommending medicine as a career, and the current/ anticipated DHoH patient population size.
RESULTS: The survey obtained a 65% response rate. Nearly half were trainees (medical students or residents), with a mean age of 37 years; almost all were comfortable with spoken English, while nearly one-third used signed communication. Specific accommodations (e.g., interpreters, captioning) varied widely, but 93% of respondents reported at least one accommodation, while 73% reported using more than one form of accommodation. 64% of physicians and 68% of trainees reported their accommodations met their needs well, although some spent up to 10 hours weekly arranging accommodations. Of practicing physicians, 76% reported primary-care specialties; 31% of trainees planned to enter primary-care specialties. Over 20% of trainees anticipated working with DHoH patients, whereas 10% of practicing physicians did. For practicing physicians, accommodation satisfaction was positively associated with career satisfaction and recommending medicine as a career.
CONCLUSIONS: DHoH physicians and trainees appear satisfied with frequent, multi-modal accommodations from employers and educational institutions. Our results can assist such organizations in planning accommodation provisions. Because DHoH physicians and trainees appear interested in serving DHoH patients as generalist physicians, recruiting and training DHoH physicians has implications for the care of this underserved population as well as the composition of a subset of the US generalist healthcare workforce.
DECREASING DISPARITIES IN BREAST CANCER SCREENING IN REFUGEE WOMEN USING

CULTURALLY TAILORED PATIENT NAVIGATION Sanja Percac-Lima1,3; Barbara Bond4; Jeffrey Ashburner2; Sarah Oo1,3; Steven Atlas2. 1Massachussetts General Hospital, Chelsea, MA; 2Massachusets General Hospital, Boston, MA;
3Massachusets General Hospital, Boston, MA; 4Massachusets General Hospital, Boston, MA. (Control ID #1333593)

BACKGROUND: Refugee and recent immigrant women have low breast cancer screening rates. Patient navigation can improve breast cancer screening in low income, ethnic/racial minorities, but little information is available for refugee women. The objective of this study was to evaluate the effect of a culturally tailored patient navigator program on decreasing disparities in breast cancer screening in refugee women from Africa, the Middle East and Bosnia.

METHODS: Since April 2009, all women who self-identified as speaking Arabic, Somali or Serbo-Croatian (Bosnian) and were eligible for breast cancer screening at an urban community health center, were enrolled in a patient navigator program. Patient navigators were women from the same community who spoke the same language as the patients they served. Patient navigators educated women about breast cancer screening, explored their barriers to screening, and tailored interventions to individual women to help them complete mammography screening. We compared breast cancer screening rates in refugee women to English and Spanish speaking patients receiving care at the same health center over a four year period, starting 1 year prior to the navigator program (2008), using Chi-square tests. RESULTS: Over the 4 year period, there were on average 147 refugee women eligible for breast cancer screening. Among these women, 19% were Somali speaking, 25% were Arabic speaking, and 56% were Serbo-Croatian speaking. Over the same period, there were on average 1555 English and 1494 Spanish speaking women eligible for breast cancer screening at the same health center. In 2008, prior to the start of the navigator program for refugee women, there were marked disparities in mammography screening rates: 35.5% for refugee women compared to58.3% for English and 62.4 % for Spanish speaking patients ($p<0.001$). Over the three years of the patient navigator program, mammography rates increased among all patients, showing an increase of 3.4% for English, and 5.4% for Spanish speaking women and 29.3% for refugee women. As of October 31, 2011, mammography screening rates were similar in all groups, with 64.8% of refugee women screened compared to 61.7% in English and 67.8% in Spanish speaking patients (both $p=0.47$) (Table 1).

2008 49/138
(35.5%)
960/1647(58.3%)
<0.001 942/1510(62.4%)
<0.001
2009 81/151
(53.6%)
963/1599(60.2%)
0.12 1006/1536(65.5%)
0.004
2010 85/156
(54.5%)
936/1560(60.0%)
0.18 1047/1533(68.3%)
0.001
2011* 92/142
(64.8%)
872/1414(61.7%)

0.47 946/1396(67.8%)
0.47
* Through 10/31/2011
DECREASING DISPARITIES IN COLORECTAL CANCER PREVENTION USING A CULTURALLY TAILORED PATIENT NAVIGATOR PROGRAM Sanja Percac-Lima1,3; Lenny Lopez2,4; Jeffrey M. Ashburner2; Alexander Green2; Steven J. Atlas2. 1Massachussetts General Hospital, Chelsea, MA; 2Massachusetts General Hospital, Boston, MA;
3Massachussetts General Hospital, Chelsea, MA; 4Massachusetts General Hospital, Boston, MA. (Control ID #1338780)
BACKGROUND: Despite evidence that reductions in colorectal cancer (CRC) morbidity and mortality can be achieved through early detection and treatment, CRC screening rates are relatively low, particularly in low-income and minority patients. In 2007, a culturally-tailored, multi-faceted CRC screening navigator program was implemented at an urban community health center (CHC) with the aim of increasing CRC screening. We sought to evaluate the impact of the CRC screening patient navigator program on disparities in CRC prevention during the four years of the program.
METHODS: All patients due for CRC screening at the CHC were offered patient navigation (PN). CRC screening rates in patients getting care at the CHC with PN were compared with the CRC screening rates in patients receiving care in the other practices within the same academic primary care network during 2006- 2010 using chi-square tests. CRC screening rates for non-English speaking and Latino patients in these two settings were analyzed separately. To determine whether the rate of increase in CRC screening was greater at the site with PN compared to other practices over the four years, we ran logistic regression models which adjusted for age, gender, race, language, insurance status, and calendar year among all patients. Similar models were also performed comparing non-English speaking patients and Latino patients at the site with PN compared to those at the non-PN clinical sites. Adjusted slopes were calculated by including an interaction term between primary care site and calendar year.
RESULTS: In 2006, before the CRC screening PN program was established,49.2% of all eligible patients at the CHC were up to date for CRC screening compared with 62.5% of patients cared for in other practices. In 2010 the CRC screening rate at the CHC was 69.2%, compared with 73.6% ($p<0.001$) in practices without PN. Non-English speaking patients from the CHC had similar CRC screening rates in 2006 compared to other practices (44.3% vs. 44.7%, $p=0.79$), but higher screening rates in 2010 (70.6% vs. 58.6%, $p<0.001$). Latino patients at the CHC had lower CRC screening rates in 2006 compared to other practices (47.5% vs. 52.1%, $p=0.02$), but had higher screening rates in 2010 (73.5% vs. 67.3%, $p<0.001$). Among all patients, the adjusted rate of increase was higher in patients from the CHC compared to other practices (5.0% vs. 3.4% per year, difference=1.6%, $p<0.001$). Additionally, the adjusted rate of increase was higher in patients from the CHC compared to other practices for non-English speaking patients (6.4% vs. 3.6% per year, difference=2.8%, $p<0.001$) and Latino patients (6.3% vs. 3.8% per year, difference=2.5%, $p<0.001$). CONCLUSIONS: Culturally-tailored CRC screening patient navigator programs can not only increase the overall colorectal screening rates, but can significantly decrease disparities in CRC prevention in vulnerable patients. Long term support of patient navigator programs is a promising method for reducing cancer screening disparities.
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DEFINING PROFESSIONAL ROLES IN AN INTERDISCIPLINARY ENVIRONMENT: THE VACHS CENTER OF EXCELLENCE IN PRIMARY CARE EDUCATION Rebecca Brienza1,2; Emily M.
Meyer1,3. 1VA Connecticut Healthcare System, West Haven, CT; 2Yale University School of Medicine, New Haven, CT; 3Yale University School of Medicine, New Haven, CT. (Control ID #1331785)

BACKGROUND: The Veterans Affairs Connecticut Healthcare System (VACHS) was one of five sites to receive funding to develop a Center of Excellence (COE) in Primary Care Education. The goal of the COE is to build a transformative model of health care professions education. COE teams at VACHS include medicine residents and nurse practitioner fellows who provide shared team care for a panel of patients over 8-week immersion blocks and throughout the year. Through a curriculum of interprofessional clinical care months, health policy seminars, facilitation, and shared decision making training, the COE offers trainees an innovative approach to post-graduate medical education. The goal of this project was to elicit trainees attitudes towards this approach to training prior to entering the COE.
METHODS: A qualitative methodologist conducted semi-structured interviews with COE trainees between September and December 2011 (n =9). Interviews were audiotaped, transcribed verbatim, and de-identified. The transcripts were topic-analyzed and iteratively coded using the qualitative data analysis software program, Atlas.ti. Using the constant comparative method of Glaser and Strauss Grounded Theory, textual data underwent three rounds of reduction. Any coding ambiguities were resolved by project staff prior to embarking on the next phase of analysis. Through a process of conceptual mapping and code refinement, major themes and domains of experience were identified and documented. RESULTS: COE trainees are eager to learn and care for patients in an interprofessional team environment: There's a high demand for physicians and it is important to bring in other people from different perspectives, other professions like PAs, NPs it's really necessary to optimize patient care. Despite this, resident trainees were unfamiliar with the roles and scope of practice of their nurse practitioner trainee colleagues. Several residents could not articulate what a nurse practitioner actually does (I think that, I mean, we just know that they are there and we don't really know what they do. I mean that's the truth). Nurse practitioner fellows, on the other hand, saw their own role in accordance with their physician peers scope of practice: (I think that nurse practitioners are immediately more open to the various things that affect a person's health in a much broader realm). Every participant agreed that a transformation from silo to team models of health professional training was necessary to meet the needs of the current health care system and improve patient outcomes.
CONCLUSIONS: The VACHS COE offers health care professional trainees an opportunity to learn and care for patients in a team based interdisciplinary environment. This model is in contrast to the typical silo model of post-graduate health professional education. Our findings suggest an initial lack of interprofessional understanding between medical and nursing models. However, the philosophical differences, potential challenges, and role ambiguities noted by trainees demonstrate the need for this type of training. It is imperative that trainees talk openly about their roles, relative contributions, strengths, and weaknesses early on in their professional development. Only then can they begin to work together to provide excellent patient-centered care and optimize patient safety and clinical outcomes.

DEMENTIA IS INDEPENDENTLY ASSOCIATED WITH A HIGHER 30-DAY HOSPITAL READMISSION RATE

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6Healthcentric Advisors, Providence, RI. (Control ID #1339460)

BACKGROUND: Individuals with dementia have high healthcare utilization and are at increased risk for hospitalization, but it is unknown if their 30-day readmission rates are higher than in people without dementia. Dementia is frequently co-morbid with the discharge diagnoses targeted by CMS for improvement in 30-day readmission rates, and as our population ages, understanding the role of dementia will be increasingly important. Our objective was to investigate the association between a diagnosis of dementia and the risk of hospital readmission within 30 days of discharge in a cohort of Medicare beneficiaries.
METHODS: We performed a retrospective cohort study to examine Medicare Fee for Service beneficiaries who

were admitted to any Rhode Island hospital between January 2009 and December 2009. Index and subsequent hospital admissions were identified through Medicare hospital claims data. A diagnosis of dementia was identified by either 1) an ICD-9 code for dementia from Medicare Part A or Part B claims or 2) documentation of 2 or more prescriptions for medications used to treat dementia from Medicare Part D pharmacy claims. The odds of 30-day readmission were calculated using conditional logistic regression, controlling for age, gender, race, antipsychotic use, number of comorbidities, dual eligible status, length of stay of index admission, number of admissions in the previous year, and hospital of index admission.
RESULTS: From a cohort of 25,839 hospitalized patients, we identified 3,908 patients with dementia. Patients with a dementia diagnosis were older (mean age (SD), 81.0 (11.7) vs. 72.4 (14.5) years; p<0.0001), were more likely to be female(62.4% vs. 55.0%; p <0.0001), and had more comorbid illnesses (3 comorbidities; 28.1% vs. 25.3%; p<0.001) than those without a dementia diagnosis. Nearly 20% of the cohort (N=5,133) was readmitted within 30 days of the index hospitalization. Compared to Medicare beneficiaries without a dementia diagnosis, those with dementia were more likely to be readmitted within 30 days, even after adjusting for potential confounders (adjusted odds ratio, 1.18; 95% CI, 1.08 - 1.29).
CONCLUSIONS: Medicare Fee for Service beneficiaries with a dementia diagnosis are at increased risk for 30-day hospital readmission. Much of the recent research aimed at decreasing 30-day readmission rates excludes patients with cognitive impairment or focuses on self-management and patient activation, which may not be as effective in patients with dementia. Given the high healthcare costs and negative health outcomes associated with acute hospitalization in people with dementia, our findings have important implications for quality improvement efforts to decrease readmission rates in elderly, hospitalized patients.
DEMOGRAPHIC ANALYSIS OF CLINICA ESPERANZA, A STUDENT-RUN FREE CLINIC IN MEMPHIS, TN
Sumeet S. Vaikunth; Whitney Cesari; Mukta Panda; J. B. Lewis. University of Tennessee, Chattanooga, TN.
(Control ID #1276087)
BACKGROUND: Census data show that Memphiss Hispanic population increased from 3.0% to 6.5 % from 2000 to 2010. To serve the growing uninsured Hispanic population, medical students with faculty sponsor Alicia McClary, PhD, at the University of Tennessee Health Science Center (UTHSC) began Clinica Esperanza in 2005. The clinic runs Wednesday evenings at Christ Community Health Center on Broad Avenue. This study aims to identify the clinic's patient demographics and health issues. METHODS: A retrospective chart review of patient files from 2005 through 2010 was undertaken, as approved by UTHSCs Institutional Review Board. RESULTS: From 2005 through 2010, Clinica Esperanza fielded 2,551 patient visits, comprised of 951 patients, 609 females and 342 males. Mean age was 34 years. 60% of patients presented once, while 13% followed up for 1 year, 9% for 2 years, 6% for 3, 6% for 4 and 4% for 5. Pap smear, abdominal pain and follow-up lab results ranked as the three most frequent presenting issues, respectively. Womens health accounted for 19% of patient visits, followed by HEENT (14.5%), health maintenance (12%), gastrointestinal (9.5%) and musculoskeletal (9.2%) complaints. 65% reported length of time in Memphis-14% had lived in Memphis less than 1 year, 8% for 1 year, 13% for 2 years, 13% for 3 years, 12% for 4 years, 10% for 5 years and 32% for more than 5 years. 72% reported marital status- 61% were married and 36% were single. 73% reported country of origin-70% were from Mexico, 11% from Honduras, 8% from Guatemala and 5% from El Salvador. 50% reported occupation-31% worked in construction/ landscaping, 28% in factories/ warehouses and 16% in cleaning/housekeeping. 24% reported educational attainment- 19% attended elementary school, 27% middle school, 49% high school and 6% college. CONCLUSIONS: Based on these demographics of the clinics population, improvements in health care services can be made, including better continuity,

emphasis on gynecologic services and provider education in medical Spanish. Thus a medical Spanish elective has been created, and the clinic has been open for the entirety of 2011. Future plans include on site pharmacy, smoother referrals, and new clinics on UTHSCs other campuses.

DEPRESSION AND INCREASED ASTHMA MORBIDITY IN THE ELDERLY: POOR ADHERENCE MAY BE A KEY FACTOR Katherine Krauskopf1; Anastasia Sofianou1; Melissa Martynenko1; Mita Goel2; MichaelS. Wolf2; Ethan Halm3; Howard Leventhal4; Jonathan Feldman5; Alex Federman1; Juan P. Wisnivesky1. 1Mount Sinai School of Medicine, New York, NY; 2Northwestern University, Chicago, IL; 3UT Southwestern, Dallas, TX; 4Rutgers, The State University of New Jersey, New Brunswick, NJ;
5Yeshiva University, Albert Einstein School of Medicine, New York, NY. (Control ID #1338700)
BACKGROUND: Asthma is a growing cause of morbidity and mortality for elderly urban Americans. The impact of depression, a common comorbidity in the elderly, on asthma morbidity is unknown. We sought to determine the association between depression and asthma outcomes in a cohort of older urban asthmatics and to assess if this relationship would be mediated, in part, by adherence.
METHODS: Asthmatics 60 years of age were recruited from two hospital-based primary care clinics in New York City and Chicago for this prospective cohort study (n=317). Data was obtained through standardized English or Spanish interviews. Depression was evaluated using the Patient Health Questionnaire (PHQ-9); patients were classified as depressed if they had a PHQ9 score of 10. Outcomes included asthma control (Asthma Control
Questionnaire), quality of life (Asthma Quality of Life Questionnaire), medication adherence (Medication Adherence Report Scale), and asthma-related acute resource utilization at baseline. Multiple regression adjusting for sociodemo-graphics (age, sex, race, income) asthma history (years with asthma, past intubation) and comorbid conditions (diabetes, hypertension, congestive heart failure) was used to evaluate the association of depression with these outcomes. RESULTS: The mean age of subjects was 67.46.6 years; 83% were female, 33% were Black and 30% Hispanic. A third of all subjects were college graduates. Overall, 17% had symptoms of depression. In unadjusted analyses, depressed subjects were more likely to have inpatient resource utilization (odds ratio [OR] 2.03, 95% confidence interval [CI] 1.043.99), worse asthma control (mean difference: 1.010.16, p<0.0001) and lower asthma-related quality of life (mean difference: 1.41.8, p<0.0001). The presence of depressive symptoms was also associated with poorer medication adherence (OR 0.23, 95% CI 0.100.52). Similarly, in adjusted analyses, depressed subjects were more likely to have worse asthma control (mean difference: 0.870.17, p<0.0001) and lower asthma-related quality of life (mean difference: -1.220.18, p<0.0001). Poorer asthma medication adherence (OR 0.18, 95% CI 0.060.51) was also associated with depression in adjusted analysis.
CONCLUSIONS: Depression is a risk factor for increased asthma morbidity and poorer quality of life in elderly patients. Our results indicate that medication adherence may mediate, in part, these findings. Further studies examining self-management behaviors and self-efficacy in this population might elucidate the mechanism underlying this association and suggest possible targets for effective interventions.
DEPRESSIVE SYMPTOMS ARE RELATED TO PERCEIVED BUT NOT OBJECTIVE SEVERITY OF HEART FAILURE Bruce L. Rollman; Bea Herbeck Belnap; Fanyin He; Sati Mazumdar; Charles F. Reynolds. University of Pittsburgh, Pittsburgh, PA. (Control ID #1340613)
BACKGROUND: Heart failure (HF) affects over 5.7 million Americans with over 660,000 newly diagnosed cases and 277,000 deaths annually, and is the only major cardiovascular disease whose mortality rate has remained essentially unchanged over the past decade despite advancements in care. One potential cause of these persistently poor outcomes is depression which is present in 16-38% of hospitalized patients with HF, and strongly linked to poorer adherence with HF treatment regimens and increased risk of cardiovascular morbidity and mortality. Physicians may have difficulty recognizing depression in HF patients as the symptoms of these conditions can overlap (e.g., fatigue, disordered sleep). Patients may therefore be harmed if initiation of effective depression treatment is
delayed pending adjustments in HF pharmacotherapy and additional tests ordered to treat symptoms that are, in fact, due to the underlying depressive episode. Therefore, we examined the relationship between mood

symptoms and with objective and subjective measures of HF severity to guide physicians caring for these patients and to highlight the impact of co-morbid depression. METHODS: Over a 16-month period ending 4/09, two trained study nurses screened and enrolled 471 patients from 4 Pittsburgh-area hospitals with: (a) systolic HF (left ventricular ejection fraction (EF) <40% confirmed objectively by cardiac catheterization, echocardiogram, or MUGA); and (b) New York Heart Association (NYHA) functional class II-IV symptoms by subjective patient self-report prior to discharge. They collected sociodemographic and clinical information by patient self-report and chart review, and administered the PHQ-9 to assess the 9 cardinal symptoms of depression described in DSMIV. We used scatterplots and Pearson correlation coefficients to determine the association of EF with: (a) total PHQ-9 score; (b) somatic subscale (psychomotor, sleep, appetite, fatigue); and (c) cognitive subscale (mood, anhedonia, wothlessness, concentration, suicidal ideation) symptoms of depression. We also used Fischers exact test to calculate a P-value for the association of NYHA class with: (a) total PHQ-9 score; and (b) EF. RESULTS: The 471 enroled patients had a mean age of 66 (range 23-93) and 65% were male, 85% White, 41% diabetic, and they had a mean EF of 26% (SD: 7.6) and mean PHQ-9 score of 9.6 (SD: 5.2). EF was neither associated with total PHQ-9 score nor with the somatic or cognitive subscales (all R-squared<0.0002). Moreover, while EF was similar across perceived severity level of HF symptoms as categorized by NYHA class, greater perceived HF severity was associated with higher mean PHQ-9 score (Table). CONCLUSIONS: Severity of depressive symptoms is associated with perceived but not objective severity of HF. Patients whose HF symptoms are out-of-proportion to the objective severity of their disease and those whose symptoms fail to respond to appropriate medical therapy for HF should be screened for depression. Physicians caring for HF patients expressing mood symptoms should not delay initiation of appropriate therapy for depression as effective treatment can reduce symptom amplification and improve health-related quality of life.

NYHA Class II (N=183)
III (N=178) IV (N=110)
P
EF, mean (SD) 26.4 (7.5) 25.0 (7.3) 25.7 (8.3) 0.25 PHQ-9 score, mean(SD)
7.7 (5.1) 9.8 (4.8) 12.6 (4.7) <0.0001

DESIGN AND EVALUATION OF A MULTI-DISCIPLINARY WEB-BASED HANDOFF TOOL Jeffrey L. Schnipper1,2; Andrew S.
Karson3,2; Susan K. Morash4; Brett Glotzbecker6,2; Marsha J. Milone7; Deborah S. Yolin Raley6; Nyryan V. Nolido1; Jan Horsky8,1; Laura Leinen8; Ishir Bhan5,2; Christian Dankers3,2; Kendra L. Church6; JacquelynA. Minahan1; Catherine Yoon1. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Massachusetts General Hospital, Boston, MA; 4Massachusetts General Hospital, Boston, MA; 5Massachusetts General Hospital, Boston, MA; 6Brigham and Women's Hospital, Boston, MA; 7Brigham and Women's Hospital, Boston, MA;
8Partners Healthcare, Boston, MA. (Control ID #1336148)

BACKGROUND: Failures in communication among healthcare personnel during intra-hospital handoffs in care are known threats to patient safety. In August, 2009, our healthcare system held a multi-stakeholder summit on handoffs, developed consensus around the need for a system-wide electronic handoff tool, and recommended a pilot study to develop and evaluate this technology.

METHODS: We adapted a web-based, multi-disciplinary handoff tool used by a single residency program. Enhancements to the existing tool included: 1) implementation at a second hospital in our system; 2) support for simultaneous handoffs by nurses, residents/PAs, and attendings with shared information among the different roles; 3) custom structured templates for each user group; and 4) the ability to create progress notes and multiple sign-out forms from the same core data. The tool was refined and tested on a general medicine teaching service at one hospital and a hematologic malignancy PA service at the other.

For 3 months pre-intervention and 4 months post-implementation, we surveyed receivers of handoffs regarding continuity of care and evaluated signout content using explicit criteria. We also conducted formal usability testing using simulated cases. We conducted principal components analysis to derive categories from the survey questions and create composite scores for each category.
RESULTS: We received survey responses from 315 clinicians (66% response rate). In a pre-post analysis, 2 of 5 composite scores improved: perceived negative impact of handoff on clinical information and decision-making (composite score 14.7 pre, 10.2 post, p=0.01), and negative subjective rating of handoff quality and accuracy (28.4 vs. 25.8, p=0.01). Among survey questions to nurses, 10 improved, including an increase in how well handoffs prepared them for things that might go wrong (47.3 vs. 65.2, p=0.01). In the explicit review of written sign-outs, inclusion of 5 data elements (e.g., % tasks with if/then statements) increased, but decreases were noted in other data elements. Usability testing revealed a tension between desire for a clinical narrative and the use of structured template fields.
CONCLUSIONS: A multi-disciplinary, web-based sign-out tool was able to increase subjective measures of sign-out quality and impact on clinical decision-making, particularly among nurses. Much of the improvement may have come from the ability to produce both a progress note and sign-out with one tool, which led to more frequent updating of sign-outs and greater faith in their accuracy. The use of customized templated fields was inconsistent and suggests that these should be minimized to those most necessary for continuity of care. Greater improvements in care may require further enhancements in usability of the tool, training in use of the tool, and education in best practices in handoffs in care.
DETECTING AND MEASURING DEPRIVATION IN PRIMARY CARE: DEVELOPMENT, VALIDITY AND RELIABILITY OF A SELF-REPORTED QUESTIONNAIRE - THE DIPCARE-Q Paul Vaucher1,2; Thomas Bischoff3; Esther-Amlie Diserens1; Lilli Herzig3; Giovanna Meystre-Agustoni4; Francesco Panese5; Bernard Favrat1; Catherine Sass6; Patrick Bodenmann1. 1University of Lausanne, Lausanne, Switzerland; 2University of Geneva, Geneva, Switzerland; 3University of Lausanne, Lausanne, Switzerland; 4University of Lausanne, Epalinges, Switzerland; 5University of Lausanne, Lausanne, Switzerland; 6Centres d'Examens de Sant, St-Etienne, France. (Control ID #1317320)
BACKGROUND: General practitioners play a central role in taking deprivation into consideration when caring for patients in primary care. Social environment and the subjective social and individual conditions of life affect health by enhancing stress and diminishing material means to fight against affections. Validated questions to identify deprivation in primary-care practices are still lacking. For both clinical and research purposes, this study therefore aims to develop and validate a standardized instrument measuring both material and social deprivation at an individual level.
METHODS: The Deprivation in Primary Care Questionnaire (DiPCare-Q) was developed using qualitative and quantitative approaches between March 2008 and April 2011. A systematic review identified 199 questions related to deprivation. Using judgmental item quality, these were reduced to 38 questions. Two focus groups (primary-care physicians, and primary-care researchers), structured interviews (10 laymen), and think aloud interviews (eight cleaning staff) assured face validity. Content validity was evaluated by six experts in the field of social medicine, and 17 primary-care physicians. Item response theory analysis was then used to derive the DiPCare-Q index using data obtained from a random sample of 200 patients. Patients completed the questionnaire a second time over the phone three days later to enable us to assess reliability. For construct and criterion validity, the final 16 questions were administered to a random sample of 1,898 patients attending one of 47 different private primary-care practices along with questions on subjective social status (subjective SES ladder), education, income, and welfare status.

RESULTS: Deprivation was defined in three distinct dimensions; material deprivation (eight items), social deprivation (five items) and health deprivation (three items). Item consistency was high in both the derivation (KR20=0.827) and the validation set (KR20=0.778). The DiPCare-Q index was reliable (ICC=0.847), and items were relevant (Table). The DiPCare-Q index was correlated to patients estimation of their position on the subjective SES ladder (rs=0.539).
This position was correlated to both material and social deprivation independently suggesting two separate mechanisms enhancing the feeling of deprivation.
CONCLUSIONS: The DiPCare-Q is a rapid, reliable and validated instrument useful for measuring both material and social deprivation in primary care. Compared to commonly used socio-economic determinants, these questions are better social indicators of patients perceptions of themselves. Questions from the DiPCare-Q are easy to use when investigating patients social history and could improve clinicians ability to detect underlying social distress related to deprivation.
Deprivation determinants used in the DiPCare-Q.

DETERMINANTS OF READINESS FOR PRIMARY CARE-MENTAL HEALTH INTEGRATION (PC-MHI) IN THE VA HEALTH CARE SYSTEM Evelyn Chang1; Danielle Rose2; Elizabeth M. Yano2; Kenneth Wells3,4; Martin Lee2; Lisa V. Rubenstein2,4. 1VA- Greater Los Angeles, Los Angeles, CA; 2VA HSR&D Center of Excellence for the Study of Healthcare Provider Behavior, North Hills, CA; 3UCLA, Los Angeles, CA; 4RAND, Santa Monica, CA. (Control ID #1311610)
BACKGROUND: Substantial evidence demonstrates the value of primary care-mental health integration (PC-MHI) to improve patient outcomes. While several evidence-based models exist, the readiness of practices to adopt them has not been well-studied. In 2006, the VA endorsed three different PC-MHI approaches: (1) co-located collaborative care, where mental health services are offered in PC, (2) a care manager-based depression collaborative care intervention called TIDES, and (3) a computer-assisted screening intervention for depression/alcohol/anxiety called Behavioral Health Laboratory (BHL). METHODS: We examined variations in the adoption rates for these PCMHI approaches in relationship to organizational readiness factors in VA clinics. In this cross-sectional study of the 2007 VA Clinical Practice Organization Survey (n=225), we assessed adequacy of resources, motivation for change, staff attributes, and organizational climate for each clinic. The survey included the level of implementation for each PC-MHI approach. We performed bivariate analyses for each readiness variable by each PC-MHI approach. We then constructed separate multivariate models for PC-MHI approaches with sufficient sample size.
RESULTS: By 2007, 107 (47.5%) clinics had implemented co-located clinics, 39 (17.3%) had implemented TIDES, and 17 (7.6%) had implemented BHL. In bivariate analyses, PC clinics with psychologists or psychiatrists, greater financial sufficiency and greater spatial sufficiency were significantly more likely to implement BHL. Multivariate analyses largely confirmed bivariate RESULTS: clinics with established processes for quality improvement (OR 2.30, 95% CI [1.36, 3.87], p=0.002) or a depression clinician champion (OR 2.36, [1.14, 4.88], p=0.02) were more likely to adopt co-location. Clinics with greater IT sufficiency (OR 1.61,[0.97, 2.67], p=0.07) or located in VA regional networks that had endorsed TIDES (OR 8.42, [3.69, 19.26], p<0.001) were more likely to adopt TIDES.
CONCLUSIONS: Adoption of each PC-MHI approach was associated with different readiness factors. Better understanding of local readiness factors may be used to improve the match between PC-MHI approaches and local site resources.
DEVELOPING FEMALE ACADEMIC LEADERS: OUTCOMES OF THE VA WOMENS HEALTH FELLOWSHIPS 1995-2011. Sarah A. Tilstra1,2; Melissa McNeil1,2; Doris Rubio2. 1UPMC/VAPHS, Pittsburgh, PA; 2University of Pittsburgh, Pittsburgh, PA. (Control ID #1322148)
BACKGROUND: While some progress has been made in allocating research grants and administrative

positions to women the medical community remains dissatisfied with the low proportion of female academic leaders. The VA has been a pioneer in developing academic leaders in womens health, many of whom are women, by instituting the VA Womens Health Fellowships (VAWHF). These programs have never been evaluated to determine if these fellowships are producing female academic leaders. The objectives of this study are to describe the career outcomes of female graduates of the VAWHF in terms of academic productivity, leadership roles, and clinical practices in womens health. METHODS: In this cross-sectional survey study, all graduates of the VAWHF from 1995-2011 identified by the VA central office were eligible for participation. A 60-item survey consisting of multiple choice, short answer and Likert scale questions was developed to assess employment and academic advancement. Contact information was obtained for 80 graduates from current program directors, PubMed and the internet. Graduates received a letter or email inviting them to participate in this survey, which were completed online using REDCap electronic data capture tools hosted at the University of Pittsburgh. Preliminary results were analyzed with descriptive statistics. RESULTS: Twenty-five (31%) graduates have responded to date. Average age was 40 yrs, average time post-fellowship was 8 yrs, 96% were female, and 64% have obtained an advanced degree during fellowship (MS in Research (44%), Public Health (19%), Education (19%), or Epidemiology (13%)); one pursued a PhD. Most graduates were trained in internal medicine (80%). For female graduates, 79% currently hold academic positions with 47% on a tenure track. Eighty percent have held a position in a teaching setting. Clinician educators represent 38% of graduates, 38% are clinician researchers, 13% are clinicians, 5% are administrators, and 5% fill other academic roles. Seventy-five percent practice womens health and of these, 85% teach womens health to trainees. Graduates show a high rate of productivity for academic activities including successful grant funding (88%), published peer reviewed article (76%), presented at national meeting (96%), curricular development/evaluation (64%), and received teaching/research award (56%). All academic graduates <5 yrs in training are assistant professors. Associate professors comprise 10% of graduates 5-10 yrs in training. Of graduates >10 yrs in training, only 25% have achieved associate professor status without any obtaining professorship. Sixty percent of graduates have obtained administrative/leadership roles in primary medical education (31%), residency/fellowship (20%), division/section (27%), and clinical settings (27%). CONCLUSIONS: The VAWHF Program has been successful in training leaders in womens health while producing exceptional female role models in academic medicine. These graduates are likely to stay in academics, practice and teach womens health, and have a high rate of productivity and achievement of leadership positions. However, the rate of academic promotion is slow. This may be due to the phenomenon of late-peaking academic careers for female graduates due to family rearing or part-time work, which were not assessed in this study. The unique elements of the VAWHF that have made it successful bear further scrutiny and may serve as a template for future development of female leaders in academic medicine.

DEVELOPING A COMMUNITY OF PRACTICE USING AN HIV TREATERS MEETING David Feldstein1; Marge Sutinen1; Julie Yendrek1; Barbara E. Cuene2; Raymond G. Bachhuber1; Peter L. Havens3,2; Iram Nadeem3; James M. Sosman1. 1University of Wisconsin School of Medicine and Public Health, Madison, WI; 2Children's Hospital of Wisconsin, Milwaukee, WI; 3Medical College of Wisconsin, Milwaukee, WI. (Control ID #1320004)

BACKGROUND: The development of new therapies and longer life expectancies has led to increased complexity in HIV infection management. Low-volume HIV providers find it difficult to keep up with changes in care and often feel isolated. The HIV Treaters Meeting is a monthly, 1-hour, case based conference. The Meeting links five sites throughout Wisconsin via videoconference. Two cases are discussed at each meeting. Clinicians present cases for discussion and seek input from attendees on treatment decisions. Our objective was to evaluate the HIV Treaters Meeting to determine its impact on patient care and as a community of practice.

METHODS: The evaluation consisted of three components: 1) presenter pre and post-meeting questionnaires; 2) attendee session evaluation questionnaires; 3) a web-based questionnaire. Case presenters received pre-

meeting questionnaires asking them to identify specific patient questions they wanted answered. Six weeks after the Treaters Meeting they were sent a post-meeting questionnaire and reported if their patient questions were answered satisfactorily and the effect of the meeting on their patients treatment. Attendees completed session evaluation questionnaires between March 2010 and May 2011 at the end of each Treaters Meeting. Attendees rated aspects of the meeting on a 5-point Likert scale and provided free text answers describing what they would do differently as a result of the meeting. The web-based questionnaire was sent to all 132 people who attended a Treaters Meeting between September 2009 and November 2010. For the evaluation, all categorical answers and Likert scales were analyzed using descriptive statistics and all free text answers were analyzed using content analysis.
RESULTS: Twenty three cases were presented at 13 Treaters Meetings. Eighteen presenters (78%) answered the pre-meeting questionnaire and eleven (48%) answered both pre and post-meeting questionnaires. The 11 presenters had 29 of their 30 patient care questions answered to their satisfaction. The meeting changed the treatment plan for two patients and confirmed the treatment plan for the nine others. Meeting attendees

completed 523 session evaluation questionnaires. The average overall rating for the meetings was 1.68 (SD 0.69) (1=excellent to 5=poor). Major themes of the effect on attendees practice include changes in screening or testing, changes in patient counseling, changes in therapy, increased collaboration for patient care and system changes. Fifty-six people (42%) completed the web-based survey. Forty seven (84%) of those completing the survey reported the meeting introduced them to new experts in HIV care. Forty four (78%) reported that they would contact experts from the meetings with clinical questions. Twenty six (47%) had contact with other meeting attendees outside of the meetings with the majority for patient care and patient resources. Forty seven (84%) felt that the Treaters Meetings have improved the patient care they provide. One respondent described how the meeting made them aware of a problem their system had with collecting HIV RNA samples that led to a system wide process change. CONCLUSIONS: The HIV Treaters Meeting has successfully established a community of practice with attendees who share a passion for HIV care and their patients receive improved care because of the interaction. Attendees interact outside of the meeting providing a venue to support low volume HIV treaters. We will identify ways to expand the program in the future.
DEVELOPING AN INTERDISCIPLINARY PRIMARY CARE TRAINING PROGRAM: PRE-PROGRAM ASSESSMENT OF PERCEPTIONS OF INTERNAL MEDICINE RESIDENTS AND NURSE PRACTITIONER STUDENTS Theodore Long1,2; Ali
Khan1,2; Rebecca Brienza1,2. 1Yale University, New Haven, CT; 2VA Connecticut Healthcare System, West Haven, CT. (Control ID #1310517)
BACKGROUND: In 2010, the Veterans Administration (VA) Office of Academic Affiliations funded five sites to establish Centers of Excellence (COE) in Primary Care Education. These programs were charged with transforming health-care professional training by developing new inter-professional educational training models. During the development of our COE, we sought to understand internal medicine resident and nurse practitioner perceptions about their current training as well as level of interest in participating in this new model.
METHODS: We developed two surveys focused on eliciting perspectives of internal medicine residents and nurse practitioner students about current education models. The resident survey included Likert scale questions about the trainees primary care experience, in addition to a qualitative section about interdisciplinary education and level of trainee interest in participating in our program. The survey was sent to residents of the Yale Traditional Internal Medicine Residency Program (~60 residents), with 30 surveys being returned. Means were calculated from the Likert scale questions, and the qualitative data was evaluated for common themes. We administered a similar survey to a random sample of nurse practitioner students at Fairfield University School of

Nursing (approximately 30 students) with 14 surveys being returned.
RESULTS: Among the residents who responded to the survey, the mean score on a scale of one to five (1=not at all confident, 5=very confident) regarding their level of confidence about their primary care education was4.0. The mean score regarding perception of preparedness for practicing team based ambulatory care was 3.8. Residents most commonly indicated that the need for inter-professional training is a current reality and a future direction of primary care. The qualitative data revealed a common theme that the primary care ambulatory experience could be most improved by including more continuous experience in the ambulatory clinic setting. Among the nurse practitioner students, the mean response of confidence in providing outpatient care at time of graduation was 3.14. The majority of nurse practitioner students (71%) reported that they would be interested in completing a one year post-graduate fellowship in primary care. CONCLUSIONS: The majority of medical residents indicated that primary care education would be improved through increased experience in the ambulatory setting, and that interdisciplinary training and care is important to the future direction of primary care. The majority of nurse practitioner students indicated that they were modestly confident about providing independent outpatient care at the time of graduation, but the majority demonstrated an interest in completing a primary care post-graduate fellowship including interdisciplinary education and team care. These surveys were utilized to inform the development of the VACHS COE in Primary Care Education.
DEVELOPMENT AND DISSEMINATION OF NEW PHYSICIAN DECLARATION IN POST HIPPOCRATIC ERA.
Seiji Bito; Shinji Matsumura. NHO Tokyo Medical Ceter, Tokyo, Japan. (Control ID #1315848)
BACKGROUND: "Medical Professionalism in the New Millennium: A Physician Charter" precisely describes the attitudes and behavior expected of modern physicians and has been accepted in many countries as a new set of standards. We aimed at the development of new physician declaration that support the everyday activities of physicians in modern society. METHODS: Research Design: Action Research Development process: The development process involved the following steps. STEP 1. First, we established web page to facilitate development of the declaration document. We conducted open brainstorming using Twitter for recruitments of candidate declarations. Every tweet should be started with I will and had hashtag ishisengen (means physician declaration in Japanese). STEP 2. The development committee were consist of 7 physicians and 4 non MD advisers. After discussions regarding the basic concepts underlying the declaration, the 11 members selected statements they individually felt should be either included in the final draft, consolidated with other declarative statements, or omitted from the final prospective declaration. STEP 3. A publicly advertised World Caf session was held, in which the content was carefully examined and prospective items were selected. STEP 4. Core members selected final candidate statements based on the results of the World Caf session. STEP 5. After the prospective items were displayed on the homepage and Facebook fanpage, a public vote was held using the Facebook voting function. STEP 6. By incorporating the results of the vote, the core members and advisers established a final declarative statement. To disseminate the declaration after it was finalized, medical professionals who approved of actions based on the declaration were able to register on the homepage as followers by interfacing with the profile function on Facebook.
RESULTS: In STEP 1, 235 initial statements were collected and classified into 4 broad categories and 12 subcategories. In STEP 2, the 63 items that received scores of 5 or more points were shortlisted. The breakdown showed that 36 items received 10 or more points and 27 items received 5-9 points. These items were classified into 5 categories: (1) questioning ones motives, (2) confronting risk and uncertainty, (3) considering the interests of the patient, (4) doing ones best while being aware of ones limitations, and (5) accepting others and conducting introspection. The 12 items included in the new physicians declaration were ultimately established as a result of the processes in STEPS 3-6. These items included the following: I, will not forget that medical practice may harm the patient at any time. If unfortunately an event of a serious side effect occurs to the patient, I will continue to sincerely confront the sorrow of the patient and the family.I, will say "thank you" in voice, when patients and colleagues had helped out. Also when a colleague close by is about to

break down, I will ask "what happened?" and listen. One month after the declaration was made public, 625 Japanese medical professionals became followers of the declaration. CONCLUSIONS: This declaration for a new generation of physicians encompasses doctors relationships with patients, potential harm during treatment, and diverse outcomes. The process of creating the declaration prompted the interest, involvement, and understanding of many medical professionals.

DEVELOPMENT AND IMPLEMENTATION OF A PATIENT ADVISORY GROUP IN A STUDENT-RUN FREE CLINIC Devora Aharon; Yasmin S. Meah; Linda Wang; Temitope P. Awosogba; Matthew Spinelli; Laura Belland; David C. Thomas. Mount Sinai School of Medicine, New York, NY. (Control ID #1333736)

BACKGROUND: Clinics that aim to provide patient-centered care should offer venues to elicit patient feedback and increase patient investment in self-care. The time and resource limitations of a student-run free clinic, however, may hinder the ability to provide a patient-driven clinical experience. To increase patient involvement in our clinic operations, the East Harlem Health Outreach Partnership (EHHOP) established a Patient Advisory Group (PAG) consisting of patients invested in improving the quality of care at EHHOP. Composed of three meetings per year, the goals of the PAG are as follows: 1) to

improve EHHOPs patient-centered services, 2) to empower patients to take a more active role in their clinic experience, 3) to foster relationships among fellow patients, and 4) to cultivate dialogue and promote collaboration between patients and students.

METHODS: All patients who visited clinic in the weeks prior to each PAG meeting were invited to participate, and about 30 patients expressed interest in participating. The first meeting took place in May 2011, the second in November 2011, and the third meeting will take place in January 2012. 5 patients and 3 student moderators participated in the first session, and 8 patients and 4 student moderators were present at the second. Both sessions were conducted in English and Spanish and audio taped. Conversation was participant-driven, with student-moderators facilitating discussion through open-ended questions.

RESULTS: Feedback revealed key themes around wait-times, navigation of referrals, and patient-clinician relationships. Participants offered creative, realistic solutions to streamline clinic flow and improve patients understanding of their treatment plans and referrals. Participants also agreed to serve as patient-liaisons who will publicize the results of the PAG to fellow patients and encourage their participation in future feedback sessions. A number of patient complaints addressed issues that student-clinicians were already working to improve, indicating that patients and clinicians concurred on areas in need of improvement. Changes already implemented in response to PAG feedback include streamlining the phone system; creating a welcome guide for patients; utilizing downtime in clinic to conduct benefit screening and patient education; and instituting patient-navigators to assist patients through a complex referrals process. CONCLUSIONS: A Patient Advisory Group can provide a means for clinics to generate insightful feedback and suggestions from patients about clinic operations, policies and quality-improvement measures. Furthermore, it has the potential to strengthen patient-clinician partnerships, create patient-patient partnerships and promote patients investment in their own care. Finally, the institution of a PAG at a student-run free clinic helps train students to foster a patient-centered approach in a healthcare delivery system.

DEVELOPMENTAND VALIDATION OFA PREDICTIVE MODELTO IDENTIFY PATIENTS WHO PHYSICIANS DEFINE AS COMPLEX Clemens S. Hong; Yuchiao Chang; Richard W. Grant; Jeffrey M. Ashburner; Timothy Ferris; Steven J. Atlas. Massachusetts General Hospital, Brookline, MA. (Control ID #1340103)

BACKGROUND: Health system redesign efforts increasingly focus on patients with complex health needs. The ability to prospectively identify patients defined as complex by their primary care physician (PCP) using available electronic data sources may allow health systems to better allocate resources and tailor programs to improve patient care and

physician experience. We previously characterized physician-defined complexity and described associated

factors. Here we develop and validate a predictive model for physician-defined complex patients. METHODS: 40 PCPs from 12 primary care practices in the Massachusetts General Hospital Practice-based Research Network reviewed a random sample of 120 of their own patients. After excluding patients for whom they were not responsible, PCPs identified 1126 of their 4302 patients as complex. We randomly split this PCP-reviewed cohort into two subsets: 2/3 for model development and the remaining 1/3 for model validation. We generated 1000 bootstrap samples from the development subset. For each sample, we ran separate logistic regression models with backward elimination (significance=0.05) to identify predictors for physician-defined complexity, stratifying our models by patient age (age<60, age60). We included only variables chosen in greater than half of bootstrap samples. We evaluated model discrimination using c statistics and calculated test characteristics. We obtained all predictive variables from an electronic data repository.
RESULTS: Among patients under 60 years old, the odds of being identified as complex increased with age (OR 1.04 [1.03-1.06]), Charlson score (OR 1.52 [1.11-2.06]), number of prescribed medication (OR 1.08 [1.06-1.10]) and number of no shows in 3 years (OR1.24 [1.13-1.36]), Hemoglobin A1c>9 (OR 9.43 [2.86-31.11]), Medicare (OR 5.07 [2.70-9.51]) or Medicaid (OR 1.76 [1.18-2.62]) insurance, depression (OR 1.73 [1.25-2.38]) or alcohol related diagnosis (OR 2.80 [1.39-5.65]), and billing codes for MRI (OR1.54 [1.07-2.22]). Among patients 60 years or older, the odds of being identified as complex increased with age (OR 1.04 [1.02-1.06]), number of prescribed medications (OR 1.08 [1.05-1.10]) and number of no shows in 3 years (OR 1.34 [1.13-1.59]), Medicaid insurance (OR 2.66 [1.14-6.20], diabetes (OR 1.96 [1.26-3.05]), atrial fibrillation (OR 2.19 [1.25-3.83]), and billing codes for psychotherapy (OR 3.31[1.68-6.52]) or a complex patient visit (OR 1.54 [1.11-2.15]). C statistics from the development cohort were 0.82 for age<60 and 0.79 for age60 and 0.83 and 0.77 in the validation cohort, respectively.
We defined complexity when predicted probability was 0.45 for age <60 and 0.59 for age60 to achieve highest accuracy, and this resulted in an overall accuracy of 82%. Table 1 shows model test characteristics in the to subsets.
CONCLUSIONS: We were able to develop a robust general model to predict PCP-defined patient complexity. Age, markers of chronic disease and mental illness, Medicaid insurance, and no show visits were common predictors of complexity in both age groups. Applying this type of predictive model to populations of patients may help health systems effectively identify complex patients for resource allocation and interventions to improve primary care quality and physician experience.
Model Test Characteristic for Development and Validation Datasets
Dataset Prevalence of
Complexity
Accuracy Sensitivity Specificity Positive Predictive
Value
Negative Predictive Value
Developmental 0.16 0.82 0.45 0.95 0.76 0.83 Validation 0.15 0.81 0.43 0.95 0.74 0.82
DEVELOPMENT OF A POTASSIUM REPLETION PROTOCOL TO DECREASE INTERRUPTIONS DURING ICU TRANSFER OF CARE Lyudmila Shvets1; Wajahat Khan1; Mona Ali2; Michael P. Carson1. 1Jersey Shore University Medical Center, Neptune, NJ; 2Jersey Shore University Medical Center, Neptune, NJ. (Control ID #1312273)
BACKGROUND: Resident work hour limitations have highlighted the importance of avoiding interruptions during transitions of care, especially in the intensive care unit (ICU). Calls regarding abnormal potassium (K+) results are a common cause of such interruptions in
our ICU. We implemented an automated K+repletion protocol for ICU patients with mild hyperkalemia and collected data to a) determine if it could decrease the number of phone calls made by nurses and received by residents, b) monitor and assess the response to the repletion dictated by the protocol, and c) determine

whether protocol use changed the average time to first K+dose.
METHODS: ICU nurses and residents completed surveys regarding the current potassium replacement system, and for a week tracked the relative number of calls/pages made regarding K+repletion. A written order set was developed, approved by the ICU committee and piloted

for a month. The nurses used the automated protocol to direct K+ repletion only for patients whose eGFR was>=50 cc/min AND initial morning K+was between 3.3 and 3.9 meq/L (Protocol Used Group). For those with an eGFR<50 OR an initial K+<=3.2, the nurses called/paged the residents as usual (Standard Care). The protocol was only used once per day. The following were recorded each day: initial K+levels, creatinine, eGFR, K+supplement dose, time to administration, repeat K+values, and medications. K+repletion was separately tracked for those with eGFR<50 cc/min.
RESULTS: Prior to the pilot program, residents received an average of 7 pages/day from nurses during morning sign-out rounds regarding potassium repletion orders. The median time to the first K+dose was longer for the Standard Care patients, and was over 9 hours for 4 (Table), but the difference between the mean time to repletion was not significantly different (Wilcoxn-Rank Sum p=0.13). 14 additional patients with an eGFR <50 (range 12-44) treated by Standard Care were tracked: the average morning K+was 3.5 meq/L, the average repletion dose was 43 meq of KCl, and the average next morning K+value was 3.7 meq/L, similar to the patients with an eGFR>=50. The nurses and residents thought the protocol was an effective tool.
CONCLUSIONS: The pilot protocol was well received by the staff, did not cause hyperkalemia, prevented long delays in repletion, and prevented 2-3 interruptions/day during the morning transition of care when the pilot was implemented. Those with an eGFR<50 received similar repletion doses without developing hyperkalemia. Patients on the protocol received less total repletion because it was only implemented for those with a K+>=3.3 meq/L. The protocol is now in place as part of our standard, computerized, ICU order set and except for those with critically low K+, it is being used to address the first daily K+ regardless of eGFR. As 88% of patients had a K+>=3.3 meq/L, it has the potential to prevent at least 5-6 interruptions per day.
Protocol Used (n=52)
Standard Care (n=31)
Entire Cohort
Mean Age (years) 71 73 71.5 Mean Morning Potassium(meq/L)
3.6 3.4 3.5
Potassium administered via
Protocol (meq)
cardiovascular disease, yet a standard set of CKD quality measures for primary care physicians is lacking. The purpose of this study was to develop a primary care CKD quality measure set as the first step of a quality improvement project.
METHODS: This study was conducted in 2011 within PPRNet, a national primary care practice based research network whose members use a common electronic health record and pool data for quality improvement and research purposes. Ten practices from 9 states with 52 providers volunteered to participate. Eight were family medicine practices, one an internal medicine practice and one a family medicine residency. An extensive review of current CKD practice guidelines, published quality measures and existing literature was performed to generate a preliminary list of CKD quality measures. Using a measure development process based on the RAND Appropriateness method, face validity and reliability of these measures was determined through an online survey. Respondents were asked to rate each potential measure against a 1 to 9 integer scale: Is this a useful measure of quality? with 1 being the lowest quality and 9 being the highest quality. Respondents were

also invited to provide comments on each measure. Measures with an overall median value of 8-9 were considered face valid and reliable.
RESULTS: Eighteen measures were developed and included in the preliminary CKD survey. Thirty-two out of 52 (61.5%) providers completed the survey. The median score for seven of these measures was 7, for nine measures 8, and for two measures 9. The 11 measures with a median score of 8-9 include: 1)Estimated Glomerular Filtration Rate (eGFR) for patients at risk for CKD or with known CKD; 2)Screening for proteinuria in all at-risk or known CKD patients; 3)Blood pressure (BP) measurement for CKD patients; 4) Most recent BP<140/90 for all CKD patients; 5)Prescription for ACE-inhibitor or angiotensin receptor blocker for patients with CKD, hypertension and proteinuria; 6)Lipid measurement for all CKD patients; 7)Complete blood count in Stage 3-5 CKD; 8)Avoidance of non-steroidal anti-inflammatory drugs in Stage 3-5 CKD; 9)Avoidance of most sulfonylureas in Stage 3-5 CKD; 10)eGFR every 6 months in Stage 3-5 CKD; 11)Referral to nephrologist for eGFR<30. Measures eliminated from the preliminary set included diagnosis of CKD for patients with eGFR<60, statin therapy and lipid control, measurement of bone metabolism (calcium, phosphorus, parathyroid hormone) for stage 3-5 CKD, avoidance of nitrofurantoin and bisphosphonates in patients with reduced eGFR, and eGFR every 3 months in stage 4 CKD. Comments on these measures included concern about their level of evidence and the preference to have nephrologists handle management of bone metabolism and monitoring of later CKD stages. CONCLUSIONS: Using a consensus process, a set of primary care CKD quality measures rated as valid and reliable has been developed. Future steps based on these measures include an initial assessment of CKD management followed by a quality improvement project.
DEVELOPMENT OF A COMPREHENSIVE MOBILE SYSTEM FOR OUTREACH MEDICAL RESEARCH DATA COLLECTION AND MANAGEMENT: THE DOC-R PROJECT (DATA OUTREACH COLLECTOR FOR RESEARCH) Nicolas Senn1; Romain Thrisod2; Constant Barthel1; Jacques Cornuz1; Markus Jaton2. 1University of Lausanne, Lausanne, Switzerland; 2University of Applied Sciences of Western Switzerland, Yverdon, Switzerland. (Control ID #1321909)
BACKGROUND: In clinical research, data are often collected through paper questionnaires, with high potential of missing data, time consuming data entry and cleaning. With the rapid emergence of electronic technologies (Smartphone), new systems have been developed to achieve more efficiently the collection of data. However, most technologies are often not designed for medical research, expensive, requiring high level of computer expertise or incompatible with the confidentiality of medical research. A high degree of mobility is also mandatory when research is performed in primary care or community medicine. A school of engineering and a university primary care research institution combined their efforts to develop the DOC-R system (Data Outreach Collector for
28 28
Potassium administered via
Other Route (meq)
30 60 25
Range of Time For K+Repletion(Hours:Minutes)
00:41 to 05:59
00:44 to
16:45
Mean Time to Administration of
First Potassium Dose Once ResultAvailable in the Computer (Minutes)
136 220
Median Time to Administration of First Potassium Dose Once Result Available in the Computer(Minutes)
109 141
Next Morning K+Level (meq/L) 3.8 3.8

DEVELOPMENT OF A QUALITY MEASURE SET FOR CHRONIC KIDNEY DISEASE CARE IN PRIMARY CARE PRACTICE Cara Litvin1; Steven M. Ornstein2. 1Medical University of South Carolina, Charleston, SC; 2Medical University of South Carolina, Charleston, SC. (Control ID #1336225)

BACKGROUND: Chronic kidney disease (CKD) is commonly managed by primary care physicians. Although there are existing practice guidelines for the management of patients with CKD, many of these are based on expert opinion and/or focus on patients with later stages of disease usually managed by nephrologists. Early interventions may reduce progression of renal disease and risk for

Research), a comprehensive, mobile system able to manage data acquisition in a primary care.

METHODS: The objectives of the DOC-R project are: 1) to develop an integrated system allowing medical researchers to perform all steps of data collection: generate electronic questionnaires, organize mobile data collection through GSM devices, and access database directly in a format suitable for analysis 2) to provide the researcher with a system that is owned by himself 3) to respect confidentiality of data following medical research standards. The DOC-R system comprises: 1) a server based on LAMP technology (Linux Apache MySQL PHP) requiring no specific framework 2) EditQuest, a Java/Swing-based software developed within our institution to generate offline XML format questionnaire 3) ad hoc Android application for mobile device (tablets/Smartphone). RESULTS: To assess if DOC-R was operational, 2 researchers in primary care were asked to set up a simple survey with a minimal

training (based on simple didactic material). First tests showed that the entire system was operational and the different steps displayed in figure 1 could be achieved by nave users. The Android mobile client application uses caching and delayed write techniques in order to achieve full functionality even in absence of any network access; thus, the user is kept largely unaware from any technical contingencies, with the exception of battery life. Typical answer size is less than 1000 bytes/questionnaire, which grants an optimal efficiency, even in poor network quality conditions.

CONCLUSIONS: This work established the proof of principle that the integrated mobile data collection system DOC-R is operational and able to provide researchers with a simple, reliable and efficient tool to manage all critical steps of outreach data collection. Further developments are already going on to test its feasibility in real life research settings. DOC-R will be available for testing and demonstration.

DIAGNOSTIC UNCERTAINTY AND ANTIBIOTIC PRESCRIBING FOR ACUTE COUGH IN PRIMARY CARE Lauren E. Whaley; Alexandra C. Businger; Patrick P. Dempsey; Jeffrey A. Linder. Brigham and Women's Hospital, Boston, MA. (Control ID #1338072)

BACKGROUND: Despite guidelines stating that clinicians should not prescribe antibiotics for acute cough/acute bronchitis, nationwide rates of antibiotic prescribing for acute bronchitis are over 70%. To inform solutions to reduce inappropriate antibiotic prescribing, we evaluated clinician diagnoses and antibiotic prescribing for acute cough in a primary care practice.

METHODS: We identified all acute cough visits in one primary care practice between March 1, 2011 and December 20, 2011. We defined acute cough as a cough lasting 21 days or less in an adult aged 18-64 without chronic lung disease. We excluded patients who had a visit within the previous 30 days. From acute cough visit notes in the electronic health record, we abstracted information about patient demographics, symptoms, signs, diagnoses, and prescribed medications. We also assessed whether the diagnosis was antibiotic-appropriate and whether clinicians expressed uncertainty regarding the diagnosis - using words like possible or balancing two different diagnoses, like URI versus sinusitis.

RESULTS: During the study period, we excluded 17,182 of 33,215 (52%) visits to the practice due to age, the presence of chronic lung disease, and having made a visit in the previous 30 days. We reviewed 16,033 visits from 10,487 patients, of which 601 (2% of all visits) met our definition of acute cough. Of acute cough visits, patients were 73% women and their mean age was 44 years old. The mean duration of cough at the time of visit

was 8 days. A total of 160 different clinicians saw the acute cough patients. The most common non-cough symptoms were nasal congestion (57%), sore throat (49%), and phlegm (37%). Clinicians documented a lung abnormality in 12% of visits. The most common cough-related diagnoses were upper respiratory infection (43%), acute
bronchitis (9%), sinusitis (9%), and pneumonia (9%). Overall, clinicians prescribed antibiotics to 23% (140) of patients. Non-antibiotic-appropriate diagnoses accounted for 25% of antibiotic prescribing. Clinicians prescribed antibiotics to 25% of patients diagnosed with acute bronchitis. Overall, clinicians expressed diagnostic uncertainty in 112 (19%) visits. Clinicians expressed diagnostic uncertainty more often for antibiotic-appropriate diagnoses than for non-antibiotic-appropriate diagnoses (47% versus 8%; $p<0.001$). Likewise, clinicians expressed diagnostic uncertainty more often when prescribing antibiotics than when not prescribing antibiotics (34% versus 14%; $p<0.001$).
CONCLUSIONS: The antibiotic prescribing rate for acute cough in this practice was lower than national rates. Non-antibiotic-appropriate diagnoses accounted for a quarter of antibiotic prescribing. Diagnostic uncertainty was strongly associated with antibiotic prescribing. To further reduce antibiotic prescribing for acute cough, future efforts should focus on eliminating antibiotic prescribing for non-antibiotic-appropriate diagnoses and improving diagnostic certainty.
DIFFERENCES IN PATIENT PERCEPTIONS OF THE QUALITY OF COMMUNICATION AMONG STAFF AND RESIDENT PRIMARY CARE PHYSICIANS Jeffrey M. Ashburner; Charlotte E. Ward; Yuchiao Chang; Blair W. Fosburgh; Steven J. Atlas. Massachusetts General Hospital, Boston, MA. (Control ID #1337504)
BACKGROUND: Physicians are increasingly evaluated based on measures of performance. The Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey is a standardized instrument which asks patients to report on and evaluate their experience with health care. We examined how staff primary care physicians (PCPs) compared to resident PCPs on items related to communication skills from the CAHPS patient experience of care survey.

METHODS: We studied 209 staff PCPs and 245 resident PCPs in 13 primary care practices within the Massachusetts General Hospital practice-based research network with completed CAHPS surveys between August 2008 and June 2011. For each of 6 individual questions within the communication domain of the survey, staff and resident PCPs were compared by top-box score, or the proportion of surveys where Always was chosen, using chi-square tests. A communication composite score was calculated for each survey as the proportion of all questions where the top-box was chosen, and requiring that at least 4 of the 6 questions were answered. We compared unadjusted composite scores among staff and resident physicians in linear regression models accounting for clustering by PCP. Adjusted scores were also compared after controlling for patient age, gender, insurance status, race, language, education, Charlson score, and date of survey completion.
RESULTS: CAHPS data were available for 209 staff PCPs (median 84 surveys per PCP) and 245 resident PCPs (median 4 surveys per PCP). Patients of staff PCPs were older (59.6 vs. 53.2 years), more likely to be female (61.5% vs. 54.5%), white (83.5% vs. 68.7%), speak English (94.3% vs. 86.8%), graduate college (54.7% vs. 41.0%), have private insurance(56.0% vs. 53.1%), and have higher mean Charlson scores (1.33 vs. 1.24, $p=0.02$) compared to patients of resident PCPs (all $p<0.001$ unless noted). For individual items, staff PCPs had higher top-box scores for explaining things in an easily understood way (87.3% vs. 82.1%), giving easy to understand instructions (86.3% vs. 82.4%), knowing the patients medical history (80.8% vs. 72.7%), and respecting patients comments (91.2% vs.87.9%) (all $p<0.001$). Resident PCPs had higher top-box scores for spending enough time with the patient (84.1% vs. 81.7%, $p=0.04$). Scores were similar for listening carefully to the patient (86.3% vs. 87.7% in Resident PCPs, $p=0.17$). Mean communication composite scores were higher

for patients seen by staff PCPs compared to resident PCPs (85.8% vs. 82.4%, difference: 3.4%, p<0.001). After adjusting for patient characteristics, staff PCP mean scores remained higher than resident PCPs(85.9% vs. 83.0%, difference: 2.9%, p=0.004).
CONCLUSIONS: Staff PCPs scored higher in most communication-related measures of patient experience of care, including a composite measure of communication survey items. Staff PCPs had average scores higher than the overall CAHPS 75th percentile (84%) for the communication composite, while resident PCP average scores fell below this threshold. Adjusting for differences in the patient characteristics of those seen by staff or resident PCPs did not substantially change mean composite scores. Residency programs should provide feedback on patient experience of care survey data to residents as part of training on quality assessment and improvement. Future studies should address whether specific training interventions can decrease these differences among staff and resident PCPs.
DIFFERENCES IN PRESCRIBING PRACTICES OF ANALGESICS TO TREAT MODERATE TO SEVERE ACUTE PAIN AMONG PHYSICIAN SPECIALTIES Aarti Patel2; Bill McCarberg1; Carmela Benson2; Samir Mody2; Wing Chow2; Gary Vorsanger2; Myoung Kim2.
1Kaiser Permanente, San Diego, CA; 2Janssen Scientific Affairs, LLC, Raritan, NJ. (Control ID #1333223)
BACKGROUND: Patients have reported inadequate control of their moderate to severe acute pain. Additionally, opioid-related side effects can be a significant barrier to adequate treatment of such pain. The objective of this survey was to gain insight into the differences among physician specialties in the management of acute pain in their practices, including prescribing practices of analgesics for the treatment of moderate to severe acute pain and management of opioid-related side effects, among physician specialties through the Physicians Partnering Against Pain (P3) Survey.
METHODS: The P3 survey, the largest survey of pain management practices in the U.S., was a nationwide study of U.S. physicians and their patients with severe to moderate acute pain. Physicians completed a brief questionnaire upon enrollment and were surveyed about the management of acute pain in their practice: volume of patients presenting in a typical week, frequency of prescribing opioid analgesics, the percentage of patients that return for a follow-up visit
after treatment, reasons patients discontinue treatment, frequency of prescribing or recommending treatment for opioid-related gastrointestinal (GI) side effects, and frequency of patients taking opioid analgesics that also take additional treatments to manage GI side effects.
RESULTS: A total of 5,982 physicians were surveyed about the management of moderate to severe acute pain in their practice of which 52% were primary care physicians (included family practitioners, general practitioners, and internists), 23% other specialists (included rheumatologists and orthopedic surgeons), and 25% pain specialists. Of the 1,042 physicians surveyed that responded seeing >60 patients with moderate to severe acute pain per week, 17% were primary care physicians (PCPs), 23% were other specialists, and 61% were pain specialists. PCPs and other specialists were less likely than pain specialists to prescribe opioid analgesics to their patients with moderate to severe acute pain (25.8%, 29.5% and 44.8%, respectively) but were slightly more likely to have 75% or more of their patients with moderate to severe acute pain return for a follow-up visit(37.7%, 35.1% and 27.3%). Of the 3,226 physicians surveyed that ranked unacceptable gastrointestinal side effects as primary or secondary reasons for discontinuing opioid analgesic treatment in patients with moderate to severe acute pain, 53.2% were PCPs compared with 21.7% other specialists and 25.1% pain specialists. Despite this, there was little difference among PCPs, other specialists and pain specialists in those that recommend or prescribe treatments to manage opioid-related side effects, such as nausea, vomiting and constipation (38.3%, 23.1% and 38.5%, respectively). CONCLUSIONS: The P3 Study confirms the challenge of pain management: balancing efficacy and tolerability of opioid treatments. Differences among PCPs, pain specialists and other specialists exist in pain management for patients with moderate to severe acute pain. Compared to pain specialists and other specialities, PCPs were less likely to prescribe opioid analgesics and

were more likely to discontinue treatment due to unacceptable GI side effects.

DISCONTINUATION OF DIABETES MEDICATIONS DIFFERS BY SOCIOECONOMIC STATUS FOLLOWING LAPAROSCOPIC BANDING, BUT NOT GASTRIC BYPASS Kristina H. Lewis1; Matthew W. Gillman1; David E. Arterburn2; Claire F. Canning3; Fang Zhang3; Dennis Ross-Degnan3; James F. Wharam3. 1Harvard Medical School/ Harvard Pilgrim Health Care Institute, Boston, MA; 2Group Health Center for Health Studies, Seattle, WA; 3Harvard Medical School/Harvard Pilgrim Health Care Institute, Boston, MA. (Control ID #1333552)

BACKGROUND: Few long-term studies compare outcomes after laparoscopic (lap) banding and gastric bypass, and no national studies have determined the more effective surgery among low socioeconomic status (SES) patients. Gastric bypass causes rapid resolution of diabetes (DM) largely independent of patient behavior, whereas lap banding requires some weight loss and behavior change to resolve DM. We hypothesized that SES would not modify rates of DM resolution after bypass, but that lower SES patients would do worse after lap banding due to poorer adherence to necessary post-op lifestyle changes.

METHODS: Using CPT and ICD-9 codes from claims to a national commercial insurer, we identified 14,434 patients age 18-64 y who underwent lap band or gastric bypass during 2001-08. Of these, we studied 3,393 patients (17 % lap band, 37% lap bypass, 46% open bypass) who were dispensed one or more DM meds in the 6 m before surgery, and who had at least 1 y follow-up after surgery. From a linked consumer credit database, we obtained individual data on race/ethnicity, household income, net worth, and education. Our outcome was discontinuation of DM meds, i.e, no dispensing for a period of at least 6 m after surgery. We used survival analysis and Cox proportional hazards models to assess differences in discontinuation rates by surgical type and by educational level (HS or less v. some college or greater), income (or>
$20 K) and net worth (or>$25 K) within surgical type. RESULTS: Mean age was 46.8 y; 77% were white and 75% were female. 41% had a HS education or less, 10% had incomes<$20 K, and 18.9% had

net worth<$25 K. Mean (SD) follow-up time after surgery was 2.6(1.5) y. Baseline age, sex, race/ethnicity, and SES factors were similar between the surgical groups. After adjusting for education, income, and race/ethnicity, lap band patients were less likely to discontinue DM meds than bypass patients (HR 0.55, 95% CI 0.49-0.61). Among bypass patients, however, DM med discontinuation did not differ by education (HR 1.00, 95% CI 0.91-1.08, Figure 1), or income. However, lap band patients with post-HS education discontinued DM meds at a slower rate than those with HS education or less (HR 0.80,
95%CI 0.65-0.98, Figure 2), a finding that was unaltered after adjusting for race (HR 0.80, 95% CI 0.65 - 0.99). Findings were similar, but NS, when stratifying by income (HR 0.75, 95% CI 0.54-1.04) or by net worth (HR 0.78, 95% CI 0.55-1.11). CONCLUSIONS: As expected, patients discontinued DM meds at a lower rate after lap band than after bypass, and SES factors did not modify discontinuation rates after bypass. However, contrary to our hypothesis, higher (not lower) SES was associated with reduced discontinuation rates after lap band.

DISCOUNT FOOD STORES IN HIGH DISADVANTAGE LOS ANGELES COUNTY NEIGHBORHOODS EXPLAIN MOST INDIVIDUAL DIFFERENCE IN BODY MASS INDEX (BMI) Peter Capone-Newton3,2; Arleen Brown1; Paul M. Ong2. 1University of California Los Angeles, Los Angeles, CA; 2University of California Los Angeles, Los Angeles, CA; 3University of California Los Angeles, Los Angeles, CA. (Control ID #1340106)

BACKGROUND: Poor diet and physical inactivity is the second leading cause of mortality in the US after smoking. Cross-sectional, ecologic studies have associated specific obesogenic food environments (OFE examples: smaller distance to fast food restaurants, higher counts of fast food per population, larger distance to grocery stores, lower counts of grocery stores per population) to higher rates of poor diet or higher body mass index (BMI). These OFEs are more prevalent in some low-income
and racial/ethnic minority neighborhoods potentially contributing to widening health disparities. Recent analyses

of two longitudinal cohorts (CARDIA; Framingham Offspring Cohort), found no associations between ecologic measures of OFEs and poor diet or BMI, possibly because they do not capture the characteristics of the OFEs associated with poor diet or BMI. We assessed the hypothesis that current ecologic OFE measures do not capture the link between food environments and BMI because they ignore variability in food store types and ignore actual distance traveled to purchase food. Populations defined by store type or distance may better describe the potential causal link.
METHODS: The Los Angeles Family and Neighborhood Survey (LAFANS) is a longitudinal cohort of 2619 households in Los Angeles County. In 2001-2002, households were asked where they shopped for groceries, (store name and location), self-reported BMI and details of household structure and resources. A six-category food environment

measure based on store name and frequency was developed: high-frequency (HF) English-language named stores (major chain), discount stores (less, value, etc. in the name), HF Spanish-language stores, English-language specialty stores, multi-purpose or bulk purchase stores, other HF stores, and other low frequency stores of any language. We analyzed associations of this food environment measure with self-reported BMI, controlling for individual and household characteristics.
RESULTS: Of all LAFANS households, 2297 (88%) reported both BMI and a valid store name. In Los Angeles County, 37% of households shop at the nearest grocery store, the remaining bypass an average of 13 stores, and 13% shop in their home census tract. The median distance to store is 1.12 mi (IQR 1.32), and the distribution of shopping by concentric radii of <1, 1-2.99 and 3 to 4.99 km, is 28%, 46%, 16%. Adjusting for individual, household and neighborhood characteristics, discount store shoppers have substantially higher BMI than the referent group, major chain store shoppers in low disadvantage neighborhoods (BMI difference 1.40 points, 95% CI 0.62 - 2.18, p=0.004), equivalent to a weight difference of 8.4 lbs. for an individual of median height and weight (55,160 lbs.). CONCLUSIONS: Distinguishing between store types may better describe the causal link between individuals, stores and BMI than ecologic measures. In L.A. County, discount stores, found almost exclusively in high disadvantage and racial/ethnic minority neighborhoods are associated with individual differences in BMI. Further research should assess whether the association between discount stores and BMI is related to unmeasured elements of store content or individual characteristics. Current policy efforts focused on modifying small markets or building major chain stores in high disadvantage neighborhoods may inadequately address food environment based racial/ethnic and income based health disparities in BMI.
DISCRIMINATION BASED ON CRIMINAL RECORD AND ACCESS TO HEALTHCARE Joseph Frank1; Emily Wang2; Marcella Nunez-Smith2; Megan Comfort3. 1Brigham and Women's Hospital, Boston, MA; 2Yale School of Medicine, New Haven, CT; 3RTI International, San Francisco, CA. (Control ID #1334729)
BACKGROUND: Incarceration is a common experience among low-income populations and is associated with poor access to healthcare. The experience of healthcare discrimination attributed to a criminal record may play a role, as it does in employment and housing sectors. Therefore, we sought to examine the association between reported discrimination attributed to having a criminal record and access to healthcare.
METHODS: We used data from the Relate Project (R01MH0787443), a cross-sectional survey of 172 male-female couples recruited based on a recent release from state prison of the male partner. The independent variable was self-reported lifetime history of discrimination based on criminal record history by doctors, nurses, psychiatrists and others in helping jobs. We stratified by gender as inclusion criteria and therefore incarceration history differed markedly by gender. Among the 172 male respondents, we examined the association of patient-reported discrimination with three outcome variables measuring healthcare access: 1) lifetime history of a general check-up, 2) history of an Emergency Department (ED) visit since age 18, and 3) history of a medical

visit while incarcerated. We used chi-square tests and multivariable logistic regression models, adjusting for age, race, insurance status and number of times incarcerated. Chi-square tests were used to compare characteristics by reported discrimination history among the smaller group of 85 female respondents surveyed regarding discrimination based on criminal record.
RESULTS: Among 172 male respondents, 73 (42%) reported a history of healthcare discrimination attributed to criminal record. The group reporting healthcare discrimination was significantly older (mean, 42 vs. 39), had a more extensive incarceration history (median, 15.5 yrs vs. 8.5 yrs) and was more likely to report prior drug or alcohol treatment (82% vs. 67%). Among all male respondents, 146 (84%) reported a history of a general check-up, 148 (86%) reported an ED visit since age 18 and 117 (68%) reported a physician visit while incarcerated. In adjusted analyses, the group reporting discrimination was less likely to report a history of a general check-up (OR 0.48, 95% CI 0.19-1.22), more likely to report an
ED visit (OR 1.76, 95% CI 0.67-4.63) and significantly more likely to report a medical visit while incarcerated (OR 2.31, 95% CI 1.11-4.78). Among female respondents, 20 (24%) reported discrimination based on criminal history. The group reporting discrimination had a more extensive incarceration history (median, 2.5 yrs vs. 76 d), was more likely to report a history of depression (65% vs. 34%), anxiety (65% vs. 31%), drug or alcohol treatment (90% vs. 55%) and current intravenous drug use (55% vs. 17%). Reported discrimination by female respondents was not significantly associated with study outcomes.
CONCLUSIONS: To our knowledge, this is the first description of patient-reported discrimination by healthcare providers attributed to criminal record. Reported discrimination was associated with duration of incarceration and contact with correctional healthcare. Trends toward decreased utilization of primary care and increased use of ED services, though not significant in this small sample, suggest that the experience of discrimination based on criminal record may act as a barrier to healthcare access. Efforts to improve access for ex-prisoners should seek to better understand and mitigate experiences of discrimination.
DISCRIMINATION AND MEDICATION ADHERENCE IN HYPERTENSIVE AFRICAN AMERICANS: THE ROLE OF STRESS AND DEPRESSION Jessica M. Forsyth; Antoinette Schoenthaler; Joseph Ravenell; Gbenga Ogedegbe. NYU School of Medicine, New York, NY. (Control ID #1338663)
BACKGROUND: Poor adherence to antihypertensive medication among African Americans is recognized as a major contributor to racial disparities in blood pressure control. Research has shown that psychosocial factors such as stress and depression are associated with poor medication adherence. Perceived racial discrimination is an important psychosocial factor that has been associated with poor health outcomes in African Americans; its effect on medication adherence among hypertensive patients remains untested. In this study, we examined the influence of discrimination on medication adherence among hypertensive African American patients, and the mediating role of stress and depressive symptoms on this relationship.
METHODS: Participants were 740 patients enrolled in the Counseling African American To Control Hypertension (CAATCH) trial. CAATCH was a cluster-randomized trial designed to evaluate the effectiveness of a multilevel intervention, targeted at physicians and patients, on blood pressure control among hypertensive African Americans followed in 30 underserved community health centers. Analysis for this substudy utilized baseline measurements from CAATCH participants with complete data. The outcome variable was medication adherence assessed with the Morisky scale; higher scores indicate poor adherence. The predictor variable, perceived racial discrimination was assessed with the lifetime scale of the Schedule of Racist Events; higher scores indicate more frequent exposure to perceived discrimination. The mediator variables were stress, assessed with the Perceived Stress Scale, and depressive symptoms, assessed with the PHQ-9, with higher scores indicating more stress and depressive symptoms, respectively. Mediation was tested using the Baron and Kenny analytic framework examining four regression pathways. Age, income and education level were controlled for in all analyses. The Sobel test was used to determine if the mediating effect was significant.
RESULTS: Most patients were low-income and had a high school education, with a mean age of 57 years. In

pathway 1, discrimination was associated with poor medication adherence (=.086, p=.019). In pathway 2, discrimination was associated with increased stress (=.197, p =.000) and depressive symptoms (=.363, p=.000). In pathway 3, stress (=.236, p=.000) and depressive symptoms (=.190, p=.000) were associated with poor medication adherence. In pathway 4, when stress and depressive symptoms were added to pathway 1, the relationship between discrimination and medication adherence became non-significant, indicating a mediating relationship (=.008, p=.832). The Sobel test confirmed that the mediation was significant.
CONCLUSIONS: This study provides evidence that exposure to discrimination is associated with poorer medication adherence among low-income hypertensive African Americans, and that this relationship is partially explained by the negative effects of discrimination on perceived stress and depressive symptoms. Further assessment of situations where

African American patients report high exposure to discrimination in combination with higher levels of perceived stress and depressive symptoms could provide a key starting point in addressing the lower rates of adherence in this patient population.
DISCUSSIONS BETWEEN PREMENOPAUSAL WOMEN AND THEIR PHYSICIANS REGARDING CALCIUM, VITAMIN D, AND OSTEOPOROSIS Kenzie A. Cameron1; Karin B. Ulstrup2,1; Charlie Zei1; Anne Henson1. 1Northwestern University, Chicago, IL; 2Chicago Lake Shore Medical Associates, Chicago, IL. (Control ID #1332733)
BACKGROUND: More than 40 million adults in the United States have or are at risk of developing osteoporosis. Although the risk of osteoporosis in women increases significantly after menopause, by maintaining strong bones throughout life with proper calcium and vitamin D intake, premenopausal women may decrease their risk of osteoporosis. It is not known how frequently physicians are discussing osteoporosis and/or calcium and vitamin D supplementation with female premenopausal patients.
METHODS: Female premenopausal (18-49 years old) patients were approached by a research assistant in the waiting rooms of an internal medicine practice or an obstetrics and gynecology practice in Chicago, IL. Those who consented were asked to complete a self-administered survey about calcium, vitamin D, and osteoporosis and were called 1-2 weeks later to complete a follow-up phone interview.
RESULTS: Three hundred and forty-five participants completed the initial self-administered survey; these results report on the 198 participants who also completed the follow-up phone interview. Participants mean age was31.3 years (SD 6.5); the majority of participants were white (77.8%), 10.6% were African American, 5.1% Hispanic/Latino, and 6.1% Asian/Pacific Islander. 45.5% reported taking a calcium supplement and 46.0% reported taking a vitamin D supplement. However, only 31.5% and 36.3% of those who reported taking calcium and vitamin D supplements, respectively, reported having started supplementation based upon a physician recommendation. Only17.2% reported ever having discussed osteoporosis with their physician, with41.2% of those 34 individuals having done so at their most recent visit. Participants reported that physicians brought up the topic of osteoporosis47.1% of the time. In comparison, 35.4%, and 28.8% reported ever having discussed calcium and vitamin D intake, respectively, with their physician, with 45.7% and 63.2% having done so at their most recent visit. Physicians brought up these topics 74.3% and 75.4% of the time. Women reported obtaining information about calcium and vitamin D from a range of 1 - 5 sources (mean 1.8 different sources), including: the internet (46.0%); family and friends (43.9%); the doctors office (34.8%); newspaper, books, magazines(31.6%); and television (17.7%).
CONCLUSIONS: Physicians appear to be more likely to raise the topics of calcium and vitamin D intake than they are to raise the topic of osteoporosis with their premenopausal female patients; however, even discussions of calcium intake are reported by fewer than 40% of surveyed patients. Women are receiving information about calcium and vitamin D from multiple sources, including the Internet and family and friends. The accuracy of the information from these sources is unknown and worthy of further study, particularly as almost 50% of the

surveyed women indicate they are taking calcium and/or vitamin D supplementation. The majority of women who did start calcium and vitamin D did not do so based upon a conversation with their physician. We are unable to assess the context in which calcium and vitamin D supplementation is being discussed, but it appears as though such discussions are often occurring in the absence of any dialogue regarding osteoporosis. Physicians may wish to consider explicitly stating the connection between calcium, vitamin D and osteoporosis in discussions with their patients.

DISPARITIES IN PROCESS OF CARE FOR PATIENTS WITH WITH CIRRHOSIS IN A PUBLIC HOSPITAL CLINIC VERSUS A FACULTY PRACTICE Seth N. Sclair; Paul Martin; Frank Czul; Olveen Carrasquillo. University of MIami, Miami, FL. (Control ID #1339094)

BACKGROUND: Vulnerable populations are at higher risk of death from liver disease and receipt of services at facilities disproportionately serving
such groups is a major contributor to health care disparities. We sought to examine differences in process of care among cirrhotic patients at two health care facilities in our Miami community. One is the hepatology clinic of a public hospital (PH) and the other is a private faculty practice (FP). Academic hepatologists provide and/or oversee care by trainees and mid-level providers at both sites.

METHODS: We used claims data to identify 596 cirrhotic patients seen at each practice over a 6 month period. We selected 210 consecutive records for review of which 153 met inclusion criteria (FP=74, PH=79). We conducted a structured retrospective chart review of electronic records (physician notes, labs and procedures) to examine adherence to cirrhosis practice guidelines by the American Association for the Study of Liver Disease. These include hepatitis A &B vaccinations, surveillance for hepatocellular carcinoma (HCC) and esophageal varices (EV), antibiotic prophylaxis for spontaneous peritonitis (SBP), and referral for liver transplant (LT) evaluation. Chi square analysis was used to test for statistically significant differences.

RESULTS: Patients at both sites were similar in age, gender, number of visits, and cirrhosis etiology. 72% of PH patients were uninsured/Medicaid versus 8% of FP patients. PH patients were more likely than FP patients to have met vaccination guidelines (proven immunity or completion of vaccination series); 81% vs 46% and 76% vs 29% for hepatitis A and B, respectively ($p<.01$ for both). PH patients were more likely to have received annual HCC screening by serum AFP and imaging, 90% vs 70% ($p<.01$). However, patients at the FP practice were more likely than PH patients to have had endoscopic screening for EV, 97% vs 87% ($p<.05$). Further, excluding patients with a prior index variceal bleed, 71% of FP patients underwent primary EV screening within 6 months of establishing care vs 43% of PH patients ($p<.01$). Among those with varices, B blocker utilization was similar, but PH patients tended to have less prophylactic endoscopic banding therapy. Documentation of and scores for Model for End Stage Liver Disease (MELD) were similar at both sites, but FP patients were more likely than PH patients to have had a documented discussion about LT with their provider or to have been referred for LT evaluation; 81% vs 53%, and 42% vs 20%, ($p<.01$ for both). The number of patients with an indication for antibiotic prophylaxis for SBP was small (14 at FP and 13 at PH), however, the proportion of PH patients (1/13) receiving antibiotics was lower than FP patients (6/14).

CONCLUSIONS: We found very large disparities in the adherence to cirrhosis practice guidelines across sites. However the direction of the observed disparities was not uniform with the safety net site having higher adherence rates than the faculty practice in several process of care measures. In general, PH patients had higher adherence to less service intense measures such as vaccinations, imaging and blood testing. In contrast, FP patients had higher adherence to more service intense measures, such as endoscopy and transplant evaluation. Providers noted difficulties in arranging elective endoscopies for indigent patients in PH and insurance reimbursement policies for vaccinations of FP patients as barriers to care.

DO IMMIGRANTS SUBSIDIZE THE HEALTH CARE OF THE US-BORN THROUGH MEDICARE? Leah Zallman1,2; Steffie Woolhandler3,1; David Himmelstein3,1; David Bor1,2; Danny McCormick1,2. 1Cambridge Health Alliance, Cambridge, MA; 2Harvard Medical School, Boston, MA;

3City University of New York School of Public Health, New York, NY. (Control ID #1331397)
BACKGROUND: The Medicare Trustees forecast that the Hospital Insurance Trust Fund (HITF) will be exhausted by 2024; the HITF funds Medicare Part A (primarily hospitalizations, skilled nursing, and hospice) and partially funds Part C (Medicare Advantage). Immigrants contribute to the HITF through taxes but may withdraw less than the US-born because they are younger and because they are often ineligible to receive Medicare benefits (i.e. they are undocumented or have legally resided in the US for<five years). METHODS: We calculated HITF contributions from and withdrawals by immigrants and the US-born. Using US Census Bureau data from the 2008 Current Population Survey (which represents data from 2007) we calculated the proportion of Medicare tax collections accounted for by immigrants and by US-born individuals. To calculate payroll contributions, we multiplied wage and salary earnings by 2.9% (the rate of payroll taxes that fund Medicare). To calculate taxes paid on social security benefits, we

calculated the taxable portion of social security benefits that funds Medicare according to taxation laws and multiplied this number by the federal income tax rate. We made a small adjustment to account for miscellaneous sources of HITF revenue (interest, premiums and other) as reported by the 2008 Medicare Trustees Report (which reflects 2007 events). For this correction, we assumed that immigrants share of contributions to miscellaneous revenue was the same as their share of total payroll taxes. We tabulated HITF withdrawals using nationally representative data from the 2007 Medical Expenditure Panel Survey (MEPS). We first calculated the proportion of hospitalization, home health care, and Medicare Advantage expenditures made on behalf of immigrants and US-born individuals. In order to account for the known underrepresentation of high expenditure Medicare hospitalizations in the MEPS, we used a weighting correction proposed by Zuvekas and Olin (2009). We applied this corrected proportion to total HITF expenditures as reported in the 2008 Medicare Trustees Report. This procedure corrected for underestimates of home health care, Medicare Advantage, and inpatient expenses in the MEPS as well as skilled nursing facility, administration, and other expenses. Finally, for each group, we calculated the overall and per capita subsidies defined as the difference between contributions and withdrawals from the HITF. We used the same process to calculate subsidies provided by citizen and non-citizen immigrants.
RESULTS: In 2007, immigrants made up 12.2% of the U.S. population. They contributed $30.8 billion to the HITF and withdrew $19.1 billion (net subsidy =$11.6 billion). US-born individuals contributed $192.9 billion and withdrew $184.0 billion (net subsidy=$9.0 billion). On average, immigrants provided $305 per capita in subsidies, nearly nine times the per capita subsidy of $35 provided by US-born individuals. All of the net subsidy was accounted for by non-citizen immigrants who contributed $15.3 billion and withdrew $2.6 billion (net subsidy=$12.7 billion or $645 per capita). CONCLUSIONS: In 2007, immigrants withdrew only two dollars worth of care from the HITF for every three dollars they contributed; non citizen immigrants withdrew only one dollar for every six dollars they contributed. Despite the wide perception that immigrants, in particular non-citizen immigrants, consume healthcare resources, we find evidence that non-citizen immigrants heavily subsidize Medicare.
DO INSURED YOUNG ADULTS SEE THEIR PRIMARY CARE DOCTOR MORE? INSURANCE COVERAGE AND PRIMARY CARE ACCESS AMONG ADULTS AGES 27-32 Jennifer H. Chuang1;
Karen Soren1,2; John Santelli1,2. 1Columbia University Medical Center, New York, NY; 2Columbia University, New York, NY. (Control ID #1339516)
BACKGROUND: After maturing out of pediatrics, young adults face challenges of inadequate health insurance coverage and access to age-appropriate primary care. Prior to 2011, adults ages 18-26 were the age group most likely to be uninsured in the United States. Passage of the Affordable Care Act in 2010 allowed coverage

under parents health insurance plans up to age 26. Surveys in early 2011 show that adults 27-35 are now the group most at risk of being uninsured in the United States. This study examines whether insured adults ages 27-32 in 2007-2008 were more likely to have routine check-ups compared to those without health insurance coverage.
METHODS: Cross-sectional analysis of Wave IV of the National Longitudinal Study of Adolescent Health collected in 2007-2008 of 13,105 adults ages 27-32 in the United States. Primary predictor was health insurance coverage in the previous 12 months. 12 months of insurance was considered full coverage, 1-11 months as partial coverage, and 0 months as no coverage. Outcome variable of interest was having had a routine check-up in the previous 12 months. Chi-squared analysis examined covariate relationships of tobacco use, binge drinking, illicit drug use, low household income, contraception, having a sexually transmitted disease, exercise, diagnosis of mental illness, and diagnosis of a chronic health condition. Multivariable logistic regression was performed to analyze the association between health insurance coverage and having a routine check-up in the previous 12 months, adjusting for the above covariates. .
RESULTS: 11,243 subjects ages 27-32 were included in the analysis after excluding respondents with missing values. 71.7% had full health insurance coverage for the previous 12 months, 14.8% had partial coverage, and 13.5% had no coverage. 63.0% of respondents had a routine check-up within the previous 12 months and 37.0% had not had a check-up in over 12 months.40.8% of respondents had one or more chronic health conditions. Chi-squared analysis demonstrated significant associations between insurance status and routine check-ups with the covariates described above in the methodology. Results of the multivariable logistic regression model are shown in the table. CONCLUSIONS: This study demonstrates that before implementation of the Affordable Care Act, over one-quarter of adults ages 27-32 in this sample had partial or no insurance coverage in 2007-2008. Adults in this age group had greater odds of accessing routine check-ups if they had full or partial insurance coverage. With the passage of the Affordable Care Act, young adults may now be covered under their parents health insurance plan up to age 26. This study suggests that adults ages 27-32 are more likely to have routine check-ups if they have health insurance coverage, but this group remains at risk for insufficient health insurance coverage. Future studies performed after the implementation of the Affordable Care Act may reveal further information regarding insurance coverage and primary care access among this age group.
Relationship between health insurance coverage and routine check-up
Total Males FemalesOR 95% CI p-value OR 95% CI p-value OR 95% CI p-value Full vs. partial and no coverage 2.2 2.0-2.4 <0.0001 2.0 1.8-2.3 <0.0001 2.4 2.1-2.8 <0.0001 Full and partial vs. no coverage 3.6 3.2-4.1 <0.0001 3.0 2.5-3.5 <0.0001 4.0 3.4-4.8 <0.0001 Full vs. no coverage 3.9 3.4-4.4 <0.0001 3.1 2.6-3.7 <0.0001 4.5 3.7-5.4 <0.0001
Full coverage=12 months insurance; Partial coverage=1-11 months insurance; No coverage=0 months insurance
DO PATIENT ACTIVATING INTERVENTIONS IMPROVE QUALITY OF LIFE FOR ADULTS WITH TYPE 2 DIABETES? Alida M. Gertz1; Carl V. Tyler2; Apoorva K. Chandar4; Adam T. Perzynski3; Corinna Falck-Ytter3; Donna Windish5; Paulette A. Sage3; Shari Bolen3.
1Johns Hopkins Hospital, Baltimore, MD; 2Cleveland Clinic, Cleveland, OH; 3Metro Health Medical Center, Cleveland, OH; 4Case Western Reserve University, Cleveland, OH; 5Yale, New Haven, CT. (Control ID #1339037)
BACKGROUND: Studies of self-management interventions effects on quality of life (QOL) in adult patients with type 2 diabetes have had mixed
results. Comprehensive information regarding the impact of patient activating interventions on QOL is critical since patients may be more inclined to participate in interventions that improve their QOL. We therefore conducted a systematic review of patient activation interventions (defined as interventions targeting knowledge,

beliefs, and skills for self management) effects on QOL in adults with type 2 diabetes. METHODS: We searched the MEDLINE, EMBASE, CINAHL and Cochrane Central Register of Controlled Trials databases from inception for original English-language articles. Our search strategy combined terms for Type 2 diabetes, randomized controlled trials, and self-management interventions. We selected original studies in adults

with type 2 diabetes that assessed the impact of patient-activating interventions on QOL. Reviewers extracted data for each article using standardized protocols. Data from these articles was analyzed and examined to compare the different types of patient activation interventions and to determine their respective effects on QOL. Patient activation interventions were grouped according to which of the 7 AADE (American Association of Diabetes Educators) behaviors were targeted (Healthy Eating, Being Active, Monitoring, Taking Medication, Problem Solving, Reducing Risks and Healthy Coping). RESULTS: Out of 10,219 citations, 30 articles reported a validated QOL measure as either a primary or secondary outcome. On average, the studies reported enrolling 193 participants (range 25 to 2570). The majority of studies were published after 2000 (N=26), and most occurred in the U.S. (N=16). The mean time of follow-up was 11.9 months. The SF-36 (N=10) and DQOL (Diabetes Quality of Life; N=7) were the two most common instruments used to measure QOL out of the 10 types of instruments used. Eighteen studies (60%) found significant improvements in QOL in intervention groups compared to control groups. The most frequently targeted AADE behaviors among studies that reported significant improvements in QOL were healthy eating (N=13) and being active (N=12). Dietitian-led interventions were the most commonly used (N=5) among studies that reported positive outcomes. Problem solving (N=9) and didactic education (N=9) were the most commonly cited in studies with positive outcomes, whereas studies without positive outcomes cited didactic education (N=6) and individual care plans (N=6) most frequently. Of studies that used non-diabetes specific QOL measurement tools (N=20), only 45% (N=9) demonstrated positive QOL outcome, whereas 64% (N=7) of the studies that used diabetes specific QOL measurement tools (N=11) demonstrated positive QOL outcomes. CONCLUSIONS: The majority of patient activation interventions improve QOL in adults with type 2 diabetes, in particular when assessed with diabetes specific QOL instruments. Future interventions targeting improvements in QOL should consider using patient activation interventions.

DOCTOR SHOPPING BY OVERWEIGHT AND OBESE PATIENTS IS ASSOCIATED WITH INCREASED HEALTHCARE UTILIZATION Kimberly Gudzune1; Sara N. Bleich1; Thomas M. Richards1; Krista Hodges2; Jonathan Weiner1; Jeanne Clark1. 1Johns Hopkins, Baltimore, MD; 2Healthways Hawaii LLC, Honolulu, HI. (Control ID #1320754)

BACKGROUND: Negative interactions with healthcare providers may lead patients to switch physicians or doctor shop. We hypothesized that overweight and obese patients would be more likely to doctor shop, and as a result, have increased rates of emergency department (ED) visits and hospitalizations as compared to normal weight non-shoppers. METHODS: We combined claims data from a single health plan with information from beneficiaries health risk assessments. The primary outcome was doctor shopping, which we defined as having claims for visits with 5 different primary care physicians (PCPs) during a 24-month period. The independent variable was NIH standard categories of weight by BMI. We performed multivariate logistic regression to evaluate the association between weight categories and doctor shopping. We conducted multivariate zero-inflated negative binominal regression to evaluate the association between weight-doctor shopping categories with counts of ED visits and hospitalizations. All regression models were adjusted for age, sex, survey year, mental health diagnosis, and co-morbid disease severity.

RESULTS: Of the 20,726 beneficiaries, the mean BMI was 26.3 kg/m2 (SD 5.1), mean age was 44.4 years (SD 11.1) and 53% were female. As compared to normal weight beneficiaries, overweight beneficiaries had 23% greater adjusted odds of doctor shopping (OR 1.23, 95%CI 1.04-1.46, p=0.02) and obese beneficiaries had 52% greater adjusted odds of doctor shopping (OR 1.52, 95%CI 1.26-1.82, p<0.01). As compared to normal weight non-shoppers, overweight and obese shoppers had significantly higher rates of ED visits (IRR 1.85,

95%CI 1.37-2.45, p<0.01; IRR 1.83, 95%CI1.34-2.50, p<0.01, respectively), but not hospitalizations (IRR 1.72, 95%CI0.82-3.62, p=0.15; IRR 1.92, 95%CI 0.93-3.96, p=0.08, respectively). CONCLUSIONS: Frequently changing PCPs may impair continuity of care for overweight and obese patients and result in increased healthcare utilization.

DOES PCP SUPPORT CONTRIBUTE TO WEIGHT MAINTENANCE EFFORTS FOLLOWING LIFESTYLE INTERVENTION? Molly B. Conroy1; Kathleen Spadaro2; Kathleen Sward1; Irina Karpov1; Dana L. Tudorascu1; Wishwa N. Kapoor1. 1University of Pittsburgh, Pittsburgh, PA; 2Chatham University, Pittsburgh, PA. (Control ID #1327113)

BACKGROUND: Unfortunately, weight regain and return to sedentary behavior are very common after lifestyle interventions. Little is known about specific strategies and behaviors that may be used to maintain weight and physical activity (PA) following a lifestyle intervention, and in particular, the contribution of primary care provider (PCP) support to such efforts. METHODS: Data were gathered from the Healthy Bodies, Healthy Hearts Study, in which 99 inactive women aged 45-65 with BMI30 were recruited from 3 primary care clinics associated with the University of Pittsburgh. Participants were randomized to a 12-week, in-person activity intervention program (IP) or to a self-guided, at-home (AH) intervention. At the one-year follow-up assessment, participants were weighed by a research assistant and completed a survey assessing maintenance strategies used in the past 6 months. Physical activity levels were measured with the one-month version of the Modifiable Activity Questionnaire. Strategies were categorized as self-monitoring, group/commercial support, behavioral skills, and professional support, with the last category including PCP support. PCP support items were general discussion, encouragement, more frequent visits, diet counseling, PA counseling, referral to health educator, and referral to commercial program. Chi-square tests were used to determine differences in frequency of strategies by intervention group. Wilcoxon tests were used to compare change in weight and PA by use of strategies. RESULTS: Data was available from 83 women (84% of sample). Mean (SD) age was 53.6 (5.0) years at baseline and 34% were black. Mean baseline weight was 92.6 (18.6) kg. Mean weight loss at one year was -1.3(5.5) kg. Participants reported using a high number of maintenance strategies in the past 6 months: 65% reported self-monitoring, 69% reported group/commercial support, 98% reported behavioral skills and 72% reported professional support. 64% of participants reported discussion with PCP. Most (54%) participants received encouragement from PCP, but fewer received specific dietary (40%) or physical activity (38%) counseling. 24% were referred by PCP to health educator, but few were asked to come for more frequent visits (11%) or referred to a commercial program (4%). PCP support did not differ by intervention arm and was not related to weight or PA change outcomes at one year.

CONCLUSIONS: Women who had recently participated in a lifestyle intervention reported frequent use of maintenance strategies at one year after randomization, including PCP support. However, PCP support was not associated with weight or physical activity outcomes, consistent with literature suggesting low- to moderate-intensity counseling has limited efficacy in weight management. It remains to be seen whether more intensive PCP support could be effective in maintenance efforts.

DOES PATIENT NAVIGATION IMPROVE TIME TO DIAGNOSTIC RESOLUTION OF ABNORMAL MAMMOGRAMS AMONG DEPRESSED VULNERABLE WOMEN? Andrea Kronman1; Ignacio DeLaCruz1; Karen Freund1,3; Sharon Bak1; Cynthia Schoettler1; Timothy Heeren2; Tracy Battaglia1. 1Boston University School of Medicine, Boston, MA; 2Boston University School of Public Health, Boston, MA; 3TUFTS University, Boston, MA. (Control ID #1338261)

BACKGROUND: Depression is more common in women, lower socioeconomic groups, certain racial/ethnic minorities, and is associated with higher breast cancer mortality. Patient navigation has been shown to improve access to timely cancer care in a patient-centered manner, by identifying and helping to overcome barriers to healthcare in vulnerable populations. Our objective is to determine if patient navigation improves time to diagnostic resolution after abnormal mammograms for vulnerable women who are depressed.

METHODS: The Boston University Patient Navigation Research Program provided navigation for all patients who had an abnormal screening mammogram in 3 inner-city community health center (CHC) 2007-2008, while another 3 CHCs served as control sites and received usual care. A woman was categorized as depressed if depression was recorded in her

medical record during the 12 months preceding the screening test abnormality. All women were followed for 12 months to determine if they completed diagnostic evaluation. Demographic characteristics of depressed and non-depressed women were compared through chi-square tests. Differences between the time to resolution of depressed women in the control group and depressed women in the navigated group were tested using Cox Proportional time to event analysis, and described with hazard ratios and 95% confidence intervals.
RESULTS: Among 1299 women with abnormal mammograms, 17 % were depressed, 12 % had anxiety. Most of the women were non-White: 28% Hispanic, 35% Black, and 11% Vietnamese; English was the primary language in 58%, and less than one third had private health care insurance. Depression was positively associated with white race and Hispanic ethnicity (P<0.01), English and Spanish language (P <0.001), older age (P =0.03), anxiety (P<0.001), and public health insurance status (P<0.001); and negatively associated with no insurance status (P<0.001). Among depressed women (N=221), there was no significant difference in time to resolution between navigated and control patients (HR=0.96 (0.73, 1.3) p=0.8). CONCLUSIONS: Depression is common in vulnerable women needing diagnostic testing for abnormal cancer screening. In this preliminary analysis among women with depression, patient navigation did not significantly improve time to diagnostic resolution after abnormal breast cancer screening, even after adjusting for demographics and insurance status. These results suggest that patient navigators may need additional training to accommodate the needs of depressed patients in order to impact health outcomes. This analysis was limited by the small sample size, which limited adjusting for all relevant covariates. Future analyses will use a larger sample size, and adjust for variations within CHCs, interactions with anxiety, time-dependent covariates, and depression treatments.
DOES SEVERITY OF MENTAL HEALTH SYMPTOMS AFFECT QUIT RATES IN SMOKING CESSATION TELEPHONE COUNSELING? Juan E. Arevalo1; Nicholas Lanzieri1; Erin Rogers1,2; Scott Sherman1. 1New York University, New York, NY; 2VA New York Harbor Healthcare System, New York, NY. (Control ID #1331057)
BACKGROUND: Proactive telephone-based smoking cessation counseling is an emerging approach to helping mental health patients quit smoking, and it is unclear whether all patients benefit equally. We examined whether mental health patients enrolled in a telephone smoking cessation program with higher Global Assessment of Functioning (GAF) scores had better quit rates at 6 month follow-up compared to mental health patients with lower GAF scores.
METHODS: We analyzed preliminary data from a multi-site VA study implementing a telephone care coordination program for smokers with mental illness. VA providers referred smoking patients to the program via a CPRS consult, and 366 referred patients enrolled in the program. We randomized participants to receive counseling from either a state Quitline or a VA counselor. We collected patient GAF scores through the CPRS system for those enrolled in counseling using the most recent GAF score received prior to their program enrollment date. Based upon the GAFs definition of functionality and of what constituted serious impairment of functioning, we categorized GAF scores above 50 as high functioning and scores 50 and below as low functioning. Patients completed a phone survey at 6 months that assessed their 30-day point prevalence abstinence.
RESULTS: GAF scores were available for 103/180 patients who had enrolled in counseling and completed the 6 month follow-up. Of those patients, 70 (68%) had high GAF scores and 33 (32%) had low GAF scores. At 6-

month follow-up, 33/103 (32%) had quit smoking. There was no difference in abstinence rates between the high and low functioning GAF groups (33% versus 30%, OR=1.13, 95%CI=0.46-2.75). The GAF score was completed on average 125 days before the smoking cessation referral, and there was no significant difference in the interval between the high GAF and low GAF groups (99 vs. 181 days; p>.05). CONCLUSIONS: The telephone smoking cessation program produced excellent long-term abstinence rates and was equally effective for persons with mental illness who have high and low GAF scores. Telephone cessation counseling is effective for mental health patients regardless of their GAF scores. Mental health providers should not use severity of mental health symptoms in determining who would be appropriate for tobacco cessation treatment.

DOES TRANSITION TO A PATIENT CENTERED MEDICAL HOME EFFECT TEAMWORK AND BURNOUTAT RESIDENCYAND NONRESIDENCY CLINICS SIMILARLY? Erin J. Goss1; Jason Fletcher2; Claudia Lechuga2; Paul Meissner2; David Lounsbury2; Arthur Blank2; Diane McKee2. 1Montefiore Medical Center, Bronx, NY; 2Albert Einstein College of Medicine, Bronx, NY. (Control ID #1339561)

BACKGROUND: Patient Centered Medical Home (PCMH) pilot projects have shown that practice transformation, especially to team-based care, is challenging. Projects have described the experience of providers and staff at both independent and residency clinics, however we found no studies comparing outcomes of practice transformation among clinics with and without residents. We observed previously that staff at resident clinics within our institution report lower levels of teamwork than non-teaching clinics. Currently two pilot clinics are one-year into PCMH transition. Our objective is to evaluate change over time in perceived teamwork and burnout among staff at pilot clinics relative to comparison clinics, and at teaching relative to non-teaching clinics.

METHODS: Two pilot ambulatory clinics (1 with residents), and 4 comparison clinics (2 with residents), are included in this study. Over the past year, PCMH pilot clinics have received support from a PCMH facilitator, added support staff, redistributed tasks, and instituted team huddles. Staff (including clinical and clerical staff) completed a survey at baseline and year 1, which included the Healthcare Team Vitality Instrument (HTVI) and Burnout Self Report - a 15-item questionnaire where higher scores indicate more burnout. Both are rated on a 1-5 Likert scale and the ten-question HTVI was adapted to the outpatient setting. Using validated methods, factor scores were calculated for support structures, engagement and empowerment, patient care transitions, and team communication. Results from the Burnout Self Report and HTVI factors were compared between baseline and year 1 at pilot and comparison clinics using t tests. The Maslach Burnout Inventory - General Survey, added at year 1, was analyzed within 3 subscales of professional efficacy, exhaustion, and cynicism. Results from resident and nonresident clinics, as well as between pilot and comparison clinics were compared using t tests. RESULTS: To date, 196 employees responded to the year 1 survey (76 from pilot clinics; 117 from comparison clinics), compared to 335 responses to the baseline survey. At year 1, resident clinics have significantly higher levels of exhaustion (13.7 vs. 8.4; p<0.001) and cynicism (8.9 vs 5.0; p<0.001) on the Maslach than non-teaching clinics; there were no differences in the professional efficacy subscale (p>0.05). No significant differences were observed between pilot and comparison clinics on Maslach subscales. Compared to baseline, intervention clinics did not significantly improve in regards to mean scores on the Burnout Self Report (40 vs 37.5) or HTVI factors of support structures (3.70 vs. 3.56), empowerment (3.18 vs 3.2), care transitions (3.18 vs 3.17), or team communication (4.01 vs 3.82; p>0.05 for all). Similarly there were no improvements at comparison clinics (p>0.05). CONCLUSIONS: While resident clinics demonstrate higher levels of burnout, neither pilot clinic showed improvement in teamwork or burnout at 1 year. These results, although disappointing, generate further questions. Early survey respondents may differ from clinic staff as a whole and skew our results. Negative effects from practice disruption may have obscured the benefits from interventions intended to improve teamwork within the PCMH model. Alternatively, interventions at our pilot clinics may truly not improve staff perceptions of teamwork at one year. Further analysis is needed to determine the barriers to teamwork at teaching and non-teaching clinics.

DOES A BITE CAUSE CANCER? MISPERCEPTIONS OF BREAST CANCER ETIOLOGY AMONG LOW-INCOME URBAN WOMEN. Erin N. Marcus1; Noella Dietz2. 1University of Miami Miller School of Medicine, Sylvester Comprehensive Cancer Center, Miami, FL; 2University of Miami Miller School of Medicine, Miami, FL. (Control ID #1337724)

BACKGROUND: Adequate patient understanding is an important component of shared decision making (SDM) in the screening, diagnosis and

treatment of breast cancer. Health beliefs about the causes of cancer may influence womens perceptions of their personal cancer risk and ability to participate effectively in SDM. The objective of this qualitative study is to describe the beliefs of a cohort of urban low-income women regarding the causes of breast cancer.

METHODS: A convenience sample of 34 women was recruited in the community to participate in 4 focus groups, each of which was led by an African-American female moderator. All of the women had undergone mammogram screening within the past 2 years. None had ever been diagnosed with cancer. The overarching purpose of the focus groups was to explore the womens experiences learning of their mammogram results and elicit their preferences for how they would like to learn of their results. Focus group discussions were audiotaped and transcribed. Two investigators separately performed a thematic analysis of the transcripts using an immersion and crystallization approach. RESULTS: 36 women participated in the study. 85 % (n=29) self-identified as black or African-American. 39 % (n=14) qualified for Medicaid; 36% (n=13) reported that they lacked insurance. 56 % (n=20) reported an annual income of less than $10,000. 38% (n=13) reported that they needed help reading health materials, a marker of low health literacy. A prominent theme that emerged in the discussion was an uncertainty of why women develop breast cancer. Many participants stated that they believed that certain foods, infections, bites, trauma, large breast size, and sexual activity could cause breast cancer. Even though all the women had undergone mammography screening, many voiced skepticism about mammographys effectiveness in women with no obvious symptoms of breast cancer.

CONCLUSIONS: Despite widespread educational campaigns about mammography, misperceptions about the causes of breast cancer still exist among low-income urban women. The effect of these misperceptions on screening and treatment behavior is unclear. Nonetheless, these beliefs may serve as a barrier to successful SDM regarding cancer screening, diagnosis, and treatment. Clinicians should be cognizant of possible misperceptions among their patients when discussing breast cancer with them. Educational media about breast cancer should seek to dispel such beliefs. Additional research is needed to elucidate the role of these beliefs in shaping patient behavior about breast cancer screening and treatment.

DOES DOCUMENTATION OF CHRONIC KIDNEY DISEASE ON A PATIENTS PROBLEM LIST CORRELATE WITH HIGHER QUALITY CARE? Lipika Samal1; Adam Wright1; David W. Bates1,2.
1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA. (Control ID #1319137)

BACKGROUND: Most electronic health records allow for maintenance of a discrete clinical problem list. Such problem lists can be used for patient care, clinical decision support, quality measurement and research, but problem list accuracy is variable. Chronic kidney disease (CKD) is asymptomatic, but carries high morbidity and mortality in late stages. We hypothesized that problem list documentation of CKD may be associated with higher quality care because it is an explicit marker of recognition of the disease and because it prompts stage-appropriate monitoring and treatment for CKD. We assessed the relationship between problem list documentation and quality of care. METHODS: We obtained problem list, medication list, and laboratory data on adult patients seen in 12 Brigham and Womens Hospital-affiliated primary care practices. We included 3,149 patients with stages 3 or 4 CKD (defined as two past estimated glomerular filtration rates (eGFR) 15-60 mL/min/1.73 m2) who also had at least one primary care visit during 2009. We examined the association of demographic characteristics and comorbidities with problem list documentation using the chi-squared test. We assessed the association of problem list documentation with five outcomes: 1) annual serum eGFR test, 2)

annual urine protein test, 3) an ACE/ARB prescription, 4) mean systolic blood pressure, and 5) blood pressure control<130/80 mmHg. We used multivariable logistic regression to adjust for confounders.
RESULTS: Only 496/3149 patients had CKD on the problem list (16%). Problem list documentation was more likely in patients with lower mean eGFR (38 vs. 48 mL/min/1.73 m2), male gender (53% vs. 32%), black race (29% vs. 22%), hispanic ethnicity (10% vs. 8%), diabetes (40% vs. 25%), or hypertension (78% vs. 65%). We performed a multivariate analysis of race/ ethnicity and problem list documentation and found that there was no significant association after controlling for diabetes and hypertension. Problem
list documention was significantly positively associated with annual serum eGFR measurement before (98% vs. 93%, p<0.0001) and after adjustment for eGFR, gender, race, diabetes and hypertension (98% vs. 95%, p=0.03), annual urine protein measurement before (48% vs. 29%, p<0.0001) and after adjustment (49% vs. 42%p=0.04), as well as ACE/ARB prescription before (75% vs. 64%, p<0.0001) and after adjustment (82% vs. 77%, p=0.02). Problem list documentation was not associated with mean blood pressure or blood pressure control in unadjusted or adjusted analyses. CONCLUSIONS: Problem list documentation was poor for chronic kidney disease. Severity of disease, demographic characteristics, and comorbidities were associated with problem list documentation. We found that patients with CKD on the problem list were more likely to undergo monitoring of serum eGFR and to receive ACE/ARB, but they were not more likely to have blood pressure under control. In the future, clinical decision support may improve recognition of CKD, for example by automatically flagging patients with sustained low eGFR, and may also improve stage-appropriate monitoring and treatment for CKD.
DOES IMPROVING THE EDUCATIONAL ENVIRONMENT REDUCE ADOLESCENT SUBSTANCE USE AND EXPOSURE TO SUBSTANCE-USING PEERS? RESULTS FROM A NATURAL EXPERIMENT. Mitchell D. Wong1; David Kennedy2; Martin F. Shapiro1; Richard Buddin2; Paul Chung3; Rebecca Dudovitz3; Arleen Brown1; Karen Coller1. 1David Geffen School of Medicine at UCLA, Los Angeles, CA;
2RAND, Los Angeles, CA; 3David Geffen School of Medicine at UCLA, Los Angeles, CA. (Control ID #1340138)
BACKGROUND: The link between wealth and health is well documented in observational studies, but few randomized trials have been conducted to improve health through interventions targeting socioeconomic status. Despite the obvious challenges of trying to improve socioeconomic conditions, our nations public schools may be one of the few social institutions with the potential to create large, long-term reductions in poverty and socioeconomic disparities. Encouragingly, innovative educational programs have recently demonstrated remarkable results in improving educational achievement among low-income minorities, suggesting that reducing poverty through education may be more possible than commonly believed. This study examines whether adolescents randomly selected to attend an academically successful charter high school report lower substance use, and less exposure to substance-using peers, compared to control school students attending poorly performing public high schools. METHODS: This study takes advantage of a natural experiment in Los Angeles in which students applied to attend one of the three high-performing charter high schools and were randomly selected via a lottery admissions process. The charter schools in our study, which are located in very low income neighborhoods in Los Angeles, have graduation rates around 90% compared to 30-50% in nearby public schools. Analyses compare 498 students selected to attend a charter school (Experimental Group) vs. 437 who were not selected (Control Group). Students were excluded from analyses if they went to other charter or private schools. Intent-to-treat analyses were used to compare the two groups on their personal social network characteristics (based on naming 20 network members and then answering follow-up questions about each network member to identify same-aged peers and substance use by network members), as well as their own past month alcohol, cigarette, and drug use. RESULTS: Students in the Experimental and Control Groups attended schools with an average California standardized test score of 751 and 685, respectively (Academic Performance Index score 0-1000 scale with higher scores indicating better performance). The two groups were

similar in terms of race/ethnicity, gender, language preference, and parental education and income. The Experimental Group reported a greater number of same-aged peers in their network who drank (6.10 vs. 5.50, p<.001) and used drugs (3.83 vs. 3.27, p<.001) compared to the Control Group. However, there were no group differences with respect to students 30-day rates of smoking cigarettes (11% vs. 9%, p=0.31), alcohol use (33% vs. 34%, p=0.93), and marijuana use (21% vs. 21%, p=0.91). An important caveat to these findings is that the Control Group was more likely to refuse participation (27.7% vs. 18.1%) and difficult to find (20.2% vs. 9.6%) compared to the Experimental Group. CONCLUSIONS: Although being in more academically rigorous and successful school environment was associated with greater exposure to

peer network alcohol and drug use, students in this environment were not more likely to engage in substance use. Although limited by differential consent and participation rates, results from this study suggest that improving an adolescents educational environment might buffer students from pro-drug network influences.

DOES PRIMARY CARE MANAGEMENT OF CHRONIC KIDNEY DISEASE DIFFER FROM CO-MANAGEMENT WITH NEPHROLOGY? Lipika Samal; Adam Wright; Joseph V. Bonventre; Jeffrey A. Linder. Brigham and Women's Hospital, Boston, MA. (Control ID #1319268)

BACKGROUND: Primary care physicians (PCPs) commonly manage early stage chronic kidney disease (CKD). We sought to determine whether patients managed solely by PCPs receive better or worse quality care than patients co-managed with nephrologists.

METHODS: We obtained data on 3,149 adults with stages 3 or 4 CKD (defined as two estimated glomerular filtration rates [eGFR] 15-60 mL/min/1.73 m2 measured three months apart) with at least one visit to a PCP in the Brigham and Womens Primary Care Practice-Based Research Network practice during 2009. We identified patients managed solely by a PCP and patients who had at least one visit with a nephrologist and compared number of PCP visits, demographic characteristics, eGFR value, and co-morbidities between the two groups. We assessed the relationship of nephrology co-management with five quality measures: 1) annual serum eGFR test, 2) annual urine protein test, 3) ACE/ARB prescription, 4) mean systolic blood pressure, and 5) blood pressure control (< 130/80 mmHg). For each measure, we used multivariable logistic or linear regression to adjust for confounding factors and we present adjusted percentages and means.

RESULTS: Fourteen percent of patients (453/2923) adults with stage 3 and 4 CKD were co-managed with a nephrologist. Solo PCP management was associated with older patient age (75 vs. 68 years), higher eGFR (48 vs. 35 mL/ min/1.73 m2), fewer PCP visits (3.9 vs. 4.8), female gender (66% vs. 54%), white race (68% vs. 52%), less diabetes (25% vs. 43%), and less hypertension (66% vs. 74%;all comparisons, p<0.01). PCP solo management was significantly associated with less annual serum eGFR testing (93% vs. 100%, p<0.0001), a relationship that persisted after adjustment for number of PCP visits, age, gender, race, eGFR, diabetes, and hypertension (96% vs. 100%, p=0.002). Solo PCP management was associated with less annual urine protein testing before (25% vs. 74%, p<0.0001) and after adjustment (35% vs. 80%, p<0.0001). Solo PCP management was associated with fewer patients given an ACE/ARB prescription (63% vs. 77%, p<0.0001), but not after multivariable adjustment (74% vs. 78%, p=0.13). Solo PCP versus nephrology co-management was not associated with a difference in mean systolic blood pressure in unadjusted analysis (133 mmHg vs. 132 mmHg, p=0.32), but after adjustment the systolic blood pressure of co-managed patients was significantly lower (131 mmHg vs. 129 mmHg, p=0.04). Solo PCP versus nephrology co-management was not associated with likelihood of BP control <130/80 mmHg in crude (43% vs. 47%, p=0.09) or adjusted analyses (49% vs. 53%, p=0.17). CONCLUSIONS: Though only 14% of patients were co-managed with nephrology, quality of care for primary care patients with CKD was generally better with nephrology co-management. Specifically, nephrology co-management was associated with better stage-appropriate monitoring and marginally lower mean blood

pressure, but not a higher rate of blood pressure control. To improve the quality of care for CKD patients, we should develop and evaluate strategies - for example, education, feedback, or clinical decision support - to facilitate referral and co-management with nephrology as well as improve stage-appropriate monitoring and treatment in primary care.

DOES PROVIDING ACCESS TO SPECIALTY CARE TO AN UNINSURED POPULATION REDUCE ED UTILIZATION? Lauren Block1; Sai Ma2; Matthew Emerson3; Anne Langley3; Desiree M. de la Torre3; Gary Noronha4. 1Johns Hopkins University School of Medicine, Baltimore, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 3Johns Hopkins Medicine, Baltimore, MD; 4Johns Hopkins Community Physicians, Baltimore, MD. (Control ID #1321075)

BACKGROUND: Nationally, the annual number of emergency department (ED) visits increased 23% between 1997 and 2007. Higher utilization

rates of ED services by the uninsured has been identified as a possible contributor to this increase. We hypothesized that care coordination and access to specialty care services provided by The Access Partnership (TAP) program would reduce ED utilization among uninsured patients with a usual source of primary care. We further hypothesized that while rates of inpatient admission would not change significantly, TAP patients would have fewer non-necessary ED visits that did not result in admission. METHODS: We conducted a retrospective cohort study to examine rates of monthly ED utilization and inpatient admission among TAP patients and a comparison group of eligible patients who were referred to the program but did not enroll. Administrative data on ED visits and inpatient hospitalization was used to examine monthly ED utilization and inpatient admission rates for both groups before referral to TAP and subsequent to referral, within a study period 2007-2011. Difference-in-differences estimation and multivariate linear regression were used to compare TAP and non-TAP patients, while adjusting for demographic and socioeconomic factors.

RESULTS: During the first 21 months of the program, 673 patients were referred to TAP. 374 patients joined the program (the treatment group), and the other 299 patients did not join the program (the comparison group). Rates of ED visits per month increased in both groups, from 0.039 to 0.051 (difference post-pre=0.012) visits per month among TAP patients and 0.057 to 0.083 (difference post-pre=0.026) visits per month among non-TAP patients. Difference-in-difference of monthly ED use comparing TAP with non-TAP patients was 0.014 (p=0.15). Among heavy users with at least one visit per three months, ED utilization declined among TAP patients (difference post-pre=-0.012) and increased among non-TAP patients (difference=0.022, p=0.16). Among the subgroup of ED visits that did not result in inpatient admissions, the number of visits per month was relatively constant among TAP patients (difference post-pre=0.006), whereas the rate increased among non-TAP patients (difference=0.023). Difference-in-difference comparing TAP with non-TAP patients was 0.017 (p=0.05). Non-TAP status was a moderate predictor of ED visits not leading to admission, after controlling for age, gender, and zip code (t=2.01, p=0.045). CONCLUSIONS: Our evaluation finds some promising evidence that a program combining access to specialty care services with care coordination may help shift utilization patterns relative to a comparison group of patients who did not enroll in the program. A longer study period may help obtain stronger indications of decreased ED use.

DOES THE KNOWLEDGE OF PATIENT READMISSIONS AFFECT HOSPITALISTS ATTITUDES OR BEHAVIOR? JenniferE. Bracey1,4; Scott Wright2,4; Regina Landis1; Romsai T. Boonyasai3,4. 1Johns Hopkins Bayview Medical Center, Baltimore, MD; 2Johns Hopkins Bayview Medical Center, Baltimore, MD; 3Johns Hopkins University School of Medicine, Baltimore, MD; 4Johns Hopkins University School of Medicine, Baltimore, MD. (Control ID #1338968)

BACKGROUND: Hospitalists are often not aware when a patient for whom they have provided care is rehospitalized. Yet, there may be much to learn from readmissions, both in terms of clinical care and systems improvement. To address this concern, we conducted an intervention to inform hospitalists when their patients were readmitted. We hypothesized

that doing so would improve hospitalists clinical care and communication behaviors.
METHODS: This IRB approved intervention was conducted at a 365 bed teaching hospital. Over a 12 week period, all hospitalists involved with a patients care (admission, in-house follow-up care, or discharge) were electronically notified if the patient was rehospitalized within 30 days of discharge from the hospitalist service. The electronic notification linked to a website where a research assistant had uploaded clinical summaries and patients responses to a bedside interview conducted during their rehospitalization. We evaluated this intervention by surveying participants attitudes and self-reported behaviors before and after the intervention. All responses were collected on a 5-point Likert scale. For analytic purposes, we dichotomized responses to compare the 2 highest responses (always and often or strongly agree and agree) with the remaining responses. Comparisons were analyzed using Chi-square tests.
RESULTS: During the study period, 194 notifications involving 82 rehospitalized patients were sent. Hospitalists viewed 134 of these notifications (68%). Twenty-seven hospitalists (100%) at our institution completed the pre- and post-intervention surveys. Thirteen (48%) were male and 20 (74%) had worked within the hospitalist group for>1 year. Results from the survey are shown in Table I. CONCLUSIONS: Self-reported care coordination practices, including communication with patients, PCPs, and nurses improved following this intervention. However, hospitalists attitudes and behaviors related to giving and receiving feedback about their clinical practice did not change. Yet, hospitalists could learn from one another. Future provider notification systems of patient readmissions should foster the sharing of best practices and feedback amongst colleagues.
Table I
Variable Pre n (%)
Post n (%)
DUCTAL CARCINOMA IN SITU: KNOWLEDGE OF ASSOCIATED RISKS AMONG LATINAS AND NON-LATINA WHITES Leah Karliner1,2; Anna M. Napoles1,2; Celia Kaplan1,2. 1UCSF, San Francisco, CA; 2UCSF, San Franicsco, CA. (Control ID #1334627)
BACKGROUND: Since the advent of mammography screening for breast cancer, ductal carcinoma in situ (DCIS) has become a common diagnosis, accounting for almost one-third of breast cancers. While DCIS is not life-threatening, it can progress to invasive disease if left untreated and does confer a higher risk of future breast cancer. Several treatment courses are possible and understanding the disease is crucial for women to deciding the optimal treatment course. Among women with DCIS, we investigated their knowledge of DCIS and whether knowledge differed by language and ethnicity. METHODS: Telephone interviews of California Latina and non-Latina White women diagnosed with DCIS between 2002-2005. We examined participants knowledge of DCIS with four true/false statements about DCIS. The four statements were: This type of breast problem is not itself life-threatening, Women with this type of breast problem have more chances of developing breast cancer in the future, If untreated, this type of breast problem can become invasive cancer, and The chances of dying from the breast problem are the same for women who have a mastectomy and for those who have a lumpectomy with radiation. We modeled the odds of giving a correct answer for each question by ethnicity-language (Latina English-speakers, Latina Spanish-speakers, white English-speakers) and surgical treatment type (lumpectomy or mastectomy), adjusting for family history of breast cancer, educational attainment, age, insurance, geographic region in California, time since diagnosis to interview, and having sought out a second-opinion.
RESULTS: Of 710 participants, 52% (n=368) were white English-speakers, 21% (n=152) Latina English-speakers, and 27% (n=190) Latina Spanish-speakers. Overall, 67% had undergone lumpectomy and 33% mastectomy. Less than half (41%) of participants were aware that DCIS is not life-threatening and only 32% knew that mortality risk is the same for mastectomy and lumpectomy plus radiation; whereas two-thirds (67%) were aware that DCIS confers increased risk of future breast cancer, and almost all (92%) knew that it could become invasive if not treated. In adjusted analyses, compared to White English-speakers, both Latina English-

and Spanish-speakers had significantly lower odds of knowing that their DCIS was not life-threatening. In contrast, compared to white English-speakers, Latina Spanish-speakers had more than two-fold higher odds of knowing that DCIS increases risk of future breast cancer, but English-speaking Latinas were no different from English-speaking whites. Surgical treatment type was not associated with knowledge. CONCLUSIONS: Our data suggest that physicians diagnosing and treating women with DCIS are more successful at conveying the risks conferred by DCIS than the nuances of the difference between DCIS and invasive cancer. This uneven communication is most marked for Spanish-speaking Latinas. Efforts are needed to create culturally and linguistic standardized information for DCIS patients.

p

Usually or always contact the primary care provider (PCP) after patient's discharge

2 (7) 8 (31) 0.01

Usually or always ask patient to repeat what you discussed at discharge

3 (11) 7(27) 0.04

Usually or always discuss discharge plan with patient's nurse

14 (52) 20 (77) 0.05

Usually or always communicate with readmitting provider

11 (41) 5 (19) 0.01

Usually or always ask for feedback from colleague about the medical care you provided

2 (7) 1 (4) 0.5

Usually or always give feedback to colleague about the medical care they provided

1 (4) 0 (0) 0.17

A lot or complete comfort in giving feedback to colleague

8 (29) 6 (23) 0.13

A lot or complete comfort in asking for feedback from colleague

12 (45) 13 (50) 0.09

A lot or complete confidence that nursing will complete assigned task

10 (37) 14 (54) 0.05

DUPLICATE FEDERAL EXPENDITURES FOR DUAL ENROLL-EES IN MEDICARE ADVANTAGE PLANS AND THE VETERANS AFFAIRS HEALTH CARE SYSTEM Amal N. Trivedi1,2; Regina C. Grebla2; Lan Jiang2; Jean Yoon3; Vincent Mor1,2; Kenneth Kizer4. 1Alpert Medical School of Brown University, Providence, RI; 2Providence VA Medical Center, Providence, RI; 3Palo Alto VA Medical Center, Palo Alto, CA; 4UC Davis, Sacramento, CA. (Control ID #1339259)

BACKGROUND: When eligible adults simultaneously enroll in a Medicare Advantage (MA) plan and the Veterans Affairs health care system (VA), MA plans receive federal subsidies to insure veterans who receive health services from another taxpayer-funded health system. Using national data from 2004 to 2009, we quantified the prevalence of dual enrollment in VA and MA, the concurrent use of medical and surgical services in each setting, and the costs of Medicare-covered services incurred by the VA to care for MA enrollees.

METHODS: We merged VA and MA administrative data to derive the national population of veterans with at least one month of simultaneous enrollment in an MA plan during the study period. To estimate the cost of VA services, we used VA HERC average cost methods and the VAs direct payments for third party and pharmaceutical care. We inflation-adjusted all cost estimates using the CPI-U. We determined the demographic characteristics and use of services among: (1) exclusive VA users, (2) VA - MA dual users, (3) exclusive MA users, and (4) non-users. We used Chi-square and ANOVA tests to determine whether characteristics differed

among these groups. For each dual user, we calculated the proportionate reliance on VA inpatient and outpatient care. A sensitivity analysis excluding 9% of beneficiaries who enrolled in their MA plan after January or exited their MA plan prior to December yielded similar findings.
RESULTS: The number of persons concurrently enrolled in the VA and Medicare Advantage increased from 485,651 in 2004 to 924,792 in 2009. Over 60% of dual enrollees used VA health care services each year. In 2009, 11% of all VA enrollees and 8% of all MA enrollees were dually enrolled. The total inflation-adjusted cost of VA care for MA enrollees was $12.4 billion over 6 years, increasing from $1.0 billion to $3.2 billion. Among VA users enrolled in MA plans, the mean annual non-drug spending increased from $3,151 in 2004 to $4,703 in 2009. Among dual enrollees, 10% exclusively used the VA for outpatient and acute inpatient services, 38% exclusively used the MA plan, 48% used both the VA and MA, and 3% received no services. Compared to dual users and exclusive MA users, exclusive VA users were more likely to be black, reside in the south, and have more intensive use of outpatient visits and acute hospital care ($p<0.001$ for each comparison). The VA financed 45% of outpatient visits, 19% of acute medical admissions, 24% of acute medical hospital days, 11% of acute surgical admissions, and 10% of acute surgical inpatient days. In 2009, the VA submitted collection requests totaling $52.3 million on behalf of care provided to MA enrollees. Of these requests, the VA collected $9.4 million from MA plans, representing 0.3% of the total cost of care for this population.
CONCLUSIONS: From 2004 to 2009, the VA spent a substantial and rapidly increasing amount of funds to care for enrollees in MA plans. Because the federal government simultaneously pays MA plans to provide comprehensive care, policymakers should consider measures to identify and eliminate these duplicative expenditures.

DUTY HOURS 2.0: EFFECT OF THE ACGME 16-HOUR RULE ON QUALITY AND EFFICIENCY OF CARE

Neesha N. Choma; EduardE. Vasilevskis; Kelly C. Sponsler; Jacob Hathaway; Daniel G. Stover; Cecelia Theobald; Jennifer Green; Joshua Denny; Shea Polancich; NeerajaB. Peterson; Sunil Kripalani. Vanderbilt University Medical Center, Nashville, TN. (Control ID #1324596)

BACKGROUND: Effective July 1, 2011, the Accreditation Council for Graduate Medical Education reduced interns maximum consecutive hours of duty from 30 to 16. Vanderbilts Internal Medicine Residency Program instituted 16-hour duty limits for all residents in April, 2011. We compared the quality and efficiency of care delivered to non-intensive care unit (ICU) medical inpatients under the 30-hour and 16-hour duty limits.
METHODS: We defined two cohorts of patients admitted to and discharged from six internal medicine teaching services at Vanderbilt University Hospital, Nashville, TN, between July 1 and September 30, 2010 (30-hour cohort) and July 1 and September 30, 2011 (16-hour cohort). Data were extracted from the Vanderbilt Enterprise Data Warehouse (EDW) and the Rapid Response Team (RRT) Database. The EDW is a relational electronic data repository of clinical and administrative information and the RRT database is a manually maintained database of demographic and RRT/code event specific information. We compared the cohorts on indices of hospital continuity (number of handovers per week); efficiency (adjusted length of stay [LOS]); and the quality and safety of care delivery (30-day readmissions to the same facility, observed to expected mortality, in-hospital rapid response and code events, escalations of care to an ICU, and adverse events). Adverse events were defined by the number of Agency
for Healthcare Research and Quality (AHRQ) patient safety indicators and University HealthSystem Consortium (UHC) complications. Non-parametric statistical tests were conducted to compare the quality and efficiency outcomes in the two groups.
RESULTS: The 30-hour cohort included 987 patients and the 16-hour cohort included 903 patients. The 30-hour and 16-hour groups were similar in terms of age (median 53 vs.54 years), gender (51% vs. 50% male), and payor mix (78% vs. 77% Medicare or commercial insurance). The median all patient refined diagnosis related group (APR-DRG) risk of mortality was 2 (interquartile range [IQR] 1, 3) in the 30-hour cohort and 3 (IQR 2,3) in the 16-hour cohort. The structural changes made to accommodate the 16-hour duty rule more than doubled the

total number of weekly handovers across the six medicine teams (41 to 95). Adjusted LOS in days did not differ significantly (4.34 for 30-hour vs. 4.65 for 16-hour, p=0.33). No differences were seen in AHRQ patient safety indicators (5 vs. 1 per 1000 patients, p=0.13); UHC complications (34 vs.30 per 1000 patients, p=0.58); observed to expected mortality (0.23 vs.0.3, p=0.9); or all-cause 30-day readmission (19.55% vs. 19.05%, p=0.75). While there was no significant difference in the number of rapid response team calls (26 vs. 38 per 1000 patients, p=0.18) and codes (1 vs. 3 per 1000 patients, p=0.28), there was an increase in the number of escalations of care to an ICU (9 vs. 23 per 1000 patients, p=0.01) in the 16-hour cohort.
CONCLUSIONS: Despite the shortened resident duty hours and increased number of total handovers of care, we observed no statistically significant difference in the efficiency or quality of care provided to non-ICU medical inpatients. The finding of increased care escalations to an ICU needs to be further monitored from both a quality and utilization perspective. This may be due to temporal trends towards higher acuity of patients as reflected by APR-DRG risk of mortality or may represent a more proactive escalation of care.
E-LEARNING AND DELIBERATE PRACTICE FOR ORAL CASE PRESENTATION SKILLS: A RANDOMIZED TRIAL Heather L. Heiman1,2; Toshiko Uchida1,2; Craig Adams4; John Butter1,2; Elaine Cohen1; Stephen D. Persell1; Paul Pribaz4; William C. McGaghie3; Gary J. Martin1. 1Northwestern University Feinberg School of Medicine, Chicago, IL; 2Northwestern University Feinberg School of Medicine, Chicago, IL; 3Northwestern University Feinberg School of Medicine, Chicago, IL; 4Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1338669)
BACKGROUND: The oral case presentation is an essential clinical skill. A competent presentation allows for efficient transfer of information between providers, and it permits evaluation of students clinical reasoning. Medical students express anxiety about their oral presentation skills. They seek a rule-based structure to use in developing their presentations. We therefore aimed to develop and rigorously evaluate an oral presentations curriculum using on-line learning and deliberate practice to better prepare second year medical students for clinical clerkships.
METHODS: We developed a web-based, interactive oral presentation curriculum emphasizing conciseness and clinical reasoning. The curriculum consists of two components: 1) an on-line, interactive module followed by 2) deliberate practice of case presentations with detailed checklist-based feedback from a fourth-year medical student coach. To permit standardized feedback and assessment, we created a set of video cases with accompanying written physical exam reports for students to use as the basis for their presentations. Chief concerns for all cases were common primary care symptoms. Using a waitlist control design, groups of second year students were randomly assigned to receive the curriculum in December 2010 (intervention group) or in April 2011 (waitlist control group). Medical students completed presentation assessments at baseline, at a midpoint when half had taken the curriculum, and at a final point when all students had taken the curriculum. Performance of a class of students who did not receive the curriculum was also examined as a historical comparison.
RESULTS: One hundred thirty-two second-year medical students (67 in the intervention group and 65 in the waitlist control group) were evaluated

at the three time points. At the midpoint evaluation, mean scores of the intervention students improved from 60.2% to 70.1%, while scores of the waitlist control students improved from 61.8% to 64.5% ($p<0.01$ for between-group difference in improvement). At the final evaluation, the mean scores for the intervention and waitlist control students rose to 77.8% and 78.4%, respectively, as compared to 68.1% for the 142 untrained comparison students ($p<0.0001$ compared to all curriculum students). Inter-rater reliability across the content portions of the checklists was substantial at 0.73 (range 0.61-0.81).
CONCLUSIONS: This study demonstrates that a curriculum of online learning followed by deliberate practice improved performance on a reliable assessment of oral presentation skills. The curriculum is sustainable,

potentially exportable, and can be used to ensure that early medical students demonstrate competence in the case presentation before moving to the clinical environment. .

EARLY VS. LATE ACCESS TO PALLIATIVE CARE CONSULTATION: DOES IT MAKE A DIFFERENCE? Jessi Humphreys; Stephanie Harman. Stanford University, Stanford, CA. (Control ID #1333817)

BACKGROUND: Palliative care services in the United States are increasing in their prevalence but continue to vary in their implementation, with different approaches to palliative care team composition, referral policies and patient access to services. Stanford Hospitals Palliative Care Service currently depends on referrals from inpatient attending physicians, with no current policies or triggers guiding when patients are referred to palliative care. As a result, there is potential for large variability in the time similar patients may wait before being referred to palliative care. For patients who receive a palliative care consult, it is important to understand whether the timing of referrals has an impact on patient outcomes, as this can help optimize care and guide hospital policies. While some studies have found lower quality of care associated with later referrals to hospice, it is currently unknown what impact the timing of inpatient palliative care consultation has on patient outcomes.

METHODS: A retrospective analysis was done on patients with pre-existing oncologic diagnoses who received a palliative care consultation (n=1249) since the establishment of Stanford Hospitals Palliative Care Service. Multiple linear &logistic regression analyses were applied to data to look at the impact of timing of referral on patient outcomes.

RESULTS: Those oncologic patients referred to palliative care in the first week following admission had shorter lengths of stay, a greater desire to limit aggressive interventions and lower in-hospital mortality as compared to patients referred after one week. Groups were similar in terms of DNR status, level of sickness as measured by number of recent inpatient admissions, and demographic variables, except later referrals tended to be younger and were more likely to be white. Groups differed significantly in time-to-consultation and length-of-stay following consultation. Regression analyses, adjusted for demographic variables, DNR status and sickness revealed that for each day palliative care consultation was delayed, length-of-stay following the consult was associated with an increase of0.22 days ($P<0.001$). Waiting one week or more to refer a patient was associated with an overall increased length-of-stay of 2.76 days ($P<0.001$), which increased to 5.27 days ($P<0.001$) when patients who died in-hospital were removed from the data, suggesting in-hospital mortality was not independently driving the trend. Waiting one week or more to refer was associated with increased odds of a patient dying in the hospital (vs. being discharged alive) by a factor of 3.15 ($P<0.001$). Additionally, if a patient was referred in the first week, the odds of the patient deciding to limit aggressive interventions increased significantly (OR:1.7; $P<0.001$).

CONCLUSIONS: Recent studies have shown that decreased hospital length-of-stay for advanced cancer patients has been linked to increased patient quality of life, decreased hospital-acquired infection rates and decreased patient and hospital cost. If palliative care referral timing has the capacity to impact length-of-stay, and allow for potentially improved care and patient quality of life at lower cost, this argues for the design and implementation of hospital policies that encourage early referral to palliative care for advanced cancer patients.

EDUCATOR-ASSESSED SALT REDUCTION KNOWLEDGE, BUT NOT SELF-REPORTED SALT REDUCTION IS ASSOCIATED WITH REDUCED HEART FAILURE HOSPITALIZATION ChristineD. Jones1; George M. Holmes2,4; Darren A. DeWalt3,4; Brian Erman4; Victoria Hawk4; Kimberly Broucksou4; Crystal Cene3,4; Jia-Rong Wu5; David W. Baker6; Dean Schillinger7; Bernice Ruo6; Kirsten Bibbins-Domingo7; Aurelia Macabasco-O'Connell8; Michael Pignone3,4. 1University of North Carolina at Chapel Hill, Chapel Hill, NC; University of North Carolina at Chapel Hill, Chapel Hill, NC; 3University of North Carolina at Chapel Hill, Chapel Hill, NC; 4University of North Carolina at Chapel Hill, Chapel Hill, NC; 5University of North Carolina at Chapel Hill, Chapel Hill, NC; 6Northwestern University, Chicago, IL; 7San Francisco General Hospital, University of California San Francisco, San Fracisco, CA; 8University of California Los Angeles, Los Angeles, CA. (Control ID #1334412)

BACKGROUND: Patients participating in HF self-care programs are often educated about the importance of salt reduction. Yet, whether salt reduction knowledge or self-reported salt reduction is associated with HF-related outcomes is uncertain. We sought to measure the relationship between both educator-assessed salt reduction knowledge and self-reported salt intake reduction with HF hospitalizations.
METHODS: We conducted a prospective cohort study among participants who underwent intensive HF self-care training as part of a 4-site randomized trial. All participants received a 40-minute in-person training session followed by one year of ongoing telephone-based support and education on topics including salt reduction. Educator-assessed salt reduction knowledge was evaluated by a clinical educator through structured telephone assessment. Patients were considered to have achieved mastery of salt reduction knowledge once they correctly answered a series of nine questions on two separate attempts that included recognizing the effects of salt on the body, reading sodium content on food labels, and identifying foods high and low in salt. Self-reported salt intake reduction was assessed at 12 months using the following question: "How successful have you been at sticking to your plans to eat foods that are low in salt? Patients who indicated that they were very successful were categorized as having salt reduction success; those who indicated that they were somewhat or not at all successful were categorized as not having salt reduction success. We evaluated the outcome of HF hospitalization over 1 year; HF hospitalizations were determined by a masked adjudication committee. We used negative binomial regression to examine the relationship between self-reported and then educator-assessed mastery of salt reduction with the incidence of HF hospitalization, adjusted for study site, NYHA class, subjective SES, age, gender, race, literacy, HF related quality of life, systolic dysfunction, chronic kidney disease (GFR <60 mL/min), hypertension, coronary heart disease, beta-blocker use, and ACE inhibitor or ARB use.
RESULTS: Among 303 participants over one year, we identified 74 HF hospitalizations. Participants mean age was 61 years, 52% were male, 32% had NYHA Class III or IV at enrollment, and 39% were African American. At 12 months, 42% of participants who completed a survey (122 of 291) self-reported success with salt intake reduction and 76% of participants (230 of 303) had achieved educator-assessed mastery of salt reduction knowledge. We found that participants who attained educator-assessed mastery of salt reduction knowledge had an incidence rate ratio (IRR) of 0.31 (0.21, 0.46) for HF hospitalizations compared to those who did not attain mastery. Participants who reported success with salt intake reduction had an IRR of 1.11 (0.38, 3.22) for HF hospitalizations compared with those who did not report success with salt. CONCLUSIONS: We found that educator-assessed mastery of salt reduction knowledge, but not self-reported success with salt intake reduction, was associated with fewer HF hospitalizations. Mastery of how to reduce salt intake may be an important goal for self-management training programs.
EFFECT OF ELIMINATING THE MEDICARE PART D COVERAGE GAP ON HEALTH OUTCOMES OF DIABETES AND CARDIOVASCULAR DISEASE Amal N. Trivedi1,2; Chang
Liu1; Vincent Mor1,2; Alan Zaslavsky3,2; Lewis Kazis4; John Z. Ayanian3.
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BACKGROUND: Although the Affordable Care Act will phase out the Medicare Part D coverage gap over ten years at a projected total cost of $43 billion, there is little empirical evidence about the health consequences of closing this coverage gap. Using a difference-in-difference design, we examined whether enrollees age 65 and older in Medicare Advantage (MA) plans that eliminated the Part D coverage gap experienced better health outcomes compared with concurrent trends for seniors in matched control plans that did not change drug benefits.

METHODS: We identified 15 case MA plans with continuous participation in Medicare from 2006-9 that eliminated the coverage gap for at least 90% of enrollees in either 2007 or 2008. We matched each case plan to at least one control plan with continuous Medicare participation from 2006-9 that retained the coverage gap over this time period. Control plans (n=28) were located in the same state or a neighboring state with the same tax-status and model type. Among enrollees ages 65-75, key outcomes derived from HEDIS measures were control of LDL cholesterol<100 mg/dl among enrollees with diabetes and coronary heart disease, HbA1c <9.0% among enrollees with diabetes, and blood pressure <140/90 mm Hg among enrollees with hypertension. We estimated generalized linear regression models for each outcome with indicators for whether the plan was a case or
control, time (the year before or year after the addition of gap coverage), and their interaction. The models also adjusted for age, sex, race, area-level income, area-level education, plan fixed effects, and multiple observations from enrollees using GEE. Observations from control plans were weighted to reflect the sample size of their matched case plans.
RESULTS: The sample included 33,862 observations in case plans and 55,123 in control plans. The characteristics of enrollees in case plans were: mean age 71.6 years (SD 4.2 years), 51% female 87% white, 9% black, 3% other, 8% below poverty and 34% with college attendance. Characteristics of enrollees in control plans were: mean age 71.6 years (SD 4.4 years), 51% female 86% white, 12% black, 3% other, 9% below poverty and 30% with college attendance. None of these characteristics changed by more than 1 percentage point or0.1 years between the year before and year after the coverage gap was eliminated. Trends in outcomes and adjusted estimates are shown in the Table and indicate no significant differences in the clinical outcomes.
CONCLUSIONS: We found no evidence that eliminating the coverage gap resulted in significantly improved control of blood pressure, cholesterol, and glucose for seniors with Part D drug coverage.
EFFECT OF TRANSFORMATION OF THE VETERANS AFFAIRS HEALTH CARE SYSTEM ON THE QUALITY OF HYPERTENSION CARE Rebecca Brienza1,2; Daren Anderson4; Joseph L. Goulet1,5; EmilyM. Meyer1,3; Aldo Peixoto1,2. 1VA Connecticut Healthcare System, West Haven, CT; 2Yale School of Medicine, New Haven, CT; 3Yale School of Medicine, New Haven, CT; 4Community Health Center, Inc., Middletown, CT; 5Yale School of Medicine, New Haven, CT. (Control ID #1337903)
BACKGROUND: Over the past decade, Veterans Health Administration (VA) has achieved substantial improvement in hypertension control. This accomplishment exceeds national rates and coincides with a broad, national VA redesign and quality improvement effort. We hypothesized that the improvement in blood pressure control is the result of an improvement in clinician "treatment intensification" or patient medication adherence brought about by a broad series of reforms in the measuring and monitoring of clinical performance.
METHODS: We measured patient adherence to antihypertensive treatment and treatment intensification rates between 2000 and 2008 using VA pharmacy data from the local facility. Hypertension control was defined as a blood pressure of<140/90 or<130/80 among Veterans with both hypertension and diabetes (ICD-9 250.xx).Adherence was determined by calculating the total days of medication dispensed from a VA pharmacy during the year for each patient with a diagnosis of hypertension. Treatment intensification was defined as a binary variable (yes/no) indicating an increase in the dose of an existing anti-hypertensive medication or the addition of a new anti-
hypertensive medication after a clinic visit in which the patient had an above goal blood pressure reading. We modeled intensifications and adherence using linear mixed effects regression models that included fixed effects for time and random effects for provider and facility. RESULTS: Between 1999 and 2008, 52,215 Veterans had a diagnosis of hypertension and at least one primary care visit: 97.0% were male, and31.4% had diabetes. The mean age was 74 years. Over time, hypertension control rates increased from 50% to 78%. Patients with diabetes saw a similar rate of improvement, increasing from 28% to 54%. Average adherence rates improved significantly from a low of 60% in 2000 to a high of 68% in 2007 (p<0.0001). Adherence was significantly higher

for older Veterans, males, diabetics and those with 1+ visits. During the observation period, 37,712 Veterans with hypertension had 150,812 visits with a high BP event. Of these, 77,780 (51.5 %) events had subsequent treatment intensification. Results from the analyses of yearly changes that accounted for clustering were similar in that treatment intensification rates were relatively stable. Provider-specific intensification rates increased, from an average low of 55% in 2000 to a high of 61% in 2003 (p=0.0068). However, intensification rates declined after 2003 (p=0.0034). Diabetics were less likely to receive intensification but trends over time were similar between these groups.
CONCLUSIONS: The improvement in hypertension control over the past ten years at the VA provides an important opportunity to study systems redesign and to learn more about quality improvement. Our results suggest that rates of Veteran medication adherence to anti-hypertensive medications have improved from year to year from 2000-2008. Measures utilized

in this study could be applied to other chronic diseases such as diabetes, obstructive lung disease, or pain management where both adherence and treatment intensification are also critically related to clinical outcomes. The results have broad applicability for other VA and non-VA practice settings.
EFFECT OF A MODIFIED MEDITERRANEAN DIET AND THERAPEUTIC LIFE-STYLE CHANGE ON BODY MASS INDEX(BMI) AND FAT MASS IN A COMMUNITY MEDICAL PRACTICE Reshmi Siddique1; Rania Siddique1; Iftekhar Mahmud1; Anthony Cannon1; Mahmood Siddique1,2. 1Sleep and Wellness Medical Associates, LLC, Hamilton, NJ; 2Robert Wood Johnson Medical School, New Brunswick, NJ. (Control ID #1282637)
BACKGROUND: Although randomized studies have shown that Mediterranean-style, low glycemic load diets may treat metabolic syndrome and reduce obesity, real world cohort studies are needed to increase external validity of such therapies. A modified Mediterranean diet, along with therapeutic life style changes and medical foods were incorporated as part of a comprehensive program in a community medical practice. The objective of this study was to assess the impact of this program on Body Mass Index (BMI) and fat mass in obese and overweight subjects. METHODS: Eighteen obese subjects, aged 35 to 70 were recruited to participate in this program, with a follow-up of 6 months. Participants were instructed to follow a modified Mediterranean style diet, including a list of allowable phytochemically-rich foods that had low glycemic load. Whole grains were limited to 1 serving per day (75-100 calories). Patients were asked to consume from this list until satisfied. Additionally, they were asked to consume a phytochemical (soy protein, phytosterols, proanthocyanidins and rho iso-alpha acids) enriched powdered medical beverage of 2 servings a day. Life-style modifications of incorporating exercise was also a part of this program. Data on BMI and fat mass measurements were collected at baseline and 6 months for analysis. Means were calculated and T tests were used to determine statistical significance.
RESULTS: The mean age was 54.4. Males comprised 53 % of the subjects. Across all patients, BMI decreased from 38.9 to 36.7 ($p<0.2382$). Fat mass decreased from 41.8 to 40.6. For males, BMI decreased from 36.7 to 34.3. ($p<0.2367$). Male fat mass decreased from 35.7 to 35.1. For females, BMI decreased from 41.9 to 38.7. ($p<0.4740$). Female fat mass decreased from 49.5% to 47.6% ($p<0.1650$).
CONCLUSIONS: The improvement in BMI and fat mass in obese subjects demonstrated the clinical relevance of this program in a community practice setting. Further studies with larger sample sizes are needed to confirm such findings.
EFFECT OF A PAY-FOR-PERFORMANCE INCENTIVE TO INCREASE TOBACCO USE DOCUMENTATION IN AN ELECTRONIC HEALTH RECORD Gina R. Kruse1,2; Yuchiao Chang3,2; Jennifer H. Kelley4,5; Jeffrey A. Linder6,2; Nancy A. Rigotti1,2. 1Massachusetts General Hospital, Boston, MA; 2Harvard Medical School, Boston, MA;
3Massachusetts General Hospital, Boston, MA; 4Massachusetts General Hospital, Boston, MA; 5Partners

Health Care, Boston, MA; 6Brigham and Womens Hospital, Boston, MA. (Control ID #1339349)
BACKGROUND: Documentation of tobacco use status is a Meaningful Use standard for electronic health records (EHR) and is necessary to permit the use of chronic disease and population management strategies to reduce tobacco use. However, achieving high rates of tobacco use documentation is a challenge for many systems. Starting on January 1, 2010, 3 commercial insurers for a large Massachusetts integrated health care delivery system offered a pay-for-performance incentive (P4P) to practices achieving 80% documentation for eligible patients. Eligibility was defined as having (1) an outpatient visit in 2010, (2) a high-risk chronic condition (hypertension, diabetes, or coronary heart disease) and (3) a participating insurer. To help reach the goal, a tobacco use documentation reminder was added to the EHR for all patients. We studied whether the P4P incentive and the EHR reminder increased documentation for eligible and ineligible patients.
METHODS: Among adult (18yo) patients who visited outpatient practices, we measured the change in the proportion of patients with
tobacco use documented over the year before (2009) and the year after (2010) P4P implementation. To calculate this change, we measured documentation on December 31 of 2008, 2009, and 2010. We compared P4P-eligible patients to a subset of similar but ineligible patients; these patients had a qualifying high-risk condition and a commercial insurer but the insurer was not in the P4P program. We used a logistic regression model with generalized estimating equations techniques to compare documentation before and after P4P implementation by P4P eligibility, adjusting for patient factors (age, gender, race/ethnicity, English-speaking, visits/year) and provider factors (age, gender) and accounting for provider-level clustering.
RESULTS: Over 460,000 adults visited an outpatient provider each year in 2009 and 2010; 3% (n=16,364) met P4P eligibility criteria in 2009, 5% (n= 21,063) were P4P-eligible in 2010 and 1% (n=3,370 in 2009 and n=4,005 in 2010) were in the ineligible subset with a chronic condition but non-P4P commercial insurance. In the year after P4P implementation (2010), tobacco use documentation accelerated for all patients; documentation rates in 2008, 2009, and 2010 were 55%, 57%, and 70%, respectively. The increase was even more rapid among both the P4P-eligible group (61%, 63%, and 80%) and the subset of ineligible patients (61%, 63%, and 77%). In a multivariable model, documentation improved after P4P implementation compared to before implementation in both the P4P-eligible (AOR, 2.3; 95% CI, 1.9 to 3.0) and the P4P-ineligible patients (AOR, 1.9; 95% CI, 1.5 to 2.5). The documentation rate was significantly higher for P4P-eligible vs. ineligible patients (AOR, 1.3; 95 % CI, 1.2 to 1.5, p=0.009).
CONCLUSIONS: A targeted P4P incentive from insurers plus a non-targeted EHR reminder significantly accelerated tobacco use documentation in a large health care delivery system. The improvement was greatest among adults targeted by the P4P incentive, but documentation also improved significantly for ineligible patients. The improvement among ineligible patients may be attributable to the EHR reminder provided for all patients or to spillover in documentation behavior stimulated by the P4P incentive. The performance incentive and EHR enhancement were effective quality improvement tools that will facilitate the health care systems use of population management strategies to reduce tobacco use.
EFFECT OF A ROTATION IN A PRIMARY CARE BASED HEPATITIS C CLINIC ON RESIDENT KNOWLEDGE OF HEPATITIS C MANAGEMENT Shelly-Ann Fluker; Lesley Miller; Leslie Davis-Singletary; Michael Fost. Emory University School of Medicine, Atlanta, GA. (Control ID #1334372)
BACKGROUND: Hepatitis C virus (HCV) infection is the most common chronic blood-borne disease in the United States and chronic hepatitis C (CHC) is a leading cause of cirrhosis and death from liver disease. Most patients are diagnosed with CHC by generalists, yet studies reveal that generalists have significant knowledge deficits regarding the natural history and treatment of CHC. Given a projected shortage in available specialist care for CHC, generalists ability to care for CHC will become increasingly important. Internal medicine (IM) residents represent the next generation of practicing internists but studies show that residents also have suboptimal knowledge about screening and management of HCV infection. To our knowledge no study has

documented a successful strategy to improve IM resident knowledge about CHC. At Grady Memorial Hospital, which serves a predominantly low-income, African American population, general internists have provided management and treatment of CHC in the Liver Clinic since 2002. We hypothesized that a resident rotation of 3 - 4 sessions in the Liver Clinic would lead to improved and sustained knowledge about management and treatment of HCV infection. The objective of our study was to evaluate IM residents knowledge of hepatitis C management and treatment using a self-administered questionnaire at three time points: just prior to, just after, and 6 months after the rotation. METHODS: IM residents assigned to the Liver Clinic were recruited at the beginning of the rotation and completed informed consent. Residents then completed a 23 item self-administered questionnaire (pre-test) that evaluated their knowledge of management of HCV infection. Subjects completed an identical questionnaire at the conclusion of the rotation (post-test), and 6 months after their rotation (late post-test). The questionnaires were graded by the investigators (who were blinded to the subject) to yield an overall score that was compared at the three time points.

RESULTS: Thirty two residents were enrolled in the study from March 2010 to October 2011. All residents completed the pre-test. As of December 2011, 69% and 28% of the residents had completed the post-test and late post-test respectively. The average score on the pre-test was 71%. The average improvement in score from the pre-test to the post-test was 14.6 points which represented an increase of 21.91% (n=22, p-value=0.00000002). The average improvement in score from the pre-test to the late post-test was 11.12, which represented a 17.5 % increase from the baseline (n=9, p-value=0.009158). CONCLUSIONS: IM resident knowledge of management and treatment of HCV infection, as tested by a self-administered questionnaire, significantly improved after a rotation in a primary care based hepatitis C clinic. Six months after completing the rotation resident knowledge showed a sustained increase in knowledge of 17.5% over baseline. Other studies that have evaluated resident knowledge after other types of IM specialty rotations have noted similar gains in knowledge. These findings have several implications, including: 1) Our primary care based hepatitis C clinic can serve not only as a model for provision of hepatitis C care for urban patients but also as a venue for resident education about hepatitis C; 2) Our study adds to the small body of literature that describes methods of evaluating and validating the educational experiences that residents get on specialized outpatient clinical rotations.

EFFECT OF PHYSICIAN FOLLOW-UP AND SPECIALTY DIFFERENCES ON 30-DAY READMISSION FOR HEART FAILURE PATIENTS David Jang; Haiyong Xu; Jose Escarce; Michael Ong. UCLA, Los Angeles, CA. (Control ID #1340492)

BACKGROUND: One-fifth of Medicare patients are re-hospitalized within 30 days after discharge, with heart failure being the most common diagnosis for the initial hospitalization. On an institutional level, hospitals with lower rates of physician follow-up within seven days after discharge have higher rates of 30-day readmission. We sought to determine on an individual level whether heart failure patients who had an outpatient physician visit within 30 days after discharge had a lower rate of 30-day readmission than patients without such a visit. We also examined whether the medical specialty of the physician seen at the first outpatient visit had an effect on the rate of 30-day readmission.

METHODS: We examined 1265 Medicare Advantage patients discharged with a principal diagnosis of heart failure from an academic medical center's affiliated hospitals between June 2005 and July 2010. We then examined hospitalizations not preceded by another hospitalization within 30 days. We examined inpatient and outpatient data to determine if a rehospitalization occurred within 30 days and if an outpatient visit occurred within 30 days of these index hospitalizations. Outpatient visits occurring after a rehospitalization were not included. The academic medical center's medical staff rosters were used to determine the identity and specialty

of physicians who provided the initial post-discharge outpatient care. We examined the relationship between 30-day readmissions and outpatient visits within 30 days using bivariable and multi-variable analyses. RESULTS: Of heart failure patients who saw a physician within 30 days after discharge, 17.0% had a 30-day readmission, compared to 29.8% of patients who did not see a physician. Compared to a reference group of patients who had no outpatient visit, the adjusted odds ratio for 30-day readmission for patients who first saw a cardiologist was 0.33. The odd ratios for patients seen by primary care and other specialty physicians were 0.48 and 0.49, respectively. CONCLUSIONS: This study suggests that patients discharged for heart failure should have physician follow-up within 30 days after discharge to reduce the risk of 30-day readmission. Follow-up with a cardiologist provides for the greatest reduction in readmission risk.

EFFECT OF THE ACGME 16-HOUR RULE ON INTERNAL MEDICINE INTERN EDUCATIONAL OPPORTUNITIES Daniel G. Stover; Cecelia N. Theobald; Jacob Hathaway; Neesha N. Choma; NeerajaB. Peterson; Jennifer Green; Joshua Denny. Vanderbilt University Medical Center, Nashville, TN. (Control ID #1329844)

BACKGROUND: The most recent regulations regarding resident duty hours became effective in July, 2011 and included restriction of shifts to a maximum of 16 hours for interns in all specialties. There is little objective data regarding the impact of these new duty hour limits on resident education. We hypothesized that the duty hour changes would not have a significant impact on intern educational opportunities. METHODS: Vanderbilt University Medical Center is a large tertiary care hospital in Nashville, TN with 47 interns in 2010 and 50 interns in 2011. We evaluated intern educational experience at our university hospital training site over the first six 4-week blocks of the 2010 and 2011 academic years. All inpatient services went from a 30-hour maximum shift length (2010) to a 16-hour maximum shift length (2011). Using KnowledgeMap Portfolio, a concept-based curriculum management program that captures all trainee-authored notes written in the electronic medical record, we evaluated several objective metrics: number of notes written (history and physical or daily progress note), number of unique patients seen, numbers of five common procedures (arterial line placement, central line placement, thoracentesis, paracentesis, and lumbar puncture), and attendance at two academic conferences. All analyses were limited to inpatient experiences and restricted to intern experiences. We also compared average weekly intern duty hours. RESULTS: When comparing the first six blocks of 2011 to 2010, interns cared for more unique patients (mean 140 vs. 118 patients per intern; p=0.005) and wrote more history and physicals (mean 87 vs. 73; p=0.005). There was no difference in the number of daily progress notes (289 vs. 286, p=0.92) and overall notes (376 vs. 360, p=0.51). There was no difference in the median number of procedures performed (4 vs. 3 per intern p=0.71) or exposure to any individual procedure. Attendance was higher at the weekly noon chief resident conference (68% vs. 60% p<0.0001), but unchanged at morning report conferences (79% vs. 78%, p=0.49). There was no difference in average weekly duty hours per intern (69.4 vs. 68.2 hours/week; p=0.293). CONCLUSIONS: Using four objective metrics of educational opportunities - notes written, unique patients seen, procedures performed, and attendance at academic conferences - we demonstrate that educational opportunities for interns were not decreased after implementation of 16-hour shifts. In fact, our data suggests that interns cared for more unique patients, did more initial patient evaluations (history and physicals), and had higher attendance at a weekly educational conference. It will be important to evaluate the impact of these increased opportunities on medical knowledge and decision-making over the course of residency training. To our knowledge, this is the first study to objectively evaluate the impact of the 16-hour rule change on intern education.

EFFECTIVENESS AND SAFETY OF PATIENT ACTIVATING INTERVENTIONS FOR ADULTS WITH TYPE 2 DIABETES: A SYSTEMATIC REVIEW AND METAREGRESSION Shari Bolen1,6; Adam T. Perzynski1; Donna Windish3; Carl V. Tyler2; Corinna Falck-Ytter1; Alida M. Gertz4; Apoorva K. Chandar6; Paulette A. Sage5; Steven Lewis1. 1MetroHealth/Case Western Reserve University, Cleveland, OH; 2Cleveland Clinic, Cleveland, OH; 3Yale University, New Haven, CT;

4Johns Hopkins University, Baltimore, MD; 5Case Western Reserve University, Cleveland, OH; 6Case Western Reserve University, Cleveland, OH. (Control ID #1334407)

BACKGROUND: Given the multitude of recent publications on self management interventions for adults with type 2 diabetes, health care providers and patients alike could benefit from a comprehensive overview of potential interventions. We conducted a systematic review of studies which targeted improvements in patient activation (defined as targeting knowledge, beliefs, and skills for self management) in adults with type 2 diabetes. METHODS: We searched the MEDLINE, EMBASE, CINAHL and Cochrane Central Register of Controlled Trials databases from inception for original English-language articles. Our search strategy combined terms for Type 2 diabetes, randomized controlled trials, and self management interventions. We selected original studies in adults with type 2 diabetes that assessed intermediate outcomes (HbA1c, LDL cholesterol, weight, and systolic blood pressure), long term clinical outcomes (e.g. cardiovascular morbidity) and serious adverse events (e.g. hypoglycemia) of patient activating interventions. Reviewers extracted data for each article using standardized protocols. We conducted meta-analyses when there were at least 20 trials, using a random-effects model to derive pooled estimates. We also conducted metaregression to identify which intervention characteristics had a greater impact on HbA1c.

RESULTS: Out of 10,219 citations, 100 articles were included in the review. Too few studies (N<10 for each outcome) with too few events reported on the safety and long-term clinical outcomes; therefore, we were unable to draw firm conclusions on these outcomes. Patient activation interventions improved all intermediate outcomes including HbA1c (pooled estimate -0.3%, 95% CI -0.4 to -0.2%), weight (pooled estimate -2.4 lbs, 95% CI -4.3 to -0.6 lbs), LDL cholesterol (pooled estimate -2.9 mg/dL, 95% CI -5.6 to -0.3 mg/dL), and SBP (pooled estimate -3.0 mmHg, 95% CI -4.3 to -1.8 mmHg). No publication bias was found and no single study influenced the results except for the outcome of weight. Metaregression for HbA1c revealed that interventions focused on the AADE (American Association of Diabetes Educators) self management behaviors of problem solving skills, reducing risks of complications, and exercise had larger between group differences in HbA1c after adjusting for study quality, mean baseline HbA1c, study followup, the other AADE self management behaviors, and other aspects of the intervention (p<0.02). The intensity and location of the intervention did not account for significant heterogeneity in the metaregression for HbA1c.

CONCLUSIONS: The combined improvements of patient activation interventions on multiple intermediate outcomes can have a strong impact on health in adults with type 2 diabetes. Despite the variety of interventions, few intervention characteristics besides the 7 AADE behaviors accounted for the heterogeneity of the results in HbA1c. Problem solving skills, reducing risks, and exercise may be particularly important components of interventions to more effectively lower HbA1c.

EFFECTIVENESS OF HEALTH PROMOTION OUTREACH FOR DIABETES CARE: A RANDOMIZED-CONTROLLED TRIAL AT THE UNIVERSITY OF COLORADO Ingrid Lobo; Mitra A. Razzaghi; L Miriam Dickinson; William G. LeBlanc; Crystal Reingardt; Trina C. Mizrahi; Stephen Ross. University of Colorado, Denver School of Medicine, Aurora, CO. (Control ID #1327160)

BACKGROUND: The chronic care model recommends using clinical information systems and delivery system redesign to improve management

of diseases like diabetes. A novel care delivery system (the Center for Health Promotion, CHP) has shown promise in advancing guideline-concordant preventive care. This study was conducted to assess whether CHP could improve diabetes management.

METHODS: A randomized-controlled trial enrolled patients from February 1, 2009 to March 31, 2010 from primary care practices in an academic medical center. Inclusion criteria included (1) an ICD-9 code of 250.XX on two separate administrative billing claims records (2) practice visit in the past 18 months, and(3) lack of concordance to one or more of the following criteria: HgAlC<7%, LDL-C<100 mg/dL, systolic blood

pressure<130 mmHg, diastolic blood pressure<80 mmHg, and urine microalbumin assessment in the last year. Eligible patients were identified weekly and were sequentially assigned to the intervention or control group in a 3:1 ratio using a predetermined randomization scheme. Tailored outreach interventions included scheduling a primary care visit, lab work, Endocrinology consultation, diabetes education, and a retinal examination. Using generalized linear mixed models and data obtained in the processes of care, we assessed whether the two groups differed in changes in guideline concordance (for HgA1C, LDL-C, blood pressure, urine microalbumin, and a composite measure) over the 12 month period following enrollment. We also assessed for differential changes in continuous measures.
RESULTS: 3243 patients were assessed for eligibility; 2800 were randomized (2195 intervention, 605 control). 54% of patients were female and the mean age was 60.9. While continuous measures improved in both groups, the composite measure of quality actually declined in both groups, and the observed changes did not differ between the intervention and control groups (Table 1).
CONCLUSIONS: CHP outreach did not result in superior process or outcome measures of diabetes quality relative to usual care. The primary limitation of this analysis is that observations were collected during the course of care rather than systematically, which could reduce the power to detect intervention effects. Further analysis may identify why the composite measure of quality declined in spite of outreach, whether outreach reduced clinical inertia, and whether outreach could be targeted to subgroups of patients with diabetes who are more likely to benefit.
EFFECTIVENESS, PATIENT PREFERENCE AND COMPLIANCE OF SPLIT-DOSE POLYETHYLENE GLYCOL (PEG) COMPARED WITH STANDARD DOSE PEG IN HOSPITALIZED PATIENTS AT A TERTIARY CARE HOSPITAL. A PILOT STUDY Ali Raza; Kashif Ahmed; Jonathan Kushner. The University of Cincinnati, Cincinnati, OH. (Control ID #1313013)
BACKGROUND: The importance of good quality bowel preparation cannot be overstated. The likelihood of missing a small lesion is higher in patients with poor bowel preparation. Split-dose PEG is shown to be better than standard PEG in the outpatient setting. The aim of this study is to
evaluate if similar results can be accomplished in hospitalized patients, thus decreasing the need of re-scoping and prolonging hospital stay. METHODS: In this on-going prospective, single blind study, we have enrolled 22 hospitalized patients who required colonoscopy for their care. Patients were randomized to receive split-dose PEG (2 liters the evening prior to colonoscopy and 2 liters the morning of colonoscopy) or standard PEG (4 liters the evening prior to colonoscopy, ending before morning). Both groups were placed on the same dietary restrictions (clear liquids the day prior to colonoscopy and nothing to eat or drink except PEG after midnight). Patients with bowel obstruction, intractable nausea and vomiting before PEG administration, or massive gastrointestinal bleed were excluded from the

study. Patients with a past experience of a different PEG dosing schedule were asked to answer a question comparing the ease of current and past experience. An independent operator, who was blind to the nature of the PEG regimen received, evaluated each patients colonoscopic findings using an Ottawa score. Patients ability to finish the PEG was also recorded.
RESULTS: Twelve of 22 patients were males. Median age of the sample was 50 years (Range 23 to 81 years; mean, + SD 54+17 years). Thirteen patients received standard PEG-ELS bowel regimen while 9 received the split-dose regimen. Six (42%) of 13 patients receiving standard regimen could finish it, compared to 7 (78%) of 9 patients receiving the split-dose regimen (Fishers exact test p-value 0.184, odds ratio 4.08). Mean Ottawa score for standard regimen was significantly higher than the split-dose regimen (8.33 and 2.22 respectively; p-value 0.023). Four patients in the split-dose regimen group had a standard regimen in the past. All of these

patients (100%) preferred the split-dose regimen over the standard regimen. No patient in standard PEG-ELS group ever received a split-dose PEG-ELS regimen in the past. CONCLUSIONS: Split-dose PEG was significantly better than standard PEG in terms of quality of bowel preparation. Patients having the split-dose bowel preparation were four times more likely to finish the whole solution compared with patients having standard PEG. All patients in the split-dose PEG arm who had standard bowel preparation in the past, found split-dose preferable. Split-dose may reduce the length of hospital stay in patients requiring colonoscopy by improving quality and adherence to the regimen.

EFFECTS OF HEALTH-PROMOTING COUNSELING ON HYPER-TENSIVE PATIENTS WILLINGNESS TO CHANGE Courtney Moore; Maithili Shenoy; Angela Zanardelli; Kenneth D. Dorsette; DianeL. Levine. WSUSOM, Detroit, MI. (Control ID #1324669)

BACKGROUND: Per the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) about 50 million Americans and 2 billion people globally are hypertensive [systolic blood pressure (SBP) >140 or diastolic blood pressure (DBP) of >90]. Current recommendations outline the importance of counseling
to adopt a health-promoting lifestyle beginning at the pre-hypertension stage. However, there is little data exploring a relationship, if any, between counseling and their willingness towards lifestyle changes. It is unclear if time spent counseling, age, history or stage of hypertension impact willingness to change. METHODS: We conducted a cross sectional study utilizing a four-stage counseling station at which patients received blood pressure screening and either 5 or 10 minutes of hypertension, cardiovascular health, nutrition and stress management counseling. (Table 1) At each station we identified behaviors that were less than optimal for blood pressure (BP) control and, through counseling, provided the patient with more health-promoting alternatives. At the conclusion of the four stations patients were asked if they felt more willing to change their behaviors to integrate health-promoting choices following counseling. RESULTS: Mean age of our sample was 5412 years with 49% males. 44% reported past history of hypertension. 11% had normal BP at exam, 50% had BP <139/89, 30% had BP <159/99, 8% had BP >160/100. 55% were counseled for up to 5 minutes, 45% were counseled for 5 to 10 minutes. 70% reported willingness to change after being counseled. People who were willing to change based on counseling were significantly younger (49.79.9 vs. 61.111.3, p <0.001). Multivariate logistic regression analysis revealed that age was the only significant predictor of willingness to change with counseling (OR 0.9, 95% CI 0.86-0.95, p <0.001) after adjustment for potential confounders. People aged50 years were 0.25 times less likely to change as compared to people aged<50 years (CI 0.09-0.67, p 0.006). Patients with BP<120/80 were most receptive to counseling (92.3 % vs 63.7%, p 0.039). Willingness to change was independent of sex, history or stage of hypertension and time spent counseling. CONCLUSIONS: 70% patients were willing to change after counseling. However, spending more time being counseled did not improve willingness to change. Younger patients were more willing to modify health behaviors with counseling. Patients with normal blood pressures were more receptive to counseling than their hypertensive counterpart which indicates the need for health-promoting lifestyle counseling before the development of hypertension. Further studies are required to determine if longer sessions are needed or if repeated counseling sessions make a difference. Additionally, integration of age-specific strategies for older patients needs to be explored.

Table 1

EFFECTS OF MEDICAID DRUG POLICIES ON PRESCRIPTION FILLS FOR PEOPLE DIAGNOSED WITH MENTAL ILLNESS IN COLORADO AND OREGON Judy T. Zerzan1,2; Dan Hartung6; NancyE. Morden5; Traci Yamashita2; Suhong Tong4; Anne Libby3. 1State of Colorado, Denver, CO; 2University of Colorado School of Medicine, Denver, CO; 3University of Colorado School of Pharmacy, Denver, CO;
4University of Colorado School of Public Health, Denver, CO; 5Dartmouth University, Hannover, NH; 6OHSU College of Pharmacy, Portland, OR. (Control ID #1339756)

BACKGROUND: Colorado and Oregon State Medicaid Programs implemented a series of drug policy interventions on prescriptions for sleep aids. Insomnia is a common symptom in individuals with mental illnesses and affects both function and mental illness treatment outcomes. These two states were concerned about policy impact on people diagnosed with severe and persistent mental illness (SMI), and people with less severe mental health diagnoses (non-SMI). Colorado Medicaid implemented cost sharing in July 2003 and added sedative hypnotics to a preferred drug list (PDL) in April 2008; Oregon required cost sharing in Jan 2003 and PDL for these drugs in October 2007. Medicaid officials hypothesized the policies reduced utilization of sedative hypnotics and possibly been associated with substitution to low dose atypical antipsychotics and first generation antihistamines.
METHODS: State prescription fill claims, associated medical claims and enrollment data were obtained from Colorado and Oregon Medicaid from 2002-2009. Prescription rates were calculated in monthly time series as prescription fills per 1,000 person months. Interrupted time series was implemented with shift factors at each policy implementation date. Policy effects were measured as mean change in fill rate at implementation and as pre- vs post-policy slope changes. Policy impact on expenditures and medical services utilization are underway.

RESULTS: During this time period Colorado Medicaid covered 129,848 individuals using any mental health drug of which 14.7% had SMI and57.7% non-SMI. For Oregon Medicaid 222,479 individuals were covered with 17.5% SMI and 66.3% non-SMI. Among both SMI and non-SMI patients in Colorado, we observed increases in sedative hypnotic fill rates at implementation of cost sharing (SMI .55 p=.05; non-SMI 1.46, p=.01) Post-cost sharing antipsychotic fill rate increases per month were attenuated increasing by .15 per month compared to the .58 monthly increase prior to cost sharing (p=.03). Sedative hypnotic fill rates declined after implementation of PDL with corresponding increases in atypicals and antihistamines. However, significant increases were only observed among SMI and non-SMI patients using antihistamines (SMI .35, p =.04; non-SMI .43, p=.05). In Oregon, we observed reduction in sedative hypnotic fills at PDL implementation for SMI (-.34, p<.001) and non-SMI (-.47, p=.03) with corresponding decrease in pre vs post PA antipsychotic fills among non-SMI (p<.001) and decrease for SMI (p=.05). The impact on use of clinical services and total costs are currently being analyzed.
CONCLUSIONS: Drug policies that create hurdles for prescribers change prescription use and may impact sleep and clinical symptoms in people with SMI and non-SMI. The policy intent was to encourage providers to be more mindful of prescribing sedatives. We interpret these findings as evidence that Medicaid drug policies influence prescription behavior by providers and SMI patients may be more affected by changes in policy. Policymakers are aware of unintended consequences of policy actions and researchers can assist them in using observational data.
EFFICACY AND TOLERABILITY OF ARMODAFINIL IN HEALTHCARE WORKERS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER Mary G. Umlauf1;
Richard K. Bogan2; Ronghua Yang3. 1University of Alabama, Hoover, AL;
2SleepMed, Inc, Columbia, SC; 3Teva Pharmaceuticals Ltd., Frazer, PA. (Control ID #1334491)
BACKGROUND: Individuals, such as healthcare workers, who typically work permanent or rotating night shifts are susceptible to developing excessive sleepiness and, ultimately, shift work disorder (SWD). Excessive sleepiness in shift workers may lead to increased workplace accidents and mistakes. The wakefulness-promoting agent armodafinil has been shown to significantly improve clinical condition and wakefulness during the night shift and overall functioning in patients with SWD. Specifically, this study examined the late hours of the night shift. This post-hoc analysis examined efficacy and tolerability of armodafinil in healthcare workers with SWD. METHODS: Patients in this 6-week, randomized, double-blind study were clinically diagnosed with SWD (DSM-IV and ICSD-2 criteria), worked at least five 6- to 12-hour night shifts per month (between 10:00 PM and 8:00 AM), with Global Assessment of Functioning (GAF) score <70, and late-in-shift sleepiness (between 4:00

AM and 8:00 AM) represented by a mean Karolinska Sleepiness Scale (KSS) score >6. Following randomization, patients received 150 mg armodafinil or placebo 30-60 minutes before beginning their night shift. Efficacy assessments were change in Clinical Global Impression-Change (CGI-C) related to excessive sleepiness late in the shift (including the commute home), GAF, late-in-shift KSS, and modified Sheehan Disability Scale (SDS-M) from baseline to final visit. The SDS-M was modified to determine the effect of shift work on work, family, and social life. Final visit data included last observation carried forward.
RESULTS: Of the 383 patients enrolled in the original study, 56 (15%) were healthcare practitioners and 37 (10%) were healthcare support staff. After pooling both healthcare worker populations, 47 patients received armodafinil and 46 received placebo. In contrast to what was previously observed for the general study population, the proportion of patients in this analysis with an improvement in late-in-shift CGI-C from baseline was not significantly greater in the armodafinil group versus the placebo group at final visit (67% vs. 51%; p=0.0978). However, the proportion of patients with late-in-shift CGI-C improvement from baseline was significantly greater in armodafinil patients who completed the 6-week study (72% vs. 49%; p=0.0350). Significant improvements in the GAF, late-in-shift KSS, and SDS-M were observed at final visit and for Week 6 completers. Headache and nausea were the most common adverse events.
CONCLUSIONS: Consistent with earlier findings, these results demonstrate that armodafinil significantly improved late-in-shift clinical condition after 6 weeks of treatment. Armodafinil also significantly improved overall functioning and late-in-shift wakefulness and reduced patient disability score. Similar to the overall study population, headache and nausea were the most common adverse events. This study was funded by Cephalon, Inc, now a part of Teva Pharmaceuticals Ltd.
ELECTRONIC HEALTH RECORD ADOPTION IN FEDERALLY FUNDED HEALTH CENTERS Michael Wittie1; Lydie A. Lebrun1; Leiyu Shi2; Heather Ngai1; Quyen Ngo-Metzger1. 1U.S. Department of Health and Human Services, Rockville, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD. (Control ID #1324046)
BACKGROUND: Health Information Technology (HIT) has been widely promoted for its potential to improve the quality, safety, efficiency, and cost-effectiveness of health care in the US, but there is concern that a digital divide in adoption could cause or exacerbate disparities in access to quality care. Health centers, supported by the Health Resources and Services Administration (HRSA), provide comprehensive primary care and supportive services to vulnerable populations to increase access and reduce disparities, and must report data each year to the Uniform Data System (UDS). The UDS collects information on their operations, clinical quality, and electronic health record (EHR) adoption and use. We analyzed UDS data to determine health centers use of EHRs and the possibility of a digital divide.
METHODS: Organization-level data from the 2010 UDS on 1124 health centers, which served 19.5 million patients in 2010, were used to examine the relationships between EHR adoption and a variety of patient, provider, and organizational characteristics. Relationships between EHR adoption and geography, patient characteristics, size, funding, and duration of operation were assessed using 2 or t tests.
RESULTS: In 2010, 65% of health centers reported having an EHR in use, including 50% of health centers using EHR at all of their sites. The data also reveal that health centers were using many advanced EHR functionalities, including computerized provider order entry for lab tests (85% of EHR users) and electronic entry of prescriptions

(94% of EHR users). 80.4% of centers had the capability to provide clinical summaries, and 63.5% had the capability to provide patients with an electronic copy of their health information. There was considerable geographic variation in adoption rates, with the US Department of Health and Human Services Region X

(Washington, Alaska, Idaho, Oregon) being the highest at 81.4% and Region IX (Nevada, American Samoa, Arizona, California, Guam, Hawaii, Northern Mariana Islands) the lowest at 46.2%. State adoption rates ranged from 0% to 100%. However, there were no indications of disparities or a digital divide in adoption based on centers urbanicity, HRSA funding stream, or payer mix.
CONCLUSIONS: The 2010 UDS represents the first and to date only opportunity to examine EHR adoption in the full universe of health centers. Findings reveal that a large proportion of centers are using EHRs. In addition, there was no evidence of a digital divide among centers, indicating that EHRs are being implemented in keeping with their mission to reduce disparities in access to quality care among vulnerable patient populations. Federally funded health centers are adopting EHR apace with other ambulatory providers, and without the disparities seen in those settings or evidence of a digital divide in HIT. Health centers appear on track to make the quality transformations which are critical to improving health outcomes, population health, and the efficiency of care enabled by the Meaningful Use of EHRs. Additional data from the upcoming 2011 UDS will shed additional light on health centers progress towards Meaningful Use and further narrowing of the digital divide for HIT.
ELECTRONIC HEALTH RECORD TOOL REDUCES ANTIBIOTIC USE: THE INTEGRATED CLINICAL PREDICTION RULES (ICPR) TRIAL Devin Mann1,3; Joseph Kannry3; Juan P. Wisnivesky3; James Stulman3; Lauren McCullagh2; Anastasia Sofianou3; Alice Li3; Diego Chiluisa3; Megan Knaus2; Daniel Edonyabo3; Thomas McGinn2. 1Boston University, Boston, MA; 2North Shore-LIJ/Hofstra, Manhasset, NY; 3Mount Sinai, New York, NY. (Control ID #1338921)
BACKGROUND: Clinical decision supports (CDS) have been developed as platforms within electronic health records (EHRs) to help introduce evidence-based medicine (EBM) into routine care. Clinical prediction rules (CPRs) are frontline decision aids that combine evidence with real-time patient history, exam, and laboratory data. Despite being well-validated EBM tools, CPRs have been underutilized in practice. Previous studies of CDS for upper respiratory infections (URIs) have demonstrated negative results with utilization rates as low as 6%. We have developed an Integrated Clinical Prediction Rules Clinical Decision Support system (iCPR) that incorporates two well-validated URI CPRs (Walsh Streptococcal Pharyngitis and Heckerling Pneumonia CPRs) into the most widely used commercial outpatient EHR system (EpicCare). Our study is a randomized controlled trial of the effectiveness of the iCPR tool in changing provider antibiotics and diagnostic test ordering behaviors for URIs within an urban ambulatory primary care practice that uses a large commercial EHR system.
METHODS: The study setting was a large ambulatory academic primary care practice. All primary care providers (140 residents and faculty) were recruited for participation. Consenting providers were randomized in a 1:1 fashion into intervention or control. After a brief training, intervention providers had the iCPR tool activated in their EHR profile. The intervention consisted of an optional EHR embedded CDS that triggered from specific complaints, diagnoses, and/or orders relevant to strep or pneumonia placed at the point-of-care. The interface then guided risk stratification and facilitated antibiotic orders, notes, supportive therapies, and patient instructions. The primary outcome was the difference in antibiotics ordered for step or pneumonia during encounters between intervention and control providers after one year. Secondary outcomes included differences in diagnostic test ordering between groups and use of each component of the iCPR tool among intervention providers. Generalized estimating equations were used to test for differences in antibiotic utilization among groups accounting for clustering by provider. RESULTS: Over 1 year, enrolled providers conducted 1007 (586 intervention, 421 control) encounters that triggered the iCPR tool, representing 3% of all their encounters during this period. More than half (63%) of the encounters
seen by providers enrolled in the intervention arm launched the risk stratification tool and 58% utilized the bundled iCPR interface associated ordering option. We observed a 40% reduction in the likelihood of antibiotic ordering in intervention versus control encounters (30% vs. 39%, OR: 0.6 [0.5-0.9], p=.01). Chest x-rays for pneumonia were ordered in 20% of control encounters and 21% of intervention encounters (OR: 0.9 [0.5-1.6], p=.70) while rapid strep tests were 30% less likely in the intervention arm (29% vs. 40%, OR:0.7 [0.5-1.0],

p=.05). Broad spectrum antibiotics were ordered less frequently amongst intervention encounters (71% vs. 77%, OR: 0.75 [0.44-1.31], p=0.31). CONCLUSIONS: The iCPR randomized control study demonstrated significant reductions in antibiotic and some diagnostic test ordering. Moreover, the tool was frequently used by providers; a significant improvement over previous CDS studies for URIs. These data suggest that EHR embedded CPRs have the potential to enhance the implementation of EBM in primary care and improve quality.

ELECTRONIC HEALTH RECORD-BASED PATIENT IDENTIFICATION AND INDIVIDUALIZED MAILED OUTREACH FOR PRIMARY CARDIOVASCULAR DISEASE PREVENTION: A CLUSTER RANDOMIZED TRIAL Stephen D. Persell1; Donald M. Lloyd-Jones2; Elisha M. Friesema1; Andrew J. Cooper1; David W. Baker1.

1Northwestern University, Chicago, IL; 2Northwestern University, Chicago,IL. (Control ID #1336645)

BACKGROUND: Many individuals at higher risk for cardiovascular disease (CVD) dont get beneficial treatments. Prior interventions using personalized risk information to promote prevention did not test the clinic-wide effectiveness of these approaches.

METHODS: We compared the effectiveness of a strategy that included EHR-based identification of patients with increased CVD risk and individualized mailed outreach delivered at the level of the practice. We performed a 9-month cluster-randomized trial, clustered by primary care physician. Internists at a practice affiliated with an academic medical center were eligible. Physicians were enrolled. Their eligible patients were included with a waiver of consent. Patients were included in the intention-to-treat analysis if: age was 40 to 79 years, they were not prescribed lipid lowering medication, they had no CVD or diabetes mellitus, and had at least two clinic visits in the past 24 months. LDL cholesterol had to have been done in the past 5 years and: LDL was100 mg/dl and Framingham Risk Score (FRS) was >20%, LDL130 mg/dl and FRS was 10 to 20%, or LDL160 mg/dl and FRS was 5 to <10%. The FRS was calculated from EHR data retrieved electronically. Physicians could indicate patients they did not wish to have the intervention. Patients were mailed individualized CVD risk depicted in written and graphic formats and describing benefits of using a statin (and treating hypertension or quitting smoking when relevant). The control group received usual care. The primary outcome was occurrence of a LDL-cholesterol level that was repeated and was at least 30 mg/dl lower than prior. Secondary outcomes included: lipid lowering drug prescribing; aspirin prescribing (among those not prescribed at baseline); change in blood pressure, increase in number of antihypertensive drugs prescribed (among patients who had uncontrolled hypertension at baseline); and documentation of quitting smoking (among smokers). The study was powered to detect a 10% increase in primary outcome assuming control rate5%. Analyses used generalized linear mixed models with physicians as random effects. Clinicaltrials.gov identifier: NCT01286311. RESULTS: 14 physicians with 218 patients were randomized to intervention, and 15 physicians with 217 patients to control. Characteristics were similar. There was no difference in the primary outcome, LDL-cholesterol level repeated and at least 30 mg/dl lower at 9 months (11.0% intervention, 11.1% control, OR 1.0, 95% CI 0.53-1.86). Few patients returned for repeat lipid testing during the study period after receiving a new prescription. Intervention group patients were twice as likely to receive a prescription for lipid lowering medication (11.9%, vs. 6.0%, OR 2.1, CI 1.03-4.4, p=0.041). Among the subgroup with uncontrolled hypertension with follow up blood pressure, decline in systolic blood pressure was non-significantly greater in the intervention group (-13.3 mmHg vs. -10.4 mmHg, p=0.18). More intervention patients with uncontrolled hypertension had an increase in the number of antihypertensive drugs prescribed, 11.8% vs. 4.7% (also non-significant, p=0.15). Other outcomes did not differ.

CONCLUSIONS: In this effectiveness trial, individualized mailed CVD risk messages increased the frequency of new lipid lowering drug prescriptions but not the primary study outcome. The duration of follow up may have been insufficient to demonstrate the effects of increased prescribing on lipid levels.

ELEVATED SERUM COBALAMIN: SHOULD WE BE PAYING MORE ATTENTION? Sindhu L. Joseph; Geetanjali K. Dang; Vishnu Vandana Palle; Arvind Rangarajan Murali; Geeta Kutty; Brian P. Lucas. John H. Stroger Jr. Hospital of Cook County, Chicago, IL. (Control ID #1326823)

BACKGROUND: Roughly 15% of serum cobalamin (vitamin B12) levels are elevated. Studies suggest an association of high serum cobalamin with liver disease and hematologic malignancies. These studies were based on small patient populations. We hypothesized that there is a higher association of liver disease and cancer with elevated serum cobalamin levels than previously understood. We therefore conducted a retrospective chart review of patients with elevated cobalamin levels to determine the frequency of liver disease and cancer.

METHODS: Our cohort was general medicine patients discharged from Cook County Hospital from July 2009 through June 2010 who had at least one cobalamin level drawn between their admission and when our review began in July 2011. From this cohort we identified patients who had a serum cobalamin greater than or equal to 900 ng/dL. Among these patients, we selected a 50% random sample. Trained investigators then abstracted data from electronic medical records with standardized data collection instruments to determine whether or not patients had a diagnosis of liver disease or cancer. RESULTS: Of 10,003 inpatients, 3055 patients had at least one cobalamin result drawn during the 2 year study period. Among these patients, 25% (778 out of 3055) had an elevated level. 61% of our random sample of 778 patients with high cobalamin (237 out of 388 patients) had either liver disease or cancer. At the time of our review, 151 patients were not diagnosed with either liver disease or cancer. Among these patients, 26 had a disease likely to be associated with elevated cobalamin; these included systemic lupus erythematosus (n=2), alcohol abuse (n=3), and heart failure (n=21). 125 patients, however, had no clear cause of elevated cobalamin by the end of the study period.

CONCLUSIONS: We found that a quarter of our patients hospitalized on the general medicine wards have an elevated serum cobalamin. More than half of these patients have liver disease or cancer, a higher proportion than previously recognized. This suggests that elevated serum cobalamin levels should not be ignored and may provide some diagnostic value. We plan to follow up this early data with a matched case-control study comparing the prevalence of liver disease or cancer among patients with elevated serum cobalamin to those with normal serum cobalamin.

EMERGENCY DEPARTMENT UTILIZATION AMONG RECENTLY RELEASED EX-PRISONERS Joseph Frank; Christina Andrews; Traci C. Green; Aaron M. Samuels; Trong T. Trinh; Peter D. Friedmann. Alpert Medical School of Brown University, Providence, RI. (Control ID #1320137)

BACKGROUND: The population of ex-prisoners returning to their communities is large. Morbidity and mortality is increased during the period following release. Understanding utilization of emergency services by this population may inform interventions to reduce adverse outcomes. We sought to examine Emergency Department utilization among a cohort of recently released ex-prisoners.

METHODS: We linked data on all Emergency Department (ED) visits in a single large hospital system in Rhode Island occurring between 2007-2009 with data from the Rhode Island Department of Corrections (333,369 ED visits with 5,147 visits by recent ex-prisoners). We used primary ICD-9 visit diagnoses to identify visits related to substance use and mental health as

defined by the New York University ED Algorithm and ambulatory care sensitive conditions per Agency for Healthcare Research and Quality criteria. We reported the proportion of ED visits for each of these conditions among ex-prisoners and the general population. Fixed effects logistic regression modeling estimated the association between ex-prisoner status and use of the ED for these conditions, controlling for age, gender, race/ethnicity, visit year and location and ZIP code level unemployment and population of individuals place of residence.

RESULTS: ED visits by ex-prisoners were more likely to be made by men (85% vs. 48%, $p<0.001$) and by Blacks (26% vs. 16%, $p<0.001$) compared to the Rhode Island general population. Visits by ex-prisoners were

more likely to have a substance use diagnosis (16% vs. 4%, p<0.001) or a mental health diagnosis (6% vs. 4%, p<0.001). Unadjusted rates of ambulatory sensitive condition diagnoses were equivalent between groups (14% vs. 14%, p=0.79). After controlling for patient and community level factors, ex-prisoners ED visits were significantly more likely to be due to a substance use diagnosis (OR 1.93; 95% CI 1.77, 2.11), a mental health diagnosis (AOR 1.43; 95% CI 1.27-1.61) or an ambulatory care sensitive conditions (AOR 1.09; 95% CI 1.003-1.181).
CONCLUSIONS: Among ex-prisoners in Rhode Island, recent release from prison was independently associated with increased Emergency Department visits related to mental health, substance use and ambulatory care sensitive conditions. Future work should determine whether greater access to outpatient services during the transition from prison might reduce ex-prisoners utilization of emergency services.
EMERGENCY DEPARTMENT AND HOSPITAL UTILIZATION AMONG THE HOMEBOUND ELDERLY Ania Wajnberg1; KristoferL. Smith2; David Russell3; Joseph S. Ross4; John Doucette1; Anastasia Sofianou1; Alex Federman1. 1Mount Sinai School of Medicine, New York, NY; 2North Shore University Hospital, Manhasset, NY; 3Visiting Nurse Service of New York, New York, NY; 4Yale School of Medicine, New Haven, CT. (Control ID #1331186)
BACKGROUND: Over three million community-dwelling seniors have functional impairments that limit their access to office-based physician care. Although these patients are likely to be high utilizers of healthcare services, little is known about their patterns of acute care use. METHODS: English and Spanish speaking homebound adults over 65 years of age were recruited into two home-based care programs, the Mount Sinai Visiting Doctors (MSVD) program or the Visiting Nurse Services of New York Long-term Home Health Care Program (VNS). Homebound status was defined as leaving the home infrequently and requiring assistance when leaving the home. All patients were able to provide written consent or had a proxy to provide consent. Healthcare utilization was assessed by asking patients/proxies to report how many Emergency Department (ED) visits and hospital admissions they had three months before and after MSVD or VNS enrollment. Univariate tests were performed to determine overall and within group change in ED visits and hospital admissions before and after enrollment. Multivariate Poisson regression was used to examine differences in utilization rates between the MSVD and VNS groups, controlling for pre-enrollment utilization and demographics.
RESULTS: To date, we have collected complete baseline, pre enrollment and post enrollment data on 73 patients. At baseline, 31 (43%) were personally interviewed and 42 (57%) required proxies/surrogate interviews due to cognitive impairment. Mean age was 82 years (SD=9.5), 61 (84%) were female, 26 (36%) were Latino and 21 (29%) were African-American. Most were poorly educated and poor: 29 (43%) had not graduated from high school and 50 (75%) reported an income<$1350/month. 61 (84%) lived with family, friends or a paid caregiver and among those who had a home attendant/aide (94%), 60 (95%) required >5 days/week assistance. The majority of patients (66%) rated their baseline General Health (SF-1) as poor or fair. In the three months prior to enrollment, 33 (45%) reported at least one ED visit and 29 (39%) had at least one hospitalization. Of the patients who reported1 hospital

admission in the three months prior to enrollment, 86% had no admissions during their first three months in the program (p<0.001); and 78.8% of those who had 1 ED visit 3 months prior to baseline had 0 visits after enrollment (p<0.001). In regression analysis, baseline utilization, proxy interviews and increased ADL dependencies were predictive of increased hospital admissions.
CONCLUSIONS: Homebound older adults in this study have substantial physical and cognitive limitations and experience high rates of ED visits and hospitalizations. At three months after enrollment into physician or

nursing led home-based care programs, our data indicates a 30% decrease in ED/admission utilization.

ENHANCING OUT-OF-HOME INFORMAL CAREGIVING THROUGH HEALTH INFORMATION TECHNOLOGY Donna M. Zulman1,2; John D. Piette3,4; Steven Asch1,2; Ann-Marie Rosland3,4. 1Stanford University, Stanford, CA; 2VA Palo Alto Health Care System, Menlo Park, CA; 3University of Michigan, Ann Arbor, MI; 4Ann Arbor VA, Ann Arbor, MI. (Control ID #1337076)

BACKGROUND: Rapidly advancing health information technology (HIT), such as electronic personal health records and mobile health applications, offer opportunities to actively engage patients family members and friends in their health care. This study aimed to understand HIT use by out-of-home caregivers (individuals who provide care for a family member or friend living in a different household), and to identify barriers to such use.

METHODS: We conducted an Internet-based survey of a nationally-representative sample of individuals who previously reported a willingness to care for a family member or friend with a chronic illness living outside of their household. Respondents reported their use of computers, the Internet, and e-mail to help care recipients manage their health and health care, for example by finding health information online, sending messages to health care providers, tracking personal health record information, or filling medications. We also asked caregivers to describe barriers to HIT use. Using bivariate statistics, we examined differences in HIT use across caregiver subgroups defined by sociodemographic characteristics.

RESULTS: Among the 452 current or potential caregivers who completed the survey (response rate 75%), the mean age was 48 years (SD 15; 28%> 60 years), 62% were female, 41% were Black or Hispanic, 33% had at most a high school education, and 42% had an annual income<$50,000. The majority of care recipients were either the respondents parent (35%) or a sibling (34%). All caregivers had access to the Internet, either through independent means (77%), or as compensation for their participation in the research panel, and 64% reported that their care recipient also used the Internet. Only 30% of caregivers reported using HIT to help manage a care recipients health, most commonly to find health information online (n=93, 21%). In bivariate analyses, non-Hispanic Blacks were more likely than non-Hispanic Whites to use HIT for caregiving (OR 1.68, p=0.04), but technology use did not vary significantly by caregiver age, sex, education, or income. Among technology non-users, 69% reported thatif it would help their care recipient improve his or her healththey would be likely to use HIT in the future, for example to find health information (63%), track personal health or health care information (45-50%), or send messages to health care providers (42%). The most commonly cited barriers to using technology for caregiving were lack of familiarity with relevant programs or websites (24%) and health system privacy rules that limit caregivers access to care recipients personal health information (24%).

CONCLUSIONS: In this diverse sample of current and potential outof-home caregivers, there was strong interest in using HIT for caregiving activities, although fewer than one-third of out-of-home caregivers currently do so. Electronic personal health records and other mobile health technologies should incorporate and promote features that enable long-distant caregiver engagement, such as shared access to patient health information, and applications that offer education and tools for caregivers.

ENROLLMENT AND SATISFACTION WITH COMMUNICATION USING AN ELECTRONIC PERSONAL HEALTH RECORD Joan Neuner2; Megan F. Fedders1; Marilyn Schapira3. 1Medical College of Wisconsin, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI; 3University of Pennsylvania, Philadelphia, PA. (Control ID #1332677)

BACKGROUND: Electronic personal health records (PHRs) have the potential to improve patient involvement in care and communication with physicians, particularly with regard to medications. Little is known, however, about their actual use or effects, particularly with older patients who use the internet less overall.

METHODS: We examined enrollment in and satisfaction with a commercially available personal health record (EpicCare) linked to the electronic medical record of a multispecialty academic group practice and seven affiliated community primary care clinics. The PHR allows patients to make appointments, email providers, and review major medical record content (problem lists of diagnoses, medications, laboratory and radiology results,

and immunizations). PHR medication lists included doses and frequency, and diagnosis and laboratory information were linked to a commercial library of patient educational materials. Enrollment and use of the PHR was examined electronically, and satisfaction with communication was examined through an anonymous survey sent electronically a single time to all active PHR users in early 2011 (response rate, 20.1%). Survey items included general satisfaction, satisfaction with specific elements of the EMR, desire for additional elements, and communication measures from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) clinician and group surveys. Subjects were asked to respond to the CAHPS questions for only one of their providers. Most items used four-point Likert scales (eg very dissatisfied to very satisfied, never to always). RESULTS: PHR utilization: Between 10-30% of adults in each of the practices enrolled in the personal health record in its first two years.49.8% of enrollees accessed the PHR in the month prior to the survey, with each user averaging 4.6 visits. 4% of those visits included access to patient educational materials. Survey RESULTS: 30.3% of the 2,989 survey respondents were age 56-65 and 21.4% were over 65. 80% reported having a primary care provider and 81% a specialty care provider at our organization. 96.5% were satisfied with the PHR (66.5% very satisfied and 30.0% satisfied), and 97.7% would recommend it to a friend/family member. There were no statistically significant differences by age +/- 65 in these responses. Few patients (6.6%) used another PHR, and more patients were interested in additional education information for the PHR in future (75.1%) than were interested in integration with a separate web site to hold information from many healthcare providers(52.1%). 86.6% of respondents agreed that the PHR improved communication with the care team. In response to questions from CAHPS about communication overall (ie not just with the PHR), 78.7% reported that their provider always gave easy to understand instructions about how to take their medicines, and 69.4% that he/she always explained the side effects of medications in a way that was easy to understand. CONCLUSIONS: Our results show patients frequently use and are highly satisfied with a PHR linked to an EMR. Patients also reported improved communication with providers with the PHR. A substantial minority reported communication quality issues even in areas like medication information that optimal future PHR design and use could help address.

ESTIMATING THE STAFFING INFRASTRUCTURE FOR A PATIENT-CENTERED MEDICAL HOME Mitesh Patel1; Martin Arron2; Thomas Sinsky3; Eric Green4; David W. Baker5; Judith Bowen6; Susan Day1. 1Hospital of the University of Pennsylvania, Philadelphia, PA; 2Beth Israel Medical Center, New York, NY; 3Medical Associates Clinic, Dubuque, IA; 4Mercy Catholic Medical Center, Darby, PA; 5Feinberg School of Medicine at Northwestern, Chicago, IL; 6Oregan Health and Science University, Portland, OR. (Control ID #1334413)

BACKGROUND: The patient-centered medical home (PCMH) offers an innovative method of delivering primary care by utilizing a team-based approach where members work collaboratively at the top of their scope of practice. The staffing infrastructure required for a PCMH is not well establishedMETHODS: The objective of this study was to define the personnel infrastructure, staffing ratio, and associated costs needed to implement a PCMH within an academic clinical practice that includes internal medicine trainees. In February 2011, with support from the Josiah Macy Jr. Foundation, the Society of General Internal Medicine convened an Education Summit to discuss implications of implementing such a model. Based on this discussion, we designed a study that had two phases. First, we completed a thematic review of the PCMH literature to elucidate the roles and training of team members required for implementation. Second, we used a social networking approach to determine a convenience sampling of primary care clinical practices that were known to have transitioned to a PCMH practice model or in process of implementing this model. Nine leaders of primary care health systems agreed to be interviewed. Practices included academic medical centers, non-profit and for-profit institutions, and government-owned health systems. Interview results were aggregated and ranges in staffing at each position were calculated. A model incorporating an estimate of staffing at each level was developed based on published literature standards and data ranges from the interviews. To translate this increased staffing estimate into

additional resources required, we calculated the incremental cost of staffing a PCMH compared to benchmark MGMA data.
RESULTS: In addition to physician providers, literature review indicated the importance of including the following members/augmented functions in the staffing of a PCMH: nurse practitioner/physician assistant, MA/Tech/LPN, health coaches, nurse case manager, pharmacist, social worker, nutritionist, data analyst/population health manager, clerical staff. Interviews revealed that panel sizes for attending physicians varied significantly based on the PCMH setting. Panel sizes ranged from 625-2500 patients for full-time practicing physicians compared to 30-60 patients for PGY-1 residents and 100-125 patients for PGY-3 residents. Per physician FTE, we estimate that 3.95 FTEs should be allocated to PCMH staffing, compared to the base-case MGMA model of 2.68 FTE. The incremental cost per-patient-per month (pppm), including population health, is estimated to be $4.90. Annually this rate and staffing ratio totals about $126,346 for staffing per physician FTE.
CONCLUSIONS: Implementing a patient-centered medical home requires an evaluation of the practices current staffing and functional roles, along with a determination of the needs of its patient population. Experience from PCMH practices suggests that in order to achieve the goals of improved outcomes and better care, at reasonable cost, additional staff with specific expertise and training will be required. Further investigation on the value added with increased staffing, and opportunities for funding is needed if the full potential of the PCMH-model of care is to be realized within an academic clinical practice.
EVALUATING ALLOPURINOL THERAPY AND SERUM URIC ACID LEVELS IN MEDICARE BENEFICIARIES WITH GOUT Melea Ward1; Anthony M. Louder1; Keith Szymanski2; Leonardo Tamariz3.
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BACKGROUND: Higher serum uric acid levels in gout patients have been associated with an increased frequency and risk of gout flares and greater subsequent healthcare costs. Despite the wide availability of allopurinol, achieving a therapeutic serum uric acid (sUA) level remains problematic for clinicians and patients. The objectives of this study included identifying predictors of an sUA response to allopurinol and investigating the associated healthcare costs.
METHODS: A retrospective cohort study of a large health benefits company was conducted among Medicare Advantage Prescription Drug (MAPD) plan patients with gout newly initiated on allopurinol between 1/ 1/08 and 12/31/10. Patients were separated into two cohorts defined by their
sUA response to allopurinol (sUA<6 mg/dL or sUA>6 mg/dL). Mean allopurinol adherence, as measured by proportion of days covered (PDC), was reported at 12 months follow-up. Multivariate logistic regression was used to determine factors associated with allopurinol response. A generalized linear model was developed to assess the association between allopurinol response and total healthcare costs.
RESULTS: Of the 2,703 patients initiated on allopurinol, 57% had a baseline sUA and 33% had sUA6 mg/dL in the follow-up period. Higher adherence was associated with achieving an sUA<6 mg/dL compared to> 6 mg/dL (PDC=0.74 and 0.59, respectively, p<.0001). Predictors of sUA< 6 mg/dL included female sex, higher allopurinol PDC, and allopurinol dose >100 mg/day (OR:1.74, CI:1.41-2.13; OR:12.28, CI:8.25-18.28; OR:5.84, CI:4.73-7.20, respectively). Hispanic ethnicity, higher baseline sUA, renal impairment (Stage 3 vs. Stage 1), colchicine use, and NSAID use were associated with lower odds of responding to allopurinol therapy (OR:0.32, CI:0.14-0.76; OR:0.60, CI:0.56-0.66; OR:0.41, CI:0.30-0.55; OR:0.79, CI:0.65-0.97; OR:0.68, CI:0.55-0.85, respectively). There were no significant differences in total healthcare costs between the two cohorts.
CONCLUSIONS: A large percentage of patients initiated on allopurinol did not have adequate sUA monitoring, and did not achieve an sUA<6 mg/dL. Drivers of a therapeutic response included increased adherence and dose escalation. This study demonstrates that ample opportunity exists for clinicians and patients to improve sUA monitoring and treatment adherence when initiating urate lowering therapy.
EVALUATING FAILURES IN WEIGHT AND DIABETES MANAGEMENT IN AN HIV COHORT Barbara S.

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BACKGROUND: HIV-infected (HIV+) people in the U.S. die from non-HIV-related causes more than HIV-specific complications. Diabetes (DM) is a growing threat with several studies reporting a greater risk of DM for HIV+than non-HIV+persons. Limiting weight gain and controlling DM should be considered clinical care metrics for HIV providers. In an HIV clinic serving South Texas, we evaluated prevalence and predictors of:a) clinically significant weight gain and b) poor DM control. We hypothesized that less frequent HIV clinic visits and lack of co-management with non-HIV providers would be associated with these poor outcomes.
METHODS: Of 1938 HIV+patients with 2 HIV clinic visits in 2007-10, 1464 had 12mos observation, and 1292 had a body mass index (BMI) recorded at 2 visits. We excluded 36 (3%) with BMI<18.5 kg/m2. From first to last BMI in the most recent 6-12mos [median 336 d intraquartile range (IQR) 228, 367], we calculated % change in BMI with 3% increase considered clinically significant per non-HIV cohorts. DM was defined from ICD9 codes at 2 visits or hemoglobin A1c (HbA1c) 6.5%. HIV clinic visits in the most recent 12mos was analyzed in quartiles, then dichotomized to high/low intensity at the median [6, IQR:4, 8]. Co-management was defined as any primary care or diabetes specialist visit in the same 12mos. Insurance categories were based on type recorded in the majority of visits in 2007-10. HIV disease status was assessed by CD4+ count and viral load. The two study outcomes were: a) 3% increase in
BMI/year and b), among those with DM, a most recent HbA1c 8.0%. The key predictor was HIV care intensity in logistic regression models that adjust for demographics, insurance, HIV disease status, and baseline BMI.
RESULTS: In 1256 HIV+subjects, median age was 42y [IQR:35, 48]. Most were men (77%) and Hispanic (55%); fewer were white (27%) or black (14%). Most common HIV risks were men having sex with men (43%) and heterosexual sex (22%). Predominant insurance types were: Medicare (29%), a county indigent medical assistance plan (CareLink, 25%), Medicaid (13%),

and self pay (10%). Median CD4+ cell count was 411 cells/mm3 [IQR: 255, 581]; 64% had virologic control, and 90% on antiretrovirals. Baseline BMIs were: 36% normal (18.5 to <25 kg/m2), 36% overweight (25 to<30 kg/m2), and 28% obese (30 kg/m2). DM was diagnosed in 184 (15%). Only 3% were co-managed.Thirty percent had 3%/yr gain in BMI and 17% of diabetics had HbA1c 8%. A 3% gain was not associated with frequent HIV visits [adjusted odds ratio (AOR) 0.96; 95%CI:0.71, 1.30] but AORs were increased for: Medicaid or CareLink [AOR 1.53; 95%CI:1.07, 2.18] and self pay [AOR1.65; 95%CI:1.04, 2.63] versus Medicare. Obese persons had lower odds of 3% gain [AOR 0.54; 95%CI:0.37, 0.79]. The only significant predictor of poor diabetes control was less frequent (<6/yr) HIV visits [AOR 4.87; 95%CI:1.72, 13.7].
CONCLUSIONS: The 28% prevalence of obesity in this largely Hispanic HIV+cohort is far higher than in other HIV+cohorts (14-17%). Thirty percent had 3% BMI gain in one yr compared with NHANES data for a national U.S. sample reporting mean 3.4-5.2% weight gain over 10 yrs. Co-management was rare. Lower HIV clinic visit frequency (<6/yr) was not predictive of weight gain but was associated with a fourfold greater odds of poor DM control. HIV providers should make obesity management a priority at visits and patients with poor DM control should be followed more closely. Comanagement may also help improve these outcomes.
EVALUATION OF COPD MEDICATION USE IN THE PRIMARY CARE SETTING Daniel A. Belletti1; Christopher Zacker1; Jennifer Wogen2. 1Novartis Pharmaceuticals, East Hanover, NJ; 2MedMentis Consulting,

Towaco, NJ. (Control ID #1339300)
BACKGROUND: The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines recommend the use of short-acting bronchodilators only in Stage I (mild) COPD, with the use of inhaled corticosteroids (ICS) recommended only for symptomatic patients with Stage III (severe) or IV (very severe) COPD. While ICS use may be appropriate for those patients with COPD and asthma, prior research has suggested that ICS may be over-utilized
in COPD treatment, particularly among those with less severe disease. Our study objective was to describe treatment patterns in the primary care setting related to respiratory medication use among COPD patients with and without comorbid asthma.
METHODS: This cross-sectional study was performed via retrospective chart review by investigators at 11 primary care sites, using a random sample of from 50-150 adult patients, aged 40 through 89 years with a diagnosis of COPD, per site. (total N=1517). Data extracted from patient primary care medical records included patient demographics, clinical information (spirometry testing, respiratory medications, co-morbid conditions, and risk reduction measures). Medication use was evaluated, focusing on ICS use by severity and comorbid asthma.
RESULTS: Mean patient age was 67.2 (SD+11.3) years, 54% were female, and 62% were Caucasian. 18.7% of patients had co-morbid asthma, . Mean duration of COPD was about 4.8 years. Only 27% of patients had a current FEV1% result documented in their chart. More than half (52%) of patients did not have a documented COPD stage; 20% were classified as mild (stage I), 13% moderate (stage II), 12% stage III (severe),3.4% very severe (stage IV). Medication class distribution is shown in figure 1. Mean number of respiratory medications was 1.8, and 23% were on no respiratory medications (mostly stage I). 14.8% were on mono-therapy and 62.8% were on polytherapy. Overall, 51% of patients were prescribed inhaled corticosteroids (ICS); of patients without asthma, 39% were prescribed ICS, including a combined 28.7% in the mild and severe stages.
CONCLUSIONS: While almost 1 in 4 patients with COPD are not prescribed respiratory medications, more than 25% of patients with mild/ moderate COPD are prescribed early ICS use (mild or moderate stages). These individual and concurrent scenarios suggest the use of potentially inappropriate therapeutic strategies which may limit COPD treatment options as disease severity progresses. Our findings highlight a need for educational initiatives geared at increasing primary care providers knowledge of COPD guideline-recommended therapeutic management strategies.
EVALUATION OF INITIAL EMPIRIC ANTIBIOTIC THERAPY IN A COMMUNITY HOSPITAL FOR PATIENTS DIAGNOSED WITH SEPSIS AND ITS IMPACT ON HOSPITAL LENGTH OF STAY. John Kim; Stephen RIso; Saleha Butt; Arismendy Nunez; Carlo Palarca; Simi Philip; Samuil Rafailov; Kell Julliard; Naser Yazigi. Lutheran Medical Center, Brooklyn, NY. (Control ID #1332621)
BACKGROUND: Infection-related hospital admissions are highlighted in recent years for their associated higher mortality, morbidity and high financial burden. Recent studies have suggested incidence of initial inappropriate antibiotic therapy to be significantly high leading to higher mortality and morbidity and longer length of stay. Goal of this retrospective analytic cohort study was to evaluate the role of the initial

antibiotic selected based on patient illness, residence and suspected etiology and then comparing mortality, morbidity, ICU admission and length of stay in patients who received appropriate versus inappropriate antibiotics. METHODS: Patients with sepsis of infectious etiology were selected and all cultures taken within the first 72 hours were examined for microbio-logical pathogen and subsequent susceptibility. Antibiotics selected were classified as appropriate versus inappropriate by the senior author. Patients were subclassified by severity of disease based on APACHE II and Charlson score and were tracked through hospital stay. ICU admission, total length of stay, mortality and morbidity and were then compared in appropriately versus inappropriately treated groups.

RESULTS: Of the 152 patients meeting study criteria, 35 (23%) were deemed to have received inappropriate antibiotics in the ED. Those receiving appropriate vs. inappropriate antibiotics did not differ in hospital length of stay, ICU length of stay, Apache II score, Charlson Index, gender, residence before admission, or ICU admission. In-hospital mortality of those treated appropriately (21%) was significantly lower than those treated inappropriately (54%) ($p<0.001$). Of 59 patients with sensitivity information, sensitivity of 96% of the 49 patients treated appropriately was present, and was present in 20% of 10 patients treated inappropriately ($p<0.001$).
CONCLUSIONS: This study suggests that inappropriate antibiotic administration in the ED is associated with higher mortality, even though the appropriate and inappropriate groups were similar in disease severity. Because mortality would be expected to shorten both hospital and ICU lengths of stay, this could explain the equivalence of these lengths of stay in the inappropriately and appropriately treated groups. The implication that the timeliness and appropriateness of antibiotics can influence both mortality and length of stay indicates the importance of this topic for future research and clinical practice.

EVALUATION OF A CURRICULAR INNOVATION IN OBESITY ASSESSMENT AND MANAGEMENT Pardha Devaki; Diane L. Levine. Wayne state university, Detroit, MI. (Control ID #1339078)

BACKGROUND: Obesity substantially increases the risk of morbidity from illnesses such as Diabetes Mellitus, coronary artery disease, dyslipidemia, and hypertension. Evidence shows that patients who receive weight loss advice from physicians show increased effort at weight loss. Educational intervention aimed at improving the confidence and frequency of dietary counseling by the resident physicians was shown to be effective and also resulted in changing dietary behaviors of patients. At Wayne State University (WSU)/Detroit Medical Center we evaluated the effectiveness of an obesity curriculum by measuring improvement in care of paper based obese patients by Internal Medicine residents.

METHODS: Residents attending a conference were provided with a primary-care patient (Scenario #1) and asked to develop a diagnostic and management plan. Residents then received two one-hour educational sessions (obesity curriculum) in obesity evaluation and management. Within two months residents were provided with a second primary-care patient scenario (Scenario #2) providing a nearly identical patient and again asked to develop a diagnostic and management plan. Residents did not know the focus of the study and were told that purpose of the scenarios was to evaluate their primary care management. Patient plans were analyzed based on NHLBI obesity guidelines with a focus on if and how obesity evaluation and management was addressed. Data from the first and second scenarios were compared. Data was analyzed using Fishers exact test. The study was exempted by the investigational review board at WSU. RESULTS: Fifty-six residents completed the first case scenario. Twenty-five completed the second scenario. A statistically significant decrease in inappropriate drug prescribing practice was observed; 11 of 56 residents prescribed statins for hyperlipidemia for the first case (ten year risk <10%) compared to 0 of 25 after the curriculum ($p<0.01$). Approximately 50% of residents diagnosed obesity. However, there was no increase in obesity history obtained, BMI measurement, waist circumference, or diagnosis of obesity. An increase in referrals to nutrition services was noted ($p<0.02$).

All residents recommended some component of lifestyle change even those who did not diagnose obesity.

CONCLUSIONS: Residents have poor knowledge of obesity evaluation and management. A two-hour educational curriculum impacted inappropriate statin utilization but was insufficient to improve knowledge and overall management of obesity. Residency programs need to identify effective strategies to improve care of obese patients by the resident physicians.

Table: Summary of pre and post intervention data

Pre-intervention

Post-intervention

p-value

BMI - calculated 15/56 8/25 0.79 BMI - calculated correct value 14/56 6/25 1.0 Diagnosis of obesity 26/56 12/25

1.0 Used BMI for diagnosis ofobesity
14/56 6/25 1.0
Waist circumference 2/56 0/25 1.0 Dietary assessment 6/56 6/25 0.17 Additional dietary history 7/56 1/25 0.42 Body weight history 4/56 0/25 0.3 Some type of dietary strategy 56/56 25/25 1.0 Drug therapy 11/56 0/25 <0.01* Referral 5/56 8/25 <0.02*
*statistically significant
EVALUATION OF A PATIENT FINANCIAL REWARDS PROGRAM TO ENCOURAGE PREVENTIVE CARE
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BACKGROUND: The Affordable Care Act increased coverage for preventive health services, but research has shown that removing out-of-pocket costs will only have a limited impact on the discrepancy between recommended and actual use. Patient incentives have been promoted as a mechanism to increase receipt of preventive care. When making the choice to receive preventive care, patients must tradeoff current and future costs/ benefits. In theory, incentive programs can help by increasing short term benefits. An unusually innovative preventive care incentive program has been pioneered by Discovery, a private health insurance company operating in South Africa, the United States, the UK, and China. In their voluntary program, which now includes over one million people, the receipt of preventive care services earns an enrollee points and the points can then be used for gifts such as discounted travel and retail goods such as movie tickets or cell phones. These types of incentive programs have significant potential to improve preventive care, but there have been no empirical evaluations of their impact. We assessed the impact of the incentive program on receipt of preventive care services among 3.3 million Discovery health members in South Africa of whom 1.5 million were ever enrolled in the incentive program. Of note, South Africans with private health insurance are similar to the US population in terms of education and income.
METHODS: We analyzed the receipt of 9 preventive care services (e.g. mammogram, Pap smear, HIV test) among all members of Discovery (those in the incentive program and those that are not) over the years 2005-10. To try and address the selection bias inherent in an elective program, we used a difference-in-difference analysis where we compared the change in an individuals receipt of preventive care services before and after they enter the program compared to similar patients who are in not in the incentive program. We used a logistic model with random effects for each individual with controls for year and type of health plan product.

RESULTS: Compared to those who never joined the incentive program, those who joined the incentive program were younger (e.g. 60yo, 5% vs.
20%) and healthier (no chronic illnesses, 68% vs. 62%). In our models, being part of the incentive program was associated with a statistically higher odds of receiving all 9 preventive care services (e.g. Odd ratio for Cholesterol testing 1.5, Glucose testing 1.2, HIV test 1.9, Mammogram1.3, Pap smear 1.3). However, receipt of preventive care among those in the incentive program was still low. For example, among members of incentive program eligible for the care, receipt of Pap smear was only 24%. CONCLUSIONS: Voluntary participation in a patient incentive program was associated with a higher likelihood of receiving preventive care. However, receipt of preventive care among those in the program was still much lower than ideal.
EVALUATION OF A POCKET-SIZED ULTRASOUND DEVICE AS AN AID TO THE PHYSICAL EXAMINATION
James Colbert1,2;
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and Women's Hospital, Boston, MA. (Control ID #1342364)
BACKGROUND: Advances in technology have allowed for miniaturization and decreased price of ultrasound devices such that individual ownership and daily use is now practical. These pocket-sized ultrasound devices are powerful tools and have been found to perform as well as more traditional high-end portable systems when used by experienced clinicians. It remains to be seen, however, if such devices will improve the diagnostic accuracy of internal medicine residents in a broader range of physical findings with minimal training in the performance and interpretation of ultrasonography.
METHODS: We hypothesize that the use of pocket-sized ultrasound devices will improve the diagnostic accuracy of internal medicine residents. Physical findings being studied: pleural effusion, hepatomegaly, cirrhotic liver, splenomegaly, ascites, aortic stenosis, mitral regurgitation, right atrial pressure, abdominal aortic aneurysm, deep vein thrombosis. Study Design: 40 residents will be randomized into two groups. One group will receive training on pocket-sized ultrasound and will then have 4 weeks to practice with the devices. The other 20 residents will receive a training session on physical exam skills. After 4 weeks all of the residents will undergo an evaluation to determine if use of the pocket-sized ultrasound allows them to identify a greater percentage of physical findings. RESULTS: Our study is still in process and the results are not yet final, however we will be able to report the results at the SGIM conference in May, 2012.
CONCLUSIONS: Primary Aim: - Determine the diagnostic accuracy of residents using a handheld ultrasound device compared with residents using more traditional physical exam techniques for the physical findings mentioned above. Secondary Aims: - Determine Medical Residents comfort with the traditional physical exam versus a pocket-sized ultrasound - Evaluate the perceived utility of the physical exam versus ultrasound for various findings among medical residents - Evaluate the perceived ability of residents to integrate ultrasound examination into their daily patient care routines - Determine the diagnostic abilities of residents using the physical exam for various physical findings -Determine the ability of residents to diagnose various physical findings using ultrasound.
EVALUATION OF A WEB-BASED RISK ASSESSMENT TOOL IN THE PRIMARY CARE SETTING Heather J. Baer1,2; Louise I.
Schneider1,2; Graham A. Colditz3; Hank Dart3; Analisa Andry1; Endel J. Orav1,2; Jennifer Haas1,2; George Getty4; Elizabeth Whittemore1; DeborahH. Williams1; David W. Bates1,2. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Washington University, St.Louis, MO; 4Partners HealthCare, Boston, MA. (Control ID #1321789)
BACKGROUND: Primary care clinicians play an important role in identifying individuals at increased risk of cancer and other chronic diseases, but they have limited time and often lack adequate systems for collecting and synthesizing risk factor information. We conducted a pilot study to evaluate the feasibility and effectiveness of using a brief, web-based risk assessment tool in the primary care setting.
METHODS: We adapted a web-based risk assessment tool to collect information from patients on family history and lifestyle factors and estimate their risk of cancer, heart disease, diabetes, and stroke. We then conducted a pilot study of this tool in several primary care practices within a large, academic medical institution. Three practices were assigned to the intervention group, and two practices were assigned to the control group. Eligible patients in the intervention practices were asked to complete the tool on a laptop computer in the waiting room before an annual visit. Patient-entered information on family history of cancer was sent to their electronic health record (EHR) for their primary care clinician to view during the visit. If the clinician accepted it, it populated existing fields in the EHR and could trigger reminders about colon and breast cancer screening. Patients also received a summary report with their estimated risk of each condition and tailored recommendations for prevention. Eligible control group patients received usual care. We examined the percentage of patients who had new information on family history of cancer entered into their EHR within 30 days after the visit and the percent who received moderate or high risk reminders for colon and breast cancer screening. Logistic

regression models with generalized estimating equations were used to compute odds ratios (ORs) and 95% confidence intervals (CIs), accounting for clustering and adjusting for potential confounders.
RESULTS: There were 9647 eligible patients in the intervention group and 5848 eligible patients in the control group. Among eligible patients in the intervention group, 996 (10.3% of eligible) completed the web-based risk assessment tool at their visit. Among eligible patients in the intervention group, 2.0% had new information on family history of cancer entered into the EHR within 30 days after the visit, compared to 0.6% of eligible patients in the control group (adjusted OR=4.3, 95% CI: 1.2-15.7, P=0.03). Of the 996 eligible patients in the intervention group who completed the tool, 10.6% had new information on family history of cancer entered into the EHR, compared to 0.8% of 637 eligible patients in the control group who would have been most likely to complete the tool, based on a propensity score model (adjusted OR =15.9, 95% CI: 3.5-72.1, P=0.0003). There were no significant differences in the percent of patients who received moderate or high risk reminders for colon or breast cancer screening in the two groups.
CONCLUSIONS: It is feasible to use a brief, web-based risk assessment tool to collect information on family history and lifestyle factors from patients in the primary care setting. Use of this tool was associated with increased documentation of family history of cancer in the EHR, although the percentage of patients with new family history information was very low in both groups. Further research is needed to determine how risk assessment tools can be better integrated with practice workflow and how they affect screening and health behaviors.
EXCESSIVE SLEEPINESS AND ITS IMPACT ON SHIFT WORKERS: AN INTERNET SURVEY OF SHIFT WORKERS AND PATIENTS WITH SHIFT WORK DISORDER Lauren Sylvester; Sharon Paik. Ipsos, Norwalk, CT. (Control ID #1333577)
BACKGROUND: Shift work disorder (SWD) is a circadian rhythm sleep disorder characterized by excessive sleepiness and/or insomnia in people who work permanent or rotating shifts. It is estimated that 45% of shift workers (SWs) have excessive sleepiness and up to 23% of SWs have SWD, although the exact prevalence is unknown due to under recognition by both patients and physicians. This market research examined how shift work impacted quality of life in SWs

with excessive sleepiness and compared the similarities and differences between patients with diagnosed SWD and those SWs without a formal diagnosis of SWD.
METHODS: An online survey was administered to SWs with or without a self-reported diagnosis of SWD. Participation in the SWs survey required 21 hours per week working shifts in the previous 2 weeks, a diagnosis of SWD or 10 score on the Epworth Sleepiness Scale (ESS), and 5 score on any of the subscales of the Sheehan Disability Scale (SDS). Significant differences between respondents diagnosed with SWD and without a SWD diagnosis were tested at a 95% confidence interval.
RESULTS: The survey was completed by 260 respondents (103 with diagnosed SWD and 157 without a SWD diagnosis). Diagnosed and undiagnosed respondents demonstrated similar ESS (13.7 vs. 13.6) and Karolinska Sleepiness Scale (KSS) (6.0 vs. 5.5) scores suggesting similar levels of sleepiness in these groups. SDS social life and family life scores were similar between the two groups although diagnosed respondents had a greater SDS work disability score compared with undiagnosed respondents(6.7 vs. 5.5; p<0.0001). Significantly more respondents diagnosed with SWD had chronic fatigue syndrome, restless leg syndrome, decreased sexual desire, and insomnia compared to undiagnosed respondents (p
0.0161). Quality of life was more impaired in diagnosed patients in terms of ability to drive safely, propensity for accidents, work performance, and anxiety (p0.039 vs. undiagnosed). However, other quality of life measures such as alertness, irritability, motivation, ability to get sufficient sleep, and energy level were impaired in a similar proportion of respondents in both groups. Work-related accidents (16% vs. 5%; p=0.0076) and injuries at work (17% vs. 7%; p=0.0233) were also reported by significantly more diagnosed respondents than undiag-

nosed. Many respondents used caffeine and 57% of diagnosed respondents received prescription medication to treat symptoms such as excessive sleepiness and/or insomnia. The use of behavioral modifications was significantly more common among diagnosed respondents. However, there was not a significant difference in overall use of non-prescription treatments with the exception of natural/ herbal remedies/vitamins for wakefulness.
CONCLUSIONS: Individuals with diagnosed SWD demonstrated impairment in many quality of life measures and increased work-related accidents and injuries and use of non-prescription/behavioral remedies compared to undiagnosed respondents. Still, many measures of quality of life and prescription drug usage were similar between groups. This study was funded by Cephalon, Inc, now a part of Teva Pharmaceuticals Ltd.
EXERCISE REDUCES BLOOD PRESSURE IN DIABETICS WITH PERIPHERAL ARTERIAL DISEASE Philip Twumasi-Ankrah; Tracie Collins. KU School of Medicine - Wichita, Wichita, MN. (Control ID #1338252)
BACKGROUND: Patients with diabetes mellitus and peripheral arterial disease (PAD - defined by an ankle-brachial index - an objective measure of lower limb blood flow - <0.9) are at high risk for systemic ischemic events (i.e., myocardial infarctions and ischemic cerebrovascular accidents) in addition to critical limb ischemia. A major risk factor for such adverse events is hypertension. Routine exercise is known to reduce blood pressure in sedentary populations but less is known about its impact in persons with diabetes mellitus and PAD. We sought to determine the association of exercise behaviors and blood pressure in persons with diabetes mellitus and PAD.
METHODS: We conducted a secondary analysis of a clinical trial in which we enrolled participants with diabetes mellitus and PAD to a six-month home-based walking intervention versus control. Participants completed baseline, three-month, and six-month assessments of exercise behaviors, as captured by the Stanford Patient Education Research Center Exercise Behaviors Instrument (higher scores indicate more frequent use of exercise), and treadmill walking distance. Linear regression was used to assess the relationship of the independent variables of exercise behaviors and walking distance with the
dependent variables of systolic and diastolic blood pressure measurements for all three time points.
RESULTS: We analyzed data for 145 participants (mean age 66.5 years10.1 years). Forty-five (31%) were women, 119 (82%) had a known diagnosis of hypertension, and 132 (91%) had a body mass index (BMI)> =25. At baseline, mean systolic blood pressure was 138 (SD 18.95), mean diastolic blood pressure was 70.53(SD 12.51), and mean exercise behavior score was 18 (SD 16.5), which corresponds to 30-60 minutes of exercise per week. Mean maximal walking distance was 0.255 meters (SD 0.15). At baseline, for each unit increase in exercise behavior score, participants had only a 0.01 mmHg decrease in systolic blood pressure. At three-months, resting systolic blood pressure decreased by 6.64 mmHg for every unit increase in the exercise behavior score (adjusted for multiple comparisons, P=0.0145, as compared to baseline). At six-months, resting systolic blood pressure decreased by 8.87 mmHg for every unit increase in the exercise behavior score (adjusted for multiple comparisons, P=0.0026 , as compared to baseline). These findings were more pronounced among participants with a BMI>=25. There were no statistically significant associations of exercise behavior scores with resting diastolic blood pressure. Comparing six-months to baseline, each unit increase in mean maximal walking distance was associated with a 6.1 mmHg decrease in systolic blood pressure (P=0.007).
CONCLUSIONS: Greater levels of exercise are associated with lower resting systolic blood pressure and this association is more pronounced with time and in persons who are obese. These findings highlight the need for routine exercise to reduce systolic blood pressure among high risk groups including obese persons with diabetes mellitus and PAD. Further research is needed to identify which forms of exercise are most efficacious to reduce blood pressure in persons with multiple risk factors for adverse systemic events.
EXPANDING PRIMARY CARE RESIDENCY TRAINING MEDICAL CARE IN UNDERSERVED COMMUNITIES Kelly White; Karen Chacko. University of Colorado SOM, Aurora, CO. (Control ID #1332138)

BACKGROUND: There is a national need for primary care doctors in rural and underserved areas of the United States. Our primary care internal medicine training program selects for students demonstrating an interest in practicing in these areas. Historically, we have offered month long preceptorships in rural and urban underserved settings for both educational value and evidence that exposure to both rural and underserved populations leads to increased probability of career choice in these areas (reference here). Despite high interest in doing such rotations, few residents previously chose rural preceptorships mainly due to financial and logistical barriers. Our goal was to couple the interest and the exposure to primary care in rural and underserved sites in hopes of increasing the number of primary care residency graduates who choose careers in rural and underserved areas. METHODS: Potential rural and underserved teaching sites were identified. Site visits were completed which included faculty development focusing on enhancing teaching skills in the clinic setting and competency-based evaluation process. Primary care residents were educated regarding rural sites and rural health career opportunities including loan repayment options. Resident preceptorship choices were recorded. RESULTS: The grant began in April of 2009. Site visits were completed shortly afterwards. Resident education was also completed shortly after funding. Career choice at graduation is actively being tracked. (See Chart-1) CONCLUSIONS: Offering established rural and underserved preceptor-ship sites to internal medicine primary care track trainees increases their likelihood of doing such a preceptorship. It is our hope that this will also lead to an increase number of our graduates choosing careers in such sites, and our early data would suggest this is true. This model can be implemented at other programs around the country as we work together to realign the physician supply and patient demand for services in our country. We will continue to track the career choices of our graduates both

in the short and long-term to better understand how training exposure affects career choice after graduation.

EXPECTATIONS FOR MEDICAL STUDENT WORK HOURS IN INPATIENT CLINICAL CLERKSHIPS Rebecca A. Mazurkiewicz1;
Erica Friedman2; Reena Karani2; Jenny J. Lin1. 1Mount Sinai School of Medicine, New York, NY; 2Mount Sinai School of Medicine, New York, NY. (Control ID #1321077)

BACKGROUND: Each medical school must develop mission-based competencies and curricula to attain them; however, no standards exist regarding the specific skills that medical students should learn, or how much time should be allotted to learn them, during the clinical undergraduate medical experience. As time spent on activities may imply which associated skills are acquired, we aimed to determine how third-year medical students allocate their time in the hospital during clerkships. We also assessed and compared how students and clerkship directors (CDs) reported time should be allocated to specific activities to best achieve clerkship goals.

METHODS: From January 2011 to June 2011, Mount Sinai School of Medicine third-year students from the Class of 2012 were given an anonymous survey midway through an inpatient rotation during their Internal Medicine-Geriatrics or Surgery clerkships. This survey asked students to estimate the number of hours they spent on common clerkship activities on an average non-call day during the rotation. These activities included direct patient care (e.g. admissions, pre-rounding, post-OR checks, etc.), rounding, coordinating care (e.g. calling consults, speaking with ancillary staff, etc.), participating in procedures or in OR, attending didactics and conferences, writing notes, studying and researching, idle time, and other. Students were also asked to indicate the amount of time they felt they should have spent on those activities in order to achieve the clerkship competencies. CDs (n=4) were given an analogous survey asking them to estimate the amount of time their students are currently spending on common clerkship activities and how much time they should have spent on those activities. Mann-Whitney U-tests were performed comparing results between students and CDs.

RESULTS: All 4 CDs (100%) and 104 of 110 eligible students (95%) completed surveys. For the Internal Medicine-Geriatrics clerkship, CDs reported that their students are spending significantly more time rounding(3.25 hours vs. 2 hours, p=0.007) and studying (2 hours vs. 0.75 hours, p=0.04) than students reported they were. For the Surgery clerkship, CDs perceived that their students are spending significantly more time writing notes (1 hour vs. 0 hours, p=0.02) and studying (3 hours vs. 0.5 hours, p=0.02) and significantly less idle time (0 hours vs. 1 hour, p=0.04) than students reported they were. CDs felt students should spend more time rounding (3 hours vs. 2 hours, p=0.004) during the medicine clerkship and more time on educational activities (2 hours vs. 1 hour, p=0.02), studying(3.5 hours vs. 1 hour, p=0.03), and total time in hospital (16.5 hours vs. 12 hours, p=0.04) during the surgery clerkship than students felt they should. CONCLUSIONS: There is discordance between how students and CDs report students allocate their time in the hospital during clerkships. In
addition, there is discrepancy between students and CDs reports regarding the amount of time that should be allotted to certain educational activities in order to achieve clerkship objectives. These differences may be due to external mediators; however, CDs should ensure clear communication with students to promote their understanding of which activities will prepare them for exams and internship.

EXPECTATIONS FOR STUDENT ORAL CASE PRESENTATIONS: DO INTERNAL MEDICINE AND PEDIATRIC COURSE DIRECTORS SEE EYE TO EYE Eric Green1; Linda O. Lewin2; Steven Durning7; Linda DeCherrie3; Mark J. Fagan4; Bradley A. Sharpe5; Warren Hershman6. 1Mercy Catholic Medical Center, Darby, PA; 2University of Maryland, Baltimore, MD; 3Mount Sinai School of Medicine, New York, NY; 4Alpert Medical School of Brown University, Providence, RI;
5University of California San Francisco, San Francisco, CA; 6Boston University School of Medicine, Boston, MA; 7Uniformed Services University of Health Sciences, Bethesda, MD. (Control ID #1322482)

BACKGROUND: There are no universally accepted standards for oral case presentations (OCP) by medical students. We hypothesized that pediatric and internal medicine medical educators would value the same attributes of the OCP.

METHODS: We included questions regarding 22 attributes of the OCP done by a third year student on an annual survey of pediatric medical education leaders conducted by the Counsel of Medical Student Education in Pediatrics (COMSEP) in 2010. Respondents rated the relative importance of each of these attributes using a Likert scale ranging from 1 (not important) to 5 (very important). 18 of these questions were identical to the questions posed to members of the Clerkship Directors in Internal Medicine (CDIM) in 2007. We also asked both groups about the expected length of the OCP. We used chi squared analysis and t-tests for comparisons.

RESULTS: COMSEP received 157 complete replies from 334 surveys (response rate 47%) with at least 1 respondent from 71% of all U.S. allopathic medical schools, while CDIM received 82 of 110 surveys (response rate=75%). Eight attributes of the oral case presentation were rate as very important by more than 50% of internists and pediatricians (see table). The only statistical difference seen between internists and pediatricians was in the prioritized problem list, rated as very important by 76% of internists and 63% of pediatricians (p=.04). The only pediatric-specific attribute with>50% rating as very important was inclusion of growth parameters. Pediatricians, compared to internists, believed OCPs should be slightly shorter (6.8 3.3 vs 8.24.2 min, p=.006).

CONCLUSIONS: North American undergraduate medical education leaders in internal medicine and pediatrics share common expectations for oral case presentations. They both expect the OCP to include a comprehensive report of the history, along with a targeted and reasoned

physical exam, assessment, and plan. Pediatricians expectations only differ from internists in the expected length of the presentation and inclusion of a single pediatric-specific attribute. Our findings suggest that the OCP, like history taking and physical exam, has interdisciplinary rather than discipline-specific standards. The identified shared attributes can be used to develop interdepartmental instruction in, and assessment of, OCPs.

Percentage of Respondents Rating Attribute as Very Important
Attribute Medicine (n=81)
Pediatrics (n=147)
tional conferences, patient care, and efficiency on the wards, there were fewer residents who strongly agreed with each of these statements after deployment of the iPads (17% post vs 44% pre, p<0.0001 for education; 15% post vs 34% pre, p=0.009 for patient care; 24% post vs 41% pre, p=0.034 for efficiency). The biggest barriers to why residents did not use their iPad more were: difficult to type (47%), cumbersome to carry (42%), wireless access point (e.g. hotspot) connection delay (37%), and slow user interface of the EMR on the iPad (32%). Surprisingly, compared to before deployment, more residents reported after deployment of the iPad that they preferred pen and paper to organize their thoughts (67% post vs 39% pre, p<0.001). In spite of this, 84% of residents thought the iPad was a good investment for the residency program, and over half of residents (58%) reported that patients commented on the iPad in a positive way. After using the iPads for 4 months, more residents agreed with the statement [the iPad] has changed my life (16% post vs 6% pre, p=0.02).
CONCLUSIONS: While the use of mobile computing devices like the iPad is associated with improved efficiency among internal medicine residents and is generally well-received by residents and patients, the high initial expectations of the iPad highlight the danger of implementing new technologies. Here, we show inflated expectations specifically in the areas of education, patient care, and efficiency, in addition to a stronger preference for pen and paper after the iPad. For those considering deployment of mobile devices, it is important to consider how to manage initial expectations to avoid the trough of disillusionment and maximize the adoption of new technologies.

EXPERIENCES OF REPORTED HEALTHCARE DISCRIMINATION: INSIGHTS FROM FOCUS GROUPS WITH SPANISH-LANGUAGE SPEAKING PATIENTS. Gladys Rodriguez; Rosana Gonzalez-Colaso; Marcella Nunez Smith. Yale School of Medicine, New Haven, CT. (Control ID #1339692)

BACKGROUND: Healthcare discrimination is emerging as an important correlate of outcomes for racial/ethnic minority patients. However, Hispanic/Latino (H/L) populations have been largely underrepresented within this body of research and the influence of English language proficiency is rarely disaggregated. Building upon a previously conducted qualitative study and embedded within a parent study (2R21 CA134980-01A2) we sought to gain a better understanding of reported healthcare discrimination in this population and capture emerging novel themes.
METHODS: We conducted four online English- and Spanish-language focus groups with self-identified H/L participants (n=5-6 participants). Focus groups were defined by participant English language proficiency (proficient or less than proficient) and geographic location (Connecticut or Texas). A moderated online forum was established within the parent studys webpage; participants confidentially posted and replied to comments at their convenience over a 3-day period. Focus groups began with the broad question How does your ability to speak English influence your interactions in health care settings, if at all? Two additional focus groups are currently in progress.
RESULTS: Five novel themes capturing unique perspectives not previously described in the prevailing literature emerged from preliminary analysis: 1) Patients defined a range of healthcare discrimination experiences that they attributed to English language proficiency; 2) Regardless of their level of English proficiency, participants viewed their role within the healthcare system as advocates for high quality care; 3) Participants detailed unexpected standards to assess interactions with individual providers regarding healthcare discrimination; 4) Participants prioritized several key components in the provider-patient interaction above ethnic or language concordance; 5) Participants valued information sharing regardless of the type of clinical situation or setting.
CONCLUSIONS: We were surprised to find data from the focus groups that ran counter to many prevailing ideas regarding Spanish-speaking patient populations. This study provides support that neither H/L patients nor LEP Spanish-speaking patients are monolithic. A broad diversity of knowledge and expectations exist within this

population that can inform patient-provider interactions and reduce the experience of healthcare discrimination.
P value
Organized According to Standards 85 77 .13 Chief Complaint 80 76 .41 Accurately describe symptoms 82 72 .13 Includes all pertinent facts 65 67 .85 Sequence of events leading tohospitalization
64 64 .97
Detailed assessment and plan for the most important problems
76 63 .04
Targeted physical examination germane to the patients complaint
62 62 .99
Prioritized problem list 67 61 .45 Growth history not asked 56 Structured to guide the listener toconclusion (e.g \"makes a case\")
43 36 .31
Comprehensive assessment and plan for all problems
12 25 .02
Clearly Spoken 30 23 .24 Complete physical exam 10 17 .77 Excludes all not pertinent facts 18 14 .45 Uses Precise terminology 24 14 .09 Detailed social history 15 13 .74 Developmental history not asked 12Complete review of systems 5 12 .09 Impact of the illness on the patient 18 10 .07 Complete family history 7 10 .55 Vaccination history not asked 7
EXPECTATIONS OF IPAD USE IN AN INTERNAL MEDICINE RESIDENCY PROGRAM: IS IT WORTH THE HYPE? Nancy Luo1; Bhakti Patel2; Christopher G. Chapman1; James Woodruff1; Vineet Arora1. 1University of Chicago Medical Center, Chicago, IL; 2University of Chicago Medical Center, Chicago, IL. (Control ID #1339342)
BACKGROUND: Hospitals and residency programs are increasingly looking to mobile computing to enhance physician efficiency and improve patient experience. While anecdotal reports highlight its benefits, introduction of any new technology in the workplace could result in an inflated peak of expectations according to the Gartner Hype Cycle. Few studies examine this phenomenon. The aim of the study is to compare expectations of use of an iPad among residents in a teaching hospital with perceptions after deployment.
METHODS: One-hundred and fifteen internal medicine residents were given Apple iPadsTM (Cupertino, CA) with access to the electronic medical record (EMR) [EpicTM (Verona, WI)] via Citrix client in October of 2010. Residents were surveyed in the month prior and four months after deployment of iPads to assess the potential impact on their workflow and efficiency. Questions used a five-point Likert scale to assess excitement, anticipated and actual use, as well as barriers to use in terms of portability and user interface. Data were merged in Excel, and Pearsons chi squared tests were performed to assess for differences before and after iPad deployment.
RESULTS: Ninety-nine percent (114/115) of residents completed a matched pre- and post-deployment survey. Most residents [78%] reported using the iPad during the call day. After deployment of the iPad, fewer residents reported spending time looking for a computer (16% post vs 65% pre, $p<0.0001$) and waiting for a computer to log into the EMR (30% post vs 63% pre, $p<0.0001$). Interestingly, while most residents before deployment believed that the iPad would improve attendance at educa-

EXPLORING CHALLENGES AND PREFERENCES AT HOSPITAL DISCHARGE IN A LOW HEALTH LITERACY POPULATION Cristina M. Gonzalez1,2; Pajtesa Kukaj1. 1Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1340186)
BACKGROUND: Health literacy is a set of skills, including the ability to perform basic reading and numerical

tasks, required to function in the health environment. Low health literacy (LHL) contributes to health disparities. Patients with LHL have a poorer understanding of prescription medication names, indications for use, instructions and more unreconciled medications. Evidence suggests that poor communication plays a role in many medication errors after hospital discharge, and is exacerbated by LHL. The objective of this study was to ascertain the challenges and preferences of patients at risk for LHL when providers are communicating with them about their medications at the time of hospital discharge. METHODS: Patients were selected by convenience sampling from the medicine service at a university hospital in Bronx, NY. Informed consent was obtained and semi-structured interviews (in English or Spanish) were conducted regarding current or previous hospital discharge. Two investigators independently reviewed the transcribed data to generate a codebook using grounded theory. A third researcher reviewed any data where disagreement in coding arose. Saturation of themes was reached after 14 interviews. RESULTS: Three major themes emerged from analysis of the interview data: challenges to asking questions, patients preferences for delivery of medication instructions, and the effect of trust on patients perceptions of the discharge process. Most patients acknowledged that at times they wanted to ask questions and did not. Frequently a barrier to question asking could not be identified, with patients merely stating: It didnt occur to me to ask. Patients preferred instructions to contain pictures of pills. Most patients organized their medications with a pillbox and identified pills by color; in contrast to the delivery of medication instructions by name, dosage and indication. They preferred explicit, simple language, with careful attention to any dangers. Dont take the medicine you got at home because you could get real sick. I remember that one. Its important. She just kept emphasizing what he shouldnt have. Low trust in the medical system challenged patients ability to solve problems after discharge. Patients with regular follow-up stated they would call their doctor or pharmacist if they had a problem. Without a trusted provider, problem solving suffered. If I cant get it [medication] that day, Ill have to wait the next day, sometimes two days. Patients worried when they could not get their medications. Regarding pill color changes, I really dont know what I would do was a common response. I wanted to know what Im taking and whyit never happened. Then I refused to take the medication. Some mistrust stemmed from a misconception of standard residency program practice. So many different doctors and they come and ask different questions so many times.
They dont know too much. You have a young doctor, they dont know what theyre doing. So they [patients] wont tell them. CONCLUSIONS: The results of this analysis suggest providers need a mechanism to uncover patients questions and that medication instructions are not currently delivered in a way to minimize post-discharge medication errors. Additionally, efforts to enhance trust may increase patient problem solving abilities after discharge. Further research is needed to develop and evaluate methods for patient-centered discharge planning that account for low health literacy.

EXTREME HYPERFERRITINEMIA IN HOSPITALIZED PATIENTS: CAUSES AND PROGNOSTIC SIGNIFICANCE Jay Lipshitz; Yair Keilson; Nelli Fromer; Summer R. Branda; Oscar Lahoud; Yiqing Xu; Alan B. Astrow; William B. Solomon. Maimonides Medical Center, Brooklyn, NY. (Control ID #1336714)

BACKGROUND: Extreme hyperferritinemia (serum ferrtin >1000 mcg/ dL) commonly occurs in states of iron overload where it serves as a marker for toxic levels of tissue iron. Very high serum ferritin values may also occur in conditions of acute or chronic inflammation. There is little information regarding the causes and significance of extreme hyper-ferritinemia in hospitalized patients.

METHODS: We reviewed the records of all adult inpatients with serum ferritin values greater than 1000 mcg/dL over a 6-month period at our institution to determine the causes of extreme hyperferritinemia and markers of disease severity. Markers for severity included ICU admission, length of stay and in-hospital mortality. We compared the results in our patient cohort to those in all hospitalized adults for the same 6-month period to assess whether there may be an association between extreme hyperferritinemia and adverse outcomes.

RESULTS: Ninety-two patients with a serum ferritin value greater than 1000 mcg/dL were identified. In the vast majority of cases extreme hyperferritinemia could be attributed to one of four causes, infection (42.4%),

hepatitis (16.3%), malignancy (15.2%) and renal insufficiency (10.9%). Iron overload accounted for a small minority(5.4%). Patients with extreme hyperferritinemia had worse outcomes in all clinical measures. Mortality was 10.9% compared with 2.7% for all adult inpatients. 18.5% of patients with extreme hyperferritinemia had an ICU visit during hospitalization compared with 7.4% for all patients. Median length of stay was 10 days for the patients with extreme hyperferritinemia compared with 3 days for all patients. CONCLUSIONS: Extreme hyperferritinemia in hospitalized patients can usually be attributed to infection, malignancy, hepatitis or renal insufficiency. A serum ferritin level greater than 1000 mcg/dL may be associated with adverse outcomes in hospitalized patients.

FACTORS CONTRIBUTING TO IMPROVED HYPERTENSION MANAGEMENT AT THE VA

Rebecca Brienza1,2; Emily M. Meyer1,3; Daren Anderson4; Aldo Peixoto1,2. 1VA Connecticut Healthcare System, West Haven, CT; 2Yale University School of Medicine, New Haven, CT;
3Yale University School of Medicine, New Haven, CT; 4Community Health Center, Inc., Middletown, CT.
(Control ID #1331509)

BACKGROUND: Every 10 mmHg reduction in blood pressure results in a 35% reduction in rates of stroke. The Veterans Health Administration (VHA) has achieved substantial improvement in hypertension control over the past decade, far exceeding national rates. While this improvement coincides with a broad, national VHA redesign and quality improvement efforts, it is unknown how VHA achieved these superior results in blood pressure control. Therefore, we hypothesized that the improvement in blood pressure control is the result of an improvement in clinician treatment intensification brought about by a broad series of reforms in the measuring and monitoring of clinical performance.

METHODS: Our study used a mixed methods approach to evaluate hypertension treatment from 1998 to 2008. This abstract will focus on our qualitative results. We conducted four focus groups with clinicians, pharmacists, and health care leaders using a semi-structured data collection protocol. All sessions were digitally recorded and transcribed verbatim. The transcripts were topic-analyzed and iteratively coded by an independent investigator with extensive training in qualitative data analysis. We did not utilize an existing theoretical model to frame analysis; rather we implemented the constant comparative method of Glaser and Strauss Grounded Theory. Through a series of open coding, the development of data tables, conceptual mapping and iterative code refinement, hierarchical themes and associated sub-themes were generated.

RESULTS: Our qualitative data suggest that providers are taking a more active role in hypertension management through enhanced VHA system redesign (e.g. electronic health records, clinical reminders, and performance reports), interdisciplinary collaboration and prescribing optimal pharmacological therapies and doses. According to one provider participant, while seeing patients in the primary care clinic, it [electronic reminders] just reinforces the importance of blood pressure control. Participants also noted several barriers to improved blood pressure management. Many Veterans still struggle with challenges in proper medication adherence due to polypharmacy and low health literacy. Failure to refill prescriptions regularly, self-discontinuation due to side effects, and reluctance to take multiple medications were also noted. Our participants observed that adherence was especially problematic among women; this is possibly the result of multiple mental health comorbidities. Providers suspect that some of the challenges associated with adherence are attenuated when men have a supportive spouse or family caregiver to assist them.

CONCLUSIONS: This study aimed to understand why blood pressure control improved at the Department of Veterans Affairs (VA) over the past decade. Focus group participants indicated that systems improvements and an interdisciplinary team approach to blood pressure management played major roles. They also felt that a general attitude shift towards aggressive monitoring and treatment occurred during the last ten years. Challenges to medication adherence in women Veterans with psychiatric comorbidities and the powerful role of supportive caregivers to maintaining a treatment regimen were highlighted. Future research should investigate

the impact of systems redesign for other chronic conditions on Veteran health care outcomes and the unique social needs and challenges to medication adherence for Veterans receiving primary care at VHA.
FACTORS INFLUENCING ADHERENCE TO AN URBAN PUBLIC HOSPITALWEIGHT MANAGEMENT PROGRAM Himali Weerahandi; Lisa Parikh; Galle C. Pierre; Brian Diskin; Elenore Patterson; Albert Ahn; Camila Deza; Colleen Gillespie; Michelle McMacken. NYU School of Medicine, New York, NY. (Control ID #1333574)
BACKGROUND: Much research has been devoted to identifying factors that predict weight loss and weight loss maintenance. Studies of low-income and minority populations, who are disproportionately affected by obesity, have
shown that increased social support, increased nutritional knowledge, and attendance at structured weight loss programs have been linked to increased weight loss. Previous research from our own urban weight management clinic demonstrated that the number of revisits to clinic was the most significant predictor of weight loss and that approximately half of the patients did not return for a second visit. There are limited data on factors influencing adherence to structured weight loss programs in a minority, low-income population. Our study sought to identify predictors of revisits to our clinic. METHODS: We retrospectively reviewed electronic medical records of all patients seen in our weight management clinic between January 2006 and July 2010. The following data were collected for each patient: age at first visit, gender, provider-documented race, referral source (primary care provider vs other), presence of family/friend support (patient self-report, indicated as yes/ no) diagnosis of axis 1 psychiatric disorder, use of medications associated with weight gain, language concordance with weight management clinic provider, weight lost at second visit, total weight lost, and total number of revisits. RESULTS: Data were collected for 318 patients seen during the study period. Of these, 146 had documented information on age, gender, family/ friend support, language concordance with provider, diagnosis of axis 1 psychiatric disorder, referral source, and use of medications associated with weight gain. These were the factors included in the regression analysis. Two patients were identified as outliers (standardized residuals greater than3), and excluded from the analysis. Of those included, 46% were identified as Hispanic, 15% as black, 3% as white, 2% as Asian, and 1% as another racial group; race/ethnicity data were missing for 33%. Also, 79% were female, 29% carried an axis 1 psychiatric diagnosis, 34% were on medications associated with weight gain (primarily insulin, thiazolidinediones, sulfonylureas, and antipsychotics), 78% were referred to the clinic by their primary care provider, 76% had language concordance with the weight management clinic provider, and 59% reported support from family/friends. The average age at the first visit was 46. When controlling for age, gender, and use of medications causing weight gain, age at first visit was negatively related to the total number of revisits (=-.22, p<.01) - older patients had fewer revisits. Presence of family/friend support was also negatively related (=-.29, p<.001). Use of medications associated with weight gain was positively related to total number of revisits (=.25, p<.01). No other variables were significantly related to revisits. CONCLUSIONS: In our urban, safety-net hospital weight management clinic, older patients and those who reported receiving support from family and friends were less likely to adhere to return visits; in contrast, patients taking medications associated with weight gain were more likely to follow up. No other variables were associated with adherence. Future studies should further refine the reasons for attrition in weight management programs, as the number of return visits seems to correlate with success in weight loss.
FACTORS ASSOCIATED WITH DEPRESSIVE SYMPTOMS AT 6 WEEKS POSTPARTUM AMONG WOMEN WITH RECENT GESTATIONAL DIABETES MELLITUS Jacinda M. Nicklas1,2;
Laura J. Miller3; Chloe A. Zera4; Sue E. Levkoff5,6; Ellen W. Seely2.
1Beth Israel Deaconess Medical Center, Boston, MA; 2Brigham and Women's Hospital, Boston, MA; 3Brigham and Women's Hospital, Boston, MA; 4Brigham and Women's Hospital, Boston, MA; 5Brigham and Women's Hospital, Boston, MA; 6University of South Carolina, Columbia, SC. (Control ID #1339498)
BACKGROUND: Postpartum depression affects 10-15% of new mothers, and can impair both self-care and

infant care. Identifying women at increased risk for postpartum depression may help guide prevention efforts. Little is known about predictors for postpartum depression among women with a history of gestational diabetes (GDM). We sought to identify factors associated with symptoms of postpartum depression at 6 weeks postpartum among women with recent GDM.
METHODS: We administered the Edinburgh Postnatal Depression Scale (EPDS) at 6 weeks postpartum to women whose most recent pregnancy was complicated by GDM (confirmed by laboratory data or chart diagnosis). An EPDS score 9 indicated depressive symptoms. We measured weight and height, measured thyroid stimulating hormone, and administered a questionnaire to collect demographic data as well as information about breastfeeding and sleep. We obtained pre-pregnancy weight by self-report, and calculated

pre-pregnancy BMI using measured height (BMI categorized as <25, 25-30, >30). We performed a chart review to obtain data about medical history, including insulin use during pregnancy. We used backward selection to fit multivariable logistic regression models to identify factors associated with depressive symptoms.
RESULTS: Our study included 74 women (mean age 33 years 5; 51% Caucasian, 32% African-American, 12% Asian, 5% Other; 20% Hispanic; mean pre-pregnancy BMI 30 kg/m26). Measured weight at 6 weeks postpartum was 184 lbs 40. Fifty-four percent reported annual household incomes>$75,000, while 25% reported incomes of<$25,000 annually. No cases of hypothyroidism were identified. Thirty-five percent of women studied had depressive symptoms at 6 weeks postpartum. When controlling for income level, higher pre-pregnancy BMI category (OR 2.5, 95% CI 1.2-6.0) was associated with depressive symptoms. Use of insulin during pregnancy, perceived lack of sleep, breastfeeding status, and race/ethnicity were not retained in the model. Among those women with weights recorded within 5 days of delivery (N=63), gestational weight gain was 28 lbs 16. In this group, gestational weight gain was also associated with depressive symptoms (OR 1.3, 95% CI 1.1-1.6 per 5 lb increment of weight gain). CONCLUSIONS: Higher pre-pregnancy BMI was associated with postpartum depressive symptoms among women with recent GDM in this study. Gestational weight gain may also be associated with depressive symptoms in this population. If confirmed in larger studies, pre-pregnancy BMI and gestational weight gain may identify women with GDM at increased risk for postpartum depression.
FACTORS THAT SUSTAIN HUMANISM IN TEACHERS OF INTERNAL MEDICINE RESIDENTS Carol Chou; Katherine Kellom; Judy A. Shea. University of Pennsylvania, Philadelphia, PA. (Control ID #1339628)
BACKGROUND: The humanistic care of patients has been shown to improve patient satisfaction and patients' trust in their doctors. Humanism is often taught by example; teaching faculty are thus charged with modeling humanistic behavior to learners. Residents are vulnerable to declining empathy during their training and therefore can especially benefit from humanistic teachers. However, with many demands and pressures on teaching faculty, it can be hard to sustain humanism, much less to model humanistic behavior to learners. The goal of this study was to identify factors that exemplary humanistic teachers believe help them to maintain their caring attitudes. METHODS: A survey was administered to all internal medicine residents at the University of Pennsylvania in June 2011, asking them to nominate up to three teaching attending physicians who served as excellent role models for the humanistic care of patients. Faculty members who received the most nominations were invited to participate in a one-on-one interview to identify factors that sustain humanism in their teaching and patient care. Interviews were conducted until themes reached saturation. The interviews were transcribed anonymously and coded with NVivo software by an independent coder; codes were verified by one of the investigators (CC). RESULTS: 119 of the 150 internal medicine residents at the University of Pennsylvania responded to the survey (71% participation). 92 of the 591 internal medicine teaching faculty (15.5%) received one or more votes. The range of votes per faculty member was 1 to 21. The top sixteen nominees, with votes ranging from 5 to 21, were invited to be interviewed; response rate was 100%. Demographics describing interviewees are as follows: mean age was43.2 years. Nine interviewees were women (56%) and seven

(43.7%) were general internists. Other specialties included pulmonary/critical care (25%), hematology/oncology (12.5%), infectious disease (12.5%), and GI (6.25%). Factors that sustain humanism for these interviewees include: engaging in ongoing self-reflection (68.7%); deriving sustenance for humanism from the patient interaction itself, including a desire to find a connection with the patient(62.5%); being humble to receiving feedback and striving to improve ones practice (50%); and being conscious of living up to a standard of being a good doctor, as well as treating others as one would want to be treated (37.5%). 15 of the 16 interviewees identified role models within medicine that had positively influenced them; the sixteenth cited negative role models in medicine that were a reminder of how not to act. 8/16 (50%) had had personal experiences with illness or close family members with illness which inform their current humanistic tendencies.
CONCLUSIONS: These findings have implications for producing future generations of humanistic internal medicine physicians. Identifying teachable factors that help to sustain exemplary humanistic physicians may allow us to replicate those factors and create an environment in which those factors are fostered. Faculty development programs based on these factors may improve the teaching and delivery of humanistic care.
FACULTY DEVELOPMENT UTILIZING EDUCATIONAL VIDEO-BASED SCENARIOS AND EVALUATIVE INSTRUMENT FOR HANDOFF COMMUNICATION Saba Berhie1; Vineet Arora2,1; Leoral. Horwitz3; Mark Saathoff2,1; Paul G. Staisiunas2; Jeanne M. Farnan2,1.
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BACKGROUND: The most recent iteration of the Accreditation Council for Graduate Medical Education (ACGME) duty hour regulations, released in July 2011, has further limited PGY-1 shift duration to 16 hours. Explicit language in these regulations also mandates handoff education for trainees and for residency training programs to assess handoff quality. However, there is a lack of validated tools for the assessment of handoff quality and to utilize for trainee education.
METHODS: Faculty were recruited via email to participate in a workshop on handoff education and evaluation to both pilot test the videos and for instrument validation. Six video-based scenarios were developed which highlight varying levels of performance in the domains of communication skills, professionalism and setting. Each video permuted one domain of performance while holding the others constant. Scripts were based upon real-time clinical observations. Videos ranged in length from 3-5 minutes. Videos were shown in a random order and faculty were instructed to use the Hand-off CEX to rate the performance; debrief occurred immediately after to identify barriers and facilitators to the displayed behaviors. The Handoff CEX was developed is a paper-based instrument in which individuals are rated in six domains on a nine point scale (unsatisfactory[1] to superior[9]) with qualitative anchors defining each level of performance. Descriptive statistics and two tests of reliability, Cronbach's alpha and Kendall's coefficient of concordance, were performed. Two tests of validity were performed: a test of trend across ordered groups and a Two-Way ANOVA to examine for rater bias.
RESULTS: 172 of a possible 189 (91%) handoff observations were captured. Reliability testing revealed a Cronbach's alpha of 0.77 (0.8= optimal) and Kendall's coefficient of concordance of 0.68 to 0.77 (>0.6= high reliability). Faculty were able to reliably distinguish the different levels of performance in professionalism and setting, but had greater difficulty distinguishing between satisfactory and superior communication. Two-way ANOVA revealed no evidence of rater bias. Faculty participants commented on face validity of video scenarios, specifically those portraying setting and communication skills. In addition, robust discussion resulted in identifying the barriers and facilitators to the behaviors demonstrated in the video.
CONCLUSIONS: Video-based scenarios, utilized to highlight differing levels of performance, with focused debrief are an effective way to observe specific domains and behaviors in handoff communication. In addition, the Hand-off CEX is a reliable and valid tool to assess varying levels of videos depicting handoff performance.
FACULTY-LIBRARIAN COLLABORATION ON AN EVIDENCE-BASED MEDICINE BLOCK CURRICULUM IN INTERNAL MEDICINE RESIDENCY Roy L. Kao1; Ellen M. Justice2; Sharon Easterby-Gannett2; Ene Belleh2;

Daniel J. Elliott1. 1Christiana Care Health System, Newark, DE; 2Christiana Care Health System, Newark, DE. (Control ID #1324925)
BACKGROUND: As a component of the practice-based learning competency of the Accreditation Council for Graduate Medical Education (ACGME), Internal Medicine residents must demonstrate the ability to practice evidence-based medicine (EBM). Previous EBM efforts at our institution were focused on critical appraisal of articles but lacked

comprehensive development of knowledge and skills in the four steps of EBM. These steps include formulating an answerable question, finding the best evidence, appraising the results for validity and usefulness, and then applying these findings to clinical practice and evaluating performance. Our objective was to create a curriculum to increase residents knowledge, skills, and comfort levels in EBM.
METHODS: We developed a 2-week, dedicated EBM block rotation for first and second year internal medicine residents. Internal Medicine faculty and medical librarians jointly taught the course. The curriculum was organized around the four steps of EBM and included limited didactics with an emphasis on hands-on sessions to teach literature searching and critical appraisal within a small group setting. At the conclusion of the rotation each resident presented a critically appraised topic at a residency program core lecture. We assessed EBM knowledge and skills with the validated Fresno test at the beginning and end of the rotation. Residents similarly rated comfort with EBM resources on a Likert scale. Pre- and post-test scores and confidence survey results were compared using the paired t-test.
RESULTS: In 2011, eleven residents completed the curriculum and the test and survey. Residents' performance on the 212-point Fresno Test improved from a mean score of 114.3 on the pre-test to 154.6 on the post-test (mean difference 40.3, $p<0.001$). There was also significant improvement in the subsections addressing formation of questions (mean difference 3.7, $p=0.01$), creating search strategies (mean difference 4.3, $p=0.004$), appraising an article's relevance (mean difference 6.2, $p=0.006$), and calculating and understanding biostatistics (mean difference 18.9, $p<0.0001$). Confidence ratings on a 4-point Likert scale significantly improved in defining a question; searching and using MeSH terms, advanced limits, and subheadings in Ovid within a reasonable amount of time; and finally conducting a literature review and presenting it to a wider audience (all $p<0.001$). Residents also rated their comfort with EBM databases significantly higher ($p<0.001$).
CONCLUSIONS: Our findings demonstrate that a comprehensive, dedicated evidence-based medicine block rotation utilizing a faculty-librarian partnership can be effective in improving residents' knowledge, skills, and comfort levels in the four steps of EBM.

FALLING THROUGH THE CRACKS: STATIN USAGE BASED ON POPULATION CHARACTERISTICS IN AMBULATORY CARE
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BACKGROUND: Statin therapy is recommended for secondary prevention in all patients with known cardiovascular disease or the risk equivalent. Knowledge about the possible differences in the use of statin among high risk population in US is vital in order to stimulate a positive change in the health of society. Our objective is to assess the association between statin use and patient demographics in high risk population in ambulatory setting.
METHODS: We conducted a retrospective cross sectional analysis on the limited access dataset of National Ambulatory Medical Care Survey from the year 2007 to 2009. Patients less than 18 years of age were excluded from our analysis. High risk patients were defined by history of smoking, diabetes mellitus, hypertension,

hyperlipidemia and coronary artery disease. Multivariate logistic regression model was used to compute the adjusted odds ratio to compare the demographic characteristics with and without statin use in this high risk population. All statistical analysis was performed using SAS 9.2 version.
RESULTS: There were a total of 45, 391 high risk patient visits in United States from 2007 to 2009. Statin use was documented in only 20 % of the total visits. Compared to the younger patients (age 18 - 45 years), middle-aged (age 45-64 years) and elderly (> 65 yrs) patients were more likely to receive statin [OR 6.23 95% CI (5.16 to 7.51)]. Men were more likely to receive statin [OR1.38; 95% CI (1.27 to 1.51)] compared to women in high risk population. The use of statin was more likely in the Medicare patients [OR 1.13; 95% CI (1.01 to 1.29)] and the community health centers [OR 1.36; 95% CI (1.16 to 1.61)] compared to private practices. High risk patients visiting internists were more likely to be prescribed statin compared to family practitioners [OR 1.21; 95% CI (1.05 to 1.39)]. Among different races, statin use was less likely in African Americans [OR 0.89; 95% CI (0.81 to 0.97) than Caucasians. Despite the similar prevalence, statin use was less likely in lower socio-economic strata [OR 0.86; 95% CI (0.75 to 0.98)] compared to patients of higher socioeconomic status. No differences were noted in the statin use based on the region and ethnicity.
CONCLUSIONS: Our findings indicate consistent association between patient 's demographic characteristics and statin use in high risk population. Future efforts should concentrate on enhancing more statin use among African Americans and uninsured high risk population, with a goal of reducing adverse events from cardiovascular and cerebrovascular incidents.
FAMILY HISTORY OF DIABETES IS LINKED TO MORE AWARENESS, LESS FATALISM, BUT NO DIFFERENCES IN PHYSICIAN COUNSELING BEHAVIOR AMONG MINORITIES WITH HIGH DIABETES RISK. Kezhen Fei; Ashley Fox; Euny C. Lee; Carol Horowitz. Mount Sinai School of Medicine, New York, NY. (Control ID #1338299)
BACKGROUND: Family history is powerful risk factor for diabetes, but the non-modifiable quality of this risk factor may lead patients to be fatalistic about their ability to prevent diabetes onset. Alternatively, having a family history of diabetes could make patients more aware of diabetes risk factors and increase the likelihood of modifying their behaviors to prevent diabetes. Physicians may also counsel patients differently based on their family history, which may also affect patients risk perceptions. The objective of this study was to assess overweight adults perceived risk for diabetes and their physicians roles in defining preventive strategies as part of a community-academic partnership in East Harlem.
METHODS: Using a community-based participatory research approach, we recruited overweight adult residents of East Harlem (measured BMI of25) with no known history of diabetes, and surveyed their family history of diabetes, and dietary attitudes and behaviors. Respondents were asked to list the three most powerful risk factors diabetes and a series of questions regarding their ability to control diabetes. In addition, participants were asked about advice that they had received from their primary care providers regarding their weight, diet and exercise and ways to minimize diabetes risk. Bivariate analysis and multivariate models were run to assess the relationship between family history of diabetes and knowledge of perceived risk factors for diabetes, fatalism and providers counseling regarding diabetes risk factors.
RESULTS: The final cohort was predominately low-income (47%< $15,000), female (84%) and Latino (74%). Fifty-six percent had a family history of diabetes. Respondents listed unhealthy eating (67%), being overweight (47%), being physically inactive (38%) and having a family history of diabetes (32%) as the most powerful risk factors for diabetes. Nearly a quarter could not name any risk factor for diabetes. Those with a family history were more likely to identify family history as a risk factor for diabetes (35% vs. 28%; p=0.04). Those with a family history were less likely to agree with the statement, If you are going to get diabetes, there is not much you can do about it (56% vs. 47%; p=0.02). Among the 76% of participants with a regular doctor, two thirds had been informed by their physicians that they needed lose weight, be more active, and eat healthier. Multivariate models suggested that physicians did not counsel patients differently whether or not they had a family history of

diabetes. CONCLUSIONS: In a cohort of overweight participants who have not received a diagnosis of pre-diabetes or diabetes, those with a family history of diabetes were more likely to accurately report family history as a risk factor. Although the relationship could have gone either way, individuals with a family history were less fatalistic about their ability to prevent diabetes onset. Nevertheless, physicians did not adjust their counseling based on whether an individual had a family history of diabetes. Clinicians should consider eliciting this history and determining whether tailored counseling for those with a diabetes family history will better engage this high risk group in diabetes prevention activities.

FAMILY ACCOMPANIMENT TO ROUTINE MEDICAL VISITS IS ASSOCIATED WITH BETTER SELF-CARE BEHAVIOR IN HEART FAILURE PATIENTS Crystal Cene; Laura B. Haymore; Diane Dolan-Soto; Feng-Chang Lin; Michael Pignone; Darren A. DeWalt; Christine D. Jones; Jia-Rong Wu; Giselle Corbie-Smith. University of North Carolina, Chapel Hill, NC. (Control ID #1335013)

BACKGROUND: Family involvement is one dimension of patient-centered care and a tenet of the chronic illness care model. Family accompaniment to routine medical visits may be associated with better inter-personal processes of care, but findings are inconsistent. In order to better understand the pathways by which families exert their influence within routine medical visit and their impact on health outcomes, we examined the association between more (vs. less) frequent family accompaniment to medical visits and Heart Failure (HF) self-care behaviors.

METHODS: We conducted a cross-sectional survey of community-dwelling patients with systolic or diastolic HF seen in a university internal medicine or cardiology clinic. We separately assessed the following HF self-care behaviors: self-care maintenance (i.e., engaging in behaviors to help maintain physiologic stability, such as medication adherence and frequent weighing) and self-care management (i.e., decision-making in response to symptoms, such as recognizing signs of fluid overload and adjusting diuretic dose) using the well-validated Self-Care of Heart Failure Index (SCHFI). SCHFI scores range from 0-100 (higher scores represent better self-care) and scores 70 are considered adequate self-care. Family accompaniment was assessed with the question, how often does one of your family members or friends come in the exam room with you for your doctors visit (scored from 1-5 ranging from never to every visit). We dichotomized this variable as never/rarely vs. some/most/every visit. We used logistic regression to examine associations between family accompaniment and adequate self-care maintenance and management, adjusting for age, race, gender, household living status, educational level, and self-rated health.

RESULTS: Of the 150 HF patients (mean age 61 yrs; 51% female; 44% African Americans), 62% of patients were accompanied to some/most/ every visit. Mean HF self-maintenance and management scores were 69.9 (SD 13.9) and 56.8 (SD 24.2), respectively; 52% had adequate self-care maintenance and 32% had adequate self-care management. In multivariate analysis, more frequent family accompaniment to visits was associated with adequate (vs. inadequate) self-care maintenance (OR 2.3; 95% CI 1.1-5.0; p=0.03) and adequate (vs. inadequate) self-care management (OR 5.0; 95% CI 1.7-14.8; p<0.01). These results were qualitatively similar when we analyzed family accompaniment as a continuous variable and when we analyzed self-care maintenance and self-care management as continuous variables.

CONCLUSIONS: More frequent family accompaniment to medical visits is strongly associated with behaviors to maintain physiologic stability and with decision-making related to symptom management in HF patients. Future studies should examine mechanisms (e.g. patient-provider communication) that might explain these associations. Clinicians should encourage patients to have family members attend clinic visits as it may further enhance self-care processes.

FEASIBILITY AND ACCEPTABILITY OF A SYSTEMATIC SPECIALIZED SMOKING CESSATION

INTERVENTION TO SMOKERS HOSPITALIZED FOR AN ACUTE CORONARY SYNDROME. Reto Auer1,2; Baris Gencer2; Rodrigo Tango3; Pierre-Frdric Keller4; David Carballo4; Jean-Paul Humair3; Jacques Cornuz2; Nicolas Rodondi5.
1UCSF, San Francisco, CA; 2University of Lausanne, Lausanne, Switzerland; 3University Hospital of Geneva, Geneva, Switzerland; 4University Hospital of Geneva, Geneva, Switzerland; 5University of Bern, Bern, Switzerland. (Control ID #1340142)
BACKGROUND: Smoking cessation interventions initiated in hospital increase smoking cessation rates among smokers hospitalized for an acute coronary syndrome (ACS). Hospitals offering specialized smoking cessation services currently do not provide systematic
interventions to patients admitted for an ACS in Switzerland. Clinicians in charge of patients may decide to request a specialized smoking cessation consultation according to their perception of patients needs. The shift from a cognitive to a motivational approach in behavior change and the effectiveness of smoking cessation interventions for inpatients suggest that these should be offered to all smokers, regardless of their motivation to quit. Our study aimed to determine the feasibility and acceptability of a proactive, systematic, smoking cessation intervention using motivational interviewing for all smokers hospitalized for an ACS.
METHODS: We designed a before-after study where we prospectively included smoking patients hospitalized with the main diagnosis of ACS in two university hospitals in Switzerland. In the observation phase, clinicians in charge of patients could request a specialized smoking cessation intervention through a simple phone call. In the intervention phase, we actively screened and included in the study all smokers hospitalized for an ACS who agreed to participate. A trained resident physician systematically offered to all subjects a smoking cessation intervention that included prescription of nicotine replacement therapy and counseling tailored to the clinical situation and the patient's stage of behavioral change. In the intervention phase, discharged patients also received four telephone counseling sessions over two months. To assess feasibility and acceptability, we measured the change in smoking cessation interventions rates between both phases and the participation rate in the intervention phase. RESULTS: In the observational phase (September 2009 to October 2010), 24% (N=58/233) of ACS smokers received a specialized smoking cessation intervention based on the evaluation of their HCP. In the intervention phase (November 2010 to October 2011) using a systematic approach, 93% (N=166/178) of ACS smokers received a specialized smoking cessation intervention ($p<0.001$). In the intervention phase, less than 2 % (N=3/178) of smokers refused discussions about their smoking habits and 5% (N=9/178) were discharged before any smoking cessation counseling could take place. The duration of smoking cessation intervention ranged from 2 to 120 minutes (mean: 52 minutes). 90% of patients accepted the ambulatory telephone counseling. Smoking cessation rates at one year were 40.1% (N=59/ 147) in the observation phase and 71.4% (N=60/84) at 2 months in the intervention phase.
CONCLUSIONS: A proactive strategy offering a specialized smoking cessation intervention based on motivational interviewing to all smoking patients hospitalized for an ACS is well accepted and significantly increases the proportion of patients receiving an intervention as compared to a reactive strategy dependent on the request of health care providers. Further research should assess the impact on long-term smoking abstinence and cardiovascular events.
FEASIBILITY AND VALIDATION OF A SIGN-OUT EVALUATION TOOL. Leora I. Horwitz1; David A. Rand2; Paul G. Staisiunas3; Jeanne M. Farnan3; Vineet Arora3. 1Yale University, New Haven, CT; 2Hahnemann University Hospital, Philadelphia, PA; 3University of Chicago, Chicago,IL. (Control ID #1338984)
BACKGROUND: Residency programs must now ensure and monitor effective, structured hand-over processes, and ensure that residents are competent in communicating with team members in the hand-over process (sign-out). There is a lack of validated sign-out assessment tools. METHODS: We developed two sign-out evaluation tools based on the mini-CEX format: one for the sign-out provider and one for the sign-out recipient. The provider tool included domains for setting, organization, communication, content, judgment, professionalism,

and overall competency. The recipient tool included the same domains with the exception of content, which was omitted. Each domain was scored 1-9 where 1-3 was unsatisfactory, 4-6 was satisfactory and 7-9 was superior. Extremes were anchored by descriptors. We tested the tool in house staff day to night shift changes at Yale and in hospitalist day to night changes at University of Chicago. Each handoff was evaluated by a peer (participant in the hand-off) and by at least one external observer. One consistent external observer scored all handoffs

at each institution. In addition, many handoffs at Yale included supervising residents as additional external observers. Mean scores were compared with t tests.
RESULTS: A total of 149 sign-out sessions involving 98 subjects were observed, yielding 343 sign-out CEX evaluations of sign-out providers and 330 of sign-out recipients. 34 unique subjects were evaluated at the University of Chicago and 64 unique subjects were evaluated at Yale. A total of 468 evaluations (69.5%) assessed trainees or mid-level providers (sub-interns, interns, residents and nurse practitioners); the remainder assessed hospitalist attendings. Evaluators used the full spectrum of unsatisfactory (1-3) to superior (7-9) scores. For sign-out providers, mean scores were lowest for content (6.9) and highest for professionalism (7.5). Scores for recipients were higher than scores for providers at borderline significance for most domains: setting ($p=0.05$), organization ($p=0.07$), judgment ($p=0.05$) and overall ($p=0.01$). Hospitalists and trainees received similar scores for providing sign-out except that attendings received significantly higher ratings for judgment than trainees (mean score 7.6 vs. 7.2, $p=0.03$). Conversely, attendings received significantly lower scores than trainees for judgment (7.2 vs. 7.6, $p=0.01$) and organization (7.1 vs. 7.5, $p=0.03$) when receiving sign-out. Overall, external evaluators gave significantly lower scores than peer evaluators in every domain for both sign-out providers and recipients ($p<0.0001$ for every domain using paired t test). External and peer evaluator scores were well correlated, with Spearman correlation coefficients ranging 0.33-0.39 for provider sub-domains and 0.47 for the overall provider score. Weighted kappas for interobserver reliability of provider unsatisfactory/satisfactory/superior scores were in the low-moderate range: setting0.22 (0.09-0.35); organization 0.35 (0.21-0.48); communication 0.32(0.20-0.44); content 0.29 (0.18-0.41); judgment 0.27 (0.14-0.40); professionalism 0.42 (0.28-0.55) and overall 0.40 (0.27-0.53). Kappas for recipient scores were lower, ranging 0.14-0.33. CONCLUSIONS: An evaluation tool for providers of sign-out is feasible and moderately reliable. Peers provide significantly higher scores than external observers, suggesting difficulty in providing negative feedback to peers. The sign-out CEX is best used by an external observer such as an attending.
FEASIBILITY OF PORTABLE TECHNOLOGY TO DIAGNOSE SLEEP APNEA IN UNDERSERVED COMMUNITIES Jillian E. Nickerson1; Ana C. Krieger2; Ellen P. Simon3; Sandra Talavera4; EunyC. Lee1; Michael Nedelman1; Carol Horowitz1. 1Mount Sinai School of Medicine, New York, NY; 2Weill Cornell Medical College, New York, NY;
3Union Settlement Association, New York, NY; 4Senior Health Partners, A Healthfirst Company, New York, NY. (Control ID #1339585)
BACKGROUND: Despite high prevalence of risk factors such as obesity and diabetes, Latinos and Blacks are under-diagnosed and under-treated for obstructive sleep apnea (OSA), partly due to decreased access to costly traditional overnight studies. One in four adults have pre-diabetes. Untreated OSA may speed their development of diabetes, both because compensatory mechanisms to compensate for apnea may exacerbate hyperglycemia, and because the associated fatigue may thwart weight loss. Yet, little is known about the prevalence of OSA among pre-diabetics. In addition, portable OSA monitoring devices may improve access to diagnosis among high-risk, low-income populations, but no data exist on portable testing among vulnerable populations. A community-academic partnership in East Harlem, the epicenter of diabetes in New York City, aimed to assess the feasibility and acceptability of portable OSA diagnosis and explore the prevalence in OSA in a pre-diabetic, minority population. METHODS: We recruited a convenience sample of participants who completed a diabetes prevention randomized controlled trial. All participants wore an ApneaLinkPlus portable

monitor overnight and afterwards engaged in open-ended interviews about their experience using the equipment and underlying perceptions about OSA. Those with moderate or severe OSA (>15 AHI per hour) received auto-titrating CPAP machines and returned at 30 days for follow-up. Measurements of health were collected in conjunction with the parent study. We analyzed interview
transcripts and calculated means and standard deviations for continuous variables, proportions for categorical variables and group comparisons using chi-square and students t-test in SPSS v17.
RESULTS: We tested 52 pre-diabetic, overweight adults. Most were Latino (64%), or Black (31%), uninsured (31%), low-income (50% earned<$15,000 per year), and undereducated (28% with<high school diploma). Use of at-home sleep monitors was feasible in this population: of the 121 approached, 58% agreed to testing, and 100% of those given home monitors returned them promptly. No participants required OSA test in overnight lab, as the home diagnoses were conclusive. Participants found monitors comfortable and convenient (87% would recommend the test). Nearly half (48%) had OSA (>5 AHI events/hour); 13% had moderate to severe OSA (>15 events/ hour) requiring treatment with CPAP. Screening with the commonly used, verbally administered Epworth Sleepiness Scale did not accurately predict which participants had OSA compared to those diagnosed by the ApneaLink Plus (p=.506). Mean systolic blood pressure (BP) was significantly higher in those with OSA (119 vs 109 mmHg, P=0.01), but BMI, cholesterol and depressive symptoms were not statistically different between those with and without OSA We interviewed all 18 participants with moderate to severe OSA and found that most had a misconception that OSA would cause them to die in their sleep. However, they were appropriately concerned that OSA could cause progression to diabetes, and thought weight loss could prevent or improve OSA.
CONCLUSIONS: At-home sleep monitors represent a feasible and acceptable method for diagnosing OSA in high-risk minorities. The prevalence of mild-severe OSA in this population is much higher than the US average (48% compared 3-28%) indicating need to increase accessibility to OSA diagnosis in this population.
FEEDBACK ABOUT FACULTY FEEDBACK: DO STUDENTS AND FACULTY AGREE ON WHAT IS USEFUL?
Neil Mehta; AlanL. Hull; J. H. Isaacson; Amy S. Nowacki; Pavel Ermakov. Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, Cleveland, OH. (Control ID #1340475)
BACKGROUND: Students need useful performance feedback to improve skills and behaviors. Many institutions, provide faculty development to help faculty provide useful feedback, faculty get little information about the usefulness of the assessments they provide. Our institution has a web-based formative feedback system where faculty provide written narrative feedback to students on observed patient encounters. The objective of our study was to compare student and expert perceptions of the usefulness of these assessments. This is the first step in a plan to provide faculty regular feedback on the usefulness of the student assessments they provide.
METHODS: Students can rate the written faculty comments as useful or not (or no comments) by answering the question This feedback identifies specific behaviors/skills I did well and/or I can improve. Data were collected for 1 month. We randomly selected 100 assessments received and rated by students during 7 core disciplines. Two experts also independently rated the blinded comments as useful or not. We analyzed the agreement between the 2 experts and between the experts consensus and the students. Iif either or both experts rated the comments as useful, the expert consensus was considered useful.
RESULTS: A total of 65 students received 945 assessment forms from 389 faculty members during this 1 month period. The 100 randomly selected assessments were completed by 74 different faculty for 27 unique students. A total of 75 forms were used in the analysis (25 excluded because students did not provide a usefulness rating). Students rated 89% of faculty feedback comments as useful (N=67) while the experts rated 68% of faculty feedback comments as useful (N=51). Experts had good to excellent agreement (Kappa=.69, see Table 1). Students and the combined expert assessment showed poor agreement overall (Kappa=.28, see Table 2). When students rated a form as not useful, experts agreed with them 63% (5/8) of the time. When

students rated a form as useful, experts agreed 81% (54/67) of the time.

CONCLUSIONS: While students identified more of the feedback as useful compared to the experts, there was good agreement (81% of cases) between the two. There was less agreement between the two when the students rated the forms as not useful. One explanation is that students rate the usefulness of the feedback in the context of their learning experience. They may also interpret the comments in light of any verbal feedback they might have received during the patient encounter. It is also possible that students were reluctant to identify faculty comments as not useful. We believe that student generated assessments of faculty comments have potential to provide strong reinforcement for faculty to provide useful, behaviorally-based, feedback to students and help target faculty development.
table 2
studentnot useful usefulexperts not useful 5 13 18
Useful 3 54 57 8 67 75
FINANCIAL CONSIDERATIONS IN RESIDENTS DECISIONS ABOUT END-OF-LIFE CARE Neil J. Farber; Lisa J. Wastila. University of California, San Diego, La Jolla, CA. (Control ID #1319231)
BACKGROUND: One of the most contentious issues in end-of-life care is that of financial concerns in decisions made on the behalf of patients by patients surrogates. While physicians emphasize the emotional cost involved, some patients emphasize the financial costs, including the fear that the patients family would suffer financially if the patient died. Since there have been no studies which examine physicians decisions to withdraw life-sustaining treatment based on the influence of surrogates financial gain from such decisions we studied internal medicine residents regarding their attitudes about withdrawing life-sustaining treatment when financial considerations are involved.
METHODS: A survey was developed which was pre-tested for face and content validity among 40 general internal medicine physicians. The survey contained 8 scenarios in which a patient who was terminally ill and lacked capacity had a decision to make regarding withdrawal of the ventilator. The life sustaining treatment had been deemed by the ethics committee to be medically futile. Nested variables included agreement or disagreement between the surrogate and patient, decision to withdraw or continue the ventilator, and financial gain or no financial gain for the surrogate based on the decision. Residents were asked how likely they were to withdraw the ventilator in each scenario based on a 4 point Likert scale. The survey was administered to all internal medicine residents at UCSD. The differences between scenarios in which there was the presence or absence of each of the three nested variables was analyzed via T tests.
RESULTS: Residents were more likely to withdraw the ventilator when requested to do so, than when it was requested to be continued, despite the scenario indicating futility of care ($p<0.001$). They were also more likely to withdraw the ventilator when there was agreement in the decision between the surrogate and the patient ($p<0.001$). Residents were more likely to withdraw or withhold the ventilator when financial benefits were not an issue for the spouse, than when the spouse was likely to accrue such benefits ($p=0.032$). This difference was largely due to the scenario in which there was disagreement between the surrogate and patient but in which the ventilator was requested to be removed, where residents were
significantly more likely to remove the ventilator when financial benefits were not to be accrued by the surrogate ($p=0.02$). CONCLUSIONS: Internal Medicine residents make some decisions about whether to withdraw life sustaining treatment based on financial considerations for the patients surrogate. Residents also make such decisions based on the wishes of the surrogate and the agreement or disagreement of the patient and surrogate, despite determination of futility by and ethics committee. There needs to be ongoing communication with residents and education about end-of life decisions in terminally ill patients where conflicts may exist

between the surrogates and patients and between the surrogates and physicians.

FOLLOW-UP PROVIDER VISITS AFTER HOSPITALIZATIONS: WHO YA GONNA CALL? Claire F. Snyder1; Kevin D. Frick2; Robert J. Herbert2; Amanda L. Blackford3; Bridget A. Neville4; Antonio C. Wolff3; Michael A. Carducci3; Craig C. Earle5. 1Johns Hopkins School of Medicine, Baltimore, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 3Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, Baltimore, MD; 4Consultant, Boston, MA; 5Institute for Clinical Evaluative Sciences, Toronto, ON, Canada. (Control ID #1315642)

BACKGROUND: Patients who are hospitalized for conditions such as stroke, diabetes, and depression require follow-up visits after discharge. However, it is not always clear whether these follow-up visits should be with the patient's primary care provider (PCP) or a specialist. This issue may be exacerbated for cancer survivors who frequently have visits with a variety of primary care and specialty care providers. This analysis examined the provider specialties visited by cancer survivors following hospitalizations for non-cancer medical problems.

METHODS: We used the Surveillance, Epidemiology and End Results (SEER)-Medicare linked database which combines the clinical cancer data from the SEER registry system with Medicare claims. The sample included survivors of loco-regional breast, colorectal, or prostate cancer who were diagnosed in 2004, age>=66 at diagnosis, continuously enrolled in fee-for-service Medicare, and survived>=3 years from diagnosis. The study time period was the transition from cancer treatment to survivorship, defined as days 366-1095 from the cancer diagnosis. We examined the provider specialties visited during the 2 or 4 weeks following discharge (based on published quality indicators) for the following conditions: depression, diabetes, malignant/severe hyper-tension, gastrointestinal bleeding, transient ischemic attack, cerebrovascular accident, unstable angina, acute myocardial infarction, and congestive heart failure. Provider specialty was determined using the American Medical Association Masterfile and was grouped into PCP, oncology specialist, or other specialist. We analyzed the data descriptively to examine the proportion of patients with visits to each provider type to determine the specialties from whom patients were most likely to seek care.

RESULTS: The total sample included 8661 cancer cases (53% prostate, 22% breast, 26% colorectal). The mean age was 75, 65% male, 85% white. The table summarizes the number of patients who were hospitalized for each condition and the number (%) of patients with visits to PCPs, oncology specialists, and other specialists during the time period specified by the published quality indicator. With the exception of patients with unstable angina (39%), patients were most likely to have visits with a PCP (67%-85%). Patients were equally likely to see other specialists as PCPs following hospitalization for acute myocardial infarction (67%) and more likely to visit other specialists following hospitalization for unstable angina (85%). Visits to oncology specialists following hospitalization for any of the conditions were rare (<22%).

CONCLUSIONS: Patients were most likely to visit a PCP during the period immediately following hospitalization. This finding is particularly noteworthy given our sample of cancer survivors, many of whom seek care from a complex array of physician specialties. These results support the critical role PCPs play in managing patients' overall health.

N (%) with Other Specialist Visits

Depression (2 weeks) 72 56 (78) 6 (8) 26 (36) Diabetes (4 weeks) 299 211(71)

52 (17) 142 (48)

Malignant/Severe Hypertension (4 weeks)

13 11 (85) 0 (0) 5 (39)

Providers Visited After Hospitalization

Reason for Hospitalization (Time Period for Follow-Up Visit)

Number Eligible

N (%) with PCP Visits

N (%) with Oncology Specialist Visits
Gastrointestinal Bleeding (4 weeks)
63 48 (76) 10 (16) 22 (35)
Transient Ischemic Attack (4 weeks)
32 24 (75) 5 (16) 19 (59)
Cerebrovascular Accident (4 weeks)
117 90 (77) 8 (7) 52 (44)
Unstable Angina (4 weeks)
33 13 (39) 4 (12) 28 (85)
Acute Myocardial Infarction (4 weeks)
52 35 (67) 11 (21) 35 (67)
Congestive Heart Failure (4 weeks)
236 164(70)
27 (11) 119 (50)
FOOD INSECURITY IN RELATION TO CHANGES IN SELF-EFFICACY, NUTRITION, AND HEMOGLOBIN A1C DURING A DIABETES EDUCATIONAL INTERVENTION Courtney R. Lyles1; Michael S. Wolf2; Allison Dahlke2; Terry Davis3; Laura Curtis2; Darren A. DeWalt4; Dean Schillinger1; Hilary Seligman1. 1University of California San Francisco, San Francisco, CA; 2Northwestern University Feinberg School of Medicine, Chicago, IL; 3Louisiana State University Health Sciences Center - Shreveport, Shreveport, LA; 4University of North Carolina Chapel Hill School of Medicine, Chapel Hill, NC. (Control ID #1336988)
BACKGROUND: Food insecurity refers to being at risk of going hungry because of the inability to afford food. It is a way in which poverty may predispose individuals to poorer diabetes management, as patients may shift their dietary intake toward inexpensive, calorically-
dense foods. While previous, cross-sectional analyses have shown an association between food insecurity and worse glycemic control and diabetes self-management, this study uses longitudinal data to assess food insecurity in relation to changes in self-efficacy, nutritional intake, and glycemic control. We hypothesized food insecure individuals would have worse outcomes over time.
METHODS: The dataset is from the Missouri Health Literacy and Diabetes Communication Initiative, conducted in 2008-2009. We enrolled 621 patients with diabetes from urban, suburban, and rural safety net sites into a trial evaluating a low-literacy diabetes guide for self-management support. Two thirds received a defined intervention designed to engage patients in setting feasible diabetes action plans, and remaining patients received usual diabetes care. In this study, we conduct a secondary analysis of baseline food insecurity (6-item scale dichotomized into food secure vs. food insecure) in relation to several outcomes over 1 year. We compared unadjusted differences of diet and diabetes self-efficacy (scales scored 1-5), fruit and vegetable consumption (# per day), and glycemic control (A1c) by food insecurity status at each time point using two-sided t-tests. Adjusted differences by food insecurity over time were examined using generalized estimating equations, clustering on individual and controlling for time, age, gender, race, income, and intervention arm, as well as an interaction between time and food insecurity.
RESULTS: 35% (n=214) of the diabetes sample reported being food insecure. These participants were younger, with less income, and were more likely to be current smokers and unemployed. At baseline, food insecure individuals had higher A1c as well as lower diet and overall diabetes self-efficacy and fruit and vegetable consumption compared to food secure individuals (Table). Food insecure individuals had significantly greater improvements in A1c (reduced on average by0.39%), diet self-efficacy (increased by 0.23), and diabetes self-efficacy (increased by 0.26) over time (interaction terms: $p<0.05$). This improvement for food insecure individuals resulted in no significant difference in A1c between the groups at follow-up.
CONCLUSIONS: As expected, individuals experiencing food insecurity were more likely to begin this study with

poorer measures of self-efficacy, nutritional intake, and glycemic control. However, contrary to our hypotheses, food insecure patients made significant improvements on A1c and self-efficacy over time. This finding may suggest that food insecure patients are particularly sensitive to diabetes self-management support.

Outcomes of Interest by Food Insecurity

Unadjusted Baseline Unadjusted Follow-up Adjusted Longitudinal Model

Comparing Insecure to Secure

Food Secure Food Insecure P-value Food Secure Food Insecure P-value (95% CI)

Mean # fruit/day 1.00 (0.7) 0.78 (0.7) 0.001* 1.09 (0.8) 1.00 (0.9) 0.27 -0.003 (-0.17, 0.16)

Mean # veg/day 2.03 (1.1) 1.75 (0.9) 0.01* 2.10 (1.2) 1.76 (0.9) 0.002* -0.25* (-0.45, -0.05)

Mean diet self-efficacy 3.49 (0.8) 3.09 (1.0) <.001* 3.55 (0.8) 3.41 (0.8) 0.07 -0.17* (-0.33, -0.01)

Mean diabetes self-efficacy 3.57 (0.4) 3.33 (0.5) <.001* 3.70 (0.4) 3.60 (0.4) 0.01* -0.09* (-0.16, -0.01)

Mean A1c 7.8 (1.6) 8.4 (1.9) 0.002* 7.8 (1.6) 8.1 (1.8) 0.12 0.22 (-0.17, 0.60)

Adjusted for age, gender, income, race, intervention arm, time, and interaction between food insecurity and time. * p<0.05 Note: Self-efficacy and nutrition outcomes: n=455; A1c: n=343

FORMATIVE EVALUATION OF A PRIMARY CARE SHARED PANEL MANAGEMENT PROGRAM: THE FIRST YEARS EXPERIENCES Tara F. Bishop1; Melinda A. Chen1; Amanda S. Parsons2; Daniel I. Gottlieb2; Priya K. Desai2; Sarah C. Shih2; Lawrence P. Casalino1. 1Weill Cornell Medical College, New York, NY; 2Primary Care Information Project, New York City Department of Health and Mental Hygeine, New York, NY. (Control ID #1326122)

BACKGROUND: Outreach to patients who are overdue for recommended chronic disease care is difficult for small practices. These practices often lack the time and resources to utilize their electronic health records (EHR) disease registries to arrange follow-up appointments. We describe the motivations for, barriers to, facilitators of, and experiences with the first year of a publicly initiated shared panel management program for small primary care practices in underserved areas.

METHODS: We conducted a formative evaluation of the New York City Department of Health and Mental Hygienes Primary Care Information Projects (PCIP) shared panel management program using individual interviews with administrators, shared prevention outreach specialists (POSs), physicians, and practice staff. We used the constant comparative method to identify major domains and themes from interviews.

RESULTS: Prior to the program, none of the physicians interviewed regularly used the EHRs registry function to track patients. Physicians and POSs generally perceived the program as useful. Barriers to program implementation were technical problems, lack of practice workspace, POS training, and difficulty recruiting practices. Facilitators of implementation included having POSs onsite at each practice, creating a portable training manual, and engaging providers in the process.

CONCLUSIONS: This program demonstrates that it is possible for a public agency to provide shared technical and personnel resources to enable small primary care practices in underserved areas to promote patient follow-up. With pressures from health care reform and new payment models to improve care coordination, programs like this could serve as a model enabling small primary care practices to improve patient follow-up.

FREQUENT USERS OF EMERGENCY DEPARTMENTS PRESENT VERY HIGH PREVALENCE OF MENTAL HEALTH AND SUBSTANCE USE DISORDERS, WHICH ARE LARGELY UNDERDIAGNOSED BY CLINICIANS Francis Vu1;

Jean-Bernard Daeppen2; Olivier Hugli3; Katia Iglesias4; Stephanie Stucki4; Patrick Bodenmann1. 1Department of Ambulatory Care and Community Medicine, Lausanne, Switzerland; 2Lausanne University Hospital, Lausanne, Switzerland; 3Lausanne University Hospital, Lausanne, Switzerland; 4Lausanne University Hospital,

Lausanne, Switzerland. (Control ID #1330179)
BACKGROUND: The objective of this study was to determine if mental health and substance use diagnoses were equally detected in frequent users (FUs) compared to infrequent users (IUs) of emergency departments (EDs).
METHODS: In a sample of 399 adult patients (18 years old) admitted to a teaching hospital ED, we compared the mental health and substance use disorders diagnoses established clinically and consigned in the medical files by the ED physicians to data obtained in face-to-face research interviews using the Primary Care Evaluation of Mental Disorders (PRIME-MD) and the Alcohol, Smoking and Involvement Screening Test (ASSIST). Between November 2009 and June 2010, 226 FUs (>4 visits within a year) who attended the ED were included, and 173 IUs (4 visits within a year) were randomly selected from a pool of identified patients to comprise the comparison group.
RESULTS: For mental health disorders identified by the PRIME-MD, FUs were more likely than IUs to have an anxiety (34 vs. 16%, Chi2(1)=16.74, p<0.001), depressive (47 vs. 25%, Chi2(1)=19.11, p<0.001) or posttraumatic stress (PTSD) disorder (11 vs. 5%, Chi2(1)=4.87, p=0.027). Only 3/76 FUs (4%) with an anxiety disorder, 16/104 FUs (15%) with a depressive disorder and none of the 24 FUs with PTSD were detected by the ED medical staff. None of the 27 IUs with an anxiety disorder, 6/43 IUs (14%) with a depressive disorder and none of the 8 IUs with PTSD were detected. For substance use disorders identified by the ASSIST, FUs were more at risk than IUs for alcohol (24 vs. 7%, Chi2(1)=21.12, p<0.001) and drug abuse/dependence (36 vs. 25%, Chi2(1)=5.52, p=0.019). Of the FUs, 14/54 (26%) using alcohol and 8/81 (10%) using drugs were detected by the ED physicians. Of the IUs, 5/12 (41%) using alcohol and none of the 43 using drugs were detected. Overall, there was no significant difference in the rate of detection of mental health and substance use disorders between FUs and IUs (Fishers Exact Test: anxiety, p=0.567; depression, p=1.000; PTSD, p=1.000; alcohol, p=0.517; and drugs, p=0.053).
CONCLUSIONS: While the prevalence of mental health and substance use disorders was higher among FUs, the rates of detection were not significantly different for FUs vs. IUs. However, it may be that drug disorders among FUs were more likely to be detected.
FUNCTIONAL IMPAIRMENT AND DISABILITY DURING THE LAST TWO YEARS OF LIFE Alexander K. Smith; Yinghui Miao; W. John Boscardin; Kenneth Covinsky. University of California, San Francisco, San Francisco, CA. (Control ID #1324289)
BACKGROUND: We know little about the national prevalence of disability at varying points across the last years of life.
METHODS: Data are from participants ages 50+ who died in the Health and Retirement Study (HRS) between the years 1995 and 2008. Each participant was interviewed once in the last 24 months of life. We used the HRS interview closest to death to reconstruct national estimates of the monthly prevalence of functional impairment and disability in the two years prior to death. Measures of functional impairment and disability included: IADL difficulty (Difficulty with cooking, shopping, using telephone, taking medications, managing money); ADL dependence (requires assistance with dressing, bathing, eating, transferring, walking across the room, and toileting). We estimated the predicted probability of functional impairment or disability by age at death and gender, adjusting for race or ethnicity, educational level, net worth, and proxy status.
RESULTS: There were 7624 decedents (mean age at death 80, 52%% women, 84% White, 10% African-American, 4% Latino, 27% proxy interview). The unadjusted prevalence of all forms of functional impairment rose linearly over the last two years of life (Table). The predicted prevalence of disability prior to death rose with advancing age. After adjustment for gender, race/ethnicity, educational level, net worth, and proxy status, the predicted prevalence of any ADL dependency for elders ages 50-69 12 months prior to death was 24% (95% CI 18-29), compared to 29% (24-34) for ages 70 to 79, 37% (31-44) for ages 80 to 89, and 47% (41-54) for ages 90 and older (p for trend<.0001). Adjusting for age and the above factors, the predicted prevalence of any ADL

disability was more common in women 12 months before death (38%, 95% CI 33-44) then men (29%, 24-34) (p<.0001).
CONCLUSIONS: Those who live to an older age are more likely to experience a protracted period of disability prior to death. Nearly half of all elders who live to their tenth decade will be dependent in ADL a year prior to death. Independent of age, women are at greater risk then men.
Prevalence of Disability in the Months Before Death
Domain 24 months before death (95% CI)
12 months before death
Last month of life
Prevalence of any IADL difficulty
34% (27-41) 50% (44-56) 73% (61-82)
Prevalence of any ADL dependence
21% (16-27) 35% (29-41) 56% (47-65)
GENDER, ETHNIC AND RACIAL DIFFERENCES IN PRIMARY PREVENTION OF STROKE IN YOUNG ADULTS Arun K. Muthusamy; Diane L. Levine. Detroit Medical Center / Wayne State University, Detroit, MI. (Control ID #1276251)
BACKGROUND: There has been an increase in the incidence of stroke in young adults. From 1994 to 2004 stroke increased from 4.5% to 7.3% in adults younger between ages 18 and 45 years old. Primary prevention of stroke in this

age group is particularly important to prevent years of disability. Furthermore, life style modification alone has been shown to lower risk of a first stroke by 80%. Our aim is to assess how frequently primary care physicians provide counseling to address modifiable risk factors such as smoking, hypertension, obesity, diabetes mellitus and hyperlipidemia in young adults and whether such rates differ by patient gender, ethnicity and race.
METHODS: The National Ambulatory Medical Care Survey is a limited access dataset that provides visit-based data on documented preventive counseling services in primary care physician offices. All patients of age 18 to 45 years were included in the analysis. The likelihood of being counseled on three health promotion topics (i.e., diet, exercise, and weight reduction) and two risk reduction topics (i.e., tobacco use/ exposure, medication prescription for hypertension, diabetes mellitus, obesity and hyperlipidemia) were measured. Multivariate survey logistic regression model was used to investigate the discrepancies based on patient demographic characteristics.
RESULTS: There were a total of 10,580 patient visits between18 to 45 years in 2008 and 2009. The majority of these visits were to Family Medicine(45.8%) and Internal Medicine (20.5%) practices and only 2.5% visits were to Neurology. Smoking (21.6%) was the most prevalent risk factor, followed by obesity (17.1%), hypertension (13.3%), hyperlipidemia (8.6%) and diabetes (7%). Women were more likely to receive prescription medications for obesity and statins than men. Men were more likely to receive diet counseling in diabetes mellitus [OR 1.60, 95% CI (1.04 to 2.45)], hypertension [OR 1.47 95% CI (1.07 to 2.02)] and hyperlipidemia [OR 1.97, 95% CI (1.33 to 2.91)] than women. Men with hyperlipidemia were more likely to receive exercise counseling [OR 1.75, 95% CI (1.12 to 2.72)] compared to women. Hispanics were more obese and were more likely to receive diet counseling compared to non-Hispanics. Hispanics were also less likely to receive tobacco cessation counseling [OR 2.40, 95% CI (1.07 to 5.39)]. Among hypertensives, Hispanics were more likely to receive diet counseling than non-Hispanics. There were no statistically significant differences between Caucasians and African-Americans in preventive counseling.
CONCLUSIONS: Our results indicate that less than one third of the at-risk patient population received any preventive health counseling during outpatient office visits. In addition, there were significant differences in health promotion counseling based on gender and ethnicity. Efforts should be undertaken by primary care

physicians to improve counseling rates for patients with risk factors for stroke and to bridge the differences across the gender and race.

GENDER, RACIAL AND ETHNIC DISPARITIES IN THE UTILITY OF ELECTRONIC HEALTH RECORD IN AMBULATORY CARE Arun K. Muthusamy; Diane L. Levine. Detroit Medical Center / Wayne State University, Detroit, MI. (Control ID #1276235)

BACKGROUND: Health Information Technology (HIT) has been recognized as an important tool to improve overall health care. Significant emphasis has been made on the use of Electronic Health Records (EHRs), a component of HIT, to improve the quality of ambulatory care. However, data on the role of the EHR in improving outcomes in this setting is scant. Our aim was to assess the association between EHR use and the quality of ambulatory care delivered. A secondary aim was to determine if use of an EHR evaluated the racial, gender and ethnic differences as implemented in a nationally representative survey.

METHODS: The National Ambulatory Medical Care Survey is a limited access dataset that provides visit-based patient data from 2008 to 2009 in outpatient physician offices. We analyzed the utility of EHR use to the guideline-concordant care using 16 previously validated quality indicators by Institute of Medicine (IOM). Multivariable logistic regression model was used to examine the racial and gender differences across the strata adjusted for other risk factors.

RESULTS: There were a total of 61,022 patient visits in 2008 and 2009 which represents a weighted frequency of an estimated 1.7 billion annual visits in the United States. EHRs were used in 49.5% of the weighted frequency visits. Use of an EHR was associated with improvement in two of 16 IOM indicators (diet/nutrition counseling and exercise advice in high risk adults). In women, EHR use was associated with higher rates of ACE inhibitor use in congestive heart

failure [42% Vs 35% (P=0.02)] and aspirin use in coronary artery disease [76% Vs 67% (P=0.003)]. Among men, smoking cessation counseling [22% Vs 18.6% (P=0.03)] was associated with use of an EHR as compared to non-EHR visits. There was no difference in use of inappropriate medication prescription in elderly [93.5% Vs 94.1% (P=0.04)] by EHR use. Caucasian patients seeing physicians who used an EHR had higher rates of statin use than those seeing a physician who did not use an EHR [46% vs 42%; (P=0.01)]. There was no difference in concordant guideline care in statin use among African American patients seeing a physician who used an EHR [44.6 Vs43.7; (P=0.98)]. In Hispanics, EHR use was associated with higher rates of anti-thrombotic therapy in atrial fibrillation [91% Vs 64% (P=<0.0001)], aspirin in coronary artery disease [69% Vs 53% (P=0.03)] and TMP-SMZ in urinary tract infection [98% Vs 88% (P=<0.0001)] as compared to non-EHR use. There was no difference in concordant guideline care in among non-Hispanic patients seeing a physician who used an EHR in these three areas. CONCLUSIONS: Our findings indicate that EHR use had significant but limited impact on a panel of quality indicators and that in African Americans and non-Hispanics an EHR did not result in better care as measured by IOM indicators. Use of an EHR does not alone fulfill the promise of improving quality. Additional research is needed to improve quality of care.

GENERAL INTERNIST CONCEPTUALIZATION OF THE COMPLEX PATIENT: A QUALITATIVE STUDY Danielle F. Loeb1; IngridA. Binswanger1,2; Carey Candrian3; Elizabeth A. Bayliss4. 1University of Colorado Denver, Aurora, CO; 2Denver Health Medical Center, Denver, CO; 3University of Lugano, Lugano, Switzerland; 4Kaiser Permanente, Denver, CO. (Control ID #1337469)

BACKGROUND: While improving care for complex patients has become a national research and policy priority, the definition of patient complexity requires further elucidation. Definitions of patient complexity generally include patient demographic and psychosocial factors that may affect disease outcomes as well the state of having multiple chronic diseases. However, since demographic and psychosocial factors can be difficult to quantify, most measures of complexity focus on the number and types of chronic illnesses. We used in-depth open-ended interviews to explore how primary care physicians (PCPs) conceptualize patient complexity.

METHODS: We used personal emails to recruit 15 physicians from 2 university clinics and 3 community health

clinics. We used systematic non-probabilistic sampling to achieve an even distribution with respect to gender, years in practice, and type of practice. The in-person interviews focused on PCP experiences with complex patients in general, with additional focus on specific patient-level factors that contribute to patient complexity. PCPs brought de-identified notes from 3 patients they considered complex. Interview transcripts were coded and analyzed utilizing a participatory general inductive approach.
RESULTS: PCPs identified four types of complexity: 1) medical complexity in which patients had chronic conditions that complicated treatment of other chronic conditions; 2) mental illness with medical illness; 3) socio-economic challenges; and 4) cognitive challenges that interfered with patients ability to manage their medical conditions (Table 1). PCPs expressed the belief that truly complex patients had additional contributing factors beyond chronic medical illness, as expressed by one PCP: I think for me, a complex patient is a patient who makes me think outside of the exam room.... (p. 13) Or more specifically, I don't think it is a number of conditions. I think it is somebody that I have difficulty controlling their symptoms for whatever reason because of psychosocial factors, economic factors, transportation difficulties. (p. 14)
CONCLUSIONS: In this qualitative study we were able to gain a better understanding of PCPs conceptualization of complex patients. They conceived patients as highly complex if they had medical illnesses, mental illnesses, socioeconomic challenges, and/or cognitive deficiencies that complicated care for chronic medical illnesses. Although challenging to quantify, this study points to the importance of taking socio-economic,

psychological, and cognitive factors into account when measuring complexity.
Table 1
GEOGRAPHIC AND FACILITY CHARACTERISTICS ASSOCIATED WITH DIALYSIS FACILITY QUALITY
Milda R. Saunders.
1University of Chicago Medical Center, Chicago, IL; 2University of Chicago Medical Center, Chicago, IL.
(Control ID #1340052)
BACKGROUND: In 2012, the Centers for Medicare and Medicaid Services (CMS) began mandatory pay-for-performance for dialysis facilities. Dialysis facilities are an important unit of analysis and site of intervention because they affect clinical outcomes for patients with end-stage renal disease through the quality of the medical care provided. We examined whether dialysis facility characteristics, neighborhood demographics, and region are associated with CMS dialysis facility quality measures.
METHODS: We linked US census data to the Center for Medicare and Medicaid Services (CMS) Dialysis Compare File which contains information for facility outcomes for all CMS certified dialysis facilities in 2009 (n =5616). We used three CMS measures of quality: 1) patient survival, facilities actual survival rates compared to predicted, after controlling for demographic and clinical characteristics; 2) adequate anemia management, proportion of patients with Hgb between 10 and 12 g/dL; and 3) dialysis adequacy, proportion of patients with a urea reduction rate >65%. We then used linear and logistic regression to characterize the association between dialysis facility quality and dialysis facility characteristics (profit status,
size, length of operation, chain), neighborhood demographics (percent African American and percent of population below poverty), and region. RESULTS: In adjusted analysis, worse than expected survival was associated with for-profit status (OR 2.22, 95% CI 1.63, 3.02), increasing length of operation (OR 1.03, 95% CI 1.02, 1.04), increasing proportion of African Americans (OR 3.27, 95% CI 2.10, 5.09), and increasing proportion of poverty in the neighborhood (OR 7.19, 95% CI 2.46,20.98). Compared to facilities in the Midwest, dialysis facilities in the South had a worse than expected patient survival (OR 2.18, 95% CI 1.63,2.90). Greater dialysis adequacy is associated with for-profit status (=1.26), being part of a chain (=1.85), and having a greater number

of stations (=0.113), all p<0.05. Facilities in the South (=1.59) and Northeast (=1.66) also had greater dialysis adequacy, all p<0.05. Lower dialysis adequacy is associated with dialysis facilities with an increasing proportion of African Americans in the neighborhood (=-3.14). Better anemia management within a dialysis facility is associated with having a greater number of stations (=0.065, p<0.05). Worse anemia management is associated with being part of a chain (=-5.02), having an increased proportion of African Americans in the neighborhood (=-3.36), and dialysis facilities in the South (=-2.22), all p<0.05.
CONCLUSIONS: Neither region nor dialysis facility characteristics such as profit status, size, length of operation, or being part of a chain

have a consistent relationship across all three measures of dialysis facility quality. Having an increasing proportion of African Americans in the neighborhood is consistently associated with worse dialysis facility outcomes, even after controlling for neighborhood poverty. Quality improvement efforts, while important overall, are particularly needed in minority communities.

GROUP MEDICAL VISITS VERSUS USUAL CARE ON SATISFACTION AND PATIENT-CENTERED CARE EXPERIENCES: RESULTS FROM A THREE-YEAR STUDY. Leonie Heyworth1; Ronen Rozenblum1; Mark Meterko3; Debra Prescott4; Zeev Neuwirth4; Steven R. Simon2,1. 1Brigham and Women's Hospital, Boston, MA; 2VA Boston Health Care System, Boston, MA; 3VA Boston Health Care System, Boston, MA; 4Atrius Health, Boston, MA. (Control ID #1339480)
BACKGROUND: Group medical visits (GMV) aim to improve access, efficiency and outcomes. As patient-centered medical homes emerge, GMV are an increasingly common approach to patient-care delivery. However, little is known about the impact of GMV on patient satisfaction or other measures of patient-centered care.
METHODS: In a large multispecialty group practice, we identified 36 539 adults who had at least one internal medicine office visit from 2008-2010, including 981 who had taken part in a GMV and 35 558 who received usual care (UC). Each 90-minute GMV comprised approximately 10 patient-participants and a care team consisting of a primary care internist, a behaviorist (e.g., a psychologist, social worker or nurse practitioner) and documentation specialist. UC participants experienced a routine one-on-one clinician-patient encounter. Mail surveys were sent to both groups one week following their visits and were completed by 40% of GMV patients and 37% of UC patients. We used chi-squared analysis to compare GMV and UC patients overall satisfaction, the primary endpoint, and responses to specific items measuring elements of the patient-centered medical home. To control for baseline characteristics of participants, we dichotomized overall satisfaction and employed multivariable logistic regression to compare overall satisfaction between GMV and UC participants.
RESULTS: Compared with UC patients, GMV participants were more likely to be over age 65 years (p<0.001), male (p<0.001), white (p<0.001) and have a chronic illness (hypertension, diabetes, heart disease, each p<0.001). Overall, 70% of GMV participants and 71% of UC participants were very satisfied with their visit (p=0.76). Compared with UC patients, GMV participants were more likely to report enhanced access to care (p<0.001), whole-person orientation of their care provider (p<0.001), and team-based care (p<0.001). There was no difference in perceptions of care coordination (p=0.66). After adjusting for baseline patient characteristics, overall patient satisfaction for GMV and UC participants was similar (adjusted odds ratio 0.9, 95% confidence interval 0.7 -1.1). Of GMV participants, 76% reported that they were likely or very likely to schedule another GMV.
CONCLUSIONS: Overall patient satisfaction was similar among participants of GMV and UC, although potential selection bias limits inference. GMV participants were significantly more likely to report that their care embodied five elements of the patient-centered medical home. Organizations and providers adopting the medical-home model should consider group visits as a way to enhance patient-centered care.

GUATEMALA INTERNAL MEDICINE PHYSICIANS KNOWLEDGE OF NON-COMMUNICABLE DISEASE

CLINICAL PREVENTIVE SERVICES. Juan E. Corral1; Erwin E. Argueta1; Akshay Ganju2; Lauren Arnold2; Joaquin Barnoya1,2. 1Cardiovascular Unit of Guatemala, Guatemala, Guatemala; 2Washington University in St. Louis, School of Medicine, St. Louis, MO. (Control ID #1294700)

BACKGROUND: Non-communicable diseases (NCDs) represent a considerable toll in Guatemala accounting for 47 % of all deaths. Clinical preventive services (e.g. smoking cessation counseling and colonoscopy) are key to reducing the burden of NCDs. Internal medicine staff are
fundamental to providing these services, and their knowledge and practices are a cornerstone of NCDs control and prevention. On February 2011, the Guatemalan Ministry of Health released their NCDs Prevention and Treatment Guidelines. Designed to be implemented in rural health posts and centers, the guidelines are based on reports and guidelines from international associations (e.g. Alliance for Cervical Cancer Prevention) and other countries (e.g. Mexico) rather than on cost-effectiveness analyses from Guatemala.

METHODS: We conducted a cross-sectional survey of internal medicine departments in teaching hospitals nationwide. Four trained surveyors invited interns, residents, and attendings to participate. The self-administered anonymous survey included demographic data, percentage of time devoted to outpatient care, preventive service recommendations, perceived availability and barriers to providing each service, and opinion on who should be responsible for preventive services guidelines and training. Answers regarding recommendation practices were compared with US Preventive Services Task Force (USPSTF) guidelines due to the scope and limitations of Guatemalan guidelines. USPSTF classifies preventive services as A (strongly recommend), B (recommend), C (recommend against routine use but can provide on individual basis), D (recommend against), or I (insufficient evidence recommend for or against). Services were considered cost-effective if they require less than $35,000 per quality adjusted life-year saved. Data analysis was done with STATA/SE 11.2.

RESULTS: Of 443 physicians invited to participate, 394 completed the survey (88.94% response rate). Recommended services (grade A or B) were offered as frequently as non-recommended services (grade D or I)(51.09% vs. 50.39%, p=0.9). Among A and B services, physicians did not prioritize those considered cost-effective. Only colorectal ($p<0.001$) and prostate ($p=0.006$) cancer screening recommendation practices differed by level of training. Tobacco cessation interventions (grade A) had the highest recommendation rates (99.20%) and screening for colorectal cancer (gradeA) had the lowest recommendation rates (55.75%). Almost two-thirds of physicians recommended screening for coronary heart disease with an EKG (grade D). Regarding services availability, hypertension screening was perceived as the most available service (93.57% indicated it is available at their hospital) and tobacco cessation pharmacotherapy as the least available (4.83%). Furthermore, the most frequent barriers to providing services were lack of time (46.38%) and inadequate patients resources (31.34%). When asked about who should provide training in preventive services, 42% considered the Ministry of Health responsible, followed by Schools of Medicine (30%), and the Guatemalan College of Physicians (14%).

CONCLUSIONS: Internal medicine physicians in Guatemala are inappropriately trained on preventive services for NCDs control and prevention and do not prioritize recommendations based on cost-effectiveness. These data should prove useful to strengthen preventive medicine education and implement an evidence-based national screening program.

HIV CONSPIRACY BELIEFS AMONG RACIAL/ETHNIC MINORITIES IN CHICAGO: IMPLICATIONS FOR HIV TESTING AND PARTICIPATION IN RESEARCH Elizabeth Jacobs1; Ryan West-ergaard1; Mary Catherine Beach2; Somnath Saha3. 1University of Wisconsin School of Medicine &Public Health, Madison, WI; 2Johns Hopkins University, Baltimore, MD; 3Oregon Health &Science University, Portland, OR. (Control ID #1340669)

BACKGROUND: Conspiracy beliefs about the origin of HIV and the governments role in HIV research have been reported among African-Americans in the United States. We hypothesized that endorsing such beliefs would be associated with decreased willingness to undergo physician-initiated screening for HIV infection or to participate in HIV research. METHODS: We conducted a cross-sectional, computer-adapted survey of a

convenience sample of African American (n=208), white (n=198), and

Latino or Hispanic (n=195) adults shopping at one of 12 supermarkets located within a socioeconomically diverse group of Chicago neighborhoods. Using a 5-point Likert scale, participants rated their level of agreement with 6 statements reflecting HIV conspiracy beliefs (Figure). Respondents then indicated whether they would agree to be tested for HIV infection if it was recommended by a doctor and rated their willingness to participate in an HIV vaccine study. Ordinal logistic regression models were used to assess the influence of holding conspiracy beliefs on willingness to undergo HIV testing or participate in research while adjusting for race/ethnic group, gender, age, family income and education level.
RESULTS: African-American and Hispanic/Latino respondents were more likely to agree or strongly agree with at least one HIV conspiracy belief compared to white/Caucasian respondents (60.4% and 59.0% vs. 38.8%, respectively, $p<0.001$). African-Americans were significantly more likely to report they would accept HIV testing if
recommended by a doctor (82.9%) than whites (73.9%, $p<0.05$), and expressed greater willingness to participate in an HIV vaccine study(58.9% very willing or probably willing) than whites (39.3%) or Hispanic/Latino respondents (49.5%, $p<0.001$ for trend). In adjusted models, level of agreement with HIV conspiracy beliefs showed no association with either report of HIV test acceptance or willingness to participate in HIV research. Of the variables analyzed, racial/ ethnic group was the only significant predictor of HIV test acceptance: African-Americans had 75% increased odds of reporting they would accept an HIV test compared to whites (adjusted OR=1.75, 95% CI=1.0 - 3.1).
CONCLUSIONS: HIV conspiracy beliefs remain common and are disproportionately held by racial/ethnic minorities. Endorsing such beliefs, however, does not appear to influence reported willingness to undergo HIV testing in health care settings or to participate in HIV research.
HIV STATUS IS AN INDEPENDENT PREDICTOR OF RECEIVING OPIOID ANALGESICS E. J. Edelman1,2; Kirsha S. Gordon3,4; William Becker2,3; Joseph L. Goulet3; Melissa Skanderson3; Julie R. Gaither5; Jennifer B. Braden6; Adam Gordon7; Robert Kerns3; Amy C. Justice3,2; David A. Fiellin2. 1Yale University School of Medicine, New Haven, CT; 2Yale University School of Medicine, New Haven, CT; 3VA Connecticut Healthcare System, West Haven, CT; 4Columbia University School of Public Health, New York, NY; 5Yale University School of Public Health, New Haven, CT; 6University of Washington, Seattle, WA; 7University of Pittsburgh and VA Pittsburgh Healthcare System, Pittsburgh, PA. (Control ID #1339823)
BACKGROUND: Opioid analgesics are increasingly prescribed. HIV-infected patients may be particularly vulnerable to the toxicities and risks associated with opioid analgesics, yet limited data about receipt of opioids comparing HIV-infected and uninfected patients exist.
METHODS: We conducted a cross-sectional analysis of the Veterans Aging Cohort Study - Virtual Cohort (VACS-VC), using data from October 1, 2005 to September 30, 2006 of 40,594 HIV-infected and 81,188 age/ race/ethnicity/site-matched uninfected patients. We excluded patients who had an ambiguous HIV status; a cancer diagnosis other than nonepithelial skin cancers; no inpatient or outpatient visit in FY2006; or unclear opioid pharmacy data. Clinical characteristics, including pain diagnoses, and alcohol and substance use disorders, were determined based on ICD-9 codes. Using pharmacy data, we defined: opioid receipt as at least one outpatient prescription for an opioid; high dose opioid therapy as an average daily dose of at least 120 mg of morphine equivalents; and long-term therapy as 90 consecutive days of opioids. Descriptive statistics for all variables by HIV status and opioid receipt were performed. We constructed multivariate models, adjusting for demographics, site of care based on urbanicity, Hepatitis C virus (HCV) status, pain diagnosis (acute, chronic), serious mental illness, and alcohol and substance use disorder, to determine factors independently associated

with opioid receipt.
RESULTS: Our sample (N=78,748) was 97% male, with a mean age of 46 years, diverse (39% white, 48% black, 8% Hispanic), with 86% receiving care in urban settings. Thirty-one percent of HIV-infected and 28% of uninfected patients (p<0.001) received any opioids. Among patients who received opioids, HIV-infected patients, were less likely to have a pain diagnosis (60.7% vs. 73.8%), but more likely to have depression (8.7% vs. 7.6%), Hepatitis C infection (40.8% vs.19.1%), and an alcohol (13.0% vs. 11.2%) or substance use disorder(17.3% vs. 10.4%) than uninfected patients. Median average daily morphine equivalent dose was 20.0 mg (Interquartile range (IQR)

13.5, 36.0) among HIV-infected patients and 20.6 mg (IQR 14.6,36.8) among uninfected patients, with 6.1% vs. 4.9% (p<0.001) receiving high doses. Median number of days of opioids supplied was 44 days (IQR 14, 189) among HIV-infected and 60 days (IRQ 17, 212) among uninfected patients, with 38% vs. 42% receiving long-term opioid therapy. HIV status was associated with receipt of opioids unadjusted (OR 1.17, 95% CI 1.13, 1.21) and adjusted (AOR 1.40, 95% CI 1.35, 1.46) analyses. HCV infection, pain (acute or chronic), PTSD, and depression were positively associated, while non-White race/non-Hispanic ethnicity, schizophrenia, and alcohol abuse were negatively associated with receipt of opioids.
CONCLUSIONS: Though HIV-infected patients may be particularly vulnerable to the toxicities and risks associated with opioid analgesics, they are 40% more likely than uninfected patients to receive opioids after controlling for pain and other factors.
HIV KNOWLEDGE AND TESTING AMONG PREGNANT WOMEN IN RURAL MOZAMBIQUE: VALIDATION OF THE HIV KNOWLEDGE SCALE-27 (HK-27) Shannon Skinner1; Carolyn Audet1; Srgio Roques2; Troy Moon2,1; Sten Vermund1; Russell L. Rothman1; Philip J. Ciampa1. 1Vanderbilt University School of Medicine, Nashville, TN; 2Friends in Global Health, Zambzia, Mozambique. (Control ID #1337858)
BACKGROUND: The prevalence of HIV infection in Mozambique was 14% among women in 2009, yet it is estimated only 18% of women have comprehensive HIV knowledge. Limited knowledge may have negative implications for testing uptake and treatment adherence, but research has been limited by the lack of a comprehensive, validated instrument to measure HIV knowledge in Mozambique. METHODS: We adapted items from existing measures of HIV knowledge (HIV-KQ-45, BSS, DHSAIDS) and added items about HIV treatment. The adapted scale (the HK-27) was translated into Portuguese and Echuabo and orally administered to women seeking prenatal care at two clinics in rural Mozambique. The HK-27 consists of 27 items that assess knowledge across several HIV content domains; for each item, respondents could agree, disagree, or state that they were uncertain. A summary score is based on the percent correct (range 0-100%). Sociodemographic characteristics and HIV testing were determined by self-report. HIV status was abstracted from medical records. Analyses were stratified by survey language. Kuder-Richardson (KR-20) coefficients estimated internal reliability. Construct validity was established by testing bivariate associations between HK-27 score and sociodemographic characteristics chosen a priori. The association between knowledge and HIV test utilization was estimated by multivariable logistic regression.
RESULTS: Participants (N=348) had a median age (IQR) of 24 (20-28); 188 spoke Portuguese, and 160 spoke Echuabo. Over half(57.6%) had no formal education. Mean HK-27 scores were higher for Portuguese-speaking participants (68.3, SD 18.6) than Echuabo-speaking participants (42.2, SD 22.6). Internal reliability was strong (KR-20>0.8) for scales in both languages. Higher HK-27 scores were significantly (p0.05) correlated with more education, more media items in the home, and maternal work outside of the home (Table 1). Eighty-five percent of women reported past HIV testing. Women with higher HIV knowledge had higher odds of past HIV testing, even after adjusting for study language, site, travel time to the clinic, and maternal work in the multivariable model (aOR 5.0, 95%CI:1.2-22.1, p=0.03).
CONCLUSIONS: HK-27 is a reliable and valid measure of HIV knowledge of Portuguese and Echuabo-

speaking women seeking prenatal care in rural Mozambique. HIV knowledge was higher than in previous estimates, though gaps remain especially for non-Portuguese speakers. HIV knowledge was associated with HIV testing in this cross-sectional sample, though the study design limits its ability to prove causation. Further work should explore the relationship among HIV knowledge and health-seeking behaviors in low income settings.

Table 1: Correlation among HIV knowledge and sociodemographic data

Characteristic Portuguese-SpeakingParticipants

Echuabo-Speaking Participants

Continuous Variables

N Correlation with HK-27 ()

P N Correlation with HK-27 ()

P

Age 188 0.05 0.49 160 -0.02 0.78 Years ofeducation

188 0.68 <0.001 159 0.19 0.02

Numberof children

187 -0.18 0.01 160 0.00 0.90

Media items owned

182 0.28 <0.001 159 0.17 0.04

Categorical Variables

N Mean HK-

27 Score (SD)

P N Mean HK-

27 Score (SD)

P

188 160

Yes 156 69.7 (18.3) 0.05 141 43.5 (22.6) 0.04 No 32 62.5 (19.3) 19 32.4 (20.7) Maternal work 188

160Domesticwork

99 65.4 (20.4) 0.01 14 64.0 (11.1) 0.02

Agriculture 53 65.8 (15.2) 143 39.6 (22.3) Business 15 74.3 (15.4) 2 63.0 (0.10) Teacher 21 84.8 (7.0) 1 59.3 ()

HOSPITALIZATION: A MISSED OPPORTUNITY TO ASSESS FOR OSTEOPOROSIS Eileen Hennrikus; Christopher Weber; Nida Rizvi; Edward Fox. Penn State Milton Hershey Medical Center, Hershey, PA. (Control ID #1338639)

BACKGROUND: More than 1.5 million fractures result from osteoporosis annually in the United States at a cost of fifteen billion dollars. Less than 25% of these patients receive treatment for osteoporosis. We hypothesize that hospitalization offers an opportunity to screen patients utilizing the very simple Osteoporosis Self-Assessment Tool (OST).

METHODS: From 2007 -2010, 790 patients, >age 50, were identified by ICD-9 diagnoses for fragility fractures. Patients were excluded if they: had a high impact, or pathologic fracture, not consistent with a fragility fracture, could not be contacted, received pre and post-fracture care at another facility, suffered dementia, or were deceased. 320 patients with insufficiency fractures remained and responded to a phone survey. They were asked about a prior diagnosis of osteoporosis and the administration of a Dexa scan, Calcium and Vitamin D. Medical records were reviewed for all hospitalizations five years prior to the patients fracture. Data collected included the principle diagnosis, age, weight and Bone Mineral Density (BMD) scores among other variables. The OST was utilized to calculate a fracture risk assessment score based on weight and age. The Spearman correlation test was used to test correlation between the OST score and Hip and Lumbar T-scores.

RESULTS: 127 of the 320 patients (40%) were hospitalized within the past 5 years. These 127 patients were

admitted 312 times with a mean of 2.5 hospitalizations per person. The top 5 reasons for hospitalization included: Cardiac, Infectious, Musculoskeletal, Gastrointestinal and Neurologic/Psychiatric. 78% of patients were female. The mean age was 74 years. 45% had a prior diagnosis of osteoporosis. Of the 127 patients, only 45 (39%) had BMD tested prior to their fragility fracture. . The mean lumbar T-score was -1.71 and the mean hip T-score was -2.17. 87 patients (69%) had an OST<2.0. The mean OST score was 1.47 (an OST value<2.0 indicates osteoporosis risk). Although the OST score did not correlate with the lumbar T-score, it did correlate moderately with the hip T-score 0.46 (95% CI 0.25-0.67).
HIV test obtained

CONCLUSIONS: Forty percent of patients >50 years old who sustained an osteoporotic fracture had been hospitalized during the previous 5 years. Of these, less than half had been screened with a DEXA scan. 69% of these patients had an OST score <2.0. The OST score is easy to calculate and can easily be incorporated as a screening tool for hospitalized patients. Although there is only a moderate correlation with the hip T-score value, the OST score has potential to function as the initial hospital screening tool by virtue of its simplicity, thereby making it possible to routinely screen patients in the hospital.
HAS QUALITY IMPROVEMENT RESULTED IN THE REDUCTION OF INAPPROPRIATE CARE? Minal Kale1; Alex Federman1; Salomeh Keyhani2. 1Mount Sinai School of Medicine, New York, NY;
2University of California, San Francisco, CA. (Control ID #1330375)
BACKGROUND: In the past decade there has been a major focus on improving the quality of care. However, efforts to improve the quality of healthcare have largely concentrated on developing publicly reportable underuse measures. Overuse and misuse of health care services are also important aspects of the quality of healthcare. We compared changes in the quality of ambulatory care in the US between 1998/1999 and 2008/2009 using measures of underuse, misuse, and overuse of health care services. METHODS: We performed a cross-sectional analysis of the National Ambulatory Medical Care Survey (NAMCS) and the outpatient department component of the National Hospital Ambulatory Medical Care Survey (NHAMCS), which are nationally representative annual surveys of visits to non-federally funded ambulatory care practices. We identified a total of twenty-three quality indicators using a combination of current quality measures and guideline recommendations. Each indicator was chosen because it pertained to outpatient quality of care and could be reliably calculated using information in the 1998, 1999, 2008, and 2009 NAMCS and NHAMCS. We categorized our quality indicators into underuse (9), overuse (12), and misuse (2). We estimated the rates of underuse, overuse, and misuse and their 95% confidence intervals, accounting for the complex sampling design of the NAMCS and NHAMCS.
RESULTS: We observed a statistically significant improvement in six out of nine underuse quality indicators. In the ten year interval under consideration, there was an improvement in the use of antithrombotic therapy for atrial fibrillation (45.9% to 71.9% ,p<.01), the use of aspirin in coronary artery disease (CAD) (28.4% to 64.5%,p<.01), the use of beta blockers in congestive heart failure (CHF) (20.6% to 59.7% ,p<.01) and beta blockers in CAD (28.1% to 55.2% ,p<.01). There were also improvements in the use of statins in CAD (26.8% to 58.6%, p<.01) and diabetes (12.1% to 36.2%, p<.01). We observed an improvement in only two of 12 overuse quality indicators, one indicator became worse and 9 did not change. There was a statistically significant decrease in the overuse of cervical cancer screening in visits for females older than 65, (3.1 to 2.2%, p=.02) and a statistically significant decrease in the overuse of antibiotics in asthma exacerbations (22.3% to 6.8% ,p<.01). However, there was an increase in the overuse of prostate cancer screening in men older than 74, from 3.5% to 5.7% (p=.03). There were no changes in the remaining nine overuse measures: laboratory screening tests and ECG testing in general medical exams, antibiotics for upper respiratory infections and acute

bronchitis, mammography for women older than 74, pap tests in women younger than 21, and imaging in acute back pain. Out of the two misuse indicators, there was one significant improvement. The proportion of patients with a urinary tract infection who were prescribed an inappropriate antibiotic decreased from 24.9% to 2.7% ($p<.01$). There was no change in the proportion of elderly patients who were prescribed inappropriate medications.
CONCLUSIONS: Quality improvement efforts have resulted in the reduction in the underuse of appropriate ambulatory care. However despite significant policy attention focused on reducing waste in the US health care system, we found little improvement in the delivery of inappropriate ambulatory care in the past decade.
HEALTH INFORMATION EXCHANGE REDUCES HOSPITAL ADMISSIONS FOR CHEST PAIN James E. Bailey1; Xinhua Yu2; RyanD. Ward1; Guy L. Reed1. 1University of Tennessee Health Science Center, Memphis, TN; 2University of Memphis, Memphis, TN. (Control ID #1339000)
BACKGROUND: Presentation to the emergency department (ED) for chest pain can result in potentially avoidable hospital admission and/or cardiac evaluation. By providing useful patient data to emergency staff, health information exchange (HIE) may reduce unnecessary hospital admissions, cardiac testing, and associated costs. This study seeks to determine whether HIE reduces hospitalizations and cardiac catheterizations in patients presenting to the ED with chest pain.
METHODS: Cross-sectional analyses of 21,257 individual patient-visits for 12,385 adults diagnosed with chest pain without active cardiac conditions presenting to any Memphis Metropolitan Area (MMSA) ED 2 or more times between 8/1/2007 and 7/31/2009. Outcome measures included hospital admission and cardiac catheterization.
RESULTS: The majority of the repeat patient-visits for chest pain were for males (58.3%), Medicare patients (32.5%) with median age of 54 (IQR 42 - 69) and median of 1 previous ED visit for chest pain (IQR 1 - 2; range 1 -48). HIE data was accessed for 6.5% of visits for chest pain. For 80.2% of visits troponin was obtained, 7,964 (37.5%) resulted in hospital admission, and 1,134 (5.3%) resulted in cardiac catheterization. After controlling for demographic factors, comorbidity, hospital system, and previous visits, HIE use was associated with decreased odds of hospital admission (OR0.77, CI 0.65 - 0.91) but was not associated with reduced odds of cardiac catheterization (OR 1.08, CI 0.81 - 1.46).
CONCLUSIONS: HIE use in the ED is associated with decreased hospital admission for patients seen for chest pain. Rates of cardiac catheterization were appropriately low overall for this population and HIE did not impact use of cardiac catheterization. Low HIE use rates by providers in the ED limited the effectiveness of HIE in reducing potentially avoidable hospitalizations. We estimate that over 1,150 hospitalizations could be potentially prevented annually in the MMSA if providers used HIE for all ED chest pain visits. Assuming a similar reduction in admissions as seen in Memphis, we estimate that 100% provider HIE adherence nationwide could avoid over 297,000 chest pain hospitalizations yielding potential cost savings between $1.3B and $3.2B annually. Further studies are needed to assess best methods to increase HIE use.
HEALTH LITERACY AND COGNITIVE DECLINE IN OLDER ADULTS Shwetha S. Sequeira1; Rebecca Silliman1; Timothy Bickmore2; Lori Henault1; Michael Winter1; Debbie M. Cheng1; Kerrie Nelson1; Laura Eggermont3; Michael Paasche-Orlow1. 1Boston University Medical Center, Boston, MA; 2Northeastern University, Boston, MA; 3VU University, Amsterdam, Netherlands. (Control ID #1321298)
BACKGROUND: Limited health literacy is associated with a range of neurocognitive measures including executive function and verbal fluency. We hypothesized that people with limited health literacy would have greater decline in executive function and verbal fluency over time than people with higher health literacy.
METHODS: Participants were recruited from three urban ambulatory care practices for a randomized controlled trial of an intervention to promote walking. Enrollment criteria were age65, community dwelling, and permission from their primary care physician to participate. Subjects were excluded if they screened positive for cognitive impairment (2 on the Mini-Cog) or depression (PHQ-9 15). The study is a secondary analysis of information

collected on health literacy, demographics, education status, co-morbidities and neurocognitive measures. Health literacy, the main independent variable, was assessed with the Short Test of Functional Health Literacy in Adults, categorized as limited (0-22) and higher (23-36). Executive function was assessed using the Trails Making Test (TMT): the time taken to connect a series of numbers (TMT-A) and alternating numbers

and letters (TMT-B) is recorded in seconds and scored as time for TMT-B minus time for TMT-A (TMT B-A). A faster time reflects better executive function. Verbal fluency was assessed using the FAS test, where the score is the average number of words starting with F, A and S said in one minute for each and the Naming test, where the score is the number of animals and vegetables named in one minute. A higher score indicates better verbal fluency. The primary outcomes were the change in each neurocognitive measure between enrollment and 12 months. The association between health literacy and neuro-cognitive measures at baseline was modeled with multivariate linear regression adjusting for clinic location, age, sex, race, number of comorbidities, PHQ-9 score, and education. In addition, baseline neurocognitive scores and randomization group were added to model change from baseline to 12 months.
RESULTS: Of 263 participants, 226 completed baseline and 12 month visits and were included in the analysis. Mean (sd) age at enrollment was71.4(5.4); 63% were Black; 63% female and 37% had limited health literacy. At baseline, those with limited health literacy were 74 seconds slower in TMT B-A (159.3 vs 85.6, $p<0.0001$), scored 12 fewer words in FAS (22 vs 34, $p<0.0001$) and 6 fewer words in Naming(24.1 vs 29.8, $p<0.0001$) compared to higher literacy participants. In adjusted models, those with limited health literacy were 49 seconds slower for TMT B-A ($p<0.0001$), scored 8 fewer words in FAS ($p<0.0001$) and 2 fewer words in Naming ($p=0.06$) at enrollment. In the adjusted models of change from baseline, TMT B-A was 24 seconds longer ($p=0.01$) for those with limited health literacy compared with the higher health literacy group, but there were no significant differences in change from baseline on Naming and FAS scores by health literacy status. CONCLUSIONS: As we explore mechanisms of cognitive decline it is important to understand the role of health literacy. Interventions aimed at delaying cognitive decline should be evaluated in relation to health literacy.
HEALTH PROMOTION IN AFRICAN AMERICAN CHURCHES: WHO SAYS THEY WILL ATTEND? Adebowale Odulana1; Mimi Kim1; Malika Roman Isler1; Melissa Green1; Yhenneko Taylor2; Paul Godley1; Giselle Corbie-Smith1. 1UNC at Chapel Hill School of Medicine, Chapel Hill, NC; 2UNC Charlotte College of Human and Health Services, Charlotte, NC. (Control ID #1339215)
BACKGROUND: While churches have been identified as an important partner for improving health within the African American community, there is little literature describing who and how congregants are reached by health promotion activities. Increasing emphasis on community-academic partnerships to address health disparities creates a need to understand the expectations and interests of those engaged by outreach activities. Identifying individual attributes and contextual characteristics associated with willingness to attend health promotion programs allows faith based health collaborations to better target members to improve health. We examined how church characteristics and congregants beliefs and interests in faith-based health promotion are associated with their willingness to attend church-based health promotion activities.
METHODS: We surveyed adult members (n=1204) of 11 predominately African American churches in regions with significant health disparities in North Carolina. We collected data on demographics, health concerns, lifestyle habits, health beliefs, and health ministry characteristics and these independent variables were categorized into four domains: demographics (age, sex, education, health status), behavioral (church attendance, respondent food choices, and physical activity), cognitive(church based health promotion belief, bible based healthy living interest, healthy living resource interest), or environmental (family health, church travel distance, church health ministry activity, church members food choices). We used a dichotomous outcome; interest in attending programs offered by the health ministry (yes vs. no). . We constructed a series of domain specific models and a full model and used logistic generalized estimating equations to adjust for

clustering of the data.
RESULTS: Of the 1204 congregants, 72% were female, 57% age 50, 84% hada high school education, and 77% had a chronic health
condition. In bivariate analyses, congregants who wanted to learn more about resources for healthy living (OR 6.67, 95% CI 4.37-10.19) and who believed the church is responsible for health promotion (OR5.15, CI 3.33-7.96) had the highest odds of willingness to attend. These cognitive characteristics remained significant in domain-specific models. Additionally, in the behavioral and environmental domains respectively, factors with the highest odds of willingness to attend were reporting making healthy food choices (OR 2.53, CI 1.77-3.61), and having fellow church members who make healthy food choices (OR 2.90, CI 1.70-4.93). In models adjusting for all four domains simultaneously, cognitive factors were most highly associated with willingness to attend, while no demographic characteristics remained significant.
CONCLUSIONS: Congregants belief in the churchs role for health promotion and their desire to learn about healthy behaviors highlight the role of the black church as a partner in addressing health disparities and the need to capitalize on this expectation through stronger partnerships between medical and faith communities. Additionally in a time of limited resources, these findings help churches and investigators more efficiently target the concerns of those who are most willing to attend.
HEALTH STATUS AND HEALTH CARE EXPERIENCES AMONG HOMELESS PATIENTS IN FEDERALLY SUPPORTED HEALTH CENTERS: FINDINGS FROM THE 2009 PATIENT SURVEY Travis P. Baggett2; Lydie A. Lebrun1; Darlene Jenkins3; Alek Sripipatana1; Ravi Sharma1; Arthur S. Hayashi1; Charles Daly1; Quyen Ngo-Metzger1. 1U.S. Department of Health and Human Services, Rockville, MD; 2Harvard Medical School, Boston, MA; 3National Health Care for the Homeless Council, Nashville, TN. (Control ID #1324072)
BACKGROUND: The Health Resources and Services Administration (HRSA) provides federal funding to health centers to provide health services to homeless persons as well as other low-income, minority, and uninsured or publicly insured individuals. In 2010, health centers provided primary health care, as well as mental health services and substance abuse treatment, to over 1 million homeless patients and individuals who were formerly homeless or at risk of homelessness. The purpose of this study was to examine the health status and health care experiences of homeless patients in health centers, and compare them with their housed counterparts.
METHODS: Nationally representative data came from the 2009 Health Center Patient Survey conducted by HRSA. Computer-assisted personal interviews were conducted with health center patients. Cross-sectional analyses were limited to adults (n=2,735). We compared sociodemographic characteristics, health conditions, access to health care, and utilization of services among homeless and non-homeless patients. Health status and medical conditions included self-reported fair/poor health status, any activity restrictions in the past 3 months, food insufficiency, obesity, various chronic conditions, vision impairment, oral health problems, mental health problems, and substance use. Access and utilization measures included unmet needs for medical care, usual source of care, emergency department (ED) visits, hospitalizations, and receipt of preventive services. We employed multiple logistic regression models to examine the independent effect of homelessness on health care access and utilization.
RESULTS: Homeless patients were mostly male (57%), not married (93%), and non-Hispanic White (36%) or African American (37%). Homeless patients had worse health statuslifetime burden of chronic conditions, mental health problems, and substance use problems compared with housed respondents. For instance, 42% of homeless patients had 2 or more chronic conditions, compared with 33% of non-homeless patients ($p<0.01$). Psychological distress in the past month was more prevalent among homeless patients than non-homeless patients (68% vs. 41%, $p<0.001$). About 60% of homeless patients were current smokers, compared with 30% of non-homeless patients ($p<0.001$). In addition, twice as many homeless patients reported binge drinking than non-homeless patients (40% vs. 20%, p<

0.001), and 14% of homeless patients had ever injected drugs compared with 3% of non-homeless patients (p<0.001). In adjusted analyses, homeless patients were twice as likely as housed patients to have an ED visit in the past year (OR=2.00, 95% CI: 1.37-2.92), and twice as likely to have unmet medical care needs (OR=1.98, 95% CI:1.24-3.16). Among homeless patients, having a usual source of care was associated with 50% lower odds of an ED visit (OR=0.51, 95% CI: 0.29-0.90).
CONCLUSIONS: There is an ongoing need to focus on the health issues which disproportionately affect homeless populations, and federally supported health centers play a key role in providing quality primary care to these patients. Addressing the primary and preventive care needs of homeless populations may help to curb ED visits and unmet medical needs.

HEALTH-RELATED QUALITY OF LIFE IN INSURED, OLDER ADULTS WITH DIABETES DIFFERS ONLY MARGINALLY BY RACE OR ETHNICITY: RESULTS FROM THE DIABETES &AGING STUDY

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BACKGROUND: Racial and ethnic disparities exist in the quality of diabetes care and rates of diabetes-related complications in adults, and a previous study reported racial/ethnic differences in HRQL in older rural adults with diabetes. Since race/ethnic differences in access to care may confound the relationship between race/ethnicity and HRQL, we explored this relationship among older adults with diabetes who are members of an integrated health care delivery system with uniform access to care. METHODS: We studied a race/ethnic stratified, random sample of adults 60 years with diabetes, enrolled in Kaiser Permanente Northern Californias Diabetes Registry, who self-reported HRQL (based on SF-8TM Health Survey) in the DISTANCE (Diabetes Study of Northern California) survey. Race/ethnicity was classified as self-reported non-Hispanic White (White), non-Hispanic Black (Black), Hispanic, Asian (non-Filipino), Filipino, Multi-racial, and other race. Responses to the HRQL assessment were transformed into physical and mental HRQL scores (both ranges: 0-100, and means: 50) using published algorithms. We constructed a series of weighted linear regressions models to estimate the associations between race/ethnicity and HRQL, and evaluate whether they were explained by potential mediating factors: Model 1: race/ethnicity adjusting for demographics (age and sex); Model 2: Model 1+marital status, education, income, birthplace and English proficiency; Model 3: Model 2+health behaviors (alcohol/smoking history, physical activity); Model 4: Model 3+geriatric conditions (fall history, underweight, chronic pain, depression, incontinence), Model 5: Model 4+diabetes complications (congestive heart failure, myocardial infarction, stroke, end-stage renal disease, amputation, blindness, foot ulcer, and neuropathy). Least square means of the HRQL scores are reported with the p-values comparing the HRQL scores between each race/ethnicity and Whites (reference group). RESULTS: There were 6,317 eligible survey respondents with mean age of 67 years and diabetes duration of 12 years. The sample size adequately supported race/ethnic contrasts. Physical HRQL changed marginally across Models 1 to 5 for all races; thus we present only Model 1 results. Whites (Model 1: 42.9; 95% Confidence Interval (CI), 42.6-43.2, p<.001) had only a marginally lower physical HRQL score than Blacks (44.2; CI 43.3-45.1, p<.001), Latinos (45.1; CI, 44.2-46.0, p<.001), Asians (48.1; CI,46.8-49.3, p<.001), Filipinos (48.3; 95% CI, 44.9-47.9, p<.001), and respondents reporting other race (46.1; CI 43.9-48.5, p=.03). Physical HRQL did not differ significantly between Whites and Multi-racials. Mental HRQL differed only minimally by race/ethnicity. In Models 1, 2, and 3, only Asians (e.g. Model 1: 52.7; 51.6-53.7, p=.01) reported slightly higher mental HRQL than Whites (51.0; CI, 50.7-51.3). These differences were not present in Models 4 or 5. In Models 4 and 5, respondents reporting other race (e.g. Model 4: 47.3; CI, 45.4-49.3) had slightly lower mental HRQL than Whites (50.2; CI, 49.6-50.8).

CONCLUSIONS: In an integrated health care delivery system affording uniform access to health care, health-related quality of life in older adults
with diabetes differs only marginally by race/ethnicity. Moreover, these differences were not clinically relevant or explained by a wide range of potentially explanatory factors.

HEPATITIS B SURFACE ANTIBODY TITERS AS A MARKER OF IMMUNITY IN HEMODIALYSIS (HD) PATIENTS: A SINGLE CENTER PROSPECTIVE QUALITY IMPROVEMENT STUDY

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BACKGROUND: Hepatitis B virus (HBV) is a DNA virus that is capable of causing significant liver disease including acute hepatitis, chronic hepatitis, cirrhosis and hepatocellular carcinoma. HBV is responsible for 80% of hepatocellular carcinoma cases worldwide. The burden of HBVin HD patients has markedly decreased. The main factors include: introduction of HBV vaccination, routine screening of blood products for HBV, the use of erythropoietin and effective Infection Control measures. It is the standard of care to confirm that all ESRD patients are vaccinated for HBV prior to starting HD. This response is measured by monitoring protective antibody titer (HBs Ab). A titer above 10 is considered protective. Despite all the efforts to vaccinate HD patients, their response to HBV vaccine is lower and less sustained than healthy individuals. The CDC recommends post vaccination testing only in certain population, which includes HD patients. HBV is an efficiently transmitted blood borne pathogen. HBV can stay alive on surfaces, which make HBV more capable of producing outbreaks especially in HD units. Inpatient HD units receive higher percentage of acute HD patients that could lead to HBVoutbreaks if a new HBV positive patient is introduced to the HD unit.

METHODS: The goal of the study was to estimate the base-line protection against HBV in HD patients. It was a quality improvement initiative to improve protection against HBV in HD patients. All HD patients at our inpatient unit were included in the study and got HBV serology monitored during their HD session. The following serum markers were monitored: HBsAg, HBsAb titer, HBcAb total. Vaccination was offered to all patients with no evidence of protective HBsAg (titer<10).The schedule of HBV vaccination was based on CDC recommendations. Outpatient HD units were notified with our recommendations regarding further vaccination needs. The study was done over a period of two months and included 60 HD patients.

RESULTS: Sixty patients were included in this study. Forty two (70%) patients had received prior vaccinations, either complete or incomplete and eighteen (30%) patients had no history of prior vaccination. Seventeen (40%) patients who had prior vaccination had low HbsAb titers and hence were vulnerable. All patients who were vulnerable [thirty five (57%) patients] were offered vaccination. Twelve patients received HBV vaccination shots during their inpatient stay. Rest of the vulnerable patients could not be vaccinated due to factors like death, vaccination refusal and discharges before vaccine administration.

CONCLUSIONS: Although the rates of HBV infection have decreased markedly in the general population as well as in HD patients, it still poses a great potential for producing outbreaks particularly in inpatients HD units. Monitoring HBV serology (HBsAg, HBs Ab, HBc Ab) on routine basis is essential to prevent such potential outbreaks. Monitoring HBs Ag alone is not sufficient and has to be coupled with other serology to assure adequate protection for this particularly vulnerable population.

HETEROGENEITY AND VARIATION IN BODY MASS INDEX IN THE FRAMINGHAM HEART STUDY OFFSPRING COHORT OVER 37 YEARS

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BACKGROUND: The rapid trajectory of average weight in the US has implicated changing environmental or neighborhood factors as possible

contributing factors. Using longitudinal data from the Framingham Heart Study (FHS) Offspring Cohort over 37 years, we examined trends in BMI accounting for residential mobility to determine variation in BMI at the individual and neighborhood levels over time.
METHODS: Subjects were examined up to eight times through 2008. We excluded observations with missing body mass index, smoking status, alcohol intake or census tract of residence and when a subject was living in a nursing home or the age of a subject was less than 21 years. The final sample size was 4,148 subjects with 27,133 observations. We used gender-stratified, cross-classified multilevel models to account for time-varying attributes of individuals and residential neighborhoods (census tracts) with measured BMI as the outcome, controlling for individual demographics and behaviors and neighborhood poverty. We included a random slope for linear time at the individual level to account for heterogeneity in BMI trajectories between individuals.
RESULTS: Mean BMI increased from 24.0 kg/m2 at Wave 1 to27.7 at Wave 8 for women and from 26.6 to 29.0 for men. The proportion of the total BMI variance explained by the individual level, the intraclass correlation coefficient (ICC), was high, 0.88 for women and 0.86 for women, meaning that the individual level explained 88% and 86% of all variation in BMI. Inclusion of the individual-level covariates did not appreciably change the ICCs, explaining less than 10% of the individual-level variance for women and none of the variance for men. Neighborhood-level variance contributed minimally to BMI variance. Large individual-level random slopes demonstrated that the variance in BMI increased significantly over time for both men and women (Figure 1). Covariates that were positively associated with BMI for men and women were increasing age, alcohol consumption, a high school education, being married, and being employed. Smoking was negatively associated. Neighborhood poverty was not significantly associated with BMI. CONCLUSIONS: Unmeasured individual factors explained almost all of the variation in BMI over nearly 40 years, and BMI variance increased substantially over time. The limited relationship of the neighborhood of residence to BMI variation over time suggests that neighborhood-level interventions may have an overall limited impact on weight.
HIGH PREVALENCE OF PATIENTS <65 YEARS OLD WITH COMPLEX BEHAVIORAL AND MEDICAL PROBLEMS AMONG HOSPITAL READMISSIONS - A PILOT STUDY Brent C. Williams; Laura Haley; Donna Fox. University of Michigan, Ann Arbor, MI. (Control ID #1319638)
BACKGROUND: Most studies examining the characteristics of patients readmitted to hospitals in the United States have focused on patients >65 years of age. Relatively little is known about the prevalence and characteristics of patients <65 among hospital readmissions. We sought to compare the prevalence and reasons for readmission among patients >65 (older) and <65 (younger) years old readmitted to medical services at an academic medical center.
METHODS: At the University of Michigan discharge summaries for all Medicare patients not already under care management (e.g., dialysis and transplant patients); and all patients with capitated public insurance (Medicaid managed care, county health insurance, and uninsured) discharged from UM medical services are reviewed by 5 care managers (social workers or nurses) through the Complex Care Management Program (CCMP), who call all patients post-discharge, and provide care management to high-risk patients. Patients: Consecutive case series of all 108 patients discharged from the hospital and reviewed by the CCMP over a 3-month period from 6/15/2010 to 9/14/2010 who had been admitted <30 days following a hospital discharge. In addition to demographic and clinical information from the medical record, responses by care managers (social workers or nurses) to standardized questions completed after the initial post-discharge call to the patient regarding the reason for readmission were recorded. Simple descriptive statistics were applied using either patients or readmissions as the unit of analysis. P values were calculated sparingly due to small sample size.
RESULTS: The 108 readmissions were experienced by 69 patients, the majority of whom (65%) were <65 years old. 16 patients accounted for 55 (51%) of readmissions. Younger patients disproportionately accounted for multiple readmissions; with all 5 patients with 5-6 readmissions <65 (p=0.15). Equal proportions of patients older and younger than 65 experienced at least one readmission for the same diagnosis as the immediately

previous discharge (67% in each group), whereas younger patients were more likely to have had at least one readmission due to missed follow up appointments (27% vs. 12%; p =.2) or to have a new diagnosis as reason for at least one admission (40% vs. 33% p=NS). Using readmissions as the unit of analysis, 77 (71%) were among younger patients. Among readmissions a similar but stronger pattern of reasons for readmission was observed as for individual patients, with 73% of readmissions among younger vs. 64% among older patients due to the same diagnosis as the previous admission, and 34% vs. 3% due to missed follow-up appointments ($p<0.001$).
CONCLUSIONS: In a population of discharged medical patients not already in disease-based care management, younger patients were highly prevalent, and more likely to be readmitted for behavioral reasons as compared to older patients. Future studies and current debates over the size and scope of programs to decrease readmissions should examine whether

age split at 65 (a marker for insurance and disability status) provides a readily available marker for differences in patient characteristics, clinical needs, and most appropriate interventions. One example is the current debate in the State of Michigan over proposed program and finance reform for dual eligibles (patients on Medicare and Medicaid), which frequently make no distinction among patients above and below 65 years of age.
HIGH PREVALENCE OF ENGLISH-ONLY LABELED MEDICINE BOTTLES FOR SPANISH-ONLY SPEAKING ELDERS: IS IT TIME TO CHANGE LABELS? Huai Cheng. University of Virginia, Charlottesville, VA. (Control ID #1314569)
BACKGROUND: It is very important for patients to understand what medications they are taking and how to take them. Without this understanding, medication errors, adverse drug events, and non-adherence are more likely to occur. It is known that medication bottle labeling is often challenging to understand, not only due to low literacy but also due to the lack of standardized medication labeling. Minority older patients, especially those who have multiple co-existing conditions, are on multiple medicaitons, and are non-English speaking, are vulnerable to medication errors, adverse drug events, and non-adherence. While it is obvious that that giving Spanish-labeled medications to Spanish-speaking patients makes sense, how often this occurs has not been studied. In this study, we determined the language of medicine bottle labels among a group of Spanish-only speaking elderly patients.
METHODS: The study subjects were Spanish-only speaking older patients (65 years old and above) who were seen consecutively at a hospital-based ambulatory clinic in New York City between 06/2008 and 06/2009. This clinic was surrounded by a large low income Spanish-speaking population; was staffed by a Spanish-speaking clerk, a nursing assistant, and a nurse practioner; and was designed as a medication review and reconciliation clinic for minority elderly patients. These patients were usually refered by hospitalists and other subspecialty physicians. Pharmacies were located in Broadway and nearby. At each visit, patients were requested to bring all their medication bottles (prescribed and over the counter). Each medication bottle label was examined by the author with help from Spanish-speaking staff or translator and recorded as English-label, Spanish-label, or both. The age, gender, comorbility, and the number of medications were also recorded. Decriptive statistics was used for data analysis. IRB approved this study.
RESULTS: 78 older patients were identified as Spanish-only speaking. The majority of patients (73%, 57/78) were women. The mean age was 77 years (range 65-96), the mean number of co-existing conditions per patient was 4 (range 1-10), and the mean of number of medications per patient was 6 (range 2-20). A total of 506 medication bottle labels from 78 patients were examined and recorded. 44% (222/506) of medication bottles from 39 patients were labeled in English, 45% medication bottles (230/ 506) from 35 patients in Spanish, and 11% medication bottles (54/506) from 4 patients in both.

CONCLUSIONS: There was a high prevalence of English-only labeled medication bottles among older Spanish-only speaking patients at an ambulatory clinic in New York City. The association of English-only medication labels with medication errors, adverse drug events, and non-adherence in this vulerable population needs to be further examined. A larger, systematic survey is warranted to further define the extent of the problem and to identify strategies to improve medication labeling.

HIGH PREVALENCE OF HEALTH CARE FORGONE FOR ECONOMIC REASONS IN A COUNTRY WITH UNIVERSAL HEALTH-INSURANCE COVERAGE: A POPULATION-BASED STUDY Idris Guessous; Jean-Michel T. Gaspoz; Jean-Marc Theler; Hans Wolff. Geneva University Hospitals, Geneva 14, Switzerland. (Control ID #1336496)

BACKGROUND: Forgoing health care for economic reasons may worsen chronic diseases and increase the risk of complications and hospitalization.

Little is known about the importance and trends of health care forgone for economic reasons in Switzerland. We estimated the extent and the 4-year evolution of health care forgone for economic reasons in Switzerland and identified associated factors.

METHODS: A population-based cross-sectional survey (2007-2010) of a representative sample aged 35-74 years in the Canton of Geneva, Switzerland. Health care forgone, income level categories (1CHF1$, Jan 2012), education, job position, civil status, children dependence, insurance status (franchise, premium subvention) and cardiovascular comorbidities and risk factors were collected using standardized questionnaires and measures. Prevalences with 95%CI intervals were calculated and Cochran-Armitage test used to test trends. Logistic regression models were used to test associations between forgoing health care for economic reasons and study variables. RESULTS: 2601 subjects (50.3% women, mean age 51.7 years) were included in the analyses. 13.8% (358/2243) (95%CI 12.4-15.1) forgone health care for economic reasons. This prevalence varied from 3.7% (13,000CHF monthly income category) to 30.9% (<3,000CHF monthly income category). In subjects with monthly income <3,000CHF, forgoing health care increased from 22.5% in 2007/8 to 32.7% in 2009 and 34.7% in 2010. It remained stable in other income categories. In multivariate analyses, forgoing health care for economic reasons was positively associated with decreasing income category (<3,000CHF vs 13,000CHF OR=7.59, P trend<0.0001), female gender (OR=1.32), smoking (OR=1.58), having dependent children at home (OR=1.50), being divorced not in couple (OR=1.53), increasing franchise insurance category (OR=1.27), and receiving premium subvention (OR=1.41). Having a complementary health insurance decreased the risk of forgoing health care for economic reasons (OR=0.45). Among those who renounced (N=358), 75.1% renounced dental care, 39.9% physician consultation (25.4% specialist,14.5% general practitioner), 25.7% health devices, 12.1% medication, and5.8% surgery. These prevalences remained stable across survey years.

CONCLUSIONS: In a Swiss region with universal health-insurance coverage, the prevalence of forgoing health care for economic reasons was high and highly dependent of socioeconomic status. In 2010, more than 30% of the lowest income group forgone health care for economical reasons in the previous year. This important and increasing lack of socioeconomic equity for health care in Switzerland needs to be addressed.

HOSPITAL CHARACTERISTICS ASSOCIATED WITH HIGH RATES OF IMAGING UTILIZATION Jason S. Mathias; Joe Feinglass; David W. Baker. Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1339770)

BACKGROUND: The Hospital Outpatient Quality Reporting Program (HOQR) publicly reports U.S. hospitals performance on imaging use measures for four tests that may be problematic if overused: magnetic resonance imaging for low back pain without antecedent therapy (MRI), follow-up imaging after screening mammography (MAM), and abdominal and thoracic computed tomography performed with and without contrast (A-CT and T-CT). In this study, we sought to characterize performance on these measures, determine whether performance was consistent across measures, and identify hospital characteristics associated with high outlier performance.

METHODS: Variations in performance were examined with descriptive statistics. Correlation across measures

was assessed using Spearman rank-order tests. We linked 2008 HOQR data to the 2009 American Hospital Association Survey and examined associations between hospital characteristics and high outlier status using multivariable logistic regression. The dependent variable was high-outlier performance on an HOQR imaging use measure, defined as a performance score in the top decile among reporting hospitals. Independent variables included HOQR-reported volume and AHA-reported for-profit ownership, rural setting, and non-teaching status. All hospital characteristics were entered as dichotomous variables except for imaging volume (i.e., the N in the measure denominator), for which we created quartiles and used the middle 50% as the reference group. In addition, models included the proportion of all discharged patients with Medicare or Medicaid insurance as a covariate, entered as a continuous variable.
RESULTS: Hospital performance varied widely. Performance across measures was weakly correlated (rho<0.10) except A-CT and T-CT

(rho=0.42, p<0.0001). Imaging volume was inversely associated with high-outlier performance. Compared to hospitals with measure-specific imaging volume in the 25th-75th percentile, adjusted ORs [95% CI] for high-outlier performance among <25th percentile volume hospitals were MRI 4.22 [3.04-5.84], MAM 1.72 [1.31-2.26], A-CT 1.38 [1.05-1.80], T-CT 1.66 [1.28-2.16]. Rural location was associated with increased likelihood of high-outlier performance on all measures except MAM (adjusted OR [95% CI] MRI: 1.42 [1.21-1.68], MAM: .80 [.69-.92], A-CT: 1.46 [1.28-1.66], T-CT: 1.32 [1.16-1.51]). For-profit ownership was significantly associated with increased likelihood of high-outlier status on both MAM (aOR 1.47 [1.10-1.98]) and T-CT (aOR 1.71 [1.28-2.27]). Non-teaching status was significantly associated with high-outlier status only on T-CT (aOR 1.69 [1.11-2.58]). CONCLUSIONS: Wide variation in performance suggests low-value imaging use is common. Inconsistent performance across measures will make it difficult for patients to identify and avoid hospitals with high use of all types of imaging, because few such hospitals exist. Although publicly reporting data may drive some hospitals to change imaging practices to avoid the stigma associated with public identification as a high outlier, the types of hospitals that are more likely to be high outliers may be unable or unwilling to support efforts to reduce imaging use that, if successful, could decrease hospital revenue. The effect of publicly-reporting hospital performance on these measures may be limited. It may be necessary to institute stronger policies to influence hospitals that continue to have very high use of these imaging tests.
HOSPITAL REPORT CARDS FOR HOSPITAL-ACQUIRED PRESSURE ULCERS: HOW DOES HOSPITAL PERFORMANCE BY CLAIMS DATA COMPARE TO PERFORMANCE BY STANDARDIZED SURVEILLANCE EXAMS FOR HOSPITAL-ACQUIRED PRESSURE ULCER RATES? Jennifer Meddings; Heidi Reichert; Laurence F. McMahon. University of Michigan, Ann Arbor, MI. (Control ID #1318710)
BACKGROUND: Since March 2011, hospital rates of hospital-acquired complications (e.g., pressure ulcers) from administrative discharge data (i.e.,
claims data) are publicly reported online. In 2015, these claims-data generated complication rates will be used by Medicare to identify the top quartile of poor performing hospitals, to penalize by 1% less pay for all admissions. Concern exists regarding the accuracy and validity of complication rates as reported in claims data to compare hospitals. We evaluated whether hospitals in the top quartile of poor performance for hospital-acquired pressure ulcer (HAPU) rates according to claims data would be scored similarly when compared by HAPU rates from quarterly hospital-wide patient surveillance exams. METHODS: Using claims data from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Dataset for all adults discharged from 185 acute care California hospitals in 2007, we generated hospital rates as a percentage of discharges with at least one HAPU. We assessed how hospital ranking according to HAPU rates from claims data compared to these hospitals ranking according to HAPU rates from quarterly prevalence surveillance exams, as conducted by trained examiners in 2007 and reported by hospitals to the California Nursing Outcomes (CalNOC) Pressure Ulcer Prevalence Study and CalHospitalCompare.org. RESULTS: According to HCUP data, 6378 (0.4%) of

admissions had a HAPU diagnosis; 1258 (19.7%) of these admissions also had a pressure ulcer diagnosis listed as present-on-admission. 886 (0.06%) had a pressure ulcer with unspecified status at admission. Hospital HAPU rates ranged from 0 to 1.7% (mean 0.3%) of discharges according to HCUP data, and from 0 to 9.4% (mean 3.3%) according to the CalNOC dataset. Of the 46 hospitals identified in the top quartile (Graph A) of poor performing hospitals according to claims data, only 20 (43%) also were identified in the top quartile of poor performing hospitals according to CalNOC prevalence data (Graph B).
CONCLUSIONS: Overall, hospital rates of hospital-acquired pressure ulcers were much higher according to quarterly prevalence exams compared with claims data. Relative hospital performance regarding HAPU rates varied significantly from claims data compared with prevalence surveillance exams, with less than half of hospitals identified in the top quartile as poor performing hospitals by claims data also being in the top quartile according to prevalence exam data. These findings imply that claims data may not be an accurate or valid datasource for comparing hospitals for public reporting or financial penalties for hospital-acquired pressure ulcers.
Hospital Ranks by HAPU rates according to HCUP data (Graph A) and CalNOC data (Graph B)

HOSPITAL VARIATION IN USE OF POST-OPERATIVE MEDICINE CONSULTATIONS Lena M. Chen1,2; Mousumi Banerjee2; John D. Birkmeyer2. 1VA Ann Arbor Healthcare System, Ann Arbor, MI; 2University of Michigan, Ann Arbor, MI. (Control ID #1311052)
BACKGROUND: Medicare payments around episodes of inpatient surgery vary as much as 40-70% across hospitals. Although such variation is attributable to multiple factors, differential use of physician services is one key component. In this context, we explored the use of medicine consultations after inpatient surgery, factors associated with increased utilization, and variations in practice patterns across hospitals.
METHODS: We used national Medicare data to identify elderly patients undergoing colectomy or total hip replacement (THR) between January 2005 and November 2007. Hierarchical logistic regression was used to examine factors associated with medicine consult use. A random effect was incorporated to account for variation due to unmeasured hospital factors. To better understand reasons for variations in medical consultation rates among hospitals, we compared use in low risk patients (<75 yo with1 co-morbid condition) versus high risk patients (80 yo with2 co-morbid conditions).
RESULTS: Our cohort included 105,810 (244,693) patients undergoing colectomy (THR) at 3,957 (3,447) hospitals. In this sample, 49.2% (47.8%) of colectomy (THR) patients received1 general medicine consult. Other common consults were cardiology (21.7%) and oncology (22.0%) after colectomy, and physical medicine and rehabilitation (8.6%) after THR. Factors associated with a greater likelihood of receiving a medicine consult included older age, more co-morbidities, and being treated at a non-teaching hospital (all p-values<0.05). The use of medical consultations varied widely across hospitals (Figure). Although high risk patients received substantially more consultations, low risk patients were primarily responsible for wide variation in consultation rates across hospitals. CONCLUSIONS: Post-operative medical consultations are common, but their use varies widely across hospitals. The greatest variation was seen among low risk patients. It is unclear whether this represents an opportunity for hospitals to improve efficiency, or whether these practice patterns benefit patients.

Variation in Hospital Use of Medicine Consults after Colectomy (top panel) and Total Hip Replacement (bottom panel)
HOSPITALIST STAFFING AND PATIENT SATISFACTION IN THE NATIONAL MEDICARE POPULATION
Lena M. Chen1,2;
John D. Birkmeyer2; Sanjay Saint1,2; Ashish K. Jha3,4. 1VA Ann Arbor Healthcare System, Ann Arbor, MI;

2University of Michigan, Ann Arbor, MI; 3VA Boston Healthcare System, Boston, MA; 4Harvard School of Public Health, Boston, MA. (Control ID #1314918)

BACKGROUND: Starting in October 2012, Medicare will base part of its hospital payments on how hospitals perform on patient experience metrics. Given the inpatient expertise of hospitalists and their 24/7 presence, increasing hospitalist staffing may be one approach to enhancing patient satisfaction. METHODS: Using 2009 national Medicare data we examined the association between hospitalist staffing and patient satisfaction scores. To determine

hospitalist staffing, we estimated the proportion of medicine inpatients cared for by hospitalists at each included hospital. We used a well-validated approach that classifies general internists with at least 90% of their evaluation and management (E&M) billings from inpatient care to be a hospitalist. Patient experience metrics were derived from the Hospital Consumer Assessment of Providers and Systems (HCAHPS) survey (Table). In multivariable regression, we adjusted for potential confounders, including percent Medicaid patients, hospital size and teaching status, location, presence of a medical intensive care unit, and nurse staffing.

RESULTS: Our cohort included 132,814 patients index medicine admissions at 2,843 hospitals in 2009. Overall, 44% of general medicine admissions were cared for by hospitalists. At 17% of hospitals no medicine admissions were cared for by hospitalists; at 4% of hospitals all medicine admissions were cared for by hospitalists. In multivariable analyses, compared to hospitals with low hospitalist staffing, hospitals with high hospitalist staffing had modestly higher patient satisfaction scores across most dimensions of care (Table). For example, among hospitals in the highest tertile of hospitalist staffing, 80.4% of patients reported being satisfied with discharge compared to 77.6% in the lowest tertile (p-value <0.001).

CONCLUSIONS: Hospitals with higher levels of hospitalist staffing have modestly higher performance on patient experience scores across most dimensions of care, including satisfaction with discharge planning. Understanding why hospitals with more hospitalists have higher patient satisfaction is important for clinical leaders hoping to improve performance on these metrics.

Hospital-level Association Between Hospitalist Staffing and Patient Satisfaction, Adjusted

Patient Satisfaction Score Dimensionof Care
Hospitals in Highest Tertile of Hospitalist Staffing
Hospitals in Lowest Tertile of Hospitalist Staffing
Difference (Highest minus Lowest Tertile)
P-Value
Would Recommend 68.6 64.8 3.8 <0.001 Overall Satisfaction 65.6 62.7 2.9 <0.001
Discharge 80.4 77.6 2.8 <0.001 Nursing Services 62.8 61.4 1.4 <0.001 Communicationwith Nurses
75.4 74.1 1.3 <0.001
Pain Control 68.8 67.7 1.2 <0.001 Quiet 59.4 58.3 1.1 0.0012 Communicationabout Medications
58.3 57.4 0.9 <0.001
Clean 68.5 68.0 0.6 0.004 Communicationwith Doctors
80.4 80.5 0.0 0.91

NOTE: Numbers are rounded, so the numbers in the difference column do not always equal rounded patient satisfaction scores for hospitals in the highest tertile of hospitalist staffing minus rounded patient satisfaction scores for hospitals in the lowest tertile of hospitalist staffing.

HOSPITALS WITH LOWER RATES OF PERIOPERATIVE BLOOD CLOTS BY CLAIMS DATA DO NOT REPORT BETTER ADHERENCE TO PROPHYLAXIS MEASURES BY MEDICAL RECORD REVIEW. Jennifer Meddings1; Heidi Reichert1; Mary A.M. Rogers1; Jack Iwashyna1,2; Laurence F. McMahon1. 1University of Michigan, Ann Arbor, MI; 2Ann Arbor VA HSR&D Center for Excellence, Ann Arbor, MI. (Control ID #1334934)

BACKGROUND: Discharge data (i.e., claims data) have been used since 2008 to identify hospital-acquired

complications (HACs) as non-payable diagnoses, and more recently to compare hospitals by HAC rates as measures of patient safety. Previously, hospitals were compared only by adherence to certain HAC prevention measures using medical record reviews, as self-reported on-line by HospitalCompare. Using the example of hospital-acquired blood clots (venous thromboembolism, HA-VTE), we evaluated whether hospitals that report higher adherence to perioperative VTE prophylaxis were more likely to have lower rates of HA-VTE during an admission for knee or hip replacement as recorded in claims data.
METHODS: Using claims data from the Healthcare Cost and Utilization Project State Inpatient Dataset for adults discharged from 177 acute care California hospitals in 2009 that performed knee and hip replacements, we generated hospital-specific rates of HA-VTE among patients undergoing knee or hip replacements. We linked each hospitals VTE rates from claims data with the hospitals adherence to perioperative VTE prophylaxis for Medicare patients as reported on HospitalCompare, using a composite measure averaging the SCIP-VTE1 and SCIP-VTE2 measures (correlation r=0.97, p <0.001) which assess prophylaxis ordered from admit until 24 h post-op. Using zero-inflated negative binomial regression, we tested the hypothesis that a hospitals rate of HA-VTE during admissions for hip and knee replacement would be significantly and inversely associated with the hospitals adherence to VTE prophylaxis.
RESULTS: Hospital rates of HA-VTEs during admissions for knee and hip replacements ranged from 0% for 110 (62%) hospitals to 13%, with a mean of 1.2%. Hospitals with zero HA-VTE events in claims data (noted by black dots in Figure) reported VTE prophylaxis from 37-100% (mean 84%). For hospitals that reported at least one of these VTE events (gray dots), prophylaxis ranged from 59-100% (mean 90%). Overall, a 1% increase in composite SCIP-VTE adherence score was associated with an increase in VTE rate by a factor of 1.02, p=0.04.

CONCLUSIONS: Overall, hospital rates of hospital-acquired VTE events during admissions for hip and knee replacements are low by claims data, with more than half of hospitals reporting zero cases. Unexpectedly, hospitals with lower VTE event rates did not report higher adherence to perioperative VTE prophylaxis. These findings suggest important limitations in comparing hospitals by HA-VTEs from claims data, which may be an incomplete record of HA-VTE events and does not adjust for individual patient risks for VTE.
HOW MUCH DOES PATIENT PANEL COMPOSITION INFLUENCE PHYSICIAN PERFORMANCE RANKING ON PATIENT EXPERIENCE OF CARE QUALITY MEASURES? Charlotte E. Ward; ClemensS. Hong; Jeffrey M. Ashburner; Yuchiao Chang; Steven J. Atlas. Massachusetts General Hospital, Boston, MA. (Control ID #1338082)
BACKGROUND: Quality assessment for primary care physicians (PCPs) and practices increasingly includes assessment of patient experience of care through surveys, such as the Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey. Previous research suggests that adjustment for differences in patient panel composition impacts CAHPS outcomes. We compared patient experience of care rankings among PCPs within a large academic primary care network with and without adjustment for differences in patient panel composition.
METHODS: We analyzed 15,612 adult patients who completed 18,874 CAHPS surveys following visits to any of 13 Massachusetts General

Hospital practices between August, 2008 and June, 2011. We calculated CAHPS composite measures for access, communication and office staff by taking the average Top Box score (the percentage of patients that answered Always to each question within the composite). We ranked 167 PCPs based on unadjusted CAHPS composite measures and re-ranked them after adjusting for patient gender, age, language, education, race, insurance, Charlson score, and no-show appointments using linear regression models. We also categorized

PCPs into tertiles based on their rankings for each composite and compared patient panel characteristics between PCPs in the top and bottom tertiles.
RESULTS: PCP panels varied by gender (0-80.7% male), age (41.3-81.3 years), language spoken (18.2-100% English), education (7.8-86.4% college or above), race (0- 93.9% minority), insurance (0-37.9% Medicaid/ uninsured), Charlson score (9.2-71% Charlson score2), and no-shows over the prior year (0-38.7%1 no-show). Patient characteristics varied significantly between top and bottom tertile PCPs. Top tertile PCPs for the Access composite cared for more males than bottom tertile PCPs (46.0% vs. 30.5%, P <0.001). PCPs in the top tertile for the Communication composite cared for fewer minority (10.2% vs. 19.5%, P<0.001) and non-English-speaking patients (1.7% vs. 7.5%, P=0.01), and more patients with a Charlson score
2 (41.2% vs. 36.1%, P=0.05). PCPs in the top tertile for the Office Staff composite cared for more males (45.1% vs. 28.6%, P <0.001), and patients with a Charlson score2 (45.9% vs. 33.3%, P <0.001), and had patients that were older (64.2 years vs. 58.0 years, P <0.001). Adjusting for patient panel composition among individual PCPs resulted in a relative mean change in PCP ranking of 2.7 percentiles for Communication, 7.6 percentiles for Access, and 12.6 percentiles for Office Staff. Within Communication, 6% of PCPs were reclassified into different tertiles, while 10.8% of PCPs were reclassified within Access, and 18% of PCPs were reclassified within Office Staff. CONCLUSIONS: Among PCPs practicing within the same primary care network, PCP panels with greater proportions of minority, female, non-English speaking, and younger patients with fewer comorbidities were associated with lower relative patient experience of care rankings. Adjusting for differences in patient panel composition had a differential impact on PCP rankings with greater impact seen with the access and office staff composites compared to the communication composite. As the use of patient experience measures increases, including for physician reporting and pay-for-performance, we must be aware of the potential effect of patient panel composition on physician ranking for different patient experience composites.
HOW NOT TO GET LOST IN TRANSLATION: ASSESSING BARRIERS TO INTERPRETER UTILIZATION
Alissa Detz1; HemalK. Kanzaria2; Sara L. Swenson1. 1California Pacific Medical Center, San Francisco, CA; 2University of California, San Francisco; San Francisco General Hospital, San Francisco, CA. (Control ID #1340127)
BACKGROUND: Using professional interpreters for patients with limited English proficiency (LEP) improves health outcomes. Despite the importance of language services and a national mandate to provide professional interpreters for LEP patients, this resource is often unavailable or underutilized. Understanding barriers at both the individual and system level is key to improving access to professional interpreters. We sought to identify utilization patterns and barriers to the use of professional interpreters at a community-based teaching hospital.
METHODS: California Pacific Medical Center (CPMC) is a community-based teaching hospital in San Francisco. Approximately 10% of CPMC patients are LEP. In-person professional interpreters provide services to four hospital campuses in the most commonly spoken languages during business hours with limited weekend availability. Professional interpreters are available by phone 24 hours a day. We solicited a convenience sample of 74 internal medicine residents and attending physicians to assess perceptions of interpreter services and obstacles to interpreter use in the hospital setting. We conducted a 34-item anonymous online questionnaire. Respondents quantified their frequency and practice patterns of interpreter use, time parameters of interpreter-aided encounters, use of ad hoc interpreters, and desire for education regarding interpreters and LEP patients. We limited our analysis to descriptive statistics.
RESULTS: Our response rate was 68%, with 71% of residents and 48% of attending physicians completing surveys. Only 55% of physicians reported using any interpreter (professional or ad hoc) for the majority of encounters with LEP patients. Use of interpreters varied with the type of clinical encounter. Physicians were more likely to use professional interpreters to obtain consent for procedures (66% vs. 33%) and for code status discussions (72% vs. 26%). Ad hoc interpreters were more frequently used for daily rounds (43% vs. 19%). When asked about their most recent encounter using an interpreter, physicians reported a median delay of 10

minutes (range 0-30 minutes), and 32% felt their patients care was postponed. Seventy-four percent of physicians reported that it was somewhat or very challenging to arrange a professional interpreter, and 75% cited at least one instance of not using a professional interpreter, but wishing they had. Constraints of time and availability posed significant barriers, and physicians often cited the availability of ad hoc interpreters as a reason for not obtaining professional language services. Only 11% cited lack of comfort working with interpreters as an important barrier, despite reporting little formal training on working with interpreters.
CONCLUSIONS: We found low utilization of interpreters in the hospital setting, even for high stakes encounters such as admissions, discharges, and code status discussions. Time constraints and availability were the most important barriers to using professional interpreters. Availability of ad hoc interpreters may also detract from widespread use of professional language services. We aim to use these results to design targeted systems-based changes. Onsite interpreters dedicated to one hospital campus, computer alerts to signal language preference to staff, and improved technology for utilization of remote interpreters could make using professional interpreters more efficient and feasible in the inpatient setting.

HYDROCORTISONE IN ACYCLOVIR 5%/ HYDROCORTISONE 1% CREAM DOES NOT ADVERSELY AFFECT HEALING TIME IN IMMUNOCOMPROMISED PATIENTS WITH RECURRENT HERPES SIMPLEX LABIALIS Jason T. Olin2; Stephen K. Tyring1; Tina Lin2.

1University of Texas Medical School at Houston, Houston, TX; 2Valeant Pharmaceuticals North America LLC, Bridgewater, NJ. (Control ID #1336336)

BACKGROUND: Acyclovir (AC) 5%/ hydrocortisone 1% cream (AHC) has been shown to be a well-tolerated and efficacious treatment option for patients with recurrent herpes simplex labialis (HSL); however, the effects of hydrocortisone in immunocompromised patients are unknown, and could be associated with inhibited immune function and increased healing time.
METHODS: In this randomized (2:1), double-blind study, immunocom-promised adults (CD4+ T-cell count 100-500/mm3) with recurrent HSL were assigned to a self-initiated treatment with topical AHC or AC (in AHC vehicle) 5 times per day for 5 days after the first sign of a recurrence. Patients were tracked for up to 1 year. The primary outcome measure was episode duration; a non-inferiority analysis was used to assess whether healing time was at least twice as long in the AHC group compared with the AC group.
RESULTS: A total of 201 participants were randomized (136 AHC; 65 AC); 77 and 30 participants, respectively, experienced an HSL recurrence and initiated treatment. The mean episode duration was 6.7 days in both treatment groups; median duration was 6.4 days in the AHC group and 6.6 days in the AC group. Adverse events (AEs), experienced by 6 (8%) participants in the AHC group and 5 (17%) in the AC group, were consistent with an immunocompromised study population. No participants discontinued the trial due to AEs.
CONCLUSIONS: These data suggest that AHC cream is a safe and well-tolerated treatment option in immunocompromised patients with recurrent HSL, with efficacy and tolerability comparable to that of AC cream.

IBCD: EFFECTIVENESS AND SUSTAINABILITY OF A CHECKLIST TO IMPROVE QUALITY OF CARE FOR HOSPITALIZED GENERAL MEDICAL PATIENTS Anthony V. Aspesi1; Greg Kauffmann1; Andrew M. Davis1; Elizabeth Schulwolf2; Valerie G. Press1; Vineet Arora1. 1University of Chicago, Chicago, IL; 2Loyola University, Chicago,IL. (Control ID #1326430)

BACKGROUND: Although checklists have shown significant promise as a tool to improve care in surgery and intensive care units, they have been underutilized in hospitalized medical patients. The objectives of this study were to ascertain whether there were sustained improvements in processes of care addressing four hospital conditions [(I) pneumococcal immunization, (B) pressure ulcers (bedsores), (C) catheter-associated urinary tract infections (UTIs), and (D) deep venous thrombosis (DVT)] for hospitalized general medical patients during the IBCD checklist intervention. METHODS: The IBCD checklist was integrated into the established routine of post-

call morning rounds for new admissions. Checklists prompted teams to offer Pneumovax vaccine for indicated patients (I), perform a skin exam for patients high risk for bed sores (B), remove Foley catheters from patients without an indication (C), and administer pharmacologic DVT prophylaxis when indicated (D). Charts were reviewed to ascertain if documentation on the checklist resulted in care intended.
RESULTS: Seventy percent (46/66) of medical teams during July 2010 - March 2011 used the IBCD checklist with 1168 (52.5%) patients. While participation varied by month, the variation was not statistically significant (X2=8.37, p=0.40). Overall, the IBCD checklist prompted 301 actions, and overall adherence to these four domains
increased from 68% on admission to 82% after checklist use (p<0.001). During the IBCD checklist intervention, average adherence rates for immunizations increased from 52% on admission to 74% after checklist use (p<0.001). For pressure ulcers, average adherence increased from 44% to 62% (p<0.001). For catheters, average adherence increased from 73% to 86% (p<0.001). While DVT prophylaxis was high on admission prior to checklist use (93%), the checklist was associated with near universal prophylaxis (96%, p<0.01). A statistically significant improvement on adherence to quality measures on admission, a learning effect, was observed for bedsores(0.034) and catheters (0.01) suggesting more residents completed the quality measure on admission before use of the checklist. CONCLUSIONS: A checklist can be a useful tool to improve adherence to four key quality indicators in general medicine. Improvements were greatest for appropriate use of catheters. The observed learning effects indicate that the checklist intervention can be effective in helping teams incorporate quality measures into their routine of care. Future work will include chart review of a historical control group, examining the use of a new checklist adapted for our electronic health record, and studying the effect of the checklist on patient outcomes.
IDENTIFYING KEY BARRIERS TO MEDICATION ADHERENCE IN SURVIVORS OF STROKES AND TIAS Ian Kronish1; Michael Diefenbach2; L. Alison Phillips3; Kezhen Fei2; Carol Horowitz2. 1Columbia University Medical Center, New York, NY; Mount Sinai Medical Center, New York, NY; 3George Washington University, Washington, DC. (Control ID #1323578)
BACKGROUND: Stroke is the 3 rd leading cause of death and most common cause of severe disability in US adults. Adherence to antihypertensive, antiplatelet, and statin medications is essential to reducing the risk of recurrent stroke. Despite the importance of medications, about 1 in 3 stroke survivors has suboptimal medication adherence. We aimed to identify key barriers to medication adherence

in survivors of stroke or TIA. As stroke disproportionately affects patients from low income and minority groups, we sought to assess barriers in stroke/TIA survivors from these groups.
METHODS: We surveyed 510 participants who were recruited into a stroke prevention intervention targeted at stroke survivors in under-served communities in New York City. Participants were eligible if they were40 yrs and had a stroke or TIA in the past 5 years.
Medication adherence was measured at baseline using the 8-item Morisky questionnaire (score 0 to 5=non-adherent; 6 to 8=adherent). Potential barriers to adherence were assessed at baseline by interviewing participants using previously validated instruments (e.g., Beliefs about Medicines Questionnaire). Our selection of 9 potential barriers (see Table) was guided by Osterberg and Blaschkes model postulating that barriers emerge from suboptimal patient-doctor and patient-health system interactions. Hierarchical multivariate logistic regression was then used to calculate the adjusted ORs of barriers to adherence. Models were additionally controlled for age, race/ethnicity, income, and years since most recent stroke/TIA.
RESULTS: The mean age of participants was 63 yrs, 61% were women, 14% were White, 23% preferred Spanish, and 55% had income <$15,000/yr. Thirty-nine percent had poor adherence to medications. Both the

cluster of variables representing patient-doctor (Nagelkerke R square 0.09, p<.001) and patient-health system interactions (Nagelkerke R square 0.03, p=.04) were significantly associated with poor adherence beyond sociodemographic factors. More specifically, in the fully adjusted model (Table), high concerns about medications [OR2.7, 95% CI 1.7 to 4.4) and perceived discrimination by the health care system [OR 1.9, 95% CI 1.2 to 3.2] were associated with increased odds of poor medication adherence.
CONCLUSIONS: In this low-income, minority population where medication adherence is particularly important, poor adherence was common. Key barriers to medication adherence were unfavorable beliefs about medications and perceived discrimination by the health care system. Thus, special efforts are needed to assess adherence in this population. Interventions to modify medication beliefs and overcome perceptions of discrimination may improve adherence and outcomes in stroke/TIA survivors.
Potential Barriers of Medication Adherence
IDENTIFYING OVERUSED PROCEDURES WITH CLAIMS DATA Jodi B. Segal1,2; John Bridges2; Hsien-yen Chang2; Eva Chang2; Najlla Nassery1; Jonathan Weiner2; Kitty Chan2. 1Johns Hopkins University School of Medicine, Baltimore, MD; 2Bloomberg School of Public Health of the Johns Hopkins University, Baltimore, MD. (Control ID #1319820)
BACKGROUND: The spending on healthcare in the United States may surpass 20% of the Gross Domestic Product by the year 2020. This is unsustainable and was a driving force for the passage of the Patient Protection and Affordable Care Act of 2010. Provisions in this law encourage adoption of medical practices with proven effectiveness with the expectation that this will restrain spending. Many healthcare practices do not have widely-proven effectiveness and are rightly considered as overused practices. Overuse is defined as a service used in the absence of a clear medical basis for its use, when the risk of harm exceeds its likely benefit; or more expansively, when the added costs do not provide proportional benefits. As a step in our developing an index of overuse, we identified therapeutic and diagnostic procedures that have been called overused procedures, and quantified them, by region, using claims data. METHODS: We identified key organizations with interests in quality improvement and/or cost-containment. These included professional societies, federal agencies, and non-profit organizations. We reviewed relevant publications that described the medical procedures classified as overused by these organizations, which typically used group process methods to identify them. We took the initial unrestricted list and classified the procedures according to the feasibility of determining overuse of the procedure with only administrative claims data. For each procedure deemed feasible, we developed an algorithm to be used in claims data for determining usage of the procedure. We applied the algorithms to a 5% Medicare data set from 2008, and tabulated counts for each Health Referral Area (HRA) as defined by the Dartmouth Group. Our population was 1,379,521 enrollees in Medicare 65 years of age and older who were not enrolled in a managed Medicaid plan in 2008, and who had continuous enrollment during that year. These enrollees are a representative sample of Medicare-insured individuals across the U.S.
RESULTS: We identified guidelines or practice recommendations from a consortium of North American cardiology societies, the American Academy of Orthopedic Surgeons, the Agency for Healthcare Quality and Research, the National Quality Forum, the National Health Service (United Kingdom), the National Guidelines Clearinghouse, and the Institute of Medicine Board on Health Care Services. We identified 337 procedures considered to be overused by these organizations. We graded 100 of these as possibly feasible for operationalizing with claims data and selected 32 representing different clinical areas for further development. The volume of use of these 32 procedures varied importantly across Health Referral Areas, even with case-mix adjustment, and the magnitude of this variation differed across procedures. CONCLUSIONS: Overused procedures can be quantified with claims data. We found unexplained variation in usage of these procedures. Future research will include the development of tools for use with claims data for identifying regions or health systems with global overuse practices, and for evaluating the outcomes of interventions to reduce overuse. These tools will also facilitate exploration of determinants of overuse, including systematic processes that drive

overuse that could respond to intervention.

IDENTIFYING RACIAL/ETHNIC DISPARITIES IN DIABETES MANAGEMENT IN FEDERALLY SUPPORTED HEALTH CENTER PATIENTS Alek Sripipatana; Lydie A. Lebrun; Quyen Ngo-Metzger. U.S. Department of Health and Human Services, Rockville, MD. (Control ID #1324011)

BACKGROUND: Racial/ethnic minorities have higher risks for cardiovascular disease morbidity and mortality compared with whites. This excess burden of morbidity and mortality among minorities may be attributable to uncontrolled diabetes and subsequent complications. Health Centers care for over 19 million patients, 93% of whom are below 200% poverty, and 63% of

Model 1 OR (95% CI)
P-Value
Model 2 OR (95% CI)
P-Value
Patient-Doctor Barriers High Concerns About Medications
2.8 (1.8-4.4) <.001 2.7 (1.7-4.4) <.001
Low Perceived Necessity of Medications
1.6 (0.7-3.7) .26 1.7 (0.7-3.8) .26
Low Knowledge of Risk Factors for Stroke
0.7 (0.6-1.8) .74 1.1 (0.6-1.8) .78
Low Trust in Personal Doctor
1.2 (0.6-2.5) .57 0.9 (0.4-1.9) .78
Problems Communicating with Doctor Due to Language
1.6 (0.9-3.1) .13 1.4 (0.7-2.7) .31
Patient-Health System Barriers Perceived Discrimination Due to Race, Ethnicity, Education, or Income
- - 1.9 (1.2-3.2) .01
Problems Affording Medications
- - 0.9 (0.5-1.5) .64
Difficulty Accessing Health Care
- - 1.4 (0.7-2.9) .32
Poor Continuity of Health Care
- - 1.3 (0.7-2.4) .41
Nagelkerke R square Model 1=0.15; Model 2=0.18

whom are racial/ethnic minorities. Given their patient population, Health Centers have the opportunity to reduce diabetes-related health disparities among Americas most vulnerable populations.

METHODS: Cross-sectional analyses of a 2009 nationally-representative sample of federally-supported Health Center (HC) patients. For patients 18 years and older with diabetes (n=848), we estimated logistic regression models to predict the likelihood of: 1) Process measures including: a) eye exam in past year, b) foot exam in past year, and c) hemoglobin A1C test at least twice in past year; and 2) Intermediate outcome measures

including:a) frequency of high blood glucose and b) diabetes-related hospitalization or ED visit in the past 2 years. Our models statistically controlled for patient characteristics including age, gender, type of diabetes medication, diabetes care support, health care access, and transportation. RESULTS: Among Health Center patients 18 years and older with diabetes, there were no racial/ethnic disparities found in: receipt of eye exam (p=0.816), receipt of A1C testing (p=0.637), high blood glucose levels (p=0.569), and diabetes-related hospitalization or ED visit (p=0.252), after controlling for confounders. In fact, Hispanic/Latino (OR:1.58, 95% CI: 1.01, 2.47) and non-Hispanic African Americans (OR: 2.16, 95% CI: 1.39, 3.38) were more likely than non-Hispanic whites to have a foot exam in the past year. Having health insurance and a usual source of care increased the likelihood of having an eye exam (ORs: 2.52, 95% CI:1.85, 3.44; 1.65, 95% CI: 1.08, 2.51) and foot exam (ORs: 1.78, 95% CI:1.25, 2.54; 2.25, 95% CI: 1.32, 3.85). Reporting high blood glucose Sometimes/Most of time/Always was associated with increasing age. Men were more likely to have a diabetes-related ED visit or hospitalization (OR: 1.61, 95% CI: 1.08, 2.40).
CONCLUSIONS: Health Centers are part of larger federal efforts to eliminate racial/ethnic health disparities, like the National Partnership for Action to End Health Disparities. The finding that racial/ethnic minority patients did not appear to be disadvantaged in the diabetes measures being studied indicate that Health Centers are making progress in this effort. In addition, health care access (having insurance and a usual source of care) may increase preventive health care use (eye and foot exams) which may ultimately reduce diabetic retinopathy and amputations across all racial/ethnic groups. Targeted and early interventions directed at men and older adults may help reduce the complications associated with diabetes.
IDIOPATHIC GRANULOMATOUS MASTITIS: NON-SURGICAL MANAGEMENT WITH STEROID THERAPY IN A CASE SERIES OF 49 WOMEN Tanu Pandey; Pamela Ganschow; Leah Bressler; Elizabeth Marcus. John H Stroger Hospital of Cook County, Chicago, IL. (Control ID #1339893)
BACKGROUND: Idiopathic granulomatous mastitis (IGM) is a rare benign breast disease of unclear etiology. Only a few hundred cases have been reported as case reports and small case series. Clinical features are similar to infectious mastitis and it may radiologically resemble breast cancer. Treatment options remain controversial and recent studies have advocated surgical treatment with wide excision or mastectomy as well as oral corticosteroids. We present one of the largest case series of women with IGM. The aim of the study was to describe the demographic characteristics, clinical features, associated conditions, and the outcomes of initial treatment focused on the use of non-surgical therapies.
METHODS: We conducted a prospective observational study in the breast clinics of a large safety net hospital in Chicago by enrolling all women with biopsy proven granulomatous mastitis between 2006 and 2010. Demographic, clinical, laboratory, and radiological data were obtained from electronic and paper records. Secondary causes of breast granulomas were excluded. Treatments prescribed included oral steroids, observation or surgical excision. The primary end points were the number of women who achieved complete resolution of disease with non-surgical treatment and the time to resolution. Resolution was defined by clinical examination and not self-report. IRB approval and patient consent were obtained.
RESULTS: 49 women were diagnosed with IGM during this period and all were enrolled into the study. The mean age was 35 years (range 24-67). 39(80%) women were Hispanic whereas one third of overall referrals to the breast clinics are Hispanic. 34(70%) were born in Mexico. 39(80%) women presented with a painful breast mass with overlying erythema. 29(59%) women were initially prescribed antibiotics for presumed infectious mastitis to which they had minimal response. 44(90%) women were prescribed oral steroids, 2(3%) women had surgical excision and 3(6%) remained under observation only. Of the 44 women who received oral steroids, 35(80%) had complete resolution of disease, 6(14%) were lost to follow up, 2(5%) remained on steroid treatment at the time of submission and 1 had surgical excision after failure of steroid treatment. Excluding one woman who was non-adherent to her treatment, the mean time to complete resolution on steroids was 194 days (range 45-581) with 20(59%) resolving within 6 months. Weight gain and epigastric discomfort were the most

common side effects from steroid treatment during the study period. CONCLUSIONS: Idiopathic granulomatous mastitis is a rare benign breast disease for which surgery, including mastectomy, has been widely used for treatment but may be unnecessary. In our case series, surgery-sparing treatments (primarily with oral steroids) led to resolution in over 90% of women suggesting that most patients with this disease may be successfully managed with conservative therapy alone. In addition, the predilection of IGM among young Hispanic women of childbearing age in our study supports similar findings from other studies and may suggest a common genetic, environmental, immunological or infectious etiology, which warrants further multidisciplinary investigation.

IMMUNE RISKS FOR PERSISTENT DEBILITY AFTER MOLD EXPOSURE &RESPONSE TO ANTIFUNGAL BIOFILM THERAPY Irene H. Grant; James F. Rini. New York Medical College, Valhalla, NY. (Control ID #1340240)

BACKGROUND: Tissue barriers &cell-mediated immunity(CMI) defend against fungal penetration. Stachybotrys(S) products irreversibly damage tissues.Culture &microscopy routinely fail to detect Aspergillus-Penicillium (AP) invasion in the severely immunocompromised. Non-invading fungal biofilms support mold proliferation, persistence &elaboration of myriad inflammatory, toxic, anticoagulant or immunosuppressive products. While only Amphotericin (Ampho) eradicates mold biofilms, it cannot cross tissue planes. Since toxin-producing biofilms may cause persistent debility long after exposure,biofilm-directed antifungal therapy (Rx) was studied. Objectives:(1) Correlate clinical spectrum after mold exposure with immune risks, antibody &mycotoxin detection, (2) Determine efficacy of antifungal biofilm Rx. METHODS: Prospectively monitored 47 ill mold-exposed patients(16 M,31 F,13-86 yrs.),for immune risks, fungal antibodies, urine mycotoxins (MT's) &response to antifungal Rx (nasal lavage with oral swish &swallow Ampho +/- systemic azoles or capsofungin). RESULTS: Of 47 patients with documented exposure to S &/or AP, 55% had severe persistent symptoms (sxs), 28% disabling &11% life-threatening. Those exposed to both S&AP were at greater risk for more sxs. Prolonged debility was associated with exposure intensity, impaired CMI, &multiple MT excretion.11% had impaired CMI risks: vitamin D, protein or zinc deficiencies, steroids,neutropenia. A.fumigatus+IgG titers in 25/26 (96%); S.chartarum+ IgG in 21/28 (75%), +IgA in 2 &IgE undetectable in 28/28. MT excretion in 28/32 (88%): Ochratoxin 27, Tricothecenes(T's) 21, Aflatoxin 11; 19 excreting multiple MT's were severely debilitated. All 21 excreting T's had chronic fatigue syndrome (CFS), fibromyalgia (FM) &persistent pain. Rx response was striking: 44/47 (94%) unequivocally improved: 25%completely; 28% residual disability; 55% relapsed with Rx interruption, most improving on restart. Flares were common on initiation,waning over time. Sxs improved in all categories, most in 2-3 wks; some 1-3 mo. Many with impaired CMI or markers for penetration (adenopathy, nodules, calcification) required prolonged(> 2 yrs), relapsing with interruptions. Most refusing to continue RX steadily deteriorated. 18 relapsed on mold re-exposure. CONCLUSIONS: Mold exposure with impaired immunity &/or Stachybotrys-exposure can result in persistent debility &MT excretion. Biofilm-focused antifungal +/- systemic Rx dramatically reverses chronic,

unexplained debility in over 90%(bleeding, CFS, FM, sinusitis, vertigo, choking, GERD, IBS, tremors, ataxia, paresis, seizure, delerium, sleep
apnea). Better methods to detect mold &controlled clinical trials for antifungal Rx are needed.

IMPACT OF HEALTH DISPARITIES EDUCATION ON MEDICAL STUDENTS CULTURAL COMPETENCE April S. Fitzgerald1; Mary Catherine Beach1; Somnath Saha2. 1Johns Hopkins University, Baltimore, MD; 2Oregon Health &Science University, Portland, OR. (Control ID #1340803)

BACKGROUND: In response to mounting evidence that physicians may contribute to widespread disparities in the quality of health and health care, medical educators have worked to determine the most effective methods of teaching about health disparities and increasing the cultural competence of physicians-in-training. Although

many studies have demonstrated a positive impact of these educational efforts, few if any have examined the impact of health disparities education on the cultural competence of medical students. METHODS: The Health Care Disparities course is the first course taught to first year medical students at Johns Hopkins University, occupying 3 full days in the week following Orientation, and modeled after a health disparities course developed, taught and evaluated at University of Chicago. The goals of the course are to improve 1-awareness of the effect of social needs and demands on care of patients, 2-knowledge of existence of health care disparities and the demographic influences on health care quality and effectiveness, 3-self-awareness of personal biases in their approach to health care delivery, and 4-cross-cultural communication skills. The course contains short lectures, small group work with video presentation and active learning exercises, community tours and service experiences. One-hundred and twenty students are in the Class of 2015; of those, 119 students completed the health disparities course in August 2011. We evaluated the effectiveness of the course using a previously validated instrument measuring 5 domains of physician cultural competence: Cultural Awareness, Perceived Cultural Self-Efficacy, Awareness of Racial Disparities, Valuing Diverse Perspectives, Support for System-Level Cultural Accommodations. Each domain includes 5-8 individual items, rated on a 5-point scale (strongly agree - strongly disagree). Resulting scores for each domain range from 1 (lowest cultural competence) to 5 (highest cultural competence). We used t-tests to measure differences before and after the course in students self-assessment of their cultural competence across all five remaining domains.
RESULTS: Most students completed a pre- course cultural competency self-assessment (n=103) and all completed the post-course self-assessment (n= 119). Students demonstrated statistically significant improvements in all five domains measured (See Table).
CONCLUSIONS: Our health disparities course was effective in improving the cultural competence of medical students. To the extent that greater cultural competence is associated with more equitable health care delivery, health disparities education in medical school may help reduce the physician contribution to racial and ethnic disparities in health care.
IMPACT OF HEALTH INSURANCE, EDUCATION AND INCOME STATUS ON CANCER SCREENING RATES IN MINORITY POPULATIONS: 2001 - 2010 Raxitkumar Jinjuvadia; Prateek Lohia; Theresa E. Vettese. Wayne State University/Detroit Medical Center, Detroit, MI. (Control ID #1339654)

BACKGROUND: Despite the beneficial effect of cancer screening methods, utilization of these resources remains low among minority population. Our aim was to evaluate impact of medical insurance, education level and income status on colorectal cancer (CRC), breast cancer (BC) and cervical cancer (CC) screening among minority populations using Behavioral Risk Factor Surveillance System (BRFSS) 2001 to 2010.
METHODS: 184,092 and 451,075 individuals participated in BRFSS in 2001 and 2010 respectively, including those from minority populations (African American, Asian, Native Hawaiian, American Indian). CRC screening was defined as having FOBT in last 1 year or colonoscopy in last 10 years in individuals >50 years. BC screening was defined as mammogram in last 2 years in women >40 years. Individual was considered to have CC screening if she had Pap smear in last 3 years. Education status was categorized as less than high school, and high school or more. Participants in an annual income group>$25,000 were compared with those in a lower income group. Cancer screening rates were evaluated for years 2001 to 2010 with respect to medical insurance, education and income status. Logistic regression analysis was used to calculate adjusted odds ratios (aOR) for receiving cancer screening for the year 2010. All analyses were performed using SAS 9.2. RESULTS: In 2010, after implementing eligibility criteria, the study cohort for CRC, BC and CC included 25426, 22302 and 22083 participants respectively.
Overall screening rate for CRC, BC and CC for minority population in year 2010 was 62.2%, 77.5% and 83.7% respectively. Individuals with medical insurance had a significantly higher screening rate compared to those without, for all cancer screenings. (CRC-65.9% vs 37.7%; BC-81.2% vs 56.1%; CC-86.2% vs 72.9%, p values

<0.001). Though not as prominent as insurance status, a significant difference was noted with respect to a higher education level (CRC-64.3% vs 52.6%; BC-78% vs 74.5%; CC-84.6% vs 77.2%). Participants with>$25,000 income had higher screening rate (CRC-68.4% vs 55.6%; BC-81.7% vs 72.8%; CC-87.8% vs 78.7%). After adjusting for age, sex, race, BMI, smoking, alcohol and cost factors; insurance, education and income status were found to be independent predictors of CRC and CC screening. The aOR for insurance, education and income status were 2.09 (1.92-2.27), 1.52 (1.41- 1.64) and 1.66 (1.56-1.76) for CRC; and 2.37 (2.17-2.59), 1.15 (1.03-1.28) and 1.72(1.59-1.87) for CC screening respectively. Only insurance (2.66, 2.45-2.89) and income (1.57, 1.46-1.69) status were found to independent predictors of BC screening, but not education (1.05, 0.95-1.15). Similar results were noted for other years.
CONCLUSIONS: Among minority populations, health insurance status seems to be the most important socioeconomic factor affecting cancer screening rate, along with education and income status. More targeted efforts are required to improve screening rate among this population.
IMPACT OF INTERN WORKLOAD AND DISCONTINUITY OF CARE ON 30-DAY READMISSION Stephanie Mueller; Jacques Donze; Robert Burke; Jeffrey L. Schnipper. Brigham and Women's Hospital, Boston, MA. (Control ID #1332280)
BACKGROUND: Recent modifications to Accreditation Council for Graduate Medical Education (ACGME) duty hour restrictions have resulted in greater variation of intern workload and increased transitions of care by housestaff. We evaluated the association between intern workload and discontinuity of patient care on probability of 30-day readmission. METHODS: We performed a retrospective cohort study at an academic medical center in Boston, MA. Data were obtained from administrative sources and electronic medical records. Patients were eligible for inclusion if discharged from the general medicine service to home or a rehabilitation facility between July, 2009 and June, 2010. The outcome of interest was 30-day readmission to any of three hospitals within the healthcare system. Intern workload predictors included: (1) Number of admissions completed by intern on day of patient discharge, dichotomized into >2 vs2 to account for on-call vs non call days, (2) Number of discharges completed by intern on day of patient discharge, and (3) Intern census (i.e., total patients cared for) on day of patient discharge. Discontinuity of care predictor was defined as the number of different physicians writing orders on the patient during hospitalization, which
was categorized into quartiles of<8 physicians (reference), 8-11, 11-15, and>15. We performed logistic regression to examine the association of predictors with 30-day readmission, accounting for clustering by intern, and controlling for patients demographics, healthcare utilization in past year, length of stay, comorbidities, source of admission, discharge destination, number of medications on discharge, weekday vs weekend discharge, and nurse workload on day of patient discharge (i.e., number of patients cared for on the nursing unit).
RESULTS: Of the 10,731 patient discharges, 2398 (22%) were readmitted within 30 days. Intern workload predictors demonstrated a mean of 0.7 patient admissions, 1.7 patient discharges, and mean census of 4 patients on day of patient discharge. Of the 10,731 discharges, 1098 (10.2%) occurred on intern call days (admissions>2). Discontinuity of care predictor showed the mean number of physicians writing orders on a patient during hospitalization was 12.2. Results of multivariate analysis demonstrated no association between number of intern admissions or intern census and odds of 30-day readmission. However, with every increase in number of intern discharges on day of patient discharge, the odds of 30-day readmission increased by 5% (adjusted OR 1.05 [1.00, 1.11], p<0.05). Increasing number of physicians writing orders on a patient during hospitalization was not significantly associated with increased odds of 30-day readmission on adjusted analysis.

CONCLUSIONS: We found that increased number of patients an intern discharges on day of patient discharge is associated with increased odds of 30-day readmission. We also found that only 10% of patients are discharged on intern call days, less than expected given a traditional 4-day call schedule. Our findings suggest that workload associated with multiple patient discharges may adversely impact patient outcomes, and that interns potentially self-regulate workload on call days by decreasing the number of patient discharges. Future research should further examine workload associated with patient discharge and potential mechanisms of mitigating negative consequences.

IMPACT OF MASSACHUSETTS HEALTH CARE REFORM ON THE RISK OF HOSPITALIZATION FOR CARDIOVASCULAR AMBULATORY CARE SENSITIVE CONDITIONS. Danny McCormick1; Amresh D. Hanchate2,3; Nancy R. Kressin2,3; Mengyun Lin3; Meredith D'Amore3; Karen E. Lasser3. 1Harvard Medical School / Cambridge Health Alliance, Cambridge, MA; 2VA Boston Healthcare System, Boston, MA; 3Boston Medical Center/Boston University School of Medicine, Boston, MA. (Control ID #1337863)

BACKGROUND: The 2006 Massachusetts (MA) health reform increased the number of insured residents, particularly among racial/ethnic minorities. Yet, little is known about whether this insurance expansion translated into improvements in access to medical care for MA residents as a whole or for the states racial and ethnic minorities. Ambulatory care sensitive conditions (ACSCs) such as congestive heart failure (CHF), hypertension and angina, are a set of medical conditions for which good outpatient care can potentially prevent the need for hospitalization. Decreased admission rates for these conditions are validated measures of improved access to outpatient care. We therefore evaluated whether such rates declined for residents of MA following health reform and whether racial and ethnic disparities in admission rates declined.

METHODS: Using complete data on acute care hospital admissions in MA and in two states that did not implement comprehensive health care reform, New York and Pennsylvania, we identified all hospital admissions for cardiovascular ACSCs (CHF, angina and hypertension) during the 21 months preceding and following health reform implementation (7/1/ 2006 - 12/31/2007). Using US census population data we calculated preand post-reform age- and sex-standardized admission rates for the 3 ACSCs combined among patients 18-64 (those affected by reform). Treating MA as the intervention cohort, and NY and PA together as the control cohort we used multivariate Poisson regression models to conduct difference-in-difference analyses to estimate post-reform changes in admission rates in MA adjusted for contemporaneous changes occurring in control states. The models were also adjusted for age, gender and race. Using this approach, we also assessed whether health reform was associated with decreases in admission rates for racial and ethnic minorities compared with whites.

RESULTS: There were 84,286 hospital admissions for CHF, angina and hypertension combined in the pre and post reform periods in MA and 535,726 during the same time periods in control states. The hospital admission rate (number/100 k population) for ACSCs declined in MA (128.7 to 121.7 [5.4%]) and in control states (232.2 to 208.4 [10.2%] from the pre to post reform period. When adjusted for secular trends in control states, age, gender and race, however, there was a 6.2% (95% CI, 2.9-9.6) increase in admissions in MA. The admission rate among blacks in MA increased (477.5 to 511.5 [7.1%]) but in control states increased less (683.3 to 693.3 [1.5%]). The admission rate among Hispanics declined in both MA (295.3 to 267.2 [9.5%]) and control states (278.1 to 254.4 [8.5%]). The admission rate among whites declined in both MA (102.9 to 92.1[10.5%]) and control states (150.5 to 121.3 [19.4%]). After adjustment, there was no significant change in the admission rate for blacks compared with whites in MA (+3.7% [95% CI, -11.1 - 4.5]) or for Hispanics compared with whites in MA (+9.3% [95% CI, -18.2 - 0.6]). CONCLUSIONS: Hospital admissions for cardiovascular ACSCs did not decline in MA as a whole, or for minorities relative to whites, in comparison with 2 large control states that did not implement health reform. Additional insurance or health care system reforms in MA may be needed to decrease potentially avoidable hospitalizations and improve access to care.

IMPACT OF MASSACHUSETTS HEALTH REFORM ON RACIAL AND ETHNIC DISPARITIES IN USE OF

INPATIENT CARDIOVASCULAR SURGERIES Amresh D. Hanchate1,2; Xin Zheng2; Karen E. Lasser2; Danny McCormick3; Meredith D'Amore2; Alok Kapoor2; Nancy R. Kressin1,2. 1VA Boston Healthcare System, Boston, MA;
2Boston Medical Center/Boston University School of Medicine, Boston, MA; 3Cambridge Health Alliance, Cambridge, MA. (Control ID #1336492)

BACKGROUND: The 2006 Massachusetts (MA) health reform increased insurance coverage to near-universal levels, but its impact on access to care or disparities in access is unclear. We examined post-reform change in racial/ ethnic differences in use of two cardiovascular (CV) procedures, percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft (CABG), for which disparities in use have been noted in numerous past studies. As use of these procedures is sensitive to outpatient referral, impact of reform on procedure use can serve as a marker for impact on access to care. We hypothesized that reform will result in increased use of procedures, and that the increase in use will be greater among minorities. We contrasted the results with those for two comparable orthopedic procedures (total knee replacement and total hip replacement).

METHODS: Using the comprehensive MA Hospital Inpatient Data of all discharges in all non-Federal hospitals from 1/1/2004 to 9/30/2009, we obtained state-level counts of individual procedures stratified into 30 cohorts by age (40-44, 45-49, 50-54, 55-59 &60-64), sex and race/ethnicity (Whites, Blacks and Hispanics) for each quarter. To separate the impact of MA reform from secular changes, we used corresponding data from New York (SPARCS Inpatient Data) to capture changes unrelated to MA reform. To convert procedure counts into rates (# procedures/10,000 population), we obtained Census data to create a measure of population at risk for each cohort. Treating a quarter as the unit of time, the study period comprised of 10 pre-reform, 6 transition and 7 post-reform quarters. Applying a difference-in-difference specification, we used segmented time series Poisson regression models to estimate the impact of MA reform on the procedure rates for Blacks and Hispanics relative to those for Whites.

RESULTS: Reflecting national trends, there was a secular decrease in MA in the use of PTCA and CABG (-8.0% per year for each) throughout the study period. For the pre-reform period procedure rates in MA were: PTCA=31.5 and CABG=7.7 per 10,000 population. In MA, compared to Whites, pre-reform rates of both procedures were lower among Blacks (Incidence Rate Ratio [IRR]: PTCA=0.79 &CABG=0.73; all p values<0.001) but similar among Hispanics. For the post-reform period, the procedure rate in MA was unchanged for PTCA but was 11% higher (95%CI=[2%, 20%]) for CABG. In MA, health reform was associated with 14% higher post-reform rates of PTCA +CABG (combined) use (95% CI=[3%, 27%]) among Hispanics than that among Whites; no significant impact was noted for Blacks (2%; 95% CI=[-9%, 15%]). In contrast, the orthopedic procedures experienced secular increases in use. In MA, reform was associated with higher post-reform use of both procedures (combined) among Blacks (15%, 95% CI=[4%, 28%]) and Hispanics (36%, 95% CI=[17%, 58%]) than that among Whites. CONCLUSIONS: MA health reform may have increased the use of CV and orthopedic procedures among minorities, thereby indicating improved access to care. While orthopedic procedure use increased among Blacks and Hispanics, the increase for CV procedures was smaller in magnitude and limited to Hispanics. The weaker impact on CV procedures may be indicative of less pent-up demand or greater acuity of conditions targeted relative to orthopedic procedures.

IMPACT OF MEDICAL AND PSYCHIATRIC COMORBIDITY BURDEN AND MORTALITY IN VETERANS WITH TYPE 2 DIABETES Cheryl P. Lynch1,2; Mulugeta Gebregziabher1,2; Kelly J. Hunt1,2; Carrae Echols1; Gregory Gilbert1; Leonard E. Egede1,2. 1Ralph H Johnson Veterans Affairs Medical Center, Charleston, SC;
2Medical University of South Carolina, Charleston, SC. (Control ID #1340363)

BACKGROUND: Greater disease burden earmarks affected individuals for premature disability, hospitalizations and death. Among people with diabetes, common medical and psychiatric conditions such as obesity and depression greatly increase morbidity and mortality risks. Therefore, we examined the

relationship of medical versus psychiatric comorbidity burden and mortality among veterans with type 2 diabetes.
METHODS: A national cohort of veterans with type 2 diabetes was created by linking multiple patient and administrative files from 2 large VA databases. The main outcome measure was time to death, defined in months between the date of study entry and the date of death (or study end or censored). The predictor was comorbidity burden measured by count of medical and psychiatric conditions. Cox regression methods were used to model the association between time to death and comorbidity burden. Both unadjusted hazard ratios (HR) and adjusted HR were computed with their corresponding 95% confidence intervals.
RESULTS: The study cohort comprised a total of 629,563 veterans, nearly all male, with type 2 diabetes followed up over a 4-year period. The overall mortality rate was 22.2%. Obesity (67%) and hypertension (59%) were the most common medical comorbidities. In comparing those with no comorbidities to those with one, two and three or more additional medical comorbidities the unadjusted HR were 1.16 (1.14,1.18), 1.60 (1.57,1.63) and 2.47(2.42,2.51), respectively. After adjusting for all covariates, the corresponding HR were 1.01 (0.99,1.03), 1.34 (1.32,1.37) and 1.99 (1.96,2.03), respectively. Having three or more comorbidities in addition to diabetes is associated with a two-fold risk of death compared to those having only diabetes. Similarly, having one or two psychiatric comorbidities in addition to diabetes was associated with 1.26 (1.25,1.28) and 1.46 (1.41,1.50) fold risk of death, respectively. Looking at both comorbidity groups together, having three, four or five comorbidities was associated with 1.86 (1.82,1.89), 1.98 (1.93,2.02) and 1.99 (1.92,2.06) fold risk of death, respectively.
CONCLUSIONS: Risk of death doubled for veterans with diabetes having 3 or more additional medical comorbidities. In addition, those having two psychiatric comorbidities had nearly 50% greater odds of death. These findings amplify the crucial need for healthcare providers to co-treat or integrate care management plans for diabetes-related medical and psychiatric comorbidities in veterans.

IMPACT OF PRIOR ANTIBIOTIC USE ON OUTCOMES FOR PATIENTS HOSPITALIZED WITH PNEUMONIA

Eric Mortensen1;
Ata Rahman2; Antonio Anuzeto2. 1VANTHCS, Dallas, TX; 2UTHSCSA, San Antonio, TX. (Control ID #1336324)

BACKGROUND: Despite the growing number of antibiotic-resistant pathogens, the effect of prior use of antibiotics on pneumonia-related outcomes is unclear. Prior studies examining the effect of use of antibiotics prior to hospitalization for pneumonia have lead to divergent findings. Therefore, the purpose of our study was to examine the association between prior outpatient antibiotic use and clinical outcomes for those subsequently hospitalized with pneumonia.
METHODS: We identified patients>65 years of age admitted to a Department of Veterans Affairs hospital in fiscal years 2002 - 2007 with a discharge diagnosis of pneumonia. We examined the impact of prior antibiotic use within 90 days on 30-day mortality, intensive care unit (ICU) admission, use of mechanical ventilation, and use of vasopressor therapy. RESULTS: Our cohort was comprised of 50,119 patients with a mean age of 75.0 years (standard deviation 6.8 years) and 98.2% of subjects were male. In this cohort, 29% received antibiotics within 90-days of admission. Mortality at 30-days was similar for the prior antibiotic vs. no prior antibiotic groups (13.9% vs. 14.2%, p=0.4). Patients that did not receive antibiotics prior to hospitalization had higher rates of ICU admissions (14.2% vs. 13.2%, p=0.005), but not use of mechanical ventilation (6.6% vs. 6.3%, p=0.2). Vasopressor use was similar (4.4% vs. 4.6%, p=0.4). Rates of staphylococcus aureus and pseudomonas infections were higher for those who received beta-lactams or fluoroquinolones vs. non-users. In a multilevel regression model, after adjusting for other potential confounders, prior receipt of beta-lactams, but not other types of antibiotics, was associated with increased risk for 30-day mortality (OR 1.23, 95% CI 1.05 - 1.45).
CONCLUSIONS: A clinically important proportion of patents in our cohort were found to have antibiotic use prior to hospitalization for pneumonia, and the prior use of beta-lactams was associated with increased risk of

mortality. Patients treated as outpatients for pneumonia should be treated with non-beta lactam antibiotics.
IMPACT OF VENDOR COMPUTERIZED PHYSICIAN ORDER ENTRY ON ADVERSE DRUG EVENTS IN PATIENTS WITH RENAL IMPAIRMENT Alexander A. Leung1; Gordon Schiff1; Carol Keohane1; Mary Amato1,2; Steven R. Simon1; Bismarck Cadet3; Michael Coffey4; Nathan Kaufman4; Eyal Zimlichman1; Diane L. Seger1; Catherine Yoon1; David W. Bates1. 1Brigham and Women's Hospital, Boston, MA; 2Massachusetts College of Pharmacy and Health Sciences, Boston, MA; 3New England Medical Specialists, Boston, MA; 4Partners Community Healthcare, Inc., Boston, MA. (Control ID #1326705)
BACKGROUND: Adverse drug events (ADE) are common among hospitalized patients with renal impairment. Computerized physician order entry (CPOE) systems with clinical decision support (CDS) may help prevent many ADEs by providing timely laboratory information, recommending renally-adjusted doses, and offering a knowledge base to assist with prescribing. However, decision support for renal disease varies widely among current vendor systems. Given the uncertain benefits of CPOE, especially with the wide range of associated CDS, we sought to determine the impact of these systems on the rates of ADEs among patients with kidney disease in the community hospital setting, where mainly vendor-developed applications are used.
METHODS: We conducted a before-and-after quasi-experimental study from January 2005 to September 2010 at five Massachusetts community hospitals to evaluate the impact of CPOE implementation on ADE rates. Three distinct levels of CDS were studied: basic CPOE only; rudimentary CDS with laboratory display; and, advanced CDS with suggested renal dosing and automated corollary laboratory orders for monitoring. We sampled a total of 1,590 patients with renal impairment (defined as an admission creatinine 1.5 mg/dL) who were prescribed a renally-cleared and/or nephrotoxic drug. Charts were reviewed for orders, medication lists, laboratory reports, admission histories, notes, discharge summaries, and flow sheets. The primary outcome was the rate of preventable ADEs. Secondary outcomes were the rates of potential ADEs and the average lengths of stay. The occurrence of each outcome was determined according to hospital site and rates were calculated. To account for hospital effects in the analysis, we fit a fixed-effects model using Poisson regression. RESULTS: There was a 45% decrease in the rate of preventable ADEs following implementation (8.0/100 vs. 4.4/100 admissions; $p<0.01$), and the impact was related to the level of decision support ($p=0.03$ and 0.02 for pairwise comparisons between advanced CDS vs. rudimentary CDS and basic CPOE, respectively). Basic CPOE was not associated with any significant benefit (4.6/100 vs. 4.3/100 admissions; $p=0.87$), and there was a decrease in preventable ADEs with rudimentary CDS, which did not meet statistical significance (9.1/100 vs. 6.4/100 admissions; $p=0.22$). However, substantial reduction was seen with advanced CDS (12.4/100 vs. 0/100 admissions; $p=0.01$). Despite these benefits, a significant increase in potential ADEs was found for all systems (55.5/100 vs. 136.8/100 admissions; $p<0.01$). There was a significant decrease in median length of stay following implementation at all sites (5.0 vs. 4.0 days; $p<0.01$).
CONCLUSIONS: Vendor-developed CPOE with appropriate CDS can reduce the occurrence of preventable ADEs, and was associated with a decreased average length of stay. Our findings support the use of vendor CPOE systems as a means to reduce drug-related injury and harm. The potential ADE rate could be reduced by making refinements to the vendor applications and their associated decision support.
IMPACT OF A PATIENT ACTIVATION TOOL TO IMPROVE AGENDA SETTING IN CHRONIC DISEASE ENCOUNTERS: A RANDOMIZED CONTROLLED TRIAL Patrick G. O'Malley1,2; Dorothy Becher1,2; Janice Hanson4,1; Jacqueline LeeHoffman2; Chengqing Li2; John J. Ominski2; Jeffrey L. Jackson3,1. 1Uniformed Services University, Bethesda, MD; 2Walter Reed National Military Medical Center, Bethesda, MD; 3Medical College of Wisconsin, Milwaukee, WI; 4University of Colorado School of Medicine, Aurora, CO. (Control ID #1321978)
BACKGROUND: Patients with chronic illness often have a complicated visit agenda. Their visit interactions tend to be poorly organized resulting in miscommunication and potentially poor health outcomes. We hypothesized

patients organize their thoughts in order to improve communication, satisfaction with the encounter, and health-related outcomes.
METHODS: Randomized Controlled Trial. We enrolled a consecutive sample of 120 consenting participants aged 40-80yo with hypertension, at least 2 additional chronic conditions (excluding dementia), who were scheduled to see their internist for a routine appointment. Of 11 participating providers, each had 8-12 patients randomized (using a computer generated random sequence with allocation concealment) to a pre-visit intervention tool or usual care. Intervention: Using patient and physician focus groups, the tool was systematically designed to prompt the patient to reflect on, articulate, and prioritize their visit goals. The tool was administered at least 20 minutes prior to the visit. The primary outcomes were change in 4 and 12 week blood pressure (BP) readings and hypertension medication adherence using validated measurement processes. Analyses were perfomed by intention to treat. Covariates included patient functional status, health literacy, locus of control, and physician psychosocial attitudes and mindfulness.
RESULTS: Of the 106 patients who attended and completed their visit, the demographics were: mean age, 67; 53% female; 55% African-American (AA); 88% were on5 medications; and only 8% had "poor" health literacy. The physician profile was: 48yo, 55% F, 27% AA, 19 yrs since graduation. At baseline, patient characteristics, comorbidities, and biometrics were equally distributed and comparable among the study arms indicating effective randomization. Immediately after the visit, there was no difference in patient satisfaction or trust. At 4 and 12 weeks follow-up, there was no difference between groups on BP, medication adherence (by pill count or Morisky score) or trust (see Table). Intervention patients were more satisfied with physicians' explanations but this only approached statistical significance (78.6% vs 68.9% fully satisfied; P=0.07).
CONCLUSIONS: A single, simple pre-visit tool designed to prompt patient initiated agenda setting and articulation of visit goals does not impact BP control, adherence, patient satisfaction, or trust in chronic illness patients with hypertension. More robust patient and physician interventions are likely needed to optimize agenda setting and communication in ways that improve patient-centered outcomes.
Baseline - Post Visit
4 Weeks 12 Weeks P Value
Activated Usual Care
Activated Usual Care
Activated Usual Care
Systolic BP (mm Hg)
139.0 136.0 133.0 130.5 129.2 128.6 NS
Diastolic BP(mm Hg)
81.5 80.2 78.1 77.0 76.8 76.3 NS
Pill Count (%Adherence)
51.7 42.8 45.8 49.5 49.3 51.1 NS
Morisky Score
4.5 4.8 5.0 5.1 4.9 5.1 NS
Satisfaction (%)
78.6 73.8 NS
Trust Score
11.3 12.8 12.3 12.7 11.9 13.6 NS
BP (avg of 3 measurements, 5-min apart); Morisky (6-item; motivation +knowledge); Satisfaction (% fully

satisfied, RAND); Trust (8-item PCAS); P-values were for comparisons of change in continuous values, and for differences in % fully satisfied.

IMPACT OF A TRAINING PROGRAM ON SUPERVISORS ABILITY TO PROVIDE FEEDBACK ON RESIDENTS COMMUNICATION SKILLS Noelle Junod Perron1; Mathieu Nendaz1; Johanna Sommer2; Martine Louis Simonet1; Anne Gut2; Anne Baroffio2; Diana Dolmans3; Cees Van der Vleuten3. 1Geneva University Hospitals, Geneva, Switzerland; 2Geneva Medical School, Geneva, Switzerland; 3School of Health Professions Education, Maastricht, Netherlands. (Control ID #1334027)

BACKGROUND: Lack of clinical supervisors training in teaching skills is often cited as a main obstacle to post-graduate teaching of communication skills (CS). We report the results of a training program for clinical supervisors on how to provide feedback on residents communication skills.

METHODS: We designed a pretest-posttest controlled study in which clinical supervisors working in the service of general internal medicine and the division of primary care at the Geneva University Hospitals, Switzerland, were invited to attend a program in teaching CS including small group training sessions with simulated patients and 2 individual supervision sessions over a period of 6 to 9 months. Controls were recruited among supervisors of a similar service not taking part in the training program. Before and after the training program, supervisors were videotaped while giving feedback on residents communication skills bu using an OSTE-video (objective structured teaching encounter). The feedback given by the supervisors was analysed using a 20-item feedback rating instrument.

RESULTS: Twenty nine 29 clinical supervisors took part into the training program and 20 were included in the control group. Apart from age and training experience, the two groups were similar in terms of socio-demographic data and self-perceived knowledge in CS and teaching experiences. After training, a higher percentage of trained participants demonstrated statistically significant improvement (differences in mean scores before and after intervention using Wilcoxon signed rank test) in the following items: exploring residents feelings/needs (intervention: pre=2.92 and post=4.16, p=0.01; control: pre=2.90 and post=3.35, p=0.87), stimulating residents self-assessment (intervention: pre=2.24 and post=3.68, p<0.001; control pre=1.90 and post=2.45, p=0.04), limiting feedback to a few items (intervention: pre=3.40 and post=4.24, p<0.001; control: pre=3.70 and post =3.60, p=0.87), making the resident active in finding solutions (intervention: pre=2.40 and post=4.04, p<0.001 ; control: pre=2.90 and post=2.85, p=0.78), checking understanding(intervention: pre=1.36 and post=4.28, p<0.001 ; control: pre=1.40 and post=1.35, p=0.80). Improvement was higher among inpatient clinical supervisors than among outpatient clinical supervisors. CONCLUSIONS: These preliminary results suggest that a training program is effective in increasing clinical supervisors feedback skills on residents communication skills.

IMPACT OF INSTALLING AN OFFICE BASED AUTOMATED POINT OF CARE MEDICATION DELIVERY SYSTEM ON OUTCOMES AMONG DIABETIC PATIENTS ON CHOLESTEROL LOWERING MEDICATIONS Ana M. Palacio1; Leonardo Tamariz1; Jessica Chen2; Hua Li1; Olveen Carrasquillo1. 1University of Miami, Miami, FL; 2Chen Medical Associates, Miami, FL. (Control ID #1339234)

BACKGROUND: To date most patients receive their medications from traditional or mail order pharmacies. Automated point of care medication delivery system (POCMDS) are a relatively new innovation allowing patients to receive their medications at the time of their visit with their health care provider. Literature on the impact of POCMDS on outcomes is sparse. The aim of this study is to evaluate the impact of a POCMDS implementation in medium size practice on adherence, costs and lipid control among a group of diabetic patients.

METHODS: Between 2008 and 2010, the POCMDS was implemented in a network of five South Florida capitated private practice clinics located predominantly in underserved areas. The POCMDS formulary included mostly generic medications provided to patients by their physicians during the clinic visit free of charge. When possible, patients were switched from name brand to generic medications as part of this process. To evaluate

the impact of POCMDS on outcomes we conducted a pre-post analysis in a cohort of 308 diabetics who had 12 months of follow-up before and after the POCMDS was installed. Eligible patients had to have an ICD-9 codes for diabetes in the pre-evaluation period, drug code for a statin medication prior to the POCMDS period and at least one LDL measurement within a year before and after the POCMDS. Race, co- morbidities and LDL were obtained from the electronic medical record. Medication refills and costs were collected from claims data prior to POCMDS and subsequently from the POCMDS prescription records. As a measure of adherence, we used the medication possession ratio (MPR) calculated as the percentage of time

the subject had a statin available during the 12 months before and after the intervention.

RESULTS: We analyzed data on 238 Black and 70 White subjects. With respect to medication adherence, the medication possession ratio nearly doubled among both whites and blacks (p<.01, Table 1). Our costs analyses show a significant reduction in per patient statin related costs from an average of $ 120 before POCMDS to $ 90 after the enrollment on POCMDS (p=0.04). However, while both groups experienced significant improvements in the MPR, we did not observe a significant improvement in the average LDL.

CONCLUSIONS: Among diabetic patients in this capitated system a POCMDS implementation was associated with significant improvements in the medication possession ratio and lower statin medication drug costs. Lack of change on LDL levels could be related to the transition from more potent brand statins to less potent generic ones or relatively low LDL levels at baseline. Our cost data excludes the savings experienced by patients whom are no longer are charged drug co-payments. Ongoing analyses are examining data on diabetes and blood pressure control.

Race Number MPR before POCMDS MPR after POCMDS p-value White 70 0.490.28 0.800.22 <0.01 Black 238 0.400.26 0.840.19 <0.01

LDL before POCMDS LDL after POCMSWhite 70 95.631.8 92.128.0 0.51 Black 238 96.029.6 96.532.4 0.72

IMPACT OF THE ELECTRONIC MEDICAL RECORD (EMR) ON RESIDENTS MEDICAL EDUCATION Diane L. Levine; Satyam Patel; Ahmad Muneer. Wayne State University/Detroit Medical Center, Detroit, MI. (Control ID #1334914)

BACKGROUND: With the 2009 American Recovery and Reinvestment Act, new funding for Health Information Technology will result increased adoption of EMR. A previous study showed that interns spent 5% more time entering orders with computerized physician order entry (CPOE) than before implementation of CPOE. In 2009 our institution implemented an EMR with level-five capabilities (Healthcare Information and Management Systems Society classification). In 2010, the Department of Medicine mandated full use of the EMR for all patient documentation. Anecdotal evidence suggested that this resulted in residents spending excessive amounts of time on the EMR. The impact of use of a level-five EMR on graduate education is unknown. We conducted a survey-study to determine the impact of the EMR on residents daily activities, time spent on the EMR, and on residents reading and education.

METHODS: A survey consisting twenty-eight multiple-choice questions was developed. An email with an information sheet and an online encrypted survey link was sent to trainees at the Detroit Medical Center/ Wayne State University (WSU). Participation in the survey was voluntary and anonymous. The study was exempted by the Institution Review Board at WSU.

RESULTS: A total 138 residents completed the survey; response rates were highest from the Departments of Medicine (49), Pediatrics (26), and Emergency Medicine (23). Trainees spent considerable time on the EMR during duty hours. The majority (95%) spent more than one hour and almost 73% spent more than two hours. In contrast, 56% of residents spent less than two hours in direct patient care and 45% spent less than 90 minutes. Residents spent additional time on the EMR after duty-hours with 42% spending more than one hour. Primary-care residents spent significant time on the EMR after duty hours as compared to non primary-care residents (p=0.036). Residents who spent more time on the EMR during the work were more likely to spend time on the

EMR after the work and less likely to spend time reading; 52% of residents spending more than two hours on the EMR during the work-day spent more than 60 minutes on the EMR after work as compared to 15.8% of residents spending less than two hours ($p<0.001$). 66% of residents spending more than two hours on the EMR during work spent less than 30 minutes reading as compared to 44.7% of residents spending less than two hours ($p=0.023$). 81% of residents spending more than one hour on the EMR after work spent less than 45 minutes for reading as compared to 63.8% of residents spending less than one hour ($p=0.027$). Residents spending more than two
hours on the EMR perceived that use of the EMR decreased efficiency ($p=0.021$) and did not contribute to education as compared to those spending less than two hours ($p=0.028$).
CONCLUSIONS: Residents spent considerable time on the EMR impacting time for reading and other activities. It is unclear whether time spent on the EMR after duty-hours should be included in duty-hour computations. The impact of the EMR on resident education needs to be further studied.

IMPACT OF USING ADMINISTRATIVE VS. CHART-ABSTRACTED DATA ON CALCULATIONS OF FINANCIAL INCENTIVES FOR HEALTH CARE PROVIDERS IN A PAY-FOR-PERFORMANCE PROGRAM

Laura A. Petersen; Tracy Urech; Kate Simpson; LeChauncy D. Woodard; Salim S. Virani; Mark Kuebeler; Meghan Lutschg. Michael E. DeBakey VA Medical Center HSR&D Center of Excellence and Baylor College of Medicine, Houston, TX. (Control ID #1338522)

BACKGROUND: Pay-for-performance programs often rely on claims and other administrative data sources, but it is not clear whether these data accurately reflect information contained in patients medical records. To evaluate the impact of using administrative data on the calculation of financial incentives in a study of pay for performance, we compared the calculation of financial incentives based upon administrative data with calculations using data collected via chart review to reward use of guideline-recommended antihypertensive medications.
METHODS: Trained abstractors collected data from VA medical records reflecting care provided to hypertensive patients between April and July 2009. The same data elements were collected from administrative data, including patients comorbidities that impact drug regimens, current antihypertensive medications, and medication allergies or contraindications. Two clinicians, an internist and a cardiologist, independently reviewed procedure and diagnosis codes (ICD-9-CM and CPT) for conditions identified as compelling indications by JNC 7 guidelines for hypertension treatment: diabetes mellitus, chronic kidney disease, unstable angina, myocardial infarction, ischemic heart disease, and nephropathy. We also reviewed diagnoses codes to identify contraindications to certain therapies, e.g., angioedema. When possible, we supplemented diagnoses and procedure codes with laboratory data to identify certain conditions (e.g., diabetes). We identified clinically relevant allergy information and vital sign data from the VA Corporate Data Warehouse (one of the administrative data sources). Using these data, we determined whether or not a patients antihypertensive medication regimen was consistent with JNC 7 guidelines.
RESULTS: 2834 of 2840 patients (99.8%) were eligible for evaluation in the administrative data. Comparing the chart abstracted and administrative data, 84.4% of patients had the same comorbidity history for the 6 conditions examined. Agreement was highest for diabetes (kappa=0.92) and lowest for unstable angina (kappa=0.38). In the medical record data,72.3% of patients received guideline-recommended medications compared to only 62.7% in the administrative data. Over half (55.6%) were identified in both sources (kappa=0.46). Among the patients with the same comorbidity history in both data sources (n=2391), chart abstracted data showed that 71.9% received appropriate medications while administrative data identified 63.1% of patients (kappa=0.51). Overall, incentive earnings decreased by an average of $28.37 (SD=$33.68) (11.6% [SD=9.9%]) for the 85 health care personnel when we calculated payments using only administrative data. Compared to the payments providers received in the study, seventy-nine (92.9%) providers would have received less money, three (3.5%) would have received the same amount, and three (3.5%) would have earned

more money.
CONCLUSIONS: We found moderate agreement for use of guideline-recommended antihypertensive medications when we compared abstracted data from medical records to data in VA administrative sources. Overall, incentive payments decreased by an average of 11.6% when evaluating providers performance using only administrative data. Given the resources and time needed to abstract medical record data, quality initiatives implementing pay for performance should consider using administrative and claims data to evaluate provider performance.

IMPACT ON LENGTH OF STAY AND COSTS IN PATIENTS ADMITTED TO AN OBSERVATION UNIT WITH CHEST PAIN, SYNCOPE AND ABDOMINAL PAIN Aziz Ansari; Elizabeth Schulwolf. Loyola University Medical Center, Maywood, IL. (Control ID #1339798)
BACKGROUND: Hospitals are focusing more on patient admission status as inpatient or observation due to changes in reimbursement and increased scrutiny from regulatory agencies. Observation units allow for more efficient and appropriate care for patients admitted under observation status. Implementation of these units may decrease resource utilization, length of stay (LOS) and costs.
METHODS: We compared data of patients admitted under observation status either to the general floor in Quarter 4 of 2009 or to the observation unit in Quarter 4 of 2010. The data was obtained from our administrative database and included primary diagnosis, LOS and total charges. We excluded patients who were classified as inpatient at any time during the admission, regardless of the patients length of stay. All patients were cared for by a hospitalist. Patient cohorts were compared overall and then by primary diagnosis: chest pain, syncope and abdominal pain. Continuous variables were compared using the Students t-test. Dichotomous variables were compared using the chi-square test. All data was analyzed using Stata 11, College Station, TX and Microsoft Excel.
RESULTS: The overall mean LOS significantly decreased in the OBS unit(19.04 hours vs. 29.55 hours, $P<0.001$). Overall mean total charges also significantly decreased ($7,230 vs. $8,709, $P<0.001$). The percentage of patients staying beyond 24 hours was reduced from 42.9% baseline to21.9% post implementation of the OBS unit ($P<0.001$). In chest pain patients, significant decreases were seen in LOS (17.92 hours vs. 26.71 hours, $P<0.001$) and total charges ($7,157 vs. $8,920, $P<0.001$). Significantly fewer patients were hospitalized for more than 24 hours(19.5 % vs. 35.7%, $P<0.001$). In syncope patients, LOS for patients admitted to the OBS unit significantly decreased (23.00 hours vs. 43.44 hours, $P<0.05$). There was no significant difference in total charges but a significantly lower proportion were hospitalized for more than 24 hours(28.7% vs. 66.6%, $P=0.003$). In abdominal pain patients, no statistically significant differences were seen any in of the metrics. Readmission rates were negligible both pre and post implementation.
CONCLUSIONS: There was an improvement in overall LOS, total charges and percentage of patients staying longer than 24 hours. In subgroup analyses, patients admitted with chest pain or syncope had a significant reduction in all metrics. The lack of effect in abdominal pain patients is likely due to small sample size and variability in clinical presentation and evaluation needs. Our comparison shows that implementation of an observation unit improves key metrics in hospital efficiency without affecting readmission rates. Additional studies are needed to assess other metrics such as patient satisfaction, ER throughput of patients admitted to the observation unit, effects of incorporating case managers into the triaging process to determine admission classification, and the use of standardized clinical protocols.
IMPLEMENTATION OF A PHARMACIST-MANAGED TELEPHONIC HOSPITAL DISCHARGE FOLLOW-UP PROGRAM Sarah L. Anderson1,3; Joel C. Marrs1,3; Joseph P. Vande Griend1; Rebecca Hanratty2,4. 1University of Colorado Skaggs School of Pharmacy and Pharmaceutical Sciences, Aurora, CO; 2Denver

Health Medical Center, Denver, CO; 3Denver Health Medical Center, Denver, CO;
4University of Colorado School of Medicine, Denver, CO. (Control ID #1340091)
BACKGROUND: The early post-hospital discharge time period can be wrought with patient confusion and potential for medication errors, potentially resulting in patient harm and/or unnecessary 30-day readmissions. Low income and minority patients may be at higher risk for hospital readmission. Because of their intricate knowledge of medications, pharmacists are well-positioned to assist patients during this transitional period with medication-related questions and problems and prioritization of post-hospital discharge follow-up appointments. In this study we conducted a retrospective observational cohort analysis to determine the rates of attendance at post-hospital discharge follow-up appointments and 30-
day readmissions in patients who were successfully contacted and intervened upon by a Clinical Pharmacy Specialist via telephone within 48 to 96 hours post-discharge compared to rates in those patients unable to be contacted.
METHODS: Adult patients who were discharged from a safety-net hospital between July 1, 2010 and June 30, 2011 and were included in the hospital discharge follow-up quality improvement initiative at a community health center for underserved populations were included in this retrospective observational cohort study. Patients were categorized into one of two cohorts: 1) those who were successfully contacted and2) those who received a voice message or were unable to be contacted.
RESULTS: Clinical Pharmacy Specialists attempted to contact 470 patients within 48 to 96 hours of hospital discharge. Of those, 207 were successfully contacted and intervened upon (Group 1), 112 were left voice messages and 151 were unable to be contacted (Group 2). Of those patients with scheduled follow-up appointments at time of discharge, those in Group 1 were more likely to attend their follow-up appointments (104 attended, 40 unattended) than those in Group 2 (92 attended, 63 unattended; p=0.03). Similarly, patients who did not have scheduled follow-up were more likely to schedule and attend a visit with their Primary Care Physician within 30 days of discharge if they were in Group 1 (36 attended, 27 unattended) compared to those in Group 2 (28 attended, 84 unattended; p<0.0001). Patients who were contacted had lower rates of 30-day readmission (25 readmissions [12%]) compared to those who were not (53 readmissions [20%]; p=0.03). The reduction in readmissions represents a potential savings of over $300,000.
CONCLUSIONS: Clinical pharmacists in the ambulatory care setting are well-positioned to improve patient transitions of care from the inpatient to outpatient setting based on their extensive medication knowledge and ties to the patients clinic care in a county health system. Telephonic intervention by a Clinical Pharmacy Specialist in the early post-discharge time period increased patient attendance at post-hospital discharge follow-up appointments and resulted in a lower 30-day hospital readmission rate compared to patients who were left voice messages or were unable to be contacted. Because such advantages have both positive clinical and financial impact, institutions should consider allocating resources for pharmacist-managed post-hospital discharge follow-up services.
IMPLEMENTATION OF AN ELECTRONIC HEALTH-RECORD-BASED TOBACCO CARE MANAGEMENT SYSTEM FOR IMPROVING TREATMENT IN PRIMARY CARE Gina R. Kruse1,2; Jennifer H. Kelley4,1; Jeffrey A. Linder3,2; Elyse R. Park6,5; Nancy A. Rigotti4,2.
1Massachusetts General Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Brigham and Womens Hospital, Boston, MA; 4Massachusetts General Hospital, Boston, MA; 5Massachusetts General Hospital, Boston, MA; 6Massachusetts General Hospital, Boston, MA. (Control ID #1312192)
BACKGROUND: Effective treatments for tobacco cessation are under-used in primary care. Using principles of chronic disease management, we designed and implemented a novel Tobacco Care Management system to improve the delivery of tobacco treatment at primary care visits. It used the electronic health record (EHR) and team-based care coordination to link smokers to treatment without increasing the burden on primary care providers (PCPs). We assessed the systems feasibility and acceptability to patients and to PCPs.

METHODS: At 2 community health centers affiliated with a Boston, MA, health care system, we added a 1-click referral functionality to the EHR. It gave PCPs an easy way to refer smokers to a centrally-located tobacco treatment coordinator (TTC). The TTC called smokers referred from both health centers to counsel and connect them to local specialty tobacco services and the state quitline. The TTC reported back to PCPs after each referral and was available for their inquiries. We evaluated the implementation of the system over 18 months with a mixed-methods design. Using TTC and EHR records, we measured PCPs utilization of the referral function and the proportion of smokers connected to treatment. At 2 semi-structured focus groups (n=24), we elicited PCPs reasons for using the

system, barriers to use, expectations of the referral, and experience with real-time feedback. Two coders independently conducted content analyses of focus group transcripts.

RESULTS: From 2/1/10-7/31/11, 33 (92%) of 36 PCPs used the functionality, generating 466 referrals for 422 unique patients (15% of 2,894 total smokers seen in the health centers during the study period, 42 patients were referred2 times). The health centers differed in the race/ethnicity and insurance status of smokers, but within each center there was no difference between smokers who were and were not referred. The TTC reached 246 smokers (58% of 422 referred smokers) by telephone and connected 133 (32% of those referred) to further treatment. At 1 center, the clinic leader spontaneously sent PCPs monthly feedback about their utilization compared to their peers. This center generated 79% of the referrals, and in focus groups PCPs identified this feedback as a motivator for using the system. Other themes that emerged were appreciation of (1) the simplicity of the 1-click function, (2) the easy access to up-to-date tobacco resources, and(3) a time-efficient means of addressing smoking in addition to their own efforts. PCPs were discouraged when the TTC was unable to reach the smokers they had referred and wanted information about the quit rates of referred smokers. They collectively supported continuation of the system.

CONCLUSIONS: A novel EHR-based Tobacco Care Management system was adopted by PCPs, especially those who received regular performance feedback, and successfully connected one-third of referred smokers to tobacco treatment resources. It is a promising, time-efficient model for improving tobacco treatment in primary care. The integrated design with a system-wide care coordinator has the potential for adoption by patient-centered medical homes and is scalable to multiple clinics within a healthcare system.

IMPROVEMENTS IN DIABETES QUALITY OVER TIME ARE ASSOCIATED WITH DIFFERENCES IN PAYER MIX, TEACHING STATUS, AND THE PRESENCE OF DIABETES PERSONNEL IN A LARGE URBAN AMBULATORY NETWORK Calie Santana; James Grigg; Yuming Ning. Montefiore Medical Center, Bronx, NY. (Control ID #1337375)

BACKGROUND: Although policies like Accountable Care Organizations encourage integrated networks, the performance of these networks in diabetes care for vulnerable populations has not been studied. Previously, we studied an established, 20-site integrated network in NY. We found significant cross-sectional differences among sites, associated with site payer mix and presence of residents (teaching), but not presence of diabetes personnel like nutritionists and care managers. We now sought to measure whether these site characteristics are associated with improvements in diabetes quality over time. We hypothesized that commercial insurance-predominant and teaching sites would improve over time, while those with diabetes personnel would not.

METHODS: Our study population included adults with diabetes (by ICD9, HbA1c6.5, or problem list) seen in both 2008 and 2010 (twice/year). Diabetes quality outcomes were: (1) HbA1c8%, (2) LDL100, (3) microalbumin checked once, (4) blood pressure (BP) 130/80, and (5) BP 140/90 based on the last value for 2008 and 2010. Payer mix was the payer for 60% of patients (commercial or government-sponsored). Presence of residents, and diabetes personnel was gathered from a survey of site medical directors. Payer mix and teaching status were combined (commercial/nonteaching, n=10; government/teaching, n=5; and government/nonteaching, n=5) due to the relationship between payer and being seen at a teaching site. Four sites had nutritionists and 11 had

care managers at least half-time. We measured the association between each independent variable and our main dependent variable (site percentage of each outcome met in 2010 minus the 2008 percentage) using a 2-level mixed effects logistic regression with sites as random effects. This technique accounts for clustering of patients within sites when using patient-level outcomes and site-level independent variables. Models were adjusted for patient age, sex, race/ethnicity and insurance.
RESULTS: Our analysis included 13,001 patients. A significant association was found between improvement in 2 of 5 outcomes and payer mix/teaching status. Commercial/nonteaching and government/teaching sites were significantly more likely to improve over time than government/non-teaching sites in microalbumin checks (OR 1.89 and 1.41, $p<0.001$) and BP130/80 (OR 1.75 and 1.40, $p<0.005$). There was no improvement in the other measures of diabetes quality. The association of diabetes quality and the presence of nutritionists or of care managers followed an identical pattern, with significant improvements in microalbumin checks and BP control.
CONCLUSIONS: Contrary to our previous findings, we found that both site characteristics like payer mix and teaching status, and diabetes personnel are associated with significant improvements in diabetes quality over time. Since personnel are a modifiable site characteristic, adding them might help alleviate differences in diabetes quality over time in our ambulatory network. We still observe that sites where government insurance predominates and no residents perform worse than other sites, even in this centrally managed network. Additional patient-level factors (e.g.adherence) and site resources (improvement activities) likely still play a role in diabetes quality. Although the promise of system integration is driving policy changes, we must continue to carefully identify and promote workforce and other changes beyond integration that can promote quality in vulnerable populations.
IMPROVING COMPLIANCE WITH CDC RECOMMENDATIONS REGARDING PRENATAL VITAMIN ADVICE IN AN INTERNAL MEDICINE RESIDENT-RUN CONTINUITY CLINIC Taral Jobanputra; Christina Gulotta; Sunil Asnani; Michael P. Carson. Jersey Shore University Medical Center, Neptune, NJ. (Control ID #1331613)
BACKGROUND: Prenatal vitamins (PNV) with 400mcg folic acid can decrease the rate of neural tube defects when taken before pregnancy. 50% of the pregnancies in the U.S are unplanned, so women of childbearing age should be advised to use PNV. We determined the historical rate of PNV usage or recommendations in our medical clinic, then developed a tool to increase those rates. The primary outcomes were the rates at which the tool was used and documentation of advice regarding use of PNV or Family Planning.
METHODS: Retrospective chart review of women aged 18-45 seen in the continuity clinic in 2008. Hysterectomy (TAH), tubal ligation (TL), IUD, and oral contraceptive use (OCP) status were noted. A checkbox prompt was added to the progress note: "Is Prenatal Vitamin Indicated? Yes/No". The form was introduced and the staff oriented in December 2010. Women with TAH or TL were considered to be surgically sterilized. Chart review was repeated in May 2011.
RESULTS: PRE-INTERVENTION: 77 charts were reviewed, 9% were on PNV. 10% of the 59 women who did not have a prior TAH or TL took a PNV. Discussions regarding pregnancy (FIGURE) were documented in 17% of the total cohort, and 22% of the women who did not have TAH/TL. No notes had documentation regarding advice to use PNV. POST-INTERVENTION: 42 of 92 (46%) notes had the PNV prompt checked. FIGURE: The rate of documentation regarding PNV use (Striped Columns) rose from zero to 12% among the total cohort (chi2 $p=0.0017$), and by 16% for those surgically sterilized. The Black Columns show Family Planning discussions. Documentation regarding PNV use OR Family Planning (White Columns) was 25% for the entire cohort, and 29% among those not surgically sterilized. Advice regarding PNV/Family planning was documented for 23% of those with the box checked, and 26% of those without it. PNV use was 9%. The second review was not timed to detect an increase in PNV usage.
CONCLUSIONS: The simple prompt on the progress notes was associated with a significant increase in the rate of documentation regarding PNV advice, regardless of box check status, and a more modest 7-8% increase regarding use of PNV OR Family Planning. The first clinical goal was to change behavior by increasing

awareness among all women of childbearing age, not just those on birth control. Provider awareness increased, but only 46% of the PNV prompts were checked. This information will be fed back to the medical staff, and consideration given to a systems based approach such as adding additional prompts to the "Plan" section of the progress notes, in order

to increase compliance with this evidence based intervention with proven benefit.
IMPROVING PARTNER NOTIFICATION: A QUALITATIVE STUDY OF MEDICAL CASE MANAGERS, DISEASE INTERVENTION SPECIALISTS AND MEN WHO HAVE SEX WITH MEN E. J. Edelman1,2; Christopher A. Cole3; Wanda Richardson4; Nicholas Boshnack3; Marjorie S. Rosenthal1,5. 1Yale University, New Haven, CT; 2Yale University, New Haven, CT; 3AIDS Project New Haven, New Haven, CT;
4CT Department of Public Health, Hartford, CT; 5Yale University, New Haven, CT. (Control ID #1339674)
BACKGROUND: Approximately 21% of HIV infected individuals are unaware of their status. Partner notification, or contact tracing, is the strategy whereby partners are notified of a potential exposure to a particular disease, including HIV. Notably, the rate of newly diagnosed infections among tested partners ranges from 10-30%. Partner notification, however, is limited by suboptimal referral rates and difficulty eliciting partner names and contact information, particularly from men who have sex with men (MSM). To identify opportunities to improve partner notification for MSM, we explored the perspectives and experiences of medical case managers, state public health authorities responsible for partner notification known as Disease Intervention Specialists (DIS), and MSM.
METHODS: In partnership with the Connecticut Department of Public Health and AIDS Project New Haven, we used a community-based participatory research approach to conduct a qualitative study of the perspectives and experiences of partner notification. The in-depth interviews and focus group were audio-recorded and professionally transcribed. Our multi-disciplinary, academic/community-based research team analyzed the transcripts using grounded theory and the constant comparative method. We determined sample size at the point we reached thematic saturation. RESULTS: We conducted 21 in-depth interviews (seven DIS and 17 MSM) and one focus group (14 medical case managers). We identified four domains which hinder the implementation of partner notification for MSM, including:1.) client-based, such as concerns about confidentiality; shame about both HIV and sexuality; and fears of partner rejection; 2.) relationship-based, such as need to have a trusting relationship before discussing notification; sense of need to manage crisis intervention vs. prevention; 3.) structurally-based, such as availability of clinic appointments for follow-up testing; and 4.) knowledge-based, such as lack of knowledge about the referral process among health care providers and lack of knowledge online social networking among state public health authorities.
CONCLUSIONS: Through a community-based participatory research process, we found multiple opportunities for developing interventions that may improve partner notification for HIV among MSM. Through our multi-disciplinary team, we plan to translate our findings into systematic changes. As the National HIV/AIDS Strategy and routine HIV testing becomes implemented, health care providers, including Generalists, will have the opportunity to lead and participate in these changes.
IMPROVING A MEDICAL STUDENT EBM CURRICULUM WITH A WEB-BASED EDUCATIONAL PRESCRIPTION David Feldstein1; Craig A. Umscheid3; Matthew Maenner2; Mark A. Albanese2.
1University of Wisconsin School of Medicine and Public Health, Madison, WI; 2University of Wisconsin - Madison, Madison, WI;
3University of Pennsylvania Medical School, Philadelphia, PA. (Control ID #1320177)
BACKGROUND: The AAMC requires that medical students apply the principles of Evidence-based Medicine (EBM) to patient care as part of the Learning Objectives for Medical Student Education. Integrating EBM

teaching into clinical care improves learners skills. The objective of this study is to evaluate the feasibility and impact of integrating a web-based, EBM educational prescription (EP) into clinical clerkships. METHODS: The study was performed over one year at the University of Pennsylvania School of Medicine. Third year medical students completed EPs on questions arising from clinical care on their Internal Medicine, Family Medicine and Pediatrics clerkships. The web-based EP was developed to guide learners through the steps of EBM to answer patient care questions including describing a clinical question, documenting a search strategy, analyzing the quality of evidence found, reporting the results, and describing how to apply the evidence to their individual patients. EP results were evaluated using a web-based form by physician fellows in a Masters of Clinical Epidemiology program. EPs were graded on: 1) question formation; 2) searching; 3) evaluation of evidence; 4) application to patient; and 5) overall competence. Each area was scored on a scale of 1 (not yet competent) to 9 (superior) using an integrated grading rubric. Time to complete and grade EPs, and whether the EP changed patient care were recorded with each EP. Students and fellows completed end of study questionnaires about their attitudes toward the EP and barriers to its use. Student change in EP scores over time was evaluated using a mixed-model regression controlling for within-person effects.
RESULTS: 166 students completed 541 EPs (mean 3.3 EPs). The majority of EPs (73%) involved a question about therapy. Twenty three fellows graded 523 of the EPs (mean 22.7 EPs). Students average overall competency score was 7.36 (SD 1.57). The change in overall score over one year was 1.26 points (95% CI: 0.79 - 1.73). Students took a median of 90 minutes (IQR 60-120) to complete EPs and fellows took a median of 20 minutes (IQR 15-30) to grade EPs. The EPs changed patients treatment plans or would have changed the treatment plan if they had the information sooner 19% of the time. Seventy three students (44%) and 86% of fellows completed end of study surveys. Forty one (56%) students reported they received adequate instruction on using the EP and 30 (41%) described the EP as a valuable experience. Students most frequently cited barriers to using the EP included time (34%), personal attitude toward EBM (27%), and comfort evaluating the quality of evidence (21%). Fellows only commonly cited barrier to grading was time (79%). CONCLUSIONS: This represents the first study of the EP in medical students, which was previously evaluated in Internal Medicine residents. The EP was easily incorporated into medical student clerkships. Performing EPs effected patient care and student scores increased significantly over the year. However, students reported inadequate instruction on how to perform EPs and the majority did not feel that it was valuable. Time and student attitudes were major barriers. Increased student training and further assessment of barriers are necessary to improve the students experience. We will expand the results of this study to include analysis of the validity of the EP as an evaluation tool in students, as well as the impact of the EP on EBM skills.
IMPROVING THE EFFICIENCY OF BLOOD PRESSURE TREATMENT WITH BENEFIT-BASED DECISION-MAKING Jeremy Sussman1,2; Sandeep Vijan2,3; Rodney A. Hayward1,3. 1University of Michigan, Ann Arbor, MI; 2Ann Arbor Veterans Affairs Hospital, Ann Arbor, MI; 3University of Michigan, Ann Arbor, MI. (Control ID #1339911)
BACKGROUND: Current guidelines for blood pressure (BP) medication use, such as the Joint National Committee (JNC 7), focus on

achieving BP targets with limited attention to the effectiveness of medications in reducing cardiovascular (CV) events. Since many factors beyond BP, such as cardiac risk, influence the chance that BP treatment will prevent a CV event, we hypothesized that BP treatment could be made more efficient. We developed a BP treatment strategy based on an individualized estimate of the expected benefit of advancing BP treatment (tailored treatment) and compared it with JNC 7 guidelines.
METHODS: We developed a data-driven Monte Carlo simulation model to estimate the clinical implications of each strategy. Model inputs were drawn from nationally representative CVD risk factor data, randomized studies of blood pressure reduction, and CVD outcome data. We used a society perspective to assess the benefits of

each strategy - the JNC 7 guidelines and the tailored treatment strategy that we developed on a representative population of U.S. adults aged 30 to 75 years with no history of CV disease (primary prevention). Our primary outcome measure was lifetime change in quality-adjusted life-years (QALYs) for 5 years of treatment by the JNC7 vs. the tailored treatment regimens. We also examined the implications of these different strategies on representative individuals.
RESULTS: Compared with the standard JNC 7 regimen, the tailored treatment approach is more efficient. Using JNC 7 guidelines 42% of adults aged 30-74 would receive BP medications (mean number of BP medications per patient treated=2.27) compared to 38% treated with a mean of 2.24 BP medications for tailored treatment. In spite of treating fewer people and using fewer BP medications, tailored treatment prevented 300,000 more major CV events than following JNC 7, an almost 20% gain in relative effectiveness. Treatment by JNC 7 guidelines would save 260 QALYs per 1000 persons treated, while tailored treatment would save 300 QALYs per 1000 persons treated. Tailored treatment had greater efficiency due to treating higher CV risk patients more intensively and lower CV risk patients less intensively, particularly people with known cardiac risk factors, such as smokers. The greater efficiency of tailored treatment was generally robust to broad variations in model assumptions in our sensitivity analyses.
CONCLUSIONS: Compared to the traditional treat-to-target approach to hypertension therapy, tailored treatment has the potential to prevent more CVD events while limiting polypharmacy, treatment side effects, and costs. Prevention of CVD can be made more efficient and effective by basing BP treatment decisions on a patient's estimated CV event reduction, rather than purely on a patient's BP level.
IMPROVING THE STATE OF QUALITY MEASUREMENT: LESSONS FROM DOWN UNDER Sangeeta Ahluwalia. Veterans Administration Greater Los Angeles, Los Angeles, CA. (Control ID #1326627)
BACKGROUND: Quality problems in todays healthcare system are widely manifest, and a major thrust of recent reform has been to develop and implement better signals of quality to guide purchasers and users of care. However, how should quality indicators be optimally implemented to guide improvement? How can signals of quality be appropriately linked with resources for improvement to maximize their impact? We evaluated these questions across multiple levels of the healthcare system to better understand the individual and organizational factors that facilitate or hinder quality measure implementation and to inform policy, programmatic, and clinical efforts in the Australian and United States healthcare systems to improve the quality of care.
METHODS: We conducted semi-structured in-depth interviews with 35 clinicians, senior government officials, and agency managers across the scope and levels of the cancer care system in Australia and representing a wide range of organizations (n=27) with responsibility for care delivery and policy-making in the cancer field within national and regional government, area health services, practice management organizations, hospital systems and individual practice units. Interviews were audio-taped, transcribed and analyzed according to qualitative content analysis methods.
RESULTS: We identified several factors associated with quality measure implementation. Identified barriers included: the complexity of managing multiple sources of information regarding care quality; difficulties in coordinating quality measurement efforts across practice units; difficulty coordinating patient-provider activities necessary for quality measurement such as follow-up, tracking, and monitoring, and the lack of clinician support for quality measurement activities. Identified facilitators included: having a robust informatics infrastructure, especially care registries and point-of-care decision support; utilizing regional provider-led quality improvement groups to track performance and train clinicians within individual practice units, and employing various policy levers, such as linking accreditation to quality improvement efforts, shifting reimbursement for quality improvement from the practice level to the individual clinician, and providing financial incentives for having relevant policies and processes in place.
CONCLUSIONS: Several immediate opportunities for improving quality measurement efforts exist. Working with clinicians from the outset to develop and implement quality measures can assure buy-in and a clinically

meaningful measurement process. A robust informatics system is key to supporting provider efforts to improve quality, by providing clinical decision support, facilitating tracking and monitoring activities, managing multiple sources of information, and coordinating patient-provider interactions. Finally, financial incentives targeted towards specific efforts supportive of quality measurement, such as having a care registry in place, or towards specific clinicians, rather than broadly disseminated, can foster more sustainable and enduring quality improvement efforts.

INADEQUATE UNDERSTANDING OF CODE STATUS IMPROVED BY CASE-BASED LEARNING Aroonsiri Sangarlangkarn1;
Margaret Drickamer2. 1Yale School of Medicine, New Haven, CT; 2Yale School of Medicine, New Haven, CT. (Control ID #1310190)

BACKGROUND: Multiple studies demonstrate continued deficiencies in physicians education on end-of-life care. However, there is limited literature on whether healthcare providers have an adequate understanding of DNR/ DNI, which is essential in end-of-life care and discussion. Our study evaluates the understanding of DNR/DNI among physicians in training and the efficacy of case-based learning in code status education.

METHODS: From September-October 2011, we surveyed medical students and residents at noon conferences during internal medicine rotations at Yale School of Medicine, before and after a course on challenging end-of-life cases that provide clinical applications of DNR/ DNI. Constructed using the same standards as the nationally utilized Yale Office-Based Medicine Curriculum, the course focused on DNI/not DNR patients, reversibility of code status, and futility of care. The exact Mcnemar test was used to evaluate changes in responses.

RESULTS: Results from 44 surveys are shown in attached image. Figure 1 demonstrated that a significant number of participants would provide contraindicated interventions to coding DNR patients. Figure 2 demonstrated that while none of the participants would intubate DNI patients, many failed to offer manual lung inflation to DNI patients in respiratory distress. After the course, participants were 9 times more likely to correctly forego amiodarone in coding DNR patients (p=0.02), and 11 times more likely to correctly offer ambu-bag in DNI patients (p=0.01). When asked if participants possess adequate understanding of DNR/DNI on a scale of 1 (disagree) to 5 (agree), there was a 0.93 point increase after the course (before=3.26, after=4.19, p=0.00). While 7% of the participants feel neutral, 93% would recommend the course to others.

CONCLUSIONS: Surveys showed that many participants would provide contraindicated interventions to coding DNR patients while failing to offer appropriate interventions to DNI patients. After the course, more participants reported having an adequate understanding of DNR/DNI. A significant number correctly withheld antiarrhythmics in coding DNR patients and appropriately offered manual lung inflation to DNI patients. Our study showed that physicians in training may benefit from code status education, particularly case-based

learning which may improve their understanding of DNR/DNI and the quality of end-of-life discussion.

INCARCERATION HISTORY AND CHRONIC DISEASE MANAGEMENT AMONG NEW YORK CITY ADULTS Joseph Frank1; Emily Wang2; Heather J. Baer1; LeRoi Hicks3. 1Brigham and Women's Hospital, Boston, MA; 2Yale School of Medicine, New Haven, CT; 3UMass Memorial Medical Center, Worcester, MA. (Control ID #1334523)

BACKGROUND: Individuals with a history of incarceration have disproportionately higher rates of chronic disease and lower rates of community health care. A better understanding of chronic disease management among ex-prisoners is important given the imminent expansion of health insurance coverage in this population.

METHODS: We used data from the New York City Health and Nutrition Examination Survey (NYC HANES), a population-based, cross-sectional survey of adults20 years old. Among respondents with at least one of three common chronic disease diagnoses (diabetes (DM), hypertension (HTN) and hypercholesterolemia), we

examined the association between self-reported prior incarceration and three disease management outcomes:1) disease control (defined as HgbA1c<7%, blood pressure<140/90 and LDL<160 mg/dL), 2) healthcare utilization (self-reported number of healthcare visits in the prior year) and 3) access to primary care (self-report of either a regular site of primary care vs. no routine place of care or the Emergency Department as the site of routine care). We used a multivariable binomial regression model to determine the odds of uncontrolled disease for each participant given their total number of diagnoses. We used multivariable logistic regression models to determine the odds of the utilization and access outcomes. All models adjusted for age, gender, race/ethnicity, insurance status, obesity, disability, tobacco, alcohol and drug use. Results were considered significant at p<0.05. RESULTS: Among 1701 survey respondents, 755 (44.4%) had at least one of three chronic disease diagnoses. 65 (8.6%) reported a history of incarceration. Individuals with a history of incarceration were significantly more likely to be male, Black, disabled, smokers and to report heavy alcohol and recent drug use. The proportion of respondents who were unaware of a chronic disease diagnosis (i.e. were diagnosed by survey testing) or had an untreated diagnosis did not differ significantly between the groups. 20.9% of all individuals with a chronic disease reported no routine place of care, 13.4% reported no healthcare visits in the prior year and 41.3% had at least one uncontrolled chronic disease. After adjustment, participants with a history of incarceration were significantly more likely to report having no routine place of care (OR 2.2, 95% CI 1.0-4.7) when
compared to participants without prior incarceration. Incarceration history was not significantly associated with rates of uncontrolled chronic disease diagnoses (OR 1.3, 95% CI 0.7-2.3) or with rates of no healthcare utilization in the prior year (OR 1.21, 95% CI 0.4-3.4). CONCLUSIONS: Our analysis of a population-based survey found that history of incarceration was significantly associated with poor access to primary care but not chronic disease control or rates of recent healthcare utilization. These findings suggest that individuals with a history of incarceration are more likely to receive their medical care in non-primary care settings such as the Emergency Department or correctional facilities. Efforts to capitalize on expanding insurance coverage among ex-prisoners must consider current care-seeking behaviors.

INCIDENCE OF VENOUS THROMBOEMBOLISM (VTE) AFTER BARIATRIC SURGERY: A POPULATION-BASED COHORT STUDY David A. Froehling; Paul Daniels; Karen F. Mauck; Scott Litin; Maria L. Collazo-Clavell; Tanya M. Petterson; Michael G. Sarr; John A. Heit. Mayo Clinic, Rochester, MN. (Control ID #1314877)

BACKGROUND: Bariatric surgery is considered a high VTE-risk operation, but the incidence of VTE after bariatric surgery is uncertain. In order to better estimate the incidence of symptomatic VTE after bariatric surgery, we carried out a retrospective population-based cohort study.

METHODS: Using the resources of the Rochester Epidemiology Project and a Mayo bariatric surgical database, we identified all Olmsted County, MN residents who underwent bariatric surgery and all residents with incident VTE over the 19-year period, 1987-2005; all discrepancies were resolved by direct review of the patient operative report. Using the dates of bariatric surgery and VTE events, we estimated the cumulative incidence of VTE after bariatric surgery using the Kaplan-Meier estimator with censoring at date of death or last follow-up, or 12/31/2005, whichever came first. The log-rank test and Cox proportional hazards model were used to test patient age at bariatric surgery and sex as potential predictors of VTE after bariatric surgery.

RESULTS: 404 residents (mean age of 43.8 years at first bariatric operation, SD=10.1 years, 80.5% women) underwent 410 bariatric operations. Unfractionated heparin (5000 units SubQ BID or TID) and external pneumatic compression for the duration of the postoperative

hospitalization were used routinely for thromboprophylaxis. Nine patients developed VTE within six months (seven within one month) after bariatric surgery. Three patients had only pulmonary emboli, two patients had both pulmonary emboli and deep vein thrombosis, and four patients had only deep vein thrombosis within six months after surgery. The cumulative incidence of VTE at 7, 30, 90, and 180 days after bariatric surgery

was0.3%, 1.8%, 2.1%, and 2.3%, respectively (180-day 95% CI: 0.8%, 3.8%). Seven VTE events occurred after hospital discharge. Patient age (but not sex) was a predictor of postoperative VTE (hazard ratio=2.10 per 10-year increase in age; 95% CI: 1.16, 3.83; p=0.015).
CONCLUSIONS: Compared to a mean 2.5% and 1.8% three-month cumulative incidence of VTE after total hip or knee replacement surgery, bariatric surgery is a high VTE-risk operation, especially among older patients. Because most VTE events occurred after hospital discharge, a trial of extended out-of-hospital thromboprophylaxis is warranted.
INCIDENCE OF POST-SURGICAL INFECTIONS AFTER LOW-RISK, SHORT-STAY SURGERIES PERFORMED IN AMBULATORY AND INPATIENT SETTINGS Claudia Steiner1; Pamela L. Owens3; Marguerite L. Barrett2. 1Agency for Healthcare Research and Quality, Rockville, MD; 2M.L. Barrett, Inc, Del Mar, CA; 3Consultant to AHRQ, Rockville, MD. (Control ID #1339423)
BACKGROUND: Healthcare-associated infections rank among the leading causes of death in the U.S. and are a growing public health concern. Limited information is available on post-surgical infections following short-stay surgeries. The objective of this study was to determine the incidence of post-surgical infections across a spectrum of low-risk procedures routinely performed in ambulatory surgery centers (ASCs) and short-stay (less than two days) hospitalizations.
METHODS: Surgical procedures across body systems, general and gender-specific (e.g., cholecystectomy, hernia repair, anterior cruciate ligament (ACL) repair, hysterectomy, and transurethral prostatectomy (TURP)) were selected. The study included patients from eight states (CA, FL, GA, HI, MO, NE, NY, TN) that participate in the Healthcare Cost and Utilization Project (HCUP). Surgeries were performed in hospital-owned ASCs or community hospitals between February and November 2009 in which the patient was discharged with no indication of infection. State Inpatient, Ambulatory Surgery, and Emergency Department Databases with verified, synthetic person identifiers were used to identify surgeries and track infections. Post-surgical 14- and 30-day rates per 1,000 surgeries were calculated for each surgery and setting. We differentiated the rates for directly-related surgical site infections (SSIs), such as wound infections, indirectly-related infections such as pneumonia, and post-surgical hospital care for any cause.
RESULTS: The rate of directly-related SSIs within 14 days per 1,000 ASC surgeries varied from 1.3 (laproscopic inguinal or femoral hernia repair) to9.7 (laproscopic incisional or abdominal hernia repair), while indirectly-related SSIs within 14 days ranged from 1.1 (ACL repair) to 21.3 (TURP). The average directly-related rate increased from 4.9 to 7.8 when the time frame was extended to 30 days; and the indirectly-related rate increased from 6.4 to 9.6. The average rate of all-cause, post-surgical hospital care per 1,000 ASC surgeries was 58.2 (14 days) and 88.8 (30 days) and included visits primarily for pain. Surgeries performed as a short-stay inpatient often resulted in the same or higher infection rates as those in an ASC.
CONCLUSIONS: This study provides baseline estimates of post-surgical infections following low-risk, short stay surgeries performed in ambulatory and inpatient settings. Although there is a range of rates across type of surgery, infection, and setting, the rates are relatively low, and much lower that the any-cause post-surgical hospital care. Inpatient hospitals with strict infection control standards did not demonstrate lower infection rates than ASCs. Further investigation is needed to determine whether inpatient cases were more complicated, and therefore, at higher risk of infection.
Post-Surgical Infection Rates per 1,000 ASC Surgeries
Surgical Procedure Directly-related SSI rate in first 14 days
Directly-related SSI rate in 30 days
Indirectly-related infection rate in first 14 days
Indirectly-related infection rate in 30 days
Cholecystectomy -
Laparoscopic

4.3 5.9 5.2 7.3
Hernia - Inguinal/ Femoral - Open
2.8 4.0 3.2 4.7
Hernia - Inguinal/
Femoral - Laparoscopic
1.3 3.2 3.0 4.2
Hernia - Incisional/
Abdominal - Open
7.8 16.7 4.9 7.7
Hernia - Incisional/
Abdominal -Laparoscopic
9.7 12.1 12.1 16.0
ACL Repair 3.7 6.8 1.1 1.7 Spine Surgery 4.0 8.1 3.7 6.1 Hysterectomy 7.3 9.4 9.0 13.7 TURP 2.4 3.5 21.3 35.1

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project.
INCREASE IN PREVALENCE OF NON-MEDICAL USE OF PRESCRIPTION OPIOIDS IN THE U.S., 2000-2009 William Becker; David A. Fiellin. Yale University School of Medicine, New Haven, CT. (Control ID #1339656)
BACKGROUND: Opioid prescribing increased markedly in the U.S. from 2000-2009, concurrent with leading healthcare organizations emphasis on assessment and treatment of pain and aggressive product marketing by pharmaceutical companies. This increase included a shift towards Drug Enforcement Agency (DEA) schedule II opioids, which are of higher potency and may increase risk for adverse consequences including dependence and overdose. We sought to describe changes in the prevalence of non-medical use of prescription opioids and prescription opioid abuse and/or dependence over the 10 years from 2000-2009.
METHODS: We analyzed data from the 2000 through 2009 annual waves of the National Survey on Drug Use and Health (NSDUH). For each of the ten years, we calculated the following demographic and clinical features among those who reported non-medical use of prescription opioids: mean age, proportion female, proportion non-white and proportion with self-reported good, very good or excellent health compared to fair or poor health. Next, for each of the ten years, we calculated the following outcomes related to prescription opioids: prevalence of past-year non-medical use and past-year abuse and/or dependence, mean age of first non-medical use, and prevalence of lifetime non-medical use of opioid classes (e.g. DEA schedule II) and individual opioids. We then compared sequential year-to-year pairs of demographic and clinical features and outcomes related to prescription opioids, using chi-square tests to compare proportions and t-tests to compare means.
RESULTS: The full analytic sample consisted of 557,282 individuals with approximately 55,000 individuals per year. From 2000 until 2009, the prevalence of past-year non-medical use of prescription opioids increased from 2.8% to 4.8% ($p<0.0001$). Among individuals with non-medical use of prescription opioids, mean age increased from 22.4 to 24.2 years ($p<.0001$). The proportion female decreased from 49.6% to 43.7% ($p=.02$) while the proportion non-white and the proportion reporting good, very good or excellent health did not change significantly across the 10 years. The prevalence of past-year prescription opioid abuse and/or dependence increased from 0.3% to 0.7% ($p<.0001$). Mean age of first use did not change. The prevalence of lifetime non-medical use of a DEA schedule II opioid increased from 42.3% to 48.3% ($p<0.0001$). The proportion of these respondents with any lifetime non-medical use of propoxyphene, codeine; hydrocodone; oxycodone; and controlled release oxycodone all increased.

CONCLUSIONS: Non-medical use of prescription opioids, lifetime non-medical use of DEA schedule II opioids and prescription opioid abuse and/ or dependence increased during 2000-2009, a period of increased prescribing of these medications.

INCREASING HIV TESTING IN PRIMARY CARE: OVERCOMING BARRIERS AND LESSONS LEARNED

Elana R. Sydney; Penelope Demas; Jason Leider. Jacobi Medical Center, Bronx, NY, NY. (Control ID #1320336)

BACKGROUND: Failure to diagnose HIV in a timely manner contributes to increased morbidity, mortality and high rates of transmission. CDC data support routine HIV testing in the primary care setting. According to the CDC, approximately 250,000 people are unaware that they are HIV infected. It is estimated that these unaware adults account disproportionately for 54% of new sexual transmissions. Clearly routine screening is crucial to the reduction of transmission. Despite these data, primary care physicians have reported multiple barriers to HIV testing: insufficient time, competing priorities, perceived burden of consenting requirements. Our goal was to test a model that would increase HIV screening in a busy medical clinic.

METHODS: The study site was an urban medical clinic with 300 patient visits per day. This pilot study had two phases conducted over four months during one weekly clinic session. In Phase I (4 weeks), all patients were offered testing by patient care assistants (PCA's) regardless of risk stratification. If the patient consented, they were brought to the HIV counselor prior to being seen by their physician and received pre and post test counseling. If patients did not consent, they were given a printed version of the 7 points of counseling mandated by NY State. The provider then met with the patient and assessed whether the patient was now willing to consent. In Phase II (11 weeks), all elements were the same except a pre-test counseling video replaced the written material. Patients watched a vignette where a patient interacted with their doctor and learned of the importance of HIV testing. The primary study end points were number of patients consenting to HIV testing in the pilot, and in the clinic as a whole. In addition, the role of PCAs, physicians, and educational materials (written vs. video) in obtaining consent was analyzed.

RESULTS: In phase I, a total of 32 patients were approached and 19 agreed to be tested (59%). Men=19% and Women=81%, Mean age=56, Hispanic 43%, AA34%, Caucasian 12%, other 11%. The PCA's consented 68% of the patients. An additional 6 patients, 32% that initially refused the PCA, consented to the MD after reading the 7 points. In phase II, a total of 66 patients were approached and 32 agreed to be tested (48%). Men=28% and Women=72%, Mean age=58, Hispanic 62%, AA 27%, other 11%. Of the 32 patients that consented, 17 (53%) consented to the PCA while an additional 15 (47%) that refused the PCA, consented to the MD after watching the video. In total, 51 patients agreed to HIV testing out of 98 patients approached. The PCA consented 28 (55%), while the MD was able to consent an additional 23 (45%) of the patients. Moreover, of the 70 patients who refused the PCA, the MD was able to change the mind of 22 patients (30%). Baseline testing rates in the ambulatory clinic were approximately 80 per month prior to the pilot study. At the end of the 4 months, testing rate of the patients rose 200% (275 tests per month). The pilot study increased awareness of HIV screening and led to an overall increase in the referral rate throughout the clinic.

CONCLUSIONS: Widespread screening in a busy urban clinic can be accomplished. Barriers to HIV testing can be improved by patient education through the addition of HIV screening videos, written material, and by assisting physicans in the consenting and counseling process with ancillary staff. The patient physician relationship is powerful in persuading patients to consent to HIV testing.

INFLUENCE OF HEALTH LITERACY ON DIABETES MELLITUS OUTCOMES

Daniel Goldsmith; Mushtaq Anis; Katia Dieguez Otero; Saba A. Hasan. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1337421)

BACKGROUND: Health Literacy is a measure of patients ability to read, comprehend, and act on medical information. Poor health literacy is common among diabetic patients and those with other chronic diseases, especially in racial and ethnic minorities and elderly persons. Little is known about the extent to which health

literacy affects clinical health outcomes. This study intends to examine the association between health literacy and clinical outcomes among patients with diabetes mellitus.
METHODS: This is a single-center observational study of 48 English and Spanish speaking adult patients, with either type 1 or type 2 diabetes mellitus. We identified our study group from the Internal Medicine Residency Programs continuity clinic patients. In 2009, a program of focused diabetic visits was instituted. At that time, patients baseline health literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM) and Short Assessment of Health Literacy for Spanish Adults (SAHLSA-50), and scored as either adequate or inadequate. Measures of diabetes control and other health risk parameters were collected retrospectively from these patients charts. The patients were then closely followed in focused diabetic visits, emphasizing patient education and counseling. Health literacy was then re-assessed along with diabetic parameters including glycohemoglobin, LDL, urine micro-albumin, blood pressure and BMI, and compared to data from the baseline assessment. Results were evaluated using the Pearson Chi-square test. RESULTS: The patients were 44% female and 56% male, and 45.8% Hispanic, 27% African-American, 20.8 % Caucasian, and 6.2% Asian. In the first assessment, 64.5% of patients had inadequate health literacy, but in the second assessment, 35.5% had inadequate health literacy, indicating that 31.2 % of patient improved their health literacy from inadequate to adequate. 35.5% of patients remained inadequate, and 33.3% were adequate in both assessments. In the group that improved health literacy, rates of achieving goal parameters improved with glycohemoglobin ($p<0.003$), LDL($p<0.003$), urine microalbumin($p<0.021$), and blood pressure ($p<0.012$). No improvements were observed in any parameter in the groups where health literacy remained unchanged. Also, BMI was unchanged in all groups.
CONCLUSIONS: Among our primary care patients with type 1 and 2 diabetes mellitus, improved control of diabetes and related parameters was associated with whether health literacy had improved over the study time. No improvement was seen in those whose health literacy remained static, even when that literacy was measured as adequate at both assessments. Our experience suggests that focused diabetic visits should be coupled with educational efforts to improve overall health literacy in order to maximize benefit.
INFLUENCE OF GENDER ROLE ATTITUDES IN SMOKING AND DRINKING AMONG GIRLS FROM JUJUY, ARGENTINA Raul Mejia. UCSF, San Francisco, CA. (Control ID #1324365)
BACKGROUND: Gender role is influenced by culture, temporal factors, traditions, expectations and assumptions. Ideas about gender roles and femininity may have a role in explaining differences in tobacco and alcohol consumption in adolescents. Objective: To evaluate the effect of gender role attitudes in smoking and drinking among mostly Indigenous girls from northwest Argentina.
METHODS: Self-reported data were obtained from a 2006 survey of tenth grade female students attending a random sample of 27 urban and rural schools in Jujuy Province. Questions about tobacco smoking and alcohol consumption were adapted from global youth surveys. We also constructed a scale to assess adolescents perception of traditional or egalitarian sex roles based on a comprehensive literature review. In formative work, the questionnaire was reviewed by a panel of experts in gender studies and administered to 10 adolescents during in-depth interviews to evaluate comprehension and face validity. The final scale consisted of 10 items with 5-point response options of agreement-disagreement scale where 1=strongly agree to 5=strongly disagree. Factor analysis of the item data suggested a 5 item factor with a Cronbach alpha of 0.72. These items asked about women staying at home to care for children, men working to earn a living for the family, women accepting mens decision if they disagree, women working outside the home leading to more crime by youth and the women belonging at home and not in a job. Responses

to the items that minimize sexual stereotypes reflected non-traditional/ egalitarian gender roles. In this study we hypothesized those girls who ascribe to more egalitarian gender roles have higher risk of ever or current smoking or drinking than those who ascribe to more traditional roles.

RESULTS: In 2006, 2,133 girls aged 13-18 responded, 71% identified as Indigenous, 22% as mixed indigenous/European, and 7% as European. Nearly 60% were ever smokers (ever tried or experimented with cigarette smoking), 32% were current smokers (in past 30 days), 58% were ever drinkers, 27% have drunk in the previous month, and 13% were heavy drinkers (had 5 or more drinks in past month). A logistic regression model was generated for each outcome using the gender role scale as the main predictor and adjusting for known confounders from these data (having any friends who smoke, having a job, repeating a grade in school, living with both parents, living with someone who smokes at home, depressive symptoms in previous year, worked in tobacco growing and/or selling, and smoking media literacy). Gender role was positively associated with significantly increased odds of ever smoking and ever drinking, drinking in the last month and heavy drinking.
CONCLUSIONS: Girls in Jujuy who ascribe to more egalitarian gender roles have greater chances of smoking or drinking than those who ascribe to more traditional ones.
Outcome Odds Ratio(OR)
OR Lower CL
OR Upper CL
P
Ever smoker (even a puff)
1.25 1.09 1.44 0.001
Current cigarette smoker (past 30 days)
1.17 0.99 1.39 0.056
Ever drink alcohol 1.24 1.10 1.40 <0.001 Drink an alcoholicbeverage in pastmonth?
1.21 1.07 1.37 0.002
Heavy drinking (5 drinks in past month)
1.15 1.00 1.33 0.049
INNOVATIVE CARE DELIVERY MODEL TO ADDRESS HEALTH DISPARITY IN UNDERSERVED POPULATION Nia S. Mitchell1,4;
David L. Washington5; James O. Hill2,3. 1University of Colorado, Aurora, CO; 2University of Colorado, Aurora, CO; 3University of Colorado, Aurora, CO; 4University of Colorado, Aurora, CO; 5Center for African American Health, Denver, CO. (Control ID #1340007)
BACKGROUND: African Americans are more likely to be overweight or obese compared to other racial/ethnic groups, and are subsequently more likely to be diagnosed with weight-related co-morbidities such as hypertension, diabetes, and cardiovascular disease. Based on the chronic care model, obesity may be effectively managed in a setting that combines self-management, patient education, and outreach utilizing the infrastructure of an existing community organization. The objective of this study is to describe the implementation and effectiveness of a community-based participatory research project that recruited African American subjects through a community organization to join a weight loss program and determine weight change after 12 weeks.
METHODS: The Senior Wellness Initiative and TOPS Collaboration for Health (SWITCH) study is a prospective analysis of the weight change of the individuals who were recruited through a community organization to join a weight loss program. Participants were recruited through the Senior Wellness Initiative (SWI), a community program designed to help older African Americans maintain their independence. SWI participants aged 50 and older with BMI25 were eligible to participate. Take Off Pounds Sensibly (TOPS)
is a national, peer-led weight loss program that has been shown to help participants lose 5% of their initial weight, which is clinically significant. Its program consists of weekly peer-led meetings where there is a private weigh-in followed by educational programming on nutrition, physical activity, and behavior modification. TOPS chapters were started at three SWI sitesa senior center, a senior residence for independent living, and a church.

Informational sessions were held at each site, and participants were
encouraged to invite others to attend. Weight change in kg was calculated as the average difference from the initial date of participation to week 12. For participants who were in the program for less than 12 weeks, their last weight measurement was carried forward. Weight change was also calculated as the percentage change from initial weight. Weight was subsequently categorized as weight loss or gain of 0 to 5% and 5%.
RESULTS: Sixty-six people attended the informational sessions, and 50 people joined the three TOPS chapters. The average age of participants was69.5 years (SD=8.2). Their average starting weight was 91.7 kg (SD=17.5) and the average baseline BMI was 34.7 kg/m2 (SD=6.4). The average weight change for all participants was 1.8 kg (SD=2.5), equal to 2.0% (SD=2.7) of initial weight. Almost 82% of participants lost weight during the 12 week period10% of all participants lost 5% or more and 71% lost between 0 and 5% of their initial weight.
CONCLUSIONS: This study suggests that integrating community organizations with effective self-management tools can help address health disparities. Using the infrastructure of a community organization, recruitment goals of a study in the African American community were met with only three informational sessions. Ten percent of the individuals who participated in the SWITCH program lost a clinically significant amount of weight, while a majority of participants either maintained their weight or lost a modest amount.
INSIGHTS FROM THE POWER PRACTICE-BASED WEIGHT LOSS TRIAL: A FOCUS GROUP STUDY ON THE PCPS ROLE IN WEIGHT MANAGEMENT Wendy L. Bennett; Kimberly Gudzune; Lawrence J. Appel; Jeanne Clark. The Johns Hopkins University, Baltimore, MD. (Control ID #1339591)
BACKGROUND: Despite the obesity epidemic, primary care providers (PCPs) infrequently engage in weight counseling due to lack of time and knowledge. The Practice-based Opportunities for Weight Reduction (POWER) Trial at Hopkins was a 3 arm, randomized trial that tested two behavioral weight loss interventions implemented as part of routine medical practice compared to usual care. POWER used external counselors to provide weight loss counseling, but still engaged the PCP unlike current commercial programs. This trial provided a unique opportunity to understand what PCPs perceived their role to be when a patient is enrolled in an external weight management program.
METHODS: During the summer of 2010, we conducted five focus groups of community-based PCPs who had at least 4 patients enrolled in POWER. Focus groups were moderated using a semi-structured guided, audio recorded and transcribed verbatim. Two investigators independently coded transcripts for thematic content using editing style analysis.
RESULTS: Of the 30 eligible PCPs, 26 participated in 1 of 5 focus groups. Mean years in practice were 16.4 (SD 11.7) and 77% practiced general internal medicine. We identified 5 themes (with illustrative quotations) related to PCPs role during the POWER weight management program. 1) Refer patients into the program and provide endorsement: I really pushed the patients that I hadcause I felt like it was something that I could do for them, whereas, normally, I dont have a lot becausenutritions not coveredSo this was something free and easy that I could encourage them to get involved in. 2) Have limited role in management: She did great. And she did it with the help of the coach, and not from any input from me. 3) Provide accountability for patients: You can drop out of Weight Watchers and nobody will know or carebut he's going back to his primary care physician. [Y]ou are adding a layer of accountability with the patient, which I think could potentially be important. 4) Cheerlead for patients successes during interval visits: And just trying to encourage them, to say, If you're heading in the right direction that's better than going backwards. 5) Maintain trust and support through the long-term relationship with patients despite ups and downs: I think one key may be just having a primary care doctor that you know for a while instead of switchingit helps to know someone for a while and to get into the head of your patient a little bit and get to have a comfort level with them. CONCLUSIONS: PCPs with patients in the POWER trial described themes related to their role in patients weight management, including program referral and endorsement, yet continuing long-term relationships

with patients, and cheerleading for their successes. Practice based weight loss programs have great potential to partner with PCPs to build upon the existing the patient-provider relationship to improve patient accountability and sustain behavior change.

INTEGRATED ANALYSIS OF EFFICACY OF A ONCE-DAILY GASTRORETENTIVE FORMULATION OF GABAPENTIN IN PATIENTS WITH POSTHERPETIC NEURALGIA WHO ARE AT LEAST 75 YEARS OLD

Daniel Kantor3; John T. Mathis1; Richard L. Rauck2; Gordon Irving4; Michael Sweeney1; Geertrui F. Vanhove1.
1Depomed Inc, Menlo Park, CA; 2Carolinas Pain Institute, Winston-Salem, NC; 3Neurologique Foundation, Ponte Vedra, FL; 4Swedish Pain Center, Seattle, WA. (Control ID #1332499)

BACKGROUND: Gabapentin is a first-line treatment for postherpetic neuralgia (PHN). However, due to gabapentins short elimination half-life and its absorption by a saturable transporter with limited distribution in the proximal small bowel, gabapentin needs to be dosed TID. Gabapentin TID is associated with a high incidence of somnolence and dizziness that may prevent efficacious dosages from being reached. Recently, a once-daily gastroretentive formulation of gabapentin (G-QD) was approved for the treatment of PHN. Upon contact with gastric fluid, G-QD tablets swell to a size that promotes retention in the fed stomach. This prolonged retention (approximately 8 to 10 hours) allows gabapentin to be gradually released to the site of absorption, minimizing the chance of saturating transporter uptake, and resulting in greater absorption. This permits once-daily dosing and may result in less somnolence and dizziness, which is especially important for older individuals, who are at risk for falls. METHODS: Integrated efficacy analyses were performed on two placebo-controlled, Phase 3 studies in patients with PHN. The analysis included 333 randomized to receive 1800 mg G-QD gastroretentive gabapentin and 340 to receive placebo, both taken with the evening meal. The primary efficacy assessment was the change in average pain for the past 24 hours as assessed by the Numeric Pain Rating Scale (NPRS), with scores recorded every morning from Baseline to Week 10. Subgroup analyses were performed on patients 75 and older (the very elderly), for whom PHN is more common.
RESULTS: A total of 179 patients (94, G-QD; 85, placebo) were 75 and older. The mean absolute last observation carried forward (LOCF) change in NPRS score was significantly greater with G-QD than with placebo (
2.2 vs. 1.4; p=0.032). A greater proportion of G-QD patients achieved a 30% response compared with placebo (52% vs. 29%; p=0.002). At Week 10, significantly more G-QD patients felt Very Much or Much improved compared with placebo (36% vs. 19%; p=0.001) and the mean absolute LOCF change in SIS was significantly greater with G-QD than with placebo (2.4 vs. 1.3; p=0.0044).
CONCLUSIONS: G-QD can be an effective treatment option for PHN in the very elderly and had a similar efficacy profile in the subgroup 75 compared to the overall efficacy population.

INTENSITY OF MESSAGING NECESSARY TO ENCOURAGE PATIENTS TO ACCESS THE PHR: PRELIMINARY RESULTS FROM THE SMART-PHR STUDY

Rachel Hess1; Gary Fischer1; Melissa Weimer1; Sunday Clark2; Caroline Zieth1; XinXin Dong1; Mark S. Roberts1. 1University of Pittsburgh, Pittsburgh, PA; 2Weill Cornell Medical College, New York, NY. (Control ID #1339903)

BACKGROUND: Care for individuals with chronic disease, such as cardiovascular disease, in the United States is not optimal. Personal Health Records (PHR) provide an opportunity to more actively involve patients in their own care. We have developed and are testing an active PHR that pushes information regarding prevention gaps, (diabetes foot exam, dilated retinal exam, A1C testing, creatinine testing, lipid testing, and influenza vaccination) to patients with high cardiovascular risk. We describe our preliminary findings regarding the intensity of messaging necessary before the patient accesses the PHR.

METHODS: Beginning in July, 2010, patients with high cardiovascular risk were recruited from 64 primary care practices in Western Pennsylvania and enrolled in a randomized controlled trial comparing the active PHR in which patients are alerted to prevention gaps to the traditional passive PHR in which patients were not alerted to prevention gaps. Participants randomized to the active PHR receive an initial email alert regarding prevention gaps. If the PHR is not accessed, an additional email alert is sent followed by a mailed letter informing them of the prevention gaps. The cycle repeats every two months. We describe the numbers of messages sent, the percent of individuals who accessed the PHR after receiving an alert, and the closure of prevention gaps between message cycles.
RESULTS: Of the 1169 people enrolled, 559 are randomized to the active PHR and form the basis of the data described here. On average, subjects in the active arm are 60.9 year old, 48% are female, 11% are non-white. Among these 1169 participants, 1069 initial alerts regarding prevention gaps were delivered in any cycle. The PHR was accessed 582 (54%) times after the initial alert and 725 (68%) times after the initial alert and one reminder. The PHR-access rate was 71% in the first cycle and decreased slightly to 62% in the second cycle and 64% in the third cycle. Sixty-two percent of prevention gaps open at the beginning of a cycle were closed by the beginning of the subsequent cycle.
CONCLUSIONS: Among participants with high cardiovascular risk enrolled from a large number of primary care practices throughout Western Pennsylvania, a low intensity of messaging prompts a significant proportion of patients to access their PHR regarding prevention gaps. Further work will examine if the active PHR results in a reduction in prevention gaps compared to the traditional, passive PHR.
INTEREST IN QUITTING SMOKING AND SELF-PERCEPTION OF SMOKING-RELATED DISEASE AMONG DAILY AND NON-DAILY CIGARETTE SMOKERS AT AN ACUTE CARE CLINIC: A UNIQUE OPPORTUNITY.
Yinchong E. Mak; Pamela M. Ling; Ralph Gonzales. UCSF, San Francisco, CA. (Control ID #1310447)
BACKGROUND: Acute care clinics have assumed a prominent place in the US health care delivery system by providing same-day walk-in medical attention to patients with limited access to primary care. Because acute care clinics serve a disproportionate number of patients who do not have a primary care provider, this setting also represents an opportunity to deliver important preventive health services such as smoking cessation counseling. We examined the prevalence of smoking, patterns of use, self-perception of smoking-related disease, and interest in quitting among patients at an acute care clinic in California.
METHODS: The study was conducted April - September 2011 in an academic-affiliated walk-in acute care clinic that provides care to 75-100 adults daily. As part of routine clinical care, patients completed a computerized check-in process that included questions about demographics, chief complaint, past medical history, social history, smoking history, interest in smoking cessation, and if they believed their reason for visit was caused or made worse by smoking. The 364 patients who self-reported smoking on at least 1 of the past 30 days were classified into three groups: daily smokers (smoked 30 out of the previous 30 days), regular non-daily smokers (smoked 20-29 days in the past month), and occasional non-daily smokers (smoked 1-19 days in the past month). Comparisons were conducted between daily and non-daily smokers using chi-square test for categorical variables, and t-test for continuous variables. Multivariable logistic regression analysis was used to identify factors independently associated with interest in quitting (defined as smokers reporting they already quit in past month, are trying to quit right now, or will quit in the next month).
RESULTS: The prevalence of smoking within the last 30 days was 13.1% among patients completing the computerized check-in system. The majority of smokers were non-daily smokers (65%) and did not identify

a primary care doctor (67%). Of the non-daily smokers, 68% were occasional smokers. Overall, 30% of daily, 53% of regular, and 73% of occasional smokers were interested in quitting (P<0.0001). Multivariable logistic regression analysis showed a stepwise relationship between smoking frequency and interest in quitting, with occasional non-daily smokers (OR 6.80, 95% CI 4.03-11.48) and regular non-daily smokers (OR2.80, 95% CI

1.54-5.10) being significantly more likely to be interested in quitting compared to daily smokers. Believing that the reason for visit may be caused or made worse by smoking was also independently associated with patients interest in quitting (OR 4.24, 95% CI 1.05-17.06). Age, gender, race/ethnicity, insurance status, having a primary care doctor, alcohol and recreational drug consumption, blood pressure, level of nicotine dependence, and the number of cigarettes smoked per smoking day were not independently associated with interest in quitting. CONCLUSIONS: Acute care clinics present an important opportunity to screen for tobacco use and conduct brief interventions for smoking cessationparticularly for occasional non-daily smokersas smokers in this setting have a high interest in quitting and these patients frequently do not have an established primary care provider. Helping patients to understand when their symptoms or reason for visit are related to smoking may be one strategy to motivate smoking cessation and transform acute care visits into true teachable moments.

INTERNAL MEDICINE RESIDENT SENIOR COMMUNITY SERVICE LEARNING EXPERIENCE Rachel K. Miller1; Karen M. Goldstein2; Jennine Groce-Martin1; Gala True1; Jerry Johnson1. 1University of Pennsylvania, Philadelphia, PA; 2Durham VA Medical Center, Durham, NC. (Control ID #1339633)

BACKGROUND: We developed, piloted, and evaluated a program to provide a service-learning and community-based, interactive experience focused on Geriatric Medicine and ACGME core competencies to medical residents. Service-based learning promotes core competencies by enriching learners experiences, promoting understanding of community resources and cultural norms, providing help to service agencies and communities, and developing leadership and professional skills.

METHODS: We developed and piloted a service-based community learning program with 20 Internal Medicine residents of the University of Pennsylvania. The program, which consisted of a half-day morning session, was embedded in a local senior center or senior housing facility. A community outreach coordinator of the Division of Geriatrics orchestrated program implementation, assisted in site selection, and facilitated communication between the project leader and key contacts at each site. At the site, residents toured the facility, learned about the mission and activities of the site, and gave a supervised presentation or brown-bag review for the seniors on a Geriatrics topic. A ten-minute presentation on local senior resources ended the experience. RESULTS: Resident evaluation of the community based learning and service experience was administered electronically via an IRB-approved survey using the internal medicine evaluation system. Of 19 evaluations received, 84% (16) of the internal medicine residents found the tour of the facility informative; 42% (8) of the residents agreed or strongly agreed that the service they performed expanded their knowledge of senior health issues; 68% (13) of the residents agreed or strongly agreed that this interaction with the seniors helped them learn more about communicating with older patients. Themes from open-ended questions included increased knowledge in senior community resources and facilities, enjoyment of interactions and learning from seniors outside a hospital setting.

CONCLUSIONS: Overall, this pilot program of service-based community learning provided residents with insight into the lived environment and community resources available to seniors while increasing awareness of the importance of effective communication with seniors. Future directions include having all trainees perform an aging presentation, expansion of topics, and obtaining evaluations from the seniors at the sites.

INTERPERSONAL TRUST, RACE/ETHNICITY, AND ACCESS TO HEALTHCARE Anthony Nguyen1; Paul Rathouz2; Elizabeth Jacobs1.

1University of Wisconsin School of Medicine and Public Health, Madison, WI; 2University of Wisconsin School of Medicine &Public Health, Madison, WI. (Control ID #1338126)

BACKGROUND: Interpersonal trust between a patient and their physician is important to delivering effective medical care. Compared to Non-Hispanic white populations, interpersonal trust has been shown to be lower in racial/ethnic minority groups and may contribute to health disparities. Our objective was to examine the relationship between race/ ethnicity and interpersonal trust, and if healthcare access modified this relationship.

METHODS: To achieve a sample of individuals with a range of socioeconomic status and healthcare

experiences, we conducted a cross-sectional, computer-adapted survey study of a convenience sample of African American (n=138), white (n=154), and Mexican American (n= 144) adults shopping in a diverse group of Chicago supermarkets who indicated they had a personal doctor. We used the validated 11-item Hall Trust Scale to measure interpersonal trust. The scores were normally distributed and we used tertiles indicating low, middle, and high interpersonal trust in a multivariate logistic regression analysis. We first examined the relationship between race/ethnicity and interpersonal trust. Then we added 4 measures of healthcare access (individually and then together): In the last 2 years, how hard has it been for you to get health services you have needed? (Hard vs. Not Very Hard); The last time you were sick or needed medical attention, how quickly could you get an appointment to see a doctor or health professional? (<5 days vs. >6 days); Is there anytime during the past 2 years when you did not seek medical care because it was too expensive or health insurance did not cover it? and Has there been a time that you did you not follow the doctor's advice or treatment plan because it cost too much? (Yes vs. No, for both items). Analyses were adjusted as follows Model 1=gender, marital status, age, race/ethnicity; Model 2=Model 1+employment status, highest level of education, family income; Model 3=Model 2+ healthcare setting, number of doctor visits within 12 months, and insurance status.
RESULTS: The majority of respondents were female, married, had a family income>$16,000, not currently working for pay, and had a high school degree or less. The mean age was 41 years. The Hall measure had high reliability (=0.91). Before adjustment, there was no significant difference in interpersonal trust between the 3 racial/ethnic groups (P=.41) and this relationship did not change after adjustment. Before adjustment, all 4 access barriers were statistically significant predictors (P<.05) of lower trust. After adjustment, only difficulty getting care in the last 2 years, longer wait time to last doctors appointment, and not following physician advice/treatment plan because of cost were significantly (P<.05) associated with lower trust. Results did not vary significantly across the adjusted Models.
CONCLUSIONS: We found that patterns of interpersonal trust did not differ significantly across racial/ethnic groups and that systemic factors appear to be important determinants of interpersonal trust regardless of race/ethnicity and other patient characteristics. Healthcare reform may enhance physician trust through improved access and reduced cost

INTERVENTION THRESHOLDS: AN ESSENTIAL ELEMENT OF ADVANCE CARE PLANNING Karen G. Scandrett; Brian T. Joyce; Linda Emanuel. Northwestern University, Chicago, IL. (Control ID #1309507)
BACKGROUND: Advance care planning (ACP) can refer to designation of a surrogate decision maker, documentation of physician orders, or a living will. Each of these approaches results from discussion with the patient about care preferences, and each, despite limitations, contributes important information to the decision-making process in real time. We present empirical evidence for another element of ACP: the individuals intervention threshold. The intervention threshold is intuitively understood by clinicians and lay public, but has not been thoroughly described, measured, or analyzed. METHODS: We used a mixed-methods approach to develop the concept of the intervention threshold. From a population of chronically ill general medicine outpatients, we recruited 52 subjects for a 20-minute, structured telephone interview assessing knowledge, attitudes, and prior ACP activities. Next, respondents were presented with four scenarios representing a spectrum of life-limiting medical situations, and a list of 11 interventions. For each scenario, they were asked if they would accept or decline each intervention. Descriptive statistics were generated via excel, and preferences for each intervention by scenario were plotted. The

presence of intervention thresholds was evaluated by visual inspection of the data, and patterns were identified in an iterative process. Disagreements in data interpretation were resolved through consensus.
RESULTS: Complete data were obtained from 52 patients, aged 21-81 years (mean 64.5, SD 13.0), 34.6% of

whom were male. Although92.3% of respondents declined at least one intervention, only 17.3% reported a prior discussion with a physician. Five threshold patterns were identified: wanting all interventions, wanting no interventions, wanting interventions if there is potential for recovery, wanting interventions in select baseline states, and wanting only the least invasive interventions in all scenarios.
CONCLUSIONS: These data provide evidence for individual, intervention thresholds that may be identified using a scenario-driven process. Factors contributing to the threshold included the possibility of recovery, the baseline health state, and the invasiveness of the medical procedure. The intervention threshold, and the values represented by each dimension, may provide guidance for future surrogate decision-makers. Further research is needed to determine effective ways to identify, measure, and represent an individuals intervention threshold, to facilitate informed decision making during future incapacity.

INTERVENTION REDUCES INPATIENT ORDERING OF CARDIAC ENZYMES AT JOHNS HOPKINS BAYVIEW MEDICAL CENTER Marc Larochelle; Amy Knight; Jeff Trost. Johns Hopkins Bayview Medical Center, Baltimore, MD. (Control ID #1333625)

BACKGROUND: Inpatient diagnostic testing is overused. Modifying physician ordering behavior has the potential to reduce costs and improve patient care. Physicians for Responsible Ordering (PRO), a multi-departmental, physician-led committee was organized to understand and improve physician ordering of diagnostic tests at Johns Hopkins Bayview Medical Center. As an initial target, we set out to influence cardiac enzyme test ordering.
METHODS: Based on a review of clinical evidence and guidelines, and discussions with cardiologists, criteria for appropriate ordering of cardiac enzymes for the diagnosis of acute coronary syndromes (ACS) were identified. At an academic hospital in Baltimore, we conducted an assessment of an inpatient intervention that promoted appropriate cardiac enzyme ordering. Presentations were made to faculty and housestaff to outline the project objectives and communicate the guidelines. A quick reference card summarizing appropriate ordering was developed and disseminated in September 2011. Changes to the computerized provider order entry system were made in October 2011 to facilitate adherence to the guideline. Cross-sectional analysis was performed on all inpatients admitted to JHBMC in November 2010 (pre-intervention) and November 2011 (post-intervention). Primary outcome was mean number of orders per patient for total creatine kinase (CK), CK-MB, and troponin I. Secondary outcomes were total charges for CK, CK-MB, and troponin I. The number of patients with a primary diagnosis of ACS (ICD-9 codes 410x or 411x) was also tracked in the pre- and post-intervention groups. Subgroup analysis was conducted for patients admitted to a medicine service as medicine services admit the majority of patients with possible ACS and are more likely to order cardiac enzymes.
RESULTS: Orders were compared for 1,881 patients in the pre period and 1,865 patients in the post period. Mean age was 49 years in both groups, and 52% of patients were female in both groups (both $p>0.05$). There was no difference in the incidence of ACS between groups, with 20 (1.06%) patients in the pre period and 21 (1.13%) patients in the post period ($p=0.85$). The mean numbers of tests per patient for the pre and post groups respectively were: 1.23 and 0.26 for total CK ($p<0.0001$); 1.08 and 0.14 for CK-MB ($p<0.0001$); and 1.06 and 0.74 for troponin I ($p<0.0001$). 774 (41%) of the pre group and 781 (42%) of the post group were admitted to a medicine service. In this medicine subgroup, the mean numbers of tests per patient for the pre and post groups respectively were: 2.41 and 0.42 for Total CK ($p<0.0001$); 2.15 and 0.22 for CK-MB ($p<0.0001$); and 2.05 and 1.45 for troponin I ($p<0.0001$). The total number of cardiac lab tests (total CK, CK-MB, and troponinI) declined from 6,329 during the pre period to 2,125 during the post period, a 66% reduction. This change corresponds to a decrease in charges of $109,946 for the one month of this analysis.
CONCLUSIONS: The multi-faceted intervention changed physician behaviors to be consistent with guidelines. The new practice patterns resulted in substantive savings without affecting the incidence of ACS. This approach is scalable to other diagnostic tests and institutions and represents an opportunity to improve care quality and reduce costs nationwide.

INTERVENTIONS TO IMPROVE MINORITY HEALTH AND REDUCE RACIAL AND ETHNIC DISPARITIES IN CARE FOR CERVICAL CANCER: A SYSTEMATIC REVIEW Amanda R. Clarke1; Susan Glick3; Anita Blanchard2; Amy K. Whitaker2. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; 3University of Chicago, Chicago, IL. (Control ID #1322071)

BACKGROUND: Cervical cancer is a preventable illness yet women in the United States continue to develop the disease and to die from it. This burden is not shared equally among women of different races and ethnicities. Interventions to maximize the prevention, screening, diagnosis or treatment of cervical cancer have the potential to reduce racial and ethnic disparities, yet there exists no comprehensive review of the literature to determine which interventions are effective. Our objective was to systematically review the intervention research literature to characterize interventions with the potential to improve the prevention, screening, diagnosis, or treatment of cervical cancer among racial and ethnic minority women.

METHODS: We performed electronic searches in the Medline, Cochrane Register of Controlled Trials, CINAHL, PsycINFO and Cochrane Systematic Reviews databases for original articles published in English between the inception of the databases and 2010. Medical Subject Heading (MeSH) terms related to cervical cancer or interventions were combined with terms for minority populations. We included studies with at least one intervention designed to improve cervical cancer prevention, screening, diagnosis or treatment. Additionally, included studies linked participants to the healthcare system; presented data for US racial and/or ethnic minority populations; and measured medical outcomes. We reviewed the included articles to determine the intervention(s), study design, sample size and constituency, length of follow up, limitations and outcomes. Study quality was assessed using a modified version of the Downs and Black (DB) checklist, designed to assess the methodological quality of health care interventions. This checklist has a maximum score of 29; studies with scores at or above 15 were determined to be of good or higher quality. RESULTS: Thirty-one studies met inclusion criteria. DB quality scores ranged from nine to 23, with a median score of 14. Although 25 studies described interventions to increase cervical cancer screening, only 11 of these earned DB scores of 15 or above. Of the six studies to improve the diagnosis of premalignant lesions of the cervix, 3 were of good or higher quality. No studies examined interventions to prevent or to treat cervical cancer. The most common interventions studied were patient education, patient navigation or a combination of the two. Seven higher quality studies involved direct contact with patients via telephone or in-person (with or without an indirect component). Of these, 6 showed positive results, although one of these did not show an effect for the minority groups included. Four higher quality studies described interventions reaching patients indirectly only, via mail or media; 2 were ineffective and 2 resulted in a negative outcome. Two studies with both direct and indirect contact showed a significantly better response for the direct contact group.

CONCLUSIONS: Although high quality data is limited, interventions that target patients directly via telephone or in-person show promise for improving cervical cancer screening and diagnosis among racial and ethnic minorities. Telephone counseling in particular appears effective for increasing diagnosis of premalignant disease of the cervix. More high quality studies are needed to explore ways to improve the prevention, screening, diagnosis, and treatment of cervical cancer for minority women.

INVESTIGATING OLDER ADULT MULTIMORBIDITY: A LATENT CLASS FACTOR MODEL OF CHRONIC DISEASES AND GERIATRIC CONDITIONS Christine Cigolle1,2; Jersey Liang1; Jinkyung Ha1; Lillian Min1,2; Tanya Gure1; Pearl Lee1,2; Caroline Blaum1,2. 1University of Michigan, Ann Arbor, MI; 2VA Ann Arbor Healthcare System, Ann Arbor, MI. (Control ID #1336881)

BACKGROUND: The traditional disease model is limited as an approach to multimorbidity in older adults. Their health status may be more fully conceptualized and described in terms of their combinations of chronic diseases and geriatric conditions. Latent class factor analysis enables the examination of the structure of underlying patterns of diseases and conditions. We hypothesized that (1) geriatric conditions constitute a critical

component in the complex health status of older adults and (2) latent classes of chronic diseases and geriatric conditions predict disability and mortality in older adults. METHODS: We analyzed the 2004-2008 waves of the Health and Retirement Study, a nationally-representative longitudinal health interview survey. Our study sample included adults>=65 years old (n=11,113, representing 37.1 million). Independent variables included 4 geriatric conditions (dementia, DEM; falls, FALL; incontinence, UI; sensory impairment, SI) and 5 chronic diseases (diabetes, DM; hypertension, HTN; heart disease, HEART; stroke, CVA; musculoskeletal conditions, MSK). Outcome variables included new dependency in activities of daily living (ADL) and instrumental activities of daily living (IADL) and mortality. We employed latent class factor modeling to examine classes of older adult health status, using the Akaike information criterion, the Bayesian information criterion, the likelihood ratio test for goodness of fit, and misclassification error to select the model that best fit the data. RESULTS: Using latent class factor analysis, older adult morbidity proved to sort best by two factors: first, cardiovascular disease (low and high burden groups), and, second, geriatric conditions (low, intermediate, and high burden groups). Jointly, these two factors resulted in six classes, as depicted in the profile plot (Figure). These classes were characterized by distinctive 2-year and 4-year outcomes (Table).
CONCLUSIONS: Confirming our hypotheses, latent class factor modeling demonstrated the importance of geriatric conditions to the complex health status of older adults. Further, the classes of diseases and conditions predicted disability and mortality at two- and four-years. This approach provides new insight into multimorbidity in the older adult population and can be a tool to more completely characterize complexity in clinical settings.
Outcomes Classes Class 1-1
Class 1-2
Class 1-3
Class 2-1
Class 2-2
Class 2-3
IS CHADS2 SCORE PREDICTIVE OF LA THROMBUS IN A PATIENT WITH ATRIAL FIBRILLATION? Siddesh V. Besur; Rohit Bishnoi; Muni Krishna Theertham; Anil Nalubotula; Vidya Sagar Kollu; Mahesh Borhade; Siva K. Talluri. McLaren Regional Medical Center, FLINT, MI. (Control ID #1318901)
BACKGROUND: Atrial fibrillation (AF) is associated with an increased risk of systemic thromboembolic events due to Left Atrial (LA) thrombus. The presence of LA thrombus is excluded by Transesophageal echocardiography (TEE) before cardioversion. While the CHADS2 score predicts chronic thromboembolic risk in patients with AF, it is unknown if it can also predict LA thrombus obviating the need for TEE. We aim to study if CHADS2 score predicts the LA thrombus in patients with AF.
METHODS: We retrospectively studied consecutive patients with AF who underwent TEE at a Midwestern tertiary care medical center during years 2005-2009. All patients with AF aged 18-100 years were included. Patients with rheumatic valvular heart disease, mitral stenosis and those requiring valve replacement were excluded. We identified patients with AF who have undergone TEE by using ICD-9 and CPT codes respectively. The TEE reports were reviewed for the presence of LA thrombus. The information collected included demographic data,comorbid factors (history of diabetes meleitus, hypertension,congestive heart failure,prior stroke or transient ischemic attack, cancer, hypercoagulable state,aspirin use, warfarin use and most recent INR). We calculated CHADS2 scores for each patient by assigning 1 point for age more than 75 years, hypertension, diabetes, heart failure, and 2 points for prior stroke or transient ischemic attack. The association between CHADS2 and LA thrombus were analysed using Fishers exact test.
RESULTS: We identified 173 patients with AF who underwent TEE. We included 145 patients after applying the inclusion and exclusion criteria. LA thrombus was identified in 9 (6.2%) patients. Patients with LA thrombus were predominantly female (56%), aged less than 75 years (67%) and had hypertension (89%). Higher percentage of patients with CHADS2 score 2 developed LA thrombus compared to those with CHADS2 score<1

(8.6% vs1.9%, p=0.16).
CONCLUSIONS: We found a high incidence of LA thrombus in patients with higher CHADS2 score as compared to those with lower CHADS2 score, though it was statistically not significant.
IS EPIDEMIOLOGY LOSING IMPORTANCE IN AN ERA OF MOLECULAR TARGET SCIENCE AND PERSONALIZED MEDICINE? Prantesh Jain1; Harsha Poola1; Sushma Bharadwaj1; Sonia Sandhu2; Shweta Gupta2,1; Susan McDunn2,1. 1John H Stroger Jr Hospital of Cook County, Chicago, IL; 2John H Stroger Jr Hospital of Cook County, Chicago, IL. (Control ID #1340182)
BACKGROUND: Epidemiology is an essential science, which over time has proved its worth by discovery of various causative agents of many diseases, including certain cancers. The role of human papilloma virus in the causation of cervical, anal and head &neck cancers is very well established. In breast cancer epidemiological factors help identify patients who may have a worse prognosis. Such factors then in turn promote the development of agents designed to overcome the process. Gynecological and obstetric history is important in a patient with breast cancer but is often forgotten about. We undertook this study as a short clinical research project to see the documentation of this history in patients with breast cancer.
METHODS: We retrospectively reviewed the charts of 211 consecutive women with breast cancer since January 2009 identified from the tumor registry of our inner city community-based teaching hospital. Patients who were seen in a general medicine or sub-specialty clinic (breast clinic, breast surgery, medical oncology, gynecology) at least once were included in the study. The charts with no pathology report, no clinical notes or incomplete notes were excluded. Patients whose charts had only emergency room or Medical ICU visits were also excluded. The charts were screened for age of onset of cancer, menarche, menopause, age at first pregnancy, gravidity and parity of the woman. Patients with any of the above data not reported were identified and a note was made of the number of different licensed physicians who had seen the patient in a non-emergent setting at least once.
New ADL Dependency at Two
Years (%)
3.0 7.7 42.0 7.8 10.0 26.3
New IADL Dependency at Two
Years (%)
5.1 13.9 60.2 11.5 15.3 53.2
Mortality at Two
Years (%)
4.8 13.7 44.4 6.4 13.0 35.5
Mortality at Four
Years (%)
10.3 25.7 73.3 13.8 24.2 59.8
Note: p<0.01 for each outcome.
JGIM
ABSTRACTS
S235
RESULTS: A total of 211 charts were screened out of which 12 were excluded based on the above criteria. A total of 199 patients were included in the study. 104 patients (52.3%) patients lacked the complete gyneco-logical history. An average 7 physicians each saw these patients in a non-emergent setting with a range from 1 to 37 physicians. The median number of physicians seeing these patients was 5. A number of these patients lacking complete data were also seen by medical students, who also did not chart the detailed gynecologic history. The medical student number was not included in the physician count.
CONCLUSIONS: In the era of great advancement in cancer care with targeted therapy and personalized

medicine around the corner, we believe physicians may be losing the importance of epidemiology, which actually forms the basis of many of the treatment developments in the field of oncology. Our study is just one small example of the same in the most common cancer in women in the United States. We believe this knowledge gap should be identified and attempts be made to further promote the importance of collecting epidemiological data at the medical student curriculum and resident training level so that clinicians can have a more solid base, especially ones who would one day be clinical or translational researchers.

IS WEIGHT GAIN BENEFICIAL FOR HIV INFECTED INDIVIDUALS INITIATING COMBINATION ANTIRETROVIRAL TREATMENT (CART) REGARDLESS OF INITIAL BODY MASS INDEX? Mary Logeais1; Janet P. Tate2,1; Amy C. Justice2,1. 1Yale University School of Medicine, New Haven, CT; 2VA Connecticut Healthcare System, West Haven, CT. (Control ID #1339321)

BACKGROUND: Since the advent of combination anti-retroviral therapy (cART), patients are living longer and increasingly experiencing comorbid disease associated with obesity. Most individuals initiating cART are now normal weight or overweight. We compare 12-month trends in weight among uninfected and HIV infected individuals initiating cART and ask whether benefits associated with weight gain depend upon weight status at cART initiation.

METHODS: We analyzed data from the Veterans Aging Cohort Study (VACS), a longitudinal prospective multi-site observational study of HIV infected and uninfected veterans across 128 nation-wide Veterans Administration (VA) sites. We identified 4,732 HAART initiators between the years of 2000 and 2008 who were alive and in follow-up at one year, as well as 18,769 HIV negative comparators. Changes in weight were examined over a 12-month period. Patients were stratified into those who gained weight (> 5 lb. increase in weight), those who lost weight (> 5 lb. decrease in weight), and those who stayed the same (weight change within 5 lbs.). Our outcomes were the VACS Risk Index (a validated prognostic index comprising age, CD4, viral load, hemoglobin, FIB4, GFR and hepatitis infection) and all cause mortality.

RESULTS: Fifty-one percent of HIV positive patients gained>5 lbs. in the first year after cART initiation compared to 32% of uninfected patients in the same period (p<.0001). Mean one year weight change was 6.6 lbs. greater in HIV infected compared to uninfected veterans (p>0.05). Among the 43% HIV+who started out overweight (BMI>25), 72% gained >10 pounds and 36% gained >20 pounds. HIV positive patients who gained weight had lower baseline CD4 counts, higher viral loads, and experienced greater improvements in their VACS index. Among HIV positive veterans, weight gain was associated with improved survival across all starting BMI categories. For every five pounds of weight gained, mortality decreased by 4% (p<0.0001, HR 0.96, CI 0.93-0.98). Half of this association was explained by VACS Index Score.

CONCLUSIONS: In the first year of cART, HIV infected individuals gain weight well beyond that observed among demographically and behaviorally similar uninfected veterans and, compared to HIV infected individuals who maintain weight, weight gain is associated with improved clinical biomarkers and overall survival regardless of baseline weight. Despite real weight gain after cART among normal and overweight individuals, we find no support for weight loss or maintenance interventions in this population.

Dashed = >5lbs weight gain Solid=no change in weight

IS HONESTY THE BEST POLICY? THE IMPACT OF ROUTINE CONFLICT OF INTEREST DISCLOSURE BY PRE-CLINICAL LECTURERS ON MEDICAL STUDENT ATTITUDES TOWARD THE PHARMACEUTICAL AND DEVICE INDUSTRIES. Azalea Kim2; Lawrence A. Mumm2; Deborah Korenstein1. 1Mount Sinai School of Medicine, New York, NY; 2Mount Sinai School of Medicine, New York, NY. (Control ID #1334000)

BACKGROUND: Pharmaceutical industry influence pervades medical education. Disclosure has been recommended to manage potential conflicts of interest (COI), but data on the impact of disclosure is limited. In September 2010, Mount Sinai School of Medicine mandated disclosure of relevant COI by lecturers to pre-

clinical medical students. Our objective was to determine the impact of routine exposure to COI disclosure on pre-clinical medical students attitudes toward industry relationships and disclosure.
METHODS: The intervention included brief lectures introducing COI concepts and the disclosure policy for year 1 and 2 (pre-clinical) students followed by routine COI disclosure. Disclosures were made during lectures (verbally or slide-based) and were available in an on-line database. We administered a survey to all pre-clinical students prior to the intervention and again at the end of the academic year. The survey was adapted from a published survey and used a 4-point Likert scale to assess attitudes toward the appropriateness of industry gifts to physicians, industry-sponsored education and industry/faculty relationships and the role of COI disclosure. We performed 2 analyses, first comparing student attitudes before and after disclosure exposure and second utilizing quasi-experimental design to compare post-exposure first year (intervention) students to pre-exposure second year (control) students, both having completed 1 medical school year. We dichotomized responses as strongly agree/agree or disagree/ strongly disagree and used Fischers exact test to determine the significance of between-group differences.
RESULTS: Most lecturers (77.4%) completed disclosures; 92% had no COI. Survey response rates at the beginning and end of the academic year were 66.2% and 60.9%. Demographic data were similar in the 2 classes. Exposure to COI disclosure was associated in both analyses with significant ($p<0.05$) increases in student beliefs that schools should limit industry meetings with students (56.5% vs 71.9%, pre-post; 54.3% vs.73.5% control-intervention) and educators (39.8% vs 56.5% pre-post;37.6% vs 53.0% control-intervention), a decrease in student belief that industry should fund medical school programs (61.5% vs 44.2% pre-post;61.1% vs 44.9% control-intervention), and a near-significant increase in the belief that receiving gifts/food from industry increases a physicians prescribing of that companys products (70.1% vs 79.4% pre-post, $p=0.05$;68.5% vs 84.5% control-intervention, $p=0.01$). There were no changes in student attitudes toward industry educational products, acceptability of gifts/lunches, or the impact of industry relationships on educational content. There was a near-significant increase post-intervention in students strongly agreeing with the statement The content of lecturesis evidence-based and unbiased regardless of any relationship the lecturer may have

with private industry (8.9% vs 19.5%, $p=0.05$). There was no change in attitudes toward disclosure though nearly all students (97.0-98.9%) favored disclosure in all surveys.
CONCLUSIONS: Routine COI disclosure to medical students lead students to favor more limitations in some industry interactions, but did not impact perceptions of the impact of industry relationships on education content or of disclosure itself. Our study suggests that COI disclosure may make students less aware of potential bias in lectures, though further investigation is needed.
IS INSURANCE STATUS ASSOCIATED WITH THE TRANSFER OF HOSPITALIZED PATIENTS? Janel Hanmer; Peter Cram. University of Iowa, Iowa City, IA. (Control ID #1340802) BACKGROUND: Little is know about factors associated with the transfer of hospitalized patients to other acute care hospitals.
METHODS: We used 2008 all-payor State Inpatient Data to identify all patients age 18 to 64 discharged from seven states with any of nine common principal diagnoses (pneumonia, acute myocardial infarction, congestive heart failure, cerebrovascular accident, chronic obstructive pulmonary disease, diabetes, hip fracture, skin infection, or gastrointestinal bleed). We excluded patients who were admitted in transfer from another acute care hospital, died during hospitalization, or left against medical advice. The outcome of interest was whether a given patient was transferred to another acute care hospital. The independent variable of interest was patient insurance status categorized as Medicare, Medicaid, private insurance, or self-pay. Univariate, bivariate, and multivariate logistic regression methods were used to examine the association between patient insurance coverage and inter-hospital transfers while accounting for an array of patient factors (age, sex, race, comorbid conditions) and hospital factors (teaching status, community hospital status, bed size, and hospital ownership).
RESULTS: We identified 499,562 discharges across 9 diagnoses (range of 8276 - 78633 patients per

diagnosis). In total, 3.5% discharges were transferred to another acute care hospital (range of 0.9% for skin infections to 17% for acute myocardial infarction). Overall, 23% of patients were insured by Medicare, 22% by Medicaid, 41% by private insurance, and 14% were uninsured. In bivariate analysis, uninsured patients were more likely to be transferred compared to other insurance categories for 6 of our 9 diagnoses. In multivariate analyses, uninsured patients were significantly more likely to be transferred when compared to privately insured patients for 9 of our conditions even after adjusting for patient and hospital factors. Patients with Medicaid were significantly more likely to be transferred when compared to privately insured patients for 3 of our conditions after adjusting for patient and hospital factors. We also observed that smaller hospitals (<100 beds) were less likely to transfer patients for all of our conditions (when compared with larger hospitals).
CONCLUSIONS: Uninsured patients were significantly more likely to be transferred than patients with private insurance, Medicare, or Medicaid. This raises important concerns about potential treatment delays for acutely ill uninsured patients and potential violations of federal Emergency Medical Treatment and Active Labor Act Laws.

IS REDUCTION IN SMOKING A MEANINGFUL OUTCOME IN MENTAL HEALTH PATIENTS? RESULTS FOR A TELEPHONE TREATMENT STUDY Alfredo Axtmayer; Erin Rogers; Scott Sherman. Department of Veterans Affairs, New York, NY. (Control ID #1335644)
BACKGROUND: Providers and patients are encouraged by reduction in the number of cigarettes smoked, but it is unclear this represents a meaningful outcome. A proactive telephone smoking cessation counseling study in smokers with mental illness examined whether a reduction in number of cigarettes smoked per day (CPD) from baseline to 2 months associated with sustained reduction or abstinence at 6 months. METHODS: Participants (421) from a multi-site VA study evaluating telephone care for VA smokers with mental illness received smoking cessation education, were offered cessation medications and received telephone counseling from the VA or State Quitline. Participants completed
a structured assessment upon enrollment, and 2 and 6 months post-enrollment. Chi-square analyses examined whether persons who were abstinent or had reduced their CPD by at least 50% by 2 months were more likely to be abstinent or have continued their reduction in smoking at 6 months.
RESULTS: 104 participants completed baseline, 2 month and 6 month surveys. 49% (50/104) achieved at least a 50% reduction in CPD by 2 months, 44% (22/50) were abstinent. 50% (26/50) of patients who achieved at least 50% reduction in CPD by 2 months remained at the reduced number of CPD or decreased their CPD more by 6 months. Patients who reduced CPD by 50% by 2 months were more likely to be abstinent at 6 months compared to patients who had not achieved 50% reduction in CPD by 2 months (44% vs. 19%, OR =3.46, 95%CI 1.43-8.38). Patients who were abstinent by 2 months were more likely to be abstinent at 6 months compared to patients who were not abstinent by 2 months (81% vs. 17%, OR=21.9, 95%CI 6.4-74.5).
CONCLUSIONS: Data support short-term harm reduction as a model for long-term abstinence in a mental health population. Referral to smoking cessation counseling and initial harm-reduction steps should be encouraged for patients not ready or able to immediately quit. All smokers, no matter their stage of change, should be offered effective cessation treatment. Although smoking reduction is a meaningful outcome for mental health patients, short-term abstinence should remain a primary goal of cessation treatment, as it is significantly associated with long-term abstinence.
KICKING THE TIRES OF CPOE SYSTEMS: TESTING VULNERABILITY TO REPORTED CPOE-RELATED MEDICATION ERRORS Gordon D. Schiff1,3; Andrew C. Seger1,2; Mary Amato2; DianaL. Whitney1; Jennifer Boehne1; Ali Rashidee5; Robert B. Elson6; Ross Koppel4; David W. Bates1,3. 1Brigham and Women's Hospital, Boston, MA; 2Massachusetts College of Pharmacy &Health Sciences, Boston, MA; 3Center for Patient Safety Research and Practice, Boston, MA;
4University of Pennsylvania, Philadelphia, PA; 5Quantros, Inc., Milpitas, CA; 6MetroHealth Center for Health Care Research and Policy, Cleveland, OH. (Control ID #1338870)

BACKGROUND: A recent IOM report on HIT and Safety highlighted the need for enhanced EMR safety. The Leapfrog Group performed tests of CPOE capabilities and found significant safety gaps. As part of an in-depth review of CPOE-related medication errors reported to MEDMARX, a medication error reporting database, we extracted recurrent errors and created test scenarios designed to evaluate the vulnerability of leading CPOE systems to these reported errors. We examined ways current commercial and home grown systems were vulnerable to these erroneous/dangerous orders. METHODS: MEDMARX collected medication error reports with a coded field designating CPOE as a cause of error. We analyzed a 15% random sample of 63,040 reports and constructed a taxonomy of error types, causes, and prevention strategies. We flagged representative cases and created 21 scenarios based on error frequency, severity, generalizability, testability, and correctability. These included erroneous/problematic orders related to: wrong units, overdoses, drug allergies, omission errors, wrong frequency, and drug-disease contraindications. Additionally, we developed 3 correct but complex test orders (e.g. prednisone tapers, alternate-day dosing) that often led to problem-prone workarounds. We identified test sites and obtained permission to enter orders on test patients in a sample of leading vendor and homegrown CPOE systems. We recruited typical users (mostly medical residents), and instructed them to enter the erroneous orders. Outcomes (whether orders were successfully entered) and behaviors (of MDs and CPOE systems) were recorded by a pharmacist and RA observer who rated the ease (or difficulty) of entering the orders using a Likert scale with accompanying operational definitions.
RESULTS: Testing the vulnerability of selected CPOE systems to 21 selected prototypical cases found that of 307 attempted erroneous (incorrect) orders, 174 (57%) were able to be easily replicated (entered easily or w/ minor workarounds) with no warning/blocking of such potentially dangerous drug orders. In total >80% of attempted erroneous orders were able to be successfully entered. Of 57 attempted complex orders, prescribers had moderate or significant difficulty entering 30 (53%) orders. 30% of orders generated specific warnings related to the erroneous order. Of these, 61% were passive alerts, often ignored, another 28%

required workarounds but could still be entered. Failures included no warnings for a 100-fold levothyroxine overdose in 84%, erroneous orders for pioglitazone accepted for CHF patients in 74%, and orders for insulin 60 ml (rather than units) going through in 79%. In thinking aloud test subjects articulated multiple frustrations and insights about CPOE systems and practices.
CONCLUSIONS: Testing reported CPOE errors on current systems revealed a significant and disturbing rate of successful entry of potentially dangerous medication orders. Scenarios harvested from actual reported cases were useful in probing systems and physicians ordering behaviors. We uncovered remarkable variability between inpatient and outpatient systems as well as different implementations of same systems at different sites. Ethnographic study of physician ordering demonstrated frustrations with specific potentially correctable features, patterns of overriding/ignoring warnings, frustrations with complex orders, and tolerance for suboptimal orders based on assumptions that potential errors would be corrected by pharmacists downstream.
LEARNING MORE ABOUT THE FEEDBACK PROCESS Laura K. Snydman; Daniel Chandler; Kimberly Dowdell; Joseph Rencic. Tufts Medical Center, Boston, MA. (Control ID #1339385)
BACKGROUND: It is generally assumed that feedback is a good thing. Guidelines on feedback techniques to enhance learning have been published. While many models exist on how to deliver effective feedback, there is little research about the feedback process in the setting of clinical teaching. This is most likely due to the complexity of the feedback process itself and the challenge in measuring learner outcomes in the clinical setting. The objective of this study was to analyze the content and nature of the feedback session involving attending physician observers and residents after direct observation of teaching on work rounds.
METHODS: All post-graduate year 2 internal medicine residents at one academic medical center participated in

a randomized controlled trial involving direct observation and feedback of work rounds. Residents were randomized to a feedback group or control group. Each resident was observed on two occasions 3 days apart. After the first observation, residents in the feedback group received verbal feedback from a trained attending observer using a standardized process created by the authors (LKS, DC, JR) using expert opinion and existing literature. Residents in the control group did not receive feedback after the first observation. All residents received feedback after the second observation. The feedback sessions were audiotaped to allow for qualitative analysis. One author (LKS) coded comments into dominant and supporting themes using the Stanford Faculty Development Programs (SFDP) clinical teaching framework.
RESULTS: Twenty-five internal medicine residents participated. The feedback sessions ranged in length from 7-35 min, mean 18 min, median 15 min. Residents self-assessments of their teaching were vague 29% of the time and nearly half of the time they stated only things they did well (47%). When asked to identify behaviors they did well versus behaviors they could improve upon, 45% of the statements were in the SFDP categories of Understanding and Retention (UR) and Control of Session (CS) respectively. Most of the time residents self-assessments (reinforcing and corrective) did not correlate with the attending assessments (85-90%). Residents in the feedback group did not provide more detailed self-assessments after the 2nd observation despite having participated in the same standardized feedback process 3 days prior. The majority of attending reinforcing and corrective feedback was in the categories UR and Learning Climate (LC). When asked to recall the attendings 3 pieces of reinforcing feedback and 3 pieces of corrective feedback given a few minutes earlier, 33% and 83% were remembered respectively. Residents in the feedback group were better at remembering the reinforcing feedback after the 2nd observation (52%). CONCLUSIONS: Our data indicate that corrective feedback is more likely to be remembered than reinforcing feedback, though nearly a fifth of the corrective feedback was not remembered minutes after it was discussed. While educators discuss the importance of providing feedback to learners as a means of enhancing skills or correcting mistakes, if the feedback is not remembered, is there still utility in giving it? What can be done to enhance their memory? These questions deserve further study.
LEARNING OUTCOMES DESCRIBED IN MEDICAL EDUCATION COMPETENCY-BASED FRAMEWORK TO PREPARE STUDENTS TO TAKE INITIATIVE ROLES FOR HEALTH PROMOTION: INTERNATIONAL COMPARISON AND FUTURE CHALLENGES Yuko Takeda1; Katsuya Takemura2; Ann Wylie1. 1King's College London School of Medicine, London, United Kingdom; 2University of the Ryukyus Hospital, Nishihara, Japan. (Control ID #1340280)
BACKGROUND: The emphasis on learning outcomes that equip medical graduates with the competencies required to provide optimal care for patients and society, has led various regulatory bodies and accrediting agencies to develop a set of standards within the competency-based framework. Physicians need to understand and respond appropriately to the complex relationships of individual behaviour and health determinants, including environmental and social conditions. Learning outcomes to prepare students for such competencies should be stated in the medical education framework.
METHODS: In order to identify a set of learning outcomes, we reviewed the medical education frameworks in the UK (Tomorrows Doctors 2009), the USA (Standards for Accreditation of Medical Education Programmes leading to the M.D. Degree), Canada (The CanMEDS 2005 Physician Competency Framework), Australia (Assessment and Accreditation of Medical Schools), and Japan (Model Core Curricula 2010), as well as World Federation for Medical Education (The WFME Global Standards for Quality Improvement). The learning outcomes and competencies in each framework were carefully reviewed twice by the authors. When any of the following words were contained or reflected in a sentence it was extracted: prerequisites for health; determinants of health; political, economic, social, cultural, environmental, behavioural; equality, equity; intersectoral approach (interprofessional collaboration). We also conducted a literature review using six databases: MEDLINE (via Ovid), EMBASE (via Ovid), Web of Sciences, IBSS, CINAHL and ERIC, to find practical examples of curricula/programmes designed to achieve the outcomes. In order to locate educational

programmes focusing on the disciplines of health promotion described in the Ottawa Charter, [determinant of health] (or [health determinant]), [inequity], and [disparity] were used. RESULTS: The term health promotion is a standard term used in medical education quidelines in the UK, the USA, Canada and WFME without specification. However, in various frameworks, there are statements regarding relevant competencies; recognising advocacy roles and social responsibility of physicians; understanding cultural factors and diversity; describing principles of health policy; discussing social justice and social equity/inequity; and identifying social determinants of health. After conducting the literature review, five main themes were identified in the educational programmes: social construction of health, knowledge and skills to promote healthier lifestyle, determinants of health, social responsibility and professionalism. The majority of these programmes have been provided in communities that have become part of the recent trend for global health programs conducted in low-income countries. Examples of community-based activities were community needs assessment, community service, and collaboration with community (community mobilisation). It has been pointed out that medical schools bear responsibility to provide students adequate knowledge and practical skills to prepare them for both the clinical and ethical challenges of working in socially disadvantaged and medically underserved community. CONCLUSIONS: In competency-based frameworks, there has been an emphasis on preparing graduating students to identify the social determinants of health in order to become aware of their potential roles as clinicians. How to achieve these has presented challenges yet to be significantly addressed.

LESSONS IN RECRUITMENT OF OLDER ADULTS USING ANTI-DEPRESSANTS Elizabeth M. Haney; Melanie Abrahamson. Oregon Health &Science University, Portland, OR. (Control ID #1340291)

BACKGROUND: We recruited two groups of older adults to participate in a prospective study of bone turnover: men and women who were starting selective serotonin reuptake inhibitors (SSRIs) and a comparison group who had not taken SSRIs in at least 1 year. Our intention was to follow 150 participants (75 users and 75 non-users) at 6 clinic visits over 1 year. We were interested in patients who had started SSRIs within the past 30 days.

METHODS: Initial recruitment began in the Internal Medicine clinic and was expanded to include other primary care clinics within the university health system (Family Medicine and Womens Health clinics). Subsequently, a local health maintenance organization was also added. Both health systems had electronic medical records that were used for recruitment; the two differed on whether direct contact with patients was allowable without consent of the PCP.

RESULTS: To achieve our desired enrollment, we made early changes to our recruitment strategy and expanded our clinic sites. Multiple comorbidities and health concerns were prominent and some people reported being to sick to participate. Some participants had difficulty scheduling around work either because of their own job or a family members job. To combat these issues we offered transportation, when this was the main barrier to participation; home visits once someone had completed the baseline assessment, in order to gather as much longitudinal data as possible; increased the monetary incentive for participation; allowed verbal responses to our surveys instead of just written; and attempted to coordinate study visits with other appointments in the university health system when applicable. We successfully utilized the electronic medical record, under both organizations IRBs for identification of potential participants. This greatly reduced the burden on research staff and primary care providers. In total we recruited and enrolled 94 users and 106 SSRI users in order to assure >150 participants at the end of the study. We identified 1274 SSRI users and 1060 non-user controls through the electronic medical records in order to enroll this number. Of the 200 men and women enrolled, 166 completed the 12 month study (a 17% drop out rate). SSRI users were more difficult to retain than controls: 78% of users completed the 12-month study vs 86% non-users. SSRI users completed a lower percentage of their total possible study visits than non-users (85% vs. 91%). Anecdotally, women were easier to recruit than men; they seemed to perceive osteoporosis as a personally important problem, may have more flexible work schedules, and have higher rates of SSRI use.

CONCLUSIONS: Several lessons about recruitment of older adults taking antidepressant medications may be generalizable to other studies wishing to include an older frail population with and without mental health concerns. Health issues, care giving and care giver schedules, coordination with other appointments, and transportation to the study site are all important factors in recruitment of older adults. Those with mental health concerns require additional attention and extra recruitment effort.

LIMITED AVAILABILITY OF INFLAMMATORY BOWEL DISEASE CLINICAL TRIAL RESULTS ON CLINICALTRIALS.GOV Zackary Berger; Rachel Blair; Eric Bass; Lisa M. Wilson; Susan Huftless. Johns Hopkins University School of Medicine, Baltimore, MD. (Control ID #1330731)

BACKGROUND: To reduce selective reporting of trial results, the International Committee of Medical Journal Editors required in 2005 that all clinical trials be registered in publicly accessible databases. In 2007, the US Food and Drug Administration (FDA) required reporting of trial results on ClinicalTrials.gov within a year of trial completion. Inflammatory bowel disease (IBD) is a condition for which multiple drugs have been studied in randomized controlled trials (RCTs) funded by industry and non-industry sources. To ascertain availability of IBD trial results and compliance with the FDA requirement, and to determine the relationship between funding source and such reporting, we conducted a systematic review of RCTs of IBD treatments.

METHODS: We searched ClinicalTrials.gov in July 2011 for Phase II and III clinical trials in IBD, ulcerative colitis, and Crohns disease. Two reviewers independently reviewed RCTs that tested biologics, immunomodulators, steroids, or aminosalicylates. We excluded trials that did not conduct interclass or intraclass medication comparisons or were not placebo-controlled. We extracted data on intervention, study result availability, and funding source (industry, government, academic, or other). We specified if results were provided via a link to a peer reviewed publication, a table of results in ClinicalTrials.Gov, or on an outside website (ClinicalStudyResults.org). To identify publications not directly listed on ClinicalTrials.gov, we searched PubMed, EMBASE, and Cochrane databases for IBD RCTs conducted after 1997 using the same criteria as was used for the registry entries. We then matched trial registry entries to their corresponding publications using NCT

number, study acronym, intervention, and participants enrolled. To examine compliance with FDA mandates, we analyzed the subset of trials initiated or ongoing as of September 2007 and completed by July 2010.

RESULTS: Of 513 trials identified in ClinicalTrials.gov, 133 trials met inclusion criteria. 50 (38%) of the included trials had available results. Of the 67 trials completed by July 2010, 35 (52%) had available results. 30 (45%) had corresponding peer reviewed publications, but only 19 (28%) directly provided links to peer reviewed publications containing trial results on ClinicalTrials.gov. 39% (23/53) of exclusively industry funded trials had corresponding peer reviewed publications, compared with 75% (3/4) of exclusively non-industry funded trials. Only 18% of trials required to report results on ClinicalTrials.gov complied with the 2007 FDA mandate (21% of exclusively industry funded trials and 0% of exclusively non-industry funded trials).

CONCLUSIONS: Availability of trial results for Phase II and III IBD RCTs is limited, and few trial sponsors are complying with 2007 FDA requirements to post trial results within a year of trial completion. The FDA may need to increase monitoring and enforcement of its requirement in order for ClinicalTrials.gov to effectively decrease the impact of publication bias on the availability of trial results in IBD and other conditions.

LONG-TERM EFFICACY AND TOLERABILITY OF MILNACIPRAN FOR THE MANAGEMENT OF FIBROMYALGIA: RESULTS FROM AN OPEN-LABEL, FLEXIBLE-DOSING STUDY FOLLOWED BY A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED DISCONTINUATION STUDY Allan Spera3; Daniel J. Clauw1; Lesley M. Arnold2; Yimin Ma3. 1University of Michigan, Ann Arbor, MI; 2University of Cincinnati College of Medicine, Cincinnati, OH;

3Forest Research Institute, Jersey City, NJ. (Control ID #1338386)

BACKGROUND: Fibromyalgia (FM) is a chronic widespread pain disorder often accompanied by symptoms including fatigue, stiffness, impaired physical function, and cognitive dysfunction. Due to the persistent nature of

this disorder, medications that can manage the symptoms of FM over a long-term period are important. Milnacipran is a dual serotonin and norepinephrine reuptake inhibitor approved for the management of FM. The efficacy of milnacipran in treating the symptoms of FM has been demonstrated in several 3- to 6-month placebo-controlled trials and in 6- to 9-month extension studies. The current studies evaluate the efficacy and tolerability of milnacipran in patients with FM during a 3-year, open-label (OL) study and a subsequent randomized, double-blind, placebo-controlled discontinuation study.
METHODS: Patients completing previous milnacipran studies were eligible to participate in a 3-year, OL study (Study 1). Study 1 comprised a 2-week washout period, a 2-week dose-escalation period to 100 mg/day, an 8-week stable-dose period at 100 mg/day, and a flexible-dose period (50-200 mg/day) for up to 3.25 years. Key efficacy outcomes included weekly-recall VAS pain and the Patient Global Impression of Change (PGIC). Patients completing Study 1 were eligible to enroll in a double-blind, placebo-controlled discontinuation study (Study 2). Patients enrolling in Study 2 continued OL milnacipran treatment for 4 weeks at the dose received in Study 1. After the 4-week OL period, patients achieving a 50% reduction in VAS pain score from pre-milnacipran exposure and receiving 100 mg/day were considered responders and randomized to milnacipran or placebo for 12 weeks. The primary outcome in Study 2 was the time to loss of therapeutic response, defined as a worsening in VAS pain score to 30% reduction from premilnacipran exposure or worsening of FM requiring an alternative treatment. RESULTS: In Study 1 (N=1227), the group of patients reaching the 3-year visit (n=217) demonstrated a 23.9 mm improvement in weekly recall VAS pain score. Additionally, 70.3% of patients at the final visit rated themselves much improved or very much improved from Study 1 baseline on the PGIC scale. The most common treatment-emergent adverse events (TEAEs) during Study 1 were nausea, headache, hypertension, and sinusitis. AEs led to study discontinuation in 20.5% of patients, most commonly due to nausea(2.7%). Of those continuing into Study 2 (N=358), a total of 150 patients met the responder criteria (50% pain improvement and dosage 100 mg/day) and were included in the intent-to-treat analysis population. At the end of Study 2, 64% of the patients switched to placebo (n=50) experienced a loss of

therapeutic response vs 35% of patients who continued milnacipran (n=100). The time to loss of response was significantly shorter for patients switched to placebo than for patients who continued milnacipran (P=.0004). There were no discontinuations due to AEs in patients switched to placebo; 2 patients continuing milnacipran discontinued due to AEs.
CONCLUSIONS: These findings provide support for sustained long-term efficacy (in some cases exceeding 3 years of continuous usage) and tolerability of milnacipran in the treatment of FM. The loss of therapeutic response upon discontinuation of long-term milnacipran treatment provides further evidence of the continuing efficacy of milnacipran in FM patients.
LOW RATE OF COLORECTAL CANCER SCREENING AMONG A COHORT OF HIV-INFECTED PATIENTS
Greer Burkholder; Ashutosh Tamhane; Lauren E. Appell; Michael J. Mugavero; James H. Willig; Michael S. Saag. University of Alabama at Birmingham, Birmingham, AL. (Control ID #1322079)
BACKGROUND: Given the dramatic improvement in survival among HIV-infected patients due to potent combination antiretroviral therapy (ART), we can expect increasing incidence of colorectal cancer (CRC) in this aging population. Prospective studies comparing CRC screening in HIV-infected patients at average risk with uninfected controls have found higher prevalence of neoplastic lesions and more advanced disease among those diagnosed with CRC. HIV primary care guidelines recommend screening colonoscopy beginning at age 50 in HIV-infected patients at average risk. However, there are few studies on rates and determinants of screening in this population. This study evaluated time to CRC screening from age 50 in HIV-infected patients and examined associations between socio-demographic, clinical, and psychosocial variables and likelihood of

screening.
METHODS: A retrospective follow-up cohort study was conducted at the UAB 1917 HIV Clinic. Patients with1 primary HIV provider visit at age 50 between January 1, 2003 and December 31, 2010 were included. Patients with history of CRC, colonic polyps or inflammatory bowel disease prior to age 49 were excluded. Patients receiving diagnostic colonoscopy between ages 40 and 48 were also excluded, as they were not at risk for screening by age 49. Patients screened between age 49 and 50 were considered screened at time 0 (age 50).
RESULTS: Of 1,869 patients, 242 met eligibility criteria (age range50.2-57.8 years; 78.5% male; 38.4% African American; 86.0% insured). 77.7% of patients received primary care from their HIV provider. Overall, 83 (34.2%) of patients ever received CRC screening. Median time to screening from age 50 was 1.2 years (IQR 0.2-2.4), with a maximum of 5.5 years. Among screened patients, 12 (14.5%) had neoplastic polyps. Among unscreened patients (n= 159), 29 were referred but never received CRC screening, 6 declined referral, and in 33 patients the provider documented the need for CRC screening but did not refer the patient; there was no documentation of the need for CRC screening in the remaining 91 patients. In a multivariable Cox proportional hazards model, only male gender was significantly associated with screening (HR=2.2, 95% CI: 1.1-4.3, p=0.02) while adjusted for: African-American race (HR=1.0; p=0.93), public insurance (HR=1.6, p=0.23), private insurance (HR=1.6, p=0.23), history of smoking (HR=0.7; p=0.12), CD4 count <200 cells/mm3 (HR=0.8; p=0.58), having an outside general medicine provider (HR=1.6; p=0.07), and history of CRC in a first degree relative (HR=1.1; p=0.86).
CONCLUSIONS: Only modest delays were observed among patients receiving CRC screening in this cohort of HIV-infected patients. However, despite the majority of patients having insurance, the overall rate of screening was low, and lower among women. Although frequency of neoplastic polyps was lower than in other studies of HIV-infected patients, it was substantial enough to raise serious concerns for missed lesions in our unscreened patients. Barriers to CRC screening appeared to occur at multiple points along the continuum from HIV provider visits to screening. Further research using qualitative methods is urgently needed to determine patient and provider factors along this pathway that contribute to low screening rates, in order to allow for the development of effective interventions.

LOW SES IS ASSOCIATED WITH INCREASED RISK FOR HYPOGLYCEMIA IN TYPE 2 DIABETES PATIENTS: RESULTS FROM THE DIABETES STUDY OF NORTHERN CALIFORNIA (DISTANCE) Seth Berkowitz1; Andrew J. Karter2; Jennifer Y. Liu2; Dean Schillinger1; Nancy E. Adler1; Howard H. Moffet2; Urmimala Sarkar1.
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BACKGROUND: Minimizing hyperglycemia is a clinical priority and quality goal in diabetes care. Hyperglycemia-lowering therapies can improve diabetes-related outcomes, but may also increase the risk of hypoglycemia. Past European studies have reported greater risk of hypoglycemia among those with low socioeconomic status (SES), but this research was conducted prior to the focus on more intensive glucose lowering. Therefore, we sought to determine if low income, a marker of low SES, was associated with greater risk for hypoglycemia in a modern U.S. cohort of adults with diabetes. METHODS: We conducted a cross-sectional analysis of the DISTANCE study, a survey follow-up cohort comprised of adult diabetes patients enrolled in the Kaiser Permanente Northern California diabetes registry. DISTANCE included an ethnically stratified random sample, and the baseline survey (response rate 62%) was conducted in English, Spanish, Mandarin, Cantonese, and Tagalog. The outcome of interest was patient report of 1 or more episodes of significant hypoglycemia, those resulting in unconsciousness or requiring outside assistance, in the past 12 months. The exposure of interest was household income. We specified unadjusted (bivariate) and multivariate logistic regression analysis, controlling for sociodemographic variables such as age, gender, race/ethnicity, education, and health literacy, and clinical variables such as medication use (insulin, secretagogues, metformin, or mixed), HbA1c, duration of diabetes, chronic kidney disease, self blood glucose monitoring, CVA, and dementia. Models accounted for the complex sampling design (non-proportional sampling fractions) through

expansion weights, for survey response bias using Horvitz-Thompson weights, and for item non-response with multiple imputation.
RESULTS: 14,357 patients were included. The mean age of our sample was 58 years (SD 10 years), and was 49% female. The sample was 23% Asian, 22% white (non-Latino/a), 18% Latino/a, 17% African-American, and 20% mixed/other. The mean HbA1c was 7.6 (SD 1.6). 17% had household income below $25,000 annually, and 33% had income>$65,000. Hypoglycemia was common, with 11% of patients reporting significant hypoglycemia in the past year. In bivariate analysis, low SES was associated with nearly twice the frequency of hypoglycemia, with 16% of those with incomes<$25,000 reporting hypoglycemia, compared to only 8.8% of those with incomes> $65,000 (Cochran-Armitage test for trend Z score 7.82, p <0.0001). In our multivariate logistic regression analysis, hypoglycemia remained significantly associated with low SES. The effect was significant for both the poorest (incomes<$15,000, OR hypoglycemia 1.51, 95% CI 1.11-2.05, p=0.008) and the second poorest (incomes $15,000-24,999, OR 1.41, 95% CI 1.01-1.99, p=0.045) cohorts (reference group income>$65,000).
CONCLUSIONS: Low income is associated with substantially increased hypoglycemia risk. This finding persisted even after adjustment for potentially confounding and mediating risk factors. Clinicians should be aware of this increased risk when caring for vulnerable patients and prioritize treatment strategies which minimize hypoglycemia. This has important implications for diabetes clinical guidelines and quality metrics, which must balance the risk of hypoglycemia against the benefits of diabetes treatment. More work is needed to understand why lower income is linked with greater risk of hypoglycemia and whether this disparity is modifiable.
LOW INCIDENCE OF ADVERSE EVENTS FOLLOWING VARENICLINE PRESCRIPTION AMONG OPIATE DEPENDENT PATIENTS WITH COMORBID PSYCHIATRIC AND MEDICAL ILLNESS Shadi Nahvi1; Bryan Wu1; Kimber P. Richter2; Steven L. Bernstein3; Julia H. Arnsten1. 1Albert Einstein College of Medicine, Bronx, NY; 2University of Kansas, Kansas City, KS; 3Yale University, New Haven, CT. (Control ID #1340381)
BACKGROUND: Substance abuse treatment patients smoke at four times the prevalence of the general population and suffer high rates of tobacco-

related disease and mortality. Varenicline is more efficacious for smoking cessation in non-substance abusers than bupropion and nicotine replacement therapy, but has potential psychiatric and cardiovascular risks. Little data exist on the safety or effectiveness of varenicline among smokers with mental health and substance abuse issues.
METHODS: In this retrospective observational study, we reviewed all patient charts in two urban methadone clinics that provide on-site primary care. Subjects included all smokers prescribed varenicline between May 2006 and December 2009. We evaluated adverse events, including events prompting treatment discontinuation, psychiatric symptoms, and cardiovascular events in the six months following varenicline prescription. We also assessed varenicline treatment course, smoking cessation, and the association between treatment course and smoking cessation. RESULTS: We reviewed 718 patient charts and identified 581 smokers(80.9%). Seventy smokers (12%) were prescribed a total of 82 courses of varenicline treatment. There was six months of clinical follow up for 100% of patients following each of the 82 varenicline treatment courses; patients had a median of six [Interquartile range (IQR) 3-9] medical visits and 10 (IQR 7-13) substance abuse counselor visits in the six months following each varenicline prescription. The mean age of patients prescribed varenicline was 50 years and 46% were female. Cardiovascular risk factors and psychiatric illness were prevalent: 20% had diabetes, 51% had hypertension, 23% had hyperlipidemia, 53% had preexisting depression, 30% had preexisting anxiety, 8.6% had preexisting bipolar disease, and 10% had preexisting psychotic disorders. Among 82 varenicline courses, nine (11%) were discontinued due to adverse effects; two discontinuations were due to depressive symptoms. One patient initiated new psychiatric treatment within six months of initiating varenicline, but did not

discontinue varenicline. There were no reports of suicidal ideation, no reports of agitation prompting clinical intervention, and no psychiatric hospitalizations. There were also no incident cardiac or vascular events within 6 months of varenicline prescription. Only 16 patients (22.9%) received the recommended 12 week treatment course; those with a
12 week treatment course were significantly more likely to report tobacco abstinence at follow up than those with a <12 week treatment course(29.4% v 2.8%, p=0.01).
CONCLUSIONS: Smokers in treatment for opiate dependence, who have high rates of psychiatric and cardiovascular comorbidity, experience adverse events from varenicline infrequently. Treatment course duration is significantly associated with cessation. Interventions are needed to optimize use of smoking cessation treatment among opiate dependent smokers.
LOWER RATES OF NEPHROTOXICITY AND OTHER ADVERSE EFFECTS WITH LIPOSOMAL AMPHOTERICIN B VS. LIPID COMPLEX AMPHOTERICIN B IN HOSPITALIZED NEUTROPENIC PATIENTS
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BACKGROUND: In previous clinical studies, liposomal amphotericin B (L-AMB) and amphotericin B lipid complex (ABLC) were significantly less nephrotoxic compared to conventional amphotericin B deoxycholate. Additionally, some trials have suggested differences in nephrotoxicity between L-AMB and ABLC. We examined rates of nephrotoxicity and other adverse effects among adult inpatients administered L-AMB or ABLC with neutropenia for therapy of invasive fungal infections (IFIs).
METHODS: The Health Facts database (Cerner Corp, Kansas City, MO) was used to extract information for analysis regarding neutropenic hospitalized patients aged>=18 y receiving L-AMB or ABLC from 1/1/01-6/30/10 from 141 participating US hospitals. Patients had a positive blood culture or diagnosis of Aspergillus, Candida, and/or Cryptococcus and at least one absolute neutrophil count <1000 cells/mm3 prior to L-AMB or ABLC administration. Renal function was evaluated by changes in serum creatinine (SCr) and nephrotoxicity was defined as a post SCr >100% increase
from baseline and an absolute level >1.2 mg/dL. Univariate inference tests and multivariate analyses (MVA) utilizing generalized linear models were used to assess differences between groups.
RESULTS: 63 L-AMB and 116 ABLC patients were identified for analysis. The L-AMB and ABLC groups were similar in gender (67% vs 57%, p=0.202) and mean (SD) age 48.4 (22.2) vs 55.8 (18.1) (p=0.171). The most common diagnosis was myeloid leukemia seen in 17.5% of L-AMB and20.7% of ABLC patients (p=0.603). Organ system dysfunction (respiratory, hematologic, hepatic, cardiovascular or renal) within 48 h of admission was seen in 77.8% of L-AMB and 67.2% of ABLC patients (p=0.138). Comorbid conditions were generally similar between the two cohorts with the mean (SD) Charleston Comorbidity Score for L-AMB of 2.52 (1.99) and for ABLC of 2.97 (2.09) (p=0.164). Mean (SD) baseline SCr was 1.2 (0.9) mg/dL for L-AMB and 1.1 (0.7) mg/dL for ABLC (p=0.411). For those with sufficient data, mean (SD) pre-to-post % increase in SCr was 58.1 (84.8) for L-AMB (n=52) and 120.66 (159.1) for ABLC (n=106) (p=0.004), while14.3% of L-AMB and 31.9% of ABLC patients met the definition of nephrotoxicity (p=0.01). In MVA, ABLC patients were 2.97 times more likely to have nephrotoxicity than patients receiving L-AMB (95% CI, 1.22 -7.25, p=0.016). While not statistically significantly different, hypokalemia was more frequent for ABLC (69.1%, n=97) vs. L-AMB (62.5%,n=48, p=0.429) as was hypomagnesemia (L-AMB 36.8%, n=38) vs. ABLC (41.2%, n=85) (p=0.650), and infusion-related reactions requiring treatment were more frequent in ABLC (23.3%) vs. L-AMB (14.3%, p=0.152).
CONCLUSIONS: In this retrospective study of neutropenic hospitalized inpatients comparing the use of L-AMB to ABLC for therapy of IFIs, LAMB demonstrated a significantly lower rate of nephrotoxicity. When an amphotericin B agent is required, the consequences of nephrotoxicity should be strongly considered before selecting a particular agent.

M.O.L.E.S (MULTIMEDIA ON-LINE EDUCATION IN SKIN CONDITIONS) OFFERED AS SELF-DIRECTED TEACHING MODULE RESULTS IN LOW RATES OF USE AMONG INTERNAL MEDICINE ATTENDINGS

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BACKGROUND: A study in 2004 by Antic, et al. in Dermatology studied the diagnostic accuracy of dermatologic conditions in 1290 patients by General Internists. Only 51.1% of these conditions were accurately diagnosed and a significant amount of referrals from Generalists are deemed unnecessary by receiving Dermatologists. We identified the top ten dermatologic conditions that both Dermatologists and Internists in our NYU community believe that Internists should be able to diagnose and manage. We built a multi-media online teaching tool targeting these conditions to aid in improving patient care and preventing unnecessary referrals. Despite great initial enthusiasm from Internists to have access to the modules we have seen a very low rate of completion in the first six months of availability.

METHODS: We developed a self-directed multi-media on-line teaching tool based on data collected using an IRB approved structured survey method of facilitated focus groups (twenty Internists and Dermatology Residents and Attendings, associated with NYU School of Medicine). The top ten dermatologic conditions generated from these focus groups that generalists should be able to diagnose and manage included: general skin care, skin exam and basic nomenclature, drug eruptions, suspicious moles, dermatitis, alopecia, acne, lower extremity lesions (stasis dermatitis, cellulitis, vasculitis), common outpatient procedures, and fungal infections. The modules were announced in person and via email to invite participation of Internists. Email reminders were sent monthly for 6 months to those requesting access. We monitored module use and pre- and post-test scores.

RESULTS: Despite initially greatly expressed enthusiasm of Internists to have access to these modules, very few attempted or completed them. Of the 43 Internists who requested access to the on-line modules, only 9 attempted all 10 modules, and only 1 completed 8 modules. Eight completed module 1, six completed module 2, two completed modules 3, 4 and 5, one completed modules 6, 7, and 8, and zero completed modules 9 or 10. The majority of attempts and completions occurred within the first

month of their release. This drop off in participation demonstrates a participant cascade effect.

CONCLUSIONS: The low rate of interested Attnendings attempting the modules might be a reflection of lack of time and sustained motivation. Incentives such as CME credits, gift cards, protected learning time, and more frequent email reminders may ameliorate this participant cascade effect. Surveying the Attendings about the obstacles to attempting the modules might prove very helpful in evaluating the usability of our teaching tool. Because of the low rate of completion so far, thorough assessment of the modules effectiveness is difficult at this time. We are hopeful that through the aforementioned incentives and surveys, better participation rates shall occur.

MEDLEAD: DEVELOPMENT AND IMPLEMENTATION OF A HEALTH PROFESSIONAL LEADERSHIP AND POLICY CURRICULUM

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BACKGROUND: Increasing attention has been placed to the need for greater integration of health policy and team-based improvement in medical education. In 2010, the Veterans Administration Office of Academic Affiliations established five Centers of Excellence (CoE) in Primary Care Education. The program represents a new frontier in the transformation of American medicine: educational paradigms that foster new inter-professional care models while emphasizing innovation, continuous improvement and team leadership. In creating leaders in primary care delivery, however, attention must be paid to another key domain: grounding in

translational health policy -with a focus on the skill set necessary to succeed as agents of change. Via deliberate, structured curricula in health policy and public leadership, the VA Connecticut CoE aims to endow trainees with the tools necessary for effectual action across sectors - while building a national model for training in medicine and public service.
METHODS: We developed a survey assessing two major components: content assessment of trainees knowledge of public policy and leadership concepts and attitude assessment of trainees' comfort with application of those concepts, focused on the Batalden medical education domains and measured on five-point Likert type scales. The survey was administered to matched groups of CoE and non-CoE resident physician/nurse practitioner fellow trainees prior to participation in the CoE's MedLEAD curriculum, a learner-driven educational paradigm focused on domestic health policy, leadership and public sector engagement. Championed, developed and taught by CoE senior residents, curricula include novel assessment models to both determine the impact of MedLEAD training and flexibly accommodate learners of varying experience to allow for rapid advancement in skill acquisition. Interval means were calculated and analyzed for statistical significance.
RESULTS: Baseline knowledge of and comfort with core health policy and leadership concepts was low among CoE trainee respondents. Most respondents (66%) rated their prior involvement in public policy and leadership experiences as minimal to non-existent (1=non-existent, 5= extensive, mean=2.3); similar proportions indicated that the integration of health policy and leadership development training within their medical education was lacking, with mean Likert ratings of disagreement to neutrality (2.6) as to whether prior training in these areas was appropriate. Respondents uniformly (100%) expressed neutrality to discomfort (mean2.2) with their ability to effect cultural, structural or policy change across a variety of sectors (public/private/non-governmental).
CONCLUSIONS: Findings among trainees mirror the growing consensus in American medicine: training in health policy and leadership is necessary (and frequently absent) within medical education. Policy and leadership curricula that exist, however, overwhelmingly emphasize either international or private sector action. MedLEAD's public sector focus thus represents a unique curricular model in American medical education. More research is needed to measure MedLEAD's impact on its intended core outcomes: acquisition and retention of knowledge of core policy and leadership concepts, confidence in newly acquired knowledge - and, uniquely, the application of those concepts in everyday practice (as measured by skills, behaviors and clinical outcomes).
MALPRACTICE RISK AND RATES OF IMAGING USE AT US HOSPITALS Jason S. Mathias; Joe Feinglass; David W. Baker. Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1339819)
BACKGROUND: Physicians consistently report that fear of malpractice claims encourages them to order diagnostic tests, even when tests are of low-value. The Centers for Medicare and Medicaid Services has identified four imaging tests that may be of low value if overused, and U.S. hospitals rates are publicly reported in the Hospital Outpatient Quality Reporting Program (HOQR): magnetic resonance imaging for low back pain (MRI), follow-up imaging after screening mammography (MAM), and abdominal and thoracic computed tomography with and without contrast (A-CT and T-CT). We sought to determine if high-outlier (i.e., top decile) performance on the HOQR imaging use measures was associated with three measures of local malpractice risk: 1) average county malpractice insurance premiums,2) state claims risk per physician, and 3) caps on non-economic damages. METHODS: The dependent variable was high-outlier performance on an HOQR imaging use measure, defined as a performance score in the top decile among reporting hospitals. We used logistic regression to examine the association between high-outlier performance and three measures of regional malpractice environment 1) a county level average of internal medicine, general surgery, and obstetrics and gynecology annual malpractice premiums derived from the Medical Liability Monitor 2008, 2) state claims risk per physician (2008 claims per physician times average payment per claim), and 3) states with tort law reforms capping non-economic damages as of 2008. The premium and claims risk data were divided into tertiles and entered as categorical variables with the lowest tertile as the reference group. Caps on non-economic damages

were coded as present or absent. All analyses were adjusted for hospitals HOQR-reported measure specific imaging volume and 2009 American Hospital Association Survey reported geographic setting, ownership status, teaching status, and percentage of discharges with Medicare or Medicaid insurance. RESULTS: When compared to hospitals in areas in the lowest tertile for malpractice premiums, those in the highest tertile were more likely to be high-outliers on MAM (adjust OR 1.98 [1.43-2.74]) and less-likely to be high-outliers on MRI (OR .56 [.37-.84]). Similarly, when compared to hospitals in areas with lowest tertile claims risk per physician, those with highest tertile claims risk per physician were more likely to be high-outliers on MAM (OR1.76 [1.32-2.35] and less likely to be high-outliers on MRI (OR .61 [.41-.91]). Neither premiums nor claims risk were significantly associated with high-outlier status on A-CT or T-CT. There was no consistent relationship between the presence of caps on non-economic damages and high-outlier status (adjusted OR [95% CI] MRI: .73 [.53-.99]; MAM: .99 [.77-1.27]; A-CT: 1.62[1.27-2.06]; T-CT: 1.39 [1.08-1.78]).
CONCLUSIONS: Higher local malpractice risk (e.g., higher premiums, higher claims risk) was associated with increased likelihood of high-outlier status on MAM but not MRI, A-CT, or T-CT. The relationship between caps on non-economic damages and high-outlier status was inconsistent. Interventions focused solely on alleviating malpractice risk may decrease overuse of specific imaging studies. However, to meaningfully reduce overuse of all imaging studies, interventions will need to simultaneously address other factors that may encourage imaging overuse.

MANAGEMENT OF CARDIOVASCULAR RISK FACTORS IN DIABETIC PATIENTS: COMPLIANCE TO GUIDELINES IN THE UNITED STATES. Bhavana Siddegowda Bangalore1; Siva K. Talluri1; Jyosthna Talluri1; Punnaiah Marella2; Siddesh Besur1. 1Mclaren Regional Medical Center, Flint, MI; 2Banner Estrella Medical Center, phoenix, AZ. (Control ID #1320393)

BACKGROUND: Individuals with diabetes have twice the risk of myocardial infarction and stroke as the general population. Current guidelines recommend treatment of all modifiable cardiovascular disease risk factors (CVD-RF) in diabetic patients. Although the incidence of CVD events in patients with diabetes has declined over the past decade, many studies have shown that CVD-RF control has been inadequate. Our study

objective is to examine compliance to American Diabetic Association (ADA) guidelines for CVD-RF modification in the United States (US). METHODS: National Health and Nutrition Examination Survey (NHANES) is conducted by the US National Center for Health Statistics. It collects participants demographic, socioeconomic, dietary and health-related information. Its complex design allows nationally representative random sampling of US patients. We conducted a secondary data analysis of a retrospective cohort of adult diabetic patients included in the 2008 NHANES. We excluded those not seeing a doctor for their diabetes. The primary outcome was to measure the proportion of US diabetic patients that met ADA diabetes care guidelines on control of blood sugar, blood pressure, cholesterol and albuminuria and secondarily examine gender differences. We defined as diabetic those individuals told by their doctor to have diabetes. We described their demographic characteristics. We calculated the proportion meeting diabetes care guidelines. We compared compliance to guidelines among men and women using Chi-square test. We analyzed the data with SPSS complex samples 19.0 software (SPSS Inc, Chicago, IL). Our study was reviewed and exempted by the Institutional Review Board.

RESULTS: There were 759 adults with diabetes in our sample (projected to18.5 million in the US). We excluded 182 who were not seen by a doctor for diabetes (leaving a projected US population of 14.6 million). The goal of hemoglobin A1C<7 was met in 49% (95% CI 39%-59%), LDL was<100 in 62% (95% CI 54%-69%), triglycerides<150 in 54% (95% CI 46%-62%), blood pressure<130/80 in 51% (95% CI 41%-62%), HDL goal of>40 in men and>50 in women was met in 60% (95% CI 50%-69%), urine albumin creatinine ratio<30 in 59% (95% CI 51%-66%). Majority were non-smokers 65% (95% CI 51%-66%). Men were more likely to meet guideline goal achievement only for LDL, odds ratio 2.7 (95% CI 1.4-5.3, P =0.006), and HDL, odds ratio 2.18

(95% CI 1.3-3.5, P =0.003). No other gender differences were appreciated.
CONCLUSIONS: Treatment goals for CVD-RF were met in slightly more than half of diabetic patients. Men are more likely to meet LDL and HDL goals compared to women. The proportion not meeting goals of care was similar to the 2002 NHANES published results except for an improvement in control of HDL and triglycerides in 2008. We did not have information about medication compliance, which plays an important role in reaching treatment goals. We need to focus on strategies to optimize CVD-RF modification and compliance to ADA diabetes care guidelines.
MANAGEMENT OF IMPLANTABLE DEFIBRILLATORS IN HOSPICE PATIENTSNEED FOR A POLICY?
Deirdre R. Pachman1;
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(Control ID #1326201)
BACKGROUND: Implantable cardioverter-defibrillators (ICDs) are common as indications for device implantation expand. However, shocks from ICDs can be painful and distressing, and may negatively affect quality of life in patients at end of life. Recent studies have demonstrated that patients enrolled in hospice may experience shocks at end of life yet many hospice programs do not have policies addressing ICD deactivation. In this study, we explored the experiences of regional hospice programs with patients with ICDs, the final goal was to assist programs in policy development. METHODS: Forty-nine hospice programs were identified in the referral area of our academic medical center (i.e., Minnesota, Iowa, and Wisconsin). An email with a link to a survey was sent to each program. The survey was comprised of 23 closed and open-ended questions and participants were given 4 weeks to respond. The survey collected data on organizational characteristics, professional experiences with ICD management, and the existence and function of policies related to the care of patents with ICDs. Descriptive statistics were used.
RESULTS: Twelve hospice programs responded to the survey. All programs admitted patients with active ICDs but only 25% had questions on the intake form that inquired about the presence of an ICD. The discussion and decision to deactivate the ICD caused distress for 50-75% of patients and families. In addition, 58% of programs reported that the discussion caused distress for the hospice staff and this was more common in programs without a policy. Only five programs specifically trained staff
in having conversations with patients and their caregivers about ICD deactivation. The most common method of ICD deactivation was in the patients home by an industry employed allied professional and the majority of programs did not have a magnet available for emergency ICD deactivation. Some programs (25%) reported that patients were shocked at end of life and 50% of programs had policies. All six programs without policies perceived they would benefit from a policy. A sample policy was developed with input from experts in the field of palliative medicine, cardiology, and ethics. This policy will be provided to interested hospice programs.
CONCLUSIONS: ICD shocks can be a source of pain, suffering, and anxiety for patients at end of life. However, the discussion of ICD deactivation can also cause distress for patients, family, and hospice staff. A formal policy to address ICD management in hospice patients may reduce the stress and discomforts associated with ICD deactivation discussions by providing direction, ensuring consistency, and promoting communication, as well as prevent unwanted shocks at end of life.
Management of ICDs in Hospice Programs
Program Responses N=12 Programs with a formal policy addressing ICD deactivation 6 (50%) Staff specifically trained in conversations with patients/caregiversabout ICD deactivation
5 (42%)
Discussion to deactivate ICD caused distress for patients 6 (50%) Discussion to deactivate ICD caused distress for family 9 (75%) Discussion to deactivate ICD caused distress for hospice staff 7 (58%) Patient shocked by ICD at end of life in past 5 years 3 (25%) Magnet available for emergency ICD deactivation 4 (33%)

MANAGEMENT OF SUBSTANCE ABUSE AND DEPENDENCE IN U.S. AMBULATORY CARE, 2001-2009
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BACKGROUND: Psychosocial therapy has long been a mainstay in the treatment of substance abuse and dependence but effective pharmacologic options have increased over the past decade. We sought to examine predictors and trends in the provision of pharmacotherapy and psychosocial therapy for the treatment of substance abuse and dependence in U.S. ambulatory care.
METHODS: We conducted a serial cross-sectional analysis of the 2001-2009 National Ambulatory Medical Care Survey (N=252,450 visits) and the National Hospital Ambulatory Medical Care Survey (N=302,440 visits). We identified visits related to alcohol or drug abuse or dependence (N=9741) by diagnosis codes (ICD-9) or reason for visit codes. Among these 9741 visits, we identified visits in which either of the two main modalities of treatment of these conditions was provided. We defined pharmacotherapy as the prescription of methadone, buprenorphine, acamprosate, naltrexone or disulfiram. We defined psychosocial therapy as the provision of either psychotherapy or other mental health counseling. We examined treatment trends across 3-year time periods using chi-square trend tests. We used multivariable logistic regression to identify predictors of each treatment modality, adjusting for time period and available patient, visit, and practice characteristics. We used SUDAAN software to account for the complex survey design.
RESULTS: Of an estimated 46.8 million visits for substance abuse and dependence in the US between 2001 and 2009, 19% of patients were >55 years old, 58% were male, 81% were White and 39% had a primary payment source of Medicaid or Medicare. Total visits increased from 12.4 million in 2001-2003 to 19.3 million in 2007-2009 (p=.02). Physicians prescribed pharmaco-therapy in 6.3 million (13%) visits, psychosocial therapy in 25 million (55%) visits, and both therapies in 4.2 million (9%) visits; neither therapy was recorded in 18.7 million (40%) visits. Methadone and buprenorphine accounted for 77% of pharmacotherapy visits. Rates of pharmacotherapy were 5% (643,000 visits) in 2001-2003, 12% (1.7 million visits) in 2004-2006 and 20% (3.9 million visits) in 2007-2009 (p<.001). Independent predictors of pharmacotherapy included age >55 years old (OR 0.3 compared to age <35 years old; 95% CI 0.2-0.6), Psychiatry clinic visits (OR 0.4 compared to Internal Medicine/Family Practice clinic visits; 95% CI 0.2-0.8) and

Substance Abuse clinic visits (OR 0.4 compared to Internal Medicine/Family Practice clinic visits; 95% CI 0.2-0.9). Rates of psychosocial therapy were unchanged over time (59% in 2001-2003, 52% in 2004-2006, and 56% in 2007-2009, p=.28). Independent predictors of psychosocial therapy included age >55 (OR 0.6 compared to age <35; 95% CI 0.4-0.9), Psychiatry visits (OR14.5 compared to Internal Medicine/Family Practice clinic visits; 95% CI 9-24) and Substance Abuse clinic visits (OR 3.4 compared to Internal Medicine/ Family Practice clinic visits; 95% CI 1.8-6.2).
CONCLUSIONS: Total ambulatory visits involving substance abuse or dependence have increased over time, and visits involving pharmacotherapy have accounted for an increasing share. Adoption within Internal Medicine and Family Practice specialties appears to have driven this growth while psychosocial therapy remained more common in Psychiatry and Substance Abuse visits. Greater use of both pharmacotherapy and psychosocial is needed as 40% of visits with a diagnosis of substance abuse or dependence did not involve treatment.
MANAGING CHRONIC PAIN WITH OPIOID MEDICATIONS: PATIENT VOICES
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BACKGROUND: Over the past two decades opioid prescribing for chronic pain has increased dramatically, along with rates of opioid abuse and opioid-related overdose deaths. National guidelines stress that health care

providers should monitor for opioid effectiveness, adverse effects, adherence, and signs of misuse, addiction, or diversion among patients on opioid therapy. Some monitoring strategies, such as contracts and urine screening, have potentially punitive undertones and may have unintended alienating or stigmatizing effects. The goal of this qualitative study was to develop a better understanding of the experiences, perceptions, and challenges patients with chronic pain face when communicating with their primary care physicians about opioid therapy and monitoring. METHODS: Semi-structured interviews were conducted with 24 patients from a federally funded hospital in the Midwest. Purposive and snowball sampling techniques were first used to identify 14 primary care physicians, who then provided lists from which patients were randomly identified. All of the patients were receiving long-term opioids for chronic pain. RESULTS: Qualitative thematic analysis of the interviews revealed three major themes: 1) avoiding opioids; 2) wanting pain to be acknowledged; and 3) treating patients as individuals. Wanting to avoid opioids was one of the most common themes and was overwhelmingly driven by patient fears of addiction, although other reasons included side effects, as well as how opioids limit daily functioning and cover up underlying symptoms. Patients discussed their initial discomfort with starting opioids and their desires to taper off of them or stop them completely. As one patient described, You prescribe pain medicine, you just started a junkie. Another patient recalled, each one of them [opioids] I took myself off of.like, Im not gonna become a dope addict, you know, because of pain. The second theme of wanting pain to be acknowledged deals to a large extent with how the patients often did not feel as though the physicians wanted to hear about their experience of pain or talk about it during the appointment. As one patient said, I mean they dont really ask you how, you know, whats your problems she [current doctor] never really wanted to listen to what I tell her. And Im like, well, Im trying to explain to you that Im hurting, you know. Its like, what do you want me to do? Thats her words, what do you want me to do? The third theme was related to patients wanting their physicians to treat them as individuals, as opposed to being stereotyped (e.g., assuming patients are addicts based on that one bad apple as put by one patient), or lumped into broad categories when it comes to prescribing. As stated by another patient, everything needs to be on a one-to-one, on a personal basis, no matter what it is. CONCLUSIONS: Gaining in-depth knowledge about patients struggles with opioid therapy is an important step in creating interventions that help both patients and providers with chronic pain management. Important implications for clinical practice from this study include specific strategies for how primary care physicians can approach patients.

MANY HOSPITALIZATIONS THAT ORIGINATE FROM NURSING HOMES ARE POTENTIALLY PREVENTABLE Rebekah Gardner1,4; Orna Intrator3; David Gifford2,1; Stefan Gravenstein1,4. 1Alpert Medical School of Brown University, Providence, RI; 2American Health Care Association, Washington, DC; 3Brown University, Providence, RI;
4Healthcentric Advisors, Providence, RI. (Control ID #1334907)

BACKGROUND: Quality initiatives are increasingly focused on preventing unnecessary hospital admissions, as hospitalizations are burdensome for patients, costly to the healthcare system, and may indicate an opportunity to improve care. Ambulatory care sensitive conditions have been used by researchers to measure potentially preventable hospitalizations in an outpatient population. These outpatient conditions may not apply to the generally frailer and more medically complex nursing home residents, who reside in an environment offering 24-hour observation and care. We sought to develop a model that identified potentially preventable hospitalizations from the nursing home setting in order to examine regional variation and to highlight structural issues that could be targeted for improvement.

METHODS: We convened an expert panel to review diagnoses in a revised version of the ambulatory care sensitive conditions and to identify which diagnoses best identified potentially preventable hospitalizations of nursing home patients. Diagnoses from preventable hospitalizations are those conditions that are more likely to be avoided or managed in the nursing home. The Residential History File (based on fee-for-service Medicare claims and eligibility files and minimum data set [MDS] assessments) was used to identify hospitalizations

originating from a nursing home in 2009. The closest MDS prior to the hospitalization was used for demographic and clinical characteristics. Residents were stratified based on length of nursing home stay (0-7 days, 8-30 days, 31-90 days, and long-stayers over 90 days), and the prevalence of potentially preventable nursing home hospitalizations (PPNH) for each group was examined. Variation in the rate of PPNH was explored at the state and regional levels.
RESULTS: Twenty six PPNH categories with ICD-9 codes were identified. There were 563,036 nursing home residents who had at least one hospitalization, and a total of 808,937 hospitalizations. Almost 60% of all hospitalizations were among nursing home residents who had been in the facility for at least 90 days. Hospitalized nursing home residents were more often female (64.5%) and 39.4% were 85 years or older. Among all hospitalizations, 25.8% were classified as potentially preventable in residents who had been in the nursing home for fewer than 7 days,29.3% in residents who had been in the nursing home for 8-30 days, 31.7% in residents there for 31-90 days, and 34.8% in residents there for >90 days. Most potentially preventable conditions were more prevalent among long-term residents, including COPD, glycemic abnormalities, pneumonia, and urinary tract infections. However, CHF, diarrhea, and delirium/confusion were more common diagnoses among short-stay residents. There was substantial variation in rates of PPNH by state (ranging from 27.0% in California to44.7% in South Dakota).
CONCLUSIONS: Adapting ambulatory care sensitive conditions for the nursing home setting revealed a high number of hospitalizations from nursing homes that are potentially preventable. The regional variation both in the number of hospitalizations and the diagnoses leading to those admissions indicates an opportunity for improvement. These measures can be used to test quality improvement interventions in this setting as well as to highlight concerns about national long-term care infrastructure and policy.
MASSACHUSETTS HEALTH REFORM DID NOT REDUCE 30-DAY READMISSIONS FOR ACUTE MYOCARDIAL INFARCTION AMONG MASSACHUSETTS RESIDENTS OVERALL OR AMONG RACIAL/ETHNIC MINORITIES. Karen E. Lasser1,4; Chieh
Chu1; Danny McCormick2; Nancy R. Kressin3,1; Meredith D'Amore1; Howard Cabral4; Alok Kapoor1; Adam Rose5,1; Amresh Hanchate3,1.
1Boston Medical Center/Boston University School of Medicine, Boston, MA; 2Cambridge Health Alliance/Harvard Medical School, Cambridge, MA; 3VA Boston Healthcare System, Boston, MA; 4Boston University School of Public Health, Boston, MA; 5Bedford VA Medical Center, Bedford, MA. (Control ID #1310972)

BACKGROUND: Following Massachusetts (MA) health reform, the percent of uninsured residents fell from 8.4% to 3.4%. Prior studies have not examined the effect of this policy change on 30-day readmission rates for acute myocardial infarction (AMI). We hypothesized that these admissions, which are sensitive to access to outpatient care, would decline in MA following reform, particularly among minorities historically disadvantaged in terms of insurance coverage.
METHODS: We analyzed 2004-2009 inpatient discharge data from MA and New York ([NY], which did not undergo health reform). We compared 30-day readmission rates (for any cause) after a hospitalization for AMI overall, and among racial/ethnic subgroups, for patients age 18-64 (those affected by health reform) in the 21 months prior to and following MA reform. We used chi-square tests to compare unadjusted 30-day readmissions for AMI between groups. Treating MA adults as the intervention cohort, and NY adults as the control cohort, we used logistic regression to conduct a difference-in-difference analysis that estimates odds of readmission in the post-reform period vs. the pre-reform period in MA adjusted for secular changes unrelated to reform. We performed this analysis for the entire sample and also stratified by whites, blacks, and Hispanics. The model was also adjusted for age, gender, and Charlson Comorbidity Score. In order to assess differences in white vs. minority disparities over time between the pre and post reform periods in MA relative to NY, we

used logistic regression to conduct a difference-in-difference-in-differences analysis.
RESULTS: There were 50,720 admissions for AMI in NY and MA over the study period. In MA, pre-reform and post-reform readmission rates were11.5% and 10.5%. In NY, they were 12.8% and 12.3% respectively. The post-reform decrease in MA was not significantly different than that in NY (difference-in-difference adjusted OR [AOR] 1.0, 95% confidence interval [CI], 0.9-1.1). In MA, blacks had higher readmission rates than whites both pre-reform (16.9% vs. 11.3%; p=0.003) and post-reform (16.1% vs. 10.2%; p =0.0006). In NY, blacks also had higher readmission rates than whites pre-reform (18.8% vs. 11.4%; p<0.0001) and post-reform (17.2% vs. 11.2%; p<0.0001). Prior to reform in MA, Hispanics had significantly higher readmission rates than whites (16.5% vs. 11.3%, p=0.005); post-reform there was no significant difference in readmission rates (12.8% vs. 10.2%, p=0.1). In NY, Hispanics had significantly higher readmission rates than whites, both pre- and post-reform (15.9% vs. 11.4%, p<0.0001 and 16.3% vs.11.2%, p<0.0001, respectively). Difference-in-difference estimates stratified by race/ ethnicity indicated that the post-reform changes in readmission rates in MA and NY were not significantly different among whites, blacks, and Hispanics. In difference-in-difference-in-differences analyses, there was no significant change in the presence of disparities between whites and blacks or between whites and Hispanics in NY vs. MA pre- and post-reform. CONCLUSIONS: A major coverage expansion in MA was not associated with a reduction in 30-day readmissions for AMI overall or a reduction in racial and ethnic disparities in this outcome. Other interventions may be needed to further reduce 30-day readmissions for AMI overall, and to decrease disparities in such readmissions.
MAXIMIZING TEACHING EFFECTIVENESS: PREDICTORS OF LEARNER SATISFACTION WITH TEACHING ON ROUNDS Chad Stickrath1,2; Megan Griffiths2; Allan V. Prochazka1,2; Eva M. Aagaard2; Melver Anderson1,2; Melissa N. Deloughry2. 1Denver VA Medical Center, Denver, CO; 2University of Colorado Denver, Aurora, CO. (Control ID #1339996)
BACKGROUND: Traditionally, inpatient academic internal medicine teams have employed "attending rounds" to fulfill their patient care and teaching duties. As a part of a study to assess the current characteristics and impressions of internal medicine attending rounds, we investigated the predictors of learner satisfaction with attending teaching on rounds. METHODS: We conducted a cross-sectional study of attending ward rounds on the general inpatient medicine services at four teaching hospitals affiliated with a large public medical school. Trained, independent observers accompanied general internal medicine teams on attending rounds to observe, time, and record the activities of these rounds, including
the location, participants, patient care activities, communication activities, and teaching activities. A single observer followed each team, observing one post-call day and one non-post-call day. Observations did not occur on the first day of the month and were otherwise completed on random days during the month. After observing the entire episode of attending rounds for the day, observers then invited attendings and trainees to complete a 12-item self-administered questionnaire. Items on the questionnaire utilized a 4-point Likert scale to assess: overall teaching effectiveness, attending input to patient care plans, effective teaching of history-taking or physical exam skills, the opportunity for trainees to direct the learning, medical topic teaching, helpful references being made to the medical literature, areas for future learning, the attending providing useful feedback, the creation of a safe learning environment, and whether the observed rounds were representative of a normal day. We used Chi Square testing and logistic regression to assess predictors of learner satisfaction with attending teaching.
RESULTS: We observed 63 rounding sessions involving 605 patients and 206 trainees (34% residents, 27% interns, 25% third-year medical students, 7% sub-interns). Rounds lasted on average 123 minutes (42). Trainee satisfaction with teaching on rounds was high overall (45% strongly agreed and 50% agreed that effective teaching occurred on rounds that day). Perceptions about the quality of teaching was not influenced by trainee level or the duration of rounds (p=NS for all comparisons). In logistic regression, the independent predictors of high satisfaction with attending teaching were the attending adding valuable patient care

information (OR7.44), effectively teaching physical exam skills on rounds (OR 2.01), being given the opportunity to identify topics for learning (OR 2.48), helpful references to the literature being given (OR 1.83), and history taking skills being taught effectively (OR 1.76). Provision of feedback and a safe learning environment were not independently predictive of teaching satisfaction.
CONCLUSIONS: We found that trainee satisfaction with attending teaching related to discrete activities that emphasize clinical skills (history/physical exam), discussion of medical literature and providing information that is felt to be valuable for patient care. Interventions to improve the quality of attending rounds teaching should consider focusing on these key elements.
MEASURING SURVIVAL-TO-DISCHARGE RATES FOR IN-HOSPITAL CARDIAC ARREST WITH THE USE OF THE LUCAS-CPR CARDIOPULMONARY RESUSCITATION (CPR) ASSIST DEVICE Daniel Gutteridge; Siva K. Talluri; Bhavana Siddegowda Bangalore; PramodK. Kalagara. McLaren Regional Medical Center, Flint, MI. (Control ID #1339491)
BACKGROUND: Cardiopulmonary resuscitation gained popularity during the 1960s. The national in-hospital survival-to-discharge rates are 15-20%, similar to those observed two decades earlier. The recent addition of cardiopulmonary resuscitation (CPR) assist devices may have the potential to improve the current survival-to-discharge rates. The LUCAS-CPR device, an active compression/decompression CPR assist tool, provides chest compressions at an optimal rate and depth in an uninterrupted manner. This eliminates human error due to physical fatigue by both limiting interruptions and inadequate compressions that can impair adequate circulation. The LUCAS-CPR creates higher coronary perfusion pressures with a lower incidence of rib fractures. Early studies in the out-of-hospital setting showed no increase in survival-to-admission rates with the adoption of CPR assist devises. We found no studies reviewing in-hospital use of assist devices. Our objective is to compare survival-to-discharge rates of in-hospital cardiac arrests using the LUCAS-CPR assist device to those that did not employ the device at our facility. METHODS: This is a retrospective analysis of hospitalized patients who experienced a CPR-related event over a 21-month period (2010-2011) in a US community hospital. Patients were excluded if Code Sheets were incomplete or Advanced Cardiac Life Support (ACLS) was stopped within 5 minutes due to by family request or advance directives noted in the chart. The population studied was characterized

according to age, sex, race, cardiac rhythm, co-morbid conditions and the use of LUCAS-CPR at the time of CPR initiation. We also looked at the individual patients All Patient Refined-Diagnosis Related Group (APR-DRG) morbidity and mortality risk, a system wide insurance tool that stratifies risk to evaluate severity of illness of hospitalized patients based on current condition and procedures. RESULTS: One hundred nineteen patients had in-hospital CPR-related events with Code Sheets. Thirty met exclusion criteria leaving a study population of 89. The mean age (SD) of study population is 71(13.5). It was predominantly men 57.3% (N=51) and Caucasian70.8% (N=63). Cardiac rhythm at the time of cardiac arrest was predominantly Pulseless Electrical Activity (PEA) 50.6 % (N=45) followed by asystole 20.2 % (N=18). Survival-to-discharge rate in the study population was 25% (N=22). LUCAS-CPR machine was used in 57.3% (N=51) of patients. The mean age (SD) of patients in LUCAS-CPR group was 70 (13.2) and non-LUCAS-CPR group was 71 (14.1). Cardiac rhythm at the time of arrest was similar in LUCAS-CPR group, PEA 49% (N=25) and asystole 21.6% (N=11) and non-LUCAS-CPR group PEA 52.6% (N=20) and asystole 18.4% (N=7). We found that there was no statistically significant difference in survival-to-discharge rates between patients in the LUCAS-CPR and non-LUCAS-CPR groups. Small sample size may have prevented us from achieving statistical significance (odds ratio 1.42, 95% CI 0.53-3.83, P=0.53). Survival to discharge rate in patients in the non LUCAS CPR group was 21.2% and in the LUCAS-CPR group was 27.6%. Absolute risk reduction was 6.4% and number need to treat was 15.6.

CONCLUSIONS: Though not statistically significant the rate of survival was 1.4 times higher in the LUCAS-CPR group. Due to our limited sample size, a large multi-center study is required to further explore these findings.

MEDICAL INTENSIVE CARE UNIT ADMITTING PATTERNS IN A NATIONAL COHORT Lena M. Chen1,2; Anne E. Sales1; Edward H. Kennedy1; TImothy Hofer1,2. 1VA Ann Arbor Healthcare System, Ann Arbor, MI; 2University of Michigan, Ann Arbor, MI. (Control ID #1314351)

BACKGROUND: Critical care makes up nearly 1% of the US gross domestic product, but there is wide hospital variation in critical care resource use. It is possible that some hospitals have higher ICU admission rates because of patient factors beyond their control such as admitting diagnosis. Therefore, we sought to describe the diagnosis-specific association between severity of illness and ICU admission rates.

METHODS: We created a retrospective cohort of the first non-surgical admission of patients admitted from the Emergency Department or Outpatient Clinic to 120 Veterans Affairs (VA) acute care hospitals from July 2009 to June 2010. Our primary predictor was severity of illness, which was defined as 30-day predicted mortality on admission, and estimated using the validated VAICU severity score. We constructed separate multilevel models (random intercept and slope) predicting ICU admission rates for each of the nine most common admitting diagnoses. Our models did not adjust for any covariates beyond severity and admitting diagnosis.

RESULTS: The 278,335 patients in our cohort had a median 30-day predicted mortality of 1.5%. The ICU admission rate for a median severity patient varied from 3.8% for pneumonia to 46.5% for acute myocardial infarction. The odds ratio for the change in ICU admission rate for a one standard deviation change in severity of illness varied from 1.08 for chest pain to 2.39 for gastrointestinal hemorrhage. Compared to non-cardiac diagnoses (i.e., sepsis, chronic obstructive pulmonary disease, gastrointestinal hemorrhage, and pneumonia), ICU admission rates for cardiac diagnoses were not as strongly associated with changes in predicted mortality (Figure).

CONCLUSIONS: Our results quantify the disparate way in which the ICU is used across diagnoses, and suggest that measures of ICU utilization that aggregate across diagnoses will not work well as global measures of efficiency. Our findings also raises the larger question of whether current diagnosis-specific patterns of ICU utliization represent the best use of an expensive resource.

MEDICAL HOME RECOGNITION AND DIABETES QUALITY OF CARE IN COMMUNITY HEALTH CENTERS Robin Clarke1; Chihong Tseng1; Robert Brook1,2; Arleen Brown1. 1UCLA, Santa Monica, CA; 2RAND Corporation, Santa Monica, CA. (Control ID #1310231)

BACKGROUND: The Affordable Care Act increased funding to community health centers (CHCs) to double the number of newly insured, low-income patients for whom they provide ambulatory care services. The Center for Medicare and Medicaid Innovation and Health Resources and Services Administration (HRSA) have launched programs incentivizing CHCs to transform into patient-centered medical homes (PCMH). These programs measure a PCMH by the assessment tool developed by the National Committee for Quality Assurance (NCQA). At this time, little is known about if and how CHC performance on the NCQA tool is associated with the quality of chronic disease care provided by these clinics.

METHODS: CHCs which were members of a Los Angeles County consortium, employed at least one physician and provided health services were invited to participate. Participating organizations completed the NCQAs 2008 PCMH tool. A NCQA level was assigned to each organization based on a 100-point scale and number of must-pass elements passed. Patient socio-demographic information and diabetes clinical data were collected for 50 randomly selected adult diabetic patients from each organization. National Quality Forum diabetes care processes (e.g. Hemoglobin A1c in last 12 months) and intermediate outcomes (e.g A1c<8%) were collected. CHC structural characteristics about each organization were extracted from a public database. Random intercept mixed effects models were conducted using NCQA performance as the independent variable and adjusting for patient- and clinic-level characteristics and clustering within clinics. Predicted probabilities and

relative risks were created for each diabetes outcome comparing clinics at higher levels of NCQA recognition to those at the lowest level.

RESULTS: Of the 46 organizations within the consortium, 40 were eligible, and 30 (75%) participated in the study. The structural characteristics of the participating and non-participating organizations were not substantially different. Each of the organizations exceeded the threshold to be recognized by the NCQA as a medical home. Eight (27%) earned the highest Level 3 recognition, three (10%) received Level 2, and 19 (63%) received Level 1. Forty-five patient observations were dropped because of missing values creating a final sample of 1455 patients. For each care process and intermediate outcome, there was a distribution with organizations providing diabetes care below and above established standards from other CHC samples. The relative risks for each of the diabetes care processes and intermediate outcomes comparing the Levels 2 and 3 NCQA level clinics to the Level 1 clinics were non-significant. Sensitivity analyses using score on the 100-point scale and on each of the tools 9 domains also produced no significant relationship between NCQA performance and diabetes care.
CONCLUSIONS: These analyses indicate that a diabetic patient has a similar probability of receiving a screening test or having a risk factor controlled in CHCs eligible for the highest and lowest NCQA recognition levels. Our findings raise the possibility that implementing the NCQA medical home components may be necessary but not sufficient for improving quality of diabetes care in CHCs. The implications are that the HRSA and Innovation Center programs should consider expanding PCMH transformation beyond just the NCQA tool in order to shape the primary care delivered by CHCs to millions of newly insured Americans.
MEDICATION DISCREPANCIES IN INTEGRATED ELECTRONIC HEALTH RECORDS Amy Linsky1,2; Steven R. Simon1,3. 1VA Boston Healthcare System, Boston, MA; 2Boston University School of Medicine, Boston, MA; 3Brigham and Women's Hospital, Boston, MA. (Control ID #1314930)
BACKGROUND: Medication reconciliation has emerged as a process to reduce medication-related errors. Medication discrepancies are often used as a proxy for potential errors. Electronic health records (EHRs) have been suggested as a way to reduce the presence of these discrepancies, but there is no evidence that EHRs or electronic medication reconciliation processes are associated with fewer discrepancies. Given that the Veterans Affairs (VA) healthcare system has an established EHR integrated with pharmacy dispensing, we sought to determine the prevalence of medication discrepancies, the medications involved and the factors associated with them. METHODS: We analyzed data from a convenience sample of patients (N=105) seen in ambulatory care clinics at VA Boston, 3/10-7/11, by fourth-year medical students. Students performed medication reconciliation to a computer-generated medication list (List) that included all medications and non-durable medical supplies dispensed at VA Boston(i.e., locally-dispensed), from other VA facilities (i.e., remotely-dispensed) and non-VA sources. The main outcomes were the presence of non-mutually exclusive types of discrepancies, including commissions (medications present on List but not taken per patient report), omissions (medications not present on List but taken per patient report), duplications (present more than once) or alterations in dose or frequency. Characteristics included patient age (65 vs. <65 years), sex, number of items on List, care provided at other VA facilities (yes vs. no) and presence of non-locally dispensed medications (yes vs. no). Single predictor and multivariable logistic regression models estimated the associations of patient and system factors with the presence of each type of discrepancy.
RESULTS: We analyzed 104 medication reconciliations. This Veteran cohort was predominantly male (95%); 59 (57%) were age 65 years or older. The median number of medications was 8 (IQR 5-13). Sixteen patients (15%) had evidence of care in other VA systems, and 50 (48%) had documentation of non-locally dispensed medications. Sixty-two (60%) patients had at least one medication discrepancy. Prevalence of commissions, omissions, duplications and alterations in dose or frequency were 36%, 27%, 11% and 19%, respectively. In unadjusted analyses, each additional medication was associated with higher likelihood of commissions (OR 1.1;

95% CI 1.1-1.2) and duplications (OR 1.2; 95% CI 1.1-1.4) and with lower likelihood of omissions (OR0.9; 95% CI 0.8-1.0). Non-locally dispensed medications was associated with increased odds of duplications (OR 5.7; 95% CI 1.2-27.9). In adjusted analyses, an increasing number of medications remained associated with commissions (OR 1.2; 95% CI 1.1-1.3) and omissions (OR 0.9; 95% CI 0.8-1.0). The involved medications differed by type of discrepancy, but non-opioid analgesics and herbal therapies were commonly seen in errors of commission and omission. CONCLUSIONS: In a system with a well-established EHR that is directly linked to pharmacy dispensing, medication discrepancies occurred in 60% of patients visiting ambulatory clinics. Patients with greater number of medications were more likely to have errors of commission and duplication, but were less likely to have errors of omission. Our findings highlight that relying on EHRs alone will not ensure an accurate medication list and stress the need to review medication taking thoroughly with patients to capitalize on the full potential of EHRs.

MEETING PERFORMANCE STANDARDS FOR ANTICOAGULATION EDUCATION: WHAT SHOULD BE TAUGHT? Christopher Moreland1; Richard L. Kravitz2; Debora Paterniti2; Chin-Shang Li2; Tzu-Chun Lin2; Richard H. White2. 1The University of Texas HSC - San Antonio, San Antonio, TX; 2University of California, Davis, Sacramento, CA. (Control ID #1339651)

BACKGROUND: The Joint Commission (JC) Venous Thromboembolism quality measure outlines four criteria for the education of patients starting warfarin on discharge. However, these criteria do not specify educational content regarding patient recognition of potentially dangerous warfarin-related scenarios, nor has any study investigated this potentially critical element of warfarin education. The authors designed this study to investigate how well patients assess the risks and consequences of potential warfarin-related safety threats, as well as what high-risk scenarios are not recognized as dangerous. METHODS: From a population of adult patients on long-term warfarin therapy through an anticoagulation clinic at an academic medical center, we randomly selected 480 for a telephone-based survey, with 38.3% participation. Warfarin knowledge questions were drawn from a previous survey; warfarin-associated risk scenarios were developed via focus interviews. Expert anticoagulation pharmacists categorized each scenario as urgent, moderately urgent, or not urgent; survey participants did the same. The initial measure was percentage of correct responses to knowledge questions. Main measures were accuracy, over-estimation, and under-estimation when categorizing clinical scenarios urgency, as well as identification of scenarios for which patients characterization most diverged from pharmacists.

RESULTS: 184 participants completed the survey. The mean knowledge score was 69% (SD 0.20). Overall classification accuracy of situational urgency was 59% (95% CI 57.3-60.3%). Respondents over-estimated non-urgent-severity situations 23% of the time (95% CI 20.8-24.7%), while underestimating urgent-severity situations 21% of the time (95% CI 19.0-23.9%). Four situations were underestimated by >20%: acute vision loss, head trauma, prescription of a new medication, and missing a warfarin dose. CONCLUSIONS: Despite fair factual knowledge of warfarin, participants did not appear to recognize well the clinical severity of warfarin-associated scenarios. In addition to JC measure requirements, warfarin education programs should incorporate patient-centered strategies to teach recognition of high-risk situations that compromise patient safety, including stroke symptoms, head trauma, and medication management.

MENTAL HEALTH STATUS AND PHYSICAL FUNCTION OF COMBAT-INJURED MILITARY PERSONNEL AT HOSPITAL DISCHARGE Valerie Lawrence1,2; Polly H. Noel1,2; Linda H. Yoder3,4; John E. Cornell2,1; Anthony E. Johnson5; Joseph R. Hsu4,5; Steven E. Wolf6. 1South Texas Veterans Health Care System, San Antonio, TX;

2University of Texas Health Science Center, San Antonio, TX; 3University of Texas at Austin, Austin, TX; 4United States Army Institute for Surgical Research, Fort Sam Houston, TX; 5San Antonio Military Medical Center, Fort Sam Houston, TX; 6University of Texas Southwestern Medical Center, Dallas, TX. (Control ID #1326553)

BACKGROUND: Much is unknown regarding mental health and physical function outcomes among service members injured in Iraq and Afghani-

stan. The San Antonio Military Medical Center (SAMMC) provides combat trauma care to all active duty personnel whose home base is in the Great Plains Regional Medical Command, which encompasses 17 states. We hypothesized that combat-injured service members would have significant residual mental and physical impairment when well enough for discharge from inpatient care at SAMMC.
METHODS: Joint VA-DoD prospective cohort study of consecutively consenting combat-wounded service members 18 years old, hospitalized 72 hours at SAMMC after medical evacuation from Iraq or Afghanistan, surveyed at the time of discharge from inpatient care, using a battery of psychosocial and functional status measures, and annually thereafter for 4 years.
RESULTS: Of 70 combat-injured enrolled, 67 were men (95.7%). Other demographic characteristics were: age range 19-45 years old with a mean (sd) age of 27.8 (6.2) and 54 (77%) nonHispanic white, 10 (14.3%) Hispanic, and 6(8.6%) African-American or other. Mean ADL and IADL scores were 10.7(2.7) and 14.4 (3.5). Mean pain score (McGill Short Form Pain Questionnaire) was 3.8 (2.1). For health-related quality of life, mean SF12V PCS and MCS scores were 29.03 (7.4) and 54.6 (10.0), respectively. Regarding PTSD and depression, mean PCL-M (military) and CES-D scores were 32.2(12.2) and 18.1 (6.1) respectively. Based on National Center for PTSD cutoff scores for those serving in Iraq or Afghanistan, 48 (66%) had positive PTSD screens and 44 (63%) met criteria for diagnosis. Using a CES-D score of 16, 44 (63%) met criteria for clinical depression.
CONCLUSIONS: After recovering from combat injury sufficiently to be discharged from inpatient care, this cohort had some impairment in ADL and IADL but still scored better than the U.S. average on the PCS. Despite scoring at about the U.S. average on the MCS, a high proportion (>60%) met criteria for clinical depression and screening and diagnostic criteria for PTSD. These data will be important for examining recovery trajectories over the four-year follow-up period for the cohort. The findings suggest that primary care providers will need to coordinate care for mental health and physical rehabilitation, in addition to medical comorbidities, for substantial numbers of combat-injured as they continue recovery as outpatients and after leaving the military.
MENTORING IN ACADEMIC MEDICINE: THE PERSPECTIVE OF THE MENTOR Rebecca E. Selling1; Scott De La Cruz2; Steven R. Lowenstein3; Traci Yamashita1; Eva M. Aagaard2. 1University of Colorado School of Medicine, Aurora, CO; 2University of Colorado School of Medicine, Aurora, CO; 3University of Colorado School of Medicine, Aurora, CO. (Control ID #1340036)
BACKGROUND: Mentoring is an important predictor of career success and productivity in academic medicine. Opinions regarding mentoring have previously been studied predominantly from the perspective of the protg.
METHODS: We conducted a cross-sectional online survey of all faculty members at the University of Colorado School of Medicine in April, 2010. The survey included 28 items and assessed faculty attitudes toward mentoring, ways in which mentorship was valued by the department and school, barriers to mentoring and interest in mentor-training programs. Data analysis included basic descriptive statistics (frequencies, means, standard deviations, medians, interquartile ranges) and proportions with 95% confidence intervals. RESULTS: The response rate was 24%; the final sample included 499 faculty members. Fifty-two percent of participants were female; with respect to academic rank, 23% were professors, 28% were associate professors, 36% were assistant professors, and 13% were instructors. Thirty-eight percent of participants spent 50% professional time on research. Forty-four percent of participants spent 50% professional time on clinical practices. Seventy-nine percent (95% confidence interval [CI]75.8-82.2) of faculty reported acting as a mentor. Mentors had a median of 4 (IQR 3,8) protgs. The average time spent mentoring was 5.45.4 hours per week. Ninety-seven percent (95% CI 95-98) of participants felt mentoring was an important part of their job and 95% (95% CI 93-96) felt the

School of Medicine should do more to encourage mentoring. Acknowledgement in annual performance reviews was the most common way in which mentorship was rewarded (57%, 95% CI 53-61); a monetary stipend was the least common (8%, 95% CI 6-10). Inadequate time (90%,
95% CI 88-92) and the importance of other responsibilities (87%, 95% CI 84-90) were identified as the greatest barriers to mentoring, but two-thirds of survey participants (67%; 95% CI 63-71) also identified a lack of adequate training as a barrier. A similar proportion of faculty (68%; 95% CI 64-72) were interested in a mentor-training program. The preferred format for such training was a workshop (82%, 95% CI 78-86). Participants reported the greatest interest in learning how to mentor with regard to career planning (86%, 95% CI 83-89) and conflict resolution skills (75%, 95% CI 71-79).
CONCLUSIONS: This study contributes the perspective of the mentor to the current literature regarding mentoring in academic medicine. Recognition of the time and effort required for this important role is necessary. Moreover, most faculty are interested in training to improve their skills as mentors.
METHADONE DOSE-RELATED INCREASE IN QTC WITHOUT CLINICALLY SIGNIFICANT PROLONGATION OR ARRHYTHMIA Karran A. Phillips1; David H. Epstein1; Dave Reamer1; Gavin Bart2; Kenzie L. Preston1. 1NIDA/NIH, Baltimore, MD; 2University of Minnesota, Minneapolis, MN. (Control ID #1340383)
BACKGROUND: Methadone is an effective treatment for opioid dependence. However, some studies suggest that methadone may increase QTc intervals, possibly leading to cardiac arrhythmias and death. We prospectively determined the impact of methadone dose on QTc prolongation in methadone-maintained participants.
METHODS: Methadone-maintained outpatients underwent electrocardiograms (ECGs) in triplicate at baseline prior to first dose and at 4-6 week intervals for 30 weeks (7 time points). Automated measurements for QTc were averaged for each triplicate. We defined QTc prolongation as >450 ms for males and >470 ms for females. Participants who provided ECGs at baseline and at least one other time point were included in this analysis.
RESULTS: The 93 participants provided 1683 ECGs (561 triplicates). Mean age was 38.4 (SD 8.2) years; 55% were African American, and 74% male. Baseline positive urines were 98% for heroin, 82% for cocaine, and 4% for benzodiazepines. Baseline ECG findings and self-report suggested a low prevalence of structural heart disease, hypertension, and hyperlipidemia. Use of QTc-affecting medications and electrolyte abnormalities were infrequent. At baseline, mean QTc was 410.2 (SD 16.6) ms, with only 1 participant meeting criteria for QTc prolongation. During the study, only 33 (7.5%) of the 561 ECG triplicates met criteria for QTc prolongation. Controlling for age and sex, mean QTc was higher at each time point than at baseline (all $p<0.001$), but no mean increase occurred after week 6. Controlling for study week, age, and sex, only mean methadone dose (range 70-190 mg) in the 5 days prior to ECG was associated with QTc prolongation ($F(1,338)=19.58$, $p<0.001$). In all 561 ECG triplicates obtained, only 7 (in 5 participants) had an increase in QTc interval of >60 ms or >15% from baseline or >500 ms. Multiple logistic regressions showed no significant effect of dose on these outcomes. There were no adverse clinical outcomes associated with QTc prolongation in this sample.
CONCLUSIONS: Our findings, and the lack of evidence that QTc monitoring is an effective risk stratification tool for sudden cardiac death, suggest that it is premature to recommend QTc risk evaluation in this population.
METHODS TO IMPROVE INFORMED CONSENT PROCEDURES FOR RESEARCH SUBJECTS WITH LOW LITERACY: A SYSTEMATIC REVIEW Leonardo Tamariz; Ana M. Palacio; Mauricio Robert; Erin N. Marcus. University of Miami, Miami, FL. (Control ID #1336856)
BACKGROUND: Research subjects do not adequately understand information presented to them during the informed consent (IC) process. Inadequate health literacy may exacerbate the limited understanding of the informed consent.The purpose of this study is to evaluate the evidence supporting interventions to improve comprehension of the IC process in low literacy research subjects. METHODS: A MEDLINE database search (1966 to November 2011) supplemented by manual searches of bibliographies of key relevant articles

was performed. We selected all studies in which an intervention was tested to improve comprehension of informed consent and the intervention was evaluated in low literacy populations. The main outcome evaluated was comprehension measured using written test or verbal comprehension. RESULTS: Our search strategy yielded 58 studies, of which only 4 met our eligibility criteria. The four studies included 593 research participants. The table summarizes the results of each study. The studies predominantly included populations that were older (median age 61 range 49-64), ethnic minority, and with literacy level of 8th grade or below. Only one study had a randomized design. The specific intervention differed in each study. Two of the studies included the teach-back method or teach to goal method and achieved the highest
level of comprehension. An intervention that involved changing the readability level of the informed consent document resulted in the lowest comprehension among study subjects.
CONCLUSIONS: The evidence supporting interventions to improve the informed consent process in low literacy populations is extremely limited. Efforts to improve understanding through the use of multimedia and enhanced consent forms have had only limited success. As in the field of health education having a study team member spend more time talking one-on-one to study participants is the most effective available way of improving research participants understanding. Additional research is needed because of the lack of randomized controlled trials.
Source Intervention Population and literacy
Sample size Comprehension score in control arm
Comprehension score in intervention arm
Bickmore, 2009 Computer agent with touch screen interaction
Older minority with8th grade or lower level
13 30 25
Kripalani, 2008 Teach back method Older minority with CAD and <8th grade level
284 NA 31
Sudore, 2006 Teach to goal method Older minority with TOHFLA <23 45 NA 98 Young, 1990 Changing IC to 6thgrade reading level
Middle age 251 NA 13
NA: Not controlled arm studies IC: informed consent
MISSED OPPORTUNITIES FOR EFFECTIVE PATIENT EDUCATION AND COUNSELING: WHAT THE UNANNOUNCED STANDARDIZED PATIENT EXPERIENCE CAN TELL US Colleen Gillespie; Nina Yeboah; Angela Burgess; Kathleen Hanley; David Stevens; Andrew B. Wallach; Sondra Zabar. New York University School of Medicine, New York, NY. (Control ID #1337759)
BACKGROUND: Patient education and counseling skills are critical to patient safety and outcomes, especially for achieving behavior change and managing chronic conditions. The goal of this study was to explore the nature and quality of patient education and counseling skills through in-depth qualitative analysis of resident physician interactions with Unannounced Standardized Patients (USPs) - trained actors integrated incognito into practice. We sought to describe, from the ground up, variation in how resident physicians educate and counsel patients, focusing on aspects that might not be captured through commonly used checklists based on the ASK-TELL-ASK model of patient education.
METHODS: Highly trained USPs portrayed two clinical cases, one involving asthma medication education and the other a routine visit requiring both education about a common condition and general preventive recommendations. They were scheduled as new patients and seen by Internal Medicine Residents in two busy, urban primary care clinics. Residents were aware they would see USPs in clinic, but did not know when. USPs completed a comprehensive checklist that assessed communication skills, including those patient education and counseling skills associated with the ASK-TELL-ASK model (assess understanding, provide clear explanations, check understanding), as well as other core clinical skills, after each visit and used a concealed

digital recorder to audiotape visits. The 18/ 37 audible encounters comprise the analysis sample; Asthma case= 8 and Routine Visit case=10. Average visit length was 26 minutes (range 12 - 37 minutes). Case portrayal was assessed and found to be consistent. Tapes were transcribed and entered into Atlas TI, a qualitative analysis software program, to facilitate coding and analysis. Major themes were identified by listening to the audio while reading the transcripts so as to include tone, emotion, and other verbal cues. RESULTS: The qualitative data validated core aspects of the checklist assessment, namely that the clarity of explanations and degree of summarizing/reviewed varied, and that evaluation of patient under-
standing was rare. Further analysis revealed that checklists may miss some significant aspects of the interaction -critical moments when patients could be more fully educated and engaged. These missed opportunities fell into four categories: 1) failing to orient patients (e.g., not setting an agenda or explaining reasons for actions; mean=4.2 times/visit); 2) failing to engage patients in behavior change (e.g., not reinforcing connections between symptoms and behavior change; postponing decisions until later visits; not making direct recommendations; mean=5.1 times/visit); 3) failing to engage patients in the treatment plan (e.g., not explaining reasons for medication, how to take, what to expect, when to follow-up and why; mean=2.9 times/ visit); and 4) failing to help patients navigate the system to obtain recommended services (mean=1.9 times/visit). CONCLUSIONS: While checklists capture critical positive aspects of education and counseling practice during the patient-physician encounter, in-depth qualitative exploration of USP interactions suggests the need to include assessment of missed opportunities to educate and activate patients. These missed opportunities may be essential to achieving intended outcomes of care with enhanced efficiency and therefore not only merit further study but are important targets for education and training.

MISSED OPPORTUNITIES FOR TREATMENT OF UNCONTROLLED HYPERTENSION AT PHYSICIAN OFFICE VISITS IN THE UNITED STATES, 2005-2009 Raman R. Khanna1; Ronald G. Victor2; Farzaneh Pour Ansari3; Premere Knowles2; Kirsten Bibbins-Domingo1; Eric Vittinghoff4; Pamela G. Coxson1; Larissa Thomas1; Martin F. Shapiro5; Mark J. Pletcher1,4. 1University of California, San Francisco, San Francisco, CA; 2Cedars-Sinai Medical Center, Los Angeles, CA; 3University of California, San Francisco, San Francisco, CA; 4University of California, San Francisco, San Francisco, CA; 5University of California, Los Angeles, Los Angeles, CA. (Control ID #1333898)

BACKGROUND: National guidelines recommend prescribing new blood pressure medication for all untreated patients with an established diagnosis of hypertension and at least Stage I-level blood pressure elevation (systolic blood pressure 140-159 and/or diastolic blood pressure 90-99). Some recent guidelines also recommend prescribing new blood pressure

medication (as compared to escalating medication dose) for patients who, despite treatment, have Stage II-level blood pressure elevation (systolic blood pressure 160 or diastolic blood pressure 100). It is unclear how often U.S. physicians adhere to these guidelines at each office visit. METHODS: We analyzed the National Ambulatory Medical Care Survey (NAMCS), a multistage, nationally representative, detailed survey of all office visits to non-federally employed physicians in the U.S. from 2005-2009 to determine the likelihood of new blood pressure medication prescribing for patients with uncontrolled hypertension at each office visit in the U.S. The NAMCS does not record medication dose so were not able to assess blood pressure medication dose escalation. We restricted our analysis to a visit population of non-pregnant adults with an established hypertension diagnosis and a visit blood pressure above the JNC 7 goal (systolic 140 mm Hg and/or diastolic 90 mm Hg) who were seeing a family/general practitioner, internist, or cardiologist. In this population, we analyzed predictors of new blood pressure medication prescribing, including demographic, clinical, and physician characteristics using multivariable regression. All analyses were sample weighted to account for the complex

survey design.
RESULTS: From 2005-2009, NAMCS recorded 8,071 observations meeting the above-specified restrictions, which represent approximately 58 million annual U.S. office visits. New blood pressure medication was prescribed to only 27.5% of untreated patients, 18.2% of treated patients with Stage II level blood pressure elevation, and 17.5% of all patients with uncontrolled blood pressure. Prescribing was more likely with higher visit blood pressure (adjusted odds ratio [aOR]=1.27, 95% confidence interval [CI] 1.20-1.34, and 1.44, 95% CI 1.25-1.65, for each 10 mm Hg of systolic and diastolic blood pressure, respectively), when patients were previously untreated (aOR=0.42 for one current medication, 95% confidence interval [CI] 0.34-0.52; aOR=0.18 for two or more current medications, 95% CI0.14-0.22), and when patients identified blood pressure as a visit reason (aOR=2.58, 95% CI 2.16-3.10). New medication prescribing only exceeded 50% in untreated patients with Stage II-level blood pressure elevation who identified blood pressure as a visit reason. New medication prescribing did not increase from 2005-2009 (p=0.40 for trend).
CONCLUSIONS: Missed opportunities to improve blood pressure control by prescribing new blood pressure medication for patients with uncontrolled hypertension are common during outpatient physician office visits in the U.S.
MODEL OF ADHERENCE TO BLOOD PRESSURE MEDICATIONS Jeffrey L. Jackson1; Patrick G. O'Malley2; Janice Hanson2.
1Zablocki VAMC, Milwaukee, WI; 2Walter Reed Army Medical Center, Bethesda, MD. (Control ID #1336718)
BACKGROUND: Hypertension is a common medical problem. Aherence to blood pressure medications is low, generally less than 50%. Better understanding of factors contributing to hypertension control could improve interventions to improve medication adherence.
METHODS: We enrolled a consecutive sample of consenting participants aged 40-80 y.o. who had hypertension, at least 2 additional chronic medical conditions, and were scheduled to see their internist for a routine appointment. Surveys assessed depression (PHQ-9), somatization (PHQ-15) and functional status (MOS SF-6). Post-visit surveys assess satisfaction (Rand-9). Adherence was assessed at 1 and 3 months using pill counts and was defined as greater than 80%. Models were developed using structural equation modeling and reported direct and indirect effects using standardized estimates, also known as effect sizes.
RESULTS: Among 106 participants, the average age was 66, 53% were women, 56% African-American and 88% were on5 medications. Average adherence at baseline, 1 and 3 months was: 47%, 49% and 50% respectively. The models for both 1 month and 3 month adherence were identical. Variables that directly increased adherence included baseline blood pressure (ES: 0.18, 95% CI: 0-0.37), Patient satisfaction (0.24, 95% CI: 0.05 to 0.42) and patient functional status (0.18, 95% CI: 0-0.38). Patient characteristics that indirectly decreased adherence (through effects on functional status) included worse depression scores (ES: -0.62, 95% CI: -1.3 to 0.0), somatization (-0.18 95%CI: -0.42 to 0.00) and number of comorbid conditions (-0.40, 95% CI: -0.97 to 0.0). The total number of medications was not related to hypertensive medication adherence (ESL -0.86, 95% CI: -2.3 to 0.61). Our model was well fitted (Chi2: 0.58) CONCLUSIONS: There are a number of patient characteristics that modulate adherence to hypertensive medications. Being depressed, having a greater number of comorbid conditions, higher somatization and poor functional status decrease adherence, while higher blood pressure readings and satisfaction with their provider increase adherence. Among these factors, depression and number of comorbid medical conditions had the greatest impact.

MONO AND DUAL RENIN-ANGIOTENSIN-ALDOSTERONE-SYSTEM (RAAS) INHIBITION STRATEGIES IN TYPE 2 DIABETES MELLITUS: SAFETY AND EFFICACY EXPERIENCES OF AN ENDOCRINOLOGY PRACTICE Michael P. Kane1,2; Alecia M. Heh1,2; Robert S. Busch2; Gary Bakst2; Jill M. Abelseth2; Robert A. Hamilton1; Daniel A. Belletti3. 1Albany College of Pharmacy and Health Sciences, Albany, NY; 2The Endocrine Group, LLP, Albany, NY; 3Novartis Pharmaceuticals, East Hanover, NJ. (Control ID #1279236)

BACKGROUND: Blockade of the RAAS has been shown to lower BP, decrease proteinuria and slow the decline in GFR in patients with CKD, and decrease morbidity and mortality in patients with chronic heart failure. While fairly standard practice, the utility of dual RAAS inhibition has not been studied in real world practice. We report our experience of various dual RAAS inhibition therapies in hypertensive, type 2 diabetes mellitus (T2DM) patients with proteinuria.
METHODS: This is a cross-sectional observational study comparing two cohorts of hypertensive, diabetes patients of a private endocrinology practice. Patients were identified via a computerized text search of patient electronic medical records (EMR) using generic and brand names of ACEIs, ARBs and direct renin inhibitors (DRI) available in the United States in April, 2011. Inclusion criteria: age between 18-89 years, documented diagnosis of HTN and T2DM for at least one year, history of proteinuria, at least one year of care with the practice, and stable RAAS agent therapy for a minimum of six months. Exclusion criteria: pregnancy, type 1 diabetes, and patients with ESRD. Mono and dual therapies were compared to each other in regards to efficacy (BP and urinary creatinine/ albumin ratio), and safety (serum potassium, BUN, serum creatinine, and mortality) at 6 and 12 months after initiation of therapy. A last observation carried forward (LOCF) analysis was performed; statistical analysis utilized the Kruskal-Wallis one-way nonparametric analysis of variance.
RESULTS: EMR search identified 866 patient records, including 242 patients who met all study criteria. 53 patients received ACEI or ARB monotherapy, 67 patients received ACEI/ARB combination therapy, 51 patients received ACEIDRI therapy, and 71 patients received ARB-DRI therapy. Average baseline patient age was 63 years (12), 63.6% were men, 89.3% were Caucasian, mean diabetes duration was 10 years (7), and average BMI and A1C values were 35.3 kg/m2 (7.7) and 7.59% (1.57), respectively. Significant baseline differences between groups included a shorter mean duration of diabetes, lower weight, and significantly less mean and median albuminuria at baseline in the monotherapy group compared to dual RAAS inhibition groups, and a lower baseline serum potassium and higher diastolic blood pressure in the monotherapy group compared to the DRI groups. There were no significant baseline differences between groups in BUN, serum creatinine, SBP, or A1C. LOCF analysis demonstrate similar overall efficacy in BP and albuminuria reduction, though the ACEI/DRI group had a greater reduction in albuminuria compared to the monotherapy group, but not compared to other dual therapy groups. LOCF analysis demonstrated similar overall safety between the groups(i.e., no significant differences in subsequent BUN, SCr, or K values). While baseline serum potassium was statistically different between monotherapy and DRI-based dual RAAS therapies (4.39+0.42 vs. 4.58+0.44) the LOCF values were equivalent and the changes were not significantly different (0.21+0.42 for mono; 0.16+0.41 for ACE/ARB; 0.11+0.47 for DRI based dual therapy) between groups. There were no significant differences between the groups in mortality.
CONCLUSIONS: Dual RAAS blockade using ACEI/ARB or DRI-based dual RAAS inhibition was well tolerated, demonstrating similar safety and efficacy compared to monotherapy in hypertensive patients with T2DM and proteinuria who required additional therapy.
MORE THAN MEETS THE EYE: MEASURING THE DUAL RISKS OF LOW HEALTH LITERACY AND POOR VISION FOR HOSPITALIZED GENERAL MEDICINE PATIENTS Madeleine I. Shapiro1; Vineet Arora2; Ainoa M. Mayo3; David Meltzer3; Valerie G. Press3. 1University of Chicago, Chicago, IL; 2University of Chicago Medical Center, Chicago, IL; 3University of Chicago Medical Center, Chicago, IL. (Control ID #1310958)
BACKGROUND: As our nation focuses on how to reduce healthcare costs, there is an increasing focus on improving care transitions by empowering patients. In fact, SGIM along with 5 other professional medical societies has adopted a set of care transition principles which include communication with patients and their caregivers about not only who their medical home is, but also focused education on treatment plans and follow-up expectations. While we should aim for a universal precaution approach when communicating with our patients, it is important to recognize that in resource-limited hospital settings, identification of vulnerable, high-risk (e.g. low health literacy [HL]) patients may be necessary to ensure adequate education for safe care

transitions. In order to identify these at-risk patients, an effective clinical screening tool is needed. Chew et al have validated a questionnaire to detect low HL among outpatients. Our objective is to evaluate the validity of the Chew tool for hospitalized patients.
METHODS: General medicine inpatients were enrolled from an ongoing study of resource allocation and quality of care at our hospital. Eligible patients (cognitively intact, English-speaking) completed the Chew tool: (q1) How often do you have problems learning about your medical condition because of difficulty understanding written information?; (q2) How confident are you filling out medical forms by yourself?; (q3) How often do you have someone help you read hospital materials? Participants responded on a Likert scale from 0-4 and were considered at-risk for poor HL if they answered sometimes, often, or always (q1, 3) or somewhat, a little bit, or not at all (q2). To validate the tool, we administered the REALM-R to participants if their vision was sufficient (Snellen screening chart).
RESULTS: To date we have enrolled 216 participants. The mean age is 53; the majority were female (54%) and African-American (82%). About 1/2 havehigh-school degree. Of the 122 participants who completed both HL tools (Chew and REALM-R), 39 (32%) were considered at-risk based on the Chew screening tool, while 56 (46%) were considered to have inadequate HL based on the REALM-R (p=0.02). The Chew tool had a sensitivity of 45%. Of note, about one-third (n=57) of participants approached for the REALM-R (n=179) were unable to complete it due to insufficient vision; 51% of these participants did not have their glasses with them in the hospital. Participants with insufficient vision (32/57, 56%) were more likely to be 'at risk' for poor HL on the Chew tool compared to those with sufficient vision (39/122, 32%; p=0.002).
CONCLUSIONS: We demonstrate that in a low-income, primarily African-American urban hospitalized population, two health literacy tools found differing prevalence of low HL. Our data suggest that the Chew screening tool may have low sensitivity among hospitalized and/or African-American patients; if upon completion of the study these findings remain, further evaluation of clinically relevant tools is needed. Additionally, the prevalence of poor vision (~1/3 of participants) in this population is non-trivial and may be an under-recognized risk factor for hospitalized patients. Internists should take into account the implications of the dual risks of poor HL and poor vision: up to 63% of patients may have difficulty reading, and/or understanding written material provided in the hospital setting, which may impede patient empowerment and high-quality care transitions.
MOTIVATION, SELF-EFFICACY, AND PERCEIVED AUTONOMY SUPPORT IN PATIENTS ENROLLED IN A CLINIC-BASED BEHAVIORAL WEIGHT LOSS PROGRAM Stephanie A. Rose1; Shu Shen2; Kelly H. Webber3. 1University of Kentucky, Lexington, KY; 2University of Kentucky, Lexington, KY; 3University of Kentucky, Lexington, KY. (Control ID #1336374)
BACKGROUND: Level and type of motivation can be predictive of completion and success in weight loss programs. The type of motivation (autonomous and controlled), level of self-efficacy, and perceived level of autonomy support in patients enrolled in a clinical weight loss program were assessed. The relationships between the measured variables were also explored.
METHODS: We performed a quantitative survey of patients at the start of a 12-week clinic-based medically-managed weight loss program based on the Diabetes Prevention Program between January and November 2011.

The survey included questions from the Treatment Self-Regulation Questionnaire (TSRQ), the Health Care Climate Questionnaire for maintaining a healthy diet (HCCQ), the Perceived Competence Scale (PCS), as well as questions regarding obesity screening and treatment practices by the patients primary care physician (PCP).
RESULTS: 28 overweight and obese patients (body mass index (BMI) 25 kg/

m2) agreed to participate. 85% reported having seen their PCP at least once in the past year. All patients reported that their PCP had ever told them that they needed to lose weight. 64% felt that their PCP was able to help them with weight loss, but only 36% felt it was their PCPs responsibility to help them with weight loss. The mean level of autonomous motivation (AM) was 6.04 (SD0.65) and the mean level of controlled motivation (CM) was 2.76 (SD 1.24). The mean level of self-efficacy was 4.75 (SD 1.46). The mean level of perceived PCP support of AM was 4.73 (SD 1.74). There was a positive correlation between self-efficacy and AM (r=0.27), and a negative correlation between self-efficacy and CM (r=-0.15). There was a small negative correlation between PCP support of AM and AM (r=-0.05), and a negative correlation between perceived PCP support of AM and CM (r=-0.41). CONCLUSIONS: Patients enrolled in a weight loss program reported higher mean levels of AM versus CM. This is similar to previous weight loss programs. Enrolled patients reported high levels of self-efficacy and perceived health care provider autonomy support. There was a positive correlation between self-efficacy and AM and a negative correlation between self-efficacy and CM. There was not a positive correlation between perceived AM support and AM, though there was a negative correlation between perceived AM support and CM. Future goals include linking these surveys to patient demographics, BMI change, and responses to post-intervention data, comparison of surveys of patients not enrolled in the weight loss program, and implementation of an intervention that improves health care provider support of autonomy.

MOTIVATIONAL INTERVIEWING BY HIV CARE PROVIDERS IS ASSOCIATED WITH PATIENT COMMITMENT TO REDUCE UNSAFE SEXUAL BEHAVIOR. Tabor E. Flickinger1;
Somnath Saha2; Todd Korthuis2; Ira Wilson3; Victoria L. Sharp4; JonathanA. Cohn5; Gary S. Rose6; Stephen Berry1; Michael B. Laws3; Mary Catherine Beach1. 1Johns Hopkins University School of Medicine, Baltimore, MD; 2Oregon Health and Science University, Portland, OR;
3Brown University, Providence, RI; 4St. Luke's Roosevelt, New York, NY;
5Wayne State University, Detroit, MI; 6Massachusetts School of Professional Psychology, Boston, MA. (Control ID #1337733)

BACKGROUND: Commitment to behavior change, when expressed by patients during clinical encounters, is associated with better patient outcomes. Motivational interviewing (MI) is a counseling style with the potential to elicit this commitment. The extent to which HIV providers use MI when counseling patients about safe sex, and whether its use is associated with patient commitment to safer sex practices, is unknown. We hypothesized that more MI-adherent provider counseling would be associated with patient expressions of commitment to safer sex. METHODS: Routine follow-up visits between 426 HIV-infected patients and 45 healthcare providers collected as part of the Enhancing Communication and HIV Outcomes (ECHO) Study were audio-recorded, transcribed and searched for sexual risk counseling. Our study outcome was the presence of expressed patient commitment to reduce high-risk sexual behavior, coded using the Client Language Assessment in Motivational Interviewing. The independent variable was the extent to which providers used communication behaviors consistent with MI, coded by the Motivational Interviewing Treatment Integrity (MITI). Using the MITI, we calculated an overall summary score reflecting the balance of MI adherent minus non-adherent provider talk. We used logistic regression analysis, with generalized estimating equations accounting for clustering of patients within providers, to investigate whether more provider MI-adherence was associated with patient commitment to sexual behavior change.

RESULTS: Of the 426 total audio-recorded encounters, 27 contained provider counseling regarding unsafe sexual practices. Six of the 27 dialogues included patient commitment talk to reduce unsafe sexual practices. The most
common provider behaviors within the 27 dialogues were giving information (e.g. The higher the viral load, the more likely the risk of infection n=114 utterances), and asking closed questions (e.g. Do you always use protection? n=95). The most common MI-adherent behaviors were reflections (e.g. You always use condoms then n=56) and patient affirmation (e.g. That is a very smart decision n=19). Less common MI-adherent

behaviors were emphasizing patient control (e.g. Youre the one who would say yes or no n=7) and support (e.g. You know we are here for you n=1). The most common MI-nonadherent behaviors were advising without permission (e.g. If youre gonna have sex with him, just use a condom n=16), directing the patient (Dont give it to anybody n=12) and confronting the patient (Its not okay for you to have sex without a condom n=6). The summary score of MI balance was higher in dialogues in which patients expressed commitment than in dialogues in which they did not (mean 4.0 vs. 1.2). The odds of expressed patient commitment were higher when providers used more MI adherent than non-adherent behaviors, OR: 1.17 (1.01-1.38).
CONCLUSIONS: Patients were more likely to express commitment to safer sex during clinical encounters in which their healthcare providers used communication behaviors consistent with the principles of motivational interviewing. With 1.2 million HIV-infected individuals in the United States, and 84% of new HIV infections caused by sexual transmission, MI holds promise as one strategy to help reduce the spread of HIV. More research is urgently needed to determine the most effective communication strategies to influence patient sexual risk behavior.

MOTIVATIONS OF RESIDENT TIME SPENT IN CLINICAL AND EDUCATIONAL ACTIVITIES AT HOME: IMPLICATIONS OF NEW DUTY HOURS SIGLIN, S; CORK, D; DEANO, R; GIANGRECO, D; APPANAGARI, A; DOLL, J; DEKOSKY, A.; POTTS, S; VARKEY, A; ARORA, A. Scott Siglin; David Cork; Roderick Deano; Vineet Arora. University of Chicago Medical Center, Chicago, IL. (Control ID #1338847)

BACKGROUND: The ACGME required implementation of resident duty hour restrictions across the U.S. in July 2011 and time spent performing patient care activities while out of the clinical setting is now being counted as part of the maximum allowed hours. While prior studies show that many residents access electronic health records (EHR) from home to complete clinical tasks, no study has yet examined what compels residents to complete clinical tasks from home after leaving the hospital. The aim of this study is to ascertain the motivation among Internal Medicine housestaff from three teaching hospitals to perform clinical work outside of the monitored duty hours.
METHODS: An anonymous two-page survey was created to assess the frequency by which residents perform clinical activities from home via telephone, internet, or remote access of EHR (checking labs, reviewing records, placing orders, communicating with ward teams, or managing clinic patients). Residents were also surveyed regarding their motivation to perform clinical duties from home on a 5-point agreement Likert scale. Paper surveys were distributed to Internal Medicine residents at mandatory housestaff meetings at three Midwestern teaching hospitals in Spring 2011. The surveys were entered into an Excel database and statistical analysis was performed by use of STATA 10.0. Chi square tests were utilized to assess differences by site or by residency training year.
RESULTS: 156 of residents responded with an overall response rate of 77%. Site responses varied from 68% to 86% (p=0.02). Residents reported accessing the electronic health record from home for checking labs for inpatients (86%) and outpatients (73%), ordering labs for inpatients (71%) and outpatients (56%). Communicating via phone or text with a co-resident was common (84%), and 74% reported contacting the cross-cover team from outside the hospital. Nearly a third (29%) of residents reported coming to the hospital to complete patient care work on their designated day off. 39% came to work on their day off for educational purposes. The most common reason residents reported working from home was to monitor a patients progress (81%) and to complete unfinished work (65%). Most residents (88%) believe the ability and skill-set to work from home is useful for future independent practice. There were differences between PGY classes, where interns were

more likely to believe their program expects them to access the EMR at home for inpatient and outpatient care (32% of interns compared to 25% of residents agreed). Almost half (45%) believe outside hospital clinical activity should also be more closely and formally monitored by the ACGME. Significant site differences were

noted regarding resident motivation and the programs expectation of residents to manage clinics from home, to complete unfinished work from home, and the desire for formal ACGME monitoring. The majority of housestaff (40%) believed that accessing EMR from home did not interfere with their personal life versus those that did (26%).
CONCLUSIONS: In spite of residency duty hour restrictions, many residents report accessing the EHR from home to advance care, primarily to monitor a patients progress and to complete unfinished work. As most residents believe this is a useful practice skill, it is important for residency programs to recognize this out of hospital activity and develop curricula and policies for remote use of electronic health records.
NATIONAL TRENDS IN ORAL ANTICOAGULANT USE IN THE UNITED STATES, 2007-2011 Rachel Kornfield1; Kate Kirley2; Dima M. Qato1; Randall S. Stafford3; G. Caleb Alexander1,4. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; 3Stanford University, Palo Alto, CA; 4University of Chicago, Chicago, IL. (Control ID #1322519)
BACKGROUND: Oral direct thrombin inhibitors offer a new means of preventing thromboembolism in ambulatory settings, yet little is known regarding their adoption in clinical practice. We described trends in oral anticoagulation for the prevention of thromboembolism in the United States.
METHODS: We used the IMS Health National Disease and Therapeutic Index, a serial cross-sectional nationally representative audit of office-based providers, to quantify patterns of oral anticoagulant use among all subjects and stratified by clinical indication. Our main outcome measure was an office visit where oral anticoagulation was used (treatment visit). We also quantified oral anticoagulant expenditures using the IMS Health National Prescription Audit.
RESULTS: Between 2007 and 2011, warfarin treatment visits declined from approximately 2.1 million [M] quarterly visits to approximately1.6 M visits. Since its market release in October 2010, dabigatran use increased from 0.062 M quarterly visits (2010Q4) to 0.231 M visits (2011Q3), reflecting its increasing share of oral anticoagulant visits from3.1% to 12.3%. The majority of oral anticoagulant treatment visits occurred with patients aged 65-84 years, but dabigatran use was even more focused within this age group than warfarin. The proportion of dabigatran use that occurred among individuals 85 years or older decreased from 22% to 3% over the four calendar quarters of available data. In contrast to warfarin, the majority of dabigatran visits have been for atrial fibrillation, though this proportion decreased from 92% (2010Q4) to 71% (2011Q3), with concomitant increases in dabigatrans off-label use. The most common off-label uses of dabigatran were for coronary artery disease, hypertensive heart disease and venous thromboembolism. Among atrial fibrillation visits, warfarin use decreased from 55.8% of visits (2010Q4) to45.4% (2011Q3), while dabigatran use increased from 4.0% to 11.9%. Of atrial fibrillation visits, the fraction without any oral anticoagulant use has remained unchanged at approximately 40% since the introduction of dabigatran. Prior to the availability of dabigatran, the majority of visits reporting oral anticoagulant use were with physicians practicing in internal medicine (30%), cardiology (34%), and family practice (19%), with fewer visits accounted for by physicians affiliated with osteopathy (5%), oncology (3%), or other specialties (8%). By contrast, most dabigatran visits during the four calendar quarters of available data were accounted for by cardiologists (54%), with fewer visits associated with internal medicine (29%), family practice (12%) or other clinical fields (6%). Expenditures related to dabigatran increased rapidly from $16 M in 2010Q4 to $141 M in 2011Q3, approaching expenditures on warfarin ($144 M) in 2011Q3.
CONCLUSIONS: Although representing a minority of all oral anticoagulant visits, dabigatran has been rapidly adopted into ambulatory practice in the United States, primarily for treatment of atrial fibrillation, but increasingly for off-label indications. We did not find evidence that it has increased overall atrial fibrillation treatment rates.
NEUROBIOLOGICAL CHANGES ACCOMPANY PATIENT-CENTERED INTERVIEWING Robert C. Smith; Issidoros Sarinopoulos; Seungcheol Lee; Chelsea Gordon; Lu Wang; Ashley Hesson; Francesca C. Dwamena. Michigan State University, East Lansing, MI. (Control ID #1324573)

BACKGROUND: Patient-centered interviewing (PCI) enhances the provider-patient relationship (PPR) and health outcomes, but the biological basis for this is unknown. Recent fMRI investigations report neurobiological changes during other dyadic interactions, for example, reduced threat-related neural activation in anterior insula in the presence of a strong marital relationship. In the first fMRI study of PCI/PPR we are aware of, we hypothesized that an evidence-based, behaviorally-defined PCI method, compared to isolated clinician-centered interviewing (CCI), would be associated with attenuated brain activation in the pain processing regions in anterior insula, the region that instantiates the emotional component of pain and where pain-related activation can be attenuated by supportive figures. METHODS: We recruited 9 right-handed females between 45 and 60 years of age from a primary care clinic. One of the authors (RCS) conducted the evidence-based PCI method in 5 randomly selected subjects or a standard, disease-focused CCI in the other 4 subjects for 20-25 minutes. One blinded, independent rater subsequently rated videotapes of the interviewers success in achieving the 5 steps and 21 substeps in the PCI method. Another independent rater (AH) completed interactional sociolinguistic analyses of the interviews. Patients also completed a well-validated Satisfaction with the PPR questionnaire. Patients then underwent fMRI scans while we intermittently applied aversive vs. imperceptible stimulation to their left hand. Pain trials started with a red arrow cue and were followed by a red dot and aversive stimulation. Non-pain trials started with a blue arrow cue and were followed by a blue dot and imperceptible stimulation. Monitoring segments comprised blocks of three trials during which patients saw either the picture of the consulting doctor (PCI or CCI) or the picture of an unknown doctor. We analyzed single-subject fMRI time-series data to yield contrast maps between pain and non-pain conditions.
RESULTS: The satisfaction questionnaire and the rater successfully differentiated PCI and CCI (both $p<.01$). The linguistic analysis showed significantly more physician space-providing moves in the PCI than CCI ($p<0.05$) and fewer physician questions in the PCI than CCI ($p<0.05$). Qualitatively, several markers indicated co-constructed, accommodative discourse in the PCI. We then confirmed that the anticipation and response to aversive stimulation elicited increased activation in pain related areas of interest in bilateral anterior insula ($p<.05$, corrected). We then submitted extracted percent-signal change values from these regions to repeated-measures GLM analyses, Consultation 2 (PCI, CCI) x Doctor 2 (Consulting, Unknown) x Hemisphere 2 (Right, Left) x Period 2 (Anticipation, Experience). The type of intervention (PCI vs. CCI) predicted pain-related activation, as indicated by a statistically significant consultation x doctor interaction. Follow-up pairwise t-tests revealed significantly decreased activation during the experience of pain associated with monitoring by the positive PPR doctor compared to the unknown doctor. Based on convention, all analyses were one tailed ($p<0.05$). CONCLUSIONS: These findings represent an initial step in identifying the neural mechanisms underlying the previously observed positive health outcomes associated with PCI and a positive PPR.
NEW DRUGS: UNSAFE AT ANY SPEED? LENGTH OF TIME TO BLACK BOX WARNINGS AND WITHDRAWALS FROM 1975 TO 2010. Cassie Frank1; David Bor1; Steffie Woolhandler1; David Himmelstein1; Karen E. Lasser2. 1Cambridge Health Alliance, Cambridge, MA; 2Boston Medical Center, Boston, MA. (Control ID #1333853)
BACKGROUND: Black box warning labels are an important signal of drug safety problems, and a principle way that the FDA communicates such problems to doctors and the general public. An earlier study of drugs approved between 1975 and 1999 found that serious safety warnings often emerged years after drug approval. We extended this study to drugs approved through

2009 to assess the safety of newly approved medications and the effects of regulatory efforts that have abbreviated the FDA approval process. METHODS: We compiled a list of all drugs that the FDA approved from 1975-2009 and designated as new molecular entities (NMEs). NMEs contain an active ingredient that has not

previously been approved for marketing in the United States in any form. We excluded over-the-counter medications, diagnostic agents, and biologics. We collected data from three sources: the Physicians Desk Reference (PDR), PDR.net, and http://drugs@FDA.gov
Web End =drugs@FDA.gov . We determined if drugs were withdrawn for safety reasons from information on the FDA website and the Center for Drug Evaluation and Research (CDER) Report to the Nation 2005. First, we searched the 2010 PDR and PDR.net to establish if a drug currently has a black box warning. We then looked through earlier editions of the PDR from 2000-2010 and at drug label information on http://drugs@FDA.gov
Web End =drugs@FDA.gov to determine the date the black box warning first appeared. If a black box warning was present in the PDR or FDA-approved label when the drug first appeared, we excluded it. We used the date the drug was first approved to approximate the date the drug was first marketed, and we counted an event as the date a drug received a black box warning or was withdrawn for safety reasons. For drugs that had more than one black box warning, we counted each new warning as a separate event. We performed survival analyses to generate Kaplan-Meier plots to determine how much time passed between drug approval and withdrawal or receipt of a black box warning.
RESULTS: The FDA approved 745 NMEs between 1975 -2009; 117(15.7%) drugs received new black box warning and 26 (3.5%) drugs were withdrawn from the market for safety reasons. In Kaplan-Meier Analyses, the estimated probability of acquiring a new black box warning or being withdrawn from the market over 35 years was 44%.
CONCLUSIONS: Despite efforts to ensure drug safety prior to drug approval, many new drugs receive serious new warnings or are withdrawn from the market many years after they are first approved. New drugs should be used with caution, and older drugs with a more established safety profile should be used preferentially.
NO DETECTABLE EFFECT OF MARIJUANA USE ON HEALTH OR HEALTHCARE UTILIZATION AMONG PATIENTS WITH ANY ILLICIT DRUG USE IDENTIFIED BY SCREENING IN PRIMARY CARE. Daniel Fuster1; Debbie M. Cheng1,2; Donald Allensworth-Davis3; Tibor P. Palfai4; Jeffrey H. Samet1; Richard Saitz1. 1Boston Medical Center/ Boston University School of Medicine, Boston, MA; 2Boston University School of Public Health, Boston, MA; 3Boston University School of Public Health, Boston, MA; 4Boston University, Boston, MA. (Control ID #1326904)
BACKGROUND: Federal programs encourage screening for drug use, including marijuana, in general health settings. Marijuana is the illicit drug most commonly used by patients in primary care identified by screening, and when identified in patients using other drugs, questions arise regarding how to address it. Although use can be associated with adverse health effects, the impact of marijuana on health is not extensive. Therefore, we assessed the association between marijuana use and health and healthcare utilization among patients with any illicit drug use identified by screening in primary care. METHODS: We analyzed data from patients in an urban primary care clinic who, when screened, reported any past 3-month drug use (marijuana, opioids, cocaine, others). We assessed comorbidity with the Charlson comorbidity index (Deyo modification) using ICD-9 codes obtained from the electronic medical record. By interview, we determined health status with the Euroquol [index from 0 (worst) to 100 (best possible health)] and healthcare utilization (past 3-month emergency department use and hospitalization). Recent marijuana use (past 3 months) was the main independent variable and defined as any vs. no use. Separate multivariable models adjusting for age, sex, and any recent (past 3 months) other type of substance use (separate indicators for heavy episodic drinking; cocaine use; opioid use [prescription opioids or heroin] and any other drug use [sedatives, amphetamines, hallucinogens and inhalants]) were used to assess the association between recent marijuana use and the four outcomes of interest: any comorbidity, health status, any emergency department use, and any hospitalization.
RESULTS: Participants (n=554) were 69% male and mean age was 41 years. All participants reported recent drug use: marijuana 84%, heavy episodic drinking 44%, cocaine use 26%, opioid use 23%, other drug use 8%; 57% reported use of marijuana only, 8% cocaine use only and 4% reported opioid use only. The median

Charlson comorbidity index value was 0 (range 0-7, 37% with values 1); the mean Euroquol score was 70; 36% had recent emergency department use and 14% a recent hospitalization. In analyses adjusted for age, sex and use of any other drugs, recent marijuana use was not significantly associated with emergency department use (adjusted odds ratio (AOR)0.71, 95% confidence interval (CI) 0.42, 1.22), hospitalization (AOR1.16, 95% CI 0.59, 2.28), health status (adjusted mean Euroquol score 66 versus 65, p=0.86) or Charlson index 1 (AOR 0.64, 95% CI0.37, 1.13). A multivariable analysis with recent marijuana use defined in 3 categories (daily use, less than daily use, vs. no use) yielded similar results.
CONCLUSIONS: Among adults in primary care who reported any recent illicit drug use, we were unable to detect an effect of marijuana use on health or on emergency department or hospital utilization. Addressing marijuana use among patients who use illicit drugs may not yield short-term benefits as captured by health status, comorbidity and utilization measures. Future studies should assess the longitudinal impact of marijuana use on these and other measures and include patients who do not use other drugs.
NON-VISIT CLINICAL BURDEN OF EFFORT AMONG 82 ACADEMIC GENERAL INTERNISTS Liselotte Dyrbye; Colin P. West; Tim Burriss; Tait Shanafelt. Mayo Clinic, Rochester, MN. (Control ID #1339411)
BACKGROUND: Primary care doctors are struggling to provide access to Americas aging population. This problem is exacerbated by a declining supply of internists and - although welcomed - an expansion of insured patients who are seeking care. In response, some practices may expand hours and shorten visits lengths to accommodate more patients. Such practice redesign efforts, however, do not take into account the clinical workload that occurs outside the office visit. Previous small (4-33 physicians) observational or self-reported time studies over short intervals suggest physicians spend 8-15 hours per week on uncompensated work. In this study we electronically measured actual tasks commonly performed by general internists beyond interviewing and examining patients (e.g. prescriptions, notes, orders, etc.). The objective of the study was to evaluate the work burden of non-reimbursable practice related activity among general internists.
METHODS: Board-certified general internists at a large academic medical center who spent at least 20% of their work efforts in the outpatient setting were included. All use an electronic health record. From electronic databases we obtained the exact number of: prescriptions written and signed; orders placed; electronic clinical notes authored, edited, and signed; electronic patient care messages reviewed and responded to; outpatient visits; and clinic days for each physician for an entire calendar year (2010). In addition, we collected the number of minutes each physician spent dictating. We calculated basic summary statistics for each workload variable. The study was IRB approved.
RESULTS: Among the 82 (71%) academic internists who devoted at least 20% to the outpatient practice, 50 (61%) were male. In 2011 each of these physicians wrote a mean of 3,108 prescriptions, placed 7,627 orders, authored 1,967 clinical notes, responded to 681 electronic patient care messages, and spent 88 hours dictating. Mean totals per outpatient visit and per clinic day for each workload variable are shown in Table 1.
CONCLUSIONS: Outpatient visits are associated with substantial numbers of non-reimbursable tasks that must be completed by physicians. Efforts to increase the number of outpatients seen by internists must address this workload as it may form an under recognized limit to how many patients can be seen in a workday.

smoking cessation and an opportunity to encourage evidence-based cessation treatments.
NUMERACY VERSUS READING SKILLS: UNPACKING HEALTH LITERACY Elizabeth A. Wilson1; Allison Dahlke1; Laura Curtis1; Lee Lindquist1; Alex Federman3; Michael S. Wolf1,2. 1Northwestern University, Chicago, IL; 2Northwestern University, Evanston, IL; 3Mount Sinai, New York, NY. (Control ID #1338290)
BACKGROUND: Recent work in the field of health literacy has led to the development of a variety of distinct measures of literacy, including assessments that focus specifically on reading skills or on numeracy exclusively. We sought to investigate the relationship between reading and numeracy as well as examine the relative impacts of each on comprehension, retention, and problem solving for health-related information.

METHODS: Three-hundred-four primary care patients aged 55-74 completed a series of literacy assessments, three of which examined reading skills: the Rapid Estimate of Adult Learning in Medicine (REALM), the American Nelson Adult Reading Test (AMNART), and the reading section of the Test of Functional Health Literacy in Adults (TOFHLA), and three of which examined numeracy skills: the Lipkus Numeracy Scale, the Newest Vital Signs (NVS), and the numeracy portion of the TOFHLA. To assess the relationship between each measure, scores for all were correlated. Additionally, participants were presented with a number of different hypothetical health scenarios and asked to complete a series of health tasks about each to gauge comprehension, reasoning, and retention for the information contained in each scenario. To examine the relative impact of reading and numeracy skills on health performance, we performed a series of regression analyses to determine whether factor scores for reading skills and numeracy separately, as well as simultaneously, impacted health-task performance (scored on a scale of 1-100). RESULTS: Scores on all assessments of numeracy and reading skills were highly correlated (0.39r0.69, p<0.001). After adjusting for age, gender, race, education, and comorbidity, in regression analyses, when reading ability was entered into a model it was found to significantly predict health-task performance (, 10.4; CI, 9.0 - 11.8, p<0.001), and 64% of the variance was explained. When numeracy was entered into a separate model, it also significantly predicted performance (, 11.3; CI, 9.7 - 12.8, p<0.001), and again 64% of variance was explained. Finally, in a model including both reading and numeracy concurrently, both factor scores significantly predicted performance (, 7.1; CI , 5.7 - 8.6, p<0.001; , 7.3; CI, 5.7 - 8.9; p<0.001 for reading and numeracy, respectively). In this final model, 72% of the variance was explained, providing a significantly greater goodness of fit than was found for either model that included either reading or numeracy alone (p<0.001). CONCLUSIONS: Reading and numeracy skills are highly associated, and each in isolation explains a large and comparable amount of variance in performance related to common health-based tasks. Additionally, consideration of both skills together provides an even clearer predictor for health-task success. As such, health literacy likely encompasses a broader set of abilities than either reading or numeracy alone, and rather entails cognitive processing at large. Designers of health-related interventions should consider universal cognitive constraints in information processing when creating interventions to mitigate the impacts of low health literacy.

NUTRITIONAL STATUS AND LONG-TERM SURVIVAL OF THE ELDERLY INITIATED ARTIFICIAL NUTRITION: FROM JAPAN ASSESSMENT STUDY ON PROCEDURES AND OUTCOMES OF ARTIFICIAL NUTRITION (JAPOAN) COHORT Seiji Bito1; Tetsuo Yamamoto2; Harumi Tominaga3. 1NHO Tokyo Medical Ceter, Tokyo, Japan; 2NHO Yonago Medical Center, Yonago, Japan; 3NHO Kure Medical Center, Kure, Japan. (Control ID #1333813)

BACKGROUND: Clinical choice of artificial nutrition therapy for the elderly requires careful consideration because artificial nutrition routes have both merits and demerits. The objective of this study is to compare the effect of different artificial nutrition methods on long-term survival and short-term nutritional condition for the benefit of the elderly who need long-term artificial nutrition support.

Non-reimbursable practice related activity completed by 82 academic general internist in 2011

Mean total per outpatient visit

Mean per clinic day

Prescriptions written and signed

2.84 30.80

Orders placed * 7.41 69.94 Clinical notesreviewed,edited, and signed

1.86 19.11

Electronic messages 0.62 6.5 Minutes of dictation 5.02 48.12

* includes imaging, laboratory studies, and consultations

NOVEL TOBACCO PRODUCT USE AND ASSOCIATION WITH SMOKING CESSATION: A NATIONAL STUDY Pamela M. Ling1,2;

Lyudmila Popova2. 1University of California San Francisco, San Francisco, CA; 2University of California San Francisco, San Francisco, CA. (Control ID #1340098)

BACKGROUND: Since 2006, the major US cigarette manufacturers acquired smokeless tobacco companies and have begun selling smokeless tobacco products bearing cigarette brand names (e.g. Marlboro snus, Camel snus). At the same time, electronic cigarettes (e-cigarettes) have begun to be aggressively promoted on the internet as a smoking cessation device or as a way to use nicotine in smokefree environments. There is a dearth of clinical data on effect of novel tobacco product use on smoking cessation, and these products are not approved for this purpose. We examined rates of trial and current use of novel alternative tobacco products among smokers and its association with smoking cessation behavior.

METHODS: A nationally representative probability-based sample of 1,836 current or recently former (quit within last two years) smokers completed an online cross sectional survey in November 2011. Current (past 30 day) and ever use of traditional smokeless tobacco (loose leaf, moist snuff), novel smokeless tobacco (snus, dissolvable), hookah, and electronic cigarettes was compared among former smokers (23.3% of sample), smokers who tried to quit in the past year (59.9%), and smokers who did not try to quit (16.8%). Comparisons between groups were made using chi-square tests for categorical variables, and multivariate logistic regression was used to evaluate the association between current alternative tobacco product use and quit attempts, controlling for age, sex, race/ethnicity and education.

RESULTS: Overall, 44% of smokers had tried one of the novel/alternative tobacco products, and 30% of smokers expressed interest in using novel tobacco products to try to reduce their health risk, cut down, or quit smoking. Electronic cigarettes had been tried most frequently (20.4% of respondents had ever used, with 40% of ever users reporting current past month use), and dissolvable tobacco products had been tried least frequently (2.8% ever used). Males used traditional smokeless and snus tobacco products more frequently than women ($p<.001$); women used e-cigarettes more frequently ($p<0.05$), and use of hookah, and dissolvable tobacco did not differ by gender. E-cigarettes had been used significantly more frequently by smokers who tried to quit smoking but failed (22.5%), than successful quitters (17.6%) or smokers who had not tried to quit smoking (15.2%) ($p=0.006$). Ever using an alternative tobacco product was associated with having made a cigarette quit attempt in the past year (OR=1.47, 95%CI [1.20, 1.80]), as was current use of any product (OR=1.30 [1.06, 1.59]). Ever using an alternative tobacco product was not independently associated with successful smoking cessation. CONCLUSIONS: Many smokers in the USA have tried novel alternative tobacco products, and e-cigarettes were tried more frequently than both the traditional and newer smokeless tobacco products like snus. New smokeless tobacco products and e-cigarettes appear to appeal more to women than traditional smokeless tobacco. Alternative tobacco product use is associated with attempting to quit smoking, but not having quit successfully. Clinicians should be aware of novel tobacco products, particularly e-cigarettes, and should screen for use among smokers, as this may indicate stronger interest in

METHODS: [Study Design] Multi center prospective cohort study. [Setting] Sixty-two National Hospital Organization (NHO) facilities in Japan. [Patients] Patients 60 years old or over who are admitted to each NHO facility and judged to be needed to take artificial nutrition therapy with an aim to maintain/ improve nutrition and who actually went under the artificial therapy, except postoperative management purpose. [Intervention variable] At the start of administration of artificial nutrition, patients were enrolled in either nutritional route group of total parenteral nutrition group (TPN), nasal tube feeding group (EN_N) or percutaneous endoscopic gastrostomy (PEG) nutrition group (EN_G). Nutritional routes were selected based on the clinical judgment, not experimentally. [Outcome measures] Observation started with the start of the artificial nutrition, and survival periods until the death were recorded. Serum albumin was also observed and recorded at 2 weeks and 4 weeks

after the intervention.
RESULTS: A total of 548 patients were enrolled. 524 out of them, 152 patients, 183 patients and 189 patients were classified into TPN group, EN_N group and EN_G group, respectively. Slight but significant difference was observed in age at the time of registration, gender, performance status and Body Mass Index among three groups. Mean serum albumin level was 2.8 mg/dl, 3.1 mg/dl and 3.0 mg/dl in TPN group, EN_N group and NE_G group, respectively (P<0.0001). More than 80% of patients in both EN_N group and NE_G group were suffering from neurological disease as the primary disease, while 37% in TPN group (p<0.0001). Adjusted means of the serum albumin level at 2 weeks/4 weeks later were 2.5 mg/dl, 2.5 mg/dl; 2.8 mg/d, 3.0 mg/dl; and 2.8 mg/d, 3.0 mg/dl in TPN group, EN_N group, and EN_G group, respectively (p<0.0001). Estimated mean survival time [95% CI] from the intervention to the death was 361 days [297-426 days], 489 days [436-543 days], 596 days [538-655 days] in TPN group, EN_N group, and NE_G group, respectively. As compared to EN_G group, the relative hazard ratio [95% CI] against the survival time in Cox proportional-hazards model in EN_N group and TPN group was 1.2 [0.9-1.7] and 1.8 [1.3-2.5], respectively. CONCLUSIONS: [Limitations] Adjustments for center in multicenter study is needed. The distribution of the primary disease in TPN group differs from the other two groups. [Generalization] The result of our study supports the hypothesis, that is, enteral nutrition is superior, as compared to intravenous nutrition, in short-term retention of nutritional status as well as long-term survival for patients who need artificial nutrition continuously. It was indicated that the favorable effect of PEG nutrition was not significant comparing to nasal nutrition.
OFF THE HAMSTER WHEEL? QUALITATIVE EVALUATION OF A PAYMENT-LINKED PATIENT CENTERED MEDICAL HOME (PCMH) PILOT Gordon Schiff1; Asaf Bitton1,2; Elizabeth Stewart4; Greg Schwartz1; Carol Keohane1; Lydia A. Flier1; Daniel Henderson1,3; David W. Bates1,5. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3University of Connecticut School of Medicine, Farmington, CT; 4American Academy of Family Physicians, Farmington, CT; 5Harvard School of Public Health, Boston, MA. (Control ID #1338014)
BACKGROUND: Deepening our understanding of ways to improve primary care represents a high priority for building a quality, caring, and cost-effective health system. Multiple Patient-Centered Medical Home (PCMH) initiatives are being implemented throughout the U.S, but few have combined comprehensive payment reform with PCMH transformation. As part of a larger evaluation of 2 unique PCMH initiatives centered around practice change and payment restructuring (Goroll, JGIM 2006), we conducted a qualitative evaluation of initial participating practices to better understand context, mechanisms, and impacts of these pilot efforts.
METHODS: We used a qualitative comparative case study approach to explore underlying dynamics of transformation efforts at 5 practices participating in a PCMH effort linked with payment reform. Sites were evaluated after engaging in transformation activities for 12-18 months. Data collection included review of practice-generated descriptive and quantitative data. Intensive 4-6 hour site visits by a team of 3 general internists included structured interviews, observations, and artifact review, and were followed by analysis of dictated transcripts guided
by an experienced qualitative researcher to identify themes and insights.
RESULTS: The qualitative review generated detailed components of each practices transformation efforts, as well as a grounded taxonomy of themes and insights. Data comparing the genesis, rationale for change, organizational structure, change approach, team care design, EHR deployment, practice-wide changes, clinician point-of-care changes, quality improvement measures, specifics of payment plan, helped to identify 8 recurrent but often contrasting themes among the study sites. They included 1) unique historical motivation and contexts, 2) wide variations in changes implemented, 3) varied role and value of change catalysts (consultants, trainers, and lean methods),4) ubiquitous but multiple challenges in harnessing health information technology (HIT), 5) varying definitions and deployment of teams and teamwork, 6) centrality of compensation reorganization to organizational leadership in contrast with stated physician indifference, 7) challenges in pace

of change if too rapid (change fatigue) or slow (disillusionment), 8) surprise confounders incidentally uncovered including unreported concurrent insurer restructuring toward high deductable plan. Practices differed in their emphasis on re-engineering the clinical encounters, vs. directing efforts at redesign of population management and intra-visit care level.
CONCLUSIONS: In a payment-linked PCMH transformation pilot, we noted widespread activation of clinician and staff experimentation with care delivery innovation, in addition to other adaptive responses that should inform further PCMH transformation activities and research. The issues raised included evidence of uncertain replicability; questions about comparability and standardization; challenges around HIT deployment, particularly related to obtaining ED and hospitalization information; ambiguous interpretations of teamwork varying from redesigned staffing to joint project activities; disconnect between leaders and practitioners understanding and commitment to payment reform; and outlier practices and practitioners. Interpretation and generalizability of metrics collected from this and other PCMH experiments will need to weigh the specifics and themes emerging from the on-the-ground realities of change implementation and outcomes.
ON THE WRONG SIDE OF THE DIGITAL DIVIDE: ACCESS, INTEREST, AND ATTITUDES TOWARD INTERNET-BASED COMMUNICATION FOR HEALTH AMONG PATIENTS IN THE SAFETY NET Urmimala Sarkar; Adam Schickedanz; David Huang; Andrea Lopez; Tom Bodenheimer. University of California, San Francisco, San Francisco, CA. (Control ID #1326469)
BACKGROUND: Communication between patients and their health care team via email or a patient portal with secure web messaging has been shown to increase patient satisfaction, enhance provider productivity, and improve health outcomes. We sought to characterize access to and interest in web-based communication in a diverse group of patients from a large urban safety net clinic network.
METHODS: A cross-sectional, survey of English, Spanish, and Cantonese-speaking adults attending an ambulatory clinic visit in the San Francisco Community Health Network, a large group of urban community and hospital-based clinics. The primary outcomes were the level of patients' use of web-based communication and interest in web-based communication for health care related. Self-reported sociodemographic characteristics (age, gender, language, race/ethnicity, educational level) were collected.
RESULTS: Participants were generally representative of the overall clinic network patient population. Among the participants, 54% were female, 79% were under 60 years old, and 68% had income less than $20,000 per year. Eighty-one percent did not identify as white, only 55% were primarily English speaking, and 25% reported poor English proficiency or no English proficiency at all. 60% of our study participants used email regularly, and 59% of those who used email accessed it in their home. Demographic characteristics associated with

greater access to and use of email included younger age (especially age less than 40 years old), income over $20,000 per year, being housed, some college education, white race, speaking primarily Spanish or English, and higher English proficiency. Cantonese language and Asian descent were negatively associated with email use. Seventeen percent of patients were already using email to communicate with their medical providers. Eighty-two percent agreed that email would improve the clinical communication with their doctor or nurse.
CONCLUSIONS: Our data show racial and ethnic disparities in email use and interest in electronic health-related communication among patients in the safety net. We found an unmet demand for technology for health communication among patients in the safety net. Furthermore, most of patients have access to the web, and most agreed it would likely improve clinical communication and efficiency. Usability testing and tailoring of these technologies in vulnerable populations will be critical to ensure that patients in disadvantaged populations benefit equally. Moreover, patients in resource-poor communities, especially those with limited health literacy and lower educational attainment, may require training in the use of these technologies to achieve the greatest benefit.
Interest by Access and Language

ONE YEAR AFTER: LUNG RESECTION SURGERY IMPROVES FUNCTIONAL OUTCOMES IN PATIENTS WITH EARLY STAGE LUNG CANCER. Samuel Cykert1; Franklin McGuire2; Paul Walker3; Giselle Corbie-Smith1. 1University of North Carolina School of Medicine, Chapel Hill, NC; 2University of South Carolina School of Medicine, Columbia, SC; 3Brody School of Medicine, East Carolina University, Greenville, NC. (Control ID #1339607)

BACKGROUND: Many patients and their doctors decide against lung cancer surgery because of worries that lung resection could lead to significant debility or death. We recently found that surgical acceptance goes down markedly if patients believe that quality of life will be worse with surgical treatment one year after diagnosis. We performed a prospective cohort study designed to identify reasons for decisions against lung cancer surgery and Black-White disparities in surgical treatment. In this report we examined outcomes one year after diagnosis in the surgery and non-surgery groups related to important pre-operative variables including age, socioeconomic status, and race.

METHODS: Using pulmonary, oncology, thoracic surgery, and generalist practices in 5 communities, we enrolled 437 newly diagnosed patients with early stage, non-small cell lung cancer.

Inclusion criteria for patients were: at least 18 years old, have a tissue diagnosis or>60% probability of non-small cell lung cancer using Bayesian methods, and be limited to Stage I or II disease by clinical and radiological testing. After being informed of the diagnosis of probable or definite lung cancer, but before the establishment of a treatment plan, patients were administered a 100-item survey that included a Short Form 12 Functional Assessment. Chart reviews were performed 4 months after enrollment to assess comorbidities, pulmonary function tests, and receipt of surgery. At one year follow-up, chart audits, follow up calls, and death certificate checks were used to identify survivors at which point the SF-12 was re-administered. To account for death and debility, we constructed a combination variable representing death or an SF-12 physical component score<30 one year after diagnosis. Descriptive statistics were compiled. Bivariate and multivariate analyses were performed. The independent variables examined included age, gender, marital status, SES, race, comorbid illness, having a regular source of care, and receipt of surgical treatment.

RESULTS: All deaths were identified and confirmed. Counting deaths, death-debility information at one year was available for 358 of 386 patients who remained eligible for lung cancer surgery based on diagnostic stage and absence of absolute contraindications. Of those patients enrolled, 29% were AA, 90% had health insurance, and the median age was 66 years. Sixty-six patients died within one year while 72 recorded a physical component score<30 yielding a combined death-debility rate of 39%. Predictors of the one-year outcome of death or debility were 2 or more significant comorbid illnesses (OR 2.6, 95% CI 1.3-5.2) and age>66 years (OR 1.9, 1.1-3.0). Surgical treatment significantly reduced the risk of the death or debility outcome (OR0.53, 0.33-0.86). Despite an 11% decrement in lung cancer surgery rates for African-Americans, race was not an independent predictor of functional outcome.

CONCLUSIONS: Surgical treatment, even when controlling for comorbid illness and age, is associated with improved functional outcome at one year. Any patient perceptions that lung resection surgery leads to debility or death compared to no surgery need to be recognized and systematically refuted . More granular predictors for elderly patients with severe comorbidities need to be explored.

OPIOID ANALGESIC MISUSE IN A COMMUNITY-BASED COHORT OF HIV-INFECTED INDIGENT ADULTS Maya Vijayaraghavan1; Joanne Penko2; David Guzman2; David Bangsberg3; Christine Miaskowski2; Margot Kushel2. 1University of California, San Diego, San Diego, CA; 2University of California, San Francisco, San Francisco, CA;

3Harvard School of Medicine, Boston, MA. (Control ID #1320815)

BACKGROUND: Rising rates of opioid analgesic misuse and overdose have made the practice of prescribing opioid analgesics for chronic non-cancer pain (CNCP) controversial. Individuals with CNCP and cooccurring mental illness and substance use disorders are at higher risk for misuse than those without. In a longitudinal

study of a community-based cohort of HIV-infected indigent adults, we examined rates of opioid analgesic misuse, the source of misused opioid analgesics, and determined factors associated with misuse.
METHODS: At a community-based field site, we interviewed participants every three months over two years about demographics, pain, treatment for pain, depression and illicit substance use (cocaine, heroin and methamphetamines). Using Audio Computer Assisted Self-Interviewing (ACASI) technology, participants self-reported opioid analgesic misuse (using opioid analgesics to get high, altering the route, selling or stealing, exchanging opioid analgesics for sex or illicit drugs, or attempting to forge a prescription). We determined lifetime (at baseline) and past 90-day rates of opioid analgesic misuse and the source of these medications. Using generalized estimating equations (GEE), we determined factors associated with opioid analgesic misuse.

RESULTS: The mean age of the participants (N=296) was 49.4, 41.2% were African American, and 82.1% had a lifetime history of homelessness. Of the 296 participants, 48.9% reported severe pain in the past week,27.4% reported moderate to severe depression, and 34.8% used illicit substance in the past 90 days. Almost half (47.9%) reported misuse in their lifetime; at baseline, 17.9% reported misuse in the past 90 days. A high proportion of participants reported receiving the misused opioid analgesic from a health care provider (HCP) (37.9% for getting high, 69.2% for selling opioid analgesics, 45.8% for exchanging opioid analgesics for sex or illicit drugs, and 31.3% for altering the route). In GEE models, staying in a shelter or street (Adjusted odds ratio (AOR) 1.8, 95% CI 1.1-2.8), men who have sex with men (MSM) (AOR 1.6, 95% CI 1.0-2.6), current smoking (AOR 2.1, 95% CI 1.3-3.5), illicit drug use (AOR 2.0, 95% 1.4-2.8), moderate to severe depression (AOR 1.5, 95% CI 1.0-2.1), and having severe pain (AOR 1.8, 95% CI 1.1-2.8) were associated with misuse.
CONCLUSIONS: In this high-risk cohort, participants reported high rates of opioid analgesic misuse. Approximately half of the time, they reported obtaining the misused analgesics from a HCP. Consistent with previous studies, we found that illicit substance use, mental illness, current smoking, and severe pain were associated with misuse. We identified novel risk factors including current homelessness and MSM. Given the high rates of misuse using a prescribed opioid analgesic, HCP need to develop strategies for close assessment of the risk/benefit profile prior to deciding to prescribe these medications. This should be accompanied with careful monitoring for efficacy and misuse behaviors if prescribed, and a willingness to discontinue opioid analgesics when goals of treatment are unmet or when problematic behaviors develop.
ORGANIZATIONAL BARRIERS TO CHANGE AND REDUCING DISPARITIES IN HYPERTENSION CONTROL IN AN URBAN PRIMARY CARE NETWORK Brooke Cunningham1; Max J. Romano2; Jill A. Marsteller3; Lisa A. Cooper1,3. 1Johns Hopkins School of Medicine, Baltimore, MD; 2Johns Hopkins School of Medicine, Baltimore, MD;
3Johns Hopkins University, Baltimore, MD. (Control ID #1339317)
BACKGROUND: National organizations and leaders in healthcare have affirmed that addressing disparities and achieving equity in healthcare delivery should be central objectives of quality improvement. Organizational culture affects the sucess of quality improvement efforts, but is relatively understudied. We hypothesize that organizational factors are associated with disparities in hypertension control between blacks and whites and will influence the uptake and success of interventions to improve hypertension control.
METHODS: The Multi-Method System Quality Improvement to Reduce Hypertension Disparities is a pragmatic trial of three system level interventions to reduce racial disparities in hypertension, set in six urban primary care clinics within the same primary care network in Baltimore. Semi-structured interviews were conducted with 25 senior and practice level managers. The interview guide focused on the process of identifying and implementing change within the organization, challenges with blood pressure management, and initiatives around health care disparities and cultural competency. Interviews lasted approximately an hour, were audio-recorded, and were

transcribed. Two independent reviewers used the constant comparative method to code the transcripts for themes. Disagreements were adjudicated by a third reviewer.
RESULTS: Respondents identified several barriers to implementing and sustaining change in the organization. Barriers, such as time constraints, staffing, data quality, competing priorities, poor patient adherence and provider resistance, made organizational change and improving blood pressure difficult. Most respondents felt the best ways to improve blood pressure control were through interventions that targeted patients, such as reduced drug costs and improved outreach, rather than interventions directed at clinicians or staff.
Change initiated at the practice level tended to focus on the logistics of day to day work or was made in response to senior management objectives. Respondents report that there has been little explicit discussion of or activities related to health care disparities within the organization.
CONCLUSIONS: Primary care clinicians and staff face significant challenges in making changes to reduce racial disparities in hypertension. Interventions that improve workflow, target patients, or help practices meet senior management objectives are more likely to be implemented. For success in implementation and dissemination, organizational leaders must make the reduction of disparities in hypertension care a management priority.
OUTCOMES ASSOCIATED WITH EXPOSURE TO HIGH RISK MEDICATIONS IN ELDERLY WITH CHRONIC PAIN KoKo Aung1;
Barbara J. Turner1; Mary Jo Pugh2,3. 1University of Texas Health Science Center at San Antonio, San Antonio, TX; 2University of Texas Health Science Center at San Antonio, San Antonio, TX; 3South Texas Veterans Affairs Medical Center, San Antonio, TX. (Control ID #1340819)
BACKGROUND: Preventing adverse drug events (ADEs) in seniors is a patient safety priority. Exposure to high-risk medications for the elderly (HRME) is one of the HEDIS quality measures. Seniors with chronic pain may be at high risk for ADEs related to HRMEs such as opioids. Objective: To assess the association between incident HRME among seniors with chronic pain and a subsequent emergency room or hospital care indicating ADE.
METHODS: This retrospective cohort study was conducted among veterans aged65 in FY 2006 who received VA care from FY2004-06, and had a chronic pain-associated diagnosis, defined by ICD-9 codes for conditions associated with persistent pain in the elderly by the American Geriatrics Society. Incident exposure to HRME was identified from pharmacy data. Medical records were searched for emergency room or inpatient encounters for diagnoses consistent with an ADE (likely ADE-related acute care) including: syncope, falls/ fractures and other conditions that may be associated with specific drug classes during one year following the date of initial exposure. Hierarchical logistic regression models examined association between likely ADE-related acute care and incident HRME exposure, controlling for demographic characteristics, chronic disease states, indicators of disease burden and prior history of these outcome events in the previous year.
RESULTS: Among 1,780,787 eligible veterans, 523,361 were diagnosed with chronic pain and, of these, 17.6% had incident HRME exposure compared with 4.5% in the overall cohort ($p<0.001$). Incident exposure to opioid analgesics significantly increased the odds of likely ADE-related acute care (adjusted odds ratio (AOR)1.58; 95% CI, 1.08-2.30) within one year. The odds of likely ADE-related acute care after incident exposure to other HRME were also significantly increased for: AOR 1.93; 95% CI, 1.67-2.24 (antihistamines), AOR 1.99; 95% CI, 1.29-3.07 (psychotropics), and AOR 2.28; 95% CI, 1.74-2.84 (muscle relaxants).
CONCLUSIONS: Incident exposure to HRME among older veterans with chronic pain is significantly higher than the overall population and is associated with adverse outcomes such as syncope, falls and fractures. Further research is needed to develop intervention measures to reduce exposure to these high risk drugs.
OVERACTIVE BLADDER MEDICATIONS: COMPARATIVE PERSISTENCE AND ADHERENCE OF PATIENTS WITH AND WITHOUT DIABETES Gabriel Haas1; Stephen Johnston2; Stephen Janning3; Kathleen Wilson2; David Smith2; GinaMarie Reckard1; ShunPing Quan1; Stan Bukofzer1. 1Astellas Pharma Global

Development, Inc., Deerfield, IL;
2Thomson Reuters, Washington, DC; 3GlaxoSmithKline, Research Triangle Park, NC. (Control ID #1325991)

BACKGROUND: Overactive bladder (OAB) affects ~33 million adults in the US. A recent study showed 22.5% patients with diabetes had OAB, which was more prevalent in individuals aged >50 years with diabetes for >10 years versus those with diabetes duration 10 years and age 50 years. Poor adherence and persistence to medication can lead to symptom relapse and high retreatment rates, yet 80-90% of patients discontinue their OAB medications within the first year of treatment, and only 30% of patients have an adherence rate >80% at the end of first year. The objective of the current study was to evaluate and compare persistence and adherence to OAB medication in a subpopulation of patients with diabetes, versus those without the condition.
METHODS: Administrative claims and encounter records of patients 18 years old who initiated at least one OAB medication (darifenacin, oxybutynin, solifenacin, tolterodine, trospium) between 1/1/2005 and 6/30/2008 were analyzed retrospectively using Thomson Reuters MarketScan Research Databases. The date of the initial OAB medication claim was defined as the index date. A 12-month pre-index baseline period was used to classify patients into diabetes (ICD-9-CM code 250.xx) and non-diabetes cohorts and measure demographics and clinical characteristics; patients with an OAB medication prescription during the baseline period were excluded. Patients in each cohort were directly matched 1:1 based on index year, age, sex, and geographic region. Primary outcomes included OAB medication adherence, refill of a second OAB medication prescription, and time to non-persistence with OAB medications (from the index date until a gap in OAB medication of 45 days), each assessed over a 12-month post-index evaluation period. Multiple logistic regression was used to separately compare the outcomes of 80% adherence to OAB medications and refilling a second OAB medication prescription. The Cox proportional hazards model was used to compare the outcome of time to non-persistence with OAB medications. All models were adjusted for patient demographics and clinical characteristics.
RESULTS: The matched diabetes and non-diabetes cohorts each comprised 36,560 patients. In both cohorts, the mean age was ~69 years and 59.8% were female. Patients in the diabetes cohort had poorer baseline health and were more likely to have various comorbidities than patients in the non-diabetes cohort. Additionally, those in the diabetes cohort were more likely to have had more frequent encounters with the healthcare system compared with patients in the non-diabetes cohort. The diabetes cohort had 21.5% higher odds of 80% adherence to OAB medications, 16.6% higher odds of filling a second OAB medication prescription, and 10.3% lower hazard of non-persistence with OAB medications compared with the non-diabetes cohort; these differences were statistically significant.
CONCLUSIONS: This study showed that patients with diabetes were more likely to persist and adhere to OAB medications and had higher odds of filling a second OAB medication prescription than patients without diabetes. This finding may be important when considering treatment in diabetic patients with coexisting OAB and may advance the understanding of factors that contribute to improved persistence and adherence with OAB medications; further studies are needed to identify other contributory factors, such as disease severity, patient behaviour and response to OAB medication.
OVERWEIGHT/OBESITY AND WEIGHT-RELATED TREATMENT AMONG RACIALLY AND ETHNICALLY DIVERSE PATIENTS IN FEDERALLY SUPPORTED HEALTH CENTERS Lydie A. Lebrun; Joya Chowdhury; Alek Sripipatana; Suma Nair; Naomi Tomoyasu; Quyen Ngo-Metzger. U.S. Department of Health and Human Services, Rockville, MD. (Control ID #1324032)
BACKGROUND: The Health Resources and Services Administration provides funding to health centers to improve access to primary care for about 20 million medically underserved patients, including racial/ethnic minorities, the uninsured, and low-income populations. The prevalence of overweight/obesity is a growing public health problem in the U.S., and health centers are well-positioned to serve as first responders to the obesity

epidemic among vulnerable populations. We sought to determine the prevalence of overweight/ obesity, weight-loss attempts, and weight-related counseling among adult health center patients, and to investigate whether racial/ethnic disparities existed for these measures. We also examined whether certain sociodemo-graphic and health-related characteristics were associated with the outcomes of interest.
METHODS: Nationally representative data came from the 2009 Health Center Patient Survey. Analyses were limited to adults (n= 3,949). We examined several weight-related measures, including body mass index (BMI), self-perceived weight, and weight-loss attempts. We also included treatment measures relevant to overweight/obese patients: being told by provider of a weight problem, receipt of weight management counseling, nutritionist referrals, weight-loss prescriptions, and cholesterol checks. We conducted bivariate analyses to determine the distribution of sociodemographic, health, and weight-related measures for the total sample, and also by race/ethnicity. We ran logistic regressions to determine which sociodemographic and health-related factors were associated with weight-loss attempts in past year and with being told by a provider of a weight problem. RESULTS: Overall, 76% of the adult health center patients were overweight or obese (BMI25.0 kg/m2). However, only 55% of overweight patients, and 87% of obese patients correctly perceived themselves as overweight. There were no racial/ethnic differences in BMI categories or self-perceptions of weight. About 60% of overweight/obese patients reported trying to lose weight in the past year; among these, 46% tried to do so through both diet change and exercise, while the remainder used either one or the other strategy. There were no racial/ethnic disparities in several weight-related treatment measures among overweight/obese patients, including weight management counseling, weight-loss prescriptions, and cholesterol checks. However, a larger proportion of Hispanic/Latino and African American patients received nutritionist referrals compared with non-Hispanic White patients (61%, 53%, 26%, respectively, $p<0.05$). In adjusted regressions, overweight/obese patients had higher odds of a weight-loss attempt if they perceived themselves as overweight (OR=3.30, 95% CI: 1.88-5.77), were female (OR=1.95, 95% CI: 1.05-3.64), or were African American (OR=3.34, 95% CI: 1.29-8.66) or Hispanic/Latino (OR=2.14, 95% CI: 1.13-4.06). Overweight/obese patients had higher odds of being told by a provider that they had a weight problem if they were Hispanic/Latino (OR=2.56, 95% CI: 1.21-5.38) or if they had two or more chronic conditions (OR=2.77, 95% CI: 1.28-6.01). CONCLUSIONS: Health centers are uniquely positioned to address the obesity epidemic among a vulnerable segment of the population. Efforts to promote weight counseling during primary care visits, and patient education on healthy weight, diet, and physical activity have the potential to reduce the burden of obesity and its sequellae among health center patients.
PET-NEGATIVE AT 2, 3 OR 4 CYCLES OF ABVD IN HODGKINS LYMPHOMA IS STILL GOOD. George Yaghmour; Mirna Farhat; Bertha Sanchez Valdivieso; Nalini Janakiraman. henry ford health system, Detroit, MI. (Control ID #1340172)
BACKGROUND: Our objective is to assess the prognostic value of anytime negative PET scan in the course of first line treatment in Hodgkins lymphoma (HL) patients receiving ABVD (Adriamycin, bleomycin, vinblastine, and dacarbazine) chemotherapy

METHODS: Thirty two patients with newly diagnosed HL were retrospectively included in the study. All underwent standard ABVD therapy. One, two, and three year survival was compared between patients with negative results after 2, 3 or 4 cycles vs. positive results after 4 cycles. A two-sided log-rank test was used to test whether or not there was a significant difference in overall survival between the two groupsRESULTS: Thirty two patients were evaluated. 13 females and 19 males. Median age at diagnosis was 32.2 years. 25 patients achieved a negative PET status and 7 were persistently positive after the 4th cycle of ABVD. Ten patients received PET scan at 2 cycles (7 negative, 3 positive), 6 patients had PET scan at 3 cycles (all 6

negative), and 16 patients had their first PET scan at 4 cycles (12 negative , 7 positive). When all 25 patients with negative PET by 4 cycles were compared to those with persistently positive PET scan at completion of 4 cycles, 1 year, 2 year, and 3-year survival were all higher in patients that had negative PET results. Overall survival was also significantly higher in patients with a negative result when compared to patients that had persistent positive results (p=0.0043) (see table)

CONCLUSIONS: The favorable prognosis of Hodgkins disease patients achieving PET negative status after 2 cycles of chemotherapy is well recognized. We tried to extend this to up to 4 cycles and found that t hey still do better than patients that are PET positive after 4 cycles. The numbers are too small for subset analysis looking at the influence of other prognostic factors. 1 year, 2 year, and 3 year survival were all higher in patients that had a negative PET results when compared to patients that had a persistent positive PET result. Overall survival was statistically significantly higher in patients with a negative result when compared to patients that had persistent positive results (p=0.0043).

Overall Survival in Hodgkin Lymphoma Patients after PET 4 cycle Detection

PET Results

N N Deaths (%) 1 year

Survival

Overall

P-value

Negative 25 (2/25) 8.0% 0.952 0.902 0.902 0.0043 Positive 7 (4/7) 57.1% 0.571 0.429 0.429

2 year Survival

3 year Survival

1 year, 2 year, and 3 year survival were all higher in patients that had a negative PET results when compared to patients that had a persistent positive PET result. Overall survival was statistically significantly higher in patients with a negative result when compared to patients that had persistent positive results (p=0.0043).

PAID MALPRACTICE CLAIMS FOR ADVERSE EVENTS RESOLVED BY JUDGMENT AND SETTLEMENT

Tara F. Bishop;Jessica B. Rubin. Weill Cornell Medical College, New York, NY. (Control ID #1320015)

BACKGROUND: Defensive medicine is commonly cited as a driver of overuse of health care services. Although previous research has shown that most malpractice cases are settled out of court, physicians, policymakers, and the public likely derive their perceptions of

malpractice from cases that are judged in court because these are the cases that are often reported on by the lay and medical press. We sought to understand what characteristics predict whether a malpractice suit will be settled out of court or judged in court and how outcomes differ by the type of resolution.

METHODS: We performed a retrospective trend analysis and cross-sectional comparison of malpractice claims paid on behalf of physicians using the National Practitioner's Data Bank (NPDB) from 2005-2009. We evaluated trends in the number and proportion of paid claims, and mean payment amount by resolution type. We used multivariable logistic regression to identify which patient, physician, and claim characteristics were most associated with each resolution type. Finally, we examined the effect of resolution type on mean payment amount and time to claim resolution.

RESULTS: Between 2005 and 2009, there were 58,667 claims paid on behalf of physicians. Of these paid claims, 56,850 (96.9%) were settled outside of court, and 1,817 (3.1%) were judged in court. There was no significant change in the proportion of suits resolved by settlement versus judgment over the five-year period (p=0.828); nor was there a significant change in the mean payment amount in either resolution group (settlement, p=0.9366; judgment, p=0.3577). Claims in which the physicians had no prior non-malpractice reports (adjusted odds ratio [aOR]=0.82, 95% confidence intervals [CI] 0.70-0.96), that were paid by a state malpractice program (aOR=1.65 95% CI 1.39-1.97) for adverse events to a fetus (aOR =3.39, 95% CI 1.92-

5.99), and for surgical error (aOR=1.44, 95% CI 1.26-1.65) were more likely to be judged in court. Mean payment amount ($592,283 vs. $317,447, p<0.001) and time to decision (6.50 years vs.4.93 years, p<0.0001) were significantly higher in judged claims compared with settled claims.
CONCLUSIONS: Although only a very small percentage of malpractice claims are judged in court, a number of physician, patient, and event characteristics are associated with judged cases. For example, cases on behalf of fetuses and for surgical errors are more likely to be judged in court. These differences may shape perceptions of which physicians are at greatest risk for malpractice and which errors are most common. Similarly, higher payment amounts in judged cases likely shape perceptions of the cost of medical malpractice to our health care system.
PAIN ADVERSELY AFFECTS RESPONSE TO A COLLABORATIVE CARE INTERVENTION FOR ANXIETY DISORDERS IN PRIMARY CARE Natalia Morone; Debra K. Weiner; Bea Herbeck Belnap; Fanyin He; Sati Mazumdar; Bruce L. Rollman. University of PIttsburgh, Pittsburgh, PA. (Control ID #1341010)
BACKGROUND: Primary care patients with Panic Disorder (PD) and Generalized Anxiety Disorder (GAD) experience poorer than expected clinical outcomes despite the availability of efficacious pharmacologic and non-pharmacologic treatments. A barrier to recovery from PD/GAD may be the co-occurrence of pain. To evaluate whether pain intensity interfered with recovery from PD and/or GAD we studied primary care patients who had participated in a clinical trial of collaborative care for anxiety disorders. Our objective was to describe the prevalence of pain in this population and to determine the impact of pain on treatment response for PD and/or GAD.
METHODS: We performed a secondary data analysis on a randomized, controlled effectiveness trial comparing a telephone-delivered collaborative care intervention for primary care patients with severe PD and/or GAD to their doctors usual care. Patients had to have a diagnosis of PD and/or GAD and a severe level of anxiety symptoms, defined as a Panic Disorder Severity Scale (PDSS) score14 or a Hamilton Anxiety Rating Scale (HRS-A) score20. Outcomes measures were collected over 12-months and included pain and anxiety symptoms. Pain was assessed using the Bodily Pain scale of the SF-36. Anxiety symptoms were measured with the HRS-A, PDSS and Generalized Anxiety Disorder Severity Scale (GADSS). The 124 patients randomized to the collaborative care intervention were analyzed. Participants were divided into two pain intensity groups based on their response to the SF-36 Bodily Pain scale (none or mild pain vs. at least moderate pain). Descriptive statistics were used to summarize demographic characteristics. Chi-squared tests were performed to test the proportions of patients achieving a 50% decline from baseline levels in the HRS-A, GADSS and PDSS at 12 months. To test the report of pain over time and the effects of baseline pain on anxiety outcomes a repeated measures mixed effect model was run.
RESULTS: The sample was predominantly white and well-educated. Patients with pain were significantly more likely to be older, single, and unemployed. At baseline, patients with pain were significantly more likely to endorse more anxiety symptoms on the HRS-A (30.1 vs. 25.4, P<.001). They were also more likely to endorse significantly more pain on the SF-36 Bodily Pain scale (32.5 vs. 50.4, P<.0001). Patients with pain were significantly more likely to be on an NSAID or an opioid, and carry a chronic pain diagnosis, but there was no difference between groups in anxiolytic medication use at baseline. Among the patients with severe anxiety symptoms 65% (80/124) endorsed experiencing at least moderate pain in the previous month. A significantly lesser number of patients achieved response at 12-months on the HRS-A and GADSS in the pain group compared to the no pain group (P=.01 and P=.04, respectively). The PDSS did not show a significant difference between groups. CONCLUSIONS: Coexisting pain was common in a sample of primary care patients with severe PD/GAD and appeared to negatively affect response to anxiety treatment. It is important to remember that these conditions are commonly comorbid, and response to anxiety treatment may be hampered by the presence of pain.
PALLIATIVE CARE: PREPARING TO IMPLEMENT A BROADENED TRAINING CURRICULUM FOR

INTERNAL MEDICINE RESIDENTS Sanaz Kashan1; Ghassan Bachuwa1; Kay Taylor2. 1Hurley Medical Center, Flint, MI; 2Hurley Research Center, Flint, MI. (Control ID #1309416)

BACKGROUND: Chronic diseases including cancer, heart disease, lung disease, and diabetes account for three-quarters of our nations health care expenses. Additionally there are 35 million Americans aged 65 and older which account for greater than one-third of outpatient visits and hospitalizations. Caring for those with chronic diseases and older patients involves providing not only effective preventive and curative therapies, but increasingly appropriate palliative care as well. The successful palliative care curriculum will need to use a multifaceted approach, incorporating a variety of intentional strategies to address the multiple competencies required. But when examining residency training program curriculum in this key areamost descriptions tend to focus on a single strategy (e.g., reflection with use of individual case histories, a hospice rotation, reading materials, etc.). Our curriculum study team developed an expanded curriculum that would utilize multiple approaches to learning (including the aforementioned strategies as well as a noon conference lecture, a computer module and role-playing sessions). But it was important for us to learn what aspects of palliative care were weakest for the resident physicians in order to help our teaching faculty to concentrate on those areas most in need of improvement. METHODS: We developed a 40-item survey with a true-false and multiple-choice option format. There were 35 knowledge items and 5 attitude items. Knowledge questions targeted such areas as palliative care definitions, goals, benefits, and roles. Attitude items targeted perceptions of competency as well as an assessment of the current palliative care curriculum. The questionnaire was distributed via Survey Monkey to all 1st and 2nd year Internal Medicine resident physicians. (An exemption from full-board review was granted by the hospitals Institutional Review Board.)

RESULTS: Resident physicians had a strong understanding of the broad goals of palliative careas well as the importance of working as a team with other health care professionals to support the patient and family. But there were some significant knowledge deficits about advance directives including misperceptions about its impact on patient requests for all care possible. Regarding self-evaluations of competency, only a small percentage (17%) rated their overall knowledge level as being strong or very strong. And less than one-third expressed that they were very comfortable or comfortable in addressing the issue of palliative care with the patient and/or family. Finally, the majority (60%) expressed the need to enhance the current palliative care curriculum.

CONCLUSIONS: The intent of the planned expanded curriculum is to strengthen our residents knowledge, attitudes and skills related to the provision of palliative care. We propose to implement a varied curriculum with both knowledge and experience-based activities. The pre-test survey allowed us to identify which palliative care issues would require the greatest attention. It also permitted us to establish the residents current learner status such that we can later conduct a posttest to assess changes in knowledge, attitudes and skills. Palliative care is a growing field that represents an integral part of the foundational care that physicians offer to their patients. There is a need for more rigorous curricular evaluation.

PANEL MANAGEMENT IN PRIMARY CARE: WHAT PRIMARY CARE PROVIDERS COULD LEARN FROM NURSE CARE MANAGERS Colleen Gillespie; Jaclyn Fox; Alfredo Axtmayer; Anne Dembitzer; Joseph Leung; Scott Sherman; Mark Schwartz. New York University School of Medicine, New York, NY. (Control ID #1332213)

BACKGROUND: Panel management strategies are generally viewed as a central element of Patient Centered Medical Home models and yet, there is little information on how to prepare health care professionals to actually manage the health of their patient panels. As part of an initiative to study the implementation and efficacy of panel management within the Patient Aligned Care Team (PACT) model in two VA primary care clinics, we

report on a baseline survey of Primary Care Providers (PCPs) and Nurse Care Managers (RNs) designed to better understand how prepared these professionals feel to manage their patient panel, their attitudes toward panel management more generally, and their use of panel management strategies in routine practice. METHODS: Surveys were sent to the 46 PCPs (MDs with 1 NP and 1 PA) and 18 RN Care Managers at two urban VA Primary Care Clinics. 39 responses have been received thus far (61% response rate, 57% for PCPs and 72% for RN Care Managers). Items assessed include perceived sufficiency of training and education in panel management (5-point, disagree/agree scale), panel management self-efficacy (4 items including: ability to recognize groups of patients with distinct needs, to use data to identify panel needs, and to implement specific strategies for targeting patients with poor outcomes; 10-point Likert scale), attitudes toward panel management (2 items: influence of individual team member on panel outcomes and the importance of panel management to patient health; 5-point, disagree/agree scale), and routine use of panel management strategies (1 item, 5-point, disagree/agree scale). RESULTS: Overall, only 23% of survey respondents reported that they had sufficient training and education in panel management (23% of PCPs and 23% of RNs). Mean self-efficacy for four panel management skills was 6.73 (SD 2.51) on a 10-pt scale, 5=confident and 10=completely confident (PCP mean=6.70, SD=2.5 and RN mean=6.74, SD=2.56, p =.96). 71% somewhat or strongly agreed that as an individual they had an influence on panel outcomes and 86% somewhat or strongly agreed that panel management is critical for improving patient health. Only 20%, however, reported routinely using panel management strategies. All the RN Care Managers (13/13) agreed that panel management is critical compared with 77% of PCPs (20/26) (Chi Sq p=.040) and 38% of RN Care Managers (4/13) compared with 15% (4/26) of PCPs (Fishers Exact p=.047) reported routinely using panel management strategies. CONCLUSIONS: While primary care health professionals endorsed the importance and impact of panel management, they did not feel fully prepared or confident in managing patient panels. More RN Care Managers, perhaps due to their new role within the patient-centered home model currently being implemented throughout VA primary care, endorsed the importance of and routine use of panel management than PCPs in these settings. The small, single system sample limits generalizability but our findings suggest that RN Care Managers may be well suited to promote panel management within their teams and to educate team members, including PCPs, on how to effectively manage their panels of patients.

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PATIENT ACTIVATION AND IMPROVED OUTCOMES IN HIV-INFECTED PATIENTS Todd Korthuis4,5; Rebecca Marshall1; Mary Catherine Beach2; Somnath Saha3,4; Tomi Mori5; Mark O. Loveless5; Judith H. Hibbard5,6; Jonathan A. Cohn7; Victoria L. Sharp8. 1Oregon Health &Science University, Portland, OR; 2Johns Hopkins University School of Medicine, Baltimore, MD; 3Portland VA Medical Center, Portland, OR; 4Oregon Health &Science University, Portland, OR;
5Oregon Health &Science University, Portland, OR; 6University of Oregon, Eugene, OR; 7Wayne State University, Detroit, MI; 8St. Luke's-Roosevelt Hospital Center, New York, NY. (Control ID #1332545)
BACKGROUND: Patient activation, the knowledge, skill, and confidence to manage ones own healthcare, is associated with improved health behaviors that may improve outcomes, but has not been studied in HIV primary care, where healthy behaviors such as medication adherence are essential to treatment success. The objective of this study was to determine1) patient characteristics associated with patient activation and 2) associations between patient activation and HIV outcomes. METHODS: The design was a cross-sectional survey conducted in 4 HIV clinics in Baltimore, Detroit, New York, and Portland. Participants were 433 HIV-infected patients, age 18 or greater receiving care from 45 HIV

providers. Patient activation was measured using the 13-item Patient Activation Measure (PAM) (possible range 0-100). HIV outcomes included CD4 cell count>200 cells/mL3 and HIV-1 RNA<400 copies/mL (viral suppression), abstracted from medical records, and patient-reported adherence (100% antiretrovirals taken as prescribed).
RESULTS: Overall, patient activation was high (mean PAM=72.3 [SD16.5, range 34.7 - 100]). Activation was lower among those without vs. with a high school degree (68.0 vs. 74.0, p<.001), and greater depression(77.6 lowest, 70.2 middle, 68.1 highest tertile, p<.001). In multivariable models, every 10-point increase in PAM was associated with greater odds of CD4 count>200 cells/mL3 (aOR 1.22 [95% CI 1.02, 1.46]), adherence (aOR 1.32 [95% CI 1.07, 1.62]), and HIV-1 RNA suppression (aOR 1.18 [95% CI 1.00, 1.38]). The association between PAM and viral suppression was mediated through adherence.
CONCLUSIONS: Higher patient activation was associated with more favorable HIV outcomes. Interventions to improve patient activation should be developed and tested for their ability to improve HIV outcomes.
PATIENT IDENTIFICATION OF THEIR MOST AND LEAST IMPORTANT MEDICATION Amy Linsky1,2; Steven R. Simon1,3. 1VA Boston Healthcare System, Boston, MA; 2Boston University School of Medicine,

Boston, MA; 3Brigham and Women's Hospital, Boston, MA. (Control ID #1314956)
BACKGROUND: Medication adherence is associated with better outcomes, but patients adhere to only half of prescribed medications. Static and dynamic factors influence medication-taking behaviors, and non-adherence suggests that patients place priorities on specific medications. It is unknown whether patients explicitly can and will identify and express to their providers one of their medications as most important or least important. Our objective was to determine the frequency with which any medication was explicitly identified as most important or least important and the types of medications chosen by Veteran patients.
METHODS: We analyzed data from a convenience sample of patients (N =105) seen in ambulatory care clinics at VA Boston, 3/10-7/11, by fourth-year medical students. Prior to the visit, patients independently answered two questions: Which one of your medicines, if any, do you think is the most important? (if none, please write none) and Which one of your medicines, if any, do you think is the least important? (if none, please write none). Reconciliation was made to a computer-generated medication list (List) that included all medications and non-durable medical supplies dispensed at VA Boston (i.e., locally-dispensed), from other VA facilities and non-VA sources. Medications were classified according to the VA Medication Class codes. Additional factors included patient age (>65 vs. <65 years), sex, number of items on List, care provided at other VA facilities (yes vs. no) and presence of non-locally dispensed medications (yes vs. no). We describe the patterns of responses and the medications chosen by Veteran patients. Associations with patient and system factors were tested with chi-square.
RESULTS: We analyzed 104 medication reconciliations. This Veteran cohort was predominantly male (95%); 59 (57%) were age 65 years or older. The median number of medications on the list was 8 (IQR 5-13). Sixteen patients (15%) had evidence of care in VA systems outside of Boston, and 50 (48%) had documentation of non-locally dispensed medications. In response to the most important, 41 (39%) chose one specific medication; 26 (25%) chose more than one medication or chose medications to treat a diagnosis; 21 (20%) wrote none and 16 (15%) responded with n/a, not sure, a nonsensical answer or left it blank. There was no association between choosing one medication and any measured factor. The three most commonly chosen classes of most important medications were beta blockers (n=8), ACE inhibitors (n=7) and anticoagulants (n=5). In response to the least important, 31 (30%) chose one specific medication; 2 (2%) chose more than one medication or chose medications to treat a diagnosis; 51 (49%) wrote none and 20 (19%) responded with n/a, not sure, or left it blank. The three most commonly chosen classes of least important medications were vitamins (n=12), nonopioid analgesics (aspirin) (n=4) and antilipemic agents (n=2).
CONCLUSIONS: Approximately one in three Veteran patients did not identify a most important medication, and more than two in three patients did not identify a least important medication. This may reflect poor understanding of the question, limited knowledge of medications and their indications, or unwillingness to state preferences to health care providers. Further understanding of how patients prioritize their medications can guide interventions to enhance adherence to beneficial medications and withdrawal of less essential medicines.
PATIENT NAVIGATION TO IMPROVE COLPOSCOPY FOLLOW UP AFTER AN ABNORMAL PAP SMEAR AMONG LATINA WOMEN Carly Benner1; Bruce Chabner1,2; Raymond Lui1,3; Leslie Aldrich5; Sarah Oo4,5; Nessa Rodgers5; Sanja Percac-Lima1,4. 1Harvard Medical School, Boston, MA; 2Massachusetts General Hospital, Boston, MA; 3Massachusetts General Hospital, Boston, MA; 4Chelsea HealthCare Center, Massachusetts General Hospital, Boston, MA; 5Center for Community Health Improvement, Massachusetts General Hospital, Boston, MA. (Control ID #1333761)
BACKGROUND: Cervical cancer disproportionately affects Latina women in the United States and around the world. Patient navigation can improve compliance with cancer prevention, diagnosis and treatment in underserved populations. The aim of this study was to evaluate the impact of patient navigation on colposcopy clinic attendance rates, time to colposcopy follow up after an abnormal Pap smear, and grade of cervical abnormality at colposcopy among Latina women.

METHODS: Eligible women self-identified as Latina, had an abnormal Pap smear requiring colposcopy follow up, and were receiving care at a health center providing cervical patient navigation within an academic primary care network. The usual care group consisted of Latinas with abnormal Pap smears referred to the same colposcopy clinic from practices in the same network without navigation. Primary outcomes were the percentage of missed colposcopy appointments, time to colposcopy after an abnormal Pap smear, and grade of cervical abnormality at colposcopy. Data were collected using electronic medical records from January 1, 2004 to April 15, 2011. Comparisons were made with means and associated t-tests for continuous variables and chi-squared tests for categorical variables. Difference-indifference analysis was used to compare group trends over time, with the study period divided into two halves: 2004-2007 and 2008-2011. Grades of cervical abnormality were given numerical values: 1=no dysplasia, 2=mild dysplasia, 3=moderate dysplasia, 4=severe dysplasia, and 5=carcinoma in situ.
RESULTS: Of the 786 women in the study, 533 (67.8%) were navigator program participants and 253 (32.2%) received usual care. The mean age of each group was approximately 35 years (p=0.370). More comparison group women had private insurance compared to navigated women (34% vs. 24%, p=0.006). In the navigated group 47.6% had less than a high school education compared to 22.8% in the comparison group (p<0.001). Navigated women had a lower percentage of missed colposcopy appointments over time, with the average falling from 19.8% (95% CI 17.5, 22.1) to 15.7% (95% CI 13.1, 18.4, p=0.024). The usual care group no show rate did not change significantly, going from 18.6% (95% CI 14.8, 22.5) to20.6% (95% CI 17.0, 24.2, p=0.454). The colposcopy clinic no show rate over the course of the study period was significantly lower for navigated women (p<0.001). Time to colposcopy follow up for navigated women decreased from 127 days (95% CI 115, 140) to 120 days (95% CI 108, 131, p=0.393). The comparison group follow up time did not change significantly, increasing from 116 days (95% CI 97, 134) to 122 days (95% CI 93, 151, p=0.717). Comparison of group trends over the entire study period showed a significant difference in time to follow up (p=0.010). The grade of cervical abnormality in navigated women decreased between the first and second study periods from a numerical value of 2.03 (95% CI1.84, 2.22) to 1.83 (95% CI 1.69, 1.90, p=0.035). In the non-navigated group there was an increase from 1.83 (95% CI 1.66, 2.0) to 1.92 (95% CI1.66, 2.17, p=0.573). Comparison of group trends over the full study period showed a significant decrease in the severity of cervical abnormality for the navigated group (p<0.001).

CONCLUSIONS: Culturally-tailored patient navigator programs for cervical care can improve compliance with colposcopy appointments, shorten the time to colposcopy follow up, and decrease severity of cervical abnormalities over time among Latina women.
PATIENT NAVIGATION TO PROMOTE SMOKING CESSATION IN PRIMARY CARE: BASELINE RESULTS FROM A PILOT RANDOMIZED CONTROLLED TRIAL Karen E. Lasser1,2; Karey S. Kenst1; Lisa Quintiliani1; Renda S. Wiener3; Jennifer Murillo1; Deborah J. Bowen2. 1Boston Medical Center/Boston University School of Medicine, Boston, MA; 2Boston University School of Public Health, Boston, MA;
3Boston Medical Center/Boston University School of Medicine, Boston, MA. (Control ID #1317420)
BACKGROUND: In primary care, few interventions have connected poor/minority smokers to smoking cessation treatments. Patient navigation is an evidence-based method for improving connectedness to the health care system, is well-suited to underserved populations, and holds promise for engaging patients in smoking cessation treatment.
METHODS: In a pilot randomized controlled trial (RCT) of the feasibility/ acceptability of navigation to link patients to smoking cessation treatment, we included patients age>= 18 who smoked cigarettes in the past week, had a visit with a primary care provider (PCP), had a telephone, and spoke English. We excluded

patients with a transient residence, who had cognitive impairment or severe illness; or who were using evidence-based smoking cessation treatment. Patients were recruited from 5 primary care practices at an urban safety-net hospital. Intervention patients received educational material followed by phone calls or in-person meetings with a navigator; control patients received only educational materials. The navigator was a community health worker trained in motivational interviewing, and in identifying/addressing barriers to engaging in smoking cessation treatment. The educational materials were print-based brochures about smoking risks, smoking cessation treatments, and resources to quit smoking such as quit lines and hospital-based smoking cessation groups. The navigator assisted with appointment scheduling and linked patients to resources to help with social needs such as housing. The primary outcome is engagement in smoking cessation treatment at 3 months; baseline data are presented below.
RESULTS: To date, 21 patients enrolled in the study. About half (48%) were female; most (75%) were non-white, with an average age of 46 years. One-fifth of patients were married or living with a partner; all reported that their partner smoked. Three-fourths had completed at least a high school education, and most (81%) were unemployed. The majority (81%) had a household income under $30,000. Participants smoked a mean of 13 cigarettes per day, and had smoked for a mean of 29 years. Most patients (62%) were in the precontemplation stage with respect to quitting smoking, and 29% had attempted to quit in the past year. Two-thirds had asked their PCP about ways to quit smoking, and two-thirds had been advised by their PCP to quit. 43% reported feeling supported or very supported by their PCP to quit. Only 43% of patients had heard of a smokers quitline, and only 11% had ever been referred by a doctor to a quitline. Most (81%) were aware of local programs to promote smoking cessation, but only 24% had ever been referred by their PCP, and 18% had attended such programs. 43% of patients agreed with the statement I am suspicious of nicotine replacement products, and 40% felt that they did not need these products to quit smoking. CONCLUSIONS: Baseline data indicate that patients reported low levels of motivation to quit smoking, low awareness of quitlines, and infrequent referrals to quitlines from their PCP. Patient navigators could play a role not only in motivating patients to quit, but in educating patients about the safety/efficacy of nicotine replacement, and linking patients to evidence-based cessation.

PATIENT OPINION OF HOSPITAL CARE IN ENGLAND: ANALYSIS OF REVIEWS FROM THE NHS CHOICES WEBSITE Tara Lagu1,2; Sarah L. Goff1,2; Nicholas S. Hannon1; Amy S. Shatz1; Peter K. Lindenauer1,2. 1Baystate Medical Center, Springfield, MA; 2Tufts University School of Medicine, Boston, MA. (Control ID #1331588)

BACKGROUND: The increasing number of websites allowing patients to write reviews about health care providers suggests that health care consumers are often as interested in the subjective judgments of their peers as they are in more formal measures of quality. In the United Kingdom, the National Health Service (NHS) encourages patients to provide feedback to hospitals on their quality reporting website, Choices. We used mixed qualitative and quantitative methods to analyze the content of hospital reviews on Choices.
METHODS: We identified all English hospitals listed on Choices that provided medical care. We excluded dental, homeopathic, and psychiatric hospitals and further limited the sample to hospitals that had at least 10 reviews. Of 264 eligible hospitals, we used random number generation to select 20 hospitals for analysis and included the most recent 10 reviews from each (for a total of 200 reviews). Applying directed qualitative content analysis methods, four research team members (two physicians and two research assistants) developed an a priori codebook and coded small sets of up to 20 reviews to check for coding consistency, discuss emerging themes, and update the codebook as needed. Two team members then independently coded the remaining reviews. Reviews were analyzed until no new themes emerged in 100 sequential reviews. We calculated the frequency of recurring themes for descriptive purposes.
RESULTS: Major themes that emerged from the directed qualitative content analysis included positive and negative comments about staff, facilities, and technical aspects of care. Of the 200 reviews, 166 (83%)

contained positive content. One hundred forty nine reviews (74%) contained positive comments about staff (e.g., Nurses and doctors were professional, friendly, caring and polite at all times.), 55 reviews (27%) commented positively about the facility (e.g., The ward was exceptionally clean), and 73 reviews (36%) commented positively about technical aspects of care (e.g., The bypass was expertly done.). A majority of reviews (75%) contained negative content. Patients made negative comments about staff in 74% of reviews (e.g., Doctors need improvement in bedside manner.). Sixty-one reviews (30%) contained negative comments about technical aspects of care (e.g., After two and a half weeks no correct diagnosis was made.), and 73 reviews (36%) made negative comments about the facility (e.g., Parking is an absolute nightmare.). Hospitals responded to reviews 55% of the time. Of these responses, 36% contained information about how the hospital would change policies in response to feedback (e.g., We plan to expand our vegetarian menu.).
CONCLUSIONS: This content analysis of hospital reviews in England demonstrated similar domains to those covered in existing satisfaction surveys, such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). Patients did provide feedback on technical aspects of care, but this was less frequent than comments regarding staff attributes. Unlike surveys such as HCAHPS, however, Choices enables all patients, not just a randomly selected subset, to share their experiences with other patients and with the hospital. The high response rate from hospitals demonstrates the potential for this type of feedback to be an effective tool for hospital care quality improvement.

PATIENT PERCEPTIONS OF HAVING 1ST AND 2ND YEAR MEDICAL STUDENTS INVOLVED IN THEIR CARE

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BACKGROUND: Many medical schools are developing earlier clinical experience in the ambulatory setting. Understanding patient perceptions of having students involved in their care is important to assess the impact of moving patient-based teaching of clinical skills earlier in the curriculum. Most literature regarding patient acceptance/satisfaction with medical student involvement in ambulatory settings has focused on 3 rd/4th year students. At our institution, each student is assigned a longitudinal primary care preceptor with whom they have 43 clinic sessions over the first 2 years. During these sessions student see 3 or 4 patients and practice their interviewing and physical examination skills. Preceptors see additional patients without students during these sessions. The objectives of our study

were to answer the following questions and compare responses for patients seen by a 1st or 2nd year medical student and preceptor to those for patients seen by the preceptor alone. 1. How satisfied are patients when their visit includes a student? 2. How satisfied are patients with the time spent with their physician when their visit includes a student? 3. What is the patient perception of quality of care when their visit includes a student?4. Do patients perceive any added value when their visit includes a student? 5. Do patients who see students want to have students involved in their care at future visits?
METHODS: We developed an anonymous survey that included demographic information and questions related to the 5 study objectives listed above. All patients answered questions related to overall visit satisfaction, adequacy of time spent with their physician and perceived quality of care. Patients seen by students answered questions related to the added value of a having a student involved in their care and interest in seeing a student again in the future. The survey was given to the patients of 23 faculty preceptors at 2 locations. During half-days when preceptors had 1st or 2nd year medical students in clinic all patients were asked to complete the survey after the visit. We compared responses for patients seen alone by the preceptor and patients seen by the preceptor and a student.
RESULTS: A total of 315 patients returned surveys, 202 of who saw a student with the preceptor and 113 of who saw only the preceptor. The percentage of patients very satisfied with their visit was high in both groups

(83% student, 91% preceptor only; p=.07) and patients in both groups felt they had enough time with their physician (98% student, 96% preceptor only; p=.41). Most patients rated the quality of their visit as excellent (92% students, 98% preceptor only; p=.047). Of the 205 patients who saw students, 35% would want to see a student again, 50% had no preference and 15% would prefer to see the preceptor alone at a future visit. Forty three percent thought having a student added value to their visit.
CONCLUSIONS: Our study suggests that patient satisfaction with their care was preserved and largely unaffected by the involvement of a 1st or 2nd year medical student in an outpatient primary care setting. Most patients would be willing to have medical students involved in their care again and many patients felt having a student added value to their visit. These results suggest that 1st and 2nd year students can be successfully integrated into an ambulatory primary care practice for early clinical experience.
PATIENT AND PHYSICIAN CONCORDANCE ON PERCEIVED DEGREE OF SHARED DECISION MAKING OF THE SAME MEDICAL ENCOUNTER Patrick G. O'Malley1,2; Janice Hanson4,1; Dorothy Becher1,2; Jeffrey L. Jackson3,1. 1Uniformed Services University, Bethesda, MD; 2Walter Reed National Military Medical Center, Bethesda, MD; 3Medical College of Wisconsin, Milwaukee, WI; 4University of Colorado School of Medicine, Aurora, CO. (Control ID #1322301)
BACKGROUND: Patients with chronic illness often have a significant decision burden with complex trade-offs, necessitating a sophisticated process of shared decision making with their physician. Given the variation in decision making style among patients and physicians, we sought to determine how well patients and their physicians agree on the degree to which shared decision making is occurring. We hypothesized that patients and physicians could reliably agree on the relative degree of shared making within a shared interaction.
METHODS: We enrolled a consecutive sample of 120 consenting participants aged 40-80 y.o. who had hypertension, 2 additional chronic medical conditions (excluding dementia), and were scheduled for a routine Internal Medicine appointment with their primary provider. Immediately prior to the visit, patients were surveyed to self-assess, on a 20-point visual analog scale, their preferred decision making style along a spectrum ranging from doctor-dominant to shared to patient-dominant decision making, for new and ongoing problems. The scale included behavioral descriptors along the spectrum in order to anchor one's choice. Immediately after the visit, both physicians and patients were independently asked to rate the style that best characterized their encounter using the same scale, while blinded to each other's ratings. Agreement between
patient and physician post-visit ratings of the encounter, and between patients pre-visit self-assessed style and their post-visit rating of what actually happened, were measured using the intraclass correlation coefficient (ICC).
RESULTS: Of the 120 patients who consented to participate, 106 attended and completed their visit: 53% F, 55% African-American, mean age -67 years; 8% with poor health literacy. Of the 11 physicians, 6 were female, 3 were AA, the mean age was 48 years, and the mean time since medical school was 19 years. Collapsed into 3 categories, patient preferences for decision-making were similar by type of problem, whether new or ongoing (See Table). Immediately after the visit, there was no agreement between patients and physicians on the degree of shared decision making that occurred during the visit (ICC=0.06, P=0.37). Agreement between the patients rating of the actual encounter and their preferred style of decision making was moderate for both new (ICC=0.54, P<0.001) and ongoing (ICC=0.66, P <0.001) problems. CONCLUSIONS: In this cohort of mostly older, literate patients with multiple chronic problems who mostly prefer a shared style of decision making, there was no agreement between patients and physicians ratings regarding the degree to which shared decision making actually occurred in a routine visit. Patients preferred style of decision making only moderately correlated with their assessment of what actually happened in the encounter. This indicates a gap in communication interactions which poses a substantial barrier to optimal shared decision-making.
Spectrum of DecisionMakingControlDoctor Shared PatientPre-Visit Patient PreferenceNew Problem 20.2% 65.4% 14.4%

Ongoing Problem 20.2% 61.5% 18.3%
Post-Visit Rating of Encounter ICC 0.06 By Patient 23.3% 68.0% 8.7%
By Doctor 37.5% 44.2% 18.3%
PATIENT AND PROVIDER ATTITUDES TOWARD OBESITY CARE IN THE PRIMARY CARE SETTING
Stephanie A. Rose1;
Arnold Stromberg2; Joseph Conigliaro3. 1University of Kentucky, Lexington, KY; 2University of Kentucky, Lexington, KY; 3New York University, New York City, NY. (Control ID #1336230)
BACKGROUND: Despite published guidelines, physicians are not routinely screening and counseling for obesity. We assessed prevalence of and patient factors associated with obesity care. We hypothesized that obesity care varies widely in clinical practice and does not meet guideline standards.
METHODS: We developed a quantitative survey of primary care providers (PCPs) and adult (18 years of age) patients (pts) at rural and urban primary care settings in Kentucky. PCPs were mailed paper surveys and reminder cards with a web link. Pts were invited to fill out a paper survey at their appointment time. We excluded non adult-care PCPs, and pts who reported not having seen their doctor or who were pregnant in the previous year.
RESULTS: Independent surveys were sent and 147 PCP and 132 pt surveys met criteria for analysis. PCPs were 93% primary care and 47% female. PCP practices included 25% urban, 38% rural, 31% academic, 26% community, and 22% private. Pts were 68% white, 70% female, median age of 52, and 77% insured. 24% were normal weight (NW), 27% overweight (OW), and 49% obese (OB). 80% reported an obesity-related condition (64% NW, 75% OW, 91% OB, p=0.024). 76% self-perceived the need to lose weight (32% NW, 75% OW, 98% OB, p<0.001). 100% of PCPs reported discussing weight loss with their patients, while 44% of pts reported ever having been told by their PCP that they needed to lose weight (4% NW, 25% OW, 75% OB, p<0.0001). 99% of PCPs reported measuring pt weight, while 96% of pts reported their PCP had ever

measured their weight. 93% of PCPs and 41% of pts (35% NW, 40% OW, 44% OB, p=0.74) felt it was the PCPs responsibility to help with weight loss. 16% of pts reported their PCP had ever helped them lose weight (8% NW, 19% OW, 18% OB, p=0.41). Pts who reported their PCP told them they needed to lose weight were more likely to have tried to lose weight than those whose PCPs had not (98% versus 53%, p<0.0001).
CONCLUSIONS: PCPs report more patient weight loss counseling than reported by patients. Pts report a positive correlation between weight loss advice and weight loss attempt. PCPs appear to be missing opportunities for guideline-concordant obesity care. Future goals include focus groups to better understand ideas for improvement of obesity care.
PATIENT FACTORS ASSOCIATED WITH EXPERIENCES OF DISCRIMINATION IN HEALTH CARE IN A PROSPECTIVE COHORT AFTER HOSPITALIZATION WITH HEART FAILURE
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3Hines VA Hospital, Hines, IL; 4Medical University of South Carolina, Charleston, SC. (Control ID #1341536)
BACKGROUND: Few studies have examined experiences of discrimination (EOD) in healthcare among diverse patients with severe chronic medical conditions and among patients in VA Medical Centers. Patients with chronic conditions who are frequent users of healthcare or are Veterans may have different EOD than others.
METHODS: We conducted a prospective observational cohort study of patients hospitalized for an exacerbation of heart failure at 2 VA Medical Centers (geographically located in Northern and Southern US). At up to two outpatient follow-up visits in the 6-months after discharge, we examined the association of reported EOD with patient demographics, visit outcomes, and adherence to physicians recommendations for 162 patients; 61.7%

Black (N=100) and 38.3% White (N=62). Patients with dementia and terminal illness were excluded. Patients completed questionnaires to collect demographics, functional status, trust in physician and healthcare system, heart failure related quality of life and functional status. All patients completed a previously validated self-report measure of EOD in healthcare and daily life. Analyses comparing discrimination with potential covariates used chi-square, t-tests, and correlations, as appropriate. Repeated measures analyses were conducted to examine the association of EOD in health care with trust, health status, and adherence measured after each visit.
RESULTS: There were no statistically significant differences for reported EOD in health care in black compared with white patients(14.0% vs. 11.3%; P=0.62) or for ethnicity, gender, age, income, education, or geographical site (P>0.20). However, compared to white patients, black patients were significantly more likely to report EOD in every other area of daily life measured: school, employment, work, housing, store and restaurant services, financial services, public settings, and law enforcement (P<0.01). In repeated measures analyses examining all patients, those who reported EOD in health care also reported less trust of the VA health care system (P=0.02) and lower self-efficacy to communicate with their physician (P=0.04), but no statistically significant differences (P>0.05) were reported for trust in physician, heart failure specific health status, and adherence to physicians recommendations.
CONCLUSIONS: In this cohort of heart failure patients, there was no significant racial difference in EOD in health care. EOD also did not significantly differ by geographical location of the VA hospital in the northern and southern US. Patients who indicated that they had EOD in health care indicated less trust in the VA system and lower self-efficacy to communicate with their physician. Possible limitations of our findings include an association with social desirability and that EOD in health care is measured with a single item. Nonetheless, our findings may also be explained by the fact that all participants were Veterans and were chronically ill. Unique characteristics of Veterans as a special population include Veterans shared sense of identity, which may have been just as strong as or stronger than identification with a particular racial group. Although patients reported being discriminated against in other settings, they reported adherence to their doctors recommendations, which is consistent with veteran culture of following the orders of those who are in a perceived higher position of authority.
PATIENT NAVIGATION FOR FORMER PRISON INMATES: A PILOT RANDOMIZED CONTROLLED TRIAL
Ingrid A. Binswanger1,2;
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BACKGROUND: Many states are releasing prison inmates early to address budget constraints, but prior research has demonstrated high mortality rates during the transition from prison to the community. Little is known about how to prevent poor health outcomes in former inmates. The objective of this study was to test the feasibility of a randomized controlled trial (RCT) of patient navigation to reduce barriers to healthcare and hospitalizations during the transition from prison to the community. METHODS: Forty former prison inmates 18 and older were recruited into an RCT within 15 days of release from prison. Eligible individuals had a history of a drug related offense or endorsed 3/7 symptoms of substance dependence; could understand study procedures in English; did not plan to leave the area for 6 months; and were not living in a locked halfway house. Recruitment took place at a re-entry center, a program for returning prison inmates sponsored by the prison system. Participants were randomized to 3 months of patient navigation with facilitated enrollment into an indigent care discount program (intervention) or facilitated enrollment into an indigent care discount program alone (control). Structured interviews were conducted at baseline and 3 months which addressed the number of barriers to healthcare and the number of emergency department/ urgent care visits and hospitalizations. Outcomes were measured as a change in number of self-reported barriers to care and change in the rate of health service use per 100 person days from baseline to 3 months.
RESULTS: We recruited 40 participants in 2.5 months. There were no significant differences between

intervention and control participants in days since release, age, race/ethnicity, and educational attainment. Participants were enrolled an average of 7 days after release. The mean age was 42. Overall, 18% were women and 30% reported being Latino. In terms of race, 58% were white, 20% were African American, 5% were American Indian, and 18% did not report a race. At 3 months, 21(52.5%) had completed the follow-up interview. Fourteen (35%) participants were not available to be interviewed due to re-arrest, 3 (7.5%) had absconded from the criminal justice system, 1 (2.5%) could not be located, and 1 (2.5%) had withdrawn. The mean number of reported barriers to care was reduced at 3 months in both groups (intervention: -1.82.7; control: -1.12.4). The change in rate of emergency department/urgent care visits per 100 person-days from baseline was 1.10.9 among intervention participants and 0.50.5 among control participants. The change in rate of hospitalization per 100 person-days from baseline was 0.10.3 in intervention participants and 0.81.5 in control participants.

CONCLUSIONS: Our intervention feasibility work suggests that recruitment of former inmates into RCT of patient navigation was highly feasible, but follow-up was limited by re-arrests and individuals who absconded from the criminal justice system. Preliminary results suggest a trend towards lower hospitalization rates among navigation participants at 3 months, but that the rate of emergency room or urgent care visits was not improved, perhaps due to the high use of these services to access routine care. Given high recidivism, an adequately powered RCT should allow for follow-up in prison and repeated episodes of navigation at re-release. Future research will examine the effect of patient navigation on poor health outcomes and costs of care in former prison inmates.

PATIENT PERCEPTIONS OF POST-DISCHARGE EDUCATION AND SUPPORT. Leora I. Horwitz1; John Moriarty1; Boback Ziaeian2; Sandhya V. Kanade2; Grace Y. Jenq1; Christine Chen2. 1Yale University, New Haven, CT; 2Yale New Haven Hospital, New Haven, CT. (Control ID #1338865)

BACKGROUND: Patient education at the time of hospital discharge is a crucial component of transitional care. However, the degree to which patients recall receiving and understanding discharge information is uncertain. Furthermore, the degree to which hospitals adequately assess and meet post-discharge needs from the patient perspective is uncertain. METHODS: A prospective cohort of patients admitted to the medical service at Yale New Haven Hospital with pneumonia, heart failure or acute myocardial infarction and discharged home was enrolled from May 1, 2009 to April 4, 2010. The hospital has a higher than average readmission rate for pneumonia and heart failure. Patients were interviewed within one week of discharge by telephone. The interview consisted of approximately 50 questions, addressing diagnosis, discharge instructions, communication with primary physicians, follow-up appointments, medications and patient education. Where available, we used standardized, validated questions, including the CTM-3 and HCAHPS for assessment of patient satisfaction with discharge education. The CTM-3 includes three questions (the hospital staff took my preferences and those of my family or caregiver into account in deciding what my healthcare needs would be when I left the hospital, when I left the hospital I had a good understanding of the things I was responsible for in managing my health, and when I left the hospital I clearly understood the purpose for taking each of my medications). RESULTS: The study cohort included 395 patients. Included patients had a mean age of 77 years; 54% were male. A total of 39% had heart failure, 24% had pneumonia and 52% had acute coronary syndrome. 14% had more than one diagnosis. One third of patients reported receiving less than one days advance notice of discharge, and 246 (66.1%) reported that staff asked if they would have the support they needed at home prior to discharge. After arriving home, 42 (10.9%) reported that they would have liked the hospital to provide them with additional services. A total of 330(86.4%) of patients reported that they were told who to call if symptoms got worse after discharge, but only 201 (51.0%) reported receiving a scheduled follow-up appointment prior to discharge. Overall, 354 (90.3%) of patients reported receiving written discharge instructions prior to discharge. A total of 325 (87.4%) found them easy to read, 319 (86.0%) found them easy to understand, and 306 (82.5%) reported

being able to ask questions about them. 330 (83.5%) reported that the instructions contained information about what symptoms or health problems to look out for after they left the hospital - identical to the publicly reported hospital-wide result on this HCAHPS measure (83%) and slightly above the national average of 82%. The mean CTM-3 score was 77.2 (SD 18.3). A total of 91 (21.7%) patients would have liked a pharmacist to be involved in discharge education; only 14 (3.3%) recalled actually speaking to one. CONCLUSIONS: Patients at this hospital with above average readmission rates reported high levels of satisfaction with patient education and discharge instructions. By contrast, they reported receiving little time to prepare for discharge and inconsistent post-discharge follow-up. A substantial minority reported inadequate assessment of home needs. Our findings suggest that a successful discharge requires more than a focus on high quality patient education.

PATIENT RECALL AFTER MISUSE OF A BLOODLETTING DEVICE IN AN AMBULATORY CARE SETTING

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BACKGROUND: Single- and multi-patients devices have been used indistinctly by mistake in our ambulatory care setting, combining primary care and anticoagulation clinics. Transmission of blood-borne pathogens may occur despite needle change between patients because of blood contamination of the tip of the device. Regarding to that risk, a recalling procedure of all concerned patients was implemented. The objective was to assess barriers, efficacy and relevance of recalling patients after misuse of a single-patient bloodletting device on several patients.

METHODS: A task force was set up, composed of representatives from the medical and nursing direction of the hospital, physicians and nurses from the ambulatory care setting, and specialists in infection control and public health. The patients potentially exposed to blood contact were identified, and a process for internal and external communication singled out. A procedure to recall the patients and organize the consultation, blood analyses and communication of results was established, including ways to deal with the reactions from both medias and patients. Recalled patients underwent serology testing for HBV (HBsAg, total anti-HBc), HCV (total anti-HCV), and HIV (anti-HIV1/2, p24 Ag). Possible transmissions were investigated by mapping visits to the clinics, and by comparing viral sequences in the suspected source and secondary cases.

RESULTS: A total of 280 patients were considered for recall. Of these, 263 patients (94%) responded to the invitation to be tested, and seventeen patients (6%) could not be tested (9 patients had died in the interval, with no suspicion of blood-borne infection; 5 patients refused to be tested; 2 patients could not be contacted; and 1 patient lived in a country where testing was not possible). From these 263 tested patients, 218 (83%) had negative test results; 37 healed hepatitis B ; 5 hepatitis C (of which 4 were already known); and 3 both infections (2 already known). Only 1 was HIV positive (already known). For the newly discovered hepatitis C, contamination was considered very unlikely after genetic sequencing. For the newly discovered both infection case, the sequence of events excluded contamination through misuse of the bloodletting device. The recall process included 330 letters, 287 consultations, 1 year management and hotline availability, and 1500 working hours for the nursing, administration and medical staff. All tested patients accepted that such an error could occur and submitted to testing and communication of results without difficulty. It implied however an important investment in time and energy from the clinicians and laboratories involved in the process. CONCLUSIONS: Recalling patients after an error in a process of care is possible though difficult to carry out. Patients had a surprisingly good acceptance of the whole process and understanding that such an error could occur. Given the low yield of positive results, the usefulness of such a procedure in this kind of situation should be carefully assessed before launching it.

PATIENT SHARING AND THE COSTS OF CARE Craig E. Pollack1;
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BACKGROUND: Improving care coordination is a national priority and key focus of health care reforms. However, the success of these policies will be hindered by the lack of available care coordination measures that may be used with existing claims data. Prior research has found that doctors whose patient panels frequently overlap with one another in claims data (i.e. have many shared patients) were more likely to communicate with and refer to one another. This may, in turn, facilitate care coordination. We tested whether patients with higher rates of patient sharing among his/her physicians tended to have lower costs of care and lower likelihoods of hospitalization.
METHODS: We performed a cohort study using 2009 data from 5 private insurers. Plans ranged in size from 460,000 to 890,000 members and represented all four US Census regions. We examined two clinical conditions for which care coordination has been postulated to reduce costs: congestive heart failure (CHF) and diabetes. For 9,596 patients with congestive heart failure (CHF) and 22,765 with diabetes, we calculated the amount of patient sharing among his or her providers. The numerator in this measure is the total number of instances of patient sharing over a year

among a patients doctors. The denominator is the total number of pairs of doctors for that individual patient. We used multivariable models to test whether patient sharingat the patient-levelwas associated with costs and rates of hospitalization after adjusting for case-mix.
RESULTS: The average total annual health care cost for patients with CHF was $29,456, and $16,508 for those with diabetes. In risk adjusted analyses, the highest tertile of patient sharing was associated with lower total costs compared to the lowest tertile ($3,310 lower for CHF and $2,121 lower for diabetes, $p<0.001$). Lower inpatient costs and rates of hospitalization were found for patients with CHF and diabetes with the highest amounts of patient sharing among his/her providers, and, for those with diabetes, lower outpatient costs were found for the highest patient sharing. Pharmacy costs were not significantly associated with patient sharing.
CONCLUSIONS: Patients treated by physicians who collaborate more frequently have lower costs. The degree of shared patients among a patients providers may be an important measure that can be used to evaluate aspects of care coordination and track the performance of health care systems.
PATIENT-PROVIDER COMMUNICATION ABOUT RISK FACTORS FOR DIABETES COMPLICATIONS DURING BETWEEN-VISIT ENCOUNTERS Courtney R. Lyles1; Lou Grothaus2; Urmimala Sarkar1; James Ralston2. 1University of California San Francisco, San Francisco, CA; 2Group Health Cooperative, Seattle, WA. (Control ID #1336722)
BACKGROUND: Secure messaging (SM) and phone encounters are becoming widespread to increase patient access to providers between visits. Although these encounters have the potential to improve the care of chronic conditions, we know little about their content in relation to traditional in-person visits. Within a diabetes patient population, we examined discussions about risk factors for diabetes complications, exploring patterns among all encounter types. We hypothesized that those with better control would report more risk factor discussions.
METHODS: We surveyed adult English-speaking patients with diabetes receiving care at Group Health Cooperative in Seattle, WA in 2009. All had 1 in-person visit with their primary care provider in the previous year. Since 2003, all patients have been able to exchange SMs and have phone encounters with their

providers, as well as have access to an electronic medical record with additional features (e.g., refilling medications, requesting in-person appointments). Patients reported on discussions with providers about risk factors for diabetes complications; automated data was obtained on A1c , BP, and LDL to determine which patients were in clinical control at the same time (A1c7%,
BP130/80 mmHg, and LDL100 mg/dL). We extracted data on outpatient encounters (in-person, phone, and SM encounters) and examined unadjusted associations of risk factor discussions by encounter type and clinical control. RESULTS: 592 patients responded to the survey (response rate 65%). These analyses are limited to the 85% who responded to the risk factor discussion items: 51% were age 65, 50% were male, 35% hadcollege education, and 67% were white. In addition, 67% had A1c7.0, 57% had BP130/80 and 27% had LDL100, and 77% had 1 between-visit encounter (63% phone, 41% SM). Discussions of glycemic control with providers were reported by 89% of patients during in-person visits and 42% during between-visit encounters, compared to 82% &17% for BP and 76% &20% for LDL (all p<0.001). During between-visit encounters, patients in poor control were more likely to have risk factor discussions (see table). During in-person visits, those with elevated BP were more likely to discuss BP. CONCLUSIONS: In this system, diabetes patients reported significantly fewer risk factor discussions during between-visit encounters compared to in-person visits. Access to SM and phone visits may have fulfilled acute care needs of patients with diabetes, as opposed to shifting practices toward proactive chronic care management. Those with poorer risk factor control, however, reported more risk factor communication during between-visit encounters, suggesting some patients and providers are using between-visit encounters to help address unmet chronic care need. Additional information about all discussion content across encounters is needed to better understand
these patterns. These findings are relevant for systems implementing phone and SM encounters, especially those transitioning to medical home models.

Visit type, clinical control, and patient-reported risk factor discussions

Clinical control
N % reporting risk factor communication
OR (95% CI)of communication: out of control vs. in control

In-person visits

A1c in control A1cout of control
163 327
91 89 0.84 (0.45, 1.59)

BP in control BPout of control
214 287
78 85 1.59* (1.01,2.50)

LDL in control LDL out of control
324 120
76 81 1.33 (0.79, 2.27)

Between-visit encounters

A1c in control A1c out of control
136
244
35 45 1.56* (1.01,2.38)

BP in control BPout of control
167
221
12 21 1.92* (1.09,
3,45)

LDL in control LDL out of control
247 102
17 25 1.67 (0.96,2.94)
* p<0.05 p<0.10
PATIENTS' ESTIMATION OF EXPECTED LENGTH OF HOSPITALIZATION PREDICTS 30-DAY READMISSION RATES Dennis G. Gibson; Stephanie Pezzo. University of South Florida, Tampa, FL. (Control ID #1276840)
BACKGROUND: Previous research has indicated that many hospitalized patients have a poor understanding of their plan of care. We hypothesize that patients are poor predictors of their expected length of stay, and that this may be related to 30-day readmission rates.
METHODS: Sixty patients were interviewed about their expected hospital length of stay. The patients' physician and nurse completed the same interview. A chart review was performed thirty days after the study period to determine the actual discharge date and whether the patient was readmitted to our hospital. Fisher's exact test was used to assess for association between accuracy and readmission.
RESULTS: Physician, nurse, and patient accuracy in predicting length of stay was poor (50%, 29.3%, and 34.5% respectively). Although physician and nurse predictions were not associated with readmission rate, patients who were inaccurate about their length of stay had a significantly higher 30-day readmission rate (p=0.0105).
CONCLUSIONS: These results stress the importance of communication to patients regarding their expected discharge date.
PATIENTS' RETENTION OF HEPATITIS B KNOWLEDGE AFTER EDUCATION SESSIONS AT STUDENT-RUN SCREENING AND VACCINATION CLINICS Cindy Lai1; David Ouyang1; Leslie Sheu1; Neal Yuan1; Gary Lau2; Cheng Chen3. 1UCSF, San Francisco, CA;
2UCSF, San Francisco, CA; 3Keck School of Medicine of USC, Los Angeles, CA. (Control ID #1339765)
BACKGROUND: Although hepatitis B virus (HBV) infection disproportionately affects the Asian Pacific Islander population, low HBV awareness and knowledge persist in this community, which may negatively impact preventive practices and early disease detection. Results are conflicting on whether community education can lead to

long-term knowledge retention. The effectiveness of student-run education sessions on increasing patients long-term knowledge retention has not been explored.
METHODS: From September to December 2011, we assessed patients retention of HBV knowledge at two monthly student-run HBV screening and vaccination clinics affiliated with our urban health sciences campus and the Department of Public Health. One-on-one patient education was provided by trained first- and second-year medical, nursing, and pharmacy students using a script and aided by undergraduate interpreters. Using a 16-question true/false survey adapted from a previously validated tool for assessing hepatitis C knowledge, we evaluated patient knowledge of HBV risk factors, transmission modes, and management at three time points: before education (baseline), at the end of the initial visit, and at a one-month follow-up visit. Paired and unpaired T-tests were used to compare scores over time and a generalized linear model was used to assess associations between performance and socioeconomic factors. RESULTS: Seventy-nine patients completed the first survey with a mean score of 8.72 out of 16 (SD=2.44); 78 (99%) completed the second survey (mean score 10.99 (SD=2.37)) and 64 (81%) completed the third survey (mean score 10.91 (SD=2.56)). There was a statistically significant difference in scores between the first and second tests (p<0.001) and the first and third tests (p<0.001) but no significant difference between the second and third tests (p=0.85). A similar result was obtained when including only patients who completed all three tests (paired T-test, p<0.001, n=46, 95% CI of difference between first and third test: 1.28-2.76). Demographics provided by 36 (46%) patients revealed that

patients were older (mean age 53.2, SD=18.2), predominantly female (68.6%), of lower SES (46.7% income less than $20,000), and had limited English proficiency (58.3% monolingual East Asian language speakers). Patients had on average resided in the US for 22 years. A generalized linear model revealed no difference in performance by age (p=0.15), gender (p=0.24), income (p=0.20), primary language (p=0.79), or years of residence in the United States (p=0.81). Patients demonstrated greater retention of knowledge related to positive risk factors of HBV transmission compared to knowledge of Hepatitis B management and treatment (13.3% vs. 1.9% improvement).
CONCLUSIONS: Our study suggests that one-on-one education for patients led by trained health professional students at student-run clinics can be used to impart HBV health knowledge that is retained at one month after initial education. Retention appears to be independent of demographic or socioeconomic indicators. Patients may retain certain types of knowledge, such as information on positive risk factors for disease transmission, better than other types. Whether such knowledge retention ultimately translates into changed health behaviors remains unconfirmed. Nevertheless, these results warrant further consideration of student-led educational sessions at student-run clinics as a promising community health education model.
PATIENTS CHOICES FOR LIFESTYLE CHANGE VERSUS MEDICATION USE TO REDUCE ELEVATED CVD RISK Stacey L. Sheridan1,2; Lindy B. Draeger2; Michael Pignone1; Thomas C. Keyserling1,2. 1University of North Carolina at Chapel Hill, Chapel Hill, NC; 2University of North Carolina at Chapel Hill, Chapel Hill, NC. (Control ID #1337795)
BACKGROUND: Coronary heart disease (CHD) is the leading cause of death in the United States. Although lifestyle change and medication use can substantially reduce CHD risk, little is known about patients preferences for lifestyle versus medication to reduce elevated CHD risk or about what affects their preferences.
METHODS: We developed two versions (web-based and counselor-based) of a combined lifestyle and medication intervention to reduce CHD risk and compared their effects in a randomized trial conducted at five socioeconomically diverse clinics in a practice-based research network. Both versions included the same content: a web-based decision aid and 7 structured counseling sessions tailored to participants baseline risk factors and treatment preferences. After completing baseline surveys and viewing the decision aid (which educated patients on their CHD risk and risk reducing options), participants reported their preferences for lifestyle, medication, or both to
lower their CHD risk. Here we examine those preferences and whether they vary by patient characteristics.
RESULTS: We enrolled a consecutive sample of 340 participants with 10-year Framingham CHD risk >10%. Mean age was 63. 51% were female, 26% were African-American and 72% white. 14% read at less than a 7-8th grade reading level. 87% had a prescription drug plan. When offered a choice about how to reduce their CHD risk, 92% (277/296) of participants with unhealthy diet chose to change their diet; 61% (204/243) with low physical activity chose to exercise more; 68% (55/81) who smoked chose to stop smoking; 30% (36/116) with high blood pressure chose to take medicine; 31% (69/229) with abnormal cholesterol chose to take medicine; and 59% (38/112) who were eligible for aspirin chose to take it. 80% of individuals chose more than one intervention to lower their risk, with the most popular combinations including diet and exercise (36%), diet and meds (10%), and diet, exercise and meds (12%). In unadjusted analysis, choices for lifestyle and medication interventions were consistent by gender, CHD risk level, health literacy level, race, and prescription drug plan with two notable exceptions: whites were less likely than African-Americans to chose to take cholesterol medicines (25% versus 49%, p<0.001), and those without a prescription drug plan were less likely to chose to quit smoking than those with a prescription drug plan (47% versus 74%, p=0.03).
CONCLUSIONS: When offered a choice, a majority of participants preferred to change their lifestyle to lower their CHD risk and to intervene on multiple risk factors at once. Preferences varied little by the patient characteristics we examined. More work is needed to understand whether patients make choices that optimize long term risk reduction.

PATIENTS PATTERNS AND PREFERENCES OF USE AND CONTENT OF SOCIAL MEDIA Gurjeet Singh; Balaji Ramasamy; Satyam Patel; Gaurav Bhalla; Diane L. Levine. Wayne State University/ Detroit Medical Center, Detroit, MI. (Control ID #1336667)

BACKGROUND: The use of various social media sites (such as Facebook, Twitter, and MySpace) as well as short messaging system (SMS) text messaging have seen dramatic increases in usage, particularly among adolescents and young adults. There is also an increased usage of social media by medical professionals and medical organizations. Social media offers healthcare organizations (HCOs) an abundance of potential benefits, including enhanced community outreach, improved patient satisfaction and management. As use of electronic media (social media, internet, email, or text messaging) continues to evolve, it is unclear which media type patients might prefer for their healthcare needs. Exploring these preferences could potentially help in designing more tailored and effective interventions. This study was done with the objective to assess patients usage pattern of social media and to evaluate patients perceptions and preferences of the use and content of social media for healthcare and medical purposes.

METHODS: We developed a survey instrument comprising 20 questions to assess patient perceptions of social media use. An informational sheet was provided. No personal identifying information was collected. All patients attending internal medicine clinics at Wayne State University (WSU) /Detroit Medical Center (DMC) were eligible to participate in the online survey. Patients willing to participate took the survey posted on Google documents using iPads or laptops. Participation in the study was completely anonymous and voluntary. The survey was conducted over a four week period from December 2011-January 2012. The study was exempted by the WSU institutional review board.

RESULTS: A total of 503 patients completed the survey. The majority of patients were 40-59 years old (47.5%), were African American (84.3%), female (61.2%) and unmarried (68.4%) with children (73.4%). Nearly seventy percent had Medicare or Medicaid. Most (72%) had chronic medical conditions. Although 30.4% of our patients have never used internet to access social media sites, almost an equal proportion (29.4% of patients) use the internet to access such sites multiple times in a day. The remaining patients (40.2%) access the internet occasionally. Patients using social media sites use home internet (37.6%) or mobile phone (29.0%) to access internet; the majority (55.1%) do not use smart phones. The two most favored social media sites included Facebook and Google. The

majority of patients have access to email and mobile texts. Most of our patients (77.3%) do not follow any health-related webpage and do not trust medical information provided on such websites (47.5%) and nearly all(92.2%) do not share their medical concerns on social media sites. Almost half of patients (45.1%) wants to be friends with their physicians on social media sites, and would like physicians to interact with patients utilizing Facebook or email, to help them better understand medial issues (90.5%) and to provide them with information regarding appointment schedules and follow-up.

CONCLUSIONS: There is an untapped potential for use of social media to improve patients healthcare delivery. Physicians and healthcare providers should utilize these tools for improving patient care.

PATTERN OF SEXUAL HEALTH ISSUES DOCUMENTED IN THE FIRST 6 MONTHS OF CARE OF RECENT COMBAT VETERANS Drew Helmer1; Gregory R. Beaulieu2,3; Cheryl Houlette4; Michael Kauth2,3. 1VA-NJHCS, East Orange, NJ; 2MEDVAMC, Houston, TX;
3Baylor College of Medicine, Houston, TX; 4MEDVAMC, Houston, TX. (Control ID #1338739)

BACKGROUND: Despite the importance of sexual health and the known, common risk factors for sexual dysfunction in Veterans of Operations Enduring Freedom and Iraqi Freedom (OEF/OIF Veterans) (e.g., depression, PTSD, psychoactive medications), the sexual function of and best practices for addressing sexual

health concerns in this group are not well described. We examined patient medical records to characterize and quantify the documented sexual health issues and related care to establish the importance and possible means of improving sexual health for these patients.
METHODS: We reviewed the medical records of consecutive patients presenting for an initial evaluation at the post-deployment clinic of a large, urban, academic, tertiary care VA medical center in late 2009. The clinic provides an integrated primary care, mental health, and case management assessment in a half-day visit. We abstracted information from the primary care and mental health clinician notes, templated clinical reminder screenings, and pharmacy report documented at the initial visit through the first 6 months of care. All text possibly related to sexual health issues was abstracted, as were screening results for PTSD, depression, alcohol use, military sexual trauma, and traumatic brain injury. Demographic information was also recorded. Sexual health issue text was coded and categorized. We noted whether each documented sexual health issue was an element of a standard note template or not. Medications prescribed by a VA provider in the study period were recorded by generic name and categorized into drug classes.
RESULTS: The sample (n=106) was primarily male (n=94 (84%)), white (n=51 (48%)) or black (n=28 (26%)), and non-Hispanic (n=106 (100%)). Mean age was 29.7 years (SD 7.1). Screening results indicated possible depression in 24 patients (23%), PTSD in 52 (49%), alcohol misuse in 43 (41%), and TBI in 31 (29%). Military sexual trauma was not report by any patients. A selective serotonin reuptake inhibitor or serotonin-norepinephrine reuptake inhibitor was prescribed to 35 (33%) patients. A sexual health issue was documented in 26 patients (25%) in the first 6 months of VA care. Of 30 sexual health issues documented, 18 (60%) were recorded at a follow up visit. There were 8 categories of sexual health issues recorded. The most common templated sexual health issues were low libido and history of sexually transmitted disease (STD). The most common nontemplated issues were low libido, erectile dysfunction, and acute or resolved STD. At the initial visit, only 25% of sexual health issues were recorded as non-templated text; in the 6 month follow up period the proportion of non-templated issues rose to 56%. Vardenafil was prescribed to 6 men (6%).
CONCLUSIONS: Sexual health issues were common among VA care-seeking OEF/OIF Veterans. The range of sexual health issues was broad and the frequency of documentation, nature of documentation (templated vs. non-templated), and type of issue differed between initial and follow up visits. More systematic use of a sexual health template might promote faster and more comprehensive assessment of sexual health in this population.
PAYING THE PRICE: THE DEARTH OF PUBLICALLY AVAILABLE PRISON HEALTHCARE COST DATA Brie Williams1,2; Cyrus
Ahalt1. 1University of California San Francisco, San Francisco, CA; 2San Francisco VA Medical Center, San Francisco, CA. (Control ID #1339155)
BACKGROUND: The U.S. prison population is aging rapidly. Over 10% of prisoners are age 50 or older and older prisoners often have poor health, adverse health outcomes and high medical costs. In 2001, state prisons spent $3.2 billion on medical care for prisoners. By 2010, 4 state prison systems, with 26% of all prisoners, required the same amount of health spending. Prior medical research using the Dartmouth Atlas of Health Care has shown that easily accessible, publically available data can serve as a powerful tool to compare outcomes across health care systems and identify the drivers of healthcare costs. Given that recent dramatic increases in the cost of incarceration are associated primarily with prison healthcare and aging prisoners, we sought to assemble a publically available data compendium of correctional healthcare cost by age and expenditure category in 50 state prison systems.
METHODS: We reviewed all current publically available statistics, annual reports and special reports from the Departments of Corrections of all 50 states. Through content analysis, we identified those prison systems that make prison healthcare cost data publically available and those that provide cost data by age group and / or expenditure category. We then identified opportunities to improve the availability of relevant data.
RESULTS: All 50 state Departments of Correction issue publically available annual statistical reports and 90%

make available some prison healthcare cost information. Yet none provide a systematic breakdown of healthcare costs for prisoners by age or age group and only 5 states (10%) report healthcare costs by expenditure categories such as personnel, prescription medication, or outside medical care. Though no state Departments of Correction report age-stratified healthcare data in their annual reports, 4 states (8%) have estimated healthcare costs for older versus younger prisoners on a per person per day basis in special reports. In these special reports, the average ratio of prison healthcare cost for older versus younger prisoners was 3.8:1. Finally, states significantly vary in the age cutoff used to define older prisoners. One state (2%) did not report any age groups above age 40 yrs, 16 (32%) used an age cutoff of 50 yrs, 8 (16%) used a cutoff of 55 yrs, 2 (4%) used a cutoff of 60 yrs or older, and 23 states (46%) did not clearly define the age of older prisoners. CONCLUSIONS: Despite both the aging of U.S. prisoners and an associated rise in prison healthcare costs, no state reports publically available data on prison healthcare costs by age and expenditure category. This absence of data represents a significant missed opportunity to engage in serious, cost-reducing correctional health policy reform as would be made possible by a data source like the Dartmouth Atlas. To provide researchers, public officials, and policy-makers with a vital tool to address the budgetary and healthcare crises in American corrections, we recommend four simple changes to data collection and dissemination by state Departments of Corrections: (1) determine a uniform age for older prisoners as indicated by experts in health and aging in the criminal justice system; (2) adjust data collection tools to report age-stratified health expenditures; (3) expand data to include health expenditures by category; and (4) disseminate data in the annual statistical reports currently issued by all 50 states.

PERCEIVED CONTROL &SLEEP IN HOSPITALIZED ADULTS: A SOUND HYPOTHESIS? Marie Adachi; Paul G. Staisiunas; Kristen Knutson; David Meltzer; Eve Van Cauter; Vineet Arora. University of Chicago, Chicago, IL. (Control ID #1320135)

BACKGROUND: Although sleep is important for recovery from acute illness, it is often hampered by noise in hospitals. Interestingly, some patients are more vulnerable to noise disruptions, which is now a publicly reported quality measure by Medicare for hospitals. Perceived control over sleep, or the belief of personal ability to bring about a health outcome related to sleep, could be responsible for this variation. High perceived control is associated with fewer hospitalizations and lower mortality rates in older patients, warranting its study in the context of sleep. The aim of

this study was to assess the association between perceived control over sleep and inpatient sleep time after controlling for noise levels. METHODS: All non-institutionalized patients over age 50, who were ambulatory on admission and admitted to a general medicine ward were eligible. Patients with prior sleep disorders, in the hospital greater than 72 hours, with prior ICU stay or in respiratory isolation were excluded. Perceived control over sleep was measured using the Sleep Self-Efficacy Scale (SSE) which is a 9 item scale which ranges from 9 to 45 and asks patients to report their confidence ranging from 1 (Not Confident) to 5 (Very Confident) of ones ability to carry out activities related to sleep (i.e. lie in bed, feeling mentally relaxed). Baseline sleep habits were assessed using the Epworth Sleepiness Scale. Patients were also asked daily about whether their sleep was disrupted by noise the night before. Sleep in hospital was measured nightly using wrist actigraphy (Actiwatch). Noise level was measured nightly in dB using bedside Larson Davis sound meters. Descriptive statistics and multivariate linear regression were used to discern the association between perceived control and sleep duration controlling for noise and clustered by subject.

RESULTS: From April 2010 to Aug 2011, 76 patients (61%) were enrolled whose mean age was 67+/-12 years. Two thirds were African American and 57% were female. Over two-thirds of subjects (67%) were characterized as average or above average sleepers at baseline with Epworth Sleepiness Scale scores 9. Mean in-hospital sleep time was 329123 mins, which was significantly shorter than the self-reported sleep duration of 393119 mins prior to admission ($p<0.0001$). Roughly half (46%) of patients complained of noise. Noise levels in the

loudest tertile rooms ranged from 37 dB (conversation) to 94db (chainsaw). Median sleep self-efficacy was 35 (IQR 26-41). In unadjusted analyses, patients with above median SSE had almost and hour (58 min) more sleep (95% CI [15-100], p=0.009). This effect remained significant after controlling for noise level and routine demographics. Of note, the loudest noise levels were associated with nearly an hour less sleep (-52 minutes). Patients with high SSE also had 70% lower odds of reporting noise-disrupted sleep [OR 0.31 (0.13,0.73), p<0.05] in both adjusted and unadjusted analyses. Sensitivity analysis using raw SSE scores showed similar findings. CONCLUSIONS: Controlling for noise levels, high Sleep Self-Efficacy among hospitalized older patients is associated with longer sleep duration and fewer complaints of noise. In addition to noise control, hospitals should consider interventions (coaching, empowerment) to boost perceived control over sleep to improve the sleep of hospitalized adults.

PERCEPTION OF CHEMOTHERAPY INFLUENCING TREATMENT DECISIONS IN WOMEN WITH HORMONE-POSITIVE BREAST CANCER Tracy A. Proverbs-Singh1; Kezhen Fei2; Rebeca Franco2; Nina A. Bickell1,2. 1The Mount Sinai Hospital, New York, NY;
2The Mount Sinai Hospital, New York, NY. (Control ID #1339684)

BACKGROUND: Women with hormone receptor positive (HR+) (>1 cm) breast cancer are a heterogeneous group for whom systemic chemotherapy can provide benefit for some, but not for all. Unnecessary chemotherapy can adversely affect patient quality of life and inflict undue cost and morbidity. Gene array analysis, to predict recurrence risk, can reduce unnecessary adjuvant chemotherapy; however, not all HR+patients receive this test. While tumor biology effects chemotherapy decision making, patient perception of cancer recurrence may also affect treatment decisions. Women who perceive a greater risk of recurrence may feel more obligated to undergo chemotherapy in addition to hormonal therapy. We undertook this study to determine whether women with HR+tumors (>1 cm) who undergo chemotherapy, have stronger concerns about cancer recurrence and stronger beliefs in the efficacy of chemotherapy than women who do not get chemotherapy.

METHODS: Women participating in a Breast Cancer Patient Assistance Trial in 2006-2010 were surveyed shortly after their definitive surgery about their cancer knowledge, beliefs and attitudes about breast cancer and its treatment; charts were abstracted 6 months later to measure treatments received. 211 women had HR+ >1 cm tumors. Nottingham Prognostic indicator (NPI), which uses stage, tumor size and lymph node involvement was calculated. Chi-square and logistic regression analyses examined associations between receipt of chemotherapy and tumor stage, NPI,
physician recommendation for chemotherapy, patient demographics and beliefs about chemotherapy making women live longer, reducing recurrence and concern about unwanted side effects.

RESULTS: 130/211 (62%) women with HR+tumors received chemotherapy and 197/211 (93%) received hormonal therapy. Only 46/211 (22%) had gene array analysis performed, and of these, all those with high risk recurrence scores (7/46 [15%]), 9/15 (60%) with intermediate risk and 1/24 (4%) low risk got chemotherapy. On average, women with HR+tumors treated with chemotherapy vs those without chemotherapy were younger (mean 52.5 yrs vs 62.3 yrs, p<0.0001), had higher stage cancer (stage II: 65% vs 23%, p<0.0001), worse NPI (poor prognosis:15% vs 2% &moderate prognosis: 62% vs 30%; p<0.0001), physician recommended chemotherapy (92% vs 34%, p<0.0001) and patient concern that without chemotherapy their cancer would recur (very worried 70% vs 15%; p<0.0001). Multivariate analysis found that physician recommendation and poor or moderate NPI were most strongly associated with receiving chemotherapy [RR=3.2, (95% CI: 1.8-5.6), 1.7, (95%CI:1.3-2.2); 1.6, (95%CI:1.2-2.0)], respectively, followed by womens worry that without chemotherapy cancer would recur (RR=1.3; 95%CI: 1.0-1.6), and belief that chemotherapy allows women to live longer (RR=1.1; 95%CI: 1.0 - 1.2). Older age was associated with less use of chemotherapy (RR=0.99; 95%CI: 0.978-0.995).

CONCLUSIONS: Physician recommendation and disease severity greatly influence the utilization of

chemotherapy among women with HR+breast cancer. Decisions are also strongly affected by their concerns about recurrence and beliefs about chemotherapys effectiveness. The study is limited in the small proportion of patients undergoing gene array analysis to help inform decision-making. Patients may benefit from education to augment their ability to make informed decisions about disease recurrence and risk of adverse outcomes from chemotherapy.

PERCEPTIONS AND BARRIERS TO USAGE OF GENERIC MEDICATIONS IN A RURAL AFRICAN-AMERICAN POPULATION Keri Sewell1; Susan J. Andreae2; Elizabeth Luke1; Monika Safford2. 1UAB, Birmingham, AL; 2UAB, Birmingham, AL. (Control ID #1334886)

BACKGROUND: Usage of generic medications in chronic diseases has been shown to have many benefits, such as similar efficacy for lower price, leading to increased adherence. However, there is significant underuse of generic medicines in African-American communities as well as in communities with low socioeconomic status and low health literacy, such as those found in the rural Southeastern United States. Prior studies have found that such communities have lower trust of generics, particularly for chronic or serious diseases, and increased reluctance to switch from brand to generic. No studies, however, have focused on perceptions of rural, Southern African Americans toward generic medication use. METHODS: To gain insight into causes of low usage of generic medications among Africans Americans in the rural South, we conducted focus groups in Alabamas underserved and low-income Black Belt area. Inclusion criteria included age of 18 years or older, residence in Alabamas Black Belt region, African-American race, and current use of a daily medication for chronic disease. A total of 30 community members participated in four focus groups. After transcription of the focus group recordings, analysis was performed using NVivo9. Two authors independently identified themes and then reached a consensus on themes before coding all transcripts. The focus group members were primarily middle-aged women, with over half having only a high school education or less. Most were not employed, and one-fourth had no health insurance. RESULTS: The general themes that emerged included perceived differences in efficacy and side effects of generic medications versus brand medications; the perception that generics were not real medicine; willingness to take generics for minor but not serious illnesses; mistrust in doctors and the health system that affects medication adherence; and the perception that, while generics cost less, people of limited means had to settle for less. CONCLUSIONS: Our focus group data showed barriers to generic medication use in disadvantaged communities that include both misinformation about the safety and efficacy of generic medications as well as deeper feelings of mistrust and abuse by the medical system. While education about generics may rectify some of the misinformation, other views, such as mistrust of the health system and the belief

that poor people must settle for inferior therapies by taking generics, may be more challenging to overcome. Both policy makers and physicians should consider these perspectives when working to increase generic drug usage in these populations.

PERCEPTIONS OF PHYSICAL ACTIVITY AMONG SOMALI MEN Ahmed A. Mohamed1; Jennifer A. Weis1; Irene G. Sia2; Mark L. Wieland2. 1Mayo Clinic, Rochester, MN; 2Mayo Clinic, Rochester, MN. (Control ID #1308494)

BACKGROUND: Immigrant and refugee populations arrive to the US healthier than the general population, but their cardiovascular risk profiles approximate and exceed those of the US average with increasing duration of residence. One critical factor contributing to these declines is adoption of a more sedentary lifestyle. Somali immigrants and refugees are the fastest growing subset of African migration to the US, yet little is known about their perceptions of physical activity in a new country. While preliminary work has described perceptions among Somali women, we report the first exploration (to our knowledge) of physical activity perceptions among Somali

men. Community-based participatory research (CBPR) has been successful in targeting health issues among immigrant and refugee populations, and it is an intuitively appropriate approach for addressing health behaviors in a sociocultural context. The Rochester Healthy Community Partnership (RHCP) is an established CBPR partnership where community and academic members work together through all phases of research. Research question formation, recruitment, study implementation and data analysis for this study were all derived and executed through the RHCP infrastructure.
METHODS: An RHCP community partner recruited Somali men for three age-stratified focus groups to elicit perceived facilitators and barriers to physical activity. Moderators and note takers for the focus groups were Somali men trained in focus groups moderation. Three in-depth interviews were conducted to expand and/or clarify themes that emerged from the focus groups. All focus groups and interviews were digitally recorded, transcribed and translated. The Health Beliefs Model informed focus group question development and data analysis. Team-based, thematic inductive analysis was conducted with transcripts and field notes from the sessions with the help of NVIVO-9 software.
RESULTS: A total of twenty Somali men participated in the focus groups and interviews. Participants demonstrated significant knowledge of physical activity principles, but identified the following barriers to adhering to these principles: loss of walking culture in the US, embarrassment about standard exercise outfit, fear of harassment, competing priorities, cost, transportation for elders, and winter weather. Perceived facilitators to physical activity included a wealth of knowledge about how to be healthy, success stories as inspiration, and community cohesion. CONCLUSIONS: Perceived barriers and facilitators to physical activity identified in this study may be used as cues to action for CBPR partnerships and public health agencies to derive interventions aimed at maintaining a healthy weight and cardiovascular risk profile among Somali immigrant and refugee men.
PERCEPTIONS OF READMITTED PATIENTS ON THE TRANSITION FROM HOSPITAL TO HOME Shreya Kangovi1,2; David
Grande3,4; Daniel A. Ryan2; Patricia Meehan5; Nandita Mitra6; Richard Shannon3; Judith A. Long1,3.
1Philadelphia Veterans Affairs Medical Center, Philadelphia, PA; 2Robert Wood Johnson Foundation Clinical Scholars Program, Philadelphia, PA; 3University of Pennsylvania Perelman School of Medicine, Philadelphia, PA; 4University of Pennsylvania, Philadelphia, PA; 5University of Pennsylvania Health System, Philadelphia, PA; 6University of Pennsylvania, Philadelphia, PA. (Control ID #1336091)
BACKGROUND: Policymakers and hospital leaders are focused on reducing the risk of hospital readmissions. However, these efforts have had mixed success and have not fully considered the patient perspective on the root causes of readmission. The objective of this study was to describe challenges that patients believe contributed to their need for readmission and to determine whether these challenges vary by socioeconomic status.
METHODS: A six-item survey instrument was administered to 1,084 inpatients selected for inclusion if their hospitalization was an unplanned 30-day readmission from home. Surveys were administered at an urban tertiary care academic medical center and an affiliated urban community hospital, both located in West Philadelphia. RESULTS: 45.5% of readmitted patients reported experiencing challenges during the transition from hospital to home which contributed to readmission. The most common transition challenges encountered by readmitted patients include lack of preparedness for discharge (11.8%), difficulty performing activities of daily living (10.6%), difficulty accessing(5.0%) and adhering to (5.7%) discharge medications and lack of social support (4.7%). Readmitted patients of low socioeconomic status (SES) were significantly more likely than high SES patients to attribute readmission to difficulty understanding and executing discharge instructions (3.6% vs. 1.3%, p=0.01), difficulty accessing (7.2% vs. 4.1%, p=0.04) and adhering to (8.5% vs. 4.6%, p=0.01) discharge medications, lack of social support (7.5% vs.3.6%, p<0.01), substance abuse (3.9% vs. 0.6%, p<0.01)and lack of basic resources such as food, transportation or telephone (3.6% vs. 1.3%, p=0.01). CONCLUSIONS:

Patients face modifiable transition challenges which they believe contributes to illness relapse and readmission. Interventions which are designed to address these challenges and tailored for patient characteristics such as SES may better address the root causes of readmission.

Transition Challenges by Socioeconomic Status

Low SES (Uninsured/
Medicaid/Dual Eligible)
High SES (Commercial/ Medicare)
p*
n=307 n=777Unprepared for DC 13.7% 11.1% 0.23 Understanding DCinstructions
3.6% 1.3% 0.01
Executing DC instructions
5.2% 2.4% 0.02
Activities of daily living
10.4% 10.7% 0.90
Medication access 7.2% 4.1% 0.04 Medicationadherence
8.5% 4.6% 0.01
Lack of social support
7.5% 3.6% <0.01
Lack of food, transportation, telephone
3.6% 1.3% 0.01
Substance abuse 3.9% 0.6% <0.01 Symptoms only 15.3% 18.8% 0.18

* 2 for categorical variables **Abbreviations: DC: Discharge

Reported Issues Contributing to Readmission

PERCEPTIONS OF VULNERABLE PATIENTS ABOUT CLINICIAN COMPUTER USE IN A SAFETY NET CLINIC Neda Ratanawongsa1,2;
Jennifer L. Barton1,2; Dean Schillinger1,2; Jennifer E. Hettema3; Paula J. Lum1. 1UCSF, San Francisco, CA; 2UCSF, San Francisco, CA; 3University of Virginia, Charlottesville, VA. (Control ID #1317074)

BACKGROUND: Safety net clinics disproportionately serve patients with limited English proficiency (LEP) and limited health literacy (LHL), whose barriers to communication put them at risk of poorer health outcomes. Electronic health records (EHRs) are increasingly present in patient encounters due to Health Information Technology for Economic and Clinical Health Act incentives. Prior research suggests that EHR use may facilitate and inhibit clinician-patient communication, but little research exists regarding impact on LEP and LHL patients. We conducted a cross-sectional survey to elicit patient attitudes toward EHR use in a safety net clinic preparing to transition to fully functional EHR.

METHODS: The county's current EHR allows clinicians to type unstructured notes, prescribe medications, review test results, track healthcare maintenance, and review hospitalization data; the EHR lacks computerized order entry, guideline-based alerts, and most subspecialty and inpatient notes. In June-August 2011, we conducted a cross-sectional, anonymous, self-administered survey of English-, Spanish-, and Cantonese-speaking adults receiving primary care at an internal medicine clinic at a large academically-affiliated county hospital in San Francisco. Using daily convenience sampling, bilingual research assistants recruited patients in the waiting room and assisted patients who could not read or complete questionnaires. The questionnaire used items with closed-ended and LIkert scale responses to assess perceptions of EHR computer use. We analyzed proportions selecting responses and used multivariate logistic regression adjusting for age, gender, and race to examine the association between language / educational attainment and perceptions of high clinician EHR use.

RESULTS: Among 345 respondents, 31% were Latino, 29% Asian, 17% African-American, and 18%

Caucasian. The average age was 54.5 (SD12.6, range 21-88), and 55% were women. A quarter (25%) had 8th grade or less educational attainment, 22% were Spanish-speaking, and 18% were Cantonese-speaking. Thinking about a typical visit, 57% of patients reported that their providers spent little or no time on the computer, 25% half the time, 12% most of the time, and 7% all the time. Most patients agreed or strongly agreed that the computer helped their providers understand the patients health issues (88%), remember the patients concerns (85%), or take better care of them (82%). However, 22% agreed or strongly agreed that their providers listened less carefully because of the computer, and 15% agreed or strongly agreed that their providers looked at them less because of the computer. These perceptions were not significantly associated with patient background. Patients with 8th grade or less educational attainment (OR 2.3, 95% CI 1.0-5.1, p=0.04) and Cantonese-speaking patients (AOR 3.8, 95% CI 1.2- 12.4, p=0.03) had higher odds of reporting that their providers used the computer half or more of the time during a typical visit.
CONCLUSIONS: In this study, most patients in a safety net clinic perceived advantages to clinician computer use, but lower educational attainment and Cantonese language were associated with higher odds of perceiving high clinician computer use. Future studies using mixed methods approaches are needed to explore how patient-clinician-computer interactions differ by language and literacy and potentially affect care for vulnerable patients.

PERSONAL INFANT-FEEDING INTENTIONS AND BEHAVIOR OF PHYSICIANS IN INTERNAL MEDICINE

Maryam Sattari1;
Janet R. Serwint2; Dan Neal1; David Levine2. 1University of Florida College of Medicine, Gainesville, FL; 2Johns Hopkins University School of Medicine, Baltimore, MD. (Control ID #1343128)

BACKGROUND: Physicians breastfeeding advice has been shown to influence patients breastfeeding initiation and continuation. A strong predictor of female physicians breastfeeding advocacy is their personal breastfeeding experience. We sought to explore infant-feeding intentions and behavior of physicians in Internal Medicine (IM) or one of its subspecialties.
METHODS: Data was extracted from our database on breastfeeding of physician mothers, mainly affiliated with 2 academic medical centers in Baltimore, Maryland and Gainesville, Florida. Criteria for inclusion were (1) being a female physician, (2) current or previous training in IM, and (3) having had at least one biologic child. All physicians meeting above criteria were included regardless of stage of career or infant-feeding methods.
RESULTS: Thirty four physicians met eligibility criteria, of whom 26 had completed training and 8 were still in training. Maternal age ranged from 28 to 50 years (mean 36.7). These mothers had 67 children overall. While 71% of mothers intended to breastfeed for 12 months, only 52% of infants were breastfed up to 12 months. Breastfeeding rates were 96%, 77%, and 52% at hospital discharge, 6 months, and 12 months respectively.
CONCLUSIONS: Breastfeeding continuation rates were higher than those reported in previous physician studies that had either only included certain specialties such as Obstetrics-Gynecology or had a lower proportion of participants form IM. This finding raises the question of impact of maternal specialty on breastfeeding duration and warrants further investigation. The discrepancy between actual and intended breastfeeding duration suggests importance of work-related factors in breastfeeding behavior of physician mothers in IM, which will be discussed further.

PHOTOGRAPHIC EVIDENCE FOR THE EFFICACY OF PIMECROLIMUS CREAM 1% IN PEDIATRIC AND ADULT PATIENTS

Jason T. Olin2; Vincent Falanga1. 1Roger Williams Medical Center, Providence, RI; 2Valeant Pharmaceuticals North America LLC, Bridgewater, NJ. (Control ID #1336236)

BACKGROUND: Pimecrolimus cream 1% (PIM), a topical calcineurin inhibitor, is indicated for the short-term and intermittent long-term treatment of mild-to-moderate atopic dermatitis (AD) in patients aged 2 years. This study was designed to photographically document the effects of PIM in pediatric (2 years of age) and adult patients with mild-to-moderate AD.
METHODS: This Phase 4, open-label study was designed to document the observed treatment response of

twice-daily PIM over 6 weeks in patients aged 2 years with mild-to-moderate AD who were affected at 5% of total body surface area, in 2-5 target areas. Efficacy measures included head/neck and overall Investigators Global Assessment (IGA) and Eczema Area and Severity Index (EASI); safety measures included adverse events (AEs) and serious AEs (SAEs). Since this study was not designed for hypothesis testing regarding efficacy or safety, only photographic documentation and descriptive statistics were performed. RESULTS: Of the 41 subjects who received 1 dose of study medication (safety population), 38 had at least 1 post-baseline efficacy measurement (intent-to-treat population). More than half of the subjects (53.7%) were 2-12 years of age; 9.8% were aged 13-17 years, and 36.6% were aged 18 years. At Day 43, approximately half of the subjects demonstrated improvement in head/neck and overall IGA scores (50.0% and 52.6%, respectively) with 63.2% (95% confidence interval=46.0-78.2) and 31.6%(17.5-48.7), respectively, attaining IGA scores of 1, which was defined as treatment success. With each visit, mean EASI scores were successively reduced for a final reduction from Baseline of 52.8% (SD=36.2). Photographic evidence obtained during the study illustrates the results obtained for these secondary efficacy endpoints (photograph examples will be part of the presentation). Over half (56.1%) of the patients experienced 1 AE with the most frequently reported (5%) being nasopharyngitis (24.4%) and headache (7.3%). All but 1 AE (thermal burn SAE) were mild or moderate in intensity and most (approximately 75%) were considered to be unrelated to treatment. Of the AEs considered to be related to treatment, all but 1 (rash AE) were administration site reactions. No deaths were reported. Two subjects withdrew due to an AE: 1 with moderate rash that was considered to be related to treatment, 1 with a mild molluscum contagiosum infection that was not considered treatment related.
CONCLUSIONS: In this study of pediatric and adult patients with mild-to-moderate AD, PIM-treated patients showed improvement in signs and symptoms of AD, as assessed by IGA and EASI and confirmed by photographic evidence. PIM was well tolerated in this patient population, with treatment-related AEs being predominately mild or moderate in severity and primarily involving application site reactions.

PHYSICAL ACTIVITY, OPIOID MEDICATION USE, AND INTEREST IN YOGA IN AN URBAN COMMUNITY HEALTH CENTER Claudia Campos; Nancy M. Denizard-Thompson; Carolyn R. Pedley; David P. Miller; James L. Wofford. Wake Forest University, Winston-Salem, NC. (Control ID #1320836)
BACKGROUND: The practice of yoga can decrease pain and enhance physical and psychological function. Yoga practice has been most popular among white, middle-aged educated females, and little is known about attitudes toward yoga among disadvantaged and minority populations. To explore the feasibilty of offering a yoga program at an urban community health center clinic, we surveyed patients to determine their attitudes towards yoga and whether their attitude was affected by current exercise habits or opioid medication use.
METHODS: We provided a written survey to all patients registering for an appointment in the adult medicine clinic during a one-week period in August 2011. The self-administered survey posed five questions (yes/no, short answer) related to current exercise patterns, perceived medical contraindications to exercise, previous experience with yoga, and willingness to enroll in a yoga program. One investigator (CC) reviewed the medical charts of surveyed patients to examine the use of and indication for opioid medications.
RESULTS: 213 patients returned survey cards during the designated 1-week study period (response rate 38%). Survey respondents were predominantly African-American (65%) versus white (29%) or Hispanic (6%), and female (69%), and the mean age was 50.4 years (+13.2). 22% (47/213) of respondents reported a sedentary lifestyle, and walking was the most common physical activity reported (37%, 78/213) followed by work (10%). 25% (52/213) of respondents were taking prescription opioid medications. The majority of clinical indications (75%, 39/52) were for musculoskeletal complaints, with back pain being the leading cause for use of opioids (25%, 13/52). Only 8% (18/213) of respondents reported a medical contraindication to exercise, most commonly

lower back pain (72%, 13/18). Most patients (69%,148/213) were willing to participate in a yoga program, 27% refused and 4% were undecided. Past yoga participants were no more willing to participate versus patients with no prior yoga experience (74%, 26/35 vs 68%, 20/177, chi-square p=.18). African American respondents were more yoga-willing than whites, or hispanics (74%, 59%, and 61% respectively), but there was little difference by age group (age>50 versus younger) or by gender. Opioid users were less likely to indicate interest in yoga than those who did not use opioids (60%, 32/53 vs 73%, 113/155, chi-square p=.036).
CONCLUSIONS: The prevalence of sedentary lifestyle was high among survey respondents at this urban community health center. Over two-thirds of respondents were willing to participate in yoga, and African-Americans appear to be particularly receptive. The majority of opioid users expressed interest in yoga. Implementing a yoga program in this community health center clinic is supported by a high level of patient interest and is a potential strategy for improving pain management and encouraging healthy lifestyles.
PHYSICIAN ANXIETY DUE TO UNCERTAINTY AND THE USE OF RACE IN MEDICAL DECISION MAKING
Brooke Cunningham1;
Sherrill L. Sellers2; Vence L. Bonham3; Lisa A. Cooper1. 1Johns Hopkins School of Medicine, Baltimore, MD; 2Miami University, Oxford, OH;
3National Human Genome Research Institute, Bethesda, MD. (Control ID #1340393)
BACKGROUND: Physicians must manage uncertainty from ambiguous clinical presentations, incomplete information, multiple diagnosis and treatment possibilities, and poor communication between physicians and patients. Studies show that uncertainty leads to higher rates of repeat tests and healthcare costs. The 2003 Institute of Medicine report, Unequal Treatment, hypothesized that clinical uncertainty may promote the activation of prejudice and stereotypes. When there is uncertainty, a physician may treat the patient according to prior beliefs about the group to which the patient belongs, and by doing so, may poorly match care to the patients needs. This study evaluates whether anxiety due to clinical uncertainty is associated with a higher propensity, among general internists, to use race as a heuristic in clinical decision-making.
METHODS: The Health Professionals Genetics Education Needs Exploration (HP GENE) survey is a national web and mail survey developed to describe physician knowledge and clinical application of genetics and genomics. The survey was sent to a random sample of 1,738 practicing general internists Apr-Dec 2010. We measured anxiety due to clinical uncertainty (ACU) using a previously validated 5-item Likert scale by Gerrity et al. (1990, 1995). Bonham and Sellers Racial Attributes in Clinical Evaluation scale (RACE) is a new 7-item Likert scale (Cronbachs alpha 0.86). Two items relate to the use of race in determining genetic risk; 2 relate to medication choice and dose; and 3 relate to other aspects of clinical practice, such as initiating screening, how aggressive to be in treatment, and self-reported frequency of considering race. We used multivariate linear regression to assess the association of ACU with RACE, first coding ACU as a continuous predictor variable and then recoding it as a categorical variable (low, low-moderate, moderate, and high anxiety).
RESULTS: Responses were obtained from 787 (45%) of the sample. Mean age was 48.6 years. 65% were male; 67% white, 20% Asian, 6% black, 8% another race; 30% foreign-born; and 75% US medical graduates (USMGs). The mean score on the anxiety due to clinical uncertainty scale (ACU) was19.9 (SD=5.6). Women (=1.4, p=.002), Asians (=2.7, p<.0001) and those who do more clinical work (=0.59, p=0.005, for every additional day of clinic per week) reported higher levels of ACU. USMGs (=-2.9, p<.0001) and those who have been out of residency longer (=-0.08, p=.002, for every additional year) had lower ACU. Mean score on the RACE scale was 20.5 (SD =5.6). After adjusting for race, sex, years since residency, location of medical school, genetics coursework in medical school, fellowship training, clinical days per week, and the racial make-up of patient panels, physicians with higher levels of ACU had higher levels of RACE (=0.08, p<.030, for each one-point increase in ACU). Using ACU categorically, those in the highest quartile of ACU scored 1.6 points higher (p=.010) on RACE than those in the lowest quartile of ACU.
CONCLUSIONS: This is the first study to our knowledge to empirically demonstrate an association between

anxiety due to clinical uncertainty (ACU) and the use of race in clinical decision making. This suggests that more attention needs to be paid to the factors that contribute to physician ACU, such as poor patient-physician communication, and the potential impact of ACU on healthcare disparities.

PHYSICIAN AWARENESS AND USE OF RESOURCES TO REDUCE PRESCRIPTION MEDICATION COSTS FOR PATIENTS Toshiko Uchida; Kenzie A. Cameron; Charlie Zei; Anne Henson; ArianeM. Garrett; Eric D. Christoff; Ami Desai; Erik Orelind; Leslie Ramirez; Michael Zielinski; David W. Baker. Northwestern University Feinberg School of Medicine, Chicago, IL. (Control ID #1326908)

BACKGROUND: Patients are concerned about costs of prescription medications, yet in the literature only a minority report discussing concerns with their physicians. Physicians report insufficient time and the lack of specific solutions to offer patients as barriers to initiating such discussions. This study assessed the effectiveness of a brief educational intervention to equip providers with resources and strategies to help their patients reduce medication costs.

METHODS: Physicians at 9 academic and private practice internal medicine sites in the Research and Education for Academic Achievement (REACH) Practice Based Research Network affiliated with the Northwestern University Feinberg School of Medicine were asked to complete an online pre-test; those who did not were provided a paper copy. Participants then attended a 20-minute educational session led by 2 experienced physicians focused on identifying resources and strategies to help patients reduce medication costs. Several weeks later, physicians were sent a post-test survey (on-line, with paper copy follow up). Both surveys included Likert-type and yes/no items about physicians comfort with and perceptions of their responsibility in discussing medication costs. The surveys also inquired about physicians knowledge and behaviors regarding patients prescription medication costs.

RESULTS: Sixty-six out of 75 physicians completed the pre-test (88.0%); 46 attended the training session (61.3%), and 58 completed the post-test (77.3%). These results report on the 40 physicians who attended the training session and

completed both pre- and post-tests. Participants were 55.3% female, mean age43.4 (sd=6.9) and had been practicing a mean of 13.25 years (sd=7.25). On a scale of 1=strongly disagree to 5=strongly agree, physicians felt very comfortable talking with their patients about prescription medication costs [pre-test M=4.25 (sd=0.87); post-test M=4.35 (sd=0.66), p=ns]; felt that they should discuss medication costs with patients [4.08 (0.03); 4.25 (0.67), p=ns]; and disagreed that there was sufficient time to assist patients in lowering prescription medication costs [2.15 (0.89); 2.38 (0.95), p=0.06]. Following the intervention physicians were significantly more likely to agree that there are ways to help lower prescription medication costs for patients [4.03 (0.48); 4.24(0.58), p<0.01] and that they were knowledgeable about available resources[3.00 (0.88); 3.63 (0.74), p<0.01]. At pre-test, physicians reported that they had switched a patient to a generic (100%), discontinued medications due to cost (80%), reviewed patients formularies (90%), prescribed a higher dose to allow for pill splitting (90%), prescribed a 90-day supply (100%), and encouraged patients to apply to patient assistance programs (93%), to comparison shop at multiple pharmacies (93%) and to use a mail-order pharmacy (95%) to lower prescription medication costs; no differences were seen at post-test. At post-test, significantly more providers reported encouraging patients to use a pharmacy discount card (pre-test 48%; post-test 60%, p <0.05) and to visit websites to comparison shop (30%; 55%, p <0.01). CONCLUSIONS: Although many physicians are already engaging in behaviors to assist patients in lowering costs of prescription medications, a brief physician intervention appears to be effective in increasing physicians knowledge of additional resources to help their patients save money on prescription medications.

PHYSICIANS WILLINGNESS TO PAY FOR MEDICAL MEETINGS IN A HEALTH CARE SYSTEM COMBINING FEE FOR SERVICE AND UNIVERSAL COVERAGE. Shahzia Lambat Emery; Reto Auer; Nicolas Senn; Isabella Locatelli; Jacques Cornuz. Department of ambulatory care and community medicine, Lausanne,

Switzerland. (Control ID #1323885)
BACKGROUND: Sponsoring of physicians meetings and conferences by life science companies (e.g., pharmaceutical and health technology companies) has led to reduced participation fees for physicians but questions potential drawbacks including conflict of interest, as well as direct and indirect commercial products promotion. In many countries, ongoing discussions are proposing to ban such sponsoring which may increase physicians participation fees. We aimed to evaluate factors associated with physicians willingness to pay (WTP) for medical meetings and physicians support of a binding legislation in Switzerland, a country with a health care system combining fee for service and universal coverage. We also questioned Swiss physicians opinion on alternative financing options such as the creation of a general fund set up by life science companies and centrally administered by an independent body.
METHODS: We sent an anonymous web-based questionnaire to the 447 general practitioners of one state of the French-speaking part of Switzerland, identified through their affiliation to the Swiss medical association. The questionnaire evaluated physicians WTP for congresses, their opinion on the introduction of a binding legislation and alternative financing options, their perception of a bias in prescription practices induced by commercial support, their frequency of exchange with pharmaceutical sales representatives and other relevant socioeconomic factors. We built a multivariate predictor logistic regression model to identify the determinants of WTP.
RESULTS: Of the 115 physicians answering (response rate of 26%), about a half (48%) of physicians were willing to pay more than what they currently pay for their congresses, 79% disagreed that commercial support introduced a bias in their prescription practices and 54% disagreed that it introduced a bias in their colleagues prescription practices. Two thirds (76%) of physicians did not support the introduction of a binding legislation prohibiting the sponsoring of congresses by life science companies and 53% were in favor of creating a general fund set up by life science companies and centrally administered by an independent body. Based on the multivariate logistic regression, the perception of a bias in peers prescription practices (OR=7.47, 95% CI 1.65-38.18) and group practice structure (OR=4.62, 95% CI 1.34-22.29) were significantly associated with an increase in WTP.
CONCLUSIONS: Despite a low participation rate, our results suggest that perception of the influence of bias in peers prescription practices and group practice structure are predictors of an increase in physicians WTP for congresses. Most responders did not support the introduction of a binding legislation prohibiting the sponsoring of congresses by life science companies. For decision makers willing to regulate the mutual dependence of physicians and life science companies, an independent body that would centrally administer a general fund set up by life science companies to various congresses might be better received by physicians than a legislation banning the sponsoring of physicians congresses by life science companies.
POPULATION-BASED PREVALENCE OF HEALTH-RELATED INTERNET USE IN SENIORS AND ITS IMPACT ON HEALTH Joseph Finkelstein; Eunme Cha; Jeremy Barron. Johns Hopkins University, Baltimore, MD. (Control ID #1318164)
BACKGROUND: Older adults are the fastest growing age group in the US. Despite the increasing trend of using the internet for obtaining health information, data on population-based prevalence of health-related internet (HRI) use in seniors are not readily available. The goal of this project is to determine the population-based prevalence of HRI usage in seniors, and to assess its predictors and impact on overall health status in seniors.
METHODS: In 2009, five questions were used in the National Health Interview Survey (NHIS) to collect information on HRI usage in the US population. The survey participants were asked if they accessed the Internet to look up health information, to learn about health topics in chat groups, to refill prescriptions, to schedule appointments, or to communicate with their provider. In our study, a positive answer to any of these 5 questions qualified a respondent to be assigned to the HRI user group. The prevalence of HRI usage was stratified by age groups (60-64, 65-69, 70-74 and 75+ years old), gender, race and different chronic conditions.

Further, two logistic regression models were performed to analyze the predictors of HRI use and its impact on overall health status. Independent variables included gender, race, income, education, marital status, and presence of any chronic health condition. RESULTS: There were a total of 7,543 seniors with age 60+ in 2009 Sample Adult file. The final dataset included 6,076 subjects after excluding the missing frequencies of other variables. In this population, a decreasing trend of HRI use was observed with age. The population-based prevalence of HRI usage was 54% in 60-64, 46% in 65-69, 35% in 70-74, and 18% in 75+ age groups. Except for Asians, women were more active HRI users than men in all racial groups. The highest usage was reported from the White females in 60-64 age group (62%), and the lowest was reported from the African American males in 75+ age group (1.2%). In all HRI users, the most prevalent chronic condition was hypertension (54%) followed by arthritis (48%). Only 4% reported to have stroke and 3% had emphysema. Younger age groups (60-64 OR 5.3, p<.0001; 65-69 OR 3.8, p<.0001), females (OR 1.2, p=0.02), being married (OR 1.2, p=0.02), higher education (>12 years OR 9.5, p<.0001), higher income level (poverty income ratio>=2 OR 2.9, p<.0001), and presence of a chronic condition (OR 1.4, p=0.008) predicted HRI use. After adjusting for socio-demographic variables (age, gender, race, marital status, education, income level, presence of chronic conditions, physical activity, body mass index, smoking, and drinking), the seniors who were HRI users in the last 12 months were 1.4 times (CI 1.1-1.7, P=0.007) more likely to report that they had better health compared to the last year. CONCLUSIONS: About half of seniors are using internet for health related purposes in their sixties and internet use among older adults will likely continue to rise in the coming years. Socio-demographic factors and the nature of chronic condition may also have affected the HRI usage behavior. Furthermore, because the older adults who were HRI users were more likely to report overall improvement in health status compared to a previous year, the internet appears to be a potentially powerful means for assisting seniors with their health concerns.

POST-TRAUMATIC STRESS DISORDER (PTSD) IS ASSOCIATED WITH LOWER MEDICATION ADHERENCE IN US VETERANS Ian Kronish1; Yongmei Li2; Donald Edmondson1; Beth Cohen2. 1Columbia University Medical Center, New York, NY; 2University of California, San Francisco, San Francisco, CA. (Control ID #1320452)

BACKGROUND: Individuals with PTSD have worse prognosis from comorbid chronic medical diseases. The mechanisms explaining this association remain poorly understood. Medication adherence represents one of the most essential health behaviors for preventing complications from chronic disease. Accordingly, we tested whether PTSD was associated with worse medication adherence in a cohort of US veterans.

METHODS: The Mind Your Heart Study includes 747 patients recruited from2 VA medical centers between 2008 and 2010. PTSD was assessed with the gold-standard Clinician Administered PTSD Scale. Medication adherence was assessed by asking participants how often they "forgot to take" and "decided to skip" their medications ["never", "once/mo", "2-3 times/mo", "once/wk", "several times/wk", "nearly every day"] and by asking how often they overall "took their medication as prescribed" ["all the time", "nearly all the time", "most of the time", "half the time", "less than half the time"]. Chi-square and t-tests were used to compare patients with and without PTSD. Ordinal logistic regression was used to examine the association of PTSD with each of the 3 adherence variables including all possible adherence response categories. Models were adjusted for covariates that differed significantly by PTSD status and that have been associated with adherence in prior studies. In bivariate analyses, participants who forgot or decided to skip medications once/wk or more and participants who took medications half the time or less were categorized as non-adherent.

RESULTS: The mean age of participants was 58 yrs, 58% were White, and 32% had income<$20,000/yr. Thirty-nine percent had PTSD. Compared to patients without PTSD, those with PTSD were more likely (p<.05)

to be female (10% vs 3%), to have depression (82% vs 37%), hypertension (59% vs 47%), COPD (23% vs 16%), diabetes (22% vs 16%), and prior MI (14% vs 9%). In bivariate analyses, participants with PTSD were more likely to forget (p<.001) and skip medications (p<.001) and had a trend toward lower overall adherence (p=0.11). In adjusted ordinal logistic regression analyses, participants with PTSD had increased odds of skipping medications (OR 1.8, 95%CI1.2-2.7, p=.002) and of having overall worse adherence (OR 1.5, 95%CI 1.0-2.1, p=.03), and had a trend toward increased odds of forgetting medications (OR 1.4, 95% CI 1.0-1.9, p=.06).
CONCLUSIONS: PTSD was associated with a greater prevalence of chronic illnesses and with worse adherence to medications. There was a stronger association between PTSD and intentionally skipping medications as compared to unintentionally forgetting medications. Clinicians should carefully assess adherence to medications in patients with PTSD. Future studies should explore the relationship between PTSD and beliefs about medications.
POTENTIAL HARM OF NON-STEROIDAL ANTI-INFLAMMATORY DRUGS TO FEBRILE ELDERLY PATIENTS: SECONDARY ANALYSIS FROM ELECTRONIC MEDICAL RECORD DATABASE Yasuhiro Yamada; Seiji Bito. Tokyo medical center, Meguro-ku, Japan. (Control ID #1340154)
BACKGROUND: The elderly is often fragile and has an unstable hemodynamics. Administration of Non-steroidal anti-inflammatory drugs
(NSAIDs) has potential harm to the febrile elderly people. However, there are few empirical evidences that examined a risk of topical use of NSAIDs on vital signs of febrile elderly, compared with acetaminophen use or no drug use. We examined whether use of antipyretic have influence of blood pressure changes of the elderly.
METHODS: We examined secondary data analysis from electronic medical record database in two municipal hospitals in Japan to evaluate blood pressure changes of elderly (over 75 years) inpatients with fever above 38 degrees from October 2010 to April 2011. We set three cohorts for exposure variation; A1 using NSAIDs suppository, A2 using internal NSAIDs, B using acetaminophen or no drug. Clinical outcomes were blood pressure reductions, defined as over 50 mmHg reduction of systolic blood pressure and under systolic blood pressure 100 mmHg.
RESULTS: There are 1609 inpatients, 230 in group A1, 195 in group A2, 1189 in group B. Blood pressure reductions occurred in 94 patients (42%) in A1, 64 patients (32.8%) in A2, 331 (27.8%) in B. There was a significant difference between NSAIDs suppository and acetaminophen or no drug (Odds ratio 1.79, P<0.001), while internal NSAIDs did not have the significant difference compared with acetaminophen or no drug (Odds ratio 1.27 P=0.15)
CONCLUSIONS: Inadvertent using of NSADs may be harmful on hemodynamic of the elderly. When NSAIDs are administered to febrile elderly patients, their vital signs should be monitored carefully.
POTENTIALLY AVOIDABLE 30-DAY HOSPITAL READMISSIONS IN MEDICINE PATIENTS: DERIVATION AND VALIDATION OF A PREDICTION MODEL Jacques Donze1; Drahomir Aujesky2; Jeffrey L. Schnipper1. 1Brigham and Women's Hospital, Boston, MA; 2University Hospital of Bern, Bern, Switzerland. (Control ID #1336481)
BACKGROUND: Hospital readmission prediction models are useful to target post-discharge interventions to patients who might benefit the most. Most existing risk prediction models perform poorly, do not differentiate between avoidable and unavoidable readmissions, or rely on information not commonly available prior to discharge. To help clinicians target transitional care interventions most effectively, we derived and internally validated a prediction model for potentially avoidable 30-day hospital readmissions in medical patients using readily available administrative and clinical data.
METHODS: This retrospective cohort study included 10,731 admissions to the medical services of Brigham and Womens Hospital (BWH) during the 2009-2010 academic year. The outcome was an index admission followed by a potentially avoidable 30-day readmission to any service at BWH or to two other hospitals in the Partners

Healthcare system, which together account for over 80% of readmissions. Potentially Avoidable Readmissions (PAR) were differentiated from non-avoidable readmissions using a validated computerized algorithm based on administrative data (SQLape) commonly used in Switzerland to benchmark and compare hospitals. Admissions were randomly assigned to derivation (2/3) and validation (1/3) sets. Baseline demographic data, previous health care utilization, co-morbid conditions, and laboratory testing were used as predictors in a logistic regression model with 30-day PAR as the dependent variable.
RESULTS: There were 2,398 (22 %) admissions followed by a 30-day readmission, of which 1,101 (10%) were identified as PAR. The prediction score identified 6 independent factors, which we refer to as the PAR ScOrE: any ICD-9 coded Procedure, number of Admissions in the previous 12 months (0, 1 to 5, or >5), Renal failure (glomerular filtration rate of 0-29, 30-59, or60 ml/min) at the time of discharge, low Sodium level (< 135 mmol/l) at the time of discharge, discharge from an Oncology service, and Elective admission (Table). We then developed a scoring system to stratify risk of potentially avoidable 30-day readmission into 4 categories. With this prediction model, low-risk patients having 0-1 points (13% of patients) had a 3% risk of PAR, while high-risk patients having 7 points (15% of patients) had a 27% risk of PAR. The PAR ScOrE had a good discriminatory power (C-statistic 0.72 and 0.70) and had good calibration (Hosmer-Lemeshow goodness-of-fit statistic P=0.67 and P=0.72) in the derivation set and validation set, respectively.

CONCLUSIONS: This simple prediction model accurately identifies the risk of potentially avoidable 30-day readmission in medical patients. While it still needs external validation, this score has potential to easily identify patients in need of more intensive transitional care interventions to prevent avoidable hospital readmissions.
Table 1. PAR ScOrE for 30-day potentially avoidable readmissions
Attribute Value Points Procedure during hospital stay (any ICD-9 codedprocedure)
yes 2
Number of hospital Admission(s) during the previous year 0 0 1-5 2 >5 3
Renal failure, glomerular filtration rate in ml/min at discharge
<30 2 30-59
1
60 0
Low Sodium level (<135 mmol/l) at discharge yes 1 Discharge from an Oncology service yes 3 Elective admission yes 1
PREDICTING RISK OF HOSPITALIZATION OR DEATH AMONG PATIENTS RECEIVING PRIMARY CARE WITHIN THE VETERANS HEALTH ADMINISTRATION Stephan D. Fihn1,2; Li Wang1;
Brian Porter2; Charles Maynard1; Christopher L. Bryson1; Haili Sun1; Elliott Lowy1; Indra Gupta1; Mary McDonell1; Kathleen Frisbee1; Christopher Nielson1; Shawn Loftus1. 1Department of Veterans Affairs, Seattle, WA; 2University of Washington, Seattle, WA. (Control ID #1338954)
BACKGROUND: Statistical models to accurately identify patients at highest risk of hospitalization or death have been difficult to construct. The objective of the study was to use the clinical and administrative data sources available within VHA to produce models with better performance than those reported. METHODS: We identified a total of 4,505,501 patients who were receiving primary care from the Veterans Health Administration within 1 year prior to the index date, October 1, 2009, and tracked outcomes of hospitalization and death during the subsequent year. Using multinomial regression, we constructed statistical models to predict hospitalization or death occurring during the subsequent 90 days and 1 year. Predictors were selected from variables related to socio-demographics, medical conditions, vital signs, use of health care services, medications and laboratory tests. For each endpoint we sorted patients into 20 equal-sized risk strata based on quantiles of predicted probability for the endpoint in ascending order. RESULTS: The C-statistics for 90-day and 1-year outcomes were 0.840 (95% CI 0.839, 0.841) and 0.814(0.813, 0.815), respectively for hospitalization;0.860 (0.858, 0.861)

and 0.847(0.846, 0.848) respectively for death without hospitalizations; and 0.816(0.815, 0.817) and 0.790(0.789, 0.790) respectively for either event. Among patients who were in the 20th risk stratum, the 90-day event rates for hospitalization, death without hospitalization and either event were 20.1%, 6.3% and 23.2% respectively, as contrasted with the population averages of 2.7%, 0.7% and 3.4% respectively. The 1-year event rates in the 20th risk stratum were 44.9%, 18.9% and 51.8% respectively, compared with the population average of 8.3%, 2.6% and 10.9% respectively. CONCLUSIONS: These models incorporating demographic, administrative and clinical variables from electronic health records were able to accurately stratify the patient population according to the estimated risks with greater accuracy than those previously reported. The models have clinical implications to identify patients for whom selected interventions might reduce the risk for adverse outcomes.

PREDICTORS OF MAJOR CARDIAC ADVERSE EVENTS IN PATIENTS WITH CARBON MONOXIDE POISONING Osama Amro; Ahmed Ibrahim; Shadi Mayasy; Keyvan Ravakhah; Joseph Sopko; Srinivas Merugu; Robert Steele. St.Vincent Charity Medical Center, Cleveland, OH. (Control ID #1311916)

BACKGROUND: Carbon monoxide (CO) is the most common cause of death from poisoning in the United States. Cardiovascular complications and their contribution to acute outcomes are yet to be defined. METHODS: We retrospectively reviewed all the cardiovascular manifestations of CO poisoning in patients presented to St Vincent Charity Medical Center, the regional center for CO poisoning treatment between the periods of January 2009 to September 2011. Patients demographics, comorbidities, electrocardiograms (EKG), laboratory results and echocardiograms were identified from chart review and retrieved for analysis. RESULTS: We identified 47 patients, mean age 49.3 years and majority were male (72%). The mean hospital stay was 2.6 days. The average carboxyhemoglobin (COHb) level was 24.9%. 20% of cases were intentional poisoning, 19% were unconscious on presentation (UOP) and 20% were intubated. Cardiovascular risk factors in these patients were DM 9%, HTN 36%, dyslipidemia 6%, smoking 32% and family history of premature coronary artery disease 4%. Obesity was present in 19% with 4% having documented history of CAD and 14% with cocaine abuse prior to admission. Troponin I was found to be greater than 0.2 ng/mL in 37 % of patients and more than 1 ng/mL in 17%. Ischemic EKG changes were found in 4 % of patients. Corrected QT interval was prolonged (>440 msec) in 68% of patients. Echocardiogram was done in 9% of patients and 4% had depressed left ventricular ejection fraction which recovered after hyperbaric oxygen treatment. 92% of patients received treatment with hyperbaric oxygen (HBO). Two patients died by anoxic brain injury that was unrelated to their cardiac status. There was no correlation between COHb level and troponin or QTc (r=-0.2 and 0.02 respectively). UOP and intubation were the main predictors of significant myocardial injury with55.5% of UOP group (P=0.002) and 62.5% 0f intubated patients having a troponin I>1 ng/Ml (P=0.001). HTN was the only predictor of significant QTc prolongation with 88% of hypertensive group having a QTc >440 msec (P=0.016). CONCLUSIONS: Myocardial damage in patients presenting with CO poisoning is common and manifested by increased troponins and prolonged QTc. There is no correlation between COHb level and myocardial injury. In these patients, UOP and intubation are the only two significant predictors of troponins elevation while HTN is associated with more QTc prolongation. This damage is usually transient and is reversed with urgent HBO therapy. Our study although limited by being a retrospective study clearly adds to our understanding of predictors for carbon monoxide morbidity and helps prioritize medical care.

PREDICTORS OF PATIENTS WHO LEAVE AGAINST MEDICAL ADVICE FROM THE EMERGENCY DEPARTMENTS Mauli Mehta; Arun K. Muthusamy; Diane L. Levine. Detroit Medical Center / Wayne State University, Detroit, MI. (Control ID #1333592)

BACKGROUND: Discharge against medical advice (AMA) from emergency departments (ED) continues to be a prevalent (0.1-2.7%) and frustrating problem, yet the literature is limited to medical record reviews and retrospective analysis from single institutions. Data and guidelines for physicians on how to effectively manage and intervene with these patients are scant. In addition, multiple studies have shown that hospitalized patients

that leave AMA are at increased risk of adverse medical outcomes and re-admission. Our objective is to determine the patient characteristics and clinical conditions associated with leaving AMA from ED across America.
METHODS: The National Hospital Discharge Survey is a limited access dataset that includes visit-based data during ED admissions. Patients of all ages from year 2007 to 2009 were included in the analysis. Patient demographic characteristics were compared. A multivariate survey logistic regression model was used to investigate the discrepancies in patient demographic characteristics and the reasons for visit between those who were discharged and who left AMA.
RESULTS: A total of 104,566 ED visits were documented, of which 1.1% (1135) were AMA. Patients who left AMAwere significantly more likely to be male (Odds ratio[OR] 1.22; 95% confidence interval[CI] 1.09-1.37), Hispanic (OR 1.26; 95%CI 1.02-1.56) and from metropolitan areas (OR 1; reference). The positive predictors for leaving AMA are ages 18 to 65 (OR 1.89; 95%CI

1.53-2.34), annual income less than $52,388 (OR 1.31; 95%CI 1.06-1.61) and pain described as none (OR 1.42; 95%CI 1.08-1.87). Patients from the South (OR 1; reference), West (OR 0.88; 95%CI 0.82-1.16) and Midwest (OR 0.97; 95%CI 0.75-1.04) regions had higher rates of leaving AMA than the Northeast (OR 0.79; 95%CI 0.68-0.94). The day of the week did not influence AMA rates; but, rates of leaving AMA were higher during the months of January through July except for April and June (OR 1.39; 95%CI 1.01-0.91). Compared to patients with private insurance (OR 1; reference), patients with Medicare (OR 1.59; 95%CI 1.04-2.45), Medicaid (OR 1.66; 95%CI 1.25-2.21) and self-pay (OR 1.78; 95%CI 1.31-2.43) had higher rates of leaving AMA. Although most patients arrived to the hospital via personal transportation (79.7%), a specific mode of arrival to ED was not statistically correlated with leaving AMA. African American race (OR 1.01; 95%CI 0.85-1.21) and wait time to see MD/DO/PA/NP did not correlate with leaving AMA (OR0.90; 95%CI 0.77-1.06). Patients with prior ED visits within a year had higher likelihood to leaving AMA (OR 1.49; 95%CI 1.24-1.79). Of the top 10 presenting complaints to the ED, AMA patients were significantly more likely to present with chest pain (13.8%,p<0.0001), musculoskeletal pain (15.5%,p<0.0001), convulsions (2.1%,p=0.0004), shortness of breath (6.2%,p=0.0016), fever (2.3%,p=0.004), vertigo/dizziness (3.9%,p=0.02), gastrointestinal complication (17.7%,p=0.03) and MVA (3.9%,p=0.048). In our study, alcoholism(1.5%,p=0.16) and headache (6.3%,p=0.34) was not significantly associated with AMA.
CONCLUSIONS: Predictors for patients who leave AMA from the ED can be identified at admission and include: males, Hispanics, in no pain, previous ED visits, not having private insurance and lower annual income. Efforts should be made to recognize patients at risk and intervene early to prevent adverse medical outcomes.
PREDICTORS OF SUBJECTIVE WORKLOAD IN ON-CALL INTERNS Kathlyn E. Fletcher1; Alexis M. Visotcky2; Jason M. Slagle3; Sergey Tarima2; Matthew Weinger4,3; Marilyn Schapira5. 1Milwaukee VAMC/Medical College of Wisconsin, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI; 3Vanderbilt University, Nashville, TN;
4Tennessee Valley VAMC, Nashville, TN; 5Philadelphia VAMC/University of Pennsylvania, Philadelphia, PA. (Control ID #1334976)
BACKGROUND: Physician workload has been linked to patient care errors and adverse events. However, methods for measuring workload vary significantly from study to study. In this study, we sought to determine the relationship between intern self-rated workload during an admitting period and possible predictors of that workload.
METHODS: This was a prospective observational pilot study. Subjects were internal medicine interns rotating on general medicine wards at a VAMC. We trained observers to shadow interns during an on-call period. The

observers shadowed the interns and continuously recorded the tasks the interns performed using laptop computers with specially designed software. The observer was also prompted to have the intern rate their self-rated workload on a validated 6-20 scale (6= low workload activity, i.e. using the internet). These prompts occurred randomly every 30-90 minutes, regardless of what activity the intern was performing. The observers also rated their own perceptions of the interns workload before they asked the interns to rate themselves. We also collected demographic information and objective workload information such as the number of patients cross-covered by the intern and how many patients each intern had at the start of the day. Data was analyzed using SAS. We tested the univariate relationship between intern self-rated workload and various possible predictors using Pearson correlations, and we conducting multivariable modeling to predict intern self-reported workload using generalized estimating equation with intern as a random effect.
RESULTS: We recruited 25 (out of 36) interns to participate (69%). Our sample had 14 women (56%). The average age was 28.6 (SD2.4). Mean number of months in training was 4 (SD3.7). Interns started the day with a mean of 2.6 (SD1.6) patients and cross-covered a mean of27.2 (SD12.1). The mean intern self-rated workload was 12 (SD 2.4), with a range of 8-16. Mean observer-rated workload was 11.6 (SD1.8). The observer and intern self-rated workload levels were
highly correlated ($r=0.92$, $p<0.001$). Mean intern self-rated workload while performing direct patient care tasks (such as taking a history) was 12.5 (SD 3.0). Intern self-reported workload while performing indirect patient care tasks (such as documentation) was 12.1 (SD 3.5). There was no significant difference between these workload values. In univariate analyses, there was no correlation between intern self-reported workload and months in training ($r=-0.14$, $p=0.5$), intern census at the start of the day ($r=0.21$, $p=0.31$), or the number of patients cross-covered by the intern ($r=0.18$, $p=0.44$). In multivariable modeling including physician demographics, only physician age was significantly correlated with workload ($beta=0.46$, $p<0.05$). However, number of patients at the start of the day ($beta=0.53$, $p=0.18$) and number of patients cross-covered ($beta=0.05$, $p=0.15$) trended toward significance.
CONCLUSIONS: Prior studies of physician workload have used physician census as the main proxy for workload. Our study suggests that physician age may also be important. In addition, other aspects of intern work such as cross-cover load may be important determinants of overall subjective workload. In order to understand how best to structure inpatient work to achieve maximum patient safety, it will be necessary to further explore the relationship between intern characteristics, the work done by interns and the impact of those on workload.

PREDICTORS OF WEIGHT LOSS IN AN URBAN, SAFETY-NET HOSPITAL WEIGHT MANAGEMENT PROGRAM. Himali Weerahandi; Elenore Patterson; Albert Ahn; Camila Deza; Lisa Parikh; Galle C. Pierre; Colleen Gillespie; Michelle McMacken. New York University School of Medicine, New York, NY. (Control ID #1334620)

BACKGROUND: More than one-third of U.S. adults are obese; minorities and populations with low socioeconomic status are disproportionately affected. These underserved populations face limited resources for weight management programs, and are not typically represented in large weight loss studies. Moreover, there is a paucity of data on variables that predict successful weight loss in any population.
METHODS: We conducted a retrospective chart review of all patients seen in an urban, safety-net hospital weight management clinic between January 2006 and July 2010. We examined the following variables: age, gender, initial weight, presence of an axis I psychiatric diagnosis, use of medications that may cause weight gain, prior enrollment in other weight management programs, source of referral, and number of revisits. The primary outcome measure was percentage weight change; we categorized patients into two groups: weight loss (defined as having lost5% of initial body weight) or no weight loss.
We used a hierarchical logistic regression analysis to examine which variables predicted weight loss.
RESULTS: Of the 323 patients enrolled during this time period, 161 had an initial weight and at least two total

weights recorded. Of these, 80% were women and 32% carried an axis I psychiatric diagnosis; the mean age was 48. At baseline, 39% of patients were taking medications associated with weight gain (primarily insulin, thiazolidinediones, sulfonylureas, and antipsychotics). Approximately 11% had previously been enrolled in a weight loss program, and 72% were referred by their primary physician. Fifty-five patients (34%) lost 5% of their initial body weight (weight loss group). Of all variables examined in descriptive, correlation, and regression analyses, only the number of revisits was significantly different between the weight loss and no weight loss groups (p 0.01). The weight loss group averaged 6.62 visits (SD 6.96), versus 3.66 visits (SD 4.93) in the no weight loss group. A Pearson correlation of 0.24 was observed between number of revisits and percentage weight loss ($p<0.01$). Hierarchical logistic regression analysis revealed a positive association between number of revisits and weight loss with an odds ratio of 1.11 (95% CI 1.04-1.19). No other variables were significantly associated with weight loss. CONCLUSIONS: Among patients with at least one return visit, one-third achieved clinically significant weight loss in our urban, publicly funded, hospital-based weight management program. Patients who attended more visits were more likely to lose weight. Further research should focus on effective strategies for preventing attrition from weight loss programs.

PRELIMINARY OUTCOMES OF GENETIC RISK TESTING IN PRIMARY CARE FOR COMMON DNA VARIANTS ASSOCIATED WITH TYPE 2 DIABETES

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7Duke University, Durham, NC. (Control ID #1340442)

BACKGROUND: Prevention of type 2 diabetes requires patient engagement and behavior change. Offering genetic risk testing for common DNA variants linked to type 2 diabetes has been proposed as a possible strategy for bolstering engagement. Little data exist about the uptake of such testing by patients in clinical settings where available; the impact on clinical and behavioral outcomes; and possible unanticipated negative consequences. Here we report three-month outcomes of a study of genetic risk testing for type 2 diabetes in primary care.

METHODS: Adult patients in two primary care clinics were offered DNA testing for four single nucleotide polymorphisms (SNPs) associated with type 2 diabetes risk. Interested patients were randomized to disclosure of results plus standard risk assessment (SRA+G), versus SRA alone with an option to receive genetic risk results at the end of the study. Those declining genetic testing were offered SRA without testing in a third study arm. Baseline measurements and surveys assessed weight, fasting glucose and insulin, family history, health behaviors, attitudes, and demographics. Participants were asked to return for risk counseling with a physician extender already working in the clinic. At three months they were asked to complete a survey including self-reported weight, health behaviors, and attitudes; and at 12 months to return for a final visit to repeat measurements and surveys done at baseline. For this preliminary analysis, linear-mixed models for longitudinal data were used to test for difference in weight change after three months between the SRA+G and SRA-only arms. RESULTS: 30% of 1424 patients approached consented to participate. 391 of 409 eligible patients enrolled (96%) wanted genetic risk testing. Only 18 patients entered a third, no-test arm. Mean age was 49.913.3 years; 70% were female. 58% of participants self-identified as White, 29% African American, and 13% some other race. 37% did not complete college. There was a high prevalence of prediabetes, obesity, and positive family history. Nearly all participants (92%) returned for counseling. Mean baseline weight was 190 lbs in both the SRA+G and SRA-only arms. After three months, it was 185 lbs in the SRA+G arm, and 186 in the SRA-only one ($p=0.37$). Subgroup analysis of overweight/obese participants found mean weight change of -

1.5% (SD 3.0%) in the SRA+G arm; -1.6% (SD 3.0%) in the SRA-only arm, and -1.1% (SD 3.4%) in the third no-test arm. Additional analysis of overweight/obese participants without family history of diabetes found mean weight change of -1.8% (SD3.0%) in the SRA+G arm and -1.4% (SD 2.8%) in the SRA-only one. In both subgroup analyses, differences did not achieve statistical significance. CONCLUSIONS: Interest in genetic risk testing for type 2 diabetes was high in a heterogeneous sample of primary care patients. The high prevalence of risk factors and return rate for counseling may suggest interest in confirmatory or explanatory information regarding personal risk for diabetes. After three months, each of the three arms showed a small decrease in mean weight. There was no difference - positive or negative - in weight change between participants randomized to comprehensive type 2 diabetes risk assessment including disclosure of genetic risk testing results, and those receiving risk counseling based on conventional risk factors alone. Analyses of full 12-month and secondary outcomes are still ongoing.

PREMENOPAUSAL WOMEN, CALCIUM, AND VITAMIN D: HOW MUCH DO WE KNOW? Kenzie A. Cameron1; Anne Henson1; Charlie Zei1; Karin B. Ulstrup2,1. 1Northwestern University, Chicago, IL; 2Chicago Lake Shore Medical Associates, Chicago, IL. (Control ID #1332709)

BACKGROUND: Calcium and vitamin D are two essential nutrients long known for their role in bone health; dietary intake alone seldom provides a
sufficient amount of either nutrient. Women may be able to lower their risk of osteoporosis by adhering to the daily intake guidelines of 1000 mg of calcium and 600 IU of vitamin D set by the Institute of Medicine. The goal of this study was to assess premenopausal womens attitudes and knowledge regarding calcium, vitamin D and osteoporosis, as they are not well known. METHODS: Premenopausal (18-49 years old) women presenting at either an internal medicine or an obstetrics and gynecology practice were approached, consented, and asked to complete a self-administered survey assessing knowledge and attitudes about calcium, vitamin D, and osteoporosis. Participants responded true, false, or dont know to knowledge items (dont know was later coded as incorrect) and responded on a Likert scale (1=strongly disagree to 5=strongly agree) for attitude items. RESULTS: Three hundred forty-five participants completed the survey, mean age 31.7 (sd=6.7). The majority of participants (75.1 %) were white, 11.3% were African American, 6.1% Hispanic/Latino and 7.0% Asian/Pacific Islander. Women correctly answered a mean of 5.52 (sd=2.05) out of 9 knowledge items (range 0 - 9); with the vast majority (94.5%) knowing that osteoporosis leads to an increased risk of bone fractures. Fewer women (57.4%) knew that one in four women over the age of 60 will develop osteoporosis. Even fewer women recognized that two glasses of milk per day would not provide an adequate calcium intake (26.1%). Reponses to the attitude items indicated that women perceive osteoporosis as a serious disease (M=4.53, sd=0.75), but do not perceive themselves to be particularly at risk for developing osteoporosis (M=3.56, sd=1.10). 49.0% and 48.0% of participants report taking calcium or vitamin D supplements, respectively. Further, 33.6% and 40.9% of women report they believe that are not getting enough calcium or vitamin D from their diet, respectively, and 20.9% and 31.0% report they are unsure if they are receiving enough from their diet. When asked to identify the recommended daily intake of calcium, 77.7% indicated they did not know; and only 6.1% were able to provide the accurate answer of 1000 mg. When asked about the recommended daily dose of vitamin D, 80.0% responded they did not know; only five participants (1.4%) accurately answered 600 IU.
CONCLUSIONS: Many women recognize that they are likely receiving insufficient amount of either calcium or vitamin D from their diet, yet only about half are supplementing their dietary intake. Although women are aware of potential severity of osteoporosis, they are less likely to perceive themselves to be at risk. Therefore, it is unlikely to be sufficient to educate premenopausal women about the need to take calcium and vitamin D supplementation. Rather, educational efforts must also provide information to allow women to better understand their risk of osteoporosis and be able to accurately assess their current dietary intake of calcium and vitamin D so they can better understand the need to discuss supplementation with their physician.

PREPARING INTERNAL MEDICINE RESIDENTS FOR EFFECTIVE PRACTICE IN THE PATIENT

CENTERED MEDICAL HOME: IDENTIFYING EDUCATIONAL NEEDS AND PERCEIVED SKILLS Margaret Horlick2,1; Jaclyn Fox2,1; Colleen Gillespie1. 1NYU School of Medicine, New York, NY; 2NY Harbor VA Health Care System, New York, NY. (Control ID #1340117)

BACKGROUND: Little is known about how best to prepare physicians, and particularly resident physicians, to work within Patient Centered Medical Home models of primary practice. This study explores changes in resident physicians perceived medical home skills prior to and one year after implementation of a medical home in their continuity clinic and compares these skills to residents from the same program whose continuity clinic site had not yet implemented the medical home model.

METHODS: Prior to implementation of the medical home at one of two continuity clinic sites in the NYU Internal Medicine residency program, we assessed, via survey, residents perceptions of their patient-centered medical home skills. One year after implementation of the medical home in the resident clinic of the VA clinic, which included an introductory conference and workshop and regular team meetings while on the ambulatory care block, we repeated the survey to assess change in perceived medical home skills and included a question about perceptions

of the sufficiency of the education and training they had received. We also compared VA clinic residents perceived skills with a sample of residents whose continuity clinic (a public safety net hospital's outpatient clinic) had not yet transformed into a medical home model. Perceived skills were assessed in 5 areas: practice-based learning and improvement (PBLI), system-based practice (SBP), panel management, effective primary care practice, and teamwork. Cronbachs alpha>.70 for all domains. Change from pre- to post-medical home was compared using paired sample t-tests and comparisons between medical home and non-medical home sites used independent sample t-tests.

RESULTS: Results 61% (31/51) of the VA clinic-based residents completed the pre-survey and 10/51 have completed the one-year post-survey to date. 11/60 city clinic-based residents (medical home not yet implemented) have thus far completed the survey. Among the residents in the medical home model (n=10), 60% strongly and 40% somewhat agree that they have received sufficient training and education for the new model of care. Residents perceived skills show improvement from pre- to post-medical home in 4/5 domains with significant changes in SBP (pre mean=2.40, SD .72; post mean=3.45, SD .49; p<.05) and PBLI (pre mean 2.35, SD .81; post mean 3.00, SD .53; p<.05). Residents whose continuity clinic implemented the medical home model (n=10) reported feeling more competent than residents whose continuity clinic had not (n=11) in 4/5 domains, 3 significantly: SBP (mean 2.60, SD .88 vs 3.45, SD .50; p =.016); PBLI (mean 2.10, SD .66 vs. 3.00, SD .53; p=.004); and primary care practice (mean 2.33, SD .70 vs. 3.33, SD .67; p=.007). Across all assessments, residents rated their panel management skills lowest. CONCLUSIONS: Results suggest residents need more education/training in panel management but that they perceive the training theyve received to practice in the medical home model to be at least adequate. In our small sample of residents exposed to the medical home model, we saw significant increases in some skills (SBP and PBLI) but not in others and that residents exposed to the medical home model in their continuity clinic reported greater competence than those not yet exposed. Results suggest a need for targeted education to fully prepare residents to practice in the medical home model and highlight the importance of having opportunities to practice within new models of care.

PREPARING HEALTHCARE PROVIDERS FOR DIVERSITY : CURRENT SITUATION REGARDING CROSS-CULTURAL CARE IN A SWISS UNIVERSITY HOSPITAL. Patrick Bodenmann2; Sophie Paroz1; Florence Faucherre3; Orest Weber3; Esther-Amlie Diserens3. 1Lausanne University Hospital, Lausanne, Switzerland;

2Lausanne University, Lausanne, Switzerland; 3Lausanne University Hospital, Lausanne, Switzerland. (Control ID #1335406)

BACKGROUND: Switzerland is a multicultural country with a growing immigrant population. Around one third of Lausanne University Hospital patients are not Swiss citizens and part of them - asylum seekers, undocumented migrants, foreign-language speaking residents - are characterized by a poor access to care and health status. Improving the ability of the providers to address linguistic and cultural barriers is a key issue for Swiss healthcare institutions. Within a national initiative encouraging centers of competences in cross-cultural care, Lausanne University Hospital assessed the distribution of cross-cultural competences between the hospital departments as well as between medical doctors and nurses. METHODS: A self-administered questionnaire was used to explore 1) expert resources (knowledge, access), 2) education (access, self-perceived preparedness), 3) practices (specific issues, self-assessed skillfulness) and4) opinions (hospital policy) regarding care of immigrants patients. The questionnaire consisted of 64 items, some of which were adapted from a US validated scale, whereas others were derived from a similar survey conducted at Geneva University Hospital. A mail survey was sent in November 2010 to every resident, chief resident and nurse of a sample of 11 hospital departments : the 5 departments with at least one internal cross-cultural resource (clinical team or training program) and 6 departments chosen randomly within the departments without such resources. The first group of departments (primary care, psychiatry, gynecology, pediatrics, emergency room) was categorized assensitizedto cross-cultural care, the second group (internal medicine, neurology, rheumatology, urology, radio-oncology) asnon sensitized.

RESULTS: A total of 371 out of 885 eligible healthcare providers participated (response rate 41.2%). Respondents included 59.7% of healthcare providers from sensitized departments and 33.6% of medical doctors. Healthcare providers from sensitized departments had a significantly better knowledge and access to the hospital expert resources than providers from non-sensitized departments, they attended more cross-cultural trainings and rated themselves more prepared to care for culturally diverse populations. Medical doctors had a significantly better knowledge and access to the expert resources than nurses, they attended more trainings and rated themselves more competent at most intercultural tasks. However no statistically significant difference of opinion appeared regarding the hospital diversity policy, neither between departments nor between professions : the necessity for hospitals to adapt to linguistic barriers (speaking or writing) was fairly accepted (66.4% and 71.9%) while the necessity to adapt to cultural barriers was poorly accepted (16.2%).

CONCLUSIONS: Despite a remarkable homogeneity of opinions regarding hospital diversity management, cross-cultural competencies appear to be unequally distributed among hospital departments and between medical doctors and nurses. Addressing diversity is a challenge that must not be limited to part of the medical specialties nor to part of the healthcare professions. In parallel to the development of expert resources in specific departments, hospitals have to make sure that cross-cultural care is integrated in every nurses and physicians education cursus and that expert resources are known and available for every provider in all medical departments.

PRESCRIBING OPIATES IN RESIDENT CLINIC: CLINIC DIRECTOR AND RESIDENT PERSPECTIVES ON PROBLEMS AND POTENTIAL SOLUTIONS Alison R. Landrey2,1; Rachel Swigris1; Adam Abraham1. 1University of Colorado Hospital, Denver, CO; 2University of Colorado, Denver, CO. (Control ID #1334312)

BACKGROUND: Use of opiate therapy for chronic nonmalignant pain (CNMP) and incidence of opiate overdose are increasing. Management of patients on opiate therapy for CNMP in resident training practices presents unique challenges and may negatively affect residents continuity experience. Practice innovation to deliver safer and more patient-centered care for this population is vitally needed. We surveyed residency clinic directors and internal medicine residents to elicit perspectives on a) their experience managing CNMP in resident clinic b) problems theyve identified, and c) potential solutions to these problems.

METHODS: We developed and emailed an electronic survey to a list-serve of US internal medicine residency

clinic directors. We also modified and distributed a paper survey to internal medicine residents with continuity clinics associated with the University of Colorado. Both surveys asked questions on experiences managing CNMP in resident clinic and asked respondents to rate a variety of potential problems and solutions via 1-5 Likert scales. We additionally asked residents their opinion of a planned nurse-pharmacist run clinic for co-management of patients on opiates for CNMP. RESULTS: 40/75 clinic directors and 27/48 residents returned the surveys. The majority of clinic directors and residents perceived managing patients with CNMP in resident clinic as more or much more difficult than managing diabetes (92% and 96% respectively). Clinic directors identified both continuity of care and lack of resident knowledge of CNMP management as the biggest barriers to providing adequate care for these patients. Residents identified coexisting psychiatric illness (4.2/5 on the Likert scale), inability to address problems other than pain (4.4/5), and lack of continuity of care (4th out of 14 potential problems) as the largest challenges. A large majority (85%) of residents reported that managing CNMP negatively or very negatively contributed to their continuity experience. Clinic directors felt that enhanced resident training and access to EMR systems that document red flags would most improve their ability

to provide adequate care to patients with CNMP. Residents felt that a proposed nurse/pharmacist-run pain management clinic would be helpful and allow them to spend more time on medical issues other than pain. CONCLUSIONS: The vast majority of residents and residency clinic directors perceive managing CNMP in residency clinic as more difficult than managing the complex chronic disease, diabetes. Furthermore, residents report a negative impact on their continuity clinic experience. Solutions to assist clinicians in training clinics to safely and effectively manage CNMP are urgently needed. Although clinic directors and residents have somewhat different perspectives on the greatest challenges, both identified continuity of care as a pressing issue. There was positive feedback from residents regarding a proposed nurse/pharmacist-run clinic for CNMP management. Based on our responses, to be most effective, this type of clinic should be established in a way that enhances continuity of care for patients and allows residents to focus on other medical issues with their patients.

PRESCRIPTION CAPS: RECENT USE BY STATE MEDICAID PROGRAMS AND IMPACT ON MEDICATION USE
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BACKGROUND: Prior studies have shown that Medicaid caps limiting the number of prescriptions covered lead to worse medical outcomes. Nevertheless, states continue to employ these policies. We examined prescription cap use by Medicaid programs from 2002 to 2010 and the impact of these policies on prescription use. METHODS: We collected prescription cap policies for Medicaid fee-for-service plans from 2002 to 2010 for all states. We obtained policy data from reference publications, state websites, and direct contact with states. We classified prescription caps as applying to overall or branded prescriptions. We identified the number of states employing caps, the range in cap levels, and the number of times caps were implemented, removed, or changed. We defined essential medications for the treatment of chronic medical conditions based on prior work (Tamblyn et al., 2001). Using state-level aggregate Medicaid drug use data from CMS, we calculated the ratio of essential to total prescription use for 2 outcomes: number of prescriptions and prescription spending. We calculated these outcomes in 2002 and 2010 for (1) states implementing caps between 2003 and 2009 (2) states without caps during the study period and (3) states with caps throughout the study period. To determine the impact of cap implementation, we calculated the change in essential medication ratios between 2002 and 2010 for states implementing caps and states without caps. We compared the changes between those groups using a Students T-test. For comparison, we present data for states with caps throughout the study period. RESULTS: We were unable to obtain policy data from Arizona. For several states, we obtained only partial information. 24 states had prescription caps during the study period. From 2002 to 2010, the number of states with caps increased from 11 to 20. In 2002, 10 states had overall caps and 1 state had a brand cap. In 2010, 12

states had overall caps, 4 had brand caps, and 4 had overall and brand caps. Overall caps ranged from 3 to 15 prescriptions per month; brand caps ranged from 2 to 5 per month. During the study period states implemented 17 caps (8 overall, 9 brand) and removed 5 caps (3 general, 2 brand). States changed cap levels 12 times, 8 becoming more restrictive, 3 becoming less restrictive, and 1 unclear due to policy complexity. Table 1 presents ratios of essential to total medication use in 2002 and 2010 for each group of states and the change between 2002 and 2010 ratios. The essential medication ratio decreased from 2002 to 2010. Compared to states without caps, states that implemented caps had a smaller decrease in the essential medications ratio for prescriptions ($p<0.05$) but not expenditures ($p>0.4$). CONCLUSIONS: An increasing number of states are using prescription caps to reduce Medicaid costs. Our data suggest that implementing caps leads to a relative increase in the percentage of prescriptions for essential medications but not a significant change in the proportion of expenditures for essential medications. Given past research on the negative impact of caps, patient level evaluation is needed to understand how these recent cap policies affect patient outcomes.

Table 1. Ratio of essential to overall medication utilization 2002 &2010

Prescriptions Expenditures2002 2010 Change 2002 2010 Change Cap implemented (n=9) 0.343 0.278 0.066 0.388 0.354 0.034 No cap (n=26) 0.358 0.260 0.098 0.390 0.331 0.059 Cap throughout (n=6) 0.318 0.241 0.077 0.376 0.333 0.043

PREVALENCE OF HYPONATREMIA IN SMALL CELL LUNG CARCINOMA.

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3Cleveland Clinic, Cleveland, OH; 4Sunnybrook Health Sciences Center, Toronto, ON, Canada. (Control ID #1340179)

BACKGROUND: Hyponatremia has been found to be the most common electrolyte abnormality in patients with advanced cancers. Degree of hyponatremia has been associated with poor outcomes in patients with cirrhosis, congestive heart failure, pneumonia and meningitis. Recent studies have recognized hyponatremia as an indicator of poor prognosis in advanced cancers and small cell carcinoma of lung. Both plasma sodium and urate are predictive of survival in limited stage small cell lung carcinomas and patients with lung cancer who do not fully regain normal values of sodium have poorer survival as compared to those who do. Few retrospective studies have shown hyponatremia to be a significant prognostic factor in lung cancer. The objective of our study is to study the demographic distribution and prevalence of hyponatremia in limited and extensive stage small cell carcinoma of lung. We also attempted to determine if the degree of hyponatremia was more prevalent in a certain subset of small cell lung carcinoma patients.

METHODS: We collected data for a retrospective cohort study from electronic data base of a community teaching hospital on patients diagnosed with small cell lung cancer from 1995 to 2010. Demographic data and clinical variables including age, sex, race, degree of hyponatremia (mild, 130-135 mmol/L or moderate/ severe, less than 130 mmol/L), stage of small cell lung carcinoma (limited vs extensive) and co-morbidities such as renal failure, hypothyroidism and lung infiltrates were accounted for. Patients were staged into limited and extensive disease in accordance with Veterans Administration Lung Group 2 stage classification scheme. Patients aged less than 18 years and those with incomplete data on staging and serum sodium were excluded. Descriptive statistics for all variables and differences in means for the continuous variables and chi-square test for the categorical variables comparing degree of hyponatremia with these variables were performed.

RESULTS: Over a period of 15 years 80 patients with small cell carcinoma of lung and hyponatremia were included in our study.65.63% of patients were male and 95% were Caucasian. Those with extensive disease constituted 48% and median duration from diagnosis of hyponatremia to death was 171 days. 41% patients had mild hyponatremia. 50.63% patients also had accompanying lung infiltrates, 17% had renal failure and 8% had concomitant hypothyroidism. Mild hyponatremia was present in 65.63% patients with limited disease whereas

58.33% of patients with extensive disease had moderate to severe hyponatremia(p<0.0425).
CONCLUSIONS: The results of our study show that moderate/severe degree of hyponatremia is more prevalent in extensive stage small cell carcinoma of lung whereas patients with limited stage disease have mild hyponatremia.
PREVALENCE AND CHARACTERISTICS OF PHYSICIANS WHO RECEIVE COMPENSATION FOR QUALITY OF CARE OR PATIENT SATISFACTION Kira L. Ryskina1; Tara F. Bishop2,3. 1New York Presbyterian Hospital - Weill Cornell, New York, NY; 2Weill Cornell Medical College, New York, NY; 3Weill Cornell Medical College, New York, NY. (Control ID #1317991)

BACKGROUND: Over the past decade, public and private payers initiated numerous incentive programs compensating physicians for quality of care and/ or patient satisfaction. Little is known about the prevalence of physician compensation for quality or satisfaction on a national level. The objective of this study was to estimate the national prevalence of physicians who are compensated for quality or satisfaction, to identify physician and practice characteristics associated with compensation for quality or satisfaction, and to determine whether physicians who are compensated for quality or satisfaction have more structural and process elements to improve quality of care. METHODS: We performed a trend analysis and two cross-sectional analyses using the 2006-2008 National Ambulatory Medical Care Survey (NAMCS). NAMCS is a national survey of non-federal, non-hospital-based physicians who see patients in the ambulatory setting. Each physician is weighted to allow for national estimates of physician and practice characteristics. For the trend analysis, we used linear regression to determine whether the percentage of physicians who received compensation for quality and/or satisfaction changed from 2006 to 2008. We then used multivariable logistic regression to identify physician and practice characteristics associated with physician compensation for quality or satisfaction. Finally, we used the Pearson 2 test to identify which structural and process elements were associated with physician compensation for quality or satisfaction.
RESULTS: From 2006 to 2008, 3,813 eligible physicians completed the NAMCS induction survey. The proportion of physicians who received some compensation for quality increased from 17.2% in 2006 to 24.9% in 2008 (p=0.002). Similarly, the proportion of physicians who received some compensation for patient satisfaction increased from 15.8% in 2006 to 21.4% in 2008 (p=0.02). A substantial percentage of physicians did not know whether they received compensation for quality or patient satisfaction (17.3% and 16.9%, respectively). Physicians who received some compensation for quality were more likely to be an employee than an owner (adjusted p=0.001), in an urban area (adjusted p=0.04), in a primary care vs. surgical or medical specialty (adjusted p=0.0001 and p=0.01), and practicing in an HMO (adjusted p=0.0001). Physician compensation for quality or satisfaction were significant predictors of the practice having an electronic medical record and evening or weekend office hours (p=0.001 and p=0.0001, respectively). CONCLUSIONS: A minority of physicians received compensation for quality and/or satisfaction in 2006 to 2008 although the proportion who did increased over that time period. We found that about one in six physicians did not know whether they received compensation for quality or patient satisfaction. Our findings suggest that on a national scale, pay-for-performance programs may not be effective because physicians are either not enrolled in or unaware of these programs.
PREVALENCE AND CHARACTERISTICS OF HOSPITAL-OWNED AMBULATORY PRACTICES IN THE U.S. Tara F. Bishop; Jayme Mendelsohn; Lawrence P. Casalino. Weill Cornell Medical College, New York, NY. (Control ID #1338777)
BACKGROUND: A number of articles in the medical literature and lay press report that hospitals are increasingly buying physician practices. Competitive and revenue pressures, as well as national policies such

as bundled payments and incentives to create accountable care organizations (ACOs) may be propelling this change. Little is known about the characteristics of practices that are owned by hospitals and patient-mix of hospital versus physician-owned practices. We used data from a national survey of physicians to estimate the prevalence of hospital ownership, to identify physician and practice characteristics associated with hospital ownership, and to examine differences in infrastructure, patient access, and patient case-mix in hospital versus physician-owned practices.
METHODS: We used data from the 2005 through 2009 National Ambulatory Medical Care Survey (NAMCS) which is a national survey of physicians who see patients in the ambulatory setting. The sample does not contain information on physicians in hospital outpatient departments or in federally funded practices (e.g. Veterans Affairs practices). We performed several analyses: a trend analysis to estimate the prevalence and change in prevalence of hospital-owned practices from 2005 to 2009, a
cross sectional analysis of 2009 data that used multivariable logistic regression to identify which physician and practice characteristics predict hospital ownership, and a second cross-sectional analysis that used the Pearson 2 to examine differences in practice infrastructure, patient access, and patient case-mix.
RESULTS: From 2005 to 2009, the percentage of physicians practicing in hospital owned practices was low and did not increase over the time period(7.4% in 2005 to 5.6% in 2009, p=0.117). Compared with physician-owned practices, physicians in hospital-owned practices were less likely to be surgical specialists than primary care physicians (23.6% in physician-owned vs. 16.0% in hospital-owned, adjusted odds ratio [aOR]=0.51, 95% confidence intervals [CI] 0.32-0.81), more likely to be group practices(60.8% vs.87.2%, aOR =4.43, 95% CI 2.68-7.30), and more likely to be in rural locations (10.4% vs. 17.9%, aOR=1.85, 95% CI 1.21-2.85). Hospital owned practices were more likely to have an on-site laboratory (41.9% for physician-owned vs. 64.3% for hospital-owned, p<0.001), electronic medical records (18.9% vs. 22.6%, p=0.003), accept Medicaid patients(68.8% vs. 87.1%, p<0.001), and set aside time for same day appointments(58.7% vs. 73.6%, p=0.040). Patients who were seen by physicians in hospital-owned practices were more likely to be white (74.3% vs. 77.2%, p =0.02) and black (9.3% vs. 11.7%, p=0.02) than Hispanic (11.4% vs.6.9%, p=0.02) and were more likely to have Medicaid (10.9% vs. 17.8%, p<0.001).
CONCLUSIONS: We found that a minority of practices were owned by hospitals from 2005 to 2009 and the percentage did not increase over the time period. Hospital-owned practices had more processes to provide high quality care. Patients may benefit from improved processes of care if, in fact, there is an emerging trend for hospitals to own practices.
PREVALENCE AND CHARACTERISTICS OF HYPERTENSION AT A MEDICAL STUDENT-RUN FREE CLINIC Ognjen Katan1; JulieE. Risinger2; Thomas G. McLeod3; Mark L. Wieland3. 1Mayo Clinic, Rochester, MN; 2University of Minnesota - Rochester, Rochester, MN;
3Mayo Clinic, Rochester, MN. (Control ID #1339464)
BACKGROUND: Hypertension is a leading cause of morbidity and mortality throughout the world, but it is vastly under-diagnosed and under-treated. Medically underserved populations, the socioeconomically vulnerable, and racial/ethnic minorities are most likely to suffer from uncontrolled hypertension. Free clinics serve as safety nets for many of these patients, yet little is known about hypertension prevalence and characteristics among patients seen in these settings. Therefore, we explored hypertension and uncontrolled hypertension prevalence, treatment, and risk factors in patients who are seen by medical student providers at a free clinic.
METHODS: The REACH clinic is a medical student-run, free clinic that serves uninsured adults residing in Olmsted County, MN. Medical students participate in a longitudinal clinical experience at REACH under the supervision of faculty preceptors. We retrospectively analyzed all consecutive medical records of REACH clinic patients who were seen between January 2010 and December 2011. Data collection included hypertension diagnosis, most recent blood pressure, antihypertensive medications, comorbidities (diabetes, coronary artery disease, hyperlipidemia, tobacco use, alcohol use) and demographics (age, gender, ethnicity, and primary

language spoken). Uncontrolled hypertension was defined as a systolic blood pressure140 or a diastolic blood pressure90. Demographics and prevalence of hypertension prevalence and uncontrolled hypertension were calculated through standard descriptive statistics. Associations between a diagnosis of hypertension or uncontrolled hypertension and study variables were assessed through weighted contingency tables with comparison of proportions through Pearsons chi squared test or Fishers exact test as appropriate; level of significance was set at <0.05.
RESULTS: A total of 448 separate patients were seen by medical students at the REACH clinic during the study interval, of whom 393 (88%) had a research authorization on file. Mean patient age was 4613 years; 232 (59%) were Caucasian, 45 (11%) African immigrant, 41 (10%) Asian, 30 (8%) Hispanic, and 22 (6%) African American. 157 (40%) carried a diagnosis of

hypertension, 88 (56%) of whom had uncontrolled hypertension. 129 (82%) were prescribed at least one antihypertensive medication in the past. Diagnosis of hypertension was significantly associated with male gender (p=.0373), Asian ethnicity (p=.03), diabetes (p<.0001), hyperlipidemia (p<.0001), coronary artery disease (p=.0007), and alcohol consumption (p=.02). A diagnosis of uncontrolled hypertension was associated with male gender (p =.03) and hyperlipidemia (p=.0008). Tobacco use and speaking primarily a foreign language were not associated with previous hypertension diagnosis or with uncontrolled hypertension.
CONCLUSIONS: Among uninsured patients who receive healthcare at a student-run, free clinic, a high percentage of this relatively young patient population carry a diagnosis of hypertension. Despite the fact that most patients have been prescribed antihypertensive medications in the past, the majority of these patients had uncontrolled hypertension. These results speak to the need for qualitative data to elucidate barriers to hypertension management among these vulnerable patient populations. Furthermore, structural interventions are needed to improve longitudinal hypertension management among patients who rely on student-run free clinics for their healthcare.
PREVALENCE AND CORRELATES FOR NONMEDICAL USE OF PRESCRIPTION OPIOIDS AMONG URBAN AND RURAL RESIDENTS Karen Wang1,2; William Becker2; David A. Fiellin2. 1Yale School of Medicine, New Haven, CT; 2Yale School of Medicine, New Haven, CT. (Control ID #1333768)
BACKGROUND: Nonmedical use of prescription opioids and its complications are increasing in the United States. Concurrently, there has been an increase in unintentional overdose deaths related to prescription opioids, in particular within rural areas. Little is known about the differences in prevalence and correlates of nonmedical use of prescription opioids among urban and rural residents.
METHODS: We analyzed data from 2008-2009 National Survey on Drug Use and Health. We examined prevalence, type of opioid, and correlates of nonmedical use of prescription opioids among residents in large and small metropolitan (urban) compared with nonmetropolitan (rural) counties. We then examined bivariate and multivariate associations between nonmedical use of prescription opioids and sociodemographic and clinical characteristics, including age of first use of cigarettes, alcohol and illicit drugs and current (past year) use of these substances, stratified by urban and rural counties.
RESULTS: Among our study population (n=75964), prevalence of nonmedical use of prescriptions opioids was similar among residents in urban and rural counties (4.7% vs. 4.3%, p=0.15). Rural residents with nonmedical use of prescription opioids were more likely than urban residents with nonmedical use to be white, have an income under $20,000 per year, report nicotine and stimulant use and less likely to have a high school education, be employed, report a good health status, or alcohol use (p<.05 for all comparisons). Among those with nonmedical use of prescription opioids, rural residents were also more likely than urban residents to use acetaminophen with propoxyphene (61.1% vs. 55.8%, p=0.02), methadone (14.8% vs. 9.1%, p=0.003) and acetaminophen with codeine (3.5% vs. 1.9%, p=0.05). Among urban and rural residents, those with severe mental illness, age of first use of illicit drugs before the age of 18, nicotine use, and nonmedical of other

prescription drugs were more likely to report nonmedical use of prescription opioids. Among urban residents only, those whose age of first use of illicit drugs between age of 18-25 (AOR 1.53, CI 1.11-2.11) and those with alcohol use (AOR 1.60, CI1.20-2.13) were more likely to report nonmedical prescription use. Black and Hispanic urban residents were less likely to use prescription opioids nonmedically compared to white urban residents (Black AOR 0.62, CI0.50-0.76; Hispanic AOR 0.68, CI 0.54-0.87). Rural residents reporting good health status were less likely to use prescription opioids nonmedically than residents reporting poor health status (AOR 0.62, CI 0.39-1.00). CONCLUSIONS: Specific opioids and correlates of nonmedical use of prescription opioids differ between urban and rural counties. As characteristics differ by level of rurality, prevention and treatment interventions to address these problems may need to be tailored for specific communities.

PREVALENCE OF COMPLETE IMMUNIZATION STATUS AMONG NASHVILLE HIGH SCHOOL SENIORATHLETES Ashley R. Karpinos1,2; Katie H. Rizzone2; Sarah P. Cribbs3,4; Christianne Roumie1,2. 1Tennessee Valley Healthcare System VA, Nashville, TN;
2Vanderbilt University Medical Center, Nashville, TN; 3The Ohio State University, Columbus, OH; 4Nationwide Children's Hospital, Columbus, OH. (Control ID #1315027)

BACKGROUND: The pre-participation physical evaluation, which does not address immunizations, often serves as the only preventive healthcare visit for athletes. Our aim was to determine the proportion of high school senior athletes who received all recommended immunizations. Our hypothesis was that females would be less likely than males to be up-to-date on immunizations given the new human papillomavirus (HPV) vaccine recommendations. METHODS: We conducted a cross-sectional evaluation of the immunization status of high school senior athletes in metropolitan Nashville. Surveys assessing immunization status and healthcare utilization were distributed to senior athletes parents. The primary outcome was parent report of athletes being up-to-date on immunizations for tetanus (in the past 10 years), meningococcal (1 dose), and seasonal influenza (in the past 12 months). For females, the primary outcome also included having completed the 3-dose HPV vaccination series. We used Pearson s chi-squared to compare attainment of the primary outcome. We conducted a logistic regression model comparing immunization status among males and females adjusting for race, provider seen for pre-participation physical evaluation, and parental income. RESULTS: 462 surveys were distributed, 170 (37%) were returned, and 162 (95%) were complete for analysis. There were 104 males and 58 females; median age was 17 vs. 17 (p=0.044). Males were more likely than females to have up-to-date immunizations (16% vs. 3%, p=0.020). When we excluded HPV, there was no difference between males and females (16% vs. 16%, p=0.982). In a multivariable logistic regression model, the odds of having received all recommended immunizations was 0.13 (95% CI 0.03-0.68) for females vs. males. Athletes seen in sports medicine for their pre-participation physical evaluation were just as likely to have up-to-date immunizations as athletes seen in primary care (OR 0.53; 95% CI 0.13-2.2). Our study population had a higher prevalence of tetanus vaccination, but a lower prevalence of other vaccinations than adolescents in Tennessee (figure 1). CONCLUSIONS: The proportion of high school senior athletes with upto-date immunizations was low, and females were less likely than males to have recommended immunizations. There was no difference in immunization status among those who received their most recent pre-participation evaluation from sports medicine or primary care physicians. Policy changes recommending a review of immunizations at the pre-participation evaluation would benefit high school athletes.

Figure 1. Immunization Status. 1Among 6 mo - 17 yr in '09-'10 influenza season 2Among females only 3Among 13-17 yr in '10 4Among 17 yr in 10

PREVALENCE OF THROMBO-EMBOLIC DISEASE IN END STAGE LIVER DISEASE PATIENTS IN AN URBAN SAFETY-NET HOSPITAL 2005-2010. Maria G. Frank1,2; Angela Keniston1.

1Denver Health Hospital Authority, Denver, CO; 2University of Colorado, School of Medicine, Aurora, CO.
(Control ID #1310275)

BACKGROUND: The reported incidence of Thromboembolic disease (TED) in End Stage Liver Disease (ESLD) patients ranges from 0.5% to 4.7% in published series between 1995 and 2009. We hypothesize that ESLD patients receive less Deep Venous Thrombosis (DVT) prophylaxis than the non- ESLD group, hence they develop higher rate of TED.

METHODS: Data from Denver Health Data Warehouse were queried for all inpatient encounters discharged from Medicine between January 1, 2005 and December 31, 2010. Data were excluded for correctional care patients, patients known to be pregnant, and patients younger than 18 or older than 89. All encounters for all patients meeting inclusion criteria have been retained.

RESULTS: A total of 1448 encounters with primary or secondary diagnosis of ESLD (including chronic liver disease and cirrhosis, hepatic encephalopathy, portal hypertension, hepatorenal syndrome, and other sequelae of chronic liver disease) and 5 with simultaneous diagnosis of TED (0.34 %) were identified; in contrast with 43,821 non-ESLD discharges and 1,313 with simultaneous diagnosis of TED (2.9%). When the discharge diagnosis of superficial thrombophlebitis was added to the TED group, numbers increased to 11 (0.759%) in the ESLD group and 1,541 (3.5%) in the non-ESLD group. Forty five percent of ESLD patients received DVT prophylaxis during hospital stay, 100% of TED patients were in this group.

CONCLUSIONS: Even though pathophysiology of coagulation in ESLD seems to suggest a pro-coagulant imbalance as recently reported by Tripodi, et.al; there is no clinical evidence of higher risk for developing thrombotic episodes in the Denver Health population. There have been 5 retrospective cohort studies to delineate the risk for TED in this group of patients. The largest, by Muhammad, et.al, reviewed 449,798 nationwide discharges and found rates of TED in ESLD of 1.8% and 2.4%; the latter was true if patients were positive for HCV. Their percentage of TED for all-cause-discharge-diagnosis was 3.7%. Another retrospective cohort study by Gulley, et.al, analyzed 963 discharges and reported an association of TED and ESLD of 1.8% in contrast to 3.2% for overall discharge diagnosis. However the above mentioned studies included superficial thrombophlebitis as one of the TED diagnosis. Northrup, et.al, described a TED frequency of 0.5% out of 21,000 ESLD patients. We report a rate of TED associated with ESLD lower than most series in English literature. We also found that only half of ESLD patients received DVT prophylaxis in contrast to 65% of the non-ESLD group. While DVT prophylaxis in ESLD patients appears to be a safe practice, there is no obvious benefit from it in Denver Healths population. Further clinical studies are necessary to develop DVT prophylaxis guidelines for this unique subset of patients.

PREVALENCE OF MORBIDITY POST-DISCHARGE IN AN OLDER PATIENT POPULATION. Leora I. Horwitz1; Sandhya V. Kanade2; Christine Chen2; Boback Ziaeian2; John Moriarty1; Grace Y. Jenq1. 1Yale University, New Haven, CT; 2Yale New Haven Hospital, New Haven, CT. (Control ID #1338911)

BACKGROUND: As length of stay has shortened in recent years, patients are being discharged earlier in their clinical course. Older patients in particular, who may take longer to recover from acute illness than younger patients, may experience morbidity post-discharge. Yet the overall experience of older patients post-discharge remains uncertain. The object of this study was to quantify the symptom burden of older patients after discharge home from an acute hospitalization.

METHODS: A prospective cohort of patients admitted to the medical service at Yale New Haven Hospital with pneumonia, heart failure or acute myocardial infarction and discharged home was enrolled from May 1, 2009 to April 4, 2010. The hospital has a higher than average readmission rate for pneumonia and heart failure. Patients were interviewed one month post-

discharge by telephone. The interview consisted of 21 questions. Each participant was asked about the presence of 13 specific symptoms and had the opportunity to describe others. For each symptom, we determined whether it began post-discharge, whether the patient discussed it with a doctor, and whether it

required a physician or hospital visit. Missing visit data was treated as negative (no physician or hospital visit). RESULTS: The study cohort included 395 patients; 344 (87.1%) were reached for the one month interview. Included patients had a mean age of 77 years; 54% were male. A total of 39% had heart failure, 24% had pneumonia and 52% had acute coronary syndrome. 14% of patients had more than one condition. Patients experienced a mean of 1.6 symptoms (SD 1.6) in the post-discharge period; 67.7% of patients experienced at least one symptom. A total of 36% of symptoms began only after hospitalization. Prevalence of symptoms ranged from 2% for fever to 32% for shortness of breath (see Table). More than half of diarrhea, rash, falls, nausea/vomiting, skin breakdown and fever began after discharge. At least 22% of symptoms required a visit to the physician or the hospital. A total of 17.3% of patients were readmitted within 30 days of discharge. CONCLUSIONS: A substantial fraction of post-discharge morbidity begins in the post-discharge period. The frequency of diarrhea, rash, nausea and falls among new symptoms raise the possibility of medication-related adverse events and hospital-acquired infections in addition to chronic disease burden. Many of these symptoms require physician or hospital visits but may not be addressed in discharge instructions focused on symptoms related to hospitalization. Post-discharge care should include specific attention to common symptoms post-discharge and to potential medication adverse effects.

Post-discharge symptom burden

Symptom Prevalence n (% of patients)
Began post-discharge n (% of symptoms)
Discussed with doctor n (% of symptoms)
Required physician or hospital visit n (% of symptoms)
Shortness of breath 111 (32.4) 26 (22%) 86 (75%) 36 (32%) Polyuria 77 (22.6%) 20 (27%) 39 (53%) 10 (13%) Edema 71 (20.9%) 14 (19%) 54 (76%) 20 (28%) Pain 70 (20.5%) 29 (39%) 56 (76%) 27 (39%) Cough 67 (19.7%) 18 (28%) 33 (54%) 4 (6%) Diarrhea 23 (6.7%) 17 (74%) 12 (55%) 2 (9%) Rash 18 (5.4%) 12 (71%) 10 (63%) 4 (22%) Falls 18 (5.3%) 16 (80%) 12 (60%) 4 (22%) Inability to eat 17 (5.0%) 6 (35%) 14 (88%) 2 (12%) Nausea/ vomiting 16 (4.6%) 10 (59%) 8 (53%) 0 (0%) Skin breakdown 8 (2.9%) 6 (67%) 5 (63%) 2 (25%) Dysuria 10 (2.9%) 5 (50%) 8 (80%) 2 (20%) Fever 8 (2.4%) 5 (71%) 5 (83%) 4 (50%) Other 18 (5.3%) 8 (57%) 8 (53%) 3 (17%)

PREVENIR ES MEJOR QUE LAMENTAR: A CULTURALLY TAILORED COLORECTAL CANCER SCREENING INTERVENTION FOR LATINOS Rene Salazar; Monica Lopez; Juliette Hong; Eliseo Perez-Stable. UCSF, San Francisco, CA. (Control ID #1324966)

BACKGROUND: Rates of colorectal cancer (CRC) screening are lower in racial and ethnic minorities, including Latinos. The goal of this study was to assess the impact of a culturally tailored CRC educational brochure and DVD on CRC cancer behavior among predominantly Spanish-speaking Latinos in a primary care setting. METHODS: We conducted a randomized controlled trial of 204 Latinos age 50-79 recruited from academic and community primary care clinics in San Francisco CA. Participants were assigned to the intervention, which included a mailed bilingual CRC educational brochure and a Spanish-language DVD versus usual care. Usual care is defined by standard US Prevention Task Force recommendations within the clinical practice. Participants completed a baseline telephone survey and follow up survey 6-9 months later. Demographic data, knowledge of CRC screening and screening tests, facilitators and barriers to screening and self-reported rates of CRC screening were assessed. Descriptive

statistics were computed for all demographic and dependent variables, including means and standard deviations for continuous data and frequency distributions for each of the categorical variables. Chi-square tests and t-tests were computed for assess differences in covariate distributions across groups. Multivariate analyses were performed to determine the independent impact of the intervention on rates of CRC screening. The primary outcome was the impact of the intervention on any CRC screening.

RESULTS: 190 Latinos completed the baseline and follow up survey. The majority of respondents were female (69.5%) and the average age of study participants was 66 years (SD 9.2) Baseline survey revealed similar rates of self reported fecal occult blood testing between the intervention and control group (58.5% vs. 55.3%, p<0.65). At follow up, self reported rates of fecal occult blood testing (FOBT) were greater in the intervention group compared to the control group (73.7% vs. 60.4%, p=0.05). Rates of colonoscopy at baseline were 58.2% in the intervention group and 71.4% in the control group (p<0.13) Rates of colonoscopy at follow up were similar between the intervention and control group (73.5% vs 73.9%, p<0.38). Multivariate analysis revealed that the intervention strongly improved rates of any CRC screening among participants (OR 2.23; 95% CI 1.02-4.87). Those with prior knowledge of screening were more likely to report CRC screening (OR 6.65; 95% CI 2.8-15.6). Those who reported good health were less likely to have had any screening (OR 0.44; 95% CI 0.21-0.90), as were those with fatalistic attitudes measured by a 4-item scale (OR 0.27; 95 CI 0.13-0.58). CONCLUSIONS: Exposure to a culturally tailored brochure and DVD increased rates of self-reported CRC screening in Latinos.
PREVENTABLE FACTORS FOR REDUCING 30-DAY READMISSIONS IN PATIENTS WITH CARDIAC DISEASE IN A GENERAL INTERNAL MEDICINE CLINIC Ning Tang; Leah Karliner. UCSF, San Francisco, CA. (Control ID #1339590)
BACKGROUND: Reducing hospital readmissions through improved care transitions is a national health care priority, and in October 2012, the Centers for Medicare and Medicaid Services will enact financial penalties on hospitals with higher than average risk-adjusted read-missions for patients with heart failure and acute myocardial infarction. Little is known about how primary care practices can target patients with heart disease and develop interventions that improve patient care and reduce hospital admission. We set out to understand in our own primary care population with congestive heart failure (CHF) and coronary artery disease (CAD) the reasons for readmission and whether those readmissions were preventable. METHODS: A retrospective chart review of Division of General Internal Medicine (DGIM) clinic patients with CHF and/or CAD readmitted to University of California, San Francisco (UCSF) Medical Center within 30 days of initial hospital discharge between May 1, 2010 and April 30, 2011 was conducted. A standardized chart review tool, developed by the investigators, was used to review all inpatient and outpatient records. Study investigators developed criteria for determining if a readmission was potentially preventable and applied the criteria set to all reviewed cases. RESULTS: During the study period, there were 386 hospital discharges for 183 DGIM patients with CHF or CAD; 46 patients had one or more readmissions within 30 days of hospital discharge, totaling 87 index admission-readmission pairs. The majority of patients were discharged from the medicine (45%) or cardiology (47%) service on their index admission, with length of stay largely less than 1 week (43% 1-2 days and 43% 3-7 days). Mean time between index and readmission was 12 days (range 1-29). Half (49%) of the readmissions were directly related to the index readmission. In 60% of the index hospitalizations, a follow-up appointment in DGIM was scheduled. For patients who arrived to their outpatient appointments, compared to those who did not, mean time to readmission was 16 vs. 8 days. Almost half (48%) of readmissions were classified as potentially preventable (20% preventable with system actions alone, 18% preventable with patient actions alone, and 10% preventable with system and patient actions combined). The system-related preventable factors included: no timely follow-up appointment, inability to obtain
prescriptions, inadequate teaching on discharge medications and disease management, lack of inpatient physical therapy consult for patients with poor functional status, lack of social work and case management involvement in discharge planning, and inadequate communication between inpatient and outpatient providers. CONCLUSIONS: The potential to reduce preventable readmissions in a general internal medicine clinic population with cardiac disease is substantial. Interventions would require close collaboration between inpatient services and outpatient clinics to ensure appropriate discharge planning for patients with poor functional status, adequate communication between inpatient and outpatient providers, timely outpatient follow-up, and assistance for patients to obtain new prescriptions prior to hospital discharge.

PREVENTIVE CANCER SCREENING PRACTICES IN HIV POSITIVE PATIENTS Florence Momplaisir1; Karam Mounzer2; Judith A. Long1. 1University of Pennsylvania, Philadelphia, PA; 2University of Pennsylvania, Philadelphia, PA. (Control ID #1320210)

BACKGROUND: With the wide spread use of antiretroviral therapy, patients with HIV are living longer and are at risk of developing non-AIDS Defining Malignancies. In this study we evaluate the rates of routine colorectal and breast cancer screening in patients with and without HIV and identify factors associated with cancer screening.

METHODS: Design: We performed a cross-sectional survey of patients willing to complete the study questionnaire in waiting rooms of three outpatient HIV clinics and one general internal medicine clinic in Philadelphia, Pennsylvania. The survey asked about basic demographics; their colorectal and breast cancer screening history; cancer risk; and presence of other chronic diseases. The HIV positive patients were given additional questions about their HIV disease and their HIV providers. HIV clinics were categorized as integrated (providing HIV and primary care) and non-integrated (providing only HIV care). Study population: Women with and without HIV age 40 and older and men with and without HIV age 50 and older who agreed to complete the survey. Outcome: Survey respondents were considered current for their colorectal cancer (CRC) screening if they reported having at least one colonoscopy during the past 10 years, a flexible sigmoidoscopy during the past five years, or fecal occult blood testing during the last year regardless of the reason for the test. Women were on target on their breast cancer screening if they reported having at least one mammogram during the past year regardless of the indication for the study.

RESULTS: 762 complete surveys were collected. 401 respondents were HIV positive. Patients with HIV were younger (mean age 54 versus 62, $p<0.001$), mostly male (53.6% versus 30.5%, $p<0.001$) black, non-Hispanic(62.8% versus 56.5%, $p=0.006$) and low-income (62.8% versus 27.4%, $p<0.001$). Co-morbidity counts were similar across both groups (0.76). Patients with HIV were less likely to be up-to-date with their routine cancer screening (45.6% versus 65%, $p<0.001$ for CRC screening and20.4% versus 62.3% $p <0.001$ for breast cancer screening). After adjusting for demographic and clinical factors, the odds of up to date CRC screening were no longer significantly different between patients with and without HIV (OR 0.6; 95% CI 0.3-1.2); however, HIV positive women remained significantly less likely to be current with breast cancer screening (OR 0.1; 95% CI 0.0-0.2). HIV positive patients enrolled in the integrated and the non-integrated care clinics differed significantly: whites, males, high income and highly educated patients were more likely to attend the non-integrated care clinic. There was a trend toward decreased CRC screening and increased breast cancer screening in integrated care clinics but this finding did not reach statistical significance.

CONCLUSIONS: Routine cancer screening needs to be improved in HIV positive patients. The integrated care clinic provides care to more disadvantaged HIV patients and is not associated with higher cancer screening rates. This could be secondary to non-adherence. It is also possible that patients in the integrated care clinic encounter competing priorities between HIV care and primary care during their visits in contrast to patients in the non-integrated care clinic.

PREVIOUSLY UNDETECTED CHRONIC KIDNEY DISEASE FOUND TO BE COMMON IN PRIMARY CARE CLINICS IN THE TEXAS PANHANDLE Sudha P. Chennasamudram1; Tetyana L. Vasylyeva1; Rodney Young2; Sharma Prabhakar3; Roger D. Smalligan4.
1Texas Tech University Health Sciences Center, Amarillo, TX; 2Texas Tech University Health Sciences Center, Amarillo, TX; 3Texas Tech University Health Sciences Center, Lubbock, TX; 4Texas Tech University Health Sciences Center, Amarillo, TX. (Control ID #1338366)

BACKGROUND: Patients with chronic kidney disease (CKD) typically have multiple health problems including

underlying hypertension (HTN) and/or diabetes (DM), cardiovascular disease (CVD), anemia and mineral bone diseases. These multiple comorbidities often require a team effort by various clinicians with the primary care physician (PCP) providing overall guidance and coordination of care. Early identification and prevention of progression of CKD is of great importance due to the aging of the US population. It is estimated that over twenty-six million people are affected with CKD in the United States. The state of Texas ranks second highest in the prevalence of CKD and costs associated with it in the nation. The purpose of this study was to identify the presence of CKD in a cohort of patients in the Panhandle region of Texas and offer quality of care suggestions to the primary care physician taking care of those patients. METHODS: Patients arriving to either the Texas Tech University Health Sciences Center (TTUHSC, Amarillo) Internal Medicine or Family Medicine clinic who did not have documented renal disease were offered to participate in the study. After obtaining informed consent, data was collected including race, age, gender, presence or absence of CKD risk factors (HTN, DM, CVD, obesity) and a basic metabolic panel with estimated glomerular filtration rate (eGFR) was obtained if one was not in the record within the last 6 months. Rates and stages of CKD were determined based on eGFR by CKD EPI formula and a patients PCP was advised of any important clinical findings along with a suggested course of action if indicated.
RESULTS: A total of 170 patients with no known renal problems were enrolled in the study after obtaining an informed consent. The average age of the participants was 62. Sixty-four percent were women and 36% were men. Seventy-six percent were white, 7.6% Hispanic and 16.4% of other races. eGFR was above 90 in 23%, CKD stage 2 (eGFR 60-89) in 48%, stage 3 (30 - 59) in 27%, stage 4/5 (below 30) in 2%. Risk factors for CKD among the participants included HTN (58%), DM (10%), and CVD (6%). Among patients with DM, 70% had been tested for microalbuminuria during the past year. CONCLUSIONS: This pilot study revealed a remarkably high number of patients who visited their PCP with no previously known renal disease to have early stages of CKD (77% had stage 2 or higher). Indeed there was a high percentage of participants with significant risk factors which would be predictive of CKD and should have alerted clinicians to screen for the condition. Similarly, age is associated with higher rates of CKD and the average age of participants was over 60. This study reminds PCPs of the need to screen patients for CKD if they have the mentioned risk factors of DM, HTN, CAD or obesity. This will allow tighter control of these comorbid conditions by the PCP to delay CKD progression and early referral to a nephrologist for co-management in more advanced cases. Identifying CKD earlier will also allow clinicians to be more vigilant while prescribing potentially nephrotoxic medications or ordering contrast involved imaging studies. Important limitations of this study include its small size and disproportionate sex distribution of subjects.
PRICING TRANSPARENCY: CAN U.S. HOSPITALS PROVIDE PRICE ESTIMATES FOR A COMMON ELECTIVE SURGICAL PROCEDURE? Jaime A. Rosenthal1; Xin Lu1; Peter Cram1,2. 1University of Iowa Carver College of Medicine, Iowa City, IA; 2Iowa City VA Medical Center, Iowa City, IA. (Control ID #1333564)
BACKGROUND: Many proposals for healthcare reform incentivize patients to play a more active role in selecting providers on the basis of quality and
price. While data on hospital and physician quality are increasingly available, the availability of pricing data for medical services is less certain. Our objective was to examine our ability to obtain pricing data for a common elective surgical procedure - total hip arthroplasty (THA).
METHODS: We used Medicare Part A data to identify all 4,058 US hospitals performing THA in 2008. We randomly selected two hospitals from each state as well as 21 top-ranked Honor Role Orthopaedic Hospitals identified in the 2011-2012 US News rankings. We contacted each hospital by telephone between May-August 2011. Using a standardized script a member of our study team contacted representatives at each hospital. The essence of the script was that the callers grandmother required hip replacement surgery, had no comorbid medical conditions, and did not have insurance. The script also specified that the price quote being requested should include 4 days in the hospital and all bundled hospital fees. The caller explained that she was seeking

the lowest total cost for the procedure (hospital fee plus physician fee), would be comparing prices among competing quotes, and that her grandmother would be able to pay for the procedure out-of-pocket. When we encountered hospitals that could provide the hospital fee only, we selected a random orthopaedic surgery practice affiliated with the hospital to obtain the physician fee. This study was deemed exempt by the University of Iowa IRB. RESULTS: Of the 100 randomly selected hospitals, only 10 (10%) were able to provide a single price (hospital plus physician fee); only 6 (6%) were able to provide a single price on the first telephone call. An additional 54 hospitals (54%) could provide a total price by contacting the hospital and orthopaedic surgery practice separately. There were 22 hospitals (22%) that could provide either the hospital or physician price, but not both; 14 hospitals (14%) could provide neither the hospital nor physician prices. The mean total price from the 64 randomly selected hospitals that were able to provide both the hospital and physician fees was $41,622 (range $11,100 to $125,798); 8 had prices less than $25,000 and 15 had prices more than $50,000. Focusing on the 21 Honor Role Hospitals, 9 (43%) could provide a single price (both hospital and physician fees) and 4 (19%) provided the price on the first call; the mean price was $53,140 (range $12,500 to $105,000). One top-ranked hospital offered a price of less than $25,000, and 8 offered prices exceeding $50,000. CONCLUSIONS: We found it difficult to obtain price information for THA and wide variation in the prices that were quoted. Our results demonstrate that many healthcare providers can not provide reasonable price quotes and may not even have reasonable internal estimates of prices.

PRIMARY CARE CLINICIANS PERCEPTIONS ABOUT ANTIBIOTIC PRESCRIBING FOR ACUTE BRONCHITIS: A QUALITATIVE STUDY Jeffrey A. Linder; Patrick P. Dempsey; Alexandra C. Businger; Lauren E. Whaley. Brigham and Women's Hospital, Boston, MA. (Control ID #1326241)

BACKGROUND: Despite guidelines stating that antibiotics are not indicated for acute bronchitis, clinicians nationwide prescribe antibiotics at 70% of visits. We sought to identify and understand contemporary primary care clinician perceptions about antibiotic prescribing for acute bronchitis.

METHODS: We conducted a qualitative analysis of semi-structured, in-depth interviews with 13 primary care clinicians (12 physicians, 1 nurse practitioner) from 3 primary care practices in the Greater Boston Area. Interview questions addressed attitudes towards acute bronchitis guidelines, reasons for prescribing antibiotics, and potential solutions to decrease inappropriate antibiotic prescribing. Each interview was recorded, transcribed verbatim, and analyzed according to a standard comprehensive qualitative analysis method using structural then thematic coding.

RESULTS: Clinicians had a mean age of 43 years and 9 of the 13 respondents (69%) were women. Clinicians universally agreed with guidelines that state antibiotics are not indicated for acute bronchitis. The reasons cited for prescribing antibiotics included direct patient demand (12 clinicians), saving time (4), diagnostic uncertainty (4), and validating patients effort to come to clinic (3). Seven clinicians stated that patient demand for antibiotics was high. Five cited patient

demand as a reason for bending the guidelines. Clinicians cited other contributors to antibiotic prescribing such as a lack of accountability or feedback about prescribing (7) and financial incentives that encourage antibiotic prescribing (3). In addition, clinicians cited having patients from cultures where antibiotics are over-the-counter and frequently used (2). Furthermore, clinicians perceived that patients are now used to getting antibiotics, and patients felt they needed antibiotics in order to get better. However, 6 clinicians indicated patient demand has decreased over the last 5 years. Six clinicians felt other clinicians believed antibiotics were either the right treatment, harmless, or that acute bronchitis was not viral. To decrease antibiotic prescribing for acute bronchitis, clinicians recommended better pre-visit triage by nurses or physicians (6); and ongoing patient education (4). Clinicians also recommended patient handouts and other educational materials (5), non-antibiotic prescriptions, coaching patients about the potential harms of antibiotics, providing work and school excuse letters, and other actions that validate patients concerns. For system solutions, clinicians endorsed quality

reports and clinical decision support as potentially helpful (13).
CONCLUSIONS: Clinicians agreed with guidelines that antibiotics are not indicated for acute bronchitis. Clinicians continued to cite patient demand as the main reason for antibiotic prescribing, although clinicians felt patient demand may have lessened in the past few years. To decrease inappropriate antibiotic prescribing for acute bronchitis, clinicians endorsed the use of pre-visit triage, educational materials, quality reports, and clinical decision support.
PRIMARY CARE PHYSICIAN BELIEFS, BEHAVIORS AND PREPAREDNESS IN THE MANAGEMENT OF DEMENTIA: RESULTS OF A NATIONWIDE SURVEY Elizabeth Cogbill1,2; Sherry Baker2; Jeffrey L. Jackson1,2; Marilyn Schapira3. 1Clement J Zablocki VA Medical Center, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI;
3University of Pennsylvania, Philadelphia, PA. (Control ID #1336779)
BACKGROUND: Dementia is common and increasing in prevalence. Dementia has a highly variable clinical course and its management is complex due to many factors. Treatment options are limited to cholinesterase inhibitors. In the coming years dementia management will fall primarily to primary care physicians. Our study seeks to 1) describe primary care physician (PCP) beliefs about the effectiveness of cholinesterase inhibitors in the treatment of dementia, 2) describe cholinesterase use in clinical practice by PCP self-report, and 3) describe PCP perceptions of their preparedness to manage various aspects of dementia in light of the projected increase in prevalence. METHODS: We administered a 4 page survey 800 internal medicine, family practice and geriatric medicine physicians. We excluded physicians in training, DOs, physicians employed by government, and retired. Physician and practice characteristics were collected. To assess PCP beliefs about the effectiveness of cholinesterase inhibitors we asked Please rate the extent to which you agree with the following statementCholinesterase inhibitors are effective in treating cognitive/functional decline in dementia. To describe PCP cholinesterase use in clinical practice by self-report survey respondents answered one clinical vignette describing a patient newly diagnosed with dementia. To assess PCP perception of preparedness in the management of dementia survey respondents were asked to rate the extent to which they feel prepared to manage dementia in the following areas: initiation of prescription of medications for dementia, diagnosis of dementia, discussion of risks and benefits of treatment, and managing side effects of medications. Univariate and bivariate relationships in the data were examined. To test for significant differences between the groups, 2-sample t-tests for continuous variables and X2 tests for categorical variables were used.
RESULTS: Of the 800 sampled physicians, 354 completed the survey. The majority of respondents were white and male. Sixteen point four percent of PCPs strongly agreed that cholinesterase inhibitors are effective in treating cognitive decline, and 13.3% felt that cholinesterase inhibitors are effective in treating functional decline. Eighty six percent of PCPs felt that every patient newly diagnosed with dementia should be offered treatment with a
cholinesterase inhibitor, and 77% of PCPs indicated that they would offer and initiate treatment themselves in a straightforward case of newly diagnosed dementia. Less than half of PCPs felt very prepared to diagnose dementia, initiate medications, manage side effects, and discuss the risks and benefits of medication treatment with a patient newly diagnosed with dementia. Comments by PCPs included over 300 unique comments such as "Dementia care will suffer as the primary care base continues to erode" and "Primary care needs clearer diagnostic guidelines or an algorithm."
CONCLUSIONS: Dementia is a common and complex disease with a highly variable clinical course that makes its management challenging for PCPs. The results of our survey indicate that the majority of PCPs do not feel prepared to manage many aspects of dementia. The majority of PCPs do not feel that cholinesterase inhibitors are effective in the treatment of the cognitive or functional decline in dementia. Lastly, PCPs do not all approach the management of dementia in the same way.
PRIMARY CARE PHYSICIANS CURRENT PRACTICES REGARDING ADULT VACCINATION AND USE OF

IMMUNIZATION INFORMATION SYSTEMS Laura Hurley1,2; Lori Crane2; Erin D. Kennedy3; Sean T. O'Leary2; Brenda Beaty2; Shannon Stokley3; MandyA. Allison4,2; Michaela Brtnikova2; Andrea Clinger2; Allison Kempe2.
1Denver Health and Hospital Authority, Denver, CO; 2University of Colorado Denver, Denver, CO; 3Centers for Disease Control and Prevention, Atlanta, GA; 4University of Utah, Salt Lake City, UT. (Control ID #1337689)
BACKGROUND: Eleven vaccines are recommended for routine use in adults, including catch-up vaccines. Immunization information systems (IIS) are confidential, computerized, population-based systems that collect and consolidate vaccination data from multiple providers. IIS are available in 49 out of 50 states. While use of IISs has primarily been encouraged for pediatric vaccines, 82% of IIS nationwide have the capacity to track vaccination of persons of all ages. The objectives of this study were to assess and compare among general internists (GIM) and family medicine physicians (FM) routinely recommended vaccines stocked in the practice and awareness and use of IISs.
METHODS: Between September 2011 and January 2012, we administered an Internet and mail survey to a national network of 428 GIM physicians representative of the American College of Physicians membership and 420 FM physicians representative of the American Academy of Family Physicians.
RESULTS: Response rates were 58% (247/428) for GIM and 61% (255/420) for FM. Over 95% of GIM and FM reported providing vaccines to adults. The percent who reported stocking the various vaccines by specialty are presented in Table 1 (n=470). FM were more likely to stock a greater number of adult vaccines than GIM. GIM stocked an average of 3 (range 1-4) vaccines and FM an average of 6 (range 1-7) ($p<0.001$). FM were more likely than GIM to stock vaccines commonly required for catch-up including HPV, MMR, varicella and meningococcal vaccines. Regarding IIS, 70% of GIM and 36% of FM were unsure if their region or state had one, 21% of GIM and 60% of FM reported that their state or region did have an IIS, and 9% of GIM and 4% of FM reported that their state or region did not ($p<.001$). Of the physicians who reported that their state or region had an IIS, 55% of GIM and 82% of FM participate in it ($p<.001$).
CONCLUSIONS: Many adult physicians, GIM more than FM, are not currently providing all routinely recommended adult vaccines, particularly catch-up vaccines, creating a situation where patients might need to be vaccinated outside of the medical home. Increasing awareness and use of IISs, particularly among GIM physicians, would allow for centralized information collection for patients receiving immunizations at multiple locations and would allow physicians to more readily track immunization status, potentially reducing missed opportunities for vaccination.

Table 1
relative to hypertensive episodes treated by PCPs in the lowest workload quartile, hypertensive episodes treated by PCPs in the highest workload quartile were: similarly likely to have a follow-up appointment (odds ratio [OR] 1.0; 95% confidence interval [CI], 0.9-1.1, p=0.7) and slightly more likely to have normalized (OR 1.1; 95% CI, (1.0-1.2). CONCLUSIONS: Following MA health reform, BP control did not worsen in primary care. Time to next appointment following an episode of uncontrolled BP did not increase, nor did primary care workload. Thus, it appears that newly insured patients did not overwhelm the primary care capacity at this single safety-net institution. Future analyses should examine whether emergency department use for uncontrolled BP increased following health reform.
PRIMARY CARE FOR ADULTS WITH DOWN SYNDROME: ADHERENCE TO PREVENTIVE HEALTH CARE RECOMMENDATIONS Kristin M. Jensen1; Laura C. Taylor2; Matthew M. Davis2,3.
1University of Colorado School of Medicine, Aurora, CO; 2University of Michigan, Ann Arbor, MI; 3University of Michigan, Ann Arbor, MI. (Control ID #1314995)

BACKGROUND: Due to significant medical improvements, persons with Down syndrome now live well into adulthood. Consequently, primary care for adults with Down syndrome needs to incorporate routine care with screening for condition-specific comorbidities. This study seeks to evaluate the adherence of primary care physicians to age- , gender- and Down syndrome-specific preventive care in a cohort of adults with Down syndrome.
METHODS: In this retrospective observational cohort study, preventive screening was evaluated in patients with Down syndrome ages 18-45 years who received primary care in an academic medical center from 2000-2008. Comparisons were made based on the field of patients primary care providers (Family Medicine or Internal Medicine).
RESULTS: This cohort included 62 patients, median index age=33 years. 40% of patients received primary care by Family Physicians, with 60% seen by Internal Medicine practices. Patient demographics, comorbidities, and overall screening patterns were similar between provider groups. Despite near universal screening for obesity and hypothyroidism (>90% in both domains), adherence to preventive care recommendations was otherwise inconsistent. Screening was moderate (50-80%) for cardiac anomalies, reproductive health, dentition, and behavior, psychological, or memory abnormalities. The only areas of discrepancy observed between provider groups were in reproductive health care (adherence=Family Medicine 72%, Internal Medicine 43%, p=0.003) and in screening for cardiac anomalies (adherence=Internal Medicine 81%, Family Medicine 48%, p=0.006). Both provider groups demonstrated low adherence (<50%) in screening for obstructive sleep apnea, atlanto-axial instability, hearing loss, and vision loss.
CONCLUSIONS: We observed inconsistent preventive care in adults with Down syndrome over this 8.5 year study. This is concerning, given that the long-term consequences of many of these conditions can be prevented if discovered in a timely fashion. Further studies must evaluate the implications of screening practices and more timely identification of comorbidities on clinical outcomes.
PRIMARY CARE PROVIDERS RESPONSE TO THE USPSTF DRAFT RECOMMENDATIONS ON SCREENING FOR PROSTATE CANCER Craig E. Pollack1; Elizabeth A. Platz3; Gary Noronha2; Gene E. Green2; Nrupen A. Bhavsar3; H. B. Carter1. 1Johns Hopkins University School of Medicine, Baltimore, MD; 2Johns Hopkins Community Physicians, Baltimore, MD; 3Johns Hopkins Bloomberg School of Public Health, Baltimore, MD. (Control ID #1331321)
BACKGROUND: The US Preventive Services Task Force issued draft recommendations against routine PSA-based screening for prostate cancer in October 2011. Primary care providers views on the draft guidelines and
Percent reported stocking vaccine
p-value*
GIM FMHepatitis A 65 75 0.02 Hepatitis B 74 84 0.007 HPV 54 79 <.0001 High dose influenza 42 50 0.07 Injectable influenza 94 97 0.09 Intranasal influenza 22 38 0.0003 Meningococcal 46 81 <.0001 MMR 51 79 <.0001 Pneumococcal 98 98 0.95 Td 87 88 0.99 Tdap 93 94 0.58 Varicella 33 75 <.0001 Zoster 52 54 0.69
Abbreviations: GIM, general internists; FM, family medicine physicians; HPV, human papillomavirus vaccine; MMR, measles-mumps-rubella vaccine; Td, tetanus-diphtheria vaccine; Tdap, tetanus-diphtheria-acellular pertussis vaccine. *2 test for comparison of GIM and FM
PRIMARY CARE WORKLOAD AND BLOOD PRESSURE MANAGEMENT DID NOT WORSEN AT AN URBAN SAFETY-NET HOSPITAL IN MASSACHUSETTS FOLLOWING HEALTH REFORM Karen E. Lasser1,3; Steven D. Pizer2,3; Aaron Legler1; Meredith D'Amore1; Arlene S. Ash4; Jeroan Allison4; Christopher W. Shanahan1; William G. Adams1; Dan Berlowitz5,3; Nancy R. Kressin2,1. 1Boston Medical Center/Boston University School of Medicine, Boston, MA; 2VA
Boston Healthcare System, Boston, MA; 3Boston University School of Public Health, Boston, MA; 4University of Massachusetts Medical School, Boston, MA; 5Bedford VA Medical Center, Bedford, MA. (Control ID #1317106)
BACKGROUND: Following Massachusetts (MA) health reform in 2006, 500,000 previously uninsured

individuals gained health insurance, which may have burdened primary care capacity to treat such individuals and ensure high quality care. Prior studies have not examined the effect of health reform on clinical outcomes such as blood pressure (BP) control. We hypothesized that an influx of newly insured patients with a fixed supply of primary care providers (PCPs) would increase PCP workload, which in turn would lead to greater delays in BP normalization after an episode of uncontrolled BP.
METHODS: We analyzed 2005-2009 data from general internal medicine visits at one urban safety-net hospital in MA. We included all adult (age>18) visits with a diagnosis of essential hypertension (based on ICD-9 codes), defining the start of a hypertensive episode as the date of a second consecutive primary care visit with uncontrolled BP (SBP >140 OR DBP>90) within a 90-day period. For patients with multiple episodes, we included one randomly selected hypertensive episode in the analysis. Our primary outcome was time to BP normalization (BP <140/90 at any visit [primary care or subspecialty]); our secondary outcome was time to next appointment. We followed patients for up to 12 months, censoring observations at 12 months or after the last BP in the observation window, whichever occurred earlier. We measured primary care workload monthly, using the median number of patient visits per PCP-month, and classified PCPs into quartiles of workload. We performed a multivariate discrete time to event analysis to determine whether primary care workload was an independent predictor of time to BP normalization in the years prior to and following MA health reform, controlling for month and year effects. RESULTS: We studied 17,421 hypertensive episodes. Median time to BP normalization was 70 days in 2005, 67 in 2006, 64 in 2007, 66 in 2008, and 64 in 2009; median days to next appointment over the same 5 years was 44, 42, 41, 42, and 39, while primary care workload (visits per PCP-month) fluctuated, at 66, 62, 55, 57, and 59. Over the entire study period,

their willingness to change clinical practice patterns in response remain unknown.
METHODS: We performed a self-administered survey of 141 primary care practitioners from a university-affiliated practice network in November 2011. The network includes primary care physicians, family practice physicians, internal medicine/pediatric-trained physicians, and nurse practitioners working in 26 practice settings.
RESULTS: The response rate was 88.7% (125 out of 141). Nearly half (49.1%) agreed or strongly agreed with the recommendations while 36.0% disagreed or strongly disagreed. Few providers (1.8%) said that they would no longer order routine PSA testing and 21.9% would be much less likely to do so. Both agreement with the recommendations and expectations as to how the recommendations would change practice did not significantly vary by years since residency graduation, gender, or race/ethnicity. Even among those clinicians who agreed with the draft recommendations, less than half(41.1%) stated that they would either no longer order routine PSA screening or be much less likely to do so. Providers who were most likely to screen at baseline were least likely to believe the recommendations would affect their practices (45.8% of providers who typically recommend PSA screening did not think the draft recommendations would change their screening behavior compared to28.3% of those who typically let the patient decide, p<0.001). Providers identified multiple barriers to stopping routine PSA screening including patient expectations, lack of time to explain changes, fear of malpractice litigation, and discomfort with uncertainty associated with stopping screening.
CONCLUSIONS: If finalized, the USPSTF recommendations may encounter significant barriers to adoption, even among those primary care providers who agree with the recommendations. To the extent that PSA screening should be reduced, it may be necessary to address these barriers.
PRIOR BUPRENORPHINE EXPERIENCE IS ASSOCIATED WITH OFFICE-BASED BUPRENORPHINE TREATMENT OUTCOMES Chinazo Cunningham1; Robert Roose1; Joanna L. Starrels1; Angela G. Giovanniello1; Nancy Sohler2. 1Albert Einstein College of Medicine &Montefiore Medical Center, Bronx, NY; 2Sophie Davis School of Biomedical Education, City College of the City University of New York, New York, NY. (Control ID #1323667)

BACKGROUND: As buprenorphine treatment is increasing and illicit buprenorphine use is also increasing, many patients seeking buprenorphine treatment will have prior experience with buprenorphine. Although these two types of prior buprenorphine use (prescribed and illicit) may reflect differences in patient populations and may be associated with different treatment outcomes, both types of buprenorphine use provide individuals with an experience taking buprenorphine, a partial opioid agonist with unique pharmacologic properties and challenges. Thus, examining how any prior experience with buprenorphine may be associated with treatment outcomes is warranted. Little evidence is available to guide optimal treatment strategies for patients with prior buprenorphine experience.
METHODS: To examine whether prior buprenorphine experience is associated with buprenorphine treatment outcomes, we conducted an analysis of a longitudinal cohort study of 87 individuals who initiated buprenorphine treatment at an urban health center. Participants were interviewed at baseline, 1, 3, and 6 months, and medical records were extracted at 6 months. Dependent variables were 6-month treatment retention (measured via visit and prescription data from medical records) and self-reported opioid use (measured via interviews). The main independent variable was self-reported prior prescribed or illicit buprenorphine experience. We examined associations between prior buprenorphine experience and 6-month treatment retention using logistic regression models, and prior buprenorphine experience and opioid use using non-linear mixed models.
RESULTS: Participants mean age was 43.5 years, and most were men(73.6%), Hispanic (73.2%), and unemployed (69.0%). At baseline, 67.8% reported using heroin, 52.9% methadone, and 26.4% opioid analgesics. Most(57.4%) reported prior buprenorphine experience; of these, 40% used prescribed buprenorphine, and 60% used illicit buprenorphine. Compared to buprenorphine-nave participants, those with prior buprenorphine experience
had better treatment retention (AOR=2.69, 95%CI=1.01-7.17), but no difference in opioid use (AOR=1.27, 95%CI=0.37-4.40). When we explored type of buprenorphine experience (prescribe buprenorphine vs. buprenorphine-nave; illicit buprenorphine vs. buprenorphine-nave), we found similar findings for treatment retention, but qualitatively different findings for opioid use, though none reached statistical significance (opioid use with prior prescribed buprenorphine use vs. buprenorphine-nave, AOR=2.00, 95% CI=0.53-7.50; opioid use with prior illicit buprenorphine use vs. buprenorphinenave, AOR=0.42, 95% CI=0.06-3.09).
CONCLUSIONS: Among individuals seeking buprenorphine treatment at our health center, prior buprenorphine experience was common. We found better treatment retention in those with prior buprenorphine experience (prescribed or illicit buprenorphine use) than those who were buprenorphine-nave. As buprenorphine treatment continues to expand, and illicit buprenorphine use appears to be increasing, prior experience with buprenorphine is likely to be more common among individuals presenting for buprenorphine treatment. Understanding how prior buprenorphine experience affects treatment outcomes has important clinical and public health implications.
PROFESSIONALISM IN SOCIAL MEDIA - DO EXISTING GUIDELINES FAIL A REALITY CHECK? Neil Mehta2,1; Ehsan H.
Balagamwala1; Bryan A. Sisk1; Ilka Decker1; Jason Ho1; J. H. Isaacson2,1; Amy S. Nowacki1. 1Cleveland Clinic, Cleveland, OH; 2Cleveland Clinic, Cleveland, OH. (Control ID #1336563)
BACKGROUND: The increasing popularity of social media (SoMe) has raised many controversies regarding professionalism. Multiple guidelines have been authored to help us address professionalism in the digital age. Professionalism in SoMe is a highly complex and controversial area. We designed and implemented a workshop for third year students at the Cleveland Clinic Lerner College of Medicine to initiate discussion. Our aim was to study a) whether students could reach consensus regarding these areas with the help of existing guidelines and b) the impact of a discussion exposing them to various different points of view on this topic.
METHODS: The 2 hour workshop introduced students to various SoMe applications (such as Facebook, Twitter and blogs) with a demonstration of practical applications of SoMe for learning and building a professional

identity. We used a real life twitter post that had led to a lively debate in the online community regarding appropriate behavior by medical professionals in SoMe. Students were subsequently divided into 4 small groups, with each group being assigned one of the controversies (see Table) to guide their discussion. The workshop concluded with a large group discussion and a conference call with one of the physicians involved in the controversy. Students completed an online questionnaire before and after the workshop to report their usage of and attitudes towards social media. The questionnaire was anonymous and approved by the Institutional Review Board. Each questionnaire had 4 Likert-type questions. The pre and post workshop surveys were not linked by student and results were analyzed using Fishers exact test.
RESULTS: All 32 third year students participated in the workshop, and 32 and 28 completed the pre- and post-workshop questionnaires, respectively. Many students utilized SoMe applications such as Facebook (82%), Twitter (24%) and blogged more than one time per month (6%). At baseline, majority of the students felt that doctors should not post about their patients in SoMe (~85%) and all students felt that humor could be misunderstood in SoMe. After the workshop, students were more polarized in their opinions regarding these two questions (p=0.002 and 0.005, respectively). As a result of the workshop students also developed a stronger opinion on each side of the issue regarding posting anonymously in SoMe (p<0.001). Notably, at baseline and after the workshop a majority of the students felt that Doctors professionalism should not be judged by their posts in SoMe.
CONCLUSIONS: When exposed to real life situations, and after discussions with peers, several students changed their beliefs about professionalism in SoMe. In general, there was a decrease in consensus on some of these issues after attending the workshop. This suggests that professionalism in SoMe is a complex, multifaceted issue
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ABSTRACTS
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that is not adequately handled by existing guidelines thus requiring further study. Workshops that allow students to review and discuss
real cases of use of SoMe will help increase awareness of these complexities.
Question Strongly Agree Agree Neutral Disagree Strongly Disagree p-value It is not professional to post aboutyour patients.
Pre-seminar 65.6% (21) 18.8% (6) 6.3% (2) 9.4% (3) 0% (0) 0.002
Post-seminar 21.4% (6) 53.6% (15) 17.9% (5) 7.1% (2) 0% (0)
Doctors should not post anonymously.
Pre-seminar 9.1% (3) 9.1% (3) 69.7% (23) 0% (0) 12.1% (4) <0.001
Post-seminar 3.6% (1) 32.1% (9) 39.3% (11) 25% (7) 0% (0)
Doctors professionalism shouldnot be judged by their postsin social media.
Pre-seminar 12.5% (4) 12.5% (4) 15.6% (5) 43.8% (14) 15.6% (5) 0.76
Post-seminar 7.1% (2) 14.3% (4) 10.7% (3) 39.3% (11) 28.6% (8)
Humor can be misunderstoodin social media.
Pre-seminar 59.4% (19) 40.6% (13) 0% (0) 0% (0) 0% (0) 0.005
Post-seminar 85.7% (24) 7.1% (2) 0% (0) 3.6% (1) 3.6% (1)
PROGRESSION OF SHARED DECISION MAKING IN THE LAST15 YEARS IN THE HIGHEST IMPACT FACTOR JOURNALS IN GENERAL INTERNAL MEDICINE Xavier Blanc1; Tinh-Hai Collet1; Reto Auer2; Roland Fischer1; Isabella Locatelli1; Jacques Cornuz1.
1University of Lausanne, Lausanne, Switzerland; 2University of California, San Francisco, CA. (Control ID #1340290)
BACKGROUND: Shared Decision Making (SDM) is increasingly advocated as a model for decision making in

the medical encounter. A previous report showed an exponential growth of publications on SDM in the overall medical literature since the mid-1990s. Despite this growth, there is still low use of SDM in clinical practice. High impact factor (IF) journals might represent an efficient way for promoting SDM. We aimed to determine the dissemination of SDM among major journals in general internal medicine (GIM). METHODS: We conducted a full text search of the phrase shared decision making using advanced search on the websites of the 15 journals with the highest 2010 5-year IF in the GIM category that published at least original articles, letters and editorials. We included publications released between 1996 and 2010. We used a multivariate longitudinal analysis to predict the percentage of publications addressing SDM, according to the year of publication as a continuous variable and the IF as a dichotomous variable, based on the median value (5.6). RESULTS: Over the last 15 years, the numbers of publications per journal addressing SDM ranged from 2 (0.1% of the number of annual publications) to 181 (12.1%). We found a significant increase in both absolute and relative mean numbers of publications per year, from 1.1 (0.1%) in 1996 to 3.3 (0.5%) publications in 2010 (both p<0.001).The increase was greater among journals with IF<5.6 (0.2% to 1.3% vs. 0.4% to 0.7%, p of the difference=0.03). The two highest IF journals had the lowest proportion of publications addressing SDM over the last 15 years (0.10% and 0.08%).
CONCLUSIONS: We found an increase in both absolute and relative numbers of publications addressing SDM in the highest IF journals in GIM within the 15 last years. However, we observed a wide variation of the dissemination among the studied journals. Notably, the proportion of publications addressing SDM was low in the two highest IF journals. This significant but heterogeneous increase in major journals suggests a path for implementing SDM among the GIM community. Future research focusing on the way SDM is addressed in high IF journals might help to better understand the spread of SDM over recent years.
PROSPECTIVE COMPARISON OF CLINICAL PROGNOSTIC SCORES FOR MAJOR BLEEDING IN ELDERLY PATIENTS WITH VENOUS THROMBOEMBOLISM Nathalie Scherz1; Marie Man1; Andreas Limacher2; Marc Righini3; Kurt Jger4; Markus Aschwanden4; Hans-Jrg Beer5; Beat Frauchiger6; Joseph Osterwalder7; Christian M. Matter9; Nils Kucher8; Martin Banyai10; Anne Angelillo-Scherrer11; Bernhard Lmmle12; Michael Egloff5; Henri Bounameaux3; Jacques Cornuz13; Nicolas Rodondi1; Drahomir Aujesky1. 1Bern University Hospital, Bern, Switzerland; 2University of Bern, Bern, Switzerland; 3Geneva University Hospital, Geneva, Switzerland; 4Basel University Hospitall, Basel, Switzerland; 5Cantonal Hospital of Baden, Baden, Switzerland; 6Cantonal Hospital of Frauenfeld, Frauenfeld, Switzerland; 7Cantonal Hospital of St. Gallen, St. Gallen, Switzerland; 8Bern University Hospital, Bern, Switzerland; 9University of Zurich, Zurich, Switzerland; 10Cantonal Hospital of Lucerne, Lucerne, Switzerland; 11Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; 12Bern University Hospital, Bern, Switzerland; 13University of Lausanne, Lausanne, Switzerland. (Control ID #1323496)
BACKGROUND: The Outpatient Bleeding Risk Index (OBRI) and the Kuijer, RIETE, and Kearon scores are clinical prognostic scores for bleeding in patients (pts) receiving anticoagulants for venous thromboembolism (VTE) and other diseases. To date, the prognostic performance of these scores was never examined in elderly pts with VTE. We prospectively compared the performance of these scores in predicting the risk of major bleeding and in identifying pts at high-risk of bleeding in a multicenter cohort of elderly pts with VTE.
METHODS: We studied 634 in- and out-pts aged 65 years with acute symptomatic, objectively confirmed VTE diagnosed at 9 Swiss hospitals (11/ 2009-03/2011). The outcome was major bleeding (defined as fatal bleeding, symptomatic bleeding in a critical organ, bleeding with a reduction of hemoglobin 20 g/L, or leading to the transfusion 2 units of packed red blood cells) within 3 months after the index VTE. We classified pts into 3 categories of bleeding risk (low, moderate, and high) according to each score. We dichotomized pts as high vs. low or moderate risk in all 4 scores. We calculated the area under the receiver operating characteristic (ROC) curve, positive predictive value (PPV), and positive likelihood ratio (pLHR) for each score. RESULTS: Overall, 28 of 634 pts (4.4%, 95% confidence interval [CI]:3.0-6.3%) developed a major bleeding within 3 months. The

rate of major bleeding varied from 1.9% to 2.2% among low-risk and from 3.8% to 8.0% among high-risk pts. The discriminative power of the scores to predict major bleeding was poor to moderate, with areas under the ROC curve ranging from 0.50 to 0.61 (p-value for equality: 0.19; Table). PPVs and pLHRs to predict major bleeding were generally low. CONCLUSIONS: Existing bleeding risk scores do not have sufficient power to discriminate between elderly pts with VTE who are at high-risk of major bleeding and those who are not. Novel, more accurate risk stratification methods must be developed to predict bleeding risk in elderly pts receiving anticoagulants for VTE.

Table

Clinical score Area under ROC curve (95% CI)
PPV, % (95% CI) pLHR (95% CI)
OBRI 0.54 (0.50-0.58) 4.7 (1.3-15.5) 1.06 (0.27-4.15) Kuijer score 0.50 (0.46-0.54) 3.8 (1.3-10.5) 0.84 (0.28-2.51) RIETE score 0.61 (0.57-0.65) 8.0 (3.2-18.8) 1.88 (0.73-4.86) Kearon score 0.60 (0.56-0.64) 5.8 (2.7-12.1) 1.34 (0.64-2.78)

PROSPECTIVE COMPARISON OF CLINICAL PROGNOSTIC SCORES IN ELDERLY PATIENTS WITH PULMONARY EMBOLISM

Daniela Zwierzina1; Marie Man1; Andreas Limacher2; Marc Righini3; Kurt Jger4; Hans-Jrg Beer5; Beat Frauchiger6; Joseph Osterwalder7; Nils Kucher8; Christian M. Matter9; Martin Banyai10; Anne Angelillo-Scherrer11; Bernhard Lmmle12; Michael Egloff5; Markus Aschwanden4; Henri Bounameaux3; Jacques Cornuz13; Nicolas Rodondi1; Drahomir Aujesky1. 1Bern University Hospital, Bern, Switzerland; 2University of Bern, Bern, Switzerland; 3Geneva University Hospital, Geneva, Switzerland; 4Basel University Hospital, Basel, Switzerland;
5Cantonal Hospital of Baden, Baden, Switzerland; 6Cantonal Hospital of Frauenfeld, Frauenfeld, Switzerland; 7Cantonal Hospital of St. Gallen, St. Gallen, Switzerland; 8Bern University Hospital, Bern, Switzerland; 9Zurich Center for Integrative Human Physiology, University of Zurich, Zrich, Switzerland; 10Cantonal Hospital of Lucerne, Lucerne, Switzerland; 11Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; 12Bern University Hospital, Bern, Switzerland; 13University of Lausanne, Lausanne, Switzerland. (Control ID #1316460)

BACKGROUND: The Geneva Prognostic Score (GPS), the Pulmonary Embolism Severity Index (PESI), and its simplified version (sPESI) are validated clinical prognostic scores for pulmonary embolism (PE). To our knowledge, the prognostic performance of these scores has never been examined in elderly patients (pts) with PE who have a particularly high risk of adverse outcomes. We prospectively compared the accuracy of these scores in predicting short-term mortality and in identifying pts with PE at low risk of mortality in a multicenter cohort of elderly pts with venous thromboembolism.

METHODS: We studied 449 consecutive in- and out-pts aged 65 or older with objectively diagnosed, symptomatic PE from 9 Swiss hospitals (11/ 09-03/2011). The outcome was 30-day overall mortality. We dichotomized pts as low- vs. higher-risk in all 3 scores using the following thresholds: GPS scores 2 vs. >2, PESI risk classes I-II vs. III-V, and sPESI scores 0 vs. 1. Based on these cutoff-points, we calculated sensitivity, specificity, negative predictive value (NPV), and negative likelihood ratio (nLHR) for each score. We also compared the areas under the receiver operating characteristic curve (ROC).

RESULTS: Overall, 17 pts (3.8%, 95% CI: 2.2-6.0%) died at 30 days. Although the GPS classified substantially more pts as low-risk, the PESI and the sPESI more accurately identified low-risk pts with PE than the GPS (see table). The areas under the ROC curves did not significantly differ (p=0.47).

CONCLUSIONS: Overall, the PESI and sPESI are more accurate than the GPS in predicting 30-day mortality in elderly pts with PE. The PESI and sPESI are also more accurate in identifying low-risk pts, and as such, are more useful in safely identifying the most appropriate pts for out-pt treatment or an abbreviated hospital stay.

GPS (95%

CI)
PESI (95% CI)
sPESI (95%
CI)
Low-risk pts, % 92 (89-94) 36 (32-41) 40 (35-44) Mortality in low-risk pts,%
3.4 (1.9-5.6) 0.6 (0-3.4) 0 (0-2.1)
Mortality in higher-risk pts, %
8.3 (1.8-22.5) 5.6 (3.2-8.9) 6.3 (3.7-9.9)
Area under ROC 0.71 (0.66-0.75)
0.76 (0.72-0.80)
0.77 (0.72-0.81)
Sensitivity, % 18 (6-41) 94 (73-99) 100 (82-100) Specificity, % 92 (90-95) 38 (33-42) 41 (37-46) NPV, % 97 (94-98) 99 (97-100) 100 (98-100) nLHR 0.89 (0.71-1.11)
0.16 (0.02-
1.05)
0.00 (0.00-
1.04)

PUTTING PATIENTS FIRST: USING THE PATIENT PERSPECTIVE TO ENGINEER PATIENT-ORIENTED CLINIC HANDOFFS (EPOCH) Wei Wei Lee; Amber Pincavage; Kimberly Beiting; Vineet Arora. University of Chicago, Chicago, IL. (Control ID #1328265)

BACKGROUND: Although the year-end resident clinic handoff affects millions of patients annually and has implications for patient safety and satisfaction, little research to date has described the patient experiences as they transition to a new resident primary care physician (PCP). The aim of our study is to identify patients perceptions of risks associated with the resident clinic handoff and elicit their suggestions to inform development a new patient-oriented handoff process.

METHODS: Graduating internal medicine residents at a single academic institution identified their highest risk patients during the year-end clinic handoff. Three months after transfer to the new resident PCP, a trained research assistant conducted telephone interviews with patients using critical incident technique and appreciative inquiry to elicit both positive and negative experiences associated with the transfer to a new PCP. The interviews were audio recorded and transcribed to ensure accuracy. Using constant comparative method, two investigators independently reviewed ten transcripts to develop an initial coding classification, which was then applied to the remainder of the transcripts using ATLAS.ti software.

RESULTS: Of 323 high-risk patients that departing residents identified, 37 were excluded due to incorrect contact information, change of insurance, transfer of care to other clinics, inability to consent, or death. Of the 286 eligible patients, 103 telephone interviews have been completed. The interviews revealed patient barriers that were categorized into four overarching themes: (1) breakdowns in transition process (i.e. patient unaware transition occurred); (2) clinic logistics(i.e. difficulty rescheduling appointments); (3) doctor-patient relationships (i.e. difficulty building rapport with new PCP); (4) patient safety issues (i.e. missed lab results). Specifically, they reported seeking acute care visits (ER or urgent care) due to delayed care, missed test results or running out of medications during the transition period. For example, one patient reported: I have to hold everything in until I see [my new doctor]my pressure was so high untilthey sent me to emergency. Patients valued early notification and preparation for the transition. They also appreciated telephone visits with their new PCP prior to their first clinic visit and reported that personal sharing from the new PCP helped build rapport. For example, one patient reported: Dr. X wasgetting ready for her marriagewhen I talked to her on the phoneI was likeyoure not supposed to be worried about your patients, go get married, well talk when you get back. Patients who were aware of their role in the training mission were more understanding of the process: You hate to see them go but they have to,

they have no choice because they are residents.
CONCLUSIONS: By interviewing patients about their experiences with the resident PCP transition, unique insights into the challenges and solutions to this problem can be developed. This data can be used to develop and implement a patient-centered clinic handoff for medicine residents. Such solutions could include a patient transition packet to facilitate early notification of the handoff and introduction to their new PCP, a systematic rescheduling process for missed appointments, formally recognizing and thanking patients for their role in the resident training mission, and implementing telephone visits prior to the first visit with the new PCP.
QUALITATIVE APPROACH TO UNDERSTANDING MEDICATION CHALLENGES AMONG OLDER ADULTS AFTER HOSPITAL DISCHARGE Dandan Liu1,2; Stephanie Rennke2; Han-Lin Chi2; Michael Steinman1,2. 1SF VA Medical Center, San Francisco, CA; 2UCSF, San Francisco, CA. (Control ID #1310468)
BACKGROUND: Patients age 65 years and older have a 19% risk of 30 day readmission after hospital discharge, and medication safety plays an important role in reducing this risk. We piloted a telephone-based qualitative study to better understand the needs older adults have with medications after recent hospital discharge.
METHODS: The study population included patients 2-4 weeks after discharge from the general medicine service at an academic teaching hospital. Inclusion criteria were age 65 years, English-speaking, and discharged home with5 medications. We used semi-structured, open-ended questions assessing problems with medication since discharge, resources patients have, and what additional help they need. Transcriptions were analyzed from a grounded theory approach. For participants who answered no problems, we used common scenarios based on the medical

literature as prompts. Concurrent with our study, hospital discharge nurses attempted to reach all participants with a standard post-discharge telephone call that included 2 medication questions (Did you fill your prescriptions? Did you understand your medication instructions?).
RESULTS: We have conducted 9 interviews. All interviewees endorsed some medication-related problem including adherence, titration, side effects, and financial difficulty. Three initially denied any problems, but in response to prompts did endorse at least one. Six of the participants received the standard post-discharge phone call, but none of these revealed any medication problems. Participants identified needs at discharge along themes of lack of communication (I dont think anyone has any time to discuss with me before I left) and inclusion of family in discharge planning. Four participants denied needing any additional help at discharge with reasons being family support or confidence in self ability. The latter group, however, qualified their response by saying they did not yet need assistance.
CONCLUSIONS: Our study suggests that the brief post-discharge phone call after discharge fails to identify common medication problems among older patients. The themes of family and communication suggest focal points for future study and design of discharge programs. Even participants who denied needing assistance still qualified their response with a yet, suggesting needs are a moving target.
RACIAL DIFFERENCES IN GLUCOSE CONTROL: A SURVEY OF PATIENTS WITH TYPE 2 DIABETES ON COPING, DIET TEMPTATIONS, AND TRUST IN PHYSICIANS Kathleen O. Degnan1; Renee M. Betancourt2; Judith A. Long3. 1Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA; 2University of California San Francisco, San Francisco, CA; 3University of Pennsylvania, Philadelphia, PA. (Control ID #1332558)
BACKGROUND: Blacks have a higher prevalence of diabetes and worse clinical outcomes compared to whites. A qualitative study found that compared to well-controlled blacks and whites, poorly-controlled black diabetics were more likely to note barriers to self-care and psychosocial factors as affecting their diabetes control and

were less likely to note positive health care experiences. This study quantifies the effects of psychosocial factors on glucose control in an attempt to explain racial disparities in diabetes control.
METHODS: We enrolled adult Type 2 diabetics with providers in the University of Pennsylvania Health System (UPHS) and a recent Hemoglobin A1c (HbA1c). Patients were called within one month of their most recent HbA1c and a telephone survey was given to patients wishing to participate. The survey contained demographic and clinical questions and several standardized scales including the Jalowiec Coping Scale (JCS), the Dieters Inventory of Eating Temptations-SE (DIET-SE), and the Trust in Physician scale (TIP).
RESULTS: 332 patients (230 blacks, 71 whites, 31 other race) completed the survey. Race significantly correlated with glucose control (Hba1c< 8%), 33.0% of blacks vs 16.9% of whites were poorly controlled (p=0.023). Analysis of JCS responses showed that a confrontive coping style correlated with poor control in whites (p<0.001) but was not associated with control in blacks; emotive and evasive coping styles were not associated with control. From the DIET-SE, confidence in resisting social and internal dietary temptations correlated with good glucose control in both blacks and whites (p=0.037 and p=0.082 respectively); high caloric and negative emotion temptations were not associated with control. Scores on the TIP scale did not correlate with glucose control in diabetics of either race. These findings persisted in multivariate models adjusting for age, socio-economic status (education, income, employment, and insurance), duration of diabetes, diabetic medications, complications from diabetes, an interaction term for race and confrontive coping style and possible mediators including self-reported diet and medication adherence.
CONCLUSIONS: Findings confirm significant racial differences in glucose control; however, as measured coping styles, response to dietary temptations and trust in physicians did not account for this racial disparity. At this time there is no evidence that interventions to address these issues would reduce disparities in glucose control.
RACIAL DISPARITIES IN INTERMEDIATE OUTCOMES OF DIABETES CARE IN A PATIENT-CENTERED MEDICAL HOME Joseph A. Simonetti1; Michael J. Fine1,2; Deborah M. Simak1; Yi-Fan Chen3; Rachel Hess1. 1University of Pittsburgh Medical Center, Pittsburgh, PA; 2VA Pittsburgh Healthcare System, Pittsburgh, PA; 3University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA. (Control ID #1318208)
BACKGROUND: Racial disparities in the processes and outcomes of care for patients with diabetes (DM) have been well-documented using administrative data. Such disparities are not well-described in primary care practices organized as patient-centered medical homes (PCMH). Our aim was to assess racial disparities in DM care, controlling for potential patient and provider level confounders.
METHODS: We conducted a retrospective cohort study of patients receiving primary care (July 2009-August 2010) in a level 3, National Committee for Quality Assurance PCMH-designated, university-affiliated, internal medicine practice. We included adults (age >17) with >1 ICD-9 code for DM or use of DM medications during both the study period and preceding year. We excluded patients with unknown race (n =2) and race other than non-Hispanic white or black (n=151) due to small numbers. We used data routinely collected in the electronic medical record including patient demographics (age, race, gender, medical insurance, educational and marital status), SF-36 mental and physical health scores, DM complications, social support, and primary care provider type (attending vs. resident). Our key independent variable was race (non-Hispanic white vs. black). DM processes of care were the percent of patients who had A1C and low-density lipoprotein cholesterol (LDL-C) testing, and foot and dilated retinal examinations during the study period; intermediate outcomes were percent of patients with an A1C <7.0% (good control), A1C >9.0% (poor control), LDL-C <100 mg/dL, and BP <140/<90 mmHg as their last measured value during the study period. We used logistic regressions to assess the independent associations between race and processes of care and intermediate outcomes, controlling for patient characteristics and provider type.
RESULTS: Of 1,457 eligible patients with DM, 589 (40.4%) were black and 868 (59.6%) were non-Hispanic white. They saw one of 89 providers [41(46.1%) attending and 48 (53.9%) resident]. At baseline, compared to

white patients, black patients were significantly younger (median age 57.0 vs. 61.0), less often college attendees (42.5% vs. 71.1%), more often single (53.0% vs.25.3%), more often Medicaid-insured (25.5% vs. 6.2%), less often treated by an attending (67.6% vs. 93.7%), and reported lower median physical (36.0 vs.43.0) and mental health scores (41.0 vs. 46.0)(p<0.001, all comparisons). In unadjusted analyses, black patients were less likely than white patients to have had an eye exam (60.6% vs. 66.1%, p=0.03); there were no significant differences in foot exam (75.7% vs. 74.8%), LDL-C screening (79.8% vs.83.4%) and A1C testing (91.9% vs. 93.4%). Black patients were significantly less likely to have BP <140/<90 mmHg (64.9% vs. 75.8%), LDL-C <100 mg/ dL (57.5% vs. 67.0%), and A1C <7.0% (45.2% vs. 51.4%), and more likely to have A1C >9.0% (21.0% vs. 11.8%)(p<0.001, all comparisons). After covariate adjustment, no racial differences were observed for the four DM processes of care. Black patients continued to have significantly lower odds of achieving BP<140/<90 mmHg (OR=0.56; 95% CI 0.41-0.75) and LDL-C <100 mg/dL (OR=0.68; 95% CI 0.50-0.93) and significantly higher odds of having A1C >9.0% (OR=1.52; 95% CI 1.05-2.17). CONCLUSIONS: In a level 3 PCMH providing primary care to over 1,400 patients with DM, despite high levels of performance with racial equity for all processes of care, we observed clinically and statistically significant racial disparities in intermediate outcomes.

RACIAL DIFFERENCES IN MEN WITH BREAST CANCER Tezo karedan1; Siva K. Talluri1; Radhika Kakarala1; Madhuri Kakarala2.

1McLaren Regional Medical center, Flint, MI; 2University of Michigan, Ann Arbor, MI. (Control ID #1310568)

BACKGROUND: Breast cancer in men is rare and constitutes less than 1% of all cancers in males. The objective of our study is to compare the presenting

RESULTS: The study population was 65% African-American and 54% female. The mean age was 63 (+/- 12) years. African Americans were more likely to report low heart failure self-efficacy compared to whites (21% vs. 10%, p=0.0002). The relationship between African American race and low self-efficacy was attenuated slightly when other sociodemographics were added to the model, but the relationship remained statistically significant despite further multivariable adjustment via sequential model-building (see table). The mode of survey administration did not alter the relationship between race and self-efficacy when added to the models. CONCLUSIONS: Multifaceted chronic disease management programs, focused on improving patients clinical status, heart failure knowledge, and social support, may still be insufficient to eliminate potential racial disparities in heart failure self-efficacy. The exploration of additional novel facets of chronic disease management may be needed to address the disparities in heart failure self-efficacy.

Unadjusted and adjusted ORs (95% CI) of low self-efficacy according to race

Characteristic Model 1 Model 2 Model 3 Model 4 Model 5 Race AfricanAmerican White(ref)

2.4

(1.5,3.8)

1.9

(1.2,3.3)

characteristics, and survival rates in Caucasian and African-American men with breast cancer.

METHODS: We analyzed a retrospective cohort of breast cancer patients included in National Cancer Institutes Surveillance, Epidemiology, and End Results (SEER) Registry from 1990 to 2007. Seventeen registries are enrolled in the SEER database and include approximately 26% of the US population. Racial differences in demographic and tumor characteristics at the time of diagnosis were compared using chi-square test. Breast cancer and racial specific survival was compared using Kaplan-Meier method. Cox proportional hazards regression model was used to determine the independent effect of race on survival after adjusting for age of patient, stage, grade and receptor status of tumor.

RESULTS: We included 2348 men with breast cancer in our study; they were Caucasians (2075), and African-

American (273). A greater proportion of African American men presenting with breast cancer were younger than 60 years old as compared to Caucasians (46% vs. 31%) p<0.001. They also more often presented with advanced disease (12% vs. 6%), higher grade lesions (34% vs. 29%), tumor size greater than 2 cm (48% vs. 37%) and lymph node involvement (35% vs. 32%) compared to Caucasians. Tumors were more likely to be progesterone receptor negative (21% vs. 11%) and estrogen receptor negative (8% vs. 4%). All differences were statistically significant (p<0.05). The mean survival was lower among African Americans (12.6 yrs.) compared to Caucasians (14.3 yrs.) p<0.001 (Log-rank test). After adjusting for age of the patient, stage, grade, and receptor status of the tumor, African -Americans had shorter survival time (Hazard ratio 1.59, 95% CI: 1.11-2.29).
CONCLUSIONS: African American men present with more advanced disease and have shorter survival from breast cancer compared to Caucasian men. While male breast cancer is rare, education to raise awareness of this issue, particularly among African Americans, may help promote earlier diagnosis.
RACIAL DIFFERENCES IN SELF-EFFICACY AMONG AFRICAN-AMERICANS AND WHITES WITH HEART FAILURE Raegan W. Durant1,2; Nicole Redmond1,3; Zhiying You1; Sandral Hullett3; A. Robert Sheppard4; Isabel Scarinci1. 1University of Alabama at Birmingham, Birmingham, AL; 2Birmingham Veterans Affairs Medical Center, Birmingham, AL; 3Cooper Green Mercy Hospital, Birmingham, AL; 4DCH Regional Medical Center, Tuscaloosa, AL. (Control ID #1324371)
BACKGROUND: African Americans with heart failure are hospitalized more frequently than whites. Though chronic disease management programs have been designed to decrease hospitalization rates by enhancing patients self-efficacy for heart failure self-care, little is known about potential racial differences in self-efficacy. Therefore, we examined the relationship between race and self-efficacy.
METHODS: 734 African-American and white heart failure patients, receiving care at 3 hospitals in Alabama, completed a telephone or in-person survey. The primary outcome was a self-efficacy subscale comprised of two items from the Kansas City Cardiomyopathy Questionnaire: How sure are you that you know what to do, or whom to call, if your heart failure gets worse? and How well do you understand what things you are able to do to keep your heart failure symptoms from getting worse? (for example, weighing yourself, eating a low salt diet, etc). Combined response data from the two items was scored on a continuous scale (0-100, higher score=higher self-efficacy). Continuous scale scores were dichotomized into categories of low (bottom quartile of scale scores) and high self-efficacy (top 3 quartiles of scale scores). The primary independent variable was self-reported race. Other independent variables were categorized into 4 domains: 1) sociodemographics (age, gender, household income, education, marital status) 2) clinical status (hospital site, number of years since heart failure diagnosis, severity of heart failure, type of doctor [primary care vs. cardiologist] managing heart failure), 3) social support 4) other psychosocial factors (knowledge of heart failure, depression, trust in physicians). Sequential model-building was used to assess the impact of the successive addition of domain factors to a multivariable logistic regression model.
1.8 (1.1,3.1)
1.8 (1.1,3.0)
1.9
(1.1,3.2)
Model 1 (Base model)=race alone Model 2=Model 1+sociodemographics (age, gender, education, household income, marital status) Model 3= Model 2+clinical factors (severity of heart failure, time since heart failure diagnosis, type of doctor [primary care vs. cardiologist] managing heart failure) Model 4=Model 3+social support Model 5=Model 4+other psychosocial factors (knowledge of heart failure, trust in physicians, depression)
RARE PRESENTATION OF COCCIDIOIDOMYCOSIS WITH SPONTANEOUS PNEUMOTHORAX Saira Hussain1; Natalya Goldshytn1; Richard Lazzaro2. 1new york methodist hospital, Brooklyn, NY; 2new york methodist hospital, Brooklyn, NY. (Control ID #1319743)

BACKGROUND: 60% of Coccidioidomycosis cases are completely asymptomatic. The other 40% of cases are symptomatic with presentation ranging from influenza-like symptoms to a wide spread disseminated infection. Hence, it was to our surprise when our patient presented initially with a spontaneous pneumothorax, and was later diagnosed with Coccidioidomycosis.
METHODS: A 20 year old female with past medical history of diabetes mellitus type 1 since 7 years of age and secondary left lower extremity neuropathy, presented to the emergency room with sudden onset of, fever, dyspnea and right sided chest and shoulder pain for 1 day. Patient was born in Texas but had resided in Arizona for the past 10 years and had recently moved to NY. She did not have a primary care physician and hence was self-managing her diabetes. On arrival, patient was found to have uncontrolled diabetes. Her physical examination was significant for markedly decreased breath sounds on the entire right lung field. Chest xray showed right sided pneumothorax with complete collapse of the lung with left shift of the mediastinum. Emergent left sided pig tail pleural drainage catheter was inserted causing a decrease in the size of the pneumothorax.
RESULTS: Patient then underwent video assisted decortication and wedge ressection. Pathology of the specimen showed a broncho-pleural fistula that was positive for Coccidiomyces immitis/posadasil. The patient was started on itraconazole 200 mg bid with plans to treat for approximately 6 months. CONCLUSIONS: Of the 40% of Coccidioidiomycosis infections that are symptomatic, approximately, 35% develop symptomatic pneumonia, 5% erythema nodosum and 5% a disseminated disease. One study found that the incidence of pyopneumothorax, and or bronchopulmonary fistula is quite small. Upon the review of 274 cases,it was found that only 2.6% had a pneumothorax as a complication of the infection. When a spontaneous pneumothorax is discovered, endemic fungal infections should be considered, especially if the patient has a history of being from an endemic

area. This identifies the importance of gathering an epidemiologic history and expanding the differential diagnosis. This patient presented in NY, but because of her history of residing in Arizona, Coccidioidomycosis was suspected. Also, the importance of submitting the tissue specimen for specific testing cannot be overestimated. In this case, fungal cultures were ordered in anticipation of possible endemic fungal infection, which was confirmed.
REAL WORLD CLINICAL AND PRESCRIBING EXPERIENCE MANAGING PATIENTS WITH ALZHEIMER'S DISEASE: A HEALTH CARE PROVIDERS PERSPECTIVE
Russell L. Knoth3;
Ann Hake1; Malaz Boustani2; Sonali N. Shah4; Jana Oresayna5; Kathy Wyrwich5. 1Indiana University School of Medicine, Indianapolis, IN;
2Regenstrief Institute, Indianapolis, IN; 3Eisai, Inc., Woodcliff Lake, NJ;
4Pfizer, New York, NY; 5United BioSource Corporation, Bethesda, MD. (Control ID #1337693)
BACKGROUND: The acetylcholinesterase inhibitors (AchEI)s have long been used in the treatment mild, moderate and severe Alzheimers disease (AD). Donepezil, the most commonly used AchEI, was recently approved by the FDA in a 23 mg/day formulation for patients diagnosed with moderate to severe AD who had been maintained on a dose of 10 mg daily for at least 3 months. Although most physicians have experience prescribing the lower dosages of donepezil, few have experience with the higher dosage. The study surveyed health care providers (HCPs) who had prescribed the new dosage of donepezil to gain insight into how they identified appropriate patients for treatment, sources of information used in this evaluation, and assessment of outcomes.
METHODS: A survey was used to assess clinical practice in AD and included a web-based Harris Interactive poll of clinicians assessment and treatment of AD, followed by an in-depth interactive telephone interview.

Appropriate HCPs were identified through market research data as having prescribed donepezil 23 mg to at least two patients. Identified HCPs were contacted via email and provided with a link to the web-based survey administered by Harris Interactive. The survey consisted of 28 questions and took approximately 15 minutes to complete. Participation in the survey was not paid, but those who completed the survey were provided the opportunity to select 1 of 4 charitable organizations to receive a donation of $20. Subsequently, a subset of HCPs participating in the web study was invited to participate in the in-depth telephone survey. One-on-one interviews were conducted and HCPs received $200 as monetary compensation for their participation.
RESULTS: A total of 1,871 individuals were contacted by email and invited to participate in the web based survey. A total of 40 HCPs met the inclusion criteria and completed the survey. Average age of the respondents was 49.8 years, 85% were male, and average time in practice was 20 years. For medical practice, 95% were physicians, the most common medical specialties were neurology (38%) and geriatrics (25%), and the majority (53%) worked in a group practice. In the diagnosis of AD, the most common patient was classified as having mild to moderate symptoms (48%), and initial diagnostic testing included caregiver history (95%), neurological exam (93%), and brief neurological screen (93%). Imaging studies such as CT or MRI were also common (83%). In the treatment of AD, for mild disease the most common medication prescribed was donepezil alone (27%) or an AchEI and memantine combination (27%). For moderate and severe AD, combination therapy was most common treatment, 30% and 33% of the time, respectively. Other medications prescribed included antidepressants (54%), anxiolytics (24%), and antipsychotics (22%). The most common reasons given for escalating the dosage of donepezil from 10 mg to 23 mg was cognitive decline (70%), the ability to tolerate the lower doses of donepezil (62%), decline in daily functioning (62%), and caregiver burden (60%). Effectiveness of the 23 mg dosage was primarily evaluated by input from caregivers (85%) and the patient (70%).
CONCLUSIONS: The results of this study give insight into the diagnosis and treatment of AD in the typical outpatient medical practice. The results also speak to the importance of caregiver input to the physician in the evaluation and treatment of AD.

REAL-WORLD PRACTICE PATTERNS, CLINICAL AND ECONOMIC OUTCOMES AMONG US PATIENTS WITH TYPE 2 DIABETES INITIATING ONCE-DAILY INJECTABLE PEN THERAPY WITH INSULIN GLARGINE OR LIRAGLUTIDE Swetha Raparla1; Wenhui Wei2; Michael Grabner1; Robert M. Cuddihy2; Wenli Hu2; Ralph Quimbo1.

1HealthCore, Inc., Wilmington, DE; 2sanofi-aventis U.S., Bridgewater, NJ. (Control ID #1340378)
BACKGROUND: Initiation of injectable therapy is a major event for patients with type 2 diabetes mellitus (T2DM), and to conduct real-world comparative effectiveness studies of such therapies one needs to first understand patient characteristics and the associated treatment patterns and outcomes. This study aims to examine real-world practice patterns and outcomes among T2DM patients initiating once-daily injectable pen therapy, with insulin glargine disposable pen (GLA-P) or liraglutide pen (LIRA), a glucagon-like peptide-1 analog.
METHODS: This is a retrospective study of a large US commercial health plan using administrative claims data from the HealthCore Integrated Research Database (HIRD[SM]). Included were adult T2DM patients who were previously treated with oral antidiabetic drugs (OADs) only and initiated GLA-P or LIRA between January and June 2010, with the index date representing start of injectable therapy for T2DM. Patients were required to have continuous health plan coverage for 6 months before (baseline period) and 1 year after (follow-up period) the index date. Differences in baseline characteristics between the 2 cohorts were tested. One-year follow-up measures were assessed descriptively, including treatment persistence, hypoglycemia-related events, healthcare utilization, and cost.
RESULTS: A total of 1,709 unmatched T2DM patients (GLA-P n=1,188; LIRA n=521) were included. At baseline, significant differences (all $P<0.001$) existed between the 2 cohorts. GLA-P initiators, compared with LIRA initiators, were: older (mean age 56.9 vs. 53.2 years); male (57.7 vs.47.8%); less obese (9.2 vs. 18.8%);

less often on metformin (74.8 vs.84.6%) but more often on sulfonylureas (63.1 vs. 42.8%); had higher comorbidity (Quan-Charlson comorbidity index 1.051.67 vs. 0.731.28); had higher A1C among those with data available (GLA-P n=283 vs. LIRA n=113; mean 9.11.90 vs. 7.71.38%; 11.3% in GLA-P had A1C <7% vs. 33.6% in LIRA, and 47.7 vs. 16.8% had A1C 9%); and were more likely to have hospitalizations (11.3 vs. 5.0%), but less likely to have endocrinologist visits (22.1 vs. 34.2%). During follow-up, treatment persistence was 60.2% in GLA-P and 50.9% in LIRA (mean persistence days: GLA-P: 221.4; LIRA: 165.0). Average daily drug usage was 28 units in GLA-P and 1.44 mg in LIRA. Overall hypoglycemic event rates were25.3 (GLA-P) and 5.6 (LIRA) per 100 patients/year, with hospital- or emergency room-related hypoglycemic event rates being low in both cohorts (3 and 1 per 100 patients/year). Hospitalization rate was 18.4% in GLA-P and 10.6% in LIRA. Mean 1-year total all-cause healthcare costs were $16,466 in GLA-P (7.0% from study drug) and $14,579 in LIRA(18.9% from study drug), and pharmacy costs were $6,184 in GLA-P(18.7% from study drug) and $7,549 in LIRA (36.5% from study drug). CONCLUSIONS: This real-world study shows significant baseline differences between T2DM patients initiating GLA-P vs. LIRA as their first injectable therapy. Patients initiating on GLA-P were older and sicker, with more comorbidities and significantly different baseline A1C levels. About 1/3 of LIRA initiators had A1C <7.0% at baseline, suggesting that a substantial number of patients might not have initiated LIRA primarily for glycemic control. The data showed that patients initiating LIRA may not be directly comparable to patients initiating GLA-P, implying challenges in conducting related comparative effectiveness research.

REASONS FOR READMISSIONS IN A HIGH-RISK POPULATION Theodore Long; Leora I. Horwitz. Yale Dept of Internal Medicine, New Haven, CT. (Control ID #1339048)

BACKGROUND: Hospital readmissions represent a significant cost to the healthcare system and are a burden to patients. There is a paucity of qualitative data regarding the perspectives of patients with multiple readmissions.

Furthermore, very little is known about the factors contributing to readmissions in the urban underserved population, who comprise a disproportionate share of readmissions for many academic medical centers. We gathered qualitative data to elucidate the reasons for readmissions in a high-risk population of underserved patients at Yale-New Haven Hospital. METHODS: We conducted semi-structured qualitative interviews of patients receiving primary care services from the Yale Primary Care Center (a low-income health center serving New Haven) who had four or more readmissions in the previous six months and were currently readmitted to the hospital. All interviews were transcribed by an independent company. Two investigators independently generated codes from the primary data and developed a final code list using the constant comparative method. These codes were organized into 11 main themes.

RESULTS: To date eight interviews have been completed. We identified three major themes: self-triage, primary care discontinuity, and adequacy of formal services. Patients in the study typically went directly to the Emergency Department when they experienced a change in health status without consulting with their primary provider. Prevalent reasons for this self triage included poor telephone access to the Primary Care Center, poor access to urgent visit appointments, and the belief that the Primary Care Center could not treat acute illness. Another contributor to readmission was that patients either could not name their primary provider or stated that they did not have a primary provider. Conversely, every patient reported being able to obtain medications without undue financial burden, and every patient reported receiving adequate formal home services such as visiting nurse services, home health aides, or transportation assistance.

CONCLUSIONS: Our results suggest that there may be factors contributing to readmissions in this underserved high-risk population that are not addressed by most current interventions, which are targeted at access to medications and formal home and nursing services. In particular, patients consistently reported using self triage stemming from inadequate communication with providers when they had a change in health status. As future interventions are developed for prevention of readmissions, improvement of continuity and communication with

outpatient providers should be considered.

REASONS FOR DELAYED RECEIPT OF HORMONAL THERAPY FOR BREAST CANCER AT AN URBAN HOSPITAL Meaghan M. Crowley1; Molly E. McCoy2; Sharon Bak2; Sarah E. Caron2; Faber Alvis3; Lisa A. Kachnic4; Tracy Battaglia2. 1Boston University School of Medicine, Boston, MA; 2Boston University School of Medicine, Boston, MA; 3Boston Medical Center, Boston, MA; 4Boston Medical Center, Boston, MA. (Control ID #1338277)

BACKGROUND: Significant racial and economic disparities in breast cancer mortality may be partially explained by underutilization or delay of proven treatments in vulnerable populations. Accordingly, quality standards for timely treatment have been established. However, the underlying reasons for not meeting quality standards of treatment are poorly understood in these populations. Our objective was to identify characteristics of patients who fail to receive quality breast cancer treatment as defined by the American College of Surgeons (ACOS) Cancer Program Practice Profile Reports.

METHODS: This retrospective observational study was conducted at Boston Medical Center, an ACOS Commission on Cancer accredited center. We included women diagnosed with non-metastatic Estrogen Receptor or Progesterone Receptor positive breast cancer at an inner-city safety net hospital from 2006 to 2008. Our outcome had three levels: 1) timely hormone therapy (within 365 days of diagnosis) which met compliance with ACOS practice reports, 2) delayed hormone therapy (>365 days) and 3) no hormone therapy. Demographic and clinical data were collected from the institutions cancer registry and a chart review of the electronic medical record was conducted for all noncompliant cases (receipt of hormone therapy <365 days of diagnosis) to identify causes of delay. Bivariable analysis was performed to compare socioeconomic variables as well as tumor and treatment characteristics between the
compliant and noncompliant cases. Descriptive analysis assessed how patient, provider, and system level variables factored into noncompliance. RESULTS: Among 113 eligible cases, mean age was 57 years; majority were of racial or ethnic minority (56%), Stage II (53%), not married (60%), and had public or no health insurance (71%). Among all cases, 74 (65%) were timely or compliant, 37 (33%) were delayed, and 2 (2%) did not receive hormone therapy. Compared to noncompliant cases, compliant cases were more likely to be Hispanic (41% v. 59%, p=.02), and stage III at diagnosis (40% v. 60%, p=.001), and less likely to be white (84% v. 16%, p=.003). A more detailed review of the noncompliant cases found: 39% spoke a primary language other than English and 13% lived at a primary residence outside of the US. Median days from diagnosis to hormone therapy for the delayed group was 460 days, range 370 to 1208. Two or more primary surgeries were required in 75% of these patients. The most common reasons for noncompliance were: active medical comorbidity or treatment complication (49%); socio-cultural barriers (33%), such as patient or family requests for delay in treatment, anxiety/poor understanding of cancer diagnosis, or patient not returning to clinic; completion of herceptin treatment was recommended prior to starting hormone therapy (21%); diagnosis occurred at outside hospital prior to entering our system (18%); financial barriers (8%); and transferring care (8%). Among the two cases who never received hormonal therapy, one moved back to her home country and the other declined therapy.

CONCLUSIONS: Our results demonstrate that in an underserved diverse breast cancer population, reasons for noncompliance with recommended hormonal therapy are complex and range from complex medical co-morbidity and multi-agent treatment regimens to diverse socio-cultural factors. These findings suggest multiple areas must be targeted in order to reduce disparities in receipt of breast cancer treatment.

REASONS FOR NOT PRESCRIBING GUIDELINE-RECOMMENDED MEDICATIONS TO VETERANS WITH HEART FAILURE Michael A. Steinman1,2; Liezel Dimaano2. 1SF VA Medical Center, San Francisco, CA; 2UCSF, San Francisco, CA. (Control ID #1335207)

BACKGROUND: Performance measures for heart failure implicitly assume that higher rates of guideline-recommended treatment are better. However, little is known about whether patients not receiving guideline-concordant care have legitimate reasons for foregoing care, or about the distribution of reasons for non-

treatment.
METHODS: We conducted comprehensive chart reviews of veterans age 50 years and older in 4 VA health care systems who had systolic heart failure and were not prescribed a beta blocker and/or an ACE inhibitor or angiotensin receptor blocker (ARB). Reasons for non-treatment with these medications were identified from clinic notes based on explicit or strongly implicit statements by the treating clinician and were coded using an established taxonomy. We also interviewed subjects primary care clinicians about their reasons for non-prescribing to patients identified in the chart review.
RESULTS: Among 2846 patients screened, 301 met inclusion criteria, of whom 70% were not prescribed an ACE inhibitor or ARB, 18% were not prescribed a beta blocker, and 11% were not prescribed both drug classes. Mean age was 75 (+/- 10) years, and 85% had seen a primary care clinician in the past 6 months. Chart review identified 235 reasons for non-prescribing in 195 patients (65%). The most common reason for non-prescribing was clinical contraindications to drug treatment (58%). In addition, 18% of patients had at least one non-biomedical reason for non-prescribing, including reasons related to patient attitudes, adherence, or drug misuse (10%) and comanagement with other clinicians (6%). We compared these results with interviews of 61 clinicians whose patients were the subject of chart review. The interviews identified nearly twice as many reasons for non-prescribing as the chart (mean 1.6 vs. 0.9 reasons per patient, P<.001). While clinical contraindications were often cited (70% of patients), one or more other reasons for non-prescribing were described for 66% of patients. These other reasons included patient attitudes, adherence, or

misuse; comanagement with other clinicians; and believing that the drug is not indicated (21-27% of patients each).
CONCLUSIONS: Two-thirds of veterans with heart failure who do not receive guideline-recommended medications have a reason for nonprescribing documented in the chart, mostly involving clinical contra-indications. However, clinicians report that non-biomedical reasons for not prescribing are equally common. Guidelines and performance measures should better account for non-biomedical reasons for not providing guideline-recommended care.
REDUCING ALERT FATIGUE IN ELECTRONIC MEDICAL RECORDS Shobha Phansalkar1,2; David W. Bates1,2; Douglas S. Bell3; Blackford Middleton1,2; Amrita Desai1. 1Partners Healthcare, Wellesley gateway, MA; 2Brigham and Women's Hospital, Boston, MA; 3RAND Corporation, Santa monica, CA. (Control ID #1340482)
BACKGROUND: Alert override rates in electronic health records (EHRs) are between 49-96%. This essentially translates to the fact that despite the benefits of making clinical decision support available in EHRs, most providers end up ignoring these alerts. The Office of the National coordinator (ONC) issued a task order to study how alert fatigue could be reduced in EHRs. To a large extent alert fatigue exists because spurious interactions that do not merit interrupting a providers workflow are included in medication knowledge bases. In this study, we will describe the findings of an international expert panel to identify such interactions which could be safely suppressed from interruptive alerting.
METHODS: We convened a panel of experts with the goal of identifying those DDIs which were frequently presented in EHRs but were overridden >96% of the times. Over 4000 DDI pairs (n=4077) were assessed, these were responsible for a total of 158,794 alerts being fired in the 6-month time period. These interacting pairs were normalized to represent a final list of 1339 drug-class &class-class DDIs. From the top 0.2% DDI alerts we discussed the top 50 interactions with the panel. Panelists included medication knowledge base vendors, EHR vendors, in-house knowledge base developers from academic medical centers, and both federal and private agencies involved in the regulation of medication use. The panel evaluated these based on the

consequence of the interaction, severity levels assigned to them across various medication knowledge bases, availability of therapeutic alternatives, monitoring/management options, predisposing factors, and the probability of the interaction based on the strength of evidence available in the literature.
RESULTS: Of the 50 interactions that were assessed, the panel voted for 16 interactions to be interruptive in nature while the remaining 24 could safely be used to generate non-interruptive alerts. These 34 class based interactions account for 36% of the alerts. Thus, suppressing these alerts to be informational rather than interruptive could possibly reduce alert fatigue by about a third.
CONCLUSIONS: We identified a set of clinically insignificant drug interactions that can safely be suppressed from generating interruptive alerts in EHRs and thus make a large difference in the alert fatigue experienced by providers today.
REDUCING THE RATES OF PERSISTENTLY UNCONTROLLED DIABETES IN AMBULATORY PRACTICE THROUGH ACTIVE SURVEILLANCE AND MONTHLY INTERVENTION Muhammad A. Zafar; Jennifer Neville; Sana F. Khan; Sana Waheed; Wajeeha Yousaf; Colin Carracher; Ali Raza; Benni Hensley; Tiffiny Diers; Eric J. Warm. University of Cincinnati, Cincinnati, OH. (Control ID #1312268)
BACKGROUND: Diabetes and its related complications are an enormous health care burden and its prevalence is expected to double by 2030. Chronic hyperglycemia is the primary risk factor for most of the related complications. The majority of health benefits in terms of cost reduction and prevention of complications can be achieved by targeting the relatively small proportion of patients with uncontrolled diabetes. Objective: To reduce the rate of persistently uncontrolled diabetes at 3 monthly follow-ups in a resident-run primary care clinic.
METHODS: The study was conducted in an internal medicine resident clinic at University of Cincinnati over a period of six months. Intervention group (IG) and Control group (CG) comprised of patients being followed by six and nine residents respectively. Uncontrolled Diabetes (UD) was defined as HbA1C>9. A 3-step-intervention was performed on a monthly basis in the IG comprising of: 1) Active surveillance of Electronic Medical Record by the clinic nurse for patients with HbA1c>9 followed by each resident. ii) PCP-directed individualized intervention for each patient with UD, if needed. iii) Monthly contact with UD patients by at least one clinic member, either PCP, clinic nurse, pharmaco-therapist or diabetic educator. This contact could be in a form of a clinic encounter, a phone call or a letter. Data were collected at baseline, at 3 months and at 6 months follow up.
RESULTS: At baseline, the mean numbers of patients with UD per resident in IG and CG were 10.16 and 10.33 (p=0.93) respectively. At 3 months, the percentages of patients with persistent UD in relation to baseline were 44% in IG and 72% in CG (p=0.002). At 6 months, the percentages of patients with persistent UD in relation to 3 month follow up were 54% in IG and 86% in CG (p=0.002). At 6 months, the mean numbers of patients with UD per resident were 6.33 in IG and 8.88 in CG (p=0.06) showing a reduction in prevalence of 37.7% in IG and 14% in CG, compared to baseline.
CONCLUSIONS: Our model of active surveillance and monthly contact along with intervention as needed is highly efficacious in reducing the prevalence and rates of persistently uncontrolled diabetes in the ambulatory setting. This model is easy to adapt and distributes the burden of care over different members of the clinic staff.
REFERRALS FOR OUTPATIENT PHYSICIAN AND SOCIAL SERVICES FOLLOW-UP AMONG PATIENTS DISCHARGED FROM US EMERGENCY DEPARTMENTS AFTER TREATMENT FOR VIOLENT INJURY: A NATIONAL PERSPECTIVE. Paulvalery Roulette1; Eric Fleegler3,1; Danny McCormick2,1. 1Harvard Medical School, Boston, MA; 2Cambridge Health Alliance, Cambridge, MA;
3Children's Hospital, Boston, MA. (Control ID #1337034)
BACKGROUND: For those who experience violent injury and survive, physical and psychological sequelae are common, including depression, anxiety, PTSD and an increased risk for both experiencing another or committing a violent injury. Many violent injuries are first treated in emergency departments (ED) and studies suggest that referral to a physician or social services from the ED can mitigate these sequelae. However, few

data exist regarding national patterns of referral for follow-up care from the ED for such patients, particularly among racial and ethnic groups at high risk for assault.
METHODS: We used data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 1999-2008 to study a nationally representative sample of ED visits for patients of all ages to examine ED referrals for follow-up physician care and social services for patients discharged after treatment for violent injury. We excluded patients who were admitted to the hospital, transferred to another medical facility, left against medical advice, were dead on arrival or who died in the ED. We calculated the percentage and annual number of patients discharged with: 1. referral to a physician; 2. referral to social services; or 3. had no planned follow-up. We used multivariate logistic regression to identify patient and hospital characteristics associated with receiving referral to social services at ED discharge (compared with no social service referral). In addition, using data from the U.S. Census Bureau from the years 1999-2008 we calculated US population rates of ED visits for violent injury and ED discharge with no follow-up, according to race/ethnicity. RESULTS: Among the 3,735 ED visits (representing 12.3 million nationally) for violent injury that we studied, at discharge 68.7% [95% CI 66.2%-71.2%] were referred to a physician (845,554 annually), 4.5% [95% CI 3.7%-5.4%] were referred to social services (55, 902 annually) and 26.7% [CI 95% 24.2%-29.3%] were discharged with no follow-up (328,615 annually). Female gender (OR=2.5 [95% CI, 1.6-3.7] Age 65+ or<10 (OR=10.2 [95% CI, 3.7-28] and OR=14.2 [95% CI, 6.8-29.9] respectively, compared with age 20-29), drug/ alcohol use (OR=3.5 [95% CI, 2.0 - 6.1] and rape (compared with unarmed fight) as the type of assault (OR=7.4 [95% CI, 3.6-15.1]) were positively

associated with referral to social service in multivariate analyses; race/ ethnicity, co-existing psychiatric diagnosis, insurance type and region of the country were not. ED visit rates (per 10,000 US population) according to race were: 100.6 for African Americans, 40.6 for Hispanics and 33.0 for Whites. US rates (per 10,000 US population) for being discharged from an ED visit for violent injury with no follow-up were nearly 3-fold higher for African Americans (27.6) than for Hispanics (9.6) and Whites (9.4). CONCLUSIONS: For violently assaulted patients, discharge with social service follow-up is rare and discharge with no follow-up is common in US EDs. While rates of referral from the ED do not vary by race/ethnicity, because African Americans are substantially more likely to be assaulted, high rates of discharge with no planned follow-up disproportionately affects African Americans.

RELATIONSHIP BETWEEN PATIENT EXPERIENCE OF CARE AND PHYSICIAN PRODUCTIVITY MEASURES Charlotte E. Ward; Jeffrey M. Ashburner; Yuchiao Chang; Steven J. Atlas. Massachusetts General Hospital, Boston, MA. (Control ID #1338232)

BACKGROUND: Improving patients experience when interacting with the healthcare system has become an important quality of care measure. At the same time, greater emphasis is being placed on increasing primary care physicians (PCPs) productivity and efficiency of care. Previous studies suggest that efforts to improve productivity may adversely affect patient experience of care. Our goal was to examine the relationship between patient experience of care, using the Consumer Assessment of Healthcare Providers and Systems (CAHPS) survey, and measures of provider productivity among PCPs within one, large, academic practice network.
METHODS: We studied 14,857 patients cared for by 156 PCPs in 13 primary care practices within the Massachusetts General Hospital practice-based research network with completed CAHPS surveys (n=18,424) between August 2008 and June 2011. For each survey, we calculated CAHPS composite measures for the access (5 items) and communication (6 items) domains by taking the average of each items top box score which was calculated as the proportion of items where Always was chosen . For each PCP, productivity measures adjusted for clinical full-time equivalents (FTEs) for fiscal year 2010 included visit-based measures (total work relative value units [WRVUs] and total visits) and patient panel size. To examine the relationship between PCP productivity measures and CAHPS composite measures or individual items, we used linear regression models adjusting for patient characteristics including patient age, gender, insurance status, race,

language, education, and Charlson score, accounting for clustering by PCP.
RESULTS: Productivity measures varied considerably among PCPs: median40.4 WRVUs (interquartile range [IQR] 36.4-45.7), median 31.8 visits per FTE (IQR 27.9-35.8), median 2.3 panel per FTE (IQR 1.7-2.9). Patient characteristics also differed among PCP panels including gender (range 1.3-81.8% male), ethnicity (range 5.6-95.5% non-Hispanic white), mean age (range 38.9-82.7 years), insurance (0-37.9% Medicaid/uninsured), Charlson score (9.2-73.3% Charlson score2), education (9.0-81.8% college or above), and language (15.6-100% English speaking). There was no significant relationship between productivity measures and access composite scores or individual items. Similarly, WRVUs and visits per FTE were not associated with the communication composite. However, increasing panel size was associated with better performance on the communication composite (beta0.023, p=0.001). Communication composite scores were higher among PCPs in the top tertile of panel size compared to the bottom tertile (adjusted mean86.9% vs. 83.4%, p<0.0001). These findings were consistent among items within the communication composite, except for time spent with the patient. For this item, spending more time with the patient was inversely associated with WRVUs and visits per FTE (p<0.05 for each), but not associated with panel size (p=0.43).
CONCLUSIONS: Among PCPs practicing within the same primary care network, visit-based productivity measures were not associated with patient perceptions about access to care and quality of provider communication. Somewhat unexpectedly, PCP panel size was not associated with access to care, but was associated with better communication. As new payment models emphasize managing populations of patients, more research will be needed to assess how measures of provider panel size impact patient experience of care.

RELATIONSHIP BETWEEN THE PROGNOSTIC EXPECTATIONS OF DIALYSIS PATIENTS AND THEIR NEPHROLOGISTS Melissa W. Wachterman1; Edward R. Marcantonio1; Roger B. Davis1; Robert A. Cohen2; Sushrut S. Waikar3; Russell Phillips1; Ellen P. McCarthy1. 1Beth Israel Deaconess Medical Center, Boston, MA; 2Beth Israel Deaconess Medical Center, Boston, MA; 3Brigham and Women's Hospital, Boston, MA. (Control ID #1322478)
BACKGROUND: Selected patients undergoing hemodialysis (HD) have an annual mortality rate that exceeds 20%. Perceptions of prognosis and expectations for transplant may influence goals of care. We compared HD patients and their nephrologists perceptions of prognosis and transplant candidacy, and explored the relationship between patients expectations and goals of care.
METHODS: We conducted in-person interviews with seriously ill HD patients from 2 urban HD units and their nephrologists. We used 2 published prognostic models to identify HD patients with 20% probability of dying in the next year.
Of the 207 patients treated at these HD units between October 2010 and April 2011, 151 (73%) had 20% mortality risk. We excluded 70 of these patients because of cognitive impairment or limited English proficiency. Of the remaining 81 eligible patients, 63 participated (78% response rate). All nephrologists (n=13) for these patients were interviewed. We assessed prognostic expectations by asking patients and their nephrologists what they thought the chances were that the patient would be alive in one year (90%, 61-89%, 40-60%, 11-39%,
10%). We asked whether they thought kidney transplant was a possibility (yes, no). We then asked patients about their goals of care (prefer a course of care focused on life-extension vs. symptom-directed care). We defined transplant discordance as present when patients reported they were transplant candidates but their nephrologist reported they were not. We examined whether patients and nephrologists beliefs about prognosis and transplant candidacy differed using McNemars test for paired data. We then explored the association between goals of care and prognostic expectations and transplant discordance, respectively using Fishers exact tests.
RESULTS: Of 63 patients interviewed, 57% were female, 51% were African American, and the mean age was

6810 years. Patients were significantly more likely than their nephrologists to report a 90% chance of being alive at 1 year (82% vs. 25%, p<0.0001). Overall, in 60% of patient-nephrologist pairs, patients were more optimistic than their physician, whereas physicians were more optimistic in 10% of pairs. Patients were also significantly more likely than their nephrologists to report they were transplant candidates (66% vs. 46%, p<0.01). Of the 82% of patients reporting 90% chance of being alive at 1 year, 49% preferred care focused on extending life even if it meant more pain and discomfort, compared to 11% among patients reporting a lower probability of survival (p=0.04). 67% of patients whose beliefs about transplant candidacy were optimistically discordant with their nephrologists wanted care focused on life extension, compared to 32% of those whose transplant expectations aligned with their nephrologist (p=0.03)
CONCLUSIONS: Patients undergoing HD appear to be more optimistic about their prognosis and transplant candidacy than their nephrologists, and patients unrealistic expectations for positive outcomes may influence their treatment choices.
RELATIONSHIP OF TIMING AND QUALITY OF DISCHARGE
SUMMARIES TO CLINICAL EXPERIENCE Leora I. Horwitz1;
Christine Chen2; Grace Y. Jenq1; Sandhya V. Kanade2; Katy Araujo1; Peter Van Ness1; Boback Ziaeian2; John Moriarty1. 1Yale University, New Haven, CT; 2Yale New Haven Hospital, New Haven, CT. (Control ID #1338260)
BACKGROUND: Discharge summaries are an essential component of a safe transition from hospital to home, yet timeliness and content are known to be suboptimal. Whether clinical experience affects the quality of the discharge summary is unknown.
METHODS: A prospective cohort of patients admitted to the medical service with pneumonia, heart failure or acute myocardial infarction and discharged home was enrolled. Discharge summaries were reviewed by trained nurse abstractors for timeliness of summary dictation and the presence of individual content, including data related to hospitalization and data related to transitional

care. Two summary scores were created, one for six content elements recommended by the Joint Commission (reason for hospitalization, significant findings, procedures and treatment provided, patients discharge condition, patient and family instructions and attending physicians signature), and one for seven elements recommended by a multispecialty group (principal diagnosis and problem list, medication list, transferring physician name and contact information, cognitive status of the patient, test results, and pending test results). Timeliness and content were compared by training level (hospitalist, second or third year house staff, and cardiology advanced practice RNs [APRNs]). RESULTS: The study cohort included 377 patients. Included patients had a mean age of 77 years; 54% were male. A total of 195 (52%) had acute coronary syndrome, 146 (39%) had heart failure, and 91 (24%) had pneumonia. Discharge summaries were completed for 376/377 patients. A total of 114 (30%) had discharge summaries dictated by hospitalist attendings, 123 (33%) had discharge summaries dictated by house staff, and 140 (37%) had discharge summaries dictated by APRNs. The median days to dictation was 1 day after discharge (IQR 0-7, range 0-95 days); 255 (67.4%) were dictated within 48 hours of discharge. Summaries dictated by hospitalists were most likely to be done within 48 hours of discharge (81.6% hospitalists, 65.9% house staff,57.6% APRNs, Chi-square test, 2 df, p<0.001). Diagnosis, hospital course and tests/procedures performed during admission were included in >97% of discharge summaries. However, data related to post-discharge care such as social support (39.3%), functional capacity (26.3%), physical exam at discharge(16.5%) and whether any test results were pending (13.0%) were rarely included. Only 6.1% of summaries included a call-back number for the inpatient physician; only 4% of summaries for patients with heart failure included the discharge weight. On average, summaries included 5.6 of the 6 elements required by the

Joint Commission and 4.0 of the 7 elements recommended by a multispecialty group. Hospitalists, APRNs and house staff included the same average number of Joint Commission elements (5.6), but hospitalists on average included slightly more multispecialty elements (4.3) than did house staff (4.0) or APRNs (3.8), Kruskal-Wallis test, 2df, $p<0.001$.
CONCLUSIONS: Discharge summaries lack key information relevant to post-discharge care and are hospitalization-focused rather than transition-focused. Hospitalists produce more timely summaries that include slightly more key content than house staff or APRNs; however, no group produced consistently timely or high quality summaries. Medical training should specifically include discharge summary skills focused on transition rather than documentation.

RELATIVE INFLUENCE OF PHYSICIANS VERSUS PATIENTS IN MEASURES OF DIABETES CONTROL

Calie Santana; Joseph Deluca; Elisabeth Ihler; Marta Rico; William Southern; Yuming Ning. Montefiore Medical Center, Bronx, NY. (Control ID #1336118)

BACKGROUND: While quality improvement (QI) interventions are often delivered to providers and staff, their evaluation is based on patient-level outcomes. One such intervention, performance reports, often meets resistance from providers who do not consider themselves responsible for the patient-level outcomes included in the reports. Although patient-level factors are known to account for the majority of differences in outcomes among patients, we sought to perform an analysis to measure the contribution of individual primary care physicians (PCPs) on measures of diabetes control. METHODS: We used data from a randomized study of resident PCPs at our three teaching clinics in Bronx, NY. The experimental group received quarterly performance reports documenting appropriate testing and level of control for their patients with diabetes. In addition, they completed worksheets by ordering necessary testing and titrating medications as appropriate for the 5 patients with the highest HbA1c. The control group received performance reports only. Our outcomes were HbA1c 8%, LDL100, microalbumin30,
BP130/80 or140/90 for the most recent value in the past 12 months. Our analysis at 6 months showed improved blood pressure control in the experimental arm compared to the control arm but these differences were present at baseline. To measure the relative contribution of individual PCPs, we measured the percent of variance explained by PCP in a hierarchical model that included two levels or sources of variance (patient-level repeated measures and PCP). The model was adjusted for baseline performance, clinic at which each patient received care, the PGY level of the PCP, and patient age, sex, race/ ethnicity and insurance. Our model considered PCP as a random effect since it
defines the hierarchical level that we are interested in. The intra-correlation effect of repeated measures of each patient was taken into account using generalized estimating equation (GEE) method in our hierarchical model. RESULTS: Our study included 2,091 patients of 141 residents. The individual PCP significantly influenced the variance of all 5 outcomes measured. The percent of the variance in the outcomes between arms explained by the PCP was 11.2% for HbA1c 8% ($p=0.002$), 15.8% for
LDL100 ($p<0.001$), 45.2% for microalbumin30 ($p<0.001$), 10.1% for BP130/80 ($p=0.002$), and 16.4% for BP140/90 ($p<0.001$), with the rest of the variance being explained by patient-level factors. For example, in the HbA1c outcome, we observed a 13-fold difference in the odds of meeting the control outcome cutoff (8%) for some resident PCPs versus others.
CONCLUSIONS: In our teaching sites, diabetes control is significantly associated with the individual resident PCP assigned to each patient even after adjustment for site of care, patient characteristics, and PGY year of the PCP. Our study highlights that providers play an important role in disease control for patient with diabetes and that measuring patient-level outcomes is a valid way to measure differences in performance among PCPs even in a medically and socially complex patient population. As health systems transform into Patient-Centered Medical Homes and strive to become Accountable Care Organizations, we must identify and foster those panel management practices and processes followed by trainees associated with improved diabetes control, and

organize systems of care that support those best practices.

RESIDENT PHYSICIANS IDENTIFY NEED FOR MORE POLICY EDUCATION AND HEALTHCARE IMPROVEMENT Julia Skapik1;
Elan D. Cohen1; Hillary Lum2; Peggy Hasley1. 1University of Pittsburgh Medical Center, Pittsburgh, PA; 2University of Colorado, Denver, CO. (Control ID #1339161)

BACKGROUND: Virtually no research has assessed both knowledge and attitudes regarding health policy among graduate medical residents, but prior surveys in physicians and students indicate a knowledge gap in health policy. Ongoing health care reform efforts have led to increased interest in and need for education in health policy among physicians.

METHODS: The aim of this study was to assess current knowledge and attitudes among resident physicians. We electronically administered a survey of residents PGY1-3 in varying residency programs at a large university-affiliated medical center and two community hospitals that was designed using current data on healthcare systems, prior questions about health policy attitudes, and general questions about health policy education and experience. Responses were elicited via email link over a period of 4 months using the program SurveyMonkey and participation was rewarded with a small gift card to Starbucks. Descriptive analyses were generated and factor analyses, regresssions, and t-tests were performed using SAS.

RESULTS: All PGY1-3 residents from internal medicine, family practice, obstetrics and gynecology, psychiatry, pediatrics, general and subspecialty surgery, radiology, emergency medicine, pathology, and neurology were invited to participate in a survey on health policy; 273/635 (43.0%) responded (ages 24-41). On the knowledge section, residents performed poorly, answering only 25.3% of questions about health systems correctly and were not more likely to perform well even if they indicated experience with or interest in health policy. Most residents reported they were somewhat (45.2%) or very (13.5%) interested in health policy. Of residents surveyed, 85% felt that more healthcare leaders should be physicians, and felt that the amount of health policy education they received was very (43.7%) or somewhat (38.1%) inadequate. Only one-quarter (27.9%) somewhat or strongly agreed they had a "basic understanding of the structure and function of the U.S. healthcare system. Interestingly, residents who reported they were planning to enter a primary care specialty (general internal medicine, family medicine, pediatrics) were significantly more likely to report that healthcare was a human right, that they would accept patients with public insurance despite being reimbursed at a lower rate, that mental health should be covered at an equal level to other medical coverage, and that they supported the provisions of the 2010 Affordable Care Act. Just over half (50.4%) reported they would be hesitant to recommend a career in medicine to their friends or children given the current state of the healthcare system. Only 27.5% of

residents described the quality and safety of healthcare in the US as adequate.

CONCLUSIONS: Overall, residents both anticipated and demonstrated poor knowledge of health policy and healthcare systems. The majority of resident physicians reported a need for more health policy physician-leaders, more health policy education, and improvements in healthcare quality and safety. Residents planning to enter primary care careers were more likely to support the Affordable Care Act, mental health parity, and a universal right to healthcare. Although the response rate and location of this study may limit the generalizability of results, they strongly suggest resident physicians have an interest and would benefit from more health policy education and leadership opportunities.

RESIDENT SATISFACTION AND PREPAREDNESS AT A LEVEL THREE PATIENT-CENTERED MEDICAL HOME Shana Ratner; Kristen Amann; Paul Chelminski; Brooke B. McGuirt. UNC Hospital, Chapel Hill, NC. (Control ID #1333749)

BACKGROUND: Prior studies have shown internal medicine residency graduates are dissatisfied with continuity clinics, often citing shortcomings related to under-resourced, disorganized, and inefficient practice

environments. However, it is unknown whether the level of the practice performance influences resident satisfaction; that is, whether a highly functioning practice environment leads to improved resident satisfaction with the continuity experience. Our aim was to assess resident satisfaction and preparedness at a level three Patient-Centered Medical Home (PCMH).
METHODS: In December 2011, we asked residents to complete an anonymous clinic satisfaction survey. Residents were asked to rate their satisfaction with elements of continuity clinic using a 5-point Likert scale ranging from 1 (not at all satisfied) to 5 (very satisfied). Additionally, residents rated their preparedness to treat common ambulatory conditions, such as diabetes and headache, on a 5-point Likert scale ranging from 1 (not at all prepared) to 5 (very prepared). Data was analyzed using descriptive statistics as well as a qualitative analysis of free text comments. RESULTS: Survey response rate was 85% (29/34) with 11 PGY-1, 7 PGY-2, and 11 PGY-3. Of the residents completing the survey, 52% (15/29) had considered a career in primary care. Overall satisfaction with continuity clinic was 48%. Residents rated satisfaction with three chronic disease management programs highly, with most residents satisfied or highly satisfied with depression (83%), diabetes (93%), and chronic pain (72%). When asked for free text comments regarding what residents liked the most about clinic, 45% (9/20) listed the chronic disease management programs and visit planners. Although patient care in these disease management programs is provided almost exclusively by mid-level providers, residents who responded rated their preparedness to take care of these conditions as high, with most feeling prepared or very prepared to manage depression (100%, 27/27), diabetes (100%, 27/27), and chronic pain (78%, 21/27). CONCLUSIONS: Residents with continuity clinic at level three PCMH reported high satisfaction with chronic disease management programs specializing in care management and patient self-support, as well as patient tracking and registry functions embedded in our clinics visit planner. Additionally, residents independently noted PCMH criteria to be the best aspects of their clinic experience. Participating in a comprehensive multi-disciplinary disease management program does not detract from resident perceptions of their preparedness to treat these chronic illnesses. Future work should focus on determining if these PCMH criteria improve resident education and performance.

RESIDENT SATISFACTION WITH CLINIC AND CHOOSING A CAREER IN GENERAL INTERNAL MEDICINE

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BACKGROUND: Amid America's primary care crisis, the percentage of internal medicine trainees entering general internal medicine (GIM) has been
declining. Many believe that improving resident continuity clinic could increase interest in GIM. This study assessed which elements of resident clinic may influence pursuing employment in GIM.
METHODS: Surveys were administered at the end of the academic year to all 250 internal medicine residents with continuity clinic at 3 programs: Temple University School of Medicine, Mount Sinai School of Medicine, and Johns Hopkins Bayview Medical Center. The survey was a modified and re-validated version of the VA Learners Perception Survey, assessing, across a 4-point Likert scale, satisfaction with 32 clinic elements, grouped into 6 domains: (1) clinical preceptors, (2) educational environment, (3) ancillary staff, (4) time management, (5) clinic records and space, and (6) personal experience. Each respondent was also asked to rate the likelihood that they would "consider a future employment opportunity in GIM" (1) before their continuity clinic experience and (2) as a result of their continuity clinic experience. Bivariate analyses were performed between each clinic element and whether the respondent was likely vs. unlikely to pursue GIM as a result of continuity clinic. A generalized estimating equation was used for multivariate analysis.
RESULTS: 225 (90%) residents, evenly distributed across training year and gender, completed surveys. 48%

were likely to enter GIM before continuity clinic; 38% as a result of continuity clinic. On average, 83% were satisfied or very satisfied with the 32 clinic elements, with highest ratings for the clinical preceptor domain (96% satisfied or very satisfied) and lowest for the time management domain (66% satisfied or very satisfied). Bivariate analyses showed significant differences ($p<0.002$) between those likely vs. unlikely to enter GIM as a result of clinic, in the percentage of those "very satisfied" with 6 of 32 clinical elements: faculty mentorship (76% vs. 53%), time for patients (29% vs. 11%), number of patients (76% vs. 34%), personal reward from work (52% vs. 23%), relationship with patients (64% vs. 42%), and continuity with patients (57% vs. 32%). Being likely to enter GIM before clinic (OR 29.2, CI 20.8-41.2) and being "very satisfied" with the continuity of relationships with patients (OR 3.04, CI 1.79-5.15) were the strongest independent predictors of being likely to enter GIM as a result of clinic in the multivariate analysis.
CONCLUSIONS: Across 3 internal medicine training programs, resident satisfaction with most aspects of continuity clinic was high; yet, continuity clinic appeared to have an overall negative influence on residents' attitudes towards GIM careers. While it is likely that increasing interest in GIM before trainees begin residency would have the greatest impact on increasing the number of trainees who choose GIM careers, there is potential to increase interest in GIM by improving residents' continuity with patients and time management skills in resident continuity clinic.

RESIDENT AND FACULTY PERCEPTION OF PHYSICAL EXAMINATION LEARNING DURING RESIDENCY

John Ragsdale; Kevin Kraemer; Melissa McNeil. University of Pittsburgh, Pittsburgh, PA. (Control ID #1338697)

BACKGROUND: Physical exam (PE) skills are systematically taught in medical school with the expectation that they will continue to improve during residency through routine patient care. The available data indicate that these skills do not continue to improve; residents often perform no better than medical students. Promoting skill development in residency is difficult because not enough is known about how PE is learned in residency. We conducted this study to examine the perceived impact of various barriers, to evaluate whether residents value the skills, and to evaluate the effectiveness of various teaching methods. We surveyed residents and faculty to compare their perceptions.
METHODS: We conducted a cross-sectional survey of internal medicine residents and faculty. The survey was developed through extensive literature review and structured interviews. The survey included three principal domains: (1) barriers to learning PE, (2) self-reported value of PE and perceived value of PE to the other group, and (3) effectiveness of PE teaching methods. The scope of the survey was limited to the inpatient general medicine service. The survey was administered on-line anonymously. We used summary statistics to describe the residents and faculty. Ratings of barriers and teaching methods did not consistently fit a normal distribution so the Wilcoxon Rank Sum test was used for comparisons between the two groups. For assessment of

value, a Wilcoxon Signed Rank test was used to analyze paired responses within groups.
RESULTS: The survey was sent to 190 residents with 140 responses (74%) and to 39 faculty with 26 responses (67%). Residents ranged from PGY-1 to PGY-4 and faculty had been in practice from<5 years to >20 years. Residents rated competing demands as the barrier which most hindered their PE skill development, whereas faculty rated lack of accountability as the most important barrier. Faculty perceived 3 of the barriers as more significant than the residents did: lack of feedback, lack of accountability, and lack of teaching. When respondents were asked to rate the importance of PE compared to history, labs, and imaging, both groups rated PE high (approximately 5 on a scale of 1-7) but lower than the other 3 factors. There was no significant difference between the groups. For residents, when the ratings of self-importance were compared to perceived faculty importance, there was no difference for PE. For faculty, when the ratings of self-importance were

compared to perceived resident importance, the faculty rated PE as less important to residents than to themselves (p=0.007). Both residents and faculty rated demonstration of skills by an attending as the most helpful teaching method.
CONCLUSIONS: Faculty appear to believe that certain barriers are more significant than residents do. These data could be used to prioritize system changes and to promote improved communication regarding barriers. Lack of interest in PE by the residents is frequently cited in the literature as a major teaching barrier, an opinion faculty at our institution appear to hold. However, it appears that residents and faculty place similar value on PE. Helping faculty to appreciate that residents value and want to learn PE skills may encourage faculty to teach PE skills. Finally, both groups strongly favor learning PE skills through demonstration by an attending, highlighting the importance of bedside teaching for PE.
RESIDENT PERCEPTIONS OF FACTORS CONTRIBUTING TO ADVERSE EVENTS AND NEAR MISSES
Anu R. Lamba; Kathlyn E. Fletcher. Milwaukee VAMC/Medical College of Wisconsin, Milwaukee, WI. (Control ID #1339508)
BACKGROUND: In the last 10 years, the concepts of patient safety and medical errors have gained attention. Patient safety is becoming a more prominent part of the medicine culture, and both hospitals and residency programs have started to increase patient safety education. Current ways to detect adverse events include chart auditing and automated data mining of laboratory and pharmacy data. These methods are useful; however, they may only be able to capture adverse events and not catch near misses. In our study, we sought to find out what factors house staff perceive are contributors to near misses and adverse events.
METHODS: A survey was developed by the study team after a review of the literature. It was reviewed by the chief residents and program directors for content and clarity. The survey was anonymous and contained demographic questions and 5 additional questions about adverse events/ near misses and perceived contributors to them. Adverse events, near misses and categories of potential contributors were defined in the survey. The study was approved by our institutional review board. Participants were internal medicine interns and residents at a single Midwestern internal medicine residency program. The survey was distributed at a regularly scheduled educational meeting. Participants were asked to state if they could recall either an adverse event or near miss occurring within the last 12 months. Participants were then asked to state which of the following factors the adverse event or near miss was related to 1) Patient factors, 2) Task and technology factors, 3) Staff/Individual factors, 4) Work environmental factors, 5) Organizational and management factors, 6) Institutional context factors.
RESULTS: Participation rate was 91%. The survey was completed by 30 interns and 39 residents (PGY2 and above). Twenty-nine (42%) were male. Mean age was 28.6 (SD 2.5). Most (79%) were able to recall an adverse event within the last 12 months. All but one intern (97%) could recall an event, while 65% of residents could recall an event ($p<0.01$ for the comparison between interns and residents). Participants identified a mean of 1.8 (SD 0.8) contributing factors per event. Staff/individual factors were cited most commonly as contributors to adverse events/near
misses, reported by 74% of those who reported an event. This was noted equally commonly by interns and residents. Task and technology factors were reported by 38%, organization/management factors by 32%, patient factors by 19%, environmental factors by 13% and institutional context by 6%.
CONCLUSIONS: Our study shows that the majority of interns and residents have experienced an adverse event and/or near miss within the last 12 months. A larger percentage of interns as compared to residents recalled an adverse event or near miss. Staff/individual factors were cited by both interns and residents as the most common type of contributing factor. This suggests that our current culture of medicine still focuses on individual blame rather than systems issues as the source of errors.
RESIDENTS' PERSPECTIVES ON DISCHARGE DIDACTICS Jennifer Carnahan2; Kathlyn E. Fletcher1,2. 1Milwaukee VAMC, Milwaukee, WI;

2Medical College of Wisconsin, Milwaukee, WI. (Control ID #1334955)
BACKGROUND: Patients discharged from the hospital without adequate discharge planning are at risk of serious post-hospitalization complications. Therefore, teaching trainees safe discharge practices is extremely important. Few internal medicine programs have a discharge planning curriculum in place, instead leaving this critical education to the informal curriculum. We conducted the following study to gain a more detailed understanding of internal medicine house staff perspectives on various aspects of the discharge planning process.
METHODS: We conducted an anonymous survey of internal medicine house staff at a Midwestern residency program. The 37-question survey was developed after an extensive literature. We asked about respondent demographics, confidence in performing various aspects of discharge planning, general approach to discharge planning and education received about discharge planning. Preliminary and categorical interns and residents participated. The survey was distributed at a regularly scheduled house staff meeting during a 10-15 minute allotted time period. We report descriptive statistics for the group.
RESULTS: The response rate was 100% (n=62). Most house staff (92%) agreed that they were confident in their discharge plan when discharging patients from the hospital. However, respondents were less confident about specific aspects of the discharge process. On a scale of not at all confident to completely confident, only 40% were completely confident about ordering dietary restrictions, 34% were completely confident about fluid restrictions, 24% about activity restrictions, 53% about discharge medications and 42% about educating patients about danger signs requiring return to the hospital. When questioned on their experience with formal education in nine key areas of the discharge process, 63% of residents reported no formal instruction in any of the nine areas. Nearly all (60/62) respondents reported that the discharge plan was reviewed with them by a resident, fellow or attending at least once during internship, with 98% reporting that occurring at least half the time. However, 39% of subjects reported that a resident, fellow or attending physician never reviewed a discharge summary with them. Most (93%) of residents said that they believed that the way that primary care physicians learned about their patients hospitalization was from the discharge summary, yet less than 75% of residents agreed that primary care physicians would have access to their patients discharge summaries by the time they see them in clinic post-hospitalization.
CONCLUSIONS: Despite a reportedly high level of confidence in general with discharging patients, when asked about specific aspects of the discharge process many more residents reported perceived inadequacies. Our respondents reported little formal education about discharge planning, and the informal education is inconsistent and non-standardized. In addition to specific content gaps, we also identified a need for education on how to effectively transmit discharge summaries to primary care providers. This is concerning because discharge summaries are one of the mainstays of communication between inpatient and outpatient providers. We believe that these issues are likely to exist at other institutions as well. The next step for this work is to develop a formal curriculum on discharge planning that can be disseminated to other institutions.

RESIDENTS EXPERIENCES WITH HOME VISITS: A MIXED-METHODS STUDY Jared W. Klein; Jill M. Watanabe. University of Washington, Seattle, WA. (Control ID #1311697)
BACKGROUND: Home visits have long been an enjoyable and meaningful part of many physicians practices. Unfortunately, most internal medicine residency programs do not have formal home visit curricula. This study explores internal medicine residents experiences with home visits and how these experiences inform residents practice of medicine.
METHODS: Participants were internal medicine residents whose continuity clinic was located at a single academic general internal medicine clinic. As part of the curriculum, residents performed home visits to at least one patient on their continuity clinic panel. The week of their scheduled home visit, residents were invited to complete a brief, anonymous online survey. In the spring, after the completion of most home visits, semi-

structured focus groups lasting 30 minutes were conducted with small groups of residents. Sessions were audio-recorded, transcribed and de-identified. Using the principles of grounded theory, the authors created a coding scheme and independently analyzed the transcripts to identify key themes. Discrepancies were resolved by discussion until consensus was achieved.
RESULTS: Eighty-two percent (28/34) of residents completed an online survey, of whom 79% (22/28) successfully completing a scheduled home visit. 96% of residents felt home visits were valuable and 78% would like to perform two or more home visits per year. 76% (26/34) of residents participated in at least one of nine focus groups, providing over four hours of audio recordings. Among many compelling stories, our analysis identified several primary content domains: 1) Theres more than the 20 minutes that you see. Providing residents with context for their patients lives: Uncovering physical obstacles (small spaces, clutter, mobility issues), revealing lack of resources (poverty, social isolation, absence of family support), allowing for direct observation of health behaviors (medication administration, dietary intake), exposing unique patient attributes (previously unknown interests, backgrounds, idiosyncrasies) and re-conceptualizing the patient as a caregiver. 2) I just feel that relationship is stronger. Developing the patient-resident relationship: Rapport-building and socializing, permitting time and space for questions, earning patient trust, fostering patient pride by hosting a visit. 3) I went to go see him before he passed away. Doctoring: Exhibiting empathy, displaying compassion, developing listening skills, enhancing residents sense of responsibility for their patients, providing a service or convenience for patients. Residents largely felt that home visits enhanced their clinical care by facilitating communication, improving follow-up, reprioritizing goals of care, enlisting new resources (obtaining medisets, placing referrals), intervening early to ameliorate potential problems and raising awareness of the social complexity of many patients lives. Residents identified several challenges with their participation in home visits including busy schedules, limited experience with the practice and difficulty getting some patients to agree to a visit.
CONCLUSIONS: Residents found home visits to be useful and memorable experiences that offer unique opportunities to learn about their patients lives and provide the best, most appropriate care. Efforts should be made to encourage internal medicine residents participation in home visits and reduce barriers to incorporating home visits into the training curriculum.
RESISTANT HYPERTENSION AT US PHYSICIANS OFFICES: CAN WE DO BETTER? Valy Fontil1; Mark J. Pletcher2,3; David Guzman1; Raman R. Khanna3; Ronald G. Victor4; Kirsten Bibbins-Domingo1. 1University of California San Francisco, San Francisco, CA;
2University of California San Francisco, San Francisco, CA; 3University of California San Francisco, San Francisco, CA; 4Cedars-Sinai Medical Center, Los Angeles, CA. (Control ID #1340129)
BACKGROUND: Many patients blood pressure remains elevated despite being prescribed multiple antihypertensive medications. Guidelines for resistant hypertension include optimizing diuretic therapy by using chlorthalidone and adding an aldosterone antagonist if blood pressure
remains elevated. The extent to which U.S physicians follow these guidelines has not been fully examined. This analysis describes the prevalence of resistant hypertension among visits to US physicians offices and the antihypertensive use recorded during these visits.
METHODS: We analyzed the National Ambulatory Medical Care Survey 2006-2009 and included all visits of non-pregnant adult patients with a history of hypertension, at least one anti-hypertensive medication, and a recorded blood pressure. Resistant hypertension was defined as the concurrent use of four or more antihypertensive medications or an elevated blood pressure despite the use of three or more medications. We calculated the prevalent use of recommended antihypertensive agents in patients taking multiple antihypertensive medications. We also compared visits of patients taking diuretics (loop or thiazide) versus those who were not, based on patient socio -demographic characteristics and type of physician.
RESULTS: From 2006-2009, 13,232 of the office visits to US ambulatory sites were available for this analysis;

of these, 9.1 percent met criteria for resistant hypertension. Among visits of patients with resistant hypertension, 80% reported use of either a thiazide or loop diuretic; this rate dropped to 49% among those with only 2 anti-hypertensive medications whose blood pressure was poorly controlled. Only 0.99% of those with resistant hypertension were taking chlorthalidone, and 8% were using an aldosterone antagonist. The most frequently used classes of anti-hypertensive medications among patients with resistant hypertension were beta blockers (79%), calcium channel blockers (64%), ACE inhibitors (57%), and thiazide diuretics (50%). The use of diuretics was not associated with patient characteristics or type of physician.
CONCLUSIONS: Visits of patients with resistant hypertension account for nine percent of all outpatient visits in the US among hypertensive patients. Increased use of diuretics, particularly chlorthalidone and aldosterone antagonist, is warranted.
RESULTS OF AN ENHANCED CLINIC HANDOFF ON RESIDENT PROFESSIONAL RESPONSIBILITY AND PATIENT SAFETY Marcus Dahlstrom1; Megan Prochaska1; Kimberly Beiting1; Shana Ratner2; Julie L. Oyler1; Lisa M. Vinci1; Vineet Arora1; Amber Pincavage1. 1University of Chicago, Chicago, IL; 2University of North Carolina - Chapel Hill, Chapel Hill, NC. (Control ID #1334592)
BACKGROUND: Year-End Internal Medicine resident clinic handoffs are a vulnerable time when patients may fall through the cracks. Despite this high risk, few interventions to improve this process have been described. Our study aims to evaluate the effectiveness of an enhanced handoff protocol on this transition.
METHODS: Our needs assessment in 2010 demonstrated that although clinic scheduling was effective, patients were lost to follow-up 6 months after the handoff due to missed visits. Patients who missed visits were at higher risk for a poor handoff as they were more likely to see the wrong PCP, have pending studies missed, be lost to follow-up and have an acute visit in the ED or hospital after the handoff. Furthermore, residents reported they did not take responsibility for a patient until they have been seen in the clinic. Using this data, we formalized a 2011 handoff protocol consisting of resident education, greater scheduling coordination, automatic rescheduling for missed visits, and protected time for PGY2s to call new clinic patients to establish care during telephone visits. In both years, graduating residents listed patients they perceived to be at high risk during the clinic handoff on a structured template which they used to handoff their patients during a designated meeting. PGY2 residents assuming care were surveyed regarding their beliefs of the clinic handoff process. Signouts and charts were reviewed to determine if and when patients were scheduled, if they saw the correct PCP, and acute care visits (ED visits or hospitalizations). Descriptive statistics, including Fisher exact and chi squared tests, were used for analysis.
RESULTS: In 2011, 27 graduating residents signed-out 323 high risk patients to 27 PGY2s. This was similar in 2010 (30 graduating residents, 258 high risk patients and 20 PGY2s). Most PGY2s completed surveys (92.5% vs. 95%, p=0.11). Compared with 2010 (baseline), 2011 residents reported longer handoffs (>20 minutes, 52% vs. 6%, p<0.001), more verbal handoffs (80% vs. 38%, p=

0.003), seeing more transfer patients 3 months post-handoff (>20 patients, 52% vs. 5%, p=0.001), and more patients who were aware of the handoff (100% vs. 74%, p=0.01). Many residents from 2011 (76%) reported using a telephone visit to establish care, and 44% reported discovering a missed test at that time. Fewer 2011 residents felt uncomfortable with paperwork for new clinic patients not yet seen (40% vs. 74%, p=0.03), and reported taking ownership of handoff patients before the first clinic visit (56% vs. 26%, p=0.05). Nearly all patients [98% (317/323) vs 97% (250/258), p=0.48] were scheduled for a follow-up appointment in both years. However, significantly more patients saw their correct PCP in 2011 (82% vs 44%, p<0.001) with a trend for patients to be seen in clinic during the month that their physician intended (40% vs 33%, p=0.056). Finally, a trend towards a decreased number of patients with acute care visits (ED and hospital stays) 3 months post-

handoff was observed in the 2011 patient panel (20% vs 26%, p=0.06).
CONCLUSIONS: Our intervention successfully improved the handoff process between residents, and was associated with an increased likelihood that patients saw the correct PCP in a timely manner and a trend towards reduced acute care visits 3 months after the handoff. Internal medicine residency clinics and their patients may benefit from adopting similar interventions targeting this handoff.
RISK ADJUSTMENT AND RISK SELECTION IN MEDICARE ADVANTAGE J. Michael McWilliams. 1Harvard Medical School, Boston, MA; 2Brigham and Women's Hospital, Boston, MA. (Control ID #1319873)
BACKGROUND: To address favorable selection in Medicare Advantage (MA), adjustment of plan payments for clinical diagnoses by the Centers for Medicare and Medicaid Services Hierarchical Condition Categories (CMSHCC) model and an enrollment lock-in were implemented from 2004 to 2007. The CMS-HCC model will also serve as the basis for risk adjustment of spending targets for accountable care organizations (ACOs) and plan revenues in state health insurance exchanges. The potential benefits of exchanges and ACOs could be undermined if plans and provider organizations avoid chronically ill and costly patients for whom these reforms were intended to improve coverage and care. The performance of the CMS-HCC risk adjustment system may therefore be an important determinant of success for key programs established by the Affordable Care Act, but its effectiveness in reducing favorable risk selection in MA remains unclear.
METHODS: Using survey and Medicare enrollment data from the nationally representative and longitudinal Medicare Current Beneficiary Survey, we estimated changes from 2001-2003 to 2006-2007 in differences in self-reported medical utilization and health between beneficiaries who switched into or out of MA and other beneficiaries in traditional Medicare (TM) or MA. We also compared differences in utilization and health between all MA and TM beneficiaries over this period.
RESULTS: Compared with TM beneficiaries in 2001-2003, new MA enrollees reported 33% lower total utilization (P=0.002), 45% fewer hospitalizations (P=0.02), 18% fewer prescription drug fills (P=0.02), and better health (difference in general health score: -0.19; P=0.04), consistent with favorable selection into MA. By 2006-2007, however, these differences were significantly narrowed or reversed to 8% lower (P=0.10), 3% fewer (P=0.81), 13% higher (P=0.007), and -0.01 (P=0.82), respectively. Differences between new and incumbent MA enrollees were similarly reduced. Annual rates of disenrollment from MA decreased from 10% in 2001-2003 to 3% in 2006-2007. Those disenrolling became significantly more costly and less healthy from 2001-2003 to 2006-2007 relative to other beneficiaries, but comparisons of all MA enrollees to all TM beneficiaries indicated net reductions in favorable selection. CONCLUSIONS: Adjustment of capitated payments for clinical diagnoses and an enrollment lock-in were associated with reduced selection of less costly and healthier beneficiaries into MA. Similar risk adjustment of prospective or global payments may help mitigate incentives for ACOs and plans competing in health insurance exchanges to select patients with favorable clinical risks.
RISK FACTOR MODEL TO PREDICT A MISSED CLINIC APPOINTMENT IN AN URBAN, ACADEMIC AND UNDERSERVED SETTING. Orlando L. Torres; Michael Rothberg; Owolabi Ogunneye. Baystate Health, Springfield, MA, MA. (Control ID #1334709)
BACKGROUND: In the chronic care model setting, a missed clinic appointment (or no-show) decreases continuity, adversely affects scheduling efficiency and can harm quality of care. The aim of this study is to identify the predictors of a missed clinic appointment and to develop a model to effectively predict an individuals likelihood of missing an appointment.
METHODS: We performed a retrospective study in an urban, academic and underserved outpatient Internal Medicine clinic from January 2008 to June 2011. All patients scheduled with an attending, resident or advanced practitioners were included. The primary endpoint was whether the patient attended or missed the appointment. A missed appointment was defined as a no-show or cancellation within 24 hours of the appointment time. Each patient was included only once, using the most recent appointment. Patient variables included age, gender, marital status, race, zip code, English language and number of previous visits. The visit variables included

provider type, day of the week, time of the day, season and time from booking to actual appointment. The patient population was divided into two randomly selected samples, a test sample (70%) and a validation sample (30%). The test sample was used to generate a logistic model. The validation sample was used to validate the model using the c-statistic and the Hosmer-Lemeshow goodness of fit test.
RESULTS: During the course of 3.5 years, 11,546 patients generated 163,554 encounters. The test population missed an appointment 45% of the time. In the multivariate model, male gender (OR 1.14, 95% CI 1.02,1.26), provider type (OR resident vs. attending 1.43, 95% CI 1.26,1.63) and season (OR fall vs. winter 1.25, 95% CI 1.03,1.51) were all positively associated with a missed appointment. The strongest predictors were percentage of previously missed appointments (OR per 1% increase 1.02, 95% CI 1.02,1.02), time from booking to actual appointment (OR per day1.02, 95% CI 1.02,1.02) and younger age (OR Age Group 55-65 vs. 18-300.45, 95% CI 0.37,0.54). Non-English Proficiency (OR 0.84, 95% CI 0.74,0.95) and Day of the week (OR Thursday vs. Monday 0.82, 95% CI0.70,0.97) were all negatively associated with a missed appointment. In the validation set, the multivariable model produced deciles of mean predicted risk from 16% to 74%, while the mean observed risk over the same deciles ranged from 14% to 71% (Figure 1). The predicted and observed rates of a missed appointment were 41%. The model showed no gross lack of fit (p=0.63), and the c-statistic was 0.71.
CONCLUSIONS: A simple risk factor model can assist in predicting the likelihood that an individual patient will miss an appointment.
RISK FACTORS OF FALL AMONG COMMUNITY-DWELLING OLDER ADULTS IN TAIWAN Chi Hua Yen. 1Chung Shan Medical University Hospital, Taichung, Taiwan; 2Chung Shan Medical University, Taichung, Taiwan. (Control ID #1336621)
BACKGROUND: Falling constitutes a significant hazard to the health and well-being of seniors. Preventing fall in the elderly is one of the important public health issues. The purpose of this research is to identify the risk factors for fall among the elderly population in Taiwan.
S302 ABSTRACTS JGIM
METHODS: Data were drawn from the Survey of Health and Living Status of the Elderly in Taiwan, a national longitudinal study. A total of 2310 seniors, aged 70 years and older were recruited in 1999. 1645 complete respondents were followed up in 2003, the lost cases were due to death and incomplete data. The independent variables collected in 1999 as risk factors to predict the occurrence of falls within 2003. A fall as dependent variable was defined according to self-report. A Chi-square test was used for univariate analyses first. Secondly, the significant independent variables were entered into the logistic regression analyses by three models including age, gender, education, life style factors and medication use, chronic diseases, nutrition status and general health, physical impairments, psycho-social status, activity and mobility.
RESULTS: The prevalence rate of fall at the 4-year follow-up point was 24% (n=395):11.6% reported one fall, 12.2% (n=395) reported two falls or more. By logistic regression analysis, risk factors of fall existed among persons with prior fall history (OR=1.7, 95% CI=1.3-2.3), incontinence (OR=1.6, 95% CI=1.1-2.4), low education level (OR=1.5, 95% CI=1.1-2.0) and diabetes history (OR=1.4, 95% CI=1.0-2.0). CONCLUSIONS: We conclude that prior fall history, incontinence, low education level and diabetes history are independent risk factors for fall. Those who are at high risk of falls should require more detailed assessment and active management to prevent falling.
RISK OF FALLS AND MAJOR BLEEDS IN PATIENTS ON ORAL ANTICOAGULATION THERAPY Jacques Donze1,4; Carole
Clair2; Balthasar L. Hug3; Nicolas Rodondi5; Gerard Waeber4; Jacques Cornuz2; Drahomir Aujesky5. 1Brigham and Women's Hospital, Boston, MA; 2University of Lausanne, Lausanne, Switzerland; 3University hospital of Basel, Basel, Switzerland; 4University hospital of Lausanne, Lausanne, Switzerland; 5University hospital of Bern, Bern, Switzerland. (Control ID #1316112)
BACKGROUND: The risk of falls is the most commonly cited reason for not providing oral anticoagulation

(OAC), although data on the risk of bleeding associated with falls on OAC remain conflicting. We aimed to evaluate whether patients on OAC with high fall risk have an increased risk of major bleeding METHODS: We prospectively studied all consecutive adult patients who were discharged on OAC between January 1, 2008 and March 31, 2009 from the department of medicine at a Swiss university hospital. The outcome was the time to a first major bleeding within a 12-month follow-up period. Major bleeding was defined as a fatal bleeding, a symptomatic bleeding in a critical organ or a bleeding causing a fall in hemoglobin level 20 g/L or leading to a transfusion 2 units of packed red cells. We assessed the risk of falls using two validated screening questions: 1) Did you fall during the last year? If not 2) Did you notice any problem with gait, balance, or mobility? Patients who answered yes to 1 screening question were considered at high risk of falls. All other patients were considered to be at low risk. To examine the association between fall risk and major bleeding, we used a Cox proportional hazards model, adjusted for age, gender, alcohol abuse, number of drugs, concomitant treatment with antiplatelet agents, and history of stroke or transient ischemic attack.
RESULTS: Among 515 enrolled patients, 35 had a first major bleeding during follow-up (incidence: 7.5 per 100 patient-years). Overall, 308 patients (59.8%) were at high risk of falls, and these patients had a non-significantly higher crude incidence of major bleeding than patients at low risk of falls (8.0 vs. 6.8 per 100 patient-years, P=0.64). In multivariate analysis, a high fall risk was not associated with major bleeding (hazard ratio [HR] 1.09, 95% confidence interval [CI] 0.54-2.21). Only the number of medications (HR 1.15 per additional drug taken, 95% CI 1.04-1.26) and female gender (HR 2.19, 95% CI 1.00-4.80) were significantly associated with major bleeding (Table). Overall, only 3/35 major bleedings were directly related to a fall (incidence: 0.6 per 100 patient-years). CONCLUSIONS: In this prospective cohort, patients on OAC at high risk of falls did not have a significantly increased risk of major
bleeds. These findings suggest that being at risk of falls is not a valid reason to avoid OAC in medical patients.
Table. Risk of major bleeding in Cox multivariable-adjusted analyses (n=515)
Variable HR 95% CIHigh risk of falls 1.09 (0.54 - 2.21) Number of medication(s), per additional drug taken 1.15 (1.04 - 1.26) * Female 2.19 (1.00 - 4.80) * Alcohol abuse 0.28 (0.04 - 2.07) History of stroke or transient ischemic attack 0.82 (0.29 - 2.36) Age, per 10 years 1.17 (0.88 - 1.55) Concomitant antiplatelet therapy 0.56 (0.26 - 1.22)
* P <0.05
RISK-BENEFIT DISCUSSION PRIOR TO COMPUTED TOMOGRAPHY IMAGING - INFREQUENT AND INEFFECTIVE? Tanner Caverly1,2; Daniel Richlie2; Allan V. Prochazka2,1; Margaret K. Cook-Shimanek3; Mary Pawlak3; Jennifer Woodward3; Chad Stickrath2,1.
1University of Colorado Denver, Denver, CO; 2Denver Veterans Affairs Medical Center, Denver, CO; 3University of Colorado Denver, Denver, CO. (Control ID #1339382)
BACKGROUND: There have been calls for mandatory informed consent prior to ordering computed tomography (CT) imaging given best estimates of the risk of developing cancer after a single scan (about 1 case of cancer out of 300-2000 people scanned). The frequency and quality of shared decision making prior to ordering CT imaging is not well studied. We evaluated the frequency and impact of risk-benefit discussions for patients getting outpatient, non-emergent scans.
METHODS: This was a cross-sectional, single-center survey at the Denver Veteran Affairs Medical Center. Consecutive patients in the outpatient CT scan waiting room were invited to complete a short, self-administered survey. The survey contained items assessing participant demographics, knowledge of radiation risks, presence of risk-benefit discussion, and preference for more information (Table 1). Using a 0-10 Likert scale (0=no radiation; 10=high radiation), participants gave a subjective value to the amount of radiation associated with 1 CT scan, living 1 year in Colorado, chest x-ray, and MRI. Pearsons Chi-squared test of association was used to determine general associations.
RESULTS: Of 286 patients invited, 271 responded representing a 94.8% response rate. 85.5% of respondents

were over 50 years old, 92.1% were male, and 26.2% had a high school education or less. Only 17.4% (n=46) reported all of the following: having a shared final decision, discussing the risks, and discussing the benefits with their provider. To assess the effect that risk-benefit discussion had on knowledge, we used knowledge that a CT scan has a higher level of radiation than a chest x-ray. Overall, 40.7% (n=101) of respondents ranked the radiation exposure from a CT scan higher than a chest x-ray. This knowledge was no different between participants based on the presence of a risk-benefit discussion; 38.3% answering correctly of those who reported having a risk-benefit discussion versus 41.6% of those not reporting a risk-benefit discussion (p-value 0.617). Likewise, knowledge was no different between participants who reported a shared final decision and those who did not(47.1% versus 36.5%; p-value 0.103). When participants recalled discussing both risks and benefits with their provider they were much less likely to feel they needed more information; 5.7% feeling the need for more information of those recalling a risk-benefit discussion versus 31.3% of those who did not recall a risk-benefit discussion (p-value<0.00001). Similarly, when patients reported a shared final decision they were less likely to feel they needed more information (15.1% versus 26.9%; p-value 0.028).
CONCLUSIONS: Few patients recall discussing both risks and benefits prior to undergoing CT imaging. Although patients who did report a risk-benefit discussion did not feel they needed more information, these discussions did not seem to improve even basic knowledge of the relative radiation dose. This calls into question the quality of the few discussions

taking place. Future studies should evaluate which tools and practices can more effectively inform patients.
Risk-benefit discussion and preference for more information
Who made the final decision to have a CT scan done? (n= 267)
Frequency (%)
The doctor and I made the decision together. 34.8% Did your provider discuss the potential benefits of the testwith you (n=267)? YES
67.4%
Do you feel you need more information about the benefits(n=266)? YES
25.9%
Did your provider discuss the potential risks of the test withyou (n=266)? YES
35.3%
Do you feel you need more information about the risks(n=264)? YES
43.6%
ROFLUMILAST TREATMENT WITH CONCOMITANT TIOTROPIUM: EFFECT ON LUNG FUNCTION IN SEVERE COPD PATIENTS Leonardo M. Fabbri1; Fernando J. Martinez2; Udo-Michael Goehring3; Manja Brose3; Hassan Lakkis4; Paul Rowe4.
1University of Modena &Reggio Emilia, Modena, Italy; 2University of Michigan Medical Center, Ann Arbor, MI; 3Nycomed GmbH: A Takeda Company, Konstanz, Germany; 4Forest Research Institute, Jersey City, NJ.
(Control ID #1336196)
BACKGROUND: Chronic obstructive pulmonary disease (COPD) is characterized by chronic respiratory symptoms and airflow limitation; bronchodilators are central to symptom management in COPD. In the pivotal studies, roflumilast, a treatment to reduce COPD exacerbation rates, also significantly improved lung function. In the M2-128 study, roflumilast- and placebo-treated patients received concomitant tiotropium, a bronchodilator, to evaluate the add-on effects of roflumilast on lung function (1). The present analysis examined a subset of severe COPD patients (defined by FEV1 between 30%-50% of a patients predicted value), a cohort that is likely to be seen by clinicians and that is similar to the approved treatment population for roflumilast.

METHODS: Data were analyzed from this 24-week study examining the effect of roflumilast in moderate to severe COPD patients randomized to roflumilast 500 g QD+tiotropium 18 g QD (ROF+TIO) or placebo+ tiotropium 18 g QD (PBO+TIO). Patients were required to have chronic cough or sputum production and frequent short-acting beta-2 agonist use. These prespecified analyses assessed lung function (mean changes from baseline during treatment in pre- and postbronchodilator FEV1) in the overall population (1) and a subset of patients with severe COPD. RESULTS: A total of 743 patients were randomized to ROF+TIO (n= 371) or PBO+TIO (n=372). Of these, 244 patients had severe COPD (ROF+TIO, n=125; PBO+TIO, n=119). Demographics were similar between treatment groups in the overall population and severe patient subset. Among the severe COPD subset patients, treatment with ROF+TIO resulted in significant improvements in pre- and postbronchodilator FEV1 at all time points versus PBO+TIO (both P<0.05). Lung function with ROF+TIO treatment was also improved from baseline during treatment over PBO+TIO treatment, with differences of 68 mL and 73 mL (p=0.015 and 0.008) for pre- and postbronchodilator FEV1, respectively. CONCLUSIONS: Bronchodilators are central to COPD management, although a subgroup of patients experience recurrent exacerbations even with bronchodilator treatment. Roflumilast reduces the risk of exacerbations in patients with severe COPD associated with chronic bronchitis and history of exacerbations. Here, effects on lung function with concomitant roflumilast and tiotropium treatment were examined. Among severe COPD patients, roflumilast treatment with concomitant tiotropium significantly improved lung function versus tiotropium use alone. These results suggest that in patients with severe COPD, chronic cough and sputum production, roflumilast in combination with tiotropium may provide further improvements in lung function. 1) Fabbri LM, Calverley PM, Izquierdo-Alonso JL, Bundschuh DS, Brose M, Martinez FJ, Rabe KF; M2-127 and M2-128 study groups. Roflumilast in moderate-to-severe chronic obstructive pulmonary
disease treated with longacting bronchodilators: two randomised clinical trials. Lancet. 2009 Aug 29;374(9691):695-703.

ROLE OF SELF-EFFICACY IN THE MANAGEMENT OF TYPE 2 DIABETES MELLITUS - A SYSTEMATIC REVIEW Apoorva K. Chandar1; Corinna Falck-Ytter2; Adam T. Perzynski2; Alida M. Gertz4; Donna Windish5; Carl V. Tyler3; Paulette A. Sage1; Shari Bolen2. 1Case Western Reserve University, Cleveland, OH; 2MetroHealth Medical Center, Cleveland, OH; 3Cleveland Clinic, Cleveland, OH; 4The Johns Hopkins Hospital, Baltimore, OH; 5Yale School of Medicine, New Haven, CT. (Control ID #1339881)

BACKGROUND: Theories of health behavior change (including The Theory of Reasoned Action and The Transtheoretical Model) posit that a persons self-efficacy has a strong positive influence on health behavior change. Little is known about the extent to which self-efficacy improves across behavior change interventions and the extent to which improvements in self-efficacy are associated with improvements in intermediate diabetes outcomes like HbA1c. Therefore, we conducted a comprehensive review of published literature to assess the role of self-efficacy in self-management interventions of adults with Type 2 Diabetes Mellitus (DM).

METHODS: We searched MEDLINE, EMBASE, CINAHL and Cochrane databases from inception for original English Language articles combining the search terms for Type 2 DM, Randomized Controlled Trials, and self-management interventions. Using standardized protocols, reviewers extracted data from each article that assessed the impact of self-efficacy and also measured an intermediate outcome (A1c, SBP, weight, lipids), a long term outcome (i.e. complications or mortality), or a safety outcome. Quantitative and qualitative analysis of the data was conducted to determine the effect of self-efficacy in mediating health behavior change in Type 2 DM patients.

RESULTS: Of the 10,219 citations available, twenty-seven articles discussed self-efficacy out of 100 articles from a larger systematic review evaluating the effectiveness and safety of self management interventions for adults with Type2 DM. We were unable to combine the data in a meta-analysis due to heterogeneity in study populations, interventions, and measurement scales. More than half (n=14) of the studies were based in the US. The mean sample size was 240 (Range=57 to 824) with a mean study duration of 10 months. Twenty-two

percent of studies discussed self efficacy as a theoretical construct or mentioned it qualitatively but did not report a quantitative outcome. Of the 21 studies that quantitatively measured self-efficacy, most (71%) used fully validated scales such as the DMSES (Diabetes Management Self-Efficacy Scale). Among these, significant improvement in self-efficacy of treatment over control groups was seen in 57% (n=12). Fifty-six percent of the articles that reported a significant improvement in self-efficacy also reported a significant improvement in HbA1c (5 of 9 studies), while only 1% of the articles with no significant improvements in self-efficacy showed significant improvements in HbA1c (1 of 7 articles). Two studies reported that self-efficacy levels returned to baseline values or lower despite having shown initial improvement. Too few studies (n=3) reported mediation effects of self-efficacy levels on other positive health behaviors such as self-management, goal setting and problem solving to draw any firm conclusions. CONCLUSIONS: Improving self-efficacy is associated with improvements in important physiological outcomes such as HbA1c. However, improving self efficacy alone may not be sufficient, and we should continue to investigate other mechanisms to help promote positive health behavior change.

ROUNDING PRACTICES AT AN ACADEMIC MEDICAL CENTER Marwa Shoeb; Raman R. Khanna; Daniel Westerdahl; Bradley Monash. UCSF, San Francisco, CA. (Control ID #1339310)

BACKGROUND: Patient centered rounds (PCR), where the presentation of the history and physical and the discussion of the care plan occur in the presence of the patient, have historically served as the primary means for inpatient attending physicians to teach trainees, to learn about their patients, and to model humanistic behavior. With changing resident work hour regulations, increased reliance on information technology, and the

advent of hospital medicine, rounds have shifted away from this patient centered, bedside model. Our study aimed to determine current and optimal rounding practices at our institution.

METHODS: We conducted a survey of inpatient attending physicians at a large tertiary care urban academic medical center. Surveys were distributed through our teaching attending listserv. We outlined three models for attending rounds based on our discussion with several inpatient clinician educators and associate program directors: 1) patient-centered rounds (PCR), defined above;2) hallway rounds (HR), where the discussion of the patient and care plan occurs partially outside the patient's room and partially at the patient's bedside in the presence of the patient and team; and 3) card-flipping rounds (CFR), where the discussion of the patient and care plan occurs entirely outside of the patients room and the team does not see the patient together. We ascertained demographic information and the frequency with which different models are used. We also assessed the perceived value of each model for promoting ACGME core competencies, the primary goals of rounding, and the perceived barriers to conducting PCR.

RESULTS: Of the 39 attending physicians who responded, 25 completed the survey (64%). 52% were women and 54% had at least 3 years of experience attending on inpatient teaching services. HR proved to be the model used most frequently for new and established patients (56% and 45% respectively), followed by CFR (38% and 45%). Of the attending physicians surveyed, most agreed or strongly agreed that compared with CFR, PCR and HR promoted the following ACGME competencies: patient care (32%, 76% and 96% respectively, $p < 0.001$), systems-based practice (60%, 60% and 76%, $p=0.34$), professionalism (24%, 84% and 80%, $p=0.02$), and interpersonal and communication skills (16%, 96% and 92%, $p=0.04$). As opposed to CFR, PCR and HR also scored well in achieving the following goals of rounds: role modeling (17%, 88% and 79%, $p<0.001$), patient understanding of care plan (4%, 68% and 84%, $p=0.003$), and patient involvement in care (4%, 88% and 72%, $p=0.001$). CFR functioned well in promoting medical knowledge and team communication, compared with PCR and HR (88%, 44% and 84%, $p=0.007$). Despite its perceived virtues, 68% of surveyed attending physicians said they never used PCR. Time constraints and patient psychosocial complexities were frequently cited as barriers to performing PCR (84% and 52%).

CONCLUSIONS: PCR and HR are perceived to be equally valuable for promoting the ACGME competencies of

patient care, systems-based practice, professionalism, and communication and interpersonal skills, but PCR is considered superior for role modeling and HR for team communication. Approximately two thirds of inpatient attending physicians never use PCR, with time constraints and patient psychosocial complexities most frequently perceived as significant barriers. Despite being considered mostly inferior to PCR or HR, CFR remains frequently employed.

SMAD4 MUTATION INDICATIVE OF JUVENILE POLYPOSIS IN A LARGE FAMILY INITIALLY DIAGNOSED WITH MENETRIER DISEASE Steven H. Yale1,3; Deanna S. Cross2; James K. Burmester2.
1Marshfield Clinic, Marshfield, WI; 2Marshfield Clinic Research Foundation, Marshfield, WI; 3Marshfield Clinic Research Foundation, Marshfield, WI. (Control ID #1337741)

BACKGROUND: Menetrier disease (MD) is a rare disease characterized by hypertrophic folds within the fundus and body of the stomach with antral sparing accompanied by increased proliferation of mucous cells within the gastric glands. Clinical presentation includes hypochlorhydria, hypoproteinemia and enhanced mucous production. Current treatment involves blocking epidermal growth factor receptor (EGFR) with neutralizing antibodies or surgical gastrectomy. Understanding the role of genes which regulate TGF, EGFR, PdX1, SMAD4 and BMPR1A in Menetrier disease is critical toward gaining insight into disease pathogenesis, which may translate into more efficient, safe, and cost-effective treatments. The goal of this study is to sequence regulatory regions of the genes encoding TGF and PdX1 known to be overexpressed in a family of 50 individuals, some of whom have Menetrier disease, in order to determine if overexpression is caused by a mutation in the promoter region. We sequenced SMAD4 and BMPR1A in an attempt to determine if genes involved in Juvenile Polyposis Syndrome, a condition closely related to Menetrier disease, are also involved in this disease.

METHODS: A family of more than 100 individuals across 4 generations was identified. This family had 5 cases of MD, 1 case of MD and juvenile polyposis (JP) and 2 cases of JP. Subjects provided blood for DNA extraction and completed a questionnaire regarding gastric polyps, gastritis, gastric cancer, gastroesophogeal reflux, gastrointestinal bleeding, helicobacter pylori infection, hemorrhagic telangiectasia, epistasis, juvenile polyposis, diabetes and other diseases that may be involved in the development of MD. After diagraming the family pedigree, selected affected and non-affected family members were DNA sequenced at the coding regions of the SMAD4 and BMPR1A genes and the regulatory regions of TGF- and Pdx1 genes. RESULTS: No mutations were identified in the sequenced regions of BMPR1A, TGF- or Pdx1. A dominant 1244_1247delACAG mutation of SMAD4 was identified in each of the subjects with JP as well as each of the subjects with MD. Although this mutation segregated through the family in association with disease there were also unaffected/undiagnosed carriers of the mutation. CONCLUSIONS: The 1244_1247delACAG mutation of SMAD4 is the cause of JP and the likely cause for MD in a large family initially diagnosed with MD. This study provided the first evidence of a genetic link shared by JP and MD. Gene polymorphisms identified as associated with this disease will thus serve as markers for determining risk of acquiring Menetrier disease in unaffected family members. All family members were advised to meet with their physician and discuss genetic testing for this mutation since there are specific screening recommendation for JP and hereditary hemorrhagic telangiectasia for carriers of the SMAD4 mutation.

SUBSTITUTION TREATMENT FOR ALL DEPENDENT OPIOID USERS IS POSSIBLE IN JAIL: A CASE STUDY OF SWITZERLAND Hans Wolff; Thierry Favrod-Coune; Mariem Baroudi; Jean-Pierre Rieder; Laurent Gtaz; Javier Barro; Jean-Michel T. Gaspoz; Barbara Broers. Geneva University Hospitals and University of Geneva, Geneva, Switzerland. (Control ID #1321592)

BACKGROUND: Detainees are a vulnerable population with limited access to healthcare previous to incarceration due to educational, social and economic disadvantage. They have a high burden of disease, particularly blood borne infections and addiction. The prevalence of illicit drug use in correctional facilities is estimated 50 to 80% in most European countries and the US, mainly due to cannabis, cocaine and heroin. Opioid substitution treatment (OST) prevents transmission of blood borne infections and overdose. In

contradiction with international rules and recommendations OST is not available in every prison. In Switzerland largest pre-trial prison OST is provided by trained primary care physicians and available since 20 years for all opioid dependent prisoners. The aim of this study was to provide a detailed description of OST in Switzerlands largest remand prison, to establish if it respects the international recommendations and if OST is feasible in a pre-trial prison setting. METHODS: This retrospective longitudinal study included all standardized health records of opioid using detainees entering Switzerlands largest remand prison during 2007. OST dependence was determined by history of current opioid use with 1. a positive urine test, 2. participation in an OST program (written confirmation by direct contact with the treating physician) or 3. objective opioid withdrawal signs. Detailed information was reported concerning: sociodemographic characteristics, diagnosis and characteristics of substance use, type of opioid substitution treatment, complications during OST or death. Analyzes were descriptive. RESULTS: A total of 2566 health records were reviewed. Mean age was29.6 years (SD 7.1); 95.4% were male and 92.8% were of foreign origin. Main regions of origin were: Western Europe (28.9%), followed by North Africa, Middle East (27.5%) and Sub-Saharan Africa (20.1%). Length of stay was short, as 27% stayed less than one week and 78% less than three months. Two hundred forty-one (9.4%) used opioids. Of them, 68.9% were opioid dependent and 31.1% had occasional use. History of intravenous use was identified in 40.4% among dependent users. Other routes of use were intranasal (61%), smoked (34%) and unknown for 4.6%. OST was proposed to all dependent users. A quarter (27.1%) had established OST in the community and received OST. The majority (72.3%) of all entering opioid users had no current OST. They received a first dose of methadone of max. 40 mg with progressive adaptation according to withdrawal signs; no refusal was observed. The prescribed OSTwas methadone in 95.8% with a mean dose of 41.7 mg (SD 29.1). No death by overdose or serious side effect were

observed. Follow-up was organized for 81.2% of dependent and for 18.2% of occasional opioid users. CONCLUSIONS: Prescription of OST for all opioid dependent detainees, by trained physicians, is feasible in a pre-trial setting. Treatment was overall in accordance with international guidelines, although methadone dose was low. Better implementation of OST is needed in all correctional facilities -worldwide- and helps to improve access to community OST facilities after detention.

SAFETY OF ONCE-DAILY GABAPENTIN FOR THE TREATMENT OF POSTHERPETIC NEURALGIA IN PATIENTS WITH A CREATININE CLEARANCE <80 ML/MIN John T. Mathis1; Daniel Kantor2; Richard L. Rauck3; Gordon Irving4; Michael Sweeney1; GeertruiF. Vanhove1. 1Depomed Inc, Menlo Park, CA; 2Neurologique Foundation, Ponte Vedra, FL; 3Carolinas Pain Institute, Winston-Salem, NC; 4Swedish Pain Center, Seattle, WA. (Control ID #1331882)

BACKGROUND: Gabapentin is a first-line treatment for postherpetic neuralgia (PHN). However, due to gabapentins short elimination half-life and its absorption by a saturable transporter with limited distribution in the proximal small bowel, gabapentin needs to be dosed TID. Gabapentin TID is associated with a high incidence of somnolence and dizziness that may prevent efficacious dosages from being reached. Recently, a once-daily gastroretentive formulation of gabapentin (G-QD) was approved for the treatment of PHN. Upon contact with gastric fluid, G-QD tablets swell to a size that promotes retention in the fed stomach. This prolonged retention (approximately 8 to 10 hours) allows gabapentin to be gradually released to the site of absorption, minimizing the chance of saturating transporter uptake and resulting in greater absorption. This permits once-daily dosing and may result in less somnolence and dizziness, G-QD is renally excreted; dosing adjustment is required in patients with a creatinine clearance (CrCL) between 30 and 60 mL/min. G-QD should not be administered in patients with a CrCL <30 mL/min or in patients undergoing hemodialysis.

METHODS: An 11-week, Phase 3, double-blind, randomized, placebo-controlled study evaluated the safety and

efficacy of G-QD (1800 mg, qd) in patients with PHN. The primary endpoint was the change in average pain for the past 24 hours (ADP) as assessed by the Numeric Pain Rating Scale (NPRS), with scores recorded every morning from Baseline to Week 10. Safety was evaluated by periodic assessments of adverse events (AEs), baseline and end of study vital signs, and routine hematology and blood chemistry. Patients with an estimated CrCL <50 mL/min as calculated by the Cockcroft and Gault equation, were excluded from the study. AE subgroup analyses were performed on patients with an estimated CrCL <80 mL/min. RESULTS: 452 patients (mean age, 65.6 years) were randomized; 377 patients completed the study (84%, G-QD; 83%, placebo). G-QD was generally well tolerated and AEs were reported by 118 (53%) patients in the G-QD arm and 92 (40%) patients in the placebo arm; dizziness (11% G-QD; 2%, placebo), somnolence (5%, G-QD; 3%, placebo), and peripheral edema (3% G-QD; <1%, placebo) were some of the more common AEs, with 9% of G-QD patients and 4% of placebo patients withdrawing due to AEs. Of the patients randomized, 205 patients (100, G-QD; 105, placebo) had an estimated CrCL of <80 ml/min. In this subgroup, a total of 56 (56%) G-QD patients and 46 (44%) placebo patients reported at least one AE. The incidence of dizziness (13%), somnolence (4%) and peripheral edema (2%) in patients treated with G-QD in this subpopulation were comparable to the overall safety population. CONCLUSIONS: G-QD was generally safe and well tolerated and had a similar AE profile in the subgroup with a CrCL <80 mL/min compared to the overall safety population. G-QD can be an effective, well-tolerated treatment option for PHN even in patients with a CrCL <80 mL/min.

SCHWARTZ CENTER CONNECTIONS: QUALITY WITH COMPASSION James M. Richter2; Beth Lown1; Karen Gareis3; William Kormos2; Gila Kriegel4; Daniel A. Leffler4; Colleen Manning3; Gregg Meyer2; Ann Louise Puopolo5; Kenneth Sands4; Amy Ship4; Eric M. Weil2. 1Schwartz Center for Compassionate Healthcare, Boston, MA;

2Massachusetts General Hospital, Boston, MA; 3Goodman Research Group, Inc., Cambridge, MA; 4Beth Israel Deaconess Medical Center, Boston, MA; 5CRICO/RMF, Boston, MA. (Control ID #1319446)

BACKGROUND: Effective communication between clinicians, support staff, and patients is essential for efficient diagnosis and follow-up. Communication lapses compromise clinical care quality and patient safety resulting in poor health outcomes and increased malpractice risk. Communication between disciplines can be especially challenging given their siloed departmental structures. We implemented Schwartz Center Connections to discuss causes of communication lapses in outpatient settings and to build relationships across disciplines. METHODS: We invited primary care and gastroenterology clinicians and support staff at two academic medical centers to attend five pilot program sessions conducted over nine months. Sessions were facilitated, case-based discussions of communication lapses involving patients shared by both disciplines, derived from closed malpractice claims. We used a pre-post program-comparison group design to evaluate the program. The evaluation sample included 112 clinicians; 56 attended two or more sessions and 56 non-attendees comprised the comparison group. Data collection included online surveys and individual and focus group interviews with participants and stake-holders. ANOVAs were conducted to examine the relationship between program participation and changes in the intended outcomes. RESULTS: Ten survey items with high internal consistency were included in a composite Communication Lapse Prevention Scale." Scale items included knowledge about systems that support information sharing, roles of team members within and across departments to ensure communication about diagnostic findings, strategies to clarify responsibility for communicating about abnormal findings and for patient follow-up, and for discussing bad news and errors with patients, strategies to help patients assume responsibility for communicating and following up with providers, and for resolving differences in judgment among providers. The effect size of the program on this scale was large (d=0.79). The program had a significant impact ($p<0.01$) on the knowledge of communication strategies and self-reported communication behaviors for the treatment group at both pilot sites relative to the comparison group. At program conclusion, 91% of attendees reported increased likelihood of recognizing communication lapses; 93% reported increased likelihood of intervening to avert lapses. In addition, participants affirmed that the program fostered relationships

and promoted communication across participating disciplines and energized existing quality initiatives at both hospitals.
CONCLUSIONS: The Schwartz Center Connections program resulted in significant changes in knowledge about communication lapses, and in reported behaviors that prevent lapses which contribute to delay in diagnosis and inadequate follow-up of screening and diagnostic tests. Combining discussion sessions with working group sessions to implement suggestions for policy and/or system changes may enhance the effect of the program on patient care. The programs curriculum design, educational methods and assessment processes can be easily adapted for use across other disciplines and settings within institutions, and across health care systems. Adoption of this program may facilitate improvement in inter-provider and patient-provider communication necessary to reduce the occurrence of adverse events, poor patient health outcomes, and subsequent malpractice claims.
SECONDHAND SMOKE EXPOSURE AMONG YOUNG ADULTS ATTENDING BARS Sara Kalkhoran; Pamela M. Ling. University of California, San Francisco, San Francisco, CA. (Control ID #1337813)
BACKGROUND: Both active tobacco use and exposure to secondhand smoke (SHS) have serious health consequences. Young adults are increasingly at risk for smoking initiation, and cessation before age 30 eliminates most negative health effects of smoking. Young adults have high rates of SHS exposure, but little is known about how this relates to smoking behavior. Since bar attendance is associated with smoking, we aimed to describe sources of SHS exposure among young adults attending bars and clubs and to assess associations between SHS exposure and smoking cessation and initiation.
METHODS: Randomized time-location samples of bar-going young adults aged 18-26 in San Diego, CA (N=1305) and Oklahoma City (OKC) (N=1264) and Tulsa (N=1250), OK completed cross-sectional surveys from Sept 2010 to July 2011. Respondents reported exposure to

SHS in the past seven days in various locations (work, home, car, bar). Multivariate logistic regression was used to evaluate associations between SHS exposure and intention to quit in current smokers, and between SHS exposure and susceptibility to start smoking in nonsmokers, controlling for age, race, gender, and education.
RESULTS: Over 90% of respondents at both the California and Oklahoma study sites reported any exposure to SHS, and over 70% reported exposure in a bar (figure 1); the lowest exposure rates were in indoor workplaces. Respondents in San Diego reported SHS exposure at all locations significantly less frequently. Exposure to SHS at home was negatively associated with attempts to quit in daily smokers (OR=0.70 95%CI [0.51, 0.96]). Among nondaily smokers, exposure to SHS in a car was positively associated with attempts to quit (OR=1.48 [1.16, 1.90]). Among nonsmokers, any SHS exposure was associated with susceptibility to start smoking (OR=1.66 [1.12, 2.47]), as was reporting SHS exposure in a car (OR=1.75 [1.39, 2.21]). CONCLUSIONS: Young adults attending bars continue to report very high SHS exposure rates, particularly in bars. Though rates were significantly lower in California than Oklahoma, overall rates were higher than reported in statewide data (80% of young adults were exposed in CA in 2008). Daily smokers without smokefree homes were less likely to have tried to quit smoking, and nonsmokers exposed to any SHS were more susceptible to start smoking. Promoting smokefree environments may enhance cessation in established smokers or prevent initiation in nonsmoking young adults. Intense SHS exposure (such as in a car) may motivate quit attempts in nondaily smokers, perhaps because they are more bothered by this exposure. Clinicians seeing young adult patients should screen for and counsel against SHS exposure, and encourage them to make their homes and cars smokefree.
SELF-ADMINISTERED SUBSTANCE USE SCREENING AND ASSESSMENT IN PRIMARY CARE SETTINGS: TEST-RETEST RELIABILITY OF AN AUDIO COMPUTERIZED-ASSISTED SELF-INTERVIEW (ACASI) VERSION OF THE ASSIST Jennifer McNeely1;

Shiela Strauss2; Rubina Khan1; Shana Wright1,3; John Rotrosen3; Marc N. Gourevitch1. 1NYU School of Medicine, New York, NY; 2NYU College of Nursing, New York, NY; 3NYU School of Medicine, New York, NY. (Control ID #1319841)
BACKGROUND: To maximize the use of limited clinical time, medical providers are increasingly turning to patient self-administered health assessments. This approach is particularly relevant for behavioral health conditions such as substance use, which have high prevalence but frequently go undetected, and often require detailed assessments to guide clinical interventions. The WHO Alcohol and Substance Involvement Screening Test (ASSIST) is a comprehensive substance use screening and assessment instrument that has been validated in interview format, but not as a self-administered measure.
We therefore studied the test-retest reliability of an audio guided computer-assisted self-interview (ACASI) version of the ASSIST in identifying unhealthy use of tobacco, alcohol and illicit drugs, as a first step in establishing its feasibility in primary care settings. METHODS: We adapted the ASSIST to ACASI format and administered it on touch-screen tablet computers. Patients were approached consecutively in the waiting area of a large urban safety-net primary care clinic and screened for eligibility. Basic eligibility criteria were: current clinic patient, English or Spanish speaking, age 18-65. We oversampled patients anticipated to have greater difficulty using the ACASI instrument (less than high school education, 50-65 years old, primary language Spanish). Participants completed the ACASI ASSIST at the initial visit, and were asked to return 1-3 weeks later to repeat it. Agreement between ASSIST results at the first and second administration was evaluated with intraclass correlation coefficients (ICC) and McNemars tests.
RESULTS: The 87 participants were 55% female, with mean age 44 years (range 19-63 years, SD=9). The majority (59%) was foreign born, and 63% were Hispanic, 30% African American. 44 (51%) had less than high school education/GED. 46 participants completed the ASSIST in English, 41 in Spanish. Mean time to complete the ACASI ASSIST on the first administration was 5.4 minutes (range 1.4-14.8 min, SD=2.4). 22 (25%) participants screened positive for current (past 3 months) use of tobacco, 48 (55%) for alcohol, and 27 (30%) for illicit drugs, including nonmedical use of prescription opioids or stimulants. Based on ASSIST scores, 39 (45%) had moderate or high risk use of alcohol and/or illicit drugs (4 alcohol, 23 illicit drugs, 12 both). The 48 (55%) participants who returned for the second visit had similar demographics, but slightly higher levels of illicit drug use, than those who did not. We found excellent correlation between global ACASI ASSIST scores on the first and second administration (ICC=0.77, P<0.001). Substance specific risk scores, which distinguish between low, moderate and high risk use, had excellent correlation for tobacco and alcohol (tobacco ICC=0.80 and alcohol ICC=0.83, P<0.001) and good correlation for illicit drugs (ICC=0.64, P<0.001). There were no significant differences between test administrations in detecting moderate to high risk use, based on McNemars tests, for tobacco (P=0.63), alcohol (P=1.00), or for any illicit drug (P=0.22).
CONCLUSIONS: The self-administered ACASI ASSIST detected high levels of substance use among primary care patients, and had good test-retest reliability. Further research will evaluate the validity of ACASI ASSIST responses, as well as its feasibility in primary care practice and acceptability to patients.
SELF-PERCEPTION OF CARDIOVASCULAR RISK AMONG NICOTINE-DEPENDENT SMOKERS Benoit Desgraz1; Tinh-Hai Collet1; Nicolas Rodondi2,1; Jacques Cornuz1. 1University of Lausanne, Lausanne, Switzerland; 2University Hospital of Bern, Bern, Switzerland. (Control ID #1334352)
BACKGROUND: Previous studies suggest that smokers have a misperception of their 10-year cardiovascular risk. We aimed to compare 10-year cardiovascular risk self-perception among smokers with 10-year cardiovascular risk calculated by Framingham score, and the determinants of this possible misperception.
METHODS: We collected data on cardiovascular risk factors (RF) and demographics of 514 participants recruited for a randomized controlled trial on smoking cessation. We defined cardiovascular RF as follows: Hypertension as140 systolic mmHg and/or 90 diastolic mmHg, except for participants with diabetes mellitus130 and/or 80 mmHg; Dyslipidemia, according to ATP-III guidelines, as LDL-cholesterol2.6 mmol/L, 3.4 mmol/L, 4.1

mmol/L for high (>20%), moderate (10-20%) and low (<10%) risk subjects, respectively; Diabetes mellitus as fasting blood glucose7.0 mmol/L. Participants were asked to estimate their 10-year cardiovascular risk using a 3-item scale corresponding to high, moderate and low risk categories. We determined and compared the characteristics of participants according to their self-reported risk categories and their

Framingham score categories. We used multi-variate logistic regression models to determine characteristics of participants who underestimate their risk vs. those who correctly estimate it.
RESULTS: Participants (mean age 51.1 years, range 40-70 years; 46% women) smoked an average of 24 cigarettes per day with a median duration of 32 years. 214 smokers (42%) correctly estimated their 10-year cardiovascular risk compared to their calculated 10-year cardiovascular risk. 39% (200) overestimated their cardiovascular risk while 19% (100) underestimated it. An underestimated 10-year cardiovascular risk was associated with male gender (OR 6.33 ; CI 2.90-13.84), increasing age (OR per 5 years=1.36 ; CI 1.02-1.81), dyslipidemia (OR 2.23 ; CI 1.16-4.26) and diabetes mellitus (OR 6.27 ; CI 1.94-20.27). Socioeconomic status was not associated with inappropriate risk perception.
CONCLUSIONS: In our study of nicotine-dependent smokers, 58% of participants had a misperception of their 10-year cardiovascular risk. Male gender, older age, the presence of diabetes mellitus and dyslipidemia were associated with cardiovascular risk underestimation. These findings may help physicians emphasize on cardiovascular risk perception of patients with such characteristics to improve their health behaviors and adherence to risk-reduction therapy.
SELF-REPORTED MEDICATION ADHERENCE AND GLYCEMIC CONTROL AMONG A COHORT OF LATINO DIABETICS Bhavana Pendurthi1; Hua Li2; Olveen Carrasquillo1. 1University of MIami, Miami, FL; 2University of Miami, Miami, FL. (Control ID #1339236)
BACKGROUND: Patient adherence to pharmacotherapy is a complex but important factor in achieving positive clinical outcomes in different chronic diseases including diabetes mellitus; a disease which disproportionately affects the Latino population. However, the association between self-reported medication adherence and diabetes intermediate outcomes has not been well explored among Latinos. In this abstract, we present preliminary data on the relationship between self-reported medication adherence and glycemic control among Latinos collected as part of an ongoing prospective study. METHODS: The Miami Healthy Heart Initiative is an ongoing randomized trial testing the impact of a community health worker intervention on diabetes intermediate outcomes (A1C, LDL, SBP) among poorly controlled Latino diabetics (inclusion A1C8.0). To date, we have randomized 164 of our target 300 patients. As part of a comprehensive baseline assessment, we measured self-reported medication adherence using the Morisky Medication Adherence Scale (MMAS). The MMAS was originally developed to measure medication adherence for blood pressure medications but has also been validated for use in a range of chronic diseases and among various other racial and non-Latino ethnic populations. For Spanish speakers (95% of our sample), we translated the seven item MMAS into Spanish and then back translated the questionnaire to ensure comprehension. Patients with scores of 0-4 were considered as having low adherence (32%), 4-6 intermediate (46%) and 7 as high adherence (21%). We used ANOVA to test for statistically significant differences in A1C among the 3 groups.
RESULTS: Approximately 30% of our sample is Cuban, the rest the study subjects comprise a variety of other Latino ethnicities with no other group representing >15% of the sample. The mean AIC of the sample was (8.9% 1.7%). AIC level was correlated with adherence as follows; low adherence (9.21.8), intermediate (8.91.4), and high (8.71.7). However, our current sample size limits the statistical power of our comparison (at present, we are only powered to detect larger differences of AIC>1.0 at of .80). Interestingly, although our questions ask about adherence to diabetes medications, we also saw similar patterns for LDL; 105 mg/dl46 for low adherence,

101 mg/dl38 for intermediate, and 87 mg/dl40 for high, p=0.05. Such trends were not observed for systolic blood pressure. CONCLUSIONS: Our preliminary analysis suggests self-reported medication adherence as measured by the MMAS may be correlated with glycemic control and LDL in this study population. Thus, the MMAS may be a reasonable marker of adherence to include in studies examining diabetes control among Latinos. By May 2012, we expect to have enrolled another fifty subjects into the MHHI and thus will have greater statistical power for our comparisons.

SEXUAL ACTIVITY IS RELATED TO VAGINAL MUCOSAL MATURITY IN POSTMENOPAUSAL WOMEN

Rachel Hess1; Sam Poloyak1; Stacey Dillon1; M. B. Minnigh1; Shenay Jeffrey1; Genevieve Neal-Perry2. 1University of Pittsburgh, Pittsburgh, PA; 2Albert Einstein College of Medicine, Bronx, NY. (Control ID #1339722)

BACKGROUND: The menopause is characterized by decreased systemic levels of estrogens; a hormonal milieu that heralds the onset of menopausal symptoms (hot flashes and vaginal atrophy) which frequently negatively impact womens quality of life. While hot flashes often resolve over time, vaginal changes persist and become more prominent with advancement of the menopause. The goal of this pilot study was to examine the associations among sexual activity in postmenopausal women, sex steroids levels, and vaginal maturation indices.

METHODS: We enrolled 40 sexually active (participated in vaginally penetrative sexual activities with a partner at least 2 times a week) or sexually inactive (had not participated in partnered sexual activities in the last 6 months) postmenopausal women. We excluded women using any local or systemic hormone therapy. Women self-collected vaginal swabs for calculation of the vaginal maturation index (VMI), an objective assessment of vaginal hormone response as well as overall hormonal environment. Higher values represent more mature (better) vaginal mucosa. Blood was collected and assayed for estradiol, estrone, androstendione, and testosterone using liquid chromatography tandem mass spectrometry. Women completed demographic and sexual functioning questionnaires. We compared VMI and sex-steroid hormone levels between sexually active and inactive women using Students t-test. We then examined the correlation between VMI and sex steroid hormone levels using Pearsons correlations coefficients. Finally, we examined the association among VMI (outcome) and sexual activity and sex steroid hormone levels (independent variables) using multiple linear regression.

RESULTS: Of the 40 women enrolled, 17 were sexually active and 23 were sexually inactive. Sexually active women were younger [age (standard deviation (SD) 53 (4.9) vs. 58 (7.1) years, p=.02] and had more mature vaginal indices [VMI (SD); 38 (17) vs. 28 (8), p=.02]. Sex-steroid hormone levels did not differ between sexually active and inactive menopausal women (Table). The correlations between VMI and sex steroid hormone levels were small, ranging from 0.02 for testosterone to0.3 for estrone. In models that included individual sex steroid hormones, being sexually active was consistently associated with more mature VMI regardless of sex steroid hormone level. The relationship between sexual activity and an improved VMI remained after adjusting for age.

CONCLUSIONS: In this pilot study, participation in partnered sexual activities, but not sex-steroid hormone levels, was related to more mature vaginal mucosa in postmenopausal women. While confirmation is needed in a larger, more diverse sample, behavior modification should be considered as a method to limit the development of vaginal atrophy and improve sexual functioning and quality of life in postmenopausal women.

Table. t-test sexually active vs. inactive women for VMI* and each sex steroid hormone

Sexually active (n=17)

Sexually inactive (n=23)

p-value

VMI (mean (sd)) 38 (17) 28 (8) 0.02 Estradiol pg/mL (mean (sd)) 27 (59) 12 (29) 0.29 Estrone pg/mL (mean (sd)) 42 (44) 27 (14) 0.14 Testosteronepg/mL (mean (sd)) 204 (112) 166 (109) 0.29 Androstendione pg/mL (mean(sd))

496 (294) 477 (270) 0.84
*Abbreviations: VMI: vaginal maturation index, sd: standard deviation, pg: picograms, ml: milliliter; P<0.05 statistically significant.
SIGN-OUT; WHAT REALLY GOES ON? Lauren Shapiro1,2; Natalie Zelta1; Kevin Hauck1; Joseph Deluca1,2; Hillary Kunins1,2. 1Montefiore Medical Center, Bronx, NY; 2Albert Einstein College of Medicine, Bronx, NY. (Control ID #1339351)

BACKGROUND: Verbal and written sign-outs facilitate information transfer during clinical handoffs. Recent restrictions on resident duty hours have increased the number of handoffs and highlight the need for high quality sign-outs. In this observational study, we investigated the quality of sign-outs among residents on an inpatient medicine rotation and compared sign-out quality between covering and primary residents.
METHODS: For four days, all oral sign-outs between the day and night residents on the internal medicine teaching service at Montefiore Medical Center were audiotaped and written components collected. Day residents were either interns who were the primary caretakers of the patient or covering residents for interns in clinic or post-call. Night residents were interns assigned to cover a group of patients overnight. No formal instruction on sign-out was provided at the time of the study. RESULTS: 235 sign-outs were evaluated; ten sign-outs had missing data and could not be coded. 183 sign-outs contained both written and verbal elements; 33 were written only. The table shows the number and proportion of sign-outs containing each of the six components and globally rated as adequate.
CONCLUSIONS: Key to safe clinical handoffs are sign-outs which include the clinical condition of the patient, anticipatory guidance, and reason and plan for assigned tasks. We found that a majority of sign-outs during the four-day evaluation period included these components and were rated as globally adequate. The most common omissions were clinical condition, anticipatory guidance and plan and rationale for tasks assigned. Sign-outs by primary residents were more likely to include code status, give anticipatory guidance, and plan and rationale for tasks. These differences likely result from covering residents lack of familiarity with the patient and could portend poorer patient outcomes. Based on these findings, we developed a curriculum in clinical handoffs, and plan to assess whether it leads to improved sign-out quality and reductions in adverse patient outcomes.
Sign-out Component Total N(%)
Signouts by Primary Resident N (%)
Signoutsby Covering Resident N (%)
p value*
Clinical Condition 185 (82) 121 (92) 64 (67) <0.001 Code Status 210 (93) 127 (97) 83 (87) 0.006 Recent/Scheduled
Events
214 (95) 127 (97) 87 (91) 0.08
Anticipatory Guidance
139 (62) 95 (73) 44 (47) <0.001
Tasks to be Completed
150 (66) 75 (57) 75 (79) 0.01
Plan for Task 73 (49) 40 (55) 33 (45) 0.29 Rationale for Task 79 (53) 43 (54) 36 (46) 0.29 Globally Adequate 205 (91) 121 (92) 83 (88) 0.30
*Chi-Square Test
SIMPLIFYING A SCORING TOOL TO SELECT THE BEST CLINICAL VIGNETTES Ryan Kraemer; Jeremiah Newsom; Carlos Estrada; Lisa L. Willett; Jason L. Morris. University of Alabama at Birmingham, Birmingham, AL. (Control ID #1322023)
BACKGROUND: Academic organizations use clinical vignette presentations to foster interest in internal

medicine. The best clinical vignettes are chosen for presentation at academic meetings through standardized scoring tools. In past work, we simplified a scoring tool allowing scorers to save time without sacrificing quality. In this study, we aimed to to validate the simplified scoring tool in a multi-institutional setting and to explore whether the scoring tool could be further simplified to a single item in order to select the best clinical vignettes for presentation at academic meetings.
METHODS: In a prospective study, 70 clinician educators reviewed 211 vignette abstracts submitted to the Southern Society of General Internal Medicine meeting (2011). Reviewers independently rated abstracts on 5 items: a) clarity of presentation, b) relevance to clinical practice, c) relevance to general internal medicine, d) teaching value, and e) overall
assessment (Likert scale; 1=low, 7=high). We examined internal consistency with Cronbachs alpha and factor analysis; and also, calculated Kappa agreement for accepted oral presentations using 5-items compared to 3-items (relevance to general medicine, teaching value, and overall assessment) and to a single item (overall assessment).
RESULTS: A total of 1,215 ratings were available; each reviewer rated a mean of 17.4 (SD 0.7) abstracts; each abstract was rated by a mean of 5.8 reviewers (SD 0.7); 19% (40/211) top-rated abstracts were accepted for oral presentation. The internal consistency was almost perfect (Cronbachs alpha=0.93); and it remained excellent (Cronbachs alpha=0.91) after simplifying to three items (relevance to general medicine, teaching value, and overall assessment) using factor analysis and inter-item correlations. The agreement between the number accepted for oral presentation using the 5-item average score with the number that would have been accepted using the 3-item average score was almost perfect with 36 of the previously accepted 40 vignettes being the same (Kappa=0.88; 95% confidence interval [CI], 0.79 to 0.96). The agreement remained high comparing the 5-item tool with a single item, overall assessment, with 34 of the previously accepted 40 vignettes being the same (Kappa=0.83, 95% CI, 0.73 to 0.93).
CONCLUSIONS: A 5-item scoring tool to select the best clinical vignettes for presentation at academic meetings could be further simplified to a single item. Hence, a prospective validation of a single item scoring tool is warranted.
SMOKING BEHAVIORS IN A COMMUNITY-BASED COHORT OF HIV-INFECTED UNSTABLY HOUSED AND HOMELESS ADULTS Maya Vijayaraghavan1; Joanne Penko2; David Guzman2; Christine Miaskowski2; Margot Kushel2. 1University of California, San Diego, San Diego, CA; 2University of California, San Francisco, San Francisco, CA. (Control ID #1320912)
BACKGROUND: The prevalence of smoking is high among homeless adults, however limited data exists on patterns of tobacco use and cessation. In a longitudinal study of a community-based cohort of HIV-infected unstably housed and homeless adults, we examined smoking behaviors, factors associated with initiating a quit attempt, and successful quitting. METHODS: At a community-based field site, we interviewed participants every three months over a two-year interval about demographics, illicit substance use, alcohol use, and smoking. At baseline, we determined ever-smoking rates (smoked at least 100 cigarettes), frequency of smoking, intention to quit, and the quit ratio among ever smokers (former/ever smoker). At follow-up, we asked whether participants had smoked in the past 30 days, the number of days smoked and the number of cigarettes smoked. Among current smokers, we defined a quit attempt as having no cigarette consumption during a follow-up visit, and successful quitting as having no consumption over two consecutive follow-up visits. Using multivariable logistic regression (clustered on participant and accounting for repeated measurements), we determined factors associated with initiating a quit attempt. We used Poisson regression to determine factors associated with successful quitting accounting for interval-censored data.
RESULTS: Among the 296 participants, 41.2% were African American, 82.1% had a lifetime history of homelessness, and 34.8% had used illicit substances in the past 90 days. Of the 296 participants, 251 (84.8%) were ever smokers. The prevalence of current smoking among ever smokers was 86.6% and the quit

ratio13.2%. Among current smokers, 20.5% had an intention to quit in the next one to six months, 54.9% had an intention but not in the next six months, and 24.7% had no intention to quit at baseline. Of the 218 current smokers, 45 (20.6%) initiated a quit attempt. Of the 45 participants who made a quit attempt, 24(53.3%) successfully quit. Persons with a history of illicit drug use (Adjusted odds ratio (AOR) 0.2, 95% CI 0.1-0.6), and alcohol abuse or dependence (AOR0.2, 95% CI 0.1-0.8) were less likely to initiate a quit attempt, whereas those who intended to quit within one to six months at baseline were more likely to do so (AOR 4.4, 95% CI 1.3-15.5). In Poisson regression, illicit drug use was associated with a decreased likelihood of successfully quitting (AOR 0.1, 95%0.03-0.5), whereas having more than a high school education (AOR 4.1, 95% CI1.1-15.0) and an intention to quit within one to six months at baseline (AOR 2.6, 95% CI 1.0-6.7) was associated with an increased likelihood. CONCLUSIONS: In this high-risk cohort, current smoking prevalence was 4.5 times higher than the 19% national smoking rate, and the quit

ratio 4 times lower than the 50% national average for quit ratios. Less than one-fourth made a quit attempt during the study interval, and half of those successfully quit. Smoking cessation should be prioritized among this population. Interventions should focus on assisting persons with an intention to quit to increase their likelihood of success. Substance abuse treatment programs should motivate people to move through the stages of quitting.

SOCIAL DETERMINANTS OF PRIMARY-CARE PATIENTS FORGOING HEALTH CARE IN THE SWISS COST-SHARING SYSTEM Patrick Bodenmann1; Thomas Bischoff2; Hans Wolff3; Francesco Panese4; Lilli Herzig2; Paul Vaucher1,3. 1University of Lausanne, Lausanne, Switzerland; 2University of Lausanne, Lausanne, Switzerland; 3University of Geneva, Geneva, Switzerland; 4University of Lausanne, Lausanne, Switzerland. (Control ID #1317342)

BACKGROUND: Consequences of out-of-pocket expenses causing health disparities can be addressed by primary-care physicians in complement to upstream reforms focused on social determinants of health. By considering social conditions in clinical decision-making, primary-care physicians can address mismatches between patients health care needs and financial abilities. The aim of this study is to identify and model social determinants explaining patients decisions to forgo health care for economic reasons, and investigate whether questioning patients subjective perception of their social situation is more relevant than recording objective socio-economic status (SES). METHODS: This Swiss primary-care practice cross-sectional survey questioned a random sample of 2,025 patients over 16 years of age attending one of 47 private primary-care practices in western Switzerland between September 2010 and February 2011. Patients concerned by health care renunciation were those who reported a household member not to have sought treatment for economic reasons during the previous 12 months. For subjective social determinants, patients were questioned on their state of deprivation (DiPCare-Q), their subjective social status (subjective SES ladder), and state of health (EQ-5D). We also collected objective socioeconomical determinants (age, gender, nationality, education level, daily income, and households source of income). Using regression analysis and coefficients of determination (R2), we compared the load of self-perceived subjective social determinants to the load of objective socio-economic determinants in explaining the decision to forgo health care. Likelihood ratio test was used to assess significant level of observed differences. RESULTS: During the 2,945 monitored random consultations, physicians saw 2,811 different patients of which 2,025 were included in the analysis (response rate 72%). Among them, 10.7% (CI95% 9.4 to 12.1) were concerned by restricted health care during the 12 previous months. Forgoing health care was independently explained by level of material deprivation, social deprivation, subjective social status, health status, daily income, and source of income (related to age). Questioning patients on their subjective perceived state of material deprivation was more relevant in explaining their decision than collecting objective

socio-economical status (R2=0.226 vs. 0.097; P<0.0001), which nevertheless remains better than having physicians estimate their patients subjective social status (R2=
0.029; P<0.0001).
CONCLUSIONS: Firstly, financial difficulties, social isolation, chronic conditions, mental disorders, and younger age favor forgoing health care. This model is however limited to households for which at least one member attends a primary care physician, and does not explore other, non-economic, reasons for not accessing healthcare. Secondly, during social history, physicians are recommended to favor questioning their patients on subjective perceived social conditions over common socioeconomic determinants to detect underlying social risks of restricting access to health care. This seems particularly important in developed countries given the current increase in the number of patients concerned by rapid changes in their socio-economic situation.
SOME TALK, NOT MUCH WALK: DISCORDANCE OF PHYSICIAN-ORDERED AND NURSING-RECORDED ACTIVITY AMONG HOSPITALIZED ELDERS Hilary Mosher. University of Iowa Hospitals and Clinics, Iowa City, IA. (Control ID #1336326)
BACKGROUND: Functional decline related to low mobility during hospitalization of acutely ill elders is well-recognized. Interventions have shown variable results in relating increased ambulation with improvements in clinically meaningful outcomes including functional ability, hospital length of stay (LOS), and discharges home. Despite the acknowledged importance of maintaining functional abilities of hospitalized elders, a culture of increased activity has not broadly taken hold. The objective of this study was to assess the association between physician-ordered activity and excess LOS (defined as the difference between actual and expected LOS). A secondary objective was to compare physician-ordered activity with nursing-recorded activity level to determine if physician orders were reflected in patient activity. METHODS: A retrospective chart review was done in a convenience sample of all patients aged 65 years or older admitted to a general medicine ward of an academic medical center over a 3-month period in 2010. Data on age, LOS, discharge disposition, physician-ordered activity, nursing-recorded activity level, and physical therapy evaluation were abstracted from the electronic health record. Data analysis, including frequency statistics and ANOVA, was performed using SAS. RESULTS: A total of 329 patients accounting for 365 admissions were included in the study. Physician activity orders were for bed rest in 34 (9%) admissions, ambulate 4 times daily in 83 (23%), up ad lib in 161 (44%) and not ordered in 87 (24%) admissions. Ambulate 4 times daily orders were associated with the greatest excess days beyond expected LOS(2.84 days, SE 0.48, P<.0001), no orders were associated with 2.12 excess days (SE 0.87, P=.015), and up ad lib orders were associated with 1.14 excess days (SE 0.34, P=.001). Bed rest orders were not significantly associated with excess LOS. Physician-ordered activity and nursing-recorded activity level were discordant during approximately 50% percent of admissions, with bed rest recorded at greater frequency (72% of admissions) in the nursing records. Physical therapy assessments were performed in approximately 75% of admissions. Physical therapists often documented ability to stand or walk in patients with a nursing-recorded activity level of bed rest. The electronic health record at the study institution lacked a convenient provision by which nursing staff could communicate number of times per day a patient ambulated. CONCLUSIONS: Despite the growing recognition of the importance of maintaining mobility and function among hospitalized elders, numerous barriers to safe and appropriate mobilization remain. This descriptive study suggests that physicians, nurses, and physical therapists have a high level of discordance regarding intended and actual patient activity levels. This discordance may well account for the significant association found between ambulate 4 times daily orders and excess LOS: patients with a recognized but unmet need for increased mobilization may be at particular risk for prolonged hospitalization. Moreover, physicians failed to prescribe activity level in nearly 1 out of 4 admissions, indicating that mobility remains a frequently disregarded component of hospital care.
STATIN USE ON INCIDENT IMMUNE-MEDIATED AND INFECTIOUS CONDITIONS IN THE VETERANS ADMINISTRATION HEALTH SYSTEM Dominic J. Cirillo1,2; Robert B. Wallace2,1. 1University of Iowa, Iowa City, IA; 2University of Iowa, Iowa City, IA. (Control ID #1337695)

BACKGROUND: Statins are commonly used cholesterol-lowering medications with immunologic properties. The main study hypothesis was that statin use may be associated with alterations in immune cell function, potentially impacting subsequent diagnosis of immune-mediated conditions, including rheumatology diseases and infections.
METHODS: A modified case-cohort study was formed using administrative databases from the Midwest Veterans Administration (VA) region. To be eligible for inclusion in the study, subjects needed at least one year of medical claims and at least one pharmacy claim. Cases were identified by inpatient or outpatient medical claims using International Classification of Disease, Ninth Revision (ICD-9) codes between FY 2003-2004. The incident cases (n=28,642) included non-mutually exclusive groups of immune-mediated (n=2,327), infectious (n=8,221), and non-immunologic (n=10,730) comparison diagnoses. The referent sub-cohort was formed by randomly sampling 10,000 subjects with medical and pharmacy benefits

during fiscal year (FY) 2002. Demographic and medical variables were obtained from FY 2001-2004, and pharmacologic data from FY 2002-2004. Cox proportional hazards regression modeling was used to estimate hazard ratios for the current statin use (within the last 180 days) and former statin use, compared to non-users, including time-dependent variables for demographic factors, comorbidity as measured by Elixhauser and Chronic Disease Score variables, medications, and visit rates after initiating statins. Sensitivity analyses were conducted using variations of drug exposure definition, variations of case definition, new-user analysis, and propensity scores. RESULTS: Results for statin use and immune-mediated conditions are listed in Table 1. The results for incident infection and statin use are included in Table 2. Statin use was not associated with multiple sclerosis, thyroiditis, sarcoidosis, temporal arteritis, influenza, shingles, histoplasmosis, or pyelonephritis.
CONCLUSIONS: Although current statin use appeared protective for some study conditions, selection bias, misclassification, healthy user effects, adherence bias, confounding by indication, and surveillance bias were considered as possible explanations of the study findings. The associations are intriguing for possible positive preventive interventions using statins if causal links are confirmed.
Summary of Major Findings for Immune-mediated Conditions
Disease Outcome N Current Users Former Users
HR 95% CI HR 95% CI Psoriasis 674 0.63 (0.52, 0.77) 1.09 (0.59, 2.02) Rheumatoid arthritis 662 0.68 (0.56, 0.83) 1.22 (0.71, 2.12) IBD 307 0.60 (0.45, 0.81) 0.69 (0.22, 2.18) Polymyalgia Rheumatica 251 1.08 (0.81, 1.43) 2.11 (1.06, 4.23) Spondyloarthropathy 197 0.76 (0.53, 1.09) 0.91 (0.28, 2.95) DCTD 123 0.66 (0.41, 1.05) 1.72 (0.61, 4.89) SLE 59 0.52 (0.26, 1.01) 1.46 (0.33, 6.40) AIHA 30 0.49 (0.18, 1.33) 9.19 (2.47, 34.19) Pneumonia (Bacterial) 2,986 0.77 (0.70, 0.84) 1.04 (0.83, 1.29) Urinary Tract Infections 2,820 0.73 (0.67, 0.80) 1.13 (0.88, 1.44) Cellulitis 2,184 0.75 (0.68, 0.84) 1.11 (0.84, 1.47) Sepsis 843 0.75 (0.51, 0.72) 1.44 (1.01, 2.05) Candidiasis 565 0.72 (0.58, 0.90) 1.45 (0.91, 2.29) Osteomyelitis 454 0.75 (0.59, 0.94) 1.88 (1.18, 2.99)
N=Number of cases; HR=Hazard ratio; CI=Confidence Interval; IBD= Inflammatory bowel disease; DCTD=Diffuse connective tissue disease; SLE=Systemic lupus erythematosus; AIHA=Autoimmune hemolytic anemia
STILL PAINFUL AFTER ALL THESE YEARS? EFFECTS OF A CURRICULUM ON RESIDENT KNOWLEDGE AND ATTITUDES REGARDING CHRONIC PAIN Tracey G. Simon; Edward Feller; Donnah Mathews; Mark J. Fagan. Warren Alpert Medical School, Brown University, Providence, RI. (Control ID #1338962)
BACKGROUND: Despite studies documenting internal medicine (IM) residents unease when managing patients with chronic non-malignant pain (CNMP), few have evaluated the impact of educational interventions designed to improve resident experience with CNMP. The purpose of this study was to assess and compare IM residents attitudes and experiences with CNMP, before and after the implementation of a longitudinal, multidimensional curriculum focused on CNMP care.
METHODS: We anonymously surveyed all residents within the IM program at Lifespan/Brown University, first in

2004 (124 residents), and again in 2011 (117 residents). In 2005, we implemented a required, longitudinal CNMP curriculum, including 5 hours of didactic training as well as case-based discussion modules. The survey instrument included Likert-style questions assessing frequency of exposure to CNMP, perceived level of self-confidence when managing CNMP, resident experience with CNMP compared with the management of diabetes (1=much easier; 5=much more difficult), and the impact that interactions with CNMP patients had on residents overall clinic experience (1=very negative, 5=very positive). We compared
mean responses across gender, residency year of training, and residency track using ANOVA and chi-square analyses. The results from pre-intervention respondents were then compared to those of the post-intervention group by chi-square analysis.
RESULTS: The survey response rate was 88.7% (110/124) in 2004, and82.9% (97/117) in 2011. Compared to pre-intervention respondents, fewer post-intervention respondents rated their experience with CNMP as poor or very poor (86% vs. 76%, $p<0.002$). Self-rated experience improved with increasing level of training: the mean Likert response at the PGY3 level was 3.4, compared to only 2.1 and 2.3 at the PGY1 and PGY2 levels, respectively ($p<0.001$). There were no statistically significant differences between the pre- and post-intervention groups, with regard to self-rated level of preparation or confidence in managing CNMP. However, significantly more post-intervention respondents reported >5 cumulative hours of dedicated CNMP instruction (45% in 2011 vs. 29% in 2004; $p=0.004$). Additionally, significantly fewer post-intervention respondents reported a large or very large uncertainty about opioid pharmacology and side effects (44% in 2004 vs. 7% in 2011; $p<0.001$). Only 37% of post-intervention General Internal Medicine (GIM) residents reported that managing CNMP patients had negative or very negative impact on their view of primary care as a career, compared to 73% of pre-intervention GIM respondents ($p=0.021$). There was no statistically significant difference between pre- and post-intervention categorical residents, with regard to the impact of CNMP management on their view of primary care.
CONCLUSIONS: After the introduction of a multi-dimensional curriculum dedicated to the management of CNMP, residents at this institution reported less-negative overall experiences with CNMP, as well as increased knowledge of CNMP pharmacology and side effects. Increasing year of training and participation in the GIM residency track were both associated with more positive attitudes. Nevertheless, respondents continued to find CNMP management difficult, lacked confidence in managing patients with CNMP, and did not gain confidence over the course of training. These results highlight continued barriers to care, as well as future opportunities to improve residents experience with CNMP.

STROKE-PREVENTION BELIEFS PREDICT BLOOD PRESSURE CONTROL IN STROKE AND TIA SURVIVORS

L. Alison Phillips1;
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3The Mount Sinai Hospital, New York, NY. (Control ID #1340813)

BACKGROUND: Blood pressure (BP) control is essential for preventing recurrent stroke. In general hypertensive populations, patients who endorse a stress model of hypertension (i.e., that controlling stress will control BP) have been shown to be less adherent to medications and to have worse control of their BP than those who endorse a medical model of hypertension (i.e., that medications, diet, and exercise are required for controlling BP) (Hekler et al., 2008). Stroke survivors have the highest risk for stroke, and BP control is the most effective strategy to prevent recurrent stroke. Yet, little is known about the health belief factors that influence whether stroke-survivors will have controlled BP as compared with a general hypertensive population. The purpose of the current study was to determine if stress-model endorsement in a post-stroke population is associated with their adherence to medication and their BP control.
METHODS: Participants (n=510) participated in a stroke-prevention intervention targeted at stroke survivors in underserved communities in New York City (inclusion criteria: 40 years, had at least one stroke or transient ischemic attack (TIA) in the past 5 years). Prior to starting the intervention, medication adherence was

measured via survey using the 8-item Morisky scale; patients BP was measured three times and considered to be high if systolic BP was 140 and/or if diastolic BP was 90. Patients were asked to name the 3 most important things they would do to lower their risk of stroke; patients were considered to be stress-model-endorsers if they stated that reduction of stress is important for preventing stroke and medical-model-endorsers if they stated that taking medication (BP and/or stroke) was important for preventing stroke. Logistic regression

(for BP control) and ANOVA (for adherence) were used to assess the relationships of interest.
RESULTS: Fifty-three patients (10%) endorsed both the stress model and the medical model, 227 patients (45%) endorsed neither, 127 patients (25%) endorsed only the stress model, and 103 patients (20%) endorsed only the medical model. There was no significant difference in adherence between those who endorsed a stress model (and rejected the medical model) vs those who did not endorse a stress model, endorsing only a medical model (mean difference in adherence=-.19 (SD=.21), p=.81, 95%CI for difference=-.72, .35). However, the latter group had significantly higher BP than the former group (OR of stress-model-only endorsers having high BP compared to medical-model-only endorsers=.48, Wald=6.03, p=.01). There were no differences in adherence or BP control for those who adopted a combination of a stress and medical model or neither model.
CONCLUSIONS: Stress-model endorsement alone should not necessarily cause clinicians concern regarding their post-stroke patients BP control. However, those patients who endorsed a stress-model and rejected the notion that taking medications will control their BP did have poorer BP control compared to patients who endorsed only a medical model of BP control/stroke prevention. This is despite no differences in their self-reported adherence. Clinicians may consider eliciting beliefs about BP control in this high-risk group and devising/testing strategies to educate them about medical management of hypertension.
SUBCLINICAL THYROID DYSFUNCTION AND THE RISK OF HEART FAILURE EVENTS: AN INDIVIDUAL PARTICIPANT DATA ANALYSIS FROM SIX PROSPECTIVE COHORTS. Baris Gencer1; Tinh-Hai Collet1; Douglas Bauer2,3; Jacobijn Gussekloo4; AnneR.Cappola5; David Nanchen1; Wendy P. den Elzen4; Philippe Balmer1; Robert N. Luben6; Vincenzo Triggiani7; Jacques Cornuz1; Anne B. Newman8; Wouter Jukema9; Massimo Iacoviello10; Kay-Tee Khaw6; RudiG. Westendorp11; Drahomir Aujesky12; Nicolas Rodondi12.
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6University of Cambridge, Cambridge, United Kingdom; 7University of Bari, Bari, Italy; 8University of Pittsburgh, Pittsburgh, PA; 9Leiden University Medical Center, Leiden, Netherlands; 10University of Bari, Bari, Italy; 11University of Leiden, Leiden, Netherlands; 12University of Bern, Bern, Switzerland. (Control ID #1306405)
BACKGROUND: Heart failure (HF) is among the most frequent cause of hospitalization in persons older than 65 years. Subclinical thyroid
dysfunction is common in older individuals and has been associated with systolic and diastolic dysfunction. However, few prospective data exist regarding the association between subclinical thyroid dysfunction and heart failure (HF) events. Currently controversy persists as to whether screening and treatment of subclinical hypothyroidism is warranted, as evidence about its risks is limited.
METHODS: After a literature search we performed a pooled analysis of individual participant data using all available prospective cohorts with thyroid function measurements and subsequent follow-up of HF events. Individual data on 25,738 participants with 216,668 person-years of follow-up were supplied from 6 prospective cohorts in the United States and Europe. Euthyroidism was defined as a TSH 0.45-4.49 mIU/L, subclinical hypothyroidism as a TSH between 4.5-19.9 mIU/L and subclinical hyperthyroidism as a TSH <0.45 mIU/L both with normal free thyroxine levels. HF events were defined as acute HF events, hospitalization or death related

to HF events.
RESULTS: Among 25,378 participants, 2,065 had subclinical hypothyroidism (8.1%), 648 subclinical hyperthyroidism (2.6%) and 22,665 were euthyroid. During follow-up, 2,069 participants had HF events. In age- and gender-adjusted analyses, the risk of HF events among adults with subclinical hypothyroidism increased with higher TSH levels: hazard ratio (HR) was 1.02 (95% confidence interval [CI],0.82-1.27) for a TSH level of 4.5-6.9 mIU/L, 1.59 (CI 0.82-3.08) for a TSH level of 7.0-9.9 mIU/L, and 2.13 (CI 1.29-3.51) for a TSH level of 10.0-19.9 mIUL/L (p for trend=0.001). Results were similar after further adjustment for traditional cardiovascular risk factors. Among participants with TSH 10-19.9 mIU/L, the association remained significant after excluding those with preexisting HF (HR1.76, CI 1.10-2.81). In age- and gender- adjusted analyses, the risk of HF events among participants with subclinical hyperthyroidism was1.31 (CI 0.88-1.95) for a TSH of 0.1-0.44 mIU/L and 1.87 (0.98-3.57) for a TSH <0.10 mIU/L (p for trend=0.058).
CONCLUSIONS: This first pooled analysis of large cohorts examining the association between subclinical thyroid dysfunction and HF events shows that subclinical hypothyroidism is associated with an increased risk of HF events, particularly among those with a TSH level 10 mIU/L. The findings of our study might be useful to better define the TSH thresholds for thyroxine replacement. Given the high prevalence of both subclinical hypothyroidism and HF in the elderly, the impact of thyroxine substitution on HF events will be investigated over the next years with an appropriately powered randomized controlled trial with other clinical outcomes (TRUST study) among 3000 older adults.

SUBJECTIVE AND OBJECTIVE SOCIOECONOMIC STATUS AND CONTROL OF HYPERTENSION AND DIABETES
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BACKGROUND: Poor control of diabetes and hypertension is common among minority and low-income populations compared to higher income and white populations. Objective measures of social status, such as income and education, have been shown to account for some of this disparity. Subjective social status (SSS) defined as an individuals perception of where they stand in society, has been related to general health status and the presence of diabetes and hypertension. It is not clear if SSS might also be related to disparities in diabetic and hypertensive control. Our objective was to investigate whether SSS was significantly related to control of these chronic illnesses in a diverse, vulnerable population.
METHODS: Data was obtained from the Immigration, Culture and Health Care Study (ICHC), a large survey and data abstraction study of a convenience sample of patients with diabetes seeking care for diabetes in safety-net clinics in Chicago and the San Francisco Bay Area. Subjective social status was measured by showing participants a drawing of two ladders. Participants were told one represents their community and the other represents the overall US society. In each ladder participants were asked to choose the step of the ladder that better represents their current position within the ladders respective group. The most recent blood pressure measurement and hemoglobin A1c values were obtained from the participants electronic medical record. We defined hypertensive control as systolic blood pressure bellow 130 mmHg and a diastolic blood pressure bellow 80 mmHg. Diabetes control was defined as having a hemoglobin A1c lower than 8%. Univariate chi-square analyses were used to determine racial/ ethnic differences in SSS while sequential multivariate logistic regression models were used to assess the association of SSS with diabetes and blood pressure control. Additionally we examined the interaction between each measure of subjective social status and race/ethnicity a final multivariate model. Multivariate models were adjusted for age, gender, income, education, marital status and medication adherence.

RESULTS: Participants included 107 whites, 200 black and 404 Mexican Americans. Hypertension was controlled in 46.5% of participants, while 52% met our criterion for glycemic control. Neither measure of SSS nor race/ethnicity was significantly associated with blood pressure or diabetes control in the overall population. However, in the final model for glycemic control, there was a significant interaction between SSS and race/ethnicity when participants compared themselves with the overall US society indicating that it did matter in some racial/ethnic groups compared to others: the odds ratio for diabetes control of Mexican Americans was 2.07 ($p>0.05$) and African Americans 1.10 ($p>0.05$) for each unit increase in SSS when compared with whites, while the odds for diabetes control among African Americans was 0.50 ($p=0.02$) compared to Mexican Americans.
CONCLUSIONS: In this population of diabetes patients who seek care in safety net clinics, we found that one measure of SSS was significantly related to difference in diabetic control across racial ethnic groups but that neither measure of SSS was associated with hypertensive control. This suggests that measures of SSS may contribute to disparities above and beyond objective social status.
SURVEY RESPONSES AND MEDICATION ADHERENCE AMONG DIABETIC PATIENTS Chuan-Fen Liu1,2; Mark Perkins1; Edwin Wong1; Christopher L. Bryson1,2. 1VA Puget Sound Health Care System, Seattle, Seattle, WA; 2University of Washington, Seattle, WA, WA. (Control ID #1274896)
BACKGROUND: Medication adherence is generally described using large administrative databases or smaller, survey based data. Both methods have strengths and weaknesses. Combining patient surveys and administrative data could provide more information. However, response bias may significantly hinder generalizability compared to administrative methods. This study examines the relationship between survey response and medication adherence to oral hypoglycemic agents (OHAs) by diabetic patients.
METHODS: This study includes all diabetic patients on an OHA seen in a VA primary care clinic from FY2006-07 (504,778 patients), identified from administrative datasets. We use pharmacy refill data to calculate a medication possession ratio and classify patients as adherent if they had 80% of their OHA regimen during the first quarter of 2007. Of the study population, 52,725 were given the Primary Care Satisfaction Survey in 2006, and 63.9% responded. We classified our sample into three categories: non-surveyed patients (452,053), survey respondents (33,710), survey non-respondents (19,015). We used a logit regression to adjust for patient characteristics. RESULTS: The proportions of adherence were significantly different among the three groups ($p<0.0001$) with the highest from the complete survey respondents (0.74), followed by non-surveyed patients (0.70), and incomplete patients respondents (0.66). Compared to non-surveyed patients, after adjusting for patient characteristics, survey respondents were more likely to be adherent to OHAs (odds ratio=1.13, $p<0.0001$), while survey non-respondents were less likely to be adherent (odds ratio=0.87, $p<0.0001$). Survey non-respondents were more likely to be younger, unmarried, and to have mental health conditions, including depression, drug abuse, and PTSD, which were accounted for in the analyses. CONCLUSIONS: After adjusting for available characteristics, survey non-respondents had the lowest medication adherence compared to survey respondents and non-surveyed patients. For medication adherence, non-response bias may be a serious threat to the generalizability of survey data or interventions based on surveys to the general clinic population.
TAILORING SUSTAINABLE PATIENT AND FAMILY INTERVENTIONS TO REDUCE RACE DISPARITIES IN HYPERTENSION AMONG URBAN AFRICAN AMERICANS Sarah J. Flynn1; Patti Ephraim3; LaPricia Lewis-Boyer1; Jeffrey M. Barbers1; Jessica Ameling1; Lee Bone1,3; David Levine1; Felicia Hill-Briggs1,2; Deborah Roter3; Jennifer L. Wolff3; Leon Purnell4; Annette Fisher4; L. Ebony Boulware2,1.
1Johns Hopkins University School of Medicine, Baltimore, MD; 2Johns Hopkins University, Baltimore, MD; 3Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 4Johns Hopkins Center to Eliminate Cardiovascular Health Disparities, Baltimore, MD. (Control ID #1335656)
BACKGROUND: High rates of uncontrolled hypertension among urban African Americans persist despite the

existence of efficacious interventions to improve hypertension self-management. Studies identifying patients and their families perceived barriers to improving hypertension control could inform efforts to enhance existing interventions effectiveness and sustainability in this population.
METHODS: Using the Community-Based Participatory Research (CBPR) framework, we performed focus groups to inform the design of behavioral self-management interventions intended to improve hypertension control among urban African Americans. We conducted 90-minute focus groups of patients with controlled (1 group) and uncontrolled (1 group) hypertension receiving care in an urban community health center as well as their family members (2 groups). Trained community members moderated all groups to assess participants perceived barriers to improving their (a) self-management skills; (b) understanding of hypertension care; (c) knowledge of community resources; and (d) patient, family, and physician communication about hypertension. Moderators also assessed participants views regarding the contributions of family members and the community health center itself in helping or hindering patients self-management. The sessions were audio-recorded, transcribed, and independently coded by three investigators to distinguish themes.
RESULTS: Thirty members participated in 4 separate focus groups: patients with controlled hypertension (n=8, mean age=61, mean hyper-tension duration=19 years), their family members (n=5, mean age=50, 40% with hypertension), patients with uncontrolled hypertension (n=10, mean age=60, mean hypertension duration=19 years), and their family members (n=7, mean age=43, 71% with hypertension). Patients from both groups described difficulties with taking medication, quitting smoking, reducing sodium intake, and having few educational and community resources as barriers to their hypertension self-care. Of those patients who

had previously worked with community outreach workers, uncontrolled hypertensive patients discussed difficulties maintaining long-term relationships with them, I cancelled outshe and I were knocking heads. Although both groups identified the long waiting room time as a barrier to care, uncontrolled hypertensive patients reported leaving the clinic without seeing their doctor if they had been waiting too long. Patients desired more education about nutrition and co-morbidities. Family members perceived patients to have problems with personal motivation and difficulties [doing] the right thing. While some family members supported the patients by taking an active role in doctors visits, others didnt attend visits because of privacy concerns. Family members of patients with uncontrolled hypertension requested more education for themselves. CONCLUSIONS: Themes reflected a desire among urban African American participants for interventions addressing numerous behavioral challenges and educational needs related to their hypertension self-management. Family members recognized patients difficulties with self-management and wanted their own interventions to support patients. Community clinic operations may also influence patients engagement in hypertension care. Tailoring interventions to directly address concerns raised by urban African Americans with hypertension may improve interventions effectiveness and sustainability.
TARGETING SPECIFIC PHYSICIAN GROUPS TO IMPROVE ADHERENCE TO ESTABLISHED DIAGNOSTIC GUIDELINES IN THE EVALUATION OF SYNCOPE. David Graham; Heidel E. Robert; Mark Rasnake. University of Tennessee Knoxville, Knoxville, TN. (Control ID #1340163)
BACKGROUND: The 2009 European Society of Cardiology Task Force for the Diagnosis and Management of Syncope states that CT or MRI in uncomplicated syncope should be avoided unless indicated by neurological evaluation. It further states that for all practical purposes, a TIA concerns a focal deficit without loss of consciousness and syncope the opposite. The 2006 American Heart Association Statement on the Evaluation of Syncope recommends that neurological causes of syncope should only be pursued if suggested by the history or physical. Syncope is defined as a transient loss of consciousness due to transient global hypoperfusion characterized by a rapid onset, short duration, and spontaneous complete recovery. Studies

have looked at educating Internal medicine residents on the workup of syncope in attempts to avoid prodigal usage of diagnostic tests with no change in clinical practice. Our study intends to identify if our physicians ordering tendencies in the evaluation of syncope are according to established guidelines and to categorize the physician groups ordering these tests to identify those whose ordering tendencies should be targeted for intervention.
METHODS: All patients admitted to our hospital from 9/30/09 to 9/30/11 with the primary diagnosis of syncope (ICD-9 code 780.2) were included. Of 166 patients, 26 patients were excluded for having neurologic deficits or prolonged seizure activity documented by history or exam. Of the 140 patients meeting criteria, frequency statistics were utilized to calculate the prevalence of a) CT Head (CT) ordered for patients with and without head trauma, b) CT, MRI, and Carotid Ultrasound (US) tests ordered for patients with and without neurological deficits or prolonged seizures indicated by history or physical exam, b) US ordered for patients with and without a carotid bruit c) significant test results, d) costs per significant test result, and e) specialty of physician ordering CT, MRI, and US tests. All analyses were conducted using SPSS Version 19. A significant test result is a diagnostic test result that contributed to, confirmed, or established a diagnosis or management decision including follow up for further evaluation..
RESULTS: Of the 140 patients meeting inclusion criteria, only 29 (20.7%) had documented head trauma, yet 98 people received CT and only 2/98(2.0%) yielded significant results. ED attendings ordered 71.4% of these. Only 5 patients had carotid bruits, yet 73/140 (52.1%) received US. Hospitalists, Internal Medicine (IM) residents, and Family practice (FP) residents accounted for 75.3% of the US's ordering physicians. MRI brain and stem was ordered for 41/140 (29.2%) of the patients, of which hospitalists and IM residents accounted for 68.3% of the ordering physicians. Interestingly, $142,238 was spent on the MRI studies of which
none were significant. Notably, $53,949 and $28,175 were spent per significant result for CT and US respectively.
CONCLUSIONS: To improve cost effective utilization and adherence to established guidelines in the diagnostic evaluation of syncope, ED physicians should be targeted for intervention and training in guiding the selective usage of CT; IM residents and Hospitalists targeted for guiding the usage of MRI; and FP residents, IM residents and Hospitalists targeted for guiding the usage of US.
TELEMONITORING IN PATIENTS WITH HEART FAILURE: A SINGLE-CENTER EXPERIENCE Raid Abu-awwad; Yaser Alkhatib; Aymen Bukannan; Ghassan Bandak; Mazen El Atrache; Jacqueline Pflaum; Mohammad Zaidan; Kimberly Baker-Genaw. Henry Ford Hospital, Detroit, MI. (Control ID #1285999)
BACKGROUND: Despite advances in medical treatment for heart failure (HF), rates of death and readmission after hospitalization remain high and impact the entire health system resources. Recently, two large randomized controlled studies showed that telemonitoring does not intrinsically carry a significant benefit in terms of improving HF outcomes. This contradicts with the findings of previous systematic reviews and meta-analyses of small scale studies which showed benefits of such strategy. The aim of our study is to assess the benefits of adopting such strategy in a focused, patient centered team care clinic as opposed to the large multicenter studies.
METHODS: The study was a retrospective chart review and analysis of 212 patients who were enrolled in the "The Heart Failure Tele-Assurance Program" at a tertiary medical center between the years 2007 and 2011. Only patients with at least 6 months of adherence to the program after enrollment were included in the study. Analysis included data collected over a time period of 6 months prior to enrollment through 6 months after enrollment. The primary end-points were number of hospitalizations, emergency department (ED) visits and clinic visits, for any reason. Secondary end-points included hospitalization for HF, admission to the intensive care unit (ICU) and number of days in the hospital. Comparison of pre-enrollment data to post-enrollment data was done using Wilcoxon signed-rank tests.
RESULTS: Of the 212 patients that were included in the study, mean age was 71, 51% were female, and 78%

were African-American. Mean ejection fraction (EF) was 41%. There were significantly fewer overall hospitalizations, ED visits and clinic visits 6 months post-enrollment [decrease of 38% (p<0.0001), 28% (p =0.0002) and 24% (p <0.0001) respectively]. There were also fewer hospitalizations for HF and total number of days in the hospital [decrease of 44% (p <0.0001) and 47% (p <0.0001) respectively]. Reduction in the admissions to the intensive care unit was marginally significant (p =0.0507).
CONCLUSIONS: Despite the conflicting data in regards to the benefits of telemonitoring in heart failure patients, our study showed a significant benefit in terms of improving HF outcomes.This effect can be attributed in part to the triage of patients by a well-trained telemonitoring case manager at the initial signs of clinical deterioration, and the intervention using a prespecified protocol. Also our patients represent a population at a higher risk for readmission as compared to previous studies; older patients with lower mean EF and multiple comorbidities. We believe that identification of such patients by well trained medical professionals following a unified protocol in the proper setting can produce promising results for the health care systems adopting such strategy.
TEN-YEAR TRENDS IN HYPERTENSION, HYPERTENSION UNAWARENESS, UNTREATED HYPERTENSION AND UNCONTROLLED HYPERTENSION AMONG ADULTS IN GENEVA, SWITZERLAND
Idris Guessous1,2; Murielle Bochud2; Jean-Marc Theler1; Jean-Michel T. Gaspoz1; Antoinette Pechere1.
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BACKGROUND: Hypertension is one of the leading causes of disease burden worldwide. Guidelines recommand the screening, treatement and

control of high blood pressure. In Switzerland, there are no recent time trends in hypertension, hypertension unawareness, untreated hypertension and uncontrolled hypertension. The objectives of this study were to analyze these trends and to determine the associated factors.
METHODS: A population-based study conducted in the Canton of Geneva, Switzerland, which collects information on cardiovascular risk factors, diet and physical activity using a stratified random sampling. Hypertension was defined as mean systolic/diastolic BP 140/
90 mmHg or self-reported hypertension or presence of anti-hypertensive medication. Hypertension unawareness, untreated and uncontrolled hypertension were determined by questionnaires and BP measures. Non parametric trend tests were used to assess trends of prevalence rates across survey year. Multiple logistic regressions were used to estimate adjusted odds ratios (OR).
RESULTS: A total of 9,215 participants over a 10-year period were included. The hypertension prevalence rate increased between 1999 and 2009 from 31.1% to 36.5% (p=0.04). A significant increase was found in men (35.6% to 43.5%, p=0.04) but not in women (26.2.0% to 30.1%, p=0.45). During the same period, the prevalence rates of hypertension unawareness decreased from 37.6% to 16.7% (P <0.001), untreated hypertension increased from 43.8% to 48.9% (P=0.09), and uncontrolled hypertension decreased from 69.1% to 50.0% (P<0.001). Prevalence rates of untreated and uncontrolled hypertension were about 50% in 2009. Factors associated with hypertension unawareness were current smoking (OR=1.27, 95%CI, 1.04-1.52), male gender (OR=1.47, 1.23-1.75), hypercholesterolemia (OR=1.47, 1.23-1.75), older age (OR 65-74y vs 35-49y=1.36, 1.10-1.69), and alcohol consumption (OR upper vs lower tertile=1.20, 1.06-1.36). High level of education was associated with untreated hypertension (OR=1.39, 1.14-1.17). Male gender (OR=1.49,1.12-1.96), sedentarity (OR=0.79, 0.64-0.99), and older age (OR 65-74y vs 35-49y=1.58, 1.02-2.43) were associated with an increased risk of uncontrolled hypertension. The magnitude of these associations decreased between the 1999-2002 and the 2003-2009 periods, with the exception of the association of smoking status with uncontrolled hypertension, which increased. The prevalence rate of hypertension linearly decreased with monthly household income (from 50.0% for <3000CHF to 23.4% for >13000CHF; p<0.001), and the prevalence rates of untreated hypertension linearly increased with income (from 30.0% for <3000CHF to 50.7% for

>13000CHF; p=0.03). Hypertension and untreated hypertension prevalence rates differed by job position. Hypertension prevalence rate was the highest among the Retired, jobless, or disability insurance category(59.5%), which however had the lowest prevalence rates of untreated hypertension (26.8%)
CONCLUSIONS: In a representative sample of Switzerland, the prevalence rate of hypertension increased between 1999 and 2009. While favourable trends in hypertension unawareness, untreated and uncontrolled hypertension occurred during this period, about half of hypertensive subjects were not treated or had uncontrolled high BP in 2009. This study identified determinants that should guide interventions aimed to improving hypertension treatement and control.

THE 12-MONTH COST-EFFECTIVENESS OF TELEPHONE-DELIVERED COLLABORATIVE CARE FOR POST-CABG DEPRESSION Bruce L. Rollman; Julie M. Donohue; Bea Herbeck Belnap; Aiju Men; Fanyin He; Mark S. Roberts. University of Pittsburgh, Pittsburgh, PA. (Control ID #1312829)

BACKGROUND: Depressive symptoms commonly follow coronary artery bypass graft (CABG) surgery and are associated with poorer clinical outcomes. We demonstrated that telephone-delivered collaborative care (CC) for post-CABG depression provided in concert with patients PCPs reduces mood symptoms, and improves health-related quality of life (HRQoL) and physical functioning more than usual care (UC) at 8-months follow-up (Rollman BL, et al. JAMA 2009). We now report the cost-effectiveness of our intervention so as to guide clinicians, employers, insurers, and health systems on whether to adopt similar treatment strategies for treating depression following an acute cardiac event.
METHODS: From 3/04-9/07 we enrolled 302 post-CABG patients who screened positive for depression prior to hospital discharge; had at least a moderate level of mood symptoms two weeks later (PHQ-910); met all eligibility criteria; and were randomized to either our 8-month intervention or to UC. Later, we obtained insurance claims data for 189 (63%) patients with
12 months continuous enrollment from Medicare and the two largest health insurers in our region. We applied 2007 Medicare prices to inpatient and outpatient claims and approximated intervention costs (e.g., care manager time, pharmacotherapy) to estimate incremental costs between UC and CC from the payors perspective, and used generalized linear models with gamma distribution to correct for skewness in cost data. Then we converted SF-36 MCS scores collected at baseline, 2-, 4-, 8-, and 12-months follow-up to preference-based utilities, and calculated the incremental cost per quality-adjusted life year (QALY) gained for CC relative to UC.
RESULTS: At baseline, the 189 patients with continuous 12-month claims data were similar by: (a) sociodemographic and clinical characteristics to the 113 excluded from our analyses due to incomplete claims data; and (b) randomization status (90 CC and 99 UC; mean age: 67 years, 61% male). At 12-months, CC patients had $449 lower mean total costs than UC ($18,172 vs. $18,621), at an incremental cost effectiveness ratio of -$9,889 per QALY vs. UC (95% CI: -$11,940 to -$7,838).
CONCLUSIONS: Telephone-delivered collaborative care for post-CABG depression is both more effective and less costly than PCPs usual care and compares very favorably to other medical interventions at improving HRQoL. Future studies should examine: (1) how Accountable Care Organizations can provide similar treatment strategies for treating post-CABG depression in routine care; and (2) whether our treatment strategy is as effective and cost-effective at treating depression in patients with other cardiovascular disorders.

THE ASSOCIATION BETWEEN HOSPITALIST PHYSICIAN WORKLOAD AND HOSPITAL LENGTH OF STAY Daniel J. Elliott1;
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BACKGROUND: Hospitalist physicians are in increasingly high demand, largely because of perceived improvements in the efficiency of care. However, little data exist to determine the association between hospitalist workload and overall efficiency as measured by length of stay (LOS). The objective of this study is to

determine the association between daily hospitalist physician workload and overall LOS. METHODS: We conducted a retrospective cohort study of inpatients over 18 admitted to a large, private hospital medicine service between February 1, 2008 and January 31, 2011. We excluded patients who were admitted directly to an intensive care unit, were not discharged prior to the end of the study period, or had a hospital length of stay (LOS) <0.5 or >100 days. The exposure was the average physician workload on the day of a billed visit for each physician who billed a visit during the patients hospitalization. Daily workload was calculated for each physician as the total Relative Value Units (RVU) generated each day. We standardized RVU values to 2011 CMS guidelines. The primary outcome was overall hospital LOS. Key covariates included patient demographics, the fragmentation of care index of physician continuity, and hospital characteristics including occupancy. We included all diagnoses and used severity-adjustment algorithms from Thomson-Reuters. We used linear mixed-effects models clustered by patient to determine the association of daily workload and LOS. LOS was log-transformed for all analyses to account for skewed data.
RESULTS: Overall, 20,406 hospitalizations met study criterion. Mean daily workload was 32.5 RVU. Mean LOS was 5.4 days. The figure shows the results of the adjusted analyses. LOS was shortest when workload was in the lowest quintile ($p<0.001$). LOS increased significantly as workload increased, with a maximum LOS between 31 to 37 RVUs per physician per day. The average LOS decreased for patients in the highest quintile of workload (>37 RVUs/day).
CONCLUSIONS: Hospitalist Physician workload is strongly associated with LOS, even after adjusting for patient and hospital factors. Importantly, LOS decreases at the highest levels of physician workload, which may reflect changes in practice that occur at the extremes of workload. Further studies to

determine the impact of these LOS changes on quality and safety should be conducted, with particular attention to potential cost shifting that may occur with LOS reductions at the highest levels of physician workload

THE ASSOCIATION BETWEEN MEDICAL HOME READINESS, QUALITY OF CARE, AND RESOURCE USE

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BACKGROUND: Hopes are high that reorganizing primary care practices into medical homes will improve the value of chronic disease care. Some data suggest that medical home model implementation is associated with modest quality gains, but less is known about the association between medical home readiness and resource use. Therefore, we sought to describe whether visits to medical home ready practices are associated with both higher quality care and less resource use.
METHODS: We conducted a retrospective analysis of visits by adults 18 years or older to a nationally representative sample of office-based primary care physicians in the United States. Our primary predictor was the medical home readiness of the practice in which each physician worked. We determined this by mapping physician responses from the 2007 and 2008 National Ambulatory Medical Care Survey (NAMCS) to the 2011 National Committee on Quality Assurance's (NCQA's) medical home standards. We created two groups: physicians who worked in practices that met35% of NCQA points for medical home readiness ("medical home ready") vs. all other physicians. Our primary quality outcome was performance on each of nine previously validated outpatient quality indicators. Our outcomes for resource use were: ordering of1 lab test or1 radiology test, referral to a specialist, and admission to the hospital or emergency department. For each of the two NCQA groups, we estimated the proportion of visits meeting quality standards, and then used t-tests to test for group differences. Multivariate linear regression was used to assess the relationship between medical home readiness

and resource use while adjusting for other factors, including age, gender, race/ethnicity, severity of illness, and type of visit (general medical exam or not).
RESULTS: Our cohort included 14,144 visits to general practitioners and 5,245 visits to general internists in 2007 and 2008. 73% of all visits occurred at practices that were medical home ready. Patients with chronic conditions (e.g., CHF, CAD, COPD, CKD, or DM) were as likely to visit medical home ready practices, as patients without these conditions. For all quality indicators, performance at medical home ready practices was higher, but the differences were only significant ($p<0.05$) for four indicators: beta blocker for CHF, diuretic or beta-blocker for HTN, and diet and exercise counseling. Visits at which at least one lab or radiology test, or specialist referral was ordered, had a
higher odds of occurring at a medical home ready practice (OR: 1.43, 1.36,1.47 respectively, all $p<0.05$). Outpatient visits which resulted in emergency department or hospital visits were equally likely to occur at practices that were or were not medical home ready.
CONCLUSIONS: There was a trend towards improved quality, but more frequent ordering of tests and consults, at visits to practices that were medical home ready. Efforts to increase medical home readiness may result in modestly higher quality of care, but greater resource use at the time of the outpatient visit.
THE ASSOCIATION BETWEEN REGIONAL VARIATIONS IN MEDICARE SPENDING AND PATIENTS' OUT-OF-POCKET MEDICAL EXPENDITURES Lena M. Chen1,2; Sidney Le3; Kenneth M. Langa1,2; Arnold M. Epstein3. 1VA Ann Arbor Healthcare System, Ann Arbor, MI; 2University of Michigan, Ann Arbor, MI; 3Harvard School of Public Health, Boston, MA. (Control ID #1315603)
BACKGROUND: Wide regional variations in the costs of US medical care exist. Some policymakers hope that reducing utilization in high cost areas will decrease spending and increase efficiency. However, broad-based public support for this approach has been slow to materialize. To date, no one has examined how much regional variations in costs of care directly impact the finances of patients. We examined three questions. Compared to residents of low cost regions, do residents of high cost regions: 1) have higher out-of-pocket medical expenditures (OOPEs), 2) perceive themselves to be at higher risk for future catastrophic medical expenditures, and 3) more frequently purchase supplemental insurance coverage to protect themselves against future risk?
METHODS: We used the Health and Retirement Study (HRS) linked to Medicare data to identify a nationally representative cohort of non-institutionalized, fee-for-service elderly Medicare beneficiaries who were interviewed in 2006 and 2008. To create our primary predictor -spending quintile by hospital referral region (HRR) - we used data on total per capita standardized 2009 Medicare payments for fee-for-service Medicare beneficiaries 65 years of age or older. Our primary outcome was a self-reported, validated measure of OOPEs in the two years prior to the 2008 interview, and included OOPEs for hospital and outpatient visits, outpatient surgery, home health care, dental care, and medications. Secondary outcomes included: 2006-2007 Medicare payments for our cohort, self-reported estimates of the likelihood that medical expenses would eliminate household savings, and supplemental insurance rates.
RESULTS: Our cohort included 5,590 Medicare beneficiaries in 248 HRRs. Compared to residents of the lowest cost quintile, residents of the highest cost quintile were more likely to be poor, sick, and non-White (all $p<0.05$). Predictors of higher OOPEs included higher net worth and White race (all $p<0.05$). Median Medicare payments were $6,574 ($3,780) in the highest (lowest) cost quintile (ratio=1.74, $p<0.001$). Median OOPEs were $1,440 ($1,448) in the highest (lowest) cost quintile (ratio=0.99). Mean OOPEs were $2,637 ($2,330) in the highest (lowest) cost quintile (ratio=1.13, $p=0.006$). Estimates of the likelihood of future catastrophic medical spending, and rates of supplemental insurance coverage did not differ between the highest and lowest cost quintiles (all p-values>0.05)
CONCLUSIONS: Wide regional variations in costs of care do not translate into similarly large regional variations in OOPEs or differences in patients' concerns about future medical expenses. The protection that Medicare

provides against wide regional variations in out-of-pocket medical expenditures may limit public support for commonly proposed strategies to reduce geographic variations in health care utilization and costs.

THE ASSOCIATION OF BMI AND NEIGHBORHOOD SOCIAL CAPITAL AMONG ADULTS IN LOS ANGELES COUNTY Adebowale Odulana1; Eliana Perrin1; Tamera Coyne-Beasely1; Crystal Cene1; Feng-Chang Lin1; Arleen Brown2; Giselle Corbie-Smith1. 1UNC at Chapel Hill School of Medicine, Chapel Hill, NC; 2Univeristy of California at Los Angeles, Los Angeles, CA. (Control ID #1339394)

BACKGROUND: Environmental factors have increasingly been recognized as important contributors to health. One environmental factor, neighborhood social capital, is associated with improved health behaviors and outcomes independent of other social indicators. Social capital defined as availability of, and accessibility to, group-level resources as a result of membership within a social grouphas been shown to be an important determinant of health behaviors and therefore could affect body mass index (BMI). However, the relationship between neighborhood social capital and adult BMI is not clearly understood. In order to better understand how social capital may influence BMI, we examined the association between BMI and domains of neighborhood social capital in adults living in Los Angeles County.

METHODS: We used multi-level data from a cross sectional study of adults (n=1986) in the Los Angeles Family and Neighborhood Survey (2006-2008). Neighborhood social capital was measured by the following accepted subdomains: social cohesion, social support, informal social control, social leverage, and neighborhood organization participation. We constructed multivariate models of the association between the outcome variable, BMI, and neighborhood social capital, initially adjusting for individual characteristics (age, gender, race/ethnicity, physical activity, income), and then adjusting for the subdomains of neighborhood social capital. We used a random-effects model to estimate the association and account for clustering in neighborhoods. RESULTS: Of the adults (34% male, 60% Hispanic, 19% White, 8% African American, 5% Asian, mean age 39 yrs), mean BMI was 29.5, mean income was $31,360, and mean self-reported physical activity was1.8times/7 days. Most (91%) neighborhoods had moderate social cohesion; 52% had high social support; 50% had high informal social control; 58% had moderate social leverage; and 90% had low organization participation. Adjusting solely for individual characteristics, females (p=0.001), decreased physical activity (0.007), increased age (p=0.001), Hispanics (p=0.001), and African Americans (p=0.001) had higher BMIs. Adjusting for individual characteristics and subdomains of neighborhood social capital, adults in neighborhoods with low informal social control had higher BMIs than those with moderate informal social control (p=0.046), and, similarly, adults in neighborhoods with low social support had higher BMIs than those with high social support (p=0.034).

CONCLUSIONS: Low informal social control and low social support seem to be important domains in the relationship of neighborhood social capital and higher BMIs. This relationship provides insight into how environmental factors can lead to adverse health outcomes. These findings can be leveraged in the design of interventions that take into account and prompt both individual and group level behavioral change.

THE ASSOCIATION OF RACE CONSCIOUSNESS WITH THE PATIENT-PHYSICIAN RELATIONSHIP, MEDICATION ADHERENCE, AND BLOOD PRESSURE IN URBAN PRIMARY CARE PATIENTS LaPrincess Brewer1,4; Kathryn A. Carson2; Camara P. Jones3; Lisa A. Cooper1,2. 1Johns Hopkins University School of Medicine, Baltimore, MD;
2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD;
3Centers for Disease Control, Atlanta, GA; 4Johns Hopkins Bayview Medical Center, Baltimore, MD. (Control ID #1334803)

BACKGROUND: Discrimination has been linked to poorer adherence and impaired patient-physician relationships among African Americans (AAs). Previous studies also suggest associations between discrimination and blood pressure (BP) among ethnic minorities; however, patterns of association remain unclear. Internalized racism is one mechanism by which discrimination may negatively impact BP. We

hypothesized that race consciousness, a measure of internalized racism, would be associated with poorer ratings of the patient-physician relationship, lower medication adherence, and higher BP, among AA, but not among White patients with hypertension.
METHODS: This cross-sectional analysis includes 266 patients with hypertension seeing 41 physicians in 14 urban community-based primary care clinics serving predominantly minority or low income populations in Baltimore, MD. The predictor variable, race consciousness, was dichotomized as ever think about ones race and never think about ones race. Continuous outcomes assessed were systolic (SBP) and diastolic (DBP) blood pressures. Dichotomous outcomes were perceived respect from the
physician, likelihood of recommending the physician to a friend and adherence on the Morisky medication adherence scale. Stratifying by patient race, generalized estimating equations (GEE) were used to control for patients being nested within physicians. Models were adjusted for patients age and race concordance with the physician, but race concordance was then excluded because it did not significantly change the estimates for race consciousness.
RESULTS: Mean age was 61.3 years, 62% were AA and 65% were women. AA patients were more likely to ever think about race than white patients (49% vs. 21%, P<0.001). There were no significant associations between race consciousness and ratings of the physician or adherence among AAs. Race-conscious AA patients had significantly higher DBP (79.3 vs.74.6 mmHg, P<0.05) and somewhat higher SBP (138.7 vs. 134.8 mmHg, P=0.12) than those who were not race-conscious. Race-conscious whites were more likely to perceive respect from (57.3% vs. 27.8%, P=0.008) and recommend their physician to a friend (51.8% vs. 20.9%, P=0.008), but had significantly lower medication adherence (62.8% versus 83.2%, P<0.05) than those who were not race-conscious. There was no association between race consciousness and BP among whites.
CONCLUSIONS: Race consciousness is associated with higher DBP, and may be associated with higher SBP among AA, but not among white patients with hypertension. In contrast, race consciousness is associated with ratings of the patient-physician relationship and adherence among whites, but not AAs. Future work should explore disparities in race consciousness and its impact on health and healthcare.
THE CHOLESTEROL, HYPERTENSION, AND GLUCOSE EDUCATION (CHANGE) STUDY: RESULTS FROM A RANDOMIZED CONTROLLED TRIAL IN AFRICAN AMERICANS WITH DIABETES Benjamin Powers1,2; Janet M. Grubber2; Maren Olsen2; Matthew Crowley1,2; Hayden bOSWORTH1,2. 1Duke University Medical Center, Durham, NC; 2Durham VA Medical Center, Durham, NC. (Control ID #1340768)
BACKGROUND: Cardiovascular disease (CVD) and diabetes account for over one third of the mortality difference between African Americans and white patients. Health services interventions focusing on patient self-management and physician medication management have been proposed as means of improving chronic disease control, and some studies suggest a particular benefit from these interventions among African Americans. We sought to evaluate the effect of a nurse telephone intervention targeting CVD risk reduction in African Americans with diabetes.
METHODS: We randomized 359 African Americans receiving primary care for type 2 diabetes from one of the two participating clinics to receive either usual care or a tailored nurse telephone intervention. The intervention provided monthly self-management support by phone tailored to patient needs and quarterly facilitation of medication management through electronic communication with the physician providers. Patients were surveyed about health beliefs, health behaviors, and knowledge at baseline and 12 months. The three co-primary outcomes were change in clinic-measured systolic blood pressure, Hb A1c, and LDL cholesterol over the 12 months of intervention delivery. Data were analyzed using linear mixed models assuming a linear trend over time and adjustment for the site stratification variable.
RESULTS: Of the 359 patients included, 70% were female, 69% reported graduating from high school, 46% read below a 9th grade level, and 38% reported annual income under $10,000. The overall model-estimated mean systolic blood pressure, LDL cholesterol, and Hb A1c at baseline was 136.7 mmHg, 99.3 mg/dl, and 8.0

%, respectively. The intervention patients received a mean of 9.9 (sd+3.0) intervention sessions from the nurses. In the intervention arm, the nurses contacted the physician providers at 3, 6, and 9 months; providers replied to 76% of these encounters, and 18% of these contacts resulted in physician recommendations for medication changes. There was no significant between group difference at 12 months for SBP (2.4 mmHg higher in intervention arm; 95% CI: -1.2, 6.0; p=0.18), LDL cholesterol(0.9 mg/dl higher in intervention group; 95% CI -6.6, 8.4; p=0.81) or Hb A1c(0.07 % lower in intervention group; 95% CI: -0.39, 0.25; p=0.66). CONCLUSIONS: In spite of prior studies suggesting benefit of nurse telephone self-management interventions in African Americans and patients

with limited literacy, we found no significant difference in any of the three outcomes for this high risk population with limited resources. While patient participation in the phone calls was high, provider medication changes were low with this model of care. Consistent, effective, and sustainable interventions for high risk African Americans with diabetes remain elusive.

THE DIABETES LITERACY AND NUMERACY EDUCATIONAL TOOLKIT LATINO (DLNET-LATINO): A PRE-POST FEASIBILITY STUDY OF AN EDUCATIONAL INTERVENTION FOR LATINO ADULTS WITH DIABETES. Richard O. White1; Tebeb Gebretsadik3; Sunil Kripalani2; Russell L. Rothman2. 1Meharry Medical College, Nashville, TN; 2Vanderbilt University Medical Center, Nashville, TN; 3Vanderbilt University Medical Center, Nashville, TN. (Control ID #1340073)

BACKGROUND: Latinos are now the most populous minority group in the United States and bear a disproportionate burden of type 2 diabetes and its related complications. Deficits in health literacy and numeracy have been documented in Latinos and likely contribute to disparities in diabetes care. The aim of this study was to evaluate the feasibility of a diabetes educational intervention for adult Latinos with limited literacy and numeracy skills and to explore its potential for impacting knowledge, self-efficacy, self-care activities, and glycemic control.

METHODS: A convenience sample of adult Latino patients with diabetes was recruited from a community-based academic medical center and a federally-qualified health clinic which serve a growing immigrant population with many socio-demographic challenges in Nashville, TN. We designed a novel curriculum, the DLNET-Latino, a culturally-tailored, literacy/numeracy sensitive educational intervention with 6 modules that address general diabetes knowledge, diet, exercise, medication/insulin management, stress, and the medical visit. Participants received 4 weekly diabetes educational sessions led by a bilingual nutritionist trained in the content and delivery of the DLNET-Latino. Baseline data collection included demographics, psychosocial factors, behaviors, and clinical variables (A1c, lipids). Measures were repeated immediately post intervention and during a follow-up visit that ranged from 3-6 months later. Our primary outcome was the feasibility of intervention delivery. We also explored changes in knowledge, self-efficacy, self-care activities, and glycemic control from baseline to follow-up using Wilcoxon signed-rank tests. Results were also stratified by literacy status and compared using Wilcoxon rank-sum tests. RESULTS: 36 adults were enrolled with 22 completing all intervention sessions, and 16 providing complete follow-up data. Median age and time in the U.S. were 49 and 12 years respectively. Participants were mostly women, uninsured, had low levels of acculturation, and were of Mexican nationality. 91% earned<20 K annually, 92% had<HS education, and 42% had limited health literacy. In unadjusted bivariate analyses of baseline, post-intervention, and follow-up measures, significant improvements were observed immediately post-intervention in self-reported dietary behavior (p =0.003) and medication adherence (p=0.08). Participants with higher literacy reported significantly improved exercise behavior immediately post-intervention (p=0.029); however, none of these findings were sustained at follow-up. No improvements were seen in knowledge, glycemic control or other self-care activities.

CONCLUSIONS: The DLNET-Latino intervention was accepted by a sample of adult Latinos with diabetes. We experienced a number of challenges during the post-intervention period of our program with moderate retention at 3-6 months follow-up. This was due largely in part to the many socio-demographic challenges faced by this vulnerable population. Nonetheless, our intervention shows promise for impacting self-care behaviors among adult Latinos with limited health literacy and diabetes and warrants further evaluation.

THE ECONOMICS OF IN-PATIENT STRESS TESTING AND ITS PERCEIVED BENEFIT TO LOW RISK PATIENTS Mukesh Gopalakrishnan1; Rojina Pant1; Jeffrey Cook2; Lloyd W. Klein2. 1Advocate Illinois Masonic Medical Center, Chicago, IL; 2Advocate Illinois Masonic Medical Center, Chiacgo, IL. (Control ID #1315852)

BACKGROUND: "Acute Coronary Syndrome Rule Out" accounts for 37% of telemetry admissions. Our aim was to determine the financial burden of
such patients without known coronary artery disease (CAD), evaluate the effect of stress test on their hospital course and assess outpatient testing as a safe alternative for low risk patients.

METHODS: We conducted a retrospective observational study of 265 consecutive patients who underwent myocardial perfusion imaging. Patients were categorized into low, intermediate and high pretest probability with Diamond Forrester Risk Score (DFR) and Framingham Risk Score (FRS) for CAD. Incidence of abnormal stress tests, change in management prior to discharge with modification of cardiovascular medication regimen, interventions or consultations, and final discharge diagnosis were compared in each group. Cost analysis was done based on 24-hour hospital stay in a telemetry unit, services rendered and subsequent benefit to patients.

RESULTS: Inpatient management did not change for 93.7% of those in the low-risk FRS group, ($p<0.001$) and 92.9% in the low-risk DFR group, ($p=0.002$) based on stress tests. There were 82% with significant change in medical management that belonged to intermediate risk group. Comparing costs for inpatient and outpatient stress testing demonstrated nearly double the expense for inpatient testing to obtain an abnormal stress test ($75,967 versus $32,886). Table 1 explains cost to obtain an abnormal stress test, cost for CAD diagnosis, and cost to provide benefit in terms of change in management to one patient under the three risk categories. For every patient in the low-risk group with a meaningful change in management, 2 and 5 patients in the intermediate- and high-risk groups, respectively, would have benefited from utilization of equivalent resources. 45% of physicians surveyed felt defensive medicine played a role in the decision to order stress testing.

CONCLUSIONS: It is ideal to restrict inpatient management and further stress testing within intermediate- and high-risk groups, while relegating outpatient stress testing to low-risk patients. Based on the 2008 U.S. National Hospital Ambulatory Care Survey, this would translate to billions of dollars, yet provide a similar patient safety profile.

Table 1

Cost to Abnormal Stress Test

Cost to CAD

Diagnosis

Cost to Benefit One Patient

Low Risk $30,625 $576,450 $108,525 IntermediateRisk

$17,500 $134,226 $50,645

High Risk $14,000 $42,940 $21,705

THE EFFECT OF A STANDARDIZED CHEST PAIN PROTOCOL ON TROPONIN AND STRESS TEST UTILIZATION AND ITS IMPACT ON LENGTH OF STAY Aziz Ansari1; Mark Speyer1; Micky Simwenyi2; Elizabeth Schulwolf1. 1Loyola University Medical Center, Lisle, IL; 2Loyola University Medical Center, Lisle, IL. (Control ID #1339833)

BACKGROUND: Observation units are increasingly common and one of the more frequent admission diagnoses is low risk chest pain (CP). Variation in practice exists regarding number of serum troponins and type of stress test ordered which may impact length of stay (LOS). Factors such as time intervals between each

troponin and differences in duration of the stress test and time to test results can all influence length of stay. In April 2011 we implemented a CP protocol in an effort to standardize care for patients with low risk CP among our hospitalist group, which included ordering two troponins 6 hours apart, as well as guidelines for ordering stress tests.
METHODS: We analyzed administrative data of patients admitted to an observation unit managed by hospitalists only in an urban, academic medical center for evaluation of low risk CP from a 3-month period prior to initiation of the CP protocol (October 1, 2010 through December 31, 2010) and a 3-month period after (April 1,2011 through June 30, 2011). Variables included number of troponins and type of stress test. LOS was determined from date and time of admission to date and time of discharge. Continuous variables were compared using the Students t-test and dichotomous variables compared using the chi-square test.

RESULTS: A total of 525 patients were identified: 251 (47.8%) pre-protocol and 274 (52.2%) post-protocol. A total of 191 (36.4%) patients underwent a stress test: 91 (47.6%) treadmill stress echo, 70 (36.6%) nuclear and 29 (15.2%) dobutamine stress echo. A total of 255 (48.6%) had more than 2 troponins drawn. Mean LOS (pre 21.2 vs. post 22.2 hours) and mean total charges (pre $8014 vs. post $8282) were not significantly different. The proportion of patients receiving more than 2 troponins was significantly higher before the protocol when compared to after implementation (183 (72.9%) vs. 72 (26.2%), p<0.001). The LOS was significantly longer in patients with more than 2 troponins but did not undergo a stress test (22.0 vs. 17.6 hours, p<0.001). Similarly, patients who underwent a stress test and had more than 2 troponins had a significantly longer LOS (27.7 vs. 23.1 hours, p=0.002). In patients who underwent stress tests, LOS by stress test showed significant differences in treadmill stress echo and nuclear stress test. Patients undergoing treadmill stress tests had a shorter LOS [n=91, 23.0 vs. 26.9 hours (p=0.009)] and patients undergoing nuclear medicine tests had a longer LOS [n=70, 27.3 vs 23.8 hours (P=0.02)]. There was no difference in LOS in the dobutamine stress echo group.
CONCLUSIONS: The number of troponins and type of stress test ordered can impact LOS. The differences in LOS by stress test suggest that evaluation of the patient flow for those tests is warranted. Additionally, since 2 troponins obtained at least 6 hours apart is sufficient to rule out acute coronary syndrome in patients with low risk chest pain, establishing protocols to standardize evaluation of patients with this diagnosis could improve care efficiency and allow for improved flow of patients in an observation unit.

THE EFFECT OF DISTANCE TO PRIMARY CARE ON RESPONSE TO A HYPERTENSION TELEMEDICINE INTERVENTION AND CHANGE IN SYSTOLIC BLOOD PRESSURE

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BACKGROUND: Distance to primary care is a significant barrier to healthcare access. Telemedicine clinical encounters that do not rely on face-to-face visits have been shown to improve blood pressure control; however, less is known about the relationship between distance to care and the response to telemedicine interventions. The objective of this study was to examine the interaction between distance to primary care and exposure to a hypertension telemedicine intervention on systolic blood pressure (SBP) within the Veterans Health Administration (VHA). We hypothesized that greater distance to care would be associated with a greater improvement in SBP among telemedicine intervention participants.
METHODS: We conducted a cross-sectional analysis of 503 veterans enrolled in the Hypertension Intervention Nurse Telemedicine study. Eligible veterans had a diagnosis of hypertension, took antihypertensive medication(s), had a primary care provider at the Durham VA Medical Center, and had an 18-month SBP measurement. Veterans were stratified by distance to primary care (<30 miles vs. 30 miles) and subsequently grouped into usual care (N=147) and intervention (N=444) groups. The interaction between distance and the telemedicine intervention on 18 month SBP was examined using multivariable linear regression adjusting for

baseline SBP, age, race, and marital status. Important subgroups were also examined including those with uncontrolled baseline SBP or a diagnosis of diabetes.
RESULTS: The median distance to primary care was 41 miles (IQR 18-59). Veterans living 30 miles from care were younger (63 years vs.
65 years; p=0.006) than veterans living <30 miles from care. Patients were 92% male, 48% were white, and 42% had diabetes. Mean (SD) baseline SBP was 129 (19) mmHg for patients living 30 miles from care versus 131 (21) mmHg for those <30 miles (p=0.25). There was also no difference in baseline SBP by exposure to intervention (p=0.36). In the adjusted regression model, the interaction between distance and intervention on 18 month SBP was non-significant (beta 0.13; p=0.97). For an
average, 65 year old, single, white, veteran receiving usual care and living <30 miles to care, the SBP was 128 (95% CI 122-134). No difference in the effect of distance 30 miles on SBP in usual care (beta 0.13; p=0.97) and intervention groups (beta -0.80; p=0.79) was observed. Subgroup analyses of veterans with diabetes or uncontrolled SBP at study entry were also non-significant. Veterans had a median of 5 completed primary care visits during the study time period.
CONCLUSIONS: We did not observe an interaction between distance to primary care and the telemedicine intervention on SBP. Veterans had frequent clinical encounters and well controlled baseline SBP regardless of distance to care, possibly related to the high prevalence of diabetes and travel pay incentives provided by VHA. Although telemedicine can improve hypertension control, further work examining the relationship between distance to care and response to telemedicine interventions is needed.
THE EFFECT OF IMPROVEMENTS TO RACE/ETHNICITY DATA COLLECTION PRACTICES ON THE RACIAL/ETHNIC DISTRIBUTION OF HOSPITALIZED PATIENTS Rosette Chakkalakal1;
Jeremy C. Green3; Harlan M. Krumholz1; Brahmajee K. Nallamothu2.
1Robert Wood Johnson Foundation Clinical Scholars Program, Yale University School of Medicine, New Haven, CT; 2University of Michigan, Ann Arbor, MI; 3Yale University, New Haven, CT. (Control ID #1340440)
BACKGROUND: Hospitals collect and report data on patient race/ ethnicity that researchers and policymakers commonly use to identify and track healthcare disparities. However, substantial variation in the categories and procedures used by individual hospitals to obtain this information may make these data unreliable, particularly for smaller minority groups. In 2007, New Jersey hospitals adopted Guidelines for Systematic Collection of Data on Patient Race and Ethnicity throughout the state. This program sought to improve the process of collecting race/ethnicity data by: (1) requiring all New Jersey hospitals to use uniform categories for race/ethnicity and (2) training healthcare workers to solicit self-identified race/ethnicity data from patients using standard procedures. The purpose of our project was to determine if and how the racial/ethnic distribution of patients hospitalized for congestive heart failure (CHF), pneumonia, and acute myocardial infarction (AMI) in New Jersey changed as a result of this program.
METHODS: We used the Healthcare Utilization Project (HCUP) State Inpatient Databases (SID) to compare the racial/ethnic distribution of patients 18 years and older hospitalized with CHF, pneumonia, and AMI in New Jersey before (2005-2006) and after (2008-2009) implementation of the data collection changes relative to New York, a state with a similar racial/ethnic distribution of patients that has not implemented changes to data collection. Multinomial logistic regression was used to fit a difference-in-differences (DD) model where race/ethnicity was estimated as a function of the state in which the patient was hospitalized, the time period, the interaction of state and time period, and patient age and gender. Coefficients from the fitted model were used to predict racial/ethnic distributions for each diagnosis before and after implementation of the New Jersey program for 5 categories: non-Hispanic white, non-Hispanic black, Hispanic, Asian/Pacific Islander, and other. The percent change was calculated as the DD divided by the 2005-2006 proportions for New Jersey. Statistical significance was tested using bootstrap standard errors. RESULTS: See Table 1.
CONCLUSIONS: The racial/ethnic distribution of patients hospitalized for CHF, pneumonia, and AMI in New

Jersey changed significantly as a result of a statewide effort to improve hospital data collection practices. Changes were most evident in the increased proportion of patients identified as Asian/Pacific Islander and decreased proportion of patients identified as other for all 3 diagnoses. More widespread adoption of standardized data collection strategies within hospitals could substantially improve our understanding of healthcare needs in smaller minority groups, including Asians and Pacific Islanders, by improving the identification of these groups within healthcare data.

Table 1. Percent Change in Proportion of Individuals Identified in each Racial/Ethnic Group by Diagnosis

	CHF (n=406,326) Percent Change (95% CI)	Pneumonia (n=341,891) Percent Change (95% CI)	AMI (n=227,487) Percent Change (95% CI)
Non-HispanicWhite	3.03***(2.28, 3.78)	1.20**(0.28, 2.12)	0.98** (0.04, 1.93)
Non-HispanicBlack	-4.15*** (-6.55, -1.75)	2.71 (-0.55, 5.98)	5.60** (0.08, 11.12)
Hispanic	-7.71*** (-11.48, -3.93)	-10.10***(-15.04, -5.16)	-1.25 (-8.28, 5.77)
Asian/Pacific Islander	16.50**(1.38, 31.62)	35.61***(23.71, 47.5)	31.53***(14.72, 48.34)
Other	-45.83*** (-57.09, -34.56)	-45.74*** (-56.83, -34.64)	-55.67*** (-65.7, -45.64)

Analysis restricted to adults age 18 and over. ***p<0.01, **p<0.05

THE EFFECT OF SHIFT DURATION ON THE EFFICACY AND TOLERABILITY OF ARMODAFINIL IN PATIENTS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER John Harsh1; Steven G. Hull2; Ronghua Yang3. 1The University of Southern Mississippi, Hattiesburg, MS; 2Vince and Associates Clinical Research, Overland Park, KS; 3Teva Pharmaceuticals Ltd., Frazer, PA. (Control ID #1337964)

BACKGROUND: Shift work disorder (SWD) is a circadian rhythm sleep disorder characterized by excessive sleepiness and/or insomnia in individuals working shifts. The wakefulness-promoting agent armodafinil has been shown to significantly improve clinical condition and wakefulness during the last 4 hours of the night shift, as well as overall functioning in patients with SWD. This post-hoc analysis examined whether the length of the

night shift worked (9 hrs vs.
>9 hrs) affected the efficacy and tolerability of armodafinil in patients with SWD.
METHODS: Patients in this study were diagnosed with SWD (DSM-IV and ICSD-2 criteria), worked at least five 6- to 12-hour night shifts per month, had mean Karolinska Sleepiness Scale (KSS) score >6, and Global Assessment of Functioning (GAF) score <70. Following randomization, patients received 150 mg armodafinil or placebo on nights worked for 6 weeks. For the current analysis, patients were divided into 2 groups: those working 9-hour shifts and those working >9-hour shifts. Efficacy assessments included change in Clinical Global Impression-Change (CGI-C) score related to excessive sleepiness late in the shift (including the commute home [4:00 AM to 8:00 AM]), GAF, late-in-shift KSS, and modified Sheehan Disability Scale (SDS-M) from baseline to final visit. The SDS-M was modified to capture the effect of shift work on work, family, and social life. Final visit data included last observation carried forward.
RESULTS: Of the 383 patients enrolled in the study, 279 (73%) worked shifts 9 hrs (n=132 armodafinil; n=147 placebo) and 104 (27%) worked shifts >9 hrs (n=61 armodafinil; n=43 placebo). At final visit, a significantly greater proportion of armodafinil patients demonstrated an improvement in late-in-shift CGI-C score from baseline compared to placebo regardless of shift duration (9 hrs: 78% vs. 60% [p=0.0017];
>9 hrs: 77% vs. 46% [p=0.002]). Significantly greater improvements with armodafinil were also observed in both shift duration groups for the GAF (9 hrs: +9.5 vs. +5.4 [p<0.0001]; >9 hrs: +9.6 vs. +4.3 [p=0.0019]) and late-in-shift KSS scores (9 hrs: -2.9 vs. -1.9 [p=0.0002]; >9 hrs: -2.8 vs. -1.6 [p=0.0028]) at final visit. However, armodafinil treatment led to significantly greater improvement in composite SDS-M scores at final visit only in those patients working >9 hr shifts (9 hrs: -6.8 vs. -5.0 [p=0.0536]; >9 hrs: -6.8 vs. -2.7 [p=0.0086]). The most common adverse events were nausea and headache and a greater proportion of patients working >9 hrs had at least one adverse event compared with those working 9 hrs.
CONCLUSIONS: These findings indicate that shift duration did not affect the improvement with armodafinil over placebo in terms of late-in-shift
clinical condition and wakefulness and overall functioning in patients with SWD. Only those patients working >9 hrs demonstrated improvements over placebo in disability following armodafinil treatment. A greater proportion of patients working >9 hrs reported adverse events associated with armodafinil, although the types of events reported were similar between shift duration groups. This study was funded by Cephalon, Inc, now a part of Teva Pharmaceuticals Ltd.
THE EFFECT OF STATE MEDICAID EXPANSIONS ON MORTALITY AND INSURANCE COVERAGE AMONG NON-ELDERLY ADULTS Benjamin D. Sommers; Katherine Baicker; Arnold M. Epstein. Harvard School of Public Health, Boston, MA. (Control ID #1317587)
BACKGROUND: Several states significantly expanded Medicaid eligibility for adults in the past decade, and the Affordable Care Act will expand Medicaid dramatically in 2014. Yet the effect of acquiring Medicaid on health outcomes among adults remains unclear. Our objective was to examine whether Medicaid expansions resulted in any changes in all-cause mortality, as well as coverage, access to care, and self-reported health status.
METHODS: Our study used a differences-in-differences quasi-experimental design. The intervention group included three states significantly expanding adult Medicaid eligibility since 2000 (New York, Maine, and Arizona). The control group included neighboring states without expansions. The sample contained all adults aged 20-64, observed 5 years before and 5 years after expansions. Data sources were the CDCs 1997-2007 Compressed Mortality File for county-level mortality (N=68,012); the Current Population Survey for insurance coverage and health status (N=169,124); the Behavioral Risk Factor Surveillance System for barriers to care (N=192,148); and the Area Resource file for county-year covariates. Multivariable regression models adjusted for demographics, county of residence, and local economic conditions. Pre-specified subgroup analyses examined differential effects by age, race, and county poverty rates. Our primary outcome was all-cause mortality rate per 100,000 adults. Secondary outcomes were insurance coverage, deferring needed care due to

costs, and self-reported health status.
RESULTS: Medicaid expansions were associated with a significant reduction in all-cause mortality (-19.6 deaths per 100,000, p=0.001; from a baseline of 320 deaths per 100,000). Mortality reductions were greater for older adults, non-whites, and residents of poorer counties. Expansions increased the percentage of adults with Medicaid coverage (+2.2 percentage points, p=0.014); decreased the proportion uninsured (-3.2, p<0.001); decreased the percentage deferring care due to costs (-2.9, p=0.002); and increased the percentage reporting excellent or very good health (+2.2, p=0.045). CONCLUSIONS: State Medicaid expansions to low-income adults were associated with significant reductions in all-cause mortality over a five-year follow-up period. Our analyses of secondary outcomes provide a plausible causal chain for these mortality RESULTS: Medicaid eligibility expansions were associated with higher Medicaid coverage rates, lower rates of being uninsured, reduced financial barriers to care, and improved self-reported health. The Affordable Care Act expands Medicaid eligibility starting in 2014 to a similar group as these state expansions - primarily low-income childless adults. In contrast, budget pressures have led several states to consider cutting eligibility from previous expansions. Policymakers should be aware that major changes in Medicaid - either expansions or reductions in coverage - may have significant effects on the health of vulnerable populations.
THE EFFECT OF A SELF-AFFIRMATION WRITING EXERCISE ON RACE-DISCORDANT PATIENT-PROVIDER COMMUNICATION Rebecca Hanratty1,2; Edward P. Havranek1,2; Channing Tate1; L Miriam Dickinson2; John F. Steiner3; Geoffrey Cohen4; Irene V. Blair5. 1Denver Health Medical Center, Denver, CO; 2University of Colorado School of Medicine, Aurora, CO; 3Kaiser Permanente of Colorado, Denver, CO; 4Stanford University, Palo Alto, CA; 5University of ColoradoBoulder, Boulder, CO. (Control ID #1340110)
BACKGROUND: Although provider bias is thought to play a role in the genesis of health disparities by race, documentation of this has generally been lacking. Fear of stereotyping on the part of patients might be affecting race-

discordant patient-provider encounters. The process of self-affirmation has been shown to lessen the impact of stereotype threat.
METHODS: Within a single community health center, we randomized 99 African American patients with hypertension to perform either a self-affirmation exercise or a control exercise prior to a visit with their primary care provider and to have the visit audiotaped. We compared the patient-provider communication for the two groups quantitatively using the Roter Interaction Analysis System (RIAS), and evaluated visit satisfaction, trust, stress, and mood after the visit by questionnaire.
RESULTS: Patients were generally middle aged (self affirmation group mean 53.69.1 years, control group mean 57.310.5 years), predominantly female (69.1% and 65.9%) and had a high school education or less(76.4% and 63.6%). Patients in the intervention group requested and received more information about their medical condition (number of statements 66.36.8 in the self-affirmation group, 48.15.9 in the control group, p=0.02). Patient communication in the intervention group was rated more interested, friendly, responsive, interactive, and respectful (p=0.03) and less depressed and distressed (p=0.02). Questionnaires did not detect differences in visit satisfaction, trust, stress, or mood. CONCLUSIONS: A self-affirmation exercise improved some aspects of patient-provider communication in race-discordant primary care visits.
THE EFFECT OF CIGARETTE SMOKING ON DIABETIC PERIPHERAL NEUROPATHY: A SYSTEMATIC REVIEW AND META-ANALYSIS Carole Clair1,2; Marya J. Cohen3; Florian S. Eichler4; Nancy A. Rigotti2. 1Lausanne University, Lausanne, Switzerland;
2Massachusetts General Hospital, Boston, MA; 3Massachusetts General Hospital, Boston, MA;
4Massachusetts General Hospital, Boston, MA. (Control ID #1335435)
BACKGROUND: Diabetic peripheral neuropathy (DPN) is a common and incapacitating syndrome affecting almost one-third of people with diabetes. About one-fifth of people with diabetes also smoke. Tobacco use is a

known risk factor for development of cardiovascular complications in people with diabetes and studies suggest that it might also be a risk factor for development of microvascular complications such as DPN. The objective of the systematic review and meta-analysis is to assess the relationship between smoking and peripheral neuropathy in people with type 1 or type 2 diabetes. METHODS: A systematic review of MEDLINE, EMBASE, and Cochrane Clinical Trials databases was conducted from 1966 to August 2011. Each study was reviewed for eligibility independently by 2 authors. Studies were included if they reported DPN as an outcome and smoking status as an exposure in a population with type 1 or type 2 diabetes. Data from the included studies were extracted and quality assessed. We performed separate analysis for prospective cohort studies and cross-sectional studies. All pooled analyses were based on random effects models and heterogeneity was assessed using I2 statistics. We used Review Manager to perform the statistical analyses. RESULTS: From 1,644 abstracts, 24 studies (9 prospective cohorts and 15 cross sectional) met the inclusion criteria and agreement between reviewers was good (Kappa 0.72). The prospective cohort studies included 5,477 participants who did not have DPN at baseline. In 5 studies participants had type 1 diabetes, in 3 studies they had type 2 diabetes and in one study they had both. During a follow up ranging from 2 to 9 years, 1,539 cases of DPN occurred. Most studies reported an increased risk of DPN associated with smoking but 3 studies reported a decreased risk. Odds ratios (ORs) for DPN associated with smoking ranged from 0.22 to 2.20. The pooled OR of developing DPN associated with smoking using a random effect model was 1.16 (95% Confidence Interval (CI) 0.76-1.78). There was significant heterogeneity between studies. In sub-analysis restricted to studies where smoking status was well-defined and ORs were adjusted for at least HbA1c and diabetes duration, the pooled OR was 1.62 (95% CI 1.30-2.01) and there was no evidence of heterogeneity. There was no evidence of publication bias. The cross sectional studies included 5,627 participants, 11 with type 2 diabetes, 2 with type 1 diabetes and 2 with both. Only 7 studies had analysis adjusted for the main confounders and ORs ranged from 0.68 to 3.32. The pooled OR of DPN associated with smoking was 1.68 (95% 1.30-2.17) using a random effect model. There was no evidence of publication bias.
CONCLUSIONS: People with diabetes who smoke have an increased risk of having or developing neuropathy compared with non smokers. Targeting smoking cessation is a key factor for improvement of diabetic complications such as DPN.
THE EPIDEMIOLOGY OF WEIGHT COUNSELING IN THE UNITED STATES: A CASE OF POSITIVE DEVIANCE Christopher Sciamanna1; Jennifer Kraschnewski1; Kathyrn Pollak2; Heather Stuckey1; Nancy Sherwood3. 1PennState Hershey, Hershey, PA; 2Duke University, Durham, NC; 3University of Minnesota, Minneapolis, MN. (Control ID #1311395)
BACKGROUND: Primary care providers (PCPs) rarely counsel about weight, despite NIH guideline recommendations. To improve the rate of weight counseling, a full understanding of the epidemiology of weight counseling in primary care is needed. Although many have examined the rate of weight counseling using visit-based data from the National Ambulatory Medical Care Survey (NAMCS), no study has described the frequency of weight counseling at the level of the provider. The objective of this study was to measure the frequency of weight counseling at the level of the PCP and to identify the characteristics of patients who are seen by positive deviant PCPs who engage in higher rates of weight counseling.
METHODS: Data were examined from the 2007 to 2008 NAMCS, a national survey designed to provide reliable data about the provision of ambulatory medical care services in the U.S. We performed a cross-sectional study of 21,220 U.S. adult (age >17) outpatient primary care visits with 954 PCPs (general/family practitioner and general internal medicine). Rate of counseling was determined per PCP by dividing the number of visits with weight counseling by the total number of visits per PCP. Positive Deviance is an approach that studies successful individuals and compares them to those who are less successful. Positive deviant (PD) physicians were those who: 1) performed higher levels of weight counseling and 2) as a group, provided half of all weight counseling by PCPs in NAMCS. Visit and patient characteristics seen by PD and non-PD physicians were then

compared to understand whether the higher rates of weight counseling among PD physicians were due primarily to previously reported patient characteristics (e.g., age, ethnicity, insurance). Sample weights were applied to account for the complex sampling design and to allow extrapolation of national estimates. Chi-squared and analysis of variance were used to compare visits to PD and non-PD physicians. Logistic regression was used to describe the association between visits to PD and non-PD physicians and receipt of weight counseling, adjusting for covariates. RESULTS: Most (58%) PCPs performed no weight counseling during any patient visits. Eighty-five (8.9%) PCPs provided 52% of all weight counseling and were categorized as PD physicians. Patients seeing PD physicians were older, more likely to be male and to have hypertension, diabetes, and obesity. After adjusting for patient characteristics, including patient age, gender, race, ethnicity, insurance status, hyper-tension, diabetes and obesity, strengthened status was strongly associated with receipt of weight counseling during visits [adjusted OR=13.2 (95% CI; 11.5-15.7)].
CONCLUSIONS: In conclusion, a minority of PCPs (Positive Deviants) provide the majority of primary care weight counseling in the US. Studies of these PCPs may help to identify practical methods to increase weight counseling in primary care settings.
THE FAST PATH PROGRAM: ENGAGEMENT AND DEPENDENCE OUTCOMES IN A PRIMARY CARE-BASED ADDICTION TREATMENT PROGRAM Alexander Y. Walley1; Joseph Palmisano2; Amy Sorensen-Alawad1; Kaylyn Duerfeldt1; Anita Raj3,1; Donald Allensworth-Davies2; Jeffrey H. Samet1,2; Mari-Lynn Drainoni1,2. 1Boston University School of Medicine, Boston, MA; 2Boston University School of Public Health, Boston, MA; 3University of California, San Diego School of Medicine, San Diego, CA. (Control ID #1333471)
BACKGROUND: Addiction and medical outcomes can improve when treatment for these conditions are coordinated. Yet, it is not clear what factors are associated with engagement and reduction in substance

dependence over time within coordinated programs. To understand better how to implement coordinated care, we explored factors associated with engagement in treatment and substance dependence over time in a primary care-based addiction treatment program at an urban medical center.
METHODS: After establishing a primary care-based addiction treatment program for patients with alcohol or drug dependence and HIV or risk for HIV, we conducted a cohort study of 81% (178/220) of the patients enrolled between February 1, 2008 and December 31, 2010 who completed both baseline and 6-month follow-up interviews. The main outcomes were engagement, defined using standard criteria (2 addiction treatment encounters within the first 14 days and 2 more within the next 30 days), and persistent alcohol or drug dependence, measured at 6-months with the Composite International Diagnostic Interview -Short Form (CIDI-SF). Using logistic regression we examined the following potential factors associated with study outcomes: HIV status, self-reported serious depression previous 30 days, housing status, polysubstance use at baseline, and receipt of buprenorphine treatment during follow-up. Adjusted models included these potential factors and the following covariates: age, gender, race/ethnicity, and education.
RESULTS: Patient characteristics at baseline were 61% HIV-infected, 74% serious depression, 21% homeless, 51% polysubstance use; at 6-month 63% had been treated with buprenorphine. Engagement occurred in 66%. Persistent alcohol or drug dependence was present in 48%. In adjusted analyses, receipt of buprenorphine treatment was associated with engagement (Odds Ratio (OR) 5.8 95% CI: 2.75-12.4). Baseline depression was associated with persistent substance dependence (OR4.58 95% CI: 2.02-10.4).
CONCLUSIONS: Buprenorphine treatment was a major driver of treatment engagement within a primary care-based addiction treatment program. Engaging patients not receiving or eligible for maintenance medication presents a challenge. With a substantial burden of self-reported depression at the beginning of treatment, including mental health treatment as part of integrated care may improve addiction treatment outcomes.

Factors associated with engagement and persistent substance dependence in a primary care clinic-based substance abuse treatment program
All N=178 Engagement: Adjusted Odds Ratio (95% CI)
Substance Dependence: Adjusted Odds Ratio (95% CI)
BACKGROUND: Identifying effective interventions to improve diabetes self-management and outcomes among African-Americans is a national priority. Tailoring diabetes self-management interventions to the culture and practical needs of urban African-Americans has been shown to be effective. Nevertheless, few diabetes education interventions incorporate local community resources. We piloted diabetes education integrated with community partnerships. Our aim was to develop effective partnerships with local food organizations to support newly educated and empowered diabetes patients. We sought to assess the feasibility and preliminary effectiveness of this integrated approach to classroom and community-based education.
METHODS: Patients participated in 10 weeks of culturally-tailored diabetes education at a clinic on Chicagos South Side. Participants learned diabetes self-management, patient activation communication skills, and tips on healthful eating. Community-based grocery store tours taught hands-on skills identifying healthy choices. Partnerships with food organizations linked participants to affordable healthy food: gift cards were donated by a local food retailer in tandem with a store tour; participants were directed to a farmers market where LINK dollars were doubled; free fresh produce was given to participants at a food pantry, along with healthy recipes, nutrition advice, and free exercise lessons. Changes in clinical outcomes, diabetes self-management and self-efficacy were measured pre, post, and three months following the class (six months post-intervention data is currently being collected).
RESULTS: All patients were African-American; the mean age was 66 years. The majority was female (88%), and the annual household income was<$25 k. All participants attended at least half the classes; 86% attended at least 70% of the classes. All patients strongly agreed that they were satisfied with the program. Participants experienced improvements in clinical outcomes, diabetes self-efficacy and self-management, including reported nutrition patterns. The mean HbA1c of participants improved from 8.2% pre-intervention to 7.3% three months post (p=0.021). Self-efficacy improved in all patients, including confidence in diabetes management (p=0.047), feeling capable of handling their diabetes (p=0.011), and feeling capable of doing routine care (p=0.002). Improvements were observed in the mean number of days/week participants ate 5+ servings of fruits and vegetables (4.3 vs. 4.9, p=0.041), inspected their shoes (2.8 vs. 5.6; p=0.003), and monitored their glucose (4.6 vs. 5.6; p=0.047). Participants anecdotally expressed appreciation for the resources offered by the community partnerships. CONCLUSIONS: We aimed to assess the feasibility of integrating community partnerships into diabetes education, and the effectiveness of a program thus tailored to the culture and pragmatic needs of urban African-Americans. The partnerships proved feasible, and the education effective. Educated participants are ready and willing to eat healthily, but they need support to do so. Incorporating community partnerships that offer discounted/ free fresh produce and/or guidance in healthy food choices anchors new nutrition information and relates it to the everyday logistical, financial, and personal realities of patients. Integrating diabetes education with community partnerships has great potential to support patients as they work to sustain healthy behavior change.
THE HIDDEN CURRICULUM, PATIENT SAFETY, AND ETHICAL EROSION: EXPOSURE TO ROLE MODELING AND RESIDENTS DISCLOSURE OF MEDICAL ERRORS William Martinez; Lisa Lehmann. Brigham &Women's Hospital, Boston, MA. (Control ID #1326375)
BACKGROUND: Prior research suggests that role models for responding to medical errors are important to trainees and may constitute part of a hidden curriculum that may impact attitudes toward disclosure. We measured residents exposure to negative and positive role models for responding to medical errors and examined the association between exposure to these role models and residents own attitudes and behaviors regarding error disclosure.

METHODS: We conducted a multicenter, cross-sectional survey of residents attitudes and experiences regarding errors and their exposure to role modeling. We administered an anonymous, electronic questionnaire to 436 residents across surgical and non-surgical residency programs at two,
Age in years, Mean (Std Dev)
44 (9) 1.05 (1.00-1.09) 0.95 (0.91-1.00)
Female 33% 0.71 (0.32-1.55) 0.70 (0.33-1.47) White, Non-Hispanic 37% Ref RefHispanic 31% 1.04 (0.39-2.78) 0.63 (0.25-1.52) Black/African American,
Non-Hispanic
24% 0.45 (0.15-1.29) 0.60 (0.22-1.63)
Other, Non-Hispanic 7.3% 0.35 (0.09-1.46) 0.23 (0.06-0.95) Completed 12th grade 67% 0.92 (0.41-2.08) 0.87 (0.41-1.85) HIV infected 61% 1.76 (0.79-3.92) 0.94 (0.45-1.96) Self-reportedserious depression
74% 0.95 (0.42-2.13) 4.58 (2.02-10.4)
Homeless 21% 0.74 (0.30-1.81) 1.11 (0.47-2.63) Polysubstance Use* 51% 1.33 (0.64-2.79) 1.91 (0.97-3.80) Buprenorphine treatment 63% 5.82 (2.75-12.4) 0.82 (0.40-1.68)
Multiple logistic regression: Odds Ratios adjusted for all variables in the table. *Defined as use of >1 substance, past 30 days, at baseline: alcohol, heroin, cocaine, or marijuana
THE FEASIBILITY OF INTEGRATING DIABETES EDUCATION WITH COMMUNITY PARTNERSHIPS Tonya Roberson1; Anna Goddu1; Abigail E. Wilkes1; Marla C. Solomon2; Shelley Scott3; Sheila Harmon3; Marshall Chin1,2; Monica Peek1,2. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; 3Access Community Health Network, Chicago, IL. (Control ID #1338185)

large academic medical centers. The questionnaire asked respondents about: (1) Personal experience with medical errors; (2) Disclosure training;(3) Unprofessional behaviors related to disclosure; (4) Frequency of exposure to role modeling related to disclosure, which included a negative role modeling scale (2 items, score range: 2-8*, Cronbach =.76) and a positive role modeling scale (3 items, score range: 3-12*, Cronbach =.92); (5) Attitudes regarding disclosure, which included a disclosure attitudes scale (9 items, score range: 9-36*, Cronbach =.77); and (6) Demographics. (*Higher scores represent more frequent exposure and more positive attitudes, respectively.) Univariate statistics were used to describe the frequency of exposure to negative and positive role models. Multivariate linear regression was used to assess independent predictors of attitudes regarding disclosure. Multivariate logistic regression was used to assess independent predictors of unprofessional behavior related to disclosure, which was a composite outcome of respondents who reported not disclosing a harmful medical error to the patient, not disclosing a harmful medical error to more senior team members, or attempting to evade responsibility for a medical error. Our primary predictors were disclosure training and exposure to role modeling.
RESULTS: The overall response rate was 59% (259/436). More than 80% of residents reported exposure to positive role modeling related to disclosure; while more than 50% of residents reported exposure to negative role modeling. Independent predictors of attitudes regarding disclosure included, training, which had the largest positive effect on attitudes and, negative role modeling, which had the largest negative effect on attitudes (standardized effect estimate, 0.33, P<.001 v. -0.29, P<.001). Positive role modeling had a smaller, positive effect on attitudes (standardized effect estimate, 0.21, P<.001). Only two variables were independently associated with unprofessional behavior related to disclosure. More frequent exposure to negative role modeling was associated with an increased likelihood of unprofessional behavior (OR 1.31, 95% CI 1.02-1.70; P=.03); while more positive attitudes toward disclosure was associated with a decreased likelihood of unprofessional behavior (OR 0.83, 95% CI 0.73-0.94; P=.03). CONCLUSIONS: Reducing exposure to negative role models may increase residents likelihood of meeting their ethical obligation to disclose harmful errors to patients. Training residents on how to respond to medical errors is important, but may be insufficient to ensure

professional conduct in response to errors. Attention should be paid to identifying and remediating faculty who act as negative role models.

THE IMPACT OF 2011 ACGME DUTY HOUR REFORM: BASELINE DATA OF A SURVEY OF RESIDENT AND ATTENDING PERCEPTIONS OF RESIDENT TRAINING, WELL-BEING, AND PATIENT SAFETY

Caroline Tse; Francois Rollin; Christina E. Payne. Emory University DOM, Atlanta, GA. (Control ID #1340239)

BACKGROUND: In an effort to improve resident quality of life and reduce patient safety errors, the latest Accreditation Council for Graduate Medical Education (ACMGE) resident duty hour reform, effective July 1, 2011, decreased the intern shift length from 30 to 16 hours, while continuing previous standards of an 80-hour weekly limit. The impact of these new restrictions on patient safety, handoffs, and resident well-being remains unclear. The purpose of this study is to examine resident and attending perceptions of the quality of resident training, resident self-efficacy, and the perceived effects on patient care, before and after the 2011 ACGME work hour restrictions.

METHODS: 105 categorical post-graduate-year (PGY) 1 and PGY-2 residents and 81 attendings on medical wards were surveyed in May and June 2011, before the resident work hour restriction changes. The electronically administered survey was voluntary, anonymous, and results were obtained through aggregate totals. Responses were weighted on a 5-point scale. RESULTS: Baseline data: 40 residents (n=105; 38% response rate) responded to the survey, with 28 PGY-1 responses. 19 attendings (n=81; 23% response rate) responded to the survey, with a median number of post-residency experience of 4-6 years. Resident Quality of Life: Average shift length was reported as 20.6 hours, with 61-70 median duty hours weekly. The median amount of sleep reported was 6 hours. The majority of

residents felt depressed (51%) and overwhelmed with work or patient care (81%) some or most days in the week. 65% of residents believed personal relationships were negatively affected during an inpatient wards rotation. Patient Care: Medical Errors and Handoffs Residents perceived the majority of medical errors to occur during cross-cover, with medical errors being secondary to inadequate time (weighted scale: 2.7 out of 5), excessive workload (2.7), and fatigue (2.5). Attendings perceived resident medical errors to be related to inadequate knowledge base (2.7) and felt that adherence to duty hours is a barrier to patient care (3.7). Both residents and attendings felt there are too many patient handoffs (3.6; 3.8); however, the majority of interns felt their patients saw them as the primary caregiver(3.9) and felt personally responsible for their patients (4.3). Overall, residents felt their ability to learn was hindered by fatigue (3.9). Despite this, residents did not feel that duty hour compliance affected their attendings ability to teach on the wards and the majority felt prepared to advance to the next level of training (4.1).

CONCLUSIONS: This study collected baseline data on resident and attending perceptions of patient care and resident well-being prior to the most recent ACGME duty hour changes. Preliminary data show that the majority of residents surveyed on medical wards feel overwhelmed; with fatigue, excessive workload, and inadequate time as the most commonly perceived causes of medical errors. While the majority of residents note there are too many patient handoffs, residents still feel they are the primary caregiver for their patients and agree that they are prepared for their responsibilities in the next year of training. Future studies will further examine the impact of the ACMGE resident duty hour reform.

THE IMPACT OF BUPRENORPHINE/NALOXONE TREATMENT ON HIV RISK BEHAVIORS AMONG HIV-INFECTED, OPIOID-DEPENDENT PATIENTS: RESULTS FROM THE BHIVES COLLABORATION

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BACKGROUND: Needle-sharing and sexual risk behaviors are prevalent among opioid-dependent patients.

This finding is particularly concerning for individual and public health when considering patients who are HIV-infected. Opioid agonist treatment is associated with decreased needle-sharing practices among opioid-dependent injection drug users. The impact of buprenorphine/naloxone treatment on needle-sharing and sexual risk behaviors among HIV-infected patients over time is unknown. Therefore, we sought to assess the changes over time in needle-sharing and sexual risk behaviors among HIV-infected, opioid-dependent patients receiving buprenorphine/naloxone treatment.
METHODS: We analyzed data from the Buprenorphine-HIV Evaluation and Support Demonstration Project (BHIVES), a prospective study of HIV-infected, opioid-dependent patients initiating treatment with buprenorphine/ naloxone at 9 U.S. sites between July 2005 and December 2007. Patients completed assessments every 3 months. Outcomes of interest included self-reported needle-sharing and sexual risk behaviors, defined as non-condom use with vaginal or anal sex. Descriptive statistics were used to determine the characteristics of the population and prevalence of HIV risk behaviors over time. RESULTS: The study sample (n=303) had a mean age of 45 years, was 68% male, 23% White, 51% Black, 22% Hispanic, 81% heterosexual, and 50% unmarried. Sixty-one percent of patients were on combination antiretroviral therapy, with the most recent CD4 count less than 199 in 67% and HIV-1 RNA viral load greater than 400 copies in 58% of patients. Needle-sharing decreased over time (9% at baseline vs. 3% at 1 year, p=0.05), though non-condom use did not change (24% vs. 21%,p=0.82) (Figure 1).
CONCLUSIONS: Buprenoprhine/naloxone treatment is associated with decreased needle-sharing, but not decreased sexual risk behaviors, in HIV-infected, opioid-dependent patients. Developing interventions that specifically address sexual risk behaviors in this patient population receiving buprenorphine/naloxone may increase the public health impact of this treatment.

THE IMPACT OF PRIMARY CARE WEIGHT ADVICE Christopher Sciamanna1; Andrew Pool1; Jennifer Kraschnewski1; Heather Stuckey1; Kevin Hwang2; Kathryn Pollak3; Deborah F. Tate4; Erik Lehman1. 1Penn State Hershey, Hershey, PA; 2University of Texas, Houston, TX; 3Duke University, Durham, NC; 4University of North Carolina, Chapel Hill, NC. (Control ID #1311422)
BACKGROUND: Individuals in the United States continue to be greatly affected by the epidemic of overweight and obesity. Additionally, physicians struggle with identifying and providing effective weight counseling to their patients. Thus, there is a need for simple and effective interventions for physicians to help their overweight and obese patients to lose weight. Physician acknowledgement of a patients weight has recently been shown to have a significant effect on patients perceptions of their own weight, in addition to their desire and attempts to lose weight. The objective of this study is to examine the association of a doctors acknowledgement of a patients weight status with reported weight loss by comparing 2005 to 2008 data from the National Health and Nutrition Examination Survey (NHANES).
METHODS: We analyzed data from the 2005 to 2008 National Health and Nutrition Examination Survey to examine the association of a doctors acknowledgement of patient weight status and patient reported weight loss. We included nonpregnant overweight and obese (body mass index [BMI]25)
participants between the ages of 20 and 64 years who had responded to the question, Has a doctor or other health professional ever told you that you were overweight? (n=5054). The main outcome measure was the proportion of participants who lost at least 5% of their body weight in the past year. Bivariate relationships by BMI category were evaluated using chi square tests between participants who had and had not been told by a doctor that they were overweight, demographic characteristics and weight loss. To determine the odds of losing at least 5% weight, a logistic regression was performed, controlling for the following variables: age, sex, education, marital status, poverty to income ratio (PIR), ethnicity, place of routine care, number of physician

visits in the past year, and doctors acknowledgement of weight status.
RESULTS: Overweight participants were significantly more likely to report a 5% loss of weight in the past year if their doctor told them they were overweight (adjusted OR 2.08; 95% CI 1.62-2.66). Obese participants reported similar results (adjusted OR 1.81; 95% CI 1.34-2.44). Also, overweight and obese patients, respectively, were also more likely to report a 10% loss of body weight in the past year if their doctor told them they were overweight (adjusted OR 2.81; 95% CI 1.93-4.06 for overweight; adjusted OR 2.27; 95% CI 1.31-3.94 for obese).
CONCLUSIONS: Physicians recognition of their patients weight status is associated with significant patient weight loss. Specifically, overweight and obese individuals have almost two times the odds of reporting a 5% loss of weight in the past year - a weight loss amount that has been found to significantly improve the comorbidities associated with being overweight or obese. In addition, overweight and obese individuals were more than twice as likely to report a 10% weight loss in the past year if their doctor had told them that they were overweight. This suggests that physician acknowledgement of weight status may have a measurable impact on weight.
THE IMPACT OF REAL TIME LABORATORY COST DISPLAY ON PRIMARY CARE PHYSICIAN ORDERING PATTERNS DanielM. Horn1,2; Kate E. Koplan1; Margaret D. Senese1; Endel J. Orav2; Thomas D. Sequist1,2. 1Harvard Vanguard Medical Associates and Atrius Health, Newton, MA; 2Brigham and Women's Hospital, Boston, MA. (Control ID #1338560)
BACKGROUND: Physicians are under increased pressure to help control rising health care costs, though they may lack information regarding the relative cost implications of their patient care decisions. We evaluated whether real time display of costs with an electronic health record impacted primary care physician ordering of common laboratory tests in the outpatient setting.
METHODS: We conducted this study within a physician group practice in Massachusetts utilizing an integrated electronic health record. Beginning in April 2011, the average Medicare reimbursement rate for 22 commonly overused laboratory tests with either high annual volume (n=15) or relatively high individual cost (n=7) was displayed to primary care physicians at the time of electronic ordering. High annual volume tests included creatinine, BUN, glucose, ALT, electrolyte panel, basic metabolic panel, comprehensive metabolic panel, hemoglobin A1c, iron binding profile, lipid profile, sedimentation rate, thyroid stimulating hormone, prostate specific antigen, ferritin, and hemogram. High-cost tests included antimitochondrial antibody, brain natriuretic peptide, parathyroid hormone, testosterone, tissue transglutaminase antibody, vitamin D, and alpha fetoprotein. We used electronic health record data to measure test orders for 12 months prior to the cost display intervention and 6 months following the intervention start. Order rates (orders/ monthly patient visits) were analyzed for 157 "intervention" primary care physicians receiving the cost information and 61 "control" primary care physicians not receiving the cost information within the group practice. We assessed the longitudinal impact of the intervention on laboratory ordering using an interrupted time series analysis with a parallel control group. For each laboratory test, multivariable hierarchical binomial regression was used to compare the change-in-slope of the ordering rate in intervention physicians to the change-in-slope in control physicians. The model used the number of laboratory orders per month, per physician, as the dependent variable and accounted for both the number of patient visits per month and within-physician correlation.
RESULTS: The average number of monthly patient visits was 192 among intervention physicians and 261 among control physicians. Compared to the control group, the display of laboratory cost information among intervention physicians was associated with a directional decrease in physician ordering rates for 12 of the 15 high volume laboratory tests, with 6 (40%) achieving statistical significance ($p<0.05$). These statistically significant decreases in ordering high volume tests included lipid profile (mean decrease in intervention compared to control group -2.40 orders/100 visits), creatinine (-2.40 orders/100 visits), glucose (-2.36 orders/100 visits), ALT (-1.96 orders/ 100 visits), electrolyte panel (-0.35 orders/100 visits), and BUN (-0.03

orders/ 100 visits). For high cost laboratory tests, the intervention was associated with a directional decrease in physician ordering for only 2 of the 7 tests, and neither reached statistical significance.
CONCLUSIONS: Real time display of cost information can reduce ordering of high volume laboratory tests, and has no effect on physician ordering of lower volume, high cost tests. Future work should focus on understanding physician perceptions of cost information provision and how to optimize the value of laboratory test utilization in the primary care setting.
THE IMPACT OF RESIDENT PHYSICIAN BURNOUT ON THE QUALITY OF CARE OF HOSPITALIZED PATIENTS Rebecca A. Mazurkiewicz; Kristofer L. Smith; Deborah Korenstein; Jonathan Ripp. Mount Sinai School of Medicine, New York, NY. (Control ID #1321067)
BACKGROUND: While the impact of burnout on resident physicians has been described, few studies have explored the repercussions of trainee burnout for their patients. We sought to examine the relationship between burnout in internal medicine (IM) resident physicians early in training and the quality outcomes of hospitalized patients under their care. We hypothesized that burnout among resident physicians would be associated with poorer outcomes for their hospitalized patients.
METHODS: We surveyed members of the Mount Sinai Hospital IM residency graduating classes of 2011 and 2012 during their post-graduate year 1 (PGY1) orientation, collecting demographic information and administering the Maslach Burnout Inventory (MBI), a validated instrument measuring the 3 domains of burnout (emotional exhaustion, depersonalization, and impaired sense of personal accomplishment). In keeping with the most commonly used definition in the literature, participants were considered to be burnt out if they had high scores on either the emotional exhaustion (27) or depersonalization (10) subscales of the MBI. Subsequently, we collected data from the medical records of hospitalized patients under the care of each participant (matched by author of the discharge summary) for the following year including demographics, level of illness, co-morbidities, length of stay index (the ratio of observed length of stay to expected length of stay controlled for age, sex, race, socioeconomic status, admit source and status, severity of

illness, and co-morbidities), mortality index (calculated similarly to length of stay index), and 30-day readmissions, as well as each participants rate of discharge summary completion within 48 hours and patient satisfaction scores as measured by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey. Generalized estimating equations were used to fit linear or logistic regression models, as appropriate, to examine associations between resident physician burnout and patient outcomes.
RESULTS: Of the 104 eligible resident physicians, 91 (88%) participated in the study and were linked to the care of 7941 hospitalized patients. Thirty-three (36%) study subjects met criteria for burnout at the start of training. When controlling for characteristics of patient encounters and resident physician demographics, there was a trend toward an association between resident physician burnout and an increased length of stay index (=0.05, p=0.06). There was no association between burnout and mortality, readmissions, discharge summary completion, or patient satisfaction.
CONCLUSIONS: Our study demonstrates a trend towards an association between burnout among physicians beginning IM residency and a higher length of stay. By nature of the index, the impact of this finding will vary from patient to patient; however, the prolonged length of stay doesnt appear to affect patient care in terms of the other quality markers we measured. IM residents, burnt out at the start of training, may be able to provide quality care and ensure patient safety, perhaps due to support from other members of the treatment team, the residency program, or other resources of the hospital.
THE IMPACT OF SOCIOECONOMIC STATUS ON THE PRESCRIBING OF OPIATES IN THE EMERGENCY SETTING IN THE UNITED STATES Michael Joynt; Meghan Train; Brett Robbins; Jill Halterman; Enrico Caiola; Robert J. Fortuna. University of Rochester, Rochester, NY. (Control ID #1332919)
BACKGROUND: Racial and ethnic disparities in opioid prescribing in the emergency setting are well described,

yet the influence of socioeconomic status on the prescribing of opioids remains unclear. The objectives of this study were to: 1) evaluate the effect of both poverty and race on the prescribing patterns of opioids in the emergency setting in adult patients suffering moderate to severe pain, and 2) determine whether differences by poverty explain the racial differences in prescribing previously described.
METHODS: We used cross-sectional data from the National Hospital Ambulatory Medical Care Survey between 2006-2009 to examine the prescribing of opioids to patients, age 18 and over, presenting to the emergency department with either moderate or severe pain. We used logistic regression models to evaluate the independent association between poverty, race, and the prescribing of opioids. Models were adjusted for pain level, age, ethnicity, injury status, frequency of emergency visits in the past year, type of hospital (nonprofit, government, proprietary), region of the country, and location within urban or rural areas. Poverty was determined based on the percent poverty within a patients zip code and analyzed by quartiles.
RESULTS: We examined 183.9 million weighted visits from adults with moderate to severe pain. Opiates were prescribed more frequently to patients of the highest socioeconomic status, including percent poverty (49.0% vs. 39.4%, P<0.001), household income (47.3% vs. 40.6%, P<0.001), and educational level (46.3% vs. 42.5%, P=0.01), compared to patients in the lowest quartile. White patients were consistently prescribed opiates more frequently than black patients across all quartiles of poverty, including poverty <5.00% (50.0% vs.42.4%, P=0.02), poverty 5.00-9.99% (49.0% vs. 40.2%, P<0.001), 10.00-19.99 (44.3% vs. 40.1%, P=0.02), and poverty >20.00% (42.2% vs. 36.5%, P<0.001). In adjusted models, both black patients (AOR 0.73; 95% CI 0.67-0.80) and patients from poorer areas (AOR 0.76; 95% CI 0.68-0.84) were significantly less likely to receive opioids after accounting for pain level, age, injury status, and other covariates.
CONCLUSIONS: Patients presenting to emergency departments from poorer areas were less likely to receive opioids for equivalent levels of pain than those from more affluent areas. Black patients were also less likely than whites to receive opioids for equivalent levels of pain. Poverty did not explain racial differences in prescribing of opioids in the emergency setting.
THE MEDICARE PART D LOW-INCOME COST SUBSIDY (LICS) AND ADHERENCE TO MEDICATIONS FOR SECONDARY PREVENTION OF CARDIOVASCULAR DISEASE O. Kenrik Duru; Sarah Edgington; Carol Mangione; Norman Turk; Chi-hong Tseng; Lindsay Kimbro; Susan Ettner. University of California, Los Angeles, Los Angeles, CA. (Control ID #1320374)
BACKGROUND: Out-of-pocket costs are an important barrier to medication adherence. High copayments can be a major obstacle for patients who have already experienced a cardiovascular event, and are taking medications which are quite expensive but also critical for secondary prevention of recurrent events. Medicare Part D includes a low-income cost subsidy (LICS) for eligible low-income patients that reduces the out-of-pocket costs for chronic maintenance medications. To date, there have been few studies examining the association between LICS enrollment and medication adherence among Medicare beneficiaries. METHODS: We used 2006 and 2007 administrative data from diabetic patients within Medicare Advantage Prescription Drug (MAPD) plans offered by a large, national Part D insurer. The analytic sample was limited to patients with ICD-9 and/or CPT codes for a myocardial infarction (MI), coronary stent, or coronary artery bypass graft (CABG) in 2006, who had at least one post-event fill for a statin (MI, CABG), or clopidogrel (stent). We classified patients who were enrolled in LICS at any point during the 12-months post-event as the sample of interest, and we used nearest neighbor propensity score matching to identify a comparison group of non-LICS patients for each of the three events. We matched on age, gender, institutionalization, comorbidities, dayssupply of the last medication fill in the study window, and median poverty level in the provider billing zip code. We then constructed three multivariate logistic regression models (MI, stent, CABG) with these covariates to examine the associations between LICS status and the likelihood of good adherence over the 12-month window, as defined by a Proportion of Days Covered (PDC) of >80%. In a separate multivariate regression model, we evaluated the association between LICS status and premature discontinuation of clopidogrel after coronary stent placement,

defined as the absence of clopidogrel fills for 120 days between the end of the previous days' supply and the end of the 12 month window. We expressed results as differences in predicted probabilities.
RESULTS: Our sample after propensity score matching (n=5,332) included 2,405 LICS patients and 2,208 non-LICS patients with an MI, stent, and/or CABG. Among post-MI patients (n=2,764), LICS patients had a higher likelihood of good adherence to statins compared to non-LICS patients (35.8% vs. 28.3%, p<0.001). Among post-stent patients (n= 1,971), LICS patients had a higher likelihood of good adherence to clopidogrel (54.2% vs. 45.2%, p<0.001) and a lower likelihood of premature clopidogrel discontinuation (15.9% vs. 23.5%, p<0.001), compared to non-LICS patients. We did not find a significant association between LICS status and statin adherence among post-CABG patients. CONCLUSIONS: We found that among Medicare patients with diabetes, the LICS benefit is associated with a higher likelihood of good adherence to medications for secondary prevention after an MI or stent. This differential in adherence may translate into lower rates of recurrent MIs, less stent thrombosis, and fewer readmissions among LICS patients. Although clopidogrel and most statin medications are now off-patent, there are other very expensive drugs for which good adherence is important to prevent adverse cardiovascular outcomes. Our work underscores the need for ongoing efforts to identify and enroll eligible Medicare beneficiaries with diabetes and cardiovascular disease in the LICS benefit.
THE NATURAL HISTORY OF DIABETES COMPLICATIONS IN OLDER ADULTS: THE DIABETES AND AGING STUDY Priya John1; Andrew J. Karter2; Jennifer Y. Liu2; Howard H. Moffet2; Neda Laiteerapong1; Elbert Huang1. 1University of Chicago, Chicago, IL;
2Kaiser Permanente of Northern California, Oakland, CA. (Control ID #1323964)
BACKGROUND: Understanding the modern natural history of diabetes in older adults has implications for setting current diabetes treatment priorities. Patients over the age of 65 represent a large (40%) and growing

segment of the diabetes population. Despite their prevelance, most of our understanding of the natural history of diabetes complications in older people is based on epidemiological data from the 1980s and 1990s. There are reasons to believe that the modern history of diabetes complications in older people is now different due to secular changes in treatment and diagnosis and needs to be updated. Using a contemporary cohort, we sought to describe the natural history of diabetes in older adults by age and duration.
METHODS: We conducted a longitudinal cohort study of patients with type 2 diabetes, with no prior history of major diabetes complications, aged 60 years and older in the Kaiser Permanente Northern California Diabetes Registry. Incidence densities (events per 1000 patient years) were calculated for various age categories and duration of diabetes (0-9 years duration vs. 10+ years). Outcomes of interest included incidence of diabetes related microvascular complications (lower extremity amputation, eye disease and peripheral vascular disease), macrovascular complications (coronary artery disease, cerebrovascular disease and congestive heart failure), and all-cause mortality. RESULTS: Mean age of subjects was 71, and a mean hemoglobin A1c of 7 (SD). For 60-69 years olds, incidence of macrovascular complications was
higher than mortality and microvascular complications (e.g 10 years duration: 30.8 (Macrovascular) vs. 28.2 (Mortality) vs. 23.4 (Micro-vascular)). For 70-79 year olds, mortality had the highest incidence followed by macrovascular complications (e.g. 10 years duration:55.3(Mortality) vs. 41.6 (Macrovascular) vs. 22.7 (Microvascular)). The incidence of mortality greatly exceeded the incidence of complications in patients 80 years (e.g. 10 years duration: 114.1 (Mortality) vs. 61.9 (Macrovascular) vs. 21.1 (Microvascular)). Across all ages, longer duration (10 years) was associated with higher incidence of complications and mortality. For those with long durations of diabetes, age did not have a significant assocation on the incidence of microvascular complications.
CONCLUSIONS: There is a relatively greater incidence of macro-vascular versus microvascular complications

in patients 60 years and older with diabetes, and this pattern increases dramatically with age and duration of diabetes. This look at the modern natural history study will have implications for the future of health care utilization and costs in the aging diabetes population.

Incidence of Complication and Mortality per 1000 patient years by Age and Durations (95% CI)

<10 years duration >=10 years DurationAge Macrovascular* Microvascular* Mortality* Macrovascular* Microvascular Mortality*

60-69 16.41 (15.25,17.66) 5.33 (4.72,6.03) 10.99 (0.08,11.98) 25.93 (23.50,28.62) 20.28 (17.95,22.91) 13.41(11.76,15.30)

70-79 25.55 (23.83,27.4) 6.46 (5.68,7.34) 23.76 (2.09,25.56) 37.68 (34.48,41,17) 17.95 (15.78,20.43) 30.61(27.77,33.74)

80+ 43.05 (39.37,47.08) 8.97 (7.45,10.81) 62.20 (7.57,67.21) 58.42 (52.28,65.27) 17.75 (14.66,21.5) 75.34(68.17,83.26)

* P value for trend significant at p<0.01 across age categories

THE OUTCOME OF CARDIOPULMONARY ARREST IN CRITICALLY ILL CANCER PATIENTS Tashfeen Mahmood1; Matt Chua1; Megan Slaton1; Mohammad Abu-Zaid2; Mahmoud Kamel2; Faisal Khasawneh1. 1texas tech university health sciences center, Amarillo, TX; 2University of Arizona, Tucson, AZ. (Control ID #1327168)

BACKGROUND: The success of cardiopulmonary resuscitation is variable and depends on the patients age, the presence of comorbidities, and the promptness of appropriate medical interventions. Survival among cancer patients who suffer in-hospital cardiopulmo-nary arrest (CPA) is poor. Higher survival rates were reported in patients cared for at dedicated cancer centers. The predictors of successful cardiopulmonary resuscitation in cancer patients are poorly characterized. Objectives: 1. To characterize the outcome of CPA in critically ill cancer patients admitted to a closed intensive care unit (ICU) in a comprehensive cancer center. 2. To identify resuscitation outcome predictors in critically ill CPA cancer patients. METHODS: A retrospective chart review of all CPA cases in cancer patients admitted to a comprehensive cancer center ICU between 1/2008 and 12/2009. Patients demographics, type of malignancy, extent of disease, presence of organ failure, ICU length of stay (LOS), hospital LOS, the presence of multidrug resistant bacteria colonization and outcome data were collected. Descriptive statistics were used to summarize the data and describe the patients. Comparisons between different variables and CPA outcome were conducted using Fishers exact test.

RESULTS: During the study period, 128 cardiopulmonary arrests occurred in 104 patients (65 males and 39 females). The mean age of the cohort was49.7 years with an average APACHE II score of 23.8. Twenty seven percent of the patients had leukemia, 13% had lymphoma, 13% had lung cancer, 9% had colon cancer and 34% had different other cancers. Forty seven percent of the patients had a progressing or a relapsed cancer. Seventy four percent of the patients were on vasopressors, 82.7% were on mechanical ventilation,27.1% had acute kidney injury and 38.5% were colonized by multidrug

resistant bacteria. The mean time from ICU admission to CPA was 4.7 days. The most common initial rhythm was pulseless electrical activity/asystole. Acute respiratory failure and refractory shock were the most common causes of CPA. The mean duration of cardiopulmonary resuscitation was 17.6 minutes. Thirty four percent of cardiopulmonary arrests were resuscitated successfully but only 9 patients (8.7%) left the ICU alive and 6 patients(5.7%) left the hospital alive. The average ICU and hospital LOS were5.8 days 31.6 days, respectively. CONCLUSIONS: The outcome of CPA in critically ill cancer patients is poor. Once cancer patients suffer a CPA in the ICU, acute kidney injury (p0.008), mechanical ventilation (p 0.003), refractory shock (p 0.001), multidrug resistant bacteria colonization (p 0.001) and CPA duration of more than 10 minutes (p 0.001) predicts failed cardiopulmonary resuscitation efforts.

THE PATIENT-CENTERED MEDICAL HOME, A SYSTEMATIC REVIEW Ranee Chatterjee; George Jackson; Janet Bettger; Benjamin Powers; Alex Kemper; Rowena Dolor; John Williams. Duke University, Durham, NC. (Control ID #1328180)

BACKGROUND: As part of the Agency for Healthcare Research and Qualitys (AHRQs) Closing the Quality Gap series, this systematic review sought to identify completed and ongoing evaluations of the comprehensive patient-centered medical home (PCMH), summarize current evidence for this model, and identify gaps in the evidence.
METHODS: We searched PubMedR, CINAHLR, and the CDSR for published English language studies, and a wide variety of databases and web resources to identify ongoing or recently completed studies. Two investigators per study screened abstracts and full-text articles for inclusion, abstracted data, and performed quality ratings and evidence grading. Our functional definition of PCMH was based on the definition used by AHRQ. We included studies that explicitly claimed to be

evaluating PCMH and those that did not but which met our functional definition.
RESULTS: Seventeen studies with comparison groups evaluated the effects of PCMH. Older adults in the United States were the most commonly studied population (8 of 17 studies). PCMH interventions had a small positive impact on patient experiences, and small to moderate positive effects on preventive care services (moderate strength of evidence [SOE]). Staff experiences were also improved by a small to moderate degree (low SOE). There was little to no evidence of improved clinical outcomes or reduction in utilization or total costs. Twenty of 26 studies reported approaches that addressed all seven major PCMH components, including team based-care, sustained partnership, reorganized or structural changes to care, enhanced access, coordinated care, comprehensive care, and a systems-based approach to quality. A total of 51 related strategies were abstracted, with great variability across studies. Twenty-one of 26 studies reported information on financial systems used to implement PCMH, implementation strategies, and/or organizational learning strategies for implementing PCMH. The 30 studies included in the horizon scan of ongoing PCMH studies were broadly representative of the U.S. health care system, both in geography and in the complexity of private and public health care payers and delivery networks.
CONCLUSIONS: Published studies of PCMH interventions often have similar broad elements, but precise components of care varied widely. The PCMH holds promise for improving the experiences of patients and staff, and potentially for improving care processes. However, there is little to no evidence of improved patient clinical outcomes or reduced economic burden. Ongoing studies identified through the horizon scan have potential to greatly expand the evidence base relating to PCMH.
THE PLACEBO EFFECT IN TRIALS OF HEADACHES Elizabeth Cogbill; Jeffrey L. Jackson. Zablocki VAMC, Milwaukee, WI. (Control ID #1337950)
BACKGROUND: Headaches are common. Since other symptom-based syndromes have been shown to have a significant placebo effect, our purpose was to examine the placebo effect among treatment trials of headaches.
METHODS: We have recently conducted three systematic reviews examing the efficacy of prophylactic medications in 1) migraine headaches and 2) tension headaches and a third evaluating the efficacy of botulinum injections for both headache types. All three studies searched MEDLINE, EMBASE and the Cochrane Register through Fall 2011 (exact search terms and last search date varied). In all three reviews, data was abstracted and quality rated independently by reviewers with good inter-rater reliability. In all three the effect of treatment for both the active and placebo drugs were abstracted at all time-points reported. In this paper, we analyzed the placebo effect at each time point by calculating the standardized effect (mean/SD) for subjects receiving placebo. We pooled these at each time point using random effects methods and examined for a time-effect of placebo using random effects meta-regression with adjustment for clustering by study.
RESULTS: Our search strategies produced 8703 total articles (drug-migraine: 3943, drug-tension: 4511, botulinum: 249). From these we included 30 placebo-controlled trials of migraine headaches, 12 placebo-controlled trials of tension headaches and 27 placebo-controlled trials of botulinum injections for various headache types. Study durations ranged from 4-90 weeks. In total, there were 3,647 patients who received

placebo for periods ranging from 4-90 weeks (average: 14). The pooled headache severity at time zero was 4.8 (95% CI: 6.1-29.3, Q=8404, df=121, I2=98.6). By 4 weeks this had declined to a standardized mean of 3.68 (95% CI:2.3-5.0, Q=716, df=54, i2=92.5) and by 12 weeks, headaches had decreased to 2.84 (95% CI: 1.34-4.33, Q=617, df=45, I2=97.2). There was linear improvement over study durations reported (=-0.01, 95% CI: -0.007 to -0.02), meaning that for every week patients were given placebo, they experienced a decrease in their headaches of 0.01 standard deviations. Dropout rates varied widely, with longer trials having greater dropout rates.
CONCLUSIONS: There is a strong placebo effect in randomized trials of headache treatment. Case series or other methods that examine the efficacy of headache treatment will overstate benefit. The placebo effect appeared to increase over time, though enthusiasm for this time-effect observation should be tempered by the relatively high drop out rates seen in many headache trials.
THE PREVALENCE OF MENTAL HEALTH DISORDERS IN FREQUENTLY HOSPITALIZED HEART FAILURE PATIENTS ENROLLED IN A VA HOME BASED PRIMARY CARE PROGRAM SALLY NAMBOODIRI, JEFFREY COONEY, BROOK WATTS Sally Namboodiri1; Jeffrey M. Cooney2; Brook Watts1. 1Cleveland VA Medical Center, Cleveland, OH; 2Cleveland VA Medical Center, Cleveland, OH. (Control ID #1317614)
BACKGROUND: Heart failure patients with frequent hospital readmissions may benefit from home-based care programs targeted to improve self-management skills and medication adherence. However, the benefits of these programs may not be fully realized if patients suffer from concomitant mental health disorders such as post-traumatic stress disorder (PTSD), depression and neurocognitive impairment (NCI). In order to enhance the quality of such home care services, we sought to characterize the prevalence of PTSD, depression and NCI in a population of heart failure patients with frequent admissions who were also enrolled in a VA home-based care program.
METHODS: We retrospectively reviewed complete medical records of all patients with diastolic or systolic heart failure enrolled in an established VA Home Based Primary Care (HBPC) program and who had 3 or more inpatient admissions (including at least one for heart failure) from 11/1/09 to 11/30/10. Chart reviews were completed by an interdisciplinary team and included examination of standardized social work screenings for mental health disorders using validated instruments (i.e. PTSD 4Q for post-traumatic stress disorder, Depression PHQ-2 for depression, and the St. Louis University Mental Status Exam (SLUMS), a 30-point screening questionnaire that tests for orientation, memory, attention, and executive functions).
RESULTS: 39 patients meeting criteria were identified and all records were reviewed. Mean age of patients was 72 (range 55-96), with 95 % (N=37) male. Forty-one percent (n=16) of patients had a preexisting diagnosis of PTSD, depression,or both. An additional 10% (n=4) had a positive screen for PTSD and/or depression or exhibited signs of depression. Overall, 51% of patients (n=20) had evidence of PTSD and/or depression as determined by prior mental health evaluation or HBPC evaluation. Neurocognitive screening (NCS) was offered to all patients (n=39) of which 32 patients received screening (6 patients refused and 1 patient was not screened due to a preexisting dementia diagnosis). Of the 32 patients screened, 28% of patients (n=9) had screens suggestive of significant NCI (SLUMS score 1-20). Fifty percent of patients (n=16) had screens suggestive of mild NCI (SLUMS score 21-26). Overall, 78% (n=25) of the patients screened had results suggesting some degree of NCI. CONCLUSIONS: This retrospective evaluation of frequently hospitalized heart failure patients who were enrolled in a VA Home Based Primary Care

program found a high prevalence of PTSD, depression and neurocognitive impairment. These concomitant conditions may serve as barriers to the success of HBPC programs in preventing readmissions. This pilot data provides an important foundation for further studies that examine the role of co-treatment of mental health

issues in HBPC programs, as well as the use of PTSD, depression and cognitive screenings to identify vulnerable patients who may benefit from more intense support initiatives focused on in-home chronic disease management.

THE RELIABILITY AND VALIDITY OF READMISSION RATES AS A HOSPITAL QUALITY MEASURE: IMPLICATIONS FOR CURRENT POLICIES Matthew J. Press1,3; Dennis P. Scanlon4; Jingsan Zhu3; Andrew Ryan1; Amol Navathe5,3; Jessica N. Mittler4; Kevin G. Volpp2,3. 1Weill Cornell Medical College, New York, NY; 2Philadelphia VAMC, Philadelphia, PA; 3University of Pennsylvania, Philadelphia, PA; 4The Pennsylvania State University, State College, PA; 5Harvard Medical School, Boston, MA. (Control ID #1339736)

BACKGROUND: Recent national policies intended to encourage hospitals to reduce readmissions utilize risk-standardized readmission rates to measure hospital quality. Our objective was to assess the reliability and validity of readmission rates as a measure of hospital quality. We hypothesized that if readmission rates change year-to-year on account of statistical variance rather than true changes in quality of care, then reliability would be low, making it difficult to identify the best- and worst-performing hospitals with a high degree of certainty. Further, if readmission rates are unrelated to other measures of hospital quality, then validity would be low, challenging the premise that hospitals are the appropriate target for policies to reduce readmissions. METHODS: We conducted a retrospective analysis of hospital data published through the Hospital Compare website in 2009 and 2011 for acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia. To assess the reliability of readmission rates, we compared hospital rankings based on risk-standardized readmission rates in 2009 and in 2011. To assess the validity of readmission rates, we estimated the correlation between risk-standardized readmission rates and widely accepted indicators of hospital quality, including risk-standardized mortality rates, volume, teaching status, and process measure performance. RESULTS: For each clinical condition, approximately 45% of hospitals in the highest and lowest readmission rate quartiles in 2009 moved into other quartiles in 2011. Hospitals with higher readmission rates in 2009 tended to improve by 2011, and hospitals with lower readmission rates in 2009 tended to worsen by 2011 (R-squared values for the relationship between readmission rate in 2009 and percent change in readmission rate from 2009-2011 were0.18, 0.21, and 0.27 for AMI, CHF, and pneumonia, respectively). This pattern of longitudinal change is suggestive of regression to the mean. Hospital readmission rates had minimal correlation with mortality rates. For AMI, CHF, and pneumonia, respectively, changes in readmission rates from 2009-2011 explained 0.1%, 0.3%, and 0.8% of the variance in changes in mortality rates. In addition, 18% (AMI), 22% (CHF), and 10% (pneumonia) of hospitals designated in Hospital Compare as worse than the U.S. national rate for readmission were designated as better than the U.S. national rate for mortality. Readmission rates had no consistent correlation with hospital volume or process measure performance and were higher in teaching hospitals than in non-teaching hospitals, which is contrary to the expectation of better outcomes in teaching hospitals. CONCLUSIONS: The degree and pattern of change in hospital rankings based on risk-standardized readmission rates, in addition to the poor correlation between readmission rates and other indicators of hospital quality, raise concerns about the reliability and validity of readmission rates as a measure of hospital quality. Low reliability and validity of readmission rates could undermine the impact of current policies, including payment reform, that use readmission rates to identify low quality hospitals and create incentives to encourage these hospitals to reduce readmissions.

THE ROLE OF CARE COORDINATORS IN IMPROVING CARE COORDINATION: THE PATIENTS PERSPECTIVE Michelle M. Doty; Ashley-Kay Fryer; Anne-Marie J. Audet. The Commonwealth Fund, New York, NY. (Control ID #1311682)

BACKGROUND: Evidence suggests that care coordination can improve provider and health system quality and efficiency. To date, little is known about the impact of various approaches to improving care coordination from the patients perspective. This paper focuses on the experiences of patients who received care from multiple

doctors and explores whether patients who say they have a care coordinator, better access to primary care, and strong provider-patient communication are less likely to experience care coordination problems.
METHODS: Data come from a telephone survey conducted in 2010 among a nationally representative sample of 19,738 adults in eleven countries. We examine self-reported coordination gaps related to medical records or tests, communication failures between providers including specialists, and failure to provide information about care received during a hospitalization and/or ER visit post discharge. We use multivariate logistic regression models to examine whether having a care coordinator, accessible care, and a strong patient-provider relationship reduces the risk of coordination gaps after controlling for cofactors.
RESULTS: Transitions between different care settings are an especially vulnerable period for patients because of the potential for incomplete or inaccurate information transfer and lack of appropriate follow-up care. Having someone that helps coordinate or arrange the care patients receive from other doctors reduces the risk of coordination problems. Patients with a care coordinator were less likely to report that their test results or medical records were not available at their scheduled appointment (10% versus 23% , p<.001), they received conflicting information from different doctors (21% versus 34%, p<.001), or someone failed to follow-up about their test results (14% versus 34%, p<.001). Patients who saw specialists and had a care coordinator were also more likely to report that their regular doctor and specialist were sharing information about their care. Among hospitalized patients, those lacking a care coordinator were more likely than those with a coordinator to report that that no one made arrangements for a follow-up visit with a doctor post-discharge (35% versus 22%, p<.001) and that their regular doctor was not informed about the care they received while they were hospitalized (32%, versus 13% versus p<.001) and in the emergency room (46% versus 27% versus, p<.001). Having a care coordinator reduces the risk for all coordination problems, even after controlling for cofactors, including whether a patient has accessible care or a strong patient-doctor relationship.
CONCLUSIONS: Physicians care for a high percentage of patients with multiple chronic conditions who may be co-managed by numerous physicians and health care professionals in various settings. Not surprising, patients who receive care from multiple physicians can experience fragmented and uncoordinated care. Our findings indicate that patients who report having a care coordinator as part of their care team and who also report having a positive patient-provider relationship and easy access and communication with their practice are significantly less likely to experience care coordination problems. Results suggest that including care coordinators in care teams can be a promising strategy for improving the care of patients with complex healthcare needs.
THE SYMPTOM BURDEN OF PATIENTS CONSULTED ON BY PALLIATIVE CARE IS UNDERESTIMATED BY THE PRIMARY INPATIENT CARE TEAM Nicole M. LaRue1; Linda Pang1; Michael K. Paasche-Orlow1; Angelo E. Volandes2. 1Boston University Medical Center, Boston, MA; 2Massachusetts General Hospital, Boston, MA. (Control ID #1334505)
BACKGROUND: The delivery of high quality end-of-life care relies upon the accurate assessment of patients symptoms. Prior work focusing mainly on patients with advanced cancer, has demonstrated poor agreement between patients and health care providers regarding health related quality of life. We are unaware of prior studies evaluating concordance in ratings of symptom intensity using the validated Edmonton Symptom Assessment Scale (ESAS) for providers and their patients consulted on by an inpatient palliative care service.
METHODS: Data was gathered through interviews with patients and/or proxies who were consulted on by an inpatient palliative care service and enrolled in a study of a video decision support tool to supplement goals-of-

care discussions. Following the palliative care consultation, symptoms were measured across the nine different domains of pain, tiredness, nausea, depression, anxiety, drowsiness, well-being, appetite and shortness of breath using the validated ESAS instrument. Each symptom was rated on a 10-point scale with zero meaning the symptom was absent and 10 indicating the worst possible intensity. Subsequent to the interview with the patient and/or proxy, the ESAS was administered to the attending of record, resident physicians and nursing

staff of the primary team caring for the subject. The level of agreement was analyzed across each patient-provider dyad. For each symptom domain, a difference score was calculated as the patients score minus that of the provider. The proportion of cases in which providers under- and over-estimated patients symptom burden was compared across all nine domains.
RESULTS: This study included 62 patient-provider dyads. The prevalence of patient reported symptoms rated as five or greater ranged from 26% to 55% across the domains of pain, nausea, depression and appetite versus 71% to 90% across the domains of tiredness, drowsiness, anxiety, well-being and shortness of breath. Providers underestimated patients symptoms in near to or greater than half of cases in the domains of drowsiness (73%), tiredness (58%), shortness of breath (58%), pain (56%), well-being (54%) and anxiety (49%). The prevalence with which providers underestimated a symptom by five or more points in these domains ranged from 16% to 29%, with the exception of the domain of well-being in which symptoms were underestimated by five or more points in only 4% of cases. Symptom assessments showed greater concordance between patients and providers in the domains of depression, nausea and appetite, with symptoms underestimated in only 26% to 33% of cases. The prevalence with which providers overestimated patients symptoms by five or more points ranged from 2% to 10% across all domains with the exception of depression and appetite, in which the prevalence of overestimation by five or more points was 20% and 18% respectively. CONCLUSIONS: Patients who are consulted on by an inpatient palliative care service have a significant symptom burden that is frequently underestimated by the primary healthcare team. A failure to accurately assess the symptoms of patients with advanced disease may delay appropriate palliative care referrals and lead to unmet physical, emotional and psychosocial needs of patients and their loved ones.
THE USE OF CLAIMS DATA ALGORITHMS TO RECRUIT ELIGIBLE PARTICIPANTS INTO CLINICAL TRIALS Leonardo Tamariz; Ana M. Palacio; Ivonne H. Schulman; Gabriel Contreras. University of Miami, Miami, FL. (Control ID #1336618)
BACKGROUND: International classifications of diseases (ICD-9) codes are frequently used to identify potential clinical research participants. However, this recruitment strategy usually focuses on a single ICD-9 code and does not include exclusion criteria. The purpose of this study is to validate a claims based algorithm to identify, from VA administrative data, eligible participants to be recruited into the Systolic Blood Pressure Intervention Trial (SPRINT).
METHODS: We created an algorithm to recruit elderly hypertensive subjects without diabetes and stroke into the SPRINT trial. Subjects were labeled as eligible if they were older than 75 years of age, had a hypertension ICD-9 code (401.x-405.x, 437.2) and did not have a diabetes (250.xx) or stroke ICD-9 codes (430.x-436.x, 437.1, 437.9, 438.x). We compared the eligible subjects with the medical record, which was considered the gold standard. In the medical record we defined hypertensionif hypertension was listed as a problem in the assessment and plan of at least oneprimary care clinical note and if the subject was taking blood pressure medication. Subjects were classified as diabetics if they met the 1997 American Diabetes Association definition of diabetes and stroke if they had documentation of stroke in the clinical notes. We calculated the positive predictive value (PPV) as the outcome.
RESULTS: The algorithm identified 3591 elderly Veterans with hypertension with no diabetes or stroke and we reviewed the medical records of 75 randomly selected patients identified using the algorithm. In the sample of medical record review the mean age was83.35.4, 44% had coronary artery disease, 23% had chronic kidney disease and 5% were Black. The mean systolic blood pressure was
134.415.7. The most commonly used ICD-9 code to identify hypertension was 401.9 in 95% of the population. When compared to the medical record the PPV, for any hypertension code was 94%(95% CI: 87-97) and for the entire algorithm including older than 75 years and absence of both diabetes and stroke the PPV was 90% (95% CI: 81-95).
CONCLUSIONS: The use of any ICD-9 code for hypertension is useful to identify elderly patients with

hypertension. The algorithm to identify elderly patients with hypertension and without diabetes or stroke is a useful tool to identify eligible patients for clinical trial participation.

THE USE OF DIRECT OBSERVATION AND FEEDBACK TO ENHANCE THE TEACHING SKILLS OF RESIDENTS: A MULTIDISCIPLINARY RANDOMIZED CONTROL TRIAL AT TWO INSTITUTIONS Laura K. Snydman1; Lori Lyn Price2; Daniel Chandler1; Kimberly Dowdell1; Jessica K. Paulus2; H. Barrett Fromme3; Joseph Rencic1. 1Tufts Medical Center, Boston, MA; 2Tufts Medical Center, Boston, MA; 3University of Chicago Medical Center, Chicago, IL. (Control ID #1339288)

BACKGROUND: Little is known about the type and quality of resident teaching in the setting of work rounds, which is one of the main venues for residents to teach and lead autonomously. Yet students feel that a significant amount of their education derives from these interactions. Previous data have demonstrated improvement in attending teaching after direct observation and feedback, but no study has evaluated whether feedback in real-time clinical practice actually changes the teaching behaviors of residents. The objective of this study was to determine the effects of direct observation and feedback on ratings of inpatient teaching by pediatric and internal medicine residents as measured by resident self-ratings, learner ratings, and trained faculty observer ratings. METHODS: Pediatric and internal medicine residents at two academic medical centers participated in a randomized controlled trial involving direct observation of work rounds. Residents were randomized to a feedback group or control group. Each resident was observed on two occasions 3 days apart. After the first observation, residents in the feedback group received verbal feedback from a trained attending observer using a standardized feedback process. Residents in the control group did not receive feedback after the first observation. All residents received feedback from a trained attending observer after the second observation. The faculty observers assigned to the second observations were blinded as to whether the residents were in the feedback group or the control group. After the observation, the attending observer, the interns, and the students completed a validated tool (the Clinical Teaching Effectiveness Instrument) to assess the type and quality of teaching that occurred. The residents who were observed also completed a similar tool. Faculty observers were trained via video clips of teaching during work rounds. The rater pairs used at both sites had discussion and built consensus to achieve >80% concordance.

RESULTS: Twenty-five internal medicine residents and 11 pediatric residents participated. A total of 380 completed forms were collected with an additional 8 forms having missing information. The majority of residents (97.22%) had 6 or more CTEI evaluation forms. The results did not differ statistically between control group and feedback group for either institution alone or combined. One interesting finding was that residents who received feedback noted less improvement retrospectively than their peers in the control group (mean 2.19 vs. 2.94). Of the residents who received feedback, the competencies with the greatest improvement were as follows: organizing time, giving feedback, and asking questions. Teaching cost-appropriate care consistently ranked the lowest in terms of resident self-assessed competence and had the least improvement compared to the other competencies.

CONCLUSIONS: Our data showed no significant difference in learner, attending observer, and resident self-assessment between groups. However our data does demonstrate a difference in self-assessed improvement, with residents in the feedback group noting less improvement. This finding suggests that attending feedback may serve as a reality check which then manifests as the residents having a higher standard for themselves.

THE UTILITY OF REPEAT BONE DENSITOMETRY IN WOMEN ON TREATMENT FOR LOW BONE MINERAL DENSITY Brandon Combs; Tanner Caverly; Stephen Ross; Wendolyn Gozansky; Daniel Matlock. University of Colorado, Denver, CO. (Control ID #1339624)

BACKGROUND: It has been established that approximately 98% of patients initiated on bisphosphonate

therapy have an increase in bone mineral density (BMD) and routine monitoring may not be necessary. Also, once treatment is started changes in BMD may be misleading as they have been shown to vary widely between individual dual energy x-ray absorptiometry (DXA) scans and weakly correlate with fracture risk. This study explored the utility of repeat DXA in an average risk population on treatment for low BMD with the hypothesis that repeat testing will infrequently lead to changes in therapy.
METHODS: We identified 1782 unique patients with>1 DXA between Jan 1, 2003 and August 1, 2011 who had been seen within the past 18 months at one of five primary care clinics at the University of Colorado Hospital. Men (n=120) and patients on medications or with conditions known to cause secondary osteoporosis (n=580) were excluded. Of 1082 patients remaining, 552 were on therapy for low BMD (Vitamin D and calcium supplementation were not considered treatment). We conducted a chart review of a random sample of 25 women on therapy. Charts of each patient were reviewed to calculate the patients 10-year fracture risk using the FRAX score and to determine if repeat DXA led to changes in drug therapy within six months of DXA or next clinic visit. Considered scenarios that would require data from DXA were: change in drug class or medication change within class in the setting of significant decrease in BMD, drug holiday after 5 years of treatment in the setting of stable or increased BMD, or drug stoppage in an osteopenic patient whose FRAX score would not merit treatment (10-year probability of hip or combined major osteoporotic fracture of<3.0 or<20 percent). We considered changes as being due to factors other than repeat DXA if: changes occurred due to drug side-effects or payment reasons, if there was a medication change in the setting of stable or increased BMD, or if a drug holiday occurred in the setting of significantly decreased BMD.
RESULTS: Mean age of the sample was 68 years. Mean calculated 10-year probability of hip or combined major osteoporotic fracture was 3.25% and 13.89%, respectively. There were 58 repeat DXA scans performed during the follow up period and changes following repeat DXA are reported in Table 1. Treatment at the time of repeat DXA was with bisphosphonate in 53 of 58 instances (91.4%). Fifty (86.2%) DXA scans led to no change in therapy. Two (3.4%) repeat DXA scans led to change in drug class, while one (1.7%) led to change within class. Five repeat DXA scans were followed by stoppage of treatment though two of these did not meet drug holiday criteria - one was after four years of treatment and another was after DXA showed significant decrease in BMD. One repeat DXA leading to stoppage revealed a FRAX score too low to merit treatment, while two others met drug holiday criteria. CONCLUSIONS: In this small single center study, repeat DXA scans infrequently led to changes in drug management. The current study highlights a need for additional studies assessing the utility of routine repeat DXA in patients on treatment before this practice can be justified.
Table 1. Changes in Therapy Due to Repeat DXA
Type of change Number of repeat DXAs (%) (n=58) No change 50 (86.2)
Change drug class 2 (3.4)
Change drug within class 1 (1.7)
Stop drug 3 (5.2)
THE VALUE OF BEDSIDE ROUNDS - A QUALITATIVE ANALYSIS Jed Gonzalo1; Brian S. Heist1; Briar Duffy2; Michael Elnicki1. 1U. of Pittsburgh, Pittsburgh, PA; 2U. of Minnesota, Minneapolis, MN. (Control ID #1334200)
BACKGROUND: Bedside rounds have traditionally been integral to teaching services, but their frequency has decreased. Medical educators
have expressed concern about displacement of the patient from the forefront of education and lost opportunities to learn clinical skills, such as history-taking, physical-examination, communication, and professionalism. The transition away from the bedside has also weakened patient-physician relationships. No work has formally investigated bedside teachers motivation for performing bedside rounds. To assist in promoting bedside rounds as an educational tool, we sought to elucidate physicians motivations and reasons for performing bedside rounds on teaching services.

METHODS: Using purposeful sampling, we identified 10 academic institutions and a site principal investigator at each location to identify physicians who perform bedside rounds according to a pre-determined definition and serve as inpatient teaching attending. Two investigators conducted digitally-recorded, semi-structured telephone interviews, consisting of closed- and open-ended questions pertaining to motivations and reasons for performing bedside rounds. Interview transcripts were coded using an inductive thematic analysis to identify emerging themes. Quality control was maintained with 2 researchers independently coding the data and a 3 rd-analyst serving as a cross check. The Institutional Review Board at all institutions approved the study.
RESULTS: All 10 institutions identified at least 3 participants for inclusion. We completed 34 interviews, the largest subset with assistant professors (44%). Participants averaged 13.7 years of academic experience and 18 weeks on the teaching services with housestaff over the previous 2 years. In response to questions pertaining to motivations for performing bedside rounds, 6 categories emerged: 1. Skill development for all learners - [Learners] will never learn how to gleam physical findings from the patient or even history without somebody showing them., 2. Observation and feedback - Unless you see patients at the bedside with learners, there is no way you can assess their skills or give them feedback on [them]., 3. Role-modeling - [During conference room rounds], you can model what a good discussion should be, but you cant show them how physicians should interact with patients, how to be human, how to focus on patients.,4. Team-Building - [Bedside rounding] builds trust between all of us because if you establish the team dynamics right, we are all learning from each other and the patients trust us more., 5. Improved Patient-Care Delivery - You can hone in on information quickly and correct misinformation as the [learner] is telling you the story. It actually saves [us] a lot of time., and 6. The Culture of Medicine as Patient-Centered Care - [Bedside rounds] discourage stereotyping of patients. It keeps everybody professional and focused on the patient, rather than on test results.
CONCLUSIONS: In an era of advanced technology and duty hours, our participants believe bedside rounds enable skill development, observation, feedback, role-modeling, and team-building, all essential in fostering high quality, patient-centered care. In the context of competency-based education, raised concerns about the inadequacies of learners clinical skills, and recent efforts to promote team-building skills, bedside rounds may offer an ideal venue for the development of these skills and improved patient care delivery.

THE ABILITY OF SINGLE SCREENING QUESTIONS FOR UNHEALTHY ALCOHOL AND OTHER DRUG USE TO IDENTIFY SUBSTANCE DEPENDENCE IN PRIMARY CARE Richard Saitz1,2;
Debbie M. Cheng1,2; Donald Allensworth-Davies2; Michael Winter2; PeterC. Smith1,2. 1Boston Medical Center, Boston, MA; 2Boston University, Boston, MA. (Control ID #1333544)

BACKGROUND: Single Screening Questions (SSQs) are recommended to identify unhealthy alcohol and other drug use (spectrum of risky use through dependence). But SSQs may also provide information on severity necessary to inform brief intervention thought to be obtainable only from longer questionnaires. We assessed SSQ accuracy for identifying patients with dependence.
METHODS: In a cross sectional study in an urban primary care practice, subjects were administered the SSQs asking about heavy drinking and drug use [How many times in the past year have you had 5 (4 for women) or more drinks in a day? &How many times in the past year have you used an illegal drug or used a prescription medication for nonmedical reasons?], the Alcohol Use Disorders Identification Test-Consumption

items (AUDIT-C), the Drug Abuse Screening Test (DAST), &the Composite International Diagnostic Interview reference standard for current dependence. All possible cutoffs were evaluated by receiver operating characteristic (ROC) curve. Sensitivity (Ss), specificity (Sp), positive predictive value (PPV) and likelihood ratios positive and negative (LR+, LR- along with 95% confidence intervals [CIs]) were assessed at cut points maximizing the sum of Ss and Sp (alcohol screening tests for alcohol dependence (AD), drug screening tests for drug dependence (DD)). RESULTS: Of 286 patients, 9% had AD and 12% DD; 31% reported heavy drinking 3 times, 22% 8 times in the past year; 30% reported drug use 3 times, 22% 8 times in the past year. The area

under the ROC curve (AUC), the probability of distinguishing those with and without dependence, was high for all tests. The optimal cut points were 8 times for the alcohol SSQ, score 3 for the 3-item AUDIT-C, 3 times for the drug SSQ, and 4 for the 10-item DAST. Test characteristics appear in the table. CONCLUSIONS: Single screening question (SSQ) results appear consistent with moderate to large changes in pre- to post-test probability of alcohol and other drug dependence (LR+5-10 and LR- 0.1-0.2 generate moderate changes in pre- to post-test probability (approximately +/-30-45%); LRs >10 or <0.1 may generate larger, clinically important changes). SSQs can identify alcohol and other drug dependence, with test characteristics similar to, or in the case of alcohol, possibly better than longer screening tools (based on positive likelihood ratio CIs). If confirmed in other studies SSQs may be useful for both screening and for severity assessment (to identify substance dependence), providing information needed and overcoming a barrier (lengthy questionnaires) to dissemination of screening and brief intervention in primary care settings. Financial Support: NIAAA (R01 AA10870), NIDA (R01s DA10019, DA025068)

Test AUC Ss Sp PPV LR+(CI) LR-(CI)

SSQ Alcohol 0.88 88% 84% 35% 5.6(4.1, 7.7) 0.1(0.05, 0.4) AUDIT-C 0.87 92% 71% 23% 3.2(2.5, 3.9) 0.1(0.02, 0.4) SSQ Drug 0.93 97% 79% 38% 4.6(3.6, 5.9) 0.04(0.01, 0.2) DAST 0.96 100% 84% 46% 6.3(4.7, 8.3) 0

THE ASSOCIATION BETWEEN BLOOD GLUCOSE AND OUTCOMES IN ADULTS HOSPITALIZED WITH ACUTE CHRONIC OBSTRUCTIVE PULMONARY DISEASE EXACERBATION Melissa Simpson1; Yusuf Kasirye1; Narendranath Epperla1; Liang Hong2; StevenH. Yale1. 1Marshfield Clininc Research Foundation, Marshfield, WI;
2Marshfield Clinic Research Center, Marshfield, WI. (Control ID #1337039)

BACKGROUND: Hyperglycemia has been shown to be associated with adverse health outcomes. Recent evidence suggests that chronic obstructive pulmonary disease (COPD) complications are more common among patients with metabolic syndrome. However, little evidence exists concerning hyperglycemia specifically and outcomes associated with acute COPD exacerbations (AECOPD). The purpose of this study is to examine blood glucose (BG) during AECOPD hospitalization and clinical outcomes. We hypothesized that increased BG is associated with worse clinical outcomes. METHODS: We retrospectively studied a cohort of 209 hospitalized patients (40-80 years of age) with a physician-validated AECOPD diagnosis from 1/1/2004 to 12/31/2008. Inclusion requirements for this study were: meeting the Global Initiative for Chronic Obstructive Lung Disease criteria for COPD, AECOPD diagnosis at admission and discharge, first BG ascertained within 6 hours of admission, and 2 BG measurements during hospitalization. Regression analyses accounting for repeated BG during hospitalization were performed to estimate the odds ratio (OR) for daily mean BG (per 100 ng/ml) and length of hospitalization, 30 day mortality and hospital readmission, and 90 day all-cause mortality. Recognizing that the pathophysiologic process may be different in people with and without diabetes, we tested this association stratified by diabetes status.

RESULTS: Mean length of hospitalization was 3 days. Adjusting for age, and diabetes status, decreased BG was associated with longer length of hospitalization (OR: 0.72, 95% CI: 0.54-0.96, p-value: 0.03). Stratified analysis adjusting for age showed no association (diabetes: OR: 0.81, 95% CI: 0.56-1.15, p=0.24, no diabetes: 0.64, 95% CI: 0.38-1.09, p=0.10).

Forty one patients (19%) were readmitted to the hospital within 30 days of discharge from their index hospitalization. Adjusting for previous covariates and length of hospitalization, BG was not associated with 30 day hospital readmission (OR: 0.82, 95%CI: 0.54-1.22, p-value: 0.32), nor was it associated after stratification (diabetes: OR: 0.64, 95% CI: 0.33-1.25, p=0.19, no diabetes: 1.01, 95% CI: 0.33-1.81, p=0.96).Nine patients (4%) died within 90 days of their index hospitalization. Adjusting for previous covariates and readmission, decreased BG was associated with increased odds of 90 day all cause mortality (OR: 0.30, 95% CI: 0.11-0.86, p-value: 0.02) and the association is among people with diabetes (diabetes: OR: 0.22, 95% CI: 0.07-0.74,

p=0.01, no diabetes: 0.72, 95% CI: 0.14-3.61, p=0.69). CONCLUSIONS: We found that among patients with diabetes, decreased blood glucose is associated with increased odds of 90 day all-cause mortality. Perhaps BG response (or lack thereof) in light of hyperglycemic agents is a proxy for a patients overall physiological status, especially given that 96% of this population received corticosteroids during hospitalization. The physiology of glycemic control in this setting is extremely complex; in order to better understand the real time response to medical interventions and their association with outcomes, future studies may want to apply continuous glucose monitoring to this group.

THE ASSOCIATION BETWEEN BODY IMAGE DISSATISFACTION AND WEIGHT LOSS IN THE SMALL CHANGES AND LASTING EFFECTS (SCALE) PILOT STUDY Ginger J. Winston; Erica Phillips; Jessica Hippolyte; Mary Charlson. Weill Cornell Medical College, New York, NY. (Control ID #1319284)

BACKGROUND: Obesity is a major health problem in the United States disproportionately affecting black and Hispanic adults. Perception of current and ideal body size may play a role in weight loss patterns, however, this relationship has not been well established among overweight/ obese adults.

METHODS: The SCALE pilot study was a 12-week behavioral weight loss intervention of eligible black and Hispanic adults with a BMI25 kg/m 2 recruited at two clinical and two church sites in Harlem and the South Bronx, New York. Current and ideal body size were measured using the Gardner scale, a 13 figure scale of human silhouettes of increasing body size. Body image dissatisfaction was calculated as the difference between the participants estimate of their ideal and current body size using the Gardner scale. T-tests were used to analyze the difference in mean values of linear variables. Multivariable regression models were used to assess the relationship between body image dissatisfaction and weight change with adjustment for age, gender, race/ethnicity, insurance and education. Interaction terms were used to assess for effect modification by race/ethnicity and gender. RESULTS: 61 participants completed the 12 week pilot study (74% women, 26% men, 43% black, 57% Hispanic). Mean weight loss at study close out was 2.5 lbs and did not differ significantly by gender or race/ ethnic group (women 1.9 lbs vs. men 4.2 lbs, p=0.2; black 1.4 lbs vs. Hispanic 3.4 lbs, n=0.3). Body image dissatisfaction was higher among Hispanics compared to blacks (p=0.001). There was no significant association between body image dissatisfaction and weight loss in the study sample, however, among black participants there was a trend towards increased weight loss as body image dissatisfaction increased. CONCLUSIONS: In the SCALE pilot study, there was no significant association between body image dissatisfaction and weight loss. There was a trend towards increased weight loss among black participants as body image dissatisfaction increased despite greater body image dissatisfaction among Hispanics.

THE ASSOCIATION BETWEEN FREE PSA VELOCITY AND PROSTATE CANCER DIAGNOSIS BY BIOPSY Shoshana Weiner; Jianbo Li; Ahmed El-Shafei; J. S. Jones. Cleveland Clinic, Cleveland, OH. (Control ID #1314652)

BACKGROUND: Screening for prostate cancer with total serum prostate specific antigen (PSA) has inconsistently found a mortality benefit for prostate cancer patients. This has led to a search for new biomarkers. PSA

velocity has been widely studied, but free PSA (fPSA) velocity, the change in the concentration unbound serum PSA over time, has not been previously considered.

METHODS: All patients who presented to Cleveland Clinic between 2000 and 2009 who had at least two prostate biopsies, with one initial negative biopsy, were considered for the study. A case-control study was conducted to compare free PSA velocity between patients diagnosed with prostate cancer after a previously negative biopsy, and controls, who are patients with two sequential negative biopsies. Univariate analyses were conducted to compare absolute differences and velocities of fPSA and PSA between cases and controls. Age,

race, prostate volume, positive digital rectal exam and the pathological features of prostatic intraepithelial neoplasia (PIN), atypia and inflammation were compared between cases and controls for each biopsy. An iterative logistic regression model was constructed in order to compare fPSA velocity between cases and controls. All statistics were considered significant at a p-value of 0.05. Bonferroni correction was used in the univariate analysis.
RESULTS: Forty-nine cases and 128 controls had the necessary fPSAvalues, which were restricted to being within two months prior to each biopsy. In addition, all biopsies required at least 10 cores and needed to be at a minimum one year apart from the previous biopsy. Our population was mainly Caucasian (86%). The median ages for the first and second biopsies were 62 (IQR: 56, 67) and 64 (IQR: 58, 69), respectively. 9 (18%) of the positive biopsies had a Gleason score of 7 or greater, and most were Gleason score 6 (78%). There was no significant difference in the fPSAvelocity between cases (-0.21, IQR: -2.32,1.06) and controls (0, IQR: -1.73, 0.81). For the second biopsy, samples from cases had significantly more PIN (49% versus 26%,p-value=0.003) than controls, and controls had significantly more inflammation (69% versus 43%, p-value=0.002). fPSA velocity was not significantly associated with having a positive prostate cancer biopsy in the logistic regression model (Odd ratio:0.92; 95% CI 0.75-1.12), which adjusted fPSA for PSA velocity and absolute change in PSA.
CONCLUSIONS: fPSA velocity was not associated with a positive prostate biopsy for cancer in this population. This may be due to confounding pathological findings on biopsy such as inflammation and/ or the need for a larger sample-size.
THE CONSEQUENCES OF GOOD INTENTIONS: HIV/AIDS MEDIA DIRECTED TOWARDS AFRICAN-BORN PERSONS IN THE UNITED STATES Demetri Blanas1,2; Kim Nichols2; Carol Horowitz1. 1Mount Sinai School of Medicine, New York, NY; 2African Services Committee, New York, NY. (Control ID #1340450)
BACKGROUND: The number of African-born persons in the US increased by 750% between 1980 and 2009, a period concurrent to the epidemic expansion of HIV/AIDS in sub-Saharan Africa. In spite of this, there is a dearth of research addressing this populations HIV screening needs, and despite a number of culturally tailored screening programs conducted by a local community-based organization, screening rates remain low.
METHODS: In order to identify effective strategies to increase HIV testing and referral rates, researchers and community partners conducted focus groups to uncover barriers and potential facilitators of screening. We recruited 39 African-born persons (46% women) residing in New York City, representing a wide range of African immigrants, including taxi drivers, hair braiders, street-vendors, students, mosque and church attendees. Four focus groups were held at a community-based organization and were audiotaped, transcribed, and translated from French and Wolof to English.
RESULTS: Grounded theory analysis using ATLAS.ti revealed four previously described themes: fear of deportation; fatalistic attitudes; misinformation about HIV treatment options; and HIV stigma. Unexpectedly, we also identified two novel themes: 1) negative responses to public health messaging directed exclusively to Africans as it was viewed as inappropriately associating HIV/AIDS with Africans; and 2) preference for non-African providers so as to decrease the risk of a breach of confidentiality.
CONCLUSIONS: We found that current efforts to offer culturally-tailored HIV screening that exclusively targets African immigrants and provision of ethnically similar providers can paradoxically lead to concerns about being stereotyped and loss of privacy. Solutions proposed in the focus groups include
public health messaging that portrays both African and non-African individuals, and cultural training for non-African counselors and screeners and anonymous translation services (translation phones) in testing centers.
THE EFFECT OF A COMMUNITY-BASED DIABETES SELF-MANAGEMENT EMPOWERMENT PROGRAM ON MENTAL WELL-BEING: A CAUSAL MEDIATION ANALYSIS OF A RANDOMIZED CONTROLLED TRIAL. Takehiro Sugiyama1,2; Neil
Steers1; Neil Wenger1; O. Kenrik Duru1; Carol Mangione1. 1University of California, Los Angeles, Los Angeles, CA; 2University of Tokyo, Tokyo, Japan. (Control ID #1328528)

BACKGROUND: Diabetes impairs both physical and mental health-related quality of life (HRQL). Programs grounded in empowerment theory improve glycemic control, but their effects on mental HRQL are unknown. We investigated the effect of a community-based group diabetes self-management program on mental well-being and explored whether the effect is direct or mediated by improved glycemic control and other concurrent physiological factors.
METHODS: We performed a secondary data analysis of the Diabetes Self-Care Study, a randomized community-based intervention that improved glycemic control. Study participants (n=516) were African Americans and Latinos 55 years or older with poorly controlled diabetes (HgbA1c8) recruited from senior centers and churches in Los Angeles.
Participants were randomly assigned to intervention and control groups. Control group participants received 6 lectures on geriatric topics. Intervention group participants received 6 small-group self-care sessions based on empowerment theory. For these analyses, our primary outcome was change in Mental Component Summary score from the SF-12 (MCS-12) between baseline and 6-month follow-up. HgbA1c, body mass index (BMI), low-density lipoprotein cholesterol (LDL), and systolic blood pressure (SBP) also were measured at baseline and 6-month follow-up. For these analyses, changes in those clinical variables were used as mediators. First, we compared baseline to 6 month change in MCS-12 between study groups using Students t-test. Second, we performed a causal mediation analysis with HgbA1c as a mediator in order to determine whether there was a direct effect of the diabetes empowerment program on mental well-being apart from the indirect effect mediated by HgbA1c change. Causal mediation analyses were repeated by inserting BMI, LDL and SBP as the potential mediator. In addition, we performed sensitivity analyses to assess the robustness of the results against the violation of no-confounder (between the mediator and the outcome) assumption. We performed causal mediation analysis and sensitivity analysis using the mediation package of software R. RESULTS: The 258 participants in each group had no significant differences in baseline characteristics and there was not a significant difference in follow-up between groups (follow-up data available for 79% intervention v 76% control participants). MCS-12 increased by a mean of 1.4 points in the intervention group and decreased by a mean of 0.2 points in the control group, for a difference in change of 1.6 points (95% CI: 0.1 to 3.1). In causal mediation analysis, the empowerment intervention was shown to have a direct effect on MCS-12 improvement (1.7, 95% CI: 0.2 to 3.2) separate from the indirect effect mediated via HgbA1c change (-0.1, 95% CI -0.4 to 0.1). We found no significant indirect effects of the other mediators. In sensitivity analyses, the causal mediation analyses were robust.
CONCLUSIONS: This Diabetes Self Care Study empowerment intervention had a positive impact on mental well-being not mediated by improvement in glycemic control or other physiological factors. The MCS-12 change of 1.6 points was equivalent to the difference of MCS-12 between people with and without type 2 diabetes found in prior studies. This favorable effect of DSME on mental well-being may confer a clinical advantage that is separate from benefits achieved by pharmacotherapy.
THE EFFECT OF AGE-SPECIFIC GUIDELINES ON SCREENING OLDER WOMEN FOR CANCER Adam Licurse1,2; Pamela Soulos3; Jennifer L. Quon3; Cary Gross3. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA; 3Yale School of Medicine, New Haven, CT. (Control ID #1339917)

BACKGROUND: Because the benefits of cancer screening diminish with increasing age, some guidelines recommend against screening for cervical and colorectal cancer in older women. However, it is unclear whether these guidelines have affected patterns of screening in the Medicare population. METHODS: We created a sample of women from Medicares 5% random sample of beneficiaries from 2000 through 2009, and reviewed major age-specific screening recommendations released during this period. For Pap smear, we included the 2002 American Cancer Society cut-off age of 70, and the 2003 United States Preventive Services Task Force cut-off age of65. For colonoscopy, we included the 2008 USPSTF recommended cut-off age of 75. For each

year, our sample included women 67-94 who did not have a cancer diagnosis or history of cancer in the prior two years (per ICD9), and were continuously enrolled in Medicare during that year and two years prior. Patients were further excluded from the colorectal or cervical screening samples if they had claims for similar procedures in the preceding 9 months, and were thus ineligible for routine screening during the index year. Our primary outcome was receipt of Pap smear, colonoscopy, and mammography each year. Mammography was used as a secular comparison, as no age-specific guidelines for breast cancer screening were released during the study period. For years when a major age-specific discontinuation recommendation was announced, we compared screening rates during the 2 years prior to the recommendation with the year after the recommendation using a Chi-square test. For each screening test, we assessed the trend for the entire period using a Poisson test.
RESULTS: From 2000 through 2009 (N120,000 per year), the percent of women age67 years undergoing mammography remained unchanged at approximately 30% (p-value for trend =0.15). Over the same period in the same age group, there was a significant decline in the use of Pap smear ((rate ratio (RR) for each year: 0.97; p<0.001)). About 13.3% of women in 2000 and 2001 received a pap smear (pre-guideline period), compared to12.2% after the guidelines in 2004 (p<0.001). Conversely, there was an increase in the use of screening colonoscopy from 2000 up until the USPSTF guidelines were released after 2007 (RR for each year: 1.07;p=0.02) for women75 years of age. In the same age group, 1.5% of women in 2006 and 2007 (pre-guideline period) received colonoscopy, compared to 1.0% after the guidelines in 2009 (p<0.001).
CONCLUSIONS: National screening practices for colorectal and cervical cancer screening among Medicare beneficiaries were sensitive to guideline changes, and were associated with a decrease in use of screening among women with a lower likelihood of benefit. More attention should be paid to generating and disseminating guidelines applicable to older patients.
THE GOOD, THE BAD, AND THE TIME-CONSUMING: ATTITUDES TOWARD AND USE OF A COMMON AMBULATORY EMR Anil Makam1; Holly Lanham2,3; Kim Batchelor4; Lipika Samal5; Lynne Kirk4; Brett Moran4,6; Manjula Cherukuri4; Temple Howell-Stampley4; Noel Santini6; Luci Leykum2,3; Ethan Halm4. 1University of California San Francisco, San Francisco, CA; 2South Texas Veterans Health Care System, San Antonio, TX; 3University of Texas Health Science Center at San Antonio, San Antonio, TX; 4University of Texas Southwestern, Dallas, TX; 5Brigham and Women's Hospital, Boston, MA; 6Parkland Health &Hospital System, Dallas, TX. (Control ID #1319842)
BACKGROUND: Despite intense interest in meaningful use of electronic medical records (EMR), realizing their potential benefits to improve quality has been difficult. Most positive studies come from early-adopter institutions with home-grown EMRs. Less is known about the use of commercial EMRs especially in non-HMO, ambulatory settings. METHODS: We surveyed 210 adult primary care providers (PCPs) in 11 general internal medicine (GIM) and family medicine (FM) practices affiliated with 3 academic health systems in TX. The survey focused on providers attitudes, satisfaction, and use of the Epic EMR system, a
common commercial EMR. Most practices had>5 yrs of experience with Epic. Items on early adoption of technology, use of EMR features, and impact of EMRs on quality were based on prior surveys. Most ratings were 5-point Likert scales. Responses were dichotomized and multivariable regression examined factors associated with time using the EMR and attitudes of early adopters.
RESULTS: 144 PCPs completed the survey (69% response rate)64% were attendings, 26% residents, and 10% NP/PAs; 75% were GIM and 25% FM providers, 62% were female, and 61% were in practice for 10 yrs. Over half (55%) had3 yrs of experience using an EMR, and 64%
were classified as early adopters. Most PCPs agreed the EMR was easy to use (78%), easy to learn (62%), improved clinical workflow (69%), and helped them be more thorough in their work (78%). However, 69% said the EMR made it difficult to maintain eye contact with a patient (Pt) and 51% said it interfered with clinician-Pt communication. Most PCPs reported positive effects of the EMR on communication with other MDs (88%),

prescription refills (94%), and timely access to medical records (94%). PCPs were more likely to agree that future versions of the EMR would have positive effects on quality compared to the current version of the EMR on: preventing adverse drug interactions (89% agreed future EMR

would help this v. 78% current EMR), preventing medication errors (85% v. 75%), delivering preventive care that meets guidelines (88% v. 61%), delivering chronic disease care that meets guidelines (84% v. 51%), delivering high quality of care (87% v. 71%), and preventing things from falling through the cracks (86% v. 61%) [p<.01 for all]. Documentation practices varied with about half of PCPs using free text for the history (51%), note templates for the physical exam (57%), and free text for the A &P (54%). Two-thirds used more sophisticated features of the EMR like smart phrases (some of the time) and 47% used electronic communication with Pts and staff. For each half day clinic session, 43% reported spending 1 hr beyond their session to complete EMR documentation and 29% reported spending 1 hr to respond to messages in the EMR from Pts, staff and MDs. In multivariable regression, documentation time was not influenced by being an early adopter, EMR experience, yrs in practice, or other characteristics. Early adopters were more likely to say the EMR: was easy to learn, improves clinical workflow, helps them be more thorough, and discover new ways to use it (p<.05 for all). CONCLUSIONS: PCPs using a common commercial EMR had positive attitudes towards the EMR, perceived it to negatively affect patient communication and were hopeful future versions of the EMR would have a greater impact on quality than the current one. EMR documentation is time-consuming, even for PCPs who are early adopters of technology and have years of experience using it.

THE IMPACT OF HEPATITIS C VIRUS ON HIV RISK BEHAVIOR DURING METHADONE TREATMENT

Karran A. Phillips; David H. Epstein; Kenzie L. Preston. NIDA/NIH, Baltimore, MD. (Control ID #1340372)

BACKGROUND: Drug users have high rates of hepatitis C virus (HCV) infection, and they are important contributors in HIV, HCV, and sexually transmitted infection (STI) transmission. Better information about the specific risk behaviors in sub-populations of drug users may allow for more targeted HIV/HCV/STI risk reduction efforts.

METHODS: In this 40-week study, 140 methadone-maintained, heroin-and cocaine-abusing individuals completed the HIV Risk-Taking Behaviour Scale (HRBS) every 2 weeks. In addition, to the 11 standard questions asked, a 12th question on condom use during anal sex was added. This resulted in a 6 question drug-related risk subscale and 6 question sex-related risk subscale. Information on drug use and social/legal history and characteristics was obtained at baseline via the Addiction Severity Index (ASI) and HCV status was determined on admission. Longitudinal data was analyzed accounting for repeated measures and fixed and random effects using a multilevel mixed effects model in Stata 10.

RESULTS: Forty three percent of participants were HCV+. HCV+individuals had significantly higher scores on the drug-related risk subscale than HCV-individuals ($z=11.5$, $p<0.001$). This finding appeared largely due to route of administration. HCV+individuals had significantly lower sex-related risk scores than HCV- individuals ($z=-2.73$, $p=0.006$). The total HRBS was higher in HCV+individuals compared to HCV- individuals ($z=4.96$, $p<0.001$) and this seemed largely driven by their higher drug-related risk subscale scores. Regardless of HCV status, HIV risk decreased with increasing time in methadone treatment.

CONCLUSIONS: When compared to HCV- individuals, HCV+individuals had higher drug-related and lower sex-related HIV risk behavior. Methadone treatment appeared to be an effective tool in reducing HIV risk. The data reported here argue for tailored prevention and treatment interventions aimed at changing drug use and HIV risk behavior and accounting for HCV status.

THE IMPACT OF INSURANCE INSTABILITY ON CARE AFTER ABNORMAL CANCER SCREENING

Karen Freund1; Amresh Hanchate1; Alexis P. Isabelle1; Richard Kalish2; Alok Kapoor1; Sharon Bak1; Marc C. Flore1;

Rebecca Grochow3; Swati Shroff3; Tracy Battaglia1.
1Boston University School of Medicine, Boston, MA; 2South Boston Community Health Center, Boston, MA; 3Boston Medical Center, Boston, MA. (Control ID #1317085)
BACKGROUND: The intent of health insurance reform is to improve care through the expansion of access to care for minority, vulnerable, and
underinsured populations. In 2006 the Massachusetts Health Reform Legislation sought to improve access to care by increasing insurance coverage. We sought to assess the impact of insurance instability on vulnerable women with an abnormal screening event, looking at whether they achieved a diagnostic resolution, comparing pre and post insurance reform cohorts. We studied women at 6 Community Health Centers, as they care for a disproportionate group of women with unstable insurance coverage. METHODS: We analyzed billing data for all women following an abnormal breast or cervical cancer screening exam at 6 Community Health Centers in two groups: 2004 - 2005 (pre reform) and 2007 - 2008 (post reform). We observed insurance claims for eighteen months before and after the abnormal screening exam, and recorded insurance coverage and frequency of health insurance switches. We categorized switches into five levels of favorability from the most favorable representing women who were always privately insured to the least favorable representing women who were always uninsured. The outcome of interest is the time it takes to reach diagnostic resolution, dichotomized to those who resolved within 365 days of abnormal screening and those who did not. We conducted Cox proportional hazards regression analyses to observe if insurance instability changed the proportion of women with diagnostic resolution between the pre and post reform periods. We also generated Kaplan-Meier survival curves of the percent resolved by time.
RESULTS: We examined 1946 women, 434 women in the pre reform period and 1512 women in the post reform period. Subjects had an average age of 43 (15) years and were 35% white, 32% black, 28% Hispanic, and 4% other, primarily Asian. Women in the sample received care at their Community Health Center for an average of 25 months and during that time had an average of 17 visits. At the time of the abnormal cancer screening in the pre reform period, 39% of women were uninsured, 30% had public insurance, and 31% had private insurance. We placed women into 5 categories of insurance instability: 22% were always privately insured, 16% were always publically insured, 21% had at least one switch but were never uninsured, 22% had at least one switch to an uninsured state, and 18% were consistently without insurance. The proportion always uninsured dropped from 25% to 16% , and the proportion always privately insured increasing from 18% to 23% in the pre- compared to post-insurance reform period, X2 27.8, p<.0001. We did not find that insurance stability was associated with women reaching diagnostic resolution within one year, comparing pre and post periods, Mantel-Haenszel X2 (df 4) 5.03, p=0 .28.
CONCLUSIONS: Limitations of the study include the inability to assess the length of non coverage between switches or to identify switches which occurred between health care visits. Insurance reform significantly improved coverage, with fewer women consistently uninsured. Our results did not show an association between changes in insurance stability and delays in time to diagnostic resolution.

THE INTERACTION BETWEEN GENDER AND AMOUNT OF SMOKING IN THE PREDICTION OF ONE-YEAR WEIGHT GAIN AFTER SMOKING CESSATION Isabella Locatelli1; Carole Clair1; Tinh-Hai Collet1; Nicolas Rodondi2; Jacques Cornuz1. 1University of Lausanne, Lausanne, Switzerland; 2Inselspital, University of Bern, Bern, Switzerland. (Control ID #1314857)
BACKGROUND: Smoking cessation is associated with weight gain. We aimed to determine the amount of weight gain and its predictors among primary care smokers after 1 year of smoking cessation.
METHODS: We merged two randomized controlled studies (RCTs) assessing new interventions helping smokers to quit. The first RCT (n= 477) evaluated a program of moderate intensity physical activity; the second (n=536) assessed the effect of carotid plaque screening by ultrasound. Both RCTs studied the intervention effect on smoking cessation rates after one year compared to a control program of intensive counseling and

nicotine replacement therapies. The similarities between both RCTs and the identical control programs allowed us to merge the two studies, regardless of the individual assignment to the RCT-specific control/intervention group. The analysis included all subjects that made at least one quit attempt during the study (n=810). We used a multivariable linear regression model to test the effect on the mean weight gain at one year for the following potential predictors and all their interactions: age

(dichotomized at the median, 47 years), sex, education level, number of cigarettes at baseline and duration of smoking abstinence. We applied a backward procedure to select the best model ($p<0.05$).

RESULTS: At baseline, subjects (mean age 46.9 years, 43.7% women) smoked a median of 22 cigarettes per day, ranging from 8 to 70, and median smoking abstinence was 18 weeks during follow-up. After 1 year, the mean weight gain was 2.6 kilograms (kg, 5.7 lbs) (3.6% of the initial weight). Among smokers that were abstinent more than 18 weeks, the mean weight gain was 3.8 kg (5.3% of the initial weight). Age, sex and number of cigarettes at baseline were significantly associated with weight gain at one year. Older subjects (>47 years) gained 0.7 kg less than younger ($p=0.001$). We found an interaction between sex and the number of cigarettes smoked at baseline ($p=0.003$): men gained more weight than women when smoking <30 cigarettes per day; the reverse was observed for heavy smokers (Figure). According to this model, a woman younger than 47 and smoking more than 30 cigarettes/day could gain up to 5.5 kg on average one year after smoking cessation (9% of her initial weight). A man of the same age group and smoking the same amount would expect a mean weight gain of 4.5 kg (6% of his initial weight).

CONCLUSIONS: Age, sex and number of cigarettes at baseline predicted 1-year weight gain among smokers who quit, and a significant interaction between sex and number of cigarettes smoked was found. Young women smoking heavily at baseline were those with the highest risk of weight gain after quitting and should be followed closely by their physicians during abstinence periods.

p value

Age (y.o) 55.6617.0 54.520.0 0.425 Time (hour) 2.131.15 2.171.13 0.659 Time-score 2.590.83 2.670.81 0.181 Dr-score 4.090.79 4.150.73 0.269 Ns-score 3.990.69 4.060.7 0.225 Co medical-score 3.910.76 3.960.74 0.409 Informed Consent 3.950.68 4.050.70 0.046* response to patientsexpectation

3.820.71 3.870.80 0.444

Total-score 3.770.73 3.830.75 0.255

THE LOWER QUALITY OF PRIMARY CARE AMONG ASYLUM SEEKERS IN A COUNTRY WITH UNIVERSAL HEALTHCARE COVERAGE Yonas Martin1; Tinh-Hai Collet1; Lukas Zimmerli2; Edouard Battegay2; Jean-Michel T. Gaspoz3; Jacques Cornuz1; Nicolas Rodondi4,1. 1University of Lausanne, Lausanne, Switzerland; 2University Hospital of Zurich, Zurich, Switzerland; 3University Hospitals of Geneva, Geneva, Switzerland; 4Inselspital, University of Bern, Bern, Switzerland. (Control ID #1334067)

BACKGROUND: Differences of quality of preventive care among different population subgroups have been demonstrated in the US. In Switzerland, no study has examined the factors associated with the quality of preventive care. We assessed the association between patient and physician factors, and the quality of preventive care and chronic care of cardiovascular (CV) risk factors in Swiss university primary care settings.

METHODS: Our study was based on a retrospective cohort of a random sample of 1,002 patients aged 50-80 years followed for 2 years in 4 Swiss university primary care settings. Indicators derived from RANDs Quality

THE LEVEL OF PATIENT SATISFACTION WITH INFORMED CONSENT IS HEIGHTENED WITH THE CHANGE OF THE SYSTEM OF OUTPATIENT CLINIC OF GENERAL MEDICINE FROM TREATING ALL OUTPATIENTS TO ONLY NEW OUTPATIENTS. Hitoshi Eguchi1; Midori Nishii1; Yoshinori Tokushima2; Naoko Eguchi1; Motoshi Fujiwara1; Masaki Tago1; Yuta Sakanishi2; Motosuke Tomonaga1; Tsuneaki Yoshioka1; Masaki Hyakutake1; Yuichiro Eguchi1; Sei Emura1; Takashi Sugioka2; Shu-ichi Yamashita1. 1Saga University Hospital, Saga, Japan; 2Saga University Hospital, Saga, Japan. (Control ID #1335128)

BACKGROUND: Doctors of outpatient clinic in the department of general medicine take charge of almost all patients including patients on the long-term follow-up and new patients in Japan. Doctors working in outpatient clinic of the department of general medicine, Saga University Hospital also had taken charge of all patients since 1978, however, we changed our system of outpatient clinic treating all patients to the new system treating only new ones in October 2011. Recently, there is a tendency that hospitals survey the patient satisfaction to improve hospital functions and quality. Although previous studies have indicated the correlation between patient satisfaction and age, elapsed times, doctors attitude and car parking space, correlation with the system of outpatient clinic remains to be elucidated. This study investigated the change of patient satisfaction with the change of the system of outpatient clinic. METHODS: 680 patients who visited to outpatient clinic of the department of general medicine, Saga University Hospital for the first time were enrolled in from August to November 2011. System of outpatient clinic changed from treating all patients including patients on the long-term follow-up and new outpatients to treating only new ones in October 2011. We investigated age, elapsed time, doctors in charge, presence or absence of medical referral letter, involvement of students and a motivational condition to visit out clinic. The level of patients satisfactions with time, doctors, nurses, other health care providers, co-medical, informed consent, response to patients expectation, were evaluated by the questionnaire which scaled one-to-five. Total score was also evaluated.
RESULTS: A total of 680 patients were evaluated (male 305, 44.9%, female 375, 55.1%). There was significant sexual difference about total score ($p<0.05$, male 3.860.70, female 3.750.76). There were 374 (55%) patients who visited before the system-change (Pre) in August and September 2011, and there were 306 (45%) patients who visited after the system-change (Post) in October and November 2011. There was higher level of satisfaction with informed consent in Post than Pre with significant difference ($p<0.05$, Pre3.950.68, Post 4.050.70). Although there were tendency that the level of patients satisfactions with time score, doctors, nurses, total score was increased, there were no significant differences. There were also no significant differences in elapsed time and response to patients expectation. CONCLUSIONS: Our study indicated that it is important in order to satisfy new outpatients especially with informed consent, to change system of outpatient clinic from treating all patients including patients on the long-term follow-up and new outpatients to treating only new ones in outpatient clinic of general medicine.
Difference of the level of patients satisfaction between treating all patients and treating only new patients.
All patients (374, 55%)
Only new patient (306, 45%)

Assessment Tools were used. We constructed aggregate scores for preventive care and chronic care of CV risk factors. Percentages of recommended preventive and chronic care of CVrisk factors offered to eligible patients of the different socio-demographic subgroups were calculated.
RESULTS: Overall, patients received 69% of recommended preventive care. Men had higher scores than women (72.9% vs. 65.3%; $p<0.001$) and prevention rates declined with age (50-59 years: 71.2%; 60-69 years:69.8%; 70-80 years: 66.8%; p for trend <0.03). Prevention indicators were more likely to be met among Swiss patients than asylum seekers (71.9% vs. 61.2%; $p=0.001$), mostly because of lower rates of cancer screening and influenza immunization. The overall score for chronic care of CV risk factors was 83%. The elderly had significantly lower scores (70-80 years:79.9%) than the youngest patients (50-59 years: 84.0%; p for trend 0.033). Rates of chronic care of CV risk factors did not differ by gender and legal status. Female physicians provided significantly more preventive care than male physicians ($p=0.02$) for female patients (66.6% vs. 63.9%), and male patients (74.0% vs. 71.7%). Chronic care of CV risk factors did not differ according to patient gender or physician gender.

CONCLUSIONS: Despite universal healthcare coverage, adults in Swiss university primary care settings received less preventive care according to their gender, age and legal status. Greater attention should be paid to vulnerable populations, particularly for cancer screening and influenza immunization. Even though quality of preventive care varies between subgroups of the population, the differences are much smaller than the gap separating provided from recommended preventive care.

THE RELATIONSHIP BETWEEN EXPERIENCE AND OUTCOMES: ANOTHER LOOK AT THE JULY EFFECT Jennifer Carnahan1; AlexisM. Visotcky2; Kathlyn E. Fletcher3,1. 1Medical College of Wisconsin, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI; 3Milwaukee VAMC, Milwaukee, WI. (Control ID #1335009)

BACKGROUND: The July effect is an oft cited, occasionally proven, and pervasively feared phenomenon that refers to the supposed ill-effect of the July influx of inexperienced house staff on patient outcomes. Various studies have found evidence for and against the July effect on patient outcomes. The aim of the current study is to explore the association between the inexperience of residents earlier in the academic year and selected patient outcomes. METHODS: This project was part of a larger study of discontinuity in hospitalized general medicine patients. The data for this project comes from retrospective chart review. Patient charts from 3 sites were randomly chosen and evenly distributed over a one-year period between March 2009-March 2010. The 3 sites included a VAMC, an academic tertiary care medical center and a community teaching hospital. To be included in the study, patients were either assigned to a house staff team or a hospitalist team. Patients were excluded if their hospital stay was <48 hours. Trained nurse abstractors did the chart review which included demographics, comorbidity data, adverse events, readmission within 30 days, and ER visit within 30 days of discharge. We used Wilcoxon ranked sum tests and chi-squared analyses to compare the readmission, ER visits post-discharge and adverse events in patients by quarter of the year. We used the patients admitted to hospitalist teams as "controls" in order to evaluate for evidence of different outcomes in the first quarter of the academic year ("July-September" phenomenon). All tests were 2-tailed, with significance at $p<0.05$. RESULTS: The sample contained 1180 patients. Mean age was 61 years (SD 18). 41% of the sample was female. Racial breakdown included 51% Caucasian, 43% African-American, and 6% other. Mean Charlson score was 2.3 (SD 2.1). Mean length of stay was 5.2 (SD 4.1) days. Overall readmission rate was 22%. There was no difference in readmission rate between quarters for either the house staff or the hospitalist patients. Neither were there differences in readmission rates when house staff and hospitalist teams were compared to each other quarter by quarter. However, when differences in adverse events by quarter were tested between house staff and hospitalist teams, we found 2 differences. First, mean adverse events per patient in the last quarter of the academic year were significantly higher in the house staff patients (1.14) when compared to the hospitalist patients (0.80), $p<0.05$). Also in the last quarter, more house staff patients (47%) than hospitalist patients (34%) had at least one adverse event, $p<0.05$. No other quarters showed an adverse event disparity. In the third quarter of the

academic year, we found that hospitalist patients had a significantly shorter length of stay (4.2 days, SD 3.1) when compared to the house staff patients(6.1 days, SD 5.4), $p<0.05$. There were no significant differences in length of stay noted in other quarters.

CONCLUSIONS: Prior evidence is variable for the existence of a July effect, and our study failed to confirm its existence. Interestingly, just prior to the end of an academic year we did find a significant difference in adverse events when hospitalist and house staff teams were compared. This could be related to resident burn-out or a decrease in supervision. Therefore, although the myth of the July effect persists in the literature and in residency culture, the reality of the June effect warrants further attention.

THEY DONT KNOW WHAT THEY DONT KNOW: INTERNAL MEDICINE RESIDENTS KNOWLEDGE AND CONFIDENCE IN URINE DRUG TEST INTERPRETATION FOR PATIENTS WITH CHRONIC PAIN Joanna L. Starrels; Aaron Fox; Hillary Kunins; Chinazo Cunningham. Albert Einstein College of Medicine &Montefiore Medical Center, Bronx, NY. (Control ID #1328158)

BACKGROUND: Urine drug testing (UDT) can help to identify misuse or diversion of opioid medications among patients with chronic pain. However, misinterpreting results can lead to false reassurance or erroneous conclusions about drug use. Misinterpretation might occur when physicians who lack knowledge about UDT interpretation are overly confident in their ability to interpret UDT results. Previous studies have not evaluated the association between physicians knowledge about UDT interpretation and confidence in their ability to interpret UDT results.
METHODS: As part of a broader needs assessment, we conducted a cross-sectional study of internal medicine residents to explore the relationship between residents knowledge and confidence in interpreting UDT results. All 148 internal medicine residents in a university-based health system in the Bronx were invited to complete a 53-item questionnaire, via email or distribution at educational sessions, from October 2010 to July 2011. Residents knowledge of UDT interpretation was assessed using an 8-item scale (UDT knowledge score). Residents confidence in UDT interpretation was assessed using a single statement (I feel confident in my ability to interpret the results of urine drug testing), to which participants rated their level of agreement on a 5-point Likert Scale (strongly disagree through strongly agree). Responses were dichotomized according to confident (agree or strongly agree) or not confident. We conducted chi-square tests, t-tests, and logistic regression to determine the association between knowledge and confidence, and to examine whether resident characteristics such as gender (male, female), training level (PGY-1, PGY-2 or -3), or UDT use (routine, rare) moderated the relationship between knowledge and confidence.
RESULTS: 109 residents participated in the study (74% response rate) and 10 were excluded from the current analysis because they did not provide data on knowledge or confidence in UDT interpretation. Among 99 residents, the mean UDT knowledge score was 3.2 out of 8 (SD 1.4). Though 55 (56%) of residents felt confident in their ability to interpret UDT results, 38 (69%) of confident residents had a knowledge score of 3 or lower. Knowledge score was not associated with confidence among the full sample or when stratified by training level or UDT use. The association between knowledge and confidence differed significantly by gender (interaction term $p<0.01$). Adjusting for training level and UDT use, knowledge was positively associated with confidence among females (AOR 1.51 for each additional knowledge item answered correctly, 95% CI: 0.98, 2.32), and negatively associated with confidence among males (AOR 0.57, 95% CI: 0.30, 1.05). While neither association was statistically significant, these findings suggest that among females, greater knowledge was associated with feeling confident, and among males, lower knowledge was associated with feeling confident.
CONCLUSIONS: Despite poor knowledge about UDT interpretation, most resident physicians felt confident in their ability to interpret UDT results. Gender differences warrant further exploration, but even confident physicians who use UDT should evaluate their proficiency in interpreting UDT results. Educational initiatives to improve monitoring for patients prescribed opioids for chronic pain should emphasize the complexities of UDT interpretation.

THOUGHT PROCESS DURING MULTIPLE-CHOICE EXAMINATIONS Brian S. Heist1; Jed Gonzalo1; Steven Durning2; Dario M. Torre3; Michael Elnicki1. 1University of Pittsburgh Medical Center, Pittsburgh, PA; 2Uniformed Services University of the Health Sciences, Bethesda, MD;
3Drexel University College of Medicine, Philadelphia, PA. (Control ID #1324048)
BACKGROUND: Since the 1970s extensive research has been conducted on thought processes of physician trainees when approaching clinical scenarios in an attempt to enhance the teaching of clinical reasoning. However, little is known about the thought processes of physician trainees when approaching clinical vignette multiple-choice questions (MCQs), the standardized testing method commonly assumed to evaluate clinical reasoning. This study attempted to characterize the different thought processes used by resident physicians when solving clinical vignette MCQs, and to correlate processes with those used in clinical work and with scores on high stakes MCQ exams.

METHODS: We selected 6 clinical vignette MCQs representing 6 different organ systems from a question bank. Toward the end of their PGY-1 year, all residents training in internal medicine (transitional-year, categorical internal medicine, and med-peds residents) at our hospital were solicited for participation. During individual sessions, each subject completed the MCQs using a think-aloud protocol. Qualitative analysis of data transcriptions was performed independently by 2 investigators using a constant-comparative approach. Codes were re-evaluated until consensus was reached on activities used by the subjects. The subjects application of the activities was then correlated with scores on the USMLE Step2CK, the high stakes exam most similar to the question bank. RESULTS: Of 27 eligible residents, 10 participated. Subjects were allotted one hour but all completed the 6 questions in 25 minutes. Transcript process coding found activities were consistent for a given subject, rather than for a given question. The following activities were identified: 1. reading question prior to stem, 2. reading stem with frequent summarization, 3. querying the test writers objective, 4. summarizing key features of stem after reading alternatives, 5. using inductive reasoning, 6. considering alternatives systematically, 7. admitting knowledge deficits, 8. reaching closure prematurely, 9. reaching closure with difficulty, 10. negative suggestion effects (application of incorrect knowledge or concept without feedback), 11. generating own answer prior to reading alternatives (limited to 5/60 questions total performed by 4/10 subjects, a far lower rate than for most other activities). Subjects USMLE Step 2CK scores ranged from 189 - 260. Subjects with the two lowest Step 2CK scores (189,199) did not systematically consider answers or admit knowledge deficits, demonstrated premature closure in 2 questions, and experienced the most negative suggestion effects (3/6 and 4/6 questions respectively). Subjects with the two highest Step 2CK scores (251,260) systematically considered answers, admitted knowledge deficits, did not generate their own answers prior to reading alternatives, did not experience premature or difficulty with closure, and experienced one negative suggestion effect collectively. CONCLUSIONS: Though limited by the small number of study subjects and questions, the data suggest different patterns of thought process activities used by higher performers and lower performers during high stakes clinical vignette style MCQs. They also suggest generating an answer prior to reading alternatives, an activity important in clinical practice, is not valued by MCQs. Implications include the potential to assist lower test performers whose activities may be maladaptive, and to reconsider question format to value ones own generation of the answer.

THROMBOPROPHYLAXIS - WHEN IT FAILS Asif A. Ansari1;
Purnachander R. Vangala1; Harneet Pahwa1; Kristy Pahl3; Alan T. Davis1; Thomas Gribbin2. 1GRMEP/MSU, Grand Rapids, MI; 2Cancer and Hematology centers of west michigan, Grand Rapids, MI; 3Univeristy of Rochester, Rochester, NY. (Control ID #1320400)

BACKGROUND: Venous thromboembolism (VTE) is a major cause of morbidity and mortality that affects more than one million patients every year. A number of global registries have documented poor compliance to thrombophylaxis guidelines. Our hospital has adopted a systematic electronic admission policy to ensure compliance to guidelines. There still
remains a subset of patients who develop VTE in hospital despite appropriate prophylaxis. To our knowledge, there has been no study that details this high risk group failing prophylaxis. Our aim was to characterize the population failing thromboprophylaxis and scrutinize our practice. METHODS: This was a retrospective cohort study reviewing charts beginning from 2007 to 2010, of all patients who developed VTE after 3 days of hospitalization. We analyzed the incidence of thromboembolic events, characterized the risk factor profiles of these high risk patients in addition to the choice of prophylaxis, treatments used and their outcomes. RESULTS: The incidence of VTE in patients despite prophylaxis was 0.15% (95% CI: 0.12% - 0.19%). Seventy-two patients developed VTE during this period, of which 58 had received appropriate prophylaxis. Enoxaparin was used for prophylaxis in 35 patients, while heparin was used in 23 patients. Of the 14 patients who did not receive heparin based prophylaxis, 13 had a relative or absolute contraindication for the use of heparin products. The mean age of patients was 65 years; and 57% of them were male. Thirty patients had a DVT, 17

had a PE while 11 were diagnosed with both. The average time for the development of a DVT or PE was 7 days. There was no significant difference between the patients in the heparin and enoxaparin groups. Patients with cancer, post orthopedic or surgical intervention, or sepsis/severe inflammatory response syndrome were at a high risk to develop VTE with an incidence of 88.9% (95% CI: 79.3% - 95.1%, p value<0.000001). The incidence of treatment failure was 0.59% (95% CI: 0.45% - 0.76%). Implementation of electronic records improved the rate of documentation of VTE prophylaxis from 55% to 80% (p=0.11) and risk stratification from 20% to 72% (p=0.0008).
CONCLUSIONS: Our study details characteristics of this high risk patients failing prophylaxis. VTE during hospitalization is likely to worsen outcomes and thus must be prevented. Further studies are needed to determine the optimal dose of thromboprophylaxis in this high risk group, perhaps higher doses of heparin or enoxaparin. Electronic record keeping is likely to improve compliance to local VTE guidelines.
TIME SERIES ANALYSES OF THE EFFECT OF FDA WARNINGS ON PRESCRIBING OF WEIGHT LOSS MEDICATIONS Jason P. Block1,2; Niteesh K. Choudhry3; Angela Tong3; William Shrank4,3.
1Harvard Pilgrim Health Care Institute/Harvard Medical School, Boston, MA; 2Brigham and Women's Hospital, Boston, MA; 3Harvard Medical School, Boston, MA; 4Centers for Medicare and Medicaid Services, Baltimore, MD. (Control ID #1339856)
BACKGROUND: The Food and Drug Administration has released multiple recent warnings regarding the use of prescription weight loss medications. Final warnings were released in January 2010 for sibutramine (Meridia) regarding cardiovascular risks and in May 2010 for orlistat (Xenical) regarding case reports of severe hepatic injury. How these warnings have impacted prescribing rates of weight loss medications is unclear.
METHODS: We conducted a time series analysis of pharmacy claims data from the national pharmacy benefits manager, CVS Caremark, to examine the impact of the FDA warnings on prescribing rates of orlistat, sibutramine, and phentermine, the three medications FDA-approved for the treatment of obesity. We used data from August 2007 through December 2010 to ensure adequate data prior to and following warnings. The sample included patients continuously enrolled in CVS Caremark for six months prior to their first prescription for a weight loss medication and for at least one year after the first prescription, isolating new users with stable enrollment. We examined the impact of warnings on 1) the rates of discontinuation of each prescription medication and 2) substitution to an alternate weight loss medication in the three month period following discontinuation (e.g., switching from sibutramine to phentermine or orlistat after the warning for sibutramine). Patients were identified as discontinuers if they did not refill their medication 90 days after the previous supply was scheduled to run out. We used segmented linear regression models to evaluate level changes and trend changes associated temporally with the release of warnings.
RESULTS: From August 2007 through December 2010, 11,915 subjects received prescriptions for orlistat, 18,676 for sibutramine, and 108,295 for phentermine from among over 117 million Caremark enrollees. The overall prevalence of use of any of these medications was low: 0.06% of all Caremark enrollees used any of these medications in August 2007 and 0.02% used them

in December 2010. Most subjects receiving these prescriptions were women(76.6% to 83.5%). Subjects receiving orlistat were older and had more comorbidities, defined according to the number of additional medications taken (38.2% of orlistat users received 5 or more other medications compared to 26.5% for sibutramine and 16.5% for phentermine). In the time series analyses, we found that rates of discontinuation of each of the medications were similar before and after warnings (P value for level change of nonpersistence rate post-warning was 0.11 for orlistat, 0.85 for sibutramine, and0.55 for phentermine). The trend change of non-persistence post-warning also was not significant. Subjects who discontinued sibutramine had an increased

trend post-warning to start phentermine than before the warning (P=0.01). CONCLUSIONS: We found no evidence for an effect of FDA warnings on discontinuation of prescription weight loss medications. Subjects who discontinued use of sibutramine were more likely to switch to phentermine post-warning than prior, a concerning finding because of ongoing safety concerns about phentermine. These findings raise concern about the effectiveness of communication strategies when FDA warnings are issued.

TIMELINESS OF FOLLOW-UP AFTER ABNORMAL SCREENING MAMMOGRAPHY AT FACILITIES SERVING VULNERABLE WOMEN L. E. Goldman1; Rod Walker2; Rebecca Hubbard2; Karla Kerlikowske1. 1University of California San Francisco, San Francisco, CA;
2Group Health Research Institute, Seattle, WA. (Control ID #1337750)

BACKGROUND: Delays in breast cancer diagnoses contribute to higher mortality rates that disproportionately affect women with low income, limited education, racial or ethnic minorities, and those who live in rural areas. It is unknown whether the timeliness of evaluation following abnormal mammography at facilities serving vulnerable women compared to other facilities contributes to these disparities.

METHODS: We examined mammography that received a recommendation for subsequent imaging (herein recall) and mammography that received a recommendation for biopsy (herein biopsy recommendation) performed from 1998 to 2006 on Medicare recipients age 65 or older at 4 sites participating in the Breast Cancer Surveillance Consortium (BCSC). BCSC data were linked to Medicare claims to obtain dates of subsequent imaging and biopsy procedures. We estimated the association between timeliness of subsequent imaging and biopsy and vulnerability status of the facility. Facilities were characterized as serving vulnerable women based on the proportion of mammograms performed on racial/ethnic minorities, women with lower educational attainment or income, and those living in rural areas. Times to follow-up imaging and biopsy were estimated based on Kaplan-Meier curves, and adjusted hazard ratios (HRs) for these events were estimated using Cox regression, accounting for clustering at the level of the facility and adjusting for mammography indication, registry site, age, and prior screening mammography.

RESULTS: We analyzed 35,764 mammograms recalled for additional imaging at 142 facilities and 12,443 mammograms with biopsy recommendations at 128 facilities. Following recall, women at facilities serving smaller proportions of women with limited education and smaller proportions of racial/ ethnic minorities received follow-up imaging sooner than women at facilities serving more vulnerable women on the basis of these characteristics [education: median time to imaging 11 vs. 14 days; adjusted hazard ratio (HR) 1.44 (95% confidence intervals (CI) 1.22, 1.71)] [race/ethnicity: 11 vs. 12 days; adjusted HR 1.31 (1.00, 1.73)]. Following biopsy recommendation, women returned for biopsy sooner at facilities serving smaller proportions of rural women (median time to biopsy 18 vs. 23 days; adjusted HR 1.35 (1.16, 1.57)) and smaller proportions of limited income women (19 vs. 24 days; adjusted HR 1.35 (1.20,1.51)). Overall, at facilities serving vulnerable women were less likely to return for biopsy within 3 months after a biopsy recommendation: facilities that serve women with limited education vs. those that did not (76.7% vs. 82.0%: $p<0.01$), facilities that serve racial/ethnic minorities vs. those that did not (75.8% vs. 81.8%: $p<0.01$), facilities that serve rural residents vs. those that did not(79.5% vs. 82.5%: $p<0.01$), facilities that serve women with limited income vs. those that did not (78.9% vs. 82.3%: $p<0.01$).

CONCLUSIONS: While women at facilities serving non-vulnerable women receive follow-up imaging sooner, the differences in time to follow-up do not seem clinically significant. However, the greater likelihood that women at facilities serving vulnerable women do not return for biopsy within 3 months after biopsy recommendation may be an indicator of quality of care and an
important target for interventions to decrease diagnostic delays in breast cancer diagnoses among vulnerable women.

TOTAL HOURS MATTER: REDESIGNING RESIDENCY SCHEDULES TO MINIMIZE FATIGUE Lauren Block1; Sanjay Desai2; Leonard S. Feldman1; Albert W. Wu1. 1Johns Hopkins University School of Medicine,

Baltimore, MD; 2Johns Hopkins University School of Medicine, Baltimore, MD. (Control ID #1321094)
BACKGROUND: The 2011 ACGME residency work hour mandate reaffirms the need to design residency schedules in a way that optimizes patient safety and minimizes resident fatigue. Changes to residency schedules should be informed by an understanding of the relationship between these factors. We sought to determine whether scheduling factors were related to sleepiness, burnout, and poor patient care outcomes.
METHODS: A cross-sectional survey of medicine interns at a large academic medical center (29 interns), a smaller academic hospital (15 interns), and a community hospital (11 interns) was conducted in June 2011. The survey assessed scheduling characteristics including hours worked and adherence to the relevant ACGME mandates, such as duty hours and the 80-hour work week. Fatigue and sleepiness were measured using a modified Maslach Burnout Index and Eppworth Sleepiness scale. Other outcome measures included resident assessments of quality of life, education, handoffs, and quality of patient care, as well as attitudes towards safety (measured by an abbreviated Safety Attitudes Questionnaire), and medical errors (measured by an errors index). Reponses were analyzed using two-tailed t-tests and multivariate linear and logistic regression.
RESULTS: Response rate was 82% (N=55). Average hours worked in the past week was 76 (range 50-107). 45% of residents surveyed met criteria for high burnout (Maslach score17) and 53% for sleepiness (Eppworth score10).
Total hours worked, sleepiness, residency program, and traditional overnight call rotation were independently associated with burnout. Residency program and traditional overnight call rotation were independently associated with sleepiness. In a multivariate model adjusting for age, sex, and sleepiness; total hours worked, overnight rotation, and residency program were associated with burnout, but number of days off, leaving on time post-call, and adherence to the 80-hour work week were not. Interns with high burnout were more likely than interns without high burnout to report making errors due to fatigue (84% vs. 60%, p=0.03) and to excessive workload (70% vs. 90%, p=0.04), and fewer reported positive attitudes towards safety (74% vs. 97%, p=0.01). Those with high burnout were less likely to report satisfaction with quality of patient care provided (52% vs. 97%, p<0.001), with work life (35% vs. 83%, p=.001), and with personal life (35% vs. 63%, p=0.03), and fewer felt prepared to be a PGY2 resident (58% vs. 96%, p=0.001). Interns with high sleepiness scores were less likely to report spending at least the median time on handoffs (47% vs. 74%, p=.03), and less likely to report receiving high quality handoffs (74% vs. 96%, p=0.05) than interns without high sleepiness scores.
CONCLUSIONS: Sleepiness and burnout were prevalent among interns in this study and were independently associated with poor quality of life and undesirable patient care outcomes. While total hours worked and a traditional overnight call rotation were associated with resident burnout and sleepiness, other scheduling factors, including adherence to the 80-hour work week, leaving on time after on-call shifts, and number of days off, were not. In designing residency schedules, efforts to reduce total number of hours worked and using day and night team scheduling may be effective in improving fatigue, burnout, and patient safety.
TRANSITIONS OF CARE INTERNAL MEDICINE PGY1 AMBULATORY EDUCATION: PILOT YEAR 1 Rachel K. Miller1;
Karen M. Goldstein2; Jennifer Lapin1; Jerry Johnson1. 1University of Pennsylvania, Philadelphia, PA; 2Durham VA Medical Center, Durham, NC. (Control ID #1339811)
BACKGROUND: In one out of every five hospital discharges, there is an adverse event which can lead to hospital readmission or an ER visit. In July 2007, the American College of Physicians, Society of Hospital Medicine, and Society of General Internal Medicine came together to address quality issues and to develop consensus standards for transitions of care between inpatient and outpatient settings. While the learning of care transitions is a hidden curriculum at many medical institutions, trainees are still expected to master

this challenging skill set by the end of residency. We proposed that introducing proper transitions of care strategeies via small group, interactive didactics and a piloted post-discharge hospital home visit in the PGY1

internal medicine curriculum would increase confidence in the implementation of safer discharges for hospitalized patients.
METHODS: In pilot year 1 at the University of Pennsylvania, the first week of PGY1 internal medicine ambulatory blocks from July through December included an hour long didactic session on Transitions of Care. This interactive, small group session discussed pertinent topics such as: identifying vulnerable patients, working with multidisciplinary team members, the basics of home services and skilled nursing facilities, medication reconciliation, discharge summaries/instructions, and patient communication. During the next 3 weeks of the block, half of Internal Medicine interns were randomized to go on a post-discharge home visit. Home visits were piloted in 2009 with the University of Pennsylvania Transitions of Care Nursing Team led by Mary Naylor. On the last didactic session of the month, we reviewed discharge summaries/instructions. There was also a debriefing session for those who attended a post- discharge home visit.
RESULTS: An IRB approved pre- intervention survey was given immediately before the first and last session to all the interns and 27 paired evaluations were reviewed. Overall, the interns showed an increased degree of confidence in: identifying potential threats to a well executed transition between sites of care ($p<0.001$); anticipating the consequences of a poorly executed care transitions ($p<0.001$), and knowledge of the community resources available to patients with chronic illness ($p<0.001$). In addition, they showed increased knowledge in the roles of physical therapists ($p<0.001$), occupational therapists ($p<0.001$), nursing ($p<0.010$), and social work ($p<0.030$). CONCLUSIONS: This pilot transitions of care education initiative for internal medicine interns showed increased confidence in high risk discharge issues and increased knowledge of community resources and the role of multidisciplinary team members in safe transitions of care. Future directions include having all interns participate in post hospital discharge home visits and further evaluation of the long term impact of a transitions of care education program.
TRAUMATIC BRAIN INJURY IN HOMELESS PATIENTS CarolA. Waldmann. Frederick Memorial Hospital, Federick, MD. (Control ID #1339873)
BACKGROUND: Traumatic brain injury (TBI) Is the leading cause of death and disability among children and young adults in the United States (US). These disabilities include neuropsychological dysfunction and behavioral problems which can interfere with a persons ability to maintain stable housing, employment and relationships. Previous studies have found high rates of cognitive impairment among homeless individuals. A recent study in Toronto, Canada, found that in a representative sample of homeless individuals, 58% of men and 42% of women had a history of TBI. No published study has examined the issue of TBI among homeless individuals in the US. METHODS: English speaking patients at each of the top ten attended Boston Healthcare for the Homeless (BHCHP) clinical sites over the age of 17 were consecutively recruited to answer a 97 item questionnaire. 227 interviews occurred from 12/2006 though 8/2007. 190 of these patients were technically homeless The recruitment rate was 74%. To assure adequate distribution by clinic site when 3% of the annual patient load was reached at any site no more surveys were there. . Responses by patients reporting TBI were compared with those without TBI. Chi square and T-test analysis were used to determine statistically significant differences between the two groups. Prevalence and scope of TBI including severity, cause, and sequelae were studied. Questions about co-morbidities, risk factors, history of homelessness, and demographic information were also asked and examined.
RESULTS: Of the 190 homeless patients surveyed 129 (68%) reported having at least one TBI. Of these subjects: 69% reported having had more than 1 TBI, 1.3% reported losing consciousness, 6% reported being hospitalized,5.7% reported using alcohol or drugs when the TBI occurred. The average age at first TBI was 19, over 25% of first TBI occurred before the age of 10 suggesting that TBI may have preceded homelessness in many patients. Assault was the most common cause of TBI (29%) followed by motor vehicle accident (27%) and other accidents (25%) Patients with TBI had multiple statistically significant differences in co-morbidities and possible sequelae ot TBI including higher rates of alcohol and narcotic abuse, mental illness

including depression, criminal conviction and symptoms of irritability and anger and symptoms associated with headache including nausea, photophobia, visual changes, and aura. They were more likely to be veterans and were more likely to have problems with word finding.
CONCLUSIONS: TBI is common in homeless patients seeking care at BHCHP medical services. Patients who have had a TBI exhibit associated symptoms and conditions that may impair their ability to maintain housing, employment and adequate self care. This suggests that all clinicians caring for homeless individuals should consider screening for a history of TBI. Care plans of homeless patients particularly those with a discovered history of TBI should include consideration of patients possible impairments due to TBI including poorer emotional regulation, cognition and health status. An understanding of the impact of TBI on homeless persons health creates an opportunity to develop interventions that can improve the quality and efficiency of care to this complicated patient population.
TREATING CHRONIC NON CANCER PAIN WITH NARCOTICS-DOES IT WORK? Asif A. Ansari1; Angela Embree1; Michael Bouthillier2; Jeevarathna Subramanian1. 1GRMEP/MSU, Grand Rapids, MI; 2Ferris State University, Grand Rapids, MI. (Control ID #1334573)
BACKGROUND: Opioid analgesics are widely used by physicians to treat chronic non cancer pain (CNCP). Several professional societies and organizations have endorsed guidelines for judicial and rational use of opioids to treat CNCP. The aim of the study was to scrutinize our practice of opioid prescription to treat CNCP. In addition, we describe patient profiles and behavior patterns, role of vitamin D supplementation and association with depression.
METHODS: This was a prospective study from July 2010 of all patients at our resident out-patient clinic on long term narcotics for managing CNCP. Patients were followed on a monthly basis for 18 months, and a survey on patient perceptions was conducted by patient interview at the end of study. Patients with vitamin D deficiency were treated with supplementation for 1 year. Performance was compared to a study completed in the same setting in 2008 (n=31). A modified oswentry scoring tool was used to assess disability. RESULTS: 50 patients were identified to be treated with long term opioids for CNCP in our practice. 28 of these patients were female. Back pain was the most common site of pain, and was present in more than half of the patients. 64% of patients claimed disability due to pain. 50 (100%) patients had a signed narcotic agreement, compared to 65% in 2008 ($p<0.0001$). There was reduction in number of patients seeking narcotics from an alternative facility from 64% in 2008 to 24% during the study period ($p=0.0004$). All 50 patients has a random drug screen performed as per guidelines, treatment goals established and functional assessment performed at regular intervals, compared to 9, 20 and 3 patients retrospectively in 2008 ($p<0.0001$). Half of the patients in our study had vitamin D deficiency and a similar number had depression. Patients felt pain was better controlled with treated depression. There was no significant statistical improvement in pain control or reduction in opioid requirement after vitamin D supplementation. Although, 84 percent of patients felt improved function subjectively in activities of daily living with long term opioids, there was no significant difference objectively in pain relief score or modified oswentry score for disability at the end of study. CONCLUSIONS: The results showcase an improved performance in delivering quality care to patients on long term opioids to treat CNCP. This has been largely possible with recruitment of nurse specialist with special interest in chronic pain and formal education of resident physicians. Centers managing patients with chronic pain should follow standardized guidelines, formalize patient relationship with a narcotic agreement, and audit their performance. Patients with CNCP are likely to have depression and vitamin D deficiency; and treating these conditions may improve their quality of life. Until larger controlled studies are done, it may be prudent to screen and treat patients with these underlying comorbities.
TREATMENT OF POSITIVE URINE CULTURES IN HOSPITALIZED PATIENTS: A DRIVER OF ANTIMICROBIAL MISUSE Sarah Hartley1;
Staci Valley1; Latoya Kuhn2; Tejal N. Gandhi1; Laraine Washer1; Carol Chenoweth1; Jennifer Meddings1; Anurag Malani3,1; Sanjay Saint2,1; Scott Flanders1. 1University of Michigan, Ann Arbor, MI; 2Ann Arbor

VAMC, Ann Arbor, MI; 3St. Joseph Mercy Hospital, Ann Arbor, MI. (Control ID #1310198)

BACKGROUND: Obtaining a urine culture in hospitalized patients is extremely common. Positive cultures frequently trigger antimicrobial therapy, but the appropriateness of this treatment remains unclear. We sought to describe physician management of positive urine cultures and the extent to which treatment contributes to antimicrobial overuse.
METHODS: We randomly selected adult patients admitted to a large academic center between February 2008 and February 2009 who had positive urine cultures. Patients were excluded if they were admitted to intensive care, had a major urinary procedure (e.g., renal transplant), were actively being treated for a urinary tract infection (UTI) at the time of admission or >48 hours prior to urine collection. Two hospitalists performed retrospective medical record review to determine the presence of signs or symptoms of UTI, urinary catheter presence, antimicrobial therapy, reason for and duration of antimicrobials. Appropriateness criteria for diagnostic testing and antimicrobial treatment was defined using national and professional society guidelines (i.e., Centers for Disease Control and Prevention and Infectious Diseases Society of America) and final determination of appropriateness was adjudicated by the hospitalist reviewers and 2 infectious disease physicians.
RESULTS: Of 153 patients, 73 (48%) had an appropriate reason documented to obtain a urine culture. The most common reasons for obtaining a culture were fever (27%), altered mental status (16%) and change in character of urine (15%). A total of 94 (61%) had asymptomatic bacteriuria, including 39 patients (41%) on antimicrobials at the time the urine culture was sent. Despite the lack of signs or symptoms of UTI, 60 (64%) were treated for a UTI within 72 hours of the urine culture, including 59 (98%) who were newly started on antimicrobials for treatment. Patients with asymptomatic bacteriuria received a mean of 6.6 days of antimicrobials. Of 59 patients (39%) who met criteria for UTI, 15 (25%) had a catheter associated UTI. Fifty-five (93%) were started on initial antibiotics that were consistent with guidelines. The duration of therapy was incorrect for 16 patients (27%) including 4 patients treated an average 6 days beyond the recommended course and 12 patients with an insufficient duration of treatment. The most common reason for truncated therapy was inappropriate categorization of a patient as having an uncomplicated UTI. CONCLUSIONS: In hospitalized patients, systemic symptoms were the most common drivers of orders for urinary culture. Over half of patients with positive urine cultures had asymptomatic bacteriuria. A majority of these patients inappropriately received antimicrobials. In patients meeting criteria for UTI, antimicrobial use was inappropriate in over one quarter. Strategies to promote appropriate diagnostic testing and treatment for possible UTI in hospitalized patients are urgently needed and will likely reduce antibiotic misuse. Hospitalists can help lead these improvement efforts.
TRENDS IN ETHICS CONSULTATION PRACTICES IN A LARGE HEALTH SYSTEM David Alfandre; Kenneth Berkowitz; Ellen Fox. VA National Center for Ethics in Health Care, New York, NY. (Control ID #1336394)
BACKGROUND: The discipline of health care ethics consultation (EC) has been limited by the lack of both high quality data and quality standards. To promote high quality ethics consultation practices, staff at the National Center for Ethics in Health Care within the Veterans Health Administration (VHA) developed 2 specific EC tools, ECWeb and the EC Feedback Tool. ECWeb is a web-based database tool that promotes process standards consistent with CASES, VAs systematic approach to ethics consultation. The EC Feedback Tool, which links to ECWeb records, enables consultation participants to rate their experience on various aspects of EC. This paper describes the ethics consultation requests, processes, and evaluations from all facilities in our system.
METHODS: We analyzed data from completed ethics consultations from ECWeb records initiated between October 2008 and September 2011. For each consultation record, users documented in ECWeb the data related to utilization of the EC service (e.g., type of consultation request, requester role (i.e., physician, nurse,

patient). Additionally, ECWeb users documented, as applicable, various processes performed during the ethics consultation (e.g., capacity assessment (y/n), a face-to-face patient visit (y/n), and if the consult was identified as being symptomatic of underlying issues that are best addressed at the systems level). The EC Feedback Tool asked respondents to rate the ethics consultant(s) on 12 specific ethics knowledge and skill areas as well as their overall experience with ethics consultation, both on a 5 point Likert scale.
RESULTS: We analyzed ECWeb data for 4628 completed consults from 140 facilities across the VHA health system . Median consultation volume per facility was 7 in 2009 (mean=9.6, range=0-60), 8 in 2010 (mean=12.4, range=0-106), and 8 in 2011 (mean =12.1, range=0-119). The majority of consultations were classified by the consultants as related to shared decision making (73%). Most consultations (63%) related to patients in the inpatient setting, 25% in the outpatient setting, and 10% in long term care settings. EC processes showed minimal change over the time period studied with the exception of an increase in underlying systems issues recorded from 37% in 2009 to 42% in 2011. Of all completed ethics consultations, 32% had at least one evaluation recorded. From 2009 to 2011, participant ratings improved for the overall experience, as well as for all 12 specific knowledge and skills. In particular, ratings of the consultant on providing a helpful service and clarifying decisions that had to be made rose from 85% to 89% and 79% to 85% respectively over the time period studied. CONCLUSIONS: Data from over 4,500 ethics consultations highlight the current trends in ethics consultation requests, processes, and evaluations in our integrated health system. Developing and implementing these EC tools has set EC standards for VHA, helped to promote a quality improvement approach to EC practices, and in the case of participant satisfaction, demonstrated improved ethics quality. Further work is needed to establish relationships between these data elements and other measures of EC quality such as desirable outcomes and overall content quality. Wider adoption of EC standards outside of VA is recommended to better understand EC practices and improve EC quality as well as to establish its accountability.
TRENDS IN HEART FAILURE ASSOCIATED HOSPITALIZATIONS IN THE UNITED STATES, 2001-2009 Saul Blecker; Margaret Paul; Gbenga Ogedegbe; Glen Taksler; Stuart Katz. NYU School of Medicine, New York, NY. (Control ID #1339520)
BACKGROUND: Heart failure is among the most common reasons for hospitalizations in the United States. Recent data from Medicare suggest that the number of hospitalizations with a primary diagnosis of heart failure has declined over the past decade. However, heart failure may increase hospitalization rates for related comorbidities and individuals with heart failure are commonly admitted for other reasons. Using a nationally representative sample of hospital admissions, we studied trends in hospitalizations with both a primary and a secondary diagnosis of heart failure. METHODS: We evaluated trends in heart failure hospitalizations from 2001 to 2009 using the Nationwide Inpatient Sample (NIS), the largest all-payer inpatient database in the United States. We included hospitalizations with an International Classification of Diseases, Ninth Revision discharge diagnosis codes of 402.X1, 404.X1, 404.X3, 428.XX in any position; these codes in the primary position are used by The Centers for Medicare &Medicaid Services for reporting heart failure quality measures. Admissions were categorized as either primary heart failure hospitalization, if heart failure was the primary discharge code, or heart failure associated hospitalization, if heart failure was listed as a secondary diagnosis. National estimates of heart failure hospitalizations were calculated using the sampling weights and stratified sample design of the NIS. Yearly hospitalization rates were determined by dividing the number of hospitalizations by the United States population in a given year. Population estimates were obtained from the United States Census Bureau. RESULTS: The total number of heart failure hospitalizations in the United States increased from 3,900,305 in 2001 to 4,398,376 in 2006 and then decreased to 4,253,937 in 2009. The number of primary heart failure admissions decreased from 1,139,607 in 2001 to 1,087,913 in 2009, while the number of heart failure associated hospitalizations increased from 2,760,698 to 3,166,024 over the same period. Primary heart failure hospitalization rates also decreased from 2001 to 2009, whereas heart failure associated hospitalization rates increased from 2001 and 2006 and then slightly decreased (figure).

CONCLUSIONS: Although primary heart failure hospitalizations declined nationally over the past decade, heart failure associated hospitalizations increased during the same period. These divergent trends may reflect improved treatment for heart failure but not for related comorbidities, resulting in increased admissions for causes which may be associated with, but not directly due to, heart failure. Reduced coding of heart failure as the primary diagnosis due to public reporting of heart failure quality measures and readmissions may have also contributed to these trends.

TRENDS IN US PHYSICIAN WORK HOURS AND CAREER SATISFACTION Andrea S. Christopher1,2; Andrew P. Wilper1,2; Rick Tivis3. 1University of Washington, Seattle, WA; 2Boise Veterans Affairs Medical Center, Boise, ID; 3Idaho State University Meridian Health Science Center, Meridian, ID. (Control ID #1325066)

BACKGROUND: U.S. physician work hours declined in recent decades. We evaluated the association between physician work hours and career satisfaction overall with a focus on trends over time for primary care and subspecialty physicians.

METHODS: We analyzed the Community Tracking Survey (CTS), a publicly available data set generated from telephone surveys of a nationally representative sample of physicians. We reviewed data from the four survey cycles: 1996-97, 1998-99, 2000-01, and 2004-05. We quantified hours spent in all medically relevant work as well as the distribution of work into direct patient care and charity care responsibilities. We tested for changes in demographics using chi-square tests and repeated measure ANOVA, testing trends over time. Career satisfaction was quantified on a scale of one to five in the survey instrument. First we examined the relationship of hours in medicine with career satisfaction by dividing hours in medicine into quartiles. Next, we analyzed the proportion of physicians reporting moderate to extreme career satisfaction per quartile using chi square tests. Finally, we developed a multivariate logistic regression to examine the relationship between US physician career satisfaction and work hours. We accounted for the CTS complex survey design and used SAS 9.2 for this analysis. Weights were used to derive national estimates. The Puget Sound VA IRB approved this study.

RESULTS: Mean physician age increased from 48.5 (95% confidence interval (CI)=48.3, to 48.7) years in 1996-97 to 50 years (95% CI=49.6,50.3) in 2004-05 ($p<0.001$). The proportion of female physicians increased from 17.6% (95% CI=16.8, 18.4) in 1996-1997 to 25.0% (95% CI=23.2,26.8) in 2004-05 ($p<0.0001$). We did not detect any other meaningful trends ($p>.01$) in other population characteristics. The mean total number of weeks per year spent in practice decreased significantly among both primary care and non primary care providers (-0.2 weeks each, ($p<.01$)). The mean hours per week spent in all medically related activities (HMRA) decreased significantly across both groups ($p<.0001$). For primary care providers, HMRA decreased from 54.4 (95% CI=53.9,54.8) in 1997 to51.8 (95% CI=50.9, 52.7) in 2005 (5% decrease). For non-primary care providers, HMRA decreased from 57.4 (95% CI=56.9,57.9) in 1997 to54.9 (95% CI=54.0, 55.8) in 2005 (4% decrease). The hours per week spent performing charity work also decreased significantly amongst primary care and subspecialty physicians (down 6% and 17% per week,
respectively). The percentage of physicians reporting career satisfaction increased from 80.82% in 1996-97 to 84.26% in 2004-08 ($p<0.001$). Examining changes in career satisfaction at different levels of HMRA over time reveled a significant difference in proportion reporting satisfaction ($p<.0001$) with those at the lower quartile on HMRA showing the greatest increase in proportion satisfied (from 82% to 90%) over time. Lastly, in our multivariate logistic regression analysis, weeks worked and HMRA were significant positively ($p=.0002$) related to with the degree of career satisfaction, while controlling for age, gender, US education, primary care, type of practice, region and several others.

CONCLUSIONS: Our study demonstrates trends towards decreased work hours, regardless of physician subtype. This is associated with a concomitant increase in physician career satisfaction that correlates with the decrease in work hours.

TRUST YET VERIFY: PHYSICIANS AS TRUSTED SOURCES OF HEALTH INFORMATION ON HPV FOR BLACK WOMEN IN UNDERSERVED COMMUNITIES Cheryl R. Clark1,2; Nashira Baril3; Erline Achille3; Shauntell Foster3; Kalahn Taylor-Clark4; Natacha Johnson2; Joshua Gagne6; Oluwakemi Olukoya3; Carrie Huisingh2; Mark Ommerborn2; Vish Viswanath5,7. 1Brigham and Women's Hospital, Boston, MA; 2Brigham and Women's Hospital, Boston, MA; 3Boston Public Health Commission, Boston, MA; 4National Partnership for Women and Families, Washington D.C., DC; 5Dana Farber Cancer Institute, Boston, MA; 6Dana Farber Cancer Institute, Boston, MA; 7Harvard School of Public Health, Boston, MA. (Control ID #1331496)

BACKGROUND: Human Papilloma Virus (HPV) infection in the US is highest among Black women and women of low socioeconomic position. However, these groups are also least likely to have information about HPV or strategies for preventing its transmission. The principal channels through which Black women of low socioeconomic position obtain information regarding HPV and HPV vaccination are not fully known. Our study sought to understand key information channels for delivering health information regarding HPV and the HPV vaccine to Black women of low socioeconomic position in Boston, Massachusetts.

METHODS: We conducted a qualitative analysis using focus groups to explore constructs in the theory of communication inequality. We conducted five focus groups among 25 women in underserved neighborhoods in Boston, Massachusetts. We hypothesized that Black women of low socioeconomic position would prefer information from trusted and accessible sources including friends, family, and community agencies.

RESULTS: Contrary to our hypothesis, we found that women in all of the focus groups preferred to receive health information in general, and specific health information regarding HPV, from a physician or health care center. Focus group participants indicated that they preferred to receive information in print form from clinical sources so that they could check the veracity of the information from providers with external sources. Participants stated their actual sources of information regarding HPV were chiefly via television commercials. Participants perceived that time pressure during the clinical encounter limited physicians' accessibility as a source of general health education.

CONCLUSIONS: Our study suggests that physicians are trusted and preferred sources of information on HPV and vaccination for Black women of low socioeconomic position in Boston. Our focus group participants preferred to receive print materials from physicians and health care institutions, and to triangulate this information with data from other sources, including information received in community settings. Our data suggest the need for intervention research to design effective strategies for physicians to provide appropriate print materials and community education on HPV to Black women of low socioeconomic position.

UNDERSTANDING OBESITY: IMPACT OF SOCIO ECONOMIC STATUS ON OBESITY RATES. Rajesh Krishnamoorthi; Arun K. Muthusamy; Palaniappan Manickam; Theresa E. Vettese. Wayne State University, Detroit, MI. (Control ID #1336826)

BACKGROUND: In underdeveloped and developing countries, lower socio economic status(SES) is associated with poor nutrition and lower BMI. However, this is not true in developed countries where fast foods have become

a source of nutrition. The less expensive fast foods have higher calorie content which can potentially increase the risk of obesity in population belonging to low socio economic status. There is limited data directly supporting this hypothesis and we wanted to perform a study analyzing it. Our objective was to study the impact of socio economic status on prevalence of obesity. We also investigated if demographic factors like race and ethnicity influence obesity rates.

METHODS: We performed a retrospective analysis of the limited access dataset from the National Ambulatory Medical Care Survey from 2007 to 2009. All patients less than 65 years of age were included in the study and

categorized into lower, lower- middle, upper-middle and upper SES and obesity rates (BMI>30) were calculated for each SES. The study population was further categorized based on race and ethnicity into Caucasians, African Americans, Hispanics and Non-Hispanics. Multivariate logistic regression was used to study the impact of socio economic status, race and ethnicity on obesity rates. All statistical analysis was performed using SAS. RESULTS: 66014 patients with complete details on socio economic status were included in the study. The prevalence of obesity in lower, lower-middle and upper-middle SES was significantly higher than upper SES (Table 1). On sub-group analysis based on race and ethnicity, the results were the same in Caucasian and Non-Hispanic populations. However in African American and Hispanic populations, obesity rates were not statistically different in different SES (Table 2 &3). CONCLUSIONS: Our results confirm the hypothesis that socio economic status has an inverse relationship with obesity rates. Also, race and ethnicity are independent risk factors for obesity. Obesity rates were the same across different SES in African Americans and Hispanics unlike Caucasians and Non-Hispanics, suggesting that these populations have other confounding risk factors contributing to obesity in addition to SES. Further studies are needed to identify these risk factors to understand obesity better.

Impact of Socio Economic Status on Obesity Rate.

Table.1- Total Study PopulationSocio Economic Status Total (n) Obese (n) Odds Ratio 95% CI Lower SES 14344 2236 1.23 (1.03 to 1.46) Lower Middle SES 15028 2210 1.29 (1.10 to 1.51) Upper Middle SES 16838 2320 1.31 (1.15 to 1.50) Upper SES 19804 2078 1 (Reference) Table.2- African American PopulationSocio Economic Status Total (n) Obese (n) Odds Ratio 95% CI Lower SES 3455 726 1.04 (0.77 to 1.41) Lower Middle SES 1775 372 1.29 (0.88 to 1.89) Upper Middle SES 1536 271 1.13 (0.77 to 1.66) Upper SES 1080 181 1 (Reference) Table.3- Hispanic PopulationSocio Economic Status Total (n) Obese (n) Odds Ratio 95% CI Lower SES 2645 380 1.21 (0.83 to 1.76) Lower Middle SES 2146 284 1.21 (0.84 to 1.74) Upper Middle SES 2182 310 1.23 (0.92 to 1.65) Upper SES 1747 246 1 (Reference)

There is an inverse relationship between socio economic status and obesity rates.

UNDERSTANDING AND DECISION MAKING ABOUT SCREENING COLONOSCOPY FOR OLDER PERSONS WITH MULTI-MORBIDITY Carmen L. Lewis1; Terri Fried2; Joseph S. Ross2; Jenerius Aminawung2; Lisa Werner1; Christine Kistler1; Mary Tinetti2; Katherine McKenzie2; Inginia Genao2; Cary Gross2. 1University of North Carolina, Chapel Hill, NC; 2Yale University School of Medicine, New Haven, CT. (Control ID #1326001)

BACKGROUND: Although current guidelines recommend against colorectal cancer screening for older persons with multi-morbidity and limited life expectancy, evidence suggests that many older adults who may not benefit undergo screening colonoscopy. The purpose of this study was to assess whether an understanding of the risks and benefits of screening colonoscopy with increasing age and multi-morbidity would influence patient decision making about whether to undergo screening. METHODS: We recruited a convenience sample of participants ages 70 and older with at least two comorbidities and taking 5 or more medications in 2 geographical areas. Participants reviewed a paper teaching aid (TA), which included information and graphics describing the diminishing benefits and increasing risks associated with screening colonoscopy in the setting of increasing age and multi-morbidity. We used an open ended question to assess understanding of the information. Chi -squared tests were used to compare the associations between understanding the information in the teaching aid and the decision to undergo screening colonoscopy. Logistic regression was used to estimate the odds of a decision to screen.

RESULTS: Among 101 participants, mean age was 78, 76% were white, 71% were women, 45% had a college degree or higher, and 96% reported having previously been screened for colon cancer. After viewing the teaching aid, 55 (55%) participants understood either the diminishing benefits or the increasing risks of screening colonoscopy. When asked whether participants would choose to undergo screening colonoscopy if they were in poor health, 9 (17%) of participants who understood the information presented in the teaching aid

stated that they would choose to do so compared to 25 (57%) of the participants who did not understand the information (p<0.001). When asked whether participants would choose to undergo screening in their current health, results were similar for the two groups (43 (80%) who understood vs. 38(83%) who did not understand; p=0.38). Thirty-nine (39%) of participants classified themselves as having serious medical problems. After adjusting for perceived health status, understanding was strongly associated with a decreased odds of choosing to be screened in poor health (OR 0.15; 95% CI, 0.06 to 0.39), but not in the current state of health (OR 0.8; 95% CI, 0.28 to 2.15). Results stratified by self-reported health status are shown in the table.
CONCLUSIONS: Participants who understood the diminishing benefits or increasing risks of screening colonoscopy in the setting of increasing age or multi-morbidity appeared to have decreased interest in screening colonoscopy in the context of poor health. However, a majority of participants indicated that they would undergo screening colonoscopy in their current state of health, regardless of their self-perceived health or their level of understanding. An understanding of the risks and benefits of screening colonoscopy may not be sufficient to discourage screening in older persons who may not benefit from it.
With Serious Medical Problems P value Without Serious Medical Problems P value Decision to Screen
Understood*information inTA n=23
Did not understand information in TA n=16
Understood* information in TA n=30
Did not understand information in TA n=28
Would undergo Screeningin poor health
6 (26%) 10 (63%) 0.02 3 (10%) 15 (54%) <0.001
Would undergo screeningin current health
15 (65%) 13 (81%) 0.27 27 (90%) 25 (83%) 0.45
Participant demonstrated understanding of decreased benefits or increased risks

UNDERSTANDING THE CARE GAP AND MISSED OPPORTUNITIES FOR HEPATITIS C CONFIRMATORY VIRAL TESTING Yang Liu3;
Renee H. Lawrence1; Brook Watts1,3; Yngve Falck-Ytter1,3; Amy Hirsch2,3. 1Department of Medicine, Louis Stokes Cleveland Department of Veterans Affairs Medical Center, Cleveland, OH; 2Pharmacy Service, Louis Stokes Cleveland Department of Veterans Affairs Medical Center, Cleveland, OH; 3Case Western Reserve University, School of Medicine, Cleveland, OH. (Control ID #1323493)
BACKGROUND: Clinical practice guidelines state that diagnosis of chronic Hepatitis C (HCV) in high risk patients or those suspected of having HCV requires screening with the HCV antibody (HCVab) test followed by confirmatory viral testing. Published physician performance measure sets include rates of HCV confirmatory testing as a measure. Failure to obtain confirmatory testing may result in missed opportunities for treatment, or unnecessary emotional stress or medical care if an HCV diagnosis is inappropriately given or referenced in future documentation. To date there are no published studies that summarize information about patients in this care gap.
METHODS: Using an established HCV patient registry, we conducted a retrospective chart review of 419 patients at a large veterans affairs medical center who had history of at least one positive HCV antibody result but lacked confirmatory viral testing. For each patient, we collected demographic data (e.g., age, race, gender, etc). For each subjects first instance of a positive HCVab, we determined who, PCP or non-PCP (e.g., provider from mental health, inpatient medicine, etc.) ordered the HCVab, whether the positive HCVab was acknowledged, and by whom. If acknowledged, we then determined what the interpreting provider did in response to the result (e.g., entering HCV into the patient problem list, placing an HCV clinic consult, etc.). We also determined whether the term Hepatitis C was documented by a future medical provider who was not the ordering or acknowledging provider.

RESULTS: The average age of subjects was 60 years, and 97% were male. 47% of subjects were black, 45% white, and subjects had received health care through the VA center for an average of 8.0 years. Thirty-one percent of the positive HCVab tests were unacknowledged by any provider. Of the labs that were acknowledged, a non-PCP ordering and acknowledging the lab was more likely ($p<.05$) than a PCP to inappropriately enter HCV into the problem list in the absence of confirmatory viral testing, without taking further action (6% and 3%, respectively). Furthermore, non-PCPs were more likely than PCPs to inappropriately document HCV in the progress note only (17% and 6%). However, the majority of the time, both PCPs and non-PCPs took HCV follow-up actions (HCV education, HCV consult, etc), with PCPs more likely to do so (65% and 57%). Of those who took other actions, a PCP ordering and acknowledging the test was associated with an HCV clinic consult being placed ($p<.001$) more than non-PCPs (34% versus 6%). Overall very few consults were placed (38 out of 251). Entering HCV into the problem list was associated with evidence of future medical providers referencing the diagnosis ($p<. 001$) in their documentation, which occurred in 86% of the 145 instances. CONCLUSIONS: In this care gap, one-third of the positive HCVab tests were unacknowledged. When a positive HCVab was acknowledged, both PCPs and non-PCPs had an inadequate understanding of the diagnosis of HCV, with subsequent actions that suggested that a diagnosis was made in the absence of confirmatory testing. Furthermore, while the majority of providers provided some level of HCV follow-up, this rarely resulted in a desired specialty HCV clinic referral. Entering HCV into a patient problem list was significantly associated with other providers acknowledging the diagnosis.

USE OF ADVANCE DIRECTIVES IN AN ELDERLY HOME-BOUND POPULATION Laura Montague; Barbara A. Boland; Charmaine Wright. University of Pennsylvania, Philadelphia, PA. (Control ID #1306443)

BACKGROUND: Advance directives, including living wills and appointment of health care proxies, are valuable tools for preserving patient autonomy at the end of life, particularly in populations that interact frequently with health systems. There are 3.6 million home-bound adults in the United States over the age of 65. These individuals suffer from a wide
range of medical and psychiatric co-morbidities, and are repeatedly hospitalized. It is important for providers to engage these patients in discussions of advance directives and end of life care, as physicians and family members are not able to consistently predict patient preferences. Despite their importance, few patients complete advance directives. Furthermore, the use of advance directives in the high-risk home bound population has not been previously examined. This study aims to determine the prevalence of advance directive completion in a cohort of elderly home-bound patients residing in West Philadelphia. It also seeks to identify avenues for future interventions that may increase advance directive completion in this population.

METHODS: We performed a cross sectional survey of a population of elders (n=16) enrolled in a home-based primary care program at an urban academic medical center. An 11-question survey on advance directives was administered to subjects over the telephone or in person. If subjects were unable to participate as a result of dementia or intellectual disability, family members were asked to complete the survey. Demographic information was collected from the electronic medical record.

RESULTS: Mean (SD) age was 81.3 (12.9) years, with 56% female, and 100% black. The average (SD) number of prescribed medications was 9.3(5.3). All of the participants had at least 2 diagnoses; 25% of the participants carried a diagnosis of dementia or intellectual disability, and had family involvement in survey completion. Although 87.5% of participants were familiar with living wills (LW), only 25% had created a written LW. In addition, 94% reported that they understood the role of a power of attorney (POA) for healthcare, but only 44% of participants had an officially appointed POA. Of those that had a POA, only 43% of participants had discussed their wishes for end of life care and resuscitation with the POA. Slightly less than half (43%) of those surveyed were interested in more information on advance directives; most of these individuals (86%) desired to receive information directly from their physician, while 29% asked for written educational materials. Two-thirds (67%) identified not being asked by their physician as the primary reason that they had not yet created a LW or

named a POA. CONCLUSIONS: Elderly home bound patients understand the meaning of the terms living will and power of attorney, but very few of these patients have established advance directives. Those that had named a POA had not communicated their thoughts or wishes regarding future medical care to that individual. Most home-bound patients wish to learn more about advance directives from their physician. Future interventions should be directed at both patients and their physicians to improve communication and patient education about the importance of the LW and POA in order to facilitate increased use of advance directives.

USE OF INTERPRETERS BY PHYSICIANS FOR HOSPITALIZED LIMITED ENGLISH PROFICIENCY PATIENTS AND ITS IMPACT ON PATIENT OUTCOMES Lenny Lopez1,2; Jane R. Soukup2; LeRoi Hicks3. 1Massachusetts General Hospital, Boston, MA; 2Brigham and Women's Hospital, Boston, MA; 3University of Massachusetts Medical Center, Worcester, MA. (Control ID #1337842)

BACKGROUND: Use of professional medical interpreters for limited English-proficiency (LEP) patients is associated with increased patient satisfaction and improved disease-specific process measures however data related to clinical outcomes are less well elucidated. More specifically, whether the use of interpreters by physicians in the hospital setting impacts hospitalized patients clinical outcomes is not clear. We hypothesized that the use of interpreters is associated with decreased length of stay (LOS), 30-day post discharge emergency department (ED) visits and 30- day hospital readmission rates for LEP patients.

METHODS: We reviewed hospital administrative and interpreter services data for all hospitalized patients in 2009 admitted to the general medicine service at a large tertiary academic center (n=4224). For patients self-reported as LEP in administrative data, we collected data regarding use of interpreters during each episode of hospitalization from the hospital interpreter service database and categorized as: (1) interpreter used by non-MD (i.e., nurse); (2) interpreter used by a non-Hospitalist MD; (3) interpreter used by Hospitalist; and (4) no interpreter used during hospitalization. We examined the association of English proficiency and interpreter use (English-speaking vs. each LEP category) on outcomes utilizing poisson models with log transformed LOS and

logistic regression for the 30-day ED visits and readmission outcomes with adjustment for patient clustering at the physician level. Each model adjusted for patients age, gender, race/ethnicity, insurance, discharge diagnosis, Charlson comorbidity score, type of admitting attending physician (Hospitalist/non-Hospitalist), and the number of a patients hospital admissions in the previous year. Similar stratified analyses were conducted among only LEP patientsRESULTS: Of 4224 patients, 564 (13%) were LEP. Of these LEP patients,65.8% never had a documented interpreter visit, 16.8% utilized an interpreter with a non-MD, 12.6% utilized an interpreter with a non-Hospitalist MD and 4.8% utilized an interpreter with a hospitalist present. In adjusted models, compared to English speakers, LEP patients with no interpreters (OR 0.83 [CI: 0.76-0.90]) and those who had interpreter use with a non-MD (OR 0.83 [CI: 0.78-0.89]) had significantly shorter LOS. Among LEP patients compared to those with no interpreter use, those who had a physician present with interpreter use (both hospitalist [OR 1.32 [CI:1.09-1.11] and non-hospitalist [OR 1.28 [CI: 1.10-1.53]) had a longer LOS. There were no differences in unadjusted and adjusted readmission rates (17% vs. 18.3%, p=0.47) and ED utilization (both 19.9%, p=0.97) between LEP and non-LEP patients.

CONCLUSIONS: Academic hospital use of interpreters remains highly variable. After accounting for patients demographic characteristics and severity of disease, LEP patients who had a physician present with interpreter use had longer LOS compared to LEP patients without an interpreter. There were no differences in 30-day post discharge ED visits or readmission rates for LEP patients compared to English speaking patients. Our findings suggest that physicians may selectively be using interpreters for the sickest patients and that use of interpreters may be associated with use of other unmeasured inpatient services that may appropriately increase LOS. Interventions are needed to increase the consistent use of interpreters for all hospitalized LEP patients.

USE OF INTERPRETERS FOR LIMITED ENGLISH PROFICIENT PATIENTS WITH CANCER Lisa C. Diamond; Lalanthica Yogendran; Jennifer Leng; Abraham Aragones; Julia Ramirez; Javier Gonzalez; Francesca Gany. Memorial Sloan-Kettering Cancer Center, New York, NY. (Control ID #1341117)

BACKGROUND: Underserved minority groups have worse cancer outcomes. Having limited English proficiency (LEP) adds to these disparities. LEP patients with cancer are less accurate in their knowledge of diagnosis. The use of professional interpreters has been shown to improve outcomes for LEP patients but ad-hoc interpreters, such as a patients family member, may exacerbate misunderstandings. This study identifies which interpreter modalities were used at various types of outpatient visits for LEP oncology patients and what factors influence knowledge of cancer diagnosis.

METHODS: Patients were recruited at an urban hospital-based cancer clinic in New York City between September 2008 and December 2010. Bilingual staff administered a survey of demographic and self-reported clinical information to n=60 oncology patients. A retrospective chart review verified the diagnosis. Bivariate analyses were conducted using 2, Fishers Exact test and T-tests to assess factors associated with knowledge of cancer diagnosis. Generalized linear mixed models were used to account for clustering and compare interpreter modality and visit type. RESULTS: All patients in the sample were LEP with 85% born in a Latin American country. The majority had been in the US more than 10 years. More than 80% had no primary care physician and had not seen a social worker. Over a third were uninsured and 19% had less than a 6th grade education. Eighteen percent failed to correctly identify their cancer diagnosis. LEP patients with insurance were more likely to know their cancer diagnosis than those without ($p<.0001$). Professional interpreters less likely to be used in visits for chemotherapy ($p<.0001$) and more likely to be used in social work visits ($p=.01$) compared to other visit types. Ad-hoc interpreters were more likely to be used in surgery and oncology clinic visits ($p=.01$, $p=.0004$). Despite an identified need for an interpreter, none was used in chemotherapy visits ($p=.0002$) more commonly and in oncology clinic visits ($p=.04$) compared to other visit types. There were no significant differences in visit types when clinicians use their own non-English language skills to communicate directly with LEP patients.

CONCLUSIONS: Many LEP patients with cancer at an urban medical center did not know their cancer diagnosis. Having insurance may help improve knowledge of cancer diagnosis due to increased access to the healthcare system. Using professional interpreters at all types of visits may improve knowledge of cancer diagnosis.

USE OF VIGNETTES TO STIMULATE REFLECTION ON PROFESSIONAL DILEMMAS Elizabeth C. Bernabeo1; Eric Holmboe1; Shiphra Ginsburg2. 1American Board of Internal Medicine, Philadelphia, PA; 2Mount Sinai Hospital, Toronto, ON, Canada. (Control ID #1326726)

BACKGROUND: Many believe that the growth and renewal of professional values can serve as a stable foundation for physicians to draw upon amidst challenging and unpredictable times in health care. However, while most physicians embrace professional values, many experience challenges to exhibiting consistent behaviors in practice. Reflecting on their response to professional dilemmas may help practicing physicians identify both internal and external factors contributing to (un) professional behavior. METHODS: We developed a set of vignettes designed to stimulate physicians reflection on professional dilemmas. The vignettes are grounded in theory and extant professionalism literature, and emphasize domains such as physician- patient relationships, self- regulation, allocation of resources, conflict of interest, and confidentiality. Five focus groups were conducted during which physicians responded to the vignettes. Groups (N=40) were comprised of outpatient specialists, outpatient generalists, inpatient specialists, inpatient generalists, and one mixed group. Data were analyzed using a constructivist grounded theory approach.

RESULTS: Each scenario was effective in stimulating discussion, resulting in an average of 50 codes per scenario (range 36-93). The scenarios were perceived as authentic and familiar to participants, who endorsed facing similar dilemmas on a regular basis. Debates surrounding areas of professional ambiguity, where there

was a perceived lack of understanding of a right or wrong response to the vignette, were salient, and these cases in particular generated a broad range of responses. Two main sets of factors appeared to underpin participants responses to the dilemmas: guiding principles and modifiers. Guiding principles (N=14) included patient welfare and satisfaction, efficiency, confidentiality, availability, transparency, evidence-based medicine, reimbursement and other financial considerations, and legal concerns such as a fear of being sued. Each principle arose in all five FG discussions to some degree. We also identified several (N=6) modifiers, factors which influenced how participants interpreted and acted upon the principles. These included the relationship with the patient or colleague, risk of danger or harm, familiarity with the request, and the type of patient or nature of the illness. Importantly, these two categories are not mutually exclusive, and are often activated together and interact with each other in response to a given scenario. Our findings therefore suggest that physicians respond to professional dilemmas in a highly individualized manner, taking into consideration their resources, environment, and setting on a case by case basis. CONCLUSIONS: Providing an opportunity for physicians to reflect on professional behavior in an open and safe forum may be a practical way to guide physicians to assess themselves on professional behavior and engage with the complexities of their work. The finding that the focus groups led to reflection at a group level suggests that reflection on professional behavior may require a socially interactive process. Our finding that physicians rely on a number of principles and modifiers that interact in complex and often unpredictable ways may help explain the discordance between professional values and behaviors. Emphasizing both the behaviors and the context in which they occur can therefore be seen to be critically important for understanding professionalism in practicing physicians.

USE OF A CLINICAL DECISION SUPPORT TOOL TO PROMOTE JUDICIOUS USE OF ANTIBIOTICS IN PRIMARY CARE Cara Litvin; Andrea Wessell; Paul Nietert; Ruth Jenkins; Lynne Nemeth; StevenM. Ornstein. Medical University of South Carolina, Charleston, SC. (Control ID #1339061)

BACKGROUND: Antibiotics are often inappropriately prescribed for acute respiratory infections (ARIs). Clinical decision support tools (CDS)

may be able to target multiple factors affecting a providers decision to prescribe antibiotics for ARIs. The purpose of this report is to present the results of a pilot project assessing the impact of a CDS on antibiotic prescribing for ARIs in PPRNet, a national primary care practice based research whose members use a common EHR (McKesson Practice Partner) and pool data for quality improvement and research. METHODS: Thirty-nine providers in nine PPRNet practices in nine states participated in this 15 month study between January 1, 2010 and March 31, 2011. A CDS was designed as an electronic health record (EHR) progress note template, presenting diagnosis and treatment guidelines based on a patients symptoms along with relevant patient education. Each practice received two site visits for academic detailing and CDS training, sent representatives to two network meetings for best-practice dissemination, and received quarterly performance reports on antibiotic prescribing for ARIs. Data on CDS use, ARI diagnoses, and antibiotic prescriptions within three days of an ARI encounter were obtained from the PPRNet database. Study measures included prescription of antibiotics for ARI conditions for which antibiotics are rarely appropriate (non-specific upper respiratory infection (URI), acute bronchitis, acute non-strep pharyngitis) and use of broad spectrum antibiotics to treat these conditions.

RESULTS: During the study, the CDS was used 12,664 times for ARI encounters in adults over 18 years age. Median practice use of the CDS for ARIs was 60.8% (range 41.1% to 77.6%) of all ARI encounters. At these encounters, there were 3260 diagnoses of URI, 1602 diagnoses of acute bronchitis, 712 of non-strep pharyngitis and 1395 encounters with more than one of these diagnoses. Median practice antibiotic prescribing for these conditions was 29.6% (range 24.1% to 72.1%); lower than a comparable national average in 7 of 9 practices. Antibiotics were prescribed for 14.3% of encounters for URI, 53.5% for acute bronchitis,36.8% for non-strep pharyngitis and 69.4% for multiple diagnoses. Median practice use of broad spectrum antibiotics

when antibiotics were prescribed was 53.7% for these conditions; lower than a comparable national average in 5 of 9 practices. Broad spectrum antibiotics comprised 43.9% of antibiotic prescriptions for URIs, 68.7% for acute bronchitis, 28.9% for acute pharyngitis and 54.9% for multiple rarely appropriate diagnoses.
CONCLUSIONS: Although there was great variability in antibiotic prescribing for ARIs by both practice and by ARI diagnosis, practices using this CDS prescribed antibiotics more appropriately for these ARI conditions compared to national prescribing rates. A CDS, implemented within the context of academic detailing, user training and performance review, shows promise for promoting judicious antibiotic use for ARIs.

USE OF RETICULOCYTE PRODUCTION INDEX IN ANEMIC INPATIENTS Ariel Katz1,2; Chioma A. Ekeh1; Magdalena A. Danch1; Emad U. Hakemi1; German E. Giese1; Franklin Njoku1; Maryam Sanati1,2; Brian P. Lucas1,2. 1Stroger Hospital of Cook County, Chicago, IL; 2Rush University, Chicago, IL. (Control ID #1314451)

BACKGROUND: The reticulocyte production index (RPI) is an early branch point in most anemia algorithms: an RPI greater than 2.0 indicates an adequate bone marrow response. In our hospital, however, we have noticed that many patients with anemia never have an RPI drawn. Moreover, among those who do, it seems that values are often low (less than 2.0) except in patients with established causes of anemia where RPIs are used to monitor and not diagnose them (e.g., rule out an aplastic crises in a patient with sickle cell disease). Among a cohort of anemic inpatients, therefore, we hypothesized that few have an RPI drawn, and for those who did, the diagnostic yield would be low. METHODS: Our cohort was drawn from 13667 hospitalizations to the general medicine service of a public teaching hospital from July 2009 through June 2010. The inclusion criterion was a hospitalization with anemia defined as any hemoglobin<13 gm/dL for men and hemoglobin<12 gm/dL for women (World Health Organization criteria). We calculated the RPI as the reticulocyte percentage multiplied by the most recent hemoglobin divided by 15 and multiplied by the inverse of the maturation factor: 1 for hemoglobin>=13.3 gm/dL; 1.5 for hemoglobin<13.3 gm/dL and>= 10 gm/dL; 2 for hemoglobin<10 gm/dL and>= 6.67 gm/dL; and 2.5 for hemoglobin<6.67 gm/dL. Hospitalizations of anemic patients with RPIs greater than 2.0 were reviewed by 2 physician investigators and verified by a third. Elevated RPIs
were considered useful when they contributed to a diagnosis that was not already established or otherwise immediately obvious.
RESULTS: 13459 hospitalizations had at least one hemoglobin level. During two thirds (8602 of 13459) of these hospitalizations, patients were anemic. Of these 8602 hospitalizations, 979 RPIs were checked on 905 unique patients. Of these 905 patients, only 5% (47 of 905) had an RPI greater than 2.0. The causes of the elevated RPIs were sickle cell disease (n=30), autoimmune hemolytic anemia (n=8), acute blood loss (n=4), other hemolytic anemia (n=4), and unknown (n=1). In less than 1% (7 of 905) the elevated RPI contributed to a diagnosis that was neither already established nor otherwise immediately obvious. These diagnoses included acute blood loss (n=3), autoimmune hemolytic anemia (n=2), sickle cell trait (n=1), and spherocytosis (n=1).
CONCLUSIONS: Despite well-known diagnostic algorithms for anemia, RPIs are checked infrequently among anemic inpatients. This may be justified, however, because less than 1 in 100 RPIs are both elevated and meaningfully contribute to an anemia diagnosis. Whereas the RPI is useful in some clinical settings, it may not be useful in routinely diagnosing anemia in general medicine inpatients.

USING DIFFERENT ROUNDING TECHNIQUES TO EVALUATE PATIENT DATA RETENTION BY MEDICAL INTERNS IN THE ICU Vikram Chabra; Farzin Rahmanou; Edison Gavilanes; Stephen Karbowtiz. New York Hospital Queens, Flushing, NY. (Control ID #1334513)

BACKGROUND: Bedside rounds are conducted daily in the ICU. Interns present new cases and provide interim medical histories on already established ICU patients. They are responsible for understanding these histories, reason for ICU admission, and plan of care for the day. This studys goal is to evaluate intern retention and understanding of these basic information items for each of 12 patients in our unit. Two different modes of rounding were used and compared.

METHODS: The ICU team consists of three interns. Senior team members include a second year medical resident, a pulmonary-critical care fellow, and one intensivist attending. Interns were on 24-hour call every fourth day. To accomplish this call schedule, an intern float was utilized once every fourth day to cover. Every intern is assigned between 3-6 patients each day in our 12-bed unit. Using a questionnaire we studied three consecutive months from March-2010 to May-2010 to determine if changing the rounding technique would improve interns basic knowledge of each patient. The questionnaire was comprised of three items: 1)What is the patients diagnosis? 2)Why is the patient in the ICU? 3)What is the plan for the day? The answers were scored to allow up to a maximum of nine points per patient. A point was awarded for every aspect of the question he/ she got correct. Interns could also score maximal points for knowing their patients with lower acuity who had less than 3 aspects per question to answer. The Fellow administered the questionnaire after rounds and each question was awarded a percent score of 0%, 33%, 50%, 66% or 100%. For the first two weeks (Technique #1) of the month, patients were presented by their own assigned intern. These mornings the team would hear presentations from at least 2 but usually 3 interns. Patients admitted overnight were presented by the overnight on call intern. For the second two weeks (Technique #2) of the month, all patients were presented by the overnight on call intern. Each weekday after rounds the ICU Fellow would quiz the intern on call using the questionnaire. If the intern on call that day was a float intern a random intern was chosen for the questionnaire.
RESULTS: A statistically significant correlation was achieved showing that regardless of which rounding technique was employed, interns showed a better understanding of the 3-6 patient they are assigned compared to patients they are not assigned. There were no overall statistical differences between rounding techniques 1 and 2 when it came to interns recollection of patient diagnosis, reason in ICU, or plan of care except for one isolated month which showed technique 1 was superior. Although not statistically significant there when the data broken down by intern category; technique 2 was better for the preliminary interns.
CONCLUSIONS: Despite our efforts to invoke a sense of responsibility on the part of each individual 1st year medical, preliminary, and emergency room rotator, and to suggest that they share all the patients in the unit

equally, it appears that 1st year providers show a bias of information retention favoring those patients that are directly assigned to them. This occurs even when they are not the intern responsible for morning presentations. Whether or not this is a function of experience or dependant on other unknown factors, we should continue to seek out better methods of rounding and education to improve upon our current models.
USING PHOTOVOICE TO IDENTIFY INTERVENTIONS TO IMPROVE MENTAL HEALTH AMONG RECENT LATINA IMMIGRANTS Sarah E. Paraghamian1; Melissa Green2; Laura C. Braswell2; Rachel Page2; Georgina Perez3; Anh N. Tran3; Connie Blumenthal2; Michelle J. Lyn3; Giselle Corbie-Smith4. 1The University of North Carolina at Chapel Hill, Chapel Hill, NC; 2The University of North Carolina at Chapel Hill, Chapel Hill, NC; 3Duke University Medical Center, Durham, NC; 4The University of North Carolina at Chapel Hill, Chapel Hill, NC. (Control ID #1277321)
BACKGROUND: Latino immigrants face numerous social, economic, and political challenges as they navigate transition to life in the United States. Disparities in mental health outcomes and quality of life compared to non-Latinos are well documented, yet access to health care and mental health services is limited. We used Photovoice to elicit the perspectives of Latina mental health promotoras on barriers to well-being among their peers and to identify possible interventions to improve mental health. METHODS: Amigas Latinas Motivando el Alma (ALMA) is an academic community partnership to improve mental health among immigrating Latinas. Promotoras completing the ALMA stress reduction training served as partners using Photovoice. Through photography and guided discussion, promotoras recorded and reflected on community strengths and concerns regarding mental health. Discussions were audio recorded, transcribed, and coded using content analysis to

identify salient themes. Promotoras reviewed codes for verification (member checking) and development of themes that were presented by the promotoras in a community forum. RESULTS: Nine Promotoras aged 30 to 43 participated in Photovoice. The women have lived in the US for an average of 10 years (range 3 to 17) and most are from Mexico (78%). Two-thirds are currently employed and 44% have a college degree while 22% did not attend high school. The promotoras identified three interrelated themes that impact the mental health of newly immigrating Latinos. 1) Intergenerational tension that challenges communication between parents and children. Tension stems from concern about loss of values and acculturation, the division between foreign-born parents and their US-born children, and time constraints. 2) Limited education and employment opportunities. While many came to the US for work, participants voiced concerns about factors such as low educational attainment, limited English proficiency, lack of recognition of degrees obtained outside of the US and immigration status that limited work opportunities. 3) Language barriers and cultural isolation. In this emerging and rapidly changing immigrant community, exposure to only Spanish-language social networks and media sources was felt to limit knowledge of and access to resources. Physical barriers such as lack of transportation (complicated by immigration status) and distance from family and friends, as well as racial tension among other minorities were also discussed as factors increasing isolation. Over 70 stakeholders attended the community forum and proposed the following in response to the themes that were presented: increasing awareness of mental health resources through partnerships with Spanish-language media, churches, and businesses; school programs that foster involvement of Latino parents; and workshops to train community leaders and more promotoras to address the stigma around mental illness in order to increase utilization of existing mental health services. CONCLUSIONS: Photovoice is an effective tool to give Latina women with limited English proficiency and other vulnerable populations a platform to inform interventions designed to improve community health.
USING SOCIAL MEDIA TO ENHANCE CONTINUING MEDICAL EDUCATION: A SURVEY OF INTERNAL MEDICINE CME COURSE PARTICIPANTS Amy T. Wang; Nicole P. Sandhu; Christopher M. Wittich; Jayawant N. Mandrekar; Thomas J. Beckman. Mayo Clinic College of Medicine, Rochester, MN. (Control ID #1338638)
BACKGROUND: Social media (SM) is widely used by millions of physicians. According to recent surveys, over half of all students, residents and practicing doctors use some form of SM. Several studies have focused on the professionalism implications of SM; however, there has been little research on the utility of SM for enhancing medical learning and we are unaware of any studies on the use of SM in continuing medical education (CME). Therefore, we conducted a cross-sectional survey of U.S. and Canadian physicians attending a Mayo Clinic Internal Medicine CME course to determine their use of SM, to evaluate their attitudes regarding the value of SM for enhancing CME education, and to explore potential associations between CME participants characteristics and attitudes towards SM. METHODS: This was a cross-sectional survey and validation study that included all 539 U.S. and Canadian participants at a Mayo Clinic Internal Medicine CME course in 2011.The Social Media Use and Perception Instrument (SMUPI) consists of 10 items (5-point Likert scales) along with categorical response options for demographic variables. SMUPI content was based on existing literature and input from experts in scale design and CME assessment. Factor analysis was performed on the Likert-scaled survey items. Internal consistency reliability was calculated using Cronbach alpha. Associations between SMUPI item scores and participants characteristics were determined using the Kruskal-Wallis test. The threshold for statistical significance was set at $p<0.05$.
RESULTS: A total of 327 of 539 CME participants (response rate=61%) completed the survey. 291 (89%) of participants reported using social media, with YouTube (189; 58%), Facebook (163; 50%), and Skype (142; 43%) being the most common. Factor analysis revealed a two-dimensional assessment of CME course participants attitudes, with Factor 1 representing the value of SM to course participants (items 1-5), and Factor 2 representing the value of SM to CME course directors (items 6-9). One item was eliminated due to an ambiguous item loading. Internal consistency reliability (Cronbach alpha) was excellent for Factor 1 (0.94), Factor 2 (0.89) and overall (0.95). CME course participants favorable attitudes towards SM were associated

with characteristics (mean scores; p-value) of being younger in years (20-29=3.13; 30-39=3.40; 40-49=3.39; 50-59=3.18; 60-69=2.93; >70=2.92; p=0.02), using SM frequently (never=2.49; <once monthly=2.75; once monthly=3.21; weekly=3.31; daily=3.81; p<0.0001), and professional degree (PhD=3.00; MD=3.05; DO=3.35; PA=3.42; NP=3.50; p=0.01).
CONCLUSIONS: We describe the first validated measure of Internal Medicine CME participants attitudes regarding personal use of SM and the value of SM for learning CME. The association between positive attitudes on using SM in CME with younger age and increased frequency of SM use, suggests that CME course directors might want to direct SM learning strategies towards more youthful, technology-savvy CME physicians, and that the utilization of SM in CME will become increasingly worthwhile as junior physicians enter the profession. There remains a need for more research on developing effective methods for enhancing CME learning with SM.

USING PHOTO-ELICITATION TO IDENTIFY SOURCES OF WASTE IN AN ACADEMIC MEDICAL CENTER
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BACKGROUND: Rising medical costs in the U.S. have made health care unaffordable for many patients and force payers to make difficult coverage decisions. Identifying and reducing sources of waste in the medical system is an attractive alternative to limiting necessary health care coverage. Using photo-elicitation, an innovative approach to qualitative study, we sought to identify sources of waste in a large tertiary care academic medical center. METHODS: Participants were recruited from a broad range of departments throughout the hospital via word of mouth and were invited to take up to 10 photos of examples of waste they encountered during their workday. Participants then described the waste they captured in their photos during a semi-structured interview with a research staff member. A standardized interview guide was used; interviews were audio-taped and professionally transcribed. Transcriptions were reviewed independently

and iteratively by two study team members and a code book was developed from the transcripts. The code book was revised with each successive interview and organized into pertinent themes. Interviews were conducted until theoretical saturation was reached. Agreement in code assignment between reviewers was assessed.
RESULTS: Eighteen individuals participated in this study and 140 photos were taken; all were included in the study. Participants represented a range of health professionals, including nurses, attending physicians from a number of disciplines, respiratory therapists, administrators and administrative support personnel. Agreement between transcript reviewers reached 85%. Major types of waste described included time and tangible resources such as food, paper and energy. Factors identified in creation of waste included poorly designed or inefficient systems, medical education, poor communication and false economies. Barriers to reducing waste included inertia and regulatory systems. Consequences of waste included suboptimal patient care and satisfaction as well as physician disengagement. Although some recommendations for waste reductions appeared simple to implement, many were complex.
CONCLUSIONS: Individuals working within the health care system can offer unique insights into sources of waste they encounter in their daily routine. Although reducing waste may prove challenging, the results of this photo-elicitation study serve to generate a broad range of testable hypotheses regarding sources of waste existing in a large tertiary care hospital.
USING THE AUDIT-PC TO PREDICT ALCOHOL WITHDRAWAL IN HOSPITALIZED PATIENTS
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BACKGROUND: Alcohol dependent hospitalized patients are at risk for alcohol withdrawal syndrome (AWS); however there are currently no measures to predict the risk of AWS in these patients. Early identification of those at risk for AWS could be used to alert clinicians and lead to more
timely initiation of appropriate pharmacotherapy to prevent or treat withdrawal. The Alcohol Use Disorders Identification Test-PC (AUDIT-PC), a short 5 question survey instrument, is well validated to detect problem drinking in the primary care setting, however it has never been assessed in the hospital setting or used to predict AWS. This study examines the discriminating ability overall, and by age and gender, of the AUDIT-PC score in predicting AWS in hospitalized patients.
METHODS: All medical-surgical hospitalizations from 10/2009 to 10/ 2010 in a large single health system were examined and a retrospective case-control study was conducted. Beginning in 10/2009, AUDIT-PC scores were obtained routinely during initial nursing assessment on all adult admissions. We randomly selected 300 patients with a primary or secondary discharge diagnosis of AWS and matched them 1:1 to randomly selected controls by age, sex, and race. AUDIT-PC scores were identified by manual chart review. A hierarchical (hospital unit), case-control, weighted logistic regression was performed and area under the ROC curve (aROC) was calculated. Models included AUDIT-PC score by age (65)
and sex (male) interaction terms. Descriptive statistics were compared using the Chi-square and Mann-Whitney U tests.
RESULTS: We identified 589 (1.4%) patients with AWS out of 40,908 hospitalizations. Overall, those with AWS were younger (age 52 [SD 13] vs. 62 [SD 18], p<0.001) more frequently male (76.7% vs. 47.0%, p<0.001), and less frequently African-American (17.8% vs. 21.3%, p=0.039). Of the 300 case-control pairs, 97 were missing one or both AUDIT-PC scores and the analysis was conducted on the remaining 203 pairs. There were no significant differences in age (p=1.0), sex (p=0.48), or race (p=0.18) between those excluded and those included in this analysis. The sensitivity was 88% and specificity 90% at a cutoff value of 5 for the AUDIT-PC score (see figure). The aROC was 0.94 (95% CI, 0.92 - 0.97). aROCs were not significantly different for age (p=0.68, or sex (p=0.12), but, there were statistically significant AUDIT-PC by age and by sex interactions (p=0.003 and<0.001).
CONCLUSIONS: The admission AUDIT-PC score is an excellent discriminator of hospitalized patients developing AWS and could be an important contributing factor in the development of future clinical prediction rules. Further study including calibration and validation on a large prospective cohort is needed.
USING THE PARIHS FRAMEWORK TO INFORM THE IMPLEMENTATION OF THE VA STEPPED CARE MODEL FOR PAIN MANAGEMENT IN A MULTI-SITE COMMUNITY HEALTH CENTER Daren Anderson. Community Health Center, Inc., Middletown, CT. (Control ID #1282928)
BACKGROUND: Most patients suffering from chronic pain receive pain care from a primary care provider. However, primary care providers express low confidence in their ability to effectively manage pain, and studies suggest wide variation in adherence to best practice guidelines for pain care. Strategies are needed to improve pain care in primary care. The

Veterans Health Administration has developed an effective model for managing chronic pain, the Stepped Care Model for Pain Management (SCM-PM). The objective of this study was to use the PARIHS framework to conduct a formative assessment of pain care practice across a multisite, statewide Community Health Center to inform the process of adapting and implementing the SCM-PM.
METHODS: We selected a broad range of measures to assess the PARIHS domains of Evidence and Context. Data was collected from the electronic health record, chart reviews, and surveys of health center staff. Patients with pain were identified using pain scores and prescription records to identify chronic opioid use. Aggregate

data was evaluated for two cohorts: adults with two or more pain scores>=4 separated by 90 days or more and adults receiving prescription opioid medications for>=90 days. Charts of patients with chronic pain were chosen at random and reviewed by a trained research assistant. Surveys on knowledge, attitudes, and beliefs about pain care were administered to primary care providers. All primary care staff completed an organizational change readiness assessment. RESULTS: There were 6746 patients with two or more pain scores >4, and 1013 patients receiving opioids for>90 days. Patients with pain and chronic opioid use had an average of 15 visits per year as compared to the agency average of six visits per year. Few were referred to pain-related specialties, and only 25% were co-managed by onsite behavioral health providers. Approximately two thirds of patients on chronic opioids had signed an opioid agreement and had a urine toxicology screen in the past year. There were large gaps in recommended documentation standards. There was wide provider variability in the prescription of opioids to treat pain. Surveys found substantial variance in pain care knowledge, a lack of confidence in ability to manage pain, and dissatisfaction with the resources available to support chronic pain care. The change readiness assessment revealed higher scores on mandate for change, quality of communication, and leadership, and lower scores on peer input and on confidence that adequate resources would be allocated. CONCLUSIONS: The PARIHS framework provided a useful construct to prepare for successful project implementation. High primary care utilization and low referrals and behavioral health co-management suggest the need for multidisciplinary collaboration and better coordination of care. Low confidence and variable knowledge scores indicates a need for more training in pain care. Variation in charting, follow up, and adherence to guidelines for opioid prescribing and monitoring suggests a need for stricter policies and systems to monitor and provide feedback to providers. Based on these findings we have developed a multi-faceted intervention aimed at increasing options for behavioral health and complementary medicine support, increasing access to specialty consultation, providing pain-specific CME for providers, and improving documentation of pain care in the electronic health record.

UTILIZATION OF ANTIDEPRESSANT MEDICATIONS AMONG PATIENTS WITH DEPRESSION: COMPARISON BETWEEN USUAL CARE AND COLLABORATIVE CARE USING CARE MANAGERS.

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BACKGROUND: Depression is responsible for an estimated economic cost of more than 40 billion annually, and has a large impact on quality of life and productivity. Yet it remained under diagnosed and inadequately treated. The Sequenced Treatment Alternatives to Relieve Depression (STAR*D) trial confirmed that several sequential treatment steps are often needed to obtain remission. Only 28% of patients remitted after 12 weeks of adequate trial on a single agent; switching to another agent or augmentation with a second agent was often necessary. The collaborative care model, using care managers, has been consistently showed in numerous studies to be an effective way to manage depression and achieve sustained outcomes compared to usual care. In March 2008, the DIAMOND (Depression Improvement Across Minnesota Offering a New Direction) project, a collaborative model using care managers coordinated by the Institute for Clinical Systems Improvement, was implemented at Mayo Family Clinics Northwest in Rochester, Minnesota. The model was subsequently rolled out to the remaining primary care sites. We hypothesize that utilization of antidepressant medications among patients with depression managed under the collaborative care management (CCM) model would be different from usual care.

METHODS: Data was abstracted from medical records of patients who received a diagnosis of depression from March of 2008 defined as a screening score of 10 or greater on the Patient Health Questionnaire- 9 (PHQ-9), had given permission to have their records reviewed and had at least a 6 month follow-up. Pattern of antidepressant medications utilization were compared between patients with depression enrolled in the CCM model and those under usual care. Demographic data was also obtained. Data was analyzed using Fisher exact test. Sub-analysis was done on geriatric patients defined as those aged 65 and older.

RESULTS: There were three hundred thirty three (N=333) patients who met study criteria; two hundred forty

two (N=242) were enrolled under CCM and ninety one (N=91) were in usual care. There was no statistical difference in demographics (age, gender, race, ethnicity, marital status, initial PHQ-9 score) between the two groups. At six months, the mean PHQ-9 score of those enrolled in CCM was statistically lower compared to those in usual care (4.44 vs. 7.13; p value: 0.002). Likewise the mean difference in PHQ-9 score from baseline was also greater among those in CCM compared to usual care. Those patients who were followed under CCM had significantly greater utilization of anti-depressant medications at the end of one year (p value: <0.001). They likewise had more change in the number of medications from March, 2008 to March, 2009. CONCLUSIONS: The collaborative care model for depression management is associated with greater anti-depression medication utilization compared to usual care. It is also statistically significantly associated with greater reduction in PHQ-9 scores at 6 months and remission when compared to usual care. These findings have significant implications in depression management particularly among primary care settings.

VA ELECTRONIC PATIENT PORTAL: INCREASING ACCESS FOR VETERANS RECEIVING HOME-BASED PRIMARY CARE Rebecca Grochow1,2; Max D. Stewart1,7; Gemmae Fix4,3; Keith McInnes4,3; Judith B. Boardman5,6; Steven R. Simon1,7. 1VA Boston Healthcare System, Boston, MA; 2Boston University School of Medicine, Boston, MA; 3Boston University School of Public Health, Boston, MA;
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BACKGROUND: My HealtheVet (MHV), the VAs web-based patient portal, allows patients to access health information and communicate via secure messaging with their healthcare team. This electronic tool has the potential to improve the health of all Veterans, especially those with physical and/or psychological limitations that impede their ability to travel to a VA site for care. To date, adoption of MHV has been slow among all Veterans, including among those Veterans who receive their care through the Home Based Primary Care (HBPC) program. Eight percent of all HBPC Veterans have registered for MHV and only 1% have completed in-person authentication (IPA) to gain access to key MHV features, such as their personal medical records and secure messaging with providers. Little is known about how these Veterans perceive the potential value of MHV and the barriers to its use. We undertook a qualitative study to characterize the perspectives of Veterans and healthcare providers in preparation for developing an intervention to increase access to MHV for this vulnerable patient population.

METHODS: Using a literature-based semi-structured interview guide, we conducted in-depth interviews with HBPC-enrolled Veterans. We also interviewed HBPC providers to further inform the development of an intervention to improve enrollment. A multi-disciplinary team used content analysis to identify key themes.

RESULTS: We have interviewed 8 Veterans and 3 providers to date. All Veterans had experience using computers and the majority (5/8) had access to a computer and the internet in their homes. Four of the Veterans had heard of MHV, but only 2 had accessed it, and only 1 had completed IPA. Both MHV-enrolled Veterans had heard about MHV via an HBPC provider. Others had received flyers by mail but had not pursued access, noting that the flyer did not sufficiently explain the function and benefit of the patient portal. All Veterans expressed interest in learning about MHV from HBPC providers. HBPC providers suggested that a social worker, during the initial in-home assessment, could assess Veterans ability to use MHV and provide enrollment information. HBPC providers noted that they

would need training and expressed willingness to learn how to complete the IPA process to obviate the Veterans need to visit the Medical Center in-person. All Veterans and providers identified the ability to refill medications and to communicate electronically with healthcare providers as key features the Veterans would find useful. Many Veterans expressed frustration with the VA telephone system when trying to reach a provider or clinic. They identified the patient portal as a potentially more direct method of communication.

CONCLUSIONS: HBPC-enrolled Veterans are vulnerable patients given their limited physical access to the VA

and their high need for services. Barriers to accessing the patient portal included lack of information as well as computer access for some. Veterans expressed enthusiasm for the portal features that could provide them with health information and greater access to healthcare providers. With appropriate training, the clinical team may be able to promote adoption of MHV among these Veterans, thereby enhancing a patient-centered care model.

VACCINE TRACKING AMONG GENERAL INTERNISTS: CURRENT PRACTICES AND HOW A 2-D BARCODING SYSTEM MIGHT HELP Laura Hurley1,2; Lori Crane2; Erin D. Kennedy3; Sean T. O'Leary2; Brenda Beaty2; Shannon Stokley3; Mandy A. Allison4,2; Michaela Brtnikova2; Andrea Clinger2; Allison Kempe2. 1Denver Health and Hospital Authority, Denver, CO; 2University of Colorado Denver, Denver, CO; 3Centers for Disease Control and Prevention, Atlanta, GA;
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BACKGROUND: In August 2011, the Food and Drug Administration announced it would consider requests from vaccine manufacturers to permit alternative identification methods, including two-dimensional (2D) barcodes, on vaccines that would include product identifier, lot number and expiration date. The objectives of this study were to assess among general internists (GIM) 1) current systems for tracking vaccine supplies and recording vaccinations 2) attitudes about a 2-D vaccine barcoding system (barcode scanner/associated interface with computer) 3) barriers to using a vaccine barcoding system and 4) functions needed for the practice to adopt a barcoding system.

METHODS: Between September 2011 and January 2012, we administered an Internet and mail survey to a national network of 428 GIM physicians representative of the American College of Physicians membership.

RESULTS: Response rate was 58% (247/428). Over 90% of respondents stock some of the recommended adult vaccines. When asked about how their practices monitor vaccine inventory, most physicians reported they simply order vaccine when stock looks low (65%), when they know demand is about to pick up (57%), or use a paper-based inventory system (34%). Few physicians used an Internet-based system (7%) or an inventory software system (4%). Although 74% were satisfied with their current method for monitoring vaccine inventory, 40% reported it was time consuming to keep track of inventory and 39% reported their practices frequently run out of vaccine doses. The most common methods for recording vaccine product, lot number and expiration date in the medical record were to enter information directly into the patients electronic (50%) or paper-based (31%) record. Forty-three percent reported recording this information in two or more places. Fifty-nine percent noted that recording vaccine information was time consuming and 28% reported problems with accurately maintaining vaccine records. Physicians agreed that barcodes could facilitate tracking of vaccine inventory (90%), would be more reliable and accurate than current recording systems (90%), would improve patient safety (92%) and could improve the efficiency of vaccine administration (79%). The only major barriers reported to the use of a barcode inventory system included the need for software (22%), the need for information technology support (14%), lacking an electronic medical record (14%), and the need for computer equipment (12%). Functions needed for the practice to adopt a barcoding system included: 1) recording dose information in an electronic medical record (86%), 2) identifying patients who had received a recalled lot of vaccine (89%) 3) maintaining vaccine inventory records (71%), 4) recording that a Vaccine Information Statement was given to a patient (69%) and 5) billing for vaccine doses (70%). A majority of physicians (70%) would definitely or probably adopt a barcoding system if the total costs were less than $1000.

CONCLUSIONS: Most physicians report using inefficient systems for tracking vaccine doses and inventory and realize multiple potential benefits of incorporating a vaccine barcoding system. Costs will need to be contained and technological barriers will need to be addressed to facilitate adoption of vaccine barcoding systems.

VALIDATING THE PRESENT-ON-ADMISSION INDICATOR FOR HOSPITAL-ACQUIRED VENOUS THROMBOEMBOLISM IN ADMINISTRATIVE DISCHARGE DATA Sharon B. Kim1; RamanR. Khanna1; Ian Jenkins2; Robert El-Kareh2; Nasim Afsarmanesh3; Alpesh Amin4; Heather Sand4; Andrew Auerbach1; Catherine Chia5; Gregory Maynard2; Richard H. White5. 1University of California, San Francisco, San

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BACKGROUND: Since 2007, the Centers for Medicare &Medicaid Services (CMS) has required hospitals to flag all medical diagnoses using a present-on-admission (POA) indicator, which it uses to differentiate preexisting/admission-coincident medical conditions from hospital-acquired ones. CMS currently considers venous thromboembolism (VTE) after total knee or hip replacement a preventable hospital-acquired condition and thus does not reimburse hospitals for VTE events not POA. CMS may eventually use the POA indicator to decide reimbursement for all hospital-acquired VTE, including among medical patients; however, the accuracy of the POA indicator for hospital-acquired VTE events in a medical population is unknown. The aim of our study was to determine the positive predictive value (PPV) of the POA indicator in an inpatient medical population.

METHODS: We analyzed administrative discharge data from October 1, 2008 to September 30, 2010 from five University of California academic medical centers. We included hospitalizations for a medical illness (where the MS-DRG indicated a medical condition) with a secondary medical international classification of disease (ICD-9-CM) code for VTE. We excluded hospitalizations that were principally for VTE. Using a weighted sampling strategy we then selected approximately 50 hospitalizations with a POA indicator of yes (POA=Y) and 50 hospitalizations with a POA indicator of no (POA=N) at each medical center (N=504 total). Using a standardized instrument, trained abstractors blinded to the POA indicator then reviewed the medical record for each hospitalization and categorized each VTE event as a pre-existing/admission-coincident condition, hospital-acquired condition, or timing indeterminate condition, with the latter two counted together in keeping with CMS reimbursement rules. The abstraction classification was then compared to the POA indicator. Abstractors also ascertained the date of VTE diagnosis, tests used to confirm the diagnosis, type of VTE, location, clinical presentation, and association with an indwelling vascular catheter.

RESULTS: During the time period analyzed there were a total of 1,941 secondary VTE events flagged POA=Y, 339 events flagged POA=N, and 5 indeterminate events out of 2,072 hospitalizations. (Seven percent of hospitalizations had more than one VTE event.) Of the 254 POA=N cases abstracted, 62% were classified as hospital-acquired and 20% were clinically indeterminate. The positive predictive value of the POA=N flag for hospital-acquired VTE was thus 82% (95% confidence interval [CI], 76%-86%). The positive predictive value (PPV) of the POA=Y flag for a pre-existing/admission-coincident VTE was 78% (95% CI, 74%-84%). Both PPV and NPV varied considerably across institutions, across VTE anatomic location, and by hospital day of diagnosis (TABLE). Extrapolating from our weighted random sample to the hospital population, we estimate there were actually 654 hospital acquired VTE events (almost twice as many as POA=N events); of these, 60% of were incorrectly flagged POA=Y.

CONCLUSIONS: Our data suggest that despite a moderately high positive predictive value for both POA=Y and POA=N, the POA indicator falsely classifies many pre-existing/admission-coincident VTE events as hospital-acquired while actually missing most hospital-acquired VTE events.

VALIDATION OF A 10-YEAR MORTALITY INDEX FOR COMMUNITY-DWELLING OLDER ADULTS Marisa Cruz1; Irena Stijacic Cenzer2; Sei Lee2. 1UCSF, San Francisco, CA; 2San Francisco Veterans Affairs Medical Center, San Francisco, CA. (Control ID #1335073)

BACKGROUND: Studies suggest that the benefits of both breast and colorectal cancer screenings typically are not seen for up to 10 years after screening, leading guidelines to recommend targeting cancer screening to patients with an extended life expectancy. Although a 10- year mortality index could help identify patients most likely to benefit from cancer screening, few mortality indexes have been validated beyond 5 years. Thus, we

validated a previously published 4-year mortality index for 10-year mortality.
METHODS: The original prognostic index was developed and validated for 4-year mortality in 19710 older adults enrolled in the 1998 Health and Retirement Study (HRS), a nationally representative cohort of community-dwelling US residents. The twelve independent risk factors comprising the index were demographic factors (age and gender), comorbidities (diabetes, heart disease, lung disease and cancer), behavioral factors (body mass index and smoking) and functional limitations (bathing, managing finances, walking and pushing large objects). Cox regression was performed with these predictors, using survival through 2008 (10 year mortality) as the outcome. Model calibration was determined by comparing observed 10-year mortality rates and index point scores for the original development (Eastern, Midwestern and Western US) and validation (Southeastern US) cohorts. Model discrimination was determined using the Harrells c-statistic.
RESULTS: Our index was highly predictive of 10-year mortality in both the development and validation cohorts. The 34% of respondents in the validation cohort with risk scores of 0-3 had an observed 10-year mortality risk of 7%, while the 11% of respondents with scores of 8-9 points had an observed risk of 55%, and the 5% with scores of 13 or more points had an observed risk of 92%. The quartiles of risk within this cohort similarly ranged from 5.8% 10-year mortality risk for the lowest quartile to 70.5% risk for the highest quartile. The 10-year index demonstrated excellent discrimination with Harrells c-statistic of 0.784.
CONCLUSIONS: Our index, using self-reported demographic, behavioral, functional and comorbidity factors, accurately predicts 10-year mortality as well as 4-year mortality for community-dwelling adults over 50 years of age. Use of this and similar prognostic indices may help clinicians identify patients at increased mortality risk, who are unlikely to benefit from further preventive interventions such as cancer screening.
VARIABILITY IN PROVIDER PRACTICE IN PATIENTS ADMITTED WITH LOW RISK CHEST PAIN AND EFFECTS ON PRACTICE AFTER IMPLEMENTATION OF A STANDARDIZED CARE PROTOCOL Elizabeth Schulwolf1; Mark Speyer1; Micky Simwenyi2; Aziz Ansari1. 1Loyola University Medical Center, Lisle, IL; 2Loyola University Medical Center, Lisle, IL. (Control ID #1339918)
BACKGROUND: Observation units are increasingly common and one of the more frequent admission diagnoses is low risk chest pain (CP). Guidelines indicate that ordering 2 troponins in patients with low risk CP to rule out acute coronary syndrome is sufficient. In April 2011 we implemented a CP protocol in an effort to standardize care for patients with low risk CP among our hospitalist group. The protocol recommends 2 troponins 6 hours apart and if needed a stress test, with treadmill stress echo the preferred modality unless clinical factors indicated an alternative stress test. Variation in practice likely exists regarding care including number of troponins obtained and type of stress test ordered.
METHODS: We analyzed administrative data of patients admitted to an observation unit managed by hospitalists in an urban, academic medical center for evaluation of low risk CP from a 3-month period prior to initiation of the CP protocol (October 1, 2010 through December 31, 2010) and a 3-month period after (April 1,2011 through June 30, 2011). Variables included number of troponins and type of stress test. Dichotomous variables were compared using the chi-square test.
RESULTS: A total of 525 patients were identified: 254 (48.4%) pre-protocol and 271 (51.6%) post-protocol. A total of 191 (36.4%) patients underwent a stress test: 91 (47.6%) treadmill stress echo, 70 (36.6%) nuclear and 29 (15.2%) dobutamine stress echo. During our study period, 16 hospitalists independently cared for patients in the observation unit with the range of patient numbers per provider being 2 to 24. Three providers tended to select particular stress tests: 1 ordered nuclear stress tests more often (total stress tests ordered=17, 64.7% nuclear, p=0.01) and 2 other providers ordered treadmill stress echos more often (provider 1: total stress tests ordered=21, 61.9% treadmill, p=0.06; provider 2: total stress tests ordered=24, 75% treadmill, p=0.01). No other providers demonstrated a trend in stress test selection. Among providers, 2 tended to order more than 2 troponins (provider 1: 71.45%, P=0.007; provider 2: 75.0%, P=0.03) and 2 providers tended to order 2 or fewer troponins (provider 1: 75.0%, P=0.04; provider 2: 81.0%, P=0.03). Within providers, following the initiation of the

protocol, 5 providers significantly changed their practice from ordering 3 or more troponins more often to 2 or fewer troponins. CONCLUSIONS: These results suggest that there is provider variability in selecting stress tests and the number of troponins ordered and further evaluation is needed to understand this practice variability. It is also evident that the protocol affected individual provider practice where some providers reduced the number of troponins ordered after the protocol was implemented. Our study is limited by the small numbers of patients seen by each provider individually and evaluating the data over a longer time period should be considered.
VARIATION IN PATIENT AND PHYSICIAN EMOTIONAL INTENSITY DURING DISCUSSIONS ABOUT PAIN IN PRIMARY CARE VISITS Stephen G. Henry1,2; Susan Eggly3. 1VA Ann Arbor Healthcare System, Ann Arbor, MI; 2University of Michigan, Ann Arbor, MI;
3Wayne State University, Detroit, MI. (Control ID #1334228)
BACKGROUND: Patients and primary care physicians report that discussions about pain are often emotionally difficult, but questions remain about whether patients and physicians actually display more negative emotions when discussing pain compared to other topics. Understanding the emotional dimension of discussions about pain may be useful for improving communication and pain management in primary care. We used a thin slice approach to compare patient and physician affect (i.e. displayed emotion) during discussions about pain to patient and physician affect during discussions about non-pain topics.
METHODS: We observed and analyzed an existing archive of video-recorded primary care visits collected at a clinic serving predominantly low-income, black patients. We developed and applied a structured coding system to identify the video segments when patients and physicians discussed pain during each visit. We systematically selected 30-second video segments (i.e. thin slices) from the beginning, middle, and end of all visits that included discussions about pain (n=85). For each visit, we selected 1-2 segments that included discussions about pain and 1-2 segments that included discussions about non-pain topics for a total of 132 pain-related and 121 non pain-related. Four trained raters independently observed all video segments and rated patient and physician affect (in separate steps) during each segment on six affective dimensions. We calculated standardized mean ratings across raters for each segment and performed factor analysis to identify groupings among affect variables. We used linear regression to compare mean patient and physician affect ratings for pain-related vs. non pain-related video segments within each visit. We used a 2-level hierarchical model with visit as a fixed effect to control for segments clustered within visits.
RESULTS: Estimated reliability for mean ratings was 0.70 for nearly all variables. Based on factor analysis results, we constructed four composite variables for our primary analysis: patient and physician positive affect (warm/friendly+engaged/attentive) and patient and physician negative affect (upset/distressed+tense/anxious for patients; hesitant/uncomfortable+ tense/anxious for physicians). Within visits, patients were rated as having both significantly greater negative affect (beta-coefficient 0.36 [95%CI 0.17 to0.47], p <0.001) and significantly greater positive affect (beta-coefficient 0.21 [95%CI 0.06 to 0.35], p=0.005) during pain-related segments compared to non pain-related segments. For physicians, ratings for pain-related vs. non

pain-related segments did not differ significantly for either negative affect (beta-coefficient -0.11, [95%CI -0.25 to 0.03], p=0.09) or positive affect (beta-coefficient 0.02, [95%CI -0.13 to 0.16], p=0.84). CONCLUSIONS: The thin slice approach is a reliable method for measuring variation in patient and physician affect during video-recorded clinical visits. Findings showed patients, but not physicians, displayed both significantly greater positive and negative affect when discussing pain compared to non-pain topics. Findings suggest that for this patient population, discussions about pain are associated with greater overall emotional intensity than discussions about other topics. Additional research is needed to better understand whether patients emotional intensity influences patients perceptions of physicians, adherence, or physicians treatment recommendations.
VIDEO DECISION SUPPORT TOOL TO SUPPLEMENT GOALS-OF-CARE DISCUSSIONS WITH HOSPITALIZED PATIENTS WITH ADVANCED ILLNESSES: PRELIMINARY FINDINGS NicoleM. LaRue1;

Michael K. Paasche-Orlow1; Angelo E. Volandes2. 1Boston University Medical Center, Boston, MA; 2Massachusetts General Hospital, Boston, MA. (Control ID #1334457)
BACKGROUND: End-of-life discussions are often inadequate, leading to care that is inconsistent with patients and families wishes. The use of video to reinforce verbal descriptions of treatment options may better inform patients and families engaged in end-of-life decision making. We are unaware of prior studies to assess the effect of a video decision support tool on preferences for end-of-life care in patients and surrogate decision makers consulted on by an inpatient palliative care service. METHODS: We analyzed the preliminary findings of a temporal intervention study, to be conducted until 25 subjects are enrolled each into the observational and intervention phases. Eligible subjects included adult patients consulted on by an inpatient palliative care team (PCT) who were appropriate for a goals-of-care discussion. Subjects in the observational phase received the standard of care provided by an inpatient PCT. During the intervention phase, a video illustrating specific treatments for three levels of care (life-prolonging, basic, and comfort oriented) was integrated into the standard palliative care consultation. Following the consultation, all subjects were surveyed regarding preferences for care near the end of life, the level of certainty regarding their decision, and pain and symptom burden. The primary study outcome was the difference in proportions of subjects in each group who preferred comfort oriented care. The secondary outcomes included the level of uncertainty regarding treatment preferences (score range, 0-100; higher score indicating greater uncertainty), concordance between patient reported treatment preferences and documentation in the electronic medical record (EMR), and satisfaction with pain control and symptom management, as measured by the modified Palliative Care Outcome Scale (score range, 0-36; higher score indicating worse symptom control) and the Edmonton Symptom Assessment Scale (total symptom distress score range, 0-90; higher score indicating greater symptom burden).
RESULTS: Of 25 subjects in the observational phase, 6 preferred life-prolonging care, 6 preferred limited care, 11 preferred comfort care and 2 were unsure. Of the 9 subjects enrolled to date in the intervention phase, 2 preferred life-prolonging care, 2 preferred limited care, 4 preferred comfort care and 1 was unsure. The mean uncertainty score was 21.9 and 22.9 in the observational and intervention phases respectively. Patient reported preferences were discordant with the EMR in 28% of encounters in the observational phase and 22% of encounters in the intervention phase. The mean score for subjects on the Palliative Care Outcome scale was 14.7 (SD 6.4) and 15.2 (SD 7.1), in the observational and intervention phases respectively. On the Edmonton Symptom Assessment scale, subjects in the observational phase had a mean score of 46.5 (SD 14.3) compared to 43.0 (SD 19.2) during the intervention phase.
CONCLUSIONS: A video decision support tool illustrating treatment options is a feasible and acceptable method to supplement goals-of-care discussions with patients and families consulted on by an inpatient palliative care team. The use of video images may provide an easily reproducible method for more accurately eliciting preferences and ultimately improve end-of-life care.
WEB-BASED PTSD EDUCATION FOR MILITARY FAMILY MEMBERS Michael J. Roy1; Patricia Taylor1; Will Runge1; Evonne Grigsby2; Tonya Torgeson2. 1Uniformed Services University, Bethesda, MD; 2DefenseWeb Technologies, Inc., San Diego, CA. (Control ID #1340441)
BACKGROUND: Posttraumatic stress disorder (PTSD) is common after military service in Iraq or Afghanistan, but its presentation is frequently delayed until months after return from deployment. This is believed to be largely attributable to a honeymoon effect resulting from the fact that service members find themselves out of harms way and reunited with loved ones. Failure to promptly recognize stress-related symptoms in service members may lead to deleterious behaviors, such as abuse or dependence upon alcohol or illicit drugs, social withdrawal, and expressions of anger towards others, and even suicide. PTSD impairs service members functional status in multiple domains, including at home with family members. Since service members typically have several weeks of vacation upon their return from deployment, their family members are ideally positioned to identify warning signals, but may lack the knowledge to recognize such signals and then respond in an

effective manner. We hypothesized that an educational website developed expressly for military family members could provide them with the knowledge to improve outcomes.
METHODS: This is a three-phase study to try to significantly improve the knowledge of military family members iregarding PTSD, and further, to determine whether this knowledge translated into behavioral changes. First, focus groups were conducted with military family members across the US. and their feedback was incorporated into an educational website to improve family members knowledge of PTSD. A pilot study then tested the initial iteration of the site and a 25-item knowldege questionnaire. The site and questionnaire were modified based on the results of the pilot, and then PTSD-related knowledge was assessed in 497 military family members before and after their use of the website.
RESULTS: Use of an educational website improved military family member PTSD-related knowledge on a 25-item test, with an increase from a mean 13.9 correct responses beforehand to 18.7 after website use ($p<.001$; effect size 1.2). For 23 of the 25 items on the PTSD Knowledge questionnaire, the proportion of correct responses significantly increased between pre and post administration ($p<.002$). In addition, 217 family members returned to the site>10 days after their initial visit; 57% had taken actions such as discussing the service members symptoms with them, or persuading them to get medical attention. Seventy-four percent of those who had a discussion with the service member about their symptoms thought it was helpful, as did 82% of those who persuaded the service member to see a primary care provider only, and 95% of those who persuaded them to see a mental health provider with our without primary care. The knowledge acquired with the initial use of the site was retained at the time of return to the site, manifest by similar scores on the knowledge questionnaire.
CONCLUSIONS: Aweb-based intervention can both improve PTSD-related knowledge and foster behavioral changes in military family members.
WEB-BASED WALKING TO WELLNESS: ADOPTION AND IMPACT OF AN INSURANCE-INCENTIVIZED INTERNET-MEDIATED WALKING PROGRAM FOR OBESE ADULTS DonnaM. Zulman1,2; Ryan G. Smith4; Paul Resnick5; Erin Krupka5; Laura Damschroder3; Caroline Richardson6,3. 1Stanford University, Stanford, CA; 2VA Palo Alto Health Care System, Menlo Park, CA; 3Ann Arbor VA, Ann Arbor, MI; 4Thomas Jefferson University, Philadelphia, PA;
5University of Michigan, Ann Arbor, MI; 6University of Michigan, Ann Arbor, MI. (Control ID #1336486)
BACKGROUND: Rising obesity rates and associated chronic conditions and costs are driving demand for effective and inexpensive weight loss interventions. While Internet-mediated programs have been shown to increase physical activity levels in randomized controlled trials, it is unclear whether such programs can affect population-level behavior change. The objective of this study was to evaluate adoption and acceptance of a novel, insurance-incentivized Internet-mediated walking

program, and to assess the programs population-level impact on physical activity among obese adults.
METHODS: We conducted a formative mixed-methods evaluation of the adoption, acceptance, and impact of an Internet-mediated walking program implemented by a large Midwest insurance company. Beginning in 2010, individuals with a BMI>30 who were insured by this company could receive enhanced benefits if they participated in an Internet-mediated walking program or a traditional Weight Watchers program. Individuals who enrolled in the walking intervention received a free pedometer and could upload and monitor their daily step-counts (number of steps per day) on a personalized, interactive website. Participants who uploaded their step-count data at least once a month and achieved a goal of 5,000 average daily steps over three months were eligible for lower co-payments and deductiblesequivalent to 20% lower out-of-pocket expenses. We assessed program adoption and participation rates, and explored program impact among a subset of adherent

participants, using a paired t-test to examine changes in step-counts over a four-month period. We complemented these findings with quantitative and qualitative analyses of participant feedback to a web-based survey.
RESULTS: Among the 15,387 individuals who met eligibility criteria for the incentivized weight management program over the first nine months, 6,546 (43%) enrolled in the Internet-mediated walking program, and 5,045 (33%) enrolled in Weight Watchers. Participants in the walking program documented an average of 6,963 steps per day (SD 2,626 steps). Over 75% of walking program participants were classified as adherent based on uploads of valid pedometer data for at least 3 of 4 enrolled days. In a preliminary analysis of 1,818 adherent participants who had valid pedometer data during the first and last two weeks of the programs first four months, there was an average increase of 585 steps per day (SEM 53 days, paired t-test t=11.05, p<.0001). In a web-based survey (response rate 12%), 51% of respondents reported that they appreciated the value of the program for improving their health and decreasing their health care costs. Another 17% of respondents initially joined the program for the financial incentive and were unhappy with the program, but ultimately appreciated the program benefits.
CONCLUSIONS: In this formative study of a novel insurance-incentivized Internet-mediated walking program for obese adults, we found high rates of adoption, adherence, and satisfaction. Among adherent participants, physical activity rates increased significantly over a four-month period, suggesting that such programswhen implemented in the populationhave the potential to affect widespread change in physical activity levels. Additional evaluations should explore the long-term impact of these programs on individual and population-level health, utilization, and costs.
WEIGHT CHANGES IN THE TRANSITION TO ADULTHOOD: RESULTS FROM NHANES Arlene E. Chung1,2; Asheley C. Skinner2.
1University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC; 2University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC. (Control ID #1334638)
BACKGROUND: Although adolescents who are obese are more likely to remain so into adulthood, little is known about the amount of weight loss and gain by BMI status in adolescents during the years of transition from adolescence to young adulthood. Our objective was to examine weight loss and gain by BMI status and sex from adolescence to young adulthood in a nationally representative sample of older US adolescents.
METHODS: We examined 16-21 year olds from the National Health and Nutrition Examination Survey from 1999-2008 (n=5,827). We calculated weight loss or gain based on self-reported current weight and weight from one year ago. Measured height and weight was used to categorize individuals as overweight/obese, healthy weight, or underweight, using CDCs age-for-sex BMI percentile for those aged 16-20 and BMI in kg/m2 for those 21+. We used chi-square tests and t-tests to examine differences in any weight loss or gain and average amount of weight change by weight status, stratified by sex.
RESULTS: 61% of the participants were Caucasian, 15% African American, 18% Hispanic, and 6% other race/ethnicity. 27% had family
income below the federal poverty level. The sample had 45% that were overweight/obese, 51% healthy weight, and 4% underweight. 21% of participants reported having any weight loss in the previous year (44% male); 56% reported weight gain over the past year (54% male). The average loss was 16 pounds (lbs) and average gain was 14 lbs. Overall, females were significantly more likely to report weight loss (p<0.01) and less likely to report weight gain (p<0.01), compared to males. Among overweight/obese females, 25% reported weight loss in the past year vs. 21% of healthy weight females (p<0.05); any weight gain did not differ by BMI. Among overweight/obese males, 24% reported weight loss in the last year vs. 13% of healthy weight males (p<0.001). However, 54% of overweight/obese males reported gain in the last year vs. 67% of healthy weight males (p<0.001). Among those who lost any weight, overweight/ obese females lost more than healthy weight females (19 vs. 10 lbs, p<0.001), with a similar finding for males (22 vs. 13 lbs, p<0.001). However, when there was any

weight gain, obese females gained more than healthy weight females (20 vs. 8 lbs, p<0.001). This was also similar for males (19 vs. 13 lbs, p<0.001).
CONCLUSIONS: Although some fluctuation of weight in adolescence could be normal, the greater gain among those who are overweight or obese is concerning. Significant changes in weight occur during the period of transition from adolescence to adulthood with more than half reporting weight gain in the past year, and greater gain among those who are obese or overweight. Primary care physicians should counsel their patients about healthy lifestyles to prevent weight gain among both healthy and overweight/obese patients during the transition to adulthood.
WEIGHT GAIN AMONG FORMER WORLD TRADE CENTER RESCUE AND RECOVERY WORKERS AND VOLUNTEERS Camille Napier1,2; Rafael E. de la Hoz1,2; Ositadinma L. Mbadugha1.
1Mount Sinai School of Medicine, New York, NY; 2Mount Sinai School of Medicine, New York, NY. (Control ID #1339090)
BACKGROUND: Despite a growing national awareness, obesity continues to rise in prevalence in the United States. Studies among former World Trade Center (WTC) workers and volunteers described a high prevalence of overweight and obesity, and identified obesity markers, and weight gain during surveillance as risk factors for accelerated expiratory flow decline. We conducted a descriptive survey to identify risk factors for obesity in this patient population, including occupational WTC related exposures, employment and disability status, as well as dietary and exercise-related risk factors.
METHODS: 223 patients from the Mount Sinai WTC Treatment Program were sequentially invited to participate in a 10-minute survey to assess their occupational WTC exposures, employment and disability status, medical comorbidities, dietary and exercise habits, as well as height and weight. Body mass index was utilized to determine the obesity (BMI
30 kg/m2) status of the subjects, and univariate and bivariate analyses (tand Chi square tests, as appropriate) were used to explore its association with risk factors.
RESULTS: As expected from WTC worker cohorts, the population showed a substantial predominance of the male sex, with an average age of 51 years (SD 9.4 years), and obesity was highly prevalent (Table 1). We did not detect an association between obesity and WTC exposure variables (early arrival or prolonged stay at the WTC disaster site), disability status, or with self-reported depression/ anxiety. Employed individuals (whether full- or part-time, 99/223) were more likely to be obese (51.9% vs. 37.4%, p=0.03). Obese individuals were more likely to report less weekly exercise (3.75 vs.4.5 times/week, p=0.03), and drinking more glasses of soda daily (0.84 vs.0.55, p=0.04).
CONCLUSIONS: Obesity is highly prevalent among former WTC workers and volunteers, and we detected associations of obesity with active employment, decreased weekly exercise, and increased daily consumption of soda drinks. These associations deserve further exploration, and may guide future interventions to prevent obesity related comorbidities, including accelerated lung function decline in this patient population.

Characteristics of study population
Male sex 152 68.2% EthnicityLatinos 116 52.0% Caucasian 81 36.3% African American 23 10.3% Asian 3 1.3% WTC exposuresArrival48 hr 130 58.3%
Exposure60 d 163 73.1% WTC occupationLaw enforcement 35 58.3% Laborer 113 50.7% Construction 16 7.2% Other city employee 14 6.3% Firefighter 5 2.2% Ironworker 5 2.2% Volunteers 15 6.7% Presently employed 99 44.4% Overweight 80 35.9% Obesity 108 48.5%
WHAT CAN I DO? RECOMMENDATIONS FOR RESPONDING TO ISSUES IDENTIFIED BY PATIENT-REPORTED OUTCOMES ASSESSMENTS USED IN CLINICAL PRACTICE Claire F. Snyder4; Elizabeth F. Hughes1; Albert W. Wu2; Michael A. Carducci3. 1Johns Hopkins School of Nursing, Baltimore, MD; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; 3Sidney Kimmel Comprehensive

Cancer Center at Johns Hopkins, Baltimore, MD; 4Johns Hopkins School of Medicine, Baltimore, MD. (Control ID #1315114)

BACKGROUND: There is growing interest in using patient-reported outcome (PRO) assessments in clinical practice to improve patient management. The use of PROs in clinical practice involves patients completing questionnaires and feeding the individual's results to the patient's clinician(s) to help them monitor the patient's progress and manage issues in functioning and well-being. We have developed the PatientViewpoint website (http://www.patientviewpoint.org

Web End =www.patientviewpoint.org) which allows clinicians to assign, and patients to complete, PRO questionnaires at regular intervals. The results are available to the clinicians through the PatientViewpoint website and are linked to the electronic medical record. Based on previous research and preliminary testing of PatientViewpoint in breast and prostate cancer patients, providing clinicians guidance on how to address issues identified by the PRO questionnaires can facilitate the intervention's effectiveness. In this project, we conducted a multi-stage multi-disciplinary process to develop consensus suggestions for responding to potential problems identified by PRO questionnaires.

METHODS: We investigated 20 domains commonly covered in PRO questionnaires: anxiety, constipation, appetite loss, depressed mood, diarrhea, dyspnea, fatigue, nausea and vomiting, pain, insomnia, cognitive function, emotional function, financial problems, physical function, role function, social function, sexual function, overall quality of life, patient care &support needs, and health system &information needs. We first searched the MEDLINE database and key palliative care textbooks to summarize recommendations for addressing each of the 20 issues. We then held one-on-one interviews with experts from a variety of disciplines: internal medicine, palliative care, cancer outcomes research, medical oncology (breast and prostate), radiation oncology (breast and prostate), social work, psychiatric liaison nursing, triage nursing, clergy, and patient advocates (breast and prostate cancer). The results from the one-on-one interviews were combined with the literature recommendations to develop draft consensus statements for each issue. Finally, we held a panel meeting attended by all the experts where the draft consensus statements were reviewed and modified to develop the final consensus recommendations. RESULTS: Consensus statements were developed for each of the 20 domains. Both the literature review and the expert input supported the importance of first determining the nature of the issue, so all recommendations begin with an assessment and evaluation of the problem (e.g., its history, acute versus chronic nature, impact on patient quality-of-life). The consensus recommendations also included a range of suggestions that incorporated the expert panel members' various perspectives, ranging from medication adjustments (e.g., prescribing anti-emetics) to lifestyle modifications (e.g., addressing sleep hygiene) to referrals to other disciplines (e.g., social work).

CONCLUSIONS: Clinicians presented with their patients' PRO assessments may fail to act on them because they are uncertain about the most effective action to take. We developed consensus guidelines clinicians can access by clicking on a link "What can I do?" when reviewing patients' PRO results using our PatientViewpoint web system. While the initial pilot-testing has been done in cancer patients, the intervention is designed to be applicable across settings.

WHAT DIABETES EDUCATION IS DISCUSSED IN PRIMARY CARE VISITS? Kavitha Srighanthan1; Paulette A. Sage2; Adam T. Perzynski1; Kurt Stange3; Denise Kaiser1; Shari Bolen1,4. 1MetroHealth Medical Center/Case Western Reserve University, Cleveland, OH; 2Case Western Reserve University, Cleveland, OH; 3Case Western Reserve University, Cleveland, OH; 4Case Western Reserve University, Cleveland, OH. (Control ID #1335620)

BACKGROUND: Although diabetes education improves clinical outcomes, less is known regarding what diabetes education is given by primary care providers during patient visits with under-served populations and whether the education is consistent with diabetes education standards. As new health care delivery models are created, this knowledge will help health care providers incorporate diabetes education within primary care

practices for under-served groups.
METHODS: We observed, audio-taped, and transcribed doctor-patient visits for 10 adults with type 2 diabetes from four different primary care physicians with high quality of care scores for diabetic patients at an under-served clinic. We conducted a qualitative analysis, purposefully coding for the presence of educational messages. The messages were coded and categorized into specific groups based on the American Diabetes Associations National Standards for Diabetes Self-Management Education. The groups are as follows: description of the diabetes disease process and treatment options; incorporating nutritional management into lifestyle; incorporating physical activity into lifestyle; using medication safely and effectively; monitoring blood glucose; preventing, detecting and treating acute and chronic complications; developing personal strategies to address psychosocial issues and concerns as well as promote health and behavioral change. The educational messages were compared with Type 2 Diabetes -Basics, a textbook used widely as the basis for teaching by diabetic educators in group sessions. We also assessed whether the physician or patient brought up the education and whether or not a follow up plan was developed.
RESULTS: In a mainly African American (90%) population with fair control of intermediate outcomes (HbA1c 7.5%, BP 134/81 mmHg, and LDL 100 mg/dl), the mean total education issues discussed in a scheduled 20 minute primary care visit was 8 (range 4 to 17). The majority of the 79 education issues covered diabetes-related topics (77%), and most educational points were brought up by the physician (72%). Educational topics covered the full range of ADA recommended national educational standards. The two diabetes education topics brought up most frequently by providers were preventing, detecting and treating chronic complications (27%) and monitoring blood glucose (22%). Similarly, the two educational topics most frequently brought up by patients were preventing, detecting, and treating chronic complications (58%) and using medication safely and for maximum therapeutic effectiveness (33%). Fifteen percent of educational messages were not in the diabetes handbook used for group sessions due to the individualized message, three percent were inconsistent with the diabetes handbook, and the remaining 83% were either consistent with the handbook or not applicable. The majority of educational topics (57%) had follow up plans.
CONCLUSIONS: Diabetes education is common and individualized at primary care visits with diabetic patients. While doctors and patients in our sample routinely brought up a wide range of educational issues, the issues most often discussed were those in areas closest to provider expertise and

training. Continuing integration of diabetes educators in primary care would further support provider education on a wide range of diabetes issues, and would enhance the education on self management topics that are covered less frequently at the primary care visit.
WHAT DOES MY MAMMOGRAM RESULT MEAN? DEVELOPMENT OF A TOOL TO IMPROVE BLACK WOMENS KNOWLEDGE ABOUT SCREENING MAMMOGRAM OUTCOMES. Erin N. Marcus.
1University of Miami Miller School of Medicine, Miami, FL; 2University of Miami Miller School of Medicine, Miami, FL. (Control ID #1330386)
BACKGROUND: Effective communication of results is an important component of efforts to improve follow up after an abnormal mammogram. Federal law requires centers send every woman a letter explaining her results, but recent analyses suggest these letters may be written at a level too difficult for much of the U.S. population to understand. Research has found that many women incorrectly state their mammogram results when surveyed. New tools are needed to improve womens understanding of their results and follow up plan. The objectives of this project are to develop, refine, and pilot test a culturally targeted, literacy appropriate informational brochure explaining what happens after a routine screening mammogram, in order to improve knowledge of how common it is to have an abnormal test and why it is important to keep a follow-up appointment. We targeted our

intervention to urban black English-speaking women because they are at increased risk of presenting with advanced stage breast cancer at time of diagnosis. METHODS: Using principles of community-based participatory research, we conducted a qualitative study of black women recruited from the community in inner city Miami. 6 focus groups were convened and the discussion was audio-recorded and transcribed. The initial focus groups have been described previously and discussed the womens preferences regarding how mammogram centers communicate results while eliciting advice regarding the development of materials to improve this communication. The final 2 focus groups discussed womens preferences regarding the refinement of these materials. The investigators analyzed the transcriptions using an immersion and crystallization approach. A pilot study to evaluate the brochures efficacy in improving follow-up and understanding of results among low income black, English-speaking women with a BIRADS 0 (incomplete, requiring additional follow up) mammogram center is now being conducted.
RESULTS: Focus group members stated that the brochures incorporation of a 1 800 informational number and its messages dont be afraid to come back and you are not alone were its most important features. They found icon arrays and pie charts confusing and preferred risk be explained through the use of absolute numbers stated simply. They were receptive to the incorporation of testimonials as well as photographs of smiling realistic-appearing minority women of all age groups . They were unenthusiastic about photos of women who appeared too corporate. CONCLUSIONS: Women in our groups were receptive to culturally targeted photographs and testimonials and clear, uncomplicated messages regarding breast cancer risk and the importance of follow up after an abnormal mammogram. Including clear "next-step" information and telephone numbers to call is important when creating educational materials about mammogram outcomes. Additional study is needed to assess the effectiveness of these materials in improving mammogram follow-up among vulnerable populations.
WHAT IS ON THE HORIZON?: RESIDENTS FORECAST THE CONSEQUENCES OF THE LATEST DUTY HOUR REFORM Elizabeth A. Paesch1; Furman S. McDonald2; Lisa L. Willett3; Saima Chaudhry4; Karen Chacko5; Andrew J. Halvorsen6; Vineet Arora1. 1University of Chicago, Chicago, IL; Mayo Clinic, Rochester, MN; 3University of Alabama at Birmingham, Birmingham, AL; 4North Shore-Long Island Jewish Health System, Manhasset, NY; 5University of Colorado Denver, Aurora, CO; 6Mayo Clinic, Rochester, MN. (Control ID #1340453)
BACKGROUND: Recent single-center and small multi-center studies have shown that residents believe duty hour reform brings positive and negative consequences. Interestingly, junior residents have been less concerned than senior residents about possible negative consequences of duty hour restrictions. However, it is not known if the differences of
opinion between residents at different training levels seen in these studies hold true for all U.S. internal medicine residents. Nor is it known if differences of opinion exist among residents who are not alike in other respects such as IMG status.
METHODS: Data from the Internal Medicine In-Training Examination 2010 Residents Questionnaire was analyzed. The exam and questionnaire were administered to approximately 75% of the categorical and primary-care internal medicine residents in the United States in 2010-2011. PGY levels, IMG status, and attitudes regarding the new duty hour regulations were extracted from the database. For example, residents were asked What do you think the consequences of the new regulations will be on resident ownership of patients? Their response options were uncertain, decrease, stay the same, and increase. Descriptive and inferential statistics including the chi-squared test were used to describe the data and look for inter-group differences. RESULTS: 16,205 residents were included in the study of whom 36% were PGY-2 s, 33% were PGY-3 s, 52% were USMGs, and 45% were female. Residents were concerned duty hour restrictions would worsen resident ownership of patients (41% thought it would worsen vs. 10% thought it would improve), autonomy (24% vs. 10%), clinical experience (40% vs. 13%), quality of educational experience (27% vs. 25%), quality of handoffs

(29% vs. 23%), errors due to handoffs (34% vs. 24%), and faculty morale (20% vs. 15%). Residents were hopeful duty hour restrictions would improve resident fatigue (58% thought it would improve vs. 6% thought it would worsen), work intensity (41% vs. 16%), time for education (31% vs. 25%), time for electives (33% vs. 20%), time for ambulatory rotations (21% vs. 15%), patient safety (36% vs. 15%), errors due to fatigue (56% vs. 4%), errors due to workload (47% vs. 7%), and resident morale (34% vs. 12%). PGY-2 s and PGY-3 s were more worried than PGY-1 s about the possible negative consequences of the new duty hour restrictions (PGY-2 ORs=1.38-1.68, PGY-3 ORs=1.38-2.02, all p<.0001). As well, USMGs were more concerned than IMGs about potential consequences of duty hour reform (USMG ORs=2.85-3.68, all p<.0001). CONCLUSIONS: This observational study demonstrates that residents anticipate both positive and negative consequences from the new duty hour regulations. Interns are less worried than junior and senior residents about the negative consequences new duty hour reform might bring; and IMGs are less concerned than USMGs. Residents may be more worried than interns because they have some experience in the system, so they may either fear change or have more insight into the possible consequences of change. IMGs may be less concerned than USMGs because they have foreign clinical experience which shapes their perception of the consequences of the changes, and they strongly desire to fit into the U.S. system. Future research should examine these and similar hypotheses as well as track the opinion of residents via--vis duty hour restrictions after more have trained only under the new requirements.

WHATS COST GOT TO DO WITH IT? CHARACTERISTICS OF HIGH COST USERS OF HEALTH CARE AND THE OVERLAP BETWEEN COSTS, HOSPITAL ADMISSIONS, AND EMERGENCY DEPARTMENT VISITS

Oanh K. Nguyen; Ning Tang; John M. Hillman; Ralph Gonzales. University of California San Francisco, San Francisco, CA. (Control ID #1340176)

BACKGROUND: Care management programs targeted at high cost individuals, or those deemed at risk for becoming high cost - those with frequent hospital admissions or readmissions, emergency department (ED) visits or outpatient visits - are increasingly common among health systems seeking to reduce costs. Among high cost individuals, it is unclear what proportion of costs are potentially responsive to care management and to what extent high cost individuals are also frequent users of the hospital and ED. We examined a population of high cost patients within a university-based primary care population to explore the extent of overlap between cost, admissions, readmissions and ED visits.

METHODS: We analyzed hospital cost and use metrics from July 1 2010 to June 30 2011 for all adults18 years old with a primary care provider (PCP) at the University of California San Francisco (UCSF) with at least one hospital admission at UCSF (n=2,727). We defined cutoffs for the top 10% of individuals by hospital costs (>$63,239, n=273) and hospital admissions (3, n=251). Demographic characteristics between groups were compared using McNemars chi-square and two-way analysis of variance. Hospital costs (excluding physician fees), admissions, emergency department visits and

medical diagnosis groups as coded by Centers for Medicare &Medicaid Services Diagnosis Related Groups (CMS-DRGs) were obtained from administrative billing data. To identify admissions for the top 3 CMS core conditions, we used CMS-DRGs 089, 090, 121, 122, 123 and 127 to identify admissions for pneumonia, myocardial infarction and heart failure. RESULTS: High cost individuals represented 10% of the study population but accounted for 46% of hospital costs and 22% of hospital admissions. Compared to those who were not high cost, they were more likely to be male (49% vs. 36%, p<0.001), African-American (24% vs. 14%, p<0.001) and have Medicare or Medicaid as a primary payor (77% vs. 57%, p<0.001). Fewer than half (48%) of high cost individuals were also within the top 10% by admissions. Those who met cost criteria alone had an increased length of hospital stay (15.617.3 vs. 8.356.0 days, p<0.001); greater average costs per admission ($72,66664,942 vs. $30,18336,432); and a smaller proportion of readmissions (16% vs. 47%, p<0.001) compared to those who met both cost and admissions criteria. Additionally, those who met cost criteria alone

had a greater proportion of admissions for surgical procedures (56% vs. 28%, p<0.001) and had a lower proportion of admissions for a CMS core condition (3% vs. 6%, p=0.07) compared to those who met both cost and admissions criteria. Fewer than half (43%) of high cost individuals had 1 or more ED visits within the study period. A significantly smaller proportion of those meeting only cost criteria had 1 ED visit (35%) compared to those who met both cost and admissions criteria (52%, p=0.005).
CONCLUSIONS: Defining high use by costs alone may not adequately identify the population with expenditures potentially amenable to intervention, while defining high use by volume of service (admissions and ED visits) alone may inadequately capture costly patients. A multi-faceted definition of high users incorporating both cost and service volume data may more effectively identify high users with preventable costs and use and help to inform more effective strategies to improve the quality of care for these patients.
WHEN DO SUPERVISING PHYSICIANS DECIDE TO ENTRUST RESIDENTS WITH UNSUPERVISED TASKS? A QUALITATIVE STUDY Kevin Choo1; Vineet Arora2,1; Paul Barach3; Julie K. Johnson4; Jeanne M. Farnan2,1. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; 3University Medical Centre Utrecht, Utrecht, Netherlands; 4University of New South Wales, New South Wales, NSW, Australia. (Control ID #1326394)
BACKGROUND: Attending physicians are often challenged by the decision of when to allow trainees autonomy in procedural tasks and clinical decision-making. Medical educators have struggled to find ways to evaluate trainees and assist faculty in determining trainees' preparedness to independently perform tasks. The aim of this study was to create a conceptual framework to identify factors determining attending and resident perceptions of trust in clinical decision-making.
METHODS: Internal medicine residents and attending physicians were interviewed between January and November 2006, at the conclusion of their Internal Medicine rotation. Participants at a single academic medical center were asked, using the Critical Incident Technique, to describe important entrustment decisions made during their rotation and final call night. Audio-taped interviews lasted on average 45 minutes. All personal and patient data were de-identified during transcription. Interview transcripts were reviewed and analyzed using a deductive approach and the Entrustable Professional Activities (EPA) framework. Data were coded to construct themes of trust, and to identify the factors that promoted, undermined, or otherwise described trust. Two investigators (JMF, KJC) independently reviewed representative portions of the transcripts until consensus was achieved. The inter-rater reliability was calculated using a generalized kappa-statistic (). The coding scheme was then applied to the entire set of transcripts.
RESULTS: Eighty four percent (42/50) of residents and 80% (40/50) of attending physicians were interviewed. The analysis yielded 535 discrete mentions of trusting factors, which were coded into 35 sub-themes. The inter-rater Kappa for coding between the two raters was high at 0.84. Four major domains of trust were described, each with specific sub-themes: trainee factors (confidence, recognition of limitations, area of specialty/career plans); supervisor factors (approachability, area of clinical expertise, perception of clinical obligations); task factors (urgency/
severity of illness, transitions, level of difficulty, situational characteristics); and, systems factors (workload, duty hours, training philosophy). Supervisors frequently base entrusting decisions on direct observation of trainee performance. Situational factors such as adequacy of support staff and team dynamics were noted to influence the entrustment decisions. Relational factors such as personality characteristics and prior work experience were frequently mentioned. Attendings noted that the career plan or sub-specialty choice influenced their provision of resident autonomy, with those pursuing a sub-specialty perceived as more competent and worthy of trust.
CONCLUSIONS: The development of trust is multi-factorial and comprises factors driven by the supervisor, trainee, task and environment. Trust is often driven, despite objective metrics, by subjective conclusions drawn from direct trainee observation. Supervising physicians base decisions on personal characteristics, including honesty, disposition, and self-confidence, which may not correlate with trainee competency. It is important to

recognize bias toward sub-specialty bound residents, which may hinder the growth of those planning generalist careers. Future studies should address drivers behind these decisions, correlations with patient outcomes, and tools to enable faculty to justify their entrustment decisions and assess readiness of residents to proceed without supervision.

WHICH WOMEN VETERANS ARE MOST LIKELY TO LEAVE VHA? Sarah A. Friedman1; Ciaran S. Phibbs2,1; Alison Hamilton3; DonnaL. Washington3; Elizabeth Yano3; Patricia M. Hayes4; Sally G. Haskell4,5; Susan M. Frayne1. 1VA Palo Alto HSR&D Center of Excellence, Menlo Park, CA; 2VA Palo Alto Health Care System, Menlo Park, CA; 3VA Greater Los Angeles HSR&D Center of Excellence, Sepulveda, CA; 4VA Central Office, Washington DC, DC; 5VA Connecticut Healthcare System, West Haven, CT. (Control ID #1339187)

BACKGROUND: Nationally, 30% of women Veterans new to VHA do not return within 3 years. In a research/clinical partnership, we investigated whether attrition is higher among new women patients, controlling for other factors, and explored factors contributing to their attrition. METHODS: Data came from VHA enrollment and utilization databases. We examined predictors of attrition (alive but did not return for VHA outpatient care in 2nd-3 rd years after first FY06 visit) using two logistic regression models: Model 1 tests whether, among women Veteran with an FY06 face-to-face visit, new users (no outpatient services in three years before first FY06 visit) are as likely to leave VHA as return users, controlling for age, service-connected status, receipt of fee-basis care, receipt of inpatient care, and outpatient visit use (overall, primary care, mental health). Model 2 tests whether, among the subset of women new to VHA, these control variables predict attrition. Both models allow for non-linearity in age and visit counts. Only adjusted odds ratios (AORs) significant at p<.05 are reported. RESULTS: Of the full cohort (n=232,491), 11% had attrition. New women were more likely than returning women to leave VHA (30% vs. 8%), even when controlling for other factors (Model 1 new user AOR: 2.8). Model 2 found that among the 13% who were new, odds of attrition were lower in those 45+ years old (versus 18-44 year olds) (45-64 AOR: 0.72; 65+ AOR: 0.88), and in those with service-connected status (AOR: 0.92), fee-basis use (AOR:0.84), or any primary care visit (AOR: 0.65), and higher in those with inpatient use (AOR: 1.26). Also in new users, frequent use in their first year of care was associated with especially low attrition (9+ visits [versus 1 visit] AOR: 0.10). CONCLUSIONS: Attrition is higher in new women patients, even after controlling for other factors. Among new women, odds of attrition vary by age: those older than 45 years were most likely to stay, even among Medicare eligible women. Attrition was lower in new women who used primary care during the first year of care. To reduce the loss of new women patients, strategies may include age-relevant services for the youngest new VHA patients, and continued aggressive efforts to assure access to primary care for patients entering the system.

WHO LEAVES AGAINST MEDICAL ADVICE (AMA): PREVALENCE AND PREDICTORS OF LEAVING AMA IN UNITED STATES Siva K. Talluri1; Pramod K. Kalagara1; Steven J. Pierce2; Siddesh Besur1; Jyosthna Talluri1; Anne Dohrenwend1. 1McLaren Regional Medical Center, Flint, MI; 2Michigan State University, East Lansing, MI. (Control ID #1336490)

BACKGROUND: Health care providers are often frustrated when patients decide to self-discharge against medical advice (AMA). Such patients are frequently readmitted within weeks resulting in substantial utilization of financial resources. Our goal was to estimate AMA discharge prevalence and its predictive patient characteristics. METHODS: We conducted a secondary data analysis of a retrospective patient cohort in the 2008 National Hospital Discharge Survey (NHDS). NHDS is a publicly available, nationally representative sample survey with discharge information from 208 U.S., non-federal, acute care hospitals. All adult patients (>19 years) discharged routinely and those who left AMA were included. We excluded deaths and discharges to

short and long term rehabilitation facilities. Categorical demographic characteristics were compared using chi-square tests and the continuous variables with Wilcoxon rank-sum tests. We identified significant (P <0.05) patient variables by univariate analysis and used logistic regression analysis to identify independent risk predictors.
RESULTS: The NHDS survey included 153,055 patients. Total study patients were 106,714 and included those routinely discharged (105,004) and those leaving AMA (1,710). We excluded 46,341. The prevalence of patients leaving AMA was 1.3%.Patients who leave AMA as compared to those routinely discharged were more likely to be younger (47+16 years vs. 53+20 years), male (58% vs. 38%), African-American (23% vs. 13%), not currently married (36% vs. 28%) and admitted through the emergency room (75% vs. 47%). They predominantly were either self-pay (16% vs. 6%) or had Medicaid insurance (25% vs. 16%); had shorter length of stay(2.7 vs. 4.1 days) and left AMA within 24 hours of admission. The odds-ratios (ORs) and corresponding 95% confidence intervals (CIs) for patient characteristics that independently predicted leaving AMA are: age less than 60 years (OR=3.38, CI=2.51-4.57); male sex (OR=2.31, CI=1.91-2.80); African-American race (OR=1.33, CI=1.06-1.66); not currently married (OR=1.39, CI=1.05-1.85); non-private payment sources of Medicare (OR=3.11, CI=2.31-4.18), Medicaid (OR=2.82, CI=2.18-3.65), other (OR=2.44, CI=1.59-3.74) and self-pay (OR=3.82, CI=2.87-5.09). The diseases that were listed as first diagnosis in those who left AMA in order of frequency included alcohol withdrawal, viral meningitis, alcohol dependence, acute pancreatitis and congestive heart failure.
CONCLUSIONS: We found that the prevalence of those leaving AMA is low. Young men, African-Americans and those without insurance were more likely to leave AMA and frequently had an alcohol-related diagnosis.
A LOT OF MEDICINE, OKAY?: GAPS IN COMMUNICATION IN OUTPATIENT CARDIOLOGY CLINIC ENCOUNTERS Anna Neumeier; Eliseo Perez-Stable; Andrea Lopez; Kirsten Bibbins-Domingo; Urmimala Sarkar. University of California, San Francisco, San Francisco, CA. (Control ID #1338892)
BACKGROUND: Effective patient-physician information exchange is necessary for ambulatory care. Although evidence of sub-optimal communication in primary care abounds, less is known about communication for outpatient sub-specialty visits. Thus, we sought to examine the adequacy of communication needed for self-management in outpatient visits to a cardiology clinic within a safety-net health care system. METHODS: We reviewed 10 clinical encounters obtained as part of a larger observational communication study of patients cared for in an outpatient county-based cardiology clinic. Data analysis is ongoing. The encounters were audiotaped, transcribed, and de-identified (English, n=12; Spanish, n=14). One investigator read and listened to all recordings and created a coding scheme which was collaboratively revised by the entire team. Then 2 investigators reviewed and applied codes to the transcripts. Differences were resolved by discussion. Thematic saturation was obtained with 10 interviews. All analyses were done using Atlas.ti software. For this analysis, we report on themes relating to medication use, diagnosis, and symptom assessment, which are core aspects of ambulatory chronic disease care. We calculated the Medication Communication Index (MCI), a validated measure of medication communication adequacy, for each visit. MCI ranges from 0-5, with higher scores indicating better communication.
RESULTS: 10 interviews have been analyzed to date. Nearly half of the interview content was medication-related (118/256). The majority of these themes related to medication reconciliation (87/118). There was usually an approach to obtain a comprehensive patient medication list (7/10) with frequent discussion of the medication names (33/87) but often not the directions (13/87), dose (9/87) or medication indication (9/87). When new medications were introduced, name, directions and indications were mentioned (5/5). Anticipated duration and side effects were omitted. The average MCI score was 2/5. Symptom assessment was variable, with an average of 2 symptoms per visit, but ranged from no symptom discussion (2/10) to 11 symptoms (3/10) discussed. Most commonly discussed symptoms included palpitations (5/10) and shortness of breath (5/10). In 4/10 interviews an assessment of the patients functional status/New York Heart Association class was obtained. During an encounter, 1-4 patient diagnoses were discussed either explicitly or implied. the problem is you have

a weak heart now due to the heart attack. Most common diagnoses were hypertension and heart failure. Investigators were unable to deduce the diagnosis from the transcript in 4 cases.
CONCLUSIONS: In the outpatient cardiology setting, discussion of medication-related topics occupies the majority of the clinical encounter, yet falls short of recommended communications standards. Symptom assessment and determination of functional status, although critical for provision of anticipatory guidance, is variable and at times absent. Similarly, communication about specific diagnoses was less frequent than expected and may impact patients understanding of their illness. Overall, our findings imply that communication in outpatient visits does not adequately support patient self-management for cardiac diseases.
Figure: Medication reconciliation exchange
IM TALKING ABOUT PAIN: SICKLE CELL DISEASE PATIENTS WITH EXTREMELY HIGH HOSPITAL USE
Daniel Weisberg1; Gabriela Balf-Soran3; William Becker2; William Sledge3. 1Yale University School of Medicine, New Haven, CT; 2Yale University School of Medicine, New Haven, CT; 3Yale University School of Medicine, New Haven, CT. (Control ID #1339405)
BACKGROUND: Sickle cell disease (SCD) is marked by painful vaso-occlusive crises that may precipitate inpatient admission. Most
individuals with SCD manage their pain at home, with sporadic admissions occurring on average 1.5 times per patient year. A small minority of patients with SCD accounts for the great majority of inpatient hospital stays. Admitted as often as several times a month, over successive years, this cohort of patients has not been studied in depth despite their disproportionate contribution to inpatient hospital costs in SCD. The objective of this study is to characterize the subjective experience of extremely high hospital use in patients with SCD, and generate hypotheses about the precipitants and consequences

of this phenomenon with the ultimate goal of aiding the design of interventions that will improve quality of care.
METHODS: This is a qualitative study involving in-depth, open-ended interviews using a standardized interview guide. Participants consisted of eight individuals of varying age and gender identified through hospital claims data as among the highest hospital use patients with SCD over a three-year period at a single urban academic medical center. The design, interview process, and subsequent analysis were based on the principles of grounded theory for qualitative research. A qualitative review was performed by four members of the research team. The analysis involved creating narrative summaries according to an established process in phenomenological research. These summaries were used to organize emergent themes into an analytic paradigm, and facilitate a return to the interview transcripts in order to catalog data.
RESULTS: A common narrative emerged from the interview transcripts. Participants were exposed to the hospital environment and intravenous opioids at a young age, and this exposure was associated with extremely high hospital use in adulthood evident in descriptions of multiple dimensions of their lives: their upbringing, their history of hospitalization and opioid use, and their personal relationships with peers, caregivers, and family members. Opioid use, due to its reinforcing effects and side effects of therapy, as well as hospitalization itself perpetuated developmental failures that hindered participants ability to manage SCD-related pain apart from the hospital-based healthcare system and resulted in further hospitalization, lost social and vocational opportunities, and isolation from support structures. Escalating opioid use appeared central to the failure to fulfill social roles, a hallmark of addiction. That this escalation was propagated by clinicians complicates the patient-caregiver relationship. CONCLUSIONS: Our results suggest a systematic process of alienation from mainstream society, support structures, and caregivers based on increasing hospitalization, growing dependency on opioid medications, as well as missed developmental milestones. Breaking this spiraling cycle may be possible with early interventions, and alternative strategies in pain management, and renewed effort to delineate the pathologies of acute pain, chronic pain, and addiction. Further study should be geared towards formally defining extremely high hospital use in SCD, and quantifying its prevalence. Resources and research focused on this

group will likely benefit SCD care at large.

SHE MAKES ME FEEL LIKE AN ALL-STAR: PATIENTS EXPERIENCES WITH SELF-MANAGEMENT EDUCATION IN AN INTERVENTION FOR CHRONIC MUSCULOSKELETAL PAIN Marianne S. Matthias1,2; Laura J. Myers1,3; Edward J. Miech1,2; Christy Sargent1; Matthew J. Bair1,2. 1Roudebush VAMC, Indianapolis, IN;
2Regenstrief Institute, Inc., Indianapolis, IN; 3Indiana University, Indianapolis, IN. (Control ID #1322172)

BACKGROUND: Chronic pain is prevalent, costly, and exerts a significant burden on both primary care providers (PCPs) and patients. In this study, we elicited patients experiences following completion of a stepped-care intervention for chronic musculoskeletal pain. METHODS: We conducted qualitative interviews with patients who participated in the intervention arm of a randomized controlled trial for chronic pain management at a VA Medical Center. Step 1 of the intervention consisted of analgesic treatment coupled with pain self-management strategies, followed by brief cognitive behavioral therapy in Step 2. A nurse care manager delivered all elements of the intervention via telephone. At the end of this trial, we asked patients open-ended questions about their experiences in the RCT. Interviews were audio-taped, transcribed, and checked for accuracy. Sampling continued until theoretical saturation was reached. We used grounded theory and constant comparative methods to analyze the data.

RESULTS: Patients (N=26) were 24 to 62 years old; four were women; all had moderate to severe chronic musculoskeletal pain. While patients varied in their descriptions of the stepped-care intervention and the self-management education received in the study, they all spoke of the important role played by the nurse care manager. Three themes emerged related to the nurse care managers role in pain self-management. Theme 1, Finding What Works: Patients appreciated having someone they knew to talk to about different options pain self-management: The best part is having somebody there to talk to, to go over ideas you have about what works and what doesnt, and get feedback on your progress. (Participant 7) Theme 2, Being Held Accountable: Patients felt accountable to the nurse. They knew she would call them, and they wanted to be able to tell her (truthfully) that they were using their self-management strategies. It kept me accountableUsually nobody asks me, Are you walking? Stretching? I dont want to lie to her, so I do it, where normally Id just do nothing. (Participant 19) Theme 3, Motivation/Emotional Support: For some, the nurses phone calls provided motivation to continue with their self-management strategies. For others, emotional support was more critical: When I got off the phone, I felt better. I was more relaxed and I felt that somebody's helping me. Youre in a bad spot and somebody cares enough to lend a hand. It was a big deal. Its comforting. (Participant 25) One veteran simply valued the personalized attention: She makes me feel like Im an all-star. (Participant 11)

CONCLUSIONS: This study highlights the important role played by a nurse care manager in helping patients self-manage their chronic pain. Specifically, the nurse helped patients find different self-management options, held patients accountable in self-management goals, and provided emotional support and motivation to patients. Incorporating nurses into pain management in primary care may potentially alleviate some of the burden on PCPs caring for patients with chronic pain.

CLINICAL VIGNETTES

"A PAINFUL JOURNEY" Adam Abraham; Alison R. Landrey; Rachel Swigris. UCH-Denver, Denver, CO. (Control ID #1339830)

LEARNING OBJECTIVE 1: Identify potential solutions to help minimize inappropriate opiate prescriptions for chronic non-malignant pain (CNMP) in resident clinic.

CASE: From 1996-2011, a 59-year-old female with a history Crohns disease, polysubstance abuse and chronic abdominal pain presented to our resident clinic 90 times, often because of pain. She was treated with opiates in progressively increasing doses. There was ample evidence that her Crohns was inactive and not her pain source. There was extensive documentation of both opiate seeking behavior and untoward side effects. Chart review revealed over 26 patient calls for early opiate renewals, 7 reported falls, 4 reports of stolen opiates, and

an episode of walking into oncoming traffic. Clinicians did not document clear functional goals, a discussion about stopping opiates or referring her to a treatment program until 2011. In 2011, a review of the Colorado Prescription Drug Monitoring Program database indicated continued outpatient opiate refills during a hospitalization and receipt of opiates from non-University providers. Her clinician stopped prescribing her opiates and offered a methadone clinic referral.
DISCUSSION: This case highlights three system shortcomings which we feel contribute to inappropriate prescribing patterns in resident clinics: (1) lack of care continuity, (2) limited provider knowledge regarding CNMP treatment guidelines and (3) inability to quickly identify red flags during clinic visits. This patient saw over 22 resident and 24 attending physicians, leading to repeated instances where different, relatively inexperienced providers had to decide whether to refill opiates or modify a prior treatment plan. Nearly every time, they continued opiates despite evidence of potential harms. One mitigating strategy would be to have an attending physician, not just supervise, but also share ownership of each patient with CNMP. This would enhance continuity when the resident is out of clinic and upon graduation. The American Academy of Pain Medicine recommends documenting pain intensity, level of functioning, progress toward achieving functional goals and presence of adverse events when prescribing opiates. Tapering patients off opiates who engage in repeated aberrant drug-related behaviors is also advised. In our case, these steps were not taken. We suspect most providers are unfamiliar with these guidelines and believe that enhanced training in them is crucial. Our electronic medical record (EMR) had no easy way for providers to rapidly detect red flags and identify previous opiate misuse. On 5 occasions, clinicians documented that the patient had no evidence of aberrant seeking behavior, despite contradictory evidence, scattered throughout the chart. EMRs should be customized so red flags are present on a single page and accessible with one mouse click. Prescription painkiller overdoses killed more than 15,000 people in 2008, a rise of over 300% from 1999. We

believe that implementation of the proposed tactics can help training clinics meet our primary obligation, First, do no harm.
"CRYO"-ING OUT OVER RENAL FAILURE Aarti Ravikumar; Michal Gross; Sheira Schlair. Montefiore Medical Center, New York, NY. (Control ID #1338994)
LEARNING OBJECTIVE 1: Recognize the types and clinical manifestations of cryoglobulinemiaLEARNING OBJECTIVE 2: Recognize causes of renal failure in a patient with chronic lymphocytic leukemiaCASE: 47 year-old male presented with lower extremity edema, progressive dyspnea and decreased urinary output for two weeks. The patient had a history of extranodal marginal B cell lymphoma and chronic lymphocytic leukemia (CLL) on bone marrow biopsy, diagnosed in 2009, for which he was followed regularly by an oncologist and had not received any treatment. Physical Exam: Patient was tachypneic and breathing 25 breaths per minute. His lungs and heart were clear. Patient had bilateral lower and unilateral upper extremity edema. He had petechiae on his legs. He had no hepatosplenomegaly or lymphadenopathy. An echocardiogram was normal. Initial lab tests revealed acute renal failure (BUN 99, Cr 2.2) along with progressive oliguria that eventually required hemodialysis. Urinalysis revealed 100 mg/dl protein and large blood. He was found to a white blood cell count of 13,700 (88% granulocytes and 6% lymphocytes). An autoimmune panel was sent, which was positive for low C3 (63) and C4 (3); all other tests were normal. Cryoglobulin screen was positive and HCV was negative. A bone marrow biopsy was done which was unchanged from the prior done in 2009. Renal biopsy showed membranoproliferative glomerulonephritis (MPGN) type I with IgG-IgM co-deposits, consistent with mixed cryoglobulinemia and interstitial deposition of previously diagnosed CLL.
DISCUSSION: Renal failure in CLL is a problem that should be recognized by the internist and trigger a broad differential diagnosis that includes cryoglobulinemia, lymphangitic spread of CLL, and transformation to acute

leukemic crises with tumor lysis. Cryoglobulins are immunoglobulins that precipitate out of blood at temperatures lower than 37C. This precipitation causes a systemic inflammatory syndrome. Type I is a pure monoclonal IgG or IgM, often associated with an underlying lymphoproliferative disorder. Symptomatic Type 1 causes hyperviscosity symptoms and/or thrombosis. Type II and III are both mixed cryoglobulinemia. Type II involves polyclonal IgG and monoclonal IgM, and type III involves polyclonal IgG and IgM. Mixed cryoglobulinemia (MC) tends to be associated with various infectious (especially HCV), immunological and neoplastic disorders. There are no universal diagnostic criteria, but the triad of circulating cryoglobulins, low C4 and skin purpura are the hallmarks of MC, and biopsy of suspected tissue is the best diagnostic method. The typical pathological finding of MC is a leukocytoclastic vasculitis of the small and medium vessels. Mean survival is 50-60% at 10 years after diagnosis, but those with renal involvement have a worse prognosis. Nearly 10-27% of cases of MC have renal involvement. The most common renal manifestation of MC is type I membranoproliferative glomerulonephritis (MPGN), which accounts for 80% of cases. In cases of MPGN type I secondary to malignancy, the treatment consists typically of immunosuppression with steroids and cytotoxic agents, with or without plasmapheresis. Renal failure is a common finding, and for those with an underlying malignancy, cryoglobulinemia should be considered in the differential even if the malignancy does not appear to be active.

"PACEMAKERS ARE FOR LIVING - NOT FOR FIDDLING!" Tatyana Der; Venkataramanan Gangadharan; Vijay Ramu. ETSU, Quillen College of Medicine, Johnson City, TN. (Control ID #1275983)

LEARNING OBJECTIVE 1: - Recognise Twiddler syndrome and its importanceLEARNING OBJECTIVE 2: - Management of Twiddler syndrome CASE: Mrs. X is a functional 94 year old woman admitted with complaints of chest pain, few days in duration. She had a past medical history significant for complete heart block with permanent pacemaker placement 7 years ago, hypertension, gout and osteoporosis. Physical exam revealed an elderly

woman with moderate build with normal controlled vital signs. Patient was worked up for possible acute coronary syndrome by obtaining cardiac isoenzymes, troponin T, an EKG and routine chest x-ray. Lab work was essentially benign as was her EKG revealing a ventricular paced rhythm. Routine chest x-ray, however, revealed significant twisting and descent of her pacemaker device since its initial implantation. Patient herself denied any manipulation of the device either voluntarily or involuntarily. The device had no specific abnormalities on interrogation. Since the patient was pacemaker dependent, elective revision was performed and the device was re-implanted by creating a new pocket superior and lateral to the previous pocket, and device was sutured to the fascia with more secure knotting. The leads weren't extracted but moved and reattached to the new generator. Follow up chest x-ray and device interrogation revealed the corrected position and normal function.

DISCUSSION: Twiddlers syndrome is rare but a potentially dangerous complication of device therapy for arrhythmias. It is important for primary care physicians and cardiologists to be aware of this syndrome since it can be easily prevented. Twiddler's syndrome refers to the intentional or unintentional twisting of the generator within the pacemaker pocket by the patient resulting in either lead dislodgement or fracture without damage to the generator itself. Patients at risk for this condition are usually elderly, obese and often female presumably due to their relaxed subcutaneous tissue that facilitates the rotation. Patients with psychiatric illnesses present an understandable challenge too. Diagnosis is often incidental but could also present as problems on device interrogation such as loss of capture, diaphragmatic stimulation, stimulation of the pectoral muscle. Clinically it can manifest as twitching of the pectoral or abdominal muscles, chest pain, dysrhythmias, syncope or pre-syncope. Treatment proposals include limiting the pocket size or changing its location, use of a Parsonnet pouch or a Dacron patch for the patients at risk, sturdier tethering of the device to the underlying fascia or using abdominal rectus muscle for device implantation. With this case we also hope to advocate that careful patient selection with appropriate counseling on the dangers of generator manipulation is essential before any form of

device implantation.
"PANCORONARITIS SYNDROME"; UNCOMMON PRESENTATION OF A COMMON DISEASE PROCESS
Abhishek Biswas1; Anisha Shah2; Patricio A. Sanchez Cueva3. 1UPMC Mercy, Pittsburgh, PA; 2UPMC Mercy, Pittsburgh, PA; 3University of Pittsburgh, Pittsburgh, PA. (Control ID #1309906)
LEARNING OBJECTIVE 1: Recognize an important cause,clinical setting and pathophysiology of sudden cardiac death.
LEARNING OBJECTIVE 2: Manage all cases of v fib cardiac arrest appropriately with cardiac catheterization even in the absence of classic EKG and clinical findings suggestive of acute occlusive coronary artery disease.
CASE: A 84 year old diabetic lady was recovering after laparoscopic cholecystectomy when she developed chest pain and shortness of breath. She went into ventricular fibrillation, was resuscitated per ACLS protocol and transferred to the CCU for TH protocol. EKG on arrival showed normal sinus rhythm with evidence of inferior Q waves. Troponin was 2.67 at arrival and went up to 552.34 within eight hours. She was immediately cooled to a target of 33 degrees Celsius. Coronary angiogram showed 100% acute occlusion of the mid LAD and RCA, both of which were stented. An echo showed non dilated LV with akinesis of the septum, lateral and inferior walls with apical clot and an EF of 25-30%. She subsequently developed a pneumothorax, required increasing doses of inotropes and subsequently was made CMO by her family. She passed away after 24 hours.
DISCUSSION: Atherosclerosis is regarded as an inflammatory state. In light of that view, plaque instability should not be regarded as a random "vascular accident", but rather a result of a "pan-coronary" inflammatory process. The phenomenon of simultaneously developing multiple coronary thromboses, although infrequently observed by cardiologists, has been known to pathologists for years. It seems likely that multiple coronary thrombosis often has a rapid and fatal course which may explain its rarity in the clinical setting. A remarkable postmortem study on patients with SCD showed that 38% of such patients had more than one discontinuous

segment with thrombosis (multiple coronary thrombi).It is suggested that this pancoronary process of inflammation leads to simultaneous multiple plaque instability and thrombi generation when provoked by other stressors such as post operative states. This case also illustrates the fact that acute multivessel thrombosis is quite common in the post operative state. Unfortunately electrocardiograms are unable to predict acute coronary occlusions in a significant proportion of cardiac arrests.Hence, immediate coronary angiography in all such patients may be feasible in view of the poor predictive value of clinical findings and electrocardiograms in identifying acute coronary occlusion. Multiple simultaneously occurring coronary occlusion is clinically rare,hard to diagnose on the EKG and has a significant mortality rate,hence we must have a high index of suspicion for it in the appropriate clinical setting. TH: therapeutic hypothermia V fib: Ventricular fibrillation SCD: Sudden cardiac death CMO: Comfort measures only
'ROID RAGE
Anwar Rizvi; Joshua Pinner; Sander Koyfman. New York Methodist Hospital, Brooklyn, NY. (Control ID #1320524)
LEARNING OBJECTIVE 1: Corticosteroids are widely used to treat many inflammatory conditions. Along with their numerous beneficial effects, however, come many adverse side effects. One such side effect is corticosteroid-induced psychosis.
CASE: 61 year old male with a history of hepatitis B and hypertension, but with no known psychiatric or substance abuse history, was admitted for shortness of breath. He received methylprednisolone 60 mg every 8 hours for presumed idiopathic pulmonary fibrosis (IPF) with improvement of symptoms. He was discharged on tapering doses of prednisone over 5 days. At home the patient became manic and agitated and was re-admitted. Patient was given haloperidol with good effect and discharged. Patient continued to fluctuate as to mania and required eight readmissions over five months. Lorazepam was added for acute mania and lead to moderate symptom resolution alongside with haloperidol up to 5 mg daily. Patient never fully returned to

premorbid cognitive functioning but was sufficiently improved to be placed in the community. Extensive work-up found no independent causes of altered mental status. CT and MRI of the brain were negative for vasculitits and intracranial hemorrhage; arterial blood gas revealed no hypoxia; blood and urine cultures were negative; serum vitamin B12, ceruloplasmin, antibodies for autoimmune disorders or vasculitis, urine toxicology for drug abuse, alcohol-related studies, and lumbar puncture were all negative or normal. Biopsy showed a "respiratory bronchiolitis-like pattern." Corticosteroids were presumed to be the likely precipitant for the observed mental status changes.
DISCUSSION: Corticosteroids often cause a sense of euphoria; however, many patients develop disturbing psychiatric symptoms. The incidence of steroid induced psychosis in patients treated with prednisone doses <40 mg/day is 1/3%, but is 4.6% in patients treated with doses of 41-80 mg/day, and 18.4% in patients receiving doses above 80 mg/day. Some of these side effects can occur quickly, within days of initiating corticosteroids. Psychosis can occur at any dose, but almost exclusively at doses above 20 mg/day. Approximately 10% of patients have persistent symptoms despite reduction of corticosteroids. Before the availability of antipsychotic drugs, psychiatric symptoms usually remitted between 14 and 210 days after discontinuing corticosteroids, with up to 80% of cases remitting by the sixth week. Now, with the use of antipsychotics, symptoms remit in 1-150 days, with a mean recovery at 22 days. Of note, 40% of patients respond to antipsychotic drugs within 7 days, 55% recover fully within 14 days, and >90% recover within 42 days. However, our patient's psychiatric symptoms took approximately 5 months to remit requiring re-admissions, despite corticosteroid discontinuation and adequate antipsychotics. Corticosteroid-induced psychosis should be one of the earlier adverse effects picked up by physicians today. Although steroid-induced psychosis can easily be treated by discontinuing the corticosteroid and beginning antipsychotic therapy, our patient's course was unusually long. Greater selectiveness when prescribing corticosteroids is advisable because steroid psychosis affects 3-6% of patients treated with corticosteroids for medical illnesses.
26 YEAR-OLD WOMAN WITH ABDOMINAL PAIN AND XANTHOMAS Rishi Jain; Jason A. Korcak. Montefiore Medical Center, Bronx, NY. (Control ID #1339922)
LEARNING OBJECTIVE 1: Recognize the pathophysiology and clinical features of hypertriglyceridemia.
LEARNING OBJECTIVE 2: Diagnose and manage hypertriglyceridemia-induced pancreatitis.
CASE: A 26 year-old woman presented with worsening epigastric pain for 2 days. The pain radiated to the back and was associated with nausea, vomiting, and anorexia. The patient had a history of diabetes mellitus type 1 and hypertriglyceridemia. She reported taking long-acting insulin daily, but was not compliant with a low-fat diet and other medications, including simvastatin, fenofibrate, and mealtime insulin. She also recently began an estrogen and progesterone vaginal ring for contraception. Her exam was notable for tachycardia, diffuse abdominal tenderness to palpation, eruptive xanthomas over the elbows and knees, and yellowish discoloration of the palmar creases. Initial laboratory values demonstrated serum sodium 122 meq/L, measured serum osmolality 295 mosm/kg, total cholesterol 967 mg/dL, triglycerides 5456 mg/dL, and lipase 248 U/L. Extensive peripancreatic edema consistent with pancreatitis was present on abdominal CT scan. Further evaluation revealed a VLDL to triglyceride ratio of 0.36, supporting a diagnosis of familial dysbetalipoproteinemia.
DISCUSSION: While acute pancreatitis is a problem commonly encountered by internists, hypertriglyceridemia-induced pancreatitis presents unique diagnostic and management challenges. Although the exact mechanism is unknown, hypertriglyceridemia-induced pancreatitis likely begins with capillary obstruction by chylomicrons and VLDL. The resultant ischemia promotes pancreatic enzyme release and exposure of triglycerides to lipase, creating proinflammatory free fatty acids and damaging free radicals. There is no threshold triglyceride value for the development of pancreatitis, but levels are typically greater than 1000 mg/ dL. It is not uncommon for individuals with hypertriglyceridemia-induced pancreatitis to have an underlying disorder of lipid metabolism. In familial dysbetalipoproteinemia, a deficiency in apolipoprotein E prevents clearance of VLDL and chylomicrons by the liver. Additional factors such as poorly controlled diabetes, high-fat diet, or changes in estrogen, provide

a second hit to lipid metabolism, raising triglycerides to dangerous levels. Patients with severe hypertriglyceridemia may develop various types of xanthomas due to lipid leakage from the vasculature into surrounding tissues. For instance, lipid deposition in the palmar creases, striae palmaris, is pathognomonic for familial dysbetalipoproteinemia. Patients with hypertriglyceridemia-induced pancreatitis may also present with pseudo-hyponatremia, as volume displacement by extreme hyperlipidemia causes artificially low measurement of serum sodium. In addition to the typical treatment modalities for acute pancreatitis, a continuous insulin infusion helps to lower triglycerides by increasing lipoprotein catabolism and decreasing lipolysis. Severe, refractory hyperlipidemia may also warrant the use of plasmapheresis to lower triglyceride levels. Moreover, anti-oxidant therapy, such as vitamin E, may help prevent recurrent pancreatitis in hyperlipidemic patients by reducing free radical activity. Through an understanding of the pathophysiology and clinical features of hyper-triglyceridemia, internists can more effectively identify and treat hyper-triglyceridemia-induced pancreatitis.
ALCALIGENES XYLOSOXIDANS AS A CAUSE OF PNEUMONIA IN PATIENTS WITH IMPAIRED COUGH REFLEX Sagar S. Mungekar; Daniel Eiras; Benjamin Wertheimer. NYUSoM, New York, NY. (Control ID #1339609)
LEARNING OBJECTIVE 1: Recognize the clinical manifestations of A. xylosoxidans infectionsLEARNING OBJECTIVE 2: Manage patients with complicated pneumonia who are unable to clear secretionsCASE: An 81-year-old woman presented with four days of fever, shortness of breath, and cough. She has a history of cervical and transverse myelitis due to progressive multiple sclerosis resulting in triplegia and dysphagia; she is on steroid maintenance therapy of prednisone 10 milligrams daily. Upon presentation to the emergency room, the patient's oxygen saturation

was 79% on room air, which resolved with suctioning and supplemental oxygen. A pulmonary examination was notable for rhonchi heard throughout bilateral lung fields that did not clear with cough. The patient was initially treated for presumed community-acquired pneumonia with azithromycin and ceftriaxone, and was also given metronidazole for anaerobic bacteria coverage given her high risk for aspiration. The patient continued to have daily fevers on this regimen and serial chest roentgenograms demonstrated evolving bibasilar and retrocardiac consolidations. Blood cultures had not shown any growth; cultures of sputum from expectoration were reported as growing normal pharyngeal flora. Videofluoroscopic assessment of swallowing demonstrated significant amounts of penetration into the laryngeal vestibule with thin liquids and an inconsistently elicited cough reflex in response to misdirected material. Culture of a sputum sample retrieved by deep tracheal aspiration revealed innumerable Alcaligenes xylosoxidans subspecies denitrificans resistant to multiple antibiotics including ceftriaxone but sensitive to piperacillin/tazobactam in vitro. Infusion of this antibiotic was begun. The patient continued to have an oxygen requirement and developed hypotension that responded to fluid resuscitation. The patient underwent a therapeutic thoracentesis to improve her respiratory status. DISCUSSION: A. xylosoxidans is an opportunistic, aerobic, Gram-negative bacillus that causes infections including pneumonia, bacteremia, and meningitis. It has been found to colonize the human gut. Cases of A. xylosoxidans infections have been reported often in neutropenic and cystic fibrosis (CF) patients, often nosocomial or as a result of instrumentation. This case of A. xylosoxidans pneumonia is unique in that it occurred in a patient on low-dose steroids but who is otherwise immunocompetent and not recently hospitalized. Airway inflammation and chronic pulmonary disease is found in CF patients presumably due to their inability to clear secretions adequately. This patients bed-bound state and impaired gag and cough reflexes functionally mimic this phenomenon. This case illustrates a severe infection by a rare organism that may be a normal colonizer, but can be pathogenic and is difficult to treat given its resistance to multiple drugs. This patients risk factors of microaspiration and impaired cough reflex predis-posed her to a rapid deterioration. Patients with multiple risk factors for infections and

limited ability to clear secretions should be identified early and treated with broad-spectrum antibiotics. In patients with impaired cough reflex, sputum retrieved from deep tracheal aspirates may yield more microbiological culture data than those retrieved from expectoration. Although A. xylosoxidans may be a component of normal oropharyngeal flora, it should be considered pathogenic when recovered from deep tracheal aspirates in a patient with pneumonia.

A 24 YEAR OLD MALE WITH A MYOCARDIAL INFARCTION AND CARDIAC ARREST SECONDARY TO AN UNCOMMON ETIOLOGY Daniel Gutteridge; Kavitha Kesari. McLaren Regional Medical Center, Flint, MI. (Control ID #1333681)

LEARNING OBJECTIVE 1: Recognize a rare familial cause of myocardial infarction in a non-traditional population.

CASE: A 25-year-old male with no previous medical history presented to emergency medical services after developing typical left sided chest pain radiating to the left arm at rest. The patient had a normal body habitus, no family history of early coronary artery disease and no illicit drug use. The only traditional risk factor present was smoking. Initial electrocardiogram done by emergency medical services showed ventricular tachycardia that led to ventricular fibrillation and cardiac arrest. Upon arrival at the emergency department resuscitation was continued and was converted to atrial fibrillation with ST elevation in anterior lateral leads and depression in inferior leads. Emergent cardiac catheterization showed complete occlusion of the left anterior descending coronary artery requiring intravascular thrombolysis and placement of 2 bare metal stents and temporary intraaortic ballon pump. A hypercoagulable workup was done, showing a positive result for homozygous factor V Leiden. He recovered and was discharged with life long anticoagulation and genetic counseling.

DISCUSSION: Factor V Leiden (Factor V G1691A) mutation is the most common hereditary blood coagulation disorder in the United States. The prevalence of Factor V Leiden for heterozygous carriers is 3-5% and 1% of those total carriers are homozygous. Association of resistance to activated protein C with deep venous thrombosis is well established, where as

arterial thrombosis is unknown. The frequency of MI among patients aged less than 45 is rare and is typically associated with atheromatous coronary artery disease, non-atheromatous coronary artery disease, hypercoagulable states and MIs related to substance abuse. There have been case-control studies showing an increased correlation with myocardial infarction at an early age in female patients, 18-44 years that have Factor V Leiden and concomitant tobacco use. Research up to this point has been based on heterozygous mutations due to the rarity of homozygous cases. Individuals with homozygous factor V Leiden mutation who smoke may be at a significantly increased risk for MI as young adults. In particular homozygous Factor V Leiden individuals are at risk for both arterial and venous embolism, even unprovoked, and will require lifelong anticoagulation when identified. The effect of homozygous mutation on arterial thrombus, especially with concomitant risk factors like smoking, needs to be studied further.

A 26 YEAR-OLD MAN WITH METASTATIC PARAGANGLIOMA. Emily E. Hurstak1; Adrienne Green1; Aaron B. Neinstein2. 1UCSF, San Francisco, CA; 2UCSF, San Francisco, CA. (Control ID #1340075)

LEARNING OBJECTIVE 1: Diagnose catecholamine excess in a patient with a neuroendocrine tumor.

LEARNING OBJECTIVE 2: Management of catecholamine crisis in a critically ill patient.

CASE: A 26 year-old man with metastastic paraganglioma presented with shortness of breath. In 2005 he was diagnosed with a spermatic cord tumor, which was resected. In 2009, he presented with low back pain, lower extremity weakness, and facial numbness. An MRI demonstrated vertebral lesions with cord compression and a skull base mass consistent with paraganglioma. He received radiation therapy, but the disease progressed causing diplopia from a sixth nerve palsy. At the time of presentation, he complained of two months of palpitations, diaphoresis, weight loss, and one week of progressive shortness of breath. He was afebrile, hypertensive, and tachycardic. He had a II/VI systolic murmur and coarse breath sounds. Initially alert and oriented, he rapidly became confused with increased work of breathing and hypoxia requiring intubation. Initial

labs included a white count of 17, platelets of 59, fibrinogen 180, anion gap 17, lactate 6, and a troponin 1.2. His EKG demonstrated sinus tachycardia. Chest CTA demonstrated bilateral ground glass opacities with a dense lower lobe consolidation and bilateral pleural effusions. He had diffuse lytic sclerotic rib metastases, a T6 vertebral body compression fracture, and a soft tissue mass within the spinal canal and surrounding the T5-T7 vertebra. A TTE showed moderate depression of left ventricular function with increased LV wall thickness, and global hypokinesis. The patient was felt to have mixed septic and cardiogenic shock. He was started on broad-spectrum antibiotics, placed on the ARDS net protocol, and admitted to the ICU. By the third day of hospitalization the patient was persistently febrile, tachycardic, and hypertensive. Cultures of blood, urine, and respiratory sources had no growth. The patient was started on phenoxybenzamine. On hospital day 6, he became pulseless and expired after multiple rounds of CPR. The following labs resulted post-mortem: serum free metanephrine 97 (nl<57), normetanephrines 58,279 (ULN 412), a chromogranin A level 2600 (nl<15) and total metanephrines 58,629 (nl <604). The family declined a post-mortem autopsy.
DISCUSSION: This patient with metastatic paraganglioma died from a catecholamine induced cardiomyopathy and subsequent malignant arrhythmia. Paraganglioma are tumors arising in neuroendocrine tissues. Parasympathetic paragangliomas are typically located in the head and neck and 95% are non-secretory, while sympathetic paragangliomas originate in the thorax, abdomen and pelvis and are typically secretory. The initial treatment of secretory neuroendocrine tumors involves alpha blockade with secondary addition of low doses of beta blockers for adjunctive blood pressure control. The definitive treatment is surgical. A diagnosis of hereditary paraganglioma syndrome was likely in this case given the clinical history and genetic testing. The nuclear genes SDHD, SDHC, and SDHB encode subunits of the mitochondrial enzyme succinate dehydrogenase; mutations are inherited in an autosomal dominant manner. Detection of these genetic mutations is helpful in guiding surveillance and early detection of neuroendocrine tumors. Catecholamine crisis is rarely encountered on the medical service; rapid diagnosis and treatment are essential for good clinical outcomes.

A 30 YEAR-OLD MAN WITH HEADACHE AND FEVER Sarah A. Weiss. Montefiore Medical Center, Bronx, NY. (Control ID #1318368)
LEARNING OBJECTIVE 1: Diagnose tuberculous meningitis. LEARNING OBJECTIVE 2: Recognize cerebrospinal fluid (CSF) characteristics of tuberculous meningitis.
CASE: A 30 year-old Puerto Rican man presented with 5 days of severe headache associated with vomiting, photophobia, neck stiffness, and fevers. He denied head trauma, sick contacts, or upper respiratory symptoms. He worked in construction, recently travelled to the Dominican Republic, and denied toxic habits. Physical exam revealed a temperature of 100.9 F, photophobia, clear lungs, and no focal neurologic deficits. Lumbar puncture (LP) showed: glucose 61 mg/dl, protein 98 mg/dL, and cell count 336 leukocytes/mL with 87% lymphocytes. Empiric treatment with Ceftriaxone, Vancomycin, and Acyclovir was begun and discontinued after bacterial CSF cultures and HSV PCR were negative. Laboratory testing was negative for HSV, VZV, and enterovirus CSF PCR, CSF Cryptococcal antigen, RPR, and HIV. Repeat LP showed a lymphocytic pleocytosis and elevated protein, but now low glucose (35 mg/dl). Tuberculin skin test resulted in a 10 mm induration. Empiric treatment for tuberculous meningitis (TBM) was immediately initiated. Initial CSF gram stain and cultures for acid fast bacilli (AFB) were negative. A third LP after starting treatment showed a cell count of 713 leukocytes/ml with 55% neutrophils. MRI Brain revealed basilar meningeal enhancement. Clinical course was significant for waxing and waning mental status and persistent headaches, but no neurologic deficits. The patient was discharged on directly-observed anti-tuberculosis therapy. Mycobacterium tuberculosis was isolated on AFB culture 3 months later. DISCUSSION: TBM occurs in 1% of all tuberculosis cases in the U.S. Prompt clinical suspicion of TBM is imperative because of high mortality rates (20-50%) and lasting neurologic deficits (20-30%). Risk factors include young age, HIV-infection, malnutrition, alcoholism, malignancy, and use of immunosuppressive drugs.

TBM is caused by Mycobacterium tuberculosis that seeds the meninges and forms tubercles that rupture into the subarachnoid space. Diagnosis of TBM is challenging because of variable presentation and CSF characteristics that may mimic subacute meningitis, cryptococcosis, neurosyphilis, parameningeal infections, and herpes encephalitis. A 1-2 week prodrome of fever, headache, and irritability can progress to cranial nerve palsies, seizures, and eventually coma and death. CSF usually demonstrates a lymphocytic pleocytosis (100-500 leukocytes/mL), low glucose (<45 mg/dL), and high protein (100-500 mg/dL). Once treatment is begun, a paradoxical response occurs in which the CSF cell count becomes neutrophilic, due to a hypersensitivity reaction caused by tubercular protein release. Gold standard for diagnosis is identification of AFB in CSF gram stain and culture. AFB are seen on gram stain in only 10-20% of cases and cultures are slow growing with low sensitivity (25-70%). Sensitivity can be increased by examining at least 6-10 mL of CSF for 30 minutes by a skilled technician. CT and MRI may show tuberculomas, basilar meningeal exudates, and hydrocephalus, all nonspecific findings. Treatment is 4 drug therapy (rifampin, isoniazid, pyrazinamide, and ethambutol) for 2 months followed by 7-10 months of isoniazid and rifampin. Corticosteroid use remains controversial. Clinical suspicion of TBM requires immediate treatment, even in the absence of definitive diagnostics, given its high morbidity and mortality.

A 47-YEAR OLD WOMAN WITH BILATERAL ANKLE ARTHRITIS Michelle Fox; Brigid M. Dolan. Brigham and Women's Hospital, Boston, MA. (Control ID #1334642)

LEARNING OBJECTIVE 1: Devise a differential diagnosis for bilateral ankle arthritisLEARNING OBJECTIVE 2: Describe the classic presentation and diagnosis of Lofgrens syndromeCASE: A 47-year old African-American female presented to urgent care with 2 weeks of bilateral ankle pain, limiting her ability to walk or wear shoes, and diffuse muscle aches. A trial of non-steroidal anti-inflammatory medication afforded minimal relief. She denied associated fevers, chills, cough, rash, or conjunctivitis. Exam revealed tender, swollen ankles bilaterally without other joint involvement or rashes. Chest x-ray revealed bilateral hilar adenopathy. A diagnosis of Lofgrens sarcoidosis was made, although the patient declined
mediastinoscopy for tissue biopsy. The patient was treated with prednisone with significant improvement in her symptoms.

DISCUSSION: Here we present a case of a 47-year old woman with bilateral ankle arthritis and hilar adenopathy, consistent with Lofgrens Sarcoidosis. The CDC estimates that nearly 50 million Americans have arthritis, and as a many 25% of primary care visits are related to musculoskeletal complaints [1]. Bilateral ankle arthritis is an example of an uncommon presentation and its presence should prompt a chest xray to evaluate for the presence of hilar adenopathy. The presence of bilateral ankle arthritis and hilar adenopathy is consistent with the diagnosis of Lofgrens sarcoidosis[2]. Lofgrens syndrome, first described by Sven Lofgren in 1953, is a variant of sarcoidosis classically described as the constellation of hilar adenopathy, erythema nodusm, and other joint symptoms [3, 4]. More recently, bilateral ankle arthritis has been recognized as a hallmark of this syndrome as well [5]. Some argue that these classic findings are sufficient to seal the diagnosis, even in the absence of tissue biopsy[6]. It is important for clinicians to distinguish Lofgrens sarcoidosis from other forms of sarcoidosis, as Lofgrens has a better prognosis, higher rates of remission, and significantly lower relapse rates [7].1. CDC, Arthritis: Meeting the Challenge, in At A Glance, N.C.f.C.D.P.a.H. Promotion, Editor. 2011. 2. Figueira-Coelho, J. and P. Mendonca, Male presenting with bilateral ankle arthritis? Request a chest X-ray! Mod Rheumatol. 20(6): p. 640-2. 3. Lofgren, S., Primary pulmonary sarcoidosis.II. Clinical course and prognosis. Acta Med Scand, 1953. 145(6): p. 465-74. 4. Lofgren, S., Primary pulmonary sarcoidosis. I. Early signs and symptoms. Acta Med Scand, 1953. 145(6): p. 424-31. 5. Mana, J., et al., Periarticular ankle sarcoidosis: a variant of Lofgren's syndrome. J Rheumatol, 1996. 23(5):p. 874-7. 6. Reich, J.M., et al., Mediastinoscopy in patients with presumptive stage I sarcoidosis: a risk/benefit, cost/benefit analysis. Chest, 1998. 113(1): p. 147-53. 7. Mana, J., et al., Lofgren's syndrome revisited: a study of 186 patients. Am J Med, 1999. 107(3): p. 240-5.

A BONNET FULL OF SNAKES Mrunal L. Shah; Zahraa Hajjiri; John Eiser; Chetan Mittal; Raymond Hobbs.

Henry Ford Health System, Detroit, MI. (Control ID #1314346)
LEARNING OBJECTIVE 1: Recognize that visual hallucinations may occur in otherwise normal individuals with extremely poor vision. LEARNING OBJECTIVE 2: Diagnose the Charles Bonnet Syndrome and realize that failure to make the correct diagnosis can lead to mislabeling the patient as psychotic and result in unnecessary institutionalization.
CASE: A 76 year-old nearly blind woman complained of seeing snakes and lizards three days after receiving intravitreal, bevacizumab injections for wet age related macular degeneration. She knew the visions were unreal and could make them disappear by closing her eyes. There was no history of psychiatric illness, alcoholism or drug abuse. Laboratory testing, CT scans and an EEG were normal. She had the Charles Bonnet syndrome, an obscure condition that is unknown to most physicians. Such patients can be erroneously diagnosed with dementia, delirium, psychosis, etc and inappropriately institutionalized. DISCUSSION: The Swiss naturalist, Charles Bonnet, first described the syndrome that bears his name in 1760 when he reported complex visual hallucinations in his 87 year old grandfather who suffered from cataracts. It was relatively unknown in the English literature until 1982. The syndrome occurs in patients with loss of visual acuity or visual field loss. Although 11-15% of geriatric patients with impaired vision have visual hallucinations many will not report them for fear of being labeled with a psychiatric problem. Current theory suggests that visual sensory deafferentation leads to disinhibition of the visual cortex which then fires spontaneously. The characteristic that makes them different from typical hallucinations is that the patient realizes they are not real. Our patient received monthly bevacizumab injections to help her vision. After each round of therapy she had hallucinations but this time they were more distressing and persisting longer. Her hallucinations paradoxically may have been made worse as her visual acuity improved since the hallucinations may stop when blindness occurs. She was treated with reassurance and distraction therapy. Low dose atypical antipsychotics can be useful as well. Perhaps the most important intervention was explaining that she did not have a psychiatric problem and giving her a card with the diagnosis to present to future doctors who may not be aware of the condition.

A BUG ON THE BACK: A UNIQUE CASE OF SALMONELLA OSTEOMYELITIS SACHIN MOHAN MD, PHD AND SATYAJEET ROY MD, FACP DEPARTMENT OF INTERNAL MEDICINE, COOPER UNIVERSITY HOSPITAL, CAMDEN, NEW JERSEY 08103, USA Sachin Mohan; Satyajeet Roy. Cooper University Hospital, Camden, NJ. (Control ID #1334723)
LEARNING OBJECTIVE 1: To recognize that metastatic lesions in Salmonellosis can cause spinal osteomyelitis, presenting as non-specific back/abdominal pain.
LEARNING OBJECTIVE 2: To diagnose and treat osteomyelitis of spine associated with SalmonellaCASE: A 62 year-old male with history of recent overseas travel, presented with fever, fatigue, dry cough, decreased appetite, weight loss, mild pain and increased sensitivity over left upper abdomen for one month. On further questioning, the patient reported an episode of self-limited diarrhea lasting about four days during his stay in India. Labs revealed no leukocytosis or leucopenia. Liver function tests, urine analyses, and tuberculin skin testing were unremarkable. An Ultrasound-Abdomen and a CT-Abdomen/Pelvis with contrast did not reveal any major pathology. Surprisingly, a CT-Chest showed T8-T11 osteomyelitis with para-vertebral extension, and mild-moderate cord compression. Interestingly, both the stool and the spinal-biopsy identified Salmonella typhi that was ampicillin-sensitive but levofloxacin-resistant. Per-sensitivity, empiric coverage with levofloxacin was switched to ceftriaxone and ampicillin, and thoracic spinal abscess drainage, laminectomy, and fusion were done. The patient recovered well and was able to resume all of his activities of daily living.
DISCUSSION: Salmonella are principally motile, Gram-negative, rod-shaped Enterobacteria that cause diseases like typhoid fever, paratyphoid fever, and food-borne illness. Salmonella typhi is specific to humans

and spreads by contaminated food and water or via a chronic carrier. Though extra-intestinal dissemination is widely seen, spinal involvement occurs in only 0.8 % of Salmonella infections. As a disease entity, Salmonella osteomyelitis comprises only 0.45% of all types of osteomyelitis. Other than S.typhi, osteomyelitis has also been reported with S.typhimurium, S.panama andS.enteritidis. Though Salmonella osteomyelitis is classically described in patients with sickle cell disease, pre-existing bone disease, and hemoglobin-opathies; typhoid osteomyelitis is more commonly seen in patients with liver disease, diabetes, lymphoma, prior surgery, prolonged steroid use and at extremes of age. Usual sites of infection are diaphysial regions of long bones like femur and humerus, with other important sites including lumbar vertebrae, radius, ulna and tibia. While single bone involvement is usual, multiple bone involvement has also been seen. Remarkably, the symptom-free period between the initial infection and osteomyelitis can extend from months to decades. Definitive diagnosis is by culture of blood, urine, stool or marrow along with serology, while anemia, leukocytosis/leucopenia, along with raised ESR in the appropriate context should raise early clinical suspicion. Bone lesions usually show destruction of bone with erosion of diaphysis. In wake of ampicillin and bactrim resistance, ceftriaxone combined with debridement is recommended for severe systemic illness, while ciprofloxacin is used empirically. Here, we report a rare presentation of vertebral typhoid osteomyelitis in an otherwise healthy individual that was successfully treated by surgery and antibiotics. Given the significant morbidity associated, early suspicion for typhoid osteomyelitis in the setting of travel, prolonged continuous fever and diarrhea is critical in successful identification and management of the disease.

A CASE REPORT OF IGA NEPHROPATHY IN ANTI-GLOMERULAR BASEMENT MEMBRANE GLOMERULONEPHRITIS

HIroshi Yamaguchi1; Hideki Takizawa1; Yayoi Ogawa3; Christine Kwan2; Tamaki Takada1; Izumi Yamaji1; Nobuyuki Ura2. 1Teine keijinkai Medical Center, Sapporo, Japan; 2Teine Keijinkai Medical Center, Sapporo, Japan; 3Hokkaido Renal Pathology Center, Sapporo, Japan. (Control ID #1340344)

LEARNING OBJECTIVE 1: Recognize that anti-glomerular basement membrane (GBM) glomerulonephritis (GN) can coexist with IgA nephropathy (NP)

CASE: A 46 year-old Japanese man with significant past medical history of well-controlled hypertension, diabetes mellitus, hyperlipidemia, and

microscopic hematuria with intermittent proteinuria for 3 years presents with 1 weeks history of nausea, vomiting, and lower abdominal pain. He reports preceding fevers, chills, and malaise while denying dyspnea, hemoptysis, arthralgias, myalgias, and bowel movement changes. He smokes 5 cigarettes /day for 26 years; his family history is unremarkable. Physical examination shows blood pressure of 134/83 mmHg, heart rate of 84 beats/minute, normal respiratory rate range, and body temperature of37.5C. No skin lesions, joint tenderness, effusions, or edema has been found; the rest of the examination is unremarkable. Significant laboratory data include hemoglobin of 11.9 g/dL, white blood cell count of 17,350/ mm3, C-reactive protein of 16.7 mg/dL, blood urea nitrogen of 64.9 mg/ dL, creatinine of 5.2 mg/dL (baseline 0.7 mg/dL), IgA level of 640 mg/dL, and anti-GBM antibody level of 214 EU. Urinalysis shows proteinuria(2.98 g/gCr) and >100 red blood cells/high power field. Serology for human immunodeficiency virus types 1 and 2, hepatitis B and C, PR3-ANCA, MPO-ANCA, cryoglobulin, C3, C4, and CH50 are within the normal range. Computed tomography shows normal sized kidneys and no pulmonary abnormalities. With rising creatinine levels to 6.6 mg/dL, renal biopsy reveals 1 of 16 glomeruli with global sclerosis while the remainder shows cellular crescents. Light microscopy shows fragmented basement membranes; no mesangial proliferation has been observed. The diffuse tubular and interstitial infiltrates are composed of monocytes and neutrophils. In immunofluorescence (IF) microscopy, linear staining for IgG along the GBM is accompanied by granular staining of IgA in the mesangial region. Electron microscopy shows glomerulis exhibiting wrinkling and irregularity of the GBM. No electron-dense deposits, even in the mesangium, has been observed. The diagnosis, therefore, of anti-GBM GN and IgA NP has been established; his renal function, however, does not recover so he undergoes hemodialysis.

DISCUSSION: Rapidly progressive GN (RPGN) is characterized clinically by a rapid progression to end-stage

renal disease and histologically by profuse epithelial proliferation often with epithelial crescents. RPGN can be classified into three categories: pauci-immune, anti-GBM, and immune complex. Among them, anti-GBM GN can occur in all ages and is pathologically and clinically the severest form of GN. While its coexistence with another disease having an additional distinctive pattern of glomerular IF staining does not occur frequently, concomittent processes of ANCA disease and membranous glomerulopathy have been observed. This case, however, illustrates an even rarer occurrence of having coexisting anti-GBM GN and IgA NP. In crescentic anti-GBM GN, the average creatinine level at the time of diagnosis is higher than any other type of glomerular disease. Given its severity and rapidity, the number of glomeruli free from destruction is very limited. For this reason, the pathological feature of IgA NP may not be observed, even when IgA NP precedes it, thereby possibly causing a lack of case reports describing the combination of anti-GBM GN and IgA NP.

A CASE OF ACUTE COPPER TOXICITY Punal Patel; K. Andhavarapu;P. Shah; N. Menon; J. Feldman. SJHMC, Phoenix, AZ. (Control ID #1323769)

LEARNING OBJECTIVE 1: Wilson disease, also known as hepatolenticular degeneration, is due to an autosomal recessive defect in copper transportation. Ceruloplasmin represents circulating copper in the plasma. The hepatic production of apoceruloplasmin, ceruloplasmin without copper, causes the low level of serum ceruloplasmin found in patients with Wilson disease. Furthermore, the inappropriate function of the Wilson disease protein, ATP7B, leads to an impairment in biliary copper excretion, which allows copper to accumulate and deposit in the hepatic, neurologic, renal, and ophthalmic systems. Important clinical features of the disease include cirrhosis, acute liver failure, movement disorders, psychosis, and premature osteoporosis.

CASE: 25 year old male with a history of panhypopituitarism s/p removal of a suprasellar mass secondary to langerhans histiocytosis presented with altered mental status, generalized weakness, and lethargy. Of note, he had discontinued use of his DDAVP for several weeks. On admission he was found to have a serum sodium level of 172. He was immediately started on pituitary hormone replacement therapy which included, desmopressin, solucortef, and synthroid. Furthermore, he was found to have new onset elevated liver function tests, ammonia, and INR. Initially, his altered mentation was presumed to be a combination of hypernatremia and hepatic

dysfunction. As a result, he received lactulose and rifaximin. His sodium level improved, however, he remained encephalopathic. His acute liver failure was further evaluated by gastroenterology and hepatology. Diagnostic laboratory tests revealed low ceruloplasmin, high serum copper, and an elevated urinary copper level. He subsequently underwent a liver biopsy which demonstrated portal fibrosis and steatosis stage III-IV, and portal and parenchymal infiltrates stage II-IV, both were consistent with Wilson disease. He was started on pencillamine which led to immediate improvement in his mental status. The ATP7B gene was pending on discharge. He will undergo a slit lamp exam on an outpatient basis. He was discharged home with close gastroenterology and hepatology follow up.

DISCUSSION: Wilson disease should be considered in any individual between ages 3 and 55 with liver abnormalities of uncertain cause, and must be excluded in any patient with unexplained liver disease accompanied by a rapid neurological deterioration. Diagnosis of Wilson dsease is made by a slit lamp examination to identify Kayser-Fleischer rings, which represent deposition of copper in decemets membrane of the cornea. Biochemical tests demonstrate elevated liver function tests, low levels of ceruloplasmin, and high levels of serum and urinary copper excretion. Increased hepatic parenchymal copper content provides critical diagnostic information and should be obtained in cases where the diagnosis is not straightforward. Histological abnormalities found on liver biopsy include steatosis, hepatocellular necrosis, fibrosis, and cirrhosis. If the diagnosis remains elusive, molecular genetic studies such as the ATP7B mutation can be obtained. Treatment options include D-penicillamine, a chelator that promotes urinary copper excretion, trientine (also a chelator) which is indicated in patients intolerant of pencillamine, and zinc which interferes with uptake of copper from the

gastrointestinal tract.

A CASE OF AVASCULAR NECROSIS OF HIP JOINTS Emran Rouf; Maybelline Lezama; Lisa Forrester. Scott and White Healthcare, Temple, TX. (Control ID #1303096)

LEARNING OBJECTIVE 1: 1) Diagnose avascular necrosis (AVN) of hip when typical risk factors are absentCASE: A 33-year-old white male presented to our clinic with progressively worsening low back and hip pain for about 6 months. At the onset, he noticed spontaneous low back pain with radicular symptoms, which was then followed by moderate-to-severe bilateral hip pain, left worse than right. He denied any leg weakness, bowel or bladder incontinence. He is a welder and denied any major trauma to his back or hip regions. He had no history of hip dysplasia as a child, nor did he report any surgeries to his back or hip. His medical history is notable for peptic ulcer disease which is treated with a PPI. Although he was not on any chronic steroid therapy, he reported at least two episodes of intermittent systemic steroid therapy in the preceding 12 months, once for a bout of interstitial pneumonitis, and the other for an acute treatment of his low back pain. Primary care physician, neurologist and a neurosurgeon evaluated his pain. MRI of his lumbosacral spine was notable for mild degenerative joint disease, and he was managed conservatively. Two months prior to presentation, he developed progressive worsening of his bilateral hip pain, and at that point he sought medical care at our institution. His physical examination was only remarkable for significantly reduced range of motion at both hip joints, left worse than the right, along with an antalgic gait. X-ray of bilateral hip joints revealed significant avascular necrosis of both hips, although he had more disease on left. An urgent referral to Orthopedics was done. He underwent an uncomplicated left total hip replacement and is doing well since then.

DISCUSSION: Avascular necrosis of bone is a devastating, yet treatable condition that requires prompt diagnosis and often surgical management. Although a definitive pathogenesis is unknown, critical ischemia is thought to be the final etiologic mechanism. Hip joints are affected in most patients, although shoulder, knee and ankle joints can be involved as well. For symptomatic patients, as described in our vignette, a plain X-ray of the affected joint usually yields the right diagnosis. Our case highlights two major learning points: first, when hip pain accompanies lumbosacral radiculopathy, it can be attributed to the lumbosacral pathology as a referred pain, and this type of reasoning may miss a concurrent, potentially severe diagnosis. In such a scenario, physician should be meticulous to determine if hip pain is
exceedingly more severe than what a referred pain would suggest. In our case, hip pain was much more severe and disabling which alerted us to think about a possible alternate pathology. Second, in the absence of established risk factors for osteonecrosis, such as chronic steroid use and sickle cell disease, one should consider any past treatment of systemic steroid as a potential risk factor. Case reports of avascular necrosis have been reported after a single corticosteroid injection. Our vignette serves as an example of how careful history-taking and diagnostic reasoning help physicians in clinical problem-solving.

A CASE OF CAPNOCYTOPHAGUS AND THE FUTURE OF IDENTIFYING INFECTIOUS DISEASE PATHOGENS. William J. Rust1; Danny Spinuzzi1; Robert Volosky1,2. 1Allegheny General Hospital, Pittsburgh, PA; 2Infectious Disease Associates of Western Pennsylvania, Pittsburgh, PA. (Control ID #1283611)

LEARNING OBJECTIVE 1: Recognize Capnocytophagus as a potential source of sepsis in those at risk.

LEARNING OBJECTIVE 2: Recognize Ibis T5000 as a game-changing tool in rapidly isolating and identifying pathogens from a broad range of samples.

CASE: A 67-year-old man presented to an outside hospital with altered mental status and acute respiratory failure, with a past history of asplenia secondary to a gunshot wound. The patients wife reported acute onset of confusion on the evening prior, along with several episodes of vomiting, a temperature of 104 degrees Fahrenheit and a non-productive cough. The patient became increasingly short of breath and was evaluated at the outside hospital ER. The patient was febrile at 105.2 and had a white blood count of 16.6. He was pan-cultured and started on vancomycin, ceftriaxone, acyclovir, as well as steroids for presumed meningitis. A lumbar puncture was unable to be performed because of a TENS unit. The patient was intubated and

transferred to our MICU. Upon arrival, the patient had cold extremities with multiple petechiae. The tip of his nose was also involved and cultures were redrawn. When checking a blood count, the lab noted rod-shaped bacteria intra/extra-cellularly. Infectious disease and critical care staff assessment included sepsis (encapsulated organism versus Listeria versus other potential pathogen), as well as DIC, lactic acidosis, and acute kidney injury. On hospital day one, the wife asked if a dog bite could be responsible, as the family dog nipped at the patients nose and caused a minor break in the skin on the day prior to evaluation. The differential now included Capnocytophaga Canimorsus, a gram-negative bacillus in the canine flora that requires an oxygen rich environment. The organism is very difficult to isolate in culture. The patients DIC persisted and his extremity/nose necrosis continued to worsen. His somnolence continued despite sedation discontinuation. The family requested withdrawal. Multiple cultures from our facility were negative, as well as samples sent to outside facilities. The initial blood culture from the outside hospital was later reported as likely Capnocytophagus species. Post-mortem, six of the blood samples were analyzed using state-of-the-art Ibis T5000, which is a universal biosensor that allows one to identify a broad range of pathogens without requiring an anticipated organism. All six of our patients samples were grossly positive with Capnocytophaga Canimorsus.
DISCUSSION: This vignette highlights the importance of taking a thorough history and identifying Capnocytophagus as a potential source of sepsis in those at risk. Our patient was asplenic and the initial concern was for typical encapsulated organisms, however Capnocytophagus can cause devastating DIC and sepsis in asplenics. Capnocytophagus is very difficult to isolate, requiring an oxygen-rich environment. We were unable to grow the organism from multiple samples. This case introduces Ibis T5000 technology as a potential game-changer in the world of infectious disease and overall patient care. The system incorporates mass spectrometry and PCR technology to identify a broad range of pathogens, including bacteria, fungi, viruses, and protozoa, without requiring the individual to state what they are anticipating. The system can identify pathogens, including their resistance and virulence factors, in less than eight hours. The technology allowed our staff to identify an organism that we were unable to grow in culture.

A CASE OF DENGUE IN THE COLORADO ROCKY MOUNTAINS Ingrid Lobo. University of Colorado, Denver School of Medicine, Aurora, CO. (Control ID #1333772)

LEARNING OBJECTIVE 1: Recognize and diagnose Dengue in a non endemic area.

LEARNING OBJECTIVE 2: Manage and treat Dengue.

CASE: 33 year old female of Thai origin presented from an urgent care with 1 day history of bloody diarrhea, heavy menstrual bleeding, and nosebleeds. Preceding this, she complained of a 3 day history of fevers, nausea, vomiting, and headaches. Patient lives in Colorado but had recently traveled to Thailand. At the urgent care, patient was found to be thrombocytopenic and sent to the ER. Her review of systems revealed blurry vision, bruising, and myalgias. She denied confusion, congestion, cough, breathing issues, chest pain or hematuria. She had no past medical history or known bleeding issues. She denied any family history for hematologic disorders. In Thailand, they prescribed her an unknown antiemetic and antibiotic for gastroenteritis 2 weeks prior. She had not taken any other remedies or drugs. She was mainly in Bangkok but did travel to the coast. She was slender in no distress with normal vitals. She was oriented with no focal findings. She had dried blood on her nose. Her exam was otherwise normal. Negatives included no petichiae, rash, murmurs, crackles, hepatosplenomegaly or lymphadenopathy. Pertinent laboratory findings included thrombocytopenia [7 (150-400)] with a normal white count and hemoglobin, abnormal liver function tests (AST 228 U/L, ALT 120 U/L, albumin 3.2, with normal alkaline phosphatase and bilirubin), elevated d-dimer (2210 FEU), elevated PT (26.5 seconds), elevated PTT (41.9 seconds), elevated LDH (636 U/L), and a normal creatinine and fibrinogen. A peripheral smear showed no schistocytes. The patient was transfused platelets and Hematology was consulted.

The differential included an autoimmune etiology, infection, TTP, HUS, or a medication reaction. The patient was thought to have low grade DIC. Hematology suggested an Infectious disease consult and prompted us to start steroids for an immune mediated process. Infectious disease thought the presentation was most suggestive of Dengue, but asked us to test for Salmonella, blood borne pathogens, HIV and malaria as well. Dengue IgM and IgG antibodies were elevated. The patient improved with fluids, a 1 week prednisone taper, and no further transfusions.
DISCUSSION: Dengue virus is a mosquito-borne infection that affects millions worldwide. The World Health Organization (WHO) defines Dengue Fever as an acute febrile illness with 2 of the following: headache, retro-orbital pain, myalgia, arthralgia, rash, hemorrhagic manifestations, or leukopenia. Dengue hemorrhagic fever, a clinically worse scenario, must have the following: fever, active bleeding, thrombocytopenia, and evidence of vascular permeability. Dengue Shock Syndrome is when the disease progresses to circulatory failure. On literature review, diagnosis can be made clinically, but confirmed with antibody titers and PCR. It can be difficult to differentiate Dengue from other febrile illness in endemic areas, but the above clinical signs are suggestive. Upper respiratory symptoms, sore throat, congestion and cough are less likely. Treatment is largely supportive and steroids have not been found to be helpful. Our patient met WHO criteria for Dengue hemorrhagic fever. This case illustrates that clinicians must remember that a good history and a broad differential is key in diagnosis as even a tropical illness can present itself in a non tropical mountain region.
A CASE OF DYNAMIC DESATURATION Carolyn D. Sy1; Jennifer Hsieh2; Yelena Averbukh2. 1Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1288451)
LEARNING OBJECTIVE 1: Consider intrapulmonary shunts in patients with platypneaLEARNING OBJECTIVE 2: Identify diagnostic modalities for intra-pulmonary shuntsCASE: An 89 year-old woman with no smoking history or respiratory disease presented with worsening dyspnea on exertion. This was her fourth admission for the same complaint in five months. On prior admissions, she received nebulizer treatments with limited effect. The patient was a frail woman in no distress. Her respiratory exam was clear to auscultation bilaterally. She had a regular rate and rhythm without murmurs; the JVP
was not elevated. She had no lower extremity edema or tenderness. On room air, the patients respiratory rate was 18 breaths per minute and her oxygen saturation was 98%. After walking, she dynamically desaturated to 90%. Her saturation returned to 98% when supine and without supplemental oxygen. CBC, electrolytes and liver function tests were within normal limits. Chest XRay revealed no pulmonary consolidation, effusion or fluid overload. Non-contrast chest CT revealed mild pulmonary emphysema. Transthoracic echocardiogram revealed normal left ventricular wall motion and an ejection fraction of 60%. Following injection of agitated saline augmented with the valsalva maneuver, late bubbles entered the left atrium from the pulmonary veins four heart beats after their appearance in the right heart; indicating an intrapulmonary shunt. DISCUSSION: Dyspnea on exertion causing hypoxemia is a common clinical complaint. Most cases can be explained by acute insults like pneumonia and MI, or chronic cardiac or pulmonary conditions like CHF, COPD, and interstitial fibrosis. However, when the etiology is not readily apparent, further investigation is required. This patient exhibited signs of platypnea-orthodeoxia; wherein dyspnea and desaturation are exacerbated in the upright position and relieved when supine. Platypnea requires two components to develop: a shunt and a functional component that promotes shunting. In this patient, exertion acted to promote shunting through the intrapulmonary shunt revealed by the bubble study. While they are commonly congenital abnormalities or secondary to cirrhosis, evidence suggests large intrapulmonary shunts exist in otherwise healthy individuals and can lead to significant impairment of gas exchange. Several modalities are available for visualizing intrapulmonary shunts. Contrast-enhanced echocardiography using agitated saline has a sensitivity approaching 100% in detecting them. Due to the possibility of revealing clinically insignificant shunts, further anatomic evaluation is warranted. Spiral CT with contrast is the preferred modality for confirming intra-pulmonary shunts. However, this technique may not depict small shunts and may make visualization of large shunts challenging due to the breath holding requirement.

Pulmonary angiography is the gold standard for defining the anatomy of intrapulmonary shunts due to its high specificity and treatment potential. However, its invasive nature makes other imaging modalities preferred. In patients with dyspnea on exertion without a clear cause, consideration should be given to other causes for hypoxemia, like intrapulmonary shunts. Non-invasive diagnostic modalities like contrast-enhanced echocardiography or CT have high sensitivity and can lead to better patient care.

A CASE OF MULTIFOCAL OSTEONECROSIS AND ACQUIRED IMMUNODEFICIENCY SYNDROME. Tierney Sparks; Jennifer Adams. University of Colorado School of Medicine, Aurora, CO. (Control ID #1333787)

LEARNING OBJECTIVE 1: Recognize risk factors for developing osteonecrosis in patients with HIV.

LEARNING OBJECTIVE 2: Diagnose osteonecrosis in patients with HIV.

CASE: 47-year-old male with PMH of AIDS, Hepatitis C and alcohol and tobacco abuse presented to his PCP in 2009 with bilateral hip and low back pain. Exam revealed diminished range of motion and significant pain in his right hip. An x-ray was consistent with bilateral osteonecrosis of his hips, and an MRI demonstrated stage IV disease on the right and stage II disease on the left. Several months later, he underwent right hip arthroplasty. Six months after surgery, the patient presented again to his PCP with a new complaint of right shoulder pain. An x-ray demonstrated osteonecrosis. Prior to evaluation by orthopedics, the patient returned complaining of left shoulder pain and osteonecrosis was evident on x-ray of this joint. The patient was diagnosed with multifocal osteonecrosis of bilateral hips and shoulders. Prior to the diagnosis, the patient had been treated intermittently for three years with prednisone for idiopathic thrombocytopenia and had multiple admissions for acute pancreatitis secondary to alcohol abuse. The patient had been on antiretroviral therapy (ART) for three years. At this time, the patient is scheduled for a hip arthroplasty on the left and is awaiting orthopedic evaluation for his bilateral shoulder disease.

DISCUSSION: Osteonecrosis is characterized by the in situ death of bone leading to joint destruction. The hip is the most frequently affected site, although the shoulder, knee, wrist, and ankle may also be affected. Osteonecrosis is insidious in onset, affects adults between the ages of 20 and 50, and is more common in males. The pain is periarticular and triggered by weight bearing or moving the affected limb. The physical exam may reveal decreased range of motion or joint pain. Among HIV-infected patients, the incidence of mono-articular osteonecrosis is less than0.1%. Few cases of multifocal osteonecrosis in patients with HIV have been reported. Risk factors for osteonecrosis in patients with HIV include the use of systemic corticosteroids, hypercoagulable states, alcohol abuse, inflammatory states (i.e. pancreatitis), hyperlipidemia, osteopenia or osteoporosis, tobacco use, and ART. Glucocorticoids are the most commonly implicated risk factor for osteonecrosis. Steroids are thought to alter lipid metabolism leading to fatty infiltration of the bone marrow and obstruction of blood flow. Steroid- and alcohol-induced hyperlipidemia promotes fat embolization within the bone vasculature. ART has direct effects on bone metabolism thought to contribute to the development of osteonecrosis and, in addition, is associated with independent risk factors for osteonecrosis including hyperlipidemia, pancreatitis, and osteopenia. An HIV-infected patient presenting with periarticular pain and risk factors for osteonecrosis should undergo evaluation for osteonecrosis. Initial work up should include X-ray of the affected joint, with a sensitivity of 40%. If the X-ray is non-diagnostic, MRI should be pursued and has sensitivity over 90%. A bone scan may be considered if clinical suspicion remains high and MRI is not diagnostic. MRI is used for staging. Conservative management, including decreasing weight bearing is recommend for limited involvement of the bone (<15% of the bony head affected). For advanced disease, core decompression, bone grafting, and joint arthroplasty may be considered.

A CONSCIENTIOUS WORK-UP OF REGIONAL LYMPHADENOPATHY Jonathan S. Lee; Hollis Day; Peggy Hasley. University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1339348)

LEARNING OBJECTIVE 1: Evaluate and manage regional lymphadenopathyLEARNING OBJECTIVE 2: Diagnose and treat cat scratch disease CASE: A 40 year old man with no significant PMH presented with one

month of worsening neck pain and swelling. Following upper respiratory symptoms, the patient had developed two painful marble sized masses in the left side of his neck. He was initially treated with a two week course of oral clindamycin without improvement. He also noted occasional night sweats but denied fevers, chills or weight loss. The patient had a history of incarceration with previous negative PPDs. He had not traveled outside of the United States. He reported having a cat at home with a recent flea infestation. The patients exam was remarkable for multiple firm, tender neck masses with minimal overlying erythema. A CT scan showed multiple necrotic cervical lymph nodes. Fine needle aspirate showed focal acute inflammation and granulomatous reaction favoring an infectious process. Gram stain, culture and AFB were negative. Studies for HIV, streptococcus, tuberculosis, mononucleosis and toxoplasma were negative. The patient was treated with broad spectrum antibiotics. Serology later returned positive for Bartonella henselae IgM with an IgG titer of 1:256.
DISCUSSION: Regional lymphadenopathy is a common presenting complaint. The differential diagnosis is primarily comprised of infectious versus malignant etiologies. Infectious causes include mononucleosis (EBV or CMV), bacterial infection (commonly strep or staph), toxoplasma, scrofula from tuberculosis, and cat scratch disease. Regional malignant causes focus on metastatic head and neck cancers. While malignancy is always a concern, only 1.1 percent of patients presenting to their PCP with lymphadenopathy are estimated to have malignancy. Age is the most important risk factor with those 40 years or older having an estimated tenfold increase in risk (4 vs 0.4 percent). Evaluation begins with a thorough history including onset, duration and progression of swelling, associated symptoms (fever, weight loss, night sweats, fatigue, URI), and travel and exposure history (insects, animals, sun, tobacco, alcohol, radiation). Physical exam should focus on the size, consistency, tenderness and location of the nodes. The thyroid, salivary glands, skin and oropharynx should also be carefully examined. Disease specific laboratory testing and
treatment is performed based on the initial evaluation. Patients with suspected malignancy and those who do not improve after 1 month of empiric antibiotics or observation should undergo further testing with contrast-enhanced CT scanning and fine-needle aspiration or biopsy. Cat scratch disease is caused by Bartonella henselae, a gram-negative bacterium that is believed to be transmitted to humans through cat scratches and bites. Tender regional lymphadenopathy is the hallmark of cat scratch disease but disseminated disease can also occur. Diagnosis is typically based on serology because of difficulty culturing and visualizing Bartonella from tissue. A positive IgM or an IgG titer>1:256 strongly supports a diagnosis of cat scratch disease. Most cases of cat scratch disease manifest solely as regional lymphadenopathy and are self-limited. However, given that disease can disseminate to the liver, spleen, eye and central nervous system, some experts advocate treating with antibiotics, though clinical evidence studying the benefits of treatment is sparse.
A CURIOUS CASE OF FORGETFULNESS Salman J. Bandeali1;
Fawad Aslam2; Anna Kolpakchi1; Lee Lu1. 1Baylor College of Medicine, Houston, TX; 2University of Arkansas for Medical Sciences, Little Rock, AR. (Control ID #1339533)
LEARNING OBJECTIVE 1: Recognize limbic encephalitis (LE) as a cause of forgetfulness and mental status change.
LEARNING OBJECTIVE 2: Review idiopathic LECASE: A 40-year-old previously healthy female presented with a three week history of increased forgetfulness and intermittent dull headache. She denied fever, nausea, vomiting and photophobia. The family reported paranoid behavioral changes, episodes of lip smacking, and staring spells lasting one minute. There were no jerky movements, bowel or bladder incontinence. On exam, she was oriented to person but not to time and place. Frequent lip smacking was observed. The rest of her neurological exam was normal. A MRI of the brain showed hyperintense signal on T2-weighted images in bilateral hippocampi. A lumbar puncture revealed lymphocytic pleocytosis, no RBCs with normal glucose and protein. Cultures were negative for bacteria, HSV, VZV, CMV, Borrelia Burgdorferi and VDRL. ANA was positive with 1:320 titers; Anti-Smith, Rheumatoid factor, and Anti-dsDNA were negative. Other laboratory studies included normal TSH, normal complement levels, negative EBV antibody, HIV, RPR, hepatitis panel and HHV-6

PCR. The patient was treated empirically with acyclovir without clinical response. An electroencephalogram showed epileptiform activity in the bilateral temporal lobes. She was started on Levetiracetam, and the lip smacking and staring spells resolved. Based on the clinical presentation, the lack of response to anti-viral therapy, and MRI findings with a negative infectious work up, she was diagnosed with limbic encephalitis (LE). The search for an occult neoplasm was initiated. Workup was negative for Anti-Hu, Anti-Yo, Anti-Ri, Anti-GAD65, Anti-CV2 and Anti-Ma2 antibodies. A mammogram, PAP smear, transvaginal ultrasound, CT scan of the thorax and MRI of abdomen and pelvis were normal. Hence, a final diagnosis of idiopathic LE was made. She was started on prednisone 60 mg daily which was tapered over six months with clinical improvement. A year later and off steroids, her mental status remains at normal baseline. DISCUSSION: Limbic encephalitis is typically associated with 0.01% of all cancers. Recently, 70% of LE has been reported without an associated malignancy, known as idiopathic LE. The incidence is not known. New-onset anterograde amnesia and psychiatric symptoms are the hallmark features. Diagnosis is based on the clinical presentation, CSF and MRI findings. Eighty percent of patients have CSF lymphocytic pleocytosis, normal glucose and elevated protein, and 70 to 80% of the MRI findings show hyperintense signal in the medial aspect of the temporal lobes on T2 images. LE, as a paraneoplastic syndrome, is usually associated with lung cancer (50%), testicular germ cell malignancy (20%), and breast cancer (8%). Therefore, the diagnosis of idiopathic LE can only be made if there is no identifiable malignancy. However, surveillance for malignancy with full body imaging is recommended for at least 2 years after the diagnosis. Treatment options for idiopathic LE include immune modulation using steroids, azathioprine, rituximab, intravenous immunoglobulins, and plasmapheresis. Patients typically respond well with full recovery. Thus, idiopathic LE should be recognized as an entity causing anterograde amnesia and psychosis, especially in patients with a negative infectious and malignancy work up.

A CURIOUS CASE OF LOWER URINARY TRACT SYMPTOMS -CLINICAL SIGN IDENTIFYING ILIOPSOAS MUSCLE STRAIN AS ETIOLOGY OF CHRONIC PROSTATITIS Ayodeji O. Shedu1; Bruce Karlin1; Mike Roberts Roberts2. 1St Vincent Hospital, Worcester, MA;
2Central Massachusetts Physical Therapy, Worcester, MA. (Control ID #1313038)

LEARNING OBJECTIVE 1: Consider Iliopsoas strain in the differentials of lower urinary tract symptomsLEARNING OBJECTIVE 2: Use appropriate clinical sign to elicit iliopsoas muscle strain in setting of chronic prostatitisCASE: A 50yo otherwise healthy male, presented to the outpatient clinic with urinary urgency and frequency of 7 days duration, and nocturia up to 3 times nightly. He had mild lower back pain which he attributed to multiple repetitions of abdominal crunches he recently added to his vigorous daily workout. He denied fever, urethral discharge, or change in sexual habits. He had no medical history and family history was not contributory. He had seasonal allergies and worked as an engineer. Vital signs were stable and physical examination revealed no focal back tenderness. DRE elicited mild tenderness of prostate. Despite negative UA, UTI was presumed and treated with ciprofloxacin. 3 days later, patient returned to clinic with worsening symptoms. He was referred to a Urologist who made a diagnosis of inflammatory prostatitis and started a 2 weeks course of Tamsulosin. For the next 15 months, various urologists prescribed multiple courses of antimuscarinic drugs and antibiotics for Chronic Prostatitis. His symptoms improved after 6 months treatment with Solifenacin and it was tapered. Two months later, his urinary symptoms returned along with increasing back pain. IPSS was 23, back exam was negative, and PVR was negligible. A cystoscopy was negative. An MRI was initially read as L2-3 root impingement but neurosurgery dissented. A physical therapy assessment revealed tenderness to palpation along the iliopsoas muscle belly. Palpation of the proximal portion of the iliopsoas was done by palpating at the midpoint of the umbilicus and anterior superior iliac spine at the lateral border of the rectus abdominis muscle with patient supine and lower limb extended. The patients head was

resting on a pillow to relax the abdominal musculature. A diagnosis of iliopsoas strain was made and patient was treated with physical therapy intervention consisting of manual myofascial massage, neuromuscular reeducation and stretching. His symptoms completely resolved by the end of the 5th session. He remains asymptomatic.
DISCUSSION: Symptoms suggestive of chronic prostatitis has a prevalence of about 8%, accounting for nearly 2 million ambulatory care encounters annually. The diagnosis of Chronic Prostatitis currently encompasses many conditions unrelated to the prostate. Abdominal and/ or pelvic floor muscle tenderness have been associated with this condition. The patient is an avid rower and was preparing for a competition by doing up to 500 crunches at a time immediately prior to symptom onset. His lower urinary tract symptoms probably developed secondary to Iliopsoas strain as a result of his vigorous exercises. Elicitation of exquisite iliopsoas muscle tenderness correctly identified myofascial strain as a contributor to his symptoms. Routine clinical assessment of muscular involvement in prostate symptoms can easily identify patients who may respond to physical therapy intervention. This will engender significant reduction in patients suffering and health care cost.
A DEVIATED TONGUE Alice Jacob; Kurt J. Pfeifer; Ehab Atallah. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1314701)
LEARNING OBJECTIVE 1: Describe the presentation of extramedullary leukemiaLEARNING OBJECTIVE 2: Review the treatment of chronic myelogenous leukemia and extramedullary leukemia.
CASE: A 43-year-old man with no significant medical history presented with slurred speech and tongue deviation for 2 days. He also had night sweats, migratory arthralgias, 30-pound weight loss over 2 months and intermittent headache. On admission he had an isolated left cranial nerve XII palsy. Other pertinent exam findings included a right scapular mass and bilateral testicular enlargement. Laboratory studies were notable for hemoglobin of 8.7 g/dl, platelet count 429,000/cu mm and white blood cell count of 18,100/cu mm with an absolute neutrophil count of 12,800/ cu
mm. Infectious etiologies, including HIV and tuberculosis, were ruled out. AFP and Beta-HCG were within normal limits. Brain MRI revealed a clivus mass impinging on the left hypoglossal nerve. Scrotal ultrasound was suggestive of an infectious or lymphoproliferative disorder. A positron emission tomography scan showed patchy infiltrates in both lungs, hypo-attenuating areas within the muscle surrounding the right scapula and abnormal left kidney uptake. Bone marrow biopsy demonstrated a myeloid neoplasm - Philadelphia chromosome-positive (Ph+) chronic myelogenous leukemia (CML) with 1.6% blasts, 90% of which were myeloid. Scapular mass biopsy was consistent with an extramedullary lymphoid blast crisis of Ph +CML. Given that the brain and testes are not well targeted by chemotherapy, he received brain and testicular irradiation. His chemotherapy regimen consisted of dasatinib and HyperCVAD (cyclophosphamide, vincristine, doxorubicin and dexamethasone) followed by methotrexate and cytarabine. On completion of radiation therapy and his first few cycles of chemotherapy, he had resolution of his tongue deviation and testicular enlargement. DISCUSSION: Chronic myelogenous leukemia (CML) is a clonal malignancy characterized by the chromosomal translocation of the breakpoint cluster region gene (BCR) from chromosome 22 fusing with the ABL gene on chromosome 9, commonly known as the Philadelphia chromo-some. Granulocytic sarcomas (GS) or extramedullary tumors occur most frequently in acute myelogenous leukemia (AML) but also in CML and other myeloproliferative disorders. Their occurrence in AML is seen in 2.5-9.1% of patients but is five times less frequent in CML patients. Patients with GS are frequently asymptomatic, and 50% of cases are diagnosed only at autopsy. These tumors can involve any part of the body, including bone, spine, brain, and other visceral organs, and multiple sites simultaneously. CML has three phases: chronic, accelerated and blastic. Blast crisis is the terminal phase of CML and behaves like acute leukemia. The BCR-ABL fusion gene product is a tyrosine kinase.Treatment for patients with myeloid blast crisis, lymphoid blast crisis and Ph+ALL includes tyrosine kinase inhibitors such as imatinib, dasatinib, and nilotinib. Recent studies show that although the BCR-ABL tyrosine kinase inhibitor imatinib is effective in Ph+leukemias, relapse does occur. In such cases, dasatinib

induces hematologic and cytogenetic responses in patients with CML or Ph+ALL who cannot tolerate or are resistant to imatinib.

A DIAGNOSIS THAT IS HARD TO SWALLOW: COMPLEXITIES OF MEDICAL MANAGEMENT Andrew Ayers. Creighton University Medical Center, Omaha, NE. (Control ID #1334785)

LEARNING OBJECTIVE 1: Recognize clinical features of Amyotrophic Lateral Sclerosis (ALS) as part of the differential diagnosis when working up progressive dysphagia.

LEARNING OBJECTIVE 2: Manage multiple general and medical subspecialty resources to diagnose and treat ALS.

CASE: A 78 year old male with a past medical history of CAD with five coronary stent placements, hypertension, hyperlipidemia, and diabetes mellitus presented as a new patient to internal medicine clinic with a complaint of difficulty swallowing solids for several months. Prior to this clinic visit, he had seen multiple primary care providers and had undergone esophageal dilatation twice, with trace improvement in symptoms. Upon presentation, the patient noted that in addition to dysphagia, his voice would become hoarse after talking for 10 to 15 minutes, and after a brief period of rest, his ability to speak would recover. He also relayed that he felt like he could not breathe while lying flat but had no symptoms when lying on his side. He was admitted 3 months prior for chest pain for which catheterization revealed a 70% RCA lesion not requiring intervention. He was discharged with plans to undergo a cardiac stress test but was lost to follow up. At the time of clinic evaluation, the patient had a hoarse voice but no other pertinent physical exam signs. He was referred to gastroenterology and otolaryngology and was set up for EGD with plans for esophageal dilation if needed. Prior to the procedure, he required clearance with cardiac stress testing which demonstrated acute ischemia requiring admission. At that time, his dysphagia had progressed. He had developed a slow gait, and his head was continuously in a flexed position. CT and MRI brain were pertinent for only mild brain atrophy. Cardiac catheterization was performed, and a bare metal stent was placed in the RCA lesion to reduce the time needed for anticoagulation, given the

patients impending EGD and progressing symptoms. Subsequently, neurology was consulted for suspected visual changes. Patient admitted that visual changes were chronic in nature but, newly performed neurological examination revealed hyperactive reflexes in the lower extremities and fasciculations over the deltoid muscles on hammer strike. He underwent immediate EMG which revealed active denervation of multiple muscle groups consistent with ALS, bulbar onset type. EGD was cancelled, and the patient was started on riluzole.

DISCUSSION: ALS presents as asymmetric limb weakness in approximately 80% of patients with a prevalence of 1.7/100,000 among the general population. Bulbar onset, as described above, may occur in up to 20% of patients presenting with ALS. Clinical suspicion for neurological disorders with this presentation should be higher in patients without a significant smoking history or traditional symptoms of gastroesophageal reflux. This patients post-hospital management included chronic disease management and preventive care by internal medicine, regular follow up and treatment with neurology, gastrostomy tube placement by gastroenterology, and assistance by palliative care for end of life issues. Recognizing the presentation of ALS in this patient with active cardiac disease and history of multiple esophageal procedures was only possible once this patient established care with a permanent primary medical provider. This also allowed for the implementation of a coherent treatment plan among multiple medical specialties.

A DIAGNOSTIC ENIGMA: ANCA POSITIVE PNEUMONIA HalisK. Akturk; Priyanka Vashisht; Daniel Wehrmann; Gretchen Butler; Andrea Giomi; Againdra K. Bewtra. Creighton University Medical Center, Omaha, NE. (Control ID #1279064)

LEARNING OBJECTIVE 1: Identify the different causes of refractory cough and dyspnea.

LEARNING OBJECTIVE 2: Understand the clinical presentation of cryptogenic organizing pneumonia (COP). Comprehend the differential diagnosis of positive serological markers like cytoplasmic antineutrophil

cytoplasmic antibody (c-ANCA).
CASE: A previously healthy 62-year-old African American male presented with six week history of dry cough, shortness of breath and seven pound weight loss. The patient had dyspnea with his routine activities and often had prolonged coughing spells. He had a 40-pack year smoking history. He had no history of allergies, animal exposure, recent travel or occupational risk factors. There was no personal or family history of pulmonary disease. He was prescribed a 10-day course of moxifloxacin with no relief. He was treated with piperacillin/tazobactam and levofloxacin for 1 week without improvement and had 4 liters oxygen requirement. The patient presented to the emergency, as his symptoms were progressive worsening without any relief. The patient was afebrile, tachycardic and tachypneic. Respiratory exam revealed coarse rhonchi bilaterally with scattered wheezing. Rest of the physical exam was unremarkable. Lab investigation revealed leukocytosis (12.000 WBC/mm3) with eosinophilia (12%) and hypoalbuminemia (2 g/dl). Erythrocyte sedimentation rate was 101, c-ANCA was positive (1:320), and antibodies to myeloperoxidase and Proteinase-3 were negative. An initial chest x-ray showed bilateral interstitial shadows. Computed tomography revealed bilateral patchy ground glass opacities with areas of honeycombing. Pulmonary function test showed mild airflow obstruction with severely reduced diffusion capacity. Bronchoscopy revealed moderate lymphocytic inflammation throughout the tracheobronchial tree. Bronchoscopic biopsies were inconclusive so video-assisted biopsy of lung was obtained. It showed fibroblastic proliferation and granulation tissue filling terminal bronchioles and alveolar spaces consisted with Cryptogenic Organizing Pneumonia (COP). High dose of intravenous steroids were started and followed by oral taper. His pulmonary function tests improved dramatically with the steroid therapy. DISCUSSION: It is important to recognize the presentation of refractory cough and shortness of breath. COP previously termed Bronchiolitis Obliterans-Organizing Pneumonia (BOOP) is a clinical, radiological and pathological diagnosis, when no definite etiology such as infection or connective tissue disease is found. The onset of illness is usually acute and presents as a flu like illness. Histological sampling is imperative because corticosteroids and cytotoxics are contraindicated in many differential
diagnoses. Transbronchial biopsies usually do not provide a sufficient sample and an open/video-assisted lung biopsy is recommended to confirm the diagnosis. It is critical to understand the relevance of immunological test and the diagnosis should not be made solely on their basis. Although C-ANCA has a specificity of 88-100 % for Wegeners Granulomatosis, it should be reviewed in the context of the overall picture. An inappropriate diagnosis based solely on the results of ANCA testing could have serious consequences.
A DIZZYING DIFFERENTIAL DIAGNOSIS Tara Shankar. UPMC, Pittsburgh, PA. (Control ID #1339409)
LEARNING OBJECTIVE 1: Differentiate between peripheral and central vertigo and state initial diagnostic evaluationLEARNING OBJECTIVE 2: Recognize the clinical features of pontine infarctCASE: A 48 year old nonsmoking female with history of hypertension and family history of migraines presented with two day history of sudden onset dizziness with sensation of movement, right-sided tinnitus, nausea and vomiting. Patient additionally reported intermittent symptoms of diplopia, bitemporal headache, and transient right upper extremity weakness. Physical exam was notable for bilateral miosis, left horizontal nystagmus that did not suppress with ocular fixation, and mild dysphagia. Rinne and Weber testing was normal bilaterally and Dix-Hallpike maneuver was negative. MRI brain was performed which revealed a small infarct within the left paramedian pons, interpreted to be lacunar stroke in setting of known hypertension. Hypercoagulabilty workup was negative, as was evaluation for arrhythmia or patent foramen ovale. Antiplatelet therapy was initiated and patient referred for acute stroke rehabilitation. DISCUSSION: Dizziness and vertigo rank among the most common complaints in medicine and account for approximately 7.5 million primary care visits annually. Vertigo may pose a diagnostic challenge for physicians as it represents a large range of diagnoses from benign to immediately life threatening; therefore, distinguishing between its peripheral and central etiologies is essential. Peripheral etiologies, which frequently present with pronounced nausea and vomiting, auditory symptoms such as hearing loss, tinnitus or pain, and nystagmus suppressed with visual fixation, tend to resolve in hours to days. Conversely, central

etiologies present with severe imbalance but less prominent movement illusion and nausea, vertical or pure rotary nystagmus, and other neurologic signs such as motor and sensory deficits that tend to resolve in days to weeks. As blood supply to the inner ear and vestibulocochlear nerve arise from the basilar artery, infarction in the pontine distribution may present as vertigo of either peripheral or central origin. More commonly in pontine infarction, vertigo is accompanied by motor findings such as transient or persistent weakness and incoordination as well as oculomotor findings of nystagmus, miosis and horizontal gaze palsy. In particular, weakness of the bulbar muscles, commonly manifested by symptoms of dysphagia and dysarthria, is an important cause of morbidity in these patients. Therefore, the initial diagnostic evaluation of a patient with vertigo should utilize a combination of focused history taking, physical exam maneuvers, and diagnostic tests to evaluate the most common and most serious etiologies. History of stroke risk factors, migraines, positional symptoms and temporal relationship may help direct exam. Physical exam should include hearing and neurologic testing, as well as maneuvers such as the Head Impulse Test, which has a high specificity for peripheral vertigo syndromes. Neuro-imaging is indicated if there are neurologic signs on physical examination, if there is a new headache, and if the physical exam and history are not entirely consistent with a peripheral lesion. In this scenario, MRI and MRA of the brain, which has a specificity and sensitivity greater than 95% in detecting occlusion of posterior circulation is the test of choice.

A FIRE BEING KINDLED Holly Peek; Chayan Chakraborti. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311833)

LEARNING OBJECTIVE 1: Recognize the clinical significance of the kindling phenomenon in patients with multiple alcohol withdrawal episodes.

LEARNING OBJECTIVE 2: Identify alternative treatments to benzodiazepines for patients experiencing multiple withdrawal episodes. CASE: A 55-year-old woman with an extensive history of alcohol dependence presented to the emergency department with progressive generalized weakness over the previous several months. Her past medical history included hypertension, cirrhosis, and heavy alcohol use with several withdrawal episodes. Her heart rate was 108 bpm, but the other vital signs were normal. She was ill-appearing, pale, icteric, jaundiced, and moderately confused and oriented to person and place. She had stigmata of chronic liver disease, but had no asterixis. Her laboratory evaluation revealed anemia, thrombocytopenia, hyponatremia, hyperkalemia, hypocarbia, elevated total bilirubin, elevated ALT, and elevated alkaline phosphatase. Her urinalysis was indicative of a urinary tract infection; the toxicology screen was normal. Despite resolution of the urinary tract infection with antibiotics, adequate electrolyte replacement, and improved hyper-ammonemia with lactulose therapy, her mental status remained poor. She was not oriented to person, place, or time, requiring one-to-one observation for severe agitation and occasional treatment with risperidone and haloperidol. A brain MRI/MRAwas normal and no seizure activity was noted. The medical team treated the patient with benzodiazipines for alcohol withdrawal. The mental status initially improved but worsened when benzodiazipines were tapered. The patients condition was ultimately determined to be prolonged alcohol withdrawal associated with the kindling phenomenon.

DISCUSSION: Alcohol withdrawal is a common problem facing general internists. The kindling phenomenon occurs after several prior episodes of alcohol withdrawal building up to result in a more prolonged episode and may manifest as persistent mental decline and psychomotor agitation. Animal studies have demonstrated permanent imbalance in excitatory and inhibitory neurotransmission in animals exposed to multiple cycles of alcohol exposure, abstinence, withdrawal, and re-exposure. This is clinically supported in both human and animal studies that have demonstrated worsening withdrawal symptoms with each successive withdrawal cycle. History of multiple withdrawal episodes in these studies increased susceptibility to more severe future

withdrawals. In our patient, due to the difficulty in tapering benzodiazepine treatment and her declining mental status, she was given a 5-day taper of oral carbamazepine. Studies have shown carbamazepine to be equal in efficacy to benzodiazepine for alcohol withdrawal treatment and may be superior in treating those with multiple withdrawal episodes. Carbamazepine prevents alcohol withdrawal seizures and improves symptoms common in withdrawal states such as sleep disturbances, anxiety, and mood instability. Carbamazepine has lower abuse potential and sedating effects compared to benzodiazepines. Most promising, patients treated with carbamazepine compared to lorazepam were found to drink significantly less and take longer to return to drinking if they relapsed. Over the ensuing five days of carbamazepine treatment, the patients mental status and orientation markedly improved, no longer requiring medications for agitation. She was discharged to a nursing home and one month later due to complications of cirrhosis.

A HEART CRUSHING DIAGNOSIS OF ABDOMINAL PAIN Camila Masias; Dahlia Rizk. beth israel medicial center, New York, NY. (Control ID #1340380)

LEARNING OBJECTIVE 1: Recognize the broad differential of abdominal pain, including rare causesLEARNING OBJECTIVE 2: Diagnose Morgagni hernia as a cause of abdominal painCASE: 36 year old hispanic male, no remarkable past medical history, presented to the emergency department with a 6 month history of intermittent abdominal pain that became severe 3 days prior to admission. Pain was localized in the epigastrium and radiated to both upper quadrants. He had been taking omeprazole 40 mg, ranitidine 150 mg, and aluminum hydroxide liquid without relief. He reported nausea, but denied vomiting, diarrhea, melena, hematochezia or constipation. He also reported intermittent abdominal distention associated with increase pain. The patient was seen at two other institutions with the same symptoms. Chest x-ray, abdominal x-ray and ultrasound were normal. Esophagogastroduodenoscopy showed chronic gastritis. Abdominal computerized tomography (CT) scan showed an anterior left diaphragmatic hernia, which contained transverse colon abutting the heart. Despite findings, symptoms improved, and patient was discharged home with esomeprazole 40 mg daily. On presentation 3 months later to our institution, patient reported intermittent bloating, distention, and was in distress secondary to pain. On exam, there was no distention, however the abdomen was tender in the upper quadrants and epigastric region. There was no guarding and no masses were palpated. Laboratory tests were normal, including liver panel, amylase and lipase. Chest CT scan again showed Morgagni hernia in the anterior chest containing a loop of transverse colon and omentum with mass effect on the heart. Laparoscopic repair of the hernia was done successfully by retracting transverse colon from the mediastinal cavity. The patient was discharged 3 days after the surgery, and was followed as an outpatient with resolution of symptoms. DISCUSSION: While evaluating a patient with abdominal pain, it is important to have a broad differential of common causes, however, rare causes must also be considered. Morgagnis hernias are secondary to congenital defects in the anterior diaphragm, that later stretch secondary to the rapid rise in intraperitoneal pressure. For this reason pregnancy, trauma, obesity, constipation, and chronic chough have been found as common predisposing conditions. Morgagnis hernias seem to be more common in women, and present mostly with pain or pressure in the chest or abdomen. Occasionally, due to compression on the heart wall, dyspnea or arrhythmia may be present. Some cases are asymptomatic. Delays in diagnosis, however, may lead to serious complications such as obstruction or strangulation. Although there has been a rise in the number of cases reported, due to low clinical suspicion, this diagnosis may be present more frequently than the literature suggests. To confirm diagnosis, a plain chest radiography may be adequate, however, since the appearance differs depending on the contents of the hernia, diagnosis may be missed. CT scan is considered a more accurate method for diagnosis. The treatment is surgical, even in asymptomatic patients, as this may prevent future complications. Clinicians must have an increased awareness of rare causes of recurrent epigastric pain, chest pain or dyspnea. Morgagnis hernia is one such case that may have serious consequences if gone undiagnosed or untreated.

A HIGH PRESSURE SYSTEM: WHEN CHEMO GOES TERRIBLY WRONG S. M. Soni; Allison DeKosky.

University of California, San Francisco, San Francisco, CA. (Control ID #1338710)
LEARNING OBJECTIVE 1: Learn about a rare cause of meningitis LEARNING OBJECTIVE 2: Recognize the signs of increased intracranial pressureCASE: A 51 year-old woman presents with severe headache for two days. She has a history of advanced non-small cell lung cancer with metastases in her cerebrospinal fluid. She had undergone left upper lobe segmental resection, Ommaya reservoir placement and six cycles of intrathecal methotrexate as well as systemic chemotherapy. Three days prior to admission, she received her first dose of intrathecal liposomal cytarabine. On initial exam, she was inattentive with waxing and waning mental status, but oriented to self, place and date and answering questions appropriately. She had bilateral proptosis, pupils were reactive 5 to 2 mm bilaterally, extraocular movements were intact. She had no photophobia. Her cranial nerves 2-12 were intact and neck was supple. She had 5/5 strength in upper and lower extremities with intact sensation to light touch throughout. Five hours later she was found face down on her bed unresponsive. Her repeat exam was notable for heart rate ranging from 55-67 beats per minute and blood pressures of 160-220/98-110. Her pupils were sluggish, she had an absent gag reflex, meningismus and was leaking CSF from her Ommaya port. She was no longer following commands, repeating yes to all questions. She had 5-10 beats of clonus of the right foot that was not present on the left. CT scan of brain demonstrated mild interval increase in ventricle size concerning for early hydrocephalus compared to past imaging with Ommaya catheter tip in appropriate position. CSF analysis of fluid drawn off Ommaya port had an opening pressure of >55 mmHg with 78 WBC, 850 RBC, 69 PMNs, glucose of 81 and protein of 53 (serum glucose of 130 and serum total protein of 6.2). On further questioning of the patients family, it was revealed that patient had not taken any of her post-chemotherapy doses of dexamethasone. They also recalled that she had previous hospitalizations for intracranial hypertension.

DISCUSSION: Although headaches are commonly seen in patients receiving chemotherapy and managed in the outpatient and inpatient setting, quick identification of red flags in patient presentations and implementation of emergent management are critical skills for internists. In this patient there were several concerning features, including the patients history of malignancy with recent intrathecal chemotherapy and altered mental status. Her clinical status quickly deteriorated as her intracranial pressure increased,leading to CSF leakage through her Ommaya port. Further, she developed a profound Cushings response (bradycardia and hypertension), a finding that requires emergent intervention. Other markers of increased intracranial pressure include headache, emesis, papilledema, and cranial nerve palsies. Once these findings are present, neurosurgical consultation is mandated. Our patient underwent placement of an external ventricular drainage device. Within hours, she was alert and oriented without any residual neurologic deficits. Although this patient had an excellent recovery, fatal chemical ventriculomeningitis after intrathecal cytarabine has been reported (Butto A, et al. 2011. Fulminant chemical ventriculomeningitis following intrathecal liposomal cytarabine administration. Journal of Clinical Neuroscience 18(10):1417-1418). This episode appears to be triggered by her medication noncompliance with dexamethasone and perhaps her predisposition to hydrocephalus.
A LYTIC LESION BY ANY OTHER NAME, IS STILL A LYTIC LESION Ramsey Al-Hakim; Adam Rodman. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311870)
LEARNING OBJECTIVE 1: 1. Identify the differential diagnosis of a lytic bone lesion 2. Understand the diagnostic approach to aneurysmal bone cysts 3. Identify the risks associated with a percutaneous transpedicular vertebral biopsyCASE: A 50 year-old woman presented with a three-day history of acute onset low back pain. The lumbar pain came on suddenly after she leaned over to pick up a light load of laundry. The pain radiated to her legs bilaterally, and was associated with leg numbness. Her symptoms improved with standing, and worsened with sitting. She denied lower extremity weakness, incontinence, saddle anesthesia, or fevers. Her past history was significant only for hypertension, diabetes, and hyperlipidemia. She was afebrile, and her vital signs were normal. There was exquisite tenderness to palpation of the fifth lumbar vertebrate.

Lumbar flexion and gait were limited secondary to pain. Straight leg testing was positive bilaterally. Reflexes were normal, and her sensation and motor strength were intact. An MRI revealed an expansile lesion in the L5 vertebral body and a pathological fracture of the superior and inferior endplates; there was significant loss of vertebral height. A CT of the T/L/C-spine, abdomen/ pelvis, and thorax revealed only the L5 lytic lesion. A bone scan revealed increased uptake in L5. A percutaneous transpedicular biopsy of the lytic lesion was performed, revealing blood clots on histology and scant clusters of atypical spindle cells on cytology. Age appropriate cancer screening was performed, as was a bone marrow biopsy and immunoelectrophoresis; all diagnostic tests were normal. A repeat biopsy of the lytic lesion six months after initial presentation confirmed the aneurysmal bone cyst. DISCUSSION: Back pain and lytic bone lesions are commonly encountered by the general internist. It is important that the general internist has a disciplined approach to the evaluation of an expansile lytic lesion, recognizing that not all lytic lesions are indicative of metastatic disease. Once metastatic disease has been excluded with age-appropriate cancer screening, a primary bone disease should be considered for Lodwick grade II or III lesions. A percutaneous transpedicular vertebral biopsy with good approach can reliably detect plasmacytomas and chondrosarcomas. Repeat imaging of a lytic lesion without demonstration of significant expansile growth can effectively exclude a giant cell tumor, particularly in adults. While percutaneous transpedicular biopsy is regarded as safe with a high diagnostic rate, the risk of further collapse and worsening of symptoms increases in severely diseased vertebrae. For the general internist, it is important to understand the diagnostic approach to a lytic bone lesion. Once primary and secondary malignant processes have been excluded with a successful biopsy and appropriate imaging/studies, aneurysmal bone cyst can reliably be diagnosed without exposing a patient to further risks associated with repeat transpedicular biopsies in a severely diseased bone. Further, knowledge of this disease can avert untoward patient stress and anxiety by prematurely jumping to the conclusion that a cancer is present.

A MOVING STORY: FAHR DISEASE John Humphrey. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311725)

LEARNING OBJECTIVE 1: Recognize the clinical and radiographic presentation of Fahr disease.

LEARNING OBJECTIVE 2: Distinguish between the classifications of movement disorders as they relate to the function of the basal ganglia. CASE: A 38 year-old man experienced three months of progressive gait instability and declining functional capacity. Prior to the onset of these symptoms, he had had no medical history. He described no signs and symptoms suggestive of endocarditis or thromboembolic disease, but did note that members of his extended family had experienced similar symptoms during the fourth and fifth decade of life. His vital signs were normal. His cardiac, pulmonary, abdominal and skin examinations were norma. He was severely dysarthric but able to follow commands. Movement of the extremities was symmetric but clumsy, bradykinetic, and rigid. His gait was unstable. A computed tomography scan of the brain revealed extensive symmetric mineralization of the caudate nucleus, thalami, putamen, subcortical region, and brain stem. Subsequent laboratory testing revealed normal serum calcium, phosphorous, lead, copper, and ferritin levels. The HIV ELIZA and ANA tests were negative, and a clinical and radiographic diagnosis of familial idiopathic basal ganglia calcification (Fahr disease) was made. DISCUSSION: Over time, general internists have assumed more and more of the primary diagnosis and management of neurologic disease. While movement disorders are not as common as stroke, it is important that the general internist have a disciplined approach to the diagnosis of new-onset movement disorders. Familial idiopathic basal ganglia calcification, also known as Fahr disease, is a disorder of movement characterized by symmetric calcification of the basal ganglia in the setting of progressive neurologic dysfunction. Diagnosis is confirmed by brain imaging after excluding other metabolic, infectious, toxic, or traumatic causes. Autosomal inheritance patterns have been observed, though the cause of the disorder remains unknown. Hence, a family history of the disorder raises the pretest probability of the disease. Once the diagnosis is made, immediate family members should be offered neurologic and neuropsychiatric evaluation. This should include genetic counseling and screening neuroimaging regardless of

whether one is exhibiting symptoms of the disease. As there is no cure for Fahr disease, management is focused on pharmacologic treatment of the neurologic and psychiatric manifestations. These therapies may include anxiolytics, antipressants, antispasmodic, or antiepileptics. The general internists ability to distinguishing between the clinical presentation of the most common movement disorders, as they relate to the function of the basal ganglia, is important in identifying and managing these diseases.

A MYSTERIOUS CASE OF ESOPHAGEAL VARICES David W. Walsh. Medical University of South Carolina, Charleston, SC. (Control ID #1338514)

LEARNING OBJECTIVE 1: Overview the initial work up of patients with esophageal varices and negative liver biopsiesLEARNING OBJECTIVE 2: Describe the natural history of Idiopathic Portal HypertensionCASE: Patient is a 69 year old male with a PMH of DM, aspirin use who presented with new onset massive hematemesis requiring intubation, blood products, and vasopressor pressure support. Urgent EGD was preformed showing 3 medium sized column varices in the esophagus and clips were placed. Initial laboratory values were significant for thrombocytopenia and normal liver function tests. The patient subsequently stabilized and was able to be extubated. A liver biopsy at the time of discharge showed no evidence of cirrhosis or non-cirrhotic portal hypertension. The patient was discharged on Nadolol. He subsequently underwent MR and hypercoagulable work up to evaluate for portal occlusive disease, however the

portal system was widely patent. Out of concern for sampling error, the patient underwent a repeat liver biopsy. It again was negative cirrhosis, however it did show sinusoidal dilation and Stage I portal fibrosis consistent with idiopathic portal hypertension. DISCUSSION: Idiopathic portal hypertension is a rare, poorly understood condition that leads to clinical features of portal hypertension (i.e.- varices, spleenomegaly, etc.) with no evidence of cirrhosis or clear etiology of portal occlusive disease. Terms such as hepatoportal sclerosis, obliterative portal venopathy of the liver, and phlebosclerosis have been applied to the disease, but likely represent the same process. Clinically, it appears to act similar in nature to other patients with variceal disease and respond well to appropriate therapy. In contrast, though, these patients do not share other similar features to cirrhotic patients (recurrent infection, encephalopathy, etc). IPH is a diagnosis of exclusion; therefore it is important to rule other possible etiologies of portal hypertension including cirrhosis, venoocclusive disease, and hypercoagulable states. Once a negative liver biopsy is obtained, a reasonable next step is to perform MR to evaluate the patency of the portal system. IPH carries a better prognosis than its cirrhotic counterpart and the main cause of death is related to esophageal variceal bleeding. Patients seem to do well with beta blockade therapy and subsequent reduction in portal pressures. The 10 year survival approaches 80%.

A MYSTERIOUS CAUSE FOR A LUNG MASS Maria Sobolev1;
Andrew Lee2; Robert Ashton3; Lewis A. Eisen4; Ariel L. Shiloh4.
1Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY; 3Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY; 4Montefiore Medical Center, Albert Einstein College of Medicine, Bronx, NY. (Control ID #1337481)

LEARNING OBJECTIVE 1: Recognize foreign body aspiration as a cause for recurrent or prolonged lung disease.

CASE: A 49 year-old man with mild-intermittent asthma, a 90-pack-year smoking history, and multiple admissions for pneumonia was admitted for increasing cough, right sided chest pain, dyspnea, and hemoptysis over a three year course. There was no fever, chills, night sweats, or weight loss. Physical exam revealed right base rales. Chest X-ray demonstrated a right lower lobe infiltrate. Laboratory testing was significant for a leukocytosis (WBC 12.8 K/uL). Urine legionella, fungal cultures, PPD, and AFB testing were negative. Chest CT revealed a 4 cm x 4 cm right lower lobe mass with an endobronchial component and ipsilateral, mediastinal,

and hilar lymph nodes measuring up to 1 cm in size, consistent with malignancy. PET CT displayed a hypermetabolic mass in the same location without evidence of metastatic disease. Bronchoscopy identified an endobronchial mass surrounded by necrotic tissue almost completely occluding the right lower lobe. Cultures grew E. coli and the patient was treated with antibiotics. The transbronchial biopsy, washings, and cytology were nondiagnostic. The patient underwent right lobectomy via video-assisted transthoracic surgery. Final pathology revealed a spherical object, grossly resembling a peanut and microscopically consistent with vegetable matter, within the bronchus. There were changes suggestive of a post-obstructive pneumonia, without evidence of malignancy in the specimen or lymph nodes. On further questioning, the patient could not recall an aspiration. DISCUSSION: Among the recognized cases of FBAs, 80% occur in children. Most cases in adults, occur in patients who are elderly, have a neurological disorder, abuse alcohol or use sedatives. Adult FBAs are less likely to be fatal. Presentation of aspiration may be immediate or delayed for months to years, in a rare case described, for more than 20 years. Patients often dont recall choking and the material retrieved from the airways is not readily recognized, causing a diagnosis to be overlooked. Aspirated foreign bodies commonly lodge in the right main stem bronchus, with the right lower lobe being the most common site of impaction, presumably because of the vertical orientation of the bronchus. Complications associated with long-standing FBAs, including recurrent pneumonias, lung abscesses, bronchial stenosis, empyemas, and bronchocutaneous fistulas, make it more difficult to detect FBA radiographically. Diagnosis and occasionally treatment can be made by flexible bronchoscopy, but often rigid bronchoscopy is required. There are procedural challenges related to the location, or the foreign body itself, which can be surrounded by granulation tissue posing difficulty in removing the foreign body. Moreover, if the diagnosis of FBA is not known a priori, visualization on bronchoscopy is less likely, especially with organic material, which within hours of impaction tends to be surrounded by mucosal inflammation and granulation tissue, requiring histological examination. In our case, as there was no history of aspiration, radiographic studies and direct visualization led to misdiagnosis of bronchogenic carcinoma with surgical lobectomy leading to the correct diagnosis. FBA is often not suspected in healthy adults and may present a diagnostic challenge. Aspiration should be included in the differential diagnosis of recurrent or prolonged lung disease.

A MYSTERIOUS SLOW DECLINE: HTLV ASSOCIATED MYELOPATHY Md J. Ahmed; Michael Ryan; Nazrul Chowdhury; Roger D. Smalligan. Texas Tech University Health Sciences Center, Amarillo, TX. (Control ID #1334585)

LEARNING OBJECTIVE 1: Recognize an uncommon cause of a slowly progressive lower extremity weakness in an adult.

LEARNING OBJECTIVE 2: Diagnose HTLV Associated Myelopathy in adults.

CASE: A 58yo African American man presented with slowly progressive weakness in his lower extremities (LE) over an 8 year period. On walking short distances he had severe fatigue in his legs and would frequently fall. He had tingling in his feet, dizziness on arising, urinary urgency and nocturia. The patient denied headaches, visual or hearing changes, neck and back pain. He had no history of trauma or stroke and denied foreign travel. PMH was significant for hepatitis C and HTN. FH was negative for neurologic diseases. P/S history: positive for smoking; denied alcohol and current drug use. PE: orthostatic changes in blood pressure and pulse but otherwise normal heart, lung and abd exams. Neuro: cranial nerves intact, 4/5 strength in LEs, DTRs brisk except decreased at the ankles. Vibratory sense was absent at the toes and decreased at the ankles. Pinprick was diminished to the midfoot bilaterally and toes were upgoing. Gait was halting and unsteady. Lab: normal CBC, chemistries, coagulation panel, HbA1c, CPK, vit B12, copper and urinalysis. AST/ALT were mildly elevated. HIV, RPR, influenza were negative. CSF: WBC 11, (98% lymphs, 2% monos), normal gluc/protein and gram stain. Brain MRI showed enhancing white matter lesions on T2/FLAIR in the frontal/parietal lobes, thalamus and pons. MRI of the spine showed diffuse atrophy of the cord. HTLV I/II titers in serum and CSF were positive. NCV/EMG showed neuropathy without myopathy in LEs. The patient was treated with a trial of

steroids and had some increased strength and less falls. DISCUSSION: This patients history, exam, lab and imaging studies meet WHO criteria for the diagnosis of HTLV-Associated-Myelopathy (HAM). HTLV-I is known to be the causative agent of several diseases including adult T cell leukemia, HAM (also referred to as Tropical Spastic Paraparesis (TSP)) and distinct forms of uveitis, dermatitis and myositis. The virus is endemic in Japan, the Caribbean and parts of Africa. Transmission is by breastfeeding, blood products and intravenous drug use. It is believed that 20-30 million people are infected worldwide; 1-3% of infected individuals develop HAM/ TSP. The time from infection to onset of symptoms ranges from years to decades and between 35 to 45 years of age. The clinical picture is much like our patients: slowly progressive, symmetric LE weakness with some spasticity, hyper-reflexia and Babinski signs; upper extremities are spared. Urinary and bowel dysfunction are common as are parasthesias, although motor complaints usually predominate. HAM can mimick primary progressive multiple sclerosis except that HAM does not have a relapsing-remitting course. Diagnosis is suggested by the history and physical and confirmed with images and labs including positive IgG titers to HTLV I/II in serum and CSF. MRI can be normal but 50% of patients have white matter lesions as in our patient. Spinal cord MRI may show atrophy or degeneration. Small treatment trials have shown anti-virals to be ineffective and mixed results from steroids. Progression to wheelchair bound status occurs on average at 21 years from diagnosis but the disease is rarely fatal. Further research is needed to identify a more effective treatment regimen. Internists need to suspect HTLV associated myelopathy in any middle-aged patient with progressive weakness combined with spasticity.

A POEMS THAT DOES NOT RHYME: AN UNUSUAL CASE OF POLYNEUROPATHY Patrick Green1,2; Lara Paraskos1,2; Yoel Brito1,2; Erin N. Marcus1. 1University of Miami Miller School of Medicine, Miami, FL; 2Jackson Memorial Hospital, Miami, FL. (Control ID #1339320)

LEARNING OBJECTIVE 1: Recognize the diagnostic criteria for POEMS Syndrome.

LEARNING OBJECTIVE 2: Understand the limitation of serum protein electrophoresis for the diagnosis of monoclonal plasma cell disorders. CASE: A 59 year old male with no past medical history presented to his primary care physician with generalized abdominal pain, lower extremity numbness and tingling pain, fatigue, and erectile dysfunction. Initial studies revealed hypothyroidism, low testosterone, low Vitamin B12, thrombocytosis, and hepatosplenomegaly. Treatment was initiated with levothyroxine, testosterone replacement, a PDE-5 inhibitor, gabapentin, and B12 injections but his symptoms worsened. A fat pad biopsy was negative for amyloidosis. Four months after his initial presentation he went to an emergency department for increased abdominal pain and girth. Paracentesis showed spontaneous bacterial peritonitis. Physical exam was remarkable for ascites, hepatosplenomegaly, static mechanical allodynia and edema of the lower extremities, facial telangectasias, and a non-blanching rash on the dorsum of his feet. He was admitted and started on Cefotaxime and albumin. Laboratories showed normal liver function tests and CBC with a creatinine of 1.2, which continued to worsen. Ultrasound showed hepatosplenomegaly and patent hepatic vasculature. Hepatitis B, Hepatitis C, HIV, anti-smooth muscle antibody, anti-mitochondrial antibody, and a 24-hour urine copper were normal. Transhepatic biopsy showed congestion with negative congo red and rhodamine stains. Electromyography showed diffusely slowed nerve velocities and lack of motor responses consistent with a demyelinating process such as chronic inflammatory demyelinating polyneuropathy. The medical team entertained a diagnosis of POEMS syndrome. SPEP revealed an IgA isotype with elevations of both lambda and kappa light chains with a normal kappa/ lambda ratio interpreted as no monoclonal spike. He had an elevated serum VEGF level. Two weeks after admission he acutely developed respiratory arrest, and died. Autopsy showed an incidental low grade follicular lymphoma in the mesenteric lymph nodes.

DISCUSSION: POEMS is a clinical syndrome characterized by polyneuropathy, organomegaly, endocrinopathies, monoclonal plasma cell proliferative disorder, and skin changes. Diagnosis requires polyneuropathy and a monoclonal plasma cell disorder plus one major criteria (sclerotic bone lesions,

Castlemans disease, or elevated VEGF level) and one minor criteria (organomegaly, endocrinopathy - but not isolated diabetes or hypothyroidism, skin changes, papilledema, extravascular volume overload, thrombocytosis, or polycythemia). The majority (90%) have elevated lambda chains. Our patient had all of the characteristic findings except the monoclonal spike. Review of the literature revealed a series of 50 patients in which there was a correlation between renal failure and elevated lambda and kappa levels resulting in a normal ratio and lack of an M-spike on SPEP. Reports of the sensitivity vary with most studies citing sensitivities around 70%-98% based on methodology and the disease for which it is being used to screen. In cases with no monoclonal spike on SPEP, determination of a clonal plasma cell disorder can be made via bone marrow biopsy, flow cytometry, serum protein immunofixation. In this case, examination of the bone marrow on autopsy may have revealed a monoclonal plasma cell disorder.

A PAIN IN THE NECK: VERTEBRAL ARTERY DISSECTION AFTER CERVICAL MANIPULATION William A. Hammond. Dartmouth-Hitchcock Medical Center, Lebanon, NH. (Control ID #1339528)

LEARNING OBJECTIVE 1: Recognize, assess, and expeditiously treat vertebral artery dissections and associated posterior circulation cerebrovascular accidents.

LEARNING OBJECTIVE 2: Appropriately counsel patients about potential risks of chiropractic cervical manipulationCASE: A 33 year old right-handed man with history of mild hypertension was well until about a month prior to presentation to the Emergency

Department when he experienced pneumonia with severe cough. He recalled a prolonged coughing bout, after which his neck began to ache. This persisted, so he sought chiropractic treatment. On his second visit, immediately following cervical spine manipulation, he noted light-headedness, tingling in the right hand and foot, and became diaphoretic. He attempted to stand but noted dizziness and listing to the right. When symptoms did not rapidly resolve, he was transported to the ED and was found to be hypertensive with systolic blood pressure greater than 200 mmHg. Exam revealed mild right ptosis, right beating nystagmus, and anisocoria with a miotic right pupil. He was diaphoretic, but mental state was intact. He exhibited mild right arm ataxia and a muted right plantar reflex, however the remainder of his neurologic exam, including strength and sensation, was unremarkable. Computed tomography of his head and neck revealed an extensive right vertebral artery dissection, and subsequent magnetic resonance imaging of the brain revealed right sided cerebellar and medullary infarcts consistent with the clinical presentation of lateral medullary infarction, or Wallenberg syndrome. He was started on a heparin infusion and transitioned to full anticoagulation with warfarin for a planned course of six months of therapyDISCUSSION: Vertebral artery dissection is a rare complication of chiropractic manipulation, however, may contribute to more injuries than clinically recognized. A body of literature exists of multiple case reports indicating that dissection may be quite common. The arterial injury may be preceded by an incident causing an intimal tear, perhaps accompanied by cervicalgia. This tear allows propagation of an arterial intramural dissection when shearing forces from cervical manipulation of the vertebral bodies apply unnatural pressure to the vertebral arteries as they course through the transverse foramina. Given the anatomical predisposition to this sort of injury, patients should be warned about this potential complication of chiropractic therapy. This is increasingly pertinent as the use of complementary therapeutics becomes more ubiquitous. The most common presenting symptom of dissection is dizziness, indicating vestibulocerebellar involvement, but can also include findings similar to the aforementioned case including nystagmus, ipsilateral limb ataxia, and ipsilateral Horners syndrome. These findings are related to the infarction territory in the lateral medulla with vestibular nuclei and the descending sympathetic nervous system. The abnormal sweating and labile blood pressure is explained by lesions involving the dorsal motor nucleus of the vagus nerve. This syndrome should be recognized early so that therapy can be initiated with rapid imaging and subsequent full anticoagulation, if no contraindications exist.

A PANCREATIC PSEUDOCYST GOING ROGUE Alice Williamson; Jamie Nguyen; Joseph Luka; Peter S. Reynaud. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1340486)

LEARNING OBJECTIVE 1: 1. Recognize the clinical presentation of extra-abdominal pancreatic pseudocyst. 2. Understand the pathophysiology of pancreatic pseudocyst formation.
CASE: A 49 year-old woman with chronic pancreatitis presented with new-onset fever and epigastric tenderness. She noted diffuse abdominal tenderness without distention, or changes in her bowel habits. There was associated intermittent pleuritic chest pain. She had a history of rheumatoid arthritis, COPD, HIV, and multiple recurrent pneumonias over the previous two years. She had a forty-pack year history of smoking and alcohol use, but had stopped drinking three years earlier. Her vital signs were normal. Her cardiac, pulmonary and neurologic examinations were normal. She had diffuse tenderness to abdominal palpation, but no guarding or rebound tenderness; her liver size was small. The amylase and lipase levels were normal, as was her CBC and INR. The chest X-ray revealed left lower lobe airspace disease. Given her history of recurrent pneumonia and chronic pancreatitis, a CT scan of her chest, abdomen, and pelvis was obtained, revealing a peripherally-enhancing, air-containing, complex fluid collection within the thoracic cavity. The fluid collection extended from the pancreas through the esophageal hiatus into the posterior pleural space bilaterally with two main components measuring 6.0 x 4.0 cm on the left and3.0 x 1.0 cm on the right. A CT-guided drainage and contrast injection revealed contrast flowing through the medial right and left pleural spaces, along the

medial and inferior aspects of the stomach, then into the pancreatic duct - a pancreatic pseudocyst. Of note, the fluid culture grew VRE for which she was appropriately treated.
DISCUSSION: Pancreatitis is a commonly encountered diagnosis by the general internist. Past establishing the diagnosis, the internist must also be adept at recognizing the complications of this disease. Pancreatic pseudocysts are cystic cavities bound to the pancreas by inflammatory tissue. They are infrequent complications of pancreatitis and more commonly occur in alcohol-induced pancreatitis. Most pseudocysts develop in the peripancreatic area; however, they rarely extend elsewhere, preferring the paths of least resistance and presenting with symptoms of irritation to the local areas. In this case, the pathway was through the esophageal hiatus and into the posterior pleural space bilaterally. Given the complex nature of this pseudocyst and the patients recurrent illness, she needed surgical excision. She underwent exploratory laparotomy, extensive lysis of adhesions, distal pancreatectomy, and splenectomy with pleural fistula excision. Unfortunately, she passed away five days after the surgery.
A QUESTIONABLE CLOT Samuel E. Cohen; Manuela Calvo; David de Gijsel. Montefiore Medical Center, Bronx, NY. (Control ID #1324666)
LEARNING OBJECTIVE 1: 1) Discuss a case where the diagnosis of pulmonary embolism was investigated. LEARNING OBJECTIVE 2: 2) Highlight the importance of clinical epidemiology in medical decision-making.
CASE: A 52 year-old woman, with a history of scimitar syndrome (a right pulmonary vein which empties directly to the inferior vena cava), presented with shortness of breath and chest pain. The shortness of breath started two years ago and had been gradually worsening since then. It was now present at rest and there was associated three-pillow orthopnea. The chest pain was pleuritic, left-sided and radiated to the back. She was tachycardiac to 104 beats per minute. A V/Q scan was performed and revealed a segmental perfusion defect in the right lower base, which is considered to be high-probability for pulmonary embolism. Anticoagulation was initiated. Upon further examination, it was discovered that the pain was reproducible on palpation and the d-dimer was 1.0 ug/dl (low-probability). The V/Q scan was thought to be a false positive. The patient was discharged with the diagnosis of costochrondritis. Two weeks later, the patient presented to the Emergency Department with the same symptoms. At that time, an echocardiogram was done and revealed severe global left ventricular dysfunction, with an ejection fraction of 20%. Due to uncertainty regarding the interpretation of the V/Q scan from the previous admission, a CT of the thorax with contrast was performed. It revealed no

embolus, but showed bronchial-arterial dissociation in the right inferior lung i.e. the bronchial tree and arterial tree did not share the same course.
DISCUSSION: While a high probability V/Q scan in a patient with chest pain and shortness of breath would appear to make a strong argument in favor of the diagnosis of pulmonary embolism, a closer look at the clinical context of the patients presentation cautions a shrewder approach. According to the PIOPED study, a high probability V/Q scan in the setting of a low clinical suspicion as judged by a physician was positive for PE in 5 out of 9 (56%) patients. In the setting of intermediate suspicion, a high probability V/Q scan was positive for a PE in 70 out of 80 (88%) patients. As judged by the attending physician at the time of the patients first hospital admission, a pulmonary embolism was not the most likely diagnosis based on the history and physical examination. Additionally, the Modified Wells Score was 1 and the Simplified Geneva Score was 2, both considered low probability. This low risk provides a framework by which to interpret the subsequent lab tests and radiological studies. Unique to this case, the patients anomalous pulmonary vein clued in the medical team to a plausible, alternative explanation for mismatched ventilation and perfusion. Congenital heart defects, as well as heart failure, COPD, and pneumonia may cause positive V/Q scans. Consequently, the gold standard, CT angiography, corroborated and accounted for the false-positive V/Q scan. This raises an interesting point regarding the paradoxical nature of false-positive results and management of the subsequent uncertainty: when can a presumed false positive be disregarded and when is additional confirmatory testing required?
A RARE ASSOCIATION OF MONOCLONAL GAMMOPATHY OF UNDETERMINED SIGNIFICANCE. Girish Singhania; Dipaben Patel; Soujanya Sodavarapu; Swapna Chalasani. OSF St Francis Medical Center, Peoria, IL. (Control ID #1311950)
LEARNING OBJECTIVE 1: Monoclonal Gammopathy of Undetermined Significance (MGUS) can present as protein losing enteropathy by association with localized Gastrointestinal (GI) amyloidosis.
CASE: An 85-yr-old Hispanic female with history of hypertension presented with abdominal pain, diarrhea and increased abdominal distension for 4 days. She also had increased fatigue, dysphagia and edematous legs for 4 months. She denied shortness of breath, chest pain, fever or dysuria. On examination, she was alert and oriented but fatigued. There was no jaundice or macroglossia. She had decreased bibasilar breath sounds, normal heart sounds, distended abdomen without hepatosplenomegaly and +2 lower extremity edema. Initial labs showed CBC, electrolytes, creatinine, lipase, bilirubin and lactate within normal limits.. Her albumin was found to be 1.5 gm/dL. Stool was negative for helminthic ova, giardia and clostridium difficile antigen. Chest X-ray showed small pleural effusions. CT abdomen revealed diffuse fluid-filled dilation of the small bowel. Upper GI series showed moderate presbyesophagus and spasm at the esophagogastric junction. Esophagogastroduodenoscopy showed multiple soft nodules in the gastric antrum with normal esophagus and duodenum. Esophageal and duodenal biopsy showed amorphous eosinophilic material which demonstrated apple-green birefringence with Congo red stain under polarized light suggestive of Amyloidosis. Alcian Blue, Periodic acid-Schiff, Warthin-Starry stain were negative for GI metaplasia, Whipple's disease and Helicobactor pylori respectively. Etiological work-up for amyloidosis included ESR 4 mm/hr, C-reactive protein 1.3 mg/dL, Calcium 8.6 mg/dL, urine protein 384 mg/24 hr and negative Rheumatoid factor and Antinuclear antibodies. Serum protein electrophoresis detected a paraprotein spike at 1.44 gm/dL. Urine protein electrophoresis showed a faint gamma band. Immunofixation revealed increased IgG/Lamba monoclonal immunoglobulin suggestive of MGUS. Immunohistochemistry and flow cytometry from peripheral smear were negative for clonal plasma cells or malignant B-cells. Echocardiography showed no infiltrative cardiomyopathy. The patient was started on tube feeds because of dysphagia. Her clinical status continued to deteriorate with worsening dyspnea and severe malnutrition secondary to protein losing enteropathy. Percutaneous gastrostomy tube was suggested. However, after extensive discussions, the family refused and decided to withdraw all life support measures and the patient died. DISCUSSION: MGUS is defined by the presence of a serum monoclonal protein concentration less than 3 gm/dL. It has rarely been shown to be complicated by amyloidosis. Our case

describes a rare association of localized GI amyloidosis with MGUS. No clinical, laboratory and imaging findings were consistent with cardiac, renal and liver involvement ruling out systemic amyloidosis. As MGUS can be complicated by amyloidosis and multiple myeloma transformations, a follow-up of these patients and further research is needed to establish guidelines for better management.

A RARE CASE OF COMPLETE HEART BLOCK Ehtesham Ul Haq; Abdul Haseeb; Subhraleena Das; Amit S. Dhamoon. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1334129)

LEARNING OBJECTIVE 1: Recognize cardiac manifestations of RabiesLEARNING OBJECTIVE 2: Learn to monitor cardiac function in Rabies patientsCASE: A 24 year old male with no significant past medical history was bitten by a stray dog on thenar eminence of right hand. According to the patient, the dog was captured, killed and his brain was biopsied which did not show any infection with Rabies virus. The patient received a vaccine at that time but he did not remember the details of treatment. Subsequently, the patient presented seven months later with severe numbness and tingling of right hand. He also had intractable nausea, vomiting and throat tightness when drinking fluids. Physical exam was within normal limits at the time of admission. He started becoming anxious and agitated on 2nd day of hospitalization. CT scan of the head was normal. The patient became very

agitated and required intravenous Ativan, intramuscular Zipresidone and eventually required endotracheal intubation for airway protection. A provisional diagnosis of Rabies was made. Subsequently nuchal skin biopsy, salivary sample and CSF analysis were all consistent with Rabies encephalitis. After confirmation of the diagnosis, the patient was put on the Milwaukee protocol for Rabies encephalitis and was treated with Ketamine, Ribavarin, Amantadine and Fentanyl. Patient became bradycardiac with a heart rate in the 30s and went into Mobitz type II and third degree heart block. He was given atropine intravenously. Cardiology was consulted urgently and a transvenous pacemaker was placed immediately at the bedside. Cardiac injury panel remained normal in this patient. Pacemaker was rechecked multiple times during the hospital stay and it was found to have excellent capturing. Due to the complexity of ongoing medical issues, permanent pacemaker was not inserted. Hospital course was complicated by Diabetes Insipidus, ARDS requiring extracorporeal membrane oxygenation and intracranial hemorrhage. Intracranial bleed with large midline shift was not amenable to any surgical intervention. Patient was made comfort care at this point and he died.

DISCUSSION: Rabies is a preventable zoonotic disease that has the highest case fatality rate of any infectious disease. Viral replication occurs in the CNS and then virus spreads along neural pathways to Heart, Skin and other organs. In Heart, Rabies virus can cause cardiac arrhythmias and myocarditis. Myocarditis may reflect both hyperadrenergic state and direct viral infection. Cardiac injury panel should be checked periodically and patients should be kept on telemetry to monitor for myocarditis and high degree AV blocks respectively. There have been very few case reports in literature mentioning high degree heart block requiring pacemaker in Rabies patients. Our patient went into high degree AV block from Rabies requiring pacemaker. Heart block was managed appropriately with urgent pacemaker placement but multi organ failure led to his death.

A RARE CASE OF SHIGELLA BACTEREMIA Darshan Kothari; Alexis Z. Tumolo; Rebecca Hutchinson. BIDMC, Boston, MA. (Control ID #1340418)

LEARNING OBJECTIVE 1: Review causes of acute onset bloody diarrhea, recognizing Shigella as a less common cause of enteritis and bacteremia.

LEARNING OBJECTIVE 2: Recognize the importance of blood culture surveillance and immediate therapy in immunocompromised hosts. CASE: A 55 year-old male with past medical history of HIV (CD4 121, viral load 4,160), hepatitis C, and gastric lymphoma presented with a four day history of hematochezia. The patient reported 5-10 bloody bowel movements per day, without abdominal or rectal pain. He also denied fevers, chills, nausea, vomiting, melena, sick contacts, recent travel, dietary changes, prior episodes of bloody diarrhea, recent sexual contact, or drug use. On the day of admission, he was found to be lethargic and with altered

mental status. In the emergency department, the patient had 500 cc of rectal bleeding with an associated four-point hematocrit drop. Labs were notable for a leukocytosis to 17,200 with 9% bands and an anion gap with a lactate of 1.9. An abdominal CT demonstrated thickened mucosa in the terminal ileum and diffusely throughout the colon. Given these findings, intravenous ciprofloxacin and metronidazole were initiated for empiric therapy of colitis. Blood cultures were drawn on admission and within 48 hours grew Shigella flexneri, sensitive to penicillins, cephalosporins, and fluoroquinolones. Stool cultures were initially negative however ultimately grew S. flexneri. Antibiotics were tailored to ciprofloxacin. Diarrhea and mental status improved over his hospital course. As his mental status improved, he complained of severe rectal pain concerning for perirectal abscess. However, a pelvic MRI was remarkable only for findings consistent with colitis. Pain was ultimately attributed to a rectal tube placed in the intensive care unit. The patient was discharged to complete two weeks of ciprofloxacin. At two-week follow up with his PCP, his symptoms had resolved.
DISCUSSION: Dysentery is an inflammatory state of the intestine caused by an enteroinvasive pathogen resulting in bloody diarrhea. The common bacterial pathogens causing bloody diarrhea include E. coli O157:H7, Shigella, Campylobacter, and Salmonella. Bacteremia is a rare complication of dysentery but has been reported with Shigella infections. This is more frequently reported in the pediatric population, however also occurs in immunocompromised adults. In 1993, Huebner et al. reviewed twelve reported cases in Shigella bacteremia in HIV-positive patients [1]. A review article in the Archives of Internal Medicine from 1987 reported higher mortality rates in cases with isolated bacteremia than in patients with Shigella cultured from blood and stool in patients with HIV [2]. Thus, it is imperative that blood cultures be obtained from patients on presentation before initiating antibiotic treatment, especially in immuno-compromised hosts. Positive blood cultures should then define the antibiotic course, with gram-negative-rod bacteremia usually requiring two weeks of treatment.
References: 1. Huebner J, Czerwenka W, Gruner E, von Graeventiz A. Shigellemia in AIDS patients: care report and review of the literature. Infection. 1993 Mar-Apr;21(2):122-4. 2. Morduchowicz G, Huminer D, Siegman-Igra Y, Drucker M, Block Cs, Pitlik SD. Shigella bacteremia in adults. A report of five cases and a review of the literature.Arch Intern Med. 1987 Nov; 127(11):2034-7.
A RARE CASE OF HEPATOSPLENIC LYMPHOMA: THE DIAGNOSTIC CHALLENGE OF INFECTION VS MALIGNANCY Elizabeth Selden; Andrew A. Chang. NYU, New York, NY. (Control ID #1323721)
LEARNING OBJECTIVE 1: Recognize hepatosplenic lymphoma as a rare subtype of T-cell lymphomaLEARNING OBJECTIVE 2: Recognize the dangers of early diagnostic closureCASE: A 30 year-old Guinean man with no past medical history presented with cough, fever, night sweats and weight loss for two months. The patient immigrated to the US 6 years ago. Exam showed cachexia, HR 122, T 101.3, BP 105/72, RR 22, O2 96% on RA, splenomegaly, normal lung exam and no appreciable lymphadenopathy. Labs were significant for a WBC 3.0 with 73%N, Hbg of 7 and a negative rapid HIV. CXR was unremarkable. Patient was isolated for possible tuberculosis. CT revealed splenomegaly, multiple scattered low-density lesions in the liver, prominent mediastinal, hilar, axillary and retroperitoneal lymphadeopthy, with the largest node measuring 3.7 x 2.8 cm. CT-guided biopsy of the retroperitoneal lymph node revealed fibrocollagenous tissue with necrosis. AFB, fungal stains, and cultures were negative. High fevers persisted to Tmax 105.7 F. Despite three negative AFB sputums, patient was started on a liver-sparing TB regimen given clinical suspicion for extra-pulmonary tuberculosis and worsening liver function. A bone marrow biopsy was performed revealing normal bone marrow with slight megakaryocyte hyperplasia but no evidence of lymphoma. Repeat core biopsy of the retroperitoneal lymph node showed necrotic tissue with few CD3+ T cells; AFB and cultures again negative. The course was further complicated by acute hepatic failure and transfusion dependent pancytopenia. On day 20, as the risks of invasive surgical testing increased, decision was made to perform excisional biopsy of a small superficial inguinal lymph node seen on CT. Preliminary pathology showed T-cell lymphoma with cytotoxic features. TB treatment was stopped and chemotherapy with a modified EPOCH regimen was initiated. After biopsy, flank pain, severe agitation from hepatic encephalopathy and DIC developed. This was concerning for retroperitoneal

bleed and led to intubation and sedation. The patients clinical picture rapidly declined and multi-organ system failure ensued. The patient expired one month after hospital admission. Final pathology of lymph node revealed hepatosplenic T-cell lymphoma of the alpha/beta subtype. DISCUSSION: Hepatosplenic T-cell lymphoma (HSTCL) is a rapidly progressive variant of peripheral T-cell lymphoma, in which mature T cells infiltrate the spleen, liver and bone marrow. These T-cells are usually of the gamma/delta subtype; however in rare cases such as this one, they express the alpha/beta T-cell receptor. These lymphomas account for less than one percent of non-hodgkins lymphomas, and typically affect men in their thirties. Median survival is less than 2 years. This case of HSTCL was unusual in that there was significant diffuse lymphadenopathy, the T-cells were alpha/beta subtype rather than delta/gamma, and hepatomegaly was not present. Given the aggressive nature of HSTCL, expedient diagnosis is critical. The patients presenting symptoms and emigration from an area endemic for tuberculosis rightly raised concern for TB; however, it is essential to consider other diagnostic pursuits and not have early closure on diagnosis. In retrospect, an excisional biopsy should have been performed earlier in his hospital course given the inconclusive core biopsy of the

retroperitoneal lymph node. It is unclear whether this would have ultimately changed the outcome of the case, but it may have lead to earlier diagnosis and treatment.

A RARE CASE OF RECURRENT COCAINE INDUCED PSEUDO-VASCULITIS Ayodeji O. Shedu1; Yongli Ji1; Gregory Williams2; Alice Williams2. 1St vincent Hospital, Worcester, MA; 2Reliant Medical Group, Worcester, MA. (Control ID #1304923)

LEARNING OBJECTIVE 1: Consider cocaine as etiology of vasculitis during work upCASE: A 43 year old woman was admitted for a two day history of rash, swelling and pain in both hands. She also reported chills and sore throat. Further review of systems was negative except for bilateral knee pain that had resolved by admission. Her past history includes depression, heavy use of alcohol, and osteomyelitis of the right index finger secondary to a cat bite about 6 weeks before the present illness which required partial amputation. Her home medications included sublingual buprenorphine and oral clindamycin. The patient had presented with similar symptoms two years ago after an episode of cocaine consumption. C-ANCA and cardiolipin IgM at the time were positive. The lesions resolved after she had abstained from cocaine. On exam she had a low grade fever of 100.1. A purpuric rash was found on the earlobes, hands, gluteal and suprapubic regions, and both lower extremities. Some of the affected areas had bullous changes with necrosis. Severe tenderness was noted. Laboratory studies were remarkable for a positive ANA, IgM of 24, and p-ANCA 1:640. PR-3 and MPO specificity were negative. Cryoglobulin was negative and C3, C4 and CH50 were normal. Toxicology screening was positive for cocaine and alcohol. PT/INR/PTT were normal. Fibrinogen was elevated at 427 but fibrin split products were negative. Blood cultures and RPR were negative. The patient was advised to abstain from cocaine and was managed symptomatically, with complete resolution of vasculitis in six weeks.
DISCUSSION: Pseudovasculitis is often clinically difficult to differentiate from vasculitis. Cocaine use is a known but rare cause of pseudovasculitis. This patient had repeated episodes of small vessel cutaneous vasculitis which were associated with cocaine use. Her laboratory results were inconclusive for any of the primary vasculitides, and there were no identifiable triggers aside from cocaine use. The lesions resolved after she stopped snorting cocaine. This case illustrates the importance of considering cocaine as the etiology of vasculitis during the work up of patients. Identification of the etiology of pseudovasculitis and subsequent removal of the stimulus prevents unnecessary, often dangerous and expensive treatments.

A RARE CASE OF SPONTANEOUS PNEUMOTHORAX IN A YOUNG WOMAN Lindsay A. Lucas1; Tariq Cheema2,1. 1West Penn Allegheny General Health System, Pittsburgh, PA; 2Allegheny General Hospital, Pittsburgh, PA. (Control ID #1322870)

LEARNING OBJECTIVE 1: Recognize the clinical features of thoracic endometriosis.
LEARNING OBJECTIVE 2: Describe the hypothesized pathophysiology behind catamenial pneumothorax.
CASE: A 20-year-old woman presented with shortness of breath and stabbing left-sided chest pain that started at a concert that night. Pain was constant, worse with inspiration, and associated with anxiety. She is a nonsmoker, and denied trauma or recent illness. History was notable for congenital hypothyroidism and three spontaneous pneumothoraces, the first of which occurred at age 16. Family history was significant for endometriosis in her mother. In the last 18 months, she was hospitalized twice for pneumothoraces requiring chest tube decompression and had been to the emergency department several times for panic attacks with similar pain. Recently she left college and returned home due to missed classes and anxiety. Her only medication was levothyroxine. Physical exam disclosed a tall, anxious-appearing, thin young woman, BMI 18. She was mildly hypoxemic on room air. Increased work of breathing and decreased breath sounds over the left apex were noted. Chest radiograph revealed a large pneumothorax with collapse of the left upper lobe. A chest tube was placed in the ER, and she underwent video-assisted thoracic surgery the next morning for pleurodesis, wedge resection of the bleb, and pleural
biopsy. Alpha-1 antitrypsin, CBC, CMP, and thyroid studies were normal. Pathology revealed nonspecific fibrosis and chronic inflammation. Further history revealed she was menstruating prior to the onset of symptoms. She was referred to gynecology and started on oral contraceptives for catamenial pneumothorax. At six month follow up she has had no further pneumothoraces, anxiety has improved, and she doing well in community college.
DISCUSSION: Catamenial pneumothorax (CP) and catamenial hemothorax are uncommon clinical entities related to thoracic endometriosis, characterized by recurrent pneumo- or hemothorax within 72 hours of menstruation. Once thought to be rare, new data suggest thoracic endometriosis is under recognized as a cause of secondary pneumothorax. In three large studies of recurrent pneumothorax in women of reproductive age, prevalence of CP ranged from less than 1% to 24.6%. Little is known about the exact mechanism by which CP occurs. Histological evidence of endometrial tissue is identified in less than 13% of biopsied blebs, suggesting the mechanism of injury is not necessarily related to sloughing of endometrial implants on \visceral pleura, but may also include indirect effects of hormones or prostaglandins on existing blebs, and progressive destruction of alveoli from circulating endometrial cells that enter the thoracic cavity through congenital diaphragmatic defects. CP should be considered a clinical rather than histopathological diagnosis. Initial treatment includes rest for mild cases and thoracostomy for larger lesions. Long-term management is not well defined due to limited identification of the condition. Invasive strategies include pleurectomy, pleurodesis, diaphragmatic defect repair, or ablation of endometrial implants. Medical therapies are aimed at hormonal management including oral contraceptives and GnRH agonists. Thoracic endometriosis is a rare but potentially treatable cause of recurrent hemothorax/pneumothorax in women of reproductive age, and a source of significant stress on those affected. Identification and continued research will be the keys to identifying optimal treatment in the future.
A RARE HEPATIC PARASITIC INFECTION IN CENTRAL PENNSYLVANIA: THE STORY OF SHEEP AND DOGS Abdulla Damluji1;
Tareq Yasin2; Thomas J. McGarrity2; Nicole Swallow1. 1Penn State University, Hershey, PA; 2Penn State University, Hershey, PA. (Control ID #1340065)
LEARNING OBJECTIVE 1: Hydatid disease is a zoonotic infection that is caused by the larval form of tapeworms of the genus Echinococcus. It is endemic in Australia, Latin America, Eastern Europe, the Middle East, and Africa (1). In central Pennsylvania the disease is very rare. We report a case of Ecchinococcus cystic disease of the liver that presented to the Penn State MS Hershey Medical Center.
CASE: An 85-year-old male with a past medical history of hypertension, dyslipidemia, atrial fibrillation on systemic anticoagulation, peripheral vascular disease and chronic obstructive pulmonary disease presents with

few days of fevers and generalized fatigue. The fevers are low grade and continuous in nature. He denies any respiratory symptoms or severe pruritis. His review of system was significant for abdominal fullness, early satiety, and weight loss over a month time. He has no history of anaphylaxis, hepatitis, jaundice, or known liver disease. His past surgical history is significant for multiple inguinal and abdominal hernia repairs. He lived in central Pennsylvania all his life. His temperature was 38.6, HR 65, RR 20, BP 102/54, Sp O2 93% on room air. His physical examination showed no scleral icterus. His Abdomen was soft, non-tender, and his bowel sounds were normal. There was no evidence of hepatomegaly or ascitis. Laboratory values revealed his white cell count was 9.4, neutrophils93.1%, and eosinophils were normal. LFT showed AST 400, ALT 133, T Bilirubin 2.3, ALP 202, and INR 3.8. Lipase and TSH were normal. Abdominal ultrasound showed numerous bilateral hepatic cysts. A follow up abdominal MR scan showed multiple benign hepatic cysts involving both liver lobes, the largest of which measures 2.4 cm. No cysts were found in his lungs or brain. A follow up AFP was normal. His Echinococcal antibody (IgG) tested highly positive. His blood cultures grew E Coli that was thought to be biliary in origin. He was started on cefazolin for his E Coli Bacteremia and Albendazole 400 mg by mouth twice daily for his hydatid disease. He was scheduled for preoperative evaluation as an outpatient prior to surgical resection of his cysts.

DISCUSSION: Hydatid disease is rare in the United States. Most cases are due to E. Granulosus. It is prevalent where livestock is raised in association with dogs, such as in central Pennsylvania. In primary Echinococcal disease any organ can be affected with liver being most common site. Cysts can become symptomatic if they exert pressure on adjacent tissues. Cyst rupture causes spillage of viable protoscolices, which can cause secondary disease. Surgery can be curative (2). High level of suspicion is needed in rural areas with low prevalence of the disease for prompt diagnosis and management. 1. Ammann RW, Eckert J. Cestodes. Echinococcus. Gastroenterol Clin North Am 1996;25(3):655-689. 2. Guidelines for treatment of cystic and alveolar echinococcosis in humans. WHO Informal Working Group on Echinococcosis. Bull World Health Organ 1996;74(3):231-242.

A RASH: OH M-EYE! Kate Hust; Christian Fauria-Robinson. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1340478)

LEARNING OBJECTIVE 1: 1. Recognize clinical signs of zoster ophthalmicus. 2. Understand implications of zoster &appropriate clinical assessment. 3. Identify appropriate treatment regimen.

CASE: A 64 year-old man presented with four days of a rash over the left side of his face. He had a painful cyst on his nose four days earlier; he subsequently developed painless, red patches over his temple that enlarged and coalesced. He had no past medical history, including no immune-compromising conditions. He was taking no medications and he had no drug allergies. His vital signs were normal, as were his cardiac, pulmonary and abdominal examinations. There were maculopapular lesions extending from the left temple superiorly to the hairline. The lesions were hyper-esthesetic, but there were no abnormalities to cranial nerve function. The remainder of his skin examination was normal. The left conjunctiva is mildly injected; a slit-lamp and retinal examination were normal. The CBC and electrolyte panels were normal.

DISCUSSION: The general internist is frequently confronted with first presentations of dermatologic abnormalities. While most abnormalities are benign and self-limiting, it is important for the general internist to recognize dermatologic emergencies. In an aging population, herpes zoster infection becomes more prevalent, and early recognition of herpes zoster infection is critical for decreasing immediate and long-term complications. Pain followed by the appearance of maculopapular or vesicular lesions is the classic presentation of zoster infection. The most common locations are the chest and abdomen as the varicella zoster virus is reactivated from the thoraco-lumbar dorsal root ganglia; however, lesions of the face due to trigeminal or facial nerve involvement are not uncommon. Hutchinsons sign, the appearance of a vesicle over the tip of the nose, is a signal of nasociliary nerve involvement. The nasociliary nerve, from the ophthalmic branch (V1) of the trigeminal

nerve, innervates both the nose and the cornea. Recognizing nasociliary involvement is critical such that a complete ophthalmic examination can be undertaken to assess for corneal and other ocular involvement. The persistent or recurrent pain of post-herpetic neuralgia after classic zoster may occur with zoster ophthalmicus. More gravely, however, if ocular manifestations of zoster ophthalmicus are missed and left untreated, progressive vision loss and blindness may result. Treatment of zoster begins with antiviral agents to decrease duration of symptoms and risk of long-term complications. Acyclovir is the preferred agent for zoster ophthalmicus though valacyclovir or famciclovir have also been shown to be effective and have simpler dosing. Further treatment includes pain control and corticosteroids to decrease symptoms and accelerate return to baseline. The specific regimen for ocular involvement includes topical lubricants and steroids, and should be guided by an ophthalmologist. Topical antibiotics should be added for zoster conjunctivitis because of the risk of secondary infection with gram-positive organisms.

A RECURRING HAZE Naree Whang; Henry J. Hefler. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311820)

LEARNING OBJECTIVE 1: 1. Identify the clinical manifestations of neurosyphilis 2. Recognize how the diagnostic approach to neurosyphilis is
altered in patients with HIV. 3. Identify HIV as a risk factor for relapsing neurosyphilis.

CASE: A 62-year-old man with AIDS presented with a progressive history of photophobia and blurry vision in his left eye. He denied any pain, discharge, redness or floaters. There was no associated change in mental status, fever, headache, neck stiffness, or nausea. Eighteen months ago he had blurry vision in both eyes and was diagnosed with anterior uveitis secondary to neurosyphilis, for which he completed a full course of treatment. Since that time, he reported compliance with his HAART regimen and abstinence from sexual activity. The vital signs were normal. His pupils were reactive to light and accommodation. Slit lamp examination revealed cells and flare in the anterior chamber of the left eye, and visual acuity was 20/60; the right eye was normal. The remainder of his exam was normal. Laboratory studies revealed a serum RPR of greater than 1:128. The lumbar puncture revealed a VDRL titer of 1:4, a protein of 68 mg/dL, and a WBC of 42 cells/L with 94% lymphocytes.

DISCUSSION: With improvements in retroviral therapy, patients with HIV are living longer lives, and general internists are increasingly providing care for HIV patients at an older age. Recognizing the common co-existent complications of HIV, including syphilis, is important fro the general internists management of patients with HIV. Syphilis, an infection caused by the spirochete Treponema pallidum, results in systemic, chronic inflammation. Neurosyphilis can occur during any of the four stages of syphilis. Common symptoms include tabes dorsalis, seizure, stroke, meningitis, or altered mental status. Ocular manifestations, as seen in this case, include uveitis, neuroretinitis, or optic neuritis. While a reactive CSF-VDRL is diagnostic for neurosyphilis, a nonreactive test does not exclude it. In non-HIV infected patients with suspected neurosyphilis who do not have a reactive test, a CSF lymphocyte count >5 cells/L or a protein concentration >45 mg/dL is consistent with the diagnosis. Because the CSF leukocyte count usually is elevated in patients with HIV, using a higher cutoff (>20 cells/L) improves the specificity of the diagnosis. Additional evaluation using FTA-ABS testing should be considered with a nonreactive CSF-VDRL; neurosyphilis is highly unlikely with a negative CSF FTA-ABS test. The treatment of choice for neurosyphilis is aqueous crystalline Penicillin G 3-4 million units IV q4 hours or continuous infusion for 10-14 days. In this case, the patient experienced recurrence of anterior uveitis, raising concern for relapsing neurosyphilis, which has a higher prevalence in patients who are co-infected with HIV. Of the 143 patients in one study, 65% were co-infected with HIV. It is important for the general internist to recognize that patients co-infected with HIV can have relapse of syphilis despite treatment, and that these patients should be carefully monitored in the outpatient setting.

A REPORT OF NEWLY DIAGNOSED HIV/AIDS IN AN ELDERLY MAN Toru Naganuma1; Christine Kwan1; Simi Padival2; Hitoshi Honda3.

1Teine Keijinkai Medical Center, Sapporo, Japan; 2Beth Israel Deaconess Medical Center, Boston, MA; 3Teine Keijinkai Medical Center, Sapporo, Japan. (Control ID #1323653)
LEARNING OBJECTIVE 1: Recognize that the elderly population is still vulnerable to human immunodeficiency virus (HIV) infection LEARNING OBJECTIVE 2: Recognize that no age threshold should exist for obtaining sexual history and testing for HIVCASE: A 74 years old Japanese male with a past medical history of chronic obstructive pulmonary disease presents with one months history of progressive fever and dyspnea despite taking an antimicrobial agent for 3 weeks. He also reports a cough productive of yellow sputum, diarrhea, and 5-kg weight loss for 6 months. He has used 2 packs/day of tobacco for 40 years but quit 15 years ago. He denies recent travel history and sick contacts. He works as an accountant and lives with his wife and children, but he does not have pets. His physical examination includes significant findings of a fever of 39.6 degrees Celsius, oxygen saturation of 90% on room air, and fine crackles throughout the bilateral lungs. Laboratory examination at presentation reveals white blood cell of 6,820 counts/L with lymphocytopenia (550 counts/L). Blood and sputum cultures are all negative. Although chest X-ray does not show any significant infiltrates, a

computed tomographic (CT) scan shows diffuse emphysema and interstitial infiltration of the bilateral lower lobes. On further investigation, he has been found to have a history of bacterial pneumonia, trichophytosis, seborrheic dermatitis, oral-esophageal candidiasis, and amebic colitis in the past 9 months. Moreover, he discloses that he has had sexual intercourse with men for the past 20 years since his mid-fifties; he continues to be sexually active at the time of presentation with multiple male partners. Testing for HIV is subsequently positive with CD4 count of 124 counts/L and HIV viral load of 230,000 copies/mL. Despite negative sputum Pneumocystis jiroveci polymerase chain reaction, his clinical presentation, advanced HIV status, and CT scan are consistent with Pneumocystis jiroveci pneumonia (PCP) for which trimethoprim/sulfamethoxazole and prednisolone are instituted. Antiretroviral (ARV) therapy is started once the genotype result becomes available. He has had overall improvement in his symptoms and has been discharged with continuing ARV as an outpatient. DISCUSSION: Although the prevalence of HIV infection and acquired immune deficiency syndrome (AIDS) in Japan is still low compared to western countries, the incidence rate of HIV/AIDS continues to increase in Japan, especially in the younger population of men who have sex with men. As a sexually transmitted disease (STD), newly diagnosed HIV usually occurs in the younger population. Sexual history in the elderly tends to be overlooked although STD Treatment Guidelines, 2010 from the Centers for Disease Control and Prevention recommends all healthcare providers routinely obtain sexual history from all adult patients. Even though this patient has been diagnosed with several opportunistic infections and followed by a pulmonologist, gastroenterologist, and dermatologist, none of them has obtained a sexual history from him or suspected HIV/AIDS until he has developed PCP. This case, therefore, highlights the fact that the elderly population is still vulnerable to HIV infection and the importance of obtaining sexual history from all patients despite their age, especially in those suspected of having an infection.

A RIDDLE WRAPPED IN AN ENIGMA, BUT PERHAPS THERE IS A KEY! Sarita K. Sapkota; Greg Sutton; Bhumin Patel; Lisa Staton; Mukta Panda. University of Tennessee, Chattanooga, TN. (Control ID #1319987)
LEARNING OBJECTIVE 1: Discuss the differential diagnosis of cirrhosis in a young adultLEARNING OBJECTIVE 2: Discuss significance of work-up for Wilsons with diagnostic procedures, the importance of a strong clinical suspicion, and of continuity of care and communication among healthcare providers. CASE: A 26-year-old female with a past medical history of cryptogenic cirrhosis, diagnosed at age 22, presents in December 2011 with a 2-week history of abdominal pain and abdominal swelling. With the loss of insurance about 10 months prior, she was unable to maintain proper dosage of lactulose and lasix and became dependent on the many subsequent ER visits for acute care. The pain characteristics were: sharp, squeezing, pressure sensation,

located diffusely over the entire abdomen, and has a severity as high as 10/10. She complained of some nausea and vomiting, fever, and episodes of altered mental status. On exam she was afebrile, normotensive, and in no acute distress. She had significant scleral icterus, and had no apparent changes of mental status. Abdomen was firm and distended, tender to palpation with a positive fluid wave and mild splenomegaly. Abnormal labs: hemoglobin 10.7, hematocrit 32.1, negative hepatitis panel, alkaline phosphatase 532, AST 132, total bilirubin 24.8 (direct 13.6; indirect 11.2), MELD score 26 and her Child Pugh score of 10, PTT of 36, PT 29.7, and INR of 1.88. Review of her previous records from 2010 revealed a normal serum ceruloplasmin level, 24 hour copper excretion of 34 and a positive liver biopsy for copper but without any quantification. The antimitochondrial antibody, ANA, and hemochromatosis gene mutation were negative. She had been treated for depression and substance abuse (EtOH), which was the reason she had not qualified for liver transplant. However, upon further questioning we found out that she only recently used alcohol for coping after she lost her insurance. Our work-up yielded a faint Kayser-Fleischer ring, ceruloplasmin level of 20.1, elevated 24 hour copper at 86 and cooper/creatinine ratio of 78. At this point we concluded that she met the diagnostic criteria for Wilson disease and initiated treatment with D-penicillamine.
DISCUSSION: Wilsons disease is an autosomal recessive disorder (gene ATP7B) of copper transport with a prevalence of approximately 1/30000. Typical presentation includes neurological and hepatic dysfunction. Diagnosis usually requires a high index of clinical suspicion due to overlapping symptoms with other disorders. Delayed and misdiagnosis is not uncommon like in our case especially where there is a possible substance abuse history and when lack of insurance becomes a limiting factor for proper follow up and care. Therefore the importance of continuity of care and communication between the physicians cannot be over emphasized. Diagnostic criteria include: presence of Kayser-Fleishcer rings on slit-lamp, ceruloplasmin of <0.20 g/l, 24 h urinary free-copper excretion, penicillamine challenge test, liver copper measurement, and the presence of abnormal gene mutation. Mainstays of therapy include penicillamine, trientine, and zinc. For advanced disease, as in our patient, the long-term treatment is liver transplant.
A STEALTHY INFILTRATOR Ethan Kuperman. Penn State College of Medicine, Hershey, PA. (Control ID #1320884)
LEARNING OBJECTIVE 1: Recognize when further evaluation is indicated in syncope.
LEARNING OBJECTIVE 2: Identify sarcoidosis as a potential cause of infiltrative cardiomyopathy in a young adult.
CASE: A 34-year-old man presented with two episodes of syncope within six hours. The episodes were preceded by several seconds of dimming vision and light-headedness and lasted less than one minute before rapid recovery. He denied chest pain or abnormal movement and review of systems was negative. His past medical history was otherwise significant for a single episode of syncope four years previous and controlled hypertension. The patient was employed in a warehouse, which required heavy lifting. His only medication was lisinopril. On exam, he was afebrile, pulse 88 beats per minute and regular, and blood pressure 128/ 88 mmHg. Body mass index was 37 kg/m2. The patient was alert, oriented, and appeared well. There was no palpable adenopathy. His heart sounds were regular, without murmurs, rubs, or gallops. There was no jugular venous distention and point of maximal impulse was difficult to palpate due to obesity. Lungs were clear to auscultation and neurologic exam was nonfocal. There was no peripheral edema. There were no skin lesions. Laboratory studies included a normal complete blood count, thyroid stimulating hormone, and serum troponin. His electrocardiogram showed new bifasicular block. Chest x-ray was normal. An echocardiogram revealed a globally hypokinetic left ventricle with an ejection fraction of 30%. Cardiac MRI was positive for a dilated cardiomyopathy with delayed hyperenhancement and identified mediastinal lymph nodes not visualized on chest x-ray. Bronchoscopy with biopsy was not diagnostic, but mediastinoscopy was positive for sarcoidosis. The patient proceeded to AICD implantation and was started on immunosuppression. He had no subsequent syncopal episodes and maintained an excellent functional status.

DISCUSSION: General internists routinely evaluate syncopal patients, rarely finding a specific diagnosis. A complete history and physical with an electrocardiogram is typically recommended to decide if further evaluation is appropriate. This patient had recurrent episodes and an abnormal ECG; red flags which justified further workup. The combination of depressed ejection fraction and conduction disorder suggests an infiltrative process. Cardiac MRI is an increasingly available modality to evaluate disorders of the myocardium. The differential diagnosis of a dilated infiltrative cardiomyopathy includes sarcoidosis, Wegeners granulomatosis, and hemochromatosis. The typical MRI appearance of sarcoidosis includes patchy late gadolinium enhancement of the basal and inferolateral walls. Cardiac sarcoidosis can have subtle presentation and requires a high index of suspicion. It is frequently undiagnosed, particularly in the young population. Cardiac involvement is found in 40% of patients with sarcoidosis. Diagnosis can be confirmed by tissue diagnosis of affected skin or bronchoscopy when lesions are accessible. This patient had no other manifestations of sarcoidosis and plain film imaging was negative for adenopathy, necessitating invasive diagnostic procedures. Involvement may be limited to the heart in two-thirds of patients with cardiac sarcoidosis. Steroids remain the foundation of treatment, but five-year mortality may be as high as 40%. Early diagnosis is necessary due to the risk of sudden cardiac death.

A SWEET DIAGNOSIS Alexis C. Ferguson1; Rajan Kapoor2; Anu Batra3; Ritu Gothwal4; Prasanta Basak1; Stephen Jesmajian1. 1Sound Shore Medical Center of Westchester and New York Medical College, New Rochelle, NY; 2Westchester Medical Center, Valhalla, NY; 3University of Arkansas Medical Center, Little Rock, AR; 4Women's Correctional Institute, Muncy, PA. (Control ID #1313135)

LEARNING OBJECTIVE 1: Sweet syndrome is a rare dermatosis, frequently associated with hematological malignancies and solid tumors including malignancies of the breast, gastrointestinal and genitourinary tracts. We present a rare association of Sweet syndrome with myelodys-plastic syndrome (MDS).

CASE: An 80 year old female with hypertension, was admitted with progressive generalized weakness and decreased appetite for 3 weeks. She denied any chest pain, shortness of breath, abdominal pain, diarrhea, gastrointestinal bleed, or any symptoms suggestive of upper respiratory tract infection. She was tachycardic (110-120/min), had conjunctival pallor. Laboratory data revealed pancytopenia (Hemoglobin: 4.3 mg/dl, Hematocrit: 12.4%, MCV: 112 fL, WBC: 4,200/mm3 and platelets of 38,000/ mm3). Blood smear and bone marrow biopsy were consistent with MDS. She was symptomatically treated with red cell and platelet transfusions. On hospital day 4, she developed recurrent febrile episodes and painful erythematous plaques and nodules on her left forehead and right arm. She subsequently developed renal and respiratory failure and had to be intubated. Extensive work up for sepsis, including sputum and blood cultures, urine analysis, CSF exam, CT scan and Chest X-ray were noncontributory. Biopsy of a forehead skin lesion revealed diffuse neutrophilic infiltrate in the upper dermis consistent with Sweet syndrome. The patient was promptly started on intravenous steroids resulting in complete resolution of skin lesions, improvement in renal function and was successfully extubated 3 days later.

DISCUSSION: Acute febrile neutrophilic dermatosis or Sweet syndrome was first described by Robert Douglas Sweet in 1964. It is presumed to be a hypersensitivity reaction and is characterized by fever, neutrophilia, tender, erythematous skin lesions (papules, nodules and plaques) and a diffuse infiltrate consisting predominantly of mature neutrophils that are typically located in the upper dermis. It has been postulated that inflammatory cytokines may have an etiologic role in the development of the dermatosis. Twenty percent of Sweet syndrome cases are associated with MDS or other hematological malignancies. Skin lesions of Sweet syndrome may precede the diagnosis of MDS by a median of 3.5 years. Sweet syndrome occurring in patients with MDS could be a marker of advancing MDS. A skin biopsy is necessary to clinch the diagnosis of this interesting syndrome.

A TREATMENT APPROACH TO METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) SEPTIC

PULMONARY EMBOLI AND BACTEREMIA WITHOUT EVIDENCE OF ENDOCARDITIS Vinitha Reddy; Abdulla Damluji. Penn State Milton S. Hershey Medical Center, Hershey, PA. (Control ID #1340458)
LEARNING OBJECTIVE 1: Daptomycin is a bacteriocidal lipopeptide antibacterial with a spectrum of activity limited to gram-positive organisms including highly resistant species of (MRSA, VISA, VRSA, and VRE). Daptomycin has demonstrated treatment failure in lung MRSA infections(1) and success with right-sided endocarditis and septic pulmonary emboli(2). No treatment algorithm was recommended by the Infectious Disease Society of America (IDSA) guidelines for patient with MRSA septic pulmonary emboli in the absence right-sided endocarditis. For that subgroup of patients, we report a successful eradication of MRSA bacteremia with intravenous daptomycin and linezolid in a veteran presenting to the Lebanon VA Medical Center.
CASE: An 84-year-old man with a history of hypertension and benign prostatic hyperplasia presents with increasing lethargy and confusion one day prior to hospital admission. He was febrile, tachycardic, and hypotensive. He had an elevated white cell count with a left shift. The patient was fluid resuscitation and empiric antibiotics including Vancomycin were started. His initial peripheral blood cultures showed MRSA susceptible to Vancomycin. The patients fever and leukocytosis continued despite appropriate trough
levels that were kept in the range of 15 to 20. A CT scan of the chest was obtained to search for possible abscess. It revealed bilateral pulmonary cavitary lesions suspected to be septic emboli that were necrotic in nature. Transesophageal echocardiogram did not reveal any vegetations. CT scan of the pelvis revealed presacral fluid collections, which was subsequently drained under radiologic guidance. Due to treatment failure, Vancomycin was discontinued and Linezolid and high-dose Daptomycin were started. Subsequently, the patient was afebrile, his white cell count normalized, and blood cultures remained negative. He was continued on antibiotic therapy for six weeks after hospital discharge.
DISCUSSION: High failure rates in the treatment of severe MRSA pneumonia were observed with Vancomycin due to poor penetration into pulmonary tissue and lung epithelial lining fluid (3). Failure rates with high-dose Daptomycin were also reported and thought to be due to intactivation by lung surfactant (1). However, high-dose Daptomycin is FDA-approved for treatment of complicated MRSA bacteremia and right-sided endocarditis. Adjunctive therapy with protein synthesis inhibitor (i.e. clindamycin or linezolid) was proposed by IDSA as a consideration in cases of necrotizing pneumonia or severe sepsis. We report a successful treatment of cavitary MRSA pneumonia without evidence of endocarditis using a combination of high-dose Daptomycin and Linezolid. This regimen could be considered in this subgroup of severe MRSA pneumonia. References: 1. Koplowicz et al. Clin Infect Dis 2009;49(8):1286-1287. 2. Rehm et al. J Antimicrob Chemother 2008;62(6):1413-1421. 3. Cruciani et al. J Antimicrob Chemother 1996;38(5):865-869.
A UNIQUE CASE OF COEXISTING ABPA AND SEMI-INVASIVE ASPERGILLOSIS IN AN IMMUNOCOMPETENT PATIENT Oluwakemi Fagbami; Alec B. Platt. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1310713)
LEARNING OBJECTIVE 1: Semi-invasive aspergillosis is an infection usually seen in immunosuppressed individuals. Rarely, semi-invasive aspergillosis can overlap with allergic bronchopulmonary aspergillosis (ABPA)in an immunocompetent patient.
CASE: A 61 year-old previously healthy male with mild asthma and seasonal allergies was evaluated two months post hospitalization for community acquired pneumonia and methicillin sensitive Staphylococcus aureus bacteremia. Transesophageal echocardiogram (TEE) showed no vegetation and repeat blood cultures during four weeks of treatment and surveillance were negative. A CT scan showed mild bronchiectasis; resolution of bilateral lower lobe and progressive enlargement and cavitation of multiple 1 cm bilateral pulmonary nodules. There were no prior hospitalizations for asthma, childhood history of pneumonia or other chronic infections. He had only rare episodes of sinusitis. He had not been on any steroids or immune suppressive medications. The patient, a nonsmoker, had a history of occupational exposure to mold in an office setting. Physical examination including lung exam was normal. Total IgE was 6155 IU/ml; IgA, IgG and IgM were normal. Aspergillus

fumigatus IgG (121 IU/ml) and peripheral blood eosinophils (9.8%) were elevated. ESR, ANA, rheumatoid factor, ANCA, HIV, PPD, cystic fibrosis screens were negative. Pulmonary function tests were normal. Fiber optic bronchoscopy washings of a left upper lobe area of cavitation were negative for AFB but grew Aspergillus fumigatus and methicillin resistant staph aureus. Transbronchial biopsies were negative. Repeat surveillance blood cultures were negative. The patient was treated first with oral Linezolid for four weeks and then Voriconazole for six weeks. The cavitary lesions progressed on serial CT scans and patient subsequently developed Methicillin resistant Staphylococcus aureus endocarditis and pneumonia. A video assisted thoracoscopic wedge resection of a left lower lobe cavitary lesion demonstrated Aspergillus fumigatus organisms with limited surrounding tissue necrosis classified by outside expert histologic review as semi-invasive aspergillosis. The patient received six weeks of Vancomycin and began a six month course of Prednisone and Voriconazole. With the exception of mild intermittent asthma, he remains symptom free on follow-up. Repeat CT scan imaging three months into treatment showed partial resolution of the cavitary lesions and a decrease in IgE to 695 IU/ml.
DISCUSSION: Pulmonary spergillosis infection can be subdivided into five categories: simple aspergilloma, allergic bronchopulmonary aspergil-

losis (ABPA), chronic necrotizing aspergillosis (also known as semi-invasive aspergillosis), airway-invasive aspergillosis and angioinvasive aspergillosis. ABPA is seen in patients with long-standing bronchial asthma while aspergilloma is seen in patients with underlying obstructive or fibrotic lung disease. Chronic necrotizing aspergillosis is rarely seen in immune competent hosts and has not been well reported in association with ABPA. This case illustrates the need to be aware of the different forms of aspergillosis which may coexist rarely in immunocompetent patients.
A CASE OF HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS AFTER EPSTEIN-BARR VIRUS INFECTION SIMULATING SEVERE SEPSIS Eduardo J. Bazan; Claudia P. Taramona Espinoza; Ravneet Thind; Javier Diaz-Mendoza. Henry Ford Hospital, Detroit, MI. (Control ID #1335024)
LEARNING OBJECTIVE 1: To recognize the clinical features of Hemophagocytic Lymphohistiocytosis (HLH) in a patient admitted for severe sepsis in a Medical Intensive Care Unit (MICU).
LEARNING OBJECTIVE 2: To discuss the importance of early diagnosis of HLH for treatment success.
CASE: A 27 year-old previously health female presented with a 2-week history of fever. Her boyfriend had been febrile one week prior to the beginning of her symptoms. She was initially prescribed amoxicillinclavulanate and cephalexin with no improvement. She developed jaundice and a diffuse rash which prompted her admission to the hospital. The patient developed fever, tachycardia, hypotension and hypoxemia requiring admission to the MICU for possible sepsis. Physical exam revealed cervical lymphadenopathy and hepatomegaly. Laboratory workup showed elevated AST, ALT, total bilirubin, INR, D-dimer, ferritin, triglycerides as well as low fibrinogen, anemia, thrombocytopenia and a brief period of neutropenia. IV fluids were given for hypotension with good clinical response as well as IV antibiotics. Work up for hepatitis, HIV, CMV and autoimmune disease was negative. IgG for Parvovirus and serology for Epstein- Barr virus (EBV) were positive. Pancultures were negative. Abdominal ultrasound showed hepatomegaly with mild bilateral pleural effusions. Secondary HLH was considered in the differential and a bone marrow biopsy suggested this diagnosis. IVantibiotics were discontinued and oral steroids were started. She improved clinically and was discharged home on tapering doses of steroids which were later on discontinued. She is now following only with her PCP.
DISCUSSION: HLH is a rare disease with high mortality. It is classified as primary (a familial form) and secondary. The latter one is most commonly related to infections, being EBV the most frequent etiology. Secondary HLH varies widely from inflammation that resolves spontaneously to progressive disease with

hematopoietic cell transplantation as final treatment. The diagnosis is based on clinical, laboratory and histopatho-logical findings. Patients with HLH suffer from prolonged fever, cytopenias and diseminated intravascular coagulation-like presentation who are unresponsive to antibiotics. This clinical course has to prompt us to look for a complete HLH evaluation. Based on the diagnostic guidelines proposed by the Histiocytic Society in 1991 and updated in 2004, it is not necessary to wait for completion of all criteria before initiating therapy. In this case, the patient had 5 out of 8 of the following diagnostic criteria: fever, cytopenia, hyperferritinaemia, hypertriglyceridemia and haemophagocytosis in the bone marrow. The patient did not have splenomegaly on physical examination. NK-cell activity or sCD25, the two left criteria, were not checked. The therapy has to be adjusted depending on the grade of disease severity. This patient experienced a mild disease as she was clinically stable, requiring only conservative therapy with oral dexamethasone and supportive therapy in MICU. High clinical suspicion is critical. Understanding of the pathophysiology of HLH by the clinicians is crucial for early diagnosis and treatment to prevent poor outcome including death.

A CASE OF KETOSIS-PRONE TYPE 2 DIABETES MELLITUS IN A NIGERIAN MALE Rebecca Braunstein1; Vafa Tabatabaie2; CristinaM. Gonzalez1,2. 1Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1339517)

LEARNING OBJECTIVE 1: To recognize the diagnosis of Ketosis-Prone Type 2 Diabetes Mellitus (DM) in a patient presenting with severe hyperglycemia or diabetic ketoacidosis (DKA).

LEARNING OBJECTIVE 2: To describe the natural disease course of this subtype of DM.

CASE: A 54 year old Nigerian male with no significant medical history presented with fatigue, polyuria, polydipsia, polyphagia, and weight loss. He endorsed dry mouth, and denied fevers, dysuria, cough, chest pain, shortness of breath, nausea, vomiting, abdominal pain, blurry vision, or headache. He denied toxic habits. Family history was positive for type 2 DM. Initial vitals were T 97.5F, P 106 BPM, BP 138/93 mmHg, RR 19 RPM, FSG 592 mg/dL. Pertinent exam findings included dry oral mucosa, lungs clear to auscultation, tachycardia, benign gastrointestinal exam, and no neurological deficits. Labs were significant for WBC 8.2 X 103/L, an anion

gap metabolic acidosis (AG 19), positive serum ketones, pH 7.395, and troponin-T <0.01 ng/mL. Urinalysis was negative for infection. The patient was treated with aggressive fluid resuscitation, intravenous insulin drip, and electrolyte repletion. HbA1c was 12.7%. One month later he was doing well on oral hypoglycemics with a HbA1c of 8.4%.

DISCUSSION: DM is one of the most frequently encountered diagnoses by the internist. Ketosis-Prone Type 2 DM, also known as Flatbush Diabetes, is a subtype of DM typically seen in African American or Hispanic patients. It has unique pathophysiologic and prognostic features. This subtype of DM presents similarly to type 1 DM with severe hyperglycemia or DKA, but has many characteristics of type 2 DM. Specifically, patients do not have islet cell autoantibodies and typically display insulin resistance. Following initial treatment, studies have shown that these patients are often able to discontinue insulin therapy and maintain glycemic control with oral agents or diet alone. The prevalence of this subtype of DM in the United States is thought to be between 20-50% of African American and Hispanic patients with new-onset DM that present in DKA. The typical patient is an obese, middle-aged (mean age of40) male (3:1 predominance) with a strong family history of type 2 DM, who presents acutely with DKA or severe hyperglycemia in the absence of common triggers such as infection or myocardial infarction. Physiologically, the initial presentation is due to acute -cell failure, resulting in transient insulinopenia. There is concurrent defective insulin function and insulin resistance. -cell dysfunction often resolves after treatment. Studies have revealed that patients have significant pancreatic insulin reserve, and that 42-76% of patients achieve near-normoglycemic remission (defined as HbA1c of <6.3% and a fasting plasma glucose of <120 mg/dL) 3 months after therapy with all pharmacologic agents discontinued. In patients who achieve remission, -cell function, as measured by serum levels of C-peptide (basal and glucagon stimulated), is improved by 80% shortly after resolution of DKA or hyperglycemia. C-pepide levels and presence

of autoantibodies have been used as markers to predict likelihood of near-normoglycemic remission. Positive autoimmune markers suggests slow-onset type 1 DM or latent autoimmune DM, making future remission less likely. In conclusion, Ketosis-Prone Type 2 DM is important to recognize and understand in order to properly manage and anticipate outcomes in patients with this diagnosis.

A CASE OF REVERSIBLE POSTERIOR ENCEPHALOPATHY SYNDROME IN OVARIAN HYPERSTIMULATION SYNDROME. Cara J. Tsoi. California Pacific Medical Center, San Francisco, CA. (Control ID #1310555)

LEARNING OBJECTIVE 1: To recognize that Posterior Reversible Encephalopathy Syndrome may arise in the context of Ovarian Hyper-stimulation Syndrome.

LEARNING OBJECTIVE 2: To manage neurologic symptoms in the setting of Ovarian Hyperstimulation Syndrome.

CASE: A 38 yr-old Indian woman, G2 P1, at 4 weeks gestation, presented with visual changes and headache. The patient complained of an intermittent right parietal headache for 3 days. This was associated with episodic visual changes resembling shattered glass in her peripheral vision bilaterally, as well as left-sided colorful shapes, and right visual field loss. The patient had been undergoing experimental fertility treatments with a three drug regimen consisting of a GnRH antagonist, HCG, and recombinant FSH dosed either orally or as a long-acting weekly injection. As the patient

was enrolled in a phase III trial, it is unknown whether the patient received the oral or the injectable form. All of these drugs had been discontinued 2 weeks prior to arrival. It was unknown whether the patient had received the experimental drug or not. Of significance, she had recently been diagnosed with OHSS, with complaints of ascites and shortness of breath, and had undergone culdoparesis (transvaginal removal of ascitic fluid) with removal of2 L of fluid prior to presentation. The patients exam was notable only for mild distention of the abdomen without tenderness, and normal cranial nerve and visual field as well as cerebellar exams. A funduscopic exam was normal. MRI revealed findings significant for numerous foci of abnormal signal involving the high left parasagittal pariental lobe as well as parietooccipital pole. There was suggestion of potential associated cytotoxic change. These findings were consistent with PRES. The patients symptoms improved in-house and she was sent home on hospital day 3.

DISCUSSION: Both cerebral autoregulation and endothelial dysfunction have been implicated in the pathophysiology of PRES, as well as hypoperfusion secondary to vasospasm. Specifically, excessive autoregulation is thought to lead to dilation of cerebral arterioles and increase in cerebral blood flow which causes hyperperfusion. This hyperperfusion may lead to the breakdown of the blood brain barrier, allowing extravasation of fluid and blood products into the brain parenchyma and resulting in the clinical features of PRES. OHSS has been associated with release of VEGF with resulting increased capillary permeability. VEGF has been shown to be a potent vascular permeability factor in the brain as well. Therefore, we hypothesize that this patients OHSS caused excessive VEGF which then may have been related to development of PRES. Thus far there has been no research linking VEGF to the pathogenesis of PRES, however it may present a future topic.

A CASE OF PULSE STEROID INDUCED BRADYARRHYTHMIA IN A PATIENT WITH SLE Tushar A. Tuliani; Hemanckur Makker; Kashish Goel; Maithili Shenoy; Diane L. Levine. Wayne State University/ Detroit Medical Center, Detroit, MI. (Control ID #1336296)

LEARNING OBJECTIVE 1: Recognizing a rare side effect of pulse steroids in a patient with SLE.

CASE: A 20 year old woman with Systemic Lupus Erythematosus diagnosed at 14 and stage 3 lupus nephritis (FSGS) was admitted for fever and symptoms of upper respiratory tract infection. Her medications included: hydrochloroquine, acetaminophen, hydrocodone, mesna, trimethorpim-sulfamethoxazole, sildenafil, pantoprazole, ondansetron, mycophenolate mofetil, methylprednison, leuprolide, folic acid, diphenhydramine,

cyclophosphamide, and calcium carbonate. Vital signs revealed a temperature of 39.1 C, blood pressure 114/77, heart rate 89, respiratory rate 18. On examination the patient had a dry discoid rash present over her face, arms and posterior neck. The remainder of her exam was normal without signs of infection. Initial WBC was 3.7 (neutrophils of2.5 and lymphocytes of 0.7). Serum electrolytes were normal. Estimated GFR was 36 mL/min/1.73 m2. Urinalysis showed 3+ blood, 2+ protein with 2-5 granular casts per low power field. The initial differential diagnosis was infection versus a lupus flare. Treatment was initiated for health care associated pneumonia in the Emergency Depratment. The patient was started on pulsed methylprednisone at 500 mg IVPB BID for a total of three days for lupus flare. The patient developed asymptomatic bradycardia while she was on steroids. EKG revealed sinus bradycardia 37/ min with normal intervals (PR 0.154 s, QRS 0.096 s, QTc 0.412 s). Previous EKGs showed normal sinus rhythm. Troponins were normal. Thyroid function was normal. Bradycardia could not be attributed to her medications as the patient had not been on anti hypertensive agents for more than a week. The patients heart rate ranged from 55-38/min during her course of steroid treatment. Five hours after her last dose her heart rate had risen and varied between 51-68/min. No abnormalities were noted upon cardiology follow up.

DISCUSSION: The major cardiovascular adverse effects of pulse steroid therapy include myocardial infarction, asystole, supraventricular arrhythmias, atrial flutter and fibrillation, ventricular tachycardia and cardiac arrest. However high dose pulse steroid induced bradycardia has been reported in the past in the pediatric population. In our case, underlying involvement of the cardiac conduction system secondary to SLE is unlikely. The patient had normal EKGs both before and after completion of pulse

steroids. The patient had no alternative cause of bradycardia. Overt hypothyroidism was ruled out by a low free T4 and normal TSH (euthyroid sick syndrome). She was not on any medications known to cause bradycardia and her anti hypertensive agents had been discontinued for more than a week. An Echocardiogram revealed pulmonary hypertension and elevated right ventricular systolic pressure of 60-65 mm of Hg but no other abnormalities. Chronotropic competence was intact during her hospital stay with her heart rate increasing to more than 60/min on walking. Practitioners should be aware of the potential for bradycardia with high-dose pulse steroids in both children and young adults.

A COMMON DISEASE AS A HARBINGER OF CANCER Yogita Segon; Ankur Segon; Kurt J. Pfeifer. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1311761)

LEARNING OBJECTIVE 1: Recognize that new onset diabetes mellitus can be the initial presentation of pancreatic cancer, especially in older patientsCASE: An 82-year-old woman with a past medical history of hypertension, hyperlipidemia and stroke presented with fatigue, nausea and poor oral intake over 3-4 weeks. She was referred for hospital admission by her primary care physician when she found the patients blood glucose to be 600 mg/dL and her HbA1C 11.5%. She was treated as new-onset type 2 diabetes mellitus and was discharged home after a few days on long-acting insulin and pioglitazone. She returned to the emergency room 5 days after discharge with complaints of persistent nausea and vomiting. She also reported vague, epigastric abdominal pain. Her physical examination was significant for diffuse abdominal distension and epigastric tenderness. Her hepatic function panel was normal with a slightly elevated amylase and normal lipase. Upper endoscopy suggested retention of food in the stomach and an increased amount of fluid in the second portion of the duodenum. Subsequent small bowel follow-through suggested poor gastric motility with narrowing of the third part of the duodenum. Pancreas protocol abdominal CT showed a 6x3 cm pancreatic tail lesion causing significant compression of distal duodenum. Also noted were numerous lesions in both hepatic lobes, very likely liver metastases in the setting of primary pancreatic malignancy. Ultrasound-guided liver biopsy was subsequently declined by the family, and the patient was discharged home on hospice. She passed away 1 month later.

DISCUSSION: Age is the greatest risk factor for pancreatic cancer and incidence rises with each decade after age 50 years. The most common location is the head of the gland with the most common symptoms being

epigastric pain radiating to the back and painless jaundice due to common bile duct obstruction. Laboratory findings can be nonspecific with increases in amylase, lipase, hepatic enzymes and/or CA 19-9. A pancreas protocol abdominal CT is the most important diagnostic and staging tool for pancreatic cancer, with a sensitivity of greater than 90%. Endoscopic ultrasonography is as accurate as CT scan for detecting tumors and may be more sensitive for tumors smaller than 2 cm in diameter. Patients with unresectable, locally advanced disease usually survive for 10 months or less; patients with metastatic disease for 6 months or less. More than 75% of patients with pancreatic cancer are hyperglycemic or diabetic, but it is unclear if diabetes is a risk factor or complication of pancreatic cancer. Although type 2 DM is common in the same population at risk for pancreatic malignancy, new-onset diabetes may also be the initial presentation of pancreatic cancer especially when the tumor is present in the body or tail of the pancreas. While evidence and guidelines for pancreatic cancer screening are lacking, this etiology should be considered in any elderly patient who presents with new-onset diabetes.

A COUGH UNFIT FOR A LADY Jonathan Kirsch; Brian Bramson. University of North Carolina, Chapel Hill, NC. (Control ID #1336304)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of chronic pulmonary mycobacterial avium complex (MAC) in an elderly patient.

LEARNING OBJECTIVE 2: Identify pulmonary MAC with the use of imaging, sputum cultures and AFB staining.

CASE: An 80 year-old woman presented with an acute on chronic productive cough with yellow sputum. Over the previous 12 months, she had developed worsening a dry cough, dyspnea on exertion, anorexia, diarrhea, and experienced a 13 kg weight loss. She denied fevers, chills or hemoptysis. She had been treated by her primary care physician (PCP) with a course of azithromycin followed by levofloxacin without improvement. She was told by her cardiologist that her heart failure was stable. She was seen again by her PCP for a productive cough. A chest radiograph revealed multifocal infiltrates and she was referred for hospital admission. She was afebrile, respiratory rate was 21 breaths per minute and oxygen saturation was 96% on room air. Her weight was 51 kg and body mass index was 16. She was pleasant with mild memory loss. She was cachectic and her skin was dry. She had scattered rhonchi and bilateral rales, more in the right middle lung field. She has a history of diastolic heart failure, hyperlipidemia and paroxysmal atrial fibrillation. She drinks four glasses of wine nightly and quit smoking cigarettes 50 years ago. She lives alone. Her complete blood count and differential were normal. Her sputum gram stain was negative. Computed tomography scan of her chest revealed diffuse ground glass nodular opacities with bronchiectasis and mucus plugging. She was treated for community acquired pneumonia without improvement. Repeat sputum specimens were obtained and sent for acid-fast bacillus (AFB) staining and culture. Sputum was positive for acid-fast organisms with PCR testing negative for M. tuberculosis species. She was diagnosed with pulmonary mycobacterium avium complex (MAC) and cultures were later confirmed. She was discharged on ethambutol, clarithromycin, and rifampicin. Months later, she was seen for follow-up and her symptoms had improved. She was gaining weight and continued her antibiotic treatment.

DISCUSSION: Indolent cough with chest radiograph abnormalities is commonly encountered by general internists and hospitalists. Pulmonary MAC is being recognized with increasing frequency as an indolent infection in middle-aged and elderly women with no pre-existing lung disease, known as Lady Windermere Syndrome. It was once thought to occur in women that suppressed cough to appear more lady-like and is named after a Victorian character in an Oscar Wilde play. Pulmonary MAC infection should be considered in a patient with a chronic pulmonary infiltrate, especially in a patient not responding to standard therapies as this organism will not respond to commonly prescribed empiric antibiotics. The diagnosis may be missed without

proper imaging and sputum cultures. Diagnosis in the right setting requires abnormalities on CT or chest x-ray plus one of the following: 1) acid-fast bacilli, granulomas, or positive culture from a tissue specimen; 2) 3 positive sputum cultures without positive smears; 3) 2 positive sputum cultures with 1 positive smear; or 4) a bronchial wash culture with a 2+ or greater smear or 2+ or greater growth in culture. Treatment is difficult, requiring combination therapy for at least 12 months.

A PRESENTATION OF ACUTE COMPARTMENT SYNDROME DUE TO SEVERE BLEEDING LEADS TO A DIAGNOSIS OF MULTIPLE MYELOMA AND AN ACQUIRED COAGULOPATHY Sahar Soleymani; Peter Y. Chung. UCLA-Olive View Medical Center, Sylmar, CA. (Control ID #1334409)

LEARNING OBJECTIVE 1: Recognize that multiple myeloma may present with acute severe bleeding due to an acquired coagulopathy. LEARNING OBJECTIVE 2: Diagnose and manage bleeding diatheses due to an acquired coagulopathy in a patient with multiple myeloma. CASE: A 43 year-old male presented with sudden, spontaneous onset of left leg swelling and pain. He was found to have acute compartment syndrome secondary to hemorrhage and underwent multiple fasciotomies with subsequent amputation. During outpatient recovery, he experienced a second episode of spontaneous severe bleeding in his left arm necessitating fasciotomy for acute compartment syndrome. Physical exam demonstrated tense edema, induration of the left arm and thigh, oozing of blood and clots from surgical wounds, cachexia and kyphosis. Laboratory and imaging demonstrated WBC 5.8 (P82% L7.5% M8.9%), hgb 8.6 g/dl, platelets 93, total protein 8.0 g/dL, albumin 2.8 g/dL, serum electrophoresis M-protein3.1 g/dL, serum immunofixation IgA-Kappa, PT and PTT of 26.2 and74.4 sec. without correction on 1:1 mixing, fibrinogen 226 mg/dL, prolonged thrombin time (TT) 32 sec., normal reptilase time (RT) 19 sec.

VWF antigen, factor II, V, VII, VIII, IX, X activity levels were normal. CT Scans revealed large bilateral gluteal hematomas arising from the pelvic bone, numerous skeletal lytic lesions and compression fractures. Marrow examination of the resected left femur revealed sheets of plasma cells. DISCUSSION: Multiple myeloma, a clonal proliferation of malignant plasma cells that secrete a monoclonal serum immunoglobulin and light chain, often presents with abnormalities of screening coagulation tests; however, severe bleeding due to acquired coagulopathy is rare. The underlying mechanism in most case reports is attributed to interference of fibrin monomer polymerization by the M-protein, resulting in an unstable clot more susceptible to fibrinolysis. Other mechanisms, such as direct autoantibody inhibition of coagulation factors (i.e. VIII, XIII, thrombin) or the detection of circulating heparin-like glycoaminoglycans, have been rarely reported. Diagnostic evaluation is clinically challenging and little data exists to guide therapeutic management. Our patients abnormal PT and PTT mixing times suggested the presence of a defect in the common factor pathway. The prolonged TT and normal RT implied that the abnormal PT and PTT were more likely due to an acquired thrombin inhibitor, rather than a dysfibrinogemia or fibrin polymerization disorder. Despite initiating a bortezomib-cyclophosphamide chemotherapy regimen, our patient continued to have recurrent, painful limb bleeding refractory to factor replacement. Plasmapheresis was employed and resulted in a cessation of bleeding with a reduction of M protein, correction of PT, PTT and TT. However, bleeding at the femoral vein catheter site on day 5 of pheresis necessitated catheter removal and discontinuation of pheresis. Shortly thereafter, the patient had recurrent limb bleeding with an increase in M-protein, prolongation of PT, PTT, and TT, due to refractoriness to bortezomib-based chemotherapy. Attempts to neutralize the suspected thrombin inhibitor with IVIG and to bypass it with recombinant factor VIIa were ineffective. Fortunately, treatment with melphalan-thalidomide chemotherapy eventually resulted in the remission of bleeding, reduction of M-protein and correction of coagulation tests.

A RARE CAUSE OF COMPLETE HEART BLOCK; A CASE REPORT Wasim A. Hamarneh; Subhraleena Das; Sujith Cherian; David Landsberg. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339978)

LEARNING OBJECTIVE 1: 1. Recognise a rare cardiac complication of hydromorphone administrationCASE: A 75 -year- old female with history of ischemic cardiomyopathy presented to our institute with right upper quadrant pain, nausea and vomiting. The patient after appropriate workup was found to have acute cholecystitis and was

admitted for cholecystectomy the next day. For severe abdominal pain patient received 2 mg of IV hydromorphone. 15 mins later patient was found unresponsive and severely bradycardic. She was diagnosed to be in complete heart block (CHB), with ventricular escape at 20-25 bpm. Patient was transcutaneously paced following which patient again became responsive. During this time patient was also given 2 mg of IV naloxone. 5 mins after administration of naloxone, patient reverted back to normal sinus rhythm and remained so making requirement for pacing redundant. Acute coronary syndromes were ruled out. Given no other precipitating factor, the direct temporal association with hydromorphone administration and reversal with naloxone, hydromorphone was determined to be the cause of CHB. DISCUSSION: Review of the medical literature revealed a few isolated reported cases implicating opioids to cause varying degrees of heart block: 1. Christensen et al described complete heart block with morphine in a 40 year old female. 2. Heaney et al described LBBB with first degree heart block in a 20 year old male with propoxyphene. 3. Stein et al demonstrated cardiodepressant actions of morphine including bradycardia and atrioventricular block in murine models. Multiple theories have been proposed: 1. Increased parasympathetic activity from stimulation of the dorsal nucleus of vagus nerve by opioids. The fact atropine fails to reverse, refutes this to some extent. 2. Secondly, varying degrees of verapamil like calcium channel blockade by opioids. Consistently, in all the reported cases and as in our case, naloxone was found to reverse the cardio-depressant action completely. To conclude, our case reiterates the adverse cardiac outcomes possible with opioid usage apart from being the first reported case of CHB secondary to hydromorphone in medical literature, to the best of our knowledge.

A RARE DISEASE WITH A NOVEL TREATMENT; A CASE REPORT Wasim A. Hamarneh; Subhraleena Das; Sujith Cherian. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339934)

LEARNING OBJECTIVE 1: 1. Recognize the diagnostic challenge and the broad differential for acute symmetric polyarthritis.

LEARNING OBJECTIVE 2: 2. Diagnose and manage parvovirus arthropathyCASE: A 35-year-old- female post splenectomy for Beta thalassemia major was admitted with rapid onset of hand pain and swelling of four days. She had morning stiffness lasting more than an hour. Review of systems was unremarkable. Examination revealed synovitis in a symmetrical distribution, involving metacarpophalangeal (MCP), proximal inter-phalangeal (PIP), wrist and ankle joints with restriction of movement. Radiographs showed no erosive changes. Rheumatoid factor and anti- CCP (anti- citrullinated cyclic peptide) were negative but antinuclear antibody was transiently positive. She was started on steroids with a presumptive diagnosis of seronegative RA (rheumatoid arthritis) but her joint symptoms soon relapsed. Secondary hemosiderosis was considered, given her history of multiple transfusions; iron chelation therapy was contemplated. Serum levels of Parvovirus B19 antibodies were sent which returned strongly positive with an IgM level at 11.3(<0.9). Intravenous immunoglobulin (IVIG) infusions were started for parvovirus arthritis with good clinical response. Follow up after 3 months showed substantial reductions in the IgM level and elevated IgG levels.

DISCUSSION: Parvovirus B19 is known to cause arthropathy in adults. It presents with a symmetrical polyarthritis (RA-like) and usually resolves without joint erosions. Patients with immunosuppression and shortened red blood cell lifespan are at risk for persistent infection. Proposed mechanisms for B19- associated arthritis include immune-complex deposition, phospholipase-A2 like activity of viral capsomer protein (VP1) and molecular mimicry (VP-2 protein and articular collagen) with auto-antibody production. Viral persistence in synoviocytes may be a crucial factor in the development of arthropathy. Parvoviral infection has been linked to RA; causality has never been established. Higher viral seroprevalence and increased synovial fluid viral DNA persistence in RA cases serve as arguments for the association and merit further study. Most cases of parvoviral arthritis do not require specific therapy. Commercial IVIG (Intravenous immunoglobulin) is a good source of neutralizing anti-parvo antibodies. IVIG may also suppress TNFa (tumour necrosis factor a) and increase IL-2 (interleukin-2) production. Parvovirus arthropathy often responds to a 5-day course of IVIG. In

patients at risk, it is prudent to consider parvoviral infection as a cause of persistent arthropathy. IVIG can be considered as a therapeutic option if arthropathy persists in spite of conventional treatment.

A RARE PRESENTATION OF TAKOTSUBO CARDIOMYOPATHY Waleed T. Kayani1; Salman J. Bandeali1; Anam Khan2; Ali Hashmi1; Himabindu Kadiyala1. 1Baylor College of Medicine, Houston, TX; 2Aga Khan University, Karachi, Pakistan. (Control ID #1339973)

LEARNING OBJECTIVE 1: Recognize thyroid storm as a rare cause of Takotsubo cardiomyopathyCASE: A 50 year old female with no prior diagnosed illnesses who presented with three days of nausea, low grade fevers, ongoing right upper quadrant (RUQ) abdominal pain and one episode of non specific chest pain. Admission examination revealed a febrile lady with sinus tachycardia, RUQ guarding and tenderness. Findings of leucocytosis on blood tests and positive Murphys sign on abdominal sonogram revealed a picture consistent with acute cholecystitis. A screening electrocardiogram showed diffuse precordial STE elevations and T wave inversions. Troponin levels returned mildly elevated (0.07 ng/mL. An emergent cardiac catheterization was undertaken which did not show any evidence of obstructive coronary artery disease or plaque rupture. A transthoracic echocardiogram was done which showed moderately depressed ejection fraction (30 - 34%) with severe akinesis of mid- distal left ventricular segments. Her presentation was consistent with stress induced cardiomyopathy precipitated by acute cholecystitis. She underwent open cholecystectomy on day 2 of admission. Her post operative course was complicated by lethargy, persistent sinus tachycardia to 150/min and unremitting fever up to 103F . All infectious workup returned
negative. As no apparent cause of persistent tachycardia and fever was evident, thyroid function studies were sent which revealed TSH <0.01 uIU/ml, free T47.42 pg/ml, free T3 8.61 pg/ml consistent with severe hyperthyroidism. Her overall picture was consistent with thyroid storm (Burch Wartofsky score of55). She was started on metoprolol, methimizole and hydrocortisone with resolution of tachycardia and fever in next 2 days. Her thyroid stimulating antibodies were elevated at 491% (normal 0 - 139%). A transthoracic echocardiogram done in 2 weeks showed return of ejection fraction to normal and resolution of impaired wall motion. Final diagnosis of stress induced cardiomyopathy from thyroid storm (which in turn was precipitated by acute cholecystitis) was made. Patient continues to do well on antithyroid therapy as an outpatient.

DISCUSSION: Takotsubo cardiomyopathy is a reversible form of left ventricular dysfunction which is typically preceded by an episode of intense physical or emotional stress. The presentation mimics that of a myocardial infarction with chest pain, elevated cardiac enzymes and ST segment elevation (usually anterior); however, coronary angiography does not reveal significant coronary stenosis or evidence of plaque rupture. There is increasing evidence that the disorder may be caused by diffuse catecholamine induced microvascular spasm or dysfunction resulting in myocardial stunning or by direct catecholamine-associated myocardial toxicity. Given increased concentrations of adrenoreceptors at cardiac apex, apical ballooning may reflect focal damage from circulating catecholamines, however, it remains a hypothesis at this point. Thyroid hormones are known to increase myocardial susceptibility to catecholamines and this may explain occurrence of Takotsubos in patients with thyroid storm. Review of literature reveals only four cases of Takotsubos cardiomyopathy induced by thyroid storm. Keeping in mind the high mortality associated with thyroid storm, physicians should keep hyperthythyroidism a consideration while working up such patients.

A RARE PULMONARY COMPLICATION OF SYSTEMIC LUPUS ERYTHEMATOSUS; A CASE REPORT Sujith Cherian; Subhraleena Das; Wasim A. Hamarneh. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339789)

LEARNING OBJECTIVE 1: 1. Recognizing and diagnosing shrinking lung syndrome (SLS), an extremely rare pulmonary complication associated with systemic lupus erythematosus (SLE).

CASE: A 27-year-old female with known history of active SLE was referred to the pulmonary clinic by her rheumatologist for workup of exertional dyspnea and pleuritic chest pain. The patient had two recent admissions for the same in the past few months where radiological investigations revealed only low lung volumes and no

other acute processes. CT scan of the chest was negative for any evidence of embolism and 2 D echo was normal. Laboratory investigations confirmed the presence of active lupus with high ESR, elevated anti ds DNA titers and anti Ro/ SSA titers. Pulmonary function tests suggested severe restrictive ventilatory defect which revealed a FEV1 of 1.5 L, FVC of 1.21 L and DLCO of 11.8 ml/mmHg/min (37% , 39% and 43% of predicted respectively). A diagnosis of SLS was considered and the patient was put on an increased prednisone dosage at 1 mg/kg/day with symptomatic improvement and no further admissions, but was found to have no objective evidence of improvement on follow up.
DISCUSSION: SLE is a systemic autoimmune disease with pleuro-pulmonary involvement in 60-80 % of patients. SLS is a rare progressive pulmonary complication associated with SLE, characterized by dyspnea, pleuritic chest pain, reduced lung volumes and restrictive ventilatory defects without parenchymal abnormalities. The mechanism responsible is unclear although diaphragmatic dysfunction has been suggested. It generally presents in the third decade of life with a female predominance (9:1) and has a reported association with anti Ro/ SSA antibody positivity. There is no definitive therapy, but based on anecdotal evidence, increasing systemic glucocorticoid or increasing immunosuppressive agents as second line approach has been found to be useful. Therefore, in a patient with SLE, a strong index of clinical suspicion needs to be maintained for SLS, especially in patients presenting repeatedly with a constellation of dyspnea and pleuritic chest pain and no objective findings.

A STRANGE PRESENTATION IN THE OFFICE - MY HOUSE IS ON FIRE! Tulsi Sharma; Pankaj Mehta. SUNY Upstate Medical University, Liverpool, NY. (Control ID #1311834)
LEARNING OBJECTIVE 1: Organic brain lesions may present with atypical neurological presentations including psychiatric symptoms. LEARNING OBJECTIVE 2: Brain imaging should be considered for patients with atypical symptoms or a sudden change in clinical presentation of psychiatric symptoms.
CASE: Introduction: Patients with organic brain lesions in neurologically silent brain areas might present only with psychiatric symptoms. Case: We present the case of a 21-year-old lady who was transferred from an outside facility with a possible diagnosis of encephalitis. She woke up one day with the sensation of her house burning down. This sensation was shortlasting but later in the day she developed mild headache with nausea. She was evaluated at the office of her primary care and sent for CT head, which revealed some signal abnormalities in the temporal area. An MRI was done the same day which suggested possible encephalitis. Lumbar puncture was attempted by a neurologist but was unsuccessful, so it was abandoned. EEG was negative for any focal discharges and she was empirically started on acyclovir. Her headache improved and she was discharged home on oral acyclovir. Over the next few days she felt depressed and emotionally labile. She said that she had been crying and this is not her usual self. She is actually a very happy person with no past medical history. She went back to her primary physician and repeat head imaging was unchanged. Her emotional lability persisted but she did not have any neurological signs. She was transferred to University hospital for an opinion and a repeat CT again revealed similar findings. Lumbar puncture done was normal and PCR for HSV was negative. MR spectroscopic examination showed very high choline peak, markedly diminished N-acetylaspartate (NAA) and decreased creatine. This metabolic profile on MR spectroscopy was suggestive of a probable tumor rather than infection or inflammatory process. Our suspicion was confirmed on the biopsy which revealed a glioblastoma. She has undergone surgery and is currently on chemo-radiation.
DISCUSSION: We present this case to highlight the fact that patients with organic brain lesions may present with a variety of psychiatric symptoms. This is especially important in the outpatient primary care setting as the symptoms may include depression, personality changes, cognitive deterioration, and anorexia nervosa. Diagnosis is often delayed and needs a high clinical suspicion in the office setting. 1. Studies have reported that

1/1000 of hospitalized psychiatric patients have brain tumors. This rate is 20-times higher than in general population. 2. Visual hallucinations have been reported but olfactory hallucinations are a rare presenting symptom for brain tumors. 3. Brain imaging should be considered not only for psychiatric patients with neurologic symptoms and signs, but for all psychiatric patients with atypical symptoms or a sudden change in clinical presentation of psychiatric symptoms. Delay to perform brain imaging might have a direct negative effect on treatment options and quality of life of such patients. 4. This case highlights the role of MR Spectroscopy in the early differentiation of infectious, metabolic and malignant pathologies of the brain using metabolic indicators. MR spectroscopy helped in the early diagnosis of this patient and hopefully a favorable outcome.

A SYMPTOMATIC CASE OF R. PARKERI INFECTION DETECTED BY POLYMERASE CHAIN REACTION AMPLIFICATION FROM BLOOD AND ESCHAR SWAB SPECIMENS: A NOVEL DIAGNOSTIC APPROACH FOR A RARE CONDITION

Patrick Daly1; Jason Maguire2; Tahaniyat Lalani2. 1Naval Medical Center Portsmouth, Portsmouth, VA; 2Naval Medical Center Portsmouth, Portsmouth, VA. (Control ID #1314593)

LEARNING OBJECTIVE 1: Introduce novel approach to diagnosis of "R. parkeri" through cell culture isolate or PCR of eschar swab. LEARNING OBJECTIVE 2: Demonstrate that "R. parkeri" should be considered in all patients with suspected rickettsial infection as "R. parkeri" prevalence is likely higher than previously reported due to cross-reactivity of the existing rickettsial serologic assays.

CASE: The zoonotic, vector-borne rickettsia are clinically important worldwide and considered an emerging risk for humans. Several spotted fever group (SFG) rickettsia cause human disease such as Rickettsiae rickettsii, R. felis and R. akari. R. rickettsii, the cause of Rocky Mountain spotted fever (RMSF) is the most commonly recognized rickettsial disease in the U.S. with approximately 500-2000 cases reported annually and a case fatality rate in untreated patients as high as 25%. Within the past seven years, a previously unrecognized cause of human disease, R. parkeri, has been reported as a confirmed cause of illness on six occasions, and was recovered in cell culture from an eschar. A 43 year-old gentleman presented to his primary care clinic in May 2011 after developing an eschar on the lateral aspect of his left knee, where he had removed an embedded tick several days prior. He was prescribed topical antibiotics, though subsequently developed fevers to 104 F accompanied by chills and a diffuse rash. He returned to the primary care clinic during the following week and was prescribed a two-week course of doxycycline. Within three to four days of starting the doxycycline, the patient reported resolution of his symptoms. Approximately three weeks later, the patient noted onset of asymmetric arthralgias including bilateral knee pain along with intermittent left wrist and ankle pain without swelling. Polymerase chain reaction (PCR) performed on the patients blood and a swab of the eschar obtained at the time of his acute illness prior to antibiotic administration for R. rickettsii and R. parkeri and revealed R parkeri.

DISCUSSION: While R. rickettsii is the predominant pathogen involved in human rickettsial disease, the actual prevalence of R. parkeri is unknown because most commercial serological assays do not distinguish between SFG species. Serum specimens from previously diagnosed RMSF patients react with protein isolates from R. parkeri. Seroprevalence studies have also demonstrated higher than expected R. rickettsii sero-positivity patients without history of RMS, which suggests that they may have been infected by less pathogenic SFG rickettsii such as R. parkeri. This pathogen has military relevance as the fourth reported case of R. parkeri infection in humans with three of the four cases involving US service members in the Tidewater region of Southeastern Virginia. We also report the first instance of diagnosing acuteR. parkeri infection through non-invasive means. R. parkeri should be considered in the presence of single or multiple eschars in a patient with suspected rickettsial infection. In the current absence of serologic testing, cell culture isolate or PCR can be performed on eschar biopsy specimens and possibly eschar swabs. The clinical presentation of reported cases in contrast to RMSF will be reviewed in addition to the novel diagnostic approach employed in this case.

A WOMAN WHO PASSES OUT ON EATING

Ojas Bansal1; Janardhana Gorthi1; Aryan Mooss1,2. 1Creighton University Medical Center, Omaha, NE; 2Creighton

University Medical Center, Omaha, NE. (Control ID #1335116)
LEARNING OBJECTIVE 1: Learn the presentation and diagnosis of Swallow SyncopeLEARNING OBJECTIVE 2: Discuss various management options for Swallow SyncopeCASE: 84 year old female presented to the hospital after she had recurrent episodes of syncope. First episode occurred two days ago while she was eating lunch at a restaurant when she felt nauseous, lightheaded and lost consciousness. She regained consciousness spontaneously in about a minute. She had another episode the following morning while eating breakfast at which point she decided to seek medical attention. On presentation her Blood pressure was 176/89, heart rate 85/minute, Cardiac exam was normal with S1 S2 regular rhythm without any murmurs. During her hospitalization she had a similar episode of syncope while eating a big piece of sandwich. Telemonitoring captured Sinus bradycardia with heart rates in 40s and blood pressure drop to 70/40 mm Hg. Her past medical history included hypertension for which she was on Metoprolol succinate 200 mg, Amlodipine 10 mg and Lisinopril 20 mg daily. We stopped her beta blocker and lisinopril with marked improvement in symptoms. She subsequently underwent esophagogastroduodenoscopy which showed a schatzki ring in the distal esophagus which was then dilated. She was started on soft diet which she tolerated well and was advised to eat small bites slowly. She did not have any further symptoms.

DISCUSSION: Swallow (or Deglutition) syncope is a relatively rare type of Situational syncope. Manifestations vary from dizziness and presyncope to complete temporary loss of consciousness associated with swallowing. There have been about 80 reported cases of swallow syncope in the literature and only 2 of them were associated with Schatzki ring. Its a hypersensitive vagotonic reflex. Activation of the mechanoreceptors on esophageal distension leads to stimulation of the SA and AV node via the vagus nerve resulting in paroxysmal bradyarrhythmias and heart blocks. Others have observed that swallow syncope can occur even in the absence of bradycardia, as increased afferent vagal stimulation may lead to syncope via sympathetic withdrawal, resulting in peripheral vasodilation and hypotension, as seen in our patient. The diagnosis of swallow syncope requires careful elicitation of the temporal relationship between swallowing and syncope. Provocative testing with various types of liquid and solid foods should be attempted. As esophageal disorders may be associated with a majority of cases of swallow syncope, further work-up to exclude possible structural or functional esophageal pathology has been suggested. Echocardiogram and resting and ambulatory EKG should be performed to rule out any underlying cardiac pathology. Management of swallow syncope involves withdrawal of all medications causing delay in cardiac conduction and vasodepression. Avoidance of carbonated fluids or other agents associated with symptoms, as well as behavioral modification to change eating habits may be successful in patients with infrequent episodes of syncope. In patients with significant bradyarrythmias and AV blocks, placement of a pacemaker with a rate drop feature has been effective in controlling the symptoms. While syncope is a common presenting complaint, swallow syncope is a rare condition that may only be ascertained through thorough history, proper diagnostic work up and high index of clinical suspicion.
A FORGOTTEN CAUSE OF SEPSIS AND PNEUMONIA IN A 30 YEAR OLD MALE Neeraj N. Shah; Valay Parikh; Neville Mobarakai. Staten Island University Hospital, Staten Island, NY. (Control ID #1312108)
LEARNING OBJECTIVE 1: Recognize Lemierre syndrome as an important cause of F. necrophorum sepsis.
LEARNING OBJECTIVE 2: Diagnose Lemierre syndrome in absence of classical clinical features.
CASE: A 30 year old male presented to Emergency Department with complaints of pleuritic chest pain, abdominal pain, nausea, vomiting &diarrhea. Review of systems revealed fever, chills, malaise, myalgias, generalized weakness &decreased appetite since the past week. He was a smoker (7.5 pack-years). He appeared pale, diaphoretic &dehydrated. Vitals showed tachycardia &hypotension. Respiratory system examination revealed bilateral lower lobe ronchi. White blood count was 30,000/L with neutrophilia. Other laboratory tests were normal except for platelet count of 53,000/L, BUN of 24 mg/dl &mild conjugated hyperbilirubinemia. CT-chest showed consolidated airspace opacity in the left lower lobe along with multiple

nodular opacities with cavitation in the right base. Blood cultures were sent &empiric broad spectrum antibiotics were started. A 2D echo was negative for vegetations, ruling out infective endocarditis. Two days later, gram negative rods started growing in the blood cultures, &antibiotics were switched to linezolid, ertapenem &moxifloxacin. A week later, the blood culture report showed Fusobacterium necrophorum. Upon suspicion of Lemierre syndrome, a duplex ultrasound of neck vessels was done, which showed a partially occlusive thrombus in the right internal jugular vein. A diagnosis of Lemierre syndrome was established &antibiotics were switched to penicillin &clindamycin. The patient denied any sore throat or neck pain or swelling in the recent past &examination of the head &neck was normal, except for mild periodontitis. The patient was started on tinzaparin therapy for IJV thrombus. There was gradual clinical improvement in the patients condition &repeat ultrasound showed resolution of the thrombus 20 days later. After 3 weeks of intravenous antibiotics, the patient was discharged on oral clindamycin for 10 days and oral warfarin (target INR of 2-3) for 6 months.
DISCUSSION: Lemierre syndrome is an anaerobic suppurative thrombophlebitis of internal jugular vein (IJV) occurring following tonsillitis,
pharyngitis, otitis media, sinusitis or dental infections. The most common pathogen is Fusobacterium necrophorum. It is more common in adolescents and young adults. Septic emboli to lungs, systemic sepsis &metastatic abscesses can occur. In the preantibiotic era, it was common and fulminant, with a mortality of 90%. However, it is now so rare (incidence 0.8 cases per million general population) that many clinicians are unaware of its existence, thus leading to the term forgotten disease. With timely antibiotic treatment, the mortality maybe quite low (4.6%). The classic presentation of Lemierre syndrome is an episode of fever &sore throat followed by neck pain &swelling. In our case, however, the patient presented with abdominal pain, vomiting, diarrhea, sepsis and chest pain, which can have a broad etiology. Few cases in the literature have reported sepsis &/or cavitating lung lesions, without any evidence of pharyngitis, as the presenting features of Lemierre syndrome. This case highlights that in patients with positive blood cultures forF. necrophorum, in absence of classic features of Lemierre syndrome, it is important to perform radiologic testing for thrombosis of IJV in order to diagnose this syndrome. Without emergent antibiotic treatment, this disease can be rapidly fatal.

ACCELERATED ACUTE TUBULAR NECROSIS DUE TO VANCOMYCIN Sunay Shah; Papia Nasiri; Jose Vazquez. Henry Ford Hospital, Detroit, MI. (Control ID #1339723)

LEARNING OBJECTIVE 1: Review the risk factors of vancomycin-induced acute tubular necrosis.

CASE: A 31-year-old African American male with a history of a chronic left plantar foot ulcer, type 2 non-insulin dependent diabetes mellitus, and morbid obesity was admitted with the diagnosis of acute bacterial cellulitis on the plantar surface of his left foot with an associated ulceration. The physical examination revealed that the patient was afebrile and the second digit of the left lower extremity was markedly swollen with a linear ulceration on the lateral aspect, as well as a 3 x 3 cm stage 3 plantar ulcer. Radiographs of the left foot demonstrated gas within the soft tissues and an area of bone destruction in the proximal phalanx of the second digit. The patient was empirically started on Vancomycin (VAN) 2 gm IV every 6 hrs, cefepime, and metronidazole. After 52 hrs of hospitalization, the patient had received a cumulative dose of 16 gm of VAN. On the morning of hospital day three, the patients labs revealed a serum creatinine of 5.3 mg/dL, an increase of 4.5 mg/dL from the initial measurement [Table 1]. The first VAN trough level was found to be 76 g/mL, measured 44 hrs after the first VAN dose and after a total of 12 gm. A renal biopsy demonstrated abnormalities consistent with ATN with extensive tubular epithelial cytoplasmic microvacuolization. Despite withholding VAN, the patients serum creatinine continued to rise and eventually peaked on hospital day six at 12.1 mg/dL. On hospital days seven and eight, he underwent two sessions of hemodialysis secondary to volume overload. Over the next few weeks, the patients serum creatinine gradually improved and eventually stabilized at 1.4 mg/dL. The patient completed antimicrobial treatment with a six-week course of ceftaroline for a severe diabetic foot infection and underlying osteomyelitis.

DISCUSSION: Vancomycin is one of the most commonly used antibiotics for the empiric and definitive

treatment of MRSA and many other gram positive infections. Recently, several risk factors have been described that have been associated with increased VAN-induced nephrotoxicity. These include VAN serum trough concentrations 15 g/mL, prolonged duration of therapy 14 days, obese patients weighing >101 kg, and VAN dosing regimens of>4 gm per day. Several recent studies suggest that AKI occurs more commonly in patients who reside in the intensive care units, have had a prior episode of AKI, or have received a vasopressor and/or other nephrotoxins, such as loop diuretics or aminoglycosides. This case report is unique for several reasons. It is only the second report documenting VAN as the sole etiologic cause of ATN. Moreover, this case also demonstrates the rapidity in the development of VAN-nephrotoxicity (case patient within 72 hrs of admission). The primary risk factors associated with VAN-induced nephrotoxicity are directly related to the total amount of VAN being administered. Special considerations for calculating VAN doses and intervals should be considered in the diabetic and morbidly obese populations, since we frequently overestimate the patients actual creatinine clearance. Given the information discussed herein, should we consider the use of alternative, less toxic antimicrobials in these high-risk patient populations?

ACQUIRED THROMBOTIC THROMBOCYTOPENIC PURPURA IN AN 83 YEAR OLD WOMAN Allison E. Jordan; Merrideth A. Morris; Brad A. Keith. Medical University of South Carolina, Charleston, SC. (Control ID #1335727)

LEARNING OBJECTIVE 1: Recognize the clinical features of thrombotic thrombocytopenic purpura in a geriatric patient.

LEARNING OBJECTIVE 2: Treat with standard therapy of plasmapheresis and incorporate rituximab for refractory cases of thrombotic thrombocytopenic purpura.

CASE: The patient is an 83 year old woman with a past medical history of hypertension, nicotine dependence, and monoclonal gammopathy of unknown significance who was transferred from an outside hospital with a chief complaint of abdominal pain, nausea, and bilious vomiting for several days. During initial evaluation at the outside hospital, she was noted to have platelets of 83,000 and hemoglobin of 8.3. Due to her gastrointestinal problems, an EGD was performed which found esophageal candidiasis. Upon transfer, the patient also complained of a productive cough which had persisted for two weeks and sputum cultures had heavy growth of Pseudomonas aeruginosa. On admission to our hospital, her platelets were 70,000 and hemoglobin was 9.4. Her LDH was 661, D-dimer 4.37, haptoglobin 50 and creatinine 1.7. Her peripheral smear showed numerous schistocytes and direct Coombs test was negative. Hematology and nephrology were consulted and the patient was emergently started on plasmapheresis for presumed thrombotic thrombocytopenic purpura. An ADAMTS13 activity returned <5% and ADAMTS13 inhibitor was <0.4. Despite plasmapheresis for over two weeks, the patient continued to have thrombocytopenia. The patient was started on rituximab and received two doses while hospitalized. The patient was also treated with a two week course of fluconazole for the esophageal candidiasis and cefepime for Pseudomonas pneumonia. The patients platelet count was 103, LDH 400, D-dimer 1.59, haptoglobin 21 and creatinine 1.7 at the time of discharge. The patient was discharged to a rehabilitation facility and followed up with hematology to receive her remaining two doses of rituximab as an outpatient. Her platelet count has ranged from 240 to 330 several weeks after her final treatment and she is considered to be in remisssion.

DISCUSSION: Acquired thrombotic thrombocytopenic purpura (TTP) is a rare condition that is a medical emergency. It is caused by a deficiency of a von-Willebrand factor-cleaving protease that has autoantibodies directed against it. The etiology for most cases of acquired TTP is idiopathic. Patients present with neurological abnormalities, renal failure, hemolytic anemia and thrombocytopenia. The diagnosis can be confirmed with testing for ADAMTS13 activity however it is recommended that treatment be initiated even if there is uncertainty

about the diagnosis if the patient has thrombocytopenia and microangiopathic hemolytic anemia. Treatment involves plasmapheresis which removes the patients circulating antibody to ADAMTS13 and von-Willebrand factor multimers. Patients are also infused with normal plasma that contains ADAMTS13. For patients with refractory cases or neurologic abnormalities, rituximab has been used in a small number of patients. After four once-weekly doses, most patients go into remission. Our patient was treated with two doses of rituximab while an inpatient due to continued thrombocytopenia despite plamapheresis and her platelets improved with this therapy. After completing the four doses her platelet count has normalized. More investigation is needed to determine if rituximab should be used as part of the initial treatment of TTP with plasmapheresis.

ACQUIRED HIGH-GRADE PAROXYSMAL ATRIOVENTRICULAR BLOCK DURING PREGNANCY

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(Control ID #1314592)

LEARNING OBJECTIVE 1: Improve comprehension of mechanisms of AV block arising in pregnancy.

LEARNING OBJECTIVE 2: Demonstrate safe application of pacemaker placement during pregnancy.

CASE: High-grade atrioventricular block (AVB) arising in pregnancy is an exceptionally rare occurrence with only a few reported cases in the literature. In a review of admissions to a high-volume obstetric service, there were less than 2/100,000 cases of high-grade AVB with one attributed to congenital heart disease. Due to the limited number of reported cases in the literature, the underlying physiology and outcome of patients with acquired heart block during pregnancy is not well understood. We present the unusual case of a pregnant woman with multiple syncopal events and high-grade AVB on holter monitor. A 28 year-old female (G3P1) with history of depression and attention deficit hyperactivity disorder presented to the Emergency Department (ED) at approximately 10 weeks of pregnancy reporting dizziness, fatigue, and exertional dyspnea. She was discharged from the ED with an event monitor that documented variable degrees of AVB. She had no previous history of AVB or other cardiac conditions and had never experienced similar symptoms. Her first pregnancy was complicated by intrauterine fetal demise at 24 weeks gestational age, while she delivered a healthy infant at term during her second pregnancy. Patient remained active during this pregnancy and was not limited by her symptoms. Within several weeks of initial presentation, she had one syncopal event at rest after eating as well as a pre-syncopal episode while walking in her house. The remainder of her pregnancy was remarkable for pre-syncopal and syncopal episodes with electrocardiographic documentation on outpatient event monitors of high-grade AVB. A transthoracic echocardiogram was normal. A transvenous pacer was placed prior to the patient developing active labor. She delivered a healthy infant during an uncomplicated vaginal delivery, after which the transvenous pacer was removed. She continued to suffer from presyncopal episodes several times per week postpartum. Five months following delivery a dual-chamber pacemaker placed with subsequent resolution of her symptoms.

DISCUSSION: The physiology of AVB onset during pregnancy has not been established. There are several possible mechanisms with the most likely being a mechanical phenomenon involving increased vagal tone due to uterine compression of abdominal and pelvic vasculature. The hormonal changes occurring during pregnancy may alter the refractory period of the AV node or His-Purkinje system. Alternatively, autoantibodies to elements of the cardiac conduction system that arise during pregnancy could be the cause of the variable AVB. Certainly more research is needed to determine the etiology of new-onset AVB in pregnancy. Given the rarity of pregnancy-induced AVB, optimal therapy has not been well-established. These patients must be monitored closely with the knowledge that the AVB will likely be progressive in severity. Both temporary and permanent pacemaker placement during pregnancy has been performed without maternal or known fetal complications.

ACUTE HIV-1 INFECTION MISDIAGNOSED AS STREPTOCOCCAL PHARYNGITIS

Aalok D. Patel1; Girish L. Kalra2. 1Emory University, Atlanta, GA; 2Emory, Atlanta, GA. (Control ID #1322694)

LEARNING OBJECTIVE 1: Recognize the clinical features of acute HIV-1 infection.

CASE: Case A 33-year-old African American man presented to the emergency department with several days of fever, sore throat, chest discomfort, vague difficulty swallowing, and occasional nausea/vomiting. Documented exam was notable for pharyngeal erythema and cervical lymphadenopathy. Rapid strep antigen screen returned positive. He was treated for streptococcal pharyngitis with intramuscular penicillin and discharged. He returned two weeks later for persistent symptoms and anorexia. Vital signs and exam were unremarkable. We did not appreciate cervical lymphadenopathy or pharyngeal erythema. Laboratories revealed a mildly elevated serum creatinine of 1.4 mg/dL, CPK of 2294 U/L, and AST of 108 U/L. Upon detailed questioning, he endorsed a history of routine unprotected sex with male and female partners, intermittent homelessness, and a remote history of treated syphilis. An investigational point-of-care HIV screening test was negative. He was admitted for dehydration due to swallowing difficulty. He was treated conservatively with fluids, analgesics, and a proton pump inhibitor. He experienced intermittent fevers. Endoscopy revealed three superficial ulcerations in the mid-esophagus; biopsy later revealed severe inflammation without evidence of infection. Given persistent symptoms and a history of high-risk behaviors, the possibility of acute HIV infection was entertained, and formal HIV antibody and RNA testing were ordered. Initial ELISA screen

was positive, but confirmatory western blot returned negative. The diagnosis of acute HIV was confirmed when his RNA viral load was found to be >10 million copies/mL. CD4 count was 326/mcL (39%). His swallowing gradually improved, and he was discharged with a plan for close follow-up with an infectious diseases specialist.

DISCUSSION: In acute human immunodeficiency virus (HIV)-1 infection, patients often present with a constellation of varied signs and symptoms, including fever, fatigue, rash, myalgias, headache, pharyngitis, gastrointestinal disturbance, and lymphadenopathy, beginning 1-4 weeks post-transmission. Painful mucocutaneous ulcerations, such as those found in our patient, are also commonly seen. The acute illness lasts days to weeks and is commonly misdiagnosed because of its nonspecific nature. Diagnosis is particularly challenging because HIV antibody tests are typically negative or indeterminate for several weeks following transmission. P24 antigen testing enhances sensitivity, but still has considerable diagnostic lag time. The most valuable test for early detection is the HIV RNA viral load, though it is not routinely ordered during screening. Thus, high clinical suspicion is necessary in order to diagnose acute HIV-1 infection. This case highlights the importance of asking patients about uncomfortable topics such as sexual history, homelessness, and drug use. In our patient, the diagnosis was delayed partly due to a positive rapid strep antigen screen; it is unclear whether this represents rare coincidence, colonization, or lab error. Nonetheless, detailed history-taking and recognition of the clinical syndrome at the time of follow-up led to the correct diagnosis.

ACUTE RESPIRATORY DISTRESS SYNDROME RESULTING FROM PRE-EXCLAMPSIA IN THE POST-PARTUM SETTING, A RARE BUT POTENTIALLY DEADLY COMPLICATION Daniel Gutteridge; Bhavana Siddegowda Bangalore. McLaren Regional Medical Center, Flint, MI. (Control ID #1333654)

LEARNING OBJECTIVE 1: Recognizing risk factors for acute respiratory distress syndrome in the post-partum setting.

CASE: A 24-year-old G1P1 38 week pregnant female was delivered by C-section after failed induction for pre-eclampsia. Postoperatively , she was transferred to the intensive care unit due to progressive hypoxia. Findings suggestive of evolving ARDS on x-ray with impending respiratory failure led to intubation and mechanical ventilation. She was noted to be febrile with urine cultures showing pseudomonas and sputum cultures positive for staphylococcus aureus. Broad spectrum antibiotics were initiated. Hypoxia persisted and continued to worsen; ultimately she was transferred to a university hospital for rapid oscillator ventilation and evaluation for extracorporeal membrane oxygenation. After 9 days of treatment and subsequent stabilization she was transferred back to the referring hospitals intensive care unit for continued care.

DISCUSSION: Acute respiratory distress syndrome (ARDS) is a severe lung injury with rapid decline in

pulmonary oxygenation status and subsequent respiratory failure requiring mechanical ventilation. There is severe hypoxemia with acute alveolar-capillary injury leading to non-hydrostatic pulmonary edema. As of 2005 there were approximately 200,000 cases in the published literature with in-hospital mortality rates ranging from 25% to 60%, depending on patient age. Typical pathologies include severe sepsis, trauma, drug overdose and pancreatitis. ARDS is a rare and lethal complication in the postpartum setting with an incidence 1 in 10,113 deliveries. Prolonged ventilator support is typical and justified in this setting in order to decrease the otherwise high mortality rate. The majority of ARDS cases in the postpartum setting stem from infection and pre-eclampsia. In our case the patient presented with both, potentially increasing the risk. With identifiable causes of ARDS in the setting of pregnancy, prevention is the mainstay of treatment. Once ARDS presents, supportive care with mechanical ventilation with low tidal volumes and treatment of underlying cause is critical.

ACUTE CARDIOMYOPATHY SECONDARY TO NUTRITIONAL DEFICIENCY Ming Yeong Lim. Mayo Clinic, Rochester, MN. (Control ID #1279476)

LEARNING OBJECTIVE 1: Recognize the importance of screening patients at risk of malnourishment for selenium deficiency

LEARNING OBJECTIVE 2: Recognize that selenium deficiency can lead to acute cardiomyopathy, which can mimic acute coronary syndrome (ACS)

CASE: A 69-year old male presented with a 1-day history of generalized weakness and dyspnea. Two months prior, he underwent a right hemicolectomy for a carcinoid tumor in the terminal ileum. Post-operatively, he developed atrial flutter, which resolved spontaneously. Echocardiogram then showed normal left ventricular size; ejection fraction (EF) 61%. Serial cardiac biomarkers were negative. Post-surgery, he developed 5-6 watery bowel movements daily. To limit the frequency of diarrhea, he reduced his oral intake substantially. On examination, he was cachetic, dehydrated, tachycardic and hypotensive (92/59 mmHg). Lung auscultation was clear bilaterally. Abdominal examination showed a healed incision scar. Electrocardiogram showed sinus tachycardia with non-specific ST and T-wave changes. Initial troponin-T was 1.58 ng/mL (N<0.01). Bedside echocardiogram demonstrated left ventricular enlargement with global hypokinesis;EF 35%. He was transferred to the Coronary Care Unit due to concern for ACS. Serial troponin-T levels were 1.84 ng/mL and 1.99 ng/ mL at 3 and 6 hours respectively. He declined invasive diagnostic intervention with cardiac catheterization. He underwent CT angiogram of his coronary arteries, which revealed normal coronary arteries, thus ruling out ACS. With his cachexia, he was tested for nutritional deficiencies and found to be selenium deficient at 55 ng/mL (95-165 ng/mL). He was diagnosed with selenium-deficient cardiomyopathy and started on oral selenium (80ug/day). On dismissal, he received medical therapy for heart failure (ACE-I and -blockers). Clinical improvement was noted after selenium supplementation for 2 weeks, which correlated with echocardio-gram findings of normalization of his left ventricular size; EF 43%. DISCUSSION: Selenium-deficient cardiomyopathy was first described in 1935 in Keshan, China, where the soil was poor in selenium, and was reversed with selenium supplementation. As selenium is absorbed in the small intestine, patients with malabsorption states, on chronic total parenteral nutrition, with small intestine surgery or disease are at risk for selenium-deficient cardiomyopathy. Selenium is an integral part of the enzyme glutathione peroxidase, which catalyzes active oxygen species, thus protecting cells from free radical damage. Loss of this protective mechanism with accumulation of free radicals has been proposed as the pathophysiology of selenium-deficient cardiomyopathy. Despite its importance, the daily requirement remains unclear due to the wide range of reference values for selenium and the variability in expression of symptomatic selenium deficiency. Also, selenium presents a nutritional conundrum as it is both essential and highly toxic. The World Health Organization suggests an intake of 30-40ug/day to meet healthy adult requirements. However, treatment of symptomatic selenium-deficiency patients requires intakes of 80ug/day. This case highlights the importance of selenium awareness in patients with malabsorptive or malnutrition states. Screening these patients for selenium deficiency is recommended. Early detection allows for prompt correction, thus avoiding potentially life-threatening complications, such as in

our patient.
ACUTE CHOLECYSTITIS AND PRIMARY EPSTEIN-BARR VIRUS INFECTION: A RARE COMPLICATION
Alexander Zider; Magdalena Ptaszny. University of California, Los Angeles, Los Angeles, CA. (Control ID #1340235)
LEARNING OBJECTIVE 1: Recognize cholecystitis as a rare complication of primary Epstein Barr virus (EBV) infectionCASE: A healthy, obese 32 year old female presented to the emergency room with five days of progressive headaches and three days of photophobia. In addition to these symptoms, she also had fevers (recorded as 100F at home), night sweats, sore throat, anorexia with five pounds of weight loss, diarrhea, and generalized myalgias. Lastly, she had non-focal abdominal pain present on deep inspiration. Laboratory workup revealed a lymphocytosis with atypical lymphocytes (peak absolute lymphocyte count of 8700 on HD#8), thrombocytopenia (nadir of 117 on HD#4), and a transaminitis (peak aspartate and alanine aminotransferase (AST and ALT) of 266 and 286 IU/L, respectively, on HD#5). Her initial heterophile antibody and EBV-specific serologies were negative; these became positive 15 days after initial presentation, with positive heterophile and EBV-VCA (viral capsid antigen) IgM antibodies. Of note, on hospital day #4, the

patients abdominal pain worsened and localized to the right upper quadrant (RUQ). Her total bilirubin had elevated slightly from 0.4 mg/dL on admission to 1.2 mg/dL with a conjugated bilirubin of 0.3 mg/dL (from0.1 mg/dL). A RUQ ultrasound had a positive sonographic Murphys sign and demonstrated gallbladder wall thickening, pericholecystic fluid, and cholelithiasis. The patient underwent cholecystectomy on HD#5, which confirmed calculous cholecystitis grossly and on histological examination (Figure). She denied any prior symptoms of biliary colic. DISCUSSION: EBV is a ubiquitous virus, with carriage by over 90% of adults world-wide (1). Primary EBV infection, known as infectious mononucleosis or glandular fever, afflicts about 500 people per 100,000 per year (1). Classic signs and symptoms of infectious mononucleosis include fatigue, fevers, pharyngitis, lymphadenopathy, hepatitis and splenomegaly. Acalculous cholecystitis in the setting of acute EBV infection is a rarely reported complication. There may be a female predominance, in contrast to the slight male predominance usually seen in acalculous cholecystitis (2). Concomitant Gilberts syndrome has been seen in some patients (3). There have been several hypotheses regarding the mechanisms of EBV infection leading to cholecystitis. It may be akin to acalculous cholecystitis seen in critically ill patients (4). Alternatively, EBV hepatitis has been shown to cause cholestasis (5), which may lead to acute cholecystitis (4). Lastly, some have proposed direct invasion of the gallbladder by EBV (6). This type of viral cholecystitis has been seen with hepatitis A, where viral antigen in the gallbladder was identified on histology (7). EBV-DNA has been observed in surgical cholecystitis specimens: a case series noted 70% of cholecystitis patients had EBV-DNA detectable by PCR on cholecystectomy specimens. Of note, all of these patients were EBV-VCA IgM (-) and IgG (+), suggesting latent EBV infection (8). This appears to be the first reported case of calculous cholecystitis in the setting of primary EBV infection, at least in the United States. Possibly, her cholelithiasis simply may have been an unrelated concurrent process. The gallstones may have exacerbated the inflammation already present from cholestasis or EBV invasion. Most likely, the combination of her EBV hepatitis, cholelithiasis, dehydration and severity of infection all contributed to the development of her cholecystitis.
ACUTE VISUAL LOSS AND HALLUCINATIONS IN A GERIATRIC PATIENT: GRAVES OPHTHALMOPATHY AND THE CHARLES BONNET SYNDROME. Cecily K. Peterson; Wenjing Liu. Duke University Health System, Durham, NC. (Control ID #1338676)
LEARNING OBJECTIVE 1: Diagnose and manage Graves ophthalmopathyLEARNING OBJECTIVE 2: Recognize partial sightedness as a risk for visual release hallucinations: Charles Bonnet SyndromeCASE: An 88-year-old woman with a history of diabetes, coronary disease, and macular degeneration presented with

double vision and vision loss in her left eye. The patient reported occasional horizontal and vertical binocular diplopia during the preceding nine months. She was found to have thyrotoxicosis and began treatment with methimazole. During the three weeks after initiation of therapy, she noticed a decline in the vision of her left eye. She also noted right frontal headaches occurring two to three times per week but denied jaw claudication. Visual acuity was 20/70 in the right eye and 20/400 in the left eye. She had bilateral proptosis, limited elevation and abduction of both eyes, and a left afferent pupillary defect. The erythrocyte sedimentation rate was 61 seconds. Thyroid stimulating hormone was 0.05 microIU/mL (low), free thyroxine 1.21 ng/dL (normal), and free triiodothyronine 2.34 pg/mL (normal). The patient began intravenous methylprednisolone for 5 days and a temporal artery biopsy revealed no arteritis. Orbital MRI showed bilaterally enlarged extraocular muscles. Graves ophthalmopathy was diagnosed. Her methimazole dose was increased and a subTenon injection of triamcinolone resulted in no visual improvement. During her hospital stay, she reported exquisitely detailed and increasingly frequent non-threatening visual hallucinations that she knew were not real. The images she reported were in far more detail than her visual acuity could distinguish and she and her family were puzzled and distressed by this. Due to cardiovascular risk factors, the patient chose radiation therapy to the orbits. Visual acuity improved to 20/ 50 in the right eye and 20/60 in the left eye.
DISCUSSION: The clinical presentation and course of Graves ophthalmopathy (GO) is varied. Presenting symptoms may include eyelid retraction, exophthalmos, extraocular muscle dysfunction, ocular pain, and lacrimation. A minority of patients with Graves disease can also develop sight-threatening optic neuropathy or corneal breakdown. Initiation of anti-thyroid therapy has been associated with worsening ophthalmopathy. Differential considerations include temporal arteritis, ischemic optic neuropathy, myasthenia gravis, orbital myositis, statin-induced orbital myopathy and orbital tumors. Once a diagnosis of GO is established, treatment options include glucocorticoids, immunomodulators, surgical decompression, and radiation therapy. In patients with visual loss or visual field loss, it is important to recognize Charles Bonnet syndrome (CBS) as a cause of visual release hallucinations. Any vision loss can be associated with CBS but is commonly due to age-related macular degeneration, diabetic retinopathy, cataract, multiple sclerosis, or occipital infarction. Symptoms often go unreported for fear that psychiatric illness is responsible, but survey data suggests upwards of 15% of older patients with visual impairment have hallucinations. The natural history of visual release hallucinations varies with the rapidity of onset, underlying cause for visual impairment, and further change in vision over time. Early recognition with education and reassurance is helpful for many patients.
ADENOMAS AND ANTIBODIES: A STICKY SITUATION Kristy Bojazi; Varsha Somasekharan; Domnica Fotino. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1337248)
LEARNING OBJECTIVE 1: 1. Recognize the clinical manifestations of anti-phospholipid antibody syndrome 2. Identify the differential diagnosis of anti-phospholipid antibody syndrome 3. Understand the pathophysiology and treatment of anti-phospholipid antibody syndromeCASE: A 44 year-old diabetic man presented with the sudden onset of severe headaches, blurry vision, and photophobia. The pain was frontal, radiating down his right neck. On the day of admission, he had fallen, striking his head. Subsequently, he noted left upper and lower extremity weakness. He denied neck stiffness, fevers, or chills. His temperature was 100.7 F; remaining vital signs were normal. He had bi-temporal hemianopsia. His motor strength was 5/5, and his upper and lower extremity reflexes were 2+ and 1+. His white blood cell count was 8,100 cells/mm3; his electrolyes were normal. The total protein was 8.8 and the albumin was 4.1. The hemoglobin A1C was11.9%. A bilateral carotid artery ultrasound, transthoracic echocardio-gram, and CT angiography of the head and neck were normal. An MRI of the brain revealed multiple two-centimeter acute and sub-acute infarcts in the right cerebral hemisphere. A three-centimeter pituitary macro-adenoma was compressing and displacing the suprasellar anatomical structures; cavernous sinus involvement was indeterminate. The prolactin level was low at 0.8; a cortisol stimulation test was normal. The antiphospholipid antibody level was elevated at 11.6, and the lupus anticoagulant was elevated at 55. The patient was diagnosed with ischemic stroke caused by a hyper-

coagulable state secondary to antiphospholipid syndrome, in turn due to the pituitary macroadenoma. DISCUSSION: Although atherosclerosis is the most common cause of stroke, the general internist must entertain other etiologies when confronted by a young patient with headache and unilateral weakness. This differential diagnosis should include hemorrhagic stroke, a cerebral mass lesion, atypical seizures, septic emboli, and complicated migraine. One uncommon etiology of ischemic stroke is a hyper-coaguable state secondary to anti-phospholipid syndrome (APS). APS should be tested for in patients who present with signs and symptoms of multiple infarcts. APS is marked by venous and arterial thromboses in the presence of serum antibodies directed against phospholipid-protein complexes. Our patient met the criteria for APS with both an elevated antiphospholipid antibody and lupus anticoagulant. His pituitary masss slight displacement of the intracranial vessels was considered clinically insignificant in his multiple infarcts. The pituitary infarcts were likely secondary to APS. Low-dose aspirin is commonly used for ischemic stroke, but its effectiveness in APS has not been proven. Patients with severe APS may require corticosteroids, immunosuppression, intravenous immunoglobulin and/or

plasma exchange. In our patient, long-term oral anticoagulation with warfarin was the treatment of choice.

ADULT OSTEOPETROSIS AND MARKED EXTRAMEDULLARY HEMATOPOESIS : A CAUSE OF RESPIRATORY FAILURE Surabhi Thakar; Nikhil Kalva. University of Illinois College of Medicine at Peoria, OSF St Francis Medical Centre, PEORIA, IL. (Control ID #1311964)

LEARNING OBJECTIVE 1: Osteopetrosis or Albers Schonbergs disease is a rare heterogeneous inherited metabolic bone disorder caused by impaired osteoclastic activity resulting in impaired bone resorption. It results in striking generalized osteosclerosis (Figure 1) with characteristic X-ray findings of bone within bone appearance. Due to impaired osteoclastic function, Osteopetrosis presents with recurrent jaw osteomyelitis, fractures with poor healing and rarely marrow failure with extramedullary hematopoiesis involving spleen and liver. Here we describe a case of Osteopetrosis with marked extramedullary hematopoiesis involving paravertebral region (Figure 2) resulting in progressive respiratory failure and deathCASE: A 65 yr old male was admitted for evaluation of increasing progressive dyspnea, decreased appetite and weight loss over 1 year. He had chronic dyspnea from COPD, a result of long standing smoking. He reported no symptoms of chest pain, orthopnea or PND. He had noticed a marked reduction in his activity of daily living with symptom onset on minimal exertion. He appeared cachectic, BMI 19, tachypneic, using accessory muscles and supplemental oxygen to maintain saturations along with wheezing and diminished breath sounds. His admission hemogram showed markedly decreased reticulocyte count (0.5), macrocytosis (MCV 102) with normal folate and vitamin B12 levels, and thrombocytopenia (73,000) which is below his usual baseline. His admission Chest X ray was remarkable for striking generalized osteosclerosis and increasing paraspinal densities. A CT chest, abdomen and pelvis revealed paravertebral soft tissue densities in the thorax, retroperitoneal and parasacral region with features suggestive of extramedullary hematopoiesis. His respiratory status continued to deteriorate and required endotracheal intubation complicated by failure to wean off the mechanical ventilator needing tracheostomy. He eventually died from respiratory complications despite aggressive attempts to liberate from the mechanical ventilator. The cause of death is likely multifactorial from COPD along with paravertebral extramedullary hematopoiesis contributing to respiratory failure.

DISCUSSION: Extramedullary hematopoiesis usually presents in the setting of primary marrow failure syndromes such as Primary Myelofibrosis or rarely with Myelophthisic Process from secondary marrow encroachment like in this patient. In certain primary marrow failure syndromes, cytoreductive therapy such as hydroxyurea has been shown to control respiratory symptoms. Alternatively low dose thoracic radiation can also be attempted to control the symptoms. Both thoracic radiation and hydroxyurea were not considered in this patient due to concern of worsening respiratory and marrow failure respectively.

AEROCOCCUS URINAE CAUSES AN INFECTIOUS ENDOCARDITIS Muhammed Sherid; Salih Samo;

Samian Sulaiman; Meenu Singh. University of Illinois at Chicago, St.Francis Hospital, Evanston, IL. (Control ID #1314374)
LEARNING OBJECTIVE 1: To suspect infectious endocarditis in a new onset stroke and feverLEARNING OBJECTIVE 2: To understand that Aerococcus urinae is highly implicated as a causative agent of endocarditis in the presence of bacteremiaCASE: A 65 year old male presented with a twelve hour history of right-sided weakness with slurred speech and several days history of fever. There was no history of recent travel or sick contacts. He denied nausea, vomiting, diarrhea, abdominal pain or urinary symptoms. There was no history of cough, shortness of breath, headache or loss of consciousness. Past medical history was significant for left sided stroke two years ago with no residual defects. He did not have
any history of substance abuse. He was married and was monogamous with his wife. On physical examination, blood pressure was157/79, pulse 121, temperature 101.6 F, oxygen saturation 96%. He was pale and anicteric. There was no jugular venous distension or lymphadenopathy. Chest was clear to auscultation. There was a 2/6 systolic murmur in the base of the heart without any radiation. The abdomen was soft, non tender and did not reveal any organomegaly. Neurological exam was significant for right sided hemiparesis. Cranial nerves were intact. He did not have any pedal edema or skin rash. Laboratory studies showed an elevated white blood cell count at 14.2, platelet of 560, Hb 9.6 and Hct 28.5. Comprehensive metabolic panel was within normal limits. A CT scan of the head was unremarkable following which an MRI of the brain was done which showed acute ischemic changes along the medial cortex of the left frontal lobe. A chest x-ray was unremarkable. Urinalysis showed pyuria. He was started on broad spectrum antibiotics. Urine culture grew mixed gram positive bacteria indicative of possible contamination. His blood culture grew Aerococcus urinae. A transesophageal echocardiogram was done which showed large vegetations noted on the mitral valve accompanied by severe mitral regurgitation and a smaller vegetation on the tricuspid valve. The antibiotics were changed to ampicillin and gentamycin after the organism was identified. However, despite therapy his condition deteriorated and the patient expired approximately two weeks after admission.
DISCUSSION: Aerococcus urinae is a gram positive alpha hemolytic coccus that grows in pairs and clusters. This organism is commonly misidentified as streptococcus or enterococcus. It commonly causes UTI, but has also been frequently incriminated in cases of endocarditis. This organism is associated with a high mortality when isolated from patients with endocarditis. A retrospective study of endocarditis caused by A.urinae showed that 9 out of 13 patients died. Review of literature shows that A.urinae is usually treated with penicillins or vancomycin with gentamycin.

ALCOHOL WITHDRAWAL: A RISK FOR DEVELOPING TAKOTSUBO CARDIOMYOPATHY Carmen Campbell; Shobhina Chheda. UW Madison, Madison, WI. (Control ID #1338970)
LEARNING OBJECTIVE 1: Recognize the diagnostic criteria of takotsubo cardiomyopathy (TM).
LEARNING OBJECTIVE 2: Consider patients undergoing alcohol withdrawal at risk for development TM.
CASE: A 49-year-old male with a history of chronic pancreatitis complicated by pseudocyst and alcohol abuse presented with tremor, anxiety, and hypertension. He reported drinking approximately one liter of hard alcohol daily for the past week; his last drink was the day of presentation. His blood pressure was 145/95, pulse 108, temperature 36.7 Celsius, and respiratory rate 18. Physical exam was notable for diffuse abdominal tenderness, tremor, and orientation only to person and place. Laboratory studies were notable for elevated liver function tests and negative blood alcohol level. EKG demonstrated sinus tachycardia without any ST or T wave changes. Patient was admitted to the ICU for management of severe alcohol withdrawal. On day 3, new T-wave inversion and ST depression were noted on EKG. Patient was delirious, but endorsed a history of exertional chest pressure. Serial troponins were followed and peaked at 0.23 ng/ml. Patient was treated with aspirin and beta blockade. Cardiology thought that the EKG changes and troponin leak were secondary to demand ischemia in the setting of tachycardia. A transthoracic echocardiogram was obtained which demonstrated global wall motion abnormalities involving the anterolateral, apical, and inferoapical segments and an LVEF of 40%.

Patient underwent cardiac catheterization, which revealed no significant fixed coronary artery lesions. Patient was diagnosed with TM. Patient was started on carvedilol and continued on lisinopril. Two months later, a transthoracic echocardiogram demonstrated normalization of left ventricular function and resolution of wall motion abnormalities.
DISCUSSION: General internists in the hospital setting commonly encounter alcohol withdrawal. Case studies have been published in which alcohol withdrawal was identified as the stressor that precipitated TM among male patients. TM should be included in the differential diagnosis

of acute coronary syndrome (ACS). Two decades ago, several Japanese patients presented with abnormal left ventricles similar in appearance to the eponymous Japanese octopus trap (narrow necks, wide bases). TM accounts for at least 2% of patients who present with ACS. TM most often affects women (>90% cases) who are middle-aged; however, cases have been documented in all age groups. Patients typically present with chest pain/pressure (70-90%); other symptoms include: dyspnea (20%), ventricular arrhythmias, cardiogenic shock, and cardiac arrest. Often an emotional stressor, such as loss of a loved one, preceded the diagnosis. The proposed diagnostic criteria for TM include: 1) Transient hypokinesis/ dyskinesis of left ventricular mid segments that extends beyond a single coronary bed, 2) No obstructive coronary disease or evidence of acute plaque rupture, 3) New electrocardiographic changes (ST elevation, T-wave inversion) or mild troponin elevation, and 4) Absence of pheochromocytoma or myocarditis. The pathophysiology of TM remains unknown, but is thought to be in part secondary to catecholamine surge. Treatment of TM acutely is similar to that of patients with ACS. Sub-acutely and chronically, patients are often treated with an ACE inhibitor and beta-blocker. Complete recovery of left ventricular systolic function occurs in the vast majority of patients, over a period of days to weeks. Recurrence occurs in up to 10% of patients.
AN 85 YEAR OLD WOMAN PRESENTING WITH WHIPPLES TRIAD FOR HYPOGLYCEMIA Yasuko Nagasaka1,2; Annie A. Lee1,3; Junsung Rho4; Kristin A. Cox1,4. 1Newton-Wellesley Hospital, Boston, MA; 2Massachusetts General Hospital, Boston, MA; 3Massachusetts General Hospital, Boston, MA; 4Tufts University, School of Medicine, Boston, MA. (Control ID #1334135)
LEARNING OBJECTIVE 1: Recognize the causes of hypoglycemia. LEARNING OBJECTIVE 2: Recognize the clinical presentation of an IGF-2 secreting tumor.
CASE: AH is an 85 year old woman with PAF, CHF, HTN, hypothyroidism and liver mesenchymal sarcoma s/p chemoembolization who presented with hypoglycemia to 40 checked on her home glucose monitor. She reported increasing frequency of hypoglycemia over two months and often awoke at night feeling sweaty and lightheaded. These symptoms resolved with eating snacks. Her medications were notable for prednisone 5 mg daily, metoprolol, furosemide, spironolactone, levothyroxine, and coumadin. VS: T 98.1, HR 91, BP 118/72, RR 20, 94% on RA. PE was notable for an elderly, overweight woman with coarse facial features and a large tongue, systolic ejection heart murmur, clear lung exam, and distended abdomen with palpable, enlarged, firm liver, and trace lower extremity edema. Admission labs were significant for glucose of 97 mg/dl, WBC of9.4 x 103/L, AST of 14 IU/L, ALT of 19 IU/L. During the patients hospitalization, she had several episodes of blood sugars ranging from 40-45 in spite of a D10W infusion. When fasting, patient became hypoglycemic to 44 within four hours. While fasting and hypoglycemic, labs revealed a low insulin level (0.1 IU/mL), low c-peptide level (0.3 ng/mL), low proinsulin level (2.9 pmol/L), low beta-hydroxybutyrate level (0.1 mmol/L) and negative sulfonylurea screen. Her hypoglycemia rapidly improved from 44 to 95 with intravenous glucagon. Insulin-like growth factor 2 (IGF-2) was elevated (818 ng/ml) whereas IGF-1 was normal. Due to frequent and severe episodes of nocturnal hypoglycemia, the patient was started on diazoxide which failed to adequately treat her hypogyclemia and was complicated by hyponatremia. Subsequently, octreotide was administered concomitantly

with prednisone 20 mg daily, which resulted in resolution of her hypoglycemia. DISCUSSION: This patient presented with Whipples triad: symptoms of hypoglycemia, a low glucose level, and resolution of these symptoms with treatment of hypoglycemia. The differential diagnosis of hypoglycemia includes surreptitious insulin use, insulinoma, sulfonylurea use, depletion of liver glycogen stores, and hypoglycemia mediated by an insulin-like factor. In this case, exogenous insulin use, insulinoma, and sulfonylurea use was excluded by low levels of insulin and c-peptide, and a negative sulfonylurea screen. Correction of hypoglycemia with glucagon suggested that she had sufficient liver glycogen stores to produce glucose. The elevated IGF-2 level confirmed the diagnosis of hypoglycemia mediated by IFG-2 which was likely produced by her liver tumor. Management of hypoglycemia from an IGF-2 secreting tumor involves treatment of the
tumor or medications. This patients hypoglycemia did not respond to three chemoembolizations and she was felt not to be a candidate for tumor resection given invasion of nearly the entire liver. Diazoxide, which inhibits insulin secretion from the pancreas, can be used to treat hypoglycemia but can cause worsening congestive heart failure. Prednisone can be used to treat hypoglycemia but has significant side effects. Octreotide also reduces insulin secretion and although typically ineffective in treatment of hypoglycemia mediated by IGF-2 was effective in this patient when used in combination with prednisone.

AN ACUTE PRESENTATION OF POLYMYALGIA RHEUMATICA (PMR) OR SOMETHING DIFFERENT?

Shiva Taasoobshirazi; Bhavin Adhyaru. Emory University, Atlanta, GA. (Control ID #1334998)

LEARNING OBJECTIVE 1: Understand the clinical presentation of the RS3PE syndromeLEARNING OBJECTIVE 2: Recognize the differences between the RS3PE syndrome and PMRCASE: A 62 year old African-American male presented to the ED with altered mental status after being found down in his apartment in his urine and feces by his landlord. In the ED, the patient was minimally responsive, would not open his eyes, and was unable to move his extremities. Friends of the patient noted he was in his usual state of health the previous week, but did notice he had some difficulty with stepping into a car. Friends also noted that the patient had been complaining of shoulder pain, weakness, and difficulty completing tasks like dressing and bathing over the past couple months. Of note, the patient had presented to the ED the previous month with a rash and fever and was discharged the same day. On exam, the patient was oriented only to person and was agitated and diffusely tender to touch. He had dry oral mucosa, decreased skin turgor, and ulcerated lesions on his lips and tongue. He was unable to lift both his upper and lower extremities, had decreased range of motion in all extremities, and had generalized muscle atrophy more proximally than distally. He also had a diffuse scaly, macular rash. In addition, he had swelling of the wrists bilaterally with pitting edema. Laboratory data showed an elevated ESR and CRP. Aspiration of the wrist joint was consistent with inflammatory arthritis. The differential included PMR but given the patients presentation, he was diagnosed with Remitting Seronegative Symmetrical Synovitis with Pitting edema (RS3PE) syndrome and it was thought that his altered mental status was secondary to dehydration as he was bed-bound from pain and weakness. He was started on a low dose of prednisone (5 mg BID) and had dramatic improvement in his strength. Within a week he was able to walk using a walker. DISCUSSION: The RS3PE syndrome is classified as an autoimmune disease similar to polymyalgia rheumatic (PMR) and in the same spectrum as Seronegative Rheumatoid Arthritis. It was first described in 1985 in a case series. Since its discovery there has been some controversy on whether this and PMR are the same syndrome but they share different HLA haplotypes. The criteria for diagnosis include the following: bilateral pitting edema of both hands, sudden onset of polyarthritis, age>50 y/o, and negative rheumatoid factor. The syndrome is generally more prevalent in males, responds well to very low dose steroids, and has good long-term prognosis. Some recent case series show that RS3PE syndrome may be a paraneoplastic syndrome with underlying malignancy. Our patient presents with a classic presentation of the RS3PE syndrome and the patient did have a diagnosis of prostate cancer that was treated in the past. The presentation of AMS is likely a manifestation of dehydration from decreased oral intake from the profound weakness and pain this syndrome had on the patient. This case illustrates that RS3PE syndrome should be considered in patients presenting with

acute polyarthritis and pitting edema in the hands or feet and if found, they should have appropriate work-up for underlying malignancy.

AN ALTERNATIVE TREATMENT OPTION FOR COLLAGENOUS SPRUE WITH LYMPHOCYTIC GASTRITIS

Sandhya Bogi; SushmaP. Banda. St.Joseph Mercy Hospital, Ypsilanti, MI. (Control ID #1339583)

LEARNING OBJECTIVE 1: To learn treatment options for rare gastrintestinal disease.

CASE: A 60-year-old woman with insulin resistence presented with a two-month history of severe watery diarrhea, nausea and intractable vomiting associated with a 40-pound weight loss. Previous endoscopy revealed Helicobacter pylori associated gastritis, which had been treated. Physical examination revealed an ill appearing woman. Laboratory studies were remarkable only for hypoalbuminemia. Work up of her diarrhea included normal serum gastrin, vasoactive intestinal peptide (VIP) and 24 -hour urine for 5- hydroxyindole acetic acid (5-HIAA). Celiac serologies and stool studies were negative. Stool electrolytes were not suggestive of secretory diarrhea. Computerized tomography (CT) scan of the abdomen was normal. Colonoscopy with random biopsies was non diagnostic. Repeat endoscopy was unremarkable but duodenal biopsies revealed villous blunting and intraepithelial lymphocytosis with increased sub-epithelial collagen deposition. These findings were consistent with collagenous sprue. Antral biopsies revealed lymphocytic gastritis, which has been reported rarely in association with this disease.

DISCUSSION: There are seventy six reported cases of collagenous sprue in the literature since 1970; only four other cases have been associated with lymphocytic gastritis. Historically, collagenous sprue has been treated with immune-suppressants such as prednisone and azthiopine. Rare reports of treatment with Budesonide exist. Our case is the first example of a positive response with the use of Budesonide in a case of collagenous sprue with lymphocytic gastritis. It is yet to be determined whether this agent will be effective in maintaining this response and in preventing the severe complications associated with this disease.

AN ANAESTHESIA INTRICACY: METHEMOGLOBINEMIA.

Jasleen Kaur1; Alaeddin Maeza1; Cosmin Dascalu1; Palaniappan Manickam1; Iuliana Niculescu2. 1WSU/Crittenton Hospital Medical Center, Rochester, MI;
2William Beaumont Hospital, Royal Oak, MI. (Control ID #1334365)

LEARNING OBJECTIVE 1: Methemoglobin is a form of hemoglobin which cannot bind oxygen due to Iron oxidation from ferrous state to ferric state. Methemoglobinemia can be Congenital or Acquired. Acquired Methemoglobinemia is more common and life threatening particularly due to exposure to certain drugs or toxins.

LEARNING OBJECTIVE 2: Diagnose methemoglobinemia with early treatment.

CASE: A 81 y/o female,known hypertensive with past h/o TIA ,presented with sudden onset of headache,nausea and vomiting for 2 hours. Associated symptoms include lightheadedness,generalised weakness,disorientation and confusion. On examination, she was hypertensive with systolic BP ranging 160-170 mm Hg and bradycardic with 50 beats per min. Rest of the examination was unremarkable. CT scan and MRI indicated an acute ischemic change in the right temporal lobe and right occipital lobe adjacent to thalamus, compatible with involvement of cortical branches of right posterior cerebral artery (PCA). Echocardiography and U/S Carotids findings were insignificant. To rule out cardiac source of emboli in the setting of PCA Stroke, patient was taken for Transesophageal Echocardiography. During the procedure, local Hurricane 20 % was given to back of her throat in the form of 2 sprays. Within 10 min,she developed blue discoloration on her face and extremities notably on hands, dizziness and altered mental status. She was short of breath dropping her sats to 68% on 100% rebreather mask.The first set of ABG revealed chocolate colored blood with MethHb level of 61.0. She immediately received Methylene Blue 6 mg over 5 min. She recovered significantly after 2 hrs without any respiratory compromise.

DISCUSSION: Methemoglobinemia occurs when RBCs contain>1.5% of methemoglobin. It is clinically

characterised by cyanosis, low pulse oximetric readings and chocolate brown blood on ABG sampling with normal arterial Po2 values. This condition requires prompt diagnosis and treatment with Methylene Blue given in a dose of 1-2 mg/Kg over 3-5 min and repeated every 30 min as necessary. Although the association between Benzocaine and Methemoglobinemia remains unclear but patients with co-morbidities such as anemia, cardiovascular disease, lung disease, sepsis, or presence of other abnormal hemoglobin species (e.g. carboxyhemoglobin or sickle hemoglobin) may experience moderate to severe symptoms at much lower levels (as low as 5-8%). Acquired Toxic Methemoglobinemia can be life-threatening. Multiple cases have been reported in the literature including 2 large studies,especially with the use of Benzocaine. Since the warnings issued by FDA Public Health

Advisory in 2006, 72 new cases have been reported including 3 deaths. FDA continues to warn against the use of Benzocaine and recently issued guidelines for the proper doses and concentrations to be used in various settings. Health-care professionals should be more aware of this serious reaction in order to make early diagnosis and prompt institution of treatment to prevent complications.

AN ATYPICAL CASE OF AUTO-IMMUNE HEPATITIS: CAN WEIGHT-LOSS AND HERBAL SUPPLEMENTS ACT AS TOXIN-INDUCED PRECIPITATORS IN A SUSCEPTIBLE HOST? Madeline Sterling1,2; Sarang Kim1.

1UMDNJ-RWJMS, New Brunswick, NJ;

2UMDNJ-SPH, New Brunswick, NJ. (Control ID #1310831)

LEARNING OBJECTIVE 1: Recognize an atypical case of Autoimmune Hepatitis (AIH).

LEARNING OBJECTIVE 2: Consider toxin-induced acute hepatic necrosis and evaluate sources of injury.

CASE: A 29 year-old Hispanic female presented with a 3 week history of abdominal pain, decreased appetite and jaundice. She reported gray-white colored bowel movements and darker colored urine for the past two weeks. She denied any fevers, chills, pruritus, rashes or bleeding. She denied recent infections, sick exposures, previous hepatitis, blood transfusions, or ingestion of medications or mushrooms. She was trying to lose weight with herbal and dietary supplements hydroxycut and herbalife, which she took for 1 month 3 months prior. Her past medical history was significant for 2 spontaneous abortions. She does not smoke, drink alcohol, or use drugs. She saw her PMD 2 days prior to arrival because of her jaundiced skin; initial labwork revealed AST of 2409, ALT of 2000, TBili of 15.1 and AlkPhos of 154, and she was advised to go to the emergency room. On physical exam she had scleral icterus, jaundice and mild mid-epigastric tenderness without hepato-splenomegaly, asterexis or mental status changes. Diagnostic evaluation was negative for hepatitis A, B, C, CMV and EBV. Autoimmune panels revealed an elevated ANA at 1:1280, A-SMA 1:10, normal AMA and LKM1 titers. Ceruloplasmin, Ferrittin, TSH and lipid panels were WNL. An US-guided liver biopsy showed findings consistent with both acute hepatocyte necrosis secondary to toxin exposure and ongoing AIH. During her hospitalization, her hyperbilirubinemia and jaundice resolved and her ALT and AST improved without intervention to 1375 and 1149 respectively. At outpatient follow-up, she was found to have persistent transaminitis and was started on prednisone and AZT for AIH. She has been counseled on the dangers of herbal supplements and has agreed to discontinue this means of weight loss.

DISCUSSION: Dietary supplements are common causes of liver toxicity and hepatic injury. Case reports have shown Hydoxycut and Herbalife to be two of the most commonly used supplements, both of which contain components likely to inflict hepatocellular injury. This case demonstrates a temporal relationship between dietary supplement use and subsequent liver injury, though hepatic necrosis was not the only culprit. Her clinical and laboratory presentation, along with her liver biopsy results, indicate that an autoimmune process was present as well. Several drugs have been implicated in the onset of AIH, including minocycline, nitrofurantoin, methyldopa, NSAIDS, and hydralazine. In this patient, weight loss medication may have precipitated an autoimmune hepatitis or caused hepatic necrosis which subsequently unmasked subclinical AIH. As a result of the obesity epidemic, supplements advertising weight loss continue to flourish. This case highlights the need for healthcare providers to be aware of such products and their dangers, especially for patients with underlying

chronic or autoimmune diseases. More clinical and epidemio-logic research is needed to ascertain the mechanism by which they cause damage and the prevalence and effects of their use among susceptible populations.

AN IGNORED IATROGEN Adegboyega O. Olayode; Lindsay C. Northam; Temple Brannan. Creighton University Medical Center, Omaha, NE. (Control ID #1323226)

LEARNING OBJECTIVE 1: - Recognize the clinical features of serotonin syndrome

LEARNING OBJECTIVE 2: - Manage serotonin syndromeCASE: A 53 year old male who had been previously seen at two medical facilities was transferred due to findings of fever, tachycardia, elevated white blood cell count (WBC) with bandemia and elevated creatine phosphokinase (CPK). Preliminary diagnoses from the referring facilities included sepsis and rhabdomyolysis. Prior to transfer he was started on IV fluids and given a 2 mg dose of IV lorazepam for agitation. History revealed anxiety, agitation, restlessness, diaphoresis and a mild non-productive cough. On careful review of his outpatient medications, it was observed that he was simultaneously taking three serotonergic agents: bupropion, citalopram and tramadol. On initial assessment of vital signs he was febrile, tachycardic and had a blood pressure of 104/68. Physical examination revealed resting tremors and hyperreflexia predominant in the lower extremities. Initial lab data revealed a WBC of 16.7 with 19% bands and a CPK of 1496. Investigative procedures revealed no demonstrable foci of infection. Urine drug screen was negative. Serotonergic agents were held at the time of admission and IV fluids were continued. The patient was placed on continuous cardiac monitoring and treated symptomatically with IV lorazepam for tremor and agitation. Symptom resolution, including cessation of tremor and agitation, occurred quickly in less than 24 hours and was accompanied by normalization of white blood cell count and significant decrease in CPK level.

DISCUSSION: It has been reported that over 85% of physicians are unaware of serotonin syndrome as a clinical diagnosis. This case illustrates how easily it may be misdiagnosed and highlights the importance of taking a detailed history including the use of prescription drugs, over-the-counter medications and illicit substances along with performing a thorough physical examination. Serotonin syndrome commonly presents as a triad of mental status changes (agitation, restlessness, delirium, disorientation), autonomic dysfunction (diaphoresis, tachycardia, hyperthermia, BP instability, vomitting, diarrhea) and neurologic abnormalities (tremor, hyper-reflexia, myoclonus, muscle rigidity, bilateral Babinski sign). The diagnosis of serotonin syndrome is a clinical diagnosis. Serum serotonin concentrations dont correlate with clinical findings and no lab tests confirm the diagnosis. Nevertheless it can be associated with some non-specific lab findings namely: leukocytosis, elevated CPK, transaminitis, metabolic acidosis and these can be used to monitor for potential complications. The Hunter Toxicity Criteria Decision Rules represent the most accurate diagnostic criteria for it. To fulfill the Hunter Criteria a patient must have taken a serotonergic agent and have ONE of the following: spontaneous clonus, inducible clonus plus agitation or diaphoresis, ocular clonus plus agitation or diaphoresis, tremor and hyper-reflexia, hypertonia, temperature above 38C plus ocular clonus or inducible clonus. In mild cases, discontinuation of inciting medications, supportive care, and sedation with benzodiazepines is generally sufficient. Moderately ill patients require more aggressive treatment of autonomic instability and possibly treatment with a serotonin antagonist (cyproheptadine). Hyperthermic patients are critically ill and often require paralysis and endotracheal intubation.

AN INCIDENTAL AORTIC ULCER IN A PATIENT DIAGNOSED WITH COLON CANCER: HICKAM'S DICTUM VERSUS OCCAM'S RAZOR Christiane N. Mbianda; Jennifer Yacub; Peter-Trung Phan; Siddhartha Singh. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1287468)

LEARNING OBJECTIVE 1: To recognize clostridium septicum aortitis and its strong association with colon

cancerLEARNING OBJECTIVE 2: To highlight the diagnostic dilemma faced in a patient with Clostridium Septicum Infection.
CASE: A 73-year- old male was hospitalized for evaluation of a four-week history of diarrhea. On admission, he was comfortable and notably afebrile. The initial evaluation revealed peripheral leukocytosis (WBC=16,000/l); elevated inflammatory markers (ESR=88 mm/Hr) and an abdominal CT showed colonic thickening around the hepatic flexure. Blood cultures were drawn on admission. A colonoscopy revealed an ulcerating, necrotic mass in the cecum which was confirmed to be an adenocarcinoma on pathological exam. Awaiting further workup, the patient had an episode of atrial flutter and underwent a contrast enhanced chest CT as an evaluation for suspected pulmonary embolism (PE). The chest CT showed no PE but incidentally revealed an aortic ulcer in the distal aortic arch. This
was initially considered to be an atherosclerotic ulceration. A PET scan requested as a staging work up for the colon cancer showed no metastatic disease, but marked uptake in the region of the aortic ulcer, suggesting inflammation. A literature search revealed an association between infectious aortitis and colon cancer but blood cultures drawn on admission remained negative, the patient had no chest pain and remained afebrile. Subsequently, the patient was noted to have a hoarse voice, which prompted repeat imaging that revealed marked progression of the aortic ulcer and a3.3 cm pseudo aneurysm. The patient underwent emergent surgery and the resected necrotic aortic arch grew Clostridium septicum. The patient initially made a remarkable recovery, but 3 days prior to the planned resection of his colon cancer - he suffered a cardiac arrest and died.
DISCUSSION: This case is notable for two reasons. Firstly, Clostridium septicum is an uncommon cause of aortitis and has a striking association with colon cancer. To the best of our knowledge, we are reporting the 27th case of C. septicum aortitis and the 21st case associated with colon cancer. Secondly, the diagnostic journey in our case is intriguing. The incidental discovery of an aortic ulcer in a patient with newly diagnosed colon cancer set into play an age old conflict between Occams razor and Hickams dictum. Occams razor, which states plurality must not be posited without necessity is the classic heuristic of medical diagnosticians but with our aging patient population suffering an epidemic of chronic diseases, Hickams dictum, which states a patient can have as many diagnoses as he darn well pleases is holding true more often. In our case, as blood cultures were negative and the patient remained afebrile, Hickams dictum dominated initially - prompting the hypothesis of an atherosclerotic aortic ulcer and an unrelated diagnosis of colon cancer. This changed with the development of hoarseness of voice (involvement of the recurrent laryngeal nerve) - which signaled the progression of the aortic arch pathology. This prompted repeat imaging, surgery and subsequent pathological exam which revealed a parsimonious explanation for the patients clinical conditions and the ultimate triumph of Occams razor: Proliferation of C. septicum in the anaerobic, necrotic areas of the colon cancer with eventual occult C. septicum bacteremia and resulting aortitis.
AN INTERESTING CUTANEOUS FINDING IN A YOUNG ADULT WITH DISSEMINATED COCCIDIOMYCOSIS Lisa Ngo. SJHMC, Phoenix, AZ. (Control ID #1336472)
LEARNING OBJECTIVE 1: Coccidiomycosis is caused by Coccidioides immitis, a dimorphic soil fungus native to the San Joaquin Valley of California, southern portions of Arizona, northern portions of Mexico, and scattered areas in Central America and South America. The disease is usually mild, with flu-like symptoms and rash. Serious complications include severe pneumonia, lung nodules, and disseminated disease. The disseminated form of valley fever can devastate the body, causing skin ulcers, abscesses, bone lesions, severe joint pain, pericarditis, urinary tract infection, meningitis, and often death. The skin is the most common site of dissemination. Involvement ranges from superficial maculopapules, keratotic nodules, and verrucous ulcers to subcutaneous fluctuant abscesses CASE: 25 year old African American male without significant past medical history presented with complaint of left scapular and shoulder pain for five months. Pt also initially complained of a small nodule medial to his left scapula which progressively increased in size. Pt noted night sweats for one month, but denied fever, chills, weight loss, cough, or dyspnea. Pt was initially treated with rest, narcotics, and

physical therapy with minimal improvement. Pt was eventually sent for imaging studies including CT of neck and chest, and MRI of the cervical and thoracic spine, which shown a heterogeneous soft tissue mass involving the left posterior chest wall as well as the cervicothoracic spine region. Pt underwent a CT-guided biopsy of the mass, pathology revealed granulomatous inflammation with rare spherules consistent with coccidioides. Cocci serology was positive for IgM and IgG with a titer of >1:256. Pt was treated with long term treatment with fluconazole. Pre- and post-treatment imaging demonstrated near resolution of his subcutaneous abscess. DISCUSSION: Fewer than 1% of infected individuals develop disseminated coccidiomycosis. The clinical manifestations of disseminated coccidiomycosis range from a fulminant illess that is fatal within a few weeks if left untreated, to an indolent chronic disease that persists for

months or years. One or more sites may e involved, but the skin, soft tissue, bones, joints, and meninges are most commonly affected. Cutaneous and subcutaneous lesions are among the most common manifestations of disseminated cocidiomycosis. Cutaneous lesions may be single or multiple and can persist for long periods. They may appear as verrucous papules, erythematous plaques, and nodules. The large, cold abscess that may develop in soft tissue with C. immitis can be mistaken for tuberculosis, sebaceous cyst, or lipoma. This case was remarkable because of the size of his subcutaneous abscess and also how he was misdiagnosed for a prolonged period of time because of his atypical presentation. Disseminated coccidiomycosis has a broad range of clinical presentations. This case emphasizes the importance of including coccidiomycosis as a differential diagnosis in unexplained skin, soft tissue, bone and joint manifestations for patients in areas with a high prevalence for coccidiomycosis.

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be mistaken for tuberculosis, sebaceous cyst, or lipoma. This case was remarkable because of the size of his subcutaneous abscess and also how he was misdiagnosed for a prolonged period of time because of his atypical presentation. Disseminated coccidiomycosis has a broad range of clinical presentations. This case emphasizes the importance of including coccidiomycosis as a differential diagnosis in unexplained skin, soft tissue, bone and joint manifestations for patients in areas with a high prevalence for coccidiomycosis.

AN UNCOMMON CAUSE OF INFLAMMATION May Tun Saung; Luciana Catanese; Priya Joshi. Boston Medical Center, Boston, MA. (Control ID #1340212)

LEARNING OBJECTIVE 1: Recognize clinical features of hemophagocytic lymphohistiocytosis (HLH)

LEARNING OBJECTIVE 2: Treat HLHCASE: A 53 year-old woman presented to an outside hospital with complaints of 1 week of fevers, myalgias, URI symptoms, and 1 episode of fainting. She was hypotensive, but responded to fluid resuscitation. Marked hematologic derangements were seen, including leukopenia of 1.3 with 15% bands, transaminitis AST 397/ALT 239, ferritinemia 65,000 and LDH 2,000. A chest radiograph showed a possible infiltrate, leading to the diagnosis of presumed severe sepsis secondary to community-acquired pneumonia, but pancytopenia and transaminitis worsened despite broad-spectrum antibiotics, prompting the transfer to our hospital. Additional labs at our hospital showed neutropenia of 0.5, hypertriglyceridemia 379, and a positive DIC panel. Flow cytometry and a peripheral smear did not indicate malignancy. All infectious and rheumatologic studies were negative except for a positive EBV DNA PCR. A bone marrow biopsy showed hemophagocytosis with numerous nucleated erythroid precursors engulfed by histiocytes, indicative of HLH. DISCUSSION: There are two types of HLH which present similarly. Primary HLH is due to an autosomal recessive trait and is predominantly seen in children. Secondary HLH is seen more often in adults, and is caused by the bodys reaction to another condition such as infections (EBV is the most commonly associated infection), autoimmune disease, malignancies, immune deficiencies or suppression, and post-transplantation. The central pathophysiology of HLH is an excessive immune response. A cytokine storm leads multi-organ dysfunction via infiltration of activated T-lymphocytes, natural killer (NK) cells and histiocytes. Autoantibodies may also contribute to the cytopenia. The key diagnostic finding is hemophagocytosis of blood cells in the bone marrow, spleen and lymph nodes. HLH can typically be diagnosed if at least five of the following criteria are fulfilled: fever, splenomegaly, cytopenia, hyper-triglyceridemia or hypofibrinogemia, hemophagocytosis, hepatitis, low or absent NK cell activity, marked ferritinemia and elevated IL-2 receptor. Though HLH is a rare condition, incidence may be higher given the need for complex diagnostic workup and is commonly misdiagnosed as severe sepsis (as in this patients case), FUO, hepatitis, renal failure, ARDS, and various CNS diseases to name a few. Prompt diagnosis is crucial, since without treatment, median survival is 1 to 2 months. To address this, the first international treatment protocol, HLH-94, was developed and studies have shown a significant improvement in survival rates. The HLH-2004 protocol (Grade 1B) is the current standard of care: immediate immunochemotherapy with dexamethasone and etoposide, aggressive supportive therapy and for selected patients, hematopoietic cell transplantation (HCT). Whether cyclosporine should be administered upfront as proposed by HLH-94 or later is controversial. This patient was treated with dexamethasone and intravenous immunoglobulin since the latter is an appropriate adjunct for most viral infections. The patient improved following 2 days of therapy and supportive care, and etoposide was never started. EBV-associated HLH can range from spontaneously resolving inflammation to persisting illness requiring HCT, and the patients presentation is closer to the former. During her outpatient follow-up visit, her laboratory values normalized except for a slight down-trending ferritinemia.

AN UNLIKELY FOE: IATROGENIC MULTI-SYSTEM ORGAN DYSFUNCTION Aliza Norwood; Allison DeKosky; Manisha Israni. UCSF Medical Center, San Francisco, CA. (Control ID #1340146)

LEARNING OBJECTIVE 1: Recognize the unanticipated adverse effects of prolonged courses of broad-spectrum antibioticsLEARNING OBJECTIVE 2: Recognize an unusual cause of altered mental status in hospitalized patients.

CASE: A 59 year-old man with diabetes, Stage I congestive heart failure, and crytogenic organizing pneumonia on chronic steroids was admitted for surgical treatment of recurrent retrocalcaneal abscesses. He received two weeks of vancomycin and piperacillin-tazobactam before a flap repair. Intra-operative wound cultures grew pseudomonas and the patient was therefore switched to cefepime. Two weeks post-operatively, repeat deep wound cultures grew resistant enteroccoccus and empiric vancomycin (restarted three days prior) was changed to linezolid; cefepime remained on

medication list throughout. Four days later, he was found to be somnolent and confused. Computed tomography of his brain was normal. Over the next twelve hours, his mental status worsened and he developed facial edema and a macular, confluent erythematous rash that spread from his torso to his face, ears, and upper extremities with no mucosal involvement. He became hemodynamically unstable with fever, tachycardia, hypotension and anuria. His creatinine had increased over the previous two days from 0.7 to 3, while maintaining a normal BUN. He developed leukocytosis with 3.5% eosinophils. His urinalysis revealed pyuria with no nitrite, bacteria or casts, consistent with acute interstitial nephritis. He ultimately required vasopressor support in the ICU and continuous veno-venous hemodialysis. Cefepime was then stopped and meropenem was initiated. Within a few days, his mental status and renal function improved. No organisms grew on multiple repeat blood and wound cultures. High-dose steroids were initiated for a concern of DRESS syndrome (Drug Rash, Eosinophilia and Systemic Symptoms). A biopsy of the rash revealed perivascular infiltrates containing eosinophils. DISCUSSION: Cefepime hydrochloride, a fourth-generation cephalosporin, is a common tool in physicians arsenals for treating severe infections, especially Pseudomonal infections. Prolonged use of cefepime increases the risk of complications, which are compounded when renal function deteriorates. Our patient presented with rapid progression of altered mental status and acute renal failure in the setting of long term antibiotic treatment with vancomycin and cefepime for recurrent abscesses. Cefepime has been associated with encephalopathy, myoclonus, and seizures that usually resolve within 24-48 hr of discontinuation of the drug. The drug is removed easily by hemodialysis, which accounts for the rapid improvement in mental status seen in patients with cefepime neurotoxicity treated with dialysis. This patient had multiple cefepime-induced toxicities including severe neurotoxicity resulting in profound encephalopathy, more likely to be seen with high doses of cefepime; interstitial nephritis, and the less known DRESS syndrome. This drug hypersensitivity syndrome typically develops two to six weeks after the responsible drug is begun, consistent with this patients time course. Fever and erythroderma are common characteristics, while the facial edema and ear involvement are hallmark features. DRESS syndromes constellation of symptoms can be mistaken for sepsis-induced multi-organ failure or toxic shock syndrome. Internists should be aware of the unusual but critical complications associated with commonly used drugs like cefepime.

AN UNUSUAL CASE OF MENINGITIS Jordan B. Strom; Cynthia M. Cooper. Massachusetts General Hospital, Boston, MA. (Control ID #1311012)

LEARNING OBJECTIVE 1: Diagnose and distinguish medication-related etiologies of community acquired aseptic meningitis. LEARNING OBJECTIVE 2: Recognize the role of taking a thorough medication history in the assessment of a patient with suspected meningitis.

CASE: A 58-year-old woman presented with a severe headache with onset three hours after taking prophylactic amoxicillin for a routine dental cleaning. She described a constant bifrontal headache with mild photo-phobia, multiple episodes of emesis, diarrhea, fevers, chills, and myalgias. She denied any phonophobia, visual changes, neck stiffness, or other neurologic symptoms. She described similar symptoms five months prior, 6 hours after amoxicillin use for a dental cleaning, which resolved spontaneously in less than 24 hours without medical intervention. Past medical history was remarkable for a right total hip replacement one year ago after a

traumatic fracture and anaphylaxis to soy, nuts, peanuts, beans and legumes. She was married, a non-smoker, with no history of alcohol or illicit drug abuse and employed as a health care lawyer. Her only medications were amoxicillin and epinephrine 1:1000 pen. On exam, she was febrile to 103 degrees Fahrenheit, but otherwise non-toxic. Physical exam and detailed neurologic exam were normal. Cerebrospinal fluid was obtained by lumbar puncture. There were 611 nucleated cells in tube 1 (92% neutrophils, 370 red blood cells) and 624 nucleated cells in tube 4 (90% neutrophils, 17 red blood cells). Total protein was 228 mg/dL and glucose 67 mg/dL. The patient received meningitic dosing of vancomycin, ceftriaxone, and acyclovir. Culture, gram stain, and herpes simplex virus DNA amplification of her cerebral spinal fluid were all negative. Her symptoms rapidly resolved within 12 hours. An allergy consultation was obtained. Given the recurrent pattern of symptoms with amoxicillin exposure, she was felt to have amoxicillin-induced aseptic meningitis. She was discharged home with instruction to avoid all penicillin-based products.

DISCUSSION: Drug-induced aseptic meningitis (DIAM) is an uncommon cause of community-acquired aseptic meningitis. Its true incidence is unknown. DIAM has been associated with use of nonsteroidal anti-inflammatory drugs, Cox-2 inhibitors, antibiotics, anticonvulsants, and immunomodulation therapies, e.g, IVIG and OKT3 antibodies. It typically presents with a neutrophilic pleocytosis, and can be mistaken for infectious meningitis. DIAM appears to be more common in patients with autoimmune disease. There are only eight other case reports of amoxicillin-induced meningitis in the literature. The mechanism of DIAM is unknown, but hypersensitivity and immune complex formation have been postulated. Resolution occurs within days of antibiotic cessation. This report adds to the evidence-base and emphasizes the importance of taking a thorough medication history in individuals with suspected meningitis.

AN UNUSUAL CASE OF SEPTIC ARTHRITIS DUE TO STREPTOCOCCUS PNEUMONIAE Tina Constantin; Karen Schmitz; Girish L. Kalra. Emory University School of Medicine, Atlanta, GA. (Control ID #1334313)

LEARNING OBJECTIVE 1: Diagnose septic arthritis in a patient with inflamed joints and fever even when the fluid analysis fails to impress. LEARNING OBJECTIVE 2: Recognize features of pneumococcal septic arthritis, an uncommon but important entity.

CASE: A 51-year-old African American woman with type 2 diabetes mellitus presented to the emergency department with one week of progressively worsening pain and swelling involving her right knee, left ankle, and proximal right thumb. She also complained of severe fatigue, myalgias, and subjective fevers. She denied any precipitating injury, but recalled feeling ill one day before the onset, after a strenuous day at work as a housekeeper. 12 days before the onset of her illness, she saw a podiatrist for chronic ankle pain and was treated with bilateral intraarticular steroid injections. On admission, she was tachycardic to 135 bpm and febrile to 38.9 C. Exam revealed warm, tender effusions and painfully restricted motion in the right knee and both ankles. She had frank synovitis on her dorsal right thumb over the metacarpophalangeal (MCP) joint. Labs revealed white blood cell (WBC) count of 20.6 K/mcL; this later rose to32.8 K/mcL. Joint aspirate from her right knee showed only 4,150 WBC/ mcL with 80% neutrophils and negative gram stain. She received one dose of vancomycin and was transitioned to ceftriaxone to cover possible gonococcal arthritis. Cultures from joint aspirate and blood later grew Streptococcus pneumoniae. Chest x-ray and subsequent transthoracic echocardiogram failed to identify other sources for her bacteremia. Repeat arthrocentesis of her right knee the following day revealed pus and 20,100 WBC/mcL. She underwent surgical lavage of her right knee and thumb and slowly improved on ceftriaxone therapy, though she remained weak and largely immobile. On hospital day 12, she was discharged to a skilled nursing and rehabilitation facility to complete 6 weeks of IV ceftriaxone.

DISCUSSION: Streptococcus pneumoniae is an uncommon cause of septic arthritis, comprising only 3-5% of cases. As this case illustrates, polyarticular involvement is common and seen in 36% of adults, while bacteremia is particularly characteristic and seen in 72%; rates of both findings are lower with other causes of nongonococcal bacterial arthritis. The most commonly affected joint is the knee, followed by the shoulder and elbow. Patients are typically systemically ill, with fever and leukocytosis present in more than half. Synovial fluid

is purulent and mean WBC is 127,000. The most commonly identified extra-articular source of pneumococcal infection is pneumonia; others include meningitis and endocarditis. However, as is seen here, in half of patients with pneumococcal septic arthritis, no extra-articular focus of infection is found. This case highlights the importance of maintaining a high clinical suspicion for septic arthritis in any patient with an unexplained inflammatory arthritis, particularly if fever is present. Indeed, the American College of Rheumatology recommends synovial fluid analysis even in those with a flare of an established cause of arthritis (eg, rheumatoid arthritis) if febrile.

Moreover, though synovial fluid leukocytosis exceeding 50,000/mcL is present in most patients with septic arthritis and values below 25,000 modestly reduce the likelihood, a mildly inflammatory cell count alone is insufficient to exclude the diagnosis if clinical suspicion is high, as is illustrated here. In these cases, it is imperative to await culture results.

AN UNUSUAL CAUSE FOR DYSPNEA? Lauren M. Maragh. New York- Presbyterian, New York, NY. (Control ID #1339305)

LEARNING OBJECTIVE 1: 1.) Recognize the importance of sexual education in regards to prophylactic practice in those at low risk for sexually transmitted infections.

LEARNING OBJECTIVE 2: 2.) Recognize clinical manifestations of tertiary syphilis and potential complications if left untreated.

CASE: A 63 year-old woman presented to her primary care provider concerns for dyspnea on exertion. She had been treated in the past for hypertension, hyperlipidemia, and GERD. She reported that she had been compliant with her medications. Within the last 6 months she reported decreased exercise tolerance due to dyspnea. She had no other complaints. A physical exam in the office was notable for a new late peaking systolic murmur and several ulcerations on her nose and upper lip. Initial labs and chest x-ray are unremarkable. Echocardiography showed mild aortic regurgitation. She additionally underwent nuclear stress tests which were interpreted as normal. She had been seen by several specialists and undergone a skin biopsy which showed the lesions on her face to be consistent with granulomatous disease. She is about to start a course of oral prednisone for possible sarcoidosis when she reported to a local emergency room with concerns for a transient ischemic attack. The patient was discharged and instructed to follow-up with her primary care provider. There she underwent a secondary evaluation for her neurologic symptoms which included serologic immunofluorescence studies that revealed the presence of Treponema pallidum antigen. The patient has become sexually active in the last 2 years. She reported that both she and her ex-husband had been tested for sexually transmitted infections over 20 years ago. She does not regularly use prophylactics during sexual intercourse because she believes this was more for prevention of pregnancy. She recently completed a 10 day course of intramuscular penicillin G with oral probenecid without complications and continues to receive serologic monitoring.

DISCUSSION: Syphilis is a disease caused by Treponema pallidum and is commonly spread through sexual intercourse (vaginal, anal or oral) with an individual who has syphilis chancre. Tertiary syphilis manifestations may, but classically include the cardiovascular system (syphilitic aortitis), central nervous system, and visceral cutaneous manifestations (gummas). Biopsied gummas often appear as granulomas and can be mistaken for other granulomatous type diseases such as sarcoidosis. The manifestation of gummas is uncommon given ease in detection and treatment in this era; however, there are still individuals who have not been treated for primary disease. The Centers for Disease Control reported from 2001-2009 the annual rate of primary and secondary syphilis increased by 4.1% from the previous decade which saw record lows. The number of cases of latent syphilis has increased 4.3%. The groups with the highest incidence of infection were men who have sex with men and those in the age group of 20 to 39. Those 45 years or older still are at risk and may be diagnosed later than their younger counterparts due to misconceptions regarding sexuality in older individuals and condom use. Syphilis itself is an independent risk factor for HIV and persons aged 50 and older account for

15% of new HIV/AIDS diagnosis and 24% of individuals living with HIV/AIDS. Lower risk does not assume lack of risk. Therefore, the importance of educating this group on how to prevent sexually transmitted infections is important.

AN UNUSUAL CAUSE OF GI BLEEDING Salih Samo; Muhammed Sherid; Vinod Kharti; Samian Sulaiman; Samaneh Dowlatshahi; Shahriar Dadkhah; Harvey Friedman. Saint Francis Hospital/University of Illinois at Chicago, Evanston, IL. (Control ID #1275998)

LEARNING OBJECTIVE 1: To recognize that metastatic melanoma of the colon may occur many years after the primary lesion, but rarely. LEARNING OBJECTIVE 2: It may even present as gastrointestinal bleeding. CASE: An 81 year old male was admitted to the hospital to undergo coronary angiogram after he had chest pain during stress test. He denied chest pain,breathlessness, cough, abdominal pain, or change in bowel movements at time of admission. His past medical history was significant for scalp melanoma which was excised along with right neck dissection 6 years ago (stage 3) and bladder cancer. On physical examination patient was awake and alert. Vital signs were unremarkable. Neck was remarkable for surgical scar in right neck. Heart exam revealed an ejection systolic murmur at left sternal border radiates to both carotids. Lung exam was unremarkable. Abdomen was soft, non-tender, and non-distended. Bowel sounds were present. Rectal exam was unremarkable but FOBT was positive. Laboratory studies revealed anemia with hemoglobin of 8.3, hematocrit of 25.7, MCV of 94.5, and MCH of 30.5. During hospitalization he underwent colonoscopy which revealed an ulcerated, hemorrhagic, fungating mass in the descending-sigmoid colon junction area. Histopathology showed diffuse sheets of large malignant cells with pleomorphic nuclei with large nucleoli. Histochemistry staining of HMB-45 as well as S100 was positive which confirms the diagnosis of melanoma. CT-chest and abdomen showed a mass measuring 3.5 x 2.52.5 in the lingual of upper lobe of the left lung. Biopsy from lung mass was consistent with melanoma. Subsequently, patient underwent laparoscopic limited sigmoid resection. Readmission: Three weeks later he presented with melena and Hgb that dropped from 10 to 8 mg/dl. Colonoscopy revealed normal colon with normal anastomosis without any bleeding. A re-review of the abdominal CT scan showed thickening in the proximal jejunum. The small bowel study showed a filling defect in the ileoceal area. Upper endoscopy revealed a mass in the proximal jejunum. The patient underwent laparatomy and found to have a mass approximately 15 cm beyond ligament of Treitz and another lesion approximately one foot distal to the first one. Both lesions were resected. Biopsy from both lesions revealed findings consistent with melanoma. Patient was discharged home after surgery uneventfully.

DISCUSSION: Metastatic melanoma of gastrointestinal (GI) tract is well documented. The small bowel is the most common site followed by stomach. Colonic metastasis is distinctly rare and on review of literature, none of them have presented with GI Bleeding. In our case GI bleeding was probably occurring from multiple sites. The interval time between diagnosis of the primary malignant melanoma and metastatic disease to the colon is long; more than 7 years according to the literature.

AN UNUSUAL CAUSE OF BLACK URINE AND ACUTE KIDNEY INJURY Kunal V. Domakonda; Ashish Verma; Golla Venkata; Matthew Trainor; Konstantin Abramov. University of Massachusetts Medical School, Shrewsbury, MA. (Control ID #1327657)

LEARNING OBJECTIVE 1: Manage parental injection of bleach leading to acute kidney injury.

LEARNING OBJECTIVE 2: Recognize the importance of early hemodialysis in preventing nephrotoxicity in the parental injection of bleach.

CASE: An 18-year-old white female presented with black urine following self-infusion of 100-mL of domestic bleach through a Port-A-Cath meant for administration of antibiotics for chronic Lyme disease. Past history was significant for depression, attempted suicide, anxiety, chronic Lyme disease, Babesiosis and Bartonellosis. On admission, patient was awake, confused and had tachycardia. Blood pressure, oxygen saturation and systemic physical exam were normal. A tunneled internal jugular catheter was noted on the anterior chest wall. Admission labs and several sets of labs thereafter were hemolyzed. First Creatinine was 0.63 mg/dL on a

handheld blood analyzer. It rose rapidly thereafter despite adequate volume resuscitation and continued to worsen. Hemolysis was evident on serial labs. Urine remained black for several days and sediment only showed monomorphic RBCs. A renal biopsy was performed. Light microscopy showed extensive loss of proximal tubular epithelium. Many tubular lumens contained fragmented, strongly eosinophilic, anucleate cellular debris, likely representing hemolyzed red blood cells. Interstitium contained focal acute inflammatory infiltrates surrounding necrotic tubules with no significant chronic parenchymal changes. Hemodialysis was initiated the next day for removal of toxin as patient remained oliguric

and uremic. She required six dialysis sessions before renal function improved. Patient was hemodialysed for removal of toxin and a week later, she had complete renal recovery with resolution of hemolysis. Port-a-cath was removed as infectious disease evaluation showed no evidence of ongoing Lyme disease.
DISCUSSION: NaClO has been used as disinfectant for syringes, dialysis machines and in dental procedures. Large volume injection of IV bleach causes severe AKI which is usually reversible with early initiation of dialysis. Nephrotoxicity is due to direct tubular injury and hemolysis from rapid protein degradation in the presence of a strongly alkaline and hypertonic solution. No antidote is known but forced diuresis, hydration and sodium thiosulfate have been used with unclear benefits. NaClO molecule is easily dialyzable due to low molecular weight and small volume of distribution. Given that early hemodialysis may prevent toxic injury, as clinicians, bleach toxicity should be on the radar in the setting of AKI and 'black urine'. Cresol poisoning, hemoglobinuria, myoglobinuria, alkaptonuria, tyrosinuria, porphyrinuria and melaninuria (in malignant melanoma) are the other causes of black urine.

AN UNUSUAL PRESENTATION OF ATRIAL MYXOMA Fritzie S. Albarillo; Azhar Kothawala; Ahmet A. Oktay; Tanmayee Bichile. St. Francis Hospital, Evanston, IL. (Control ID #1339792)

LEARNING OBJECTIVE 1: List the differential diagnoses of dysphagia. LEARNING OBJECTIVE 2: Manage a patient with atrial myxoma. CASE: A 68 year-old male presented to the ER after a mechanical fall 3 days prior. He also complained of a 90-lb weight loss for the past 3 months secondary to progressive dysphagia for solid foods as well as no urine output for the past 4 days. He is single, lives with his sister and has no other significant social history.His vital signs were within normal limits. Physical examination revealed a disheveled, cachectic male with a grade 4 systolic murmur best heard at the apex and left sternal border, and a palpable mass in the hypogastric area. There were no focal neurologic deficits.Laboratory tests showed hemoglobin of 9.5, hematocrit of 28, WBC of 12.4, BUN of 204, creatinine of 12.40 and phosphorus of 9.1. CT scan of the head without contrast was unremarkable. CT scan of the abdomen and pelvis revealed a distended bladder.Foley catheter was inserted draining approximately 2700 ml of dark brown urine. Patient was started on liquid diet and a swallow evaluation was done which showed frequent regurgitation of pureed liquid.Esophagogastroduodenoscopy did not reveal any pathology. A transthoracic echocardiogram showed severe aortic stenosis and a 7.3 x 2.8 cm lobulated mass of soft tissue consistency with a ball valve effect attached to the anterior mitral valve leaflet. This was later confirmed by a transesophageal echocardiogram as most consistent with an atrial myxoma.MRI of the brain reported a 3 mm punctuate area of acute ischemia in the left frontal lobe.Patient underwent resection of the left atrial mass as well as aortic valve replacement on hospital day 5. Biopsy of the specimen confirmed atrial myxoma.Patient recovered from the surgery well and reported improvement of dysphagia. DISCUSSION: Primary cardiac tumors are very uncommon. Metastatic cardiac tumors are 20 times more common. Atrial myxoma is the most common benign primary tumor of the heart which accounts for 40-50%. 90% are solitary and pedunculated and 75-80% occur in the left atrium. Its presentation varies from being asymptomatic to sudden cardiac death. The cases may present with dyspnea, fatigue, dizziness, syncope or symptoms related to embolization. The most common cause of dysphagia is

usually a pathology within the esophagus itself, e.g, neoplasm, achalasia, strictures and webs. However, there are a few cases where dysphagia can be caused by an abnormality in adjacent structures that can compress the esophagus. In our case the patients dysphagia could either have been caused by direct compression of the esophagus by the left atrial mass or an embolization causing a stroke. However, the prompt improvement of dysphagia after resection of the myxoma points more towards the former. Furthermore, the findings of an acute ischemia in the left frontal lobe by MRI do not correlate with dysphagia. Surgical resection is the treatment of choice. Long-term prognosis is excellent with a 1-5% recurrence rate. But recurrence after 4 years is rare.

AN UNUSUAL CAUSE OF MULTIPLE PULMONARY NODULES Tulsi Sharma; Pankaj Mehta; Roberto Izquierdo. SUNY Upstate Medical University, Liverpool, NY. (Control ID #1311838)

LEARNING OBJECTIVE 1: Pulmonary nodules that exhibit lack of growth for more than two years are generally considered benign. But there are a few exceptions to this rule, especially in the presence of multiple nodules.

LEARNING OBJECTIVE 2: Papillary thyroid carcinoma is the most common malignant thyroid cancer with the best prognosis but may present with atypical presentations especially in the younger patients.

CASE: Introduction: Many diseases can present with a miliary lung pattern, especially in immunocompromised patients. What can be the differential in a young asymptomatic and immunocompetent individual? Case: We present the case of a 21-year-old lady who had been in her usual state of health until October 2008 when she had a motor vehicle accident. A CT-thorax obtained at an outside facility did not reveal any traumatic injury, however, it revealed a diffuse reticulonodular pulmonary process. Subsequent sputum for AFB and PPD were negative and she was asymptomatic. She did not return for her follow-up appointments and returned to her PCP in November 2009 for a regular yearly evaluation. Repeat CT-thorax revealed a stable nodular pattern. She was then referred to Upstate Medical University with possible diagnosis of sarcoidosis. At the time of referral in early 2010 she still denied any constitutional symptoms. Clinical exam was normal. Repeat CT-thorax revealed persistence of the miliary pattern. Blood work, ACE-level and PPD were negative. What would cause these numerous nodules which have been stable for 2 years and without any clinical manifestations? After discussion of the risks and benefits of bronchoscopy, the patient agreed to the procedure. Bronchoscopy with transbronchial biopsy revealed metastatic well-differentiated papillary thyroid carcinoma (PTC)! Sonography of the thyroid revealed a small solid nodule in the left thyroid lobe with internal and peripheral vascular flow on doppler interrogation of the nodule. The patient underwent a near-total thyroidectomy and a limited central compartment neck dissection. The patient has since undergone radioactive iodine therapy and is on thyroid hormone replacement therapy. Her follow up hypothyroid I-131 whole body scan showed a significant decrease in uptake in the lungs.

DISCUSSION: Papillary thyroid carcinoma is the most common malignant thyroid cancer, and accounts for approximately 80% of thyroid cancers. Involvement of regional lymph nodes is seen in 20-80% of patients with PTC at the time of initial surgery. Diffuse lung metastatic disease from an occult thyroid cancer is however extremely rare. Diagnosis based on a transbronchial biopsy in an asymptomatic patient with incidental nodules makes it even more intriguing. The growth rate of pulmonary nodules is often used to help differentiate benign from malignant disease. Pulmonary nodules that exhibit lack of growth for more than two years are generally considered benign. However, nodular lung metastases from papillary thyroid carcinoma are an exception and may demonstrate lack of significant growth over years. The arrest of metastatic growth in PTC is more common in the younger patients and is thought to be related to the immune response to the cancer. The exact cause of this growth arrest is however not known. PTC has the best prognosis of the thyroid malignancies with a 90% 10-year survival. Even in the presence of metastatic spread, survival periods may exceed 20 years, especially in the young. Hopefully the accident was actually a blessing in disguise!

AN INTERESTING CASE OF CRAZY PAVING Sourabh Prabhakar; Susan Mathews; Kameron Ashker; Rohit Varghese; Marvin Balaan. Allegheny General Hospital, Pittsburgh, PA. (Control ID #1340481)

LEARNING OBJECTIVE 1: Recognize a relatively rare but now treatable cause of progressive

dyspneaLEARNING OBJECTIVE 2: Treatment of Pulmonary alveolar proteinosis using Veno-Venous ECMO (Extracorporeal Membrane Oxygenation) and whole lung lavageCASE: A Young female presenting with progressive shortness of breath and 35 lbs weight loss over past 4 months. 34 year old Caucasian female with history of asthma presented with flu-like symptoms and a 4 month

history of feeling unwell. This included episodes of dry cough, chest congestion, progressive dyspnea and a 35 lbs weight loss. She had only mild response to intermittent courses of antibiotics and steroid tapers. In addition, she had no travel or sick contact history. Finally, the patient progressively became worse and presented to the ER were she was found to have oxygen saturations in 70s. Her chest radiography revealed diffuse alveolar infiltrates, EKG was normal, and CT chest showed diffuse bilateral ground glass opacities throughout lungs with septal thickening and yields a crazy paving appearance. Her ABG showed pH 7.4; Pco2 33 mm Hg; pO2 34 mm Hg on 4 L via nasal cannula. All her bloodwork was normal except for LDH value of 494. Bronchial aveolar lavage was positive for PAS stain consistent with Pulmonary Alveolar Proteinosis (PAP) and was had not growth on gram stain and negative cultures. Unfortunately she was persistently hypoxic and was became difficult to oxygenate therefore required intubation. She then underwent Veno-venous Extracorporeal Membrane Oxygenation (V-V ECMO) and subsequently bilateral sequential whole lung lavage(WLL). Another important level revealed was the level of Anti-Granulocyte Macrophage CSF 1,537.4 pg/mL (Normal <0.4 pg/ml). After these critical interventions, she was extubated and was discharged without need for supplemental oxygen. DISCUSSION: PAP is a rare pulmonary disorder characterized by accumulation of lipo-proteinaceous material within the alveolar spaces. It presents in three forms: congenital, secondary and most commonly, acquired. Symptoms are nonspecific and include dyspnea, dry cough or fever. Physical exam can exhibit rales, clubbing or cyanosis. An elevated LDH is frequently seen. High-resolution CT reveals the crazy paving appearance shown by a reticular, nodular airspace disease with intra/interlobular thickening. There is little or no lung inflammation, and the underlying lung architecture is preserved. The milky BAL fluid under light microscopy exhibits large foamy macrophages with increased lymphocytes and minimal inflammatory cells which stains PAS positive. As in this case, a whole lung lavage utilizes a large quantity of saline, up to 50 liters, divided into small aliquots. The procedure is terminated when the lavage effluent becomes clear. There have very few cases (less than 10) where bilateral sequential WLL was performed under V-V ECMO. Until recently, the pathogenesis has eluded investigators. Experimental trials with human recombinant GM-CSF, have shown that it activates alveolar macrophages, improving surfactant clearance, leading to clinical, physiological and radiographic improvements. With an accurate diagnosis and treatment, progression of PAP can be halted, improving the clinical course and outcome.

AN INTERESTING DIFFERENTIAL FOR UNILATERAL PLEURAL EFFUSION Ojas Bansal1; Swapna Kanuri1; Nachiket Patel1; Dan Schuller2,3. 1Creighton University Medical Center, Omaha, NE; 2Creighton University Medical Center, Omaha, NE; VA hospital Omaha, Omaha, NE. (Control ID #1335079)

LEARNING OBJECTIVE 1: Describe clinical presentation of pancreaticopleural fistulaLEARNING OBJECTIVE 2: Management strategies for pancreaticopleural fistulaCASE: 53 year old Caucasian male was admitted with severe left sided chest pain radiating to his left shoulder and fever. He had similar presentation without fever four weeks ago and a CT scan at that time showed moderate left pleural effusion and a 10 cm splenic cyst. He underwent thoracentesis and cyst aspiration that were inconclusive for any specific etiology from the limited labs performed on the fluid. Past history is significant for hypertension, diabetes and smoking. He has a history of alcohol abuse but quit drinking 25 years ago. He was never hospitalized for any complications of alcoholism namely severe withdrawal symptoms or acute pancreatitis. On examination Vitals- Temperature- 101, BP120/59, HR-128, RR- 30, SaO2- 95% on RA. He appeared dehydrated with normal heart and lung examination. Abdomen was diffusely tender with no guarding or rebound. Relevant labs include WBC count-30.86 with 4% bands, amylase-374 and lipase-694. Liver function tests were normal and cardiac enzymes

negative. EKG revealed sinus tachycardia. A CT chest and abdomen re-demonstrated a moderate sized left pleural effusion, compressive atelectasis, splenic cyst (9.9 x 6.2 cm) and multiple pancreatic calcifications. He was started on empiric antibiotics vancomycin, zosyn and ciprofloxacin with
aggressive rehydration and pain management. Thoracentesis revealed a turbid exudative effusion with PH- 6.9, WBC count 20000, Amylase and lipase levels in the pleural fluid were>20000 and >6000 respectively, Cytology and pleural fluid cultures were negative. After a tube thoracostomy, he underwent a magnetic resonance cholangiopancreatography (MRCP) showing multiple fluid collections consistent with pseudocysts, proximal duct dilatation with suspected pancratolith and pancreatic calcifications. Endoscopic retrograde cholangiopancreatography (ERCP) confirmed a pancreatic duct fistula at the junction of the body and tail. A stent was placed after a pancreatolith was removed at the neck. Amylase and lipase levels in splenic cyst aspirate were very high confirming a pseudocyst.
DISCUSSION: Pancreatico-pleural fistula is an extremely rare complication of pancreatitis occurring only in 1% of the cases. These patients usually have a history of excessive alcohol intake or recurrent episodes of pancreatitis, predominantly present with chest symptoms. The underlying mechanism is usually a leak of incompletely formed or ruptured pseudocyst or direct pancreatic duct leakage. CT scan is often the initial imaging modality. MRCP is non invasive and is superior to CT scan in identifying the fistula. ERCP is critical in confirming the diagnosis and aids in therapeutic intervention. Medical management with synthetic somatostatin analogs significantly reduces output and hastens the closure of fistula. Endoscopic pancreatic stenting is an effective therapeutic option, creates a least pathway of resistance allowing the fistula to heal. Pancreatic duct strictures and stones downstream can be treated with balloon dilation, basket extraction and stent placement. Patients with large cysts, multiple strictures and complete duct disruption are managed with surgery usually a distal pancreatectomy followed by pancreatico jejunostomy. Following appropriate management the prognosis is good.
AN UNCOMMON CAUSE OF TONGUE LESIONS Mili Shum. Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, NY. (Control ID #1339119)
LEARNING OBJECTIVE 1: Recognize the variable presentation of tongue amyloidosis as a cause of oral lesions in multiple myeloma patients. LEARNING OBJECTIVE 2: Recognize that tongue amyloidosis is a debilitating disease that may severely impact the patients quality of life and is associated with poor outcomes in multiple myeloma patients. CASE: A 65 year-old woman presented with two years of progressively worsening tongue pain. She has a history of light chain multiple myeloma (MM) diagnosed four years ago and was treated with multiple courses of chemotherapy including melphalan and other cytotoxic agents. She complained of ulceration and soreness mainly involving the anterior region of her tongue and was experiencing difficulty with speech and eating. This subsequently led to fatigue and weight loss. Antifungal treatment was ineffective at treating her tongue lesions and mucositis cocktails provided little relief. Head and neck examination revealed a diffusely stiff tongue that was enlarged with firm nodules and ulcers on the anterior 1/3 of tongue and whitish flat plaque on the posterior 1/3 of tongue. Serum cytomegalovirus and herpes simplex virus testing revealed no evidence of infection. A biopsy of the left lateral tongue did not demonstrate features of candida, herpes simplex virus, or cytomegalovirus infection. It revealed benign squamous mucosa with subepithelial amyloid deposition. A positive Congo Red stain confirmed the diagnosis of amyloid. She received mucositis cocktails and topical lidocaine for symptomatic treatment of her tongue lesions. She concurrently received chemotherapy for multiple myeloma. Her tongue symptoms persisted resulting in inadequate oral intake and deterioration in functional status. As a result, she was no longer suitable for further chemotherapy due to her functional status. She died seven months after the diagnosis of tongue amyloid in association with MM.
DISCUSSION: Amyloidosis is caused by extracellular deposition of insoluble fibrils. In the setting of multiple myeloma, the insoluble fibrils are composed of excess immunoglobulin light chains from the abnormal proliferation of plasma cells. MM-associated amyloidosis portends a poor prognosis with a mean survival of 5 to

15 months. This case demonstrates that oral amyloidosis can have rapid and debilitating consequences. Amyloidosis affects 10-20% of patients with MM. Up to one-third of patients with amyloid have oral manifestations. Macroglossia with tooth

indentations along the lateral border and mucosal pain are the most common presentation. However, mucosal nodules are considered to be more specific of oral amyloid. Tongue ulceration is an infrequent presentation. This patient had diverse tongue lesions that included white plaques, ulcerations and nodules highlighting the heterogenous presentation of oral amyloid. Tissue biopsy and Red Congo staining is considered a gold standard and should be obtained for the diagnosis of amyloidosis. Clinicians should be aware of the variable ways in which oral amyloid may present within the oral cavity and undergo a thorough investigation of oral discomfort or lesions in a patient with multiple myeloma. This patient had symptoms for 2 years before diagnosis was made. Screening for oral symptoms may allow for earlier diagnosis and management and possibly result in reduced morbidity associated with the disease.

AN UNFORTUNATE COMPLICATION OF ANTI-PLATELET THERAPY: A CASE REPORT Subhraleena Das; Sujith Cherian; WasimA. Hamarneh; Ehtesham Ul Haq; David Landsberg. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339683)

LEARNING OBJECTIVE 1: Recognize the rare but potentially fatal complication of diffuse alveolar hemorrhage (DAH) with clopidogrel. LEARNING OBJECTIVE 2: Manage clopidogrel induced DAH. CASE: A 72-year-old man was transferred to the ICU with hemoptysis and dyspnea. The patient had been admitted for an elective carotid endarterectomy a day prior and had been given 150 mg of clopidogrel before the procedure and was continued on aspirin and clopidogrel post procedure. Examination revealed tachypnea and bilateral rales. A Chest X-ray and CT scan of thorax revealed bilateral alveolar infiltrates. Both aspirin and clopidogrel were held, with improvement in respiratory status. Aspirin was restarted without complications. However, an attempt to restart clopidogrel resulted in sudden respiratory deterioration. The patient was started on pulse dose steroids with no improvement and was subsequently intubated.2 D echo revealed diastolic dysfunction, and vasculitis workup was negative for ANA, ANCA, anti- GBM antibody with normal complement levels. Flexible bronchoscopy revealed blood throughout the broncho-alveolar tree. Broncho-alveolar lavage was negative for infectious agents and cytology negative for malignant cells. Clopidogrel was again held with marked improvement, thus confirming the diagnosis of clopidogrel induced DAH. DISCUSSION: Clopidogrel is a thienopyridine derivative used to inhibit platelet aggregation by irreversible binding of adenosine diphosphate to the low affinity type 2 platelet receptors. It is commonly associated with increased incidences of gastrointestinal and intracerebral hemorrhage, and very rarely with DAH. DAH is most likely, an idiosyncratic hypersensitive response to clopidogrel, with a potential fatal outcome. Diagnosis is established by demonstrating a temporal relationship with the drug and ruling out other infectious, vasculitic and neoplastic processes by bronchoscopy. Due to the long half life (277- 433 hours) of the drug, even after stopping the drug, DAH may worsen. Therefore, supportive treatment with mechanical ventilation, if needed, is key. Of note, platelet infusions are futile as donor platelets are also irreversibly inhibited by clopidogrel in the system. Thus, our case highlights the importance of identifying DAH secondary to clopidogrel, which if not diagnosed in time may prove to be fatal. We reiterate the need for maintaining a high index of suspicion in these patients as it may easily be overlooked as pulmonary edema in the setting of acute coronary syndrome, where the drug is frequently used.

AN UNUSUAL CASE OF AUTOIMMUNE PANCREATITIS PRESENTING AS PANCREATIC MASS AND OBSTRUCTIVE JAUNDICE Betre Workie. SJHMC, Phoenix, AZ. (Control ID #1324256)

LEARNING OBJECTIVE 1: There are two types of autoimmune pancreatitis (AIP) - Type 1 AIP and Type 2 AIP. Type 1 AIP (the classical form) is associated with elevated serum IgG4 levels and tissue infiltration by IgG4+

plasma cells.
CASE: A 53-year-old female presented with three weeks history of abdominal pain, nausea, vomiting and diarrhea. She was unable to tolerate any oral intake because she vomited after every meal. She reported being afraid to eat anything
and had consequent weight loss which she could not quantify. She also reported dark urine. On the day of presentation, patient continued to have dull, aching abdominal pain in bilateral upper quadrants, non-radiating, with 8/10 severity. She described her diarrhea as brownish, semi-solid stool with no blood. She denied any hematemesis, fever, chills, itchiness or any such episode in the past. She reported drinking alcohol socially, denied any tobacco or illicit drug use and she was not on any medication. On physical exam, patient was afebrile, hypertensive at 220/106 and the rest of her vitals were within normal limit. She had scleral icterus and her abdomen was soft, tender to palpation on bilateral upper quadrants with no rebound tenderness and bowel sounds were normal. Laboratory studies showed normal CBC, AST 339, ALT 423, total bilirubin 7.9, direct bilirubin 5.5, serum alkaline phosphatase 539, amylase 29, lipase less than 4. CT scan showed diffuse mild enlargement of the pancreas with sausagelike appearance, dilated intrahepatic bile ducts, hydropic gallbladder and prominent common bile duct measuring 1.3 cm. Serum immunoglob-line measurement showed elevated total IgG at 1625 with IgG4 subclass at 284. ERCP showed a 2 cm stricture in CBD which was stented and biliary bushing was obtained which was found to be non-malignant. Endoscopic ultrasound showed 33 mm mass at head of pancreas which appeared to be inflammatory in nature. FNA of the pancreatic mass was non-diagnostic. Given the radiologic, laboratory and extra-pancreatic findings, patient was diagnosed with auto-immune pancreatitis type 1 and was initially treated with IV steroids and later transitioned to oral steroid. Her liver enzymes rapidly improved after stenting of biliary stricture. A follow up MRI showed resolution of biliary ductal dilatation and improved pancreatic edema. On day of discharged, all labs and vitals were within normal limit and patient was tolerating oral intake.
DISCUSSION: There are two types of autoimmune pancreatitis (AIP) -Type 1 AIP and Type 2 AIP. Type 1 AIP (the classical form) is associated with elevated serum IgG4 levels and tissue infiltration by IgG4+ plasma cells. Main symptoms include pancreatic mass, cholestatic jaundice, chronic diarrhea and abdominal pain. Extra-pancreatic lesions include bile duct strictures, retroperitoneal fibrosis, inflammatory bowel disease, and Sjogrens syndrome. Elevated IgG4 (>135 mg/dL) is the most sensitive (95%) and specific (97%) for AIP type 1. Imaging features include irregular narrowing of the pancreatic duct, a peri-pancreatic capsule-like rim, and enhancement at the late phase of contrast-enhanced images. A dramatic response to steroids is another characteristic. Biopsy would show lymphoplasmocytic sclerosing pancreatitis. Corticosteroids are the standard treatment for type 1 AIP. Other therapies which can be considered for refractory cases include immunosuppresion with azathioprine or 6-mercaptopurine, and rituximab administration.
AN UNUSUAL CAUSE OF CHEST PAIN - SYMPTOMATIC GIANT CORONARY ARTERY ANEURYSM.
Jeffrey S. Wilkinson1; Ahmad Moustapha2; Paul Schulte2; Payam Dehghani2. 1Queen's University, Kingston, ON, Canada; 2University of Saskatchewan, Regina, SK, Canada. (Control ID #1310886)
LEARNING OBJECTIVE 1: Review the differential diagnosis, diagnostic approach, and important features of coronary aneurysms.
LEARNING OBJECTIVE 2: Discuss the utility of CT angiography for assessing coronary artery anatomy.
CASE: A 58 year-old man presented with severe retrosternal chest pain radiating to his jaw and left arm. He was obese, had a 40 pack-year history of smoking, and was on statin therapy for hypercholesterolemia. He did not report any significant personal or family history of coronary artery disease, vasculitis, connective tissue disorders, or history of Kawasakis as a child. He had non-specific ECG findings and a mild enzyme rise. Cardiac angiography showed a large aneurysm of the left main artery (LM). It involved the ostial left anterior descending artery (LAD) - with a double density contour at the aneurysm segment. It was difficult to determine if the haziness in the aneurysmal segment represented artery dissection, plaque rupture, or de novo thrombus

formation secondary to stasis. A cardiac CT angiogram was ordered urgently to help delineate this ambiguous lesion. The aneurysm of the LAD had dimensions of 3.0 x

1.8 x 1.6 cm and the hypodense filling defect was in fact clot, representing impending embolization. An emergent consultation with cardiovascular surgery was requested. The patient was taken for surgery due to the ongoing ischemic chest pain and suggestion of impending embolization of clot into the mid-segment of the LAD. The surgeon performed an aneurysmorrhaphy, bypass grafting, and removed the clot en bloc. Finger-like projections forming a cast of septal perforators could be seen. The post-operative period was uncomplicated. He was discharged on coumadin, aspirin, an ACE inhibitor, and a beta-blocker. The surgical pathology report showed benign fibromuscular tissue representing true aneurysmal dilatation.
DISCUSSION: Coronary artery aneurysm (CAA) is defined as the abnormal dilation of a coronary artery greater than 50% of its normal size. The incidence of CAA has been estimated to be 4.9% in one series of 978 patients who underwent coronary angiography. CAAs are most commonly related to atherosclerosis, but have also been known to occur in Kawasakis disease, connective tissue disorders such as Ehlers-Danlos, sepsis leading to mycotic aneurysm, trauma, cocaine use, and in various vasculitides including polyarteritis nodosa and Takayasu arteritis. When symptoms occur as the primary presentation they have been documented to cause angina, mimic an acute coronary event, arrythmia, coronary rupture, and obstruction resulting in superior vena cava syndrome. Definitive diagnosis with invasive angiography may be difficult because dissection, plaque wall rupture, and acute thrombus may mimic a true aneurysm. In our case, CT angiography provided a better assessment of the coronary anatomy due to its inherent capability of investigating the vessel wall, the filling defect, the embolization potential of the clot, and identification of extra-vascular structures for surgical planning. As CT angiography continues to become more cost-effective, improve performance and image quality and decrease radiation dosage, this tool will have increasing utility in the management of patients with coronary artery disease. This case highlights the importance of individualized assessment and treatment, which requires a broad assessment with a number of specialties including internal medicine, cardiology, rheumatology, radiology, and surgery.
AN UNUSUAL COMPLICATION OF CRACK ABUSE Melissa Stein.
1Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1318722)
LEARNING OBJECTIVE 1: Identify complications of crack cocaine abuse with attention to technique and paraphernalia used to smoke crack cocaine.
LEARNING OBJECTIVE 2: Recognize severity of compulsion to smoke crack cocaine.
CASE: A 50 year-old woman presented to the Emergency Department (ED) complaining of dyspnea for two hours. She had a history of laryngeal cancer and tracheostomy several years prior but because of longstanding discomfort at the tracheostomy site, she did not have a tracheostomy tube in place. She had a history of polysubstance abuse and was enrolled in a drug treatment program where she received methadone and psychosocial support. Urine toxicology reports at the program were intermittently positive for cocaine. In the ED she reported that an object had fallen into her tracheostomy. On physical examination the patient was tachypneic and agitated. Her lungs were clear to auscultation. Her oxygen saturation was 78% on room air. Chest radiography revealed a tubular radiodensity overlying the region of the carina and right mainstem bronchus. Bronchoscopy was performed urgently and a glass tube 3.2 cm in length was removed from the right mainstem bronchus. The tube was the size and shape of a pipe used to smoke crack cocaine. Copious secretions had accumulated behind the obstruction, but no injury to the airways was observed. The patient recovered uneventfully and continued intermittent cocaine abuse until just prior to her death three years later. She died due to a recurrence of her laryngeal cancer.
DISCUSSION: Cocaine, including crack, is the second most commonly abused non-prescription illicit drug with

1.9 million Americans reporting use in the past month. Cocaine is associated with more emergency department visits than any other illicit drug. Cocaine abuse can lead to dysfunction of multiple organ systems. For example, injecting cocaine can lead to skin and soft tissue infections as well as transmission of viral hepatitis and HIV. Smoking crack increases risk of pulmonary infections and chronic pulmonary disease. By any route, cocaine can cause myocardial infarction, cardiac arrhythmia and seizure. Cocaine is highly addictive. Few psychosocial interventions have proved effective in treating cocaine abuse. Though multiple medications have been tried, none have proved effective in treating cocaine abuse in randomized controlled trials. Cocaine vaccine is currently being investigated as a tool to prevent relapse among prior cocaine users. Amongst poor urban populations, cocaine is most frequently smoked in the form of crack, the least expensive form of cocaine. Crack is commonly smoked from a glass pipe (stem) with a steel wool filter. Oral injuries such as burns and lacerations are common among crack abusers and can be routes of viral infection when smoking paraphernalia is shared. Tracheal and esophageal aspiration of smoking paraphernalia are rare sequelae of crack abuse. Published reports include cases of aspiration of bagged cocaine by a body packer, aspiration and ingestion of a steel wool filter and ingestion of a crack pipe. This unusual case graphically illustrates the tremendous compulsion to smoke crack, even in the face of extreme risk. Given the morbidity associated with cocaine abuse, efforts to prevent cocaine abuse as well as identify and treat patients who abuse cocaine are warranted.

AN UNUSUAL PRESENTATION OF WEGENER'S GRANULOMATOSIS OF GENITALIA Waqas Qureshi; Marilyn Karam; Salman Siddiqui; Sean Drake. Henry Ford Health Systems, Detroit, MI. (Control ID #1311917)

LEARNING OBJECTIVE 1: 1. To understand that autoimmune diseases of skin might present with superimposed infectious process. LEARNING OBJECTIVE 2: 2. To elucidate the work up of destructive skin disease also includes autoimmune work up, if the biopsy does not reveal malignancy and symptoms are not improving with broad coverage antibiotics.

CASE: A 52 year old Caucasian gentleman developed a non-pruritic and non-tender papular erythematous well demarcated rash on the shaft of his penis associated with a 4 cm growth. This rash extended on the dorsal surface of the penis over the course of 2 weeks. Since, it was suspicious of a malignancy, an initial biopsy was done, but the biopsy showed chronic inflammation. Even though the biopsy did not reveal malignancy, due to a a high suspicion of malignancy, the patient was referred to a urologist for deep penile biopsy and circumsicion after a month of initial symptoms. Over the next 1 week, his rash progressed quickly involving most of the skin of penis. Patient was admitted to the hospital with fever, chills and pyuria. He was treated for complicated urinary tract infection (UTI) and another biopsy was done showing methicillin resistant Staphylococcus aureus (MRSA). Antibiotics were continued. Meanwhile, the rash continued to progress slowly. After a week of treatment, the rash started healing which had progressed to the lower part of the abdomen but the penile lesion still looked the same. Now, the patient started developing palpable purpura on the lower extremities. Autoimmune work up was done and biopsy of the purpura was also carried out. Penilectomy was also performed and the specimen was sent for biopsy. A diversion urethrostomy was also carried out after the penilectomy. The biopsy from the lower extremities revealed leukocytoclastic vasculitis and autoimmune work up showed strongly positive c-ANCA. There were necrotizing vasculitic granulomas present on the biopsy of the penis. A CT scan with contrast was done of the chest to find any pulmonary lesions thinking that if this is wegener's granulomatosis, then there might be pulmonary involvement. The CT scan showed granulomas of the lungs. Patient was started on high dose pulse steroids, with improvement in the lesions.

DISCUSSION: This is a rare case of limited Wegener's granulomatosis, which was not diagnosed until 2 months after the development of skin disease. Only few similar case reports exist. Our case was unique because the initial lesion that presented was a growth, rather than an ulcer which was the presentation in other case reports. Late diagnosis led our patient to undergo penilectomy. There have been other cases of penile Wegener's granulomatosis and a vasculitis should be considered in the differential diagnosis after ruling out malignancy as it is a treatable condition and can prevent the patient from developing significant morbidity.

ANGIOIMMUNOBLASTIC T-CELL LYMPHOMA: A DIAGNOSIS IN DISGUISE Brittany K. Ragon; Matthew Semler. Vanderbilt University Medical Center, Nashville, TN. (Control ID #1334410)
LEARNING OBJECTIVE 1: Distinguish the unique presentation of Angioimmunoblastic T-Cell Lymphoma from the rheumatologic, infectious, and malignant diagnoses raised by the conditions clinical and laboratory findings.
LEARNING OBJECTIVE 2: Recognize the importance of clinical judgment in interpreting diagnostic testing when the results do not fit the clinical picture.
CASE: A 58-year-old Caucasian male with coronary artery disease and type 2 diabetes mellitus presented to the emergency department with 6 weeks of joint pain and rash. Initially, he had experienced the gradual onset of dull, aching pain and swelling in his ankles which progressed over several days to involve his knees and then hands. Four days after the onset of symptoms, he noticed a painless rash resembling tiny pinpricks appearing intermittently on his lower extremities. His abdomen and chest developed diffuse pruritic erythema, and he began to experience fever, chills, fatigue, intermittent diarrhea, and a 20-lb weight loss. Seen by his primary care physician, he received doxycycline out of concern for Rocky Mountain Spotted Fever. He did not improve and was referred to dermatology where a biopsy was read as leukocytoclastic vasculitis and attributed to his metformin and trazadone. At this time a c-ANCA was positive. Despite discontinuation of both medications, the patient continued to worsen and was admitted to the hospital for further evaluation. Physical exam at admission showed a well-appearing man in no distress with normal vital signs. Further examination showed diffuse, large, and firm cervical lymphadenopathy. Heart and lung exam were normal. Abdominal exam did not show hepatosplenomegaly. A faint, reticular rash diffusely covered his trunk, and resolving purpura were visible on both shins. Laboratory studies showed a mild eosinophilia, elevated ESR and CRP, low complement, increased total protein, negative ANA, and positive c-ANCA. An ELISA for HIV came back positive, and CD4 count, PCR, and Western Blot were sent. A radiograph of the chest showed 2-3 cm bilateral hilar adenopathy. Fine needle aspiration of a cervical lymph node showed lymphoid infiltrate, negative for malignancy. Finally, an excisional biopsy of an inguinal lymph node was performed and revealed effacement of the nodal architecture with an infiltrate of lymphocytes admixed with eosinophils and histiocytes with CD4 and CD10 positive staining confirming a diagnosis of Angioimmunoblastic T-Cell Lymphoma (AITL). Review of his prior skin biopsy showed evidence of AITL, and his repeat c-ANCA and HIV Western Blot and PCR returned negative. DISCUSSION: AITL is an aggressive form of nodal, mature T-cell neoplasm that presents with fever, generalized lymphadenopathy, pruritic or vasculitic rashes, arthritis, and a unique set of confounding laboratory abnormalities including eosinophilia, polyclonal hypergammaglobulinemia, and rarely, a falsely positive HIV ELISA (1). Because AITL is characterized by diffuse symptoms resembling infectious or rheumatologic conditions and falsely positive antibody tests for these conditions, recognizing AITL requires a high index of clinical suspicion. This case demonstrates both a classic presentation of AITL and the importance of employing clinical judgment when the results of diagnostic testing do not fit the clinical picture. 1. Seiji et al. False-positive HIV antibody test and autoimmune hemolytic anemia in a patient with AITL. Intern Med 50:2383-2387, 2011.
ANOGENITAL PYODERMA GANGRENOSUM IN INFLAMMATORY BOWEL DISEASE Daniel Lin; Jason A. Korcak. Montefiore Medical Center, Bronx, NY. (Control ID #1339186)
LEARNING OBJECTIVE 1: Recognize the clinical presentation of pyoderma gangrenosum.
LEARNING OBJECTIVE 2: Identify the relationship between pyoderma gangrenosum and inflammatory bowel disease.
CASE: A 24 year-old man presented with perianal and genital lesions for three months. He described the lesions as red bumps, which gradually grew into larger, non-draining ulcers. The patient also reported intermittent episodes of watery brown stool with small amounts of blood and occasional crampy abdominal pain

in his left lower quadrant over the prior six months.
He had chills, night sweats, and a ten-pound weight loss during this time. The patient had a temperature of 100.8 F. His abdomen was soft, but tender to palpation in the left lower quadrant. He had painful ulcerations with irregular borders in the perianal area and at the base of the penis. There were no oral ulcers, other skin lesions, or palpable lymph nodes. The white blood cell count was 16.0 K/L. Stool culture and assays for Clostridium difficile, ova and parasites, and fecal fat were negative. HIV, Hepatitis B and C, gonorrhea, chlamydia, and RPR tests were also negative. Pancolitis was present on abdominal CT scan, and colonoscopy revealed an erythematous mucosa with deep ulcerations and severe active colitis. A biopsy of the perianal skin showed neutrophil rich dermatitis without evidence of infection. The patient was diagnosed with inflammatory bowel disease (IBD) and associated pyoderma gangrenosum (PG).
DISCUSSION: Rare skin lesions, such as PG, present a diagnostic challenge for the general internist. PG is a non-infectious neutrophilic dermatosis likely caused by dysregulated cellular immunity and abnormal neutrophil function. PG begins with tender papules or pustules that rapidly progress to painful ulcers with erythematous, violaceous borders. Lesions primarily present on the lower extremities and are seldom described in genital or perianal regions, as in our patient. The lesions may endure for months to years and heal with an atrophic cribriform scar. Histopathology is non-specific, with neutrophilic infiltration of the dermis, as well as hemorrhage and necrosis of the epidermis. PG most often occurs in adults 25-54 years of age and is found equally in men and women. Although PG may present as an idiopathic condition, at least half of PG cases are associated with systemic diseases, including autoimmune disorders, such as lupus erythematosus, hematologic disorders, such as acute myeloid leukemia, and most commonly, IBD. The prevalence of PG is estimated at 1-10% in ulcerative colitis and 0.5-20% in Crohn's disease. The onset of PG may coincide with active colitis, but can also occur before or after the clinical development of IBD. Like all forms of PG, lesions may arise at sites of trauma, such as after colostomy placement. While PG remains a diagnosis of exclusion, a better understanding of the clinical presentation of PG and its association with IBD will help internists recognize this rare skin disorder.
ANOTHER GREAT MASQUERADER Rachel R. Johnson. Medical College of Wisconsin, New Berlin, WI. (Control ID #1334874)
LEARNING OBJECTIVE 1: Describe an interesting presentation to an increasingly prevalent disease.
LEARNING OBJECTIVE 2: Highlight the importance of early diagnosis to prevent spread of infection and to begin treatment promptly.
CASE: A 19-year-old gentleman with a past medical history of chronic constipation and seasonal allergies presented with complaints of rectal pain for 1 week along with fever, chills and malaise. Prior to presentation, he had been evaluated at an outside hospital and underwent a rectal exam under anesthesia with no identification of abnormalities. On presentation at our institution, physical exam was significant for a low grade fever, maculopapular rash on his torso, and perianal mucosal ulcerations. Initial lab evaluation was significant for elevation of hepatic transaminases and thrombocytopenia. He was admitted for further treatment and evaluation, and ceftriaxone was initiated to cover for Gram-positive bacterial infections, including sexually transmitted diseases. Rectal swabs were negative for herpes simplex virus (HSV) and bacteria, including group A streptococcus and H. ducyeri. Further laboratory work-up was negative for viral hepatitis, syphilis, gonorrhea, and chlamydia. Initial HIV antibody assay was also negative, but serum HSV serologies (IgG and IgM) were positive. When informed of his HSV infection, the patient admitted to having 13 male sexual partners in the last year, which prompted concern for an acute retroviral infection. HIV RNA PCR was ordered and revealed an HIV viral load of over 700,000. The patient was discharged home with outpatient infectious disease clinic follow-up. As an outpatient, antiretroviral medications were started, and the patients HIV viral load eventually became undetectable after 6 months of therapy.
DISCUSSION: Acute retroviral syndrome (ARS) describes the clinical signs and symptoms of primary HIV infection which includes the period from initial HIV infection to HIV seroconversion. The initial presenting signs

and symptoms of primary HIV infection are often nonspecific. The most common presentation is an acute mononucleosis-like illness characterized by fever,

sore throat and lymphadenopathy. Other symptoms include lethargy, malaise, myalgias, weight loss, headache and a diffuse maculopapular rash. Acute retroviral syndrome can also involve multiple organ systems. Mucosal ulcerations of the oropharynx, esophagus and the genitalia have been reported to occur in 28%, 17%, and 6% of patients respectively. Involvement of the gastrointestinal system can include vomiting and diarrhea along with pancreatitis, colitis and epiglottitis. Hepatitis is a common presentation that often resolves as the hosts immune system gains control over the initial viral replication. Other laboratory abnormalities include anemia, leukopenia and thrombocytopenia. Neurologic involvement most commonly includes headaches but can also include aseptic meningitis or encephalitis. The signs and symptoms of ARS usually begin within 2-4 weeks of initial HIV infection and last approximately 2-3 weeks. During the primary HIV infection, the viral load is very high and the patient is highly infectious. Early identification is important, not only for initiation of anti-retroviral therapy to preserve the hosts immune responses, but also to decrease transmission through patient education and therapy. Clinicians should have a high index of suspicion of ARS in patients with generalized mononucleosis-like symptoms and risk factors for HIV infection.

ANTI-COAGULANT/ANTI-PLATELET MEDIATED SAPHENOUS VEIN GRAFT RECANALIZATION Suchet Kaur1; Hemendra Sarda2; Dexter Dexter3; Sulaiman Rathore3; Timothy Ball4. 1carilion clinic, Roanoke, VA; 2Carilion Clinic, Roanoke, VA; 3Carilion Clinic, Roanoke, VA; 4Carilion Clinic, Roanoke, VA. (Control ID #1310613)

LEARNING OBJECTIVE 1: Systemic anticoagulation with dual anti-platelet therapy may provide a treatment option for the rare patient presenting with an SVG with heavy thrombus burden not amenable to PCI. CASE: A 51 year old man with history of hyperlipidemia and tobacco use presented with ST segment elevation myocardial infarction (STEMI). Emergent angiography revealed multi-vessel coronary artery disease and he was referred for emergent CABG with conduit composed of the right internal mammary artery, radial artery and saphenous vein. On post-op day 18 the patient presented with chest pain and was diagnosed with a non-STEMI. Coronary angiography revealed heavy thrombus burden within the SVG to the ramus intermedius. The native ramus was stented with four drug-eluting stents. Post-procedure, the patient developed heparin induced thrombocytopenia and thrombosis (HITT); he was treated with lepirudin, bridged to warfarin and discharged on aspirin, clopidogrel and warfarin for 6 months. Over the ensuing months the patient developed progressive exertional angina, stress testing was positive for antero-apical ischemia and repeat coronary angiography demonstrated complete recanalization of the thrombosed SVG to the ramus and patent stents in the ramus. Three months after discontinuation of warfarin, the patient presented again with chest pain and he was again diagnosed with a non-STEMI. Coronary angiography revealed complete mid-graft occlusion of the SVG to the ramus with widely patent ramus stents.

DISCUSSION: Aorto-coronary grafting is a common method for surgical myocardial revascularization, which is often complicated by early and late graft thrombosis. An in depth review of the literature identified three reports of thrombus resolution with recanalization of the SVG without Percutaneous Coronary Intervention (PCI). We report a case of thrombus regression in a thrombus laden SVG in a patient placed on systemic anticoagulation. The authors believe that systemic anticoagulation therapy for the treatment of HITT resulted in resorption of the thrombus within the SVG possibly protection from rethrombosis owing to the fact that rethrombosis of the SVG occurred within 3 months of the discontinuation of warfarin therapy. As with venous thrombosis, the treatment goal of systemic anticoagulation is to prevent clot propagation and recurrence while allowing normal thrombus resorption and vascular recanalization. We propose that systemic anticoagulation with dual anti-platelet therapy may provide a treatment option for the rare patient presenting with an SVG with heavy thrombus burden not amenable to PCI.

ANTIPHOSPHOSPHOLIPID SYNDROME WITH MULTI-SYSTEM ORGAN FAILURE Maciej Walczyszyn; Raghu Thirumala; Larry DiFabrizio. Lenox Hill Hospital, New York, NY. (Control ID #1339631)

LEARNING OBJECTIVE 1: To recognize early signs of a life threatening autoimmune disease.

CASE: A 65 year old, previously healthy, female presented with weakness and progressive exertional dyspnea for 10 days. She complained of orthopnea, palpitations, chills, and loss of appetite; yet, denied chest pain and fevers. Her past history was significant for hysterectomy, bilateral mastectomy, and epilepsy controlled on daily carbamazepine. On physical exam, the patient was in respiratory distress with a respiratory rate of 30/ min, temperature of 97.1 F, heart rate of 110/min and blood pressure of 180/90 mmHg. Cardiopulmonary exam was notable for bilateral rales and a 2/6 systolic murmur in the aortic region. The remainder of the exam was normal. Labs were significant for hemoglobin of 7.3 gm/dl, serum creatinine of 2.37 mg/dl, peak troponin of 2.5 ng/ml, and BNP of 147,060 pg/ml. EKG revealed sinus tachycardia. Chest X-ray showed cardiomegaly with pulmonary edema. Cardiac echo revealed moderate aortic regurgitation and stenosis, elevated pulmonary artery systolic pressure (65 mmHg), moderate left ventricular hypertrophy, dilated left atrium, akinetic apex and generalized hypokinesis with an estimated ejection fraction of 25%. The patient was treated for acute systolic congestive heart failure with i.v. nitroglycerin and diuretics as well as transfused packed RBCs; which resulted in improvement of hemodynamics and renal function. While awaiting cardiac catheterization, the patient had an acute change in mental status. MRI of the brain revealed multiple infarcts of bilateral cerebral hemispheres, cerebellum, basal ganglia and thalami, consistent with emboli. Subsequently, a transesophageal echo found a large, ill-defined mass attached to the aortic valve. A lung perfusion scan showed a wedge shaped defect within the right upper lobe consistent with pulmonary embolism. The patient was started on anticoagulation along with antibiotics to cover for presumed infective endocarditis. Blood cultures remained negative and a gallium scan did not identify inflammatory uptake; thus, antibiotics were stopped. Serologic studies were strongly positive for antinuclear, anti-double standed DNA, antiphospholipid (aPL), and anti-2-glycoprotein I antibodies; consistent with Systemic Lupus Erythematosus (SLE) and Libman-Sacks endocarditis. Multiple thromboemboli to brain and lung, and multiorgan dysfunction were consistent with catastrophic antiphospholipid syndrome (APS), which was treated with high dose steroids and anticoagulation. Steroids were subsequently tapered with the addition of mycophenolate mofetil. The patient improved and is undergoing physical therapy.

DISCUSSION: Catastrophic APS is a rare cause of acute multi-system organ failure due to wide spread thrombosis. The presence of aPL antibodies in SLE patients increases the risk of valvular heart disease and thromboembolic complications. Diagnosis requires: 1) evidence of involvement of at least 3 organs; 2) development of manifestations within 1 week; 3) histopathology confirming small vessel occlusion; and 4) laboratory confirmation of the presence of an aPL antibody. In conclusion, maintaining a broad differential and a high index of suspicion is necessary to diagnose non-infective endocarditis in the setting of a life threatening immunologic disorder, to appropriately initiate early treatment with anticoagulation and immunosuppresion.

AORTIC THROMBUS IN GIANT CELL ARTERITIS Catherine A. Barry; Mala Joneja; Phillip Wattam. Queen's University, Kingston, ON, Canada. (Control ID #1319961)

LEARNING OBJECTIVE 1: Assess the causes of an aortic thrombus and aortitisLEARNING OBJECTIVE 2: Recognizing the complications of large vessel vasculitisCASE: An 80 year female with a one year history of giant cell arteritis and a recent history of unilateral leg deep vein thrombosis presented to her Rheumatologist with a few day history of increasing dyspnea. Her past medical history included transient ischemic attacks, hypertension and dyslipidemia. She was taking a tapering course of prednisone for her vasculitis and anticoagulation for the DVT. Two weeks prior to presentation, she was admitted to hospital for syncope. At that time her INR was found to be supratherapeutic and her ongoing anticoagulation was held. Due to a miscommunication at follow up, it was never restarted. At this presentation she was tachypneic and hypoxemic. She was treated empirically in the

emergency department with heparin for possible pulmonary embolus. Her CT pulmonary angiogram showed small segmental pulmonary emboli, and more remarkably a 6.5 cm thrombus in her thoracic aorta causing 75% narrowing of the aortic lumen without evidence of aortitis, dissection, aneurysm, or artherosclerotic disease. There was no evidence of peripheral or end-organ ischemia clinically or on investigation. In consultation with Rheumatology it was suggested that the thrombus developed as a complication of aortitis from her giant cell arteritis and the patient was started on higher doses of prednisone. She remained stable through the next few days and was sent home with low molecular weight heparin treatment for her aortic thrombus. Investigations were also sent for antiphospholipid antibody syndrome.
DISCUSSION: Aortic thrombus, most often caused by artherosclerotic disease, has been described in aortitis and rarely in antiphospholipid antibody syndrome. Aortitis is a known complication of large-vessel vasculitis such as giant cell arteritis and Takayasus arteritis. However it is rare for an aortic thrombus to develop from aortitis in the absence of an aneurysm. It is also unusual for thrombus to develop in the thoracic aorta. There have been a few case reports linking anti-phospholipid syndrome and aortitis/aortic thrombosis. The quandary in this patients case is that imaging of the aorta did not show a clear cause of thrombus formation, and its etiology remains unknown. Although this patient has risk factors for atherosclerosis, sub-radiographic aortitis from giant cell arteritis in association with an undiagnosed thrombophilia could have resulted in this patients thoracic aortic thrombus.
APPROACHING THE GRAVE $4 AT A TIME Rudy Kimmerling. UC Denver, Aurora, CO. (Control ID #1312882)

LEARNING OBJECTIVE 1: Recognize the risks inherent in outpatient transitions of care.
LEARNING OBJECTIVE 2: Assess adverse drug effects based on history and exam.
CASE: A 60 year-old female presented to clinic for a regular follow up exam. One month prior, her home health agency had finished their period of care and stopped weekly medication and lab monitoring of electrolytes and INR. Since then, the patient endorsed increasing weakness to the point of being unable to ambulate for the past week. She decided to wait until her scheduled appointment to be seen because of cost concerns, having recently become a Medicare and Medicaid beneficiary. Review of systems revealed easy bleeding though the patient denied dark stools. She had lost 4 lbs over 6 weeks. Medications had previously been prescribed predominantly from the $4 list. They included spironolactone, levothyroxine, lisinopril, warfarin, amiodarone and furosemide, all new medications prescribed upon discharge from a prior hospitalization. Thorough medication reconciliation revealed the patient had been accidentally taking a double dose of furosemide, she was taking the other medications as previously prescribed. Vital signs obtained by medical assistants showed normal temperature and heart rate though there was difficulty obtaining a blood pressure. Examination revealed a slightly disoriented tremulous woman in no acute distress. Mucous membranes were dry with dried blood on her lips. Lungs were clear; heart rhythm was irregular with a new 2/6 systolic ejection murmur heard diffusely throughout the chest. Neurologic exam showed diffuse hyperreflexia. The vitals were rechecked and the patient was found to have a heart rate of 80 and a manual blood pressure of 66/40. The patient was placed in a wheelchair and taken to the emergency department by the physician. EKG showed atrial fibrillation with wide QRS complexes and tall peaked T waves. Laboratory abnormalities included a potassium of 8.0, CO2 of 14, BUN of 276, creatinine of 16.2, and INR >10.4. Other electrolytes, LFTs and TSH were normal. Her hematocrit had dropped from 42.5% to 25.6%. The patient was admitted for urgent dialysis and blood product transfusion. No evidence of active GI bleeding was found. She recovered rapidly and was discharged home 4 days later on a reduced drug regimen, all symptoms apparently caused by adverse medication effects exacerbated by iatrogenic hypotension and occult GI bleeding.

DISCUSSION: Transitions of care have increasingly become danger points for patients as they move through our fragmented health care
system. In our current system with multiple providers involved in patient care, medication and laboratory monitoring can fall through the cracks. According to the Commonwealth Fund, 11 to 15 of every 1,000 Americans visit a health care provider because of adverse drug effects in a given year. Of these, more than one quarter are considered ameliorable with better communication between physicians and patients. In this patient, poor communication between providers left a critical gap in monitoring of common but potentially dangerous medications. By establishing better tools and incentives for coordination and communication within care delivery systems, potentially fatal adverse events like the one above can be reduced.

ARE SURGICAL COMPLICATIONS WITHIN THE PURVIEW OF THE INTERNIST? Shuchi Gulati; Jorge Scheirer. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1339080)

LEARNING OBJECTIVE 1: Recognize complications of ablative techniques used to treat renal cell carcinomaCASE: A 78 year old male was noted to have a heterogeneous mass arising from the posterior pole of the right kidney, measuring 13 mm X 15 mm on an abdominal CT scan obtained during evaluation for a bowel obstruction. On serial follow up, the SRM increased to 22 mm. The urologist elected to treat the SRM with open exploration and cryoablation therapy. 2 weeks after hospital discharge, the patient presented to his primary care internist with complains of a twenty-pound weight gain, fatigue and weakness. On examination he was pale and orthostatic. The abdominal exam revealed a tender palpable mass in the right upper quadrant. The CBC revealed hemoglobin of 11.3 g/dL (compared to9.8 g/dL at the time of discharge) and the BUN and creatinine were 28 mg/dL and 1.22 mg/dL, respectively. CT scan of the abdomen revealed a 13 x 12 x 23 cm fluid collection adjacent to the surgical site of the right kidney. Ultrasound guided drainage of the collection yielded 1.8 liters of blood-tinged urine; a culture of this urine was negative. Definitive drainage was achieved via a short-term percutaneous catheter. Follow up CT images over the next several months confirmed resolution of the urinoma.

DISCUSSION: Renal cell carcinoma (RCC) is the 7th most common cause of cancer and the 10th most common cause of cancer death in the United States. Treatment has long been surgical excision by radical nephrectomy. For small renal masses (SRMs, defined as a mass<4 cm), ablative therapies such as cryoablation, radiofrequency ablation are being used with increasing frequency. Advantages to ablative approach include lower morbidity, shorter lengths of hospital stay with short term and intermediate oncologic outcomes similar to nephrectomy. Though deemed to be safer than nephrectomy, ablative techniques used to treat SRMs are associated with a 4.9% complication rate. Common complications associated with ablative techniques include hemorrhage requiring transfusion, loss of renal function, and injury to adjacent organs. A meta-analysis of 46 series including data on 1,055 patients undergoing renal ablation revealed that urinary leaks or urinoma formation occurred in less than 0.1% of the cases. If left untreated, large urinomas can lead to complications like abscess formation, sepsis, hydronephrosis, paralytic ileus, and electrolyte abnormalities. Given the propensity to discharge patients undergoing minimally invasive surgery within 48 hours, it is likely that patients with complications of renal cryoablation will present to their family physician. As cryoablation becomes commonplace, ambulatory internists will need to be familiar with complications of this procedure.

ARTERIOVENOUS FISTULA: A RARE PRECIPITANT OF CONGESTIVE HEART FAILURE IN HEMODIALYSIS PATIENTS Prajit Arora1; Ambreen Gul2; Susie Stokley2. 1University of New Mexico, Albuquerque, NM; 2University of New Mexico, Albuquerque, NM. (Control ID #1308421)

LEARNING OBJECTIVE 1: To recognize high output cardiac failure as a potential etiology of decompensated heart failure in patients getting hemodialysis (HD) through an Arteriovenous fistula (AVF).

LEARNING OBJECTIVE 2: Diagnosis and treatment options available for high output cardiac failure secondary to AV fistula in Hemodialysis patientsCASE: 55 year old female with End stage Renal Disease (ESRD) on thrice

weekly Hemodialysis (HD) secondary to Diabetes Mellitus, Hypertension admitted with complaints of shortness of breath, cough, subjective fevers and generalized fatigue. The patient had HD one day prior to admission and had been compliant with her dialysis regimen. On exam, patient was afebrile, slightly tachypneic and hypoxic with oxygen saturations of 70 percent on room air. She had jugular venous distension, bilateral basilar crepitations and trace bilateral lower extremity pitting edema. The patient also had an AV fistula noted at Left Upper extremity with bruit/thrill and aneurysmal dilatation with an additional aneurysm noted at Left Upper Extremity vein proximal to the fistula. Laboratory data was significant for leukocyte count of 4100 cells/L, hemoglobin 11.0 gm/dL, platelets 124,000 cells/L, Sodium 137 mEq/L, potassium 3.5 mEq/L, BUN 10 mg/dL, creatinine2.7 mg/dL.Troponin was normal, BNP 98,996 pg/ml and Lactate was0.7 mEq/L.The patient had a chest x-ray done which showed findings of congestive heart failure and pulmonary edema with possibility of pneumonia not excluded. Transthoracic Echocardiogram showed Normal Ejection Fraction with additional findings of restrictive filling pattern and Right Ventricle Pressure/Volume Overload. The patient did have a fistulogram done for evaluation of Arteriovenous fistula as concern present for increasing dilatation at site, which did show aneurysmal dilatation of Left Upper extremity cephalic vein and patent arteriovenous anatomizes, with tortuosity and kinking noted in the vein in the lower upper portion of the upper arm. Flow velocities were obtained which showed increased flow rate greater than 2 liters/minutes. The patient was started on treatment for Health care associated pneumonia and received daily Hemodialysis with Decrease on EDW from 56 to 49.4 kgs.The patient noted improvement in symptoms with decreased oxygen requirements. Vascular Surgery was consulted and the patient is planned for surgical revision of her AV fistula as an outpatient.
DISCUSSION: High Output Cardiac failure can result from a number of etiologies such as systemic AV fistulas, Chronic Anemia, Thyrotoxicosis, beri beri and psoriasis. Physical exam may reveal findings such as tachycardia, central venous hum, particularly over the Deep Internal Jugular vein and bounding pulse with wide pulse pressure. These conditions are associated with increased Cardiac index and low Systemic vascular resistance. The degree of increase in cardiac output secondary to the AV fistula depends on the size of the shunt. There is a shunting of blood from high pressure Artery to low pressure vein with decrease in Systemic Vascular Resistance and compensatory changes such as an increase in Stroke Volume, Heart rate and total plasma volume as well. Treatment involves surgical revision/banding of the site. Angiotensin receptor blockers and beta blockers may worsen the condition secondary to further decrease in Systemic vascular resistance. Upper arm AV fistulas and male gender pose an increased risk and this condition is generally associated with flow rate greater than 2 liters/min.

ARTHRITIS DUE TO AN UNUSUAL HUMAN PATHOGEN AngelaH. Shin; Amy Sargious; Ramin Motarjemi. university of california, San Diego(UCSD), San Diego, CA. (Control ID #1324350)

LEARNING OBJECTIVE 1: Familirize Physicians with Streptococcus equi infection in humans.
LEARNING OBJECTIVE 2: While a rare cause for infection in humans, should be considered in patients who have systematic or local signs and symptoms and are in contact with horses.
CASE: Case Presentation: This is a 65 year old male with diabetes and hypertension who presented to the emergency room with a complaint of right shoulder pain. He was found to be febrile with a tender,erythematous and swollen shoulder. A shoulder arthrocentesis was attempted but was unsuccessful in aspirating synovial fluid. Blood cultures were drawn and the patient left the emergency room against medical advice. The blood cultures grew positive for gram positive cocci and the patient was called to return to the emergency room. Further questioning revealed that he had a subjective fever for 3-4 weeks, mild fatigue, but otherwise no localizing
signs or symptoms of infection other than his shoulder pain. He also noted that he lived on a ranch with horses, with one particular horse that had been sick with distemper who had to be isolated from the rest of the animals. The patient was initially started on vancomycin and ceftriaxone until speciation of the blood culture revealed streptococcus equi. The patient was continued on ceftriaxone alone. His AC joint fluid analysis revealed WBC

3490, PMN 95%, and grew strep equi. The glenohumoral joint aspiration was unsuccessful in aspirating fluid after 3 separate attempts. The patients fever and leukocytosis resolved by day 2 of antibiotics, CRP decreased from 38.2 to 8.94, and a TTE revealed no vegetations. The patient was discharged with a 4 week course of IV ceftriaxone.
DISCUSSION: DISCUSSION: Streptococcus equi from group C streptococci is the etiologic agent for the upper respiratory disease in horses commonly referred to as strangles or distemper. The clinical signs in horses are fever, usually Lymphadenopathy, Mucopurulent nasal discharge, Pharyngitis and upper airway stridor. Subsequently, there is swelling of cervical nodes, which can drain purulent material. Transmission is direct horse-to-horse contact. Human infections are rare, but have been described in case reports. The clinical presentations in humans include pharyngitis, septicemia, meningitis, purulent arthritis and endocarditis. Poststreptococcal glomerulonephritis has also been described in connection with human infections. The source of human infection is often traced back to contact with horses. Our case lived in a ranch, and bred horses. There were 3 cases of strangles in his horses, which they all had pustules with draining pus. Patient later commented that he did not use gloves in several occasions when he was cleaning the pustules. We believe that he got infected through direct contact, and the bacteremia caused the arthritis. He was treated successfully, and repeat cultures were negative.
ASEPTIC MENINGITIS ASSOCIATED WITH INTRAVENOUS IMMUNOGLOBULIN THERAPY IN A CASE OF MILLER-FISHER SYNDROME. Sean Raj; Elena Katz; Mario Romagnoli. Lenox Hill Hospital, New York, NY. (Control ID #1318238)
LEARNING OBJECTIVE 1: Recognize the clinical features of aseptic meningitis associated with IVIG in a case of Miller-Fisher Syndrome. CASE: Intravenous immunoglobulin (IVIG) therapy is widely utilized in the treatment of Guillain-Barre Syndrome (GBS). Although generally considered to be safe, IVIG has been associated with rare cases of aseptic meningitis. We report a case of aseptic meningitis associated with high dose IVIG in the treatment of Miller-Fisher Syndrome, a variant of Guillain-Barre. A 42-year-old male triathlete presented to the ER with acute-onset double vision worsening over five days prior to admission. The patient also reported new upper and lower extremity numbness and tingling for three days prior to admission that progressed from his hands and feet proximally to his elbows and knees, respectively. At the initial onset of blurry vision, the patient was seen in the ER of an outside facility, where a MRI/MRA of the head and neck was unrevealing. An outpatient neurologist performed EMG studies, which were unremarkable, but advised the patient to return to the ER for further work-up of possible Guillain-Barre syndrome if his symptoms did not improve. Ten days prior to developing these symptoms, the patient suffered a bout of bloody diarrhea with positive stool cultures for Campylobacter jejuni. Of note, the patient competed in the Ironman triathlon, during which he swam in the Hudson River, recently polluted with a sewage spill just two weeks earlier. On presentation to the ER, the patient had lateral gaze palsy in his right eye, decreased patellar reflexes, and decreased sensations to light touch in both his lower and upper extremities, but strength that remained intact throughout. A lumbar puncture (LP) on admission, revealed a normal cerebrospinal fluid analysis (CSF) with a WBC 0/L. Treatment with IVIG daily (high-dose of 0.4 g/kg/day) for presumptive diagnosis of Miller-Fisher Syndrome and ciprofloxacin for Campylobacter jejuni infection was initiated - GQ1B-IgG Antibody positivity later confirmed GBS. After completion of IVIG, on admission day five, the patient developed an acute-onset severe migraine-type headache, photophobia, neck-stiffness, and was febrile to 100.5 F. LP demonstrated a CSF with normal protein and glucose levels, CSF culture with no growth, but a WBC of 296/L, suggestive of aseptic meningitis. The patients meningeal signs resolved over the subsequent three days after discontinuation of IVIG therapy and

supportive care. On discharge, mild residual lateral gaze palsy and blurry vision remained, with a near-normal

return of sensations throughout, normal VC and NIF. He was discharged with neurology follow-up as an outpatient. DISCUSSION: In patients receiving high-dose intravenous immunoglobulin therapy, clinicians should include aseptic meningitis in their differential for the constellation of symptoms of fever and a headache in the 6-48 hour period following the completion of an IVIG infusion.

ASYMPTOMATIC ISOLATED LEFT VENTRICULAR NONCOMPACTION (LVNC) IN SIBLINGS- A THERAPEUTIC DILEMMA. Robin Singh1; James D. Holloway2. 1University of Louisville, Louisville, KY; 2Baptist Health Heart Institute, Little Rock, AR. (Control ID #1327631)

LEARNING OBJECTIVE 1: Recognition of isolated LVNC as a specific form of genetic cardiomyopathy and its characteristic echocardiographic features.

LEARNING OBJECTIVE 2: Understanding the variable prognosis and the therapeutic challenges of this disease.

CASE: A 33 year old male (Case A) was referred for cardiac evaluation because of his elder brother's abnormal echocardiogram aged 37 (CaseB) and a history of sudden cardiac death (SCD) in the father at age 38. The patient was totally asymptomatic and had unremarkable past medical and social histories. Physical examination, EKG and Chest X-ray were normal. Echocardiogram revealed normal left ventricular (LV) internal dimension and EF>55% with normal cardiac valves. Deep trabeculations were noted in the LV myocardium with intertrabecular recesses involving a large part of the LV myocardium. This gave the appearance of a spongy myocardium and LV hypertrophy. Color flow Doppler demonstrated communication between LV and intertrabecular recesses. The characteristic echocardiogrpahic findings led to the diagnosis of LVNC. The ratio of the noncompacted to the compacted myocardium was 3. RV morphology and function was normal. The echocardiogram report of case B, done at another facility, was obtained and was reported to have possible apical hypertrophic cardiomyopathy or prominent trabeculations. Echocardiogram was repeated and demonstrated identical features of isolated LVNC as in case A with normal LV EF. Case B was also asymptomatic and had normal physical examination, EKG and Chest x-ray. Due to the rarity of the condition, not much is known about the prognosis except in patients with severely reduced LV EF or documented episodes of ventricular tachycardia (VT). Based on the limited observational data, both the patients were advised to have implantable cardiac defibrillators (ICD) to reduce the risk of SCD because of the history of SCD in the father at age 38. Case A declined to have the ICD implant at this time. Case B opted to have ICD implant but had no inducible sustained VT during EP study prior to ICD implant.

DISCUSSION: Isolated LVNC is a rare disorder and is classified as a primary genetic cardiomyopathy with varying genetic heterogeneity. It can be either sporadic or familial. Autosomal dominant inheritance is more common than recessive or X-linked inheritance. It is characterized by an altered myocardial wall with prominent trabeculae and deep intertrabecular recesses resulting in a thickened myocardium with two layers consisting of compacted and noncompacted myocardium. Echocardiogram is very helpful in making the diagnosis and can distinguish it from dilated and hypertrophic cardioymypathy. Cardiac MRI and CT may be helpful. Common clinical presentations include heart failure, arrhythmias and embolic events. ICD implant in patients with reduced LVEF of<35%, sustained VT, and history of SCD are considered acceptable indications. The prognosis of LVNC in asymptomatic patients with normal LVEF is not well known but the family history of sudden cardiac death prompted advice for ICD implants in our patients.

ATRIAL SEPTAL DEFECTS IN THE ADULT PATIENT: A CASE REPORT AND LITERATURE REVIEW Christopher Sankey. Yale School of Medicine, New Haven, CT. (Control ID #1316191)

LEARNING OBJECTIVE 1: Appreciate the prevalence and potential consequences of atrial septal defects in the adult patient.

LEARNING OBJECTIVE 2: Recognize the clinical presentation of atrial septal defects and identify the options and recommendations for defect closure.

CASE: A 26-year-old Hispanic female without a significant medical history presented with new-onset diabetic

ketoacidosis. She was admitted, and blood sugars and metabolic derangements quickly normalized with insulin and intravenous fluids. Physical examination on repeat assessment was notable for a systolic ejection murmur at the left upper sternal border with a prominent split of the second heart sound. She had no exertional symptoms, and denied any family history of congenital heart disease. Chest radiograph revealed mild enlargement of the right atrium and pulmonary arteries. Electrocardiogram demonstrated sinus tachycardia, with P wave morphology suggestive of right atrial enlargement. Transthoracic echocardiogram subsequently revealed an enlarged right atrium and right ventricle with diastolic interventricular flattening, consistent with volume overload. Injection of agitated saline confirmed the presence of a left-to-right intracardiac shunt, suggestive of an atrial septal defect (ASD). Transesophageal echocardiogram further demonstrated left-to-right shunting across a large secundum ASD. The patient was referred for outpatient percutaneous device closure. DISCUSSION: ASD is an important diagnostic entity in the adult patient evaluated by General Internists and Hospitalists, with considerable morbidity and mortality if left unrepaired. ASDs account for approximately one third of all adult congenital cases. Three quarters of ASDs are secundum defects, which are more common in women than men. Most ASDs represent spontaneous genetic mutations, though some are associated with heritable chromosomal abnormalities. Symptoms at presentation are nonspecific and most often include fatigue and exertional dyspnea. Long-term complications of uncorrected ASDs include atrial arrhythmias, right ventricular dilatation and failure, pulmonary hypertension, recurrent pulmonary infection, paradoxical embolism and cerebrovascular accident. Atrial fibrillation is rare in patients younger than 40, but there is an age-related increase in prevalence after age 40 which is independent of subsequent repair. Percutaneous device closure is standard of care for secundum ASDs in tertiary medical centers worldwide. Procedure efficacy has been demonstrated with experienced providers and appropriately selected defects. Compared with surgery, percutaneous closure is associated with a significantly lower risk of complication and has reduced hospital lengths of stay. Device closure of ASDs also affords significant improvement in exercise capacity, left ventricular filling, and cardiac output. Surgery remains first-line therapy in patients with specified defect complexities. Symptoms and evidence of structural right heart abnormalities are predominant indicators for immediate intervention. In conclusion, ASD is a frequent congenital cardiac abnormality, the physiologic subtlety of which often results in the delay of diagnosis well into adulthood. The significant age-related morbidity and mortality associated with ASDs can be mitigated with timely defect closure, and is recommended in most patients regardless of age.

ATRIO-ESOPHAGEAL FISTULA; A RARE BUT DEADLY COMPLICATION IN THE TREATMENT OFATRIAL FIBRILLATION Lindsay A. Lucas1; Michael Errico2; Anthony Zikos3. 1West Penn Allegheny General Health System, Pittsburgh, PA; 2West Penn Allegheny Health System, Pittsburgh, PA; 3Allegheny General Hospital, Pittsburgh, PA. (Control ID #1339485)

LEARNING OBJECTIVE 1: Recognize atrio-esophageal fistula as a potential risk of pulmonary vein isolation in the treatment of atrial fibrillation.

LEARNING OBJECTIVE 2: Identify the signs and symptoms of atrioesophageal fistula.

CASE: A 57-year-old man with a history of chronic atrial fibrillation on anticoagulation and previous right parietal ischemic stroke was admitted with acute-onset fevers, vomiting, and disorientation. His surgical history was notable for mitral valve replacement, PFO closure five years prior, and radiofrequency pulmonary vein isolation for restoration of sinus rhythm 30 days prior to admission. On presentation he was hypotensive, tachycardic, febrile, and complaining of a headache. He was volume resuscitated, pancultured, and empirically started on intravenous antibiotics for meningitis. Physical exam revealed equal and reactive pupils with mild periorbital edema and pale conjunctiva, bibasilar rales, and no focal neurologic deficit or abnormal cardiovascular findings. Laboratory studies

revealed an INR of 1.5 and lactic acid of 3, but otherwise unremarkable complete blood count and metabolic

panel. CSF was unrevealing. CT head showed a subacute left frontal infarct and an old right parietal infarct. Cultures and chest plain film were negative. Initially his symptoms improved with antibiotics, but overnight he developed dark blood per rectum, vertigo, weakness, and shock, requiring intubation and fluid resuscitation. His clinical signs strongly indicated a left atrio-esophageal fistula formation with septic embolic infarct. A CT chest confirmed a fistulous connection between the esophagus and left atrium. MRI brain revealed innumerable, acute, bilateral cerebral and cerebellar embolic infarcts. The patient was immediately taken to the operating room and underwent successful closure of the left atrium and esophageal tear. Despite early surgical intervention, the patient's mental status failed to recover and his family withdrew care.
DISCUSSION: Left atrial catheter ablation to encircle the pulmonary veins is becoming increasingly recognized as an effective treatment for atrial fibrillation in cases where the arrhythmic activity originates in the muscle sleeves of the pulmonary vasculature. Less recognized is the small but potentially lethal risk of esophageal injury caused by creating a radiofrequency-induced deep tissue injury to the left atrial posterior wall. While left atrio-esophageal fistula formation occurs in fewer than 1% of cases, it should be considered in any patient presenting with symptoms of meningitis, endocarditis, stroke, or gastrointestinal bleed with a history of pulmonary vein catheter ablation within the last 30 days. Mortality is greater than 50% and those who survive are usually recognized early and have few co-morbidities. Treatment is immediate surgical correction of the defect in the tissues walls, antibiotics, and supportive care. Research in risk reduction is limited, due to the relative infrequency of the condition. Low frequency radiation and continuous monitoring of esophageal temperatures is thought to reduce risk of injury, however, these have not been shown to significantly decrease mortality. Left atrio-esophageal fistula is a rare but often fatal complication of pulmonary vein isolation in the treatment of atrial fibrillation and should be considered in any patient presenting subacutely with sepsis, stroke, or GI bleed.
ATYPICAL STRESS INDUCED CARDIOMYOPATHY Aiman M. Smer; Manu Kaushik; Dennis Esterbrooks. Creighton University Medical Center, Omaha, NE. (Control ID #1293250)
LEARNING OBJECTIVE 1: Recognize the clinical features and types of stress induced cardiomyopathyLEARNING OBJECTIVE 2: Diagnose stress induced cardiomyopathy using the Mayo Clinic CriteriaCASE: A 58-year-old woman presented to a tertiary center with new onset chest pain associated with shortness of breath and diaphoresis. This started a few minutes after hearing news of her husbands demise. Her initial ECG revealed normal sinus rhythm with T-wave inversions in leads I and aVL. Troponin was elevated at 2.7. Patient was initially treated as ACS with medical therapy with anti-platelets and anticoagulants. Cardiac catheterization showed normal coronary arteries. Left ventriculography revealed akinesis of the midventricular segments predominantly inferiorly. The remaining ventricular segments were hyperdynamic. Serial echocardiography demonstrated improving LV function. A diagnosis of atypical stress induced cardiomyopathy was made based on the transient LV systolic dysfunction at the mid-ventricular segments, ECG changes, and normal coronaries. The patient was medically managed and discharged in stable condition.
DISCUSSION: Stress induced cardiomyopathy is a rapidly reversible cardiomyopathy characterized by transient systolic dysfunction in absence of obstructive coronary disease. The typical form of SIC first described in Japan in 1990 by Sato et al is characterized by hypokinesis of the apex with hyperkinesis of the basal ventricular segments. SIC usually occurs in postmenopausal women and is triggered by psychological or physical stress. Although, the pathogenesis of SIC is not well understood, it has been suggested that SIC maybe caused by catecholamine excess causing coronary spasm and myocardial stunning. Initial presentation typically mimics ACS with ST segment elevation and T-wave inversions in the precordial leads being the most common ECG finding. Recently, four diagnostic criteria were proposed to diagnosis SIC. 1.Transient hypokinesis, akinesis or dyskinesis of the left ventricular mid segments with or without apical involvement
2.Absence of obstructive coronary disease 3.New ECG changes (either ST-segment elevation and/or T wave inversion) or modest elevation in cardiac troponin 4.Absence of pheochromocytoma or myocarditis. Acute

complications of SIC include acute heart failure, arrhythmias, cardiogenic shock, and transient left ventricular outlet obstruction. Patients who survive the acute episode typically recover normal left ventricular function within one to four weeks. This case suggests that atypical forms of SIC may have partial and noncircumferential mid-ventricular involvement, and that no region of ventricular myocardium is spared from possible involvement SIC.
AXONAL PERIPHERAL NEUROPATHY; AN UNCOMMON SEQUELA OF ALCOHOL ABUSE. Mira Kaga; Aprajita Mattoo. Montefiore, Bronx, NY. (Control ID #1339122)
LEARNING OBJECTIVE 1: Recognize the clinical presentation of alcoholic polyneuropathy.
LEARNING OBJECTIVE 2: Identify the differential diagnosis of peripheral neuropathy.
CASE: A 60 year-old female with no significant past medical history presented with three months of progressively worsening weakness, numbness, and tingling in her upper and lower extremities. She also had occasional sharp, lancinating pain throughout her legs over this same period of time.These symptoms were of insidious onset, first appearing several years prior to presentation and then precipitously worsening over the last three months. Her weakness, numbness and tingling was present in a stocking-and-glove distribution. There was evidence of muscle wasting in the medial and lateral aspects of her thigh and calf muscles bilaterally and in the thenar and interossei muscles of her hands. Though her sensory exam was intact, both her vibrioception and propioception were decreased and she had a scissored, ataxic gait with a positive rhomberg sign. A basic metabolic panel revealed a sodium of 132, a potassium of 2.8 and a magnesium of 1.0. The mean corpuscle volume was found to be elevated to 114 with a folate deficiency of3.8. Total vitamin D2+D3 was deficient to 5.8 and a recent hemoglobin A1c was 4.8. Electromyography of the lower extremities demonstrated sensorimotor axonal peripheral neuropathy without evidence of demyelination. These findings were consistent with nutritional deficiencies secondary to chronic alcohol abuse. On further questioning, the patient revealed a history of one to three glasses of white wine per day for approximately thirty years with an increase in consumption over the past three months to 6-10 glasses per day. Her alcohol history was unknown to her primary care physician.
DISCUSSION: Weakness and parethesia are problems commonly encountered by the internist. A methodical approach to peripheral neuropathy must include less common causes of the disease state such as chronic alcohol use. Like diabetic neuropathy, alcoholic neuropathy is a primary axononal sensorimotor peripheral polyneuropathy that manifests distally first. Symptoms are typically symmetric and follow a stocking-and-glove distribution, involving the hands and arms once lower extremity involvement progresses past the ankle. Sensory symptoms such as numbness, dysesthesias, paresthesias, and loss of position and vibration sense are commonly seen and usually manifest prior to motor symptoms such as weakness and muscle wasting. Gait ataxia may be caused by cerebellar degeneration, sensory ataxia, or simply distal muscle weakness. As with the case above, patients who have alcoholic neuropathy often have nutritional deficiencies as well. Electrolyte abnormalities such as those demonstrated in our vignette and vitamin deficiencies, particularly thiamine, B12, and folate, are therefore supportive of the diagnosis. The pathophysiology behind the disease state is still an area of debate but it is believed that the segmental thinning and loss of myelin that is seen in alcoholic neuropathy is a combination of both nutritional deficiencies and the direct toxic effects of ethanol on neural tissue. Identification of patients who abuse alcohol is an important aspect of primary care that is often not addressed during patient visits. Treatment includes improving nutrition and the cessation of drinking. Although complete recovery from severe neuropathy is uncommon, low doses of tricyclic antidepressants, or gabapentin can be used to control dysesthesias.
AZATHIOPRINE HYPERSENSITIVITY MIMICKING SEPSIS IN A PATIENT WITH CROHN'S DISEASE. Oxana Haflund; Asif Iqbal. Aurora Sinai Medical Center, Milwaukee, WI. (Control ID #1313477)

LEARNING OBJECTIVE 1: Recognize a case of Azathioprine hypersensitivity mimicking sepsis in a patient with

Crohn's disease.
CASE: A 68 years old man with past medical history of atrial fibrillation and recent diagnosis of Crohns disease presented with two days history of fevers as high as 102.8 F, chills, mild nasal congestion and mild cough with production of small amount of whitish sputum. He did not complain of any abdominal pain or diarrhea. He did not have any chest pant, joint pain, rash or urticaria. Patient was recently diagnosed with Crohn's disease after having multiple episodes of bloody diarrhea. Diagnosis was confirmed by colonic biopsy. Treatment was started with Azathioprine and Prednisone. On our examination patient looked ill and was having severe rigors and high grade fevers. Abdominal exam showed mild tenderness of the left lower quadrant on deep palpation without guarding or rebound tenderness and normal bowel sounds. Laboratory date showed normal white count and venous lactate level. Chest X-ray, urine analysis, and blood culture results were unremarkable. CT scan of the abdomen and pelvis with contrast showed mild intrahepatic biliary dilation with normal common biliary duct and gallbladder and diverticulosis without abscess or any other pathology. Suspecting an intra-abdominal abscess, treatment with Cefoxitin was started. Patient continued to have fevers and rigors after starting antibiotics. Azathioprine was then stopped suspecting a hypersensitivity reaction. Fever and rigors promptly disappeared after discontinuation of Azathioprine. Patient clinically improved and did not have any more fevers and rigors after Azathioprine was discontinued.
DISCUSSION: Systemic hypersensitivity is a rare side effect of azathioprine. The common side effects include gastrointestinal disturbances, granulocytopenia and hepatocellular injury. The majority of reactions occur in the first four weeks of initiation of the treatment. Hypersensitivity should be suspected and included in the differential diagnosis if a patient experiences fever, malaise, hypotension and renal failure. The above mentioned symptoms could relate to a true adverse drug reaction in some versus exacerbation of underlying disease or sepsis in others. We suspected hypersensitivity to azathioprine in this patient due to: timing of initiation of azathioprine, presence of above mentioned symptoms and improvement after discontinuation of azathioprine. A rechallenge test may be used to confirm the diagnosis of azathioprine hypersensitivity. Optimally rechallenge should be done under careful supervision. Rechallenge was not conducted in this case because it is dangerous and can lead to life-threatening reoccurrence of symptoms.
B CELL LYMPHOMA MASQUERADING AS GROSS HEMATURIA Lindsay A. Mazotti2; Jaclyn Watkins1; Hugh Benedict2; Thomas N. Hackford2; Stacy Shoshan2; Benjamin L. Maring2. 1UC San Francisco, School of Medicine, San Francisco, CA; 2Kaiser Permanente: Oakland Medical Center, Oakland, CA. (Control ID #1340083)
LEARNING OBJECTIVE 1: Recognize gross hematuria as a possible presentation of B cell lymphomaLEARNING OBJECTIVE 2: Recognize uric acid nephropathy in the setting of spontaneous tumor lysis syndromeCASE: A 72 year old man with a history of diabetes mellitus type 2, hypertension, asthma, and GERD presented to the emergency department with two episodes of painless gross hematuria, recent night sweats, and two weeks of intermittent non-bloody diarrhea. Physical examination revealed bilateral petechiae on the legs and mild bilateral CVA tenderness. Urinalysis was notable for 2+ uric acid crystals. Abdominal CT revealed bilateral obstructing stones without marked hydronephrosis. The patient was found to be in anuric acute renal failure with a creatinine of 4.84 compared to baseline of 1.01. Further evaluation revealed new anemia and thrombocytopenia. Though TTP-HUS was entertained given recent diarrhea, serial blood smears did not reveal schistocytes. Lab work on hospital day two revealed a serum uric acid of 22.4 mg/dL and markedly elevated LDH at 44977 U/L, raising the suspicion of spontaneous tumor lysis syndrome with acute uric acid nephropathy. After bilateral ureteral stent placement, the patient was emergently hemodialyzed and started on allopurinol. He remained anuric for three days. Renal function gradually improved with alternating IVF and IV furosemide. A bone marrow biopsy
obtained on hospital day two initially suggested leukemia. However, further staining of the sample revealed high-grade B cell lymphoma with extensive bone marrow involvement. The patient was started on R-CHOP. At

discharge, creatinine was 0.96. Several weeks after presentation, the patient developed multiple cranial nerve palsies secondary to CNS lymphoma. Intrathecal chemotherapy failed to resolve the palsies, and the patient entered Hospice care.
DISCUSSION: Tumor lysis syndrome is defined by several metabolic complications that may arise in the setting of rapidly proliferating tumors, a large tumor burden, or during treatment of a drug-sensitive neoplasm. Metabolic abnormalities associated with TLS include serum uric acid>= 8 mg/dL or a 25 percent increase from baseline, serum potassium>=6.0 mmol/L or a 25 percent increase from baseline, serum phosphate>=6.5 mg/dL or a 25 percent increase from baseline, and serum calcium<=7 mg/dL or a 25 percent decrease from baseline. The symptoms of TLS include those associated with the metabolic abnormalities (eg nausea, vomiting, arrhythmia, seizure, tetany, syncope, sudden death). Additionally, if uric acid or calcium precipitates in the urinary tract leading to nephrolithiasis, flank pain may result. Uric acid precipitation within the renal tubules with resulting oliguric or anuric renal failure is known as acute uric acid nephropathy (UAN). UAN typically results from a combination of overproduction and overexcretion of uric acid as seen in patients with lymphoma and leukemia. UAN should be considered when there is acute kidney injury in the context of marked hyperuricemia (>15 mg/dL). UAN secondary to spontaneous TLS may be treated with allopurinol, rasburi-case, and hemodialysis. Gross hematuria is not a typical presentation of UAN. However, it has been described, mostly in case reports, as a presentation of leukemia or urinary tract non-Hodgkins lymphoma. Based on CT, our patient did not have evidence of urinary tract tumor burden. However, biopsy of the urinary tract was not performed.
B-CELL LYMPHOMA MANIFESTING AS A HEPATIC GRANULOMATOSIS Kerry-Anne Machado. Allegheny General Hospital, Pittsburgh, PA. (Control ID #1339946)
LEARNING OBJECTIVE 1: Demonstrate a unique etiology of hepatic granulomas.
LEARNING OBJECTIVE 2: Illustrate the clinical and laboratory features of granulomatous hepatitis in an adult.
CASE: This is a 42-year-old Caucasian female who was admitted for intermittent fevers for 3 months. She complained of weakness, diaphoresis, weight loss, and right upper quadrant abdominal pain with associated nausea and vomiting. She denied jaundice, confusion, pruritus, dark urine, and diarrhea, melena or hematochezia. She underwent a cholecystectomy one year ago. She denied sick contacts or recent travel. She is a nonsmoker and denied alcohol use. Family history was significant for cirrhosis that her father had developed as a complication of NASH. Her vital signs demonstrated a temperature of 102F, the pulse rate 115/min, blood pressure 110/60 mmHg and respiration rate 12/min. On physical examination sclera was nonicteric and there were no palpable lymph nodes. Her abdomen revealed moderate tenderness in the epigastrium and right upper quadrant without rebound, guarding, organomegaly or masses. The heart and lung exams were normal. Initial lab work was notable for an elevated alkaline phosphatase of 143 U/L with normal synthetic function. There were mild intermittent rises in AST and ALT, though chronic liver disease panel was unremarkable including anti-mitochondrial antibody, anti-smooth muscle antibody, viral hepatitis serologies, ANA, anti-LKM antibody, HSV, EBV and CMV serologies. Infectious workup including blood and urine cultures as well as further imaging including chest CT and transthoracic echocardiogram were unremarkable. An enhanced abdominal CT scan demonstrated hepatomegaly with multiple ill-defined, low-density liver lesions up to 1.3 cm x 2.5 cm in size. Subsequently, a liver biopsy was done which showed non-caseating epithelioid granulomas and mild steatosis. An extensive workup was done for her granulomatous disease including studies for bacterial and fungal infection, malignancy, and autoimmune mediated causes. In addition a bone marrow biopsy, bronchoscopy with broncheoalveolar lavage, and transbronchial biopsies were done, all of which were unrevealing. The etiology of her granulomatous disease was unclear and suspicions leaned towards autoimmune

mediated disease. The patient was treated with NSAIDs, prednisone and ursodiol, with mild improvement in her constitutional symptoms, however she did not defervesce. The patient became progressively ill and sought

additional care at a tertiary care center. A PET scan demonstrated numerous hypermetabolic foci throughout the liver with involvement in the spleen. Subsequently a repeat biopsy of the liver supported the diagnosis of EBV-positive B-cell lymphoma. Large atypical cells were strongly positive for CD20, PAX-5, CD30, MUM-1. In situ hybridization recognized EBV encoded RNA, further solidifying the diagnosis. Given these findings the patient was referred to her local oncologist to initiate therapy for her lymphoma.
DISCUSSION: Hepatic granulomas are not uncommon, seen in 2-10% of patients who undergo routine liver biopsy and may be caused by a variety of conditions. However, the presence of noncaseating epithelioid granulomas in association with B-cell lymphoma is both distinctive and rare. Very little has been published to demonstrate the diversity of etiologic factors in granulomatous liver diseases. Therefore, this case serves to emphasize a less common histopathologic diagnosis.
BABESIOSIS IN A NEW ENGLANDERFROM PRIMARY CARE TO INTENSIVE CARE Asa Z. Oxner; Jeffrey William. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1334637)
LEARNING OBJECTIVE 1: Distinguish patients at risk for Babesia infection over other co-infectionsLEARNING OBJECTIVE 2: Recognize laboratory values and evidence of organ damage that accompany severe babesiosisCASE: A 63 year-old gentleman with history of Non-Hodgkin lymphoma (NHL) presented to his community hospital with two weeks of neck stiffness, body/joint aches, and daily fevers to 102-105F with rigors. He is an air quality scientist who frequently hikes in the backwoods of New England. He recalled removing two ticks engorged with blood prior to presentation. His NHL was treated with chemotherapy and in remission since 2010, confirmed by CT imaging. The community hospital started doxycycline due to concern for Lyme disease and discharged him home. A few days later he returned with persistent fevers and worsening thrombocytopenia and transaminitis. He was hypotensive despite six liters of volume resuscitation and required vasopressor initiation. Azithromycin and atovaquone were added to doxycycline and he was transferred to our intensive care unit. Within hours of arrival, volume resuscitation was continued and his vasopressor requirement decreased. Physical exam was notable for mild jaundice but absence of erythema multiforme or petechiae. His laboratory studies were significant for: platelet count of 36 K/L, hematocrit of 33.4, creatinine 1.2 mg/dl, AST/ALT 838/777 IU/L, LDH 2399 IU/L, total and direct bilirubin of 3.9 and 2.8 mg/dl. Urinalysis showed large blood with only 7 RBCs. A thin parasite smear showed many red cells with single ring forms with an estimated parasitemia of 10% consistent with severe babesiosis. Antibiotics were changed to quinine and clindamycin, remaining on doxycycline until Lyme, Anaplasma, and Ehrlichia serologies returned negative. He underwent exchange transfusion pheresis with resolution of parasitemia to 2%. He returned home to complete a 10-day course of atovaquone and azithromycin. DISCUSSION: Babesiosis is an uncommon human illness caused by a parasite called Babesia microti, transmitted by the Ixodes scapularis tick, most prevalent in the mid-Atlantic and New England regions of North America. Most people infected with the Babesia parasite are asymptomatic, but severe infections can present with symptoms and signs similar to malaria: high fevers, rigors, and hemolytic anemia. Immunosuppressed patients are at increased risk for clinically significant babesiosis, including those with functional asplenia, HIV/AIDS infection, malignancy, age> 50 years, or on chronic immunosuppressive medications. Severe babesiosis is characterized by parasitemia >10% on peripheral blood smear, hemolysis, respiratory distress, disseminated intravascular coagulation, renal/hepatic failure, or death with a mortality rate of 5-10%. No early clinical markers foretell a severe Babesiosis nor distinguish it from Lyme. However, labs showing early organ dysfunction should hint that more than Lyme is at play. Given the risk of co-infections carried by the Ixodes tick, doxycycline 100 mg PO BID is an important therapy to initiate until serologies return negative. Mild infection should be treated with
atovaquone 750 mg PO BID and azithromycin 250 mg PO daily and severe infection with clindamycin 600 mg IV Q6H and quinine 650 mg PO Q8H; both courses are 7-10 days. In rare cases with parasitemia>10% or evidence of organ damage, exchange transfusion is a life-saving therapy to remove the parasites and hemolysis byproducts.

BEFORE THE CURTAIN FALLS Cady Blackey. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311862)

LEARNING OBJECTIVE 1: 1. Recognize the clinical presentation of temporal arteritis 2. Identify the most useful symptoms, physical examination findings, and laboratory data for diagnosing temporal arteritis3. Identify how to obtain accurate temporal artery biopsy resultsCASE: A 63 year-old woman presented with three months of a progressive headache. She reported episodes of stabbing pain in her left forehead lasting seconds to minutes, occurring multiple times a day and increasing in frequency and severity. She denied associated photophobia, phonophobia, or nausea. She reported pain in her forehead and jaw after eating. She denied fever or a stiff neck. She had two episodes of vision loss in her left eye that she described as a curtain coming down over my eye. She complained of fatigue, in addition to stiffness and soreness in her wrists each morning that resolved after 2-3 hours. The physical exam revealed a thickened and tender left temporal artery; the retina were normal bilaterally. Her neurologic examination was normal. The c-reactive protein was less than 0.5, and the sedimentation rate was was 30. An oral prednisone regimen was initiated, and she was immediately sent for a temporal artery biopsy. The biopsy revealed mild lymphocytic inflammation in arterial adventitia and mild intimal hyperplasia. Her symptoms improved with prednisone, without further episodes of visual disturbance.

DISCUSSION: Headaches are one of the most commonly encountered chief complaints by the general internist. Maintaining appropriate suspicion for temporal arteritis is imperative, as the diagnosis is largely established on historical information, and timely diagnosis is imperative: blindness can develop rapidly if it is not promptly treated. Signs and symptoms that should raise suspicion for temporal arteritis include headache, particularly in an older patient, jaw claudication, visual symptoms, scalp tenderness, fever, malaise, arthralgias and tender, beaded, engorged or pulseless temporal arteries. However, the presentation of this disease can vary greatly depending on which symptoms predominate. Temporal artery biopsy is the gold standard for diagnosis, but immediate biopsy is often logistically impractical. Knowing how the presence or absence of given signs and symptoms impacts the likelihood of having the disease is essential in determining which patients to treat. Jaw claudication (+LR 4.3), diplopia (+LR 3.5) and temporal artery abnormalities on exam (+LR 4.6) have been shown to be the most useful in predicting positive biopsy results; normal ESR levels (-LR 0.2) and young age are valuable in excluding the disease. Treatment should begin promptly if temporal arteritis is considered likely. Steroids are the mainstay of therapy, but dosing, route and duration vary depending on the clinical presentation. Steroids do not impact biopsy results if suspicion of temporal arteritis is high, so treatment should not be delayed. However, inadequate biopsy specimen length and greater duration of time between steroid initiation and biopsy have both been shown to decrease the number of positive biopsies. Thus, a biopsy should be performed by an experienced specialist within two weeks of steroid initiation. With an aging population in the US, physicians should be adept at diagnosing this cause of headache from which significant morbidity is possible.

BING NEEL SYNDROME- A RARE COMPLICATION OF WALDENSTROMS MACROGLOBULINEMIA Akshiv Malhotra; Toni Pacioles; Teresa Gentile. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339584)

LEARNING OBJECTIVE 1: Recognize the neurological complications of Waldenstrom's macroglobulinemia.

LEARNING OBJECTIVE 2: Diagnose Bing Neel syndrome based on the MRI and CSF findings.

CASE: 70 year old female presented to the Emergency Department with worsening left upper extremity weakness, dysarthria and confusion. Her past

medical history is significant for Waldenstrom's macroglobulinemia (WM) diagnosed 1 year ago, breast cancer diagnosed 11 years ago, status post lumpectomy, radiation and Tamoxifen. About a year ago, she was noted to

have anemia and paraprotein in her blood and underwent a bone marrow biopsy which showed a lymphoplasmacytic infiltrate. She then underwent CT scans to look for enlarged lymph nodes. She was found to have a mass of the left kidney which on biopsy showed Lymphoplasmacytic lymphoma with an IgM monoclonal protein (WM). She was treated with 4 cycles of Rituximab to which she responded well. However, she started having intermittent confusion and balance problems and now, presented to the ER with left upper extremity weakness, dysarthria and confusion. The patient was admitted to the neurology service. The symptoms resolved within 6 hours of onset. She underwent CT of the head without contrast which showed no evidence of acute bleed/ infarct. MRI of the brain showed dural enhancement. Lumbar puncture was performed which showed Protein of 768 mg/dl and White count of 108/cu mm with 100% monocytes. The cytopathology report and flow- cytometry came back consistent with previously diagnosed B cell lymphoma (Lymphoplasmacytic lymphoma). Decadron 4 mg every 6 hours was started. An intraventricular reservoir was placed and Intrathecal methotrexate was started twice a week for 8 cycles. CSF cleared up with no evidence of malignancy. She was then treated with craniospinal irradiation and has remained in remission for 4 months.
DISCUSSION: Bing Neel (BN) syndrome is a very rare complication of Waldenstroms Macroglobulinemia (WM) that should be considered in patients with neurologic symptoms and a history of WM. Neurologic complications occur in 25% cases of WM, but are most commonly due to serum hyperviscosity syndrome and immune related neuropathy. Direct malignant lymphoid infiltration of the CNS, the so called Bing Neel syndrome is extremely rare. BN syndrome is defined as WM with perivascular infiltration of small lymphocytes, lymphoplasmacytoid cells, and plasma cells in the CNS. BN syndrome refers specifically to the involvement of perivascular infiltrates rather than stroke or hemorrhage due to hyperviscosity. Symptoms may include seizures, confusion, cognitive decline, headache, blurry vision, pain, numbness, paresthesias, hearing loss, or weakness. Serum laboratory tests show macroglobulinemia, normocytic anemia, IgM kappa or lambda light chain restriction. CSF analysis shows lymphocytic pleocytosis of 100-500 cells/cu mm, elevated protein 40-2000 mg/dl and CD20+ lymphoplasmacytoid cells in flow cytometry and cytology. MRI shows T2/FLAIR hyperintensity and gadolinium enhancement. Remission in BN syndrome has been reported with the use of intrathecal Methotrexate alone, or with radiation therapy.
BLISTER IN THE SUN: A CASE OF PORPHYRIA CUTANEA TARDA Judith Griffin; Regina Lee. Montefiore Medical Center, New York, NY. (Control ID #1334532)
LEARNING OBJECTIVE 1: Discuss the presentation and diagnosis of porphyria cutanea tardaLEARNING OBJECTIVE 2: Review the relationship between PCT and hepatitis CCASE: A 67 year-old man with a history of hypertension and end stage renal disease on hemodialysis presented with a blistering skin rash on his hands and face. Two weeks prior, the patient noticed blisters on his right and left hands; a blister on his lower lip developed and burst. The lesions were painful but not pruritic. On exam the patients blood pressure was elevated, but he was afebrile and vital signs were otherwise normal. His non-dermatologic exam was normal. The skin exam revealed a swollen, hypopigmented lower lip, and multiple flesh-toned plaques and ulcers on palmar and dorsal hands. No vesicles were intact, and there were no lesions on his trunk, lower extremities, or genitals. An HIV ELISA was negative, but the hepatitis C (HCV) viral load >100,000/mL. Fractionated plasma porphyrins were elevated with uroporphyrin 262.4 mcg/L (<0.2mcg/L), heptaporphyrin 214.4 mcg/L (<0.2mcg/L), hexaporphyrin 7.8 mcg/L (<0.3mcg/L), pentaporphyrin81.5 mcg/L (<0.4mcg/L) and coproporphyrin 12.8 mcg/L (<0.8mcg/L). Skin biopsy of the right hand was consistent with porphyria cutanea tarda (PCT). Based on the presence of elevated plasma porphyrins and characteristic skin biopsy, the patient was diagnosed with PCT.
DISCUSSION: PCT is a metabolic condition resulting from the deficiency of hepatic uroporphyrinogen decarboxylase, the fifth enzyme in the heme synthetic pathway. The deficiency leading to PCT can be hereditary or acquired and the incidence of PCT is one in 25,000, typically occurring in patients over thirty. PCT has been described in patients on chronic hemodialysis, with the pathogenesis likely due to the lack of clearance of porphyrin precursors and their accumulation in the serum. Multiple studies have also revealed a

strong association between PCT and HCV, with significant geographic variation between regions depending on HCV prevalence. In North America, prevalence of HCV in patients with PCT may be as high as 66 percent. The mechanism linking the two is not known, but several have been proposed including release of iron from hepatocytes due to damage from HCV leading to oxidative stress. PCT is associated with accumulation of porphyrins in the liver, which typically result in mild elevations in serum alanine aminotransferase and aspartate aminotransferase. Porphyrins also accumulate in the skin and exposure to ultraviolet or visible light creates oxidized substances that activate collagenases, leading to disruption of cell components in the subepidermis and the formation of bullae on sun-exposed areas. Other dermatological findings include hypo- and hyperpigmentation and scarring also on sun-exposed areas. PCT should be suspected in any patient who presents with blistering on sun-exposed areas, especially if risk factors are present. The diagnosis is confirmed by demonstration of markedly elevated porphyrins in the plasma or urine. Patients diagnosed with PCT should also undergo testing for HCV, HIVand iron overload. In patients with or without iron overload, the treatment of PCT is repeated phlebotomy. Low-dose hydroxychloroquine is an alternative therapy if phlebotomy is not tolerated. Supportive care, such as analgesia, avoiding sun exposure, and wearing protective clothing, is also recommended during therapy.

BLOOD TRANSFUSIONS IN PATIENTS WITH SICKLE CELL DISEASE: A DOUBLE EDGED SWORD

Jonathan Kirsch; Pahresah Roomiany. University of North Carolina, Chapel Hill, NC. (Control ID #1318358)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of delayed transfusion reaction.

LEARNING OBJECTIVE 2: Differentiate delayed transfusion reaction from sickle cell pain crisis.

CASE: A 21 year-old man with sickle cell anemia (SS disease) presented with acute lower extremity pain. He noted fatigue and subjective low-grade fevers. His symptoms began on the day of presentation and were constant. He did not have trauma to the legs, Wells score was zero and he did not have sputum production or cough. He had a history of acute chest syndrome and delayed hemolytic transfusion reactions. He was transfused with packed red blood cells for acute chest syndrome 1 week prior to admission. At that time hemoglobin rose from 3.8 to 6 grams per deciliter and hemoglobin A was low but present at 38.2% with a hemoglobin S of 55%. A three out of six systolic murmur was heard loudest at the left lower sternal border. His lower extremities were globally tender to palpation. No rash, effusion or erythema was present. Chest X ray was normal. White blood cell count was 16 x 10^9 per liter. Hemoglobin was 4 grams per deciliter and dropped to 3 grams per deciliter within two days. LD was 1600 units per liter and total bilirubin was5.5 mg per deciliter. Lactate dehydrogenase was 1500 units per liter and Coombs test was negative. Reticulocyte count was 10% and haptoglobin was less than 20 milligrams per deciliters. Hemoglobin A was no longer present and hemoglobin S was 92%. He had developed a delayed transfusion reaction.

DISCUSSION: Sickle cell disease is commonly encountered by internists, particularly in the hospital setting. Recognizing complications of blood transfusions in this population is important for treating sickle cell disease in both the short and long-term. Delayed hemolytic transfusion reactions can be a life-threatening complication in patients with sickle cell disease. Exposure to red blood cell transfusion increases the likelihood of occurrence as antibodies to red blood cell antigens develop. Findings associated with delayed hemolytic transfusion reaction include pain, anemia and evidence of hemolysis. Delayed hemolytic transfusion reactions should remain on the differential when patients with sickle cell

disease present with pain crisis. Inquiring about transfusion history and recent hospitalization is important. Diagnosis of hemolytic transfusion reaction is based on history, labs consistent with hemolysis and absence of hemoglobin A on electrophoresis. Once the diagnosis has been made, further red blood cell transfusions should be withheld unless critical. Treatment is aimed at improving anemia and suppressing the immune response to blood cells. As patients respond to therapy, their anemia will improve and reticulocyte count will increase appropriately.

BOERHAAVE SYNDROME REVISITED: PROXIMAL ESOPHAGEAL RUPTURE MANAGED CONSERVATIVELY Kalpana Nagarkar; Marta Herrera; Sundip Kaur; Ronald Warren; Joseph DeAntonio; Daniel Goldsmith. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1319929)

LEARNING OBJECTIVE 1: Recognition of unexpected physical findings in Boerhaave Syndrome can lead to early diagnosis and management.

LEARNING OBJECTIVE 2: A subset of proximal esophageal ruptures is appropriate for conservative management and can present in unusual ways.

CASE: A 56 year old African American male patient presented to the ED with acute difficulty breathing and swallowing for a few hours. He reported that he woke up with sudden onset of breathlessness, and had difficulty swallowing and hence had to spit out repeatedly. He denied any history of chest pain or cough. He further reported vomiting multiple times the prior day associated with nausea and retching. Past medical history was pertinent for essential hypertension and alcohol abuse. Physical examination revealed that the patient preferred a sitting position and was constantly spitting. He was able to speak but the voice was muffled. Oral examination revealed swelling and a large bubble-like lesion of the right pharyngeal wall. Chest radiography was normal apart from mild elevation of the right hemi-diaphragm. CT scan of the neck and chest revealed extensive free air tracking through the fascial planes of the neck, extensive mediastinal air tracking along the esophagus greatest in the oral pharyngeal regions surrounding the epiglottis and aryepiglottic folds suggestive of a proximal esophageal tear. The Gastrograffin esophagram showed focal out-pouching of contrast from the cervical esophagus. After conservative management, subsequent CT of the neck showed resolution of the air and repeat esophogram showed that the leak was contained and the patient recovered without further intervention.

DISCUSSION: Unexpected physical findings may be the key to the correct diagnosis. Proximal esophageal rupture with para-esophageal air tracking may be difficult to appreciate on physical examination, until the air reaches the oropharyngeal cavity and can be seen on oral inspection. Further, the patients general appearance of preferring upright position and constant spitting suggests a proximal swallowing obstruction. Despite the dramatic and worrisome nature of the diagnosis, proximal esophageal ruptures are managed differently from distal, and can frequently be successfully treated with conservative observation.

BOWEL BEYOND BORDERS: A MASSIVE PARAESOPHAGEAL HERNIA MIMICKING A PULMONARY EMBOLISM Michael Farbaniec; James Lamberg; Ethan Kuperman. Penn State University Hershey Medical Center, Hershey, PA. (Control ID #1339107)

LEARNING OBJECTIVE 1: Distinguish between the different types of hiatal/paraesophageal hernias and recognize less common presenting symptoms.

LEARNING OBJECTIVE 2: Understand the management of paraesophageal hernias.

CASE: An 87-year-old woman with gastroesophageal reflux disease but no history of cardiopulmonary disease presented with a fracture of her right femoral neck after a mechanical fall. The night of her admission, she became acutely short of breath, tachycardic, and developed increased oxygen requirements. Chest auscultation revealed decreased breath sounds along the left lung field but occasional bowel sounds could be heard in the bases and midlung fields bilaterally. With initial suspicion for pulmonary
embolism, computed tomography of her chest was performed. No pulmonary embolism was identified but a 7x10cm type IV paraesophageal hernia was revealed, which included the entirety of her stomach and pancreas, portions of the duodenum, the splenic flexure of the colon, and associated vasculature. She remained stable after conservative treatment and was taken to surgery the following day for a right hip hemiarthroplasty. The procedure was uncomplicated and she was extubated successfully. After extubation, her oxygen requirements had diminished. Cardiothoracic surgery was consulted for management of her large paraesophageal hernia. The patient decided to decline any further surgical intervention at this time and remained asymptomatic upon discharge.

DISCUSSION: Hiatal hernias are classified into four different types. Type I classifies sliding hernias and

accounts for 95% of hiatal hernias while II, III, and IV are collectively known as paraesophageal hernias. Type II classifies herniation of the stomach through the hiatus while the gastroesophageal junction remains below the diaphragm. Type III is classified by the gastroesophageal junction herniating through the diaphragm. Type IV is classified by any other intraadbominal organs besides the stomach herniating through the diaphragm. Most common symptoms include reflux and vomiting but about 3% may develop dyspnea. Fewer than 8% of paraesophageal hernias involve viscera beyond the stomach. The small bowel and colon are often involved, but only five previous cases have reported pancreatic involvement. This patients unique hernia is the only documented paraesophageal hernia to contain the entirety of the pancreas as well as being one of the largest currently documented in the literature. Management of these hernias has been controversial. A majority of past publications suggest correction of all paraesophageal hernias regardless of symptomatology. However, large database studies show a mortality rate of 1.4% in elective repair but only 1.1% developed acute symptoms requiring emergent surgery. Indications for elective surgery include failed medical management of reflux or persistent vomiting. Indications for emergent surgery include volvulus, obstruction, bleeding, and respiratory failure. In this case, the patients dyspnea resolved after her surgery and she remained asymptomatic. This did not make her a candidate for elective surgical repair.

BROKEN-HEARTED? NON-ACS CAUSES OF ELEVATED TROPONINS Cady Blackey. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311854)

LEARNING OBJECTIVE 1: 1. Identify etiologies of elevated troponins2. Determine the most likely cause of an elevated troponin level 3. Identify the utility and limitations of troponin as a diagnostic toolCASE: A 44 year-old woman presented with severe, sub-sternal chest pain that radiated to her left arm. The pain was associated with diaphoresis and relieved with nitroglycerin. She denied prior episodes of chest pain, and she reported no recent stress. She was a non-smoker, but her mother had died of a myocardial infarction at the age of 53. The patient had been recently diagnosed and treated for right thigh myosarcoma Her vital signs were normal. She was an overweight, slightly anxious woman. Her cardiovascular exam was normal, and her lungs were clear; she had no jugular venous distension or peripheral edema. Her chest pain was not reproducible and not affected by position. The EKG revealed a normal sinus rhythm without ST changes or Q waves, but her troponin was 6.75. She was treated for a non-ST elevation myocardial infarction; her troponin levels peaked at 12. A left heart catheterization and coronary angiography revealed patent coronary arteries and normal pressures with focal hypokinesis of the mid-anterolateral wall. The echocardiogram was normal.

DISCUSSION: Coronary artery disease (CAD) affects 17.6 million Americans, making it one of the most common diagnoses encountered by the general internist. Highly sensitive troponin assays have revolutionized the diagnosis of acute coronary syndrome (ACS); however, this test is not a sufficient substitute for sound clinical reasoning. The physician must suspect other etiologies when the clinical picture is inconsistent with ACS. General internists should be equipped with a differential diagnosis for common non-ACS etiologies of elevated troponins. Causes include pulmonary embolus, congestive heart failure, sepsis, cardiac arrest, cardiac

ablation/cardioversion, stroke, renal failure, cardiac contusion, pericarditis and myocarditis. The presence of risk factors for atherosclerosis, typical chest pain, and ischemic changes on echocardiography or electrocardiogram increase the probability of cardiac ischemia. In the absence of these signs and symptoms, a thorough history and physical exam can identify most non-ACS causes of elevated troponin. Securing the proper diagnosis prevents unnecessary intervention and allows for appropriate treatment. Very rarely, a thorough history and exam fail to reveal an alternative source for elevated troponin. Both tropnin isomers, cTnI and cTnT, are specific for cardiac muscle; however, earlier generation assays have detected elevated troponin levels in circumstances when skeletal muscle is damaged and regenerating. Purely analytical error can also cause false positive

troponin results in as many as 1/2000 assays, due to cross reactivity between cTnI assay components and a product in the patient's blood (rheumatoid factor, heterophile antibodies, macroglobulin, fibrin clots, bilirubin). In a patient with muscle disease, it is important to consider the possibility of cross-reactivity of abnormal skeletal muscle with the troponin assay. Such was the case in our patient who had recently underwent surgical resection and chemotherapy for a sarcoma. Though troponin levels are helpful in ruling out cardiac ischemia, elevations in troponin are not specific for ACS. Physicians cannot allow themselves to be lured towards a convenient conclusion without first developing a differential diagnosis.

BRONCHOMEDIASTINAL FISTULA PRESENTING AS PURULENT PERICARDITIS IN A HEALTHY 32 YEAR-OLD MAN Aiman M. Smer; Jamil Abuzetun; Mahmoud A. Abu Hazeem; Alok Saurav; Aryan Mooss. Creighton University Medical Center, Omaha, NE. (Control ID #1293075)

LEARNING OBJECTIVE 1: Recognize the clinical features and complications of bronchomediastinal fistulaCASE: A previously healthy 32-year-old Hispanic man presented with acute onset retrosternal chest pain associated with subjective fever, dry cough, and dyspnea on exertion. Physical examination was remarkable for pericardial friction rub. Laboratory studies showed leukocytosis with left shift and elevated ESR. The electrocardiogram revealed sinus tachycardia with diffuse ST segment elevation, and PR segment depression consistent with the diagnosis of acute pericarditis. Patient was treated with Ibuprofen. On day 2 of admission, the patients clinical condition deteriorated and became more dyspnic and tachypnic. Transthoracic echocardiogram showed moderate pericardial effusion with no evidence of tamponade (Figure 1). Computed tomographic scan of the chest revealed left bronchomediastinal fistula with mediastinal adenophathy, along with moderate pericardial and bilateral pleural effusions (Figure 2). A rigid bronchoscopy confirmed the presence of 1 cm in size left bronchomediastinal fistula (Figure 3). Thoracocentesis was performed and 130 ml of pus was drained. Both Blood culture and pleural fluid culture grew eikenella corrodens. The patient was started on intravenous ampicillin after sensitivity and susceptibility testing. There was no obvious cause for the bronchomediastinal fistula, especially that the patient never had symptoms of respiratory or oropharyngeal disease or previous trauma. Barium swallow study and esophagogastroduodenoscopy were normal. The patient underwent operative drainage of the pericardial sac, debridement and decortications of the left lung, and placement of silicone stent at the left main bronchus (Figure 4). He completed four weeks of intravenous ampicillin. The patients clinical condition continues to improve and he was discharged home three weeks after the surgery. The bronchial stent was removed six weeks later during follow up visit.

DISCUSSION: Acute purulent pericarditis is rarely caused by anaerobic bacteria and is almost always a complication of another disease. In our case mediastinitis due to spontaneous bronchomediastinal fistula was found to be the primary source of infection. Esophagomediastinal fistula, odontogenic, or pleuropulmonary infections have been reported to be the primary source of purulent pericarditis. To our knowledge this is the fourth case of eikenella corrodens pericarditis reported in the literature. This case illustrates the importance of a diligent search for the primary source of infection in order to diagnose and treat these patients properly. Treatment of purulent pericarditis hinge on pericardial fluid drainage and appropriate antibiotic therapy

CAN BUPRENORPHINE MAKE YOUR LIVER ANGRY? Houman Sharifi; Thomas Daniel; Nazrul Chowdhury; Matt Chua. Texas Tech University of Health Sciences, Amarillo, TX. (Control ID #1324418)

LEARNING OBJECTIVE 1: Recognize clinical features and laboratory results of Buprenorphine induced hepatitis in patients on therapeutic dose of this medication.

LEARNING OBJECTIVE 2: Recognize rare side effects of Buprenorphine and its mechanism to cause these side effects since its wide spread use to control opiate withdrawal symptoms.

CASE: 48 year old white female admitted to psychiatric department for opiate withdrawal symptoms. She has past medical history of bipolar disease, hepatitis C, GERD and prescribed opiate dependency for years. She was on multiple medications including trazodone, clonazepam, duloxetine and hydrocodone/acetaminophen. She was abusing hydro-codone/acetaminophen and her last use was 3 days prior to admission. Her basic labs

and liver function test was normal prior to admission. She was started on buprenorphine 0.3 mg IM every 8 hours. She developed tremor, mild nausea and right upper quadrant pain on the second day of treatment. It was the first time she had buprenorphine in a treatment program. On physical exam her temperature was 98.4, blood pressure of 112/71 mmHg, heart rate of 78 bit/min and respiratory rate of 18. She had unintentional tremor but no asterixis and right upper quadrant tenderness without hepatomegaly. Laboratory data showed AST of 759 U/L and ALT of 1524 U/L, Alkaline phosphatase of 150 U/L. She had normal Bilirubin Total and Amylase/Lipase. Her acetaminophen level was within normal limits. Her right upper quadrant ultrasound was normal. Buprenorphine induced acute hepatitis was suspected and the drug was discontinued and supportive care initiated, her abdominal pain and extremity tremor subsequently improved and liver function test on next day showed trending down of enzymes. She was discharged home after 6 days and later follow up care after 2 weeks showed her liver function test back to normal. DISCUSSION: Buprenorphine is a semi-synthetic opioid derived from thebaine which is an alkaloid of opium. It has partial agonist antagonist effect on mu receptor and some effects on kappa receptor. It has been approved for opiate dependency detoxification and maintenance therapy by FDA in 2002 with or without Naloxone in sublingual form but using IM form is also common in psychiatric wards. Common side effects of buprenorphine include: nausea and vomiting, dry mouth, constipation, insomnia, drowsiness, dizziness, orthostatic hypotension and sweating. Among less common but more serious side effects are acute hepatitis and renal failure, respiratory depression, bronco-spasm, angioneurotic edema and anaphylactic shock. Buprenorphine is mainly metabolized in liver by cytochrome P450 (CYP) 3A4 and less than 10% is excreted by the kidney. Studies showed that buprenorphine concentrates within mitochondria and it uncouples and inhibit mitochondrial respiration and also inhibits fatty acid beta-oxidation in higher serum levels causing liver toxicity. Although liver toxicity is a rare adverse effect of buprenorphine but with widespread use of this medication, it is strongly recommended that patients with risk factors like chronic viral hepatitis, concurrent use of alcohol or CYP3A/mitochondrial competitor drugs should undergo liver function test within the first week of treatment of Buprenorphine.

CANT DIAGNOSE HEPATIC FAILURE? BETTER HODG(KINS) YOUR BETS Ahmed Mohiuddin; Casey Dunn. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339245)

LEARNING OBJECTIVE 1: 1. Recognize the clinical signs and symptoms of Hodgkins lymphoma-related idiopathic cholestasis. 2. Understand the implications of cholestasis on prognosis of Hodgkins lymphoma 3. Identify treatment optionsCASE: A 19 year-old woman presented with two weeks of fever, nausea, bloody vomitus and worsening jaundice. She was not taking any medications and denied any recent drug or alcohol use. She has a history of anemia diagnosed at childbirth, but no other past medical history. She has a heart rate of 112 beats/min; the remaining vital signs were normal. Her cardiac and pulmonary examinations were normal. She had diffuse jaundice, including scleral and sublingual icterus. The abdominal examination was normal with no tenderness or hepatomegaly. She had a diffuse macular

rash extending from her abdomen to her lower back. Her total bilirubin was9.0, the direct bilirubin was 6.0, and her AST and ALT were 540 and 805; the alkaline phosphatase was 1375. Acetaminophen and salicylate levels were normal; her INR was 2.0. A viral hepatitis panel was normal. An ultrasound of her abdomen was revealed a contracted gallbladder, but no focal dilatation. An MRCP and EGD were without any abnormalities. A CT of the abdomen revealed multiple anterior mediastinal soft tissue masses, the largest one measuring 8 x 7 x 5 cm. A subsequent biopsy confirmed Hodgkins lymphoma of the nodular sclerosing subtype.

DISCUSSION: The general internist is commonly confronted with acute hepatic failure, often without a clear etiology on presentation. Hodgkins lymphoma-related idiopathic cholestasis is a rare but often lethal cause of hepatic failure that must be recognized quickly for appropriate treatment. Hodgkins lymphoma-related idiopathic cholestasis often presents as hepatic failure of unknown etiology. The patient is often jaundiced and has other signs of hepatic failure including nausea and vomiting. The diagnosis should be considered after the more

common etiologies of viral and toxic hepatic failure have been excluded. Importantly, the general internist should recognize that the cholestasis due to lymphoma-induced liver failure can be deadly. Although a third of patients with this syndrome survive with reversible hepatic injury, most will die due to fulminant liver failure or sepsis. Early recognition and treatment of the lymphoma with a hepatic sparing chemotherapy regimen is the most aggressive and effective treatment for this condition. It is imperative to identify early and treat Hodgkins lymphoma-related idiopathic cholestasis as this rare disease is often fatal but can be reversible with appropriate treatment.

CANT HEAR, CANT SEE, AND MY NOSE BLEEDS. NOT YOUR USUAL PRESENTATION OF MULTIPLE MYELOMA. Phyllis Kim; Jeffrey Miller. UCLA-Olive View Medical Center, Sylmar, CA. (Control ID #1339599)

LEARNING OBJECTIVE 1: Recognize hyperviscosity syndrome as a presentation of multiple myeloma.

CASE: A 56 year old male presents with 4 months of dizziness, fatigue, recurrent epistaxis, bilateral vision loss, and unilateral hearing loss. Initial workup revealed anemia (Hgb 7.9 g/dL), mild thrombocytopenia, coagulopathy, hypoalbuminemia, elevated total protein (10.8 g/dL), and a large M spike on SPEP (3.2 g/dL). Fundoscopic exam revealed bilateral central retinal vein occlusion with significant macular edema. The constellation of symptoms was concerning for hyperviscosity syndrome. The patient was immediately started on plasmapheresis and had a marked clinical and laboratory response. A serum viscosity level was later confirmed to be 24.1 cp (normal 1.4-1.8 cp). Despite nondiagnostic bone marrow biopsies, the patient had compelling evidence for a diagnosis of Multiple Myeloma (MM) by virtue of a monoclonal protein (IgG kappa monoclonal band), hyperviscosity syndrome, and myeloma related end organ damage (anemia, severe osteoporosis). A full body CT scan excluded extramedullary involvement or lymphoma. Peripheral blood smear revealed rouleaux formation. Based on both the Durie-Salmon and International Staging System, the patient has symptomatic Stage III IgG kappa Multiple Myeloma. Total protein levels were noted to rise while not receiving plasmapheresis and induction chemotherapy was begun.

DISCUSSION: Multiple Myeloma classically presents with the CRAB symptoms (hypercalcemia, renal insufficiency, anemia, bone lesions), however up to 20% of patients with MM present with a variety of other non-CRAB manifestations. These include hyperviscosity syndrome, neurologic disease, extramedullary plasmacytomas, hemorrhage/coagulopathy, generalized weakness, weight loss, and infection. This case demonstrates hyperviscosity as an uncommon presentation of myeloma. Hyperviscosity is more frequently associated with monoclonal hyper-gammaglobulinemia as seen in the plasma cell dyscrasias Waldenstrms macroglobulinemia and MM. However, the incidence of symptomatic hyperviscosity is significantly higher in Waldenstrms macroglobulinemia (10-30%) as compared to myeloma (2-6%). Symptoms usually develop with serum viscosity levels exceeding 4-5 cp. Clinical features include constitutional symptoms, bleeding, as well as ocular, neurologic, and cardiovascular disease. Bleeding occurs due to paraprotein coating of platelets and clotting factor, especially Factor X. Ocular symptoms include blurred
vision or diplopia. Uncommonly, central retinal vein occlusion and retinal detachment can occur. Impairment of the CNS microcirculation due to hyperviscosity results in headache, dizziness, impaired hearing, seizure, stroke, and coma. High output heart failure may develop as a result of expanded plasma volume. In symptomatically hyperviscous patients, immediate therapy with plasmapheresis is directed at reducing paraprotein levels. As viscosity is logarithmically related to protein levels, even a modest reduction in proteins results in dramatic symptom relief. Transfusions should be avoided in anemic patients until after plasmapheresis as this may aggravate hyperviscosity and trigger lethal complications. Long term management is aimed at treating the underlying disorder and reducing paraprotein disease burden.

CARDIAC TAMPONADE FROM CHYLOPERICARDIUM Syed Zaidi; Jose Cuellar-Silva; Christopher Pallas; Vincent Robinson; Deepak Kapoor. Georgia Health Sciences University, Augusta, GA. (Control ID #1315588)

LEARNING OBJECTIVE 1: Diagnose chylopericardium, a rare cause of pericardial effusion in patients with end stage renal disease. LEARNING OBJECTIVE 2: Recognize unsual complication of catheter induced thrombosis

of central veins.
CASE: 32 year old black female with end stage renal disease on hemodialysis presented to emergency department with dyspnea for 1 week. She had a left brachiocephalic vein thrombosis 5 months ago as a complication from tunneled catheter in left Internal Jugular vein and was treated with removal of catheter and mechanical thrombectomy. She has no history of trauma or cardiac surgery. She was afebrile, tachycardiac and hypotensive. She had elevated jugular venous distention, distant heart sounds and bibasilar crackles. An echocardiogram showed large pericardial effusion with tamponade physiology. She underwent pericardiocentesis and 500 ml of fluid was drained. Fluid analysis showed milky colored fluid, elevated triglycerides (2160 mg/dl), cholesterol (101 mg/dl), elevated lymphocytes (98% of white blood cells) with negative cultures. Lymphoscintigraphy didnt reveal lymphatic drainage into the pericardial space. She continued to drain fluid for 4 days through pericardial catheter. A repeat echocardiogram showed small pericardial effusion with no hemodynamic compromise. Unfortunately, patients pericardial drain came out and she insisted to leave without undergoing further evaluation. She was sent home on a low fat diet enriched with medium-chain triglycerides.
DISCUSSION: Chylopericardium is composed of chyle, the normal content of lacteals and thoracic duct Chylopericardium may be idiopathic or most commonly results from obstruction or injury to the thoracic duct. The diagnosis is confirmed by analysis of the pericardial fluid, which is milky and opaquea with a triglyceride level greater than 500 mg/dL, cholesterol/triglyceride ratio of less than 1, negative cultures and lymphocyte predominance. Catheter induced thrombosis was the probable cause of chylopericardium in this patient. The hypothesized mechanism of chylopericardium formation is obstruction of the thoracic duct ostium with presumed reflux of chyle back into the pericardium. Lymphoscintigraphy has poor sensitivity to show a macroscopic connection between the pericardium and thoracic duct. Substantial leakage of chyle causes serious nutritional, metabolic, and immunologic abnormalities. In addition, cardiac complications can occur including cardiac tamponade, acute pericarditis or chronic constriction. Chylopericardium without treatment is associated with a high mortality rate. Treatment varies with the etiology and includes adherence to low fat diet enriched with medium-chain triglycerides, ligation of thoracic duct and pericardiotomy or pericardiectomy. In cases of thrombosis-associated chylopericardium treatment is similar. Additional treatment includes removal of the indwelling catheter if present, anticoagulation, thrombolytics, mechanical thrombectomy as well as stent placement within a thrombosed vessel. Chylopericardium, although rare, should be included among the serious sequelae of catheter induced thrombosis of central veins.
CARDIOMYOPATHY: A RARE BUT SERIOUS COMPLICATION OF SCLERODERMA Damanpreet K. Grewal; Sara Taherkhani; Brent Hardman; Arpit Bhargava. Allegheny General Hospital, Pittsburgh, PA. (Control ID #1340056)

LEARNING OBJECTIVE 1: Importance of recognizing scleroderma as a multi-organ condition.
LEARNING OBJECTIVE 2: Early treatment of Cardiomyopathy due to scleroderma can reduce morbidity and mortality associated with this condition.
CASE: A 43 year-old Caucasian female with a 3-year history of untreated systemic sclerosis presented with 2 weeks of shortness of breath associated with chest heaviness, nausea and decreasing exercise tolerance. Upon further review, patient revealed multiple visits to local ER over the last 8 months for chest pressure and palpitations with elevated cardiac enzymes and BNP at each visit. An Echo and PET CT scan done 2 months after initiation of symptoms were normal. A prior cardiac catherization from late 2007 was also normal. These visits were attributed to anxiety and panic attacks. Initial work-up, including a CT Angiogram, was negative for a PE, but significant for pleural effusions, dilated esophagus, cardiomegaly, mediastinal adenopathy and

pericardial effusion. Again, the patient was noted to have elevated cardiac enzymes, with an echocardiography significant for an EF of 5-10%. A cardiac MRI revealed an LVEF of 8% and RVEF of 28% with a non-coronary distribution pattern and abnormal late-gadolinium enhancement, including prominent lateral and inferior epicardial enhancement, typical of a connective tissue inflammatory disorder. Rheumatology was consulted and patient was started on 1 g solumedrol daily for a total of 3 days. Subsequently, she underwent a cardiac catherization, significant for moderately elevated right atrial and pulmonary artery wedge pressures, and a normal cardiac output. A biopsy of the heart tissue was inconclusive and showed occasional hypertrophic myocytes. At this point, IV Cytoxan was initiated with significant improvement in patients symptoms. A repeat echocardiogram prior to discharge showed an EF of 15-20% and the patient was discharged with a life-vest.
DISCUSSION: Systemic sclerosis is a rare condition characterized by immune activation, vascular damage and buildup of collagen in the extracellular matrix. The peak onset occurs at 30-40 years of age with an annual incidence of 200 per 100,000. It affects women more than men, with a female-to-male ratio of 3-6:1. The condition typically involves the skin, but can frequently occur in other organs. Although rare, clinically significant cardiomyopathy associated with this condition is rare, but early diagnosis using frequent evaluation of cardiac enzymes, BNP and echocardiography can help with timely initiation of aggressive treatment and improved outcomes. This case demonstrates the need for close surveillance of patients with scleroderma given the possibility of internal organ involvement and significant morbidity and mortality benefits.
CATHECHOLAMINE CATASTROPHE Jodie Bryk; Peggy Hasley; Hollis Day. University of Pittsburgh, Pittsburgh, PA, PA. (Control ID #1317155)
LEARNING OBJECTIVE 1: 1. To list the "5 Ps" of pheochromocytoma2. To describe tests for pheochromocytoma in low and high risk patients 3. To summarize the pre-operative management of pheochromocytomas CASE: A 34 year old presented for establishment of primary care. At her initial appointment she complained of panic attacks for the past two years. During these episodes, she experienced palpitations, headaches, chest tightness, perspiration, and tremulousness. She had been previously treated with multiple benzodiazepines and anti-depressants for presumed anxiety and depression without relief of her symptoms. Her blood pressure was found to be elevated to 180/ 120 mmHg and her fasting blood glucose was 158 mg/dL. Her plasma free metanephrines were elevated to 2132mcg (NI<57). A 24-h urinary fractionated metanephrines and catecholamines were significantly elevated. MRI of the abdomen and pelvis showed a 5.7x5.3x5.7 cm spherical well-circumscribed left adrenal mass. MIBG scan showed no additional extra-adrenal involvement. She underwent laparoscopic removal of the left adrenal gland mass after pre-operative management with phenoxybenzamine and then propranolol. Pathology showed an encapsulated pheochromocytoma. Post-resection, her plasma free metanephrines decreased to 25mcg. Her mood significantly improved and she was able to discontinue all psychiatric medications. She underwent complete sequencing of the Von Hippel Lindau, RET, neurofibromatosis 1, and familial paraganglioma genes whereupon an inherited predisposition to pheochromocytoma was ruled out.
DISCUSSION: Pheochromocytomas present clinically with the five Ps of pressure, pain, palpitations, perspiration, and pallor. If a patient is suspected to be high risk of having a pheochromocytoma, plasma free metanephrines is the test of choice given its 99% sensitivity. However, if a patient is suspected to be at low risk for pheochromocytoma, 24-h urinary fractionated metanephrines and catecholamines is the preferred test given its higher specificity. It is important to note that acute illness, tricyclic antidepressants, and labetalol may interfere and cause false positives for both tests. Treatment of pheochromocytoma involves first alpha blockade with phenoxybenzamine followed by beta-blockade with propranolol immediately prior to laparoscopic removal. Plasma free metanephrines and chromogranin A levels are monitored post-operatively. All patients with diagnosed pheochromocytoma should be referred for genetic counseling for an extensive evaluation for hereditary causes of pheochromocytoma including MEN syndromes, von Hippel-Lindau, neurofibromatosis, and succinate dehydrogenase abnormalities.

CAUGHT IN THE ACT: THROMBUS IN TRANSIT WITH PARADOXICAL EMBOLISM Rajan Garg; Daniel Goldsmith; Bipinpreet Nagra. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1336951)
LEARNING OBJECTIVE 1: Significance of early diagnostic intervention using Echocardiogram in patients presenting with symptoms of Stroke LEARNING OBJECTIVE 2: Treatment modalities for Paradoxical EmbolismCASE: A 72 year old male with recent hospitalization for TIA presented with left hemiparesis. Workup revealed an acute large right MCA stroke with small hemorrhagic transformation in the right frontal lobe. A right lower extremity DVT was also found. Transthoracic echocardiogram (TTE) revealed long mobile thrombi in both left and right atria extending into both ventricles. TEE done subsequently the same day revealed no thrombus in the ventricles, but emboli were seen in the pulmonary artery and multiple large mobile emboli in the descending aorta along with a large PFO. The patient could not be treated with tPA secondary to the hemorrhagic conversion of stroke. Subsequent CT scan of chest revealed bilateral pulmonary emboli for which an IVC filter was placed. The patient also developed acute left leg ischemia from aortic emboli and underwent urgent thrombus retrieval. Because of multiple comorbidities and hemodynamic instability, the patients family chose comfort measures and the patient expired on hospital day three.
DISCUSSION: Diagnosis of a paradoxical embolus usually is inferred from the presence of DVT, embolic phenomena and a PFO. The capture of a thrombus in transit by echocardiogram demonstrating movement of the thrombi from venous to arterial circulation confirms that our inferred pathophysiology is likely correct. Given the high mortality associated with paradoxical embolism, urgent anticoagulation, thrombolysis and/or embolectomy is required, if no contraindications.
CAUSES AND DANGERS OF NON-HEPATIC ACUTE HYPER-AMMONEMIA Brita Roy. University of Alabama at Birmingham, Birmingham, AL. (Control ID #1339767)
LEARNING OBJECTIVE 1: Recognize that acutely elevated serum ammonia levels can cause cerebral herniation and understand how to prevent/treat.
LEARNING OBJECTIVE 2: Emphasize non-hepatic causes of hyper-ammoniemia, and that some inborn errors of metabolism may present in adulthood.
CASE: A 41-year-old white woman with a history of bipolar disorder presented initially to an outside hospital with nausea, vomiting diarrhea and encephalopathy for 3 days following exposure to a sick contact. She then became progressively somnolent and was intubated on day 2 for airway protection and vasopressors were initiated for hypotension. Her husband denied a history of ingestions, suicidal ideation or alcohol abuse. Her family history was positive only for coronary disease and diabetes mellitus. She was transferred to our hospital on day 3, and at that time vital signs were temperature 100 F, heart rate 114, respiratory rate 37, blood

pressure 124/63 (on vasopressors), and oxygen saturation 98% on 40% FiO2. Examination revealed crackles in the right middle lung field; abdomen was benign without organomegaly; neurologic exam revealed positive corneal reflex, 3+ reflexes throughout, downgoing toes. Laboratory evaluation was significant for a serum pH 7.29, pCO2 22, pO2 208, pHCO3 10.6, anion gap 26, lactic acid 3.1, creatinine1.7, white blood cell count 6.18 with 92% neutrophils, ALT 75, AST 255, alkaline phosphatase 49, creatine kinase 9805, amylase 733, lipase 15, and ammonia of 547. Chest roentenogram revealed a right middle lobe infiltrate and broad spectrum antibiotics were initiated for septic shock. Due to the severity of hyperammonemia, dextrose infusion, lactulose, rifaximin, sodium benzoate-sodium phenylacetate and arginine were administered to prevent intracranial hypertension. Urine and plasma amino acid levels were examined for evidence of an inborn error of metabolism which were consistent with isovaleric acidemia.
DISCUSSION: Independent of the cause, acute elevation of serum ammonia (NH4) levels above 200 mol/L can precipitate intracranial hypertension and cerebral herniation. Thus, agents to peripherally convert ammonia such as sodium benzoate-sodium phenylacetate should be rapidly administered in addition to lactulose and rifaximin to reduce serum ammonia levels quickly. If these measures are ineffective, hemodialysis may be initiated.

Additionally, administration of mannitol and/or hypothermia may be considered to reduce intracranial pressure. Administration of intravenous dextrose to prevent muscle breakdown and subsequent elevation of NH4 is also important. Of note, unlike acute hyperammonemia, chronic elevation of NH4 has much lower risk of cerebral edema. If hyperammonemia is thought not to be due to acute hepatic failure, workup for alternate causes should be initiated. Non-hepatic causes of elevated NH4 include infection with herpes or urease-producing bacteria, muscle breakdown, starvation, gastrointestinal hemorrhage, and malignancies like multiple myeloma. Additionally, drugs such as HMG CoA reductase inhibitors, non-steroidal anti-inflammatory agents, antibiotics, antifungals, antiretrovirals, antiepiliptics, antidepressants and total parenteral nutrition can cause hyperammonemia. Finally, inborn errors of metabolism such as urea cyle disorders, organic academias (ie, isovaleric acidema diagnosed in our patient) and fatty acid oxidation defects may present with hyperammonemia in adults during times of metabolic stress.

CEREBRAL IMMUNE RECONSTITUTION INFLAMATORY SYNDROME SECONDARY TO NEUROSYPHILIS

Zouyan Lu1; JaneN. Wainaina2. 1Medical College of Wisconsin, Milwaukee, WI; 2Medical College of Wisconsin, Milwaukee, WI. (Control ID #1304683)

LEARNING OBJECTIVE 1: Describe the clinical presentation of immune reconstitution inflammatory syndromeLEARNING OBJECTIVE 2: Review risk factors and treatment for development of immune reconstitution inflammatory syndromeCASE: A 45 year-old gentleman with history of HIV presented with acute onset aphasia approximately 1 year after self-discontinuing his HAART. CT of the head showed acute ischemic stroke and potential vasculitis. Cerebrospinal fluid (CSF) analysis was consistent with meningitis, and serum free treponemal antibody was reactive. He was treated for meningovascular syphilis with 2 weeks of intravenous penicillin and restarted on his previous HAART of efavirenz and lamivudine/zidovudine. One day after completing treatment he returned with complaints of fever, neck pain and acute onset headache. CT scan showed intraventricular hemorrhage, new right parietal infarcts and findings consistent with vasculitis. He was started on empiric treatment with IV vancomycin, ceftriaxone, and acyclovir. Within 24 hours of admission, he had acute neurological decline, repeat imaging showed new infarcts. CSF was significant for elevated red blood cell count, low glucose and neutrophilic pleocytosis. Gram stain and culture were negative. CSF cryptococcal antigen, HSV PCR, and VDRL were also negative. His HIV viral load, when compared to values obtained 3 weeks prior, showed a 3 log decrease and his CD4 increased from 30 to 52. Brain MRI showing more new infarcts and leptominingeal enhancement. Given his rapid decline in viral load as well as signs of continued vasculitis, there was concern for immune
reconstitution inflammatory syndrome (IRIS). Empiric antibiotics were stopped and high-dose steroids were started with initial response. But the patient later developed step-wise decline in neurologic status when steroids were tapered down. The patient eventually became minimally responsive with extensor posturing. After discussion with his family, he was transferred to home hospice.

DISCUSSION: IRIS often presents with a paradoxical decline in a patients clinical condition after initiation of HAART. IRIS is though to be the result of a pathologic response of the hosts reconstituted immune system to antigens of opportunistic pathogens, including mycobacterial, fungal and viral infections. Some investigators have reported an incidence as high as 23% in patients starting HAART. The risk for developing IRIS appears to increase with the burden of opportunistic infections. IRIS should be suspected when patients present with unusual symptoms or disease course with a temporal relation to immunological recovery following initiation of HAART. It is most commonly described in association with mycobacterial, fungal, and viral infections. While, any organ system can be involved, reports of CNS IRIS are less common. There are no published trials for the treatment of IRIS, but case studies suggest appropriate treatment of the underlying opportunistic infection with or without the addition of corticosteroids.

CERVICAL LYMPHADENOPATHY IN A YOUNG, HEALTHY FEMALE: AN UNCOMMON DIAGNOSIS

Amy Iwamaye; Stephen Gluckman. University of Pennsylvania, Philadelphia, PA. (Control ID #1339505)

LEARNING OBJECTIVE 1: Recognize and diagnose other benign causes of persistent lymphadenopathyCASE: A 29 year old female, with no significant past medical history, presented to her primary care physician complaining of 4 weeks of left-sided, non-tender, posterior cervical lymphadenopathy. She denied any fevers, chills, or preceding illness. She had ten pounds of intentional weight loss. On physical exam, she had multiple, enlarged lymph nodes, which were firm, rubbery, and mobile along the L posterior cervical chain. She had no other adenopathy. The remainder of her exam was within normal limits. Her laboratory tests including CBC and BMP were unremarkable. A fine-needle aspiration was performed and flow cytometry was negative for a clonal population. An excisional biopsy was performed which showed histiocytic necrosis with numerous foamy macrophages and occasional crescentic nuclei, consistent with necrotizing lymphadenitis. No Reed Sternberg cells were found. T-cell rearrangement studies excluded a T-cell lymphoma. Ultimately, the patient was given a diagnosis of Kikuchis Disease. Her symptoms resolved within 1 month of her diagnosis without treatment. DISCUSSION: Kikuchi's Disease is an uncommon, benign cause of cervical lymphadenopathy. It was first described in Japan and is often associated with young Asian women, but has been described in both sexes, with a slight female predominance, and has been found in various racial and ethnic groups. The etiology is unknown. There is histologic suggestion for infectious etiology, including HHV-6, EBV, and parainfluenza, although studies have failed to confirm this. Clinical symptoms usually include persistent cervical lymphadenopathy, but can be systemic, as well as fever. Most common lab abnormalities include leukopenia, anemia, and elevated ESR. The condition is generally self-limited and benign, and symptoms usually resolve in 1-4 months. Steroids have been used for treatment in symptomatic cases. It should be noted that pathologically this condition can be misdiagnosed for SLE and malignant lymphoma, leading to unnecessary treatment including, in some cases, chemotherapy. This case report serves to illustrate that Kikuchis disease, an uncommon benign condition, should be included in the differential diagnosis of unexplained persistent localized lymphadenopathy.

CHEST PAIN IN A 21-YEAR OLD WITH SLE - WHEN TRADITIONAL MODELS BREAK DOWN Satish Misra; Grant Chow; Steven Schulman. Johns Hopkins, Baltimore, MD. (Control ID #1311095)

LEARNING OBJECTIVE 1: Recognize SLE as an independent risk factor of coronary artery disease and acute coronary syndrome.

LEARNING OBJECTIVE 2: Management of coronary artery disease in SLE patients.

CASE: A 21-year-old female with a history of systemic lupus erythematosus (SLE), treatment for which was self-discontinued three years prior, presented to the emergency room with 12 hours of pleuritic, sharp, left sided chest pain that worsened with laying supine. When an electrocardiogram revealed mild ST-elevations in the inferior leads and PR depression in the inferior and lateral leads, she was initially diagnosed with pericarditis. However, her pain worsened and a bedside echo revealed mild inferior and inferolateral wall hypokinesis. Coronary angiography revealed a 100% left circumflex artery occlusion, with diffuse disease noted in the left anterior descending and right coronary arteries. She underwent percutaneous coronary intervention (PCI) with thrombectomy and placement of two sequential drug-eluting stents in the left circumflex artery. She was subsequently treated with aspirin 325 mg, clopidogrel, and a low-dose beta blocker. An ACE-inhibitor could not be started due to low blood pressure, and statin therapy was discontinued due to rising liver function tests (LFT). Further evaluation revealed antiphospholipid syndrome, for which she was started on warfarin. Due to advanced atherosclerosis and newly diagnosed lupus nephritis, she was started on high-dose steroids, hydroxychloroquine, and mycophenolate mofetil. As an outpatient, she was initiated on atorvastatin that was rapidly uptitrated to maximum dose with frequent LFT monitoring. She was additionally started on lisinopril 2.5 mg that has been slowly increased. Finally, she has received frequent dietary counseling and was initiated in a

cardiac rehabilitation program.
DISCUSSION: There is a well-documented association between SLE and accelerated atherosclerosis, with the relative risk for patients with SLE to have nonfatal myocardial infarction or coronary artery disease-related death estimated to be 10-fold and 17-fold greater than what would be predicted by traditional risk factors. The etiology is thought to be related to the pro-inflammatory state of SLE, with proposed mechanisms including generation of pro-inflammatory high density lipoprotein (HDL) molecules and generation of LDL-containing antibody complexes. Recognition of SLE as an independent risk factor for coronary artery disease is critical for diagnosis of acute coronary syndrome (ACS) in patients who would otherwise be deemed low-risk based on traditional scoring methods. Regarding management, aggressive risk factor modification per standard guidelines for coronary artery disease is critical. It is also imperative that any associated SLE complications, such as anti-phospholipid antibody syndrome (APS) or lupus nephritis, be aggressively treated due to further increased risk of coronary and vascular disease. There may be a cardioprotective effect of hydroxychloroquine in SLE patients, with conflicting data on steroids and azathioprine. In summary, this case of an atypical presentation of ACS in a young woman with SLE highlights a critical risk factor for patients who would otherwise be considered low-risk. Patients with SLE who present with chest pain should be managed with a high index of suspicion for cardiovascular disease.
CHEST PAIN WITH ST SEGMENT ELEVATION-BRUGADA SYNDROME-AN IMPORTANT NON-ISCHEMIC CAUSE IN WOMEN Manju Bengaluru Jayanna; Syed M. Mohiuddin; Janardhana Gorthi. Creighton University Medical Center, Omaha, NE. (Control ID #1340523)
LEARNING OBJECTIVE 1: Recognize Brugada Syndrome as a differential in diagnosis of Chest pain with ST elevation.
LEARNING OBJECTIVE 2: Recognize Hypokalemia unmasks asymptomatic Brugada Syndrome.
CASE: 55 year Old Caucasian female with hypertension, hypothyroidism, recent laparoscopic cholecystectomy and pyelonephritis presented with two day symptoms of progressive exertional dyspnea, retrosternal chest pain radiating to her shoulder blades, subjective fever and fatigue .Examination was unremarkable except for a temperature of 99.3 F and few bilateral scattered wheezes. Lab data showed leukocytosis of 13,000; elevated D dimer of 4.98, hypokalemia of 2.7 and normal serum troponin. Urinalysis showed infection. EKG revealed new coved type ST segment elevation with T wave inversion in leads V1-V3 compared to her previous EKG. Echocardiogram was unremarkable with normal LV systolic function and no regional wall motion abnormalities.Emergent CT scan of chest was found
to be normal.She was treated with IV potassium chloride and antibiotics for Urinary tract infection. Serial EKGs revealed complete resolution of ST segment elevation of the over the next 12 hours and her symptoms of chest pain resolved over the next 24 hours.CT abdomen revealed malposition of previously placed left double J stent and left renal stone and was treated surgically Since she had asymptomatic Brugada syndrome with no symptoms of syncope, no documented ventricular fibrillation, ventricular tachycardia and no family history of sudden cardiac death she managed with close follow up.
DISCUSSION: The patients EKG changes were consistent with Brugada syndrome(BS) Type 1. This syndrome typically occurs in male patients in their twenties or thirties, and is characterized by distinct ECG changes in the right precordial leads (V1-V3) and susceptibility to ventricular fibrillation in the absence of structural heart disease. The Brugada pattern is much more common in men than in women, being as much as nine times higher in one analysis.BS is usually diagnosed in adulthood. The average patient at diagnosis is 41 years. Its much more common in Asian populations and prevalence in United states vary anywhere between 0.4 and 0.012 percent.EKG changes in BS are transient. Various provoking factors include pacing, vagal maneuvers, increased alpha-adrenergic drive, beta blockers, tricyclic antidepressants, lithium, local anesthetics, fever, hypokalemia, hyperkalemia, hypercalcemia, and alcohol and cocaine toxicity. Characteristic ECG abnormalities may be exposed by a sodium channel blocker, such as flecainide, thereby identifying those at risk. Possible

provoking factor in our patient was severe hypokalemia. She had additional factors, including mild fever and increased sympathetic drive secondary to her proinflammatory state. The exact mechanisms by which Brugada pattern is uncovered by all the various provoking factors is yet be determined. There have been reports of Chest pain and ST elevation associated with fever in patients with asymptomatic BS.In conclusion its important to consider BS in a patient who presents with chest pain and characteristic EKG pattern and avoid unnecessary invasive interventions, but rather treat underlying provoking factors emergently because ST elevation in BS may be a harbinger of malignant cardiac rhythms including ventricular fibrillation and sudden cardiac death.

CHOLESTASIS NOT DUE TO STASIS Stephanie Haimowitz1; Yelena Averbukh2,1; Jennifer Hsieh2. 1Albert Einstein College of Medicine, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1311805)

LEARNING OBJECTIVE 1: To consider Hydroxycut use as an inciting factor for hepatic failure.

LEARNING OBJECTIVE 2: To recognize a clinical syndrome consistent with Porphyria syndromes in the adult population as a cause for cholestatic liver failure.

CASE: A 23 year-old man with no significant past medical history except a few months of upper extremity photosensitive rash presented with nausea, vomiting and abdominal pain for four days. Remaining review of systems was negative, but the patient did admit to using the OTC weight loss remedy, Hydroxycut, for the past few months. Physical exam was significant for a toxic appearing man with temperature of 102 F, heart rate of 125, marked jaundice, and right upper quadrant abdominal tenderness. Notable labs included WBC 40.3, total bilirubin of 24.4 mg/dL, conjugated bilirubin of 17.5 mg/dL, alkaline phosphatase of 91, AST 194, ALT 92 and INR 2. Abdominal ultrasound showed no cholelithiasis or biliary duct dilatation. CT scan of the abdomen and pelvis was unremarkable. Extensive infectious disease work up, including bacterial, mycobacterial, viral, and parasitic etiologies, was non-diagnostic. Persistent leukocytosis and fevers led to work-ups for hematologic malignancies which were also non-diagnostic. Because the patient continued to deteriorate despite supportive care and discontinuation of Hydroxycut, other etiologies of liver failure were explored. Given his history of a photosensitive rash along with his cholestatic liver failure, it was hypothesized that he may have porphyria. Measurement of plasma porphyrin showed a total porphyrin level of 100.2 mcg/L, (20 times the upper limit of normal), and a coproporphyrin level of 93.6 mcg/L (normal <0.9 mcg/L). Genetic testing identified a mutation in the cpox gene, which is suggestive of hereditary

coproporphyria. Thus, the patient was diagnosed with porphyria, treatment with hemin was started, and the patient improved.

DISCUSSION: Garcinia, a component of Hydroxycut, has been associated with hepatotoxicity in 23 case reports, perhaps due to increased oxidative stress. Upon cessation of the drug, liver function is expected to improve within 7 weeks, normalizing by week 14. However, because our patient did not improve as expected, we considered rarer etiologies as the cause of his liver failure. Porphyrias are a heterogenous group of metabolic syndromes that result from abnormal enzymatic activity in the heme biosynthetic pathway. In hepatic porphyrias like hereditary coproporphyria, neurovisceral symptoms, such as abdominal pain, motor neuropathy, hyponatremia, seizures and cutaneous manifestations such as photosensitivity, result from abnormal heme synthesis which is needed for the production of hepatic CYP enzymes. In these patients, an oxidative insult to the liver from the use of hepatotoxic medications like Hydroxycut, can rapidly induce acute porphyria symptoms despite discontinuation of the precipitating agent. However, an acute attack is reversible if treated promptly with intravenous hemin. Work-up includes testing urine, serum, or feces for elevated porphyrins. Definitive diagnosis is made via genetic testing and mutation analysis for specific abnormalities. Cholestatic liver failure is commonly seen by primary care physicians. Once common etiologies are ruled out, rarer causes should be pursued. While porphyrias account for less than 1% of all patients presenting with cholestatic liver failure, a timely diagnosis and treatment can be lifesaving.

CLINICAL CLUES TO RECOGNIZE A RARE CAUSE OF ACUTE PANCREATITIS Mansumeet Singh.

Creighton University, Omaha, NE. (Control ID #1311960)
LEARNING OBJECTIVE 1: Recognize clinical clues to diagnose Intraductal Papillary Mucinous Neoplasm (IPMN), a rare cause of Acute Pancreatitis (AP).
CASE: A 78 year old Caucasian male with history of Ischemic Cardiomyopathy and Diabetes was admitted with chest pain and dyspeptic symptoms. Initial work up for cardiac causes of chest pain was negative. Further investigations revealed elevated levels of Amylase (193 U/L) and Lipase (698 U/L), and normal liver function tests. A Computerized Tomography scan of the abdomen revealed an atrophic appearing pancreas and a dilated pancreatic duct. No history of alcohol use was elicited and the patient had undergone a cholecystectomy 20 years prior to presentation. There was no history of recent change of medications, or use of over the counter products, or herbal agents. Endoscopic ultrasonographic (EUS) exam of the pancreas was later undertaken as the etiology of pancreatitis was not clear. Findings of EUS and fine needle aspiration (EUS-FNA) were consistent with a diagnosis of main duct IPMN of the pancreas. The patient was referred for a surgical consultation; however he passed away within a few weeks due to cardiac related mortality.
DISCUSSION: 1) Main duct IPMN should be recognized as a rare etiology of AP once the common causes of acute pancreatitis have been ruled out. 2) Clinical clues for IPMN as the etiology of AP include initial presentation of AP in the elderly, history of diabetes, and presence of pancreatic duct dilation on transabdominal imaging studies. 3) EUS is a relatively noninvasive modality for the evaluation of AP with an unclear etiology.
CLOSTRIDIUM PERFRINGENS BACTEREMIA IN A PATIENT WITH PROSTHETIC AORTIC VALVE: ENDOCARDITIS OR COLON CANCER - THAT IS THE QUESTION? Amaninderapal S. Ghotra1; Tanmay S. Panchabhai1; Raul Nakamatsu2. 1University of Louisville, Louisville, KY; 2University of Louisville, Louisville, KY. (Control ID #1339824)
LEARNING OBJECTIVE 1: Discuss the differential diagnosis of gram positive bacilli in blood.
LEARNING OBJECTIVE 2: Review the association of colon cancer with bacteremia caused by bacteria from genus Clostridium.
CASE: A 66 year old male presented with symptoms of nausea, vomiting and fever since 3-4 days. The emesis was non-projectile, non-bloody and
was associated with diarrhea with constipation, on and off for the past one month. The patients past medical history was significant for a prosthetic aortic valve (for aortic stenosis), uncontrolled diabetes, chronic kidney disease and a negative screening colonoscopy one year prior to admission. The patient was febrile (101.7F) and physical examination revealed a 4/6 ejection systolic murmur best heard in the aortic area, a distended abdomen with intact bowel sounds and negative rectal examination. An abdominal radiograph revealed partial abdominal obstruction. Initial laboratory data was unrevealing except left shift (85% neutrophils). Nasogastric suction with bowel rest was initiated and blood cultures were drawn in view of the new onset fever and prosthetic aortic valve. Preliminary gram stain revealed gram positive bacilli. With a working diagnosis of infective endocarditis with accompanying bowel obstruction, possible organisms being considered were Clostridium, Bacillus, Corynebacterium, Listeria, Rhodococcus and Nocardia. Intravenous Ampicilin-Sulbactam was initiated and a CT scan of the Abdomen/pelvis with oral contrast revealed a 10 cm circumferential rectal thickening surrounded by induration and stranding. Four blood cultures grew Clostridium perfringens and antibiotics were changed to high dose penicillin with clindamycin (for decreasing toxin production). A Transesophageal echocardiogram (TEE) did not reveal vegetations or abscess formation suggestive of endocarditis. In view of the negative colonoscopy done a year ago, infective and inflammatory colitis causing persistent bacteremia was higher on our differential. The patient was continued on antibiotics and had two negative blood cultures. A flexible sigmoidoscopy showed no grossly ulcerative/obstructive lesions, however, multiple cold forceps biopsies from the area of thickening seen on CT scan were positive for adenocarcinoma of the rectum. Bacteremia resolved with high dose penicillin which was continued for 14 days and the colon cancer

was staged at IIIB. Being a poor operative candidate, platinum based chemotherapy was initiated.
DISCUSSION: Our case clearly defines the need for high suspicion in patients with gram positive bacilli causing persistent bacteremia as very few organisms like Clostridium, Bacillus, Corynebacterium, Listeria, Rhodococcus and Nocardia fall in to this category. Our patient presented with persistent bacteremia from Clostridium perfringens with a prosthetic aortic valve and rectal thickening increasing the diagnostic challenge as one case of clostridial endocarditis has been previously reported in literature. With Clostridium bacteremia, a detailed physical examination to look for any obvious source where the anaerobic organism can grow, especially feet, oro-genital areas and any infected wounds is warranted to formulate the initial approach for management. Genus Clostridium, especially the septicum species have been associated with colon cancer, the mechanisms being tumor necrosis, ulceration and bacterial translocation. Other clostridium species however have been implicated as well which needs to be kept in mind.
CLUBBING IN THE DIGITAL ERA Lynn Sauers; Thomas Jaeger. Mayo School of Graduate Medical Education, Rochester, MN. (Control ID #1296845)
LEARNING OBJECTIVE 1: Recognize the clinical manifestations of hypertrophic osteoarthropathyLEARNING OBJECTIVE 2: Identify underlying disease states associated with hypertrophic osteoarthropathyCASE: A 59 year-old male with no significant past medical history presented to the outpatient clinic for evaluation of bilateral knee pain of four months duration. He had been evaluated by an orthopedist at another institution, and suspicion was for degenerative joint disease, though MRI revealed relatively mild degenerative changes. The patient noted no significant benefit from multiple intra-articular steroid injections during that time. He reported that his pain was now interfering with his ability to work, which required him to stand on a hard surface for up to ten hours at a time. Social inquiry was significant for a 40 pack-year smoking history as well as history of alcoholism, now sober for over 10 years. On physical examination, mild tenderness over the medial joint space and patella was noted bilaterally, but knee exam was otherwise unremarkable. Digital clubbing was noted, however, prompting chest imaging in addition to knee.

Knee X-ray demonstrated diffuse cortical thickening of the femoral, tibial, and fibular shafts, consistent with hypertrophic osteoarthropathy. Chest X-ray revealed a 7 cm lobulated right apical lung mass. The patient ultimately proceeded to a right upper lobectomy. Pathology revealed stage IIIB adenocarcinoma (grade 3 of 4), with invasion of the visceral pleura and chest wall. On follow-up one month after surgery, he noted complete resolution of his knee pain.
DISCUSSION: Hypertrophic osteoarthropathy (HOA) is characterized by digital clubbing and periostosis of tubular bones. It is most often secondary to processes involving a possible arteriovenous shunt, including non-small cell lung cancer, cyanotic congenital heart disease, and cystic fibrosis. It has been estimated to occur in up to 30% of non-small cell lung cancers, most commonly adenocarcinoma and squamous cell types. The finding has been described for over a century, but pathophysiology remains poorly understood. Recent hypotheses have suggested possible mechanisms involving vascular endothelial growth factor, platelet-derived growth factor, or prostaglandin E2. The finding of digital clubbing should prompt investigation into intrathoracic pathology. Bone scan is the best modality for identifying affected bones. The pain of HOA can be severe and is frequently refractory to typical analgesics, but treatment of the primary cause frequently leads to regression of signs and symptoms.
COCCIDIOIDES ENDOPHTHALMITIS IN AN IMMUNOCOMPETENT HOST. Michael Cheng; Edward Ha. University of California, Los Angeles, Los Angeles, CA. (Control ID #1334560)
LEARNING OBJECTIVE 1: Recognize endophthalmitis as an unusual presentation of Coccidioides infection.
LEARNING OBJECTIVE 2: Manage medical workup and treatment of fungal endophthalmitis.

CASE: A 55 year-old white male from Santa Clarita, CA developed a severe pneumonia four months prior to admission. With his symptoms almost resolved, he reported scratching his left eye with his eyeglasses, and thereafter developed increasing injection and pain with progressive loss of vision from 20/10 without correction to hand motion only. The patient underwent vitrectomy with intravitreal injection of empiric vancomycin, ceftazidime, voriconazole, and dexamethasone. Aqueous fluid culture returned positive for mold. He was admitted for systemic anti-fungal therapy. The patient had no significant past medical history or risk factors for HIV. Social history was notable for avid mountain biking in the Central Valley, and prior handling of birds as a falconer. Physical exam was notable for left visual acuity limited to hand motion only, limited extra-ocular movement, conjunctival injection, and intravitreal fluff balls. WBC was elevated at 15,700. HIV testing was negative. CTchest demonstrated micro-nodules in the right upper lobe suspicious for prior pulmonary coccidioidal infection. The patient began IV voriconazole at 4 mg/kg IV Q12H. Aqueous fluid cultures grew Coccidioides, and serum IgG coccidioidal antibody was elevated. CT brain, lumbar puncture, and bone scan were normal. The patient was discharged on oral voriconazole 350 mg twice daily. He was transitioned to oral fluconazole 800 mg daily one month later. The patient subsequently underwent 13 subsequent intravitreal injections of amphotericin and voriconazole, as well as two vitrectomies. As of eight months following discharge, the patients best-corrected visual acuity was 20/25.

DISCUSSION: Coccidioidomycosis is endemic in the southwest United States. Symptoms vary, from subclinical infection to acute pneumonia to disseminated disease. Disseminated disease occurs more commonly in immunosuppressed individuals, typically involving the skin, meninges and bone. Intraocular coccidiomycosis is being recognized with greater frequency, but remains very rare [1]. A high index of suspicion should be retained in endemic regions, as early diagnosis and treatment may mitigate visual loss and extension of disease. Evaluation for other foci of disease should include careful history and physical examination, bone scan, CT chest, imaging of the brain, and lumbar puncture. Evaluation for immunosuppression, including HIV status, should be pursued. Diagnosis of fungal endophthalmitis can be difficult, and empiric therapy often must be started before the etiologic agent is known. While fluconazole has good CNS and ocular penetration, it has a limited spectrum and lacks activity against many of the common etiologic agents of fungal endophthalmitis, notably Aspergillus, Fusarium, and Paecilomyces. Voriconazole is a second-generation derivative of fluconazole with an expanded spectrum[2]. Future research may be directed to evaluate whether voriconazole or fluconazole is superior after Coccidioides has been identified, when broad coverage can safely be narrowed, and optimal treatment duration.

1. Cutler JE, et al. Metastatic coccidioidal endophthalmitis. Arch Ophthalmol 1978;96:689-91. 2. Marangon FB, et al. In vitro investigation of voriconazole susceptibility for keratitis and endophthalmitis fungal pathogens. Am J Ophthalmol 2004; 137:820-825.

COINFECTION OF CLOSTRIDIUM BUTYRICUM AND CLOSTRIDIUM DIFFICILE IN AN ADULT PATIENT

Jennifer Hsieh; Sharon Leung. Montefiore Medical Center, Bronx, NY. (Control ID #1339943)

LEARNING OBJECTIVE 1: Recognize that Clostridium butyricum is an uncommon cause of bacteremia.

LEARNING OBJECTIVE 2: Review the risk factors, prevalence, and management of C. butyricum bacteremia.

CASE: A 63 year-old woman with a history of peripheral vascular disease with a left below the knee amputation and a recent right above the knee amputation (AKA) presented from nursing home with altered mental status and lethargy for one day. Upon arrival, BP was 108/54, pulse 132, respiration rate 42, temperature 100.4 F and oxygen saturation 88% on room air. The patient was unresponsive and breathing was shallow. Physical exam was notable for diffuse abdominal tenderness, right AKA stump with foul smelling pus, and multiple stage IV sacral and right gluteal decubitus ulcers along with copious amounts of loose stool. Pertinent labs included WBC 25, Na 150, K 5.5, HCO3 12, BUN 122, Cr 2.9, pH 7.20, lactate 8.4 and an anion gap of 24. CT imaging revealed left lower lobe pneumonia, bowel thickening in sigmoid colon and rectum as well as soft tissue emphysema in the left ischiorectal fossa extending into the perineum, but no soft tissue emphysema along the fascial planes of the muscle to suggest necrotizing fasciitis. The patient was resuscitated with 6 liters of fluid

and empirical antibiotic coverage with intravenous vancomycin, piperacillin/tazobactam, clindamycin and metronidazole was initiated. The blood culture grew Clostridium butyricum, the respiratory culture grew multidrug resistant Klebsiella pneumoniae, and the wound culture grew Pseudomonas aeruginosa. Clostridium difficile toxin was also positive. The patient received extensive debridement of necrotic tissue from the sacral and gluteal region, and her antibiotic regimen was changed to imipenem/cilastatin and PO vancomycin in order to cover the multidrug resistant Klebsiella and C. difficile infection, respectively. She subsequently improved.
DISCUSSION: C. butyricum has been cultured from the stool of healthy children and adults, and is commonly found in soured milk and cheeses. It is an anaerobic endospore-forming Gram-positive rod that is uncommonly reported as a human pathogen. To date, it has only been reported as a causative pathogen in an adult with history of intravenous drug use, and in pediatric patients with underlying gastrointestinal infections, or abdominal, rectal, and oropharyngeal abscesses. Similarly, in adults, Clostridia infections often arise from a gastrointestinal source. Risk factors include patients who are elderly, have underlying conditions such as diabetes, or malignancy who are receiving chemotherapy and/or radiation therapy. Other extremely uncommon clostridium species, such as C. novyi, have also been reported to cause extensive and progressive wound infections, resulting in septic shock. In general, Clostridia are generally susceptible to antibiotics used in the treatment of anaerobic infections. Studies have shown that the susceptibility of C. butyricum isolated from intra-abdominal infections has a reasonable minimum inhibitory concentration (MIC) with metronidazole (MIC of 90% isolates was2). Because Clostridium infections are associated with high mortality, a high index of suspicion, early administration of antibiotics and aggressive surgical debridement of the affected tissue is crucial to better ensure a successful outcome. To our knowledge, this is first reported coinfection with two Clostridium species in an adult, causing extensive C. difficile colitis and widespread cellulitis from C. butyricum.
COMMON THINGS BEING COMMON Marissa Shams; Domnica Fotino. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311733)

LEARNING OBJECTIVE 1: 1. Recognize the clinical presentation of primary headache in HIV/AIDS population. 2. Identify the treatment of headache in patients with HIV. 3. Utilize cost-efficient diagnostic strategies in the diagnosis of headacheCASE: A 27 year-old woman presented with three-weeks of a progressive frontal headache. The headache was associated with dizziness and blurry vision. She had taken no medications for the headache, and could not recall any inciting event. She had a history of HIV with a CD4 count of 240 cells/mm3. Her vital signs were normal; she was afebrile. Her cardiac, pulmonary, abdominal and skin examinations were normal. The neurologic examination was also normal; there were no sensory or motor defects, and her cranial nerves were intact. Her BMI was 33. She had a history of positive cryptococcal antigen titer 1:64, with prior negative CSF fungal culture. A head CT was negative for intracranial mass or acute lesion. An MRI/MRV of the head was negative for cranial thrombosis. CSF studies from revealed normal glucose, protein and cell counts.
DISCUSSION: In patients with HIV, headache is the most common chief complaint encountered by general internists. Despite the fear of intracranial infections or malignancies, it is important that the general internist recognize that more than two thirds of HIV patients with headache are diagnosed with primary headaches, including migraine, tension and cluster headaches. Despite the high prevalence, many patients remain undiagnosed after their initial presentation and suffer from headache-associated morbidity, even after AIDS-defining neurologic complications have been excluded. Primary headache in AIDS patients is usually associated with depression, anxiety or insomnia. Like patients without HIV, these patients often have a positive family history or a personal history of headache prior to seroconversion. Clinical prediction rules based on symptoms and CD4 counts have been developed to aid in the recognition of patients that require prompt diagnostic imaging or invasive testing for headache management. The algorithms are utilized to decrease the risks associated with invasive procedures and imaging while helping control rising medical costs. Patients are

stratified as low, intermediate and high risk for intracranial mass/lesion based on the presence of focal neurologic symptoms, altered mental status, past history of seizure, and CD4 count. Low-risk patients are treated clinically. Both intermediate and high-risk patients deserve imaging and invasive testing for a complete workup. This patients headache was relieved with a regimen of ketorolac, divalproex sodium and promethazine. She was discharged on a daily regimen of topiramate. Primary headache is a clinical entity that occurs in a many HIV/AIDS patients. Prompt recognition and appropriate treatment can restore a patients quality of life and decrease both treatment and disease-associated morbidity.

COMMON VARIABLE IMMUNODEFICIENCY IN A PATIENT WITH RECURRENT BRONCHITIS PRESENTING WITH PNEUMOCOCCAL SEPSIS Natasha Parekh1; Farhan Zaidi1; Jo-Anne Suffoletto1,2.
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2VA Pittsburgh Health System, Pittsburgh, PA. (Control ID #1321195)

LEARNING OBJECTIVE 1: Consider immunodeficiency in a patient with a history of recurrent infectionsLEARNING OBJECTIVE 2: Distinguish common variable immunodeficiency (CVID) from other immunodeficiencies using history and laboratory testingCASE: A 29 year-old male presented with a 2-day history of fever, dyspnea, and pleuritic chest pain. On admission, he was febrile, diaphoretic, and tachycardic; CBC showed leukocytosis (WBC 33,000/ L) and chest X-ray showed left lower lobe opacity. Blood cultures were positive for Streptococcus pneumonia. Labs revealed he was in acute kidney injury (AKI) with a creatinine of 1.6 mg/dL (baseline 0.7); his urinalysis showed proteinuria and hematuria. He denied cough, meningismus, or gastrointestinal and urinary symptoms. Further questioning revealed a 16-year history of 1-2 bronchitis episodes a year. He clinically improved and blood cultures cleared within 48 hours of hydration and treatment with intravenous (IV) antibiotics. Given his history of recurrent bronchitis, current sepsis, and AKI with proteinuria and hematuria, an extensive lab work-up was performed, including HIV, Hepatitis B and C, ANA, p-ANCA, c-ANCA, anti-GBM, complements, and immunoglobu-
lins. This was remarkable for an IgA level of <6.67 mg/dL (normal 53-334), IgG of 36.1 mg/dL (normal 53-334), and IgM <4.17 mg/dL (normal 53-334). Titers for diphtheria, pertussis, tetanus, hemophilus influenza B, and streptococcus pneumonia showed absent response. Based on his markedly reduced immunoglobulin levels, deficient response to immunization, and absence of any other identifiable immunodeficiency, a tentative diagnosis of CVID was made. Repeat immunoglobulin titers showed persistently low IgA and IgM but an increase in IgG from 31.6 to 519. Because of the IgG increase, he was given Tdap and pneumococcal vaccines and post-vaccination titers will be sent shortly to gauge response and confirm diagnosis. If the diagnosis is confirmed, he will receive his first dose of IVIG.

DISCUSSION: CVID is a rare entity, affecting 1 in 50,000 patients. It is a primary antibody deficiency that can lead to a host of pathologies, including recurrent infections, chronic lung disease, gastrointestinal issues, autoimmune disorders, and malignancy. It is defined as low serum levels of IgG, IgA, and IgM with poor or absent antibody production and exclusion of other causes of immunoglobulin deficiency. Sinopulmonary infections (like otitis media, sinusitis, bronchitis, and pneumonia) are the most common presentations of patients with CVID, occurring in up to 73% of patients. Pneumonia in CVID can be severe and frequently requires IV antibiotics. Complications of pneumonia include sepsis, pleurisy, bronchiectasis, and empyema. When considering immunodeficiency, it is vital to distinguish between CVID and other immunodeficiencies. Age of onset is important as patients over 15 years rarely present with X-linked (Brutons) agammaglobulinemia (characterized as decreased serum immunoglobulins and absent B cells) or X-linked hyper-IgM syndrome. Serum immunoglobulin levels are essential to distinguish CVID from hyper-IgM syndromes and selective IgA deficiency. Medication history is important as certain drugs can induce hypogammaglobulinemia such as anti-malarials, steroids, and sulfasalazine. This case illustrates a severe complication as the presentation of a rare medical problem. It is essential to consider a broader differential in a patient with recurrent infections, and to differentiate CVID from other immunodeficiency syndromes.

COMPETENT ENOUGH FOR CRYPTOCOCCUS: CRYPTOCOCCUS GATTII MENINGOENCEPHALITIS Starr Steinhilber1; Victoria A. Johnson2. 1University of Alabama at Birmingham, Birmingham, AL; 2University of Alabama at Birmingham, Birmingham, AL. (Control ID #1334651)

LEARNING OBJECTIVE 1: Emphasize Cryptococcus gattii as an emerging pathogen causing meningoencephalitis in immunocompetent hosts.

LEARNING OBJECTIVE 2: Recognize that C. gattii is more difficult to treat and clear than C. neoformans.

CASE: A previously healthy 49-year-old African American male presented with weeks of fever, headache, back pain, and vomiting unresolved after multiple ER visits and empiric treatment with doxycycline for a tick bite. His headache persisted with new blurry vision. Examination revealed an oriented male with meningismus and bilateral nystagmus upon left lateral gaze. There was no rash, fever, seizures, history of trauma, or travel outside of Alabama in over twenty years. Immunologic work up including HIV antibody, CD4 lymphocyte assay, serum complement and immunoglobulin levels were negative or normal. Lumbar puncture (LP) revealed opening pressure of 23 mmHg, cerebrospinal fluid (CSF) protein of 129 mg/dl, and CSF glucose of 29 mg/dl. India ink was positive for encapsulated yeast. CSF cryptococcal antigen was positive (1:2048). Amphotericin lipid complex 5 mg/kg/d and flucytosine 100 mg/kg/d were administered. CSF cultures were positive for Cryptococcus species and remained positive for fourteen days despite combination therapy. His headache and blurry vision resolved with serial therapeutic LPs. Opening pressures were as high as 46mmHG, and a ventriculoperitoneal shunt was placed on day fourteen of hospitalization. MRI revealed cryptococcomas in the cerebrum and spinal cord. Interferon-gamma was initiated on day twenty for refractory infection. The Cryptococcus species was identified as C. gattii, and he received seventy-five days of amphotericin and was discharged on long-term fluconazole. DISCUSSION: Meningoencephalitis is one of the most serious consequences of cryptococcosis, and is a well-known pathogen among immunocompromised

patients. Primary infection occurs through the respiratory tract, but it has a propensity for the central nervous system. Cryptococcus is a basidiomycetous yeast and is further classified into two species with important differences, C. neoformans and C. gattii. C. neoformans affects primarily immunocompromised, whereas C. gattii affects immunocompetent hosts. A case series from Australia showed that all cases of C. gattii were in immunocompetent hosts, and most cases presented insidiously with evolving neurologic symptoms, similar to our patient. Though C. neoformans infection has a higher mortality rate, C. gattii causes a greater number of cryptococcomas, leading to more neurological sequelae and slower response to treatment. C. gattii has been cultured from trees in Australia and was originally seen in places where those trees were sent. However, since 1999, over 200 immunocompetent cases of C. gattii infection have been reported in British Columbia and the northwestern United States with rare cases are now being reported in other areas of the US. C. gattii is known to develop resistance to antifungal agents and treatment with Amphotericin and flucytosine is often required for longer than a month. Interferon-gamma was added as adjunct therapy due to its suggested benefit in decreasing time to clearance of resistant C. neoformans in immunocompromised patients. C. gattii is still rare in most of the US but is emerging in immunocompetent hosts. Education is needed as it can present more indolently than other more common causes of meningoencephalitis and often requires lengthy and more complicated treatment regimens for successful outcomes.

COMPLICATED GASTRO-ESOPHAGEAL REFLUX DISEASE FOLLOWING LAPAROSCOPIC ADJUSTABLE GASTRIC BANDING. Adetokunbo F. Oluwasanjo; Richard Alweis. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1333825)

LEARNING OBJECTIVE 1: Recognize and manage new-onset gastroesophageal reflux (GERD) disease as a complication of laparoscopic adjustable gastric banding (LAGB).

LEARNING OBJECTIVE 2: Identify patients at risk for esophageal complications following LAGB.
CASE: A 68 year old man presented with a one month history of cough, heartburn and episodes of nocturnal regurgitation. He had no history of gastro-esophageal reflux disease (GERD) and had undergone laparoscopic adjustable gastric banding (LAGB) 8 months prior to presentation. His past medical history was notable for chronic obstructive pulmonary disease (COPD), obstructive sleep apnea, type II diabetes, hypertension and hyperlipidemia; and a review of his preoperative records showed radiographic evidence of a small hiatal hernia. Omeprazole 20 mg twice daily was initiated and an upper gastrointestinal series demonstrated a more dilated hiatal hernia, significant reflux and probable stricture formation. His band was loosened, but his symptoms persisted. Over the next 15 months, he underwent three surgical repairs for recurrent hiatal hernias and was hospitalized for left lower lobe pneumonia. His symptoms progressively worsened with nasal and oral regurgitation, but he had achieved significant weight loss, with a reduction in his body mass index (BMI) from 41 to 27; and was reluctant to have his band completely deflated. One month after being discharged from the hospital, he presented with a productive cough, worsening dyspnea, anorexia and fatigue. His chest radiograph indicated persistent left lower lobe infiltrate and a chest computed tomography (CT) scan revealed bilateral pulmonary nodules that were too numerous to count. The diagnosis of exclusion was metastatic disease. After 7 days of levofloxacin and prednisone, he underwent bronchoscopy with evacuation of copious amounts of vegetable matter and mucus plugs. His lung biopsy was consistent with organizing aspiration pneumonia and follow-up chest CTs at one and three months showed continued resolution of the nodules, strongly supporting an inflammatory etiology. With persistent symptoms resulting in poor quality of life and radiographic evidence of esophageal dysmotility, the decision was made to completely deflate the gastric band. Over the next 4 months, his symptoms completely resolved.
DISCUSSION: Laparoscopic adjustable gastric banding (LAGB) is gaining popularity as a relatively safe and effective bariatric procedure with the advantages of being minimally invasive and reversible. There are however long-term esophageal complications of this procedure, including dilatation, dysmotility and GERD. The reported incidences are conflicting, suggesting a sub-set of patients may be at a higher risk of developing these complications. While there is no established tool to help risk-stratify patients, a review of literature suggests that abnormal preoperative pH monitoring and an esophageal caliber>35 mm are risk factors, while abnormal preoperative esophageal manometry and a preceding history of GERD or hiatal hernias are inconsistent predictors. In most patients, removal or partial deflation of the band leads to symptom resolution in most patients; however, there are reports of irreversible complications. Prior to LAGB, preoperative risk-stratification should be performed and patients educated on the potential long-term complications.
CONFUSED? TAKE A [2ND] LOOK AT THE SMEAR Edward Mannina; Daniel Salerno. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338507)
LEARNING OBJECTIVE 1: 1. Recognize the presentation of malaria and complicated malaria. 2. Understand the diagnosis and treatment of Plasmodium infection. 3. Appreciate the importance of a detailed social history.
CASE: A 53 year-old man presented with altered mental status following a motor vehicle accident. He had no medical, surgical, family, allergy, prescription or recreational drug history. He worked as a helicopter pilot in Nigeria. He complained of diarrhea, dark urine and dry mouth. On admission, his temperature was 104 F; his heart rate was 130 beats/min., the blood pressure was 142/77 mmHg, and his respiratory rate was 24 breaths/min. He was diaphoretic and confused with no focal deficits. His cardiac, pulmonary and abdominal examination was normal. A CBC revealed a WBC of 2,800 cells/mm3, a hemoglobin of 10.1 g/dl, and a platelet count of 26,000 cells/mm3. He had a bilirubin of 1.5, a lactate 4.5 and an LDH of 527. A peripheral blood smear showed normocytic red blood cells with thin ring forms, consistent with Plasmodium falciparum infection denoted as severe or complicated by cerebral malaria. Intravenous quinidine was unavailable, so intravenous artesunate was initiated. Since his fever paroxysms were more frequent than expected, a second look at the peripheral smear revealed rare enlarged/ovoid red blood cells with larger ring forms, suggesting concurrent

Plasmodium ovale infection. In addition to the artesunate, oral atovaquone/proguanil was initiated. With smears negative for four days, and after glucose-6-phosphate dehydrogenase deficiency was excluded, he was discharged for an additional forteen days of oral primaquine.
DISCUSSION: As the global economy continues to expand, general internists are likely to encounter more and more patients who work abroad as part of their primary employment. Recognizing diseases acquired abroad, even in patients presenting within the continental United States, will become increasingly important for the general internist. Plasmodium infection produces nonspecific findings of fevers, tachycardia, tachypnea, headache, and myalgias. Laboratory findings are also nonspecific: low cell counts, hyper-bilirubinemia, and an elevated BUN and creatinine. The social, travel and employment history is therefore the key to establishing the pre-test probability requisite for pursing the diagnosis. Peripheral smears remain the diagnostic gold standard and are used to quantify disease burden as percent parasitemia. Infection of more than 5% of the red blood cells/hpf denotes severe malaria, an advanced condition involving the kidney, liver, lungs or brain with hemolysis, intravascular coagulopathies and circulatory collapse described. Due to chloroquine resistance, oral artemisinin-combination therapies are recommended while parenteral artesunate or quinidine is used for complicated disease. Infection with Plasmodium ovale or P. vivax requires an agent such as primaquine to kill liver hypnozoites preventing relapse.
CONFUSION AND UPPER EXTREMITY WEAKNESS IN AN ELDERLY WOMAN; CASE OF LYME ENCEPHALOPATHY AND RADICULNEURITIS Naba R. Mainali; Madan R. Aryal; Madan Badal; Anup Subedee. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1310520)

LEARNING OBJECTIVE 1: Recognize that lyme disease may present with peripheral neuropathy involving non-cranial nerves.
LEARNING OBJECTIVE 2: Diagnose and treat neurological involvement of Lyme disease.
CASE: Lyme disease is a tick borne, multi system disease caused by the spirochete, Borrelia burgdorferi. Early symptoms include fever, headache, fatigue, and a characteristic rash called erythema migrans. Lyme encephalitis and radiculoneuritis are rare entities among seropositive individuals which can present months to years after initial infection. Patients with lyme encephalitis usually present with mild confusion, language difficulties and sleep disturbances. Here we present an interesting case of elderly female who presented with confusion and weakness 6 weeks after the tick bite which was finally diagnosed as lyme encephalopathy and radiculoneuritis. A 78 year old female with history of Lyme disease 2 years ago, treated with doxycycline was again bitten by a bug 6 weeks back without characteristic rash. Subsequently, she started noticing mild confusion, slurred speech, and more recent onset of weakness and mild pain in bilateral upper extremities. Neurological exam revealed intact cranial nerves. Extra ocular movements were full without nystagmus or diplopia. Muscle strength on bilateral upper extremities across all the joints was 3/5. However muscle strength in lower extremity were full across all joints. There was decreased sensation in glove and stocking distribution bilaterally on upper and lower extremities. MRI of the brain showed mild periventricular and subcortical white matter hyper-densities consistent with multiple sclerosis or Lyme disease. CT of the cervical spine was normal. Lumbar puncture revealed glucose of 54, total protein 274, white blood cells 296 with 92% lymphocytes. Lyme ELISA in the blood was positive. Western blot IgG and IgM for Lyme were positive. Culture of stool for Campylobacter, EHEC and Giardia were negative. CSF West Nile virus serology, Ehrlichia and anaplasma serologies were negative. CSF IgM for Lyme was positive. However, Lyme by PCR was negative. EEG was normal. Patient was started on ceftriaxone 2 g daily after which the patient had remarkable improvement.
DISCUSSION: Clues to the diagnosis of Lyme encephalopathy and radiculoneuritis include history of tick exposure and confusion, elevated CSF protein and lymphocytic pleocytosis, positive serologies and abnormal brain imaging. Although cranial neuropathy is the most common focal nervous system abnormality, presentations of early dissiminated Lyme disease may include mononeuritis multiplex or radiculoneuritis

elsewhere. Symptoms as well as MRI scan can sometimes be confused with multiple sclerosis. Confirmation of CNS infection requires either presence of intrathecal antibodies or positive PCR for DNA. The prominent feature of Lyme radiculoneuritis is pain and resembles mechanical radiculopathy like sciatica. The neurological abnormality is usually treated with ceftriaxone or cefotaxime for 2 to 4 weeks.

CRYPTOCOCCAL MENINGITIS MASQUERADING AS NORMAL PRESSURE HYDROCEPHALUS IN AN IMMUNOCOMPETENT INDIVIDUAL. Vijai Bhola; Ekta Bansal; Jean Smith. Carilion Clinic, Roanoke, VA. (Control ID #1340206)

LEARNING OBJECTIVE 1: Cryptococcal meningitis is a rare cause of meningitis in immunocompetent patients, and often presents atypically. Diagnosis is thus often delayed leading to poor outcomes. We present a unique case of cryptococcal meningitis to highlight its atypical presentation and discuss the management options and possible pitfalls.

CASE: A 54 yr old male with no impressive past medical history presented with a one-month history of nausea, vomiting, urinary incontinence, falls and unsteady gait. He denied fever, chills, sick contacts, recent travel. On examination, the patient was afebrile, vital signs within normal range. Unsteady gait and positive Rombergs sign were noted. Labs revealed normal white cell count, hemoglobin, creatinine, thyroid function, vitamin B12, and folate. Negative urine drug screen and HIV. With a glycosylated Hemoglobin of 8.5, he was diagnosed with Diabetes Mellitus. Magnetic Resonance Imaging of the brain showed moderate enlargement of the ventricular system and he was diagnosed with Normal Pressure Hydrocephalus (NPH). Lumbar Puncture (LP) revealed normal opening pressure, White Cell Count 107/cmm, Lymphocytes 71%, Protein 319 mg/dl, Glucose 59 mg/dl. 50 cc of CSF was withdrawn and patient had some
improvement in gait. CSF Cryptococcal Antigen returned positive. Blood and Cerebrospinal (CSF) cultures were negative. Amphotericin B and Flucytosine were started on Day 8 and the patient had slow clinical improvement to baseline by discharge.

DISCUSSION: Cryptococcal meningitis presents in immunocompetent individuals with features of a more indolent neurological disease, with symptoms such as headache, anorexia and neurologic abnormalities such as ataxia. It can therefore be misdiagnosed with diseases such as migraine, tension headache or NPH. One small series described median time lag between symptom onset and diagnosis to be 44 days, diagnosis typically made only after multiple physician encounters and time delay. CSF antigen testing (sensitivity, 93-100%; specificity, 93-98%) is useful pending culture results. Cryptococcus Gatti is a Cryptococcal variant, identifiable by molecular speciation. First seen in the United States in 2007, this variant is associated with increased incidence of hydrocephalus and cryptococcomas. Treatment recommendations are a combination of amphotericin B and flucytosine for a 4-6 week induction phase, followed by a consolidation phase of fluconazole 800 mg daily for 8 weeks, then maintenance, at 200 mg daily for 6-12 months. Amphotericin B can be substituted with liposomal preparation if renal failure develops. An Immune Reconstitution Syndrome (IRIS) can be seen during treatment, and needs to be distinguished from treatment failure, as steroids plus acetazolamide can be indicated. Repeat LP or drainage procedures are indicated for refractory elevations of CSF pressures. An increased index of suspicion for cryptococcal meningitis may lead to earlier diagnosis and initiation of appropriate treatment for this disease entity, decreasing morbidity and mortality.

CUT TO THE CASE Taimur Khan; Marissa Karpoff; John Scopetta; Marcia Glass. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338576)

LEARNING OBJECTIVE 1: 1. Understand the importance of early microbial diagnosis when initiating antimicrobial therapy in patients with multiple comorbidities.

LEARNING OBJECTIVE 2: 2. Recognize the clinical presentation of histoplasmosisCASE: A 35-year-old woman with a history of systemic lupus erythematosus and polymyositis, previously on leflunomide, presented with four weeks of progressively worsening cellulitis refractory to multiple antibiotics. On initial presentation, she had cutaneous lesions on her inner left thigh. She was afebrile with negative blood and urine cultures. An

outside facility initiated broad-spectrum antibiotics, including linezolid, pipericillin/tazobactam and fluconazole. MRI of the thigh revealed focal edema and fluid of the lateral soft tissues near the periosteum with no suggestion of deep abscess or osteomyelitis. Wound cultures were positive for Pseudomonas. Ceftazadime was empirically initiated. The patient continued to worsen clinically, with increased wound purulence and spiking fevers. Fluconazole was initiated for fungal coverage. Fungal stains of punch biopsy returned as Histoplasma. We then adjusted her therapy to itraconazole for the remainder of the hospitalization. The patient went home on itraconazole but soon returned with weakness and jaundice. She eventually expired during this readmission.
DISCUSSION: The early diagnosis of infectious etiologies is paramount is avoiding unnecessary side effects. By empirically treating these patients, unintentional harm may be caused. Physicians should be particularly conservative when approaching patients with multiple comorbidities, such as autoimmune processes, immunosuppression secondary to treatment, and chronic renal insufficiency. Without a final diagnosis, delaying broad-based treatment may be preferable to avoid detrimental side effects. With this particular patient, an earlier diagnosis would have helped us provide a focused and successful antifungal regimen and, likely, a much better outcome by sparing her multiple, toxic antimicrobials. This is especially important as this patient adversely responded to most of the medications she received. She presented with signs of heparin-induced thrombocytopenia, with elevated liver enzymes levels, and with pancytopenia - each problem likely a drug side effect. Perhaps, treating her symptomatically until we received the biopsy results could have spared her renal function and the other complications. Whereas most immunocompromised patients

may require more aggressive, empiric treatment in order to halt infection as early as possible, a highly sensitive patient may require a less aggressive approach despite also being immunocompromised. Furthermore, since this patient was iatrogenically immunocompromised, she may have benefited in the interim by inducing her immune system more aggressively. With the average patient, a reflexive reaction to empirical antimicrobials is often the safest option. However, in patients who are physiologically fragile and are presenting unusually, deferring empiric treatment may help patients avoid unfavorable side effects. It is this high level of attention to such details that will make the difference in the healthcare provided to these unique patients.

CUTTING OUT THE NEUTROPHILS: LEVAMISOLE TOXICITY IN CHRONIC COCAINE USERS Robert Li; Amit Kothari. UT Southwestern Medical School, Dallas, TX. (Control ID #1339977)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of levamisole toxicityLEARNING OBJECTIVE 2: Manage complications of adulterated cocaine abuseCASE: A 51 year-old woman presents with one week of swelling, blistering, and tenderness of the left ring finger. She has a history of neutropenia, cocaine dependence, and has had multiple finger amputations secondary to dry gangrene and osteomyelitis. On admission, the patients temperature was 39.1C with a heart rate of 91 bpm. On exam, tender purpura were seen on both cheeks and extensive morbilliform rashes were noted on the abdomen, legs, and toes. Examination of the left ring finger showed circumferential swelling of the middle and distal phalanges and a 1 cm long dorsal lesion near the PIP joint. The affected finger was tender to palpation with mild erythema but there was no warmth, purulence, or signs of crepitance. CBC revealed a WBC count of 1200 cells/mm3 and an ANC of 120 cells/mm3; hemoglobin was 9.2 mmol/L and the platelet count was 171,000 per mm3. X-ray of the left hand showed diffuse soft tissue swelling of the fourth digit. Rheumatologic workup revealed a negative c-ANCA, positive p-ANCA, positive proteinase-3, positive rheumatoid factor, and equivocal meyloperoxidase. The patient was given appropriate wound care, ticaracillin/clavulanate, vancomycin, and G-CSF which successfully resolved her fever, modestly improved her ANC, and preserved the finger.

DISCUSSION: Given her recurrent presentations with digit gangrene and significant neutropenia, systemic etiolgies to the patients illness including vasculitis, arteritis, malignancy, infection, and autoimmune etiologies

were considered and worked up. In a chronic cocaine user, especially one with dermatologic findings, the differential diagnosis for neutropenia should also include levamisole toxicity. Levamisole is an anti-helminthic drug used as a cutting agent to adulterate up to 70% of street cocaine. Previous use of levamisole as an immunomodulator for rheumatoid arthritis and for adjuvant therapy in colorectal cancer revealed agranulocytosis as a side effect of therapy. Recently, the CDC has linked levamisole to 21 cases of agranulocytosis associated with cocaine use. Levamisole toxicity is also associated with pruritic rashes, ulcers, lichenoid eruptions, fixed drug eruptions, necrotizing thrombotic vasculitis, and the generation of autoimmune antibodies. Detection of levamisole is difficult as the plasma half-life is 5.6 hours and relatively little (~12%) is recovered in the urine. A gas chromatograph/mass spectrometer (GC-MS) is required for confirmation of the presence of levamisole in serum or urine samples. No commercial tests are available and therefore, a high clinical suspicion and positive urine toxicology for cocaine remain the most viable route for diagnosis. Treatment of levamisole toxicity includes G-CSF administration, steroids, and avoiding further exposure. A complete dermatological and serological recovery, even without G-CSF, usually occurs within weeks to months. However, it remains critical to suspect levamisole toxicity in a cocaine user as a reversible cause of agranulocytosis given the high morbidity and mortality associated with complications such as bacterial sepsis.

CYTOMEGALOVIRUS AND EPSTEIN BARR VIRUS COINFECTION IN AN AIDS PATIENT Mamatha Racheruvu; Kumar Sanam; Jyoti S. Samant. UAB Montgomery, Montgomery, AL. (Control ID #1339805)

LEARNING OBJECTIVE 1: Distinguish infection versus neoplastic process causing neurologic complications in a HIV patient.

CASE: 42 year old white female with a history of HIV infection for 14 yrs presented with right-sided facial weakness, double vision, vertigo and gait instability. She began having tinnitus and fullness in her right ear two months back, which continued to worsen, causing bilateral hearing loss. She also complained of productive cough. She was not receiving highly active antiretroviral therapy (HAART). Physical exam revealed complete paralysis of the right side of the face, bilateral hearing loss, bilateral ophtalmoplegia and nystagmus, remaining exam was normal. Initial differential was stroke or Central Nervous System (CNS) infection. MRI of brain revealed dorsal pontine abnormality, with enhancement in the ependymal/subependymal region adjacent to the lateral ventricles suspecting infectious process. Lumbar puncture (LP) was done.Opening pressure was 16cmH2O. Cerebrospinal fluid (CSF) was clear, colorless with glucose of 30 mg/dl, protein of 99.4 mg/dl, W.B.C of 23/mm3, with differential of 94% monocytes. CSF was negative for toxoplasma, mycobacteria, cryptococcus, or syphilis. CD4 count was 27cells/mm3 with a viral load of 33,126c/mL. She was started on HAART but her neurological symptoms worsened.There was concern for Immune Reconstitution Inflammatory Syndrome, so HAART was stopped and was started on steroids. She continued to worsen so MRI and LP were repeated. CSF PCR was positive for Cytomegalovirus (CMV) and Epstein Barr Virus (EBV) with viral load of 2914c/ml and 14,900c/ml respectively. MRI revealed progression of pontine lesion with extension into right cerebellar hemisphere periventricular tissues and worsening of subependymal enhancement. Ganciclovir and foscarnet were started and HAART was resumed. A chest x-ray done for pneumonia showed ill-defined mass in left lung, CTof the chest confirmed the mass along with multiple nodular densities in both lungs. Lung biopsy was done.Pathology revealed Lymphomatoid granulomatosis with focal progression to diffuse large B-cell lymphoma and EBV positive lymphocytes. Lesions in brain were difficult to biopsy, so flow cytometry of CSF was done which revealed B-cell lymphoma. As she was a poor candidate for chemotherapy, and patient wished for comfort care, so supportive care was provided. She died after one month of initial presentation. DISCUSSION: This case illustrates an unusual neurologic viral coinfection in an AIDS patient. Our patient developed EBV related primary CNS lymphoma (PCNSL) and CMV encephalitis. We describe the first case of CMV and EBV coinfection in an AIDS patient leading to rapid neurologic decline. Neurologic manifestations of CMV disease in AIDS patients are encephalitis, ventriculoencephalitis, cerebral mass lesions, myelitis, polyradiculitis. Occurrence of CMV disease in AIDS is associated with poor prognosis and higher mortality. PCNSL is an

important alternative condition in the differential diagnosis of intracranial mass lesions in toxoplasma seronegative AIDS patients. Lesions can be single or multiple and can produce edema and mass effect. CSF EBV PCR is helpful in confirmation of diagnosis. Open brain biopsy is required for tissue confirmation before cranial irradiation for PCNSL. We hope our case raises the awareness of CMV as an important differential in intracranial mass lesions in AIDS patients which can lead to rapid neurologic decline and increased mortality.

CYTOMEGALOVIRUS GASTRITIS IN AN IMMUNOCOMPROMISED PATIENT: CHALLENGES IN DIAGNOSIS Pranjal Sharma; Savio Reddymasu; Pallavi Bellamkonda. Creighton University, Omaha, NE. (Control ID #1339708)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of cytomegalovirus (CMV) gastritis in an immunocompromised patient. LEARNING OBJECTIVE 2: Identify that CMV infection is a known cause of mortality and morbidity in patients with solid organ transplantation and understand that even if the serum PCR is negative, gastric biopsies and cultures should be done to further confirm the diagnosis.

CASE: A 61 year-old man with history of idiopathic pulmonary fibrosis and status post bilateral lung transplantation and taking immunosuppressive medications for the past 4 years, presented with epigastric pain associated with nausea, weight loss and dyspepsia. Pertinent positives in physical examination were mild distress secondary to pain and epigastric tenderness. Complete blood count revealed pancytopenia with absolute neutrophil count of 400. Comprehensive metabolic panel and abdominal

X-rays were within normal limits. Cytomegalovirus Polymerized Chain Reaction (PCR) serology was negative. Gastroenterology was consulted and Esophagoduodenoscopy (EGD) with biopsies was done; EGD showed small ulcerations and biopsy results were positive for cytoplasmic CMV inclusions in gastric epithelial cells. Patient was treated with Ganciclovir and later showed clinical improvement.

DISCUSSION: The complaints of epigastric pain and dyspepsia are commonly encountered in the hospital setting and should be taken seriously, especially in immunosuppressed patients. Complete history and physical examination are critical in arriving at an accurate diagnosis. CMV infection is a known cause of mortality and morbidity in patients with solid organ transplantation and CMV gastritis can present with symptoms of epigastric pain, dyspepsia and also GI bleeding (hemorrhagic gastritis). Diagnosis is with DNA PCR and also Endoscopy with biopsies should be done. Gastric biopsies would show cytomegalic owl-eye cells. There should be a high level of suspicion of CMV infection in immunocompromised patients who present with acute to sub-acute gastrointestinal symptoms and even if the DNA PCR is negative, these patients warrant further investigationi.e., Endoscopy with gastric biopsies.

DRESSED AS IRIS Jorien G. Breur1; Yelena Averbukh2; Hanna Lee2.

1Albert Einstein College of Medicine, New York, NY; 2Montefiore Medical Center, New York, NY. (Control ID #1332568)

LEARNING OBJECTIVE 1: Consider IRIS in AIDS patients presenting with fever and rash after recent initiation of HAARTLEARNING OBJECTIVE 2: Recognize DRESS syndrome in patients presenting with rash and fever after exposure to new medications CASE: A 31-year-old woman with AIDS and history of cryptococcal meningitis, disseminated Mycobacterium avium complex (MAC), hepatitis B (HBV), P. jirovecii pneumonia, and multiple drug allergies presents with high-grade fevers and a diffuse rash in the setting of recent initiation of HAART and MAC therapy. On physical exam the patient exhibited a diffuse, macular, blanching, pruritic rash, diffuse lymphadenopathy, and was febrile to 102.5F. Laboratory findings were significant for 7% eosinophilia, IgE levels elevated to 21839 (nl<180 IU/mL) and elevated aspartate transaminase to 444, alanine transaminase to 208, and alkaline phosphatase to 933. Infectious disease work-up was significant for positive MAC blood culture and elevated HBV viral load. Since initiation of HAART with Raltegravir, Emtriatabine, and Tenofovir two weeks prior, the patients viral load decreased from 1.7 million to 816, and her CD4 count increased from 3 to 14. Allergic drug reaction was suspected and as the patients medications were stopped the rash, fever, and

liver laboratory abnormalities began to improve. The patients MAC regimen was restarted without any adverse reaction and the patient was scheduled for outpatient drug allergy testing prior to initiation of HAART to evaluate a causal relationship. DISCUSSION: Given the similarities in presentation between immune reconstitution inflammatory syndrome (IRIS) and Drug Rash with Eosinophilia and Systemic Symptoms (DRESS) syndrome, potential allergic drug reactions should be considered in AIDS patients presenting with fever and rash in the setting of recent HAART initiation. Initiation of HAART in the profoundly immune-deficient patient can be associated with a paradoxical clinical worsening due to opportunistic infection (OI) as a direct result of immune restitution. The exuberant inflammatory reaction seen in IRIS typically presents from weeks to months of initiating HAART and is manifested clinically with fever, lymphadenopathy, and multi-organ dysfunction depending on the underlying OI. Allergic drug reaction, which occurs at a much higher frequency in HIV+patients, must be ruled out whenever a patient treated with a new drug develops an exacerbation or a new medical problem. DRESS syndrome reflects a serious hypersensitivity reaction to drugs which usually begins several weeks after exposure to the offending drug. Clinical features include fever, lymphadenopathy, rash, hypereosinophilia>1,500/L, and multi-organ dysfunction. HAART agents Raltegravir, Emtriatabine, and Tenofovir have all been implicated in DRESS syndrome. While the prognosis of IRIS is relatively benign, the overall mortality of DRESS syndrome is 10%. IRIS treatment is supportive and HAART therapy is continued, while DRESS syndrome necessitates that all potentially offending agents be stopped immediately. Our patient was at risk for both IRIS and DRESS syndrome due to her severely immuno-deficient state, presence of OIs, and recent HAART initiation.
Based on the presence of hypereosinophilia and elevated IgE levels, elevated liver transaminases, and cutaneous involvement a clinical diagnosis of DRESS syndrome was made. Clinicians should be aware of DRESS syndrome when prescribing s new drug due to the potential mortality if drug therapy is not discontinued.

DABIGATRAN TOXICITY IN A 65 YEAR OLD MALE WHO FAILED OTHER ANTICOAGULATION METHODS
Rachel Harold2;
Matthew Tuck1,2. 1Department of Veterans Affairs Medical Center, Washington, DC; 2George Washington University, Washington, DC. (Control ID #1329853)
LEARNING OBJECTIVE 1: Recognize the interaction between dabigatran and P-glycoprotein (PGP) inhibitors and inducersCASE: When dabigatran was introduced to the US market in 2010 as an oral anticoagulant, it was heralded as a welcome alternative to warfarin. Among its reputed benefits, dabigatran does not require monitoring of levels. This case report describes a 65 year old male who developed dabigatran toxicity on the manufacturer's recommended dosage. The patient had a history of chronic atrial fibrillation maintained on amiodarone, pulmonary embolism, ischemic cardiomyopathy with ejection fraction 25%, mitral and tricuspid regurgitation and chronic kidney disease with a creatinine clearance (CrCl) of 52.8 mL/min, who was admitted for a heart failure exacerbation. Prior to admission, he reported inconsistent adherence to medications, including dabigatran 150 mg twice a day, which was started months earlier after failing to reach therapeutic levels with warfarin and developing heparin induced thrombocytopenia on dalteparin. On hospital day four, he had an episode of melena. Labs showed a markedly elevated PTT of 113.3, INR 3.4 and PT 33.7. Dabigatran was held. Amiodarone was also held out of concern that the interaction with dabigatran led to toxic levels. Fortunately, the patient had no further episodes of melena. Endoscopy demonstrated gastric erosions without active bleeding. As expected, based on the elimination half-life of dabigatran of 12-17 hours, the coagulation studies improved by the following day: PTT 66.7, INR 1.8 and PT 20.5. With these anticoagulation challenges, electrical cardioversion was planned to address the atrial fibrillation, but the procedure was aborted when a thrombus was discovered in the left atrium. In consultation with hematology, warfarin was restarted so that levels could be monitored.
DISCUSSION: The patient likely developed dabigatran toxicity on the recommended manufacturers dose due to

concomitant amiodarone use. As a result of a number of post-marketing surveillance reports, the manufacturer recently changed the prescribing information to include warnings of interactions with PGP inhibitors, such as amiodarone. Specifically, the package insert recommends lowering the dose to 75 mg twice a day when co-administered with dronedarone or ketoconazole as well as a contraindication in patients with a CrCl <30 mL/min when co-administered with a PGP inhibitor. The recommended dose of dabigatran 150 mg twice a day may present added risk without dramatic added benefit over a lower dose for patients with atrial fibrillation. The Randomized Evaluation of Long-Term Anticoagulant Therapy trial showed the 150 mg dose of dabigatran was superior to both warfarin and the 110 mg dose of dabigatran in preventing stroke and systemic emboli. Importantly, the 110 mg dose was noninferior to warfarin, but with a decreased risk of bleeding when compared to the 150 mg dose among all subgroups. The FDA approved the higher dose because it wagered the added benefit of preventing systemic emboli outweighed the reduced risk of bleeding afforded by the lower dose. For patients with a CrCl of 15-30 mL/min, the suggested dose is 75 mg twice daily. No other dosing options are available and there is no antidote for dabigatran. When prescribing dabigatran for a patient taking PGP inhibitors or inducers with concomitant chronic kidney disease, one should use alternate dosing and consider monitoring coagulation studies or drug levels.

DANGER LURKING IN THE DARK: THE INCIDENTAL FINDING OF A MASSIVE SUPRARENAL TUMOR.

Javier Perez-Rodriguez1,2;
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(Control ID #1296242)

LEARNING OBJECTIVE 1: Outline the endocrinology work up after detection of a suprarenal mass.
LEARNING OBJECTIVE 2: Describe differential diagnosis and management of suprarenal incidentalomas.
CASE: A 20 year-old African-American woman G1P1 presented with persistent postpartum bleeding 6 weeks after an uneventful vaginal delivery. The patient was nursing her healthy infant, had no significant PMH and review of systems was positive only for right shoulder pain worsened by lying supine. A transvaginal ultrasound was performed and revealed a large right-sided suprarenal mass. Abdominal MRI with contrast showed a 13 x 11.4 x 6.9 cm retroperitoneal mass overlying the superior pole of the right kidney and displacing the vena cava. Extensive lab work up included CBC, BMP, aldosterone, renin, adrenal androgens (DHEAS, androstenedione, testosterone, 17-OH progesterone), cortisol stimulation test and plasma/urine levels of metanephrines and catecholamines. These tests were within normal limits. Surgical consult was obtained and recommended immediate excision given the likelihood of adrenocortical carcinoma by radiologic criteria. However, due to patients preference, a CT guided needle biopsy was performed. Preliminary diagnosis of ganglioneuroma was made after which the patient consented to surgery. The procedure posed serious technical difficulties as the tumor abutted the aorta medially, the IVC laterally, the right renal vein inferiorly and the porta hepatis anteriorly. The capsule was adherent to adjacent vessels and the adrenal gland (which had to be partially excised), but there was no tissue invasion. The pathological analysis of the specimen confirmed the diagnosis of ganglioneuroma.
DISCUSSION: Our patient presented with an incidentaloma that topo-graphically was suspicious for an adrenal mass. In this anatomic location differential diagnoses of adrenal origin include adenoma, pheochromocytoma or adrenocortical carcinoma. Potential non-adrenal etiologies of retroperitoneal tumors include benign soft tissue growths, soft tissue sarcoma, lymphoma, extragonadal germ-cell tumors, peripheral nerve tumors and metastatic disease. After such finding, a full adrenal work up is indicated given that treatment and/or preoperative preparation depend on activity or lack thereof of the tumor. In the case of adrenal incidentaloma, criteria for excision are functionality of the mass or imaging criteria suspicious for malignancy. Biopsy is not

indicated in most cases as it cannot differentiate adenoma from carcinoma, a hypertensive crisis could be precipitated if the neoplasm is a pheochromocytoma and needle track seeding might occur in case of malignancy. However, this approach might be appropriate after pheochromocytoma has been ruled out. In this case a biopsy yielded the diagnosis of ganglioneuroma which was later confirmed by analysis of the surgical specimen. Ganglioneuromas are benign, encapsulated, slow growing nerve sheath tumors of the sympathetic chain more commonly found in female patients before the age of 20. These tumors are asymptomatic until they start exerting a local mass effect and are usually discovered after their diameter exceeds 7 cm. Although benign, complete excision is sometimes impossible due to adherence of the tumor capsule to important anatomic structures. Postoperative autonomic dysfunction is uncommon.

DEEP VEIN THROMBOSIS IN KLINEFELTERS SYNDROME Abhishek Seth1,2; Robert L. Penn2,1. 1LSU Health Sciences Center, Shreveport, LA; 2Overton Brooks VA Medical Center, Shreveport, LA. (Control ID #1339753)

LEARNING OBJECTIVE 1: Association of deep vein thrombosis with Klinefelters syndrome.

LEARNING OBJECTIVE 2: Bring attention to association between genetic mutations and predisposition to thrombosis in Klinefelters syndrome patients.

CASE: We report a 40 year old white male with Klinefelters syndrome (47XXY karyotype) , on testosterone replacement therapy , who presented with a month long history of left lower extremity pain, warmth and swelling . Venous doppler ultrasonography of the extremities revealed thrombosis in the proximal, mid and distal superficial femoral vein, popliteal vein and the peroneal vein. His past medical history has been significant for osteopororsis , hypertension, dyslipidemia, seizure disorder and major depression. Family history was positive for deep vein thrombosis in

his mother. The patient was admitted to the inpatient medicine service for anti coagulation and appropriate workup. Coagulation studies showed a PT of 34 seconds, PTT of 14.3 seconds, and an INR of 1.1. Tests for various genetic causes of hypercoagulability states were found to be normal, including the protein C, protein S , homocysteine and anti thrombin III levels. Mutation in the prothrombin gene and Factor V Leiden were absent. Other risk factors for thrombosis such as prolonged immobility, malignancy, recent surgery and major trauma also werent present in our patient. Varicose veins, stasis dermatitis and other signs of venous insufficiency were absent as well. However, our patient was found positive for MTHFR-C677t and MTHFRA1298 heterozygous mutations, increased Factor VIIIc activity and increased Ig M anti-cardiolipin antibody (repeat testing is pending). Anticoagulation was initiated with enoxaparin and warfarin , and he was discharged home to continue oral warfarin therapy.

DISCUSSION: Klinefelters syndrome is the most common cause of primary testicular failure. It is characterized by small and firm testes, azoospermia, gynecomastia and a variable degree of eunuchoid features. An association between Klinefelters syndrome and venous and arterial thrombo embolic disease has been found in a case series and several case reports. The exact causes for this association are unknown, but hypoandrogenism leading to hypofibrinolysis has been postulated as the most likely underlying mechanism. Most of the reported Klinefelters patients with thromboembolic disease were found to have some congenital or acquired conditions which predisposed them to thrombosis. Previous reports of Klinefelters patients with thrombosis have found heterozygous mutations of the MTHFR-677 C>T and 1298A>C genes, factor V Leiden with and without the G20210A prothrombin mutation, and hyperhomocysteinemia. The exact role of MTHFR mutations in thrombosis is poorly understood. Our patient is the first case reported with Klinefelters syndrome and deep vein thrombosis, who was found to have both MTHFR mutations and elevated factor VIIIc levels. The results of the pending repeat anti-cardiolipin assay will clarify the importance of the elevated titer found during the acute presentation. Optimum duration of anticoagulation for deep vein thrombosis in patients with Klinefelters syndrome is unknown and needs more clarification.

DEMENTIA AS THE INITIAL PRESENTATION OF HIV/AIDS Christopher Goodman; Kristina L. Lundberg.

emory, Atlanta, GA. (Control ID #1337851)
LEARNING OBJECTIVE 1: Recognize HIV as a cause of progressive dementiaCASE: We present the case of a 58yom with history of CKD, HTN, and previous CVA (without lasting deficit) who was brought by friends to the hospital for progressive decline in functional and mental status over two weeks prior with prominent apathy and memory difficulty such that the patient now required help with all iADLs. The patient was a poor historian and seemed oblivious to the deterioration described by his friends denying there were any problems. He did agree to 15 lb wt loss over the last few months, and his only complaint was feeling short of breath despite appearing comfortable. He denied changes in speech or vision, focal weakness, and sensory changes. He denied fever, chills, and chest pain. T:36.9C P: 93 R: 20 BP: 138/83 Pox: 95%, RA Pertinent physical exam demonstrated a thin, adult male who appeared older than stated aged and malodorous. He was AAOx2, not oriented to time. He had poor dentition. Lung bases had coarse crackles. Neuro exam revealed symmetric hyper-reflexia (3+), 4/5 strength to LUE and LLE with 5/5 to RUE/RLE, negative Romberg, absent Babinski but sustained ankle clonus b/l. MMSE: 19. Work-up initially focused on his prominent neurological symptoms. Routine lab studies including TSH, B12, RPR were all normal. CT head demonstrated microvascular changes and possible subacute stroke suggestive of vascular dementia. On day three of admission the patient became progressively more hypoxic with O2 sats in low 80s while on 4 L nc. While awaiting bronchoscopy and CT imaging which would eventually confirm the diagnosis of PCP, the initial HIV screen came back positive -CD4 returned at 2/1%. When the patient was more stable, an MRI head confirmed the vascular findings of the CT head as well as white matter changes consistent with HIV dementia. LP studies did not yield an alternate diagnosis.

DISCUSSION: HIV-associated dementia (HAD) has been a recognized clinical entity (although it has undergone changes in definition and nomenclature) since AIDs was first recognized in the 1980s with a wide-ranging reported prevalence of 15% to 60% likely reflecting the difficulty in both making and defining diagnoses of neurocognitive impairment. Classically, it is considered a subcortical dementia with decline occurring over weeks to months; faster progression may be seen with greater immunosuppression. Dementia as the initial presentation of AIDS is fairly uncommon. From surveillance data by the CDC this was the presenting diagnosis in about 3% of AIDS patients. However, this was data from the mid-1990s and the incidence of HAD has been steadily declining since the introduction of HAART. For our patient, it would have been even easier to miss given the presence of significant vascular disease on imaging suggesting vascular dementia as the cause of his symptoms. Furthermore, HIV/AIDs is becoming increasingly common in patients over age 50 and not just because more people are living with the disease. In 2005, based on data from the CDC, individuals over the age of 50 accounted for 15% of new HIV/AIDs diagnoses. This case provides a good reminder of the importance of regular HIV screening of older individuals, especially those with evidence of dementia. If the diagnosis had been delayed or not considered it could possibly have left him at greater risk of mortality from untreated OIs such as the PCP that became apparent during his admission.
DIABETIC MUSCLE INFARCTION: A RARE BUT SERIOUS COMPLICATION OF DIABETES MELLITUS
Jessica Clima; SaraL. Swenson. California Pacific Medical Center, San Francisco, CA. (Control ID #1334735)
LEARNING OBJECTIVE 1: Recognize diabetic muscle infarction as a rare but serious complication of long-standing diabetesLEARNING OBJECTIVE 2: Distinguish diabetic muscle infarction from other causes of thigh pain in diabeticsCASE: A 48 year-old African American female presented with a 2-month history of progressive left thigh pain and swelling. She had long-standing type 2 diabetes mellitus complicated by end stage kidney disease requiring hemodialysis, severe peripheral neuropathy, retinopathy, and hypertension. Two months prior to admission, the patient reported left medial thigh pain. One month later, she reported persistent left medial thigh pain that worsened with movement and hemodialysis. The pain was constant, accompanied by intermittent swelling, and she noted a masslike sensation. She denied parasthesias, fevers, or joint symptoms. Interval work-up included doppler ultrasounds that were negative for deep vein thrombosis and the recommendation of

physical therapy. In the week prior to admission, her pain intensified to the point that she could not walk so she presented to the emergency department. On examination, her left anteriomedial thigh was swollen and exquisitely tender to palpation without palpable masses, erythema, crepitus, or inguinal adenopathy. Pertinent laboratory studies included a WBC of 7.1 K/uL, CPK of 447 U/L and negative blood cultures. Given her severe pain, we obtained an MRI. It revealed diffuse intramuscular and perifascial edema of the left vastus medialis and vastus intermedius without focal fluid collections. Similar, but less severe findings were seen in the right thigh adductors and vastus medialis. We managed the patient conservatively with rest and pain control, and her symptoms gradually improved.
DISCUSSION: Diabetic muscle infarction (DMI) is a rare vascular complication of poorly controlled, long-standing diabetes mellitus. It results from ischemic necrosis of skeletal muscle with local inflammation. It is slightly more common in women(59%) and type 1 diabetics(62%). As in our case, patients typically have microvascular complications, such as nephropathy(71%), retinopathy(57%) and neuropathy(55%). Common symptoms include pain(80%), swelling(76%), mass(34%), and fever(10-50%). DMI usually occurs in the thigh, most commonly the vastus lateralis and medialis muscles. Bilateral involvement occurs in 8-30% of cases. Laboratory data is non-specific but can include leukocytosis and an elevated creatinine kinase or erythrocyte sedimentation rate. MRI shows a hyperintense signal on T2-weighted images. Muscle biopsy showing microvascular disease with muscle necrosis and inflammation can confirm the diagnosis. As with our patient, diagnosis is often delayed due to the rarity of the disease and misdiagnosis of more common etiologies such as infections or neuropathies. The differential diagnosis includes focal myositis, polymyositis, pyomyositis, deep vein thrombosis, nectrotizing fasciitis and calciphylaxis. Our patients case highlights features that suggest DMI, including her characteristic pain and swelling associated with typical MRI findings. MRI findings are generally confined to a single muscle or muscle group and lack the focal, well-demarcated intramuscular fluid or gas collections of pyomyositis or necrotizing fasciitis. Our patient also lacks the rapid progression of severe systemic symptoms that herald necrotizing fasciitis or pyomyositis. Other helpful diagnostic features include the absence of dermal and subcutaneous fat necrosis seen in calciphylaxis.
DIAGNOSING VITAMIN B12 DEFICIENCY - WHEN NUMBERS LIE! Nataliya Mar; Anita Pudusseri; Robert E. Graham. Lenox Hill Hospital, New York, NY. (Control ID #1320149)
LEARNING OBJECTIVE 1: Recognize the limitations of serum cobalamin levels in diagnosing vitamin B12 deficiency and be aware of alternative tests available.
LEARNING OBJECTIVE 2: Know when to institute empiric B12 replacement therapy.
CASE: A 75-year old male presented with generalized weakness and dizziness for 3 weeks. His medical history included colon adinocarcinoma treated with resection 13 years ago, hypertension, and mild thrombocytopenia of unclear etiology. He denied fevers, dyspnea, chest pain, bleeding, or diarrhea. Vital signs were notable for a blood pressure of 106/82 with positive orthostatics. Physical exam was unremarkable while rectal exam showed heme-negative stool. Laboratory analysis was as follows: white cell count, 5,900/L; hemoglobin, 8.9 g/dL (from 13.4 g/dL 4 months ago); mean corpuscular volume, 121.4 fL; platelets, 79,000/L (from 105,000/L 4 months ago); lactate dehydrogenase, 527 U/L; total bilirubin,1.8 mg/dl; direct bilirubin, 0.4 mg/dl; haptoglobin, <8 mg/dl; negative direct antiglobulin test; negative urine hemosiderin; reticulocyte count,1.6%; and thyroid stimulating hormone, 1.13 mclU/ml. Peripheral smear showed 3+ schistocytes, moderate spherocytes and ovalocytes, and hypersegmented neutrophils. The patient received 1 unit of packed red cells and vitamin B12/folate deficiency was suspected. However, folate level was 12.3 ng/ml [normal, 3.1 - 17.5 ng/ml] and vitamin B12 level was 489 pg/ml [normal, 254 - 1320 pg/ml]. Repeated vitamin B12 level was 321 pg/ml. Bone marrow biopsy showed erythroid hyperplasia, megaloblastic changes, hypersegmented neutrophils, increased iron stores, and normal flow cytometry/cytogenetics. Empiric daily cyanocobalamin (1 gram intramuscularly) was initiated with good hematologic response. With time, the following tests were resulted: methylmalonic acid, 28 nmol/ml [normal, <0.4 nmol/ml]; homocysteine, 72.4 mcmol/L [normal, 3.2 - 10.7 mcmol/L]; and markedly increased anti-parietal

cell and intrinsic factor antibody titers. A formal diagnosis of vitamin B12 deficiency due to pernicious anemia was made.
DISCUSSION: This case highlights the difficulty in establishing a diagnosis of vitamin B12 deficiency due to repeatedly false-negative serum cobalamin (sCbl) assay results. In clinical practice, sCbl levels are the diagnostic test of choice due to being easily-accessible and cost-effective [2]. However, they lack sensitivity and specificity, missing many patients with tissue B12 deficiency [1, 3]. Several reports also commented on false-negative sCbl results due to intra-assay variability when B12 deficiency was clinically evident [4, 5]. As such, measurements of serum methylmalonic acid (MMA) and homocysteine (Hcy) levels, which are elevated in B12 deficiency, become useful when sCbl levels are equivocal but clinical suspicion remains high [2]. Short-term intra-individual variations in MMA and Hcy values are also common, leading to false normal results [6]. Accumulating evidence indicates that serum holotranscobalamin (holoTC), an earlier marker that decreases before total sCbl, may be superior to other assays and has been proposed for use as a first-line diagnostic test [2, 3, 7]. A major challenge arises when deciding on whether to institute empiric B12 therapy when laboratory results contradict the clinical picture or additional tests are pending. In this setting, it is prudent to start replacement therapy and continue treatment provided a clinical improvement is evident or until a final diagnosis can be made [2, 6].

DIAGNOSIS OF DISSEMINATED HISTOPLASMOSIS WITH A PERIPHERAL SMEAR Richard A. Lau. UCLA - Olive View, Sylmar, CA. (Control ID #1330160)
LEARNING OBJECTIVE 1: Recognize that the different diagnostic modalities available for the confirmatory diagnosis of systemic histomplamosis infection can take days to weeks to result, with the exception of the examination of the buffy coat on a peripheral smear which can be performed and completed within hours.
LEARNING OBJECTIVE 2: Recognize the presentation of disseminated histoplasmosis.
CASE: Pt is a 38 year old Guatamalan male, recently moved to California, presenting with 1 month history of fevers, fatigue, abdominal pain, and diarrhea. The patient initially experienced symptoms of subjective fevers and fatigue. Several days later, he began experiencing unremitting abdominal pain. He localized the pain as diffusely over his abdomen and characterized the pain as a "hot" and "gurgling" sensation. Then several days prior to presentation, the patient began having profuse, non-bloody, watery diarrhea. Initial vital signs were T 35, HR 122, BP 114/67, RR 20 and O2 sat 99% on RA. Physical exam was significant for leukoplakia, hepatosplenomegaly, minimal diffuse abdominal tenderness to deep palpation, and mildly enlarged bilateral inguinal LNs. Labs notable for a CBC diff showed WBC 1.9 (79% neutrophils, 13%lymphs,6%mono) Hb/Hct 8.6/26 PLT 25. CT scan of the c/a/p revealed enlarged mediastinal LAD, bilateral nodular opacities in the lungs, HSM, multiple enlarged retroperitoneal LNs extending from the level of the kidneys to the common iliac arteries. The patients clinical presentation at this point was concerning for HIV. Subsequently, HIV lab tests were sent, which came back positive, with HIV VL of 683,395 copies/mL and a CD4 count of 1/cubic mm. After confirmation of HIV, additional tests were done throughout the hospital course to assess for disseminated histoplasmosis, including urine histoplasma antigen, fungal blood cxs, bone marrow bx, and a retroperitoneal LN bx and cx. All such tests were consistent for disseminated histoplasmosis. However, of all the tests mentioned, the peripheral smear confirmed the diagnosis days to weeks prior to all the other tests. After confirmation with peripheral smear, pt was started on liposomal amphoteracin with good response to therapy.
DISCUSSION: In the patient described in the case, his clinical course was consistent with disseminated histoplasmosis. Numerous modalities are available for the diagnosis of disseminated histoplasmosis. The most common of which is the histoplasma antigen of the urine, serum or csf. Other diagnostic tests include fungal cxs of blood or tissue specimens, histoplasma serologies, and histologic examination of biopsy specimens.

However, all such tests are limited by time, up to days to weeks, either because of processing or procurement. Examination of the buffy coat on a peripheral smear is an old and forgotten, but fast and inexpensive test for the diagnosis of certain disseminated infections. The detection of small yeasts in circulating mononuclear cells is very specific for histoplasmosis, as no other fungi which causes human disease can have such an appearance within white blood cells. However, because of the lack of data on the use of buffy coats to diagnose disseminated histoplasmosis, the exact sensitivity is unknown. Therefore, although a negative buffy coat examination does not rule out disseminated histoplasmosis, a positive result is very specific and can expeditiously guide initial therapy, even before the results of the other diagnostic modalities (serologies, cultures, biopsies) return days to weeks later.

DIAGNOSTIC DELAY IN ACHALASIA Ahmet A. Oktay. Saint Francis Hospital, Evanston, IL. (Control ID #1338687)

LEARNING OBJECTIVE 1: Considering achalasia within the differential diagnosis of vomiting and dysphagiaLEARNING OBJECTIVE 2: Timely use of barium swallow evaluation CASE: 26 year-old African American female with no significant past medical history presented to the emergency department with history of vomiting and dysphagia which was described as inability to swallow solids or liquids. Patients symptoms began one week after returning from a trip to Nigeria. She was initially experiencing epigastric burning pain accompanied by difficulty swallowing solids without vomiting. Her symptoms progressively worsened within weeks and for the past 4 months she had had bouts of emesis typically within 60 seconds after any oral intake. She had lost 32 pounds over this time period. She denied any intentional component of dysphagia. She reported being evaluated for her symptoms during 5 different visits to the emergency departments in Chicago-land area. She denied any hospital admissions. She was given treatment with proton pump inhibitors and antibiotics for possible gastroesophageal reflux disease and Helicobacter Pylori. But she hadnt had any relief of her symptoms. Her physical examination revealed body mass index at 17.7 Kg/m2, blood pressure at 96/67 mmHg, heart rate at 82. Physical exam was otherwise unremarkable. Her laboratory tests were not significant except albumin 3.2 mg/dL, lipase 12 IU/L, hemoglobin10.7 mg/dL, bicarbonate 16 mmol/L. Obstructive series in ED demonstrated nonobstructive bowel gas pattern. Patient underwent esophagogastroduodenoscopy procedure, which revealed food retention in distal esophagus. Lower esophageal sphincter was passed with modest pressure on endoscope. Barium swallow evaluation of the esophagus demonstrated sharp tapering of the distal esophagus characteristically known as a "birds beak" sign. There was subsequent dilatation of the distal half of the esophagus. Loss of peristalsis was noted within the distal esophagus and a fluid-fluid level was noted indicative of esophageal dysmotility. Those findings were suggestive of achalasia. Patient underwent motility studies at another medical center, which confirmed the diagnosis (verbal report). DISCUSSION: This case illustrates the importance of considering achalasia within the differential diagnosis of vomiting and dysphagia. Achalasia findings can sometimes misinterpreted as GERD or H. Pylori infection. Timely use of barium swallow evaluation would have established the correct diagnosis earlier in this case. And with the use of pneumatic dilatation or surgical myotomy procedures, the severe gastrointestinal discomfort for 4 months and the significant weight loss would have been prevented.

DIET PILL SHOCK Sean Condon1; Eric Green2; Manzoor Rather2.

1Drexel University College of Medicine, Philadelphia, PA; 2Mercy Fitzgerald Hospital, Darby, PA. (Control ID #1339083)

LEARNING OBJECTIVE 1: Recognize potential side effects of over the counter (OTC) diet pillsLEARNING OBJECTIVE 2: Recognize caffeine induced anaphylaxis CASE: A 24-year-old African American female presents with 12 hours of diaphoresis and severe stabbing abdominal pain, which awoke her from sleep. She also notes the appearance of a red pruritic maculopapular rash covering her body including palms and soles, periorbital edema, lip swelling, and shortness of breath. She began an over the counter (OTC) diet pill, D4 Thermal Shock, seven days ago. She had a similar, yet less severe reaction to another diet pill called

Oxyproelite. Medical, social, and family histories are non-contributory, and dietary history is notable for very rare ingestion of caffeinated beverages. She has no known allergies. Physical exam was remarkable for a temperature of 103.9 degrees F, tachypnea, diffuse expiratory wheezes bilaterally, a diffuse blanching maculopapular rash and 2+ lower extremity edema. Labs including EKG, chest X-ray, electrolytes, complete blood count, and a urine drug screen were normal. She was treated initially with epinephrine, then admitted and treated with antihistamine and steroid therapy. Her symptoms abated within 36 hours and she was discharged home with instructions to avoid OTC weight loss pills. DISCUSSION: This patients history strongly suggests anaphylaxis. Her lack of other dietary or medication triggers, past history of an adverse reaction from diet pills, and her recent use suggests the OTC diet pill was the culprit. A large number of OTC products have been marketed for weight loss, and 15.2% of adults have used a weight loss supplement. However, the adverse effects of OTC diet pills have been poorly described. In part this is likely because almost all of these agents are marked as dietary supplements and therefore are not subject to FDA oversight for safety and efficacy, nor are they subject to after-market collection of adverse effects. Anaphylaxis has never previously been reported as a side effect from OTC diet pills. On review of the ingredient list for both diet pills, the only common ingredient was caffeine. Thus, this patient may be allergic to caffeine or one its metabolites. Although rare, there have been 5 documented cases of caffeine causing hypersensitivities including urticaria, rash, anaphylaxis and even death. A 21 year-old boy presented very similarly with pruritus of the soles and palms, generalized urticaria, cough, wheezing

and shortness of breath after drinking a cup of coffee. Cases were confirmed with skin prick tests and oral tolerance. In all cases, caffeine induced urticaria/ anaphylaxis was dose dependent. It remains to be seen whether caffeine-induced urticaria represents IgE-mediated type I allergy or a nonallergic hypersensitivity. Further studies are needed to determine the exact pathophysiology. Regardless, due to the prevalence of caffeine and its use, a caffeine allergy may be the underlying cause of many cases inappropriately termed idiopathic anaphylaxis.

DIFFICULTY GETTING UP IN THE MORNING: A CASE OF THYROTOXIC PERIODIC PARALYSIS Cliff W. Hampton1; JosephR. Sweigart1; Susan M. Nikels1; Michael Hanley2. 1University of Colorado Denver, Aurora, CO; 2University of Colorado Denver, Aurora, CO. (Control ID #1327979)

LEARNING OBJECTIVE 1: Recognize thyrotoxic periodic paralysis as an uncommon complication of thyrotoxicosisLEARNING OBJECTIVE 2: Treat thyrotoxic periodic paralysis with nonselective beta blockade and cautious potassium supplementation CASE: A 47 year old man of Eastern European descent was brought to the emergency department after awakening with profound muscle weakness. He got out of bed at 6:00 am, but was so weak he fell to the floor and was unable to get up. After some time, he pulled his phone to the floor and called emergency medical services. He had noticed some mild myalgias in his right thigh the previous night, but had no other recent symptoms. On exam, he was afebrile, heart rate was 90 beats per minute and blood pressure 160/94 mmHg. He had flaccid proximal quadriparesis and diffuse mildly-diminished reflexes. Mental status, sensation, speech, and cranial nerves were normal. He denied recent exertion, high carbohydrate intake, or stimulant use. However, he did admit to being under significant stress related to personal life events. Labs revealed severe hypokalemia of 1.7 mmol/L and subsequent ECG showed associated changes. Further investigation revealed an undetectable thyroid stimulating hormone and a moderately elevated free thyroxine value of 2.2 ng/dL. Other labs were unremarkable. He did not present with obvious symptoms of hyperthyroidism, but in retrospect did recall recent episodes of loose stool, fine hand tremors, and palpitations over the preceding months. Thyrotoxic periodic paralysis was diagnosed and the patient was admitted overnight for close monitoring. After receiving propranolol and gentle potassium repletion the hypokalemia resolved, the muscle weakness improved dramatically, and the ECG normalized. Prior to discharge, he was started on methimazole and beta blockade. As an outpatient, he was later diagnosed with Graves disease.

DISCUSSION: Thyrotoxic periodic paralysis (TPP) is a well-described complication of hyperthyroidism. It is relatively common in patients of Asian lineage. However, it remains quite rare in other races. Patients tend to be young adult men presenting with flaccid paralysis that progresses from the lower to the upper extremities. Sensation is unaffected. Patients most often present early in the morning after an overnight onset. The event is often preceded by high carbohydrate intake, alcohol intake, or strenuous exercise. This patients attack seems instead to have been precipitated by personal life stress, suggesting a common pathway involving glucocorticoid and insulin excess. It is thought that the excess thyroxine simultaneously increases the adrenergic response, the activity of the Na+/K+-ATPase pumps and insulin release, all of which shift potassium ions intracellularly. The functional hypokalemia causes hyperpolarization of the motor neurons leading to paralysis. Neither the severity, duration, nor the etiology of the hyperthyroidism are correlated with TPP. When treating TPP, total body stores of potassium are not decreased and overaggressive potassium repletion can be fatal. Potassium repletion is, however, important in prevention of fatal hypokalemic arrhythmias in the acute setting. Ongoing supplementation for prophylaxis against attacks is not helpful. Administration of a non-selective beta blocker may be as useful as potassium chloride administration and is without the risk of rebound hyperkalemia. These should be taken until the patient reaches a euthyroid state and definitive treatment for hyperthyroidism is completed.

DIFFUSE LARGE B-CELL LYMPHOMA OF THE NECK COMPLICATED BY TRACHEAL PERFORATION

Janine Adamczyk. Montefiore Medical Center, Bronx, NY. (Control ID #1340131)

LEARNING OBJECTIVE 1: Recognize Non-Hodgkin lymphomas as highly invasive and rapidly enlarging cancers which can lead to unusual complications such as tracheal perforationLEARNING OBJECTIVE 2: Identify the critical role of a good physical exam in clinical decision-makingCASE: An 80 year old female with a history of asthma presented with shortness of breath and painless swelling of her neck. An intravenous contrast enhanced CT scan showed a 7.3x5.8 cm central neck mass with necrotic areas and surrounding adenopathy. A lymph node biopsy established the diagnosis of a diffuse large B cell lymphoma which was classified as stage 2B. Increasing respiratory distress necessitated endotracheal intubation of the patient. Chemotherapy according to the R-CVP protocol (Rituximab, Cyclophosphamide, Vincristine, Prednisolone) was initiated. A repeat CT neck showed a significant reduction in tumor mass after the first cycle. However, the patient failed multiple attempts to wean her from the ventilator. Two days into the second therapy-cycle she developed a sudden inspiratory stridor. A CT neck revealed a tracheal perforation at the thoracic inlet with the endotracheal tube extending through the defect. Bronchoscopy confirmed a tracheal perforation between the 2nd and 7th tracheal ring with extensive tissue necrosis. The patient was managed conservatively by bridging the defect with an endotracheal tube and by starting antibiotics. One week later, she was successfully extubated and remained stable, a repeat bronchoscopy after two weeks showed beginning granulation of the lesion.

DISCUSSION: Respiratory distress is a common complaint encountered by internal medicine physicians. Malignancy inside or outside of the thorax is an important differential diagnosis. With an incidence of 7 cases per 100 000 person years, diffuse large B-cell lymphoma represents the most common histologic subtype of Non-Hodgkin lymphoma (approximately 25%). NHL can be highly invasive and rapidly enlarging. The disease most commonly arises from lymph nodes in the neck and abdomen but can virtually affect any tissue. Depending on the stage, 5-year survival rates between 21 and 83 percent can be achieved after treatment with systemic chemotherapy with or without involved-field radiotherapy. Perforation of the gastrointestinal tract in patients with gastrointestinal lymphoma undergoing chemotherapy has been well described. Only a few case reports link lymphoma with tracheal perforation. Tracheal rupture itself is a rare condition most commonly caused by head and neck trauma or by intubation, tracheostomy, bronchoscopy, radiotherapy or infection. In this case, rapid tissue necrosis due to chemotherapy-induced vascular compromise caused the patients tracheal perforation. Previously described risk factors for tracheal perforation are mainly anatomic in nature, e.g. tracheal distortion by lymph node collections or smoking-related COPD. The management includes surgical

closure, stent placement or conservative therapy. Complications such as mediastinitis and tracheal stenosis have been described. In our patient, an interventional closure was not possible due to the inability to anchor a tracheostomy for ventilation below the defect. Overall, the detection of inspiratory stridor in physical exam led to rapid diagnosis of this potentially lethal complication and a positive outcome in this case.

DIFFUSE PULMONARY CAVITARY LESIONS AS A RARE PRESENTATION OF ACUTE SARCOIDOSIS. Bassam Yaghmour; George Yaghmour; Mustafa Abas; Michael Eichenhorn. HFHS, Detroit, MI. (Control ID #1340088)

LEARNING OBJECTIVE 1: Recognize pulmonary cavitary sarcoidosis as a rare form of acute sarcoidosis. LEARNING OBJECTIVE 2: Review of Pulmonary cavitary sarcoidosis including pathogenesis, characteristics, natural history and treatment. CASE: A 27-year-old African-American female presented to the hospital with complaints of acute upper respiratory tract infection symptoms and blurred vision of five days duration. These symptoms were overlying a one month history of progressive dyspnea and non-productive cough associated with constitutional symptoms including fatigue, subjective fever, chills, night sweats and a 15 lb weight loss. There was no history of sick contacts, travel outside of Michigan, occupational exposure, or TB exposure. Chest x-ray showed multifocal cystic changes, patchy opacity, and hilar lymphadenopathy. CT scan of the chest showed multiple, bilateral cavitations as well as

hilar and mediastinal lymphadenopathy. Laboratory data showed a high level of serum angiotensin converting enzyme 172. The patient was placed in isolation and TB was ruled out. Histological findings of specimens obtained by transbronchial lung biopsy and by trans-bronchial fine-needle aspiration of mediastinal lymph nodes demonstrated noncaseating granulomatous inflammation consistent with sarcoidosis. Infection, autoimmune, and malignancy evaluations were negative. Since the patient was symptomatic with dyspnea and blurry vision, she was started on prednisone 40 mg daily. As the patient began to improve clinically, she decided to forgo an ophthalmologic exam to evaluate for uveitis and further radiological images. DISCUSSION: Pulmonary cavitary lesions are a rare and often confusing manifestation of sarcoidosis. Clinicians unfamiliarity with this atypical presentation is compounded by the relative scarcity of reported cases in the United State as compared with other parts of the world. A retrospective series performed in France estimated the prevalence of cavitary sarcoidosis with no pulmonary comorbidities to be 2.2%. Cavitations do not appear to be specific to radiologic stage of disease as they have been reported in stages II through IV. Regardless, most cases were reported in patients with severe and active sarcoidosis including a majority associated with extrapulmonary sarcoidosis. Additionally, the serum angiotensin-converting enzyme was more than 2 times the upper limit of normal range in most of the reported cases indicating highly active disease. The pathogenesis of cavitation in the context of sarcoidosis is unclear as there have been several mechanisms hypothesized to contribute, however, it is accepted that cavitary lesions are related to ischemic necrosis with extrusion of hyaline material from conglomerate sarcoid granulomas. The evolution of the cavitations is unpredictable as a literature review of case reports has shown inconsistent improvement versus developments of complications when the patient is treated with steroids for extrapulmonary manifestations. Despite the observation that some patients cavitations completely resolve, complications frequently arise in patients with cavitary sarcoidosis. These include aspergilloma, hemoptysis, secondary infection, and pneumothorax. Selected case reports in which there was a reduction in cavitary lesions suggests that systemic steroids are effective in the treatment of cavitary sarcoidosis.

DISSEMINATED INTRA-VENTRICULAR ENDOCARDITIS (DIVE) SYNDROME Sara Taherkhani; Damanpreet Grewal; Robert Biederman; Triston Smith. Allegheny General Hospital, Pittsburgh, PA. (Control ID #1335078)

LEARNING OBJECTIVE 1: Recognize the embolic manifestations of endocarditis in a timely fashion and utilize

the best method for accurate diagnosis of intra-ventricular endocarditis.
CASE: A 30 year old male IVDU was initially found unresponsive at home and though alert in ED, became progressively lethargic, tachypneic and hypotensive requiring intubation and MICU admission. CBC showed leukocytosis of 25,000 with a left shift. Physical exam was remarkable for bilateral subconjunctival hemorrhages, diffuse rhonci, 2/6 apical systolic murmur, needle tracks on upper extremities and Janeway lesions on several fingers and toes. Empiric broad spectrum antibiotics were initiated after blood cultures were drawn, given the concern for endocarditis, which subsequently grew MSSA. CT showed bilateral, scattered, subcentimeter pulmonary nodules, multiple splenic infarcts and various small foci of intraparenchymal hemorrhages in the brain, all suggestive of septic emboli. Initial TTE was normal but subsequent TEE with 3D reconstructed images showed multiple highly mobile densities extensively throughout the left ventricle and the outflow tract attached to the surface, as well as a large mobile mass attached to the anterior infindibulum of the right ventricle with resulting outflow tract obstruction. No valvular involvement was present, nor were there any structural abnormalities. Unfortunately the patient presented too late in the course of his illness and was no longer thought to benefit from surgical intervention. Despite aggressive antibiotic therapy, he succumbed to intracranial hemorrhage.
DISCUSSION: Although Staphylococcus aureus is capable of infecting normal heart valves, infection is usually preceded by injury to the endocardium by various turbulent hemodynamic mechanisms. In an IVDU without known preexisting cardiac disease or immunosuppression, infection is presumed to be due to trauma to heart valves by contamination with debris and bacteria during injection. Though rare, mural endocarditis has been reported in the past but our case is the first to diffusely involve both ventricles with diagnosis by TEE alone. Although TTE is considered the best method for detecting masses in the LV apex, TEE proved to be superior in our patient. Hence, when suspicion for endocarditis is high, it is advised to proceed directly to TEE as its sensitivity and specificity are greater than TTE. Embolization, with its high mortality, is the most feared complication of mural endocarditis, which warrants attention and awareness as early diagnosis with surgical intervention, when possible, is of paramount importance in the patient's outcome.
DISSEMINATED HISTOPLASMOSIS IN A PATIENT WITH CROHNS DISEASE WHO IS MAINTAINED ON INFLIXIMAB, PREDNISONE AND AZATHIOPRINE Abdallah Abou Zahr1; Pete Yunyongying1,2. 1university of texas south western medical center, Dallas, TX; 2Dallas VA medical center, dallas, TX. (Control ID #1333846)
LEARNING OBJECTIVE 1: Diagnose histoplasma infection in patients with crohns disease who are maintained on immunosuppressive regimen.
CASE: The patient is 43 yo man with Crohns Disease who is maintained on azathioprine, prednisone and infliximab. He presented to his private gastroenterologist with worsening odynophagia. Esophagogastroduodenoscopy (EGD) was performed and showed inflammatory changes in the oropharynx including the epiglottis. He was managed as Crohns flare so his immunosuppressive regimen was increased. However the patient's symptoms worsened. So additional work up was done including laryngos-copy and biopsy of the epiglottis was taken. The result showed histoplasma epiglotittis. The patient's immunosuppressive regimen was tapered down and he was started on amphotericin initially and then itraconazole with rapid improvement in his symptoms.
DISCUSSION: Crohns disease is associated with significant infectious complications, both treatment and nontreatment related. A broad spectrum of treatment related infectious complications has been reported and these include viral, bacterial, protozoal and fungal infections. Among these infections disseminated histoplasma is interesting because its presentation can mimic crohns flares. Data regarding fungal infections in IBD patients who are maintained on immunosuppressive regimens including infliximab is limited to case reports and case series. 240 cases of histoplasmosis associated with use of tnf alfa inhibitors has been reported to FDA AERS till September 2008. Clinically 70 to 90% of patients with disseminated histoplasmosis have gastrointestinal involvement. The GI symptoms include nausea, vomiting, diarrhea, bleeding, abdominal pain, weight loss,

obstruction, and perforation. Many of these GI symptoms overlap with Crohns flare. Also there is significant overlap among the endoscopic findings that include plaques, small polyps, mucosal edema, ulcerations, strictures, and masses. So the differentiation between histoplasma infection and crohns flare is not easy given the significant overlap in clinical and endoscopic features. However it is very important to be able to recognize histoplasma infection in these patients because the treatment of Crohns disease with immunosuppressive regimens can worsen histoplasma infection. In this case there are several clinical clues that hint at infectious reasons for patient presentation. First the patient did not have symptoms of Crohns flare elsewhere as he usually has. Another important clue is that symptoms became worse after the escalation of the immunosuppressive regimen which is unusual for Crohns flare. A high index of suspicion is needed in patients with worsening symptoms despite being on multiple immunosuppressive regimen. A diagnostic work up should be initiated and it includes fungal sputum and blood cultures, histoplasma antibodies and antigen in blood and urine, as well as histopathological testing. However histopathology is only 50% sensitive. This case presents a diagnostic challenge because of significant overlap between some of treatment related infectious complications of Crohns disease and Crohns flare. A high index of suspicion is needed because missing the diagnosis of disseminated histoplasmosis can result in deleterious consequences.

DOC, WHY DOES MY KNEE HURT? GOUT, THE FALL, THIS TICK OR NONE OF THE ABOVE? Jonathan Kirsch; Jack Kuritzky; Mukhtar Adem. University of North Carolina, Chapel Hill, NC. (Control ID #1339600)

LEARNING OBJECTIVE 1: Understand the approach to a patient with acute inflammatory joint pain through history and synovial fluid analysis. LEARNING OBJECTIVE 2: Recognize the clinical presentation and three pathogenic mechanisms of primary meningococcal arthritisCASE: A 66 year-old man presented with left knee swelling, pain, fever malaise and a rash. He had been treated with doxycycline for 3 days for a presumed tick-borne illness after finding a tick on his arm. His knee pain and swelling progressed and he presented to the hospital when he could no longer ambulate. He was also involved in a motorcycle accident one month prior to admission, but his knee pain resolved quickly. He had a history of gout, affecting his toes and knees, but hadnt had any recent flares. He was afebrile. His neurological exam was unremarkable. He had a petechial rash on his lower extremities. He had normal passive range of movement in both of his knees without reproduction of pain. His left knee was tender to palpation with a moderate-sized effusion. His serum white blood cell count was 16,900 x 10^9/L with a normal serum chemistry profile. Arthrocentesis of his left knee effusion yielded monosodium urate crystals and 5800 white blood cells per high powered field with 90% neutrophils. There were no organisms on gram stain. Joint fluid was sent for culture. The patient was started on prednisone for presumed gout and continued on doxycycline for possible tick-borne illness. His knee pain and swelling didnt improve. On day 2 of his hospitalization, the culture from his arthrocentesis yielded gram-negative diplococci and ceftriaxone was initiated. On day 4, this organism was speciated as Neisseria meningitidis. Blood cultures remained negative. He was diagnosed with primary meningococcal arthritis.

DISCUSSION: Knee pain with effusion is commonly encountered by the internist. An approach to determine the etiology of knee pain should include an analysis of synovial fluid. While gram stain, culture, and polarized light microscopy may yield a specific diagnosis, the leukocyte count helps to categorize the effusion. Non-inflammatory conditions, such as osteoarthritis, tend to have a synovial leukocyte count <2,000 per m^3. Counts between 2,000 - 100,000 leukocytes per mm^3 suggest inflammatory etiologies such as gout, rheumatoid arthritis, and other rheumatologic conditions. Finally, septic arthritis is associated with at least 15,000 leukocytes per mm^3 in the synovium and it often exceeds 100,000 per mm^3. This patient had a knee infection with Neisseria meningitides and no other signs of neurologic involvement, consistent with a diagnosis of primary meningococcal arthritis. Infections with Neisseria meningitides present with rheumatologic manifestations in 2-10% of cases. Patients with arthritic complications tend to be less than 60 years old and present with monoarticular symptoms affecting the knees and ankles. Approximately 30% of patients also experience an

erythematous, maculopapular rash. The development of meningococcal arthritis can be via one of the following mechanisms: direct hematologic spread, immunologic mechanism with meningococcal antigen-antibody complexes and disseminated intravascular coagulation causing hemarthrosis in fulminant meningococcemia.
DOCTORS DILEMMA: DIFFERENTIATING BETWEEN REALITY AND DELUSION IN A PSYCHOTIC PHYSICIAN Molly A. Fisher4;
Jessica Campbell1,2; Lilia Cervantes1,2; Aaron Scott2; Kilmberly Breidenback3.
1Denver Health, Denver, CO; 2University of Colorado, Denver, CO;
3University of Colorado, Denver, CO; 4University of Colorado, Denver, Denver, CO. (Control ID #1335872)
LEARNING OBJECTIVE 1: Highlight the challenges faced when providing medical care to physicians with psychiatric illness LEARNING OBJECTIVE 2: Differentiate between different forms of delusions of parasitosisCASE: : BP is a 55-year-old retired physician who was admitted to our medicine service for observation after suffering a scalp laceration and small subdural hematoma related to a fall outside of a tavern. As the patient
sobered, he informed the team that he was a family physician with a rare case of disseminated dermatophytosis from tinea capitis. He believed the tinea was growing in the sutures of his skull and causing a host of neurological symptoms. Due to the patients vast medical knowledge, he created convincing explanations to validate his bizarre beliefs. His explanations were medically sound and created considerable debate among the team as to what extent to entertain the validity of his ideas and work-up his complaints. During his hospitalization the team recognized that whenever a test or study disproved his medical logic he created an alternative explanation and his certainty about his diagnosis never wavered. BP became outraged when the team denied his requests for specific studies and quickly discredited doctors who disagreed with him. His frustration led to angry outbursts and agitation. The situation was complicated by possible delirium secondary to the subdural hematoma, and the patients use of prescribed amphetamines. Ultimately, he was admitted to the inpatient psychiatry unit.
DISCUSSION: Delusions of parasitosis is a rare condition in which a person believes that he or she is infested by parasites. It is categorized by DSMIV as a somatic-subtype delusional disorder. Rarely delusions of parasitosis involve tinea , a fungal infection limited to the dermis. There are no previously documented cases in the medical literature of a physician with delusions of parasitosis. The greatest challenge in treating this case stemmed from BPs medical training. It was unsettling to watch as his distorted expertise wreaked havoc on his emotional state; we could imagine ourselves in his place. Our clinical decision-making was muddled with our emotional reaction to the situation making it difficult to decide how far to indulge his delusions. At times we hoped to find disseminated dermatophytosis to legitimize him and calm our own fears. This unusual case demonstrates the importance of acknowledging our reaction to patients, the difficulty of treating a physician and the challenge of effectively managing delusions.
DON'T GET TRAPPED: ASSESSING PATIENTS WITH ULNAR NEUROPATHY Meena Raj; Jillian S. Catalanotti. George Washington University, Washington, DC. (Control ID #1334655)
LEARNING OBJECTIVE 1: Develop a differential diagnosis of intrinsic hand muscle atrophyLEARNING OBJECTIVE 2: Recognize indications for surgical involvement of ulnar nerve entrapmentCASE: A 60 year old woman with a history of diabetes mellitus presented to primary care clinic with right hand pain. The patient is a legal secretary and right hand dominant. Her symptoms started after a blood draw was taken from the ulnar aspect of her right wrist six months prior to her visit. Since then, she noted severe pain with associated weakness and diminished dexterity of her fingers. On physical exam, vital signs were normal and she was well-appearing. Her neck revealed full range of motion and a non-tender cervical spine. She had 2+ radial and ulnar pulses bilaterally and her wrist exam showed no deformity, full range of motion, and no strength deficits. She had severe atrophy of the first dorsal interosseous muscle as well as the hypothenar and loss of abduction of her fifth digit (Waternbergs sign). Tinels sign was positive distal to Guyons canal but negative over the ulnar

nerve at the elbow. There was mildly reduced sensation and prolonged two-point discrimination along the fifth digit. These clinical findings were consistent with ulnar nerve palsy. Work-up was initiated with EMG, which confirmed a severe distal ulnar neuropathy. MRI demonstrated an abnormal growth distal and anterior to the styloid process of the ulna, near the course of the ulnar nerve. She was referred to orthopaedic surgery and underwent surgical decompression in Guyons canal. Pathology of the mass revealed mature adipose tissue. The patient was disappointed postoperatively, with no improvement in her significant atrophy as well as ongoing pain and decreased motor control of the fifth digit. DISCUSSION: Muscle atrophy generally occurs where there is complete, chronic muscle denervation. Diagnosing intrinsic hand muscle atrophy includes both elucidating an etiology and discerning the location of the lesion. Systemic conditions which affect the hand muscles often present bilaterally and include Pancoast syndrome, Hansens disease, rheumatoid arthritis, amyotrophic lateral sclerosis and poliomyelitis. Unilateral findings may be due to chronic repetitive trauma, fractures of the wrist bones,

thrombosis, aneurysms, or masses such as lipomas, ganglia, or synovial cysts. Sites of possible nerve involvement include the anterior horn cells(i.e. ALS), nerve roots (i.e. cervical spondylosis), brachial plexus, peripheral nerves (median or ulnar nerves), or the muscle itself (i.e. congenital myopathies). In our patient, severe ulnar neuropathy was secondary to entrapment of the nerve at the wrist by what appeared to be a lipoma and was likely exacerbated by the chronic repetitive movements from her long career as a legal secretary. Indications for surgery in ulnar nerve entrapment are lack of improvement in symptoms 2-3 months after attempts at conservative therapy, progressive palsy/paralysis or clinical evidence of a long-standing lesion such as demonstrated in our patient by muscle wasting. Post-operative prognosis is affected by duration of nerve entrapment and severity of weakness and paresthesias. In chronic cases, improvement may be limited but further progression of damage can be halted.

DON'T OVERLOOK THE WARNING SIGN. Thandar Aung1; Harvey Friedman2; Glynn . Elliott1; Karoon Nititham3. 1Saint Francis Hospital, Evanston, IL; 2Saint francis hospital, evanston, IL; 3North Suburban Cardiology Group, Evanston, IL. (Control ID #1311848)

LEARNING OBJECTIVE 1: Transient ischemic attack(TIA) is a serious warning sign for potential stroke, cardiovascular events and death. Therefore, finding consistent with TIA deserves urgent workup due to risk of significant morbidity.

LEARNING OBJECTIVE 2: Complex aortic arch plaque has taken its place along with Atrial Fibrillation(AF) and Carotid Atherosclerosis as an important cause of cerebral ischemia and peripheral embolism. Aortic arch plaque is also an independent predictor of Myocardial Infarction, Cerebral ischemia and vascular death.

CASE: 84 y/o Male, heavy smoker, with past medical history of hypertension,COPD and type 2 Diabetes came to ER because he experienced four episodes of TIA within one month. During each episode, he suddenly lost consciousness for few minutes followed by facial droop, slurring of speech and weakness of the extremities and completely resolved within an hour. In each episode, only one side of the body was affected but both sides had shown symptoms across multiple episodes. He also had 2 similar episodes last one and a half years ago. No significant family history. Physical examination, MRI of the brain, Transthoracic echocardiogram and Electrocardiogram were unremarkable. He was discharged on the same day with Aspirin and Statin. Seven months later, he was admitted to the hospital for new onset AF and heart failure due to non ST elevation Myocardial Infarction(NSTEMI). In addition to AF, physical examination revealed he had tachypnea, diffuse wheezing, decreased breath sound in bilateral lower lung field and bilateral lower extremities edema. He underwent CT chest with contrast showed no pulmonary embolism, bilateral pleural effusion, enlarged heart and there were two approximately 1 cm in thickness non calcified ulcerated linear plaque in each ascending and

descending portion of aortic arch. Thoracocentesis with fluid study showed Transudate pleural effusion. He was medically treated for heart failure, COPD exacerbation, AF and NSTEMI . TEE was done for ruling out thrombus in the heart. TEE showed 1 cm thickness ulcerated plaque with protruding thrombus and a finger like mobile thrombus(1*0.6 cm) in ascending portion of aortic arch . Later, he underwent angiogram, stent placement. Cardioversion was done for AF but his heart rhythm was controlled for only 2 days. He was discharged with Aspirin ,Plavix and Statin. After one month, his heart failure was controlled but heart rthym was still uncontrollable.

DISCUSSION: Complex aortic plaque is the plaque that contains mobile thrombi or ulceration or is 4 mm or greater in thickness. Particularly Plaques 4 mm or more in thickness proximal to origin of left subclavian artery are associated with cerebral ischemia and constitute one third of patient with cryptogenic stroke. Ulcerated , Thrombotic and Non calcified plaques are more likely to have complication and are high risk of recurrence vascular event. TEE best evaluates large vessel/ aortic disease . Patient with cryptogenic stroke, TEE revealed a potential embolic source more than TTE. There is still no firm evidence-based algorithm of treatment for atherosclerotic plaque and thrombus. A retrospective study indicates a likely benefit from statin drugs. The result for an ongoing randomized trial of warfarin vs
antiplatelet therapy(Aspirin and plavix) are still pending. There is insufficient evidence to recommend prophylactic endarterectomy or aortic arch stenting for purposes of stroke prevention.

DONT FORGET YOUR SOCIAL HISTORY! TOBACCO SMOKING ASSOCIATED ACUTE EOSINOPHILIC PNEUMONIA IN A 20-YEAR-OLD FEMALE Robert Freed; Benjamin Lloyd. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1339926)

LEARNING OBJECTIVE 1: Recognize tobacco smoking and other toxic inhalants as a trigger for Acute Eosinophilic Pneumonia LEARNING OBJECTIVE 2: Distinguish Acute Eosinophilic Pneumonia from Acute Respiratory Distress Syndrome (ARDS) based on bronchoalveolar lavage findingsCASE: A 20-year-old previously healthy female presented to the emergency department with fever, myalgias, dyspnea and productive cough. She was on no medications, family history was unremarkable and patient had no allergies. Review of social history showed no recent travel, or exposure to toxins or chemicals, but she did admit to smoking cigarettes for the first time, one pack-per-day, during the two weeks leading up to her initial presentation. Her temperature was 38.0 F, heart rate 130, respiration rate 28, blood pressure 98/63 and oxygen saturation of 92% on nonrebreather at 10 liters/min. Her examination was significant for diffuse rhonchi, but was otherwise normal. Lab work showed leukocytosis of28.4 K/L with neutrophilia and CXR exhibited diffuse alveolar infiltrates. She was started on broad spectrum antibiotics for presumed atypical pneumonia. Her respiratory failure progressed rapidly, requiring intubation and mechanical ventilation three days after onset of her symptoms. Serial chest x-rays and a chest CT scan showed progressively worsening dense alveolar infiltrates bilaterally. Extensive infectious workup, including bacterial, viral and fungal entities was negative. TEE showed no evidence of heart failure or pulmonary hypertension. Serial labs were significant for rising serum eosinophilia, reaching a peak of 14%. Bronchoalveolar lavage was obtained, which showed marked eosinophilia of 43%. Antibiotics were discontinued and intravenous corticosteroids were initiated leading to a dramatic improvement in her respiratory failure and extubation within 48 hours.

DISCUSSION: First described in 1989, roughly 150 cases of acute eosinophilic pneumonia (AEP) have been reported worldwide. Common to all reported episodes is an extrinsic inflammatory insult, most commonly cigarette smoking, but other toxin exposures have been also described including tear gas, gasoline, inhalation from fireworks and cleaning supplies, acute cocaine usage and one reported post-September 11th rescuer. Symptoms and imaging are poorly specific and patients are often initially treated for presumed infectious causes. Much like acute respiratory distress syndrome (ARDS), AEP requires the exclusion of cardiogenic pulmonary edema and pulmonary infection, but the presence of eosinophilia is a key criteria of AEP. Eosinophil count of 25% or greater in bronchoalveolar lavage fluid is required for the diagnosis of AEP, but concomitant

rise in serum eosinophil count to above 10% may also be present. Despite being uncommon, with early diagnosis and appropriate steroid treatment, the prognosis of affected AEP patients remains excellent with survival exceeding 95% based on two retrospective studies of 55 patients. In summary, despite being exceedingly uncommon, AEP should be considered in the differential diagnosis of ARDS, in patients with suspected toxin exposure for whom antimicrobial treatments have failed.

DONT TAKE HYPERCALCEMIA TOO LIGHTLY Rachel Anquez; Robin Klein. Emory University, Atlanta, GA. (Control ID #1339551)

LEARNING OBJECTIVE 1: Identify classic clinical and laboratory features of light chain myelomaLEARNING OBJECTIVE 2: Review the diagnostic serum and urine testing for multiple myelomaCASE: A 76 year old female presents with back pain for six months. She reports progressively worsening back pain along with fatigue, weight loss, and dizziness. Two months prior, she was found to have hypercalcemia with elevated PTH levels. She underwent parathyroidectomy

for hyperparathyroidism. However, her calcium remained elevated following her operation. Exam was notable for point tenderness over the thoracic spine. Laboratories revealed a creatinine of 1.35 mg/dl, calcium 10.9 mg/dl, albumin of 4.3 gm/dl, and total protein of 7.5 gm/dl. WBC was 5,900/mcl and hemoglobin was 11.5 g/dl. No protein was detected on urinalysis. PTH was 82 pg/ml. MRI of the spine revealed multiple spinal masses causing spinal canal stenosis and pathologic compression fractures. CT scan to evaluate for primary lesions found no suspicious masses but showing extensive lytic lesions throughout the osseous skeleton including multiple ribs and vertebrae, scapula, clavicles, and pelvis. Serum protein electrophoresis (SPEP) showed no monoclonal elevation in gamma globulins. Serum immunofixation revealed increased beta-2 microglobulin (386 mg/l). Serum free light chain (SFLC) analysis showed elevated kappa protein at 6209 mg/dl. Urine protein electrophoresis (UPEP) showed 1.2 grams of protein with 78% kappa light chain paraprotein, and was confirmed with urine immunofixation. Bone marrow biopsy revealed a plasma cell dyscrasia consistent with myeloma.

DISCUSSION: Multiple myeloma (MM) is a plasma cell malignancy leading to excessive and abnormal antibody production. Myeloma can produce all classes of immunoglobulins as well as kappa light chains, lambda light chains, or any of the five types of heavy chains. Isolated light chain myeloma comprises 16-20% of myeloma cases. Patients typically present with anemia, renal failure, proteinuria, hypercalcemia, and a globulin gap. In our case, the presentation with hypercalcemia, bone pain, anemia and renal insufficiency was suspicious for myeloma. However, the diagnosis of MM was not pursued due to the elevated PTH, lack of proteinuria and absence of globulin gap. These values were falsely reassuring. As light chains are small proteins, they are usually not detected by urine dipstick and do not lead to the textbook globulin gap that is considered synonymous with MM. As such, proteinuria and globulin gaps are not prominent features of light chain myeloma. Furthermore, in our case, initial serum testing with SPEP was unremarkable. However, SPEP alone will not capture the diagnosis of MM in every patient and addition of serum immunofixation and UPEP increases the sensitivity significantly. 82% of MM patients will have a monoclonal band evident on SPEP. Addition of serum immunofixation increases the sensitivity of serum testing to 93%, and addition of UPEP and urine immunofixation increases the sensitivity of detection to 97%. In patients with suspected MM, testing with SPEP in combination with immunofixation, and confirmatory urine studies are necessary so as to not miss light chain disease. Conclusion The diagnosis of light chain myeloma is challenging due to the absence of classic findings such as proteinuria and globulin gap. Understanding the utility and limitations of serum and urine diagnostic testing is necessary to avoid missing the diagnosis.

DOUBLE THE DOSE OF DJRINE: A RARE CASE OF BILATERAL MEDIAL MEDULLARY INFARCT Lindsey Wooliscroft; Aiman Shokr; Nazrul Chowdhury; Matt Chua. Texas Tech University Health Sciences Center, Amarillo, TX. (Control ID #1311077)

LEARNING OBJECTIVE 1: To recognize the heterogeneous clinical features of acute bilateral medial medullary infarction.
LEARNING OBJECTIVE 2: Appreciate the prognosis of this rare infarct.
CASE: A 59-year-old male with history of CAD, HTN and CABG 18 months prior, presented with right-sided weakness in the upper and lower extremities. On admission he was afebrile, BP 191/109 mmHg, HR 68 /min, RR 16/min, and O2 sat of 97% on room air. At that time, he was alert and oriented and exam revealed motor strength was 5/5 in the left side and 1/5 on the right side, no sensory deficit, and cranial nerves were grossly intact. CT of the brain neither showed obvious infarct nor hemorrhage. However, within 36 hours, he developed weakness of the left upper and lower extremities with motor strength of 1/5. There was decreased tone noted in all four extremities. Bilateral Babinski sign and hyperreflexia were also noted. The patient also began to exhibit mild to moderate dysarthria with dysphagia, confirmed by a swallow evaluation. The patient continued to have no sensory deficits. The MRI of the brain showed bilateral medullary pyramid infarctions, with increased signal intensity on diffusion weight as well as T2 and flare. His transthoracic echocardiogram and carotid Doppler were unremarkable. MRA revealed only mild atherosclerotic change in the vertebrobasilar system without suggestion of significant stenosis. There was no evidence for myelitis, or cervical compression myelopathy. He was monitored closely and stroke management was instituted, unfortunately there was no significant neurologic recovery during his hospital stay. He was subsequently transferred to a rehab hospital for further physical therapy. DISCUSSION: Even unilaterally, medial medullary infarction is rare accounting for approximately 0.5% of all acute brain infarctions. Bilaterally, this condition becomes even more uncommon with less than 20 reported cases by 2010. Medial medullary infarction is characterized by Djrines syndrome, with consequent dysfunctions of hypoglossal nerve fibers (lingual palsy or dysarthria), medullary pyramids (contralateral hemiparesis), and the medial lemniscus (sensory loss). However, the symptoms are heterogeneous depending on the extent of the infarct, with motor pareses being the most common clinical manifestation in documented cases. Most of these infarcts result from infarction of the vertebral or anterior spinal artery or their small branches. Prognosis for these patients is guarded, with respiratory infections or respiratory failure being the most common cause of death. Therefore, it is imperative to continue to monitor respiratory function and watch for infection.

DRUG INDUCED ASEPTIC MENINGITIS ASSOCIATED WITH INTRATHECAL TRASTUZUMAB IN THE TREATMENT OF LEPTOMENINGEAL CARCINOMATOSIS FROM HER2/NEU POSITIVE METASTATIC BREAST CANCER. George Yaghmour; Doyle Thomas. henry ford health system, Detroit, MI. (Control ID #1340231)

LEARNING OBJECTIVE 1: Recognize the significant adverse event associated with use of intrathecal trastuzumab as a first published report. CASE: 43 year old African American female who presented with a history of frontal headache, anorexia, weakness, and ataxia for the last 7 days. No focal neurologic deficits were noted. Her past medical history was significant for stage IV metastatic inflammatory breast ductal carcinoma, strongly positive (+3) for the HER-2/neu oncogenic protein, ER positive / PR negative with metastasis to the liver and lungs. Following her diagnosis, she received neoadjuvant chemotherapy followed by a modified radical mastectomy, radiation, and adjuvant chemotherapy. Despite several chemotherapy agents, her disease continued to progress. In the emergency department the patient received MRI of her brain as well as a LP. An Abnormal enhancement of the leptomeningeal surfaces was found; suspicious for metastatic disease.CSF analysis was significant for elevated protein, low glucose, and 58 atypical cells which were determined as adenocarcinoma cells. Infectious etiologies were excluded. She was diagnosed with Leptomeningeal carcinomatosis. Upon admission the patient was a suitable candidate for intrathecal chemotherapy with trastuzumab. The patient was started on dexamethasone which did yield some improvement in aphasic symptoms. Twelve days after her admission, she received her first dose of 30 mg of trastuzumab intrathecally via Ommaya reservoir. Within 2 hours of receiving trastuzumab, she had sudden mental status change with

nausea and vomiting episodes as well as marked obtundation, severe dizziness, and urinary incontinence. She received a subsequent CT scan of her head which ruled out intracranial hemorrhage or acute ischemia. The Ommaya reservoir was not noted to be misplaced on imaging. An EEG suggested moderate encephalopathy but no seizure activity. Five days after administration, a repeat CSF analysis was positive for 9% malignant adenocarcinoma cells, slightly low glucose levels (37 mg/dL), elevated protein (127 mg/dL), 3310 red blood cells, and 50 white blood cells, 21% of which were neutrophils. With no infection etiology. She continued to have slurred speech, delayed reaction time, and difficulty following commands. Her case deteriorated without improvement.

DISCUSSION: Leptomeningeal carcinomatosis refers to the seeding of the leptomeningeal membrane of the CNS by malignant cells originating from solid tumors. LC is associated with significant morbidity and mortality and is diagnosed in 5% of patients with breast cancer. Common presenting symptoms include headaches, mental status changes, cranial nerve palsies, hemiparesis, diplopia, and motor weakness. In general,

median survival is less than 3 months from diagnosis, however if left untreated death typically occurs within 6 weeks. Intrathecal administration of trastuzumab has been described as a treatment for LC secondary to HER-2 positive breast cancer with positive results in overall survival and a lack of significant adverse effects. The use of intrathecal trastuzumab has been described in 10 published case reports using doses up to 100 mg all without any significant adverse effects. This is the first published report of any significant adverse event associated with use of intrathecal trastuzumab. Clinicians must be aware of this potential adverse effect to a therapy with which limited experience exists in treating a rare but serious complication to metastatic Breast cancer.

DRUG INDUCED ASEPTIC MENINGITIS IN A HEALTHY YOUNG FEMALE Pinky Jha; Mallory Cohen. Medical College Of Wisconsin, Milwaukee, WI. (Control ID #1310501)

LEARNING OBJECTIVE 1: To recognize Trimethoprim-Sulfamethoxazole (TMP-SMX) as a cause of aseptic meningitis in a healthy young female.

CASE: A healthy, immunocompetent 26 year old female with no significant past medical history presented to the ED with a severe headache and fever. The pain was located at the top of her head radiating to the neck. On exam she was in severe distress due to headache and had fever of 101.1 F. She had nuchal rigidity and positive kernigs sigh. She underwent a lumbar puncture and was started on empiric iv antibiotic for possible meningitis based on the history and exam. Cerebrospinal Fluid (CSF) analysis showed Glucose 51, CSF Protein 110, CSF WBC Count 152, CSF RBC Count 2, CSF Monocytes 16, CSF Polysegmented Neutrophils 28. The CSF gram stains showed no PMNS, few mononuclear cells, and no bacteria. CSF culture and viral PCR was negative. Infectious disease was consulted. On further questioning she gave a history of using TMP-SMX for a UTI prior to admission. After completing the three day course of TMP-SMX she had developed back pain followed by this severe headache and fever. Given her presentation and recent use of TMP-SMX a diagnosis of aseptic meningitis was made. IV antibiotics were stopped as per ID as the infectious disease workup was negative. She was discharged to home in stable condition after three days. She was advised to avoid trimethoprimsulfamethoxazole in the future.

DISCUSSION: : Aseptic meningitis is the cause of meningitis in a patient who has clinical and laboratory evidence of meningitis without a positive bacterial culture or viral PCR. Drugs, viruses, and malignancies are known causes of aseptic meningitis. Drug-induced aseptic meningitis is an uncommon and mysterious adverse reaction to some commonly used medications. This condition can mimic the signs and symptoms of true infectious meningitis. The most common drugs to cause aseptic meningitis are NSAIDs and antibiotics. The first documented case of drug-induced aseptic meningitis was reported in 1963 in a patient who had taken 2 tablets

of sulfamethizole. Drug-induced aseptic meningitis is a rare but important and often-challenging diagnosis . Trimethoprim-Sulfamethoxazole has been shown in case reports to cause aseptic meningitis in immunocompromised and older patients. This is rarely shown in young, healthy females as in this patient.

DUODENAL DIVERTICULA AND ACUTE PANCREATITIS Sandipani Sandilya1; Andrea Porrovecchio2. 1Montefiore Medical Center, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1334444)

LEARNING OBJECTIVE 1: Recognize duodenal diverticula as a possible etiology for acute pancreatitisLEARNING OBJECTIVE 2: Understand the pathophysiology of duodenal diverticula and how they can play a role the etiology of acute pancreatitisCASE: A 67 year old woman presented with sharp abdominal pain radiating to the back, nausea, and vomiting for one day. She had a history of cholelithiasis and was status post-laparoscopic cholecystectomy. She was taking celecoxib, pregabalin, and cyclobenzaprine, and denied any recent changes in medication. She was a smoker and had a 50 pack year history, but denied drugs or alcohol. She was afebrile and hemodynamically stable, and had epigastric tenderness and guarding on examination. Significant laboratory values were amylase of 1,829 and lipase of 8,125. An ultrasound revealed mild dilatation of the pancreatic and common bile ducts with no gallstones and a hypoechoic structure posterior to the head of the pancreas. Triglycerides were normal. The CT was consistent with pancreatitis and revealed a large juxtapapillary duodenal diverticula (JPDD) compressing the pancreatic head, pancreatic duct and common bile duct. The patient was treated with bowel rest, intravenous hydration, and pain control, and made an uneventful recovery.

DISCUSSION: Acute pancreatitis is extremely common cause of hospital admission, with an incidence of 79.8 cases per 100,000 in the United States, frequently encountered by the internist. The majority of cases are caused by alcohol and cholelithiasis. Rarer causes include hypertriglyceridemia, trauma (including iatrogenic), medications, infections, and autoimmune processes. Cases in which no etiology is found (8-44%) are labeled idiopathic pancreatitis. The patient had an unexpected finding of JPDD on imaging which was an etiological factor for her acute pancreatitis. The incidence of JPDD increases with age - retrospective analyses of ERCPs have revealed a 6% prevalence among patients below 50, 22% among patients between 60 and 69, and 30% among patients above 70. While a congenital factor may be involved, the major etiology is thought to be due to an increase in intraduodenal pressure and a weakening of duodenal smooth muscles. The majority of diverticula are asymptomatic, but they have been associated with serious complications like hemorrhage and perforation, which are surgical emergencies. Compression of the pancreatic duct from distension of the diverticulum is implicated in the etiology of pancreatitis. A retrospective analysis on 433 patients who underwent ERCP over a 2 year period observed that the prevalence of idiopathic pancreatitis was 14% in patients with JPDD and 2% in patients without JPDD. The recommendation of the study was that JPDD be excluded before making a diagnosis of idiopathic pancreatitis, especially in older patients. There are no established guidelines on the management of duodenal diverticula. The main surgical option is diverticulectomy, which is not recommended for asymptomatic diverticula. In summary, idiopathic pancreatitis is a common diagnosis, and a number of studies support a pathophysiological role for JPDD. While there are no guidelines on the management of diverticula, it is important for the internist to be aware of the increasing prevalence of these anatomical abnormalities and their relationship to pancreatitis in an increasingly aging population.

ECTHYMA GANGRONOSUM SECONDARY TO METHICILLIN-SENSITIVE STAPHYLOCOCCUS AUREUS SEPTICEMIA IN A PATIENT WITH DRUG - INDUCED AGRANULOCYTOSIS. Shahrzad Shidfar; Jay Jahanmir. umassmemorial, Worcester, MA. (Control ID #1311941)

LEARNING OBJECTIVE 1: Recognize Staphyloccous Aureus as a etiology of ecthyma gangronosum. . LEARNING OBJECTIVE 2: Identify predisposing factors to ecthyma gangronosum.

CASE: A 47 year-old man presented with five days of rash. The rash began on his fingers as red firm bumps or blisters and then spread to chest, arms, back, neck and face and roof of his mouth and a large red tender swelling in right axilla over a period of a week. These lesions became more painful and developed black centers

over the next few days. He also had subjective fever, chills, sweats and nausea two days prior to presentation. He developed shortness of breath and right lower chest wall pain on the day of presentation. Eight days prior to his presentation, he had returned from a 10-day trip to Brazil where he he spent all his time in urban areas. He denied any sick contact or contact with sheep, sheepskins or animal skins while in Brazil. He had contact with domesticated parrots and had a few mosquito bites. He had history of hypertension and diabetes controlled with diet and exercise. He lived at home with his dog. He was afebrile with heart rate of hundred beats/minutes, respiratory rate of eighteen and normal oxygen saturation. He had several discrete red nodular plaques with black necrotic centers on right nasal ala, left inferior jaw, chest and abdomen. He had two pustules on the hard palate. There was approximately an eight cm firm, red and

tender swelling in right axilla that was well demarcated with surrounding erythema and central black plaque. He had pleural friction rub at right lung base. There were no heart murmurs, hepatosplenomegaly, joint edema or peripheral stigmata of endocarditis. CBC revealed WBC 400 th/mm3 with 12% segmented cells, 75% lymphocytes, 13% monocytes, Hb 13 gr/dl, Platelet 111000 th/mm3. HIV serology was negative. Cat scan of chest revealed multiple foci of ground glass opacities of varying sizes with bilateral axillary and mediastinal adenopathy and right lower lobe pneumonia. There were no valvular vegetations on the transthoracic echocardiogram; left ventricular ejection fraction was mildly depressed. Skin Punch biopsies revealed epidermal necrosis with prominent collection of gram positive cocci consistent with ecthyma gangronosum. Blood culture grew Methicillin sensitive Staphyloccous Aureus . On further questioning the patient said he took 5 doses of an over the counter medication called Dipyrone for isolated headaches in Brazil.

DISCUSSION: Ecthyma gangrenosum is an skin lesion commonly associated with Pseudomona aeruginosa septicemia in immunocompromised patients. Microorganisms invade the media and adventitia of vessels, causing ischemic necrosis. The most common predisposing factors include leukemia, Hodgkins disease, chemotherapy and immunsuppression and lymphoma. Less commonly ecthyma gangronosum presents in patients with a history of burns, pneumonia, tuberculosis or urinary tract infection. Our case is unique in that the patient had none of the usual predisposing factors and skin lesions, which preceeded chest pain and shortness of breath by five days, were associated with methicillin -sensitive staphylococcus aureus septicemia. Our possible explanation for his Neutropenia is agranulocytosis as a side effect of Dipyrone. Dipyrone is an over the counter powerful analgesic that carries a small risk of causing agranulocytosis and widely used in Brazil. He was started on Naficillin and his Absolute Neutrophil Count recuperated to normal levels as the infection cleared.

EMBOLIC STROKE, A DELAYED SEQUELA OF BLUNT CHEST TRAUMA. Sonali Arora1; Auras R. Atreya1; Taraka V. Gadiraju1; Srikanth Penumetsa1,2; William L. Hiser1,2. 1Baystate Medical Center/Tufts University School of Medicine, Springfield, MA; 2Baystate Medical Center/Tufts University School of Medicine, Springfield, MA. (Control ID #1339845)

LEARNING OBJECTIVE 1: Recognize coronary artery dissection as a potential complication of blunt chest trauma.

CASE: A 30 year old healthy man presented to an outside facility with word finding difficulty and right sided neglect lasting for few minutes during a wrestling match. An MRI brain showed 3 punctate lesions involving the left frontal and parietal hemisphere, suggestive of embolic etiology. A transthoracic echocardiogram (TTE) showed a 1.5 x 1.5 cm mass present in the left ventricular (LV) apex. The patient was transferred to our institution for further evaluation by cardiac surgery and possible removal of mass. On detailed questioning, he reported an incident of blunt chest trauma during a martial arts exhibition fight that took place 2 years back. He had experienced acute chest pain radiating to both arms, diaphoresis and dyspnea following the episode. He was taken to an ER but was sent home after a period of observation. Reportedly, no diagnosis was made. Given this history, a pre-operative cardiac catheterization was done to exclude coronary artery dissection. It

showed 30% stenosis in mid-LAD without any other significant obstructive lesion. A transesophageal echocardiogram showed akinesis of the LV apex and confirmed TTE finding of a mass, the appearance of which was consistent with an apical thrombus. The decision to operate was deferred and patient was started on anticoagulation. A cardiac MRI done 2 weeks later showed akinesis of the apical segment. Patients remote history of blunt trauma was consistent with possible left anterior descending artery (LAD) dissection causing apical infarction and akinesis predisposing to formation of LV thrombus. DISCUSSION: An embolic stroke as a sequela of remote blunt chest trauma is a rare clinical presentation. Blunt chest trauma can cause various acute cardiac complications like arrhythmias, myocardial rupture, injury to coronary arteries resulting in dissection and myocardial infarction. However, delayed consequences such as left ventricular thrombus resulting in thromboembolic phenomena are reported infrequently. LAD is the most commonly affected coronary vessel by blunt traumatic injuries, likely due to its vulnerable anatomical position on the anterior aspect of the heart. A variety of mechanisms including intimal tear, rupture and spasm have been implicated in the pathogenesis of myocardial infarction after blunt chest trauma. A subacute development of an intimal tear might escape early diagnosis such as this case. A history of trauma should be sought in otherwise healthy patients with only a single vessel disease. Patients who present with stable dissection without occlusive thrombus on angiography can be managed conservatively. However, in the event of significant thrombus burden, angioplasty and stenting might be necessary. In summary, although coronary artery dissection leading to myocardial infarction in the setting of blunt chest trauma is rare, it should remain a consideration.

EMPLOYMENT RELATED BACK PAIN Kenneth Cerreta. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311864)

LEARNING OBJECTIVE 1: 1. Recognize the complications of vertebral osteomyelitis 2. Identify the differential diagnosis of neurologic dysfunction in the setting of back pain 3. Understand the pathophysology of spinal epidural abscessCASE: A 54 year-old man presented with one month of progressively worsening back pain and bilateral leg numbness and weakness, progressing to paralysis one week prior to admission. He noted urinary incontinence for the past three days, but no fevers or night sweats. Vital signs were normal. Cranial nerves were normal, and the upper extremities had full strength and equal sensation. He had decreased sensation to light touch and cold stimuli inferior to the nipples; lower extremities had 0/5 strength, flaccid tone, upgoing toes, and five beats of clonus. Rectal tone was flaccid. There was point tenderness over the T1-3 vertebral processes. MRI revealed a large mass destroying the T2 vertebral body and extending into T1 and T3 vertebral bodies, the paraspinal soft tissue, and the epidural compartment from T1-4, compressing the thecal sac and deforming the spinal cord. Biopsy of the mass demonstrated filamentous fungi consistent with coccidiomycosis. On further questioning, the patient reported that he had been working as a landscaper in western Texas prior to the onset of his weakness. A detailed evaluation demonstrated no evidence of immunologic dysfunction.

DISCUSSION: Spinal cord dysfunction is a common problem encountered by the general internist. Unlike other diagnostic dilemmas, there is no one diagnosis that stands out as being more prevalent than the others. As a result, it is important that the internist have a systematic method for approaching spinal cord dysfunction to systematically evaluate all potential etiologies. Also unlike other diagnostic dilemmas, the physical examination is particularly important to the evaluation of spinal cord dysfunction. One diagnostic method is to trace the nerves starting from the cerebral cortex caudally. The level where neurologic dysfunction begins is typically 1-2 levels caudal to the site of the lesion. In this case, cranial nerve function was not impaired and upper extremities had full strength and sensation with dysfunction beginning at T4. The location of pathology, therefore was likely to be two levels rostral to T4. An MRI was subsequently obtained, confirming the destructive lesion located at T2. The epidural space of the spine, unlike the that of the skull, is a space between the ligamentum flavum/posterior longitudinal ligament and the dura. This space consists of loose fatty tissue, lymphatics, small arteries, and the epidural venous plexus. Microorganisms can gain access to this space through hematogenous spread, direct extension from infected vertebral bodies, or direct inoculation during instrumentation. While in the

space, organisms can grow rapidly, especially in the thoracolumbar region where this space is larger and contains more infection prone fatty tissue. The neurologic sequela are directly related to degree of spinal cord impingement. While coccidiomycosis is a rare pathogen for the epidural space, especially in an immunocompetent patient, it is not unheard of. Coccidiomycosis, unlike other fungal infections, can infect the immunocompetent host, and the general internist must be aware of this potential pathogen affecting the central nervous system. As in the case, the history, particularly employment and travel, is instrumental in raising pre-test probability of the diagnosis.

ENCEPHALOPATHY DUE TO HYPERAMMONEMIA IN A PATIENT WITH HEREDITARY HEMORRHAGIC TELAGECTASIA: A CASE REPORT Alvin Wycoco; Shebene Chacko; Jose Concepcion; Jitendra Patel. Kingsbrook Jewish Medical Center, Brooklyn, NY. (Control ID #1335746)

LEARNING OBJECTIVE 1: Recognize symptoms of hereditary hemorrhagic telangectasia.

CASE: A 70-year-old female with a history of recurrent nose bleeds presented to the emergency room with an acute change in mental status, persistent epistaxis, coffee ground emesis and rectal bleeding. She was brought to the hospital after becoming severely agitated and confused. Past medical history was significant for a brain aneurysm with surgical clipping. Patient was hemodynamically stable and had a significant flapping tremor on presentation but was otherwise neurologically intact. Blood drawn on admission revealed Hemoglobin 9.3 g/dl and a hematocrit 28%. The rest of the CBC and metabolic panel were within normal limits. Ammonia was also elevated at 1.08 ug/ml and stool guaiac was positive. CT of the head on admission was normal except for the surgical clips. Contrast abdominal MRA revealed hypertrophied common hepatic artery and collateral branches from the superior mesenteric artery extending to the hepatic parenchyma with extrahepatic vascular anomalies suggestive of arteriovenous malformation. Small telangectasias were suspected in the spleen. The patient was subsequently diagnosed with Osler-Weber-Rendu Syndrome and transferred to the ICU for persistent bleeding. The patient required intubation with worsening mentation and progressively increasing ammonia levels. She was started on intravenous fluids, blood transfusions, intravenous PPI, octerotide drip, lactulose and decompressed via gastric suctioning. Nasal bleeding and GI bleeding spontaneously resolved later in the course with marked improvement of ammonia levels. Further vascular imaging MRI studies showed multiple telangectasias in the abdomen and aorta. The patient was extubated uneventfully and returned to baseline mental status prior to discharge with complete resolution of bleeding. DISCUSSION: Hereditary Hemorrhagic Telangectasia also known as Osler-Weber-Rendu Syndrome, is a genetic disorder inherited in an autosomal dominant pattern. This disorder manifests by mucocutaneous telangiectases and arteriovenous malformations and typically presents with epistaxis. This disorder shows lesions in the nasopharynx, central nervous system, lungs, liver, spleen as well as the urinary and GI tracts. In the United States frequency has been estimated at 1 case per 16,500 persons in a Vermont study, Guttmacher AE et al. HHT can be identified with diagnostic imaging studies such as contrast enhanced MRI or CT scans particularly in the vasculature of affected organs. Endoscopy may reveal telangiectasias in patients with GI bleeding. Hyperammonemia may occur as a complication of HHT as patients develop hepatic arteriovenous shunts, in turn causing hepatic encephalopathy. Ammonia entry to the brain is a primary cause of neurologic disorder. Treatment of HHT includes multi-system therapy. Controlling bleeding especially those in the brain and GI tract must have emergent intervention such as intracranial clipping of aneurysms and GI endoscopy to identify varices and AVMs. Protein intake should be limited, if not stopped, to help prevent encephalopathy with hyperammonemia. Lactulose aids in acidifying colonic contents to inhibit diffusion of ammonia back into the blood. Genetic therapy has not yet been successful in treatment of HHT, however awareness and detection of HHT may aid in improvement of outcome before significant clinical complications occur.

EOSINOPHILIA SECONDARY TO TOXOCARA CANIS Laila Shiekh Sroujieh; Mona Hassan; Mayur Ramesh. Henry Ford Hospital, Detroit, MI. (Control ID #1334281)

LEARNING OBJECTIVE 1: Approach to a patient with severe EosinophiliaLEARNING OBJECTIVE 2: Diagnostic Approach to Toxocara canis CASE: A 25-year-old male patient with history of autism and end stage renal disease presented to the ER with fever and chills associated with abdominal pain. Basic blood work showed evidence of severe eosinophilia [54%; 9.99 K/uL]). The patient was admitted for further diagnostic evaluation and to rule out hypereosinophilic syndrome. Hematology was consulted and a bone marrow biopsy was performed and showed reactive eosinophilia without evidence of hypereosinophilic syndrome. The patient denied any history of allergy. Infectious work up including stool for ova and parasites and fungal panel was unremarkable. CT scan of the abdomen, chest and pelvis revealed focal hypodensities in the liver and soft tissue nodules with ground glass halos within the lungs. LFTs were within normal limits. Clinically, there was no evidence of specific organ involvement. Autoimmune work up including RF, ANA, ESR and CRP were within normal

limits. Immunoglobulin panel revealed mildly elevated IgG. The patients medications were reviewed and none of his medications were known to cause hypereosinophilia. After a thorough history was taken, it was noted the patient spent much time with his pet dog. Given his history of autism and exposure to a dog, it was likely patient may have contracted a parasite from the dogs saliva. It was decided to test the patient for Toxacara Canis antibodies. The antibodies returned positive and the patient was started on albendazole. The patients eosinophilia improved with treatment.

DISCUSSION: Eosinophilia is not an uncommon finding in clinical practice and when it is associated with additional signs and symptoms, it can guide physicians to eventually establish a certain diagnosis. Secondary or reactive eosinophilia can develop in response to parasitic helminthic infections or allergens as well as in the setting of solid tumors or lymphomas. Rarely, eosinophilia is clonal in nature resulting from hematopoietic stem cell mutation. Eosinophilia is defined as a blood eosinophil count exceeding 500 cells/uL. Eosinophilia can further be differentiated into mild (500 to 1500 cells/uL), moderate (1500 to 5000 cells/uL), and severe (> 5000 cells/ uL). The level of blood eosinophilia is an incorrect assessment for the potential of eosinophil-mediated tissue damage. However, an eosinophilic cell count of>1500 cells/uL is classically considered the level above which organ damage is more likely to occur. Helminthic parasite associated eosinophilia can be constant or fluctuate over time and can be observed at any level of severity. Toxocariasis can be contracted after ingestion of soil/vegetables contaminated by excrement from infected dogs and is often relatively asymptomatic. Although stool examination for ova and parasites are warranted in patients with eosinophilia, these examinations are insensitive and therefore serologic testing is recommended in all eosinophilic patients in the appropriate clinical suspicion.

EOSINOPHILIA WORK UP IN PRIMARY CARETHINKING BEYOND THE USUAL CAUSES Leena Jalota; Madan R. Aryal; Richard Alweis. Reading Hospital and Medical Center, West Reading, PA. (Control ID #1335685)

LEARNING OBJECTIVE 1: Recognize how to diagnose and treat Non Allergic Rhinitis with Eosinophilia Syndrome (NARES) in a patient presenting with eosinophiliaCASE: Non-allergic rhinitis with eosinophilia syndrome (NARES) is a relatively rare condition with an estimated prevalence of 13 - 33% in patients with non-allergic rhinitis. It presents with symptoms similar to allergic rhinitis, but is characterized by absence of atopy and more than 20% eosinophils in the nasal cytology. We present a case in which a prolonged work-up for eosinophilia was finally diagnosed as NARES. A 40 year old female with past medical history of Multiple Sclerosis, stable on glatiramer acetate, and obstructive sleep apnea, presented to the outpatient clinic with profuse watery rhinorrhea, nasal pruritus, and nasal obstruction for one month. She also complained of occasional shortness of breath and loss of smell, which she specifically noticed while cooking. Review of systems was negative except as noted. Family history was non contributory. Physical examination was negative

except for occasional crackles noted in the bibasilar lung fields. She received one week of amoxicillin for possible bronchitis, but her clinical condition did not improve. Blood work was performed, and the differential of the compete blood count revealed an eosinophlilia of 13.3%. On further questioning for possible causes of eosinophilia, she denied weight loss or a loss of appetite, joint pain, eczema, rashes, tick exposure or recent history of travel outside the United States. Further workup for eosinophila was carried out, including: chest radiograph, pulmonary function tests with methacholine challenge, TSH and HIV antibody, all of which were negative. She was ultimately referred for allergen skin testing, which was also negative. Serum IgE and total immunoglobulin were normal. While total immunoglobulin and total IgE levels in nasal secretions were normal, nasal cytology revealed more than 25% eosinophils. Serum IgE antibody to specific allergen was absent. She was treated with intranasal beclomethasone. There was significant improvement in her symptoms over the next few weeks, although she continues to have recurrences several times per year.
DISCUSSION: NARES usually presents with sneezing, watery rhinor-rhea, nasal obstruction, anosmia and nasal itching, precipitated by nonspecific irritants and weather changes. It is more common in females, with some cases having a positive family history. The pathophysiology of NARES is poorly

understood, but a key component involves a self-perpetuating, chronic eosinophilic nasal inflammation with development of nasal micropolyposis and polyposis. Anosmia is a prominent feature, which can differentiate it from allergic rhinitis. It can be associated with sleep apnea and aspirin sensitivity. Diagnose is made by nasal eosinophilia, in the absence of allergy in patients history, negative skin tests and normal IgE. NARES responds well to nasal steroids and there may also be benefit from treatment with oral antihistamines.
EOSINOPHILIC PNEUMONIA AFTER INFLUENZA VACCINATION Mouhamad Mansour1; Daniel A. King2; Rishi Sharma1. 1Henry Ford Hospital, Detroit, MI; 2Wayne State University, Detroit, MI. (Control ID #1336498)
LEARNING OBJECTIVE 1: To review the clinical manifestations of chronic eosinophilic pneumoniaLEARNING OBJECTIVE 2: To report an association between influenza vaccine and the development of chronic eosinophilic pneumoniaCASE: A 74 year old non-smoker male with history of asthma and allergic rhinitis presented with a 3-week history of malaise, low-grade fever, non-productive cough and shortness of breath. He denied recent travel, sick contacts, pet exposure, inhalation of chemicals, tobacco, or starting new medications. He had received his yearly influenza vaccine a week before the onset of his symptoms. On exam, the patient was in no distress. Pulse oximetry measured 95% on room air. Auscultation revealed fine crepitations in lung bases bilaterally. Laboratory exam was remarkable for leukocytosis(30.6 k/uL) with 71% eosinophils. Chest radiography showed slight atelectasis and effusion at the right lung base, and high-resolution chest computed tomography demonstrated bilateral lower lobe airspace disease with ground glass opacities and septal thickening, compatible with eosinophilic pneumonia. Further testing showed increased IgE (918 IU/mL) but testing for Aspergillus-specific IgE was negative, as were p-ANCA, and c-ANCA. Sputum culture was negative. The patient was started on treatment with oral prednisone, with remarkable improvement of respiratory symptoms, radiographic appearance and resolution of peripheral eosinophilia. A spiro-gram, done 2 weeks after the initiation of steroids, was normal. DISCUSSION: Chronic eosinophilic pneumonia (CEP) was first described in 1969 as a potentially life-threatening illness with fever, night sweats, weight loss and severe dyspnea. Important characteristics include association with asthma, photo-negative of pulmonary edema x-ray apperance, and rapid response to corticosteroid treatment. Approximately 50% of patients have history of asthma with a mean onset in the fourth decade of life, with a female predominance. The etiology of the CEP is idiopathic, and is diagnosed after considering other differentials of pulmonary eosinophilia. Those typically include helminthic and other infections, allergic bronchopulmonary aspergillosis, churg-strauss syndrome, malignancy, medications, toxins, and vaccines. Vaccination with inactivated respiratory syncytial virus reportedly results in pulmonary eosinophilia with substantial inflammation on re-infection, but we did find reports of association with influenza vaccine. Given that our patient had no clearly identifiable triggers, administration of

influenza vaccine may have triggered eosinophilic pneumonitis in this case.

EXPAND YOUR MIND (AND BRAIN) WITH KNOWLEDGE OF C. NEOFORMANS Bobbie Jo Dodson; Jason Halperin. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338783)

LEARNING OBJECTIVE 1: 1. Recognize the manifestations of Cryptococcus neoformans infection 2. Identify the differential diagnosis of headache in an HIV-positive patient 3. Understand the role of serum cryptococcal antigen in the diagnosis and monitoring of extra-pulmonary disease.

CASE: A 38 year-old man presented with two weeks of headaches and a tender enlarging head mass. Over the past week, he had noted a large fluctuant mass over the right parietal region. He had no fevers, altered mental status or nuchal rigidity. He was HIV positive, with a CD4 count of 560 and no history of opportunistic infections. His vital signs were normal, as were his cardiac, pulmonary, abdominal and neurologic examinations. CSF analysis yielded clear fluid with a normal opening pressure; there
were 4 WBCs, 1 RBC, 69.5 protein, 85 glucose, VDRL negative, and negative cryptococcal antigen. An MRI of the brain demonstrated an epidural subgaleal soft tissue mass eroding through the cranial bone into the sub-pericranial space enhancing with contrast and consistent with an abscess. Laboratory studies were unrevealing with the exception of a positive serum cryptococcal antigen(Titer 1:32). Cranial bone biopsy grew encapsulated yeast, positive for Cryptococcus neoformans. Neurosurgery debrided the abscess with craniectomy and dissection confirmed an intact dura with cryptococcal epidural abscess and overlying osteomyelitis. He was started on intravenous liposomal amphotericin B and oral flucytosine for a six-week course.

DISCUSSION: The general internist commonly encounters headache in an HIV-infected patient as a diagnostic dilemma. The differential diagnosis is broad, including including HIV-associated aseptic meningitis, cryptococcal meningitis, HSV meningoencephalitis, CNS toxoplasmosis, primary central nervous system lymphoma, and infective intra-cranial abscesses. Timely contrast-enhanced imaging and CNS analysis are necessary for evaluation and prompt diagnosis. Unrecognized infectious or malignant causes of headache in an HIV positive patient can be fatal. CNS infections represent the most common extra-pulmonary site of Cryptoccocal neoformans infection; manifestations include meningitis, cryptococcomas, and rarely epidural abscesses. Those most at risk for extra-pulmonary infection include patients with HIV, Hodgkin disease, long-term corticosteroid therapy, transplant recipients, TNF-inhibitor therapy or patients undergoing chemotherapy.. 95% of HIV-infected patients have a positive serum cryptococcus antigen in the setting of cryptococcal meningitis. 83% of patients with extra-pulmonary disease have a positive serum crpytococcal antigen, which most likely demonstrates disseminated disease. Persistently elevated serum cryptococcal antigen in HIV-infected patients carries a poor prognosis and likely indicates ongoing production of fungal spores. In the majority of patients the serum cryptococcal antigen titers decrease over time, yet it has not been shown to be useful in the monitoring of invasive disease. Headache in an immunocompromised patient can alert the general internist to primary CNS involvement or a disseminated disease process. Extra-meningeal Cryptococcus is a rare presentation of headache but must be considered for immediate surgical intervention and prompt initiation of antifungal therapy.

FROM EMPTYNESS TO A TOTAL ECLIPSE OF THE HEART Jerson Munoz Mendoza; Ricardo Correa; Willy Marcos Valencia Rodrigo; Veronica Pinto; Kargi Atil. University of Miami-Jackson Memorial Hospital, Coral Gables, FL. (Control ID #1339793)

LEARNING OBJECTIVE 1: Recognize panhypopituitarism as a cause of cardiac tamponadeLEARNING OBJECTIVE 2: Identify the clinical presentation of empty sella syndromeCASE: A 39-year-old Hispanic female presented to the emergency room with progressively worsening shortness of breath, pleuritic chest pain and fatigue. The information was provided by her family, who described a 30-lb-weight lost over 6 month, denied fever, cough or sick contacts. The patient had hypothyroidism and familial hypokalemic periodic paralysis, with four female relatives affected by the latter. She was in acute respiratory distress. Her skin was dry and cold skin, without lesions or hyperpigmentation, absent pubic and axillary hair. Her pulse was 110 bpm and blood

pressure was 50 mmHg. She had a 7-cm jugular vein distention. The thyroid was not palpable. The lungs were clear to auscultation bilaterally. The heart sounds were distant without murmurs, rub or gallops. She had a 1+ bilateral pitting edema below the knees. Her blood tests showed normocytic, normochromic anemia, leukocytosis and normal platelet count, hypokalemia, non-anion gap metabolic acidosis with increased lactic acid, and elevated creatinine. Liver tests were within normal limits. The TSH was normal (0.84 IU/mL). The EKG showed low voltage QRS complexes. A chest x-ray showed interstitial pulmonary edema. A transthoracic echocardiogram revealed pericardial effusion, signs of diastolic collapse of the right atrium, and normal ventricular function. Emergent pericardiocentesis removed 100 mL of straw-colored fluid, yet the patient remained hemodinamically unstable, requiring increasing doses

of vasopressors. Infectious and rheumatologic causes were ruled out. A stimulation test with 250 g of cosyntropin showed serum cortisol of1.0 and 2.8 g/dL, and IV steroids were started. The pressors were decreased but could not be weaned off. A hormonal panel was obtained, with low levels of prolactin, corticotropin, gonadotropins and estradiol, while free T4 (0.15 ng/ml), free T3 (0.5 pg/ml) and reverse T3 (12 ng/ml) were also low. Levothyroxine and then liothyronine were added, and slow clinical improvement followed. A MRI of the brain found an empty sella turcica with residual pituitary tissue. After thirty days, the patient was discharged with a regimen of levothyroxine and dexamethasone daily, follow up instructions and bracelet alert for adrenal insufficiency and hypothyroidism. DISCUSSION: Most cases of empty sella syndrome are asymptomatic. For those who develop hormonal defficiency, partial or total panhypopituitarism may occur. Hypothyroidism is considered a rare cause of cardiac tamponade, much less frequent is the association with central etiology. Two isolated reports suggest that adrenal insufficiency may play a role in the pathogenesis of pericardial effusion as well. Our literatture review revealed five reported cases of pericardial effusion secondary to panhypopituitarism, three due to a pituitary mass and two due to Sheehan syndrome. To our knowledge, we report the first case of empty sella syndrome manifesting with panhypopituitarism leading to cardiac tamponade. Prompt recognition of this association, pericardiocentesis and proper hormonal replacement are paramount to effective therapy of this life-threatening condition.

FAT LEAKING FROM A BROKEN TIBIA: NEAR DEATH AND BACK AGAIN IN TWO WEEKS Brian S. Heist. University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1333161)

LEARNING OBJECTIVE 1: Diagnose fat embolism syndrome from its clinical, imaging, and laboratory manifestations.

CASE: A 31 year-old physically fit Caucasian man with unremarkable medical history experienced closed fracture of his left tibia and fibula while snowboarding in rural Hokkaido, Japan. He was evaluated promptly at a local hospital where he was admitted, with surgery scheduled for a week later. Two days after admission, he experienced fever (39 degrees C) and dyspnea, and imipenem-cilastatin was commenced for suspected pneumonia. Over the following 2 days, he developed intermittent confusion, visual changes, left eye ptosis, and then several hours of progressive stupor and respiratory distress (SpO2 60% on room air), prompting emergent air flight to our hospital 50 km away. On arrival, the patient experienced hemoptysis. Respiratory rate was 30 breaths per minute with SpO2 97% on 6 L O2 facemask. Fever persisted. Vitals were otherwise normal. In addition to the ptosis, anisocoria was present. Lungs were clear to auscultation. Petechiae were observed in the conjunctiva and diffusely over the neck, chest, and abdomen. Based on the history and physical exam, the diagnosis of fat emboli syndrome (FES) was made. Blood tests were remarkable for normal WBC (8300 cells/L) and hematocrit(36.0 mg/dL), but also thrombocytopenia (124 K/L) and elevated PTT(29.3 sec), INR (1.44), and FDP (12 g/ml) worrisome for impending DIC. Fibrinogen was elevated (552 mg/dL) and CRP was markedly elevated(12.95 mg/dL). Emergent intubation and open reduction external fixation of the tibial fracture were

performed without complication. Chest CT showed diffuse peripheral infiltrates and ground glass opacification concerning for alveolar hemorrhage and ARDS. Over the next 36 hours, the hemoptysis and respiratory status worsened, as did the DIC serum markers. Ventilator support was provided per ARDSnet protocol (FiO2 0.8 and PEEP 10 required on post-op day #2). Six units of pRBCs AND 14 units of FFP were administered. Subsequently, however, the patients blood tests as well as respiratory and mental status steadily and rapidly improved. Brain MRI was completely normal. On post-op day #5 he was extubated to room air. Neurologic exam was normal. He was transferred to the orthopedic ward and one week later, discharged with a flight home to the U.S. the next day. Ten weeks later, he reported complete recovery from his fractures.
DISCUSSION: This case exemplifies the rapidly fatal consequences of fat emboli syndrome and the consequent need to monitor for its presentation in any patient with a long bone fracture. Trauma-associated FES is identified with pelvic and femoral fractures, but cases secondary to tibial fractures have also been reported. While the mechanisms underlying the diverse
manifestation of FES have not been completely clarified, they are understood to involve mechanical injury from fat droplet embolization, biochemical conversion of embolized fat into toxic metabolites, and activation of the complement system and coagulation cascade by tissue thromboplastin released from the marrow. In turn, FES typically presents 12-72 hours after fracture, with progression from respiratory to neurologic, and then hematologic manifestations as observed here. This case also demonstrates the dramatic recovery that may occur with expeditious repair of the fracture and supportive care, at least in an otherwise healthy young individual such as this patient. At present, no other measure has proven helpful.
FATIGUE AND APATHY: DEPRESSION OR KLINEFELTER SYNDROME Jasleen K. Pannu; Vamsi K. Emani; Sriranjini C. Ramaswamy; Aron Blecher. Western Reserve Care System/NEOUCOM, Youngstown, OH.
(Control ID #1340261)
LEARNING OBJECTIVE 1: Recognize Klinefelter syndrome as an important differential in a man with chronic, unrelenting depression and fatigue even with normal sexual function and advanced age.
CASE: A 56 year old Caucasian man with history of hyperlipidemia, depression, recurrent falls and irritable bowel syndrome came for a regular office visit with complaints of progressive fatigue since few weeks and difficulty climbing stairs. He did not report any shortness of breath at rest, weight loss or loss of appetite. He was a heterosexual and reported having a normal sexual life. He reported having morning erections and normal libido. He was seen in the office intermittently over a period of 10 years and had long history of recurrent falls, apathy and depression. At baseline he was always socially withdrawn and had lagged behind his peers most of his life. Review of systems was negative. On physical exam at baseline he was pale with height of 5 10 , weight 178lbs and with scant hair on his body. Genital exam showed presence of testicles on lower side of normal in terms of size and normal in consistency. Pubic, axillary and facial hairs were scant but present. No gynaecomastia was seen. No change from his baseline on physical examination was seen. Testosterone level was 66 ng/dl and 22 ng/dl on repeated testing . Free testosterone levels low(3 pg/ml) . Luteinizing hormone levels was high(32 mIU/ml). Levels of sex hormone binding globulin and cortisol were normal. Free T4 level was 0.82pmol/L and TSH was 0.6mIU/L. Subsequently, karyotyping revealed XXYpattern and diagnosis of Klinefelters syndrome was established. Testosterone therapy followed and marked improvement was noticed in his physical and psychiatric symptoms over the next several weeks. Periodic assessment over 3 year period revealed resolution of fatigue and depression along with dramatic and sustained enhancement of his physical abilities and psychiatric symptoms.
DISCUSSION: Sporadic case reports in the past have attributed depression and psychosocial problems to an organic brain syndrome secondary to Klinefelters syndrome. Dramatic improvement following testosterone therapy in our patient further validates this hypothesis. Further studies to reveal pathogenesis of such occurrence are warranted. Also, it is imperative to keep Klinefelters syndrome as an important differential while treating males with chronic depressive psychosocial disorder and disabling fatigue.

FEVER OF UNKNOWN ORIGIN; FINDING THE NEEDLE IN A HAYSTACK Sujith Cherian; Subhraleena Das; Wasim A. Hamarneh. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1339897)
LEARNING OBJECTIVE 1: Diagnosing the cause when faced with fever of unknown originLEARNING OBJECTIVE 2: Distinguishing and recognizing the rare intravascular variant of large B cell lymphomaCASE: A 65-year-old Caucasian male was referred to our institution by his primary care physician for evaluation of fever of 3 weeks duration. Review of the systems was positive for the presence of decreased appetite, a weight loss of around 15 pounds and increasing fatigue over the previous 4 weeks. His past medical history was significant for diabetes mellitus and hypertension, both of which were well controlled. He had no history of recent travel or any exposure to pets. He was sexually active with one partner for the last 30 years. Physical examination did not reveal any

abnormalities with no evidence of any masses or organ enlargement. Laboratory data revealed normal leucocyte count with monocytosis (18%) on differential, calcium level of 11.4 mg/dL, and lactate dehyrdogenase (LDH) level of 1276 IU/L. Rheumatology workup blood, urine cultures, serum /urine protein electrophoresis were negative. Other electrolytes and hepatic function panel was within normal limits. After admission, radiological investigations done were significant only for mild splenomegaly. Workup for fungal etiology and endocarditis remained negative. Ultimately, the patient underwent a bone marrow biopsy which revealed large atypical CD20 positive lymphoid cells in clusters intravascularly, with markedly irregular nuclei and multiple nucleoli, clinching the diagnosis of intravascular large B cell lymphoma. The patient was subsequently started on chemotherapy with R-CHOP (Rituximab, Cyclophophamide, Adriamycin, Vincristine and Prednisone). Following four cycles of R-CHOP and intra-thecal methotrexate the patient has been afebrile and doing well after 4 months of disease diagnosis. DISCUSSION: Intravascular large B cell lymphoma (IVLBCL) is a rare and often fatal variant of extranodal diffuse large B cell lymphoma with only around 300 cases reported so far. Median age of diagnosis is in the sixth to seventh decade with no sex predilection. It is characterized by lymphoma cells that are confined to lumina of small vessels, hence they do not present with masses or lymphadenopathy. Clinical presentation appears to differ by country of origin with involvement of the nervous system and skin tending to be more common in the western countries, whereas involvement of the bone marrow, liver and spleen being more common in the asian countries. Fever of unknown origin may be the presenting feature in 60 % of cases. Most common laboratory abnormalities include elevated lactate dehydrogenase and beta 2-microglobulin (80-90%). Diagnosis needs a high index of suspicion and is established by demonstrating the presence of large lymphoma cells within small to medium sized blood vessels. Treatment is generally with systemic chemotherapy, i.e-anthracycline based chemotherapy (R-CHOP) and central nervous system directed therapy with methotrexate and radiation. If a timely diagnosis is made, remission with 60% response rate to chemotherapy and 30% three year survival is seen. Our case highlights the importance of a thorough workup when faced with the problem of fever of unknown origin and sheds light on one of the rarer causes.
FIRST SIGNS OF METASTATIC CANCER: AFTER VIRCHOW'S NODE, NOW THROMBOSED NECK VEINS. Jasleen K. Pannu; Sriranjini C. Ramaswamy; Ritha Kartan. Western Reserve Care System/ NEOUCOM, Youngstown, OH. (Control ID #1340274)
LEARNING OBJECTIVE 1: Recognize that local or distant malignancy (Trousseau's syndrome) is an unusual but significant cause of spontaneous thrombosis of internal jugular veins and calls for an extensive work up. CASE: A 61 year old Caucasian male with COPD, hypertension, hyperlipidemia and gastroesophageal reflux disease presented to our hospital with swelling and mild pain on right side of his neck for three days. He had no complaints of dyspnea, dysphagia, odynophagia, chest pain, syncope, weight loss, fever or chills. Patient reported resection of right sided Warthin's tumor 10 years prior without any post operative complications. On examination, his vital signs were stable. There was mild edema and tenderness on the right side of the neck. Cardiorespiratory and abdominal exam was normal. Laboratory studies were normal except hemoglobin level of

9.2gm/dl. CT scan of neck with contrast revealed a long segment of thrombus within the right jugular vein without evidence of collateral circulation. Mild subcutaneous inflammatory change without evidence of abscess and mild right sided deep cervical lymphadenopathy was also seen. Patient was started on intravenous heparin therapy and warfarin was added subsequently. The workup for hypercoagulability was negative. By third day of anticoagulation patient's hemoglobin dropped to 7.2gm/dl. Fecal hemoc-cult test was positive.He never had a colonoscopy before and previous fecal hemoccult tests were negative. Patient refused colonoscopy and opted to continue anticoagulation. His hemoglobin stabilized after blood transfusion and he was discharged home on warfarin. He was readmitted 6 weeks later with critically high INR, a near syncopal episode and hemoglobin of 4.2 gm/dl. Alkaline phosphatase levels were
664U/L with SGOT of 41U/L and SGPT of 59U/L. Esophagogastroduodenoscopy and ERCP with biopsy revealed poorly differentiated gastric adenocarcinoma causing biliary and gastric outlet obstruction. Metastatic lymph nodes were found in mediastinum and retroperitoneum. Also multiple venous thrombosis developed in left jugular, axillary and subclavian veins. Patient was subsequently discharged on chemotherapy after duodenal and bile duct stentingDISCUSSION: Thrombosis of neck veins as the first sign of occult malignancy has been sparsely reported. Adenocarcinomas are notorious for causing hypercoagulability and thromboembolic phenomena. Hence, in the setting of spontaneous jugular and mediastinal vein thrombosis with unknown precipitating cause, extensive diagnostic work up to rule out an occult malignancy is warranted. Also, benign appearing skin manifestations as seen in our patient should be viewed with high suspicion for underlying thrombosis even in the absence of other signs of malignancy.

FIRST DO NO HARM. WHAT YOU SHOULD CONSIDER PRIOR TO TREATING SJOGREN'S SYNDROME

Angel Brown; Michael Brit. UT Chattanooga College of Medicine, Chattanooga, TN. (Control ID #1313962)

LEARNING OBJECTIVE 1: To recognize extra-hepatic manifestations of hepatitis C(HCV) and what impact these manifestations have on the treatment of HCV.

LEARNING OBJECTIVE 2: To become familiar with differences between primary Sjogrens syndrome(pSS), secondary Sjogrens syndrome(sSS) and Sjogrens-like syndrome.

CASE: A 64 year-old male presented to a primary care provider with right eye pain. He was referred to an ophthalmologist. His CBC and BMP were normal. ANA, SSA and SSB were negative. Rheumatoid factor(RF) and total protein were elevated. Albumin was decreased. Non-contrasted head CT showed bilateral enlargement of the lacrimal and parotid glands with a diffuse miliary pattern of abnormal enhancement. The otolaryngologist who evaluated him noted xerostomia, firmness and enlargement of submandibular, lacrimal and parotid glands. Biopsy of minor salivary and parotid glands was performed. The pathologic diagnosis was chronic sialadenitis. Histology revealed a fibrotic stroma with diffuse lymphocyte and plasma cell infiltration. Diagnosis of pSS was suggested. He was started on prednisone therapy. His symptoms failed to improve. He was referred to a rheumatologist. Review of systems at the rheumatologist's office was positive for dry eyes and physical exam revealed enlarged, hardened parotid glands. Further testing revealed negative ANCA, HIV, RPR and hepatitis B. ESR and IgG were elevated. Hepatitis C antibody was detected. The patient was referred to a hepatologist. DISCUSSION: Sjogren's syndrome is a chronic autoimmune inflammatory disease. It targets exocrine glands. It is characterized by sialadenitis, keratoconjunctivitis sicca and xerostomia. Symptoms are due to lymphocytic infiltration of salivary and lacrimal glands which leads to gland failure. Primary Sjgrens syndrome occurs without underlying rheumatic disease, whereas sSS is associated with underlying rheumatic disease. Sjgrens affects 0.1-4% of the world's population. It is more prevalent in females. Sjgrens-like syndrome describes individuals with sicca symptoms and chronic HCV. HCV impacts individuals worldwide. An estimated 3 million people are infected with HCV yearly. 130-170 million people are chronically infected with HCV. Chronic HCV infections can be asymptomatic or have extra-hepatic manifestations which include arthalgia, neuropathy and sicca syndrome. There is a risk of misdiagnosing patients with HCV and sicca symptoms as pSS. Patients in both groups can have positive RF. Histology of exocrine glands will usually show lymphocytic infiltration.

However, patients with HCV are more likely to have abnormal liver function, whereas patients with pSS usually test positive for ANA, SSA and SSB. Different patterns of immunological response have been described for these two groups. The lymphocytes in pSS are predominantly CD4+T-cells. In HCV CD8+ T-cells predominate. Treatment for Sjogrens involves symptom relief, DMARDs and immunosuppressive agents. Immunosuppressive therapy and DMARDs can increase hepatitis C viral replication and worsen hepatic function. There is data that sicca symptoms improve after treatment of HCV. In conclusion, the above case illustrates the importance of considerating HCV infection in individuals with decreased salivary and lacrimal gland secretion

and enlargement. Confusion exists in nosology of sicca syndrome. As such a diagnosis of sSS should not be applied for cases of HCV, or the definition of sSS should not be limited to rheumatic disorders.

FIRST DO NO HARM: A CASE OF DRESS Anna Corey. University of Wisconsin Hospital and Clinics, Madison, WI. (Control ID #1340087)

LEARNING OBJECTIVE 1: Recognize the clinical features of DRESS syndrome and identify common medication culprits.

LEARNING OBJECTIVE 2: Verify reported medical diagnoses in new patients prior to continuing or starting medications.

CASE: A 42-year-old woman with a history of atypical absence seizures presented with three weeks of fevers, lymphadenopathy and rash. She first developed tender axillary and inguinal adenopathy, followed by fevers and a painful papular erruption on her shins that progressed to involve her entire body. The rash was pruritic, severely painful and burning in quality. Her medication regimen included levetiracetam and gabapentin with the recent addition of lamotrigine one month earlier. Her vital signs were normal. Skin examination revealed tender, erythematous papules on the lower extremities and edematous, erythematous macules and thin plaques on the upper extremities, abdomen and chest, which coalesced into erythrodermic plaques on the back. Tender, mobile adenopathy was noted in the cervical, axillary and inguinal areas. Laboratory evaluation revealed leukocytosis with eosinophilia and mild hepatitis. Out of concern for drug reaction, possible culprits lamotrigine and levetiracetam were discontinued. Prednisone was initiated at a daily dose of 1 mg/kg. Dermatopathology revealed focal spongiosis and superficial mixed dermal inflammation consistent with a medication reaction. Lamotrigine-triggered DRESS syndrome was thought to best fit the clinical and laboratory data. Over the next two weeks, her rash improved, laboratory parameters normalized and prednisone was slowly tapered. Unfortunately, it was discovered that the patient's diagnosis of epilepsy was questionable. Her staring spells, which were her usual absence seizures, were captured on video EEG monitoring and not associated with EEG changes. She was evaluated by neurology and evidence for a seizure disorder was not found. Her frequent requests for additional medication prompted a thorough chart review which revealed that several historical diagnoses stated by the patient, a former nurse, had never been confirmed.

DISCUSSION: The Drug Reaction with Eosinophilia and Systemic Symptoms or DRESS syndrome is a life-threatening drug reaction with hallmark features of severe skin rash, fever, eosinophilia, atypical lymphocytes, lymphadenopathy and internal organ involvement, most commonly hepatitis, pancreatitis, interstitial pneumonitis or nephritis. DRESS usually develops 2-6 weeks after initiation of the drug and can persist or worsen despite discontinuation. The most frequent offenders are allopurinol, sulfonamides, and anticonvulsants such as phenytoin, pheno-barbital, carbamazepine and lamotrigine although over fifty drugs have been implicated. The pathogenesis of DRESS is incompletely understood but thought to include detoxification defects leading to reactive metabolite formation and subsequent immunological reactions and reactivation of EBV and HHV-4,6 and 7. Treatment involves removal of the offending agent and initiation of corticosteroids. Prompt diagnosis is paramount as the mortality rate is up to 10%. This case exemplifies a serious complication arising from a

medication prescribed for a condition that the patient did not likely have. Physicians must verify diagnoses prior to prescribing and ensure that the potential benefits of a medication do indeed outweigh the risks.

FIRST IS THE WORST Dandan Liu2,1; Alvin Rajkomar2; Sumant Ranji2; Sumana Kesh2. 1SFVA Medical Center, San Francisco, CA;
2UCSF, San Francisco, CA. (Control ID #1304372)

LEARNING OBJECTIVE 1: Recognize limits of laboratory data in diagnosing acute pancreatitisLEARNING OBJECTIVE 2: Review treatment of hypertriglyceridemic pancreatitis (HTGP)

CASE: A 23 year old man with no significant medical history presented to the emergency department with sudden onset abdominal pain and 6
episodes of nonbloody emesis along with new polyuria and polydipsia. He had abstained from alcohol for two years and denied any ingestions. On initial exam, he had a soft abdomen that was nontender. Labs revealed glucose of 321 mg/dL, anion gap of 29, normal lactate, and lipase of 59 units/L. He was treated with IV fluids and insulin drip for presumed new onset diabetic ketoacidosis (DKA) as well as pain control. Overnight, patient was noted to have increasing pain medication requirements, and his abdomen was increasingly distended with reproducible tenderness in the epigastric region. An abdominal CT with contrast confirmed diagnosis of pancreatitis with no evidence of gallstones. The patients blood was noted to be lipemic. Morning labs showed elevated triglyceride 7470 mg/dL and elevated lipase 143 units/L. He was continued on an insulin drip for management of hypertriglyceridemia induced acute pancreatitis (HTGP) and concomitant DKA. By hospital day 3, his triglycerides decreased to 720 mg/dL, and he was transitioned to subcutaneous insulin. His GAD and islet cell antibodies were negative. He was discharged on hospital day 6 with minimal abdominal pain, tolerating food, with plans for close outpatient follow-up for his diabetes and hypertriglyceridemia. DISCUSSION: Acute pancreatitis is commonly precipitated by gallstones or alcohol, but HTGP, with triglycerides >1000 mg/dl, accounts for 2-10% of cases. Serum lipase is a specific test for pancreatitis (spec 82-97%, sens 67-85%). While there is not much literature on the reliability of lipase in lipemic samples, serum amlyase levels are known to be spuriously low in lipemic blood. DKA itself can conversely cause nonspecific elevations in amylase and lipase apart from pancreatitis in approximately 10% of cases. When the history and lab findings are incongruent with an evolving exam, the diagnostic "gold standard" should be ordered: a contrast enhanced CT. The mechanism of HTGP is not clearly defined, but there is likely secondary hydrolysis of triglycerides by lipase in pancreatic arteries, leading to release of free-fatty acids that are toxic to the capillaries or acinar cells. A cascade of capillary ischemia then promotes activation of trypsinogen and thus pancreatitis. Management is fairly uniform despite etiology. Most commonly, insulin infusion is used, thought to induce lipoprotein lipase activity. Heparin infusion can also be used, although it ultimately leads to a decrease in lipolytic activity. If refractory, plasmapharesis, lipid pheresis, and extra-corporeal lipid elimination are possible, although there are no direct comparisons between these treatment methods, and they are not readily available. Long-term treatment of hypertriglyceridemia is aimed to reduce levels <1,000 mg/dL to decrease the likelihood of pancreatitis. Dietary restriction with <20% of calories from fat is the first step to reduce chlomicron-mediated contribution to elevated triglycerides. Pharmaceuticals including niacin, fibrates, and fish oil can also be employed, although each carries its own set of side effects and costs. This case, with close outpatient follow-up and patient adherence to dietary restrictions should illustrate the adage "first is worst.

FOOLED TWICE AND MAYBE MORE: AN INSIDIOUS CASE OF BRUCELLOSIS Susanna Tan; Alissa Detz; Paul Aronowitz; David Busch. California Pacific Medical Center, San Francisco, CA. (Control ID #1334990)

LEARNING OBJECTIVE 1: Recognize cognitive biases that lead to diagnostic error.

CASE: A 77-year old Spanish-speaking woman with history of arthritis presented with fever and fatigue for one week. She received antibiotic treatment for a urinary tract infection but returned with worsening arthralgias, abdominal pain, and decreased appetite. On admission, she was found to be hypercalcemic (12.3 mg/dl) and was diagnosed with primary hyperparathyroidism (PTH 224 pg/ml and 25-OH Vitamin D 13 ng/ml). Fever(38.1

C) was attributed to a lower extremity deep vein thrombosis. Six weeks later, she presented with persistent malaise and fevers. She was again hypercalcemic and treated for urinary tract infection. She was discharged but was readmitted when gram-positive cocci grew in two blood cultures. The organism was too fastidious for routine identification. A transesophageal echocardiogram was negative. When repeat blood cultures were negative, the initial blood cultures were considered a contaminant, and she was discharged. Five days later, the second set of blood cultures grew a Gram positive organism that again defied identification. She was then admitted for her third hospitalization in two months with continued complaints of fevers, malaise,

arthralgias, and worsening back pain. MRI of the spine showed T9-10 diskitis with epidural abscess. Blood cultures and a culture from a bone biopsy grew an organism that was finally determined to be Gram-negative and was identified as Brucella melitensis . She was started on antibiotics with slow symptom improvement; she eventually required debridement of the epidural abscess. A more thorough history later revealed travel to central Mexico three months prior to symptom onset. In Mexico, she had consumed milk from local ranches.
DISCUSSION: This case highlights the importance of thorough history taking and exemplifies several cognitive biases that led to delays in care. The patients diagnosis of primary hyperparathyroidism likely dissuaded physicians from considering alternative diagnoses, an example of anchoring bias. The case also highlights the importance of clinical correlation in pursuing identification of positive blood cultures. Fastidious organisms may not grow rapidly in culture, and Gram stain interpretation may be difficult. This is an example of expectation bias, the tendency to only believe and pursue data that agree with ones expectations. At the time of diagnosis, the patient had been seen by more than seventy physicians at multiple hospitals. Lack of continuity of care and the patients non-English speaking status also contributed to her delayed diagnosis. As physicians, we must be aware of cognitive biases that may influence our thinking and result in delay of care to our patients.
FOR WHOM THE BELL TOLLS Ryan Brown. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339195)
LEARNING OBJECTIVE 1: 1. Identify the clinical presentation of conversion disorder-induced paralysis. 2. Recognize the clinical presentations of Bells Palsy. 3. Identify the treatment of acute Bells Palsy. CASE: A 19 year-old man presented following the sudden onset of left-sided upper and lower extremity paralysis while lying in bed. He experienced no pain or loss of consciousness. His initial symptom began the previous night, when his lips felt numb at dinner. Later, when he went to bed, he was unable to close his right eye. These symptoms persisted until late the following morning, when the paralysis occurred. He had no past medical history, and no risk factors for stroke or embolic disease. He reported two years of anhedonia and decreased energy for the past two years, citing unemployment and a friends death as the causes. At the time of his presentation, his paralysis had resolved. His cranial nerves were intact and he had 5/5 strength and 2+ reflexes throughout; his gait and cerebellar examination were normal. He was again able to close his right eye, but his lips remained numb and now his left cheek was numb. He had a flat affect, low, mumbled speech, and poor eye contact. A head CT revealed no abnormalities. Thyroid function testing was normal, and periodic paralysis was excluded on clinical grounds. He was admitted for observation and subsequent testing. Overnight, he developed a right facial droop including forehead paralysis. To exclude multiple sclerosis, a non-contrast MRI of the brain was performed, revealing enhancement of the right facial nerve, consistent with Bells Palsy. He was discharged on a prednisone taper with outpatient psychiatric follow-up.
DISCUSSION: The general internist is frequently the first to encounter physical manifestations of psychiatric disease. Conversion disorder is the unconscious manifestation of a physical CNS symptom secondary to psychiatric conflict (usually anxiety or depression). Conversion disorder, unlike somatization disorder, manifests as a single neurologic symptom, often abruptly. The treatment of conversion disorder focuses on treating the underlying psychiatric disorder with antidepressants, and psychotherapy, gently illustrating to the patient the connection between their psychiatric illness and their physical symptom. Hospital admission with inpatient

treatment (namely, physical therapy), validation of symptoms, and allowance of slow, face-saving improvement are methods that have proven effective. Bells Palsy is the most common cause of unilateral facial paralysis. Normally, it is an acute, lower motor neuron paralysis of the facial nerve that resolves in 80-90% of cases. Etiology varies, but a viral source, particularly reactivation of Herpes Simplex 1 and Herpes Zoster, is the most consistent and validated cause. Presentation may include unilateral facial droop, inability to close eye, hyperacusis, and ageusia. Presence of forehead paralysis suggests the lesion is peripheral, not central. Meta-analyses suggest that oral glucocorticoid treatment within three days of onset of symptoms is beneficial. Using an adjunctive antiviral, such as acyclovir, is helpful in severe cases, but remains controversial in routine cases. Beyond three days, medications do not affect the outcome.

FORAGING FOR LIVER FAILURE Alvin Htut; Lauren Shapiro. Montefiore Medical Center, BRONX, NY. (Control ID #1334207)

LEARNING OBJECTIVE 1: Recognize the clinical manifestations and treatment options of acute mushroom toxicity.

LEARNING OBJECTIVE 2: Remind clinicians of the time course of Amatoxin poisoning.

CASE: A healthy 44 year-old woman presented with crampy abdominal pain, vomiting and watery diarrhea for one day with subjective fevers and myalgias. Her symptoms began 10 hours after eating an omelet made with mushrooms found in her backyard. Her initial vital signs were normal. On exam the patient was tender to palpation in the left lower quadrant of her abdomen without guarding or rebound. Initial laboratory and imaging evaluations were also normal. Repeat laboratory studies 24 hours later revealed aspartate and alanine aminotransferases of 360 / 349 u/L respectively, an INR of 1.5, bicarbonate of 15 mEq/L and lactic acid of3.8. mmol/L. Her transaminases peaked at 10,556 / 9,302 u/L and her INR was 2.4 after another 12 hours. Total bilirubin peaked at 60 mg/dL several days later. The patient underwent rapid transplant evaluation for acute liver failure, received IV Penicillin G and N-Acetylcysteine and was transferred to the ICU. Acetaminophen levels were normal as were markers of viral hepatitis. Her course was complicated by recurrent watery diarrhea and lower gastrointestinal bleeding. Although the patient was listed urgently for a liver transplant, she made a full recovery with supportive care. The mushrooms the patient ingested were confirmed to be from the Amatoxin producing Gallerina genus. DISCUSSION: Acute liver failure is a serious clinical entity encountered by general practitioners. The differential diagnosis often includes Acetaminophen toxicity, acute viral hepatitis, ischemic injury and other toxic exposures such as wild mushrooms. Amatoxin mushrooms accounts for 90% of mushroom related fatalities, with Amanita Phalloides being the most potent species. Once ingested, the toxins enter the portal circulation and are actively transported into hepatocytes, stopping protein synthesis and inducing apoptosis. Approximately 6-24 hours following ingestion the patient develops gastroenteritis with abdominal pain, diarrhea and vomiting with normal liver tests. 24-36 hours following ingestion, mild elevations in transaminases are detected. Two to four days afterwards, hepatocyte death, disruption of hepatic venous and biliary flow occurs, with significant elevations in transaminases and hyperbilirubinemia. Coagulopathy and encephalopathy follow, which can progress to multi-organ failure and death. Treatment is supportive but measures can be taken to decrease toxicity. IV Penicillin blocks uptake of toxin to hepatocytes and NAcetylcysteine limits damage from oxidative stress. Assessing the need for liver transplantation is critical because delays can lead to death as these patients can progress rapidly. Retrospective analysis of previous cases indicate that there are some tests that may help guide the clinician towards transplantation, including an elevated serum creatinine (>1.2 mg/dL) with a decreased prothrombin index (<10%) 3-4 days after ingestion. Both appear to be indicators of a poor outcome; neither criterion was met by our patient. Initial evaluation of patients with suspected mushroom toxicity may not reveal any abnormalities. The delayed onset of symptoms following ingestion and the rapid progression of hepatotoxicity are telltale signs of Amatoxin ingestion, a rare but often fatal cause of acute liver failure.

FOREIGN BODY INGESTION AS A CAUSE OF ACUTE DYSPHAGIA IN THE ELDERLY Shuchi Gulati;

Priyanka Vyas; Richard Alweis. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1339130)
LEARNING OBJECTIVE 1: Recognize foreign body ingestion as a cause of dysphagia in elderly.
LEARNING OBJECTIVE 2: .
CASE: A 73 year old man called his primary care physician with complaint of sudden onset of difficulty in swallowing solids and liquids for one day with regurgitation of undigested food. Past medical history was

significant for GERD on proton pump inhibitors and chronic atrial fibrillation for which he was on warfarin. Colonoscopy done one year earlier was normal. The patient did not have a history of smoking or alcohol abuse. Physician recommended urgent esophageal barium swallow which showed a 3 cm disc-like foreign body lodged within the distal esophagus. Patient was advised to go to the emergency department (ED) for endoscopic removal of the foreign body. The foreign body was thought to be a coin. Emergent endoscopy was planned despite therapeutic INR as patient was symptomatic for almost 48 hours. When the foreign body was removed endoscopically, it was found to actually be a circular 20 mm energizer 2032 lithium button battery. Endoscopy also showed focal severe esophagitis at the site of impaction. Later on, patient admitted to the accidental ingestion of the lithium battery.
DISCUSSION: Button battery ingestion is an uncommon scenario, with an incidence of 10-15 cases per million population per year. Lithium batteries are commonly used as a household battery, hence fatal outcomes associated with lithium battery ingestion have been increasing over the last 10 years. Potential complications include severe local esophagitis, perforation, tracheoesohageal fistula, esophageal stricture, vocal cord palsy, mediastinitis, aspiration pneumonia and cardio pulmonary arrest. Although systemic absorption is possible after ingestion of lithium button battery, systemic toxicity has not been reported. Lithium batteries produce local corrosive effect by producing electrolytic current which hydrolyzes tissue fluids and produces hydroxide at negative pole. The outcome of lithium button battery ingestion depends upon anatomical position, diameter, chemistry and age of the battery. Injury-free outcome can be achieved by removing battery in less than 2 hours. This case illustrates that foreign body ingestion should be included in the differential diagnosis of acute dysphagia because early endoscopic removal can prevent fatal complications. This case further illustrates the need to expand beyond a coin to more toxic ingestions when one is considering foreign body ingestion as a likely etiology for acute dysphagia, and expedite evaluation.
FRESH WATER PERIL Claire Zeigler. Oregon Health Science University, Portland, OR. (Control ID #1295560)
LEARNING OBJECTIVE 1: Diagnosis and epidemiology of leptospirosis LEARNING OBJECTIVE 2: Role of convalescent antibody testing in confirming diagnosisCASE: Leptospirosis is a spirochetal infection associated with freshwater exposure. Its primary manifestations of fevers and flulike symptoms with or without multiorgan failure are non-specific, making it a diagnostic challenge. A 47 year old previously healthy man was transferred from a referring hospital for fevers, acute renal failure, and thrombocytopenia concerning for TTP. He initially presented to the referring ED one day prior to admission with fevers of 101-102; labs at that time were significant for a normal creatinine, platelets of 139, hematocrit of 38.4, and negative urinanalysis and blood cultures. He was sent home, but returned the following day with recurrent fevers and rigors. At this time, he reported developing myalgias, abdominal pain and watery, non-bloody diarrhea five days prior. As a competitive wind surfer, he had recently competed on the Oregon coast and in Hood River. Travel history was also notable for wintering in Mexico three months out of the year. He denied weight loss, night sweats, lymphadenopathy, and rash. On presentation, physical exam was significant for fever, tachycardia, and slight conjunctival pallor. Labs were significant for a creatinine of 5.4, BUN 40, hematocrit 36.6, platelets 90,000, and mild transaminitis. In order to rule out TTP, an LDH was ordered but was normal. CXR, blood cultures, echocardiogram, anti-

streptolysin, ANCA, peripheral smear, leptospirosis serology were ordered. He was started on empiric broad-spectrum antibiotics including doxycycline. Urine sediment revealed muddy brown and granular casts, consistent with acute tubular necrosis. Over the course of several days, his fevers remitted, his renal function began to improve and his platelets rebounded. Initial leptospirosis antibody was negative, but treatment with doxycyline was continued for 10 days because of strong suspicion for this diagnosis. Convalescent leptospirosis titers, done through the state health department, resulted as strongly positive after discharge. He was seen in Infectious Disease clinic several weeks later where he reported to be doing well.
DISCUSSION: Leptospirosis is a surprisingly common yet under diagnosed infection. It should be considered in patients with abrupt onset of fever, abdominal pain, renal or hepatic failure, and exposure history (in this case, recent fresh water wind surfing). Physical examination is usually not helpful in diagnosis, but occasionally, conjunctival injection, hepatosplenomegaly and edema are observed. In severe cases, complications include organ dysfunction, specifically ARDS, renal failure, myocarditis, uveitis and rhabdomyolysis. Diagnosis is usually by serologic testing, though blood and urine cultures are positive in approximately 50% of the time. Microscopic agglutinin test is considered gold standard, but because it is not widely available, IgM antibody and PCR are more commonly used. As in this case, convalescent antibodies should be sent several weeks after onset of symptoms for serologic confirmation.
FULMINANT NEUROGENIC PULMONARY EDEMA FROM SUBARACHNOID HEMORRHAGE Madan R. Aryal; Leena Jalota; Naba Mainlai; Madan Badal; Anthony Donato. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1329267)
LEARNING OBJECTIVE 1: Recognize neurogenic pulmonary edema in the setting of acute CNS lesion.
LEARNING OBJECTIVE 2: Describe the management of neurogenic pulmonary edema.
CASE: The fulminant form of neurogenic pulmonary edema (NPE) is a rare, life threatening complication in patients with subarachnoid hemorrhage. It may develop very quickly within minutes and may be the initial presentation of an acute CNS event. We report a fatal case of NPE that was associated with subarachnoid hemorrhage. A previously healthy 47 year old female was brought to the ED by an EMS after having intense headache followed by loss of consciousness and jerking movements of the hands and legs. On examination, patient was dyspneic with respiratory rate 30/min, blood pressure 152/80 mm Hg, HR 140/min and oxygen saturation 88% on room air. She was intubated in the ED for airway protection and required 80% FIO2 to maintain saturation. Following intubation she was noted to have copious pinkish frothy discharge from the endotracheal tube. She was then transferred to the ICU. She rapidly developed hypotension that was refractory to infusion of 6 L of normal saline and 2 L of albumin and maximum doses of norepinephrine and vasopressin. In lung exam, she had fine crackles in the lung bases. Heart examination was unremarkable. Chest X ray showed diffuse bilateral pulmonary edema pattern, EKG showed normal sinus rhythm with nonspecific ST, T wave changes. Cardiac enzymes were normal. BNP was 720 pg/ml. Bedside echocardiogram done immediately in the ED was normal. Echocardiogram done after 3 hours showed left ventricular ejection fraction of 43% and decreased wall motion of the left ventricle. Pulmonary capillary wedge pressure was 19 mm Hg. In the subsequent 5 hours the neurological examination did not demonstrate any findings consistent with brainstem, higher cerebral and cranial nerve functioning. The CT scan and CT angiogram showed diffuse subarachnoid hemorrhage from rupture of aneurysm of posterior inferior cerebellar artery (PICA) with hydrocephalus. Patient died after 6.5 hours of arrival in ED and 7 hours of symptom onset.
DISCUSSION: Fulminant NPE usually occurs within minutes to hours from a severe CNS insult with acute onset of dyspnea. Higher grades of CNS insult radiologically as well as PICA aneurysmal bleeding are important factors for the development of NPE. NPE shows broad clinical spectrum ranging from asymptomatic patients to the rapid development of respiratory failure. Differential diagnosis for NPE includes aspiration pneumonitis, ventilator associated pneumonia and ventilation induced lung injury. Chest radiograph classically shows bilateral alveolar infiltrates. Initial studies of cardiac function including EKG, echocardiogram, CVP and PCWP

are usually unremarkable; however serial monitoring of cardiac function may demonstrate reduced left ventricular function and regional wall motion abnormalities. PCWP may increase and approach high levels. Increase permeability of the vascular bed as well as stunned myocardium are proposed mechanisms of this condition. The treatment is supportive with the primary aim of decreasing the intracranial pressure. Prognosis depends on the underlying neurological problem unless significant respiratory complications develop.

GOO! WHERE TO START? Edward Mannina; Ken Harang; Danielle King. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338656)
LEARNING OBJECTIVE 1: 1. Learn to manage the symptomatology of gastric outlet obstruction. 2. Recognize the acid-base disturbances that can result from prolonged gastric outlet obstruction. 3. Implement a treatment strategy for starvation and define refeeding syndrome.
CASE: A 54 year-old man presented with four months of nausea and non-bloody vomiting. He reported a forty-pound weigh loss and decreased appetite; he had not had a bowel movement for over a week. He had a past medical history of hypertension. His vital signs were normal with the exception of a blood pressure of 94/43 mmHg. He had hypoactive bowel sounds and tenderness to palpation in the epigastrum; there was no evidence of hepatosplenomegaly. Serum chemistries included a potassium of 3.2, a choloride of 69, and a bicarbonate of 45; the BUN was 58 and the creatinine was 4.2. Liver enzyme and function tests were normal. An arterial blood gas revealed a pH of 7.57, a pCO2 of 60, and a pO2 of 151. Plain films of the abdomen and chest were normal. He was started on intravenous pantoprazole, ondansetron and compazine. A nasogastric tube was placed and set to suction, returning 2 L of brownish fluid. Aggressive fluid resuscitation was initiated. The hypotension resolved, and the acute kidney injury began to correct. A diagnosis of metabolic alkalosis secondary to prolonged vomiting was established. His anion gap starvation ketoacidosis was treated with fluid resuscitation followed by peripheral parenteral nutrition. Esophagogastroduodenoscopy revealed gastric outlet stricture by a sub-mucosal mass. Dilation was performed for symptom alleviation. Electrolytes were monitored for evidence of re-feeding syndrome; potassium and phosphate were repleted as needed. Following biopsy results, the patient was referred to hematology-oncology for treatment of a gastric adenocarcinoma.
DISCUSSION: The general internist is frequently confronted with the symptoms of nausea, vomiting and weight loss. While most cases are due to self-limited diseases, it is important for the internist to recognize the signs and symptoms that suggest more serious etiologies. Months of nausea and vomiting with decreased oral intake and significant weight loss should prompt an investigation of the upper gastrointestinal tract to exclude obstruction. In addition to visualization of the gastrointestinal tract, is equally important that the internist suspect a mixed acid-base disorder and electrolyte abnormalities secondary to vomiting and starvation. The treatment should aim to alleviate symptoms of gastric outlet obstruction while aggressively fluid resuscitating and supplementing nutrition. As nutrition restoration prompts insulin release and anabolism, serum electrolytes can be depleteda condition called refeeding syndrome. Abnormal serum values of potassium and phosphate can cause muscular dysfunction, including the myocardium. Electrolyte repletion and telemetric monitoring are thus advised.
GRAM NEGATIVE SEPSIS IN A WOMAN WITH ORIENTAL CHOLANGIOHEPATITIS. Joshua C. Obuch; Amy R. Weinstein. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1339601)
LEARNING OBJECTIVE 1: Characterize Oriental Cholangiohepatitis (OCH) and review its epidemiologyLEARNING OBJECTIVE 2: Understand the pathophysiology of OCH cholangitis, anatomical assessment, and treatment optionsCASE: 74 year old Vietnamese female with OCH and prior cholecystectomy and Roux-en-Y hepaticojejunostomy for repeated biliary stones presented to her hepatology visit with fevers for several weeks after returning from a month in Vietnam. She also had epigastric pain, anorexia, 6lbs weight loss, and fatigue. She denied other GI issues, jaundice, night sweats, pulmonary or urinary symptoms. In Vietnam, she received antibiotics for a presumed UTI. She takes omeprazole and risendronate. She does not smoke or

drink. History is notable for being a fishing industry supplier in Vietnam. On presentation she had fevers to 102 F, epigastric tenderness, alkaline phosphatase of 818 and WBC of 12.5 without bandemia. IV ampicillin/sulbactam was started, but switched to ceftriaxone and metronidazole for continued fevers. MRCP showed old biliary strictures and dilation, caudate lobe inflammation, necrosis, abscess posterior to the IVC, and areas of ongoing cholangitis. ERCP was deferred, but PTC showed contrast flow from the left duct into the jejunum, but moderate degree of stenosis, stricturing, and stasis in the central left and right duct. Stricture biopsies and bile cultures were done, and a drainage catheter was placed. Meropenem (MPM) was started due to continued fevers. Bile cultures showed eggs concerning for trematode infection. Stool and urine were sent for ova and parasites. Blood cultures grew highly resistant E.Coli sensitive to MPM. She remained afebrile with clinical improvement on MPM and stayed in house with pending biopsies and trematode serologies.

DISCUSSION: Oriental cholangiohepatitis (OCH) entails recurrent bouts of cholangitis with strictures and dilation of biliary ducts along with pigment stone formation within the ducts. It typically affects 20-40 year olds, and is endemic to southeast Asia. Pathogenesis is thought to be from chronic biliary infestation with parasites, such as Clonorchis sinensis and Ascaris lumbricoides, causing dilation, inflammation, stricture, sludging, and stone formation. Parasitic eggs and sloughed epithelial cells can block ducts causing stasis and bacterial proliferation. This cyclical process leads to repeated stricture formation and episodes of cholangitis. Patients can present with RUQ pain, fever, and jaundice, with evidence of obstructive cholangiopathy, hepatic injury, and infection on labs. Workup includes US, CT, and MRCP. US can show extra and intrahepatic duct dilatation and narrowing of smaller intrahepatic branches, along with presence of stones. CT can provide biliary detail and evidence of chronic disease with abscess and necrosis. MRCP provides additional detail of proximal ducts and possible intraductal mass lesions. Mild symptoms can be treated with oral fluoroquinolones. Moderate to severe cholangitis needs broader GNR and enterococci coverage. If improvement fails, coverage changes to ESBL GNRs and VRE. It is unclear if fluke treatment changes the chronic disease course. ERCP can stent and dilate strictures and remove stones. If ERCP cannot be done, PTC can accomplish duct drainage, stenting, and biliary samples. Localized disease may be surgically resected with hepatic lobectomy or duct resection via Roux-en-y hepaticojejunostomy. In refractory disease, orthotopic liver transplant should be considered.

HIV AND MALIGNANCY IN THE POST-HAART ERA- A STORY OF BURKITT'S LYMPHOMA Reshma Gupta; Santiago Neme; Shireesha Dhanireddy. University of Seattle, Washington, Seattle, WA. (Control ID #1324075)

LEARNING OBJECTIVE 1: Assess differences in disease outcomes between AIDS-related Burkitt's lymphoma and other AIDS defining malignanciesLEARNING OBJECTIVE 2: Distinguish the correlation between virologic suppression, CD4 recovery, and progression of AIDS-related Burkitt's lymphomaCASE: 28 year old HIV-positive man with history of Burkitts lymphoma presented with severe upper back pain and vomiting. He was diagnosed with HIV four years ago (CD4 count 300) and highly active antiretroviral therapy (HAART) was initiated. One year ago, he presented with a right axillary mass and small bowel obstruction. He was diagnosed with stage IV Burkitts lymphoma, negative for bone marrow and CNS involvement. He received E-POCH with methotrexate, RDHAP, and auto-stem cell transplantation. At baseline, he was highly functional with a CD4 count 192 and undetectable viral load on efavirenz-tenofovir-emtricitabine. Upon admission, he was afebrile, ambulating well with no alarming laboratory findings. At 9 am the next day, he had worsened back pain and difficulty ambulating. By noon, he was unable to move his lower extremities and had reduced lower extremity strength, T4-T11 point tenderness, T3 sensory level, and urinary retention. MRI lumbothoracic spine showed a dorsal epidural mass lesion from T2-T11 with compression of the thecal sac. Dexamethasone was started, and he emergently underwent a T3-T6 laminectomy and decompression. Inflammatory gelatinous vascular tissue compressing the spinal cord was found in the epidural space. Post-operatively, he regained sensation but not strength. Cytology of intraoperative tissue showed high-grade Burkitts lymphoma. He started radiation therapy, however, given CNS involvement and relapse after

transplantation, his prognosis was poor and no further therapy was recommended.
DISCUSSION: Burkitts lymphoma is an aggressive B-cell lymphoma and one of the most common initial AIDS-defining illnesses. With the advent of HAART, many AIDS-related malignancies have decreased in incidence. However, in the post-HAART era, survival for AIDS-related Burkitts lymphoma has not improved significantly compared to other AIDS-related malignancies (38.1 months for Kaposis sarcoma vs 5.1 months for Burkitts lymphoma, $p<0.005$). People with HIV are still at increased risk of mortality to AIDS-related Burkitts lymphoma independent of the degree of immunodeficiency or antiretroviral therapy. This patient remained physically active and adherent to HAART with an undetectable viral load; however, he still developed a devastating CNS lymphoma. Progression of AIDS-related Burkitts lymphoma involves unique mechanisms that require targeted interventions plus HAART. HIV causes loss of T-cell function reducing immunoregulation of Epstein-Barr virus-infected B cells and chronic B-cell hyperactivation that increases genetic mutations. These are targets for new therapies for AIDS-related Burkitts lymhoma, a treatment challenge in the post-HAART era.
HAEMOPHILIA IS NOT ONLY MENS DISEASE Nayan K. Desai; Vijay Rajput. Cooper university Hospital, UMDNJ, Camden, NJ. (Control ID #1319349)
LEARNING OBJECTIVE 1: Approach to a patient with isolated elevation of partial thromboplastin time.
LEARNING OBJECTIVE 2: Recognise the hematological causes of bleeding in postpartum females.
CASE: BACKGROUND: Haemophilia A is a hereditary disorder of young men. Acquired Haemophilia A (AHA) is rare but critical diagnosis in young women with postpartum bleeding, caused by an autoantibody to factor VIII. It must be distinguished from congenital hemophilia and other acquired bleeding disorders for appropriate and timely treatment in young women with postpartum bleeding. Case report: A 24 year Asian -Indian women presented with recurrent, spontaneous bruising over her lower limbs and continuous noncyclical vaginal bleeding over four months after normal delivery. On examination she had pallor, ecchymotic patches on lower limb with swelling and tenderness of right calf. Her haematological parameters were consistent with iron deficiency anaemia and platelet count was within range. Coagulation tests revealed elevated activated partial thromboplastin time (aPTT) and normal prothrombin time. aPTT on mixing studies did not decrease by 50%. Factor VIII levels were less than 1 %, consistent with severe hemophilia. Inhibitors to factor VIII were positive with levels of 5 Bethesda units/ml. Lupus Anticoagulant was negative. Ristocetin and ADP aggregation test were normal. Diagnosis of Postpartum AHA was made based on clinical and laboratory presentation. She responded to oral corticosteroids.
DISCUSSION: Von Willebrand disease, platelet function defects and acquired factor inhibitors are rare but important haematological conditions in women with postpartum bleeding. AHA is an acquired autoimmune disease caused by polyclonal autoantibody to factor VIII, which leads to FVIII deficiency, which results in insufficient generation of thrombin through the intrinsic pathway. The incidence is estimated to be 0.2-1.0 case per 1 million persons per year. More than two third women with postpartum bleeding have autoantibody against factor VIII. Hepatitis B and C; solid and haematological malignancies; drugs are other causes of AHA. Mortality ranges from 8-22% if not diagnose early in first week of bleeding. Deep soft tissue, mucosal and subcutaneous bruising is common, but haemarthoses is relatively uncommon compared to hereditary hemophilia A. The diagnosis is confirmed by the finding of low FVIII and raised inhibitor titer on Bethesda assay. The principles of treatment are to control of bleeding with recombinant Factor VIIa; eradication of inhibitor by immunosuppressive agents; removal of inhibitors with plasmapheresis or immunoabsorption. Corticosteroids are first line therapy for inhibitor eradication either alone or in combination with cyclophosphamide. Rituximab is second line agent for refractory cases or failure of first line therapy. Most patients spontaneously clear inhibitors after a median period of 30 months and less likely to recur with subsequent pregnancies. Conclusion: Isolated elevation of aPTT with

postpartum
bleeding in primiparous female is a key towards diagnosis of AHA. Early recognition and treatment can avoid the life threatening bleeding and its complications.
HAH, WHAT ARE YOU SAYING? BY: SARA HANNA, MD, PETER SIDAROUS, MD, PRAMIL CHERIYATH, MD Sara Hanna; Peter Sidarous; Pramil Cheriyath. Pinnaclehealth, Harrisburg, PA. (Control ID #1340422)
LEARNING OBJECTIVE 1: To recognize the features of cryptococcal meninigitis in healthy subjectsCASE: Introduction: Cryptococcus is the most common fungal infection of the CNS and meningitis is the most frequent CNS involvement. It mostly infects immunocompromised individuals but can happen in healthy subjects. Other presentations are also seen such as pneumonia, osteomyelitis and skin infections. This is a case presentation of Cryptococcal meningitis in an apparently healthy patient who presents with bilateral hearing impairment as well as deteriorating mental functions. Case Presentation: This is a 58 years old African American male with past medical history of Diabetes mellitus, hypertension, Hepatitis C virus, Genital herpes who presented with history of weakness and multiple falls for two month. According to his family, he has not been acting himself lately. His main other complaint was migraine that are not improving on any medication. On presentation, his examination was benign except for impairment in hearing which is sensorineural in nature. His initial laboratory finding was only significant for hyperglycemia of 350 mg/dl and hyponatremia of 129 mmol/L after correction. CT brain was done due to history of falls which did not reveal any hemorrhage or acute infarct. Overnight, he became more confused. All labs including ammonia, TSH, vitamin B12, folic acid were within normal limits. A lumbar puncture was done that revealed glucose of 4 mg/dl, protein of 61 mg/dl and nucleated cells of 183 cell/mm cube with lymphocytic predominance. India ink was positive and Cryptococcus neoformans was cultured. Blood cultures were also done that showed disseminated disease. HIV testing was negative twice as well as the viral load. CD4 count was 87 with an absolute percent of 56% that was attributed to sepsis. Patient was started on Amphotericin and Flucytosine followed with treatment with Fluconazole. MRI was done that excluded cryptococcoma. Repeat of lumbar puncture after 2 weeks revealed Cryptococcus which did not grow on cultures. Patient recovered gradually and his hearing impairment improved but functional and mental status never returned to normal.
DISCUSSION: Cryptococcal meningitis was a fatal disease until Amphotericin and Flucytosine were used in the treatment. Clinical presentation is variable and usually extends for several months before the diagnosis is made. Headache, lethargy, coma, personality changes and memory loss are some of the typical symptoms. Deafness is seen in up to 30% of cases and is characterized by being mostly bilateral and senisorineural through direct effect of the auditory nerve is either by infection or compression. Other cranial nerve involvement was also described, most commonly the optic nerve. Treatment consists of antifungal treatment in the form of Amphotericin B with Flucytosine for 2-4 weeks followed by Fluconazole for consolidation therapy. Treatment should also include management of increased intracranial pressure and improving immunologic status. Prognostic factors indicating treatment failure include low CSF glucose, high CSF lactate, high CSF cryptococcal antigen titer, level of consciousness, seizure and hydrocephalus. Early diagnosis, initiation of treatment and correction of electrolyte abnormalities are important in successful management.
HARD TO FIGURE OUT DARLINGS Allison Heinen1,2; Lee Lu1,2;
Anna Kolpakchi1,2. 1Baylor College of Medicine, Houston, TX; 2MichaelE. Debakey Veteran's Affairs Medical Center, Houston, TX. (Control ID #1316275)
LEARNING OBJECTIVE 1: Histoplasmosis can frequently mimic sarcoidosis.
LEARNING OBJECTIVE 2: To avoid fatal outcome, histoplasmosis should be considered before treatment of sarcoidosis with steroid is initiated.

CASE: A 44 year old Caucasian man with psoriatic arthritis has been receiving infliximab for one year. He presented initially to his private doctor with shortness of breath and fatigue for one week. He denied fever, chills,

cough, and weight loss. Physical exam showed no lymphadenopathy and clear lungs. Chest radiography showed mediastinal lymphadenopathy only. A lymph node biopsy revealed non-caseating granulomas. The patient was diagnosed with sarcoidosis and treated with prednisone with improvement in his symptoms. He presented one month later with worsened shortness of breath, fever to 1030 F, fatigue, and 10 lb weight loss. Physical exam showed hypoxia with O2 saturation of 70% on room air, fever of 102.30 F, 2 cm ulceration over the lower lip, and diffuse rhonchi. Chest radiography showed diffuse bilateral interstitial infiltrates. Abnormal laboratory studies included: sodium 127, alkaline phosphatase 268, ALT 199, AST 593, ESR 14, CRP4.59, and LDH 9378. Urine and serum histoplasma antigen were elevated at >39 ng/ml (normal <0.6 ng/ml). The patient was diagnosed with disseminated histoplasmosis, treated with amphotericin B and itraconazole with full recovery.
DISCUSSION: Sarcoidosis can frequently mimic lymphoma or diseases characterized by a mononuclear cell granulomatous inflammatory process, such as the mycobacterial and histoplasma infections. Sarcoidosis and histoplasmosis (a.k.a Darlings disease, Cave disease, Ohio valley disease, Reticuloendotheliosis, Spelunkers Lung, and Caver's disease) can present with similar clinical and laboratory features and distinguishing the two can be difficult at times. Erythema nodosum, uveitis, retinitis, splenomegaly, skin or mucosal ulcers, and mediastinal lymphadenopathy are frequent physical findings in both. Elevated ESR, LDH, alkaline phosphatase, angiotensin converting enzyme, hypercalcemia, and non-caseating granulomas are also common in both conditions. The added challenge to diagnose histoplasmosis, is the fact that sputum and blood cultures take many weeks to grow histoplasma and they can be negative. Sensitivity for cultures can be as low as 15% in acute pulmonary histoplasmosis, between 50-85% in chronic pulmonary histoplasmosis, and less than 25% in mediastinal histoplasmosis. Histopathology is often unreliable. Histo-plasma antibodies are often falsely negative especially in patients with sarcoidosis. Urine and serum histoplasma antigen tests have the highest sensitivity and spesificity. In patients with disseminated histoplasmosis (excluding patients with AIDS), 92% have antigenuria and 50% anti-genemia. As shown in this case, diagnosing histoplasmosis can be a challenge. But if it is misdiagnosed as sarcoidosis and treated with steroid, histoplasmosis can become disseminated which can lead to fatal outcome.
HARLEQUIN SYNDROME: EXERCISE-INDUCED FLUSHING IN ZUMBA CLASS Charlotte M. Carlson. UCSF, San Francisco, CA. (Control ID #1333752)
LEARNING OBJECTIVE 1: 1) Recognize the diagnostic approach to unilateral facial flushingLEARNING OBJECTIVE 2: 2) Distinguish Harlequin syndrome from other neurologic disordersCASE: A 46 year-old premenopausal Brazilian female presented to primary care with a 2 month history of unilateral facial flushing after joining a Zumba exercise class. During intense exertion, the right side of her face showed excessive flushing and sweating, while the contralateral side remained pale and dry. She denied any associated visual changes, dizziness, neck pain, or headache. Her past medical history was significant for well-controlled hyperlipidemia on simvastatin. She was a nonsmoker and denied any alcohol or drug use. Neck, cardiac, and respiratory examination were normal. Neurological examination was normal. Formal ophthalmologic testing revealed no ptosis, miosis, or anhidrosis. Basic laboratory tests were normal. Chest X-ray and MRI thoracic spine were normal. DISCUSSION: Unilateral facial flushing is typically caused by injury or activation of the autonomic nervous system on one side of the body. When the sympathetic nervous system is involved, lesions can occur in the hypothalamus, descending sympathetic tract in the brainstem, spinal cord, or in the cervical sympathetic ganglia, which then have fibers that ascend around the internal carotid artery. A unilateral ptosis and miosis syndrome is often concurrently found. While most cases of facial flushing are of benign nature, imaging of the chest to exclude a Pancoast's tumor, the carotid arteries to exclude a carotid dissection, and often imaging of the
brainstem and thoracic spinal cord are indicated. If workup is otherwise negative or no clear evidence of other sympathetic dysfunction is found (e.g. ptosis, miosis), a diagnosis of an idiopathic autonomic disorder, known as

Harlequin syndrome, can be entertained. Harlequin syndrome is considered to be an idiopathic, benign condition, resulting from compromise of vasomotor sympathetic nerve supply to one side of the face with compensatory overreaction of corresponding fibers on the intact side. It is an uncommon disease with onset is typically in childhood, and if it presents later in life, a structural lesion should be excluded.

HEART BLOCK AS A PRESENTING SIGN IN A PATIENT WITH WEGENERS GRANULOMATOSIS Sandra Zaeh1; StephenK. Lau2; Dustin T. Smith1,3. 1Emory University School of Medicine, Atlanta, GA; 2Atlanta Veterans Affairs Medical Center, Decatur, GA;
3Atlanta Veterans Affairs Medical Center, Decatur, GA. (Control ID #1310105)

LEARNING OBJECTIVE 1: Recognize both typical and atypical presentations of Wegeners GranulomatosisLEARNING OBJECTIVE 2: Understand organ systems commonly affected by Wegeners GranulomatosisCASE: A 62 year-old male with no past medical history was placed on hemodialysis after being found in renal failure of unknown etiology. The patient reported dyspnea as well as fevers, night sweats, weight loss, and swelling. His vital signs were normal except for decreased oxygen saturation. Physical exam revealed uveitis, regular heartbeat without murmur, bibasilar lung crackles, and an ulcerated skin lesion on his ankle. Laboratory investigation showed a leukocytosis, elevated BUN and creatinine, but normal electrolytes. Urinalysis revealed hematuria and proteinuria. Renal ultrasound had findings of medical renal disease. Chest imaging demonstrated a cavitary lung lesion. Electrocardiogram revealed complete heart block. Investigation for infection was negative including bacterial cultures and serologies for viral hepatitides, HIV, and other infectious etiologies. Serum complement levels were normal. Anti-proteinase-3 antibody levels were elevated. The patient was admitted to the intensive care unit for monitoring where he experienced variable degrees of atrioventricular (AV) block. Echocardiography showed normal ejection fraction. The patient spontaneously converted to first-degree AV block and his shortness of breath improved. He remained stable from a cardiovascular standpoint during his hospitalization. Renal biopsy revealed necrotizing crescentic glomerulonephritis. The patient was diagnosed with Wegeners granulomatosis based on his biopsy results and clinical findings. He was treated with prednisone, cyclophosphamide, plasma exchange, and hemodialysis. DISCUSSION: Wegeners granulomatosis (WG) is a rare cause of kidney failure that is typically associated with upper and lower respiratory tract signs and symptoms. It has been reported that up to 44% of Wegeners cases have cardiac findings, including supraventricular tachycardia, pericarditis, coronary artery vasculitis, and aortic valve disease. There have been only a few case reports of reversible heart block associated with WG. The etiology of heart block in WG is unknown but may be due to disease involvement of the coronary arteries or involvement of the conduction system secondary to small vessel vasculitis. Granuloma formation is another possibility. The cytoplasmic pattern on immunofluorescence for anti-proteinase-3 antibodies has high sensitivity and specificity in the diagnosis of WG. Renal biopsy typically demonstrates segmental necrotizing glomerulonephritis with multiple crescents and supports the diagnosis. Granulomas can also be found in tissue specimens. Treatment of WG is directed to prevent end-organ damage. Cyclophosphamide and prednisone can induce temporary remission in most patients. Plasma exchange has been shown in trials to decrease mortality and improve renal function in patients who present acutely with severe renal disease. This case recognizes the clinical manifestations of Wegeners granulomatosis and reports the rare finding of heart block associated with this disease.

HEMOGLOBIN CHICAGO, A RARE VARIANT OF ALPHA THALASSEMIA. Namratha R. Vontela1; Pranitha Naini2; Alva B. Weir2. 1University of Tennessee, memphis, TN; 2University of Tennessee, memphis, TN. (Control ID #1309280)

LEARNING OBJECTIVE 1: Recognize coexistent thalassemias in patients with iron deficiency anemia. CASE: Patient is a 43 year old African American female with history of hypertension and diabetes who

presented to the clinic with fatigue. She reported a long standing history of heavy menstrual bleeding and denied any hematuria or rectal bleeding. Her last colonoscopy an year ago showed benign polyps. Physical examination was normal. Laboratory data at presentation demonstrated microcytic, hypochromic anemia with Hb of9.6 g/dL and very low MCV of 69.3 fL. RDW was 19.6. Ferritin level was2.9 ng/mL and transferrin saturation was 2% leading to the impression of iron deficiency anemia. However her RBC count was 4.4 M/uL which was in the normal range in spite of the anemia. This lead to the suspicion of an additional factor contributing to the low MCV apart from her established iron deficiency anemia. Therefore hemoglobin electrophoresis was performed which demonstrated "Hemoglobin Chicago", a rare variant of alpha thalassemia. Patient was started on oral iron and repeat labs in 3 weeks showed RBC - 4.8 M/uL, Hb - 10.3 g/dL. Her MCV - 69.2 fL remained the same. Her ferritin improved to 5.1 ng/mL and transferrin saturation increased to 3%.
DISCUSSION: We report a rare case of "Hemoglobin Chicago" in a woman who presented with iron deficiency anemia. Hemoglobin Chicago is a rare variant of alpha thalassemia in which the leucine residue at position 136 of alpha chain is substituted by methionine. This rare variant was first described in 1986 in a black newborn girl and her father and has since had few reported cases. This mutation is either carried alone or in combination with sickle cell trait or sickle cell disease. In our patient, as Hemoglobin Chicago was coexistent with iron deficiency anemia the diagnosis had been missed for several years. Hence physicians should consider ruling out thalassemia in cases of iron deficiency with normal RBC count and microcytosis out of proportion to the degree of anemia, and especially in cases where serum ferritin corrects with iron therapy but the MCV remains low. This approach may protect patients with coexistent thalassemias from iron overload caused by long term iron therapy in an attempt to correct hemoglobin and MCV rather than true iron deficiency.
HEMOLYTIC ANEMIA IN SYSTEMIC LUPUS ERYTHEMATOSUS Sumana Nagireddy1; Robert Avery2. 1UAB Montgomery, Montgomery, AL;
2UAB Montgomery, Montgomery, AL. (Control ID #1339614)
LEARNING OBJECTIVE 1: Recognize various types of anemia in SLE and diagnose SLE presenting as auto immune hemolytic anemia (AIHA) LEARNING OBJECTIVE 2: Differentiate autoimmune hemolytic anemia from micorangiopathic hemolytic anemiaCASE: A 27 year old female with history of discoid rash, hair loss and hypertension for one year was hospitalized for generalized weakness and fatigue. On admission vitals were stable other than temperature which was elevated at 101.9o F. She was alert but showed limited communication. Examination showed discoid lesions on all extremities. Her blood cultures were negative with no source of infection noted. Lab studies showed hemoglobin of 3.4 g/dl, MCV of 112.7 fl, Platelets 150,000 k/cumm, creatinine 2.34 mg/dl and total bilirubin 1.5 mg/dl. Serum folate and B12 levels were normal. Hemolytic anemia was suspected so, hemolytic indices were tested which showed LDH of 1749 IU/L (normal 98-192 IU/L), and haptoglobin <14 mg/dl (normal 30-200 mg/dl). Hemoglobin electrophoresis was normal. . Peripheral smear showed nucleated red cells, spherocytes but no schistocytes thus ruling out microangiopathic anemia. .Direct antiglobulin test was positive confirming the diagnosis of AIHA. ANA was positive with titer of 1:160 (normal <1:40), dsDNA was elevated to 67 IU/ml (>10 positive), complement C3 and C4 were low, 44 mg/dl (Normal 75-175 mg/dl) and 7 mg/dl (14-40 mg/dl) respectively. She met diagnostic criteria for lupus (>4 out of 11) and her initial presentation was with AIHA, alopecia, discoid rash, nephritis and cerebritis. She was started on pulse dose steroids for AIHA and her clinical status and anemia improved over the time and she was discharged for outpatient follow up.
DISCUSSION: Anemia in lupus may be caused by multiple reasons including chronic inflammation, renal insufficiency and hemolysis. Hemolytic anemia in patients with lupus frequently presents with considerable diagnostic and therapeutic difficulties to clinician as its incidence is low. In lupus patients hemolysis may be because of auto immune hemolytic anemia (AIHA) or thrombotic microangiopathic hemolytic anemia (MAHA). AIHA
is a hematologic diagnosis that is based on the presence of anemia, signs of hemolysis, and detection of red

cell-reactive antibodies (positive coombs test). AIHA may be a primary (idiopathic) or a secondary disease. Secondary AIHA may be from lymphomas and systemic autoimmune disorders, and less frequently from organ transplantation, infections, or solid tumors. For AIHA first line of treatment is glucocorticoids and second line of treatment is splenectomy. In refractory cases rituximab (anti-CD20) and mycophenolate mofetil are effective. If MAHA associated with fever, neurological symptoms, kidney involvement HUS should be ruled out as it needs urgent management. In lupus patients less severe MAHA can be treated with high dose steroids but more severe MAHA involving major organs needs treatment with plasmapheresis as in TTP-HUS. This case illustrates the importance to recognize various types of anemia in SLE diagnose AIHA as a initial presentation of SLE and differentiate AIHA with MAHA as prognosis and treatment are different.

HEPATITIS B REACTIVATION WITH FULMINANT HEPATITIS AFTER RITUXIMAB CHEMOTHERAPY IN A PATIENT WITH FOLLICULAR LYMPHOMA Aditi Kumar1; Ioannis Politikos1; Chirag Acharya2. 1Mount Auburn Hospital, Cambridge, MA; 2Dana Farber Cancer Institute, Boston, MA. (Control ID #1333887)

LEARNING OBJECTIVE 1: To recognize Hepatitis B reactivation as a complication of rituximab chemotherapy.

LEARNING OBJECTIVE 2: To recognize the importance of checking Hepatitis B serologies before institution of rituximab chemotherapy. CASE: 83 year old male with follicular B cell lymphoma who received rituximab chemotherapy presented to our hospital with nausea and fatigue. He had received 6 cycles of rituximab, cytoxan, vincristine and prednisone followed by one dose of rituximab two months after the last cycle as part of maintenance therapy. After two months of the last rituximab dose, the patient came to the hospital and had rapidly rising aminotransferase and bilirubin levels. He had positive serology for HBsAg, HBeAg and HBsAb and negative for HBcAb. HBV load detected by PCR was elevated to 467000 IU/ml. His Hepatitis B status prior to start of chemotherapy was unknown. His presentation was considered to be secondary to rituximab induced Hepatitis B reactivation. The patient was started on telbivudine but died of fulminant hepatic failure despite anti viral therapy.

DISCUSSION: This case illustrates late reactivation of hepatitis B virus after immunosuppressive and cytotoxic therapies such as rituximab. Full Hepatitis B serologies must be obtained in all patients prior to administering intensive immunosuppressive therapies. For patients who are HBsAg positive, a baseline HBV DNA should be performed and preemptive lamivudine therapy should be given and continued for at least 3 months after cessation of chemotherapy. Patients with high baseline HBV DNA levels may need prolonged lamivudine therapy (12 months or more). HBeAg positive patients should continue therapy till HBeAg seroconversion occurs. However, HBV reactivation may still occur while patients are on lamivudine due to development of drug resistant HBV variants with YMDD mutations .The development of mutants is more commonly associated with prolonged lamivudine administration and is accompanied by a surge in HBV DNA levels. It is therefore necessary to monitor patients on lamivudine with HBV DNA and liver transaminase levels. Newer nucleoside analogues such as entacavir, adefovir, telbivudine and tenofovir are available for treatment of lamivudine resistant Hepatitis B infection. Early use of these agents may be justifiable when prolonged anti HBV therapy is necessary for patients requiring prolonged immunosuppression. Another concern with lamivudine use is the occurrence of withdrawal hepatic flares upon cessation of antiviral therapy and this is usually associated with high prechemotherapy viral load. Therefore close monitoring of serum HBV DNA and aminotransferase levels for evidence of withdrawal flares is recommended after withdrawal of lamivudine therapy. Despite lamivudine, HBV associated mortality has been reported in upto 20% HBsAg positive patients treated due to delay in administration of antiviral at a time when severe hepatic impairment has already occurred. The best strategy in managing patients with occult HBV infection is less clear. These patients are HBsAg negative and HBcAb positive. Among these patients, the HBsAb negative patients have higher likelihood of HBV

reactivation. Serial monitoring of HBV DNA and transaminase levels for early diagnosis of HBV reactivation and beginning antiviral therapy when HBV DNA is detected in the serum is a reasonable strategy though the optimal

frequency and duration of such HBV DNA monitoring is not clear.

HEROIN INDUCED RHABDOMYOLYSIS AND COMPARTMENT SYNDROME: EARLY RECOGNITION TO PREVENT MITIGATION OF SERIOUS MORBIDITY AND MORTALITY Jordan Brodsky; Elizabeth Gilbert. Beth Israel Medical Center, New York, NY. (Control ID #1277337)

LEARNING OBJECTIVE 1: The need for clinicians to possess a high level of suspicion for rhabdomyolysis and compartment syndrome in heroin users presenting with non specific pain.

LEARNING OBJECTIVE 2: The mitigation of serious morbidity and mortality is dependent on early diagnosis and adequate therapy of rhabdomyolysis.

CASE: A 26 year old man with a history of intravenous heroin presented to the Emergency Department with right lower extremity pain and swelling for three days. History revealed that he had traveled on a plane to Mexico ten days prior to arrival in the Emergency Department and used heroin intravenously in the right antecubital fossa three days prior. One day after intravenously heroin use he experienced increased pain and swelling in his right lower extremity calf. He denied any history of overdosing, seizures, unconsciousness, trauma, recent exercise or extensive walking. In the Emergency Department physical exam revealed a right swollen red leg below the knee that was firm and painful to touch on the medial calf along the anterior lateral leg. Strength on right foot was 3/5, pulses 2+ diffuse and patient was unable to dorsiflex his right foot; there was decreased pin prick sensation on the right foot. Labs revealed a CPK 112,747 IU/L, BUN 9 mg/dL, creatinine 2.77 mg/dL, Calcium 8.8 mg/dL, Phosphate 5.2 mg/dL, potassium 4.8 mEq/L, AST 1389 U/L, ALT 450 U/L, urine analysis showed large blood with only 3 RBC. The patient was diagnosed with rhabdomyolysis and acute renal failure. He was started on half normal saline with bicarbonate1.5 amps at 200 ml/hr. X-ray of tibia/fibula showed no evidence of fracture. Ultrasound was done and showed no signs of a deep vein thrombosis. Compartment pressure was measured at 10 mmHg. Right anterior compartment fasciotomy was performed as he was diagnosed with right anterior compartment syndrome after his pain and neurological deficit increased. Post surgery his numbness subsided, sensation and movement returned to his right lower extremity. His creatinine trended down and fluids were decreased to 150 ml/hr and subsequently stopped. He clinically improved and CPK trended down to 273 IU/L. The patient underwent split thickness skin graft and wound closure. He was subsequently discharged home with visiting nurse service for wound care.

DISCUSSION: In recent years, Emergency Departments have reported an increased number of cases of non traumatic rhabdomyolysis associated with heroin addiction. Even if the last time heroin was used was days prior, early diagnosis and treatment of rhabdomyolysis after intravenous heroin, is imperative in preventing complication such as electrolyte abnormalities, renal failure and compartment syndrome. While the causes of rhabdomyolysis vary, compartment syndrome is a serious complication that must be recognized early. The diagnosis of compartment syndrome can be missed or delayed in the setting of rhabdomyolysis. Inexperience with non traumatic rhabdomyolysis leading to compartment syndrome may delay necessary surgical treatment and lead to permanent disability. Physicians must take into account that rhabdomyolysis and the development of compartment syndrome can occur days after the administration of a drug. A high index of suspicion for rhabdomyolysis and compartment syndrome is essential in drug abusers presenting to the Emergency Department with non specific pain as the prognosis and treatment is imperative to prevent morbidity and mortality.

HICKAMS DICTUM ILLUSTRATED: THE SIMULTANEOUS PRESENTATION OF TWO METASTATIC CANCERS Brandon Verdoorn; Jeremy Larsen; Elise C. Carey. College of Medicine - Mayo Clinic, Rochester, MN. (Control ID #1312636)

LEARNING OBJECTIVE 1: Recognize the typical pattern of metastasis of differentiated thyroid cancer.

LEARNING OBJECTIVE 2: Use pattern of metastasis to help predict primary tumor site(s) in a patient with newly suspected metastatic cancer on imaging.

CASE: A 56 year-old male with remote 18 pack-year smoking history was admitted to the hospital with cough

and low back pain. Ten days prior to admission he was evaluated for a one-month history of cough. He was found to have cervical lymphadenopathy and right middle lobe consolidation on chest x-ray. He was treated with azithromycin, but returned two days prior to admission with persistent cough and new, severe low back pain. Computed tomography (CT) scan of the neck and chest revealed a large, cystic right thyroid mass, cervical and mediastinal lymphadenopathy, innumerable pulmonary nodules, lytic lesions throughout the spine, bilateral adrenal masses, and right lower lung consolidation. The patient was admitted to the hospital with suspected widely metastatic cancer. Magnetic resonance imaging of the head and spine demonstrated multiple ring-enhancing cerebral and cerebellar lesions with surrounding vasogenic edema and confirmed extensive lytic disease throughout the spine. The patient underwent fine needle aspiration of an enlarged cervical lymph node and the right thyroid mass. Pathology showed papillary thyroid carcinoma (PTC). Positron emission tomography scan revealed uptake in the brain, axial skeleton, pulmonary nodules, right lower lung consolidation, mediastinal lymph nodes, bilateral adrenal glands, right supraclavicular fossa, and a right cervical lymph node. The thyroid gland had no uptake. The aggressive nature of his disease was felt inconsistent with typical PTC and he subsequently underwent CT-guided biopsy of an L2 vertebral lesion. Pathology showed adenocarcinoma of unknown primary origin, most consistent with lung or upper gastrointestinal tract malignancy. The patient was discharged from the hospital, and underwent palliative radiation therapy to the brain and spine. A course of carboplatin and Taxol was offered for the adenocarcinoma, but the patient elected to pursue hospice care and passed away shortly thereafter.

DISCUSSION: The simultaneous presentation of multiple metastatic malignancies is rare. Pattern of organ involvement on staging work-up is an important clue to synchronous occurrence of tumors originating from multiple primary sites. Papillary and follicular carcinomas of the thyroid gland, often referred together as differentiated thyroid cancer (DTC), are metastatic at presentation in only 1-9% of cases. When this does occur, solitary lung or bone metastases are most common. Only rarely are multiple metastatic sites involved at presentation. In a patient with newly diagnosed DTC and imaging evidence of widely metastatic disease, evaluation for a second primary tumor may be warranted. Synchronous occurrence of DTC and other primary cancers has been reported. To our knowledge, simultaneous diagnosis of metastatic DTC and adenocarcinoma of unknown primary origin has not been previously reported in the literature.

HIDDEN WHIRLPOOL Tashfeen Mahmood; Roger D. Smalligan; James ". Walker. Texas Tech University Health Sciences Center, Amarillo, TX. (Control ID #1327392)

LEARNING OBJECTIVE 1: Recognize and diagnose an unusual cause of abdominal pain in adults.

LEARNING OBJECTIVE 2: Manage midgut volvulus with early surgical intervention to reduce morbidity and mortality.

CASE: A 38yo man with uncontrolled type 1 diabetes presented with nausea, slightly bloody vomitus, abdominal pain, myalgias and subjective fever for 7 days. He also complained of some blood in his stools recently. Surgeries - none. Personal/Social - methamphetamine and cocaine use. Incarcerated for several months. Denied alcohol and tobacco use. Physical exam: Alert &oriented in mild distress, T 98.6, P137, BP 75/60, RR 20 O2 sat 96% on 2 L O2. Dry mouth, clear lungs, abdomen with mild distention, mild tenderness in the RLQ, BS present, no rebound. Lab: WBC 7.8 k with 38% bands, Hgb 15.9, PLT 67 k, Na 123, BUN 76, Cr 1.92, glucose 481, CO2 20, lactate 5.3, albumin 1.5, INR 1.6. Imaging: abdominal CT showed a whirlpool sign with clockwise swirling of the superior mesenteric artery (SMA) and vein twisted around each other suggesting intestinal volvulus. The patient was resuscitated with IV fluids and taken for laparotomy where

volvulus of the midgut and necrosis of the jejunum were found and resected. End to end anastomosis was performed and the patient recovered well. DISCUSSION: Although well known among neonates, midgut

volvulus is a rare entity in adults. A search of Pubmed found less than 40 cases in the literature of volvulus leading to malrotation in adults. Review of these cases shows that some adult patients present acutely with symptoms of bowel obstruction and ischemia while others, especially those with a midgut or cecal volvulus, present more insidiously with chronic, vague abdominal pain. Diagnosis is typically made with ultrasonography (US), computed tomography (CT), angiography or emergent exploratory laparotomy depending on the presentation. The clockwise whirlpool sign on color Doppler US or CT has been described as essentially a pathognomonic finding in midgut volvulus. It consists of wrapping of the SMV and the mesentery around the SMA in a clockwise pattern as the SMA descends into the midgut region. In malrotation the mesenteric root, which normally forms a diagonal line from the ligament of Treitz to the cecum, is shortened. This shorter mesenteric attachment of the small bowel permits its rotation around the axis of the SMA resulting in midgut volvulus. Clinical findings depend on the severity of the twist around the SMA and range from mild abdominal pain with protein losing enteropathy, if only the venous and lymphatic structures are involved, to more severe abdominal pain, bilious vomiting, and bloody stools if a complete twist is involved. The most severe cases present as an acute abdomen due to severe bowel ischemia and necrosis of the entire jejunum and ileum. Surgical treatment remains the Ladd procedure as described in our case. This case reminds internists to maintain a high index of suspicion of volvulus in patients with signs of obstruction or chronic abdominal pain in order to make a prompt diagnosis and save as much viable bowel as possible with definitive surgical treatment.

HIDDEN IN THE TUNNEL! Muhammed Sherid; Samian Sulaiman; Salih Samo; Meenu Singh. University of Illinois at Chicago, St.Francis Hospital, Evanston, IL. (Control ID #1314389)

LEARNING OBJECTIVE 1: To consider Trichinella between the differential diagnosis for any muscle lesion.

LEARNING OBJECTIVE 2: To recognize that cases of Trichinella still can be found in the US even it is rare.

CASE: A 48 year female underwent surgical release of median nerve for the left hand carpal tunnel syndrome. She had have numbness and tingling in the first three fingers in the left hand for a year which developed after fracture in the same wrist a year prior. She had local steroid injection twice without any relief of symptoms. Finally, the decision was made to go for surgery after the failure of all conservative measures. . During surgery, in addition of release of the median nerve, her surgeon took a biopsy from her left thenar because he felt a small lump in that area. Her past medical history was consistent with asthma and depression which were controlled by advair and sertraline respectively. Her social history; she was nonsmoker non alcoholic, was living in Chicago. Surprisingly, the biopsy from the thenar showed one encapsulated larvae between muscle cells (see figure1). Once the biopsy result came back, a detailed history was taken regarding her exposure to any kind of parasite. She did not have any pets and denied exposure to alive animals. As for her consumption of raw or undercooked meat, she stated that she was in Hawaii 6 months prior. She ate once a meat from pork cooked on the ground. The source of animal was not clear. She stated it could be a wild boar. Also, she recalled that after 2 weeks from the consumption of that meat she developed flu-like symptoms and had worsening asthma symptoms which required systemic steroids for 2 weeks. Also both, her son and husband, developed similar symptoms around that time, and her husband had conjunctivitis and periorbital edema. She recalled also one of her friends, from the same group went to Hawaii, had 1 week history of nausea, vomiting diarrhea and abdominal pain. Her laboratory studies showed negative Toxocara antibodies, but Trichinella Ig G was positive. The diagnosis of trichinellosis was made. Her family members and friends checked for trichinella, but all of them were negative.

DISCUSSION: Trichinella is parasitic nematode that infects primarily pigs, but it can infect horses, wild animals such as foxes, wolves, bears, skunk, raccoons, rats, and other small mammals. Humans can get infected when they consume raw or undercooked meat even tasting very small pieces of undercooked meat during preparation. There are still 11 cases reports to CDC every year, most of the same are not related to pork meat. Trichinellosis has 2 phases, first is gastrointestinal symptoms such as nausea, vomiting and diarrhea which occur during the period ingested larvae release and mature in the intestine. Second phase is muscular

symptoms such as myalgia, fever, periorbital edema and conjunctivitis which occur when newborn larvae penetrate to vessels and spread throughout the body until reaching their final location, mostly muscles. The symptoms vary up to the burden of larvae which could minimal and goes without diagnosis. The diagnosis is made either by muscle biopsy or positive anti-trichinella antibody in appropriate clinical scenario. The treatment is albendazole or mebendazole for 10-15 days. Steroids should be given when muscular symptoms are very severe to decrease the body reaction and inflammation.

HILAR MASS IN YOUNG FEMALE - TB??/ LYMPHOMA??/ SARCOID?? THINK AGAIN!! Sashank Kolli; Chanunya Srihawan; Thomas Liao. Advocate Illinois Masonic Medical Center, Chicago, IL. (Control ID #1339209)

LEARNING OBJECTIVE 1: Introduction: Hilar/ mediastinal masses have a broad differential including malignancy, infectious and connective tissue disorders. In young people tuberculosis (TB), lymphoma or sarcoid are prime considerations. The patient may present with respiratory or constitutional symptoms, or a mass may be discovered incidentally on routine chest x-ray. Further evaluation is usually undertaken; options include CT chest, bronchoscopy and thoracic biopsy by thoracic surgery. CASE: Our patient is a 27 year old female with a past medical history significant for pulmonary embolism, who initially presented to her PCP for persistent cough. She had no systemic symptoms. Chest x-ray showed a left hilar mass, which was new compared to xray one year ago. CT scan confirmed a left hilar mass which also was causing mass effect on pulmonary arteries and left lower lobe bronchus. Additional mediastinal lymphadenopathy was also observed. Bronchoscopy showed narrowing of lingula and bronchus but lavage and biopsies were inconclusive. After evaluation by thoracic surgery she underwent thoracotomy, which showed a friable mass with adherence to pulmonary arteries. Biopsy was done and was most consistent with fibrosing mediastinitis, negative for malignancy and infections. Additional work up revealed positive Histoplasma titres and Quantiferon TB Gold was indeterminate. DISCUSSION: Fibrosing mediastinitis is a rare disorder, with extensive fibrotic reaction in the mediastinum. Most commonly identified cause of this reaction is infection with Histoplasma capsulatum although it may be drug related (methysergide) or idiopathic. It can be a progressive disease and diagnosed when complications occur secondary to mass effect on mediastinal structures such as airways, great vessels, heart and the esophagus. Prognosis is variable with no proven treatment benefits with either antifungals or steroids. Surgery is considered when life threatening complications arise from mass effect such as obstruction of the superior vena cava, pulmonary artery or major airway. Ours is a very rare case of fibrosing mediastinits which is consistent with literature for being secondary to Histoplasma infection. Not all hilar lymphadenopathy is TB, lymphoma or sarcoid.

HISTO FOR HISTO Zouyan Lu; Karrie L. Martin; Adam Meyers. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1289805)

LEARNING OBJECTIVE 1: Review available diagnostic strategies for histoplasmosis.

LEARNING OBJECTIVE 2: Recognize patient factors which impact selection of the optimal pharmacologic treatment of histoplasmosis. CASE: A 73-year-old woman on long-term infliximab for Crohns disease presented with a two-week history of recurrent high fevers. She also complained of headache, sore throat, intermittent non-productive cough, malaise, and occasional night-sweats. Her additional medical history included monoclonal gammopathy of undetermined significance, hypothyroidism, and short-gut syndrome requiring chronic total parenteral nutrition

(TPN). Following unremarkable initial laboratory testing, she was admitted to the hospital, and a chest CT revealed multiple, new pulmonary nodules, and hilar and mediastinal lymphadenopathy. Blood cultures were negative, a transthoracic echocardiogram was unremarkable, and urine antigens for Histoplasma and Blastomyces were negative. Bronchoalveolar lavage (BAL) was performed, and transbronchial biopsy of the right upper lobe revealed nonnecrotizing granulomas with negative GMS and AFB stains. The patient continued

to have intermittent fevers, but without a definitive source of infection, treatment was not initiated. In order to obtain a diagnosis, biopsy of an enlarged pre-tracheal lymph node was performed and revealed multiple epithelioid cell granulomas with central necrosis and GMS stain positive for multiple H. capsulatum organisms. Later, culture of BAL fluid also grew histoplasma organisms, and the patient was started on oral itraconazole. Though she became afebrile, she did not achieve therapeutic levels of itraconazole, and follow-up CT showed disease progression. Therapy was changed to high-dose oral fluconazole, and after three weeks of treatment, repeat scans showed radiographic response.
DISCUSSION: Histoplasma capsulatum is endemic to the Ohio and Mississippi River valleys. Severity of infection is related to level of exposure and host immune status. Histoplasmosis can range from mild, self-limited disease to life-threatening, disseminated infection. Pulmonary histoplasmosis often presents with fever, chills, headache, chest pain, and cough. It should be considered in patients with mediastinal or hilar lymphadenopathy and pulmonary nodules. The gold standard for diagnosis is fungal culture; however, results may take weeks. More rapid diagnosis is often made by antigen or antibody detection in urine, blood, or BAL fluid, or by histopathologic examination of fluid or tissue. Urine antigen testing may be negative in pulmonary disease, and serologic testing is less useful in immunosuppressed patients due to a lack of antibody response. Itraconazole is the drug of choice for treatment of mild-moderate histoplasmosis, but bioavailability is variable when taken by mouth. Despite evidence that fluconazole is less effective, it has 90% bioavailability, and as in our patient, may be more successful in achieving therapeutic levels in patients with short-gut syndrome.
HORNER SYNDROME-NOT TO BE SNEEZED AT! Krishna Khatri; Vinod Khatri; Tanmayee Bichile; Harvey Friedman. St. Francis Hospital, Evanston, IL. (Control ID #1339140)
LEARNING OBJECTIVE 1: Dissection of cervical internal carotid artery can occur without any apparent trauma.
LEARNING OBJECTIVE 2: Horners syndrome may be the only sign on presentation.
CASE: 62 yrs old Caucasian male was admitted with 7 history of headache which started after an upper respiratory tract infection. Headache was dull aching, left sided, mild to moderate in intensity and was only relieved for few hours with analgesics. He had no significant past medical history and was in good health. On examination his vital signs were stable, he had no carotid bruit. The cardiac and respiratory exams were essentially normal. On CNS exam he had mild ptosis on the left side and his left pupil was smaller than the right. Rest of the neurological exam was non-focal. On evaluation his routine labs were normal. An MRI/MRA head revealed decrease in the signal involving the left distal internal carotid artery in the cervical portion. The lumen of the cervical left internal carotid artery was narrowed over approximately 2.5 cm length which appeared to be from internal carotid artery dissection that started several cm after the carotid bulb and internal carotid artery origin. There was eccentric hyper-attenuation within the wall consistent with an intramural hematoma suggestive of a sub-acute nature. He was started on anticoagulation and was discharged home and advised regular follow up.
DISCUSSION: Internal carotid artery dissection is a potentially life-threatening condition and carries a substantial risk of disabling stroke. Carotid dissection is under-recognized as a cause of Horner syndrome and can be missed. Spontaneous dissection of the cervical internal carotid artery causes, in more than 90% of patients, carotid territory ischemia, local signs and symptoms on the side of dissection, or both, whereas the remaining are clinically asymptomatic. Local signs and symptoms include head, facial, or neck pain, Horner syndrome, pulsatile tinnitus, and cranial
nerve palsy. Horner syndrome consisting essentially of miosis and ptosis is detected in about one third. Most of cases of Horner syndrome due to internal carotid artery dissection are painful. It is important to diagnose dissection because anticoagulation can prevent carotid thrombosis and embolism. The investigation of choice is magnetic resonance imaging and angiography scan of the head and neck. The treatment advocated for dissection is anticoagulation for 3-6 months.
HUMORAL HYPERCALCEMIC CRISIS AND ADENOCARCINOMA OF THE GALL BLADDER Kalpana

Nagarkar; Tania Calzada; Emily Chen; Shodhan Patel. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1319938)

LEARNING OBJECTIVE 1: Rare presentation of humoral hypercalcemic crisis secondary to adenocarcinoma of the gall bladder. LEARNING OBJECTIVE 2: The presentation of high serum calcium and PTHrP early in the course of disease appears to correlate to a poor response to treatment and rapid disease progressionCASE: A 54-year-old African American female presented with persistent nausea and vomiting along with abdominal pain. CT scan of the abdomen and pelvis revealed large metastases in the right lobe and medial left lobe of the liver. There were also gallstones in the neck of the gallbladder, focal gallbladder wall thickening and a soft tissue density in the medial wall of the gallbladder. Serum calcium was 11.9 mg/dL at presentation. Elevated PTHrP (109 pg/ml) and low PTH (8 pg/ml) suggested humoral origin of the hypercalcemia due to malignancy. She underwent liver biopsy and was diagnosed with adenocarcinoma arising from the gallbladder with liver metastases. A bone scan showed no evidence of bony metastatic disease. The patient was managed with intravenous fluids and bisphosphonate therapy without resolution of the hypercalcemia and she was referred to oncology for chemotherapy.

DISCUSSION: Parathyroid hormone-related peptide (PTHrP) is a tumor-derived circulating factor that has been associated with hypercalcemia of malignancy and is generally seen in squamous cell malignancy. The role of PTHrP as a prognostic indicator remains unclear. Studies suggest that it may function as a growth factor; and, recently, the ability of PTHrP to induce cytokine expression has been described. It is postulated that PTHrP is associated with systemic inflammation and adverse nutritional status. We expect the hypercalcemia to improve with definitive treatment of the underlying malignancy and reduction of the PTHrP level. Teaching points: There are very few cases in the literature that describe hypercalcemia associated with adenocarcinoma of the gall bladder. The elevated PTHrP level, sub-baseline PTH level, and absence of bony metastases confirmed that the hypercalcemia was humoral, mediated by the adenocarcinoma of the gallbladder. The presentation of high serum calcium and PTHrP early in the course of disease appears to correlate to a poor response to treatment and rapid disease progression. Though it can be postulated that presence of PTHrp itself with or without hypercalcemia predicts prognosis, more such studies are needed.

HYDRONEPHROSIS IN A HEALTHY 40 YEAR OLD: WHATS THE ROLE OF ROUTINE SCREENING?

Christian Suarez-Fuentes; Ashwin Sridharan; Ari Kriegsman; Lauren Shapiro. Montefiore Medical Center, Bronx, NY. (Control ID #1338336)

LEARNING OBJECTIVE 1: To make internists aware of hydronephrosis and renal failure secondary to cervical cancer, an infrequent occurrence in the developed world because of routine screening LEARNING OBJECTIVE 2: To draw attention to health disparities in cervical cancer rates and mortalityCASE: A 40 year old Hispanic female with no past medical history was brought into the emergency room for altered mental status. As per her family, she had a three month history of lower abdominal pain radiating to her back exacerbated by her periods. Her menses were increasingly irregular and heavy and her urine output was less. One week prior to admission her previously unlimited exercise tolerance was severely limited secondary to fatigue and shortness of breath. In the ED her temperature was 94.5 F, her pulse was 105, her blood pressure was 189/91, and her respiratory rate was 22. On exam, she

appeared pale and was breathing rapidly. A friction rub and rales were noted. She was oriented only to person with no other neurological deficits. Laboratory evaluation showed a serum creatinine of 15.3, BUN of 155, bicarbonate of 7, potassium of 9.2, and a hemoglobin of 5.1. She was intubated, dialyzed, transfused blood, and transferred to the MICU. CT scan of the abdomen and pelvis showed bilateral hydronephrosis with relative atrophy of the left kidney and lower right retroperitoneal lymphadenopathy. She was extubated on hospital day

2. As her mental status improved, the patient recalled a Papanicolaou smear showing a high grade squamous intrapeithelial lesion five years ago. She had not followed-up with doctors for this since she had lost her insurance. Cervical biopsy showed cervical intraepithelial neoplasia III, consistent with cervical cancer stage IIIB. Bilateral nephrostomy tubes were placed with improvement in renal function. She was started on radiation therapy and discharged with follow-up.
DISCUSSION: This case demonstrates advanced sequelae of cervical cancer infrequently seen in the United States because of comprehensive preventative health care services. This patient knew about her abnormal screening test five years before but was unable to seek appropriate medical care. Cervical cancer can cause hydronephrosis through several etiologies, including adhesion to the pelvic sidewall, direct bladder outflow obstruction, and obstruction secondary to diffuse bulky lymphadenopathy. Cervical cancer was the third most commonly diagnosed cancer in women and the fourth leading cause of cancer death in women worldwide in 2008. It disproportionally affects women in the developing world, where screening is less readily available. In the United States, cervical cancer disproportionately affects underprivileged minorities. In 2007, there were 7.9 cases per 100,000 women across all races, with 11.5 and 10.2 cases per 100,000 among black and hispanic women, respectively. These women were also more likely to die from cervical cancer than whites and asians. A causative role for the human papillomavirus has been established, with a vaccine now available against the four most common serotypes; however, another 30% of cervical cancers are caused by other strains so routine screening must be continued. In summary, hydronephrosis due to cervical cancer is infrequent but preventable. Our case highlights the importance of routine papanicolaou smears for screening and appropriate gynecologic treatment for positive results, especially in poor minority populations.
HYPERBARIC OXYGEN AS A TREATMENT OPTION FOR DIABETIC MYONECROSIS :A CASE REPORT
Tanvi Tiwari; Malvika Varma. saint francis hospital, Evanston, IL. (Control ID #1309929)
LEARNING OBJECTIVE 1: Diagnose diabetic myonecrosis, an under recognised complication of longstanding diabetes mellitus. Illustrate a rare occurance of this condition in a patient without advanced diabetic end organ damage.
LEARNING OBJECTIVE 2: Investigate role of Hyperbaric oxygen as a potential treatment option.
CASE: 31 year old female with type 1 diabetes mellitus presented with pain and swelling of the right medial thigh since two weeks. There was no history of fever, trauma, joint pain, joint stiffness or sensory loss. She had a similar episode two years ago involving both calf muscles treated with rest and analgesics and took several months to resolve. Past medical history was significant for type 1 diabetes, Graves disease, malignant neoplasm of thyroid s/p thyroidectomy, post surgical hypothyroidism. She was non compliant with her medications which included levothyroxine, NPH insulin and Lisinopril. Clinical examination was significant for low grade fever and sinus tachycardia. Right lower extremity was edematous and extremely tender without erythema or crepitus. The medial right thigh was most tender without any fluctuant mass. There was no swelling or stiffness of the knee and distal neurovascular function was intact. Muscle strength was difficult to assess proximally due to severe pain but was normal distally. Sensations were intact to monofilament, light touch, pin prick and joint position. Labs were remarkable for a mildly elevated white count, microcytic iron deficiency anemia and a normal renal function. Thyroid stimulating hormone was 105.6 and free T4 was 0.675. Total creatine kinase was 309. Glycated hemoglobin was 10.8%. Urine microalbumin to creatinine ratio was 330.7 suggestive of occult diabetic nephropathy. Hypercoaguable workup was positive for lupus anticoagulant. ANA panel was negative. CT scan showed massive intramuscular, subcutaneous and
fascial edema of vastus musculature specially vastus medialis. Arterial and venous dopplers of the lower extremities were negative for deep vein thrombosis and arterial occlusion. She was initially treated with intravenous antibiotics, opioid analgesics. MRI done 48 hours later confirmed the CT findings and now showed edema extending proximally into the pelvic muscles and distally into the calf muscles. Needle biopsy of vastus medialis revealed acute inflammation and hemorrhagic necrosis of the skeletal muscle consistent with diabetic

muscle infarction(DMI) and she was started on NSAIDs and aspirin. A trial of daily hyperbaric oxygen treatment (HBOT) at 2.5 atmospheres absolute (ATA) was started after informed consent. By the fourth treatment her symptoms were reduced by 50% and she was discharged on day ten after 5 HBOTs, with remaining treatments scheduled as outpatient. Patients recovery was gauged by symptomatic improvement.
DISCUSSION: Diabetic muscle infarction is a rare and under recognized complication of diabetes mellitus, characterized by localized acutely painful inflammation and necrosis of muscles involving the extremities. It is typically associated with long standing poorly controlled diabetes type1. Pathogenesis of the condition remains unclear but largely involves muscle ischemia secondary to diabetic vasculopathy. Since the underlying process in diabetic myonecrosis involves tissue ischemia, HBOT could possibly play a crucial role in its treatment.
HYPERKALEMIC ASCENDING PARALYSIS Abdur Baig; Hector Castro; Giselle Guerra; Oliver Lenz. University of Miami, Miller School of Medicine, Miami, FL. (Control ID #1339565)
LEARNING OBJECTIVE 1: Recognize the differential diagnosis of ascending paralysis.
LEARNING OBJECTIVE 2: Importance of measuring the serum potassium in acute ascending paralysis.
CASE: A 79-year-old man with a history of stage IIIA follicular lymphoma, recently transformed to diffuse large B-cell lymphoma, presented with acute onset of ascending paralysis. Before this presentation he was complaining of generalized weakness, malaise, loss of appetite, and weight loss of about 5 pounds. On the day of admission he tripped and fell, and was unable to move any extremities. Medications included amlodipine, aspirin, levothyroxine, lovastatin, and nadolol. Physical examination showed a blood pressure of 136/ 76 mmHg, pulse 68 beats/min, temperature 36.6 C and respirations 18/min. He was alert, awake, oriented, and had flaccid paralysis with absent reflexes in both upper and lower extremities. No extrapyramidal signs were noted. Sensation was present, but disturbed. Laboratory data included sodium of 120 mEq/L, potassium 9.3 mEq/L, blood urea nitrogen 81 mg/dl, creatinine9.9 mg/dl, phosphorus 5.7 mg/dl, calcium 8.5 mg/dl and uric acid 9.6 mg/dl. Electrocardiogram showed heart rate of 70 per minute with widened QRS complexes with disappearance of p-waves, but T-waves were not peaked. He was immediately treated with intravenous calcium gluconate, regular insulin, dextrose 50%, albuterol nebulizations, and multiple doses of oral sodium polystyrene sulfonate. He also received aggressive intravenous fluids. Potassium decreased to 7.2 mEq/L within four hours, quadriparesis improved significantly. QRS widening also disappeared with appearance of P waves as potassium level decreased. Within 24 hours potassium became 4.3 mEq/L, renal function progressively improved and later normalized. He received first cycle of chemotherapy.
DISCUSSION: Ascending paralysis is an uncommon complication of hyperkalemia that generally presents with flaccid motor paralysis with intact sphincter tone. Sensory and cranial nerve examinations are normal. Secondary respiratory failure has also been reported. Richardson et al. first described this clinical entity in 1953, which may mimic the Guillain-Barr syndrome. Other differential diagnosis includes traumatic spinal cord injury, botulism, drug-induced weakness, and a variety of metabolic abnormalities. By decreasing the intracellular to extracellular potassium ratio, hyperkalemia adversely affect the function of excitable tissues, and cardiac muscle affected before the skeletal muscle. Our patient developed hyperkalemia as part of tumor lysis syndrome (TLS). He also had hyperphosphatemia, hyperuricemia, and renal failure. In 1997 Evers S et al. reviewed all the published cases of secondary hyperkalaemic paralysis and found only 17 cases. The most probable cause was intake of spironolactone or amiloride. In majority of the cases (12) chronic renal failure was the underlying mechanism of hyperkalemia. Six

patients required dialysis. Two patients died of cardiac arrest or convulsions due to hyperkalemia and one of pulmonary embolism. None was reported having TLS. Management includes immediate intravenous infusion of calcium, close monitoring of the vital signs, and in case of respiratory compromise mechanical ventilation. If digoxin toxicity is suspected magnesium sulfate should be used instead of calcium. This is followed by infusion of insulin and glucose, sodium polystyrene sulfonate resin, furosemide or dialysis. Prompt diagnosis and

treatment is crucial to prevent fatal outcome.

HYPOCALCEMIA; A RARE CAUSE OF ST ELEVATION MYOCARDIAL INFARCTION !! Ehtesham Ul Haq; Abdul Haseeb; Subhraleena Das; Amit S. Dhamoon. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1334005)

LEARNING OBJECTIVE 1: Learn to diagnose one of the rarest causes of STEMILEARNING OBJECTIVE 2: Learn the relationship between hypocalcemia and coronary vasospasmCASE: ST elevation Myocardial Infarction is a life threatening emergency mostly caused by cardiac ischemia. There have been very few case reports in the literature mentioning hypocalcemia as one of the rarest causes of STEMI. A 53 year old male was diagnosed with a cancerous thyroid nodule and underwent thyroidectomy which was complicated by an accidental parathyroidectomy three weeks prior to this admission. He was brought to the hospital because of numbness and tingling in both hands and face for 1-2 days duration. On admission, he denied any other complaints. His physical exam was only significant for a positive Chvosteks sign. His labs showed total Calcium of 5.4 mg/dl, Ionized Calcium 0.08 mmol/L, Albumin 3.8 gm/dl, Magnesium 2.3 mEq/L, CPK 145 U/L, CKMB 2.5 ng/ml and Troponin I of 2.4 ng/ml. Rest of the labs were within normal limits. EKG was normal. Stat echocardiogram showed EF of 55-60 percent with no wall motion abnormalities. He received intravenous and oral Calcium replacement during his hospitalization. On his 2nd hospital day, he developed left sided chest discomfort with no associated symptoms. Repeat EKG showed ST segment elevation>1 mm in inferior leads. Repeat set of cardiac enzymes showed CPK of 1573 U/L, CKMB 173 ng/ml, Troponin I of 62.6 ng/ml. Emergent cardiac catheterization showed normal coronary vasculature and normal LV function. Chest pain improved with sublingual nitroglycerin and intravenous morphine. Meanwhile, he was kept on Calcium replacement. After about 72 hrs of admission, ionized Calcium level went up to 1.15 mmol/L and troponin I level dropped down to 6.4 ng/ml. ST elevations on EKG also normalized with Calcium supplementation. At the time of discharge, the patient was chest pain free and was sent home on oral Calcium supplements. DISCUSSION: Calcium is essential for cell function, cell membrane stability, neuronal transmission, blood homeostasis and cell signaling. Calcium has central role in myocardial contraction coupling and hypocalcemia reduces myocardial function. Coronary vasospasm must be considered as the most likely cause of myocardial infarction in the setting of hypocalcemia. Hypocalcemia has been reported as reversible cause of cardiac failure; due to its rarity, it is largely ignored in clinical teaching and standard textbooks. Hypocalcemia can result in several cardiac manifestations including QT prolongation on EKG and more rarely congestive heart failure and Cardiomyopathy that is reversible once the hypocalcemia is corrected. In this case, hypocalcemia was the most likely cause of coronary vasospasm which improved after treatment with nitrates.

HYPOTHERMIA IN SEPTIC SHOCK: PROTECTIVE OR HARMFUL? Jilalu A. Kelbe; Harvey Friedman. Saint Francis Hospital of Evanston, Evanston, IL. (Control ID #1338821)

LEARNING OBJECTIVE 1: Describe the effects of hypothermia on blood lactate level.

LEARNING OBJECTIVE 2: Recognize the potential protective effect of hypothermia in septic shock with multiple organ failure.

CASE: A 36 yr-old man presented with altered mental status of 1 day duration. The patient was unable to provide further history. His past medical history is remarkable for advanced multiple sclerosis and the patient is wheel chair bound because of it. On examination, he was

comatose. Vital signs were: Heart rate 48/min, BP 79/44 mmHg, T 84 F (rectally). He had a scalp wound with purulent drainage. Chest was clear and no murmur on cardiac examination. He was in deep coma with minimal grimace to painful stimuli. Lab tests revealed WBC 11,600/mm3 with 28% bands; platelets 28,000/mm3. The metabolic panel showed BUN 63, creatinine 0.82, CO2 31; AST 217, ALT 139. Lactic acid was 2.2, PT16.3 sec; PTT 40 sec. Scalp wound, urine, and blood cultures grew MRSA. The patient was treated with IV fluids, norepinephrine and antibiotics for septic shock. He was also treated with warm normal saline infusion for hypothermia. His renal function worsened in the first 2 days but afterwards he progressively improved by all

parameters. His lactate level remained in the normal range. DISCUSSION: The patient presented with septic shock and multiple organ failure as evidenced by altered mental status, abnormal liver function tests, lab tests consistent with DIC and the subsequent development of azotemia. However, his lactate level remained normal. One possible explanation for the normal lactate level despite the severe septic shock could be the severe hypothermia the patient had at the time of presentation. There was no apparent cause for hypothermia other than sepsis. Although hypothermia is one of the manifestations of sepsis, could it be protective of damage from tissue hypoperfusion in the setting of septic shock? In a study of 81 patients with TBI, mild hypothermia therapy was shown to reduce blood lactate levels. The role of hypothermia protocols in improving neurologic outcomes in post-cardiac arrest patients is well established but its role in septic shock has not been reported. This observation will hopefully stimulate further study to understand the role of hypothermia in the setting of septic shock and how aggressive reversal of hypothermia should be.

ISONIAZID, A RARE CAUSE OF ACUTE PANCREATITIS Johny S. Kuttab; David Veltre; Paul Yi; Vikrum Rangan; Lisa E. Norton. Boston University Medical Center, Boston, MA. (Control ID #1338726)

LEARNING OBJECTIVE 1: Recognize INH as a potential culprit in the differential diagnosis of acute pancreatitis.

LEARNING OBJECTIVE 2: Early recognition, and withdrawal of INH results in excellent prognosis.

CASE: A 74 year old female, with a history of reflux disease, Iron Deficiency anemia, hyperlipidemia, and latent TB infection (LTBI) on INH monotherpay (300 mg daily) inititated 3 months prior to presentation presented with one day of gradually worsening 6/10 RUQ pain, dull, constant, non radiating, associated with multiple episodes of non-bloody, non-bilious emesis, exacerbated by oral intake of solids and liquids, and not relieved by any measures. There were no associated fevers or chills, no change in bowel habits, no jaundice, hematochezia, melena, dysuria or hematuria. Physical exam was remarkable for normal vital signs, RUQ/ RLQ tenderness, slight guarding and hypo-active bowel sounds. The rest of the exam was normal. Labs showed: WBC 17.7 K/UL, HCT 41 (baseline of 35%), glucose 137 mg/dl , normal chemistry panel, normal LFTs, with slightly elevated Lipase to 167 U/L, in the setting of a normal amylase. Abdominal Ultrasound showed a normal GB, without any stones. An abdominal CT with contrast was significant for inflammatory changes around the pancreatic head, uncinate process, and 2nd/3 rd part of the duodenum consistent with groove pancreatitis. Antiemetics were given for nausea and she was admitted to the geriatric service for further management. Gallstone and alcohol induced pancreatitis were both ruled out based on imaging and history. Given that she was on INH for 3 months at that point, INH induced pancreatitis was the leading diagnosis. INH was discontinued immediately. The patient was managed conservatively with bowel rest, IV fluids, and pain medications with complete resolution of her symptoms on the 3 rd day. On the 4th day she was discharged home, tolerating a full diet.

DISCUSSION: Medications are an uncommon cause of acute pancreatitis. Based on reporting of adverse events in German and Swiss centers, the incidence of drug induced-pancreatitis is believed to be between 0.3-2%. Drug-induced pancreatitis has no distinguishing features. Therefore a high index of suspicion and a careful drug history are important in the diagnosis. Onset could vary from weeks to months depending on the offending agent. The pathogenesis is poorly understood, but may be due to an idiosyncratic reaction or direct toxic effects. Other proposed theories include alteration

in the zymogen granule formation, stability, migration and release. INH is considered a Category I medication in the causation of acute pancreatitis.i.e. At least one case report with a positive recurrence after drug re-challenge. Most of the reported cases of INH induced pancreatitis had an onset within 3 weeks of drug initiation, however in our case the onset was delayed to 3 months, which may suggest an alternative mechanism of injury,

or earlier onset pancreatitis which was misdiagnosed. (Our patient was diagnosed with food poisoning a few months earlier) Regardless of the offending agent, the prognosis of drug-induced pancreatitis is generally excellent. In one report of 22 cases, 19 were associated with interstitial pancreatitis and none were associated with necrosis on CT and none died. In our case, the patient had evidence of necrosis, however the area that was involved was small (groove pancreatitis). There were no reported deaths in this case series suggesting a low overall mortality rate.

IDIOPATHIC RETROPERITONEAL FIBROSIS: AN UNCOMMON CAUSE OF BACK PAIN Sadia Moinuddin. SJHMC, Phoenix, AZ. (Control ID #1339030)

LEARNING OBJECTIVE 1: Low back pain is one of the most common chief complaints in primary care setting. We present a case of idiopathic retroperitoneal fibrosis diagnosed in the evaluation of back pain.

CASE: A 50 year-old male presented to his PCP with low back pain at rest, dull, accompanied by muscle spasms, 8/10, with radiation to abdomen and groin area. There was no preceding trigger event and pain was unrelieved by anti-inflammatory medications, muscle relaxants or opiates. Patient denied having fever, chills, weight loss, and recent travel. An Xray showed enlarged aorta and CT showed peri-aortitis with diffuse circumferential encroachment of the aorta and vena cava, characteristic of retroperitoneal fibrosis. Patient denied use of beta-blockers, ergot derivatives, and no infections were found during work-up. CTA demonstrated thickened aortic wall without aneurysm. Laboratory data showed elevated CRP, ESR, and serum IgG4. Patient was treated with corticosteroids with clinical improvement. Repeat MRI one month later showed decreased peri-aortic soft tissue swelling. After tapering and discontinuing steroids patient had recurrence of back pain and imaging showed interval increase of the ring of soft tissue surrounding the aorta as well as fibrotic process surrounding both ureters at the level of the aortic bifurcation resulting in mild bilateral hydronephrosis.

DISCUSSION: Idiopathic retroperitoneal fibrosis (IPRF) should be considered in the presence of chronic peri-aortitis. It is characterized by fibro-inflammatory tissue surrounding the abdominal aorta and iliac arteries. The inflammatory tissue is composed of lymphoplasmacytic inflammation and fibrosis with large number of the plasma cells expressing IgG4. Pathogenesis is unclear, however, leading theories propose IPRF is either an enhanced inflammatory reaction in response to aortic atherosclerosis by oxidized LDL or a systemic manifestation of autoimmune disease, the latter being supported by the presence of constitutional symptoms, elevated acute phase reactants, and auto-antibodies. Other pathogenetic processes may also include the presence of IgG4 producing plasma cells. Symptoms include a non-specific dull low back pain in early stages and obstructive uropathy in advanced disease. Most common cause is idiopathic and secondary causes being medications, infections, malignancies, trauma, surgery, radiation. Diagnosis should start by excluding possible primary causes of IPRF, such as drugs, infections, malignancies, radiotherapy, trauma, or previous surgery. IPRF is diagnosed by MRI which provides a more exact anatomic definition than CT, because of its multi plane capabilities; CT is usually the initial test. CT reveals a periaortic soft tissue mass that may extend laterally to entrap the tumors. When the mass presents atypically, biopsy is recommended. Management of IRPF often requires surgical, urological, or medical intervention to address anatomic complications for example ureteral obstruction or ureterolysis. Medical treatment can be directed to treat the acute inflammation and suppress the chronic immunologic process with subsequent fibrosis. Glucocorticoids are generally considered the mainstay of therapy for IPRF due to the non-specific inflammatory nature of the disease but other steroid sparing agents such as tamoxifen, azathioprine, mycophenolate mofetil also may have a role. Overall IPRF responds to corticosteroid therapy initially but often recurs without treatment as is the case with our patient.

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IMPRESSIVE LASTING EFFECTS OF A "REVERSIBLE" CONDITION Alice Williamson; Erin Boswell; William B. Rothwell; Peter S. Reynaud. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338834)
LEARNING OBJECTIVE 1: 1. Recognize the clinical presentation of Posterior Reversible Encephalopathy Syndrome (PRES). 2. Identify the hypothesized pathophysiology of PRES.
CASE: A 29-year old woman with HIV presented with one day of intractable seizures. She had as history of end-stage renal disease, hypertension and Posterior Reversible Encephalopathy Syndrome (PRES), for which she had received supportive care. She had never had seizures prior to her initial episode of PRES nor had she seized prior to this

admission. On presentation, her blood pressure was 251/210 mmHg and her heart rate was 138 beats/min; her remaining vital signs were normal. She was lethargic; her cardiac, pulmonary and abdominal examinations were normal. There were no neurologic deficits aside from the frequent seizures. Her white blood cell count was 10,800 cells/mm3. Blood cultures grew Staph epidermidis and Staph haemolyticus; she refused a lumbar puncture. A head CT revealed no findings of PRES. After her blood pressure was controlled, she had no further seizures. The bacteremia was treated with vancomycin.

DISCUSSION: PRES, Posterior Reversible Encephalopathy Syndrome, is a constellation of symptoms seen in immunocompromised patients, including altered mental status, hypertension, visual changes, and seizures with specific radiologic evidence of cerebral edema. This patient presented as she had with her prior episodes of PRES; however, this third presentation of seizures was without radiographic evidence of PRES. PRES is a typically a reversible cause of seizures; however, it is important that the general internist recognizes that it can be a recurrent disease. This patient with hypertension, AIDS, and end-stage renal disease on hemodialysis had the rare combination of recurrent PRES with resulting epilepsy. This patient likely had permanent cerebral dis-autoregulation resulting from the recurrent episodes of brain edema, requiring indefinite anticonvulsant therapy.

INCURABLE BUT TREATABLE PLASMA CELL CANCER Darshan Patel; Rachana Kanaujia; Jiwon Lee; William Hauger. Conemaugh Valley Memorial Hospital, Johnstown, PA. (Control ID #1338938)

LEARNING OBJECTIVE 1: Waldenstroms Macroglobulinemia, also known as Lymphoplasmacytic lymphoma is a very rare type of B-cell non-Hodgkins lymphoma with an incidence rate of 3 cases per million per year that is characterized by an increased proliferation of immunoglobulin (Ig) M paraprotein.

CASE: A 55 year old African American male contractor, with no past medical history presented to the ER with new onset mild pain and fullness of left upper quadrant of the abdomen that had increased in severity over the past 4 weeks. Over the course of time patient lost sixteen pounds, complained of early satiety, and occasional night sweats. He mentioned having an unknown blood disorder in a first degree relative. Physical examination did not reveal frank distention but he had massive splenomegaly that extended beyond the pelvic brim and was quite firm and tender with no palpable lymphadenopathy. Initial laboratory data revealed leukopenia, anemia and prolonged PT and PTT. CT scan of the abdomen confirmed massive splenomegaly with mass effect compressing the stomach, displacing the left kidney inferiorly, loops of bowel to the right and inferiorly. A lymphoplastic disorder was suspected. SPEP revealed IgM level of 2107. Urine protein electrophoresis showed small monoclonal protein typing as free kappa light chain. On the second day, bone marrow biopsy revealed lymphocytic infiltrate of monoclonal B-cells. Immunohistochemistry showed monoclonal B cell population positive for CD 19, CD 20, CD 23, CD 38 plasmacytoid cells with kappa light chain restriction, while negative for CD5 and CD10 with kappa chain restriction. Diagnosis of Waldenstroms Macroglobulinemia was established. Following that a serum viscosity of 2.2 was noted. Plasma exchange was done prior to beginning treatment in anticipation of disease flare post treatment. Patient was started on Velcade, Rituxan and Dexamethasone. Meanwhile, patients abdominal pain had resolved by 4th day at the hospital, although labartory values remained unchanged, notably the elevated PT and PTT.

DISCUSSION: Waldenstroms Macroglobulinemia can manifest with pancytopenia due to bone marrow infiltration and direct affect of IgM monoclonal gammapathy in the blood leading to spontaneous bleeding, peripheral neuropathy, hyperviscosity syndrome, lymphadenopathy, and organomegaly. Risks of developing this condition include genetic factors, environmental exposure not limited to but including wood dust, organic solvents as could be the case in this patient. It is important to recognize that high levels of paraprotein can lead to alterations in platelet function by inhibition of fibrin polymerization and coaguloapathy leading to spontaneous bleeding. Although in our case, the patient did not exhibit severe signs of hyperviscosity syndrome, plasmapheresis may be necessary to prevent adverse effects related to paraprotein. Due to rarity of this condition, Waldenstroms macroglobulinemia
can often be overlooked and misdiagnosed. Consequence can lead to life threatening complications. However, with appropriate treatment patients may have years of symptom free remission and live active lifestyles.

INITIAL EMPIRIC THERAPY FOR STAPHYLOCOCCUS AUREUS BACTEREMIA: IS VANCOMYCIN MONOTHERAPY ENOUGH? Renuka Tipirneni; Ana Weil; Xiaosong Zhang; Daniel P. Hunt. Massachusetts General Hospital, Boston, MA. (Control ID #1334986)

LEARNING OBJECTIVE 1: Recognize the limitations of vancomycin monotherapy for empiric treatment of S. aureus bacteremia. LEARNING OBJECTIVE 2: Assess risk factors for community-acquired methicillin-resistant

S. aureus (MRSA).
CASE: A 53-year-old woman with a recent diagnosis of breast cancer presented with fever and low back pain. She had undergone an uncomplicated mastectomy with reconstruction three months prior to admission, and had not received chemotherapy or radiation. Two weeks prior to admission she developed fever, shaking chills and oral ulcers that resolved with ibuprofen. Four days prior to admission she developed recurrence of fever and chills, and also experienced myalgias and progressive severe low back pain. On initial exam, her temperature was98.2. She was hemodynamically stable and ill appearing. Exquisite tenderness was apparent upon palpation over the L5 vertebra. She had no murmurs, intravascular catheters, prostheses, or rashes. MRI of the lumbar spine showed L5/S1 osteoarthritic disc changes without epidural collection or osteomyelitis. On arrival to the medical floor, blood cultures resulted with growth of gram-positive cocci in clusters. Given high suspicion of S. aureus infection, vancomycin was given. Later that night her temperature rose to 104.6. Nafcillin was added to her antibiotic regimen. Four of four blood cultures later grew S. aureus, susceptible to penicillin, methicillin and vancomycin (minimum inhibitory concentration, or MIC, =2 mcg/mL). Her antibiotic regimen was narrowed to penicillin and surveillance blood cultures were negative. Subsequent imaging revealed L5 osteomyelitis and abscess formation at the L5/S1 vertebral space.
DISCUSSION: Is vancomycin monotherapy adequate empiric treatment for S. aureus bacteremia? Since its introduction in the 1950s, vancomycin has become the standard initial treatment for resistant S. aureus infections. In an era of increasing incidence of MRSA, including community acquired MRSA (CA-MRSA), vancomycin is frequently initiated for gram-positive cocci bacteremia, pending further susceptibility data. However, vancomycin monotherapy has limitations. First, it is less bactericidal than beta-lactams, which may result in longer periods of bacteremia. Second, it has reduced penetration into some tissues, including bone, lung and CSF. Third, with high inocula drug efficacy is reduced. Fourth, resistance is emerging, with rising MICs and the breakpoint MIC is now considered 2 mcg/mL. In light of these limitations, it is not surprising that in cases of methicillin-sensitive S. aureus (MSSA) bacteremia, patients treated with vancomycin have higher rates of relapse, reinfection and treatment failure, when compared with beta-lactam antibiotics such as nafcillin. In our patient, the addition of nafcillin may have led to increased bactericidal activity, improved penetration of bone, and increased efficacy in the setting of high grade bacteremia. She had some traditional risk factors for MRSA infection (recent hospitalization and chronic illness). However, she did not use injection drugs or have recent antibiotic exposure, and lacked additional risk factors for CA-MRSA, which include skin trauma (her surgical incision was well healed), contact sports, crowded or unsanitary living conditions, and men who have sex with men. Given that our patient was ill, with risk factors for vancomycin failure, and low probability of CA-MRSA, the addition of a beta-lactam while awaiting susceptibilities was a reasonable choice over vancomycin alone.
INTESTINAL PURPURA: AN ATYPICAL PRESENTATION OF ADULT-ONSET HENOCH-SCHNLEIN PURPURA Melissa Y. Wei; Tanvi A. Dhere. Emory University, Atlanta, GA. (Control ID #1339263)
LEARNING OBJECTIVE 1: Recognize atypical features of adult-onset Henoch-Schnlein purpura (HSP)
LEARNING OBJECTIVE 2: Appreciate HSP without palpable purpura as a syndrome of IgA enteropathy subset of HSP or alternatively as a novel

entity of IgA-mediated systemic vasculitis under which HSP encompasses individuals with cutaneous involvementCASE: A 23 yo G1P0101 African American woman with immunoglobulin A (IgA) nephropathy presented with abdominal pain and watery diarrhea for 4 days. She was diagnosed with biopsy-proven IgA nephropathy and treated with high-dose prednisone and two doses of Cytoxan until she became pregnant. During her third trimester she developed preeclampsia and underwent a Caesarean-section. She delivered a healthy girl and was discharged with prednisone for persistent renal failure. Two days after discharge she

developed severe, diffuse abdominal pain with multiple episodes of non-bloody watery diarrhea. On admission she was afebrile with blood pressure 150/101. Her abdomen was guarded with epigastric tenderness. No palpable purpura, joint tenderness or synovitis were appreciated. Her labs revealed creatinine 4.5 mg/dL (baseline 2.2 mg/dL), WBC 17.2 x10^3/L and albumin 2 g/dL. Her urinalysis had massive proteinuria, hematuria and granular casts. Her ANA panel, complement, ANCA, anti-dsDNA, HIV and hepatitis panel were negative. Stool lactoferrin was positive but other stool studies were negative. An abdominal MRI/MRA showed small bowel loop dilation with wall thickening and edema but no vasculitis. A repeat renal biopsy showed IgA nephropathy with >8% scarring. Due to continued abdominal pain and diarrhea, a small bowel enteroscopy was performed that showed multiple ulcerated, purpuric lesions in the jejunum. Biopsies of the lesions showed leukocytoclastic vasculitis with intravascular thrombi and vascular wall staining with IgA consistent with gastrointestinal involvement by HSP. With methylprednisolone her abdominal pain and diarrhea resolved, and her creatinine decreased to a new baseline of 3.5 mg/dL. She was discharged home on prednisone.
DISCUSSION: HSP is an IgA immune complex-mediated systemic leukocytoclastic vasculitis that primarily affects children with the classic tetrad of palpable purpura, polyarthralgia, acute abdominal pain and nephropathy. The prevalence of gastrointestinal symptoms is up to 85%, and petechiae referred to as intestinal purpura may occur throughout the GI tract (Saito 2011), particularly the small bowel. Adult onset HSP is rare but often more severe, requiring aggressive therapy with high dose steroids and possibly cytotoxic immunosuppressive agents. Diagnosis in adults is challenging due to an atypical clinical presentation, particularly absence or delayed onset of pathognomonic purpura. Our patient presented with renal and GI manifestations of HSP. While palpable purpura was absent, her jejunum revealed multiple purpuric lesions and a large hemosiderin-laden ulcer with histopathologic analysis consistent with HSP vasculitis. HSP without palpable purpura is rare but has been reported in an adult (Nakamura 2010) and case series of children (Kato 2004, Murayama 2007). These individuals may be classified under a proposed syndrome of IgA enteropathy subset of HSP, or alternatively under a novel entity of IgA-mediated systemic vasculitis under which HSP encompasses individuals with cutaneous involvement. While the exact diagnostic category may be debated, aggressive therapy should be initiated early to prevent irreversible disease progression.

INVASIVE TONGUE ASPERGILLOSIS: A RAPIDLY PROGRESSIVE INFECTION Shuang Guo; Jason A. Korcak. Montefiore Medical Center, Bronx, NY. (Control ID #1339418)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of invasive tongue aspergillosis.
LEARNING OBJECTIVE 2: Develop a differential diagnosis of necrotic tongue lesions.
CASE: An 86 year-old woman presented with three days of generalized weakness and diarrhea. She had a past medical history of hypertension and atrial fibrillation, as well as a recent admission for lower extremity cellulitis. On presentation, the patient became hemodynamically unstable and was intubated. The oropharynx was unremarkable prior to intubation. The patient was started on broad-spectrum antibiotics and high dose intravenous steroids with clinical improvement and was extubated on hospital day four. Three days later, the patient complained of difficulty swallowing secondary to tongue pain. A gray-green plaque without bleeding or ulceration was present on the anterior tongue. Metronidazole was discontinued given suspicion for a drug reaction. The tongue lesion rapidly increased in size with loss of normal architecture and necrotic changes. Fungal elements were present on tongue biopsy. The patient was given fluconazole and oral nystatin without improvement. Further fungal speciation revealed Aspergillus flavus and antibiotics were changed to intravenous voriconazole. The tongue lesion failed to improve, and the patient expired several days later from overwhelming sepsis of unclear etiology.
DISCUSSION: The broad differential diagnosis of necrotic tongue lesions presents a challenge for the general internist. The initial appearance of our patients lesion led to a consideration of oral candidiasis, lichen planus, medication side effect, or trauma from intubation as possible causes. The rapid onset of tongue necrosis expanded the differential to include invasive fungal, bacterial, and viral infections, malignancy, and vasculitis.

Although not present in our case, other types of vascular compromise, such as disseminated intravascular coagulation, and chemical or radiation exposure can lead to a similar presentation. Invasive aspergillosis is a rapidly progressive and often life-threatening infection that is characterized by invasion of blood vessels resulting in ischemia and necrosis. Direct oral mucosal invasion is uncommon. There are 27 reported cases of primary oral aspergillosis, most commonly affecting the gingiva, and only two reported cases involving the tongue. Risk factors for invasive aspergillosis include severe and prolonged neutropenia and other drugs or conditions that chronically impair cellular immune responses. In all reported cases of oral aspergillosis, the patients were immunosuppressed from a primary malignancy or chemotherapy. Several factors may have increased our patients susceptibility to an invasive fungal infection, including immunosuppression from high dose corticosteroids, alteration in normal oral flora from broad-spectrum antibiotics, and inoculation during traumatic endotracheal tube placement. Although invasive aspergillosis is rare, the development of an oral lesion that rapidly becomes necrotic should raise suspicion for the diagnosis, especially in immunocompromised patients. This case highlights the need for internists to form a broad differential diagnosis when encountering necrotic tongue lesions.

ISOLATED 6TH NERVE PALSY- AN UNCOMMON PRESENTATION OF LYMES DISEASE Leena Jalota; Robert Freed; Shashank Jain. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1340434)

LEARNING OBJECTIVE 1: Recognize common signs and symptoms of isolated sixth nerve palsyLEARNING OBJECTIVE 2: Appreciate the differential diagnosis including rare causes such as Lymes diseaseCASE: Introduction: The clinical manifestations of Lyme disease can generally be divided into 3 phases: early localized, early disseminated and late disease. However patients may present in a later stage without a history of prior signs or symptoms of early disease. In particular, early disseminated cases can present subacutely after initial inoculation with neurological findings which, although rare, may include isolated nerve palsies. CASE: A 55-year-old male with hypertension and diabetes, both controlled with oral medication, presented to the emergency room with complains of new-onset double vision of one-day duration. He initially deemed it trivial, even driving long-distance to a sporting event, but later presented to the hospital with progressive binocular diplopia. Specifically his vision was worsened with distance and he denied eye pain at rest or with movement. He denied associated trauma or similar episodes in the past and denied other neurological deficits. Patient was a truck driver and prior smoker who drank alcohol occasionally. Family history was pertinent for stroke and cardiovascular disease in his father and brother. The patient denied foreign travel, exposure to sick individuals and specifically denied bug and tick bites. Review of systems was positive for horizontal diplopia only. On exam: He was afebrile with elevated blood pressure of 172/86, vitals were otherwise normal. Patient was awake, alert and oriented X 3. Neck was supple, sclera anicteric and pupils of 4 mm bilaterally, equally round, and reactive to light. On right lateral gaze, the patient had a convergent strabismus, consistent with a sixth nerve palsy. Extra-ocular muscles otherwise intact and remainder of examination was entirely unremarkable. Laboratory: CBC, electrolytes and coagulation panel were normal. Both TSH and Free T4 were also normal. CVA work-up including non-contrast CT, MRI, echocardiogram and carotid duplex ultrasonography

were normal. Other diagnosis entertained included temporal arteritis, HIV and syphilis all of which were deemed less likely with normal ESR, negative HIV ELISA and negative RPR, respectively. Initial Lyme ELISA, however returned positive with subsequent confirmatory Western blot testing. Patient was begun on Doxycycline 100 mg twice daily for 28 days with appropriate follow-up in place. Upon follow up, patient had mild to moderate improvemet in symptoms.

DISCUSSION: Patients with isolated 6th or abducens nerve palsy often complain of diplopia which should be binocular and purely horizontal. It is typically worse when looking at objects at a distance and in lateral gaze towards the affected side, although some patients may also complain of visual deficit in primary position. New

onset cranial nerve palsies in adults most often result from myasthenia gravis, diabetes melitus, meningitis, microvascular disease or giant cell arteritis. Other less likely causes include Lyme disease, CNS tumors, metastatic lesions, autoimmune disorders and vitamin deficiencies. After ruling out common causes appropriate workup should ensure to rule out rare and reversible causes. Lyme disease, although a rare cause, can present with isolated cranial nerve palsies and should be ruled out even in diabetic patients, regardless of overt tick exposure.

ISOLATED PULMONARY ANTI-GBM DISEASE Yaser Alkhatib1;
Ghassan Bandak1; Waqas Qureshi1; James E. Novak2. 1Henry Ford Hospital, Detroit, MI; 2Henry Ford Hospital, Detroit, MI. (Control ID #1328098)

LEARNING OBJECTIVE 1: Although Anti-GBM disease usually involves the kidneys, it might very rarely presents exclusively in lungs LEARNING OBJECTIVE 2: Early recognition and treatment of Anti-GBM disease might delay or prevent renal involvementCASE: A 30-year-old Caucasian lady presented to the hospital with severe dyspnea that started one week after exposure to smoke from burning leaves. The dyspnea progressively worsened until she became symptomatic at rest prior to presentation. It was associated with non-productive cough but not chest pain, paroxysmal nocturnal dyspnea, orthopnea, hemoptysis, wheezing, or fever. Her past medical history was negative for lung disease. She was not taking any medications. Social history was significant for 2 packs per day cigarette smoking. In the emergency room, she quickly progressed to hypoxemic respiratory failure requiring intubation and mechanical ventilation. Initial chest X-ray revealed alveolar infiltrates and she was diagnosed with acute pulmonary edema. She was treated with diuretics but became hypotensive and oliguric. She was also started on empirical antibiotics for possible pneumonia. The lack of response in the next 72 hours prompted discontinuation of antibiotics, and flexible bronchoscopy suggested alveolar hemorrhage. At this point, the patient developed renal failure requiring hemodialysis. Infectious and rheumatological work up was negative and anti-glomerular basement membrane (anti-GBM) antibodies were found to be strongly positive. There was a concern that renal failure might be secondary to anti-GBM disease. The patient was started on high dose steroids on day 5. Since the patient was too unstable to undergo kidney biopsy, plasmapheresis was given empirically for 14 days. Oxygenation improved, and the patient was extubated on day 9. Subsequently, kidney biopsy was performed that revealed acute tubular necrosis but not anti-GBM disease. The patient resumed urinating after three weeks, and creatinine improved to almost normal prior to discharge.

DISCUSSION: Anti-GBM disease is a rare autoimmune disease with an annual incidence of 0.5 cases per million in the general population. The disease is secondary to anti-GBM antibodies against the noncollagenous 1 domain of the alpha 3 chain of type IV collagen found in the glomerular basement membrane. The disease manifests in type IV collagen-rich organs such as kidney (anti-GBM glomerulonephritis) and lungs (Goodpasture's disease). Very rarely, it may only present in the lungs, as in our case. Isolated pulmonary anti-GBM disease has been reported in the literature. Renal involvement might be absent, subtle, or eventually develop months to years from initial presentation. The inciting event is usually environmental exposure to inhalational toxins, representing an environmental trigger in a genetically predisposed individual. It was hypothesized that early recognition and treatment prevented overt renal involvement in our patient. Alveolar hemorrhage is an important differential diagnosis of alveolar infiltrates on chest X-ray and should prompt a physician to check for anti-GBM antibodies in a patient without a clear etiology for ARDS, pneumonia, or pulmonary edema. Timely diagnosis and treatment could be life-saving. Follow up is essential in patients with isolated pulmonary anti-GBM disease. Recurrence is common and can occur months to years after the initial presentation as an isolated pulmonary disease or with frank pulmonary-renal syndrome.

ISOLATED RIGHT VENTRICULAR PULSUS ALTERNANS IN SEVERE PULMONARY HYPERTENSION ASSOCIATED WITH HIV INFECTION. Robin Singh1; Hanan Makhoul2. 1University of Louisville, Louisville, KY; 2Little Rock Diagnostic Clinic, Little Rock, AR. (Control ID #1327677)

LEARNING OBJECTIVE 1: HIV associated pulmonary arterial hyper-tension (PAH) needs an early diagnosis and treatment, as 2D Echo and Doppler should be utilized early in the evaluation of dyspnea in HIV patients.
LEARNING OBJECTIVE 2: Isolated right ventricular (RV) and pulmonary arterial (PA) pulsus alternans in HIV associated PAH signifies severe right ventricular dysfunction.
CASE: A 31 year old African American female with a 9 year history of HIV presented with progressively exertional dyspnea of 1 year duration. She had mild leg edema but no history of fever, productive cough, chest pain, palpitation, syncope, orthopnea or PND. She had mild hypertension. She had no history of tobacco, alcohol or drug abuse, and family history was noncontributory. Medications included antiretroviral drugs and Furosemide. Physical Examination: No acute distress, BP 150/90, 80/min/regular, elevated JVP, loud P2, 3/6 holosystolic murmur in the left parasternal area without respiratory variation. Lungs clear to auscultation bilaterally and mild leg edema. CD4 count 128/cmm with HIV PCR count of 1910 copies/ml. EKG: sinus rhythm, right axis, RBBB. Chest x-ray: moderate cardiomegaly, no pulmonary edema or infiltrates. Echocardiogram: markedly dilated RV and RA. Ventricular septum was flattened indicating increased RV pressure and volume. LV EF was 50%. No valvular disease. Doppler showed moderate tricuspid regurgitation and severe PAH with an estimated PA systolic pressure of 115 mmHg. Moderate pericardial effusion was also noted. Right Heart Catheterization confirmed severe PAH (PA pressure100/40, mean 60, wedge pressure of 10, RV diastolic pressure of 15 mmHg). Cardiac output 2.0 L/min. PA saturation: 17%. Intermittent PA and RV pulsus alternans during regular sinus rhythm. Radial arterial saturation: 95%. Radial pressure wave form did not show alternans. Pulmonary scan: low probability for PE. Diagnosis of HIV associated severe PAH with congestive heart failure was made. Patient was treated with Bosentan and WarfarinDISCUSSION: Noninfectious cardiovascular complications of HIV such as PAH remain poorly understood. HIV associated PAH occurs at all stages of the disease and does not seem to be related to the degree of immune deficiency. HIV infected patients have a 2500 fold increased risk of developing PAH compared to the general population (1-2 per million). Echocardiogram has an important role in the early evaluation of HIV associated cardiovascular diseases. This case illustrates the association of severe PAH with HIV.- the interesting hemodynamic finding of isolated right ventricular and pulmonary artery pulsus alternans as noted in this patient has been very rarely reported in PAH in contrast to systemic arterial pulsus alternans in patients with severe LV dysfunction. The exact mechanism of alternans is not known but may be secondary to alternation of loading conditions or contractility or alteration of intracellular calcium. Presence of RV and PA alternans represents significant RV systolic dysfunction and carries a poor prognosis. The severe right ventricular dysfunction explains the lack of respiratory variation of the Tricuspid regurgitation murmur.

IT'S TIME TO QUIT SMOKING - A CASE OF PULMONARY LANGERHANS CELL HISTIOCYTOSIS Sarat Chandra Ayyagari; Randhir Jesudoss; Sandeep Kapur; Rajan Prakash. The Christ Hospital, Cincinnati, OH. (Control ID #1303510)

LEARNING OBJECTIVE 1: * Consider Pulmonary Langerhans Cell Histiocytosis in the differential diagnosis of Interstitial lung disease in smokers.
LEARNING OBJECTIVE 2: * Early diagnosis is important because the clinical course of the disease may be dramatically altered by a single intervention i.e. smoking cessation.
CASE: A 50 year old Caucasian female with no prior respiratory ailments presented with worsening non productive cough and exertional dyspnea for four months. She denied fevers, weight loss or lower extremity swelling. She was prescribed multiple courses of antibiotics, oral steroids and bronchodilators with no subjective improvement. In fact, her cough worsened to a point where she sustained bilateral rib fractures after a prolonged coughing spell. She reported an 18 pack year history of ongoing smoking. She denied any exposure

to metallic dusts, recent travel or any unusual pets. Her physical exam was unremarkable. Chest CT revealed lower rib fractures, mild hyperinflation and bilateral pulmonary nodules measuring up to 5 mm predominantly in the upper lobes. A comprehensive autoimmune, allergic and infectious workup that included bronchoscopy failed to identify an etiology of her interstitial lung disease .Differential diagnosis at this point included sarcoidosis, lymphangiomatosis, eosinophilic pneumonia and diffuse metastases. She subsequently underwent an open lung biopsy, which showed multiple stellate nodules that were S-100 protein-positive and CD-68-positive diagnostic of Langerhans Cell Histiocytosis. At this point, she was strongly recommended to quit smoking. On a follow up visit at six months, she denies any cough and dyspnea markedly improved.
DISCUSSION: Pulmonary Langerhans Cell Histiocytosis (PLCH) is a rare interstitial lung disease occurring exclusively in young cigarette smokers. The extremely low incidence and non-specific presentation often poses a diagnostic challenge to clinicians. Pulmonary LCH belongs to a spectrum of diseases characterized by the proliferation of specific histiocytes, known as Langerhans cells, and their infiltration of organs. An ongoing debate exists over whether LCH is a reactive or neoplastic process. Its association with smoking has been well described and it is now classified under smoking related interstitial lung diseases. Patients typically present with chronic non productive cough, dyspnea or spontaneous pneumothorax. Extra pulmonary manifestations including cystic bone lesions and diabetes insipidus have been described. In our patient, it is unclear whether the rib fractures represent a purely mechanical complication versus extra pulmonary involvement. Radiological appearance is typical with nodular opacities with upper lobe predominance and interstitial fibrosis on a HRCT; however, most patients require a surgical biopsy for confirmation. Smoking cessation is the cornerstone of management. No other intervention consistently results in clinical stabilization. In fact, cases of complete radiological resolution following smoking cessation have been reported. Steroids and chemotherapy have been tried in refractory cases. Long term complications include pulmonary hypertension and respiratory failure. Physicians should consider PLCH in the differential of interstitial lung disease in young smokers. Early diagnosis is important because the clinical course of the disease may be dramatically altered by a single intervention i.e. smoking cessation.
KAPOSI'S SARCOMA PRESENTING AS ATYPICAL CONJUNCTIVITIS Schuyler D. Livingston; Valeria Cantos; Minh Nguyen. Emory University SOM, Atlanta, GA. (Control ID #1339822)
LEARNING OBJECTIVE 1: Recognize ocular Kaposi's sarcoma (KS) LEARNING OBJECTIVE 2: Identify indications for systemic chemo-therapy in KSCASE: A 35 year-old African-American male presented to clinic with a 2-week history of progressive right eye redness with associated nasal congestion. Redness had spread to the left eye several days before. The patient had been diagnosed with AIDS five months prior, with an initial CD4 count of 4, and viral load of 140,000. Physical exam was notable for bilateral conjunctival erythema, with thickening of the right lacrimal caruncle. Moderate nasal mucosal edema was noted. Further exam did not reveal additional mucosal or cutaneous lesions. On laboratory evaluation, viral load was now undetectable on boosted darunavir and fixed-dose tenofovir/emtricitabine. The patient returned to clinic 1 month later with worsening bilateral eye redness and facial edema. Physical exam revealed a
beefy-red, crescent-shaped right conjunctival mass with mildly dilated surrounding vasculature. Violaceous nodules were present in the posterior oropharynx and left superior gingiva. There were two small (~1 cm) hyperpigmented plaques on the right thigh and upper abdomen. Marked facial edema and narrowing of the nasal passages had developed. Though no respiratory or constitutional symptoms were present, chest X-ray revealed diffuse nodular infiltrate, with perihilar predominance. A clinical diagnosis of Kaposis sarcoma (KS) related to immune reconstitution was made, with pulmonary involvement. Due to a shortage of doxorubicin, chemotherapy consisting of paclitaxel was administered the following day. The patient reported rapid improvement in symptoms over the next few days.
DISCUSSION: KS is a well-known complication of AIDS, associated with human herpesvirus 8 infection. Visceral involvement is common, with predilection for the oral cavity, GI tract, and lungs. Ocular disease is seen

in approximately 20% of cases, affecting the conjunctiva, eyelids, and lacrimal sacs. Conjunctival lesions are usually bright red or violaceous in color, slightly raised, and may bleed. The inferior fornix is the most common site of involvement. Early lesions may appear similar to subconjunctival hemorrhage. Eyelid KS is more common, typically presenting as a raised purple lesion, similar to an ecchymosis. Associated lymphedema is common with KS and may be severe, possibly explaining the facial edema and nasal congestion seen in this case. Treatment with systemic chemotherapy is indicated for KS in the following settings: extensive cutaneous disease, lymphedema, symptomatic visceral disease, and immune reconstitution inflammatory syndrome (IRIS). In this patient, KS manifested after 6 weeks of antiretroviral therapy, supporting a diagnosis of IRIS. IRIS refers to unmasking or worsening of an opportunistic infection with response to combined antiretroviral therapy (cART). It occurs in about 10% of patients with AIDS starting cART. Affected patients usually have low baseline CD4 counts and high baseline viral loads. KS is among the most common underlying diseases in IRIS, presenting as early as 3 weeks to as late as 1 year following initiation of therapy. In one case series, IRIS occurred in 12/41 (29%) cases of pre-existing Kaposis sarcoma. Visceral KS occurring in IRIS tends to be aggressive, with potential for chronic lymphedema, and mortality estimated at 50%. Systemic chemotherapy with doxorubicin or paclitaxel is potentially life-saving in such patients.

LABOR: NOT YOUR TYPICAL PAIN IN THE NECK Lauren Shapiro; Naeema Ginwala. Montefiore Medical Center, Bronx, NY. (Control ID #1320839)

LEARNING OBJECTIVE 1: Learning objective: To make internists aware of bilateral carotid dissection as a rare, but serious, complication of childbirth.

CASE: 34 year-old female with no significant past medical history, presented to the emergency room with complaints of right hand weakness and numbness on the right side of her face. Two weeks prior, a few days after a normal spontaneous vaginal delivery, the patient reported feeling a left-sided neck pain. Ten days later, the patient noted numbness of the right side of her face, and subsequently weakness of her right arm and hand that limited her ability to grasp and pick up objects. When she presented to the hospital she was slightly hypertensive at 151/98 with a right hand grip 3/5 and finger extension 2/5. Evaluation with a CT scan of the head was negative for an intracranial bleed, however an MRI of the brain showed several foci of acute left frontal and parietal infarctions, suggestive of arterial emboli. She subsequently underwent an MRA of the neck, which showed bilateral proximal internal carotid artery narrowing suggestive of bilateral carotid artery dissections. The patient was treated conservatively with anticoagulation. Her neurological deficits gradually improved and were completely resolved approximately two months following the event. DISCUSSION: The case above demonstrates the rare, but dangerous, labor complication of carotid artery dissection leading to embolic stroke. There have been few case reports of women who have experienced postpartum internal carotid artery dissections (ICAD), and none that describe bilateral dissections related to labor. Ipsilateral head and face pain, with or without neck pain, is the most common sign for dissection. ICAD have been described in patients with predisposing conditions such as

fibromuscular dysplasia, cystic medial necrosis, Marfans, and Ehlers Danlos syndromes. However, several case reports have documented women with no previous risk factors to dissection as having experienced this postpartum. There are several physiological reasons why parturition may cause or exacerbate ICAD. In pregnancy, physiologic vascular wall remodeling enhances arterial diameter and compliance, increasing vulnerability to dissection. Elevated blood flow and cardiac output during pregnancy may intensify shear forces and subsequently increase the risk of intimal tear. In addition, the hypercoagulable state of pregnancy helps in the development of thrombi at the site of dissection, allowing for subsequent embolization. Lastly, expulsive forces have been proposed as precipitating factors to ICAD for women reaching the second stage of labor. Studies show that pregnancy increases the risk of stroke as much as 13-fold, and that peri- and postpartum periods are the most at-risk times. The incidence of ICAD, however, as the cause of puerperium stroke is rare,

and bilateral dissections even more so. Physiologic changes to womens vasculature and hypercoagulability make pregnancy a high-risk state for ICAD. Strain during labor has often been overlooked as a form of trauma that may leave the internal carotids arteries vulnerable to injury. ICAD is an important complication of pregnancy and cause of stroke that internists should be aware of in their patients.

LAMBLS EXCRESCENCES AND CEREBROVASCULAR ACCIDENT Leon I. Igel. New York Presbyterian/Weill Cornell Medical Center, New York, NY. (Control ID #1316208)

LEARNING OBJECTIVE 1: To review the potential etiologies of recurrent embolic stroke in a young patientLEARNING OBJECTIVE 2: To compare Lambls Excrescences and Papillary FibroelastomasCASE: An athletic 25-year-old man with no known past medical history presented with sudden onset of slurred speech and right-sided body weakness. Emergent head CT and follow-up MRI brain revealed the presence of an acute stroke as well as evidence of a subacute embolic stroke of unclear age. The patient subsequently received tPA with complete neurologic recovery. Stroke and hypercoagulability workups were completed, with the only abnormality encountered being a 13 mm mass seen on the cusp of the patients aortic valve on both transthoracic and transesophageal echocardiograms. Given that no additional risk factor or alternative etiology for the recurrent emboli could be found, the patient underwent open heart surgery for resection of the aortic valve mass. Histopathological studies performed on the excrescence revealed fibrous tissue with myxoid change and the mass was termed a large Lambls Excrescence. The patient has remained without further incident since the time of his procedure and follow-up transthoracic and transesophageal echocardiograms have demonstrated absence of new valvular mass development.

DISCUSSION: There are many plausible causes for recurrent embolic stroke. However, in a young, healthy patient without known risk factors (i.e. hypertension, diabetes mellitus, dyslipidemia, known hypercoagulable state, tobacco use, known cardiac arrhythmias including atrial fibrillation) the possible etiologies are substantially narrowed, with the most likely cause being a cardioembolic source. It is estimated that a cardioembolic source is responsible for approximately 25% of all ischemic strokes in the general population. Potential cardiac sources for emboli include masses (i.e. thrombi, atherosclerotic plaque, valvular calcification, vegetations, and tumors) and aberrant passageway for embolism (including patent foramen ovale and atrial septal defect). Lambl Excrescences are fibrinous strands most often found at the contact margins of the aortic valve. There is a great deal of controversy as to whether these valvular excrescences are etiologically associated with embolic events, but the predominant sentiment is that they are rarely, if ever, associated with cardioembolic stroke. Giant Lambls Excrescences have been documented, and these larger filamentous masses have been causally associated with embolic stroke in case reports. However, at the size described in this case (13 mm), it would be important to consider a small Papillary Fibroelastoma as part of the differential diagnosis. Fibroelastomas are benign cardiac tumors that are most frequently located on the aortic (36%) or mitral (29%) valves. They often have frond-like arms emanating from a stalked central core (similar in appearance to large Lambls Excrescences), with a
mean size of 9 mm. They can be a source of systemic embolization either from migration of thrombus from the tumor surface, or secondary to tumor embolization. Surgical excision of fibroelastomas is frequently recommended in patients who experience embolic events and in patients who have large (>10 mm) tumors.

LEFT BLACK AND BLUE BY A VACCINE Kokila Bindiganavile Nagendran; Harvey Friedman; Salih Samo. Saint Francis Hospital, Evanston, IL. (Control ID #1339700)

LEARNING OBJECTIVE 1: Immune thrombocytopenia can be a potential life threatening complication of Hepatitis B Vaccination in adults. LEARNING OBJECTIVE 2: The hepatitis B vaccine has a good level of efficiency and its rare adverse effects, including ITP, must not put its use in question.

CASE: We present the case of a 57 y/o male with ESRD on hemodialysis who was transferred from the nursing home due to an abnormally low platelet count (3000/ mm3) found on a blood test. The patient had noticed bruising around his left eye, hemorrhagic blebs on his tongue, hematuria, tarry stools and diffuse ecchymosis

over his extremities. He also reported a mild frontal headache. History was significant for receiving the recombinant hepatitis B vaccine 2 days prior to admission. He had received the vaccine previously with no documented adverse reaction. Past history revealed splenectomy at age eleven after a motor vehicle accident. Physical examination revealed ecchymosis, conjunctival haemorrhage and mucosal bleeding in the mouth. A CT head showed no intra cranial haemorrhage. On admission, the results of analytical tests were: white blood count of 11,200/mm3, haemoglobin of 12.8 g/dL, platelet count of 3000/mm3, and peripheral smear showed no schistocytes, clumping and normal platelet morphology; prothrombin time and active partial thromboplastin time were normal as were assays for heparin-induced antibodies, heparin induced platelet aggregation, antinuclear antibodies. Serological assays for hepatitis B virus, hepatitis C virus and Human immunodeficiency virus were negative. He was initially transfused single donor platelets with no improvement in the platelet count. A diagnosis of immune thrombocytopenic purpura was made and he was started on IV solumedrol, intravenous immunoglobulin and aminocaproic acid. By the end of the fifth day, the platelet count was 102,000/mm3 and was 259,000/mm3 at discharge. He was sent to the nursing home on tapering oral steroids for a month. Platelet counts remained normal on a six month follow -up.

DISCUSSION: Universal vaccination with Hepatitis B vaccine was instituted since 1991.The vaccine is usually well tolerated, with few side effects; but several cases of thrombocytopenia after recombinant vaccine have been described in literature since 1994. ITP is thought to be caused by the presence of autoantibodies to glycoprotein IIb/IIIa molecules present in the platelet membrane. Repeated doses of vaccine may function as a booster to autoantibody formation. Previously recognized cases had a latency period of three to four weeks in patients who received their second or third dose. Compared to that, our patient had rapid onset of thrombocytopenia. Diagnosis remains one of exclusion. Most cases resolve spontaneously and do not experience recurrence even after the same vaccination months later. Steroids may be used as a first line agent with prompt increase in platelet count.

LEMIERRES SYNDROME: RECALLING THE FORGOTTEN DISEASE Ramon Jacobs; Bora Toklu. NYU School of Medicine, New York, NY. (Control ID #1319359)

LEARNING OBJECTIVE 1: Distinguish clinical clues to assess for Lemierres Syndrome.

LEARNING OBJECTIVE 2: Manage Lemierres Syndrome when appropriate anaerobic antibiotics are not sufficient.

CASE: A 24-year-old healthy female was admitted after presenting with fever, sore throat, neck and pleuritic chest pain that started 3 days prior to admission. On physical examination, the patient appeared in mild respiratory distress requiring supplemental oxygen, and noted to have swelling and tenderness along the left sternocleidomastoid muscle with associated left tonsillar exudate and bibasilar pulmonary rales. Her initial

complete blood count revealed isolated mild thrombocytopenia and a bandemia of 79%. A rapid strep test returned negative and a rapid influenza A/B RNA test also was negative. Following admission, a CT scan of the neck with contrast showed left peritonsillar abscess extending into the hypopharyngeal region with extensive lymphadenopathy. The patient was subsequently started on piperacillin-tazobactam and metronidazole after her admission blood culture began growing gram-negative anaerobes, which later speciated as Fusobacterium necrophorum. As the patient continued to spike high grade fevers, metronidazole was switched to intravenous sulbactam-ampicillin. On appropriate antibiotic coverage, the patient continued to complain of worsening dyspnea requiring increased supplemental oxygen by nasal cannula. A CT scan of the chest then showed multifocal pneumonia and multiple lung nodules concerning for septic emboli. In search for the source of her septic emboli, an echocardiogram showed normal findings, while a repeat CT of the neck with contrast revealed new findings of multiple necrotic lymph nodes and left internal jugular vein thrombus leading to a diagnosis of

Lemierres Syndrome. Subsequently, given clinical deterioration, patient was initiated on intravenous anticoagulation and the left internal jugular vein was resected. Over the ensuing several days, the patients clinical picture had improved significantly on the same antibiotic coverage. She was eventually discharged on oral antibiotics to complete a 4-week course. DISCUSSION: Lemierres Syndrome is a potentially fatal complication of oropharyngeal bacterial infections, most commonly of anaerobic Fusobacterium species, leading to ipsilateral jugular vein suppurative thrombophlebitis and subsequent septic emboli. It is a rare disease, but incidence is reportedly increasing, postulated to be due to more conservative patterns of antibiotic prescription for oropharyngeal infections. Any oropharyngeal infection involving adjacent pharyngeal tissue with an anaerobic septicemia and/or respiratory distress should prompt clinicians to evaluate for Lemierres Syndrome by a simple cervical venous duplex scan or a more sensitive CT scan of the neck with contrast. Although potentially fatal, it can be treated easily if diagnosed in a timely fashion. A high degree of clinical suspicion and prompt initiation of anaerobic antibiotic therapy are of paramount importance to reduce the associated risk of mortality. Although the role of anticoagulation and jugular vein excision is controversial, we believe these measures should be considered if the clinical picture deteriorates on anaerobic antibiotic therapy alone.

LITHIUM TOXICITY IN THE SETTING OF NON STEROIDAL ANTI INFLAMMATORY MEDICATIONS Zahraa Hajjiri1; Sandeep K. Walia1; Syed Hassan1; Sandeep Soman2. 1Henry Ford Health System, detroit, MI; 2Henry ford Hospital, Detroit, MI. (Control ID #1335286)

LEARNING OBJECTIVE 1: Lithium toxicity is known to affect multiple organ systems, including the central nervous system. Lithium levels have been used in the diagnosis of toxicity and assessing response to management. There is evidence that non steroidal anti inflammatory medications (NSAID) can increase lithium levels and decrease renal lithium clearance. We present a case of lithium toxicity, which demonstrates this effect and also highlights the fact that lithium levels do not correlate with clinical improvement, especially the neurological deficit. CASE: The patient is a 51 year old AA male with a history of schizophrenia and bipolar disorder who was chronically taking lithium, valproate, quetiapine, and risperidone. He presented to the emergency department with progressively worsening mental status that was preceded by dysarthria, abnormal gait, and diarrhea. Prior to presentation, he was taking ibuprofen (an NSAID) for pain control in the setting of a recent dental procedure and had poor oral intake. He was found to have an elevated lithium level (3 Mmol/L) with mild renal failure (serum creatinine 1.6 mg/dl) and was treated with intravenous hydration and supportive care. Hemodialysis (HD) was not initiated as renal function along with his lithium levels improved rapidly. His serum lithium levels normalized without improvement in his mental status. Subsequently, he required intubation with infectious/metabolic workup being negative, an unremarkable CT scan of the head, and an electroencephalography revealing metabolic encephalopathy. With a few days of supportive care, the patient was extubated and his mental status returned to baseline.

DISCUSSION: We report a case of lithium toxicity in the setting of NSAID use, where a patient had normalized serum lithium levels with

delayed improvement in mental status. It is recommended that lithium levels be checked every 4-5 days after starting an NSAID to assess for toxicity. We emphasize that lithium levels may be helpful in the primary diagnosis of toxicity; however, serial levels should not be used to assess response to treatment. In cases of acute toxicity, lithium is mainly an extracellular water soluble ion rapidly cleared by intravenous hydration or HD. However, in cases of toxicity following chronic lithium ingestion, intracellular and intracerebral concentrations are high. When the serum lithium level normalizes, intracellular concentrations remain elevated and further clinical decompensation is possible. This occurs because lithium equilibrates slowly between both compartments, requiring multiple prolonged HD treatment sessions. Reviewing this case retrospectively reinforces the current guidelines for the management of lithium toxicity. Any patient who comes in with altered mental status associated with toxic lithium levels (greater than 2.5 Mmol/L) should undergo multiple prolonged

HD sessions to adequately deplete intracellular lithium.

LOST ART OF PHYSICAL EXAM Nikhil Mukhi; Tushar Shah; Tauseef Ahmed. Westchester Medical Center, Valhalla, NY. (Control ID #1327566)

LEARNING OBJECTIVE 1: A good physical exam should be used to guide the diagnostic workup of a patient.

LEARNING OBJECTIVE 2: A good physical exam helps avoid delay in diagnosis and unnecessary testing.

CASE: A 29 years-old Hispanic construction worker admitted for evaluation of an abdominal mass and weakness. Patient noted a painless mass in his abdomen 1 year ago which he stated was initially the size of a lemon and had gradually progressed in size. For 3 months he was experiencing progressive dysphagia to solid foods and markedly diminished appetite with approximately 25 pound weight loss. One month ago he started having episodic projectile nausea and vomiting occurring immediately after food intake. The vomitus was bilious, contained food but no blood and was associated with burning chest pain. He denied abdominal pain or change in bowel movements. He developed weakness one week prior to admission which prompted him to seek medical attention. He had subjective high grade fevers not associated with chills or night sweats for one month. He is a non smoker, occasionally drinks a beer and doesnt use any recreational drug. The physical examination was entirely normal other than mild tachycardia and a 15.0 x 15.0 cm firm, mildly tender, non-pulsatile mass with smooth borders occupying the area between symphysis pubus to umbilicus. No hepatosplenomegaly or adenopathy was appreciated. Initial labs revealed WBC count of 4.4 k/mm3 (Diff - 68% Neutrophils, 14%Lymphocytes and 15% monocytes), Hb of 11gm/dl (MCV 83.6 and RDW 15.6) and platelet count of 193 k/mm3. Chemistry revealed BUN: 34 mg/dl, Cr: 2.54 mg/dl, K: 3.3 meq/l, LDH: 786U/l, Alkaline Phosphate: 453U/l, Calcium: 14.6 mg/dl, Uric acid:10.3 mg/dl. In the setting of monocytosis, hypercalcemia, hyperuricemia and abdominal mass, a preliminary diagnosis of lymphoma was made and patient was transferred to our facility. Bone marrow biopsy revealed a normal trilineage and the cytogram analysis showed no evidence of lymphoma/leukemia. CT Chest/Abdomen/Pelvis revealed a large (8.9 x10.5 cm) homogeneous posterior mediastinal mass extending inferiorly into the retroperitoneum and two additional soft tissue masses (7.8x17.4x14.4 cm and 10x15.7x14 cm) within the intraperitoneal space which contained areas of necrosis and calcification. On repeat exam, patient had a normal left testis and an absent right testis. Ultrasound of the scrotum confirmed the findings. Patient underwent a CT guided biopsy of the intraperitoneal mass which showed a classic type seminoma associated with non-necrotizing granulomas. Patients Serum AFP was 1.6 ng/ml and -hCG was 42.3mIU/ml. Patient was diagnosed with Stage 3 Seminoma, has received 4 cycles of BEP regimen [bleomycin, etoposide, cisplatin] and is currently awaiting postchemotherapy evaluation.

DISCUSSION: Testicular cancer is the most common solid malignancy affecting males between the ages of 15 and 35, although it accounts for only 1 percent of cancers in men. With a five year survival rate of over 95% even in advanced germ cell tumors, it is one of the most readily treatable cancers. Varghese et al described how the electronic medical record and advanced imaging technology have led doctors away from the bedside but also devalued the importance of a good bedside physical exam.

He also stated that clinicians who are skilled at the bedside examination make better use of diagnostic tests and order fewer unnecessary tests. Our case illustrates that physical exam should be used to guide the diagnostic tests.

LOST IN TRANSLATION? HOT FLASHES IN A MAN Jaseena Elikkottil; Tseganesh Selameab. HCMC, Minneapolis, MN. (Control ID #1308485)

LEARNING OBJECTIVE 1: Review diagnosis and treatment of prostatic disease in resource poor settingsLEARNING OBJECTIVE 2: Recognize cultural differences in patient-provider communicationCASE: A 76-year-old Amharic speaking male from Ethiopia presented with chief complaint of "hot flashes". He had arrived in the United States less than one month prior. When interviewed with a professional interpreter, he reported being healthy till one year prior when he had surgery for removal of his "seeds" to relieve urinary

obstructive symptoms. Patient denied ever having a history of malignancy and denied having any other treatments, such as injections or radiation. Since that surgery the patient reported feeling alternately "hot and cold", and often waking up at night drenched in sweat. On his initial physical exam, the patient was afebrile but diaphoretic and was noted to have a supra-pubic horizontal scar. The genital exam was remarkable for absence of testes bilaterally. Hemogram, TSH and comprehensive metabolic panel were unremarkable. Further evaluation revealed an elevated PSA and a very low testosterone level. After the initial visit, a family member revealed to the care team that the patient had been diagnosed with prostate cancer in Ethiopia and had undergone bilateral orchiectomy and prostatectomy. The diagnosis of prostate cancer had been kept from the patient by both the family and the medical team caring for him in Ethiopia.
DISCUSSION: Bilateral orchiectomy is commonly used as the first line treatment for prostate cancer in many parts of Africa and other resource poor areas. According to one study from Africa, 89% of the prostate cancer cases presented as locally advanced or metastatic disease. Diagnosis is commonly made by a digital rectal exam due to the expenses associated with lab testing. A histological diagnosis was obtained prior to surgery in only 39% of cases. Bilateral orchiectomy was done in 71% of the cases, and 28% of those received additional therapy. Additionally, there are practice differences amongst cultures regarding revealing bad news, specifically a diagnosis of cancer, to the patient. In many Eastern cultures, the diagnosis is disclosed to a close family member first and their input may be sought on how and when to break the news to the patient. Our patient was not aware of his diagnosis of prostate cancer made in Ethiopia. These possibilities should be kept in mind when working with a culturally diverse population. Obtaining collateral history from family becomes even more important in such a scenario.
LUMPS, BUMPS, AND SLE Stephanie J. Davis; Shana Ratner. University of North Carolina Hospitals, Chapel Hill, NC. (Control ID #1339487)
LEARNING OBJECTIVE 1: Recognize lymphadenopathy as a potential presenting symptom of Systemic Lupus ErythematosusLEARNING OBJECTIVE 2: Learn about Familial Multiple Angiolipomatosis, a rare yet benign inherited conditionCASE: A 49 year old adopted female presented to the General Medicine clinic to establish care. She complained of the sudden appearance of greater than twenty lumps beneath the skin that seemed to bruise easily. She denied fevers, chills, or unexplained weight loss but did note night sweats for many years which she attributed to menopause. Her past medical history included squamous cell carcinoma of the eyelid treated with excision, and menorrhagia requiring blood transfusion, resolved since uterine ablation. She had not been in contact with her birth parents, and thus did not know her family history. Review of systems revealed a photosensitive rash on the cheeks that she had been told was atypical rosacea. On exam she was found to have nontender, bilateral, rubbery, 1 cm epitrochlear nodes, as well as nontender, scattered, rubbery soft tissue nodules on the inner aspects of her arms and anterior and posterior thighs
that appeared bruised. No cervical, supraclavicular, axillary, or inguinal lymphadenopathy was found on exam. Labs were notable for mild leukopenia, positive ANA with a titer of 1:640, and a positive RNP. Other rheumatologic serologies, HIV, RPR, and urinalysis were unremarkable. Based on concern for lymphoma versus systemic lupus erythematosus (SLE) presenting with lymphadenopathy, the patient was sent for excisional biopsy. Biopsy of a presumed epitrochlear node and a nodule on the anterior thigh both revealed angiolipoma on pathology. Due to the abundance of these angiolipomas, the patient may have familial multiple angiolipomatosis; however, due to her adoption status, she is unaware of her family history. During the workup of this benign condition, the patient was also found to have SLE, which was likely an unrelated, yet interesting, finding.
DISCUSSION: Familial multiple angiolipomatosis is a rare, benign entity that is inheritied in an autosomal-dominant fashion and may be a subtype of Familial Multiple Lipomatosis (FML), a condition that presents in the third to fifth decade of life, characterized by numerous, encapsulated lipomas on the trunk and extremities. Treatment of the angiolipomas for cosmetic purposes (as the lipomas are benign) typically consists of surgical

excision or liposuction. In this case, the presence of bilateral nodules in the epitrochlear region was concerning for lymphadenopathy, prompting a workup for malignancy, autoimmune condition, or systemic inflammatory disease. While the angiolipomas in this patient were found to be benign by pathologic evaluation, oddly enough, systemic lupus erythematosus happened to also be present and, thus far, undiagnosed in this patient. Although only occurring in approximately 5% of SLE patients, generalized lymphadenopathy can be a presenting symptom of SLE.

LYMPHOMA PRESENTING AS HYPERCALCEMIA AND NORMALIZATION OF PARATHORMONE IN A PATIENT WITH UNDERLYING SECONDARY HYPERPARATHYROIDISM Abhishek Singla1,2; Vrinda Agrawal1,2; James Fulton1,2; Mary Tadros2,1.
1Creighton University Medical Center, Omaha, NE; 2VA Omaha, Omaha, NE. (Control ID #1333798)

LEARNING OBJECTIVE 1: To emphasize the need to evaluate every case of severe hypercalcemia for underlying malignancy.

LEARNING OBJECTIVE 2: To review the management of severe hypercalcemia caused by lymphoma and identify the role of early steroid and chemotherapy.

CASE: A 86 year old caucasian male with past medical history of chronic kidney disease (Stage III) with secondary hyperparathyroidism, dilated cardiomyopathy with poor EF, chronic obstructive lung disease; presented with severe fatigue, anorexia, weight loss and back pain. On examination, spleen was palpable. A complete laboratory work up was done with the following RESULTS: Calcium 14.8 mg/dL (normal 8.2-10.2), Phosphorus3.5 mg/dL (2.6-4.9), alkaline phosphatase 50 IU/L (38-126), BUN 55 mg/dL (9-20), creatinine 3.2 mg/dL (0.7- 1.5), TSH 1.18 mIU/L (0.47- 6.20), PTH 17 pg/ml (12-88), Vitamin D 91 pg/mL (18-72), PTH-rP 27 pg/mL (14 -27). Review of labs done four months prior showed calcium10.4 mg/dL and PTH 180 pg/ml. Urine electrophoresis was positive for monoclonal protein noted in the beta-gamma region and free kappa light chains identified by immunofixation electrophoresis but no evidence of monoclonal protein on serum electrophoresis. CT scan of abdomen showed large left upper quadrant mass (13 cm x 13 cm x 15 cm) resulting in anterior displacement of the abdominal viscera with multiple large lymph node in the left para-aortic region. Biopsy of mass showed diffuse infiltrate of intermediate to large atypical B-cells positive for CD45, CD20; suggestive of high-grade B-cell lymphoma. Molecular cytogenetic studies were positive for 3q27 (BCL6) and 18q21 (BCL2) and negative for t(14;18)(q32;q21); which is most consistent with diffuse large B-cell lymphoma. Bone marrow examination was normal. Patient was treated with IV fluids, palmidronate, calcitonin. After confirmation of type of lymphoma patient was started on vincristine and prednisone. Patients calcium normalized; however, treatment was soon complicated by tumor lysis syndrome.

DISCUSSION: Patients presenting with severe hypercalcemia should be evaluated for malignancy irrespective of past history. Lymphomas can cause severe hypercalcemia most commonly by overproduction of calcitriol, which results in decreased parathormone production. Furthermore, hypercalcemia is

usually associated with aggressive lymphomas, and early treatment with steroids and chemotherapy becomes paramount.

MMM: MYSTERIOUS MEDICATION MANIA Shawn Brickner; Carl Fichtenbaum. University of Cincinnati College of Medicine, Cincinnati, OH. (Control ID #1309443)

LEARNING OBJECTIVE 1: Describe common manifestations of baclofen withdrawal particularly acute psychosis.

LEARNING OBJECTIVE 2: Understand and be able to explain to patients that baclofen should never be stopped abruptly.

CASE: Introduction: Baclofen is commonly prescribed to alleviate pain in patients with muscle spasms. Abrupt

withdrawal of baclofen can lead to frank psychosis. Case Presentation: A 60-year-old male with hypertension, diabetes mellitus and chronic lumbago presented with an episode of fatigue, shaking, abnormal speech and altered mental status. The evening prior to admission, the patient had been exhausted from performing physical labor at his home and fell asleep without taking his medications. He awoke the next morning still tired and very shaky, to the point that he could not hold a glass of water without spilling it. The day progressed and his wife noticed his abnormal speech. He developed memory problems. EMS found him to be hypotensive at 73/40 but normoglycemic with a blood glucose of 102. Admitting physicians did not want medications to complicate his altered mental status and held his home medications of gabapentin, zolpidem, citalopram and baclofen. An extensive work-up for metabolic, cardiac, and neurologic causes of altered mental status revealed only an elevated CK of 2022. By hospital day 3, his mental status had deteriorated to the point that three separate episodes of psychiatric codes were called on him. He was found to be screaming, tremulous, rigid, hyper-religious and having visual hallucinations. His acute psychosis caused concern for a toxidrome and poison control was called. After discussing the case with poison control, his baclofen was restarted. Within a few hours, he returned to his normal self.
DISCUSSION: Baclofen has a short half-life of 3-4 hours. Symptoms of withdrawal can develop within 12-72 hours of cessation. Patients can present with symptoms of tachycardia, autonomic instability, seizures, hyperthermia and spasticity. Spasticity can lead to rhabdomyolysis. If baclofen is not restarted, patients can develop frank psychosis or even die from the withdrawal. The exact cause is unknown, but thought to be due to baclofen causing continuous inhibition of monoamine neurotransmitters. The neurotransmitter receptors become highly sensitive to monoamines and once baclofen is stopped and norepinephrine and dopamine reach the receptors, it leads to autonomic arousal and delirium. Readministration of baclofen leads to rapid resolution of delirium. When baclofen is prescribed, patients should be advised to never stop it abruptly. If baclofen needs to be discontinued, it should be tapered over 1-2 weeks to prevent withdrawal. Finally, it is important to remember to continue baclofen when patients are hospitalized, even for those with altered mental status.
MEDIASTINAL CLUTTER CAN MAKE YOUR HEART FLUTTER! Vinod Khatri; Krishna Khatri; Harvey Friedman. St. Francis Hospital, Evanston, IL. (Control ID #1339066)
LEARNING OBJECTIVE 1: Large mediastinal masses can cause pressure symptoms on the heart.
LEARNING OBJECTIVE 2: This elevated mediastinal pressure may lead to atrial flutter/fibrillation.
CASE: CASE: 1 73 yrs old gentle man with past medical history significant for indolent lymphoma presented to hospital with history of progressive dysphagia, exertional dyspnea. He denied any constitutional symptoms. On examinations his vital signs were WNL. His neck exam revealed a mobile, rubbery about 2.5 cm lymph node in ant cervical group on left side. Chest was clear to auscultation, Cardiac exam revealed regular rate &rhythm, normal S1S2, with no murmurs. On evaluation his CT scan of chest showed extensive bulky mediastinal lymphadenopathy which was causing mass effect on right side of heart. He underwent mediastinoscopy and lymph node biopsy, which was consistent with marginal zone lymphoma. While in hospital, patient developed an episode of atrial flutter with 2:1 block which converted to sinus rhythm after amiodarone infusion.
Pt had another episode of atrial fibrillation with rapid ventricular response during the course of hospitalization which was treated successfully with amiodarone again. CASE: 2 68 yrs old female with past medical history of HTN and dyslipidemia was admitted with shortness of breath. She denied any chest pain, fever or cough. On examination her vital signs revealed T-97.2, P-130/min, BP-114/70, and RR-20/min. Chest exam revealed focal rales in the right infraclavicular &mammary regions. On cardiac exam she had an irregularly irregular rhythm and had no murmur. On evaluation her routine labs were WNL. EKG revealed Afib with RVR, so patient was anticoagulated and started on Multaq and digoxin. On radiological evaluation patients chest CT showed a large (7.8 x 5.8 x 10 cm) anterior mediastinal mass located in the right hemithorax abutting major vascular structures. A CT guided biopsy of the mass was consistent with thymoma. About a month later when patient underwent resection of tumor, the mass was noted to encircle the innominate vein extending up to its junction with SVC. As

a result of extensive adhesions the innominate vein had to be resected along with tumor. Final biopsy confirmed the diagnosis of widely invasive thymoma.
DISCUSSION: Both of above cases illustrate that large mediastinal mass lesions can cause pressure symptoms on heart, and may present with atrial fibrillation/flutter. On review of literature there are few case reports of mediastinal tumors causing atrial arrhythmias, many of which were a result of chemotherapy. Lymphomas and thymomas have also been reported to invade the pericardium and cause cardiac tamponade as a result of mass effect, but till date no case has been reported to cause atrial flutter/ fibrillation as a result of mass effect on right side of heart or invasion of innominate vein or SVC.
METHADONE MAINTENANCE THERAPY- A POTENTIAL TWISTER! Krishna Khatri; Vinod Khatri; Muhammad Shahreyar; Harvey Friedman. St. Francis Hospital, Evanston, IL. (Control ID #1340205)
LEARNING OBJECTIVE 1: Methadone maintenance therapy for opioid dependence has been associated with prolonged QT interval in EKG in several patients.
LEARNING OBJECTIVE 2: These patient are also predisposed to torsade de pointes.
CASE: 26 yr old female was admitted with 2 episodes of syncope on day of admission. Each episode lasted for less than a minute. There was no history of shaking, tongue bite or urinary incontinence. She reported abusing cocaine and clonidine few hours prior to presentation. She denied having chest pain, shortness of breath or palpitations. Her past medical history was significant for anxiety and heroine abuse for which she was on methadone maintenance program for past three years. On admission she was alert, awake and oriented X 3; vital signs were stable and had no evidence of orthostatic hypotension. Cardiovascular revealed no JVD, normal S1, S2 and no murmurs, neurologic exam was essentially non focal. On evaluation her routine labs including were found to be normal. Her urine toxicology screen was positive for cocaine and benzodiazepines. Her EKG revealed sinus bradycardia with prolonged QT interval (626 ms) which was at 454 ms a year back. During hospital course had multiple ventricular arrhythmias including premature ventricular contractions, bigeminy, runs of ventricular tachycardia and multiple episodes of torsade de pointes. Most of these were self limited and one methadone was tapered and stopped patients QT interval reduced back to 444 ms and patient had no more ventricular arrhythmias.
DISCUSSION: Methadone is associated with prolongation of the QT interval (QT) as well as torsade de pointes. It has recently been suggested that methadone promoted sudden cardiac death based on the absence of structural heart disease in an autopsy cohort. Abnormalities in voltage-gated potassium channels have been shown to lead to prolonged action potentials that are expressed as long QT intervals, and methadone has been found to interact with the voltage-gated potassium channels of the myocardium. Because not every patient experiences QT interval prolongation with methadone, recent research has elucidated risk factors that predispose patients to this adverse effect, including female sex, hypokalemia, high-dose methadone, drug interactions, underlying cardiac conditions, unrecognized congenital long QT interval syndrome, and predisposing DNA polymorphisms. A baseline electrocardiogram (ECG), personal and family history of syncope, and a complete

medication history should be obtained before a patient begins treatment with methadone. Buprenorphine, a partial micro-opiate-receptor agonist and a kappa-opiate-receptor antagonist does not cause QTP or torsade de pointes. It is a useful and effective alternative to methadone in a select group of patients, including those with documented ventricular arrhythmias on methadone. Pacemakers or defibrillators should be reserved for patients who have failed buprenorphine or a reduced methadone dose.
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MICROANGIOPATHIC HEMOLYTIC ANEMIA IN A PATIENT WITH HEMOGLOBIN C TRAIT: TTP OR B12 DEFICIENCY - THAT
IS THE QUESTION? Tanmay S. Panchabhai1; Alireza Abdolmohammadi2; Elizabeth C. Riley2; Charlene K. Mitchell1. 1University of Louisville School of Medicine, Louisville, KY; 2University of Louisville School of Medicine, Louisville, KY. (Control ID #1321283)
LEARNING OBJECTIVE 1: Discuss the similarities and differences of the microangiopathic hemolytic anemia picture in TTP and that due to vitamin B12 deficiency
LEARNING OBJECTIVE 2: Recognize the role of hyperhomocysteinemia in the causation of microangiopathic hemolytic anemia from vitamin B12 deficiency
CASE: A 42 year-old AAM with type II diabetes mellitus presented with pre-syncope and diabetic ketoacidosis. History revealed a relatively normal dietary pattern, polyuria, and a daughter with sickle cell disease. Initial laboratory data showed glucose of 466 mg/dl; anion gap of 19; urine ketones (+); and toxicology screen (-). He had pancytopenia with Hgb8.1 g/dl (baseline 14.5) with an MCV of 107.1 fl, WBC 4,100 /mm3, and platelets 39,000 /mm3. The peripheral smear had macrocytes, schistocytes (1+), occasional teardrop cells, and hypersegmented neutrophils. Serum ferritin was 102 ng/ml with iron of 174 mcg/dl, saturation of 87.4%, and TIBC of 199 mcg/dl. The workup for infectious causes was negative. DKA resolved with an insulin drip and he was transitioned to home insulin. An evaluation for hemolytic processes revealed: serum LDH 5368 U/L, haptoglobin <5.83 mg/dl with normal fibrin-split products and fibrinogen; hemoglobin electrophoresis showed

50.8% HbA and 49.2% HbC diagnostic for Hemoglobin C trait. As TTP was an initial concern with its high associated mortality, plasmapheresis and parenteral steroid therapy was initiated, but there was no improvement in blood counts. Subsequently, a profound Vitamin B12 deficiency (B12<159 pg/ml) was identified with markedly elevated homocysteine (88.3 Umol/dl), and normal serum folate(17.9 pg/ml) levels. Parenteral B12 and oral folate were initiated. MTFR (methylene tetrahydrofolate reductase) mutation analyses to evaluate hyperhomocysteinemia and an ADAMTS 13 mutation analysis for TTP were both negative. Marked clinical response was observed with B12 replacement (platelets 39,000 to 111,000, MCV 107.1 to 97.6, LDH 5368 to 642, homocysteine 88.3 to 14.5). Plasmapheresis was discontinued prior to normalization of platelets because of anaphylactoid reactions. An intrinsic factor antibody was positive and the patient was discharged with B12 and folate supplementation.
DISCUSSION: Our patients megaloblastic anemia, high iron saturation, and absent reticulocytosis could not be explained by TTP. However, hemolytic anemia complicates severe B12 deficiency secondary to ineffective erythropoiesis in the marrow. Recent reports have fueled interest in hyperhomocysteinemia in B12 deficiency causing a pseudo-thrombotic angiopathy by causing microvascular thrombi. Homocysteine, a reactive thiol, is metalolized by remethylation (requiring MFFR, B12 and
folate). B12 deficiency when coupled with MTFR mutations have been shown to produce marked elevations in homocysteine causing micro-angiopathic hemolysis in addition to marrow hemolysis. Our patient tested negative for MTFR mutations but the presence of HbC trait may have lowered the threshold for peripheral microangiopathic hemolysis triggered by the hyperhomocysteinemia. Normalization of laboratory parameters in our patient with B12 replacement supports this point.
MILKY MALIGNANCY Kate Hust. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339127)
LEARNING OBJECTIVE 1: 1. Recognize pleural effusion and its causes. 2. Understand Lights Criteria for exudative effusions. 3. Identify chylous effusion and its causes. 4. Understand appropriate treatment for chylothorax.
CASE: A 44 year-old woman with stage IV lung adenocarcinoma was admitted for dyspnea secondary to malignant ascites and malignant pleural effusion. Her breath sounds were decreased at both bases and throughout the right lung fields, where there was also dullness to percussion. An initial chest x-ray confirmed extensive right-sided and small left-sided pleural effusions. Symptoms initially improved after therapeutic removal of straw-colored fluid from the peritoneal and right-sided pleural cavities, but patient subsequently developed respiratory distress. After right-sided pleurodesis for recurrent effusion, dyspnea again improved but never completely resolved. Concurrently, chest x-rays showed worsening left-sided effusion, resulting in near-complete opacification of left lung field. Two liters of milky fluid were removed from left pleural cavity, and fluid analysis revealed LDH of 220 units/L and triglycerides of 1392 mg/dL. DISCUSSION: Pleural effusions often contribute to dyspnea, a complaint commonly faced by general internists. These occur when the absorption of pleural fluid is overwhelmed by the formation of fluid. It may be a disorder

of excess pleural fluid creation or of decreased absorption. Pleural effusions may be a consequence of both systemic and local processes. Transudative effusions result from systemic diseases such as heart failure, cirrhosis, and nephrotic syndrome. Exudative effusions are caused by local processes including malignancy, infection, and collagen-vascular diseases. Less commonly gastrointestinal disease, medications, sarcoidosis, and chylothorax may lead to exudative effusion. To find the etiology of pleural effusion, it must first be classified as transudate or exudate. Lights Criteria indicate an effusion is exudative if one of the following are met: (1) ratio of pleural fluid protein to serum protein greater than 0.5, (2) ratio of pleural fluid LDH to serum LDH greater

than 0.6, or (3) pleural fluid LDH greater than two-thirds the upper limit of normal for serum LDH. When an exudate is identified, further studies to elucidate etiology should include glucose and amylase levels, cell count and differential, microbiology, and cytology. In the case of milky fluid, chylous effusion should be suspected and fluid analyzed for triglycerides; diagnosis is made with triglycerides greater than 110 mg/dL. The first step in planning treatment of chylothorax is identifying the underlying cause. Chylothorax is often secondary to trauma when damage to the thoracic duct results in leakage of chyle into the pleural space. Non-traumatic chylothorax results from obstruction of the thoracic duct. Lymphoma is the primary non-traumatic cause of chylothorax though malignancy, mediastinal radiation, and congenital abnormalities may also contribute. Most important in treating chylothorax is treating its cause. Decompression with placement of chest tube alleviates symptoms but should not be used as long-term therapy because recurring chylous effusions can lead to immunologic incompetence and malnutrition. A low fat diet and bowel-rest with parenteral nutrition may also be used. Pleural effusions are commonly encountered by the hospitalist and understanding their large differential diagnosis is important in guiding the most efficient treatment.

MOTOR COMPLICATIONS OF HERPES ZOSTER Tania Calzada; Damian Casadesus; Manuel Vergara; Sarah Sordo. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1327746)

LEARNING OBJECTIVE 1: Physicians must be aware that segmental motor paresis is a debilitating complication of herpes zoster even in immunocompetent patients.

LEARNING OBJECTIVE 2: A high level of suspicion should be maintained because prompt diagnosis and treatment are critical to minimize morbidity.

CASE: A 63 year-old male presented to the outpatient office complaining of a vesicular rash in the left groin. He had a history of diabetes mellitus, hyperlipidemia, hypertension and a resected squamous cell carcinoma of the skin. The rash was followed by severe low back pain and few days later by the extension of the rash on the left thigh and leg associated with weakness of that extremity. The pain was described as sharp and burning with hypersensitivity to touch in the back, thigh, groin, leg and gluteal regions. At physical examination, there was an extensive vesicular rash to the left groin, inner part of the proximal thigh, and the antero-medial part of the leg. Neurological examination showed weakness of the left lower extremity: hip flexion 2/5, hip adduction 3/5, knee extension 0/5, with other muscle groups spared. All the deep tendon reflexes were absent in the left leg. There was hypersensitivity to touch in the anterior thigh, and decreased pinprick and temperature to the inner aspect of the thigh and left foot was noted. He needed support to ambulate and limped on the left side. He received treatment with acyclovir, pregabalin and physical rehabilitation, but the weakness has only improved slightly.

DISCUSSION: Segmental motor paresis develops in approximately 3 % of patients with herpes zoster. Peripheral motor weakness is felt to result from spread of Varicella-Zoster virus from the dorsal root to the anterior horn. The onset of motor paresis is coincident with the development of pain and cutaneous eruption in a dermatomal distribution. Varicella-Zoster becomes latent in the cranial nerve and dorsal root ganglia and frequently reactivates decades later to produce a skin rash with the dermatome distribution of the affected nerve. Segmental motor paresis is a rare complication resulting in muscle atrophy; however, more than 75% of patients experience gradual recovery of motor strength with early diagnosis and treatment.

MULTIPLE MYELOMA, BUT NO MONOCLONAL PROTEIN Erin Jou; Radha Raghupathy. Montefiore Medical Center, Bronx, NY. (Control ID #1334857)

LEARNING OBJECTIVE 1: Diagnose multiple myeloma in the absence of monoclonal protein in the serum and urine.

LEARNING OBJECTIVE 2: Recognize the characteristics of nonsecre-tory myeloma.

CASE: A healthy 57 year old male presented with a four month history of right lateral chest wall pain that had worsened over one week. The pain was exacerbated by movement and was minimally responsive to ibuprofen. He also noted a 10 pound weight loss over 6 months but denied fevers or night sweats. Exam was significant for diffuse fullness with tenderness in the right lateral chest wall over the 4th to 6th ribs. Laboratory data on

presentation was remarkable for hemoglobin of 10.9 gm/dL and creatinine of 1.6 mg/dL. Calcium was 10.4 mg/dL, total protein 7.3 g/dL and albumin5.1 g/dL. Chest radiography showed a large right extrapleural chest wall mass with destruction of the underlying 4th rib and multiple bilateral rib fractures. Skeletal survey revealed multiple lytic lesions throughout all visualized bony structures. Monoclonal protein (M-protein) was not detected in the serum or urine by electrophoresis or immunofixation. Serum free light chains showed normal kappa at 5.9 mg/L and slightly decreased lambda at 3.5 mg/L. Quantitative IgG, IgA and IgM were significantly decreased at 413, 16 and 8 mg/dL respectively. Bone marrow biopsy was performed and showed a hypercellular marrow diffusely replaced by sheets of atypical plasma cells. In the absence of M-protein or clonal light chains and the presence of clonal marrow plasmacytosis, a diagnosis of nonsecretory myeloma was made.
DISCUSSION: Multiple myeloma (MM) is often discovered by internists through routine bloodwork. It has an incidence of 4-5 per 100,000 in the US and constitutes 1% of all cancers. MM is characterized by a proliferation of malignant plasma cells producing an overabundance of monoclonal immunoglobulin. The detection of this M-protein in the serum or urine is a major criterion for diagnosis. Patients present with signs and symptoms related to infiltration of plasma cells into the bone or other organs, or to kidney damage from excess light chains; common clinical features include anemia, bone pain, renal failure, and hypercalcemia. Nonsecretory myeloma is a rare variant of MM and accounts for 1-5% of all myelomas. It is characterized by the absence of a detectable M-protein or clonal excess of free light chains in the serum and urine. Defective immunoglobulin synthesis, increased intracellular proteolysis of synthesized immunoglobulins, defective immunoglobulin efflux mechanisms or rapid extracellular degradation of secreted paraproteins may contribute to the nonsecretory state. Clinical manifestations are similar to classic MM but renal failure is less common since there are no detectable light chains. Hypogammaglobulinemia is frequently seen due to failure of malignant plasma cells to synthesize normal immunoglobulins. Diagnosis is often delayed due to the absence of serum markers. Induction therapy and response rates for nonsecretory myeloma are similar to classic MM and consolidation with high dose melphalan and autologous stem cell transplant is offered to eligible patients. Assessment of response to therapy remains a challenge and reduction in marrow plasmacytosis should be demonstrated to confirm a symptomatic response. Our case is a rare presentation of nonsecretory myeloma with a chest wall plasmacytoma and mild renal failure, and emphasizes that the diagnosis of myeloma should not be overlooked in the absence of M-protein.

MY CALCIUM IS DRIVING ME CRAZY! TREATMENT OF HYPERCALCEMIC ENCEPHALOPATHY IN A PATIENT WITH DECOMPENSATED HEART FAILURE Raquel Villavicencio. Indiana University Medical Group, Indianapolis, IN. (Control ID #1311955)

LEARNING OBJECTIVE 1: Managing hypercalcemic crisis in a patient with decompensated cardiomyopathy, fluid restriction, and vitamin D deficiency in todays dynamic healthcare setting.

CASE: Ms. X is a 26 year-old black woman with history of neuroblastoma status post irradiation and doxorubicin, who presented to the ED in heart failure. Echocardiogram revealed left ventricular ejection fraction of 22%. Aggressive diuresis was initiated with IV furosemide leading to improved

dyspnea and tachycardia. However, it was not long before her new, euvolemic state unveiled evidence of hypercalcemia, peaking at 12.9 mg/dL (8.5-10.5). Other lab values were as follows (normal reference ranges in parentheses): parathyroid hormone (PTH) 183 pg/mL (14-72); 25-OH vitamin D 7 ng/mL (30-80); magnesium 0.9 mg/dL (1.3-2.7); phosphorus 2.9 mg/dL (2.4-5.1); and Cr 0.9 mg/dL (0.5-1.1). As her calcium rose, her mental status plummeted causing increased somnolence and a decline in speech and cognition. Treatment of Ms. Xs hypercalcemia in the face of heart failure, fluid restriction, and low vitamin D posed a true management dilemma. DISCUSSION: Labs were consistent with primary hyperparathyroidism as PTH was inappropriately elevated given her hypercalcemia. This was later confirmed by neck ultrasound showing a 2.1 cm hypoechoic structure posterior to the right thyroid consistent with parathyroid adenoma. Definitive treatment would be

parathyroidectomy, however controlling her serum calcium in the short-term was of optimal concern. First line treatment of hypercalcemic crisis consists of administration of normal saline, with consideration of addition of furosemide only after any volume deficit has been corrected. Given her recently diagnosed decompensated cardiomyopathy, addition of fluids was contraindicated and any further furosemide would push her into a negative fluid balance and actually increase serum calcium instead of decreasing it. Bisphosphonates decrease calcium levels by inhibiting osteoclast activity and reducing bone resorption. This would be the next step in treatment; however, given the degree of vitamin D deficiency, there was concern for precipitation of hypocalcemia on a bisphosphonate. Nonetheless, the benefit outweighed the risk and the patient received one dose of pamidronate 30 mg IV with subsequent decline of calcium to a level of 10.4 mg/dL coinciding with an improvement in cognition. She was also started on gentle vitamin D repletion with 2,000 units of cholecalciferol per day and scheduled for weekly calcium monitoring as an outpatient to detect potential hypocalcemia. In summary, severely hypercalcemic patients with low cardiac output and vitamin D deficiency should be considered for bisphosphonate therapy and followed closely thereafter for possible hypocalcemia. This type of management and follow-up requires good communication amongst physicians. As our health systems grow, so do the potential for errors. This complicated patient was cared for by multiple providers which could have resulted in confusion, delays in care, and catastrophic outcomes. However, through the collaboration of her inpatient team, consultants, surgeon, and primary care physician she was treated successfully and had a smooth transition to the outpatient setting.

MY TEETH WON'T LET ME EAT Ravi J. Patel; James M. Sosman. University of Wisconsin Hospitals and Clinics, Madison, WI. (Control ID #1334808)

LEARNING OBJECTIVE 1: To recognize the differential diagnosis for a patient presenting with trismus.

LEARNING OBJECTIVE 2: To distinguish disease manifestations and review management of a patient with Tetanus.

CASE: A 78 year-old female presented to the ED by EMS after being found on the floor of her home by neighbors. She was found unresponsive with possible seizure-like activity. An oral airway was initially placed, but removed after improvement in her mental status. The patient lived in unsanitary conditions with a dirt floor and each room filled with hoarded items. In the ED, the patient complained my teeth won't let me eat. She was hungry but stopped eating due to fear of choking. She also complained of weakness and sacral pain due to a fall. Her VS: BP 138/48, HR 84, RR 22, T 37.8 C. Her exam revealed episodes of interrupted speech due to clenching her jaw which lasted only a few seconds. She had no other neurologic deficits. She had no visible wounds, however her feet and toe-nails were caked with dirt. Her labs revealed WBC 12.0 K/uL, CK 2369 (N 0-175), troponin 0.29 (N 0-0.05), Ca9.1, BUN 60, Cr 1.6. EKG showed anterolateral T wave flattening and the CXR had RML infiltrates. Initial therapy included a heparin drip for possible NSTEMI and IV Ceftriaxone for aspiration pneumonia. The differential diagnosis included Tetanus, so she was begun on IV Metronidazole and Tetanus IG which required several hours to obtain sufficient doses from other health care facilities. Subsequent tests revealed a normal TTE and EEG negative for seizure-like activity. The patient's symptoms quickly progressed with frequent episodes of trismus along with apnea and hypoxemia. She also developed spastic contractions of her upper extremities, muscle rigidity, and 1st and 2nd degree AV block with 5 second pauses. The patient was given muscle relaxants, and 3000 units of IM Tetanus IG. She refused intubation or CPR. She developed progressive apnea and bradycardia despite atropine and died within 48 hours. Her blood cultures revealed no growth. DISCUSSION: Tetanus is a disorder caused by the toxin producing anaerobe Clostridium tetani. Now rare in the developed world, the CDC estimates an annual incidence of 1 per 10 million people in the US, and 2.3 per 10 million in those ages>65. The bacterium is ubiquitous in soil and remains a threat to all unvaccinated people. Infection occurs through penetrating injury with a foreign body, or within devitalized tissue. In 10% of cases, no cause is identified. C. tetani spores produce tetanospasmin that irreversibly binds to receptors of anterior horn cells. This results in autonomic

instability, increased muscle tone, and severe spasms. Tetanus is a clinical diagnosis with 50% of cases presenting with trismus, a forceful spasm of the masseter muscle. Differential diagnosis includes Strychnine poisoning, drug-induced dystonias, neuroleptic malignant syndrome, and Stiff-person Syndrome. Treatment includes wound care and antibiotics to halt toxin production, neutralizing unbound toxin with Tetanus IG, sedatives to control spasms, and intubation with paralysis for weeks. Though the majority of patients survive with optimal management, mortality is as high as 50% in those who are treated conservatively. Unfortunately, our patient had not received health care or vaccinations for over two decades. This case underscores the importance of continued tetanus vaccination even during a time of advanced medical care.

MY EYES ARE DROOPING! Waleed T. Kayani1; Salman J. Bandeali1; Anam Khan2; Ali Hashmi1; Radha M. Rao1; Himabindu Kadiyala1.
1Baylor College of Medicine, Houston, TX; 2Aga Khan University, Karachi, Pakistan. (Control ID #1339849)

LEARNING OBJECTIVE 1: Recognize the most common cause of acute Horners SyndromeLEARNING OBJECTIVE 2: Review internal carotid artery (ICA) dissectionCASE: A 53 year old Caucasian male with history of aortic valve replacement, hypertension, DM and hyperlipidemia who presented with complaints of drooping of the right eyelid for 2 days. He also noted some redness, tearing, and a deep pressure behind the right eye. Patient denied any history of trauma or falls. On examination, significant findings included conjunctival injection, miotic right pupil, 1 mm anisocoria in light and 2 mm anisocoria in dark. Mild ptosis of the right eye was noted which resolved after instillation of phenylephrine eye drops. Extraocular movements were intact bilaterally and no anhydrosis was observed. There were no carotid bruits appreciated. An emergent CT Angiogram was ordered which revealed dissection of right ICA as it entered the skull base. The patient was started on unfractionated heparin infusion. Any invasive intervention was deferred by neuroradiology given the location of his dissection and risk of extension. He continued to improve as an inpatient and was discharged 2 days later. His only complaint on discharge was mild eye pressure, and only exam finding, residual conjunctival injection. He was advised to avoid any heavy lifting and observe strict control of hypertension and diabetes. He was bridged to warfarin. His eye symptoms gradually resolved and the patient continues to do well. DISCUSSION: Horners syndrome, also called oculosympathetic paresis is characterized by miosis, anhydrosis and ptosis. Causes range from benign to serious, requiring a methodological approach to diagnostic evaluation. Acute Horner's syndrome with neck or facial pain should be presumed to be caused by carotid dissection until proven otherwise. Around 50 percent of patients with internal carotid artery dissections present with an isolated painful partial Horner's syndrome. Partial Horner syndrome is used because anhidrosis is absent. The sympathetic fibers innervating the facial sweat glands are anatomically located on the external rather than internal carotid artery; thus, anhidrosis is not a finding in the setting of internal carotid dissection. Patients often have an antecedent history of neck trauma, but this can be subtle, and a number of carotid dissections are spontaneous events. Patients with acute carotid dissection are at a high risk for cerebral infarction, which usually occurs within days or few weeks after onset of the Horner's syndrome. An axial MRI of the neck with T1-weighted, fat-suppressed sequences and magnetic resonance

angiography (MRA) or CT scan with CT angiogram will detect most internal carotid artery dissections. However, conventional angiography remains the gold standard. Patients with ICA dissection, who have neurologic symptoms, should be treated with anticoagulation, using unfractionated heparin followed by warfarin for six months. At that time, as long as symptoms are not recurrent and the arterial lesion is thrombosed or healed, warfarin can be stopped and long-term antiplatelet therapy initiated. Transcranial Doppler, duplex Doppler, CTangiography, and MR angiography can help decide the status of the arterial system prior to discontinuing therapy.

NAIL PATELLA SYNDROME (NPS): AN INTERNISTS CHALLENGE Bhavana Siddegowda Bangalore; Parul Sud. Mclaren Regional Medical Center, Flint, TN. (Control ID #1339960)
LEARNING OBJECTIVE 1: Recognize the diagnostic features of NPS, a rare congenital syndrome.
LEARNING OBJECTIVE 2: Recognize the co-morbidities associated with NPS.
CASE: A 46 year old Caucasian female with a diagnosis of NPS presented with chronic generalized pain and intermittent numbness of the left arm. Past medical history included club feet at birth, multiple corrective joint surgeries and irritable bowel syndrome (IBS). Family history was significant for NPS in father and sons. She denied smoking or drinking. Patient was thinly built with a high forehead and fine hair. Her gait and posture were normal. She had bilateral dystrophic thumb nails, triangular lunules in finger nails, absence of dorsal skin crease on index fingers, hypoplastic patellae, iliac horns, club feet and orthopedic surgical scars. Elbows had limited extension. She exhibited 18/18 painful trigger points. Pertinent lab results included albumin to creatinine ratio of 21, osteoporosis on bone mineral density study and left ulnar neuropathy on electromyography/nerve conduction studies. Pain persisted despite multiple medications including narcotics, muscle relaxants, steroid injections at trigger points, physical therapy and counseling. Extreme emotional stress resulted from her conviction that she would be wheelchair bound. DISCUSSION: NPS consists of a clinical tetrad of hypoplastic or absent patellae, dystrophic nails, dysplastic radial heads, and iliac horns. Prevalence is estimated at one in 50,000. It is a rare autosomal dominant disorder with mutations of LMX1B gene of the distal end of the long arm of chromosome 9. This gene is necessary for dorso-ventral patterning of limbs. This explains the pattern of decreasing severity of dystrophic changes in nails marching from lateral to medial. This is purely a clinical diagnosis. Nail features are present in 98% of patients, primarily a symmetric pattern of dystrophic or absent nails. Triangular lunules in finger nails are considered diagnostic. Loss of dorsal distal digital crease is a sensitive (96%) sign. About 75% of patients have absent or hypoplastic patellae. Dislocation or subluxation of knee joints is common. Iliac horns, bilateral conical bony processes at the anterior-superior iliac crest most commonly noted on x-ray, is sine qua non of NPS. Fibromyalgia (FM) and decreased bone density are reported co-morbidities. Open angle glaucoma, IBS, entrapment neuropathies and depression may also coexist. Renal involvement occurs in up to 25% of patients, is sporadic and may result in renal failure, which is associated with a poor prognosis. Renal transplant, however, carries a favorable outcome. Management recommendations include annual screening for proteinuria, hypertension, and monitoring for glaucoma. Genetic counseling should be offered to all patients. The management challenge in our patient was pain control. Patients with NPS experience joint and ligamentous pains, however, our patients pattern of pain met clinical criteria for FM. Anchoring heuristics of the patient and lack of physician experience led to an overemphasis on NPS, thus delaying identification and treatment of FM. Our patient eventually accepted her dual diagnosis of NPS and FM, resulting in improved functionality and pain control. Management barriers in NPS result from its rarity, compounded by physicians lack of knowledge and experience. Patients and providers should be aware of anchoring heuristics which may cloud clinical judgment especially when dealing with rare disorders.
NECROTIZING PULMONARY SARCOIDOSIS MASQUERADING AS SUPERFICIAL THROMBOPHLEBITIS John Matulis. Dartmouth-Hitchcock Medical Center, Lebanon, NH. (Control ID #1334933)
LEARNING OBJECTIVE 1: Recognize and manage superficial migratory thrombophlebitisLEARNING OBJECTIVE 2: Identify a rare extra-pulmonary manifestation of sarcoidosisCASE: Sarcoidosis is a multi-system inflammatory disease of unknown etiology which predominantly affects the lungs and intra-thoracic lymph nodes; its hallmark is the presence of non-caseating granulomas in affected tissue. Sarcoidosis has been documented to initially present with a variety of symptoms and is often a challenging diagnosis. Here I document an unusual presentation of pulmonary sarcoidosis. A 72 y/o caucasian female presented with non painful, slightly pruritic raised lesions on her bilateral lower extremities. She was referred to dermatology and a biopsy was taken which showed superficial venous thrombosis consistent with a migratory thrombophlebitis. Labarotory testing at that time revealed normal blood counts, chemistries, ANA, thrombosis panel, ENA,

ANCAS, SPEP, ACE level, CA 19-9 and CA-125. Her CRP was 24.1 and her ESR was 32. A CT of the chest and abdomen revealed circumferential thickening of the ascending colon, scattered enlarged mesenteric lymph nodes and non-specific prominent right paratracheal lymph nodes. A mammogram and colonoscopy were unrevealing and a BAL was non-diagnostic. Endobronchial ultrasound guided mediastinal lymph node biopsy revealed dense, lymphoid tissue without evidence of malignancy or connective tissue disease. The patients symptoms remained stable and further workup was deferred. A few months later repeat CT scans showed no progression of the lymphadenopathy, and she began treatment for her thrombophlebitis with ibuprofen, colchicine and plaquenil with partial response. The patient remained symptomatically well for an additional 6 months before presenting with several weeks of progressing dyspnea; she was found to have an oxygen saturation of 85% and new bi-basilar crackles. Repeat Ct scan showed extensive pulmonary nodules throughout her lung fields with her pre-tracheal adenopathy remaining stable. Open lung biopsy and VATs procedure was performed and tissue histology was diagnostic of necrotizing sarcoidosis. She was started on high dose steroids and seen in follow-up with improvement, but not resolution of her symptoms. Her superficial thrombophlebitis is largely resolved since initiation of steroid therapy.
DISCUSSION: This case illustrates the presentation and workup of superficial migratory thrombophlebitis as well as an unusual presentation of occult pulmonary sarcoidosis. The key teaching point in this case is the workup of superficial migratory thrombophlebitis. Recent reviews have shown that isolated, superficial thrombophlebitis is much less commonly a presentation of occult malignancy than previous thought (between 2 and 5%). It can generally be managed in a more conservative manner and will most often resolve without further adverse sequelae. In this case, Sarcoidosis remained on the differential diagnosis throughout her evaluation, but the unusual presentation made her case perplexing. It is unclear whether sampling other sites of inflammation or lyphadenopathy would have made for a more timely diagnosis, but awareness of unusual presentations of connective tissue diseases can certainly be helpful in determining sequence of diagnostic testing. In this case, Rheumatological laboratory values were also difficult to interpret, illustrating their limited utility in making a diagnosis.
NEUROINVASIVE WEST NILE VIRUS: RAPIDLY INCREASING IN PREVALENCE BUT RARELY PART OF THE DIFFERENTIAL Daniel Gutteridge; Bhavana Siddegowda Bangalore. McLaren Regional Medical Center, Flint, MI. (Control ID #1333634)
LEARNING OBJECTIVE 1: Recognize the increasing prevalence of neuroinvasive West Nile virus.
LEARNING OBJECTIVE 2: Diagnostic evaluation in the suspicion of neuroinvasive West Nile virus.
CASE: A 58 year old Caucasian female with no significant past medical history was found lying in her bathroom by EMS and was brought to the emergency room. In the ER patient was alert, oriented and cachectic. Patient apparently had flu-like symptoms three days before presentation and was suspected to have been unresponsive for more than 14 hours. There was multi-organ failure at presentation with rhabdomyolysis (CPK: 14000), acute kidney failure, leukocytosis, elevated troponins and elevated liver enzymes. She was intubated later for respiratory distress but chest x-ray

was negative for infiltrates. Initially treatment was directed at septic inflammatory response syndrome. Post-extubation on third day patient was found to have profound proximal and distal muscle weakness, greater in the lower limbs, areflexia and mildly reduced vibratory sense in the lower limbs. Computed tomography of the head and MRI of the brain and spinal cord demonstrated no acute findings. Lumbar puncture was positive for IgG and IgM antibodies for West Nile virus. Patient progressively improved on supportive treatment and was transferred to a long-term inpatient rehabilitation unit.
DISCUSSION: In the past decade a new infectious disease with serious consequences has rapidly spread across the United States. West Nile virus (WNV) started raising some red flags in 2000 when 19 cases of neuroinvasive disease were reported in New York. Over 11,000 confirmed cases have been identified in 48

states since then. Neuroinvasive WNV cases represent 41% of all documented WNV disease and both are believed to be strongly under-reported. The challenge has been the non-specific presentation with symptoms ranging from flu-like symptoms to flaccid paralysis and altered levels of consciousness. Diagnosis is suspected based upon thorough history and physical exam, then confirmed by finding IgM antibody in cerebrospinal fluid and radiologic findings of signal intensity abnormalities on magnetic resonance imaging (MRI). Initial presentation of a patient in this manner forces a physician to explore a broad differential diagnosis. Difficulty lies in the fact that it takes time to obtain immunologic testing results for a growing, but still uncommon, disease. The lack of typical radiologic findings can further delay treatment. When working up a patient with new onset severe neurologic deficits and no clear diagnosis, WNV should be in the differential diagnosis due to its epidemic prevalence over the past 10 years.

NEUROSARCOIDOSIS: MORE THAN MEETS THE EYE Lauren Chan; Priscilla Yee. CPMC, San Francisco, CA. (Control ID #1340126)

LEARNING OBJECTIVE 1: Cranial neuropathy is the most common presentation of neurosarcoidosis given that it is primarily a clinical and pathologic diagnosis.

LEARNING OBJECTIVE 2: MRI plays a supportive role in the diagnosis of neurosarcoidosis and should be used as an adjunctive diagnostic technique. It may be helpful in following regression of disease with steroid treatment.

CASE: 41 year old African American male presents with one month of headache and several weeks of diplopia, L ptosis, L periorbital/maxillary stinging pain, diaphoresis of the forehead, with worsening of these symptoms one week prior to presentation. He also noted an unintentional twenty pound weight loss over 2 months. On exam the patient had stable vitals, normal fundoscopic exam without lymphadenopathy or papilledema. His exam was notable for L ptosis, inability to adduct the L eye medially or gaze upward, dilated L pupil, paresthesia and decreased sensation over L forehead and cheek. Basic labs, Quantiferon, induced sputum cultures for AFB and fungal, HIV, RPR, myasthenia gravis antibodies were all negative. ACE was elevated at 96 and LP revealed a lymphocytic predominance with elevated protein and no malignant cells or organisms. CTchest/abdomen/pelvis showed mediastinal and pretracheal lymphadenopathy and bilateral upper lobe interstitial infiltrates. MRI brain showed a mass in L Meckels cave with extension to the L cavernous sinus. Nasal endoscopy ruled out infection of sinuses. Brain biopsy was deferred in favor of transbronchial lung biopsy which demonstrated non-necrotizing micro-granulomas highly suggestive of sarcoidosis. The patient was started on Decadron with resolution of symptoms within a couple days of treatment.

DISCUSSION: Neurosarcoidosis is primarily a clinical and pathologic diagnosis and appears in about 5% of patients with sarcoidosis. This diagnosis relies heavily upon the clinical findings especially when brain biopsy presents significant risk. Clinicians should recognize common presentations of neurosarcoidosis such as cranial neuropathies which occur in up to 50% of patients with neurosarcoidosis. Facial nerve palsy is the most common. Other presentations include encephalopathy, peripheral neuropathy, meningitis, seizure, spinal cord dysfunction, and myopathy. In this case, the patient presented with findings consistent with CN III and V1/V2 palsies. A lymphocytic predominance with protein elevation in the CSF was suggestive for neurosarcoidosis but not specific. The findings of

mediastinal lymphadenopathy and bilateral upper lobe infiltrates, elevated ACE, congruent CSF profile, lung biopsy showing non-necrotizing micro-granulomas, and rapid resolution of neurological findings with steroid treatment strongly favored the diagnosis of neurosarcoidosis. While imaging defined a cavernous sinus mass and identified the mediastinal lymphadenopathy and bilateral infiltrates suggestive of sarcoid, the MRI was not the definitive diagnostic technique. The literature suggests there is poor correlation between imaging findings and clinical symptoms. About 40% of symptomatic cranial nerve deficits are not visible on imaging and around 40% of cranial nerve lesions seen on imaging are asymptomatic. Depending upon the location of the lesion, MRI may demonstrate resolution of enhancement with resolution of symptoms. Clinical and imaging

improvements after steroid treatment are most likely to correlate in cranial nerve and spinal lesions, and less likely in dural and parenchymal lesions.

NON-OPERATIVE MANAGEMENT OF STREPTOCOCCAL HEPATIC ABSCESS Elizabeth Selden; Andrew A. Chang. New York University, New York, NY. (Control ID #1321104)

LEARNING OBJECTIVE 1: Identify indications for surgical intervention in the case of hepatic abscessesLEARNING OBJECTIVE 2: Review appropriate management of new pleural effusionsCASE: A 56 year-old woman presented with weight loss, malaise and polyuria for two months. On admission, HR 135, BP 107/80, RR 22, T 101, O2 94% on RA. Exam revealed cachexia, bilateral lower extremity edema, decreased breath sounds in lower half of right lung with decreased tactile fremitis and coarse crackles superiorly. Labs were notable for WBC 33 and glucose 559. EKG showed sinus tachycardia. CXR revealed a right pleural effusion. Patient was pan-cultured and empirically started on vancomycin, piperacillin/tazobatam and azithromycin for presumed pneumonia. Despite insulin and IV fluids, she remained tachycardic. CT angiogram revealed a large pulmonary embolus in the left basal pulmonary artery and a large loculated right pleural effusion with no pleural enhancement. Abdominal CT revealed 8 cm septated hepatic mass, hepatic vein thrombus extending into the IVC, and a small amount of air in the wall of the gallbladder. Heparin drip was started and patient was taken for percutaneous drainage of hepatic mass and thoracentesis. Only small samples were obtained given loculation. Pleural fluid was exudative, gram stain showed white cells but no organisms, pH 7.22, glucose 169. Chest tube was placed. Strep viridans grew from pleural and hepatic fluid; blood cultures grew strep anginosus and c. albicans. Antibiotics were narrowed to ceftriaxone and caspofungin. Given pneumobilia, hepatic abscess was presumed to be from GI source with empyema formation from local spread of infection and hepatic vein thrombus from local inflammation. EGD/colonoscopy failed to find communicating track between bowel and biliary systems. Surgical intervention was deemed risky given large clot burden and patient was managed with antibiotics alone. Repeat imaging two months later at discharge showed significant resolution of hepatic and pulmonary collections. She completed five weeks of ceftriaxone followed by four weeks of oral ciprofloxacin and a total of six weeks of fluconazole. She continues to do well without recurrence of sepsis.

DISCUSSION: Strep anginosus, a subgroup of strep viridans, lives in the normal flora of the GI tract. It often presents in polymicrobial infections and produces a cytolytic toxin that is a virulence factor for deep-seated infections which are most commonly seen in the head, neck and abdomen. Traditionally, solitary liver abscesses have been managed with surgical or percutaneous drainage. Arenas-Jimenez et al. demonstrated that antibiotics alone are safe in stable patients with hepatic abscesses, but those with signs of sepsis should be managed with drainage. This case represents an example of successful management of pyogenic liver abscess with antibiotics alone despite sepsis. On admission, CT revealed pleural effusion, which, per radiology, was not suggestive of empyema given lack of pleural enhancement. However, thoracentesis done nearly 24 hours later revealed a complicated parapneumonic effusion bordering on empyema. This raises the question of whether CT can exclude empyema. Studies show that although there are typical findings on CT that suggest empyema - pleural thickening and extrapleural fat enhancement -lack of these findings cannot rule out empyema. Any new pleural effusion with fever should prompt clinicians to perform immediate thoracentesis to rule out empyema regardless of radiologic findings.

NOT ALL ITS CRACKED UP TO BE: A NEW PUBLIC HEALTH CAMPAIGN Noelle Northcutt2; Ramya Mishra2; Colleen Barry2; Katarzyna Mastalerz1; Mary Maher1; Jessica Campbell1. 1Denver Health, Denver, CO; 2University of Colorado Anschutz Medial Campus, Aurora, CO. (Control ID #1340113)

LEARNING OBJECTIVE 1: Diagnose the clinical manifestations of levamisole-associated thrombotic vasculitis.

LEARNING OBJECTIVE 2: Raise awareness about a growing substance-abuse related public health topicCASE: A 41-year-old female with a history of substance abuse presented to the Emergency Department with one month of bilateral lower extremity rash and severe pain. On arrival patient was noted to have altered mental status and met SIRS criteria of fever and tachycardia. She was also found to be leukopenic with an ANC of 1600. Initially, the rash was purpuric with stellate lesions and associated erythematous borders. A few of the lesions were bullous and necrotic. A poorly demarcated erythematous macule was noted on the right ear. Workup yielded normal renal function, computed tomography negative for acute thrombotic stroke, no sign of infection, and urinalysis with trace protein with no evidence of hematuria. P-ANCA was noted to be strongly positive at a titer of 1:2650 and polyreactive to MPO Ab and PR3. Vancomycin was empirically started for suspicion of MRSA super-infection. Supportive care was provided with volume resuscitation, anti-pyretics, and wound care. Thigh skin biopsy histopathology taken during a similar presentation to an outside hospital three months prior revealed cocaine microangiopathy, or levamisole-associated thrombotic vasculitis. On this admission, her urine drug screen was positive for cocaine metabolites and patient admitted to using the day prior to presentation.
DISCUSSION: This is the 9th confirmed case of levamisole-associated thrombotic vasculitis at our hospital. Levamisole was historically used as an immunomodulator in rheumatoid arthritis and colon cancer until its withdrawal from the US market in 2000 due to agranulocytosis. The synthetic imidazothiazole derivative continues to be used today as an effective antihelminthic in veterinary medicine, and outside the US for childhood nephrotic syndrome. In 2010, it was found as a contaminant in 78% of cocaine at this safety net hospital. The clinical presentation of levamisole-associated thrombotic vasculitis includes characteristic retiform purpura with propensity for pinna involvement, high-titer ANCAS reactive to multiple target antigens, and neutropenia is common. Treatment for this condition is not well established and remains largely supportive. Unless targeted efforts to eradicate levamisole laced cocaine are undertaken, cases like this may become a common presentation of cocaine abuse. Epidemiologic data for the Midwest and Western US indicates increasing prevalence of levamisole-adulterated cocaine. Unfortunately, cocaine and crack use is the second-most common illicit drug-associated cause of ED visits in the Denver metro area. There is need for a robust public health campaign targeted at cocaine users regarding this life-threatening and potentially deforming drug related complication

NOT CRYING WOLF: AN ATYPICAL MANIFESTATION OF SYSTEMIC LUPUS ERYTHEMATOSUS Alexis Eastman; Khin Mae Hla. University of WI Hospitals and Clinics, Madison, WI. (Control ID #1339586)
LEARNING OBJECTIVE 1: Identify an uncommon cutaneous complication of systemic lupus erythematosus (SLE)
LEARNING OBJECTIVE 2: Diagnose and treat lupus erythematosus profundusCASE: A 56 year-old African-American female with well-controlled SLE on hydroxychloroquine and low dose prednisone presented to clinic with a new right volar forearm mass. Initially, the mass was 1.5 cm in diameter, mildly tender, without fluctuance or skin changes. She denied fevers, chills, night sweats, weight loss, or trauma. An ultrasound was ordered which showed non-specific findings of subcutaneous edema and fat globules, with a broad differential concerning for infection, post-traumatic ossification, or malignancy. A week later, the mass had increased to 4 cm with tenderness, a small fluctuant area, erythema and accompanying daily subjective low-grade fevers. An MRI was obtained and was suggestive of
an infectious or inflammatory process with no drainable fluid collection. She was started on empiric antibiotics, and surgical biopsy was obtained. Pathology showed a benign dense lymphoplasmacytic infiltrate involving the dermis and subcutis, rare perivascular fibrinoid necrosis, consistent with lupus erythematosus profundus. In the interim, her fevers had resolved and the mass had become non-tender. Her hydroxychloroquine was continued, antibiotics were stopped, and the lesion subsequently resolved.
DISCUSSION: Cutaneous manifestations of systemic lupus erythematosus (SLE) are common, occurring in

75% of patients with SLE. The majority of these are discoid lupus, of which lupus erythematosus profundus (LEP) is a variant. LEP is usually found prior to or independent of SLE (10-42% of cases); only 2-5% of patients with pre-existing SLE will develop LEP. It is more prevalent in women, with a 2-9:1 female:male ratio. It presents asymmetrically on the face, proximal extremities and trunk as a tender subcutaneous nodule that resolves with subsequent lipoatrophy and skin depression. Presentation on the distal extremities is unusual. The differential includes infection and malignancy. Patients with SLE are at increased risk of infection from underlying leukopenia and immunosuppressive medications. Historically, infection is one of the leading causes of death in SLE, especially in patients with early SLE (less than 2 years). Given this, infectious processes must always be ruled out. Surgical biopsy is the standard diagnostic tool. Histologically, LEP shows a mostly lobular dense infiltrate of lymphocytes and morphologically unremarkable plasma cells, dense perivascular and periappendigeal lymphocytic infiltrate in the dermis. Subcutaneous panniculitis-like T-cell lymphoma can also closely mimic LEP, and can be difficult to differentiate histologically: recent case series found significant overlapping findings. Thus, if patients present atypically with subcutaneous masses, it is important for primary care givers to be aware of LEP and the possibility that the findings are actually an evolving lymphoma. The treatment of choice for LEP is hydroxychloroquine for both acute and maintenance therapy. Intralesional corticosteroids may worsen the eventual lipoatrophy, and should be avoided.

NOT ALL BREAST MALIGNANCIES ARE BREAST CANCER: SMALL CELL LUNG CARCINOMA METASTASIS TO THE BREAST. Laura E. Paletta; Kimberly Pedram. VCU, Richmond, VA. (Control ID #1337439)

LEARNING OBJECTIVE 1: 1. Recognize when a chronic cough warrants further work-upLEARNING OBJECTIVE 2: 2. Understand that extra-mammary breast metastases are rare cause of breast masses.

CASE: A 48 year-old female smoker with no significant history presented with a chronic productive cough for 2 months and a mass in her left breast. She was initially treated with cough suppressants and an antibiotic but her cough persisted. She denied a history of fevers, chills, night sweats or hemoptysis. She reported that her breast mass was without tenderness or nipple discharge. Her physical exam was notable only for diffusely coarse breath sounds and a 2-centimeter, firm mass in the upper outer quadrant of her left breast. Laboratory evaluation was unremarkable. An x-ray and later chest CT revealed a large right hilar mass and mediastinal nodal extension highly suspicious for malignancy with evidence of a post-obstructive pneumonia as well as left breast mass. Biopsies from the paratracheal and hilar mass obtained with endobronchial ultrasound revealed small cell carcinoma. Needle biopsy of the breast mass also demonstrated small cell carcinoma.

DISCUSSION: Chronic cough is a common complaint encountered by a general internist. A cough that persists for longer than eight weeks without known cause needs to be worked up further with imaging. While it is a concern, lung cancer is the cause of cough in less than 2% of patients presenting with a chronic cough. In this patient, the laryngeal nerve irritation caused by mediastinal small cell lung carcinoma was the cause of her presenting symptom. Metastatic lesions of the breast are also rare, accounting for 0.4-6.6% of all breast malignancies. The most common cancers to metastasize to breast are malignant melanoma and leukemia/lymphoma. Others that have been reported include carcinoma of the kidney, stomach and lung. These patients usually present with a small, painless lump in the upper outer quadrant in contrast to the pain, tenderness and nipple discharge commonly seen with a primary breast malignancy. In addition, metastases to

breast will often spare the adjacent skin architecture and often do not show characteristic calcification or spiculation on mammogram. The majority of these patients have a previously diagnosed non-mammary malignancy; in this patient the lung mass and breast mass were discovered concomitantly. The prognosis for patients with cancer metastasized to the breast is poor; it is reported that 80% of these patients will die within one year. It is not uncommon for general internists to make the first diagnosis of breast malignancy. In this patient, it was fortuitous that she presented with a chronic cough that prompted an x-ray and CT. Otherwise, her

primary malignancy may have been missed.

NOT ALWAYS MOANS, GROANS AND BONES: RECOGNIZING THE DIFFERENT FACES OF HYPERCALCEMIA. Maliha I. Jumani; Ioannis Politikos; Arooj Hyat. Mount Auburn Hospital, Cambridge, MA. (Control ID #1309745)

LEARNING OBJECTIVE 1: Emphasize the importance of a thorough history while evaluating patients with common presentations. LEARNING OBJECTIVE 2: Recognize the resurgence of milk alkali syndrome as a cause of hypercalcemia.

CASE: A 53 year old male with past medical history of obesity, type 2 diabetes, hypertension, atrial fibrillation and chronic kidney disease presented to clinic with three days of vomiting and decreased oral intake. He was noted to be slightly hypotensive and was sent to the ED. On arrival at the ED, patients vital signs were notable for blood pressure 93/60. His physical exam revealed clear lungs, normal heart sounds and abdominal exam showed no tenderness, guarding or rigidity. The initial diagnosis was gastroenteritis and patient was started on IV hydration, zofran and pantoprazole. His labs were notable for creatinine of 2.6 and calcium of 15.4. Upon further questioning, patient revealed that he had eaten at a fast food restaurant 5 days ago and developed significant heartburn; subsequently he had started taking calcium carbonate tablets six to seven times a day for relief of his symptoms. Two days after this he developed intractable vomiting and anorexia. In light of this information, the patient was diagnosed with hypercalcemia secondary to milk alkali syndrome and acute on chronic renal failure. PTH level was also checked during hospitalization and was noted to be 4.2, further supporting the diagnosis. The patient was given IV fluids and his calcium level was monitored. Upon discharge his calcium level had normalized at 10.2 and creatinine returned to his baseline of 1.4.

DISCUSSION: Our patient had a common clinical presentation of persistent vomiting and resultant hypotension. These symptoms were initially perceived to be due to gastroenteritis. It was only after a careful history was taken with reference to the chronology of events and lab work became available that it became apparent the cause of his symptoms was hypercalcemia due to milk alkali syndrome. This demonstrates the importance of a thorough history especially in the evaluation of common clinical presentations. Although in recent times patients with milk alkali syndrome are noted to be asymptomatic and findings of hypercalcemia and acute renal failure are incidental, our patient presented with the classic symptoms of the acute form of this syndrome including nausea and vomiting. The milk alkali syndrome was originally seen in association with the use of milk and sodium bicarbonate for treatment of peptic ulcer disease. Its incidence dropped significantly with the initiation of modern day treatment for peptic ulcer disease. The syndrome re-emerged in the 1990s with the increased use of over-the-counter antacids and is now the third leading cause of hypercalcemia after primary hyperparathyroidism and malignancy. The modern presentation differs from the classical presentation in that the patients are often asymptomatic, hypophosphatemia is common (due to lack of the phosphate load caused by milk drinking and the phosphate binding properties of calcium carbonate) and hypocalcemia may develop as a result of therapy.

NOT EVERY FECAL INCONTINENCE AND ABDOMINAL PAIN IS FROM GI TRACT SOURCE: A CASE OF GIANT LAMINATED BLADDER STONE Muhammed Sherid; Salih Samo; Samian Sulaiman; Meenu Singh. University of Illinois at Chicago, St.Francis Hospital, Evanston, IL. (Control ID #1314361)

LEARNING OBJECTIVE 1: To understand the pathogenesis and clinical manifestations of bladder stones LEARNING OBJECTIVE 2: To recognize this uncommon disorder in the appropriate clinical settingsCASE: A 75 year old man presented with a two week history of fecal incontinence while urinating, associated with severe suprapubic abdominal pain. The fecal incontinence occurred while urinating in both the sitting and standing positions. The patient had a history of urinary frequency, urgency and suprapubic abdominal discomfort for duration of one month. He denied any history of diarrhea, constipation, nausea, vomiting or fever. He was treated with two courses of antibiotics without improvement. Past medical history is significant for removal of bladder stones two times, thirteen and ten years ago (the size of stone was more than 5 cm both the times). He

was diagnosed with benign prostatic hypertrophy three years ago. Social history: He is from Belize in Central America and works as a teacher. No family history of kidney or bladder stones. On physical examination, he was afebrile with normal vital signs. Cardiopulmonary examination was unremarkable. Abdomen was soft. A firm mass was palpated in the suprapubic area associated with mild tenderness. He also had tenderness in the right costovertebral angle. Rectal exam revealed normal sphincter tone; prostate was enlarged with no nodules or masses. An attempt at urethral catheterization failed. Laboratory studies showed hematuria and pyuria with positive nitrite and leukocyte esterase. Urine culture grew Escherichia Coli. Complete blood count and comprehensive metabolic panel were unremarkable except for mild elevation of creatinine. CT scan of the abdomen and pelvis showed a large radioopaque laminated bladder stone measuring 8 x 7 x 6 cm. Bilateral hydronephrosis was noted as well. Patient underwent an open cystolithotomy with removal of the bladder stone which weighed one kilogram. The analysis showed uric acid 80% and calcium oxalate 20%. After surgery, his symptoms, bilateral hydronephrosis, and acute renal failure all resolved. The patient had an uneventful hospital course and was advised to increase his oral fluid intake and get six monthly ultrasound examinations.
DISCUSSION: Bladder stones occur in adult men in the vast majority of cases. They are usually secondary to bladder outlet obstruction. However, in some patients they originate from the upper urinary tract and migrate into the bladder where they grow after additional deposition of crystals. The incidence of bladder stones has been declining in developed countries while it still remains common in developing countries. The majority of these stones are composed of uric acid. Calcium oxalate, phosphate and struvite stones are next in frequency.
NOT EVERY GRANULOMA IS SARCOID: PULMONARY TALCOSIS CAUSED BY BABY POWDER IN ADULT. Chanunya Srihawan; Sashank Kolli; Soamsiri Niwattisaiwong; Thomas Liao. Advocate Illinois Masonic Medical Center, Chicago, IL. (Control ID #1335063)
LEARNING OBJECTIVE 1: Importance of history taking for the diagnosis of pulmonary talcosis.
CASE: A 63 year-old-male, nonsmoker, was referred to the pulmonary consult service for evaluation of multiple bilateral lung nodules incidentally found on a computed tomography (CT) scan of the abdomen during a workup for abdominal pain. The patient had no respiratory symptoms. Both lungs were clear to auscultation. The rest of physical examination was unremarkable. Subsequent CT scan of the chest revealed ill-defined spiculated nodules scattered throughout both lungs, most pronounced in upper lobes. The largest nodule measured 1.5 to 2 centimeters. Sarcoidosis was considered and bronchoscopy discussed, but patient opted for observation. The patient was followed with serial CT scans and after four years of follow-up, patient still had no respiratory symptoms. However, the follow-up CT scan of the chest eventually showed a subtle increase in size of confluent nodules associated with architectural distortion and bronchi-ectasis. Pulmonary function testing revealed a moderate obstructive pattern, slightly responsive to bronchodilators. On bronchoscopy, bronchoalveolar lavage was negative for mycobacterium, fungus and other infectious organisms. Transbronchial biopsies revealed non-caseating granulomas with refractile particles, which raised our suspicion for non-infectious causes of non-caseating granulomas. A detailed history revealed the use of baby talcum powder in a small, non-ventilated room everyday for at least 10 years. The diagnosis of pulmonary talcosis was made based on the history, radiological, and histological findings. The patient was advised to stop using baby powder to prevent further progression of disease.

DISCUSSION: Pulmonary talcosis should be in the differential diagnosis of generalized lung nodules. This condition is usually either under-diagnosed or misdiagnosed as more common granulomatous lung diseases because of unrecognized talc exposure history and non-specific radiologic findings. Modifying patients behavior by discontinuation of talc exposure will prevent disease progression to an irreversible obstructive or restrictive pulmonary disease.

NOT FOR HUMAN CONSUMPTION Eric Edwards. University of North Carolina School of Medicine, Chapel Hill, NC. (Control ID #1291853)
LEARNING OBJECTIVE 1: Recognize that the abuse of "bath salts" is a rapidly growing problem.
LEARNING OBJECTIVE 2: Recognize the signs and symptoms of bath salts intoxication.
CASE: A 49 year-old man presented with a one day history of chest pain as well as visual and auditory hallucinations. He denied past medical history and medication use. He admitted to binge drinking and smoking marijuana. He was mildly tachypneic, but physical examination was otherwise unremarkable. His white blood cell count was 18,000/L, blood alcohol level was 114 mg/dL, and creatine kinase level was 5280 units/L. Troponin I was undetectable. Urine toxicology screen was positive for cannabinoids. On EKG, T waves were inverted in leads II, III, V5, and V6. He was treated with intravenous fluids and lorazepam for agitation. His visual and auditory hallucinations resolved over the next 24 hours. Serial creatine kinase values trended downward. On further questioning, the man revealed that he had been snorting bath salts that he had purchased from a tobacco store.
DISCUSSION: Drug induced hallucinations are commonly encountered in the emergency department. A rapidly growing cause for this type of presentation is a group of synthetic drugs commonly referred to as "bath salts." These drugs are sold in powder or crystal form under a variety of names such as Bliss, Purple Wave, Ivory Wave, and Vanilla Sky. Bath salts contain stimulant compounds such as 3,4-methylenedioxypyrovalerone (MDPV), mephedrone, and methylone. The use of bath salts has risen rapidly in the United States during the past year, particularly among teenagers and young adults. In 2010, less than 300 calls in reference to bath salts were placed to poison control centers nationwide; in 2011, over 5600 calls were placed as of October 31st. Bath salts are commonly sold at "head shops," convenience stores, and over the internet. Packaging is often labeled with the phrase "not for human consumption." Until recently, the use of bath salts was still legal in many states. However, in October of 2011, the United States Drug Enforcement Administration (DEA) exercised emergency scheduling authority to control MDPV, mephedrone, and methylone, effectively making the sale and possession of bath salts illegal. Bath salts may be taken orally, intranasally, intravenously, or rectally. Signs and symptoms of bath salts intoxication include agitation, tachycardia, delusions, hallucinations, tremors, seizures, and rhabdomyolysis. Of note, routine urine toxicology screens do not detect the active ingredients of bath salts. Treatment of bath salts intoxication is supportive, including benzodiazepines for agitation and intravenous fluids for rhabdomyolysis. With the abuse of these synthetic drugs on the rise, physicians need to be familiar with the existence of bath salts and the clinical presentation and management of bath salts intoxication.
NOT JUST ANOTHER CASE OF "RULE OUT MI" Vijaya Rao; Vibhav Rangarajan; Lisa Dunning; Karen Orjuela; Elizabeth Schulwolf. Loyola University Medical Center, Maywood, IL. (Control ID #1338844)
LEARNING OBJECTIVE 1: Recognize spontaneous coronary artery dissection (SCAD) as a rare cause of angina in middle aged male patients LEARNING OBJECTIVE 2: Managing SCAD in non-pregnant patients without other obvious risk factors for developing SCADCASE: The patient is a 55 year old male with past medical history significant for hypertension, hyperlipidemia, and GERD who presented with a one month history of progressive dyspnea and exertional angina. His electrocardiogram on admission was notable for prior inferior and anterior wall infarct. Serum troponin was negative. Patient also underwent stress echocardiogram that showed inferior and apical septal hypokinesis with localized thrombus in the apical segment; transthoracic echocardiogram revealed an ejection fraction of 45%, left ventricular hypertrophy, mild hypokinesis of the left ventricle, akinesis of the apical septal segment, and again left ventricular apical thrombus. The patient ultimately underwent coronary angiography which revealed a healed spontaneous coronary artery dissection of the mid-distal left anterior descending artery (LAD). The patient denied any history of blunt trauma to the chest or connective tissue disorders, though his mother died of scleroderma and patient had recently been concerned that he is developing the disease. He was ultimately ruled out for scleroderma (Anti-Scl 70, ANA, and ENA negative). He was discharged with a medication regimen to optimize his heart failure (carvedilol, aspirin,

lisinopril, simvastatin) and warfarin 5 mg for anticoagulation for the LV thrombus.
DISCUSSION: Spontaneous coronary artery dissection (SCAD) is a rare phenomenon, estimated to comprise approximately 0.2-0.3% of cases acute coronary syndromes in the general population. Reported cases have been typically associated with the peri or post-partum period in young women, intense exercise, blunt trauma to the chest, cocaine use, connective tissue diseases such as Ehlers-Danlos or Marfan's syndrome, fibromuscular dysplasia, use of oral contraceptives or drugs such as cyclosporine, as well as history of atherosclerosis. Still, the underlying pathophysiology remains elusive. SCAD encompasses a broad spectrum of clinical presentations, ranging from asymptomatic to both stable and unstable angina, acute myocardial infarction, arrhythmias, and sudden cardiac death. However, one study reports that 77% of all SCAD reported in the literature presented with chest pain, with reportedly 65% revealing ST-segment elevation on electrocardiogram. The diagnosis is typically confirmed with cardiac computed tomography or coronary angiography; approximately half of the lesions found are in the LAD. In regards to an appropriate treatment plan, the results are mixed. Some studies have shown that conservative management may simply lead to delay of an inevitable procedure given that approximately 60% of lesions managed without intervention remained the same or worsened on repeat angiography. Others state that recurrent dissection is generally rare. The extent of the ischemia, amount of preserved coronary flow, and location of the dissection should ultimately dictate the possibility of intervention. In the case of our patient, coronary angiography revealed a well-healed mid-distal dissection with preservation of the remainder of his coronary vasculature. Given that the dissection was not acute, was in the mid-distal LAD, and coronary flow was preserved, conservative medical therapy with close follow up was chosen as a reasonable approach.
NOT SO BENIGN BACITRACIN Jessica Prange; Kurt J. Pfeifer. Medical College of Wisconsin, New Berlin, WI. (Control ID #1337438)
LEARNING OBJECTIVE 1: Identify Patients at Increased risk for bacitracin induced anaphylaxisLEARNING OBJECTIVE 2: Manage anaphylacitic shockCASE: A 94 year old female presents for a routine pacemaker generator change. The original dual chamber device was un-eventfully placed for sick sinus syndrome seven years ago. Prior to the procedure the patient received fentanyl, vancomycin, and xylocaine. The genrator was replaced, and the pocket was irrigated with a dilute bacitracin solution. Within minutes of the irrigation, the patient experienced acute pruritis, shortness of breath, hypotension, facial and toungue edema. She required emergent nasopharyngeal intubation, IV fluids, and IM epinephrine. She was stablilized and then transferred to the cardiovascular ICU. On exam she was afebrile, normotensive, and found to have severe facial and toungue edema without rash. Laboratory and imaging studies were unremarkable. Clinical course included 5 days of steroid therapy, diphenhydramine, and famotidine. Allergy/Immunology was consulted, and it was felt that the bacitracin used to irrigate the pacemaker pocket was the most likely cause of her anaphylactic shock. On hospital day 5 she was extubated, and ultimately was discharged to a subacute rehab facility. DISCUSSION: Bacitracin, although thought to be a benign drug, is known to be a potent sensitizer for allergic reactions. Therefore, patients at the highest risk of reaction are those that have had prior exposure to the drug. Reactions to topical bacitracin have been well described, but anaphylaxis due to intraoperative bacitration irrigation solution is extremely rare with less than 10 cases reported in the literature. There is good evidence to support the use of prophylactic IV antibiotic administration prior to cardiac

device placement to reduce post-procedure infections. Antibiotic irrigation during cardiac device placement on the other hand, has little data to support its use. Careful assessment of the risks versus benefits of using bacitracin irrigation should be considered for all patients undergoing cardiac device placement, especially in those patients with prior exposure to the drug.
NOTHING IN ISOLATION Joseph A. Avalos. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311875)

LEARNING OBJECTIVE 1: 1. Identify the differential diagnosis of acute kidney injury. 2. Recognize the clinical presentation of multiple myeloma3. Identify the appropriate imaging in the setting of acute renal failure. CASE: A 48 year-old man with history of well-controlled hypertension presented with one week of lethargy, lightheadness, and a ten-pound weight gain. He noted decreased appetite and oral intake, as well as a recent decline in urine output. The abdominal examination was normal; there were no masses, the bladder was not distended, and there were no spinal, paraspinal, or CVA tenderness. His lungs were clear, the JVP was normal and he had no edema. The BUN was 98, the creatinine was 17, and the potassium was 6 mmol/L. His calcium was 10.8; the total protein was 6.7, the albumin was 4.2, and his hemoglobin was 10.6 g/dl. The urinalysis revealed a protein 30 mg/dL. A renal ultrasound was obtained, revealing mildly enlarged bilateral kidneys without hydronephrosis. There were multiple lytic lesions to the spine and pelvis on CT of abdomen and pelvis. An immuno-electrophoresis and subsequent bone marrow biopsy confirmed the diagnosis of multiple myeloma with a predominance of kappa light-chains.
DISCUSSION: Acute kidney insufficiency is commonly encountered by the general internist. While the most common causes include urinary obstruction and inadequate perfusion of the kidneys, the internist must have a disciplined diagnostic approach to identify the less common causes of acute renal insufficiency. Once pre-renal and post-renal causes are excluded, the general internist should have a disciplined approach to evaluating potential intrinsic renal damage. Intrinsic insults can occur due to prolonged hypo-perfusion or obstruction, or exposure to either exogenous or endogenous nephrotoxic agents. Common exogenous toxins are aminoglycosides and contrast; common endogenous nephrotoxins included heme-containing products, uric acid, or Bence-Jones proteins. Based upon the age of our patient, and the normal physical examination, post-renal obstruction was quickly excluded. His decreased oral intake increased the pre-test probability of pre-renal azotemia, as was suggested by the initial laboratory findings of an elevated BUN and creatinine. This case illustrates, however, that it is important that the general internist not succumb to premature closure in the diagnosis of pre-renal azotemia based upon only a few laboratory findings in isoloation. When interpreted in the context of the anemia and hyper-calcemia, the elevated BUN and creatinine suggested an intrinsic renal toxicity. Multiple Myeloma (MM) is characterized by renal failure, skeletal involvement, anemia, and hypercalcemia; common presenting symptoms include bone pain, impaired renal function, anemia, hypercalcemia, recurrent infections, and hyperviscosity. Although the median age at presentation of myeloma is seventy years, fifteen percent are younger than sixty years of age at diagnosis. In our patient, the context of acute renal insufficiency, anemia, hyper-calcemia and lethargy prompted the clinical suspicion for myeloma. In such cases, a skeletal survey is the best initial imaging modality, as the lesions of myeloma are purely lytic, and will thus not be revealed by a bone scan. The role of CT scanning is reserved for clarifying indistinct lesions, or to better evaluate difficult regions such as the ribs, sternum, and scapula. The role of MRI is limited to assessing suspected cord compression.

NUMB CHIN SYNDROME: A HARBINGER FOR METASTATIC PROSTATE CANCER. Raji Shameem; Robert E. Graham. Lenox Hill Hospital, New York, NY. (Control ID #1339942)
LEARNING OBJECTIVE 1: Recognize Numb Chin Syndrome in the setting of systemic malignancy.
LEARNING OBJECTIVE 2: Identify Numb Chin Syndrome as a precursor for Metastatic Prostate Cancer.
CASE: A 59-year-old male presented to the hospital with a one-month history of severe and diffuse bone pain most prominent in the spine. Of note, three months prior to the onset of diffuse bone pain the patient had noticed persistent decreased sensation and pain over his jaw. The patient did not consider the symptom to be of any significance and did not go see a physician for evaluation. Eventually severe bone pain brought him to the hospital. On clinical examination there was hypothesia over the chin. In addition, on rectal examination the prostate was enlarged with a nodular consistency. Prostate specific antigen was substantially elevated at 1,920. CT imaging revealed widespread osteoblastic bony metastases, including the vertebrae, ribs, and mandible. These findings were consistent with metastatic prostate cancer.

DISCUSSION: Numb Chin Syndrome is an uncommon condition. It is characterized to be a neuropathy of the mental nerve, a branch of the trigeminal nerve. Affected individuals describe decreased sensation and/or pain over the sensory distribution of the mental nerve. The sensory distribution involves the skin of the chin, lower lip, and the gingiva. A wide variety of conditions are associated with Numb Chin Syndrome. The extensive list includes multiple sclerosis, dental infection, sickle cell anemia, and systemic malignancy. Numb Chin Syndrome has been shown to be a symptom in the setting of systemic malignancy. Examples include breast, ovarian, lung, and prostate cancer. The fact that the majority of these malignancies are widespread with severe diffuse involvement emphasizes the importance of clinical recognition of Numb Chin Syndrome. Prostate cancer rarely has been shown to be a culprit behind Numb Chin Syndrome. Previous case reports that have linked Numb Chin Syndrome with prostate cancer have been when the cancer had metastasized. However, in this case, Numb Chin Syndrome was an apparent initial presenting factor for prostate cancer months before the onset of generalized bone pain. Given the temporal relationship of initial symptoms and the subsequent development of diffuse bone pain we argue that Numb Chin Syndrome appears prior to the metastasis of prostate cancer. Clinicians must be cautious of Numb Chin Syndrome with a high index of suspicion because of its ominous association with malignancies such as prostate cancer. If this is done malignancy will be detected earlier prior to the onset of metastasis.

OMENTAL INFARCT: RARE CAUSE OF UNEXPLAINED ABDOMINAL PAIN Jochebed A. Pink; Robin Klein. Emory University School of Medicine, Atlanta, GA. (Control ID #1339693)

LEARNING OBJECTIVE 1: - Recognize the clinical presentation and risk factors of omental infarctionLEARNING OBJECTIVE 2: - Review the treatment and management of omental infarctCASE: A 48-year-old male with a history of obesity, diabetes mellitus, and hypertension presented with chest and abdominal pain. Three days prior, he reported the sudden onset of left sided chest pain over his lower ribs. The pain was sharp and constant, independent of exertion, deep breathing, or position. The following day, the pain spread to his left upper quadrant. The pain was unrelated to eating, gas, or bowel movements. He denied shortness of breath, nausea, vomiting, fever, chills, and changes in weight. On exam, his abdomen was soft, nontender, and nondistended without guarding. Bowel sounds were normal and no masses were palapable. Laboratories revealed white cell count 9.2 x 109 K/mcL. Lipase was elevated at 77 U/L and lactic acid was 1.3 mmol/L. CT scan of the abdomen and pelvis revealed stranding of the fat tissue in the upper abdominal mesentery with a ring of hyperattenuation measuring 1.2 x5.0 cm consistent with omental infarction with epiploic appendigitis. He was diagnosed with omental infarction. He was initially treated with intravenous levofloxacin, metronidazole, and heparin, which were discontinued after consulting general surgery who confirmed that omental infarction is a benign condition. The patients pain was well controlled with hydrocodone/acetaminophen and he was discharged home. DISCUSSION: Omental infarction occurs when blood supply to the abdominal omentum is compromised. This can occur in the setting of spontaneous venous thrombosis, torsion of the omentum around its vascular pedicle, vasculitis of the omental vessels, or venous outflow obstruction. Risk factors include obesity, strenuous activity, congestive heart failure, recent abdominal surgery, and abdominal trauma. Typically, patients present with acute pain that can arise in any abdominal quadrant. The presentation may

mimic other more common causes of abdominal pain such as cholecystitis, diverticulitis, appendicitis, perforated peptic ulcer, or ruptured ovarian cyst. Given its nonspecific presentation, accurate diagnosis relies upon on imaging. Both abdominal CT and ultrasonography can demonstrate inflammatory changes in the fat consistent with infarction. Fortunately, omental infarction is a benign, self-limiting condition. Pain typically resolves in 1 week with conservative treatment with analgesics. However, the imaging findings may persist for up to 6 months. While benign, accurate and timely recognition of omental infarction is key. Clinically, it is

indistinguishable from more ominous causes of pain such as an acute abdomen. Misdiagnosis may lead to unnecessary treatment with antibiotics and even surgical intervention. While rare, physicians need to consider omental infarction in patients presenting with abdominal pain given the potential morbidity of misdiagnosis.

ONE MORE WAY THAT SMOKING IS BAD FOR YOUR HEALTH Jeffrey DellaVolpe. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1338803)

LEARNING OBJECTIVE 1: Recognize acute pulmonary eosinophilia as a cause of fever, dyspnea, and cough especially in the setting of a recent airborne exposureLEARNING OBJECTIVE 2: Understand the differences in treatment of acute pulmonary eosinophilia versus the treatment of infectious pneumonia CASE: A 22 year-old man on military deployment presented to a remote clinic in Central Africa. He had experienced two days of worsening dyspnea on exertion, fever, and fatigue; he denied a cough. His symptoms worsened despite treatment with azithromycin by the field medic. He was a non-smoker, however, over the last two weeks, he had been smoking local cigarettes to help him stay awake during night patrols. On physical examination, his temperature was 103.9oF, his heart rate was120 beats/ minute, and his respiratory rate was 32 times/minute; his oxygen saturation was 80%. He had decreased air movement bilaterally, in addition to bilateral inspiratory crackles best heard at the bases of the lungs. There was a tactile fremitus on the right side. Laboratory capabilities were limited, but rapid malaria and rapid influenza tests were negative. His chest X-ray demonstrated diffuse alveolar infiltrates and homogenous opacification of the right hemithorax. He was placed on continuous oxygen by ventimask and started on intravenous ceftriaxone and vancomycin. He was given normal saline, which had a modest effect on his heart rate. Attempts to wean his oxygen consumption were accompanied by an immediate desaturation to 80%. Because of the limited supplies and minimal improvement, he was transported to a facility with greater capabilities. His CBC revealed a leukocytosis with no eosinophils. He underwent bronchoalveolar lavage (BAL) which showed 30% eosinophils. A diagnosis of acute eosinophilic pneumonia was established, and he was started on prednisone. He experienced a rapid resolution of symptoms and was completely weaned off oxygen two days later. The following week he was released from the hospital and able to return home to his unit.

DISCUSSION: Acute eosinophilic pneumonia (AEP) is part of a heterogenous group of disorders known as the eosinophilic lung syndromes. The syndrome typically consists of an acute febrile illness, severe hypoxia, pulmonary infiltrates, increased eosinophils on BAL, and an absence of infection or other cause. The most commonly documented presenting signs and symptoms are dyspnea, fever, cough, and crackles on inspiration. The diagnosis is established based on pulmonary eosinophilia and exclusion of chronic causes of eosinophilic pulmonary disease. It is important to recognize, as was the case in our patient, that pulmonary eosinophilia can exist in the absence of a peripheral eosinophilia due to a pulmonary eosinophil sequestration. Although idiopathic causes have been described, patients usually develop the syndrome following an airborne toxin exposure. One key exposure that has been well described is new onset smoking, which was seen with our patient. Typically, patients are in their mid-20s and develop symptoms consistent with AEP within one month of initiation of smoking. The treatment of AEP is steroids, typically IV methylprednisolone. Dosages vary, but the consensus is 60-125 mg of methylprednisolone every six hours followed by an oral prednisone taper. Relapses of AEP have not been described in the literature, and the prognosis is typically excellent if identified rapidly and treated appropriately.

PRES AS UNCOMMON CAUSE FOR SUDDEN BLINDNESS KhaledM. Abouelezz; Abhilash Akinapelli; Pranjal Sharma; Mahmoud A. Abu Hazeem; Bruce L. Houghton. Creighton university medical center, Omaha, NE. (Control ID #1339044)

LEARNING OBJECTIVE 1: Recognize Posterior Reversible Encephalopathy Syndrome (PRES) as a possible cause of sudden blindness. LEARNING OBJECTIVE 2: Recognize possible causes that can lead to PRES. CASE: 66yo Caucasian female admitted with paraspinal abscess and MSSA bacteremia, hospitalized for drainage, laminectomy and IV nafcillin. Patient developed Acute Kidney Injury and required blood transfusion for

her low hemoglobin during hospital course. Blood pressure was normal since admission but started to elevate on days 9, was not treated aggressively due to risk of hypotension. On day 10, patient started to have an acute onset of dizziness, frontal headache radiating to the base of the skull, decreasing visual acuity and color vision. 7 hours later she developed complete blindness in both eyes. On examination blood pressure was 171/86, baseline 120/71, pulse 91, RR 22, T 96.9, she was conscious but confused. There was no light perception in both eyes. She had normal fundoscopic examination, otherwise normal neurological exam and normal electrolytes. Urgent MRI w/o contrast was done showed increased diffusion and T2 signal in the bilateral occipital and posterior partial regions most consistent with posterior reversible encephalopathy syndrome. Patient was transferred to ICU for tight control of her blood pressure and close monitoring. Follow up MRI after 5 days from the first one showed picture consistent with resolving PRES. On day 11, patient appreciated hand motion vision. Her vision gradually improved to near normal on day20. DISCUSSION: DISCUSSION: PRES is a clinical radiographic syndrome characterized by unique pattern of brain vasogenic edema of heterogeneous etiologies that are grouped together because of similar findings on neuroimaging studies, first described by Hinchy et al. Frequently PRES was described in association with hypertensive encephalopathy, eclampsia, and the use of cytotoxic and immunosuppressants. PRES can also be seen in infection specially gram positive bacteria, acute or chronic renal diseases, blood transfusion, chemotherapy, TTP, HUS , vasculitis, Porphyria, hypercalcemia, hypomagnesemia, contrast media exposure (cerebral, coronary angiography). In our patient PRES may be multifactorial due to transfusion, renal insufficiency but mainly due to infection with GR+ve cocci and moderate elevation of blood pressure. In one study it is found that PRES associated with Infection/sepsis gram-positive organisms predominate(84%), and in 40% of patients, blood pressure is normal or only minimally increased. Clinical manifestations include insidious onset of headache, confusion, visual changes, and seizures. In our patient it is manifested with acute onset of bilateral complete cortical blindness. DD: Other neurologic conditions can be manifested with similar presentation such as stroke, venous thrombosis, toxic, metabolic encephalopathy, demyelinating disorders, vasculitis, or encephalitis. Management: usually treating the cause but hypertension is a feature in the majority of PRES patients, regardless of etiology. With blood pressure lowering, patients will often improve dramatically. Prognosis: Most patients recover within two weeks. MRI findings can be helpful in identifying patients with worse prognosis. CONCLUSION: PRES may be considered as an important differential diagnosis in hospitalized patients with sudden onset of visual changes when infection, hypertension, blood transfusion or kidney injury is present.

PTU: SUPPRESSING MORE THAN THYROID HORMONE Thomas Jensen1; Jerald Marifke2. 1MCW, Milwaukee, WI; 2MCW, Milwaukee, WI. (Control ID #1328071)

LEARNING OBJECTIVE 1: To describe a rare case of PTU-induced agranulocytosis in a patient with a relapse of Graves hypothyroidism, who previously tolerated the medication.

CASE: A 56 year-old woman with a past medical history of Graves disease presented with a chief complaint of fever, chills, nonproductive cough, and general malaise for 4 weeks. Her symptoms began immediately after initiation of propylthiouracil (PTU) for recurrence of hyperthyroidism, though she failed to report this until a day before admission. She was diagnosed with Graves hypothyroidism in 1996 and initially treated with

methimazole. However, she did not tolerate this and was switched to PTU. She received this therapy for two years, at which time it was stopped due to remission of her disease. At this presentation the patient had a temperature of 100.3 F, rigors, exudative tonsillar lesions, and an erythematous pharynx. She had a normocytic anemia (hgb of 9.2 g/dL), and thrombocytopenia (123e3/uL), but more substantially her white cell count (WBC) was 1.3x10^9/L, and an absolute neutrophil count of 0. Her TSH was 0.015U/mL. PTU was held and hematology concurred a diagnosis of PTU-induced agranulocytosis. Granulocyte colony stimulating factor (GCSF) was not started since evidence was inconclusive as to it being a benefit in PTU-induced agranulocytosis. Her neutrophil count recovered on hospital day 10 to 1.8x10^9 and remained above 1.5

x10^9/L during the remainder of the hospital stay. She had a WBC of 4.8 x10^9/L, hemoglobin 11.8 g/dL, and platelet count of 265e3/uL on day of discharge. She underwent radioactive iodine treatment for definitive treatment. DISCUSSION: Agranulocytosis is a rare, serious complication of thionamides occurring in 0.3% of patients. Of interest, there are very few case reports of PTU-induced agranulocytosis on second time exposure. Therefore, physicians and patients must be aware of symptoms of agranulocytosis even if they previously tolerated the medication, discontinue the thionamide, and perform further investigation immediately. Routine monitoring is not recommended since agranulocytosis develops suddenly, though typically within the first three months of initiation of therapy. The median time to resolution of agranulocytosis is 10-14 days. Conflicting data exists from retrospective and small randomized control studies as to whether GCSF improves recovery time. Management includes discontinuation of the thionamide and supportive treatment with antibiotics for neutropenic fever is recommended. Either RAI or thyroidectomy should then be pursued for definitive treatment of Graves disease. Agranulocytosis is a serious complication of thionamides that can occur even after prior tolerance to the medication.

PACING THE BLOCK Kate Hust; Chayan Chakraborti. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339148)

LEARNING OBJECTIVE 1: 1. Recognize atrioventricular block. 2. Identify etiologies of atrioventricular block. 3. Understand pathophysiology and natural history of atrioventricular block. 4. Identify appropriate treatment for atrioventricular block.

CASE: A 58 year-old man presented with three weeks of chest pain, shortness of breath, and weakness. He reported past episodes upon exertion, but now had resting symptoms. He had no past medical history, and he was taking no medications. His admission vital signs and physical examination were normal. The troponin was 0.07 ng/mL, the BNP was less than 20 pg/mL; his urine toxicology was positive for cocaine. An initial EKG showed J-point elevation in the anterior leads, but no other abnormalities. He was admitted for observation. He remained asymptomatic overnight. His troponin level normalized, but an EKG revealed a first-degree atrioventricular (AV) block. Telemetry recorded intermittent episodes of bradycardia, second-degree AV block, and pauses up to four-seconds. An echocardiogram and stress test were normal, and he was discharged with a cardiac event monitor. He re-presented two days later with recurrent symptoms and pre-syncope. Interrogation of his event monitor showed corresponding bradycardia and Mobitz II second-degree AV block.

DISCUSSION: Cardiac arrhythmias are frequently encountered in hospitalized patients, and recognizing heart block is important for guiding appropriate medical care. Natural conduction of a cardiac impulse is from sinoatrial node to atrioventricular (AV) node and then along the Bundle of His, bundle branches, and Purkinje fibers. Prolongation of the PR-interval indicates slowed conduction, generally within the AV node, and is diagnostic of first-degree AV block. Second-degree blocks are evidenced by P-waves without corresponding QRS complexes. They are subdivided into Mobitz I (Wenckebach), with progressively prolonged PR-interval leading to a dropped QRS complex, and Mobitz II, with dropped QRS complexes lacking the progressive PR-prolongation. Complete dissociation of the P-waves and QRS complexes is diagnostic for third-degree or complete AV block. These advanced degrees of AV block often occur distal to the AV node in the Bundle of His. Conduction abnormalities in AV block are caused by chronic infiltrative and inflammatory diseases leading to permanent fibrous changes. Fibrosis may also occur after infections such as syphilis or Lyme disease. Other irreversible heart blocks may be caused by diseases affecting cardiac structure - congenital heart disease, ischemia, trauma, or neoplasm. Common, reversible etiologies for AV block include metabolic derangements, medication side effects, and vasovagal or autonomic stimulation. When treating AV block, a reversible cause must first be ruled out. Providing heart rate support is the mainstay of therapy. Medications such as atropine may be used in the short-term, but definitive treatment is pacing. Permanent pacemakers are indicated in symptomatic bradycardia or irreversible second- and third-degree block. Waking heart rate below forty, left ventricular dysfunction, wide-complex QRS in second-degree block, and cardiomegaly with acquired third-

degree block may be indications for pacemaker placement in asymptomatic individuals. AV blocks are not uncommonly seen by hospitalists, and recognizing these bradyarrhythmias is important to optimize care.
PANCREATIC ASCITES, A CASE OF TWO PSEUDOCYSTS Mona Hassan; Laila Shiekh Sroujieh. Henry Ford Hospital, Detroit, MI. (Control ID #1334661)
LEARNING OBJECTIVE 1: An approach to pancreatic ascites and pancreatic pseudocyst causing it.
LEARNING OBJECTIVE 2: ERCP transpapilary stent placement as a treatment option for pancreatic ascites secondary to a pancreatic fistula. CASE: A 47 year old female with cirrhosis and chronic pancreatitis secondary to alcohol abuse, presented with epigastric abdominal pain radiating to the back of 3 days duration following an episode of binge drinking. Serum amylase and lipase were elevated and CT of the abdomen showed inflammatory changes consistent with acute pancreatitis, pancreatic body small pseudocyst (2.0 x1.9 cm), large pancreatic tail perisplenic pseudocyst(7.3 x 8.7 cm) and ascites. Ultrasound guided diagnostic paracentesis was performed and showed findings consistent with pancreatic ascites (serum ascitic albumin ratio of <1.1, ascitic fluid protein >3 g/dl, ascitic fluid amylase was 15954 IU/L and the ascitic fluid to serum amylase (741) ratio was>6.0). An ERCP was performed due to suspected drainage from the pancreatic pseudocyst into the peritoneal cavity. ERCP revealed a large pseudocyst at the tail of the pancrease with complete disruption of the end of the pancreatic duct with free flow of fluid from the pseudocyst into the peritoneum. A 5 fR, 12 cm pancreatic stent was inserted that ended inside the pseudocyst. There was a good flow of pancreatic juice through the stent into the duodenum. The pancreatic enzymes continued to trend down after stent placement and the ascites clinically decreased.
DISCUSSION: Pancreatic ascites accounts for 1% of all cases of ascites. It occurs in 3.5% of patients with chronic pancreatitis and 6-14% of patients with pancreatic pseudocyst. ERCP with stent placement is a treatment option for pancreatic ascites as surgical management is associated with 15-25% chance of morbidity and mortality. A case of pancreatic ascites secondary to a pancreatic pseudocyst draining into the peritoneal cavity is presented her. ERCP with stent placement is presented as a treatment option. Either conservative management with prolonged NPO for pancreatic rest or surgery are management options for pancreatic fistulae. An alternative treatment for pancreatic fistula with evidence of disruption of the pancreatic duct and causing ascites is endoscopic placement of a transpapillary stent. The presence of pancreatic ascites should raise the suspicion of a pseudocyst draining into the peritoneal cavity. This case encourages us to consider ERCP with stent placement as a treatment option in pancreatic ascites not responding to conservative medical therapy and provides a safer alternative to surgery.
PANCREATICOPLEURAL FISTULA (PPF) Madan Badal; Madan R. Aryal; Naba R. Mainali. Reading Hospital, Reading, PA. (Control ID #1340452)
LEARNING OBJECTIVE 1: When to suspect the case of Pancreaticopleural fistula (PPF)
LEARNING OBJECTIVE 2: How to manage the case of Pancreaticopleural fistula (PPF)

CASE: A 45 years old Caucasian woman with a history of chronic pancreatitis secondary to alcoholism presented with a 2 week history of progressive shortness of breath, dry cough and right sided pleuritic chest pain. On physical examination, she was found to have decreased breath sound at right lung base, stony dull percussion note on the area with positive vocal fremitus on auscultation. As per patient, she visited acute care center and got pleural fluid aspiration done twice over last two months for increased shortness of breath. Chest x- ray on admission confirmed the clinical finding of large right sided pleural effusion. Thoracentesis was performed yielding 2.5 liter serosanguinous pleural fluid with an exudative pattern. The findings were: pH 7.37, lactate dehydrogenase (LDH) 493 U/L (serum LDH 144 U/L), total protein 1.4 g/dl (serum total protein 6.5 g/dl), lipase 60778 U/L (Serum lipase 63 U/L) and amylase 45,500 U/L (Serum amylase 165 U/L). Liver function tests

were within normal limit. Contrast CT scan of thorax/ abdomen revealed massive right pleural effusion and a pseudo cyst adjacent to the pancreatic head which was tracking superiorly and entering the right pleural space. The patient was managed conservatively with bowel rest and started on intravenous octeotride. ERCP with possible endoscopic stenting of pancreatic duct was planned for the following week.
DISCUSSION: Pancreaticopleural fistula (PPF) is rare but a known serious complication of chronic pancreatitis or pancreatic trauma. It is estimated to occur in 0.5% of patients presenting with pancreatitis. Unlike the small pleural effusions that can usually be seen in acute pancreatitis, PPF can produce large and recurrent pleural effusions. PPF requires a high index of suspicion in patients presenting with chest symptoms or pleural effusion with history of pancreatitis or alcoholism. Extremely high amylase and lipase in pleural fluid aspirate are common findings. Early suspicion and recognition of a PPF is crucial, as delay in definitive treatment is associated with a higher rate of complication, with mortality up to 5%. A ductal disruption on the anterior surface of the pancreas usually leads to pancreatic ascites, whereas the posterior ductal leakage usually results in thoracic fluid collections. The pancreatic juice spreads retroperitoneally through the paths of least resistance, commonly through the aortic or esophageal hiatus. The management options in PPF include conservative treatment and endoscopic or surgical intervention. Medical therapy of PPF fails in 59%-69% of cases. Treatment of obstruction of a main pancreatic duct proximal to the fistula is to decompress the obstructed duct endoscopically and for cases refractory to endoscopic management, surgery is recommended.
PARASPINAL COMPARTMENT SYNDROME IN THE SETTING OF RHABDOMYOLYSIS Garrett M. Chinn; Kathleen Finn. Massachusetts General Hospital, Boston, MA. (Control ID #1286064)
LEARNING OBJECTIVE 1: Recognize when to consider paraspinal compartment syndrome as a cause of back pain.
LEARNING OBJECTIVE 2: Understand who is at risk for paraspinal compartment syndrome.
CASE: A 34 year old man with history notable for myocardial infarction at age 29, polysubstance abuse, hepatitis C, and lumbar disc disease presented with debilitating back pain and extremity weakness. The patient is a mixed martial arts fighter who had been restricting fluids while training to make a lower weight class for a fight. During the match he suffered repeated blows to the back. Afterward he ingested an unknown amount of ibuprofen and snorted cocaine. He then slept for 1 hour but awoke with severe back pain and could not move his arms or legs. He stated his strength returned but noted lower back numbness and "tightness" without radiation. Physical exam revealed hard left paraspinal muscles and tenderness to palpation over this area, but no swelling. Pain was out of proportion to exam. Sensation was intact and he had normal bilateral lower extremity motor strength. Initial laboratory measurements were as follows: serum creatinine, 3.5 mg/dL; aspartate aminotransferase, 1106 U/L; alanine aminotransferase, 289 U/L; creatinine kinase (CK), 91,790. Lumbar x-rays showed a loss of lordosis and a non-contrast computed tomography (CT) demonstrated mild degenerative changes of the spine without fracture or paraspinal muscle abnormality. Compartment pressure measurements were obtained. Left and right proximal paraspinal muscle pressures were 20 and 38 mmHg respectively. Fasciotomy was not performed at this time because the differences between compartment and diastolic pressures (83-86 mmHg) were
greater than 40. The following day his CK had improved to 63,310. However, persistent severe back pain prompted repeat pressure measurements showing left and right sided pressures of 110 and 115 mmHg respectively. He was taken for an emergent fasciotomy.
DISCUSSION: Acute compartment syndrome occurs when increased pressure within fascial spaces results in neurovascular compromise and ischemia. While rare, paraspinal compartment syndrome occurs in both traumatic and non-traumatic cases. Risk factors include strenuous physical exertion, trauma, or impaired circulation during aortic bypass surgery. It is most commonly reported in young men who weight lift or ski. All but one were admitted for rhabdomyolysis and reported significant back pain. Paraspinal compartment syndrome can share findings with other common causes of back pain. However, physical exam findings include

tender paraspinal muscles, loss of lumbar lordosis, absent bowel sounds, and localized sensory loss. Pain is out of proportion to exam and is exacerbated by valsalva maneuvers, passive and active spinal flexion, or straight leg maneuvers. CT imaging can show swelling of the musculature, but may be normal. Magnetic resonance imaging demonstrates increased T2-weighted signal intensity. Although compartment pressure measurement remains the gold standard for diagnosis, there is no consensus regarding an absolute pressure threshold for fasciotomy. Some use 30 mmHg as a cut off, while others utilize the difference between diastolic and compartment pressures (delta pressure). Definitive management includes surgical decompression. Early recognition of paraspinal compartment syndrome in a patient with severe back pain and rhabdomyolysis is crucial to prevent permanent muscle and nerve damage.

PEDIATRIC SYNDROMES FOR INTERNISTS: OPSOCLONUS MYOCLONUS ATAXIA IN AN ADULT Kalpana Nagarkar; Tsao-Wei Liang; Manuel Vergara; Rajeshree Anandakrishnan. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1319784)

LEARNING OBJECTIVE 1: Opsoclonus myoclonus ataxia can be mistaken for anxiety, status epilepticus, cerebellar ataxia, Sydenhams chorea and others.

LEARNING OBJECTIVE 2: Internists need to be aware that though this is mostly a pediatric syndrome, it can present in adults and unlike in children, the patient can show better response to IVIG than to ACTH treatment.

CASE: A 19 year old African American female presented with acute onset of unstable gait, chaotic eye movements and tremulousness of the whole body associated with nausea and vomiting. She denied fever or recent flu-like symptoms. Vital signs were normal including no fever. She was alert and oriented with normal mental status. Cranial nerve examination showed conjugate, arrhythmic, chaotic, large amplitude eye movements, predominantly in horizontal direction. Voluntary ocular movements were full but tended to exacerbate the opsoclonus. She had severe truncal and appendicular ataxia, along with truncal and limb myoclonus. Her myoclonic movements markedly increased on attempted movement. The deep tendon reflexes were normal and no paresis or sensory deficit could be found. Remaining neurological and systemic examination was normal. EEG was negative for epileptiform activity. LP revealed 19 WBC/hpf 96% lymphocytes and normal protein and glucose. CSF was negative for HSV, Lyme, VDRL and enterovirus. MRI of the brain was normal. She underwent intensive negative evaluation to rule out malignancy. She was diagnosed with opsoclonus myoclonus ataxia (OMA), and initially received high dose corticosteroids and ACTH therapy without any response. Later she received IVIG treatment with improvement.

DISCUSSION: OMA affects mainly young children with a mean age of 1.5 to 2 years. Non-paraneoplastic OMA has been reported in adults in association with various infections, including Lyme disease, enterovirus, West Nile virus, Epstein Barr virus, HIV, salmonella, cytomegalovirus, after anti-Rubella vaccination, and post-streptococcal infection. Many cases of non-paraneo-plastic OMA are idiopathic and often assumed to be parainfectious in origin. Our case was presumed to be a post viral syndrome as other causes were ruled out, CSF pleocytosis was present, and symptoms responded to IVIG treatment. Teaching Points: This infrequent syndrome can be mistaken for anxiety, status epilepticus, cerebellar ataxia, Sydenhams chorea and others. Unlike in children, our patient showed better response to IVIG than to ACTH treatment. In order to develop novel and effective therapeutic strategies, further studies on the immunopathogenesis and pathophysiology of OMA are required.

PERSISTENT HEADACHE: A FUSS OVER CRYPTOCOCCUS Leila Zuo; Amit Kothari. UT Southwestern Medical School, Dallas, TX. (Control ID #1339930)

LEARNING OBJECTIVE 1: Identify the clinical presentation of cryptococcal meningitis.

LEARNING OBJECTIVE 2: Recognize the utility of corticosteroids and surgical intervention as adjunctive therapy for cryptococcoma.

CASE: A 36 year-old man presented with a 3-week history of headache. He also noted neck stiffness,

photophobia, persistent nausea, and intermittent vomiting during this time. Ibuprofen, acetaminophen, and marijuana did not provide relief. He denied high risk sexual behavior and was not known to be HIV positive. Past medical history is only notable for psoriasis without previous immunosuppressive therapy. Lumbar puncture revealed elevated protein &low glucose. Vancomycin and ceftriaxone were started as empiric therapy for presumed bacterial meningitis. Subsequent CSF culture revealed budding yeast identified as Cryptococcus neoformans. Vancomycin and ceftriaxone were discontinued, and a 6-week course of ambisome and flucytosine was started. A right temporal ring-enhancing 3 cm mass with central necrosis was seen on initial MRI, consistent with cryptococcoma. His hospital course was complicated by partial seizures for which he was treated with phenytoin. After ventriculo-peritoneal shunt placement and 5-weeks of antifungal treatment, the patients headaches persisted. Repeat MRI/CT scan revealed stable size of the lesion but with worsening cerebritis and more prominent vasogenic edema. Due to ongoing headache and increased edema, dexamethasone was added to his treatment regimen. Four days of treatment with corticosteroids did not improve his headaches, and he underwent resection of the cryptococcoma. DISCUSSION: General internists should recognize the triad of headache, photophobia, and nuchal rigidity as possible meningitis. Internists should understand how to work-up this patient, as his subacute presentation points to a differential of a wide variety of infectious, inflammatory, and malignant etiologies. To determine the cause of subacute meningitis, patients should undergo a complex workup that includes serologic assays, imaging tests, and repeated lumbar puncture. Though more common in immunocompromised patients, cryptococcal meningitis should be considered in any immunocompetent individual presenting with subacute to chronic meningitis and antigen testing of the CSF for C. neoformans should therefore be performed. Cerebral cryptococcomas can cause significant neurologic morbidity and are difficult to treat, often requiring prolonged antifungal treatment with multiple rounds of induction therapy. As there are no prospective studies of therapy for cerebral cryptococcomas, current treatment recommendations are based on case reports and retrospective analyses. Corticosteroids and surgical resection should be considered for cases refractory to antifungal therapy. Although unusual, cases of immunocompetent individuals with cryptococcoma successfully treated with antifungal drugs, corticosteroids, and surgical resection have been reported. In this patients case, corticosteroids were initiated to decrease intracranial edema and for symptom management. Future MRI results and post-operative evaluation of his condition could potentially add to the sparse scientific literature regarding treatment strategy for cryptococcoma.

PHEOCHROMOCYTOMA PRESENTING AS CARDIOGENIC SHOCK: AN ATYPICAL CASE. Danny Spinuzzi; William J. Rust. Allegheny General Hospital, Pittsburgh, PA. (Control ID #1283926)

LEARNING OBJECTIVE 1: To recognize pheochromocytoma as a potential cause in patients who present with shock of unknown etiology. LEARNING OBJECTIVE 2: To identify the various manifestations of pheochromocytoma, as well as tools to screen and treat.

CASE: A 51 year old white female with a past medical history of hypertension and diabetes mellitus (DM) presented to the emergency department complaining of chest pain, shortness of breath and several episodes of emesis over the preceding 2 days. Vital signs include a blood pressure (BP) of 60/30 mm Hg, heart rate (HR) of 130 beats per minute (bpm) and respiratory rate (RR) of 34 /min. Physical exam revealed bilateral crackles and cool extremities. Sinus tachycardia with diffuse ST segment and T wave changes were seen on the initial electrocardiogram (ECG). Initial cardiac enzymes were elevated. Other pertinent presenting laboratory values included a leukocyte count of 19.7 k/ml, BUN of
27 mg/dL, and a creatinine of 2.5 mg/dL. An arterial blood gas revealed a pH of 6.99 and HCO3 of 6.6. A chest X-Ray revealed bilateral pulmonary edema. She was emergently intubated, and started on dopamine and dobutamine. An emergent cardiac catheterization found normal coronary arteries and severe left ventricular (LV) dysfunction with an ejection (EF) of 10%. An intra-aortic balloon pump was placed for hemodynamic support and the patient was evaluated for possible left ventricular assist device. In the CCU, systolic blood

pressure ranged from 90-220 mm Hg and HR ranged from 120-280 bpm. She had urine metanephrine of 3195(Normal 30-180 ug/24 hr), total metanephrine 4838(Normal 164-588 ug/24 hr) and normetanephrine of 1643(Normal 124-484 ug/24 hr). Anti-hypertensive medical therapy included phentolamine, phenoxybenzamine and labetolol. Computed Tomography (CT) revealed a left adrenal mass highly suspicious for pheochromocytoma. Pathology from an abdominal tumor resection confirmed the diagnosis. The hospital course was complicated by acute renal failure and respiratory failure, but she gradually improved post-operatively and a repeat echocardiogram revealed an EF of 65%. She was discharged to home without anti-hypertensive therapy. DISCUSSION: Pheochromocytoma is a rare neuroendocrine tumor derived from enterochromaffin cells and is found in less than 0.3% of hypertensive individuals. 0.01% present with shock. Symptoms typically include a triad of headache, palpitations and diaphoresis. Less common cardiac manifestations include acute myocardial infarction, arrhythmias, dilated cardiomyopathy, and in some extreme cases, acute heart failure. This case illustrates a near fatal presentation of Pheochromocytoma. Sudden release of catecholamines may precipitate hemodynamic compromise and multi-system organ failure. Catecholamine induced focal myocardial necrosis with inflammatory infiltration can cause pulmonary edema and LV dysfunction as seen in this patient and appears to be reversible with both medical management and subsequent removal of the tumor. Although rare, the diagnosis of pheochromocytoma should be considered in patients that present with cardiogenic shock of unknown etiology. This case illustrates the significant morbidity and mortality associated with pheochromocytoma and the importance of recognizing its various clinical manifestations.

PITYRIASIS LICHENOIDES ET VARIOLIFORMIS ACUTA (PLEVA): A CASE REPORT Peter T. Georges; Menhel Kinno. Umassmemorial health care, Worcester, MA. (Control ID #1312840)

LEARNING OBJECTIVE 1: The purpose of reporting this case is to increase awareness of this rare disease, and promote research of its pathophysiology, prognosis, and therapy.

CASE: This is a 29 year old Caucasian male who presented with a rash and systemic symptoms for 1 month. Initially, he developed painful papules on the trunk which spread to the extremities and head, with palmar and plantar sparing. Additionally, he had fever, bodyaches, and sore throat. His serology was positive for varicella and he was treated with 1 week of valacyclovir. He presented to the hospital for therapy failure. He had tender papules with central hemorrhagic crust distributed over trunk, extremities, genitalia, and head, with sparing of mucosa, palms, and soles. He was febrile and tachycardic. He denied any past medical history. He smokes 1.5 ppd of cigarettes, denies IVDA, and is homosexual with 1 partner. Laboratory results showed leukocytosis, negative HIV test, and positive VZV and HSV serology. The infectious disease team evaluated the patient and treated him with IV acyclovir for 10 days. His symptoms did not resolve and dermatology was consulted. They performed a skin biopsy of a lesion which showed features consistent with PLEVA and plasma cells, which is atypical for this disease. A syphilis test was performed prior to discharge. Patient was discharged on Azithromycin for 10 days for treatment of PLEVA. The syphilis test was positive and the patients primary care physician was notified and he received treatment with Penicillin as an outpatient. He followed up with the dermatology clinic and had mild improvement in his symptoms following treatment for syphilis. DISCUSSION: PLEVA, or Mucha-Habermann disease, is a cutaneous disorder with erythematous macules and papules, usually on the trunk and extremities. The lesions present at different stages with either a central punctum or evolve into vesicopustules with hemorrhagic necrosis or crust. It is seen in an acute or chronic form. It occurs most frequently in the second or third decades of life and is more frequent in men. Its etiology is unclear but it is suggested to be an inflammatory reaction triggered by

infectious agents or an immune complex-mediated hypersensitivity. EBV, adenovirus, toxoplasma gondii, parvovirus B19, s. aureus, and s. pyogenes are pathogens thought to cause PLEVA. Upper respiratory tract

infections, chickenpox, and streptococcal pharyngitis may precede the onset of PLEVA. PLEVA is diagnosed by skin biopsy and histopathology shows perivascular and diffuse lymphocytic and histiocytic infiltration that obscures the dermoepidermal junction. There is a febrile ulcerative Mucha-Habermann disease (FUMHD), which is a potentially lethal variant. Treatment includes tetracycline, macrolides, or phototherapy. Treatment of FUMHD is more challenging and includes steroids, methotrexate, and dapsone.

PLASMAPHORESIS IN THYROID STORM WITH MULTI-ORGAN FAILURE Deepa Rani Nandiwada; Andrew A. Chang. NYU Langone Medical Center, New York, NY. (Control ID #1339438)

LEARNING OBJECTIVE 1: Diagnose thyroid storm causing multi-organ failureLEARNING OBJECTIVE 2: Assess the use of plasmaphoresis in the treatment of thyroid stormCASE: A 31 year-old man presented with palpitations and worsening shortness of breath for two months associated with worsening orthopnea and decreased exercise tolerance. Over the past two weeks he noted worsening chest pain, yellowing of his skin and eyes, darkening of his urine, and twenty-pound weight loss. He denied fever, chills, cough, chills, diarrhea or abdominal pain. On exam, he appeared cachectic in moderate respiratory distress with T 101.7 F, HR 165, RR 20 O2 sat 95% on room air. Scleral icterus, exophthalmos, jugular venous distension, decreased breath sounds at bilateral bases crackles, and hepatomegaly were appreciated. On laboratory exam the patient had a white blood cell count of 9,800 and hemoglobin of 10.3,AST 56, ALT 22, ALP 179, direct bilirubin 4.8, INR 2.8 TSH <0.04, free T4 5.4. Chest X-Ray demonstrated bilateral pleural effusions and increased vascular congestion. EKG revealed atrial flutter with 2:1 conduction and a ventricular rate of 165. An echocardiogram revealed an ejection fraction of 25%. He was admitted to the Intensive Care Unit and started on propylthiouracil, potassium iodide, and hydrocortisone. A beta-blocker drip was started, but was ineffective in controlling his heart rate. Eventually he became hypotensive requiring multiple pressors. Vancomycin and Pipercillian-tazoactam were started empirically as the patient was hypotensive and febrile, although initial cultures were negative. He eventually required intubation and continuous venous-venous hemofiltration. Fulminant hepatic failure ensued presumably due to shock liver on top of his thyrotoxic liver injuries. Plasmaphoresis was trialed while the patient was being evaluated for possible liver transplant. This resulted in temporary improvement in mental status and hormone levels. As the patient was undocumented, he did not qualify for transplant. A multi-disciplinary conference was held and the patient's prognosis was deemed futile without a liver transplant. The patient ultimately expired.

DISCUSSION: In-hospital mortality from thyroid storm is high, reaching up to 30%, with multi-organ failure seen in less than 10% of these cases. Diagnosing and treating thyroid storm early can reduce mortality and prevent multi-organ failure. Based on the Burch-Wartofsky scale, the patient met criteria for high suspicion of thyroid storm. Hepatotoxicity is reported in up to 30% of patients with thyrotoxicosis, however fulminant hepatic failure is only reported in 4 case reports and is associated with 80% mortality without transplant. Vulnerable populations can be even more challenging due to lack of access to primary care for early disease management and diagnosis. As seen in our patient transplant was not an option due to his undocumented status. The mainstays of thyroid storm treatment include medications that control increased adrenergic tone and medications that control the release and conversion of T3 and T4 including thionamide, iodine solution, iodinated radiocontrast, and glucocorticoids. Plasmaphoresis in thyroid storm has been attempted in only a few case reports, often with positive outcomes. Indications for plasmaphoresis include treatment failure, thyrotoxicosis induced cardiotoxicity, neurotoxicity, coma, and rapid clinical decompensation.

POST TRANSFUSION PURPURA VERSUS HEPARIN INDUCED THROMBOCYTOPENIA: A DIAGNOSTIC DILEMMA Subhraleena Das; Sujith Cherian; Wasim A. Hamarneh; Ehtesham Ul Haq. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1334621)

LEARNING OBJECTIVE 1: 1. Recognize the complexity of sudden onset thrombocytopenia in an inpatient setting.

LEARNING OBJECTIVE 2: 2. Distinguish between post transfusion purpura (PTP) and heparin induced

thrombocytopenia (HIT) when faced with the dilemma.
CASE: A 59 year- old- African American man with history of hypertension and severe peripheral vascular disease was admitted for evaluation of fever. The patient was just recently discharged 7 days prior to the admission, during which he underwent a left below knee amputation, which was complicated with severe bleeding, requiring 2 units of packed red cells (PRBC) transfusion. During the present admission, review of systems was negative. Physical examination was benign except for a temperature of 101.5 degrees F. Labs revealed anemia with a hematocrit of 25, for which 2 units of PRBC was given. Over the next day, platelet counts plummeted from 160,000 to 4,000.All heparin products were discontinued empirically. However, HIT antibody was negative. PTP was considered, given the previous history of blood transfusion, and he was started on intravenous immunoglobulin (IVIG). A positive human platelet alloantigen (HPA) antibody confirmed the diagnosis. Platelet counts subsequently improved. After a week, the patient developed right upper extremity pain and was a Doppler ultrasound confirmed the diagnosis of basilic vein thrombosis, and blood counts at the time also revealed a rapid drop in platelet count raising a suspicion for HIT. HITantibody was positive and the diagnosis of HIT was confirmed with serotonin release assay (SRA). Patient was started on argatroban infusion thereafter and discharged subsequently on warfarin.
DISCUSSION: PTP and HIT are two immune syndromes causing extreme thrombocytopenia, but with marked differences in pathogenesis and treatment. PTP is characterized by marked thrombocytopenia <15 Gpt/L, with platelet alloantibodies (most commonly anti HPA-1a antibody) following human platelet alloantigen incompatible blood product transfusion which may be complicated by severe hemorrhagic complications. Treatment options include mainly IVIG therapy. HIT is associated with platelet nadir between 20 to 150 Gpt/L, usually with generation of antibodies to heparin and platelet factor 4 (PF4) antigen complexes, and thrombotic complications. Treatment is discontinuation of all heparin products with initiation of danaparoid products or recombinant hirudin. Delayed onset HIT can occur as late as even 3 months after heparin products are discontinued. Our case is unique with the presence of both HPA 1a antibody and HIT antibodies, which has been reported only once before, emphasizing the importance of making the right diagnosis due to the difference in treatment of both the conditions.
POSTINFECTIOUS GLOMERULONEPHRITIS IN AN ELDERLY PATIENT-A CASE REPORT AND REVIEW OF THE LITERATURE Mamatha Racheruvu1; Zipporah Krishnasamy2. 1UAB Montgomery, Montgomery, AL; 2University of Alabama at Birmingham, Birmingham, AL. (Control ID #1334206)
LEARNING OBJECTIVE 1: Recognize the cause of rapidly progressive renal failure in an elderly patientCASE: 65 yr old white male with history of Diabetes, Hypertension, Congestive Heart Failure, Aortic Stenosis status post aortic valve replacement six weeks earlier was admitted with Methicillin Resistant Staphylococcus Aureus (MRSA) infection at surgical site. On admission Creatinine (Cr) was 1.5 with baseline Cr of 1.1-1.3. Cr started to increase slowly to 5.5 over a period of one month. During the hospital stay patient was on vancomycin for MRSA infection. On physical exam patient had petechial rash on both lower limbs, 2+pitting edema at sacrum and auscultation of lungs revealed bilateral basal crepitations. Remaining exam was normal. Chemistries showed sodium of 138 mEq/L, potassium of4.2 mEq/L, chloride of 99 mEq/L, bicarbonate of 30 mEq/L, blood urea nitrogen of 48 mg/dL, and creatinine of 5.5 mg/dL. On Hematology, white blood cell count was 11,000 with differential of 76% neutrophils, and 6% eosinophils (Eos). Urine analysis showed yellow, cloudy urine with PH of5.0, 3+ protein, 2+blood and 1+ Eos. Random urine sodium was 64 mEq/L, with Fractional excretion (Fe) of sodium of 4%, FeUrea of 67%. 24 hour urine protein was 3.3 g/dL. Serum Antinuclear Antibody titer was less than 1:80,Rheumatoid factor was negative, complement C3 and C4 levels were normal, Anti-neutrophilic cytoplasmic antibodies (ANCA)-C and ANCA-P

were negative and Hepatitis B was negative. Renal Ultrasound was benign with both kidneys of normal size of 12 cm each. Biopsy of the petechial rash revealed leukocytoclastic vasculitis due to moxifloxacin, which was

started four weeks earlier. Initially the Renal failure was attributed to Allergic Interstitial Nephritis and moxifloxacin was stopped, but Cr subsequently worsened and then it was thought due to cardio-renal syndrome or Vancomycin toxicity as Vancomycin trough levels were 25mcg/ml (15-20mcg/ml). Since therapeutic approach for management of these possible etiologies differs, and with worsening renal function it was thought he would benefit from kidney biopsy. Renal Biopsy showed Post Infectious Glomerulonephritis with diffuse mesangial staining for IgA (2+), C3 (3+) along with one large hump type subepithelial deposit. DISCUSSION: This case illustrates IgA-dominant acute postinfectious glomerulonephritis (APIGN).The presence of diabetes with recent MRSA infection at the surgical site were the risk factors predisposing to APIGN. So far 109 cases of APIGN were reported. The average age at diagnosis was 60 years. Most patients were Caucasian (53%) and Asian (26%), with few African Americans, Hispanics and Native Americans. Underlying diabetes mellitus was present in 27 patients (55%), others include malignancy, IV drug use, alcoholism, HIV infection and atopic dermatitis. The most common site of infection was skin, infectious agent identified was Staphylococcus in 76%. The latent period between infection and onset of renal disease was typically 1 to 6 weeks. Clinical presentation included renal failure, hematuria, proteinuria and hypertension. The pathogenetic mechanism likely involves specific host responses to the inciting pathogen. On pathology, stronger immunofluorescence staining for C3 than IgA, and the presence of subepithelial humps on electron microscopy are characteristic of APIGN Despite therapy directed to the infection, prognosis is guarded with less than a fifth of patients fully recovering renal function.

POTASSIUM WASTING IN AN HIV PATIENT ON HIGHLY ACTIVE ANTIRETROVIRAL THERAPY Genevieve Lozier; Stephen Harder. University of Texas - Southwestern, Dallas, TX. (Control ID #1338825)

LEARNING OBJECTIVE 1: Recognize the potential for proximal tubular toxicity in HIV patients on tenofovir.

LEARNING OBJECTIVE 2: Assess risk factors for the onset of tenofovir-induced Fanconi syndrome.

CASE: A 48 year-old man with HIV treated with Atripla (efavirenz/ emtricitabine/tenofovir) presented with incidental findings of hypokalemia and hyponatremia. Since being diagnosed with HIV he had experienced gradual weight loss, but described no other recent changes in medication or general health and had no diarrhea or vomiting. On physical exam, he was cachetic with dry mucous membranes. Initial laboratory studies demonstrated potassium of 2.7 meq/L, sodium 131 meq/L, chloride 99 meq/L, bicarbonate 19 meq/L, albumin 3.7 g/dL, and anion gap 13 meq/L, indicative of a nonanion gap metabolic acidosis. A proximal renal tubular acidosis was suggested by a urine sodium of 38 meq/L, potassium 28 meq/L, chloride 35 meq/L, osmolality 285 mOsm/kg, pH 7.0, and urine anion gap 31 meq/L. With a transtubular potassium gradient of 7.6, renal potassium wasting was present. Twenty-four hour urine studies showed additional wasting of phosphate and protein, confirming the diagnosis of Fanconi syndrome.

DISCUSSION: Fanconi Syndrome is characterized by proximal renal tubular dysfunction causing proteinuria, amino aciduria, phosphaturia, glycosuria, and bicarbonate wasting. Fanconi syndrome is most often caused by monoclonal gammopathies and heavy metals, but may be drug-induced as with tenofovir, a first-line component of highly active anti-retroviral therapy (HAART). Tenofovir is excreted by both renal filtration and secretion from proximal tubular cells, which are injured by intracellular tenofovir accumulation. In this case, weight loss was the inciting factor leading to a higher dose relative to the patients weight. Other risk factors for tenofovir-induced toxicity include advancing age, decreasing renal function, and the addition of nephrotoxic agents. While tenofovir-induced Fanconi syndrome is rare, there is evidence that subclinical renal tubular toxicity is common, and monitoring is warranted. Physicians investigating a renal tubular acidosis in an HIV patient on HAART should keep tenofovir-induced proximal renal tubule dysfunction in their differential diagnosis.

POTASSIUM FOR A BROKEN HEART Sumaira Shaikh1; Suhail Shaikh2; James M. Sosman1. 1University of Wisconsin Hospitals and clinics, Madison, WI; 2Sea Mar CHC, Olympia, WA. (Control ID #1334458)

LEARNING OBJECTIVE 1: Recognize the clinical features of Tako-Tsubo cardiomyopathy and the difficulty in differentiating between Tako-Tsubo cardiomyopathy and Ischemic cardiomyopathy based on history, physical exam, EKG, cardiac markers and echocardiogramLEARNING OBJECTIVE 2: Recognize that hypokalemia can

affect the musculature of the heart along with the electrical system, leading to Tako-Tsubo CardiomyopathyCASE: : A 62 yr old lady presented with progressive weakness over the past 6 months requiring her to use a walker to ambulate. She reported extreme anorexia and a 50 lb weight loss. She had not seen a physician in 38 years since the birth of her daughter. PE revealed HR 88, BP 100/60, dry skin, clear chest, cardiac exam with palpitations but no murmurs, and non-focal neuro exam with generalized 4/5 muscle strength. Lab tests revealed K 1.2, Mg 0.8, Ca 5.7, Na 136, Cl 90, HCO3 35, BUN 12 Cr 1.36 Glu 95, TSH 35, Hgb 9.9 and elevated Troponin 0.65. EKG showed prolonged PR and QT with LBBB. Her electrolytes were replaced and her PR and QT interval normalized and LBBB resolved. Her weakness was considered secondary to low K . A TTE revealed EjFx 40% and anterior and anteroseptal wall motion abnormality c/w infarction. She was started on metoprolol but had persistently low BP (90s/50s). That same night, the patient reported dyspnea. Exam revealed elevated JVP and bilateral chest crackles. CXR showed bilateral pulmonary edema. Repeat EKG showed anterior infarct along with poor R wave progression. Troponin increased to2.33. She was taken for cardiac catheterization next morning, which revealed minimal CAD with maximum stenosis<25 % but ventricular apical ballooning with EjFx 25%. She was thought to have Tako-Tsubo cardiomyopathy, as a result of severe hypokalemia. The hypokalemia may have been from GI losses secondary to laxative abuse or renal losses secondary to diuretic abuse, vomiting, Barters or Gitelmans syndrome. She was continued on metoprolol tartrate, low dose levothyroxine, potassium replacement and discharged home with outpatient physical therapy. DISCUSSION: Transient left ventricular (LV) apical ballooning syndrome or Tako-Tsubo cardiomyopathy (TTC) is a syndrome characterized by transient LV dysfunction, ECG changes that mimic acute MI with myocardial enzyme release in the absence of obstructive CAD. TTC was first described in 1991 in Japan and named Takotsubo due to its similar echo appearance to a Japanese pot with a round bottom and narrow neck used for trapping octopuses (LV apical ballooning) . This case illustrates how difficult it is to differentiate between TTC and ischemic cardiomyopathy. TTC has been increasingly recognized mostly in post-menopausal women (90%), who present with dyspnea and chest pain from a presumed acute MI (prevalence 2.5 %). TTC is often preceded by emotional or physical stress. Hypokalemia has known effects on the electrical system of the heart which were noted on the patients admission EKG. Severe hypokalemia may have been the triggering factor for Takotsubo cardiomyopathy in this patient. The patient was seen in cardiology clinic 4 weeks after discharge. She reported feeling better with improved energy and no return of chest pain or dyspnea. Most patients with TTC have complete resolution of cardiomyopathy, within days to weeks after the event.

POTENTIALLY FATAL MUSCLE SPASMS Sana F. Khan; LeAnn Coberly. University of Cincinnati Academic Health Center, Cincinnati, OH. (Control ID #1310136)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of Tetanus, as timely diagnosis and treatment can prevent severe morbidity. CASE: A healthy 56 year old Caucasian male presented with a 16 hour history of facial, neck and upper extremity twitching and spasms. The symptoms initially started with bilateral, symmetric, painless spasms occurring over the lower face, lasting for a few seconds and resolving spontaneously. The patient was unable to talk during spasms, and occasionally felt a choking sensation. The spasms worsened by talking or activity, and were associated with five episodes of locked jaw earlier in the

day. The physical exam was otherwise unremarkable. There was no history of recent wounds, sutures, soil or animal exposures. The patient was admitted to the ICU anticipating the need for respiratory support and close monitoring of vital signs. Treatment was initiated with IM tetanus immunoglobulin, IM tetanus toxoid, IV metronidazole and IV diazepam. A dark quiet environment was provided and supportive IV fluids initiated. Supportive care resulted in resolution of symptoms and the patient was transitioned to oral diazepam and metronidazole, and was subsequently discharged home.

DISCUSSION: Tetanus is a potentially fatal disease, with case fatality rates in developed countries as high as 20%. With the advent of successful immunization strategies, only 31 cases per year have been reported from 2002 to 2007. Generalized tetanus is the most commonly recognized type of tetanus and diagnosis is mainly on clinical findings. Though most cases are associated with contaminated wounds, 7% to 21% of cases are cryptogenic. Symptoms usually start with episodes of muscle spasms and trismus, followed by stiffness of neck, shoulder and back muscles. Sustained contraction of facial and back muscles produce characteristic risus sardonicus and opisthotonus respectively. Spasms are spontaneous and provoked by slight stimulation. Laryngeal along with respiratory muscle spasms results in respiratory failure which is the leading cause of death. Additional complications include autonomic instability, spinal fractures and rhabdomyolysis with renal failure. Other conditions mimicking generalized tetanus include seizures, dystonic reactions, meningitis/encephalitis, hypocalcemia, and strychnine poisoning. Treatment is aimed at wound debridement, antimicrobial therapy and supportive care. Tetanus immunoglobulin is used to neutralize unbound toxin, whereas metronidazole is currently the preferred antimicrobial. Ventilatory support and an environment without tactile and auditory stimuli are essential. Benzodiazepines are commonly used to control rigidity and spasms. Specific therapies for autonomic instability have not been defined, but labetalol, magnesium sulfate and morphine have been shown to be effective. Besides immunoglobulin, primary immunization with tetanus toxoid is also initiated at time of diagnosis.

PRIMARY EFFUSION LYMPHOMA IN AN HIV-NEGATIVE PATIENT WITH ABDOMINAL DISTENSION

Jessica Taff; Nicole Adler. New York University Langone Medical Center, New York, NY. (Control ID #1334581)

LEARNING OBJECTIVE 1: Primary effusion lymphoma can present atypically with complaints of abdominal distension and ascites. LEARNING OBJECTIVE 2: Although most common in HIV positive patients or those with immunocompromise, primary effusion lymphoma may occur in HIV negative and otherwise immunocompetent patients. CASE: A 76 year-old Filipino man presented with two weeks of generalized weakness and decreased exercise tolerance. He also endorsed worsening polyuria, polydipsia, and diffuse abdominal swelling that prompted admission. On physical exam, the patient was alert and oriented to self and place. He had jugular venous distension to the angle of the mandible and bibasilar crackles. His abdomen was distended with shifting dullness. He had pitting edema to the thighs bilaterally. Labs were notable for a hemoglobin of 9.2 g/dL, platelets of 106,000/mm3, sodium of 109 mmol/L, and chloride of 81 mmol/L. Aspartate aminotransferase was66 U/L and alkaline phosphatase was 81 U/L. B-type natriuretic peptide was 883.5 pg/ml and lactate dehydrogenase was 391U/L. A diagnostic paracentesis revealed 5650 red blood cells/mm3 and 930 white blood cells/ mm3, with 69% lymphocytes. Abdominal CAT scan revealed a large amount of abdominal and pelvic ascites with ill-defined stranding and nodularity of the peritoneal surface. Liver and spleen were normal. A peripheral blood smear revealed large neoplastic lymphoid cells. Hematoxylin and eosin staining showed pleomorphic large atypical cells with nuclear stippling. The cells were CD38 positive on flow cytometry and positive for CD 138 and Human Herpesvirus - 8 (HHV-8) on immunohistochemistry. The patient was diagnosed with primary effusion lymphoma and elected against treatment. He was transferred to hospice where he died several weeks later. DISCUSSION: Primary effusion lymphoma (PEL) occurs when there is infection of tumor-clone cells by HHV-8 with subsequent liquid phase growth in serous cavities in the absence of tumor mass. It was originally classified as a distinct type of B cell Non-Hodgins Lymphoma in AIDS patients who were also positive for HHV-8. The malignant cells are
recognized as pre-terminally differentiated B cells. The cells traditionally express a common gene profile distinct from other Non-Hodgkins lymphoma, with the tumor cell corresponding to a stage of B-cell development intermediate between that of immunoblasts and plasma cells. HHV-8 is thought to be a requirement for pathogenesis by promoting tumor growth. Approximately 70% of PEL patients are also co-infected with Epstein-Barr virus (EBV), as was our patient, although this relationship is less well clarified. Although patients with PEL

most often present with symptomatic pleural effusions, this patients main complaint was abdominal distension with ascites. His fluid had characteristic findings of PEL, with ascites plasmablastic cellular morphology and positivity for CD 138, HHV-8, and EBV without B-cell markers. Also unique about this case is that the patient was HIV negative. Although there are case reports of PEL in HIV negative patients, these people usually have an associated degree of immunocompromise. Other than older age, this patient did not have any known risk factors for an immunocompromised state. In conclusion, this case presents an unusual diagnosis of primary effusion lymphoma in an HIV negative patient without additional evidence for an immunocompromised state. While rare, his presentation had many of the typical features of this uncommon disease.

PRINZMETAL'S ANGINA: AN UNDER RECOGNIZED CAUSE OF RECURRENT ST ELEVATION MI Pratik Choksy; Rebecca Napier; Gyanendra Sharma. Georgia Health Sciences University, Augusta, GA. (Control ID #1339356)

LEARNING OBJECTIVE 1: Prinzmetal's angina is a well documented but under recognized etiology of recurrent ST elevation MI, which should be considered in patients with recurrent angina with both typical and atypical cardiac risk factors.

LEARNING OBJECTIVE 2: Medical management with nondihydropyridine calcium channel blockers and nitrates is the key for treatment of Prinzmetal's Angina and helps in preventing recurrent cardiac catheterization.

CASE: A 67 year old male with past medical history significant for hypertension, hyperlipidemia, and tobacco use presented to his primary care physician with complaint of intermittent chest discomfort during the previous 2-3 weeks. The pain was described as a substernal pressure which was nonradiating and occurred daily lasting 5-15 minutes per episode. The pain occurred spontaneously and there was no identifiable association with rest or exertion. EKG was obtained at presentation and consistent with ST elevation in the inferior leads. Patient subsequently underwent urgent cardiac catheterization notable for 90% proximal and 90% distal RCA (right coronary artery) lesions for which he underwent uncomplicated balloon angioplasty without stenting. Off note patient had a peak troponin of 0.02 and ejection fraction (EF) of 65% with mild inferior wall hypokinesis by left ventriculography. At two week follow up, the patient continued to complain of recurrent chest discomfort often occurring upon awakening in the mornings. Patient developed chest pain during his office visit. EKG showed 3 mm ST elevation in leads II, III and aVF and reciprocal ST depression in leads I and aVL. Patient was given nitroglycerin and repeat EKG showed gradual decrease in ST elevations with symptomatic improvement in the chest discomfort. Given concern for reocclusion of RCA, the patient again underwent urgent cardiac catheterization showing subtotal occlusion of the proximal RCA. During the procedure, intracoronary nitroglycerin was administered with visible resolution of the occlusion via angiography consistent with coronary vasospasm. Patient was therefore initiated on therapy with amlodipine and isosorbide mononitrate and remained symptom free at subsequent follow up visits.

DISCUSSION: Prinzmetals or variant angina is characterized by a transient reduction in luminal diameter of a coronary artery resulting in spontaneous and often recurrent episodes of angina with EKG findings consistent with ST elevation. Such findings can often result in repeat invasive studies such as cardiac catheterization. Key findings for diagnosis of coronary vasospasm include simultaneous resolution of STsegment changes and anginal symptoms spontaneously or with nitroglycerin, or reversibility of coronary occlusions upon intraluminal injections of nitroglycerin. Though the underlying pathogenesis of variant angina is unclear, there appears to be some component

of autonomic and endothelial dysfunction resulting in spasm of vascular smooth muscle. Those with variant angina are typically younger, often female, and lack traditional cardiovascular risk factors, though vasospasm may occur in association with atherosclerotic plaques. Symptoms often occur in the early morning hours awakening patients from sleep and may occur in association with exercise, hyperventilation, or substance

abuse. Medical therapy is aimed at cardiovascular risk factor reduction and pharmacological management through the vasodilatory effects of non dihydropiridine calcium channel blockers and nitrates.

PROPOFOL USE IN A PATIENT WITH NEUROLEPTIC MALIGNANT SYNDROME INDUCING HYPERTHERMIA Somy S. George; Swati Choudhary; Narendra Khanchandani; Mark Villeneuve. St. Mary Mercy Hospital, Livonia, MI. (Control ID #1311432)

LEARNING OBJECTIVE 1: Neuroleptic malignant syndrome (NMS) is a life threatening neurologic emergency associated with the use of neuroleptic agents and characterized by a distinctive clinical syndrome of mental status change, rigidity, hyperthermia and dysautonomia. Central dopamine receptor blockade in the hypothalamus may cause hyperthermia and other signs of dysautonomia. Propofol has been commonly used as a sedative in the intensive care unit and is generally considered safe. Case reports have shown that Propofol can cause hyperthermia in patients who have predisposing factors such as neuroleptic malignant syndrome.

CASE: Patient was a 41 year old caucasian female with past medical history significant for Diabetes Mellitus Type II, Bipolar Disorder and Hypertension was admitted with acute respiratory failure, altered mental status, and a temperature of 104. She was intubated and broad spectrum antibiotics were given for suspicion of pneumonia. Pan-culture was done which showed no bacterial growth. Her home medications included Benztropine, Chlomipramine, Clonazepam, Lamotrigine, Lithium and Ziprasidone. All her medications were stopped on the day of admission secondary to the possibility of Serotonin Syndrome versus Neuroleptic Malignant Syndrome (NMS). She was started on Propofol drip due to agitation and was weaned off slowly within 3 days. Fever resolved within 2 days of admission. Patient was extubated on day 4 but then was re-intubated the following day secondary to continuing respiratory failure. During second intubation, jaw clenching was noticed and one dose of succinylcholine was given for rapid sequence intubation and Propofol was restarted. Patients temperature slowly started to rise with a rate of approximately 1 degree F/day to a maximum of 107 F. Propofol was then discontinued and patient was given Dantrolene and Bromocriptine for possibility of malignant hyperthermia. Her temperature started decreasing to normothermia within 2 days after discontinuation of Propofol. During the time of her hospital stay, the patient developed multi-organ failure. Due to patients poor prognosis the family made her hospice and she passed 19 days after admission. Multiple factors were responsible for hyperthermia, including NMS, use of succinylcholine, and propofol. But due to the duration of onset of hyperthermia, propofol was the most likely culprit.

DISCUSSION: Propofol should be used cautiously in patients who have mulitple risk factors to hyperthermia. Alternative sedative agents should be used. Further studies need to be done to understand the exact mechanism of hyperthermia caused by propofol in these high risk patients.

PROTON-PUMP-INHIBITOR INDUCED HEPATITIS Jennifer K. Lue; Daniel Eiras; Nicole Adler. New York University School of Medicine, New York, NY. (Control ID #1334557)

LEARNING OBJECTIVE 1: Recognize and distinguish the clinical features of drug-induced hepatitis from other etiologies of hepatitis LEARNING OBJECTIVE 2: Manage acute drug-incuded hepatitis with concomitant hepatitis C infectionCASE: A 61 year-old Hispanic female presented with jaundice, dark urine and progressive fatigue of three weeks duration. The patient presented to her primary care physician three weeks prior to admission with bloating and early satiety, and was started on rabeprazole 20 mg daily. After one week, blood tests were drawn which were notable for an AST/ ALT of 1680/1123 u/L, alkaline phosphatase of 283 u/L, and total bilirubin of 1.7 mg/dL. The patient subsequently noted worsening abdominal discomfort, fatigue and jaundice. She was referred for an endoscopy that demonstrated severe gastritis. The patient was then prescribed omeprazole 40 mg daily and ranitidine 20 mg daily, with discontinuation of rabeprazole.

Due to progression of her symptoms the patient presented to our hospital where she was found to have an AST/ALT of 3423/1620 u/L, alkaline phosphatase of 269 u/L, total bilirubin 10 mg/dL, and a direct bilirubin 6 mg/dL. Physical exam was significant for jaundice, icteric sclera, and mild right upper quadrant pain. A CAT

scan of the abdomen and pelvis demonstrated several small hepatic cysts, but was otherwise normal. The patient's medications including omeprazole were held, and her hepatic enzymes subsequently improved, which was suggestive of a diagnosis of drug-induced hepatitis. In addition, workup of the patients liver function abnormalities revealed a positive hepatitis C antibody and viral load of 7x 10 6 copies/mL.
Due to suspicion of acute hepatitis C versus drug-induced hepatitis, a liver biopsy was performed which was significant for acute drug induced hepatitis intermixed with elements of chronic hepatitis C.
DISCUSSION: In cases of acute hepatitis of unclear etiology, medications should always be considered as possible culprits and reviewed thoroughly. Although Proton-Pump-Inhibitors (PPIs) are generally recognized as low-risk medications, they should be taken into consideration during the evaluation of hepatotoxicity of unknown origin. The more common side effects of PPIs are diarrhea, nausea, vomiting, and abdominal pain. Generally, one can see a minimal elevation in liver enzymes secondary to PPI use 1. However, case reports of acute hepatitis in subjects without previous liver disease have been reported for omeprazole, lansoprazole, and recently pantoprazole 2-5, but to our knowledge, there
are no published cases involving rabeprazole. Our patient had a similar course to those described in the literature, where the development of acute hepatitis resolved spontaneously when the PPI was held. This patients acute presentation was likely complicated by her underlying hepatitis C infection, and highlights the important point that underlying hepatic dysfunction has been shown to alter PPI pharmacokinetics, and may exacerbate the acute presentation of drug-induced hepatitis, although the impairment was less significant in patients with hepatitis compared to cirrhotics 6. In addition, patients with non-alcoholic fatty liver disease were more likely than patients with hepatitis C to develop drug-induced hepatitis 7.
It is likely that baseline hepatic dysfunction made our patient more susceptible to liver injury, and this report may be the first known case of drug-induced hepatitis in a patient with chronic hepatitis C.
PULMONARY AMYLOIDOMA: A RARE CAUSE OF DYSPNEA Qura Tul Ain Rashid; Robin Klein; Dominique Cosco. Emory University School of Medicine, Atlanta, GA. (Control ID #1337547)
LEARNING OBJECTIVE 1: 1. Review the pathophysiology of amyloidosis. 2. Recognize the presentation of nodular pulmonary amyloidosis. 3. Consider pulmonary amyloidosis in the differential diagnosis in patients with calcified nodules on imaging.
CASE: 65 y/o caucasian female presented with new onset dyspnea on exertion for three months. Past medical history was significant for hypertension and pulmonary embolism. Patient denied chest pain, fever or weight loss. Physical exam was unremarkable. Echocardiogram showed normal ejection fraction and mild left ventricular hypertrophy. Right heart catheterization was negative for pulmonary hypertension. Calcified lesions were noted on the chest x-ray. CT chest showed multiple irregular soft tissue masses abutting pleural surface bilaterally. Bronchoscopy revealed normal airway. Biopsy of lung mass showed amorphous eosinophilic material with in lung parenchyma, consistent with amyloidosis. Follow up diagnostic studies including serum and urine protein electrophoresis, free light chain analysis, abdominal fat pad aspiration and bone marrow biopsy were negative for systemic amyloidosis. Patient was diagnosed with nodular form of pulmonary amyloidosis. Pulmonary function test showed mild obstructive disease. Patient is currently being followed by pulmonary service as an out patient for symptom surveillance.
DISCUSSION: Amyloidosis is characterized by the deposition of insoluble amyloid fibrils in extracellular tissue. Classically, these fibrils demonstrate apple-green birefringence under polarized microscopy confirming the presence of amyloid proteins. Protein deposition may occur in association with autoimmune, hereditary, neoplastic or inflammatory conditions. It may involve

multiple organs systems or localize to a single site. The type of precursor protein, the tissue distribution, and the

amount of amyloid deposition largely determine the clinical manifestations. Sites of clinically important amyloid deposition are the kidneys, heart, and liver. Localized pulmonary amyloidosis is defined as amyloid deposition isolated to respiratory tract without systemic deposition. Typically, nodular pulmonary amyloidosis presents in older individuals as asymptomatic nodules identified on chest x-ray. Symptomatic presentations are uncommon. Histology reveals well circumscribed, consolidated masses of amyloid with inflammatory cell infiltrate. Calcification of these lesions is common. We present a case of nodular pulmonary amyloidosis. While often asymptomatic, our patient had subacute dyspnea due to her underlying disease process. The combination of symptoms and calcified nodules on imaging raised suspicion for malignancy. However, demonstration of classic histologic findings confirmed the diagnosis of amyloidosis. Physicians should consider pulmonary amyloidosis in the differential diagnosis of calcified pulmonary nodules.

PULMONARY AND OROPHARYNGEAL KAPOSI SARCOMA IN A HIV-INFECTED MALE Sabyasachi Roy. SJHMC, Phoenix, AZ. (Control ID #1336671)

LEARNING OBJECTIVE 1: Epidemic or AIDS associated Kaposi Sarcoma (EKS) is a vascular tumor associated with Human Herpes Virus 8 (HHV8) and is an AIDS defining illness. EKS is seen primarily among men who have sex with men as compared to other HIV-infected groups (intravenous drug users, women, transfusion recipients). Research from nine population-based cancer registries reporting to the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute, demonstrated a significant decline in KS. Rates among white men had risen from 0.5/100,000 people/year in 1973, to between 31.3 and 33.3 from 1987 through 1991, and then declined to 2.8 in 1998. With the introduction of highly active antiretroviral therapy (HAART), EKS is an uncommon finding in HIV-infected persons.

CASE: We report the case of a 44 year old homosexual male patient diagnosed with HIV seven years ago who now presented with new chest xray findings of bilateral perihilar opacities and violaceous discoloration of the inside of his mouth. He did not have any skin lesions, cough or fevers. He had a history of alcohol abuse and was non-compliant with his HAART medications. We proceeded with a palatal biopsy which was definitively positive for Kaposi Sarcoma (KS), and a bronchoscopy, which showed multiple violaceous lesions in the tracheobronchial tree. Transbronchial biopsy was negative for KS. Bronchoalveolar lavage (BAL) studies for bacteria, viruses, PCP were also negative. A presumptive diagnosis of pulmonary KS and a definitive diagnosis of oropharyngeal KS was made and the patient was started on Taxol (Paclitaxel) and HAART therapy.

DISCUSSION: The prevalence and aggressiveness of EKS has dramatically decreased since the introduction of HAART. Cutaneous lesions are still the most common presentation. Visceral manifestations are rarer and, in the absence of any skin findings can be a challenging diagnosis. Common extra-cutaneous sites involved are the oral cavity, respiratory system and GI tract. Bronchoscopy, upper GI endoscopy and colonoscopy are required for definitive diagnosis. Skin lesions vary in color, are often elliptical, along skin tension lines and may be papular, plaque like or fungating in appearance. Oral lesions commonly affect the palate and gingival mucosa. GI lesions occur as isolated or confluent hemorrhagic nodules in any part of the GI tract, and they may be asymptomatic or they may cause pain, nausea, bleeding, malabsorption or obstruction. These are present in about 40% of patients at time of diagnosis in the absence of HAART. Respiratory symptoms include chest pain, cough, dyspnea, fever, hemoptysis or asymptomatic with variable finding on chest radiographs. Bronchoscopic lesions typically appear as raised cherry-red spots. Widespread systemic involvement has also been described in the heart, pancreas, liver, testes, bone marrow and even skeletal muscle. Biopsy is the mainstay of definitive diagnosis, but a presumptive diagnosis can be made, as in the above case with characteristic lesions in the trachea and negative BAL studies for other pathogens. Physicians and dentists should maintain a high degree of suspicion in identifying EKS lesions even in the absence of classical skin findings, and proceed with invasive evaluations if deemed necessary.

RASH AND ARTHRITIS Qura Tul Ain Rashid; Robin Klein; Kristina L. Lundberg. Emory University School of Medicine, Atlanta, GA. (Control ID #1337107)

LEARNING OBJECTIVE 1: Recognize parvovirus infection as a cause of poly arthritis in immunocompetent adult.
LEARNING OBJECTIVE 2: Recognize the difference between clinical features of parvovirus infection in children and adults.
CASE: 30 year old African American male presents with diffuse joint pains and rash for four days. The nonpruritic rash started on his wrist, then spread to abdomen, chest and lower extremities, sparing palms and soles. He reported pain and swelling in his wrists and knees. He had no recent travel and denied fever, chills or weight loss. He denied sick contacts but did have small children at home. He did report unprotected sex a week before onset of symptoms. He denied a history of arthritis or autoimmune disease. Skin exam revealed blanching violaceous macules and papules on his abdomen, anterior chest, and extremities. Right wrist, hand and knee joint were mildly swollen and tender. Admission labs revealed an ESR of 87 mm/h, AST of 98u/L, and ALT of 189u/L. Patient was treated empirically for disseminated gonococcal infection. HIV viral load, RPR, and hepatitis panel were negative. Urine gonorrhea test was negative and antibiotics were discontinued. Rheumatoid factor and ANA were negative; complement levels were normal. Parvovirus antibody was elevated with IgM of 2.2 mg/dL and IgG 4.8 mg/dL. He was diagnosed with parvovirus infection, was treated with analgesics, and symptoms improved over weeks.
DISCUSSION: Parvovirus B19 is a member of the Parvoviridae family of DNA viruses that affects humans. In children and adolescents, parvovirus infection presents with the classic slapped check rash, a lacy rash on the trunk and extremities, or papules in a stocking glove distribution. In adults, the rash is less prominent and infection typically manifests as arthritis in the hands, wrists, and knees. Symptomatic infections are more common in females than males. Typically, symptoms last 2 to 3 weeks but in up to 20% of patients, arthritis can last weeks to months. Parvovirus is highly infectious and easily spreads between individuals by respiratory droplets. About half of household contacts will be infected following exposure to an infected family member. Since 50% of adults were exposed as children, many will not manifest symptoms due to prior antibody production. It is most contagious during active viral replication which occurs 5 to 10 days after initial exposure. Rash and arthralgia signify B19 specific antibody production and patients are no longer contagious once these symptoms appear. Given the nonspecific symptoms, parvovirus infection is often confused with autoimmune diseases such as rheumatoid arthritis, lupus, seronegative arthropathies, or other infections. In our patient, the initial suspicion for acute HIV or gonococcal disease was high due to his sexual history. Parvovirus was considered only after he reported contact with young children given its highly infectious nature. As this case illustrates, parvovirus infection should be considered in adults with arthritis despite the absence of the classic features that are common in children.
RASH AND BODY ACHES IN A RETURNING TRAVELER James Y. Wang; Glenn Mathisen; Michael Rotblatt. Olive View - UCLA Medical Center, Sylmar, CA. (Control ID #1308400)
LEARNING OBJECTIVE 1: Recognize the initial clinical presentation of Dengue fever in patients with recent travelLEARNING OBJECTIVE 2: Utilize the CDC website to obtain information on epidemics in various countriesCASE: A 54-year-old healthy woman developed fever, an itchy leg rash, mild nausea, and epigastric pain immediately upon return from a trip to El Salvador. She presented to the ED one week later with new-onset severe leg and joint pain. She denied sick contacts during her travel. Upon presentation to the ED, the patient was afebrile and the exam was significant for epigastric tenderness and scattered oropharyngeal and bilateral lower extremity petechiae. The leukocyte count and coagulation studies were normal; however, the patient had thrombocytopenia (19,000 cells/mm3) and abnormal liver tests (AST;ALT were 5-10 times above normal). The patient was admitted and treated with IV fluids. Studies including peripheral smear (for malaria), urinalysis, blood/urine cultures and assays for HIV, ANA, CMV,

EBV and leptospirosis were ordered and found to be negative. During her hospital stay, the patient remained

afebrile without hemodynamic instability. No new petechiae were noted and platelet counts trended upward rapidly; the liver tests improved and trended back to baseline. At discharge, the patient was clinically improved and her platelet count had increased to 80,000 cells/mm3. One week later, specific serologies drawn at the time of admission (ELISA IgM) confirmed dengue as the cause of the patients clinical syndrome. DISCUSSION: Dengue fever should be high on the differential diagnosis in patients with fever and rash who have recently traveled to an endemic region. Since serological confirmation of dengue viral infection may take up to one week, diagnosis and therapy must be initially based on clinical suspicion. The presence of abrupt onset of fever, severe myalgias/ arthralgias, and severe headache are common. The presence of a blanching macular rash is also an early clue to the diagnosis. In addition, there is a biphasic pattern to the disease with subsequent recurrence of fever, often accompanied by a generalized maculopapular rash. Patients may develop petechiae in association with thrombocytopenia and/or capillary fragility. In dengue hemorrhagic fever, the most severe form of dengue, widespread hemorrhage may occur with associated hypotension. Our patient presented relatively late during the recovery period - she had a history of previous rash; however, on our exam the only finding was petechiae due to thrombocytopenia. The abnormal liver tests suggested a concomitant hepatitis, a common finding in dengue. Fortunately, our patient improved rapidly and did not have evidence of hemorrhage. Diagnosis of dengue depends on the typical clinical presentation with subsequent serological confirmation. Treatment is primarily supportive with transfusions and IV fluids for those with hypotension or extensive bleeding. In the returning traveler with fever, the clinician needs a high index of suspicion and should look for the presence of clinical clues including the typical rash, severe myalgias or arthralgias, relative bradycardia, and the common clinical/ laboratory findings associated with dengue. In our case, going to the CDC website after her serologies returned revealed that, at the time of the patients presentation, El Salvador was in the midst of a dengue fever epidemic. Checking this website on initial presentation would have helped us make an earlier presumptive diagnosis.

REACTIVATION OF TROPICAL DISEASE AS A PRESENTING DIAGNOSIS OF AIDS Alison B. Rapoport1,2; Genevieve Bergeron1,2; Linda Shipton1,2. 1Cambridge Health Alliance, Cambridge, MA; 2Harvard University, Cambridge, MA. (Control ID #1324749)

LEARNING OBJECTIVE 1: Recognize the clinical features of visceral leishmaniasis and its occurrence with HIV co-infection.

CASE: A 32 year old man from El Salvador with no significant past medical history presented in the summer to a Boston-area hospital with subjective fevers, chills, diaphoresis, myalgias, abdominal bloating and cough. He immigrated to the U.S. in 2005, lives in an apartment with his brother and works in a restaurant preparing food. He is sexually active with females only and admits to recent encounters with sex workers. He denied recent travel, history of intravenous drug use or alcoholism. Vital signs: temperature 103.8, heart rate 112, BP 101/59, respiratory rate 16. Physical exam was significant for a distended, non-tender abdomen with a palpable spleen tip and no hepatomegaly. Cardiopulmonary, musculoskeletal, neurologic and skin exams were normal. Significant laboratory abnormalities included leukopenia (WBC 2.5 cells/ml), anemia (Hemoglobin 8.7 g/dl, normal MCV), thrombocytopenia (platelets 50,000 TH/uL) and elevated LDH (421 IU/L). Peripheral smear confirmed thrombocytopenia but was otherwise normal. Blood chemistry, liver function tests, CXR and head CT were unremarkable. On hospital day 1, testing was done for HIV 1/2 antibodies and viral load, Parvovirus, Epstein Barr Virus, Cytomegalovirus, Hepatitis B and C, Borrelia Burgdorferi, Ehrlichia and Babesia. Blood cultures were done and a PPD was placed. Abdominal ultrasound revealed splenomegaly of 17 cm without hepatomegaly, portal hypertension or ascites. CT of the chest, abdomen, and pelvis revealed splenomegaly and nonspecific paraaortic and retroperitoneal lymphadenopathy. On hospital day 2, the patients HIV antibody returned positive with a CD4 count of 15 cell/uL and viral load >500,000 copies/ml. EGD and CSF evaluations were normal. He was started on prophylaxis for Mycobacterium Avium Complex and Pneumocystis Jiroveci. Several days into hospitalization he remained febrile. All other studies returned negative, prompting the

decision to pursue bone marrow biopsy to evaluate for infectious and malignant processes. Biopsy revealed macrophages containing numerous amastigotes with a few well visualized kinetoplasts. Samples were sent to the CDC for PCR analysis, confirming the diagnosis of Leishmania Donovani Chagasi. Of interest, serum indirect florescent antibody testing was negative for L. Donovani. The patient was started on antiretrovirals and Liposomal Amphotericin, therapies he continues to date, now five months after initial presentation. He has returned to work and his HIV viral load is undetectable. Despite these gains, he remains pancytopenic (WBC 1.8 TH/uL, Hgb 9.3 g/dl, Plt 67 TH/uL) with a CD4 count of 16 cells/uL, worsening splenomegaly (now >20 cm) and the need for indefinite Liposomal Amphotericin therapy pending CD4 reconstitution.
DISCUSSION: HIV and Visceral Leishmaniasis (VL) co-infection can lead to highly variable clinical presentations. Serologic testing for VL exists (IFA, ELISA, DAT), however poor sensitivity in co-infection often requires PCR testing or visualization of amastigotes (typically in bone marrow or splenic specimens) for diagnosis. In the U.S., VL is treated with Liposomal Amphotericin given its favorable safety and efficacy profile, but cost limits its use in the developing world. Treating VL in HIV-infected patients is especially challenging due to diminished drug efficacy, long treatment courses and high rates of relapse and death despite treatment.
RED AND SWOLLEN: A CASE OF POLYARTICULAR GOUT ARTHRITIS. Bassel Obaid; Jennifer Dooley. UT, Chattanooga, Chattanooga, TN. (Control ID #1339925)
LEARNING OBJECTIVE 1: To highlight a case of polyarticular gout arthritis as first manifestation of gout in a patient with multiple risk factors of gout.
CASE: 57 year-old Caucasian male presented to ED complaining of painful swollen knees and ankles started 3 days ago, and gradually got worse that he became chair-bound for 24 hours prior to admission. He denies fever chills, skin rash, any recent trauma or over use of joints or bug bites. He had similar episode about a year ago that lasted few days before gradually subsided, he did not seek any medical help then. Past medical history includes diabetes mellitus type 2, hypertension, coronary artery disease status post arteriography and angioplasty, chronic kidney disease stage 3 and tobacco abuse. No history of sexually transmitted disease before. He is unemployed and lives with girlfriend with whom he has monogamous relationship for the past three years. He denies alcohol or drug abuse. His medications include insulin, carvidelol, furosemide, aspirin, digoxin and lisinopril. Vital signs were: oral temperature 98.2, blood pressure 142/74, Heart rate 100, RR 17. On exam he appears uncomfortable due to pain but otherwise nontoxic, he was awake and fully oriented. Musculoskeletal exam reveals swelling tenderness, warmness and mild erythema over knees and ankles bilaterally with limited range of motion in both knee joints due to pain, no evidence of trauma, bites, rash or tophaceous deposits on skin exam. Other joints appear within normal limits. Rest of physical exam was unremarkable. Initial laboratory studies showed WBC of14.9, Hb 13.4, Sodium 132, Urea 38 and creatinine 2.1(baseline 1.2), glucose 99, uric acid was 12.5, CRP >16 mg/dl, negative RPR and HIV test and normal liver function test. Patient had left knee arthrocentesis and joint fluid analysis showed WBC >90, 000 with 90% PMNs, protein 5.2 grams and glucose of 53. Microscopic exam reveals uric acid crystals whereas gram stain and culture were negative. Patient was admitted to the hospital and started on oral prednisone with good response.
DISCUSSION: Gout is a common inflammatory arthritis caused by articular precipitation of monosodium urate crystals. It usually affects the first metatarsophalangeal joint of the foot and less commonly other joints, such as wrists, elbows, knees and ankles. It is characterized by recurrent episodes of inflammatory arthritis, tophaceous soft tissue deposits of monosodium urate crystals, uric acid renal calculi and chronic nephropathy. Polyarticular gouty arthritis is the initial manifestation in less than 20 percent of patients with gout, but occurs with increasing frequency in later flares. Polyarticular symptoms are particularly common late in the course of untreated gout, when multiple recurrences, short or absent symptom-free intervals, and palpable tophaceous deposits are common. Treatment options of acute gout arthritis include NSAIDS, Colchicine, or corticosteroids

(systemic or intraarticular). Use of interlukine-1 inhibitors (kanacinomab) is still under investigation. For patients with polyarticular involvement, systemic glucocorticoid is preferred. In our case, we chose to treat with 20 mg of oral prednisone that was gradually tapered over 7 days.
RENAL INVOLVEMENT IN LEVAMISOLE CONTAMINATED COCAINE VASCULITIS. Adetokunbo F. Oluwasanjo; Richard Alweis. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1333855)
LEARNING OBJECTIVE 1: Recognise renal complications of levamisole-contaminated cocaine vasculitisCASE: A 46 year old Hispanic male with a history of cocaine abuse presented initially with recurrent painful necrotic purpuric plaques involving his earlobes, trunk and extremities associated with diffuse arthralgias and hematuria. Significant laboratory findings revealed leukopenia, acute kidney injury, urine toxicology positive for cocaine and blood toxicology positive for levamisole. A presumptive diagnosis of levamisole-induced vasculitis was made and he was started on 30 mg of Prednisone twice a day. On day 4 of admission, the patient was discharged with significant resolution of his skin lesions, normal white cell count and resolving renal failure. His work up was positive for p-ANCA and lupus anticoagulant, but negative for anti-cardiolipin antibodies. Over the next 9 months, the patient demonstrated non-compliance to medications and poor follow-up with medical appointments. He presented twice to the emergency department during this time with diffuse arthralgias and was noted on both occasions to have worsening renal function. He claimed he had abstained from cocaine usage over the last 5 months, which was corroborated by the absence of cutaneous lesions as well as negative urine screens for cocaine on both occasions. Due to his worsening renal function (peak creatinine of 5.2 mg/dL), a renal biopsy was done that revealed a pauci-immune, segmental, necrotizing, concentric and sclerosing glomerulonephritis. This overall picture was consistent with microscopic polyangiitis and he was started on high dose corticosteroids and rituximab. His renal function slowly improved, with his creatinine decreasing to 2.2 mg/dL prior to discharge. DISCUSSION: Levamisole is a veterinary anti-helmintic that has been used as a human anti-neoplastic immunomodulatory agent. It is illegally used to adulterate cocaine presumably because it is cheap and adds bulk, and also because it enhances the dopaminergic effects of cocaine. Recently, there have been a number of case reports describing a classic ANCA-associated cutaneous vasculopathy secondary to the use of levamisole-contaminated cocaine. Skin biopsies of cutaneous lesions in this disease are also reportedly consistent with microscopic polyangiitis. The incidence appears to be increasing and is gaining public health significance as the amount of cocaine entering the US containing levamisole is reportedly as high as 82%. The progression and pathology of levamisole-induced vasculitis is not fully understood and there are rising concerns about the systemic complications of levamisole as more becomes known about this agent. In this case report, the patient had resolution of the cutaneous manifestations of the vasculitis but persistent worsening of his renal function in spite of reported abstinence and laboratory findings confirming this. Clinicians need to be aware of the fact that while abstinence improves the skin manifestations of the disease, it appears that systemic involvement may continue to progress and require long term therapy and follow-up.
RETAINED RISK Julie Kim; Brian Brinkerhoff; Kurt J. Pfeifer. Medical College of Wisconsin Affiliated Hospitals, Milwaukee, WI. (Control ID #1333782)
LEARNING OBJECTIVE 1: Recognize epithelioid angiosarcomas as a rare complication of chronically retained synthetic materials LEARNING OBJECTIVE 2: Identify patients at risk for development of epithelioid angiosarcomasCASE: A 70-year old man with a history of end-stage renal disease secondary to hypertension treated with deceased donor kidney transplantation presented with a four-month history of recurrent coagulase-negative Staphylococcus soft-tissue infection directly over his right upper arm polytetrafluoroethylene (PTFE) hemodialysis graft site. He reported no complications with the graft while undergoing hemodialysis for approximately three years prior to receiving his

donated kidney. After his transplant, the patient inquired about removing the graft but was advised against elective surgery to avoid unnecessary complications. The graft remained in place for an additional seven years to the time of his recurrent infections. Wound cultures were positive for coagulase-negative Staphylococcus infection, and the patient failed multiple oral and intravenous antibiotic therapies. Due to the patient's immunocompromised status and failure to respond to antibiotics, magnetic resonance imaging (MRI) of his right upper arm graft site was performed, which showed an 8.2 x 13.6 cm vertical mass concerning for ulcerated malignancy. The mass was resected, and histopathological analysis revealed diffuse skin infiltration with a high grade malignant vascular neoplasm which stained positive for endothelial cell marker CD31, consistent with a diagnosis of epithelioid angiosarcoma. Two weeks later, a 2.5 x 2.0 cm right thigh mass was found, excised, and confirmed to be an epithelioid angiosarcoma metastasis. He was referred to oncology for recommendations regarding chemotherapy treatment.
DISCUSSION: Epithelioid angiosarcomas are extremely rare and aggressive neoplasms comprising <1% of all soft tissue tumors. They typically arise de novo in superficial or deep soft tissues but have been known to occur in the setting of retained synthetic materials, particularly Dacron grafts. Epithelioid angiosarcomas often present as large hemorrhagic masses and are easily confused with hematomas or local infections. These tumors readily metastasize to local lymph nodes, lung, bone, and remote soft tissue and carry a median survival of 7 months. Negative prognostic factors include older age, histologic grade, size (>5 cm), and retroperito-neal location. Very few cases of angiosarcoma arising in arteriovenous (AV) fistulae of renal transplant patients have been documented in the literature. It is well established that renal transplant patients have an increased risk of malignancy overall due to immunosuppression with common malignancies including basal cell carcinoma, Kaposi's sarcoma, and lymphoma. Complicating the diagnosis of epithelioid angiosarcomas in the setting of an AV graft site is their association with hematoma and infection. Given the dismal prognosis of epithelioid angiosarcomas, prompt clinical evaluation and diagnosis is critical.
RETURN OF THE GREEN DEMON: ABSINTHE AS A POTENTIAL FACTOR IN EXACERBATING EXERTIONAL RHABDOMYOLYSIS Jill Jin; Elijah Wasson. Olive View-UCLA Medical Center, Sylmar, CA. (Control ID #1338795)
LEARNING OBJECTIVE 1: Recognize eccentric exercise such as the P90x Extreme Home Fitness System as a risk factor for exertional rhabdomyolysis even in baseline physically active individuals. LEARNING OBJECTIVE 2: Recognize consumption of Absinthe alcohol as a potential factor in exacerbating exertional rhabdomyolysis.
CASE: A 21-year-old previously healthy and physically active male presented to the Emergency Department for two days of progressive thigh and buttocks pain as well as dark urine following a one-hour P90x workout involving eccentric strength-training exercises. Patient was physically active at baseline with both aerobic and nonaerobic exercise, though never with P90x. On exam, he was markedly tender in the bilateral thighs/ buttocks but otherwise neurovascularly intact. Initial creatine kinase (CK) level was >45,100 (maximum reported value) and urinalysis showed large blood without red blood cells. Patient was diagnosed with exertional rhabdomyolysis and treated supportively with intravenous fluids. On the 5th hospital day however, patients CK level remained >45,100 despite continuous intravenous hydration, which raised concern for a secondary process exacerbating muscle injury. Patient had no prior history of rhabdomyolysis, even with much more prolonged and intensive exercise. Patient denied any drug use including cocaine, but further questioning revealed that he had consumed six shots of Absinthe alcohol following his workout, which he had previously never done. Patients CK level finally decreased to <5000 on the 8th hospital day, at which time he was discharged with subsequent full recovery. Patients kidney function remained normal throughout admission.
DISCUSSION: This case of exertional rhabdomyolysis is unusual in the severity of muscle injury and length of recovery time out-of-proportion to level of exertion. The patients presentation was complicated by two factors: 1) eccentric nature of exercise, and 2) consumption of significant amount of Absinthe alcohol following exercise. Though the development

of exertional rhabdomyolysis can be unpredictable in relation to type and amount of exercise, and is certainly more often seen with eccentric exercise, generally CK levels peak 1-3 days following exertion and decline rapidly within 3-5 days. There are case reports of exertional rhabdomyolysis where CK levels take over one week to resolve, but these often involve a secondary muscle insult such as medications (e.g. statins), genetic predisposition (e.g. sickle cell trait, metabolic myopathy), or extreme hot weather/hyperthermia, none of which were present in this case. Although alcohol in itself can also cause rhabdomyolysis, this is usually in the context of prolonged immobilization/coma secondary to severe intoxication, also not present here. Thus, in this case where no clear secondary insult could be identified, it is possible that Absinthe consumption resulted in some level of direct muscle toxicity leading to the severe presentation. Absinthe is a highly alcoholic (45-74% alcohol by volume) spirit made from the Wormwood plant historically associated with hallucinations and seizures, causing it to be banned in the U.S. from 1915 until 2007 when the FDA instituted new regulations on the maximum content of thujone in Absinthe. The mechanism of action of thujone is unclear. There are currently no case reports on Absinthe alone causing rhabdomyolysis, though it may be an interesting area of further case reporting, especially with the recent legalization of Absinthe in the U.S.

RHABDOMYOLYSIS INDUCED BY A MILD CASE OF SALMONELLA GASTROENTERITIS Anjali Singla; Anunta Virapongse. Lenox Hill Hospital, New York, NY. (Control ID #1338951)

LEARNING OBJECTIVE 1: Recognize that rhabdomyolysis can be a rare complication of infectious diarrheaCASE: We report a case of a 19-year-old male with no past medical history who presented with two days of abdominal pain, chills, diarrhea, and dark colored urine. Upon presentation, he described dull left lower quadrant abdominal pain and cramping, as well as 10 bouts of diarrhea with occasional blood over 24 hours. The patient denied subjective fevers, previous similar episodes, sick contacts, recent travel or alcohol use. On examination, he was afebrile with stable vital signs, dry mucous membranes, and with mild abdominal tenderness in the epigastric area and left lower quadrant without guarding or rebound tenderness. Labs were significant for aspartate aminotransferase 1602 U/L, alanine aminotransferase 452 U/L, alkaline phosphatase 59 U/L, and white blood cells (WBC)6.2x103/uL. Serum electrolytes, calcium and phosphate were within normal limits. Urinanalysis revealed 5-10 WBC/HPF, 5-10 RBC/HPF, and large blood and was negative for nitrites and leukocyte esterase. A computerized tomography scan of the abdomen showed wall thickening and pericolonic inflammatory changes consistent with infectious or inflammatory colitis. The patient was started on empiric antibiotics and stool studies were sent to the lab for evaluation for likely gastroenteritis. Given the degree of transaminitis and large blood in the urine, a serum creatinine kinase (CK) was obtained and found to be 112,360 U/L. Erythrocyte sedimentation rate was normal at 11 mm/hr. Upon further questioning, the patient revealed that four days prior to admission he had exerted himself with strenuous running and weight-lifting. Antibiotics were discontinued and intravenous hydration with normal saline was increased to 300 cc/hour to treat rhabdomyolysis. We closely monitored the patients clinical status, CK level, renal function, electrolytes (calcium, phosphorous, potassium), and fluid balance to ensure the patient was recovering from both the gastroenteritis and rhabdomyolysis. Symptoms and labs improved within the next 24 hours. Stool studies later revealed Salmonella species (further speciation pending).

DISCUSSION: Rhabdomyolysis is a rare complication of Salmonella infection, and generally presents with other severe complications, such as acute renal failure, hepatitis, cholecystitis, pancreatitis, and septicemia. The pathophysiology behind Salmonella induced rhabdomyolysis is poorly understood, and is likely multifactorial. Current literature suggests involvement of increased intracellular calcium concentrations, along with factors such as tissue hypoxia, bacterial toxin release, direct bacterial muscle invasion, and alteration of enzyme activity. To our knowledge, this is the first case of rhabdomyolysis seen in Salmonella gastroenteritis without concomitant sepsis and multi-organ system failure. In this case, the patient's Salmonella-induced rhabdomyolysis may have been exacerbated by recent exercise, thereby explaining the degree of CK elevation

in the
setting of relatively mild gastroenteritis. Clinicians are urged to monitor patients with even mild Salmonella gastroenteritis closely, as rhabdomyolysis, infectious involvement of other organs, sepsis, and multi-organ failure are all possible complications that can be avoided with early recognition and awareness.
RUNNING ON EMPTY Anjali Masand. Montefiore Medical Center, Bronx, NY. (Control ID #1334950)
LEARNING OBJECTIVE 1: Recognize anemia as an important cause of heart failure.
LEARNING OBJECTIVE 2: Understand the pathophysiology of anemia-induced high output heart failure.
CASE: A 43 year-old woman with a history of menorrhagia presented with three weeks of progressively worsening shortness of breath and lower extremity swelling. She had a heart rate of 120 beats per minute and conjunctival pallor. Her jugular venous pressure was elevated, and she had an enlarged, laterally displaced PMI. There was lower extremity pitting edema extending up to the thighs bilaterally. There was four chamber dilatation by echocardiography, with an ejection fraction of 60%. The initial hemoglobin level was 2.5 g/dL, and the mean corpuscular volume was 47.2 fL. Results of iron studies revealed severe iron-deficiency anemia, with an iron level of 13 ng/mL, total iron-binding capacity of 410 ng/mL, percent iron saturation of 3%, and ferritin of 5 ng/mL. After 2 units of packed red blood cells and several days of intravenous Furosemide, she had improvement of her symptoms. DISCUSSION: Heart failure is among the most common conditions that an internist treats, but the diagnosis is not always secondary to structural heart disease. Typically, patients with heart failure have either systolic or diastolic dysfunction with a low or normal cardiac output, respectively. However, in some cases the resting cardiac index is elevated beyond the normal range of2.5 to 4.0 L/min per m2. A number of disorders can lead to a rise in cardiac output resulting in high output heart failure, and iron deficiency anemia is an important cause. Other conditions that can lead to high output heart failure include sepsis, systemic arteriovenous fistulas, thyrotoxicosis, beriberi, multiple myeloma, obesity, pregnancy, and carcinoid syndrome. Several characteristic findings are usually seen on physical examination in patients with high output heart failure. The pulse pressure is typically wide, and the pulse is usually bounding with a quick upstroke. Pistol-shot sounds auscultated over the femoral arteries and a systolic bruit heard over the carotid arteries are both highly suggestive of elevated left ventricular stroke volume due to a hyperdynamic state. In high output heart failure, patients typically have warm rather than cold extremities due to low systemic vascular resistance and peripheral vasodilation. Patients with chronic high output may develop signs of pulmonary and systemic congestion associated with low output heart failure, including raised jugular venous pressure, pulmonary rales, and peripheral edema. Only in cases of severe anemia (hemoglobin less than 5 g/dL) does heart failure develop in the absence of underlying heart disease. Although the mechanism is not completely understood, it is postulated that anemia can cause peripheral vasodilation through increased renal and vascular nitric oxide production. This, in turn, causes low systemic vascular resistance. Severe anemia also results in reduced serum viscosity. Ineffective blood pressure and volume leads to chronic activation of the sympathetic nervous system, renin-angiotensinaldosterone axis, and increased serum vasopressin concentrations. Over time, chronic volume overload and increased stroke volume gradually cause ventricular enlargement, remodeling, and heart failure. Clinicians should be able to recognize the signs and symptoms of high output heart failure, as it is often associated with a potentially reversible etiology.
ST SEGMENT ELEVATION IN AVR HERALDING LEFT MAIN CORONARY ARTERY (LMCA) OCCLUSION IN FATAL MYOCARDIAL INFARCTION Chinyelu Ofodile. Virginia Tech Carilion School of Medicine, Roanoke, VA. (Control ID #1340296)
LEARNING OBJECTIVE 1: The importance of lead aVR to localizing and predicting Left main coronary artery obstructionLEARNING OBJECTIVE 2: evaluation of studies showing the imprtance of lead aVR

CASE: A 41 year old female, known hypertensive smoker, presented to Emergency Department (ED) with a two hour history of severe, substernal chest pain. Electrocardiogram (EKG) in ED was significant for 4 mm ST-elevation in AVR, 2 mm ST elevation on Lead V1, and diffuse ST depression in all other leads. Initial Troponin I was 0.31 ng/ml. She was taken emergently for cardiac catheterization, which revealed 99% ostial stenosis of the LMCA, patent Right Coronary Artery (RCA). Emergent Coronary Artery Bypass Grafting (CABG) was considered, however patient went into cardiac arrest and expired.
DISCUSSION: Lead aVR is the only ECG lead that records electrical activity from the basal interventricular septum. This portion receives its blood supply either from the proximal septal branches of the left anterior descending artery or from the posterior descending branch of the RCA in those with prior Left Coronary Artery (LCA) occlusion. Patients with aVR ST-segment elevation may have severe proximal LCA disease, usually LMCA disease. High ST-elevation in lead aVR, compared to V1 was a useful indicator for predicting acute LMCA obstruction, mandating immediate aggressive treatment. aVR ST-elevation has been associated with higher 30-day mortality independent of concomitant ST-segment changes in the other ECG leads. This association was strong for patients with Anterior AMI with an ST-level cut point>=1.5 mm, and for patients with an inferior AMI with an ST level cut point of>=1 mm. When ST-elevation was present, 30-day mortality was high and similar for both Anterior and inferior AMI. ST-elevation in aVR also has an important role in exercise stress testing where it has an overall predictive accuracy of 80% for LMCA or ostial LAD stenosis. In some cases it can be used as an adjunct to cardiac scintigraphy, conferring an increased sensitivity to detecting subendocardial ischemia. ST-segment depression in aVR also has prognostic significance. In patients with acute Anterior MI, the concomitant presence of aVR ST-depression was also associated with higher 30-day mortality. Resolution in ST-depression in aVR in patients undergoing fibrinolytic therapy was associated with lower mortality. The utility of aVR extends out of the scope of ischemic heart disease. Prominent PR segment elevation can be indicative of acute pericarditis and a prominent R wave can indicate significant tricyclic antidepressant poisoning. Lead aVR is often neglected in routine clinical practice and in education of medical students and residents, perhaps because it is directionally non-adjacent to any other ECG lead. More attention should be paid to this important but largely ignored lead in the screening for, diagnosis and prognosis of cardiac ischemia, as well as other non ischemic pathologies. Physicians should maybe simply think of AVR as "A-cute V-essel R-evascularization" needed.

STAY OFF THE METRO(NIDAZOLE) WITH THE DARK URINE Brian Zwecker; Anna Kolpakchi; Lee Lu. Baylor College of Medicine, Houston, TX. (Control ID #1334605)

LEARNING OBJECTIVE 1: To realize that commonly used medications can precipitate an acute intermittent porphyria (AIP) attack. LEARNING OBJECTIVE 2: To review the clinical presentation of an AIP attack.
CASE: A 23-year-old Hispanic woman with past medical history of AIP presented with a three-day history of generalized abdominal pain. Physical exam was significant for cervical motion tenderness and the presence of a minimal white vaginal discharge. The patient was diagnosed with pelvic inflammatory disease (PID) and treated with ceftriaxone IM and fourteen days of oral doxycycline and metronidazole. Over the subsequent three days, she developed nausea and had three episodes of non-bloody non-bilious emesis, darker than usual urine, and worsening of abdominal pain. On admission, she was afebrile with blood pressure of 122/81 and heart rate of 93; physical exam was remarkable for moderate diffuse abdominal tenderness without rebound or guarding. There was no organomegaly. Complete blood count and comprehensive metabolic panel were within normal limits. UA showed 3+ leukoesterase, 9 WBCs, and a few bacteria. However, urine studies revealed elevation in urinary porphobilinogen of 95.6 (normal 0 - 2.0). She was diagnosed with an AIP attack due to metronidazole. She was treated with intravenous hemin and 10% dextrose with complete resolution of nausea and vomiting and discharged home with some residual abdominal pain well controlled on oral pain medication.
DISCUSSION: AIP is an autosomal dominant disorder caused by mutations in the porphobilinogen deaminase (PBGD) gene, leading to heme precursor build up with an estimated prevalence of 1-5 per 100,000 in the U.S.

Most patients present with severe abdominal pain. Additional symptoms may include a prodrome of anxiety or restlessness, nausea with or without emesis, constipation, red or dark-colored urine, and such manifestations of increased sympathetic activity as tachycardia, hypertension, and excessive sweating. AIP attacks may be precipitated by hormone fluctuations, fasting, infections, or drugs. Commonly used medications which can precipitate acute attacks include oral contraceptives, sex hormones, simvastatin, pravastatin, tetracy-lines, nitrofurantoin, and metronidazole. Some of these medications are believed to be porphyrogenic through their actions on hepatic P450 enzymes, whereas others, such as sex hormones, have been shown to directly stimulate heme biosynthesis. The mechanism through which metronidazole may induce AIP attacks is unclear, but metronidazole is listed by several international porphyria societies as an inducer of AIP attacks as compiled by the Norwegian Porphyria Centre. The incidence is unknown. Our case illustrates the importance of recognizing that commonly prescribed medications such as metronidazole should be avoided in patients with a history of AIP to prevent attacks.

SCURVY FROM "TOO MUCH COCA-COLA" IN A MALNOURISHED AND BIPOLAR WOMAN. Payal Jhawar; Richard Steingart; Jackcy Jacob. Baystate Medical Center, Springfield, MA. (Control ID #1309707)

LEARNING OBJECTIVE 1: To recognize the specific populations affected by scurvy in the industrialized world.

LEARNING OBJECTIVE 2: To identify the clinical signs and symptoms of vitamin C deficiency.

CASE: A 54-year-old malnourished female with poorly treated bipolar disorder was sent to the emergency room by a caseworker for concerning behavior including two weeks of food refusal, not bathing and placing bags of feces around her room. On arrival to the ER, she was severely anemic with a hemoglobin of 5.9 and hematocrit of 17.4. She denied any hematuria, melena, hematochezia, bleeding gums, menorrhagia, trauma or sexual assault. She also denied use of NSAIDs or Aspirin and had no history of a colonoscopy. She attributed bruising on her skin to excessive Coca-Cola ingestion, and instead started drinking "Sprite with no lemon lime because it is pure. On examination, her blood pressure was 76/48, but she was asymptomatic. Her skin and conjunctiva were pale, and she had poor dentition and gingival swelling. She had significant lower extremity pitting edema and palpable purpura with perifollicular hemorrhages and coiled hairs in addition to ecchymoses on her left thigh. We were initially concerned for sepsis and DIC given her hypotension and ecchymotic thigh; however, her diet history had stimulated a nutritional panel, which revealed a vitamin C level of zero. With prompt vitamin C treatment, her clinical findings of scurvy disappeared within 1 week.

DISCUSSION: Scurvy is a disease caused by a deficiency of vitamin C, which is necessary for the formation of mature collagen and blood vessel integrity. It is prevalent in approximately 13% of the US population according to the NHANES III, and serum concentrations of<11.4 mol/L are indicative of substantial vitamin C deficiency.1 The earliest symptom of fatigue occurs after weeks of being deficient.2 Other clinical findings include hypotension, ecchymoses, anemia, cutaneous follicular hyperkeratosis, perifollicular hemorrhages, palpable purpura, poor wound healing, leg edema, coiled body hairs, and gingival swelling.3 Administration of vitamin C leads to dramatic improvement in clinical findings within a few days to weeks. Scurvy is not just a disease of the sailors! In patients with nutritional deficiency, it is an important diagnosis to consider because if left untreated, it can be fatal. With supplementation, manifestations of scurvy improve dramatically, making the prognosis excellent. References: 1. Schleicher, RL et al. Serum vitamin C and the prevalence of vitamin c deficiency in the United States: 2003-2004 National Health and Nutrition Examination Survey (NHANES). Am J Clin Nutr 2009;90:1252-63. 2. Hirschmann, JV et al. Adult Scurvy. J Am Acad Dermatol 1999;41:895-906.3. Velandia, B et al. Scurvy is Still Present in Developed Countries. J Gen Intern Med 23(8):1281-4.

SCURVY IN AN AIDS PATIENT Torrey R. Schmidt; Richard Alweis; Jorge Scheirer. Reading Hospital and Medical Center, West Reading, PA. (Control ID #1304419)

LEARNING OBJECTIVE 1: Scurvy is very rare in modern America because of enriched food products.

LEARNING OBJECTIVE 2: Scurvy should be considered in the chronically malnourished patient population.

CASE: A 54 year old male with advanced HIV/AIDS (CD4 142) on HAART complicated by Mycobacteria xenopi osteomyelitis of the spine, and resistant candida esophagitis, presented with fatigue, lower extremity edema, sore gums with pustular discharge, and easy bruising on his arms. His appetite was poor and he did not eat citrus fruits or green vegetables. His total caloric intake was estimated to be 1,000 kcal per day. He did not take vitamin supplements, aspirin or non-steroidal anti-inflammatory drugs. Over the preceding 3 months, his weight decreased from 71 kg (BMI 21.4) to 57 kg (BMI 17.2). Physical examination revealed cachexia with erythematous and edematous gingiva, upper extremitiy ecchymoses, and lower extremity edema. The platelet count was 189,000 cells per cubic mm (CMM, normal 130-400,000 CMM), a PT and PTT were normal. Ascorbic acid level was 0.1 mg/dL (normal range 0.6 to 2.0 mg/dL). He began to take ascorbic acid 500 mg daily by mouth with subsequent improvement in his gingival symptoms. A repeat ascorbic acid level after 3 weeks of treatment was 2.0 mg/dL.

DISCUSSION: Water soluble vitamin deficiencies are uncommon in the supplement crazed modern world, but should be suspected in patients with poor nutritional status, including advanced HIV/AIDS. Ascorbic acid deficiency or scurvy typically appears 2 to 3 months after consuming a diet lacking Ascorbic acid. Symptoms include, fatigue, easy bruising, petechiae, gingival bleeding, and extremity edema. The pathogenic mechanism underlying these signs is increased vascular fragility owing to defective collagen synthesis. The dermatologic findings in scurvy can easily be misdiagnosed as vasculitis. Physicians should be cognizant of the signs and symptoms of all vitamin deficiencies including ascorbic acid, and monitor for them in their chronically malnourished patient population, as well as alcohol and drug abusers, and those living in poverty without access to vitamin supplements or nutritious foods.

SCURVY: NOT GONE, BUT OFTEN FORGOTTEN Juan A. Pena1;
Erin Wilmer1; Dean Abtahi1; Rebecca Beyth2,1. 1University of Florida College of Medicine, Gainesville, FL; 2North Florida South Georgia GRECC, Gainesville, FL. (Control ID #1336105)

LEARNING OBJECTIVE 1: Recognize populations at risk for Vitamin C deficiencyLEARNING OBJECTIVE 2: Identify clinical signs and symptoms suggestive of scurvyCASE: A debilitated 72 year old man with multiple comorbidities including rheumatoid arthritis, alcohol and tobacco abuse presented with malaise, generalized weakness, myalgias, joint pain, non-pruritic rash, coffee-ground emesis, renal insufficiency and transaminitis. He had a similar episode 4 months prior that resolved after a prolonged hospitalization; all lab studies and skin biopsy were non-diagnostic. He was afebrile, HR 97 and BP 100/53. On exam he had multiple regions of petechiea, hemorrhagic papules with overlying necrosis, areas of coalesced ecchymoses and purpura on his extremities, torso and face, periungal hemorrhages and diffusely tender joints. Stools were guiaic positive and his hemoglobin progressively declined. Differential diagnosis for the rash included septic emboli, rheumatoid vasculitis, coagulopathy and vitamin C deficiency. Infectious causes were unrevealing with multiple negative cultures and transthoracic echo without valvular vegetations. Hepatitis, vasculitis and coagulopathy panels were negative. Vitamin C level was<0.12 mg/dL (0.2-1.7 mg/dL). Interestingly, the patient was craving extra fruit with meals. He was treated with oral Vitamin C and the rash improved within days.

DISCUSSION: Acute vitamin C deficiency leads to scurvy, a renowned disease of 15th-16th century sailors, but it is an often forgotten diagnosis in the modern era; 7% of the US population is Vitamin C deficient. High risk groups include alcoholics, smokers, anorexics, patients with psychiatric illness, those with low socioeconomic status and restricted diets (1-2).

Smokers and rheumatoid arthritis patients have much lower levels of Vitamin C compared to healthy controls (3). Scurvy is primarily a clinical diagnosis supported by a history of inadequate vitamin C intake. Clinical manifestations vary and relate to the diverse biological roles of Vitamin C including energy metabolism via carnitine production and collagen biosynthesis, which is required for vascular integrity. Deficiency results in symptoms of weakness, malaise and myalgia and blood vessel fragility (petechiae, purpura, ecchymoses, perifollicular hemorrhages, GI bleeding, and hemarthroses) (5). Thus, it is easily mistaken for a systemic

vasculitis. Decreased levels of Vitamin C in the setting of oxidative stress (i.e., sepsis, injury, inflammatory disease) may contribute to microvascular dysfunction and organ failure (6). In this patient with multiple risk factors, weakness, myalgia, petechiae, mucosal bleeding and GI bleeding were harbingers of an underlying vitamin C deficiency. Scurvy is easily treated with oral vitamin C, but the results can be devastating if the diagnosis is missed. 1.Schleicher RL, Carroll MD, et al. Serum vitamin C and the prevalence of vitamin C deficiency in the US: 2003-2004 NHANES. Am J Clin Nutr. 2009 Nov;90(5):1252-63.2.Velandia B, Centor RM, et al. Scurvy is still present in developed countries.JGIM 2008; 23:1281-4. 3.Jaswal S, Mehta HC, et al.Antioxidant status in rheumatoid arthritis and role of antioxidant therapy.Clin Chim Acta. 2003 Dec;338(1-2):123-9. 4.Rebouche CJ.Ascorbic acid and carnitine biosynthesis. Am J Clin Nutr.1991 Dec;54(6 Suppl):1147S-1152S. 5.De Luna RH, Colley BJ 3 rd, et al.Scurvy: an often forgotten cause of bleeding. Am J Hematol.2003 Sep;74(1):85-7. 6.Wilson JX, Wu F.Vitamin C in sepsis.Subcell Biochem.2012;56:67-83.
SEEING THE FOREST THROUGH THE TREES: THE NEED FOR CLINICAL AWARENESS IN A COMPLICATED AIDS CASE Lee Chang; Bradley Monash. UCSF, San Francisco, CA. (Control ID #1340042)
LEARNING OBJECTIVE 1: Recognize the clinical features of Multi-centric Castlemans DiseaseLEARNING OBJECTIVE 2: Recognize the anchoring heuristic, including its pitfalls and how to overcome themCASE: A 46-year-old man presented with recurrent fevers, diffuse lymphadenopathy, and worsening Kaposi sarcoma lesions on his feet. He was in his usual state of health until five months prior to admission when he presented with a syphilitic rash. Two months prior to admission, he developed painful bruising on the arches of his feet. His CD4 count and HIV viral load were 99 and 1 million, respectively. Skin biopsy revealed Kaposis sarcoma (KS). He began a regimen of truvada, atazanavir, and ritonavir, but his functional status deteriorated and he was hospitalized multiple times for severe foot pain, fungal esophagitis, and suicidal ideation. On admission, his feet were so painful he could no longer walk. He complained of xerostomia, confusion and fatigue. He had generalized, bulky lymphadenopathy. Violaceous plaques were scattered on his arms and covered the plantar surface of both feet; none were detected on his oral mucosa. Serial cognitive assessments revealed attention and memory deficits. He remained despondent throughout his hospitalization. Multiple transfusions were required for Coombs-positive anemia. Persistent hyponatremia remained stable with fluid restriction. A repeat CD4 count and viral load were 332 and 4500, respectively. He had intermittent fevers, with a negative infectious workup. His ongoing symptoms were attributed to immune reconstitution inflammatory syndrome (IRIS). Chemotherapy was offered to treat his KS in the setting of IRIS, but he opted instead for irradiation of his plantar lesions, which proved unsuccessful. While awaiting placement for physical rehabilitation, further consideration of his signs and symptoms led to an excisional lymph node biopsy, which was diagnostic for hyaline vascular multicentric Castlemans disease. After starting rituximab, his fevers resolved and his lymphadenopathy and altered mental status improved. He reported less pain and regained his ability to walk. However, a new lesion suspicious for KS was detected on his palate and he developed hematochezia, suggestive of visceral involvement, hastening plans to initiate chemotherapy.
DISCUSSION: Despite public health efforts at early diagnosis, many patients with HIV continue to present with AIDS-defining illnesses. For AIDS patients who present with KS, the differential should include Castlemans disease given its strong association with human herpesvirus

8 and rising incidence. In these patients, the presence of unexplained fever, lymphadenopathy, pulmonary symptoms, splenomegaly, central nervous system findings, xerostomia, or anemia is an indication for lymph node biopsy. Moreover, this case illustrates the danger of prematurely anchoring to a diagnosis and failing to adjust the differential in the presence of new or seemingly disparate data. For our patient presenting with recurrent fevers and worsening KS, we were sold on the first logical correlation presented: immune

reconstitution inflammatory syndrome. However, fixating on IRIS, and its nebulous time to resolution, clouded our capacity to extend our differential to account for his other problems. This delayed our diagnosing of multicentric Castlemans disease. Although anchoring is instinctive and sometimes efficient, patients are ultimately best served by constant reevaluation of all available information and diagnostic possibilities.

SENSE AND SENSITIVITIES Erin L. Reigh; Adam F. Binder; Anita Vanka. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1340032)

LEARNING OBJECTIVE 1: List the signs and symptoms of ovarian vein thrombosis.

LEARNING OBJECTIVE 2: Contrast the treatment of malignancy-associated ovarian vein thrombosis with postpartum ovarian vein thrombosis. CASE: This is an 81 year old female with a history of bladder cancer status post trans-urethral resection and ureteral stent placement who presented with urinary frequency and malodorous urine for two days. She also reported a temperature of 100.3, chills, sweats, and left flank pain. Initial lab data was remarkable for a white blood cell count of 11.4 K/uL and an elevated BUN and Cr of 49 and 2.3 mg/dL, respectively (baseline creatinine 0.7 mg/dL). Urinalysis was positive for leukocyte esterase and 182 white blood cells. A CT abdomen/pelvis was obtained without contrast. It showed malposition of the ureteral stent, uretero-hydronephrosis, and extensive bladder cancer metastases. A percutaneous nephrostomy tube was placed and she was started on vancomycin and cefepime for pyelonephritis. Urine culture revealed E. coli sensitive to cefepime. Despite appropriate antibiotic therapy, the patient continued to have fevers. A repeat CT abdomen/ pelvis was obtained with contrast. It demonstrated resolution of the hydro-nephrosis and no abscess, but revealed a new finding of left ovarian vein thrombosis. She was started on enoxaparin 1 mg/kg BID for treatment of malignancy-related venous thromboembolism (VTE). She defervesced and was discharged in stable condition.

DISCUSSION: Ovarian vein thrombosis (OVT) is rare and most commonly related to pregnancy. In these cases, it involves the right ovarian vein 90% of the time due to physiologic changes that occur in pregnancy. Over 50% of cases are associated with infection. Symptoms include flank/pelvic pain, fever, and a palpable cord in the abdomen. The diagnosis is often made on CTor MRI imaging when a febrile postpartum patient does not respond to antibiotics. Complications include PE (13%), ureteral obstruction, renal vein thrombosis, abscess, ovarian infarction, and death. This case is unusual as the patient was not postpartum and likely developed an OVT secondary to her active malignancy. Malignancy-associated OVT is rare; there are only a few dozen cases reported. Her concomitant pyelonephritis may have also played a role, given the association between OVT and infection. For treatment of OVT, observational studies in postpartum patients report varying lengths of anticoagulation, from 10 days to 6 months. There is little data on OVT treatment in malignancy, but studies on VTE in this population demonstrate a mortality benefit when treated with low-molecular-weight heparin (LMWH), which reduces recurrence of VTE without increasing bleeding risk compared to coumadin (NEJM 2003; 349). Dosing is 1.5 mg/kg daily or 1 mg/kg twice daily. Some studies indicate twice daily dosing is more efficacious, but further study is needed (J Oncol Pharm Pract 2011; Sep). Duration of treatment is an ongoing debate, but continued anticoagulation in patients with residual malignancy is considered reasonable. Some data even indicate a survival benefit in patients who are maintained on LMWH indefinitely (Pol Arch Med Wewn 2008; 118 (4)). In summary, OVT is a rare complication of malignancy and should be considered in a patient with flank pain, intra-abdominal pathology, and fevers unresponsive to appropriate antibiotics. Treatment data is limited, so it is reasonable to manage OVT in a fashion similar to VTE, with LMWH as first-line therapy.

SEVERE HYPONATREMIA AND SEIZURES FOLLOWING COLONOSCOPY PREPARATION Quang V. Ton; Mark Nader; Shaheryar Siddiqui; Susan M. Clifford. Englewood Hospital Medical Center, Englewood, NJ. (Control ID #1340487)

LEARNING OBJECTIVE 1: Recognize the clinical risk factors for hyponatremia.

LEARNING OBJECTIVE 2: Manage the adverse effects of bowel preparations.

CASE: An 80-year old female without previous neurological disease presented with unresponsiveness and

generalized seizure. Three days prior, patient began bowel preparation for routine colonoscopy consisting of clear liquids with low sodium and protein intake followed by bisacodyl. On night of admission patient was scheduled for polyethylene glycol. It was never taken as patient was found by family unresponsive in bathroom. At baseline, she has normal cognitive function and is independent of all activities of daily living. Past medical history included mild depression on venlafaxine and hyperlipidemia on atorvastatin. On examination, she was afebrile with stable vitals. Neurological examination found the patient not responsive to voice but to noxious stimuli, GCS of 6/15. Pupils were reactive, toes up-going, bite marks on tongue noted. Remaining physical exam was unremarkable. During examination, patient began to have generalized tonic clonic seizure abated by lorazepam 2 mg intravenous. She was then was post-ictal. Significant laboratory results drawn before seizure revealed serum sodium 112 mmol/L, potassium 3.7 mmol/L, chloride 75 mmol/L, bicarbonate 25 mmol/L, calcium 8.3 mg/dl, phosphorus 1.8 mg/dl, blood urea nitrogen 12 mg/dl, creatinine 0.5 mg/ dl, creatinine kinase 463 u/L, serum osmolality 237, urine osmolality 446, urine sodium 112 mmol/L, and urine potassium 31 mmol/L. CT scan of the brain showed no acute abnormality. Patient was intubated, admitted to intensive care unit, and prescribed 3% hypertonic saline at a rate of 30 ml/ hr. Venlafaxine was stopped. Hypertonic saline was stopped when serum sodium was 121 mml/L. Serum sodium rose to 128 mmol/L in 24 hours Desmopressin and D5W were given to slow the rate of sodium correction. Patient was extubated and returned to baseline mentation. Sodium was stable at 138 mmol/L prior to discharge.

DISCUSSION: Bisacodyl is a diphenylmethane stimulant laxative that is used in the treatment of constipation and part of bowel preparation before colonoscopy. Electrolyte and fluid imbalances are well recognized adverse effects of all bowel preparations but rarely of significance. There have been only five reports of hyponatremic seizures with non-phosphate bowel preparation and eight reports with oral sodium phosphate-containing purgatives. For the patient described in our report, her advanced age, gender and SNRI use may have led to SIADH. The clear liquid diet and stimulant laxative were contributing factors resulting in severe hyponatremia leading to seizures. Thus, clinicians should use caution when prescribing bowel preparation regimens in elderly patients. Patients should be encouraged to keep hydrated with electrolyte containing solutions.

SHIGELLA FLEXNERI: AN UNRECOGNIZED SEXUALLY TRANSMITTED INFECTION Jason Halperin. Tulane University, New Orleans, LA. (Control ID #1313018)

LEARNING OBJECTIVE 1: Recognize Shigella Flexneri as a serious cause of enterocolitis in the HIV positive population.

LEARNING OBJECTIVE 2: Recognize that shigellosis can be sexually transmitted and therefore a thorough social history is imperative to identify risk factors.

CASE: A 21-year-old HIV positive man (CD4 count 270 at 24%) presented with a three-day history of abdominal cramping, diarrhea and vomiting. He described frequent stooling with non-bloody bowel movements. He denied anorexia and hematemesis. His pain was relieved with defecation. He denied sick contacts, change in diet, or previous episodes. He denied exposure to unpasteurized foods, daycare facilities, nursing homes or recent antibiotic use. He had not traveled recently nor had any animal contacts. He was diagnosed with HIV five years ago during routine screening. He recently stopped taking his anti-retroviral medications (HAART) because he was feeling so good. He described frequent sexual contact with both men and women, engaging in both insertive and

receptive sex as well as direct oral-anal contact. He reported condom use and did not know of any sexual contacts with similar symptoms. His physical exam demonstrated a mildly distressed man, alert and oriented with normal build. He was febrile to 102.6, tachycardic, normotensive and positive for orthostatics. His mucous membranes were dry and his oropharynx was clear. His skin exam showed decreased skin turgor. His abdominal exam demonstrated tenderness in all four quadrants without rigidity, rebound tenderness and negative for murphys, roevsings and psoas sign. Diagnostic testing revealed acute renal failure. Abdominal CT

scan showed severe inflammation in the sigmoid colon with a normal gallbladder and appendix. Testing was negative for acute hepatitis. Stool studies were positive for fecal leukocytes, and negative for clostridium difficile toxin assay, giardia antigen, and cryptosporidium antigen. His stool culture grew Shigella Flexneri, sensitive to ciprofloxacin. He was discharged with resolved acute kidney injury and a 10-day course of antibiotics. He was referred for re-initiation of HAART and counseled on safe sexual practices.

DISCUSSION: In the industrialized world, shigella species are typically transmitted by direct or indirect fecal-oral contact and frequently associated with daycare facilities, nursing homes and contaminated food or water. Yet, HIV infection has been recognized as an important risk factor for shigellosis. The Center for Disease Control (CDC) demonstrated a 30 times greater incidence of infection in the HIV positive population compared to HIV negative. Furthermore, HIV positive individuals are four times more likely to require hospitalization. Since the mid-1970s, outbreaks of shigella infections have been recognized in the MSM population. Efficient sexual transmission has been suggested due to direct fecal-oral transmission and the very small inoculums of shigella-as low as 10 organisms-able to cause disease. In addition, concurrent HIV infection has been suggested to have several effects on shigella transmission including extended carriage of shigella species as well as increased asymptomatic shedding. A recent population-based study of shigella cases in San Francisco demonstrated independent associations for MSM, HIV and specifically direct oral-anal sexual contact with an odds ratio of 8 for each risk factor.

SHOT TO THE HEART Kate Hust. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1340501)

LEARNING OBJECTIVE 1: 1. Identify signs and symptoms of heart failure. 2. Recognize non-ischemic etiologies of dilated cardiomyopathy. 3. Identify medications and lifestyle modifications for treatment of alcoholic cardiomyopathy. 4. Integrate an understanding of the disease course of alcoholic cardiomyopathy for patient counseling.

CASE: A 64 year-old man presented with three days of bilateral lower extremity swelling. He had had no trauma to the lower extremities, and no immobilization. He noted associated orthopnea and a recently decreased exercise tolerance from twenty to five blocks. He had no known past medical history. Further history revealed chronic alcohol use, characterized as one-half pint of whisky several times weekly. His vital signs were normal. The heart sounds were distant but regular; there were no murmurs. Pulmonary crackles were absent, though his JVP was elevated. He had pitting edema extending to the knees bilaterally. A trans-thoracic echocardiography showed an ejection fraction of less than 20%, grade III/IV diastolic dysfunction, and a pulmonary artery pressure of 50-69 mmHg. Subsequent right- and left-heart catheterizations showed unobstructed coronary arteries. After six-months of treating the heart failure and abstinence from alcohol, his ejection fraction improved to 35%, the diastolic dysfunction reduced to a grade I/IV, and the pulmonary artery pressure normalized.

DISCUSSION: Both heart failure and alcohol abuse are frequently addressed issues by the general internist. Understanding their interaction is important for appropriate treatment and counseling. Though ischemic disease is the most common cause of dilated cardiomyopathy, the general internist must keep an open mind to the additional causes of cardiomyopathy. Genetic variations may result in familial forms of dilated cardiomyopathy. Often myocardial damage is secondary to infection, toxic agents, or metabolic end-products. Glycogen storage diseases, connective tissue disorders, and muscular dystrophies can all lead to dilated cardiomyopathy. Common toxic etiologies include the anthracycline derivatives, cocaine, and alcohol. Alcoholic cardiomyopathy may occur from several mechanisms including direct toxic effects of alcohol or additives to alcoholic beverages, concurrent thiamine deficiency leading to beriberi, or hypertensive changes. Ensuring the appropriate treatment for alcoholic cardiomyopathy is essential as it is a reversible cardiomyopathy. As in heart failure of any etiology, the mainstays of therapy are angiotensin-converting enzyme inhibitors, for their impact on cardiac remodeling, and beta-blockers, for their impact on remodeling as well as anti-arrhythmic effects. Though without mortality

benefit, diuretics should be added for relief of fluid overload symptoms. Additionally, alcohol cessation is critical. Cessation will not only prevent further damage but also allow for reversal of current damage. The reversibility of alcoholic cardiomyopathy should be stressed to patients upon diagnosis and continually reinforced during follow-up as encouragement for continued abstinence. Alcoholism and heart failure are two conditions for which the general internist commonly offers care, and it is important to recognize their intersection to offer appropriate counseling and treatment.

SIMULTANEOUS DETECTION OF HEPATITIS E AND EPSTEIN-BARR VIRUSES ASSOCIATED WITH ACUTE HEPATITIS Damian Casadesus; Syed Hassan; Tania Calzada; Izabella Zathureczky; Joseph DeAntonio; Daniel Goldsmith. Capital Health Regional Medical Center, Trenton, NJ. (Control ID #1278529)

LEARNING OBJECTIVE 1: Practitioners need to be aware of the presence of Hepatitis E in the United StatesLEARNING OBJECTIVE 2: Positive results of EBV antibody testing can be potentially a false positive in the setting of acute hepatitis. CASE: A 39-year-old Indian male presented to the emergency department with recent onset of anorexia, 5 pounds of weight loss, and one week of jaundice. He recently traveled to India three months before admission. There was no significant past medical history, except an evaluation for infertility that was negative. At presentation, physical examination showed jaundice, itching and dark urine. Relevant clinical laboratory data showed AST 1734 U/L, ALT 2125 U/L, alkaline phosphatase 215 U/L, total bilirubin 14.9 mg/dl, total protein7.5 g/dl, albumin 3.7 g/dl, prothrombin time 13.7 s, Hepatitis A IgM negative, all Hepatitis B studies were negative, and Hepatitis C antibody and RNA titer were negative. By ultrasound, the liver was normal in size and heterogeneous in appearance suggesting focal fatty infiltration. Liver biopsy showed moderate to severe hepatitis of uncertain chronicity and etiology, moderate steatosis and mixed hepatocellular and reticuloendothelial siderosis. Further laboratory data showed Hepatitis E (HEV) IgM positive, Epstein-Barr virus (EBV) IgM and IgG positive and Cytomegalovirus IgM negative. Overall, a diagnosis of acute hepatitis E was made and we hypothesize that the patient was probably infected by fecal-oral transmission during his trip to India.

DISCUSSION: We describe a case with positive serology for two viral agents which may be implicated in the etiology of acute hepatitis. Three different possibilities can explain the simultaneous detection of EBV and HEV: i) an acute infection by HEV with false positivity for EBV, ii) an acute infection by EBV with false positivity for anti-HEV IgM, iii) a double viral infection. To our knowledge, this is the third case described with positive serology findings for both HEV and EBV, but the explanation of which virus produced a false positive result remains uncertain. Previous studies support the theory that hepatitis viruses can induce false positive results for phylogenetically similar viruses. In our patient, the detection of EBV IgG suggests a distant infection, and his recent travel to an endemic area of hepatitis E and the presence of HEV IgM makes the diagnosis of hepatitis E with false positive reactivity for EBV most persuasive. Further, the acute illness of EBV infection is not typically associated with his pattern of liver function abnormalities. This case illustrates the need for practitioners to be aware of the presence of Hepatitis E in the United States, such that positive results of EBVantibody testing are recognized as being potentially a false positive in the setting of a clinical syndrome consistent with acute hepatitis.

SIN, SEX AND HEARTACHE: AN UNUSUAL PRESENTATION, EVEN FOR THE GREAT IMITATOR Maria G. Frank1,2; Barbara Statland1,2; Jessica Campbell1,2. 1Denver Health Hospital Authority, Denver, CO; 2University of Colorado, School of Medicine, Aurora, CO. (Control ID #1310287)

LEARNING OBJECTIVE 1: Diagnose atypical presentations of early syphilis.

LEARNING OBJECTIVE 2: Recognize the importance of obtaining a detailed sexual history and review of systems.

CASE: A 21 year-old male with no significant past medical history presents with two episodes of acute pericarditis in a one month period. The first episode was complicated by cardiac tamponade requiring pericardial drain. Work up during initial presentation revealed a large pericardial effusion with tamponade physiology and serologic studies that were unrevealing as to the underlying etiology. Patient remained asymptomatic for 4 weeks after his discharge, until his chest pain recurred and was readmitted with diagnosis of recurrent acute pericarditis. Review of symptoms obtained during this admission was notable for a resolved0.5 cm non-tender penile ulcer of two months duration. Exam revealed bilateral inguinal lymphadenopathy. Patient was found to have a positive RPR as well as a reactive T.pallidum IgG. Hence, he was treated with Penicillin for early syphilis with no further relapses of pericarditis. DISCUSSION: We present a case of a patient with recurrent pericarditis attributed to early syphilis. Syphilis has re-arisen worldwide. Cases of early syphilis detected in Colorado have increased almost 300% since 2007. Although known to affect almost every organ system, including the heart in tertiary syphilis, pericarditis is not a frequently recognized manifestation of the disease. We found only 3 case reports of syphilis pericarditis in the literature. In this case, the temporal relationship of symptoms and the resolution of them after treatment point to syphilis as the cause of the pericarditis. This case highlights the importance of a careful sexual history and review of symptoms in the diagnosis of syphilis, especially as new cases of syphilis are growing. Even today syphilis remains The Great Imitator; Oslers words ring true still, the physician who knows syphilis knows medicine

SKIN, LIGHT, AND MEDS: LOVE OR HATE? Shant Ayanian; JillianS. Catalanotti. George Washington University Medical Center, Arlington, VA. (Control ID #1335561)

LEARNING OBJECTIVE 1: Diagnose and treat photosensitivity reactionsLEARNING OBJECTIVE 2: Identify common medications that may cause photosensitivityCASE: WF is a 67 year old African American gentleman with diabetes, hypertension, dyslipidemia and prostate cancer who presented to the general internal medicine clinic with a rash over his face and neck of three months duration. He described his skin as darkening, scaling and thickening since August. Each morning he used a razor blade to remove scaling skin from his cheeks and neck. He denied using any new cosmetic or topical products, any new ingestions, use of new soaps or detergents, changes to his medications, or any previous rashes. The patient reported regular sun exposure of the face during twice monthly golf games. He denied personal or family history of lupus or other autoimmune or photosensitive diseases. His medications included atenolol, nifedipine, hydrochlorothiazide, lisinopril, aspirin and simvastatin. He had no known drug allergies. Physical exam was remarkable only for violaceous, scaly hyperkeratotic plaques over the face and neck with notable sparing of the post-auricular and peri-orbital areas as well as directly under the chin. Punch biopsy was performed and revealed hyperkeratosis, parakeratosis, irregular epidermal hyperplasia, spongiosis and perivascualr inflammation predominantly of lymphocytes and eosinophils consistent with either spongiotic (eczematous) dermatitis or hypersensitivity dermatitis. He was referred to a dermatologist, who diagnosed photoallergy, most likely due to hydrochlorothiazide. He was treated with desonide 0.5% cream twice daily for three weeks and advised to use mild soap and sunblock with SPF 30 or higher with good effect. Hydrochlorothiazide was discontinued. The rash responded well to treatment. DISCUSSION: Photosensitivity consists of phototoxicity and photo-allergy. It can be caused by either topical or systemic agents. Phototoxicity is an immediate reaction that presents after sufficient UVA exposure and manifests hours later as an exaggerated sunburn. Histology shows an acute inflammatory pattern. The exact mechanism of phototoxicity depends on the inciting molecule, but a common trend is the radicalization of an elemental chlorine atom. In contrast, photoallergy is a far less common, type IV delayed, immune-mediated hypersensitivity reaction that that seems to be Tcell mediated. Photoallergy usually presents as a papulovesicular or eczematous rash that typically appears on sun exposed areas days to weeks after sun exposure. Biopsy reveals a spongiotic dermatitis pattern. Both phototoxicity and photoallergy are caused by exogenous substances that interact with one or multiple specific wavelengths of light to induce a biochemical change in the tissues; if caused by an administered medication they are termed an adverse drug reaction. The

most commonly associated medications are diuretics, nonsteroidals, antimicrobials, and antipsychotics. The true incidence of photosensitivity is difficult to assess but is thought to be in the range of 1.4-12%. The investigation of photosensitivity reactions should include a detailed exposure history, skin biopsy and photopatch testing. Treatment includes withdrawal of the inciting agent, regular and consistent use of sunblock with SPF of at least 30, and consideration of short-term topical steroids.

SMALL LEADS TO BIG: THE PERILS OF THROMBOCYTOSIS IGNORED Siyang Leng1; Leonard J. Appleman2; Gregory M. Bump1.
1University of Pittsburgh Medical Center, Pittsburgh, PA; 2University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1314555)

LEARNING OBJECTIVE 1: Recognize that the myeloproliferative disorders are associated with thrombocytosis and thrombosis. LEARNING OBJECTIVE 2: Distinguish between reactive and clonal thrombocytosis.

CASE: A 44 year old man who has no medical problems presented with severe, substernal, burning chest pain that woke him up one hour prior. He has had similar pain for the past one month that was not exertional and lasted for hours to days each time. There is no family history of coronary artery disease, and the patient does not smoke, consume alcohol, or use recreational drugs. On exam, he was in significant distress, clutching his chest. Cardiac auscultation revealed regular rate and rhythm with no murmurs, extra heart sounds, jugular venous distention, or lower extremity edema, and the rest of his exam was similarly unremarkable. An EKG found ST elevations in leads V2-6, I, and aVL. The initial troponin was 0.08 ng/mL. The patient underwent left cardiac catheterization, which found a 100% occlusion in the proximal left anterior descending artery, which was then stented. No significant coronary artery disease was found. The troponin peaked at 127 ng/mL. Lipid panel and hemoglobin A1c were unremarkable. However, it was noted on the admission CBC that the patient had a platelet count of 771,000 /mL^3. The patient remembered being informed over 10 years ago while donating blood that he had elevated platelet counts in the 500-600,000 /mL^3 range. A JAK2 mutation was checked, and was positive. Bone marrow biopsy found an increased number of megakaryocytes, some of which were dysplastic. Trilineage hypercellularity and reticulin fibrosis were also noted. The pathological diagnosis was myelofibrosis. The patient was started on aspirin and hydroxyurea and discharged home.

DISCUSSION: This patient developed a myocardial infarction secondary to his myeloproliferative neoplasm. He did not have significant atherosclerosis on coronary angiography, suggesting that hypercoagulability rather than coronary artery disease was the predisposing factor for his myocardial infarction. The myeloproliferative neoplasms significantly increase the risk of thrombosis, with arterial thromboses being more frequent than venous. Paradoxically, they also increase the risk of hemorrhage, although this is less frequent and severe than thrombosis. Multiple mechanisms are thought to account for these bleeding diatheses -hyperviscosity, platelet aggregation abnormalities, leukocytosis, and downstream effects of the JAK2 mutation that is commonly seen in these disorders. In addition to thrombosis, the myeloproliferative neoplasms also predispose to thrombocytosis. While we initially thought that our patients thrombocytosis was secondary, or reactive, further history taking suggested that it in fact was clonal, or myeloproliferative, in nature. Reactive etiologies are most commonly infection, rebound thrombocytosis, tissue damage, inflammation, and malignancy. Distinguishing between reactive and clonal thrombocytosis can be difficult. Findings that suggest clonal processes include pruritus (often after showering), erythromelalgia, splenomegaly, dysplastic megakaryocytes or myelofibrosis on bone marrow exam, and positive JAK2 mutation testing. The JAK2 mutation is prevalent in the

myeloproliferative neoplasms, and should be checked when a patient has persistent thrombocytosis without an apparent reactive cause.

SMOOTH TRANSITIONS? COMPLICATIONS OF POOR TRANSITION OF CARE IN SICKLE CELL PATIENTS Matthew Calzetta3; Dina E. Adimora-Nweke3; Princess Dennar3; Michael D. Landry1,2. 1Tulane University, New Orleans, LA; 2Southeast Louisiana Veterans Healthcare system, New Orleans, LA; 3Tulane University,

New Orleans, LA. (Control ID #1332854)
LEARNING OBJECTIVE 1: Recognize common medical and psychosocial complications arising from poor care transitions from pediatric to adult healthcare systems in sickle-cell patients.
LEARNING OBJECTIVE 2: Identify essential concepts for appropriate care transitions including key advancements from Patient Centered Medical HomesCASE: A 32 year-old man with Hemoglobin SS sickle-cell disease presented to Med-Peds clinic with a two year history of untreated, non-progressive, constant 8/10 shoulder pain. He described his shoulder pain as swollen, numb, and typical of his many sickle cell pain crises. He denied taking any medication including analgesics, hydroxyurea, folic acid, or penicillin. His immunizations were not current. Laboratory studies revealed a hemoglobin of 7.8 g/dL, a reticulocyte count: 17%, and albumin 2.3 g/dL. Medical records show that he transitioned from a pediatric to an adult hematologist at 18. Since then, he had multiple primary care physicians, a disproportionate number of emergency room visits and duplicate work-ups at multiple sites. He showed poor compliance with his care plan and primary care appointments. He had numerous x-rays showing cardiomegaly and an echocardiogram showing right heart dilatation with mild pulmonary hyper-tension, but was never seen by Cardiology. The patient dropped out of college at 21 and applied for disability. He was never formally evaluated for depression. He started his individualized medical care plan including pain management, preventive care, specialty referrals and imaging studies. DISCUSSION: This patient demonstrates the result of poor transition of care from pediatric to adult healthcare systems in chronically ill patients. His disease progressed without the attenuating effects of proven sickle-cell treatment. He suffers daily symptoms, a prognostic sign for early mortality in sickle-cell disease. He lacks the benefits of reduced pain crises and decreased mortality seen with increased fetal hemoglobin levels from hydroxyurea treatment. Overutilization of the healthcare system, with multiple emergency room visits and varied primary care physicians, places financial burdens on the healthcare system. The Society for Adolescent Medicine defines successful transitions of care as a purposeful and planned process with continuity of care amongst providers, patients and families encompassing medical, psychosocial and educational patient specific-needs. Ideal transition programs account for developmental and temporal differences in individuals. The transition process begins at diagnosis with education of the entire family with careful attention to patient-specific medical and psychosocial needs. As an adolescent, formal transition programming must prepare patients for the culture of adult medicine, promote self-advocacy in seeking assistance from schools and employers, and address funding for future health care services. Through each stage, patients at risk for poor outcomes require further patient-specific interventions to ensure proper transition. Our case highlights the negative impact of poor transitional care: worsening disease burden, diminished quality of life, psychosocial and educational strain, and poor utilization of the healthcare system. This case demonstrates the essential need for established protocols in the transition from pediatric to adult healthcare systems in chronic medical illness. Advancement of key components of the Patient Centered Medical Home may provide structural frameworks that will improve transitions of care.
SO, YOU ARE TELLING ME I JUST HAVE TO DEAL WITH MY P.M.S.? Aaron Kline; Gary Malakoff; Jacob Noe; Mukta Panda. University of Tennessee, Chattanooga, TN. (Control ID #1319984)
LEARNING OBJECTIVE 1: Recognize the indications for head imaging in the context of new onset seizure
LEARNING OBJECTIVE 2: Review the presentation initial management and imaging of cerebral venous thrombosisCASE: A 45-year-old euthyroid white female with a history of bilateral carpel tunnel syndrome, depression and oral contraceptive hormone use for perimenopausal complaints presented with her first witnessed generalized tonic-clonic seizure. Review of systems revealed a headache for the past two weeks requiring increasing ibuprofen and acetaminophen doses. The patient had no family history of clotting disorders. Initial laboratory studies showed no significant abnormalities. Computerized Tomography (CT) imaging of her head revealed likely sagital sinus thrombosis. She was placed on heparin drip and antiepileptic medication. Re-imaging with Magnetic Resonance Imaging (MRI), Magnetic Resonance Arteriography (MRA) and Magnetic Resonance Venography (MRV) of her head confirmed the suspected sagital sinus thrombosis. Hormonal

therapy was discontinued. The patient was monitored for hemorrhagic conversion of thrombosis for 72 hours. She was transitioned to warfarin. The patient begrudgingly agreed to abstain from her hormonal therapy at discharge DISCUSSION: For adult patients presenting with an unprovoked first seizure, head imaging should be performed (1). In the emergency department, a CT is often ordered to rule out an intracranial bleed. The preferred brain imaging modality in the setting of seizure is MRI. Cerebral venous thrombosis is relatively uncommon with an annual incidence of less than 1/100,000. Women are three times more commonly affected than men. Risk factors include hypercoaguable conditions, such as oral contraceptive hormone use, intracerebral lesions and trauma. Headache, of varying duration, is a predominate symptom in women. Other symptoms include focal neurological symptoms, encephalopathy or seizure. In the context of cerebral venous thrombosis, it is not uncommon for a patient to have a normal brain CT. Initial management is aimed at reversing the cause of the hypercoaguable state and starting anticoagulation therapy. Monitoring for thrombosis hemorrhagic conversion is prudent, especially at the initiation of anticoagulation therapy. Over half of patients presenting with cerebral venous thrombosis are on oral contraceptive hormones (2). This case illustrates the importance of maintaining a high index of suspicion for rare entities in the context of risk factors. References: 1. Adams SM and Knowles PD. Evaluation of a first seizure. Am Fam Physician. 2007 May 1;75(9):1342-7. 2. Saposnik G, et al. Diagnosis and management of cerebral venous thrombosis: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2011, 42:1158-1192
SOME LIKE IT HOT: A CASE OF CANNABINOID HYPEREMESIS SYNDROME Jeffrey D. Welder. University of Iowa, Iowa City, IA. (Control ID #1326703)
LEARNING OBJECTIVE 1: Recognize the clinical features of cannabinoid hyperemesis syndromeLEARNING OBJECTIVE 2: Manage cannabinoid hyperemesis syndrome CASE: A 29 year-old male with possible fructose-intolerance presented with acute abdominal pain and vomiting. He had a 10-year history of recurrent pain and vomiting for which he had been hospitalized multiple times, most recently 2 months prior, improving with 1-2 days of hydration and pain medication. An extensive workup including labs, lactose breath test, multiple CT scans and ultrasounds had always been negative. Fructose tolerance testing performed at the onset of symptoms was inconclusive. Yet, the patient attributed his symptoms to this diagnosis. Physical exam revealed a diaphoretic and moderately distressed individual curled in the fetal position and retching. He was afebrile and tachycardic. Mild periumbilical tenderness was present but the abdomen was soft. Labs were notable for phosphorus of 0.7 mg/dL and 2+ urine ketones. The patient was given IV fluids, morphine and phosphorus. Over the next 2 days the patient had resolution of symptoms. On every attempt to interview the patient, however, he was found in the shower. Nursing documented that the patient was spending hours each day taking hot showers and refused to come out for meals or receive medications. Upon further questioning, he admitted that he had been spending hours almost every day for the past 6 months in the shower, which relieved his nausea and pain. He began this practice around 4 years ago. Cannabinoid hyperemesis syndrome was suspected and at this point the patient admitted to daily marijuana use starting at age 16. He held a medical marijuana

card for nausea and smoked daily. He had never divulged this information to past providers because he didnt find it relevant. The patient was counseled on the association between daily marijuana use and vomiting and agreed to a trial of abstinence. The patient was contacted 4 weeks after discharge and reported complete resolution of pain and vomiting during this period. DISCUSSION: Cannabinoid hyperemesis syndrome (CHS) is a condition of cyclic vomiting and compulsive bathing to relieve symptoms in patients with chronic daily marijuana use. It is more common in males, and typically presents after 10 years of daily marijuana use, with most patients beginning use as teenagers. These patients spend an average of 5 hours daily in hot baths when

symptomatic. In a large review of cases it was found that the diagnosis was made an average of 4.5 years after onset of symptoms, with patients receiving repeated radiologic imaging and invasive procedures with no diagnosis. Significant clinical improvement is seen within 12-24 hours with cannabis cessation. In all cases, complete resolution of CHS is found with abstinence, which is the only treatment. The etiology remains unclear, but is likely related to chronic stimulation of cannabinoid-like 1 (CB1) receptors in the enteric plexus by Delta-9-tetrahydrocannabinol (THC), which slows gut motility. While these receptors usually mediate an anti-emetic effect, a paradoxical effect is thought to induce emesis in CHS. As for the hot baths, it is thought that warm water counteracts the effects of THC on CB1 receptors in the hypothalamus, which controls temperature. CHS should be suspected in patients with recurrent abdominal pain and vomiting. Recognition of this of this under-diagnosed syndrome will decrease unnecessary testing and provide a solution for these patients.

SOMETIMES RED SOMETIMES BLUE; I WONDER WHY MY FEET CHANGE THEIR HUE! Fatima Khalid; Syed Hassan; Waqas Qureshi; Kelly Caverzagie. Henry ford Hospital, Detroit, MI. (Control ID #1311895)

LEARNING OBJECTIVE 1: To identify the clinical features of Erythromelalgia.

LEARNING OBJECTIVE 2: To recognize the role of aspirin in the treatment of Erythromelalgia.

CASE: We present a case of a 64 years old female who presented to the Emergency Department with bilateral foot pain, redness and warmth, more prominent in the right foot. The pain was excruciating, 10/10, burning in quality and worsened with ambulation as well as being placed in a dependent position. Her medical history was significant for hypertension, myeloproliferative disorder in remission and stroke for which she was started on aspirin two years ago. One week prior to presentation she was found to have right iliac artery thrombosis and anticoagulation with Coumadin was initiated with discontinuation of aspirin. Other medications included gabapentin, anagrelide, omeprazole and atenolol. On examination she was hemodynamically stable and afebrile, distal pulses were intact and there was blanchable erythema in the bilateral lower extremities. Laboratory studies showed normal WBC and platelet count with an elevated INR. Initial differential diagnosis included cellulitis, arterial or venous insufficiency which were systematically excluded. A presumptive diagnosis of erythromelalgia was made and aspirin 325 mg was initiated with symptomatic improvement within 24 hours.

DISCUSSION: Erythromelalgia is a rare disease characterized by redness, warmth and severe burning pain of extremities aggravated by temperature changes. It usually involves the lower extremities and is more prevalent in women. Diagnosis is usually based on history and physical examination. Primary erythromelalgia is classified into idiopathic, familial (autosomal dominant) and sporadic subtypes. Secondary erythromelalgia is associated with myeloproliferative disorders, lupus, multiple sclerosis, diabetes and the use of some medications including verapamil, nifedipine and bromocriptine. Etiopathogenesis is not clear, however, a prevalent theory is the vascular hypothesis suggesting improper distribution of nerves to skin vasculature causing endothelial edema, hypoxia and activation and aggregation of platelets that release prostaglandins causing pain and erythema. The familial variety has been attributed to mutations in the Na(v)1.7 sodium channel, expressed in the dorsal root ganglia cells and sympathetic neurons, causing perturbation in pain sensation. There is no definite medical management Aspirin, misoprostol, sodium nitroprusside
and gabapetin have been found to be helpful but with limited success. Prior case descriptions of erythromelalgia describe this entity in the setting of significantly elevated platelet counts. Our case is unique as the platelet count was normal at the time of presentation because the patient was on anagrelide. Another unique feature is that the symptoms were precipitated by withdrawal of aspirin in a patient who did not have a known diagnosis of erythromelalgia.

SPINAL TUBERCULOSIS: A BIG PAIN IN THE BACK. Stephan Hanses; Jillian S. Catalanotti. George Washington University, Washington, DC. (Control ID #1338201)

LEARNING OBJECTIVE 1: Recognize spinal tuberculosis as a cause of intractable back pain.

CASE: A 24 year old otherwise healthy man presented to clinic with new onset, severe 9/10 back pain in the spinal and para-spinal lumbar region, which radiated into the right buttock, and right posterior thigh. It was

aching in character, and lasted up to several hours a day. Movement, in particular, back extension and hip flexion, exacerbated the pain. Leaning forward while ambulating alleviated the pain. It improved with rest, but would not resolve completely, and at times the pain awakened him from sleep. He denied injury, radicular symptoms, or neurologic deficits. He took no medications, had no allergies, and no family history of illness. Social history was significant for immigrating to the US from India at the age of 6. Review of systems was otherwise negative. Vital signs were unremarkable. Physical exam revealed tenderness to palpation along the lumbar paraspinal muscles bilaterally, and spinal tenderness at several points distal to L2. Strength, sensation and reflexes were normal. He was treated for a presumed back strain with ibuprofen and cyclobenzaprine. This provided relief, however, over the course of a year, he continued to suffer bouts of back pain. He presented to the emergency room, where a spinal MRI showed multiple, noncontiguous abscesses in his thoracic and lumbar vertebrae. There was also an 8 cm lesion in his right psoas muscle. PPD and interferon gold tests were positive, and aspiration of the psoas abscess showed acid fast bacilli. Culture grew mycobacterium tuberculosis. DISCUSSION: Lumbar muscle strain is the most common etiology of back pain in a young adult, and accounts for more than 90% of cases. More serious causes of spondylar disease should be considered for intractable pain that fails to respond to conservative treatment, pain that occurs at night while resting, accompanied by systemic symptoms or neurologic deficits, or if there is spinal tenderness on exam. 11,182 TB cases of active tuberculosis were reported in the United States in 2010.Tuberculous spondylitis (Potts Disease) is an uncommon form of active tuberculosis and occurs in about 1% cases. It is usually seen in older children and young adults from TB endemic countries. Spinal tuberculosis is the result of either hematogenous spread, lymphatic spread, or extension of contiguous disease from an extraspinal source.Lesions are most commonly seen in the lower thoracic and upper lumbar spine, and can spread to the intervertebral disc, adjacent vertebrae, distant vertebrae, epidural space, psoas muscle, and the posterior iliac crest. Physical exam often shows spinal tenderness. Advanced disease can lead to muscle weakness and paralysis. Systemic tuberculosis symptoms are often absent, and Xrays can miss early lesions. MRI is the most sensitive in identifying early disease and is the standard for evaluating disk-space infection, osteomyelitis of the spine, and extension of disease into soft tissues. Tuberculomas on MRI show thin, smooth enhancement of the abscess wall, whereas pyogenic spondylitis is characterized by thick and irregular enhancement of the abscess wall. The diagnosis of spinal TB is confirmed with an AFB positive aspirate. Treatment is with antimycobacterial agents.

SPONTANEOUS BACTERIAL PERITONITIS (SBP) IN A WOMAN WITH METASTATIC GASTRIC CANCER WITHOUT LIVER INVOLVEMENT Jamie Osman; Tanping Wong. NYU, New York, NY. (Control ID #1309954)

LEARNING OBJECTIVE 1: Recognize a case of malignant ascites complicated by SBP with a high serum-ascites albumin gradient (SAAG) despite absence of primary liver disease.

LEARNING OBJECTIVE 2: Broaden a diagnostic differential for peritoneal infection in the setting of peritoneal carcinomatosis.

CASE: A previously healthy 41yo Ecuadorian woman presented with 2 months of intermittent sharp epigastric pain that improved with eating, and worsening abdominal distention accompanied by a 15 lb weight loss, dysphagia, and dyspnea; days before admission, she developed nausea, nonbilious/non-bloody emesis, constipation and fevers. She denied sick contacts or recent travel, was taking no medications besides herbals for gastritis, and denied all toxic habits. Vitals: T 102 F, BP 115/81, HR 130 s, R 22, O2 94% on RA. She was cachectic with bitemporal wasting, anicteric sclera, shallow breathing and decreased bibasilar breath sounds. Her abdomen was massively distended with fluid wave, dull to percussion, diffusely tender, with no hepatosplenomegaly. Extremities were cool, moist, non-edematous, with normal pulses. Labs showed serum Na 121; AST 43, ALT 16, Alk phos 78, albumin 3.4; WBC 19.7 (92%N), Hb 11.3, MCV 69, RDW 30; guaiac negative. Abdominal CT showed massive ascites with jejunal and gastric fundus thickening, peritoneal carciomatosis, normal liver and spleen. Paracentesis yielded 4.5 L of cloudy yellow fluid, RBC 1500, WBC 4890

(81% seg), protein 4.3, albumin 2.3 (SAAG 1.1), negative gram stain, cytology with inflammatory but no malignant cells, and culture with gram negative rods (Klebsiella oxytoca). The patient's family later revealed her recent diagnosis at an outside hospital with stage IV gastric cancer, confirmed by biopsy report showing high grade invasive signet ring cell type gastric adenocarcinoma. Her course was complicated by multiple bilateral pulmonary emboli, bilateral pleural effusions, electrolyte disturbances, and labored breathing requiring nighttime bipap. On day 24, she was discharged to hospice.
DISCUSSION: This was a case of a 41yo woman with gastric adenocarcinoma and peritoneal carcinomatosis with K. oxytoca SBP and SAAG of 1.1. SBP was diagnosed using standard criteria: ascitic fluid PMNs>=250cells/ mm3 (3961), positive culture without secondary causes, and monomicrobial infection. Portal HTN is an instigator of SBP via suppression of the hepatic reticuloendothelial system (RES) function, intestinal bacterial overgrowth due to intestinal hypomotility, and venous status causing increased permeability to enteric bacteria. Although our patient had a SAAG of 1.1, and SAAG>=1.1 is 97% specific for ascites due to portal hypertension, she had a non-dilated IVC, no parenchymal liver disease or sequelae of hepatic failure. Isner at al. reported a case of strep pneumonia SBP in a patient with metastatic gastric adenocarcinoma, without portal hypertension, proposing that massive metastases led to SBP via loss of the hepatic RES. Makharia et al. incriminated chemotherapy-induced immunosuppression and active severe GI bleed or perforation with increased mucosal permeability due to bowel ischemia as additional causes of SBP. However, our case did not involve these established prerequisites for malignancy-related SBP (liver metastasis, portal hypertension, bowel hemorrhage/perforation). Furthermore, the high ascitic protein of4.3 and infection with common gut flora defied the standard SBP milieu, adding evidence for altered gut permeability secondary to cancer-related physiologic changes.
SPONTANEOUS PNEUMOTHORAX: THE GATEWAY TO A UNIQUE CLINICAL ENTITY Rosana Ayoub; Christine Yu; Michael Rotblatt. Olive-View UCLA Medical Center, Sylmar, CA. (Control ID #1339902)
LEARNING OBJECTIVE 1: Recognize the numerous clinical and radiologic manifestations of tuberous sclerosisLEARNING OBJECTIVE 2: Recognize that Sirolimus is a new ground-breaking treatment for certain manifestations of tuberous sclerosis CASE: A 27 year old woman with PMH of a seizure disorder presented to the ED complaining of sudden onset chest pain and DOE. The physical exam was significant for decreased breath sounds over the left lung, multiple facial lesions over her bilateral cheeks and nasal bridge, hypopigmentation of her arms, and pitting of her nails. The CXR revealed a left sided pneumothorax, and the CT demonstrated mixed solid and fat containing lesions suspicious for pulmonary lymphangioleiomyomatosis and large renal angiomyolipomas. Taken together, the history, exam and radiologic findings were suspicious for tuberous sclerosis, and a brain MRI further revealed multiple cortical and subcortical tubers, numerous subependymal nodules, and a white matter hamartoma. To provide a
complete assessment of this condition, the patient was referred for Ophthalmic examination, which identified bilateral retinal hamartomas. This constitution of clinical findings, along with her history of seizure disorder and facial adenomas, reinforced the diagnosis of tuberous sclerosis. A chest tube was placed to treat the pneumothorax, but treatment of the renal angiomyolipomas and lymphangioleiomyomatosis proved more difficult. A decision was made to begin treatment with sirolimus, which has been documented in a recent RCT to be effective in reducing the size of renal angiomyolipomas and improving spirometric measurements in patients with lymphangioleiomyomatosis from tuberous sclerosis. DISCUSSION: Tuberous sclerosis is a disease of widespread hamartomas, commonly in the CNS, kidneys, and skin, commonly identified clinically with a triad (Vogts triad) of seizures, mental retardation, and facial angiofibromas. However, these hamartomas can occur in almost any organ system, including pulmonary lymphangioleiomyomatosis, renal angiomyolipomas, cardiac rhabdomyoma, retinal nodular hamartomas, and CNS cortical tubers and supendymal nodules. Enlargement of renal angiomyolipomas pose a significant threat of pain and enlargement with possibility of hemorrhage, and renal cell carcinoma can rarely occur in less that two percent of patients. Trials involving use of sirolimus as a

suppressor of mTOR (mammalian target of rapamycin) signaling have found a significant reduction in the size of renal angiomyolipomas during the duration of administration. The major pulmonary manifestation in women with tuberous sclerosis is lymphangioleiomyomatosis, which is characterized by formation of parenchymal cysts and the infiltration of smooth muscle cells. With sirolimus treatment of tuberous sclerosis patients, gas trapping and airflow can improve significantly. However, the most common cause of death is neurologic disease, such as status epilepticus and subependymal giant cell tumors, which are not affected by sirolimus treatment. The manifestations of tuberous sclerosis are numerous and, as in our patient, become more obvious with more complications. It remains crucial for clinicians to identify the constellation of findings in order to diagnose the disease as early as possible, and consider innovative treatments such as sirolimus.

SPURRING CONVERSATIONS OF PATIENT CARE: SPUR CELL ANEMIA IN LIVER CIRRHOSIS PATIENTS Mary J. Dennison; William Niehaus; Ankur Segon. Medical college of Wisconsin, Milwaukee, WI. (Control ID #1297231)

LEARNING OBJECTIVE 1: Recognize the association between end stage liver disease and spur cell anemiaLEARNING OBJECTIVE 2: Recognize spur cell anemia as an ominous prognostic marker in end stage liver diseaseCASE: A 57-year-old Caucasian male with child class C alcoholic liver cirrhosis (current drinker), DM-2, and chronic kidney disease presented to the ED from a skilled nursing facility due to altered mental status and a hemoglobin of 4.8 mg/dL (baseline 7-8 mg/dL). Upon arrival, he was lethargic but arousable, icteric, and oriented only to person. Workup showed stable vital signs, clear chest X-ray, hemolytic anemia, and elevated creatinine. He was transferred to the MICU where he received 6 units of RBCs, had a paracentesis that was negative for bacteria, and had an NG tube placed. He was transferred to the floor after 6 days but continued to respond poorly to treatment with lactulose, rifaximin, and zinc. While on the floor, he regularly needed blood transfusions. His encephalopathy worsened despite treatment and his creatinine began to rise. A family meeting was held to determine goals of care for the patient. It was communicated that he was not a liver transplant candidate and he would likely have a poor prognosis, but the family decided to continue life saving care. On review of peripheral smear, it was discovered that the patient had Spur Cell Hemolytic Anemia. The fact that presence of spur cells confers a particularly poor prognosis in end stage liver disease was communicated to the family in the next family meeting. Based in part upon this information, the family decided to withdraw current support and focus solely on comfort care, with death as the expected outcome. The patient was discharged 16 days after admission in stable and terminal condition to a hospice facility close to his family. DISCUSSION: 5% of patients with end stage liver disease also have spur cell anemia. Alcohol related liver disease is most commonly associated with spur cell anemia. The presence of spur cells on peripheral smear in a

patient with advanced hepatocellular disease is an ominous marker and portends a survival of a few weeks. Liver transplant can be curative in this situation: however, such patients might not be candidates for transplantation due to multiple other reasons. In our case, we found this objective finding to be a useful facilitator of goals of care discussion with family members.

STREPTOCOCCUS BOVIS BACTEREMIA ASSOCIATED WITH COMPOSITE LYMPHOMA Ahmet A. Oktay1; Fritzie S. Albarillo1; Janis Atkinson2. 1Saint Francis Hospital, Evanston, IL; 2Saint Francis Hospital, Evanston, IL. (Control ID #1338539)

LEARNING OBJECTIVE 1: Recognizing the importance of work-up to rule out underlying malignancy in patients with Streptococcus bovis(S. bovis) bacteremia.

LEARNING OBJECTIVE 2: Learning the general features of a very rare form of lymphoma; composite lymphoma.

CASE: An 86-year-old male patient with past medical history of mild dementia, deep vein thrombosis, hypertension, and type-2 diabetes mellitus was admitted for generalized weakness and asymptomatic hypoglycemia. Family members reported that the patient had been having generalized weakness, poor appetite and had fallen multiple times recently without loss of consciousness. His medications had included warfarin, metformin and glyburide. When he presented to the ED his vital signs were within normal limits. On examination he was found to be lethargic, diaphoretic and oriented only to person and place. Initial laboratory tests were unremarkable except for serum glucose of 69 mg/dL. Initial urinalysis showed hematuria without any sign of urinary tract infection. Blood cultures and urine culture from the day of admission were negative. On the third day of admission he was found to have severe sepsis. His blood cultures on that day reported S. bovis and Enterococcus faecalis. The latter also grew in the urine culture. The patient responded well to intravenous Vancomycin and fluid replacement. An extensive work-up was done to identify the source ofS. bovis bacteremia. Trans-esophageal echocardiography showed no evidence of thrombus or vegetation. His colonoscopy showed a single sessile polyp with no evidence of malignancy. CT of the chest, abdomen and pelvis showed a 4.2 x 5.6 cm intra-abdominal mass adjacent to the liver and diffuse thoracic, abdominal and pelvic lymphadenopathy. An incisional biopsy of deep cervical/scalene lymph node and immunophenotypic analysis revealed composite lymphoma: classical Hodgkins lymphoma and CD5 positive B-cell lymphoproliferative disorder. DISCUSSION: Streptococcus bovis (S. bovis) infections in humans are usually associated with bacteremia and infective endocarditis (IE). Gastrointestinal tract is the main portal of entry for S. bovis. It has been well known that S. bovis bacteremia, with or without IE, is associated with underlying malignancy of the colon as well as extra-colonic malignancy or liver disease. Every patient with S. bovis bacteremia should undergo evaluation for IE and gastrointestinal malignancy. S. bovis bacteremia with underlying lymphoma, mostly gastric lymphoma, was reported in very few case reports. To our knowledge this is the first S. bovis bacteremia case reported to be associated with composite lymphoma which is a rare disease and defined by the presence of two or more distinct lymphoma types in a single lymph note. The underlying mechanism for the association between S. bovis infection and malignancy remains elusive. We believe that, in our case, the liver involvement has provided a portal of entry from the hepatobiliary tree for S. bovis. This case supports the fact that S. bovis bacteremia cases need extensive workup to rule out underlying malignancy.

STROKE IN YOUNG ADULT: THINK OF CAROTID ARTERY DISSECTION Mohamed El khashab. Creighton University Medical Center, Omaha, NE. (Control ID #1336098)

LEARNING OBJECTIVE 1: Carotid Artery Dissection is a common and easily missed cause of stroke in young adults.

LEARNING OBJECTIVE 2: Presentation of Carotid Artery Dissection might be similar to complicated Migraine headacheCASE: A 28-years old female presented with right arm and leg weakness/ numbness for two hours. Associated symptoms included frontal headache
and expressive aphasia . The patient had complete resolution of her neurological symptoms in 2 hours. Physical exam was unremarkable at time of presentation as the symptoms had resolved. CT of the brain was unremarkable. However, within few hours of admission the patient started to have upper limb weakness. MRI/MRA showed diffusion restriction at the level of left the insula consistent with acute ischemia involving distal L MCA. MRA of the neck showed absence of flow within the left internal carotid artery, findings was suggestive of carotid artery dissection and secondary progressive thrombo-embolic events. The patient was started on Heparin and aspirin. However, she experienced worsening of neurological status to include right leg. Interventional cardiology performed carotid angiogram which showed long linear dissection of L ICA, and a 4 mm bare metal stent was placed in L ICA with good results and distal flow was considered excellent. The patient immediately experienced increased strength in the right leg but continued to have right arm weakness and aphasia.

DISCUSSION: Carotid Artery Dissection accounts for 5-20% of CVA in young adults. It is usually related to

trauma and connective tissue disease causing arteriopathies. Spontaneous Carotid Artery Dissection is not uncommon in clinical practice. This might be associated with intramural thrombus formation. Focal neurological deficit and frank stroke with fronto-temporal and hemi-cranial headache are the frequent presentations of carotid artery dissection. Some of these presentations could be misinterpreted as complicated migraine headache. Carotid bruit may be heard over the carotid artery and ecchymosis would be seen in cases of trauma. Carotid angiogram is the gold standard diagnostic tool. MRA is considered an alternative to angiography for evaluation of carotid dissection. Angiography would be considered if there was significant discrepancy between the findings of MRA and Dupplex ultrasonography that would impact on intervention planning. Clinical judgment with prompt investigations and early treatment can prevent devastating neurological consequences in these young adults. At that time the benefit of anticoagulation, intervention with stenting and less commonly surgical intervention would improve the clinical outcome.

SUBMUCOSAL GASTRIC LIPOMA PRESENTING WITH ABDOMINAL PAIN AND SYMPTOMS OF OBSTRUCTION SterlingK. Hansen. SJHMC, Phoenix, AZ. (Control ID #1339006)

LEARNING OBJECTIVE 1: Although gastric lipomas (GL) are benign, they can be large, causing abdominal pain, symptoms of obstruction, and/or GI bleeding. Abdominal CT is the imaging modality of choice, but a definitive diagnosis requires tissue either from upper GI endoscopy or post-resection biopsies. Surgical resection is the mainstay of treatment for symptomatic GL.

CASE: An 80-year-old, Hispanic female, with past medical history of type II diabetes mellitus, remote cholecystectomy and partial hysterectomy, presented with a 3-day history of sharp, intermittent RUQ abdominal pain, nausea, and vomiting. She had had no recent diarrhea or constipation. She noted a 20-lb unintentional weight loss over the preceding 2-3 months. On physical exam, she was hemodynamically stable. Abdomen was soft and non-distended, with mild diffuse abdominal tenderness to palpation. No rebound or guarding was elicited, and no abdominal masses were palpated. Upon admission, abdominal CT showed gastric outlet obstruction likely secondary to a 5.6 x 4.6 cm mass, consistent with a GL, at the gastroduodenal junction. A NGT was placed, and the patient was placed on NPO status with some relief of pain. Upper GI endoscopy with biopsies performed on hospital day 2 confirmed a diagnosis of submucosal GL. General surgery was consulted, and after medical clearance, an exploratory laparotomy with partial gastrectomy and excision of GL was performed on day 11. Patient recovered well post-operatively, was able to tolerate a regular diet, and was discharged home on hospital day 13.

DISCUSSION: GL are rare, representing 2-3% of benign gastric tumors and less than 1% of all gastric tumors1. Tumor growth is usually indolent with the peak incidence in the 7th decade of life2. GL are mostly asymptomatic when smaller than 4 cm but can become symptomatic with various presentations when larger1. A PubMed search using the terms gastric lipoma returned multiple case reports describing the more common presentation of GI hemorrhage secondary to ulceration of the overlying mucosa. Only 8 cases

were found with presentations of abdominal pain and/or obstruction, as seen in this case. Dyspepsia has also been reported as a presenting symptom1. Abdominal CT is a highly-specific imaging modality in the detection of GL, with radiological findings generally showing a homogenous, non-invasive structure with negative Hounsfield units, indicative of a fat density3. MRI and high-resolution ultrasound can be useful in the detection of GL1. Upper GI endoscopy with biopsy also aids in the diagnosis of GL but often does not reach the submucosal layer, where 95% of GL originate3. As a result, a definitive diagnosis of GL is often made from biopsies obtained post-resection. The treatment of asymptomatic GL is controversial, but symptomatic GL are treated with surgical resection. Laparoscopic resection is advised for tumors less than 6 cm in diameter, though larger tumors have been removed laparascopically.

SUCCESSFUL TREATMENT OF ACQUIRED ANGIOEDEMA USING RITUXIMAB Chang Na1; David Podell1; David Dreyfus2; Christopher Randolph2; Denise M. Kearney2. 1Yale Primary Care Program, Waterbury, CT;

2Allergy, Asthma &Immunology Group, Waterbury, CT. (Control ID #1279059)
LEARNING OBJECTIVE 1: Learn about the immunobiology underlying acquired angioedema (AAE)
LEARNING OBJECTIVE 2: Make treatment decisions based on mechanism of disease and the latest literature dataCASE: A 41 year old woman with a past medical history of myasthenia gravis and anti-phospholipid syndrome, presented with recurrent diffuse abdominal pain. She had low C1q, C2, C3, and C4 levels and CT abdomen revealed thickened ascending colon consistent with bowel edema. She was diagnosed with AAE based on her low complement levels, recurrent angioedema symptoms and the presence of IgG antibodies (Ab) against C1 inhibitor (C1-INH). Despite the established association between AAE and lymphoproliferative disorders (LPD), our patient had a subsequent normal CT chest/abdomen/ pelvis, normal SPEP, and flow cytometry that showed normal lymphoid phenotype. She continued to have recurrent episodes of angioedema involving the colon and the larynx requiring intubations. She was treated with various medications including loratadine, cetirizine, and ranitidine for prevention and methylprednisolone without benefit. She also did not appear to benefit from ecallantide, a novel kallekrein inhibitory peptide that is used in acute exacerbations of hereditary angioedema. The patient was eventually treated with rituximab (RTX) with significant improvement in severity of her latest angioedema episode. After she finished the course of RTX, a decrease of anti-C1-INH Ab titer was observed and she remained without further angioedema episodes.
DISCUSSION: AAE is a rare condition that is characterized by acquired deficiency of C1-INH, hyperactivation of the classical complement pathway and recurrent angioedema symptoms. C1-INH is a protease inhibitor that regulates the activation of kallikrein and the classical complement pathway. C1-INH deficiency, which can be hereditary or acquired due to anti-C1-INH Ab, can lead to unregulated activation of the complement system and increased generation of bradykinin via kallikrein activation. Clinically, it is thought that uncontrolled bradykinin production results in angioedema. In hereditary angioedema, there is either a lack of synthesis of C1-INH or synthesis of a nonfunctional protein. In AAE, there is either an excessive consumption of C1-INH or formation of a circulating anti-C1-INH Ab that cleaves C1-INH into a nonfunctional form. Acquired C1-INH deficiency has been associated with LPD and autoimmune disorders. Treatment includes emergent therapies for potentially fatal episodes, such as laryngeal edema, and therapies to curb recurrences by treating the underlying disease and using antifibrinolytics and immunosuppresants. RTX has been shown to be effective as adjunctive treatment of LPD, in particular B-cell lymphomas, and there have been recent case reports of RTX effectively treating AAE secondary to LPD. It is postulated that RTX, a monoclonal Ab directed against glycoprotein CD20 expressed on B cells, works by depleting B cells and subsequent auto-Ab production, thereby making it an effective treatment of AAE mediated by high circulating auto-Ab. This case is unique in that RTX was successfully used to treat AAE in a patient
without LPD. RTX was chosen in this patient since she had other underlying autoimmune disorders that are associated with auto-Ab production by B cells, which may also underlie the C1 INH auto-Ab production and subsequent AAE. Our case highlights that RTX can be an effective treatment for acquired C1-INH deficiency that is not related to LPD.
SURGICAL CURE FOR AUTOIMMUNE HEMOLYSIS-NOT THE SPLEEN Yue Sha1; Cheng-jin Huang1; Gurpreet Dhaliwal2; Wei-gang Fang1; Xin-yan Liu3; Xin-yu Ren4; Hui Zhang5; Xue-jun Zeng1. 1Division of General Internal Medicine, Department of Medicine, Peking Union Medical College Hospital, Beijing, China, Beijing, China; 2Department of Medicine, University of California San Francisco and San Francisco VA Medical Center, San Francisco, CA; 3Department of Obstetrics and Gynecology, Peking Union Medical College Hospital, Beijing, China;
4Department of Pathology, Peking Union Medical, Beijing, China;
5Department of Emergency, Peking Union Medical, Beijing, China. (Control ID #1310384)
LEARNING OBJECTIVE 1: Recognize Ovarian Teratoma Induced AIHALEARNING OBJECTIVE 2: Treat Ovarian Teratoma Induced AIHA CASE: A 39-year-old woman was evaluated for palpitations, fatigue, and

dizziness for one week. She had lost consciousness for minutes when standing up several times before admission. She denied abdominal pain or dark urine. She was previously healthy other than a large right ovarian mass (9 x 9 x 9 cm) that was detected 3 months earlier by ultrasound ordered to evaluate irregular menstruation. The mass was suspected to be an ovarian teratoma. She took no medications or illegal drugs and did not smoke or alcohol. She was afebrile. Her heart rate was 100 beats per minute and her supine blood pressure was 125/75 mmHg without orthostatic changes. Her conjunctivae were pale and scleral icterus was present. Heart, lung, and abdominal exam were normal. No hepatosplenomegaly. The hemoglobin was 40 mg/dL with a reticulocyte count of 23%
and MCV 105 fl. Ferritin 342 ng/ml (normal 14-336 ng/ml), serum iron 135ug/dl (normal 50-150 ug/dl), total iron-binding capacity 315ug/dl (normal 300-430 ug/dl), transferrin saturation 42% (normal 25-50%), vitamin B12 1500 ng/mL (normal 180-914 ng/mL), folic acid 20 ng/L (normal >3 ng/L). The serum level of total bilirubin was 28 mg/dL, conjugated billirubin 10 mg/dL, lactate dehydrogenase 743U/L (normal 97-270U/L), anti-IgG direct antiglobulin test was positive (4+). Anti-nuclear antibody (ANA) and anti-double stranded DNA antibody were negative. She received oral prednisolone (1 mg/kg/day), intravenous cyclophosphamide, and intermittent blood transfusion for one month for idiopathic autoimmune hemolytic anemia. After the initiation of immunosuppression and several transfusions (800 ml of RBC in total), her hemoglobin gradually increased to 94 mg/dL, but then returned to a stable level of 76 mg/dL with a simultaneous increase in the reticulocytes from 10% to 25%. A decision was made to remove the teratoma. One week after the operation her hemoglobin rose to 110 mg/dL with the reticulocyte count dropping to 6%. Cyclophosphamide was stopped and corticosteroids were gradually tapered over 2 months. During 2 years of follow up her hemoglobin, reticulocyte count, and Coombs test have remained normal. DISCUSSION: AIHA can be induced by autoimmune diseases, lymphoproliferative disorders, infections, neoplasms, and drugs. Ovarian teratoma is a rare cause of AIHA. We identified less than 30 cases of hemolytic anemia associated with ovarian teratoma or dermoid cyst in PubMed from 1966 through 2011. All patients had hemolytic anemia refractory to steroids, other immunosuppressants, plasmapheresis, or splenectomy. All responded to resection of the teratoma or dermoid cyst. The mechanism of autoimmune hemolysis induced by ovarian teratoma is unknown.Ovarian teratoma has been associated with other autoimmune phenomena, including Graves' disease, encephalitis, and the palmar fasciitis and arthritis syndrome. The relationship has typically been recognized after unanticipated reversal of the autoimmune symptoms following removal of the tumor. In the recently described cases of ovarian teratoma with encephalitis, anti-NMDA (N-methyl-D-aspartate) receptor antibodies were found to be pathogenic. This case reminds clinicians to consider alternative antigenic sources such as teratoma when cases of unexplained or refractory autoimmune hemolytic anemia are encountered, similar to the approach that is increasingly adopted for young patients with unexplained encephalitis.

TB OR NOT TB, THAT IS THE QUESTION Lucius Howell; Michael Queen; Michael D. Landry. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339185)

LEARNING OBJECTIVE 1: 1. Identify hemoptysis and weight loss as symptoms in chronic mycobacterial infections 2. Understand the epidemiology and treatment of non-tubercular mycobacterium infections 3. Recognize the critical role of transitions of care in preventing re-hospitalizationCASE: An 83 year-old man with myelodysplastic syndrome presented with one month of hemoptysis and a fifty-pound weight loss. He noted increasing fatigue, anorexia and dysguesia. Three months earlier, he was diagnosed with reactivation pulmonary tuberculosis based on a positive Purified Protein Derivative (PPD), an abnormal chest X-ray and sputum smear positive for acid fast bacilli (AFB). He was treated with standard rifampin, isoniazid, pyrazinamide, ethambutol (RIPE) therapy without symptomatic improvement. On presentation, he had bilateral

temporal and extremity wasting with coarse breath sounds bilaterally. His labs revealed pancytopenia. A chest X-ray revealed a large opacification in the right upper field. A follow-up CT with contrast revealed scattered nodular opacities with a right apical cavitary lesion. An AFB smear and culture was positive for Mycobacterium abscessus. A review of his medical record revealed his prior positive culture for Mycobacterium abscessus. Appropriate inpatient treatment was initiated.
DISCUSSION: Unintentional weight loss, hemoptysis, upper lobe cavitary lesion, and a positive PPD is the classic presentation of Mycobacterium tuberculosis (TB). While TB is the most common of the mycobacterial infections, the general internist must recognize that it is not the only infection to present in this way. While patients suspected of having TB are commonly discharged on antibiotics, it is important that the internist recognize the importance of following-up on cultures and sensitivities to confirm the diagnosis. Prior to instituting long-term treatment, it is important to confirm that the etiology by following up on culture results, antibiotic sensitivities and ensuring patient follow up. Mycobacterium abscessus is a non-tubercular mycobacterium that exists in water, sewerage, and soil. It is endemic to the Southeastern United States, but is reported throughout North America. Risk factors for M. Abscessus include immunosuppression, chronic lung diseases and prior tuberculosis. Among patients with hematological malignancies associated with pancytopenia, there is a higher prevalence of non-tuberculous mycobacteria infections. Mycobacterium avium-intracellulare is the most commonly isolated species, followed by M. abscessus, M. fortuitum, and M. kansasii. The Initial evaluation of symptomatic patients includes excluding Mycobacterium tuberculosis and underlying malignancy followed by sputum culture. The treatment of non-tubercular pulmonary infections is based on active symptoms and the overall risk versus benefit of treatment. The treatment typically includes six months of an oral macrolide plus intravenous amikacin, tigecycline or cefoxitin. Antibiotics may only prevent dissemination and may not be curative secondary to the bacterias relative resistance to antibiotics. Continual treatment may be chosen if the patient remains symptomatic with cough, hemoptysis or B symptoms. Surgery is the only definitive treatment.
TMP/SMX-INDUCED SEVERE THROMBOCYTOPENIA Ramon Jacobs; Bora Toklu. NYU School of Medicine, New York, NY. (Control ID #1323997)
LEARNING OBJECTIVE 1: Recognize that TMP/SMX can induce a severe, potentially life-threatening, isolated thrombocytopenia.
CASE: A 50-year-old healthy female without significant medical history presented with a day history of non-pruritic red rash on her torso. The patient was in her usual state of good health until three days prior to admission when she starting trimethoprim/sulfamethoxazole (TMP/SMX) for a possible dental infection. Except TMP/SMX, she was not taking any other prescribed or over the counter medication. Two days after starting taking TMP/SMX, she noticed the rash and presented to the hospital. On initial physical examination, the patient noted to have scattered non-blanching red petechial rash over her torso extending down to the bilateral lower extremities. The rest of her physical exam and review of systems were unremarkable. Her initial complete blood count (CBC) revealed an isolated thrombocytopenia with a platelet count of 4.000/mm3. The rest of her blood work including chemistry, coagulation, liver function and hemolysis panels were all within normal range. A subsequent peripheral smear confirmed thrombocytopenia with large platelets, but otherwise was normal. Bactrim was held off as a possible causative agent, and the patient was being evaluated for possible idiopathic thrombocytopenic purpura (ITP). Patients platelet count responded poorly to the first unit of single donor platelets (SDP) transfusion, while a second unit of SDP tranfusion led to appropriate increase in platelet count. Within 36 hours of her hospital stay, the platelet count recovered to a normal range without any further transfusion requirement or glucocorticoids for initially presumed ITP. This led to a diagnosis of TMP/SMX-induced severe thrombocytopenia. Her presenting petechial rash also gradually resolved over hospital course. Patient was discharged on hospital day 3 with a platelet count of 202.000/ mm3. A week after discharge, her repeat platelet count was 425.000/mm3. DISCUSSION: Based on the Naranjo probability scale, TMP/SMX is a probable cause of thrombocytopenia in our patient. Hematologic adverse effects associated with TMP/SMX,

although uncommon, can involve any of the three cell lines. TMP/SMX-induced severe isolated thrombocytopenia is a very rare finding, and only a few case reports of this exists in literature. Although very rare, this is a potentially life threatening adverse effect. We would like to remind clinicians that serious and potentially fatal side effects exist even with frequently prescribed medications, such as in our case.

TAKING SYPHILIS TO HEART April Evans. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311712)

LEARNING OBJECTIVE 1: Identify the differential diagnosis for isolated aortic insufficiency.

LEARNING OBJECTIVE 2: Identify the diagnostic tests necessary for staging syphilis infection.

CASE: A 70 year-old man presented with three days of sudden-onset severe unilateral knee pain and swelling. He reported progressive fatigue over the past three months. He noted no fever, dyspnea; there was no inciting trauma to the knee. His vital signs were normal with the exception of a wide pulse pressure; the blood pressure was 158/65 mmHG. The pulmonary, abdominal and neurologic examinations were normal. He had isolated left knee swelling which was exquisitely tender to touch and movement. He had a four-out-of-four blowing diastolic murmur located at the cardiac base that increased in intensity when he leaned forward and held his breath. The murmur also increased in intensity when in the Trendelenberg position. There was also a two-out-of-four mid-diastolic murmur at the cardiac apex; the PMI was displaced down and to the left. De Mussets sign and Beckers sign were present. The pulse was bounding and arterial pulsations were seen extending down into the arms bilaterally. Joint aspiration of the left knee showed monosodium urate monohydrate crystals and 34,000 white blood cells/mm3. Severe, isolated aortic insufficiency was revealed on echocardiogram; the left ventricle was dilated. An eight centimeter dilated aortic root without calcification was revealed on CT scan. The RPR was reactive and TP-MHA test was positive. CSF studies revealed a protein of 58 and a negative TP-MHA.

DISCUSSION: Syphilitic aortitis is an uncommon finding after the advent of penicillin, but it is substantially more common in patients who have not had access to penicillin-based drugs for incidental infections via primary care. As such, the general internist providing care to underserved patient populations must still be vigilent for the signs and symptoms suggestive of a systemic syphilitic infection. Recognizing the physical manifestations of aortic insufficiency is one such clinical presentation of which the general internist must be aware. The finding of an isolated aortic regurgitation, especially in the younger patient without signs and symptoms of endocarditis, merits screening for syphilis. Primary, secondary, latent, tertiary and neurosyphilis are treated with different penicillin-based regimens and appropriate identification is important to define the duration of treatment. Cardiovascular manifestations automatically stage the syphilis infection as tertiary. Importantly, the general internist should recognize that at the time of aortic insufficiency, it is likely that the patient has nonatherosclerotic coronary artery disease caused by obliterative endarteritis at the coronary ostia. In patients with late latent syphilis or tertiary syphilis that is not considered to be neurosyphilis, the recommended treatment is intramus-

cular benzathine penicillin G, in a dosage of 2.4 million U once weekly for three weeks.

TELLING SIGNS OF TROUBLE: A SWOLLEN NECK AND TIGHT RINGS Shanthini Kasturi; Leonor Fernandez. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1334598)

LEARNING OBJECTIVE 1: Recognize the physical exam findings suggestive of superior vena cava (SVC) syndromeLEARNING OBJECTIVE 2: Manage emergent and non-emergent SVC syndromeCASE: A 56 year old woman presented to her primary care physician complaining of three days of swollen neck veins. She had been seen one week earlier when she was started on amlodipine for uncontrolled hypertension and wondered if this was a side effect of the medication. She reported a cough and congestion of five days, but denied dyspnea, chest pain, hoarseness, stridor, or dysphagia. She had not noticed increased swelling of her extremities, but on questioning noted that her rings felt tighter on her fingers. She denied recent fevers, nightsweats, or weight loss. Her past medical and social history was notable for hypertension and a sixty-pack year smoking history. Her

family history was remarkable for throat cancer in her father. On examination, vital signs were within normal limits. The patient had visibly engorged external jugular veins without significant facial swelling or flushing. There was no cervical or supraclavicular lymphadenopathy. Lungs were clear to auscultation and cardiac exam was without murmurs or gallops. There was slight swelling of the fingers, but no lower extremity edema. A chest X-ray was obtained which showed a mediastinal mass at the right tracheobronchial angle. The patient was sent for urgent computed tomography of the chest, which revealed a5.8 x 6 cm superior right mediastinal mass obliterating the superior vena cava and narrowing the right mainstem bronchus. She was admitted for expedited work up with flexible bronchoscopy and needle aspiration of the mass yielding a diagnosis of small cell lung cancer. Given rapid progression of facial and upper extremity edema, a stent was placed in her SVC to relieve obstruction prior to the initiation of chemotherapy. DISCUSSION: This case highlights how jugular venous distention, a familiar physical exam sign most typically associated with heart failure, can herald a less common diagnosis. The appearance of engorged neck veins with subtle signs of upper body edema in the absence of generalized volume overload is an early sign of SVC syndrome. SVC syndrome is characterized by edema of the head, neck, and arms, often with associated facial plethora. Urgent chest imaging is indicated to distinguish extrinsic compression versus internal obstruction of the SVC. The differential diagnosis of SVC syndrome is divided into malignant (65%) and non-malignant etiologies, the latter including thrombosis, often associated with intravascular devices, or rarely aortic aneurysms or fibrosing mediastinitis. A smoker who presents with upper body swelling without history of intravascular manipulation, has a high likelihood of an underlying diagnosis of pulmonary neoplasm. Management of SVC syndrome involves relieving symptoms of obstruction, typically by treating the underlying malignancy. Supportive care with head elevation and diuretics are commonly employed though there is no definitive data documenting their efficacy. Ideally a tissue diagnosis is obtained prior to initiating definitive treatment with chemo or radiation therapy. If symptoms are severe- marked by stridor, respiratory compromise, or depressed central nervous system function- SVC stent placement, localized thrombolysis, and/or emergent radiation therapy may be indicated.

TESTING FOR STDS, DISCLOSURE OF RESULTS AND PARTNER NOTIFICATION - AN ETHICALLY SLIPPERY SLOPE? Eleanor Weinstein; Lisa Rucker. Jacobi Medical Center Albert Einstein College of Medicine, Bronx, NY. (Control ID #1341486)

LEARNING OBJECTIVE 1: To Increase awareness of the ethical issues surrounding testing for STDs and disclosure of results to patients and contacts.

LEARNING OBJECTIVE 2: To become knowledgeable about the role of EPT - its potential advantages and ethical considerations.

CASE: AJ, a 35 yo man, was diagnosed and treated for chlamydia The patient asked his provider to treat his spouse, witholding information as to the specifics of the infection. The provider disclosed that she was being treated for a "urinary tract infection".

DISCUSSION: Telling the truth in a clinical context is an ethical obligation but determining just what constitutes the truth remains a clinical judgment. Truth telling must be seen in association with other ethical principles of beneficence, nonmaleficence, and protection of the community. Is there a place in clinical care to disclose less than the full truth or to deceive? There are well described situations where it appears to be justified to withhold information. At times, patients themselves may request not to be given full disclosure of information. This practice may not ordinarily violate major ethical principles of veracity, autonomy and beneficence. However, in some cases respecting the patients request not to know may create a danger to the patient themselves or to others. In this case, the patients request may not be respected as it would violate core principles of beneficence and nonmaleficence. Additionally, in certain cultures it may be more acceptable to see the individual patient as a part of a family unit or extended family, rather that as an autonomous entity. What about the moral obligation of the physician to properly inform the partner of her husbands transgressions, her risk for future exposure to infection and her possible risk for other STDs and HIV? Participating in the deception prevents this full

disclosure and thus prevents any meaningful education or opportunity to counsel the partner. The deception however results in a desired outcome - treatment of chlamydia. In our case, the physician would have the right to disclose the wife's test results without the index patients permission and to discuss the implications - since she now had consented to her own treatment and had entered into an independent relationship with the physician. Considering the many factors involved, it is not surprising that partners of index patients infected with STDs may not receive treatment despite the high likelihood that they are also infected. Available data suggests that about 50% of all partners of persons with gonorrhea or chlamydia infection receive appropriate treatment. Expedited partner therapy (EPT) is the practice of treating the sex partners of persons with STDs without an intervening medical evaluation or professional counseling. This is usually achieved through patient delivered partner therapy (PDPT). Recent evidence suggests that EPT is a useful option to facilitate partner management among heterosexual men and women with gonorrhea and chlamydia and the Center for Disease Control advocates that EPT be available to clinicians in addition to the current standard practices such as patient referral or provider assisted referral. Despite concerns regarding missed opportunities for medical evaluation, screening for other STDs, and professional counseling, as well as the concern for adverse effects from medications dispensed, EPT appears to be an ethically acceptable and practical option in states where it is legal and available.

THE "EYES" HAVE IT: AN UNUSUAL CASE OF OPHTHALMOPLEGIA Matthew Lander. University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1339854)

LEARNING OBJECTIVE 1: Recognize the proper approach to evaluation of ophthalmoplegia.

LEARNING OBJECTIVE 2: Identify the various malignancies that can present in the ocular orbit.

CASE: A 70 year old woman presented with eight months of restricted right eye movement. Her PMHx included hypertension, a previous TIA, and basal cell carcinoma of the right upper eyelid. Symptoms were reported as right eye pain, headache, and diplopia associated with a forty pound loss of weight over six months. She denied any fevers, chest or abdominal pain, numbness, or weakness. Physical examination revealed that she was afebrile and her right eye was notable for injection, decreased visual acuity, and severely restricted gaze in all directions. There was also some milky discharge from the epicanthus. An MRI revealed diffuse abnormal enhancement of the right orbital tissues and extra-ocular muscles. A biopsy of a mass in the right inferior fornix initially was interpreted as undifferentiated carcinoma. Cytology of ascites fluid showed malignant cells with staining suggestive of metastatic breast carcinoma. Mammogram of her right breast showed 5 lesions in total, all less than 1 cm in diameter. Pathology revealed an invasive breast carcinoma. Re-staining of the

previous orbital biopsy revealed similar pathology confirming the diagnosis of metastatic breast carcinoma to the orbit.

DISCUSSION: Impairment of extra-ocular movements is commonly seen by general internists. The differential diagnosis for this condition is broad and requires knowledge of the involved patho-physiology and neurologic pathways. Basic understanding of the six extra-ocular muscles and the three cranial nerves that supply them is vital. A lesion, impingement, or injury anywhere along the tracts, such as the muscle itself, the cavernous sinus, or brainstem, can result in abnormal extra-ocular movements. Pertinent information for discovery of a cause includes time of onset, unilateral versus bilateral, and associated symptoms such as eye pain, numbness, or weakness. Execution of a thorough physical examination can elucidate a diagnosis. This would include full ocular movements, but also evaluation for proptosis, conjugate gaze palsy, nystagmus, and Argyll Robertson pupils. The ability of a physician to accurately determine the cause of ophthalmoplegia can lead to the discovery of important and life-threatening diagnoses, which may otherwise go unseen. Breast carcinoma is one of several malignancies that has been found to metastasize to the orbit. Excluding the eye itself still leaves

numerous structures that may be affected. Primary malignancies of the lacrimal gland, optic nerve, optic sheath, bone, and connective tissue are all possibilities. One review has stated only 2-7% of all orbital tumors are from solid tumor metastasis. In this rare subset of patients, lung and breast carcinomas are by far the most common primary tumors, followed by skin, genitourinary, and gastrointestinal tract. A retrospective analysis of a small patient population showed 88% of patients that underwent fine needle aspiration had identification of their primary malignancy. This has important implications for the internist who is faced with such a rare presentation for a common malignancy.

THE ALLURE OF A FIRST DIAGNOSIS Vincent Wong. Baylor, Houston, TX. (Control ID #1333906)

LEARNING OBJECTIVE 1: Expand the differential diagnosis of elevated transaminases in young alcoholic patients.

LEARNING OBJECTIVE 2: Review risk factors and diagnostic challenge of cholangiocarcinoma (CCA).

CASE: A 29-year-old male with a history of heavy alcohol abuse presented with epigastric and left upper abdominal pain associated with nausea, pruritis, dark urine, clay stools, and jaundice for several days. He denied fever, weight loss, recent illness, travel, IVDA, and medication use. He reported drinking 80-90 cans of beer weekly. Exam was significant for jaundice and epigastric and left upper quadrant pain without rebound and guarding. Laboratory studies revealed ALT 804 U/L, AST 487 U/L, ALP 507 U/L, total bilirubin 9.6 mg/dL, direct bilirubin 7.7 mg/dL, and GGT 2254 U/L. Total protein was 8 g/dL, albumin was 4.4 g/L, and platelets were normal. Hepatitis panel, EBV IgM, ANA, alpha1 anti-trypsin, anti-smooth muscle antibody, cerulopasmin, and iron saturation were negative/ normal. An ultrasound showed increased echogenicity of liver and a contracted gallbladder but no masses and no ductal dilation. He was diagnosed with alcoholic hepatitis and was discharged home with recommendation of alcohol cessation. Patient continued to drink ETOH and returned one week later with severe abdominal pain. His liver panel worsened. A MRCP revealed a beaded hepatic ductal pattern consistent with primary sclerosing cholangitis (PSC) and an exophytic hepatic mass. CA19-9 was 66.78 U/ml (0-35 U/ml). Core biopsy and pathology showed invasive cholangiocarcinoma, Klatskins tumor. The mass was deemed non-resectable, and he was offered chemotherapy and possible liver transplant.

DISCUSSION: Cholangiocarcinoma occurs in patients 50 to 70 years of age but can present two decades earlier with PSC. In patients with PSC, there is an annual incidence of approximately 1% of developing CCA, with half being detected at the same time or within 1 year of diagnosis. The other known risk factors include parasitic infections, hepatolothiasis, and biliary duct cysts. Other less established risks are IBD, hepatitis B and C, obesity, smoking, and alcohol abuse. Altaee et al, in a retrospective study, reported that heavy alcohol consumption was present in nearly half of 112 patients with CCA, but subsequent studies did not find this cause-effect relationship. Thus, whether excessive ETOH abuse is a risk factor for this patient remains controversial. The pathogenesis is unclear but possibly reflects a step wise accumulation of defects in oncogenes (eg K-ras, EGFR) and tumor suppressor genes (eg p53). Symptoms include jaundice, weight loss, and abdominal pain. Diagnosing CCA is challenging. CA 19-9 has a sensitivity and specificity of 79 and 98%, respectively. Ultrasound, CT and MRI have positive predictive values of 48%, 38%, and 40% in identifying CCA. ERCP and MRCP have lesser positive predictive values. Brush cytology has 100% specificity but possesses low sensitivity (18-40%). There is no established standard therapy, but 5-FU, gemcitabine, cisplatin and oxaliplatin have activity. Survival after 2 years is extremely rare. Liver transplantation following neoadjuvant therapy is recommended for early stage (<3 cm in diameter without metastases) not amenable to resection. This case illustrates the importance of broadening the differential diagnoses of elevated transaminases in young alcoholic patients.

THE ANSWER IS IN THE HISTORY: AN UNCOMMON CAUSE OF PALPITATIONS Elizabeth Sandman. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1339763)

LEARNING OBJECTIVE 1: Explain the evaluation and diagnosis of palpitations.

LEARNING OBJECTIVE 2: Describe the clinical presentation, diagnosis and treatment of pheochromocytoma.

CASE: A 40 year old Caucasian woman with no past medical history presented to clinic with several months of palpitations. Medical work up including TSH and toxicology screen were negative. She was diagnosed with generalized anxiety disorder and started on as needed clonazepam. One year later, the patient returned to clinic with report of an intermittent tremor worsened during times of stress. She was diagnosed with essential tremor and declined medical therapy. Two years later, she presented to an outside emergency room with severe abdominal pain. She was found to be hypertensive to 204/100 with a pulse of 138. She underwent CT scan for evaluation of abdominal pain but developed hypoxia and delirium and was emergently intubated before the scan was completed. EKG demonstrated ST elevations in V2-V4. She was transferred to our facility for cardiac catheterization, which showed no flow limiting disease. Echocardiography showed an ejection fraction of 20% with apical sparing. Subsequently she developed hypotension ultimately requiring three pressor support. Upon questioning of her husband, he reported the patient recently complained of increased diaphoresis and diarrhea for the last month. Bedside renal ultrasound was performed given high clinical suspicion for pheochromocytoma and a 5 cm hypervascular mass was seen superior to the right kidney. After hemodynamic stability was achieved, she underwent right adrenalectomy and pathology returned as pheochromocytoma. Following surgery she recovered completely. After a brief stay in a rehabilitation facility she was discharged home.
DISCUSSION: Palpitations are a common complaint in the primary care setting. The most common cause is anxiety disorder. Older age at presentation may suggest a non-psychiatric cause. The most common non-psychiatric, non-cardiac causes of palpitations include thyroid disease, anemia, alcohol, and stimulants. As most patients presenting with palpitations are without symptoms at time of presentation, initial work up should include a careful history to elucidate underlying cause. A 12-lead EKG is the first diagnostic test that can be performed in the office. If suspicion is high for a cardiac arrythmia as the cause of palpitations and work up for systemic disease is negative, ambulatory cardiac monitoring can be done. Pheochromocytoma is a rare malignancy that classically presents with headache, tachycardia and diaphoresis though the majority of patients do not demonstrate this triad. It should be considered in patients presenting with hyperadrenergic episodes. Cardiomyopathy from catecholamine excess is a rare presentation of pheochromocytoma but may demonstrate a reverse Takosubo pattern on echo with apical sparing. Treatment for pheochromocytoma is initially medical with alpha-adrenergic blockade followed by surgical resection. In rare cases where there is family history of other neuroendocrine tumors, a neoplastic syndrome such as multiple endocrine neoplasia 2a should be considered and genetic testing performed. Pheochromocytoma is a rare cause of palpitations that should be considered in patients with other signs and symptoms of a hyperadrenergic state.

THE CASE OF THE MISSED PHYSICAL EXAM Yasmeen Kabir; Jeffrey Miller; Michael Rotblatt. UCLA-Olive VIew Program, Sylmar, CA. (Control ID #1334506)

LEARNING OBJECTIVE 1: Recognize metastatic testicular carcinoma as part of the differential diagnosis in young men who present with GI bleeding.
LEARNING OBJECTIVE 2: Recognize the importance of the comprehensive admission physical exam, especially the GU exam that is often neglected.
CASE: A 30-year-old Hispanic male with a history of heavy NSAID use presented with complaints of melena and severe abdominal pain for approximately 3 weeks. He had presented to the Emergency Department several times previously over the past 4-5 months for similar, but milder symptoms. The patient was severely anemic with Hg 7.8 and MCV 78 on admission. A complete physical exam revealed no pertinent findings. Endoscopy revealed a small ulcer with erosions in the gastric antrum, and a large ulcer with heaped up edges and overlying clot in the second portion of the duodenum. These findings were concerning for malignancy vs. NSAID induced ulcer. The patient only then endorsed a right swollen testicle, which had been missed on all previous exams, and a non-tender enlarged right testicle was then found on GU examination. Testicular UTZ revealed a 3.5x2.0x2.0 cm mass. Tumor markers were elevated: HCG 50, AFP 1990, LDH 534. CT demonstrated a

16x11cm enhancing mass of the right psoas, right hydronephrosis due to encasement of the right ureter, and invasion of the duodenum. The initial EGD Biopsy revealed malignant germ cell tumor (GCT), consistent with embryonal carcinoma. Due to extensive tumor involvement, the patient was treated with systemic chemotherapy and a right orchiectomy with good response.
DISCUSSION: Testicular carcinoma most commonly presents as a painless testicular mass. The presenting manifestations of testicular cancer are attributable to metastatic disease in approximately 10% of patients. Symptoms vary with the sites of metastases. Back pain can occur with skeletal metastases or retroperitoneal disease involving the psoas muscle. Pulmonary symptoms such as shortness of breath, chest pain, and hemoptysis can occur in patients with advanced pulmonary disease or primary mediastinal GCT. Approximately 5% of patients with GCT of the testis present with GI metastasis. GI metastasis is associated with nonseminomatous germ cell tumors of which the duodenum is the most commonly affected part of the small intestine. Testicular metastasis to the duodenum occurs as a result of lymphatic drainage of the testes to the inter-aortocaval lymph nodes and para-aortic nodes. Direct spread from tumor masses can also invade the duodenum and cause ulceration, as in our patient. The most common presenting symptom among patients with duodenal metastasis is GI hemorrhage with melena, hematemesis, and abdominal pain, most of which occurred in our patient. GI bleeding is an important presenting finding in a small percentage of cases of germ cell tumors. When men (especially young men) present with symptoms suggestive of GI bleeding it is essential to recognize metastatic testicular carcinoma as part of the differential diagnosis. As with all hospital admissions, a complete comprehensive physical exam is required, including the frequently neglected GU examination.
THE COCCI IN CLUSTERS CONUNDRUM John Humphrey. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339036)
LEARNING OBJECTIVE 1: 1. Identify the risk factors and clinical features of spinal epidural abscess. 2. Understand the diagnostic approach to confirming a spinal epidural abscess 3. Recognize the treatment of spinal epidural abscessCASE: A 57 year-old man presented with three days of back pain, fever and confusion. He had a history of Crohns disease and was taking prednisone and infliximab. He additionally reported injuring his back while playing basketball one week prior to presentation, and acknowledged receiving intravenous analgesics at home during the days leading up to presentation. His vital signs were normal. Kernig and Brudzinski signs were positive, and there was a grade 3/6 holosystolic murmur at the apex. The white-cell count (WBC) was 20,000/mm3 with 88% neutrophils. The lumbar puncture yielded cloudy fluid containing WBC 29,028 cells/l. A Gram stain revealed gram-positive cocci in clusters, later identified as methicillin-sensitive Staphylococcus aureus. He was initially given ceftriaxone for presumed meningitis. However, the history of back pain
prompted concern for a spinal epidural abscess. Contrast-enhanced MRI confirmed a dorsal epidural abscess at level L1-4 that was not compressing the spinal cord. This was managed non-operatively with antibiotics. An echocardiogram visualized a two-centimeter mitral valve vegetation causing severe mitral regurgitation. This required mitral valve repair; he recovered without residual neurologic or cardiac dysfunction. DISCUSSION: The general internist must maintain a high index of suspicion for spinal epidural abscess, as prompt diagnosis has been cited as the most important factor in patient outcome. In this case, the presence of back pain, fever, and elevated inflammatory markers provided important clues to the diagnosis. Lumbar puncture is not indicated to diagnose spinal epidural abscess as instrumentation may seed the cerebral spinal fluid to induce meningitis. It is likely that the treating physician inadvertently sampled fluid from the lumbar epidural abscess rather than the subarachnoid space for two reasons: first, the typical CSF WBC count in bacterial meningitis is 1,000-5,000 cells/mm3, far below that obtained in our patient; second, S. aureus is responsible for up to 70% of cases of SEA, compared to 1-3% of bacterial meningitis cases. In this patient, intravenous drug use while taking immunosuppressant medications likely led to endocarditis, which by hematogenous dissemination, served as a source for infection of the epidural space. The history of a recent back injury in this patient may serve to connect

the two by the principle of locus minoris resistentiae, in which bacteria preferentially seeds an area of recent trauma. Physicians must be cognizant about the possibility of spinal epidural abscess given the importance of early diagnosis in disease outcome.

THE CURIOUS CASE OF EXTREMITY WEAKNESS AND AMBULATORY DIFFICULTY: AN UNUSUAL PRESENTATION OF POLYMYALGIA RHEUMATICA (PMR) Anuradha L. Mookerjee; Bert M. Bieler; Sachin Mohan. Cooper University Hospital, Camden, NJ. (Control ID #1334504)

LEARNING OBJECTIVE 1: Recognize an unusual presentation of Polymyalgia Rheumatica (PMR) in an elderly manLEARNING OBJECTIVE 2: Treat the symptoms of PMR early to enable effective regression of symptomsCASE: A 63 year-old Caucasian male presented with two days of lower extremity weakness and difficulty in ambulation. Two weeks prior, the patient had bilateral shoulder pain and marked stiffness. He continued to experience a burning sensation which migrated from his upper arms to his fingertips and grew in intensity. This was associated with weakness in the upper girdle and an inability to raise his arms above his shoulders. Review of systems was positive for subjective fevers and diarrhea five days prior to admission, but had resolved at time of admission. Family history was negative for any rheumatologic disorders. Medications included metoprolol, lisinopril, atorvastatin, and aspirin for his known hypertension, hyperlipedimia and coronary artery disease. On physical exam, the patient had normal vital signs and the neurologic exam revealed decreased tone and power in motor function of both his upper and lower extremities, with normal sensations and reflexes. The cranial nerves, the cerebellar exam and gait were all within normal limits. The laboratory data for chemistry, liver function tests, CK, TSH and aldolase were all within the normal ranges. The RF, ANA and Lyme antibodies were negative. The patient did show a significant rise in his ESR at 64 and in CRP which was 10. Based on the clinical presentation and elevated inflammatory markers, the patient was diagnosed with PMR and started on steroids. He showed remarkable improvement in all of his symptoms. The lower extremity pain and weakness along with the burning sensation in the arms and fingers was completely resolved within twenty four hours and he was discharged home. A three week follow-up confirmed that the patient continued to do well on a very slow taper of steroids. DISCUSSION: This case of PMR reminds us that uncommon disorders may present uncommonly. Classically PMR occurs in Caucasians over 50 years, with a 3:1 female to male ratio. It is associated with shoulder and hip girdle pain and an elevated ESR, usually above 40. This case was unusual in that the patient presented with weakness and ambulatory dysfunction, potentially delaying the diagnosis. The differential diagnosis included inflammatory myopathy, statin-induced myositis, systemic vasculitis, radiculopathy, Guillain-Barre, myasthenia gravis, Lambert-Eaton syndrome, ALS, severe hypothyroidism, RA, and fibromyalgia. Key to

solving the puzzle was a good history. Initially, with the patients main complaints, one might have been steered towards a neurological disorder or myositis as the diagnosis. When further questioned, the symptoms included shoulder girdle pain of a waxing and waning nature. With an elevated ESR and CRP and an otherwise normal exam and laboratory studies, PMR became the leading diagnosis. Rapid response to steroid therapy clinched the diagnosis.

THE FLEXNERI REPORT Jason Halperin; Obinna Nnedu. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311857)

LEARNING OBJECTIVE 1: Identify Shigella flexneri as a serious cause of enterocolitis in the HIV positive population.

LEARNING OBJECTIVE 2: Recognize that shigellosis can be sexually transmitted and therefore a thorough social history is imperative to identify risk factors.

CASE: A 21-year-old an with HIV (CD4=270 cells/mm3) presented with a three-day history of abdominal

cramping, diarrhea and vomiting. He described frequent stooling with non-bloody bowel movements. He denied anorexia and hematemesis. His pain was relieved with defecation. He denied sick contacts, change in diet, or previous episodes. He denied exposure to unpasteurized foods, daycare facilities, nursing homes or recent antibiotic use. He had not traveled recently nor had any animal contacts. He was diagnosed with HIV five years earlier during routine screening. He recently stopped taking his anti-retroviral medications because he was feeling so good. He described frequent sexual contact with both men and women, engaging in both insertive and receptive sex as well as direct oral-anal contact. He did not know of any sexual contacts who had experienced similar symptoms. He was febrile to 102.6F, tachycardic, normotensive and orthostatics. His cardiac, pulmonary, neurologic and skin examinations were normal. His abdominal exam demonstrated tenderness in all four quadrants without rigidity; Murphys, Roevsings and the psoas sign were absent. Diagnostic testing revealed acute renal failure. An abdominal CT scan revealed severe inflammation in the sigmoid colon with a normal gallbladder and appendix. He was negative for viral hepatitis. Stool studies were positive for fecal leukocytes, and negative for Clostridium difficile toxin assay, giardia antigen, and cryptosporidium antigen. On the second hospital day, his stool culture was positive for Shigella flexneri, sensitive to ciprofloxacin. He was discharged once the acute kidney insufficiency had resolved, and he was treated with a ten-day course of antibiotics. He was referred for re-initiation of anti-retroviral therapy and counseled on safe sexual practices.

DISCUSSION: In the industrialized world, shigella species are typically transmitted by direct or indirect fecal-oral contact and frequently associated with daycare facilities, nursing homes and contaminated food or water. It is important, however, that the general internist recognize HIV-infected patients as being at higher risk for shigella infection, especially when unsafe sexual practices are a part of the history. The Center for Disease Control (CDC) demonstrated a 30 times greater incidence of infection in the HIV positive population compared to HIV negative. Furthermore, HIV positive individuals are four times more likely to require hospitalization. Efficient sexual transmission has been demonstrated by direct fecal-oral transmission; very small inoculums of shigella, as low as 10 organisms, are able to initiate disease. Concurrent HIV infection is associated with extended carriage of shigella species, as well as increased asymptomatic shedding. A recent population-based study of shigella cases in San Francisco demonstrated independent associations of HIV and men who have sex with men, specifically direct oral-anal sexual contact, with an odds ratio of 8 for each risk factor.

THE G.I.S.T. OF NEUROFIBROMATOSIS Akshiv Malhotra; Jonathan Wright; Ajeet Gajra. SUNY Upstate Medical University, Syracuse, NY. (Control ID #1338977)

LEARNING OBJECTIVE 1: Recognize the increased incidence of gastrointestinal stromal tumors in patients with neurofibromatosis. CASE: A 64-year-old man with known Neurofibromatosis type 1 (NF1) during preoperative workup for a CABG was incidently noted to have a
large inhomogeneous pelvic mass with dimensions of 9 cm x 10 cm x7.8 cm on a CT abdomen/pelvis. Biopsy of the mass showed palisaded appearing long spindle cells. On immunohistochemical testing, S-100 was negative (ruling out schwannoma) and there was strong and diffuse positivity for CD117(KIT) and CD34 indicating a gastrointestinal stromal tumor (GIST). The tumor was considered to be marginally resectable, so neoadjuvant treatment with Imatinib 400 mg daily was started to decrease the tumor size preoperatively. After three months on the repeat CT abdomen/pelvis multiple foci of air were seen in the mass, suggestive of necrosis though the size remained stable at 11 X 9.7 X 7.7 cm. His tumor was then surgically resected en-bloc. Large cavity was noted within the tumor along with fistula formation necessitating partial excision of small intestine. After the surgery he was restarted on Imatinib 400 mg daily for 36 months. DISCUSSION: Neurofibromatosis type 1 (NF1) , also known as Von-Recklinghausens disease is amongst the most commonly transmitted hereditary autosomal dominant diseases, with an estimated birth incidence of 1:3,000. Loss of NF1 tumor suppressor gene on chromosome 17 leads to the development of benign and malignant tumors in NF1. In addition to cutaneous, soft tissue, and visceral (plexiform) neurofibromas, this syndrome is associated with several types of

gastrointestinal (GI) and abdominal tumors. Here we present the case of a patient with NF1 who was incidentally found to have an extraintestinal Gastro-Intestinal Stromal Tumor (GIST). Extra-intestinal GIST is a very rare entity, accounting for< 5% of cases of GIST. There is a known correlation between NF1 and GIST. GIST develops in 7% of patients with NF1, although the incidence of GIST in the general population is 1.5/100,000/year. NF1 patients tend to develop GIST at a younger age (median 49 years) than sporadic GIST (56 years). This brings forward a need to formulate guidelines to screen for GIST in patients with NF1 at an earlier age. GIST may be associated with gastrointestinal bleed, perforation or obstruction as demonstrated by pathological findings in our case. Imatinib has greatly enhanced outcomes in patients with GIST.

THE GREAT MASQUERADER Haleh Moazen1; Amir Ansari-Ezabadi2.
1Montefiore Medical Center, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1310573)

LEARNING OBJECTIVE 1: Recognize amyloid as a cause of rapidly progressive congestive heart failure.
LEARNING OBJECTIVE 2: Describe the clinical, echocardiogram and cardiac magnetic resonance imaging features of cardiac amyloid.

CASE: A 54 year old woman was admitted for the evaluation of shortness of breath on exertion and paroxysmal nocturnal dyspnea for three months. History elicited a recent diagnosis of eosinophilic gastroenteritis after a colon biopsy revealed eosinophilic infiltration. The patient also had a history of hypertension. Physical exam was remarkable for rales.Labs revealed eosinophilia. Radiograph demonstrated heart failure. Echocardio-gram revealed moderate pericardial effusion and a normal ejection fraction .Workup for eosinophilia was initiated and revealed a positive Strong-yloides IGg titer. Empiric treatment for Strongyloides and heart failure were started. Symptoms initially improved but two months later the patient returned with recurrent heart failure and worsening pericardial effusion. Echocardiogram again revealed moderate to large pericardial effusion and a normal ejection fraction. The patient received a pericardial window. A pericardial biopsy revealed chronic inflammation with occasional granulomas but no acid fast bacilli was noted. Treatment for presumed tuberculosis pericarditis was initiated. Two months later the patient returns with rapidly progressive heart failure despite appropriate treatment for heart failure and tuberculosis pericarditis. On computerized tomography of the chest, the pericardium was noted to be nodular with a tubular configuration of the heart suggesting constriction. Cardiac magnetic resonance imaging demonstrated pericardial nodularity and straightening of the interventricular septum suggestive of constrictive pericarditis. Cardiac catheterization revealed both constrictive and restrictive patterns. The biopsies of the pericardium and the gastrointestinal tract done prior were restained with Congo red stain and demonstrated apple-green birefringence under polarized light microscopy consistent with AL amyloidosis. A bone marrow biopsy revealed multiple myeloma. DISCUSSION: Systemic AL amyloidosis is a multiorgan systemic disease. Fifty percent of patients with AL amyloidosis initially present with clinical

features of heart failure. Cardiac disease in AL amyloidosis is an important cause of progressively worsening heart failure and conduction system abnormalities. Clinically, amyloid heart disease may mimic constrictive pericarditis, coronary artery disease, valvular heart disease, and idiopathic hypertrophic or congestive cardiomyopathy. No single noninvasive test nor abnormality is classic for cardiac amyloid. The diagnosis of cardiac amyloid is considered to be more likely if there is evidence of reduced electrocardiographic voltages in combination with the following echocardiographic findings; thickened left ventricular wall,biatrial dilation, increase echogenicity and less commonly thickened valves and a small pericardial effusion. Cardiac magnetic resonance imaging findings occur late in the disease and usually reveal global subendocardial late gadolinium enhancement of the myocardium. Amyloid is a very difficult disease to diagnosis and has been known as the great masquerader. This case illustrates that an infiltrative myocardial cardiomyopathy such as amyloid should be included early in the differential diagnosis of patients presenting with rapidly progressive heart failure.

THE HEART BRAIN CONNECTION Robert L. Glover; Robert E. Graham; Ranjit Suri. Lenox Hill Hospital, New York, NY. (Control ID #1333931)

LEARNING OBJECTIVE 1: Recognize an uncommon underlying cause of seizures.
CASE: The patient is a 73 year old male with 3 year history of a seizure disorder, hyperlipidemia, left bundle branch block and mitral regurgitation who presented to an outside hospital after experiencing seizures. The patients wife reports that the patient experienced a seizure event with generalized shaking and incontinence while asleep lasting 2-3 minutes. Shortly after, the patient suffered an additional event of similar quality for roughly eight minutes. Emergency medical services were called and the patient seized again while in transit to the hospital. 1 mg of ativan and 100 mg of keppra were given intravenously with successful resolution. The patient was placed on telemetry and had paroxysmal complete heart block with an unstable escape rhythm resulting in pauses up to 5.5 seconds. The patient did not seize during this event and there were no significant metabolic abnormalities, changes in cardiac enzymes or notable findings on intracranial imaging. Transfer was arranged from the outside hospital to our tertiary cardiac center for emergent permanent pacemaker placement. The following day a permanent pacemaker was placed without complication. Concurrently during hospitalization an EEG was performed that did not demonstrate any seizure activity.
DISCUSSION: Details regarding the patients history of seizure disorder revealed that the patient had first started experiencing seizures at the age of 70. These seizures generally occurred in three to six month intervals and lasted approximately 2-3 minutes with incontinence and generalized shaking. The patient was referred to a neurologist who performed a CT, MRI and EEG scan of the brain which did not reveal any overt cause of seizures. Despite pharmacological treatment with keppra, the patient continued to have intermittent seizures of cryptogenic origin. This case highlights the importance of an expanded differential diagnosis in the event that an underlying neuro structural origin for seizures cannot be found, especially in a patient with known cardiac conduction disease. It is hypothesized that this patients seizure disorder was triggered by transient hypoxia secondary to episodes of third degree heart block. This condition is called Stokes-Adams syndrome. Stokes-Adams syndrome is more broadly defined as loss of consciousness with or without seizures caused by a sudden decrease in cardiac output. Seizures in Stokes-Adams syndrome are notable for lacking an aura and starting and ending abruptly. Witnesses may also describe the patient has suddenly becoming very pale just prior to seizure onset. The patient has been asymptomatic since pacemaker implantation - suggesting that the original diagnosis of seizure disorder is likely incorrect.
THE IMPORTANCE OF DONATING BLOOD Anna Postolova; Jason Halperin. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1339076)
LEARNING OBJECTIVE 1: 1. Identify the differential diagnosis of hemoptysis. 2. Recognize the clinical presentation of Eisenmenger syndrome. 3. Understand the pathophysiology of Eisenmenger syndrome.
CASE: A 44 year-old Honduran man presented with four hours of hemoptysis, muscle weakness, dyspnea and fatigue. Each episode had produced approximately three tablespoons of blood. On physical examination a IV/VI holosystolic murmur was heard best at the upper left sternal border. Significant jugular venous distention was present with an associated hepatojugular reflux. There was wheezing in the lower lung fields, bilaterally. The abdomen was distended, soft, and mildly tender without hepatosplenomegaly. He had fingernail clubbing, 2+ lower extremity edema, and no cyanosis. Laboratory studies revealed a hemoglobin of 18.6, a hematocrit of 60.4, and a brain naturetic peptide of 1,911. The cardiac silhouette was enlarged by chest X-ray. Echocardiography demonstrated a patent ductus arteriosous, a pulmonary artery pressure of 160 mm Hg and Eisenmenger physiology.
DISCUSSION: Hemoptysis is a symptom commonly encountered by the general internist. While the differential diagnosis is broad, the physical examination can be instrumental in the general internists attempts to narrow the differential diagnosis. In our patient, the clinical presentation of shortness of breath, an elevated JVD, edema and clubbing were indicative of heart failure. The presence of hepatojugular reflux suggested right ventricular impairment, an important clue in considering the diagnosis of Eisenmenger syndrome, which was later confirmed by echocardiography. Eisenmenger syndrome is an advanced form of pulmonary arterial

hypertension secondary to a congenital heart defect. The development of Eisenmenger syndrome begins with left-to-right shunting of blood flow generating increased pulmonary blood flow, endothelial dysfunction and vascular remodeling. The ensuing increased pulmonary vascular resistance leads to pulmonary infarction or rupture of dilated pulmonary arterioles and hemoptysis. As the shunt reverses, due to the equalization of pressures in the right and left ventricle, circulating deoxygenated blood does not meet physiologic demand resulting in erythrocytosis, polycythemia, and hyperviscosity. Symptoms of hyperviscosity include headache, muscle weakness, fatigue and hemoptysis. The treatment for symptomatic hyperviscosity includes lowering the red blood cell mass via phlebotomy. This must be performed conservatively and asymptomatic patients, regardless of their hematocrit, should not be treated nor should treatment be targeted to a predetermined hematocrit. Treatment should be targeted to symptoms; excessively aggressive treatments can lead to iron deficiency, further exacerbating the inadequate delivery of oxygenated blood. Hemoptysis is frequently encountered by the internist. Eisenmenger physiology though is rare and often due to inadequately treated congenital heart disease, uncommon in the United States. Yet, with dynamic migratory patterns in our increasingly globalized world, the primary care physician will need to be prepared to consider rare causes of common presentations such as hemoptysis due to an untreated patent ductous arteriousus.

THE USE OF TRANSHEPATIC CATHETERS IN URGENT DIALYSIS Jennifer Yehl; Munazza Anis; Sujeev S. Bains. Medical University of South Carolina, Charleston, SC. (Control ID #1339088)

LEARNING OBJECTIVE 1: Indications for urgent dialysis LEARNING OBJECTIVE 2: Alternative access sites for hemodialysis and complicationsCASE: CB is a 33 year old African American male with a past medical history of end stage renal disease (ESRD) secondary to posterior urethral valves, chronic hypocalcemia secondary to parathyroidectomy, recurrent symptomatic hypotension secondary to diastolic heart failure, history of DVT, and anemia who presented to an outside hospital with significant metabolic abnormalities (K+=7.6, Ca2+=5.5, Phos=13.3, Cr=22) indicating the need for urgent dialysis. CB has a history of difficult vascular access requiring peritoneal dialysis along with medical non-compliance. Consequent to his poor compliance, his peritoneal site became infected with gram positive cocci. Unable to gain alternative access for dialysis, CB was subsequently transferred to the MUSC MICU for placement of a transhepatic catheter to serve as his access site. This is achieved by advancing a needle at the right midaxillary line at the level of the twelfth rib and contrast is infused as the needle is withdrawn to the point when the hepatic vein is opacified. A wire is then advanced centrally into the right atrium and a tunnel is created in the right abdominal wall. Following this, the dialysis catheter is then placed over the guidewire into the right atrium under fluoroscopic guidance. Real-time

fluoroscopy was used to visualize catheter placement and confirm appropriate placement using radiographic films. CB was able to undergo dialysis to correct his electrolyte abnormalities and improved enough to be transferred to the general medicine team. He was discharged the subsequent day with follow-up for continued dialysis and monitoring.

DISCUSSION: The National Kidney Foundation recommends initiation of dialysis for chronic kidney disease (CKD) for patients with eGFR< 15 mL/min/1.73 m2 or stage 5 CKD (1). While CKD may take years to advance to stage 5, some conditions indicate the need for more immediate dialysis. Urgent indications include acidemia, drug intoxication, electrolyte imbalance, fluid overload, and uremia. Dialysis access sites include arteriovenous grafts, peritoneal dialysis, and transhepatic catheters. While AV grafts are commonly used, the use of transhepatic catheter access is still rare. Currently, the literature has very limited data regarding the ease of access, longitudinal efficacy, and possible complications of transhepatic catheter dialysis. One study describes six complications that may arise during catheter placement (2). Of these complications, bleeding accounted for four of the six difficulties patients experienced. The various bleeding sites included an access site bleed, a liver

capsule tear, a catheter tract bleed, and a massive intraperitoneal hemorrhage which proved to be fatal. One patient experienced a kink in his catheter, while another patient died from a previously diagnosed subdural hematoma following the procedure. The remaining patients in the study showed successful results. The catheters lasted an average of 138 days (ranging from 0 to 599 days), and each patient received a range of 1 to 6 catheter exchanges. While this type of access is not often implemented in emergent hospital settings, it is a viable option for patients with multiple failed attempts and difficult vascular access (2).

THE WAY TO A MANS HEART IS THROUGH HIS STOMACH Nachiket Patel1; Kyle G. Ulveling2; Tom Hee2. 1Creighton University Medical Center, Omaha, NE; 2Creighton University Medical Center, Omaha, NE. (Control ID #1340409)

LEARNING OBJECTIVE 1: Recognize deglutition syncope as a unique cause of loss of consciousness.

CASE: The patient was a 64-year-old white male with a PMH significant for HTN who was transferred from an OSH for evaluation of three episodes of loss of consciousness (LOC) over a 6-hour period. He presented to the OSH ED after LOC while driving. For three days prior to his presentation, he had epigastric discomfort, which he described as gas bloating, which was relieved with antacids. On day of admission, the pain was more intense and lasted longer. He denied any associated N/V/D, melena, or hematochezia. Pt bought food at a local fast food restaurant on his drive home. While driving on country roads, he experienced symptoms of nausea and tunnel vision lasting <10 seconds, followed by LOC. Pt woke up in a cornfield. There was no trauma to himself, or damage to his vehicle. Pt called his family who drove him to the local ED. Pts vitals signs were within normal limits. His CBC and electrolytes were unremarkable. Troponins, amylase, and lipase were negative. Physical exam was significant for epigastric abdominal tenderness. Heart and lung exams were unremarkable. ECG showed NSR with a HR of 80 bpm. In the ED, pt had 2 witnessed episodes of LOC, lasting 5-10 seconds each. Telemetry at the time demonstrated high-degree AV block with rates in the 30s. Pt was transferred to Creighton for further management. On arrival pt had a CT chest/ abdomen which showed an intrathoracic stomach due to a large hiatal hernia. Surgical repair of the pts hiatal hernia was scheduled. Pt was started on a clear liquid diet. Immediately after he ingested ~20 ccs of broth, his HR slowed from a baseline of 75 bpm to a bradycardic 30-40 bpm, to sinus arrest with junctional escape beats, at which time pt lost consciousness. A nurse who was in the room started chest compressions. After the second compression, pt regained consciousness, and his rhythm reverted back to sinus. Pt was kept NPO and underwent laproscopic take down of his stomach and diaphragmatic repair. Following the surgery, pt was able to tolerate food without any symptoms.

DISCUSSION: Deglutition syncope, also known as swallow syncope, is an uncommon cause of LOC, and is neurally mediated. The afferent path of the reflex is thought to be in the vagus nerve (but also documented in the glossophyrngeal nerve). The intense afferent stimulation results in
sympathetic inhibition. It also results in an efferent signal returning down the vagus nerve resulting in a decrease in HR, and peripheral vasodilitation, resulting in hypotension. Swallow syncope was first described in Classical Descriptions of Disease by Spens in 1793. It was more thoroughly described in 1972 by Levin &Posner in the journal Neurology. The description of the event typically includes dizziness, light-headedness, confusion, and/or fainting during swallowing of food or liquids. Numerous disorders have been reported with deglutition syncope including diffuse esophageal spasm, hiatal hernia, esophageal diverticulum, esophageal cancer and achalasia, resulting in CHB, SVT, and atrial fibrillation. Treatment includes avoidance of the inciting food/beverage and anticholenergic medications. In our pt, the intrathoracic pressure from the hiatal hernia, precipitated by swallowing, likely resulted in intense vagal nerve stimulation causing sinus node slowing followed by sinus arrest resulting in the transient syncopal episodes.

THE ENDANGERED PANDA (SIGN): THE DIAGNOSTIC DILEMMA OF PULMONARY NECROTIZING GRANULOMAS Efrain Irizarry. New York Methodist Hospital, Brooklyn, NY. (Control ID #1315664)

LEARNING OBJECTIVE 1: Necrotizing granulomas of the lung are usually observed in the setting of infection, most commonly mycobacterium. In contrast, non-necrotizing granulomas in pulmonary tissue are considered

the hallmark of pulmonary sarcoidosis.
CASE: A 27 year old African American man was admitted with cough productive of green sputum, progressive dyspnea on exertion, and intermittent fevers for one month. The patient denied weight loss, night sweats, hemoptysis, exposure to tuberculosis, occupational exposures, and family history of autoimmune disease. He smoked pack-per-day of cigarettes for 14 years and quit four months ago. Chest x-ray demonstrated hilar lymphadenopathy. Computerized tomography of the chest showed mediastinal adenopathy and scattered sub-centimeter pulmonary nodules. Laboratory studies were as follows: Quantiferon Gold - negative, erythrocyte sedimentation rate of 68 mm/H (elevated), c-reactive protein of 75 u/L (normal), human immunodeficiency virus-negative, anti-nuclear antibody-negative, and rheumatoid factor-negative. Tuberculin skin test was non-reactive. Daily sputum stains over a five-day period for acid-fast bacilli were negative. Fiberoptic bronchoscopy with biopsy was unrevealing. Mediastinoscopy with sampling of station 4R paratracheal nodes revealed caseating granuloma; stains for acid-fast bacilli and fungal elements were negative. The patient was started on four-drug anti-tuberculosis therapy (rifampin, isoniazid, pyrazinamide, and ethambutol). While on therapy, fevers continued despite a normal leukocyte count. Due to the inconsistent clinical and laboratory findings, as well as elevated liver enzymes, anti-TB therapy was stopped and an alternate diagnosis was considered. The patient underwent a total body gallium 67-citrate scan which showed intense uptake in the parotid glands (Panda sign) and bilateral lungs (Lambda sign) consistent with pulmonary sarcoidosis. Prednisone therapy was initiated and anti-tuberculous (TB) treatment was restarted following improvement in liver function test. He demonstrated quick clinical improvement and was discharged from the hospital on this regimen. On follow-up, cultures and nucleic acid amplification (NAA) were negative for Mycobacterium tuberculosis (99% specificity and sensitivity of 75% to 90%). With these results in hand, anti-tuberculosis medications were discontinued.
DISCUSSION: Sarcoidosis is a multisystemic inflammatory condition with pulmonary manifestations in over 90% of cases; distinction from pulmonary Mycobacterium tuberculosis is at times challenging. In general, sarcoidosis is confirmed with non-caseating granulomas on histopathology; however, a recent rigorous study of 500 lung biopsies containing granulomas found necrotizing granulomas in 4% of sarcoidosis specimens. In our patient, initial treatment was influenced by the findings of necrotizing granulomas on pathologic specimens suggesting pulmonary tuberculosis. Utilizing both old and new technologies, we successfully continued the patient on appropriate therapy with steroids, and discontinued anti-tuberculous medications. There exists no definitive diagnostic tool for sarcoidosis at this time, and part of the initial evaluation requires dismissing other causes, specifically Mycobacterium tuberculosis infection.

Therefore, one of the first diagnostic tests that should be instituted should be the NAA for tuberculosis from sputum, cultures or biopsies.
THE EVALUATION OF EOSINOPHILIA IN THE OUTPATIENT SETTING Caroline DeFilippo; Athanasia Vasiliadis. Mount SInai Medical Center, New York, NY. (Control ID #1314879)
LEARNING OBJECTIVE 1: Identify an approach to eosinophilia in the ambulatory settingLEARNING OBJECTIVE 2: Recognize the clinical manifestations of Strongyloides in an immunocompetent hostCASE: A 33-year old Peruvian male with a past medical history of congenital deafness presented to an outpatient clinic with ten years of intermittent right lower quadrant abdominal pain. He does not recall when he first noted the pain but describes it as dull and with no identifiable exacerbating or relieving factors. He denies pain elsewhere in his abdomen and denies any change in the pain with eating or fasting. He has no dyspepsia, nausea, vomiting, diarrhea or constipation. He does endorse occasional right testicular fullness. His weight has remained stable during this time and he denies fevers or chills. He has no family history of any abdominal illnesses or malignancies. He takes no medications. He is a non smoker with no drug abuse history and travels to Peru annually. He is sexually active with one partner. On exam, the patient was afebrile, normotensive and well appearing. His abdominal exam was notable from mild pain in the right lower quadrant with no guarding,

normoactive bowel sounds and a soft abdomen. He had no flank tenderness. A testicular exam was within normal limits. The remainder of his head, neck, cardiovascular, pulmonary and skin exam were within normal limits. A complete blood count was significant for a white count of 7400/L initially with 19.1% eosinophilia. Over the course of four visits, the patient was noted to have a normal renal function panel, liver function tests, negative hepatitis b and c serologies, negative HIV panel, negative urine gonorrhea and Chlamydia tests, a normal urinalysis and negative stool ova and parasite exam. A testicular ultrasound was within normal limits and a serum Strongyloides IgG was strongly positive. The patient was treated with a one-time weight based dose of Ivermectin. DISCUSSION: This case highlights the importance of evaluating eosinophilia detected on complete blood counts. The differential of eosinophilia can be remembered through the pneumonic NAACP: neoplasms, atopy/allergic disease, adrenal insufficiency, collagen vascular disease and parasites. The patient was screened for testicular cancer with an ultrasound given his symptoms of fullness and age. He had no history of atopy or allergies. He had no history or symptoms to suggest an immune disorder and his vital signs and lab values were not consistent with adrenal insufficiency. Finally he had no signs of collagen vascular disease. Strongyloides is a nematode endemic to tropical regions worldwide. There is no gold standard for diagnosis. Stool studies have poor sensitivity. Serum antibody testing, as was performed in this patient, can be helpful but does not distinguish between old and active infections. Strongyloides has a broad range of clinical manifestations depending on the hosts immune status. In immunocompetent hosts, such as this patient, they are often asymptomatic or have chronic intestinal infections. These can manifest as nonspecific abdominal complaints. Often patients will have respiratory complaints with cough and shortness of breath that mimic asthma or COPD. Ivermectin is the preferred treatment for Strongyloides and can be given in one or two doses with cure rates up to 100%.

THE IMMUNOCOMPROMISED HOST: WHAT LIES BENEATH THE ITCHY RASH? Shuchi Gulati; Gaurav Gulati; Elizabeth Dohan; Richard Alweis. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1339018)

LEARNING OBJECTIVE 1: Recognize that immunosuppressed patients are at a high risk of developing atypical infectionsLEARNING OBJECTIVE 2: Earlier recognition of skin infections is critical, especially when confounded by underlying rheumatologic/ dermatologic conditionsCASE: A 51 year old female with history of dermatomyositis and uncontrolled diabetes was admitted to the hospital in an obtunded state secondary to severe

diabetic ketoacidosis and sepsis. Over the last few months, her dose of prednisone for dermatomyositis had been increased to as high as 80 mg a day due to worsening symptoms. In addition, she was receiving methotrexate 20 mg weekly and hydroxychloroquine 600 mg daily. On physical exam, she was found to be febrile with a temperature of 39.50 Celcius and was obtunded. On skin exam, she had diffuse erythematosus and hyperkeratotic patches covered with thick scales. Lesions were especially prominent in interdigital spaces of her hands, scalp, breasts and upper arms. Diffuse excoriation marks were noted. She had twice seen her PCP with this rash in the preceding 2 weeks, and her prednisone dosage has been increased as the rash was attributed to dermatomyositis. Initial laboratory evaluation revealed: normal CBC with differential; chemistries significant for blood glucose of over 1000 mg/dL, 3+ serum ketones, serum sodium of 151 mEq/L (normal 135-153 mEq/L), and potassium 7.1 mEq/L (normal 3.5-5.3 mEq/L); and an elevated anion gap metabolic acidosis with pH of 7.16 and gap of 21 mEq/L. Serum osmolality was 378 Mosm/K (normal 280-290 Mosm/K). CSF analysis was normal. Urine culture indicated a Klebsiella pneumoniae urinary tract infection. The patients metabolic derangements were corrected with subsequent return of consciousness over 2 days. Upon awakening, she revealed that she had been living at an assisted living facility where there had been an outbreak of scabies. This prompted a direct microscopic examination of skin scrapings with demonstration of numerous mites and eggs. A diagnosis of crusted or Norwegian scabies was made. Treatment was initiated with permethrin 5% cream for 3 days and repeated after 1 week. Because of the generalized manifestations,

additional oral ivermectin at a dose of 0.2 mg/kg, to be repeated at weekly intervals for 4 weeks was administered. There was rapid clinical response with almost complete resolution of skin lesions at the time of dischargeDISCUSSION: Atypical clinical infections are more prevalent in institutionalized or debilitated patients, or those who are immunosuppressed from underlying disease or drug therapy. Norwegian or crusted scabies is one such infection. It is a fulminant and highly infectious form of scabies which results from a failure of the host immune response to control the proliferation of the scabies mite in the skin, thus causing hyperinfestation. Clinically, the hyperkeratotic skin lesions with crusting and scaling can resemble rheumatologic conditions like psoriasis. Though documented as rare in previously published papers, with the recent surge in the use of immunosuppressant agents for treating rheumatologic conditions and cancers, Norwegian scabies will become more prevalent. A high index of suspicion is required to enable early recognition and treatment, to prevent associated morbidity and spread.

THE MANY FACES OF ARTEMIS: A PECULIAR CASE OF POLYARTERITIS NODOSA Anuradha L. Mookerjee; Sachin Mohan; Bert M. Bieler. Cooper University Hospital, Camden, NJ. (Control ID #1334538)

LEARNING OBJECTIVE 1: Recognize radiological findings of beading and aneurysms of abdominal arteries as an acceptable alternative to establish the diagnosis of PAN (Polyarteritis Nodosa).

LEARNING OBJECTIVE 2: Diagnose and treat PAN in the acute phase to prevent further complications.

CASE: A 55 year old Caucasian female presented with one week history of diffuse abdominal pain, symptomatic anemia and syncope. She also reported intermittent skin irritation, dryness of eyes and mouth, nasal sores, hair loss, weight loss of 50 pounds in less than one year, repeated infections, fevers, weakness and numbness in her left leg, and muscle and joint pains in her knees and feet. Her past medical history was significant for myocardial infarction, stroke and Thrombotic Thrombocytopenic Purpura leading to acute renal injury about four years ago. Physical exam revealed a cachectic female with marked abdominal tenderness in all quadrants and mild guarding. Her laboratory tests revealed elevated inflammatory markers and marked anemia. ANCA was negative. HIV and hepatitis panel were also negative. CT scan of abdomen showed acute intra peritoneal hematoma. The distal Superior Mesentric Artery was noted to have irregular beaded appearance suggestive of microaneurysms and vasculitis. A biopsy of the artery could not be performed due to increased risk of bleeding but she underwent successful evacuation of her hematoma. With a radiologically convincing diagnosis of PAN, the patient was started

on steroids. The patient responded dramatically over the next week with marked improvement of all her symptoms.

DISCUSSION: PAN is a multisystem vasculitis involving medium and small sized arteries of the viscera and sparing the pulmonary arteries. PAN represents a spectrum of disease rather than a single entity. Deposition of circulating antigen antibody complexes has been proposed as a possible mechanism of narrowing of the arteries. The diagnosis of PAN remains a challenge as most patients present with vague signs and symptoms like fever, weight loss, abdominal pain, malaise and myalgias. There is no specific laboratory diagnostic test with usual findings being elevation in leukocyte count, anemia, raised ESR and hypergammaglobulinemia. Although biopsy of the involved vessels with demonstration of characteristic vasculitic changes is diagnostic; radiological findings with aneurysmal changes in the involved arteries is an acceptable alternative to establish diagnosis. Overall prognosis of untreated patients remains poor with five year survival rate of less than twenty percent. In conclusion, we present a case of Polyarteritis Nodosa with abdominal hematoma and bleeding, diagnosed radiographically with its beaded appearance of the superior mesenteric artery, which responded effectively to steroids.

THIS ADMISSION IS A PAIN Morgan Katz; Michelle M. Guidry. Tulane University Health Sciences Center, New

Orleans, LA. (Control ID #1340471)
LEARNING OBJECTIVE 1: 1. Recognize the clinical presentation of pyomyositis 2. Identify an approach to diffuse pain in the hospitalized patientCASE: A 25 year-old man with no past medical history presented with three days of a severe bilateral "gnawing" pain in his calves and forearms. The pain began in his right calf and spread to the opposite calf and both forearms; in both cases, the pain was preceded by overlying erythema. He recalled several recent episodes of profuse sweating and chills but denied other complaints. He also denied recent muscle trauma, vigorous exercise, alcohol or drug use and was taking no medications. He had been stationed in Haiti and Iraq within the past eighteen months while serving in the army. The vital signs were normal. Both calves and forearms were exquisitely tender to palpation and the skin overlying the right forearm was erythematous and warm. Laboratory studies were significant for leukocytosis, an elevated erythrocyte sedimentation rate and creatine phosphokinase; blood cultures were negative. Serology for HIV and antinuclear antibody were negative. A lower extremity MRI revealed multifocal microabscesses in both gastrocnemius muscles consistent with pyomyositis. The diagnosis was confirmed by muscle biopsy which showed perimysial and endomysial inflammation with myophagocytosis and myofiber necrosis. Empiric antibiotic therapy was initiated and within two days the patient was asymptomatic. DISCUSSION: The general internist is frequently tasked with uncovering the cause of diffuse pain. In many cases diffuse pain is often a constitutional symptom referable to a primary diagnosis. Nonetheless, it is important for the hospitalist to have a defined method in assessing pain and formulating a cogent differential diagnosis. Pyomyositis is a purulent infection of skeletal muscle occurring predominantly in tropical areas, often in otherwise healthy individuals. In contrast, cases in temperate climates have been associated with previous trauma, infection or immunocompromised state. Muscle groups most commonly affected include quadriceps, gluteal, iliopsoas and abdominal. Multisite involvement is noted in up to twenty percent of cases but to our knowledge bilateral, multifocal involvement has been reported only once previously in immunocompetent residents of temperate areas. Laboratory findings are typically nonspecific but bacteremia is observed in 10% and 35% of tropical and temperate cases, respectively. MRI is the gold standard for diagnosis as other imaging modalities may reveal only nonspecific changes. Treatment includes surgical drainage of abscesses and at least 2-4 weeks of antibiotics which cover Staphylococcal aureus, responsible for up to 90% of cases with an identifiable pathogen. Mortality is reported to be less than 1% when treatment is initiated early but increases to 15% when delayed; overwhelming sepsis is the most common cause of death. The differential diagnosis of myalgias includes a variety of conditions that cause symptoms similar to pyomyositis. In the absence of positive blood cultures, laboratory findings are nonspecific. Our patient highlights the importance of
obtaining a travel history and an early MRI in the evaluation of unexplained myalgias and severe muscle tenderness. The prompt initiation of antibiotics may be curative in this unfamiliar but potentially fatal disease.
THOSE WHO SEEK WILL FIND - UNRELENTING MSSA BACTEREMIA AND VERTEBRAL OSTEOMYELITIS
Moises Auron1; Kai Wang2; Sravani Avula1; Lucileia Johnson3. 1Cleveland Clinic, Cleveland, OH; 2Cleveland Clinic, Cleveland, OH; 3Cleveland Clinic, Cleveland, OH. (Control ID #1338856)
LEARNING OBJECTIVE 1: Recognize MSSA bacteremia as a life threatening condition which requires a persistent diagnostic approach. LEARNING OBJECTIVE 2: Diagnose vertebral osteomyelitis in the setting of an initial negative MRI of the spine.
CASE: A 77 year old African American man with HTN, AFib and osteoarthritis with chronic low back and neck pain was admitted after one week of worsening back pain and intermittent fever. The onset of pain was one day after discharge from other hospital where was admitted for Afib; at that admission he developed right hand superficial phlebitis at an IV site with wound culture positive for MSSA treated with topical mupirocin. Examination revealed fever 38.4oC, and cervical and lumbar spine tenderness with no neurological deficits. Laboratory showed WBC 22,460/L, CRP 40.8 mg/L, ESR 115 mm, Procalcitonin 5.71 pg/mL, BUN 66 mg/dl, creatinine 2.12 mg/dl, Potassium 3.9 mEq/L and Bicarbonate 20 mEq/L. A cervico-thoraco-lumbar spine MRI

without contrast showed advanced degenerative spondylosis with multilevel moderate to severe central foraminal stenosis and disk edema, predominantly at L1-L2. Empiric iv antibiotics (vancomycin and piperacillin/tazobactam) and vigorous iv hydration were started; blood culture grew MSSA. Vancomycin was switched for i.v. oxacillin. Patient continued to have back pain and daily fever up to 38.9oC and all daily blood cultures from day 1- day 9 grew MSSA. Renal function normalized by day 8 Tagged WBC scan showed increased L1-L5 uptake concerning for osteomyelitis. Echocardiogram and transesophageal echocardiogram showed normal cardiac function and no vegetations. Due to persistent fever and worsening lumbar pain a repear lumbar MRI with contrast was done on day 8 showing disk space infection and osteomyelitis of L1-L2 with new bilateral psoas abscess and extensive epidural abscess from L1-S1. On day 9, emergency L1-L2 laminectomy and drainage of pockets of epidural abscesses was done. Oxacillin dose was increased to 2 g i.v every 6 h. Fever remitted and blood cultures converted to negative on day 10. Abscess cultures were negative. A repeat MRI one week post-op showed interval improvement of epidural and psoas collections. CRP dropped to 15 mg/L prior to discharge and patient was discharged on day 17 to LTAC to complete 6 weeks of IV oxacillin.

DISCUSSION: Pyogenic vertebral osteomyelitis is a severe infection with an incidence of 2.4/100,000 and results most often from hematogenous spread, being Staphylococcus aureus and E. coli the most commonly implicated microorganisms. Clinicians are most fearful of resistant bacteria; however even when MSSA is the etiology it should be treated aggressively. Magnetic resonance imaging (MRI) is the imaging study of choice and although it has a specificity of 90% for diagnosing spinal osteomyelitis, a diagnostic challenge occurs in erosive osteochondrosis whose features may mimic those of vertebral osteomyelitis. Direct bone biopsy/aspiration with culture is the gold standard for diagnosis. In our case initial MRI without contrast did not show evidence of osteomyelitis, which was evident on a repeat MRI with contrast 8 days afterwards. A tagged WBC scan was suggestive of osteomyelitis on day 5 of admission suggesting that in cases with equivocal results in initial imaging, alternative persistent diagnostic approaches should be undertaken.

THROMBUS IN TRANSIT Armaan Shaikh; Kurt J. Pfeifer. Medical College of Wisconsin Affiliated Hospitals, Milwaukee, WI. (Control ID #1339757)

LEARNING OBJECTIVE 1: Recognize patent foramen ovale (PFO) and paradoxical embolus as causes of systemic embolizationLEARNING OBJECTIVE 2: Describe treatment options for PFO-associated thrombus

S494 ABSTRACTS JGIM

CASE: A 35-year-old woman presented with a 24-hour history of fatigue, chest tightness and dyspnea at rest. Additionally, she developed nausea and lightheadedness with episodic near-syncope on the morning of admission. Her past medical history was remarkable for Brugada syndrome and ventricular tachycardia found 4 months prior which lead to placement of an implantable cardiac defibrillator (ICD). Initial evaluation included a chest radiograph showing an enlarged cardiac silhouette and an echocardiogram showing a large pericardial effusion with tamponade physiology. She underwent pericardiocentesis with removal of 300 cc of sanguineous pericardial fluid. Despite these interventions, the patient's dyspnea persisted, and she developed episodic paresthesias. Repeat echocardio-gram showed a significant decrease in the pericardial effusion but also noted a mobile, left atrial mass. Transesophageal echocardiogram revealed a large, filamentous, mobile mass attached to the septum and passing through a large patent foramen ovale (PFO). A small mobile mass was also noted at the tip of the right atrial lead. Therapeutic intravenous heparin was immediately initiated, and the patient was taken for minimally invasive surgical PFO closure and thrombus evacuation. The patient did well post-operatively and was discharged home 4 days later on long-term anticoagulation. DISCUSSION: A paradoxical embolus originates in the venous system and enters the arterial circulation through an anomalous connection between the two systems, such as a PFO. While there is an increased incidence of PFO in patients with cryptogenic stroke, the detection of a PFO in a patient with embolic stroke does not prove a cause-and-effect association. Therefore the diagnosis of a paradoxical embolus is often one of exclusion, unless imaging

reveals a thrombus in transit. When a thrombus in transit is identified, treatment is aimed at inhibiting growth of the thrombus through anticoagulation with eventual clot dissolution. In severe cases, surgical evacuation of the thrombus may be necessary.

TOXOPLASMA ENCEPHALITIS IN HIV: IS A CD4+ COUNT GREATER THAN 200/L REASSURING? Auras R. Atreya1; Sonali

Arora1; Taraka V. Gadiraju1; Jos Martagn-Villamil1,2. 1Baystate Medical Center/Tufts University School of Medicine, Springfield, MA; 2Baystate Medical Center/Tufts University School of Medicine, Springfield, MA. (Control ID #1340366)

LEARNING OBJECTIVE 1: Recognize the possibility of Toxoplasma Encephalitis (TE) in an HIV positive patient with CD4+ count >200/L. CASE: Ms. XYZ is a 55-year-old female with a history of HIV/AIDS, well controlled on HAART, CD4+ count in the 300/L range for >1 year, as well as stage II (T3 N0) adenocarcinoma of the appendix , status post appendectomy, who presented with the acute onset of headache, nausea and vomiting. A brain CT scan revealed lesions suspicious for metastases. Subsequent brain MRI was consistent with multiple ring-enhancing supratentorial and infra-tentorial parenchymal lesions, which further pushed the working diagnosis towards metastatic disease, especially given history of adenocarcinoma. The possibility of TE and primary CNS lymphoma were considered but deemed unlikely given her robust maintenance of CD4+ count near 300/L for over a year. She had been on her current HAARTconsisting of raltegravir, co-formulated emtricitabine/tenofovir and etravirine for 3 years and had been off Pneumocytis primary prophylaxis for 10 months (trimethoprimsulfamethoxazole also acts as prophylaxis for TE). Her Toxoplasma IgG titer was >250 IU/mL, but given the high seroprevalence in the community, this was not considered diagnostic of an active TE. She had no other evidence of metastatic disease in her body. Since her primary appendiceal adenocarcinoma had been low grade, resected over a year ago with no evidence of metastasis to the liver, all medical and surgical teams were in favor of obtaining a tissue biopsy due to her unusual presentation. It was felt that an attempt to characterize the lesions histologically would be prudent. The brain biopsy obtained via craniotomy demonstrated Toxoplasma tachyzoites within necrotic tissue. Immunohistochemistry and in-situ hybridization studies showed no evidence of lymphoma or carcinoma. Subsequently, treatment was started with sulfadiazine, pyrimethamine and leucovorin with good clinical response. DISCUSSION: The primary differential of multifocal enhancing lesions in the CNS in HIV-positive patients may include TE, primary CNS lymphoma, metastatic lesions, Nocardia, brain abscesses, among others. Although TE is a common occurrence in HIV-positive patients, it is almost always seen with CD4+ counts less than 100/L. Indeed, discontinuation of prophylaxis for TE is recommended when CD4+ counts are above 200/L for 3-6 months, as close follow-up in observational and randomized studies demonstrated no cases of TE. A likely explanation for this unusal presentation could be a defect in CD4+ cells. The first line treatment of TE is sulfadiazine, pyrimethamine and leucovorin for 6 weeks followed by lower dose as secondary prophylaxis. In circumstances such as this, there are no recommendations about cessation of secondary prophylaxis. This case illustrates the gray zone between work-up of multifocal lesions in HIV-positive patients with CD4+ count<200/L and those who are immunocompetent. Although one would not expect the development of Toxoplasmosis in this patient's CD4+ range to be common, it can occur and remains a challenge to address this unususal presentation.

TRANSFUSION - TRANSMITTED BABESIA Chiti Parikh; Erica Phillips. New York Presbytarian Hospital, New York, NY. (Control ID #1331734)

LEARNING OBJECTIVE 1: To recognize Babesiosis as a possible cause of unexplained post transfusion fever and hemolytic anemia, especially in asplenic patients.

CASE: A 47 year old female with transfusion dependent beta thalassemia intermedia status post spleenectomy, presented to her primary hematologist with 1 week of right upper quadrant pain and fever upto 102 F. Examination in the providers office revealed epigastric tenderness. Labs were ordered including complete blood count, complete metabolic panel, blood and urine cultures, which were significant for hemoglobin of 5.7, down

from 6.9 the day before. She was transfused two units of packed red blood cells. Abdominal ultrasound and MRCP were also ordered, which were negative. She continued to experience abdominal pain with fevers and presented to the emergency room two days later for further work up. Her history is notable for bimonthly blood transfusion due to thalassemia since age two and hepatitis C with undetectable viral load. She has been on iron chelation therapy for over 20 years. On presentation to the emergency room, she was febrile to 101.8 F, physical exam was significant for right upper quadrant tenderness. Labs showed hemoglobin of 7.7, total bilirubin 2.7, indirect bilirubin 2.3, elevated reticulocyte count with normal LDH and haptoglobin. Blood smear was positive for B. microti with 0.59% parasitemia, later confirmed with PCR. Her blood cultures, urine cultures, EBV, CMV, parvovirus PCR were negative. CT scan of abdomen and pelvis was negative for any acute changes. She was started on Atovaquone and Azithromycin for a six week course and iron chelation therapy was held. Her symptoms improved over three days after which she was discharged. Her parasitemia continued to decrease while on treatment and was cleared after four weeks. DISCUSSION: There has been a recent increase in cases of transfusion transmitted Babesia. Based on recent CDC data, 159 B. microti transfusion-associated cases were documented between 1979 - 2009. 77% of those cases occurred during 2000-2009 and most of them were in the 7 main B. microti-endemic states in the northeast and upper Midwest. This case illustrates the potential for B. microti to cause post transfusion infections which can often be life threatening in a population that is chronically ill and requires frequent blood transfusions. This includes patients with malignancy, hemoglobinopathies, and liver failure. Most of these patients often have functional asplenia which increases their risk of complications from B. microti. As our blood donor pool becomes more diverse, many of them are likely to have been exposed to more exotic microbes. Since B. microti is an intra-erythrocytic microbe, leukoreduced blood products do not reduce risk of transmission. Currently, there is no way to reduces transmission by screening blood besides donor deferral. Thus our differential for post transfusion hemolytic anemia and fever should include B. microti, especially in asplenic patients, since early identification and treatment can be life saving.

TRUE - TRUE - RELATED: AN UNUSUAL CAUSE OF BOWEL OBSTRUCTION Marwa Shoeb; Susan Wlodarczyk; Somnath Mookherjee. UCSF, San Francisco, CA. (Control ID #1339220)

LEARNING OBJECTIVE 1: Recognize that catastrophic sequela of blunt abdominal trauma can occur many weeks after the event.

LEARNING OBJECTIVE 2: Recognize radiological mimickers of intussusception and small bowel obstruction. CASE: A previously healthy 38 year-old man presented with abdominal distention, nausea, and vomiting. Two weeks prior, he was admitted to an outside hospital with the same symptoms. At the time, computerized tomography (CT) scan showed small bowel obstruction (SBO) with transition point in the left mid-abdomen and terminal ileum wall thickening. He was treated with nasogastric tube decompression, but left against medical advice without a diagnosis when his symptoms improved. He presented to our emergency department with recurrentf abdominal distention and new feculent emesis. He denied fevers, chills, blood in his stool, melena, or history of abnormal bowel movements. He reported that three weeks prior to the first hospitalization, he had suffered a bicycle collision in which the handlebars struck his abdomen, resulting in severe abdominal pain. There had been no open wound or blood per rectum after the accident. On physical exam at the time of admission, he had normal vital signs and mild abdominal distention and tenderness. Laboratories showed normal complete blood count, electrolytes, aminotransferases, bilirubin, and lipase. CT scan of the abdomen and pelvis with intravenous contrast showed wall thickening of the distal jejunum and proximal ileum, probable ileal enteroenteric fistula, two segments of jejunojejunal intussusception with upstream bowel dilation, and diffuse lymphadenopathy. Taken together, the findings were thought to be most consistent with inflammatory

bowel disease (IBD). Unfortunately, before a diagnostic colonoscopy was done, the patient ate a large meal. Overnight, he developed severe abdominal pain, went into shock and was taken emergently to the operating room. He was found to have obstruction of the terminal ileum due to an adhesion and upstream perforation with food in the peritoneal cavity. He underwent resection of 140 centimeters of terminal ileum and end-ileostomy. Final pathology showed a mixed acute and chronic inflammatory reaction within the serosa associated with small vessel proliferation, organization, and foreign material; there was no evidence of IBD or cancer. The diagnosis was felt to be intussusception and SBO as a result of intestinal trauma from his bicycle accident.
DISCUSSION: Inpatient providers often care for patients with undifferentiated SBO. Blunt abdominal trauma can cause injury to the mesentery, hemorrhagic mucosal infarction, and subclinical bowel perforation. Subsequent healing with fibrosis and stricture can lead to intussusception and SBO with a delayed onset of symptoms. Intussusception and SBO after abdominal trauma are rare; there are 22 reports representing 91 cases in the literature. Patients typically present with intermittent abdominal pain and vomiting within 4 to 8 weeks of the trauma, but symptoms can be delayed by years. Diagnostic criteria include (1) prior blunt abdominal trauma, (2) absence of intestinal disease, (3) new intestinal symptoms, (4) radiographic confirmation of stenosis, and (5) lack of inflammatory or neoplastic changes in resected segment of bowel. In managing patients with abdominal pain or SBO, inpatient providers should consider prior blunt abdominal trauma in the differential and appreciate the variable timing in symptom onset.

TWO BLOWS, BUT NO HIT Patrick Richard; Bassam Maalouf. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1311742)

LEARNING OBJECTIVE 1: 1. Identify the differential for thrombocytopenia. 2. Identify the etiologies, pathophysiology, and clinical manifestations of HIV-associated immune thrombocytopenia (ITP). 3. Recognize the association between secondary ITP and solid malignancy. 4. Recognize the treatment for HIV-ITP and when to initiate.

CASE: A 64 year-old man with HIV and metastatic lung cancer was admitted from clinic after it was discovered that his platelet count was 3,000 cells/mm3; his baseline platelet count had been 150,000 cells/mm3. He denied any bleeding symptoms except mild epistaxis. He had been hospitalized one week earlier, and had been started on heparin for DVT prophylaxis at that time. His vital signs were normal. He had ecchymoses on his hands and petechiae on his ankles and palate. His fibrinogen was 727 IU, and the d-dimer 3.7 IU. His INR was 0.9; the PT and PTT were10.9 and 24.7. His peripheral smear did not reveal schistocytes. The heparin-induced thrombocytopenia antibody was negative. Despite being transfused twelve platelet transfusions, his platelet count dropped to 2,000
cells/mm3. He was diagnosed with malignancy and HIV-associated secondary ITP and was initiated on prednisone 1 mg/kg oral daily. His platelets increased to 13,000 cells/mm3 at discharge; in clinic, two days later, his platelets had increased to 108,000.

DISCUSSION: Thrombocytopenia is a common condition encountered by the general internist. Further, as anti-retroviral therapy has prolonged the life expectance of patients with HIV, general internists are increasingly encountering long-term complications of HIV, as well as age-expected co-morbid diseases independent of HIV. Because ITP is a diagnosis of exclusion, it is important that the general internist utilize a systematic approach to diagnosing the cause of the thrombocytopenia. Our patient had HIV-associated ITP; however, other causes such as HIT, DIC, and TTP were first excluded prior to settling on the diagnosis of ITP. HIV-ITP has a complex pathophysiology including reduced platelet survival and decrease production of megakaryocyte progenitors. Patients with HIV-ITP are at increased risk of thrombocytopenia from other causes, as was the case in our patient, whose lung cancer contributed to the paraneoplastic thrombocytopenia. General internists should be aware of the recent American Society of Hematology guidelines, which no longer recommend a bone marrow biopsy for patients older than 60 years of age who have ITP without evidence of depression of other cell lines. Treatment should be based on symptoms, and not the absolute platelet count. If HIV-associated ITP is

confirmed, zidovudine should be initiated. In patients developing ITP who are already on anti-retroviral therapy, as was the case with our patient, prednisone at 1 mg/kg for 21 days is indicated. For contraindications or cases refractory to steroids, IVIG or splenectomy may be pursued. Using a systematic approach to thrombocytopenia, the internists will efficiently diagnose secondary ITP. An understanding of the treatment options and timing for HIV-associated ITP will prevent unnecessary, ineffective treatments and improve outcomes.

TWO CASES OF SPINAL CORD INFARCTION - A COMPARISON Muhammed Sherid; Samian Sulaiman; Salih Samo; Meenu Singh. University of Illinois at Chicago, St.Francis Hospital, Evanston, IL. (Control ID #1314386)

LEARNING OBJECTIVE 1: To suspect spinal cord infarction in nonaortic surgical settingsLEARNING OBJECTIVE 2: To understand the etiology of spinal cord infarction.

CASE: Case 1: A 64 year old Romanian man presented to the ED with a two hour history of severe, sharp circumferential lower chest and back pain, associated with left leg weakness and numbness. These symptoms started when he was at work at his auto-body shop. He did not have headache, loss of consciousness, urinary or fecal incontinence. Past medical history was significant for diabetes, dyslipidemia, hypertension, and infrarenal abdominal aortic aneurysm. His vital signs and general examination were unremarkable. Neurological examination revealed normal level of consciousness. Cranial nerves were intact. Motor examination revealed a power of 0/5 in all muscle groups of the left lower extremity. Sensations to light touch, pain, vibration and position sensations were normal. He was unable to distinguish between warm and cold temperature sensations from the level of the nipples down to the mid thigh bilaterally. Deep tendon reflexes were absent in the left knee and ankle. Babinskis sign was positive on the left and neutral on the right. Rectal tone was decreased but he was able to squeeze the examiners finger. Laboratory studies and electrocardiogram were unremarkable. CT scan showed marked atherosclerotic changes with a protruding thrombus, plaque and penetrating ulcers with subintimal hematoma in the descending thoracic aorta to the upper abdominal aorta. An infrarenal abdominal aneurysm measuring 3.7 x 3.8 cm unchanged from the previous study was identified. MRI brain and spinal cord were unremarkable. A diagnosis of anterior spinal cord infarction was made. His symptoms resolved within twenty four hours without residual deficits. Case 2: A 51 year old African American man presented to the ED with sudden onset paralysis of both the upper and lower extremities associated with neck pain. There was no headache, loss of consciousness or bowel and bladder disturbances. Past medical history was significant for diabetes mellitus, atrial fibrillation, and hypertension. On examination; his blood pressure was 180/ 97 with irregular heart rate of 114. On neurological examination he was alert,

awake and oriented to time, place and person. Cranial nerves were intact. Motor examination revealed a power of 0/5 in bilateral upper and lower extremities. Sensations to touch and pain were intact. Deep tendon reflexes were absent in all four extremities and Babinskis sign was positive bilaterally. Laboratory studies were unremarkable. MRI revealed infarction in the cervical spinal cord from C2-4. MRA showed occlusion in left vertebral artery. The patient was intubated initially due to respiratory distress. His symptoms improved over the next twenty four hours and extubated. He was discharged with mild left sided weakness.

DISCUSSION: Spinal cord infarction is a rare disorder. Aortic surgery is the most common etiology; however, other etiologies include atherosclerosis, vasculitis, infection, embolic and thrombotic occlusion, and severe hypotension. The clinical presentation is acute onset of paraparesis or quadriparesis. A therapeutic algorithm exists regarding this condition in the setting of aortic surgery, but no definitive therapy has been shown to be of benefit in other settings.

TYPE B LACTIC ACIDOSIS IN ESOPHAGEAL CARCINOMA: AN INTERESTING CASE. Sandesh Murali; Shabeta Sahore; Harsha Ramchandani. St. Mary Mercy Hospital, Livonia, MI. (Control ID #1311164)

LEARNING OBJECTIVE 1: Identification of different types of lactic acidosisLEARNING OBJECTIVE 2: Pathogenesis of Lactic Acidosis in MalignancyCASE: A 53 year old Caucasian male was admitted to general

medical floor for sepsis. His past medical history was significant for Diabetes Mellitus, Hypertension, Hyperlipidemia, Stage 4 esophageal adenocarcinoma with metastasis to lung, spine and liver. Esophageal cancer was diagnosed two months prior to current admission. He had received 2 cycles of Taxol/carboplatinum. His last chemotherapy was 3 weeks before admission. On day 1, positive findings in physical exam included hypotension, tachycardia, crackles in right lung base and stage 2 non-infected decubitus ulcer on the sacrum; his significant blood labs were WBC- 15.7, lactic acid-5.7, AST- 83, ALT- 49. He was treated with antibiotics vancomycin and piperacillin-tazobactum to cover organisms causing health care associated pneumonia. On day 6 of admission, his lung exam was clear bilaterally, vital signs were stable and blood labs were-WBC 10.8, lactic acid 6.5, AST- 41 ALT -51. Despite pneumonia resolution, and improving sepsis, his lactic acid levels increased from 5.7 on admission to 12.1 on day 10. He was not on any medications known to cause lactic acidosis. Lactic acidosis was worsening despite resolution of hypotension, hypoperfusion and sepsis. Due to poor prognosis, patient changed his code status to DNR and requested discharge to hospice without further workup. Patient passed away at hospice the day after discharge. DISCUSSION: Lactic acidosis is the most common cause of metabolic acidosis in hospitalized patients. There are three different types of lactic acidosis type A, B and D. Type A lactic acidosis is due to tissue hypoperfusion and acute severe hypoxaemia. Type B lactic acidosis could be due to hereditary metabolic diseases, drugs/ toxins (Biguanides, salicylates, nucleoside reverse transcriptase inhibitors and methanol), systemic disorders or malignancies. Type D Lactic acidosis can occur in patients with short bowel syndrome or other forms of malabsorption. In tumors, Type B lactic acidosis pathogenesis may involve liver dysfunction due to massive liver metastasis leading to lactate underutilization and subsequently lactic acidosis. During the last decade evidence has emerged supporting the role of overproduction of lactic acid due to ischemia in the neoplastic tissue bed and cancer cells having an aberrant energy production. Lactic acidosis in malignancy was first described in patients with acute leukemia by Field et al. in 1963. Since then, it has been observed often in hematological malignancies, but rarely in solid non-hematological tumors such as small cell lung cancer, cholangiocarcinoma, breast cancer, gynecological cancers, hepatoma and metastasis from unknown primary carcinoma. Our case illustrates an uncommon cause of lactic acidosis. Treatment of lactic acidosis due to malignancy includes chemotherapy to decrease tumor burden, bicarbonate infusion and hemodialysis. Lactic acidosis in the background of malignancy is an indicator of poor prognosis.

UNFOLDING THE ENDOCRINOPATHY SOUP James W. Ragins; Patrick Siler; Mukta Panda. University of TN, College of Medicine, Chattanooga, Chattanooga, TN. (Control ID #1289489)

LEARNING OBJECTIVE 1: Review the differentiating features between primary and secondary adrenal insufficiencyLEARNING OBJECTIVE 2: Discuss the key features of Polyglandular Autoimmune Syndrome (PAS) Type I and IICASE: A 46-year-old Caucasian female presented initially in November 2002 after a syncopal episode and was found to have a 14 x 18 mm pituitary adenoma. She had low levels of TSH, FSH, LH and random cortisol. The patient treated for panhypopituitarism with prednisone and synthroid and subsequently underwent transforaminal hypophysectomy for lymphocytic hypophysitis. In July 2011, the patient presented to the emergency department with nausea, vomiting and diarrhea for three days associated with cramping and tingling in her upper and lower extremities. Her home medications included synthroid 112 mcg daily, prednisone 10 mg daily and over the counter Tylenol. On presentation her blood pressure of 108/73 mmHg, pulse of 100/ min, respiratory rate of 20/min, and temperature of 98.9 F. Physical examination was significant for mild left upper quadrant tenderness and multiple hypopigmented areas on bilateral upper extremities consistent with vitiligo. Laboratory data showed hyponatremia (Na 127), hyperkalemia (K 6.2), leukocytosis (WBC 16.5), TSH 0.114 and free T4 0.85. Urinalysis revealed a large amount of leukocyte esterase, no nitrites and WBC 47, low vitamin B12(233) and increased methyl melonic acid.Primary adrenal insufficiency and pernicious anemia were considered. She had positive adrenal and anti parietal antibodies.She was admitted and treated for acute adrenal crisis and urinary tract infection.

DISCUSSION: PAS should be considered when a patient presents with two or more endocrinopathies. There are two main classifications of PAS: type I and type II. Type I PAS is usually seen in childhood and characterized by deficiency in thyroid and adrenal function along with mucocutaneous candidiasis. Type II PAS or Schmidt syndrome, is seen more frequently in adult women and is characterized by adrenal insufficiency, thyroiditis or type 1 dibetes mellitus. Other associated conditions include celiac disease, pernicious anemia, Graves disease, hypophysitis and vitiligo. Type II PAS has an autosomal dominant inheritance pattern that is not manifested in all persons of a family who posses the affected gene. Autoantibodies seen in PAS type II can include antibodies against the thyroid gland, adrenals and pancreas. Because the clinical manifestations of adrenal insufficiency may be difficult to detect and fatal if not diagnosed,it is important to screen patients at risk for PAS routinely with the cosyntropin stimulation test. The key differences between primary and secondary disease lies with the ACTH and aldosterone level. Primary disease have a high ACTH level which likely result in hyperpigmentation of skin due to elevated melanocyte-stimulating hormone and a low aldosterone level because the rennin-angiotensin system is dysfunctional resulting hyperkalemia. Secondary disorder will not have the hyperpigmentation or hyperkalemia. Screening studies for adrenal insufficiency should be done routinely every 1-2 years up to about the age of 50 in families with PAS type II and until about the age of 40 in patients with type I PAS. Treatment includes managing each individualized endocrine dysfunction, usually with hormonal replacement. Special attention should be towards the recognition and prevention of acute adrenal crisis.

UNLEASHING THE WOLFF: A CASE OF LIFE THREATENING COCAINE INDUCED TACHYCARDIA

Jonathan S. Lee; Hollis Day; Peggy Hasley. University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1339264)

LEARNING OBJECTIVE 1: Describe the ECG characteristics, acute manifestations and management of Wolff-Parkinson-White syndrome LEARNING OBJECTIVE 2: Recognize that cocaine can induce life threatening reentrant tachycardias in patients with WPWCASE: A 50 year old female with no cardiac history presented from home following the acute onset of palpitations, weakness, nausea and vomiting after imbibing only 3 drinks of alcohol. EMS was called to evaluate the patient and found her pre-syncopal with narrow complex tachycardia at a rate of 280 beats per minute. She was DC cardioverted into normal sinus rhythm and immediately felt better. On presentation to the hospital the

patient appeared very anxious but her exam was otherwise unremarkable. Urine was positive for cocaine and tetrahydrocannabinol. An ECG revealed normal sinus rhythm at a rate of 90 beats per minute with a PR interval of 90 milliseconds and slurring of the QRS upstroke suggesting the diagnosis of Wolff-Parkinson-White syndrome. After discussion of treatment options, the patient underwent catheter-based radiofrequency ablation. She was also advised to abstain from cocaine.

DISCUSSION: The ECG pattern in Wolff-Parkinson-White is a result of conduction from the atria simultaneously through the AV node and through an accessory tract bypassing the AV node. The bypass tract leads to faster initial ventricular depolarization compared to the AV node but slower conduction within the ventricular myocardium compared to the His-Purkinje system. This results in ventricular pre-excitation and the characteristic findings of slurring of the QRS upstroke - the delta wave - and a short PR interval less than 120 milliseconds. The prevalence of the WPW ECG pattern has been estimated as high as 1 in 400 people in the general population. Diagnosis is complicated by the fact that the ECG pattern can be intermittent and can disappear over time. In addition, not all patients develop tachyarrhythmias. In one study only 1.8 percent of patients with the WPW ECG pattern had episodes of tachyarrhythmias, and the risk of sudden cardiac death, the most feared complication, was estimated to be very low at 0 to 0.4 percent. Treatment of WPW is generally

reserved for symptomatic patients with episodes of AVRT or atrial fibrillation. They should be referred to electrophysiology for ablation which is potentially curative. Acute pharmacologic therapy generally involves intravenous antiarrhythmics such as procainamide. It is important to recognize that in patients with wide-complex tachycardia or atrial fibrillation and a known history of WPW, AV nodal blockers such as beta-blockers, calcium-channel blockers, adenosine and digoxin are contraindicated as they can potentially precipitate ventricular fibrillation and sudden cardiac death. Cardioversion is still first-line therapy in an unstable patient. Cocaine inhibits the reuptake of norepinephrine and dopamine at nerve terminals. This increase in sympathetic tone along with direct cardiotoxic effects is hypothesized as the cause for the wide range of arrhythmias with which cocaine has been associated. In addition, at high doses cocaine acts as a sodium channel blocker with class I antiarrhythmic effects, which can theoretically promote reentrant arrhythmia. While cannabis has not been associated with arrhythmias, it may increase plasma levels of cocaine, thereby increasing arrhythmogenic potential. In this patient, it is possible that all of these factors played a role.

UNMASKING OF UNDIAGNOSED PRE-EXISTING CENTRAL DIABETES INSIPIDUS AFTER RENAL TRANSPLANTATION Jerson Munoz-Mendoza; Veronica Pinto. University of Miami - Jackson Memorial Hospital, Miami, FL. (Control ID #1335028)

LEARNING OBJECTIVE 1: Recognize that central diabetes insipidus may be masked by chronic kidney disease and disclosed by renal transplantationLEARNING OBJECTIVE 2: Identify empty sella syndrome as a cause of central diabetes insipidusCASE: A 59-year-old Hispanic woman with end stage renal disease (ESRD) of unknown etiology on dialysis was admitted to the hospital to undergo deceased donor renal transplantation. The pre-operative history and physical examination, along with blood work and other investigations were unremarkable. Diuresis started within the first hour and rapidly exceeded 600 ml/h with a total urinary output of 10 liters during the first 24 hours after the surgery. In the early postoperative course the patient developed increased urinary frequency, thirst and water intake. Over the coming days, despite treatment with free water, her urine output remained 10 liters per day and serum sodium level and serum osmolality increased to 161 mmol/L and 324 mOsm/Kg H2O respectively. Since urine osmolality was persistently low, diabetes insipidus was suspected and intravenous desmopressin 4 g was initiated on the sixth hospital day. Two and half hours later the urine osmolality rose from 67 to 219 mOsm/kg, and the plasma sodium level and serum osmolality dropped from 159 to 146 mmol/L and from 317 to 297 mOsm/Kg H20 respectively, which is consistent with the diagnosis of CDI. Maintenance therapy with intranasal desmopressin 10 g was instituted with subsequent improvement of the symptoms including a decrease urine output. MRI revealed empty sella. The anterior pituitary

hormonal panel was within normal limits. The patient was discharged on the twelfth hospital day with diagnosis of CDI and empty sella syndrome, with serum creatinine of 0.9 mg/dL, sodium level of 141 mmol/L, and daily urinary output of approximately 3.5 liters per day.

DISCUSSION: Central Diabetes Insipidus (CDI) is a rare condition characterized by vasopressin deficiency, manifested as polydipsia and polyuria. In the setting of dialysis-dependent chronic kidney disease, new-onset CDI is largely asymptomatic and may therefore go unrecognized. We describe a case of CDI in a renal transplant recipient, in whom restoration of renal function unmasked preexisting CDI, leading to severe polyuria and electrolyte abnormalities. CDI rarely complicates the perioperative management of kidney transplantation, there are only 5 reported cases in the literature worldwide. CDI symptoms usually become apparent within 24 hours after renal transplantation and should be suspected in the setting of persistent polyuria. Treatment with desmopressin facilitated the fluid and electrolyte management without impairment of the allograft function. In our patient, CDI was most likely secondary to empty sella syndrome (ESS), which is an uncommon cause of CDI. This clinical presentation of ESS, characterized by an isolated vasopressin deficiency with intact anterior pituitary function, is unique as well.

UNUSUAL PRESENTATION OF BREAST CANCER Laura Lourdes; Umna Ashfaq. University of Florida,

Gainesville, FL. (Control ID #1338227)
LEARNING OBJECTIVE 1: Learn the unusual presentation of breast cancer.
CASE: 55-year-old post-menopausal female who with a significant past medical history of severe head trauma complicated by subarachnoid hemorrhage requiring insertion of ventriculo-peritoneal shunt (VPS) for hydrocephalus, and previous gastric bypass surgery presents to her primary care practitioner with a lump on her abdomen just below her right breast 3 years after insertion of the VPS close to the shunt site. She was reassured initially that this was scar tissue related to the shunt surgery. 2 months later she informs the neurosurgeon that this lump was getting larger and painful. An ultrasound is performed and reveals a 2x 1.4 cm mass in the inferio-medial quadrant of the right breast overriding the shunt catheter and a smaller confluent mass tracking inferiorly along the shunt. Biopsy of the mass revealed invasive papillary carcinoma ER/PR positive, HER-2 negative and TFT negative. Pathological interpretation was that this was most likely breast or ovarian tumor. CT chest, abdomen and pelvis revealed lesions within the spleen measuring up to 2.5 cm. There were areas of abnormal density were noted within the peritoneum on both the left and right measuring from 1 to2.5 cm, not including a 2.9-cm soft tissue mass at the peritoneum in the region of the umbilicus. Nodularities surrounding the shunt through the right breast with right anterior wall were also seen. On PET scan there was increased FDG activity uptake of these same lesions. No obvious breast or ovarian lesion was identified. MRI brain showed no evidence of metastasis. An initial trial of hormonal therapy with letrozole failed and since then she has been treated with multiple lines of chemotherapy and her disease remains controlled 3 years from diagnosis. A PUBMED search done with the following words breast cancer AND VP Shunt revealed no results. However there has been a case report of ovarian carcinoma with leptomeningeal metastasis via VPS, pancreatic carcinoma seeding along a VPS as well as intracranial malignancies metastasizing to the peritoneum via VPS. Hence this is the first reported care of breast cancer with peritoneal metastasis that presented with subcutaneous nodules tracking along a VPS.
DISCUSSION: This case highlights that peritoneal involvement of carcinoma, no matter the origin can metastasize along a VP shunt. As primary care practitioners, we need to be aware and have a low threshold to biopsy any masses that present as such.
UNUSUAL CAUSE OF NAUSEA, VOMITING AND ABDOMINAL PAIN Shaghayegh Khayambashi. SJHMC, Phoenix, AZ. (Control ID #1324040)
LEARNING OBJECTIVE 1: Cannabis is the third most commonly used drug after tobacco and alcohol and is the most commonly abused illicit

drug in the United States. This drug is often used as anti-emetic and appetite-stimulating agent in cancer patients and in those with acquired immunodeficiency syndrome. As such, cannabinoid hyperemesis is often an unrecognized side effect of chronic marijuana use in patients presenting with abdominal pain, nausea and cyclic vomiting unresponsive to anti-emetics. Given the increasing recreational and medicinal use of Marijuana in the United States, physicians need to be more aware of this paradoxical side effect.
CASE: A 23-year-old female presented with abdominal pain, nausea, and refractory bilious vomiting for the past 4 days. She had recurrent episodes of these symptoms over the past 4 years and the symptoms started approximately 2 years after she began using Marijuana regularly. She received conservative treatment in the emergency room on multiple occasions and was never admitted as all lab results were within normal limits. She described a non-radiating, sharp, right upper quadrant abdominal pain with 9/10 severity. Patients father described his daughter taking multiple long hot baths throughout the day to help reduce episodes of nausea and vomiting. On physical exam, the patient appeared dehydrated but was afebrile and vital signs were stable. Laboratory studies showed mild leukocytosis with white blood cell count of 12.7 which decreased to 10.4 the next day, increase in AST of 148 and ALT of 116, both of which decreased to 29 and 46 respectively. Laboratory results including pregnancy test, hepatitis panel, amylase, lipase and basic metabolic panel were

normal. CT of abdomen and pelvis was normal except for hypodensities in the liver described as vascular shunt in the subsequent MRI study. Patients symptoms resolved in 48 hours with conservative treatment and abstinence from Marijuana. She was dischargedDISCUSSION: Cannabinoid hyperemesis was first described by JH Allen in Australia. He noted this condition in a group of nineteen patients with chronic cannabis abuse and cyclic vomiting who habitually bathed in warm showers or baths to uniquely find temporary relief of their symptoms. Many subsequent cases described the association between cannabinoid use and cyclical vomiting and abdominal pain. Although the centrally mediated anti-emetic effect of cannabinoids has been described, the mechanism for its emetic action is not precisely known. With the recent legalization of Marijuana in many states, physicians will encounter cannabinoid hyper-emesis more frequently. Unnecessary expensive and invasive diagnostic, medical and surgical treatment can be avoided with the knowledge of this phenomenon.

USING THE LOUISIANA SIDS RISK REDUCTION PROGRAM AS A MODEL FOR EVALUATION OF PROGRAMS THAT AIM TO IMPROVE THE ACCURACY OF VITAL RECORDS Arta Lahiji. UCLA Olive View Medical Center, Redondo Beach, CA. (Control ID #1341363)

LEARNING OBJECTIVE 1: A public health program that aims to decrease national and local rates of SIDS/SUID should have a system of accurately documenting the incidence of SIDS/SUIDCASE: The Louisiana Office of Public Health (LAOPH) has worked to reduce the rate of Sudden Infant Death Syndrome (SIDS) and sudden unexplained infant deaths (SUID) by improving the accuracy and consistency of SIDS/SUID diagnoses. Nationally, collecting complete and accurate records on SIDS/SUID deaths has been hindered by a lack of standardized training, diagnostic criteria, and system for reclassification. The LAOPH aims to develop a more consistent system for reporting SIDS/ SUID, to both improve accuracy and potentially decrease the overall rate of SIDS/SUID. The Sudden Infant Death Syndrome Risk Reduction Program (SIDSRRP) aims to improve the accuracy of SIDS/SUID reporting through standardized coroner and death scene investigator training, incentive programs for data collection, and legislation compliance. This work was done as part of the Centers for Disease Control Program Evaluation Training for Harvard School of Public Health students. A mixed-method approach using both quantitative and qualitative data was utilized. Four key informant interviews (SIDSRRP program coordinator, Child Death Review (CDR) Medical Director, facilitator, and state-wide coordinator) were conducted. Three investigative forms (death scene investigation (DSI) form, coroner's invoice, and SUID home visit form), two pieces of legislation (Coroner's Law, Child Death Investigation statute), and the Title Five Maternal and Child Health Block Grant were reviewed. This was used to design a programmatic logic model and an evaluation method for assessing the arm of the SIDSRRP that aims to improve the accuracy of SIDS/SUID reporting. A time-series evaluation design and suggested measurable process indicators : 1- Number/percent of complete SIDS records 2- Number/percent of reclassified records are proposed. As coroners and death scene investigators receive standardized training on SIDS/SUID classification and comply with legislation requiring that they submit full autopsies, DSIs and SUIDI forms, the expected number/percent of complete SIDS/SUID records will increase. This is a measurable indicator of the programs process. It is assumed that as the number/percent of complete SIDS/SUID records increase, the amount of information coroners have to make an accurate initial diagnosis will also increase. Furthermore, the number/percent of reclassified records can serve as an indicator of the ultimate impact goal of improved accuracy of the SIDS/ SUID reported rate. We can expect with standardized training and compliance with regulations, forms, and procedures, there will be an improved initial accuracy of SIDS/SUID diagnosis and decreased reclassification rate over time by the CDR.

DISCUSSION: By improving the accuracy of reporting, SIDS rate in Louisiana may be decreased, in itself fulfilling the program aims. The proposed evaluation of Louisianas SIDSRRP aim of improving accurate SIDS/SUID reporting can be beneficial for their program planning and resource allocation. The proposed evaluation of Louisianas SIDSRRP can be used as a model for other state programs that aim to improve the accuracy of SIDS/SUID reporting in vital records. A public health program that aims to decrease national and

local rates of SIDS/SUID should have a system of accurately documenting the incidence of SIDS/SUID.
VARICEAL BLEEDING WITHOUT CIRRHOSIS? Victor Estacio; Zeeshan Qureshi; Lee Lu. Baylor College of Medicine, Houston, TX. (Control ID #1321258)
LEARNING OBJECTIVE 1: Review the etiology and pathophysiology of Left-sided Portal Hypertension (LSPH)
LEARNING OBJECTIVE 2: Discuss diagnosis and management options of LSPH.
CASE: A 37-year-old Caucasian male presented with two weeks of melena followed by four days of light-headedness, weakness, and shortness of breath. He denied abdominal pain, nausea, vomiting, hematemesis, early satiety, or NSAID use. He was monogamous with his wife, rarely drank alcohol, and denied drug use. Exam showed pallor without icterus or jaundice. There were no stigmata of chronic liver disease, no hepatosplenomegaly, and no ascites. The rest of the exam was unremarkable. Admission Hgb was 5.9 g/dL, platelets were 88,000/uL, and iron panel showed severe deficiency. Liver function tests were within normal limits. Ultrasound did not reveal cirrhosis or splenomegaly. He was transfused 4 units pRBC, and endoscopy showed large grape-like fundal varices with a sentinel clot, without esophageal varices. To further investigate the underlying etiology, an MRI of the abdomen revealed a 5.3 x 7.2 cm splenic hilar mass encasing the pancreatic tail and a 2.8 x 3 cm periaortic retroperitoneal adenopathy. The pathology of the fine needle biopsy of the periaortic lymph node was consistent with a non-small cell carcinoma with squamoid features. AFP, CEA, CA19-9, and CA-125 were negative. Staging CT chest, repeat EGD/ colonoscopy, and testicular ultrasound could not identify possible primaries or metastases. He thus underwent distal pancreatectomy and splenectomy and was diagnosed with squamous neoplasm of the pancreatic tail with extension to the spleen and involvement of the retroperitoneal lymph nodes. The gastric varices were mainly due to LSPH secondary to splenic vein obstruction by the mass.
DISCUSSION: LSPH is an uncommon clinical entity caused by splenic vein obstruction (SVO), leading to venous hypertension distally, and predisposing to increased left-sided venous collateral circulation flow. It accounts for less than0.5% of all causes of portal hypertension. Most LSPH originate from pancreatic disorders. These include pancreatitis, pancreatic cancer, or pancreatic expansion as in pseudocysts. Other causes include abdominal surgical procedures, metastatic cancers, hypercoagulability, and retroperitoneal fibrosis. LSPH leads most commonly to isolated gastric or combined gastroesophageal varices, although LSPH-associated isolated esophageal or colonic varices have been described. While most cases are asymptomatic, patients can present with

abdominal pain, jaundice, fatigue, gastrointestinal bleeding, or weight loss. Splenomegaly is a common finding. Work up should include an MRI or MRV to look for SVO. Treatment involves splenectomy in those with known variceal bleeding. However, primary prophylactic splenectomy is discouraged in patients without history of bleeding due to low bleeding rates. Prognosis is intimately related to the primary pathology causing the LSPH. Those with pancreatic cancers were found to have 2-12 months survival with deaths not related to bleeding. In benign processes, prognosis remains good once bleeding is controlled, and further rebleeding is uncommon at 0-3%. Hence, in patients with varices or variceal bleeding without evidence of liver disease or portal vein thrombosis, LSPH should be considered and further work up is warranted.
VARICELLA ZOSTER VIRUS (VZV) MENINGOENCEPHALITIS IN AN IMMUNOCOMPETENT HOST Brandon Verdoorn; Ryan Hurt. College of Medicine - Mayo Clinic, Rochester, MN. (Control ID #1312623)
LEARNING OBJECTIVE 1: Recognize the typical presentation of VZV meningoencephalitis in an immunocompetent host.
LEARNING OBJECTIVE 2: Diagnose VZV meningoencephalitis using cerebrospinal fluid (CSF) analysis.
CASE: A 72-year old immunocompetent male with past medical history of hypertension, hyperlipidemia, and

obesity presented to his local Emergency Department with 2-day history of fever, confusion, generalized weakness, and painful erythematous vesicular rash affecting his left torso. He was transferred to a tertiary care center following an unremarkable head CT. On initial presentation to our facility, he was noted to be febrile (38.5C) with otherwise normal vital signs. On examination, he was fully oriented with a Glasgow Coma Scale (GCS) of 15. There were no focal neurologic signs or findings of meningeal irritation. A unilateral vesicular rash was noted on the left chest wall, in approximately a T4 dermatomal distribution. Examination was otherwise unremarkable. Laboratory studies were unremarkable aside from a mild normocytic anemia (Hemoglobin12.8 gm/dl), mild thrombocytopenia (Platelets 114 x 10^9/L), and mild monocytosis (Monocytes 1,100/mm^3; 17.3%) with normal leukocyte count. Blood cultures were obtained, and he was initiated empirically on intravenous (IV) acyclovir given suspicion for disseminated herpes zoster infection. He was admitted to the hospital and noted to have waxing and waning confusion. Lumbar puncture was performed, revealing clear cerebrospinal fluid with elevated total protein (85 mg/dl) and elevated cell count (159/uL) with 56% lymphocytes, 42% monocytes, and 1% neutrophils. PCR for VZV DNA was positive, while bacterial culture, Grams stain, and PCR for HSV DNA were negative. He was diagnosed with VZV meningoencephalitis, and continued on a course of IV acyclovir for a total of fourteen days. Human immunodeficiency virus (HIV) screening test was negative. His confusion progressively improved and eventually resolved, and he was dismissed on hospital day seven. DISCUSSION: Varicella zoster virus (VZV) infection in adults is typically due to reactivation of latent virus, which lies dormant in sensory ganglia following primary infection (varicella, or chickenpox). Reactivation manifests as herpes zoster (shingles), characterized by a painful vesicular rash that is usually unilateral and restricted to the distribution of the dermatome supplied by the involved sensory ganglion. The rash may be preceded by pain (preherpetic neuralgia), and pain may persist chronically following resolution of the rash (postherpetic neuralgia). Treatment with antiviral agents may be effective in shortening duration of symptoms and reducing risk of postherpetic neuralgia when started early in the course of the illness. Systemic dissemination of reactivated VZV is rare. Varicella zoster virus (VZV) meningoencephalitis is an uncommon clinical entity, typically affecting immunocompromised hosts, particularly those with human immunodeficiency virus (HIV) infection. Cases in immunocompetent hosts have been reported, however, and it is important to consider VZV meningoencephalitis in the differential of undifferentiated acute neurologic disease, particularly in patients with skin findings suggestive of zoster infection. With prompt intravenous (IV) antiviral treatment, most patients recover to their baseline level of neurologic function.

VARICELLA ZOSTER VIRUS VASCULITIS IN AN HIV-POSITIVE MALE PRESENTING WITH STROKE Molly Kraus. SJHMC, Phoenix, AZ. (Control ID #1339132)

LEARNING OBJECTIVE 1: The approach to an HIV-infected patient that presents with an abnormal neurologic exam can be challenging. In patients with CD4 cell count <200/microL, the differential diagnosis is broad. Varicella Zoster Virus (VZV) vasculitis is important to consider in this population. Findings on imaging and CSF fluid analysis can lead you to this diagnosis.

CASE: A 35 year-old hispanic male with HIV presented for a 3 day history of headache, right sided numbness and weakness, and difficulty ambulating for 3 days. He had been diagnosed with HIV/AIDS 2 months prior to this admission and was started on HAART therapy. Past medical history was relevant for syphilis treated with penicillin 3 years ago. His last CD4+ count was 8. On exam, he was an ill-appearing, frail male, who was alert and oriented, tachycardic at 106. Cranial nerves were intact; there was mild nuchal rigidity, and multiple skin lesions in lower extremities. Strength was decreased on right lower extremity to 3/5, right upper and left lower extremities 4/5, 2+ reflexes throughout. Laboratory was significant for normocytic anemia with hemoglobin of 8.6. A lumbar puncture was performed which was positive for VZV by PCR, RPR was positive. CT-angiagraphy showed infarct in the posterior limb on the left with suggestion of vasculitis. An MRI of the brain revealed an acute infarct involving the left thalamus with moderate chronic small vessel ischemic changes. A CT-angiogram was performed and beaded appearance of vasculature was noted. The patient was started on IV acyclovir and

steroids for the treatment of VZV vasculitis leading to the presentation of stroke. DISCUSSION: Strokes caused by VZV are most often ischemic strokes. Vasculitis can be caused by either a primary infection or with viral reactivation, affects large and small arteries and this complication can occur without the characteristic zoster rash. The classic clinical presentation of VZV vasculopathy in adults is opthalmic distribution zoster followed by acute contralateral hemiplegia. Clinical presentations vary widely and include mental status changes, aphasia, ataxia, hemi-sensory loss and visual changes. Two-thirds of patients will have a history of rash within the previous several months. Prior to antiretroviral therapy, VZV CNS infections were detectable in 1.5 to 4.4 percent of HIV-positive patients at autopsy. Most cases occur in patients with severely low CD4 count. VZV causes stroke by the direct infection of the cerebral arteries leading to inflammatory and noninflammatory processes such as necrosis, dissection, and aneurysm formation. The proposed transaxonal spread is through afferent fibers from trigeminal and dorsal root ganglia to both intracranial and extracranial blood vessels. Differential diagnosis includes a broad number of infections and diagnosis including: HIV vasculitis, CMV infection, intracranial lymphoma, cerebral toxoplasmosis among others. MRI typically shows superficial and deep lesions in both the gray and white matter, particularly at the gray-white matter junctions. Multifocal lesions are common. Typical angiographic changes are segmental constriction with post-stenotic dilatation, or beading. In about two-thirds of patients with CSF analysis show modest pleocytosis, usually fewer than 100cells/mm3, monocytes predominance. CSF protein is also typically elevated, with oligoclonal bands. Intrathecal production of anti-VZV antibodies or VZV DNA in the CSF.

WAITING TO EXHALE Sharifa Llemit; Ravi S. Hira. Baylor College of Medicine, Houston, TX. (Control ID #1284932)

LEARNING OBJECTIVE 1: Recognize septic pulmonary embolism (SPE) as a complication from a peripheral intravenous line. LEARNING OBJECTIVE 2: Review septic pulmonary embolism. CASE: A 47-year-old white male presented with blurring of vision, progressive dyspnea on exertion, and hemoptysis. He was diagnosed with relapsing remitting multiple sclerosis 4 months prior and was treated 1 week ago with IV Steroids for a relapse. Two days prior to presentation, he noted blurry vision in his left eye, increasing dyspnea on exertion, and later had an episode of hemoptysis. He denied fevers or chills but did complain of bilateral pleuritic chest pain. On exam, he was afebrile and tachypneic, lung exam was clear with decreased breath sounds and vocal resonance in the right base and oxygen saturation of 95% on 2 L by nasal

canula. Additionally, he was noted to be tachycardic without any murmurs or rubs and skin exam revealed no abnormal lesions. CXR showed multiple vague densities suggestive of metastatic disease. CT Chest with contrast revealed bilateral lung nodules, some of which had cavitation suggestive of septic pulmonary emboli. On ophthalmological exam, an intra-vitreal abscess was found in his left eye which was subsequently incised and drained. Blood cultures were positive for MRSA. Transthoracic and transesophageal echocardiograms did not reveal valvular vegetation. The patient later developed pain, swelling, and tenderness in his right cubital fossa at the site of his previous peripheral IV access and was found to have septic thrombophlebitis of his cephalic vein, requiring vein resection. The culture from the vein also grew MRSA. Patient was diagnosed with SPE caused by a peripheral IV line and treated with IV Vancomycin for 6 weeks.

DISCUSSION: Superficial thrombophlebitis is a common complication from peripheral IV lines with an incidence of 25 to 35% and suppurative thrombophlebitis occurring in 0.2 to 2%. SPE is one of the rare but serious sequelae with an infected thrombus embolizing to the lungs. Risk factors include age over 50 years, underlying immunocompromised status and intravenous drug abuse (IVDA). Our patient had been on steroid therapy. The common organisms identified are coagulase-positive Staphylococcus aureus and group A Streptococcus. Historically, IVDA has been a major risk factor as reported in a case series in 1978 describing 60 patients with SPE over a 5-year period with 78% of their cases caused by IVDA. However, with heightened awareness of needle hygiene over the years, SPE is becoming a rare complication of IVDA. A recent case series of 14

patients with SPE in 2005 found only 1 patient to be an IVDA. The others were Lemierres syndrome, central line infections, prosthetic valves, infected pacemaker leads and abscesses. All 3 patients with central line infections were immunocompromised. Symptoms of SPE include fever, cough, dyspnea and hemoptysis. Positive blood cultures may aid in diagnosis. CXR is often the initial study but is usually non-diagnostic. The use of CT has increased the sensitivity and specificity in diagnosing SPE. If SPE originates from suppurative thrombophlebitis, in addition to antibiotics, surgical resection of the involved vein is the treatment of choice. Hence, in the current medical era where peripheral IV lines are often used, physicians must be cognizant of SPE as a potential complication, especially in immunocompromised patients.

WALKS LIKE SEPSIS, TALKS LIKE SEPSIS, BUT STILL NOT SEPSIS: HEMATOPHAGOCYTIC LYMPHOHISTIOCYTOSIS Asma Khaliq1; Marc Zumberg2; Ge Xiong1; Margaret C. Lo1. 1University of Florida, Gainesville, FL; University of Florida, Gainesville, FL. (Control ID #1321277)

LEARNING OBJECTIVE 1: Distinguish between the clinical and diagnostic features of sepsis versus hematophagocytic lymphohistiocytosis (HLH)

LEARNING OBJECTIVE 2: Recognize the diagnostic need for serial bone marrow assessments (BMA) and close clinicopathologic collaboration in HLHCASE: A 65 year-old, African-American female with rheumatoid arthritis presented as a hospital-to-hospital transfer for fever of unknown origin after 2-weeks of recurrent fever spikes, anorexia, confusion, and hypotension. She failed to respond to vasopressors, broad-spectrum antibiotics, and neupogen for presumed septic shock with neutropenic fever. Addition of micofungin for subsequent candidemia (1 of 4 bottles) provided no clinical benefit. Full body CT revealed no infections. BMA revealed hypercellular marrow, but was otherwise nondiagnostic. Upon transfer, physical examination revealed a cachectic, confused, febrile (103 F) female with severe ulnar deviation of fingers and massive hepatosplenomegaly. Labs demonstrated trilinage pancytopenia (WBC 1,300/mm3, Platelets 10,000/mm3, Hgb 6.9 g/dL), LFT abnormalities (AST 370U/L, ALT 1400U/L, total bilirubin 10 mg/dL, direct bilirubin 7 mg/dL, alkaline phospatase 35 mg/dL), and DIC with hypofibrinogenemia (35 mg/dL). Evaluation for infectious etiologies was negative i.e. pancultures, viral hepatitis, EBV, CMV, HSV, Parvovirus, HIV. Rheumatoid serologies and ceruloplasmin were normal. Ferritin was significantly elevated (71,000 ng/ml). Repeat BMA revealed erythroid-predominant
trilineage hypercellular marrow, without increased blasts or plasma cells, but noted extensive hemophagocytosis. Patient remained refractory to broad-spectrum antibiotics, antifungals, and multiple blood product transfusions. Our differential diagnosis was Feltys syndrome with severe sepsis, large granular lymphocytic leukemia or secondary HLH. Diagnosis of HLH secondary to rheumatoid arthritis was made upon meeting 5 of the 8 diagnostic criteria (fever; splenomegaly; cytopenia 2 cell lines; hypertriglyceridemia; hypofibrinogenemia; ferritin 500 g/l; sCD25 2400 U/ml; decreased/absent NK-cell activity; hemophagocytosis in bone marrow, CSF or lymph nodes). Patient did not respond to IVIG therapy and became critically ill from severe lactic acidosis secondary to bowel ischemia from celiac arterial thrombosis. Family chose palliative care; patient died shortly thereafter. DISCUSSION: This case demonstrates that severe systemic inflammatory response syndrome (SIRS) does not always represent sepsis and can result from noninfectious processes such as HLH. Literature reports many cases of HLH mistakened for sepsis. HLH is a severe immune dysfunction with hypercytokinemia and impaired NK and cytotoxic T-cell hyperfunction causing life-threating tissue damage. Sensitivity of such diagnostic criteria as fever, hypofibrinogenemia, and splenomegaly is <50%. Literature promotes BMA as the optimal test in HLH recognition. Yet, initial BMA maybe false-negative and serial BMA are needed for positive results. Close clinicopathologic collaboration is recommended for diagnostic accuracy. Although many parallels exist in the clinical and pathophysiologic features of HLH and sepsis, the exaggerated immune response of HLH requires the prompt use of immunosuppressants such as IVIG, etoposide, or steroids, per Histiocyte Societys 2004 HLH protocol. Early recognition of the differences between sepsis and HLH is important for optimal patient outcome given the rapidly progressive and drastically different therapy of HLH.

WATCH OUT FOR THE STORM! Bhavana Siddegowda Bangalore; Daniel Gutteridge; Radhika Kakarala; Raj Ethiraj. Mclaren Regional Medical Center, Flint, TN. (Control ID #1339909)
LEARNING OBJECTIVE 1: Recognize the increasing prevalence of electrical storm in the automatic implantable cardioverter-defibrillator (AICD) era.
LEARNING OBJECTIVE 2: Recognize management dilemmas that surround an electrical storm.
CASE: A 49 year old Caucasian female with multiple co-morbidities, arrived with a chief complaint of her AICD firing. It was accompanied by a sudden onset of transient dizziness and mild shortness of breath just before the firing. She had two episodes of appropriate firing in the ER. Pertinent medical history is significant for dialated ischemic cardiomyopathy with systolic heart failure (ejection fraction 20%) status post AICD in 2010, COPD, PAD, CAD with multiple stents. AICD interrogation showed 10 episodes of shocks delivered within 48 hours which were appropriate. Despite antiarrhythmic therapy with intravenous (IV) amiodarone, subsequently combined with procainamide, repeated AICD firing were triggered by episodes of sustained ventricular tachycardia (VT). Coronary angiogram was done which showed patent stents. She was transferred to a university hospital for ablation therapy evaluation due to persistent episodes of sustained VT. However ablation was contra-indicated secondary to left ventricular thrombus and she was ultimately discharged. She was re-admitted due to repeated AICD firing, 23 shocks in 24 hrs, which took place as an outpatient. After two days of persistent arrhythmias and shocks in spite of IV antiarrthymics the patient opted to turn off the AICD and eventually passed away.
DISCUSSION: Electrical storm or defibrillator storm is an emerging phenomenon in the defibrillator era representing a highly lethal cardiac state of recurrent ventricular fibrillation or hemodynamically unstable ventricular tachycardia. In people with defibrillators it is defined as 3 or more appropriate shocks delivered for ventricular arrthymias. Electrical storm has multiple risk factors including acute myocardial ischemia and new or worsening heart failure with a low ejection fraction. It occurs at a rate of 10 to 28 percent during the initial 3 years post defibrillator implantation based upon the definition and population of interest. There are contradictory views about the prognostic value of electrical storm although the AVID and MADIT II trials demonstrate it to be a poor prognostic

factor. There is emerging evidence demonstrating cluster VTs to be a poor prognostic factor. Intracellular calcium overload secondary to recurrent VF and recurrent shocks may be responsible for ineffective defibrillation serving as a trigger for recurrent VF. Treatment options include IV amiodarone +/- procainamide or catheter ablation. Although it has a high incidence and hospitalization rate, awareness among internists remains low. There is a need for increased knowledge about this phenomenon. Whether rapid deterioration of myocardial function due to recurrent shocks actually decreases survival needs to be further studied. The role of an active AICD in patients with a poor prognosis as well as ethical considerations of switching off AICDs in these patients should be considered. The question that remains unanswered is Should we switch off AICDs in patients with electrical storm who have a poor prognosis and end stage heart disease?
WHAT A COUPLE OF JERKS: LANCE-ADAMS SYNDROME Brita Roy. University of Alabama at Birmingham, Birmingham, AL. (Control ID #1339638)
LEARNING OBJECTIVE 1: Recognize an important complication of cerebral anoxia resulting in significant, prolonged morbidity. LEARNING OBJECTIVE 2: Distinguish the difference between myoclonic status epilepticus and Lance-Adams syndrome.
CASE: A 47-year-old white woman presented from home complaining of new onset falls that began two days ago. She had been hospitalized the previous week due to a cardiac arrest secondary to status asthmaticus. Upon discharge from the hospital three days prior, she was walking normally without assistance. However, the

following day she described that she would suddenly lose control of her legs when ambulating, resulting in a fall. She had multiple episodes like this daily, and symptoms worsened over the course of two days preceding presentation. She denied loss of consciousness, seizure-like activity, post-ictal state, headache, chest pain, and dyspnea. Past medical history was significant for asthma, congestive heart failure, and history of non-STelevation myocardial infarction. She denied family history of movement disorders. Home medications included aspirin, moxifloxacin, prednisone, enalapril, and pravastatin. Vital signs, including orthostatics, were normal. Neurologic examination revealed fully intact cranial nerves, myoclonic jerks in all four extremities which limited testing for dysmetria, hyperreflexia throughout with clonus, and no fasciculations. Laboratory evaluation including electrolytes, thyroid panel and cardiac enzymes were normal except for a white blood cell count of 16,000. Electrocardiogram revealed T-wave inversions in lateral leads that were unchanged from previous. CT head showed no abnormalities and recent echocardiogram was normal. She was diagnosed with Lance-Adams syndrome, or post-anoxic myoclonus, and treated with low-dose clonazepam with rapid improvement in symptoms.

DISCUSSION: Lance-Adams syndrome (LAS) is a rare disorder, first described in the 1960s, that presents in survivors of profound hypoxic episodes, similar to our patient. The incidence of this disorder is unknown as the diagnosis is underrecognized, but over 100 cases have been reported. The pathophysiology of LAS is not well understood, but one hypothesis is that anoxia leads to death of Purkinje cells at the fastigial nucleus of the cerebellum, and the subsequent loss of GABA-inhibition of the motor thalamus results in myoclonus. Alternate hypotheses include depression of the serotonergic system. LAS can be difficult to differentiate from myoclonic status epilepticus, but consciousness is undisturbed and electroencephalogram may show spike discharges preceding myclonic jerks by 7-32 milliseconds in patients with LAS. LAS results in significant disability, with uncontrollable myoclonus upon purposeful movement that typically develops days to weeks post anoxic injury, and thus may present during post-hospital discharge clinic visits. LAS is not curable but may be treatable. Clonazepam seems to be the most effective benzodiazepine used to treat LAS. Anti-epileptic agents such as valproic acid, leviteracetam and zonisamide may also be used to control symptoms. If these agents are ineffective, continuous globus pallidus internus stimulation was recently found to be successful.

WHAT IS HIDDEN BEHIND SUDDEN-ONSET ABDOMINAL PAIN? Chiaki Terashima; Michinori Mayama; Naoki Misumida; Naomi Otowa; Mitsunori Iwase. Toyota Memorial Hospital, Toyota, Japan. (Control ID #1323425)

LEARNING OBJECTIVE 1: Identify isolated dissection of the superior mesenteric artery as a possible cause of sudden-onset abdominal pain. LEARNING OBJECTIVE 2: Recognize the clinical features of isolated dissection of the superior mesenteric artery.

CASE: A 46-year-old Japanese-Brazilian man presented to the emergency department complaining of severe epigastric pain. The pain had begun two hours prior to presentation and he could recall the exact time of its onset. The pain was persistent and radiated to the left upper quadrant as well as his back. He denied having nausea, vomiting, or diarrhea. His past history was significant for hypertension, which had been medicated with telmisartan. He did not smoke, had no family history of cardiovascular diseases. His vital signs were normal except for a slightly elevated blood pressure of 140/ 96 mmHg and no differences were noted between the left and the right extremities. On physical examination, his bowel sounds were normal and his abdomen was soft to palpation. He complained of slight epigastric tenderness, but there was no bruit on auscultation and no guarding or rebound tenderness on palpation of the same area. His laboratory tests were unremarkable except for a subtle elevation in white cell count; 10,800/mcL. Other tests, including chest X-ray, EKG, and plain abdominal CT were unremarkable. The sudden-onset nature of his abdominal pain, however, warranted further investigation and contrast-enhanced abdominal CT was ordered. It revealed an intramural hematoma of the superior mesenteric artery (SMA) and no aortic lesions were found. He was diagnosed as having an isolated dissection of the SMA. There was no sign of ischemia so conservative management with hypotensive drugs

was initiated and the patients blood pressure was well controlled. His pain subsided by day three of admission and the clinical course was uneventful. He was discharged from the hospital on day seven without any symptoms.

DISCUSSION: Although isolated dissection of the SMA is uncommon, in recent years, more cases have been reported because of the development of diagnostic imaging technology. Most patients with isolated dissection of the SMA present with sudden-onset abdominal pain in the epigastrium. It is critical to diagnose this condition at an early phase for intestinal ischemia may develop. Mortality rate rises when the patient has intestinal ischemia so it is prudent to consider isolated dissection of the SMA as a possible cause when seeing a patient with sudden-onset abdominal pain. The sudden-onset nature may be the only clue to reach the diagnosis as demonstrated in this case. Fibromuscular dysplasia, atherosclerosis, smoking, and hypertension are some reported risk factors. Typical CT findings include intramural hematoma, intimal flap, and/or enlarged diameter of the SMA. No standard treatment protocol exists for this condition but surgery, stents, and conservative management are currently available options. When the patient presents with signs and symptoms of intestinal ischemia, emergency surgical treatment is essential. Patients put on conservative management usually follow a good clinical course, though clinicians should watch, with extreme caution, for the development of intestinal ischemia.

WHAT? I CANT HEAR YOU! GENETIC SYNDROME PRESENTING WITH UNILATERAL HEARING LOSS

Kathleen M. Buchheit; KatherineT. Johnston. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1339479)

LEARNING OBJECTIVE 1: Explain the primary care evaluation of unilateral hearing lossLEARNING OBJECTIVE 2: Recognize the clinical features of neurofibromatosis type 2CASE: Ms. B is a 30 year-old female without significant past medical history who presents for her annual exam. She reports unilateral hearing impairment for one year. When in loud environments, she cannot hear well in her right ear; sounds are muffled. She denies tinnitus, head trauma, headaches, or visual changes. No vertigo or gait imbalance. As a child she had multiple ear infections requiring tympanostomy tubes bilaterally. She takes an oral contraceptive daily. Remaining history is non-contributory. Complete physical examination was normal. Normal tympanic membranes with tympanostomy tube scar on left. Neurologic exam with hearing intact to whisper and finger rub bilaterally. Weber test non-lateralizing. Rinne test with air conduction greater than bone conduction bilaterally. No plaques or nodules present on skin exam. She was referred for audiogram, which demonstrated right sensorineural hearing loss. MRI head revealed a large

mass extending from right internal auditory canal, most consistent with large vestibular schwannoma and numerous (>10) extra-axial masses, most consistent with meningiomas. A diagnosis of neurofibromatosis type 2 (NF2) was made due to the vestibular schwannoma and multiple meningiomas present. She was referred to neurosurgery for removal of the vestibular schwannoma. Genetic testing for the patient and screening for siblings was advised.

DISCUSSION: Sensorineural hearing loss results from pathologic changes to inner ear structures and may be genetic or acquired from exposure to loud noise, inner ear infections, toxic exposures, or systemic diseases. Patients with sensorineural hearing loss typically have difficulty filtering background noises. The first screening test in primary care practice involves asking the patient about hearing impairment. The whispered voice test is also a useful screening test and patients with positive results should be referred for formal testing. Rinne and Weber tests are not useful as screening tools, but help to distinguish conductive from sensorineural hearing loss, which helps direct further evaluation. Formal audiograms are required for a complete evaluation of hearing loss and should always be performed in patients with unilateral hearing loss. NF2 is caused by an autosomal dominant or de novo mutation predisposing people to nervous system tumor development; thus, family history may not be present. The average age of onset of NF2 is 18 - 24 years. Individuals with NF2 also develop

schwannomas of other cranial and peripheral nerves, meningiomas, and ependymomas. Patients may have visual impairment from cataracts and optic nerve meningiomas. Cutaneous manifestations include hyperpigmented plaque-like lesions and subcutaneous nodules. Following suspected or clinical diagnosis of NF2, the extent of the disease should be evaluated by a head MRI, hearing evaluation, ophthalmo-logic evaluation, and cutaneous exam. Treatment of vestibular schwannoma is primarily surgical. Treatment for hearing loss from vestibular schwannoma includes hearing aids or cochlear or brainstem implants. All affected individuals need coordinated care among their primary care providers, neurologists, neurosurgeons, and genetic counselors. Family members should also be referred for evaluation.

WHATS THE ITIS? UNRESOLVING GASTROINTESTINAL SYMPTOMS IN A YOUNG ADULT Hector R. Perez1; Andrea Porrovecchio2. 1Montefiore Medical Center, Bronx, NY; 2Montefiore Medical Center, Bronx, NY. (Control ID #1338540)

LEARNING OBJECTIVE 1: Recognize the clinical presentation of eosinophilic gastroenteritis.

LEARNING OBJECTIVE 2: Recognize the differential diagnosis of gastroenteritis with a peripheral eosinophilia.

CASE: A 25 year-old woman with an allergy to milk presented with three weeks of severe post-prandial epigastric pain, severe nausea and vomiting, and diarrhea. She had originally presented twice with similar symptoms to an outside hospital in the two weeks prior and was admitted with the inability to tolerate oral intake. An endoscopy was performed before her discharge. Her gastrointestinal symptoms persisted. During the current presentation, her vital signs were normal. She had minimal epigastric tenderness, and her stool guaiac was negative. Her white blood count was 15,000 and her eosinophil count was 4100. A CT scan revealed extensive intraabdominal ascites along with thickening and distention of the small bowel. A paracentesis revealed a cloudy yellow fluid containing 8500 white blood cells with a 94% eosinophilic predominance. Stronglyloides serologies and stool testing for ova and parasites were negative. Serum IgE was elevated to 861 (normal is less than 180). Biopsy results of the endoscopy performed at the outside hospital revealed chronic gastritis, duodenitis, and jejunitis with numerous eosinophils consistent with eosinophilic gastroenteritis. She was started on prednisone and improved clinically.

DISCUSSION: Abdominal pain is a common problem encountered by the internist. A stepwise approach to diagnosing abdominal pain is important, particularly when symptoms fail to resolve after empiric treatment. Eosinophilic gastroenteritis (EG), a rare disease in which eosinophils infiltrate the walls of the gastrointestinal tract, can present with a wide variety of gastrointestinal symptoms depending on the extent of the involvement. Most commonly, it is associated with post-prandial abdominal pain, nausea, vomiting, and diarrhea. Over 50% of patients have histories of allergic disorders. The major laboratory abnormality is a significant peripheral eosinophilia; ascites fluid, if present, also demonstrates significant eosinophilia. In patients with abdominal symptoms and peripheral eosinophilia, the differential includes intestinal parasites and gastrointestinal malignancies. Stool testing and serologies for Strong-lyoides and other parasites should be performed. Endoscopy with biopsy is necessary to make the diagnosis of EG, as a normal appearing mucosa can still harbor significant eosinophilic infiltration. A thorough allergy history and workup should follow once a diagnosis is settled, as food hypersensitivity plays an important but undetermined role in EG pathogenesis. Treatment has not been evaluated in a randomized clinical trial and is limited to case reports. Clinical and histologic remission can occur with a six-week elimination diet. Based on the clinical severity, systemic steroids are often used and have also been shown to lead to remission. Long term data on the natural history of EG is lacking, but most experts consider EG to be a chronic disorder characterized by relapses and remissions. While EG is rare, making the diagnosis requires a high index of suspicion. A timely diagnosis along with treatment can have lasting effects on a patients morbidity and quality of life.

WHEN ANCHOVY PASTE IS UNSAVORY: AMEBIC LIVER ABSCESS IN A YOUNG MAN Mahmuda Islam; Roger D. Smalligan; Md J. Ahmed; Nazrul Chowdhury; James ". Walker. Texas Tech University Health Sciences Center, Amarillo, TX. (Control ID #1332505)

LEARNING OBJECTIVE 1: Diagnose amebic liver abscess. LEARNING OBJECTIVE 2: Recognize the epidemiology of extra-intestinal manifestations of Entamoeba histolytica.
CASE: A 20-year-old male Burmese refugee presented with diffuse, intermittent abdominal pain for two weeks. The pain made him unable to eat solids and he had been drinking only liquids for several days and was losing weight. He denied fever, chills, nausea, vomiting and diarrhea but was having sweats. Past medical history and family history were negative. He smoked 1 pack-per-day of cigarettes and denied alcohol and drug use. Physical exam: BP 106/82, P 110, RR 30, T 98.5, O2 sats 100% on RA. Lungs and heart were normal. Abdomen was tender in the right upper and lower quadrants and there was mild guarding and rigidity. Bowel sounds were normal. Labs: WBC 27.8 k; neutrophils 94.8%; bands 42%; platelets 645,000; INR 1.64, AST 18, ALT 16, alk phos 238; bilirubin 1.2; albumin2.5; total protein 7.7. Abdominal CT showed an 8x8cm hypodense mass in the right lobe of the liver. Aspirate of the abscess showed an anchovy paste like substance with negative Gram, AFB and fungal stains as were bacterial cultures. IgG for Entamoeba histolytica later returned strongly positive with negative antibodies for Echinococcus. Hospital course: Patient was treated with metronidazole and albendazole and he responded well. DISCUSSION: Many cities in the USA participate in the US Refugee Program that facilitates the immigration and resettlement of people from developing or war-torn countries each year (over 50,000 were received in 2011). This influx of people requires internists who treat these patients to broaden their differential diagnoses to include tropical diseases not frequently encountered in this country. Extra-intestinal manifestations of E. histolytica are not common but when they do occur, amebic liver abscess is most common followed by pleuropulmonary, cardiac and brain involvement. Amebic liver abscess can occur after travel exposure as short as four days but the condition is predominantly seen in immigrants from endemic countries. Approximately 3,000 cases are seen annually in the USA with about 10 deaths. For travelers returning from an endemic area, presentation usually occurs within 8 to 20 weeks, although a longer lag time (sometimes years) has been reported. For unclear reasons, amebic liver abscess is 10 times more common in men than women and is rare in children. Clinically, patients generally present with slowly progressive RUQ pain and fever and may have malaise and weight loss like our patient. Hepatomegaly is common (over 50%) and recent diarrhea may be reported in 30% of patients. Leukocytosis and elevated alkaline phosphatase are common though jaundice is uncommon. Diagnosis can be made by ultrasound, CT or MRI. Aspiration can be performed which will yield the anchovy paste type substance with negative stains, in contrast to a pyogenic liver abscess which would show bacteria and neutrophils. Antibodies to E. histolytica are present in over 95% of patients. Treatment is usually successful with metronidazole for 7-14 days, often followed by paramomycin to eliminate intraluminal cysts. Internists must include amebic liver abscess in their differential of RUQ abdominal pain in immigrant patients or travelers to endemic areas.

WHEN HALLUCINATIONS ARE NOT DUE TO DELIRIUM OR PSYCHIATRIC DISEASE: CHARLES BONNET SYNDROME
Taraka V. Gadiraju1; Auras R. Atreya1; Sonali Arora1; Maura J. Brennan1,2.
1Baystate Medical Center/Tufts University School of Medicine, Springfield, MA; 2Baystate Medical Center/Tufts University School of Medicine, Springfield, MA. (Control ID #1334597)
LEARNING OBJECTIVE 1: Distinguish atypical hallucinations in Charles Bonnet Syndrome from those occurring in delirium and psychiatric illnesses.
CASE: A 92 year old man with hypertension had a subacute on chronic worsening of vision. (He had acquired ocular toxoplasmosis 10 yrs prior). He was a retired French teacher with no personal or family history of neuropsychiatric illness. He was well overall but had 3 days of intermittent, complex visual hallucinations which first occurred as he awoke. He saw pink snow that later became red and blue finally turning into smoke. At other times he saw children, a witch, and huge trees. He retained insight and knew these visions were not real. The

hallucinations lasted minutes to hours and occasionally disappeared with an attempt to touch them or by closing his eyes. He did not drink alcohol, had no head trauma and family did not report any cognitive change (except for some difficulty finding his way due to worsening vision). He was attentive and organized in his thought processes. He did not appear ill in any way and denied depression. Cranial nerves were intact (except for poor vision) with no other neurological deficits. His score on the Mini-Mental State Examination (barring those items which require intact eyesight) was perfect. An electroencephalogram and MRI head were unremarkable. In short, he showed no signs of delirium, dementia or depression. A diagnosis of Charles-Bonnet Syndrome (CBS) was made given his classic presentation of advanced age, progressive visual loss and isolated vivid visual hallucinations in the absence of mental illness. He was reassured, his symptoms eased over time and his anxiety about the meaning of the hallucinations abated. DISCUSSION: The classic triad of CBS consists of visual hallucinations, visual impairment of any etiology and intact cognition. Also called visual release hallucinations, CBS was first described by Charles Bonnet in 1769. A decline in eyesight precedes the onset; patients maintain intact reality recognizing the hallucinations are not real. CBS is quite prevalent; approximately 50-60% of those with severe visual loss experience hallucinations. However, it remains under-reported by patients who may fear being labeled as psychiatrically impaired. It is also under-diagnosed by clinicians many of whom are unaware of its existence. CBS is thought to result from disordered neuronal activity between the thalamus and the visual cortex. The broad differential for bizarre hallucinations includes atypical seizures, Lewy Body Dementia, drug withdrawal, delirium, narcolepsy, peduncular hallucinations, psychiatric illness, etc. This patient had an unremarkable EEG, normal brain imaging and no evidence of dementia, depression, delirium or sleep disorders. CBS is usually self-limited; there are no clear treatment recommendations, although various medications, behavioral strategies, and ophthalmologic interventions can be used if symptoms are troubling. Reassurance remains the mainstay of treatment. Physicians must be able to recognize and diagnose CBS. This allows both appropriate reassurance of patients and avoidance of iatrogenic injury from unneeded procedures, hospitalizations and investigations especially in elders. This will also conserve scarce healthcare resources.

WHEN LATENT MAY BECOME FATAL Jonathan Katz1; Jordan Brodsky1; Dahlia Rizk1; Ya Ju Chang1; David Beyda2; Jose A. Cortes1.

1Beth Israel Medical Center, Manhattan Campus of the Albert Einstein College of Medicine, New York, NY; 2University Hospital of Brooklyn at Long Island College Hospital, Brooklyn, NY. (Control ID #1296876)

LEARNING OBJECTIVE 1: Recognize risk factors, signs, symptoms, and potential complications of Strongyloides stercoralis.

LEARNING OBJECTIVE 2: Recognize the importance of diagnosis and treatment of latent as well as active strongyloidiasis in light of the rise in incidence.

CASE: CASE PRESENTATIONS Case 1: 69 yo F Chinese immigrant with rheumatoid arthritis on prednisone and methotrexate presented with weakness, abdominal discomfort, cough, fever and chills. She developed sepsis with bilateral lung opacities. Endoscopic gastric biopsy revealed Strongyloides stercoralis. Case 2: 72 yo M Cuban immigrant with chronic

obstructive pulmonary disease, lumbar plexopathy, and recent exposure to steroids was admitted for increasing dyspnea. He developed sepsis with bilateral interstitial infiltrates and respiratory failure. Bronchoalveolar lavage revealed S. stercoralis. Case 3: 70 yo F Puerto Rican with lupus nephritis and recent initiation of prednisone presented with weakness, anorexia, and rash over the chest and abdomen. The hospital course was complicated by respiratory failure and sepsis. Skin biopsy showed S. stercoralis larvae. Case 4: 45 yo F from China recently diagnosed with lupus nephritis on prednisone and mycophenolate mofetil presented with generalized weakness and progressive dysphagia. She developed sepsis and respiratory failure. Computer tomography (CT) showed bilateral pneumothoraces, pneumomediastinum, pneumoperitoneum, subcutaneous emphysema, and ground-glass opacities. Bronchoscopy revealed diffuse alveolar hemorrhages and multiple filariform larvae consistent with S. stercoralis. Case 5: 56 yo M from Dominican Republic with multiple myeloma

treated with dexamethasone, melphalan, and thalidomide presented with weakness of the lower extremities. After radiation therapy for bone lesions, he developed gastrointestinal complaints and sepsis. CT chest showed extensive ground-glass opacities. Bronchoalveolar lavage showed filariform larvae consistent with S. stercoralis. We describe five cases of patients with hyperinfection originally from endemic regions that were all secondary to immunosupressive agents. All patients were treated with antihelmintics. 3 of the 5 patients did not survive. DISCUSSION: Strongyloides stercoralis, an intestinal nematode, affects 30-100 million people worldwide. While latent or asymptomatic infection is most common, hyperinfection, a rare complication, has a mortality rate reported as high as 85%. The incidence of strongyloidiasis may be rising in developed countries due to globalization, increased use of immunosuppressive therapies, and the prevalence of immunocompromised patients. The presence of sepsis or fever with any level eosinophil count, chronic anorexia, bloating, weakness, skin rash or wheezing, in a patient from an endemic area or undergoing immunosuppression, should prompt testing for S. stercoralis. Practitioners planning on prescribing medicines that will affect immune status must be aware of this potential complication and consider screening prior to starting treatment. In cost effectiveness studies for the treatment of intestinal parasites in immigrants, it was concluded that presumptive administration of albendazole to all immigrants at risk for parasitosis would save lives and money, while screening-based treatment would be less cost effective. Although ivermectin is more effective than albendazole, it is more costly. Consideration should be given to creating guidelines for screening and prophylaxis in high-risk populations.
WHEN A POSITIVE TURNS NEGATIVE: CASE REPORT OF A FALSE POSITIVE CLUSTER IN RAPID HIV TESTING Rachel Zhuk; David C. Thomas; Yasmin S. Meah. Mount Sinai School of Medicine, New York, NY. (Control ID #1317405)
LEARNING OBJECTIVE 1: To report a cluster of false positive oral fluid HIV tests in a primary care clinicLEARNING OBJECTIVE 2: To understand the reliability of rapid HIV testing in light of post-market surveillanceCASE: In 2008, rapid oral fluid HIV testing was introduced at the student-run, attending-directed free clinic of the Mount Sinai School of Medicine. Screening was performed with the OraQuick ADVANCE Rapid HIV-1/2 Antibody Test, a qualitative immunoassay compatible with oral fluid, whole blood or plasma. A cluster of false positive results, however, raised concerns about the validity of the oral test. Patient 1 was a 58-year-old woman with multiple past sexual partners and recent unprotected sexual activity with an abusive partner. Informed consent was obtained and a rapid oral fluid test performed. One student and two attendings perceived a faint pink line in the test zone, considered a preliminary positive. The patient was distressed by the result and considered confronting her recent partner. When blood was drawn for confirmatory testing, two ELISA tests were negative. The patient was notified immediately and noted relief, describing the experience as a wake-up call. Within one week, a second rapid test was positive. Patient 2 was a 50-year-old obese man in a monogamous 5 year relationship with a woman. The test was reactive according to both student and attending. In the following week, the patient

reported significant depression and anxiety. Again, ELISA testing showed the patient to be HIV-negative. DISCUSSION: Though clusters of false positives have been noted, the specificity of Oraquick oral fluid testing is well above the FDA-required 98%, and close to 99.8% premarket specificity (Orasure, 2007). Data from NYC STD Clinics and several large, multi-center prospective studies showed 99.6%-99.8% specificity, with the 95% CI above 98%. Whole blood testing was marginally more specific. (CDC, 2008; Delaney, 2006; Wesolowski, 2006; Zelin, 2008). However, six documented false positive clusters nationally have distressed both patients and providers. While specificity within these clusters generally remained near 98%, it fell to95.9% in one study, with a positive predictive value (PPV) of just 28%. Investigation revealed no connection to test lots, operators, or patient characteristics. Retraining produced no change in false positive rate (CDC, 2008; Delaney, 2006; Wesolowski, 2006; Zelin, 2008; Walensky, 2008; Brown, 2007). A tests PPV significantly impacts the experience of patients and providers. It is difficult to trust a test when, even temporarily, nearly of patients with

positive results do not have HIV. Given the potential for psychological trauma, as well as the risk of compromising trust between patient and provider, our clinic emulated NYC STD Clinics and discontinued oral fluid testing. Instead, whole blood testing from fingersticks was adopted for its higher specificity. Our clinic remains committed to rapid testing which increases both testing rate and percentage of patients who receive their results (Hutchinson 2006). Test completion rates were similar between fingerstick and oral fluid testing in a randomized study, and in our clinic, patient refusal rates have declined since implementing fingerstick testing (Spielberg, 2005; Stephens 2010). This simple change in testing protocol has allowed us to continue providing HIV testing to our uninsured population while diminishing test-related anxiety.

WHEN THE END OF LIFE COMES TOO CLOSE TO THE BEGINNING: CARE OF A TERMINALLY ILL YOUNG ADULT PATIENT Aaron D. Losey1; Gene R. Quinn2; James A. Thomas2.
1University of California, San Francisco, San Francisco, CA; 2University of California, San Francisco, San Francisco, CA. (Control ID #1335106)

LEARNING OBJECTIVE 1: Describe the clinical presentation, prognosis, and treatment options for anaplastic thyroid carcinoma.

LEARNING OBJECTIVE 2: Recognize the unique challenges of end-of-life care in critically ill young adults.

CASE: A 25-year-old single mother with anaplastic thyroid cancer metastatic to the lungs and mediastinum presented with two weeks of progressively worsening shortness of breath, orthopnea, and pleuritic chest pain. On exam she was noted to have an oxygen saturation of 80% on room air, bilateral severely decreased lung sounds, and was in respiratory distress. A CT scan revealed the bilateral lungs largely replaced with tumor, compressing the bronchi. She was placed on high flow oxygen and admitted to the intensive care unit for respiratory care. The patient had been in good health until a year and half prior to admission when she presented with a rapidly enlarging neck mass. After pathology showed anaplastic carcinoma, she underwent total thyroidectomy and subsequent extensive neck dissection. Multiple cycles of radiation and chemotherapy were attempted, all with continued progression of her disease. She was enrolling in a phase I clinical trial at the time of admission. Despite aggressive respiratory therapy, the patient continued to have increasing oxygen requirements and work of breathing. After consultation with multiple subspecialty services, no further treatment options could be identified. The patient expressed her wishes not to be intubated if there was no foreseeable possibility of extubation. Child life services were contacted and worked with the patients three-year-old daughter to say goodbye. Our social worker helped the patient document her wishes for her daughters guardianship. In consultation with palliative care medicine, comfort care measures were initiated for her dyspnea. She passed away peacefully on hospital day four with her family present. The patients final wish was for others to learn from her case.

DISCUSSION: Anaplastic thyroid carcinoma (ATC) is a rare, rapidly progressive tumor with a median survival of less than 6 months. Patients typically present with a rapidly enlarging neck mass and receive the diagnosis after pathology reveals poorly differentiated cells. Metastases are present in 50%
of patients at the time of diagnosis. Surgery in combination with radiation and chemotherapy is the preferred treatment for resectable tumors. For metastatic disease, the treatment is palliative. Caring for young patients at the end of life presents unique challenges for providers. Young adults are more likely to receive aggressive care with the goal of cure at the end-of-life and die in the intensive care unit than their older counterparts. Physicians must learn when to shift focus to ensure proper palliative care and ease suffering. Physicians must initiate and facilitate difficult conversations with young patients and their families. For parents with young children, the overriding concern at the end-of-life is usually about the impact of their death on their children. A multidisciplinary team including social workers, psychologists, child life specialists and chaplains is vital. Provider reflection and formal debriefing is also important for ensuring physician well-being. Strategies for shifting focus to palliation, ensuring physician well-being during tragedy, and comprehensive end-of-life care for young patients will be presented.

WHEN THE PHYSICAL EXAM TELLS MORE THAN THE LABORATORY RESULTS. Maggie K. Benson; Peggy Hasley. University of Pittsburgh Medical Center, Pittsburgh, PA. (Control ID #1338317)
LEARNING OBJECTIVE 1: Recognize the importance of the cardiovascular exam during an evaluation of abdominal pain.
LEARNING OBJECTIVE 2: Discuss the advantages and disadvantages of treatment options for malignant pericardial effusion.
CASE: A 57 year old man with a history of tobacco abuse presented to the emergency department with one day of progressive dyspnea on exertion and vague right upper quadrant abdominal pain. He denied experiencing fevers, weight loss, cough or chest pain. His AST and ALT were mildly elevated, alkaline phosphatase was normal and abdominal ultrasound showed pericholecystic fluid and thickening of the gallbladder wall. He underwent emergent cholecystectomy during which his liver appeared congested. The next morning, he had acute liver injury with AST and ALT in the 3000s, prompting his transfer to a tertiary care center. On arrival, his exam revealed tachycardia, an elevated jugular venous pressure, >10 mmHg drop in blood pressure with inspiration, and a hepatojugular reflex. A CT scan of the chest revealed a moderate pericardial effusion, a 1.9 x 2.7 cm spiculated right upper lobe lung mass and heterogenous liver enhancement. An echocardiogram confirmed the presence of a pericardial effusion with diastolic collapse of the right ventricular free wall, consistent with cardiac tamponade. An emergent pericardiocentesis was performed with drainage of 900 mL of fluid. Cytology was positive for malignant cells, non small cell lung cancer type. He had continued drainage from his pericardiocentesis catheter, so pericardial sclerosis with doxycycline was attempted, but unsuccessful. He ultimately required placement of a pericardial window. His liver function gradually returned to normal, and he was discharged with plans for systemic chemotherapy. DISCUSSION: Pericardial effusions are present in up to 20% of patients with malignancy. Although malignant pericardial effusions (MPE) more commonly present with gradual accumulation of fluid and slowly progressive dyspnea, the presentation can be more dramatic with acute tamponade physiology. Approximately 80% of MPEs occur in the setting of lung cancer, breast cancer or hematologic malignancy. Malignant cells invade the pericardium through either direct or hematogenous spread. The presence of malignant cells in the pericardial fluid is a poor prognostic indicator. A careful history and focused physical examination are key in the diagnosis of cardiac tamponade. The sensitivity of dyspnea, tachycardia, elevated jugular venous pressure and pulsus paradoxus>10 mmHg are all greater than 75% and should increase suspicion for tamponade. Mild transaminase elevation and right upper quadrant abdominal pain in the setting of other signs of heart failure may be an indication of congestive hepatopathy. The hepatojugular reflex has a specificity of 93-96% and thereby helps to rule in right heart dysfunction. The management of MPE presents a challenge for internists. Pericardiocentesis can be performed emergently, with low complication rate, and provide immediate relief of symptoms, however recurrence rates are high. Various sclerosing agents instilled into the pericardium have been effective in preventing effusion reaccumulation, but have variable side effect profiles. Finally, surgical intervention with subxiphoid pericardial window, thoracoscopy with pericardiopleural window or thoracot-

omy with pericardiectomy are effective, although more invasive and must take into consideration overall prognosis and goals of care.
WHEN THERES MORE THAN MEETS THE EYE: NOT YOUR TYPICAL FUNGAL INFECTION. Nadia N. Amin; Hilit F. Mechaber. University of Miami, Miami, FL. (Control ID #1339691)
LEARNING OBJECTIVE 1: Differentiate between malignant and benign dermatologic lesions of the genital area in elderly patients LEARNING OBJECTIVE 2: Recognize Extramammary Pagets disease as a marker of malignancyCASE: 64 y/o Nicaraguan male with a history of rheumatoid arthritis, HTN, BPH, osteoporosis

presents to the clinic with an erythematous, pruitic rash of the genital area. He notes that it has been worsening over the past few days, which he attributed to the hot humid weather. He has not tried any over the counter medication and is concerned with potential interactions with his current RA therapy. On physical exam the intertrigenious folds were erythematous with some flaking of the skin that extended onto the upper thigh. Pt was treated for a case of presumptive tinea cruris with clotrimazole cream but there was incomplete resolution, so he was referred to dermatology for further evaluation. Pt was diagnosed with lichen simplex chronicus and started on clobetasol and ketoconazole. Pt used the clobetasol and ketoconazole for approximately one month with minimal resolution of symptoms, so a shave biopsy was done and patient was tentatively treated with zinc oxide for possible irritation dermatitis. The biopsy results showed extramammary Pagets disease and the patient underwent a full evaluation for possible malignancy.
DISCUSSION: Extramammary Pagets disease (EMPD) is a rare, cutaneous adenocarcinoma that affects mainly elderly, Caucasian females. EMPD usually presents with an exquisitely pruitic lesion in the vulva, perianal, perineal, scrotal or penile region but it can appear in any apocrine gland containing site. Approximately 25% of cases of EMPD are associated with neoplastic disease such as colorectal cancer, bladder carcinoma, prostate carcinoma, and various uterine malignancies. EMPD is often misdiagnosed due to its nonspecific findings, with an average time to biopsy of approximately 1 year. Of note, the site of the EMPD can give an indication to the type of malignancy as scrotal lesions had a greater incidence of genitourinary malignancies and perianal lesions had a greater incidence of gastrointestinal malignancies. EMPD is particularly important for the primary care provider to identify as it may be a marker for malignancy, and its diagnosis is often delayed. After an underlying malignancy has been fully investigated, primary EMPD limited to the dermis can be treated with an immunomodulator, Imiquimod, for 12 weeks. Mohs surgery and radiation therapy have also been used.
WHO IS THE FIRST VICTIM - THE LUNG OR THE KIDNEY? Kurt J. Pfeifer; Sana S. Gafoor. Medical College of Wisconsin, Wauwatosa, WI. (Control ID #1338417)
LEARNING OBJECTIVE 1: Recognize microscopic polyangitis (MPA) as a key differential diagnosis in patients presenting with pulmonary-renal syndrome.
LEARNING OBJECTIVE 2: Diagnose and treat MPA early to reduce remission rates and improve overall mortality.
CASE: A 65-year-old woman with a history of nonspecific interstitial pneumonitis (NSIP), diabetes mellitus, and hypertension presented with the chief complaint of fatigue. The patient was on chronic steroid therapy for the past five years for her NSIP, but her steroid therapy was stopped three months prior to the start of her symptoms due to stabilization of her disease. She was transferred from an outside facility after her initial evaluation revealed new laboratory findings of a microcytic anemia (hemoglobin 6.0 g/dl) and azotemia with a creatinine of 7.23 mg/dl. Her associated symptoms included lower extremity myalgias, shortness of breath, and a dry cough over the last four weeks. Significant physical exam findings included bibasilar lung crackles and a 2/6 ejection murmur in the aortic area. She had no clear signs of uremia, rashes, or musculoskeletal findings. Urinalysis revealed 2+ blood and protein in addition to numerous granular casts, waxy casts, and dysmorphic red blood cells. Renal biopsy
revealed a myeloperoxidase antibody-positive (p-ANCA) necrotizing crescenteric glomerulonephritis. The patient was given IV methylprednisolone for 3 days and then transitioned to oral prednisone. Given the histological findings, absence of granulomas, and p-ANCA positivity, a working diagnosis of MPA was given. The patient was continued on immunosuppressive therapy with oral prednisone and monthly cyclophosphamide. By time of discharge, the patients shortness of breath had improved and her renal function had stabilized.
DISCUSSION: MPA typically presents as a systemic necrotizing vasculitis with few or no immune complexes that mainly affects small vessels. The affected vessel caliber and absence of granulomatous inflammation are key differentiating features from polyarteritis nodosa and Granulomatosis with Polyangiitis respectively. As in

the discussed patient, renal manifestations are the most predominant feature of MPA. In our patient, it is not clear if the steroid responsive NSIP was the initial presentation of the disease process or if the chronic steroid therapy prevented progression of an undiagnosed MPA. Further research of the patients records revealed that she had been found to have a positive p-ANCA serology in the past. Combined therapy with high-dose steroids and cyclophosphamide is the first-line treatment of MPA. Earlier diagnosis may help prevent further progression of renal disease and decrease the potential for requiring renal replacement therapy. MPA should be a consideration in the differential diagnosis of any pulmonary-renal syndrome since tailored therapy has been shown to decrease disease relapse rates and mortality.

WHOLE LOTTA SHAKIN GOING ON Aimee Aysenne. Tulane University Health Sciences Center, New Orleans, LA. (Control ID #1340495)

LEARNING OBJECTIVE 1: 1. Recognize neurological symptoms associated with Acute Human Immunodefiency Virus (HIV) infections. 2. Identify the association of acute HIV meningitis and myoclonus. 3. Understand how to interpret the results of cerebral spinal fluid (CSF) in HIV patients.

CASE: A 33 year-old woman presented with five hours of abnormal and uncontrollable movements of her legs. The movements began with spontaneously with jerking, then facial twitching and grunting began. Each episode lasted about one minute, occurring every fifteen minutes; she was asymptomatic between episodes. She had been to another hospital prior to this admission, at which time a head CT was found to be normal; she was sent home on diazepam and ibuprofen. On this admission, she was found to have a flaccid paresis of the lower extremities and hyperreflexia. During one of the episodes, she was tachycardic with symmetric non-rhythmic movements of her legs and increased tone in both arms. Also noted was twitching of the face symmetrically and loud grunting; she was unable to follow verbal commands. A lactic acid level was 3.9 mmol/L, and a creatine kinase was 8,000 IU/L. The remainder of her laboratory values were normal. She developed a fever and acute kidney injury. The episodes worsened: occurring more frequently, involving the face, arms and legs, increasing heart rate to 200 beats per minute during the episodes and including hypoxic which required positive pressure ventilation. Brain imaging remained normal. The CSF had 26 leukocytes per L with 92% lymphocytes and a protein level of 76.8 mg/dl. All cultures were negative. An HIV test was reactive with a viral load of 1,500,000-copies/ mL and a CD4 count of 408 cells per L. The diagnosis of acute HIV syndrome associated with myoclonus was made. She treated with levetiracetam, clonazepam and anti-retroviral therapy, with subsequent improvement of the symptoms. DISCUSSION: It is important for the general internist to recognize the neurologic manifestations of acute HIV syndrome. Common symptoms include meningitis, encephalitis, polyradiculoneuritis, and peripheral mono-neuritis. Primary symptomatic infection (PSI) with HIV occurs two to six weeks after infection and lasts one to two weeks. The initial phase of viral replication occurs systemically, meningeal or both. CSF pleocytosis with lymphocytic predominance and elevated levels of several soluble immuno-logical markers can be found in acute HIV. Patients are typically asymptomatic. Generally, CSF HIV infection responds well to anti-retroviral therapy. The relative rates of viral decay in the serum and CSF may differ in some patients, with HIV viral concentrations falling more slowly in the CSF than in serum. Mild mononuclear pleocytosis is common in untreated,

asymptomatic HIV infected individuals with blood CD4 counts greater than 50 cells per L. Meningitis should be suspected and investigated when CSF cell counts are greater than 20 cells per L in untreated HIV patients, CSF cell counts are greater than 5 cells per L in patients with blood CD4 counts less than 50 cells per L, or CSF cell counts are greater than 5 cells per L in patients taking anti-retroviral therapy regardless of serum HIV viral load and CD4 count. While this is an unusual case, the general internist should be aware of neurologic presentations of acute HIV syndrome and be able to interpret the CSF analysis in HIV infected patients.

WHOOPS! PERTUSSIS AFTER VACCINATION FAILURE TorreyR. Schmidt; Richard Alweis; Gaurav Gulati. Reading Hospital and Medical Center, West Reading, PA. (Control ID #1304413)

LEARNING OBJECTIVE 1: Vaccinations vary in efficacy rate, with pertussis being 92% effective.
LEARNING OBJECTIVE 2: Pertussis should be considered in a coughing case lasting longer than 5 days, despite the lack of the classic "whoop."
CASE: A 43 year old otherwise healthy male presented to the Emergency Department (ED) with continued shortness of breath and a two week history of low grade fever and non-productive cough without whoop. The patient had received Tdap vaccination a year prior. He had previously been seen twice in his primary care providers office with these complaints and an initial sore throat. After his first visit, he was thought to have a viral URI and given supportive care. On day 7, he was placed on prednisone and albuterol for putative bronchospastic complications manifesting as occasional wheezing. His symptoms failed to improve requiring admission for further management. He complained of dyspnea at rest and on exertion but denied hemoptysis or chest pain. His exam was notable for hypoxia (85% on Room Air) with dry rales and end-expiratory wheezing, without respiratory distress. Routine labwork was unremarkable; chest radiograph and CT scan did not demonstrate signs of infection. Because of the lack of specific findings, prolonged symptoms and significant hypoxia, atypical infections were considered. Serology for mycoplasma, chlamydia and Bordetella were sent. Bordetella IgM and IgG titers were significantly elevated, indicating a vaccine failure. He was successfully treated with azithromycin.
DISCUSSION: Despite advancements in vaccination, cases of pertussis are still seen sporadically in the adult population. This has led to the original recommendation for a Tdap booster between the ages of 19 to 64 and now also after age 65. The Acellular Pertussis Vaccine Trial (APERT) was a multi-center, double blinded, controlled study that demonstrated Tdap efficacy to be 92%, although many providers assume this number to be higher. In this case, despite a recent well-publicized outbreak less than 20 miles away, providers did not consider a vaccination failure due to this assumption, resulting in significant morbidity requiring hospitalization. Therefore, although rare, pertussis vaccination failure does occur, and should be considered in the workup for a coughing illness lasting more than 5 days, even without the classic whoop.

WILSONS DISEASE WITH NORMAL LIVER FUNCTION AND LOW COPPER LEVELS: AN UNCOMMON PRESENTATION Gaurav Gulati; Shuchi Gulati; Hai P. Nguyen. The Reading Hospital and Medical Center, West Reading, PA. (Control ID #1338991)
LEARNING OBJECTIVE 1: Diagnose Wilsons disease in a patient with normal liver function and low serum copper.
LEARNING OBJECTIVE 2: Recognize Wilsons disease in young patients presenting with Parkinsonian features.
CASE: A 24 year old previously healthy female was hospitalized with recurrent numbness and headaches accompanied by Parkinsonian symptoms (tremors, slurred speech and drooling with difficulty swallowing). She had a significant family history of psychiatric illnesses in her mother and sister. Physical exam was notable only for mild dysarthria and subjective weakness on the left side. Initial laboratory data including a CBC, basic metabolic panel, liver function tests, thyroid function, ESR, CRP, Lyme PCR, HIV and RPR/VDRL were all negative. She had a normal CSF exam with negative paraneoplastic panel, IgG index, viral studies and cryptococcal antigen. Urinalysis was unremarkable and urine drug screen unrevealing. Autoimmune workup including ANA and rheumatoid factor was negative. A CT scan of the head revealed abnormal, symmetric, diffuse hypo-densities of bilateral basal ganglia. An MRI to further evaluate the soft tissue abnormalities showed increased T2 signal within the right and left lenticular nucleus. A heavy metal screen was ordered. Arsenic, mercury, lead, cadmium and copper levels were all low. Given the high index of suspicion a ceruloplasmin level was ordered which was extremely low at 3.1 mg/dL (normal: 14 - 78 mg/dL). A liver biopsy showed mild chronic active hepatitis grade 2, septal fibrosis stage 3 and retained copper within hepatocytes, confirming a diagnosis of Wilsons disease. An ophthalmologic exam under slit lamp showed clear Kayser-Fleischer (KF) rings. She was started on trientine and zinc, and over subsequent follow up her KF rings

disappeared and neurological symptoms showed modest improvement.
DISCUSSION: Hepatolenticular degeneration (Wilsons disease) is an autosomal recessive defect in copper export with a prevalence rate of one in 30,000 live births. It is caused by reduced biliary excretion of Copper leading to its buildup in the liver, subsequently progressing to other organs. Diagnosis is based on clinical presentation combined with physical, biochemical and histologic findings. Neurologic disease (present in 35 percent patients) includes Parkinsonian tremor, rigidity and clumsiness of gait, speech problems and drooling. Ten percent patients exhibit psychiatric symptoms varying from subtle personality changes to overt depression, catatonia and paranoia. Serum amino-transferases are usually elevated, but their severity does not correlate with histologic hepatic injury. Total body copper levels are elevated, but serum levels may be low in patients with low ceruloplasmin levels. In the presence of only neurological symptoms with normal liver function and low copper levels, a slit lamp exam to look for KF rings should be considered. If positive, it strongly suggests Wilsons disease. A liver biopsy may be required for further confirmation of the diagnosis.
WITHOUT A TARGET: UNDERSTANDING ATYPICAL PRESENTATIONS OF LYME DISEASE Bethany J. Hyduke; Robert Krippendorf; Kurt J. Pfeifer. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1337133)
LEARNING OBJECTIVE 1: Recognize nonspecific array of symptoms as manifestations of disseminated Lyme diseaseLEARNING OBJECTIVE 2: Treatment of Lyme disease once it reaches the CNSCASE: A 75 year old male presented with a 3-week history of weakness, low back pain, upper extremity tremors and double vision. As a result of these symptoms, he reported having difficulty writing, dialing phone numbers and reading. His daughter also observed word-finding difficulty and a weight loss of 20 pounds over several weeks. The patient attributed this to decreased appetite, dysphagia and odynophagia. Prior to the onset of these symptoms, the patient was very active, including working as a substitute teacher. He denied possible ingestions of toxins, inappropriate use of medications, recent travel and insect or tick bites. The patients neurologic exam was significant for decreased reflexes throughout his extremities but normal muscle tone, bulk and power. He had a positive Romberg test, intention tremor with finger-to-nose testing, delayed rapid alternating hand movements on his left side and a wide-based gait. He also had vertical diplopia with leftward gaze and scored only 13 out of 30 on Montreal cognitive assessment. Brain MRI was significant for slightly prominent ventriculomegaly and global volume loss. He underwent lumbar puncture, and cerebrospinal fluid (CSF) analysis revealed elevated protein, elevated leukocyte count, normal glucose, negative cytology, and negative gram stain and culture. Subsequent MRI of his lumbar spine revealed diffuse leptomeningeal enhancement along the visualized lower cord, conus and cauda equina. Eventually, CSF Lyme serologies returned positive for IgG and were confirmed by western blot. The patient was treated with a 2-week course of ceftriaxone and was improved at the end of his therapy. He was still experiencing achy low back pain and parethesias in his upper extremeties. However, his cognitive function was improved on his follow up mental status exam.

DISCUSSION: Lyme disease is the most common tick-borne disease in the United States and Europe. The most common clinical manifestation is the classic target lesion of erythema migrans, which develops 7 to 14 days after tick detachment. Patients also present without erythema migrans with nonspecific complaints such as headache, arthralgias, fatigue, cognitive slowing and memory difficulty. The more serious clinical sequelae of Lyme disease develop as a consequence of the hematogenous spread of the spirochete. Approximately 10 percent of patients with erythema migrans who go untreated will have a neurologic manifestation, such as trigeminal neuralgia, facial nerve palsy, meningitis or encephalopathy. Lyme encephalomyelitis is a rare observation that occurs when inflammatory appearing parenchymal abnormalities appear in the brain or spinal cord. Randomized trials have shown that doxycycline, amoxicillin and cefuroxime are effective oral treatments

for Lyme disease. Those patients who have evidence of disseminated infection, including neurologic manifestations or Lyme carditis, might be considered for parenteral antibiotics. Prevention of tick bites by using repellants and keeping skin covered as much as possible are the most effective ways of avoiding transmission.
WORKING UP RIGIDITY: KEEPING THE DIAGNOSIS FLEXIBLE Prameela Rao; Coral Parikh; Andrea Porrovecchio. Montefiore Medical Center, Bronx, NY. (Control ID #1336499)
LEARNING OBJECTIVE 1: Review the natural history and differential diagnosis of ParkinsonismCASE: An 81 year old female presented with three months of progressive bilateral lower extremity weakness and stiffness.She was fully functional prior to the onset of a slow gait and neck stiffness. Two weeks prior to admission, her walking was characterized as locking.One week prior, her upper extremities, neck, and shoulder girdle were involved. She was bradyphrenic with a masked face, but with normal mental status.Strength was 3/5. She had severe rigidity of all extremities.There was increased tone in all muscle groups, but no tremors or clonus. Her sensory exam was normal. She was unable to stand. TFTs and CPK were normal and an LP was negative. Since extensive brain imaging was normal, a paraneoplastic process was on the differential, but a malignancy workup was negative. EMG showed continuous motor unit activity which is seen in Stiff Person Syndrome(SPS). Anti-glutamic acid decarboxylase (GAD) antibodies were not elevated. An empiric trial of high dose steroids was initiated, followed by IVIG therapy resulting in some increased mobility.
DISCUSSION: Rigidity is a common ailment amongst the elderly. Neurologic conditions can present with stiffness and result in gait abnormalities therefore internists should be cognizant of the natural history of these conditions. Due to the patients age and symptoms, Parkinsons disease, a movement disorder occurring in 2.5 percent of patients over the age of 80, was initially considered. Parkinsons disease comprises 75% of all cases of Parkinsonism, which is diagnosed clinically in those with signs of bradykinesia, rigidity, resting tremor, shuffling gait, and postural instability. The rapid progression and symmetric nature of her presentation makes Parkinsons disease far less likely. Primary neurological disorders such as progressive supranuclear palsy (PSP) or Lewy body dementia can also present with Parkinsonism. PSP is characterized by gait impairment, early falls, bulbar abnormalities, and anti-NMDA antibodies, which were negative in our patient. Lewy body dementia is characterized by visual hallucinations and onset of dementia within one year of Parkinsonism. The acuity of her symptoms and intact cognition argue against these diseases. Secondary Parkinsonism can be seen in paraneoplastic syndromes,; associated malignancies include: small cell lung cancer, breast, ovarian, testicular, thymoma and Hodgkins lymphoma. SPS is characterized by progressive muscle stiffness and muscle rigidity. Presentation of SPS is usually between the third and fifth decades of life, and equal amongst the sexes. Symmetric rigidity and stiffness begin in the axial muscle groups and progress proximally. Sixty percent of patients are found to have anti-GAD antibodies in the CSF and serum. These antibodies are found to inhibit GABA-ergic nerve terminals in the CNS, a similar effect produced by the tetanus toxin. Anti-GAD antibodies are familiar to the internist due to their new role in identifying type 1 diabetics. The presence of these antibodies in both SPS and type 1 diabetes supports the hypothesis that SPS is an autoimmune phenomenon. Most diseases associated with Parkinsonism are diagnosed clinically, therefore variations from the
expected time course should alert physicians to be more flexible in their diagnoses.
YET ANOTHER PATIENT WITH DYSPNEA! ANCA NEGATIVE PAUCI IMMUNE GLOMERULONEPHRITIS - A CASE REPORT Chitra Srinivasan. Saint Francis Hospital, Evanston, IL. (Control ID #1340476)
LEARNING OBJECTIVE 1: Pauci immune crescentic glomerulonephritis is a common cause of rapidly progressive glomerulonephritis. In a majority of patients, it is a manifestation of ANCA associated vasculitis. However, ANCA can be absent in a subset of patients.
CASE: 83 y/o male presented to the emergency room with a 3 day history of shortness of breath. He also complained of fatigue and loss of appetite for the last 2 weeks. Past medical history was significant for hypertension and sick sinus syndrome. Physical exam revealed bilateral crackles at the lung bases and trace pedal edema. Laboratory examination showed BUN -71, Creatinine - 4.8 (0.8 one month ago), Potassium - 6

and Hemoglobin -8.9. Chest X ray revealed bilateral pulmonary congestion. Patient was administered intravenous furosemide and kayexalate with some improvement in symptoms. Urinanalysis was positive for proteins, blood and eosinophils. A renal ultrasound showed normal sized kidneys with increased corticomedullary differentiation. Serological tests showed a positive ANA (SS/B in a titer of 2.5). ANCA was negative. C 3 levels were slightly decreased and C4 levels were normal. SPEP and hepatitis panel were negative. Hemodialysis was initiated due to worsening renal function. A renal biopsy showed focal segmental necrotizing crescentic glomerulonephritis. There was severe interstitial fibrosis and tubular atrophy. Acute interstitial nephritis with eosinophilic infiltration was also seen involving 25% of the cortex. Immunoglobulin deposits were absent. A diagnosis of ANCA negative pauci immune crescentic glomerulonephritis was made. He was started on immunosuppressive therapy with prednisone and cyclophosphamide.
DISCUSSION: ANCA negative pauci immune glomerulonephritis accounts for less than 5% of cases of rapidly progressive glomerulonephritis. Patients can present with acute onset of macroscopic hematuria, decreased urine output and edema. Alternatively, onset can be insidious with initial symptoms being just fatigue or edema. Early and accurate diagnosis with serologic testing and renal biopsy is essential to initiate appropriate therapy and prevent progression to irreversible renal failure. Renal biopsy typically shows a focal necrotizing and crescentic glomerulonephritis with little or no glomerular staining for immunoglobulins by immunofluorescence microscopy. As with ANCA positive vasculitis, treatment involves induction therapy with intravenous methylprednisone and cyclophosphamide followed by oral prednisone and cyclophosphamide for six to nine months. Azathioprine is used to maintain remission.
ZOSTER RASH MANIFESTING WITH ENCEPHALITIS AND PARESIS Jennifer C. Fuller1; Vinhfield X. Ta2; Suzanne Donovan2.
1David Geffen School of Medicine at UCLA, Los Angeles, CA; 2Olive View-UCLA Medical Center, Sylmar, CA. (Control ID #1339929)
LEARNING OBJECTIVE 1: Recognize that encephalitis and segmental motor paresis are rare but serious complications of varicella zoster virus (VZV) in an immunocompetent adult with typical zoster rash.
CASE: A 63-year-old diabetic man presented with a subacute onset of right lower extremity weakness over four days and one day of confusion and word-finding difficulty. He had a mild headache, but denied fever, neck stiffness, dizziness, loss of consciousness, back pain, or incontinence. He also complained of tingling pain on his right lateral leg. History was negative for recent trauma, animal or insect bites, travel, and tobacco, alcohol or other drugs. The patient was found to be febrile to 38.8 C, tachycardic and mildly hypertensive. He had no meningismus or lymphadenopathy. On neurological exam, he was alert and oriented with fluent speech, but slowed mentation, inability to follow 3-step commands, 0/3 delayed recall, instability on standing, and a right foot drop that worsened from 4/5 to 1/5 during hospitalization. A few small red papules were initially noted on the dorsum of the right foot, which evolved over a day to form many scattered non-tender,

non-pruritic, blanching erythematous macules with 1-2 mm pustules in the L5 distribution. An initial workup for infection and stroke was unrevealing, with the absence of peripheral leukocytosis, blood or urine culture growth, and brain CT or MRI findings. However, lumbar puncture revealed elevated cerebral spinal fluid (CSF) protein, normal glucose, monocytic pleocytosis, and negative Gram and India ink stains. While awaiting further studies, acyclovir, ceftriaxone, and fluconazole were empirically started. Two days later, VZV polymerase chain reaction (PCR) of the CSF and VZV total antibody returned positive. Skin biopsy of the right leg rash was also consistent with VZV. The patient completed a 14-day course of IV acyclovir. Over this time, his mental status quickly returned to baseline, the pustular rash crusted over, and the right foot drop persisted, although the patient was able to walk with physical therapy.
DISCUSSION: This case illustrates rare but important complications of herpes zoster reactivation. Our patient presented with altered mental status secondary to encephalitis and focal motor weakness prior to the typical

cutaneous and sensory signs. Segmental motor paresis, seen in 3-5% of cases, occurs in the same distribution as the cutaneous eruption due to spread of VZV from the dorsal root ganglion to the anterior root or horn, most commonly affecting C5-C7 or L1-L4, within 2 weeks of skin findings. Rarely, as in this case with L4-5 motor and L5 cutaneous involvement, weakness may precede the rash. Importantly, complete or partial motor recovery is seen in 75% but may take up to 1-2 years. Another uncommon complication in our patient was VZV encephalitis. This is believed to result from a vasculopathy and most commonly occurs in immunocompromised patients, but can also affect immunocompetent adults. Most cases are seen with cranial nerve or cervical involvement, making this case unique. As in this case, 80% of cases have normal neuroimaging and typical CSF findings include moderate pleocytosis (52% lymphocyte- and 26% monocyte-predominant), elevated protein, and normal glucose. CSF PCR is a rapid and sensitive means of diagnosis. Mortality is 5-10% and 10-20% have long-term sequelae. Vaccination can prevent shingles and its potential complications, and is currently recommended for adults aged 60 and over.

RAPIDLY PROGRESSIVE DEMENTIA: SOMETIMES IT IS A ZEBRA Jennifer L. Neville; Carl Fichtenbaum. University of Cincinnati, Cincinnati, OH. (Control ID #1312807)

LEARNING OBJECTIVE 1: To describe the salient features and differential diagnosis of encephalitis.

LEARNING OBJECTIVE 2: To define clinical evaluation for encephalopathy and Creutzfeldt-Jakob Disease.

CASE: A 54 year-old white male with diabetes mellitus and hyperlipidemia presented with right-sided weakness, dizziness, and shortness of breath. On the morning of admission he developed numbness and weakness on his right side with a foot drop that resolved prior to presentation. The history obtained from the family revealed a functional status decline over the past several months. They described increasing confusion, memory loss, ataxia, tremors, occasional double vision, tinnitus, decreased appetite, dysphagia, choking on food, frequent throat clearing, sixty pound weight loss over the past three to four months, insomnia, sleep talking, and odd jerking movements while asleep. Prior to the onset of symptoms, the patient was highly functional. He had a history of significant alcohol intake for 30 years (six beers/day) but had quit 4 months prior to presentation. Prior ambulatory evaluation by a neurologist suggested a possible diagnosis of Frontal Lobe Parkinsons and treated with rivastigmine. A family medical history was significant for a maternal grandfather with early onset Alzheimers disease and his paternal grandmother was diagnosed with Alzheimers disease in her seventies.

DISCUSSION: The hallmark presentation for CJD is a rapidly progressive dementia with myoclonus. The incidence in the United States is one case per million person-years. Mental decline presents as dementia with behavioral abnormalities, and deficits involving higher cortical function. Mood changes such as apathy and depression are more common where as emotional lability and anxiety are less frequent. Extrapyramidal signs, cerebellar manifestations, and corticospinal tract involvement can develop. Brain biopsy is the gold standard test for CJD. The WHO criteria for the
diagnosis of CJD include MRI and/or EEG abnormalities consistent with CJD, CSF protein studies, and ruling out other causes. Clinicians should be aware of CJD and consider this in the differential diagnosis of persons presenting with dementia particularly those with a rapidly progressive declining clinical status.

A DANGEROUS WOLF IN SHEEP`S CLOTHING: A CASE REPORT OF DESTRUCTIVE ENDOCARDITIS CAUSED BY STAPHYLOCOCCUS LUGDUNENSIS Daiki Morikawa. Teine Keijinkai Medical Center, Sapporo, Japan. (Control ID #1335636)

LEARNING OBJECTIVE 1: Recognize that a positive blood culture of coagulase-negative staphylococci may not always be a contaminant LEARNING OBJECTIVE 2: Recognize the clinical signs and symptoms of endocarditis caused by Staphylococcus lugdunensisCASE: A 70 year-old Japanese woman with a past medical history of cerebral palsy presents with 1-month`s history of decrease in appetite and weight. She also reports generalized body weakness while denying fevers, chills, chest pain, palpitations, shortness of breath, cough, urinary changes, and rashes. Her significant physical findings include temperature of35.3Celsius, blood pressure of 85/48 mmHg, heart rate of 87 beats/minute, respiratory rate of 30 breaths/minute, and oxygen

saturation of 100% on 10 liters of oxygen. She is lethargic and disoriented to time, place, and person; she also has poor oral hygiene with saprodontia. She has no heart murmurs, costovertebral angle tenderness, back pain, or skin lesions. The remainder of her examination is unremarkable. In addition, significant laboratory findings consist of white blood cell count (WBC) of 23,240/L (4% bands, 93% segmented neutrophils), hemoglobin of 7.9 g/dL, platelets of 65,000/ L, blood urea nitrogen of 68 g/dL, and creatinine of 1.2 mg/dL. Urinalysis shows 2+ protein , 3+ heme, >100 red blood cells/high power field (HPF), >100 WBC /HPF, and 3+ bacteria. A computed tomographic scan of the chest, abdomen, and pelvis reveals bilateral pleural effusions and bladder masses with hydronephrosis. Given her septic shock from presumed urinary tract infection, she has been empirically started on meropenem. Her encephalopathy, however, does not improve, and she even develops right-sided hemiparesis; a magnetic resonance imaging of the brain shows multiple areas of embolic cerebral infarcts. She also develops a renal infarction, splenic abscess, and iliopsoas abscess for which their drainage shows no bacteria. Her antimicrobial regimen has thus been changed to ceftriaxone and vancomycin for suspicion of infectious endocarditis; a transesophageal echocardiogram shows a vegetation on the mitral valve with regurgitation. During this time, all 3 sets of blood cultures have grown coagulase-negative staphylococcus (CNS), Staphylococcus lugdunensis in particular. Despite aggressive medical management and scheduled mitral valve replacement, the patient dies after 18 days of admission.
DISCUSSION: As part of the normal skin flora, CNS has often been identified as a blood culture contaminant but has become increasingly recognized as a clinically significant pathogen even in cases of native valve endocarditis (NVE). In particular, S. lugdunensis can cause severe infections frequently attributable to Staphylococcus aureus. While both of these species produce a bound coagulase, S. lugdunensis, however, does not produce a free coagulase. Patients with immunosuppression and foreign bodies such as prosthetic devices and intravascular catheters are at a higher risk of infection with S. lugdunensis. The clinical presentation of NVE caused by CNS is indistinguishable from Streptococcus viridans and includes fever, generalized weakness, weight loss, and anorexia; about 25-33% of patients exhibit Oslers nodes, Janeway lesions, and splinter hemorrhages. While this case may have clinical signs and symptoms similar to S. viridans, one must not discount blood culture results initially showing CNS as just a blood culture contaminant.
BATH SALTS: A NEW HIGH, NOT FOUND IN THE HYGIENE AISLE William A. Hammond. Dartmouth-Hitchcock Medical Center, Lebanon, NH. (Control ID #1333709)
LEARNING OBJECTIVE 1: Recognize bath salts as new designer drugs of abuse undetectable by current readily available screening techniques

LEARNING OBJECTIVE 2: Recognize signs of intoxication and adverse effects of bath salt use and appropriately advise at risk patient populations of these adverse effects.
CASE: A 32 year old man with chronic low back pain (LBP) and a remote history of opioid and other substance abuse presented to an Emergency Department (ED) with new onset LBP after lifting a washing machine. Despite being febrile to 38.8 degrees Celsius, he was diagnosed with mechanical injury and discharged with opioids, benzodiazepine, and prednisone. Over the ensuing 24 hours, he experienced worsening fever, systemic symptoms, and new onset left-sided facial droop. His fiance returned him to the ED for reevaluation. He quickly became septic with decreased mental state and was transferred to a tertiary care facility after tracheal intubation. Just prior to his dramatic decline, he admitted to recently injecting bath salts, a legal synthetic amphetamine. Exam on transfer revealed temperature of 38 degrees Celsius, hyperdynamic pulses, multiple skin pustules, bilateral wrist track marks, and involuntary neck flexion with flexion of the knees. Lumbar puncture returned frank pus, and subsequent magnetic resonance imaging of the spine and brain revealed a large psoas abscess with extension into the epidural space, ventriculomegaly with ventriculitis, and bilateral

pontine infarcts. He was treated with intravenous antibiotics, as well as rapid extraventricular drain placement to remove purulent fluid and reduce intracranial pressure. Cultures returned with methacillin sensitive Staphylococcus aureus. After multiple surgical drainages, he made a surprising recovery to discharge to a local rehabilitation facility.
DISCUSSION: Bath salts are new synthetic amphetamine-like substances that have been legally sold, prior to October 2011, in smoke shops with the intent of abuse. These products were sold legally with the label not for human consumption under clever labels such as bath salts, plant food, or insect repellant. Manufacturers circumvent the law by creating substances with slightly altered structure or side chain so that the substances do not require Drug Enforcement Agency monitoring. The most common substances are synthetic cathinones, most commonly methylenedioxypyrovalerone (MDPV), however numerous other substances have been produced and sold similarly. The substances are typically consumed orally or via inhalation, however they can also be taken intravenously, such as the patient in the clinical presentation. The effects are similar to those of amphetamines, producing euphoria, hyperactivity, and hypersexuality, however negative effects including hallucinations, paranoia, and seizures. Public media reports of emotional lability with injury to self and others, as well as suicidality among teenage and young adult users have been increasing. Currently, there are no readily available screening tests for bath salts, so the diagnosis must be made on clinical suspicion along with elimination of other substances as the causative agent in an intoxicated patient.
CRACK THE CASE: REPORT OF COCAINE/LEVAMISOLE-INDUCED CUTANEOUS VASCULITIS Cory Walker; Andre C. Eaddy; Cathryn Caton. Medical University of South Carolina, Charleston, SC. (Control ID #1340456)
LEARNING OBJECTIVE 1: Recognize the characteristic clinical presentation and serologic findings of cocaine/levamisole-induced vasculitis to facilitate rapid diagosis.
LEARNING OBJECTIVE 2: Review the proposed role of levamisole (an antihelminthic used as a cocaine cutting agent) in cocaine-induced vasculitis. CASE: 40 year old female with a 1 year history of lower extremity cutaneous vasculitis with limited response to systemic steroids treated at an outside hospital presents with 1 month worsening of rash and polyarthralgias. Her past medical/surgical and family history are unremarkable. On physical exam, she had diffuse necrotic appearing palpable purpuric and bullous lesions extensively on bilateral lower extremities, on arms bilaterally, and smaller lesions on the vertex of the head and on the abdomen. Although the patient denied cocaine use, lesions were suspicious for cocaine-induced vasculitis. Skin biopsy revealed leukocytoclastic vasculitis. Urine drug screen was positive for cocaine. MPO and RF were positive and ANCA was positive with a perinuclear pattern. This patient was newly diagnosed with Hepatitis C. Levamisole, a cocaine cutting agent associated with cocaine-induced vasculitis, was measured in serum by HPLC. These findings are all consistent with case reports of cocaine/
levamisole-induced vasculitis. Although other causes/contributors to cutaneous vasculitis such as ANCA-, SLE-, Hepatitis C- associated vasculitis cannot be definitively ruled out, this patients condition improved with abstinence from cocaine use and supportive care. The patient was discharged in improved and stable condition and was provided resources to pursue rehabilitation.
DISCUSSION: Levamisole, an antihelminthic agent used in veterinary medicine, is present in 30-40% of U.S. crack cocaine and is used as a cutting agent because of its physical similarities to crack cocaine and its reported hallucinatory effects. Levamisole-contaminated cocaine has been associated with thrombotic vasculopathy and a leukocytoclastic vasculitis in several case reports and is becoming increasingly more prevalent. Unfortunately, neither the mechanism nor threshold of toxicity has been elucidated. Interestingly, cocaine/levamisole-induced vasculitis has been associated strongly with ANCA positive findings and moderately associated with ANA, Hepatitis C, anti-phospholipid, dsDNA, RNP and/or MPO antibody positive patients in the setting of detectable levamisole in either urine or serum. This cutaneous vasculitis, usually occurring in middle aged women, has a characteristic physical presentation involving the extremities and/or earlobes and these

patients have numerous serological findings. There are patients who also require debridement and reconstructive surgery, compounding the sequelae of exposure to this agent. We encourage clinicians to recognize and quickly diagnose cocaine/levamisole-induced vasculitis in patients at high risk for drug abuse and with vasculitis of unknown etiology.

DOCTOR, I CAN NOT STOP VOMITING!" Salman J. Bandeali1;
Jolie Britt2; Anna Kolpakchi1; Lee Lu1. 1Baylor College of Medicine, Houston, TX; 2Baylor College of Medicine, Houston, TX. (Control ID #1317605)

LEARNING OBJECTIVE 1: Recognize that common gastrointestinal (GI) symptoms of nausea and vomiting could be the initial presentation of immunoglobin light-chain GI amyloidosis.

LEARNING OBJECTIVE 2: Review GI amyloidosis.

CASE: A 47-year-old African American male with poorly controlled hypertension presented with nausea, vomiting, and early satiety with a 30 pound unintentional weight loss. He denied dysphagia, odynophagia, fever, abdominal pain, diarrhea or constipation. He had no sick contacts or recent travel. The patients symptoms started 2 months prior at which time he was admitted with dehydration and acute kidney injury with a creatinine (Cr) of3.4 mg/dL from a normal baseline Cr. Urinalysis showed granular casts and proteinuria. He was treated with supportive care, and his Cr improved to2.0 mg/dL but failed to normalize completely. He was presumed to have developed chronic kidney disease due to long-standing hypertension as evidenced by medical renal disease on ultrasound. His nausea and vomiting persisted with intermittent flares requiring multiple emergency room visits. One month later, he was admitted again for the same complaints. An abdominal CT scan showed an incidental supraumbilical hernia along with a ventral hernia, but no evidence of incarceration. The ventral hernia was thought to be the source of his intractable nausea and vomiting; thus, a laparoscopic hernia repair was performed. Few weeks later, his symptoms recurred. Physical exam at that time was significant for hyperactive bowel sounds and a liver span of 14 cm. Laboratory studies showed a Cr of 2.9 mg/dL and 3(+) proteinuria. Esophagogram was normal, and gastric emptying study showed accelerated gastric emptying. An esophagogastroduodenoscopy revealed antral erythema, and the biopsy of duodenal mucosa was positive for Congo red staining. Serum protein electrophoresis identified IgG kappa and lambda M spikes. Bone marrow biopsy showed 5% plasma cells. A diagnosis of AL amyloidosis with gastrointestinal involvement was made. The patient received bortezomib and dexamethasone treatment with resolution of his symptoms. DISCUSSION: Nausea and vomiting are common GI complaints, and the long differentials usually do not include GI amyloidosis as an etiology. Gastric and duodenal involvement in AL amyloidosis occurs in 8% of patients by biopsy, with only 1% cases being symptomatic. As an initial presentation of AL GI amyloidosis, nausea and vomiting are extremely rare. Patients typically present with epigastric pain, diarrhea, constipation, or bleeding. Due to the non-specific symptoms and endoscopic findings, diagnosing GI

amyloidosis in patients without a prior history of amyloidosis can be challenging and delayed. The endoscopic findings vary from polypoid protrusions to mucosal friability and erosions. Most common site of involvement is small intestine. Biopsy of the intestinal mucosa with positive Congo red staining confirms the diagnosis. Treatment usually is with supportive care for the specific symptoms, and the chemotherapy used in multiple myeloma may be administered to reduce the abundance of the amyloidogenic precursor protein to improve organ dysfunction. Weight loss is noted to be an independent poor predictor of survival. Hence, although rare, GI amyloidosis can present with intractable nausea and vomiting and should be considered in the differential diagnosis.

IVE LIVED A GOOD LIFEETHICAL DILEMMAS IN THE TREATMENT OF GERIATRIC PATIENTS WITH HIGH RISK SURGICAL CONDITIONS AND COGNITIVE IMPAIRMENT Jennifer Carnahan; Kurt J. Pfeifer. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1334863)

LEARNING OBJECTIVE 1: Recognize appropriate circumstances to recommend aortic valve replacement.

LEARNING OBJECTIVE 2: Manage ethical dilemmas of surgical referral of geriatric patients with cognitive impairmentCASE: An 87-year-old male presented from home complaining of intermittent, exertional chest pain, associated with an increase in exertional dyspnea. He had known aortic stenosis, atrial fibrillation, diabetes, and mild cognitive impairment and had been hospitalized recently after sustaining several falls. He lived in his own home with a caretaker-friend who received free room and board from him in exchange for help with his activities of daily living. On physical exam, he had a loud systolic murmur at the left upper sternal border that radiated to the neck. He was delirious at admission and during much of his hospital course. An echocardiogram showed a normal left ventricular ejection fraction with an aortic valve area of 0.4-0.5 cm2 and a mean valve gradient of 29 mmHg. This represented a significant progression of his aortic stenosis. Cardiac catheterization showed three-vessel disease not amenable to stenting. When the possibility of coronary artery bypass graft (CABG) and aortic valve replacement was introduced to this patient he responded, Ive lived a good life, and expressed a desire to not have surgery. He was assessed by the geriatrics consult team and deemed decisional. A family meeting was held and after much discussion with his family and caretaker, he reversed his decision and elected to have the aortic valve replacement and CABG. Two weeks after the surgery he died of disseminated intravascular coagulation.

DISCUSSION: Indicators for aortic valve replacement in severe aortic stenosis include heart failure, chest pain, and syncope. Without surgical intervention the average five-year survival rate for patients with severe symptomatic aortic stenosis is less than 50%. Geriatric and surgical literature is rife with discussion on whether or not advanced age can or should be used as a criterion for or against surgery. However, pre-operative mental status is also an important consideration. On the one hand, our patients mental status called into question his decisionality regarding the surgery. Assuming he was decisional, the acceptability of family influence or coercion is also a major concern. Our patient clearly had indications for surgery; however, whether that was the best decision for him is debatable. As generalists, we are often at the front line of decision-making for geriatric surgical candidates. Patients and their families solicit our opinions regarding surgery. We must take a patients full medical picture into account when we make recommendations. More importantly, we must take into account more elusive considerations such as the patients quality of life and assumed wishes. With geriatric patients we must also negotiate with patients family members to arrive at a decision. Such complex issues are encountered daily but cannot be solved in a day.

POLIOMYELITIS: BUT NOT DUE TO POLIO Irem Nasir. greenwich hospital, Greenwich, CT. (Control ID #1333244)

LEARNING OBJECTIVE 1: To recognize acute flaccid paralysis (AFP) as a symptom of West Nile Virus (WNV) neuroinvasive disease. LEARNING OBJECTIVE 2: To name interferon A (INF A) as possible therapy for WNV neuroinvasive disease.

CASE: A 63 year old male, residing in Greenwich, CT, presented in late summer, with 1 week of low grade fevers, nonproductive cough, myalgias, frontal headache without photophobia, neck and low back pain. He had acute RLE weakness x1 day, that progressed to flaccid paralysis.He denied any bowel/bladder incontinence, saddle anesthesia, or sensory deficits.There was no dysphagia, gastrointestinal symptoms, or dysuria.He denied sick contacts. There was no history of IVDA or risky sexual behavior. He traveled to Canada 2 months prior.He did not recall any tick or mosquito bites. On exam, he was febrile at 101.4 F. He was fully conversant, nontoxic. His lung exam was normal. Cranial nerves 2-12 were intact with no nystagmus. His RLE was flaccid at 0/5 strength. DTRs were absent in the R ankle and knee.Sensation was intact. Sphincter tone was normal. Labs revealed a WBC7.8 (82%PMN) and ESR 2. CXR was normal. CT and MRI brain were negative. Urgent MRI Cervicothoracolumbar spine was negative for abscess or abnormal enhancement. Spinal fluid had WBC 271, (71% PMN, 24% Lymphs), glucose 64, protein 63. CSF gram stain revealed many polys, no bacteria. Ceftriaxone and vancomycin were empirically started. CSF HSV 1, 2, varicella, enterovirus PCR, and cryptococcal Ag were all negative. CMV, adenoviral, HSV, and varicella rectal cultures were negative. Blood

and urine cultures were negative.Given the above symptoms, there was a high index of suspicion for WNV meningomyelitis. INF A therapy at 3 milliunits daily for 5 days was initiated. WNV IgM in CSF and serum resulted positive on day 5 of admission. He was discharged to rehab. After 4 months, he had persistent RLE paralysis.
DISCUSSION: WNV, a mosquito-borne RNA flavivirus, has the highest incidence in summer months. While 80% of WNV infections are subclinical, 20% have a self-limited febrile illness w/ headache, fatigue, and rash (WN Fever), <1% develop neuroinvasive disease (encephalitis, meningitis, and AFP). AFP is the least common and results when there is direct spinal cord anterior horn (SCAH) cell destruction, resulting in an irreversible asymmetric poliomyelitis-like syndrome with severe long-term morbidity. On CSF initially, there can be a left shift pleocytosis,which then converts to lymphocytosis. Guillain-Barre, a postviral peripheral demyelinating syndrome, has been included in the differential, but this is symmetric. In a patient with the above symptoms, WN IgM in the CSF is diagnostic of acute neuroinvasive disease, indicating intrathecal synthesis. WNV PCR is highly specific, but not sensitive, and is used largely in the surveillance of birds and mosquitoes. MRI signal enhancement of SCAH has been noted in the literature, but the absence of such changes, as in our patient, does not preclude poliomyelitis. Treatment for WNV neuroinvasive disease is largely supportive, and control of mosquito vectors may reduce incidence of human infections. Benefits for INF A have been seen only in case reports and are difficult to interpret due to a highly variable clinical course for WNV neuroinvasive disease. In endemic areas, clinicians must maintain a high index of suspicion that assymetric AFP without sensory deficits can be of spinal origin due to WNV. This will help prevent unnecessary diagnostics and therapy.
PROSTATE CANCER AFFECTING THE LUNG WITHOUT BONY METASTASIS VIKRAM CHABRA DO, EDISON GAVILANES MD, FARZIN RAHMANOU DO, KENNETH SHA MD NEW YORK HOSPITAL QUEENS, FLUSHING NY Vikram Chabra; Edison Gavilanes; Farzin Rahmanou; Kenneth Sha. New York Hospital Queens, Flushing, NY. (Control ID #1334465)
LEARNING OBJECTIVE 1: Prostate adenocarcinoma is generally described as a slow growing malignancy that can metastasize in predictable order to other areas of the body. Bone and lymph nodes are commonly affected. Prostate cancer screening remains a debatable issue and is responsible for the detection of some cancers in asymptomatic patients. It is also among the differential for patients presenting with lower back pain, other bone pain, difficulty in urinating, and erectile dysfunction.
CASE: The patient is a 73 year old male with a history of Benign Prostatic Hyperplasia who presented with dry cough for three weeks associated with hoarseness of voice and anorexia. His other medical history included hypothyroidism, osteoarthritis, and type two diabetes mellitus. Prior to his admission he was evaluated by ear nose and throat and was placed on montelukast without relief. On physical exam he had a hoarse voice and clear lung fields. The balance of his history and exam were unremarkable with the

exception that he had a family history of lung cancer in mother and sister, and gastric cancer in father. A chest CT showed innumerable bilateral pulmonary nodules some of which formed cavities. A CTof the abdomen/pelvis revealed an enlarged heterogeneous prostate measuring 6 cm in diameter which was correlated with a total PSA of 244 to make the presumptive diagnosis of metastatic prostate cancer. A subsequent nuclear medicine whole body bone scan however failed to reveal any evidence of metastatic bone disease. The patient underwent bronchoscopy followed by CT guided biopsy of the left lung. These specimens were CK7, CK 20, TTF-1, CDX-2 negative, and PSA positive. A diagnosis of metastatic adenocarcinoma consistent with prostate primary was made. The patient was started on bicalutamide for the treatment of his prostate cancer and was discharged home to follow up with his oncologist. DISCUSSION: We report on the rare case presentation of metastatic prostate cancer with extensive lung pathology not involving the musculoskeletal

system. Prostate cancer with metastasis to lung without metastasis to bone is rare. Although metastatic pathways in prostate cancer are not entirely understood, patterns of progression in prostate cancer are highly predictable. Metastasis to bone is the most common primary site and usually precedes metastasis to lung or any other organ.

THERE WILL BE BLOOD Shubhum Misra; Dhruti Patel; Halis Sonmez; Armen Simonion. Capital Health, Trenton, NJ. (Control ID #1335764)

LEARNING OBJECTIVE 1: LEARNING OBJECTIVES: Symptomatic paraesophageal hernias account for less than 5% of all subtypes of hiatal hernias encountered during endoscopic evaluation of the upper GI tract. The major risk factor for developing a symptomatic paraesophageal hernia is morbid obesity due to increased intra-abdominal pressure. The major complications are severe anemia and strangulation of the esophagus, which is a surgical emergency.

CASE: CASE DESCRIPTION: This is a case of a 52-year-old African American male that presents with complaints of fatigue and progressively worsening dyspnea over 18 months. He denies melena, hematochezia, change in bowel habits, weight loss, dyspepsia, diarrhea, constipation, or hematemesis. The patient originally noticed easy fatigability, while working construction, but did not seek medical attention. Eventually the patient was laid off from work due to poor productivity and sought help from social services for public disability and unemployment benefits. The patient was referred to a PMD for routine lab work, which revealed severe anemia. The patient was immediately referred to our emergency department for acute care. At that time the CBC showed hemoglobin of 4.4, hematocrit of 16.8, MCV of60.3, WBC of 4000, and platelets of 340,000. Iron studies were performed and reveled severe iron deficiency anemia. In addition, his reticulocyte count was2.2%, yielding a reticulocyte index of 0.33. The initial physical exam of the patient was grossly normal except for BMI of 45, grade 2/6 systolic ejection murmur at the apex, mucosal pallor and weakly positive Heme-occult test. Subsequent fecal occult blood tests were negative three times, but a colonoscopy was performed to rule out an occult lower GI bleed and was normal. Next an esophogastroduodenoscopy was performed which showed a sliding type hiatal hernia with linear streaking pattern associated with submucosal aggregation of blood vessels and occult blood loss. It was decided that the hiatal hernia required further investigation with upper GI series with barium swallow, and this revealed a large type II sliding/paraesophageal hernia which was non-strangulating. The patient was transfused 6 units packed red blood cells and was discharged with follow-up for elective hernia repair and iron supplements.

DISCUSSION: DISCUSSION: Morbidly obese patients should have thorough examination of any hernias encountered during endoscopic evaluation of the upper gastro-intestinal tract in order to rule-out a potentially lethal complication such as paraesophageal hernia.

CLINICAL PRACTICE INNOVATIONS

A CLINICAL DECISION AID FOR HOSPITALISTS: SAFE DISCHARGE ASSESSMENT FOR LOW RISK CHEST PAIN ADMISSIONS Andrew McWilliams1; Christopher Caulfield1; Jonathan Weeks2; E. Allen Liles1; Jonathan Kirsch1. 1University of North Carolina, Chapel Hill, NC; 2North Carolina State University, Raleigh, NC. (Control ID #1340410)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): There is a paucity of data to help guide hospitalists in risk stratifying patients who are low risk for Acute Coronary Syndrome (ACS) but are referred for admission with chest pain.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): This study aims to: further characterize a cohort of low-risk chest pain patients referred for admission to our hospitalist group; demonstrate current outcomes for this cohort, and to develop an efficient clinical decision aid. The primary outcome is 30 and 90-day cardiac event rate (MI, NSTEMI, unstable angina, revascularization, sudden unexplained death, or death from a cardiac cause). Secondary outcomes are length of stay, 30 day readmission and Emergency Department (ED) visit rates, and rates of significant non-ACS conditions at discharge.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Chest pain accounted for 5.5 million ED visits in the United States during 2007-2008. While 13.0% of these patients had acute coronary syndrome (ACS), the majority did not. Correctly identifying patients without ACS, who can be expeditiously discharged home, continues to be a challenge. At our academic, suburban, tertiary care hospital, the hospitalist group is called upon to admit the majority of low risk chest pain patients. The hospitalists perform a secondary assessment (following that of the ED staff) of ACS risk. The opportunity to perform a secondary assessment of ACS risk prior to admission may uniquely position the hospitalist to identify a subset of patients that can be safely discharged. We retrospectively reviewed the charts of all patients referred for admission to the hospitalist service from the ED with chest pain as a chief complaint. Patients were excluded if they had a history of coronary artery disease, previous myocardial infarction, or age >70 years. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Our database (including patients demographic data, presenting symptoms, laboratory and clinical data, discharge data, and 30 and 90 day outcomes data) will allow for outcomes analysis on the cohort as well as multivariate analysis of risk factors and prediction modeling. Our study is designed with 80% power to show a 0.1% adverse event rate (goal n=300 patients).
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Data collection is currently in process. The average age of our preliminary cohort (current n=65 patients) was 53 years, 49.2% had hypertension, 75.4% had diabetes, 78.5% had hyperlipidemia, 52.3% were smokers and 51.0% had a family history of coronary artery disease. Of these, 78.5% had chest pain not relieved by rest or nitroglycerin and 69% had chest pain not worsened by exertion. The average length of stay for our cohort was 47.9 hours. Thirty and ninety day readmission/ED visit rates were 20% and 23.1% respectively. Cardiac event rates will be further verified with follow-up phone call interviews. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Outcomes data and prediction rules are key resources to help guide physicians making a bedside determination of the need for hospital admission. Our research will help inform the decision making process for hospitalists performing secondary assessments of patients with low-risk chest pain.
A COLLABORATIVE EFFORT BETWEEN A PATIENT CENTERED MEDICAL HOME AND A PATIENT ADVISORY GROUP TO CREATE A PATIENT GUIDE TO SERVICES Scott Joy; Henry Wooten; Lynn Daugherty; Marilyn Hartman; Ron Witt; George Snowden; Elizabeth Domingoes. Duke University, Durham, NC. (Control ID #1327085)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): To take advantage of all the services offered by a Patient Centered Medical Home (PCMH), patients must first be aware of current services offered, understand how to best access those services, and be given the opportunity to provide input into the development and description of the services offered.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Identify key services and processes offered by the PCMH 2. Create a Patient Advisory Board (PAB) where patient advisors would discuss relevant topics with PCMH leadership 3. Create a document resulting from this collaborative communication that empowers patients to optimize clinical servicesDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Patients need to be aware of services offered by a PCMH, and PCMH leadership need patients perspectives regarding their understanding of these services, if the processes to access these services need to be improved, or if new services need to be offered. Clinical services and processes in need of review were identified, including after- hours care, follow-up after ER, urgent care visit, hospitalization, contacting a care manager, scheduling an appointments, receiving test results,

using an online patient portal, managing medication refills, requesting copies of medical records and completion of forms, and obtaining referrals . A PAB was created by asking each provider in the practice to nominate a patient who they felt would be an active contributor in a group setting and had an online patient portal account and e-mail address. Nominated patients were contacted by the practice medical director, and those who agreed to participate were invited to meet every 2 months for 2 hours at the practice site. Patient advisors, practice medical director, health center administrator, nurse manager, and clerical manager attended the meetings. Creating a patient guide to services was determined to be the best starting project, as it created a framework for discussion, all participants had experience with the services and processes being discussed, and the effort would result in a tangible product (printed brochure).
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Establish a PAB and create an ongoing forum for collaboration and discussion between patient advisors and PCMH leadership 2. Create a patient-centered brochure that outlines the services offered by a PCMH and describes the optimal processes that will empower patients to access these servicesFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 1. A total of 6 hours (3 meetings) were required for 8 patient advisors and PCMH leadership to discuss, revise, edit, and create the patient guide to services 2. A brochure was created that listed the practice address, phone/fax numbers and e-mail address, and described the optimal processes for requesting medication refills, lab/x-ray results, and copies of medical records. 3. Methods for appropriate use of telephone triage and care management, accessing after-hours care, and follow-up after ER, urgent care and inpatient hospitalization were also described. 4. Initial printing was 10,000 brochures, and the brochures are widely available in the practice waiting room and exam rooms for distribution to all patients.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Creating a patient guide to services is an excellent initial opportunity for engaging a Patient Advisory Board and promotes a sense of communication, collaboration, empowerment, and accomplishment for all parties involved.
A COMPARISON OF REFERRAL MODALITIES FOR DISEASE MANAGEMENT PROGRAMS IN A PRIMARY CARE SETTING Scott Joy1; Patrick J. Maheney2; William Schiff2; Peter D. Jacobi2; Christina L. Crosby2. 1Duke University, Durham, NC; 2Duke University, Durham, NC. (Control ID #1327124)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): What is the most effective referral process in primary care (PC) to enroll patients in an external disease management (DM) program? OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1.Develop and offer multiple methods for referral from PC to an external DM program, including telephone referral, written prescription, or electronic referral 2.Evaluate the effectiveness of different options by determining number of referrals given using each modality 3.Compare referral rates/enrollment into DM program after 1 year of implementationDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): As part of a basic benefit package, DM services are often offered to patients, but may be underutilized. Many DM programs are centrally based, and receive referrals from multiple practices in an area. This often results in a disconnect between patient, provider, practice and DM service. Improving the referral process into DM programs is thus paramount to optimizing use of these programs. Our DM program is available to 39,566 covered lives as an employee benefit. The DM services are marketed to participating PC practices in multiple ways, including quarterly practice visits, all provider meetings, and staff/provider in-services. However, sustaining referrals has been a challenge. With collaborative input from health plan and practice administrators, physicians, and practice and DM nurses, a menu of options for referrals was developed. 1.Telephone Referral: PC practice staff would call the DM team with referrals, and the DM team would then contact the patient to schedule. 2.Written Prescription: Prescription pads were given to each PC practice to be used by providers at the point of care for

patients deemed interested or suitable for DM. The patient's name would be written on the prescription that included a contact phone number for the DM program that the patient could call to enroll. A carbon copy of each prescription was also generated and was placed in a box for members of the DM team to collect who would also then proactively contact the patient by telephone to schedule. 3.Electronic Referral: An electronic process was developed within the electronic health record (EHR, McKesson HAC) that allowed a PC provider/nurse to electronically send a DM referral to the DM team. Upon receiving the referral, DM care managers would contact the patient, and sent an electronic message back to the referring PC provider. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Evaluate uptake of different methods for referrals into DM program 2. Increase in overall number of referrals to DM from previous yearFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Type of referral and number of each referral submitted for 2010 and 2011: Telephone: 1 in 2010, 11 in 2011: Written Prescription: 31 in 2010, 41 in 2011: Electronic: 0 in 2010, 267 in 2011: Total: 32 in 2010, 319 in 2011 Telephone referrals decreased dramatically over the year as electronic referrals were implemented 7 patients were eligible for and enrolled in high level DM programs in 2010, 126 patients were eligible and enrolled in 2011KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1.Multiple referral processes can improve engagement and enrollment in DM programs 2.Electronic referrals were shown to be the most common method for referral into the DM program, suggests that integrating DM care managers into the electronic workflow of providers and practices is an effective method to refer patients to DM programs.

A HUB AND SATELLITE MODEL TO IMPROVE THE QUALITY OF CARE FOR PATIENTS WITH CONGESTIVE HEART FAILURE Michael E. Bowen1,3; Christianne Roumie1,3; Ann Minnick4; Beth Donaghey4; Amy S. Wilson5; Cynthia A. Fink2; Henry Ooi2. 1VA Tennessee Valley Healthcare System, Nashville, TN; 2VA Tennessee Valley Healthcare System and Vanderbilt University Medical Center, Nashville, TN; 3Vanderbilt University Medical Center, Nashville, TN;
4Vanderbilt University School of Nursing, Nashville, TN; 5VA Tennessee Valley Healthcare System, Nashville, TN. (Control ID #1336642)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Evidence-based treatments for congestive heart failure (CHF) can modify disease progression and reduce admissions; however, a quality gap between current and desired practice exists.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To provide CHF management support to community primary care providers (PCPs) from a regional CHF team 2. To determine model impact on CHF performance metrics 3. To determine model acceptability and facilitators/barriers to implementation

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The model consisted of a multidisciplinary CHF team (heart failure physician, nurse practitioner, and pharmacist) at a regional hub center that provided clinical support to 6 PCPs in 3 community satellite clinics within the Veterans Health Administration. The model consisted of 4 components: 1) A 3 day CHF management course; 2) Availability of a clinical pharmacist to assist in medication titration; 3) Open-access communication with the CHF hub team; 4) Quarterly performance feedback to PCPs. CHF patients with an ejection fraction <40% were included in a before-after analysis. CHF patients followed by non-study providers in the same clinics formed a concurrent control group.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE

USED TO EVALUATE PROGRAM/INTERVENTION): Nine CHF quality metrics were assessed by chart review at baseline and 12 months after the intervention. Metrics included: weight, activity and volume assessment, use of ACE-inhibitor/ ARB and beta blockers, and the percent target dose achieved. Coumadin use in atrial fibrillation and use of evidence based beta blockers were also measured. Structured interviews were conducted with study providers prior to training and at study conclusion.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Two hundred fifty-eight patients (129 intervention; 129 control) followed by 32 PCPs (6 intervention; 26 control) were followed from May 2010-May 2011. Patient characteristics and performance on quality metrics were similar between groups at baseline and after intervention. Performance exceeded 80% on 5 metrics at baseline including: weight, volume, use of ACE/ARB, beta blockers, and evidence based beta blockers. The subgroup referred for pharmacist-led medication management improved performance on evidence based beta-blocker use and beta blocker target dose; however, less than 20% of eligible patients were referred. Intervention PCPs saw CHF patients only twice during the study and contacted the CHF team a total of 3 times. More than 85% of study patients were followed by a cardiologist, and PCPs cited perceptions that patients were already in the system as a key barrier to utilizing the program. Interviews found high satisfaction with the educational training and performance feedback. PCPs reported that the program increased their confidence and ability to manage complex CHF patients.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The model enhanced PCP confidence in CHF management, and PCPs were receptive to education and performance feedback. High performance on quality metrics at baseline and infrequent PCP visits may limit opportunities for improvement. Contamination of the control group by the intervention may have limited the ability to detect a difference. Improved implementation strategies are needed to increase provider engagement. Inclusion of pharmacists in CHF management teams may improve performance on medication measures. Greater understanding of roles and responsibilities among members of the CHF care team may enhance outcomes of disease management programs.
A SUCCESSFUL PDSA: IMPROVING COMPLIANCE WITH PLATELET TRANSFUSION GUIDELINES. Elena Katz; Malgorzata Klek; Randy Levine; Robert E. Graham. Lenoxhill Hospital, New York, NY. (Control ID #1318228)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): How can physician compliance with up-to-date platelet transfusion guidelines be improved?
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To improve physician compliance with up-to-date platelet transfusion guidelines through an educational intervention.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): All patients receiving platelet transfusions over a five-month period from Jan-Feb, and April-June 2010, admitted to the medical, critical care and cardiac services
were reviewed. The medical record clinical indication was then evaluated against the ASH 2007 Evidence-Based Platelet Transfusion Guidelines (Slichter SJ. Hematology 2007): bleeding and platelets 50, 000/L, preinvasive procedure and platelets 50, 000/L, prophylactic transfusion for platelets 10, 000/L and WHO bleeding grade2. We also assessed how the patients clinical indication met the previous prophylactic threshold for platelet transfusion of 20, 000/L. Following initial data collection, we implemented an educational intervention by giving a lecture, reviewing all indications for platelet transfusions, and distributing a pocket card to the house-staff on the medical wards in August, 2010. We subsequently gathered post-intervention data following the methods described above for four consecutive months from Sept-December, 2011.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Descriptive statistics were collected on the pre and post

intervention groups and data analysis was conducted using a Z-test with =0.05 and Z critical value=1.96. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Eighty-six patients on the selected units received a total of 241 platelet transfusions pre-intervention and 81 patients received a total of 237 platelet transfusions post-intervention. The patients clinical indication met the old guidelines in 63% of cases pre-intervention and in 81% of cases post-intervention with a significant p-value of <0.05. The patients clinical indication met the currently accepted 2007 ASH guidelines in 41% of cases pre-intervention and in 53% of cases post-intervention with a significant p-value of <0.05. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Based on the significant difference observed between the pre- and post-educational intervention groups, updating physicians on current evidence-based guidelines for platelet transfusions is a simple and effective means to improve transfusion practices. Periodic educational interventions and their assessment may prove to even further enhance physician compliance with up-to-date guidelines.

A COMPREHENSIVE DISCHARGE TRANSITION INTERVENTION REDUCES READMISSIONS IN A GENERAL MEDICINE POPULATION Christopher Wong1; Andrew White1; Susan Merel1; Carol Charles2. 1University of Washington, Seattle, WA; 2University of Washington, Seattle, WA. (Control ID #1332748)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): We present the results of a quality improvement initiative to reduce readmissions after discharge from the general medicine service at an academic hospital.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Reduce the 30 day readmission rate of the general medicine service. 2. Improve intermediate outcomes pertaining to optimal transitions of care, including discharge summary completion rates by housestaff.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We applied the following multi-modality intervention to a general medicine service at an urban academic hospital: 1. Enhanced primary care provider (PCP) communication via a team assistant. 2. Housestaff education through a monthly teaching session pertaining to transitions of care, daily interaction with a nurse care coordinator to discuss discharge planning, and a discharge (DC) summary timeliness intervention utilizing provider-level real-time data. 3. Enhanced follow up via a team assistant arranging appointments and nursing follow up phone calls through a parallel hospital initiative. 4. Medication reconciliation and an improved patient-friendly medication list on discharge. 5. Nurse care coordination, including care plans for frequently readmitted patients.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. 30 day readmission rate for the General Medicine Service. 2. Intermediate measures: % DC summaries complete within 48 hours of discharge, percentage of PCPs identified and

contacted on admission, percentage of DC Summaries sent to PCPs, % follow up appointments completed within 21 days of discharge, % medication reconciliation on admission and on discharge, use of Patient friendly medication lists, provider feedback regarding nurse care coordination.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The baseline 30 day readmission rate for the General Medicine Service was 18.3-18.7% for the preceding 2 years. Post intervention, the 30 day readmission rate decreased to 14.5%, consisting of 3 consecutive months of readmission rates lower than the pre-intervention baseline. Secondary outcome measures showed improvements in PCP identification (up to 100% of eligible patients), discharge summaries sent to PCPs (up to 96%), discharge summary timeliness (98-100%, most showing improvement pre and post receipt of individual performance data), follow up appointment completion (90% at 21 days), and follow up phone calls made (up to 83%). Medication reconciliation remained at a high baseline (96-100%).

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): A multi-modality intervention focused on improving care transitions lowered 30 day readmission rates in a general medical population cared for predominantly by medical residents. Behavior change among physicians was able to be achieved by providing the rationale for the promoted behavior (teaching key concepts of transitions of care) combined with an accurate and timely feedback mechanism (report of discharge summary timeliness). Quality metrics for PCP communication and follow up showed high levels of success but less reliability diminished intermediate outcomes during team assistant absences revealed a gap in the improvement intervention. Future directions include diagnosis-specific interventions, improving patient education via additional teach-back training, improving written patient discharge materials, development of patient coaching, improving rates of patient follow up calls, and increasing primary care clinic involvement. Behavior change interventions will continue to require adequate training and feedback mechanisms.

A SUCCESSFUL ROLE FOR A "PAIN PHARMACIST" IN A LARGE ACADEMIC TEACHING PRACTICE Lori Tishler1; Michele Matthews3,2; Edgar Ross2; Robert Jamison2. 1Brigham and Women's Hospital, Boston, MA; 2Brigham and Women's Hospital, Boston, MA;
3Mass College of Pharmacy and Health Sciences, Boston, MA. (Control ID #1310763)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): How can teaching practices help residents and staff learn the best practices for caring for patients with chronic pain?

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To help patients with chronic pain in a familiar setting. 2. To help residents and faculty learn best practices for monitoring patients on opioids. 3. To facilitate team-based care. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our practice is a large academic teaching practice. Like many teaching practices, we are challenged by patients with chronic pain. Our desire to help treat their pain is balanced by our concerns about addiction, aberrant behavior, and drug diversion. While we have a wonderful consultative pain service, the care of these patients is often best done in the practice. Yet, particularly for newer physicians, at both the resident and faculty level, this care can be quite challenging. Working together with our pain service, we discussed ways that we might improve patient care. We have had success with a clinical pharmacist for co-management of chronic diseases and ultimately, the Jen Center and the pain service decided to try embedding a pharmacist with particular interest in chronic pain into our practice. Our "pain pharmacist" comes to the practice one afternoon/week, where she is free to meet with patients as well as consult with residents and staff. In her downtime in our practice, she is reviewing our log of patients on chronic opioids and helping to make suggestions for better processes and protocols. When she is not in the practice, she easily and quickly consults with residents, faculty, and staff via phone or e-mail. She has integrated well and it's made a huge impact on our practice and resident experience.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We will use the following measures to help us determine success of the program. These questions speak to both the need for improved knowledge and process. 1. Treatment of chronic pain is an issue in my practice (pretest response was 53/59 respondents agreed) 2. I am confident in my ability to manage chronic pain (pretest: 22/ 59 respondents agreed) 3. I always follow a defined protocol when I prescribe opioids. (pretest:14/59 respondents agreed) 4. I am afraid that my patients will become addicted if I prescribe chronic opioids (38/59 respondents agreed)

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): While our post intervention study has not yet been completed, we have found that the embedded pain pharmacist has been quite successful in the following areas: 1. The availability of a real-time consultant has been extremely helpful in guiding us towards best practice. We see, for example, more appropriate use of urine screens and pain

agreements in the practice. 2. As we move toward a PCMH model, the embedded pharmacist has been an excellent example of collaborative, team-based care. 3. An embedded pain pharmacist in primary care has helped enhance communications between our practice and the pain service.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Key lessons from our project to date include: 1. There is tremendous value in working collaboratively with specialty services, but keeping care based within a primary care practice. 2. Without adding FTE resources, we can provide improved care for patients with chronic pain who use opioids. 3. There is tremendous need for improved care and communication to allow primary care physicians to manage opioids independently and competently.
ADDRESSING POOR DIABETIC CONTROL IN AN UNDERSERVED POPULATION WITHIN THE FRAMEWORK OF A PATIENT-CENTERED MEDICAL HOME Sarah Richards; Thomas G. Tape; Rachel Bonnema; Andrew Vasey. University of Nebraska Medical Center, Omaha, NE. (Control ID #1340426)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): There are several barriers to care that inhibit adequate diabetes management in low-income patients.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Improve access to care 2. Improve patient education 3. Improve overall diabetes management DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Midtown Clinic is a resident-run Internal Medicine clinic that functions as a Patient-Centered Medical Home. Over 32% of patients serviced are self-pay or Medicaid. The clinic board of directors has developed several innovative programs within the context of the PCMH model to help our low-income diabetic patients. 1. Improved Access to Care: Internal Medicine residents raise several thousand dollars per year via a department-wide raffle. Our full-time social worker uses a portion of these funds to ensure that patients have transportation to and from their clinic appointments by providing free bus tickets or paying for their taxi fare. The clinic is also involved in a collaborative project with the College of Nursing in which nursing students do post-hospital discharge home visits. The nursing students ensure our patients know about their follow-up appointment and the transportation options available. 2. Improved Patient Education: Our clinic employs a full-time on-site Diabetes Educator who provides same-day diabetes self-management counseling. Additionally, we offer free, group Diabetes Education classes. We look forward to offering a free Diabetes Cooking Class in January 2012 as part of a collaborative project with the dietetic students. The aforementioned classes are made possible completely via donations and volunteers. 3. Improve Overall Diabetes Management: We provide several generic medications to patients free of charge. Specifically, the clinic appropriates donations and fundraising dollars to buy metformin, glipizide and lisinopril as well as meters in bulk at a reduced cost. Our social

worker also helps our patients with the paperwork necessary to obtain insulin via patient assistance programs.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Failed appointment rates are tracked on a monthly basis. 2. Surveys are sent to patients after they attend our diabetes education classes. 3. Hgb A1C, LDL and systolic blood pressure readings of diabetic patients have been tracked over the last three years.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 1. Failed appointment rates have dropped from 15.3% prior to July 2011 to a current rate of 12.7%. 2. Patients have reported a high level of satisfaction after attending education classes. 3. Among our diabetic patients, the percentage of patients with a Hgb A1C level greater than 9% has dropped from 20.4% to 20.1% in the last three years. The percentage of systolic blood pressure readings greater than 140 has dropped from 30.7% to 28.6%.

Further, average LDL levels have dropped from 94.6 mg/dl to 87.6 mg/dl over the last three years. We are awaiting new data from the last 6 months and expect an even greater improvement in these measures.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1. Identify barriers to care among low-income diabetic patients 2. Consider fundraising as a means to provide patients with free or reduced cost medications and transportation. 3. Invest in collaborative and multidisciplinary projects

AN INNOVATIVE AND TRANSPARENT ELECTRONIC HAND-OFF MODEL TO IMPROVE PATIENT SAFETY

Mukesh Gopalakrishnan; Federico Silva-Palacios; Mohammed Samee. Advocate Illinois Masonic Medical Center, Chicago, IL. (Control ID #1317418)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Recent ACGME resident duty hour guidelines increased frequency of transfers in patient care thus imposing the need to create an efficient, safe and standardized hand-off process.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Improve Patient Safety - The clinical handover is one of five key areas identified under the World Health Organization Alliance for Patient Safety High 5 s Project. 2. Improve efficiency - Verbal handovers are associated with loss of all data, written handovers lose 31% of data, and a combination of written and verbal handover results in minimal loss of data. The medical model of handover stresses on standardization and a minimal dataset.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Ours is a 440-bed community based teaching hospital with resident teams following patients from admission to discharge. A cross-cover or night float team takes care of overnight events, with communication between the teams established via this electronic tool. Our focus was to create an electronic standardized handover tool that avoids redundancy and provides consistent, easy access to data while improving patient safety and decreasing errors during transitions of care. The goal was to transfer information on patient presentation, current status, and anticipatory guidance. This custom-built HIPAA-compliant online module was created within Microsoft SharePoint. Built-in automation pulls patient demographics and allows for simultaneous viewing and editing capability by all care providers including physicians, nursing, and pharmacy staff. During the identification of handover fields to be included in the module, key areas common to different departments were identified. This led to the creation of a collaborative electronic handover to augment verbal transaction.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Adverse patient safety events were monitored as a measure of success with initial goal at implementation being to maintain patient safety at the same level as before implementation. User feedback was taken into consideration to assess the user friendly nature of this module and make updates.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Allowing for a team-based approach streamlined care and provided a complete picture of the patient. The electronic clinical handover successfully identified unstable patients and clinical concerns, forwarded pending tasks, and provided anticipatory guidance. Furthermore, psychological and social needs could be addressed. Patient safety events did not show any deterioration after implementation and are being monitored to ensure further improvement. Feedback from users showed increasing familiarity with the module improved efficiency with less time being spent on preparing a hand off.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Our solution provides a standardized and a streamlined dataset, collaboration within the patient care team, and an electronic platform that is HIPAA-compliant. This defines and establishes a separation between the handover and the clinical content in electronic medical records. This provides a consistent handover process, yet affords flexibility for mobile solutions. Technology allows for

advanced capabilities, such as instant messaging, web-based group meetings, and audio and video uploads, making this method truly distinctive. Our tool lays the foundation for a reliable patient-centric handover. This unique implementation of team-based approach is innovative in the realm of patient safety. Our copyrighted application will be expanded to other institutions within our network.

AN INNOVATIVE MODEL FOR HIGH QUALITY, LOW COST, END OF LIFE CARE Kristy Deep. Univ of Kentucky, Lexington, KY. (Control ID #1340432)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): A large proportion of Americans die in acute care hospitals where care is expensive, fragmented, and provides inadequate pain and symptom management. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Provide higher quality, lower cost care for dying adult patients and their families using a hospice model. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our 473 bed academic medical center partnered with a free-standing community hospice to develop an inpatient hospice service to offer expert level care for actively dying patients. Inpatient hospice services are provided throughout several hospital units. The hospice team includes 0.5 FTE palliative physician (who becomes attending of record) and 1 FTE nurse, social worker, and chaplain. These team members are employed by the hospice and work alongside hospital staff. Patients actively dying or terminally ill with uncontrolled symptoms are referred for hospice admission by their primary admitting service. If their care meets the requirements for inpatient hospice under Part A Medicare Hospice Benefit (MHB), they are administratively discharged from acute care and admitted with a new encounter to inpatient hospice while remaining in the same facility. Under the MHB, a per diem rate ($623) is paid to the hospice with a portion (67%) passed through to the hospital. A similar structure applies for Medicaid and commercial insurers.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Administrative measures include average daily census (ADC) and average length of stay (ALOS). We calculate a capture rate defined as the proportion of expected adult deaths admitted to inpatient hospice when documentation indicated that the patient was receiving symptom focused care (code v66.7). Quality measures include symptom management ratings and family and referring provider satisfaction. Financial impact is assessed by cost avoidance compared to non-hospice comfort care deaths.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The mean hospice admissions per month is 24 (range 19-35). ADC is 4 patients with ALOS of 5.74 days. Overall, 88% of hospice inpatients die with the remainder discharged home or to long term care with hospice. The monthly capture rate of comfort care deaths exceeds 40%. Inpatient hospice deaths do not affect a hospitals

mortality rate which has led to a statistically significant drop in our observed/expected mortality index (YTD=0.61). Surveys of bereaved family members show 91% rate their inpatient hospice care as excellent with 94% stating the patient received adequate pain management. The majority of referring physicians (80%) rate ease of referral as excellent and 92% find the service helpful for their patients. The most common barrier identified was bed availability as only some units offer hospice. Financial analysis reveals substantially lower costs for hospice deaths compared to usual care expected deaths. We demonstrated a 54% reduction in total costs for the patients last 3 days of life (cost avoidance of $1204.45/day). The greatest cost avoidance was seen in direct variable costs. This signifies the hospice teams decreased utilization of lab, pharmacy, imaging and other diagnostic or therapeutic services that were non-essential for supporting the patients comfort.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): A collaborative initiative between an acute care hospital and a community hospice led to highly rated patient and family centered care at a lower cost to both the hospital and

society. This model requires little start-up investment and is highly generalizable.

AN INTERACTIVE, POINT-OF-CARE COMPUTER PROGRAM TO FACILITATE DIAGNOSIS AND TREATMENT OF FEMALE URINARY INCONTINENCE IN PRIMARY CARE Alison Huang; Ralph Gonzales; Anne Chang; Jeanette S. Brown. UCSF, San Francisco, CA. (Control ID #1317557)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Urinary incontinence affects up to a quarter of adult women, but is under-recognized and under-treated in primary care. Patients may avoid seeking attention for incontinence because they are embarrassed or uncomfortable, while providers may lack time during clinic visits or may be unfamiliar with evidence-based diagnosis and treatment.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) To develop a brief, interactive computer program designed for touch-screen computers in primary care waiting rooms to facilitate diagnosis and treatment for incontinence in women; 2) To evaluate the feasibility of integrating this program into two types of primary care practices (general medicine and general gynecology). DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A brief (<10 minute), point-of-care computer module was developed to guide female patients in self-diagnosing and self-classifying incontinence, assess their interest in treatment, and identify co-morbid problems that could complicate care. For women with weekly stress, urgency, or equally-mixed incontinence and no co-morbidities requiring specialist referral (e.g., major neurologic condition, pelvic cancer or surgery), the module was designed to print out the results of the evaluation for their providers, along with recommendations for evaluation and treatment. After pre-testing, the module was field-tested in the waiting rooms of an academic internal medicine practice and general gynecology practice, using a touch-screen tablet computer. Female patients (regardless of age) were invited to try the computer while waiting to see their providers; those who reported weekly, classifiable incontinence in the absence of major co-morbidities, expressed interested in treatment, and received provider printouts were invited to participate in a follow-up telephone call. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We tracked the numbers of patients trying the computer program who: 1) successfully completed the module in the waiting room; 2) self-identified as having any or weekly incontinence; and 3) self-diagnosed as having stress-, urgency-, and mixed-incontinence in the absence of co-morbidities requiring referral. Of women completing follow-up calls, we examined rates of patient-provider discussion about incontinence and patient perceptions of the module.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): During 60 half-days of field-testing, 371 women tried the computer program, and 206 (56%) completed
the program in the waiting room. Of these, 131 (50%) reported any incontinence, and 61 (30%) reported weekly incontinence in the past 3 months. Twenty-six (45%) self-classified as having stress, 13 (22%) as having urgency, and 12 (21%) as having mixed incontinence. Of the women completing follow-up phone calls, 100% reported showing their printouts to their providers, and 80% reported discussing their incontinence at that visit. No women were referred to see a specialist for incontinence. Over 80% felt that the module had had a positive effect, and none felt that it had a negative effect on their visit.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): An interactive, point-of-care computer program has the potential to overcome barriers to diagnosing and treating female incontinence in primary care, although systematic administration may be necessary to consistently identify women with symptoms. Assisting physicians and their patients in discussing incontinence may have important implications for womens quality of life.

AN OUTPATIENT INTRAVENOUS DIURESIS CLINIC AS AN INNOVATIVE APPROACH TO THE MANAGEMENT OF HEART FAILURE Sunal Makadia1; Ugonna Nwosu1; Tanya Simmons1,2; Nowreen Haq1; Kapil Parakh1,2. 1Johns Hopkins Bayview Medical Center, Baltimore, MD; 2Johns Hopkins Medical Institutes,

Baltimore, MD. (Control ID #1332888)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): In this IRB approved study, we present pilot data from a recently launched, institution-based intravenous (IV) diuresis clinic as a novel approach to provide treatment and education for patients with heart failure. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): (1) To establish an institution-based outpatient IV diuresis clinic as a novel treatment strategy in heart failure(2) To utilize the outpatient IV diuresis clinic as a novel venue for heart failure education (3) To reduce costs associated with heart failure by reducing heart failure hospitalizationsDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A clinic was set up at an academic community hospital to provide IV diuretics to outpatients. Protocol: On arrival, vitals are checked, and labs and EKG are obtained for every patient. A cardiologist evaluates all patients and assesses suitability for IV diuretic therapy. Where appropriate, IV furosemide is administered at a pre-determined dose with electrolyte supplementation as needed. Patients are monitored in clinic for at least 3 hours for adverse events. Urine output is recorded as well as weight on arrival and discharge. During diuresis, patients receive education from a dedicated HF nurse. Clinically unstable patients are stabilized and referred directly to the hospital. Patients are re-assessed by the cardiologist prior to discharge. Arrangements are made for subsequent sessions as appropriate. Patients are followed up by telephone call within 30 days to evaluate symptoms, quality of life, and number of readmissions to the hospital. All data reported in this study is routinely collected as part of clinical services provided.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): (1) Rate of admission to the hospital within 30 days (2) Quality of life within 30 days (3)Heart failure knowledgeFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): To date, we have data from 66 total IV diuresis sessions from 16 patients. No patients required admission to the hospital after outpatient IV diuresis. One patient experienced dizziness and orthostatic hypotension the day after diuresis but these symptoms resolved. The cardiologist determined to not administer IV diuretics on 10 sessions based on clinical data (hypokalemia n=2, elevated creatinine, n=5, orthostatic hypotension n=3). One patient left clinic prior to receiving diuresis. Two patients were determined to require emergent care on arrival to the diuresis clinic and were referred directly to the hospital. Average length of visit was 3 to 4 hours and mean fluid loss was

1160520 ml per session. To date, two of our patients have required inpatient admission for decompensated heart failure within 30 days of treatment. One of these patients died after admission. All patients treated have voiced significant satisfaction with IV therapy in clinic and report better quality of life. Patients report significant satisfaction with HF education and report better understanding of their illness and disease management. Providers and referring physicians expressed much satisfaction with the service.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Pilot data from the Johns Hopkins Bayview Diuresis Clinic suggest that outpatient IV diuresis appears to be a promising strategy to provide treatment and education for heart failure patients. As the cost of a diuresis clinic visit is significantly less than the cost of hospitalization, there is substantial potential for cost reduction. Further studies are needed to establish the safety, cost-effectiveness, efficacy, and impact on readmissions.
ANALYZING READMISSIONS AT A COMMUNITY HOSPITAL Lee Park1,3; Danielle Andrade1; Andrew Mastey1; LeRoi Hicks2. 1Newton Wellesley Hospital, Newton, MA; 2University of Massachusetts Medical Center, Worchester, MA; 3Harvard School of Public Health, Boston, MA. (Control ID #1338518)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Despite high readmission rates, our institution did not have a process for systematically evaluating medical discharges that led to readmissions.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Evaluating whether or not hospitalists were aware of readmissions. 2. To determine institutional-specific risks factors for readmission by reviewing processes for readmitted patients compared to those without readmission.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our institution is a community hospital with a hospitalist group that cares for most medical admissions. Readmission was defined as rehospitalization within 30 days of discharge. We first surveyed 21 hospitalists in May 2010 about 34 recently discharged patients to evaluate whether or not they were aware of their readmissions and to ascertain their opinions on the cause for readmission. We then conducted a review of 100 discharges with diagnoses of either congestive heart failure (CHF) or pneumonia (PNA) utilizing data from the Transitions Systems Incorporated database and data from the electronic medical record as well as from the hospitalist group records to compare characteristics between cases that were and were not readmitted. We then collected data from all inpatient medical discharges (n=4012) from January 1, 2009 until December 31, 2010 with diagnoses of CHF, PNA and/or chronic obstructive pulmonary disease (COPD) excluding patients who were transferred to another acute care hospital or expired during the admission. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We are currently evaluating the larger dataset and have preliminarily found that readmissions at our institution have similar characteristics to those documented in the literature. We will further analyze these data to examine our hospital-specific factors identified from the survey and limited chart review.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Of our surveyed hospitalists, 13 (62%) responded regarding 21 patients. Of these, 9 (42%) were aware of the readmissions with 4 of these patients (44.4%) readmitted to the same hospitalist. In the smaller analysis of 100 charts, we examined factors that reflected processes at our institution including hospitalist hours and census on the day of discharge, census of the floor and floor of discharge, service (housestaff vs. non-housestaff), day of discharge (hospitalist and housestaff switch days vs. non-switch days). We found a significant trend between readmissions and switch day when compared with a chi-square test (OR 2.5[0.99-2.26]). Of the 4,012 discharges from the medical service, 697 (17.3%) were readmitted in 30 days. In preliminary analyses, we found discharges leading to readmissions are more likely to be older (mean age 77.5 yrs vs. 75.6 yrs), have an admission in the previous calendar year (22.8% vs. 14.8%), have a longer length of stay (mean 5 days vs. 4 days), have a higher Elixhauser sum score (mean 4.3 vs. 3.9), and were more likely to have initially been discharged to a facility (42.6% vs. 34.0%). We have also found that readmissions are more likely to come from discharges from the housestaff service (85% vs. 80.4%).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We found that hospitalists are not aware of their readmissions the majority of the time and that it is possible at a community hospital to find ways to link readmissions back to the previous discharge and discharging hospitalist to systemically analyze readmissions.

AUTOMATED COMPUTER ALERTS TO IMPROVE WARFARIN PRESCRIBING AMONG HOSPITALIZED INPATIENTS Michele Fang; Todd Burstain; Peter Cram. University of Iowa Carver College of Medicine, Iowa City, IA. (Control ID #1331740)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Anticoagulant drugs are a common cause of preventable adverse drug events in hospitalized patients.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): We developed and implemented computer alerts into our electronic medical record (Epic Systems Madison, WI) based upon the Joint Commission National Patient Safety Goal for Anticoagulants. The alerts consisted of an automated

warning, a link directing providers to correct the deficiency, and a brief explanation of the rationale for the alert. For example, a computer alert would be triggered reminding the provider to check an INR level if a patient receiving warfarin did not have an INR ordered within the last 72 hours. Initiation of the reminder alerts was supplemented by an educational session for residents on proper monitoring of anticoagulants and use of the warning alerts. Our goals were to use the alerts to improve compliance with National Patient Safety Goals for anticoagulants and decrease the proportion of supratherapeutic INRs and bleeding complications.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We conducted a retrospective before-after study of the effectiveness of the computer alerts and resident education session. The analysis included all adult patients admitted to a tertiary referral center between September 1, 2010 through February 19, 2011 during 3 different time periods: (phase 1: alerts fired silently without notification to providers, phase 2: alerts fired with notification of providers, phase 3. alerts notifying providers with resident education).
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1) proportion of INR>4; 2) the percentage of patients experiencing bleeding complications; 3) the number of alerts relative to anticoagulation orders; 4) the number of alerts that resulted in an appropriate response.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): We observed a 55% decrease in the number the proportion of patients with INR>4 when comparing Phase 3 to Phase 1 (143 out of 10699 in the post-alert period, 201 out of 6751 in the pre-alert period) (P<.001) We did not see a significant decline in the number of bleeding episodes (1.7% in Phase 1, 2.1% in Phase 2). There were signs that the computer alerts changed physician behavior. There was on average a 55% decrease in the firing of warfarin computer alerts in Phases 2 and 3 when compared to Phase 1 (one-tailed proportion test $p<0.001$) even as the number of warfarin prescriptions remained stable. Approximately 33% of computer alerts resulted in the recommended response by the clinician during Phase 2. After completion of resident education (Phase 3), approximately 47% rate of alerts resulted in the appropriate response.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Use of computer alerts embedded in the electronic medical record with mandatory stops is an inexpensive method to improve

compliance with anticoagulant monitoring and decrease the rate of supratherapeutic INRs. A single session of resident education seemed to enhance provider response to the alerts.

BAYVIEW PATIENT CONNECTION (BPC): AN AMBULATORY INTENSIVE CARE EXPERIENCE FOR HIGH-UTILIZING MEDICAID PATIENTS IN AN INTERNAL MEDICINE RESIDENCY CONTINUITY CLINIC Marc Larochelle; Melissa Dattalo; Huy Do; Sean Tackett; Justin Elfrey; Ryan E. Childers; Lauren Graham; Lana Elpert; Wendy L. Bennett; Laura Hanyok. Johns Hopkins Bayview Medical Center, Baltimore, MD. (Control ID #1334968)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Delivering high quality care to high-utilizing medically and psychosocially complex patients in residency continuity clinics is challenging, and this experience may discourage residents from pursuing careers in general internal medicine (GIM).
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Improve care for high-utilizing Medicaid patients through translation of evidence-based interventions. 2. Reduce unnecessary inpatient admissions and emergency department (ED) visits. 3. Improve resident skill and satisfaction with caring for challenging patients. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): High-utilizing patients from a Medicaid HMO who receive primary care at the Johns Hopkins Bayview GIM Clinic were identified. 15 new July 2011 interns were assigned a high-utilizing patient

whose PCP was an outgoing PGY3 resident. A multifaceted intervention was designed and implemented with the intern-patient pairs. Intervention patients were offered a home visit with their new PCP, with the goal of identifying psychosocial factors influencing health behaviors. Interns received training in shared decision making and motivational interviewing, and an Action Plan document was created to record and track goals. Every two weeks, interns met as a group with a faculty mentor and multidisciplinary team members to share experiences and problem solve. Intervention patients were scheduled office visits every six weeks with their assigned intern. Each intervention patient was assigned a case manager from the Medicaid HMO. 23 high-utilizing patients with rising PGY2 and PGY3 resident PCPs served as a usual care cohort for comparison.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Administrative data from the Medicaid HMO will be used to compare the number of inpatient admissions and ED visits. Patient-perceived quality of care, quality of the patient-provider relationship, and satisfaction with the outpatient experience for patients and residents will be compared using validated surveys. Resident specific outcomes include their attitude toward challenging patients and self-reported adequacy of training in Systems-Based Practice. Number of visits, phone notes, and Action Plans from the clinic EMR will be tracked to assess the degree of intervention implementation.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Of the 165 Medicaid HMO patients who regularly attend the Bayview GIM clinic, 49 (30%) accounted for 82% of hospital utilization with a mean of 8.0 inpatient admissions and ED visits for the 12 months ending February 28, 2011. During the programs first 6 months, intervention patients attended, on average, a similar number of office visits (3.0 visits, 53% with PCP) compared to usual care patients (2.9 visits, 60% with PCP). Intervention patients had more contact with their PCPs outside of clinic visits. Ten (67%) interns visited their intervention patients at home, while no usual care patients received home visits. Intervention patients had phone contact with their PCP 2.0 times on average compared with 0.6 times for usual care patients. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): This intervention has the potential to transform resident frustration with challenging outpatients into a learning opportunity that may increase self-efficacy and inspire more trainees to pursue GIM careers. If the model is successful, dissemination to other academic practices has the potential to add tremendous value with minimal resources.
BUILDING AN ACADEMIC PRIMARY CARE-BASED CENTER FOR INTEGRATIVE MEDICINE: THE BETH ISRAEL DEACONESS MEDICAL CENTER (BIDMC) EXPERIENCE Kim D. Ariyabuddhiphongs. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1342331)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Surveys have shown that nearly 40% of Americans use complementary and alternative medicine (CAM) annually and there is emerging evidence on the utilization, safety, and efficacy of CAM for common medical conditions including musculoskeletal pain, mood disorders, insomnia, hyperlipidemia, hypertension, and diabetes.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Integrative Medicine (IM) embodies many aspects of exceptional primary care: patient-centered care that attends to the whole person, features healing partnerships between providers and patients, and creates a culture of self-care and wellness. Integrative medicine also combines both conventional treatments and CAM practices. Our academic IM center at BIDMC aims to promote healthy behavior and self-care by providing IM services to support our patients in attaining and maintaining optimal health. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our center is one of the first of its kind in Boston: an innovative primary-care based model where patients can engage in integrative therapies alongside and under the supervision of their primary care physician (PCP). The development of our program has required significant planning-obtaining support from hospital leadership, designing a plan for sustainability, recruiting a team of

administrators, and IM-trained physicians, and selecting a PCP to champion the program. The center will be located within our primary care practice serving more than 40,000 patients. We will provide IM services with trained providers in healing traditions (acupuncture, Tai Chi, yoga), massage therapy, and behavioral and lifestyle therapies (nutrition, exercise, health coaching). Our center will also offer consultations on integrative nutrition, cardiovascular health, and mind-body medicine, provided by physicians with IM fellowship training. All providers will collaborate in monthly team meetings with case-based discussion. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): In addition to clinical services, our program will educate physicians and the community on IM and healthy behaviors through continuing medical education programs, resident rotations, and public programs on topics such as exercise counseling. We will develop tailored IM programs to specific disease populations, such as Tai Chi for patients with congestive heart failure, yoga for patients with asthma, and demonstrations on healthy cooking for patients with diabetes. Successful dissemination of our program will involve demonstrating referral to the Center for Integrative Care by greater than 90% of PCPs. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Because a comprehensive center of this scope had not previously existed at BIDMC, we have undertaken a process facilitated by a start-up fund from philanthropists. An IM Advisory Group composed of key division leaders, IM fellowship-trained physicians, and donors, has been central to the Centers development. Discussions on efficacy, safety and legal aspects have been instrumental for hospital approval. In addition, attention has been paid to physician supervision, communication, and documentation. Future steps will involve recruitment, hiring, and credentialing of IM providers. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Our clinical practice innovation details initial steps necessary for the creation of our Center for Integrative Care including: hospital executive, legal, patient safety, and credentialing approval, team member recruitment, programmatic development, and development of a physician consult in Integrative Care.

CONTINUED BENEFIT OF A DIABETES GROUP CLINIC (DGC) IN AN URBAN CLINIC POPULATION

Corinna Falck-Ytter; Guptha Baskaran; Christina Sanders; Lucinda Newshutz; Douglas Einstadter. MetroHealth Medical Center at Case Western Reserve University, Cleveland, OH. (Control ID #1339328)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): We examined the effects of the DGC on Hemoglobin A1c (HBA1c) for all patients and for those with a comorbid mental health disorder. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Improve Hemoglobin A1c and self-management skills.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The DGC offers group visits for up to 13 patients at a time. Initially the patients are assessed individually based on information from a diabetes summary that is available through our electronic medical record. A group discussion on topics chosen by the attendees and led by a diabetes educator follows. Topics include diet, exercise, medications and cost of medications, and adjustment to illness and self-management. Each patient is then seen individually by the MD or NP and therapy is adjusted, referrals made and exams performed as needed. When necessary, additional individual sessions to teach skills such as insulin injection or self-monitoring are completed. Patients are referred to the DGC by their primary care physician (PCP) when eligible (type 2 diabetes, Hemoglobin A1c (HBA1c)>7%, English speaking, no gestational diabetes). Patients follow up once a month until their target HBA1c is achieved and continue to see their PCP as needed. DGC sessions are conducted by an RN and CDE (scheduling, assessment, group education, individual teaching), MD and NP (exam, medication adjustment,

referrals) and a nurse who manages the diabetes registry for the Medical Home and can refer patients directly to the DGC. The individual care plans that are part of the Medical Home are given to the patients at the end of the visit and contain general information about their diabetes and individualized goals and commitments until their next visit.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Before and after HbA1c for DGC attendees compared with non-attendees.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Between October 2009 and August 2011, 166 patients were referred, 85 (51%) of whom attended at least one visit to the DGC. The mean age for patients attending DGC was51.3 years, 44% were women, 51% African American, 33% uninsured and 60% had a documented MHD. The mean baseline HbA1c was 10.4% for the attendees and 10.2% for non-attendees. Those who attended experienced a 1% decrease in their HbA1c over the subsequent 6 months. During the same time period the HbA1c for non-attendees decreased by 0.1 %. In the attendee group the HbA1c decreased by 0.5% for those with a MHD and decreased by 1.3% for those without a MHD. In the non-attendee group the HbA1c increased by 0.82% for those with a MHD and decreased by 0.5% for those without.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): At our institution, the Diabetes Group Clinic has been associated with improved outcomes for patients with poorly controlled diabetes in an urban resident clinic, including those with coexisting MHD. In our experience it is important to incorporate the data available through the electronic medical record to educate patients about their diabetes and to formulate clear goals between visits. For patients with diabetes and MHD, we are exploring the establishment of joint group visits co-led by both mental health and internal medicine providers
CONTINUITY OF CARE IN AN INTERNAL MEDICINE RESIDENCY AMBULATORY CLINIC:FACT OR FICTION Maria Palomata; Delaram Moazami. Capital Health, Trenton, NJ. (Control ID #1339635)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Is high rate of continuity of care attainable in an Internal Medicine Residency Ambulatory Clinic or is it an idealistic goal? OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To evaluate the effectiveness of systems based changes in continuity of care in an Internal Medicine Residency Ambulatory Clinic serving an ethnically diverse urban population.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Continuity of care powerfully affects patient-focused outcomes and has shown to benefit patients with chronic medical illness. It is also associated with patient and provider satisfaction, high quality of care and decreased cost. There is a scarcity of published reports specifically for Internal Medicine Residency Ambulatory Clinics regarding continuity. The ACGME and Internal Medicine RRC support continuity in resident clinics and require residents to attend a minimum of 130 longitudinal continuity clinic sessions during their training. Every effort is made to maintain continuity. However, rotation requirements limit residents availability. Recent changes in healthcare delivery promote team-based care. From July 2010, systems based changes, including 1) establishing a distinct resident/patient practice team 2) chart color coding to identify patients practice team and 3) staff education and close monitoring of appointment assignment, were implemented .
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Residents patient panels were identified based on consecutive clinic registration from July 2010-June 2011. A retrospective analysis of data from registration and medical record review was completed for July 2009-June 2011. We included patients seen at least 3 times each academic year. We collected the total number of patient visits per academic year, visits with primary resident,

visits with primary residents team, or other providers. Three indices were used to measure continuity: Usual Provider Continuity Index (UPC-visits with usual provider/total visits), Team Provider Continuity Index (TPC-visits with team provider/total visits) our modification of UPC to measure care provided by the primary providers team and Modified, Modified Continuity Index (MMCI-a measure that considers the number of providers seen). Data from one academic year before and one year after implementation of systems based changes were measured and compared using independent sample T-test.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Data from 112 eligible patients were included in the analysis after review of 773 patients registration record and 148 charts. 19 residents were identified as usual providers for these eligible patients and were grouped into 5 teams. Mean number of visits for each eligible patient was 5.11 before systems based changes and4.76 after. Initial mean UPC, TPC and MMCI were 0.73, 0.89 and 0.69 respectively. After systems based changes, these improved to 0.81, 0.94 and 0.76 (p value<.01, <.01, <.05).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Data validated that for patients seen at least 3 times per year, continuity of care can be maintained to a high degree in an Internal Medicine Residency Ambulatory Clinic. Systems based efforts improved continuity. Analysis confirms that we outperform the average continuity indices in published literature for academic settings (UPC 0.43-0.68; MMCI 0.44-0.64). Having a team based approach and a new index to measure adherence (Team Provider Continuity Index/TPC) allowed scheduling flexibility for better patient access if the primary resident is not available, yet it limited the number of providers a patient can see.
CREATING MODELS FOR GLOBAL HEALTH AND PRIMARY CARE: A TEAM-BASED APPROACH FOR MANAGING GLOBAL HEALTH RESIDENT PATIENT PANELS Charlotte A. Wu1; Rose M. Kakoza1; Joy E. O'Brien1; Charles A. Morris1; Lori Tishler1; Joseph J. Rhatigan1; Andrew L. Ellner1,2. 1Brigham and Women's Hospital, Boston, MA; 2Harvard Medical School, Boston, MA. (Control ID #1334436)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Despite shared missions within primary care and global health to serve vulnerable populations and develop innovative health care delivery approaches, balancing global health training with resident continuity clinic is challenging and few models exist for practicing physicians to pursue global health and stay in primary careOBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): The Global Health Equity Resident

Primary Care (GHE-PC) team in The Jen Center for Primary Care (PJC) was established in order to: -Create a robust system for team-based care delivery to support GHE residents while away -Improve continuity of care and communication -Increase patient, staff and provider satisfaction DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Residents in the Global Health Equity (GHE) residency at Brigham &Womens Hospital (BWH) complete 12 months of global health training over 4 years. The PJC, a faculty/resident clinic at BWH with ~40,000 patient visits/yr, is the training site for nearly 80 residents including the majority of GHE residents. The GHE-PC team embedded in the PJC includes: -A team of GHE residents with a dedicated faculty preceptor and a NP -New care plans for high-risk patients with clarified hand-off, communication, and coverage models There are 2 implementation phases: Phase 1: establishment of a dedicated joint preceptor for GHE residents for co-management, pilot-testing integrated support package; Phase 2: addition of NP MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Quantitative and qualitative evaluations of pre/post implementation metrics for a sample of GHE resident patients: -Continuty of care: Percentage of out-of-team urgent care visits/contact -Patient utilization of hospital/ambulatory resources: ED utilization rates, 30-day hospital re-admission rates -Patient, resident, and

staff experiences: Qualitative data obtained through patient focus groups and surveys FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Preliminary data after Phase 1 Patient Outcomes: -Decreased care fragmentation for high risk patients and urgent/ post-discharge visits Patient Experience: -Increased comfort with seeing the team preceptor in transitional care -Increased satisfaction and feeling of security by being seen more often -Decreased sense of abandonment when PCPs are away Team Member Experience: -Increased resident satisfaction in their primary care experience and delivery of care to medically and psychosocially complex patients -Substantial decrease in staff complaints about GHE resident absences and impact on patient care -Improved communication with clear sign-outs when GHE residents go abroadKEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): This model addresses the significant issue of fragmented care created by balancing global health and primary care training. Preliminary data shows that our model may significantly improve service utilization and patient, staff, and provider experience Lessons learned can inform: -Other practice settings with providers with interest in global health, creating career paths for combining primary care and global health, and fostering active exchange of care delivery strategies -Team-based ambulatory training models for all residents to support discontinuity in outpatient care -New measures of continuity of care In the movement towards team-based primary care, we implemented a model for building capacity among non-physician staff to support vulnerable populations within a fragmented care system

DECREASING OPERATING ROOM DELAYS WITH COMPREHENSIVE PREOPERATIVE CARE Barbara Slawski; Kurt J. Pfeifer. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1338267)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Operating room (OR) delays cause significant patient and physician dissatisfaction and have financial impact on medical facilities, who often set goals to decrease OR delays.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Standardize preoperative medical evaluations and testing. 2. Centralize administrative functions related to preoperative care, such as chart preparation. 3. Improve OR efficiency by utilizing a standardized, interdisciplinary program.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The Pre Admission Testing Clinic (PAT) is a multidisciplinary preoperative clinic at an academic center performing over 15,000 OR cases annually. Causes of OR delays are numerous and include lack of chart completion and unaddressed medical problems. The goal of PAT is to provide safe, consistent and reliable preoperative care in a comprehensive manner to surgical patients. Key services provided in PAT include standardized preoperative evaluations performed by Anesthesiology, Internal Medicine, or non-physician providers; diagnostic testing completed in a protocolized and streamlined manner; medication reconciliation by a pharmacist; patient education; and completion of required preoperative RN evaluations and paperwork. Referral of preoperative patients to PAT is elective at the discretion of the surgeon. Currently, about 8,000 patients are seen in the clinic annually.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Scheduled Procedural Start to Wheels In and Scheduled Procedural Start to Actual Procedural Start are dashboard metrics routinely measured by surgical services. Wheels In is the actual time the patient enters the OR. These outcomes were compared for surgical patients in August and September 2011 who were seen and not seen in PAT Clinic.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Patients seen in PAT had shorter surgical delays than patients not seen in PAT. The Scheduled Procedural Start to Wheels In was on average 20.0 minutes for patients who were seen and 35.1 minutes for patients who were not seen in PAT (95% CI 15.9-24.0 and 29.8-40.4 respectively, p=0.0004). The Scheduled Procedural Start to Actual Procedural Start was an average of 14.2 minutes less for patients who were seen in PAT (95%CI 50.6-59.2 and

63.8-74.4 min respectively, p=0.001). OR availability may have allowed early surgical starts, but when negative start times were adjusted to zero, data remained significant with an average difference in surgical delays of 19.4 and 15.9 minutes, respectively (p<0.0001 for both).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Perioperative medicine is a growing clinical area within Internal Medicine. There is not a single accepted model for preoperative care. This preoperative clinic focuses not only on delivery of standardized clinical care, but also on the administrative processes required to prepare patients and associated documentation for surgery. Use of the preoperative clinic decreases the number of minutes patients are delayed in the OR, improving efficiency, and having the possibility of improving staff and patient satisfaction. Establishing and expanding a sustainable preoperative clinic is challenging, as these clinics are often viewed as non-revenue producing. Creation of a sustainable perioperative program requires identification and demonstration of improved measures that are aligned with institutional goals. OR costs are often estimated at over $20 a minute. Linking improvement in OR efficiency to a preoperative clinic can establish significant financial benefit of a preoperative clinic to the institution.
DESIGN AND DEVELOPMENT OF A CHURCH-BASED, PHOTOVOICE INTERVENTION FOR LATINOS WITH DIABETES Arshiya A. Baig1; Cara A. Locklin2; Michael T. Quinn1; Marla C. Solomon3; Lisa Sanchez-Johnsen4; Deborah L. Burnet1; Marshall Chin1.
1University of Chicago, Chicago, IL; 2University of Illinois at Chicago, Chicago, IL; 3University of Illinois at Chicago, Chicago, IL; 4University of Illinois at Chicago, Chicago, IL. (Control ID #1326842)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Churches provide a novel setting for chronic disease self-management programs; however, data from Latino communities are lacking. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To assess the effect of a church-based diabetes self-management intervention on diabetes outcomes among LatinosDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We partnered with two Latino churches in an urban, low-income community. In Phase I, we conducted focus groups with 37 Latino adults with diabetes and their family members to assess preferences for church-based diabetes interventions. In Phase II, we formed a community advisory board (CAB) of

key stakeholders to guide the development of the intervention. We used input from the CAB and the data from the focus groups to design a church-based diabetes intervention for Latinos with diabetes, Picture Good Health (PGH). PGH is an 8-week church-based diabetes intervention that consists of weekly diabetes self-management classes led by trained lay leaders, a photovoice component, an exercise program and patient navigation services. For the photovoice, participants receive disposable cameras to take photos of their lives with diabetes. The photos are used in the class to facilitate discussion around diabetes self-empowerment. For the exercise component, participants engage in weekly church-based aerobics and exercises classes. To enhance linkages to the healthcare system, patient navigators assisted participants in finding primary care physicians. In Phase III, we are now recruiting English and Spanish-speaking adults with diabetes to enroll in a community-based, randomized control study to assess the impact of the intervention on diabetes outcomes. Participants in the control group are offered a one-hour diabetes education class and diabetes educational materials.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): A sample size of 100 participants provide 80% power to detect mean differences between groups of 1.26% in HBa1c at any two time points. The primary outcome is

change in HbA1c from baseline to follow-up at 3 and 6 months. Secondary outcomes include changes in systolic blood pressure, weight, lipids, diabetes self-management, self-efficacy, self-empowerment, knowledge and medication adherence. We are also conducting a process evaluation to understand the feasibility and challenges of implementing the intervention. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): To date, we have recruited 72 Latino adults with diabetes. Three intervention classes have been given and the control group has received two diabetes lectures. We have 3 month follow-up data on 20 participants (10 control and 10 intervention). Participants in the intervention arm have had a 0.980.23% drop in HbA1c versus a 0.510.4% drop in the control arm (p=0.20). In preliminary theme analyses, we found participants took photographs of food, the neighborhood, their homes, family and friends, medication, and diabetic supplies.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): A multi-component, church-based diabetes intervention shows an early trend towards improved HbA1c among Latinos with diabetes.
DEVELOPING A PRACTICAL, SELF-SUSTAINING, CLINIC-BASED YOGA PROGRAM FOR PATIENTS WITH CHRONIC LOW BACK PAIN AT AN URBAN ACADEMIC HEALTH CENTER Brian C. Hilgeman; Steve Hillson; Anna Cox; Nissa Valdez; Sheri Thorson; Adrian Sotro. Hennepin County Medical Center, Minneapolis, MN. (Control ID #1327420)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Can an Internal Medicine clinic located in a large county hospital successfully implement and sustain a Yoga program for patients with chronic low back pain?
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): - Implement and sustain weekly Yoga classes for our patients with chronic low back pain - Objectively and subjectively assess for improvements in pain and disability among our patients - Measure the financial feasibility of such a program
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Therapeutic yoga is a form of exercise involving stretching, breath work, and meditation that has strong evidence supporting its efficacy in treating chronic mechanical low back pain. However, its utility has not been proven to be practical outside of the research realm. Further, practical limitations (such as availability, cost, transportation and scheduling) and patients concerns about community-based programs made it difficult to engage our patients in off-site yoga programs. We sought to develop an on-campus, low- or
no-cost therapeutic yoga program for these patients. Our intervention was conducted at Hennepin County Medical Center in Minneapolis, MN, a large community-based county health system. Our internal medicine clinic serves a total of 10,328 patients with multiple staff and resident providers. Our patients are 55% male, 69% minority with 48% African American, and the majority of our patients rely on public health insurance. We recruited patients with chronic, mechanical low back pain via provider referral. We were able to procure 43 referrals and enroll 14 patients in our first session. Our intervention consisted of weekly 75 minute classes for a total of 12 weeks held in the Chapel of our hospital. Each patient had a brief staff or resident physician visit in the group setting, vital signs were taken and medical concerns were addressed. Typically, a level 1 or 2 provider encounter was billed to insurance. The classes were led by a professional Yoga instructor implementing therapeutic and restorative Yoga postures specifically focusing on relieving chronic low back pain. We provided our patients with Yoga mats, blankets, bolsters, and blocks to use throughout the class. In attendance, we had a range of 3-8 patients with an average age of 50 (42-72), 33% men, all enrolled in public insurance (4 MA, 6 Medicare), and 7/10 of African-American or African-born heritage. All of our patients had no exposure to Yoga prior to our intervention and came with significant physical limitations.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We plan to analyze average weekly pain scores,

Oswestry Diability Scores (from start of intervention to completion of intervention), and subjective reports of pain improvement to measure the success of our program.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): We have thus far analyzed basic demographics as outlined above. Analysis of average weekly pain scores and disability scores will be available by the time of poster presentation. We also hope to have data about the financial feasibility of this intervention.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): - There is strong evidence to support the use of Yoga to treat chronic low back pain - Implementing a Yoga program for patients with chronic low back pain is practically and financially feasible (and professionally satisfying) in a community based clinic, specifically in a county academic health center that serves a largely under-served, minority, and impoverished population.
DEVELOPING A TOOLKIT TO ENHANCE PATIENT CENTERED MEDICAL HOME IMPLEMENTATION: IMPROVING HYPER-TENSION AND SMOKING OUTCOMES THROUGH PANEL MANAGEMENT Mark D. Schwartz1,2; Jaclyn Fox1,2; Stella Savarimuthu1,2; Katelyn Bennett1,2; Karolina Pekala1,2; Joseph Leung1,2; Anne Dembitzer1,2; Scott Sherman1,2; Colleen Gillespie1,2; Alfredo Axtmayer1,2. 1Veteran Affairs Hospital, New York, NY; 2NYU School of Medicine, New York, NY. (Control ID #1337677)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): To determine how adding a non-clinical member to primary care teams can improve hypertension and smoking cessation outcomes in Veteran Affairs New York Harbor Healthcare Systems (VA NYHHS) implementation of the VAs Patient Centered Medical Home (PCMH) model, known as Patient Aligned Care Teams (PACT).
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): As part of the Program for Research on Outcomes of VA Education (PROVE) study, we sought to define a toolkit of panel management strategies that Panel Management Assistants (PMAs) will use to improve outcomes in smoking cessation and hypertension across patient panels.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Coincident with the nation-wide implementation of PACT across the VA system, PROVE explores the incremental impact of panel management and clinical microsystem education on hypertension and smoking outcomes. Two-thirds of randomly selected PACT teams in ambulatory care clinics

at the Brooklyn and Manhattan campuses of the VA NYHHS had a PMA added to the team. Based on literature review and qualitative interviews of clinicians and key stakeholders at VA NYHHS, we developed a core toolkit of strategies utilizing clinical databases to target subsets of smokers and hypertensive patients that could benefit from specialized panel management interventions outside of the patient visit, such as identifying smokers who have not recently received tobacco cessation medications.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Prior to PROVEs intervention, we determined baseline rates of hypertension (uncontrolled and controlled) and smoking for all PACT panels. To assess PROVEs effectiveness of integrating panel management strategies by PACT teams, we will survey providers and nurses at baseline, 6 and 12 months to measure the teams changing views and patients at baseline, 6 and 12 months. We will also measure the change in number of smoking quit attempts, quit rate, rates of controlled versus uncontrolled hypertension, increased medication adherence, medication possession ratio and no-show rate. Additionally, PMAs will keep activity trackers to monitor intervention attempts and team cohesion to identify the most successful strategies for improving panel wide outcomes.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Researchers conducted semi-structured interviews with 12 primary care providers and 5 administrators and staff to identify

care gaps amenable to PMA intervention. These 9 care gaps became the basis for the strategy toolkit and are addressed by 10 specific PMA strategies. The gaps were grouped into 5 domains - access to care, patient centeredness, patient education, and hypertension- and smoking cessation-specific strategies. Toolkit examples include: 1) Domain: Access to care; Gap: Increasing outreach to vulnerable patients; Strategy: Perform database queries and follow-up for uncontrolled hypertensive patients not seen in 1 year. 2) Domain: Smoking cessation-specific strategies; Gap: Addressing barriers to quitting; Strategy: Follow-up phone call two weeks after patient prescription of nicotine replacement. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): PROVE will provide a foundation for implementing panel management in primary care clinics. We will determine which PMA toolkit activities are most successful in improving health outcomes and patient and provider satisfaction, and thus facilitate adaptation of panel management to various settings and locations.

DEVELOPMENT AND EFFECTIVENESS OF GROUP WEIGHT LOSS VISITS IN A FEDERALLY QUALIFIED HEALTH CENTER Adam G. Tsai1,2; Elizabeth Raube1; Judith Conrad1; Jeanne M. Rozwadowski1,2. 1Denver Health, Denver, CO; 2University of Colorado, Aurora, CO. (Control ID #1309589)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Obesity and its co-morbidities are extremely common in primary care settings, but the brief primary care visit is not well suited to an in-depth discussion of weight management.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) Establish group visits for weight loss in our federally qualified health center 2) Motivate patients to attend weekly classes for 5 weeks and to keep records of food and physical activity during that time 3) Induce weight losses of 1-2 pounds per week during the period of the group visitsDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We offered a 90 minute group visit, once weekly for five weeks. The group visit is offered quarterly and is open to all patients from our practice and from 7 other primary care practices that make up the outpatient department of Denver Health (the city hospital for Denver, Colorado). Materials used were from the National Institutes of Health and the American Dietetic Association. These materials were supplemented with visual aids to teach portion size and calorie counting. Classes are co-led by a registered nurse and either a nurse practitioner or a primary care physician. We seek to have patients keep records of food intake and physical activity and to lose approximately 1-2 pounds per week. Each class consists of a "check-in" for patients to report calorie intake and physical activity, time for didactic teaching, time for questions, and time at the end of each class for patients to set goals. We are able to bill for these visits using a primary diagnosis code for obesity, and by individualizing patients' goals.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We have tracked referrals, enrollments, attendance, and weight loss over a period of 7 quarters (21 months). FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): During the first 21 months, a total of 180 patients were referred to the groups. Of these 180, only 58 patients attended a first class. Of the 58 that attended a first class, 47 finished the 5 weeks of the group visits. These 47 individuals lost 2.9 pounds between week 1 and week 5 of the groups and regained 1.7 pounds at 22 weeks after the end of the group visits (weights abstracted from the medical record). We informally surveyed 30 patients that registered but did not attend a group. most of these individuals reported that they wanted to attend the groups but had other more pressing commitments (child or family care, seeking work).

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1) Weight losses of nearly 1 pound per week can be achieved in a low income patient population with a high percentage of ethnic minorities. 2) Weight regain was observed after the end of the 5 week group visit. This is common in behavioral interventions and shows that longer/more intensive

intervention may be needed. 3) The no show rate for the group visits was very high, illustrating the challenges of conducting behavioral interventions in a low income patient population. We are attempting to overcome this by registering a larger number of patients for each group.

DISCHARGE PROCESS IMPROVEMENT ON A GENERAL INTERNAL MEDICINE INPATIENT TEAM Gwen Crevensten; Maria Winne; Kathleen Buckley; Sara Macchiano; Theresa Mills; Jennifer Harris. Massachusetts General Hospital, Boston, MA. (Control ID #1340508)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The hospital discharge process coordinated by inpatient general medicine teams can be hurried, inefficient, and disorganized, resulting in patient and staff dissatisfaction, discharge delays, and potentially errors in patient care. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Our team sought to improve the organization and fluidity of patient discharge as measured by predictability of discharge timing and staff perception of the ease of discharge.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The discharge process improvement pilot took place on the Academic Hospitalist Service, an inpatient general medicine team at Massachusetts General Hospital with an average census of 10-13 patients. This service encompasses portions of two general medicine inpatient floors, and includes patients cared for by hospitalists as well as MGH-affiliated primary care providers in conjunction with nurse practitioners. Patients included in the pilot were discharged to home, skilled nursing facilities, acute rehab, and long-term acute care. The pilot was coordinated by a multidisciplinary team comprised of case management, MDs, NPs, floor nurses, social work, and physical therapy. Prior to the intervention, a survey was conducted to collect background data to better define the causes for inefficient, delayed, or hurried discharges. Interventions were developed targeting the most frequent causes for delay or disorganization identified in this survey. The teams interventions focused on a multidisciplinary approach to predicting the estimated date of discharge, and a structured communication of this estimated date to the patients, their families, and the extended care team. The interventions were iterated weekly in response to feedback gathered during a brief huddle with the clinical team.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Measures of success for this pilot were to both improve the staffs perception of the organization of the discharge process, and to improve the teams ability to accurately predict the date of discharge.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Over a 3-month period in which the pilot was implemented and iterated, the perception of an organized and well-coordinated discharge rose from 46 to 80%. The ability of the team to predict an accurate discharge date increased from 30% to 48%. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Coordination of the discharge process is a critical component in the care of hospitalized patients. Clinical decisions and arrangements for follow-up made at the time of discharge have the potential to significantly impact the patients health and safety, as well as chance of readmission. Improved management of the discharge process also creates more time to spend with patients and their families to discuss their hospitalization and plans for follow-up, and to communicate with outpatient providers. Depending on patient volume, acuity, and level of involvement of residents, inpatient medicine teams in many other settings likely experience disorganized, rushed, or delayed discharges. The interventions developed here, while suited to this particular general medicine inpatient team, highlight two approaches that may be useful to teams in diverse settings: drawing on multi-disciplinary input to estimate the

date of discharge, and implementing a structured method to communicate and disseminate this date.
DRIVE TO BEAT SHINGLES EXCEEDS EXPECTATIONS RadhaM. Rao; Himabindu Kadiyala; Charles Wright; Nicholas Masozera. Michael E Debakey, Houston, TX. (Control ID #1338848)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Herpes Zoster vaccination rates have traditionally been low in our outpatient primary care clinics at the Michael E Debakey center after it was approved for patients 60 and older in 2006OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To see if vaccination rates for Zoster can be improved in a tertiary VA medical center through educating nurses and providers and increasing supplyDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Zoster vaccine was approved for adults 60 and older in 2006 .The most recent federal survey reports state as of 2009 only 10 percent of adults 60 and older were vaccinated against shingles Obstacles like intermittent shortages that last months have kept Merck from consistently marketing the vaccine and have forestalled public health campaigns that could have built awareness of the need for it. With Zostavax again in short supply, a C.D.C. advisory committee in June declined to vote on whether to recommend the vaccine for people in their 50s, even though the F.D.A. had already approved it for that group in March 2011, Recent attention on this vaccine prompted us to review our electronic medical records and we found that only 272 veterans had received the zoster vaccine out of a total of 18,656 eligible patients from 2006 to 0ctober 2011. 700 vials of Zoster vaccine were purchased from Merck in bulk in October 2011.All the Primary care providers were notified that there was fairly large supply of vaccines available. Veterans aged 60 and above both males and females, coming into the primary care clinics at the Houston VA for routine visit were identified by the epidemiologist in the department. Nurses received education from the epidemiologist and the pharmacy representative. Nurses and providers were given a list of eligible patients that had no contraindications at the beginning of the week between October 24 th 2011 and Dec 9th 2011. These patients were offered the zoster vaccineMEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Data regarding zoster vaccination was entered by the nurses in the electronic medical records.This data was later reviewed for accuracy and collected by the epidemiologist on site.It was
determined that about 1000 patients above the age of 60 visited the primary care clinics in those 9 weeks between October 24th and December 9th 2011 and of those 700 got vaccinatedFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): A record number of vets , approximately 700 of them were vaccinated between the months of Oct 24th 2011 and December 9th 2011 .
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Raising awareness through education and reminders among providers and nurses and increasing vaccine supply on site can dramaticaly improve vaccination rates
ECHO: AN INNOVATIVE CAMPUS-COMMUNITY PARTNERSHIP FOR MANAGING RESISTANT HYPERTENSION IN AN URBAN UNDERSERVED AREA Christopher Masi1; Tamara Hamlish2; AndrewM. Davis1; Kristine Bordenave3; Stephen Brown4; Brenda Perea5; Glen Aduana6; Marcus B. Wolfe7; George Bakris1; Daniel Johnson2. 1University of Chicago, Chicago, IL; 2University of Chicago, Chicago, IL; 3Humana Inc., Chicago, IL; 4University of Illinois, Chicago, IL; 5Advocate Healthcare Systems, Chicago, IL; 6Chicago Family Health Center, Chicago, IL;
7University of Chicago, Chicago, IL. (Control ID #1291887)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Providers at community health centers often have limited access to specialists for assistance in managing complex, chronic diseases, including resistant hypertension.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): The objectives of this intervention were to increase 1) hypertension management knowledge and 2) hypertension management

self-efficacy among primary care providers (PCP's) at six Federally Qualified Health Centers (FQHC's) on Chicago's South Side.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We created an interactive videoconference network in collaboration with six urban FQHC's to support Project ECHO (Extension for Community Health-care Outcomes), a 12-session educational program designed to teach state-of-the-art management of resistant hypertension. Each one-hour session began with a 20-minute lecture by a university-based hypertension specialist. PCP's then presented cases of patients with resistant hypertension. After each case, the hypertension specialist led an interactive discussion across the participating sites regarding management of the case. Learning occurred through the hypertension lectures, as well as through the case discussions. We hypothesized that this mini-fellowship, case-based approach would enhance hypertension management knowledge and self-efficacy in the intervention group but not among controls.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Carters 26-item hypertension management questionnaire was used to measure PCP knowledge at baseline and immediately following the intervention. We adapted Aroras disease management self-efficacy scale (1=no skill at all, 7=expert) to measure PCP confidence in managing hypertension at baseline and post-intervention. Twelve PCPs (9 intervention and 3 controls) participated in the study. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Demographic characteristics of the 9 intervention participants included a mean age of 33 years (SD=4.3), mean duration of practice of 6.8 years (SD=10.49), 7 female, 7 physicians, and 2 physician assistants; 3 were Caucasian, 1 African-American, 1 Latino, 2 Asian/Pacific Islander, and 2 East Indian. The mean number of correct answers on the 26-item hypertension knowledge test increased significantly in the intervention group (13.11 (SD=3.06) to 17.44 (SD=1.59), $p<.01$) but not in the control group (14.33 (SD=3.21) to 13.00 (SD=3.46), $p=.06$). Similarly, the mean score on the 7-item hypertension management self-efficacy scale increased in the intervention group (4.68 (SD=.75) to 5.41 (SD=.55), $p<.01$) but not in the control group (5.29 (SD=.49) to 5.62

(SD=.62), $p=.11$). Upon completion of the follow-up surveys, the PCPs requested additional curricula in diabetes, congestive heart failure, obesity, rheumatology, and dermatology. They also suggested that the sessions be archived for future use.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): By creating a community of learners using videoconference technology, the ECHO model increased hypertension management knowledge and self-efficacy among PCPs in an urban underserved area. The case-based, interactive discussions created learning opportunities for all participants, not just for those who presented cases. Videoconferencing is a convenient way to enhance interaction between community health center providers and university-based specialists, thereby increasing the likelihood that uninsured and underinsured patients will receive state-of-the-art care for complex, chronic diseases.
ELECTRONICALLY REPORTED INFORMATION FOR PATIENT-CENTERED PRIMARY CARE Arlene E. Chung1,2; Matthew Waters1; Shaun McDonald1; Carmen L. Lewis1. 1University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC; 2University of North Carolina at Chapel Hill, Chapel Hill, NC. (Control ID #1318391)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Patient-reported information is difficult to obtain in time for patient visits, so innovative approaches to obtain this information are needed to improve patient-centered care.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1.To leverage

health IT to facilitate patient-centered care through a web-based tool to collect electronically reported patient information. 2.To integrate this electronic information into the electronic health record (EHR) for review prior to visits. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our innovative program was implemented in a large, academic general medicine clinic. A web-based survey tool was created to improve patient-centered care by enabling collection of electronic information. The tool allows patients to enter 3 top health issues (agenda setting) that he/she want to discuss at their upcoming primary care provider (PMD) visit and collect other patient information. The tool interfaced to link the data securely into our EHR, which sent PMDs a note with agenda items for review before the visit. Inclusion criteria were all patients who had PMD visits and an email address on file. The tool has other functions, which will be added over the coming months including review of systems, decision support tools, etc. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Completion/non-completion of the survey tool were assessed. Patients opinions about the survey tool were collected and categorized as positive, neutral, or negative. Patient satisfaction including questions which were rated on a 5 point scale (1-strongly agree, 5-strongly disagree): I liked being able to tell my doctor about issues I wanted to address before my clinic appointment; I liked being contacted by email to prepare for my appointment and share my needs in advance; The website was easy to use; and This is an important new service that Internal Medicine should continue to offer. For non-completers, we attempted to contact patients to determine reasons for non-completion. Patients comments about the survey were elicited and recorded verbatim by a research assistant and were coded by 2 investigators for themes on barriers/facilitators for completion and attitudes about the survey tool.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 168 patients (pts) were eligible and sent an email web-link to the survey tool over 4 months. 26% (43 pts) completed the tool and 74% did not. 9 of 25, who did not complete the survey, logged on. For those who completed the tool, average satisfaction (see above) ranged from 1.72-1.95 (1=strongly agree, 5=strongly disagree). 25 of 43 pts completed the satisfaction survey. Over 80% had positive opinions about the survey tool vs. 58% among non-completers. 8 pts had negative opinions with most citing security concerns. Comments elicited were grouped into themes: liked the tool, felt it helped
prepare for their visit, felt it helped providers prepare, security concerns, felt it was unnecessary/too time-consuming, or preferred other communication. 54 of 87 pts were contacted and reached in post-survey follow-up for non-completers. The reasons for non-completion were mainly not receiving the email link or the patient forgetting to complete the survey (64%).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1.Validate email addresses by sending test messages prior to full implementation. 2.Consider providing information about data security since patients cited security concerns. 3.To ensure timely delivery of information to PMDs and to sustain the program, it must be integrated into existing EHR systems.
EVIDENCED-BASED DECISION SUPPORT TO ENHANCE STRESS TEST ORDERING: A QI PROJECT John Mafi1; Diane Brockmeyer1; Ryan Nall1; Kristin A. Cox2; Kenneth Mukamal1. 1Beth Israel Deaconess Medical Center, Brookline, MA; 2Newton-Wellesley Hospital, Newton, MA. (Control ID #1338808)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Despite the publication of multiple evidenced-based guidelines, cardiac stress imaging remains an expensive and increasingly over-utilized diagnostic modality.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): A guideline-based electronic decision support tool to enhance stress test ordering will significantly reduce cost, radiation exposure, unnecessary downstream procedures, and potentially improve cardiac catheterization diagnostic yield. The

intervention will provide non-inferior quality of care among primary care patients with stable chest pain syndromes.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We have designed an evidenced-based electronic decision support tool that calculates the pretest probability of coronary ischemia based on age, gender, and anginal sub-type. The provider answers two brief multiple-choice questions, and the program uses those answers along with the electronic record to prompt to the appropriate stress test to order. For example, for an ambulatory patient who has a normal ECG and a low pretest probability of ischemia, the tool will prompt to a non-imaging exercise treadmill stress test. The use of imaging would require free-text justification. The study will then prospectively analyze primary care providers who use the electronic decision support tool to order stress tests versus usual care. The intervention groups will consist of 2 out of 4 academic primary care clinics with 2 comparable control clinics. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Outcomes of interest include (1) number of stress tests and stress test type ordered (including order attempts/diversions) over a 1 year period among intervention versus controls (including associated costs and radiation exposure), (2) ratio of positive to negative tests in both groups, (3) cardiac catheterization diagnostic yield (those with stenosis >50%),(4) provider satisfaction with the decision support tool, and (5) rates of MI and all-cause mortality between the two groups.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Findings to date reveal the following: of the 51 cardiac stress tests ordered in February, 2011, 32 or 59% used imaging. After retrospectively applying the guideline-based electronic decision support tool, 15 or 47% of providers would have been prompted to order a non-imaging exercise treadmill stress test (all 15 were ambulatory and had normal ECGs). While imaging was usually not inappropriate, it was not necessary to use imaging in any of these 15 cases. This could significantly reduce healthcare costs and prevent 10 milliSieverts (=200 chest x-rays) of radiation exposure per nuclear study avoided.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): In the new era of Accountable Care Organizations, rational decision support tools for expensive diagnostics will need to play a central role in providing cost-effective and high quality care. Changing

clinician behavior remains one of the most vexing challenges in modern medicine. Education is necessary but not sufficient in implementing real change, as evidence reveals its effects alone are temporary at best. Seamless and intelligent decision support can bring guidelines to the point of care, improving the cost-effectiveness and quality of healthcare.
EVOLUTION AND REFINEMENT OF A DEPRESSION DISEASE MANAGEMENT PROGRAM IN AN ACADEMIC INTERNAL MEDICINE PRACTICE Kristen Amann; Paul Chelminski. University of North Carolina at Chapel HIll, Chapel HIll, NC. (Control ID #1312415)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Depression is common in general practice and complicates the management of chronic disease.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): We developed and refined a depression disease management program in an academic internal medicine practice with both resident and faculty providers. The objectives of this quality improvement project were: 1. Apply a validated screening and treatment metric clinic-wide for depression, the Patient Health Questionnaire 9 (PHQ-9). 2. Implement a depression algorithm coupled with an electronic registry to optimize population-based

management. 3. Integrate a mid-level provider with expertise in problem-solving therapy into a multi-disciplinary team.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Our intervention unfolded over several years with multiple PDSA cycles spearheaded by residents. The major cycles were: 1. A first investigator described the burden of depression in clinic patients with diabetes (2009). 2. An evidence-based screening and treatment algorithm was incorporated into the clinic's visit planner and refined over five PDSA cycles (2009-2010). 3. The clinic hired a social worker experienced in problem-solving therapy (2010). 4. Three interim analyses of algorithm uptake led to refinement of depression care (2010-2011). MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Measures of treatment algorithm adherence varied according to PDSA cycle. These measures included: 1. Percentage of patient visits where depression was addressed and managed according to the algorithm. 2. Change in patient PHQ-9 scores.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): A needs assessment (2009) indicated under-diagnosis and under-treatment of depression. This was especially true in patients with a high burden of non-psychiatric co-morbidities. We found that 24% of diabetic patients had affective or anxiety disorders and that non-intervention was common. For example, only 39% of patients with mental illness had a documented mood assessment. This led to the implementation of PHQ-9 screening for diabetic patients. High levels of depression were found, but non-intervention persisted. Subsequent PDSA cycles investigated barriers to provider intervention. Some barriers were systems based; others, provider based. To improve intervention, we next developed a depression algorithm and integrated a provider trained in problem-solving therapy. An interim analysis (July 2011) of 897 patients screened over a two-month period showed that providers adhered to the algorithm in 69% and 85% of patients with moderate and severe depression, respectively. After further process refinements, algorithm adherence rates were assessed on 150 patients. This analysis showed an increase in adherence from 69% to 92% in patients with moderate depression and from 85% to 93% in patients with severe depression. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Over three years, multiple PDSA cycles led to substantive improvements in process measures of depression care linked to better outcomes. Resident physicians spearheaded these cycles. Quality improvement is a powerful educational tool that benefits patients.
FITNESS NOW: A PHYSICIAN-RUN EXERCISE PROGRAM Charmaine S. Wright; Sara Slattery; Edernst Noncent; Cindy Armstrong. University of Pennsylvania School of Medicine, Philadelphia, PA. (Control ID #1339465)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): In an urban academic Internal Medicine practice in Philadelphia, 42% of all patients have BMI (body mass index) >30 kg/m2 and 15% have diabetes mellitus type II. This population demonstrates several previously-studied barriers to fitness including low self efficacy, low health literacy, and limited disposable income to engage in structured exercise and nutrition instruction.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): The goal of Fitness Now is to create a supervised low cost exercise program in the waiting room of the clinical practice, centered on partnership between the patient and practice physicians, emphasizing safety.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Components of the first pilot included 32 sessions of live exercise class with fitness lesson moderated by a personal trainer and practice physician, pedometer usage, financial incentive, and social support provided by phone and text messages. The majority of patients were referred by their health care provider (n=38), but a few self-referred after seeing posted fliers in the waiting room

(n=10). 41 participants were women, 40 designated their race as black, 18 were diabetic, and all had BMI >28 kg/m2.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Of those followed for 16 weeks with post program evaluation, 12 were regular class participants receiving supportive calls and texts, and 18 received calls and texts alone and never participated in a class. There was no difference between these two groups in the following measures taken at the start of the program: mean health rating (3.1 on a 5 point Likert scale), confidence that they would follow through with the class (4.5), or self-efficacy for exercise (29 out of 50 on a 10-question validated scale). However, weight loss was larger among those who came to class (-7.3 (3.0) pounds versus 0.5 (5.5) pounds, p=0.001) and self-efficacy for exercise in post program evaluation was higher among those who came to class (1.2 (4.0) versus -11.2 (8.3), p=0.003). FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): This pilot identified several barriers to exercise and healthy eating in an urban patient population namely compliance, but shows significant short-term weight loss and increased self-efficacy for exercise when virtual support was coupled with live classes. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We demonstrate the importance of motivating healthy behavior change in high-risk patients in places both real and virtual, outside of the regular office visit. Planned further piloting of the program and a randomized controlled trial is needed to test this intervention on a larger scale with long-term follow-up.
IDENTIFYING OPERATIONAL FACTORS AFFECTING PATIENTS UNDERSTANDING OF TREATMENT
Jessica J. Chen; John Fontanesi. University of California at San Diego, La Jolla, CA. (Control ID #1341290) STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Can clinic operation condition affect pts understanding of treatment? OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): confirming operational factors do affect patients understanding of treatment identifying operational factors which affect patients understanding of treatmentDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): 75 clinic encounter workflow observations were conducted at two primary care clinics in a single academic center. Observations were encoded using Observational Checklist of Patient Encounter (OCPE), which document time requirement and operation conditions occurring at the time of service. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): At conclusion of each observed clinic visit, patients were asked to select from a checklist of specific treatment

recommendations and/or discussion topics for specific test results. Checklist items included your doctor discussed laboratory results, your doctor ordered laboratory studies, your doctor reviewed your medications, your doctor changed your medications etc. Patient recollection was then compared against provider documentation and scored for congruence. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): patients ability in hearing provider recommendation are strongly correlate with the amount of wait time before seeing the provider the wait-time was strongly correlated with provider to staff ratio and provider to exam room ratioKEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): recognizing that patients understanding of treatment plan is not solely dependant on the quality of physician-patient direct interaction excessive patient wait-time could diminish quality of physician-patient interaction and understanding of treatment plan excessive wait-time are closely linked to provider to staff ratio and provider to exam ratio clinic operation factors can affect the quality of patient care
IMPLEMENTATION AND EVALUATION OF AN INNOVATIVE CHILDHOOD CANCER SURVIVOR FOLLOW-UP CLINIC: TACTIC
Linda Overholser1; Brian Greffe3; Timothy Garrington3; Kristin Leonardi-Warren4; Kristin

Kilbourn2; Traci Yamashita1. 1University of Colorado Denver, Denver, CO; 2University of Colorado Denver, Denver, CO; 3Childrens Hospital Colorado, Denver, CO; 4University of Colorado Hospital, Denver, CO. (Control ID #1334953)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): A mechanism to facilitate the transition of care for childhood cancer survivors into adulthood must include coordination between pediatric oncologists and adult primary care due to the significantly increased risk for late and long term effects in this population. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) Implement a primary care based clinic for survivors of childhood cancer; 2) Evaluate patient satisfaction with a primary care based survivorship clinic; 3) Evaluate the effect of a survivorship clinic intervention on self reported health behaviors, knowledge and confidence regarding managing health as a cancer survivor. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The TACTIC (Thriving After Cancer Treatment is Complete) Clinic at the University of Colorado Denver was started in 2008 and is housed in the Division of General Internal Medicine adult outpatient clinic. The clinic serves adults over the age of 18 who have been treated for any childhood cancer, are at least 5 years from diagnosis and are at least 2 years from completion of therapy. After consultation with a general internist, pediatric oncologist, health psychologist and oncology nurse educator, patients receive a detailed treatment summary and risk-based survivorship care plan. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Surveys are conducted at baseline and 2 and 8 weeks following receipt of survivorship care plans; domains include patient satisfaction, health habits, self-reported health, knowledge and confidence about managing ones health. Analysis includes frequency distributions and use of Likert scales. Non-parametric methods are used to evaluate changes in knowledge and self efficacy from baseline to 8 weeks. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Since its inception 63 patients have been seen; sixteen (16) have consented to be part of the study since IRB approval was received in 2010. Median age of consenting survivors is 28, with an average of 17.9 years since childhood cancer diagnosis. From baseline to 8 weeks after receipt of their survivorship care plan respondents (n=7 completing both baseline and 8 week follow up surveys) demonstrated significant improvements in ability to identify cancer survivorship resources, knowing who to talk to about specific medical issues, and identifying unique health risks associated with their cancer experience (p=.03). Trends towards significant improvements in ability to identify late and long-term effects of their cancer treatment were identified (p=.06). Patients have expressed
satisfaction with the format and content of survivorship care plans. Most have preferred the adult healthcare setting (4 on a scale of 1-5) versus pediatric oncology.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The TACTIC clinic model represents a feasible, acceptable and effective way to provide risk-based care to pediatric cancer survivors and emphasizes the important role that primary care has in survivorship care. Challenges include supporting the significant resources required to prepare the treatment summaries and care plans.

IMPLEMENTATION OF FORMAL TEACHBACK TRAINING FOR NURSES TO IMPROVE POST-DISCHARGE MEDICATION ADHERENCE Joshua Metlay2; Deepshikha Charan1; Kathryn Green3; Lisa Fidyk4; Emmanuel King2. 1Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA; 2Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA; 3Hospital of the University of Pennsylvania, Philadelphia, PA; 4Penn Medicine, Philadelphia, PA. (Control ID #1337436)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Reducing unplanned hospital readmissions is a national quality and patient safety priority and there is evidence that patient misunderstanding of medications is an important cause of avoidable readmissions. OBJECTIVES OF PROGRAM/INTERVENTION

(NO MORE THAN THREE OBJECTIVES): To determine if training nurses in the innovative teachback method would have an impact on medication related post-discharge outcomes.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A team of nurses and physicians developed a formal training course on teachback for nurses on a general medicine, non-housestaff hospitalist unit. Teach-back utilizes serial patient teaching sessions, followed by a thorough assessment of patient understanding. The first stage involved developing educational booklets which were used at a 4 hour teachback retreat with didactics on adult learning theory and health literacy. Role-playing allowed nurses to use teachback in such challenging situations as educating a diabetic patient new to insulin. Every nurse rotated as a role-player or observer, leading to self-reflection and external feedback. The session concluded with a multidisciplinary panel on transitions of care, including physicians, home care and clinic nurses, and a patient who shared his experience about the discharge transition. All 44 nurses on the unit have participated in the program, with plans for expansion to other units starting April 2012.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We studied patients discharged between April and October 2011 who were enrolled in home care nursing. Home care nurses administered a 24 question survey on medication related issues in the immediate post-discharge period. We compared responses between patients with and without teachback education, using chi-square statistics with $p>.05$ indicating statistical significance.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Of 99 patients in the study, 38 (38.4%) had been taught by teachback trained nurses. Most (n=55, 59.1%) were on 8 or more medications, and most were on at least one high-risk medication such as warfarin or insulin (n=58, 58.6%). Few appeared to be in the hospital directly due to medication issues (n=4, 4.7%). Comparing patients who received teachback to those who did not, a similar percentage reported that they had been taught about their medications pre-discharge (81.5% vs.88.6%, p=0.40). Likewise, a similar percentage were felt by the home care nurse to have a good understanding of their medications (74.3% vs.86.2%, p=0.15). There was no significant difference in the frequency of medication discrepancies between patients with and without teachback education (21.6% vs. 8.6%, p=0.07). There were only two areas where we observed a significant difference. Patients who had teachback more frequently reported multiple past hospitalizations due to medications (14.7% vs. 1.8%, p=0.016), and were more likely to have had multiple medication changes prior to discharge (50% vs. 24.5%, p=0.01).

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): At this preliminary stage, teachback training does not appear to have an impact on medication-related patient outcomes in the post-discharge setting. The only significant correlations appear to be in the numbers of patients who had more frequent medication-related past hospitalizations or multiple medication changes prior to discharge. This suggests that higher risk patients may have been unintentionally assigned to teachback-trained nurses. We will follow more outcomes, including readmission rates, to further study the value of teachback training.
IMPLEMENTING A SYSTEM OF INTEGRATED POST DEPLOYMENT CARE FOR RETURNING COMBAT VETERANS Lucile Burgo-Black1,2; Stephen C. Hunt3,4. 1VA Connecticut Healthcare System, West Haven, CT; 2Yale University, New Haven, CT; 3VA Puget Sound Healthcare System, Seattle, WA; 4University of Washington, Seattle, WA. (Control ID #1340184)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): This presentation will describe the health

impacts of combat on military personnel returning from Iraq and Afghanistan and the comprehensive, interdisciplinary system of post-deployment integrated care that has been implemented nation-wide in VHA through the collaborative efforts of primary care, mental health, social work and rehabilitation services.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Describe the most common health concerns of Veterans returning from Iraq and Afghanistan Describe effective approaches for addressing co-morbid health concerns in this population Review data from a study of system wide implementation of the program DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The conflicts in Iraq and Afghanistan have exposed combat Veterans to risks of physical injury (including traumatic brain injury from blast wave exposure), psychological trauma, environmental agent exposure and numerous psychosocial stressors potentially impacting financial, social, and family life. A broad spectrum of mental health conditions and psychosocial difficulties are common among these Veterans; clinical presentations involve complex combinations of physical and mental health symptoms and conditions and a variety of psychosocial issues that vary widely from Veteran to Veteran. A VA-wide education and training campaign collaboratively created and implemented by all of the programs and disciplines involved in post-combat care (primary care, mental health, social work, rehabilitation services, addictions services and pain services) was created and implemented to educate and train VA staff nationally. The symptom overlap and frequency of co-occurring PTSD, chronic pain, mild TBI and substance abuse have highlighted the need for inter-disciplinary, integrated care and proactive case management/social work support. This session will describe the impacts of combat on the lives and health of Veterans returning from Iraq and Afghanistan and the model of post-deployment integrated care that has been implemented in VA to address these health issues.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Initial evaluation by Mental Health, Social Work and Primary Care on same day Continuity of care with same clinicians over time Team based care plan Integrated team meetings Team function supported by shared notes, instant messaging, warm handoffs, curbside consults. Completion of relevant clinical reminders Psychosocial screening rates Enrollment in VA secure messagingFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): From the inception of the Post-Deployment Integrated Care Initiative in 2008 until end of 2010: 84% of VA Centers have dedicated resources to specialized primary care arrangements for post-combat care. 54% of VA Centers link their primary care, mental health and social work initial evaluations on the same day to reduce the number of visits the Veteran must make to the center. In 65% of facilities regular integrated team meetings are held, primarily between PC, MH, and SW; 54% rated the meetings as highly useful; other providers attending these meetings include polytrauma/rehab medicine staff, suicide risk reduction staff, Pain staff, SUDs staff and Womens Health clinicians.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Train the trainer implementation nationally Importance of outreach, transition support, intake, interdisciplinary assessment and ongoing case/care management Central role of OEF/OIF/OND Program managers and case management Necessity of educating teams on military culture and unique concerns of returning service members Network of champions

IMPROVING ADHERENCE TO BEST PRACTICES FOR OPIOID PRESCRIBING IN NON-CANCER CHRONIC PAIN PATIENTS IN A PRIMARY CARE PRACTICE JoAnne Gottridge1; Mark Stokes1; Pauline Leong1; Janet R. Zolli1; Sandy Balwan1; Nissa Mazzola2,1.
1Hofstra North Shore LIJ School of Medicine, Great Neck, NY; 2St. John's University, Queens, NY. (Control ID #1336281)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Opioid prescribing for non-cancer chronic pain has increased and been associated with large increases in abuse and overdose of prescription opioids,

despite publication of best practices that can reduce these risks.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Implement current best practices for opioid prescribing in a primary care practice; 2. provide education, guidelines and decision support for best practices, including at the point of care; 3. measure the adherence to best practicesDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A large General Internal Medicine practice certified by the NCQA as a Patient Centered Medical Home, using an Electronic Medical Record (EMR) as the only patient record, and serving as a site for Internal Medicine Resident Education, cares for approximately 1000 individuals receiving chronic narcotics. To standardize and improve the care of these patients a series of interventions were developed and implemented in late, 2011. Firstly, a practice Policy and Procedure Document for narcotic prescribing was developed, based on recently published clinical guidelines and expert opinion. This Policy and Procedure document was discussed and reviewed with all providers. Secondly, a "chronic opioid" templated note for the EMR, that allows for easy documentation (point and click) of mandatory elements from the Policy and Procedure document, was provided. This templated note was developed to promote adherence to policies and procedures at the point of care, and to improve documentation of the care that was provided. Thirdly, a templated Opioid Flow Sheet in the EMR, populated by elements in the templated opioid note, was implemented, to serve as a quick review of adherence to guidelines. Lastly, a practice Narcotics Review Committee, with participation by a Clinical Pharmacist, was developed to review and make decisions about any chronic opioid patient care challenges in a team setting . MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Reports will be generated from the EMR to determiine adherence to policies and procedures post-intervention, including: completion of the tool for assessment of risk of opioid abuse, periodic urine drug testing, presence of narcotics agreement in the medical record, and adherence to refill protocols. The number of patient cases referred for discussion at Narcotics Review Committee will also be tracked.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Preliminary indications are that provider acceptance and adherence to the established policies and procedures for narcotic prescribing is high. It is too soon after the intervention to determine any significant metrics.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): If these described interventions are successful in improving adherence to best practices for opioid prescribing, they may serve as an example for implementation in other primary care practices that prescribe a significant amount of opioid medications.

IMPROVING ALLERGY RECONCILIATION PROCESS IN THE AMBULATORY SETTING: FIVE MINUTES THAT CAN SAVE A LIFE AND LOTS OF MONEY! Stephen B. Erban1,2; Trudy Manchester1,2; Aimon C. Miranda3; Michelle E. Conroy1,2; Marisela Navarro1. 1UMass Medical School, Worcester, MA; 2UMass Memorial Medical Center, Worcester, MA; 3University of South Florida, Tampa, FL. (Control ID #1321079)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): In the era of electronic health records (EHRs), information interfaces, copy &paste notes, and meaningful use (MU), medication allergies and adverse drug reactions tend to accumulate in the EHR and are rarely critically reviewed or reconciled; this project highlighted the importance of allergy reconciliation along with providing educational interventions for clinicians to improve allergy reconciliation.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1.Review the impact of inaccurate allergy data on the cost and quality of care. 2. Describe the intervention and impact. 3. Future directions for work.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): UmassMemorial

Healthcare in is an integrated delivery system in Central Massachusetts that utilizes the Allscripts Enterprise EHR in most ambulatory sites. There are approximately 400,000 active patient records in the EHR. Approximately 36,200 (9%) of these records have penicillin allergy and 22,000 (5.5%) have some version of sulfa allergy. Prior work suggests that most these labels are not valid when more detailed history or skin testing is utilized. The intervention was made in a hospital-based, adult general internal medicine practice with 31 attending physicians and 4 nurse practitioners. Residents were excluded (low patient volumes). A multifaceted intervention was designed to improve the accuracy of the allergy data in the EHR. Components included: 1) Patient education and patient self-review of their allergy data; 2) Face-to-face didactic education for physicians and NPs on allergy reconciliation; 3) email distribution of educational materials to clinicians after the didactic presentation.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The Allscripts EHR tracks allergy data activity to allow queries for how often data was viewed (allergy tab clicked on) or changed (created, deleted or edited). Baseline rates for viewing and changing allergy data were measured for all clinicians. Post-intervention rates were reassessed about 10 weeks after the presentation and about 2 weeks after the emailed distribution of information.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Two of 4 NPs and 15 of 31 physicians attended a single 30 presentation on this topic. It is unclear how many clinicians viewed the emailed intervention. Follow-up rates of review and modification of allergy data in the EHR was measured. Baseline rate for physician viewing and changing allergy data was 52.3% and 12.6%, respectively. Post-intervention rates were 49.8% (-2.5%) and12.4% (-0.2%), respectively. Baseline rates for NPs viewing and changing were 75.8% and 10.6% respectively. The post-intervention rates were 90% (+14.3%) and 10% (-0.6%).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1. There is no gold standard as to how often allergy data should by viewed, edited, and/or reconciled - or by whom and in what setting. 2. Individual provider behavior with respect to viewing, editing, and reconciling allergy data varies widely. It appears that allergy reconciliation is often ignored, which may lead to lower quality and higher cost of care. 3. Improving performance will likely require more than a multifaceted educational approach involving patients, providers and staff. 4. Nurse practitioners in our setting responded positively to this intervention, whereas there was no significant change in physician behavior. Strategies to incorporate nursing support staff and/or pharmacists may be more successful and help to leverage scarce resources to do this work.
IMPROVING CANCER SCREENING USING A NOVEL PATIENT-CENTRIC, POPULATION-BASED HEALTH INFORMATION TECHNOLOGY SYSTEM Jeffrey M. Ashburner; Adrian Zai; RichardW. Grant; Sanja Percac-Lima; Steven K. Wong; Charlotte E. Ward; StevenJ. Atlas. Massachusetts General Hospital, Boston, MA. (Control ID #1336967)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Evidence suggests health information technology (HIT) can improve quality of care, but it remains uncertain how to use HIT systems to most effectively and efficiently deliver care.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To implement a novel HIT system that uses a visit-independent, patient-centric approach to screen a primary care population for preventive cancer screening. We hypothesize that involving primary care providers (PCPs) by using their unique knowledge about her/his patient panel to direct outreach will result in more effective and efficient care compared to an automated HIT screening system.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We designed the

TopCare system (Technology for Optimizing Population Care in A Resource-limited Environment) to identify all patients seen in primary care practices affiliated within an academic hospital-based network who are eligible and overdue for breast, cervical, and/or colorectal cancer screening. Practices were randomly assigned to intervention or control groups. In intervention practices, PCPs screen their panel of overdue patients and decide whether and by which method to contact a patient. Providers may choose to 1) have a reminder letter sent to the patient followed by tracking and outreach by a scheduling delegate, 2) directly send the patient to a delegate for prioritized outreach, or 3) directly send a limited number of patients to a health navigator for more intensive outreach. In control practices, this process is sequentially automated: Overdue patients first receive a reminder letter and are transferred to a scheduling delegate list. Patients unscheduled after 4 months are referred to a health navigator if risk-based decision support identifies them as likely to not undergo screening. Patients in intervention practices default to the automated outreach if their PCP does not take action.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Primary outcomes include average cancer screening test completion over 1-year of follow-up for each eligible patient in all eligible cancers, and for each individual cancer. Secondary outcomes include measures of system usage, cancer detection rates, provider satisfaction, and cost-effectiveness analyses.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 96,491 patients were eligible for breast, cervical, and/or colorectal cancer screening as of the trial start date of June 15, 2011. As of October 31, 2011, 73 of 94 (78%) intervention providers have used the TopCare tool and reviewed 6969 patients overdue for at least one screening test. Among these patients, 5141 were selected to receive a reminder letter, 334 were sent directly to a scheduling delegate for follow-up, and 26 were sent to a health navigator. Another 6600 patients received letters through an automated mechanism after no provider action was taken. Additionally, providers removed 1468 patients from their roster by deferring screening (n= 1113), indicating the patients receive care from a different provider and/or practice (n=140), permanently excluding screening (n=120), or adding updated out of network screening data (n=95). In control practices, 14,196 letters were mailed to overdue patients without provider review.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Population-based HIT systems can be used to identify and contact patients regarding care outside of routine office visits, but require providers and staff input to redesign care processes and integrate such systems into existing visit-based approaches.

IMPROVING CARE AT A SAFETY-NET RESIDENT CLINIC Michael E. Hochman1; Arek Jibilian2; David Goldstein2; Steven Asch3; Carol Mangione4. 1Robert Wood Johnson Clinical Scholars Program at UCLA and the VA, Los Angeles, CA, Los Angeles, CA; 2Keck School of Medicine, Los Angeles, CA; 3Veterans Administration of Palo Alto Healthcare System, Palo Alto, CA; 4David Geffen School of Medicine at UCLA, Los Angeles, CA. (Control ID #1322293)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): National health care reform will provide new opportunities to promote patient-centric primary care. However, implementing such changes will be challenging, particularly in safety-net settings and in resident teaching clinics where the residents are present only intermittently. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): In collaboration with the Los Angeles Department of Health Services, and with grant support, we have implemented a pilot program to expand access to care and to improve care management at a safety-net primary care internal medicine clinic operated by resident physicians.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G.

INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The program offers the following new services for patients: 1) Enhanced telephone services including telephone triage by resident physicians and after-hours access to an on-call resident physician for urgent questions; 2) medication renewals by telephone; 3) urgent care appointment availability; 4) expanded care management; and 5) outreach to patients who visit the hospital and emergency room.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Here, we describe a process evaluation of the program in its first four months following implementation. We are planning a formal, controlled evaluation that will also assess the programs impact on: 1) patient satisfaction; 2) resident physician satisfaction; 3) emergency room and hospital utilization; and 4) hemoglobin A1C and LDL control among patients with diabetes. Two other resident clinics located at the same medical center will serve as controls.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): During the first four months, 2,752 (64%) of the approximately 4,300 clinic patients visited the clinic and were exposed to the new services. During month four, the call center received an average of 35.3 (SD 9.2) calls per weekday, of which 11.5 (SD3.9) were distinct patients requiring telephone advice from a resident physician. Each week, 15.6 medications were prescribed by telephone (mostly medication renewals, but occasionally new medications). Each day, patients used 3.2 (SD 1.3) urgent care appointment slots. The care coordinators completed an average of 3.8 (SD 2.5) care management tasks per weekday and outreach to 28.3 clinic patients per week who visited the emergency room or hospital. Feedback surveys completed by clinic staff and resident physicians indicate high satisfaction with the program with scores of4.0 on a scale of 1 (low satisfaction) - 5 (high satisfaction) for all questions. Preliminary results from the controlled evaluation show that emergency room and hospital utilization has remained stable since program implementation: At baseline, there was an average of 79 emergency room and hospital visits per 1,000 patients per month in both the intervention and control clinics. In the first two months since program implementation, there has been an average of 78 emergency room and hospital visits per 1,000 patients in the intervention clinic vs. 80 in the control clinics (P=0.81).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We have implemented a program providing expanded access to care and enhanced care management at a resident safety-net primary care clinic. Thus far, feedback from residents and clinic staff has been positive. In contrast to some similar programs, we have not seen an increase in emergency room and hospitalization rates as access to care has been expanded. We believe this program, if it continues to be successful, could serve as a model for resident safety-net primary care clinics in Los Angeles County and perhaps elsewhere.
IMPROVING COORDINATION OF MEDICAL AND MENTAL HEALTH CARE FOR CO-MANAGED PREGNANT VETERANS Neha Pathak. 1Providence VA Medical Center, Providence, RI; 2Alpert Medical School Brown University, Providence, RI. (Control ID #1316263)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): We anticipate that demand for pregnancy-related care will increase among veterans and it is unlikely that prenatal care can be delivered through the VHA alone; so it is imperative that a clearly defined procedure exists between VA and non-VA providers to offer coordinated, comprehensive care as new evidence suggests an increased risk of medical and mental health problems among veterans during pregnancy.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Our goal is to use the VA Patient Align Care Team (PACT) Model (known as the patient centered medical home in the community) to improve coordination of care between VA and non-VA providers by: 1) monitoring the number of requests for prenatal care 2) monitoring for and enhancing the management of developing mental health disorders during pregnancy within the VA 3) monitoring outcomes of pregnancy in our veteransDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS.

OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We are developing a templated system utilizing the EMR and PACT within the Providence VAWomens Health Outpatient Clinic to aid our pregnant veterans in navigating a fragmented system of care. 1) Provider to complete Templated Pregnancy Note and request creation of Pregnancy Flag in EMR a) Templated Pregnancy Note to trigger: i) Review of patient history and medications ii) Referral to Clinic Nurse for authorization for release of information iii) Referral to Social Work for benefits information iv) Referral to Behavioral Health (BH) b) Copy of templated note sent to non-VA provider at initial visit c) Pregnancy Outcomes TRACKED by clinic nurse 2) BH Provider to evaluate veteran at time of pregnancy diagnosis, then 3, 6, 8 months, and post-partum with PHQ-9 (a standardized tool used to monitor for development of mental health issues in all veterans). a) Screen for post-partum depression with the Edinburgh Postnatal Depression Scale (EPDS) at 8 months and postpartum. b) Patient to be seen more frequently or referred to psychiatric services if necessary. c) Development of new behavioral health issues TRACKED by BH provider. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1) Creation of pregnancy template note/ flag within EMR 2) Creation of standard operating procedures for each member of PACT 3) Creation of Patient Brochures to aid Pregnant Veterans in navigating the co-managed system 4) Monitoring: requests for prenatal care, completion of pregnancy template note/flag, regular VA BH follow up, documentation of new mental health diagnosis, outside documentation of pregnancy care and outcomes 5) Assessment of patient satisfaction via survey instrument FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Data prior to implementing our intervention show: 1) An annual increase in the request for prenatal care over the past 3 years. Over the past year, 17 veterans, between the ages of 21-43, requested prenatal care. 2) All veterans received prenatal care outside of the VA and did not return for medical or mental health care until after pregnancy. 3) VA providers did not formally assess for new mental health issues at any time during pregnancy, though data suggest that veterans are at higher risk for mental health disorders during pregnancy. 4) No documentation of pregnancy care or outcome from non-VA providers was scanned within EMR.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): By realigning the already existing PACT resources and utilizing the EMR, we can create a sustainable, efficient protocol that can easily be implemented in other VA Medical Centers to coordinate co-managed care for an increasing numbers of pregnant veterans.

IMPROVING OSTEOPOROSIS SCREENING IN A RESIDENT-RUN PRIMARY CARE URBAN CLINIC Zahi Mitri; Anthony Gamboa; Rinku Chatterjee; Nurcan Ilksoy. Emory University, Atlanta, GA. (Control ID #1332420)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The U.S preventive services task force recommends routine osteoporosis screening in all women aged 65 and older, as well as younger women whose fracture risk is equal to or greater than that of a 65 year-old white woman who has no additional risk factors.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Bone density measurements accurately predict the risk of fractures in this patient population. Unfortunately, many of these women, despite clinic attendance, do not undergo timely screening for osteoporosis. They thus go untreated and are at increased risk of fractures. This project aimed at improving the prevalence of bone density screening through DEXA scanning to 80% in women 65 years and older in a primary care clinic.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): This quality improvement project was conducted as part of the Emory Internal Medicine Residency Performance Improvement Curriculum. It was held in the resident continuity clinic at a community teaching hospital. Team members included Emory Internal Medicine residents, the nursing and ancillary staff from Grady Memorial Hospital. A retrospective chart review was done initially to determine a baseline screening percentage, and identify potential

barriers to screening. These fell into four categories: provider, patient, system, and nursing/ancillary staff related. The first test of change was implemented in 1/2011, and consisted of verbal reminders between providers. The second test of change was implemented on 2/2011, and consisted of adding a written reminder for DEXA screening to the electronic medical record clinic template. The project spanned from 11/1/2010 until 5/1/2011.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The results consisted of monthly chart reviews to tabulate the percentage of eligible patients screened for osteoporosis. The barriers to screening were divided into the aforementioned four categories. The goal was to reach 80% screening rates by the end of the project. The results were calculated using basic statistical tools. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The baseline screening rate based on data from 11/1/2010-1/1/2011 was 50%. This was similar to that found in the previous year in the same clinic. The rate of screening did not improve after the first test of change, remaining at 50%. The rate however increased to 73% after the second test of change. The main barrier to screening was identified as being provider related, accounting for 100% of cases at baseline, 67% of cases after the first test of change, and 50% after the second test of change. A follow up analysis after the end of the project was done, spanning the timeline from 5/1/2011 to 7/1/2011. The rates of screening dropped down to 65% in 5/2011 and 55% in 6/2011. The main barrier to screening was provider related, accounting for 91% of cases.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The key lessons learned through this project were first that a large fraction of eligible patients were not undergoing routine screening for osteoporosis, the main barrier to that being provider related factors. In addition to that, it was noted that verbal reminders were ineffective in changing clinical practices. On the other hand, written reminders were successful in improving screening rates, as well as decreasing the barrier proportion that is provider related. Finally, the drop in screening rates after the end of the project may be an indicator for the need for additional tools, in addition to written reminders, to maintain awareness for appropriate screening for patients in a primary clinic setting.
INPATIENT MANAGEMENT OF THE END-STAGE RENAL DISEASE PATIENT: COMPARING GENERALISTS TO NEPHROLOGISTS AS PRIMARY CAREGIVERS Vipulkumar Rana; Julie L. Mitchell; Siddhartha Singh; David S. Marks; Hariprasad Trivedi; Sundaram Hariharan; Kory Koerner; Kavita Naik; Pinky Jha; Molly Robischon. Medical Collegel of Wisconsin, Milwaukee, WI. (Control ID #1339395)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Is primary coordination of inpatient care for patients with End-Stage Renal Disease (ESRD) achieved more efficiently with nephrologists or generalists?
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Maintain or Improve Mortality and Length of Stay (LOS) Index for ESRD patients 2. Maintain or Reduce Direct and Total Costs per case for ESRD patients 3. Maintain or Improve inpatient capacity despite reduced resident work hours DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Traditionally, we have admitted ESRD patients under the care of Nephrologists to our hospital. Starting July 1st 2011, we admitted ESRD patients to general medical teams staffed by hospitalists or general internists with a Nephrology consultation for specialty care. This now allowed nephrologists to concentrate on specialty care, nephrology procedures, and outpatient visits. We hired 2.4 FTE hospitalists and 1 FTE physician assistant to staff a new Hospitalist-Physician assistant team and eliminated a resident based Nephrology team. To facilitate this transition, the nephrology service provided generalists education on the care of the ESRD patient and created systems to increase responsiveness of their consultation services.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We used University Healthsystem Consortium (UHC)

methodology to calculate Mortality Index, the ratio of observed to expected deaths, and LOS Index, the ratio of observed to expected inpatient LOS. We also calculated total and direct costs per case. Direct Cost includes such services as radiological and laboratory studies. We compared data for ESRD patients discharged 12 months prior and 4 months after the intervention date (5 months for cost data). FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): We analyzed LOS and mortality data on 1783 discharges. There were 111 patients per month before and after the intervention. The LOS index decreased from 1.16 to 0.92 ($p<0.01$). The mortality index increased from 0.8 to 1.1 ($p=0.16$). 30-day readmission rate did not change. The total and direct costs per case decreased: respectively, from $27 k to $24 k ($p=0.11$), and, from $17 k to $15 k ($p=0.23$). Administrative data demonstrated no loss of wRVU production by providers in either the hospitalist or nephrology services.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We found generalists were able to lower LOS in ESRD patients compared to nephrologists in the inpatient setting. The intervention may have lowered hospital costs and increased physician wRVUs. We were able to maintain inpatient capacity in the context of decreasing resident work hours. While our intervention had the possibility of worsening efficiency of care via the decreased coordination of dialysis services by generalists and relative decrease in clinical expertise of generalists, our preliminary analysis has shown the opposite to be true. We hypothesize that the decrease in LOS is the result of a responsive nephrology consultation service, preparatory education for generalists and the system expertise of generalists. We plan on building on our findings by exploring a wider variety of clinical and operational outcomes as well as studying patient and provider experience over a longer follow up period. In conclusion, our preliminary findings have merit and relevance for the planning of inpatient services and show that a transition to generalist inpatient care of ESRD patients may reduce LOS and cost.
LESSONS LEARNED IN ESTABLISHING A MEDICAL NEIGHBORHOOD BETWEEN A PRIMARY CARE MEDICAL HOME AND DERMATOLOGY SPECIALTY SERVICES. Kathleen Waite1;
Scott Joy1; Linda Dorman2; Russell P. Hall2. 1Duke University, Durmam, NC; 2Duke University, Durham, NC. (Control ID #1333579)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The process by which to integrate a subspecialty neighbor into a Patient Centered Medical Home (PCMH) to improve patient access to, and care coordination with, specialty services (SS), has not been optimally defined.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1.Create an electronic form to refer patients from a PCMH to SS (Dermatology) that defines the reason and urgency of the referral and establishes ongoing care coordination for patients. 2.Evaluate improvement in access to dermatology with the new process.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Duke Primary Care at Pickett Road is a General Internal Medicine, Tier 3 NCQA certified PCMH in Durham, NC . The Department of Dermatology at Duke University entered into an agreement with this PCMH to serve as a medical neighbor with the intent to improve access to dermatology services for patients. Using the McKesson HAC electronic health record, a web-based electronic form was created that served multiple purposes:1. placing a referral, 2. documenting reason for the referral, 3. documenting the urgency of the referral (urgent - within 1 week, priority - within 2 weeks, routine - within 1 month),and 4. setting the expectation for care coordination (pre-consultation exchange to expedite care, formal consult to address discrete question, co-management with shared management of disease, co management with principal care limited time, transfer of patient to specialist for

entirety of care). During the trial period, two physicians within the PCMH used the electronic form/ process to directly communicate with a triage nurse in dermatology who reviewed, processed, and scheduled the patients referral and visit. The remaining 6 physicians used the standard referral process, creating an electronic referral sent to an in-practice referral coordinator who then contacted the dermatology scheduling hub. No comment was required regarding urgency of the referral or expectations for follow-up care. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Compare the number of days between the date of the referral and the date of the dermatology appointment between the two different referral processes. 2.Identify the most common referral priority level. 3.Observe if there was a difference in wait time depending on the referral priority level.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): From January 2011 through September 2011, 28 referrals were generated (23 routine, 4 priority, 1 urgent). Of the routine referrals, 1 patient declined an appointment when contacted and 4 referrals were not completed for unclear reasons. 93% of the referrals were formal consult to address a specific question and/or for procedure. There was improvement in dermatology access with the median time from date of routine referral to appointment being 36.5 calendar days (mean 38 days). This compared to the wait time for referrals done via the standard referral process during this same time varying between 150 and 180 days. Priority referrals were seen with a median of 13.5 calendar days (mean 12.5 days).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1. Creating an electronic process for dermatology referrals and a medical neighbor relationship improved patient access to dermatology evaluation and care. 2. Having a level of priority attached to a referral allowed patients with more clinically urgent issues to be seen before routine referral. 3. Reason for referral and expectations for follow-up care plans can be established at time of referral using a standard template.
LESSONS LEARNED WITH PATIENTS COMPLETING AN ONLINE HRA VIA A PATIENT PORTAL PRIOR TO A PRIMARY CARE OFFICE VISIT Scott Joy; Geoff Ginsburg; Jeffrey Saville; Pete L'Engle; Boyd Carlson. Duke University, Durham, NC. (Control ID #1327053)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Health Risk Assessments (HRA's) can help providers better understand a patient's family, social, and exercise history and personal health goals, and thus it is important to develop new methods to efficiently collect this type of data before the visit and display in the electronic health record (EHR) prior to patient contact.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Select key questions from a current,
paper-based HRA, convert into electronic format, integrate into an online patient portal, and push to patients to complete online prior to their annual visit 2. Include this document in the EHR for providers to review before or during the office visit 3. Measure the time required by patients to complete the HRA, evaluate the number of patients completing each section, and identify most common personal health goalsDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): HRAs are often obtained outside of the office visit, are not integrated into clinical work flow, and patient responses to HRA questions are often not documented in the EHR. A HRA (Insight) has commonly been used by our HR department as part of disease management/wellness program offered by the health plan. This HRA is completed on paper or by telephone interview, and individual patient information from the HRA has not been integrated into the clinical or electronic work flow of the primary care practices. As a result, individual practices often have patients, staff or providers wastefully duplicate this effort during the office visit. We chose key questions (family history, alcohol, tobacco use, exercise patterns, personal health goals) from the existing HRA and created an original electronic document that was integrated into our patient portal and could be used to meet meaningful use criteria. Patients

received an e-mail prior to their appointment that encouraged them to check in online. Patients choosing to check-in online received a message from their provider requesting that they follow a link to complete the HRA questions online prior to their visit. Patients were able to print off a summary of their responses after completing the HRA questions. The completed HRA was then stored as a document in the EHR and was able to be reviewed by the providers prior or during the patients annual visit. A six week trial period in March-April of 2011 was chosen to analyze the operation feasibility and the data received.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Successful integration of the HRA into the patient portal and the EHRFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 107 patients completed an HRA online (estimated 15% of those receiving e-mail); Average time to complete HRA online: 4 minutes, 25 seconds (range 54 seconds to 1 hour 1 minute, 41 seconds); 100% completed exercise, smoking, and alcohol use history; 4% reported interest in reducing smoking; 8% reported interest in reducing alcohol consumption; 100% reported interest in increasing frequency of exercise; 72% completed family history; 84% completed personal health goals; Most common health goals were reach a healthy weight and get the right amount of exerciseKEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1. A paper HRA can be converted into electronic form that meets meaningful use criteria, pushed to patients via an online patient portal, and a summary of the patients responses can be posted in the EHR 2. All patients completed categories for smoking, alcohol and exercise histories, fewer patients responded in categories related to family history and personal health goals

MAINTAINING CONNECTIONS BETWEEN HOSPITALIZED PATIENTS AND THE PRIMARY CARE PRACTICE ATATEACHING COMMUNITY HEALTH CENTER James L. Wofford; Claudia Campos; Kirsten Feieriesel; Carolyn R. Pedley; Ramon Velez; Robert E. Jones. Wake Forest University, Winston-Salem, NC. (Control ID #1320823)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): When patients are hospitalized, they often lose their connections to their primary care provider and practice; as a result, follow-up appointments are haphazard, uncoordinated, confusing both patients and clinicians. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): (1) Improve availability of hospital follow-up visits for established patients in the practice. (2) Improve awareness/involvement of the practice during the patient's hospitalization.

(3) Assess changes in continuity and co-management that occur with hospitalization.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): In the hopes of making safer post-hospital transitions, we tracked all patients from a single-site community health center clinic practice who were hospitalized at the parent hospital during a two-week period (November 2011). Newly hospitalized patients were identified through a daily computerized query of the practice registry, a spreadsheet maintained separately from the EMR. Through daily huddles, multiple rapid learning cycles, and staff meetings, we made incremental improvements in tracking hospitalized patients who belong to the practice and to an individual PCP, and developing stronger practice ownership of the post-hospital transition period with specific timelines and policies for hospital follow-up visits (add-on to PCP's continuity schedules within two weeks of discharge).
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): (1) Proportion of patients who are scheduled to see their PCP within 2 weeks of hospital discharge. (2) Proportion of patents who actually attend their hospital follow-up visit. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): 46 adult patients from the practice were hospitalized during the two-week pilot period (29 on general medicine/hospitalist

services, 17 on speciality services). Three patients were hospitalized for symptoms suggestive of pneumonia, 10 for chest pain, and 1 for heart failure. Length of stay averaged 2.6 days (+1.3), with 6 patients (12%, 6/46) still in the hospital at the end of the two-week pilot. At the time of hospitalization, 3 patients had already transferred to another continuity relationship (1 patient to the VA system, one to a nursing home, and 1 dialysis patient who did not clearly belong to the practice). One patient expired during the hospitalization. Of the remaining 36 patients, 27 (75%, 27/36) were given follow-up appointments in the practice by a hospitalist team with an average number of days of 7.6 days (+3.5) until the hospital follow-up visit. The majority of follow-up appointments were scheduled within one week (59%,16/27) and 89% (24/27) within 2 weeks. Although 70% (19/27) of patients had PCPs with available clinic schedules during the follow-up period, only 30% (9/27) of patients were scheduled to see their PCP. 9 patients had PCPs who were not available (maternity leave), or had resident providers who had left the practice and had not yet been reconnected with a new resident physician.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Initial identification of practice patients who are hospitalized can best come through electronic practice registry query and notification, and should not depend on personal communication from hospitalists. Follow-up visit strategy can best come from the practice, not the hospital, in order to maintain continuity and optimize patient safety. Reengineering of follow-up strategies requires vigilance on the part of the primary care practice to manage post-hospital transitions in a fragmented healthcare system.

MULTIDISCIPLINARY ENGAGEMENT TO IMPROVE MEDICATION RECONCILIATION IN AN ACADEMIC OUTPATIENT PRACTICE USING LEAN METHODOLOGY

Zhou Zhang1,3; Jason Fish2,3; Edward Hui3; Brandon Koretz3; Katherine Steinberg3; Wendy Senelick3; Katherine Serrano3; Krisan Soriano3. 1Kasier Permanente, Woodland Hills, CA; 2University of Texas Southwestern, Dallas, TX; 3University of California, Los Angeles, Los Angeles, CA. (Control ID #1311376)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Medication errors are the third leading cost of healthcare costs behind cardiac problems and cancer (Schumock 2000), a large percentage of medication errors can be attributed to suboptimal medication reconciliation process.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To improve the safety of medication usage for patients during and between office visits through the development and implementation of an appropriate medication reconciliation program based on the Joint Commissions National Patient Safety Goal. 2. To rework the medication reconciliation process in a multidisciplinary manner to ensure sustainability.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A committee composed of physicians, medical students, nurses, patient services representatives, administrative leaders, and performance improvement staff was organized to better understand and improve the medication reconciliation process in an outpatient general internal medicine office. The key measurement was Joint Commission recommended documentation with listing of drug name, route, dose and frequency. Using LEAN methodology, an A3 value stream map identified the scope of the problem and mapped out the current processes and stakeholders across multiple disciplines. Baseline data was collected based on current work-flow, which identified that only 8% of clinic visits and 0% between clinic visits had successful medication reconciliation. A future state map was subsequently created that included the use of an electronic medication prescribing program with a reworking of clinic flow to generate and update the medication list, and to perform electronic prescribing.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Percentage of clinic visits that maintain a complete list of drug names, route, dose, and frequency; percentage of patient charts with updated medication changes during

and in between visits; and percentage of patient charts with medication list readily available to physician and patients.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Three months were spent generating appropriate protocols, with full implementation of the pilot across four physician practices beginning in month four. After three months of full implementation, a random sample of 50 patient visits were reviewed, as well as 25 random sample of patient visits from physician practices not in the pilot but practicing in the same clinic (control group). In the intervention group, 60% of the patient visits satisfied the Joint Commission National Patient Safety Goal, up from 8%, whereas only 4% of the visits from the control group satisfied the Goal. When examining between-visit medication reconciliation in a random sample of 20 visits for the pilot group and 20 visits for the control group, 72% of the intervention group visits had medication reconciliation completed compared to 0% in the control group.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Using LEAN methodology, individuals across multiple disciplines participated in improving the medication reconciliation process with adherence to the Joint Commission National Patient Safety goals and little disruption of clinic productivity. We were able to demonstrate that the electronic and multi-disciplinary medication reconciliation process significantly increased the accuracy of patients medication lists, although more rapid cycling is needed to improve this process further.
ONLINE PHYSICIAN PEER REVIEW PORTAL: REINVENTING A TRADITION FOR CHANGING TIMES
Sandhya K. Rao. Massachusetts General Hospital, Boston, MA. (Control ID #1334406)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Is it feasible to develop an online peer review portal that facilitates efficient review of clinical documents, supports continuing education, meets physician performance evaluation requirements of hospitals, and results in measurable improvements in documentation in a way that satisfies physicians?
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Re-engage physicians in the tradition of peer review as both a continuing education initiative and quality improvement activity 2. Transform paper-based chart audit focused on quality assurance into an automated, efficient experience focused on measurable quality improvement 3. Develop a tool to support efforts to meet JACHOs Ongoing Physician Performance Evaluation requirement

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Clinical leaders develop a clinical documentation scoring instrument, which is programmed into the web-based tool. The tool pairs participating physicians, presents a sample of ambulatory notes based on an automated selection algorithm, and enables note review and data collection in one view. The physician receives a report of completeness, clarity, relevance and overall scores. Participants address an improvement area and complete a second review to receive CME credits in accordance with the AMA PI CME model. Three departments within our academic medical center have participated in this pilot.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Quality of Notes: To date, we have calculated the change in scores produced by the review. We will conduct an independent review of notes from before and after the intervention using blinded non-participants and will use the average of individuals' change in scores as outcome measures. 2. Physician Satisfaction: A survey of participants addressed if physicians felt there were opportunities to improve documentation, if the exercise led to identification of improvement opportunities, and if it was worth the time spent.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The average change in overall scores reported by participating physicians in one group that has completed two reviews was a modest .88%. More interestingly, the average change in completeness was -2%. In the absence of blinded review by non participants, it is impossible to know if there was an actual decline in performance or if there was change in participants' standards for completeness after participating in the intervention. This finding raises important concerns about the reliability of peer review data for performance appraisal. Forty-five percent of physicians in one department identified an area for improvement in documentation and 94% reported that they will change how they perform clinical documenation. However, 50% of physicians did not find the review questions clear and almost 40% would not recommend the tool to another practice.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Despite advances in performance measurement based on adminstrative and clinical data, physicians still value peer feedback and may make changes in practice based on it. It is feasible to engage physicians in peer review using an online tool that reduces the burden of paper based review and enables improvement activities through which they can earn CME credit. In one practice, peer-reported completeness scores were lower in the follow up review. This may be the result of decline in completeness after physicians received feedback, a shift in scoring as participants progress through the intervention, or lack of clarity of the questions. Objective review by non-participants is a critical component of evaluation of such programs.
OPTIMIZING THE USE OF BEDSIDE PATIENT SAFETY ASSISTANTS TO IMPROVE PRODUCTIVITY, DECREASE COST, AND IMPROVE OUTCOMES Christine Andre1; Michelle Ryerson2; David Paul2. 1University of Texas Health Science Center San Antonio, San Antonio, TX; 2University Health System, San Antonio, TX. (Control ID #1322056)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): We sought to determine whether applying a standardized protocol for when to use patient safety assistants (PSAs) and other safety measures would improve staffing productivity without compromising patient safety as monitored by rates of falls, injuries and elopement.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Improve productivity with better utilization of limited staffing resources. 2. Decrease costs to University Hospital. 3. Show that adherence to the protocol does not compromise patient safety.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We used quality tools such as fishbone diagrams and flowcharts to determine the baseline
utilization patterns of PSAs at University Hospital in San Antonio. After performing a literature review of best practices, we selected a process algorithm to guide appropriate PSA utilization. The tool was implemented on a single inpatient general medicine ward on July 5, 2011. Data was measured for 60 days and we ran control charts on PSA utilization before and after our intervention as well as on rates of patient falls and elopements.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Decrease in total number of PSAs used per day. Decrease in total hours of PSAs used per month. Decrease in overtime hours. No increase from baseline in the volume of falls, falls with injury, and elopements.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The total hours of Patient Safety Assistant utilization decreased by 69% (average of 3832 hours per month from January 1 through June 30, 2011 decreased to 1188 hours per month by the end of August). The average number of PSAs used decreased by 60%. The average number of patients requiring a PSA decreased from 5 to 2 per shift. The total amount spent on overtime for PSA staffing decreased for the entire hospital by 41% (from an average of 627.5 hours biweekly over 9 pay periods to an average of 370.5 hours biweekly over 4 pay periods).

Overall, this project decreased costs by $49,003 with an annual estimated hard savings of $576,000 and a return on investment of 295%. There was an increase in total falls in July to 13, one with moderate injury, one with minor but during August, this rate stabilized and returned to the pre-pilot baseline of 6 total falls. None were with injury. There was 1 elopement in July and 2 in August but data was insufficient to show a trend. At baseline there are 1 to 3 elopements per month.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Implementing an algorithm for appropriate utilization of patient safety assistants has led to improved use of hospital employee resources with a substantial cost savings without an increase in falls or elopements.
PREDICTING AND DECREASING LOW-ACUITY ED VISITS FOR AN ACADEMIC PRIMARY CARE CLINIC WITH AVAILABLE URGENT CARE Neil Wagle; Dave Chokshi; Laura Gandy; Dorothy Goulart; Monica Hynes-Payack; Ravi Kavasery; Adam Licurse; Morgan Maglich; Mary Montgomery; Rita Nguyen; Audrey Provenzano; Sonja Rakowski; Daniel Solomon; Charles A. Morris. Brigham and Women's Hospital, Boston, MA. (Control ID #1340514)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Decreasing utilization of the emergency department (ED) by patients with low-acuity complaints is a goal for primary care practices that aim to provide better continuity of care at lower cost, but this population is heterogeneous and factors contributing to this utilization are unclear. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): To measure and analyze demographic factors that predispose patients to utilize the ED for low-acuity visits; To understand the motivations behind low-acuity ED utilization; To decrease low-acuity ED utilization in favor of in-clinic Urgent Care utilization DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Primary care residents at Brigham and Womens Hospital received formal training in Lean process improvement methods. Using this framework, we addressed the prevalence of patients from a single clinic, The Phyllis Jen Center for Primary Care (PJC) using the Emergency Room for low acuity problems. Residents analyzed patients demographic data and worked with the clinic staff to perform chart reviews and structured patient interviews. A new automated data extraction tool allowed for implementation of post-ED visit follow up wherein a nurse performed phone call outreach both for continuity of care and to understand the motivation behind utilizing the ED. This helped to create a structured visit closure process including business cards with bilingual information for patients regarding PJC Urgent Care.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Awareness of Urgent Care among providers and patients Utilization of visit closure resources (cards). Call volume to Urgent Care ED utilization for low-acuity issues FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): We followed 18,814 PJC patients and tracked their ED utilization over 9 months. There were a total of 3,616 ED visits, 1,010 of which were classified by the pre-existing ED triage system as low-acuity. Black and Hispanic patients were at much greater risk of a low-acuity ED visit compared to White patients (Relative Risk: Black=3.86, Hispanic=3.64). Younger patient were also at greater risk compared to patients aged 65-80 (Relative Risk: age <35=2.38, age 35-50=2.18, age 50-65=1.44, age >80=1.48). Patients with Spanish as primary language were not at significantly greater risk of a low-acuity ED visit compared to English-speaking patients (Relative Risk: 1.09). Patients of residents were 2.9 times more likely to have a low-acuity ED visit than patients of faculty members, though this may be partially explained by payor mix. Full multivariate analysis is pending. The post-ED visit follow-up demonstrated increased patient satisfaction, possibly improved continuity of care, and provided qualitative information regarding why patients utilized the ED. Patients using the ED for low-acuity visits were often unaware of the PJCs capacity to accommodate urgent care. This led to a new visit closure

process, the effect of which is still pending.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Use of a process improvement framework revealed key opportunities for intervention in our ambulatory clinic and previously underappreciated disparities in care. Once identified, the barriers to urgent care utilization can be successfully addressed within a rapid-cycle improvement framework. This work permitted identification of populations at particularly high risk for ED utilization, which will allow for more targeted interventions in the future.
PRIMARY CARE PROVIDERS DRIVE GENERIC PRESCRIPTION RATES OF A MULTI-SPECIALTY PRACTICE Julie L. Mitchell; Karen Fickel; Robert Acker; Nandita Nanchal; Christopher Spahr; Siddhartha Singh. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1327341)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): In the climate of value-based medicine, how can we increase our use of lower-cost prescriptions?
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1.Increase the rate of lower-cost medications in a large multi-specialty practice 2.Respond to a pay-for-performance (P4P) initiativeDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Over one year, we sent letters to all providers, met with clinical leaders, set benchmarks including the national overall and specialty-specific average generic rates for our state, developed a website with patient- and provider-oriented information about generics and links to formularies, and changed our EHRs e-prescribing defaults so generic prescriptions are prompted first. We targeted commonly prescribed non-preferred medications with low-cost alternatives.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We used pharmacy claims data from our two largest commercial payors. Payor #1 designates a tiered formulary where the lowest tier (preferred medications) includes nearly all generics plus other selected medications. Payor #2s lowest tier is essentially generics and generics alone. We compared our historical preferred prescription rates (averaged over 12-months) to our post-intervention rates (averaged over 5-months).
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Our multi-specialty adult and pediatric group included an average of about 900 physicians over the study period. For Payor #1, our preferred prescription rate increased from 65% to 71% ($p<0.01$); 129,808 prescriptions were dispensed post-intervention. While primary care providers (PCPs) in internal medicine, family medicine and pediatrics represented 18% of the groups providers, they were responsible for 54% of the rate increase, largely because PCPs prescribed 47% of the prescriptions. General internists represented 9% of all providers but prescribed 27% of the prescriptions and were responsible for 34% of our rate improvement. Their rate increased from 68% to 76% ($p=0.03$). For Payor #2, the generic rate increased from 67% to 72% ($p=0.16$); 23,666 prescriptions were dispensed post-intervention. The most frequently prescribed non-preferred medications were the same for both payor data sets. While PCPs wrote 43% of the prescriptions, they were responsible for only 22% of the payors medication costs.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We were able to increase the rate of lower-cost prescriptions about 5 percentage points, meeting our P4P goals. We found payors were interested in hearing about our strategies. We encountered resistance from physicians. A higher generic rate reduces costs and likely improves patient adherence to chronic medications. Our initiative, part of a P4P program for commercial payors, may have been perceived to be aimed at lowering costs rather than improving patient care, and thus may be less of a motivator for physicians. Physicians had trouble negotiating the payors formularies. Although our practice subscribes to a point-ofprescribing service linking a patients individual pharmacy benefits to our EHR, we found several limitations to this service, such as ease of use and untimely formulary updates. Primary care handles the bulk of

prescriptions in a large multi-specialty practice. Any intervention to lower the cost of prescriptions must involve primary care to succeed. Future strategies will include making a stronger case for improving patient care with use of lower-cost of medications and a systematic approach to providing individual physician feedback on their prescribing practices.

PRIMARY CARE-BASED CARE MANAGEMENT FOR HIGH RISK PATIENTS: IMPLEMENTING EVIDENCE-BASED PRACTICE IN A REAL-WORLD CLINIC Elizabeth Davis1; Julia Janssen1; Anneliese Johnson1; Fern Ebeling2; Claire Horton1. 1San Francisco General Hospital, University of California San Franisco, San Francisco, CA; 2San Francisco General Hospital, San Francisco, CA. (Control ID #1340196)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): In the General Medicine Clinic (GMC) at San Francisco General Hospital, there is a small group of primary care patients that account for a disproportionate number of GMC patient hospitalizations, reflecting both the poor health of these patients and the high cost of their care. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): For patients in the GMC Complex Care Management Program (CCMP), we seek to: (1) Reduce ambulatory care sensitive admissions, (2) Reduce cost of care, and (3) Improve patient satisfaction and functional status. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The design of CCMP is based on a literature review of care management for high risk patients in geriatric primary care clinics, Medicaid health plans, and homeless populations, all of which show improved utilization, improved health, and reduced cost of care. Our program is unique in that it adapts lessons from research to a real-world primary care clinic, but instead of solely focusing on geriatric or homeless patients, we are including all high utilizing patients in our clinic. The CCMP team, composed of an RN, behavioral health staff, and health workers, works closely with primary care providers to achieve program objectives. The process begins with an in-home patient-centered assessment focusing on self-management, function, social issues, behavioral health, and safety. From this assessment, the CCMP team develops a care plan together with the patient and primary care provider. Care managers proactively work with patients toward care plan goals and patients have direct access to care managers by phone. There are three tiers of care management intensity of contact, ranging on from weekly patient contact initiated by the care team to solely patient-initiated

contact. Patients can move up or down tiers depending on their stability. Patients move to the highest tier when they have new events or transitions of care. The CCMP team has direct access to GMCs electronic medical record, where they document care plans and medication reconciliation. CCMP uses an electronic registry to track patients. The activities of care managers are tracked using a program on their mobile phones. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Hospitalizations, HbA1c, BP, and adherence to guidelines for diabetes, COPD, and CHF will be measured quarterly. Patient experience will be measured using patient satisfaction surveys and a quality of life measure. Health care costs will be measured quarterly. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): As our program is beginning now, we do not yet have evaluation data, but we do have data about our target population. In GMC, only 2.7% of patients account for 35% of all hospital admissions. For this group, the top three admission diagnoses CHF, angina, and pneumoniaare all ambulatory care sensitive and accounted for 26.7% of primary admission diagnoses. Diabetes and COPD, also ambulatory care sensitive conditions, were in the top 12 primary admission diagnoses.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): CCMP is a patient-centered model that other primary care clinics can

learn from as they try to improve care for their highest risk patients. This model combines lessons learned from research on care management and adapts them to a real-world primary care clinic. Our use of information technology demonstrates how a primary care clinic can use its EMR and existing resources to meet program needs.

QUALITY IMPROVEMENT IN THE ADMISSIONS PROCESS: A RESIDENT-LED ANALYSIS OF THE EMERGENCY DEPARTMENT DOOR-TO-FLOOR TIME Krishan Soni; Gene Quinn; Elizabeth Le; Gabrielle Berger; Seth Berkowitz; Stacy Brenner; Jennifer T. Chang; Nathaniel Gleason; Yinchong E. Mak; Erika Moseson; Jorge Tello; Arpana Vidyarthi; Read Pierce. University of California, San Francisco, San Francisco, CA. (Control ID #1339974)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Despite significant efforts, emergency room wait times and admission times at our institution continue to be prolonged.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): For academic medical centers, the involvement and input of house-staff are critical to achieving meaningful results in decreasing the ED Door-to-Floor time (ED D2F). We describe here a resident-led analysis of the ED D2F process in an attempt to reduce wait times. We set out to conduct a comprehensive resident-led analysis of the ED D2F time and present recommendations to the medical center leadership for improvement using novel strategies, particularly with regards to (1) interdepartmental teamwork and communication, (2) effective resource utilization and(3) improved care transitions.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The analysis of the Emergency Department Door-to-Floor process for a 600 bed academic medical center was undertaken over several months in the spring of 2011. Residents embarked on a comprehensive literature review, interviewed key staff across multiple departments, engaged in discussion with thought leaders and representatives at peer institutions and carried out process mapping and failure modes effects analysis to better understand the scope and details of the ED D2F time problem. Additionally, the residents designed and piloted a unique staff position, called the Triage Hospital-ist, comprised of an Internal Medicine Hospitalist charged with facilitating appropriate patient admissions while in the ED, to try and decrease the door-to-floor time while safely triaging admitted patients.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The medical center is continuing to track ED Door to Floor times.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Overall results of our analysis focused on the need for simultaneous attention to workflow, culture, and incentives to achieve change in a complex system. With regards to workflow, an early emphasis on destination, reducing redundancy, and unbundling of specialized monitoring services was emphasized. Changes in the culture of the admitting process emphasized training house-staff to make early triage decisions, shifting traditional ED tasks upstairs and the creation of a safe and appropriate environment for expedited care on the medicine floors. Lastly, attention was paid to identifying stakeholders and their incentives, avoiding the creation of unintended incentives, and the role of continuous feedback in modifying behavior. Strong positive feedback during presentation to the medical center leadership has resulted in the inclusion of residents on the Patient Flow Committee, streamlining of the admissions process from the house-staff perspective and increased collaboration between the Emergency Department and admitting services. Since presentation of our analysis to the medical center, median ED D2F times have fallen by approximately 20 minutes.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Prolonged wait times in the Emergency Department have a strong negative impact on both patient satisfaction and inpatient health outcomes. A resident-led analysis to shorten

admission times highlights the importance of simultaneously addressing workflow, culture, and incentives to create sustainable and appreciable change.

REDUCING CONGESTIVE HEART FAILURE READMISSIONS: A SUCCESSFUL PROGRAM BETWEEN AN ACUTE HOSPITAL AND SKILLED NURSE FACILITY. Diego F. Martinez-Vasquez1; Jan Lear1; Marsha J. Butler2; Suzanne Proctor3. 1Franklin Square Hospital Center, Baltimore, MD; 2Genesis Health Care, Towson, MD; 3Medstar Health Visiting Nurse Association, Calverton, MD. (Control ID #1313452)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Congestive Heart Failure (CHF) is among the leading cause for hospital readmissions. Discharge to Skilled Nurse Facility (SNF) occurs in approximately 1 in 5 Medicare beneficiaries after hospitalization for CHF. Among these patients 23.5% are readmitted to acute hospitals within 30 days. CHF readmissions worsens patient outcomes are very costly and can be preventable in approximately 40% of the cases. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Develop a program to decrease CHF readmissions from patients discharged to a SNF. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The program started in February, 2011 and focused on CHF admissions that came to the hospital and were further discharged to a SNF. One specific SNF was chosen for this program. Upon admission to the hospital a readmission tool was administered to early detect the risk for a future readmission. A multidisciplinary team including the attending and nurse carrying for the patient, pharmacist, social worker, cardiologist and a SNF and VNA liaison performed medical rounds. After the acute hospitalization, patients who met criteria for SNF placement were sent to the specific SNF chosen for the program. This SNF has also developed a multidisciplinary team similar to the hospital one. After discharge from the SNF patients went home with or without VNA services. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Readmission tool Multidiciplinary team metrics and goals for each patient Appropriate coordination of care checklist between acute hospital and Skilled Nurse facility including discharge summaries, medication reconciliation and consults P value One way anovaFINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The data analyzed is until November 30th 2011.The readmission tool helped the multidisciplinary team focused on high yield reasons for potential readmission. During this period the hospital sent 68 patients with a Dx of CHF to the SNF vs. 20 same

period previous year. Out of the patients sent by the hospital to the SNF, the hospital had 17 readmissions (25%) within 30 days in comparison with 13 readmission (65%) $P<0.05$. from previous year. Among the readmissions 10 (59%) came from the SNF and 7 (41%) from home. 8 readmissions (47%) had a diagnosis of CHF. Among the readmissions 15 (88%) did not have a VNA service set up when they went home from the SNF compared with only 2 (12%) who had a VNA service. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The program decreased readmissions from patients sent to SNF by 40%. VNA services should be a part of a readmission program. Building programs of care between acute hospitals and SNF are fundamental to achieve reduction in CHF readmissions.

REDUCING HOSPITAL READMISSIONS: DEVELOPING A TRANSITIONS-OF-CARE PROGRAM AT UCSFS GENERAL INTERNAL MEDICINE CLINIC Ning Tang. UCSF, San Francisco, CA. (Control ID #1340044)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): How can general internal medicine (GIM) clinics develop a comprehensive program to reduce hospital readmissions?

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Track and understand trends in all-cause 30-day readmission rates in a GIM clinic 2. Test interventions to reduce readmission rates 3. Improve communication and collaboration between inpatient services and the GIM clinic around transitions-of-care (TOC)

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Starting in June 2010, UCSF's GIM clinic has been tracking 30-day readmission rates for its panel of 21,000 patients. Targeting services where the majority of our patients were hospitalized, we collaborated with inpatient physician leaders towards the common goal of reducing readmissions. The initial focus of our program was to ensure patients were offered outpatient follow-up appointments within 14 days of discharge. Our clinic nurses called patients who refused, cancelled, or did not arrive for the appointment. In the second phase of our program, we improved communication between inpatient and outpatient physicians at the time of discharge and developed standardized processes for the post-hospitalization appointment, including reserving appointment slots to ensure patient access, longer appointment times with a nurse visit prior to the physician visit, completing full medication reconciliation, and notifying the primary care physician (PCP) about the outcome of the follow-up appointment. A final component of our TOC program has been reviewing cases of patients who are repeatedly hospitalized to identify modifiable causes of readmission and identifying a list of high-risk patients for active surveillance and case management. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The primary outcome measure is all-cause 30-day readmission rate. Secondary outcome measures include percentage of patients with post-hospitalization follow-up appointments within 14 days of discharge and PCP satisfaction with the TOC program. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): During our intervention months, we offered over 90% of our patients follow-up appointments within 14 days of discharge, or had a nurse call patients who refused, cancelled, or did not arrive for their appointment. Reducing 30-day readmission rates has been more difficult to sustain. Prior to the intervention, all-cause 30-day readmission rates averaged 15.3%. In the 4 months following the intervention, the readmission rate averaged 12.8%. However, the monthly readmission rate has fluctuated, ranging from 10.2% to 22.2%. In informal discussions, PCPs showed appreciation for communication about hospital discharges.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): - Tracking patients on admission, at discharge, and on the appointment day is very labor intensive. Automated computer
systems could streamline the process. - Patients may refuse follow-up appointments if they are already seeing a specialist. Patients may refuse follow-up appointments with an acute provider if they have an appointment with their PCP at a later date. - Physician access is variable. Proactive steps should be taken to reserve appointment slots for physicians with high hospital discharge volume. - There may be an increased role for nurse phone call after discharge, especially in patients who refuse the 14-day follow-up appointment or where physician access is limited. - Post-hospitalization follow-up appointments frequently require more time (up to 1 hour). It can be difficult to schedule adequate time for these appointments.
REDUCING EMERGENCY ROOM VISITS IN A HIGH RISK POPULATION IN A TEACHING COMMUNITY HEALTH CENTER Carolyn F. Pedley; James L. Wofford; Mary M. Smoak; David Mount; Miriam Baird. Wake Forest, Winston-Salem, NC. (Control ID #1339780)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The Medicaid population has a high use of the emergency room for nonemergent reasons which greatly increases the cost of caring for this population.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1 To identify high users of the emergency room in the Medicaid population assigned to a community clinic 2 . To devise interventions based in the clinic to reduce emergency room use by these individuals 3 Improve use of the community health clinic by these individuals DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Medicaid patients assigned to a teaching community health clinic were screened for emergency room use by utilizing an alert system and the electronic medical record . Individuals going to the

emergency room three or more times in the previous year were enrolled in interventions based in the clinic. Patients were contacted by telephone, mailings and were given information about the clinic's desire to have them access the clinic rather than going to the emergency room They were given the telephone numbers of two health navigators and were made aware of extended clinic hours and weekend clinc hours Patients also received proactive calls from the Navigators who arranged for them to be seen in the clinic when they felt the need to be seen urgently The patients were also invited to participate in support groups run by a Psychologist. The Navigators also assisted in arranging transportation and access to medications.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The number of emergency room visits were counted one year before and at four months and eight months following enrollment in the interventions.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Fifty five patients were identified as having gone to the emergency room three or more times in the previous year, were part of the practice and were willing to participate in the interventions One year prior to enrollment these patients went to the emergency room an average of six times or .5 ED visits per patient per month. Four months after enrollment ED visits by these 55 were reduced to .45 visits per patient per month and after eight months the ED visits were reduced to .36 visits per patient per month. The 12 month figures are now being gathered. At the eight month rate more than 90 emergency room visits would be avoided in a year.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): A program to identify frequent emergency room users and to intervene by proactive strategies can result in significant reductions in emergency room use by these individuals. At the same time these patients can be more actively engaged in their home clinic. These reductions in emergency room use will result in cost savings and enhanced engagement in the clinic will result in better continuity of health care

REDUCING INPATIENT HYPOGLYCEMIA: DIABETES- A TEAM APPROACH Sunil Asnani; Lyudmila Shvets; Christian Kaunzinger. Jersey Shore University Medical Center, Neptune, NJ. (Control ID #1340189)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Hypoglycemia in an inpatient setting is associated with an increased length of stay, higher health care costs and an increased risk of inpatient mortality.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To identify etiology of inpatient hypoglycemia. 2. To reduce inpatient hypoglycemia 3. To establish protocols and pathways in the hospital to minimize the risk of inpatient hypoglycmiaDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Retrospective chart review of patients with severe hypoglycemia (<40 mg/dl) was conducted over a continuous 6 months period from January-June 2007. After an intervention period of 4 years, a similar chart review was conducted from May-November 2011. The planning phase was extensive and multidisciplinary including administration, medical staff, nursing, dietary, radiology and surgical services. Intervention phase was over 2 years and is ongoing.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Severe hypoglycemia (<40 mg/dl) rates over a 6 month period will be compared pre and post intervention. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): PRE-INTERVENTION: 474 episodes of severe hypoglycemia were confirmed over 6 months; 54% occurred in ICU; 20% in type 1 diabetes, 30% between 12-6 AM; over 50% had altered nutritional status (NPO/TPN/tube feeds/perioperative): 35% had only sliding scale insulin ordered; 20% were on steroid taper. INTERVENTION- Strategies were developed to tackle each high risk group. Nursing,

dietary and patient education regarding insulin-meal match was undertaken and continues on an ongoing basis. Pre-meal fingerstick blood glucose and insulin administration and consistent meal delivery from kitchen is now a goal at each nursing unit. The insulin infusion protocol at the ICU is now trended and hypoglycemia rates are down by over 90% in the ICU. The medical staff of the hospital is constantly being urged to adopt basal-bolus insulin when ordering instead of the sliding scale culture; order sets are being developed to assist the physicians to guide them down this pathway. Diabetes management team consults are being encouraged in patients with type 1 diabetes, steroid taper, and those with known history of severe hypoglycemia. POST-INTERVENTION: After 4 years of intervention, education and ongoing culture changes, the data collection was reattempted. 190 episodes of severe hypoglycemia were noted over 6 months; ICU rates were down 90%. Majority of episodes still occurred in type 1 diabetes, steroid taper and altered nutritional status. Use of basal insulin has increased but sliding scales remain visible.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Inpatient hypoglycemia can be largely preventable in a majority of patients (>60%). It is, however, a collective effort. Developing strategies to prevent or to reduce hypoglycemic events should include identifying high risk patients, recognizing precipitating factors, use of appropriate scheduled insulin and appropriate nutrition support for hospitalized patients. Nursing should be constantly alert and physician orders for anti hyperglycemic therapy must be frequently revised in high risk patients to avoid hypoglycemia. Diabetes management team consults may be helpful in certain high risk patient populations. Constant physician education is necessary to break the grip of sliding scales. A hospital-wide policy should be established for the appropriate response to triggering events. Optimal diabetes care and improving outcomes in an inpatient setting needs a team approach.
REVIEW OF INDIVIDUAL READMISSIONS BY HOSPITALISTS: PRELIMINARY FINDINGS OF A QUALITY IMPROVEMENT PROJECT. Sumanta Chaudhuri; Vipulkumar Rana; Kartik Reddy; Ritesh Panwar; Adil Jadoon; Bipin Thapa; Kathleen Idstein; Binod Dhakal; Conti Mary; Siddhartha Singh. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1339814)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Readmissions are considered a costly and avoidable waste in the healthcare
system yet reasons for readmissions are poorly understood and reducing readmissions has been challenging.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): We undertook a quality improvement project where each faculty and physician assistant in our hospitalist section reviewed charts of patients discharged by them who were readmitted within 30 days. Its objectives were: 1. To allow hospitalists to learn from reviewing readmission cases and change their individual practice 2. To discuss important lessons learned and translate them into systems based changes 3. To reduce readmission rates to our hospitalist section DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Starting January 2011, we provided all hospitalists a weekly list of patients discharged by them who were readmitted within 30 days. We asked them to write a short report on each case with an emphasis on strategies to prevent that readmission. Starting March 2010, we asked the hospitalists to use an online Microsoft Access based tool to abstract data from each case reviewed to allow easier collation of data. The fields in this tool are partly populated through the discharge abstract database and partly filled in manually following the review of the chart. It is housed on a shred but secure password protected drive. We also conduct monthly meetings where individual data on readmission rates are shared, strategies to reduce readmissions are discussed and a few exemplary cases are reviewed in detail in a group setting.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): During the period March 2011 till May 2011 we have asked the hospitalist group to review a total of a 152 cases and a review has been completed on 79 (52%). Rich

data has been collected about factors contributing to readmissions such as discovering that in approximately 10% of readmissions were related to medication changes made during index admission; only 22% of patients readmitted saw their primary care provider after discharge and in 18% each of cases social and psychiatric issues contributed to the readmission. In addition the monthly meetings have increased the collective awareness of the group to the problem of readmissions and we have brainstormed a number of issues relevant to reducing readmissions such as improvements in discharge planning, in the care of the non-compliant patient, and better input with consulting services at discharge.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The readmission rates for our hospitalist group for the period while we have reviewed readmissions (January to April 2011) of 15.9% has decreased significantly compared to a similar period last year (January to April 2010; 19.9%; P=0.005) and also when compared to the immediate 4 months prior to our intervention (September to December, 2010; 18.7%; P=0.019).
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Hospitalists reviewing their own individual readmissions is feasible and is a valuable learning tool to determine factors contributing to readmissions. It also has the potential to act as an intervention to reduce readmissions.
SPREAD: AN EFFECTIVENESS TRIAL COMPARING A COMMUNITY HEALTH WORKER DISCHARGE INTERVENTION TO STANDARD CARE IN POST-MYOCARDIAL INFARCTION PATIENTS Tanvir Hussain1; Denis Xavier2; Rajeev Gupta3; Philip Devereaux4; Alben Sigmani2; A. Soumya2; Salim Yusuf4. 1Brigham &Women's Hospital, Boston, MA; 2St. John's Medical College, Bangalore, India; 3Fortis Escorts Hospital, Jaipur, India; 4McMaster University, Hamilton, ON, Canada. (Control ID #1340484)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): While mortality is highest in the first year after a myocardial infarction (MI), there is inadequate infrastructure to support patient adherence to medical recommendations post-discharge, particularly in communities with poor health literacy.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To test the feasibility of training community health workers (CHWs) in post-MI care in resource-poor settings. 2. To study the effectiveness of lay health workers in improving lifestyle and medication adherence post-MI.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): This effectiveness trial will randomize patients diagnosed with MI from fourteen hospitals across India for follow-up care at the time of discharge: 400 to standard care and 400 to the CHW intervention. CHWs will conduct patient visits at discharge, months 1, 3, 5, 7, and 9 of follow-up, and finally at 12 months. CHWs will identify red flag symptoms; increase health literacy; conduct medicine reconciliation; encourage lifestyle and medication adherence through motivational interviewing, personalizing solutions to overcome barriers, goal setting and action planning, and identifying social supports. One CHW has been identified per hospital; selection criteria included: age >18 years, no more than secondary education, and fluency (written and spoken) in the local language. A CHW training manual and workbook were developed by the above authors. Content includes cardiovascular physiology, pathophysiology of ischemic heart disease, lifestyle recommendations and medications for secondary prevention. Skills-training covers rapport building, vital signs measurement, and behavioral change techniques. CHWs were evaluated during a week-long capstone training using simulated patient encounters.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): This mixed-methods study is powered to detect a 10% difference between groups in adherence to post-MI medications at one year. Secondary quantitative outcomes include cardiovascular events, adherence to healthy lifestyle, and patient knowledge of and attitudes toward cardiovascular disease prevention. Qualitative assessment will include structured interviews of CHWs and of a

selection of trial participants. Also, patient-encounter reports completed by CHWs will be reviewed. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): CHWs are currently conducting follow-up visits for enrolled patients. Effectiveness data are not yet reportable; however, it is also critical to evaluate the CHW training process for this clinical innovation. Defining the CHW role was informed by multi-stakeholder focus groups, which revealed consensus that physicians should not task-shift clinical duties to CHWs; rather, CHWs should provide patient and community support (with adherence and health care navigation). Decentralized CHW training, led by study site officers using a standard training manual, provided logistical ease and individualized pacing without jeopardizing quality. After didactic instruction, CHWs still felt unprepared to facilitate behavior change around adherence, so an additional training component was included: CHWs shadowed and participated in fifty physician-led patient counseling sessions. Of the fourteen CHW selected, two were replaced: one for failure to demonstrate required competencies; another due to personal circumstances. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): CHWs may add clinical value and increase social capital in communities with poor health literacy.

STREAMLINING FOLLOW-UP: A NEW TECHNOLOGY FOR PATIENT-CENTERED CARE. Sabrina Felson1; Lauri Calkins2; Mae Callanan3. 1Veterans Health Administration New York Harbor Healthcare, New York, NY; 2Veterans Health Administration East Orange, New Jersey, NJ; 3Veterans Health Administration New York Harbor Healthcare, New York, NY. (Control ID #1317885)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Primary care providers need a way to formalize and simplify complicated follow-up instructions so patients can successfully navigate the health-care system in between visits with their doctor.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): The individualized Electronic Primary Care Follow-up Plan is designed to maximize the efficiency and utility of face-to-face visits; encourage patient participation; and facilitate communication between the patient and health care team.

DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Using the Veterans Affairs (VA) electronic medical record we designed a Follow-up Plan that translates physician follow-up orders into a single page, individualized instruction sheet for the patient to take home at the end of each primary-care visit. This templated note not only supplies the patient with an instruction tool; it also provides the physician with the convenience of ordering all referrals from one place. Physicians view a checklist of all possible relevant follow-up orders, expandable when prompted to offer additional, more specific options. For instance, if a physician orders imaging, a menu box of options appears with different imaging modalities; if a referral is required, a list of specialty clinics appears. The selected follow-up then automatically links to electronic orders. The final chart note pulls in only patient-relevant data. The patient leaves the primary care visit with a one-page personalized instruction sheet explaining how, when and why to accomplish each follow-up task. Checkout lines are minimized as patients no longer wait in line to schedule appointments. The note, which documents that patient communication took place with an electronic signature, remains in the medical record and can be consulted and reprinted at any time between visits by any member of Patient Aligned Care Team (PACT). The follow-up plan shows how the healthcare system can harness technology to improve patient care. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): A primary measure of the Plan's success thus far is the excitement that it has generated among providers and the administration. Most primary care providers in NY Harbor, including residents, use the note. As part of a leadership fellowship, Dr. Laurie Calkins imported the Follow-Up Plan note, which she renamed E-FUN, to primary care at the VA NJ. We plan to roll out the note to all facilities in the NY/NJ Veterans Integrated Service Network, which includes 9 large primary care facilities. Next month we will introduce it to a group of national VA primary care leaders for possible adoption on a larger scale.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Dr. Calkins developed a chart review comparing 60 patients with primary care visits in VA NJ and found that 94% of patients with E-FUN compared with 81% of patients without it completed recommended follow-up tasks. A phone survey of the 30 patients who received E-FUN revealed that 37% found it "very helpful and "60% found it "helpful." We plan a similar study with the more urban and indigent population at NY Harbor.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): We recommend the presence of a local champion, preferably a physician, who collaborates directly with an IT expert in constructing a note that enhances workflow for the busy provider and facilitates follow-up by the patient. We have prepared a detailed instruction guide for exporting E-FUN to other VA sites for possible inclusion in the national PACT "toolkit." We are also working to offer a patient version of instructions in Spanish.
SUCCESSFULLY ACHIEVING THE TRIPLE AIM FOR THE HIGH-RISK HIGH-COST MEDICARE POPULATION: LESSONS LEARNED FROM AN INTENSIVE PRIMARY CARE-BASED CARE MANAGEMENT PROGRAM Norifumi Kamo. Massachusetts General Hospital, Boston, MA. (Control ID #1340255)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): High-risk Medicare patients account for a disproportionate amount of spending, while interventions to improve quality of care and reduce costs have had mixed results.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Improve health outcomes and achieve cost savings for high-risk Medicare beneficiariesDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The MassGeneral Care Management Program (CMP) is a Medicare demonstration project that utilizes an intensive primary care-based care management

program for high-risk, high-cost Medicare beneficiaries. The program is based at 19 hospital and community-based primary care practices associated with a large academic medical center. The CMP program assigned primary care-based nurse care managers with extensive medical-surgical experience to 2600 program participants. 800 additional participants were added after one year. In close collaboration with primary care physicians, nurse case managers provide customized interventions to improve self-management of chronic conditions, facilitate access to resources, assist with care transitions, and address changes in participants clinical conditions. CMP also includes other specialized services for program participants (e.g. a mental health team). The program is supported by an integrated health IT system and data analytics to evaluate trends in hospitalizations and costs.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Quantitative metrics were assessed by Research Triangle International, Inc., which conducted regression models comparing costs, hospitalization rates, emergency room visits, 90-day readmission rates, mortality rates between the intervention cohort and a comparison cohort. Qualitative analysis of the programs success factors were evaluated by a focus group attended by nurse care managers and other CMP staff, site visits, semi-structured interviews with program staff and primary care physicians. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Over a three-year period, the program demonstrated cost savings, reduced number of hospitalizations and emergency department visits, decreased mortality rate, and improved beneficiary quality of life relative to a comparison cohort. CMP did not reduce 90 day readmission rates. Success factors included: - Appropriately targeting patients where benefit from intensive outpatient care management would outweigh costs

- Leveraging organizational capabilities of the institution (e.g. strong primary care network, integrated health IT system) -Involving stakeholders early in the design of the program and obtaining institutional support - Tightly integrating the CMP program with existing primary care practices - Hiring and training clinically experienced nurse care managers who anticipate and promptly respond to changes in patients' clinical status - Actively modifying the program based on real-time data and promoting a culture dedicated to continuous improvementKEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The MassGeneral CMP demonstrated that a comprehensive primary care-based care management program is one approach to improving health care outcomes while producing savings for high-cost high-risk Medicare patients. Similar programs will likely be successful in the context of tight integration with primary care practices within integrated health organizations. Given the complexity of the high-cost high-risk Medicare population and the highly customized nature of care management interventions, similar programs will need continuous modifications guided by strong program leadership.

TELEPHONE FOLLOW-UP AFTER HOSPITAL DISCHARGE AmyR. Schwartz1,2; Gail Barrows1; Carl M. Dillon1; Jill Edwards1; Johanna Giovanniello1; Rosemary Lettiero1; Catherine Lobner1; Esterina Messeder1; Maureen Roche1; Christopher Ruser1,2; Gloria Satti-Langlois1; Monique Simmons1; Lashonda Sullivan1; Donna C. Vogel1. 1VA Connecticut Health-care System, West Haven, CT; 2Yale University, New Haven, CT. (Control ID #1339766)

STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Transition from the hospital to home is difficult; patients often have medication and other clinical questions or concerns and are at risk for readmission and other adverse events.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Call patients within 2 business days of discharge from the medical, surgical, or psychiatric inpatient services at VA Connecticut. 2. Identify medication, appointment, home care, and clinical concerns and intervene. 3. Decrease hospital readmission. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Patients are called within 2 business days after discharge by their team RN (patients
discharged to home) or RN or SW case manager (patients discharged to a facility). A templated note is used to enquire regarding medical reconciliation, appointment needs, and clinical concerns. The intervention has been successfully spread to all primary care sites in the VA Connecticut Healthcare System.

MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): 1. Successful telephone call completion.2. Identification and resolution of medication, appointment, home care, and clinical concerns. 3. Readmission rates.

FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Telephone calls following discharge identify medication concerns in about 20% of patients, appointment issues in about 26%, case management needs in 5%, and other clinical issues in 11%. Our pilot teams found that patients were often confused about their medications at discharge, and this information was used to redesign the discharge instruction and medication education process on the inpatient services. We were able to spread the process throughout all VA sites in our state. Data regarding readmission is being collected.

KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Discharge follow-up calls identify clinical problems and are well-received by patients. When developing the process for discharge follow-up calls it is helpful to have an interdisciplinary workgroup, create a clear playbook, employ team-to-team training, and periodically track contact rates and reasons for inability to contact patients.

TEXT MESSAGING TO ENGAGE PARENTS OF CHILDREN PARTICIPATING IN A COMMUNITY-BASED AFTERSCHOOL NUTRITION AND PHYSICAL ACTIVITY PROGRAM Michael T. Quinn1; Althera Steenes1;

Marla C. Solomon3; Lori McClinton-Powell2; F. Kweku Embil2; Amanda Gawin1; Shantanu Nundy1; Deborah L. Burnet1.
1University of Chicago, Chicago, IL; 2Woodlawn Community School, Chicago, IL; 3University of Illinois at Chicago, Chicago, IL. (Control ID #1339524)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): While the afterschool setting offers an ideal venue for promoting healthy nutrition and activity among children, engaging parents regarding the knowledge and skills their children are acquiring in the afterschool program can be challenging. Cellphone texting represents a promising approach to engage parents of children in an after-school program focused on healthy nutrition and exercise.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): This pilot test of a text messaging system for parents is being conducted as part of a larger initiative designed to promote healthy nutrition and activity among children in grades 3-5 who are attending an afterschool program in an urban community. The objectives of the text messaging component are: 1) develop a system of brief text messages designed to communicate with parents and engage them in the nutrition and physical activity lessons their children receive in the afterschool program, and 2) evaluate the feasibility and acceptability of the text messaging system with a sample of parents whose children attend the afterschool programDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): A total of 25 children in the 3 rd, 4th, and 5th grades at one urban public elementary school are currently enrolled in the Power Up program, a 20-week afterschool educational program designed to promote healthy nutrition and physical activity. The program is delivered by regular classroom teachers. Effectively engaging parents within the afterschool time frame has been challenging, as opportunity for face-to-face interaction is limited to the brief time when parents pick up their children and rush home to prepare dinner. A promising adjunct to this face-to-face interaction is the use of brief text messages via cell-phone. We developed a system of brief text messages for parents that are aligned with the afterschool curriculum and designed to raise awareness of content covered in class (e.g., Today, your child learned about

the Nutrition Fact Label on packaged foods), support the value of that information (e.g., Knowing how much sugar is in a food can help your child make healthy food choices.), suggest behavioral application of that information (e.g., At the grocery store, ask your child to compare the nutrition facts of a granola bar and a cereal.), and ask a related question (e.g., Ask your child to show you a portion size for rice or pasta.). We are currently recruiting a convenience sample of 10-15 parents to participate in this one-month pilot study of the feasibility of this brief text messaging system. MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We are using participant surveys and semi-structured interviews to assess acceptability and ease of use of the text messaging system, recall of content, clarity of messages, impact on confidence in changing dietary and physical activity behaviors, and effectiveness in prompting actual behavior changes.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Teachers and parents expressed interest and enthusiasm about participating in the text messaging pilot; data will be collected and analyzed this winter.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Text messaging is widely used by parents, and inexpensive technologies for creating and sending automated text messages are readily available. This technology affords an innovative opportunity to engage parents in participating in and reinforcing their childs learning and to promote their familys healthy lifestyle changes.
THE MGH COMPLEX CARE SERVICE: A CONTINUITY-FOCUSED CARE MODEL FOR MEDICALLY-

COMPLEX INPATIENTS Ryan Thompson; Deirdre Sweeney; David Finn; Steve Levisohn. Massachusetts General Hospital, Boston, MA. (Control ID #1340054)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The most complex medical inpatients often involve long length-of-stay, multiple medical team changes, and many consulting physicians; therefore maintaining inpatient continuity of care can be difficult. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) Provide team-based continuity of care to medically-complex, long length-of-stay inpatients. 2) Improve patient and family satisfaction with inpatient care through higher levels of care coordination. 3) Provide enhanced coordination of services with nursing, allied health professionals, and consulting teams through the Complex Care nurse practitioner.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The Complex Care Service at Massachusetts General Hospital (MGH) began in 2008 to address the needs of the most medically-complex inpatients at MGH. Patients referred to the service have had several common themes, including multiple consulting teams, expected long length-of-stay, and extended time spent in an intensive care unit. The service consists of three outpatient-based general internists skilled in inpatient care, and one inpatient nurse practitioner. The physicians do not rotate on- and off-service, and thus provide continuity of care throughout their patients referral admission, and on subsequent admissions if re-admitted. Referrals to Complex Care come from case management, housestaff, hospitalists, and specialist physicians. The service can follow up to six inpatients at a time, with weekend coverage provided by an affiliated primary care practice. Salary for the nurse practitioner is paid for by the hospital. Physicians receive an augmented inpatient fee and weekly management fee to compensate for the additional time required to care for these patients.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Evaluating the operational value of the service (e.g. cost savings, patient outcomes) compared to a control group is difficult given the outlier status of these patients. However, we plan to assess patient, family, and nursing satisfaction with the service through validated survey tools that assess continuity of care. We also plan to develop formal acceptance criteria for the service that will help characterize the referral base,
and allow for more systematic identification of patients who will derive greatest benefit from the service.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Since 2008, the Complex Care Service has accepted 88 unique patients onto the service, spanning 193 admissions. Referral to the service was made, on average, 26.4 days into the patients admission (median 21 days). Most referrals came from case management (59%) or other physicians (36%), both medical and surgical. The average number of consulting services per patient at the time of referral was 5.5. The average length-of-stay on the Complex Care Service for the referral admission was 21.8 days. The range of primary diagnoses for Complex Care patients has been varied, with common themes being rare complicated diagnoses (e.g. catastrophic antiphospholipid syndrome, calciphylaxis), complicated systemic infections, and inpatient medical complications. Other themes include tertiary or quaternary referrals, complicated discharge dispositions, and chronically-ill adolescent patients transitioning to adult care. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Outpatient general internists with skill and interest in inpatient care can partner with an inpatient nurse practitioner to provide continuity of inpatient care and enhanced care coordination to the most medically-complex, long length-of-stay inpatients.
THE USE OF A PERSONALIZED GENE EXPRESSION TEST TO IMPROVE DECISION MAKING IN THE EVALUATION OF PATIENTS WITH SUSPECTED CORONARY ARTERY DISEASE Michael F. Conlin1; Mark Mouton3; Lee E. Herman1; May Yau4; Mark Monane4; John McPherson5; Michael Elashoff4; Larry Wilson2. 1Johns Creek Primary Care, Suwanee, GA; 2Wake Forest Family Medicine, Wake Forest, NC; 3Mark Mouton,

Baker, LA; 4CardioDx, Palo Alto, CA;
5Vanderbilt Heart and Vascular Institute, Nashville, TN. (Control ID #1338662)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The evaluation of patients (pts) with suspected coronary artery disease (CAD) is highly variable and is associated with test overutilization, high costs, and iatrogenic complications.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): The main objective of the program is to assess the clinical utility of a personalized gene expression score (GES) among pts with suspected CAD in medical decision making by primary care physicians around referral to a cardiologist. We also assessed downstream use of cardiac noninvasive and invasive testing in these referred and non-referred pts.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The GES is a validated quantitative diagnostic test for non-diabetic pts, measuring expression levels of 23 genes from peripheral blood to determine the likelihood of a pt having at least one vessel with50% coronary artery stenosis. The GES has a negative predictive value of 96% in a recent study evaluating pts referred for myocardial perfusion imaging. We selected three community-based primary care practices for evaluation: these sites underwent education and training in the use and interpretation of the GES. Stable pts with chest pain with suspected CAD had a peripheral blood sample drawn, which was sent to a central reference lab: this lab reported the GES to the physician within 3-4 days. A total of 184 pts presented to these practices with chest pain and underwent gene expression testing from January to September 2011. We extracted information on GES, patient demographics, and chest pain symptoms as well as diagnostic tests and cardiology referrals ordered. All pts are being followed for late major adverse cardiac events.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We measured percentage of low GES (15) pts, rate of cardiology referrals, rate of noninvasive and invasive cardiac testing, and diagnostic yield at cardiac catheterization. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): The median age was 56 years old, and 49% were female. The cohort included 184 pts with typical and

atypical symptoms (112, 61%), asymptomatic pts with 3 risk factors (64, 35%) and asymptomatic pts with <3 risk factors for CAD (8, 4%). There were 88 (48%) pts with low GES (mean=9) and 96 (52%) with non-low GES (mean=25). The primary analysis was the proportion of referrals to a cardiologist among low and non-low GES pts. A total of 47 (25%) pts were referred to cardiology: 6% (n=5) of low GES and 44% (n=42) of non-low GES. The odds ratio by logistic regression for referral among low GES pts was 0.17 (p=0.011), controlling for age, gender, type of symptoms, and practice site. Additional cardiac testing was noted in 6% (n=5) of low GES pts and 36% (n=35) of non-low GES pts. Of note, there were 7 angiograms performed in the low (n=1) and non-low (n=6) GES pts: 2/7 pts (all nonlow GES scores)were found to have clinically significant obstructive CAD. KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The use of the personalized gene expression test was efficient in separating pts into low (48%) and non-low (52%) GES groups. Pts in the low GES were ~6 times less likely to be referred to a cardiologist. The low GES was associated with lower downstream cardiac testing effects as well. The findings suggest that this clinical practice innovation involving personalized gene expression scores may be used by primary care physicians to rule out low risk pts as well as identify appropriate pts needing further testing.
UNIVERSAL OPT-IN HIV SCREENING AT MASSACHUSETTS GENERAL HOSPITAL CHELSEA URGENT

CARE CLINIC Jordan Lane1; Rachel Bender Ignacio1,2; Jacqueline Chu2; Jeffrey Collins2; ValerieE. Stone1,2. 1Harvard Medical School, Boston, MA; 2Massachusetts General Hospital, Boston, MA. (Control ID #1339840)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Despite CDC guidelines that recommend routine screening of all patients 13-64 years old in all health care settings, many urgent care clinics and primary care providers do not offer universal HIV screening. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) Determine the feasibility of opt-in HIV screening at the Massachusetts General Hospital Chelsea Urgent Care Clinic in a 4 month pilot. 2) Assess the correlation between having an MGH Primary Care Physician and prior HIV screening to determine the need for screening in our urgent care clinic and to improve screening in the primary care setting. 3) Determine the acceptability of screening to patients and providers as well as the rate and demographics of undiagnosed HIV among screened patients.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): As of the 2010 census, 62.1% of the population of Chelsea, MA, a densely populated city within the urban area of Boston, self-identified as Hispanic, 38% of the population was foreign born, and the HIV prevalence was one of the highest in the state. From Oct. 2011 to Jan. 2012, all patients 18-65 years old presenting to the MGH Chelsea Urgent Care Clinic were offered HIV screening regardless of risk or reason for presentation. Patients who consented (required by MA law) were tested using our hospitals standard Enzyme Immune Assay, confirmed by Western Blot, if positive. Initially, all negative results were given by phone. An interim review necessitated having patients pick up negative results due to burden on work-flow. HIV positive individuals were notified in person with follow-up arranged with an HIV team.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We will determine acceptance of the program through consent and testing rates. Staff perceptions will be obtained in an anonymous post-pilot survey. Prior HIV screening and MGH primary care will be determined by an electronic medical records review. The key measure of success will be integration of this HIV screening protocol into standard of practice upon the pilots end.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Of the 1243 patient encounters reviewed to date, 297(23.9%) were screened. One HIV+result was encountered, although this led to the discovery of undiagnosed HIV in
their partner as well. This is a prevalence of 0.34% undiagnosed HIV. A prevalence0.1% has previously been shown cost effective. Of the 874 patients with an active MGH Primary Care Physician, 368(42.1%) had no record of prior screening. Of those patients not previously tested, 75(20.4%) underwent testing when offered.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 22% of patients seen did not have a primary care physician. These patients often have less health literacy, non-legal immigrant status, and less social stability. Many of these characteristics not only increase the risk of acquiring HIV, but also decrease the likelihood of receiving preventive care. This pilot demonstrates it is possible to routinely screen for HIV in our urgent care setting with a reasonable rate of uptake and minimal expenditure of clinical time and resources. The rate of undiagnosed HIV indicates that screening is warranted. Also, screening rates among patients receiving their primary care within the MGH system indicate that having a primary care physician is not predictive of having received screening. This data will promote better screening in our primary care and underscores the importance of screening at a health center/hospital-affiliated urgent care clinic despite theoretical availability of testing through primary care.
USE OF A RESIDENT-DRIVEN LONGITUDINAL APPROACH TO ACCOMPLISH A PRACTICE IMPROVEMENT PROJECT Dana M. Carne; Antonio L. Perez; Shiri B. Feingold; Oluseyi Ojeifo; Daniel J. Friedman; Onyinye I. Iweala; Kerri L. Palamara; Blair W. Fosburgh. The Massachusetts General Hospital, Boston, MA. (Control ID #1316177)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Due to complicated resident work schedules,

many trainee-driven practice improvement projects are difficult to execute.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Design and execute a longitudinal resident-driven practice improvement project involving all residents that are part of one large primary care practice. 2. Increase the number of patients over age 65 in the resident outpatient panels who have had an informed discussion regarding advance directives by April 2012. Document this discussion in the longitudinal electronic medical record (EMR). DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): All residents in one primary care practice mutually selected to undertake a practice improvement project to increase the number of patients who have a documented code status discussion. Every two weeks, a set of project priorities was established and accomplished by residents who were rotating on an ambulatory block. At the end of each block, work-in-progress, results, and next steps were communicated to the incoming ambulatory residents. To obtain code status baseline data, we selected three patients over age 65 from the panel of each practice resident who were seen in clinic in the last three months. The patients EMR was searched for documentation of a code status discussion. In the intervention stage, patients over age 65 who were seen in clinic during January 2011 through March 2012 were sent a letter prior to their PCP visit. This letter conferred the importance of thinking about code status and discussing this decision with family. At the office visit, the PCP discussed the issue further and offered educational materials as needed. The patient was then brought back for a second visit where the PCP reviewed the patients decision regarding code status and documented this decision in the EMR.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): At the end of the study period, a second sample of medical records of patients over 65 seen by residents in the last three months was searched for code status discussions. This rate will be compared to our baseline rate detailed below to determine if the intervention and study design were successful.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Sixty-seven patients were included in the first sample, of which 16 (24%) patients had documented

discussions regarding code status with providers. Data for the post-intervention sample will be presented in full at the meeting.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Outpatient quality improvement projects are often difficult for residents to execute due to complicated resident work schedules and short nature of individual ambulatory blocks. Our group-based, resident-driven improvement project showed that trainees can achieve meaningful accomplishments by sharing longitudinal projects over time. This process ensures that residents can work on these efforts when they have dedicated time and can pass-off project responsibilities to their colleagues as they rotate off ambulatory rotations. Attending guidance, practice support and strong resident-to-resident project pass-offs are key factors necessary for success in this approach. The majority of our patients did not have a documented code discussion. This intervention will afford patients the opportunity to discuss their wishes, while healthy, for code status with their families and healthcare proxies.
USE OF THE "HAWTHORNE EFFECT" TO INCREASE COMPLIANCE WITH HOSPITAL ADMISSION MEDICATION RECONCILIATION BY INTERNAL MEDICINE RESIDENTS Alfred Burger1,2; Amy Esposito1; Georges Ephrem1; Andrew S. Korman1; Jonathan Mazurek1; Yuichi Shimada1; Jose A. Cortes1,2; Daniel I. Steinberg1,2. 1Beth Israel Medical Center, New York, NY; 2Albert Einsctein College of Medicine, Bronx, NY. (Control ID #1330120)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Medication reconciliation at hospital admission and discharge is critical to patient safety; many institutions have difficulty ensuring consistent

provider compliance.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. Obtain a high physician compliance rate with admission medication reconciliation after launch of a new, computer order entry (CPOE) based system. 2. Sustain this high rate of compliance.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): In spring of 2011 our institution transitioned from a paper-based medication reconciliation process to one embedded in our CPOE. Initial house staff compliance after launch, which included education and group-based orientation/training, was zero percent. Further educational efforts such as noon conferences by the residency program did not improve compliance. We then started twice weekly audits of our 14 inpatient medicine teams. A minimum of 10 patient charts per resident team were randomly selected for audit via computer. Results were made public to entire house staff via group email. Accountability for results was assigned to the PGY-2/3 level residents. Those who achieved high compliance rates were praised in the program wide email by name from the residency program leadership (>90% compliance warranted strong praise, 100% compliance resulted in highest praise). Lower performing residents were not singled out by name in the email but were approached and counseled individually by a program director or chief resident.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): Success was determined by the percentage of patient charts for which the medication reconciliation form was completed within 24 hours of admission. An overall goal of >95% compliance was set.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): After implementation of our feedback and reporting program overall compliance rose steadily, and at 6 months compliance was sustained at over 95%. A Joint Commission visit occurred during this time, in which medication reconciliation was noted by the inspectors to be an institutional strength. After a two month break in the auditing process, a follow up audit to check for sustained effect revealed that average compliance had fallen to 69.5%.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): The Hawthorne Effect, first described by psychologists in the 1930s studying workers at the Hawthorne Works factory, is generally accepted as a method for improving compliance. It states that individual behaviors will improve in the setting of known monitoring. Physicians are increasingly being held individually accountable for quality and patient safety outcomes, often with data reported in a public way. The ACGME requires that residents be involved in patient safety and quality improvement initiatives, and that they receive data on the outcomes of patients specifically under their care. Our intervention combined all 3 of these principles and found that an email based public reporting system improved and sustained compliance with a new admission medication reconciliation process. Withdrawal of this system likely led to a drop off in compliance. This approach was effective but may need to be done on a permanent or more long-term basis to effect durable change. In addition, such an approach might be effective in increasing housestaff compliance with other behaviors (for example, completion of medical records, evaluations, etc).
USING PILLBOX INTERVENTION FOR IMPROVING PATIENT SAFETY UPON DISCHARGE FROM HOSPITAL Nowreen Haq; Chakan Smith. Johns Hopkins School of Medicine, Baltimore, MD. (Control ID #1340904)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Elderly patients on home self-care often face the challenge of poly pharmacy and lack of knowledge for their home medications-therefore, often get under dosed or overdosed.
OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1. To see if pillboxes can reduce the error of inappropriate home medication dosage 2. To enhance confidence among the elderly patients and to create ownership of their health by improving their knowledge base on the use of

medications 3. To augment patient safety and to reduce the error of inappropriate home medication dosageDESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): All elderly patients aged >60 years, admitted to the Johns Hopkins Bayview Medical Center with intact cognition levels getting discharged on >3 medications to home self-care is our target group. On the day of discharge, the discharging physician, nursing staff or clinical pharmacists will be asking the target group patients 6 pre-intervention survey questions focusing on their home medication organization and level of knowledge on the indication, dosage of the home medications. If patients are not using pillboxes at home, the clinical staff will obtain patients' permission to teach them about using the pillboxes to organize medications . The patients then will demonstrate the staff on using the pillbox and should be comfortable using this before the planned discharge. Any issue regarding the pillbox use will be addressed at this time along with teaching on the clinical indication of the home medications and the typical side-effects of the prescribed home medication. The target group patients will then be supplied with pillboxes and the clinical staff will be contacting the patients within 3-7 days of discharge to ask the post-intervention survey questions.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): We will evaluate the target group patients for any improvement on their level of knowledge about the clinical use , side effects of their home medications and organization of home medications in pillboxes by asking them 6 questions that will focus on the relevant areas upon 3-7 days of their hospital discharge to home. Basically, each patient will serve as their own control by answering the same survey questions before and after the pillbox intervention. FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): A pilot survey was constructed among 10 patients who met the above mentioned criteria and the survey report showed that there was a significant improvement with answers from likert scale 0-1 to level 3. For example, 2 elderly patients have answered

the question which asked "How comfortable you are to understand why your home medications are prescribed". Before intervention, the answer was 0=not at all. After intervention, the response to the same question was 3=Extremely comfortable. (other choices, 1=somewhat comfortable, 2= mostly comfortable). By March 2012, we will get the survey data and we plan to summarize the report with displays of findings in tables, graphical chart and pie charts.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): 1. To enhance patient safety level among elderly home self-care patients on poly pharmacy by reducing the fatal error of over dosage or under dosage of medications by pillbox intervention and teaching on clinical indications/side-effects of medications while in hospital by clinical staff. 2. To disseminate this safety practice among community patients by adapting this approach for outpatient practice as well. 3. To boost up the independence and confidence among elderly home self-care patients to encourage ownership of their own health

USING A PATIENT PORTAL TO COMMUNICATE LABORATORY TEST RESULTS IN COMMUNITY PRACTICES Caitlin A. Colling1;
Lynn A. Volk2; Chelsea Jenter1; Marti Dembowitz2; David W. Bates1,2; Steven R. Simon3,1. 1Brigham and Women's Hospital, Boston, MA;
2Partners HealthCare, Boston, MA; 3VA Boston Healthcare System, Boston, MA. (Control ID #1337102)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Timely notification of laboratory test results is an element of CMSs meaningful use criteria and a JCAHO Patient Safety Goal. However, little is known about the use of web-based patient portals to communicate test results in community practices.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): Objective 1: Evaluate timeliness of test result notification using a patient portal of an electronic health record (EHR) in community-based primary care practices. Objective 2: Examine how physicians and patients portal use for laboratory test result notification changes after the initial implementation.
DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): Following the adoption of EHR-based patient portals by 3 community practices, we studied the time and method of test result notification. After results are provided to the EHR, the physician must review results, click a box that marks the results as reviewed, and indicate the results should be released to the patient portal. At the same time, the EHR generates a HIPAA-compliant e-mail message notifying the patient of new portal activity. For analysis, we extracted automated data related to laboratory test RESULTS: date result delivered to the EHR; date result reviewed by physician; whether result was posted to the portal; date of posting; and patient log-in date. We also extracted variables to indicate patient notification of test results via other routes (e.g., telephone encounter or letter). For each practice, we defined 3 time periods: 1) 6 months immediately prior to portal adoption (pre-adoption); 2) 6 months beginning four months after portal activation (early post-adoption); and 3) 6 months from 6/1/10 to 12/1/11 (late post-adoption).
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The primary outcome measure was the time to patient notification of a test result after physician review. Secondary measures included 1) whether a patient was notified of an abnormal result within the assigned time frame and 2) whether clinician follow-up was performed within an appropriate time frame.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): In a single pediatric practice, 1840 results were reviewed in the early post-adoption period. To minimize autocorrelation, we included one randomly selected laboratory test per patient per period. A total of 56% of laboratory tests reviewed were sent to the portal. For test results posted to the portal, 40% of patients logged into the portal within 30 days of the posting, with an average of 7.6 days between posting and patient log-in. In the late post-adoption period, the
percent of results posted to portal dropped to 50%, with fewer patients (31%) logging into the portal within 30 days of posting. For those patients who logged in following result posting, the average time between posting and log-in dropped to 3.0 days.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Understanding patient preferences for the use of a patient portal for test notification will help to improve timely results management. The data from a single practice, to be confirmed in the two other practices, suggest that, over time, patients using a portal log in more quickly following the posting of a test result. However, given the reduction in both the percentage of results posted to the portal and the proportion of patients with tests posted who logged in, this route may not be preferred by the majority of patients. Thus, when implementing a portal, physicians need to assess patient preferences to make informed decisions on the optimal use of the portal for test result notification.
VIDEOCONFERENCING FOR REMOTE SPANISH INTERPRETATION IN A COMMUNITY HEALTH CENTER: LESSONS LEARNED USING THE TABLET COMPUTER Claudia Campos; Dominic Johnson; Nancy M. Denizard-Thompson; Monica T. Brown; James L. Wofford. Wake Forest University, Winston-Salem, NC. (Control ID #1321932)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): The advent of more mobile, more reliable, and more affordable videoconferencing technology finally makes it realistic to offer remote foreign language interpretation in the office setting; still, such technology deserve proof of acceptability to clinicians and patients before there is widespread acceptance and routine use.

OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): We sought to examine (1) the audio and video technical fidelity of iPad/Facetime (TM) software. (2) the acceptability of videoconferencing to patients and clinicians. DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): The convenience sample included Spanish-speaking adult patients presenting to a community health care medicine clinic in August-November 2011. Videoconferencing was accomplished using Facetime software on 2
Apple iPads, a swiveling computer stand in the exam room, and a wireless network of 2.0 Mps bandwidth. As clinicians and interpreters gained comfort with the technology, the introduction/orientation to the patient by the interpreter took place over the videoconferencing device rather than in-person. The clinician was oriented to the device (rationale, computer positioning) by an investigator with no other special instructions. During the clinical encounter, the interpreter was seated in a separate, quiet office elsewhere in the building. The interpreter spoke with the patient in-person after the clinical encounter to administer the survey and debrief.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): A five-item survey was used to solicit opinions from patients and clinicians on overall quality of the videoconferencing device, audio/video integrity/fidelity, perception of encounter duration, and attitude toward future use.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Participants were most often female (20/ 25, 80%), and of mean age 42.3(+5.1). 3 patients refused to use the device. 18 clinicians and 5 interpreters participated in the project. Most patients rated overall quality of videoconferencing as good/excellent (24/25), with only 1 '"fair" rating. The quality of audio/video was rated as good/excellent by 72% (18/25). 11 patients rated the amount of time as no longer than in-person, and 9 reported it as shorter than in-person. Most patients 94% (24/25) favored using videoconferencing during future visits. For the 18 clinicians, the results were similar. 94% (17/18) of clinicians found the overall experience good/excellent and the audio/video fidelity acceptable, with only 1 "fair" rating. 12 clinicians rated the amount of time as no longer than in-person, and 4 of shorter duration than in-person. 14/18 clinicians favored using the device again in the future. Challenges included concerns over ambient noise and multiple conversations

during the clinical encounter, and the absence of a dedicated room for the interpreter.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): Based on our experience at a single-site community health center, the audio/video fidelity of the videoconferencing technology appeared to be flawless, and both patients and clinicians were satisfied. Implementation still required attention to quality of the wireless network, orientation and device positioning strategies, and psychological effects on interpreters. Expansion of videoconferencing to other off-site healthcare professionals(i.e., sign language interpreters, diabetic educators, mental health counselors) should be considered in the search for more cost-effective healthcare.
WHO NEEDS DETOX? AN EVIDENCE-BASED PROTOCOL FOR SYSTEMATIC EVALUATION OF PATIENTS WITH ALCOHOL DEPENDENCE AND WITHDRAWAL. John Stephens; Ria Dancel; Jonathan Kirsch; Edmund A. Liles; Michael Gilchrist; Kelly Stepanek. UNC Hospitals, Chapel Hill, NC. (Control ID #1308493)
STATEMENT OF PROBLEM OR QUESTION (ONE SENTENCE): Our tertiary hospital medicine practice noted a high number of admissions and readmissions to the internal medicine service for acute detoxification from alcohol, and also noted a lack of a clear, evidence-based system for determining which patients would benefit from inpatient detoxification versus those who might be safely treated as an outpatient. OBJECTIVES OF PROGRAM/INTERVENTION (NO MORE THAN THREE OBJECTIVES): 1) Develop an evidence-based protocol to evaluate alcohol dependent patients presenting to the emergency department requesting inpatient

alcohol detoxification, specifically addressing safety of outpatient detoxification and identifying risk factors for complicated alcohol withdrawal 2) Improve co-ordination with community resources for alcohol dependence treatment 3) Measure specific metrics before and after implementation of the protocol to see if protocol would impact utilization of inpatient services DESCRIPTION OF PROGRAM/INTERVENTION, INCLUDING ORGANIZATIONAL CONTEXT (E.G. INPATIENT VS. OUTPATIENT, PRACTICE OR COMMUNITY CHARACTERISTICS): We formed a task force to develop the protocol for alcohol detoxification. The task force reviewed best available evidence on acute alcohol dependence treatment. Data are limited on this specific topic, with majority of literature focusing on predictors of delirium tremens, and these risk factors informing expert opinion on need for inpatient versus outpatient treatment for alcohol detoxification. Accordingly, we reviewed evidence on predictors of delirium tremens in developing our protocol. Briefly, the developed protocol calls for careful assessment of risk factors for complicated withdrawal coupled with Clinical Institute Withdrawal Assessment (CIWA) scores, in the context of medical and psychological history. We met with representatives from the largest community alcohol treatment facility, and the protocol incorporates a process for referring patients for alcohol dependence treatment. The protocol was reviewed with emergency room physicians and the hospital medicine group. After a period for commentary and modification was provided, the protocol was implemented July 1, 2011.
MEASURES OF SUCCESS (DISCUSS QUALITATIVE AND/OR QUANTITATIVE METRICS WHICH WILL BE USED TO EVALUATE PROGRAM/INTERVENTION): The metrics to be followed will include number of admissions to inpatient service for alcohol detoxification, 30-day readmission rate, and length of stay index before and after implementation of protocol. Other metrics may be added as data are further analyzed, including number of referrals to community alcohol treatment.
FINDINGS TO DATE (IT IS NOT SUFFICIENT TO STATE FINDINGS WILL BE DISCUSSED): Preliminary data have yielded the following RESULTS: For the 6 months preceding initiation of protocol there was an average of 18.33 admissions/month for alcohol detoxification, with a 20% 30-day readmission rate and length of stay index of 0.61. For the 2 months following initiation of protocol there was 11.5 admissions/ month with a 17.5% readmission rate and a length of stay index of 0.92.
KEY LESSONS FOR DISSEMINATION (WHAT CAN OTHERS TAKE AWAY FOR IMPLEMENTATION TO THEIR PRACTICE OR COMMUNITY?): With use of a standardized protocol, patients with alcohol dependence presenting to emergency department for substance abuse can be systematically evaluated for need for inpatient versus outpatient treatment. Utilization of the protocol appears to lower admissions to the hospital and 30-day readmission rates for alcohol detoxification.
INNOVATIONS IN MEDICAL EDUCATION (IME)
"BOLUS" AND "DRIP" QUALITY IMPROVEMENT CURRICULA FOR INTERNAL MEDICINE RESIDENTS
Amanda Carmel; Laura Fanucchi; Jennifer Lee; Lia S. Logio. Weill Cornell Medical College, New York, NY.
(Control ID #1339311)
NEEDS AND OBJECTIVES: Familiarity and experience with QI is essential for preparing residents for future careers and is an area highlighted in two of the six core competencies defined by the Accreditation Council for Graduate Medical Education. Given the many educational goals and work hour requirements, incorporating formal QI education into training programs is a challenge. At New York-Presbyterian Hospital/Weill Cornell (NYPH/ WC), we developed two QI curricula: an intensive 2-week curriculum for senior Internal Medicine residents (bolus), and a 6-month longitudinal curriculum for junior residents (drip). The goals of each were to explain the fundamentals of QI and how they impact medical practice and to mentor residents in the design of a QI project using the Model for Improvement (Plan-Do-Study-Act (PDSA)).
SETTING AND PARTICIPANTS: Junior and senior internal medicine residents at NYPH/WC.
DESCRIPTION: Both bolus and drip curricula occur during the ambulatory care block. The senior curriculum is an intensive 2-week experience where residents spend 3 afternoons a week (18 hrs) dedicated to learning and

applying QI methodology. The junior residents spend 2 mornings per week during 3 two-week blocks spaced at 6 week intervals (36 hrs). The main focus of both is to design and implement QI projects using the PDSA cycle. Didactic sessions on measurement strategies, data analysis, and other QI tools are provided. At the end of these educational units, the resident teams present their projects to an audience of key stakeholders and peers and submit a summary poster. Residents complete the validated Quality Improvement Knowledge Assessment Test (QIKAT) before and after each course. EVALUATION: Over 8 weeks in July and August 2011, all 46 senior internal medicine residents participated in the senior curriculum. From July 2011 to December 2011, 24 junior residents participated in the junior curriculum. A total of 16 posters were submitted by resident teams (12 from PGY3s and 4 from PGY2s). The average QIKAT score before the "bolus" curriculum was 8.7 (out of 15 possible points) and rose to 13.5 at the end (junior resident data pending). Both courses were rated highly among the residents with a mean evaluation score of 4.1 (Likert scale 1-5). The spectrum of projects included introducing rapid administration neostigmine injections to the Cardiac Care Unit and revising smoking cessation online resources and resident education materials. DISCUSSION / REFLECTION / LESSONS LEARNED: Both intensive (bolus) and longitudinal (drip) curricula provide in depth instruction on various components of QI and allow residents to conduct their own QI initiatives using the PDSA cycle. The senior residents understanding of QI concepts improved after the curriculum as measured by the QIKAT, and we anticipate similar improvements for the junior residents. Residents rate the experience highly in follow up evaluations. Internal Medicine residents are interested in and motivated by learning about QI. Our work is unique in that it provides two effective models for QI education, bolus and drip. We anticipate that given the two schedule options, our curriculum models can be applied to other residency programs and thus will allow better integration of QI into resident teaching, mentorship, and clinical practice.

3+1: A NEW MODEL FOR RESIDENT TRAINING Teresa Cheng1;
Maria C. DeOliveira2; Subha Ramani1; Rajlakshmi Krishnamurthy1; Angela Jackson1. 1Boston University, Boston, MA; 2Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1334456)

NEEDS AND OBJECTIVES: In 2009, the ACGME increased the number of required continuity clinics from 108 to 130 over 36 months of medicine residency training. At Boston University/ Boston Medical Center, the Medicine Residency Program believed that the previous model of residency training could not achieve the need for increased continuity clinics, high quality ambulatory clinical and educational experiences and compliance with duty hour regulations. The Program designed a new 3+1 model to: 1. Meet the number of mandatory resident continuity clinics 2. Decrease tension between the inpatient and ambulatory commitments 3. Develop meaningful and broad-based subspecialty ambulatory experiences 4. Decrease resident stress and fatigueSETTING AND PARTICIPANTS: The 3+1 model was implemented in July 2010 for categorical and primary care residents at the Boston University Medical Residency Program.
DESCRIPTION: Residents alternate between 3 week blocks of wards, units, Emergency Department or elective rotations and 1 week of ambulatory experiences. These 10 half days are scheduled with 4 primary care continuity clinic sessions, one session of unscheduled patient management time, 4 sessions of a single specialty clinic that rotates every 3 months and one session for dedicated seminar style intensive education, which complements an enhanced pre-clinic and midday conference curriculum.
EVALUATION: All residents will successfully meet the new ACGME clinic requirements. Residents were surveyed confidentially before and 8 months after implementation of the 3+1 model. The survey queried satisfaction with clinic experience, preceptors, learning and work environment and included a 2 item scale from the Maslach Burnout Inventory and the Quality of Life (QOL) Analog Scales. The post-survey also added a question on their 3+1 experience. 57 respondents (40%) answered the June 2010 survey and 52 (34%)

answered the February 2011 survey. Overall satisfaction with continuity clinic increased from 46% to 64%. Satisfaction with ability to focus in clinic without interruption was 33% pre change and 67% post change. Measures of burnout and overall QOL did not appear to vary but our QOL measure of fatigue improved, from 5 to 7, where 10 is defined as good as it gets. Qualitative analysis of comments revealed key themes categorized as work environment, ambulatory clinic environment, educational environment, and preceptors. Burn-out was mentioned often pre 3+1. Following the change, several residents expressed relief that an ambulatory week broke up the inpatient rotations. Residents appreciated the ability to focus on their inpatient and outpatient experiences separately and the ambulatory curriculum was well received. Clinic preceptors were viewed positively pre and post implementation. There was initial apprehension about the 3+1 model, but residents seem satisfied overall 8 months later.

DISCUSSION / REFLECTION / LESSONS LEARNED: We successfully implemented a new 3+1 model for residency training which easily met the target goal of 130 continuity clinics over 3 years. Separation of inpatient and outpatient experiences resulted in enhanced ambulatory clinical and educational experiences in continuity clinic and specialty clinics and a decrease in resident stress and fatigue. Major challenges include extensive coordination across multiple clinic sites with varying abilities to accommodate schedule changes and major changes in faculty schedules.

A SPACED EDUCATION CURRICULUM TO IMPROVE BONE HEALTH CARE BY INTERNAL MEDICINE RESIDENTS Brigid M. Dolan1; Graham T. McMahon2; Maria Yialamas2. 1Brigham and Women's Hospital, Boston, MA; 2Brigham and Women's Hospital, Boston, MA. (Control ID #1337189)

NEEDS AND OBJECTIVES: The increasingly compressed schedule of residents creates a need for educational interventions to effectively and efficiently generate behavior change. We have hypothesized that a spaced education intervention will be acceptable to residents and generate measurable improvements in clinical practice. We chose osteoporosis as the topic for this study, as osteoporosis is a common condition that is frequently undertreated. A sample chart review of residents in our clinic revealed that only 70% of eligible patients had received bone density screening

and only 11% of osteopenic patients had a FRAX score calculated. We have designed, implemented and will evaluate a novel curriculum to help residents improve the quality of their osteoporosis care using online spaced education. We sought to examine if this innovation would meaningfully change ambulatory practice performance by internal medicine residents. SETTING AND PARTICIPANTS: A convenience sample of junior and senior residents was chosen from an academic primary care practice in our institution. Fifty residents have been randomized.

DESCRIPTION: The intervention curriculum delivers content by email using spaced education, a method that sends short questions and explanations over time, with incorrectly answered items recycled with an increased frequency. This method has been shown to improve knowledge retention and change faculty behaviors, however, to our knowledge this has not been applied to resident practice behaviors in the primary care setting. Residents in the intervention arm received an email every 3 days containing 2 multiple-choice questions. The question set was validated prior to delivery. The curriculum adapted to learner competence resulting in a duration that varied by user, lasting between 2.5 and 6 months. The standard curriculum consisted of a one-hour lecture; these residents also received one-time access to the multiple-choice questions and answers used in the intervention arm. EVALUATION: Of the 25 residents randomized to the intervention arm, 22 residents enrolled in the curriculum. 56% of residents responded to at least 75% of the curriculum. 28% of residents completed the entire curriculum, needing an average of 64 responses total to correctly answer each question twice. Initial reports indicate that email fatigue is emerging as a challenge. In Spring 2012, residents will complete a knowledge assessment to determine retention of osteoporosis knowledge. A chart review will assess resident patient care outcomes in osteoporosis screening and treatment. DISCUSSION / REFLECTION / LESSONS LEARNED: Our initial evaluation of the acceptability of the intervention indicates that the majority of

residents voluntarily participated in this online longitudinal educational format. Residents did endorse email fatigue towards the end of the course. Using an interface that would limit emails or lengthening the delivery time of the course may be necessary if this tool is used outside of pilot intervention, particularly if content is extended to reflect the broader curricular needs of internal medicine residents. The knowledge retention tool and chart review portion of this evaluation will demonstrate if there is sufficient behavior change benefit to merit using this tool to create a comprehensive, longitudinal primary care curriculum for internal medicine residents.

A COMPARATIVE TEACHING STRATEGY FOR INTERPROFESSIONAL COMMUNICATION Hollis Day1; Susan Meyer2. 1University of Pittsburgh School of Medicine, Pittsburgh, PA; 2University of Pittsburgh School of Pharmacy, Pittsburgh, PA. (Control ID #1312206)

NEEDS AND OBJECTIVES: Interprofessional communication has long been recognized by the Institute of Medicine as a critical element to patient care. While such communication has been a key topic in all health professional schools , a national conference in 2011 specifically outlined the core competencies in interprofessional care and education that have been adopted by the major accrediting bodies of the health professions. This study compared two methods of teaching pharmacy students how to communicate with physicians in challenging scenarios: standardized colleagues (adaptation of standardized patients) and video triggers/group discussions. Objectives were 1) Design scenarios representing authentic interprofessional interactions and communication challenges to facilitate the development of interprofessional communication skills; 2) Evaluate the effectiveness of standardized colleagues as a strategy to facilitate the development of interprofessional communication skills compared to a traditional strategy of using video triggers and role play.

SETTING AND PARTICIPANTS: 104 second year pharmacy students in the context of their Profession of Pharmacy class.

DESCRIPTION: All students attended a one hour preparatory lecture for communication skills in difficult conversations. Fifty-seven students were randomized to interact with medical faculty as standardized colleagues portraying particular professional roles, attitudes, and communication styles. Cases were based on real-life situations representing the seven crucial conversations identified in Silence Kills, a seminal work on poor

healthcare communication. Faculty provided feedback on demonstrated behaviors impacting communication effectiveness. Forty-seven students were randomized to view videos demonstrating interprofessional interactions and participate in facilitated discussions of the demonstrated interprofessional communication skills. A self-evaluation of comfort and confidence in communication skills adapted from a validated instrument was administered at baseline, three, and six months. Students completed an evaluation of the perceived helpfulness of the activity. EVALUATION: Data from students with scores on all three time points were used in the analysis (n=92). Results of the repeated measures ANOVA demonstrated an increase in comfort and confidence over time ($F=42.508$, $df= 2$, $p<.001$). Paired samples t-tests showed a significant increase between baseline and three months ($t=-7.615$, $df=99$, $p<.001$). An independent samples t-test revealed a significant difference in helpfulness, confidence, and comfort between the video and standardized colleagues methods ($t=-2.396$, $df=82.69$, $p=.019$).

DISCUSSION / REFLECTION / LESSONS LEARNED: Using standardized colleagues can enhance students confidence and comfort in their abilities to communicate effectively in challenging situations. This methodology provides a safe way for students to practice difficult conversations that affect patient care. Case scenarios can be adapted to multiple health professions schools. Limitations include cost, ability to recruit medical professionals to portray physician roles, and the potential for reinforcing negative stereotypes of physicians. Other health professionas may be more eager to adopt this methodology than medicine.

A CURRICULUM FOR ELECTRONIC PATIENT-DOCTOR COMMUNICATION Bradley H. Crotty; Arash Mostaghimi. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1334944)

NEEDS AND OBJECTIVES: Despite the rise in patient-doctor electronic communication via email and patient portals, no formal training exists for online communication. In many practices, physicians are expected to use e-mail or secure messaging with patients outside of visits. In our internal medicine training program, we created a curriculum and assessment tool for patient-centered electronic communication using PatientSite, a secure patient portal at Beth Israel Deaconess Medical Center (BIDMC).
SETTING AND PARTICIPANTS: The curriculum was developed in the Internal Medicine Residency Training Program at BIDMC. Residents from all three years practicing on-site were enrolled in PatientSite (n=116). Those practicing off-site (n=32) received portions of the curriculum and assessment but did not participate in the portal.
DESCRIPTION: Our curriculum consists of a one-hour lecture, a one-hour case-based small group session, and experiential learning through PatientSite. We organized the curriculum around four domains: patients, the patient experience, the physician experience, and systems-based practice. The cases include themes of unequal access to online resources, health literacy and patient-centered communication, patient empowerment, and choosing the appropriate medium of communication for a given concern. We gave a pre-intervention questionnaire to assess baseline attitudes toward patient portals and to assess self-perceptions of communication skills. We also asked respondents to rank appropriateness of different communication media in each of 4 scenarios. We created simulated patient e-mail exchanges to assess response time, comprehensibility, clarity, and empathy. At the end of the intervention a post-test will be administered.
EVALUATION: Residents completed pre-intervention surveys. Most residents felt that the portal would increase their work (~57%), but would be better for patients. Nearly 90% of residents expressed concern about medical liability from missed or inappropriate messaging. Three months into the educational intervention, 104 patients have been enrolled.
DISCUSSION / REFLECTION / LESSONS LEARNED: Residents must learn evidence-based skills for electronic communication to be ready for ever-evolving practice models. While we are currently piloting this curriculum, housestaff have had robust discussions during the small group sessions with heterogeneous perspectives. The combination of didactics and experiential learning is promising for preparing physicians for electronic communication with patients.
ONLINE RESOURCE URL (OPTIONAL): http://themetrc.org/a-curriculum-for-patient-doctor-electronic-communication/
Web End =http://themetrc.org/ http://themetrc.org/a-curriculum-for-patient-doctor-electronic-communication/
Web End =a-curriculum-for-patient-doctor-electronic-communication/
A DEBATABLE APPROACH TO EVIDENCE BASED MEDICINE Harry Burke; Brian Cohee; Scott Hopkins. Walter Reed National Military Medical Center, Bethesda, MD. (Control ID #1324181)
NEEDS AND OBJECTIVES: There are many ways to teach residents how to use the empirical medical literature to assist them when they are making real clinical decisions in real time with real patients. One popular approach is a mini-journal club format, where residents are given a clinical question and they must find and present an article relevant to the question. One problem with this approach is that the article rather than the patient is the main focus of the discussion. We created a debate format for evidence-based medicine.
SETTING AND PARTICIPANTS: The residents who had participated in the mini-journal club format were surveyed. We changed to the debate format and asked the residents who participated in the debate format the same survey questions. We assessed our six ward teams. DESCRIPTION: For the debate format, every month, over three days, two teams at a time debated a clinical question. The question was announced when they arrived for the debate. They were assigned to argue either the affirmative or the negative. The team was allowed 30 minutes to research the medical literature and create their argument, 8 minutes to argue their side, 4 minutes for rebuttal, and 3 minutes for summation. After the debate, an attending, two chief residents, and a third year resident discussed how the evidence was obtained, its quality, and the strengths and weakness of

each side. A winning team was chosen each month.
EVALUATION: Twenty-two residents answered the mini-journal club survey and 43 residents answered the debate format. Seven questions were asked, five of which were not significantly different between the journal club and debate formats. The two key questions were: This exercise was a valuable use of my time. and For the amount of time I put into the exercise, I received a commensurate increase in learning. The residents felt that the value was greater for the debate format (lower scores were better, journal club, mean 2.0; debate, mean 1.67; p=0.035, two-sided) and they felt that the debate was a good use of their time (lower is better, journal club, mean 2.0; debate, mean 1.60; p=0.048, two-sided).
DISCUSSION / REFLECTION / LESSONS LEARNED: Residents felt that the debate-style format was more valuable and a better use of their time than the mini-journal club format. Out goal is to create a format that requires the residents to obtain, synthesize, and use evidence-based clinical information in real time so that they can use this skill both in the hospital and in outpatient clinic. We believe that out debate format provides a realistic approach for achieving our goal that the residents find valuable and a good use of their time.
A LONGITUDINAL SIMULATION BASED MEDICAL EDUCATION CURRICULUM IN AN INTERNAL MEDICINE RESIDENCY PROGRAM Raquel K. Belforti; Ngina Muigai; Mihaela Stefan. Baystate Medical Center, Springfield, MA. (Control ID #1335687)
NEEDS AND OBJECTIVES: At teaching hospitals across the country, medical residents of varying knowledge and skill levels are responsible for providing all aspects of patient care. Traditional medical education accepted the see one, do one, teach one mentality for learning, in which residents practice and master skills on their patients. Currently, due to societys change in expectations of medical care there has been a tremendous emphasis to ensure patient safety. This creates a struggle for residency programs on how to provide physicians-in-training with the opportunities to practice, attain competence, and master skills, as well as protect patients from the errors that coincide with learning. The answer to this great ethical dilemma may be in simulation based medical education (SBME). SBME can be defined as any educational activity which uses simulative aids to replicate clinical scenarios. Human Patient Simulation (HPS) provides learners with the opportunities to repeatedly practice clinical skills, and more importantly learn from errors without any harm to patients. The Accreditation Council of Graduate Medical Education has recognized the need for alternative teaching tools and has stated that the role of simulation in formative and summative competency evaluation is growing. Often the barrier to implementing a simulation curriculum to meet a programs needs is the unfamiliarity with the plethora of ways simulation can be used within residency training programs and how to get started.

SETTING AND PARTICIPANTS: The Baystate Medical Center Internal Medicine Residency Program has integrated SBME using HPS into their residency curriculum that provides longitudinal experiential learning to all levels of training.
DESCRIPTION: We have three main simulation programs. Intern Boot Camp is a 2-week intensive program for July interns to learn how to manage acutely ill hospitalized patients. Teaching Team Simulation which occurs weekly during medicine ward rotations for interns to manage patients with complicated medical conditions and for senior residents to practice debriefing and teaching skills. ACLS Leadership Training which provides weekly simulation sessions for second year residents to learn and practice crisis resource management skills integral for effective ACLS implementation.
EVALUATION: Our current state of evaluation of the effectiveness of our simulation curriculum is based on debriefing and direct feedback from residents. Each curriculum focuses on teaching and providing immediate feedback on the core competencies. After each simulation session a debriefing is held to illicit peer feedback as well as provide immediate verbal evaluation. We are currently in the process of developing and validating an

evaluation tool to be used to assess our interns performance in the simulation lab caring for unstable hospitalized patients. The goal is for this evaluation tool to be used in conjunction with other evaluations of interns performance by the clinical competency committee to determine progression onto second year of residencyDISCUSSION / REFLECTION / LESSONS LEARNED: Overall, Baystate Medical Center Internal Medicine Residency Program has a well established simulation curriculum for all levels of learners. We are currently in the process of transitioning from using our simulation curriculum for formative to summative competency evaluation.

A MULTI-STRATEGY APPROACH TO IMPROVE MEDICAL RESIDENTS CONFIDENCE IN DISCUSSING END-OF-LIFE CARE William P. Moran; Patty J. Iverson; Patrick D. Mauldin; Paul Rousseau. MUSC, Charleston, SC. (Control ID #1337730)

NEEDS AND OBJECTIVES: Elderly patients want to discuss advanced care directives but residents are not adequately trained to confidently have such discussions with their patients, and may avoid the topic. This paper describes an innovative approach to (1) increase patient opportunity to discuss end of life care wishes with their physician and (2) improve residents confidence to lead discussions about ACDs. Objectives: (1) Create an environment where residents are cued to ask patients about advanced care directives (ACD). (2) Educate residents about ACDs and provide a tool to facilitate good communication skills in discussing advanced care directives with elderly patients. (3) Increase residents confidence in leading end of life care discussions through multiple learning strategies.

SETTING AND PARTICIPANTS: This program, conducted in an out-patient internal medicine resident clinic at a southeastern United States medical university, included nearly 100 residents and 600 elderly patients.

DESCRIPTION: Education: Over a 3 month period, internal medicine residents were offered multiple learning strategies about advanced care products and discussed and practiced ways to improve their confidence in talking with their patients about their wishes. Residents were offered lecture, academic detailing by faculty in continuity clinic, faculty observation of patient discussions, and small group simulations. System change: Clinic Patient Care Technicians gave elderly patients the booklet, Isnt it Time We Talked and asked if they had ACDs. The patients response (Y or N) was noted on the chart, prompting the resident to address the following during the visit: (1) If Yes, the resident asked about their wishes and checked for a copy in the medical record; or (2) If No, the resident asked the patient if he/she wanted to discuss advanced directives now or schedule a follow-up appointment for discussion. The resident was prompted to document responses in the patients electronic medical record (EMR).

EVALUATION: On a pre- post-test, residents were asked: On a scale of 1-4 with 1 being no confidence and 4 being very confident, rate your confidence in your ability to discuss advanced care planning with an older adult patient. Resident participation in academic detailing, small group
simulations, and faculty observation were tracked and cross referenced with the residents reported change in confidence.

DISCUSSION / REFLECTION / LESSONS LEARNED: We found elderly patients do want to discuss their end-of-life care wishes with their physician and residents need training to improve their confidence in leading such discussions. When provided information and opportunity, the majority of resident continuity clinic patients expressed interest in talking with their physician about their wishes. 77% of patients asked reported no ACD and 74% of those patients wanted to talk about it during their visit or at a follow-up appointment. After education and prompting, IM resident physicians reported they were more confident having these discussions with their patients. Of the 58 residents (60% of program) who completed the pre- and post-tests, 24/58 (41%) reported improved confidence; 27/58 (46%) the same; and 7/58 (12%) less confidence. Some medical universities offer communication training in medical school however few offer on-going opportunities for residents to sharpen their skills during residency when they actually have direct patient-doctor conversations. ONLINE RESOURCE URL (OPTIONAL): http://mcintranet.musc.edu/agingq3/endoflifecareacove

Web End =http://mcintranet.musc.edu/ http://mcintranet.musc.edu/agingq3/endoflifecareacove
Web End =agingq3/endoflifecareacove
A PRIMARY CARE RESIDENCYS CORE DNA INSERTED AT PROGRAM OUTSET TO BLOOM INTO A TIGHT SPIRAL CURRICULUM Richard E. Greene; Jennifer Adams; Sondra Zabar; Rob Caldwell; Les Chuang; Carrie Mahowald; Negar Aliabadi; Kathleen Hanley; Andrew A. Chang; Julianne Cameron; Mack Lipkin. NYU School of Medicine, New York, NY. (Control ID #1339602)
NEEDS AND OBJECTIVES: Our annual residency retreat brainstorms innovations to meet needs. In 2010 needs were: to introduce foundation concepts and enable primary care (PC) residents to feel/be competent in clinic earlier; to spiral learning of core concepts, skills and attitudes from the start; and to have residents and faculty connect from the outset. We aim to equip PC clinicians to deliver bio-psychosocial, comprehensive, best evidence-based systems savvy care and to become change agents, leaders, and scholars. To meet these aims we designed a learner centered, team oriented, skills-based Essentials for PC Clinicians (EPIC) curriculum utilizing an initial, rigorous 4 week block with spiral reinforcement through 3 years. The innovation is a comprehensive, reproducible, effective method to ensure residents progress on paths of clinical, humanistic, and intellectual excellence consistent with the generalist paradigm.
SETTING AND PARTICIPANTS: EPIC is part of the NYU Internal Medicine PC Residency. Residents attend public hospital and community continuity clinics. 8 interns take the EPIC block and 24 residents spiral through the curriculum.
DESCRIPTION: EPIC begins with a 4 week intern block dedicated to core topics in PC; is reinforced in precepting and subsequent blocks; and has a weekly EPIC conference where these topics are deepened and extended. EPIC Block: The overarching themes throughout the 4 weeks focus on understanding and practice of core skills: workshops/precepting on time management, efficient use of EHR, obtaining best practices, consultation, how one learns best, practice in the medical home and engaging community resources. Week 1 focuses on diabetes, and introduces the pillars: psychosocial medicine, evidence-based practice, and systems-based policy awareness and skill. The second week focuses on hypertension. The last 2 weeks introduce 7 common, high-risk high gain conditions from smoking to hepatitis B. Teaching methods combine group learning and reflective written exercises; clinical experiences; core lectures; and a block-long problem-based group learning case set to integrate epidemiology, communications, data (physical, lab, imaging), evidence-based management, and systems quality. Spiral curriculum: All preceptors are trained in the pillar approaches and which is integrated within precepting and 10 subsequent PC blocks. EPIC conference: Weekly, in 1 hour a resident presents on a core PC topic generated by that resident's practices. This allows residents &program leaders to monitor learners needs based on their patients in a learner-centered way, modeling self-education/discovery.
EVALUATION: The EPIC Block and the subsequent curriculum are evaluated at blocks end by a 2-hour 4 station OSCE that reviews and assesses learning and skills, through evaluations and formative debriefing.

An annual 10 station OSCE is a broad assessment of skills for all 3 years of residents. Unannounced standardized patients appear in residents practices on core topics.
DISCUSSION / REFLECTION / LESSONS LEARNED: Lessons learned include that EPIC is feasible, well received, meets the initial goals, and sets the interns up for positive future experiences. Implementing early in residency quickly sets expectations/standards, engages learners, immunizes beginners against bad habits, and jump starts core PC skills. The planning effort is major but eye opening for the faculty involved. ONLINE RESOURCE URL (OPTIONAL): http://medicine.med.nyu.edu/EDUCATION/ABOUT-PROGRAM/PROGRAM/PRIMARY-CARE/PC-CURRICULUM
Web End =http://medicine.med.nyu.edu/ http://medicine.med.nyu.edu/EDUCATION/ABOUT-PROGRAM/PROGRAM/PRIMARY-CARE/PC-CURRICULUM

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http://medicine.med.nyu.edu/EDUCATION/ABOUT-PROGRAM/PROGRAM/PRIMARY-CARE/PC-CURRICULUM
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A PRIMARY CARE-BASED TEAMWORK SKILLS CURRICULUM FOR RESIDENTS AND NURSE PRACTITIONER STUDENTS Rebecca L. Shunk1,2; Calvin L. Chou1,2; Maya H. Dulay1,2; Susan L. Janson3,1; Shalini Patel1; Timothy Carmody1; Stephen Rao1; Patricia A. Cornett1,2; Bridget OBrien2,1. 1San Francisco VA Medical Center, San Francisco, CA; 2Univ of California, San Francisco, San Francisco, CA; 3University of California, San Francisco, San Francisco, CA. (Control ID #1340050)
NEEDS AND OBJECTIVES: Primary care clinics at the San Francisco VA (SFVA) have transitioned to a VA-mandated interprofessional team-based model of patient care called Patient Aligned Care Teams (PACTs). Trainees in these clinics are part of the team-based model and must work more closely with clinic staff than in traditional outpatient clinics. High-functioning teams require members to learn and practice skills together, and to know each other both professionally and personally. To facilitate development of these interprofessional skills, we created a curriculum and formative evaluation process.
SETTING AND PARTICIPANTS: In July 2011, we added trainee squads (2 second-year internal medicine residents and 1 second-year nurse practitioner student) to each of 8 pre-existing teamlets (1 registered nurse, 1 clinical associate, 1 clerical associate) in three SFVA primary care clinics. Each trainee acts as primary provider for a panel of patients. When primary providers are unavailable, trainee squad members provide backup coverage. Teamlets collaborate with trainee squads to deliver care to their patients.
DESCRIPTION: We created a multifaceted curriculum to address core competencies associated with effective interpersonal communication. Interactive small group sessions addressed elements of the TeamSTEPPS model, including handoff communication, debriefing, huddling, feedback, and conflict resolution. In addition, we held a daylong retreat attended by all trainees and teamlet members to enhance team building and to practice key communication skills. Preceptors reinforce skills and provide ongoing feedback during teamlet huddles. To assess overall team effectiveness, in September 2011, members of all 8 teams were asked to complete the Team Development Measure (TDM), created by Peace Health.
EVALUATION: Trainees rated the overall quality of the training sessions (mean 3.6 to 4.1 on a 5 point scale, 1=poor 5=excellent) and of the retreat (mean 4.4 out of 5). On the TDM, response rates for each team ranged from 67% to 86%. Individual ratings were combined to obtain aggregate scores for each team, which ranged from 55 to 68 out of maximum score of 100. Each team discussed TDM results and made plans for improvement during a 1 hour session with a faculty facilitator. The TDM will be completed again in February 2012, and teams will have another opportunity to discuss and plan for improvement based on the results.
DISCUSSION / REFLECTION / LESSONS LEARNED: Teamwork and communication skills may seem intuitive, but they require training and practice. TDM results showed that all teams had substantial room for further development and improvement. After three months, most teams were cohesive but were still establishing role clarity and working towards consistent effective communication. We found it important to teach skills in an authentic way, reinforcing them in daily practice. Time for teams to collectively reflect upon and discuss team process is critical; facilitators are helpful to guide the process and help the team generate a plan for improvement.
A RESIDENT-LED MANDATORY INTERN MEDICINE SIMULATION CURRICULUM: THE MASSACHUSETTS GENERAL HOSPITAL EXPERIENCE Fernando M. Contreras1; Susan K. Mathai1; Eli M. Miloslavsky1; Emily Hayden2,3; James A. Gordon2,3; Paul F. Currier1.
1Massachusetts General Hospital, Boston, MA; 2Massachusetts General Hospital, Boston, MA; 3Massachusetts General Hospital, Boston, MA. (Control ID #1312101)
NEEDS AND OBJECTIVES: Mannequin-based simulation for residents across specialties has gained

widespread use in recent years, but has not been expanded as a core training element on the general medicine wards. Possible explanations may include logistical challenges and resource investment. We report here on the Massachusetts General Hospital (MGH) Department of Medicines experience with a mandatory, resident-led mannequin-based simulation curriculum. The goal of the program was to introduce clinical decision-making training using medical simulation into the residency program.
SETTING AND PARTICIPANTS: Mandatory simulation sessions for interns were offered during required ambulatory blocks over the first four months of the 2011-2012 academic year and held four days per week, accommodating up to six interns at a time. All categorical and primary care interns (54 total) attended three to four sessions and completed six to eight cases. Junior and senior residents, 30 in total, participated as facilitators supervised by fellows and faculty.
DESCRIPTION: The curriculum was composed of eight simulated acute clinical situations (e.g., hypertensive emergency, rapid atrial fibrillation). Each session was sixty minutes long and covered two cases. Interns worked in groups of two to four on each mannequin. Each case began with 10 minutes of mannequin-based patient management where learners managed the clinical scenario in groups of two to three, followed by a 15-minute debriefing session led by residents. Online surveys designed to assess interns satisfaction with the program were administered.
EVALUATION: Fifty interns completed the online survey (92.6% response rate). Seventy-six percent of the interns rated the sessions as excellent (5 on a 5 point scale) and the remainder as good (4 on a 5 point scale). One hundred percent of the interns reported that the sessions significantly (52%) or moderately improved (48%) their differential diagnosis skills. Eighty-eight percent of interns responded that the simulations should be mandatory. Comments regarding program strength focused on the opportunity to debrief with residents about practical management of acute clinical scenarios, emphasizing the insider knowledge that residents brought to the cases. Almost all interns requested that there be more frequent resident-led simulation sessions as part of their residency training, and they did not believe these sessions conflicted with other residency activities.
DISCUSSION / REFLECTION / LESSONS LEARNED: Our program utilized several techniques to overcome barriers to implementation of a simulation curriculum in a large residency. Utilizing residents as facilitators significantly decreased the amount faculty hours required to run the program and was well received by the residents. Scheduling the sessions during ambulatory rotations allowed interns to participate without violating ACGME work hour rules. The initial MGH experience has been met with widespread enthusiasm by the participants. Most interns believed that this type of program should be mandatory, specifically noting that senior residents leading the debriefings was one of the highlights of the program. Notably, they felt that the scheduling of the sessions did not interfere with their clinical duties or other learning activities. Based on this experience, the Department of Medicine will continue to run a mandatory simulation program for interns and to develop new resident-led sessions for internal medicine residents.
A SMALL REWARD CAN CHANGE THE WARDS: HOW MENTORED DELIBERATE PRACTICE TRANSFORMS ACADEMIC MEDICINE Robert K. Hudon3; Jessica Campbell1,3; Maria G. Frank1,3; Caroline Leclair2; Mark Reid1,3; Lilia Cervantes1,3. 1Denver Health, Denver, CO; 2University of Colorado, Denver, Denver, CO; 3University of Colorado, Denver, Denver, CO. (Control ID #1339758)

NEEDS AND OBJECTIVES: To test an innovative approach for creating expert academic hospitalists and trainees by: 1) promoting engagement in academic works with award and recognition 2) establishing cross-generational mentorship within medical teams on the wards 3) increasing participation in conferences 4) encouraging collaboration across departments and institutions.
SETTING AND PARTICIPANTS: Denver Health is an academic teaching hospital with 38 academic hospitalists

on staff. Each year approximately 300 trainees rotate through on their internal medicine clerkship.
DESCRIPTION: Expertise and advancement in academic medicine are closely tied to academic productivity, yet the rate of publication among new attendings is consistently low. For example, a recent multi-institutional survey revealed that half of academic hospitalists have not produced an abstract, poster or first-author paper. Deliberate practice, mentorship, and reward have proven to build expertise and engagement but have not found consistent applications in medicine. The Rick Albert Prize is awarded to the medical team (ie medical student, resident and attending) with the best clinical vignette of 2011-2012. Each team is matched with an academically successful hospitalist who mentors the way from abstract to poster, to presentation at local and national conferences and ultimately publication. The winning team is given a cash prize, recognized on a plaque, and celebrated at an awards ceremony. Throughout the year, cases are disseminated through online publications and multiple presentation opportunities. Students and faculty are surveyed at the end of the academic year to determine effectiveness of this intervention and impact on job satisfaction and academic preparedness.
EVALUATION: In less than four months we have seen a dramatic 800% increase in abstract, poster, and conference submissions. Attending noon conference attendance has gone from <10% to >80% and interdepartmental collaboration is blossoming.
DISCUSSION / REFLECTION / LESSONS LEARNED: The Rick Albert prize is the first studied intervention to promote academic achievement among academic hospitalists. This successful program engages physicians at all levels of training, facilitates a new culture of mentorship and learning, and provides physicians and students with an encouraging environment that promotes involvement in patient outcomes and their own pursuit of expertise. Since the inception of this team based academic mentorship program in deliberate practice, we have seen dramatic increases in scholarly activity on the wards at Denver Health. ONLINE RESOURCE URL (OPTIONAL): http://www.denverhealth.org/Services/HospitalMedicine/TheRickAlbertPrize.aspx
Web End =http://www.denverhealth.
http://www.denverhealth.org/Services/HospitalMedicine/TheRickAlbertPrize.aspx
Web End =org/Services/HospitalMedicine/TheRickAlbertPrize.aspx
A WEB-BASED STUDENT-LED JOURNAL CLUB FOR MEDICAL STUDENTS Jane J. Lee1; Maura M. Manion1; Megan Mcnamara2,1. 1Case Western Reserve University School of Medicine, CLEVELAND, OH; 2Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH. (Control ID #1317331)
NEEDS AND OBJECTIVES: Journal clubs are a valuable tool for introducing students to primary research literature. In contrast to traditional formats which are often faculty led with little student input, a student-driven electronic journal club allows students to choose articles that specifically interest them and learn at their own pace without pressure or self-consciousness. However, only a handful of student-led journal clubs exist in US medical schools, and student-led electronic web-based journal clubs have not been described to date. The primary objective of this Electronic-journal club (E-journal club) is to increase exposure of recent publications to medical students through an informal web-based platform. Secondary objectives are to help students understand the importance of evidence based medicine and to foster skills in critiquing primary literature.
SETTING AND PARTICIPANTS: Medical students in their first 3 years at Case Western Reserve University School of Medicine (512 total students) were provided access to the E-journal club. DESCRIPTION: The E-journal club is a weekly web blog featuring recent articles selected by fourth-year medical students. Articles are selected from high-impact medical journals (JAMA, NEJM, Annals of Internal Medicine, The Lancet), journal review platforms (Journal Watch, Johns Hopkins Medicine Podcast), and news outlets (The New York Times, Science Daily). Articles are screened for relevance to medical students, innovativeness, and likelihood to impact clinical practice. Each reviewed article is preceded by a relevant clinical scenario, and the study design is described using the PICO format (patient population, intervention, comparison, outcome). The comments section includes study strengths and weaknesses, analysis of findings in the context of current practice, and commentary from faculty. A short quiz at the end of each issue is used to test the highlighted concepts.

EVALUATION: Student participation was gauged using an online statistics service from weeks 4 to 8. Also, an online satisfaction survey was conducted to assess the level of interest in the E-journal club and its effect on students article reading habits. There were 135 unique IP addresses logged. Excluding the 2 weeks of holiday season, there was an average of 37.7 visitors to the site per week. 64 of 512 students responded to the survey (12.5%). 89.5% of students were satisfied with the amount of information covered in the E-Journal club. There was a statistically non-significant increase in the volume of article reading after the E-Journal Club was initiated - a 4.7% increase in the number of students reading 1-2 articles/month, 7.9% for 3-5 articles/month, and 4.8% for >5 articles a month. The majority of students felt that their critical appraisal skills have not changed after participating in the E-journal club.
DISCUSSION / REFLECTION / LESSONS LEARNED: We have presented a model for introducing primary literature to medical students using a student-organized web-based journal club. Despite the absence of any external incentives, over 1/4 of the students participated in the E-journal club. Although not statistically significant, there was a trend toward increased volume of article reading, which was encouraging. However, there is much room for improvement in developing students critical appraisal skills. To further enhance the effectiveness of the E-journal club, we propose the use of an online comments function to encourage discussion about strengths and weakness of study.
ONLINE RESOURCE URL (OPTIONAL): http://casemed-ejournalclub.tumblr.com/
Web End =http://casemed-ejournalclub. http://casemed-ejournalclub.tumblr.com/
Web End =tumblr.com/
ADDRESSING HEALTH DISPARITIES: EXPLORING NEW AND NONTRADITIONAL PATHS TO THE HEALTH PROFESSIONS Katy Hicks1; Akua Brown2; Rachel True3. 1Alameda County Medical Center, Oakland, CA; 2Latin American Medical School, Havana, Cuba;
3MEDICC, Oakland, CA. (Control ID #1324216)
NEEDS AND OBJECTIVES: The 2004 Sullivan Report (Missing Persons: Minorities in the Health Professions, 2004) and Institute of Medicines landmark study, Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care (Smedley, B, Stith, A, Nelson, A, eds., 2003), both recommend increasing the number of minority health professionals as a key strategy to eliminating health disparities. Yet as of 2010, these groups still constitute less than 13% of the health care workforce (AAMC, Diversity in the Physician Workforce: Facts &Figures 2010). Since 2001 Cuba has been providing full scholarships for students from other countries to study medicine at the Latin American Medical School (ELAM). The US students at ELAM represent ethnic and socioeconomic demographics in proportions rarely seen in US medical schools yet face unique challenges in gaining access to clinical rotations and hence residencies in the US.
SETTING AND PARTICIPANTS: Through their participation in a unique community health project, several physicians and the CEO of the Alameda County Medical Center (ACMC) in Oakland, California traveled to Cuba in 2009. While there they observed US students in their academic setting at ELAM. Recognizing their potential as a pool of strong, diverse residency candidates, ACMC, in collaboration with MEDICC (Medical Education Cooperation with Cuba, a non-profit organization also based in Oakland), developed a new clinical clerkship program. The 4-week program provides six US ELAM students per year with practical experience serving a complex mix of poor and underserved patients. DESCRIPTION: The program was piloted at ACMC in 2010 with two tracks, (1) an outpatient clerkship for medical students in their first through third years of ELAM training and, (2) an inpatient medicine ward clerkship for students who have completed core rotations and passed Step 1. Several challenges were identified and addressed during the first two years. First,

because most students have limited financial resources, funding for stipends had to be secured. Second, individual liability insurance policies had to be identified and processed (ELAM does not provide insurance coverage). Third, schedules and orientations had to be arranged with very little communication due to limited

internet access in Cuba and the brief period students are present in the US. Fourth, since US and ELAM medical school curricula differ, the expectations for each of the clerkships needed to be carefully evaluated by faculty and students.
EVALUATION: Students and faculty completed online evaluations which the faculty used to improve the program. Faculty were impressed with the medical knowledge, clinical skills, professionalism and practice improvement of the ELAM students. A majority of the students reported that clinical expectations and the adjustment to the US systems were complex but manageable. One hundred percent of the students felt the program was a valuable addition to their training.
DISCUSSION / REFLECTION / LESSONS LEARNED: In an era of demographic shifts toward an increasingly diverse population, demand for culturally competent, bilingual and bicultural doctors is intensifying. ACMC and MEDICCs experience developing and implementing a clerkship program for US ELAM students indicates that these graduates may be a viable source of residents and physicians in the near future. It is hoped that other academic institutions will adopt this model and create similar rotations for US ELAM students in other parts of the country.
AMBULATORY HANDOFFS: A CURRICULUM AND TOOL TO FACILITATE CONTINUITY OF CARE IN A TEAM-BASED PRACTICE MODEL Melissa Bachhuber1,2; Shalini Patel1,2; Nicholas Moy1,2; Bridget O'Brien1. 1University of California, San Francisco, San Francisco, CA; 2San Francisco VA Medical Center, San Francisco, CA. (Control ID #1324692)
NEEDS AND OBJECTIVES: Team-based models of care and reduced duty hours increase the need for safe and effective patient handoffs among trainees. Few guidelines or training materials exist for handoffs in outpatient trainee continuity clinics. Our aim was to conduct a needs assessment on current and desirable handoff practices for ambulatory patients and use this information, along with literature on handoffs in other settings, to create an ambulatory handoff tool and curriculum. SETTING AND PARTICIPANTS: In the San Francisco VA Medical Center (SFVAMC) primary care clinics, Internal Medicine residents work as practice partners in which one partner spends a two month block performing inpatient duties while his/her partner performs ambulatory duties. In July 2011 one NP student joined each partner team. Team members interchangeably see their partners patients during any absence greater than two weeks.
DESCRIPTION: In our needs assessment survey completed by 29 residents, 66% indicated concern that there are times when patients should be handed off to a practice partner but are not and 33% reported that a patient sustained a preventable adverse event or near miss due to a suboptimal handoff. Residents reported the main barriers to completing handoffs were lack of time and lack of a structured system. We designed an innovation to address this patient safety issue which included an outpatient handoff curriculum, an ambulatory handoff template tool, and protected time for handoff completion. The curriculum included an overview of handoff literature and a one hour case-based session on a complex diabetic patient requiring handoff to a practice partner. The case prompted discussion of criteria to identify patients at "high risk" for adverse events and served as an example of how to use the ambulatory handoff template. The template contains the most desired information identified by residents on the needs assessment survey: Active Clinical Problems, Issues Requiring Immediate Follow Up, and Recommendations for Further Management. The completed handoffs are stored on a secure server accessible to trainees and clinic preceptors. Protected time is provided for trainees to complete handoffs before going off clinic service and practice partners are expected to review handoffs while covering their partners' patients. Quarterly check-in sessions are held to obtain feedback on the tool.
EVALUATION: Twenty-three trainees (16 R2s and 7 NP students) participated in our curriculum. Fifteen trainees (65%) have used the
template to date, entering between 1 and 4 patients per handoff. Examples of handoffs entered included patients with substance abuse and depression, and weight loss undergoing active work up. Prior to participation in the curriculum, trainees completed a survey. When asked how prepared they feel to see their partners

complicated patients, the mean response was 3.8 (SD 1.2) on a 6-point scale from strongly disagree(1) to strongly agree(6). The mean response to confidence and satisfaction with handoffs was 4.6 (SD 0.7) and 4.3 (SD 1.1) respectively. We will resurvey trainees at the end of the academic year to evaluate effectiveness of the innovation. DISCUSSION / REFLECTION / LESSONS LEARNED: Creating a structured system and curriculum for ambulatory handoffs is feasible in a team-based practice model and could be adapted to other outpatient settings.Trainee input into system improvement is critical to adoption and sustainability of new processes. Future work is needed to evaluate the impact of ambulatory handoff systems on patient safety.

AMBULATORY PROCEDURE CADAVER CLINIC Kurt J. Pfeifer; Cynthia Kay; Theodore MacKinney. Medical College of Wisconsin, Milwaukee, WI. (Control ID #1306139)

NEEDS AND OBJECTIVES: 1. Increase resident training in common clinic-related procedures. 2. Provide risk-free but realistic practice performing arthrocentesis and dermatologic procedures. 3. Improve residents confidence in performing ambulatory procedures.

SETTING AND PARTICIPANTS: The Internal Medicine (IM) Residency Program at our institution is comprised of 99 residents rotating between 3 hospitals and engaging in a variety of inpatient and ambulatory electives and mandatory rotations. During these experiences, residents can perform bedside procedures as opportunities arise during their patient care duties. First-year residents also participate in a one-day workshop utilizing simulators and models to teach common procedures. Our program, like most others, requires competency in performance of only the limited procedures mandated by the American Board of Internal Medicine (ABIM). For the approximately 30% of our residents who eventually practice outpatient general internal medicine, these requirements and educational experiences may be insufficient for preparing them to perform common, clinic-based procedures.

DESCRIPTION: Five 2-hour sessions were conducted in the gross anatomy laboratory of the Medical College of Wisconsin. Fourteen internal medicine residents of all post-graduate levels and two faculty attendings took part in these sessions. No more than 5 participants were assigned to a single day, and all but one participant attended just one session. Each workshop was run by a faculty attending with over twenty years of experience performing arthrocentesis of various joints, punch biopsies and skin excisions. Prior to the start of the workshop, participants completed a short survey rating their experience with knee, shoulder and wrist injections and skin punch and wedge biopsies, as well as their comfort level for each procedure. Each workshop was conducted in a similar manner, with the faculty director first demonstrating each procedure. Demonstrations of external anatomy and bony landmarks were done on participants and on cadavers. Then, each participant had time to practice the procedure on the available cadavers, until they felt comfortable. For arthrocentesis, some cadavers were available with joints already dissected so that joint anatomy could be easily reviewed. Faculty worked with each resident until they could reliably do knee and shoulder arthrocentesis and skin punch and wedge biopsies. Approximately 4 weeks following the workshop, participants again completed a survey rating their experience and comfort level with the procedures.

EVALUATION: Participants rated their confidence in performing the procedures on a scale from 1 to 5, with 1 corresponding to have no experience or knowledge and 5 correlating to confident to perform, teach and evaluate. Data from the surveys revealed that participants confidence rating increased by an average of one point for all procedures. Most notable were skin wedge biopsy that increased from 1.625 to 2.625 and shoulder arthrocentesis, which increased from 1.937 to 2.937. DISCUSSION / REFLECTION / LESSONS LEARNED: Though there were a small number of participants in this first cadaver-based procedure

workshop, the data supports the idea that any practice improves confidence, even after a single workshop. In addition, the use of cadavers provides a more realistic experience when compared to manikins. This workshop

could serve as a valuable supplement to traditional clinical experience, which typically relies upon chance and preceptors own procedural confidence.

AN 8-MODULE INTERN NIGHT FLOAT CURRICULUM: ENHANCING THE EDUCATIONAL VALUE OF INTERN NIGHT FLOAT AND THE TEACHING SKILLS OF SENIOR RESIDENTS Erin J. Goss; Danit Arad. Montefiore Medical Center, Bronx, NY. (Control ID #1339810)

NEEDS AND OBJECTIVES: In order to adhere to increased intern work hour restrictions, many internal medicine residency programs have increased the amount of time interns spend on overnight rotations like night float. Night float systems have been associated with reduced medical errors, but they have also been associated with dissatisfaction with the learning environment, and do not improve standardized testing scores. Overnight residents are well situated to be teachers for night floats. In addition, recent LCME guidelines suggest that residency programs formalize resident as teacher training. To enhance the educational experience of interns on night float and teaching skills of senior residents, we developed an interactive night float curriculum delivered by senior residents to night float interns.

SETTING AND PARTICIPANTS: Internal Medicine interns at MMC complete one to two, 2-week blocks of night float at either of two university hospital locations in the Bronx, NY. Four senior residents rotate through a medicine consult rotation monthly at the Moses campus. Senior residents deliver the pilot curriculum to interns at the Moses campus; interns on night float at Weiler campus receive their regular orientation.

DESCRIPTION: Senior and chief residents collaborated to design eight 30-minute evidence-based and interactive powerpoint modules along with example signouts. Modules simulate relevant clinical scenarios and focus on acute management of high yield topics such as chest pain, hypotension, respiratory distress, delirium, alcohol withdrawal, electrolyte abnormalities, DKA and pain management. In the first few days of the rotation, residents on medicine consult rotation receive an educational session on Resident as Teacher where they brainstorm and role-play teaching to adult learners and receive peer and faculty feedback on their teaching performance. The session, developed for this curriculum, is part of a larger Resident as Teacher series. Each senior resident is then responsible for presenting one module per week to each pair of night floats, so that night float interns receive all 8 didactic sessions.

EVALUATION: To determine whether modules enhance interns medical knowledge, the change in scores between pre- and post-testing on a 16 item medical knowledge exam will be calculated and compared between intervention and control sites using paired student t tests. Interns will also report their confidence in managing acute changes in patients medical conditions on a Likert scale. To assess the impact on residents skill in teaching, interns will rate residents on the quality of their teaching. Finally, senior residents are asked to rate their confidence on a Likert scale in teaching interns and medical students at the beginning and end of the rotation.

DISCUSSION / REFLECTION / LESSONS LEARNED: Currently being piloted with the first group of night floats and residents, this curriculum is innovative in its ability to formalize the overnight clinical teaching while building teaching skill capacity of senior residents. We hypothesize that this multi-layered curriculum will increase interns knowledge of acute care management of overnight issues and will increase their confidence in their role as night-float. In addition, we hypothesize that this series of activities will enhance residents teaching skills and build their confidence as teachers. Downstream effects that should be measured going forward include impact on resident teaching outside the modular curriculum, patient outcomes and frequency of medical errors.

ONLINE RESOURCE URL (OPTIONAL): http://www.night-float.org

Web End =www.night-float.org

AN EXPERIENTIAL, LONGITUDINAL INTERPROFESSIONAL QI CURRICULUM FOR HOSPITALIST RESIDENTS Darlene Tad-y; Lisa Price; Dimitriy Levin; Jeffrey Glasheen. University of Colorado Denver School of Medicine, Aurora, CO. (Control ID #1332650)

NEEDS AND OBJECTIVES: Formal training in quality improvement (QI) has become increasingly important.

Both the Accreditation Council for Graduate Medical Education and the American Board of Internal Medicine have created competencies in the areas of practice-based learning improvement (PBLI), systems-based practice (SBP) and communication that must be met. Most QI curricula for internal medicine residents are implemented in the outpatient setting and are often limited to resident learners. As part of an inpatient training program for internal medicine (IM) residents, we developed a curriculum to improve residents knowledge, attitudes, and skills in QI, and to meet competency requirements set by the ACGME in the realms of PBLI, SBP, and communication. SETTING AND PARTICIPANTS: The Quality Improvement Program (QuIP) Curriculum was developed within the Hospitalist Training Program (HTP) at the University of Colorado, which started in 2004. The HTP is a training program for 2nd and 3 rd year residents in our IM Residency Training program pursuing a career in hospital medicine. Learners, which included hospitalist residents, medical students and pharmacy residents, worked in faculty-mentored teams (QuIP Teams) to design, implement, and measure a QI project in conjunction with the relevant hospital committees as part of the curriculum.
DESCRIPTION: The QuIP curriculum is a 2-year program that incorporates didactic teaching, targeted coaching sessions, and an experiential project embedded in hospital-led initiatives. Didactic components were delivered in 2 settings: monthly educational sessions and a 1-month dedicated QI rotation. Learners also completed online QI educational content provided by the Institute for Healthcare Improvement. In the pilot year, 4 projects were undertaken by QuIP Teams: 1. Improving the time to TPA for Stroke Alerts, 2. Improvement of the Quality and Timeliness of Discharge Summaries, 3. A Physician-Centered Initiative to Decrease Inpatient Falls, 4.Reducing Informal Restraints for the Frail Elderly Patient. Faculty mentors and QuIP Team members attended educational and coaching sessions together to facilitate team learning. EVALUATION: Educational, scholarly, and clinical outcomes were evaluated throughout the program. Results demonstrated that learners had increased confidence in key QI knowledge and skill sets. Additionally, all learners earned the Institute for Healthcare Improvements Advanced certificate in QI and presented a scholarly abstract at a regional Hospital Medicine meeting. Clinical process outcomes were promising,including decreased time to TPA, implementation of EMR fall risk notification, and improved timeliness of discharge summaries. Measures of sustainability and wide dissemination are yet to be determined.
DISCUSSION / REFLECTION / LESSONS LEARNED: A longitudinal QI curriculum can successfully be implemented primarily in the inpatient setting. Interprofessional learners can master QI knowledge and skills and collaborate on projects that produce meaningful change. Internal medicine residents who participate in an inpatient QI curriculum can be better prepared to design and implement QI initiatives upon graduation from residency.
ATTENDING EVALUATION OF INTERNAL MEDICINE RESIDENTS CLINICAL ADMISSION PERFORMANCE DURING THEIR NIGHT FLOAT ROTATION Maryann T. Ally; Harry Burke; Moromoke Odina. Walter Reed National Military Medical Center, Bethesda, MD. (Control ID #1327333)
NEEDS AND OBJECTIVES: We have instituted a night float resident rotation but it is not known how to best evaluate residents clinical performance. We developed a structured attending evaluation form to assess internal medicine residents night float clinical admission performance. SETTING AND PARTICIPANTS: Over one month, hospitalist attendings evaluated internal medicine residents during their night float rotation during a weekly night float medicine conference.

DESCRIPTION: We created a two-page, structured evaluation form. A hospitalist attending selected one night float admission per resident to review. The first page of the evaluation form was filled out by the resident, who recalled information provided in the patients history and physical. The second page was filled out by the attending, who performed a face-to-face and written review of the residents workup, differential diagnoses, and treatment plan. The attending scored each area and provided a summary score for each section. This evaluative process took fifteen to twenty minutes.

EVALUATION: Hospitalist attendings evaluated fourteen internal medicine residents over one month in terms of above average, average, and below average performance on six clinical measures. Of these fourteen residents, 5 were PGY-1 and 9 were PGY-2 or PGY-3. The six measures and the results, as assessed by the attending, were: What was the chief complaint or night float issue? 64.2% above, 35.7% average, and 0% below. What were your differential diagnoses and how did you work it up?35.7% above, 64.2% average, and 0% below. What results did you obtain and what conclusions did you come to? 57.1% above, 42.8% average, and 0% below. Recalling that night and the events of subsequent days, would you say that you would have done something differently in terms of the first three questions? If so, what and why? 57.1% above, 42.8% average, and 0% below. Was there clear documentation in the chart of the house staffs thought process and plan of action? 57.1% above, 35.7% average, and 7.1% below.
DISCUSSION / REFLECTION / LESSONS LEARNED: Using a structured evaluation form, we assessed the internal medicine residents clinical performance during their night float rotation. This evaluative process identified areas for resident improvement including developing more robust differential diagnoses and more comprehensive documentation. We will address these needs by working with residents on an individual basis and by implementing system-based improvement initiatives.
BULIDING A CURRICUUM IN GLOBAL AND DOMESTIC HEALTH DISPARITIES THROUGH A LONGITUDINAL MENTORED LEADERSHIP TRAINING PROGRAM Brent C. Williams; Julie S. Perry; Andrew J. Haig; Patricia Mullan; Joy Williams. University of Michigan, Ann Arbor, MI. (Control ID #1318841)
NEEDS AND OBJECTIVES: A substantial number of UM medical school applicants and enrolled students have expressed interest in, and independently pursue, learning experiences related to underserved populations. The Deans office charged five faculty members to develop a structured opportunity for motivated students to pursue training in the care of underserved populations in the U. S. and abroad - termed the Global Health and Disparities Path of Excellence (GHD PoE). Following review of existing disparities curricula, competencies and objectives were identified to anchor the program, within the overall mission to integrate foundational, investigative and experiential learning that will prepare the medical students to be agents of sustainable change to reduce domestic and global health disparities. Competency domains include: 1) Social Determinants of Health Disparities, 2) Tools and Strategies to Promote Sustainable Change, 3) Health Care Systems and Policy, and 4) Professional and Leadership Development. Foundational goals of the GHD-PoE are to create a flexible, mentored, self-regulated environment to shape student learning.
SETTING AND PARTICIPANTS: Working groups focusing on learning methods, assessment and leadership designed the program with substantial student involvement. To date, the GHD PoE overall framework has been developed, endorsed by the schools curriculum policy committee, and initial components implemented. 3 faculty mentors have been recruited and supported at 10% each to implement the program. The GHD PoE is being implemented beginning with the entering class of 2011 (M1s), 35 of whom have expressed interest in the Path.
DESCRIPTION: Key planned features of the GHD PoE include: a) curriculum-based lecture series open to all M1s, b) regular small group meetings with faculty mentors throughout students four years, c) required capstone field projects, and d) use of electronic portfolios to document and measure progress towards goals, communicate with fellow students and
mentors, and network with GHD alumni to promote project and career development.
EVALUATION: Learner assessment will be multimodal and include: a) structured review of capstone field projects, b) review of written assignments applying readings to case studies emphasizing core curricular elements, and c) reflective essays applying principles of leadership to group field projects.
DISCUSSION / REFLECTION / LESSONS LEARNED: Compared to scholarly co-curricula at other medical schools, distinctive features of the GHD PoE include: a) focus on both domestic and international health disparities, b) central role of, and substantive investment in, faculty mentors, c) emphasis on leadership skills to promote sustained change in health care in underserved settings, d) focus on career development and

professional networking, and e) multidimensional use of portfolios by students for planning, implementing, documenting, and assessing learning experiences. As the program is developed, anticipated challenges are: a) accommodating students at widely varying levels of experience and skills, b) teaching and measuring competency in leadership skills, and c) providing ongoing faculty development support for longitudinal and project mentors.

CANCER SURVIVORSHIP: A NEEDS ASSESSMENT FOR CURRICULUM DEVELOPMENT IN RESIDENT EDUCATION Chi Kim; April Barbour; Gabriel Rivera; Jessica Logan. George Washington University, Washington, DC. (Control ID #1319793)

NEEDS AND OBJECTIVES: There are nearly 12 million cancer survivors in the United States. With ongoing innovations in cancer treatment, that population will grow to approximately 20 million by 2020. As the surviving population ages, who should oversee medical care for cancer survivors - internists or oncologists? Based upon prior surveys, oncologists feel comfortable with survivorship care, but lack the time and resources to provide long-term survivorship care to millions of patients; general internists, however, feel that they lack adequate knowledge and confidence in providing survivorship care. To date, internal medicine residents have not been assessed regarding their attitudes towards cancer survivorship care. Our unique survey was intended to assess the knowledge and attitudes of internal medicine residents towards survivorship care to prepare for the implementation of a survivorship residency curriculum. This longitudinal curriculum is aimed at increasing internal medicine residents' awareness of long term effects and their confidence in treating cancer survivors.

SETTING AND PARTICIPANTS: All internal medicine residents at George Washington were asked to complete an IRB approved survey during a town hall meeting in July 2011.

DESCRIPTION: A 10-item questionnaire was provided to assess the knowledge and attitudes of internal medicine residents on survivorship care. This survey included demographic information (PGY level, residency tract) as well as likert scale questions designed to assess the interest and confidence in providing survivorship care to patients in their practice. EVALUATION: Seventy-two (70%) of the internal medicine residents completed the survey. Overwhelmingly primary care (100%) and non-primary care bound (76%) residents felt cancer survivors should receive their long term care from both hematologist/oncologist and internists. Of those surveyed, 99% stated they were interested in learning how to provide survivorship care to their patients; however, only 61% indicated they would feel comfortable monitoring for late and long-term effects in cancer survivors. In addition, 50% of respondents stated they were familiar with late effects of cancer treatment. Finally, 37% stated they were familiar with resources or support services for cancer survivors.

DISCUSSION / REFLECTION / LESSONS LEARNED: There is a growing need to provide long-term cancer survivorship care to millions of survivors. Based on our questionnaire results, internal medicine residents are motivated to participate in the care of cancer survivors; however, they appear to lack the knowledge and confidence to provide this care. Our results are consistent with the survey results of practicing internists who also feel they lack adequate knowledge and confidence in survivorship care. Background studies establish the need for cancer survivorship education. Our results suggest that a collaborative effort between internists and oncologists would be the preferred model for resident education. In

sum, our study shows that a cancer survivorship curriculum should be part of resident education to train future internists who will be providing long-term care to our rapidly growing population of cancer survivors in the United States.

ONLINE RESOURCE URL (OPTIONAL):
http://www.gwmed.com/joomla/index.php?0ption=com_content&view=article&id=128&Itemid=234
Web End =http://www.gwmed.

http://www.gwmed.com/joomla/index.php?0ption=com_content&view=article&id=128&Itemid=234
Web End =com/joomla/index.php?0ption=com_content&view=article&id=128&
http://www.gwmed.com/joomla/index.php?0ption=com_content&view=article&id=128&Itemid=234
Web End =Itemid=234
COMPETENCY-BASED TEST OF INPATIENT GERIATRIC MANAGEMENT SKILLS Ethan U. Cumbler1; Jeannette Guerrasio1; Jean Youngwerth1; Judy T. Zerzan1; Sonja Rosen2; Suzanne Brandenburg1; EvaM. Aagaard1; Heidi Wald1. 1University of Colorado School of Medicine, Aurora, CO; 2University of California Los Angeles, Los Angeles, CA. (Control ID #1310407)
NEEDS AND OBJECTIVES: Mulitple choice or short answer examinations fail to assess important aspects of clinical behavior. Increasing emphasis is being placed on competency-based assessments in geriatric medicine. Practical, inexpensive, structured clinical examinations which assess applied knowledge and clinical skills measured across discrete competencies in the inpatient geriatric setting are needed. Objective-Derivation and validation of a novel examination designed to evaluate application of medical knowledge to clinical care in the inpatient setting using Core Competencies from Geriatric and Hospital Medicine. Hypotheses- 1. Competency-based examination will distinguish clinical skills based on level of experience and training 2. Performance on competency-based examination should improve after a dedicated educational experience designed to teach these clinical skills.
SETTING AND PARTICIPANTS: Cohorts- Construct validity examined in a cohort of 10 third year medical students (MSIII), 10 interns (R1) without prior inpatient geriatrics training, and 6 experienced third year residents (R3-post) who had completed an ACE rotation. Hypothesis 2 was tested in an independent cohort of 11 second year residents both before (R2-pre) and after (R2-post) an inpatient ACE rotation. DESCRIPTION: A standardized history and physical of a geriatric admission was designed. It describes an elderly woman with increased falls after surgery and anticholinergic medication initiation. The acute trigger for hospitalization was increased weakness induced by infection. Decreased oral intake caused acute on chronic renal failure with drug toxicity from impaired clearance. The final event bringing her to medical attention was inability to rise after a fall. The test evaluates ten selected competencies of geriatric and hospital medicine through analysis of the actions ordered by the learner in free-written admission orders. For external validity the case was reviewed by 20 expert educators in geriatrics and hospital medicine at 6 academic medical centers nationally. The scoring system applied relative weighting for action on each competency using average judgment of the 20 experts standardized to a 100 point scale.
EVALUATION: Average test performance was: MSIII 49.4% (IQR 34%-63%), R1 62% (IQR 56%-68%), R2-pre 70% (IQR 65%-76%), R2-post 92% (IQR 87%-100%), R3-post 86% (IQR 80%-88%). Statistical analysis revealed significant relationship between level of trainee and score on the pre-tests ($p=0.02$). There was also a significant difference between the R2 scores pre and post exposure to inpatient geriatric rotations ($p<0.0001$). No difference was seen between R2 and R3 scores after the inpatient geriatric rotation.
DISCUSSION / REFLECTION / LESSONS LEARNED: The competency-based admission order practical exam is a new tool to evaluate clinical practice behavior across a range of learner experience. As predicted by hypothesis 1, it distinguishes superior clinical management based on level of training. Consistent with hypothesis 2 that proficiency in these competencies can be accelerated through focused training, the test scores improved significantly in the cohort of second year residents after inpatient geriatric training and competency was indistinguishable between second and third year residents after completion of an inpatient geriatrics rotation. Methodology used in the development of this examination can be applied to the creation of other competency-based practical examinations. ONLINE RESOURCE URL (OPTIONAL): Examination and Scoring System at: http://www.pogoe.org/node/2455
Web End =http://www.pogoe.org/node/2455
CREATION AND IMPLEMENTATION OFAWOMENS LEADERSHIP CURRICULUM FOR INTERNAL

MEDICINE RESIDENTS Brigid M. Dolan1; Joel T. Katz2; Maria Yialamas2. 1Brigham and Women's Hospital, Boston, MA; 2Brigham and Women's Hospital, Boston, MA. (Control ID #1339141)
NEEDS AND OBJECTIVES: While women comprise approximately half of the physician community, women hold far fewer academic leadership positions. Prior studies indicate that women who participate in leadership development curricula are more likely to attain deanships, department chairmanships, or full professorship. Few womens leadership training programs for residents have been described. Female residents at our institution express perceived deficiencies in leadership skills and career development training for women. We created and implemented a Womens Leadership Curriculum with the following objectives. Residents will identify personal leadership strengths and compare these to those measured by an inventory tool; examine the contrasting careers of prominent women faculty, using these models to inform their own career development plan; evaluate strategies for effective communication and demonstrate ability to use skills in small groups; and evaluate different negotiation strategies and apply negotiation skills to daily activitiesSETTING AND PARTICIPANTS: Interns, junior residents and senior resident groups participate in separate half-day seminars each year. Clinical duties are covered by others for these sessions to allow all women in a given class to participate. Most sessions rely on faculty leaders, minimizing program expense. Senior residents facilitate selected sessions with more junior attendees to encourage peer-mentoring.
DESCRIPTION: The session objectives are aligned with the learners career development stage. The intern session focuses on identifying leadership strengths and learning strategies to resolve conflict and lead teams. The junior session addresses career planning and communication; methods include a workshop on how to be effectively mentored, a faculty panel on career transitions, and an interactive communication session. The senior session provides residents with basic negotiation skills.
EVALUATION: Senior residents felt that the objectives of the session were important to career development (93% strongly agreed, 7% agreed) and that they are now better able to recognize negotiation opportunities (62% strongly agreed, 38% agreed). Participants have indicated in follow-up surveys that they have used newly developed negotiation skills in daily work activities (31%). Qualitative responses indicate that the emphasis on negotiation skill development is considered especially valuable. DISCUSSION / REFLECTION / LESSONS LEARNED: Our preliminary findings indicate that women residents appreciate a dedicated curriculum in leadership skills. With departmental support, launching the program was feasible. Our residents prioritized content in negotiation, communication and self-evaluation. In this first year of implementation, the curriculum is highly valued by residents who express belief that topics are important and useful. As the program continues, we hope to develop a strategy for assessing these skills in the inpatient and outpatient settings via direct observation on rounds and resident self-review of videotaped sessions.
CURRICULUM DEVELOPMENT FOR CLINICAL OFFICER INTERNS IN NAIROBI, KENYA Kimberly M. Ganster1; Hillary Dunlevy1,3; Carole Okoth4; Jennifer Cohn2. 1University of Pennsylvania, Philadelphia, PA; 2University of Pennsylvania, Philadelphia, PA; 3Children's Hospital of Philadelphia, Philadelphia, PA; 4Mbgathi District Hospital, Nairobi, Kenya. (Control ID #1333542)
NEEDS AND OBJECTIVES: Clinical officers (COs) serve a valuable role in providing health care in Sub-Saharan Africa in areas where there are few doctors. A large proportion of medical care in inpatient, outpatient, rural and urban settings is through these providers. After high school and graduation from a three year clinical officer training program, COs complete a one year internship including rotations in medicine, surgery, pediatrics and obstetrics. In Kenya, CO interns must pass a national qualifying test after internship, however, there is little standardized or structured curriculum during this training, and the education received

during the medicine clerkship varies significantly by hospital. We aimed to evaluate a self-contained, replicable curriculum including a paper curriculum, power point lectures, and pocket cards on the medicine training of clinical officer interns in a hospital in Nairobi, Kenya.

SETTING AND PARTICIPANTS: The evaluation took place from October to November 2011 in Mbgathi District Hospital (MDH), a public training hospital in Nairobi. Thirteen CO interns completing their three month clerkship in internal medicine participated.
DESCRIPTION: The curriculum was developed through collaborative efforts between the University of Pennsylvania Global Health Equities Residency Track and the education coordinator at MDH. It was based on core internal medicine principles, Kenyas National Guidelines, and basic CO training topics provided by the Ministry of Health. At the start of the internal medicine rotation, the CO interns were given a 30 question pre-test, covering topics such as the management of hypertension, ascites, and tuberculosis. Each intern was given a 35 page inclusive paper curriculum. Weekly for six weeks the interns attended lunchtime power point lectures given by a visiting resident from the University of Pennsylvania and were given a pocket card related to that topic. The power points were designed to be self-contained and easily administered by a medical provider without specific training on the curriculum. After completion of the curriculum, the CO interns were given the same 30 question post-test.
EVALUATION: Thirteen CO interns completed the pre-test and eleven completed the post-test. The average pre-test score was 59% (17.8/30) with a range of 43 to 73%. The average post test score was 68% (20.5/30) with a range of 53 to 87%.
DISCUSSION / REFLECTION / LESSONS LEARNED: This evaluation serves as an important first step in creating a medicine curriculum for clinical officer interns, a significant accomplishment as clinical officers provide a considerable portion of the health care in sub-Saharan Africa and their training is vital to the well being of the population. Test scores improved after the curriculum and the curriculum was well received by the trainees. There were certain limitations to this evaluation. Although designed to be easily delivered without training, during this evaluation the lecture series was given by one of the internal medicine residents who helped design it. The pre-test and post-tests were not validated nor were they compared to a control group. Future directions include evaluating the tests in a control group who does not receive the curriculum, assessing the process when given by a local medical provider, and studying patient care outcomes. With the continued evaluation and success of this curriculum there is the potential for reproduction and replication in other training hospitals in Kenya as well as other parts of sub-Saharan Africa.
DESIGNING A RESIDENT CURRICULUM TO INTEGRATE LOCAL AND GLOBAL PRIMARY CARE TRAINING Renuka Tipirneni; Joseph Joyner; David Munson; Sarah Wakeman; Elizabeth Cunningham; Patrick T. Lee. Massachusetts General Hospital, Boston, MA. (Control ID #1334594)
NEEDS AND OBJECTIVES: Residency training has historically separated curricula for residents interested in promoting health equity into two tracks: advocacy for underserved populations in the U.S., and health delivery in resource-poor international settings. However, common lessons may be shared by integrating global health and primary care training. Our goal was to design a curriculum that allows residents to explore the full arc of health care delivery for vulnerable populations, from policy and planning to implementation and community engagement in order to develop future leaders in health equity in the U.S. and across the globe. SETTING AND PARTICIPANTS: Learners were 13 internal medicine interns at Massachusetts General Hospital on an ambulatory care block. Primary care interns were required to participate in the Global Primary Care curriculum, while categorical interns requested to join the block. The 4-week learning block included 14 half-day sessions of didactic and case-based teaching, and 7 experiential sessions at community organizations. Instructors included 4 senior residents involved in the curriculum design, and various faculty and leaders in community and international organizations.
DESCRIPTION: The curriculum focused on teaching general principles of health reform and community-oriented primary care through case-based examples. Teaching modalities included assigned readings, didactic lectures, interactive case discussion, and team-based discussion and projects. The class-based sessions included: examining health reform in the U.S., Mexico and Liberia; discussing community-oriented primary care

and local community health center initiatives; discussing the role of community health workers and health promoters in the U.S., Haiti and Bangladesh; evaluating primary care/public health efforts in Uganda; and a session on critical reflection. The experiential sessions included visits to: a refugee health assessment program, an HIV health promoters program, a homeless health program, a health care improvement organization, and two community health centers. Through individual and team discussions, learners evaluated various health system reform and community health initiatives, articulated lessons learned, and generated proposals for improvements in primary health care planning and delivery. EVALUATION: Two types of assessments were performed before and after the curriculum to examine the impact on learners preparedness to apply comparative health systems thinking to the care of vulnerable populations. Quantitative knowledge assessments and Likert questions on preparedness and practice intentions were performed. Qualitative interviews were also conducted to assess the depth, breadth, and complexity of learners responses to health policy and delivery scenarios. Evaluation is currently in the analysis phase.
DISCUSSION / REFLECTION / LESSONS LEARNED: An innovative curriculum linking the traditionally separate domains of training in primary care and global health is achievable. With minimal preparation, interns were able to explore policy and implementation issues and stimulate in-depth discussion on a variety of topics. Going forward, we believe it is important to strengthen the learning environment by: 1) streamlining the scheduling process in order to maximize participation; and2) refining and providing further training for learners/facilitators on the case-based method.
ONLINE RESOURCE URL (OPTIONAL): https://hub.partners.org/globalprimarycare/Programs/Curriculum
Web End =https://hub.partners.org/ https://hub.partners.org/globalprimarycare/Programs/Curriculum
Web End =globalprimarycare/Programs/Curriculum
DEVELOPING A LONGITUDINAL INTERDISCIPLINARY CLERKSHIP (LIC) AT AN URBAN TERTIARY MEDICAL CENTER: THE MOUNT SINAI INTERACT PROGRAM Yasmin S. Meah; Allison Gault; Neloofar R. Naderi; Rainier P. Soriano; Valerie Parkas. Mount Sinai School of Medicine, New York, NY. (Control ID #1319855)
NEEDS AND OBJECTIVES: 1) To describe the inception and implementation of a nascent longitudinal interdisciplinary clerkship (LIC) and 2) To discuss challenges and highlight successes of this innovative program.
SETTING AND PARTICIPANTS: Rising third year medical students (n=8-11) were selected through a competitive application process to participate in an 8-11 week LIC. Selected students demonstrated interest in longitudinally caring for vulnerable patients.
DESCRIPTION: Longitudinal integrated clerkships are gaining momentum nationally as innovative platforms to educate students in the care of patients over time. To date, only UCSF had previously implemented an LIC at a tertiary medical center. In 2010, Mount Sinai School of Medicine launched an LIC, uniquely centered in a tertiary care setting with a homebound medical program and a student-run free clinic at its primary care core. The Interclerkship Ambulatory Care Track (InterACT) is more interspersed throughout the traditional inpatient curriculum than the exclusively longitudinal model of parent programs. Created for 8-12 students, foundational ambulatory care venues of the standard curriculum traditionally taught singularly during the block clerkships are transformed into a multidisciplinary integrated longitudinal experience. During a typical InterACT week, students see patients with dedicated mentors in pediatrics, general medicine, geriatrics, homebound medicine, surgery and a student-run free clinic. InterACT didactics focus on themes central to primary care and are heavily derived from students' patient encounters. Though the model significantly differs from those of more established programs, the central concepts and missions are similar: to augment integrated rather than

siloed clinical reasoning; to inculcate strong patient ownership by nurturing students' understanding of the vicissitudes of illness and students' advocacy for patients with chronic illnesses over time; to foster longitudinal mentorship, learning and evaluation.
EVALUATION: Individual and programmatic evaluations are on going and evolving. In our pilot year, InterACT students performed as well or better on all NBME subject shelf examinations. Overall mentor and student evaluations of the clerkship were positive stressing the most valuable aspects of the clerkship as longitudinal mentorship and assessing and shaping the growth of students' skills over time. Future evaluations will focus on program impact on career choice, advocacy skills, patient-centered care and empathy compared to traditional clerkships. DISCUSSION / REFLECTION / LESSONS LEARNED: To date, InterACT is the only LIC to incorporate homebound care and care within a student-run free clinic (SRFC) as core to the structure of this program. These have proven the most successful venues to promote student ownership and advocacy for vulnerable populations. Program challenges include recruiting dedicated quality mentors; finding additional venues that promote student ownership and stress the care of vulnerable populations; establishing a grading system that balances the LIC student evaluations with the non-longitudinal core clerkship student evaluations. Lessons learned: faculty buy-in from the top down is essential to recruiting the right mentors; working with clerkship directors to mold the clerkship and disseminate the mission is key; regular student input in shaping the clerkship, designing the didactic curriculum, recruiting and retaining the right mentors and incorporating ideal clinical venues is fundamental to the growth and success of an LIC.
DEVELOPING AN IMMERSION ELECTIVE FOR RESIDENTS COMMITTED TO CARE OF UNDERSERVED COMMUNITIES Marya J. Cohen; Jessica Zeidman; Patrick T. Lee; Kristian Olson. MGH, Boston, MA. (Control ID #1336580)
NEEDS AND OBJECTIVES: Internal medicine residents interested in primary care for underserved urban communities have few opportunities to provide clinical care while gaining educational expertise in these settings during training. Our objective is to design an elective that provides an opportunity to provide care to vulnerable populations in Boston, in addition to honing educational expertise through participation in a novel curriculum that incorporates teaching, literature review, and presentation development.
SETTING AND PARTICIPANTS: Internal Medicine Residents at Massachusetts General Hospital complete two week rotations at the Crimson Care Chelsea Clinic, a student-faculty collaborative clinic run by physicians of Massachusetts General Hospital (MGH) Chelsea Health Center and Harvard Medical School students. MGH Chelsea is a federally-qualified health center with 40 years of service to a multilingual, ethnically diverse urban area in Massachusetts. The Crimson Care Chelsea Clinic is an innovative primary care clinic that seeks to improve access to the most vulnerable members of this community, particularly recently incarcerated individuals and immigrants without a usual source of care.
DESCRIPTION: To provide a foundation to inform their involvement in the clinic, residents review literature in three areas with the clinic director:(1) health of immigrant communities in the US, (2) health of post-incarceration populations, and (3) the role of student-faculty partnerships as safety-net institutions. Residents have an opportunity to gain an understanding of community resources through introduction to health center initiatives and exposure to innovative primary care programs there. During the rotation, residents teach clinical skills to first to fourth year medical students, and lead a weekly case-based discussion. Based on their review of the literature and experience in the clinic, the residents culminating project is an hour-long lecture to medical students on a topic relevant to care of these communities; for example, health disparities, health policy, a clinical case of interest, or an educational module for use in the medical student curriculum.
EVALUATION: Participants fill out online anonymous evaluations of their elective experience.
DISCUSSION / REFLECTION / LESSONS LEARNED: Involvement in the elective has provided a foundation for deeper learning for residents interested in care of vulnerable populations; there has been significant interest in the elective and in volunteering to lead case-based discussions. Residents have been incorporated successfully

into the operational and educational structure of this collaborative clinic. Embedding this experience within a student-faculty collaborative enhances the educational value of the elective by providing hands-on opportunities for instruction and mentorship of medical students. Running case - based discussions and providing training on basic clinical skills has enriched the medical students' experience and offers an opportunity for residents to reflect on the role of service learning in providing care for vulnerable communities. Future directions include expanding the clinical role of the resident through leading clinical skills workshops as well as mentoring quality improvement and research initiatives.

DEVELOPING AND IMPLEMENTING A PATIENT SAFETY ROTATION Abby Spencer1; Anasastasios Kapetanos1; Andrew Sahud2; Kathy Hayes-Light2; Diane Frndak2. 1Allegheny General Hospital, Pittsburgh, PA; 2Allegheny General Hospital, Pittsburgh, PA. (Control ID #1342262)

NEEDS AND OBJECTIVES: New guidelines highlight the need to expand patient safety education for residents via formal curricula, experiential activities, and integration of residents into safety programs at their hospitals. The goal of our curriculum is to provide didactic and experiential education that promotes a culture of patient safety, systems-thinking, error analysis, and systems-level improvement. SETTING AND PARTICIPANTS: Mandatory 2-week PGY3 patient safety rotation.

DESCRIPTION: Residents learn the fundamentals of patient safety from a series of didactics, online modules, video discussions, and experiential activities including participation in RCAs, participation on hospital committees, and conducting a safety investigation project. Residents have bi-weekly mentoring sessions with a safety officer to reflect on their observations &make recommendations for systems-improvements. They interview safety officers &leaders throughout our system to better understand their various roles. They also attend patient safety meetings to observe how the hospital system manages safety/quality. Residents visit hospital "hot spots" where they observe practices and make recommendations for error reduction. Residents are required to investigate a medical error and develop a set of recommendations for improvement. For example, residents may work with pharmacy, nursing, and IT to improve the system by which heparin is safely delivered to patients or will work with a similar team to respond to a medication error on the floor. The patient safety resident plays an important role in departmental M&M conferences, supplementing clinical education with quality/safety education and plans for process improvement.

EVALUATION: We evaluate resident learning and curricular effectiveness. In addition to post-test knowledge/attitude questions, residents write a reflection piece and an apology letter on the first and last day of the rotation. Changes in essays show more in-depth understanding of no-blame and just culture, of process issues, of individual accountability for safe care, and empowerment to address patient safety issues. The large majority felt that after the rotation they were more likely to report errors/near-miss and that they would change the way they care for patients. Activities they found beneficial were attending RCAs, preparing safety analyses of M&M conferences, learning about initiatives to prevent hospital acquired infections, and observing hand hygiene practices of staff. Residents unanimously felt they were empowered to address safety issues, one resident stated I believe every physician should have exposure to this field. Residents felt the rotation taught them to think logically about errors &enact change. They felt it will impact their patient care, documentation, and encouraged them to increase the involvement of patients and their families in decision making.

DISCUSSION / REFLECTION / LESSONS LEARNED: Our new rotation improved resident knowledge, changed attitudes, and most

importantly, changed actions. After the rotation, residents said they were more likely to recognize, report, and prevent errors. Developing a two-week patient safety rotation is feasible, effective, and provides a forum for medical educators to incorporate safety curricula into their training programs and to integrate residents into the safety operations of hospitals. Our rotation can serve as a useful model for program directors struggling to meet the challenges of meeting new ACGME requirements.

DISCHARGE VISITS IN THE MEDICINE CLERKSHIP: PILOT DATA Deborah Jones1; James Noble2; Katherine Nickerson1. 1Columbia University College of Physicians &Surgeons, New York, NY; 2Columbia University College of Physicians &Surgeons, New York, NY. (Control ID #1322100)

NEEDS AND OBJECTIVES: A number of trends in healthcare threaten the smooth transition of care between hospital and home as the acuity of inpatients rises: the rarity of doctors who work both inand outpatient environments; pressure to limit time in the hospital; and minimal contact between inpatient and outpatient providers. Pressure is also mounting to lower costs and reduce high rates of readmissions. In this environment it is essential that medical students acquire explicit knowledge, skills and attitudes to orchestrate successful transitions in care. However, nationally students report poor preparation to take on this role. Presently, students who graduate from our medical school without a Medicine Clerkship curriculum on transitions in care report inadequate instruction on continuity of care more frequently than at other schools (31% vs. 18%). The Medicine Clerkship is a natural locus to teach principles of transitions in care due to the high prevalence of chronic illness. Several medical student programs have demonstrated success with post-discharge home visits, but it is unknown if post-discharge office visits can improve student confidence and knowledge about discharges and transitions in care.

SETTING AND PARTICIPANTS: Commencing with the Major Clinical Year in January 2012, all members of the class of 2014 will discharge a patient in the initial weeks of their 6 week Medicine Clerkship. Two groups on neurology early in 2012 will serve as a controls. In the five-week Neurology Clerkship students will discharge adult patients but not attend a specifically planned follow up visit.

DESCRIPTION: Students will be provided information on discharge planning in the form of a discharge planning information card at clerkship orientation. The student will be required to attend a post-discharge outpatient follow up visit, if the visit will be with an attending physician affiliated with the home institution or is medical school faculty. The student will write up that visit and submit a report to their preceptor, identifying the issues at that visit. Students will use a template provided by the clerkship director.

EVALUATION: Evaluation of the education program will have a quantitative and qualitative component. At the beginning and conclusion of medicine and neurology clerkships students will respond to a 9-item anonymous, electronic, 5-point Likert scale survey regarding their confidence on topics related to transitions in care. All responses will be compared at the group level with a non-paired t-test. Pilot data from approximately 70 students are anticipated by May, 2012. The student write ups will be qualitatively analyzed for their thematic and reflective content with an analytic tool currently under development.

DISCUSSION / REFLECTION / LESSONS LEARNED: Opportunity to improve student knowledge and confidence in transitions in care, while helping outpatient doctors and patients with transitions, makes a discharge visit an appealing addition to the Medicine Clerkship. Many attempts have been made to teach students about continuity of care such as longitudinal curricula, and visits to homes and long term care facilities. An office based, post-discharge visit incorporated into a Medicine Clerkship is a feasible addition for all medical schools. Linking outpatient and inpatient care within the Medicine Clerkship improves student knowledge of chronic disease management, medication reconcilation and adherence, discharge planning, fosters professionalism and should ultimately improve patient outcomes.

DISEASE OF THE MONTH: A MONTH-BY-MONTH MULTIDISCIPLINARY CURRICULUM FOR AMBULATORY BLOCK OR PRIMARY CARE CLINIC H. Keels S. Jorn. Mayo Clinic, Jacksonville, FL. (Control ID #1339800)

NEEDS AND OBJECTIVES: Educators and learners in internal medicine resident clinics have a wealth of information available to them but it can be difficult to tailor the available information to needs of learners in a given clinic setting. In Disease-of-the-Month Curriculum, the material presented incorporates recognized resources for medical knowledge and patient care with multidisciplinary providers, emphasizing systems based practices of the medical center in which it is shared. In contrast to many educational resources that focus on

hospital management of acute exacerbations of chronic disease, this curriculum attempts to guide clinicians in the management of patients for the 51 weeks of the year that they arent in the hospital, with emphasis on local resources. Basics of quality of care and practice-based learning and improvement for each residents continuity panel in context of the Disease-of-the-MonthSETTING AND PARTICIPANTS: 4-5 Once-weekly 1-2 h conferences during Ambulatory Block for PGY1's and PGY2's. Occasional field trips to relevant areas of clinic, such as to physical therapy department to learn about PT for back pain. Presenters vary with the topic, but could be internal medicine physicians, home health providers, pharmacists, diabetes educators, and others. Curriculum could be adapted to a pre-clinic conference for continuity clinic.
DESCRIPTION: Common ambulatory conditions (diabetes, COPD, HTN, mental illness, etc) are selected as Disease-of-the-Month. The month is structured. Week 1: Medical overview of the condition, discussion of quality indicators for that condition, resident-selected quality measures for self-audit of their continuity patients. Week 2: PharmD lectures on pharmacology relevant to the DOM. Week 3 or 4: Non-physician provider contribution to chronic or outpatient management. Week 4 or 5: review of results of resident self-audit. Diabetes (example) Week 1: Medical overview, selection of quality measures. Week 2: Pharmacology review of medications in diabetes, emphasis on oral agents to treat diabetes and medications that can aggravate diabetes. Week 3: Diabetic nurse educator brings injection practice kits, teaches residents to use insulin pens vs. syringes. Week 4: Review of findings from self-audit and action plans for next 6 months Back Pain (example) Week 1: Medical overview, differential diagnosis, red flag features, and selection of quality measures for self-audit. Week 2: Pharmacology review, emphasis on non-narcotic medications used in back pain Week 3: field trip to physical therapy department to see, touch, experience equipment for back pain Week 4-5: chiropractor discusses non-allopathic management of back pain, review of quality measures Other examples will be available if/when presented.
EVALUATION: End of month evaluations, resident reflection on level of interest and comfort in managing chronic conditions in clinic, re-audit to verify quality items addressedDISCUSSION / REFLECTION / LESSONS LEARNED: Having a structure for the monthly cycle of conferences helps to assure that non-physician resources not immediately recognized in the practice are made more familiar to learners. Physician seen as member of treatment team is clarified. Educators from other institutions could use the skeleton of this conference as basis for their own, site specific resources. One downfall is that only the residents on the rotation experience that Disease-of-the-Month. Additional effectiveness evaluation methods are needed. Curriculum in use for 6 years.
ESTABLISHING KLIC- THE UCSF-KAISER PERMANENTE LONGITUDINAL INTEGRATED CLERKSHIP
Lindsay A. Mazotti1,2;
Juan Guerra1; Stanton Siu1; Leslea Brickner1; Wendy Smith1; Ann Poncelet2.
1Kaiser Permanente, Oakland, CA; 2University of California San Francisco, San Francisco, CA. (Control ID #1328731)
NEEDS AND OBJECTIVES: Medical education is in an exciting period of transformation as medical schools work to incorporate modern learning principles into their structure and align forces impacting delivery of care

with educational priorities. Guiding principles of longitudinal integrated clerkships (LICs) emphasize continuity with preceptors, patients and site. LIC benefits include enhanced patient-centeredness, moral development, observation and feedback on clinical skills, identity formation, and countering of the hidden curriculum. Creating LICs, however, can be both faculty and resource intensive. This educational transformation may require symbiotic partnerships with integrated community health systems such as Kaiser Permanente (KP), with potential benefits for both institutions. Our objective was to create a one year LIC at KP that emphasized:

longitudinal relationships between patients, students, teachers, and healthcare systems, the course of chronic illness and the patients experience of disease, the development of clinical reasoning skills through early introduction to patients with undiagnosed illness, and the skills and integrated knowledge needed for compassionate, effective patient-centered care.
SETTING AND PARTICIPANTS: KLIC [Kaiser Permanente (KP)-University of California San Francisco (UCSF) Longitudinal Integrated Clerkship (LIC)], a one year LIC for 8 UCSF third year medical students at KP Oakland, CA.
DESCRIPTION: Academic leaders in established LICs at UCSF began discussions with Northern California Regional KP in fall of 2009. In 2011-12, KP Oakland was chosen to pilot 8 students in an LIC, mirroring the PISCES program at UCSF. Students complete all 8 core clinical clerkships over one year with supervision from one preceptor for each clerkship. Students establish a patient cohort panel of 50-75 patients for whom they will provide longitudinal care over the course of one year. Unique aspects of the KLIC program include a novel leadership, health systems and quality improvement curriculum PULSE.
EVALUATION: Students are evaluated with formative and summative evaluations including Brief Structured Clinical Observations and faculty quarterly R-I-M-E evaluation sessions. Each clerkship is evaluated by the students at midpoint and end of year (currently pending), as well as the overall course. Didactics and PULSE leadership sessions are also evaluated. Program evaluation is semi-annual and ongoing. DISCUSSION / REFLECTION / LESSONS LEARNED: As medical education continues to transform, it will be important for university settings to collaborate further with community training sites. Benefits to UCSF may include additional resources available at the community site, a sustainable model of LIC training, opportunity for innovation across the continuum of UME and GME at KP, and a primary care focused educational site. Benefits to KP may include faculty development and faculty appointments at the university for staff, participation in an educational program aligned with the structure of KPs healthcare system, opportunity to train physician workforce who will be competent in systems-based practice and practice-based learning and to recruit future residents and staff, as well as train future doctors who can appreciate and disseminate KP values. This symbiotic LIC clerkship site is expected to be replicated at between UCSF and other local KP medical centers, but can also be exported to other university-community alliances.
FOSTERING TRANSFORMATIVE LEARNING THROUGH ASSIGNED SELF-REFLECTION AND ACTIVE DISCOURSE FOR THE FIRST YEAR MEDICAL STUDENTS. Yelena Averbukh. Montefiore Medical Center, Bronx, NY. (Control ID #1333662)
NEEDS AND OBJECTIVES: Doctors in training have minimal guidance on how to process and learn from emotions during and following clinical encounters. The Transformational Learning Theory holds that the way adult learners interpret and reinterpret their sense experience is, central to making meaning and hence learning (Mezirow, 1991). Our objective was to assess how a first-year medical student curriculum emphasizing self-reflection, paired reflection and active discourse in a small group format enhances trainees communication and professionalism during introductory clinical encounters.
SETTING AND PARTICIPANTS: Introduction to Clinical Medicine course at Albert Einstein College of Medicine in Bronx, NY. Series of fourteen 2.5-hour long precepted clinical encounters in inpatient setting at affiliated tertiary hospital.
DESCRIPTION: Students are divided in 2 groups. The students in the control group have weekly clinical encounters under an individual supervision of a preceptor with focus on standard medical interview technique and skills. The intervention group students are paired and assigned to one preceptor per pair. In addition to standard medical interview course assignments, they complete weekly written free style self-reflection assignments regarding emotions that they experienced during clinical encounters, which are then discussed during following session with their paired partner under preceptor supervision. Preceptors role is to foster transformative learning by assisting learners in becoming aware and critical of their own emotions, assumptions,

beliefs, points of view as well as assumptions of others . Small group discussions enable participants to engage in active discourse while becoming better at recognizing frames of references and alternate perspectives. This experience may facilitate transformational processing of information and actions on behalf of the participants. EVALUATION: By the end of the 14 sessions students in both groups are given anonymous surveys with 1 to 5 Likert scale assessing their comfort level in communicating with certain challenging patients (angry, depressed, psychotic, demented and disruptive) and in certain challenging situations (patient in physical discomfort, unable to provide good history). Students are then asked to read 5 clinical vignettes and choose an answer from a set of multiple-choice questions hypothetically assessing an impact of the intervention on their future professional behavior.

DISCUSSION / REFLECTION / LESSONS LEARNED: The preliminary data in this pilot project indicates a trend for enhanced comfort level in communication and professionalism in the intervention group. It is known that health care providers may fail to connect to patients in physical or emotional distress for a wide variety of reasons. Structured self-reflection and small group discussion of clinical encounters in the pre-clinical years may not only enhance self-assessment capabilities (regarding counter-transference) but may also have an impact on trainee satisfaction, and enhance patient satisfaction. Certainly, formal written processing of trainee emotions may ensure acknowledgement and prevent denial and/or avoidance. Deepening ability to reflect through structured paired discussions may help to identify emotion experienced and enable productive utilization of the current experience while validating the expression of and reflection on emotions experienced in clinical encounters. Finding effective tools and appropriate settings for transformational learning in trainees is of interest to many clinician educators.

IMPACT OF MILESTONES-BASED EVALUATIONS ON AN INTERNAL MEDICINE RESIDENCY PROGRAM

Jaya Raj. St. Joseph's Hospital and Medical Center, Phoenix, AZ. (Control ID #1338725)

NEEDS AND OBJECTIVES: The fair and accurate evaluation of residents presents a big challenge to program directors and faculty. The subjectivity and unreliability of global evaluations and the tendency of faculty to inflate residents ratings limits their value in providing useful feedback to residents. Objectives: 1. To create an evaluation tool which accurately assesses residents achievement of specific, observable milestones 2. To design an evaluation form that empowers faculty to be more specific and candid in their evaluationsSETTING AND PARTICIPANTS: Thiry-five residents and nine key clinical faculty in the St. Josephs Internal Medicine Residency Program participated. The innovation spanned both the inpatient and outpatient setting, but outcomes were measured in the inpatient setting only. DESCRIPTION: In 2008-2009, we revised all our programs goals and objectives and our promotion criteria to correspond to milestones, which we developed shortly before the release of the draft milestones document by the joint ACGME/ABIM task force. The milestones were used to design new faculty, peer, nursing/ancillary staff, and self evaluations, which were implemented in July 2009. We compared the mean and the range of summative scores from faculty evaluations in 2008-2009 versus 2010 in each competency. We also measured the correlation between residents summative scores in medical knowledge and their performance on the ABIM certification exam. In addition, the faculty were asked to

anonymously rate each graduating senior on their ability to provide autonomous care and the likelihood they would engage in lifelong learning. We then measured the correlation between the anonymous faculty ratings and the ratings that the same residents received in their evaluations. EVALUATION: In 2010, compared to 2008-2009, faculty assigned a wider range of scores to residents in all ACGME competencies except Professionalism. This effect was most pronounced for Medical Knowledge (range of 4 in 2010-2011 versus 0 in 2009). There was no statistically significant difference in mean scores. The residents summative scores for Medical Knowledge correlated better with their scores on the ABIM certification exam in 2010 (r=.861, p=.027) compared to 2008-2009 (r=0.579, p=0.038) but did not predict pass/fail. The anonymous ratings of ability to

provide autonomous care correlated with residents global evaluation scores in Medical Knowledge (Pearson correlation .536, p<.05) but not in Patient Care or Overall Competence. The anonymous ratings of lifelong learning correlated with residents scores in Medical Knowledge (Pearson correlation .695, p<.01), Problem Based Learning &Improvement (.625, p<.01), and Overall Competence (.521, p<.05).
DISCUSSION / REFLECTION / LESSONS LEARNED: The new milestones-based evaluations have resulted in small but observable changes in faculty behavior. Faculty are more likely to assign residents a range of scores in each competency, rather than the same score across the board. However, facultys global evaluations do not necessarily reflect their actual perceptions of residents competence or predict their performance on examinations. The milestones may be useful for programs in designing evaluation tools based on entrustable professional activities (EPAs), which encompass the milestones but describe more fully the key activities that physicians must be able to perform. Despite its limitations, the milestones concept is a useful step in moving residency programs toward true competency-based progression.
IMPLEMENTING A LONGITUDINAL INTEGRATED CLERKSHIP (LIC) FOR THE THIRD YEAR AT THE COMMONWEALTH MEDIAL COLLEGE Christian Adonizio; Valerie D. Weber; Janet Townsend; Susan M. Perlis; Maurice Clifton. The Commonwealth Medical College, Scranton, PA. (Control ID #1311299)
NEEDS AND OBJECTIVES: The Commonwealth Medical College (TCMC) is a new (2009) community based, allopathic medical school which provides a distributed model of education with three regional campus hubs over a 16 county region in northeastern and north central Pennsylvania. TCMC sought to design a third year curriculum which would offer opportunities for meaningful longitudinal relationships with patients and faculty and avoid the fragmentation of educational experiences seen in traditional third year hospital based clerkships.
SETTING AND PARTICIPANTS: All third year medical students (63) at The Commonwealth Medical College, a community-based allopathic medical school with three regional campuses, located in both small urban and rural communities.
DESCRIPTION: The longitudinal integrated clerkship (LIC) is a model of third year education where students: 1)participate in the comprehensive care of patients over time; 2) experience continuous learning relationships with faculty; and 3) meet the core clinical competencies across multiple disciplines simultaneously. Students are assigned to six preceptors, one in each of the six core disciplines. Students spend one half day weekly with each preceptor in office-based settings. Three half days of white space allow students to follow patients longitudinally into other care settings (hospital, OR, specialty appointments, etc) and a half day of weekly structured educational sessions round out the curricular experience. In addition, six one week bursts in inpatient Surgery and Medicine allow for concentrated experiences in the hospital setting. Cross-campus comparability is ensured through central oversight and a strong regional educational leadership structure. The success of the model is enhanced by robust faculty development. EVALUATION: Students log all clinical encounters into an e-portfolio. These are reviewed regularly by the educational leadership team to ensure the educational objectives are being met. All students complete OSCEs and take NBME content exams in each of the six disciplines. In addition, faculty evaluations at 30 days, 6 months and end of year are completed along with measures of professionalism such as cultural competency and empathy.
DISCUSSION / REFLECTION / LESSONS LEARNED: Recent reports from the Macy and Carnegie Foundation support the expansion of the longitudinal integrated clerkship as a model that supports longitudinal exposure to patients and faculty, enhances patient-centered attitudes and the maintenance of empathy, while demonstrating equivalent or better outcomes on measures such as written examinations and OSCEs compared with traditional inpatient block clerkships. Yet, no other US medical schools have as of yet expanded this curricular model broadly. TCMC offers a model for expansion of LICs that is generalizable to other US medical schools including best practices for ensuring comparability, monitoring of educational outcomes, and faculty development to support the model.
IMPROVEMENT IN RESIDENT KNOWLEDGE AND CLINICAL SKILL IN KNEE AND SHOULDER EXAMS

AFTER LARGE GROUP TRAINING IN THE CONTINUITY CLINIC SETTING. Frances Norlock1,2; Laura Sadowski1,2; Steve Clar1,2; Ernest Fontecha1,2.
1Stroger Hospital of Cook County, Chicago, IL; 2Rush University, Chicago, IL. (Control ID #1335011)
NEEDS AND OBJECTIVES: Training and proficiency in musculoskeletal examination skills is variable and frequently inadequate during medical school. Residents may be hesitant to diagnose and manage common musculoskeletal problems and refer patients unnecessarily resulting in delay of care. At our institution General Internal Medicine faculty collaborated with physiatrists to develop, implement and evaluate a workshop to internal medicine residents aimed at building their knowledge and clinical skill in the examination of the shoulder and knee joints. SETTING AND PARTICIPANTS: Residents who were not on vacation, an away rotation or in the intensive care units attended the workshop during their ambulatory clinic session (one-half day). We implemented a pilot workshop to residents who had clinic on Monday (n=19). After minor improvements, we implemented the workshop for residents during four clinic sessions, Tuesday through Friday (n=83). The approach in training residents in this material in a large group setting has not been described in the literature before.
DESCRIPTION: The workshop was composed of: 1) two large group interactive didactic sessions including observing the knee and shoulder exam of live model; 2) two small group hands-on sessions for the knee and shoulder exam with live model (4-5 learners per instructor); and 3) small group session to practice aspiration using knee joint models . EVALUATION: Residents completed a 13 item written exam, before and after the workshop to assess their knowledge of the diagnosis and management of common knee and shoulder disorders. Apriori we developed criteria for a passing score (9 of 13 correct), as well as our goal to improve knowledge scores accounting for baseline scores. All PGY1s and PGY3s passed the written exam after the workshop; 5 of the 24 PGYs (79%) passed (p=.005). The knowledge improvement goal was reached in the majority of PGY1s and PGY3s (82% and 80% respectively). Barely half of the PGY2s met our expectations for improvement of knowledge (54%). Improvement in knowledge scores differed by residency levels (PGY1=3.1; PGY2=1.6; PGY3=2.3, p=0.058). Observed structured clinical exams (OSCE) were used to assess the skill of each resident in performing a knee exam at the end of the workshop. General Medicine faculty preceptors observed each resident performing a knee exam on a human model in a patient exam room, and evaluated their technique on 11 skills. The performance score of each skill ranged from 0 to 2 (0=did not perform, 1= partially completed, 2=adequately performed). Apriori we set a passing score to be 11 points out of a maximum of 22 points. The mean OSCE score was 15.5 (range 15.0 (PGY3s) to 15.9 (PGY1s) with no statistical significance between groups (p=0.74). The mean OSCE score did not differ by self-reported previous training in the knee exam; 34 residents reported prior training and had a mean OSCE score of 15.1. PGY1s were most likely to pass the OSCE (95%) followed by PGY2s (88%) and lastly PGY3s (83%).
DISCUSSION / REFLECTION / LESSONS LEARNED: Our workshop succeeded in improving the knowledge and skills of residents. The improvement in knowledge was greatest in the PGY1s and PGY3s. The performance of PGY2s was largely influenced by a few outliers who performed very poorly (> 2 standard deviations below the mean). The

mean OSCE score for the knee exam was of 15.5 (out of 22) and did not differ by residency level or prior training, suggesting that all residents may benefit from this type of workshop training.
IMPROVING WRITTEN SIGNOUTS THROUGH EDUCATION &STRUCTURED AUDIT: THE UPDATED APPROACH Allison DeKosky1; Ananya Gangopadhyaya2; Bobby Chan3; Vineet Arora4. 1UCSF Medical Center, San Francisco, CA; University of Illinois at Chicago Medical Center, Chicago, IL; 3MacNeal Hospital, Berwyn, IL; 4University of Chicago Medical Center, Chicago, IL. (Control ID #1339970)

NEEDS AND OBJECTIVES: The July 2011 ACGME guidelines mandate that residency programs monitor and ensure resident competency in patient handoffs. The guidelines concomitant restrictions on resident duty hours are likely to increase both the volume and complexity of handoffs. The new duty hours will also likely change resident teams structures in ways that will necessitate handoffs to and by bridge or float residents with no prior knowledge or ownership of the patients. This has potential for dangerous errors. In this setting, structured handoffs often become the only continuity for several hours a day. Ensuring proper creation and vigilant maintenance of the written signout is critical in todays environment. Prior curricula to teach adequate signout communication have focused on verbal handoffs, and tools to facilitate teaching, monitoring, and evaluation of written signouts are especially lacking. The aim of this educational innovation was to develop, implement and evaluate an interactive curriculum for use in teaching and evaluating written signouts through evidence-based audits.
SETTING AND PARTICIPANTS: Workshops were held at three Chicago-area teaching hospitals, with 130 4th year medical students and residents using the UPDATED mnemonic to teach signout strategies.
DESCRIPTION: The UPDATED approach emphasizes the importance of the following: Updated administrative data, Prioritized problem list by importance, Diagnoses in the one-liner, Anticipated problems clear, preventing Too much information, Error-prone medications highlighted, and Directions that are clear. The UPDATED mnemonic was also transformed into an audit tool used during the workshop to facilitate peer or self-assessment of the written signouts.
EVALUATION: Almost all participants (95%) felt more confident in creating a written signout, and reported the process of auditing a written signout helpful (93%). The practice behaviors with most commitment to change were to include the diagnosis in the one-line summary (98%), to provide clear and specific directions with anticipated guidance and to-do items (95%), to prioritize the problem list (95%), and to prevent too much information (94%). To preliminarily assess whether this education translated into changes in practice, a random selection of actual signouts from one of the institutions was evaluated by the investigators before and after the workshop. The proportion of signouts rated as Good rose from 13% to 73% [2=35.7, P<0.0001]
DISCUSSION / REFLECTION / LESSONS LEARNED: As residency training programs are now required to ensure competency in the process of handoffs, development of tools with structured teaching and monitoring of signouts has become crucial, particularly given the rapid proliferation of electronic health records combined with multiple daily handoffs. The UPDATED approach is effective in addressing trainees competency in written signout, with an emphasis on the daily synthesis and integration of large amounts of data critical to safe patient care.

INTEGRATION OF MENTAL HEALTH AND PRIMARY CARE SERVICES IN A STUDENT-FACULTY COLLABORATIVE PRIMARY CARE CLINIC: AN APPROACH FOR PSYCHIATRY EDUCATION Chuan-Mei Lee; John Heintz; Janine Knudsen; Oriana Vesga-Lopez; Lazaor Zayas; Mary Lyons Hunter; Derri Shtasel; Marya J. Cohen. MGH, Boston, MA. (Control ID #1334734)
NEEDS AND OBJECTIVES: To demonstrate a model of integrating mental health and primary care services as an innovative approach for psychiatric education.
SETTING AND PARTICIPANTS: The Crimson Care Collaborative (CCC) at Chelsea is a Harvard Medical School student-resident-faculty collaborative clinic located at the Massachusetts General Hospital (MGH) Chelsea community health center. The clinic features co-located, integrative mental health and primary care services and serves two main patient populations: 1) recently incarcerated individuals and 2) patients who have been unable to establish routine primary care and are high utilizers of urgent care services. Harvard medical students are involved with all aspects of the clinic, from clinical care and social services to day-to-day administrative work.
DESCRIPTION: The authors will describe the operational structure of the clinic. Medical student participants will be asked to describe how the co-location of psychiatric and primary care services informed their approach to

patient care.
EVALUATION: The CCC Chelsea clinic offers several learning opportunities in psychiatry with an emphasis on interdisciplinary teamwork: 1) student participation in psychiatric patient care, 2) a case conference co-led by residents from psychiatry and internal medicine, 3) a student-led case-management system that helps patients navigate social service resources available in the community, and 4) student-initiated discussions between psychiatric and primary care teams. Descriptive results of medical students recognition of the effect of co-located psychiatric care will be presented.
DISCUSSION / REFLECTION / LESSONS LEARNED: A student-resident-faculty collaborative clinic provides a unique learning opportunity for exposure to psychiatry in the context of an interdisciplinary care model.
INTERDISCIPLINARY TEACHING SAFE TRANSITIONS CARE BASED SESSION Rachel K. Miller; Eric Goren; Christina R. Whitehouse; Anne Norris; Jennifer S. Myers. University of Pennsylvania, Philadelphia, PA. (Control ID #1339869)
NEEDS AND OBJECTIVES: Transitions of Care, the coordination of discharge care outside the hospital, has been identified as a key element of patient care and critical component of health professions education by nationwide by medical institutions, Joint Commission, and Medical Education Accreditation Commitees. In addition, the AAMC has newly identified Core Competencies for Interprofessional Collaborative Practice. We believed that the introduction of safe care transitions and the interprofessional team model would be ideal on internal medicine intern orientation day. At the end of the session, participants will be able to: 1. Identify the importance of a safe discharge from the hospital 2. Identify the complexities of creating a safe transition of care out of hospital to home or facility. 3. Identify high risk discharge issues 4. Discuss entry criteria and scope of care provided by the potential sites of care for hospital discharge.5. Identify the health professionals involved in facilitating a safe discharge and their respective roles in the process. 6. Describe the interdisciplinary discharge process and value its role in facilitating a safe discharge 7. Describe the importance of communication with patient and family members in care transitionsSETTING AND PARTICIPANTS: During intern orientation day, small group session lasting 40 minutes. Each group had an internal medicine physician-moderator, social worker, clinical pharmacist, and a visiting nurse.
DESCRIPTION: First, during the intern orientation lecture section, a fifteen minute overview of transitions of care was given. This included definition, key concepts, brief introduction to upcoming small group session, and overview of future transitions of care education initiatives during their residency. In the later part of the afternoon, there was a small group session lasting 40 minutes Each group had an internal medicine physician-moderator, social worker, clinical pharmacist, and a visiting nurse. Each group reviewed 2 cases which focused safe discharge from the hospital to home or skilled nursing facility. Each case highlighted the role of the interprofessionals and each discipline was given ample opportunity to provide information for the case, highlight their role, and emphasize key high risk discharge issues.
EVALUATION: An IRB approved survey was given immediately following the session to all the interns using a 5 point Likert scale and

56 evaluations were collected. 24 (42.8%) agreed and 31 (55.3%) strongly agreed that the session enhanced their ability to identify threats to a safe hospital discharge. 33 (58.9%) agreed and 23 (41%) strongly agreed that after attending the session, they feel more confident in their understanding of the roles of other health care professionals who participate in the discharge process. 8 (14.2%) agreed and 48 (85.7%) strongly agreed that they believe that the use of other healthcare professionals (social worker, nurse, etc) to teach this topic was effective.
DISCUSSION / REFLECTION / LESSONS LEARNED: This inter-professional case-based discussion on teaching safe transitions demonstrated an overall increased confidence in knowledge of discharge transitions, ability to identify threats to a safe hospital discharge, roles of other healthcare professionals in discharge

process, and the role of physician in discharge transition. Future directions include expanding this session and further enhancing transitions of care curriculum throughout the entirety of internal medicine residency.
INTERPROFESSIONAL TEAM-BASED LEARNING AMONG PRIMARY CARE TRAINEES Bennett Lee; Brigitte L. Sicat; Bruce Rybarczyk; Benjamin D. Lord. Virginia Commonwealth University, Richmond, VA. (Control ID #1326921)
NEEDS AND OBJECTIVES: Internal medicine residents, pharmacy residents, and psychology doctoral trainees routinely co-manage patients in our academic medical center primary care clinic. The management provided, however, is multidisciplinary versus interdisciplinary. Last year, the authors developed three Interprofessional Education (IPE) Team-Based Learning (TBL) modules whereby learners could learn with, from, and about each other. Objectives: 1. to educate primary care trainees from different professions about the expertise of each discipline 2. To foster interdiscplinary collaboration among primary care trainees 3. To educate trainees on topics commonly seen in a primary careSETTING AND PARTICIPANTS: Academic Medical Center 2 hour conference sessions Participants: Psychology doctoral students Pharmacy residents Internal medicine residents Pastoral care trainees one session DESCRIPTION: Three 2-hour IPE TBL modules were designed to promote a belief in the importance and effectiveness of interdisciplinary team work as well as application of content knowledge in the following areas: (1) Introduction to the Professions/Motivational Interviewing, (2) Depression, and (3) Non-Cancer Pain. The modules (learning objectives, readiness assessment tests, cases, and case discussion points) were developed collaboratively by an interdisciplinary faculty team. During each 2-hour learning session, learners were placed in teams of 7-9 members with each discipline represented on the teams. Interdisciplinary faculty team served as facilitators. Surveys were administered to participants after each TBL module to evaluate their perceptions of achievement of learning objectives and of learning gains from participating in the module. The Attitudes Toward Health Care Teams Scale was administered to evaluate their attitudes toward health care teams at baseline and after the second and third TBL modules.
EVALUATION: Each module had ~70 attendees and an average of 51 participants completed the survey each session (63% medical residents, 17% clinical psychology doctoral trainees, 15% pharmacy residents, and 4% chaplains; 35% male, 65% female). In an anonymous survey of the trainees in attendance, there was a uniform report of moderate gain to good gain (2 and 3 on a 5-point scale ranging from 0=no gain to 4=great gain) on the learning objectives. Disciplines were generally similar in their ratings. The TBL components were also rated in terms of how much help they provided in meeting the learning objectives. On a 0-4 scale (0=no help, 1=a little help, 2=moderate help, 3=much help, and 4=great help) the results were as follows: individual readiness assurance test=2.4, team readiness assurance test=2.7, case-based discussion within the team=3.3, and case-based discussion with the full group=3.2. Additionally, the Attitudes Toward Health Care Teams Scale showed that there was significant positive change toward viewing teams as more efficient after participating in the first two TBL modules. This change was evident in all three main participant groups (medical residents, pharmacy residents, and psychology doctoral trainees)
DISCUSSION / REFLECTION / LESSONS LEARNED: The IPE TBL sessions appear to be an effective format for teaching interdisciplinary communication as well as a belief in the importance and effectiveness of interdisciplinary team work. Additionally, it appears to serve as an effective tool for applying current clinical knowledge in areas where interdisciplinary work is beneficial in primary care.
INTERPROFESSIONAL PHYSICIAN-NURSE TEAM TRAINING USING A STANDARDIZED CLINICAL ENCOUNTER INVOLVING THEATER STUDENTS. Tabassum Salam1; Robert Dressler1; Ann Marie Baker4; Susan C. Zern5; Michelle Collins4; Amy Cowperthwait3; Allan Carlsen2. 1Christiana Care Health System, Newark, DE; 2University of Delaware, Newark, DE; 3University of Delaware, Newark, DE; 4Christiana Care Health System, Newark, DE; 5Christiana Care Health System, Newark, DE. (Control ID #1331618)
NEEDS AND OBJECTIVES: In order to facilitate the delivery of excellent patient care, it is imperative that physician-nurse teams work in a collaborative manner. We wanted to create a forum for the joint training of

physician-nurse teams in order to allow them to use their training and skills in a complementary and collaborative fashion. This educational program was designed to allow resident physicians and novice nurses to work together to care for a simulated inpatient in crisis. It also allowed the physician-nurse team to work with a live standardized patient, so that they could also practice collaborative verbal and non-verbal communication with the patient.
SETTING AND PARTICIPANTS: The venue was the Virtual Education and Simulation Center at Christiana Care Health System, in a facsimile of a full equipped inpatient hospital room, [including equipment to assess vital signs, a sham electronic medical record, computerized order entry, medication cart]. Undergraduate students from the Theater Department of the University of Delaware were trained to portray inpatients in active alcohol withdrawal. Each learner team was comprised of an Internal Medicine resident physician and a novice nurse from the nurse training program. A pair of nursing and physician educators jointly facilitated debriefing sessions with the pair of learners at the end of the bedside encounter.
DESCRIPTION: The nurse learner was given verbal signout on the patient, and initiated the encounter with a bedside assessment of the patient. Thereafter, she could page the physician learner to the patients bedside. The physician-nurse team was expected to communicate verbally and nonverbally with the patient, communicate and collaborate with each other, recognize the symptoms of alcohol withdrawal, and formulate a treatment plan. After the 10 minute bedside scenario, physician and nursing educators facilitated a joint debriefing session for each pair of physician-nurse learners.
EVALUATION: 3 variables were measured. Improvements were seen across all variables after the adaptive clinical encounter. These were: Confidence in ability to identify alcohol withdrawal [44% of participants pre-encounter to 94% of participants post-encounter], Comfort level with the CIWA protocol [41% of participants pre-encounter to 72% of participants post-encounter], Ability to communicate with team members [55% of participants pre-encounter to 81% of participants post-encounter]. DISCUSSION / REFLECTION / LESSONS LEARNED: Resident physicians and novice nurses are often thrown into stressful situations with complex inpatients. This training method will help them develop the skills needed to communicate with their clinical partner, collaborate with each other and come up with a workable treatment plan. Todays resident physicians get a lot of exposure to learning through simulation. However, our residents commented that their experiences in team-training in the past had involved a mannequin, and not a live patient. They felt that the ability to practice verbal and non-verbal communication with the patient, in collaboration with their nurse partner, was a novel experience. Overwhelmingly, the learners felt the experience was exceptionally valuable for its authenticity. The education plan was implemented in fall of 2011 as a pilot, with the intent to expand the program in 2012. Other clinical scenarios under development include the management of an inpatient with delirium, communicating bad news to patients, and educating patients about their medications at time of discharge.

LACHMANS AND JOBES AYEAR LATER: A MUSCULOSKELETAL WORKSHOP FOR INTERNAL MEDICINE RESIDENTS AIMED AT RETAINING CONFIDENCE, KNOWLEDGE, AND SKILLS Darlene LeFrancois; Sharon Leung; Cindy Sadikot. Montefiore Medical Center and Albert Einstein College of Medicine, Bronx, NY. (Control ID #1315199)
NEEDS AND OBJECTIVES: Musculoskeletal complaints are some of the most common reasons for primary care visits, yet most Internal Medicine (IM) residents do not feel confident or skilled in their ability to diagnose and treat these complaints. A primary care providers ability to examine and diagnose musculoskeletal complaints can promote cost effective care and contribute to patient and provider satisfaction. The aim of our project is to institute and assess the immediate and 1 year effectiveness of a musculoskeletal workshop on IM residents confidence, knowledge, and skills in the examination and diagnosis of common shoulder and knee

complaints.
SETTING AND PARTICIPANTS: Montefiore Medical Centers categorical residency program in IM is located in the Bronx, New York City amongst a large underserved poor urban population. The musculoskeletal workshop was delivered to our PGY2 residents during their ambulatory care rotation (ACR).
DESCRIPTION: The one hour workshop consisted of a didactic powerpoint presentation of shoulder and knee anatomy, pathology, and examination techniques followed by demonstration of exams and specific maneuvers. Housestaff then paired and practiced supervised exams until they were able to complete them correctly. Before, immediately after, and 1 year post workshop the residents completed a 4 item Likert confidence scale from 1 (strongly disagree) to 5 (strongly agree) and 8 multiple-choice case-based knowledge questions on the evaluation of common knee and shoulder complaints. A standardized case-based shoulder (8 items) and knee (9 items) examination checklist was used to measure resident observed performance at 1 year. The checklist was based on the American College of Physicians Musculoskeleletal Examination Clinical Skills Series and each item was scored as not completed, partially completed, or completed correctly. EVALUATION: All 45 housestaff (100%) who rotated on the 7 ACR months from June 2010 to June 2011 attended the workshop (range 4 to 8 subjects/month). After the workshop confidence was significantly improved in diagnosing and examining common shoulder and knee complaints ($p<0.001$). For the knowledge score, the median percent answered correctly for the shoulder and knee questions pre- and post-workshop was 48% and 70%, and 52% and 81% respectively ($p<0.001$). Of the 9 residents who have currently met the 1 year post workshop mark knowledge scores did not decline from the immediate post workshop scores but only 18% and 19% of all shoulder and knee checklist items respectively were completed correctly. The remaining approximate 80% of musculoskeletal exam checklist items were either not completed or only partially completed. DISCUSSION / REFLECTION / LESSONS LEARNED: While both confidence and knowledge improved as a result of an intensive musculoskeletal workshop intervention, observed resident examination skills at 1 year were poor in this pilot study. As such, a current study is underway that randomizes half the ACR residents to receive subspecialty ambulatory clinic training in both orthopedic and rehabilitative medicine in addition to the musculoskeletal workshop intervention that all residents will continue to receive. Confidence, knowledge, and musculoskeletal exam performance will be assessed by blinded observers against the standardized checklist at baseline, immediate post intervention, and on 1 year follow up. Retention of housestaff musculoskeletal examination skills is preferable to isolated confidence and knowledge improvements as an outcome measure of teaching effectiveness.

LEARNING SYSTEMS-BASED PRACTICE IN STUDENT-RUN CLINICS Cindy Lai3; Leslie Sheu1; Bridget O'Brien2,3; Patricia S. O'Sullivan2,3; Austin Kwong4. 1University of California, San Francisco, San Francisco, CA; 2University of California, San Francisco, San Francisco, CA; 3University of California, San Francisco, San Francisco, CA;
4University of California, Berkeley, Berkeley, CA. (Control ID #1333952)

NEEDS AND OBJECTIVES: In undergraduate medical education (UGME), the competency of systems-based practice (SBP) is often
considered the most difficult to teach and assess, particularly in preclerkship years. Student-run clinics (SRCs), most of which provide care for the underserved and have limited operating budgets, exist at many medical schools and offer potential opportunities for pre-clerkship students to gain meaningful exposure to SBP. To explore ways of linking SRCs with our schools formal curriculum and competency-based assessment system, we identified domains of SBP in students SRC experiences and mapped them to specific SBP milestones.
SETTING AND PARTICIPANTS: Four SRCs exist at our institution. Each SRC provides a variety of services to distinct underserved communities in San Francisco. Over 70% of first-year medical students voluntarily participate in one or more SRCs, and approximately 20% of second years volunteer as SRC coordinators.
DESCRIPTION: We interviewed a convenience sample of current and past student coordinators and faculty

advisors for our initial evaluation. Interviewees responded to a semi-structured set of questions on non-coordinator and coordinator roles, clinic operations, and personal reflections. Through an iterative consensus building process, we generated a list of themes on student engagement in SBP.
EVALUATION: Thirteen student coordinators and 4 faculty advisors participated. Preliminary thematic analysis revealed five major domains of SBP common to all coordinators SRC experiences: interdisciplinary patient care (roles and collaboration), resource acquisition and allocation, navigation of the healthcare system (access to care, community partnerships, insurance, referrals, follow-up processes), clinic organization (leadership and faculty roles, training of volunteers, clinic flow), and quality improvement (patient care, clinic operations, volunteer satisfaction). When asked whether SBP experiences in SRCs differed from SBP education in the formal curriculum, students and faculty unanimously agreed that engaging in SBP in SRCs significantly enhanced what they learned in the formal curriculum. When asked about their depth of understanding of SBP compared to non-coordinator volunteers, most coordinators and faculty felt that they had a deeper understanding of SBP, but expressed mixed opinions as to whether this was because of specific coordinator roles, or increased frequency of volunteering which allowed greater exposure to systems issues.
DISCUSSION / REFLECTION / LESSONS LEARNED: SRC coordinators at our institution have substantial exposure to and participate actively in SBP. Domains that emerged from our analysis paralleled those postulated in a previous article, with two key differences: 1. clinic operations was not outlined previously, and 2. quality improvement better captures our participants experiences than quality care, which focuses primarily on individual patient outcomes. Our findings provide insight into developmentally appropriate SBP milestones for UGME, and will help guide assessment plans for student achievement of these milestones. One limitation of our preliminary analysis is that student interviewees were coordinators, and thus may not reflect experiences of non-coordinator volunteers. The next phase will assess whether intensity of participation impacts the degree to which students learn about and engage in SBP through interviews with non-coordinator volunteers.
MAKING THE MOST OF 1/3 AMBULATORY Kerri L. Palamara; Hasan Bazari; Eva Chittenden; Tanya Milosh; Beverly M. Biller. Massachusetts General Hospital, Boston, MA. (Control ID #1310405)
NEEDS AND OBJECTIVES: : In exploring three core ACGME requirements (1) that all residents must have exposure to and demonstrate the ability to manage patients in each of the medical subspecialties, (2) the program must identify a Subspecialty Education Coordinator (SEC) in each subspecialty, (3) there must be a minimum of 1/3 ambulatory time, the program sought to use this opportunity to improve outpatient subspecialty experiences. Through program evaluation and resident feedback, we identified variability in our existing subspecialty ambulatory experiences and a perceived need to increase the academic rigor of these rotations to ensure that residents achieved the appropriate level of competence related to each subspecialty by the end of their training. Therefore, the residency program set a goal of creating subspecialty rotations with uniform standards and expectations that promoted a high level of rigor and learning. A secondary aim was to create a community

of subspecialty educators who could share best practices, problem solve around challenges, and be academically productive as a group.
SETTING AND PARTICIPANTS: The setting is the MGH Department of Medicine and its subspecialty divisions. Participants include Residency Program Administration, SECs, Subspecialty Faculty and MGH Housestaff.
DESCRIPTION: MGH restructured its ambulatory training paradigm with the specific aim of making outpatient rotations as rigorous as inpatient rotations. The elements of a rigorous rotation were defined and a Subspecialty Education Task Force formed to develop goals, strategies and an infrastructure to support high quality education in the ambulatory subspecialty setting. SECs were appointed, funded, and assumed responsibility for the development and coordination of 2-week ambulatory rotations, overseeing the overall curriculum in their subspecialty, and for mentoring residents interested in their field. SECs met monthly and agreed on mandatory

rotation components. Rotation goals and objectives, schedules, curricula and readings are posted in standardized format on the residency intranet site. The SEC committee collaborated to design standardized rotation evaluation forms, patient logs, and resident evaluation forms to be completed by faculty. At the end of the first year, each SEC met individually with the co-chairs of the SEC Committee to review resident feedback and to plan improvements based on the feedback. EVALUATION: Based on end of year and rotation evaluations, resident satisfaction with their ambulatory experiences increased with the above described innovation. Resident attendance during ambulatory rotations significantly improved with clarification of rotation objectives and expectations and with increased involvement and presence of the SECs. The secondary goal of the Subspecialty Education Task Force to develop a faculty community was also achieved through monthly meetings to collaborate and share common challenges.
DISCUSSION / REFLECTION / LESSONS LEARNED: The model of a community of SECs working closely together with the Program Director to design, implement and evaluate rigorous outpatient rotations is likely of interest to many medicine programs struggling to create meaningful outpatient experiences. This educational model is improving the quality of outpatient education and can be applied to community and university institutions alike. Next steps will include developing or adopting online curriculum modules and offering faculty development opportunities for the ambulatory subspecialty faculty.
MEDICINE, POLICY AND PUBLIC LEADERSHIP: THE NEXT PARADIGM FOR PRIMARY CARE EDUCATION? Ali Khan2,1;
Theodore Long2,1; Rebecca Brienza1,2. 1VA Connecticut Healthcare System, West Haven, CT; 2Yale University School of Medicine, New Haven, CT. (Control ID #1338487)
NEEDS AND OBJECTIVES: Increased attention has been placed in recent years on the need for greater integration of health policy and team-based improvement in medical education. Inclusion of training in health policy and leadership in medical education, however, remains infrequent. Existing curricula overwhelmingly emphasize either the international or private sector, thereby neglecting trainees' potential for leadership in public service. As part of the VACHS Center of Excellence (CoE) in Primary Care Education, we have developed an innovative curriculum focusing on health policy and public leadership. Our curriculum emphasizes grounding in translational health policy - with a focus on the skill set necessary to succeed as agents of change. Objectives: 1) to teach trainees the core concepts, history of and current trends in domestic health policy, health economics, health care delivery systems and health law; 2) to teach trainees the core skills, principles and applications of public leadership, organizational strategy, political analysis, media relations, advocacy and community organizing while promoting application of these concepts in everyday practice; 3) to determine if longitudinal retention of content and skills can be enhanced through a mix of didactic and experiential components.
SETTING AND PARTICIPANTS: Internal medicine residents and nurse practitioner fellows (n=9) participating in the VACHS Center of Excellence in Primary Care Education.
DESCRIPTION: Our curriculum, (MedLEAD: Medical Leadership, Economics And Domestic Policy) is learner-designed and taught by senior internal medicine residents. The program focuses on domestic health policy, leadership and public sector engagement. It is structured around three primary domains: Diagnosis, Prescription for Change, and Public Leadership. The MedLEAD curriculum is based on four guiding principles: scalability, portability, return on investment maximization and value creation. The curriculum minimizes diversion of faculty FTEs, integrates didactics, case-based learning, simulation, audience response and other adult learning techniques.
EVALUATION: To date, the model has been piloted on the first group of trainees (n=9) participating in the VACHS CoE in Primary Care Education. We are evaluating the impact of MedLEAD training on trainee knowledge and attitudes. Preliminary data indicate that trainees: 1) have greater knowledge of core health policy and leadership concepts; 2) feel more comfortable with application of those concepts in clinical practice;

3) feel the learner-driven model offers greater engagement with course material; 4) have greater interest in effecting cultural, structural or policy change.
DISCUSSION / REFLECTION / LESSONS LEARNED: We believe MedLEAD's public sector focus, learner-driven design and implementation and inter-professional application represents an innovative curricular model in medical education. The survey instrument includes assessment of confidence in newly acquired knowledge - and, uniquely, the application of those concepts in everyday practice. Given that existing health policy/ leadership curricula overwhelmingly emphasize international and/or private sector action, MedLEAD's focus on domestic public sector engagement represents a portable and scalable model for training in medicine and public service. Future work will explore how best to 1) measure application of core policy and leadership content; 2) how best to ensure curricular sustainability in a learner-driven model.
MUTUAL LEARNING THROUGH COMMUNITY COLLABORATION Joslyn Fisher; Cara Foldes; Achilia Morrow. Baylor College of Medicine, Houston, TX. (Control ID #1340114)
NEEDS AND OBJECTIVES: Although physicians often are called upon to participate in community activities such as health education presentations to local community organizations, most medical school and residency curricula do not emphasize the skills needed to facilitate responsible community involvement for our future physician leaders. Upon completion of the Internal Medicine Womens Health Elective, internal medicine residents will (1) demonstrate the ability to design and implement a health presentation for a lay community audience and (2) develop increased confidence in speaking to the public (community). A separate, yet related objective for the curriculum anticipates that community members will find the presentations to be beneficial.
SETTING AND PARTICIPANTS: As a component of a womens health elective, one internal medicine resident each month gives an oral presentation to women living in a shelter for survivors of domestic violence.
DESCRIPTION: Each month, one senior level internal medicine resident rotates on the womens health elective, during which, the resident visits various relevant clinics at our public hospital. The residents have time built in the month-long schedule to develop a short 20-30 minute oral (non-electronic) presentation on a womens health topic of their choice. The presentation outline is reviewed for content, accuracy, and interactivity by the elective faculty prior to actual implementation. The resident presents his or her discussion at the end of the month at the womens shelter and allows time for the shelter clients to ask questions.
EVALUATION: Quantitative and qualitative assessments are obtained from medicine residents. Verbal feedback is sought from shelter clients via the shelter director. Approximately 15 medicine residents have completed the rotation since the initiation of the collaboration. Between five and twenty different shelter clients attend each months resident-led health presentation. Evaluations indicate that (1) shelter clients and residents enthusiasm for the program is high and (2) medicine residents gain confidence in their ability to present publicly. While over half of the

residents responding to course evaluation are not planning on practicing outpatient primary care (nor will they specialize in womens health), they all felt it was important or very important for physicians to give health presentations to the community. All residents (37%) who had never given a previous presentation to a lay audience gained confidence in their ability to do a presentation in public. Consistently, the medicine residents noted that prior to the presentation, they felt nervous and uncertain of what to expect. After the presentation, the residents noted positive feelings and made comments about the experience, such as really rewarding and felt it really made a difference. Shelter clients found the presentations to be informativeDISCUSSION / REFLECTION / LESSONS LEARNED: To ensure the sustainability of this community collaboration, the presentation sessions must be built into the residentsschedule. The medicine residents recommend making the presentations simple, involving the audience, and focusing on practical aspects of health and healthcare. This community-oriented

program is a model for resident advocacy that can be replicated at relatively low cost and high yield at other medical schools and residency programs.

NEW LIFESTYLE: A WEB-BASED TEACHING AND LEARNING PROGRAM FOR NUTRITION, EXERCISE, AND WEIGHT MANAGEMENT David P. Miller1; Sonia Crandall2; Mara Z. Vitolins3; Stephen Davis2; Donna Kronner4; Edward Ip4; Karen Vaden2; John Spangler2. 1Wake Forest School of Medicine, Winston-Salem, NC; 2Wake Forest School of Medicine, Winston-Salem, NC; 3Wake Forest School of Medicine, Winston-Salem, NC; 4Wake Forest School of Medicine, Winston-Salem, NC. (Control ID #1337442)

NEEDS AND OBJECTIVES: Obesity is the second leading cause of preventable death in the US. Guidelines from the Association of American Medical Colleges urge medical schools to develop curricula on obesity, including its epidemiology, harms, and treatment.

SETTING AND PARTICIPANTS: A team of interdisciplinary faculty at Wake Forest School of Medicine (WFSM) developed NEW Lifestyle (Nutrition, Exercise and Weight management), a comprehensive web-based program to educate all medical students about weight management issues. More detailed learning objectives may be viewed at the curriculums website (listed below) which is available for use online at no cost. DESCRIPTION: Funded by grants from the National Cancer Institute, NEW Lifestyle consists of 8 self-contained web-based educational modules, all of which have pre- and post-quizzes. The modules cover obesity related topics including: 1) Epidemiology, 2) Cancer Risk, 3) Adverse Health Effects, 4) Energy Balance, 5) Factors Affecting BMI, 6) Counseling Skills, 7) Bias and Stigmatization, and 8) Obesity Treatment Guidelines. Unique to this program are its emphasis on confronting anti-obesity bias among providers, training medical students in culturally sensitive weight management counseling, and emphasizing the connection between obesity, inactivity, and cancer risk. Each module requires 10-15 minutes to complete. The web site resides in the public domain, allowing learners to complete the modules anytime. At WFSM, the modules were embedded into the basic science and clinical clerkship core curricula beginning with the Class of 2012.

EVALUATION: The WFSM Class of 2012 (n=116) was the first class to receive the full curriculum. Across all modules, average pre-quiz scores ranged from 47% - 80%. Overall, the percent correct increased on the post-quizzes by a mean of 28% (range 5.4% - 43%, $p<0.01$ for all comparisons). After the curriculum was completed, all students were evaluated on an encounter with an obese standardized patient (SP) who complained of inability to lose weight. Students were not aware they were being evaluated on their obesity management skills. We compared the performance on the SP encounter for the Class of 2012 (full curriculum) to the Class of 2011 (no curriculum). Students who received the curriculum more often took a dieting history (85% vs. 53%, $p<0.0001$), asked about normal eating habits (87% vs. 78%, $p=0.08$), suggested an exercise plan (91% vs. 83%, $p=0.08$), advised patients not to skip meals (84% vs. 70%, $p=0.01$), and expressed empathy about weight struggles (89% vs. 80%, $p=0.07$). In contrast, students who did not receive the curriculum were more likely to investigate medical issues, e.g., hypothyroidism (45% vs. 14%, $p<0.0001$), sleep disturbances or snoring (15% vs. 3%, $p<0.01$), and family history of weight disorders (35% vs 16%, $p<0.001$). Non-curriculum students also were more likely to stress the need for medical follow-up (56% vs. 18%, $p<0.0001$), and obesitys negative health effects (62% vs. 21%, $p<0.0001$).

DISCUSSION / REFLECTION / LESSONS LEARNED: Focus groups with students provided essential input for designing the web modules to match students learning styles. Courses that offered extra credit for module completion had higher participation rates (80%) than those in which the modules were less emphasized (43%). Therefore, we suggest requiring students to email their post-test scores to course directors. Overall, the web-based program enhanced students obesity management skills, making NEW Lifestyle a valuable addition to medical schools curricula.

ONLINE RESOURCE URL (OPTIONAL): http://www.NEWLifestyle.org

Web End =www.NEWLifestyle.org

PILOT OF A RESIDENT CURRICULUM IN TEAM-BASED CARE AND PANEL MANAGEMENT Nivedita

Ghosh2; Jessica L. O'Brien1; Charles A. Morris2; Lori Tishler2; Rebecca J. Cunningham2. 1Harvard Medical School, Boston, MA; 2Brigham and Women's Hospital, Boston, MA. (Control ID #1334880)
NEEDS AND OBJECTIVES: Increasingly, primary care practices are turning to team-based models of care, such as the patient centered medical home (PCMH), to meet patient needs and performance targets. Most medical resident clinics, however, function in more traditional models of primary care, leaving trainees ill-prepared for modern practice. To address this training gap, we piloted a curriculum that aimed to: 1. Expose trainees to new and evolving care delivery models. 2. Increase trainees knowledge of the skills and scope of practice of ambulatory care team members. 3. Teach trainees social work, nutrition, and clinical pharmacy pearls to use in their own practices. 4. Introduce the concept of panel management and provide each resident with personal panel data to encourage population-level thinking and problem-solving.
SETTING AND PARTICIPANTS: Junior internal medicine residents (n=18) rotated through a two-week ambulatory block, spending time at Brigham and Womens Advanced Primary Care Associates, a new PCMH practice.
DESCRIPTION: Through group workshops and direct patient care experiences, key non-physician health professionals educated residents about their scope of practice, role in the care team, and unique skills. In addition to group didactics and take-home exercises, residents spent one half-day each with a clinical social worker, clinical pharmacist, and nutritionist, who taught and modeled skills that residents can implement in their own practices. Finally, residents were provided diabetic and hypertension quality metrics from their own patient panels and were expected to devise a plan to systematically assist patients not meeting treatment goals. Development of this plan necessitated that residents learn how to better utilize resources within their own clinics and begin to conceptualize patient care beyond the individual. Rotation feedback was regularly elicited through quantitative and qualitative surveys. Overall, residents felt that the group workshops and individual sessions with non-physician health care workers were valuable. The most common suggestions for curriculum improvement were to schedule more patient visits during the half-day sessions and include more panel data.
EVALUATION: To measure the educational impact of the pilot rotation, a 26-item survey was developed to assess changes in residents self-reported knowledge and skills on aspects of primary care. Questions used a 5-point Likert scale to indicate the extent to which residents agreed or disagreed with statements. Comparing responses to the pre- and post-rotation survey, there were statistically significant increases in residents self-reported knowledge of new models of care, panel management concepts, and the roles and skills of social workers, pharmacists, and nutritionists ($p<.001$). Of note, all differences were greater than 1.3 points on the scale. A similar increase was reported for confidence in responding to domestic violence and using diabetic equipment ($p<.02$); there was also an increase in comfort in dietary counseling and engaging patients in their own health-care. However, residents reported no significant difference in their confidence in implementing systems-based solutions ($p=.07$). DISCUSSION / REFLECTION / LESSONS LEARNED: A brief, easily adaptable curriculum had a significant impact on resident knowledge

and attitudes towards interdisciplinary care and shows promise for higher utilization of health care teams. Having multiple clinic sites remains a challenge to providing uniform panel data and information on local resources.
PRIMARY CARE REDESIGN - A NOVEL RESIDENCY ELECTIVE Carol K. Bates; Kelly Graham; Bruce E. Landon. Beth Israel Deaconess Medical Center, Boston, MA. (Control ID #1334522)
NEEDS AND OBJECTIVES: Most resident continuity practices are not patient-centered medical homes. We developed a two-week elective rotation to immerse residents into PCMH concepts with the goal of encouraging residents to consider primary care careers by exposing them to opportunities in primary care innovation and leadership.
SETTING AND PARTICIPANTS: The elective was developed for Internal Medicine Residents at Beth Israel

Deaconess Medical Center, in Boston, MA. Participants were selected based on expressed interest in an annual survey used by the residency program to assign elective rotations. Three groups of 4-6 residents have completed the elective during academic years 2010-2011 and 2011-2012, 12 of 16 were in the Primary Care Track. Residents visited multiple innovative practice settings in the Boston metropolitan area, and completed an innovation project at HealthCare Associates, our hospital-based primary care practice site. DESCRIPTION: The course includes background reading, meetings with local leaders in primary care redesign, and exposure to a group visit. In addition, each group of residents completes a practice redesign project focused upon improving a specific aspect of care delivery or the resident experience in Healthcare Associates (HCA), our hospital-based primary care practice, and presents their plan to practice and hospital leadership as the culminating activity of the elective. Resident schedules are weighted with visits and meetings in week one and are relatively unscheduled in week two to allow for group project work. All residents visited core practice sites; individual groups met with additional resources based upon their projects. The three projects to date included a feasibility analysis of providing servies on Saturdays, a work plan for a new administrative support position for residents, and an analysis of the highest cost patients covered under a risk contract.
EVALUATION: Feedback has been obtained through an anonymous web-based survey. Ten of 16 residents were probably or definitely planning careers in primary care both before and after the elective, though 87% did feel that the elective experience increased their interest in primary care practice. Approximately 2/3 of residents thought they would have a role in practice management in their futures both before and after the elective. The degree to which residents agreed that new approaches to care delivery would improve physician work life did not change significantly. After the elective, residents felt better prepared for practicing cost effective medicine, participating in quality improvement activities, population management, and practicing in managed care settings. Residents reported their knowledge as improved in the realms of financial management, physician compensation, productivity measures, customer service, national healthcare organization, and management of our practice. 80% would definitely recommend this elective to others.
DISCUSSION / REFLECTION / LESSONS LEARNED: Feedback has been obtained through an anonymous web-based survey. Ten of 16 residents were probably or definitely planning careers in primary care both before and after the elective, though 87% did feel that the elective experience increased their interest in primary care practice. Approximately 2/3 of residents thought they would have a role in practice management in their futures both before and after the elective. The degree to which residents agreed that new approaches to care delivery would improve physician work life did not change significantly. After the elective, residents felt better prepared for practicing cost effective medicine, participating in quality improvement activities, population management, and practicing in managed care settings. Residents reported their knowledge as improved in the realms of financial management, physician compensation, productivity measures, customer service, national healthcare organization, and management of our practice. 80% would definitely recommend this elective to others.
SENIOR PRECEPTORSHIP IN CLINICAL TEACHING: A LONGITUDINAL EXPERIENTIAL AND DIDACTIC TEACHING IMPROVEMENT PROGRAM FOR MEDICAL STUDENTS William Kormos1,3; Pamela Vohra-Khullar2,3. 1Massachusetts General Hospital, Boston, MA; 2Beth Israel Deaconess Medical Center, Boston, MA;
3Harvard Medical School, Boston, MA. (Control ID #1339985)
NEEDS AND OBJECTIVES: Many training programs recognize the importance of training residents to be more effective teachers. However, fourth-year students are eager to learn these skills in anticipation of residency, and possess the knowledge and skills to assist more junior students. Although fourth year students are often used as teaching assistants in the basic science curriculum, and electives may be offered in clinical teaching skills, few medical schools have courses that combine the pedagogy of clinical teaching with a longitudinal experience in clinical teaching. The objectives of this course are: 1) To develop an approach to clinical teaching 2) To improve physical examination skills by teaching others 3) To understand future teaching roles in medicine.

SETTING AND PARTICIPANTS: This program is an elective rotation for fourth-year medical students, who serve as peer tutors to second year students over a six month period. Tutors are assigned to a hospital site affiliated with the second year physical examination course, and meet with second year students during afternoon sessions. This experiential learning is combined with a nine session curriculum in clinical teaching skills. DESCRIPTION: The Senior Preceptorship in Clinical Teaching enrolls 40-60 4th year students (tutors) each year. The longitudinal design of the course allows tutors to gain experience in clinical teaching and reflect on their own performance. Nine two-hour workshops are provided throughout the course. The initial sessions focus on clinical teaching basics: adult learning theory, feedback, use of questions, and methods for teaching psychomotor skills. The middle sessions focus on physical exam skills, and the final sessions provide opportunities to apply lessons learned to teaching during residency and beyond. These sessions rely on active learning through role playing, small group teaching, and peer feedback. The experiential part of the course allows students to gain personal teaching experience and to observe faculty preceptors. Tutors provide direct observation and feedback to 2nd year students, participate in small group teaching, and serve as OSCE faculty.

EVALUATION: Pre- and post-course surveys were electronically administered to tutors. Assessment data is provided with the most recent two years available (n=69). Tutors valued the course highly (4.51 on a 5 point scale), and 92% agreed that they would take the course again if offered the opportunity. 87% of 4th year students reported the course increased their comfort as teachers. Students reported a significant increase ($p<0.01$) in confidence in giving feedback (3.83 vs. 4.19) and bedside teaching(3.31 vs.4.04). Tutors valued the opportunity to mentor second year students and to review the physical exam. They identified scheduling conflicts with residency interviews and other rotations as the top barrier to effectively integrating into the course.

DISCUSSION / REFLECTION / LESSONS LEARNED: Our course provides 4th year medical students with a meaningful experience in clinical teaching coupled with didactic instruction. Students are eager to learn about effective teaching strategies and have a wealth of learning experience on which to reflect. Fourth year students are an invaluable part of our physical examination course, and provide a role that complements the teaching faculty. Challenges focus on time constraints due to clinical responsibilities of fourth year students. In addition, the large number of hospital sites and locations used by the tutors makes direct observation of their teaching difficult.

SHOW ME THE MONEY: IMPLEMENTATION OF A UNIQUE COST AWARENESS CURRICULUM FOR MEDICAL RESIDENTS Christopher Moriates; Krishan Soni; Andrew Lai. University of California, San Francisco (UCSF), San Francisco, CA. (Control ID #1318294)

NEEDS AND OBJECTIVES: Approximately $700B of annual health-care spending is wasted, with physicians directly influencing 87% of this expenditure. Medical training has emphasized quality improvement but

few programs are addressing the ACGME requirement that physicians-in-training now incorporate considerations of cost awareness into practice. Our objective was to develop an inpatient curriculum to promote cost awareness, highlight current clinical guidelines, improve physician attitudes towards cost control, and cultivate more cost-effective physician ordering behaviors.

SETTING AND PARTICIPANTS: Medical students, internal medicine residents, and attending physicians at a university-based academic medical center.

DESCRIPTION: We first reviewed the literature on strategies addressing discrepancies between physicians desired and actual knowledge of health care costs. The most valued educational strategy for residents has been case-based conferences. We selected 12 core topics of commonly encountered internal medicine clinical

scenarios with frequent practice and resource-utilization variability, including chest pain, syncope, pulmonary embolism, and low back pain. We created a longitudinal curriculum involving all PGY1 residents, as well as a monthly case-based conference for on-service medical students, residents, and attendings. Each month five PGY1 residents participated in a one-hour introductory cost awareness session during a quality improvement rotation. We provided them with background reading and an anonymous, itemized hospital statement for one of the core diagnoses. The learners were divided into two groups: one reviewed evidence-based guidelines and the other evaluated common practices and relevant charges. We reconvened these groups for a facilitated session to present and integrate their findings. This portion of the curriculum involved two one-hour sessions and less than five hours of independent work for the PGY1 residents. We then prepared a case-based noon conference from these collective lessons. During this conference, we reviewed a specific case and underscored appropriate, evidence-based, cost-effective care.
EVALUATION: Our early experience with this curriculum, during the 2011-12 academic year, has been highly positive. We received 116 evaluations from six conferences involving medical students (n=38), residents (n=65) and attendings (n=13). Respondents reported that the conferences were highly relevant to their clinical practices (mean of 4.47 +/- 0.65 on a 5-point Likert scale) and that they were likely to change their ordering behaviors based on the conferences (mean of 4.19 +/- 0.72). DISCUSSION / REFLECTION / LESSONS LEARNED: A resident-led educational innovation involving a monthly PGY1 curriculum, with active preparation of a facilitated, case-based conference emphasizing evidence-based and cost-effective medical practices, can be well-received, highly relevant, and likely to change ordering behaviors of a diverse internal medicine audience. The time and resources required to implement this curriculum are relatively minimal, making this paradigm sustainable and adaptable to other institutions.
SPEED DATING AS AN INNOVATIVE METHOD FOR HELPING MEDICAL STUDENTS LEARN ABOUT INTERNAL MEDICINE TRAINING AND CAREERS Jennifer Adams; Nina Yeboah; Kathleen Hanley; Sondra Zabar; Jennifer Gillman; Kathryn Jors; Ross Mccormack; Z-Hye Lee; Colleen Gillespie. NYU School of Medicine, New York, NY. (Control ID #1339777)
NEEDS AND OBJECTIVES: Despite an increasing need for physicians trained in Internal Medicine (IM), the number of medical students entering residencies in IM has declined. Misconceptions about careers in IM, pay differentials between disciplines, student debt and work hours are thought to contribute to this decline. We developed an IM Speed Dating Event to increase first year medical students awareness of the breadth and richness of IM training and careers.
SETTING AND PARTICIPANTS: Faculty members from each Division within the Department of Medicine at our institution were asked to participate to emphasize the diversity of careers paths after IM training. Medical Students were recruited via email, flyers and word-of-mouth. Over 3 years of the event (2009-2011), 51 medical students participated (14-19/year).
DESCRIPTION: This speed dating event was structured so that students rotated, in timed, five-minute blocks, speaking to a total of 10 faculty. Faculty members were organized to optimize diversity of disciplines to which students were exposed. Students asked questions about faculty members career and training paths, current roles/responsibilities, work life, and work/life balance. The event was very informal, easy to set up and organize, and the speed dating format encouraged friendly, compelling and direct, but brief, discussions.
EVALUATION: All 51 participants (n=18 in 2009, 19 in 2010, and 14 in 2011), completed a pre-event anonymous assessment of their attitudes toward and understanding of IM residency and career pathways and practices as well as their specialty and career intentions. After the event, 47 completed an evaluation of the "Speed Dating" event including listing 3 things they learned and the degree to which the event led them to become more interested in exploring IM. Pre-event assessment results suggest that medical students are quite unsure about IM careers (e.g., 45% reported being not sure whether faculty within IM Departments have all

done IM residencies and 58% reported being not confident at their specialty choice). After the Speed Dating Event, 85% strongly agreed that they would recommend this event to future students. 64% strongly and 30% somewhat agreed that this event made them more interested in exploring IM. Students reports of what they learned fell into 5 broad themes: the breadth of IM; the diversity of career pathways; the work lives associated with different specialties/physician roles; program requirements; and a better sense of the multiple roles physicians fulfill.
DISCUSSION / REFLECTION / LESSONS LEARNED: With the ever decreasing supply of internists, it is imperative that medical schools expose their students to the field of IM early in their education. This innovative approach provided a fun, educational event that exposed students to a variety of IM faculty members. It is clear from our survey that students have minimal understanding of IM training and early exposure to the field is necessary for them to understand the breadth and richness of the field. Future events can better target specific segments of IM and be provided later in training to give further guidance to students considering a career in IM. Additional research should investigate whether events such as this actually influence students' career choice.
STRUCTURED PEER OBSERVATION AND FEEDBACK TO OPTIMIZE ATTENDING TEACHING Somnath Mookherjee; Bradley Monash; Bradley A. Sharpe. UCSF, San Francisco, CA. (Control ID #1338881)
NEEDS AND OBJECTIVES: Much of the clinical teaching in medical education occurs in the inpatient setting, yet ward attendings rarely receive structured feedback on their teaching. Attending feedback is generally limited to end-rotation performance evaluation by learners, rather than formative assessment of teaching effectiveness. Therefore, we sought to develop an educational program that is based on peer observation and feedback (allowing both observers and teachers to benefit); uses structured feedback anchored in validated and observable measures; and includes evaluation of actual teaching practices with longitudinal reassessment.
SETTING AND PARTICIPANTS: All internal medicine ward attendings at a single institution were eligible to participate if they ward attended at least twice during the academic year. Learners present during teaching rounds were asked to participate.
DESCRIPTION: We derived a Structured Peer Feedback Tool (SPFT-10) from the validated Stanford Faculty Development Program (SFDP) framework. From the list of 25 effective teaching behaviors in the SFDP teaching assessment tool, we selected the 10 items felt to be most easily observable and salient for effective attending teaching rounds. In a 2-hour session, participants watched videos of teaching, learned to identify the 10 selected behaviors, developed constructive and reinforcing comments, and practiced giving peer feedback. For actual teaching observation, participants were paired into feedback dyads in which each observes the teaching rounds of the other twice over the year. Learners present at the teaching are asked to rate overall teaching effectiveness on a scale of 1 to 5 (1=very poor, 5=excellent). We hypothesize that attending teaching performance will improve as measured by improvement in SPFT-10 scores, learner ratings, and retrospective self-assessment. At year-end, we

will also assess attending reaction to the program, attitudes towards peer observation, and knowledge of key teaching behaviors. EVALUATION: Of 37 eligible ward attendings, 22 enrolled (59%), averaging 2.2 years (+/- 2.1 years SD) experience. Half-way through the academic year, 16 hospitalists (73% of enrollees) have participated in a total 13 observations. The average SPFT-10 score is 7.69 (+/- 2.0 SD) out of 10. The 3 items least likely to be present are, motivated learners to learn on their own (46%), called attention to time (54%) and stated goals clearly and concisely (69%). Representative written constructive comments included encouragement to speak more clearly, use the names of learners, make session goals clear, and to pay attention to time. Twenty-nine learners have evaluated speakers, with an average overall teaching efficacy score of 4.76 (+/- 0.44 SD).
DISCUSSION / REFLECTION / LESSONS LEARNED: We have demonstrated the feasibility of a peer observation and feedback program to improve attending teaching. Attendings can successfully observe for

behaviors known to contribute to effective teaching, and provide structured feedback to each other. Common deficiencies have been identified; these behaviors will be addressed in a mid-year refresher didactic session. While scores from peers and learners are high, there is room for improvement. Further assessment at year-end will evaluate the efficacy of the program in improving attending teaching, overall reaction to the program, and attitudes about peer observation.

SWIMMING IN THE MURKY WATERS OF SOCIAL MEDIA - DONT LET YOUR WHITE COAT GET DIRTY: A WORKSHOP FOR MEDICAL STUDENTS. J. H. Isaacson2,1; Bryan A. Sisk1; Ehsan H. Balagamwala1; Ilka Decker1; Jason Ho1; Amy S. Nowacki1; Neil Mehta2,1.
1Cleveland Clinic, Cleveland, OH; 2Cleveland Clinic, Cleveland, OH. (Control ID #1339475)

NEEDS AND OBJECTIVES: Increasing popularity of social media (SoMe) has raised many controversies regarding professionalism. Lapses in online professionalism can denigrate the physician/patient relationship and mar the image of the profession. Professionalism in SoMe is highly complex and current guidelines leave many uncertainties. We identified four especially controversial areas regarding the use of SoMe by medical professionals. Our aims were a) to introduce students to this vital discussion through the lens of a recent controversy, and b) to determine whether students could reach a consensus regarding these controversial areas.

SETTING AND PARTICIPANTS: We designed and implemented a workshop for third year students at the Cleveland Clinic Lerner College of Medicine to initiate a discussion about SoMe.

DESCRIPTION: This two-hour workshop introduced students to various SoMe applications (e.g. Facebook, Twitter and blogs) with a demonstration of practical applications of SoMe for learning and building a professional identity. We used an actual Twitter post that had led to a lively debate in the online community. The specific case involved one physician publicly rebuking another physician for an anonymous Tweet of patient information in an inappropriate context. Students were subsequently divided into small groups, with each group discussing one of four questions. The workshop concluded with a large group discussion and a conference call with the rebuking physician involved in the controversy.

EVALUATION: Students were organized in small groups with each group discussing one the controversial areas. The discussion of each group was recorded and summarized and presented to the large group for further discussion. 1) Should physicians ever post about patients in SoMe? This group demonstrated a spectrum of opinions; however, students agreed that appropriateness is influenced by the purpose, venue, content and context of the posting. 2) Is it okay to post anonymously in SoMe? The consensus was that anonymous posting is a fallacy; it is not possible to truly remain anonymous on todays internet. Thus, authors should not post anything anonymously that they would be ashamed of posting non-anonymously. A subset of students described a sense of security when writing anonymously about personal issues; they maintained that posting anonymously could still be carried out in a responsible manner. 3) Does concern for professionalism extend beyond HIPAA compliance? Students concluded that the level of
professionalism in SoMe should exceed that which is expected in other forms of communication, due to the ease with which information can spread once posted on the internet. 4) Did the rebuking physician in this specific controversy do the right thing? Students appreciated the rebuking physicians role in highlighting the controversy, but they regretted the negative tone that the online discussion took.

DISCUSSION / REFLECTION / LESSONS LEARNED: After completion of this workshop, students were unable to reach consensus on various professionalism and SoMe issues. Although professional organizations have published guidelines for the use of SoMe, our workshop with a real-life scenario showed that current guidelines insufficiently address the complexities of SoMe. A number of gray areas remain, which need further analysis. Workshops that allow students to review and discuss real cases of professionalism and SoMe will help to raise awareness of these complexities, thus serving to further the dialogue of how the medical profession should adapt to SoMe.

TEACHING QUALITY IMPROVEMENT TO RESIDENTS USING ABIM PRACTICE IMPROVEMENT MODULES: THE YALE PRIMARY CARE EXPERIENCE Daniel G. Tobin. Yale Primary Care Internal Medicine Residency Program, Waterbury, CT. (Control ID #1336687)

NEEDS AND OBJECTIVES: The Accreditation Council for Graduate Medical Education (ACGME) requires residents to systematically analyze their practice using quality improvement methods, and implement changes with the goal of practice improvement. This curriculum intended to teach fundamental principles of quality improvement using lectures and validated audit tools developed by the American Board of Internal Medicine (ABIM). Secondarily, the project intended to expose residents to the ABIM's Maintenance of Certification Program.

SETTING AND PARTICIPANTS: The project was headquartered at the Chase Center where Yale Primary Care Medicine Residents have their continuity clinic practices. Participants included 27 second and third-year residents. 9 faculty and the clinical staff at the practice site also participated. Residents participated during their 3-month Ambulatory Block rotation and the project was implemented in phases over a 2 year period. Uniquely, residents were divided into longitudinal quality improvement teams, each responsible for a specific phase of the project as well as their own patient assessments.

DESCRIPTION: Participants were enrolled in the ABIM's Hypertension Practice Improvement Module (PIM). Hypertension was chosen as a common and easily measurable condition with data driven treatment recommendations. Residents participated during their 3-month Ambulatory rotations. Each Ambulatory Block team worked collaboratively to advance project design and implementation and each block began with a didactic series about medical error and the quality improvement process. During the first year, team 1 educated colleagues and patients about the project. Team 2 standardized and implemented the chart audit and patient survey process. Team 3 reevaluated progress to date and modified processes. Team 4 managed data entry and submitted aggregate data to the ABIM. Participants conducted chart audits and collected patient surveys for their own hypertensive patients; personal results were reviewed with their preceptor. In the second year, team 1 analyzed results and picked an improvement target (DASH diet counseling). Team 2 developed educational materials and an implementation protocol. Team 3 executed the DASH diet counseling plan, and team 4 performed a targeted re-measurement to see if counseling rates improved. At the conclusion of the project, the data was submitted to the ABIM and faculty earned both CME and MOC points for their participation.

EVALUATION: The project achieved it's primary and secondary objectives. Residents reported satisfaction and a deeper understanding quality improvement principles including rapid cycles of change and the importance of a reflective practice style. DASH diet counseling increased 235% over baseline. Time constraints, language barriers, and patient willingness to complete surveys were significant barriers.

DISCUSSION / REFLECTION / LESSONS LEARNED: Implementing an outpatient quality improvement curriculum using tools employed by the ABIM MOC program is feasible within a busy residency training program.

Participants worked enthusiastically as teams and coordinated their efforts longitudinally. Data collection was hindered by time constraints, language barriers, and lack of patient willingness to complete surveys; response rates may be improved by offering patient incentives. Aggregate data analysis supplemented individual reflection. DASH diet counseling was grossly underutilized. Residents were completely unfamiliar with the ABIM's MOC process prior to completing the project.

TEACHING SELF-DIRECTED LEARNING: CAN THIS BE DONE? Maureen D. Willcox1; Michael F. O'Connor2; Jennifer Glick3; Patrick D. O'Connor4; Susan Glick5. 1Pritzker School of Medicine, Chicago, IL; 2University of Chicago, Chicago, IL; 3Washington University, St. Louis, MO; 4New Trier High School, Chicago,

IL; 5University of Chicago, Chicago, IL. (Control ID #1335087)
NEEDS AND OBJECTIVES: Self-directed learning is a requisite for lifelong learning. Third-year students are expected to be self-directed learners, selecting which content to study and the appropriate resources. Unfortunately, for most students, the educational experience in both college and the preclinical years is overwhelmingly teacher-directed, and thus students are often ill prepared for the transition to self-directed learning. How best to prepare medical students to become self-directed learners is unknown. The Foundations in Clinical Medicine (FICM) course is an immersive, 7-day experience intended to prepare rising third-year students for the clinical years. One aim of the course is to develop students self-directed learning skills in preparation for the third-year clerkships and beyond.
SETTING AND PARTICIPANTS: 47 rising third-year students participated in this classroom-based course.
DESCRIPTION: The FICM course consists of 7 distinct content areas, 3 of which focus on self-directed learning. For 2 of these content areas (Data Interpretation and Hypothesis-Driven History and Physical Examination), we created a series of structured paper and pencil exercises that required self-directed learning. Students were provided relevant resources (textbooks, original articles, Up-to-Date) and were encouraged to seek others. Faculty were present to answer questions but instructed not to initiate or lead discussion. For the other content area (FICM Laboratory), we created an unstructured setting for students to work individually or in groups to revisit content they had not yet mastered and to extend their understanding of the material. Faculty responded to students questions, but did not initiate or lead discussion.
EVALUATION: In order to determine the effectiveness of our teaching methodology, self-directed learning was assessed on the first and last days of the course using a single instrument that combined two validated measures of self-directed learning: Abd-El-Fattahs Self-Directed Learning Aptitude Scale (SDLAS) and Lees Self-Assessed Self-Directed Learning Ability (SASDLA). This project received IRB exemption. The response rate was 100% (n=47). Scores were calculated by assigning a point value to each answer (5=strongly agree to 1=strongly disagree), and then dividing the total number of points by the total number of questions answered. Use of the mean score instead of total score was necessary to correct for unanswered items. Students t-test was utilized to compare the change in self-management, motivation, self-monitoring and the total score (Abd-El-Fattahs SDLAS) as well as the total score (Lees SASDLA) before and after the course. Following the course, there was statistically significant improvement in the score for each subscale and for both total scores. For Abd-El-Fattahs SDLAS, scored on a 4-point Likert scale, the mean improvement in the total score was 0.127 (95% CI 0.064-0.189, $p<0.001$). The mean improvement in the self-management subscale was 0.126 (95% CI 0.0201-0.232, $p=0.021$), the motivation subscale 0.119 (95% CI0.0542-0.183, $p<0.001$), and the self-monitoring subscale 0.139 (0.0526-0.226, $p<0.001$). For Lees SASDLA, scored on a 5-point Likert scale, the mean improvement was 0.486 (95% CI 0.310-0.663, $p<0.001$). DISCUSSION / REFLECTION / LESSONS LEARNED: We cultivated self-directed learning in our students by immersing them in time-pressured problem-solving situations and providing them access to appropriate resource materials and faculty to keep them on-track. Self-directed learning can be taught to medical students.
TEACHING TEAMWORK: ENHANCING RESIDENT CONTINUITY TRAINING IN AN URBAN ACADEMIC CLINIC Reena Gupta; Ryan Laponis; Neda Ratanawongsa; Elizabeth Davis; Claire Horton. San Francisco General Hospital, University of California, San Francisco, San Francisco, CA. (Control ID #1340466)
NEEDS AND OBJECTIVES: As primary care moves toward medical home models of care, residents increasingly need to be trained to deliver effective patient-centered care in health care teams. Team-based care requires skills beyond traditional patient-provider relationships and clinical knowledge. Educational initiatives that emphasize skills in multidisciplinary teamwork and team-based population management are needed. We redesigned resident continuity experience and implemented a new curriculum to teach residents skills in multidisciplinary team care and team-based panel management. Our secondary objective was to enhance resident satisfaction with continuity clinic experience through strengthened team-based care.

SETTING AND PARTICIPANTS: The General Medicine Clinic (GMC) at San Francisco General Hospital (SFGH) is an urban safety net practice site for 50 internal medicine residents with a patient population of over 6500 ethnically diverse, low-income patients with complex disease. DESCRIPTION: The GMC Enhanced Medical Service (GEMS) curriculum was launched in January, 2011. The curriculum focuses on building multidisciplinary teams and teaching residents skills in panel management. Resident clinic sessions are blocked for the first hour every other week for the curriculum and team care activities. Each GEMS session includes a didactic component and 30 minutes for team huddles and panel management. Didactic sessions cover skills in team communication and huddles; optimizing teamwork with medical assistant, nurse practitioner, and clerical team members; panel management; and review of team quality metrics. We evaluated a 6 month pilot using an anonymous survey and resident focus groups.
EVALUATION: 32 of 50 residents (64%) completed the survey at the end of the GEMS curriculum. 89% felt the GEMS curriculum enhanced their understanding of clinic teams and helped them work more effectively with staff team members. 76% of residents reported "huddling with their medical assistant teams during clinic. 82% responded that the GEMS curriculum helped them understand and implement panel management. 93% of residents felt GEMS made clinic less stressful. One resident reflected, I was often in clinic for over 4 hours after my clinic day. It [made] primary care feel like an incredible burden on top of busy inpatient responsibilities. Panel management time alleviates some of this feeling and helps us get feedback on our performance and outcomes.
DISCUSSION / REFLECTION / LESSONS LEARNED: As more primary care practices become medical homes, resident ambulatory education increasingly requires training to build resident skills in multidisciplinary teamwork and population management. The GEMS curriculum helped residents function in clinic teams and learn skills of panel management. Further efforts are needed to increase team efficacy and assess residents competency in providing comprehensive primary care in team-based systems.
TEACHING INFORMATION LITERACY WITH MEDICAL RESOURCE APPS AND OPTIMIZED MOBILE WEBSITES. Sarang Kim; Kerry O'Rourke. UMDNJ-Robert Wood Johnson Med School, New Brunswick, NJ. (Control ID #1311920)
NEEDS AND OBJECTIVES: Information literacy is the ability to access information resources to make informed patient care decisions. Effective teaching of information literacy requires hands-on interaction, which can be challenging with a large group of students, and actual use of resources is limited without easy access. With widespread use of Smartphones, apps and mobile optimized web sites improve access to medical resources, and may enhance the teaching of information literacy. The objective of this educational innovation was to explore the use of apps and mobile optimized web sites in teaching information literacy to medical students.
SETTING AND PARTICIPANTS: 3 rd year students at a US medical school

DESCRIPTION: We conducted a 90 minute workshop for 120 third year medical students on efficient use of medical resources. Students were asked to bring their Smartphone and were provided instruction prior to the session on downloading select medical resource apps and optimized mobile websites. At the workshop, students were first introduced to 5 medical resources (DynaMed, Essential Evidence Plus, First Consult, MD Consult, Access Medicine), then given instructions about how to use those resources with their Smartphones to answer clinical questions provided. After students navigated through the resources on their own, they were challenged to answer new clinical questions using the EBR apps in less than 4 minutes as a practical exercise to test out how efficiently the resources may be used in real clinical settings. Pre and post tests were administered to identify students utilization of medical resources.
EVALUATION: Eighty-nine students completed the pre-test and 83 completed the post-test. On pre-test, the most commonly used resources to answer clinical questions was Google (88% of students) and textbooks (67%). A majority of students indicated that they were unfamiliar with or never used the resources discussed

during the session. On posttest, a majority of students reported being comfortable with the resources discussed (54-66%). When asked which resource they planned to use to answer clinical questions, DynaMed ranked highest, and the most commonly reported reason was its up to date content. Overall, 86% of students rated the workshop content as important to their professional education, and 88% reported that they planned to use the mobile resources in clinical care.
DISCUSSION / REFLECTION / LESSONS LEARNED: Hands-on learning utilizing students mobile devices is an effective means of teaching information literacy to a large group of students. Instructing students to download the apps prior to the session ensured access to the resources during the session and in their clerkships. We plan to survey the students at the end of their academic year to determine actual use of these resources in their clinical clerkships.
THE CLINICIAN EDUCATOR PATHWAY: MEETING THE NEEDS OF TOMORROWS MASTER TEACHERS
Maryann K. Overland1;
Lauren R. Thronson2. 1University of Washington, Seattle, WA; 2Harborview
Medical Center, Seattle, WA. (Control ID #1310895)
NEEDS AND OBJECTIVES: During an era of decreased resident work hours and increasing clinical obligations, we must identify new and innovative educational curricula to better prepare our internal medicine trainees who wish to pursue a career as a Clinician Educator. Objectives: 1. Provide residents with a toolbox of best practices for teaching in a variety of settings 2. Facilitate and encourage educational scholarship 3. Create a framework for construction of a Teaching PortfolioSETTING AND PARTICIPANTS: University of Washington Internal Medicine Residency has selected four second year residents to participate in a pilot Clinician Educator Pathway. Pathway development involved focus group feedback from residents and Clinician Teacher faculty. The pathway was created using data gained from these feedback sessions as well as reviews of the literature and evaluation of similar programs around the country.
DESCRIPTION: The pathway has three main interventions. First, the participants are paired with mentors who are working within their desired field. The goal of these partnerships is to facilitate ongoing educational scholarship in a variety of forms, including original research and curriculum development. A secondary goal is to provide mentorship and advice about career goals and the teaching portfolio. Second, the participants will engage in a 4-week educational immersion block in January of 2012. During their immersion experience, they will participate in a variety of teaching activities and small-group didactic sessions. The didactics include precepting in the outpatient setting, bedside teaching, constructing a teaching portfolio, providing feedback, and formal group teaching. They will also have the opportunity to teach in unique settings. They will facilitate problem-based learning sessions (PBL) with the preclinical medical students, an experience that will extend for eight weeks into their next clinical rotation. They will precept 4th-year medical students in a primary care setting. As proctors for observed standardized
clinical examination (OSCEs), they will formally evaluate and give immediate feedback to students under the guidance of experienced educators. They will develop and present a lecture for their resident peers. Additionally, they will have individual sessions with the University of Washingtons most highly regarded Master Teachers. Finally, the pathway participants will build a Teaching Portfolio, including a personal teaching philosophy statement and examples of their teaching and educational scholarship, to be a living document by the time they complete their residency.
EVALUATION: Although this program is in its infancy, the pathway is garnering great enthusiasm among residents and faculty. However, based on our focus group discussions, it is clear that residents understanding of educational scholarship and the academic promotion process is quite limited. Evaluation will include pre- and post-surveys for the participating residents.
DISCUSSION / REFLECTION / LESSONS LEARNED: The inaugural immersion block will be completed February 3 rd, 2012, and will therefore have reflections on the successes and challenges of that experience at

the time of the SGIM meeting in May, 2012. Additionally, we will have suggestions on pitfalls to avoid and key must-haves for a successful education immersion experience.

THE CRIMSON CARE COLLABORATIVE CHELSEA CLINIC: INTEGRATING MEDICAL, MENTAL, AND SOCIAL HEALTHCARE FOR POST-INCARCERATION AND URGENT CARE PATIENTS IN A STUDENT-FACULTY CLINIC Divya Mallampati1,2; Janine Knudsen1,2; Marya J. Cohen2,1; Jonathan Cunningham1,2; Chuan-Mei Lee1,2; Luis Ticona1,2; Rachel Bender Ignacio3,2; Brennan Bollman1,2. 1Harvard Medical School, Cambridge, MA; 2Massachusetts General Hospital, Boston, MA;
3Massachusetts General Hospital, Boston, MA. (Control ID #1334975)

NEEDS AND OBJECTIVES: Social determinants of health influence outcomes both in exam rooms and in the community, yet medical students receive little exposure to social medicine in practice. In addition, students are rarely able to explore innovative models of primary care. A new student-resident-faculty collaborative clinic at Massachusetts General Hospitals Chelsea Community Health Center (MGH-Chelsea) and Harvard Medical School (HMS) therefore seeks to educate medical students by enabling them to design comprehensive primary care strategies that deliver effective care to two underserved populations: people returning to Chelsea post-incarceration and frequent urgent care users without a usual provider.

SETTING AND PARTICIPANTS: In October 2011 HMS expanded its student-faculty clinic model, the Crimson Care Collaborative (CCC), to a new site at an MGH-Chelsea. This new clinic provides students with a valuable opportunity to care for vulnerable populations, explore social medicine in practice, and understand how medical teams implement new strategies to enhance patient-centered care. Our integrative model trains students to address the socioeconomic barriers to their patients health and the unique health care needs of two underserved populations. DESCRIPTION: We have developed a unique clinic structure to address the strong need for coordinated primary care, mental health care, and social services in our populations. Patients first meet with a social services navigator, a student who screens the patient for non-clinical issues that might impact their overall health, such as food security, employment, and legal issues. The patient next meets with student and faculty clinicians to establish a longitudinal primary care relationship. Finally, the social navigator returns to provide referrals to relevant social services organizations and establish a follow-up plan. Patients requiring additional mental health care are referred to our co-located mental health team of two students and a psychiatry resident for further assessment and management. In the future, our team will also implement a patient education program for topics including substance abuse and chronic disease.

EVALUATION: The clinic team works together closely to ensure that our socially complex patient populations have access to appropriate, high-quality services that meet both provider- and patient-identified needs. To achieve this goal, our student roles extend beyond the medical clinic. Students actively follow up with their patients for medical and social

services and are encouraged to develop strong relationships with them. In addition, a student outreach contingent has conducted structured interviews with non-profits in Chelsea and compiled an online database of more than 20 local social service assistance programs for use in our clinic.

DISCUSSION / REFLECTION / LESSONS LEARNED: Since the clinics establishment in October 2011 we have provided care to more than 50 patients, one quarter of whom are transitioning into the community from incarceration. Around 90% of our patients have received at least 1 social services referral to a local organization, and 40% have been referred to and seen by our mental health teams. Finally, more than 40 medical students and 5 residents have participated in the clinics design and operations, and our volunteer numbers continue to rise. Through our innovative, comprehensive clinic model, we will continue to educate a new generation of socially-minded, creative physicians familiar with new models of care while providing care to

two underserved populations.

THE CROSSOVER CURRICULUM: PREPARING INTERNAL MEDICINE RESIDENTS TO CARE FOR PATIENTS WITH CHILDHOOD-ONSET CHRONIC DISEASES Zadok Sacks; Anna Volerman; Niraj Sharma. Brigham and Women's Hospital/Children's Hospital Boston, Boston, MA. (Control ID #1334351)

NEEDS AND OBJECTIVES: Research has demonstrated that internal medicine residents (IMRs) are less comfortable caring for adults with childhood-onset chronic diseases (COCDs) than their pediatric counterparts. Other work has shown that this may negatively impact the quality of care these patients receive after transitioning to adult providers. A survey conducted among IMRs at our institution suggested significant interest in a curriculum focusing on the management of these patients. For each of ten COCDs identified, over 75% of respondents (N=53) felt that formal teaching of those topics would improve their care of these patients. To address this need, the Crossover Curriculum (CC) initiative was developed by our Medicine-Pediatrics (Med-Peds) residency program. Program objectives include increasing IMRs confidence in managing adult patients with COCDs; creating a unique educational niche for the Med-Peds residency program; and giving IMRs the opportunity to learn from master pediatric educators.

SETTING AND PARTICIPANTS: Our survey revealed that 84% of IMR respondents had no prior training related to the transitioning of young adults with COCDs. When surveyed regarding the preferred teaching format, approximately 90% of IMRs indicated interest in case-based morning reports or noontime lectures. Accordingly, five morning report sessions and two lectures to IMRs have been completed. DESCRIPTION: Individual CC morning report sessions have focused on anorexia, severe asthma, cystic fibrosis (CF), inflammatory bowel disease (IBD), and adult survivorship of pediatric cancer, while lectures have focused on sickle cell disease and hyperglycemic crises. All sessions have involved guest discussants from our affiliated pediatric institution. Discussions typically focus on management issues and highlight the challenges involved in transitioning patients with COCDs. EVALUATION: Feedback was obtained from IMRs both before and after this initial set of sessions. Over 75% of respondents who attended at least one session (N=70) felt that morning reports and noontime lectures were effective vehicles for learning about the management of adult patients with COCDs, while nearly all attendees felt that hearing from pediatric subspecialists enhanced their learning. Qualitative feedback has been similarly favorable. A strong majority of respondents felt that the CC adds to their education overall, with many commenting that the sessions have changed their practice. Specifically, individuals commented that they feel more knowledgeable about IBD and CF[and] more comfortable when taking care of adult patients with those diseases. Other IMRs described that they will be less aggressive with IV fluids in diabetic ketoacidosis and trust sickle cell patients [about] what dose of pain medication works for them in a pain crisis.

DISCUSSION / REFLECTION / LESSONS LEARNED: The CC is an innovative program in which there has been a great deal of interest from IMRs at our institution, who view it as a high-yield educational experience with the potential to impact management of patients with COCDs. Based on the feedback obtained to date, we plan to add additional topics to the CC (e.g. adult congenital heart disease, cerebral palsy, intellectual disability, and genetic disorders) and continue the CC in the future. The CC can be generalized to any Med-Peds residency program and its affiliated IM residency program, and fills an important educational niche; as one IMR commented, Children with these diseases are living longer now, and internists have to know how to care for them.

THE INTERNAL MEDICINE SIMULATED CASE SCENARIO PROJECT Bridget B. Stiegler. Banner Good Samaritan Medical Center, Phoenix, AZ. (Control ID #1319891)

NEEDS AND OBJECTIVES: The restriction of resident work hours has prompted the need for creation of a supplementary educational forum wherein we evaluate residents knowledge and ability to manage basic ward diagnoses. In response to this need the Banner Good Samaritan Academic Medical Service (AMS) has created a program utilizing high fidelity mannequins in a standardized patient hybrid simulation experience. In addition

to creating high yield teaching time between our residents, their clinical attendings and specialists, this program also increases the annual number of direct observation faculty evaluations.
SETTING AND PARTICIPANTS: This exercise involves second year residents on elective rotations, which occur every other month, as the residents are on a call/non call rotating schedule. Cases run monthly, prior to the start of Academic Half Day lectures, thus each resident runs approximately six cases per year. In the context of this project the resident obtains a thorough history and physical examination on his or her patient (mannequin), the voice of which is provided by an internal medicine teaching attending. After completing an exam the resident is then asked to discuss admission orders, and receives immediate feedback from his attending regarding performance and the depth of understanding of the case topic.
DESCRIPTION: Prior to test day, residents are provided with literature relevant to the medical case in question. Residents also recieve a quiz to complete prior to the simulation to ensure their preparation for the exercise. Quiz questions are management/critical thinking based, and are drawn from the assigned reading as well as from the weighted priority items as determined by the AMS attendings. Literary references and articles are chosen by the members of the SIMS Center Project committee. The SIMS Center Project host reviews the quiz answers and revisits major learning points for the case prior to the resident leaving the SIMET Center.
EVALUATION: All mannequin runners have the same case outline and patient background information to reduce inter-rater variability. The weight of each item in the history and physical examination is pre-determined by the AMS group as vital or non-vital, in the achievement of an acceptable or not acceptable grade. Residents have a comprehensive grade comprised of three elements; score on pre-test quiz, weighted case items, and Attending Evaluation. The evaluation specifically addresses learning milestones for second year residents. Deficiency in any one of these elements leads to a score of Not Acceptable, warranting close monitoring of the residents academic and clinical progress by the program director and the residents advisor.
DISCUSSION / REFLECTION / LESSONS LEARNED: Outcomes to this point have been learning based. We created 52 additional direct observation experiences during the pilot year for this project. Residents have communicated appreciation for the opportunity to practice patient management, and for one-on-one feedback that they receive from their attendings. The faculty members have been pleased with the opportunity to choose and distribute literary references they feel are vital for clinical management. Currently we are evaluating the Simulated Case Scenario Project as a teaching tool, by studying long-term retention of information covered in the simulated cases. A research proposal to evaluate the effectiveness of this teaching model using knowledge retention as endpoint is currently under review by our Institutional Review Board.

THE VA PRIMARY CARE CLINIC: AN IDEAL SETTING TO TRAIN INTERNAL MEDICINE RESIDENTS TO WORK WITHIN THE PATIENT-CENTERED MEDICAL HOME Neha Pathak1,2; Karen Woolfall-Quinn1,2. 1Providence VA Medical Center, Providence, RI; 2Alpert School of Medicine Brown University, Providence, RI. (Control ID #1318386)
NEEDS AND OBJECTIVES: Research suggests that transforming primary care delivery to the Patient-Centered Medical Home (PCMH) model could reduce health care costs AND improve the quality of acute and chronic disease care. There is an increasing trend toward creating outpatient practices that fit the PCMH model, emphasizing: 1) ongoing relationship with a physician, 2) providing continuous and comprehensive care within teams, 3) patient self-management, 4) care facilitated by information technology, 5) care provided according to patient need, such as the use of asynchronous communication, expanded hours and open-access scheduling, and 6) use of evidence-based medicine and clinical decision support tools. Internal medicine residency ambulatory education must be redesigned to produce physicians capable of effectively practicing within the PCMH. We have developed a rigorous, patient-centered, team-based curriculum in the ambulatory setting at the Providence VA Medical Center utilizing both didactic and experiential components. Our objective is to train internal medicine residents to provide comprehensive, coordinated, and continuous care for a panel of patients

within the Patient Aligned Care Team (PACT) structure in the primary care clinic.
SETTING AND PARTICIPANTS: The Department of Veterans Affairs is currently funding a $250 million effort to adopt the PCMH model nationwide (called PACT within the VA) and this provides an ideal setting to train internal medicine residents within a PCMH. The Providence VA is an ambulatory care continuity clinic site for 18 Brown University Internal Medicine Residents paired with 1of 5 dedicated faculty preceptors. Each resident is expected to provide care for a panel of patients utilizing the PACT. DESCRIPTION: Curriculum A. Didactics a) Pre-clinic Seminars on PACT topics: 1) Structure of PACT: meeting team members and understanding roles 2) Alternative modes of communication: ie telephone visits, secure messaging 3) Interdisciplinary VA resources: Nutrition, Pharmacy, Mental Health, Social Work b) Pre-clinic Outpatient Practice Improvement Seminars: Monthly review of patient panel data: 1) out-of range diabetes, lipid, hypertension metrics 2) Review of ED utilization and hospitalizations B. Clinical Experience with a Patient Panel a) Ambulatory Clinic appointments: routine follow up and open access for sick visits b) Telephone appointments c) Panel management using PACT to improve metrics d) Brief Team meetings with Primary Preceptor, Clinic nurse, resident colleagues, health techsEVALUATION: A. Resident Evaluation a) Preceptor evaluation of resident in the following categories: 1) outpatient practice improvement 2) knowledge of and ability to work within PACT TEAM b) Patient evaluation of resident B. Curriculum Evaluation a) Resident to complete PACT Recognition Survey- a tool to ascertain knowledge of the principles of PACTDISCUSSION / REFLECTION / LESSONS LEARNED: The Providence VA presents an ideal site for resident education within the structure of a patient-centered medical home as this model of care has been steadily developed within our VA for many years, most recently by a reorganization of our clinical teams. In addition, our size is an asset. Our medical center is small, allowing for geographic proximity of the interdisciplinary teams, creating an environment of easy access for consultation with team members, Mental Health providers, pharmacy, etc; this further instills the importance of the warm hand-off and providing patient-centered care in a timely, efficient manner.

THE IMPACT OF INTERDISCIPLINARY CODE SIMULATION ON PERCEPTIONS OF COLLABORATION AND TEAM PERFORMANCE AMONG INTERNAL MEDICINE RESIDENTS AND NURSING STUDENTS

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2University of Nevada-Las Vegas, Las Vegas, NV. (Control ID #1339653)

NEEDS AND OBJECTIVES: Crisis resource management (CRM) encompasses communication, leadership, situation awareness, and deci-
sion-making. These skills are critical to patient safety and quality improvement in healthcare settings. Simulation provides an opportunity for training in interdisciplinary teams facing situations comparable to those encountered in the hospital. Internal medicine residents receive ACLS training prior to starting residency, but may not have an opportunity to hone CRM skills prior to leading a code team. Similarly, nursing students have limited direct exposure to physicians during their education. SETTING AND PARTICIPANTS: Twenty-seven second year Internal Medicine residents from the University of Nevada School of Medicine and one hundred and twenty three second and fourth semester nursing students from the UNLV School of Nursing participated in high fidelity simulation at the Clinical Simulation Center of Las Vegas as part of their training during Summer 2010 and 2011.
DESCRIPTION: Residents and students participated in two collaborative emergency codes (Ventricular Fibrillation &Pulseless Electrical Activity algorithms). Nursing students acted as the nursing resuscitation team and residents acted as the on-call staff physician and team leader. Each scenario was designed to run approximately twenty minutes including initial assessment, patient decompensation, pulseless arrest, and recovery. After completing the exercise, nursing and medicine faculty facilitated video guided debriefing of the team, focusing on CRM fundamentals. EVALUATION: After each scenario, participants completed the Jefferson Scale of Attitudes toward Physician-Nurse Collaboration (JSA) and the Mayo High Performance Teamwork

Scale (MHPTS). Each instrument was completed before and after each debriefing. The JSA assesses general attitudes about collaborative education and the MHPTS evaluates perceptions of team performance. Statistically significant differences were seen in attitudes about collaborative education and perceptions of team performance. On the JSA, RM ANOVA for pretest 1 to post-test 1 revealed F (1,158)=25.69 (p=0.005) and pretest 2 to post-test 2 showed F (1,164) =15.32 (p=0.0005). On the MHPTS, statistically significant differences were only observed between pretest 2 and post-test 2 (F (1, 161)=19.24, (p=0.0005).
DISCUSSION / REFLECTION / LESSONS LEARNED: Participants reported higher mean scores for both measures on the second scenario and for the JSA on the first scenario. This suggests that the educational intervention improved general attitudes regarding collaborative education. Perceptions of team performance were also enhanced, but this occurred more slowly than changes in attitudes about collaboration. Interdisciplinary code simulation and debriefing focusing on CRM skills can be an important tool in fostering physician-nurse teamwork. Future evaluation of data from this intervention will focus on objective evaluation of team performance and its correlation with ACLS algorithm adherence.
TRAINING IN CROSS-CULTURAL COMMUNICATION FOR IMG PHYSICIANS Eric Green1,2; E. Amy Janke3; Arnold Eiser1,2.
1Mercy Catholic Medical Center, Darby, PA; 2Drexel Univiersty College of Medicine, Philadelphia, PA; 3University of the Sciences of Philadelphia of, Philadelphia, PA. (Control ID #1310829)
NEEDS AND OBJECTIVES: Most models of cross-cultural communication in medicine presume the teacher and student share a common health belief system that differs from the patient. At least one third of all U.S. graduate medical trainees are international medical graduates (IMGs) whose culturally-related health beliefs may differ significantly from that of their American-bred faculty. We hypothesized that training IMGs in communication skills and U.S. health beliefs would increase their ability to conduct appropriate cross-cultural communication during clinical interactions. We created a multi-modal cross-cultural training program to meet this need.
SETTING AND PARTICIPANTS: Our intervention is set in a university-affiliated community teaching hospital based residency based in urban and suburban Philadelphia where approximately 75% of residents are IMGs. Residents were drawn from all years .
DESCRIPTION: Our multi-modal intervention is designed to increase an IMGs understanding of U.S. health beliefs and stimulate improved doctor-patient communication between IMGs and patients. We focused on African-American patient perspectives with particular reference to the

management of non-malignant pain and shared medical decision making. The intervention included two simulated patient (SP) encounters that highlighted areas of cross-cultural differences among U.S. born teachers, U.S. born patients, and internationally educated residents; an online module; assigned readings; and an hour-long interactive didactic session. Our residents were observed during their SP encounters by a clinical psychologist who provided immediate, in vivo feedback using a behaviorally-anchored rating scale. Residents completed a self-report assessment derived from Likes Clinical Cultural Competency Questionnaire which uses a 5-point Likert scale ranging from 1 (not at all) to 5 (very) to collect pre- and post-training data on residents knowledge, skill, and attitudes in cross-cultural care. We analyzed survey results using descriptive techniques and student T-test.
EVALUATION: 15 residents completed the training program. The residents had a mean age of 32, and 40% were men. 53% were from India, with remainder from Africa or elsewhere on the Indian subcontinent. 20% were PGY 1, 47% were PGY2, and 33% PGY3. 67% reported some previous training in cultural diversity. Self-ratings on 8 items measuring cross-cultural knowledge improved from a mean of 2.94 pre-training to3.93 post-training

(p<.001), while self-reported culturally-competent skills improved from 3.26 to 4.27 (p<.001). Residents reported improvement in their ability to interpret non-verbal clues (2.87 to 3.92, p=.003) and interpreting cultural expressions for pain (2.73 to 3.92, p<.001). The residents universally enjoyed the training as whole (mean 4.83.39 on 5 point scale), and rated each component favorably (all rated>4 on a 5-point scale). We were able create the training for approximately $3000, and the cost per resident is approximately $100.
DISCUSSION / REFLECTION / LESSONS LEARNED: A multi-modal training program designed to enhance cultural competence for IMGs successfully improved residents self reported knowledge and skills in areas of cultural competency. This preliminary study also demonstrates that such a program can be developed and maintained in a cost-effective way with minimal additional time burden for training staff or residents. It appears to be a promising approach to improving communication skills and enhancing cultural competence for IMG physicians.
TRANSFORMING HEALTHCARE THROUGH A UNIT-BASED CLINICAL LEADERSHIP MODEL Robert Dressler; Virginia U. Collier; Michael Eppehimer; Barbara A. Monegan; Janet Cunningham; Diane Talarek; Vernon L. Alders; Sharon L. Anderson. Christiana Care Health System, Newark, DE. (Control ID #1339521)
NEEDS AND OBJECTIVES: The Christiana Care Department of Medicine has an attending staff of approximately 439 physicians and oversees 500 of the 1,150 beds in Christiana Care hospitals. Multiple departments, including Medicine, Nursing, Quality and Safety, Operational Excellence, and System Learning, collaborated to expand the existing unit-based medical director role. The new models goal further develops our medical director-nurse manager leadership teams to effectively lead quality improvement activities on their units and advance the value of care provided to patients.
SETTING AND PARTICIPANTS: The unit-based clinical leadership model concentrates on three specific areas; increased time commitment on the floor by the medical director, a structured training program to educate the medical director and nurse manager in leadership skills and improvement methods, and embedded support by process improvement and quality resources. The training program began April 2011 for eight inpatient medicine patient care units.
DESCRIPTION: The Unit-Based Clinical Leadership Teams (15 nurse managers and medical directors; one director assigned to two units) completed an initial 18 hours of training and development over 5 learning sessions offered between April and June 2011. Key elements of the program included: Team Kickoff - Led by Senior Leadership, introduction to Christiana Cares Annual Operating Plan, Quality and Patient Safety goals and the expectations for Unit-Based Clinical Leaders. Team Building- Individual thinking preference profiles for individuals and teams, structured discussion about leadership team expectations and working styles. Leading Through Vision - Business case studies on the importance
of a guiding vision, creation of specific unit vision for each team. Performance Improvement, Part I - Introduction to Lean / PDCA improvement tools and methodology, creation of current state process map. Team Dynamics &Change Management - Expected life cycle of teams leading change efforts, team communication and problem identification. Performance Improvement, Part II - Continued focus on Lean / PDCA tools, root cause analysis, problem identification and prioritization and future state mapping. Each nurse-physician team identified one initial performance improvement project focused on improving patient care on their units. From June through September 2011, the skills were applied to structured performance improvement efforts. Monthly meetings occurred to review progress toward goals and to prepare the teams for a 90 day report out to senior leadership.
EVALUATION: All eight unit based teams were able to apply the acquired skills and successfully completed improvements with measurable results within 90 days. Additional measures included session evaluations, project outcomes and impact, and team function status at 2 month milestone and post initial project completion (baseline data completed; post intervention data collection scheduled for end of year 2011). DISCUSSION / REFLECTION / LESSONS LEARNED: The Unit-Based Clinical Leader model fosters interaction and close collaboration between the medical and nursing staff. Building core competencies in improvement and leadership

supports organizational capability in delivering value based healthcare to patients. We are leveraging this program to further refine the Medicine Value Process (a standardized approach to quality and patient safety) in our faculty development efforts.

ULTRASOUND FOR INTERNAL MEDICINE PHYSICIANS: THE FUTURE OF PHYSICAL EXAM Megan M. Dulohery; John Eaton; Tanya Tajouri; Anjali Bhagra. Mayo Clinic, Rochester, MN. (Control ID #1336178)

NEEDS AND OBJECTIVES: Internal medicine physicians frequently perform bedside invasive procedures such as thoracentesis, paracentesis, and central venous catheter placement. With the advent of handheld ultrasound devices, it is now easier for these physicians to enhance their physical exam and procedural skills through the use of bedside ultrasound. Literature suggests that ultrasound guidance can also enhance patient safety during invasive procedures. Despite this new tool and data, few of these physicians have formal ultrasound training. The objective of this study sought to understand the physicians baseline knowledge and skill, provide education in ultrasound principles and use, and demonstrate that internal medicine physicians can learn this skill in a timely manner.

SETTING AND PARTICIPANTS: This project was completed at the Mayo Clinic, Rochester, Minnesota, USA, in June 2010 and 2011. The participants included junior internal medicine house staff in the first three years of training. The workshop took place in a multidisciplinary simulation centre. The workshop was led by subspecialty fellows, staff, and senior medical residents.

DESCRIPTION: The project involved a novel teaching intervention including didactics and hands-on ultrasound experience in human and cadaver models in a multidisciplinary simulation centre. Our study was a multidisciplinary educational intervention which included a pre- and post-assessment of knowledge of ultrasound and skill of image acquisition. EVALUATION: A total of 136 physicians completed the workshop. One hundred thirty-three participated in the pre-survey, and all participants completed the post-survey. Forty-four (33%) participants were able to identify air in the pre-test compared to 132 (97%) on the post-test. Ninety-six (72%) were able to identify fluid on the pre-test compared to 136 (100%) on the post-test. Image acquisition was tested by assessment of the internal jugular (IJ) vein. One hundred thirty-five participants had adequate data to be included in this assessment. Eighty-five (63%) were able to demonstrate the IJ in the pre-test compared to 126 (93%) in the post-test. Eighty-three (61%) could demonstrate compressibility of the IJ in the pre-test compared to 126 (93%) in the post-test. Fifty-one (38%) were able to demonstrate appropriate gain in the pre-test compared to 116 (86%) on the post-test. Thirty-nine (29%) were able to demonstrate appropriate depth

compared to 113 (84%) on the post-test. Time to image acquisition improved by an average of 30 seconds (median 35 seconds). DISCUSSION / REFLECTION / LESSONS LEARNED: A multidisciplinary educational intervention resulted in improvement in ultrasound knowledge and its use for adequate image acquisition by internal medicine physicians in the first three years of practice. Recent trends show that ultrasound is emerging as a clinical stethoscope and is likely to become an essential element of the physicians tool box for providing timely, safe, and quality care. Our findings are very encouraging and demonstrate that this skill can be learned in a timely manner to improve the skill set of the physicians.

USING ART TO ENHANCE REFLECTION ON PROFESSIONAL ATTRIBUTES Lynn Byars1; Gerald D. Denton2. 1Walter Reed National Military Medical Center, Bethesda, MD; 2Uniformed Services University of the Health Sciences, Bethesda, MD. (Control ID #1322296)

NEEDS AND OBJECTIVES: Professional behavior of doctors is increasingly discussed in the popular press and medical literature. Methods to actively teach appropriate professional behavior (beyond implicit methods like role modeling) in undergraduate medical education are beginning to emerge. We created a novel curriculum for our Internal Medicine Clerkship, which actively teaches professional attributes utilizing art as a catalyst for reflection.

SETTING AND PARTICIPANTS: This curriculum was designed for 3 rd year medical students on the Internal

Medicine Clerkship. DESCRIPTION: Recognizing that modeling appropriate behavior, the historically cited way to teach professionalism to medical students, is a necessary but not sufficient method, we designed a curriculum to transition the learning of professional behavior from a subconscious process to a conscious one. To accomplish this, we developed a self-paced online educational module that students began during week one of our twelve-week internal medicine clerkship. The attributes laid out in Dr. Herbert Swicks June 2000 article on medical professionalism were introduced. Students were instructed to pay attention to the behaviors modeled around them in the clinics and on the wards, as well as their own behavior. Next, the students selected one of 10 different paintings available in the online module and gave a short interpretation of the artwork, followed by a discussion of the attribute of professionalism they felt was represented in the artwork. These tasks were intended to enhance the students ability to reflect upon professional behavior by allowing the artwork to serve as a surrogate for self and a memory prompt to recall a critical incident they observed. During the sixth week of the clerkship, the students wrote a brief reflective essay outlining the critical incident, applying their chosen professionalism attribute, describing their impressions and discussing how this experience might change their future practice behavior. These essays were discussed in the preceptor small group sessions, allowing fellow students to gain insight from the events witnessed by their colleagues and allowing the preceptor to provide feedback on the event and the students response to it.
EVALUATION: The curriculum was implemented at the start of this academic year as an optional project and has been well received by students and faculty. 34 of 82 students have opted to complete the project. The faculty reviews have been enthusiastically positive, with one attempt by faculty to publish a project with the student and two attempts by faculty to give feedback to other faculty regarding egregious professional behavior observed by the student. Based on initial lessons learned, a more robust assessment instrument was developed and implemented.
DISCUSSION / REFLECTION / LESSONS LEARNED: This project is an effective and palatable format to incorporate explicit professionalism teaching into the clerkship curriculum. This exercise has educational implications beyond the individual student, as small group discussions generalize the concepts learned. Further, de-identified essays were presented to house staff to promote reflection and we plan to do the same with faculty, calling attention to behaviors occurring in our own program and witnessed by students. Additionally, the curriculum could easily be adopted by other clerkships or for house staff.
USING RESEARCH TO DEMONSTRATE AND IMPROVE QUALITY OF CARE IN STUDENT-LED CLINICS
Janine Knudsen1,2;
Laura Huppert1,2; Kyle E. Dempsey1,2; Karen Donelan2,1; Rebecca Berman2,1. 1Harvard Medical School, Cambridge, MA; 2Massachusetts General Hospital, Boston, MA. (Control ID #1334974)
NEEDS AND OBJECTIVES: Student-run clinics fill crucial health care gaps for our nations underserved citizens and provide valuable medical education opportunities. However, these 100+ clinics remain under-recognized and are often rumored to provide sub-optimal care, in part due to the sparse literature evaluating their success. Student-run clinics therefore have a special imperative to demonstrate that they provide high quality, patient-centered care.
SETTING AND PARTICIPANTS: At Harvards Crimson Care Collaborative (CCC), a consortium of student-faculty clinics, we aim to provide health care to those who lack access, to reduce unnecessary hospitalizations, and to expose medical students to primary care. Since the clinics start in 2009, we have used research to better understand our patient population and to enhance the care that we provide. Here, we describe our research operations, patient population, and data-driven quality improvement efforts.
DESCRIPTION: Student researchers collect data through patient intake surveys, medical chart reviews, and clinic flow mapping to better understand patient demographics and medical-social needs, assess care quality, and measure clinic outcomes. We have also adapted the Consumer Assessment of Healthcare Providers and Systems (CAPHS) survey to evaluate patient satisfaction. Our research efforts over the last year have

demonstrated positive results and also exposed areas for clinic improvement.
EVALUATION: Our original clinic at the Massachusetts General Hospitals Internal Medicine Associates has served 263 patients, including 182 urgent care patients and 81 Bridge to Care (BTC) patients, who receive up to 1 year of primary care before transferring to a regular PCP. Our BTC patients are typically low-income (56.2%), not college educated(68.2%), underemployed (78.2%), insured through MassHealth or Mass Safety Net (59.2%), and request social services (50.9%). The experience of all of our patients reflects the need for primary care access: 49.2% of our patients visited the ED multiple times in the past year and 42.7% attributed this to the lack of physician availability. Our patient satisfaction data suggests that most of our patients would recommend the clinic to their friends and family members (95%, n=41). Although many did not know prior to the visit that both medical students and physicians would see them(41.5%), they still rate our students and faculty members highly (8.9 and9.1, respectively, out of 10).
DISCUSSION / REFLECTION / LESSONS LEARNED: By gathering data about the patients we serve, our clinic has more effectively met our patients needs and expectations. To improve patient understanding of the student-faculty collaborative model, we have revised our brochures and educated the office staff to better explain the role of the medical students in their care. Our student-run resource center uses our demographic information to help patients secure affordable medications, health insurance, food stamps, and other needs. Additionally, for the 58.5% of our patients who live with chronic disease, we have piloted an education program that utilizes motivational interviewing to help them with diet, exercise, and medication management. By addressing these patients wide range of medical and social needs, our student volunteers are exposed to the breadth of primary care. This evidenced-based, patient-centered research approach provides a model for future data-driven research and operations at other student-run clinics.
UTILIZATION OF GERIATRIC ASSESSMENT TOOLS IN AMBULATORY CARE SETTING FOR IMPROVING THE QUALITY OF PATIENT CARE PROVIDED BY THE RESIDENT TRAINEES (SPONSORED BY REYNOLDS SAGE GRANT) Sujata Bhushan. Dallas VA Medical Center, Dallas, TX. (Control ID #1334634)
NEEDS AND OBJECTIVES: As the US population ages, primary care clinicians are encountering more patients with geriatric syndromes, such as

urinary incontinence,dementia,gait instability, polypharmacy. Current evidence suggests that care of these conditions does not meet expected standards and that residents in training would benefit from tools objectively evaluating these specific conditions. We developed condition specific templates within the electronic medical record, both to improve care of patients with geriatric problems, and to provide the internal medicine residents with tools to learn and practice the essence of comprehensive assessment of the geriatric outpatient in an interdisciplinary setting. SETTING AND PARTICIPANTS: We incorporated four validated geriatric assessment tools,namely, MINI COG TEST, Get Up and Go Test, urinary incontinence algorithm and polypharmacy, in the initial outpatient evaluation of patients aged 70 years and above, formulating a treatment plan using available resources/consults. The project was implemented in the residents' primary care continuity clinic at the VA . The residents received educational material in the form of formal lectures and periodic one on one/ group discussions addressing the unique aspects of care of the elderly, in particular addressing the Competency based Objectives, including medical knowledge,practice based learning,communication and interpersonal skills,system based practice and patient care. The residents were guided by the clinic attending.
DESCRIPTION: Seventy one resident trainees, with continuity clinic at the Dallas VA were participants in the project. The tools were incorporated as computerized templates into the EMR (CPRS) at the VA after close collaboration with the CPRS team. A periodic chart review was conducted by the research team to ensure compliance and proper usage of the assessment tools . Outcome measures were improved clinical skills and

level of comfort of the resident trainees in geriatric care and patient satisfaction regarding the quality of comprehensive care. The residents were tested at the beginning and at the end of the year by means of a knowledge and attitude/perception quiz. Any improvement in patient satisfaction was assessed by a questionnaire after completion of the project. EVALUATION: A total of 361 patients enrolled in the study. Of those 361,137 completed the one year follow up survey. There were significant differences between the pre and post assessment responses pertaining to discussion of memory problems with the physician (45.3% vs 26.6%, p<.001). Also, there was a 5% decrease in the incidence of falls on the post assessment surveys. There was no significant difference in the continuous survey items regarding patient perception of care received. 82 residents completed the pre study geriatric test (including some residents who did not have continuity clinic at the VA). Only 27 residents completed the follow up quiz. Only 9 residents completed both a baseline and follow up quiz, therefore our analyses were substantially underpowered.There was a 10% improvement knowledge-wise from pre to post assessment. The resident survey items assessing attitudes regarding geriatric practice revealed no statistically significant differences, but revealed noteworthy improvements in knowledge,attitudes and understanding of issues pertaining to geriatric care.
DISCUSSION / REFLECTION / LESSONS LEARNED: Because of the small numbers, our pilot study was substantially underpowered, but the results are promising, encouraging us to continue using the tools in our clinic

WELCOME TO THE NEIGHBORHOOD: TEACHING THE SOCIAL DETERMINANTS OF HEALTH Jada Bussey-Jones1; Maura George1; Carmen Mohan1; Minesh Shah2; Stacy Higgins1; Michael Saenger1; Rinku Chatterjee1; Jason Schneider1; Mehul Tejani1; Schuyler Livingston1. 1Emory University, Atlanta, GA; 2University of Illinois, Chicago, IL. (Control ID #1338530)
NEEDS AND OBJECTIVES: Physicians entering the workforce require broad medical knowledge and practiced procedural skills. Traditional training would suffice in decreasing disease burden if medical care were the only factor relevant to patient health outcomes. Research suggests, however, that multiple complex social determinants (e.g. neighborhood characteristics, social policies, available resources) play a significant role in producing or mitigating health outcomes. Further, studies suggest students knowledge about health access and attitudes toward the underserved actually become more negative throughout medical school. Most current educational environments do not prepare learners for engagement with broader health issues. We designed a curricular intervention with the following objectives: 1) To teach learners the complexity and impact of community and other social determinants of health and 2)To demonstrate ways to connect public service and advocacy with their clinical and academic work through a combination of didactic, experiential, and direct service activities. SETTING AND PARTICIPANTS: Multi-disciplinary Emory University month long electiveDESCRIPTION: 3 core activities are used. 1. SCHOLARSHIP - Includes lectures and readings on relevant topics (advocacy, literacy, community engagement, etc). Also includes a required scholarly activity (oral presentation or submission to scientific meeting or peer-reviewed publication). 2. EXPERIENCES - (1) Observational: observing and engaging community partners as appropriate for a given module. (e.g. neighborhood assessment of available resources such as green space, fresh vegetables, pharmacy supply, safety, billboards). Learners also participate in simulation experiences and are asked to navigate public hospital as a patient (e.g. request financial assistance, get prescription filled, go to clinic appointment - assessing wait times, barriers, etc). (2) Direct Service: Participants engage one of our community partners sites using an asset model approach to collaborate and participate in public service interventions. Our learners visit and engage several essential community resources that provide context for the health of many including, for example, homeless shelters, nursing homes, and prison medical facilities. Finally, they are trained and asked to complete advocacy tasks such as meeting with legislators or writing position papers. (3) Clinical experiences: Learners provide services (when appropriate) at designated community partner sites. 3. REFLECTION - Includes group discussions with faculty and community facilitator, journaling, photo journaling.

EVALUATION: 1. Assessment the effect of the Social Medicine Elective on learners attitudes compared to matched controls through validated survey instruments (MSATU, AREA) administered at 0, 1 and 12 months. 2. Semi-structured interviews at the conclusion of the elective to characterize the kinds of learners who choose Social Medicine and identify components of the elective that are best received. 3. Electronic database to facilitate longitudinal analysis of participants in the social medicine elective.
DISCUSSION / REFLECTION / LESSONS LEARNED: Our pilot month was by all accounts a success. Our core faculty work group participated in the curriculum alongside the students, attending lectures, meeting legislators, and reflecting on the determinants of health. Most found the learning activities to be interesting, innovative, and applicable. Given the complexity of the schedule, a coordinator would be a valuable asset.
WOMEN'S HEALTH (WH) CURRICULUM FOR INTERNAL MEDICINE (IM) RESIDENTS: IMPLEMENTATION BASED ON IDENTIFICATION OF KNOWLEDGE AND COMFORT LEVEL DEFICITS IN RESIDENTS
Stephanie Hartman1; JoAnn Porter1; Rachel Bonnema2. 1Creighton University Medical Center, Omaha, NE; 2University of Nebraska Medical Center, Omaha, NE. (Control ID #1339346)
NEEDS AND OBJECTIVES: The American Board of Internal Medicine and Federated Council for Internal Medicine published WH competencies include medical knowledge and counseling skills, WH procedures, and inclusion of WH content on the American College of Physicians (ACP) in-training exam and the ABIM Board exam. Recent studies suggest gaps still exist for knowledge and comfort in WH for both residents and practicing physicians. Objective: Assess IM resident knowledge and comfort with regard to medical practices specific to women or areas of medicine with important gender differences and create a dynamic curriculum to include lecture-based, web-based, and small group problem-based learning.
SETTING AND PARTICIPANTS: IM residents in a University-based program.
DESCRIPTION: Residents completed a 27-question pre-test assessment of knowledge, an 11-question demographic and prior training related to WH survey, and a 34-question Likert questionnaire on their comfort level discussing specific topics with patients, evaluation and treatment, and procedural skills.

EVALUATION: 52/72 residents completed the initial assessment tools,51.9% female, 38.5% PGY1, 36.5% PGY2, 25% PGY3, 36.5% American medical graduates. Previous exposure to WH included: completion of an ambulatory medicine rotation (65.4%), simulated pelvic exam with model(76.9%), or gynecologic teaching aide (GTA) (88.5%), simulated breast exam with model (69.2%) or GTA (61.5%). Comfort analysis of procedures using 6-point Likert score revealed least comfort with performing and reviewing vaginal wet mount (mean 2.2) and most comfort with breast exam (mean 4.1). Residents were most comfortable discussing safe sexual practices (mean 3.9) and least comfortable discussing infertility (mean 2.9). Regarding evaluation and treatment, residents were most comfortable with cardiovascular disease (mean 3.8) and least comfortable with medications safe in pregnancy (mean 2.7). Two-way ANOVA was used to evaluate the impact of training level on comfort and knowledge. Comfort level with procedures was significantly different based on training level; PGY1 2.96 0.99, PGY2 3.090.65, PGY3 3.861.16, (p=0.024). There was no difference in comfort with discussion with patients or evaluation and treatment based on training level. In multivariate analysis increased exposure to simulation experience and foreign medical graduate status was associated with increased total comfort score (p=0.034 and p=0.004 respectively). Pre-test knowledge differed by training level with total score PGY1 15.12.8, PGY2 17.72.8, PGY3 17.12.2 (p=0.010). No difference in knowledge scores was present between genders, medical school location, future employment plans or location of continuity clinic.
DISCUSSION / REFLECTION / LESSONS LEARNED: Overall, IM residents lack confidence in multiple areas of WH procedures, treatment and evaluation. As training level increases WH knowledge is improved, although comfort was not significantly improved. Comfort was improved with increased exposure to simulation experience, which indicates it is an important curriculum tool and should be included as a part of a comprehensive WH curriculum. The next step: A lecture-based, web-based, and small group problem-based

learning series will be developed based on the areas of least knowledge and perceived least comfort. At the completion of the series all residents will be asked to complete a post-test assessment including both knowledge and comfort assessments to assess improvements in knowledge and comfort level related to WH topics.

Publication date: Jul 2012

Year: 2012

A sound investment

Author: Absolon, Paul

Publication info: Power Engineering International 20.7 (Jul/Aug 2012): 28-30.
ProQuest document link

Abstract: [...]according to research carried out by Xiaoming Zhou from the East China Normal University in Shanghai, even seemingly innocuous sounds, such as the whirr of a desk fan, can cause damage if exposure is consistent and long term. [...]the turbines proved to be the source of the noise.

Full text: Headnote

When CMS Danskin Acoustics ujos brought in to reduce dangerous noise levels at a UK power station it hod to create a tailor-made efficient and cost-effective solution.

The fact that power stations produce high levels of noise will not come as much of a surprise to anyone who has spent more than a few minutes inside one. However, iust how dangerous these levels of noise can be might.

To give you an idea of the sensitivity of the human ear, the average person can hear sounds down to about 0 decibels (dB), the equivalent of a whisper or rustling leaves, and people with exceptional hearing can detect sounds as low as -1 5 dB.

It is at the other end of the scale, however, that serious problems can occur. At around 85 dB, you are likely to experience discomfort. As little as eight hours of continuous exposure to this level of noise can result in permanent damage to the inner ear, which is why 85 dB is the maximum allowed under the Noise at Work regulations.

At 100 dB, iust 15 minutes of exposure can cause permanent damage. And at 1 10 dB the exposure time drops to around a minute before harm is inflicted. Pain is experienced at 125 dB and hearing loss can be permanent. At 140 dB or above not only is the damage permanent, it is also immediate.

The Noise at Work regulations stipulate that an "employer shall ensure that risk from the exposure to noise is either eliminated at source or, where this is not reasonably practicable, reduced to as low a level as is reasonably practicable". And that "if any employee is likely to be exposed to noise at or above an upper exposure action value, the employer shall reduce exposure to as low a level as is reasonably practicable by establishing and implementing a programme of organisational and technical measures, excluding the provision of personal hearing protectors, which is appropriate to the activity".

In other words, an employer is expected to do everything they can, within reason, to protect their employees from the harmful effects of noise. And, no, it isn it enough to simply supply a pair of ear-defenders.

The damage caused by these dangerous levels of noise is referred to as Noise-Induced Hearing Loss, and can be caused by a single exposure to a very loud sound or by repeated exposure to even relatively low levels of

noise over a long time span. In fact, according to research carried out by Xiaoming Zhou from the East China Normal University in Shanghai, even seemingly innocuous sounds, such as the whirr of a desk fan, can cause damage if exposure is consistent and long term.

The human ear does not hear all frequencies with the same intensity. It is most sensitive to sounds in the 500 Hz to 8 kHz range. Above and below this range the ear becomes progressively less sensitive. To compensate for this, sound level meters incorporate electronic filtering to correspond to the varying sensitivities of the ea~ This filtering is called A-weighting and readings obtained with this weighting are referred to as A-weighted and signified as dB(A).

TAILOR-MADE SOLUTION

Uskmouth B power station is a combined-cycle gas turbine plant near Newport in Wales, built by Siemens and operated by Severn Power, a subsidiary of Dong Energy.

Acoustics and soundproofing specialist CMS Danskin Acoustics was brought in by Siemens and SPX Cooling Technologies after the recorded noise coming from the dry cooling system was between 130 dB(A) and 135 dB(A), a full 50 dB above Noise at Work regulations' acceptable levels.

Although it was identified that these dangerous and unacceptable levels of noise came from the dry cooling system, the cooling system was not creating the noise. In fact, the turbines proved to be the source of the noise.

The steam roaring from the turbines at incredibly high speeds enters the main 5.5 metre steam ducts, passes up five risers and is channelled into the steam distribution manifolds. Not only does the steam enter the dry cooling system, the accompanying noise soes, too. You might think that the 8 mm thick steel from which the ducts are constructed would go some way to containing the noise. Unfortunately steel is extremely adopt at transmitting noise and is, in many respects the asoustion worst enemy.

To make matters worse, we discovered not only high levels of noise, but also that the noise generated had a very low-frequency bias.

Low-frequency noise is the most difficult to treat from a soundproofing perspective due to the excessive length of the wave cycle. This is one of the reasons people in apartments, terraced houses and semi-detached homes will often complain of the problems of bass noises intruding from neighbouring properties, as the walls and floors filter out the higher frequencies while the lower frequencies manage to penetrate. This can seem a little counter-intuitive, as we imagine higher frequency noise to be more piercing. Their short wave cycle, however, means they can be blocked out with relatively thin soundproofing materials.

The low-frequency nature of the noise also meant that this was not just a Noise at Work regulations problem. Low-frequency noise can be particularly problematic to the population in the vicinfty of the source of that noise.

A NEW SOUND SOLUTION

Solutions for low-frequency noise issues typically involve wrapping the problem in significant quantities of acoustic insulation, with many standard solutions being as deep as 500 mm to 700 mm. The sheer volume of lagging required for an insulation-based approach to a project like Uskmouth, with a daunting 8000 m2 of ducting to be covered, would be expensive, time-consuming to install and prohibitively disruptive. What is more, there were areas around the ducting at Uskmouth which simply would not have been able to accommodate such an excessive construction height of soundproofing material.

We had to create a `thinner' soundproofing system that would meet the necessary Noise at Work regulations requirements but would be cost-effective and efficient to install.

In order to minimise disruption at Uskmouth, an off-site simulation was created near Burton-on-Trent, using a large section of identical ducting with a `door' sealing up either end. Within the duct were several very powerful speakers. For testing, highly sensitive microphones were placed in strategic positions along the outside of the duct to measure any `leakage'. Acoustic insulation solutions were conceived, implemented and assessed in this controlled environment with the assistance of acoustic consultants Muller-BBM and the installation company

Western Thermal Insulations.
Exploring a wide range of acoustic materials from CMS Danskin Acoustics' industrial acoustics range, it became clear that a single product was not going to be able to solve the problem on its own, so we opted for a combination of products working in concert, layer upon layer.
The first layer consisted of CMS HT1 B elastomeric isolation pads, constructed from a polyurethane-bound rubber granulate specifically formulated to dampen and/or isolate noise and vibrations at source and independently tested by the Institute of Structural Dynamics at the Technical University of Dresden, Germany. The 50 mm thick pads were bonded to the surface of the duct at a rate of nine per m2, creating 300 mm spaci ngs; so, as well as the dampening effects of the material itself, the construction benefited from large, evenly distributed airspaces in its foundations. Sound waves move less effectively through dead air.
The second layer consisted of 50 mm QuietSlab SVX3, a highperformance, mineral-fibre acoustic lagging.
The third layer comprised CMS WBBKT acoustic barrier, a highdensity, barium-sulphate-loaded thermoplastic polymer, which is thin, flexible and easy to work with. Whereas the QuietSlab SVX3 layer is designed to absorb and dissipate noise, this dense acoustic barrier is designed to resist the passage of noise and is particularly adept at preventing the passage of low-frequency noise.
The forth layer duplicated the second, the fifth layer duplicated the third and the sixth and final layer consisted of a corrosion-resistant Aluzinc casing.
By alternating between thick noise-absorbent layers and thin but dense noise-resistant layers, we were able to create a soundproofing solution with a depth of iust 170 mm - between 66 per cent and 76 per cent thinner than a 500-700 mm standard solution. However, the successful reduction of the construction height would mean nothing at all if it failed to deliver the necessary levels of noise reduction. The proof would be in the testing.
Personnel from Siemens attended the test. They were standing in relatively close proximity to the simulated duct while technicians from Muller-BBM set up their equipment. As always with these situations, there were delays, so the Siemens team were standing around for quite some time. Naturally, they were a little impatient and asked when the test was going to commence. They were told the test had been running for the last ten minutes. The speakers within the ducts had been generating noise levels of 1 30-1 40 dB and no-one had noticed. Only when the lagging protecting the 'door' to the duct was removed could the true extent of the racket within be appreciated.
The testing revealed that CMS Danskin Acoustics' solution cut the noise generated by 39 per cent to iust 82-83 dB(A), well under the 85 dB required by the Noise at Work regulations.
Peter Ullrich, project director at Siemens Energy, says: "Effectively controlling noise and reducing sound emissions was a top priority for us in the Uskmouth project. Not only was it essential that the dry cooling system satisfied all the legal acoustic obligations and regulations but iust as important was that neighbouring properties were not disturbed by additional noise levels."

Sidebar

To investigate how to block noise emanating from a cooling system at the Uskmouth ? power station, a simulation of the duct system was built

Sidebar

"Solutions for low-frequency noise issues typically involve wrapping the problem in significant quantities of acoustic insulation, with many standard solutions being as deep as 500 mm to 700 mm"
CMS HT1 B elastomeric isolatioo pads form the first layer of acoustic iosulatioo for Uskmouth B's dry cooliog system

Sidebar

By alternating thick noise-absorbent layers with thin-but-dense noise-resistant layers, CMS Dan skin Acoustics created a soundproofing solution with a depth of just 170 mm
HOW HEARING WORKS

To understand how Noise-Induced Hearing Loss (NIHL) occurs, it is necessary to understand how hearing works.
The generally accepted view is that sound waves strike the eardrum and these vibrations are translated into coherent information by the brain. It is more complex than that.
Sound waves do, indeed, strike the eardrum, causing the eardrum to vibrate. These vibrations are then transmitted through the ossicles (the small bones of the middle ear) to the cochlea, a spiral-shaped chamber filled with fluid and lined with tiny hair cells called stereocilia.
The vibrations cause the fluid to move which, in turn, causes the stereocilia to move. The stereocilia s movements generate neural signals with are picked up by the auditory nerve which 'forwards' these signals onto the brain where they are interpreted as intelligible sounds such as human speech, music, the beep of a car horn.
Exposure to harmful levels of noise can damage the stereocilia, breaking them or flattening them so they no longer vibrate as effectively or so they no longer vibrate at all. The result: impaired hearing or, in extreme cases, total hearing loss.
Low frequency noise is often not even 'heard' in the traditional sense. Complainants often will not even realise that noise is the problem at all; instead they will describe 'pressure sensations' and 'physical discomfort', experiencing the incursion as vibrations.
Areas of the human body can resonate when exposed to low frequencies. The chest, for example, can resonate at frequencies between 50 Hz and 100 Hz, and the head at frequencies between 20 Hz and 30 Hz. It is not unusual, therefore, for sufferers of low frequency noise to complain of anxiety, nausea and headaches. Often, they will not even be aware of the root cause of their symptoms, instead attributing them to a virus or some mystery illness.

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Publication date: Jul/Aug 2012

Year: 2012

From the Ear to the Brain: Advances in Understanding Auditory Function, Technology and Spoken Language Development

Author: Bradham, Tamala S, PhD, CCA-A

Publication info: The Volta Review 112.2 (Summer 2012): 149-180.
ProQuest document link

Abstract: OHCs do this by providing mechanical feedback into the organ of Corti, thus enhancing the input to the inner hair cells, which predominantly send information to the central nervous system. [...]during my postdoc research, Dallos and I showed that the supporting cells were electrically coupled by gap junctions (Santos-Sacchi &Dallos, 1983), presaging subsequent independent studies that suggested connexon-based communication among supporting cells was important for potassium sinking and metabolic maintenance within the organ of Corti - two phenomenon that are required for hair cell survival and proper functioning (Santos-Sacchi, 1985). OHCs also have synapses with the eighth nerve but are dwarfed in number by those of the IHC. [...]the main job of sending acoustic information to the brain centrally falls to the IHC.

Full text: These are the proceedings of 2012 AG Bell Research Symposium, presented July 1, 2012, as part of the AG Bell 201 2 Convention. The session ivas moderated by Tamala S. Bradham, Ph.D., CCC-A. For more information about the symposium, visit www.listeningandspokenlanguage.org.

The Queens of Audition

By Joseph Santos-Sacchi, Ph.D.

Alexander Graham Bell would have been amazed to find out how the ear uses outer hair cells (OHC) to boost our sensitivity to sounds. OHCs do this by providing mechanical feedback into the organ of Corti, thus enhancing the input to the inner hair cells, which predominantly send information to the central nervous system. Prestili is the protein that drives the OHC mechanical response, and we have learned much since its discovery in the year 2000. Notably, we now know that the cochlear amplifier is controlled by anions interacting with prestin. The upshot is that the OHC evolved to use very primitive constituents to do exquisite things. There is still more to iearn.

When I was a teenager I damaged my right ear by standing too close to fireworks on the 4th of July. Tinnitus and hearing loss persist to this day, only enhanced by an additional 45 years of auditory abuse. The culprit of my Joseph Santos-Sacchi, Ph.D., is a professor in the Department of Otolaryngology at Yale School of Medicine. He has an undergraduate degree in psychology from Columbia College and a Ph.D. in audiology from Columbia University. He joined Yale University in 1991. Prior to that, Santos-Sacchi worked in labs at the City College of New York, Northwestern University and the University of Puerto Rico. He has been funded continuously by NIH/NINCDS/ N1DCD since 1984 to study hair cell and supporting cell physiology. More information can be found on his website unow.YaleEarLab.org.

problem is the hair cell, probably the outer hair cell (OHC). Hair cells that enable us to perceive sound are fragile, and when lost do not regenerate, causing permanent hearing loss (and sometimes ringing in the ear). They are amazing machines, and the whole of the ear - outer ear, middle ear, inner ear and the auditory brain - is devastated without their sustenance. They are the Queens of Audition!

Pre- Amplifiention

My Ph.D. thesis was concerned with blood capillary function in the inner ear, an attempt to understand how, at the electron microscopic level, blood-borne molecules enter the inner ear (Santos-Sacchi &Marovitz, 1980). The inner ear is a privileged site that blocks most molecular entry, just as the brain does. I convinced myself (and my doctoral committee) that this was good for the inner ear - namely that the ear protects its hair cells.

Two years later I pursued a postdoc in Peter Dallos' lab at Northwestern University. I was able to directly investigate what the OHCs were doing by recording electrical activity from them through microelectrodes in living guinea pigs. Research at that time showed that OHCs are sharply tuned to particular frequencies based on the location along the cochlea (Dallos, 1985; Dallos, Santos-Sacchi, &Flock, 1982; Russell &Sellick, 1983). Hair cells in the basal part of the cochlea respond best to high frequency sounds and those in the apex of the cochlear respond best to low frequency sounds. The frequency selectivity and sensitivity of hair cells along the cochlea were predicted based on basilar membrane and eighth nerve fiber measurements (Ruggero &SantosSacchi, 1997).

Also during my postdoc research, Dallos and I showed that the supporting cells were electrically coupled by gap junctions (Santos-Sacchi &Dallos, 1983), presaging subsequent independent studies that suggested connexon-based communication among supporting cells was important for potassium sinking and metabolic maintenance within the organ of Corti - two phenomenon that are required for hair cell survival and proper functioning (Santos-Sacchi, 1985). Not surprisingly, connexon mutations are now known to underlie a major proportion of genetically based hearing loss (Kelsell et al., 1997).

Post -Amplification

Something special happens in the inner ear to provide such fine frequency tuning and sensitivity. The momentous identification of otoacoustic emissions (OAE; emissions of sound from the ear canal) by Kemp (1978) did not subdue Brownell's amazing discovery of OHC electromotility (Brownell, Bader, Bertrand, &de Ribaupierre, 1985). Indeed, the observation that OHCs are not only receptors of sound, but can respond mechanically, and the identification of OAEs prompted a paradigm change in auditory research. I joined the electromotility club early on, providing evidence that electromotility was driven by the voltage across the OHC membrane (Santos-Sacchi &Dilger, 1988). Since then I have focused on the biophysical and molecular aspects of OHC motility.

The Amazing OHC

The OHC is more specialized than its neighbor, the inner hair cell (IHC). Similar to the IHC, however, OHCs have an apical region of the cell that houses the sound transduction apparatus, a collection of yet-to-be-identified mechanically activated (MET) channels that reside in the membrane tips of stereocilia. Stereocilia are tall membrane extrusions that are stiff because they contain a tightly packed core of actin filaments. Movement of the stereociliar bundle permits MET channels to allow potassium to enter the cell, and the resulting receptor potential depolarizes the cell's membrane. For the IHC, the main purpose of this depolarization is to evoke neurotransmitter release at the bottom part of the cell where auditory eighth nerve fibers synapse. OHCs also have synapses with the eighth nerve but are dwarfed in number by those of the IHC. Thus, the main job of sending acoustic information to the brain centrally falls to the IHC.

It's the middle part of the OHC, which IHCs do not have, that piqued my interest. Research has shown that the membrane in this region houses the molecular motors responsible for electromotility (Figure 1). One of the ways to study the activity of the motors is to measure its conformational change (shape change) within the membrane when voltage across the membrane is altered, as might occur when receptor potentials are generated. The conformational change is associated with the restricted movement of motor-bound charges within the membrane that can be measured as a nonlinear capacitance (NLC).

Capacitance is the ability to store charge, and normally a membrane will have a capacitance proportional to its area, just like an electrical capacitor component. The membrane capacitance, defined as the change in charge divided by the change in membrane voltage (dQ/dVm), is the same at any membrane potential in IHCs, i.e., it is linear because this cell lacks the charged molecular motors found in the OHC. The OHCs, however, have a voltagedependent capacitance that is bell-shaped riding atop a flat linear capacitance (Figure 2). The peak of the NLC occurs at a membrane voltage where the voltage sensitivity of motor conformational activity, and consequently, electromotility, is greatest (called Vh). The range over which NLC extends across Vm is the operational range of the motor. Research in the previous two decades has established that NLC and electromotility share such common characteristics.

In 2000, Dallos and colleagues discovered the motor protein responsible for electromotility (Zheng et al., 2000). They called it prestin because it is fast. When artificially expressed in non-auditory cells, it displays all the characteristics that the native OHC displays, including a NLC with a voltage dependent mechanical response of the membrane. Prestin has been shown to display additional qualities that were previously identified in the native OHC (reviewed in Santos-Sacchi, 2003). Shared qualities include 1) a piezoelectriclike phenomenon, where not only does voltage induce a mechanical response, but reciprocally membrane deformation induces an electrical response; 2) marked temperature sensitivity; 3) a dependence of the protein's operational voltage ranges on resting potential; and 4) a dependence on intracellular chloride.

The latter characteristic, chloride dependence of the motor, has been a topic of focus for 12 years now. The anion appears to work by binding to prestin and affecting the protein's ability to change conformation within the membrane when voltage is modulated. This chloride sensitivity is not totally unexpected since prestin is part of a family of proteins that transports anions across the membrane. What is surprising is that the protein, unlike its family members, has evolved to aid in cochlear amplification. This was very apparent when, in collaboration with

Fred Nuttall's research group, we were able to reversibly reduce basilar membrane motion in the guinea pig by manipulating chloride levels bathing the OHCs (Santos-Sacchi, Song, Zheng, &Nuttall, 2006). The defeat of cochlear amplification was reversible upon restoring normal chloride levels (Figure 3).

One of the characteristic properties of chloride on prestin is to shift the motor's operating voltage range; should intracellular chloride levels decrease from normal, a shift of the electromotility function in the depolarizing direction will follow, effectively making the receptor potential incapable of generating mechanical responses. In another demonstration of the importance of prestin's operating voltage range, Dallos and colleagues (Dallos et al., 2008) were able to knock-in genetically modified prestin molecules into the OHCs of the living mouse. The new prestin was engineered to have its operating range shifted in the depolarizing direction, thus preventing the OHC receptor potential from evoking mechanical responses. Of course, in this case, the hearing loss was irreversible. Experiments such as these support the notion that, in mammals, cochlear amplification results from prestin activity, and not other mechanisms.

While we know the effects of anions on the NLC of OHCs and predict their effects on electromotility in vivo, little work has been done on OHC mechanics directly. Our predictions assume that NLC exactly characterizes electromotility. Could chloride be working in ways other than changing the OHC operating range? Lately, we have been reinvestigating the coupling between prestin motor conformational change and electromotility. It turns out that the two are variably uncoupled depending on concentration of intracellular chloride; that is, the operating voltage ranges appear to be separately modifiable (Song &Santos-Sacchi, 2012).

To further explain, within the organ of Corti, in order for OHCs to effectively promote enhanced basilar membrane motion, they must exert their forces at the proper moment during sound induced basil membrane vibration. This is akin to pushing with your child's movements on a swing, not against her. That is, the timing, or phase of, energy injection must be appropriate. In the past, cochlear modelers have resorted to various strategies to generate enough phase delay between receptor potentials and OHC forces for their models to reasonably describe experimental data. The physiological basis for such delays was always removed from the OHC. We think that the variable couplings between conformational changes of prestin (NLC) and electromotility results from a time delay between the two, and we suggest that the mechanical forces of the OHC can be tuned to the requirements of the cochlea by chloride homeostasis. Thus, we believe that anions have a preeminent role in how we hear.

Summary

Over the years that I have been working on the mechanics of hearing, I have learned about many things that the supporting cells and hair cells do right. Unfortunately, these are the same things that can be disturbed and have, I'm sure, contributed to my own hearing problems. But I am convinced that with a better understanding of how things work, we will ultimately know what and how to repair. So tell me more Queens of Audition, I'm listening!

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Speech Perception and Hearing Loss

Byjont B. Allen, Ph.D., Andrea Trevino, and Woojae Han, Ph.D.

Over 150 years after the early research of Alexander Graham Bell, it remains unclear how the auditory system decodes speech, both in individuals who have "normal ears" and those who have "non-normal ears." Recent research has shown that normal ears can decode isolated consonants without error. However, when the inner ear is damaged, such as with sensorineural hearing loss where hair cells and synaptic connections are not properly functioning, speech can be heard but not understood. In these cases, two seemingly-normal articidated utterances of the same consonant can result in totally different responses. Such specific and consistent confusions uniquely depend on the auditory system's function and the utterance. This presentation will discuss the differences between how the auditory systems of normal ears and non-normal ears receive and decode speech.

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Introduction

Existing clinical methods for diagnosing speech disorders in individuals with damaged inner ears seem fundamentally broken. Today when patients go to an audiology clinic, their pure-tone hearing thresholds are first measured. Based on the degree of tonal hearing loss, a hearing aid may be prescribed, which is subsequently

adjusted to partially compensate for the pure-tone loss. This may or may not improve the ear's speech loss (Waiden &Montgomery, 1975). But since the speech loss is infrequently measured (or worse, the method of measurement is ineffective), the change is not quantified.

Based on the evidence available, it has been shown that speech testing has not been successful in fitting hearing aids (Waiden &Montgomery, 1975). This seems counterintuitive since the main purpose of wearing a hearing aid is to improve speech understanding. Due to historically poor understanding of the fundamentals of speech perception, it has proven difficult to resolve this inconsistency. First, researchers may not understand the process of learning speech, which typically takes place in the first one to two years of life. Second, due to middle ear infections, young children can temporary lose their hearing, which can interfere with learning spoken language. It is not until the first year of school when the child is learning how to read that the child's ability to hear consonants is first fully tested.

Children who cannot accurately decode consonants may have increased difficulty with orthography. For example, if an ear cannot hear the distinction between /b/ and /d/ or between /t/ and /f/, the child is likely to misunderstand the importance of the shape of the letter [loop at bottom, closing to the left (d) or right (b), and curl at top (f) or bottom (t)]. The classroom teacher assumes that if a child's hearing is normal, then the child can hear the consonant distinctions. However, this assumption can be wrong and if so, the child's consonant decoding deficiency will go undetected (it will not show up in a pure-tone hearing test). When the child passes a hearing screen it is assumed, incorrectly, that they can decode syllables. What is needed is a targeted consonant discrimination test to predict these reading disorders.

Clinical audiologists can also make the same assumptions about adult speech perception, and research has shown that many of these assumptions can be wrong. The most serious assumption has been that consonants are homogeneous. Research has shown that for "normal ears," confusions systematically depend on the consonant (Phatak &Allen, 2007; Phatak, Lovitt, &Allen, 2008; Singh &Allen, 2012). For "non-normal ears," the errors dramatically increase, again depending on the ear, the noise-level, and, most significantly, the utterance. If consonants were homogeneous, the confusions, as a function of the noise level, would be the same from one consonant to the next. This is not the case, since consonant confusions are highly dependent on the utterance (Han, 2011; Singh &Allen, 2012). While normal ears give similar confusions for a given utterance as a function of the noise, non-normal ears are idiosyncratic in their error patterns. The idiosyncratic nature of the speech scores implies that they may not be averaged. It is this inappropriate averaging that has led clinicians to believe that speech is not a reliable measure for fitting hearing aids.

In the last few years, the Human Speech Research (HSR) group at the Beckman Institute for Advanced Science and Technology at the University of Illinois, Urbana-Champaign, has determined some key elements in this chain that seem to enlighten responses from both normal and non-normal ears. For our purposes, "normal ears" are defined as those with pure-tone thresholds less than 20 dB-SPL, and "non-normal ears" are defined as having pure-tone thresholds greater than 20 dB-SPL.

Until very recently, it was not understood that the normal ear can detect speech with essentially zero error, down to -10 dB SNR (three times more speech-shaped noise than speech) (Phatak et al., 2008). As the noise increases, the error goes from zero to chance performance over a small signal-to-noise ratio (SNR) range. These new results totally change the understanding of what is happening in normal ears because it means consonant perception is binary (Singh &Allen, 2012).

The focus of this paper is to describe this difference in performance between the normal and non-normal ear at the utterance level. The paper will explain what the HSR group has found, and then predict where this research will go in the next few years. In addition, we will discuss a speech test that teases out such natural occurring idiosyncratic speech confusions, which we argue will eventually be useful for fitting hearing aids.

How Does Speech Perception Fail?

The challenge remains to understand the auditory processing strategy of the auditory cortex, which is wired to

non-normal ears. To understand how normal ears decode consonants, the HSR group repeated the classic consonant perception experiments of Fletcher (1922) and Miller and Nicely (1955), among others. This gave us access to important new data and the ability to reassess many widely held assumptions. The first lesson of this research is the "sin of averaging" - while audiology is built on averaging measures, most of the interesting information is lost in these averages. We have shown, for example, that averaging across consonants distorts the measure as does averaging across talkers for a given consonant. We have also found that entropy (a probabilistic measure of consistency) is more robust than the average error.

In 1970-80, a number of studies explored the role of the transitional and burst cues in a consonant-vowel (CV) context. In a review of the literature, Cole and Scott (1974) argued that the burst must play at least a partial role in perception, along with transition and speech energy envelope cues. Explicitly responding to Cole and Scott (1974), Dorman and colleagues (1977) executed an extensive experiment using natural speech made up from nine vowels proceeded by /b, d, g/. The experimental procedure consisted of truncating the consonant burst and the devoiced transition (following the burst) of a CVC, and then splicing these onto a second VC sound, presumably with no transition component (since it had no initial consonant). Their results were presented as a complex set of interactions between the initial consonant (burst and devoiced cue) and the following vowel (i.e., coarticulations).

The same year Blumstein and colleagues (1977) published a related /b, d, g/ study using synthetic speech that also presented a look at the burst and a host of transition cues. They explored the possibility that the acoustic cues were integrated (acted as a whole). This study was looking to distinguish the necessary from the sufficient cues, and first introduced the concept of conflicting cues in an attempt to pit one type (burst cues) against the other (transition cues).

While these three key studies highlighted the relative importance of the two main types of acoustic cue, burst and transition, they left unresolved the identity and relative roles of these cues. No masking noise was used in the studies, ruling out any form of information analysis. Masking is key to an information theoretic analysis of any communication channel (Allen, 1994, 1996; Fletcher, 1922; Shannon, 1948). As discussed by Allen (2005), based on the earlier work of Fletcher and Gait (1950), Miller and Nicely (1955), and inspired by Shannon's source-channel model of communication, the HSR group repeated many of the classic experiments (Li &Allen, 2009; Phatak &Allen, 2007; Phatak et al., 2008). The data resulting from our several experiments will be discussed in the remainder of the paper.

Identifying Perceptual Cues

Li and colleagues (2010) first described a method to robustly identify speech cues for a variety of naturally produced CV speech sounds. This method uses a 3-dimensional psychophysical approach using a variety of noise levels, timetruncation, and high and low pass filtering. These experiments made it possible, for the first time, to reliably locate the subset of perceptually relevant cues in time and frequency, while the noise-masking data characterizes the cue's masked threshold (i.e., its strength).

Figure 4 describes the resulting consonant maps. Not surprisingly, the perceptual cues associated with fricative sounds are quite different from the plosives. Timing and bandwidth remain important variables. For the fricative sounds, the lower edge of the swath of frication noise is the perceptual cue.

Briefly summarized in Figure 4, the CV sounds /ta, da/ are defined by a burst at high frequencies, /ka, ga/ are defined by a similar burst in the mid frequencies, and /ba, pa/ were traced back to a wide-band burst. As noise is added, the wide-band burst frequently degenerates into a low frequency burst, resulting in low-level confusions. The recognition of burst-consonants further depends on the delay between the burst and the sonorant onset, defined as the voice onset time (VOT). Consonants /t, k, p/ are voiceless sounds, occurring about 50 [ms] before the onset of F0 voicing while /d, g/ have a VOT <20 [ms]. Plosive /b/ may have a negative VOT.

Based on the results of Li and colleagues (2010), this study, along with a host of verification experiments on the

~100 CV utterances in the HSR database (Kapoor &Allen, 2012; Li &Allen, 2011; Régnier &Allen, 2008), we have conclusively demonstrated that these features uniquely label the indicated consonant.

Methods

Isolated CVs were taken from naturally produced speech from 18 talkers. Noise was added to the speech with a range from -26 dB to quiet (Q). Both uniform and speech weighted spectrum level noise was added to the speech. The listener corpus consisted of more than 200 normal and 45 non-normal ears, with 9-16 consonant and 8 vowel sounds. To assure the estimates of the error are reliable, a minimum of 10 trials per utterance and SNR are required (Han, 2011; Phatak, Yoon, Gooler, &Allen, 2009; Singh &Allen, 2012). The difference between these new experiments and their classic counterparts is that the utterances of each consonant are not averaged.

Results

In Figure 5, the average probability of the error P,.(SNR) is shown (for speechweighted noise the SNR is the same as the articulation index). On the left (a), the "average normal hearing" (ANH) score P,,(SNR) (black line), along with the score for each heard consonant /h/, given spoken consonant /s/ as a function of the SNR for flat-spectrum masking noise (Phatak et al., 2009). There is a huge variation in scores across the consonants: the SNR corresponding to the 50% point ranges from -12 dB [/m, n/] to +8 dB [/θ, ö/] [shown as /?/ and /?/ in Figure 5)]. Such a large range of scores is not captured by an average. Not shown here, each utterance in the HSR database has a wide range of scores, varying in error from zero to chance depending on the masking noise intensity (Singh &Allen, 2012).

The right panel (b) shows the average scores for the 17 non-normal ears as compared to the average scores of the participants with normal hearing in speech-shaped masking noise. One of the best ears in terms of average error is 36R. Not shown is that his error for /ba/ reaches 100%, while the remaining 13 consonants tested had zero error. Thus, the reported performance is highly distorted, again due to the "sin of averaging."

A second major conclusion is that when characterizing a listener with hearing loss, one must look at the individual confusions. In Figure 6, confusion patterns (CPs) are compared to SNR. The CP is a graphical display of the confusion probabilities as a function of the intensity of the masking noise relative to the speech. To estimate a CP requires a totally different clinical measure than is being applied today. CPs allow one to visualize the confusions of each sound as a function of the SNR. From the CP it is easy to identify a sound that primes, meaning that it can be heard as one of several sounds with equal probability by changing one's mental bias. In this case the CPs show subject responses that are equal (the curves cross each other), similar to the CP of Figure 6(b) at -8 dB where one naturally primes /p/, / 1/, and, to a lesser extent, /k/ (at -10 dB).

When asked, most clinicians report that they do not have the time to make detailed measures. In our opinion, this is more a reflection of old habits than actual time constraints. The confusion sets, and their dependence on the noise, are not predictable without such tests. Utterance confusions and their masked dependence are important because they reveal the mix of underlying perceptual cues being confused with the target sound. When using an utterance confusion measure, each non-normal ear consistently makes large errors on a small subset of utterances. Furthermore, for a given utterance, there are patterns in these errors across listeners with hearing loss. In other words, normally spoken utterances are heard idiosyncratically by non-normal ears, yet with correlated error patterns.

Confusions in Non-Normal Ears

As a direct extension of earlier studies (e.g., Phatak et al., 2009), four experiments were performed (Han 2011), two of which will be reported on here. In Experiment 1 (Exp-1), full-rank confusion matrices for the 16 Miller-Nicely CV sounds were determined at 6 SNR [Q, 12, 6, 0, -6, and -12 dB] for 46 nonnormal ears (25 subjects). In Experiment 2 (Exp-2), a subset of 17 ears were remeasured, but with the total number of trials per SNR per consonant raised from 2-8 (Exp-1) to as high as 20 (Exp-2) to statistically verify the reliability of the subjects' responses in doing the task.

Figure 7 shows that listeners with hearing loss are using a common strategy that depends systematically on the utterance. Clearly, if such very different scores for the two /ba/ sounds were to be averaged together (i.e., present clinical practice), the idiosyncratic (i.e., the most important) information about the ears would be lost. As discussed earlier, the average score is a distorted metric due to its high variance a) across consonants, b) across utterances for each consonant, and c) across subjects with hearing loss. Entropy gives a direct measure of consistency and is insensitive to mislabeling errors (e.g., consistently across a voicing error, as in reporting /d/ given /t/). Given the observed increased mislabeling of sounds in non-normal ears, a high-consistency measure (i.e., entropy) seems to be a better measure.

Summary

This article has reviewed some of what the HSR group has recently learned about speech perception of consonants, and how this knowledge might impact understanding of nonlinear (NL) cochlear speech processing. However, the role of outer hair cell (OHC) processing of speech is still poorly understood (Allen, 2008; Allen &Li, 2009). It is now widely accepted that OHCs provide dynamic range and are responsible for much of the NL cochlear speech signal processing, thus the common element that links all the NL data (Allen, Régnier, Phatak, &Li, 2009). OHC dynamics must be understood before any model can hope to succeed in predicting basilar membrane, hair cell, neural tuning, and NL compression. Understanding the OHCs two-way mechanical transduction may be the key to solving the problem of the cochlea's dynamic range and dynamic response (Allen, 2003).

However, the perception of speech by the non-normal ear does not seem to be consistent with the above commonly held view. For example, the large individual differences seem inconsistent with the OHC as the tying link, and seem more likely related to synaptic dead regions (Kujawa &Liberman, 2009). Continued analysis of these confusions will hopefully provide further insights into this important question. The detailed study of how a complex system fails can give deep insights into how the normal system works.

The key open problem here is, "How does the auditory system (e.g., the NL cochlea and the auditory cortex) process human speech?" There are many applications of these results including speech coding, speech recognition in noise, hearing aids, and cochlear implants as well as language acquisition and reading disorders in children. If we can solve the robust phone decoding problem, we will fundamentally change the effectiveness of human-machine interactions. For example, the ultimate hearing aid is the hearing aid with built in robust speech feature detection and phone recognition. While researchers have no idea when speech-aware hearing aids will come to be, and the time is undoubtedly many years off, when it happens, it will be a technological revolution of some magnitude.

Acknowledgments

We gratefully acknowledge Phonak and Research in Motion for their generous support of this research. Much of the work was also supported by NIH grant # RDC009277A.

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The Restoration of Speech Understanding by Electrical Stimulation of the Auditory System
By Michael Dormán, Ph.D.
The first cochlear implant surgery was performed over 50 years ago and allowed a patient to hear "sounds." Today, professionals expect high levels of speech understanding for adults who are postlingually deaf and who receive a cochlear implant, and for children who are congenitally deaf - if the children receive a cochlear implant

early and if they receive intensive listening and spoken language intervention. This presentation will provide a broad view of the technology underlying cochlear implants and describe possible next steps in the evolution of these devices.

Over 50 years ago, William House, M.D., performed the first cochlear implant surgery. The results were modest - the patient reported hearing "sounds." Today, professionals expect that the majority of adult patients who are late-deafened, when fit with a cochlear implant, will achieve 80-100% correct scores on tests of sentence understanding in quiet (Wilson &Dormán, 2008). Professionals expect that many children who are congenitally deaf, if fitted with a cochlear implant before the age of 3 and if given extensive (re)habilitation, will perform near the level of their age-matched peers who have typical hearing on tests of speech understanding when in elementary school. These results, for adults and children, underlie the claim that cochlear implants are one of the miracles of modern medicine.

After 50 years of effort, cochlear implantation is now a mature discipline - professionals expect good results for most patients. Nonetheless, researchers continue their work and new developments extend the promise of even higher levels of speech understanding for individuals with hearing loss.

Better Hearing by "Hybrid" Stimulation

One innovation, a relatively simple one at that, is combining electric stimulation with acoustic stimulation. The majority of patients who qualify for a cochlear implant in one ear have some low-frequency acoustic hearing in the Michael Dormán, Ph.D., is a professor in the Department of Speech and Hearing Sciences at Arizona State University. He received his Ph.D. in experimental child and developmental psychology (with a linguistics minor) from the University of Connecticut in 1971. He is a Fellow of the Acoustical Society of America and the author of over 150 publications in areas including speech perception by infants, adults, listeners with hearing loss and listeners fit with cochlear implants; cortical lateralization of function; and neural plasticity. His work on cochlear implants has been supported continuously by the National Institutes of Health since 1989.

other. Researchers at Arizona State University have found that patients with hearing only at 125 Hz and 250 Hz, i.e., at very low frequencies, can use the information carried by these frequencies to improve speech understanding via their implant. This low-frequency information is especially useful in noise, which is fortunate because cochlear implants alone do not provide high levels of speech understanding when speech is presented against a background of noise.

A recent surgical innovation, hearing preservation surgery, allows surgeons to implant an electrode array and to preserve low-frequency hearing in the implanted ear. This provides much better speech understanding via the implanted ear and provides the listener with two partially hearing ears - the ear opposite the implant and the ear with the implant. Having two partially hearing ears is of benefit in listening environments where noise surrounds the listener.

Hearing preservation surgery allows patients with substantial low-frequency hearing and speech understanding to receive a cochlear implant and to benefit from "hybrid" hearing. Researchers working on this technique expect to see, in the near future, patients with up to 60% word scores by hearing alone to qualify for a cochlear implant. The logical extension of this idea is cochlear implantation for the "common variety" of high-frequency hearing loss. Of course, the greater the amount of hearing and speech understanding, the greater the consequences of losing both, if hearing is not preserved. The calculation for or against cochlear implant surgery for these individuals will not be simple.

Hearing preservation surgery will also create patients with a cochlear implant in each ear and low-frequency hearing in each ear. Researchers have tested several patients like this and, when tested in complex listening situations, find that they benefit from having two implants versus one and having two partially hearing ears versus one.

Better Hearing through Chemistry

The odds of retaining low-frequency hearing following cochlear implant surgery can be improved by the

administration of protective drugs during the surgical procedure. Studies have shown that some drugs, such as dexamethasone, can prevent inner-ear cell damage from exposure to very loud noises, similar to the noise produced by surgical drilling for cochlear implants. The same drug can rescue cells 24 hours after exposure to loud noises or other drugs that destroy hearing. These results have stimulated researchers to create electrode arrays that both deliver a drug and provide electrical stimulation to the cochlea. The delivery of drugs during cochlear implant surgery and in the weeks and months post-surgery via the electrode array will allow for the maximum conservation of residual hearing in the implanted ear.

This same technology of combined drug delivery and electrical stimulation holds tremendous promise for young children receiving cochlear implants. Research has shown that administration of a class of drugs called neurotropic drugs can stimulate the growth of neurons (Sinohara et al., 2002) and could even promote the growth of neural fibers up the chemical gradient to the electrode that is releasing the drug. If this can be achieved in very young children, then professionals will have a method of preserving the neural elements in the child's cochlea and a method of getting neural elements very close to the electrode array. The latter would allow very low levels of current to be used for stimulation and should result in much better frequency resolution. Better frequency resolution would lead to better speech understanding and, perhaps, better appreciation of music.

Better Hearing from Early Stimulation

Brain wiring is determined by both intrinsic factors of biology and by environmental stimulation. In the absence of auditory stimulation early in development, the auditory brain will not develop typically and will not have the usual connections to other areas of the brain that process speech and language (Krai &O'Donoghue, 2010). indeed, in the absence of auditory stimulation, some auditory areas can be usurped by other sensory modalities, such as vision or touch. Thus, early stimulation of the auditory pathways is critical to driving a developing brain into the configuration shown by infants with typical hearing. At issue for parents is, how early is "early" and how late is "late?" If a child has had no auditory stimulation for the first seven years of life, then the odds of achieving reasonable levels of speech understanding via a cochlear implant are poor. A child who receives a cochlear implant by age 2-3 years will have better odds of a good outcome (Svirsky et al., 2007), and age 1 year is now a standard for most children who receive cochlear implants. There is some evidence that receiving a cochlear implant under the age of 1 provides some advantages (Houston &Miyamoto, 2010), but very early implantation must be weighed against surgical risks and other factors (Cosetti &Roland, 2010).

The need for early stimulation to shape connections within and among different areas of the auditory brain puts parents, who wish to wait for something better than a cochlear implant for their child, in a difficult position. Imagine a therapy, for example, based on stem cells that could regenerate the cell bodies and related structures in the cochlea that are absent in a child who has a profound hearing loss. And imagine that this therapy is still 10 years away. What would speech understanding be like for a child with regenerated cells in the cochlea but who had been without stimulation for 10 years? Because the brain would not have developed typical connections within and between brain areas that subserve hearing and language, the value of having new cells in the cochlea could be very small. Early restoration of function should be the hope of parents who wish their child to experience typical or near typical development of speech and language skills.

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Spoken Language Development in Infants who are Deaf or Hard of Hearing: The Role of Maternal Infant-Directed Speech
By Tonya R. Bergeson-Dana, Ph.D., Indiana University
How do children learn spoken language? Most children with typical hearing learn from infancy the sound of their mother's voice, a type of speech researchers call infantdirected speech. Mothers, fathers and most adults speak to infants in a sing-song manner, exaggerating the melody and rhythm of their speech. But what happens when this connection is broken, such as with a child who has hearing loss? This article will discuss the importance of infant-directed speech, and how infants with hearing loss respond to such talk in comparison to infants with typical hearing.
How do children learn spoken language? In children who are developing typically, this feat is accomplished more or less naturally through active experiences with caregivers and the child's environment. Parents don't enroll infants and toddlers in spoken language classes; instead, they model, encourage, and stimulate their speech and language attempts by responding to the cries and coos of infants and holding simple conversations with toddlers. In fact, caregivers across the world actually speak to their infants and young children using a special style of speech commonly known as "babytalk" or "motherese." Researchers and scholars call this infant-directed speech. Mothers, fathers, and even strangers off the streets speak to infants in a sing-song manner, exaggerating the melody and rhythm of their speech (e.g., Ferguson, 1964; Fernald, 1989). Caregivers are flexible with this speech style, adjusting the levels of exaggeration according to the social context and their infant's age (e.g., Kitamura, Thanavishuth, Burnham, &Luksaneeyanawin, 2002; Stern, Spieker, Barnett, &MacKain, 1983). This speech style is now known to contribute in many ways not only to infants' social-emotional development, but also to their speech, language, and cognitive development (e.g., Liu, Kuhl, &Tsao, 2003).
Tonya R. Bergeson-Dana, Ph.D., is an associate professor, Philip F. Hoi ton Investigator, and co-director of the Babytalk Research Laboratory in the Department of Otolaryngology-Head &Neck Surgery at the Indiana University School of Medicine in Indianapolis, Ind. She received undergraduate degrees in music theory and psychology from Northwestern University, and an M.A. and Ph.D. in cognitive psychology from the University of Toronto. Bergeson is currently interested in three areas of research: the effects of hearing loss and subsequent amplification via hearing aids or cochlear implants on mothers' speech to infants with mild to profound hearing loss; the development of multimodal perception skills in infants who are deaf following amplification; and the effects of cochlear implantation and hearing experience on music perception and production in infants, children, and adults. She is particularly interested in the effects of early experience on developing language and auditory perception.
Sometimes that natural connection between caregivers and infants can be disrupted. For example, caregivers who suffer from depression have difficulty connecting with their children, speaking to them in monotones with flat affect. Researchers have shown that infants of mothers who are depressed have a difficult time learning new associations from such speech (Kaplan, Bachorowski, Smoski, &Hudenko, 2002), which likely has cascading effects on the development of spoken language and cognition. Moreover, children in families with low socioeconomic status are at a serious disadvantage compared to children in families with high socioeconomic status in terms of both spoken language input quantity and quality. Researchers have found that caregivers with fewer financial and educational resources use fewer words in their infantand child-directed speech than

caregivers with greater financial and educational resources (Hart &Risley, 1995). This effect later translates to language abilities, with children from low income homes exhibiting much worse language skills compared to children from high income homes (Hart &Risely, 1995). These studies, among others, highlight the importance of caregivers' speech to infants as they develop spoken language.

What happens, then, if infants have a hard time hearing their caregivers? How do children who are deaf or hard of hearing learn spoken language? With the advent of new technologies, such as cochlear implants and state-of-the-art hearing aids, children with hearing loss now have the most access to sound and spoken language in their environment than ever before. Because of this, we would expect caregivers to speak to their infants and children with hearing loss just the same as those with typical hearing. And children with hearing loss who use hearing aids or cochlear implants should demonstrate similar spoken language development as children with typical hearing. Children who are deaf or hard of hearing can achieve speech and spoken language abilities on par with their typically developing peers with the use of such assistive devices (e.g., Peterson, Pisoni, &Miyamoto, 2010). However, there are large individual differences among these children; not all children with hearing loss benefit to the same degree from cochlear implants or hearing aids (Pisoni, Cleary, Geers, &Tobey, 1999; Pisoni et al., 2008). As recently as 10 years ago, researchers could only guess at why this is the case because there were no pre-amplification predictors of outcome and benefit. However, recent studies have shown potential predictors of children who will succeed with hearing aids or cochlear implants that are related to early auditory experience (e.g., Bergeson &Pisoni, 2004).

Child Perception of Infant-Directed Speech

The focus of this paper is one of the most important factors that can determine infants' benefit and success in spoken language development via amplification: early auditory experiences from infants' interactions with their caregivers, or infant-directed speech. The first question addressed is, do infants who have hearing loss for the first part of their life pay the same kind of attention to infant-directed speech as infants with typical hearing do? This is one way to determine if infants with hearing loss are reinforcing caregivers' use of infant-directed speech.

To answer this question, let's first review what is known about infant attention to maternal speech in typical development. At least two types of infant behaviors have been established by researchers. First, infants with typical hearing, from birth to 12 months old, prefer to listen to infant-directed speech over adult-directed speech (Fernald &Simon, 1984; Fernald et al., 1989; Grieser &Kühl, 1988; Kitamura et al., 2002; Kühl et al., 1997). Infants are especially responsive to the melodic quality of infant-directed speech (Fernald &Kuhl, 1987). Infants' increased attention to infant-directed speech might actually help them process and understand speech and language. For example, infants find it easier to pick out new words from a spoken passage when listening to infant-directed speech rather than adult-directed speech (Thiessen, Hill, &Saffran, 2005). Mothers tend to highlight new words when speaking to infants much more so than when speaking to adults.

Second, infants with typical hearing recognize and prefer to listen to their own mothers' voice (DeCasper &Fifer, 1980). Amazingly, preference for maternal voices seems to develop even before infants are born. One study found that infants in the womb have different heart rate patterns in response to their mother's voice as compared to a stranger's voice (Kisilevsky et al., 2003). These findings also highlight the important effects of very early auditory experience on infants' speech perception abilities.

But what about infants and toddlers who have congenital hearing loss and receive hearing aids or cochlear implants? Do they pay the same type of attention to speech as infants with typical hearing? Research from the Babytalk Research Laboratory has been addressing this very question. One of the difficulties of assessing attention in this population is that the research participants are preverbal. That is, we cannot simply ask the infants and toddlers, "What do you think about this speech? Do you like this type of speech better than the other?" Instead, we use tried-and-true methods taken from the field of developmental psychology. Infants sit on their caregivers' laps inside a large sound-proof booth. We draw their attention to a TV monitor in front of them,

and then present various audio-visual stimuli. Previous research has shown that infants will naturally look longer towards a visual display near a sound source if they're interested in what they're hearing.

In one particular study, we measured infants' looking time to a red-andwhite checkerboard pattern on the TV monitor while listening to four different mothers speaking in either an infant-directed or adult-directed style of speech. The study also included silent trials to determine how much infants prefer speech in general to silence. Infants with typical hearing attended much longer to speech trials than silent trials, and generally preferred infant-directed to adult-directed speech. Infants with mild-to-moderate hearing loss who use hearing aids showed similar patterns, but it took a little longer for them to develop their preferences than infants with typical hearing. Finally, infants with cochlear implants did not show a preference for infant-directed speech over adult-directed speech until approximately 9-12 months post-implantation. And even then, they did not attend any longer to the adult-directed speech than to silence! These findings have major implications for child-caregiver interactions and spoken language development.

There are some studies about recognition of voices in children who are deaf or hard of hearing. Several studies have shown that cochlear implant users find it difficult to distinguish the voices of different talkers, particularly if the talkers are the same sex (Cleary &Pisoni, 2002; Cleary, Pisoni, &Kirk, 2005; Fu, Chinchilla, &Galvin, 2004). However, one recent study showed that children ages 5-15 years old who use cochlear implants can tell apart their own mother 's voice from other men, children, and even other women, although their performance is not as good as that of children with typical hearing (Vongpaisal, Trehub, Schellenberg, van Lieshout, &Papsin, 2010). The Babytalk Research Laboratory is in the midst of conducting another study to determine whether infants with congenital hearing loss can distinguish their own mother's voice from a stranger's voice. This study uses a habituation paradigm, in which a series of different women reciting passages in an infant-directed speech style is presented to infants who have about one year of hearing aid or cochlear implant experience. The idea is that infants will again pay attention to a checkerboard pattern on the TV monitor directly ahead of them when they are interested in the speech sounds. In a habituation paradigm, it is also expected that infants will start off with a high amount of interest and gradually become bored as the same category of sound (i.e., women's infant-directed speech) is repeated. Two test trials are presented once they reach a criterion point of boredom: one is their own mother 's voice and the other is a stranger 's voice. If they recognize their mother 's voice, infants should theoretically pay more attention than to the last habituation trial and the test trial with the stranger's voice. If they do not recognize their mother's voice, then they should pay equal attention to all three trials. Data have been collected from a handful of infants and toddlers who are deaf or hard of hearing who have used a hearing aid or cochlear implant for approximately one year. These children have not yet shown recognition of their own mother's voice from that of a strange woman. Future studies will likely be needed to determine how infants and toddlers learn to recognize their mother's voice with additional hearing aid or cochlear implant use.

Caregiver Production of Infant-Directed Speech

Thus far, research has shown that infants and young children who are deaf or hard of hearing do not pay attention to infant-directed speech, or even speech in general, in the same way as children with typical hearing until they've had at least 9-12 months of auditory experience. Imagine now parents interacting with infants who are deaf or hard of hearing. If their infants are not paying active attention to their attempts to entertain or soothe using infant-directed speech, how must this affect caregivers' further use of this special speech style? That is, do caregivers speak in the same or different ways to young children with and without hearing loss?

To date there has been very little research on caregiver speech to infants with hearing loss who use hearing aids and cochlear implants. One reason is that, prior to state-mandated universal newborn hearing screening programs, infants were typically not diagnosed with hearing loss until 2-3 years of age (Meadow-Orlans, Spencer, &Koester, 2004). The existing literature suggests that an infant's hearing status may affect the way in which caregivers speak to their infants. One study of speech to infants with hearing loss showed that mothers with typical hearing tend to increase their use of vocal exaggeration when they first discover their infant's

hearing loss, but gradually decrease the amount of vocal exaggeration over time (Wedell-Monnig &Lumley, 1980). Other studies of mother-child interactions have revealed that mothers tend to be more controlling, more repetitive, and less responsive in their interactions with children who are deaf or hard of hearing than with children who have typical hearing (Cheskin, 1981; Goss, 1970; Henggeler &Cooper, 1983). Mothers also produce fewer and less complex verbal utterances but more nonverbal attention-getting behaviors when interacting with children with hearing loss than children with typical hearing (Goldin-Meadow &Saltzman, 2000; Koester, Brooks, &Karkowski, 1998; Koester, Karkowski, &Traci, 1998). Some researchers have shown, however, more similarities in mothers' speech styles to both sets of children when the children were matched by linguistic age rather than chronological age (Cross, Nienhuys, &Kirkman, 1985; Nienhuys, Cross, &Horsborough, 1984).

The Babytalk Research Laboratory recently investigated the effects of infant age and hearing loss on several prosodie characteristics of mothers' speech to infants with typical hearing and infants with hearing loss who use cochlear implants (Bergeson, Miller, &McCune, 2006; Kondaurova, Bergeson, &Xu, 2012). The results of these studies revealed that mothers do use infant-directed speech when interacting with their infants with cochlear implants, and that their vocal styles are more similar to mothers of infants with typical hearing when infants are matched by hearing experience rather than chronological age. Thus, these mothers adapt their prosodie speech style to the hearing experience and linguistic abilities of their infants who are deaf or hard of hearing.

Researchers have proposed that one of the functions of infant-directed speech is to help infants learn about language (e.g., Fernald, 1992). For example, infant-directed speech actually exaggerates certain cues to sentence structure. Caregivers will change the pitch of their voice from the end of one sentence to the beginning of another when speaking to an infant. They will also tend to linger on the last syllable of a sentence and take an exaggerated pause before starting a new sentence. In a recent analysis of maternal speech, we found that mothers use similar sentence boundary cues when interacting with their infants who are profoundly deaf and use cochlear implants (Kondaurova &Bergeson, 2011).

Infant-directed speech might also help infants learn about the sound structure of their language. One study found that mothers potentially help their infants with typical hearing and infants with hearing loss discriminate among vowel categories (e.g., "ah," "ee," and "oo") by exaggerating the differences among them (Dilley &Bergeson, 2010). Another study measured mothers' exaggeration of cues that commonly distinguish tense vowels (e.g., "sheep") and lax vowels (e.g., "ship") in their speech to infants with profound hearing loss. There are two cues to this vowel contrast, one of which should be easily encoded with cochlear implant technology (duration of the vowel) and the other which is more problematic for cochlear implant users (spectrum of the vowel). Results showed that mothers exaggerated duration but not spectrum cues in speech to infants with hearing loss compared to speech to adults (Kondaurova, Bergeson, &Dilley, in press).

Taken together, these studies suggest that mothers' speech is sensitive to their young children's linguistic and hearing levels. In other words, mothers seem to be providing their infants and toddlers who are deaf or hard of hearing with speech cues tailored to their individual abilities. These findings are important given previous research that shows that the features of infantdirected speech have significant effects on language and cognitive development (Hart &Risley, 1995; Kaplan et al., 2002; Liu et al., 2003; Meadow-Orlans &Spencer, 1996; Pressman, Pipp-Siegel, Yoshinaga-Itano, &Deas, 1999; Spencer &Meadow-Orlans, 1996).

Nevertheless, there are still several unanswered questions regarding the acquisition of speech and language skills in both populations. Which aspects of infant-directed speech make it particularly beneficial for language acquisition? It could be that infant-directed speech is most beneficial because the vowel/ consonant categories are clearer or more exaggerated. Or it could be the case that more general exaggeration (e.g., higher pitch or slower speaking rate) in mothers' speech to infants elicits and maintains infants' attention, which then allows the infants to pay attention to particular sounds or sentence structures. Moreover, infants with hearing loss may benefit from different features of infant-directed speech than infants with typical hearing. What is the best way

for a mother (or a speech-language pathologist) to speak to an infant, and is this the same for infants who use a hearing aid or a cochlear implant? Preliminary data in the Babytalk Research Laboratory shows that some features of mothers' speech to infants with hearing loss, such as use of repetition, is associated with their infants' ability to learn new words and other speech and language outcomes. Answers to these questions will provide valuable new information to parents and clinicians of infants who are deaf or hard of hearing and use hearing aids and cochlear implants.

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Company / organization: Name: Northwestern University; NAICS: 611310;

Publication date: Summer 2012

Year: 2012

Effect of Rate-Alteration on Speech Perception in Noise in Older Adults With Normal Hearing and Hearing Impairment

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Publication info: American Journal of Audiology (Online) 21.1 (Jun 2012): 22-32.
ProQuest document link

Abstract: The purpose of this study was to evaluate the effect of using slow and fast speaking rates in competing noise on older adults with normal hearing (NH) and those with hearing impairment (HI). Thirty-four older adults (56-85 years) were grouped based on hearing ability-NH (N = 15) and HI (N = 19). Rate-altered Quick Speech-in-Noise Test (QuickSIN; Etymotic Research, 2001) stimuli were presented at 3 speech rates (slow, average, and fast), and the signal-to-noise ratio (SNR) loss was calculated for each. The older participants with HI had significantly higher SNR loss than the NH participants at all 3 speech rates. The NH participants showed improved speech perception in noise when a slow rate of speech was used. This benefit was not observed for the participants with HI. Both groups performed poorly with the fastest speech rate. Results suggest that older adults with HI who are not wearing hearing aids are not able to take advantage of additional processing time afforded by the use of slow speaking rates when speech (70-75 dB HL) is presented in competing noise. Additionally, the use of a fast speaking rate significantly reduces an individual's ability to perceive speech in noise, regardless of hearing status. Decreasing from a fast speaking rate to an average rate is beneficial and should be recommended by audiologists to increase the likelihood of older adults understanding speech in noise.

Full text: Headnote

Purpose: The purpose of this study was to evaluate the effect of using slow and fast speaking rates in competing noise on older adults with normal hearing (NH) and those with hearing impairment (HI).

Method: Thirty-four older adults (56-85 years) were grouped based on hearing ability-NH (N = 15) and HI (N = 19). Rate-altered Quick Speech-in-Noise Test (QuickSIN; Etymotic Research, 2001) stimuli were presented at 3 speech rates (slow, average, and fast), and the signal-to-noise ratio (SNR) loss was calculated for each.
Results: The older participants with HI had significantly higher SNR loss than the NH participants at all 3 speech rates. The NH participants showed improved speech perception in noise when a slow rate of speech was used. This benefit was not observed for the participants with HI. Both groups performed poorly with the fastest speech rate.
Conclusion: Results suggest that older adults with HI who are not wearing hearing aids are not able to take advantage of additional processing time afforded by the use of slow speaking rates when speech (70-75 dB HL) is presented in competing noise. Additionally, the use of a fast speaking rate significantly reduces an individual's ability to perceive speech in noise, regardless of hearing status. Decreasing from a fast speaking rate to an average rate is beneficial and should be recommended by audiologists to increase the likelihood of older adults understanding speech in noise.
Key Words: rate alteration, QuickSIN, speech perception in noise, older adults, hearing impairment
The difficulty with speech perception experienced by listeners in noisy environments has been well documented, particularly for listeners of advanced age and those with hearing impairment (HI) (e.g., Bronkhorst &Plomp, 1992; Committee on Hearing, Bioacoustics, and Biomechanics, 1988; Helfer &Wilber, 1990; Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2004). When the acoustic characteristics of the environment cannot be changed to improve the signal-to-noise ratio (SNR) and the listener's ability to perceive the target signal, communication partners often use other strategies to cope with the degrading effects of the competing noise signal. One such strategy is to adjust the talker's speech rate (e.g., Adams &Moore, 2009; Moore, Adams, Dagenais, &Caffee, 2007; Versfeld &Dreschler, 2002).

Competing noise signals can have a significant impact on an individual's ability to perceive a target speech signal. Most often, the competing signal effectively masks softer components of the speech signal, particularly the consonant phonemes, which contribute to the overall intelligibility of the speech signal. When the background noise consists of competing talkers, the noise is fluctuant in nature, containing variations in spectral composition and amplitude. These fluctuations create short-term improvements in the SNR, which allow for auditory "glimpses" of the target speech signal (e.g., Bronkhorst &Plomp, 1992; Freyman, Balakrishnan, &Helfer, 2004). Individuals with normal hearing (NH) can take advantage of the instantaneous improvement in SNR provided by the fluctuations in the masker to help them perceive the spoken message (Bronkhorst &Plomp, 1992; Peters, Moore, &Baer, 1998). However, some research has suggested that individuals with HI may not be able to take advantage of this fluctuation-induced temporary improvement in SNR. Their difficulty is likely related to reduced frequency selectivity of the auditory system rather than inaudibility of the target signal (e.g., Bronkhorst &Plomp, 1992; Summers &Molis, 2004). Despite a 30-dB increase in signal intensity for their participants with HI, Summers and Molis (2004) found that the disparity in speech perception ability between NH individuals and those with HI remained. Summers and Molis concluded that the overall increase in signal intensity was not sufficient to overcome individuals' difficulty with processing the speech signal, which was most likely caused by cochlear damage.

In addition to changes in peripheral hearing ability, the difficulty with speech perception in noisy environments experienced by older adults can also be attributed, at least in part, to age-related changes in the central auditory nervous system (e.g., Frisina &Frisina, 1997; Gordon-Salant &Fitzgibbons, 2004; Salthouse, 1996; Schneider, Daneman, &Murphy, 2005). These nonperipheral changes can lead to slowed processing, which can affect an individual's ability to process a complex signal, such as speech (Gordon-Salant &Fitzgibbons, 1995, 2004; Salthouse, 1996). Not only is the speech signal complex, but it is also transient, requiring realtime processing. Once the signal has been presented, it is only available for a brief moment. The only opportunity for a second exposure to message content is to use conversational repair strategies, such as to ask for repetition or

clarification. Slowed speech may offer an opportunity for more processing time as the signal is being presented. It is hypothesized that older adult listeners with NH and those with HI will miss less of the message as a result of the increased processing time allowed with the presentation of slowed speech.

Conversational speech rates have been documented to vary depending on the message content and speaker. Average conversational speech rates typically fall between 160 and 200 words per minute (wpm) (e.g., Miron &Brown, 1968; Moore et al., 2007; Picheny, Durlach, &Braida, 1986; Yorkston &Beukelman, 1981). Thoughtfully slowed speech rates have been documented to be as low as 60 wpm; however, the speech rate of public broadcasters has been reported to be as high as 300 wpm (Krause &Braida, 2002). The ability to comprehend speech presented in this wide range of speaking rates has been shown to vary based on an individual's age and hearing ability, sentence complexity, and the presence of background noise (e.g., Humes, Burk, Coughlin, Busey, &Strauser, 2007; Tun, 1998;Wingfield &Ducharme, 1999; Wingfield, McCoy, Peelle, Tun, &Cox, 2006). Tun (1998) evaluated speech perception with fast speech rates in varying levels of background noise in young adults and older adults with clinically normal hearing threshold levels (HTLs). Her findings indicated that the older adults had greater difficulty than the younger adults processing fast speech, particularly as the SNR decreased. This suggests that despite having normal HTLs, the older adult participants were unable to deal with the increased cognitive demands associated with speech presented at a faster rate and speech in the presence of background noise. Similarly, Gordon-Salant and Fitzgibbons (1995) used competing noise, time compression of the target speech, and reverberation to degrade speech stimuli and evaluated performance in NH younger and older adults and those with HI. These researchers also found that the older adult listeners had greater difficulty than the younger adults with perceiving speech that was multiply degraded by time compression and noise or reverberation. This finding was more pronounced in the older adult population with HI. Therefore, the research of Wingfield and colleagues, Gordon- Salant and Fitzgibbons, Tun, and others has effectively evaluated the detrimental nature of fast speech rates in NH younger and older adults and adults with HI; however, the benefit of slowing the speech rate of the target speech, particularly in noisy environments, has not been fully evaluated.

The present study was a follow-up to previously published work by Adams and Moore (2009) that evaluated the change in listeners' speech perception in noise when various speech rates were used. In this study, target stimuli from the Quick Speech-in-Noise Test (QuickSIN; Etymotic Research, 2001) were digitally manipulated to have slow (120 wpm) and fast (234 wpm) speaking rates using the "time stretch/ preserve pitch" function within Adobe Audition version 1.5 software. NH young adults were tested in two listening conditions: participants' natural hearing and a simulated mild high-frequency hearing impairment. In order to simulate the hearing impairment, the experimental speech and noise signals were filtered into discrete frequency bands and were attenuated to induce thresholds (on average) that ranged from È5 dB HL to 35 dB HL from 500 Hz to 6000 Hz (see Adams &Moore, 2009, for a full description). As expected, listeners' speech perception ability in the NH condition was significantly better than their speech perception ability in the simulated hearing impairment (SHI) condition, for all speech rates. The fastest speech rate resulted in the poorest speech perception for both listening conditions (NH and SHI).

Interestingly, in the NH condition, the slow speech rate resulted in significantly better speech perception in noise than that measured when the target speech was presented at an average speech rate. This result suggested that in the NH condition, listeners were able to use the slowed speech to enhance their speech perception, requiring a less favorable SNR to achieve 50% accuracy on the task. However, this improvement with the slow speech rate was not found when the same young adult participants were tested in the SHI condition. The SHI was designed to incorporate a mild degree of threshold elevation, reduced frequency selectivity, and recruitment at those frequencies with elevated thresholds. It is likely that these distortions rendered the participants unable to compensate when listening to speech in background noise (e.g., Baer &Moore, 1994; Nejime &Moore, 1998).

The purpose of the present study was to evaluate changes in speech perception when slow and fast speech rates were presented to NH older adults and those with true HI. Because previous research has suggested increased difficulty with speech perception in older adults related to changes in central processing of spectral and temporal properties of the speech signal (e.g., Pichora-Fuller, 2003; Pichora-Fuller &Souza, 2003), we were interested in how this population would respond to changes in speech rate in noise. A secondary purpose was to compare these results to those obtained from NH young adults from Adams and Moore (2009). An improvement in speech perception was hypothesized with the slow speech rate compared to performance measured with target speech presented at an average speech rate. In light of the finding from Adams and Moore that improved speech perception was found only in the NH condition, and not when the same participants were tested in an SHI condition, we were interested in evaluating whether a similar pattern would be found for NH older adults and those with actual HI. In addition, we were interested in further evaluating the detrimental effect of fast speech rates on speech perception in noise in these older adult populations. An additional goal for this study was to continue evaluating the impact of age and hearing loss effects on speech perception in everyday listening environments.

Method

Participants

Thirty-four older adults were recruited from the University of South Alabama in Mobile and the surrounding community and were grouped based on HTL. The first group (10 females, 5 males) ranged in age from 56 to 81 years (Mage = 67.1 years) and had mean HTLs between 10 and 25 dB HL at octave frequencies from 250 to 4000 Hz. Of note, five of these participants had thresholds at 4000 Hz that fell between 30 and 40 dB HL. The second group (7 females, 12 males) ranged in age from 56 to 85 years (Mage = 72.8 years) and had mean HTLs between 30 and 65 dB HLfrom 250 to 4000 Hz (see Figure 1). Seven individuals in the second group used hearing aid amplification, five of whom were bilateral hearing aid users; however, participants were tested without the use of their hearing aid amplification. All participants were native speakers of American English, had unremarkable nonmedical otoscopic findings, and were negative for active middle ear pathology and speechlanguage disorders. Additionally, participants reported a negative history of significant tinnitus and neurologic disorder. All participants signed a statement of informed consent that had been approved by the University of South Alabama's Institutional Review Board and were given a copy of the signed statement.

Stimuli and Apparatus

Stimuli from Adams and Moore (2009) were used in the present study. A complete description of stimuli creation is provided in Adams and Moore. The wpm speech rate of six lists from the QuickSIN test was digitally manipulated via multitrack sound editing software (Adobe Audition, version 1.5). Adobe Audition allows for digital manipulation of the speech rate without altering the pitch of the signal. The following formula was used:

...

Two QuickSIN lists were manipulated to be each of three speech rates: 120 wpm, 170 wpm, and 234 wpm. These rates have been shown in previous research to be considered slow, average, and fast rates of speaking (e.g., Moore et al., 2007; Wingfield, Tun, Koh, &Rosen, 1999). Lists 1 and 10 of the QuickSIN were chosen for the slow speech rate, lists 8 and 11 were chosen for the average speech rate, and lists 9 and 12 were chosen for the fast speech rate. These lists, with the exception of list 9, have been shown to produce equivalent speech reception performance for NH listeners and listeners with HI (Killion et al., 2004; McArdle &Wilson, 2006). List 9 was shown by McArdle and Wilson (2006) to have an irregular psychometric function; however, the mean 50% point for this list was very close to the overall mean 50% point for QuickSIN lists 1 through 18. Therefore, we included this list in the present study.

The wpm speech rates were verified through analysis of the duration for each list and the number of words contained within each list. The wpm speech rate, corresponding number of syllables per second (syll/sec), and percentage of time compression or expansion relative to the rate of the original QuickSIN stimuli are presented

in Table 1. One hundred percent time compression is equivalent to the original rate of the QuickSIN stimulus sentence. The slowed speech rate produced stimuli that were longer in duration than the original signal length. The resulting duration for the slowed stimuli was 147% that of the original stimulus. The faster speech rate resulted in stimuli with a duration that was 77% of the original signal length. The data presented represent the amount of time compression averaged across the two lists that were used for each speech rate.

Each list of the QuickSIN test has six sentences that have been prerecorded with four-talker competing babble background. The level of the background babble varies from a favorable SNR of +25 dB to a very difficult SNR of 0 dB, in 5-dB steps. This setup was maintained in the present study, and each list of six sentences was presented with decreasing SNR, starting with +25 dB SNR and decreasing to 0 dB SNR.

Procedure

Participants first completed a brief medical and audiologic history questionnaire and then underwent nonmedical otoscopic examination. Behavioral audiometric testing was conducted to obtain air conduction (EAR-TONE 3-A insert earphones) and bone conduction (Radio Ear B-71) HTLs for octave frequencies from 250 to 4000 Hz (American National Standards Institute [ANSI], 2004a; American Speech- Language-Hearing Association [ASHA], 2005) using a Grason-Stadler Inc. (GSI) 61 type II audiometer. Appropriate masking was applied when needed.

The target stimuli and competing background signal were presented from a single Lifeline speaker that was located 1.5 m from the participant at 0° azimuth in the horizontal and vertical planes. Following the published QuickSIN instruction set, the presentation level was 70 dB HL (81 dB SPL) for individuals with pure-tone average (PTA) <45 dB HL. For those individuals with PTA >45 dB HL (n = 6), the presentation level was set to a level that was designated by the individual participant as "loud, but ok." To find this level, the speech track of a QuickSIN practice list was presented, and the listener was asked to indicate an increase or decrease in loudness until the presented speech was at a level that he or she judged to be "loud, but ok." This resulted in a presentation level of 70 dB HL (81 dB SPL) for 31 participants and 75 dB HL (86 dB SPL) for the remaining three participants. Participants were presented a total of six lists from the QuickSIN test: two QuickSIN lists for each of the three rate-altered conditions (slow, average, and fast). Two lists were chosen for each condition because administration of multiple test lists has been shown to improve the reliability of the QuickSIN score to approximately ±1.9 dB at the 95% confidence interval (Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2006). Participants were asked to repeat each sentence heard in its entirety. Five target words were scored for each sentence, and the total number of correctly repeated words was tallied for each list. This total was subtracted from a constant (25.5) to determine the SNR loss for each list (Etymotic Research, 2001; Killion et al., 2004). The two SNR loss scores obtained for each speech rate condition were averaged across the two presented lists for each speech rate (slow, average, and fast), resulting in an average SNR loss for each rate-altered condition for each participant.

All QuickSIN lists were presented in random order, resulting in random order presentation of the speech rate conditions. Sentences within each list were presented in the order in which they were recorded. Testing was completed in one 45-min session, with rest periods given when needed.

The preexperimental and experimental tasks were conducted in a single-walled sound-treated room that met specifications for maximum permissible ambient noise levels (ANSI, 2003). Experimental stimuli were played from a Sony CDP-CE345 compact disc player and were routed through a GSI 61 type II audiometer that was calibrated according to ANSI standards (2004b). Electroacoustic calibration of the experimental stimuli was performed using a Quest Model 1800 sound-level meter before and at completion of data collection.

Results

For the NH older adult (ONH) group, mean (SD) SNR losses for the slow, average, and fast speech rates were 2.7 dB (1.3), 3.9 dB (2.2), and 6.1 dB (2.3), respectively. For the older adult group with hearing impairment (OHI), mean (SD) SNR losses for the three speech rates were 8.4 dB (5.7), 8.3 dB (4.5), and 13.0 dB (5.8),

respectively. The mean SNR losses and standard deviations for both groups of study participants are displayed in Figure 2, along with participant data from Adams and Moore (2009). As illustrated in Figure 2, the ONH group achieved lower (better) mean SNR losses than the OHI group across all speech rates. The SNR loss for the slow speech rate was slightly lower than the SNR loss for the average speech rate for the ONH group; however, the SNR loss with these speech rates was similar for the OHI group. Both older adult groups exhibited the highest SNR loss with the fastest speech rate (see Figure 2).

For descriptive purposes, we also chose to show participant data by hearing group and participants' decade of life. As shown in Figure 3, the discrepancy in speech perception ability between participant groups was greater at more advanced ages. Additionally, the younger participants in the NH group showed a trend for improved SNR loss with the slower speech rate as compared to the average speech rate. The oldest participant in this group, however, did not show the same trend, nor did the participants with HI. Only the two youngest participants with HI, those in their sixth decade, showed improvement in SNR loss with the slower speech rate over the average speech rate. The participants with HI in their seventh, eighth, and ninth decades demonstrated no benefit with the slowed speech rate compared to the average rate. Sample size within each decade prohibited analytic statistics to fully evaluate change in performance with ratealtered stimuli across older adulthood.

In order to evaluate the effect of speech rate on SNR loss between the two participant groups in our study, we conducted a two-way (Speech Rate ×HTL group) mixed design, repeated measures analysis of variance (ANOVA). Significant main effects of speech rate, $F(2, 64) = 65.38$, $p < .001$, $h2 = .635$, and HTL group, $F(1, 32) = 16.46$, $p < .001$, $h2 = .340$, were found. Additionally, a significant interaction was found between speech rate and HTL group, $F(2, 64) = 5.66$, $p = .005$, $h2 = .055$.

To further evaluate the significant interaction effect between speech rate and HTL group, we conducted post hoc analyses using paired-samples t tests with Holm's sequential Bonferroni adjustment of alpha level to control for Type I errors. Nine paired comparisons were conducted to further evaluate differences in mean SNR loss between and within each speech rate and HTL group. Three paired comparisons were conducted to evaluate group differences in SNR loss for each speech rate, three paired comparisons were conducted to evaluate differences in mean SNR loss between each speech rate for the NH participants, and three paired comparisons were conducted to evaluate differences in mean SNR loss between each speech rate for the participants with HI. The results from these paired comparisons are displayed in Table 2. The mean SNR losses obtained with all three speech rates were significantly better for the NH group than for the group with HI. For the NH group, there were significant differences in SNR loss with all three speech rates. Specifically, the mean SNR loss with the slow speech rate was significantly lower (better) than the SNR loss found with the average rate, which was significantly lower than that found with the fast speech rate. As the interaction suggests, the results for the group with HI did not follow this pattern. For the group with HI, the slow and average speech rates did not result in significantly different mean SNR losses. However, both the slow and average speech rates resulted in significantly lower SNR losses than that found with the fast speech rate (see Table 2).

We conducted additional statistical analyses to evaluate differences in SNR loss between data from the previous study (Adams &Moore, 2009) with young adults and the present study with older adults. Recall that participants in the Adams and Moore (2009) study had normal HTLs and participated in an NH condition (YNH) and a simulated mild high-frequency hearing impairment (YSHI) condition. Mean (SD) SNR losses for the NHcondition in the Adams and Moore study were -0.43 dB (1.43), 0.37 dB (1.21), and 1.56 dB (1.31) for the slow, average, and fast speech rates, respectively. For the SHI condition, mean (SD) SNR losses were 3.62 dB (1.73), 3.68 dB (1.64), and 7.39 dB (2.27) for the slow, average, and fast speech rates, respectively. These data are also displayed in Figure 2 and are noted with asterisks. To evaluate differences in SNR loss between the four groups of participants (two groups from the present study and two groups from Adams and Moore, 2009), we conducted a multivariate ANOVA with HTL and age as fixed factors. Results revealed significant main

effects of age group,Wilks' L= .58, F(3, 88) = 21.55, p <.001, h2 = .423, and HTL group, Wilks' L = .49, F(3, 88) = 29.58, p <.001, h2 = .502. The interaction between age group and HTL group was not significant,Wilks' L = .97, F(3, 88) = 0.81, p >.05, h2 = .009. Given the significance of the overall test, univariate main effects were examined. A significant univariatemain effect for age group was obtained for the slow, F(1, 90) = 39.64, p <.001, h2 = .207; average, F(1, 90) = 60.15, p <.001, h2 = .232; and fast, F(1, 90) = 55.64, p <.001, h2 = .342, h2 = .342, speech rates. Additionally, a significant univariate main effect for HTL group was obtained for the slow, F(1, 90) = 60.28, p <.001, h2 = .314; average, F(1, 90) = 50.25, p <.001, h2 = .194; and fast, F(1, 90) = 88.61, p <.001, h2 = .545, speech rates.

To further evaluate differences in SNR loss for each age group and HTL group across speech rate, we conducted paired comparisons using Holm's sequential Bonferroni adjustment to determine the appropriate alpha level for establishing significance. Twelve paired comparisons were conducted, wherein the SNR loss for selected conditions was compared. For each speech rate, the means from the young adults with NH (YNH) were compared to the means from the older adult group with NH (ONH) and the older adult group with hearing impairment (OHI), and the means from the young adults with simulated hearing impairment (YSHI) were compared to the means from both older adult groups (3 speech rates ×4 comparisons = 12 total paired comparisons). These results are presented in Table 3. Analyses comparing data for the NH and HI conditions within each age group were reported in the previous study (YNH data compared to YSHI data) and in the previously reported statistical analyses for the present study (ONH data compared to OHI data); therefore, these analyses were not repeated here. For all three speech rates, the paired comparisons of mean SNR loss for the YNH and ONH, YSHI and OHI, and YNH and OHI were significantly different. The only paired comparison not found to be statistically significantly different was the paired comparison of mean SNR loss for the YSHI and ONH for each of the three speech rates. The mean SNR losses for these two groups are similar, and their lack of significance is apparent in Figure 2.

To investigate the degree of change in SNR loss when the speaking rate of the primary speech stimulus was increased from an average rate to a fast rate with participant groups from the present study and from Adams and Moore (2009), we conducted ad hoc analyses. In order to make this comparison, the difference in SNR loss measured with the average and fast speech rates was calculated for each participant. From this calculation, a mean difference score was calculated for each of the four groups (YNH, YSHI, ONH, and OHI) using the young adult data from Adams and Moore and the older adult data from the present study. These data are presented in Figure 4, with the data from Adams and Moore noted with asterisks. A one-way ANOVA was conducted to compare the mean change in SNR loss for each of the four groups. A significant main effect of group was found, F(3, 90) = 14.46, p <.001, h2 = .325. Subsequent pairwise comparisons using Bonferroni adjustment of alpha level revealed that the mean change in SNR loss for the OHI group was significantly higher than the mean change in SNR loss for the YNH and ONH groups, t(14-18) = -4.04 to -4.24, p = .001, h2 = .476-.562. Additionally, the mean change in SNR loss for the YSHI group was significantly higher than the mean change in SNR loss for the YNH group, t(29) = -7.17, p = .000, h2 = .639. There was no significant difference in the mean change in SNR loss between the ONH group and either young adult group (YNH and YSHI). There was also no difference in the mean change in SNR loss between the OHI and YSHI groups.

Discussion

Many studies have evaluated the impact of fast speech rates on an individual's ability to perceive a target speech signal, with a variety of populations (e.g., Humes et al., 2007; Konkle, Beasley, &Bess, 1977; Sticht &Gray, 1969; Wingfield et al., 2006). Most of these studies have been conducted in quiet listening environments, and no study to date has evaluated the benefit of slowing the presented speech rate with older adults in the presence of background noise. This study is a continuation in a line of research evaluating the benefit of slowing the speech rate of a target speech stimulus from an average speaking rate when in the presence of competing background noise. Previous research in this line (Adams &Moore, 2009) suggested

improved speech perception in noise in young adults with normal HTLs when the target speech stimulus was slowed from an average speaking rate. In that study, the same young adults did not benefit from slowed speech when a mild high-frequency hearing loss was simulated (Adams &Moore, 2009). Therefore, the primary purpose of the present study was to examine the benefit of slowing the speech rate of the target stimulus in the presence of background noise for NH older adults and those with HI. We were also interested in evaluating speech perception in noise with fast speech rates in order to observe the change in performance in these populations as speech rate increased from slow to fast. Although researchers such as Tun (1998) and Gordon-Salant and Fitzgibbons (1995) evaluated the detrimental effect of fast speech rates on speech perception in noise, the change in performance from slow to fast rates has not been established in NH older adult populations and those with HI.

Difficulty with speech perception in noise has been established for listeners with either peripheral HI or age-related changes to central processing ability. In either case, slightly decreased speech perception is expected compared to that for individuals without peripheral or central impairment (e.g., Gordon-Salant &Fitzgibbons, 1995, 2004; Humes et al., 2007; Marrone, Mason,& Kidd, 2008;Wingfield et al., 2006). Even greater difficulty and variability has been confirmed when both peripheral HI and age-related central processing deficits are present in combination (e.g., Gordon-Salant &Fitzgibbons, 1995, 2004; Humes et al., 2007; Marrone et al., 2008; Wingfield et al., 2006). Therefore, in a population of older adults with HI, speech perception ability may be a great deal poorer than that measured in young adults with normal HTLs. The majority of studies evaluating the detrimental effect of HI and/or age-related central processing changes on speech perception in noise have been conducted using speech that is of average rate. The present study supports these previous findings in the following ways: (a) The participants with HI in the present study performed more poorly than the NH participants, regardless of speech rate; (b) the older adults in the present study showed poorer speech perception ability than the younger adults in the previous study (Adams &Moore, 2009), regardless of speech rate; and (c) the poorest performance across groups was measured in the group of older adult participants with HI. The present study extends this knowledge to show the change in speech perception in the presence of competing noise when speech rate is varied from slow to fast with older individuals who have clinically normal HTLs and those with HI.

Older adults are more likely than younger adults to experience age-related changes to peripheral hearing sensitivity and central processing abilities.With either of these changes, speech perception ability is typically decreased compared to that observed in younger adults with NH sensitivity. Further, when peripheral and central impairments co-occur, as could be the case in a population of older adults with HI, speech perception seems to be even more negatively impacted. These possibilities are discussed in the following sections using data from the present study as well as data from a related study that was conducted with young adults with normal HTLs (Adams &Moore, 2009).

Effect of Speech Rate-Alteration in Environments With Competing Noise

Similar to the findings with young adults from Adams and Moore (2009), the group of NH older adults in the present study showed improved performance in noise with the slow speech rate compared to the average speech rate. However, this finding was not confirmed in the group of older adults with HI. The results from the group of NH older adults support those of Schmitt (1983), who tested older adults with hearing considered to be normal for their age group and found that the adults in his study also performed better with time-expanded (slowed) speech. However, Schmitt's findings were isolated to a quiet environment, whereas the present study incorporated competing multitalker babble. Schmitt used two levels of time expansion, 140% (124 wpm) and 180% (97 wpm) of the original target message, which was spoken at an average rate of 174 wpm. He found that speech perception in listeners >75 years of age was adversely affected by rates that were too slow. This group of listeners performed optimally with a slightly slowed speech (140% time expansion) rather than dramatically slowed speech (180% time expansion). Schmitt hypothesized that the auditory systems of the older adult

participants were unable to tolerate the extremely slowed speech rate and emphasized the heterogeneous nature of the older adult population.

In our study, significantly poorer speech perception ability was found for both groups of participants when the target speech was presented at a faster rate compared to average or slower speaking rates. Adams and Moore (2009) found a similar trend with the younger adults tested in their study. The results of Adams and Moore and of the present study support the fact that adults of all ages and hearing abilities have greater difficulty with fast speaking rates (e.g., Gordon-Salant &Fitzgibbons, 1995, 2004; Humes et al., 2007; Konkle et al., 1977; Sticht &Gray, 1969;Wingfield &Ducharme, 1999; Wingfield et al., 2006). Additionally, the present study extends these findings to include difficulty with fast speaking rates in the presence of background noise, supporting the results of Gordon-Salant and Fitzgibbons (1995) and Tun (1998). When the target speech signal is presented too rapidly, the input cannot be processed as quickly as it is received by the listener. There may also be a loss of subphonemic cues, such as place of articulation and vowel duration, which may impede the acoustic redundancy contained within the speech signal. The perception of these subphonemic cues dictates perception of the affected phoneme or the surrounding phonemes, and ultimately, the target word. This is particularly true when the listening environment is complicated by the presence of competing background noise (Gordon-Salant &Fitzgibbons, 1995; Tun, 1998). In general, the spectral components of competing noise stimuli overlap with the target speech stimuli. This overlapping serves to fill in the naturally occurring interphonemic gaps and interword gaps in the speech signal and add additional spectral components to the speech signal, creating distortion of the target speech signal. With the added spectral components and blurring of temporal components of the target signal, listeners may have difficulty extracting the speech signal from the background competing noise. With speech that is fast, the naturally occurring gaps are already shortened, and the addition of the competing noise signal may cause even greater difficulty with extraction of the speech signal from the competing noise.

The results of the present study must be distinguished from speech perception that is measured when clear speech is used. Clear speech is a style of speaking that is often adopted by talkers in adverse listening environments in an attempt to make their communicative message more easily understood by the intended listener (e.g., Picheny, Durlach, &Braida, 1985; Picheny et al., 1986). The strategies used to achieve clear speech have been shown to vary across talker, but typically include an attempt to speak clearly, enunciate consonants and add greater vocal effort to these phonemes, and avoid using slurred speech (Krause &Braida, 2004; Picheny et al., 1985). Ultimately, the clear speech produced has different acoustic properties than conversational speech and typically occurs at a slower rate; however, the advantages of clear speech have been documented even with an average speaking rate (Krause &Braida, 2002; Picheny et al., 1985, 1986). Based on this finding, researchers have concluded that the acoustic properties inherent to clear speech, such as changes in long-term spectra and temporal envelopes, contribute to the improved intelligibility with its use, more so than the speaking rate used (Krause &Braida, 2002, 2004). Results from the present study and those from Adams and Moore (2009) support the finding that speech rate does have at least some impact on speech intelligibility for younger and older adults with normal HTLs. However, the lack of improvement in intelligibility for younger and older adults with HI may suggest the need for other acoustic modifications to the presented speech that were not accomplished with a simple slowing of speech rate performed with stimuli in the present study. Individuals with HI may, in fact, benefit more from speech presented in a manner consistent with clear speech.

Effect of HI

Speech perception measured across all speech rates was significantly poorer for the group of older adults with HI than for the NH older adults. The difficulty experienced by the group with HI was present despite the opportunity to adjust the presentation level to an intensity that was considered to be "loud, but OK" to the listener. To quantify differences in audibility experienced by these groups, the speech intelligibility index (SII; ANSI, 1997) was calculated for each listener. Third-octave band levels of the speech and competing noise signals and the listeners' audiometric thresholds were used in these calculations. The mean SIIs for the groups

of older adults with normal HTLs and those with HI were 0.849 and 0.564, respectively. Despite an attempt to improve signal audibility for the listeners with HI, only three participants took advantage of the opportunity to increase the signal level. Therefore, the simple increase in signal intensity did not appreciably impact the overall audibility for this group. The large difference in SII between the two groups suggests that the audibility of the signal differed substantially between the groups. Thus, audibility may be an important factor contributing to the differences observed between the two groups.

The performance of the individuals with HI may have been at least slightly improved if the listeners had been tested with appropriate hearing aid amplification and assistive listening technology. Further improvement may have been seen with the use of other communication strategies commonly used in difficult listening situations. Although amplification would not overcome the reduced frequency selectivity and temporal resolution of the impaired cochlea, appropriate amplification may have provided additional gain at frequencies not provided by a simple increase in overall signal level.

The discrepancy in performance observed between these groups may also have been related to the presence of spectrotemporal overlap caused by reduced frequency and temporal resolution abilities related to the sensorineural hearing loss present (Arbogast, Mason, &Kidd, 2005; Marrone et al., 2008). In essence, the reduced frequency selectivity and temporal resolution abilities of the impaired ear may cause the target speech to be more characteristically similar to the competing background noise. Thus, individuals with HI may have greater difficulty separating the target speech signal from the competing background signal (Arbogast et al., 2005; Marrone et al., 2008).

Effect of Age

Difficulty with speech perception in noise in the older adult population has been attributed, at least in part, to difficulty with central processing of temporal and spectral aspects of complex signals (Pichora-Fuller &Souza, 2003). Additionally, when the speech signal is embedded in competing noise or is presented at a fast rate, the added processing load placed on the older adult likely exceeds the difficulties encountered at the peripheral level (Pichora- Fuller, 2003). The group of older adults with normal HTLs in the present study consistently demonstrated poorer performance in noise than the younger adult group with normal HTLs from the previous study (Adams &Moore, 2009), regardless of speech rate. These two groups of participants had similar HTLs through 4000 Hz and similar SIIs (0.857 for the YNH group and 0.849 for the ONH group). Therefore, the difference in performance cannot be attributed to reduced signal audibility, and the effect of age alone was apparent. One explanation for these significant differences in speech perception in noise ability between these groups is the presence of age-related processing difficulties that cannot be ruled out in the older adult individuals in the present study (e.g., Pichora-Fuller, 2003; Pichora-Fuller &Souza, 2003; Salthouse, 1996). Despite these possible agerelated processing changes, the NH older adults in the present study were able to make use of the additional processing time afforded by the presentation of a slow speech rate. This information may be useful in counseling older adults who experience difficulty understanding speech in noisy environments. The results of the present study suggest that this population may receive benefit from having their communication partners slow their rate of speaking when communicating in an environment with competing noise.

Effect of Age and HI in Combination

The poorest and most variable performance across speech rate was measured in the group of older adults with HI. For this group, speech perception ability with the slow and average speech rates was similar. However, performance at these rates was significantly poorer than that measured for any of the other three groups used for comparison (younger adult data from Adams and Moore [2009] and NH older adults from the present study). With the fastest speech rate tested, the performance of this group decreased dramatically. When the degree of change in speech perception was calculated from the average speech rate to the fast speech rate for each group, the older adult group with HI showed the greatest decrease in speech perception ability compared to the

other three groups. This group also showed much greater variability in performance across speech rate than the other participant groups (see Figures 2 and 4). The variability in performance observed in the group of adults with HI may be attributed to differences in peripheral function and processing ability across members of this population (e.g., Willott, 1996). With a decrease in peripheral auditory function, signal fidelity is compromised at the peripheral level, and with consistent presentation of a distorted signal, central structures are likely to atrophy (e.g., Willott, 1996). This atrophy can be expected to vary across individuals, leading to variability in auditory processing ability and thus greater variability on objective measures such as a speech-in-noise task (e.g., Chisolm, Willott, &Lister, 2003; Pichora-Fuller &Souza, 2003). This finding is important for counseling in the audiology practice, as clinical audiologists may observe strong speech recognition ability for some older adults with HI and poor speech recognition ability for other older adults with HI, even when the measured hearing sensitivities are similar between the clients.

There was not a significant difference in the speech perception ability measured for the NH older adult group from the present study and the younger adult group with SHI from Adams and Moore (2009). These groups performed similarly across speech rate. The similarity in the performance between these groups suggests that individuals of advanced age and individuals with peripheral HI will show similar speech perception abilities. This finding is supported by researchers such as Wingfield et al. (2006) and Gordon-Salant and Fitzgibbons (1995). Wingfield et al. varied the speech rate of sentences with different levels of syntactic complexity and found that with more complex sentence stimuli, speech rate had a greater impact on participants' performance than when less complex stimuli were used. Additionally, these researchers found that the older group and the group of participants with HI performed similarly, both more poorly than the NH young adults.

Similarly, Gordon-Salant and Fitzgibbons (1995) found that NH young adults performed better than a group of young adults with hearing loss and an NH older adult group on a speech perception task with time-compressed speech (40% time compression) in competing noise (+16 dB SNR). The older adult group with HI showed the poorest performance of all of the tested groups. Based on these studies and the present results, it appears as though with either HI or agerelated processing changes, speech perception is degraded slightly (e.g., Gordon-Salant &Fitzgibbons, 1995;Wingfield et al., 2006). Further, when both peripheral HI and agerelated processing changes have occurred, as may be the case in an older adult population with HI, the changes in speech perception, particularly in noisy environments, are more dramatic. In this case, the spectral and temporal resolution issues related to the peripheral HI may interact negatively with the age-related changes in processing ability, resulting in poorer speech perception than when either is present in isolation, particularly in more complex listening situations (e.g., Gordon-Salant &Fitzgibbons, 1995, 2004; Marrone et al., 2008; Wingfield et al., 2006).

When participants were grouped by hearing status and age in decades, a trend of greater SNR loss was noted with an increase in age for both groups of participants and for all three speech rates (see Figure 3). It is important to interpret these results with caution as each group has a limited number of participants, one and two participants in some cases. The trend of poorer performance with increasing age was especially apparent for the older adults with HI. In addition, the mean SNR losses for the NH individuals in their sixth, seventh, and eighth decades were slightly better with the slow speech rate than with the average speech rate. However, the one participant in this group in her ninth decade of life did not show the same benefit with the slowed speech rate. In contrast, when data from the group of individuals with HI were examined, only the youngest participants (between 56 and 59 years of age) showed improvement in SNR loss with the slower speech rate over that measured with the average speech rate. Participants with HI in their seventh, eighth, and ninth decades either performed the same with the slow and average speech rates or performed more poorly with the slowed speech rate than with the average rate. Overall, this finding can be used to suggest that the results from the present study cannot be generalized to all individuals ranging in age from 56 to 85 years, nor can the findings be generalized to all older adults with either NH or HI. It appears as though NH older adults in their sixth, seventh,

and eighth decades may benefit more from the slowing of speech rate than older adults with HI. However, the issue of insufficient signal audibility cannot be ruled out as a contributing factor to the performance of the group with HI. Additionally, a larger sample size is needed to confirm these findings.

Clinical Implications

These findings are useful in counseling clients regarding strategies for communicating in the presence of background noise. Previous researchers have suggested that older adults prefer to listen to speech at slow speaking rates (Von Berg, Panorska, Uken, &Qeadan, 2009; Wingfield &Ducharme, 1999). Additionally, Schmitt (1983) suggested that slower speech rates in a quiet environment increase individuals' speech perception ability; however, this improvement in speech perception with slowed speaking rates in noisy environments has not previously been evaluated. Although results from the present study seem to suggest that decreasing the speaking rate in noisy environments from an average rate may not improve performance for an individual with HI, this recommendation will help when the listener's communication partner has a naturally fast speaking rate. In extreme cases, speaking rates have been reported to approximate 300 wpm (Krause &Braida, 2002); therefore, the recommendation to slow the rate of speaking could be beneficial, particularly when talking with an individual who speaks quickly. Additionally, based on results of the present study, the recommendation to slow the rate of speech should not be disruptive to speech perception for most individuals.

Conclusion

The NH older adults who were tested in the present study showed improvement in speech perception ability when a slow speech rate was used in competing background noise. However, the older adults with HI did not experience the same benefit with this speech rate. This pattern of results is similar to those found for NH young adults and young adults in an SHI condition from a previous study (Adams &Moore, 2009). Taken together, these studies seem to suggest that although younger and older adults with normal peripheral hearing can take advantage of slowed speech, individuals with peripheral HI do not experience the same benefit from slowed speech in the presence of background noise. It is important to note that reduced signal audibility may have contributed to the difficulty experienced by the group with HI. With the increased difficulty experienced by listeners when fast speech rates are used, the recommendation to request slower speaking rates from a communication partner is valid, as it may reduce the speaking rate from a fast speech rate to an average speech rate. This recommendation may be particularly helpful in the presence of background noise.

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Editor: Sheila Pratt
Associate Editor: Jeffrey DiGiovanni

Received June 29, 2010
Accepted November 2, 2011
DOI: 10.1044/1059-0889(2011/10-0023)

Publication date: Jun 2012

Year: 2012

Development and Evaluation of an English Language Measure of Detection of Word-Final Plurality Markers: The University of Western Ontario Plurals Test

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Publication info: American Journal of Audiology (Online) 21.1 (Jun 2012): 76-81.
ProQuest document link

Abstract: This article describes the development and evaluation of The University of Western Ontario (UWO) Plurals Test, which is an English language measure of detection of the word-final fricative cue for plurality. Normative data are provided for 26 listeners with normal hearing and 24 listeners with hearing impairment (children and adults), as are evaluations of the acoustical properties of the stimuli, the test's test-retest reliability, and the test's sensitivity to changes in hearing aid signal processing (e.g., nonlinear frequency compression). Results indicate reliable, repeated outcome measurement at the level of the individual. When compared to a global measure of real-world listening preference, the UWO Plurals Test was found to be somewhat sensitive to the effects of changes in hearing aid signal processing. Findings suggest potential use of the UWO Plurals Test to evaluate aided and unaided ability of listeners between the ages of 6 and 81 years to detect the wordfinal fricatives /s/ and /z/ as they occur in English plural nouns.

Full text: Headnote

Purpose: This article describes the development and evaluation of The University of Western Ontario (UWO) Plurals Test, which is an English language measure of detection of the word-final fricative cue for plurality.
Method: Normative data are provided for 26 listeners with normal hearing and 24 listeners with hearing impairment (children and adults), as are evaluations of the acoustical properties of the stimuli, the test's test-retest reliability, and the test's sensitivity to changes in hearing aid signal processing (e.g., nonlinear frequency compression).
Results: Results indicate reliable, repeated outcome measurement at the level of the individual. When compared to a global measure of real-world listening preference, the UWO Plurals Test was found to be somewhat sensitive to the effects of changes in hearing aid signal processing.
Conclusion: Findings suggest potential use of the UWO Plurals Test to evaluate aided and unaided ability of listeners between the ages of 6 and 81 years to detect the wordfinal fricatives /s/ and /z/ as they occur in English plural nouns.

Key Words: hearing loss, hearing aids, aided outcome measurement, speech sound detection

Fricative sounds are produced by creating a narrow opening in the oral cavity and forcing air through; this results in a "noisy" sound referred to as frication noise (Stevens, 1998). The fricative sound /s / is one of the most commonly occurring English consonant sounds. The /s / and its voiced cognate /z / play important linguistic functions in the English language, marking the plurality of nouns and word tense in the word-final

position. The sound /s / is composed of predominantly high-frequency energy that varies in spectral shape according to the talker. The spectral peak of /s/ resides between È2.9 and 8.9 kHz, with the peak of female speech residing closer to 9 kHz (Boothroyd &Medwetsky, 1992; Nittrouer, 1995). Furthermore, the spectral peak of /s/ for child speech has been measured to be higher in frequency and lower in intensity than that for adult speech (Pittman, Stelmachowicz, Lewis, &Hoover, 2003).

Research by Moeller et al. (2007) suggested that children with hearing impairment (HI)who are fitted with amplification at an early age have delayed fricative production compared to their normal hearing (NH) counterparts. Moeller et al. discussed the possible relationship between restricted hearing aid bandwidth and delayed speech and language development. Bandwidth required for accurate fricative recognition in listeners with moderate to moderately severe HI may be different for adults than for children (Pittman&Stelmachowicz, 2000; Stelmachowicz, Pittman, Hoover, &Lewis, 2001; Stelmachowicz, Pittman, Hoover, Lewis, &Moeller, 2004).

There are several signal processing options in current hearing aid technology that are designed to enhance high-frequency audibility. These include extended bandwidth hearing and frequency-lowering hearing aids. Despite improved hearing aid bandwidth, current hearing aids are still limited in providing audibility of high-frequency speech sounds for individuals with a severe high-frequency hearing loss. Frequency-lowering hearing aids provide an alternative for these individuals via extended bandwidth. The goal of frequency-lowering technology is to shifthigh-frequency components of a signal into a lower frequency region. Current research has shown successful outcomes for some individuals with high-frequency hearing loss (Simpson, 2009). Frequency lowering can be enabled/disabled in various commercially available hearing aids. Two types of currently available frequency-lowering schemes are frequency transposition hearing aid processing (Auriemmo et al., 2009) and nonlinear frequency compression (NLFC) hearing aid processing (Simpson, Hersbach, &McDermott, 2005).

One way of evaluating hearing aid benefit is through the use of aided speech perception testing. The properties of the chosen speech materials and psychometric procedure determine the sensitivity of the measure to evaluate hearing aid performance and/or benefit. For listeners receiving new audibility associated with novel hearing aid signal processing, an evaluation of any change to the aided condition may be of interest. For example, an efficacy evaluation of either extended bandwidth or frequency-lowering hearing aids, which are designed to alter the aided response associated with high-frequency signals, could be tested using speech materials and procedures that are sensitive to changes in highfrequency speech perception.

This article describes the development and evaluation of an English language measure of detection of plurality cues: The University of Western Ontario (UWO) Plurals Test. Specifically, this test assesses a listener's ability to detect the word-final fricatives /s/ and /z/ as they occur in the English plural forms of many nouns (e.g., cats). Stimuli for this task were chosen to be similar to those used in previous research related to hearing aid bandwidth and high-frequency audibility in children (Stelmachowicz, Pittman, Hoover,&Lewis, 2002). Normative data for NH listeners and listeners with HI are provided in this article, as are evaluations of the acoustical properties of the stimuli, the test's test-retest reliability, and the test's sensitivity to changes in hearing aid signal processing (specifically, frequency compression).

Method

Development of Stimuli

Stimuli were recorded and digitized using a studio-grade microphone (AKG Acoustics) coupled to a pre-amplifier, an analog-to-digital converter (USB Pre, Sound Devices LLC), and sound recording software (SpectraPlus). Each word was recorded four times; the repetition with the least variation in pitch contour (as judged by an experimenter) was selected for inclusion in the final stimulus set. Stimuliwere equalized in level using sound editing software (Goldwave). The final stimulus set included the singular and plural forms of 15 words: ant, balloon, book, butterfly, crab, crayon, cup, dog, fly, flower, frog, pig, skunk, sock, and shoe. Words

were spoken in Canadian English by an adult female talker.

To illustrate the amplitude and spectral characteristics of the chosen words, the fricative noise was excised from the plural forms of each word. Excised fricatives were then concatenated, and the spectrum of the resulting file was measured. This fricative-only spectrum was compared to the spectrum of a concatenated stimulus containing all 30 words; the task-specific spectra were compared to a spectrum of the international long-termaverage speech spectrum (ILTASS, Figure 1) (Byrne et al., 1994). All spectral curves were normalized to a level of 65 dB SPL for display purposes. On average, the word-final fricative sounds had a bandwidth of energy residing at >4 kHz and <È10 kHz, with the spectral peak residing at 5 kHz. These results are consistent with previous data reported on the spectral characteristics of the female word-final /s/ (Pittman &Stelmachowicz, 2000). Comparison to the ILTASS illustrates the atypical boost of high-frequency energy that was present in the test stimuli.

Participants

A total of 49 participants were recruited from the University of Western Ontario (UWO) H.A. Leeper Speech and Hearing Clinic, as well as from local audiology clinics and schools. Participants included 14 NH children (6-18 years old), 12 NH adults (21-27 years old), 11 children with HI (6-17 years old), and 13 adults with HI (50-81 years old). The UWO Research Ethics Board approved this study for health sciences research involving human subjects. Participants with HI were part of a larger project that was carried out at UWO (Glista et al., 2009). Pure-tone air and bone conduction thresholds were measured bilaterally using a Grason-Stadler 61 audiometer. Air conduction thresholds were obtained using Etymotic Research ER-3A insert earphones (NHparticipants), with coupling to personal earmolds for all participants with HI. Air conduction hearing level was screened at 15 dB HL across all octave and interoctave frequencies for NH child listeners and at 20 dB HL for NH adult listeners. Tympanometry revealed normal middle ear function across all NH participants. For participants with HI, thresholds were measured at all octave and interoctave frequencies between 250 Hz and 8000 Hz. Mean audiometric hearing thresholds are reported for the child and adult groups separately (Table 1).

Absolute hearing thresholds ranged from NH in the low frequencies to a profound level of impairment in the high frequencies across both age groups. Mean hearing thresholds for the child group can be characterized as sloping from a mild level of impairment in the low frequencies to a profound level in the high frequencies; mean hearing thresholds for the adult group can be characterized as sloping to a severe level of impairment. Both age groups presented with bilaterally symmetrical hearing loss. Hearing loss symmetry was assessed according to a difference in highfrequency pure-tone average values (HF-PTA), calculated using averaged threshold values across 2000 Hz, 3000 Hz, and 4000 Hz. Individual HF-PTA values ranged from 0 dB to 23 dB, with group mean difference values of 10 dB and 7 dB for adults and children, respectively.

Testing Procedure

The testing paradigm included the use of computercontrolled software to automate stimulus presentation and scoring. Stimulus files including two repetitions were automatically generated via a computer in random order, generating a score out of 60 items per measurement. Stimulus presentation was routed to a sound field within a doublewalled sound booth via a loudspeaker that was positioned at 0° azimuth. A speech-shaped noise at a +20 dB signalto- noise ratio (SNR) was presented for the entire duration of each measurement; this was generated from a clinical audiometer and was routed to four loudspeakers encircling each study participant at 72° spacing. During the pilot stage of the project, a listening check revealed a slight stimulus offset cue that was attributable to a change in the noise floor at the end of the stimulus. A low-level masking noise was therefore added to the test to ensure that audibility of the frication cue, specifically, was required to distinguish plural from singular items. Pilot testing was carried out with NH listeners under conditions of 3000-Hz low pass filtering; in this condition, with the inclusion of the masking noise, listeners could no longer perceive stimulus offset cues and could not reliably detect word-final plural markers.

A closed response set was presented on a computer monitor using pictures (from articulation cards, Super

Duper Publications) and a corresponding orthographic display. The monitor was positioned slightly behind (and offto one side of) the loudspeaker at 0°. Each response set included the singular and plural form of each target word. Participants were instructed to use the computer mouse to choose which picture best described what he or she heard.

Presentation level for the NH group was fixed at 50 dB SPL. For the group with HI, presentation level was varied to accommodate the various hearing levels and speech recognition abilities of the participants. The minimum testing level was 50 dB SPL, representing speech at a low vocal effort level (Olsen, 1998). For some listeners with HI, the test level was increased if the participant's score for a given test level was at or below chance performance. In general, presentation levels ranged from a minimum of 50 dB SPL to a maximum of 65 dB SPL across participants. Once the presentation level for a given participant was determined, the same level was used for all measures obtained from that participant. This procedure is consistent with that reported by Wolfe and colleagues (2010) in a study evaluating the recognition of word-final plurality in an open response format (Wolfe et al., 2010, 2011).

Hearing Aid Trials

All of the participants with HI were full-time hearing aid wearers before entering the study, with the exception of two adult participants and one child participant. Bilateral prototype behind-the-ear hearing aids (similar to Phonak Savia 311 or 411) were provided to each participant along with FM-compatible audio shoes. Digital noise reduction features and automatic program selectors were disabled. Device fitting was completed using methods from the DSL v5.0 prescription: Child targets were used when fitting the children, and adults targets were used when fitting the adults (Bagatto et al., 2005). Age-dependent prescriptive targets were matched using simulated real ear measures incorporating individual real ear to coupler difference values. Note that the DSL v5.0 algorithm prescribes more gain for children than for adults (Scollie et al., 2005). The Audioscan Verifit VF-1 hearing instrument fitting system was used to measure aided responses for speech at 55 dB SPL, 65 dB SPL, and 75 dB SPL, and for a 90-dB SPL tone burst test signal, across all hearing aid fittings.

Testing was completed for two aided conditions: with and without NLFC. Testing with NLFC enabled was completed after 11 weeks of real-world experience using the hearing aid, on average (Range = 3 weeks-1.3 years). A follow-up appointment was scheduled for 5 weeks later, on average (Range = 2 weeks-5 months), to measure laboratory performance without NLFC. Participants also completed real-world trials and provided double-blind global preference ratings for the hearing aid program with or without NLFC active. Participants were given the option of choosing "same" if they felt there was no difference between the programs being compared. Preference ratings were recorded in a diary format. Retrospective analysis of performance on the UWO Plurals Test and the global measure of participant preference was incorporated into this study to investigate the sensitivity of the UWO Plurals Test to changes in the aided condition.

Testing Conditions and Scoring

Sound-field testing was completed in the unaided condition for all NH participants (new data) and in aided conditions for all participants with HI (data reported in Glista et al., 2009, was re-analyzed for inclusion in this data set). Participants completed two repetitions of each test to yield one test score (60 items); this was then repeated to obtain test-retest data for each testing condition (60 items ×2). Aided testing was completed without NLFC processing to evaluate test-retest scores and with NLFC processing to evaluate performance change across testing conditions. NLFC settings were individually determined and were systematically evaluated according to previously established procedures (Glista &Scollie, 2009).

Results for the participants with HI, previously reported in Glista et al. (2009), were re-analyzed for inclusion in this study. Results were scored using critical difference values according to the binomial theorem (Thornton &Raffin, 1978). Critical difference values were used to determine when two scores were statistically different from each other according to a 60-item word list.

Results

On average, the NH listeners performed at ceiling, with scores ranging from 93% to 100% correct, whereas scores for the listeners with HI ranged from È45% to near ceiling. Results were analyzed using critical difference values to assess the following: (a) test-retest reliability of the test and (b) the sensitivity of the test in evaluating the effect of NLFC hearing aid processing on word-final plurality recognition ability.

Test-Retest Reliability

Test-retest scores for all NH and HI participants were within the 90% critical difference values, with one HI child's data point falling outside the 95% critical limit (Figure 2). Another child with HI was excluded from test-retest evaluation because of missing data for the second repetition of the test; this was due to a limitation in available testing time. The intraclass correlation coefficient (ICC) was used to evaluate test-retest reliability, using an ICC type that tests whether repetitions of the same test provide the same score.1 ICCs for test-retest across all participants equaled .95 ($F = 42.4$, $p < .01$). However, these values include many scores that were at ceiling for the NH participants, possibly inflating reliability estimates and providing only limited information about test-retest reliability in a clinical population. Therefore, the test-retest performance was re-evaluated including only the participants with HI. The ICC for the participants with HI equaled .85 and was significant ($F = 12.2$, $p < .01$). Both ICCs were >.75, indicating good test-retest reliability (Portney &Watkins, 2000).

Sensitivity

To assess the test's sensitivity, HI results obtained with and without NLFC enabled were analyzed by comparing the change in test scores to the change in global real-world preference ratings (Figure 3) (Stratford &Riddle, 2005). First, the data were dichotomized according to the presence (coded as 1) or absence (coded as 0) of benefit as judged using critical difference values for the Plurals Test (90% limits). Data points falling at ceiling were not included in the analysis (n = 2). Results for 22 participants were included; 11 data points fell outside the critical limits, indicating significant benefit with frequency lowering on the Plurals Test. No performance decrements were observed. These "change" scores were then compared with participants' retrospective global ratings of performance change using correlation analysis. This analysis evaluated whether significant changes on the Plurals Test were associated with noticeable changes to the hearing aid wearers. Preference ratings were categorized, with 1 indicating a preference for frequency lowering, 0 indicating no preference, and -1 indicating a preference for conventional hearing aid processing. For the group of children with HI (nine participants were included in this analysis), five children indicated a preference for NLFC enabled, one indicated a preference for NLFC disabled, and three indicated no preference. For the group of adults with HI (13 participants), two participants indicated a preference for NLFC enabled, two indicated a preference for NLFC disabled, and nine indicated no preference.

A two-tailed, nonparametric correlation analysis was completed using the Kendall's tau algorithm. A significant positive correlation between benefit change and overall subjective preference was measured ($a < .05$): ICC = .45 ($p = .030$). This indicates that listeners who performed better on the UWO Plurals Test with NLFC processing were also somewhat likely to prefer using NLFC on real-world trials, whereas listeners who performed equivocally across conditions were less likely to prefer NLFC (i.e., they may have had no preference or may have preferred NLFC disabled). Evaluation of the relation between preference for hearing aids without NLFC and NLFC decrement on the Plurals Test could not be performed within this data set, as no listeners experienced decrement. The significant relationship between user preference and NLFC benefit on the Plurals Test suggests that this test is somewhat sensitive to changes in the perception of word-final /s/ sounds, and that meaningful changes in scores are somewhat associated with improved hearing aid function as noticed by the hearing aid wearer.

Discussion

The UWO Plurals Test is an English language measure of the detection of plurality markers. Acoustic analyses of the stimuli illustrate the high-frequency emphasis of this task: The bandwidth of energy associated with the word-final fricative sounds resides at >4 and <È10 kHz, and the spectral peak resides at 5 kHz, on average.

The purpose of this measure is therefore limited to an evaluation of high-frequency audibility of fricatives /s/ and /z/ as bound morphemes. This test was not designed to provide information related to overall consonant recognition or speech discrimination abilities and therefore does not replace aided testing of consonant discrimination. Rather, the focus is on the identification of the presence of a plural marker in the test stimulus. High performance scores on this test are associated with detecting the word-final fricatives in the plural stimuli and do not indicate that the listener correctly perceives an /s/ or /z/ phoneme. Confusion with other phonemes could co-occur with high detection scores.

This study assessed performance across 26 NH listeners in the unaided sound field and 24 HI listeners in the aided sound field. All NH participants achieved high scores regardless of age group, suggesting that the test materials and procedures are feasible for use on individuals between the ages of 6 and 81 years. Performance for the listeners with HI was assessed in two hearing aid conditions: with and without NLFC active. Performance with NLFC digital signal processing was deemed an appropriate test condition for use in the sensitivity analyses as past investigations with the UWO Plurals Test have shown significant changes in score between NLFC-on and NLFC-offconditions (Simpson, 2009). This test was not developed to be used exclusively in evaluating the efficacy of NLFC, and may be sensitive to changes in performance with other types of frequencylowering, hearing aid bandwidth changes and/or gain characteristics. Further research is needed to assess the sensitivity of the test across these or other examples of clinically relevant aided conditions.

Results obtained in NH listeners and listeners with HI (aided conditions) indicate reliable repeated outcome measurement at the level of the individual. When compared to a global measure of hearing aid preference, the Plurals Test was found to be somewhat sensitive to the effects of frequency lowering. Testing was reliably completed with children as young as 6 years of age. Further research is needed to determine if the test can be used with younger children. Findings reported should not be generalized outside the methods used in this study.

Clinical Implications

The UWO Plurals Test has the potential to be used to evaluate detection of high-frequency fricative sounds in a word-final position in clinical environments. The test is available on CD at no charge to clinicians in some countries (refer to the Disclosure Statement). The UWO Plurals Test may offer a way of assessing performance of hearing aid technology designed to enhance audibility of high-frequency sounds beyond what conventional amplification can offer. Specifically, this test may be sensitive to amplification in the range of 5-10 kHz. Methods reported in this article used a closed response set format of administration. For example, pictures of the singular and plural version of the root word appeared on a computer monitor during testing. The listener was responsible for clicking on the picture that best described what he or she heard. The same testing paradigm could also be achieved using paired picture cards, for example, presented in the same order as a prerecorded word list; this type of method would require manual scoring by the tester.

It is possible to administer the Plurals Test in a way that requires the listener to repeat what he or she heard rather than respond by choosing a picture (i.e., an open response set format). If administered in this format, the tester must judge from the listener's verbal response whether a singular or plural form of a word was heard and mark the response as correct or incorrect on a response form; however, scoring accuracy may depend on the examiner's hearing ability in the high frequencies. When using open response set formats, it is possible for the listener to correctly identify the absence or presence of plurality without correctly identifying the root word. The impact of this issue on test-retest reliability or test sensitivity has not been evaluated in this article. However, open-set administration of theUWOPlurals Test was reported in a study byWolfe et al. (2010, 2011) that evaluated speech perception ability in children and the effects of frequency-lowering hearing aid processing. Results indicate that the test was sensitive to the effects of NLFC.

Acknowledgments

This work was supported by the Natural Sciences and Engineering Research Council of Canada and Canadian

Institutes of Health Research (Collaborative Health Research Project #313114-2005), The Hearing Foundation of Canada, The Canada Foundation for Innovation, the Masonic Foundation of Ontario Help-2-Hear Project, and Phonak AG. Special thanks to Andrea Dunn, Andreas Seelisch, Julie Seto, Julianne Tenhaaf, Marlene Bagatto, and Melissa Polonenko for their contributions to this work.

Sidebar

Disclosure Statement

A portion of test development and data collection for the work presented in this paper was supported by a Collaborative Health Research Project grant that was cofunded by the Natural Sciences and Engineering Research Council and the Canadian Institutes of Health Research. Matching funds and in-kind support (hearing aids) for this grant were provided by Phonak AG.

Phonak AG has since licensed the test described in this paper for distribution to clinical audiologists. Licensing fees are received by the University of Western Ontario and are applied to further research and technology transfer. Drs. Scollie and Glista have provided continuing education lectures under Phonak sponsorship on various topics broadly related to pediatric hearing aid fitting and technology-related outcomes. Dr. Scollie is a member of the Phonak Pediatric Advisory Board. This test is made available by Phonak at no charge to clinicians. Licensing fees for the distribution of this test are received by the University of Western Ontario and are applied to research efforts.

Footnote

1 ICCs were computed using a two-way random effects model and an absolute agreement definition.

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Editor: Larry Humes
Received November 23, 2011
Accepted February 6, 2012
DOI: 10.1044/1059-0889(2012/11-0036)

Publication date: Jun 2012

Year: 2012

Hearing Aid Processing Changes Tone Burst Onset: Effect on Cortical Auditory Evoked Potentials in Individuals With Normal Audiometric Thresholds

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Publication info: American Journal of Audiology (Online) 21.1 (Jun 2012): 82-90.
ProQuest document link

Abstract: The validity of using the cortical auditory evoked potential (CAEP) as an objective measure of hearing aid outcome has been questioned in the literature due to stimulus modifications caused by hearing aid processing. This study aimed to investigate the effects of hearing aid processing on the CAEP elicited with tone bursts that may have altered onsets. CAEPs to unprocessed and hearing aid-processed tone bursts were obtained from 16 individuals with normal audiometric thresholds when the onset time, level, and signalto- noise ratio (SNR) were matched between the 2 conditions. Tone bursts processed by the hearing aid were recorded in an anechoic box and were presented through insert receivers. Unprocessed tone bursts were superimposed with hearing aid noise floor to match the SNR of the hearing aid-processed tone bursts. Shortening of rise time and overshoot at the onset of the tone burst were evident in the hearing aid-processed stimuli. Statistical analysis of data showed no significant effects of hearing aid processing on the latency or amplitude of CAEP peaks ($p > .05$). The changes in rise time occurring in the tone bursts due to hearing aid processing may not confound CAEP measures that are used to validate hearing aid fitting.

Full text: Headnote

Purpose: The validity of using the cortical auditory evoked potential (CAEP) as an objective measure of hearing aid outcome has been questioned in the literature due to stimulus modifications caused by hearing aid processing. This study aimed to investigate the effects of hearing aid processing on the CAEP elicited with tone bursts that may have altered onsets.

Method: CAEPs to unprocessed and hearing aid-processed tone bursts were obtained from 16 individuals with normal audiometric thresholds when the onset time, level, and signalto- noise ratio (SNR) were matched between the 2 conditions. Tone bursts processed by the hearing aid were recorded in an anechoic box and were presented through insert receivers. Unprocessed tone bursts were superimposed with hearing aid noise floor to match the SNR of the hearing aid-processed tone bursts.

Results: Shortening of rise time and overshoot at the onset of the tone burst were evident in the hearing aid-processed stimuli. Statistical analysis of data showed no significant effects of hearing aid processing on the latency or amplitude of CAEP peaks ($p > .05$).

Conclusion: The changes in rise time occurring in the tone bursts due to hearing aid processing may not confound CAEP measures that are used to validate hearing aid fitting.

Key Words: hearing aid, cortical auditory evoked potential, tone burst, rise time, onset changes/temporal changes, aided, signal-to-noise ratio (SNR)

Since the 1980s, the obligatory cortical auditory evoked potential (CAEP) has been a popularly researched potential for objective validation of amplification. Recent studies have questioned the validity of using CAEP for this purpose due to the hearing aid modifying the CAEP stimulus. The areas of concern have been poor signal-to-noise ratio (SNR) caused by the raised noise floor of the hearing aid and stimulus modifications such as rise time (i.e., time taken to reach plateau amplitude; Billings, Tremblay, &Miller, 2011; Marynewich, 2010). In addition, the gain achieved may differ between the short CAEP stimulus and the long duration sounds that are used for hearing aid verification (Marynewich, 2010; Stapells, Marynewich,&Jenstad, 2010).

The effect on the CAEP of the altered envelope/rise time of tone bursts due to hearing aid processing is unclear. In recent research studies (Marynewich, 2010; Stapells et al., 2010) that quantified the effects of

hearing aid processing on the stimulus, digital hearing aids were observed to alter the onset envelope and delay the rise time whereas analog hearing aids did not, and the types of two hearing aids had varying effects on the CAEP that approximately corresponded to the lengthened rise time. Change in stimulus rise time is an important stimulus parameter to be considered as it has been shown to affect the CAEP peak amplitude and latency (Cody &Klass, 1968; Lamb &Graham, 1967; Onishi &Davis, 1968; Prasher, 1980; Skinner&Jones, 1968; Thomson, Goswami, &Baldeweg, 2009). The general consensus among these studies is that shorter rise times lead to larger amplitudes and shorter latencies. This has been explained on the basis of neural synchrony. Longer rise time increases jitter in neuron firing. The increased jitter reflects variable trigger points along the onset envelope of the tone burst (Picton, 2011, pp. 335-343). Increased jitter results in reduced neural synchrony, which leads to broader peaks with lower amplitude (Goldstein &Kiang, 1958; Onishi &Davis, 1968). The effects of rise time have also been explained by the theory of temporal integration, where detection thresholds vary as a function of stimulus duration and intensity. As rise time is increased beyond 30 ms, the effective intensity at the onset of the stimulus is reduced (Onishi &Davis, 1968).

Although the above-mentioned studies (Marynewich, 2010; Stapells et al., 2010) provided insight into the changes that are introduced in the stimulus envelope that could explain the differences between the unaided and aided CAEP, differences in the SNR between the two conditions were not measured (e.g., Billings, Tremblay, Souza, &Binns, 2007; Billings et al., 2011). SNR is a strong predictor of CAEP attributes, with poorer SNR leading to smaller amplitudes and longer latencies (Billings et al., 2011). The effect of SNR is seen for peaks P1, N1, P2, and N2 of the CAEP (Billings, Tremblay, Stecker, &Tolin, 2009; Billings et al., 2011). The effect of SNR is also seen at the subcortical level illustrated using auditory brainstem responses elicited to stimuli in noise (Burkard&Hecox, 1983; Russo, Nicol, Musacchia,&Kraus, 2004; Song, Skoe, Banai, &Kraus, 2011). This implies that the effect of SNR at the subcortical level may also be carried forward to the cortex (Billings et al., 2009). Synchronous neural discharge is the basis of AEPs (Eggermont, 2007). The addition of noise interferes with the temporal precision of firing, meaning it reduces neural synchrony (Kaplan-Neeman, Kishon-Rabin, Henkin, &Muchnik, 2006; Russo et al., 2004). Reduced neural synchrony can result in decreased peak amplitude values and increased peak latency values (Russo et al., 2004). SNR has been indicated to influence the CAEP more than the absolute stimulus level (Billings et al., 2009; Phillips, 1985, 1990; Phillips &Hall, 1986; Phillips &Kelly, 1992). The obligatory CAEP, being more stimulus driven than the endogenous potentials such as the P300, shows stronger effects of SNR. This may be a reflection of the bottom-up process in the case of the CAEP versus a top-down process in the case of the P300 (Kaplan-Neeman et al., 2006). Hence, comparison of the effect of two stimulus conditions that vary in SNR may not truly reflect the sole effect of stimulus differences.

Therefore, it is still uncertain if the CAEP is influenced by the envelope/rise time changes in the stimuli that are caused by hearing aid processing. In order to study the exclusive effects of these stimulus changes on the CAEP, comparisons are required when the SNR is matched between the conditions being compared. Matching the SNR between conditions requires consideration of several factors, including processing linearity of the hearing aid and signal input level, discussed below.

Digitally programmable analog or digital hearing aids functioning within their linear working range have been used in recent studies investigating aided CAEPs. Hearing aid technology has transformed from the mostly analog linear to mostly digital wide dynamic range compression (WDRC) type of amplification (Johnson, Cox, &Alexander, 2010). In the Unites States, nearly 100% of the hearing aids prescribed to children are multichannel with compression systems, and >90% of them use the Desired Sensation Level (DSL) prescription algorithm (Jones &Launer, 2010). This distinction is important because the effect of a compressive circuit will differ from that of a linear circuit as the amount of gain varies based on the input stimulus level (Dillon, 2001). Digital hearing aids with this adaptive gain scheme cause several important changes in the stimulus, apart from providing gain that is shaped for a specific hearing loss. First, a delay is imposed on the signal by the digital

signal processing (Kates, 2005, 2008; Schaub, 2008). Second, the time required to determine the input level and stabilize the gain for a rapid change in input level can cause a brief overshoot at the onset of the stimulus if the stimulus level is above the compression threshold (Dillon, 2001). The magnitude of the overshoot is related to the compression attack time (American National Standards Institute [ANSI], 2003). Most WDRC amplifiers have short attack times of <10 ms (Kuk, 2002). With a commonly used CAEP protocol (e.g., Hyde, 1997; Stapells, 2009), where the interstimulus interval (ISI; i.e., duration between the end of one stimulus and the beginning of the following stimulus) ranges between 1 and 2 s, the sudden increase in the input level due to the presence of the CAEP stimulus causes compression to act each time. This is likely to result in consistent overshoots in consecutive stimuli. Expansion, a processing stage in which gain decreases as the input level decreases, mainly catered to minimize internal noise of the hearing aid (Bray &Ghent, 2001), may or may not be activated during the ISI. Third, the use of a hearing aid imposes a noise floor on the signal, and nonlinear signal processing can raise the level of the noise floor (Agnew, 1997; Lewis, Goodman, &Bentler, 2010; Thompson et al., 2002).

Some of these hearing aid signal processing considerations may also interact with the input stimulus level. Recent studies of hearing aid-evoked CAEPs were conducted in individuals with normal hearing. One such study used low stimulus levels (40 dB SPL) to avoid loud hearing aid output level (Billings et al., 2011). Low stimulus levels are atypical in validation of amplification where supra-threshold levels representing conversational levels of speech are used (e.g., Golding et al., 2007; Olsen, 1998). Typical stimulus levels for softthrough loud speech inputs and for hearing aid verification range from È55 dB SPL to 75 dB SPL (Olsen, 1998). Because the stimulus level interacts with nonlinear signal processing in hearing aids, lower level stimuli will receive more gain and higher level stimuli will receive less gain. For this reason, consideration of stimulus level is important if the goal of CAEP measurement is to characterize the aided response to sound.

Further research is required to determine if hearing aids introduce temporal changes in the stimulus that influences the CAEP. Hence, the aim of this study was to evaluate the stimulus onset altering effect of a hearing aid on CAEPs that are elicited with tone bursts of varying rise times, when the effects of hearing aid signal processing delay and noise floor are controlled. This was evaluated in normal hearing listeners to permit comparison to previous studies. It was hypothesized that digital hearing aids with WDRC processing, unlike linear processing, would shorten the rise time due to the occurrence of overshoot at stimulus onset. This would be expected to result in larger CAEP amplitude and shorter peak latencies.

Method

Stimuli

Stimuli were 1 kHz tone bursts of constant 90 ms duration with symmetrical linear rise/fall times of 7.5 ms or 20 ms. These rise times are representative of shorter and longer rise times that were used in past CAEP research (e.g., Beukes, Munro, &Purdy, 2009; Billings et al., 2011; Marynewich, 2010; Stapells et al., 2010).

Hearing Aid

In an attempt to prioritize clinical utility, we selected a hearing aid that was commonly used in clinical practice by the Ontario Infant Hearing Program, based on file review. This device was a 20-channel hearing aid that used nonlinear signal processing by default. The hearing aid was programmed to match DSL v.5.0 adult targets (Scollie et al., 2005) for the standard audiogram N5, which has thresholds ranging between 65 dB HL and 80 dBHL and a three-frequency mean pure-tone average of 75 dB HL (Bisgaard, Vlaming, &Dahlquist, 2010). The N5 audiogram is one of 10 standard audiograms that were developed to represent the range of audiograms that are common in clinical practice for the purpose of standardizing hearing aid programming. The hearing aid performance and fit-to-targets were verified using the Audioscan Verifit hearing aid analyzer. The hearing aid was programmed to include an omnidirectional microphone mode with all additional features (e.g., digital noise reduction, feedback cancellation) switched off. Expansion thresholds were at hearing aid software prescribed settings. The input/ output plot at stimulus frequency 1 kHz obtained using the Audioscan Verifit revealed a

compression ratio of 2:1 and compression knee-point of 55 dB SPL. Attack time and release time measured using American National Standards Institute (ANSI) automatic gain control (2003) module in Verifit at 1 kHz were 10 and 60 ms, respectively.

Recording of Hearing Aid Output

Recordings of hearing aid output used an ear simulator (Brüel &Kjæ r [B&K] type 4157, microphone type 4134) with an ear mold simulator to which the hearing aid was connected via 25 mm of size 13 tubing (ANSI, 2003). The intention of this setup was to mimic the output of a behindthe- ear hearing aid in an average adult ear. This was set up in a B&K anechoic box (Box 4232) that also housed a reference microphone. The outputs of the reference and coupler microphones were captured using the Spectraplus Real Time Spectrum Analyzer in separate channels using a sampling rate of 44.1 kHz with sampling precision of 16 bits. The Spectraplus software was used to record the reference and coupler signals as .wav files for further signal analyses, including measurement of aided levels in 1/3 octave bands and computation of hearing aid delay.

Tone bursts (7.5-ms and 20-ms rise times) were played via the speaker in the anechoic box at 60 dB SPL (calculated using root-mean-square [RMS] amplitude measured across the plateau). This level was above the compression threshold of the hearing aid, thereby testing the hearing aid while in a signal processing mode intended for listening to conversationallevel speech (Olsen, 1998). The tone burst stimuli were played with an ISI of 1,910 ms similar to previous CAEP recording paradigms (e.g., Billings et al., 2011; Tremblay, Billings, Friesen, &Souza, 2006). The ISI was measured from the end of one tone burst to the beginning of the following tone burst. Visual inspection showed overshoots consistently occurring in consecutive tone bursts of both rise times. For both tone burst rise times, one of the repetitions from each recording was randomly chosen as the stimulus for the aided condition. To ensure that the recording of the hearing aid output (both stimulus and noise floor) was unaffected by the noise floor of the recording path, the internal noise of the hearing aid and that of the recording path were compared in a no-stimulus condition. The noise floor of the hearing aid measured 9 dB to 54.1 dB above the noise floor of the B&K anechoic box across 1/3 octave bands between 100 Hz and 10000 Hz, with the largest difference in the band centered at 5000 Hz. Higher 1/3 octave band levels of the hearing aid noise floor were measured at higher frequencies due to the sloping nature of the hearing loss and the prescribed hearing aid gain. The hearing aid provided 42.5 dB of gain for both tone bursts and introduced a delay of 7.2 ms.

Calibration

A Bio-Logic Navigator Pro (v7.0.0), which is a clinical diagnostic AEP measuring instrument, was used for electrophysiological recording in the present study. For calibration purposes, the outputs of the Bio-Logic insert receivers were routed to an ear simulator according to ANSI (2004). Because the tone bursts had varying rise times and the hearing aid altered the onset of the tone bursts in the aided condition, level measurements for calibration were made across the plateau only (between 35 ms and 70 ms relative to the onset of the tone burst). Plateau levels were calibrated to target presentation levels of 60 dB SPL across all test conditions.

Test Conditions

The protocol consisted of two conditions for tone bursts of both 7.5 ms and 20 ms rise times:

* Aided: Stimuli for this condition were obtained from the tone bursts as recorded from the hearing aid output (Spectraplus) and were cropped for the purposes of this study using Goldwave software. These aided tone bursts included the effects of nonlinear signal processing and hearing aid noise floor.
* Unaided: Stimuli for this condition were the unprocessed tone bursts with the hearing aid noise floor superimposed synthetically throughout. The hearing aid noise floor was superimposed to equalize the two conditions for the SNR (Billings et al., 2007; Billings et al., 2011). This was done in two steps using Goldwave software. First, the level of the unprocessed tone bursts was matched with that of the aided tone bursts. This essentially removed hearing aid gain specific to aided stimuli. Second, the recorded noise floor from the ISI of an aided recording was excised and was mixed with the unprocessed tone bursts.

The stimulus onsets were matched in order to remove the effects of hearing aid processing delay. The stimuli and the noise floors in both of the above conditions were spectrally matched (within 4 dB). The Bio-Logic Navigator Pro allowed for custom stimuli of maximum 500 ms duration. In an attempt to maximize the duration of the prestimulus noise floor, all stimuli were constructed using Goldwave software such that the tone burst occurred between 410 ms and 500 ms of the entire 500 ms duration of the custom stimulus. This essentially removed hearing aid delay from the aided stimulus. In summary, the only differences that remained between the aided and the unaided tone bursts were any changes that were imposed on the stimulus onset/offset by the multichannel nonlinear processing of the hearing aid. The onset of the hearing aid noise floor was ramped up to reach maximum amplitude at 200 ms. The purpose of this envelope ramp was to minimize the CAEP in response to the hearing aid noise floor onset. This was necessary because the Navigator Pro presents true silence between presentations of the custom stimuli. All of the stimuli were resampled to 48 kHz before importing into the Navigator Pro.

Verification

The output of the Bio-Logic insert receivers was verified for matched spectra (1/3 octave bands) of the stimulus and the noise floor between the aided and unaided conditions for each rise time (Figure 1). The recording apparatus was the same as that used for calibration purposes. For the tone burst with 7.5 ms rise time, the SNR obtained in the band centered at 1 kHz was 45.5 dB and 44.9 dB in the aided and unaided conditions, respectively. For the tone burst with 20 ms rise time, the SNR was 44.0 and 43.4 dB in the aided and unaided conditions, respectively. Hence, SNR was matched within 1 dB accuracy at the stimulus frequency.

Computation of Tone Burst Rise Time

Envelopes of the stimuli (consisting of noise floor followed by the tone burst) were obtained by applying Hilbert transform in Spectraplus and were smoothed using a moving average of ±50 sample points (2.26 ms). Average plateau amplitude for the predefined plateau (between 35 and 70 ms relative to the onset of the tone burst) was obtained. Each sample point of the stimulus envelope was divided by the average plateau amplitude and was multiplied by 100 to obtain the percentage (proportion) of the plateau amplitude that was achieved at the given sample time. The time, relative to the tone burst onset at 410 ms, at which the amplitude first reached 100% was noted as the rise time of the tone burst.

Participants

The study included 16 adults (7 males and 9 females) ranging in age between 20.3 and 29.3 years (Mage = 24.2 years; SD = ±2.1 years). Eligibility criteria included passing a hearing screen at 20 dB HL using insert earphones across octave and interoctave audiometric frequencies between 0.25 kHz and 8 kHz (GSI-61 Audiometer; ANSI, 2004) and a single peak tympanogram with peak pressure between -100 and +50 daPa (measured using the middle ear analyzer Otoflex 100; ANSI, 2007). Routine otoscopic examination ruled out any contraindications such as active discharge, occluding wax, or foreign body in the ear canal. Participants with normal hearing were chosen to study the effects of hearing aid- processed stimuli exclusively without the influence of hearing loss (e.g., Billings et al., 2011). None of the participants reported any history of significant neurological or otological disorders. The study protocol was approved by the Health Sciences Research Ethics Board of The University ofWestern Ontario, Canada. Participants were compensated for their time.

CAEP Testing

Asingle-channel ipsilateral recording (Vertex to ipsilateral mastoid with ground Fpz) was obtained using the Navigator Pro. Tone bursts were presented at the rate of 0.5 stimuli/s, which translates to an ISI of 1,910 ms for tone bursts of 90 ms duration. This ISI is the same as that used to acoustically record the aided stimuli. Each recorded electroencephalogram [EEG] sweep included 410 ms of prestimulus baseline (relative to tone burst onset) and 656 ms of poststimulus activity. The EEG was amplified 50,000 times and was digitized at the rate of 480.03 Hz. Responses were bandpass filtered between 0.1 Hz and 100 Hz online. The artifact rejection threshold was set to ±70 mV.

Testing was carried out in two 1-hr sessions within a 7-day period. Test ear was alternated across participant order number. Tone burst rise time conditions were alternated across session number for each participant. The sequence of conditions in a session was randomized. Two averages of 100 sweeps each were obtained for each stimulus condition. The participants watched a muted movie of their choice with subtitles only and were instructed to ignore the stimuli played (Lavoie, Hine, &Thornton, 2008; Pettigrew et al., 2004). Participants were given breaks when requested.

Data Analysis and Interpretation

Postprocessing using a MATLAB script included a second-order bandpass Butterworth filter (1-15 Hz). Criteria used to assess the presence of N1-P2 peaks included repeatability and relative prestimulus baseline activity. The examiner was blind to the test condition during interpretation. Peaks weremarked at their maximum amplitude within their expected latency regions automatically using the MATLAB script. The latency regions used to identify the peaks were between 78 ms and 170 ms for N1 and between 111 ms and 280 ms for P2. This peak marking process was cross checked manually by the examiner, and decisions were overridden where required. Corrections of 410 ms were applied for peak latency to account for the delayed onset of the tone burst within the 500 ms duration of the entire custom stimulus. The N1-P2 peak-to-peak amplitude was computed as this measure is reported to provide greater reliability and less variance across repetitions when compared to a baseline-to-peak approach (Goshorn, Marx, &Simmons, 2011). Values were averaged across the two repetitions for subsequent analysis.

Analysis

A repeated measures analysis of variance (ANOVA) was computed for N1 and P2 latencies and N1-P2 amplitude with tone burst rise time (7.5 ms and 20 ms) and stimulus processing condition (aided and unaided) as the main factors. Results of the statistical analysis were interpreted based on an a rate of 5%. The null hypothesis was rejected if the p value was <.05.

Results

The envelopes of the aided and unaided stimuli for both rise times are illustrated in Figure 2. The aided stimulus rose faster than the unaided stimulus for both rise times because the hearing aid delay ofÈ7.2 ms was taken into account while creating the stimuli. Comparing the envelopes of the aided stimuli for the two rise times, the overshoot, relative to the plateau amplitude, was minimally higher for the 7.5 ms tone burst compared to the 20 ms tone burst. The change in rise time was greater for the 20 ms condition compared to the 7.5 ms condition. The rise time of the 7.5 ms aided tone burst was 5.5 ms after processing; the rise time of the 20 ms aided tone burst was 12 ms.

Out of 16 participants tested, P2 was judged to be absent in the aided condition for one participant and in the unaided condition for a second (different) participant. The grand waveforms averaged across all participants for each condition and rise time are shown in Figure 3. Across participants, the mean within-subject test-retest difference was 10.8 ms (standard error [SE] = 3.1 ms) for peak latency. For N1-P2 amplitude, the mean within-subject test-retest difference was 1.14 mV (SE = 0.21 mV).

Neither tone burst rise time (7.5 ms vs. 20 ms) nor condition (aided vs. unaided) had significant effects on N1 or P2 latencies, or N1-P2 amplitude. (See Table 1 for mean values and Table 2 for ANOVA results.) Hence, the null hypothesis cannot be rejected.

Discussion

This study investigated the influence of hearing aid processing on the onset of the CAEP stimulus when SNR hearing aid delay and gain were carefully accounted for. Results revealed no significant effect on the CAEP of changes in the tone burst caused by hearing aid processing.

Effect of Condition (Aided vs. Unaided)

The overshoot at the onset of the tone burst in the aided stimulus (see Figure 2) is consistent with the description of temporal changes associated with a WDRC circuit when the stimulus level is above the

compression knee-point (Dillon, 2001). No significant effect of condition was found for peak latencies and amplitude. A possible explanation for non significant differences in the CAEP attributes could be the small magnitudes of the changes in rise time with hearing aid processing. The CAEP peak latency varies nonlinearly with tone burst rise time (i.e., latency increases at a slower rate than increases in rise time). For example, at supra-threshold levels (similar to this study), for up to 20 ms increase in rise time (10 to 20 ms or 10 to 30 ms), the latency of the peaks increases by roughly 6 ms or less (Kodera, Hink, Yamada, &Suzuki, 1979; Onishi &Davis, 1968). Hence, for changes in rise time as small as 2 ms and 8 ms in the present study, the change expected in the peak latency would be <6 ms, and no significant change was found. The reduction in N1-P2 amplitude with an increase in rise time of <50 ms has been reported to be nonsignificant (Onishi &Davis, 1968), or È0.2 mV for changes in rise time of 15 ms (Kodera et al., 1979). No substantial amplitude changes would be expected for the small changes in rise time observed here, and none were found. Additionally, these reported differences are smaller than the within-subject test-retest differences in peak latency and amplitude that were observed in the present study. These results suggest that the changes occurring in the tone burst due to hearing aid processing with the hearing aid used in this study may not confound CAEP measures in similar testing conditions.

Although the aided stimulus reached plateau amplitude earlier than the unaided stimulus in addition to the overshoot, the maximum increase in stimulus level (dB calculated using RMS amplitude with Spectraplus) in the first 30 ms, which is the integration time window for the CAEP (Onishi&Davis, 1968), was <2 dB. This implies that the overshoot increases the stimulus onset level by only a small amount and hence will have a small level effect on the CAEP. Although this increase in 2 dB (maximum) did not significantly affect the CAEP attributes in individuals with normal audiometric thresholds in this study, clients presenting with recruitment may show variations in this effect due to faster growth of loudness (Moore, 2007). In addition, because the effects of stimulus rise time on the CAEP can be explained on the basis of temporal integration (Onishi &Davis, 1968), the effect of altered rise time may influence aided CAEPs in individuals with cochlear hearing losses differently because poorer temporal processing relative to individuals with normal hearing has been documented in individuals with cochlear hearing losses (Florentine, Fastl, &Buus, 1988; Moore, 2007). The attack time in the hearing aid used in the present study was 10 ms (measured using Audioscan Verifit). Hence, it is likely that hearing aids with similar attack times will show similar changes to such stimuli.

Because the hearing aid was programmed for a hypothetical hearing loss of severe degree, it used high gain. Electroacoustic evaluation of the effect on the stimulus across varying hearing aid gain revealed that higher gain produced larger overshoots. Specifically, the same hearing aid programmed for greater degrees of hearing loss produced larger overshoots than when it was programmed for lesser degrees of hearing loss as the gain prescribed increases with poorer hearing thresholds. Therefore, the lack of effect on CAEP with this extent of overshoot can suggest a lack of effect with smaller overshoots, which would occur with less gain. In the present study, several factors such as level and SNR were artificially altered to evaluate the temporal effect of hearing aid processing on the onset of tone bursts; therefore, this does not mimic a typical unaided-aided condition comparison. Also, the scope of the present investigation was limited to a specific stimulus level and one hearing aid programmed for a specific hearing loss. Interactions between stimulus input level and gain applied that occur in a WDRC circuit may affect the on set of the tone burst differently, but this is beyond the scope of this study.

SNR

The SNR at 1 kHz in the aided condition was 44.9 dB for the 7.5 ms rise time and 44.5 dB for the 20 ms rise time. This is much higher than the best SNR of 22.2 dB at the stimulus peak frequency reported in Billings et al. (2011). There are several possible explanations for this difference. One reason could be differences in the noise floors of the hearing aids used. The second reason could be the higher input stimulus level that was used in the present study. The input level used in Billings et al. (2011) was 40 dB SPL, whereas it was 60 dB SPL in the

current study. Assuming that the microphone is the dominant source of internal noise in the hearing aid (Agnew, 1997; Thompson et al., 2002), the SNR at the input of the amplifier will be lower when the level of the tone burst/stimulus is lower. At any instant, the gain applied to the constant noise floor and other input stimuli will be the same because they occur simultaneously, and the gain in such cases is determined only by the higher level stimulus (Wolfe, Thompson, Swim,Wood, &Schafer, 2007). Therefore, it could be argued that the SNR in the Billings et al. (2011) study was probably lower due to the input level being closer to ambient noise and/or hearing aid noise floor.

Tone Burst Rise Time

Tone bursts of two rise times were used to evaluate the effects of hearing aid processing across rise times. Tone burst rise time, as a main variable, showed no significant effect on peak latencies or amplitude. A trend of longer peak latencies and smaller N1-P2 amplitude with the longer rise time can be observed (Table 1). This is in general agreement with literature examining the relationship between tone burst rise time and CAEP attributes. The reader is referred to the Introduction of this paper, where the physiological basis of the effect of stimulus rise time on the CAEP is described. In some studies, no statistical analysis was carried out (Skinner &Jones, 1968; Onishi &Davis, 1968). Kodera et al. (1979) found no significant change in N1-P2 amplitude and statistically significant increases in N1 and P2 latency of È6 ms with an increase in rise time from 5 ms to 20 ms. These small changes are consistent with the numerical, albeit not statistically significant, ≤5 ms increase that was observed in the present study.

Conclusion

This study was designed to explore the effects of stimulus modifications (specifically tone bursts) caused by hearing aid processing in individuals with normal audiometric thresholds when hearing aid noise floor, processing delay, and gain are controlled. SNR was artificially matched between the aided and unaided conditions, and the effects of processing delay and hearing aid gain were removed during stimulus preparation. This allowed examination of the specific effects of altered rise time caused by hearing aid processing on the CAEP. The findings of this study revealed that the alterations in tone bursts that were caused by the hearing aid used in this study (after controlling for gain, delay, and SNR) were not large enough to significantly influence CAEP responses in normal hearing listeners. This was illustrated using a clinically applicable hearing aid scenario with a well-controlled method. This effect still needs to be explored in individuals with hearing impairment to fully evaluate its clinical significance. These findings may only be generalized to conditions with hearing aids of similar configurations such as attack time and when tone bursts are used.

Acknowledgments

This work was supported by Early Researcher Award ERA07- 03-051 from the Ontario Ministry of Research and Innovation and a New Opportunities Award from the Canada Foundation for Innovation /Ontario Innovation Trust to Susan Scollie. The authors would like to thank David Suelzle for his assistance in stimulus generation for this project and Lorienne Jenstad for helpful comments on an earlier version of this manuscript.

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Editor: Larry Humes
Received December 22, 2011
Accepted March 11, 2012
DOI: 10.1044/1059-0889(2012/11-0039)

Publication date: Jun 2012

Year: 2012

Talker Differences in Clear and Conversational Speech: Vowel Intelligibility for Older Adults With Hearing Loss

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 779-790A.
ProQuest document link

Abstract: To establish the range of talker variability for vowel intelligibility in clear versus conversational speech for older adults with hearing loss and to determine whether talkers who produced a clear speech benefit for young listeners with normal hearing also did so for older adults with hearing loss. Clear and conversational vowels in /bVd/ context produced by 41 talkers were presented in noise for identification by 40 older (ages 65-87 years) adults with sloping sensorineural hearing loss. Vowel intelligibility within each speaking style and the size of the clear speech benefit varied widely among talkers. The clear speech benefit was equivalent to that enjoyed by young listeners with normal hearing in an earlier study. Most talkers who had produced a clear speech benefit for young listeners with normal hearing also did so for the older listeners with hearing loss in the present study. However, effects of talker gender differed between listeners with normal hearing and listeners with hearing loss. The clear speech vowel intelligibility benefit generated for listeners with hearing loss varied considerably among talkers. Most talkerswho produced a clear speech benefit for normal-hearing listeners also produced a benefit for listeners with hearing loss.

Full text: Headnote
Purpose: To establish the range of talker variability for vowel intelligibility in clear versus conversational speech for older adults with hearing loss and to determine whether talkers who produced a clear speech benefit for young listeners with normal hearing also did so for older adults with hearing loss.
Method: Clear and conversational vowels in /bVd/ context produced by 41 talkers were presented in noise for identification by 40 older (ages 65-87 years) adults with sloping sensorineural hearing loss.

Results: Vowel intelligibility within each speaking style and the size of the clear speech benefit varied widely among talkers. The clear speech benefit was equivalent to that enjoyed by young listeners with normal hearing in an earlier study. Most talkers who had produced a clear speech benefit for young listeners with normal hearing also did so for the older listeners with hearing loss in the present study. However, effects of talker gender differed between listeners with normal hearing and listeners with hearing loss.
Conclusion: The clear speech vowel intelligibility benefit generated for listeners with hearing loss varied considerably among talkers. Most talkerswho produced a clear speech benefit for normal-hearing listeners also produced a benefit for listeners with hearing loss.
Key Words: speech perception, hearing loss, communication strategies
Difficulty understanding speech is the primary complaint that leads individuals with hearing loss to seek hearing help, and thus the primary goal of audiologic rehabilitation is to improve everyday speech understanding. Although hearing aids are a very important component of this rehabilitation, market surveys have consistently found that fewer than 25% of people with hearing impairments have hearing aids (Kochkin, 2009). Further, although more than 80% of hearing aid users report satisfaction with the overall benefit they receive, only half say they are satisfied with the benefit received in noise (Kochkin, 2005). This suggests that to maximize speech understanding for the largest number of individuals with hearing loss, audiologists should offer other rehabilitative services. A recent survey of clinical practice showed that most audiologists do so (Prendergast &Kelley, 2002). For example, over 80% of audiologists surveyed reported offering information on assistive listening devices and training in communication strategies. Some audiologists (38%) also provide training for the frequent communication partners of their clients with hearing loss, including "speaking behaviors" intended to reduce the frequency of such breakdowns. A typical recommendation is that the communication partner "speak clearly and slowly" (Tye-Murray, 2004, p. 136).
A number of laboratory studies have demonstrated that this recommendation should lead to improved speech understanding. In these studies, talkers read printed speech materials, first in a conversational manner and later under instructions to speak as though talking to someone who has difficulty understanding them. When presented to listeners with hearing loss for identification, clear speech is significantly more intelligible than conversational speech. This clear speech benefit has been found for sentence materials (e.g., Picheny, Durlach, &Braida, 1985; Schum, 1996; Uchanski, Choi, Braida, Reed, &Durlach, 1996) and for single words (Uchanski et al., 1996). A clear speech benefit has also been found for individuals with normal hearing in degraded listening conditions identifying sentences (e.g., Liu, Del Rio, Bradlow, &Zeng, 2004; Payton, Uchanski,&Braida, 1994), words (e.g., Gagné, Masterson, Munhall, Bilida,& Querengesser, 1994), and consonantvowel and vowel-consonant-vowel stimuli (Gagné,Rochette, &Charest, 2002). Although the clear speech benefit observed for sentences and words has been similar for listeners with normal hearing and listeners with hearing loss (e.g., Payton et al., 1994), a study using vowel materials produced by a single talker (Ferguson &Kewley- Port, 2002) found divergent results for the two listener groups. Although vowels in /bVd/ context presented in a background of 12-talker babble were significantly more intelligible in clear speech than in conversational speech for listeners with normal hearing, no such clear speech vowel intelligibility benefit occurred for listeners with hearing loss.
Ferguson and Kewley-Port (2002) conceded that their surprising result "begs the question of whether the strategies our talker employed are unique to him, or whether they represent a typical response to instructions to speak as though talking to a hearing-impaired listener" (p. 270). This question has been difficult to answer, given that no previous study has directly assessed talker differences in the clear speech effect for listeners with hearing loss. However, differences among talkers are apparent in studies that included multiple talkers. In the largest such study, Schum (1996) presented sentences produced by 10 young and 10 elderly talkers to older adults with sloping sensorineural hearing loss. Although no differences were observed between younger and older talkers, a table showing individual scores for each talker displays a wide range of clear speech effects,

from as low as 4 to as high as 45 rationalized arcsine units (RAU; Studebaker, 1985). Talker variability in the size of the clear speech benefit for listeners with hearing loss can also be seen in Picheny et al. (1985) and in Uchanski et al. (1996), which used the same three talkers.

Using a database of 41 talkers, Ferguson (2004) demonstrated that the clear speech vowel intelligibility benefit enjoyed by young listeners with normal hearing varies widely among talkers. The present study extended this work to one of the clinical populations for whom clear speech is intended: older adults with hearing loss. Specifically, vowel intelligibility in noise for the 41 talkers in the Ferguson Clear Speech Database (Ferguson, 2004) was assessed for a group of 40 older adults with mild-to-moderately severe sloping sensorineural hearing loss. Talker differences in the magnitude of the clear speech vowel intelligibility effectwere examined and compared to Ferguson's results for young listeners with normal hearing. The goals of the study were to establish the range of talker variability in the clear speech benefit among talkers in the 41-talker database for listeners with hearing loss, and to determine whether talkers who produce a clear speech vowel intelligibility benefit for listeners with normal hearing also do so for listeners with hearing loss. Based on the results of Ferguson (2004) and of Ferguson and Kewley-Port (2002), the hypotheses were that the clear speech benefit (a) would vary among talkers, and (b) would be smaller for listeners with hearing loss than for listeners with normal hearing.

The study also tested several hypotheses regarding the effect of talker characteristics on the clear speech benefit for listeners with hearing loss. The first considered talker gender. When materials were presented to young listeners with normal hearing in Ferguson (2004), overall vowel intelligibility was higher for female talkers than for male talkers. Listeners with hearing loss, in contrast, often report difficulty understanding female talkers (Helfer, 1995). Although the superior intelligibility of female talkers for young listeners with normal hearing has been observed elsewhere (e.g., Bradlow, Torretta,&Pisoni, 1996), no previous study has assessed the effects of talker gender on speech intelligibility for listeners with hearing loss. The hypothesis was that for the present listeners, vowels produced by male talkers would be more intelligible than those produced by female talkers.With regard to other talker characteristics, the hypotheses were that older talkers and talkers with experience communicating with listeners with hearing loss would produce a larger clear speech benefit than younger talkers and talkers with no such experience.

Method

Materials

Test stimuli were identical to those used in the perceptual study reported by Ferguson (2004). For each of the 41 talkers in the Ferguson Clear Speech Database, two tokens each of 10 vowels (/i/, /I /, /e /, /e/, /æ /, /A/, /.../, /o/, /?/, /u /) in /bVd/ context were selected from each speaking style (clear and conversational). The /bVd/ words were excised from the carrier sentences in which they were elicited and then scaled to have the same peak RMS amplitude. The carrier sentences were meaningful but contained minimal contextual information regarding the identity of the /bVd/ word, which was centrally located within the sentence. Examples include "Vera put the _____ on the table" and "I think the word _____ is hard for kids to say." In the conversational speech condition, which was recorded first, talkers were instructed to read the sentences aloud, speaking as they would in everyday conversation. In the clear speech condition, talkers were instructed to say the sentences as they would if they were talking to a person with hearing loss. Additional details regarding recording procedures may be found in Ferguson (2004).

As in Ferguson (2004), test stimuli were presented in a background of 12-talker babble. A 15-s sample of babble was low-pass filtered at 8500 Hz and digitized from the noise channel of a recording of the Speech Perception in Noise Test (Kalikow, Stevens, &Elliott, 1977). On each test trial, a segment of babble selected from this 15-s sample was presented along with the /bVd/ word. The speech materials were recorded, and the babble was sampled at 22050 Hz; they were resampled to 24414 Hz prior to the perceptual experiment for presentation via Tucker-Davis Technologies (TDT) System III audio hardware.

Listeners

The desired number of participants (n = 40) was determined via power analysis of pilot data. To achieve this target, 54 older adults (ages 65 to 87 years, 28 women) were recruited from a subject pool maintained by the author. Subject pool members received a complete audiological evaluation upon joining the pool. To be invited to participate in the present study, pool members were required to be native speakers of American English with no history of speech or language disorders. They also were required to have mild-to-moderately severe sloping sensorineural hearing losses and good word recognition abilities (> 80% correct) for the Northwestern University Test No. 6 (NU-6; Tillman &Carhart, 1966) presented in quiet at 40 dB above the speech recognition threshold.

Upon enrollment in the present study, listeners were required to have normal cognitive status as determined by a score of 25 or higher on the Mini-Mental State Examination (MMSE; Folstein, Folstein, &McHugh, 1975), which was administered at the beginning of the experiment. All 54 participants met this criterion. Finally, listeners were required to achieve 88% correct performance on a vowel identification familiarization task (see Procedure section below). Forty (22 women) of the 54 participants reached this criterion. Their mean audiogram is shown in Figure 1; their mean NU-6 score was 96%, they ranged in age from 65 to 87 years, and their mean MMSE score was 28.75. All listeners were paid for their participation.

Procedure

All test procedures were approved by the University of Kansas Human Subjects Committee. Listeners were tested individually in a double-wall sound-treated booth, seated in front of a computer monitor and mouse. On each trial, a test word and a segment of 12-talker babble were played from separate channels of a TDT RP2 realtime processor. The babble segment, which was 1 s longer than the test word, was selected from a random location within the stored 15-s babble sample; the test word and babble segment were centered temporally. The test word and babble segment were attenuated by separate TDT programmable attenuators (PA5) to achieve the desired overall level and signal-to-babble (S/B) ratio. The speech and babble were then mixed (TDT SM5) and routed via a headphone buffer (TDT HB7) to an insert earphone (E-A-RTONE 3A) for monaural presentation. To identify the vowel of the test word, the listener clicked on the response category corresponding to that vowel. The 10 response alternatives were displayed on the computermonitor as 10 sets of three key words: (1) feet, thief, bead; (2) sit, rib, bid; (3) tape, raid, bade; (4) head, said, bed; (5) back, mass, bad; (6) pot, sod, bod; (7) cup, rug, bud; (8) rode, own, bode; (9) good, should, book; and (10) rude, news, boot. The same key words were used in Ferguson (2004). After selecting their response, listeners could click "OK" to confirm it or "cancel" if they wished to change their response due to uncertainty or a mouse-clicking error. Listeners were not permitted to replay the stimulus.

Listeners were tested in four sessions. These sessions were scheduled at the listeners' convenience; total test periods ranged from 5 days to 6 weeks. In the first session, which lasted 2 hr, listeners were given the MMSEand familiarized with the test procedures prior to beginning the experimental conditions. For familiarization, a single 41-trial block of clear vowel tokens created for Ferguson (2004) using one /bVd/ token from each talker was used. The order of the 41 stimuli was randomized each time the block was presented. After orientation to the vowel identification task and response alternatives by the experimenter, listeners completed the familiarization block, with response accuracy feedback indicating the correct answer for each trial, at a presentation level of 85 dB SPL in quiet. This block was repeated up to four times or until a criterion of 88%correct identification was achieved.Onaverage, listeners required 1.83 presentations of the familiarization block to reach criterion. Once criterion had been achieved, listeners performed an additional familiarization block at 70 dB SPL in quiet without feedback1 followed by three familiarization blocks in babble without feedback. The S/B ratios for these blocks were +3 dB, 0 dB, and -3 dB. After completing the familiarization, listeners completed two test blocks to finish out the first test session. The remaining three test sessions took approximately 90 min each. Listeners completed five test blocks in Sessions 2 and 3, and four test blocks in

Session 4.

The presentation level for the test blocks was 70 dB SPL, a level selected as a typical speech level in noisy environments (Pearsons, Bennett, &Fidell, 1977). The same level was used in Ferguson (2004). Because speech audibility differs for listeners with normal hearing and listeners with hearing loss in most real-world situations, the present study was not designed to equate audibility across listener groups. However, the S/B ratio for the listeners with hearing loss in the present study was -3 dB, in contrast with the -10 dB S/B ratio used for the listeners with normal hearing in Ferguson (2004). In Ferguson and Kewley-Port (2002) and in a pilot study, these two S/B ratios yielded roughly comparable identification performance for the two listener groups for vowels in conversational speech and prevented ceiling effects for the most intelligible vowels.

The 1,640 test stimuli (41 talkers ×10 vowels ×2 tokens ×2 styles) were arranged into 16 blocks of 100 to 120 items. These test blocks were created by dividing the stimuli into a 2 ×2 factorial design of gender by speaking style. Each block contained 20 stimuli (10 vowels ×2 tokens) from five or six talkers of the same gender from a single speaking style. That is, there were four blocks of clear stimuli from male talkers, four blocks of conversational stimuli from male talkers, four blocks of clear stimuli from female talkers, and four blocks of conversational stimuli from female talkers. Although stimuli were presented three times each in Ferguson (2004), data from that study and from a pilot study in which older adults with hearing loss identified vowels from a subset of the talkers revealed that identification was highly consistent among the three presentations. Listeners in the present study therefore heard each stimulus item just one time. However, to counteract the possibility that performance for a given talker might be affected by the specific combination of talkers in a given test block, the identical three different sets of 16 test blocks used in Ferguson (2004) were used here. Each of the three sets contained different random combinations of talkers across the four blocks within each gender and style. Roughly equal numbers of listeners heard each set. Within each set, each listener received the 16 blocks in random order, and stimuli were randomized within each block.

Data Analysis

To test whether vowel intelligibility differed significantly between clear and conversational speech and whether the magnitude of the clear speech vowel intelligibility benefit varied as a function of talker (gender, age, experience communicating with individuals with hearing loss) or listener (hearing status) characteristics, individual listener scores for each talker were converted to RAU and analyzed using mixed-effects models.Mixedeffectsmodels have several advantages over the repeatedmeasures analyses of variance techniques that typically have been used in studies comparing clear and conversational speech (including Ferguson, 2004). These advantages include higher statistical power and robustness to both missing data and violations of sphericity (Quené &van den Bergh, 2004). The chief advantage of mixedeffect models for the present investigation is their ability to simultaneously account for multiple sources of intercorrelation. For example, in the present study, scores obtained by individual listeners for the 41 talkers may be correlated: There may be listeners who achieve high intelligibility scores for all talkers and listeners who have low intelligibility scores for all talkers. Similarly, to the extent that talkers differ from each other, intelligibility scores obtained from different listeners (or different listener groups) for vowels produced by a given talker will tend to be correlated. Mixed-effects analyses handle such nonindependence by modeling its sources as random effects, keeping track of which observations are repeated measurements within the same subject. All listeners in the present study heard all of the talkers, and so talker and listener effects were modeled as crossed random effects in models that required both random factors. All analyses were performed using Stata 11 (StataCorp, 2009).

The design of the experiment includes a number of variables with several levels, most notably the talker variable with 41 levels. To reduce the possibility of error associated with multiple comparisons, all p values for contrasts tested within variables comprising more than two comparisons were corrected using a false discovery rate procedure (FDR; Benjamini &Hochberg, 1995). FDR is commonly used in behavioral genetics research,

where strains may be compared on dozens of behavioral endpoints. Benjamini, Drai, Elmer, Kafkafi, and Golani (2001) argue that FDR strikes "a balance between the concern about making toomany false discoveries and the concern about missing the discovery of a real difference that may arise from being too conservative" (p. 283).

Results

Talker and Speaking Style Effects

In the first set of mixed-effects models, which had speaking style and talker as fixed effects, a model that included listener as a random variable was found to fit better than a model with no random factors (likelihood ratio test, c2 = 1456.26, p <.001). This suggests significant differences in vowel identification among the 40 listeners; these differences are considered further in the Discussion section. Returning to the fixed effects, both speaking style and talker were found to be significant. Vowels in clear speech were significantly more intelligible than vowels in conversational speech (z = 18.97, p <.001), with an average difference between the styles of 8.8 RAU.

Overall vowel intelligibility also varied significantly among talkers. This variability is apparent in Table 1, which shows intelligibility scores (in percent correct) for each talker in each speaking style. Among the 41 talkers, vowel intelligibility scores ranged from 54% to 92% in conversational speech and from 59% to 95% in clear speech. Categorical variables with multiple levels are tested in mixed-effects models by comparing one level of the variable to all other levels. When a variable has just a few levels, it is reasonable to do this using each level of the variable as the baseline. Testing all 41 levels of the talker variable, in contrast, seemed unreasonable and was deemed unnecessary to show that the talkers differed significantly, and so just a few reference talkers were sampled for illustrative purposes. All comparisons used a criterion FDR-corrected p value of .05. The intelligibility of vowels produced by talker M17, who had the highest overall intelligibility, differed significantly from the intelligibility of vowels produced by all of the other talkers. Vowels produced by talker M07, who had the lowest overall intelligibility, had significantly lower intelligibility than those produced by all but one of the other talkers. Finally, F07's overall vowel intelligibility was very close to the mean for the group; her scores differed significantly from scores obtained for 25 other talkers.

Assessment of interaction effects with categorical variables in mixed-effects models requires the creation of an interaction term for each level of the categorical variable. This was done, and the interaction between speaking style and talker was significant. That is, the magnitude of the clear speech effect differed significantly among the talkers. As with the talker effect above, the model containing the interaction terms was tested using three different baseline talkers and a criterion of FDR-corrected p <.05. F11 had the largest clear speech vowel intelligibility benefit (37 RAU); the magnitude of the benefit was significantly greater than that achieved by all 40 of the other talkers. M06, who produced the smallest positive clear speech effect (0.5 RAU), differed significantly from 17 other talkers. Lastly, F21's clear speech vowel intelligibility benefit (8.8 RAU) was very close to the mean for the group; her clear speech effect differed significantly from that produced by 12 other talkers. The variability among talkers is apparent in the fourth column of Table 1, which shows the clear speech vowel intelligibility effect in percentage points produced by each talker (calculated by subtracting the conversational score fromthe clear score).The interaction between talker and speaking style can also be seen in Figure 2, which shows percent correct vowel intelligibility for all 41 talkers, with the talkers ordered by their scores in conversational speech. To further explore the interaction, the effect of speaking style was tested for each individual talker; it was significant for 24 of them (FDR-corrected p <.05).

Talker Gender Effects

The next analysis assessed whether talker gender affected overall vowel intelligibility or the magnitude of the clear speech vowel intelligibility benefit. To assess the effect of gender, a model was created that included speaking style and gender as fixed effects and talker and listener as crossed random effects. Note that coefficients for individual fixed factors are unaffected by adding, subtracting, or changing other fixed factors, and so the effect of speaking style remained significant (z = 18.97, p <.001) in this and all subsequent models.

Gender, on the other hand, was not significant ($z = -0.6$, $p = .55$), indicating that vowels produced by female andmale talkers were equally intelligible (82 and 84 RAU, respectively, when averaged across speaking styles). To assess whether speaking style effects varied between male and female talkers, a Gender ×Speaking Style interaction term was added to the model. It was significant ($z = 4.43$, $p < .0001$), and so a stratified analysis was performed to test the effect of speaking style for each gender. Both male and female talkers produced significantly more intelligible vowels in clear speech than in conversational speech ($z = 10.55$ and 16.35, respectively, both ps $< .0001$), but the clear speech effect was greater for the female talkers than the male talkers (10.8 vs. 6.7 RAU). The effect of talker gender was also assessed in each speaking style but was not significant in either case (conversational $z = -1.19$, $p = .234$; clear $z = 0.11$, $p = .915$). The interaction can be seen in Figure 3, which shows percent correct vowel intelligibility scores in each speaking style for female and male talkers both for the current older listeners with hearing loss and for the young listeners with normal hearing in Ferguson (2004).

Talker Age and Experience Effects

The talkers in the Ferguson Clear Speech Database were recruited into four age brackets: (a) 18-25 years, (b) 25-31 years, (c) 32-38 years, and (d) 39-45 years. Each bracket contained five male and five female talkers, with an additional female in the "18-25 years" bracket. To determine whether talker age had any bearing on the magnitude of the clear speech effect, two mixedeffect models were tested. The first model contained age bracket and speaking style as fixed factors (with talker and listener as crossed random factors); the second added interaction terms. Age bracket had no effect on overall intelligibility ($|z| < 1.9$, $p > .06$ for all between-bracket comparisons) or on the magnitude of the clear speech effect ($|z| < 1.3$, $p > .2$ for all comparisons). Table 2 shows the Ms and SDs for the percent correct clear, conversational, and difference scores for the four age brackets.

Although talkers were recruited without regard to experience communicating with individuals with hearing loss, they were asked about such experience at the end of the clear speech recording session. Based on their responses, talkers were placed into one of four experience categories: none (no prior experience; $n = 14$), little (only a few experiences; $n = 8$), occasional (a relative or friend with hearing loss but less than one interaction per week; $n = 9$), or frequent (at least one weekly contact with one or more individuals with hearing loss; $n = 10$). To test whether such experience affected talkers' vowel intelligibility or their ability to produce effective clear speech, another two mixed-effect modelswere tested. One model included style and experience group (none, little, occasional, frequent) as fixed factors,whereas the other also included interaction terms. Both models included talker and listener as crossed random factors.

No differences were observed between the four experience categories in terms of overall intelligibility ($|z| < 1.4$, $p > .18$ for all comparisons). However, a significant interaction was observed between speaking style and experience when the group of talkers with "little" experience communicating with hearing loss was compared to any of the other three groups ($|z| > 4.3$, $p < .0001$ for all comparisons). A stratified analysis revealed that the speaking style effect was significant ($|z| \geq 8$, $p < .0001$) for each experience group but was larger for those with "little" experience (14.7 RAU) than for talkers in the other three groups (none: 6.6 RAU; occasional: 8.4 RAU; frequent: 7.6 RAU). The other three groups did not differ significantly from each other. Average percent correct scores in each speaking style for the four experience brackets are shown in Figure 4.

Listener Group Effects

For the final analysis, data from the seven young listeners with normal hearing (YNH listeners) reported in Ferguson (2004) were combined with the present data from older adults with hearing impairment (OHI listeners) so that effects of listener group could be assessed. As mentioned above, mixed-effects models are robust to missing data; they also permit comparisons between groups that differ in number of and variance among participants. Preliminary testing showed that including both talker and listener as randomvariables significantly improved the fit of the model, so the first model contained speaking style and listener group as fixed factors and

talker and listener as crossed random factors. Both fixed effects were significant. Averaged across the two listener groups, vowels remained significantly more intelligible in clear speech than in conversational speech ($z = 21.17$, $p < .0001$). Averaged across the two speaking styles, scores were significantly higher for the OHI listeners than for the YNH listeners ($z = 3.37$, $p < .01$). This difference can be seen in Figure 5, which shows overall percent correct scores in each speaking style for each listener group. The Style ×Listener Group interaction term was added to the model and found not to be significant ($z = -0.2$, $p = .84$). This suggests that the magnitude of the speaking style effect was the same for the two listener groups (8.8 and 9.0 RAU for OHI and YNH

Discussion

Speaking Style, Talker, and Listener Effects on Vowel Intelligibility

Averaged across all talkers, vowel identification scores for this study's OHI listeners were significantly higher than those observed for the YNH listeners in Ferguson (2004) for both speaking styles. The most likely explanation for this difference is that the two groups were tested under different S/B ratios: -10 dB for the YNH listeners and -3 dB for OHI listeners. These S/B ratios had produced comparable conversational vowel intelligibility scores for OHI and YNH listeners in Ferguson and Kewley-Port (2002) and in a pilot study using just 12 of the database talkers. When the full set of 41 talkers was tested, however, the OHI listeners' overall score for conversational vowels was 77%, whereas YNH listeners achieved 65% correct vowel identification. Despite the difference in overall intelligibility, the magnitude of the clear speech effect for OHI listeners (about 9 RAU) was essentially identical to that observed for the YNHlisteners in Ferguson (2004). This result contrasts sharply with the results of Ferguson and Kewley- Port (2002), in which YNH listeners showed a clear speech vowel intelligibility benefit of 15 percentage points, and OHI listeners showed no clear speech benefit. The listeners in Ferguson and Kewley-Port identified vowels produced by just one talker, however. For the present OHI listeners as well as for the YNH listeners in Ferguson (2004), the 41 talkers in the Ferguson Clear Speech Database varied considerably in the magnitude of the clear speech vowel intelligibility effect. The best talker for the OHI listeners produced a clear speech benefit of 24 percentage points; the poorest showed a clear speech decrement of -9 points. The range for YNH listeners in Ferguson (2004) was slightly larger, from a benefit of 33 percentage points to a decrement of -12 points.

To explore whether talkers who produced a clear speech benefit for YNH listeners also did so for OHI listeners, a correlational analysis was performed using the RAU difference scores for each talker obtained by each listener. The correlation between the two listener groups was strong, positive, and significant, $r(41) > .75$, $p < .001$, and is illustrated in Figure 6. In the scatter plot, 31 of the 41 data points fall within 5 percentage points of the diagonal. Of the 10 values that lie outside this range, two represent talkers for whom the clear speech vowel intelligibility benefit was larger for the OHI listeners than for the YNH listeners. In the eight remaining cases, a larger benefit was seen for the YNH listeners than for the OHI listeners. However, only three of these eight talkers showed a pattern where the YNH listeners had a significant benefit and the OHI listeners had no clear speech vowel intelligibility benefit. However, the YNH listeners had a significant benefit. That is, only three of the 41 talkers in the Ferguson Clear Speech Database showed results resembling those found for the talker in Ferguson and Kewley-Port (2002). To explore this further, a series of mixed-effects models were used to test the Style ×Listener group interaction for each talker individually. When p values for those 41 analyses were corrected using FDR, only one talker, F09, showed a significant interaction between speaking style and listener group. This talker is considered again below when effects of talker experience are considered.

As noted in the Results section, the fit of the various mixed-effects models improved significantly when listener was included as a random factor. This result implies that scores for individual OHI listeners tended to be correlated with each other across speaking styles, and that listeners differed fromeach other significantly in terms of their ability to identify the vowel stimuli. Wide variability among the listeners is evident in Table 3, which shows mean percent correct vowel intelligibility scores for each OHI listener in each speaking style. Scores in

each speaking style ranged from 49% to 89% in conversational speech and from 58% to 93% in clear speech, ranges comparable to those observed across the 41 talkers. In a set of mixed-effects models that included speaking style and listener as fixed effects and talker as a random effect, the effect of listener was significant. Both the highest-scoring listener (E07) and the listener (E03) whose performance was closest to the mean for the group performed significantly differently from all but nine of the other listeners (FDR-corrected $p < .05$). When Style ×Listener interaction terms were added to these models, however, none of them were significant (FDR-corrected $p > .05$). That is, despite differences in overall performance, the clear speech effect did not differ significantly among the listeners. Comparing Tables 1 and 2, we can see that the range of difference scores among the listeners (from 0.9 to 11.7 percentage points) ismuch smaller than the range of difference scores among the talkers (from -9 to 24 percentage points).

Possible explanations for the wide variability among the OHI listeners were assessed by computing Pearson correlations between vowel intelligibility scores for each listener and several listener characteristics: age, MMSE score, individual audiometric frequencies from 250- 8000 Hz, and two pure-tone averages (PTAs). PTA1 was the traditional pure-tone average, calculated over thresholds recorded at 500, 1000, and 2000 Hz; PTA2 was calculated using 1000, 2000, and 4000Hz. Of all those possible predictors, only audiometric thresholds at 2000-4000 Hz and the PTAs were significantly correlated with overall performance, with PTA2 being the strongest predictor ($r = -.66$, FDR-corrected $p < .0001$). A t test was used to assess whether listener gender affected vowel identification performance; the result was not significant ($p = .7$). Pearson correlations and the t test for gender were also performed using difference scores for each listener, calculated by subtracting their conversational RAU score from their RAU score for clear speech. None of these tests were significant ($p > .19$). These results suggest that audibility has a significant impact on individual listeners' ability to identify vowels in general but not on the magnitude of the clear speech vowel intelligibility benefit they enjoy.

Talker Characteristics and the Clear Speech Effect

Talker gender. For the current OHI listeners, male and female talkers had similar overall vowel intelligibility. This result was contrary to two competing predicted outcomes. For the YNH listeners in Ferguson (2004), female talkers showed significantly higher overall vowel intelligibility scores (72.5%) than men (65.0%). Ferguson's results are consistent with other studies showing superior intelligibility for female talkers (e.g., Bradlow et al., 1996; Hazan&Markham, 2004) when materialswere presented to YNH listeners. Given the absence of any scholarly data on talker gender effects for OHI listeners, one might extrapolate from the YNH studies and predict that OHI listeners would also find female talkers to be more intelligible than male talkers. However, the experience of clinical audiologists would suggest the opposite outcome, at least for overall intelligibility. Individuals with hearing loss seeking hearing services frequently complain of particular difficulty understanding female voices (Helfer, 1995). On this basis, one would predict a finding of superior intelligibility for male talkers for the OHI listeners.

The present data fall between these two predictions, with no overall vowel intelligibility advantage for either gender. However, female talkers produced a larger clear speech benefit than male talkers for the OHI listeners, just as they did for the YNH listeners. In Figure 3, the interaction between speaking style and talker gender appears to be the same for the two listener groups, an impression that was confirmed with mixed-effects models of combined data from both groups. Figure 3 also suggests the possibility that gender differences might have occurred in conversational speech for the OHI listeners but were offset by the absence of a gender difference in clear speech; however, the gender effect was not statistically significant in either style. Taken together, these results suggest that whatever acoustic characteristics render female talkers more intelligible than male talkers for YNH listeners are unavailable for listeners with hearing loss. However, the acoustic changes that female talkers employ when speaking clearly that provide a larger clear speech advantage than that produced by male talkers seem to be equally beneficial to both listeners with and without hearing loss. Future research should examine the nature of these acoustic differences between male and female talkers and how they affect speech

understanding by listeners with hearing loss

Talker Age and Experience Communicating With Listeners Who Have Hearing Loss

Talkers were recruited into different age brackets under the hypothesis that those in the older brackets might have more contact with individuals with hearing loss than younger talkers and that this would make them better at producing effective clear speech. However, there was no difference between the age brackets in the size of the clear speech effect here or in Ferguson (2004). In addition, the correlation between talkers' actual age and the clear speech effect enjoyed by OHI listeners in the present study was close to zero, $r(41) = -.04$. In contrast, significant differences in the clear speech effect for OHI listeners were observed between talkers with varying amounts of experience communicating with listeners with hearing loss. Talkers who had had only a handful of such experiences produced a significantly larger clear speech vowel intelligibility benefit than talkers with no experience at all, with occasional experience, or with frequent experience. Although Ferguson (2004) found no effect of experience on the clear speech benefit, this finding was obtained through a one-way analysis of variance carried out on clearminus- conversational difference scores. Mixed-effects analyses of theYNHlistener data, in contrast, did reveal a significant interaction between experience category and speaking style. Talkers with no experience and "occasional" experience showed a clear speech effect of 6 RAU. This was significantly lower than that produced by talkers with "frequent" experience (10 RAU), which in turn was significantly smaller than that produced by talkers with "little" experience (14 RAU).

It is counterintuitive that talkers with only a few experiences communicating with listeners with hearing loss, rather than those with frequent experience, should produce the largest clear speech vowel intelligibility benefit. It certainly challenges the idea that the frequent communication partners of listeners with hearing loss should "just know" what to do to help their significant others. This idea is further challenged by the results for two specific talkers. The male talker in Ferguson and Kewley-Port (2002) was a clinical audiologist with more than 25 years of experience, but only YNH listeners benefited when he spoke clearly. The talker in the Ferguson Clear Speech Database whose results most resembled his was talker F09 (who was female). Although her vowels were significantly more intelligible in clear speech than in conversational speech (by 22 RAU) when YNH listeners identified them, the two styles yielded nearly identical performance (difference <0.1 RAU) for the OHI listeners. She also resembled the earlier talker in having had extensive experience talking to individuals with hearing loss: she reported having grown up with two brothers who were hard of hearing. Interestingly, F09 was also one of the "atypical talkers" in Ferguson and Kewley-Port (2007), which examined acoustic differences between clear and conversational speech for subgroups of talkers who had produced either a large clear speech vowel intelligibility benefit or no clear speech benefit for YNH listeners in Ferguson (2004). In Ferguson and Kewley-Port (2007), F09 was one of six "big benefit" talkers, but her acoustic data bore little resemblance to those of the other five talkers. Most notably, F09 showed a substantially reduced vowel space in clear speech, in contrast with the vowel space expansion observed in the other five big benefit talkers.

Lindblom's (1990) hyperspeech versus hypospeech (H&H) theory states that when a talker encounters a listener who has difficulty understanding the talker's speech, he or she will begin to hyperarticulate, sacrificing motor economy to achieve greater specificity in the speech signal. The results for talker F09 and the talker in Ferguson and Kewley-Port (2002) seem to negate this idea. However, H&H theory may help explain the pattern of results observed for talkers who had "little" versus more or no experience. Recall that clear speech was elicited in the Ferguson Clear Speech Database by having talkers read printed sentences aloud, imagining that they were speaking to someone with hearing loss. Talkers with no experience communicating with listeners with hearing loss would have no frame of reference for this and so would just speak in a way that sounded clear to them. In contrast, talkers who had previously communicated with listeners with hearing loss would have had the experience of adjusting their speech in a way that was helpful to their communication partner. According to H&H theory, these adjustments would have been automatic. Later, when instructed to speak clearly in the lab, they would draw on that experience and use clear speech articulatory strategies they had used when actually talking

to an interlocutor with hearing impairment.

But if talkers learn from experience, why would talkers with more experience produce a smaller clear speech effect? It is proposed that when talkers encounter listeners with hearing loss for the first time, they (automatically) use a wide array of clear speech articulatory strategies. As talkers gain experience speaking with listeners with hearing loss, however, they gradually discard some of these strategies. This process would be driven by several factors, chiefly motor economy and auditory feedback. Having no access to how speech sounds to someone with hearing loss, talkers with normal hearing will naturally use strategies that make speech sound clear to them. It may be that the more time talkers spend speaking clearly, the further away they get from what a listener with hearing loss actually needs. There are several ways to test this explanation. Using the Ferguson Clear Speech Database, acoustic differences between clear and conversational speech could be compared across the different experience groups. Perceptual data from other materials in the database, such as sentences (as in Ferguson &Kerr, 2009) or monosyllabic words, could also be compared across talker groups.

Conclusion

The current experiment demonstrates that the considerable talker variability that Ferguson (2004) found for vowel intelligibility and the clear speech vowel intelligibility benefit for YNH listeners also occurs for OHI listeners.Whengiven general instructions to speak clearly, some talkers produce speech that is much more intelligible than ordinary conversational speech, whereas others do not. Across talkers as well as for most individual talkers, OHI listeners enjoyed a similar clear speech benefit to that achieved by YNH listeners. Thus, if a certain talker produced clear speech that was effective for YNH listeners, it was also effective for OHI listeners. From a clinical perspective, this is a very encouraging result. The results from Ferguson and Kewley-Port (2002) for only one talker had suggested that talkers might need to adopt different clear speech strategies for different listener groups. The present results, however, suggest that, at least for vowels, the acoustic properties that make speech more intelligible for YNH listeners also make it more intelligible for OHI listeners.

Acknowledgments

This research was supported by National Institute on Deafness and Other Communication Disorders (NIDCD) Grants DC008886 and DC005803 and National Institute of Child Health and Human Development Grant HD002528. Data analyses were performed under the guidance of Gregory J. Stoddard of the University of Utah Study Design and Biostatistics Center, which is funded in part by National Center for Research Resources Grants UL1-RR025764 and C06-RR11234. Development of the Ferguson Clear Speech Database was supported by NIDCD Grant DC02229, awarded to Indiana University.

Douglas Kieweg, Leela Parimisetty, Katherine Beam, Jessica Stamey, and Kyung Ae Keum assisted with data collection and entry. Chiung-ju Liu and Susan Kemper assisted in participant recruiting, and the Schiefelbusch Speech-Language- Hearing Clinic provided hearing evaluations for the older adults. DianeKewley-Port, Allard Jongman, Michael Blomgren, and Sean Redmond provided useful comments on an early draftof this article.

Sidebar

Footnote

1This was done to give listeners experience with the conditions of the experiment (i.e., 70 dB SPL presentation level and no feedback) prior to adding the challenge of background noise.

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Editor: Sid Bacon
Associate Editor: Marjorie Leek
Received December 7, 2010
Revision received July 29, 2011
Accepted September 20, 2011
DOI: 10.1044/1092-4388(2011/10-0342)

Publication date: Jun 2012

Year: 2012

Speech Perception With Music Maskers by Cochlear Implant Users and Normal-Hearing Listeners

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 800-810A.
ProQuest document link

Abstract: The goal of this study was to investigate how the spectral and temporal properties in background music may interfere with cochlear implant (CI) and normal-hearing listeners' (NH) speech understanding. Speech-recognition thresholds (SRTs) were adaptively measured in 11 CI and 9 NH subjects. CI subjects were tested while using their clinical processors; NH subjects were tested while listening to unprocessed audio. Speech was presented with different music maskers (excerpts from musical pieces) and with steady, speech-shaped noise. To estimate the contributions of energetic and informational masking, SRTs were also measured in "music-shaped noise" and in music-shaped noise modulated by the music temporal envelopes. NH performance was much better than CI performance. For both subject groups, SRTs were much lower with the music-related maskers thanwith speech-shaped noise. SRTs were strongly predicted by the amount of energetic masking in the music maskers. Unlike CI users, NH listeners obtained release from masking with envelope and fine structure cues in the modulated noise and music maskers. Although speech understanding was greatly limited by energetic masking in both subject groups, CI performance worsened as more

spectrotemporal complexity was added to the maskers, most likely due to poor spectral resolution.

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Purpose: The goal of this study was to investigate how the spectral and temporal properties in background music may interfere with cochlear implant (CI) and normal-hearing listeners' (NH) speech understanding.
Method: Speech-recognition thresholds (SRTs) were adaptively measured in 11 CI and 9 NH subjects. CI subjects were tested while using their clinical processors; NH subjects were tested while listening to unprocessed audio. Speech was presented with different music maskers (excerpts from musical pieces) and with steady, speech-shaped noise. To estimate the contributions of energetic and informational masking, SRTs were also measured in "music-shaped noise" and in music-shaped noise modulated by the music temporal envelopes.
Results: NH performance was much better than CI performance. For both subject groups, SRTs were much lower with the music-related maskers thanwith speech-shaped noise. SRTs were strongly predicted by the amount of energetic masking in the music maskers. Unlike CI users, NH listeners obtained release from masking with envelope and fine structure cues in the modulated noise and music maskers.
Conclusions: Although speech understanding was greatly limited by energetic masking in both subject groups, CI performance worsened as more spectrotemporal complexity was added to the maskers, most likely due to poor spectral resolution.
Key Words: cochlear implant, music, masking, streaming, segregation
Similar to normal-hearing (NH) listeners, cochlear implant (CI) users regularly encounter music in various listening environments (e.g., movie theaters, sport events, restaurants, etc.). Although music may enhance many environments, it may also interfere with speech understanding. Music differs from environmental noise or interfering speech in terms of acoustic and semantic properties. Given the spectral degradation associated with CI signal processing, acoustic features (and consequently, semantic information) may be lost; as such, music may mask target speech similarly to environmental noise. Although energetic masking might be expected to strongly limit speech understanding in the presence of competing music, other factors may contribute to CI users' susceptibility to masking by music (e.g., the competing temporal envelopes in speech and music).
For NH listeners, interference with target speech from music may be due to energetic masking (overlapping frequency regions) and/or informational masking (similar dynamic and/or semantic cues). Energetic masking occurs at the periphery (Oxenham, Fligor, Mason, &Kidd, 2003) and is limited by the frequency and intensity of the masker. Informational masking does not necessarily depend on the physical interactions between a masker and signal (e.g., frequency overlap) but reflects the difficulty in perceiving a target in the context of other similar sounds (e.g., having similar temporal envelopes; Durlach et al., 2003; Leek, Brown, &Dorman, 1991). As such, informational masking occurs at more central levels of auditory processing (Scott, Rosen,Wickham,&Wise, 2004). For example, with competing speech, both sources are modulated at similar rates, contain similar frequency content, and carry meaningful information. In this case, listeners must use voice pitch, timbre, and/or timing cues to segregate and stream the target speech. Dynamic nonspeech sounds (e.g., gated noise) may also produce informational masking, depending on the spectral and/or temporal characteristics (e.g., temporal interference with the speech envelope region between 3 and 8 Hz; Drullman, Festen, &Plomp, 1994). The effects of informational masking also depend on attentional factors, listener expectations, and uncertainty about the signal's characteristics (Oxenham et al., 2003).
Similar to competing speech or environmental noise, music can produce energetic and/or informational masking on target speech. The frequency spectrum of music is generally broader and more dynamic than that of speech. Depending on the specific spectral content, music may produce different amounts of energetic masking on speech signals. For example, popular music is often recorded using methods that limit spectral "crowding"

between vocals and accompanying instruments. Music may also produce informational masking, as music and speech may be grouped together (Bregman, 1990). Semantic cues may also attract listeners' attention from target speech. Indeed, many factors may influence a listener's attention to background music (e.g., familiarity, aesthetics, etc.).

Due to limited spectral resolution, it is difficult for CI users to segregate and stream competing sound sources. Unlike NH listeners, CI users seem unable to utilize large differences in pitch, timbre, or timing to segregate and stream competing melodic contours (Galvin, Fu, &Oba, 2009; Zhu, Chen, Galvin,&Fu, 2011) or talkers (Stickney, Zeng, Litovsky, &Assman, 2004). The broad current spread associated with electrical stimulation limits performance, as many CI users have difficulty segregating and streaming simple, single-channel stimuli even when large pitch differences are available (Chatterjee, Sarampalis, &Oba, 2006; Hong &Turner, 2006; Oxenham, 2008). Similarly, CI users seem unable to "listen in the dips" of dynamic maskers and understand target speech (Nelson, Jin, Carney, &Nelson, 2003). Fu and Nogaki (2005) argued that CI users' susceptibility to dynamic noise was due to channel interactions between the implanted electrodes. CI users seem able to access only six to eight spectral channels (Friesen, Shannon, Baskent, &Wang, 2001), too few to support segregation and streaming of complex, competing sound sources (Shannon, Fu, &Galvin, 2004). This poor spectral resolution/channel interaction also limits CI users' music perception and appreciation. Although CI users' rhythm perception is comparable to that of NHlisteners (Kong, Cruz, Jones,&Feng, 2004), melodic pitch perception is much poorer than that of NH listeners (e.g., Galvin et al., 2005; Gfeller, Woodworth, Robin, Witt, &Knutson, 1997; Kong et al., 2004). CI users often comment that music can sound noisy, especially when played by large instrument ensembles. As such, background music may serve more as background noise for CI users.

Given the spectral and temporal dynamics of music, the expectation would be that it produces less masking than broadband noise or competing speech. However, given the poor spectral resolution and the attendant difficulties with spectrally and temporally complex maskers, CI users may be more susceptible to interference by background music. Relatively little is known about CI speech perception in the presence of background music. Gfeller et al. (2008) reported that background music significantly interfered with CI listeners' word recognition. In a related study, Gfeller, Buzzell, Driscoll, Kinnaird, and Oleson (2009) reported that sung musical lyric recognition significantly worsened as the accompanying music became more complex (i.e., from a single instrument to multiple instruments).

In this study, CI users and NH listeners' recognition of Hearing in Noise Test (HINT; Nilsson, Soli,&Sullivan, 1994) sentences was measured in the presence of different music maskers as well as in the presence of steady, speech-shaped noise (SSN; i.e., maximal energetic masking). To estimate contributions of energetic masking, sentence recognition was measured in the presence of steady noise filtered by the spectral envelopes of the music maskers (music-shaped noise [MSN]). To estimate the susceptibility to dynamic maskers, sentence recognition was also measured with MSN modulated by the temporal envelopes of the music maskers. Thus, the maskers progressed from energetic (SSN or MSN) to a mix of energetic and informational (music and modulatedMSN). The music maskers also contained spectrotemporal complexity and fine structure cues not included in the music-shaped and/or modulated noise maskers. We hypothesized that, given differences in the frequency spectra for music and speech, energetic masking provided by the music maskers would limit interference by the music maskers. Because of the limited spectral resolution, we hypothesized that, compared with NH listeners, CI users would be unable to utilize envelope or fine structure cues to segregate speech and music.

Method

Subjects

Eleven postlingually deafened adult CI users (seven women, four men) participated in this study. The mean CI subject age was 62 years (range = 25-79 years). All CI subjects had at least 1 year experience with their device.

Three subjects were unilateral CI users, five were bilateral CI users, and three were bimodal listeners (CI with a hearing aid in the contralateral ear). Table 1 lists CI subject demographics. CI subjects were tested using their clinical speech processors and settings. Volume and sensitivity were set for comfortably loud conversation levels (i.e., everyday settings); once set, these were not changed during testing. Bilateral CI users were tested while wearing both devices. Bimodal subjects were tested while using theirCI alone.NineNHlisteners (fourwomen, five men) served as experimental controls. The mean NH subject age was 36.5 years (range = 18-55 years). NH subjects all had pure-tone threshold averages better than 25 dB HL for frequencies between 500, 1000, 2000, and 4000 Hz. All subjects were paid for their participation, and all provided informed consent before participating in the experiment.

Stimuli

Masked sentence recognition was assessed using HINT sentences (Nilsson et al., 1994). The HINT stimulus set consists of 260 sentences of easy to moderate difficulty produced by one male talker. HINT sentence recognition was measured for various maskers, including: (a) SSN; (b) MSN; (c) MSN modulated by the music temporal envelope (MSMN); and (d) unprocessed, original musical excerpts (MUS). These maskers are described in detail below. The SSN masker was expected to produce maximal energetic masking, the MSN masker was expected to produce partial energetic masking, and the MSMN masker was expected to allow for potential masking release via "dip-listening" in the masker temporal envelopes. TheMUSmaskers contained greater spectrotemporal complexity and fine structure cues, which may allow for better segregation of the target speech and MUS maskers. The MUS maskers may have also allowed for reduced masking via semantic cues, as the maskers may be more readily perceived as music, rather than steady or dynamic noise. All masking and speech stimuli were normalized to have the same long-term root-mean-square (RMS) amplitude (65 dBA).

For the SSN masker, white noise was filtered to match the long-term average spectrum of the HINTsentences. TheMUSmaskers consisted of excerpts from five musical pieces (downloaded from www.freeplaymusic. com): "MC Scarlatti Mass for Four Voices 1" ("Four Voices" hereafter), "Power Theme," "TV Star Tonite," "Violin Fight," and "Lounge Lizard." Figure 1 shows the frequency spectrum (leftcolumn) and modulation spectrum (right column) for each song and a subset of 10 HINT sentences. The frequency spectrum was quite similar for Power Theme, TV Star Tonite, and Violin Fight; in general, there was greater energy for spectral frequencies above 1500 Hz. For Four Voices, there was greater energy for spectral frequencies below 1500 Hz. Lounge Lizard contained less energy for spectral frequencies above 200 Hz. The modulation spectrum was quite similar for Power Theme, TV Star Tonite, Violin Fight, and Four Voices, with Lounge Lizard exhibiting sharper peaks between 64 and 300 Hz. In most cases, the modulation was slightly deeper for the HINT sentences for modulation frequencies below 16 Hz. The modulation depth was similar for speech and music above 100 Hz.

Ten of the 11 CI patients used Cochlear Corporation devices (Freedom, Nucleus 24, or Nucleus 22) fit with the Advanced Combination Encoder (ACE; Vandali, Whitford, Plant,&Clark, 2000) or Spectral Peak (SPEAK; Skinner et al., 1994) speech processing strategies. In both strategies (assuming all electrodes are active), for each stimulation cycle, the input acoustic signal is analyzed by 22 (for ACE) or 20 (for SPEAK) filter bands, the envelope is extracted and used to modulate pulse trains delivered to the eight (for ACE) or six (for SPEAK) electrodes with the most energy (according to the signal analysis). Figure 2 shows electrodograms for representative samples of the target speech and the MUS maskers. The electrodograms were generated using the default stimulation parameters for the Nucleus 24 and Freedom devices fit with the ACE strategy (used by 9 of the 11 CI subjects). The input frequency range was 188-7986 Hz, the frequency allocation was Table 9, and the number of spectral maxima was 8. In Figure 2, as the electrode number reduces from 22 to 1, the place of stimulation shifts toward the base of the cochlea. For the HINT sentence, the stimulation pattern was distributed across the entire array and shifted from the apical to the basal regions of the cochlea with changes in the acoustic frequency content. Similar to the frequency spectral envelopes shown in Figure 1, the stimulation patterns were most similar for Power Theme, TV Star Tonite, and Violin Fight, with greater stimulation for the

basal than for the apical region of the cochlea. These maskers would be expected to produce greater masking for consonant than for vowel information. The stimulation patterns were somewhat similar for Four Voices and Lounge Lizard, with greater stimulation for the apical than for the basal region of the cochlea. These maskers would be expected to produce greater masking for vowel than for consonant information.

The two remaining masker conditions (MSN and MSMN) were created to better explore contributions of energetic and information masking. For the MSN masker, the spectral envelope of each music excerpt (see Figure 1) was used to filter white noise. For the MSMN, the temporal envelope extracted (half-wave rectification) from each music excerpt was used to modulate the corresponding MSN; the low-pass envelope filter cutofffrequency was 200 Hz, and the filter slope was -24 dB/octave.

For "peak-picking" strategies such as ACE and SPEAK, the stimulation patterns might be quite different for speech mixed with the different maskers. Figure 3 illustrates differences in the stimulation patterns for speech mixed with music at 0 dB target-to-masker ratio (TMR). The top row shows the same target sentence (HINT 012) masked by the SSN masker. As expected, the SSN masker produced maximal energetic masking, as it is very difficult to observe the original sentence (see Figure 2) in the stimulation pattern. The second row shows speech mixed with MSN maskers (Power Theme on the left, Lounge Lizard on the right). As predicted by the stimulation patterns shown in Figure 2, MSN (Power Theme) largely masks the high-frequency speech information, whereas MSN (Lounge Lizard) masks the low-frequency information. The third row shows speech mixed with the MSMN maskers. As expected, the stimulation patterns are quite similar to those with MSN, as the spectrum is identical for both masker types. The fourth row shows speech mixed with the MUS maskers; the excerpts are the same as with the MSMN maskers in row three. With the MUS (Power Theme) masker, the low-frequency speech information is more detailed than with the MSN (Power Theme) or MSMN (Power Theme) maskers. Similarly, with the MUS (Lounge Lizard) masker, the highfrequency speech information is more detailed than with theMSN (Lounge Lizard) orMSMN(Lounge Lizard) maskers.

Procedure

Speech reception thresholds (SRTs) were measured using an open-set, adaptive (one-up/one-down) procedure (Van Tassell &Yanz, 1987), converging on the TMR that produced 50% correct word-in-sentence recognition. Because some CI listeners are unable to recognize 100% of words in HINT sentences correctly when no masker is present, an alternative adaptive rule (Rule 3) was used to adjust the TMR from trial to trial to track 50% correct word recognition (Chan, Freed, Vermiglio, &Soli, 2008). Because all CI subjects were able to recognize more than 50% of words in sentences in quiet, Rule 3 allowed SRTs to be adaptively measured for all CI subjects.

All testing was conducted in the sound field. Speech and noise were delivered via single loudspeaker (Tannoy Reveal). Subjects were tested in a sound-treated booth (IAC), seated 1 m from the speaker. During testing, the masker level was fixed at 65 dBA. Note that for the MSMN and MUS maskers, a short section (the duration of the target sentence + 1 s) was randomly selected from the entire masker wave file. The masker onset and offset was 500 ms before and after the target speech. The speech level was adjusted according to subject response. A sentence was randomly selected from among the 260 test sentences in the stimulus set. If the subject recognized 50% or more of the words in the sentence, the speech level was reduced by 2 dB. If the subject recognized less than 50% of thewords in the sentence, the speech level was increased by 2 dB. Within each test run, the mean of the final eight (out of a total of 10) reversals in TMR was recorded as the SRT. Three runs were measured and averaged for each masker. The test order for the different maskers was randomized within and across subjects. All testing was conducted during a single session.

Results

Figure 4 shows mean CI SRTs for each masker condition as a function of masker song; the gray column shows the mean CI SRT with SSN. Across the three masker conditions, SRTs were generally lower with the music maskers than with SSN. Interestingly, as more spectrotemporal complexity was added in the music maskers

(MSN to MSMN to MUS), mean CI performance worsened. A two-way repeated measures analysis of variance (RM ANOVA) was performed on the CI data shown in Figure 4, with masker condition (MSN, MSMN, MUS) and masker song (Four Voices, Power Theme, TV Star Tonite, Violin Fight, Lounge Lizard) as factors. Results showed main effects of masker condition, $F(2, 20) = 23.2$, $p < .001$, and song, $F(4, 40) = 148.4$, $p < .001$; there was a significant interaction, $F(8, 80) = 5.1$, $p < .001$, most likely due to the different pattern of results across masker conditions for the TV Star Tonite, Violin Fight, and Four Voices songs. Post hoc pairwise comparisons (with Rom's correction) indicated that SRTs were significantly poorer with the MUS maskers than with MSMN (adjusted $p < .001$) and were significantly poorer with MSN than with MSMN (adjusted $p < .01$). Pairwise comparisons also indicated that SRTs were significantly lower with Lounge Lizard than with the other songs (adjusted $p < .05$) and that SRTs were significantly higher with Power Theme than with all other songs except Four Voices (adjusted $p < .05$).

Figure 5 shows meanNH SRTs for each masker condition as a function of masker song; the gray column shows the meanNH SRTwith SSN. Similar to CI performance, mean NH SRTs were generally lower with the music maskers than with SSN. Different from CI performance, mean NH SRTs improved as the maskers increased in complexity. A two-way RM ANOVA was performed on theNHdata shown in Figure 5, withmasker condition and song as factors. Results showed main effects of masker condition, $F(2, 16) = 14.2$, $p < .001$, and song, $F(4, 32) = 77.4$, $p < .001$; there was also a significant interaction, $F(8, 64) = 3.3$, $p < .01$. Pairwise comparisons (with Rom's correction) indicated that SRTs withMSMN were significantly lower than those with MSN (adjusted $p < .001$) but were not significantly different from those with the MUS maskers (adjusted $p = .10$). Pairwise comparisons also showed that SRTs with Lounge Lizard were significantly lower than with the other songs (adjusted $p < .05$) and that SRTs with Power Theme were significantly higher than with the other songs (adjusted $p < .05$).

Figure 6 shows mean CI (black bars) and NH SRTs (gray bars) across masker conditions. Because the previous analyses showed significant differences in SRTs across songs, 20% trimmed means were used to minimize the likelihood that any individual song might dominate comparisons across groups and conditions (see the Appendix in Aronoff, Freed, Fisher, Pal, &Soli, 2011). For each subject and within each masker condition, 20% trimmed means were obtained by first ranking the SRTs and then calculating the arithmetic mean across the second-, third-, and fourth-ranked SRTs. The across-subject means of these trimmed mean SRTs are shown in Figure 6. A two-way split-plot ANOVAwas conducted on the data shown in Figure 6, with subject group (CI,NH) as the between-group variable andmasker condition (SSN, MSN, MSMN, MUS) as the withingroup variable. Results showed significant main effects for subject group, $F(1, 18) = 158.2$, $p < .001$, and masker condition, $F(3, 54) = 60.9$, $p < .001$; there was also a significant interaction, $F(3, 54) = 13.1$, $p < .001$. Pairwise comparisons (with Rom's correction) showed that SRTs were significantly higher with SSN than with MSN (adjusted $p < .001$) but that there were no significant differences in SRTs between MSN and MSMN, or between MSMN and MUS. Pairwise comparisons also indicated that the change in SRTs between SSN and MSN did not differ significantly across subject group. However, the change in SRTs between MSN and MSMN did differ significantly across subject group (adjusted $p < .001$), as did the change in SRTs between MSMN and MUS (adjusted $p < .05$). To further investigate this interaction, pairwise comparisons between MSN and MSMN were analyzed separately for each group. For NH subjects, SRTs were significantly lower with MSMN than with MSN (adjusted $p < .01$), but there was no significant difference in SRTs between MSMN and MUS (adjusted $p > .05$). For CI subjects, SRTs were significantly higher with MSMNthan with MSN (adjusted $p < .02$), and with MUS than with MSMN (adjusted $p < .02$).

To further explore potential contributions of energetic masking on SRTs, the music maskers were analyzed in terms of the Speech Intelligibility Index (SII; ANSI S3.5-1997). One-third-octave band filters were used for the analyses, and the masker level was the same as for target speech (0 dB SNR). Figure 7 shows mean SRTs (across subjects) for the MSN (leftpanel), MSMN (center panel), and MUS (right panel) maskers as a function of

SII. Least trimmed squares regressions were fit to the CI and NH data, thereby minimizing disproportionate contributions of individual songs to the fit (Rousseeuw &Leroy, 1987). SRTs were strongly correlated to the masker SII for all music masker types for both CI andNH listeners (CI MSN: r2 = .99, adjusted p <.001; NH MSN: r2 = .86, adjusted p <.05; CI MSMN: r2 = .96, adjusted p <.01; NH MSMN: r2 = .86, adjusted p <.02; CI MUS: r2 = .81, adjusted p <.05; NH MUS: r2 = .76, adjusted p <.05).

Discussion

The present results demonstrate that energetic masking largely limited speech understanding in music for both CI and NH listeners. For both subject groups, masked speech performance was well predicted by SII, even though the effect of increasing spectrotemporal complexity was different for CI and NH listeners. The strong predictive power of the SII for the MSN, MSMN, and MUS maskers suggests that energetic masking may contribute most strongly to interference by music for both NH and CI listeners. CI performance worsened as envelope and fine structure were added toMSN, whereas NH subjects experienced release from masking with the addition of the envelope and fine structure cues. The results are discussed in greater detail below.

NH listeners experienced some release from masking when envelope cues (MSMN) were provided or when spectrotemporal complexity and fine structure cues (MUS) were added to the MSN masker. CI listeners experienced no such release from masking. Indeed,SRTs worsened as the music maskers became more spectrally and temporally complex. CI users may have incorrectly segregated the target from the masker and therefore grouped speech and masker envelope information. Note that the input signal was always unprocessed-that is, spectrotemporal fine structure information was preserved in the acoustic signal. It is possible that the fine structure cues caused the MUS masker and speech target to be more strongly grouped after CI signal processing. Although the additional spectrotemporal information was detrimental to CI performance, the difference in performance between the MSN, MSMN, and MUS conditions suggests that envelope and fine timing cues can affect CI listeners' performance. Unfortunately, CI users seem to have used these cues to mistakenly group music and speech. This may in part reflect the nature of peakpicking algorithms used by most of the present CI subjects. Figure 2 shows a target speech sentence (HINT 012) and a music masker (Power Theme). Figure 3 shows the same target (HINT 012) mixed with the MSN (Power Theme) and with the MUS (Power Theme) at a 0 dB TMR.With theMUS (Power Theme)masker, the electrodgram shows that the lower frequency music information is well represented, especially beyond 1.5 s. In contrast, the pattern is more diffuse for the MSN (Power Theme) masker. The ACE strategy picked the spectral peaks associated with the MUS masker because they had more low-frequency energy than did the speech target. Although peak-picking strategies such as SPEAK and ACE may result in some distortion to the acoustic input, non-peak picking strategies (e.g., continuously interleaved sampling) would most likely produce similar performance because the MUS maskers sometimes have greater low-frequency energy than does the target speech.

For these stimuli, it is difficult to distinguish conflicting envelope information from conflicting semantic information in the MUS and MSMN masker conditions. Either way, CI users seemed more susceptible to informational masking than were NH listeners, as evidenced by the increasingly poor performance as envelope and fine structure cues were added to the masker. CI users have difficulty properly segregating competing sound sources, presumably due to the poor spectral resolution, limited spectral pitch cues, and broad current spread associated with the implant device. Whereas NH listeners were able to obtain release from masking when envelope (MSMN)and fine structure (MUS) spectrotemporal cues were added to the masker (MSN), CI listeners did not. CI users' susceptibility to informational masking is perhaps best illustrated by their performance with theViolin Fight and Lounge Lizard songs, which progressively worsened as information was added to the masker (see Figure 4). For Violin Fight, mean SRTs were -2.18 dB (MSN), 0.29 dB (MSMN), and 1.88 dB (MUS); for Lounge Lizard, mean SRTs were -8.14 dB (MSN), -7.01 dB (MSMN), and -5.59 dB (MUS). As shown in Figure 7, the SII values were much lower for Violin Fight and Lounge Lizard than for the other songs; as such, Violin Fight and Lounge Lizard produced less energetic masking than the other songs. The

poorer performance in the MSMN and MUS conditions likely reflects CI users' inability to use spectral cues to correctly segregate target and masker temporal information, which leads to an incorrect grouping of masker and target, resulting in a degraded target auditory stream. Improving CI users' spectral resolution would likely improve their SRTs by facilitating correct segregation of targets and maskers, particularly in cases of limited energetic masking

It should be noted that it is impossible to disambiguate the effects of the added spectrotemporal complexity and the fine structure cues in the MUS masker conditions, or whether release from masking was due to dip listening or semantic cues (i.e., different types of information). The MUS condition allowed for glimpsing in the spectral dips of the dynamic frequency content, as well as the temporal envelope dips. For NH listeners, performance was similar in the MSMN and MUS conditions, suggesting that temporal dip listening may have accounted for the release from masking. As noted above, CI performance worsened with increasing spectrotemporal complexity, although it is unclear why performance was worse with the MUS maskers than with the MSMN maskers. Note also that the CI subject group was much older than the NH group, which may have contributed to the poorer performance with the MSMN and MUS maskers. Schvartz, Chatterjee, and Gordon-Salant (2008) found poorer speech performance in older than in younger NH subjects listening to spectrally degraded speech (as is experienced by CI users). Such poorer spectrotemporal processing by older listeners may have contributed to the present results.

The selection of music maskers was somewhat limited, as evidenced by the distribution of SII values in Figure 7, or the range of frequency and modulation spectra shown in Figure 1. Future studies may better control the spectral and temporal cues within the music masker (e.g., progressively filtering the frequency and/ormodulation spectrum of the MSN, MSMN, and MUS maskers). Nonetheless, the present data show the similar effects of energetic masking but different effects of informational masking on NH and CI listeners. Although better stimulus control may refine these relationships, the basic patterns would be expected to persist, namely that

1. Interference of background music on NH and CI NH listeners' speech understanding is largely driven by energetic masking.
2. SII largely predicts NH and CI performance with music maskers.
3. Unlike NH listeners, CI listeners are unable to listen in the dips of the modulated MSN or utilize the spectrotemporal fine structure cues available in music maskers.
4. Because of the poor spectral resolution that limits CI users' segregation and streaming, CI users are more susceptible to informational masking via competing envelope cues.

Acknowledgments

This research was supported by National Institute on Deafness and Other Communication Disorders Grant R01-DC004993. We are grateful to all research subjects for their considerable time spent with this experiment. We also thank Barbara Shinn-Cunningham for helpful comments on this article.

Sidebar

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received May 20, 2011
Revision received September 11, 2011
Accepted September 23, 2011
DOI: 10.1044/1092-4388(2011/11-0124)

Publication date: Jun 2012

Year: 2012

Application of the Envelope Difference Index to Spectrally Sparse Speech

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 824-837A.
ProQuest document link

Abstract: Amplitude compression is a common hearing aid processing strategy that can improve speech audibility and loudness comfort but also has the potential to alter important cues carried by the speech envelope. In previous work, a measure of envelope change, the Envelope Difference Index (EDI; Fortune, Woodruff, &Preves, 1994), was moderately related to recognition of spectrally robust consonants. This follow-up

study investigated the relationship between the EDI and recognition of spectrally sparse consonants. Stimuli were vowel-consonant-vowel tokens processed to reduce spectral cues. Compression parameters were chosen to achieve a range of EDI values. Recognition was measured for 20 listeners with normal hearing. Both overall recognition and perception of consonant features were reduced at higher EDI values. Similar effects were noted with noise-vocoded and sine-vocoded processing and regardless of whether periodicity cues were available. The data provide information about the acceptable limits of envelope distortion under constrained conditions. These limits can be used to consider the impact of envelope distortions in situations where other cues are available to varying extents.

Full text: Headnote

Purpose: Amplitude compression is a common hearing aid processing strategy that can improve speech audibility and loudness comfort but also has the potential to alter important cues carried by the speech envelope. In previous work, a measure of envelope change, the Envelope Difference Index (EDI; Fortune, Woodruff, &Preves, 1994), was moderately related to recognition of spectrally robust consonants. This follow-up study investigated the relationship between the EDI and recognition of spectrally sparse consonants.
Method: Stimuli were vowel-consonant-vowel tokens processed to reduce spectral cues. Compression parameters were chosen to achieve a range of EDI values. Recognition was measured for 20 listeners with normal hearing.
Results: Both overall recognition and perception of consonant features were reduced at higher EDI values. Similar effects were noted with noise-vocoded and sine-vocoded processing and regardless of whether periodicity cues were available.
Conclusion: The data provide information about the acceptable limits of envelope distortion under constrained conditions. These limits can be used to consider the impact of envelope distortions in situations where other cues are available to varying extents.

Key Words: compression, consonant recognition, envelope, vocoding

(ProQuest: ... denotes formula omitted.)

Modern hearing aids use a variety of signal processing schemes that aim to improve speech recognition for listeners with hearing loss. A hallmark of those schemes is use of wide-dynamic range compression (WDRC). The rapidly varying gain used in fast-acting WDRC systems improves audibility and loudness comfort (see Souza, 2003, for a review) but also modifies acoustic cues. In particular, WDRC affects the envelope by reducing the modulation depth and by introducing overshoot and undershoot caused by the time lag of the compressor.1 In many respects, these changes are positive; providingmore gain to low-intensity phonemes can improve audibility (and therefore intelligibility) even as it reduces modulation depth. However, altering the envelope beyond a certain point may also have a negative effect, and several studies have demonstrated that some envelope alterations can degrade speech recognition (e.g., Drullman, Festen,&Plomp, 1994a, 1994b; Souza& Turner, 1996, 1998; Van Tasell &Trine, 1996).

How can we determine when alteration of the envelope is acceptable and when it is detrimental? With regard to envelope alterations that are caused by WDRC, it is impractical to constrain envelope alteration by recommending specific parameters because all parameters interact with each other. A study that shows better performance with a short release time may appear to conflict with a study that shows better performance with a long release time, when the difference is being confounded by different attack times or compression ratios. The issue is further complicated by the finding that patients vary in their reaction to changes to the signal envelope and that those changes may be more or less important in different environments (Gatehouse, Naylor, &Elberling, 2006).

To explore these issues, it would be convenient to use a metric of envelope alteration that captures the

combined effect of all processing parameters. Such a metric could be used to confirm that a given set of parameters is unlikely to be problematic, to evaluate new signal processing schemes, or to assess differences among patients in their tolerance to envelope distortion. Several studies (Jenstad &Souza, 2005, 2007; Saade et al., 1995; Walaszek, 2008) have explored use of the Envelope Difference Index (EDI; Fortune, Woodruff, &Preves, 1994) for this purpose. In its conventional form, the EDI is obtained by rectifying and low-pass filtering the broadband input and output signals to extract the envelope, then calculating the average difference between envelopes.AnEDI of zero indicates no change in envelope due to compression, and an EDI of one indicates maximum alteration of the envelope.

Jenstad and Souza (2005, 2007) used various compression ratios and release times to create WDRCamplified signals with a range of EDI values (relative to unprocessed versions of the same tokens). At high EDIs, speech recognition decreased monotonically. For example, an increase in EDI from 0.25 to 0.34 decreased recognition by about 10% for easy speech materials and about 20% for more difficult (rapidly spoken) speech materials.

Several points raised by Jenstad and Souza (2005, 2007) require more study. The first concerns the mechanisms that the listener may be using to compensate for envelope distortions. In the Jenstad and Souza data, listeners had mild-to-moderate loss and presumably had access to non-envelope cues including periodicity and fine structure.2 Listeners might have been able to shifttheir attention to alternative cues to offset the impact of envelope distortions. With hearing loss that results in broader auditory filters, spectral cues may be less available (Souza, Wright, &Bor, 2012; Tyler, Hall, Glasberg, Moore, &Patterson, 1984), and the importance of the envelope may be increased (Boothroyd, Springer, Smith, &Schulman, 1988; Davies-Venn, 2010). Spectral cues will be even more limited for cochlear implant wearers, who typically receive only four to eight channels of spectral information (Friesen, Shannon, Baskent, &Wang, 2001). It is possible that when spectral cues are less available (i.e., the signal contains less acoustic redundancy), envelope distortions would be problematic at even lower EDIs.

A few studies have varied the amount of spectral information to determine whether availability of spectral cues will offset the effects of envelope distortion, but the findings are not conclusive. Loizou, Dorman, and Tu (1999) found that quantizing speech amplitude into a small number of steps (effectively distorting some amplitude information) reduced speech recognition for sixchannel speech but not for 16-channel speech. Although that manipulation did not reduce modulation depth in the same way as compression would have, it does suggest that distortions of the amplitude envelope may be relatively more important in cases where there is restricted spectral information. In a more direct test of compression when spectral information was limited, Zeng and Galvin (1999) found no effect of compression on consonant recognition or feature perception regardless of the number of spectral channels (4, 10, or 20). Because those studies used different speech materials and different methods of amplitude manipulation that were not modeled on WDRC hearing aids, it is not clear whether envelope distortion has a greater impact when redundant cues are not available.

A second issue is the tradeoffbetween envelope alterations that improve audibility (thereby improving speech recognition) and those that distort the envelope (thereby reducing speech recognition). In Jenstad and Souza (2005), larger EDIs sometimes improved phoneme recognition. This was attributed to improved consonant audibility from the fast-acting compression, but audibility was neither strictly controlled nor quantified in that study. In Jenstad and Souza (2007), where audibility was controlled by matching frequency-gain response across EDI conditions, a larger EDI tended to decrease sentence recognition. It is unclear whether the degraded recognition in the 2007 study was due to the sentence test material, which would have contained more prosodic cues and in which the envelope was relatively more important, or whether the effect of EDI is constant, regardless of test material, as long as it does not interact with audibility.

Third, it is of interest to understand whether envelope changes have feature- and/or consonant-specific effects. Jenstad and Souza (2005) found that altering the envelope affected some consonants more than others. This is an empirical test of Rosen's (1992) proposal that envelope would be most important to consonantmanner and

voicing and less important to consonant place. If that premise holds true, we should see that manner and voicing change with increasing EDI, but place does not.

The goal of this study was to explore the consequences of envelope change on speech recognition by using compression mechanisms representative of wearable hearing aids, for situations where listeners relied on temporal cues. All processing was done using a software simulation of a widely used hearing aid digital signal processing (DSP) platform. To focus on loss of spectral detail without the confounding effects of audibility change, we presented signals processed to limit spectral cues to listeners with normal hearing. Such signals reflect a worstcase scenario: If a given amount of envelope distortion has no detrimental effect when spectral information is very limited, it should be at least acceptable (and perhaps negligible) when spectral cues are readily available. Once we understand the acceptable limits of envelope distortion under constrained conditions, those limits can be used to consider the impact of envelope distortion in situations where other cues are available to varying extents.

Experiment 1

Method

Participants. Participants were 10 adults with normal hearing, ages 21-27 years (mean age = 25.1 years). All participants had hearing thresholds of 20 dB HL (American National Standards Institute [ANSI], 2004) or better at octave frequencies between 0.25 and 8 kHz, had no history of speech or hearing disorders, and spoke English as their sole or primary language. All participants but one (author Eric Hoover) were naive to spectrally sparse speech.

Stimuli. Test stimuliwere a set of 16 vowel-consonantvowel syllables, each consisting of a consonant / b, d, g, p, t, k, f, q, s, S, v, 8, z, Z, m, n/ in an /aCa/ context (Turner, Souza, &Forget, 1995). Each syllable was produced by four talkers (two male, two female) without a carrier phrase for a total of 64 test items. All tokens were digitally recorded at a 44.1 kHz sampling rate with 16-bit resolution.

Each syllable was transformed to signal-correlated noise (Schroeder, 1968) as follows: First, the syllable was digitally filtered into four bands. Crossover frequencies were 440, 1130, and 2800 Hz, and the lower-to-upper frequency range across all bands was 176-7168 Hz. Next, the band output was manipulated by randomly multiplying each digital sample by 1 or -1. This process removed fine-structure information but preserved envelope and periodicity information up to the limits of the listener's ability to detect such cues. Because this processing resulted in generation of energy outside the bandwidth of the filtered signal, the band was refiltered using the original filter settings and amplified with gain appropriate to correct for the power loss of the second filtering. Finally, the filtered segments were digitally mixed.The resulting four-band signal preserved envelope cues but provided only gross cues to spectral shape. Although a one-band signal would have created a pure test of envelope cues, four bands were selected based on pilot data to achieve a range of scores that avoided floor or ceiling effects. At most, such signals have approximate spectral shape and very coarse consonant-vowel transitions (Souza &Rosen, 2009).

EDI calculation. The EDI was calculated using locally developed Matlab code. In each case, the EDI represented a comparison of signal envelopes for a compressed syllable compared with an uncompressed version of the same syllable. First, a syllable was rectified and digitally low-pass filtered using a Butterworth sixth-order filter with a 50-Hz cutoffto obtain the syllable envelope. The envelope was downsampled to a sampling frequency of 6000 Hz, and the mean amplitude of the syllable was calculated. Each sampled data point of the envelope was scaled to the mean amplitude by dividing every value by the mean. This provided a common reference for comparing the two envelopes. The same steps were conducted for the second signal. The EDI was calculated using the equation below, where Env1 was the uncompressed signal-correlated noise (SCN) version of a given syllable, and Env2 was one of the compressed versions of the SCN-processed syllable:

... (1)

where N = number of sample points in the waveforms, Env1n = the envelope of the compressed waveform, and Env2n = the envelope of the unprocessed waveform.

Selection of compression parameters and target EDIs. Because we were interested in the effects of envelope alteration under conditions similar to those that might occur in practice, we first sought to determine what EDIs might occur in clinically fit, wearable hearing aids. We drew information from two sets of data. The first (Souza, Hoover, Gallun, &Brennan, 2010) measured EDI for speech amplified by wearable hearing aids. All recordings were completed using a KEMAR manikin fit with a commercial behind-the-ear hearing aid coupled to a Lucite skeleton (unvented) earmold. The WDRC hearing aid had four compression channels plus output limiting and was programmed with the manufacturer's default frequency-gain and compression parameters for a representative mild-to-moderate audiogram. Digital noise reduction and directional microphone response were disabled. Test signals were the 16 vowel-consonant-vowel nonsense syllables described above, presented in quiet at a 0° azimuth in sound field at input levels of 65 dB SPL (representing conversational speech) and 80 dB SPL (representing loud speech). Across all syllables, EDI values ranged from .05 to .27 (M = .12) for the 65 dB SPL input level and from .06 to .36 (M = .14) for the 80 dB SPL input level.

The second data set was fromWalaszek (2008). That study also used a commercial behind-the-ear hearing aid, programmed with manufacturer settings for a mild loss, with no earmold venting and with digital noise reduction and directional microphone response disabled. Both fast-acting and slow-acting WDRC were tested. Speech materials were Danish sentences presented in a background of a single female talker or in International Colleqium of Rehabilitative Audiology (ICRA) noise. Output signals were recorded in a Bruel and Kjaer ear simulator and processed to separate speech from noise, allowing the EDI calculations to be based on the target speech. Mean EDIs varied from .12 to .22 depending on the compressor speed and type of background noise.

To summarize, two independent studies suggest that commercial hearing aids set to default parameters for listeners with mild-to-moderate loss will produce mean EDI values in the neighborhood of .1-.2, with higher EDIs for some consonants.

Compression parameters (see Table 1) were chosen based on the hearing aid recording data described above and in previous work (Jenstad &Souza, 2005, 2007) to generate output signals with EDIs that varied at least across the .1-.2 range. Note that these parameters were not intended to mimic any single commercial product. Rather, we sought to create EDIs that would be typical of those that might occur in wearable hearing aids. To subject most of the speech dynamic range to compression and to mimic use of a WDRC (low-compression threshold) hearing aid, the compression threshold was set 25 dB below the root-mean-square (RMS) level of the input signal.

Each four-band syllable was processed using hearing aid simulation software (Gennum Corporation; GennEM v1.0). The GennEM application is a single-channel compressor that operates in the same manner as compression circuits in wearable hearing aids. Although current hearing aids use multichannel compression, such compression can also introduce channel interactions (and spectral distortion), and the goal here was to isolate the effect of (broadband) envelope distortion. In addition, the rationale for using multichannel compression is to achieve audibility across frequency, due to variations in the listener's dynamic range (Woods, Van Tasell, Rickert, &Trine, 2006). Because the listeners tested here had normal hearing without such variations, multichannel compression was not needed. As a control, performance was also tested with uncompressed (linear) speech.

Figure 1 illustrates the EDI calculation for the test signals. In each panel, the solid line shows the envelope of the compressed syllable /afa/, the dotted line shows the uncompressed /afa/, and the condition values indicate increasing amounts of compression (higher compression ratio and/or shorter release time) from Table 1. The primary effect of WDRC for this low-intensity voiceless fricative was to increase consonant amplitude relative to vowel amplitude. The overshoot from the compressor is also visible, particularly at the onset of the initial vowel for Condition 2. Compression had little effect on the envelope of /afa / in Condition 2, where EDI was .07. For

/afa/, the EDI reached a maximum of .20 for Condition 4, in which the highest compression ratio was combined with the shortest release time.

Test procedure. During a test session, the participant was seated in a double-walled sound booth. The digital signals were converted to analog (TDT RP2) and presented at a level of 65 dB SPL via an ER-2 insert earphone to the subject's right ear. All 16 consonants were displayed in Roman orthography on a touch-screen monitor, and the participant was asked to select the consonant heard after each trial.

Each participant completed a familiarization block consisting of 20 trials randomly selected from Condition 1, as this was the compression condition with the least envelope alteration (i.e., the longest release time and lowest compression ratio). Feedback was provided in the training phase. A test block consisted of 320 trials (16 Consonants ×4 Speakers ×5 Compression Conditions) presented in random order, with feedback. Each participant completed two blocks per compression condition. A confusion matrix representing presentations and responses was obtained for each block.

Results

Proportion correct for each EDI condition is shown in Table 2. The values were converted to rationalized arcsine units (Studebaker, 1985) for further analysis. The pattern of decreasing performance at increasing EDIs was confirmed via one-way repeated measures analysis of variance (ANOVA), $F(4, 36) = 15.43$, $p = .001$,3 with data grouped by mean EDI value (Table 1). There was no difference between EDIs of .00 and .06, $t(9) = 1.31$, $p = .223$; or .06 and .11, $t(9) = 0.72$, $p = .489$.4 Performance decreased as EDI increased from .11 to .18, $t(9) = 2.6$, $p = .028$; and .18 to .23, $t(9) = 4.0$, $p = .003$.

A secondary goal was to determine whether specific consonant features differed in their susceptibility to envelope change. Following from Rosen (1992), we expected the EDI to be strongly related to perception of consonant voicing and manner. To test this, we performed an information analysis (Wang &Bilger, 1973) for voicing, place, frication, plosiveness, and nasality. All of the features were defined as present or absent for a specific consonant with the exception of place of articulation, which was categorized as labial, interdental, or velar. For example, /aba/ was positive for voicing and plosiveness and had a labial place of articulation. It is necessary to group data into a confusionmatrix representing a set of stimulus-response pairs; these were grouped as in Table 2. The analysis was performed on the confusion matrix representing the final score in each condition and for each participant (5 Conditions ×10 Participants). Only results from the first iteration were used.

Results are shown in Figure 2. Values on the x-axis show the mean EDI (see Table 1). Values on the y-axis show proportion of relative transmitted information. For each feature, a one-way, repeated measures ANOVA was used to examine the effect of increasing EDI.

Voicing was reduced across conditions, $F(4, 36) = 13.37$, $p = .001$, with a reduction in voicing cues at the highest EDIs (EDIs = .18 and .23).5 Place scores were low, consistent with previous work indicating that place was poorly transmitted by spectrally sparse signals (Boothroyd, Mulhearn, Gong, &Ostroff, 1996; Gallun &Souza, 2008; Souza &Rosen, 2009). Place was reduced across conditions, $F(4, 36) = 15.13$, $p < .005$, with a reduction in place cues at the two highest EDIs. Note that the difference between EDIs of .18 and .23 ($p = .027$) was not significant after correction for multiple tests, but this is likely to have been constrained by a floor effect given the low overall scores.

With regard to manner, frication decreased with increasing EDI, $F(4, 36) = 27.95$, $p < .005$. Plosiveness also decreased with increasing EDIs, $F(4, 36) = 18.95$, $p = .001$; post hoc analysis indicated that EDI .06 was statistically equivalent to the linear condition; and plosiveness decreased for EDIs from .11 to .23. The pattern for nasality was slightly different. Although nasality decreased as EDI increased, $F(4, 36) = 8.38$, $p < .005$, post hoc comparisons indicated a significant decrease only for the .23 EDI. The primary cue to nasality is the spectrum of the nasal murmur (Ohde, 1994), which should be less affected by envelope change.

Finally, we considered whether envelope was more important to some consonants than to others, using a

stepwise regression procedure.6 Three factors were assessed: the predictive value of EDI, the predictive value of consonant, and a predictor based on the interaction between EDI and consonant.7 EDI was a significant predictor of performance ($p = .003$). Neither consonant ($p = .161$) nor the interaction between EDI and consonant ($p = .512$) was a significant predictor. This suggests that the effect of envelope distortion can be considered as occurring broadly across consonants.

Figure 3 shows the likelihood of choosing a particular response. Data are expressed as the percentage of time a particular consonant was selected within a condition (i.e., within-condition totals sum to 100%). To interpret these data, consider that each presented consonant comprised6% of the trials. The percent values in Figure 3 are not direct indicators of performance but rather show response bias and how that bias changes as the envelope is altered with compression. For example, for the linear control condition (black bars), listeners chose /b/, /f /, and /v/ more often than any other consonant (17%, 13%, and 12% of responses, respectively). As increasing compression was applied, there was an increase in the proportion of /s, z, S, Z/ responses. This change in the distribution of responses may simply be a result of the compression, in a situation where spectral cues are limited: Compression increased the amplitude of the medial consonant; consonants tend to have high-frequency spectra; thus, increased high-frequency energy was perceived as a fricative. However, it may also be an effect specific to use of SCN for spectral degradation, which has a dense, noisy spectrum qualitatively similar to an intense fricative. It is therefore unclear whether listeners perceived /s, z, S, Z/ due to inherent temporal envelope cues or the use of a noisy signal with a fricative-like quality. In Experiment 2, we addressed this question by using a qualitatively different method of spectral degradation employing a sine-wave carrier.

Experiment 2

In order to confirm and extend the results of Experiment 1, we performed a second experiment. In Experiment 1, SCN processing was used to restrict spectral cues. The SCN signals degraded spectral cues and removed fine structure but also contained periodic variations in amplitude that might have been redundant with envelope cues. Voicing, for example, is weakly cued by envelope but strongly cued by periodicity (Souza &Rosen, 2009). For this reason, conditions were included in Experiment 2 in which the amount of periodicity was systematically varied. This allowed us to explore the extent to which compression effects interact with the presence of periodicity information.

The second goal of Experiment 2 was to examine the extent to which responses in Experiment 1 were influenced by the signal processing used to limit spectral cues. Consider the fricatives /s, z, S, Z/, which were chosen infrequently in the linear condition but more often as the effect of the compressor increased (Figure 3). Those consonants are characterized by high-intensity, highfrequency frication noise. However, SCN signals also have a noiselike quality. It is possible that the pattern of results reflects an interaction between compression and the use of SCN processing, rather than effects of compression alone, and such an effect could limit generalization of results. In order to test this systematically, performance was compared when the syllables to be identified were processed using a variety of carrier types.

Method

Participants. Ten adults with normal hearing, ages 18-42 years (mean age = 25 years), were recruited. All participants had hearing thresholds of 20 dB HL or better (ANSI, 2004) at octave frequencies between 0.25 and 8 kHz, had no history of speech or hearing disorders, and spoke English as their sole or primary language. One of the subjects (author Eric Hoover) had participated in Experiment 1. The remainder had no experience with vocoded or SCN speech.

Stimuli. Test stimuli were the set of 16 vowelconsonant- vowel syllables used in Experiment 1. Only one female speaker was used. Five test conditions were created: (a) SCN, using the stimuli from Experiment 1; (b) noise vocoded with 30-Hz envelope-smoothing filter; (c) noise vocoded with 300-Hz envelope-smoothing filter; (d) sine vocoded with 30-Hz envelope-smoothing filter; and (e) sine vocoded with 300-Hz envelopesmoothing filter. In vocoded speech, the signal envelope is extracted, filtered, and used to modulate a sine or noise carrier. This

process removes fine-structure information and largely preserves envelope; the inclusion of periodicity information depends on the choice of cutofffrequency of the envelope-smoothing filter. It differs from SCN in that the rate of amplitude variations can be controlled. In this case, the purpose of the 30- versus the 300-Hz filter was to control the rate of amplitude variations, such that the 300-Hz filter preserved both envelope and periodicity information, and the 30-Hz filter preserved envelope information. The purpose of the noise- versus sine-vocoded stimuli was to assess contributions of carrier quality, particularly to fricative manner.

The vocoded conditions were created as follows: Each file was digitally filtered into four bands, using sixthorder Butterworth infinite impulse response (IIR) filters. Crossover frequencies were 392, 1005, and 2294 Hz, and the lower-to-upper frequency range across all bands was 100-5000 Hz.8 Next, the output of each band was half-wave rectified and low-pass filtered (fourth-order Butterworth) at either 30 or 300Hzto extract the amplitude envelope. The envelope was then multiplied by a carrier, either a tone at the band-center frequency or a noise. The resulting signal (Envelope ×Carrier) was filtered using the samebandpass filter as for the first filtering stage. RMS level was adjusted at the output of the filter to match the original analysis, and the signalwas summed across bands.

Each syllable in each condition was processed using the same hearing aid simulation software and compression parameters as in Experiment 1. An EDI value was calculated for the compressed syllable relative to its uncompressed counterpart.

Test procedure. Test equipment and procedure were as described for Experiment 1, with the following differences: After 20 familiarization trials with feedback, the subject completed two test blocks, each consisting of 400 trials (16 Consonants ×1 Speaker ×5 Amplification Conditions ×5 Signal Conditions) presented in random order, with feedback. A confusion matrix representing presentations and responses was also obtained for each subject and condition.

Results

Relationship between EDI and performance. Results are shown in Figure 4 and Table 3. The results described here are based on a two-way ANOVA, with repeated measures factors of stimulus condition and compression condition (Figure 4). The analysis was completed on the rationalized-arcsine unit-transformed values. The main effects of stimulus condition were significant, $F(4, 36) = 13.53$, $p < .005$; as were the effects of compression condition, $F(4, 36) = 19.39$, $p < .005$; and the interaction, $F(16, 144) = 1.79$, $p = .038$. The interaction was explored by completing simple main effects analyses either of the effect of compression within a stimulus type or of the effect of stimulus type within a compression condition. Statistical findings are reported in Table 4 and summarized below:

1. With the exception of the control (linear) condition, all stimulus conditions were subject to distortion of the envelope from compression, and all showed a decrease in performance relative to the control condition particularly when mean EDIs were greater than .11.
2. In general, performance was best for the sine/300-Hz condition and worst for the sine/30 Hz condition. This was consistent with data from Souza and Rosen (2009) and suggested that listeners used the periodicity cues and/or spectral sidebands in the sine/ 300-Hz condition to improve consonant recognition.
3. There was no significant difference between the two noise carriers and the SCN conditions. This was also consistent with Souza and Rosen (2009), who noted that in the presence of a noise carrier, allowing transmission of periodicity offered minimal benefit over the envelope alone. Presumably the masking properties of the carrier fluctuations minimize the advantage of periodic variations in the envelope for consonant identification (e.g., Whitmal, Poissant, Freyman, &Helfer, 2007).
4. For both the 30-Hz cutoff(envelope only) and the 300-Hz cutoff(envelope + periodicity), there was no significant difference between the noise and sine carrier.

Effect of compression on consonant features. Similar to Experiment 1, we completed an information analysis on the confusion patterns. Because only a single speaker was used, results were collapsed across the 10 subjects,

which resulted in one confusion matrix for each of the 5 EDI Conditions (Table 1) ×5 Stimulus Conditions. Results of the feature analysis are shown in Table 5. The following effects were noted:

1. Voicing was highest for the sine/300 condition and lowest for the noise/30 and sine/30 conditions. The differencewas not surprising, because periodic variations in amplitude should be a stronger cue to voicing than envelope alone, and those cues would not have been available with a 30-Hz smoothing filter cutoff(Souza &Rosen, 2009). Voicing also decreased with increasing compression; by an EDI of .23, voicing was similarly poor for all stimulus types except the sine/300 condition, in which periodicity should have been resistant to compression.
2. Consistent with Experiment 1, place was low in all conditions and especially at high EDIs. Transmitted information was worst for the sine/30 condition and highest for the sine/300 condition. Place was similar for the three noise conditions, in which only gross spectral shape would be available (Souza &Rosen, 2009).
3. For uncompressed speech, manner was higher for the conditions that contained envelope plus periodicity cues (sine/300, noise/300, and SCN) than for the 30-Hz vocoded conditions. The differences were reduced at higher EDIs. As noted by Souza and Rosen (2009), combining a sine carrier with a high smoothing filter cutoffhas the advantage of providing high-rateamplitude variations as well as spectral sidebands while excluding spurious modulations from a noise carrier.

Patterns of response by consonant. Figure 5 shows response patterns, plotted by consonant. In general, these were similar across processing type and consistent with the response patterns seen in Experiment 1 (Figure 3). Even for the non-noise (sinusoidal) carrier, listeners continued to choose strong fricative consonants more frequently as the amount of compression increased. This suggests a general effect of compression processing, rather than an artifact due to use of a noise carrier. Balakrishnan, Freyman, Chiang, Nerbonne, and Shea (1996) noted a similar effect when consonant-vowel ratio was manipulated directly, in amanner akin to amplitude compression. Balakrishnan et al. suggested that syllables with naturally high consonant-vowel ratio in their natural state might benefit from processing that exaggerates that feature, while the same manipulation degrades syllables with naturally low consonant-vowel ratio.

Discussion

Consequences of Reduced Acoustic Redundancy

Consider a continuum in which signals range from high to low redundancy and where the level of redundancy is controlled by access to mutual information from acoustic and linguistic sources, such as temporal or spectral acoustic cues or language-dependent lexical or syntactic linguistic cues. In this study, stimuli were processed to limit spectral cues. When fewer channels are available, performance will generally be worse because fewer envelope channels are provided, but there will also be reduced representation of the within-channel temporal envelope. Therefore, the spectral and temporal cues cannot bewholly separated.Nonetheless, we are certainly removing information when vocoding speech or processing it as SCN and in doing so have lowered acoustic redundancy especially in the spectral domain.

How does this apply to listeners with hearing loss? A listener with sensorineural hearing loss would be expected to have more than four channels of spectral information, so the processing used mimics spectral degradation that is more representative of a cochlear implant wearer than a listener with sensorineural hearing loss (Friesen et al., 2001). Conversely, listeners with sensorineural impairment do listen under spectrally degraded conditions (e.g., Leek, Dorman, &Summerfield, 1987; Leek &Summers, 1996; Lentz, 2006; Turner &Holte, 1987) so will likely depend to a somewhat greater extent on temporal cues, including envelope. In that sense, the signals used here model temporal cue dependence and loss of spectral information.

Another aspect of redundancy is the content of the speech materials. When high-context materials are used, the listener can apply top-down processing to understand speech even if all acoustic cues are not readily available. However, that process requires greater listening effort and allocation of cognitive resources. This effect was thought to contribute to the findings of Gatehouse et al. (2006) whereby participants who were more negatively

affected by envelope distortion (fast release time) tended to be older listeners with poorer working memory. Other situations with low linguistic redundancy include those where the hearer listens to speech in an unfamiliar accent or dialect.

The nonsense syllables used here can be considered to have very low redundancy, in that they contained minimal spectral cues and had no lexical or contextual information. The normal-rate sentences used in Jenstad and Souza (2007) were of higher redundancy because they offered spectral and lexical cues. The rapid-rate sentences from Jenstad and Souza would fall in between, with less acoustic redundancy than the normal-rate sentences but more than the spectrally limited nonsense syllables.

In the present data, recognition of nonsense syllables with limited spectral cues decreased when EDIs increased from .11 to .18. Jenstad and Souza (2007) found that recognition decreased when EDIs increased from .16 to .25 for rapid-rate sentences and from .25 to .34 for normal-rate sentences. Taken together, data across these three studies suggest that envelope distortion is of greater consequence when the signal has less acoustic (spectral) or linguistic redundancy. That idea is also consistent with Cox and Xu's (2010) finding that a short release time (which should produce more envelope distortion) is more problematic when speech has less contextual information (i.e., lower linguistic redundancy) and with data indicating envelope distortion is more detrimental as the spectral content of the signal is decreased (i.e., lower acoustic redundancy; Drullman et al., 1994a, 1994b; Fu &Shannon, 1998; Loizou et al., 1999; Stone, Fullgrabe, &Moore, 2009; Walaszek, 2008).

Audibility Versus Distortion

When considering the benefit of hearing aid compression for a listener with hearing loss, the envelope distortion represented by the EDI is only one piece of the puzzle. In the work described here, the comparison (uncompressed) signal had the same audibility as the compressed signal because we wished to focus on envelope distortion irrespective of audibility differences. Accordingly, a high EDI was always associated with reduced recognition. In clinical hearing aid fittings, compression will distort the envelope to a degree determined by the specific compression parameters, but it will also provide increased audibility of softspeech, particularly low-intensity consonants. In that sense, the EDI value might be viewed as an offset of audibility benefit. When audibility is greatly improved and EDI values are low, the net effect of compression is likely to be positive. When audibility is minimally improved and EDI values are high, the net effect of compression is likely to be negative. When audibility is greatly improved and EDI values are high (as for a listener with severe loss and reduced dynamic range), the net effect of compression is uncertain.

Recent work by Kates (2010) modeled the effects of compression as improved audibility offset by temporal and/or spectral distortion and proposed an index that incorporates multiple factors. Although Kates's work to date has focused on sentence quality (Arehart, Kates, &Anderson, 2010; Arehart, Kates, Anderson,&Harvey, 2007), an index that combines audibility with envelope distortion might also be able to predict speech intelligibility.

Another factor to consider is individual sensitivity to variations in signal amplitude. At high EDIs, recognition is probably reduced because amplitude variations have been diminished, because compression introduces overshoot or undershoot, or both. Subjects with significant loudness recruitment present an interesting case. Recent work by Brennan (2011) demonstrated that when modulated signals are presented through a compression hearing aid, listeners with hearing loss may have the same, better, or poorer modulation sensitivity compared with listeners with normal hearing. The listeners with better modulation sensitivity also had better perception of (WDRC-amplified) speech envelope cues. Although Brennan did not measure loudness growth for his participants, psychoacoustic work suggests that degree of loudness recruitment is related to modulation detection (Moore,Wojtczak, &Vickers, 1996). It is possible that listeners with more recruitment might also respond differently to envelope distortion than listeners with less recruitment.

Consonant Feature Transmission

Rosen (1992) suggested that the temporal envelope would convey strong cues to consonant manner and

weaker cues to consonant voicing (primarily due to the fact that voiced consonants have greater amplitudes than voiceless consonants). Consonant place is expected to be contained in the fine structure of the signal and not available from envelope information. The addition of periodic information (as in the sine/300-Hz vocoded stimuli used in Experiment 2) should provide strong voicing cues. Our results support these patterns. In both experiments, place was consistently lower than either voicing or manner. In Experiment 2, voicing improved as the envelope-smoothing filter was increased from 30 to 300 Hz. Altering the envelope resulted in a marked decrease in consonant manner and voicing and a smaller decrease in perception of place. The change in place is interesting, because Rosen's ideas suggest that if place is not conveyed by envelope, altering the envelope should not affect place. However, place can also be conveyed by gross spectral shape (Blumstein, Isaacs, &Mertus, 1982), so if the envelope amplitude is reduced more in one carrier band, gross spectral shape (and therefore place perception) could also change. We suspect this is the reason for the reduced place perception at high EDIs.

Alternative Signal Representations

Howdoes theEDI compare with othermetrics of temporal change? The grandfather of temporal indices, the SpeechTransmission Index (STI; Steeneken&Houtgast, 1980), is based onthe concept that preservingmodulations is a desirable outcome. However, as noted by the developers of the EDI (Fortune et al., 1994), the STI is not appropriate for application to specific elements of speech because its derivation relies on average temporal effectsmeasured over long time intervals. The STI was also devised to capture the effects of noise and/or reverberation in caseswhere the speech modulations are unchanged, and more recent evaluations of modulation transfer function (MTF)- based indices noted that they do not capture effects of nonlinear speech processing (Goldsworthy&Greenberg, 2004; Noordhoek and Drullman, 1997).

Gallun and Souza (2008) recently proposed the Spectral Correlation Index (SCI) for use with hearingaid processed speech. The SCI is a multidimensional model that characterizes changes to the signal at different modulation rates and different carrier frequency bands. Although both the EDI and SCI show a relationship to speech recognition (Jenstad&Souza, 2005, 2007; Souza &Gallun, 2010), they represent different theoretical approaches. The EDI characterizes changes to speech in the time domain and the SCI in the modulation domain. This means that each index will combine specific properties of the envelope in different ways. Our preliminary work (Souza, Gallun, &Hoover, 2009) suggested that the EDI better represents the net effect of interrelated compression parameters, whereas the SCI may be more sensitive to changes in a single compression parameter.

Two multiband implementations of the EDI have also been suggested (Jenstad, Souza, &Lister, 2006; Walaszek, 2008). Both measured the within-band EDI then averaged across bands to produce an average EDI. When the average is unweighted, this should produce similar values to the broadband EDI. For example, Walaszek (2008) found a difference of about .03, on average, between the broadband EDI and an eight-band averaged EDI.

Can the EDI Inform Clinical Practice?

The study described here tested a specific experimental question: When subjects rely on envelope cues, how much can that envelope be altered before recognition is affected? Clinical audiologists seek answers to a similar question when adjusting WDRC hearing aids (Jenstad, Van Tasell, &Ewert, 2003). The present data represent a step toward that goal by providing a measure in which we can consider the net effect of parameters on the envelope. Jenstad and Souza (2007) argued that equivalent EDIs derived with any combination of compression parameters should result in similar recognition scores. This contention is supported by the data of Jenstad and Souza (2007) in combination withWalaszek (2008). As one example, both studies processed sentences to create EDI values of .16 but with different compression parameters. Jenstad and Souza combined a higher compression ratio (4:1) with longer release time (800 ms), whereas Walaszek combined a lower compression ratio (2.5:1) with shorter release time (80 ms). The resulting sentences were recognized correctly

65%-70% of the time by Jenstad and Souza's participants and 65% of the time by Walaszek's participants. The EDI will be most meaningful when considered as a general descriptor or categorization of envelope distortion. To put this another way, the EDI is not so precise that a particular syllable with an EDI of .22 will be more difficult to recognize than the same syllable with an EDI of .20. Nonetheless, the EDI can represent the overall distortion such that each set of hearing-aid parameters will have an EDI and resulting effect on recognition. A correlate might be the use of the Speech Intelligibility Index (SII; ANSI, 1997) in hearing aid fitting, where the SII is not applied precisely on a word-by-word or syllable-by-syllable basis but is used to categorize and contrast the effect of different hearing aid settings on speech. The SII can then be considered in the context of other factors, such as loudness comfort and perceived speech quality, when making fitting decisions. The EDI might be used in a similar way. That is, it provides one piece of information in the fitting process. The clinician might then consider that envelope distortion in the context of other fitting decisions: whether the compression improves audibility; whether moderating the compression parameters would cause unacceptably low audibility or unacceptably high loudness comfort; whether that patient is likely to have ready access to spectral cues or signal redundancy, which will offset the envelope distortion.

In summary, the EDI offers a simple and convenient way to capture temporal distortion. With regard to WDRC, the data here and in our previous research suggest that the optimum set of compression characteristics should be considered not in terms of a specific release time or compression ratio but as a "balance point" where the negative effect of temporal distortion does not outweigh the positive effect of improved audibility for a particular listener and situation. Although it is not clear whether the EDI can be adapted into a useful clinical tool, it offers one approach to characterize temporal envelope change while studying various other effects. For example, when considered in the context of earlier work, data suggest that the consequences of envelope distortion may be increased in cases of lower acoustic redundancy due to either listener or situational factors. Accordingly, it offers an experimental tool suited to the study of hearing loss and/or device effects.

Acknowledgments

This work was supported by National Institutes of Health Grant R01 DC0060014 to Pamela Souza, by Department of Veterans Affairs Rehabilitation Research and Development Service Grant C4963Wto Frederick Gallun, and by the National Center for Rehabilitative Auditory Research. We thank Steve Armstrong and the Gennum Corporation for providing the hearing aid simulation software; Stuart Rosen for sharing the FIX program and vocoding algorithms; and Ashley Arrington, Alexandra Dykhouse, Louisa Ha, and Marcee Wickline for assistance in data collection.

Footnote

1Envelope refers to slow (< 50 Hz) variations in speech amplitude (Rosen, 1992).

2Periodicity refers to amplitude variations at rates between 50 and 500 Hz, which provide information about consonant voicing and manner (Rosen, 1992). Fine structure refers to rapid amplitude variations thought to provide cues to consonant place (Rosen, 1992).

3For this and later analyses, if Mauchley's test was significant, Greenhouse- Geisser adjusted values are reported.

4When the main effect was significant, the post hoc comparisons reported are based on means comparisons where the significance level was quantified by the Bonferroni adjustment.

5These are reported post hoc comparisons with Bonferroni-qualified significant differences.

6In this procedure, predictor variables are entered one at a time. Regression coefficients and tests of significance are calculated at each step. If a variable does not contribute significantly to prediction, it is

eliminated from the model (Gardner, 2001).

7The alpha-level criteria for probability of entry into the model was .05, and the probability of removal from the model was .10.

8Filter specifications for the vocoded speech differed slightly from those used in Experiment 1, due to differences in the methodology used to create the stimuli. Previous comparisons of filter settings for vocoded speech suggest that this was a negligible difference (Shannon, Zeng,&Wygonski, 1998).

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Editor: Robert Schlauch
Associate Editor: Van Summers
Received October 27, 2010
Revision received March 21, 2011

Accepted October 6, 2011
DOI: 10.1044/1092-4388(2011/10-0301)

Publication date: Jun 2012

Year: 2012

The Developmental Trajectory of Spatial Listening Skills in Normal-Hearing Children

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 865-878A.
ProQuest document link

Abstract: To establish the age at which children can complete tests of spatial listening and to measure the normative relationship between age and performance. Fifty-six normal-hearing children, ages 1.5-7.9 years, attempted tests of the ability to discriminate a sound source on the leftfrom one on the right, to localize a source, to track moving sources, and to perceive speech in noise. Tests of left-right discrimination, movement tracking, and speech perception were completed by ≥75% of children older than 3 years. Children showed adult levels of performance from age 1.5 years (movement tracking), 3 years (left-right discrimination), and 6 years (localization and speech in noise). Spatial release from masking-calculated as the difference in speech reception thresholds between conditions with spatially coincident and spatially separate speech and noise-remained constant at 5 dB from age 3 years. Data from a separate study demonstrate the age at which children with cochlear implants can complete the same tests. Assessments of left-right discrimination, movement tracking, and speech perception were completed by ≥75% of children who are older than 5 years and who wear cochlear implants. These data can guide the selection of tests for future studies and inform the interpretation of results from clinical populations.

Full text: Headnote

Purpose: To establish the age at which children can complete tests of spatial listening and to measure the normative relationship between age and performance.
Method: Fifty-six normal-hearing children, ages 1.5-7.9 years, attempted tests of the ability to discriminate a sound source on the leftfrom one on the right, to localize a source, to track moving sources, and to perceive speech in noise.
Results: Tests of left-right discrimination, movement tracking, and speech perception were completed by ≥75% of children older than 3 years. Children showed adult levels of performance from age 1.5 years (movement tracking), 3 years (left-right discrimination), and 6 years (localization and speech in noise). Spatial release from masking-calculated as the difference in speech reception thresholds between conditions with spatially coincident and spatially separate speech and noise-remained constant at 5 dB from age 3 years. Data from a separate study demonstrate the age at which children with cochlear implants can complete the same tests. Assessments of left-right discrimination, movement tracking, and speech perception were completed by ≥75% of children who are older than 5 years and who wear cochlear implants.
Conclusion: These data can guide the selection of tests for future studies and inform the interpretation of results from clinical populations.

Key Words: word recognition testing, children, normal hearing, cochlear implants
(ProQuest: ... denotes formula omitted.)
There are two main benefits of having two ears rather than one. By comparing the intensity and timing of signals between the ears, listeners can localize sources of sound (B. C. J. Moore, 2003) and can improve the perception of speech in noise (Litovsky, 2005). These spatial listening skills help children to be safe outdoors and to understand speech in noisy environments. To encourage the development of spatial listening, it is routine practice to fit hearing instruments bilaterally to children with hearing impairment (Ching, van Wanrooy, &Dillon, 2007; National Institute for Health and Clinical Excellence, 2009; The PediatricWorking Group of the Conference on Amplification for ChildrenWith Auditory Deficits, 1996). It would be desirable, therefore, to have a battery of tests of spatial listening that could be used to evaluate the benefits of bilateral fittings in children. This article describes the rationale, implementation, and evaluation of such a battery.
Ideally, a battery of tests of spatial listening would meet four criteria. First, the battery would obtain measures of both sound-source localization and speech perception in noise in a single session. Second, the battery would accommodate the wide range of performance displayed by children of different ages and with differing degrees of hearing impairment. Third, the battery would impose low cognitive and linguistic demands to maximize the number of children who could perform the tests. Fourth, it would be possible for a single experimenter to administer the battery to minimize the resources required to test children. We designed such a battery and evaluated it against the four criteria. The battery was administered to normalhearing children to establish (a) the proportion of normal-hearing children in different age bands who could complete each test; (b) the normal developmental trajectory of performance as a function of age; and (c) the reliability of the tests. Normal-hearing adults were tested to assess the upper limit of performance. The study differed from previous systematic assessments of the relationship between age and spatial listening skills, which concentrated on either sound-source localization (Clifton, 1992; Van Deun et al., 2009) or speech perception (Vaillancourt, Laroche, Giguere, &Soli, 2008; Van Deun, van Wieringen, &Wouters, 2010) rather than both skills together. Moreover, previous studies have generally not reported the age at which children can complete tests. That information is of great value when planning studies. In addition to the study of normalhearing listeners, we analyzed data from a separate study (Lovett, Kitterick, Hewitt, &Summerfield, 2010) to establish the age at which children with cochlear implants could complete the same tests.
The analyses establish the age ranges of normalhearing children and children with cochlear implants for whom the battery is suitable. Although the battery was developed and evaluated in the United Kingdom, its design is generic, and the tests could be implemented in any language. Accordingly, the results may be widely useful in guiding the choice of tests for children of different ages, and different hearing abilities, in future studies. Furthermore, the performance data fromnormal-hearing children will aid the interpretation of data from children with hearing impairment.
This article is organized in three parts. The first part describes the design and implementation of the test battery. The second part presents data on (a) the relationship between age and the ability to complete tests for normal-hearing children and children with cochlear implants and (b) the relationship between age and performance in normal-hearing children. The latter relationship was not assessed for children who have cochlear implants because, for this group, performance is influenced by variables such as the number of implants and the age at diagnosis of hearing impairment, as well as current age (Lovett et al., 2010). The third part assesses the strengths and weaknesses of the test battery.
Design of the Test Battery
The battery was designed to be delivered by a semicircular array of 13 loudspeakers and five computercontrolled monitors. The four criteria described at the beginning of this article were addressed as follows. First, to measure sound-source localization and speech perception in a single session, the length of tests was minimized, and monitors were used to deliver images and videos that sustained children's interest

while rewarding accurate responses. Second, to make the battery suitable for children ranging widely in age and hearing ability, some tests included a series of conditions of ascending levels of difficulty, whereas other tests varied the level of difficulty adaptively. Third, to minimize cognitive and linguistic demands, tests required simple responses; children either turned their head toward a source of sound or pointed toward toys. Fourth, to enable the battery to be administered by one experimenter and to minimize testing time, most of the tests were designed to measure performance on tasks whose difficulty was within the likely capabilities of normal-hearing children- that is, the tests were not designed to measure the psychophysical limits of children's listening skills (e.g., Grieco-Calub, Litovsky, &Werner, 2008).

The following sections describe each test in relation to published assessments of spatial listening skills in normal-hearing children. Further details of the implementation of the tests are given in the Method section. Videos of children taking part in the tests can be viewed at http://tinyurl.com/yorkspatial.

Tests of the Ability to Localize Sources of Sound

When a source of sound is on a listener's left, sound is more intense at the leftear than at the right ear (an interaural level difference) because some high-frequency energy reflects offthe head rather than diffracting around it (Fedderson, Sandel, Teas, &Jeffress, 1957). Moreover, the sound arrives sooner at the leftear than at the right ear (an interaural time difference) because the sound wave must travel farther to reach the right ear. Normal-hearing listeners use these cues to localize sources of sound on the horizontal plane (B. C. J. Moore, 2003). For normalhearing children, an ability to localize sources of sound is present at birth. Newborns turn their head toward a source of sound (Clifton, 1992), and 18-month-olds can discriminate the location of two sound sources separated horizontally by only ±6° (Litovsky, 1997; Morrongiello, 1988). (Throughout this article, angular locations denote points on the horizontal plane, where 0° is straight ahead and positive angles are to the right.)

We developed two tests of the ability to localize sources of sound. The first test, known as the Left-Right Discrimination Test, measured children's ability to discriminate a sound source on the leftfrom a sound source on the right based on the principles of visual reinforcement audiometry (Bamford &McSporran, 1993). One condition of this Left-Right Discrimination Test used two loudspeakers located at -60° and +60°, and the other condition used two loudspeakers at -30° and +30° (Tyler et al., 2002). On each trial, one of the loudspeakers played a sound. The test measured the percentage of trials during which the child looked or pointed toward the active loudspeaker.

The second test, known as the Localization Test, measured children's ability to locate a source of sound when presented with more than two possible source locations. In this test, a stimulus was presented from one loudspeaker in the array, and the participant was asked to indicate which loudspeaker played the sound. The percentage of correct responses was measured. Van Deun et al. (2009) used a similar test with nine source locations ranging from -60° to +60° and found that 4-year-olds responded less accurately than adults, whereas 5- and 6-year-olds performed at a level similar to that of adults. Bess, Tharpe, and Gibler (1986) used a 13-alternative task with source locations ranging from -90° to +90° and found that 6- to 13-year-old children performed at a level similar to that of adults. Thus, performance on localization tests appears to be adultlike by age 5 or 6 years. We were concerned that a large number of source locationsmight be too challenging for young children who have hearing impairment. Accordingly, the Localization Test was limited to three source locations in one condition and five source locations in other conditions.

Some listeners, such as a child who is profoundly deaf with a unilateral cochlear implant, effectively have only one functional ear. Monaural listeners cannot perceive interaural differences in level and timing, but they may be able to turn their heads and use the resulting changes in level and frequency spectrum to localize sources of sound. If the same stimulus is presented repeatedly, monaural listeners can learn the level and frequency spectrum associated with a source location (Van Wanrooij &Van Opstal, 2004). Nevertheless, on the horizontal plane, binaural hearing gives more accurate localization than monaural hearing (Van Wanrooij &Van Opstal,

2004). Therefore, it is possible that a monaural listener may show above-chance performance in a laboratory assessment of sound-source localization due to learning monaural cues during the test and yet struggle to localize sources of sound in everyday life. To reduce the opportunity for participants to learnmonaural cues, the Left-Right Discrimination and Localization tests used stimuli that were roved in level and that had been recorded by several talkers with different longterm speech spectra.

Tests of the Ability to Track Moving Sounds

A further benefit of having two ears is the ability to track moving sources of sound. Cranford, Morgan, Scudder, and Moore (1993) exploited the precedence effect (Litovsky, 1997) to manipulate the apparent location of the source of clicks presented from a pair of loudspeakers. Normal-hearing children used a laser pointer to track the source. Children ages 10-11 years tracked the apparently moving source more accurately than children ages 6-9 years. We created apparent movement using a method similar to that used by Tyler, Noble, Dunn, and Whit (2006), in which stimuli are presented from a sequence of adjacent loudspeakers. The Movement Tracking Test was scored by an observer who watched the child's behavior during each trial. Performance was scored as correct if the trajectory of the stimulus could be deduced from movements of the child's eyes, head, or body.

Tests of the Ability to Perceive Speech in Noise

Spatial release from masking (SRM) was used as a measure of the benefit for speech perception of having two ears (Litovsky, 2005).SRMis assessed by comparing performance in two conditions: (a) speech and noise are presented from the front, and (b) speech is presented from the front, and noise is presented from 90° to one side. Normal-hearing listeners can identify speech at a more adverse signal-to-noise ratio in the latter condition for two reasons. First, the head casts an acoustic shadow and shields one ear from the noise. Second, the interaural level and time differences of the speech differ from those of the noise; the auditory system can use these differences to "cancel" some of the noise (Culling &Summerfield, 1995; Durlach, 1963).

Normal-hearing children consistently show SRM, although the group-mean size of the effect varies across studies from 3 dB to 11 dB (Garadat &Litovsky, 2007; Johnstone &Litovsky, 2006; Litovsky, 2005; Vaillancourt et al., 2008; Van Deun et al., 2010). There is some evidence that SRM increases with age. Vaillancourt et al. (2008) reported that 12-year-old children showed significantly greater SRM than 6- to 10-year-old children on a test of sentence perception in speech-shaped noise. Similarly, Van Deun et al. (2010) found that adults and children older than age 6 years showed significantly greater SRM than 4- and 5-year-old children on a test of word perception in speech-shaped noise. On the other hand, Litovsky (2005) found that 4- to 7-year-old children did not differ from adults in the amount of SRM on a test of word perception in speech-shaped noise. Johnstone and Litovsky (2006) reported an interaction between age and the type of masker: 5- to 7-year-olds showed (a) significantly less SRM than adults with an amplitudemodulated noise masker and (b) significantly more SRM than adults with a reversed-speech masker.

To measure SRM, we estimated speech reception thresholds in noise using the closed-set Toy Discrimination Test (Summerfield, Palmer, Foster, Marshall, &Twomey, 1994). Previous assessments of normal-hearing children reported that increasing age is associated with improving (i.e., decreasing) speech reception thresholds (Litovsky, 2005; Summerfield, Foster, Moorjani, &Palmer, 2004; Vaillancourt et al., 2008). The differences between age groups can be substantial. Litovsky (2005) compared 4- to 7-year-old children with adults and found a difference of about 17 dB in speech reception thresholds in noise.

Reliability

One aim of the study was to assess reliability, meaning the extent to which two administrations of a test with the same child yielded similar results. For all tests, a subset of the normal-hearing participants was tested twice for the purpose of assessing test-retest reliability. The Left-Right Discrimination and Movement Tracking tests were scored by an observer who made judgments about movement of the child's eyes, head, and body. For these two tests, scores from two observers were obtained for a subset of the normal-hearing children in order to assess interrater reliability.

Hypotheses

It was predicted that the ability to complete tests would improve with age for normal-hearing children and for children with cochlear implants. For normalhearing children, it was predicted that (a) children of all ages tested would be accurate in discriminating sound sources on the leftfrom those on the right; (b) accuracy of localization would improve with age and would approximate that of adults by the age 5 or 6 years; (c) accuracy of movement tracking would improve with age; (d) speech reception thresholds would decrease with age; and (e) children of all ages tested would show SRM.

Method

Participants

Fifty-six normal-hearing children were recruited via preschools and primary schools. These children ranged in age from 1.5 to 7.9 years and were stratified by age into seven groups (Table 1). Two additional children were tested and then excluded from the study: one because of suspected hearing impairment and one who was unwilling to sit still. The children had passed National Health Service hearing screening tests with the exception of one child, who was not born in the United Kingdom. According to parental report, the children had normal hearing, had been in good health in the 2 weeks prior to testing, and had no disabilities or learning difficulties. The children went to an English-speaking preschool or school and could understand instructions in English. Eight adult participants, ranging in age from 20 to 24 years, were students of the University of York. They had pure-tone thresholds equal to or better than 25 dB HL at octave frequencies between 0.25 Hz and 8 kHz, inclusive (British Society of Audiology, 2004).

The characteristics of the 50 children with cochlear implants were described by Lovett et al. (2010). These children were severely to profoundly deaf and were between 2.3 and 16.9 years of age. Twenty children used a unilateral implant, and 30 used bilateral implants. Children with implants were stratified by age into seven groups: 2-year-olds (n = 4), 3-year-olds (n = 8), 4-yearolds (n = 4), 5-year-olds (n = 5), 6-year-olds (n = 6), 7-yearolds (n = 7), and 8- to 16-year-olds (n = 16). The study of children with cochlear implants took place after the study of normal-hearing children.

The parents of child participants received an allowance to cover travel costs; adult participants were paid for their time. Approval was obtained from the Research Ethics Committee of the Department of Psychology of the University of York and from the North West Research Ethics Committee of the National Research Ethics Service.

Apparatus

Testing took place in a single-walled booth (Industrial Acoustics Company) located inside a soundshielded room. The booth contained a semicircle of 13 loudspeakers (Bose Acoustimass 3 Series IV). The semicircle had a radius of 1.65 m, and the loudspeakers were mounted at 15° intervals on 1-m-high poles. The loudspeakers were controlled by software running on a personal computer that produced simultaneous output via a digital-to-analogue converter (MOTU 24I/O) and 13 custom power amplifiers. Five independently controlled monitors could be positioned below any five of the loudspeakers. Participants sat in a chair at the center of the semicircle equidistant from each loudspeaker and facing the seventh loudspeaker in the array. A few children sat on their parents' laps, in which case the parents listened to music via headphones to mask the acoustical stimuli. The experimenter sat in a corner of the booth and could see a live video feed of the participant from a camera at 0°. Stimulus levels were measured at the center of the array with a Brüel &Kjæ r 0.5-in. microphone (Type 4189) and sound-level meter (Type 2260 Investigator). Prior to testing, the output of individual loudspeakers was adjusted to give the same level, within ±0.1dB, of anoctavebandofwhitenoise centeredon1kHz.

Test Battery

Left-Right Discrimination Test. There were two conditions of this test. The ±60° condition used three monitors and loudspeakers situated at -60°, 0°, and +60°. The ±30° condition used three monitors and loudspeakers situated at -30°, 0°, and +30°. At the beginning of a trial, an audiovisual cartoon clip was presented from 0°. The

experimenter viewed the video feed showing the child's face. When the experimenter judged that the child was looking forward and paying attention, the cartoon was turned off, and an audio-only speech stimulus was presented from either the leftor the right loudspeaker selected randomly by the computer. The experimenter judged whether the child moved his or her eyes, head, or body to the leftor right. The experimenter entered the direction of the response into the computer, which was programmed to record a response toward the location of the source as correct and to present an audiovisual cartoon at that location as a reward. An incorrect response, or no response, resulted in no reward and a 3- to 5-s pause before the next trial. The experimenter was purposely not informed of the location of the stimulus and listened to music via headphones to mask the acoustical stimuli. To sustain the child's interest, the cartoon clips were ordered so that they told a story.
The audio-only speech stimulus was a recording of a female voice saying, "Look over here." There were five different talkers, one of whom was selected randomly on each trial. The speech stimuli had been recorded in the testing booth using a Sennheiser K3N/ME40 microphone and digitized at 44.1 kHz with 16-bit amplitude quantization. The average stimulus level was 70 dBA SPL, randomly roved for each trial by ±5 dB in 1-dB steps.

The test began with four practice trials in the ±60° condition, during which the experimenter sat next to the child and pointed toward the sound source. Data from these trials were discarded. Children then attempted 20 trials in the ±60° condition followed by 20 trials in the ±30° condition. The percentage of correct responses was measured in each condition.
Localization Test. There were three conditions. The 60° condition used three monitors and associated loudspeakers at -60°, 0°, and +60°. The 30° condition used five monitors and loudspeakers at -60°, -30°, 0°, +30°, and +60°. The 15° condition used five monitors and loudspeakers at -30°, -15°, 0°, +15°, and +30°. Seven wooden blocks, which differed in color and shape, were placed on a table in front of the child. Each monitor displayed a photograph of a different block. A speech stimulus was presented from a single loudspeaker, selected randomly on each trial. The child's task was to locate the source of sound and pick up the block displayed on the monitor below that loudspeaker. The photograph for each monitor was selected randomly on each trial. We chose to label the loudspeakers using toy blocks because they were distinctive, and during pilot testing children did not show a preference for one block over any other.
The speech stimulus was a recording of a female voice saying, "Hello; what's this?" There were five talkers, one of whom was selected randomly on each trial. The speech stimuli had been recorded in the testing booth using a Sennheiser K3N/ME40 microphone and digitized at 44.1 kHz with 16-bit amplitude quantization. The stimuli were modified to introduce variation into the monaural level and spectral cues to source location. 1 The average stimulus level was 70 dBA SPL, randomly roved by ±5 dB in 1-dB steps.
The test began with four practice trials in the 60° condition during which the experimenter stood next to a monitor and used live voice to present the speech stimulus. Data from these trials were discarded. Children then attempted 30 trials in each condition in the following order: 60°, 30°, 15°. The percentage of correct responses was measured in each condition.
Movement Tracking Test.We constructed two acoustic scenarios from publicly available recordings. The first scenario started with a doorbell followed by a door opening, footsteps, and a door closing. The second scenario started with a bugle followed by a horse's neigh, hoofbeats, and a second horse's neigh. The elements of each scenario were presented from a sequence of adjacent loudspeakers such that normal-hearing adults reported that the sound source moved smoothly around the edge of the semicircle of loudspeakers. There were four trajectories of movement, each of which was presented once in a counterbalanced order. Two trajectories were presented with the footsteps scenario and two with the hoofbeats scenario. The trajectories were left-front-right, right-front-left, left-front-left, and right-front-right. "Left," "front," and "right" denote -90°, 0°, and +90°, respectively. An independent observer attempted to deduce the trajectory of movement during each trial by watching a video recording of the child's behavior while the stimulus was presented. Typical reactions included

eye movements, head turns, and pointing. If the observer deduced the trajectory of movement correctly, that trial was scored as correct. The percentage of correct trials was measured. Children received no instructions unless they asked for guidance, in which case they were told to "point to show us where the sounds come from." There were no practice trials. Stimuli were low-pass filtered at 5.5 kHz and were presented at 71 dBA SPL.

Toy Discrimination Test. Fourteen toys were placed on a table in front of the child. A recording of a female voice was presented saying, "Point to the toy name," where toy name was one of the toys. The task was to point to the correct toy. The experimenter checked that the child knew the names of the toys and administered practice trials using a live voice before testing began. If children did not know the names of all the toys, the unfamiliar items were omitted from the test. The software permitted the test to be run with 14, 10, or four toys.

The stimuli were recorded by Summerfield et al. (1994). A single recording of the introductory phrase ("Point to the") was used on every trial. The introductory phrase had a duration of 0.5 s. The toy name was selected randomly on each trial. The level of each toy-name recording was modified so that all the names were equally intelligible to normal-hearing adults (Summerfield et al., 1994). Ten tokens of broadband pink noise were synthesized using CoolEdit 2000 (Syntrillium Software Corporation, Phoenix, AZ). Each noise token had a duration of 1.4 s and had 0.2-s linear onset and offset ramps. One noise token was selected randomly on each trial. The noise started 0.3 s after the start of the introductory phrase, so the noise was at full amplitude throughout the utterance of the toy name.

There were three conditions of the Toy Discrimination Test in noise, with noise from -90°, 0°, and +90°. The speech was always presented from 0°. The average level of the toy names was fixed at 50 dBA SPL, and the level of the noise was varied adaptively. A one-down one-up adaptive routine with a step size of 6 dB was used for the first two reversals. A two-down one-up routine with a step size of 3 dB was used for the six reversals that followed. The average of the final six reversals was taken for the purpose of estimating the 70.7% correct threshold (Levitt, 1971). In the present study, this signal-to-noise ratio was referred to as the speech reception threshold in noise (SRT[N]). Three conditions were presented in an order that was counterbalanced across participants.

For participants who completed all three conditions in noise, we also measured a speech reception threshold in quiet (SRT[Q]) to confirm that children could accurately identify the toy names at the level at which the names were presented in noise. The level of the speech was varied adaptively, and there was no noise stimulus. The other aspects of the adaptive routine were the same as for the conditions in noise. The average of the final six reversals was taken for the purpose of estimating the 70.7% correct threshold (Levitt, 1971). In the present study, this signal level was referred to as the SRT(Q). We report two sets of measures from the Toy Discrimination Test: (a) the SRT(N) for each noise location and the SRT (Q) and (b) SRM, calculated as the difference in SRT(N) between the noise-front and each noise-side condition.

Procedure

Testing took place in a single session that lasted between 1.0 and 2.5 hr. To maximize the data obtained from each child, some age groups were excluded from certain tests based on the results of pilot testing. Children younger than 2 years were excluded from the Localization and Toy Discrimination tests because they found those tests too difficult. Normal-hearing children age 5 years and older were excluded from the 60° condition of the Localization Test because they found it too easy. Children of all ages who wore cochlear implants were excluded from the 15° condition of the Localization Test because they found it too difficult. Tests and play breaks were scheduled to occur in a standard order designed to provide variety (see Appendix A, available as online supplemental materials). Encouragement was given after every trial, even if the child's response was incorrect.

The procedure for testing adults was the same as the one used for testing children, with the following exceptions. Adults responded using a touch screen except for the Movement Tracking Test, for which they drew

the trajectory of perceived movement onto a diagram of the semicircle of loudspeakers. For the Toy Discrimination Test in noise, speech was presented at 40 dBA SPL (i.e., 10 dB lower than for children). Adults completed two repetitions of all conditions of the Toy Discrimination Test; their mean SRTs are reported.

To assess test-retest reliability, normal-hearing children in the age groups 3.0-3.9 years and 7.0-7.9 years were invited to return for a second test session. These groups were selected because they were the youngest who could provide data on most of the tests and the oldest children in the study. To assess interrater reliability, two normal-hearing participants were selected at random from each of the seven groups of children. The video recording of the child performing one condition of the Left-Right Discrimination Test was edited to remove the times when the reward cartoon was presented and then was scored by an observer. Two independent observers scored the video of the child performing the Movement Tracking Test.

Statistical Analysis

Statistics were computed using PASW Statistics 18 for Windows (SPSS). All p values are two-tailed. The tests that measured a percentage of correct responses yielded data that did not distribute normally and that showed ceiling effects. For these tests, a Kruskal-Wallis nonparametric analysis of variance (ANOVA) was used to assess the effect of age group on performance. Mann-Whitney tests with a Bonferroni correction were used to assess whether any groups of children showed poorer performance than the adults.

The Toy Discrimination Test yielded data that were distributed normally. A one-way independent ANOVA was used to assess the effect of age group on SRT(Q). Tukey's honestly significant difference (HSD) post hoc tests were used to assess whether any groups of children showed higher SRT(Q) than the adults. A twoway mixed ANOVA was used to assess the effect of age group and noise location on SRT(N). Tukey's HSD post hoc tests were used to assess whether any groups of children showed higher SRT(N) than the adults. Planned comparisons with a Bonferroni correction were used to investigate the effect of noise location on SRT(N). SRM was calculated by subtracting the SRT(N) with noise at the side from the SRT(N) with noise at the front, giving two measures of SRM: with noise leftand with noise right. A two-way mixed ANOVA was used to assess the effect of age group and noise location on SRM.

Measures of reliability. Two measures of test-retest reliability were calculated for each test. The first measure is the correlation between the scores from the first and second test sessions (Rousson, Gasser, &Seifert, 2002). A high correlation indicates that the second score can be predicted from the first. The second measure is the within-subjects SD of scores (sw; Plomp &Mimpen, 1979; Summerfield et al., 1994). The sw for a group of participants is calculated with the equation

... (1)

where k is the number of participants tested, n is the number of repetitions of the test, xij is the ith participant's score on the jth repetition, and mi is the ith participant's mean score. A small sw indicates that a test is reliable. The probability of a randomly selected participant's true score lying within ±1.96sw of their observed score is ≥.95.

The intraclass correlation coefficient (ICC) between the scores of two observers was calculated as a measure of interrater reliability (Rousson et al., 2002). A two-way random effects model was used to generate a measure of absolute agreement (McGraw &Wong, 1996). This type of ICC reflects both the degree of covariance, and the difference, between the scores given by the two observers. An ICC of 1 indicates perfect agreement between observers; an ICC of 0 indicates no agreement. For the Left- Right Discrimination Test, the ICC between the score from the observer and the score obtained by the experimenter during the test session was calculated. For the Movement Tracking Test, the ICC between the scores from the two observers was calculated.

For the tests that measured a percentage of correct responses, the distribution of data meant that the assumptions behind correlational analysis, sw, and the ICC were violated. To provide an alternative metric of test-retest reliability, we also calculated the percentage of children whose second score was within 10% of their first score. Similarly, for interrater reliability, we also calculated the percentage of children whose score from the

first observer was within 10% of their score from the second observer.

Results

Ability to Complete Tests

If at least 75% of children within an age group completed a test, we judged that the test was suitable for use with that age group in future studies. The criterion of 75% is pragmatic. It is high enough to ensure a useful yield of data but low enough to accommodate a few children who fail to complete tests because of fatigue.

The gray bars in Figure 1 show the age groups in which 75% of children completed a test for children with normal hearing (leftpanel) and children with cochlear implants (right panel). For children with normal hearing, 75% completed the Left-Right Discrimination and Movement Tracking tests by age 2 years and all tests by age 4 years. For children with cochlear implants, 75% completed the Movement Tracking Test and the 60° condition of the Left-Right Discrimination Test by age 3 years, but only by age 8 years did 75% of children complete all tests.

Some children failed to complete a test but, nonetheless, provided data that could be included in analyses. Data were included if the child undertook at least 15% of the trials in a condition or, for the Toy Discrimination Test, achieved at least four reversals in the second phase of the adaptive routine. The black bars in Figure 1 show the age groups in which 75% of children provided useable data.

Left-Right Discrimination Test

The results of the Left-Right Discrimination Test for normal-hearing listeners are shown in Table 2. There was a significant effect of age group on performance in the ±60° condition, $H(7) = 24.96$, $p < .001$, and the ±30° condition, $H(7) = 38.51$, $p < .001$, such that younger participants showed lower scores. In the ±60° condition the 2-year-olds had lower scores than the adults ($z = -2.90$, $p < .01$). All other age groups had a median score of 100% correct. In the ±30° condition, the 1- and 2-year-olds had lower scores than the adults ($z = -2.95$ and $z = -3.09$, respectively, both ps $< .01$), and the 3-year-olds had scores that did not differ significantly from those of the adults ($z = -1.79$, $p > .05$). All other age groups had a median score of 100% correct.

Localization Test

The results of the Localization Test for normalhearing listeners are shown in Table 3. There was a significant effect of age group on performance in the 60° condition, such that younger participants showed lower scores, $H(3) = 14.46$, $p < .01$. The 2-year-olds had lower scores than the adults ($z = -3.13$, $p < .05$), whereas the 3-year-olds had scores that did not differ significantly from the adults ($z = -2.38$, $p > .05$). The 4-year-olds had a median score of 100% correct. The 60° condition was not administered to 5- to 7-year-old children.

There was no significant effect of age group on performance in the 30° condition,$H(6) = 8.27$, $p > .05$. Therewas a significant effect of age group on performance in the 15° condition, such that younger participants showed lower scores, $H(5) = 17.13$, $p < .01$. The 3-, 4-, and 5-year-old children had lower scores than the adults (3-year-olds: $z = -3.13$; 4-year-olds: $z = -3.02$; 5-year-olds: $z = -3.30$; all ps $< .05$). The 6- and 7-year-old children had scores that did not differ significantly from the adults ($z = -2.56$ and $z = -2.57$, respectively; both ps $> .05$).

Movement Tracking Test

The results of the Movement Tracking Test for normal-hearing listeners are shown in Table 4. All age groups had a median score of 100% correct.

Toy Discrimination Test in Quiet

The results of the Toy Discrimination Test in quiet for normal-hearing listeners are shown in Figure 2. The children who completed the quiet condition displayed SRT(Q) between 10 and 28 dBA SPL. Thus, the children could understand the speech when it was presented at a lower level than was used for the test in noise. There was a significant effect of age group, such that younger participants showed higher SRT(Q), $F(5, 37) = 7.52$, $p < .001$. The 3- to 6-year-olds all had higher SRT(Q) than the adults ($p < .05$), whereas the 7-year-olds had SRT(Q) that did not differ significantly from that of the adults ($p > .05$).

Toy Discrimination Test in Noise

The results of the Toy Discrimination Test in noise for normal-hearing listeners are shown in Figure 3. There was a significant effect of age group, such that younger participants showed higher SRT(N), $F(6, 41) = 4.15$, $p < .01$. Post hoc tests indicated that the 4- and 5-year-olds had higher SRT(N) than the adults ($p < .05$). The remaining groups of children did not differ significantly from the adults ($p > .05$). There was a significant effect of noise location, such that SRT(N) was higher when speech and noise were spatially coincident than when speech and noise were spatially separated, $F(2, 82) = 59.87$, $p < .001$. Planned contrasts indicated that SRT(N) was significantly lower in the noise-left, $F(1, 41) = 126.50$, $p < .001$, and noise-right conditions, $F(1, 41) = 62.50$, $p < .001$, than in the noise-front condition. The interaction between age group and noise location was not significant, $F(12, 82) = 1.23$, $p > .05$.

Spatial Release From Masking

TheSRMshown by normal-hearing listeners is plotted in Figure 4. Neither the effect of age group, $F(6, 41) = 0.63$, $p > .05$, nor the effect of noise location, $F(1, 41) = 2.21$, $p > .05$, nor the interaction between age group and noise location, $F(6, 41) = 1.83$, $p > .05$,was significant. In summary, all age groups showed SRM of about 5.0 dB on average, regardless of noise location. (One 2-year-old child completed only the condition with noise from the front, and therefore her data are shown in Figure 3 but not in Figure 4.)

The Effect of the Number of Toys on Performance in the Toy Discrimination Test

The primary aim of the Toy Discrimination Test was to measure SRM.Onthe basis of the results of Johnstone and Litovsky (2006), we expected thatSRMwould not be affected by the number of toys the child used during the test.Accordingly, the primary analyses of SRT(Q),SRT(N), andSRMincluded data from children who used four toys (n = 7), 10 toys (n = 1), or 14 toys (n = 43). We expected that SRT(Q) and SRT(N) would be affected by the number of toys the child used, so secondary analyses of SRT(Q) and SRT(N) were conducted using data only from children who used 14 toys. The findings of the primary and secondary analyses were very similar and do not lead to substantively different conclusions (see Appendix B, available as online supplementary materials).

Test-Retest Reliability

Eight normal-hearing 3-year-olds and seven normalhearing 7-year-olds returned for a second test session. Some 3-year-olds did not complete all of the tests. The mean interval between sessions was 21 days (range = 2-55 days). For the tests that measured a percentage of correct responses, Table 5 lists Kendall's rank-order correlation coefficients (tau-b), sw, and the percentage of children whose second score was within 10% of their first score. For the Toy Discrimination Test, Table 6 lists Pearson's product-moment correlation coefficients and sw. As a guide to interpreting sw, consider that a randomly selected participant's true score lies within ±1.96 sw of their observed score with a probability ≥.95. Thus, for the example of the noise-leftcondition of the Toy Discrimination Test, a randomly selected child's true score lies within ±5.0 dB of their observed score with a probability ≥.95.

Interrater Reliability

The ICC for the Left-Right Discrimination Test was +.92. The ICC for the Movement Tracking Test was +.46. The percentage of children whose score from the first observer was within 10% of their score from the second observer was 92.3 for the Left-Right Discrimination Test and 85.7 for the Movement Tracking Test.

Discussion

Evaluation of the Test Battery

Four criteria influenced the design of the battery. The first criterion was that it should obtain evidence of abilities in sound-source localization and speech perception in noise in a single test session. Evidence of both skills was obtained from at least 75% of normal-hearing children older than age 3 years and from at least 75% of children older than age 5 years who used implants. The second criterion was that the battery should be suitable for participants who varied in their age and hearing abilities. The simplest tests were completed by children as young as 1.5 years, but more advanced tests were completed only by older children. The data in this article,

and the results of Lovett et al. (2010), demonstrate that the tests are suitable for normal-hearing children, normal-hearing adults, and children with cochlear implants.

The third criterion was that the battery should impose low cognitive and linguistic demands. This requirement appears to have been met, given that the simplest tests were completed successfully by children age 1.5 years. Nonetheless, it is likely that a child's cognitive and linguistic abilities influence their performance, an issue discussed in the Relationship Between Age and Performance subsection. The fourth criterion-that the battery should be delivered by only one experimenter- was met. Prior to the present study, the experimenter had spent about 10 hr conducting listening tests with children. Thus, an advantage of this battery is that it can be administered by an experimenter who has not received extensive training (cf. Werner Olsho, Koch, Halpin, &Carter, 1987).

Overall, the test battery met the design criteria. Nonetheless, there are some weaknesses in the current implementation. Children with cochlear implants did not consistently complete tests of both sound-source localization and speech perception until they were 5 years old and did not consistently complete all tests until they were 8 years old. On some tests, such as the 30° condition of the Localization Test, several children with cochlear implants found the test challenging and became discouraged, which explains why few children completed all trials. This observation is supported by previous reports that children with cochlear implants show lower levels of performance on tests of listening skill than do their normal-hearing peers (e.g., Grieco-Calub et al., 2008; Van Deun et al., 2010). It is possible that data would be obtained more consistently from children with cochlear implants if the experimenter administered a subset of the tests rather than attempting to administer all of the tests. A further shortcoming is that the Left-Right Discrimination, Localization, and Movement Tracking tests suffer from ceiling effects with normal-hearing participants. For children who use cochlear implants, however, ceiling effects are absent on all tests except the ±60° condition of Left-Right Discrimination (Lovett et al., 2010).

Rliability

On the Left-Right Discrimination, Localization, and Movement Tracking tests, the variability in scores was low because of ceiling effects. Consequently, measures of reliability-such as the correlation between first and second test scores, sw, and the ICC-are uninformative. Nonetheless, there is evidence that the tests are reliable. On the Left-Right Discrimination, Localization, and Movement Tracking tests, more than 70% of children had a second test score that was within 10% of their first test score. On the Left-Right Discrimination and Movement Tracking tests, more than 80% of children had a score from the first observer that was within 10% of their score from the second observer. Further work is required to assess the reliability of these tests in populations that do not show ceiling effects.

For the Toy Discrimination Test, the measures of test-retest reliability can be compared with those reported by Summerfield et al. (1994), who administered the quiet condition to 136 children ages 2-13 years. Summerfield et al. reported a correlation between the first and second test scores of +.95 and a sw of 2.5 dB. In the present study, we measured lower test-retest correlations (ranging from +.04 to +.69) and similar or higher values of sw (ranging from 2.5 to 3.2 dB). Thus, the present implementation of the Toy Discrimination Test shows poorer test-retest reliability than has been estimated previously. This difference may have arisen because the second test session took place several days after the first session, whereas Summerfield et al. repeated the test on the same day. It is also possible that the weak correlations between the first and second test scores in the present study were caused by a lack of statistical power.

Application to Future Studies

To illustrate the use of Figure 1, consider a hypothetical project to measure the ability of children to show SRM and to localize sources of sound. If the participants had normal hearing, it is likely that at least 75% of children older than age 3 years would complete the assessments if the study employed the Toy Discrimination Test and any combination of the Left-Right DiscriminationTest, the MovementTrackingTest, and the 60° or 30° conditions

of the Localization Test. If the participants used cochlear implants, it is likely that at least 75% of children older than age 5 years would complete the assessments if the study employed the Toy Discrimination Test, the ±60° condition of the Left-Right Discrimination Test, and the Movement Tracking Test.

Relationship Between Age and Performance

Evidence that performance improved with increasing age was found for the Left-Right Discrimination, Localization, and Toy Discrimination tests. Several factors may contribute to this developmental trend. Maturational changes in the auditory cortex, which continue until the early teenage years, may enable improved listening skills (J. K. Moore&Linthicum, 2007). Moreover, the size of a child's head affects the interaural differences in level and timing that they experience. The majority of growth in head size is accomplished by age 2 years, but slower growth continues until adulthood, which means that children must repeatedly recalibrate the association between interaural differences and source locations (Litovsky&Ashmead, 1997). As a child's head approaches adult size, there will be a reduced need to recalibrate, which may contribute to more accurate localization by older children.

Although the test battery was designed to impose minimal cognitive and linguistic demands, age-related improvements in attention, memory, and language skills may have contributed to better performance by older children. An additional analysis of performance in the Left-Right Discrimination Test indicated an effect of attention, in that children in the youngest group (1.5-1.9 years) failed to respond on 10% of trials, whereas children older than age 4 years responded on every trial. The Localization and Toy Discrimination tests required children to identify the correct toy and to remember that toy while searching among the toys on the table. Thus, these tests required children to retain the correct answer in working memory, whose capacity increases throughout childhood (Gathercole, 1999). An increase in workingmemorymay have contributed to the improvement in performance with age. For the Toy Discrimination Test, it is likely that older participants with better language skills were more familiar with the target words and were more able to generate answers from a partially perceived word than younger participants with poorer language skills (Elliott et al., 1979).

Performance on the Movement Tracking Test was uniformly high with no effect of age, in contrast to a previous report that auditory movement tracking improves with age (Cranford et al., 1993). The difference in results probably occurred because the Movement Tracking Test is less challenging than the test employed by Cranford and colleagues (1993). Nonetheless, the Movement Tracking Test is useful because it is quick, highly engaging, imposes a low cognitive load, and can be completed by children as young as 1.5 years.

Spatial Release From Masking

As expected, normal-hearing children and adults identified spoken words at a more adverse signal-tonoise ratio when noise was presented from the side than when noise was presented from the front (the location of the source of the speech). Participants showed SRM of about 5 dB, on average, and there was no significant effect of age group. To check that clustering the children into groups was not disguising an effect of age on SRM, we calculated the correlation between children's age in months and SRM. The correlation was not significant (Pearson's $r = .28$, $p > .05$), which suggests that there was no significant effect of age on SRM. Some studies have reported that children show less SRM than adults with a noise masker (Johnstone&Litovsky, 2006; Vaillancourt et al., 2008; Van Deun et al., 2010), whereas other studies found no significant effect of age on SRM with either a noise masker (Litovsky, 2005) or a speech masker (Garadat &Litovsky, 2007). Further work is required to establish the extent to which the test materials influence the relationship between SRM and age.

Conclusion

The test battery was used successfully to obtain performance measures of sound-source localization and speech perception in noise from (a) at least 75% of normal- hearing children older than 3 years and (b) at least 75% of children older than 5 years who use cochlear implants. Normal-hearing children as young as 3 years were able to localize sounds, track moving sounds, and benefit from SRM. The ability to perceive speech in quiet and in noise improved with age. The results can aid in the selection of tests for future studies and inform

the interpretation of data from clinical populations.

Acknowledgments

The first author received a studentship from Deafness Research UK (419:YOR:QS) and is currently supported by an International Research Grant from Action on Hearing Loss (G48 Vickers). Asummary of the performance of normal-hearing children aggregated across age, and details of the performance of children with cochlear implants, were reported by Lovett et al. (2010).

Sidebar

Footnote

1 See Appendix A of Lovett (2010) for details.

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Editor: Sid Bacon
Associate Editor: Emily Tobey
Received April 19, 2011
Revision received August 15, 2011
Accepted October 12, 2011
DOI: 10.1044/1092-4388(2011/11-0096)

Publication date: Jun 2012

Year: 2012

Psychometric Functions for Shortened Administrations of a Speech Recognition Approach Using Tri-Word Presentations and Phonemic Scoring

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 879-891A.
ProQuest document link

Abstract: Complete psychometric functions for phoneme and word recognition scores at 8 signal-to-noise ratios from -15 dB to 20 dB were generated for the first 10, 20, and 25, as well as all 50, three-word presentations of the Tri-Word or Computer Assisted Speech Recognition Assessment (CASRA) Test (Gelfand, 1998) based on the results of 12 normal-hearing young adult participants from the original study. The psychometric functions for both phoneme and word scores were very similar and essentially overlapping for all set sizes. Performance on the shortened tests accounted for 98.8% to 99.5% of the full (50-set) test variance with phoneme scoring, and 95.8% to 99.2% of the full test variance with word scoring. Shortening the tests accounted for little if any of the variance in the slopes of the functions. The psychometric functions for abbreviated versions of the Tri-Word speech recognition test using 10, 20, and 25 presentation sets were described and are comparable to those of the original 50-presentation approach for both phoneme and word scoring in healthy, normal-hearing, young adult participants.

Full text: Headnote
Method: Complete psychometric functions for phoneme and word recognition scores at 8 signal-to-noise ratios from -15 dB to 20 dB were generated for the first 10, 20, and 25, as well as all 50, three-word presentations of the Tri-Word or Computer Assisted Speech Recognition Assessment (CASRA) Test (Gelfand, 1998) based on

the results of 12 normal-hearing young adult participants from the original study.
Results: The psychometric functions for both phoneme and word scores were very similar and essentially overlapping for all set sizes. Performance on the shortened tests accounted for 98.8% to 99.5% of the full (50-set) test variance with phoneme scoring, and 95.8% to 99.2% of the full test variance with word scoring. Shortening the tests accounted for little if any of the variance in the slopes of the functions.
Conclusions: The psychometric functions for abbreviated versions of the Tri-Word speech recognition test using 10, 20, and 25 presentation sets were described and are comparable to those of the original 50-presentation approach for both phoneme and word scoring in healthy, normal-hearing, young adult participants.
Key Words: phonemic scoring, reliability, speech recognition, tri-word testing, word scoring
(ProQuest: ... denotes formula omitted.)
Clinicians and researchers alike require speech recognition tests that are fast and results that are reliable. Fast, and thus short, tests are needed to alleviate practical constraints, such as limited time and tight schedules in the clinic or laboratory, as well as to minimize the effects of participant fatigue. Reliability is fundamental to the meaning of the test score itself and directly affects the ability to identify meaningful differences between conditions. For example, if the reliability of an 80% score is such that it could be as much as 10% higher or lower when retested simply because of chance, then one could not consider an increase or a decrease in score to be "real" unless it is bigger than the 10%variability (i.e., more than 90% or less than 70%).
These goals of having a test that is both short and reliable constitute a dilemma because well-established statistical principles dictate that scores become less reliable as the test size gets smaller. The relationship may be defined within the framework of the binomial model (Boothroyd, 1968a; Carney&Schlauch, 2007; Hagerman, 1976; Raffin &Schafer, 1980; Raffin &Thornton, 1980; Thornton &Raffin, 1978). It demonstrates that a speech recognition score (SRS) becomes more reliable when the number of items in the test gets larger and when the score itself gets closer to either 0%or 100%. Alternatively, an SRSbecomes less reliablewhen the number of itemsin the test becomes smaller and when the score itself gets closer to 50%. In more rigorous terms, the variability of a test score may be expressed as a standard deviation (SD), such that
...(1)
where p is the test score in the form of a proportion from 0 to 1.0, and n is the number of scorable items in the test.
The marginal benefit accrued by continuing to increase the number of test items becomes progressively smaller as the test size rises and becomes negligible by the time the number of test items reaches about 450. Thus, the reliability of a practical speech recognition test may be considered optimized when it includes 450 scorable test items (Gelfand, 1998).
A proposed clinically feasible method for obtaining SRSs based on 450 scorable items involves presenting 50 sets of threeCNC words each and scoring performance on a phoneme-by-phoneme basis (50 sets ×3 words ×3 phonemes = 450 test items; Gelfand, 1998). Empirical and theoretical support have been reported for three-word presentation sets (Haagen, 1945; Harris, 1980; Olsen, 1983; Sergeant, Atkinson, &LaCroix, 1979; Watson &Knudsen, 1940; Williams, Mosko, &Greene, 1976) as well as for phoneme scoring (Boothroyd, 1968a, 1968b; Boothroyd &Nittrouer, 1988; Groen &Helleman, 1960; Keidser, 1993; Mackersie, Boothroyd,& Minniear, 2001; Markides, 1978; McCreery et al., 2010; Nittrouer &Boothroyd, 1990; Olsen, Van Tasell, &Speaks, 1997). The method was originally called the Computer-Assisted Speech Recognition Assessment (CASRA) Test (Gelfand, 1998) because it was facilitated by using an interactive computer program.
The details of the test were described previously (Gelfand, 1998). Briefly, a computer program controlled the testing paradigm and presented the test words through the external input of an audiometer. Each test trial involved displaying threeCNCwords on the tester's monitor and presenting them to the listener via the audiometer. The listener's task was to repeat the words as they were heard. The tester then assessed the response on a phoneme-by-phoneme basis and indicated the incorrectly repeated phonemes by depressing

their corresponding numbers (from 1 to 9) on the keyboard. The next set of three words was then presented by depressing the "Enter" key. This procedure continued until all 50 sets were presented. The software then tallied the results, calculated the scores, and archived the data.

This approach optimizes the reliability of SRSs with the same 50 stimulus presentations involved in standard word recognition tests, such as the Central Institute for the Deaf W-22 (CID W-22) test (Hirsh et al., 1952) and Northwestern University Auditory Test Number 6 (NU-6; Tillman &Carhart, 1966). However, real-world scheduling demands, which limit the amount of time that can be spent with patients, are sufficiently compelling that most clinicians regularly use abbreviated versions of the standard 50-word tests (e.g., 25-word "halflists") in spite of the resulting loss of reliability (e.g., Martin, Armstrong, &Champlin, 1994). As a result, Gelfand (2003) suggested that the tri-word approach can be modified to provide a compromise solution to the reliability/test size issue because it can produce SRSs based on 225 scorable items with the same 25 presentations involved in commonly used half-lists. Further reducing the test to 20 tri-word sets produces scores based on 180 items, and even 10 phonemically scored tri-word presentations provide an SRS based on 90 scorable items. In this context, 10 tri-word presentations with phonemic scoring (90 scorable items) exceed the reliability of a 50-presentation standard full-listword recognition test (50 scorable items), and 10 tri-word presentations with word scoring (30 scorable items) provide approximately the same reliability of a 25-presentation halflist test (25 scorable items). In addition to enabling fast SRS testing with enhanced reliability during routine evaluations, such an abbreviated approach would facilitate the use of multiple SRS tests for comparing performance under different listening conditions (such as between presentation levels, signal-to-noise ratios, monaural and binaural conditions, and different amplification paradigms).

The initial report (Gelfand, 1998) described complete psychometric functions for normal-hearing listeners' performance on the full, 50-set Tri-Word Test. However, it did not provide corresponding functions for the 10-, 20-, and 25-set versions, which were introduced later (Gelfand, 2003). As a result, a complete picture of typical performance on shortened administrations of the Tri- Word Test is missing from the archival record. The purpose of this report is to fill in the missing pieces by describing the corresponding psychometric functions for the abbreviated versions along with those for the full-length test.

Method

Participants

The findings reported here were derived from the archived results of the 12 listeners who participated in the signal-to-noise ratio experiment described in the original report (Gelfand, 1998). They were unpaid volunteers recruited from the Queens College community and included 10 females and two males between the ages of 20 and 27 years (M= 23.2 years). All were native speakers of American English with normal hearing defined as pure-tone air-conduction thresholds of ≤10 dB HL (American National Standards Institute [ANSI] S3.6- 19961) from 250 Hz to 8000 Hz and no history, signs, or complaints of otological, neurological, or learning disorders. Informed consent was obtained in accordance with a protocol approved by the college's institutional review board.

Instrumentation and Materials

The speech materials were directed from a personal computer via an input/output (I/O) board and 10000-Hz low-pass (anti-aliasing) filter to the tape input of a Grason- Stadler Model 16 audiometer and were presented to the participants through standard supra-aural audiometric earphones (Telephonics, Model TDH-50P).

The test words were presented monaurally at a fixed level of 40 dB HL along with ipsilateral speech spectrum noise generated by the audiometer at eight SNRs between -15 dB and 20 dB in 5-dB steps. The sound pressure level (SPL) of the noise was calibrated so that it corresponded to the SPL of the 1000-Hz Tri-Word Test calibration signal in the 0-dB SNR condition.

The test-word pool consisted of 450 CNC words chosen without regard to phonemic balance from existing word recognition test lists, as shown in the Appendix. Every test word has at least one real word alternative that can

result if either of its consonants is misheard (e.g., cab or pat for cat). In addition, none of the test words contain consonant blends. As described in Gelfand (1998), the test words were produced with equal vocal effort by a male talker (first author) and stored digitally along with a 1000-Hz calibration scaled to the overall root-mean-square (rms) level of the word pool.2

Individual test lists were generated offline in advance using software that split the 450-word pool quasirandomly into three nonoverlapping lists of 150 words each, which were then arranged into 50 tri-word presentation sets without carrier phrases. The test list generation software also included algorithms tominimize the occurrence of semantically related words (e.g., cat-mouse), rhyming words, and syntactic cues (e.g., sequences such as cat-goes-home) within each three-word set. As a result, each presentation involved a unique randomization of the words. In addition, the test lists were generated and coded in groups of three so that the listener heard all 450 test words before any of the words were repeated.

Procedures

The testing procedures were as described by Gelfand (1998). Briefly, each participant had an initial interview and pure-tone air-conduction testing, followed by the speech recognition tests at the eight SNRs in randomized order. The speech tests were presented monaurally in the ear preferred by each participant. All testing was done in a sound isolated chamber meeting ambient noise level standards for audiometric rooms (ANSI S3.1-1991). Data collection involved two to three sessions, which included liberal rest periods.

The participants were instructed to listen to all three words and then to repeat the words as they were heard. They also were informed that partial credit would be given for every part of a word that was correct. These instructions were analogous to those suggested by Markides (1978) for use with phonemic scoring.

All tests were administered by a single examiner who was highly trained in and experienced with the tri-word test in order to avoid variability that might be introduced by multiple testers. Auditing errors by the tester were minimized by having the listener face the tester through the booth window so that responses could be seen and heard and by asking for clarification whenever the tester was not certain of the intended response. Right-wrong phonemic scoring was extremely straightforward because none of the test words contain consonant blends. In addition, no distinction was made between /w/ and /ã/ (e.g., witch and which were considered interchangeable) in order to account for regional variations in speech production.

All of the original test outcomes were rescored to obtain phoneme and word recognition scores based on 10, 20, 25, and 50 three-word presentations. The 10-set scores were derived from the participants' performance on the first 10 presentation sets, the 20-set scores were based on the first 20 presentation sets, and the 25-set scores were based on the first 25 presentation sets. Full test scores were based on all 50 presentation sets. Analogous approaches were used by Raffin and Schafer (1980) and Gelfand (2003).

Results

The findings are reported as percent correct scores, and statistical tests employed arcsine transformed units to stabilize the error variance associated with proportional data where appropriate. Table 1 shows the mean percent correct phoneme and word recognition scores and SDs for all SNRs. The mean scores were quite similar for the 10, 20, 25, and 50 sets. Overall performance increased from 2.73%-3.70% at a SNR of -15 dB to 96.57%-96.97% at 20 dB SNR for phoneme scoring, and from 0.42%-0.72% at a SNR of -15 dB to 91.11%-92.28% at 20 dB SNR for word scoring.

The psychometric functions illustrating how phoneme and word recognition scores depend on SNR for the 10-, 20-, and 25-set conditions are shown in Figures 1 through 3, respectively. For ease of visual comparison, each figure shows the mean recognition scores and 95% confidence intervals (CIs) for the shortened test along with those for the full (50-set) test. The psychometric functions of the shortened tests essentially overlapped those of the full test, with similar means and overlapping 95% CIs (except for small deviations at 5 dB SNR for the 10-set word score and perhaps at 0 dB SNR for the 25-set phoneme scores).

Table 2 shows the rates at which performance improved with increasing SNR in percent per decibel (%/dB),

revealing that the mean slopes were quite similar and had overlapping 95% CIs across the four set sizes. Overall, the phoneme recognition scores for the 10-, 20-, 25-, and 50-set conditions increased, with average slopes of 6.265%-6.46% per dB from -10 to 0 dB SNR, and 1.54%-1.74% per dB from 0 to 10 dB SNR; and the word recognition scores had slopes of 4.94%- 5.07% per dB from -10 to 0 dB SNR and 2.76%-2.94% per dB from 0% to 10% dB SNR.

The primary intent of this report is to describe the performance functions for shortened versions of the Tri- Word Test that were not included in the original article (Gelfand, 1998). However, it was considered desirable to provide at least some quantitative perspective on the concord between the abbreviated versions and the full test in terms of effect size estimates. As a result, regression analyses were used to assess the relationships between the full-length test and each of the abbreviated ones. In addition, effect size estimates were calculated based on repeated-measures planned contrasts comparing the slopes of the psychometric functions for each of the abbreviated versions with those of the 50-set test.

The results of the regression analyses are summarized in Table 3. It shows that performance on all of the shortened tests significantly accounted for most of the variance on the full-length tests ($p < .001$), with adjusted R^2 values increasing as the number of three-word sets rose from 10 to 25. Specifically, scores on the abbreviated tests accounted for 98.8% to 99.5% of the variance on the full test with phoneme scoring and 95.8% to 99.2% of the variance on the 50-set test with word scoring.

Table 4 summarizes the findings of the planned contrasts. There were no significant differences between the corresponding slopes of the full test and each of the abbreviated versions. Effect sizes are expressed as ω^2, which is appropriate for the design employed and can be used when sample sizes are small and/or statistical test outcomes are nonsignificant (Ferguson, 2009; Keppel &Wickens, 2004; Robey, 2004). In line with conventional practice, negative values of ω^2 were reported as 0, which is commonly found when F ratios are quite small (Keppel &Wickens, 2004). The ω^2 estimates were 0 for all contrasts except for the 10-set word scores, which were $\omega^2 = 0.021$ for the -10 to 0 dB SNR slope and $\omega^2 = 0.033$ for the 0 to 10 dB SNR slope. These outcomes suggested that using a smaller number of presentation sets accounted for little if any of the variation in the slopes of the functions, constituting "trivial" to "small" effects at most in terms of commonly encountered benchmarks (Cohen, 1988; Ferguson, 2009; Kirk, 1996).

Discussion

Aprevious report (Gelfand, 1998) provided the rationale and characteristics of a speech recognition testing approach intended to optimize reliability by combining 50 presentations of three CNC words each along with phonemic scoring of the listener's responses. It was shown that the proposed approach actually achieved the reliability of a 450-item test predicted by the binomial model and that 50 tri-word presentations with word scoring achieved the predicted reliability of a 150-item test.

A subsequent study (Gelfand, 2003) provided the rationale for using 10, 20, or 25 tri-word presentations as a compromise between the opposing goals of a short but reliable test and showed that the abbreviated tests also met their respective reliability expectations based on the binomial model.

A fundamental aspect of the original report was the provision of complete psychometric functions showing normal-hearing listeners' phoneme and word recognition performance across a range of SNRs from -15 to 20 dB. In addition to describing the operating range of the Tri-Word Test, these functions facilitate comparisons with other speech recognition tests, provide a basis of comparison for performance by other groups, and may serve as performance benchmarks for various applications of the approach. However, that report did not provide psychometric functions for normal-hearing listeners' performance on the abbreviated tests. The purpose of this report was to fill in the missing pieces by describing the corresponding psychometric functions for the abbreviated versions along with those for the full-length test.

It is possible that fewer presentation sets might lead to changes in the psychometric functions compared with those for the full-length version above and beyond the expected increase in variance associated with smaller

numbers of test items. For example, performance might be influenced by differences in short-term practice and/or fatigue effects across various test lengths. While a small but significant short-term learning effect was reported for phonemically scored isophonemic words presented one at a time (Mackersie, Boothroyd, &Minniear, 2001), it was not found across the first through fifth 10-set presentation groups of the Tri-Word Test (Gelfand, 2003). However, the later finding was based on a single-condition test administration to each listener. In contrast, the wide range of SNRs involved in obtaining psychometric functions present the listener with varying levels of difficulty and challenge that might be differentially influenced by learning, fatigue, or other factors. As a result, actual psychometric functions for abbreviated tests should provide a more appropriate frame of reference (compared with those for the full test) when the shorter versions are used with other groups and in various applications, and when compared with other speech recognition metrics.

The mean psychometric functions for both phoneme and word scores for each of the shortened versions of the Tri-Word Test overlapped those for the full test almost exactly, with only a few very small exceptions. In quantitative terms, normal-hearing listeners' performance on the shortened tests accounted for 98.8% (for 10 sets) to 99.5% (for 25 sets) of the variance of the full 50-set tests with phoneme scoring and 95.8% (for 10 sets) to 99.2% (for 25 sets) of the full-test variance with word scoring over a wide range of SNRs. In addition, shortening the tests accounted for only a tiny proportion of the overall variance in the slopes of the functions and may be interpreted as being of little if any practical significance.

The similarity of their psychometric functions supports the confidence with which the abbreviated versions of the Tri-Word Test may be used when an application does not require the optimized level of reliability provided by full, 50-set presentations.

In this context, typical testing times are about 4½ min for a representative 50-item traditional test recording (Auditec of St. Louis CID W-22 List 1A) and roughly 6 min for the full (50-set) Tri-Word Test with responsive listeners (Gelfand, 1998). Thus, a typical traditional speech recognition test requires approximately 4½ min to yield an SRS with 50-item reliability, 23 min for 25-item reliability, and roughly 52 s for 10-item reliability. In contrast, tri-word testing with phonemic scoring can achieve the reliability of a 450-item test in about 6 min (all 50 sets), the reliability of a 225-item test in about 3 min (25 sets), the reliability of a 180-item test in about 2½min (20 sets), or the reliability of a 90-item test in as little as roughly 13 min (10 sets).

Conclusions

The psychometric functions for the 25-, 20-, and 10-set versions were found to be comparable to those of the original 50-set presentation approach for both phoneme and word scoring for healthy young adults with normal hearing. Before applying them clinically, practitioners should await descriptions of the corresponding functions for a variety of clinically relevant groups. Those with sensorineural hearing loss typically have psychometric functions that vary from those with normal hearing for traditional speech recognition tests, and their functions for the Tri-Word Test certainly need to be determined. Performance functions are clearly needed for the elderly and for children, as well. (It is unlikely that the test would be used with young children, but a threeitem, short-term memory task, per se, may not be too demanding for children as young as about 6 years old. For example, a five-item digit span is 1 SD below mean performance for 6.0- to 6.3-year-olds, and a three-item digit span is 2SDs belowthe mean;Wechsler, 2003.) Moreover, there is every reason to expect that the three-word repetition task may be inappropriate for patients with confounding conditions, such as auditory processing disorders, attention deficits and similar disorders, dementia, and brain injury. Studies addressing several of these issues are invarious stages of planning and implementation.

Acknowledgments

This work was supported, in part, by City University of New York PSC-BHE Grants 663451, 665535, and 666535. We are indebted to Edward S. O'Connor, who provided valuable and constructive insights and suggestions.

Sidebar

Footnote

1Citations to ANSI standards reflect the ones in effect at the time of data collection.

2Efforts are being made to enable the materials and software to be used with commonly used contemporary formats.

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Editor: Sid Bacon
Associate Editor: Majorie Leek
Received May 20, 2011

Accepted August 23, 2011
DOI: 10.1044/1092-4388(2011/11-0123)
Appendix
(ProQuest: Appendix omitted.)

Publication date: Jun 2012

Year: 2012

Asymmetries in the Processing of Vowel Height

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 903-918A.
ProQuest document link

Abstract: Speech perception can be described as the transformation of continuous acoustic information into discrete memory representations. Therefore, research on neural representations of speech sounds is particularly important for a better understanding of this transformation. Speech perception models make specific assumptions regarding the representation of mid vowels (e.g., [e]) that are articulated with a neutral position in regard to height. One hypothesis is that their representation is less specific than the representation of vowels with a more specific position (e.g., [æ]). In a magnetoencephalography study, we tested the underspecification of mid vowel in American English. Using a mismatch negativity (MMN) paradigm, mid and low lax vowels ([e]/[æ]), and high and low lax vowels ([I]/[æ]), were opposed, and M100/N1 dipole source parameters as well asMMNlatency and amplitude were examined. Larger MMNs occurred when the mid vowel [e] was a deviant to the standard [æ], a result consistent with less specific representations for mid vowels. MMNs of equal magnitude were elicited in the high-low comparison, consistent with more specific representations for both high and low vowels. M100 dipole locations support early vowel categorization on the basis of linguistically relevant acoustic-phonetic features. We take our results to reflect an abstract long-term representation of vowels that do not include redundant specifications at very early stages of processing the speech signal. Moreover, the dipole locations indicate extraction of distinctive features and their mapping onto representationally faithful cortical locations (i.e., a feature map).

Full text: Headnote
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Method: In a magnetoencephalography study, we tested the underspecification of mid vowel in American English. Using a mismatch negativity (MMN) paradigm, mid and low lax vowels ([e]/[æ]), and high and low lax vowels ([I]/[æ]), were opposed, and M100/N1 dipole source parameters as well asMMNlatency and amplitude were examined.
Results: Larger MMNs occurred when the mid vowel [e] was a deviant to the standard [æ], a result consistent

with less specific representations for mid vowels. MMNs of equal magnitude were elicited in the high-low comparison, consistent with more specific representations for both high and low vowels. M100 dipole locations support early vowel categorization on the basis of linguistically relevant acoustic-phonetic features.
Conclusion: We take our results to reflect an abstract long-term representation of vowels that do not include redundant specifications at very early stages of processing the speech signal. Moreover, the dipole locations indicate extraction of distinctive features and their mapping onto representationally faithful cortical locations (i.e., a feature map).
Key Words: vowel processing, auditory-evoked responses, mismatch negativity, N1m dipole distances, representation of speech sounds, speech perception
Determining the representational nature of speech sounds is an integral component in furthering our understanding of the set of perceptual and neurophysiological computations that underlie the mapping between the incoming acoustic signal and lexical representations. Given their tractable nature and well-understood spectral properties (Rosner &Pickering, 1994), vowels have been exploited extensively in investigations of these processes. Typically, vowels are classified on the basis of their first two resonant frequencies (peaks of energy in an acoustic spectrum; Ladefoged, 2001; Stevens, 1998), in which the first formant frequency (F1) inversely correlates with articulatory tongue height, and the second formant frequency (F2) reflects the place of articulation in the horizontal dimension (back to front). Given these dimensions, vowels can be distinguished on the basis of tongue height (high [i] vs. low [a]) and place of articulation (front [e] vs. back [o]; Ladefoged, 2001). Distinctive feature theories (e.g., McCarthy, 1988; for a neurolinguistic account, see Poeppel, Idsardi, &van Wassenhove, 2008) assume that long-term memory representations of vowels are based on symbolic and abstract labels referring to both acoustic cues (F1, F2) and articulatory configurations (tongue height, place of articulation). They thereby connect audition and articulation (for contrasting perspectives, see Browman &Goldstein, 1989; Stevens, 2002). Rooted in distinctive feature theory, Lahiri and Reetz (2002, 2010) have offered a model of speech perception and lexical access (the featurally underspecified lexicon model) in which speech sounds are described as bundles of feature specifications (e.g., high, front [I]) and are also processed on the basis of their abstract features. Underlying (phonological) representations employ the same feature bundles, but crucially, not every feature is expressed or specified. For example, on the basis of particular assimilatory properties of front (coronal) speech sounds (Avery &Rice, 1989), their place of articulation is assumed to be unspecified for coronality (underspecified for place of articulation). Note that the assumption of Lahiri and Reetz (2002), which we adopt here, is that coronal refers to a macro-category of place of articulation. It subsumes dental, alveolar, and alveo-palatal (or postalveolar) places of articulation. These places contrast with bilabial (labial) on the one hand and with velar and uvular (dorsal) places on the other hand. Further, the term underspecification refers to the overall representation of a speech sound and indicates that some feature dimension (e.g., tongue height for [e]) is not specified at all. According to the featurally underspecified lexicon model, a consonant like [t] or a vowel like [I] would not have a long-term memory representation for its phonological place of articulation feature, [coronal]. As a consequence, themapping fromacoustic signal to underlying features is asymmetric: For noncoronal sounds, bottom-up signal information is evaluated against more detailed long-term memory representations, whereas for coronal sounds, signal information is mapped onto less detailed (i.e., underspecified) memory representations.
Regarding vowel height, it has been proposed that some tongue heights are not encoded underlyingly; that is, mid [e] is underspecified for height (Lahiri &Reetz, 2002, p. 657). This contrasts with the specification [high] for [I] and [low] for [æ].
In this article, we investigate the representational nature of mid vowels in American English, which have the precarious status of being neither [high] nor [low] in traditional distinctive feature analyses; for example, they are characterized by the conjoined lack of a positive specification (cf.Avery&Idsardi, 2001).We use the brain's magnetic response to acoustic signals derived from contrasts in tongue height as a neurophysiological measure

in a classical mismatch negativity (MMN) study (Näätänen, 2001). The aim is to examine long-term vowel representations and processes involved in translating a continuous acoustic signal into a discrete mental sound representation under the assumption that this representation does not yield a one-to-one correspondence to the physical acoustic properties of the corresponding speech sound. Although we tested American English speakers with no hearing deficits, the framework may have important clinical implications, particularly for cochlear implant (CI) patients whose vowel spaces differ in characteristic ways fromthose of healthy controls (Harnsberger et al., 2001; Löfqvist, Sahlén,&Ibertsson, 2010; Neumeyer, Harrington, &Draxler, 2010).

Neurophysiological Investigations of Vowel Perception

The cortical processing of vowels has been extensively investigated using electro-encephalography (Diesch, Eulitz, Hampson, &Ross, 1996; Diesch &Luce, 1997a, 1997b;Hill, McArthur,&Bishop, 2004; Jacobsen, Schröger, &Alter, 2004; Poeppel et al., 1997; Roberts, Flagg, &Gage, 2004; Shestakova, Brattico, Soloviev, Klucharev, &Huotilainen, 2004), that is, the brain's electric response underlying the perception and processing of vowel sounds in human cortex. Because vowels have relatively robust acoustic cues in F1 and F2, they are ideal candidates for the elicitation of early auditory-evoked components, such as the N1 or its magnetic equivalent, the N1m/M100. The M100 is a pronounced peak around 100 ms after the onset of an auditory stimulus that appears to encode basic speech processing in auditory cortices (Diesch et al., 1996; Shestakova et al., 2004). It is considered an index of temporal and topographical coding. Measures on the surface of the scalp (sensorspace) as well as measures of the source estimates producing a particular scalp electric distribution (source-space) are systematically modulated by the spectral characteristics of different vowel stimuli. For (pure) sinusoidal tones, the M100 latency inversely correlates with tone frequency (Poeppel &Marantz, 2000; Roberts, Ferrari, Stufflebeam, &Poeppel, 2000 [and references therein]), whereas for vowels, the latency of the M100 seems to track F1 (Diesch et al., 1996; Poeppel et al., 1997; Roberts et al., 2000, 2004; Tiitinen, Mäkelä, Mäkinen, May, &Alku, 2005). Recentwork, however, suggests an additional sensitivity to vowel formant ratios in dense vowel spaces (Monahan&Idsardi, 2010), inwhich larger ratios between the first and third vowel formant frequencies (F1/F3) elicit earlier M100 latencies.

Source-based parameters of the M100 are also sensitive to spectral characteristics of complex tones, vowels, and consonants (Diesch &Luce, 1997a, 1997b, 2000; Eulitz, Diesch, Pantev, &Hampson, 1995). The latter studies parallel earlier findings that showed a tonotopic organization of auditory cortex (Pantev et al., 1988; Pantev, Hoke, Lutkenhöner, &Lehnertz, 1989), that is, a spatial representation of frequency differences (frequency maps). M100 dipole locations reflect a categorical distinction of speech sounds on the basis of their formant frequencies (Mäkelä, Alku, &Tiitinen, 2003; Obleser, Elbert, Lahiri, &Eulitz, 2003; Shestakova et al., 2004). Spectral acoustic distances, as determined by Euclidean distances on the basis of two or three vowel formants, were paralleled in spatial dipole locations in a number of studies (Obleser, Elbert, et al., 2003; Shestakova et al., 2004). The crucial finding was that if two stimuli had a large spectral acoustic distance, the underlying sources of cortical activity to these stimuli had a relatively large spatial separation in auditory cortex. Conversely, the cortical sources of stimuli with a small acoustic distance were more closely collocated. Moreover, it has been found that M100 source dipoles differed along the anterior-posterior dimension according to differences in place of articulation, where [coronal] vowels reliably localized to more anterior positions in auditory cortex than [dorsal] vowels, seemingly parallel to their oral articulation (Obleser, Lahiri,&Eulitz, 2003, 2004). This pattern was replicated with CV syllables in German that contained either a dorsal ([o]) or a coronal vowel ([ø]), irrespective of the initial consonant (Obleser, Lahiri,&Eulitz, 2003). Finally, absolute dipole locations were modulated when attention was shifted away from the linguistic characteristics of the stimulus (Obleser, Elbert, &Eulitz, 2004), whereas the relative anterior/ posterior distinction was maintained. Taken together, these findings suggest that M100 source parameters are modulated by acoustic and, in particular, by linguistically relevant acoustic characteristics of speech sounds.

Neurophysiological assessments of speech sound underspecification have primarily been made on the basis of

components temporally subsequent to the M100, such as the MMN, an automatic and preattentive brain response to acoustic change or rule violation (Näätänen, 2001; Näätänen &Alho, 1997; Näätänen, Paavilainen, Rinne,&Alho, 2007;Winkler, 2007). The response is usually elicited in passive oddball paradigms, during which participants listen to frequent (standard) stimuli interspersed with infrequent (deviant) stimuli. The MMN is a fronto-temporal negativity in the difference waveform obtained by subtracting standard responses fromdeviant responses to the same acoustic stimuli and peaks between 150 and 250 ms poststimulus onset.

Designs testing coronal underspecification exploit the opposition of frequently occurring standard stimuli and rarely occurring deviant stimuli on the basis of the following logic: Standard repetitions activate memory traces, corresponding to underlying representations of speech sounds (Näätänen et al., 1997), affixes (Shtyrov &Pulvermüller, 2002a), or words (Pulvermüller et al., 2001; Pulvermüller, Shtyrov, Kujala, &Näätänen, 2004; Shtyrov &Pulvermüller, 2002b) in long-term memory. Standard repetitions set up expectations regarding feature specifications that might be violated by rarely occurring deviants with conflicting features (Eulitz &Lahiri, 2004; Winkler et al., 1999). Conflicting features are those that are mutually exclusive, such as [high] versus [low] and [coronal] versus [dorsal]. It should be noted that acoustic differences between standards and deviants will always yield some electrophysiological responses (Eulitz &Lahiri, 2004) given a minimum acoustic distance (cf. Näätänen, Tervaniemi, Sussman, Paavilainen, &Winkler, 2001). However, if acoustic differences are accompanied by featural differences (i.e., featural mismatches), the resulting MMN is expected to be larger than if there are no featural deviances. That is, the observedMMNis the result of a combination of differences from acoustic (bottom-up) information and from more abstract (top-down) distinctions.

Testing German vowels, Eulitz and Lahiri (2004) found that a coronal deviant [ø] that is preceded by a dorsal standard [o] elicited earlier and larger MMN responses than the reverse presentation, that is, a dorsal deviant [o] preceded by a coronal standard [ø]. These findings are predicted if the dorsal standard activates its fully specified place of articulation feature [dorsal], whereas the underspecified deviant fails to satisfy the prediction that a place of articulation feature is specified. Conversely, a coronal standard activates an underspecified representation in long-term memory, for which the dorsal deviant does not provide a featural mismatch. Further, underspecified standards do not generate specific predictions as to the specification of place of articulation. Thus, the observed MMN reflects a combination of these two difference measures, one pertaining to the acoustic difference between [o] and [ø] (and equivalently vice versa, [ø] and [o]) and the other one to the phonological difference between the two vowels (i.e., specified vs. underspecified). The MMN elicited by the deviant [o] was relatively small because it only reflected the acoustic dissimilarity to the standard, whereas the larger MMN elicited by the deviant [ø] additionally reflected a featural mismatch (see Bergelson &Idsardi, 2009, for similar results from music perception; see Hwang, Monahan, &Idsardi, 2010, for asymmetries in voicing of consonants).

The similar featural mismatch logic should hold for tongue height differences in English front vowels. We follow Lahiri and Reetz (2002) in the assumption that mid vowels are entirely underspecified for height, that is, never provide mismatching features to their low or high vowel counterparts. However, as before, a fully specified low or high vowel in standard position should generate a strong expectation regarding tongue height specification that might be violated if the deviant to this standard sequence is an underspecified mid vowel. Hence, in an MMN design, the mid vowel [e], preceded by the low vowel [æ], should elicit a largerMMNresponse than in the reverse case, that is, if the lowvowel [æ] is preceded by the mid vowel [e]. In the former (but not the latter) case, the standard generates a strong prediction regarding its tongue height specification that is then violated by the deviant. Further, assuming a low vowel standard and a high vowel deviant would lead to a featural mismatch between [low] and [high]. This mismatch, however, should be observed in the reverse case as well. The hypotheses discussed above are compatible with the model adjustment hypothesis (Näätänen &Winkler, 1999; Winkler, Karmos, &Näätänen, 1996) as well as the predictive coding approach to the neural source of MMN generation at frontal and temporal cortical locations (Baldeweg, 2006; Friston, 2005; Garrido, Kilner,

Stephan, &Friston, 2009). Note that the model adjustment hypothesis is part of the predictive coding account. In both approaches, the MMN results from violations of inference predictions on the basis of the repetitious standard presentations. The predictive coding account, combining the model adjustment approach with an adaptation approach ofMMNgeneration (Garrido et al., 2009), proposes that standard presentation resembles perceptual learning during which hierarchical sensory levels receive bottom-up sensory input from lower levels and receive top-down predictions from higher levels. As a result of the repetition of standard presentations, prediction errors are reduced by repetitive suppression or adaptation. A deviant presentation then leads to a violation of bottom-up prediction that is reflected in MMN generation. Applied to vowel underspecification, underspecified standards (such as mid [e]) make weaker predictions with regard to their tongue height features. As a result, the violation of such an expectation from deviant sensory information should be less severe, and the MMN ought to be reduced compared with the reverse condition, in which the underlying, specified representation of the standard can generate a stronger featural prediction.

We tested these predictions in a magnetoencephalography (MEG) MMN experiment with the American English short (lax) front vowels [æ], [e], and [I]. The choice of these vowels was determined by the observation that short front vowels in American English are less likely to be diphthongized (Hillenbrand, Getty, Clark, &Wheeler, 1995), such that our featural assumptions are more straightforward. For instance, it is not clear how to specify the diphthong [ai] in terms of tongue height features: It could subsume [low] and [high], [low] only, [high] only, or neither feature specification.

Testing Vowel Height Differences in American English

Rationale

Using an MMN design with MEG enables us to test our featural mismatch predictions and to simultaneously investigate M100 source parameters. These measures enable us to examine the neural bases of speech sound category access during the transformation of an acoustic signal into a mental representation. Note that MEG allows us to estimate the underlying source dipole of the observed magnetic field at the scalp with greater accuracy than EEG (e.g., Leahy, Mosher, Spencer, Huang, &Lewine, 1998; Lopes da Silva, Wieringa, &Peters, 1991; Nakasatp et al., 1994).

Materials

Twenty acoustically distinct exemplars of each of the American English vowels [æ], [e], and [I] were produced by a female native speaker of American English with phonetic training. This dialect and this speaker did not merge any of these vowels (cf. Labov, Ash, &Boberg, 2006) and made a robust three-way height distinction. Detailed spectral acoustic measures are provided in Table 1.

Note that the motivation of using multiple acoustic vowel exemplars is twofold: First, we want to guarantee a more natural listening situation. Second, using single vowels without any acoustic variation may result in response patterns that solely depend on the particular acoustic quality of the stimulus. In contrast, multiple exemplars in a many-to-one oddball paradigm increase the likelihood that the participants will form more abstract memory traces against which the deviants can be compared (Phillips et al., 2000; Winkler et al., 1999).

All stimuli were recorded and digitally sampled at 44.1 kHz with an amplitude resolution of 16 bits within the phonetic sound application PRAAT (Boersma &Weenink, 2009). Ten vowels of each category with similar pitch and intensity were selected as experimental stimuli. Their F1 and F2 values confirmed the threeway height distinction (see Figure 1). Stimuli intensity was normalized and corresponded to a presentation level of 60 dB (sound pressure level). An onset and offset ramp (cosine-square) of 15 ms was applied to all vowels (duration: 100 ms) that reduced sharp onsets and offsets.

Design

Stimuli were organized in a passive standard/deviant many-to-one oddball paradigm (Phillips et al., 2000; Winkler et al., 1999). The crucial mid vowel comparison was made between the low vowel [æ] and mid vowel [e]. As a control, we included the standard-deviant pair of the low vowel [æ] and the high vowel [I], both of

which are underlyingly specified for height. The vowels [æ] and [e], as well as [æ] and [I], were distributed over 2 ×2 blocks in which they occurred in either a standard (p = .875,N= 700) or a deviant (p = .125,N= 100; see Table 2) position. The different category exemplars were pseudorandomly drawn from the corresponding sets. We ensured that all exemplars occurred equally often. The number of standards between two deviants varied randomly in each block. The interstimulus intervals pseudorandomly varied between 500 and 1,000 ms to prevent participants from entraining to a specific presentation rhythm that may confound our event-related potential measures of interest. Each block contained a total of 800 trials and lasted approximately 15 min. Block order was permutated across participants. Trials were presented binaurally at a comfortable listening level (È60 dB SPL) with the software package Presentation (Neurobehavioral Systems, 2012).

Expectations

Following Eulitz and Lahiri (2004), we predict asymmetric MMN responses to the deviants [e] and [æ]. This prediction is based on the assumption that [e] is underspecified for tongue height, whereas [æ] is not. As laid out above, underspecified deviants after specified standards ought to elicit a larger MMN response than in the reverse case. In contrast, the test conditions with [æ] and [I] should show similarMMNresponses because the standard/deviant opposition always includes the specified features [low] and [high], or [high] and [low]. Furthermore, we also expect the MMN response to be modulated by the size of the acoustic differences as well, such that the larger formant distance between [low] and [high] vowels should enhance their MMN response. On the basis of previous M100 findings, we additionally expect source- and sensor-space differences between the M100 responses of all three vowels (e.g., Obleser, Lahiri, &Eulitz, 2003). This would provide further evidence for an early extraction of linguistically relevant acoustic information to access discrete long-term memory representations of speech sounds (here: vowels).

Participants and Procedure

Fifteen students from the University of Maryland (9 women, 6 men; mean age = 21.1 years, SD = 3.2; all native speakers of American English), without any reported history of hearing or neurological problems, participated for class credit or monetary compensation. All participants provided informed written consent and tested strongly right-handed (>80%) on the Edinburgh Handedness Inventory (Oldfield, 1971). Participants' head shapes were digitized before the experiment with a POLHEMUS 3 Space Fast Track system. Together with localization data from two preauricular and three prefrontal electrodes, these data allowed us to perform dipole localization analyses, as reported in the Data Analysis section.

During MEG recording and stimulus presentation, participants lay supine in a magnetically shielded chamber.Magnetic fields were recorded by a whole-head, 157 axial-gradiometerMEGsystem (Kanazawa Institute of Technology, Kanazawa, Japan) at a sampling rate of 500 Hz. Auditory stimuli were delivered binaurally via Etymotic ER3A insert earphones. Earphones were calibrated to have a flat frequency response between 50 Hz and 3100 Hz within the shielded room. This guaranteed an optimal acoustic delivery of the first three vowel resonance frequencies (Stevens, 1998). An online, 200-Hz, low-pass filter and a 60-Hz notch filter were applied to the raw data.

Prior to the main experiment, participants took part in a tone perception pretest that served as a control for dipole estimations as well as the basis for determining regions of interest on the surface of the scalp. Note that pure sinusoidal tones have been shown to engage neural circuitry in the auditory cortices, reflecting magnetic activity to the leftand right temporal scalp areas. Further, the (base) frequency of sinusoidal tones parametrically determines the center of neural activity because of the tonotopic principle of auditory cortex (Pantev et al., 1988, 1989, 1995).

During the tone pretest, participants were instructed to silently count high (1000 Hz) and low (250 Hz) sinusoidal tones (È300 total) presented over headphones in a pseudorandom order. The scalp distribution of the resulting averaged evoked M100 field was consistent with the typical M100 source in the supratemporal auditory cortex (Diesch et al., 1996). Only participants with a reliable bilateral M100 response were included in further analyses,

resulting in the exclusion of one participant.

For the main experiment, participants passively listened to vowel stimuli presented in blocks, as illustrated in Table 2. The use of acoustically variable standard vowels (10 tokens of each vowel) ensured that standards activated more abstract representations, such that a pure acoustic explanation of the resulting MMN can be excluded (Phillips et al., 2000). Block order was counterbalanced between subjects, and there was always a short break after each block. Participants viewed a silent movie during the passive listening task to reduce excessive eye movements and to maintain an awake state (Tervaniemi et al., 1999). The movie was projected onto a screen approximately 15 cm above the participants. Together with the head shape construction and the tone pretest, the entire experiment lasted approximately 90 min.

Data Analysis

Environmental and scanner noise were removed from the MEG raw data using a multishift, principal components analysis, noise-reduction algorithm (de Cheveigné &Simon, 2007, 2008). Epoch averaging used a 100-ms prestimulus interval and a 500-ms poststimulus interval. This allowed us to look at the first 500-ms poststimulus onset during which we expected the two eventrelated potential measures of interest: M100 and MMN. Epochs were baseline corrected using the 100-ms prestimulus epoch, guaranteeing that effects were truly stimulus based and not elicited by events prior to stimulus presentation. Although we used a denoising algorithm prior to averaging to reduce environmental magnetic influences, participants always produced artifacts by eye movements or muscle activity that masked our components of interest. For this reason, we rejected certain artifacts by visual inspection on the noise-reduced continuous data. Epochs were rejected if amplitudes were higher than 3 pico-Tesla (10-12 Tesla) or contained more than three consecutive eye blinks. Because of excessive noise and artifacts in the raw data, leading to exclusion rates of >15% of standards and deviants, one participant was excluded from further analyses (leaving a total of 13 participants for the analyses). Otherwise, no more than 15% of standards or deviants were excluded in any of the remaining participants. Averaged data were baseline corrected as elucidated above and were band-pass filtered by a Hamming-window digital filter with frequency cutoffs at 1 Hz and 30 Hz. The 10 strongest channels from the tone pretest were selected for subsequent amplitude and peak latency analyses separately for each hemisphere. Channels stemmed from scalp areas where the magnetic field was oriented toward the cortex (sink) and areas where the magnetic field was oriented emerging from the cortex (source). Following the usual time course of auditory-evoked MEG components (Ackermann, Hertrich, Mathiak, &Lutzenberger, 2001) and a visual inspection of the grand average waveform, several time windows with a length of 50 ms were selected. The first window (80-130 ms) covered the M100, whereas the three later windows (150-200, 200-250, and 250-300 ms) accounted for the MMN (see Figure 2). These windows were selected on the basis of previous findings (Näätänen et al., 2007; Winkler, 2007) regarding an MMN latency range between 150 and 300 ms and a particular latency difference in a window from 150 to 200 ms, which has been found to be crucial for testing underspecification (Eulitz &Lahiri, 2004).

Root-mean-squared magnetic field strengths over the selected 10 left- and right-hemispheric channels were analyzed separately for each time window of interest in mixed effect models with subject as random effect (Baayen, 2008; Pinheiro &Bates, 2000). M100 latencies were determined by visual inspection of the averaged epochs per condition and subject. MMN latencies were calculated from the difference waveforms of acoustically identical stimuli in deviant and standard positions (i.e., deviant - standard). Because of the few-to-many design of the oddball paradigm, we randomly selected 100 standard epochs to guarantee that the root-mean-squared values did not involve unequal variance between the standard and deviant stimuli.

Dipole Fitting

The fitting of equivalent current dipoles (ECDs) followed the procedure described in Obleser, Lahiri, and Eulitz (2004). An ECD is the simplified cortical source of the M100 response. It corresponds to the activity of some 10,000 neurons in auditory cortex, producing a local field potential and accompanying magnetic activity, and it

can be considered the center of cortical activity in response to an auditory stimulus. To determine the cortical location of ECDs elicited by our vowel stimuli, we first defined an orthogonal left-handed head frame, on the basis of the dimensions x and z; x projected from the inion through to the nasion, and z projected through the center-midline location according to the 10-20 system. The x coordinates defined the lateral-medial dimension, the y coordinates defined the anterior-posterior dimension, and the z coordinates defined the superior-inferior dimension. Then, a sphere, whose center position and radius were calculated in head framecoordinates,was fit for each participant covering the entire surface of his/her digitized head shape. A single ECD model in a spherical volume conductor was used for source modeling analysis of the neuromagnetic data (cf. Diesch &Luce, 1997a; Sarvas 1987). Left- and right-hemispheric dipoles were modeled separately (Sarvas, 1987). Tone and vowel source parameters were calculated from the median of the five best ECD solutions (minimally 90% goodness-of-fit) on the rising slope of the M100. Fittings after the respective peaks were not included (cf. Scherg, Vajsar, &Picton, 1990).

Results

Tones

The latency analysis (in ms) for the tone pretest included the effects hemisphere (left/right), frequency (250 Hz/1000 Hz), and the Hemisphere ×Frequency interaction. There was a main effect of hemisphere, $F(1, 36) = 11.06$, $p < .001$, and frequency, $F(1, 36) = 20.91$, $p < .001$. The M100 in the right hemisphere peaked approximately 5 ms earlier than left-hemispheric M100, and 1000-Hz tones elicited a 6-ms earlier M100 than 250-Hz tones. Both findings are consistent with previous results (e.g., Roberts, Ferrari, &Poeppel, 1998; Roberts &Poeppel, 1996). The peak amplitude analysis (in femto Tesla [f T]; 10-15 Tesla), using the same model, showed no significant effects (all Fs <2).

Tone source parameters included location in the lateral-medial, anterior-posterior, and superior-inferior dimensions (in millimeters). ECDs distinguished the high-frequency tone with a more medial location from the low-frequency tone with a more lateral ECD location (cf. Pantev et al., 1989). The spatial difference of approximately 4mmwas marginally significant,$F(1, 34) = 3.73$, $p = .06$, and was consistent with the expected spacing based on Pantev et al. (1989).

Vowels

M100 analysis. The M100 analyses were composed of the fixed effects vowel ([æ]/e / , [æ]/I /, [e]/æ / , and [I]/æ / ; the subscript denoting the context provided by the standard), position (standard/deviant), and hemisphere (left/ right) in a full-factorial design. M100 amplitudes showed a main effect of position, $F(1, 180) = 18.21$, $p < .001$, reflecting larger amplitudes for deviants than for standards. Additionally, there was a marginally significant Vowel ×Position interaction, $F(3, 180) = 2.31$, $p = .07$. In the low/mid comparison, M100 amplitudes differed between deviant and standard only for [e] ($t = 3.20$, $p < .01$) but not for [æ] ($t = 0.14$, $p = .89$). Put differently, if [e] was a deviant preceded by the standard [æ], the M100 amplitude was significantly larger compared with the M100 elicited by [e] in standard position. In contrast, the deviant [æ] preceded by [e] did not elicit a larger M100 compared with the corresponding M100 of [æ] as a standard.

First MMN window (150-200 ms). Turning now to the analysis of the latency and amplitude of the MMN component, amplitudes did not differ in the first MMN window (150-200 ms). The MMN peak latency analysis with the effects hemisphere (left/right) and opposition (low/high vs. low/mid) showed a significant effect of opposition, $F(1, 88) = 13.71$, $p < .01$, reflecting earlierMMN peak latencies (È10 ms) for the low/high contrast as compared with the low/mid contrast. Within the low/mid condition, latencies were earlier for the deviant [e] than for the deviant [æ], but this difference (È6 ms) did not reach statistical significance, $t(84) = 1.49$, $p = .13$.

SecondMMN window (200-250 ms). The amplitude analysis for the second MMN window (200-250 ms) revealed a significant effect for position, $F(1, 180) = 34.96$, $p < .001$, and a Position ×Vowel interaction, $F(3, 180) = 3.16$, $p < .05$. On average, deviant amplitudes were 12 f T higher than standard amplitudes (see Figure 3). The Position ×Vowel interaction was driven by larger differences between standards and deviants if [æ] was the

standard and [e] was the deviant than in the reverse case, that is, if [e] was the standard and [æ] was the deviant (t = 2.44, p <.01). This difference did not hold for either [æ] or [I] in the low/high contrast (t = 1.26, p = .21); that is, theMMNwas of similar size for the low/high contrast in both directions. Peak latencies did not differ in the second MMN window (all Fs <1).

Third MMN window (250-300 ms). The third MMN window (250-300 ms) showed a similar amplitude pattern. Deviants elicited a 10 f T larger amplitude than standards, F(1, 180) = 44.87, p <.001. Again, position interacted with vowel, F(3, 180) = 3.00, p <.05, reflecting the amplitude asymmetry between the low/mid condition, in which standard-deviant differences were significantly larger if [e] was the deviant than if [æ] was the deviant (t = 2.78, p <.01). No asymmetry was observed for the low/high conditions (t = 0.18, p = .86). As before, peak latencies did not differ in this MMN window. The results remain consistent when the second and third MMN windows are collapsed (i.e., 200-300 ms).

ECD Source Analysis

ECD source parameters for the M100 responses across participants in the lateral-medial dimension showed a significant Position ×Hemisphere interaction, F(2, 93) = 13.88, p <.05. In the lefthemisphere, deviants elicited ECDs that were 6mmmore medial to their standards. Dipoles in the anterior-posterior dimension differed between vowels in deviant position, F(2, 93) = 3.66, p <.05. In particular, [I] elicited a dipole that was located 7.5 mm more anterior to the dipole of either [e] or [æ] (t = 2.29, p <.05). Dipole locations for the deviants [e] and [æ] did not differ (t = 0.60, p = .55). The superior-inferior dimension analysis showed amain effect of vowel, F(2, 93) = 6.13, p <.01. The dipoles for [I] were approximately 7mm more superior to the dipoles for [æ] (t = 3.42, p <.001). Locations between [I] and [e] (t = 1.74, p = .09) and between [e] and [æ] (t = 1.30, p = .20) did not differ.

Dipole orientations differed in the horizontal dimension (i.e., deviating from the lateral-medial axis). This was reflected in a main effect of hemisphere, F(1, 93) = 7.65, p <.01. Dipoles on the right hemisphere were oriented more toward frontal areas than on the lefthemisphere. Additionally, we found a significant Vowel ×Position interaction, F(3, 93) = 4.41, p <.05. Interestingly, ECDs were oriented more toward frontal regions for the deviant [æ] if preceded by the standard [e], whereas the deviant [e] did not differ from deviant [I].

Figure 4 illustrates ECD locations in the lefthemisphere. Because the M100 source estimates appear to reflect the vowels' acoustic properties, we were interested in relating these measures. Therefore, we calculated Euclidean distances in the three-dimensional vowel space on the basis of the first three formants and related this measure toEuclidean distances in cortical space on the basis of lateral-medial, anterior-posterior, and inferior- superior locations. To obtain a correlation measure, we used a fixed effect model with the effects hemisphere (left/right), position (standard/deviant), and acoustic distance in a fully factorial design. The fixed effect acoustic distance was significant, F(1, 31) = 4.21, p <.05, showing that acoustic vowel distances were reflected in cortical ECD distances, as reported previously (e.g., Obleser, Lahiri, &Eulitz, 2004). The relation of feature distance, dipole distance, and acoustic distance is illustrated in Table 3.

On the basis of statistical model comparison and model criticism (cf. Pinheiro &Bates, 2000), we calculated a second fixed effect model to which we added the fixed effect feature difference (1 vs. 2; see Table 3). Adding additional fixed effects to such modelsmay result in a better fit to the data. The goodness-of-fit is usually indicated by an information-theoretic score (such as the Akaike information criterion [AIC] or the Bayesian information criterion [BIC]). A reduction in these scores means that the addition or removal of a fixed effect or interaction results in a better fit to the data beyond what would normally be expected by adding additional parameters. Our second model with the additional effect feature difference resulted in lower AIC and BIC scores (AIC: 337.69 vs. 326.97; BIC: 355.06 vs. 345.82). For this reason, we conclude that the second model (with the additional featural effect) should be preferred. Adding featural phonological information to the model results in a more accurate fit to the data, suggesting that ECD distances are determined by acoustic properties that bear specific importance for the corresponding long-term featuralmemory representations of the vowels. That is,

even early cortical responses are composite, deriving from both information directly from the incoming signal and the influence of expectations based on long-term memory representations.

General Discussion

From our neuromagnetic experiment on the representational nature of front mid vowels in American English, we report two main findings:

1. The M100 as index of cortical processing of acoustic stimuli provided us with source- and sensor-space measures that suggest an early processing of vowels on the basis of their spectral properties that are particularly relevant for linguistic categorization.
2. The MMN as automatic change detection response of the brain supported our claim for mid vowel underspecification in showing asymmetric change responses between low/mid and low/high vowels.

With respect to our M100 findings, the early extraction of specific acoustic structures even in variable contexts has been known for quite some time (e.g., Saarinen, Paavilainen, Schröger, Tervaniemi, &Näätänen, 1992). The physiology of auditory cortex is particularly adept at encoding acoustic distinctions by spatially distinct centers of activation (Pantev et al., 1988, 1989), as measured by M100/N1 dipole source modeling. In speech, this socalled tonotopic principle extended to formant frequency distinctions (Diesch et al., 1996; Diesch &Luce, 1997a; Eulitz et al., 1995; Mäkelä et al., 2003; Shestakova et al., 2004), particularly for F2, encoding place of articulation (Obleser, Lahiri, &Eulitz, 2003, 2004). Obleser and colleagues (Obleser, Elbert, &Eulitz, 2004; Obleser, Lahiri, &Eulitz, 2003, 2004) found that ECDs, underlying the surface field pattern of theM100, spatially distinguished coronal (front) and dorsal (back) vowels and consonants. The difference in centers of activation was found in the anterior-posterior dimension: Front segments elicited dipoles anterior to the dipoles elicited by back segments. This is in line withOhl and Scheich (1997) and Diesch and Luce (1997a), who have argued that this alignment is a F2-F1 difference map perpendicular to the tonotopic gradient along the medial-lateral axis (Pantev et al., 1989). Obleser, Lahiri, and Eulitz (2004) have argued that the ECD location pattern in their study does not support a linear F2-F1 M100 mapping. It rather suggests that the mapping is better accounted for by the assumption of more abstract, yet acoustically based, features. Vowel distances appear to be warped toward perceptually salient properties and not pure acoustic F2-F1 differences. This is also reminiscent of Stevens's quantal theory of speech production and perception, in which distinctive features express stable acoustic patterns based on salient articulatory configurations (Stevens, 1989; Stevens &Blumstein, 1978). Note that saliency of articulatory configurations appears to be particularly relevant for CI users. Whereas it has been observed that the vowel space of CI users is commonly reduced (as measured in the F2/F1 plane; cf. Harnsberger et al., 2001; Löfqvist et al., 2010),Neumeyer et al. (2010) observed that this reduction mainly affects acoustic dimensions for which there are no clearly visible (hence, salient) articulator positions. The authors found that the range of F2 (expressing place of articulation differences) was smaller in CI users compared with healthy controls, whereas the range of F1 (expressing tongue height differences) did not show significant differences between the two participant groups. They argued that CI users could still rely on visible jaw height positions for F1 in maintaining category differences, whereas there was less of a visual cue accompanying F2 differences.

Our study adds to previous findings, illustrating the correlation between acoustic distance and ECD location in the auditory cortex. The high vowel [I] differedfromthe other two vowels along the anterior-posterior and the superior-inferior axes. Note that the anterior-posterior distinctions follow the observation that more front vowels elicit more anterior dipoles. The vowel height differences, on the other hand, seem to be expressed by superior-anterior distinctions, although the directionality of our stimuli was not the same as found in Obleser, Elbert, et al. (2003). Although we cannot provide direct evidence that our dipole locations are better accounted for by abstract features, westill showthat dipole distances are statistically better explained by feature differences than by acoustic distances. Furthermore, the fact that no single spatial dimension directly correlated with one of the first formant frequencies of our stimuli provides additional evidence for the view that the auditory cortex is

particularly sensitive to more complex interactions of frequency components (e.g., Ohl &Scheich, 1997). Again, we would like to propose that these interactions are the acoustic bases for distinctive features. Localizing M100 sources obtained from the CI user promises to shed more light onto the interaction of spectral-acoustic and articulator-configuration information during vowel category formation in perception. Here, we would expect a stronger influence of articulator positions on the localizations of cortical vowel sources compared with normalhearing controls. A model comparison as reported in this article could provide the necessary statistical means by which this difference may be established. Again, this is a promising study for future work, the results of which are potentially very useful for the design and improvement of CIs as well as for possible strategies to retain perceptually robust vowel categories.

Our second main finding relates to the MMN data that provide evidence for the underspecification of tongue height in the vowel [e]. Crucially, we found the MMN in response to the mid vowel deviant [e] after the standard vowel [æ] to be significantly larger than vice versa, that is, when the mid vowel [e] was the standard and [æ] was the deviant. We assume that the low vowel [æ] in standard position activated its specified featural tongue height representation and set up a relatively high expectation for the subsequent mid vowel deviant to be specified as well. Its tongue height underspecification, however, violated this expectation and led to a larger MMNthan one would assume on the basis of acoustic differences between standards and deviants alone. It is important to bear in mind that the MMN response will always be elicited in response to a detectable acoustic change. Our claim is that the size of the MMN furthermore depended on the featural oppositions between standard and deviant vowels. Importantly, theMMNfor [e] in [æ] context was larger than if [e] was the standard and [æ] was the deviant. In this case, we assume that the mid vowel [e] in standard position did not activate a tongue height specification and, consequently, created a low expectancy as to the tongue height of the deviant. Necessarily, the [low] specification of the deviant was a less severe violation.We would expect similar results for the deviant [I]; however, because of duration limitations of MEG experiments with regard to participants' comfort levels, we could not include this condition in our current study. Clearly, the testing of the latter condition will be a necessary enterprise for future work.

The detected asymmetry in the mid/low vowel opposition was not found in the control condition that contrasted the low vowel [æ] with the high vowel [I]. This important finding enables us to reject alternative explanations for the low/mid contrast asymmetry. Here, MMNs did not differ and were of similar magnitude for the deviant [æ] and the deviant [I]. This pattern is expected on the basis of mismatching features. Both low and high vowels in standard position activate their fully specified representations for which the corresponding deviants provide a conflicting feature, that is, resulting in mutually exclusive feature oppositions of [low] versus [high], and [high] versus [low]. The fact that the MMN responses in the low/high conditions did not differ from MMN responses in the low/mid conditions furthermore suggests that the MMN amplitude is not solely driven by the acoustic distance between the standard and the deviant. This is in line with previous MMN research on vowels that suggests an interaction of auditory-sensory and phonological-categorical processing (Winkler et al., 1999), once again confirming that the size of the MMN does not linearly correlate with acoustic differences as measured as distance in formant space.

The finding that MMN latencies in the 150-200 ms window were shorter for the low/high conditions than for the low/mid conditions is consistent with earlier observations indicating that feature mismatches in passive oddball paradigms are not only reflected by higher MMN amplitudes but also by earlier MMN peak latencies (Eulitz &Lahiri, 2004; Scharinger, Eulitz,& Lahiri, 2010).

Our proposed correlation of standard-deviant feature opposition and magnitude of the resulting MMN is compatible with both the model adjustment hypothesis (Näätänen&Winkler, 1999;Winkler et al., 1996) and the predictive coding approach that incorporates the former (Baldeweg, 2006; Friston, 2005; Garrido et al., 2009). According to the model adjustment hypothesis, the MMN results from the need to update an acoustic model of the environment to incorporate (or assimilate) the respective deviant. This acoustic model, consisting of auditory

memory, is instantiated by a sequence of standard sounds and generates inferences regarding future sound events, that is, a continuation of the standard sequence. Importantly, the model can have high or low inference values, which means that a deviant is less readily or more readily incorporated in the model (Winkler et al., 1996). Put differently, the model can be more or less confident in inferring future sound events and, consequently, will show larger mismatch responses if a highly confident inference is violated.We suggest that featurally specified vowels provide relatively high inference values, that is, high expectations that the next vowel in the standard sequence is also specified for the same feature. Encountering a deviant with a different feature extracted from the acoustic signal will then require a model update and thereforewill elicit anMMN.In contrast, an underspecified vowel has a low inference value-that is, the expectation for a future sound to be specified is lower. Consequently, a deviant is more readily incorporated in the model and therefore will elicit a smaller MMN.

The predictive coding approach combines the adaption mechanism with the model adjustment hypothesis discussed above. According to the adaption mechanism, the MMN is an emergent phenomenon by subtracting adapted responses to standards from nonadapted responses to deviants (Jääskeläinen et al., 2004).Within the predictive coding approach, standard presentations help the suppression of prediction errors while integrating bottom-up sensory information with top-down predictions. Neurally, this is achieved by plastic changes in synaptic connections (adaptation). Upon encountering the deviant, the sensory bottom-up information fails to meet the top-down prediction. The consequence is the elicitation of an MMN (Näätänen &Winkler, 1999; Winkler et al., 1996). Note that the model adjustment hypothesis suggests two mechanisms for the elicitation of theMMN. One mechanism with generators at temporal locations signals deviation from the learned regularity through the standards and involves a comparison of the sensory auditory input with the memory trace of the previous stimuli. The other mechanism with generators at frontal locations relates to an automatic (involuntary) attention switching process (Escera, Alho, Winkler, &Näätänen, 1998; Escera, Schröger, &Winkler, 2000; Giard, Perrin, Pernier, &Bouchet, 1990) that modulates deviance detection (Escera, Yago, Corral, Corbera, &Nunez, 2003).

Our results are also compatible with the predictive coding approach. In a similar way to that argued above within the model adjustment hypothesis, underspecified standards-by virtue of their less specified status- should evokeweaker bottom-up predictions. In particular, underspecified [e] should not evoke specific predictions regarding the tongue height information supported from the signal. As a consequence, the deviant [æ] provides a relative weak predictive error and, consequentially, elicits a weak MMN. In contrast, specified [æ] in standard position makes strong and specific bottom-up predictions, such that the deviant [e] supplies a stronger predictive error than in the reverse case. On the other hand, underspecified [e] in standard position yields the only case in which there is no tongue height expectation, such that the low deviant [æ] provides novel information regarding a specific level of tongue height (low). The fact that we found a more frontal orientation of the M100 dipole for this deviant suggests that there might be more frontal processing already before the onset of the MMN. This would be in line with the involuntary attention switching process. Previous research has shown that the strength of the attention switching process depends on the novelty of the deviant (Escera et al., 1998; Rinne, Särkkä, Degerman, Schröger, &Alho, 2006). Thus, it could be the case that on the basis of the predictive model of the underspecified standard, the extraction of a discrete tongue height value from the deviant resulted in a stronger involuntary attention switch than in the other conditions in which the fully specified standards provided a predictive model in which the extraction of a discrete tongue height feature was more predicted. This attention switch, furthermore, might already be visible in a different M100 source configuration as reflected in a more frontal ECD orientation. Although these considerations have to remain speculative at this point, they can be taken as valuable hypotheses for future research.

Other MMN studies on vowel height differences suggest that early MMN effects are actually driven by acoustic stimulus properties. For example, Hill et al. (2004) reported that MMNs did not differ between 100 and 200 ms

poststimulus onset between a vowel condition with [e] and [I] and a tone condition matched for the vowel's F1. The vowel and tone conditions diverged only between 200 and 350 ms after stimulus onset. Although our crucial amplitude interaction in a later time window (200-250 ms) seems to support this view, care has to be taken with the interpretation of their results because they used synthetic vowels, whereas we employed spoken vowels with natural variation. Nevertheless, their results conform to our hypothesis according to which neural vowel processing is first subject to a specific acoustic analysis that focuses on formant (resonance) frequency regions and is later characterized by acoustic-phonetic feature integration and evaluation against long-term memory representations of discrete (vowel) sounds. Tone and vowel conditions in Hill et al.'s study differ at later latencies because these latencies probably reflect the comparison between acoustic-phonetic information and memory representations that differ between tones and vowels.

Hill et al.'s (2004) findings are challenged by the work of Jacobsen and colleagues (Jacobsen, Schröger, &Alter, 2004; Jacobsen, Schröger, &Sussman, 2004), who have provided evidence that language-relevant information is extracted even from complex nonspeech sounds. Jacobsen, Schröger, and Alter (2004) showed that complex tones with speech-like formant structure reliably elicited MMNs in the 100-200-ms time range after stimulus onset. In contrast, similarly complex tones without speech-like formant structure failed to elicit significant MMNs. Thus, the authors provided evidence that speech-relevant acoustic information is extracted preattentively from the incoming signal. Because the speech-relevant acoustic information, as expressed by formant structures, determines or constitutes distinctive features, we take these findings together with the results of our experiment as evidence for the brain's early and preattentive sensitivity to abstract phonetic features.

Again, ourMMNfindings may speak to the observation of reduced vowel spaces in CI users. Within underspecification theory, the higher confusability of vowels in CI users-as, for example, found by Löfqvist et al. (2010)- can be modeled by an increase in underspecified vowels. Possibly, specified vowels such as low [æ] can become underspecified if the spectral cue (F1) is consistently degraded or shows greater variation. Note that underspecified vowels are supposed to be more confusable because their long-term memory representation is compatible (i.e., not mismatching) with all the vowels that have no other mismatching feature dimensions. For example, [e] may be confused with both [æ] and [I] (underspecified vs. specified), but [æ] will be less confused with [I] (both specified). CI users might counteract the emerging confusability of vowels by focusing on feature dimensions (e.g., F1) for which an alternative (visual) cues exists. Eventually, the visual cue can restore the full representation of a vowel's tongue height. Again, this is a speculative remark at the moment, but it provides a possible starting point for fruitful future research.

Conclusion

Taken together, theMMNpattern of our experiment supports the idea of distinctive features that determine the representation of vowels and guide the perception of speech sounds. We found support for tongue height underspecification in American English mid vowels and showed that underspecification predictions for the MMN are in line with current models accounting for its underlying mechanisms. The M100 results, on the other hand, suggest that the auditory cortex categorically deals with acoustic cues to these features very early during spoken sound processing.

Acknowledgments

The research for this study was funded by National Institutes of Health Grant 7ROIDC005660-07 to the third author and David Poeppel. We thank David Poeppel and Aditi Lahiri for invaluable comments on this research. We are similarly indebted to the sound group at the University of Maryland and the audience of the 12th Conference on Laboratory Phonology (July 2010, Albuquerque, New Mexico) for helpful discussion. We also thank Ariane Rhone for helping prepare the stimuli and Max Ehrmann for laboratory assistance.

http://jslhr.asha.org/cgi/content/full/55/3/903

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Editor: Sid Bacon
Associate Editor: Emily Tobey
Received March 21, 2011
Accepted October 10, 2011
DOI: 10.1044/1092-4388(2011/11-0065)

Publication date: Jun 2012

Year: 2012

Intensive Voice Treatment (LSVT LOUD) for Children With Spastic Cerebral Palsy and Dysarthria

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.3 (Jun 2012): 930-945A.
ProQuest document link

Abstract: The purpose of this study was to examine the effects of an intensive voice treatment (Lee Silverman Voice Treatment, commonly known as LSVT LOUD) for children with spastic cerebral palsy (CP) and dysarthria. A nonconcurrent multiple baseline single-subject design with replication across 5 children with spastic CP was used. Auditory-perceptual analysis of speech, acoustic measures of vocal functioning, and perceptual ratings by parents of participants were obtained at baseline, posttreatment, and 6-week follow-up recording sessions. Listeners consistently preferred the speech samples taken immediately posttreatment over those taken during the baseline phase for most perceptual characteristics rated in this study. Changes in acoustic measures of vocal functioning were not consistent across participants and occurred more frequently for maximum performance tasks as opposed to speech. Although parents of the treated participants reported an improved perception of vocal loudness immediately following treatment, maintenance of changes at 6-week follow-up varied across the participants. No changes were observed in the 5th participant, who did not receive treatment. These findings provide some preliminary observations that the children with spastic CP in this study not only tolerated intensive voice treatment but also showed improvement on select aspects of vocal functioning. These outcomes warrant further research through Phase 2 treatment studies.

Full text: Headnote

Purpose: The purpose of this study was to examine the effects of an intensive voice treatment (Lee Silverman Voice Treatment, commonly known as LSVT LOUD) for children with spastic cerebral palsy (CP) and dysarthria.

Method: A nonconcurrent multiple baseline single-subject design with replication across 5 children with spastic CP was used. Auditory-perceptual analysis of speech, acoustic measures of vocal functioning, and perceptual ratings by parents of participants were obtained at baseline, posttreatment, and 6-week follow-up recording sessions.

Results: Listeners consistently preferred the speech samples taken immediately posttreatment over those taken during the baseline phase for most perceptual characteristics rated in this study. Changes in acoustic measures of vocal functioning were not consistent across participants and occurred more frequently for maximum

performance tasks as opposed to speech. Although parents of the treated participants reported an improved perception of vocal loudness immediately following treatment, maintenance of changes at 6-week follow-up varied across the participants. No changes were observed in the 5th participant, who did not receive treatment. Conclusions: These findings provide some preliminary observations that the children with spastic CP in this study not only tolerated intensive voice treatment but also showed improvement on select aspects of vocal functioning. These outcomes warrant further research through Phase 2 treatment studies.
Key Words: cerebral palsy, voice treatment, LSVT LOUD
Speech disorders have been reported to occur in children with spastic cerebral palsy (CP; Workinger &Kent, 1991); however, reliable prevalence figures have not been documented (Pennington, Miller,&Robson, 2009). The most common perceptual characteristics include consistent hypernasality, breathy voice quality, monotonous speech, reduced loudness, and uncontrolled rate and rhythm of voice (Workinger &Kent, 1991). Disordered respiration characterized by short vowel durations, shallow inspirations, and forced expirations also has been reported (Clement &Twitchell, 1959; Solomon &Charron, 1998). In addition, disordered articulation has been described in these children (Clement &Twitchell, 1959; Hixon &Hardy, 1964). There are limited efficacy data on speech treatment for children with CP; hence, there is a great need for research in this area (Pennington et al., 2009).

Advances in clinical neurorehabilitation have documented key elements of motor learning and principles that drive activity-dependent neuroplasticity (i.e., modifications in the central nervous system in response to physical activity), such as intensive treatment, repetitive active practice, and sensory feedback associated with movement. These elements may have merit in the context of successful treatment paradigms for adults and children with neurological disease or impairments (Garvey, Giannetti, Alter, &Lum, 2007; Kleim &Jones, 2008; Kleim Jones, &Schallert, 2003; Maas et al., 2008). Moreover, there is a growing focus in speech treatment research to translate principles of both motor learning and activity-dependent neuroplasticity into protocols for treatment of motor speech disorders in children and adults (Ludlow et al., 2008; Maas et al., 2008).

Previous studies have documented that children with CP are capable of intensive treatment regimes and that initial fatigue may be due to deconditioning effects that often decrease over time (Bower, McLellan, Arney, &Campbell, 1996; Schindl, Forstner, Kern, &Hesse, 2000). Research also has shown that the use of task-specific, repetitive practice and active practice along with increased numbers of practice trials results in marked improvements in gait (Damiano, Kelly, &Vaughan, 1995; Schindl et al., 2000), grip force production (Valvano &Newell, 1998), and anticipatory grip force precision (Gordon &Duff, 1999) in children with CP. In addition, enhanced sensory input and active attention to sensory feedback during practice may facilitate neuroplastic changes of cortical sensorimotor maps, which is thought to foster internal representations for movement important for carryover and maintenance of the new target behavior, such as reaching (Hadders- Algra, 2000; Hadders-Algra, van der Fits, Stremmelaar, &Touwen, 1999; Lenz &Byl, 1999).

Current speech treatment methods for children with CP and dysarthria are varied but typically use a systems approach to address respiration, phonation, articulation, and resonance (Pennington et al., 2009). Recently reviewed observational studies of speech interventions for children with dysarthria indicated that teaching slow, loud speech may be associated with improvements in speech intelligibility, voice quality, and clarity (Pennington et al., 2009). For example, Pennington, Miller, Robson, and Steen (2010) reported on 16 children with CP and dysarthria who received intensive treatment consisting of three 35- to 40-min sessions a week for 6 weeks, focusing on controlling breath support, phonation, and rate. Improvements were documented in single-word and connected speech intelligibility for both familiar and unfamiliar listeners.

A model of speech treatment, known as LSVT LOUD (Lee Silverman Voice Treatment), has been developed for individuals with Parkinson's disease (PD) and has documented efficacy for that population (Ramig et al., 2001). The training mode of LSVT LOUD is consistent with principles that drive activity-dependent neuroplasticity and motor learning (Fox et al., 2006). LSVT LOUD incorporates enhancement of the voice source, consistent with

improving the carrier in the classic engineering concept of signal transmission (Titze, 1993) and using vocal loudness as a trigger for distributed effects across the speech production system (Dromey &Ramig, 1988; Sapir, Spielman, Ramig, Story,&Fox, 2007). The extent towhich the effects of LSVT LOUD are specific to hypokinetic dysarthria is not clear. However, positive outcomes in acoustic measures (e.g., vocal sound pressure level [SPL]) and listener perceptions (e.g., articulatory precision) have been reported post-LSVT LOUD from single-subject and case studies of adults with spastic and ataxic types of dysarthria (Sapir et al., 2001, 2003).

The idea of targeting vocal loudness or respiratory- phonatory effort in treatment of dysarthria is not new. Establishing a respiratory-phonatory foundation before addressing other speech subsystems is consistent with approaches recommended for treating motor speech disorders that (a) create a single-motor organizing theme, (b) have a maximum impact on other aspects of speech production, and (c) increase effort across the speech mechanism (Duffy, 1995; Rosenbek &LaPointe, 1985; Yorkston, Beukelman, &Bell, 1988). Moreover, it has been recommended that treating respiratory-phonatory support for speech should occur first or at least co-occur with any focused articulation treatment in children with motor speech disorders (Strand, 1995). The unique aspect of LSVT LOUD is the singular target of training healthy vocal loudness (respiratory-phonatory effort) to the exclusion of targeting rate, articulation, and resonance.

The singular training target of healthy vocal loudness may be desirable for children with spastic CP. These children have disordered voice characteristics, which may be due to muscle weakness or incoordination of respiratory and laryngeal subsystems (Ansel &Kent, 1992;Workinger&Kent, 1991). The single focus on vocal loudness limits cognitive demands associated with treatment, which may be important for children with low-average to below-average cognitive functioning. Finally, the target vocal loudness trained in LSVT LOUD is elicited through modeling behavior (e.g., "do what I do"), which minimizes explicit verbal instructions and may allow the child's system to implicitly self-organize in order to achieve the goal (Schmidt &Fitzpatrick, 1996). Further, LSVT LOUD addresses criticisms of previous behavioral treatment studies in children with CP, for example, that (a) treatment was not delivered in a standardized manner, (b) dosages of treatment were not discrete, and (c) techniques were often combined (Butler &Darrah, 2001). LSVT LOUD minimizes these issues through a protocol of specific daily exercises prescribed for the entire treatment regime, a finite period of treatment, and a single treatment focus on vocal loudness.

The purpose of this Phase 1 treatment study was to examine any therapeutic effects of delivering LSVT LOUD in children with spastic CP and dysarthria (Robey &Schultz, 1998). The specific questions related to this purpose are as follows: (a) Do listeners prefer posttreatment over baseline speech samples of children with CP on a number of perceptual characteristics of voice and speech; (b) will intensive voice treatment affect the vocal motor system of children with spastic CP and dysarthria as evidenced by changes in acoustic measures of voice; (c) do parents perceive changes in perceptual voice and speech characteristics after intensive voice treatment; and (d) do treatment effects, if any, last over time?

Method

Participants

Five children between the ages of 5 and 7 years with a medical diagnosis of predominantly spastic CP were recruited. Characteristics of each participant are detailed in Table 1. Additional selection criteria included (a) dysarthria; (b) hearing that was within normal limits or aided to normal limits; (c) no vocal fold pathology as determined by an otolaryngologist; (d) ability to follow directions for the study tasks; and (e) stable medications, if applicable. Children with severe velopharyngeal incompetence, structural disorders of the speech mechanism, or a concomitant speech disorder (e.g., stuttering) were excluded. The medical diagnosis of spastic CP was confirmed by review of medical records. The characteristics and severity of dysarthria were determined by consensus of two certified speech-language pathologists from audio and video samples of participants with CP. Ayoked group of typically developing, sex- and agematched children was recruited to participate in this study. This allowed for a direct comparison between performance of participants with CP and their matched peers,

because data were collected using the same tasks and methodology. The typically developing peers had no known neurological disease or condition and no history of speech or voice disorders. Their ages and pairings with participants with CP are listed in Table 1.

Design

This study used a nonconcurrent multiple baseline design with replication across subjects (Barlow &Hersen, 1984; Watson &Workman, 1981). In this design, the treatment variable (intensive treatment) was applied sequentially to the same behavior (vocal output) across different but matched subjects sharing the same environmental conditions. In a nonconcurrent design, the length of the baseline phase is varied (some short and some longer) and predetermined (Watson &Workman, 1981). When participants became available, they were randomly assigned to one of the predetermined baseline conditions. This provided flexibility for conducting the research within real-world constraints while maintaining the internal validity achieved with a concurrent design (i.e., controlling for history or maturation variables; Watson &Workman, 1981).

Procedures

Participant Selection

A telephone screening questionnaire was completed with parents of potential participants followed by a faceto-face screening session with the child. All the parents signed a consent form, and children signed an assent document agreeing to participate. This study received approval from the University of Arizona Institutional Review Board. The screening session included (a) a brief voice and speech screening, (b) an assessment of abilities to follow directions related to the study tasks, and (c) a hearing screening (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz at 25 dB HL). In addition, a laryngeal examination was conducted by an otolaryngologist to ensure that no laryngeal pathology (e.g., vocal nodules or paralysis) existed. All five participants completed the entire study.

Study Conditions

Participants were randomly assigned to one of four study conditions with varying durations of baseline phases according to the nonconcurrent study design. A minimum of four baseline recordings were planned across ConditionsA(2-week baseline),B(3-week baseline), and C (4-week baseline). Participant assignment to study conditions and the actual number of recording sessions are summarized in Table 1. These conditions all included 16 treatment sessions (4 sessions a week for 4 consecutive weeks), two recording sessions 1 week immediately following treatment (POST), and two recording sessions 6 weeks after the conclusion of treatment (FUP). ConditionD matched Condition A except no treatment was delivered. Treatment was administered to the participant in Condition D following the final FUP recording session. The inclusion of an untreated participant with CP was to document potential maturational changes that may occur during the study period and affect interpretation of the results (Stiller, Marcoux,&Olson, 2003).

Recording Sessions

Equipment and setup. Data collection procedures were identical for all baseline (BASE), posttreatment (POST), and follow-up (FUP) recording sessions. Duration of recording sessions ranged from 30 min to 1 hr. Data were collected in an Industrial Acoustics Company sound-treated booth, and all sessions were videotaped. Four of the participants were comfortably seated in their ownwheelchairs.One participant sat in an adaptive chair. Audio recordings were made with the participant wearing a small omni-directional condenser microphone (Audio-Technica,Model AT 803b) taped to his or her forehead and secured with a soft, elastic cloth headband. The distance fromthe corner of the child's mouth to his or her forehead was measured for placement of the microphone at each recording session. This allowed for a constant mouth-to-microphone distance of 4 in. within and across recording sessions. Microphone signals were recorded onto a digital audiotape (DAT) recorder (Panasonic Digital Audio Tape Deck, Model SV-3500). Calibration signals were recorded at the beginning and end of each session by securing the omni-directional condenser microphone and sound level meter (SLM) microphone to a Styrofoamhead at a distance of 4 in. from the mouth of the head,mimicking the setup on the

child.Atone generator (KORGAut°Chromatic Tuner, AT-12) was placed in the same plane as the Styrofoam head's mouth. The generated tone (960.5 Hz) was recorded to the DAT, and the exact sound pressure level (dB SPL) reading from the SLM was recorded.

Data were collected by four graduate students and the first author, who were well trained in the experimental protocol. The investigator who delivered treatment (the first author) did not collect POST or FUP data. All attempts to keep the student data collectors blinded to the purpose of the study were made; however, there were occasions when the participants revealed aspects of the treatment they received. All data collectors were trained to keep the same demeanor and instructions regardless of the participants' comments.

Voice and speech tasks. The protocol included two maximum performance tasks, including a sustained vowel and maximal frequency range for vowels, as well as a sentence repetition task (Kent &Kent, 2000; Kent, Kent, &Rosenbek, 1987; Rvachew, Hodge, &Ohberg, 2005). For the maximal performance tasks, instructions were "Take a deep breath and say 'ah' for as long as you can," and "Take a deep breath and say 'ah' as high/low as you can." The data collectors were careful to use specific instructions that encouraged maximum performance for duration and frequency range but never gave any specific instructions or cues related to vocal loudness. Multiple repetitions of each task (average of six trials)were elicited during each recording session to ensure that maximum performancewas captured (Kent et al., 1987). The speech task involved repeating the sentences "Buy Bobby a puppy," "The potato stew is in the pot," and "The blue spot is on the key" three times at each recording session. The instructions were as follows: "I am going to say some sentences. After I say the sentence, I will point to you and I want you to repeat what I say." Data collectors were careful to model the sentences consistently across sessions and without exaggerated loudness, articulation, or pitch inflection. These sentences were not trained during the treatment phase of the study. The order of presentation of maximum performance and sentence repetition tasks was randomized across all recording sessions.

Parent rating forms.Avisual analog scale (Kempster, 1984; Schiffman, Reynolds,&Young, 1981) was filled out by one of the participant's parents at BASE, POST, and FUP sessions. This scale obtained ratings on 10 variables related to voice (loud, nasal, hoarse/scratchy, monotone, breathy, strained), speech (speaks so others can understand), and spoken communication (talks when playing with other kids, starts talking with other kids, frustrated when talking). The scale required the parent to place a vertical slash through a solid horizontal line (15.2 cm) that represented a continuum ranging from continuous presence of a characteristic, "Voice is always loud enough," to complete absence of a characteristic, "Voice is never loud enough." Parents were instructed to make their ratings based on perceptions of their child's speech "most of the time" versus their perception on the day of the recording session.

Intensive Voice Treatment

LSVT LOUD treatment consisted of 16 individual 1-hr treatment sessions delivered on 4 consecutive days each week for 4 consecutive weeks. Homework and carryover exercises were assigned every day during the month of treatment. All treatment was delivered by an expert LSVT LOUD clinician (the first author). All treatment sessions were conducted in the participant's home. The first half of each treatment session consisted of three daily tasks: (a) maximum duration sustained vowels, (b) maximum frequency range, and (c) repetition of 10 functional phrases (generated by the participant and his or her family) five times each. The second half of treatment sessions was spent on a speech hierarchy progressing in difficulty from single words to conversational speech. In the case where a child had reduced verbal output (one- to four-word phrases), the progression went from structured to less structured tasks (e.g., naming pictures to playing games requiring spontaneous speech output). All exercises included a minimum of 15 repetitions of each training task while incorporating sensory augmentation, such as cueing increased vocal effort and loudness, and sensory awareness by asking the children, "Did you feel your voice? Did you hear how you sounded?" Children practiced one homework session on treatment days (lasting 5-10 min) and two homework sessions on nontreatment days (lasting 10- 15 min). Daily carryover exercises were specific assignments to use the new

target voice with someone in the child's daily living environment-for example, "Say good morning to the bus driver using your 'loud' voice." The impact of the carryover assignment was discussed in the next treatment session (e.g., "Did the bus driver understand you yesterday?"). Family members assisted the child in completing homework and carryover assignments. All participants and family members were encouraged to continue homework routines at the conclusion of treatment.

Participation of Typically Developing Peers

The typically developing peers participated in two recording sessions in 1 week's time, completing the same tasks as the participants with CP. These children did not participate in the laryngeal examination or the treatment phase of this study.

Analysis

Auditory-Perceptual Data (Listener Task)

A group of seven certified speech-language pathologists who had extensive experience in the areas of motor speech disorders and voice served as judges in a paired comparison listening task. Three repetitions of the sentences "Buy Bobby a puppy," "The blue spot is on the key," or "The potato stew is in the pot" from the final BASE, POST, andFUPrecording sessions were included for speech samples. These final sessions were chosen to ensure that each child would have the greatest familiarity with the task across the study phases. Speech samples containing three repetitions of each of the sentences were constructed for BASE, POST, and FUP sessions. The order of presentation of speech samples was randomized across study phases (e.g., BASE vs. POST or FUP vs. BASE).

Listening task. Paired speech samples were presented to listeners via a computer and external speakers. They rated which sample they "preferred" for the following variables: (a) overall loudness, (b) loudness variability, (c) overall pitch, (d) pitch variability, (e) overall voice quality, and (f) articulatory precision. Listeners marked on a rating form which sample they "preferred," Sample A, Sample B, or no preference. A listening CD was created for each participant. Practice speech samples, consisting of two randomly selected pairs for that child, were provided, during which the listener could adjust the volume control on the speakers to a loudness level that was comfortable. Once the volume control was set for a given participant, it did not change at any time during the listening task for that participant. Listeners were allowed to replay the samples as many times as they wanted prior to making their decision and were given the option to provide comments about why they chose one speech sample over another. The listening task took approximately 2 hr to complete. The number of times a speech sample was preferred from the BASE session, POSTsession, or FUP session or there was "no preference" (NP) was tabulated.

Statistical analysis. Auditory-perceptual data were analyzed using two chi-square tests on the categorical assignment of preference for each participant. The first chi-square test assessed the categorical assignment of preference for BASE versus POST versus NP. The second chi-square assessed the categorical assignment of preference for BASE versus FUP versus NP. Differences in the proportional distribution of preference for three preference categories were examined for each participant, based on an a priori probability model of equal likelihood of all three categories.

Acoustic Data

Data preparation and digitizing procedures. All acoustic data were reviewed, and problematic samples, such as clipped signals (approximately 10-15 samples across all participants and sessions) and faulty microphone signals (one recording session for two participants), were excluded. Data from the DAT tapes were digitized at 22.05 kHz with the commercial software program Praat (Boersma &Weenick, 2002). Each sample of a sustained vowel, high vowel, low vowel, or sentence repetition was saved in an individual .wav file. The calibration tone for each recording session was analyzed for dB SPL. The value of the calibration tone from Praat was subtracted from the recorded SLM value, creating a correction factor. The correction factor was applied to all dB SPL values produced by Praat, providing calibrated dB SPL at 4 in. across all participants and

recording sessions.

Measurements. Vowel samples (longest, highest, lowest) from each session were displayed using Praat. Both the acoustic waveform and spectrogram, including intensity (dB SPL) and pitch (F0 in hertz) contours, were displayed for analysis. All acoustic measures were derived from standard Praat algorithms. The following measures were made for sustained vowel phonation: (a) maximum vowel duration (s) from the first to the last glottal pulse, (b) mean dB SPL (and SDs) from the first to the last glottal pulse, and (c) harmonics-to-noise ratio (HNR) selected from the middle 0.30-s segment of each vowel. For the highest and lowest vowel phonations, the acoustic waveform and pitch contours were inspected for any variations in voicing that interfered with the pitch tracking analysis, such as glottal fry. Aberrant segments were cut, and the F0 range was derived (maximum F0 - minimum F0) from the remaining pitch contour. Each digitized sentence repetition was filtered through a customized analysis program (Mathworks, code written by B. Story, 2002) that removed pauses and voiceless consonants. The acoustic waveforms, intensity contour (dB SPL), and pitch contour (Hz) of the filtered files were displayed using Praat. Pitch contours were inspected for any variations in voicing that interfered with the pitch tracking analysis, and aberrant segments were cut. The remaining voiced segment of the sentences was analyzed for mean (with SD) dB SPL and F0 range (maximum F0 - minimum F0) at each recording session.

Using the measures described above, we identified and graphed for visual analysis the following values from each recording session: (a) the duration of the single longest sustained vowel (s), (b) the maximum F0 range (Hz) from the single highest and lowest vowels, (c) the mean (and SD) dB SPL of the three longest vowels, (d) the mean (and SD) HNR of the three longest vowels, (e) mean (and SD) dB SPL of nine sentence repetitions, and (f) mean F0 range of nine sentence repetitions. The three longest duration vowels from each recording session were chosen for dB SPL and HNR of sustained phonation analysis to capture variability in trial-to-trial performance, versus only including the single "best" performance of the task (longest duration). Grand means (and SDs) also were calculated for each participant across BASE, POST, and FUP sessions. These data were used to compare performance of each participant with CP to mean (and SD) data of his or her yoked typically developing peer.

Visual analysis. Visual inspection was completed by three independent judges who did not have any contact with the children in the study. A total of 30 data graphs (six graphs per participant) of acoustic variables were visually analyzed for trend and overlapping data points (Barlow &Hersen, 1984). On the few occasions when there was disagreement between judges, the majority ruled (two of three).

Statistical analysis. Statistical analysis was applied according to the following rules: (a) if there was clear visual evidence of no treatment effect, defined as no variability in baseline data, no visual trends, and overlapping data points across all study phases, then no statistic was applied; (b) if there was clear visual evidence of a treatment effect, defined as a visual trend with no overlapping data points between study phases, statistics were used to confirmthe effect; and (c) if there was unclear evidence of a treatment effect, defined as a visual trend with overlapping data points, or no visual trend with variable baseline data, statistics were applied to ascertain whether there was a possible treatment effect not evident through visual inspection of the graphed data.

We began our statistical analysis by checking for serial dependency in the data by running a lag-1 auto-correlation (Pearson) on neighboring data points in the baseline. If there was no significant auto-correlation, then we averaged data in each phase and conducted a one-way, repeated-measures analysis of variance (ANOVA). Least significant differences were used for post hoc comparisons. If baseline data were significantly correlated, then a split-middle binomial probabilities test was applied (Siegel, 1956). A lenient post hoc analysis and p value of $<.05$ for significance was chosen, allowing liberal tolerances for Type I errors, consistent with Phase 1 treatment research goals (Robey&Schultz, 1998). Effect size calculations were derived using a modified Cohen's d statistic (Busk&Serlin, 1992), as suggested by Beeson and Robey (2006) for use with single-subject research designs. For comparison of participants with CP with their typically developing peers, a

difference in mean beyond 2 SDs was considered significant.

Parent Rating Forms

Standard procedures for analysis of visual analog scales were used (Boeckstyns &Backer, 1989). The total distance of the line (15.2 cm) representing the continuum of presence or absence of a characteristic was measured. The distance of the slash on the line from right end of the continuum was measured and calculated into a percentage based on the total distance of the line (Fox &Ramig, 1997). This percentage represents the parents' perceived presence of a particular characteristic in the child with CP "most of the time." Difference scores from BASE to POST and BASE to FUP were calculated. Given that there was only a single data point at BASE, POST, and FUP for parent ratings, statistical analyses were not applied.

Reliability

Auditory Perceptual Analysis

We determined intrarater reliability for the seven listeners by repeating 30% of the paired speech samples per participant in the listening task. Intrarater reliability across listeners ranged from 74% to 89%.

Acoustic Analysis

We calculated measurement reliability by having 20% of the data reanalyzed by a second measurer. Mean difference scores (MDs) and Pearson product- moment correlations (r) were calculated. Intermeasurer reliability scores were as follows: duration,MD= 0.005 s, r = .99; F0 range, MD = 28.5 Hz, r = .99; dB SPL of sustained phonation, MD = 0.03 dB SPL, r = .99; HNR of sustained phonation, MD = 0.01 dB SPL, r = .94; dB SPL of sentences, MD = 0.08 dB SPL, r = .99; F0 range of sentences, MD = 6.03 Hz, r = .90. These values represent good intermeasurer reliability.

Visual Analysis

We determined intrarater reliability for the three judges who visually examined data by randomly selecting 10 of the 30 graphs for repeated analysis. The intrarater reliability ranged from 98% to 100%. We determined interrater reliability by comparing agreements among the three raters. Interrater reliability was 94.7%.

Parent Ratings

We determined intrarater reliability of parent perceptual ratings by repeating a visual analog scale at one additional BASE, POST, or FUP recording. Intrarater reliability was available for all participants' parents except Participant 1 (P1). Mean difference scores (MDs) and Pearson product-moment correlations (r) were calculated. Intrarater reliability fell in the following ranges: MD = 7.00%-0.47% (0%-100% scale), r = .68-.90.

Results

Auditory-perceptual data and chi-square analyses are displayed in Table 2. The number of preference choices per BASE, POST, FUP, or NP (3 Sentence Pairs ×7 Listeners = 21 total choices per perceptual variable) and the accompanying statistic are listed. All acoustic data are displayed in Table 3. Effect size (ES) was commensurate with observed direction of change and statistical significance in all but one case (P1, dB SPL for sustained phonation). Judgments regarding magnitude of the ES were not made due to the Phase 1 nature of the study (Beeson &Robey, 2006). Difference scores across study phases of parent perceptual ratings (expressed in percentages) are displayed in Table 4. Positive and negative values reflect perceptions of improvement or deterioration, respectively.

Data for P1

Listener Ratings

Chi-square analysis revealed statistically significant preferences for the POST over BASE samples across all perceptual variables except loudness variability. These preferences were not maintained at FUP. Listener comments for preference of POST samples included "louder," "more variable," "pitch more stable," "natural," "less strain," "decreased nasal emissions," "more crisp," and "less effort." Comments for preference of BASE samples included "more consistent loudness," "louder," and "less gurgle."

Acoustic Analysis

The measures for which a visual treatment effect was observable and for which a statistically significant difference was found included maximum F0 range from BASE to POST and maximum duration "ah" from BASEtoFUP. P1 was 2SDs below the mean values of his matched typically developing peer at BASE, POST, and FUP for all variables except dB SPL and F0 range of sentence repetition at all phases.

Parent Ratings

Perceptual variables with the greatest percentage increase from BASE to POST included "always loud enough" (44%) and "never breathy voice" (31%). These percentage increases from BASE to FUP were not maintained at 5% and 2%, respectively.

Data for P2

Listener Ratings

Chi-square analysis revealed statistically significant preferences for both POST over BASE and FUP over BASE samples for overall loudness, loudness variability, pitch variability, and overall voice quality. Listener comments for preference of POST or FUP samples included "louder," "more variable," "not strained," "less monotone," "more precise," and "less hoarse." Comments when a BASE sample was preferred over FUP included "not yelling," which referred to her FUP repetition of "Buy Bobby a puppy."

Acoustic Analysis

The measures that had a visual treatment effect and also were statistically significant included maximum duration "ah," maximum F0 range, dB SPL of sustained phonation, dB SPL of sentence repetition from BASE to POSTand BASE to FUP, and F0 range for sentence repetition from BASE to FUP. P2 was 2 SDs below the mean value of her matched typically developing peer for all variables at BASE, POST, and FUP except dB SPL of sustained phonation, and F0 range of sentence repetition at POST and FUP. She was 2 SDs above the mean value for dB SPL of sentence repetition.

Parent Ratings

Perceptual variables with the greatest percentage increase from BASE to POST included "always loud enough" (39%) and "never breathy voice" (39%). These percentage increases from BASE to FUP were maintained at 40% and 39%, respectively.

Data for P3

Listener Ratings

Chi-square analysis revealed statistically significant preferences for the POST over BASE samples for all variables except overall pitch. Preference for loudness variability and overall voice quality were maintained at FUP. Listener comments for preference of POST or FUP samples included "more precise," "louder," "consistent loudness," "less breathy," "less strain and strangle," and "clearer voice quality."

Acoustic Analysis

The measure that had a visual treatment effect, which also was statistically significant, was maximum sustained "ah" from BASE to FUP. P3 was 2 SDs below the mean value of his matched typically developing peer for all variables at BASE, POST, and FUP, except for HNR of sustained phonation and dB SPL and F0 range of sentence repetition at all study phases.

Parent Ratings

Perceptual variables with the greatest percentage increase from BASE to POST included "always loud enough" (33%) and "never strained voice" (28%). These percentage increases fromBASEtoFUPwere somewhat maintained at 23% and 19%, respectively.

Data for P4

P4 was unable to repeat entire sentences; therefore, he repeated the last word of each sentence ("puppy," "pot," "key") during the sentence repetition task. There are no data for sentence repetition at BASE 2 due to P4's unwillingness to perform the task and at FUP 2 due to microphone failure.

Listener Ratings

Chi-square analysis revealed statistically significant preferences for the POST over BASE single-word repetition samples across all six perceptual variables rated. Preference for overall loudness, loudness variability, and overall voice quality were maintained at FUP. Listener comments for preference of POST or FUP samples included "louder," "more variable," "less breathy," "less pressed," "easier for child to produce," "more precise," and "more natural pitch."

Acoustic Analysis

The measures that had a visual treatment effect and also were statistically significant included maximum F0 range from BASE to POST and maximum F0 range, HNR of sustained phonation, and dB SPL of his singleword repetition from BASE to FUP. P4 was two SDs below the mean value of his matched typically developing peer for all variables at BASE, POST, and FUP, except for maximum F0 range at all phases and dB SPL of sentences at POST and FUP.

Parent Perceptual Ratings

The perceptual variable with the greatest percentage increase from BASE to POST was for "always loud enough" (33%). The second largest percentage change was in a negative direction reflecting an increase in the perception of a "hoarse, scratchy voice" (-31%). Data for FUP measures from the same parent who completed the BASE and POST ratings were not available.

Data for P5

P5 was an untreated comparison participant in this study. Therefore, the study phases of POST and FUP were actually additional BASE recordings following 1 month and an additional 6 weeks of no treatment.

Listener Ratings

Chi-square analysis revealed statistically significant preferences for the NP category for all variables rated from BASE to POSTand for overall loudness, overall pitch, and articulatory precision at the FUP session.

Acoustic Analysis

The measure that had a visual treatment effect and also was statistically significant was a decreasing performance for maximum F0 range from BASE to POST. P5 was 2 SDs below the mean value of her matched typically developing peer for all variables at BASE, POST, and FUP except maximum duration at all phases, maximum F0 range at BASE, and dB SPL of sustained phonation at BASE and FUP.

Parent Ratings

The perceptual variable with the greatest percentage increase from BASE to POSTwas for "never hoarse, scratchy voice" (26%). The next largest percentage change was a decrease (worsening) for the perception of "always speaks so others can understand" (-30%). Data for FUP measures from the same parent who completed the BASE and POST ratings were not available.

Discussion

This Phase 1 treatment study examined the effects of an intensive voice treatment in children with spastic CP and dysarthria. A nonconcurrent single-subject multiple baseline design with replication across participants was used. Listeners preferred POST speech samples for loudness, pitch variability, and voice quality over BASE speech samples in all four treated participants. Treated participantsmade a significant gain in at least one acoustic measure during maximum performance tasks; improvements were not as frequently observed for speech. All parents rated an improved percentage for "always loud enough" from BASE to POST. Maintenance of these perceptual and acoustic changes atFUP varied across participants and are detailed below. The untreated participant did not make improvements over the course of the study. The implications of these findings and directions for future research are discussed below.

Listener Preferences

Listeners preferred POST over BASE speech samples from the sentence repetition task for most of the perceptual variables rated, including five of six for P1, four of six for P2, five of six for P3, and six of six for singleword repetitions for P4. These listener ratings support an immediate therapeutic effect of the intervention.

However, these findings should be interpretedwith caution for a number of reasons. First, a lenient p value, which is consistent with Phase 1 treatment research goals, increased the potential for Type 1 error (treatment effect identified when none exists). Second, perceptual variables rated in this study were not specifically defined for the listeners. Although loudness, pitch, voice quality, and articulatory precision are standard perceptions, listeners may have interpreted these variables differently. Third, the intrarater reliability for some of the listeners was borderline acceptable. Finally, themodel for sentence repetitionwas provided by verbal output fromdata collectors. Although these data collectors were well trained on presentation style of the sentences, we cannot eliminate the possibility that differences in models may have affected the participants' speech. Future research using prerecorded samples, perhaps with animated characters to engage children (e.g., Test of Children's Speech by Hodge, Daniels, &Gotzke, 2006) would standardize this task presentation.

Acoustic Measures

Overall there were minimal changes in acoustic measures across study phases, with the exception of P2. In addition, most participants with CP were still 2 SDs below the mean performance of their typically developing peers for maximum performance tasks after treatment. These findings are consistent with those of Wit, Maassen, Gabreels, and Thoonen (1993), who reported that children with spastic CP were significantly reduced in their performance envelope compared with typically developing peers. These findings also are different from the pattern of results found in adults with PD who nearly always have large and significant changes in maximum performance tasks, which are trained targets in LSVT LOUD (Sapir, Ramig, &Fox, 2011). This was most likely related to the different etiology of the dysarthria in PDversus CP. In PD, the softvoice is often due to deficits in scaling amplitude of motor output and sensory perception of normal loudness (Sapir et al., 2011). Targeting vocal loudness in people with PD may cue or access a relatively intact motor system that is capable of scaling up output to produce normal vocal loudness. In CP, the softvoice is related to generalized weakness of respiratory and laryngeal systems, coupled with a lack of coordination between the respiratory and laryngeal subsystems (Ansel &Kent, 1992; Workinger &Kent, 1991). Thus, unlike in PD, there may be inherent neuromuscular limitations in CP that impact gains on tasks targeting the maximum performance envelope.

The acoustic variables measured for sentence repetition (mean vocal SPL and F0 range) may not have been adequate to capture what the listeners perceived in speech, when they preferred POST speech samples. Selecting different or additional acoustic measures in future studiesmay better capture potential changes in vocal motor functioning that underlie the listener-perceived changes. For example, including the entire speech envelope in vocal SPL analysis for sentences versus a focus on the voiced segments may capture the "whispered" elements of some participants' speech at the end of sentences. Although the acoustic measures did not document significant changes for most participants, written comments from listeners often indicated that children spoke with "less effort," "less strain and strangle," or "less of a struggle." These perceptions of decreased effort and strain are not reflected in measures of vocal SPL or F0 range and may have been the basis of listener preference of POST samples.

Using multiple strategies to detect change in singlesubject designs may provide the best interpretation of data. For example, P1 revealed no visual trend, no mean differences, and no effect size for dB SPL of sustained phonation, yet the split-middle technique revealed a statistically significant difference. In this case, the statistical detection of a true change is suspect. Conversely, P2 exhibited a visual trend, a statistically significant difference, and a relatively large effect size for POST and FUPduration of sustained phonation. In this case, a true change is likely. The interpretation of effect size in this study is limited. The ability to interpret effect sizes in single-subject designs requires averaging them across studies in order to establish meaningful effect size magnitudes for specific variables of interest for a given treatment approach (Beeson &Robey, 2006). Including effect size calculations in the current study will contribute to interpretation of outcomes from future studies.

Changes in Parent Ratings

Qualitative information from parent ratings identified improvement on some perceptual variables, which may

indicate a possible impact in the participant's daily living, outside of the laboratory setting. Parent ratings corroborated many of the listener perceptions of improvement immediately posttreatment. Although the parent ratings must be interpreted with caution, given the lack of replication, moderate intrarater reliability, and descriptive level of analysis, they are a step in the direction of assessing external validity of the findings. Future work should continue to address the perceived impact of treatment on family, friends, and teachers in the environment.

Did Treatment Effects Last?

Maintenance of listener preferences at FUP varied across participants. Listeners did not perceive P1 to have maintained any of the improvements in perceptual characteristics from BASE to FUP, but listeners perceived P2 to have maintained all of the improvements from BASE to FUP, P3 to have maintained two of the five improvements from BASE to FUP, and P4 to have maintained three of the six improvements from BASE to FUP. Perceptions of improvement that were maintained included those most closely related to the treatment target of voice (e.g., overall loudness, loudness variability, and overall voice quality). All acoustics measures showed maintenance or improvement of skill from BASE to FUP with the exception of F0 range for P1. Parent perceptual ratings at FUP were not maintained at POST levels for P1, but they were maintained for P2 and somewhat maintained for P3. FUP data were not available from the parents of P4.

The maintenance of treatment effects may have depended on multiple factors, such as acceptance of the treatment techniques and family support. Although we did not systematically log home practice in the 6-week interval between POST and FUP, parents reported on their child's progress. P2's parent indicated that she frequently reminded herself to use her loud/strong voice and she did so regularly in daily communication. P3's mother reported that if she could not understand her son, cueing him to repeat with his "strong voice" was a helpful strategy. P4 had four older siblings who constantly cued him to use his "big voice." For P1, changes in speech were not maintained according to listener and parent ratings. The parent reported that P1 was unwilling to practice on his own or with family members.

General Comments on Treatment Mode and Target

The intensive treatment protocol consistent with select principles of motor learning and activity-dependent neuroplasticity was well tolerated by all participants,with 100% compliance during the treatment phase. These findings are similar to those of Schindl et al. (2000) for an intensive gait-training program and Pennington et al. (2010) for intensive speech therapy for children with CP. According to parent report, physical fatigue occurred in most participants at the start of treatment; however, over time they reported that fatigue diminished. P1's parent even reported in later treatment sessions that he was "energized" and performed better on other tasks, such as physical therapy, when they occurred on the same day. Repeated active-practice trials in therapy were also well tolerated by participants with CP. Most of the treatment sessions were completed without breaks for rest.

The treatment target of vocal loudness was highly salient to the participants. At BASE, all parents reported concerns about their child's vocal loudness, citing "softspeech," "breathy, quiet voice," "maintaining loudness at end of sentences," and "whispered voice." At the same time, the speech-language pathologists reported that some of these children also had occurrences of "harsh voice quality" and "strained voice quality." We speculate that the poor voice quality that occurred prior to treatment may have been the result of compensatory strategies to overcome generalized weakness of respiratory and laryngeal musculature (Ansel &Kent, 1992). With treatment, the need for compensatory behaviors may have been diminished at POST and replaced with improved vocal strategies as indicated by listener comments of "less strain [or pressed or strangled]" for all four treated participants. This is similar to findings in individuals with PD after treatment with LSVT LOUD (Countryman, Hicks, Ramig, &Smith, 1997). To confirm these speculations, further study is needed in children with CP and dysarthria. Severity of dysarthria also may play a role in treatment success. The child with CP who demonstrated the greatest improvements across all acoustic measures in this study (P2) had the mildest rating of dysarthria. P3 differed slightly from the other participants in that he was described as having spastic- ataxic

dysarthria characterized by variable loudness. For this participant, listeners preferred POST and FUP speech samples on the measure of loudness variability, which is consistent with reported improved control over variable loudness post-LSVT in an adult with ataxic dysarthria (Sapir et al., 2003). For P4, the parents rated increased hoarseness at POST. This may be explained by the fact that, after therapy, P4 was voicing versus whispering, which may have made parents more aware of vocal quality. Increased hoarseness was not reported by listener perceptions of improved voice quality on single-word repetitions at POST and FUP or with reported HNR values.

Study Limitations and Future Directions

The single-subject design used for this study precludes generalization of these results to the population of children with spastic CP. The liberal tolerance of Type I errors may have overestimated some of the treatment outcomes. Adding a spontaneous speech task with a peer or parent interaction in a naturalistic environment would have been desirable. The inclusion of systematic monitoring of homework practice sessions would have been helpful for the interpretation of skills maintenance. Furthermore, there is a need for including ratings of speech intelligibility at a single-word and connected speech level (Pennington et al., 2010).

Future studies may investigate additional acoustic parameters of voice and speech. Examining potential physiological changes that may accompany treatment will provide insight into the mechanism of change. In addition, examination of alternative treatment targets (e.g., oromotor exercises or articulation) administered in a parallel mode and intensity will help delineate key elements of treatment success. Future studies are also required to determine duration of treatment effects (e.g., more than 6 weeks) and to delineate the most effective dosage. Finally, studies that engage a larger number of children with spastic CP are required to determine generalizability of treatment outcomes for this population.

Summary

Improving speech in children with CP is challenging. Many of these children have a range of medical problems, multiple speech mechanism disorders, and cognitive deficits, all of which may limit the magnitude and long-term effects of treatment outcomes. This Phase 1 treatment study (Robey &Schultz, 1998) examined a standardized treatment approach (LSVT LOUD) in children with spastic CP and dysarthria. Findings provide some preliminary support for intensive voice treatment to improve select aspects of vocal functioning in the children with spastic CP and dysarthria who participated in this study. Future Phase 2 treatment research studies are warranted.

Acknowledgments

This work was supported, in part, by National Multipurpose Research and Training Center Grant DC-01409 from the National Institute of Deafness and Other Communication Disorders and by the Final Project Fund from the Graduate College at the University of Arizona. This article is based on a doctoral dissertation completed by Cynthia Marie Fox at the University of Arizona under the direction of Carol Ann Boliek and Jeannette Hoit. We thank Jeannette Hoit, Brad Story, Leslie Tolbert, Becky Farley, and Lorraine Ramig for their expert advice. Special thanks go to the children and families who participated in this study.

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Editor: Anne Smith
Associate Editor: Jessica Huber
Received August 24, 2010
Revision received March 4, 2011
Accepted October 19, 2011
DOI: 10.1044/1092-4388(2011/10-0235)
Disclosure Statement
Cynthia Marie Fox receives lecture honoraria and has ownership interest in the for-profit company LSVT Global, Inc. She is in full compliance with Federal Statute 42 C.F.R., Part 50, Subpart F (see http://grants.nih.gov/grants/compliance/42_CFR_50_Subpart_F.htm) and the University of Colorado-Boulder Policy on Conflict of Interest and Commitment.

Publication date: Jun 2012

Year: 2012

Temporal and speech processing skills in normal hearing individuals exposed to occupational noise

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Publication info: Noise & Health 14.58 (May 2012): 100-5.
ProQuest document link

Abstract: Prolonged exposure to high levels of occupational noise can cause damage to hair cells in the cochlea and result in permanent noise-induced cochlear hearing loss. Consequences of cochlear hearing loss on speech perception and psychophysical abilities have been well documented. Primary goal of this research was to explore temporal processing and speech perception Skills in individuals who are exposed to occupational noise of more than 80 dBA and not yet incurred clinically significant threshold shifts. Contribution of temporal processing skills to speech perception in adverse listening situation was also evaluated. A total of 118 participants took part in this research. Participants comprised three groups of train drivers in the age range of 30-40 (n= 13), 41 50 (= 13), 41-50 (n = 9), and 51-60 (n = 6) years and their non-noise-exposed counterparts (n = 30 in each age group). Participants of all the groups including the train drivers had hearing sensitivity within 25 dB HL in the octave frequencies between 250 and 8 kHz. Temporal processing was evaluated using gap detection, modulation detection, and duration pattern tests. Speech recognition was tested in presence multi-talker babble at -5dB SNR. Differences between experimental and control groups were analyzed using ANOVA and independent sample t-tests. Results showed a trend of reduced temporal processing skills in individuals with noise exposure. These deficits were observed despite normal peripheral hearing sensitivity. Speech recognition scores in the presence of noise were also significantly poor in noise-exposed group. Furthermore, poor temporal processing skills partially accounted for the speech recognition difficulties exhibited by the noise-exposed individuals. These results suggest that noise can cause significant distortions in the processing of suprathreshold temporal cues which may add to difficulties in hearing in adverse listening conditions.

Full text: Introduction

One of the major causes of cochlear hearing loss especially in adults is noise. Prolonged exposure to high levels of noise results in noise-induced hearing loss. The prolonged exposure to high levels of noise causes damage to the hair cells in the cochlea and results in permanent noise-induced cochlear hearing loss. Noise damage to hearing is a health risk which is associated with both civilian and military occupations as well as certain leisure activities. Psychophysical evidence indicates that presence of cochlear hearing loss causes deficits in temporal processing. [1] Temporal processing encompasses a wide range of auditory skills including temporal resolution or temporal discrimination (i.e., gap detection and fusion), masking (i.e., backward and forward masking), temporal integration (i.e., temporal summation), and temporal ordering (i.e., temporal sequencing), as well as localization and pitch perception. [2] Normal perception of the temporal aspects of the stimulus is crucial for understanding speech in quiet and adverse listening conditions. [3] It has been shown that individuals with cochlear hearing loss perform poorly on tasks such as gap detection, modulation detection, and temporal integration. [1] One of the important factors that contribute to the poor performance hearing-impaired listeners on temporal processing tasks is audibility of high-frequency signals. [1] Apart from audibility, the suprathreshold distortions can also contribute to the poor performance of hearing-impaired listeners on temporal processing tasks. These suprathreshold distortions may be caused by changes in the central auditory system secondary to cochlear damage. Long-term exposure to high levels of occupational noise is shown to result in hemispheric reorganization for speech processing. [4] Brattico [5] showed that well-known left hemisphere dominance in speech discrimination became right hemisphere preponderant in individuals exposed to occupational noise. Chang et al[6] in animal model showed that when infant rat pups were reared in moderate levels of noise, it resulted in delay of organizational maturation of the auditory cortex.

Recently, it has been shown that cochlear damage can occur without significant reduction in sensitivity. Fneg et al[7] measured the temporal resolution and speech perception in adults with sloping high-frequency sensory neural hearing loss in regions of normal hearing. Temporal resolution was evaluated through amplitude modulation detection and gap detection in noise. Speech perception was assessed trough hearing in noise test. Results showed that individuals with sensory neural hearing loss performed poorly on both gap detection and modulation detection even though the stimulus was restricted to the regions of normal hearing. They hypothesized that the deterioration in temporal resolution in individuals with high-frequency sensory neural hearing loss is caused by central auditory deficits secondary to cochlear damage or subclinical cochlear damage in the lower frequencies. Evidences from the animal research also suggest that the cochlear lesion can occur without significant change in the hearing sensitivity. [8]

Consequences of cochlear hearing loss on speech perception and psychophysical abilities have been well documented. The aim of this study was to evaluate the speech recognition and temporal processing abilities of train drivers with normal hearing sensitivity who were exposed to continuous noise of more than Leq8h of 80 dBA of the engine for a period of more than 10 years.

Methods

We evaluated (1) gap detection in noise; (2) modulation detection for sinusoidally amplitude modulated noise at 8, 20, 60, and 100 Hz; and (3) duration pattern and speech recognition in the presence of multi-talker babble at -5 dB signal to noise ratio in individuals who were exposed occupational noise of more than Leq8 h of 80dBA. Results were compared with matched control group. Contribution of temporal processing skills to speech perception in adverse listening situation was also measured.

Participants

A total of 118 participants took part in this research. Participants comprised three groups of train drivers in the age range of 30-40 (n = 13), 41 50 (= 13), 41-50 (n = 9), and 51-60 (n = 6) years and their non-noise-exposed counterparts (n = 30 in each age group). Because both the temporal processing and speech perception are influenced by age, participants were subgrouped depending on age. Our earlier study has shown that temporal processing skills of individuals below 40 years were significantly different from those of elderly group. [9] All the members of the experimental group were exposed to railway engine noise for about 8-10 hours a day for a period of more than 10 years. The amount of leisure time varied between 1 and 3 hours. Noise survey showed that the engine noise at the level of the train driver's ear was Leq of 86 dBA. Participants of all the groups including the train drivers had hearing sensitivity within 25 dB HL in the octave frequencies between 250 and 8 kHz. None of the subjects reported any otological or neurological problems, usage of ototoxic drugs, or exposure to organic solvents.

Stimulus and procedure

Psychophysical tests

Gap detection and modulation detection were measured using "mlp" tool box which implements a maximum likelihood procedure in Matlab. [10] The maximum likelihood procedure uses a large number of candidate psychometric functions and after each trial calculates the probability (or likelihood) of obtaining the listener's response to all of the stimuli that have been presented given each psychometric function. The psychometric function yielding the highest probability is used to determine the stimulus to be presented on the next trial. Within about 12 trials, the maximum likelihood procedure usually converges on a reasonably stable estimate of the most likely psychometric function, which then can be used to estimate threshold. [11],[12] Stimuli were produced at 44,100 Hz sampling rate. A two-interval alternate forced choice method using a "maximum likelihood procedure" was used to track an 80% correct response criterion. During each trial, stimuli were presented in each of the two intervals: One interval contained a reference stimulus and the other interval the variable stimulus. The participant indicated after each trial which interval contained the variable stimulus. Stimuli for the duration pattern test were generated using Audacity software 1.3.5 (beta version 2008). In all of the

psychophysical tests, stimuli were presented binaurally at an intensity of 80 dB SPL. Stimuli were presented via a laptop computer (Lenovo 3000 G530) connected to EAR-3A earphones. Output of the earphones was calibrated at the beginning of the experiment and regularly thereafter to produce 80 dB SPL for a 1 kHz pure tone in a 2cc coupler. For this purpose, a 1 kHz pure tone was generated at the same root mean square (rms) level as the test signal. Output of the ear phone was routed to a 2cc coupler which was connected to a sound level meter (Quest 1800) and a microphone (Quest 4180). The volume control of the computer was adjusted to produce 80 SPL on the sound level meter. Subjects were given three to four practice trails before the commencement of each test. All psychophysical tests were carried out in a quiet room.

Gap detection in white noise

In this subjects, ability to detect a temporal gap in the center of 750 ms broadband noise was measured. Duration of gap was varied according to the listener performance using maximum likelihood procedure. The noise had 0.5 ms cosine ramps at the beginning and end of the gap. In two interval alternate force choice tasks, the standard stimulus was always a 750 ms broadband noise with no gap, whereas the variable stimulus contained the gap.

Modulation detection thresholds

Temporal modulation refers to a reoccurring change (in frequency or amplitude) in a signal over time. A 500 ms Gaussian noise was sinusoidally amplitude modulated at modulation frequencies of 8, 20, 60, and 200 Hz. Noise stimuli had two 10-ms raised cosine ramps at onset and offset. The subject had to detect the modulation and determine which interval had the modulated noise. Modulated and unmodulated stimuli were equated for total rms power. Depth of the modulated signal was varied according to the participant's response up to an 80% criterion level. The modulation detection thresholds were expressed in dB by using the following equation:

Modulation detection thresholds in dB = 20 log 10 m

where m = modulation detection threshold in percentage

Duration pattern test

The duration pattern test was administered in the manner described by Musiek et al. [13] A 1000 Hz pure tone was generated at 44,100 sampling frequency with two different durations (i.e., short 250 ms and long 500 ms) using Audacity software (ver. 1.3.5). By combining these two durations in three-tone patterns, six different patterns were generated (Short Short Long, Short Long Short, Long Long Short, Long Short Short, Short Long Long, Long Short Long). Interstimulus interval was 250 ms within a tone sequence and 6 s between two tone sequences. Following practice trails, 30 test items were administered. Participants were asked to verbally repeat the sequence.

Speech recognition with multi-talker babble

Speech recognition ability of the subjects was tested using a set of custom-made sentence material. Eighty sentences were constructed with a reasonable degree of homogeneity, complexity, and sentence length. Each sentence had four to five key words. These 80 sentences were provided to five native Kannada speakers (age range: 20-40 years) who had at least 15 years of formal education in Kannada. These five Kannada speakers served as judges. They were instructed to underline the key words and also to rate the complexity levels of the sentences on a five point rating scale (1, very difficult; 2, moderately difficult; 3, difficult; 4, easy; 5, very easy). Ten sentences were selected from this pool based on judge's ratings. The selected sentences had a 100% agreement among all the five judges in terms of the key word identification and the complexity level ratings. There were a total of 44 key words. Sentences used in the test are provided in Appendix I. A 23-year-old native male Kannada speaker spoke these sentences. Using the Praat software the spoken sentences were digitally recorded on a Presario C700 Compaq laptop in a sound treated room via a JVC MV 40 microphone. The sampling frequency was set at 44,100 Hz. Using a custom-written Matlab code, four-talker babble was added to the sentences at -5 dB SNR. The Matlab program first calculated the rms amplitude of the speech stimulus and then adjusted the rms of the four-talker babble to achieve the desired signal to noise ratio. These sentences

were randomly presented to the subjects at 80 dB SPL intensity through an insert EAR-3A earphones which were connected to a computer. Subjects were instructed to repeat the sentences. The repeated sentences were recorded and used for further analysis. Each correctly repeated key word was given a score of "1" and the total number of correct responses was calculated for each subject separately.

Results

Psychophysical tests

Gap detection in noise

[Figure 1] shows the mean and 1 SD error bars for gap detection thresholds in the experimental and control groups across different age groups. Two-way ANOVA was done to test the significance of differences between the mean gap detection thresholds of different groups. ANOVA did not reveal a significant main effect of noise exposure on the gap detection thresholds [$F(2,124) = 1.08$, $P > 0.05$].{Figure 1}

Modulation detection thresholds

[Figure 2]a shows the mean modulation detection thresholds for 8, 20, 60, and 200 Hz modulation frequencies along with the 1 SD of variation in experimental and control group in the age range of 30-40 years. The mean and standard deviation values of the modulation detection thresholds for 41-50 years and 51-60 years group are shown in [Figure 2]b and c, respectively. MANOVA was done to find the significance of differences between the means of modulation detection thresholds between experimental and control groups. MANOVA showed the significant main effect of participant groups on the modulation detection thresholds [$F(4,122) = 4.78$, $P0 < 0.01$]. Post hoc analysis with Bonferroni correction revealed that noise-exposed group had significantly poor modulation detection thresholds in higher frequencies (at 60 and 200 Hz modulation frequencies) in 30-40 years and 41-50 years.{Figure 2}

Duration pattern test

[Figure 3] shows the mean and 1 SD error bars for duration pattern scores. From [Figure 3], it can be seen that the experimental group had poorer duration pattern scores compared with control group in all the three groups. Two-way ANOVA showed a significant main effect of subject group on the DPT scores [$F(1,125) = 49.9$, $P < 0.01$]. Follow-up non-parametric independent sample t test revealed that the experimental group had significantly poorer duration pattern scores than their age-matched control group across all the three age groups [($t = 2.159$ and $= 2.159$ and $P0 < 0.05$ for 30-40 years age group), ($t = 2.323$ and $= 2.323$ and $P < 0.05$ for the 40-50 years age group), and ($t = 2.906$ and $= 2.906$ and $P < 0.05$ for the age group of 50-60 years)].{Figure 3}

Speech recognition with multi-talker babble

The speech recognition scores were converted into rationalized arcsine transferred scores [14] and all the statistical analysis was done on arcsine-transferred scores. [Figure 4] shows mean and standard deviation values for speech identification scores in experimental and control group. Two-way ANOVA revealed a significant main effect of subject groups on the speech perception scores [$F(1,125) = 51.8$, $P < 0.01$]. Follow-up non-parametric independent sample t test showed that the individual's ability to recognize speech in presence of noise was poor in noise-exposed participants compared with their age-matched control groups [($t = 4.836$ and $= 4.836$ and $P < 0.05$ for 30-40 years age group), ($t = 3.481$ and $= 3.481$ and $P < 0.05$ for the 40-50 years age group), and ($t = 2.422$ and $= 2.422$ and $P < 0.05$ for the age group of 50-60 years)].{Figure 4}

To study the relationship between speech recognition scores and temporal processing abilities, Pearson's Product Moment correlation analysis and multiple regression analysis were performed. For this purpose, data from all the age groups were combined. [Table 1] and [Table 2] show the results of multiple regression and correlation analysis. From the [Table 1] and [Table 2], it can be seen that gap detection in noise, modulation detection threshold at 200 Hz and duration pattern scores are significant predictors of speech recognition scores.{Table 1}{Table 2}

Discussion

Primary goal of this research was to explore temporal processing and speech perception skills individuals who

are exposed to occupational noise and not yet incurred clinically significant threshold shifts. Results revealed that both the temporal processing and speech perception skills were adversely affected in noise-exposed group. Given the present data, the observed deterioration in the temporal and speech processing skills in the noise-exposed individuals, in the presence of normal hearing sensitivity probably due to changes in the central auditory system was caused due to prolonged exposure to occupational noise. It has been reported that long-term noise may have persistent effect on brain function and behavior, even when the peripheral hearing sensitivity is within normal range. Persistent effects of long-term noise exposure on central auditory system were evaluated using auditory evoked potentials. Kujala et al. [4] assessed the performance in visuo-motor target tracking task and simultaneously recorded the mismatch negativity for /pa/ and /ka/ contrasts on healthy individuals who were exposed to high levels of occupational noise. All their subjects had hearing thresholds that were comparable to the control group. Results showed impaired syllable-discrimination in the left hemisphere of noise-exposed individuals in silence and increased N2b complex for the novel sounds. Furthermore, attention control and ability to focus on visuo-motor tasks were aberrant in noise-exposed group. These results suggest that long-term exposure to occupational noise effects both sound discrimination mechanism and attention control mechanism. Brattico et al[5] measured the neural responses in normal hearing, noise-exposed, and non-exposed participants to speech and non-speech deviants. Brain electrical source modeling suggested that speech sound contrast was lateralized to left hemisphere in non-noise-expose group but in right hemisphere in noise-exposed group. This group differences were not found for the non-speech deviants. These studies show that long-term occupational noise can have a detrimental effect on the central auditory system. This detrimental effect has been observed even when the peripheral hearing sensitivity is intact. The observed deficits in the temporal and speech processing abilities in normal hearing, noise-exposed individuals in this study may be due to compromised central auditory system in these individuals. However, we cannot totally exclude the deleterious effects of distorted cochlear input as a factor. Normal hearing sensitivity does not necessarily mean the normal functioning of the cochlea in noise-exposed individuals. Evidences from the animal research suggest that cochlear functioning can be affected even in the presence of normal-hearing sensitivity. [8] Since in this study otoacoustic emission testing was not carried out due to technical and logistic issues, it is difficult to rule out the possibility of subtle cochlear dysfunction. Kujawa and Liberman [8] reported a rapid and irreversible degeneration of spiral ganglion cells by the noise exposure which resulted in the temporary threshold shifts. Even after, hair cells and hearing sensitivity were recovered and neuronal loss persisted. Effects of such neuronal losses on auditory and speech processing are detrimental.

In general, a trend of reduced temporal processing skills was observed in individuals with noise exposure. Although gap detection thresholds and modulation detection thresholds for low modulation frequencies were not statistically different between noise-exposed and non-exposed group, nevertheless mean modulation and gap detection thresholds were slightly lower in the noise exposed group. Modulation detection thresholds for the high modulation frequency and duration pattern scores were significantly poorer in noise-exposed group compared with control group. In the auditory system, modulations are represented by phase locked neural discharges of the auditory nerve fibers to individual cycles of modulation frequency. Data from the animal research have shown that acoustic over exposure can cause acute loss of afferent nerve terminals and degeneration of cochlear nerve. This might cause disruption in the phase locking and synchronization in the discharge patterns of auditory nerve fibers causing poor modulation detection thresholds. Poor modulation detection thresholds for higher modulation frequencies suggest that noise-exposed individuals had difficulty in perceiving rapid fluctuations in the stimulus. Any complex broadband signals such as speech can be decomposed by auditory filters into relatively slow variations in the amplitude over time called envelop and relatively rapid oscillations called temporal fine structure. Importance of slowly varying temporal envelope in speech perception is well documented. [15] Recently, it has also been demonstrated that temporal fine structure plays a crucial role in hearing in the presence of background noise. [16] It is necessary to perceive the rapid

oscillations to derive benefits of temporal fine structure cues. Difficulty in perceiving rapid amplitude fluctuations in noise exposed group may also pose problems in coding temporal fine structure. This may be one of the reasons for poor performance of noise-exposed individuals in speech perception measures. It is also been suggest that speech is comodulated at the rate of fundamental frequency (in this study mean fundamental frequency of the target stimulus was 211 Hz). It is important to perceive these comodulations to perceptually separate target speech and background babble as different acoustic streams. Difficulty of noise-exposed individuals in perceiving the rapid amplitude fluctuations may limit their ability perceptually segregate target and background babble. [17] Duration pattern assess the auditory sequencing abilities. Auditory short-term working memory and auditory attention are crucial for good performance on duration pattern test. There is good evidence that noise exposure impairs working memory and attention. [18] These deficits in the attention and working memory capacities might have caused poor performance in duration pattern test in noise-exposed individuals.

The second goal of this study was to see whether there is a relationship between temporal processing abilities and speech perception measures. The overall speech recognition scores were poorer in noise-exposed group compared with control group. Multiple regression analysis with speech recognition scores as dependent variable showed that temporal processing skills can account for the 26% of the variability seen in the speech recognition scores. Gap detection thresholds, modulation detection threshold for 200 Hz modulation frequency, and duration patter scores were significantly related to speech perception in noise. Overall, results suggest that speech recognition in noise was adversely affected in individuals who are exposed to occupational noise, although the peripheral hearing sensitivity was intact and this deficit in speech recognition in noise was partially accounted by the poor temporal processing abilities. While interpreting the results of this study, it should be kept in mind that we did not subgroup the participants based on the duration of noise exposure as this would reduce the number of participants in each group. Duration of noise exposure along with other conditions such as cardiological problems (arrhythmia, anemia), hypertension, hyper-cholesterol, and heavy smoking could have potentially influence the results.

In summary, results of this study indicated deterioration in temporal and speech processing abilities of individuals who were exposed to occupational noise. These deficits were observed despite normal peripheral hearing sensitivity. These results suggest that noise can cause significant distortions in the processing of suprathreshold temporal cues which may add to difficulties in hearing in adverse listening conditions.

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Publication date: May 2012

Year: 2012

Computer-based hearing loss prevention education program for Veterans and military personnel

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Publication info: Journal of Rehabilitation Research and Development 49.4 (2012): vii-xvi.
ProQuest document link

Abstract: According to the learning theory, adults learn best when information is practical and relates meaningfully to their lives [11]. *The program is self-administered. [...]137 individuals used the booth more than once-a finding determined by responses to the question, "Have you used this program in this booth before?" (Table 2).

Full text: INTRODUCTION
According to the Veterans Benefits Administration, more than 672,000 Veterans were service-connected for hearing loss and more than 744,000 Veterans were service-connected for tinnitus as of fiscal year 2010 [1]. Hearing loss and tinnitus are the most prevalent disabilities experienced by Veterans who served during peacetime, Operation Iraqi Freedom/Operation Enduring Freedom, World War II, and the Korean war. In fiscal year 2010, the Department of Veterans Affairs (VA) provided 561,212 hearing aids at an estimated cost of $196.7 million and audiological services to Veterans at a cost of $227.4 million.* Therefore, hearing loss and

tinnitus prevention should be a priority for the VA. At least one type of hearing loss-noise-induced hearing loss (NIHL)-can be prevented if appropriate protective strategies are implemented.

Citing the high prevalences of hearing loss and tinnitus among Veterans, Fausti et al. concluded that programs aimed at preventing hearing loss should include education concerning the effects of both occupational and recreational noise exposures, as well as counseling on the hearing protection methods available to individuals at risk for NIHL [2]. Subsequently, authors Saunders and Griest worked with a video production company (Craftmaster Productions; Portland, Oregon) to implement this recommendation by developing a computer-based hearing loss prevention program (HLPP) for Veterans that could be accessed by patients in VA medical clinics [3].

HEARING LOSS PREVENTION PROGRAM

The HLPP uses the constructs described in the Health Belief Model (HBM) developed by Rosenstock [4] to explain individual differences in decisions to practice particular health behaviors. To varying degrees, the HBM predicts health-related behaviors, such as prenatal care visits [5], breast cancer self-examination [6], continued enrollment in diabetes-related pharmaceutical services [7], and hepatitis B vaccination [8]. The principles outlined in the HBM were described by Folmer et al. [9, p. 12] as follows:

1."Perceived Susceptibility: The feeling of being vulnerable to a condition and the extent to which the individual believes he/she is at risk of acquiring the condition.

2.Perceived Severity: Belief in the seriousness of the consequences incurred if [a person is] affected by the condition both medically (e.g. death, disability, pain) and socially (e.g. effects on family life, personal relations).

3.Perceived Benefits: The belief that intervention will result in positive benefits.

4.Perceived Barriers: The barriers an individual believes he/she needs to overcome in order to effectively conduct some form of intervention. This includes costs, negative side effects, social stigma, and time needed for implementation.

5.Perceived Efficacy: Belief the individual has that he/she can successfully use the intervention.

6.Cue to Action: A cue that prompts an individual to take action. This could be internal, such as symptoms of a health problem, or external, such as media communications, interpersonal communications, or information from healthcare providers."

One goal of the HLPP is to increase participants' knowledge about auditory system damage that can be caused by loud sounds and methods of hearing protection, which in turn would change participants' understanding and attitudes about noise exposure and hearing protection. The ultimate goal of this, and all HLPPs, is to motivate participants to change their behaviors in noisy situations so they implement appropriate hearing protection strategies. Most Veterans were exposed to loud sounds during their military service. Additional unprotected noise exposure will contribute to hearing loss in this population. Indeed, evidence exists that ears with prior noise damage age differently than those without significant noise exposure. Specifically, hearing loss progresses more quickly in noise-exposed ears than in ears not exposed to noise and loud sounds cause greater damage to already-exposed ears [10]. Given this knowledge, it follows that Veterans, whose ears were probably exposed to high levels of noise during military service, must now protect their ears to avoid exacerbating cochlear damage and thus accelerating the progression of age-related hearing loss. The VA does not provide a hearing loss prevention education program for Veterans, although such instruction would be beneficial.

The HLPP is a self-administered, multimedia, computer-based program developed for Veterans and designed for use in an outpatient clinic or in a communal area of a hospital. It has the following specifications (as described by Folmer et al. [9, p. 15]):

*The HLPP "is modular in design so that users can select topics in which they are interested. According to the learning theory, adults learn best when information is practical and relates meaningfully to their lives [11].

*The program is self-administered. It does not require a professional to supervise or train users.

*The program is low maintenance and does not require upkeep from healthcare professionals. The software can be modified to implement changes to the program's content.
*The presentation volume level is adjustable to accommodate hearing-impaired individuals, since many Veterans [already] have [some] hearing loss.
*The visual components of the program are clearly visible [e.g., large text fonts are used] in accordance with published guidelines [12]."
*All written content of the program has a reading level of between grades 5 and 8 so that it is understandable to a large proportion of the adult population [13].
In 2007, authors Leek and Fausti received a Joint Incentive Fund (JIF) award to develop a stand-alone hearing loss prevention education program for Veterans and military personnel. JIF is a VA and Department of Defense (DOD) collaborative program that is designed to facilitate the mutually beneficial coordination, use, or exchange of health care resources, with the goal of improving the access to and quality and cost-effectiveness of the healthcare provided to beneficiaries of both departments. Leek and Fausti worked with the other authors of this article to redesign and adapt the HLPP for both Veterans and Active Duty military personnel. The new version of the JIF HLPP includes the following elements, which were described by Folmer et al. [9, p. 12]:
*A sound-attenuated enclosure-called the Hearing Education Center (HEC)-"(6 feet wide by 8 feet long by 8 feet high) in which one participant at a time interacts with the program (Figure 1).
*"On a booth exterior wall, a 402 flat screen LCD [liquid crystal display] displays silent video clips and text describing [what] the booth [is] and activities available inside" (see Figure 1).
*One exterior wall of the booth features a life-size human outer ear that is made of flexible plastic and attached internally to a sound level meter (Figure 2). When participants insert an iPod or MP3 ear bud into the ear, the digital display shows the intensity of the music in decibels sound pressure level (SPL). Text in the wall panel instructs participants that 80 dB SPL or lower is a safe level for extended listening.
*The inside of the enclosure (Figure 3) has a work station with a computer touch screen monitor, a pair of high-quality headphones, a chair, and a printer that is inside a locked cabinet. The personal computer that powers the touch screen is also inside the locked cabinet and not accessible to users of the program. The touch screen allows participants to select among a variety of activities, and the printer allows them to print informational handouts and test results.
*On-screen video and audio instructions show participants how to place headphones on their ears correctly and to set the volume of the program at a comfortable listening level.
Effective health communication programs should be easily understandable, user-friendly, and culturally relevant [14]. For this reason, we worked with the Oregon Museum of Science and Industry (OMSI) in Portland, which designed and built the sound-attenuated booths and the "check your iPod" module and provided the graphical user interface and computer programs that deliver the audio and visual content. OMSI was selected to provide these program elements because the museum has a great deal of experience designing and building interactive exhibits for public use. Among its projects, OMSI built the "Dangerous Decibels" hearing conservation exhibit that was on display at the museum from 2002 to 2010 (www.dangerousdecibels.org). We also worked with a video production company (Craftmaster Productions) to develop new program content specifically for Active Duty soldiers and to produce a 3 min informational video on tinnitus. In versions of the program designed for Army personnel, content includes examples of noise exposure and hearing loss prevention strategies related to military training, combat, weapons fire, military vehicles, and recreational and occupational activities. Key messages include the importance of hearing for soldiers' readiness for duty, ability to carry out missions, and survival. By contrast, the version of the program designed for Veterans focuses more on quality of life and interpersonal communication difficulties that people with hearing loss experience, along with strategies for managing those difficulties.
After participants enter the booth, put on headphones, and set the volume of the program to a comfortable

listening level, they are asked to answer the following questions via the touch screen interface:
*Have you used this program in this booth before? (yes or no).
*I am a Veteran (yes or no).
*My age (<18, 18-29, 30-39, 40-49, 50-59, 60-69, 70-79, or 80+).
*I am (male or female).
*During the last year, I (check all that apply):
- Have been around loud sounds that made my ears hurt or "ring."
- Used power tools or loud machinery.
- Fired a gun.
- Listened to loud music.
*I wear ear plugs or ear muffs (hearing protectors) when I am around loud sounds (always, sometimes, never).
A 2 min video then introduces the program and provides some basic information about hearing, noise exposure, and hearing protection (Video). When the introductory video concludes, the program shifts to the main menu screen (Figure 4). Participants may then select from among the following activities:
*Module 1: Learn why, when, and how to protect hearing. This 4 min video provides an overview of basic information related to hearing loss prevention.
*Module 2: How do loud sounds damage hearing? This 2 min video contains 3-dimensional animations that show how hearing normally works and how loud sounds can damage inner ear structures. The animated segment was taken (with permission) from the 2004 video "Sound Advice" distributed by the Naval Medical Education and Training Center (Bethesda, Maryland).
*Module 3: How loud is too loud? First, a brief video describes how sound intensity is measured and shows examples of typical sound levels in the environment. The screen then shifts to an interactive activity that allows participants to select different listening situations of interest, including occupational and recreational settings. Participants are shown the typical sound levels for each example, safe exposure times, and appropriate hearing protection strategies to use in these situations.
*Module 4: Take a hearing screening test. Participants can conduct a self-administered hearing screening of high-frequency pure tones from 20 to 60 dB HL (hearing level). The Quick Test screens 4000 Hz (takes 2 min or less); a more complete test screens 3000, 4000, and 6000 Hz (takes 6 min or less). Participants have the option to print out test results and recommendations.
*Module 5: What does hearing loss sound like? This module begins with a brief video that demonstrates how hearing loss adversely affects communication abilities and social interactions. The screen then shifts to an interactive activity that allows participants to select from among different simulations of hearing impairment in a variety of listening situations, including speech, music, and environmental sounds. A 2 min segment from a "Flintstones" cartoon (with the audio portion filtered) demonstrates the progression from normal hearing to mild, moderate, and severe hearing loss. All these hearing loss simulations were produced by Sensimetrics Corporation (Malden, Massachusetts).
*Module 6: Learn about different types of hearing protection. Interactive screens provide information about different types of hearing protectors, with examples of what each type is most suited for. Participants have the option to print out information sheets to take with them. Brief videos show participants how to insert/fit and care for the protectors.
*Module 7: Do my ear plugs fit properly? This interactive module allows participants to evaluate the fit of their own ear plugs. The module is based on the National Institute for Occupational Safety and Health (NIOSH) "Quick Fit Test" that determines whether users are receiving at least 15 dB of attenuation from their ear plugs. The NIOSH test is available online at http://www.cdc.gov/niosh/mining/topics/hearingloss/quickfitweb.htm.
*Module 8: Learn about tinnitus (ringing in the ears). This 3 min video provides basic information about tinnitus, including strategies that will help sufferers successfully manage the condition.

*Module 9: Learn about hearing healthcare services at [booth location]. Two screens of basic information (including telephone numbers, addresses, Web sites, and clinic hours) describe hearing healthcare services available at each facility where a booth is installed. Participants have the option to print out an information sheet to take with them.
*Module 10: Learn about the National Center for Rehabilitative Auditory Research (NCRAR). Two screens briefly describe the NCRAR, the only Center of Excellence in the VA system dedicated to auditory research.
It would take participants 30-40 min to review all of the material in these 10 modules. However, participants can choose to interact with fewer modules if their time is limited.
Initial installations of HECs are at the Portland (Oregon) VA Medical Center; Joint Base Lewis-McChord, Washington; and Fort Stewart, Georgia. Access to the booths is free of charge and open to the public and does not require an appointment. The booths are located in relatively high-traffic areas, preferably where the target population may be spending some "down" time. For example, at the Portland VA Medical Center, the booth is located in a multiclinic waiting area where outpatients wait to be called for their medical appointments. At Fort Lewis, the HEC is located in the front corridor of Waller Hall, a large welcome/processing center that also contains Starbucks coffee and Subway sandwich shops. The booth at Fort Stewart is located near a food court and a large furniture/appliance store on base. The external video screen on the booth, as well as posted signs, encourage potential participants to enter the booth and use the program inside. No identifiable information is requested of program users, so there are no HIPAA [Health Insurance Portability and Accountability Act of 1996] or institutional review board issues regarding participant privacy.

DATA COLLECTED FROM PROGRAM PARTICIPANTS AT PORTLAND VA MEDICAL CENTER

At the start of the program, participants are presented with a series of questions regarding demographics, noise exposure, and use of hearing protection, responses to which are stored by the computer for later examination. Responding to questions in the program is voluntary; therefore, participants may skip (not answer) any questions if they so choose. After the preliminary questions are answered or skipped, participants watch an introductory video that provides information about hearing, noise exposure, and hearing protection. After the video, participants select among the 10 modules shown in Figure 4. When participants elect to exit the program, three additional questions are presented onscreen that ask about their experience in the HEC.
Table 1 shows the sex and age distribution for participants who visited the booth at the Portland VA Medical Center between July 1, 2010 (the day it was installed) and December 1, 2011. The fact that twice as many men versus women used the program is not surprising, given its location in a VA facility.
Table 2 shows distributions of responses to the following questions: "I am [male/female]," "Have you used this program in this booth before?" and "I am a Veteran [yes/no]." A large percentage (93.4%) of respondents reported that it was their first time using the program. Of the 2,068 individuals whose data are shown in Table 2, 1,218 were male Veterans, 150 were female Veterans, 175 were male non-Veterans, and 525 were female non-Veterans.
Table 3 contains responses to questions about participants' noise exposure during the previous year. These questions were asked before any educational content was presented. Participants were able to select more than one source of loud noise exposure. In the general population, males are more likely than females to participate in noisy activities, such as firing guns or using power tools. Data collected in the Portland HEC agrees with this trend: 512 (25%) of the total respondents (2,035) fired a gun during the previous year; the male:female ratio of shooters was >5:1, whereas the sex ratio for all booth participants was 2:1. The male:female ratio for respondents who used power tools or loud machinery during the last year was >4:1. This tendency for more males than females to engage in noisy activities is one of the reasons that male hearing sensitivity declines faster than that of age-comparable females.
Table 4 contains information related to participants' use of hearing protection devices (HPDs) when they are around loud sounds. This question was also asked before any educational content was presented. Only 13.6

percent of all respondents always wear HPDs when they are around loud sounds, a very low percentage that probably contributes to the prevalence of NIHL in this population. A relatively high percentage (48%) of females answered "Never" to this question (compared with 30% of males who answered "Never"). Some female participants possibly answered "Never" because they are seldom, if ever, exposed to extremely loud sounds, such as machinery, power tools, or gun fire.

Combining participants' responses to some questions in Tables 3 and 4 yielded the results shown in Table 5. Overall, these results indicate fairly low use of HPDs, which is typical in the general population. Particularly alarming is that only 19 percent of individuals always wore hearing protection when firing a gun, because gun fire is so loud that a single exposure without hearing protection can cause damage to inner ear structures, resulting in hearing loss and/or tinnitus. Also disappointing is the finding that only 14.6 percent of respondents always wore hearing protection when using power tools or loud machinery. These results illustrate the need for increased hearing loss prevention efforts among Veterans and the general public.

Table 6 contains participants' responses to three questions that appear on screen when participants elect to exit the session. Of more than 2,000 total program participants at the Portland VA Medical Center, approximately 50 percent of them took the time to answer these three questions. An overwhelming majority (98%) of responders thought the program was a good way to provide information about hearing protection and a similarly large percentage (97%) would recommend the program to family, friends, or coworkers. We were pleased to see that 92 percent of these responders would "now be more likely to protect" their hearing from loud sounds. Although actual implementation of hearing protection strategies is a better measure of compliance (or behavioral change), the participants' stated willingness to do so is encouraging.

Data from HECs at the two Army bases will be analyzed after a greater number of participants utilize the programs there.

DISCUSSION

According to Folmer et al. [9, p. 16], "previous studies of hearing loss prevention education programs found that it is relatively easy to increase participants' knowledge about how hearing works, how hearing is damaged by loud sounds, and how and when to employ protective strategies. However, it is more difficult to inspire participants to change existing behaviors and to implement new strategies in real-life situations" [15]. Clearly, our sample of individuals found the program to be enjoyable and useful. In fact, 137 individuals used the booth more than once-a finding determined by responses to the question, "Have you used this program in this booth before?" (Table 2).

We hope that this interactive, multimedia education program will encourage Veterans to implement hearing protective strategies in their daily lives. Author Saunders and colleagues at NCRAR are currently conducting a VA Rehabilitation Research and Development (RR&D)-funded formal evaluation of the program. The study employs personal noise dosimeters to measure real-world noise exposure; ecological momentary assessments to measure real-time reported behavior; and a questionnaire to assess knowledge, attitudes, and behaviors of participants before and after they use the HLPP.

This HLPP will require wide dissemination and utilization if it is to reduce the prevalence of NIHL and tinnitus at all. As stated by Folmer et al. [9, p. 17], we hope to make this program available to all Veterans, military personnel, and other members of the public by providing access "through the internet and medical centers throughout the country. Most of the educational content of the program can be delivered via computer anywhere and does not require sound-attenuated enclosures." Disseminating a computer-based HLPP through the Armed Forces could decrease the number of military personnel developing NIHL from noise exposure in training, combat, occupational, and recreational settings. In the long run, this would also decrease the number of Veterans experiencing and receiving compensation for hearing loss and tinnitus.

Footnote

*Dennis, Kyle C. (Audiology and Speech Pathology National Program Office, VA, Washington, DC). Email to:

Gabrielle Saunders. 2011 Nov 22.

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This article and any supplementary material should be cited as follows:

Folmer RL, Saunders GH, Dann SM, Griest SE, Porsov E, Fausti SA, Leek MR. Computer-based hearing loss prevention education program for Veterans and military personnel. J Rehabil Res Dev. 2012;49(4): vii-xvi. http://dx.doi.org/10.1682/JRRD.2012.02.0028

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ACKNOWLEDGMENTS

This project was funded by an award from the VA/DOD JIF. Additional support was provided by the VA RR&D NCRAR at the Portland VA Medical Center. The authors thank the following individuals for their efforts on this project: Mike Lewis, Kim Hall, and the staffat OMSI; Carl and Sharon Jameson at Craftmaster Productions; Eleanor Cannady, John Dodier, and staffat Portland VAMC.

Publication date: 2012

Year: 2012

HTC Titan II review

Publication info: Engadget [Engadget - BLOG] Chatham: Newstex. (Apr 12, 2012)

ProQuest document link

Links: Check LinkSource for Full Text

Full text: [Image removed: Image]Titan. It's a ballistic missile and one of Saturn's moons. The word also plays a huge role in Greek mythology and in normal use refers to something of enormous power and influence. So it's understandable, then, why HTC seems to prefer it as a name for its phones. So much so, in fact, that the release of the LTE-enabled Titan II on AT&T actually marks not the second, but fourth iteration of the name: if you recall, the company once released two Windows Mobile devices called the TyTn.We had mixed feelings as we watched the latest Titan get introduced at AT&T's Developer Summit in January. On the one hand, we were intrigued by the idea of a smartphone with a monstrous 16-megapixel camera, as well as LTE -- something the world previously hadn't seen on a Windows Phone device. But the announcement also took place a mere two months after its predecessor launched on AT&T's network, which gave us the sinking feeling Ma Bell's new strategy was to crank out a plethora of refreshed phones boasting only a couple of new features (see: the Samsung Galaxy S II Skyrocket). So what of this sequel we have before us? Will it come out victorious like Remember the Titans or a disaster like Titanic? Is it worth it to new customers to shun the free Nokia Lumia 900 and shell out $200 for this guy instead? Follow us down the page and we'll fill you in.

Gallery: HTC Titan II review

[Image removed:][Image removed:][Image removed:][Image removed:][Image removed:] Hardware It's amazing to witness the contrast in design philosophy between HTC's Windows Phones and its latest generation of Android devices (i.e., the One series). While one feels fresh, experimental, the other hearkens back to some of the Taiwanese company's older handsets. And it shouldn't be that difficult to figure out which one is which.We suppose it shouldn't come as too much of a surprise. After all, HTC likely views its Android phones as its cash cow, which is why it's invested so heavily in the success of the One X, the One S and their respective variants. The Titan II, on the other hand, doesn't appear to have received quite the same level of tender lovin' care from

HTC (or AT&T, for that matter), evidenced by its Easter Day launch, and a price at least double that of the Nokia Lumia 900 (depending on what kind of deal you find), its fiercest Windows Phone competitor. Nokia recruited Nicki Minaj to perform at a free concert in Times Square; HTC did... nothing.Of course, launch details have absolutely zilch to do with how the phone's features or performance, but we mention it to highlight one important aspect of the business: with the exception of Nokia, phone manufacturers aren't betting on Windows Phone handsets as a major source of revenue. And perhaps they won't be until the next generation of devices arrive on the scene, bearing Windows Phone 8 (Apollo). But because of this, these phones aren't given the same VIP treatment as their Android brethren. [Image removed: Image]Stepping off of our soapbox, let's dive into the ins and outs of the Titan II. It sensibly adds to the spec sheet of its predecessor in a few critical areas, such as connectivity, camera optics and battery life. Unfortunately, improvements like these never seem to have a flattering effect on the weight and size of a device. The phone measures 10.2mm (0.4 inches) at its thinnest point, 0.3mm thicker than the last-gen model. As for its thickest spot -- the hump that makes room for that larger camera sensor -- we pulled out a ruler and estimated it to be around 13mm (0.5 inches), and that doesn't even include the fact that the camera protrudes about a millimeter beyond the frame. If you believe the OG Titan's 9.9mm thickness was borderline acceptable, a 30 percent increase in thickness could be tough to swallow. The phone also tips the scales at 6.1 ounces (173g), a rather significant change from the first version's 5.64 ounces. Purchasing this phone will most certainly be a matter of compromise: it's thicker and heavier than the original (and in our opinion, its design is a touch uglier as well), but in return you're getting a larger battery, LTE connectivity and a 16-megapixel sensor instead of an 8-megapixel one.You heard it right: newer design doesn't always equate to better. The older Titan is sleeker, thinner, lighter and more elegant, while its sequel just feels more awkward and chunky in comparison. Despite its bulkier frame, the Titan II is still relatively easy to hold, especially if you're blessed with larger hands. It's still not as comfortable in our palms as the One X with its curvaceous, slightly thinner build, but at least the concave back is coated in soft-touch plastic that offers a degree of extra tactility. Still, where the One X was doable for smaller paws, this particular phone may be just a little too unwieldy for anyone with petite hands to fully appreciate it. [Image removed: Image]Quickly glancing at the front of the Titan II, you might not see much of a difference between this and the last-gen Titan: they sport the same display, along with three capacitive buttons and a front-facing camera with an Inspire 4G-style recessed speaker grille up top. Look closer, though, and you'll see the glass curves up slightly once it reaches the navigation keys at the bottom, forming a small chin.The micro-USB charging port still sits by its lonesome on the left side of the phone, while a volume rocker and two-stage camera shutter button play together on the opposite end. Up top you'll find the power / lock button, mic and 3.5mm headphone jack, which is actually designed with the signature HTC bump around it. This design flourish wasn't present on the first Titan and frankly, we preferred it that way; the bump just feels like an interruption of those smooth curves you'll find on the back side. It's a similar story around the micro-USB opening, though the effect is far more subtle. [Image removed: Image]The back side is where the phone becomes more interesting. Instead of choosing a one-piece removable battery cover that encompasses the entirety of its rear (as it did on the first Titan), the Titan II's back is separated into three sections, and only one -- the cover protecting the SIM card panel near the bottom of the device -- is removable. But be warned: removing the cover will automatically turn off the handset. This is thanks to some antenna contacts that are printed on the inside of that cover and have matching contacts in the phone's chassis. A silver microswitch labeled ALPS detects that it's been removed and powers down the device. It can come in handy if your phone freezes and you want to perform a soft reset, but woe to you if you happen to be in the middle of something incredibly important when you want to swap out your SIM. As for the cover itself, it's the only section of the handset that's textured in any way, with hundreds of shallow little divots. Despite this design choice, it doesn't offer much additional traction for your slippery hands, though we found it to be quite helpful when sliding the cover off.Moving up the back, the middle section emulates the signature HTC unibody style that was prevalent in so many models last year, but it's interrupted by another piece on the top that covers the

camera sensor, dual LED flash and speaker grille. Both sections are non-removable and each uses a different shade of grey, which isn't an unusual design choice for the Taiwanese company (why, the grey / blue One S takes a similar tack, only the fading colors are arranged inversely to this).If you're looking for heaps of storage space, you're not going to find it here. The Titan II contains 16GB of internal memory and, just like the vast majority of WP7 devices, is lacking in any external storage options. Unless you prefer to stash all of your important files away in the cloud, you'll have to be rather picky about what goes on your phone at a given time, since you only get 13.5GB of user-accessible storage. This may sound like plenty of room for some of you, but remember that as camera resolutions have increased, image files have grown much larger (roughly 4MB to 5MB per photo), and these super-sized pics are likely to eat up your available space as an appetizer.In case you're interested in the full spread of specs, we've put together a nice little table to compare the Titan II's offerings with what you'll find on the original version as well as the Lumia 900, the phone's main competition in the Windows Phone sphere, particularly on AT&T.

HTC Titan II	HTC Titan	Nokia Lumia 900	Dimensions
5.2 x 2.7 x 0.4 inches (132 x 69 x 10.2mm)	5.18 x 2.78 x 0.39 inches (131.5 x 70.7 x 9.9 mm)	5.03 x 2.7 x 0.45 inches (127.8 x 68.5 x 11.5mm)	Weight
6.1 oz (173g)	5.64 oz (160g)	5.64 oz (160g)	Screen size
4.7 inches	4.7 inches	4.3 inches	Screen resolution
800 x 480 (199ppi)	800 x 480 (199ppi)	800 x 480 (217ppi)	Screen type
S-LCD	S-LCD	ClearBlack sAMOLED+	Battery
1,730mAh	1,600mAh	1,830mAh	CPU
1.5GHz single-core Qualcomm MSM8255T (Snapdragon S2)	1.5GHz single-core Qualcomm MSM8255T (Snapdragon S2)	1.4GHz single-core Qualcomm APQ8055 (Snapdragon S2)	GPU
Adreno 205	Adreno 205	Adreno 205	RAM
512MB	512MB	512MB	Internal storage
16GB	16GB	16GB	External storage
None	None	None	Rear camera

16MP, f/2.6	8 MP, f/2.2	8MP, f/2.2	Front-facing camera
1.3MP	1.3MP	1.0MP	Video capture
720p HD	720p HD	720p HD	NFC
No	No	No	Radios
Quadband GSM / EDGE; HSPA+ 850 / 1900 / 2100; LTE 700/1700	Quadband GSM / EDGE; HSPA 850 / 1900 / 2100	Quadband GSM / EDGE / ; HSPA+ 850 / 1900 / 2100; LTE 700 / 1700	Network speeds
LTE, HSPA+	HSPA 14.4Mbps	LTE, HSPA+ 21.1Mbps	Bluetooth
2.1+EDR	2.1+EDR	2.1+EDR	MHL
No	No	Yes	Internet Sharing
Yes	Yes	Yes	FM Radio
Yes	Yes	Yes	SIM card

Display [Image removed: Image]We're not going to dwell much on the Titan II's display, because it offers absolutely no improvements over the original's 4.7-inch WVGA (800 x 480) LCD panel. The Microsoft-mandated limits of Windows Phone are to blame for the lack of progress in this area, so we won't fault HTC or AT&T this time.But we can't let the issue go without a fair amount of criticism: now that we've come to expect 4.7-inch displays with 720p resolution and pixel densities topping 315ppi, it's getting more and more difficult to excuse a WVGA model that delivers a subpar 199ppi. However, while the pixelation is painfully evident, we're at least happy with the superb viewing angles and above-average color saturation. We found we could see the screen well enough in direct sunlight, but only when the brightness was dialed up to its highest setting. Go lower and hardly anything is still readable.The bottom line is that whether you were satisfied or unimpressed with the OG Titan's display, you'll feel exactly the same way now. And if you're looking to grab a Windows Phone with a sharper screen, your best bet is to either wait for Apollo to come out (at which time, we hope, higher-res displays will be fully supported) or opt for a device with a smaller screen. Performance and battery life [Image removed: Image]The Titan II runs on a 1.5GHz single-core Snapdragon S2 45nm CPU (MSM8255) with an Adreno 205 GPU and 512MB of RAM. This is one of the better processors you can get on a Mango device, but it's the same exact setup as the original Titan. For better or worse, Windows Phones are utterly predictable in terms of performance; the lack of multi-core support on the platform means that newer devices probably won't be getting any faster or smoother until Microsoft lifts its restrictions. At the same time, there's an argument to be made that the OS is already efficient, that a cap on processing power contributes to comparatively long battery life. And don't forget, if a Kardashian is using a Lumia 900, that must mean it's good enough for us, right?In truth, though, while power users will always demand instantaneous response from their phones, the Titan II should be more than sufficient for casual users. Pinch-to-zoom feels smooth, and we love the responsiveness of the touchscreen, though as with other Windows Phones, you might end up waiting an extra second or two for the various animated transitions to run their course before you move on to your next task. We also found that

the back of the phone gets warm during CPU-intensive tasks, but not much hotter than other devices. The temperature isn't so high that the phone becomes uncomfortable to hold, though it's definitely something you'll notice with enough use.Compared to Android, Windows Phone is lacking in benchmarking tools. WP Bench and SunSpider are the main tools available to us for measuring performance, but let's face it: given that the top-end Mango devices have nearly hit a plateau for processing power, it's not like the numbers would vary too widely anyway. Nevertheless, we've tossed in a few scores for your perusal.

HTC Titan II	HTC Titan	Nokia Lumia 900	WP Bench
94.5	96	92	Battery rundown (CPU-intensive)
2:50	3:00	4:29	SunSpider (ms, lower numbers are better)

The Titan II is powered by a 1,730mAh battery -- an improvement over the original's 1,600mAh offering. Unlike its predecessor, however, this particular model doesn't come with a user-removable juicepack. It seems that this trend isn't going away anytime soon, but we're less concerned with battery life on Windows Phones than any other platform. We found absolutely no reason to be worried about the speed at which the new Titan sucks down power, since our average use (that's the usual suite of email, Twitter, Facebook, push notifications, messages and other day-to-day activities) gave us nearly a day and a half of life. Naturally, lower usage will likely make it possible to eke out a full two days before requiring a new charge.In terms of benchmark comparison, our CPU-intensive battery rundown test on WP Bench held out for two hours and 50 minutes before the phone took its last electronic breath -- a bit shorter than the original Titan, of course, but understandably so given the addition of an LTE radio. In short, we'll make this perfectly clear: if battery life is your number one priority on a smartphone, independent of processing power, a Windows Phone is going to be your best option outside of a Motorola Droid RAZR Maxx.When testing the LTE network, we found the Titan II performed just a smidgeon better than the Lumia 900, grabbing speeds of 21Mbps down and around 14 up during our tests in San Francisco. These tests were performed with four out of five bars of reception, so it's quite possible that we're not even hitting the phone's maximum capacity. Though it's in line with the AT&T Samsung Galaxy Note's next-gen tests, it's not the fastest device we've tested on the carrier's LTE network -- it's still leaps and bounds better than the carrier's HSPA+ service, however, which netted us around 4Mbps down and 1.5Mbps up.We love the Titan II's speakers for making calls and listening to music and podcasts. We placed the phone on a desk backside-up, walked into a room 20 feet away and could still hear everything with crystal-clear clarity. As for call reception and quality, we found the phone holds a strong signal and the mics and internal speakers are some of the loudest we've tested in a while. We heard the other callers so well, in fact, that there were several instances in which we had to turn down the volume. If you're hard of hearing, we doubt you'd have to worry too much, because the device offers a hearing aid compatibility setting in which the in-call volume kicks up a notch. Cameras [Image removed: Image]A 16-megapixel camera with an f/2.6, 28mm lens, backside-illuminated sensor and dual LED flash. On a phone. Such a thought is enough to shatter the mind into

smithereens. Without a doubt this is the single most marketable improvement the Titan II has to offer, and essentially the only reason you might consider purchasing this thing above the less-expensive Nokia Lumia 900. So do the extra pixels pack a picturesque punch? Is it worth another Benjamin to go with this particular Windows Phone?

Gallery: HTC Titan II sample shots

[Image removed:][Image removed:][Image removed:][Image removed:][Image removed:]First, one of our absolute favorite features made available on Windows Phones is the inclusion of a dedicated shutter button. This is becoming an incredibly rare find on most new Android devices, and we fear its extinction on the platform is nigh. Not so with Microsoft's mobile OS: here, the feature is alive and well. The Titan II's version is double-detent, which means you can hold the button halfway to lock in focus. Curiously, though, you're still not allowed to lock the exposure, which nearly defeats the whole purpose of this feature. We also noticed that our hands had to be incredibly steady when shooting pictures this way, since there's so much travel on the button itself that it's easy to shake the phone and take a blurry shot by accident. If this is the case for you, your best bet is to take advantage of the camera's image stabilization feature. If you're not a fan of the shutter button, you can alternatively tap the screen itself to autofocus and take the image. Fortunately, you can also focus anywhere on the viewfinder instead of being confined to the center.The variety of settings within the UI is also quite promising if you're willing to do some tweaking to get the perfect shot: ISO, panorama, macro focus, backlight aids, smile capture, face detection, white balance, red eye reduction, image stabilization and flicker adjustment are all on the menu. It improves on the One series by adding the ability to switch metering mode (center, average and spot are all included here), and it still offers adjustment settings for brightness, contrast, sharpness and saturation. The camera also allows for burst shooting, which in this case means being able to snap five shots in a row. It also adds in a full deck of 18 various scene options, complete with auto and "intelligent auto" modes, which proved adept at picking out the best scene for us. [Image removed: Image]And now, we're going to pick a few nits, since our expectations for the camera were so high. Many of the photos we shot in direct sunlight ended up slightly overexposed, which is naturally all too easy with most smartphone cameras. Shots taken indoors, however, turned out great. The cam also fares decently well in low-light scenarios with the flash turned off, but we noticed the autofocus continually struggles in these situations, and we ultimately encountered too much noise for our liking. We would've preferred to see HTC throw in a f/2.2 lens to add more light, much like it did with the original Titan.Aside from these small frustrations, we were impressed with how detailed the vast majority of our shots turned out. When the flash is enabled, it does an incredible job accurately capturing color, and the pair of LED lights is powerful enough to light up an entire room. We also love how well macro focus images came out, no matter the shooting conditions. All told, we captured some amazing shots, but we can't declare the Titan II the ultimate cameraphone champion of the universe -- the Nokia N8 still keeps the crown in this regard, and we weren't able to tell a large enough difference between it and the Amaze 4G's camera to even call it the best of HTC's lineup. It just goes to show that higher megapixel counts doesn't just inherently make a camera better. With that said, we were still quite pleased with the overall results and would be happy to use this camera on a regular basis. [Image removed: Image]The front-facing camera is about what you'd expect for a 1.3-megapixel shooter -- it's definitely nothing to write home about. Heck, it's barely anything to write about in this review. Self-portraits turned out wildly overexposed; believe us, this editor's pale face doesn't need any help in that department. Video taken with the front shooter records at 640 x 480, and you can't make any adjustments to how it looks. In fact, the settings button is completely greyed out, rendering it completely useless. The movies taken this way actually appear pretty smooth, but our overarching complaints about overexposure remain. Where the original Titan failed by compressing the JPEG down to a manageable 1.5MB or so per photo, its successor triumphs. The pictures come sized as 4640 x 3480, and as mentioned earlier, our images ended up being anywhere between 3.5MB and 5MB each, depending on the amount of information captured. In comparison, this is about the same size of the pictures we've taken with our 16.2-megapixel Sony

NEX-C3. Oh, and how about vids? On the Titan II, a minute-long video using 720p resolution took up 75MB (similar to the first Titan), whereas the One S hogged a grand total of 37MB, despite recording the same subject, at the same resolution for the same length of time. Speaking of video, how does the Titan II handle its 720p max resolution? It does a pretty good job capturing motion without too many choppy bits, and the audio is crystal-clear, too. Software [Image removed: Image]If you've read through the full review to this point, it's pretty obvious what kind of software to expect: it's a Windows Phone through and through, running on version 7.5 (Mango). In other words, if you're a fan of Ballmer's operating system, you already know exactly what to expect, and you'll most likely be in love with what the Titan II has to offer -- if you're on Team Android or iOS, however, this phone probably won't tempt you to switch sides unless you have an intense desire to take the camera for a spin.With Mango comes a full suite of features, one of which is Internet Sharing -- what Microsoft refers to its mobile hotspot capability -- and it's present and accounted for in the Titan II, giving you the opportunity to hook up to an AT&T tethering plan and share that 5GB of download capacity with five other devices.The Titan II also comes with a few extra settings and apps that you won't find on every Windows Phone. First, the HTC Hub gives you your own customizable set of panels consisting of stocks, news, weather and featured apps. The Hub's first panel is the time and weather, and it lets you reminisce by using the stereotypical Sense-style weather widget at the top. Clicking on it takes you into an AccuWeather panel that highlights your local forecasts and other conditions.Speaking of featured HTC apps, the Marketplace reserves a section specifically for manufacturer-made programs. Here you'll find a total of 15 apps, such as Tango video chat, Dock Mode, Converter, Connected Media, Locations, Lists, Notes, Flashlight, Compass and more. You'll also find the Photo Enhancer app pre-loaded on the Titan II (which is uninstallable, if you'd prefer to get rid of it), which lets you choose any picture in your camera roll and add a filter to it -- with 14 options available, you have plenty to pick from if you want to experiment a little.Finally, there's also the usual litany of AT&T apps that everyone loves or hates: U-Verse Mobile, Navigator, Code Scanner, YPmobile, Radio and myWireless. If that's not enough carrier love for you, there are a few more available for your downloading on the Marketplace, which leads us to ponder exactly why the included bloatware couldn't be accessed the exact same way. We suppose we shouldn't complain too much, however, since every last one of them can be uninstalled by simply long-pressing the selection on the app screen and choosing the correct action in the drop-down menu. Wrap-up [Image removed: Image]Overall, we have very few qualms with the HTC Titan II. Despite its clumsier design, it certainly has more to offer than its predecessor, which was already considered a great phone when it was released on AT&T a scant five months ago (six months if you count the European launch). But is there any reason to fork out $200 for a Windows Phone that has roughly the same feature set as the less expensive Nokia Lumia 900, which is getting subsidized beyond our wildest dreams? Unless you're a camera enthusiast, we think your money could be put to better use elsewhere.

Publication date: Apr 12, 2012

Year: 2012

Auditory Long Latency Responses to Tonal and Speech Stimuli

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 447-459.
ProQuest document link

Abstract: The effects of type of stimuli (i.e., nonspeech vs. speech), speech (i.e., natural vs. synthetic), gender of speaker and listener, speaker (i.e., self vs. other), and frequency alteration in self-produced speech on the late auditory cortical evoked potential were examined. Young adult men (n = 15) and women (n = 15), all with normal hearing, participated. P1-N1-P2 components were evoked with the following stimuli: 723-Hz tone bursts; naturally produced male and female /a/ tokens; synthetic male and female /a/ tokens; an /a/ token self-produced by each participant; and the same /a/ token produced by the participant but with a shiftin frequency. In general, P1-N1-P2 component latencies were significantly shorter when evoked with the tonal stimulus versus speech stimuli and natural versus synthetic speech (p <.05). Women had significantly shorter latencies for only the P2 component (p <.05). For the tonal versus speech stimuli, P1 amplitudes were significantly smaller, and N1 and P2 amplitudes were significantly larger (p <.05). There was no significant effect of gender on the P1, N1, or P2 amplitude (p >.05). These findings are consistent with the notion that spectrotemporal characteristics of nonspeech and speech stimuli affect P1-N1-P2 latency and amplitude components.

Full text: Headnote

Purpose: The effects of type of stimuli (i.e., nonspeech vs. speech), speech (i.e., natural vs. synthetic), gender of speaker and listener, speaker (i.e., self vs. other), and frequency alteration in self-produced speech on the late auditory cortical evoked potential were examined.

Method: Young adult men (n = 15) and women (n = 15), all with normal hearing, participated. P1-N1-P2 components were evoked with the following stimuli: 723-Hz tone bursts; naturally produced male and female /a/ tokens; synthetic male and female /a/ tokens; an /a/ token self-produced by each participant; and the same /a/ token produced by the participant but with a shiftin frequency.

Results: In general, P1-N1-P2 component latencies were significantly shorter when evoked with the tonal stimulus versus speech stimuli and natural versus synthetic speech (p <.05). Women had significantly shorter latencies for only the P2 component (p <.05). For the tonal versus speech stimuli, P1 amplitudes were significantly smaller, and N1 and P2 amplitudes were significantly larger (p <.05). There was no significant effect of gender on the P1, N1, or P2 amplitude (p >.05).

Conclusion: These findings are consistent with the notion that spectrotemporal characteristics of nonspeech and speech stimuli affect P1-N1-P2 latency and amplitude components.

Key Words: late auditory cortical evoked potential, speech stimuli, hearing

P1-N1-P2 waveform components are late auditory cortical evoked potentials occurring between 40 ms and 250 ms (Martin &Stapells, 2005; Ponton, Eggermont, Kwong, &Don, 2000; Sharma, Marsh, &Dorman, 2000). The

P1-N1-P2 complex is considered to be a sensory evoked potential where waveform components are predominantly controlled by stimulus characteristics. That is, the response is thought to reflect stimulus representation or sensory encoding in the central auditory system, particularly when the listener is not actively attending (Martin, Sigal, Kurtzberg, &Stapells, 1997; Näätänen &Picton, 1987; Ostroff, Martin, &Boothroyd, 1998; Sharma &Dorman, 1999, 2000; Whiting, Martin, &Stapells, 1998). The P1 component does not appear to be affected by selective attention of the listener, whereas the N1 component exhibits an increase in amplitude (e.g., Näätänen, Gaillard, &Mäntysalo, 1978; Picton &Hillyard, 1974). In contrast, the P2 complex is diminished with selective attention (e.g., Alho, Sams, Paavilainen, &Näätänen, 1986; Näätänen &Picton, 1987). This is due in part to the superimposition of the Nd (processing negativity) and N1 components in the latency region of the P2. The P1-N1-P2 complex can be evoked to tonal stimuli and both natural and synthetic speech stimuli, including vowels (Agung, Purdy, McMahon, &Newall, 2006; Diesch, Eulitz, Hampson, &Ross, 1996; Eulitz, Diesch, Pantev, Hampson, &Elbert, 1995; Gunji, Hoshiyama, &Kakigi, 2000; Tremblay, Friesen, Martin, &Wright, 2003) and syllables (Cunningham, Nicol, Zecker, &Kraus, 2000; Ostroffet al., 1998).

Given that the P1-N1-P2 complex is sensitive to acoustic cues, one would expect responses to be different when elicited with tonal versus speech stimuli. Several differences in the P1-N1-P2 responses recorded via tonal stimuli and speech stimuli have been reported. In general, responses recorded to tonal stimuli have shorter P1-N1-P2 latencies with equivocal findings with respect to amplitude differences. For example, Eulitz et al. (1995) investigated late auditory evoked responses to five synthetic German vowels of two different durations (i.e., 600 ms and 45 ms) and a 1000-Hz tone (600 ms) presented at 60 dB SL to 11 adults with normal hearing (four women) aged 24-41 years. N1 peak latencies were significantly longer for the speech stimuli. No significant differences were found with N1 amplitudes between speech and tonal stimuli.

Tiitinen, Sivonen, Alku, Virtanen, and Näätänen (1999) also recorded late auditory cortical evoked potentials (i.e., N1-P2 responses) to both tonal and vowel stimuli. In order to match the tonal stimuli and speech stimuli in terms of frequency and intensity, Tiitinen et al. used a 535-Hz tone and two synthetic Finnish vowels (i.e., a "soft" /a/ and a "pressed" /A/). All stimuli had durations of 200 ms. N1-P2 response amplitudes were significantly larger for the vowel stimuli versus the pure-tone stimulus.N1 latency was significantly longer for the /a/ vowel versus the tonal stimulus; however, there was no significant difference between the tonal stimulus and the /A/ vowel. Further, it was reported that P2 latencies recorded with the pure tone were significantly shorter than both vowel stimuli.

Ceponiene et al. (2001) recorded P1, N250, and N450 wave components to synthetic vowel tokens, acoustically matched complex tones, and tone bursts from 8- to 10-year-old children to investigate stimulus effects. The authors found that P100 and N250 amplitudes were larger when recorded with complex tonal stimulus compared with the "sinusoidal tones." The N250 component amplitude was also smaller when recorded using the vowel token relative to the complex tones, but the N450 component amplitude was larger when recorded with the vowel token compared with the complex tones.With respect to latency differences, P100 latencies were statistically shorter for the complex tones compared with the vowel token. No P100 latency differences were found between the vowel and the sinusoidal tones conditions. N250 latencies were shorter for the sinusoidal tones compared with the vowels but not between the complex tones and the vowel tokens. No significant N450 latency differences were reported between any of the conditions. In a follow-up study, Ceponiene, Alku, Westerfield, Torki, and Townsend (2005) extended the findings to consonant-vowel syllable and nonphonetic stimuli (i.e., a composition of five tones) matched on acoustic complexity with children and adults. Consistent with the previous study, the N1 in adults and the P2 in both groups were enhanced by the nonphonetic stimuli, whereas the N2 and N4 peaks were enhanced by the syllables.

Late auditory cortical potentials evoked to speech stimuli are gaining increased interest due, in part, to their potential clinical application (Martin, Tremblay, &Korczak, 2008). However, there are differing opinions on whether to use naturally produced or synthetic speech. For example, Picton, Alain, Otten, Ritter, and Achim

(2000) suggest that naturally produced speech should be used in electrophysiological testing so that the results can be related to everyday listening experiences. Conversely, some argue that synthesized speech tokens allow for the manipulation of distinct acoustical cues (e.g., Digeser,Wohlberedt,& Hoppe, 2009). In addition, there are perceptual/comprehension/identification differences between natural and synthetic speech. That is, listeners generally perceive synthetic speech less successfully than natural speech (e.g., Brungart, Iyer, &Simpson, 2006; Papadopoulos, Katemidou, Koutsoklenis, &Mouratidou, 2010; Reynolds, Isaacs-Duvall,& Haddox, 2002; Roring, Hines, &Charness, 2007). It is unknown whether there are differences in speech-evoked auditory event-related potentials to natural or synthetic speech stimuli. To the best of our knowledge, there have been no studies in which researchers have examined late auditory cortical evoked potentials in a group of participants who listened to both naturally produced and synthetic speech.

The purpose of this study was to further examine P1-N1-P2 waveform components of late auditory cortical evoked potentials in female and male participants who listened to both tonal and speech stimuli. It was of interest to examine previously unexplored responses to stimulus manipulations in the same listeners. These included type of stimuli (i.e., nonspeech vs. speech), speech (i.e., natural vs. synthetic), gender of speaker, speaker (i.e., self-produced vs. others), and frequency alteration in self-produced speech. Specifically, P1-N1-P2 components were evoked to the following stimuli: tone bursts, naturally produced male and female /a/ tokens, synthetic male and female /a/ tokens, an /a/ token self-produced by each participant, and the same /a/ token produced by the participant but with a shiftin frequency. We chose a short duration (i.e., <100 ms) tonal stimulus, which is typically used in clinical evaluation, because it is optimal for evoking late auditory cortical evoked potentials (Hall, 2007). As noted above, in previous studies, researchers have not explored responses to synthetic and natural speech tokens in the same cohort of listeners, nor have they examined the speaker's gender in synthetic and natural speech tokens. Our interest in examining responses to self-produced speech tokens stems from a renewed interest in the link between speech production and speech perception (Guenther, Ghosh, &Tourville, 2006) where contemporary models of speech production give more credence to the involvement of the auditory system. Historically, auditory contributions to speech production have been discounted. For example, Borden (1979) asserted that the auditory system is too slow for online monitoring of speech production. Contemporary theorists posit that speech production and speech perception are intimately linked via feedforward and feedback control subsystems working in concert. These feedforward and feedback control systems facilitate communication and, of particular importance, allow for the monitoring of internal and external vocalizations (e.g., Guenther, 2006; Jeannerod, 1998; Numminen, Salmelin, &Hari, 1999). With this line of reasoning, one must ask "Is there a difference in response to a self-produced speech token and the same speech token externally generated by another speaker?" We were interested in evaluating responses to selfproduced frequency-shifted speech tokens. Researchers have demonstrated that alterations in frequency of one's voice affect speech production (e.g., Burnett, Freeland, Larson, &Hain, 1998; Chen, Liu, Xu, &Larson, 2007; Elman, 1981; Larson, Burnett, Kiran, &Hain, 2000) and reading comprehension (Carter, Rastatter, Walker, &O'Brien, 2009; Rastatter, Barrow, &Stuart, 2007). The auditory representation of self-produced nonaltered and frequency-altered speech has not previously been undertaken. We also wanted to examine the effect of listener gender. Although a significant effect of gender has been evidenced in essentially all dimensions of auditory function in adults, there is a paucity of investigations examining gender effects on the P1-N1-P2 waveform components of the late auditory cortical evoked potential in young adults. Onishi and Davis (1968) reported that female participants "tended to give responses of larger amplitude" (p. 588) for the N1-P2 complex to binaurally presented tonal stimulus. However, they did not report the effect of gender on peak amplitude values. Hoffman and Polich (1999) also found smaller amplitude responses in female participants (i.e., P2 in response to binaurally presented tonal stimulus). In contrast, Gölgeli et al. (1999) found no differences in N1 and P2 component amplitude or latency between genders to binaurally presented tonal stimuli.

To the best of our knowledge, no other study has performed such a comprehensive investigation of stimulus effects across a multitude of speech tokens in female and male listeners. It was hypothesized that P1-N1-P2 component latencies and amplitudes would differ between tonal and speech stimuli and would differ among the various speech stimuli due to temporal-spectral differences. Namely, responses that were recorded via tone bursts would have shorter P1-N1-P2 latencies and smaller amplitudes than those that were elicited via speech stimuli (Ceponiene et al., 2001, 2005; Tiitinen et al., 1999). Owing to the similarity among all speech tokens, we hypothesized that there would not be any significant latency or amplitude differences across speech stimuli conditions (i.e., natural vs. synthetic speech, female vs. male speaker, self-produced vs. other speakers, self-produced nonaltered vs. self-produced frequencyshifted speech). Finally, it was hypothesized that there would be no differences in P1-N1-P2 component latencies and amplitudes between female and male listeners across stimuli (Gölgeli et al., 1999).

Method

Participants

Participants included 30 White, English-speaking young adults: Fifteen were male (M = 24.1 years; SD = 3.5), and 15 were female (M = 24.1 years; SD = 3.4). All participants presented with normal-hearing sensitivity, which was defined as pure-tone thresholds at octave frequencies from 250 Hz to 8000 Hz ≤25 dB HL (American National Standards Institute [ANSI], 1996) and normal middle-ear function (Roup, Wiley, Safady, &Stoppenbach, 1998). Participants were recruited on a volunteer basis from the East Carolina University student body. The University and Medical Center Institutional Review Board of East Carolina University approved this research; all participants provided informed consent prior to testing. All participants were demographically similar, with no reported history of neurological disorders, head injuries, otological disorders, learning disabilities, or speech and language impairments as assessed with a self-report questionnaire. To assess cognitive function, we administered the Mini Mental State (Folstein, Folstein, &McHugh, 1975) to all participants. All participants demonstrated scores within normal limits (M = 29.9; SD = 0.4). The Edinburgh Handedness Inventory (Oldfield, 1971) was also administered to all participants to assess handedness. Laterality Quotient scores of 40 or greater are considered to represent right-handedness. All participants who were included in the study demonstrated righthand dominance with Laterality Quotient scores >40 (M = 72.1; SD = 20.8).

Apparatus

For all experimental listening conditions, participants were seated in a comfortable reclining chair placed inside a double-walled sound-treated audiometric suite (Industrial Acoustics Corporation). This audiometric suite met specifications for permissible ambient noise (ANSI, 1999).We performed data acquisition using Compumedics NeuroScan SCAN software (Version 4.4), SynAmps2 Model 8050 electroencephalography (EEG) amplifier, and Stim2 software. We used a 64-channel Ag/Ag/Cl Compumedics NeuroScan Quik-Cap to record ongoing EEG activity. All stimuli were presented via NeuroScan ER-3A insert earphones.

Male and female natural vowel tokens. Naturally produced male and female vowel tokens were recorded from a White young adult woman and a White young adult man, both of whom had a general American dialect and spoke with a normal vocal effort. Both the man and the woman generated 10 /a/ vowel tokens that were recorded at a sampling rate of 44100 Hz. Single /a / tokens of approximately 400 ms were selected. Duration was defined as the total length of the vowel, beginning at the point of initial phonation and ending when phonation ceased. The appropriate duration for these vowels was determined on the basis of results from a pilot study that was performed in order to determine the approximate duration of the vowel /a/ produced in isolation from speakers in the dialectical region. The selected vowel tokens were normalized through the use of Peak 4 software and were saved as a .wav file.

Male and female synthetic vowel tokens. We created synthetic male and female speech tokens using an Internet-based Klatt Synthesizer Interface (www.asel. udel.edu/ speech/tutorials/synthesis) at a sampling rate of

10000 Hz. The male /a/ was created through use of the following formant (F) frequencies and bandwidths (BWs; all in Hz): F0 = 132, F1 = 710, F2 = 1150, F3 = 2700, F4 = 3300, F5 = 3700, F6 = 4900, BW1 = 40, BW2 = 43, BW3 = 105, BW4 = 400, BW5 = 500, and BW6 = 1000. These stimulus parameters were chosen on the basis of parameters used by Hawks and Miller (1995). Bandwidths 4-6 were based on default settings within the Klatt Synthesizer program. The synthetic female /a/ was created with the following Fs and BWs (all in Hz): F0 = 208, F1 = 688, F2 = 1273, F3 = 2966, F4 = 3300, F5 = 5400, F6 = 6000, BW1 = 90, BW2 = 110, BW3 = 170, BW4 = 250, BW5 = 300, and BW6 = 450. These stimulus parameters were chosen on the basis of parameters used by Assmann and Katz (2000) and Hawks and Miller (1995). Bandwidths 4-6 were based on default settings within the Klatt Synthesizer program. The F0 was varied across the duration of the vowel from 190 Hz to 208 Hz to increase naturalness of the vowel token (Assmann &Katz, 2000). In order to remain consistent, the duration of these tokens was 400 ms.

Recorded self-produced vowel tokens. Prior to collection, participants were asked to produce the vowel /a/ 10 times into a Logitech (Model 980186-0403) desktop microphone. These tokens were recorded using Bias Sound Creative Peak 4.13 running on a Macintosh PowerPC G4 at a sampling rate of 44100 Hz. Participants were asked to produce the vowel tokens using a normal vocal effort and speech rate. The duration of each vowel was then measured. To remain consistent with the other vowel tokens presented in this study, the self-produced token closest to 400 ms was selected from the sample of 10 tokens. The average duration of the self-produced male and female tokens was 388 ms (SD = 17.5) and 386 (SD = 26.8), respectively. The participants' self-produced tokens were then frequencyshifted down one-half octave through the use of Bias Sound Creative Peak software (Version 4.13) and were presented as a frequency-shifted token. All speech tokens were amplitude normalized and were saved as .wav files.

Tonal stimulus. The center frequency of the tone burst was selected based on methodology presented by Tiitinen et al. (1999). In this study, the center frequency of the tonal stimulus was generated to match the mean center frequency of the highest peak observed in vowels /a/ and /A/. Following this rationale, male and female synthetic /a/ tokens were analyzed using SpectraPRO-FFT Spectral Analysis System software (Version 3.32) on a Dell Inspiron laptop. The center of the highest harmonic of both the synthetic male and female tokens was 722.66 Hz. Accordingly, the tone burst was generated with a center frequency of 723 Hz through the use of a Dell Optiplex GX620 computer (Intel Pentium 4 CPU, 2.99 GHz, 1.00 GB RAM, with a 16-bit integrated Creative SB Audigy 4 WDM sound card operating on a MicrosoftWindows XP operating system) and Compumedics NeuroScan Stim2 Sound Editor software (Version 2) at a sampling rate of 48000 Hz. A Blackman window was employed with a 10.5-ms ramp and a 49-ms plateau. The total duration was 70 ms.

Acoustical analysis and calibration. The amplitude time waveforms for all speech stimuli are presented Figure 1. Waveforms were generated using SpectraPROFFT Spectral Analysis System software (Version 3.32). Fast Fourier transforms (FFTs) were performed on these tokens through the use of the SpectraPRO-FFT Spectral Analysis System (see Figure 2). FFTs of both male and female natural vowel tokens were generated through the use of a Hanning window with a sampling rate of 44100 Hz, an FFT size of 2048, and a decimation ratio of 1. FFTs of the synthetic male and female vowel tokens were generated through the use of a Hanning window, a 10000-Hz sampling rate, an FFT size of 1024, and a decimation ratio of 1.

All stimulus presentation levels were calibrated to 75 dB pSPL using a Brüel &Kjæ r precision soundlevel meter (Type 2231) with a Brüel &Kjæ r octave band filter (Type 1625) attached to a Brüel &Kjæ r (Type 4144) pressure microphone. In order to keep calibration parameters consistent across all tokens, we performed calibration using pSPL measurements. All stimuli were presented via the Sound Editor Module through an insert earphone (NeuroScan ER-3A) coupled to a 2 cm3 (Brüel&Kjæ r TypeDB0138) coupler attached to the sound-level meter.

Procedure

Stimuli presentations were counterbalanced according to a digram-balance Latin squares design (Wagenaar,

1969) and were presented to the listener via NeuroScan ER-3A insert earphones. We used deep insert earphone placement (Dean &Martin, 2000). All stimuli were presented bilaterally at a rate of 1.1/s. Participants were asked to sit quietly and silently count the number of presented tokens. After each condition, participants were asked to write the number of tokens they counted on the sheets provided. They were also asked to remain alert and minimize movements, especially head and neck movements, while the stimuli were presented.

EEG activity was recorded from 11 electrode sites placed about the participant's head (i.e., F3, Fz, F4, C3, Cz, C4, T4, T3, Pz, M1, and M2). The nasion served as the reference, and Fpz served as the common ground. We monitored vertical eye movements using electrodes placed vertically above and below the lefteye. Electrode impedances were maintained at or below 5000 W. EEG activity was amplified 3,000 times and was analog filtered (i.e., 1-30 Hz). Analog-to-digital conversion at a rate of 500/s for all channels was performed with a PCbased NeuroScan system and SynAmps2 24-bit amplifier. All EEG activity was saved as continuous files for offline averaging and digital filtering.

All continuous files were epoched in a time-locked window from -100 ms to +500 ms relative to stimulus onset. We selected this response window to provide an adequate time window for visualization of all pertinent waveformcomponents (Martin&Stapells, 2005; Sharma et al., 2000). A prestimulus interval of -100 was used as the baseline correction for all recording channels. Epochs were then digitally filtered (i.e., 1-30 Hz, 24 dB/octave) and were re-referenced offline to linked mastoids (M1 and M2). Ocular movement artifacts were reduced from the epochs utilizing the Compumedics NeuroScan SCAN software (Version 4.4) Ocular Artifact Reduction algorithm (Semlitsch, Anderer, Schuster, &Presslich, 1986). Epochs containing artifacts exceeding ±50 mV were rejected from averaging. We averaged 150 samples, and we replicated this for all trials. Replication was defined as two or more waveforms with identifiable P1-N1 and/or P2 peaks within 25 ms (O'Brien &Stuart, 2001). We then averaged both replications, creating seven waveforms for each individual participant.

Electrophysiological waveform analyses. Waveform components P1-N1-P2 were evaluated in terms of latency and amplitude measures. P1 was defined as the largest positive peak following stimulus onset between 40 ms and 150 ms. N1 was defined as the largest negative deflection following P1 between 75 ms and 210 ms, and P2 was defined as the following positive peak between N1 and 300 ms. Amplitudes were measured from baseline to component peak. Waveform components were also considered to be present if greater responses were visualized at the frontocentral electrode sites (i.e., Fz and Cz) in comparison to the parietal electrode (i.e., Pz). We also used polarity inversion at the mastoid sites to determine response presence (Vaughan &Ritter, 1970). However, the response was not deemed absent if a polarity inversion did not occur (Martin &Stapells, 2005; Tremblay, Piskosz, &Souza, 2003).

Results

We measured grand average N1-P2 complex amplitudes at all electrode sites to determine the electrode location where the most robust response was recorded. For all conditions, the N1-P2 complex amplitude was greatest at the Cz electrode site; therefore, all data presented in the current investigation were collected from the Cz electrode site only. Grand average of amplitude and time waveforms recorded from Cz are presented for each experimental condition in Figure 3.

P1-N1-P2 Latency

Mean latencies and SDs for the P1, N1, and P2 waveform components, as a function of condition and gender, are presented in Table 1. We conducted three separate two-factor mixed (between and repeated factors) analyses of variance (ANOVAs) to examine the effect of stimulus condition and gender on P1,N1, andP2 latencies. The results of those analyses are shown in Table 2. A significant main effect of condition was found for each latency component.We performed five post hoc mutually orthogonal single-df contrasts (Keppel&Wickens, 2004) of interest to investigate the source of main effect of stimulus condition: tonal versus speech stimuli (i.e., tone bursts vs. naturally produced male and female speech, synthetic male and female

speech, and self-produced nonaltered and frequency-shifted speech); synthetic versus natural speech stimuli (i.e., natural male and female vs. synthetic male and female); female versus male speech (i.e., natural and synthetic female vs. natural and synthetic male); self-produced versus other speech (i.e., self-produced nonaltered and frequency-shifted speech vs. natural and synthetic male and female speech); and nonaltered self-produced speech versus frequencyshifted self-produced speech.1 For P1 latencies, significantly shorter latencies occurred for the tonal stimulus versus the speech stimuli (p <.0001, h2 = .35), for natural versus synthetic speech tokens (p = .029, h2 = .15), and for male tokens versus female tokens (p = .042, h2 = .14). For N1 latencies, significantly shorter N1 latencies occurred for the tonal stimulus versus the speech stimuli (p <.0001, h2 = .62), natural versus synthetic speech tokens (p <.0001, h2 = .40), and self-produced versus other speech (p = .043, h2 = .13). For P2 latencies, significantly shorter P2 latencies occurred for the tonal stimulus versus the speech stimuli and for natural versus synthetic speech tokens (p <.0001, h2 = .62). In addition, female participants had significantly shorter latencies than male participants (p = .007).

P1-N1-P2 Amplitude

Mean amplitudes and SDs for the P1, N1, and P2 waveform components, as a function of condition and gender, are presented in Table 3. We conducted three separate two-factor mixed ANOVAs to examine the effect of stimulus condition and gender on P1, N1, and P2 amplitudes. The results of those analyses are shown in Table 4. A significant main effect of condition was found for each amplitude component. To investigate the source of this main effect, we performed the same five orthogonal single-df contrasts described above. The only significant amplitude differences were between responses for tonal stimulus versus the speech stimuli: P1 amplitudes were significantly smaller (p <.001, h2 = .32), yet N1 (p <.001, h2 = .32) and P2 amplitudes (p <.0001, h2 = .59) were significantly larger for the tonal stimulus.

Discussion

To better understand the effect of stimulus and listener gender on auditory late cortical evoked potentials, we explored manipulations of type of stimuli (i.e., nonspeech vs. speech), type of speech (i.e., natural vs. synthetic), gender of speaker, speaker (i.e., self vs. other), and frequency alteration in self-produced speech. P1-N1-P2 components of the late auditory cortical evoked potential were generated with a tonal stimulus and six speech tokens. Initially, it was of interest to evaluate the effect on component latencies and amplitudes when elicited via the tonal stimulus compared with the speech tokens (i.e., nonspeech vs. speech). We hypothesized that responses evoked with the nonspeech token would differ from those recorded via the speech tokens. Specifically, component latencies would be shorter and amplitudes would be smaller (Ceponiene et al., 2001; Tiitinen et al., 1999) when evoked with tonal compared to speech stimuli. Consistent with the proposed experimental predictions, P1-N1-P2 component latencies were significantly shorter when evoked via the tonal stimulus versus speech stimuli. The findings with respect to P1-N1-P2 component amplitudes were equivocal: P1 components were significantly smaller for the tonal stimulus compared with the speech stimuli, whereas N1 and P2 components were significantly larger for the tonal stimulus compared with the speech stimuli.

It is well established that stimulus characteristics such as duration, rise time, intensity, and frequency affect P1-N1-P2 responses. With regard to stimulus characteristics, the most notable difference between the tonal stimulus and the speech tokens was token duration. The duration of the tone burst was 70 ms, and the duration of all speech tokens was held constant at approximately 400 ms. Investigators have shown differences in component latencies as a function of duration (Davis &Zerlin, 1966; Eddins &Peterson, 1999; Onishi &Davis, 1968; Skinner&Jones, 1968). If the duration of the tonal stimulus is greater than 30 ms with a fixed rise time, there is minimal effect on P1 and N1 latency and amplitude. That is, "the amplitude of N1-P2 is apparently determined within about 30 msec after the onset" (Onishi &Davis, 1968, p. 584). In this experiment, the effect of stimulus duration should be minimal given that all stimuli were longer than 30 ms.That is, differences in stimulus durations may not contribute significantly to the latency differences found in this experiment.

Differences in token rise time also affect component latency and amplitude. With respect to stimulus onset, the

P1-N1-P2 complex-specifically, the N1 component-is an onset response and, therefore, is greatly affected by the "onset" characteristics of the token (i.e., the initial 100 ms; Elfner, Gustafson, &Williams, 1976; Skinner &Jones, 1968). Thus, manipulating the onset of the stimulus (i.e., the rise time) can affect component latency and amplitude. Milner (1969) found that as stimulus rise time increased, component amplitude decreased. Onishi and Davis (1968) found that rise times shorter than 50 ms did not significantly affect N1-P2 amplitude; however, as rise time increased beyond 50 ms, N1-P2 amplitude decreased. Thomson, Goswami, and Baldeweg (2009) reported that N1 component amplitudes decreased as stimuli rise time increased. For component latency, Hyde (1997) reported that as stimulus rise time increased, component latency increased. In this experiment, the rise time for the nonspeech token was 10 ms. The rise time of the speech stimuli was not controlled across tokens so that the parameters of these tokens would remain as close to naturally occurring as possible. This was especially true for the participant self-produced tokens, where preserving naturalness of the token was essential. Rise times2 were 54 ms, 37 ms, 174 ms, 26 ms, 76 ms, 65 ms, 16 ms, and 54 ms for the natural male, natural female, synthetic male, synthetic female, male self-produced, male frequency-shifted self-produced, female self-produced, and female frequency-shifted self-produced tokens, respectively (see Figure 1). Rise time measurements, however, are not presented for all participant self-produced tokens. It is possible that P1-N1-P2 latency and amplitude differences found here were wholly related to stimuli rise time differences, given that the onset of the nonspeech tone was comparatively shorter and more rapid than the onset of the speech tokens.

Two additional factors may have contributed to the differences on responses between the tonal and speech stimuli. Although the frequency of the tone was constructed based on the center frequency of the synthetic vowel tokens, the difference between the responses may be related to the spectral characteristics of the tokens and the complexity of the tokens (Uppenkamp, Johnsrude, Norris, Marslen-Wilson, &Patterson, 2006). Second, interstimulus interval has been shown to affect auditory late cortical evoked potentials. Increasing the interstimulus interval serves to enhance N1 and P2 amplitudes (Budd, Barry, Gordon, Rennie, &Michie, 1998; Davis, Mast, Yoshie, &Zerlin, 1966; Fruhstorfer, Soveri,&Järvilehto, 1970; Hari, Kaila, Katila, Tuomisto, &Varpula, 1982; Woods &Elmasian, 1986). This has been attributed to reflect refractory effects of the late cortical potential generators. Given that the stimulus presentation rate was kept constant at 1.1/s, but the duration of the tones were 70 ms and the duration of the speech tokens were 400 ms, there were differences in the interstimulus interval between tone and speech tokens. That is, the shorter interstimulus interval difference for the tonal stimulus may have enhanced response amplitude.

In addition to evaluating the effect of tonal stimuli compared to speech stimuli, this experiment was conducted to investigate latency and amplitude effects across the six speech conditions (i.e., natural tokens compared to synthetic tokens; self-produced token compared to the other tokens, and male synthetic and natural tokens compared to female synthetic and natural tokens).We hypothesized that there would not be any significant latency or amplitude differences across speech stimuli conditions. With respect to the natural token versus synthetic token conditions, P1-N1-P2 component latencies were significantly shorter when recorded via the natural speech tokens compared to those recorded via the synthetic speech tokens. There were no significant differences found for P1-N1-P2 amplitudes. As with the tonal stimulus compared to the speech stimuli, spectro-temporal characteristics of the stimuli (Agung et al., 2006; Digeser et al., 2009), specifically differences in the initial onset of the tokens, may account for these experimental findings. Further, it has been speculated that natural speech and synthetic speech are processed differently. Supporting evidence for this notion is equivocal. Uppenkamp et al. (2006), via functional magnetic resonance imaging, demonstrated that natural tokens and synthetic tokens produced an identical pattern of auditory cortical activation. Benson et al. (2001), however, also used functional magnetic resonance imaging and found differing cortical activations for natural speech versus synthetic speech. Tremblay, Friesen, et al. (2003) also suggested that cortical processing for natural tokens and synthetic tokens may differ, based on responses from two studies, one eliciting waveform components using

natural speech and the other using synthetic speech.

In general, significant differences were not seen across all P1-N1-P2 latency or amplitude components elicited via male voiced tokens (i.e., natural and synthetic male) compared to female voiced tokens (i.e., natural and synthetic). The only significant finding was statistically shorter P1 latencies for male tokens compared to female tokens. Again, this finding may be related to the spectral differences between the eliciting tokens. Specifically, the lower frequency content of the male tokens compared to the higher frequency content of the female tokens. P1-N1-P2 components are sensitive to stimulus frequency as responses recorded using lower frequency stimuli demonstrate shorter component latencies compared to responses recorded with higher frequency stimuli (Agung et al., 2006; Alain, Woods, &Covarrubias, 1997; Antinoro, Skinner, &Jones, 1969; Jacobson et al., 1992; Sugg &Polich, 1995).

Two of the speech tokens that were employed to elicit the evoked potentials were self-produced by each participant (i.e., participant-produced /a/ tokens with that same /a/ pitch-shifted downward). Responses to these tokens were recorded to examine the effect on component latencies and amplitudes in comparison with the other speech tokens. No significant differences between self-produced tokens and the other speech tokens were found for P1 latency, P2 latency, or P1-N1-P2 amplitude. These findings were consistent with those reported in previous investigations (Heinks-Maldonado et al., 2007; Houde, Nagarajan, Sekihara, &Merzenich, 2002). Significantly shorter N1 latencies were found for responses recorded using self-produced vowels compared to the other speech tokens. This finding was inconsistent with previous findings (Heinks-Maldonado, Mathalon, Gray, &Ford, 2005).

The finding of significantly shorter N1 latencies for self-produced speech was, however, unexpected. It is likely related to the differences in spectral characteristics of the tokens. One self-produced token was passively presented without an alteration and the other token was pitch-shifted downward, thus shifting the spectral content into a lower frequency range. Researchers have reported that N1 amplitudes are larger and latencies shorter when evoked with lower frequency stimuli (Agung et al., 2006; Alain et al., 1997; Antinoro et al., 1969; Jacobson et al., 1992; Sugg &Polich, 1995). When considering the effect of this frequency shift, our finding of shorter N1 latencies for the self-produced speech tokens compared to the other tokens is plausible.

This investigation was also designed to examine differences between responses from male and female participants. In separating males from females, stimulus or condition effects can be evaluated without the influence of gender (Kudo et al., 2004). Gender differences have been demonstrated across various electrophysiological indices (e.g., early potentials; Beagley &Sheldrake, 1978; Bergholtz, 1981; Chan et al., 1988; Dehan &Jerger, 1990; Don, Ponton, Eggermont, &Masuda, 1993; Sabo, Durrant, Curtin, Boston, &Rood, 1992), however, findings for late evoked potentials have been equivocal (Gölgeli et al., 1999; Hoffman &Polich, 1999; Onishi &Davis, 1968). P2 latencies were significantly shorter when recorded from females than from males. No other significant gender differences were found for P1 or N1 latencies or component amplitudes.

In conclusion, it was demonstrated that differences were found in the P1-N1-P2 components of the auditory late cortical evoked potential elicited with different tonal, natural, and synthetic speech stimuli. P1-N1-P2 component latencies were significantly shorter when evoked with the tonal stimulus versus speech stimuli and natural versus synthetic speech. P1 amplitudes were significantly smaller and N1 and P2 amplitudes were significantly larger for the tonal versus speech stimuli ($p < .05$). There were little differences between male and female listeners. Females had significantly shorter latencies for only the P2 component ($p < .05$). There was no significant effect of gender on the P1, N1, or P2 amplitude ($p > .05$). It can be suggested that spectro-temporal characteristics of nonspeech and speech tokens affect P1-N1-P2 latency and amplitude components.

Acknowledgments

This article was presented in part at the 2010 American Speech-Language-Hearing Association Annual Convention, Philadelphia, PA.

Footnote

1An a of .5 was adopted as the criterion for significance. Corrections for familywise error are suggested only when the number of single-df planned comparisons exceeds the number of degrees of freedom associated with the treatment source of variance (dfa; Keppel &Wickens, 2004). In this case five single-df planned comparisons were made relative to six dfa.

2Rise times were calculated from the amplitude time waveforms of the speech tokens presented in Figure 1. Rise time was operationally defined as the time from the onset of the acoustic waves to the maximum amplitude.

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Shannon Swink is now at John E. Sexton &Associates, New Bern, NC.
Editor: Sid Bacon
Associate Editor: Paul Abbas
Received December 28, 2010
Revision received April 25, 2011
Accepted July 6, 2011
DOI: 10.1044/1092-4388(2011/10-0364)

Publication date: Apr 2012

Year: 2012

Relationship Between Consonant Recognition in Noise and Hearing Threshold

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 460-473.
ProQuest document link

Abstract: Although poorer understanding of speech in noise by listeners who are hearing-impaired (HI) is known not to be directly related to audiometric hearing threshold, HT (f), grouping HI listeners with HT (f) is widely practiced. In this article, the relationship between consonant recognition and HT (f) is considered over a range of signal-to-noise ratios (SNRs). Confusionmatrices (CMs) from25 HI ears were generated in response to 16 consonant-vowel syllables presented at 6 different SNRs. Individual differences scaling (INDSCAL) was applied to both feature-based matrices and CMs in order to evaluate the relationship between HT (f) and consonant recognition among HI listeners. The results showed no predictive relationship between the percent error scores (Pe) and HT (f) across SNRs. The multiple regression models showed that the HT (f) accounted for 39% of the total variance of the slopes of the Pe. Feature-based INDSCAL analysis showed consistent grouping of listeners across SNRs, but not in terms of HT (f). Systematic relationship between measures was also not defined by CM-based INDSCAL analysis across SNRs. HT (f) did not account for the majority of the variance (39%) in consonant recognition in noise when the complete body of the CM was considered.

Full text: Headnote

Purpose: Although poorer understanding of speech in noise by listeners who are hearing-impaired (HI) is known not to be directly related to audiometric hearing threshold, HT (f), grouping HI listeners with HT (f) is widely practiced. In this article, the relationship between consonant recognition and HT (f) is considered over a

range of signal-to-noise ratios (SNRs).
Method: Confusionmatrices (CMs) from25 HI ears were generated in response to 16 consonant-vowel syllables presented at 6 different SNRs. Individual differences scaling (INDSCAL) was applied to both feature-based matrices and CMs in order to evaluate the relationship between HT (f) and consonant recognition among HI listeners.
Results: The results showed no predictive relationship between the percent error scores (Pe) and HT (f) across SNRs. The multiple regression models showed that the HT (f) accounted for 39% of the total variance of the slopes of the Pe. Feature-based INDSCAL analysis showed consistent grouping of listeners across SNRs, but not in terms of HT (f). Systematic relationship between measures was also not defined by CM-based INDSCAL analysis across SNRs.
Conclusions: HT (f) did not account for the majority of the variance (39%) in consonant recognition in noise when the complete body of the CM was considered.
Key Words: consonant confusions, audiometric hearing threshold, signal-to-noise ratio
Pure-tone audiometry is a well-established component of the audiometric test battery that measures behavioral hearing threshold to tones of different frequencies. For clinical and research purposes, many attempts have been made to test the correlation between speech recognition performance for hearing-impaired (HI) listeners and hearing thresholds. The results of such comparisons have generally shown little predictive value, particularly when speech recognition is measured in background noise (Festen &Plomp, 1983; Plomp, 1978; Smoorenburg, de Latt, &Plomp, 1982). Evidence of a poor predictive relationship between hearing threshold and sentence recognition performance in noise is well documented (Bentler &Duve, 2000; Killion, 2004a, 2004b; Lyregaard, 1982; Smoorenburg et al., 1982; Smoorenburg, 1992; Tschopp &Zust, 1994). The lack of correlation between the measures may be related to differences in the simple acoustic signals used for pure-tone audiometry and the complex nature of speech recognition even though frequency-specific audibility deficits are known to affect speech perception (Bamford,Wilson, Atkinson, &Bench, 1981; Carhart &Porter, 1971). Perception of running discourse may take advantage of increased information from complex signals and contextual and linguistic properties of speech as well as the linguistic experience of the listener.
In contrast to using meaningful sentences, some studies have investigated the relationship between speech recognition and hearing threshold using nonsense syllables (Bilger &Wang, 1976; Danhauer &Lawarre, 1979; Dubno, Dirks, &Langhofer, 1982; Gordon-Salant, 1987; Reed, 1975;Walden&Montgomery, 1975;Walden, Montgomery, Prosek, &Schwartz, 1980; Wang, Reed, &Bilger, 1978). Using nonsense syllables is essential if investigators are interested in reducing the influence of contextual and linguistic factors so that recognition relies more on the use of acoustic features (Allen, 2005; Boothroyd &Nittrouer, 1988).
Previous studies have reported an inconsistent association between audiometric pure-tone thresholds and nonsense syllable recognition under different experimental methodologies. Four studies (Bilger &Wang, 1976; Dubno et al., 1982; Reed, 1975; Wang et al., 1978) showed a systematic relationship associating better performance with lower thresholds, but another four studies (Danhauer &Lawarre, 1979; Gordon-Salant, 1987; Walden &Montgomery, 1975; Walden et al., 1980) supported no such relationship. A number of different approaches to analysis were applied across the studies.
In three studies that showed a systematic relationship with pure-tone threshold (Bilger &Wang, 1976; Reed, 1975; Wang et al., 1978), the relationship was evaluated with the results of a sequential information analysis (SINFA). SINFA provides the information for perceptual features embedded in confusion matrices (CMs) and determines the proportion of the information transmitted that is attributed to a given set of phonological features (Wang &Bilger, 1973). The procedure for constructing a (dis)similarity matrix for each subject can be summarized as follows. The results of a single SINFA were coded as a weighted vector for each of the stimulus features. The feature identified in the first iteration received the highest weight, the feature identified in the last iteration received the lowest weight, and the features not identified in the analysis received zero weight.

Whenever the number of features identified exceeded the maximum weight, the lowest ranking features were all assigned weights of one. The similarity between any two subjects was defined as the sum of the products of corresponding feature weights. Finally the similarity matrices were submitted to Johnson's (1973) pairwise multidimensional scaling procedure to represent the similarities among subjects spatially. Using this SINFAbased approach, the three studies showed a systematic relationship between phoneme recognition and configuration of the pure-tone threshold, distinguishing listeners with normal thresholds, those with a flat hearing loss, and thosewith hearing loss with sloping audiometric configurations (Bilger&Wang, 1976; Reed, 1975;Wang et al., 1978).

Unlike the SINFA-based approach, a similarity judgment task was applied in another three studies in which no systematic relationship between performance and audiometric thresholds was reported (Danhauer &Lawarre, 1979; Walden &Montgomery, 1975; Walden et al., 1980). In the similarity judgment task the subject was asked to rate the similarity between a pair of syllables using equal interval scaling (i.e., 1 being very similar, 7 being very dissimilar). Similarity judgment allows the listener to consider perceptual qualities of the phonemes being compared in addition to recognition. For example, a HI listener can judge different speech sounds to be perceptually similar because they were correctly recognized as different phonemes but judged to be perceptually similar, or because they were incorrectly recognized and judged to be the same speech sound. The results of the similarity judgment were used as input for the individual difference scaling (INDSCAL) model, a multidimensional scaling technique (Carrol &Chang, 1970). Using the similarity judgment the three studies showed no unique association between measures (Danhauer &Lawarre, 1979; Walden &Montgomery, 1975; Walden et al., 1980). It should be noted that even though Walden and Montgomery (1975) reported a systematic relationship between measures, the INDSCAL analysis with three-dimensional solutions revealed ambiguous subject space, particularly between sibilant and sonorant dimensions (see Walden &Montgomery, 1975, their Figure 2, p. 451).

Two studies analyzed phoneme recognition performance using raw CMs and compared the results with audiometric thresholds (Dubno et al., 1982; Gordon- Salant, 1987). Dubno et al. (1982) assessed consonant confusions at a fixed +20 dB signal-to-noise ratio (SNR; in cafeteria noise) in 38 HI listeners. A systematic relationship between consonant confusions and hearing threshold existed when the same consonant was given in error, most commonly for a given target across all three HI listener groups but with differences in error probability. That is, given a target /sa/, /qa/ was confused with the target at an error rate of 28.6% by the steeply sloping group, 10.4% by the gradually sloping group, and 4.2% by the flat group. However, the greatest percentage of errors was not consistently associated with a particular group. Moreover, the three HI groups were not completely separable when the complete CM was taken into account for acoustic feature (manner and place) analyses. Gordon-Salant (1987) measured CMs for consonant identification at +6 dB SNR (12 talkers babble) for three groups of elderly listeners (10 NH, 10 gradual sloping, and 10 steep sloping listeners). The INDSCAL analysis of these rawCMsrevealed no unique relationship between consonant confusions and the audiometric characteristics.

In summary, the results of four studies (Bilger &Wang, 1976; Dubno et al., 1982; Reed, 1975; Wang et al., 1978) lead to the conclusion that consonant confusions are systematically related to audiometric hearing threshold. Another four studies (Danhauer &Lawarre, 1979; Gordon-Salant, 1987; Walden &Montgomery, 1975; Walden et al., 1980) support the opposite conclusion.

An important distinction between the studies discussed above is the use of different input structures to the INDSCAL model. If SINFA-based (dis)similarity matrices (Bilger &Wang, 1976; Reed, 1975; Wang et al., 1978) or partial raw CMs (Dubno et al., 1982) were used for the INDSCAL, a systematic relationship between syllable perception and pure-tone audiometric threshold was obtained. In contrast, when similarity judgmentmeasures (Danhauer&Lawarre, 1979;Walden &Montgomery, 1975; Walden et al., 1980) or complete raw CMs (Gordon-Salant, 1987) were used as input to the INDSCAL, no systematic relationship was observed. Similarity judgment

measures are directly used as input for the INDSCAL. In contrast, SINFA-based measures should be carefully derived from raw CMs, and phonological features should be preselected by experimenters as input to the model. Consequently it is unclear how perceptual confusions embedded in CMs are reflected in SINFA-based (dis)similarity matrices. It is also unclear how the relationship between phoneme recognition and hearing threshold is impacted by these different input structures for the INDSCAL model.

Another issue in the previous studies is that CMs were measured in quiet (Bilger&Wang, 1976; Danhauer &Lawarre, 1979; Reed, 1975; Walden &Montgomery, 1975; Walden et al., 1980; Wang et al., 1978) or at +20 dB SNR (Dubno et al., 1982) and at +6 dB SNR (Gordon-Salant, 1987), which provided only partial information regarding the relationship between audiometric threshold and nonsense syllable recognition in noise. Finally, using nonsense syllables in noise provides the opportunity to evaluate performance with less use of contextual cues (e.g., meaning, grammar, prosody, etc.). These cues can increase speech understanding, particularly in noisy conditions, while not necessarily improving speech perception (Boothroyd &Nittrouer, 1988).

In the present study, we evaluate the relationship between audiometric threshold and nonsense syllable recognition with both SINFA- and CM-based INDSCAL analyses over a range of SNRs. The data evaluated here were previously studied for a separate analysis (Phatak, Yoon, Gooler,&Allen, 2009) that provided a new method to quantify the degree of consonant perception loss relative to normal hearing listeners over a range of SNRs. During the analyses, we found that consonant confusions were not hearing-threshold specific, which led to motivation for this study. In the present study, we evaluated the relationship between audiometric thresholds and syllable recognition in noise in (a) mean performanceintensity functions, (b) correlation and multiple regression models having hearing threshold as predictors, and (c) SINFA-based and CM-based similarity matrices applied as inputs to the INDSCAL model.

Method

Participants

The 22 paid participants had sensorineural hearing loss, were native speakers of American English, and were between the ages of 18 and 64 years. Three listeners had bilateral hearing loss; hence each ear was tested separately (leftand right ear identified as L and R), which resulted in a total of 25 ears tested. Descriptive information for listeners is given in Table 1.

Participants were recruited on the basis of screening preexisting audiograms obtained from the Department of Otolaryngology, Carle Clinic Association, Urbana, IL, and only those showing a three-frequency pure-tone average (0.5 kHz, 1 kHz, and 2 kHz) between 30 dB hearing level (HL) to 70 dB HLwere recruited. Listenerswhose hearing thresholdwas greater than 70 dBHL at f ≥2 kHz were not enrolled in the study because of high mean error rates in preliminary testing (see the Procedure section). The puretone audiograms of all participants were also measured for this study and are shown in the upper panel of Figure 1. All procedures were approved by both theUniversity of Illinois at Urban-Champaign Institutional Review Board and the Carle Medical Research Institutional Review Board.

Test Materials

Sixteen naturally spoken nonsense CV syllables composed of 16 American English consonants with the common vowel /a/ as in "father" were used as stimuli (Fousek, Svojanovsky, Grezl, &Hermansky, 2004). The 16 consonants presented were [/b/, /d/, /f/, /g/, /k/, /m/, /n/, /p/, /s/, /t/, /v/, /ð/, /ʔ/, /q/, /ʔ/, /z/]. Half of these syllables were spoken by five talkers and the remaining syllables spoken by another five talkers, resulting in 80 tokens [(5 talkers ×8 CVs) + (5 talkers ×8 CVs)] in total. The purpose of dividing syllables among talkers was to create a diversity of talkers and simultaneously shorten experiment time. The use of multiple utterances from several talkers also offers some assurance about the generality of the analyses beyond the experimental stimuli.

The CVs were presented in speech-weighted noise with no spectral correction (gain) as a function of SNR (-12 dB, -6 dB, 0 dB, 6 dB, 12 dB, and in quiet [Q]). Each token was level-normalized before presentation using VU-meter software (Lobdell& Allen, 2007). No filtering was applied to the stimuli. The masker was a steady-state

noise with an average speech-like power spectrum, identical to that used by Phatak and Allen (2007). For each CV, the RMS level of this noise was adjusted according to the level of the CVs to achieve the desired SNRs. Stimuli were computer-controlled and delivered via an external USB audio card (Mobile-Pre, M-Audio), and presented monaurally via an Etymotici ER-2 insert earphone. Sound levels were controlled by an attenuator and headphone buffer (TDT system 3) so that stimuli were presented at the most comfortable listening level (MCL) for each listener. The MCL was determined by each listener's self-rating with the Cox loudness rating scale (Cox, 1995) in response to 30 CVs with no error in quiet. System calibration estimates that CV presentation levels in the ear canal were between 75 and 85 dB SPL.

Procedure

The ear canal was inspected otoscopically and puretone audiometry was performed to measure hearing thresholds and to confirm type of hearing loss for each listener. Each participant was seated in a sound-treated room (Industrial Acoustics Company) for audiometry, practice, and experimental sessions. Stimuli were presented to a test ear via an insert earphone. Environmental sound to the other ear was attenuated using a foam earplug.

CV syllables were presented while participants viewed the graphical user interface that listed the 16 CVs with example words alphabetically. Participants were asked to select the button on the interface to identify the perceived CV.

A calibrate button was included so that the presentation level (MCL) could be determined by a subject's response to playing 30 CV syllables in quiet. In addition, pause and repeat buttons were available so that listeners could control the rate of stimulus presentation and could repeat the same stimulus without limit prior to responding. Our preliminary results with a few HI listeners showed no distinct influence of target repetition on performance.

Participants first performed a 30-min, two-practiceblock (120 trials per block) session on CV identification in quiet with feedback. The eligibility to participate was determined by requiring the average percent error to be less than 50% across two practice blocks in quiet. If percent error score (Pe [SNR]) was ≥50% on the two practice blocks, two additional blocks were given to further consider eligibility for participation. Listeners became eligible to participate if Pe (SNR) was ≤50% on the second pair of practice blocks, but they remained ineligible if Pe (SNR) continued to be ≥50%.

We administered the consonant identification test to measure confusion matrices for CVs in speech-weighted noise as a function of SNR. For each presentation, a CV and SNRwere selected and presentation randomized from the array of 16CVs and six SNRindices (includingQ).The set of individual stimuli [(8 CVs ×5 talkers) + (8 CVs ×5 talkers) ×6 SNRs = 480, named a set] was repeated six times (480 ×6 = 2880 trials in total), yielding 30 [2880 / (16 CV ×6 SNR)] repetitions of each CVat each SNR.

Each set (480 trials) was evenly distributed into four blocks (120 trials each), allowing participants to rest between blocks. No direct feedback about performance was provided for each CV presented. Percent correct feedback for each block was provided on the screen at the end of each block. The total number of trials and CVs already played were also provided on the screen.

Confusion matrices for each participant were plotted as a function of SNR. Any CV utterance produced by a particular talker that showed >20% error in quiet forNHlisteners was considered mispronounced and was removed from data analysis (Phatak &Allen, 2007). Total participation time to complete all protocols (puretone audiometry, CV practice, CV test, and break time) was about 6 hr and was performed in two visits.

Results

Audiometric Analysis and Pe (SNR)

The pure-tone audiograms were separated into one of two overall audiometric configurations to form a sloping group (n = 18; see Figure 1, top leftpanel) and flat group (n = 7; see Figure 1, top right panel). This classification was based on an historical scheme for describing the configuration of hearing threshold, HT (f), from the pure-

tone audiogram (Bamford et al., 1981; Clark, 1981; Goodman, 1965; Margolis &Saly, 2007; Yoshioka &Thornton, 1980). This classification scheme suggests that audiogram profiles can be classified by threshold configuration such as normal, flat, and sloping curves. In some studies the sloping curve is further divided into two subgroups, for example, sloping curves with a slope ≤20 dB/octave or ≥30 dB/octave for 1 kHz ≤f ≤4 kHz (Clark, 1981; Goodman, 1965). Similarly, the flat curve could further be divided into two subgroups, flat curves with a slope ≤15 dB/octave or ≥25 dB/octave for 1 kHz ≤f ≤4 kHz (Margolis &Saly, 2007; Yoshioka &Thornton, 1980). In our sloping group, only two out of 18 ears (denoted by the dotted line in Figure 1, top leftpanel) showed audiogram configurations with a slope ≥30 dB/octave for 1 kHz ≤f ≤4 kHz; therefore, subgroups were not defined. However, any trends indicated by the data points for these two listeners will be noted. For the flat group, all seven listeners fell into a group having slopes ≤15 dB for 1 kHz ≤f ≤4 kHz. The mean hearing thresholds (denoted as thick lines in the upper panels of Figure 1) differed significantly between the sloping and flat configuration groups, $F(1, 23) = 6.7$, $p < .05$. At frequencies <2 kHz, HT (f) for listeners with sloping hearing loss was approximately 20 dB better than for listeners with flat configuration, whereas at frequencies >3 kHz, HT (f) for the flat group is 15 dB better than for the sloping group.

A comparison of the Pe (SNR) between the two audiometric groups demonstrates a strong overlap in CV recognition performance with the range of Pe (SNR) exceeding 35% at each SNR. The lower panel of Figure 1 shows the Pe (SNR) across 16 CVs for individual listeners, coded according to the corresponding theHT (f). The mean Pe (SNR) for each group is shown by a thick line. A two-way repeated-measure analysis of variance showed no significant difference between the mean Pe (SNR) of the two groups, $F(1, 23) = 0.2$, $p > .05$. The main effect of SNR was significant, $F(5, 115) = 505$, $p < .001$. The error scores for the two listeners with slopes ≥30 dB/octave for 1 kHz ≤f ≤4 kHz generally showed poorest performance among the listeners with sloping hearing loss.

In summary, we conclude that the audiogram-based listener grouping is poorly associated with the mean Pe (SNR) for nonsense CV recognition in noise. The results shown in Figure 1 indicate that the likelihood of demonstrating representative and distinctive descriptions of speech-recognition performance across a range of HI listeners would be low if built upon the audiogrambased listener grouping.

Regression Model

To better understand the contribution of frequencydependent audibility to CV recognition, we investigated the extent to which thresholds of individual audiometric frequencies are associated with overall recognition of nonsense CVs in noise. Specifically, we determined the extent to which listener's hearing thresholds account for the variance in Pe (SNR). To study this question, a multiple regression model was tested with the slopes of Pe (SNR) forming the dependent variable and with the HT (f) at standard audiometric frequencies, as the independent variable. These slopes were computed for each listener, based on a sigmoid fit without transformation.

The HT (f) at standard audiometric octave frequencies, namely, x1 through x6 for 0.25 kHz to 8 kHz, were used as predictors. The best model was determined by testing all combinations of the 6 predictors. The search for the best combination of the predictors was finalized by finding the smallest sum of least square errors and the highest adjusted R2 values. As a result, HT (f) at 0.25 kHz, 2 kHz, and 4 kHz were included in the model as predictors. In the case of using multiple predictors, it is possible the predictors do not operate independently, but reveal multicollinearity, preventing an indication of the influence of individual predictors. Multicollinearity is >0.1 for all six predictors, which indicates no violation of the assumption that predictors operated independently (Tabachnick& Fidell, 1989). Other important assumptions were addressed appropriately.1

The final linear regression model showed an insignificant relationship between the three predictors, HT (f) and the slopes of the Pe (SNR), $F(6, 18) = 1.93$, $p > .05$. This model explained 39% of the total variance, suggesting that the balance of the variance is associated with other unmeasured variables. Based on weights (b coefficients) for the model, the order of effects on the slope of Pe (SNR) from greatest to least is for thresholds

at 2 kHz, 4 kHz, and 0.25 kHz.

INDSCAL Analysis

In this section, we attempt to use listeners' perceptual errors to identify the relationship between audiometric threshold and consonant confusions in noise. To display this relationship across subjects, we use the INDSCAL model (Carrol &Chang, 1970). The INDSCAL model takes each listener's (dis)similarity matrix (measured in a CM or similarity judgment) as its input, transforms each CM into Euclidean distances, and iterates a process of estimating individual subject differences by applying individual sets of weights to the dimensions of a common group space. In the subject space, each listener is represented as a point, and the location of a listener in the subject space is adjusted by that subject's weights, indicating the particular salience to each of the dimensions of the space. In the present study, two-dimensional solutions were retained for both SINFA-based similarity matrices and raw CMs for each subject and for each SNR. A scree plot, a graph presenting a lack-of-fit INDSCAL model relative to dimensions, supports three-dimensional solutions as the optimal number of dimensions, but a squared correlation index, the proportion of variance of the optimally scaled data, with two-dimensional solutions is also acceptable (Takane, Young, &de Leeuw, 1977). Another reason for choosing two-dimensional solutions is to avoid the complexity of interpreting stimulus features across additional dimensions. The squared correlation index for the two-dimensional solutions revealed that the model accounts for a variance of 72% to 97% over the SNRs tested.

SINFA-Based INDSCAL Model

Subject space. Evaluation of subject weight in twodimensional space, derived from the SINFA-based INDSCAL analysis, demonstrated no systematic relationship between stimulus features across SNRs and pure-tone threshold groups (see Figure 2). This result differs from that of Bilger and Wang (1976) despite obtaining (dis)similarity matrices using the same approach. However, two clear subject groups were identified, particularly by dimension (Dim.) 1. For example, seven subjects with flat hearing loss (ID is given) are consistently separated into two groups across SNRs except SNR = -12 dB; 3R and 117R were separated from other five subjects (4L, 4R, 76L, 113R, and 216L) by Dim. 1. The two listeners whose audiograms showed a slope ≥30 dB/octave for 1 kHz ≤f ≤4 kHz from the sloping group were also consistently classified in the same group across SNRs. This SINFA-based INDSCAL analysis revealed consistent groups of listeners across SNRs, but grouping was not consistent with the flat and sloping audiometric configurations.

To assess the consistency of these groups across SNRs, a retaining rate, the percentage of listeners remaining in the same group across SNRs, was computed, and the results are shown in top portion of Table 2. Overall retaining rate is constant across SNRs except -12 dB SNR. The retaining rates are given in each cell with the number of listeners in parentheses. Percentages oriented diagonally along the bottomof each column indicate the retaining rate between adjacent SNRs. For example, 23 listeners (92%) out of 25 maintained their groups between Q and 12 dB SNR and 16 (64%) out of 25 listeners were retained by their groups between -6 dB to -12 dB SNRs. Other cells indicate retaining rates for composite SNRs. For instance, 92% of listeners in the Q row remained in the same groups between Q and 12 dB SNR, but the retaining rate decreased to 68% when groups were considered over 12 dB, 6 dB, -6 dB, and -12 dB SNRs. The retaining rate decreases considerably at -12 dB SNR.

Two of the three subjects whose performance was measured separately for the right and leftears (4L/R in the flat group; 200L/R in the sloping group) were consistently categorized in the same group across SNRs (results were shown only for 4L/R in Figures 2 and 4). The third subject who was tested bilaterally (2L/R in the sloping group) was categorized in the same group at -12 dB and 0 dB SNRs, but not at other SNRs.

CM-based INDSCAL Model

Stimulus space. The group stimulus space illustrated in Figure 3 provides a graphical representation of the stimulus coordinates derived by CM-based INDSCAL. This group stimulus space depicts the perceptual proximities of the stimuli presumed to underlie all listeners' confusions. The dimensions are interpreted as the

consonant features that can best account for the arrangement of the stimuli along each axis.

The stimuli appear to be arranged in two clusters along Dim. 1: the duration consonants (/s/, /?/, /?/, and /z /) are distinguished from the other 12 CVs at three lower SNRs (see Figure 3, top panels), whereas the fricative consonants (/f/, /s/, /v/, /ð/, /?/, /?/ and /z/) best define clusters at higher SNRs (see Figure 3, bottom panels). The feature labeled as duration is adapted from Miller and Nicely (1955) to distinguish four fricative consonants that are characterized by long duration and intense, high-frequency noise. The presence of a long frication noise appears to be the important feature for defining Dim. 1 at lower SNRs.

Dim. 2 shows that the nasals (/m/ and /n/) are separated from the other 14 CVs at the four higher SNRs (see Figure 3). A misplacement of /?/ is observed for Dim. 2 at +12 dB SNR. At -6 dB and -12 dB SNRs, the consonants on Dim. 2 are arranged in a single cluster,which precludes defining that dimensionwith an interpretable feature. For Dim. 2, the manner of articulation clearly serves as the common perceptual dimension at the four higher SNRs.

Subject space. The subject weights on twodimensional solutions of the CM-based INDSCAL process with 25 HI ears are shown in Figure 4. A dimension weight reflects the strength of the dimensional property in accounting for the confusions made by each subject at each SNR. That is, the weights reflect the types of confusions made by subjects at each SNR. For example, if the confusions are mainly between stimuli that share stimulus features specified by a dimension, then subject weights will be relatively high for that dimension. Where the confusions are mainly between stimuli that do not share stimulus features described by the dimension, the subject weights for that dimension are relatively low.

The result of the CM-based INDSCAL analysis shows no discernible categorization of listeners between the two audiometric groups at any SNR, including the quiet condition (see Figure 4). At each SNR, listeners were grouped (A, B, and C), based on differences in weighted Euclidean distances, although actual subjects within each cluster vary according to SNR. This CMbased group seems to be mainly dependent on the SNR, suggesting that confusions are a function of SNR, not of audiometric configurations. One noticeable pattern in the subject space is that listenerswho had higher weights along Dim. 1 also had higher weights along Dim. 2. The variability of weights on both dimensions was noted for the two lowest SNRs. A distinct segregation of the two sloping group listeners with slopes ≥30 dB/octave for 1 kHz ≤f ≤4 kHz is demonstrated, particularly at 0 dB, 6 dB, and 12 dB SNRs, but any unique separation from other sloping group listeners across SNRs is not obvious. Because no consistency in HI grouping was found, plots of audiograms versus CM-based groups are not presented. In addition, the subjects with both ears tested (4L/R in the flat group; 2L/R and 200L/R in the sloping group) were consistently categorized in the same group at the four lower SNRs, but not for the two higher SNRs.

The retaining rate for CM-based listener grouping is shown in the bottom portion of Table 2. The retaining rate is proportional to SNR, that is, as a SNR decreases, the retaining rate also decreases, particularly at a SNR <0 dB. The rate is also largely poorer than that for the SINFA-based grouping. Out of 25 listeners, 13 (52%) maintained their groups between Q and 12 dB SNR and 11 (44%) were retained by their groups between -6 dB and -12 dB SNRs. Other cells indicate retaining rates for composite SNRs. For instance, 52% of listeners in Q row remained in the same groups between Q and 12 dB SNR, but the retaining rate decreased to 24% when groups were considered over 12 dB, 6 dB, and -6 dB SNRs. Finally only two listeners (8%) remained in the same groups over four SNRs from 12 dB to -12 dB. This retaining rate would vary with the SNR step size being compared. If equal step sizes are compared on the diagonals formed along the bottom of columns in Table 2, then a U-shaped function is more apparent with the best retention rate for comparisons at 0 dB SNR. Indeed, 0 dB SNR has the highest retention rate.

Discussion

The goal of the present study was to determine the extent to which audiometric hearing threshold is associated with nonsense CV recognition in noise. The results revealed that the Pe (SNR) does not seem to be directly

associated with the HT (f), as shown in Figure 1. However, in the quiet condition, the scores for the sloping hearing threshold group (20%) and for the flat hearing threshold group (25%) are similar to those reported by Dubno et al. (1982). Dubno et al. reported that errors among the listeners with sloping hearing loss were the lowest (22% error), whereas those with flat hearing loss were somewhat poorer (30% error), and those labeled steep hearing loss showed the highest error (50%) on CVor VC syllables in cafeteria noise at +20 dB SNR.

The multiple regression models revealed nonsignificant associations between the slopes of Pe (SNR) and HT (f). HT (f) contributed 39% of the total variances of the slope of Pe (SNR). The weights (b coefficients) for the model showed that effect on the slope of Pe (SNR) was the greatest for thresholds at 2 kHz. Carhart and Porter (1971) showed a similar finding for spondees: Adding a threshold at 1 kHz (except in the group with marked high-frequency loss) for the regression model was highly correlated with speech reception threshold (SRT), but adding threshold at 2 kHz to the model improved the prediction slightly. However, adding thresholds at 4 kHz and 0.25 kHz did not produce practical improvement in predictability for spondee SRT. Bamford et al. (1981) correlated pure-tone audiograms with the slope of sentence perception performance in quiet for 150 HI children. Poor correlation (r = 0.329) was reported. It was also reported that the correlation between measures was highly affected by the degree of hearing loss, particularly from severe to profound hearing loss.

SINFA-based listener grouping (see Figure 2) showed no unique relationship of audiometric characteristics with consonant confusions even though two distinct groups were consistently defined across SNRs. This poor relationship is related to two technical issues in the SINFA analysis.

First, the SINFA requires prior knowledge about unknown perceptual features embedded in CMs. In the SINFA procedure, phonological features are selected by the experimenter with some unknown assumption about the perceptual features. The analysis of SINFA-based INDSCAL provides only subject spaces without names of dimensions because experimenters select features for the model in advance. This is the reason that all studies that used SINFA never presented subject dimensions because the approach does not permit identification of that information. In addition, requirement of prior knowledge of perceptual features is a fundamental violation for INDSCAL model because the core concept of the INDSCAL model is to reveal unknown perceptual dimensions embedded in CMs or (dis)similarity matrices.

Another concern about using SINFA is related to the procedure for obtaining (dis)similarity matrices. As discussed in the introduction, the feature identified in the first iteration received the highest weight, the feature identified in the last iteration received the lowest weight, and the features not identified in the analysis received zero weight. Whenever the number of features identified exceeded the maximum weight, the lowest ranking features were all assigned weights of one. The similarity between any two subjects was defined as the sum of the products of corresponding feature weights. This means that a similarity matrix for one subject might be much like that of another subject even though their features were identified in very different orders. For example subject A has ratings from 6 to 1 for the same set of features, but subject B has ratings from 1 to 6. The sum of the products between subjects A and B is 56. Another two subjects, C and D, have two top ratings (6 and 5) in common, but ratings for other features are not in common. The sum of the products between subjects C and D is 61. It is highly likely that the SINFA-based INDSCAL model would consider these two pairs of subjects similar even though their feature perception is completely different.

As shown in the two-dimensional subject space derived from the CM-based INDSCAL (see Figure 4), no unique relationship between audiometric thresholds and perceptual confusions was evident across SNRs, including the quiet condition. This CM-based INDSCAL grouping seems to be a function of SNR, not of audiometric configuration.

Our CM-based INDSCAL solutions for perception in quiet are consistent with results of other studies (Danhauer &Lawarre, 1979; Danhauer &Singh, 1975; Walden et al., 1980) despite differences in some experimental conditions including (in their studies): a single talker, listener's demographics, stimulus context (CV-CV pairs), and response mode (similarity judgment using 7-point equal-appearing interval scaling). Danhauer and Singh

(1975) found that subject weights in the three-dimensional solutions generated by INDSCAL were neither obvious nor related to three different audiometric configurations. Danhauer and Lawarre (1979) also found that HI listeners represented in three-dimensional solutions could not be clustered into distinct subgroups according to three different configurations of hearing loss. Walden et al. (1980) also reported no consistent differences in feature weights between two HI listener groups represented by INDSCAL in four-dimensional solutions. This result is somewhat in disagreement with those of Walden and Montgomery (1975) who reported distinct HI listener groupings in three-dimensional subject space determined by the INDSCAL analysis. In contrast to a conclusion made by the authors, the INDSCAL analysis with threedimensional solutions revealed ambiguous subject space, particularly between sibilant and sonorant dimensions (see Walden &Montgomery, 1975, their Figure 2, p. 451). Compared with INDSCAL groupings from other studies, subject space in the study by Walden and Montgomery (1975) did not support distinct subject groups.

A study of CV perception in HI listeners by Bilger andWang (1976) provides a particularly important comparison with the current study because the complete body of information from both diagonal and off-diagonal cells in CMs was fully taken into account for the analysis. Whereas 14 CVs used by Bilger andWang were identical to those used in the current study, some details of the experimental conditions differed. For example, the number of talkers and vowels used differed (a single talker and three vowels [/i/, /a/, /u/] in Bilger andWang; 10 talkers and a single vowel /a/ in the current study). However, it has been demonstrated that differences in the vowel accompanying the consonant have little effect on the patterns of consonant confusions (Gordon-Salant, 1985; Phatak &Allen, 2007).

Grouping of pure-tone audiogram configurations as defined by SINFA-based INDSCAL of CV confusions in quiet revealed different patterns between the study by Bilger and Wang (1976, Figure 5, bottom panels) and the current study (Figure 5, top panels). Bilger and Wang found three distinct subgroups in two-dimensional space. Bilger andWang's data revealed differences in the average configuration of hearing thresholds that appear clearly discernible (Figure 5, bottom right panel). The NH/gradual group had a slope <20 dB for 1 kHz ≤f ≤4 kHz. For the same range of frequencies, the flat group had a slope <5 dB, and the steep group had a slope >30 dB. For the current study, the slopes of the average hearing thresholds showed great overlap across groups defined by SINFA-based INDSCAL (Figure 5, top right panel). For example, for 0.25 kHz ≤f ≤2 kHz, the slopes of group 1 and 2 are somewhat different (<15 dB), but for 2 kHz ≤f ≤4 kHz, the slopes of the two groups are similar (<10 dB). Listener grouping, defined by CM-based INDSCAL in the current study (Figure 5, middle panel) was different from that defined by SINFA-based INDSCAL in the current study and in Bilger andWang. For the current study, the slopes of the average hearing thresholds show great overlap across groups defined by CM-based INDSCAL (Figure 5, middle right panel). Specifically for 1 kHz ≤f ≤4 kHz, the slopes of groups A and B are similar (<20 dB), and the slope of group C is <30 dB.

The cause for the discrepancy in the results defined by SINFA-based INDSCAL between the current study and that of Bilger andWang (1976) might be talker variation. For the present study, 16 CVs were produced by 10 different talkers, whereas for the Bilger and Wang study, all CVs were produced by a single talker. It has been shown that perceptual confusions are clearly influenced by talker variation (Phatak, Lovitt, &Allen, 2008; Regnier&Allen, 2008). Phatak et al. (2008) showed that different utterances of the same consonant can produce a significant variability in performance scores and confusion patterns. The consonant most often confused with a given target consonant varied depending on the talker. The reason for using multiple talkers in the present study was to measure confusions under more realistic listening conditions. Such conditions may yield results that are more readily generalized but more complex in that the confusions are more distributed even for the same utterance. Thus, it is likely that talker variation is one of the variables that can spread the effect of the audiometric difference across subject space, resulting in inconsistent groupings for performance in quiet as shown in the current study.

The cause for the discrepancy in the results between CM-based INDSCAL in the current study and

SINFAbased INDSCAL in the study by Bilger and Wang (1976) appears to result from a difference in input structures for the INDSCAL model. In the study by Bilger and Wang, (dis)similarity matrices for the INDSCAL model were constructed from the indices of feature perception, determined by the SINFA (Wang &Bilger, 1973), whereas for the current study (dis)similarity matrices were normalized, raw CMs. Details of how (dis)similarity matrices for the INDSCAL model were constructed, based on the results of SINFA, appear in the Introduction above. The differences in the structure of (dis)similarity matrices directly alter the iteration process from an arbitrary initial configuration of subject space in the INDSCAL model, resulting in a different estimated configuration of subject spaces (Jones &Young, 1972; MacCallum, 1977; Takane et al., 1977). One of two conclusions made by Wang and Bilger (1973), about identifying distinct perceptual features for CVs from CMs measured in both in quiet and noise, is that similar information transmission for features does not guarantee similar consonant confusion patterns or vice versa. Thus, it is possible, based on the systematic differences between the present study and that of Bilger and Wang, that the dissimilarity matrices, constructed from information transmission for features (SINFA), are more reflective of audiometric threshold differences than of confusion matrices.

For both Bilger and Wang (1976) and the current studies, audibility might be one of the factors affecting internal structure of perceptual confusions. Bilger and Wang used a presentation level of 40 dB above the subject's SRT, and a MCL (75 dB È85 dB SPL) was used for the current study. Using data given in the study of Bilger and Wang, we computed the average presentation levels for each of the HI groups categorized by SINFAbase analyses as follows: 54.6 dB HL for theNH/gradual group (Figure 5, A panel), 67.6 dB HL for the flat group (Figure 5, B panel), and 67.0 dB HL for the steep group (Figure 5, C panel). For the current study, using the minimum audibility curve (ANSI S3.6-1996), the presentation levels of 75 and 85 dB SPL would be equivalent to 62.5 and 72.4 dB HL. The presentation levels in dB HL for both studies were comparable. However, an inspection of the audiograms given in Figure 5 for both studies indicates that sensation level is too low for some subjects. For example, in the study by Bilger andWang, three subjects in the NH/gradual group had sensation level less than 10 dB at frequencies >3 kHz; two and four subjects in the flat and steep groups showed the same results. In the current study, six subjects in the A group (Figure 5, middle panel) had sensation level of less than 10 dB at 3 kHz; this result was similarly evident in one and four subjects in the B and C groups, respectively (Figure 5, middle panel). Lower sensation level at high frequencies might affect perception of some consonants such as /sa/ and /?a/, but it is unclear how such a lack of audibility affects the confusion patterns. Consequently, it is difficult to predict how listener's groupings observed in both studies will be affected. It would be interesting to see how the relationship between consonant confusions and hearing threshold would be affected if a spectral compensation procedure such as NAL-R is applied to adjust frequency response based on the loudness equalization for each CV.

Another possible influence on the grouping observed in the current study is the characteristics of the noise masker (speech-shaped noise). That is, the presence of a noise stimulus might change the effective hearing loss configuration, making it more similar than different for persons with different losses. If this is the case, then the result of grouping in quiet for the current study should be different from that in noise. This was not the case for the results of the current study. For example, in Figure 2, seven subjects with flat hearing loss were consistently separated into two groups when syllables were presented in both noise and quiet. Regardless of presence of noise, the two listeners with steeply sloped hearing loss (threshold ≥30 dB/octave for 1 kHz ≤f ≤4 kHz) were also consistently classified in the same group. In addition, 3R and 117R in the sloping group were separated from five other subjects in the same group (4L, 4R, 76L, 113R, and 216L) across SNR including the quiet condition. Based on this evidence, it is unlikely that the presence of a noise stimulus changes the effective hearing loss configuration and makes persons with different losses more similar than different. The results of the present study might be useful for hearing aid fitting algorithm research.

For most current hearing aid fitting algorithms, the pure-tone audiogram is the primary input even though the

audiogram does not account for the majority of the variance in performance of speech perception in noise. Our results suggest that patients with similar audiometric configurations may require different hearing aid strategies.

Conclusions

A clear predictive relationship between the Pe (SNR) and HT (f), was not found for syllable recognition either in noise or in quiet. The result of a multiple regression model showed that 39% of total variance of the Pe (SNR) was contributed by the HT (f). The result of SINFAbased INDSCAL analysis revealed consistent grouping of listeners across SNRs, but groupings were not consistent with two configurations of pure-tone thresholds. The CM-based INDSCAL analysis showed no systematic relationship between the consonant confusions and the HT (f) at any SNRs, including the quiet condition. Thus, audiometric threshold does not account for the majority of the variance in performance of nonsensesyllable perception in noise when complete CMs were considered.

Acknowledgments

The data collection expenses were covered through research funding provided by Etymotic Research. We thank all members of the Human Speech Recognition group at the Beckman Institute, University of Illinois at Urbana-Champaign for their help. Our special thanks go to Feipeng Li and Sandeep Phatak for their careful reading and valuable suggestions. We thank Andrew Lovitt for writing the Matlab data collection code. We want to thank Justin Aronoff, associate researcher at House Ear Institute for his comments on MDS computation and interpretation of the results and thank Laurel Fisher for valuable comments on the regression analyses.

Footnote

1An assumption of normality of residual errors was tested by checking histograms for the residuals as well as normal probability plots. The linearity assumption between variables was verified by plotting bivariate scatter plots of the variables. In practice, these assumptions can never be fully confirmed; however in this case, linearity was read from these scatter plots.

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Editor: Robert Schlauch
Associate Editor: Kathryn Arehart
Received August 25, 2010
Revision received April 11, 2011
Accepted July 19, 2011
DOI: 10.1044/1092-4388(2011/10-0239)

Publication date: Apr 2012

Year: 2012

Consequences of Broad Auditory Filters for Identification of Multichannel-Compressed Vowels

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 474-486.
ProQuest document link

Abstract: In view of previous findings (Bor, Souza, &Wright, 2008) that some listeners are more susceptible to spectral changes from multichannel compression (MCC) than others, this study addressed the extent to which differences in effects of MCC were related to differences in auditory filter width. Listeners were recruited in 3 groups: listeners with flat sensorineural loss, listeners with sloping sensorineural loss, and a control group of listeners with normal hearing. Individual auditory filter measurements were obtained at 500 and 2000 Hz. The filter widths were related to identification of vowels processed with 16-channel MCC and with a control (linear) condition. Listeners with flat loss had broader filters at 500 Hz but not at 2000 Hz compared with listeners with sloping loss. Vowel identification was poorer for MCC compared with linear amplification. Listeners with flat loss

made more errors than listeners with sloping loss, and there was a significant relationship between filter width and the effects of MCC. Broadened auditory filters can reduce the ability to process amplitude-compressed vowel spectra. This suggests that individual frequency selectivity is a factor that influences benefit of MCC when a high number of compression channels are used.

Full text: Headnote

Purpose: In view of previous findings (Bor, Souza, &Wright, 2008) that some listeners are more susceptible to spectral changes from multichannel compression (MCC) than others, this study addressed the extent to which differences in effects of MCC were related to differences in auditory filter width.
Method: Listeners were recruited in 3 groups: listeners with flat sensorineural loss, listeners with sloping sensorineural loss, and a control group of listeners with normal hearing. Individual auditory filter measurements were obtained at 500 and 2000 Hz. The filter widths were related to identification of vowels processed with 16-channel MCC and with a control (linear) condition.
Results: Listeners with flat loss had broader filters at 500 Hz but not at 2000 Hz compared with listeners with sloping loss. Vowel identification was poorer for MCC compared with linear amplification. Listeners with flat loss made more errors than listeners with sloping loss, and there was a significant relationship between filter width and the effects of MCC.
Conclusions: Broadened auditory filters can reduce the ability to process amplitude-compressed vowel spectra. This suggests that individual frequency selectivity is a factor that influences benefit of MCC when a high number of compression channels are used.
Key Words: hearing aids, compression, multichannel, auditory filter, vowel
For many years, vowels were seen as "filler" between critical consonants that carried little information in themselves. Consider an example from popular culture: The voice of the "teacher" in animated Peanuts cartoons consisted of an unintelligible stream of vowel-like inflection without any consonants (actually created with a trombone). More recently, researchers have focused on the contributions of the vowel-to-speech recognition (e.g., Kewley-Port, Burkle, &Lee, 2007). Segmentally, both the static center of the vowel and the transitory onset/ offset boundaries carry useful information. For example, Rogers and Lopez (2008) found that speech recognition was impaired when the vowel center was removed, even though start and end formant transitions were intact. Vowels, then, deserve our attention for their contributions to speech recognition under different circumstances.
The most important identifying cues for a vowel are the frequency locations of the vowel formants (Hillenbrand, Houde, &Gayvert, 2006; Kewley-Port &Zheng, 1998; Klatt, 1982; Sommers &Kewley-Port, 1996; Syrdal &Gopal, 1986). Listeners can identify vowels given nothing but a sparse spectrum of tones at the formant frequencies (e.g., Molis, 2005).We can therefore view a vowel as a set of three to five spectral "peaks" separated by lower amplitude "valleys." We refer to the level difference between the peaks and valleys of the vowel spectra as spectral contrast.
To understand vowel identification, first consider representation of a vowel through a normal auditory system. With narrow auditory filters providing good frequency selectivity, the auditory system can easily resolve and distinguish the formant frequencies from the background, in which the background can be either the spectral valleys of the vowel or a masking noise. A high level of identification is achieved especially when formant information is combined with other cues, such as spectral shape and vowel duration.
Next, consider the same vowel, represented through an impaired system in which auditory filters are broader than normal (Dubno &Dirks, 1989; Glasberg &Moore, 1986). In such a system, closely spaced formants may fall within the same critical band so that the listener can no longer distinguish between vowels with similar formant frequencies. This is one reason why many listeners with sensorineural loss show degraded perception for

naturally produced vowels (e.g., Coughlin, Kewley-Port, &Humes, 1998; Liu &Kewley-Port, 2007; Richie, Kewley- Port, &Coughlin, 2003).

Even if vowel formants are resolved into separate critical bands, widened auditory filters may smear spectral detail. Consequently, listeners with hearing loss require a larger spectral contrast (i.e., peak-to-valley ratio) to achieve the same performance as listeners with normal hearing when listening to vowel-like synthetic stimuli (Leek, Dorman, &Summerfield, 1987; Turner &Holte, 1987). The individuals tested in Leek et al. (1987) needed a peak-to-valley ratio of about 6 dB (in contrast to 2 dB for listeners with normal hearing). Because naturally produced vowels have peak-to-valley ratios on the order of 5-30 dB, many vowels should still be identifiable despite the need for larger spectral contrast. However, accurate vowel identification will depend on the presented vowel, the listener's frequency selectivity, and whether alternative cues (such as vowel duration) are available.

The present study is concerned with effects of broadened auditory filters on vowel identification in combination with effects of digital amplification. Digital hearing aids invariably apply some form of wide dynamic range multichannel compression (MCC). Briefly, in MCC, the input signal is filtered into a number of channels. Gain is applied within each channel, with the goal of placing the output signal into the listener's dynamic range, and the channels are summed for the final output. Early researchers anticipated that a large number of compression channels might reduce spectral cues1 (Lippmann, Braida,&Durlach, 1981; Plomp, 1988). Although there was little empirical testing of this effect, poorer performance with MCC was assumed to be because of reduction of spectral cues (Woods, Van Tasell, Rickert, &Trine, 2006). However, loss of spectral detail was also presumed to be of minor consequence for speech recognition when considered in view of the other benefits of MCC (Yund &Buckles, 1995).

Studies of MCC have focused mainly on consonant or sentence recognition, in which spectral, temporal, and contextual cues all contain usable information. Spectral degradation fromMCCought to have the greatest consequence for vowel identification, which depends on spectral cues. Bor, Souza, and Wright (2008) undertook an acoustic analysis to quantify the acoustic and perceptual effects of MCC. Naturally produced vowels were processed with 1-16 compression channels, and a spectral contrast measure was developed to assess the effect of channel number. Most of the vowels showed significantly decreased spectral contrast, and reduced spectral contrast was associated with reduced vowel identification. It was of particular interest that recognition was reduced more for some listeners than others, even though they all had similar degrees of hearing loss.

To guide clinical choices, it would be useful to be able to determine which individuals might be most susceptible to such effects. It seems probable that the consequences of spectral change from MCC are magnified for individuals who have poorer representation of spectral detail because of broader auditory filters. Such a relationship has already been demonstrated, albeit for linearly amplified consonants (Preminger &Wiley, 1985). Given that vowels depend more heavily on spectral cues than do consonants (Xu &Pfingst, 2008; Xu, Thompson, &Pfingst, 2005), we expect a relationship between auditory filter width and perception of MCC vowels.

The present study builds upon our previous work (Bor et al., 2008) to further investigate the effects of MCC on vowel spectra and, in particular, to explore reasons for individual variability. The following goals were addressed: first, to describe auditory filter characteristics for listeners with sloping and flat loss; second, to determine whether those groups showed a difference in identification of multichannel compressed vowels; and third, to determine whether performance differences across groups were related to auditory filter width.

Method

Listeners

Twenty-eight adults2 participated in the study. The cohort included 13 listeners with sloping loss (53-88 years of age; mean age = 74 years) and 15 listeners with flat loss (44-88 years of age; mean age = 71 years). Listeners

were tested monaurally, and a loss that met the criteria in one ear was sufficient for inclusion. All listeners had sensorineural hearing loss, defined as no air-bone gap greater than 10 dB at octave frequencies ranging from 0.25 to 4 kHz and static admittance and tympanometric peak pressure within normal limits in the test ear according to Wiley et al. (1996). Each listener with sloping loss had normal hearing or a mild loss (≤ 35 dB HL)3 at 500 Hz, with 2000-Hz thresholds at least 20 dB worse than 500-Hz thresholds. Each listener with flat loss had a moderate loss (40-60 dB HL) at 500 Hz, with 500- and 2000-Hz thresholds within 10 dB of each other. Mean hearing thresholds for the two groups are shown in Table 1. Our primary interest was not audiometric configuration per se but rather the relationship between auditory filter width and identification of MCCvowels. The choice of listeners with flat and sloping loss was a convenient way to increase the probability that auditory filter patterns would vary across groups. Because pure-tone threshold and auditory filter width are moderately correlated (Carney &Nelson, 1983; Dubno &Dirks, 1989; Florentine, Buus, Scharf, &Zwicker, 1980; Stelmachowicz, Jesteadt, Gorga,&Mott, 1985), we expected that (a) low-frequency auditory filters would be wider for the listeners with flat than sloping loss, (b) high-frequency auditory filters would be similar across the two groups, and (c) there would be within-group variability.

There was no significant difference in age between groups, $t(26) = -0.68$, $p = .506$. Each listener completed the Mini-Mental State Exam (Folstein, Folstein, &McHugh, 1975) and had at least the minimum score of 26 (out of 30) considered to represent normal cognitive function. Group mean Mini-Mental State Exam scores were 29.5 points for the sloping group and 29.0 points for the flat group, with no significant difference between groups, $t(26) = 1.59$, $p = .454$.

Data were also collected for four listeners with normal hearing (26-33 years of age; mean age = 28 years). All of the listeners with normal hearing had pure-tone thresholds of 20 dB HL or better at octave frequencies ranging from 0.25 to 8 kHz. The normal-hearing data were used as a reference point for data interpretation.

English was the first or primary language for all listeners. All procedures were reviewed and approved by the local Institutional Review Board, and listeners were reimbursed for their time.

Auditory Filter Characteristics

Auditory filter characteristics were estimated with an adaptation of the procedure used by Leek and Summers (1996). Masked thresholds were determined for sinusoidal tones in the presence of notched-noise maskers. Tone frequencies were 0.5 or 2 kHz, on the basis of the auditory filters expected to be critical to the vowel identification task (first formant frequency [F1] M = 0.53 kHz, and second formant frequency [F2] M = 1.9 kHz across all vowels).

Stimuli. All signals were digitally generated in MATLAB at a 48.8-kHz sampling rate. The target tones were 360 ms in duration (including 25-ms cosinesquared rise and fall ramps). The tones were presented at 10 dB above the listener's hearing threshold at the tone frequency.4

The masker was 460 ms in duration (including 25-ms cosine-squared rise and fall ramps). Whenmasker and tone were presented together, the tone was temporally centered within the masker (i.e., the masker began 50 ms before and ended 50 ms after the tone). The masker was digitally generated in the frequency domain, resulting in two bands of noise located to either side of the target tone frequency. The maskers were placed either symmetrically or asymmetrically around the tone frequency, creating a variety of notch widths (see Table 2). Notch widths were chosen on the basis of recommended (abbreviated) parameters for estimating auditory filter widths (Stone, Glasberg, &Moore, 1992). The notch width was defined as the deviation of each edge of the central notch from the center frequency (fc), and was denoted as Df/fc. There were six notch widths: symmetrical widths of 0.0, 0.1, 0.2, and 0.4; plus two asymmetrical widths of 0.2 and 0.4 for the low and high band, and 0.4 and 0.2 for the low and high bands. The lower and upper edges for the notched noise were set at 0.8 ×fc (Baker &Rosen, 2002). Thus, the outer edges of the noise were 100 and 900 Hz for the 500-Hz tone and were 400 and 3600 Hz for the 2000-Hz tone.

Procedure. At each notch width, the tone level was fixed, and the masker level was varied adaptively to obtain

thresholds. The tone and masker were mixed and presented monaurally to the test ear via an ER2 insert earphone. The masked threshold was estimated for each notch width using a two-alternative forced-choice paradigm with feedback. In each trial, the masker was present in both intervals, and the tone was present in one of those intervals. Listeners were instructed to select the interval with the tone using a touch screen. In the first trial, signal-to-noise ratio was 0 dB. The masker increased in 5-dB steps after three consecutive correct responses and decreased in 5-dB steps after one incorrect response. The 5-dB step size decreased to 2 dB after four reversals and continued until 10 additional reversals occurred, at which point the threshold was calculated as the mean tone level of the last six reversals. A single threshold measurement was referred to as a block.

To familiarize the listener with the task, threshold was measured for each listener with the tone presented at 70 dB SPL using a symmetrical notch width of 0.2. Next, the probe level was fixed at 10 dB SL (re: audiometric threshold). For each listener, 24 thresholds (6 notch widths ×2 tone frequencies ×2 test blocks) were measured. Presentation order of the notch width and tone frequency was randomized.

Estimating the auditory filter. Auditory filter width was estimated using a roex (p, r) model, where p was the width of the filter's passband, and r was the dynamic range (Patterson, Nimmo-Smith, Weber, &Milroy, 1982). The Polyfit program (Rosen, Baker, &Darling, 1998) was used to calculate the auditory filter parameters and final equivalent rectangular bandwidth (ERB) values for this study. The model was specified to allow three polynomial terms for both the lower and upper slope of the filter, and the allowed shiftfor off-place listening was set at 0.2.

Unlike Leek and Summers (1996), we opted not to average discrepant data into the final value but rather to discard those points that, according to a quality check, did not represent a valid response to the stimuli. A data point was considered invalid if standard deviation within a block exceeded 5 dB. When invalid data points were noted during testing, the same condition was repeated in an attempt to obtain valid data. Ninetyseven percent of the data points passed the quality check and were retained. For those data, the betweenblocks difference was less than 1 dB averaged across all listeners, test tones, and notch widths. Correlation between the values for the first and second blocks was r = .89. In those cases, results for Block 1 and Block 2 were averaged together for the final notch-width result. Otherwise, results from a single block were used.

Although all listeners were able to complete the task, some estimated filters could not be fit. A modeled filter slope of zero indicated a poorly fit function. In the case of filter slope zero, each notched-noise condition was systematically removed from and/or added to the calculation to better model the filter function. In some cases, it was not possible to avoid a filter slope of zero by adding or subtracting conditions. The filter could not be modeled at 0.5 kHz for two listeners with flat loss and for one listener with sloping loss and at 2 kHz for six listeners with flat loss and for three listeners with sloping loss. Dubno and Dirks (1989) noted a similar issue, in which masked-threshold data for some listeners could not be appropriately fit by the two-parameter roex model, despite those listeners having similar hearing thresholds as the rest of the listener cohort.

Vowel Identification

Stimuli. Stimuli consisted of naturally produced vowels by six adult male and six adult female talkers. A detailed description of the vowel recording and selection can be found in Bor et al. (2008). Briefly, all vowels were recorded in an /hVd/ or /Vd/ context, including "heed" /i/, "hid" /I /, "aid" /e/, "head" /e/, "had" /æ /, "odd" /A/, "hood" /O/, and "who'd" /u/. The eight words were randomized and repeated five times, and words from equivalent positions in the set of repetitions were used to control for list effects on pronunciation. All talkers were instructed to read the list of words at a natural pace and vocal intensity. Vowels were recorded at 44.01 kHz or 22.05 kHz and were downsampled to 11.025 kHz.

One representative token of each vowel was selected for each talker on the basis of recording fidelity, clarity of each talker's voice, and similarity across vowels in the intonation. Linear predictive coding formant tracks overlaid on a wideband spectrogram and pitch tracks overlaid on a narrowband spectrogram were used to

ensure formant and pitch steady states at the vowel midpoint. The final set consisted of 96 words (12 talkers ×8 vowels). Table 3 lists means and standard errors of F1 and F2 for the vowel set. Peak amplitude was normalized across vowels. For these steady-state signals, final root-meansquare levels across vowels varied by less than 2 dB.

Compression. To create the MCC vowels, the 96 /hVd/ words were digitally filtered into 16 channels using 5-pole, Butterworth 1/3rd-octave band filters. The lower to upper range across all channels was set at 141 Hz and 5623 Hz, respectively. Division points between channels were based on equal-octave spacing (see Table 4). The channels were compressed separately using simulation software and then were summed to create the final MCC signals.

The compression parameters were the same in each channel and included a compression ratio of 3:1, an attack time of 3 ms, and a release time of 50 ms. Compression threshold was set at 30 dB below the peak level of the normalized vowel. Note that parameters suitable to test the experimental question took priority. For that reason, the compression parameters were deliberately not varied across individuals (or across channels), as would be done in the clinic. However, the compression parameters were within the range of those in clinical use. Output level of the vowels was dictated by the application of an individual frequency-gain response, described below.

To remove formant transitions and vowel duration cues, a 150-ms segment was extracted from the center of each vowel. The 150-ms duration was chosen after examining vowel duration among the entire set. Because all vowels were longer than 150 ms, the brief temporal overshoot of the attack time was removed. A 5-ms linear amplitude ramp was applied to the onset and offset of each segment.

A linear (uncompressed) condition was created using all process steps described here, except that the stimuli were bandpass filtered from 141 Hz to 5623 Hz, and there was no compression simulator.

To ensure sufficient audibility of all vowels for the listeners with hearing loss and to mimic a clinical scenario, amplification was added to the vowels prior to presentation. An individual frequency response was calculated for each listener using NAL-RP prescriptive values (Byrne &Dillon, 1986) and was used to create output targets (output as function of frequency) that were the same for the linear and MCC conditions. Output levels as a function of frequency were measured for each listener to ensure that targets were met and that there were no differences in audibility across conditions. An additional random attenuation of 1 or 2 dB was applied to prevent any unanticipated intensity biases.

Procedure. Listeners were seated in a double-walled sound booth. To familiarize the listener with the orthography of the vowel choices, each listener completed a training task at least twice or until performance was at least 88% correct. The task was to match the orthographic representation of the vowel sound to a set of three words that had the same vowel sound, using an eight-alternative forced-choice procedure. For example, /i/ was orthographically represented as "ee," and example words were cheese, meat, and leaf. There was no auditory signal during this task. Correct-answer feedback was given.

To measure vowel identification, stimuli were presented monaurally to the listeners via an ER3 insert earphone. The test ear for each listener was the same as the test ear for the notched-noise experiment.

A block consisted of 96 randomly ordered trials (8 vowels ×12 talkers). To account for learning effects (discussed in detail below), listeners completed four blocks in each condition (compressed or linear). Half the listeners heard the compressed blocks first, and half heard the linear blocks first. Listeners responded to each trial in an eight-alternative forced-choice paradigm using a touch screen. The location of response buttons on the touch screen was randomized for each block to prevent response bias.

Results

Auditory Filter Width

Figure 1 shows the auditory filter ERB for each listener group as a function of audiometric threshold. Larger ERB values indicate broader filters. Listeners with poorer thresholds tended to have wider auditory filters, but there was considerable variability.

At 500 Hz, there was a significant difference among groups, $F(2, 26) = 4.84$, $p = .017$. Post hoc analyses (Fisher's least significant difference) indicated that low-frequency (0.5-kHz) filters were wider for the listeners with flat loss than for listeners with normal hearing ($p = .007$) and were marginally wider for listeners with flat loss than those with sloping hearing loss ($p = .056$). There was no significant difference between listeners with sloping loss and with normal hearing ($p = .137$).

At 2000 Hz, there was a significant difference among groups, $F(2, 26) = 5.57$, $p = .011$. Between-groups post hoc comparisons showed no significant difference between listeners with flat and sloping loss ($p = .941$). The listeners with normal hearing had narrower filters than both the flat ($p = .008$) and sloping ($p = .004$) groups.

ERB values for 500 and 2000 Hz were correlated with each other ($r = .42$, $p = .017$). The significant but modest correlation reflects that although listeners with wide low-frequency filters tend to have wide highfrequency filters, having a wide high-frequency filter does not guarantee a widened low-frequency filter. That finding was consistent with a cohort that included listeners with sloping audiograms, for whom we would expect narrow low-frequency and wide high-frequency filters.

Vowel Identification

Learning on the task was minimal, with very similar scores across blocks. Within each condition (linear and MCC), mean scores improved by less than 5 percentage points on subsequent blocks, and performance stabilized (defined as a nonsignificant difference in scores, $p > .05$) between Blocks 2 and 3. Accordingly, scores for Blocks 2, 3, and 4 were averaged and used for all subsequent data analysis.

Scores for each group and amplification condition are summarized in Figure 2. There are several notable effects. First, the group mean performance is always poorer for theMCCthan for the linear condition, regardless of hearing status. In our paradigm, frequency-gain responses (and output levels) were the same for the linear and MCC vowels for each listener. Therefore, MCC did not provide any audibility or loudness comfort advantage, and the differences in scores between amplification conditions reflect the MCC processing.

Second, performance was better for listeners with sloping than with flat loss. Because both groups received appropriate audibility and were of similar age and cognitive status, it is likely that this effect is due to differences in cochlear processing. It is also notable that variability in the sloping loss group was quite small for linear amplification but increased with MCC. This suggests that listeners with sloping loss with similar audiograms and similar recognition of linearly processed speech may respond differently to processed signals.

The percent correct scores were converted to rationalized arcsine units (Studebaker, 1985), and a two-way repeated-measures analysis of variance was completed to compare across hearing loss group and amplification condition. Identification scores were worse for MCC than for linear speech, $F(1, 29) = 40.94$, $p < .005$, and for listeners with flat loss than for listeners with sloping loss, $F(2, 29) = 13.19$, $p < .005$. There was no interaction between hearing loss group and amplification condition, $F(2, 29) = 2.01$, $p = .153$.

Relationship Between Auditory Filter Width and Response to MCC

The analysis described above indicated that MCC had a similar (negative) effect on vowel identification for listeners with flat and sloping loss. However, the specific hypotheses motivating this work were that (a) frequency selectivity would vary within a hearing loss group and that (b) response to MCC would be influenced by frequency selectivity. The first hypothesis was supported by the data in Figure 1, in which not all listeners with a given audiometric configuration had similar frequency selectivity. The second hypothesis was tested with the following analysis.

First, the ERB values were converted to relative values by dividing each ERB (in Hz) by the test frequency. For example, an ERB of 200 Hz at an fc of 500 Hz converts to a relative ERB of 0.4, and an ERB of 200 Hz at an fc of 2000 Hz converts to a relative ERB of 0.1. Next, the relative ERB values at 500 and 2000 Hz were averaged to produce a single per-listener value that (roughly) represented the listener's frequency selectivity. Figure 3 shows vowel recognition as a function of average relativeERB for linear (filled circles) andMCC (open triangles) vowels. Best fit lines are shown for linear (solid line) andMCC (dashed line). Although there is considerable

variability, particularly for the MCC vowels, scores decreased at higher average relative ERBs.

A multiple regression model was used to determine the amount of variance in vowel identification that was accounted for by average relativeERBand type of amplification. In designing the regression model, we expected MCC to interact with auditory filter width. Consider the following example: the vowel /A/ spoken by a female talker with F1 about 800 Hz and F2 about 1200 Hz. In the compression algorithm used here, those formants would fall into Channels 8 and 10 (see Table 4). Even with reduced spectral contrast from MCC, a listener with narrow filter width may be able to resolve those closely spaced formants and correctly identify the vowel. However, for a listener with impaired frequency selectivity, the combination of reduced spectral contrast from MCC coupled with reduced spectral representation of the vowel because of loss of auditory tuning may result in an error. Accordingly, an interaction term representing the interaction between ERB and amplification type was also included in the model. Contributions of the main effect variables and the interaction were examined in a stepwise regression procedure using alphalevel criteria of .05 for probability of entry into the model and .10 for probability of removal from the model. The final model accounted for 85% of the variance in the score, $F(3, 63) = 113.57$, $p < .005$. Significant predictors were amplification type ($b = -0.16$, $t = 0.286$, $p < .005$), average ERB ($b = -1.18$, $t = -15.19$, $p < .005$), and the ERB ×Amplification interaction ($b = 1.07$, $t = 13.08$, $p < .005$). In other words, vowel identification is better for linear than MCC vowels, and it is better when the listener has good frequency selectivity. The significant interaction (illustrated by the solid and dashed fit lines in Figure 3) indicates that listeners with good frequency selectivity,whowouldotherwisebe able to resolve formant information, are more detrimentally affected by MCC than listeners with naturally poorer frequency selectivity.

Although not an experimental hypothesis, it is also of interest to examine the relationship between response to MCC and pure-tone threshold. Similar to the treatment of the relative ERB values, pure-tone thresholds (dB HL) at 500 and 2000 Hz were averaged to produce a single per-listener value that (roughly) represented the listener's hearing status. Table 5 shows pairwise correlation values (Pearson r) for average hearing threshold, average relative ERB, and vowel identification.

Vowel Error Patterns

Figure 4 shows the vowel error patterns, plotted as graphical confusion matrices. In each panel, presented (target) vowels (ordered by F1) are shown on the abscissa, and responses are shown on the ordinate. The size of each circle represents the number of responses for a particular presented vowel/responded vowel combination. Responses on the diagonal are correct, and those are noted by percent correct values. Responses offthe diagonal are incorrect. For example, for listeners with sloping loss listening through linear amplification, the vowel /i/ was correctly identified 96% of the time, and errors were about evenly distributed among the other vowels, with the exception of /e/, which was never chosen. For listeners with sloping loss listening through MCC amplification, the vowel /i/ was identified correctly only 62% of the time, and the most common errors were / I / and /?/. Qualitatively, the greater the "scatter" to either side of the diagonal, the more difficult the task. Mirroring the data from Figure 2, the largest number of errors occurred for listeners with flat loss presented with MCC vowels, and the smallest number of errors occurred for listeners with sloping loss presented with linear vowels.

Discussion

Considerations When Measuring Auditory Filter Width

Listeners with flat versus sloping loss are assumed to have different frequency resolution, particularly at low frequencies. In our data, listeners with flat loss had broader auditory filters than listeners with sloping loss at low frequencies, and they had similar filter widths at high frequencies. The exact width of the auditory filter varied among individuals even when they had similar hearing thresholds. Numerous investigators have demonstrated variability in frequency resolution (auditory filter width) among individuals (e.g., Carney &Nelson, 1983; Florentine et al., 1980; Hopkins &Moore, 2011; Stelmachowicz et al., 1985; Turner &Henn, 1989). Indeed, the pure-tone audiogram is now seen as a relatively coarse measure of hearing function, as demonstrated by

recent calls for more sensitive hearing assessment measures (Abel et al., 2009; Souza& Tremblay, 2006; Walden &Walden, 2004).

For the present data, average hearing threshold was at least as strongly related to vowel performance as the more specific filter measurements (see Table 5). Earlier work by Turner and Henn (1989) suggests that the hearing threshold-to-performance correlation is less related to audibility per se than to the relationship between auditory threshold and frequency selectivity. Listeners with better hearing thresholds tended to be those with good frequency selectivity, and they were also the listeners with the best vowel identification.

There are some practical problems with estimating auditory filters using the method reported here. Some listeners, particularly those with poorer thresholds, have auditory filter bandwidths that are too broad for precise mathematical modeling. In our data, more of these listeners were noted in the flat loss group and were excluded from data analysis. Some modeling errors can be avoided if test conditions include more repetitions at each notch width or if more notch-width conditions are included, but the amount of test time is already substantial. The average time required to obtain data for just two auditory filters was 2 hr per listener, rendering such testing inappropriate for clinical use. We have begun evaluating some "fast" auditory filter measurements that could be adapted for the clinic (Charaziak, Souza, &Siegel, 2011).

A related issue is choosing which auditory filters to measure. We selected auditory filters centered at 500 and 2000 Hz as representative of the frequency region for our vowel formants. Those frequencies were a reasonable, albeit sparse, description of across-frequency selectivity for each listener, but they are only a part of the abilities needed to perform well on the vowel task as a whole.We did not necessarily measure the auditory filter the listener would need to identify a specific formant for a specific vowel by a specific speaker. Also, identifying a formant is essential, but not sufficient, for vowel identification. The listener also needs to "reconstruct" the vowel across frequency-that is, to identify formants relative to other formants. Apoux and Healy (2009) estimated that 20 auditory filters are required for accurate vowel identification. In that sense, no single auditory filter measurement can predict vowel identification. Nonetheless, it is likely that listeners with broadened 0.5- and 2-kHz filters also have broadened filters at other frequencies and that listeners with poor frequency selectivity will have difficulty perceiving speech elements that rely on spectral contrast, such as vowels.

Influence of Auditory Filter Width on Identification of MCC Vowels

Vowel identification worsened with increasing auditory filter width and when MCC was used. There is evidence that both manipulations smooth the vowel spectra received by the listener.With regard to internal spectral representation, Leek and Summers (1996) tested listeners with hearing loss to determine how much spectral contrast was needed before they were able to separate out target components from background components. They assumed that the detectable difference in intensity between target peaks and background harmonics indicated how much contrast was preserved in the cochlear excitation pattern. Listeners with broader high-frequency auditory filters were less able to use F2 differences to make identification judgments and based their decision almost entirely on F1 peaks. Several authors (Leek &Summers, 1996; Turner &Henn, 1989) suggested that broader auditory filters create an altered internal representation (excitation pattern) of a vowel. Effectively, the output of each auditory filter results in a poorer signal-to-noise ratio than would be the case for a listener with a more sharply tuned auditory system. Animal models also support loss of frequency selectivity in a damaged cochlea (Miller, Calhoun, &Young, 1999).

Bor et al. (2008) demonstrated that increasing number of compression channels causes greater alteration to vowel spectra. They argued that overuse of MCC (i.e., using a large number of compression channels coupled with moderate to high compression ratios) could smooth vowel spectra in a manner akin to that of broadened auditory filters. After decades in which hearing aids were marketed with ever larger numbers of compression channels, there is growing acknowledgment that more is not always better, or at least that the level of acoustic manipulation should be customized for the listener (e.g., Edwards, 2007; Souza, 2011; Woods et al., 2006). The

interaction between auditory filter width and amplification type seen in the present data suggests that the spectral smoothing resulting from MCC has a relatively greater effect on a listener with narrower auditory filters, who would otherwise be able to resolve vowel formant peaks.

When MCC is needed for other reasons, such as loudness comfort or audibility across frequency, it might be possible to counteract the effects of spectral smoothing with additional processing. Spectral sharpening has been suggested for use in hearing devices (DiGiovanni, Nelson, &Schlauch, 2005; Oxenham, Simonson, Turicchia, &Sarpeshkar, 2007).However, Franck, van Kreveld-Bos, Dreschler, and Verschuure (1999) noted that vowel perception was poorer when eight-channel MCC was combined with spectral sharpening than with spectral sharpening alone. In contrast, combining single-channel compression with spectral sharpening had no effect compared with spectral sharpening alone. Although MCC alone (without sharpening) was not tested, the negative effects of MCC demonstrated by Franck et al. were consistent with the present data.

Relating Current Data to Clinical Use of MCC

To what extent will the data presented here generalize to wearable hearing aids in everyday listening situations? We know that listeners with hearing loss rely more heavily on vowel spectra than on dynamic formant transitions (e.g., Lentz, 2006), so the signals used in this study should have captured the effect of distortion on essential acoustic cues. However, our signals were more strictly controlled than would be the case in everyday listening. Under more realistic conditions, vowels amplified through hearing aids would contain other cues, such as vowel duration and formant transitions, and would also have lexical and contextual information from the word or phrase in which the vowel is embedded. We deliberately controlled for temporal confounds, such as vowel duration. The postcompression processing used here also eliminated any attack time overshoots. Accordingly, the data should be applicable to any compressor where compressor speed is sufficiently fast as to engage the compressor through the duration of the vowel. In a very slow-acting MCC system where some or all of the vowel is linearly amplified, performance might be more similar to the linear vowel scores presented here. Finally, although the spectrally flattened vowels used in this study were created with MCC parameters that were clinically feasible, an individual listener might receive more or less spectral contrast than represented here depending on the prescriptive procedure, compression parameters, cross-over frequencies, signal input level, and presence or absence of background noise. Crain and Yund (1995) noted that MCC affected vowel identification with some, but not all, compression parameters and recommended that individual adjustments be made for each listener.

The present study compared MCC and linearly amplified speech, in which the control (linear) condition was more similar to a single-channel aid with frequency shaping than to a digital hearing aid designed to function as a multichannel compressor but set to linear (i.e., compression ratio of 1:1 in each compression channel). Specifically, a digital hearing aid set to linear would filter the speech into channels (without compression) then would mix the output of the filters. Given the experimental focus on spectral cues, we chose a Butterworth filter that minimized spectral distortion within and outside the passband. Such a filter can introduce a delay in the temporal domain, particularly for very narrow filters. Spectral analysis of our filtered signals preand postcompression indicates that such distortion was minimal, in part because there was little energy present in the input signal for the narrowest (lowest frequency) filters. Moreover, even much greater amounts of temporal distortion are not expected to impact recognition of stationary-formant vowels (see Assmann &Summerfield, 2004, p. 270, for discussion of this issue).

In summary, hearing technology has become increasingly complex. First-generation digital hearing aids had no more than two or three channels, whereas today's MCC hearing aids provide as many as 20 channels. More channels have been viewed as a positive aspect of processing in terms of providing better loudness comfort, precise gain adjustments, and the potential for better noise control and feedback reduction (Chung, 2004a, 2004b). However, beyond some therapeutic point, there may be diminishing returns. Audibility can be maximized with as few as four channels (Woods et al., 2006). Despite a long-standing industry trend toward

more sophisticated processing, the most appropriate solution for some listeners may be simpler processing that preserves signal features.

Acknowledgments

Work was supported by National Institutes of Health Grant R01 DC0060014. We thank Kathryn Arehart, Marjorie Leek, Michelle Molis, and Chris Stecker for sharing code and expertise for portions of this project, and Star Reed and James Dewey for help with data analysis. Andy Sabin and Jon Siegel provided helpful suggestions regarding filter measurements. We also thank Steve Armstrong and Gennum Corporation (Burlington, Ontario, Canada) for providing the software used to simulate hearing aid compression.

Footnote

1Compression amplification applies more gain for low-level inputs and applies less gain for high-level inputs.With single-channel compression, the specified gain will be applied across the entire frequency range, and spectral peaks and valleys will be maintained. With MCC, spectral valleys will receive more gain than spectral peaks. For a more detailed description of this effect, the reader is referred to Bor, Souza, and Wright (2008).

2Number of participants was based on 80% power to detect the main effect of interest (Bausell &Li, 2002).

3Threshold values are expressed in dB HL (recommended by the American National Standards Institute, 2004).

4The presentation level was increased to 13 dB SL for three listeners because the level of the noise could not be lowered far enough for those listeners to detect the tone.

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Editor: Robert Schlauch
Associate Editor: Peggy Nelson
Received August 25, 2010
Revision received April 18, 2011
Accepted August 9, 2011
DOI: 10.1044/1092-4388(2011/10-0238)

Publication date: Apr 2012

Year: 2012

Tackling the Combined Effects of Reverberation and Masking Noise Using Ideal Channel Selection

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 500-510.
ProQuest document link

Abstract: In this article, a new signal-processing algorithm is proposed and evaluated for the suppression of the combined effects of reverberation and noise. The proposed algorithm decomposes, on a short-term basis (every 20 ms), the reverberant stimuli into a number of channels and retains only a subset of the channels satisfying a signal-to-reverberant ratio (SRR) criterion. The construction of this criterion assumes access to a priori knowledge of the target (anechoic) signal, and the aim of this study was to assess the full potential of the proposed channel-selection algorithm, assuming that this criterion could be estimated accurately. Listening tests with normal-hearing listeners were conducted to assess the performance of the proposed algorithm in highly reverberant conditions (T60 = 1.0 s), which included additive noise at 0 and 5 dB signal-to-noise ratios (SNRs). A substantial gain in intelligibility was obtained in both reverberant and combined reverberant and noise conditions. The mean intelligibility scores improved by 44 and 33 percentage points at 0 and 5 dB SNR reverberation + noise conditions. Feature analysis of the consonant confusion matrices revealed that the transmission of voicing information was most negatively affected, followed by manner and place of articulation. The proposed algorithm produced substantial gains in intelligibility, and this benefit was attributed to the ability of the proposed SRR criterion to detect accurately voiced or unvoiced boundaries. It was postulated that detection of those boundaries is critical for better perception of voicing information and manner of articulation.

Full text: Headnote

Purpose: In this article, a new signal-processing algorithm is proposed and evaluated for the suppression of the

combined effects of reverberation and noise.
Method: The proposed algorithm decomposes, on a short-term basis (every 20 ms), the reverberant stimuli into a number of channels and retains only a subset of the channels satisfying a signal-to-reverberant ratio (SRR) criterion. The construction of this criterion assumes access to a priori knowledge of the target (anechoic) signal, and the aim of this study was to assess the full potential of the proposed channel-selection algorithm, assuming that this criterion could be estimated accurately. Listening tests with normal-hearing listeners were conducted to assess the performance of the proposed algorithm in highly reverberant conditions (T60 = 1.0 s), which included additive noise at 0 and 5 dB signal-to-noise ratios (SNRs).
Results: A substantial gain in intelligibility was obtained in both reverberant and combined reverberant and noise conditions. The mean intelligibility scores improved by 44 and 33 percentage points at 0 and 5 dB SNR reverberation + noise conditions. Feature analysis of the consonant confusion matrices revealed that the transmission of voicing information was most negatively affected, followed by manner and place of articulation.
Conclusions: The proposed algorithm produced substantial gains in intelligibility, and this benefit was attributed to the ability of the proposed SRR criterion to detect accurately voiced or unvoiced boundaries. It was postulated that detection of those boundaries is critical for better perception of voicing information and manner of articulation.
Key Words: reverberation, noise, dereverberation algorithms
(ProQuest: ... denotes formulae omitted.)
Reverberation is present in most daily listening situations. Reverberation can cause significant changes in speech quality and can have a very negative impact on speech intelligibility as it blurs, for instance, temporal and spectral cues and flattens formant transitions (Nabelek, Letowski, &Tucker, 1989). Although moderate amounts of reverberation do not affect speech recognition performance by normal-hearing listeners, reverberation has a detrimental effect on speech intelligibility by listeners with hearing impairment and elderly listeners (Assmann &Summerfield, 2004; Nabelek, 1993) as well as by automatic speech recognition systems (Palomäki, Brown, &Parker, 2004). The negative effects of reverberation on intelligibility vary across age (Neuman &Hochberg, 1983; Neuman, Wroblewski, Hajicek, &Rubinstein, 2010) and between native and nonnative listeners (Nabelek &Donahue, 1984).
Nabelek and Letowski (1985) studied the effects of reverberation on vowel recognition by 10 elderly adults with binaural sensorineural hearing loss and found that themean vowel recognition score obtained in a reverberation time (T60) of 1.2 s was approximately 12 percentage points lower than the mean score obtained in the nonreverberant (anechoic) conditions. Compared with vowels, consonants are generally more affected by reverberation. The stop consonants, for instance, are more susceptible to reverberation distortion than other consonants, particularly in syllable-final position. This is because reverberation "fills in" the gaps present during stop closures. When noise is added to reverberation, listeners make different consonant confusions from those made in reverberation or in noise (Nabelek et al., 1989). That is, noise generally masks speech differently than reverberation. The combined effects of reverberation and noise are quite detrimental to intelligibility (Nabelek &Mason, 1981; Nabelek &Pickett, 1974a). In a recent study with normal-hearing children and adults, Neuman et al. (2010) assessed speech intelligibility in reverberation + noise conditions in terms of speech reception threshold (SRT). When comparing the results to SRT norms obtained by adults in anechoic conditions, Neuman et al. (2010) reported a signal-to-noise ratio (SNR) loss1 of 1.5-3 dB for adults and 7.5-9.5 dB for young children (age 6 years) when reverberation (T60 = 0.3-0.8 s) was added. The SNR loss decreased as a function of age.
Addressing the degradation in speech intelligibility and quality due to reverberation has given rise to several dereverberation algorithms (e.g., see Benesty, Sondhi,& Huang, 2007; Jin &Wang, 2009; Kollmeier &Koch, 1994; Naylor &Gaubitch, 2010). Dereverberation by means of inverse filtering-or passing a reverberant signal through a finite impulse response (FIR) filter that inverts the reverberation process-remains one of the most commonly used methods (Miyoshi &Kaneda, 1988). However, the main drawback of inverse filtering methods is

that the acoustic impulse response must be known in advance or, alternatively, needs to be "blindly" estimated. Such algorithms, however, have severe limitations because room impulse responses (RIRs), particularly in highly reverberant rooms, have thousands of filter taps, making their inversion a computationally expensive task. Furthermore, some RIRs exhibit nonminimum phase characteristics. Thus, techniques that do not rely on inversion of the RIR are more attractive and more practical.

An alternative technique based on channel selection is explored in this article. Such a technique is attractive because it does not rely on the inversion of the RIR. The proposed method is based on decomposing, in short time segments (every 20 ms), the reverberant signal into a number of channels (via a fast Fourier transform [FFT]) and retaining only a subset of channels at each segment. The proposed criterion for selecting the appropriate channels is based on instantaneous measurements of the signal-to-reverberant ratio (SRR). Envelopes (computed using the FFT magnitude spectrum of each 20-ms segment) corresponding to channels with SRR larger than a preset threshold are selected, whereas envelopes corresponding to channels with SRR smaller than the threshold are zeroed out. The SRR reflects the ratio of the energies of the signal originating from the early (and direct) reflections and the signal originating from the late reflections. Note that the resulting reverberant signal is composed of the superposition of these two aforementioned signals. Hence, the underlying motivation in using the proposed SRR criterion is to retain the signal components arising from the early reflections while discarding the signal components generated from late reflections.Early reflections are known to benefit speech intelligibility inbinaural hearing (e.g., see Litovsky, Colburn, Yost, &Guzman, 1999) for normal-hearing listeners, whereas late reflections are known to be detrimental to speech intelligibility as they are responsible predominantly for smearing the temporal envelopes and filling the gaps (e.g., closures) in unvoiced segments (e.g., stops) of the utterance.

The above SRR criterion for channel selection was used and evaluated in our prior study (Kokkinakis, Hazrati, &Loizou, 2011) with listeners who have cochlear implants. That study, however, only evaluated the effects of reverberation-that is, with no additive noise present. In the present study, we evaluated the proposed channel-selection criterion using normal-hearing listeners in conditions wherein additive noise as well as reverberation are present. Nonsense syllables were used for testing to avoid ceiling effects. The aim of this study was twofold: (a) to determine the effectiveness of the proposed channel-selection criterion in suppressing or minimizing the combined effects of reverberation and noise and (b) to determine which consonant feature (voicing, manner of articulation, or place of articulation) is affected the most in reverberation + noise conditions.

Method

Listeners

Eight normal-hearing listeners with pure-tone thresholds less than 25 dB HL (at frequencies of 250 Hz up to 8 kHz), all native speakers of American English, were recruited for the intelligibility tests. Their ages ranged from 18 to 26 years, and all subjects were paid for their participation. The majority of the subjects were undergraduate students from The University of Texas at Dallas.

Stimuli

Telephone band-limited (300-3400 Hz) syllables in /aCa/ context were used for testing. The consonant set included 16 consonants recorded in /aCa/ context, where C=/p, t, k, b, d, g,m, n, dh, l, f,v, s, z, sh, jh/. All consonants were produced by an American male speaker and were recorded in a soundproof booth using Tucker-Davis Technologies recording equipment. The consonants were originally sampled at 25 kHz and down-sampled to 8 kHz. To simulate the receiving frequency characteristics of telephone handsets, all clean and corrupted signals were filtered by the modified intermediate reference system(IRS) filters (ITU-T Recommendation P.48, 1996). Telephone band-limited consonants were used to avoid ceiling effects.

The reverberant signals were generated by convolving the clean signals with real RIRs, recorded by Van den Bogaert, Doclo, Wouters, and Moonen (2009), with average reverberation time of T60 = 1.0 s and directto-reverberant (DRR) ratio of -0.49 dB for a 5.50 m ×4.50 m× 3.10 m (length ×width ×height) room. The distance

between the single-source signal and the microphone was 1 m. Speech-shaped noise was added to the reverberant signals at 0 dB SNR and 5 dB SNR-that is, the reverberant speech signal served as the target signal in the SNR computation.

Proposed Algorithm Based on Channel Selection

The proposed algorithm, henceforth called the ideal channel-selection (ICS) algorithm, is depicted in Figure 1. It is termed ideal to indicate that a priori information about the target signal is used. First, the clean and corrupted signals are segmented into 20-ms frames (with 50% overlap between frames) using a Hanning window, and a discrete Fourier transform (DFT) is computed. Note that in the frequency domain, the DFT decomposes the signal into N frequency bins, or channels (alternatively, an M-channel filter bank could be used in place of the DFT), where N is the duration of the frame in samples. Of the N/2 available channels (due to the DFT symmetry), a subset is selected based on the SRR criterion,2 which is computed as follows:

... (1)

where t indicates the frame index, f indicates the channel or frequency bin index, and S(f,t) and R(f,t) denote the complex DFT spectra of the clean (anechoic) and corrupted (reverberant or reverberation + noise) signals, respectively. Envelopes (computed using the FFT magnitude spectrum of each 20-ms segment) corresponding to channels with SRR >T are selected, whereas envelopes corresponding to channels with SRR ≤T are discarded, where T denotes a preset threshold value. Mathematically, this can be expressed by applying a gating or binary gain (BG) function to the spectrum of the reverberant signal as follows:

... (2)

where

... (3)

and where Trepresents the threshold value expressed in dB. To reconstruct the enhanced (dereverberated) signal in the time domain, the inverse DFT of bS ðf ; tÞ is computed, and the signal is finally synthesized using the overlap-add (OLA) method (MATLAB implementation of the above ICS algorithm is available from our website3). It is important to stress that the above binary timefrequency gain function (Equation 3) is applied to the reverberant spectrum and does not explicitly "clean out" reverberation but, rather, selects the reverberant channels that satisfy the SRR criterion (Equation 3).

The above operation of (ideal) binary gating is also known in the literature as the ideal binary mask, or ideal time-frequency mask, and it has been used extensively in computational models of auditory scene analysis (see review inWang&Brown, 2006). The ideal binary mask uses as a channel-selection criterion the instantaneous SNR computed at each time-frequency unit and has been used in applications in which the objective is to segregate a target speaker from a mixture (see Brungart, Chang, Simpson, &Wang, 2006; Li &Loizou, 2008a). The SNR criterion is clearly not appropriate for the reverberation-alone conditions, considering there are no additive maskers present. Given these differences, we refer to our algorithm as the ideal channel-selection algorithm rather than as the ideal binary mask algorithm. Both algorithms select in each frame a subset of channels, but the selection is made using different criteria.

The choice of the threshold T in Equation 3 is important in the construction and application of the proposed channel-selection criterion. To illustrate this, we show in the Figure 2 example synthesized waveforms of the syllable /a p a/, with the threshold set to T = -8 dB (Panel [d]) and T = 0 dB (Panel [e]). As shown, the latter threshold (0 dB) is aggressive, considering that apart from discarding the corrupted unvoiced segments and associated gaps, it also eliminates speech in the voiced frames, which in turn leads to distortion of the processed signal. In contrast, the use of T = -8 dB seems to eliminate the overlap-masking effects caused by the overlapping of succeeding segments of speech (in our case, the stop /p/) by the preceding phonetic segments (vowel /a/ in this example). As shown in Figure 2, by appropriately thresholding the SRR function (shown in Panel [c]), we can reliably identify the vowel/consonant boundaries even in highly reverberant settings (T60 = 1.0 s).

Figure 3 shows example synthesizedwaveforms of the syllable /a s a/ corrupted by reverberation and additive noise at +5 dB SNR. Waveforms from a low-frequency channel (f = 500 Hz) are shown in the leftcolumn, and waveforms from a high-frequency channel (f = 3060 Hz) are shown in the right column. As can be seen in Panels (d) and (h), the retained (by the channel-selection process) waveforms are still corrupted by noise; however, the vowel/consonant boundaries are preserved. The gap in the /s/ spectrum, for instance, at t = 300-500 ms is maintained in the retained waveform (compare Panels [a] and [d]).

The motivation for choosing the SRR criterion to guide the channel-selection process is as follows. The SRR provides, approximately, a simple measure of the ratio of the signal energy conveyed by the early reflections (and the direct sound) to that contained in the late reflections. It seems reasonable, then, to select a given channel only when the signal energy produced by early reflections dominates the energy produced by late reflections originating from the preceding signal. This is demonstrated in Figures 2 and 3. In Figure 2, for instance, during the /p/ closure (t = 245-362 ms), the reverberant signal contains a significant amount of energy caused by leakage from the preceding vowel (overlap masking). This energy is introduced primarily by the late reflections. TheSRRtakes extremely low values (-10 to -40 dB) during that period of the /p/ closure, wherein the contributions from the late reflections dominate. Consequently, by discarding a channel when the SRR is extremely low, we are reducing (and, to some extent, minimizing) the overlap-masking effects. In contrast, a large SRR value suggests dominance of the energy from the direct signal (and early reflections), as is often the case during the voiced segments (e.g., vowels) of the utterance (overlap masking may occur during voiced segments due to the energy originating from the preceding consonant; however, its effect is minimal). Consequently, channels containing energy from early reflections are retained (see, for instance, the vowel segment from t = 450 ms to t = 738 ms).

In reality, the denominator in the SRR contains energy fromboth early and late reflections, but nonetheless, we assume that the contribution of the early reflections is small. This assumption holds for the most part during unvoiced phonetic segments containing spectral gaps (e.g., stop closures), particularly in the low frequencies where the vowel formants reside and overlap-masking effects dominate. Ideally, it would be desirable to decouple the contributions of the early and late reflections, but that is not straightforward or easy to do, particularly when the reverberation time (T60) is long. For that reason, the entire reverberant signal is used in the denominator of the SRR for practical purposes. Similarly, we assume that the energy produced from the early reflections is close to that produced by the direct path. The proposed experiments will test whether the above approximations and assumptions hold.

A number of alternative criteria to the SRR criterion have been proposed and evaluated by Mandel, Bressler, Shinn-Cunningham, and Ellis (2010). However, these criteria were evaluated in the context of improving the performance of automatic speech recognition systems rather than as a means for improving speech intelligibility. In addition, most of the criteria proposed by Mandel et al. (2010) required access to the RIR. Hence, estimating such criteria poses great challenges. In contrast, the construction of the SRR criterion does not require access to the RIR.

As mentioned earlier, we denote the proposed algorithm as the ideal channel-selection (ICS) algorithm, where the term ideal is used to indicate that a priori knowledge is used to construct the SRR. In practice, the SRR needs to be estimated from the reverberant signal alone. The aim of the proposed experiments is to assess the full potential of the SRR criterion in terms of intelligibility benefit. If a large benefit is observed, that would suggest that significant efforts need to be devoted to developing techniques for accurately estimating the SRR. The resulting data from the proposed experiments will provide the upper bound in performance that can be obtained when the SRR criterion is estimated accurately.

Procedure. The listeners participated in 15 conditions, which included clean anechoic stimuli, reverberant stimuli, stimuli corrupted by noise alone (at 2 SNRs), and reverberation + noise (at 2 SNRs) stimuli. Six additional conditions involved ICS-processed stimuli (reverberant and reverberant + noise) using two different

threshold values (T = -8 dB and 0 dB). We denote the reverberant stimuli as R, the stimuli corrupted by noise alone as N, and the reverberation + noise stimuli as R + N. Three other conditions were included for comparative purposes based on a commonly used spectral subtractive (Wu &Wang, 2006) algorithm for suppressing reverberation. This algorithmwas applied to the reverberant and R + N stimuli. The spectral subtraction algorithm has been found to be effective in removing the impact of late reverberation (Wu &Wang, 2006) and was used in this study as an additional control condition.4

The consonants were presented to the listeners in random order. Six repetitions per condition were used. The presentation order of the various conditions was randomized across subjects. A practice session, in which the clean (anechoic) consonants were presented to the listeners, preceded the actual test. To collect responses, a graphical user interface (GUI) was used that allowed the subjects to identify the consonants they heard by clicking on the corresponding button on the GUI. All listening experiments were performed in a soundproof room (Acoustic Systems, Inc.) using a PC connected to a Tucker-Davis System3. Stimuli were presented to the listeners monaurally through Sennheiser HD 250 Linear II circumaural headphones at a comfortable listening level. The test session lasted for approximately 2 hr. A short break was given to the subjects every 30 min to minimize listener fatigue.

Results and Discussion

Consonant Identification in Reverberation and Noise

The results, expressed in terms of the mean percentage of consonants identified correctly, are shown in Figure 4. The bar labeled "clean" represents the mean score obtained in anechoic conditions. A two-way, repeated measures analysis of variance (ANOVA)5 indicated significant effect of SNR, $F(2, 14) = 63.2$, $p < .0005$; a significant effect of ICS threshold, $F(2, 14) = 257.1$, $p < .0005$; and a significant interaction, $F(4, 28) = 44.8$, $p < .0005$. As shown in Figure 4, the ICS algorithm improved speech intelligibility in all conditions, including the reverberation-alone (i.e., with no additive noise) condition. The choice of ICS threshold affected performance in the two noisy conditions but had little effect in quiet conditions because of ceiling effects. For that reason, an interaction was observed between the SNR level and ICS threshold.

ICS improved intelligibility in all conditions tested. Post hoc tests, according to Tukey's honestly significant difference, were conducted to assess the differences in scores between conditions. The intelligibility scores obtained in the reverberation-alone condition improved by more than 7 percentage points when the ICS algorithm was used. This difference was found to be statistically significant ($p = .003$). Larger improvements with the ICS algorithm were noted in the R + N conditions. Recognition scores improved from 61.7% correct to 94.5% correct at 5 dB SNR, and from 51.4% to 95.2% at 0 dB SNR. In all cases, the intelligibility improvement (relative to that with unprocessed stimuli) by the proposed ICS algorithm was found to be statistically significant ($p < .005$) when implemented with either threshold value (T = -8 dB or 0 dB). In the 0-dBR+Ncondition, the score obtained with the ICS threshold set to T = -8 dB was found to be significantly ($p < .0005$) higher than the score obtained with the ICS threshold set to T = 0 dB. In the 5-dB R + N condition, the score obtained with the ICS threshold set to T = -8 dB was not found to be significantly ($p > .05$) higher than the score obtained with the ICS threshold set to T = 0 dB. High performance was consistently obtained across all conditions tested when the ICS threshold was set to T = -8 dB. In all conditions tested, performance with the ICS was near that obtained by listeners in anechoic conditions-that is, near 96% correct.

Figure 4 also shows performance obtained in the condition wherein the stimuli were corrupted only by noise (no reverberation). The intelligibility scores were 86.59%and 73.05% atSNRsof 5 dBand 0 dB, respectively. These scores decreased to 62% and 51%, respectively, after adding reverberation. In both noise conditions (0 dB SNR and 5 dB SNR), scores were reduced by 30% after reverberation was added. Noise and reverberation degrade intelligibility in a complementary fashion. That is, regions in the spectrum that were not originally corrupted by reverberation are affected or masked by noise, leading to a severe degradation in intelligibility (30% reduction in our study). As reported by others, the combined effects of noise and reverberation are greater than the sum of

both effects taken separately (Nabelek &Mason, 1981; Nabelek&Pickett, 1974b). This was also confirmed with the data in our study. Table 1 shows the effects of reverberation, noise, and combined effects of reverberation and noise for individual subjects. These effects were computed by assessing the decrement in performance relative to the performance obtained in anechoic conditions. The combined effect was computed, for instance, as the difference between the scores obtained in the R + N condition and the scores in the anechoic condition. For nearly all subjects (except S6) and for both SNRs tested, the combined effects were greater than the sum of the reverberation and noise effects.

As can be seen from Figure 4, the performance of the spectral-subtractive dereverberation algorithm (Wu &Wang, 2006) was not satisfactory. The scores obtained using the spectral-subtraction algorithm in the reverberation-alone condition were significantly ($p < .005$) lower than the scores obtained using the unprocessed reverberant stimuli. This is partly because applying spectral subtraction may introduce signal distortion and may, therefore, produce a drop in the consonant identification scores. Second, the reverberant conditions examined in this study were quite challenging (this algorithm was originally tested in shorter reverberation times [T60 = 0.2-0.4 s] byWu &Wang [2006]). Performance in R + N conditions was even less satisfactory. We believe that it was because the SS algorithm was not originally developed to cope with low SNR conditions, as it had been originally tested at a high SNR (20 dB).

In brief, the proposed ICS algorithm was found to produce substantial gains in intelligibility in both reverberation-alone conditions and in conditions involving additive noise (see Figure 4). This outcome was consistent with the benefit observed by listeners with cochlear implants in our prior study (Kokkinakis et al., 2011). We attribute the intelligibility benefit to the ability of the SRR criterion to detect accurately voiced/unvoiced boundaries (see Figure 2). In continuous speech, reliable access to these vowel/consonant boundaries has been found to be critical for lexical segmentation and word retrieval (Li &Loizou, 2008b; Stevens, 2002).

Analysis of Consonant Errors

The consonant confusion matrices were analyzed in terms of percentage of transmitted information as per Miller and Nicely (1955), and the mean feature scores for place of articulation, manner of articulation, and voicing features are presented in Figure 5. A two-way repeated measures ANOVA indicated a significant effect of SNR, $F(1, 7) = 8.6$, $p = .022$; a significant effect of feature error, $F(2, 14) = 13.3$, $p = .001$; and a nonsignificant interaction,$F(2, 14) = 0.649$, $p = .538$. As can be seen from Figure 5, all three features, especially the voicing feature, were significantly affected, $F(2, 14) = 13.3$, $p = .001$, in the R + N conditions. In the presence of reverberation, place-of-articulation scores were generally higher than the manner and voicing scores.

Overall, on the basis of Figure 5, we can conclude that the transmission of voicing information is mostly affected in the R + N conditions. We attribute this to overlap-masking effects, which are largely responsible for filling the gaps (e.g., stop closures) that are present in some consonants (e.g., stops), making it difficult to distinguish between, for instance, the unvoiced stops (e.g., /t/) and the voiced stops (e.g., /d/). The filled gaps (by reverberation and noise) clearly affect the perception of voice onset time, and it is well known that in intervocalic stops, the duration of voice onset time as well as the duration of aspiration are effective cues signaling voicing contrast (Borden, Harris, &Raphael, 1994). These cues are severely corrupted by the combined effects of reverberation and noise.

All feature errors in place, manner, and voicing were compensated by the use of the ICS algorithm. An average improvement of about 8 percentage points in amount of transmitted information was achieved in the reverberation-alone condition. A larger improvement was noted at 0 dBSNRand 5 dB SNR, respectively, and that amounted to approximately 64 and 43 percentage points (respectively) for place, 43 and 36 points (respectively) for manner, and 65 and 54 points (respectively) for voicing in R + N conditions (on average, only 4%, 2%, and 6% below the scores obtained for place, manner, and voicing features, respectively, in the anechoic quiet conditions).

Predicting the Intelligibility of R + N Speech

The speech-transmission index (STI) has been shown in a number of studies to predict reliably the intelligibility of speech in reverberation, in noise, or in both (Houtgast &Steeneken, 1985). Aside from the STI, not many intelligibility measures exist that can predict the combined effects of reverberation and noise. In this study, we evaluated the performance of a speech-based STI that has been found previously to correlate highly with the intelligibility of noisemasked and noise-suppressed speech (Chen &Loizou, 2010; Ma, Hu, &Loizou, 2009). More precisely, we selected the normalized covariance measure (NCM), which is similar to the STI in that it computes the STI as a weighted sum of transmission index values determined from the envelopes of the probe and response signals in each frequency band (Goldsworthy &Greenberg, 2004). Unlike the traditional STI, however, which quantifies the change in modulation depth between the probe and response envelopes using the modulation transfer function, the NCM is based on the covariance between the probe (input) and response (output) envelope signals. The NCM has not been evaluated previously in situations where noise is present along with reverberation. Figure 6 shows the scatter plot of the mean consonant intelligibility scores obtained in all conditions (except the control conditions) against the corresponding mean NCM values. A linear fit is shown, but alternatively, a sigmoidal-shaped function could be used to fit the data (the computed correlation coefficient was found to be the same with either fitting function). The resulting Pearson's correlation coefficient was found to be quite high, r = .98. These data clearly show that the NCM is an effective measure for predicting not only speech intelligibility in noise (Ma et al., 2009) but also speech intelligibility corrupted by both reverberation and noise.

Conclusions

The combined effects of reverberation and noise have been found in this study to be quite detrimental to consonant recognition, an outcome consistent with prior studies (Nabelek &Mason, 1981; Nabelek &Pickett, 1974b). A signal-processing algorithm was proposed for the suppression of combined reverberation and noise. This algorithm is based on the decomposition of the reverberant stimuli into a number of frequency channels and the selection of channels with SRR exceeding a preset threshold (-8 dB). Channels with SRR values falling below the threshold were discarded. Hence, in the proposed algorithm, neither reverberation nor noise was explicitly suppressed or attenuated in any way because the channel-selection process was applied directly to the R +Nstimuli. When presented to normal-hearing listeners, the synthesized stimuli have been found to yield substantial gains in consonant identification. This outcome suggests that the combined effects of reverberation and noise do not completely mask important speech information. The channel-selection process, as guided by the SRR criterion, is a powerful process that can uncover quite effectively important speech information from the corrupted (by reverberation and noise) stimuli. Analysis of the consonant confusion errors indicated that the proposed algorithm significantly improved the transmission of voicing information, along with manner and place of articulation. Much of the intelligibility benefit was attributed to the ability of the SRR channelselection criterion to accurately detect and preserve voiced/unvoiced boundaries, often smeared in the presence of reverberation.

Acknowledgment

This workwas supported by National Institute of Deafness and Other Communication Disorders Grant R01 DC 010494, awarded to the second author.

Footnote

1SNR loss reflects the increase in SNR required to attain 50% correct performance due to reverberation. This is relative to the SNR required by normal-hearing adults in anechoic, noise-alone conditions (SRT).

2Note that there are two major differences between our definition of SRR and the conventional SRR definition (Naylor &Gaubitch, 2010, Chapter 2). First, we do not use the direct-path signal, and second, the SRR given in this article is defined in the frequency domain for each T-F unit and is computed for each frame of the stimulus data.

3www.utdallas.edu/Èloizou/cimplants/

4A two-stage algorithm was originally proposed in Wu and Wang (2006). In the first stage, an inverse filtering

algorithm was adopted for reducing coloration effects followed by a spectral-subtractive algorithm in the second stage for reducing late-reverberation effects. Note that the second stage was designed to subtract out the late reflections from the reverberated signal rather than subtract out additive noise. We were not able to obtain satisfactory performance via the inverse-filtering stage due to the long impulse response used in our study corresponding to a long reverberation time (T60 = 1.0 s). For that reason, we implemented only the second stage.

5We also ran the statistics using arcsine-transformed scores, but the results and conclusions remained the same.

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received March 25, 2011
Accepted August 15, 2011
DOI: 10.1044/1092-4388(2011/11-0073)

Publication date: Apr 2012

Year: 2012

Informational Masking and Spatial Hearing in Listeners With and Without Unilateral Hearing Loss

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 511-531.
ProQuest document link

Abstract: This study assessed selective listening for speech in individuals with and without unilateral hearing loss (UHL) and the potential relationship between spatial release from informational masking and localization ability in listeners with UHL. Twelve adults with UHL and 12 normal-hearing controls completed a series of monaural and binaural speech tasks that were designed to measure informational masking. They also completed a horizontal localization task. Monaural performance by participants with UHL was comparable to that of normal-hearing participants. Unlike the normal-hearing participants, the participants with UHL did not exhibit a true spatial release from informational masking. Rather, their performance could be predicted by head shadow effects. Performance among participants with UHL in the localization task was quite variable, with some showing near-normal abilities and others demonstrating no localization ability. Individuals with UHL did not show deficits in all listening situations but were at a significant disadvantage when listening to speech in environments where normal-hearing listeners benefit from spatial separation between target and masker. This inability to capitalize on spatial cues for selective listening does not appear to be related to localization ability.

Full text: Headnote

Purpose: This study assessed selective listening for speech in individuals with and without unilateral hearing loss (UHL) and the potential relationship between spatial release from informational masking and localization ability in listeners with UHL.

Method: Twelve adults with UHL and 12 normal-hearing controls completed a series of monaural and binaural speech tasks that were designed to measure informational masking. They also completed a horizontal localization task.

Results: Monaural performance by participants with UHL was comparable to that of normal-hearing participants. Unlike the normal-hearing participants, the participants with UHL did not exhibit a true spatial release from informational masking. Rather, their performance could be predicted by head shadow effects. Performance among participants with UHL in the localization task was quite variable, with some showing near-normal abilities and others demonstrating no localization ability.

Conclusion: Individuals with UHL did not show deficits in all listening situations but were at a significant disadvantage when listening to speech in environments where normal-hearing listeners benefit from spatial separation between target and masker. This inability to capitalize on spatial cues for selective listening does not appear to be related to localization ability.

Key Words: unilateral hearing loss, informational masking, spatial release from masking, binaural, monaural, localization, selective listening

Most people listen to the world binaurally. Sounds are encoded in the auditory system via two auditory pathways, which produce an impression of an auditory scene. It is well established that binaural listening offers

significant communication advantages, particularly in complex auditory environments containing multiple sources (Bronkhorst &Plomp, 1989; Licklider, 1948; MacKeith &Coles, 1971). These advantages accrue because of the various ways that the auditory system processes interaural differences in the sounds reaching the two ears. For example, interaural differences allow listeners to localize and thus better segregate individual sound sources in the environment. Individuals with unilateral hearing loss (UHL) lose many of these advantages, because their auditory experience derives mainly from the sound present at one ear. Consequently, listeners with UHL have been shown to exhibit deficits on tasks that depend to some degree on binaural processing, namely, sound localization and speech understanding in noise (Bess, Tharpe, &Gibler, 1986; Bosman, Hol, Snik, Mylanus,& Cremers, 2003; Gatehouse &Cox, 1972; Linstrom, Silverman, &Yu, 2009; Ruscetta, Arjmand, &Pratt, 2005; Slattery &Middlebrooks, 1994). The current study was designed to expand our understanding of the deficits experienced by listeners with UHL in settings in which spatial cues would normally enhance speech recognition ability.

Speech Understanding by Normal-Hearing Listeners in Multisource Environments

Decades of research have examined how normalhearing listeners perceive speech in multisource environments. The earliest studies focused on listening conditions characterized by spectral and temporal overlap of the target and masker (French &Steinberg, 1947; Licklider, 1948), so-called energetic masking conditions. More recently, investigators have differentiated the effects of energetic masking from the effects of informational masking, which occur beyond what can be explained by overlapping excitation patterns between masker and target in the auditory periphery (Durlach et al., 2003). Informational masking occurs when the masker is qualitatively similar to the target or is characterized by uncertainty. Whereas energetic masking is thought to affect more peripheral auditory processes, informational masking is thought to affect cognitive-attentional processes (Brungart, 2001; Freyman, Helfer, McCall,&Clifton, 1999; Leek, Brown,&Dorman, 1991). Both energetic and informational masking are present in most real-world listening environments; however, one of the masker types is often dominant.

In environments dominated by energetic masking, normal-hearing listeners are known to take advantage of two binaural cues, namely, the head shadow effect and binaural interaction. The head shadow effect or better-ear effect occurs when spatial separation between the target and masker signals results in a better targetto- masker ratio in one of the ears, relative to the case where the target and masker are colocated. Thus, to the extent that a listener can attend to the ear with the better target-to-masker ratio, speech recognition is improved. This head shadow effect is between 3 dB and 8 dB, depending on the acoustical environment and the difference in azimuth between the speech target and masker (Bronkhorst &Plomp, 1988). The second binaural cue available in noisy environments to listeners with normal hearing is known as binaural interaction. Binaural interaction occurs when the target and interfering masker have different interaural timing delays (or phases), resulting in better speech detection or intelligibility than in conditions in which interaural timing delays of the target and masker are the same (Culling, Edmonds, &Hodder, 2006; Licklider, 1948). This effect is attributed to interaural differences in the absence of information that cues spatial location.A manifestation of the binaural interaction effect is the binaural intelligibility level difference (BILD). The BILD refers to the roughly 5-8 dB improvement in speech recognition threshold in noise under headphones produced by inverting the speech target in one ear with the masker presented diotically (Beutelmann, Brand, &Kollmeier, 2009; Goverts &Houtgast, 2010; Johansson &Arlinger, 2002; Levitt&Rabiner, 1967a, 1967b). Binaural interaction and head shadow effects can account for the advantages afforded by binaural hearing in most listening conditions that are dominated by energetic masking.

In settings in which informational masking is thought to play a major role, research has shown that listening performance is betterwhen the target and masker originate from different locations in auditory space than when they are colocated (Arbogast, Mason, &Kidd, 2002, 2005; Brungart &Simpson, 2007; Freyman, Balakrishnan, &Helfer, 2001; Freyman et al., 1999). This effect is called spatial release from masking, and although it occurs

with energetic maskers because of head shadow, the effect is considerably largerwhen themasker is primarily informational. The studies by Arbogast et al. (2002, 2005) employed digitally processed stimuli to maximize energetic or informational masking in various experimental conditions. The target sentences were presented simultaneously with same-band noise or sentence maskers (i.e., energetic maskers), a different-band noise masker, or a different-band sentence masker (i.e., an informational masker). The masker stimuli were presented in two spatial positions, colocated (i.e., target and masker both presented at 0° azimuth) and 90° to the right of the target (i.e., target presented at 0° and masker at +90° azimuth). In the colocated condition, listeners exhibited an average of 22 dB greater masking witha different-band speechmasker thanwith a differentband noise maker. Because the different-band noise masker and the different-band sentence masker did not contain significant spectral overlap with the target, the 22 dB poorer thresholds with the different-band sentence masker were attributed to the effects of informational masking, rather than energetic masking. In the conditions in which the different-band sentence masker stimuli were presented 90° to the right of the target, listeners received up to an 18 dB release from masking relative to the colocated condition. This is compared with a 6-7 dB spatial release that the listeners received when the same-band noise masker (i.e., an energetic masker) was separated from the target by 90° azimuth. Thus, the spatial benefits that listeners receive on informational masking tasks have been described as "perceptual" (Arbogast et al., 2002, p. 2097) and are much larger than the binaural advantages that listeners achieve by virtue of the head shadow and binaural interaction effects. Another study has shown that even compared with conditions where the better-ear signal is presented diotically, spatial separation provides a far greater release from informational masking (Best, Ozmeral, Gallun, Sen, &Shinn-Cunningham, 2005).

Speech Understanding by Listeners With UHL in Multisource Environments

Given the value of binaural cues for listening in complex auditory environments, it is not surprising that many individuals with UHL report communication difficulties in everyday listening situations. Studies conducted over the last several decades have confirmed that listeners with UHL exhibit speech understanding deficits relative to normal-hearing listeners in sound field environments having one or more sources of noise (Bess, Tharpe, &Gibler, 1986; Bovo et al., 1988; Linstrom et al., 2009; Ruscetta et al., 2005; Sargent, Herrmann, Hollenbeak, &Bankaitis, 2001; Tonning, 1971; Welsh, Welsh, Rosen, &Dragonette, 2004). Three of the more comprehensive studies examined children and revealed that children with UHL perform more poorly than their normal-hearing counterparts, even in the most favorable listening conditions where the speech was directed toward the listener's normal-hearing ear and the noisewas directed toward the impaired ear (Bess, Klee, &Culbertson, 1986; Bovo et al., 1988; Ruscetta et al., 2005). Studies examining the performance of adults with UHL have shown similar results (Linstrom et al., 2009; Sargent et al., 2001;Welsh et al., 2004). For example, Sargent et al. (2001) reported poor monosyllabic word recognition and sentence recognition in adults with UHL as compared with normal-hearing adults when the noise source was directed toward the good ear and when the noise source was directed toward both ears. In another study, Linstrom et al. (2009) compared sentence recognition of listeners with UHL who were fitted with bone-anchored hearing aids with that of normal-hearing controls. In this study, the Hearing in Noise Test (Nilsson, Soli, &Sullivan, 1994) was presented in various listening conditions in which the noise or speech was presented directly in front of the listener or 90° toward the listener's normal or impaired ear. Aided and unaided performance of the listeners with UHL was poorer than that of the normal-hearing controls across all listening conditions. These studies are consistent with others that offer anecdotal reports of listening difficulties in noise by adults with UHL (Colletti, Fiorino, Carner, &Rizzi, 1988; Giolas &Wark, 1967).

The previous studies of speech recognition in noise by individuals with UHL used paradigms in which the target speech was always presented from a different spatial location than the masker. In these conditions, normal-hearing listeners would be expected to capitalize on the binaural cues to improve recognition of the target message.We are not aware of any studies that have compared listening in noise by individuals with UHL with

that of normal-hearing individuals in listening conditions where the target and masker were colocated (i.e., in conditions in which spatial cues are minimal). Examining performance of listeners with UHL in colocated conditions is important because it would establish whether listeners with UHL have general deficits in speech understanding in noise or if their deficits are limited to listening conditions in which normal-hearing listeners take advantage of binaural cues afforded by spatial separation between the target and masker. Therefore, one of the objectives of the current study was to measure performance in both spatially separated and colocated conditions.

In environments dominated by energetic masking, one may predict performance of listeners with UHL from the relative target-to-masker ratio of the signals arriving at the listeners' normal-hearing ear. For example, in conditions in which the target is in front of the listener or on the side of the normal-hearing ear, and the masker is on the side of the impaired ear, the listener with UHL may receive some spatial benefit because the target-tomasker ratio at the normal-hearing ear would be better than if the target and masker were colocated. This benefit would be presumably limited to that afforded by the head shadow effect. In contrast, if the target is in front of the listener or on the side of the impaired ear, and the energetic masker is on the side of the normal-hearing ear, the target-to-masker ratio would be poorer at the normal-hearing ear than if the target and masker were colocated. The effect of the head shadow would put the UHL listener at a disadvantage in this condition.

It is more difficult to predict the effect of spatial separation on the performance of listeners with UHL in conditions characterized primarily by informational masking. In spatially separated conditions, listeners with normal hearing are thought to perceive the target and masker as coming from different locations and to use that information to direct their attention to the target talker and away from the other talker(s), resulting in spatial unmasking. For people with UHL, the availability of only one functioning ear precludes the comparison of auditory input from the two ears, which would presumably make determining the direction of the target and masker more difficult. Therefore, using the direction of the target and masker to achieve a spatial benefit for listening may be impossible for many listeners with UHL.

Localization in Listeners With and Without UHL

Although it is not known whether the processes by which listeners use binaural cues for localizing are the same as those they use for listening to speech in complex listening environments, it is reasonable to speculate that difficulties experienced by individuals with UHL in these tasks may be related to localization difficulties. For listeners with normal hearing, sound localization is dependent on two primary cues, interaural time difference and interaural level difference. An interaural time difference refers to the brief (less than 700 microseconds) time lag in the signal at the ear that is farther from the sound source relative to the ear that is closer to the sound source. An interaural level difference refers to the difference in intensity of the sound between the ear nearest to the sound source and the more distal ear. A large body of research on sound localization has focused on the relative salience of these two interaural difference cues, as well as other cues, such as the directionaldependent spectral shaping of input sounds by the pinnae.

Localization deficits in listeners with UHL are well documented in the literature (Agterberg et al., 2011; Bess, Tharpe, &Gibler, 1986; Bosman et al., 2003; Gatehouse &Cox, 1972; Humes, Allen, &Bess, 1980; Newton, 1983; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004; Viehweg &Campbell, 1960; Wazen, Ghossaini, Spitzer, &Kuller, 2005). These studies have reported that listeners with UHL demonstrate poor localization performance relative to their normal-hearing counterparts and that they tend to shift(or "bias") localization responses toward the side of the normal-hearing ear. These findings are generally consistent with those of studies that compared monaural and binaural localization in normal-hearing listeners by using test paradigms in which one ear was plugged for monaural conditions (Abel&Lam, 2008;Oldfield&Parker, 1986; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2007; Wightman &Kistler, 1997).

Although many listeners with UHL show very limited or no ability to localize sounds on the horizontal plane, some listeners with UHL have shown reasonable localization performance (Agterberg et al., 2011; Gatehouse

&Cox, 1972; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004). Some investigators have concluded that the performance of listeners who demonstrate some ability to localize can be explained to a large extent by their reliance on intensity cues provided by head shadow (Van Wanrooij &Van Opstal, 2004). That is, on tests of localization in which the stimuli are kept at a fixed intensity, these listeners will capitalize on level cues by localizing low-intensity stimuli closer to the impaired ear and higher intensity sounds closer to the normal-hearing ear. Head shadow cues are arguably unreliable in real-world listening environments and can be effectively eliminated in localization tasks by roving (i.e., randomly varying) the intensity of the stimuli over trials. Still, a few listeners with UHL have shown surprisingly good performance on localization tasks even when roving intensity paradigms were employed, leading several investigators to suggest that these listeners have learned to localize sounds by using monaural spectral cues that arise fromdirection-dependent filtering by the pinna (Newton, 1983; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004).

The ability to use monaural spectral cues for localization is complicated by the fact that the sound present at the eardrum includes both the spectral features provided by the pinna and the spectral features in the source itself. Thus, the pinna filtering characteristics must be decoupled from the characteristics of the corresponding sound source (Wightman &Kistler, 1997). A few studies have suggested that learning to use monaural spectral cues for localization may take considerable time and practice. For example, Abel and Lam (2008) examined horizontal localization ability by normal-hearing listeners with a monaurally occluded ear and found that these listeners showed no improvement following mass practice over a period of a few days. This is consistent with animal studies that showed it took several months of practice for monaurally occluded ferrets to show improvement in localization performance (King et al., 2001). Findings from Slattery and Middlebrooks (1994) also suggested that monaural localization skills require time to acquire. In this study, the listeners with long-term UHL demonstrated better localization ability than the normal-hearing listeners who were tested with monaural occlusion. However, the conclusion that extensive monaural listening experience is a prerequisite for capitalizing on monaural spectral cues was disputed by Shub, Carr, Kong, and Colburn (2008). They used a testing paradigm that involved feedback and reference stimuli and found no differences between listeners with UHL and those with normal hearing on a monaural listening task. These investigators suggested that the testing paradigm has greater influence on monaural localization performance of participants than does monaural listening experience.

Relationship Between Localization and Speech Understanding in Multisource Environments

Binaural listening to speech in noise is thought to be facilitated, at least in part, by a listener's ability to separately localize a target speech sound and other distracting sounds. One explanation is that because the target and masker appear to be coming from different directions, listeners may make a conscious effort to attend in the perceived direction of the target talker and away from the perceived direction of the competing talker (Balakrishnan &Freyman, 2008; Freyman et al., 1999, 2001; Gallun, Mason, &Kidd, 2005; Ihlefeld &Shinn- Cunningham, 2008a; Kidd, Arbogast, Mason, &Gallun, 2005). In general, these studies have found that listeners receive greater benefit from spatial separation between masker and target when they have a priori knowledge of the target location than when the target location is uncertain. Thus, in environments characterized by considerable informational masking (e.g., "cocktail party" environments), directed attention appears to play an important role for listening. However, other studies dispute a possible role of sound localization in spatial release from masking (Culling, Hawley, &Litovsky, 2004; Drullman &Bronkhorst, 2000; Hawley, Litovsky, &Colburn, 1999). For example, Drullman and Bronkhorst (2000) tested speech recognition in both monaural and binaural conditions using virtual display in which the number and the location of competing talkers was varied. In addition, they measured the ability of the participants to localize the target talker among competing talkers using a closed-set, five-alternative forced-choice paradigm. Although target talker localization performance in the virtual condition was quite poor (i.e., 43%-57%), the ability to recognize the target talker's message in the virtual conditions was relatively good (i.e., approximately 70%-88%) in the various competing talker conditions.

These results suggest that the impact of spatial separation on speech recognition may not relate directly to the ability to localize the target talker.

Arecent study by Gallun et al. (2008) also casts some doubt on the speculation that listeners use perceived location as a cue to distinguish target and masker in complex listening environments. This study measured detection of a 500-Hz tone masked by noise (energetic masker) or random tones (informational masker) by using a variety of interaural manipulations of the target. Findings indicated that the perceived location of the target was not related to listeners' responses for either energetic or informational maskers. This study suggests that at least for tonal maskers, location may not be the salient cue that listeners use to achieve a spatial release from informational masking.

The Present Study

The current study was motivated by three related questions. The first was whether the speech understanding deficits exhibited by listeners with UHL arise primarily in conditions in which normal-hearing listeners are known to benefit from spatial cues or whether individuals with UHL exhibit more global listening deficits. The second was whether individuals with UHL demonstrate any spatial release from informational masking on a speech recognition task. We addressed these first two questions by measuring performance in a speech recognition task in which the target and masker were colocated (i.e., no binaural cues were provided) and in conditions in which the target and masker were spatially separated by 90° on the horizontal plane. The third question was whether there is a relationship between directional hearing and selective listening for speech in listeners with UHL. This question was studied via a sound localization task.

General Method

Individuals with UHL and with normal hearing were tested in three experiments, two of which were speech informational masking tasks either with or without spatial cues, whereas the third was a sound localization task. Participants with UHL and participants with normal hearing were recruited via local audiology clinics and Internet advertisements. Most of the individuals with UHL participated in all three experiments. Normal-hearing individuals in roughly the same age range served as controls in each of the experiments. All participants were native English speakers. Participants were paid $10 an hour. Testing sessions lasted 2 hr and were scheduled at the participants' convenience. The participants were offered breaks during the testing sessions, and most completed all the experimental testing in fewer than six sessions (10-12 hr). All aspects of this project were conducted under the approval of the Human Subjects Protection Program at the University of Louisville.

Participants With Unilateral Hearing Loss

Twelve individuals with UHL served as participants. Eleven were tested in all three experiments. One participant (UHL02) did not participate in Experiment 1. Table 1 presents demographic and audiologic information for each participant. Participants' ages ranged from 18 to 64 years, with a median age of 23.5 years. Their degree of unilateral impairment ranged from mild to profound. All participants had sensorineural hearing loss, with the exception of Participants UHL02 and UHL03, who had conductive hearing loss secondary to congenital aural atresia and congenital ossicular malformation, respectively. None of the participants reported current use of an amplification device, with the exception of ParticipantUHL11, who used an implantable bone anchored hearing device (i.e., a Baha). The Baha device was turned off, and the external portion was removed during testing. With one exception, all participants had thresholds of ≤25 dBHLat 250-8000 Hz in the ear with normal hearing. ParticipantUHL09 had borderline mild hearing loss in the midfrequency range (i.e., thresholds of 25- 30 dB at 1000-4000 Hz) in the better hearing ear.

Participants With Normal Hearing

For each of the three experiments, a group of 12 normalhearing adults was recruited. For purely logistical reasons, only a few normal-hearing listeners participated in more than one experiment. The participants ranged in age from 18.8 to 60.9 years (Mdn = 24.7 years) in Experiment 1, 18.9 to 60.9 years (Mdn = 24.6 years) in Experiment 2, and 19.6 to 61.9 years (Mdn = 30.1 years) in Experiment 3. Thus, the ages of the normal-hearing

participants were roughly comparable to the ages of the participants withUHL for Experiments 1 and 2 and slightly older than the participants with UHL for Experiment 3. All of the participants with normal hearing underwent a hearing screening, which demonstrated normal-hearing sensitivity, bilaterally, as defined by audiometric thresholds of≤25 dBHLat all octave frequencies 250-4000 Hz. One of the participantswith normal hearing had elevated thresholds, bilaterally at 4000 Hz, but her performance on the listening tasks was indistinguishable fromthe performance of the other normal-hearing participants.

Experiment 1: Speech Target and Masker Presented Monaurally

Experiment 1 was designed to compare monaural listening performance with headphones of participants with UHL with those with normal hearing. The purpose of this baseline comparison was to determine whether individuals with UHL (when listening with their normal ear) demonstrate performance comparable to that of normal-hearing individuals in monaural listening conditions containing primarily informational or energetic masking.

Method

Stimuli. Selective listening was measured via the Coordinate Response Measure (CRM) paradigm (Bolia, Nelson, Ericson, &Simpson, 2000), which has been shown to be a sensitive indicator of informational masking effects (Brungart, 2001; Brungart &Simpson, 2002, 2007; Brungart, Simpson, Ericson, &Scott, 2001; Wightman &Kistler, 2005). The CRM is a closed-set task that requires the listener to attend to a target phrase, while ignoring a highly similar masker phrase. For example, the listener is presented the target phrase "Ready Baron, go to green 5 now" with the simultaneously presented masker phrase "Ready Eagle, go to red 8 now." The CRM has been used in a number of studies examining energetic versus informational masking and the effects of spatial separation (Arbogast et al., 2002, 2005; Ihlefeld &Shinn-Cunningham, 2008a, 2008b; Kidd, Mason, Brughera, &Hartmann, 2005; Marrone, Mason, &Kidd, 2008). The advantages of the CRM are that the speech material carries very little linguistic context and that the sentences may be reused without memory influencing performance. Research by Brungart (2001) suggests that the single-talker masker in the CRMis primarily an informational masker, as evidenced by greater masking effects of speech maskers relative to spectrally and temporally comparable modulated noise maskers.

In one condition, both the speech target and speech maskers were selected from the corpus of sentences that form the basis of the CRM. Talker #0 served as the talker for all of the target sentences. The target sentences were drawn from those with the call sign "Baron." Each target sentence was paired with a masker sentence spoken by a random selection of one of the remaining three male talkers. The masker sentence contained random selections from the remaining seven call signs, three colors, and seven numbers. The target and masker sentences were time aligned, such that the word "Ready" of the target and masker sentences started at the same time. Because there were small variations in speaking rates among the talkers and small discrepancies in word length, the overall durations of the target and masker sentences were slightly different.

In a second condition, the masker was a speechspectrum noise that had the same long-term spectrum as the average CRM sentence. The amplitude of noise presented on each trial was modulated by the temporal envelope of a randomly selected (as in the first condition) CRM masker message. The envelopes were derived by full-wave rectifying theCRMsentence and then filtering the result with a sixth-order low-pass Butterworth filter with a 50-Hz cutofffrequency.

Targets and maskers were attenuated, mixed digitally, and converted to analog form on a Digital Audio Labs Card Deluxe 24-bit sound card at a 48-kHz sampling rate. Beyer DT990-Pro headphones were used to present the stimuli monaurally to the normal-hearing ear of the participants with UHL or to the right ear of the participants with normal hearing.

Procedure. Participants were seated in front of a computer screen either in a sound-isolated semi-anechoic room (T60 = 0.06 s) or in a double-walled sound-isolated room (IAC 1200). The screen displayed a start button and 32 response buttons organized in four color matrices (i.e., red, white, green, and blue), each containing

eight buttons (numbered 1-8). The participantswere instructed to attend only to the speech message containing the call sign "Baron" and to ignore any distracting stimulus. Using a computer mouse, the participants initiated each trial by clicking on the start button displayed in the middle of the screen and responded by clicking on the button corresponding to the heard color and number spoken by the talker with the call sign "Baron."

Prior to the experimental trial blocks, the participants completed 30 practice trials in a no-masker baseline condition in which the level of the target was varied over a 20 dB range. The baseline condition was administered to familiarize the participants with the task and to ensure perfect performance at each target level in the absence of a masker. During each 60-trial experimental block, the overall level (root-mean-square) of the masker was held constant at 60 dB SPL. From trial to trial, the level of the target was randomly assigned one of five levels, 5 dB apart, spanning a range of 20 dB. This procedure permitted estimation of a complete psychometric function, in which performance ranged from near chance (3%) to 100% correct as a function of target-to-masker ratio. For some participants, it was necessary to adjust the range of target levels following the first couple of trial blocks in order to capture a full range of performance. Each participant completed no fewer than five blocks of 60 trials. The first trial block in each condition was considered practice and was not included in the analyses. Thus, with some minor exceptions, each estimate of proportion correct was based on a minimum of 48 trials. Trial-by-trial feedback was not provided. Participants first received one block of trials in the modulated noise masker condition, followed by one block of trials in the speech masker condition. The conditions were then presented in an alternating manner until the participants completed five blocks in each condition.

Data analysis. Psychometric functions obtained with CRM speech targets and CRM speech maskers are often nonmonotonic (Brungart, 2001; Brungart &Simpson, 2002; Wightman &Kistler, 2005; Wightman, Kistler, &Brungart, 2006). This is thought to result from the notion that, for target/masker (T/M) ratios between -15 and 0 dB, some listeners can attend to the "softer" speech sound, thus using intensity as an additional cue for segregating target from masker. The use of this level cue results in a plateau in performance, between approximately -15 and 0 dB T/M ratios. For this reason, psychometric function data from this experiment were not fit with smooth curves in order to estimate threshold and slope. Instead, individual data and group means are plotted. For each participant, a mean proportion correct score was computed over T/M ratios from -15 to 0 dB for the speech masker condition and over T/M ratios from -15 to -5 dB for the modulated noise masker. These T/M ratios were chosen because each participant contributed at least 24 responses at each of these T/M ratios. Mann-Whitney U tests were then used to compare mean proportion correct scores over these T/M ratios between participants with UHL and participants with normal hearing.

Results

All participants demonstrated near-perfect performance (97%-100% correct) in the baseline condition (no masker), at all target levels. For all but one participant, target levels were between 30 dB SPL and 55 dB SPL. One participant had borderline mild hearing loss in the "normal" hearing ear and was tested with target levels between 45 dB SPL and 65 dB SPL. At these levels, she scored 97% correct.

Figure 1 (left-hand side) shows the results from the condition in which a speech masker was presented. Data from the participants with UHL are displayed in the top panel, and data from participants with normal hearing are displayed in the middle panel. The bottom panel shows the mean performance at each T/M ratio from both participant groups. As can be seen in Figure 1, there were large individual differences in performance from both participant groups in this condition. This is consistent with the results from previous studies of normal- hearing participants in comparable conditions (Wightman &Kistler, 2005; Wightman et al., 2006). Note that three of the participants with UHL and several of the normal-hearing participants exhibited a plateau in performance between -15 dB and 0 T/M ratios that has been ascribed to the use of intensity cues. As can be seen in the bottom panel of Figure 1, the mean performance of the participants with UHL resembles that of the participants with normal hearing. This is supported by the overlapping 95% confidence intervals of the group means at each

T/M ratio. A Mann-Whitney U test indicated no significant difference between groups in proportion correct scores computed across T/M ratios of -15 to 0 dB in the speech masker condition, U(n1 = 11, n2 = 12) = 70, p = .81. Thus, in this monaural listening condition, inwhich the target andmasker were presented to their normal-hearing ear, participants with UHL performed comparably to normal-hearing participants.

The right-hand side Figure 1 shows the results from the condition in which a modulated noise was used as the masker. There are two obvious differences between the results from the modulated noise masker condition and those from the speech masker condition. First, the psychometric functions from the modulated noise condition show none of the irregularities evident in the psychometric functions from the speech masker condition. Second, individual differences in performance with the noise masker are much smaller than with the speech masker. The data from both groups are comparable to data reported by Brungart (2001).

The most important result of the modulated noise condition is evident in the bottom right panel of Figure 1, which shows the mean data from both participant groups. Note that the performance of the participants with UHL is virtually identical to the performance of the normal-hearing participants who are listening monaurally. A Mann-Whitney U test indicated no significant difference between groups in proportion correct scores computed across T/M ratios from -15 to -5 dB in the modulated noise masker condition, U(n1 = 11, n2 = 12) = 63, p = .85. Thus, when listening with their normal-hearing ear, individuals with UHL appear to achieve normal levels of monaural speech understanding performance in the presence of either a purely energetic masker (modulated noise) or a primarily informational masker (speech).

Experiment 2: Speech Target and Masker Spatially Separated

Experiment 2 was designed to compare speech understanding performance in the sound field of participants with UHL with that of participants with normal hearing. In one of the conditions, the target and masker were colocated in front of the participant. The purpose of this condition was to measure performance when no spatial cues were present. In the other conditions, the target was in front of the participant, and the masker was spatially separated from the target by 90°. Comparison of performance in the colocated and spatially separated conditions provided an index of spatial release from masking.

Previous research has shown that normal-hearing listeners obtain greater benefit from spatial separation between target and masker when a primarily informational masker is used (Arbogast et al., 2002, 2005). Thus, in Experiment 2, we used a paradigm that is dominated by informational masking. This was accomplished by digitally processing the CRM stimuli to diminish spectral overlap between the target and masker messages, thus minimizing energetic masking. In addition, the processed stimuli minimized talker cues (i.e., the processing made it difficult to recognize and distinguish the target talker's voice from that of the masker talker), thus further isolating spatial separation as the cue under examination.

Method

Stimuli. The speech targets and maskers were the same CRM sentences used in Experiment 1. Speech targets and maskers were digitally processed to minimize spectral overlap between target and masker via the procedure described by Arbogast et al. (2002, 2005). The processing involved high-pass filtering with a firstorder Butterworth filter at 1200 Hz and passing the output through a filter bank that consisted of 15 nonoverlapping filters with equal bandwidths on a logfrequency scale. The bandpass filters were one-third octave, fourth-order Butterworth filters with center frequencies ranging from 215 Hz to 5461 Hz. The envelope of the output of each filter, extracted by half-wave rectification and low-pass filtering at 50 Hz, was used to modulate a sinusoid with a frequency equal to the center frequency of the band. The target sentence on each trial was constructed by summing a random selection of 8 of the 15 modulated sinusoids. The masker sentence was constructed by summing the remaining 7 sinusoids. Thus, the target and masker consisted of nonoverlapping modulated sinusoids. Figure 2 shows the magnitude spectra of a sample pair of a target sentence (gray) and a masker sentence (black). As seen in Figure 2, the target and masker do not overlap (except where they are more than 40 dB below peak levels). Thus, energetic masking was expected to be

minimized in the target-masker presentation. Stimuli were presented using a 48-kHz sampling rate from loudspeakers (Cambridge SoundWorks) positioned at an ear-level height, 1.2 m from the participant at angles of -90°, 0°, and +90° azimuth relative to the participant on the horizontal plane. The target sentences were always presented from the 0° loudspeaker. The masker sentences were presented either from the 0°, -90°, or +90° loudspeaker, depending on the experimental condition.

Procedure. Participants were seated in a semianechoic room (T60 = 0.06 s) and were asked to respond on each trial by verbally naming the color and the number that was spoken by the target talker using the call sign "Baron." The participant's voice was picked up by a microphone, and an experimenter outside the room recorded the responses for each trial on a computer. Trial-by-trial feedback was not given.

The level of the masker was held at a fixed intensity level of 55 dB. For a few participants, the masker level was adjusted by ±5 dB for a block of trials to capture a full range of performance (i.e., approximately 0%- 100%) while ensuring target audibility. For each block of trials, the level of the target was varied randomly from trial to trial over a 20 dB range in order to estimate the psychometric function relating performance to the T/M ratio. There was some variation in target levels across blocks of trials in order to obtain performance near chance at the lowest target level and near 100% at the highest target level.

Participants completed between 60 and 120 practice trials in the baseline condition before data were collected. The baseline condition was presented without a masker in order to familiarize the participants with the processed stimuli and to ensure perfect performance at each target level. The first 30 baseline trials involved listening and responding to unprocessed CRM stimuli. Then the participant completed 30 baseline trials with the processed stimuli. Additional practice trials with the processed CRM sentences were administered until the participant demonstrated perfect or near-perfect performance at all target levels. After completing the baseline condition, participants with UHL were tested in three experimental conditions:

1. Colocated: The target and masker were digitally attenuated and mixed and presented from a single speaker positioned at 0° azimuth.
2. Masker impaired: The target was presented at 0° azimuth, and the masker was presented at 90° azimuth on the side of the participant's impaired ear.
3. Masker normal: The target was presented at 0° azimuth, and the masker was presented at 90° azimuth on the side of the participant's normal-hearing ear.

The normal-hearing participants were tested in the colocated condition and in a condition in which the target was presented from the 0° loudspeaker and the masker from the -90° loudspeaker on the participant's leftside. Participants completed a minimum of 300 trials in each of the conditions. The conditions were presented in an alternating manner in blocks of 60 trials. The presentation order of the condition blocks was selected randomly. The first block in each condition was treated as a practice block. A minimum of 48 trials was used to estimate proportion correct at each of the T/M ratios tested.

Data analysis. The data from each condition (proportion correct at T/M ratios) were fitted with threeparameter (midpoint, slope, and upper asymptote) logistic functions in MATLAB using psignfit (Wichmann &Hill, 2001a, 2001b). Thresholds (i.e., T/Mratio corresponding to 51% correct) were estimated from the fitted functions for each participant in each of the experimental conditions. The 95% confidence intervals for threshold estimates were calculated using the bootstrapping procedure described by Wichmann and Hill (2001b).

Results

In this experiment, speech targets and maskers were processed into nonoverlapping modulated sinusoids to minimize energetic masking. Performance in the baseline condition (no masker) was nearly perfect (93%-100% correct) at all target levels tested (range: 30-55 dB SPL). As with Experiment 1, the participant with borderline mild hearing loss in the "normal" ear required a range of 45-65 dB to achieve near-perfect performance.

Figure 3 presents the raw data and the fitted psychometric functions for three representative participants with normal hearing. The error bars show the 95% confidence limits of the estimated thresholds (51% correct). As

suggested by the data shown in Figure 3, there was considerable variability across participants in the estimated thresholds. Nevertheless, all participants produced monotonic psychometric functions that spanned nearly the entire range of performance from chance (3% correct) to perfect (100% correct). Confidence intervals for the threshold estimates were approximately ±1.5 dB. Note that for the participants whose data are shown in Figure 3, spatially separating the target and masker resulted in a large improvement in performance (a leftward shiftof the psychometric function, toward lower T/Mratios). Such large improvements reflect spatial release from informational masking. For the participant whose data are shown in the middle panel, the spatial release was approximately 20 dB. Similar results from participants with normal hearing have been reported previously in several studies that used the CRM paradigm with processed stimuli (Arbogast et al., 2002, 2005). Spatial release has been shown to be greatest in experiments, such as the current one, in which the masker may be characterized as primarily informational. Spatial release from informationalmasking is usuallymuch larger than the performance improvement produced by the head shadow effect, which results in a slight improvement in T/Mratio at the shadowed ear when themasking stimulus is to one side (Bronkhorst &Plomp, 1989).

Figure 4 is comparable to Figure 3 except that the data are from three representative participants with UHL. Recall that the participants withUHL were tested in three conditions, one in which both the target and the masker were presented from the loudspeaker in front of the participant (colocated), one in which the target was in front and the masker was on the side of the impaired ear (masker impaired), and one in which the target was in front and the masker was on the side of the normalhearing ear (masker normal). For these three participants, presenting the masker on the side of the impaired ear produced a small improvement in performance, and presenting the masker on the side of the normal-hearing ear produced a small decrement in performance.

Tables 2 and 3 summarize the results from Experiment 2. The tables list estimated thresholds (and 95% confidence intervals) in each condition for both normalhearing participants and participants with UHL. Consider first the data obtained from the normal-hearing participants (Table 2). There are substantial individual differences in the thresholds in the colocated condition, ranging from -11.4 dB to -0.2 dB (T/M ratio), with a mean of -5.1 dB. Such large individual differences are not uncommon in tasks dominated by informational masking (Wightman &Kistler, 2005; Wightman et al., 2006). T/M thresholds in the condition in which targets and maskers were spatially separated ranged from -28.1 to -13.8 dB, with a mean of -20.5 dB. As seen in Table 2, spatial release (from informational masking) achieved by the participants with normal hearing ranged from 10 dB (NH06) to 27 dB (NH05), with a mean spatial release of about 15 dB. These findings are comparable to those of Arbogast et al. (2002, 2005), which also showed a mean spatial release of about 15-18 dB.

Next, consider the results from the participants with UHL (Table 3). Although the range of estimated thresholds from the colocated condition was about the same as for the participants with normal hearing, most of the threshold estimates were higher, indicating poorer performance in this group. The mean colocated threshold for the participants with UHL was -0.5, compared with a mean of -5.1 dB for the normal-hearing participants. This difference was significant, $t(22) = 2.97$, $p = .007$, $h2 = .21$. Table 3 also shows that all UHL participants achieved the best thresholds (lowest T/M ratio) in the masker impaired condition and the poorest threshold in the masker normal condition. Although the threshold differences across listening conditions in the UHL participant group were small, a repeated measures analysis of variance (ANOVA) showed that they were significant, $F(2, 22) = 76.4$, $MSE = 1.63$, $p <. 001$, $h2 = .87$. Post hoc comparisons using the Bonferroni adjustment indicated that thresholds were lower in the masker impaired condition than in the colocated condition ($p <.001$) and higher in the masker normal condition ($p = .003$) than in the colocated condition. The improvement in performance of the individuals with UHL produced by moving the masker from the front to the side of the impaired ear can be described as a "spatial advantage," but as will be argued in the Discussion, it is no greater than what would be expected given the change in T/M ratio at the normal-hearing ear (i.e., the head shadow effect) and as such does not imply a perceptual effect or processing of spatial cues by these participants. The decrement in performance in the masker normal condition as compared with the colocated

condition can be explained in a similar way.

Experiment 3: Localization of Noise on the Horizontal Plane

Experiment 3 examined the ability of participants with UHL and those with normal hearing to localize wideband noise bursts on the horizontal plane. The absence of the ability of the listeners with UHL to use spatial cues may be related to poor localization skills. Therefore, the objective of Experiment 3 was to measure localization performance.

Method

Stimuli. Stimuli for the localization task were 250-ms Gaussian white noise bursts, bandpass filtered between 200 Hz and 16 kHz and shaped by 20-ms cosinesquared on-offramps. The advantage of using a wideband noise in this experimentwas that it gave participants access to high-frequency pinna cues, which have been shown to be valuable formonaural localization (Wightman &Kistler, 1997). Independent noise samples were generated on each trial. The noise signals were output at a 48-kHz sampling rate with a Digital Audio Labs Card Deluxe 24-bit sound card. The level of the stimulus on each trial was random (uniform distribution) over a 10-dB range (i.e., ±5 dB), with a mean level of 65 dB SPL. The purpose of the intensity rove, which has been employed by previous studies examining monaural localization (Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004, 2007; Wightman &Kistler, 1997), was to prevent the participantswithUHL fromusing the relative intensity of the stimuli at the normal-hearing ear as a localization cue. Single noise bursts were presented either to a single loudspeaker (Cambridge Sound Works) or, at half power, to two adjacent loudspeakers in order to simulate a position between the two loudspeakers. The frequency response of each loudspeakerwas digitally flattened with inverse filtering techniques.

Procedure. Localization testing was conducted in the same semi-anechoic room as was described in Experiment 2. Seven loudspeakers were positioned at ear level and were spaced 30° apart from -90° to +90° degree azimuth. Participants were seated in the center of the array of speakers, facing the speaker positioned at 0° azimuth, and were asked to maintain an upright and frontal orientation throughout testing. The speaker-head distance was 1.2 m. The seven loudspeakers were labeled with numbers in increments of 10, ranging from 0 to 60. On each trial, a brief 1000-Hz "warning" tone was presented from a loudspeaker located above the participant's head 1 s before the onset of the stimulus. The target noise was then presented randomly either from one of the seven loudspeakers or from one of the six simulated positions at the midpoint of two adjacent speakers. Following the presentation of the noise signals, the participant was asked to respond verbally with an integer between 0 and 60 that best identified the location where he or she perceived the noise to have originated. Responses were picked up by a microphone. Participants were told that the noise could originate from any position, either at the loudspeaker positions or anywhere in between. An experimenter in an adjacent room recorded responses and ensured that the participant maintained a frontal orientation during the presentation of the stimuli. A camera placed in the testing chamber allowed the examiner to monitor the orientation of the participant.

All participants were given at least 65 practice trials to familiarize them with the localization task. Following the practice trials, participants completed a minimum of 195 experimental trials (range: 195-585 trials). No feedback was given to participants regarding the accuracy of their responses.

Data analysis. Performance on the localization task was evaluated by examining stimulus-response plots and by calculating RMS error between the target and response angles. Mean signed error was also computed in order to evaluate response bias.

Results

Figure 5 illustrates the localization performance in the horizontal plane of each of the 12 participants with normal hearing, and Figure 6 shows the performance of the 12 participants with UHL. The panels in both figures are organized according to participant age (i.e., youngest to oldest). The scatter plots show the response angles as a function of target angle. Participants' judgments, which ranged from 0 to 60, were converted to angular

judgments for the purpose of analysis. Prior to graphing, the data points were "jittered" slightly by adding a uniform random deviate of ±2.5° to the coordinates to eliminate the overlap resulting from duplicate responses to a given target (Cleveland, 1993). The average RMS error between response and target angles is shown in the upper leftof each panel. As seen in Figure 5, the performance of the participants with normal hearing was quite good, as evidenced both by the small RMS errors and the cluster of responses around the major diagonal (response angle = target angle).

In contrast to the normal-hearing participants, there were large individual differences in performance among the participants with UHL, as seen in Figure 6, with RMS errors ranging from 16° to 68°. Some participants (UHL02 and UHL03) performed only slightly poorer than the normal-hearing individuals, whereas others (UHL09, UHL10, and UHL12) showed little or no ability to localize the stimuli. Table 4 displays mean signed error and RMS error of the participants with UHL on the side of the impaired ear and the side of the normal-hearing ear. As seen in the table, most participants showed better performance (and a response shiftor bias) on the side of their normal-hearing ear. One participant (UHL12) had better performance on the side of her impaired ear. Two participants (UHL02 and UHL10) showed equivalent performance on their impaired and normal-hearing sides.

One of the aims of the localization experiment was to compare the localization abilities of participants with UHL with their ability to receive spatial benefit on a speech task (Experiment 2). To this end, Pearson product-moment correlation coefficients were calculated between RMS error on the localization task (Experiment 3) and threshold differences from the speech task (Experiment 2). Threshold differences on the speech task were defined as the difference in thresholds between the colocated condition and the masker impaired condition (D0°-90° impaired) and the difference in thresholds between the colocated condition and the masker normal condition (D0°-90° normal). Localization performance (RMS error) was not significantly correlated with D0°-90° impaired ($r = .09$, $p = .781$) or D0°-90° normal ($r = .45$, $p = .151$), suggesting that there was no relationship between localization performance and the ability to use spatial cues on the speech task among the participants with UHL. It seems clear that even for those participants with UHL who demonstrated near-normal ability to localize (e.g., UHL02 and UHL03), spatial separation of the target and masker on the speech recognition task provided only a modest performance advantage (about 4 dB for both participants) over the colocated condition. In addition, the spatial advantages on the speech task obtained by these participants in the speech task were no greater than that obtained by participants who demonstrated no ability to localize.

Discussion

In multisource listening environments, individuals with normal hearing exploit binaural cues for understanding speech and localizing sound sources (e.g., Arbogast et al., 2002, 2005; Bronkhorst &Plomp, 1989; Freymanet al., 1999, 2001; Ihlefeld&Shinn-Cunningham, 2008a, 2008b). In contrast, individuals with UHL are not afforded such binaural benefits and consequently show perceptual deficits in environments in which normal-hearing listeners rely on spatial cues (e.g., Bess, Tharpe, &Gibler, 1986; Linstrom et al., 2009; Ruscetta et al., 2005; Sargent et al., 2001; Welsh et al., 2004). However, previous research has not systematically explored the listening performance of individuals with UHL in ways that can delineate the specific nature of their perceptual deficit. The current study sought to better define listening skills in individuals with UHL by evaluating performance on spatial and nonspatial listening tasks. Specifically, speech recognition on an informational masking task was measured under headphones in conditions in which the target and masker were presented monaurally, and in the sound field in conditions in which the target and masker were colocated or were presented with 90° of spatial separation between target and masker. In addition, localization performance was measured to investigate whether localization skills are related to the ability to achieve a spatial release from informational masking on a speech perception task in listeners with UHL.

Regarding monaural listening performance, our findings revealed no difference between the performance of normal-hearing adults and those with UHL. Specifically, when the target and masker were presented monaurally over headphones to the normal-hearing ear (Experiment 1), the performance of the participants withUHLwas

comparable to the monaural performance of normal-hearing participants who were assessed in the current study and in previous studies (Brungart, 2001; Wightman &Kistler, 2005; Wightman et al., 2006). This was true both when the masker was a single talker (informational masker) and when it was a modulated noise (energetic masker).

In contrast to monaural listening performance using headphones, performance in the sound field conditions (Experiment 2) revealed significant differences between listeners with and without UHL, even when there was no spatial separation between target and masker. Although the colocated condition of Experiment 2 should not offer any benefit from binaural listening, given that the target and the masker were not spatially separated (and thus do not produce different patterns of interaural differences), there was a significant difference of about 4.5 dB between the average threshold of participants with UHL and participants with normal hearing, favoring the performance of the normalhearing group. The source of this difference is unknown and will remain a topic for future study. However, this finding appears consistent with a handful of studies that have shown superior performance in diotic versus monaural listening conditions by normal-hearing listeners on comodulating masking release tasks (Schooneveldt &Moore, 1989), detection tasks (Langhans &Kohlrausch, 1992; Zwicker &Henning, 1985), and speech perception tasks (Bronkhorst &Plomp, 1988; Davis, Haggard, &Bell, 1990; Gallun et al., 2005). Some investigators attribute the superior diotic performance to a statistical advantage of having two independent observations versus a single observation of the stimuli (Schooneveldt &Moore, 1989; Zwicker &Henning, 1985), whereas other investigators have suggested that the monaural-diotic performance difference relates to efferent interaction between the right and leftauditory pathways (Langhans& Kohlrausch, 1992).

In the condition in which the target and masker were spatially separated in Experiment 2, the normalhearing participants used binaural spatial cues to attend selectively to the target and ignore the masker. The data (Figure 3 and Table 2) showed as much as a 27 dB release from masking in this condition. This result was consistent with several other studies of informational masking by showing large benefits in normal-hearing listeners from spatial separation between the target and masker that exceed the benefits that can be attributed to head shadow effects or binaural interaction (Arbogast et al., 2002, 2005; Kidd, Arbogast, et al., 2005; Shinn-Cunningham, Ihlefeld, Satyavarta, &Larson, 2005).

In contrast to the normal-hearing participants, participants with UHL did not demonstrate the use of spatial cues to achieve better performance when the target and masker were spatially separated. Compared with the colocated condition, when the masker was presented on the side of the impaired ear, participants with UHL showed an average threshold improvement of approximately 4 dB. When the masker was presented on the side of the normal-hearing ear, participants with UHL showed an average threshold decrement of approximately 2.5 dB compared with the colocated condition. These threshold changes are nearly identical to the those predicted by a model proposed by Zurek (1993) that takes into account the changes in T/Mratio and consequent changes in the Articulation Index (French &Steinberg, 1947; Kryter, 1962) at the normal-hearing ear. This model was designed to predict speech intelligibility in monaural and binaural conditions based on the directionality of a target and a single-source masker. Specifically, in monaural conditions using high-context speech material and a speech spectrum noise masker, Zurek's model predicts an improvement of about 4 dB when the noise is on the side of an occluded ear and a decrement of about 3 dB when the noise is on the side of the normal-hearing ear. These changes in performance reflect head shadow effects. Thus, the changes in performance (i.e., benefits and decrements) of the participants with UHL produced by spatial separation of target and informational masker appear to be predictable based on differences in T/M ratio at the normalhearing ear. This is in contrast to the large perceptual benefits of spatial separation in normal-hearing listeners that are commonly described as spatial release from informational masking. Even the participants with mild or moderate degrees of UHL appeared to be unable to achieve a true spatial release from informational masking.

The inability of listeners with UHL to achieve a spatial release from informational masking is consistent with results from a study of normal-hearing listeners by Marrone et al. (2008), who measured performance on the

CRM in binaural and monaurally occluded (i.e., plugged) conditions. In this study, the spatially separated conditions employed noise on both sides of the participant (i.e., at ±45° or ±90°); thus, there was no "better ear" in terms of T/Mratio. In the binaural condition, the participants achieved a sizable spatial release from informational masking, which was effectively eliminated in the monaural occluded condition. Thus, similar to results from the current study, this study suggested that monaural participants fail to exhibit spatial benefits when head shadow cues are discounted.

The fact that the participants with UHL in the current study did not show marked improvement in performance in what should have been the most advantageous condition for them(i.e., the condition inwhich themasker was on the side of their impaired ear) was consistent with a study by Best et al. (2005). This study measured participants' abilities to identify finch song amidst energetic and informational maskers. The participants achieved an average of 10 dB greater release from informational masking when the target and masker were spatially separated than when the better ear signal was presented diotically. Thus, in conditions characterized by considerable informational masking, normalhearing listeners receive binaural listening advantages that exceed those gains obtained simply by having access to the better ear signal. Arguably, normal-hearing listeners use central processes to obtain a release from informational masking by directing their attention toward a target signal and away from distracters. These same attentional processes used to obtain a spatial release from informational masking do not appear to be available to listeners with UHL.

The third objective of the current study was to measure localization performance in listeners with and without UHL and investigate whether spatial release from informational masking on a speech task was related to localization ability. Findings from the localization experiment (Experiment 3) were consistent with those of previous studies, in that there was considerable individual variability in performance among the participants with UHL, participants with UHL showed deficits in performance relative to participants with normal hearing, and participants with UHL tended to bias their responses toward the side of their normal-hearing ear (as seen in Table 4). Two participants (UHL02 and UHL03) in the current study were able to localize the sound sources with near-normal proficiency. However, these participants had only mild-to-moderate hearing loss in the impaired ear and thus had the greatest amount of residual hearing. Unlike the participants with severe-toprofound UHL, it is possible that these two individuals with milder degrees of UHL were able to use interaural difference cues to assist their localization. This is consistent with results from a recent study by Agterberg et al. (2011) of listeners with mild-to-severe UHL that suggested that their listeners who showed relatively proficient localization abilities were able to use their limited binaural difference cues to perform the localization task. A related finding was reported byWightman and Kistler (1997) in a study of the impact of artificial broadband interaural level differences on localization. Normalhearing listeners achieved surprisingly good localization performance, even with a 40 dB interaural level difference. In the current study, a few participants with profound UHL (i.e., UHK04 and UHL07) demonstrated localization performance that seemed better than what might be expected given their degree of UHL, but their performance was poorer than that of normal-hearing listeners.

As explained in the introduction, previous investigators have suggested that many listeners with UHL use intensity cues provided by the head shadow on localization tasks (Agterberg et al., 2011; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004). That is, these listeners tend to localize low-intensity stimuli closer to the impaired ear and higher intensity stimuli closer to the normal-hearing ear. Although these trialby- trial variations in level at the functioning ear can be valuable cues for localizing stimuli on laboratory tasks that employ fixed-intensity paradigms, such level cues are not accessible in real-world listening. In the current study, we attempted to reduce the participants' ability to rely on such intensity cues by roving the overall level of the stimuli over a 10 dB range. Although this level rove almost certainly lessened the participants' ability to utilize level cues on the localization task, it is possible that a 10 dB level rove was not large enough to prohibit some participants from using intensity cues to determine the approximate position of the sound source, as argued by Van Wanrooij and Van Opstal (2004).

Some listeners with UHL are thought to be able to capitalize on monaural spectral cues to localize sound sources (Newton, 1983; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004). Monaural spectral cues may assist in localization because the characteristics of pinna filtering change depending on the position of the sound source. The use of monaural spectral cues for localization relies on the listener's ability to extract pinna filtering characteristics from an incoming signal and associate those characteristics with the corresponding sound direction (Wightman &Kistler, 1997). Because the spectrum received at the ear is a combination of the source spectrum and the pinna characteristics, knowledge of the source spectrum is required in order to decode the pinna cues. However, some researchers suggest that after years of monaural listening experience, some individuals with UHL may learn to use monaural spectral cues to determine the direction of sound on the horizontal plane (Newton, 1983; Slattery &Middlebrooks, 1994; Van Wanrooij &Van Opstal, 2004). These studies and others (i.e., Abel &Lam, 2008; King et al., 2001) suggest that the ability to use monaural spectral cues is not learned immediately following unilateral deafness or monaural occlusion but that it is learned over a period of at least several months. However, another study by Shub et al. (2008) found no difference between listeners with UHL and those with normal hearing on a monaural localization task and suggested that the testing paradigm itself, rather than monaural listening experience, had greater influence on monaural performance of normal-hearing listeners. In the current study, all participants with UHL had their hearing loss for at least 4 years (most for over 10 years), and there did not appear to be a relationship between duration of unilateral impairment and localization ability.

Regarding a possible relationship between spatial release from informational masking and localization ability in listeners with UHL, findings from the current study suggest that there is none. Correlational analyses showed no significant relationships between the small spatial effects on the informational masking task and performance on the localization task in participants with UHL. Although there was considerable variability in the ability to localize by the participants with UHL, there was little variability on the spatial speech task in that none of the participants with UHL achieved a spatial release from informational masking beyond what would be predicted fromhead shadow effects. A few of the participants demonstrated localization performance that was nearly comparable to that of normal-hearing participants, but they did not show substantial improvements in speech understanding when the target and masker messages were spatially separated. This was despite the fact that participants were informed of the location of the target and masker sources prior to each block of trials. This finding seems to be in contrast with previous studies that have suggested that normalhearing listeners use differences in the perceived location of a target to obtain a spatial release from masking in complex listening situations and that "knowing where to listen" improves performance (Ericson,Brungart, &Simpson, 2004; Kidd, Arbogast, et al., 2005). However, findings from the current study are consistent with other studies that have cast doubt on the relationship between localization and spatial release from informational masking. For example, these studies have suggested that listeners do not appear to use perceived location to obtain binaural release from informational masking (Gallun et al., 2008) and that spatial release from masking is not well predicted by localization ability (Drullman &Bronkhorst, 2000; Hawley et al., 1999).

Conclusion

This study explored selective listening skills and localization abilities in individuals with UHL. Findings lend themselves to the following conclusions:

1. The monaural listening performance of individuals with UHL is comparable to that of individuals with normal hearing.
2. Speech understanding in noise deficits of listeners with UHL appears to be most pronounced in environments in which normal-hearing listeners are able to benefit fromspatial separation between the target andmasker. ListenerswithUHLappear to be unable to achieve spatial release from informational masking beyond what may be attributed to the head shadow effect. The inability to achieve a spatial release from informational masking by listeners with UHL appears to occur even in those who have mild degrees of UHL and/or proficient localization

abilities.

3. Listeners with UHL show great variability in localization skills. Some individuals with UHL exhibit localization ability that is nearly comparable to normal-hearing listeners, while others show little or no ability to localize sounds. Localization performance tends to be poorest on the side of the unilateral impairment.

Acknowledgments

This research was supported by National Institute on Deafness and Other Communication Disorders Grant RO1- HD023333 to Frederic L.Wightman, principal investigator.We gratefully acknowledge the assistance of Crystal Williamson with data collection and of Arun Gadre and Angie Buckingham with participant recruitment. Carissa Shafto and Derek Knisely kindly offered editorial feedback on earlier versions of this article. We would also like to thank the participants in this project for their time and involvement.

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Editor: Robert Schlauch
Associate Editor: Beverly Wright
Received July 26, 2010
Revision received January 13, 2011
Accepted August 17, 2011

DOI: 10.1044/1092-4388(2011/10-0205)

Publication date: Apr 2012

Year: 2012

Measuring Speech Recognition in Children With Cochlear Implants in a Virtual Classroom

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.2 (Apr 2012): 532-540.
ProQuest document link

Abstract: To determine the feasibility of using a virtual auditory test material to evaluate reverberation and noise effects on speech recognition of pediatric cochlear implant (CI) users and to compare their performance with that of children with normal hearing. Virtual test materials representing nonreverberant and reverberant environments were used to measure speech recognition of 7 children with CIs in quiet and in noise, and of 18 childrenwith normal hearing in the quiet condition. Performance of CI users in noise (signal-to-noise ratio resulting in 50% performance) was compared to normative data from a previous study (Neuman, Wroblewski, Hajicek, &Rubinstein, 2010). For CI users, stimuli were sent directly to the CI speech processor via auxiliary input, whereas children with normal hearing were tested using insert phones. The speech recognition of children with CIs decreased significantly in the reverberant condition. There were individual differences in susceptibility to reverberation. Children with CIs also required higher signal-to-noise ratios than children with normal hearing in the reverberant condition. Direct connect testing with reverberant test materials allows assessment of speech recognition under conditions typical of classrooms and could be useful in identifying children with CIs whose performance decreases significantly in the presence of reverberation and noise.

Full text: Headnote

Purpose: To determine the feasibility of using a virtual auditory test material to evaluate reverberation and noise effects on speech recognition of pediatric cochlear implant (CI) users and to compare their performance with that of children with normal hearing.

Method: Virtual test materials representing nonreverberant and reverberant environments were used to measure speech recognition of 7 children with CIs in quiet and in noise, and of 18 childrenwith normal hearing in the quiet condition. Performance of CI users in noise (signal-to-noise ratio resulting in 50% performance) was compared to normative data from a previous study (Neuman, Wroblewski, Hajicek, &Rubinstein, 2010). For CI users, stimuli were sent directly to the CI speech processor via auxiliary input, whereas children with normal hearing were tested using insert phones.

Results: The speech recognition of children with CIs decreased significantly in the reverberant condition. There were individual differences in susceptibility to reverberation. Children with CIs also required higher signal-to-noise ratios than children with normal hearing in the reverberant condition.

Conclusion: Direct connect testing with reverberant test materials allows assessment of speech recognition under conditions typical of classrooms and could be useful in identifying children with CIs whose performance decreases significantly in the presence of reverberation and noise.

Key Words: cochlear implants, classroom acoustics, speech perception

Increasing numbers of elementary school-age children with cochlear implants (CIs) are being educated in

mainstream classes (Daya, Ashley, Gysin, &Papsin, 2000; Sorkin &Zwolan, 2004). It is of concern that the acoustic environments in these classrooms may interfere with their ability to hear and understand speech. The recently developed American National Standards Institute (ANSI; 2002) classroom acoustics standard recommends a maximum reverberation time of 0.6 s and background noise levels of 35 dBA in classrooms. However, a recent survey of elementary school classrooms revealed that poor acoustics are still likely in many schools (Knecht, Nelson, Whitelaw, &Feth, 2002). In Knecht et al.'s (2002) study, only one of 32 classrooms surveyed was in compliance with ANSI recommendations for reverberation time and background noise levels. Approximately half of the rooms exceeded the recommended reverberation time (reverberation times ranged from 0.4 to 1.2 s), and only four rooms had acceptable background noise levels (noise ranged from 28 to 67 dBA in the unoccupied classrooms). Of further concern are reports of very high noise levels in occupied classrooms leading to signal-to-noise ratios (SNRs) poorer than +10 dB (Crandell &Smaldino, 2000; Picard &Bradley, 2001).

Although pediatric CI users must function in classrooms with challenging acoustic environments, clinical evaluations of speech recognition are administered in sound-treated rooms with minimal reverberation. A recent study conducted by Iglehart (2009) suggested that reverberation and noise levels typical of classroom environments cause far greater speech recognition difficulties for children with CIs than for children with normal hearing. Iglehart compared speech recognition performance of 17 children with CIs (ages 7-16 years) and 20 children with normal hearing (ages 5-16 years). The assessment was carried out in a single classroom with reverberation time adjusted by hanging absorptive panels. Reverberation times (RT) were 0.3, 0.6 and 0.9 s (RTs shorter than, equal to, and longer than the RT recommended in the ANSI classroom acoustics standard). Mean recognition scores (words in sentences) of children with normal hearing approximated 100% at 9 dB SNR in all three RT conditions. In contrast, the mean performance of the children with CIs reached an asymptote at +21 dB SNR. For the children with CIs, mean scores were 92% in the 0.3-s condition, 80% in the 0.6-s condition, and 68% in the 0.9-s condition. Although the mean performance in the 0.3-s condition is good, such a short RT is not typical of classrooms (Knecht et al., 2002), and such a favorable SNR (+21 dB) is not likely to occur in an occupied classroom(e.g., Crandell &Smaldino, 2000; Larsen &Blair, 2008; Picard &Bradley, 2001). The significant decrease in performance in the 0.6-s condition is alarming because this is the RT recommended in the ANSI classroom acoustics standard. Although the 0.9-s condition exceeds that recommended in the ANSI standard, classrooms with similar, and even longer, RTs are still encountered (Knecht et al., 2002). These findings raise concerns about how classroom acousticsmay be affecting children with CIs in mainstream classrooms and support the need for a method of testing the effects of reverberation and noise on children with CIs in a manner that is feasible in the clinic.

Over thirty years ago, Nábelek and Robinette (1978) suggested that, as part of the clinical evaluation, it might be important to assess the effect of reverberation and noise on the speech perception performance of persons with hearing loss; however, it is difficult to test reverberation effects in audiometric test environments, and such clinical measures are still unavailable. In research studies that have evaluated the effect of classroom acoustics on the speech perception of children, testing has often been carried out in reverberant rooms (e.g., Finitzo-Hieber&Tillman, 1978; Iglehart, 2009; Nábelek& Pickett, 1974; Yacullo &Hawkins, 1987). This approach is not feasible in the clinic because a test room with reverberation typical of classroomenvironments is not available. An alternative means of testing involves headphone presentation of reverberant test materials recorded using microphones at the eardrum locations of an auditory research manikin (e.g., Johnson, 2000;Neuman&Hochberg, 1983).Athird approach, suggested by Koehnke and Besing (1996), is to use digital signal processing techniques to create virtual auditory test materials. To create a virtual reverberant speech recognition test material, the binaural room impulse response (BRIR) is recorded in one or more reverberant rooms using a pair of microphones mounted on a manikin. The BRIR is then convolved with standard speech recognition test materials. When the reverberant test material is played through headphones, the listener hears

the speech as if he or she were sitting at the location in the room where the BRIR was recorded. Koehnke and Besing demonstrated the feasibility of measuring spatial release from masking under headphones using virtual test materials that simulated an anechoic and a reverberant environment. The virtual auditory test approach is used in currently available tests of spatial release from masking, such as the Hearing In Noise Test Pro (Bio-Logic Systems Corp., 2006) or the Listening in Spatialized Noise-Sentences test (Cameron &Dillon, 2009).

A limitation to using virtual auditory test materials with CI users is the need to deliver the signals through headphones or insert phones in order to preserve the acoustic cues related to the test room and the position of the listener (and the listener's ears) relative to the test signal(s). Testing under headphones is not typically an option in assessing performance with CIs; however, direct delivery of the test material to the CI speech processor via auxiliary input provides a way to preserve the acoustic characteristics of a reverberant room in the virtual test stimuli while testing the listener's performance with a signal processed through the speech processor of the CI. Chan, Freed, Vermiglio, and Soli (2008) demonstrated comparable test results on sound localization and spatial release from masking measures from CI users in sound field or with what they called the "direct-connect assessment technique." Therefore, if virtual test materials developed using BRIRs recorded in a classroom are delivered to a child's CI using this direct-connect assessment technique, it will be possible to determinehowthe acoustics of the classroom will affect that child's speech recognition performance. Recently, Neuman, Wroblewski, Hajicek, and Rubinstein (2010) developed a virtual auditory test material to research the effects of reverberation and noise on the speech recognition of children and adults with normal hearing. This test material may be useful for assessing the performance of children by delivering the signal directly through the CI speech processor.

The purpose of the present study was twofold: to (a) determine the feasibility of using a virtual auditory test material (delivered to the CI via auxiliary input) to evaluate reverberation and noise effects on the speech recognition performance of pediatric CI users and (b) compare performance of the children with CIs with that of their peers with normal hearing.

Method

Participants

Children with CIs. Participants in the study included seven elementary school-age CI users (Nucleus 24 device, Freedom processor, ACE strategy). Six of the seven children used bilateral CIs (sequential implantation). All were experienced CI users (6-10 years with the first implant, 5months-5.5 yearswith the second device). Demographic information appears in Table 1.

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Testing under headphones is not typically an option in assessing performance with CIs; however, direct delivery of the test material to the CI speech processor via auxiliary input provides a way to preserve the acoustic characteristics of a reverberant room in the virtual test stimuli while testing the listener's performance with a signal processed through the speech processor of the CI. Chan, Freed, Vermiglio, and Soli (2008) demonstrated comparable test results on sound localization and spatial release from masking measures from CI users in sound field or with what they called the "direct-connect assessment technique." Therefore, if virtual test materials developed using BRIRs recorded in a classroom are delivered to a child's CI using this direct-connect assessment technique, it will be possible to determinehowthe acoustics of the classroom will affect that child's speech recognition performance. Recently, Neuman, Wroblewski, Hajicek, and Rubinstein (2010) developed a virtual auditory test material to research the effects of reverberation and noise on the speech recognition of children and adults with normal hearing. This test material may be useful for assessing the performance of children by delivering the signal directly through the CI speech processor. The purpose of the present study was twofold: to (a) determine the feasibility of using a virtual auditory test material (delivered to the CI via auxiliary input) to evaluate reverberation and noise effects on the speech recognition performance of pediatric CI users and (b) compare performance of the children with CIs with that of their peers with normal hearing. Method Participants Children with CIs. Participants in the study included seven elementary school-age CI users (Nucleus 24 device, Freedom processor, ACE strategy). Six of the seven children used bilateral CIs (sequential implantation). All were experienced CI users (6-10 years with the first implant, 5months-5.5 yearswith the second device). Demographic information appears in Table 1. Neuman et al.: Virtual Test Approach 533 These children were recruited with the assistance of the New York University Cochlear Implant Center, as well as through local speech pathologists and audiologists who provide services to children with implants. Clinicians referred only those children whom they assessed as capable of performing the experimental task and of having good speech articulation and good speech recognition scores. Speech recognition scores obtained during the clinical evaluation preceding participation in the study appear in Table 2. Because testing required that children repeat sentence material, it was important to identify children whose speech production would not interfere with measurements of speech perception. Furthermore, in order to be able to demonstrate the effects of degradation of speech on performance without worrying about floor effects, it was necessary to recruit listeners who demonstrated good speech recognition performance in the nonreverberant condition. The participants in the

study functioned well with their CIs and were not chosen to be representative of all children with implants.
All children met the following five inclusion criteria: (a) diagnosed as prelingually deaf; (b) between the ages of 6 and 12 years (elementary school age), and received the first implant by age 3 years (to increase the likelihood that they would be in a mainstream educational setting, see Govaerts et al., 2002); (c) used English as their primary or only language; (d) demonstrated no errors in articulation, as evidenced by performance onthe Goldman-Fristoe Test of Articulation-2 (GFTA-2; Goldman &Fristoe, 2000); and (e) were identified by their speech therapists with no other disability or delay (including academic deficits, a learning disability, attention-deficit/hyperactivity disorder, cognitive disability, specific language impairment, etc.). One child who participated in the study received the first implant at age 3 years and one month.
Children with normal hearing. We assessed speech recognition in quiet (nonreverberant and reverberant conditions) in a control group of 18 children with normal hearing. Nine of the children were ages 6 through 7 years, and nine of the children were ages 9 through 12 years.The children with normal hearingwere typically developing American English speakers and had no history of recurrent middle ear disorders or insertion of ventilating tubes for treatment of recurrent otitismedia with effusion. All had hearing within normal limits, as established through audiometric screening (20 dB HL at 500, 1000, 2000, and 4000 Hz). None had been identified as having a language or learning disability, and none exhibited any speech articulation problems on the Goldman-Fristoe-2 Test of Articulation (Goldman &Fristoe, 2000).
Data for the listeners with normal hearing for the reverberant-noise condition were taken from Neuman et al.'s (2010) study. In that study, nine participants were in each age group (ages 6, 7, 8, 9, 10, 11, 12 years, and adult), and selection criteria for the children were identical to those described above.
This study was approved by the institutional review boards of the New York University School of Medicine and of Brooklyn College, City University of New York. Informed written consent was obtained from the parent of each child participating, and assent was obtained from each child prior to any testing.
Materials
We created a set of reverberant test materials by convolving BRIRs recorded in a classroom with recordings of the Bamford-Kowal-Bench Speech in Noise Test (Etymotic Research, 2005). A full description of the classroom, the method for recording the BRIRs, and the approach to creating test materials was reported by Neuman et al. (2010). In brief, the classroom had a volume of 228 m3 and a RT of 0.8 s. Absorptive panels were hung to record additional BRIRs to assess shorter reverberant conditions. Three sets of impulse responses were used in the current study: RTs were (a) 0.8 s, (b) 0.6 s, and (c) a nonreverberant test condition created by truncating the BRIR before the first reflection. Truncation of the BRIR yielded a test condition that maintained the Knowles Electronic Manikin for Acoustic Research (KEMAR) head-related transfer function but removed the reverberation characteristics of the room. For the quiet test conditions, the 0.8-s BRIR was convolved with the speech track (Bamford-Kowal-Bench sentences; Bench, Kowal, &Bamford, 1979) of the split-track recordings (List Pairs 9-12 and 14-18). This test condition represents an RT longer than recommended in the ANSI classroom standard, but it is still typical of many current classrooms (see Knecht et al., 2002). For the noise condition, the 0.6-s BRIR was convolved with the premixed speech in noise (List Pairs 1-7). The test materials for the 0.6-s condition are identical to those used in Neuman et al.'s study. Note that the RTs assessed in quiet and in noise differ. The original intent was to assess the 0.8-s condition in quiet and in noise; however, pilot data revealed that children with CIs found the task too difficult and frustrating when noise was combined with the longer RT. Therefore, the 0.6-s reverberant condition was used in the noise condition; this is the RT recommended by ANSI (2002).
We created test CDs with varying orders of both list and RT condition for ease of data collection.
Procedure
Testing was completed in a single test session. We first administered the GFTA-2 to determine eligibility to participate. The test protocol for children with CIs included speech recognition testing in quiet for the

nonreverberant and 0.8-s reverberant conditions as well as speech recognition testing in noise for the nonreverberant and 0.6-s reverberant conditions. Two list pairs were administered in each test condition, and key words were scored. For the test in quiet, we calculated a percentage correct score. The metric used to assess performance in noise was the signal-to-noise ratio resulting in 50% performance (SNR-50). SNR-50 was calculated as recommended in the Bamford-Kowal-Bench Speech in Noise Test manual (Bench et al., 1979). The order of testing was counterbalanced. The children with normal hearing were tested only in the quiet condition. Recall that the control group data in noise were from Neuman et al.'s (2010) study.

All children were tested in a quiet (background noise levels ≤35 dBA) or sound-treated test room. Test materials were administered using a portable Memorex CD player. The child's task was to repeat each sentence he or she heard. The examiner scored the test during the test session. The line output of the CD player was amplified and sent to monitor headphones to allow the examiner to hear the stimuli.

The only difference in instrumentation for testing the children with CIs and children with normal hearing was the transducer used to deliver the signal. When testing the children with normal hearing, we sent the CD player headphone output to a pair of Etymotic Research ER-6i isolator earphones with the volume control of the CD player set to achieve 71 dB SPL in a Zwislocki coupler. When testing children with CIs, we connected the headphone output of the CD player directly to the CI speech processor via the auxiliary input jack using the Nucleus Freedom TV/HiFi Cable (Part No. Z60829). The stimuli created from the right microphone impulse response were sent to the right ear, and the leftmicrophone stimuli were sent to the leftear (either via insert phone or speech processor). The child who used only one CI heard the recording from the microphone on the appropriate side.

The direct connection of the output of the CD player to the speech processor using the TV/hi-ficable bypasses the CI microphone. The pre-emphasis of the signal usually provided by themicrophone is incorporated into a filter that is part of the TV/ hi-ficable. When testing the children with CIs, we reduced themicrophone sensitivity setting to "5" in order to reduce the possibility of environmental noise interference, since in some cases testingwas not done in a sound-treated room. Thismicrophone sensitivity level allowed each participant to hear his or her own voice during testing but not any extraneous noises in the room. Adjusting the microphone sensitivity volume control does not affect the level of the sound from the TV/hi-ficable (Cochlear Americas, 2005). Testing was carried out at a comfortable listening level determined by the child. To find this level, the volume control of the TV/hi-ficable was set to the maximum setting, and the volume control of the CD player was manipulated by the examiner while the child listened to a practice list of the test material. The CD player volume control initially was set at the same point as was used for testing the children with normal hearing. The volume control was then systematically adjusted to determine the preferred listening level. The volume control was increased slowly until the child indicated that the sound was too loud, then was decreased until it was not loud enough, and finally increased to the level at which the speech was judged to be comfortable and clear. It is interesting to note that the children with CIs all selected a similar volume control setting. With this setting, the output of the cable (1000-Hz calibration signal from the test recordings) was approximately equivalent to the voltage that would be sent to the speech processor with a signal level of 65 dB SPL reaching the CI microphone (calibration information provided by the Cochlear Corporation, personal communication, July 10, 2009).

We used the same presentation level to test nonreverberant and reverberant conditions. Although it is true that reverberation will cause an increase in the level of the signal, for the purposes of this test material, we decided to equate speech levels in order to be able to estimate the effect of reverberation alone on speech recognition performance in quiet. Because the speech and noise are co-located, both speech and noise signal levels would be affected similarly by reverberation for the speech recognition in noise condition. The difference in SNR-50 between the nonreverberant and reverberant conditions yields information about the increase in SNR necessary to maintain a speech recognition score of 50% in the reverberant test condition. The speech recognition data collected for the children with normal hearing were also obtained with signal levels matched for the

nonreverberant and reverberant test conditions.

We used List Pair 9 as a practice list for all children. Children with CIs were tested in noise using List Pairs 1 through 8. List Pairs 10 to 18 were used for testing performance in quiet for all children. Two list pairs were administered to each child in each test condition. The test lists were distributed in an approximately balanced manner between the nonreverberant and reverberant test conditions across participants.Within each test session, each reverberation condition was assessed once in the first half of the session, and then again in the second half of the session, with a counterbalanced order of testing within the first and second half of a session. The order of testing quiet and noise conditions was counterbalanced among participants. No participant heard the same list more than once.

Results

Mean speech recognition scores in quiet in the nonreverberant and reverberant test condition are shown in Figure 1. The bars in the figure represent themean speech recognition performance for the children with CIs. Mean scores of younger (ages 6-7) and older (ages 9-12) children with normal hearing are plotted as line graphs. As can be seen, the performance of the children with CIs was quite good in the quiet, nonreverberant condition. These scores provide evidence that these CI users are capable of excellent speech recognition performance on this test material when the speech signal is not degraded by reverberation or by noise. Scores of the CI users ranged from 93% to 100% (M = 97.14%). Scores of the children with normal hearing ranged from 97% to 100% (M= 99.22%). Ceiling effects did not allow us to assess differences in performance between the children with CIs and those with normal hearing in this quiet, nonreverberant condition. In the quiet, reverberant condition, however, the mean speech recognition performance of the children with implants deteriorated dramatically, whereas the children with normal hearing still maintained good speech recognition performance. Some of the children with CIs showed large decreases in scores in the reverberant condition, and others showed only a small change. The speech recognition scores of the children with CIs ranged from 55% to 88% (M= 76.29%). The decrease in mean performance of children with CIs due to reverberation was statistically significant (Wilcoxon signed-rank test, W= 28, N = 7, $p < .01$, directional test). These data suggest that a reverberant condition typical of many classrooms can cause significant decreases in the speech recognition performance of children with CIs and that there are individual differences in the susceptibility to the effect of reverberation on speech.

The performance of the children with CIs was assessed in noise in both nonreverberant and reverberant conditions. The mean SNR-50s were 5.82 dB in the nonreverberant condition and 10.25 in the reverberant condition (a lower number is indicative of better performance). The increase in SNR required in the reverberant condition to maintain 50% performance was statistically significant (Wilcoxon signed-rank test, W = -28, N = 7, $p < .01$, directional test). In Figure 2, the performance of the children with CIs in the reverberant, noisy condition is compared with normative data obtained in Neuman et al.'s (2010) study. The mean SNR-50 for the children with CIs is shown on the far right. As one can see, on average the children with CIs require a much higher SNR for 50% performance than the children with normal hearing. Recall that the 0.6-s RT tested is typical of a classroom meeting the ANSI (2002) maximum recommended RT for an elementary school classroom.

In Figure 3, the SNR-50 of individual children with CIs is plotted in relation to mean data from children with normal hearing of similar age (data are from Neuman et al., 2010). The data for children with normal hearing show systematic decreases in the SNR required as a function of age. In contrast, a wide range of performance across the children with CIs is evident, and performance does not seem related to age (or years of experience with the CI). For example, one of the youngest children with bilateral CIs performed almost as well in noise as her peers with normal hearing, whereas one of the oldest children had the poorest performance in the noisy reverberant condition. This is the only child in our experimental group with a unilateral implant. Whether this might be a factor contributing to her need for a much higher SNR is not clear.

Discussion and Conclusions

The results of this study suggest that it is feasible to test the effect of reverberation and noise on the speech recognition performance of children with CIs using virtual auditory test materials delivered via auxiliary input to the speech processor and that the test material is sensitive to the deleterious effects of reverberation on the performance of children with CIs. Although the speech recognition performance of both children with normal hearing and children with CIs appears to be quite good in the nonreverberant, quiet test condition, the reverberant test condition clearly differentiated between the two groups of listeners. Whereas the performance of the children with normal hearing on the sentence test material was relatively unaffected in the reverberant test condition, the performance of the children with the CIs decreased significantly. This is of concern, because Knecht et al. (2002) reported that 10 of the 32 classrooms surveyed had RTs longer than the 0.8-s condition tested. The fact that all of the children with CIs scored higher than 90% on the nonreverberant test results and on the test materials administered in the clinic, but scored lower on the reverberant test material, suggests that the test results from a child's clinical evaluation will not necessarily predict performance when listening to speech degraded by reverberation and noise present in classroom environments.

When listening in the reverberant (0.6-s reverberation), noisy condition, on average, the children with CIs required a much higher SNR to obtain 50% speech recognition performance than children with normal hearing. The SNR-50s of individual children ranged from 6 dB to 14.5 dB. These findings are of concern when one considers reports of SNRs of <10 dB in occupied classrooms (Crandell &Smaldino, 2000; Larsen &Blair, 2008; Picard &Bradley, 2001); that the classrooms for the youngest children typically are among the noisiest (Picard &Bradley 2001); and that younger children require higher SNRs than older children or adults to obtain equivalent levels of performance in noisy, reverberant conditions (Neuman et al., 2010). It is clear that many of the children with CIs would have significant difficulty understanding speech in such noisy environments.

The results of this study suggest the need for a test that can identify children who are susceptible to degradations of the speech signal by reverberation, noise, and their combination. Current clinical measures of speech recognition performance of children with CIs are typically carried out in minimally reverberant, sound-treated test rooms. The test results obtained under these "optimal" listening conditions may mislead parents and educators into believing that a child with a CI will function as well as his or her normal hearing peers in the mainstream classroom. The results from this study suggest that reverberation has a very different effect on speech perception in children who use CIs than on children with normal hearing. In addition, there appears to be a range of performance in children with CIs indicating differences in susceptibility to the effects of reverberation and noise.

The direct-connect assessment approach using test materials that are representative of a range of classroom environments may make it possible to measure a child's functional listening ability in a reverberant environment. The results could be used to determine and provide documentation of a child's need for accommodation in the classroom and assist in developing a child's Individualized Education Plan.

Acknowledgments

The research reported in this article was supported by funding from the U.S. Department of Education, National Institute on Disability and Rehabilitation Research Grant H133E03006. The content of this article does not necessarily represent the policy of the U.S. Department of Education, and the reader should not assume endorsement by the U.S. federal government.

We thank Frank Iglehart of the Clarke School for the Deaf for providing access to the classroom and for advice on placement of the absorptive panels used during the recording process. Mario Svirsky and Chin-Tuan Tan provided technical guidance, and the Cochlear Corporation provided technical information required for implementing direct-connect testing. We are grateful to Susan Waltzman and William Shapiro of the New York University Cochlear Implant Center for facilitating the study and to the clinicians who helped recruit participants. Finally, we thank the children (and their parents) for participating in the study.

Etymotic Research provided ER-6i earphones and eartips for testing the children with normal hearing. The

Cochlear Corporation provided TV/hi-ficables for the study.

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Editor: Sid Bacon
Associate Editor: Emily Tobey
Received March 7, 2011
Accepted August 15, 2011
DOI: 10.1044/1092-4388(2011/11-0058)

Company / organization: Name: American National Standards Institute; NAICS: 813990;

Publication date: Apr 2012

Year: 2012

Plugged in for Sound: Cochlear Implants Today

Author: Ingrao, Brad

Publication info: Hearing Loss Magazine 33.2 (Mar/Apr 2012): 16-19.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: Headnote

You might think this kind of technology could have been around only a few years, but people have been investigating electrical stimulation of hearing for centuries. Find out more about cochlear implants and if they are right for you.

Hearing assistive technology for people with hearing loss falls into two basic categories: amplification and artificial hearing. Amplification adds intensity to incoming sound to overcome sensory or mechanical loss, but still relies on the natural hearing mechanisms to convert that sound energy to nerve impulses the brain can

interpret as meaningful sound.

When the severity of sensorineural hearing loss reaches a point where this is no longer feasible, natural hearing must be bypassed. A cochlear implant (CI) is an option for many people who are "beyond hearing aids."

Cochlear Implants 101

A cochlear implant is a device that converts sound into small electric pulses that the brain learns to interpret as speech, music and environmental sounds. While each product is slightly different in design, essentially they all work as follows:

Sound is picked up by a microphone mounted at or near the ear. The microphone converts the sound into a digital version; much like is done with current hearing aids. That digital "picture" of the sound is then sent to the speech processor. This small computer, either worn behind the ear or on the belt or collar, converts the digital sound picture into a set of instructions called a "map."

From the speech processor, the map is sent via a short cable to the external transmitter which is held in place by a magnet. The transmitter sends the map through the skin via radio waves to the internal receiver). This then decodes the map into a series of electrical pulses which travel down the electrode array to stimulate different areas of the cochlea.

After training, which may take months to years, the brain assigns meaning to these pulses and interprets them as sound.

Several factors affect how well someone will hear with a CI including how long their hearing has been impaired, the specific cause of the hearing loss, the specific anatomy of their cochleae and the availability and quality of aural habilitation services after implantation.

A Very Brief History of Cochlear Implants

In the late 18th century, Alessandro Volta connected a gang of batteries adding up to about 50 volts to two probes which he stuck inside his ears. He sensed a loud boom, followed by what he described as the sound of thick soup boiling. Not a good idea, but it was the beginning of our understanding that the brain could interpret external electrical stimulation as sound.

Several attempts were made throughout the next centuries, but it wasn't until the 1960s that we had anything close to clinical applications in humans.

In 1972, the House Ear Institute 3M single channel electrode and external speech processor was made commercially available and the race was on. Since then, rapid and significant advancements have been made in electronic hearing in people with severe to profound sensorineural hearing loss.

A Few Highlights

1981 Cochlear Corporation founded in Australia

1984 The U.S. FDA approves the House Ear Institute 3M Single Channel Cochlear Implant Clarke, et al., releases the Nucleus Multi-Channel Cochlear Implant in Australia

1985 FDA approves Cochlear's Nucleus Multi-Channel Cochlear Implant

1991 Med-El BTE processor released in Europe

1993 Advanced Bionics founded

1996 Advanced Bionics Clarion approved by FDA

1998 Cochlear ESPrit 3G BTE processor introduced

Early

2000s Contoured electrodes, improved BTE processors, T-Mic, ongoing improved connectivity and usability with telecoils, FMs, remote controls

Process, Not Products

The CI market and product offerings continue to evolve at a rapid pace. Rather than try to name anything that is "new" now, but might be "old" in a few months, let's spend some time on the process of obtaining a CI. Since the majority of Hearing Loss Magazine readers are adults, I'm going to focus on adult CI recipients. Those

looking for information on CIs for kids, should contact the manufacturers listed at the end of this article, or their audiologist.

Candidacy

Technically, each new product approved by the FDA has its own specific candidacy, but in general, the criteria for adults are as follows:

* Moderate-to-profound sensorineural hearing loss in both ears
* Pre-operative HINT sentences recognition scores of 50 percent or less in the ear to be implanted and 60 percent or less in the opposite ear or binaurally
* Pre-linguistic or post-linguistic onset of severe-to-profound hearing loss
* No medical contraindications
* A desire to be part of the hearing world

Level of Hearing Loss

It is important to note that candidacy has recently opened up to include people with less hearing loss at the time of implantation. This is due to improvements in not only the implants themselves, but also in surgical techniques. If you investigated CIs even a few years ago and were told your hearing was "not bad enough yet" you may want to revisit them.

Speech Testing Scores

Depending on factors such as specific model and preferences of the evaluation team, the specific speech tests might vary. The important point is that it must be demonstrated that your ability to understand speech at amplified levels is poorer than average for people with your level of hearing loss. The HINT mentioned above is the Hearing In Noise Test. This test measures how well you understand speech in sentence form in quiet and with different amounts of noise. Cochlear implant research has shown that for the most part, those with HINT scores worse than these demonstrate significant improvement with cochlear implantation.

Pre-linguistic or post-linguistic onset of hearing loss - Back in the old days candidacy was reserved for those who lost their hearing after learning language. Again, improvements in products and more importantly, a better understanding of how folks born deaf will do allowed the FDA to authorize CIs for people meeting other criteria regardless of when they lost their hearing. Of course, they still need to have realistic expectations. We'll get to those shortly.

No medical contraindications - Since the cochlear implant's electrode array needs to slide inside the inner ear's snail-shaped cochlea, the physical structure of this organ is important. Some congenital disorders that cause hearing loss also deform the cochlea and make inserting the electrode array difficult or impossible. Disease processes like meningitis can cause bone to fill the cochlea. While neither of these is insurmountable, having atypical cochlear anatomy affects how well the electrode array sits near the hearing nerve, and therefore how well you'll hear after implantation. As part of the pre-implant evaluation, CT scans are done of both cochleae to assist in ruling out these issues.

Realistic Expectations

While not always listed as specific implantation criteria, these are critical. As with any other medical intervention, the results of cochlear implantation vary from complete failure to pretty amazing. The bulk of people fall in the middle, but the popular press tends only to report the "miracles." While the folks we see on TV and in the news "heard instantly" or could listen on the phone in a few weeks, for most people, hearing electronically takes months or years. The mapping process makes it possible for most people to hear quiet sounds as well as a person with a slight to mild hearing loss, however, since the CI uses microphones, there will still be limitations. Speech understanding in noise will be limited by room acoustics and signalto-noise ratio just like hearing aids. It is entirely appropriate for a CI recipient to expect to hear and understand the TV, small group conversations, music and the sounds of nature with their CI alone. It is not, however, probable that they will hear optimally in large rooms, noisy restaurants or theaters without the use of some kind of Hearing Assistive Technology (HAT).

The best advice I've heard when it comes to CIs and expectations is from a friend who has bilateral implants which she received many years apart: Low expectations, high hopes.

A Desire to Be Part of the Hearing World

This is tied to realistic expectations. If a person grows up using sign language and hearing aids, but desires more access to environmental sounds and music, they might find a cochlear implant desirable. Because they are not using their hearing for their primary communication input system, they will likely derive less "benefit" than someone who primarily uses their hearing and speech to communicate. This does not preclude them from getting implanted, but the CI team should counsel them to have different expectations than someone who has used hearing and speech all their lives, despite hearing loss.

Learning to Hear Again

When you got your first hearing aid(s), you had to reacquaint yourself with the sounds of the world. Remember the first time you flushed the toilet? YEOWZA! After getting hearing aids, it is recommended that you have a few weeks or so of auditory REhabilitation. (Learning to re-awaken the parts of your brain now connected to amplified and filtered sound traveling through your not-so-perfect hearing system.)

With cochlear implants, your brain is learning to make sense of electrical pulses in the place of sound for the first time ever. We call this auditory HABilitation. Fundamentally it is similar to auditory rehabilitation, but because we are building a new foundation rather than shoring up an old one, it takes a bit longer.

Unfortunately, as with hearing aids, the habilitation piece of adult cochlear implantation is highly variable from person to person. Some folks get some advice and instructions for self-paced home-based training. For some, this means listening to familiar unabridged recorded books along with the text, then gradually relying less on the text. Some CI manufacturers offer computerbased at-home programs. Depending on your insurance coverage and location, formalized group and individual aural habilitation classes are available. Which technique is "best" for you depends on many factors, but considering the significant emotional, time and financial commitment involved in cochlear implantation, it well behooves you to do more than just go home and start hearing.

Getting a CI

If you feel you have reached the end of the road with hearing aids, ask your hearing health care professional to refer you for an evaluation. If they aren't aware of a CI center near you, visit the websites listed on page 19 of this article. In addition to a physician and center locator, they all have very good information for prospective implant recipients. As you narrow your search, be aware that some surgeons and centers only offer certain products. If there are specific features you need in a different product, discuss this with the center, or consider another center that offers the brand with features you want and feel you need.

Once you decide on a center, you'll have a CI evaluation which includes several specialized hearing tests, a medical and surgical consult and probably a CT scan. The center and CI manufacturer will work with your insurance to assist with funding and let you know what your co-pay or cost share is.

An important part of this process is to communicate with as many recipients as possible. Each manufacturer has support networks, but there are also independent listservs and online communities including HLAA's own www.myhearingloss.org. The advantage of these is that you hear about the entire range of products and experiences out there.

Surgery and Recovery

Once you select a surgeon and center, and have been cleared for a CI, you'll have surgery. CI surgery today is much less invasive than in years past. Most people can have their surgery as an outpatient procedure. A short time after surgery, your wound will be checked by the surgeon, and then you'll wait three to four weeks before your CI is activated.

Activation

During activation, the audiologist will test the electrode array's ability to carry current (impedance) and then find the lowest amount of current needed for you to sense sound at each electrode (threshold). They'll also measure

how much current you can tolerate (tolerance). This creates your first map. The map then assigns sounds reaching the microphone at between 25 and 30 dB to your threshold. This means that any sounds in the environment hitting the microphone at 25 dB will be just barely audible. Also included in the map are a few other settings related to how the speech processor codes information (called a strategy). Finally, since your brain will be acclimating to new sounds and "wanting more," the audiologist will usually make two or three additional programs with increasing amounts of "hearing" for you to work through until your next mapping. It is not uncommon for people to have two days of mapping sessions at activation, and then wait a month for the next mapping.

Follow-up Mapping

After a month or so, you'll return for more impedance, threshold and tolerance testing. Typically the difference between threshold and tolerance (dynamic range) has increased, allowing the audiologist to map access to more sound. Often this will be the first post-implant hearing test as well. Ideally, you will have already begun some type of auditory habilitation and have gotten plugged into some kind of support system.

After this appointment, you'll generally be seen every six months for a year, then annually after that unless problems occur.

One or Two?

Initially, CIs were only prescribed in one ear. Data collected over the past several years has shown that two devices really are better than one, even if you have severe to profound hearing loss. For some, this means one CI and one hearing aid (bimodal). For an increasing number of people, this means a second CI (bilateral). Discuss the relative merits of bilateral implants with your CI center, including whether you want them both at the same time (simultaneous) or one at a time (sequential). For many the deciding factor is insurance coverage, but again, each manufacturer has a department specifically tasked with helping people with finding funding or reimbursement; so be sure to ask and investigate.

Ongoing Maintenance

Like any other electronic device, CIs need maintenance. The internal components should be trouble-free for many, many years; however the external parts will need to be replaced and cared for. The speech processors should be stored in a dehumidifier like the Dry &Store®. Wires from the processor to the external transmitter need to be checked. Savvy recipients will have a spare set of wires, and magnets at home since Murphy's Law applies here as well, and most CI centers are closed when you most need that wire! Let's not forget the batteries. Speech processors use either stacks of 675 button cells or proprietary lithium-ion rechargeable batteries. Having spare sets on hand is critical if you need to hear for long days.

Wrapping Up

If your hearing loss has pushed your hearing aids to their limit, the good news is that cochlear implants are better than they have ever been. The internal components used today are designed to be compatible with future speech processors, and surgical techniques are making the process of hearing electronically easier than ever. While very remarkable, CIs are still electronics with microphones and have limitations. Combining CIs with Hearing Assistive Technology like audio loops, infrareds and FMs can now allow those with even profound losses to rejoin the hearing world.

Finally, there are tremendous resources at your fingertips for support, encouragement and education through HLAA, the manufacturers and independent listservs.

So plug in, tune up and party on!

Sidebar

If your hearing loss has pushed your hearing aids to their limit, the good news is that cochlear implants are better than they have ever been. The internal components used today are designed to be compatible with future speech processors, and surgical techniques are making the process of hearing electronically easier than ever.

Sidebar

Current CI Manufacturers in the U.S. (alphabetically)
Advanced Bionics: www.advancedbionics.com
Cochlear Americas: www.cochlearamericas.com
Med-El: www.medel.com
Exploring a Cochlear Implant
Learn about cochlear implants and if they are for you. Order or download the PDF of this guide on www.hearingloss.org. Click on the "Support" tab and then "Order Materials."

Sidebar

This article was developed under a grant from the Department of Education, NIDRR grant number H133EO80006. However, the contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the federal government.

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Publication date: Mar/Apr 2012

Year: 2012

Selective Auditory Attention in Adults: Effects of Rhythmic Structure of the Competing Language

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 89-104.
ProQuest document link

Abstract: The authors assessed adult selective auditory attention to determine effects of (a) differences between the vocal/speaking characteristics of different mixed-gender pairs of masking talkers and (b) the rhythmic structure of the language of the competing speech. Reception thresholds for English sentences were measured for 50 monolingual English-speaking adults in conditions with 2-talker (male-female) competing speech spoken in a stress-based (English, German), syllable-based (Spanish, French), or mora-based (Japanese) language. Two different masking signals were created for each language (i.e., 2 different 2-talker pairs). All subjects were tested in 10 competing conditions (2 conditions for each of the 5 languages). A significant difference was noted between the 2 masking signals within each language. Across languages, significantly greater listening difficulty was observed in conditions where competing speech was spoken in English, German, or Japanese, as compared with Spanish or French. Results suggest that (a) for a particular language, masking effectiveness can vary between different male-female 2-talker maskers and (b) for stress-based vs. syllable-based languages, competing speech is more difficult to ignore when spoken in a language from the native rhythmic class as compared with a nonnative rhythmic class, regardless of whether the language is familiar or unfamiliar to the listener.

Full text: Headnote

Purpose: The authors assessed adult selective auditory attention to determine effects of (a) differences between the vocal/speaking characteristics of different mixed-gender pairs of masking talkers and (b) the rhythmic structure of the language of the competing speech.

Method: Reception thresholds for English sentences were measured for 50 monolingual English-speaking adults in conditions with 2-talker (male-female) competing speech spoken in a stress-based (English, German), syllable-based (Spanish, French), or mora-based (Japanese) language. Two different masking signals were created for each language (i.e., 2 different 2-talker pairs). All subjects were tested in 10 competing conditions (2 conditions for each of the 5 languages).

Results: A significant difference was noted between the 2 masking signals within each language. Across languages, significantly greater listening difficulty was observed in conditions where competing speech was spoken in English, German, or Japanese, as compared with Spanish or French.

Conclusions: Results suggest that (a) for a particular language, masking effectiveness can vary between different male-female 2-talker maskers and (b) for stress-based vs. syllable-based languages, competing speech is more difficult to ignore when spoken in a language from the native rhythmic class as compared with a nonnative rhythmic class, regardless of whether the language is familiar or unfamiliar to the listener.

Key Words: selective auditory attention, competing speech, language rhythm

On a daily basis, humans are faced with the challenge of listening to speech in environments where other sounds are present. These competing sounds may include nonspeech noises and/or speech from other talkers. To accurately perceive speech in competing conditions, listeners must have adequate selective auditory attention skills so that they can select and attend to the relevant speech information (i.e., the target signal) while simultaneously ignoring any irrelevant auditory stimuli in the environment (i.e., the masking or competing signals; Medwetsky, 2002). Without these skills, listeners would be unable to function effectively in the complex acoustical conditions often present in home, work, school, and social environments.

Nonlinguistic Characteristics of Competing Speech Signals

Previous studies have shown that selective attention in competing speech conditions is affected by nonlinguistic factors, such as differences among the spatial location (e.g., Freyman, Balakrishnan, &Helfer, 2004), intensity (e.g., Cooke, Garcia Lecumberri, &Barker, 2008), number (e.g., Simpson &Cooke, 2005), gender (e.g., Brungart, 2001), and vocal /speaking characteristics (e.g., Freyman, Helfer, &Balakrishnan, 2007) of the target and masking talkers. However, isolating the individual effects of these factors is difficult because it has been shown that each nonlinguistic characteristic of a masking speech signal interacts with other nonlinguistic characteristics. For example, the effect of signalto- noise ratio (SNR) can vary depending on the gender of talkers in the primary and competing signal (e.g., Brungart, 2001; Brungart, Simpson, Ericson, &Scott, 2001). Despite these complex interactions, a common finding across most studies is that the degree of interference (i.e., masking effectiveness) provided by a competing speech signal declines and selective auditory attention performance improves as differences increase among the nonlinguistic characteristics of the target and masking speech signals. Presumably, this pattern occurs because differences among the spatial location, intensity, number, gender, and/or vocal/speaking characteristics of the target and masking talker(s) provide cues that help the listener separate the signals and selectively attend to only the target speech.

Linguistic Characteristics of Competing Speech Signals

In addition to nonlinguistic cues, listeners also may rely on differences among linguistic characteristics of the target and masking speech in order to selectively attend to a target speech signal in the presence of one or more masking speech signals. The majority of studies in this area have investigated effects of the semantic content (i.e., meaning) of masking speech using different forms of speech spoken in the listeners' native language, including meaningful forward sentences, nonmeaningful forward sentences, and reversed sentences (e.g., Chermak, 1975; Freyman et al., 2001). However, results of these studies failed to reveal a consistent

pattern regarding effects of the semantic content of masking speech signals. For example, Chermak (1975) found that adults experienced significantly greater difficulty ignoring masking speech that consisted of nonmeaningful/ grammatically correct sentences, as compared with sentences that were meaningful/grammatically correct or nonmeaningful/ungrammatical. Alone, these results appear to indicate that nonmeaningful speech is a more effective masking signal than meaningful speech. However, in contrast to this pattern, other studies have shown that sentences that are reversed (and, therefore, devoid of meaning) are easier for listeners to ignore than are forward, meaningful sentences (e.g., Freyman et al., 2001; Rhebergen, Versfeld, &Dreschler, 2005; Sperry, Wiley, &Chial, 1997). Adding to the inconsistency among findings in this area, results of other studies have revealed no significant differences between listeners' abilities to ignore masking speech consisting of meaningful forward speech, nonmeaningful forward speech, and/or reversed speech (e.g., Chermak, Vonhof, &Bendel, 1989; Johnstone &Litovsky, 2006). As such, many questions remain unanswered at this time regarding whether the linguistic characteristics of competing speech, including the semantic content of the signal(s), may influence listeners' selective auditory attention.

Given the inconsistencies between results obtained using different types of native language masking speech, a small number of studies have compared listeners' performance in conditions where competing speech is spoken in the native language versus an unfamiliar language. Speech in an unfamiliar language offers the advantage of having a more similar basic time envelope (i.e., rapid onsets and slow offsets) to the native language as compared with reversed speech (i.e., slow onsets and rapid offsets; Rhebergen et al., 2005). In addition, speech that is uttered in an unfamiliar language has no semantic content at the sentence or word level, unlike nonmeaningful, forward sentences in the native language, where individual words still carry meaning. Because of these characteristics, competing speech in an unfamiliar language may provide a better control condition than nonmeaningful forward or reversed native language sentences when testing effects of the semantic content of masking speech. Furthermore, comparison of results obtained when competing speech is spoken in different languages may reveal linguistic characteristics other than meaning that can influence the masking effectiveness of competing speech signals.

The small number of previous studies that used competing speech in an unfamiliar language can be divided into two groups based on the reported pattern of results. For example, Garcia Lecumberri and Cooke (2006) and Van Engen and Bradlow (2007) each found that listeners experienced greater difficulty selectively attending when the competing speech was spoken in the native language than when competing speech was spoken in an unfamiliar language. Together with evidence from the majority of studies that used reversed masking speech, findings from these two studies suggest that semantic content of the masking speech signal significantly affects selective auditory attention such that meaningful competing speech is more difficult to ignore than competing speech that lacks meaning. However, this explanation may be overly simplistic, given that two additional studies reported no significant differences between listeners' abilities to recognize a target speech signal when masking speech was spoken in the listeners' native language versus when it was spoken in an unfamiliar language (Freyman et al., 2001; Tun, O'Kane, &Wingfield, 2002).

The inconsistency between these two sets of results suggests that the masking effectiveness of a competing speech signal may be influenced by linguistic characteristics other than meaning. For example, languages vary in the degree to which they either share similarities or differ in areas such as lexical roots, consonant inventory, vowel inventory, syllable structure, stress patterns, and rhythmic structure (McLeod, 2007). Similarities among linguistic factors such as thesemay explain why Freyman et al. (2001) and Tun et al. (2002) each found no significant differences between monolingual listeners' abilities to recognize target speech in conditions where the masking speech was spoken in English (the native language) versus Dutch (an unfamiliar language). Previous research indicates that English and Dutch share linguistic characteristics, including use of variable stress patterns, Germanic lexical roots, a similar number of vowels, and a stress-based rhythmic structure (Sebastián-Gallés, Dupoux, Costa, &Mehler, 2000). As such, similarities between linguistic properties of English

and Dutch may have caused listeners in the studies by Freyman et al. (2001) and Tun et al. (2002) to experience an equal level of difficulty in separating target English speech from the masking speech signal, regardless of the language in which the masking speech was spoken.

In contrast, differences between linguistic characteristics of languagesmay explainwhy the studies byGarcia Lecumberri andCooke (2006) andVan Engen and Bradlow (2007) both found that monolingual English-speaking listeners experienced greater difficulty ignoring competing speech spoken in their native language (i.e., English) as compared with competing speech spoken in an unfamiliar language (i.e., Spanish in one study and Mandarin Chinese in the other). In both studies, the unfamiliar language differed considerably from the listeners' native language in areas such as lexical roots, number of vowels, and rhythmic structure of the language. Such differences may have made it easier for listeners to separate the target native language speech (i.e., English) from competing speech spoken in the unfamiliar language. However, when the target and competing speech signals were both spoken in English, overlap among linguistic characteristics of each signal may have increased the relative difficulty of the task.

Native Language Rhythmic Structure and Speech Processing

Overall, the previously described results suggest that the difficulty of a selective auditory attention task increases as nonlinguistic and/or linguistic similarities increase between the target and masking speech signals (e.g., Brungart, 2001; Freyman et al., 2004; Garcia Lecumberri &Cooke, 2006). Together, studies of this nature assist in answering the question of how characteristics of competing speech signals influence selective auditory attention. However, the ability to process a target speech signal in competing speech conditions may be also be affected by the listener's language background. One question of particular interest relates to how selective auditory attention in competing speech conditions may be affected by the rhythmic structure of the listener's native language.

With respect to spoken language, rhythm is a term used to refer to "the regularities which govern the grouping of elements in a language's phonological structure" (Murty, Otake, &Cutler, 2007, p. 78). Early researchers proposed that all languages could be classified into three rhythmic classes: stress-based, syllable-based, and mora-based. Languages such as English, Dutch, German, and Russian were classified as stress-based languages, whereas Spanish, French, and Italian were considered syllable-based languages (Abercrombie, 1967; Pike, 1945; both as cited in Nazzi, Jusczyk, &Johnson, 2000). Japanese, on the other hand, was considered to be the only member of the mora-based rhythmic category.

Studies comparing acoustic-phonetic characteristics of different languages provide evidence that at least some languages have rhythmic properties consistent with these three classes. For example, Ramus, Nespor, and Mehler (1999) analyzed speech samples from native speakers of eight languages (i.e., English, Polish, Dutch, French, Spanish, Italian, Catalan, and Japanese) and found that languages typically classified as belonging to different rhythmic classes differed significantly on two measures: the percentage of total sentence duration that involved vocalic intervals and the SD of duration measured for intervals of consonants/ clusters of consonants. No significant differences were seen between results for languages typically classified as belonging to the same rhythmic category. In a similar study, Grabe and Low (2002) measured the duration of vocalic intervals and intervocalic intervals for 18 languages. Results supported the classification of German, English, and Dutch into one rhythmic category (i.e., stress-based) and the classification of French and Spanish into a separate rhythmic category (i.e., syllablebased). However, results of the study failed to support the contention that Japanese has its own unique rhythmic structure, separate from that of stress-based and syllable-based languages. Results for the other 12 languages also failed to neatly align with one rhythmic category, suggesting that languages may vary in the degree to which they exhibit classic stress-based or syllablebased rhythm.

Despite questions as towhether all languages fall into three proposed rhythmic categories, existing acoustic-phonetic evidence indicates that at least some languages have rhythmic properties consistent with specific classes (e.g., English, German, Spanish, French). Evidence from behavioral studies suggests that as early as

infancy, listeners are able to detect rhythmic differences between languages (e.g., Grabe&Low, 2002; Nazzi, Bertoncini,& Mehler, 1998; Ramus et al., 1999), and it has been shown that these sensitivities to language rhythm play a critical role in how listeners process speech in quiet listening conditions. Specifically, studies of infants and adults indicate that native listeners of languages from the same rhythmic class tend to process speech in similar ways, whereas native listeners of languages from different rhythmic classes generally use different types of speech processing strategies (e.g., Cutler, Mehler, Norris, &Segui, 1983, 1986;Cutler&Otake, 1994;Houston, Jusczyk, Kuijpers, Coolen, &Cutler, 2000; Vroomen, van Zon, &de Gelder, 1996). These findings suggest that the rhythmic structure of the native language serves as a type of filter through which listeners process all incoming speech signals, regardless of the language in which the speech input is spoken (Sebastián-Gallés et al., 2000).

Goals

Overall, results from previous studies of selective auditory attention suggest that a competing speech signal provides a greater degree of masking as similarities increase between characteristics of the target and competing speech signals (e.g., Brungart, 2001; Freyman et al., 2004; Garcia Lecumberri &Cooke, 2006). Few studies have investigated how selective auditory attention performance is affected by (a) differences among vocal /speaking characteristics of masking talkers (i.e., variability between maskers within a language) and (b) the language in which the competing speech is spoken (i.e., variability across languages). A question of interest relates to whether-and how-the rhythmic structure of the language of a competing speech signal may affect a listener's ability to selectively attend to and process a target speech signal. In an attempt to answer this question, we compared monolingual Englishspeaking adult listeners' abilities to selectively attend to meaningful English sentences in conditions where competing speech was spoken in a stress-based language (English or German), a syllable-based language (Spanish or French), or a mora-based language (Japanese). The primary goals of the study were to determine how monolingual adult listeners' selective auditory attention performance was affected by (a) the semantic content (i.e., meaning) of the competing speech, (b) the rhythmic structure of the language in which the competing speech was spoken, and (c) the individual dif ferences between the vocal /speaking characteristics of different pairs of masking talkers of the same language.

Method

Subjects

All subjects underwent a hearing screening, completed a questionnaire, and were tested in each of the 11 conditions described in the following sections. All research procedures were approved by an institutional review board. Results from 50 monolingual Englishspeaking women were analyzed. Subjects ranged from 20 to 44 years of age, with a mean age of 23.72 years. All subjects were recruited for participation using direct person-to-person solicitation and posted notices of solicitation. To participate, each subject was required to meet each of the following criteria: (a) be 18-55 years of age; (b) have English as his or her first language, with little to no familiarity with any languages other than English; (c) be at least a high school graduate; (d) have no history of a diagnosed permanent hearing loss, auditory processing disorder, language disorder, learning disability, and/or dyslexia; and (e) pass a hearing screening at 15 dBHLin each ear at 250-8000 Hz (measured through TDH 50P Telephonics headphones or E-A-R Tone 3A insert earphones).

Results from four subjects were excluded, including three subjects who were unable to complete the testing during a single session due to scheduling conflicts and one subject who failed to comply with the test protocol (i.e., was text messaging during testing). Results from the remaining 50 subjects were included in the data analysis. Previous studies investigating monolingual adult listeners' selective auditory attention abilities included sample sizes ranging from eight subjects (Rhebergen et al., 2005) to 66 subjects (Van Engen &Bradlow, 2007). Therefore, the current study's sample size of 50 approximates the maximum number of subjects included in previous studies in this area.

Questionnaire

After signing an informed consent form, each subject was required to complete a brief questionnaire prior to any testing. The questionnaire addressed topics such as the subject's age, educational degree(s), exposure to/experience with languages other than English, and history of disorders that might affect his or her speech recognition performance.With regard to language experience, subjects were asked to (a) list any languages other than English that they could speak and/or understand and (b) specify when/where these non-English languages were learned. If an individual had experiencewith another language, he or she was then asked to respond to two rating questions/statements included on the questionnaire.

Both rating questions were adapted from the Minnesota Modified Student Oral Language Observation Matrix (MN-SOLOM; Minnesota State Department of Education [MSDE], 2003, as cited in MSDE, n.d.), which is an adaptation of the Student Oral Language Observation Matrix (SOLOM; Ortiz, 1995, as cited in von Hapsburg &Peña, 2002). The SOLOM and MN-SOLOM are informal rating scales designed to allow teachers to evaluate English oral language proficiency among students for whom English is a second language. Although not a standardized measure, the SOLOMhas beenwidely used in California andMinnesota to supplement information gained through standardized tests of language proficiency (MSDE, n.d.).

We used responses to the two rating questions to determine whether the subject met the inclusion criterion of "little to no familiarity with any languages other than English." The subjects rated their familiarity in speaking and understanding languages other than English on a five-point scale. Only native English speakers who scored a 1 or a 2 on both rating questions were included in the study. This included speakers who, at most, spoke in one- to two-word phrases in another language and, at most, understood another language if it was spoken slowly and with "frequent repetitions and rephrasing" (MSDE, n.d., p. 131). This criterion helped ensure that monolingual English-speaking adults participating in the study would be able to understand competing speech spoken only in English and not in the other four languages (i.e., German, Spanish, French, and Japanese). In addition to language experience, the questionnaire also addressed whether the subject had ever been diagnosed with a permanent hearing loss, auditory processing disorder, language disorder, learning disability, and/or dyslexia.

Test Stimuli

Target sentences. Subjects who met all inclusion criteria were tested using 22 test lists in 11 conditions. The target speech signal consisted of sentences from the original version of the Hearing in Noise Test (HINT; Nilsson, Soli, &Sullivan, 1994). The HINT consists of 250 different meaningful English sentences spoken by the same male talker. The sentences are divided into 25 lists of 10 sentences, with all lists reportedly equated for "naturalness, length, and intelligibility" (Nilsson et al., 1994, p. 1095). The HINT was specifically developed for adaptive sentence speech reception threshold (sSRT) measurement, the assessment technique used in each condition of the current study. Adaptive sSRT procedures are used to determine the lowest intensity at which a listener can correctly recognize sentences approximately 50% of the time. Similar to other speech recognition tests, adaptive sSRT measurement can be performed in quiet or in background noise. However, the sSRT is not limited by the floor and/or ceiling effects that can occur when speech recognition testing is administered at a single intensity. On the HINT, researchers have found that 1-dB changes in sSRT values correspond to an 8.94% change in intelligibility (Nilsson, McCaw, &Soli, 1996).

Although data from development of the HINT revealed no significant differences among listeners' performance on the 25 lists, the mean for List 4 was the only list mean that was not within 1 dB of the overall mean (Nilsson et al., 1994). On the basis of these findings, List 4 was excluded from use in the current study. In addition, test development data indicated that use of two HINT lists for each sSRT measurement provided the best balance between test sensitivity and efficiency. Therefore, in the current study, results for two 10-sentence HINT lists were averaged for the quiet condition and for each of the 10 types of competing conditions (i.e., Masker A and Masker B conditions for each of the five languages).

We used Cool Edit Pro Version 2 audio editing software to adapt the original HINTrecordings. The original HINT

recordings were of a male speaker sampled at 20161 Hz (Nilsson et al., 1994). We first edited each list to remove the speech noise saved to the second channel of the original HINT list recordings. We then saved the recording of each HINT list in quiet (i.e., without speech noise) to a Dell Optiplex 745 desktop computer as a one-channel *.wav file. On the basis of pilot data, we used Cool Edit Pro Version 2 to insert a 20-s segment of silence at the beginning of each HINT list and between each sentence in the list to allow time for subjects' responses during testing. The recording of each edited HINT list was normalized to 96% of peak value using Cool Edit Pro Version 2 to ensure that all lists had the same overall root-mean-square (RMS) values.

Competing speech. Subjects' selective auditory attention performance was evaluated in conditions where competing speech was spoken in one of five languages, including English, German, Spanish, French, and Japanese. In each competing test condition, the masking signal consisted of speech from one male and one female native speaker of the masking language assigned to that condition. To more closely approximate real-world listening environments, all masking signals consisted of natural, continuous speech, as opposed to the lists of unrelated sentences used in many previous studies (e.g., Freyman et al., 2001; Johnstone &Litovsky, 2006; Rhebergen et al., 2005; Van Engen &Bradlow, 2007). For the current study, we created the competing speech signals using speech from adult male and female native speakers of English, German, Spanish, French, and Japanese. An individual was considered to be a "native" speaker if he or she had spoken the target language from birth.All talkers for the language recordingswere 18 years of age or older (range = 23-56 years; M = 32.45 years) and had no history of a speech or language disorder.

We made all masking speech recordings in a soundtreated booth using an Isomax headset microphone and a TASCAMDA-P1 digital audio tape (DAT) recorder. For each recording, the talker wore the headset microphone approximately 2-4 in. from his or her mouth. The investigator adjusted the recording sensitivity to be within the target range of +20 dB to +12 dB throughout each recording to compensate for any slight differences between microphone positioning for different talkers. We made all recordings using a sampling rate of 44.1 kHz. Each recording was uploaded and saved to a desktop computer as a one-channel *.wav file using Cool Edit Pro Version 2.

All text used for the recordings met the following criteria: (a) written in the native language at approximately a seventh grade reading level or higher, (b) content appropriate for child or adult listeners, (c) no dialogue among speakers, and (d) no references to well-known American proper names. For the German, French, and Japanese recordings, each talker read continuously from a different passage written in his or her native language. A direct translation of the same bilingual education textbook was used for the recordings made in English and Spanish (Freeman &Freeman, 2006, 2007). The English text was divided into four sections so that no two English masking talkers read the same text. The edited Spanish text was divided into the same four sections so that each Spanish masking talker read a different passage of text. For the recordings in all five languages, talkers were instructed to read the text as smoothly as possible, using a natural speaking rate, an even, natural intonation pattern, and minimal pausing between sentences.

Recordings of 52 native speakers were made. For each of the five languages, the two male and two female recordings that bestmet the study's criteriawere selected (i.e., a total of 20 recordings). We used an informal language questionnaire to ensure that the same general dialect was used by the four native speakers selected for each language. With assistance from a fluent speaker of the target language, we edited each selected recording using Cool Edit Pro Version 2 in order to (a) remove sentences with a marked dysfluency, with a recognizable American proper name, and with a recognizable English word in the non-English recordings and (b) select the best continuous section of the recording. As a native speaker of English, one of the investigators ensured that editing procedures did not violate boundaries of surrounding sentences within each English recording. To maintain the same control within German, Spanish, French, and Japanese recordings, we performed all editing of non-English recordings with assistance from a fluent speaker of the language being edited.

After selecting the best continuous section, we edited the 20 recordings to ensure that all pauses were approximately equivalent within and across recordings. We determined the criterion for maximum allowable pause time on the basis of evidence reported by Smith (2005) regarding typical pause durations that occur between sentences when text is read aloud. For the current study, shorter pauses between sentences were desirable so that we could ensure that target sentences were consistently masked by competing speech recordings. As such, the criterion for maximum allowable pause duration was set at 600-700 ms, based on the shorter mean pause times reported by Smith. We used Cool Edit Pro Version 2 tomeasure pauseswithin each of the 20 individual recordings. All pauses within individual masking- talker recordings that exceeded 700 ms were shortened to 600-700 ms. Each recording was then normalized to 96% of peak value to ensure that all 20 recordings had equivalent RMS values.

The normalized language recordings were used to create two different male-female babble recordings for each of the five languages. Each two-talker babble recording consisted of a different male and a different female masking talker. For each language, one male recording (Male 1) was paired with one female recording (Female 1). Using Cool Edit Pro Version 2, we digitally mixed the Male 1 and Female 1 recordings (i.e., two signals added together in one channel) to create the first two-talker babble signal for each language (i.e., English A, German A, Spanish A, French A, and Japanese A). We digitally mixed the remaining male recording (Male 2) and the remaining female recording (Female 2) for each language to create the second two-talker babble signal for each of the five languages (i.e., English B, German B, Spanish B, French B, and Japanese B). We normalized each two-talker mixed recording to 96% of peak to ensure that the overall RMS value of each mixed signal was equivalent. We then saved each normalized twotalker recording as a single-channel *.wav file. To control for potential individual variability between vocal / speaking characteristics of masking talkers, we tested each subject in the Masker A and Masker B competing conditions for each language.

Experimental Conditions

Each subject was tested twice in a quiet condition (i.e., no competing speech) and twice in each of the 10 types of competing speech conditions (i.e., one Masker A condition and one Masker B condition for each of the five languages). Therefore, testing was performed through use of 22 different tests for each subject. Each test consisted of a unique randomly assigned 10-sentence HINT recording, such that the same HINT list was always presented with the same randomly selected test for each subject. For the 20 tests administered with competing speech, we used Cool Edit Pro Version 2 to digitally mix the recording of each HINT sentence list with its randomly assigned two-talker babble recording, with the masking speech beginning 20 s before the start of the first HINT sentence and continuing uninterrupted for the duration of that list. The masking speech ended after the final word of the last HINTsentence on the list. Each mixed recording of the target and competing speech was saved as a two-channel *.wav file, with the HINT list saved to the right channel and the two-talker babble saved to the leftchannel.

For each subject, testing was performed first through the use of two quiet lists, with the order of testing for the two lists being randomly selected. We randomized the order of the 20 competing test lists using a partial counterbalancing procedure inwhich we created a different order of lists for each subject by using an online random order generator (Carter, 2008). We used iTunes Version 8.1 to create a different digital playlist for each subject. Each playlist included a 1000-Hz calibration tone lasting 15 s, the two HINT lists randomly assigned to quiet tests, and the 20 competing tests in the order randomly generated for that subject. Each playlist was saved to a Dell Latitude D810 laptop under the code name assigned to the associated subject.

Test Setup and Procedures

All subjects were tested in a sound-treated booth. Prior to initiation of the study, all audiometric equipment was calibrated to AmericanNational Standards Institute (ANSI) 2004 standards. For all testing, the subject wore TDH 50P Telephonics headphones or E-A-R Tone 3A insert earphones. Insert earphones were used unless otoscopy revealed significant cerumen in one or both ears, in which case headphones were used. Thirty-nine

subjects were tested using insert earphones, and 11 subjects were tested using headphones. All testing was administered through use of a GSI 61 two-channel audiometer and a Dell Latitude D810 laptop, with the laptop and iTunes volume controls set to the maximum settings. The same investigator administered the testing to all subjects.

Each subject was tested in a single 2-hr session that consisted of 22 sSRT tests, including two tests administered in quiet and 20 tests administered with competing speech (i.e., two tests with Masker A and two tests with Masker B for each of the five languages). The target sentences and competing speech (if applicable) were presented simultaneously to the subject's right and leftear (i.e., diotic presentation). The sSRT for each test list was determined through the use of adaptive procedures described in the HINT manual (Nilsson et al., 1996).

For all subjects, testing was performed first in quiet so that the subject could become familiar with the task. Prior to testing, each subject was given the same set of instructions. To obtain the sSRT, an adaptive procedure was used in accordance with clinical protocols for the HINT (Nilsson et al., 1996). The investigator began by presenting the first sentence of the target HINT list at -10 dB HL (i.e., a level likely to be below each subject's threshold). Using the audiometer attenuator, the investigator increased the presentation level by 4 dB until the subject repeated the first sentence with 100% accuracy. From this point on, a new sentence was presented one time at each intensity level tested. For Sentences 1-5, the presentation level was increased or decreased by 4 dB, depending on whether the sentence was repeated correctly (i.e., intensity increased following incorrect responses and decreased following correct responses). For Sentences 6-10, the presentation level was adjusted in 2-dB steps.

For the competing speech lists, the competing speech signal was presented continuously at 65 dB HL. To begin the testing, the first sentence of the target HINT list was presented at 10 dB below the noise level (i.e., at 55 dB HL). The remaining test procedures were the same as those used in quiet, with the intensity of the target sentences being increased or decreased by 4 dB (i.e., for Sentences 1-5) or 2 dB (i.e., for Sentences 6-10) on the basis of the subject's responses.

Data Analysis

Results obtained through use of the two quiet lists were not analyzed because testing in quiet was performed only to ensure that subjects could perform the sSRT task. We determined the sSRT for each HINT list by calculating the mean presentation level used for Sentences 5-11 (Nilsson et al., 1996). Although each list consisted of only 10 sentences, the presentation level that would have been used for the 11th sentence was determined on the basis of the subject's response to the 10th sentence. To increase sensitivity, testing was performed twice in each of the 10 types of competing conditions (i.e., Masker A and Masker B for each of the five languages), resulting in 20 sSRTscores for each subject (i.e., two scores for English Masker A, two scores for English Masker B, etc.). For each of the 10 types of competing conditions, we determined the mean sSRT by averaging the score obtained on the two HINT lists administered in that condition. This resulted in 10 mean sSRT scores for each subject-one for each of the 10 types of competing conditions. We analyzed these 10 mean sSRT scores across the 50 subjects to investigate potential effects of (a) variability between masking effectiveness of different two-talker maskers within each language (i.e., English Masker A vs. English Masker B, German Masker A vs. German Masker B, etc.) and (b) differences in overall masking effectiveness of competing speech spoken in the five languages (i.e., English vs. German, English vs. Spanish, etc.).

In the current study, we used a completely withinsubjects design with two independent variables (pairs of masking talkers and language of the competing speech) and one dependent variable (sSRT). The pairs of masking talkers factor consisted of 10 levels because a different male-female pair of masking talkers was used in each of the 10 competing conditions. The language factor consisted of five levels: English, German, Spanish, French, and Japanese. As such, the design of the current study did not meet the criteria for a true factorial design because the test conditions did not include "all possible combinations of the levels of the independent

variables" (Keppel &Wickens, 2004, p. 550). For example, there was no condition in which English Male 1 and English Female 1 provided the competing speech for German, Spanish, French, or Japanese conditions. Instead of a true factorial design, the current study involved a nested, within-subjects design in which each level of the pairs of masking talkers factor appeared at only one level of the language factor. For each language, one pair of masking talkers was randomly labeled "Masker A," and the other pair was randomly labeled "Masker B." As such, there was no common factor among Masking A pairs of talkers or among Masking B pairs of talkers. The pairs of masking talkers factor was simply nested within the language factor (Keppel &Wickens, 2004). Because of this nested relationship, tests of the overall relationship between Masker A and Masker B across the five languages would not provide meaningful information and, therefore, were not analyzed.

Results

All subjects were able to complete testing in quiet with no difficulties, thus indicating that they understood the sSRT task. Figure 1 displays mean sSRTs for Masker A and Masker B for each of the five languages. Figure 2 illustrates the collapsed mean sSRT obtained when subjects' scores for the Masker A and Masker B condition were averaged within each of the five languages to create one overall mean for each language. In both figures, higher mean sSRT scores indicate that the intensity of the target sentences had to be higher in order for subjects to repeat the sentences correctly. In other words, higher mean sSRTs suggest that subjects experienced greater difficulty with the task.

We performed a series of statistical analyses to investigate differences between the mean sSRT scores for Masker A and Masker B for each language and differences between subjects' performance across the five language conditions. We analyzed all data using SPSS Version 17.0 and determined statistical significance using a criterion of $p \leq .05$. A repeated-measures analysis of variance (ANOVA) was conducted, with pair of masking talkers (Masker A or Masker B) and language (English, German, Spanish, French, or Japanese) as the within-subjects factors. Because we used a completely within-subjects design (i.e., every subject was tested in every condition), a between-subjects factor was not specified. The main effect of masker, $F(1, 49) = 53.27$, $p < .001$; the main effect of language, $F(4, 196) = 61.73$, $p < .001$; and the Masker ×Language interaction effect, $F(4, 196) = 76.67$, $p < .001$, were significant.

To further investigate the significant Masker ×Language interaction effect, we performed a series of paired t tests using the Bonferroni adjustment to compare the mean sSRT for Masker A and Masker B within each language. Results revealed a significant difference between the mean scores for Masker A and Masker B for English, $t(49) = 15.59$, $p < .001$; German, $t(49) = -4.95$, $p < .001$; Spanish, $t(49) = -5.75$, $p < .001$; French, $t(49) = 10.30$, $p < .001$; and Japanese, $t(49) = 5.90$, $p < .001$. This difference was greatest when the competing speech was spoken in English, with a difference of 4.42 dB between English Masker A and English Masker B. Differences between Masker A and Masker B within the other four languages were 1.93 dB for German, 2.05 dB for Spanish, 2.73 dB for French, and 1.86 dB for Japanese. These differences suggest that for each language, individual differences between the pairs of masking talkers affected the listeners' ability to ignore the competing speech signal, despite the fact that both pairs of talkers included one male and one female native speaker of that language.

We also conducted post hoc comparisons using the Bonferroni adjustment to identify any significant differences between the overall mean (i.e., the collapsed mean for Masker A and Masker B) for each of the five languages. Results revealed no significant difference between the overall mean for the Spanish condition ($M = 56.11$, $SE = 0.20$) and the French condition ($M = 55.77$, $SE = 0.18$, $p = .773$). These results suggest that the listeners' selective auditory attention performance was essentially the same when competing speech was spoken in two unfamiliar languages belonging to the non-native syllable-based rhythmic category. In addition, no significant difference was observed between the overall mean for the English ($M = 58.30$, $SE = 0.21$) and German ($M = 57.82$, $SE = 0.20$, $p = .433$) conditions, indicating that listeners experienced the same degree of difficulty in ignoring competing speech spoken in their native language and in an unfamiliar language belonging to their

native stress-based rhythmic category. However, the overall means for the English condition and the German condition were each significantly greater than the overall means for the Spanish condition (English-Spanish, p <.001; German-Spanish, p <.001) and the French condition (English-French, p <.001; German-French, p <.001). Therefore, listeners experienced significantly greater difficulty in ignoring competing speech spoken in a language from their native rhythmic category as compared with languages from a non-native rhythmic category, regardless of whether the language of the competing speech was meaningful (as in the English condition) or not meaningful (as in the German condition).

No significant difference was seen between the overall mean for the Japanese (M = 58.31, SE = 0.20) condition and the English condition (M = 58.30, SE = 0.21, p = 1.000) or between the Japanese condition and the German condition (M = 57.82, SE = 0.20, p = .514). However, the overall mean for the Japanese condition (M = 58.31) was significantly greater than the overall means for the Spanish condition (M = 56.11, SE = 0.20, p <.001) and for the French condition (M = 55.77, SE = 0.18, p <.001). These results indicate that listeners' sSRT for competing speech spoken in Japanese was similar to the sSRT obtained when the competing speech was spoken in English or German, despite the fact that Japanese is typically classified as belonging to a rhythmic category that was unfamiliar to the listeners (i.e., mora-based).

Due to the significant differences noted between the Masker A and Masker B means for each of the five languages, a univariate ANOVA was also performed, with language as the within-subjects factor and the difference between the Masker A mean and the Masker B mean as the covariate. Results revealed a significant main effect of language, F(4, 244) = 38.47, p <.01, indicating that a significant relationship remained between the language of the competing speech and the mean sSRTscores, even when the significant differences between Masker A and Masker B were taken into account for each language.We performed post hoc comparisons using the Bonferroni adjustment to identify any significant differences between the overall mean sSRT for each of the five languages when the Masker A-Masker B difference was used as the covariate. Results revealed the same pattern of results that was seen with the repeated-measures ANOVA, including (a) no significant difference between the mean scores for the Spanish and French conditions (p = 1.00); (b) no significant difference among the mean scores for the English, German, and Japanese conditions (English-German, p = .74; English-Japanese, p = 1.00; German-Japanese, p = .86); and (c) significant differences among all other pairs of languages, including English and Spanish (p <.01), English and French (p <.01), German and Spanish (p <.01), German and French (p <.01), Japanese and Spanish (p <.01), and Japanese and French (p <.01).

Discussion

The current study provides insight into how adult selective auditory attention is affected by (a) rhythmic structure of the language of the competing speech and (b) variability among vocal /speaking characteristics of different pairs ofmasking talkers.Because three primary categories of language rhythm have been proposed, a test of the relationship between language rhythm and selective auditory attention requires comparison of listeners' speech recognition performance in conditions where competing speech is spoken in multiple languages, including languages from each proposed rhythmic class. However, prior to the current investigation, no study had investigated listeners' selective auditory attention performance in more than two language conditions.

In the current study, we addressed this gap in existing research by assessing monolingual Englishspeaking adult listeners' selective auditory attention performance in conditions where competing speech was spoken in a stress-based language (e.g., English or German), a syllable-based language (e.g., Spanish or French), or a mora-based language (e.g., Japanese; Abercrombie, 1967; Pike, 1945; both as cited in Nazzi et al., 2000). To evaluate effects of vocal/speaking characteristics of different masking talkers, we created two different two-talker competing speech signals (i.e., labeled Masker A and Masker B) for each language. Results from the competing conditions were compared to determine how monolingual adult listeners' selective auditory attention performance was affected by the (a) semantic content of the competing speech, (b) rhythmic structure of the

language in which the competing speech was spoken, and (c) individual differences between pairs of masking talkers of the same language.

Within-Language Comparisons

For each of the five languages used as competing speech, a significant difference was noted between the listeners' mean sSRT in the Masker A and Masker B conditions. In order to interpret these findings, it is important to consider the controls used to ensure that the Masker A and Masker B competing speech signals were as similar as possible. For example, all passages read for the English Masker A, English Masker B, Spanish Masker A, and Spanish Masker B recordings were taken from translations of the same bilingual education textbook, ensuring the same reading level and general topic areas. For German, French, and Japanese, the content of the text varied. However, differences between content of the competing speech were unlikely to have affected performance in the Spanish, German, French, and Japanese conditions because the current subjects were unable to understand these languages.

Other efforts were also made to equate the MaskerA and Masker B conditions for each language. First, the HINT lists used as the target speech were of equivalent difficulty based on data reported by the test developers (Nilsson et al., 1994). All HINT lists were also normalized to be the same overall RMS amplitude, along with recordings of masking talkers and all two-talker mixed recordings being equated for RMS amplitude. In addition, the 20 competing lists were administered to each subject in a different randomly selected order. As such, the order of testing for the Masker A and Masker B conditions for each language did not follow any consistent pattern across subjects.

In light of these controls, differences between the masking effectiveness of the Masker A and Masker B competing speech signals for each language were most likely related to differences between vocal and/or speaking characteristics of individual masking talkers. This finding is consistent with results reported by Freyman et al. (2007), who found differences between the masking effectiveness of five different English-speaking female two-talker maskers (i.e., a different pair of female talkers for each masking signal). However, the current study extends these findings by providing evidence that differences between vocal /speaking characteristics of masking talkers may significantly affect selective auditory attention, even when the competing speech is not meaningful at the sentence or the word level, as was the case in the German, Spanish, French, and Japanese conditions. Individual masking talkers may vary in areas such as their fundamental frequency, vocal quality, prosody, and speaking rate (Freyman et al., 2007), but additional research is needed to specifically investigate the extent to which each of these factors may affect listeners' abilities to separate a target speech signal from competing speech spoken by one or more masking talkers.

Between-Language Comparisons

Comparison among results obtained in each of the five language conditions revealed a number of interesting findings. For example, English competing speech was only significantly more difficult for listeners to ignore than competing speech spoken in Spanish or French, two languages in which the words and underlying rhythm (i.e., syllable-based) were unfamiliar to the listeners. In contrast, no significant differences were seen among listeners' performance in conditions where the competing speech was spoken in English, German, or Japanese, despite the fact that listeners could not understand the German or Japanese competing speech. These results indicate that meaning alone does not determine the masking effectiveness of a competing speech signal. Such findings are consistent with results from previous studies which have shown that at least in some conditions, competing speech spoken in the native language is not significantly more difficult to ignore than competing speech spoken in an unfamiliar language (Freyman et al., 2001; Tun et al., 2002). Together, these findings support the conclusion that linguistic factors other than meaning can influence the masking effectiveness of competing speech.

Evidence from the current study also suggests that adult selective auditory attention performance may be affected by the rhythm of the language in which the competing speech is spoken. The possible influence of

language rhythm is first illustrated by the fact that no significant difference was seen among listeners' performance in conditions where the competing speech was spoken in languages from the same rhythmic category. For example, listeners experienced the same level of difficulty when the competing speech was spoken in English or German, two languages belonging to the listeners' native stress-based rhythmic category. Similarly, no significant difference was seen between listeners' performance in conditions where competing speech was spoken in Spanish or French, two unfamiliar languages belonging to the non-native syllable-based rhythmic category. These findings are consistent with results from two previous studies that compared selective auditory attention performance in conditions where competing speech was spoken in the listeners' native language and one unfamiliar language from the native rhythmic class (Freyman et al., 2001; Tun et al., 2002). In both studies, no significant differences were seen between listeners' abilities to recognize a target speech signal when the competing speech was spoken in English, the native language, versus Dutch, an unfamiliar language belonging to the native stress-based rhythmic class.

Collectively, the results of these two studies (Freyman et al., 2001; Tun et al., 2002) and those of the current study suggest that listeners may be sensitive to the underlying rhythm of the language of the competing speech, such that languages within the native rhythmic category provide the same degree of masking effectiveness, regardless of whether the competing language is meaningful to the listeners. However, unlike the studies by Freyman et al. (2001) and Tun et al. (2002), the current study also compared listeners' selective auditory attention performance between two conditions where the competing speech was spoken in two unfamiliar languages belonging to the same non-native rhythmic category (i.e., syllable-based). As such, languages within a particular rhythmic category provide the same degree of masking effectiveness, regardless of whether the two languages are from the native category (i.e., English and German) or the same non-native category (i.e., Spanish and French).

In addition to these findings, results of the current study also suggest that competing speech spoken in a language from the listeners' native rhythmic category is more difficult for listeners to ignore than competing speech spoken in a language from a non-native rhythmic category, at least for some languages. For example, listeners experienced significantly greater difficulty in selectively attending to the target speech when the competing speech was spoken in English or German, two languages from the native stress-based rhythmic category, than when the competing speech was spoken in Spanish or French, two languages from the non-native syllable-based rhythmic category. These findings are consistent with two previous studies which found that competing speech spoken in the native language was more difficult for listeners to ignore than competing speech spoken in an unfamiliar language from a nonnative rhythmic category (Garcia Lecumberri &Cooke, 2006; Van Engen &Bradlow, 2007). However, in the current study, we extend these findings by providing evidence that speech in an unfamiliar language from the native rhythmic category (i.e., German) is also significantly more difficult for listeners to ignore than an unfamiliar language from a non-native rhythmic category (i.e., Spanish and French).

Another finding of the current study was that listeners did not treat competing speech spoken in Japanese the same as competing speech spoken in Spanish or French, even though all three languages were unfamiliar and were from non-native rhythmic categories. Instead, no significant differences were seen among listeners' performance in the English, German, and Japanese competing speech conditions. Therefore, competing speech spoken in Japanese provided the same degree of masking effectiveness as competing speech spoken in the listeners' native language (English) and an unfamiliar language from the native stress-based rhythmic category (German). These results were unexpected, given that Japanese is typically considered to have mora-based rhythm, a rhythmic structure that should have been unfamiliar to the monolingual English-speaking listeners in the current study.

At the present time, it remains unclear why this pattern of results was observed for the Japanese competing speech conditions. The classification of Japanese as a mora-based language has been primarily based on

behavioral evidence of speech processing strategies used by listeners in quiet listening conditions. For example, previous studies have demonstrated that from birth to 6 months of age, babies from monolingual families can discriminate between Japanese and languages from the stress-based rhythmic class (Nazzi et al., 1998, 2000) and languages from the syllable-based rhythmic class (Nazzi et al., 2000). In addition, it has been found that adult native listeners of Japanese segment continuous speech according to morae, the subsyllabic units believed to underlie the rhythmic structure of Japanese speech (Cutler &Otake, 1994).

Despite this pattern of behavioral results, in acoustic- phonetic studies, researchers have reported conflicting findings regarding whether the rhythmic structure of Japanese is, in fact, significantly different from that of stress-based and syllable-based languages. For example, Ramus et al. (1999) found that Japanese speech was significantly different from speech spoken in stressbased languages (i.e., English, Dutch, and Polish) and speech spoken in syllable-based languages (e.g., Spanish, French, Catalan, and Italian) when the rhythm of each language was quantified on the basis of the duration of vocalic and consonantal intervals.However, Grabe and Low (2002) found that the acoustic-phonetic properties of Japanese were comparable to syllable-based languages or stress-based languages, depending on how language rhythm was quantified.

Therefore, the findings reported by Grabe and Low (2002) and the results of the current study suggest that Japanese may not belong to its own unique rhythmic class. Instead, the rhythmic properties of Japanese may overlap with those of stress-based and syllablebased languages. In the current study, listeners treated competing speech in Japanese the same as competing speech in English and German, two languages from the stress-based rhythmic category. In contrast, significant differences were seen between how listeners performed when competing speech was spoken in Japanese as compared with Spanish or French, two syllablebased languages. This pattern of results may indicate that for monolingual English-speaking adults, the acoustic-phonetic properties shared between Japanese and stress-based languages have a greater impact on selective auditory attention than do the acoustic-phonetic similarities between Japanese and syllable-based languages. However, additional research is needed to further explore the potential relationship between the underlying rhythm of Japanese and stress-based languages, such as English and German.

Together, the current results seem to indicate that selective auditory attention may be impacted by the rhythm of the language in which competing speech is spoken. However, it should be noted that factors other than rhythm may account for the significant betweenlanguage differences noted in the present study. For example, variability between the mean sSRT for maskers within each language (i.e., Masker A-Masker B differences) ranged from 1.86 dB to 4.42 dB, whereas the largest difference in the mean sSRT for a stressbased versus a syllable-based language was 2.53 dB (i.e., difference between English and French). As such, the possible contribution of the rhythm of the language to masking effectiveness is in the range of the variability between maskers within each language. However, a statistical analysis was conducted using the Masker A- Masker B difference as a covariate with a within-subject factor of language. This analysis confirmed the betweenlanguage pattern of results, suggesting that masking effectiveness may have been influenced by the rhythmic category of the language, even when withinlanguage variability between maskers was taken into account.

Although the current pattern of between-language differences may reflect actual differences in masking effectiveness, such differences could be related to variability in the amount of energetic masking provided by each language, rather than influences of linguistic factors such as rhythm. Although energetic masking was not specifically measured in the current study, previous studies have used the long-term average speech spectrum (LTASS) as an estimate of energetic masking (Van Engen&Bradlow, 2007) and have found the LTASS to be fairly equivalent across languages, with only a small amount of variability (e.g., Byrne et al., 1994). However, LTASS is only an approximate indicator of energetic masking, and, as such, the different languages may have variations in fine spectral detail not taken into account in LTASS measurements. On the other hand, the current pattern of between-language differences may be related to factors other than energetic masking, such as informational masking associated with linguistic characteristics of the languages. Although rhythmic differences

between languages may be a contributing factor, one could argue that linguistic characteristics other than rhythm may have influenced results obtained in the different language conditions. For example, English is of Germanic origin; therefore, it is possible that similarities in masking effectiveness between English and German could be related to their shared lexical roots. However, effects of common roots fail to explain the finding that the masking effectiveness of Japanese did not differ significantly from English or German, given that Japanese is not related to English and German in terms of root words. In addition, English has more recent roots in common with French (Finegan, 2009), but in the current study, these two languages differed significantly in terms of masking effectiveness. Therefore, although within-language variables, energetic masking, and common language roots may play a role in selective auditory attention, the development of a pattern in accordance with rhythmic structures indicates a possible contribution of rhythm to masking effectiveness.

Study Limitations and Implications for Future Research

The current study offers insight into how adult listeners' selective auditory attention performance is affected by variability between the vocal/speaking characteristics of different masking talkers and the underlying rhythm of the language in which competing speech is spoken. However, certain limitations of the study must be considered. The first limitation relates to the restricted age range of the subjects. For the 50 subjects included in the data analysis, ages ranged from 20 to 44 years of age (M = 23.72 years). However, only five subjects were over 25 years of age. As such, it remains unknown whether the current pattern of results can be generalized to other age groups, given that young children (e.g., Johnson, 2000) and older adults (e.g., Tun et al., 2002) have been shown to experience greater difficulty selectively attending than have young adults.

Another limitation relates to the language background of the subjects. Previous research has shown that language background can affect speech processing, both in quiet (e.g., Cutler &Otake, 1994; Sebastián- Gallés et al., 2000) and in competing speech conditions (e.g., Garcia Lecumberri &Cooke, 2006). Based on these findings, the current study was limited to monolingual American English-speaking adults. Controlling for language background ensured that performance on the experimental taskswould not be influenced by differences in listeners' exposure to languages other than English. However, additional research is needed to determine if the current pattern of results would be seen for listeners from other language backgrounds.

In addition to subjects' age range and language background, other limitations relate to characteristics of the competing speech signals used in the current study. For example, the masking talkers of the five languages did not all read the same text for the recordings used to create the competing speech signals. Various controls were used for the purpose of minimizing differences between the text read for each recording (e.g., reading level, age appropriateness of content, no dialogue, no references to well-known American proper names, etc.). Even without such controls, differences between the content of the text should not have affected listeners' performance in the German, Spanish, French, and Japanese competing conditions, given that these languages were unfamiliar to the subjects. However, if possible, future studies should use translations of the same text for each language to rule out extraneous effects of text differences.

With regard to characteristics of the competing speech, another limitation relates to the fact that acoustic-phonetic properties of the languages were not measured in the current study. Given that the classification of languages into rhythmic classes remains a topic of some debate, it is possible that other characteristics of the competing languages may have affected the current results. In determining the rhythm of a language, studies have taken into consideration phonological properties such as syllable structure, vowel reduction, and consonant intervals, among other aspects (Grabe &Low, 2002; Ramus et al., 1999). Studies have shown that certain languages do exhibit the "prototypical" rhythmic patterns. Specifically, it has been shown that the stress-based and syllable-based languages chosen for the current study follow the prototypical patterns for stress-based (i.e., German and English) and syllablebased (i.e., French and Spanish) rhythms. It should be noted that other aspects of language can impact the rhythmic groupings, such that some languages do not fit into the categories as distinctly (Grabe &Low, 2002). As such, in future studies, researchers should continue to

investigate aspects of language, including rhythm and other areas such as phonotactics and phonological similarity, to determine the potential impact on selective auditory attention.

Prior to generalizing the current results, it is also important to consider the number of masking talkers and the target-masker gender configuration used in the study. All subjects were tested in conditions where the competing speech consisted of one male and one female masking talker (i.e., a mixed-gender two-talker masker). Previous studies have shown that the masking effectiveness of competing speech increases as the number ofmasking talkers increases up to six talkers (Simpson &Cooke, 2005). However, effects of the content of competing speech are reduced or eliminated as the number of masking talkers increases from two to six talkers (e.g., Van Engen &Bradlow, 2007). In addition, evidence from previous studies (e.g., Brungart et al., 2001) also suggests that competing speech from two masking talkers provides essentially the same masking effectiveness, regardless of whether both masking talkers are the same gender as the target talker (i.e., same-gender targetmasker gender configuration) or whether one masking talker is male and one masking talker is female (i.e., mixed-gender target-masker configuration). Based on these findings, we chose a mixed-gender two-talker masking signal to achieve the most effective balance between maximizing masking effectiveness of the competing speech (i.e., by using more than one masking talker) and ensuring that any effects of the linguistic content of the competing signal (e.g., rhythmic structure of the language) could still be detected (i.e., by using only two masking talkers). However, additional research is needed to determine whether selective auditory attention performance is significantly impacted by the language of the competing speech if a different number of masking talkers and/or a different target-masker gender configuration is used, in addition to whether selective auditory attention varies depending on the target material (e.g., sentences, words, or syllables).

A final factor to be considered in generalizing the current results is the measurement technique that we used to assess listeners' selective auditory attention performance in each competing speech condition. Previous studies have shown that complex interactions occur between nonlinguistic characteristics of competing speech signals. For example, it has been reported that effects of SNR on selective auditory attention vary depending on the spatial location of the target and masking talkers (e.g., Freyman et al., 2001), number of masking talkers (e.g., Brungart et al., 2001), and target-masker gender relationship (e.g., Brungart, 2001). However, much remains unknown regarding how effects of the SNR may interact with linguistic characteristics of competing speech, including rhythm of the language spoken by the masking talkers. In light of these uncertainties, an adaptive sSRT procedure was used in the current study, instead of administering sentence recognition testing at a single SNR in each condition. However, additional research is needed to determine whether the same effects of language of the competing speech will be seen if selective auditory attention is measured through the use of other techniques.

Conclusions

Results of the current study indicate that the vocal/ speaking characteristics of different pairs of male- female masking talkers can provide different degrees of masking effectiveness, regardless of whether the masking talkers are speaking the listeners' native language or an unfamiliar language. In addition, the current results extend evidence from previous studies by showing that the rhythm of the native language may shape not only how a listener processes speech in quiet (e.g., Cutler et al., 1983; Cutler &Otake, 1994) but also how he or she processes a target speech signal in conditions where other talkers are speaking simultaneously in the background. Specifically, the current findings suggest that languages within the same rhythmic category provide the same degree of masking effectiveness. However, competing speech spoken in a language from the native rhythmic category is a more effective masker (and, therefore, is more difficult for listeners to ignore) than competing speech spoken in a language from a non-native rhythmic category, at least for some languages. This pattern of results occurred regardless of whether the language from the native rhythmic category wasmeaningful to the listeners, thus suggesting that the underlying rhythm of the language of the competing speech has a greater impact on masking effectiveness than its meaning. In the current study, the exception to

this pattern was that competing speech spoken in Japanese was shown to have the same masking effectiveness as competing speech spoken in languages from the listeners' native stress-based rhythmic category, despite the fact that Japanese has long been classified as having a mora-based rhythmic structure. Therefore, the current findings support previous acoustic-phonetic evidence (e.g., Grabe &Low, 2002) which has shown that Japanese may not exhibit its own unique rhythm but may instead share similarities with at least some stress-based languages.

Given the current results, additional research is now needed to explore how the language of competing speech affects selective auditory attention performance for monolingual and bilingual listeners from different age groups and different language backgrounds. Future studies should also investigate whether the current pattern of results would be replicated if other languages from the stress-based and syllable-based rhythmic categories were used as the competing speech. Together with the current results, evidence from such studies will lead to a better understanding of how exposure to the rhythmic structure of the native language(s) influences how speech is processed in competing conditions.

Acknowledgments

We gratefully acknowledge Steven Zupancic, Renée Bogschutz, Melinda Corwin, Rajinder Koul, and Nick Coppola at the Texas Tech UniversityHealth Sciences Center in Lubbock, TX, as well as Sylvia Martinez at La Casita Elementary in Clovis, NM, for their contributions to this project. We also thank the language recording volunteers, subjects, and all others who generously gave their time to make the study a success.

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Editor: Robert Schlauch
Associate Editor: Marjorie Leek
Received July 12, 2010
Revision received January 14, 2011
Accepted May 6, 2011
DOI: 10.1044/1092-4388(2011/10-0193)

Publication date: Feb 2012

Year: 2012

Speech Recognition and Acoustic Features in Combined Electric and Acoustic Stimulation

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 105-124.
ProQuest document link

Abstract: In this study, the authors aimed to identify speech information processed by a hearing aid (HA) that is additive to information processed by a cochlear implant (CI) as a function of signal-to-noise ratio (SNR). Speech recognition was measured with CI alone, HA alone, and CI + HA. Ten participants were separated into 2 groups; good (aided pure-tone average [PTA] <55 dB) and poor (aided PTA ≥ 55 dB) at audiometric frequencies ≤ 1 kHz in HA. Results showed that the good-aided PTA group derived a clear bimodal benefit (performance difference between CI + HA and CI alone) for vowel and sentence recognition in noise, whereas the poor-aided PTA group received little benefit across speech tests and SNRs. Results also showed that a better aided PTA

helped in processing cues embedded in both low and high frequencies; none of these cues was significantly perceived by the poor-aided PTA group. The aided PTA is an important indicator for bimodal advantage in speech perception. The lack of bimodal benefits in the poor group may be attributed to the nonoptimal HA fitting. Bimodal listening provides a synergistic effect for cues in both low- and high-frequency components in speech.

Full text: Headnote

Purpose: In this study, the authors aimed to identify speech information processed by a hearing aid (HA) that is additive to information processed by a cochlear implant (CI) as a function of signal-to-noise ratio (SNR).
Method: Speech recognition was measured with CI alone, HA alone, and CI + HA. Ten participants were separated into 2 groups; good (aided pure-tone average [PTA] <55 dB) and poor (aided PTA ≥55 dB) at audiometric frequencies ≤1 kHz in HA.
Results: Results showed that the good-aided PTA group derived a clear bimodal benefit (performance difference between CI + HA and CI alone) for vowel and sentence recognition in noise, whereas the poor-aided PTA group received little benefit across speech tests and SNRs. Results also showed that a better aided PTA helped in processing cues embedded in both low and high frequencies; none of these cues was significantly perceived by the poor-aided PTA group.
Conclusions: The aided PTA is an important indicator for bimodal advantage in speech perception. The lack of bimodal benefits in the poor group may be attributed to the nonoptimal HA fitting. Bimodal listening provides a synergistic effect for cues in both low- and high-frequency components in speech.
Key Words: speech recognition, electric and acoustic stimulation, acoustic features, signal-to-noise ratio, bimodal benefit

It is well known that combining electric speech processing with residual acoustic hearing leads to an improvement in speech understanding in noise. Some cochlear implant (CI) users wear a hearing aid (HA) in the nonimplanted ear (bimodal CI users; CI + HA), and other CI users wear an HA in the implanted ear (hybrid CI users). In both cases, patients have the opportunity to benefit from the combination of electric and acoustic stimulation (EAS), leading to an EAS benefit, defined as the difference in speech performance between CI + HA and CI alone. The idea behind EAS is that the loss of sensory cells can be compensated for by means of electric stimulation in the mid- to high-frequency range in combination with acoustic stimulation of the remaining low-frequency areas of the cochlear receptors.

Previous bimodal studies showed a clear trend in the improvement of speech intelligibility when acoustic hearing was added to electric hearing. Even though the degree of the bimodal benefit varies with experimental conditions such as test material, subject age, configuration of hearing thresholds for the acoustic side, and presence of a noise masker, generally the bimodal benefit ranges from 8% to 25% relative to the performance for CI alone (Ching, Incerti, Hill, &van Wanrooy, 2006; Dorman, Gifford, Spahr, &McKarns, 2008; Gifford, Dorman, McKarns, &Spahr, 2007; Hamzavi, Pok, Gstoettner, &Baumgartner, 2004; Kiefer et al., 2005; Kong, Stickey, &Zeng, 2005). The bimodal benefit is observed not only in speech perception but also in the perception of four-syllable numbers (Hamzavi et al., 2004). However, it should be noted that the majority of bimodal users received significant benefit in speech perception, but some portion of the subjects received no significant benefit (Beijen,Mylanus, Leeuw,&Snik, 2008; Gstoettner et al., 2006; James et al., 2006; Kiefer et al., 2005; Kong &Braida, 2011).

Previous EAS studies showed similar amounts of an EAS benefit in both bimodal and hybrid CI users. Kiefer et al. (2005) measured sentence recognition in quiet and noise for hybrid, bimodal, and hybrid plus contralateral HA users. The difference in performance among these combinations was less than a few percentage points. Gantz, Turner, Gfeller, and Lowder (2005) and Gifford et al. (2007) also showed similar patterns of results in

bimodal and hybrid plus contralateral HA users. These findings suggest that an EAS benefit is not based on the mechanism of binaural hearing but the integration of speech information independently processed by CI and HA processors.

Another interesting finding in EAS studies is that there is a larger EAS benefit in noise than in quiet for both hybrid and bimodal users. Gstoettner et al. (2004) reported a significant EAS benefit (30%-50%) for sentence recognition in noise for hybrid users and a few percentage point benefit in quiet. Turner, Gantz, Vidal, Behrens, and Henry (2004) compared the speech reception threshold (SRT), defined as the signal-to-noise ratio (SNR) required for 50% correct performance in sentence recognition, between hybrid and traditional unilateral CI users. A significant EAS advantage (about 9 dB SNR) was observed even though speech scores in quiet were similar between two groups. Kiefer et al. (2005) also reported an EAS benefit of 23% for sentence recognition in noise but only 8% in quiet. Even though the amount of residual hearing varied widely across studies, the EAS benefit in quiet for consonant-nucleus- consonant (CNC)word recognition is only a fewpercentage points, but the improvement in sentence recognition in noise was more than 10 percentage points (Gifford et al., 2007; Mok, Grayden, Dowell, &Lawrence, 2006). Turner, Gantz, and Reiss (2008) also reported that a significant EAS advantage (4.2 dB SNR in simple reaction time [SRT] measures) for sentence perception between hybrid and traditional unilateral CI users was observed even though consonant recognition performance in quiet was equivalent. Dorman et al. (2008) also demonstrated that the EAS benefit in sentence recognition was 10 percentage points higher in noise than in quiet for 15 bimodal users.

When the benefit of EAS in speech recognition is addressed, the audiometric threshold of the acoustic ear should be considered as a covariate. The range of pure-tone sensitivity that is known to provide a reliable bimodal benefit has been proposed. However, this is not an absolute requirement for a bimodal benefit because of poor correlation between EAS benefit and pure-tone sensitivity for the acoustic side. Ching, Incerti, and Hill (2004) found no significant correlations between hearing thresholds at .25, .5, and 1 kHz for the acoustic ear and bimodal performance and the difference between CI + HA and CI-alone performance. Gifford et al. (2007) also reported no significant relationship between bimodal benefit and the slope of hearing thresholds for frequencies of .25 kHz and 1 kHz or .5 kHz and 1 kHz. In addition, no significant correlation was reported between a bimodal advantage for any CNC measure at 10 dB SNR from 13 school-age children and aided thresholds at .25 and .5 kHz or 1 and 2 kHz (Mok, Galvin, Dowell, &McKay, 2010). These results suggest that better sensitivity to low-frequency pure tones does not necessarily lead to a greater bimodal advantage in speech perception.

In recent studies of EAS, the focus has been on finding the source of theEAS benefit. Some studies were conducted with real EAS patients (e.g., Kong et al., 2005; Mok et al., 2010; Turner et al., 2004), and other studies were acoustic simulations of CI processing with normal hearing subjects (Brown &Bacon, 2009a; Chang, Bai, &Zeng, 2006; Kong &Carlyon, 2007; Turner et al., 2004). The effect of the fundamental frequency, F0, on speech perception has been primarily evaluated as one of the possible sources of an EAS benefit. Turner et al. (2004) reported that there is a significant EAS benefit in word recognition in a simulation study for a talker background masker but not for a white noise masker; this result was confirmed with three hybrid users (Turner et al., 2004). This result suggests that voice pitch perception, which aids in separating voices in a background of other talkers, contributes to anEAS advantage. Similarly for sentence recognition in noise, the bimodal benefit is largest when the difference in F0 between the target and talker masker was largest (Kong et al., 2005). Two other studies (Chang et al., 2006; Qin &Oxenham, 2006) also showed significant improvement in sentence recognition when low-pass filtered speech containing F0 was presented to the acoustic ear. Using acoustic simulations of CI processing, Brown and Bacon (2009a) measured the EAS benefit with a tone modulated both in frequency with the dynamic F0 changes and in amplitude with the envelope of the 500 Hz low-pass filtered speech. A significant EAS benefit was observed (ranging from 25% to 57%) with a tone carrying F0 and envelope cues. The EAS benefit was even greater when both cues were combined compared

with either cue alone. This benefit was unaffected by the presence of a tone carrying these cues from a background talker. For both real hybrid and bimodal users, nearly identical patterns of results were observed with the same stimuli carrying F0 and envelope cues (Brown &Bacon, 2009b). These results strongly suggest the importance of F0 and amplitude-envelope cues in target speech to be sources of an EAS benefit.

The EAS benefit was evaluated in terms of consonant feature perception with children at +10 dB SNR (four-talker babble noise) and in quiet (Ching, Psarros, Hill, Dillon, &Incerti, 2001). It was reported that manner information was a primary contributor to the EAS benefit in quiet. Two other studies measured speech information transmitted using CNC word recognition for adults (Mok et al., 2006) and school-age children (Mok et al., 2010). The results showed that an EAS benefit in quiet arises from improved transmission of the low-frequency components in speech such as nasals, semivowels, diphthongs, and first formant (F1). In contrast, an EAS benefit in noise (+10 dB SNR in fourtalker babble noise) arises from improved perception of both low- and high-frequency speech components. Recently, Kong and Braida (2011) investigated CI users' ability to integrate consonant and vowel acoustic cues across frequencies in quiet. They reported that no sizable bimodal benefits were measured for all consonant features but that significant bimodal benefits were facilitated by better transmission of three vowel features (height in F1, backness in F2, and tense) only for those who demonstrated a significant bimodal benefit.

Previous research shows the existence of an EAS synergistic effect on speech understanding both in noise and quiet. However, the well-defined acoustic cues such as place and manner of articulation for consonants and F1 and F2 for vowels have not been evaluated with adult bimodal users as a function of SNR as a source of a possible EAS benefit. The relation between the aided PTA and the utilization of such acoustic cues in EAS mode for speech perception is also not clear. To ascertain the source of an EAS benefit, it is important to characterize exactly what speech information is affected by EAS. It is also essential to quantify how much information and whether the use of such information is determined by the aided pure-tone average (PTA). The purpose of the present study was to characterize the source of an EAS benefit in consonant and vowel recognition in terms of acoustic features in patients with a conventional CI in one ear in conjunction with an HA in the other ear. Specifically, the issues were which acoustic features for consonant and vowel recognition contributed to EAS benefit, whether such EAS benefits are related to the aided PTAof the acoustic side, whether such an EAS benefit was a function of SNR, and whether sentence performance scores could be predicted from phoneme performance scores.

Method

Subjects

Ten bimodal users (all postlingually deafened except Subject 2 [S2]) participated in the study. Subjects were native speakers of American English and were between the ages of 25 and 77 years old. Subjects were recruited with no particular consideration of age at implantation, duration of profound deafness, period of bimodal experience, etiology, CI/HA type and configuration, and processor strategy. Subject demographics are shown in Table 1. A subject's unaided and aided audiometric thresholds along with mean threshold (thicker dotted line) in the nonimplanted ear are given in Figure 1 along with the range of hearing threshold for the candidacy criteria in bimodal fitting suggested by MED-EL (dashed dot line). The top panels of Figure 1 show audiometric thresholds for each of five listeners (average age of 69) with PTA ≥55 dB hearing level (HL), and the bottom panels show hearing thresholds for the other five listeners (average age of 45) with PTA <55 dB HL over frequencies of 0.25, 0.5, 0.75, and 1 kHz. The cutoffof 55 dB HL for grouping was chosen because it is the upper cutofffor themoderatehearingloss range (41-55 dB HL). However, this standard audiological definition was not strictly applied to avoid having the S4 with a PTA of 55 dB in the good group and the S7 with a PTA of 56 dB in the poor group. All subjects provided informed consent, and all procedures were approved by the local Institutional Review Board.

Stimuli and Testing

Consonant recognition was measured in quiet and in noise at +5 dB and +10 dB SNR. Medial consonants included /b/, /d/, /g/, /p/, /t/, /k/, /m/, /n/, /f/, /s/, /S/, /v/, /ð/, /z /, /?/, and /?/, presented in an /a/-consonant-/a/ context produced by five male and five female talkers (Shannon, Jensvold, Padilla, Robert, &Wang, 1999). Consonant recognition was measured using a 16-alternative forcedchoice (16AFC) paradigm. During testing, a stimulus was randomly selected (without replacement) from the stimulus set. The subject responded by pressing on one of the 16 response buttons labeled in a /a/-consonant-/a/ context. Each consonant syllable was presented 20 times (10 talkers ×2 repetitions) for each noise condition. No training or trial-by-trial feedback was provided during testing.

Vowel recognition was measured in quiet and in noise at +5 dB and +10 dB SNR. Medial vowels included 10 monophthongs (/i/, /I/, / /, /æ /, /u/, /?/, /A/, /Ã/, //, /?/) and two diphthongs (/??/, /eI/), presented in an /h/-vowel-/d / context (heed, hid, head, had, who'd, hood, hod, hud, hawed, heard, hoed, hayed) produced by five male and five female talkers (Hillenbrand, Getty, Clark, &Wheeler, 1995). Vowel recognition was measured using a 12AFC paradigm. During testing, a stimulus was randomly selected (without replacement) from the stimulus set. The subject responded by pressing on one of the 12 response buttons labeled in an /h/-vowel-/d/ context. Each vowel syllable was presented 20 times (10 talkers ×2 repetitions) at each SNR. No training or trial-by-trial feedback was provided during testing.

Sentence recognition was measured in quiet and in noise at 0 dB, +5 dB, and +10 dB SNR using hearing-innoise test (HINT) sentences (Nilsson, Soli, &Sullivan, 1994). The HINT sentences consist of 26 lists of 10 sentences each produced by a male talker and are of easy difficulty. During testing, a sentence list was selected (without replacement), and a sentence was randomly selected from within the list (without replacement) and presented to the subject who then repeated the sentence as accurately as possible. Because there was a total of 12 conditions for the HINT test (3 listening modes ×4 SNRs) and each condition was tested with three sentence lists (i.e., a total of 36 lists are required), HINT lists that were presented at 0 dB SNR were repeated to reduce the effect of familiarization. The experimenter calculated the percentage of words correctly identified in the sentences. Sentence recognition for each set (10 sentences) was measured three times (for a total of 30 different sentences) for each noise condition. No training or trial-by-trial feedback was provided during testing.

Consonant, vowel, and sentence recognition was measured under three listening conditions: CI alone, HA alone, and CI + HA. For testing in noise, speechweighed steady noise (1000-Hz low-pass cutofffrequency, -12 dB/oct) was used. TheSNR was calculated in terms of the long-term root-mean-square of the speech signal and noise. Speech and noise were mixed at the target SNR. The combined speech and noise signal was delivered via an audio interface (Edirol UA 25) and amplifier (Crown D75A) to a single loudspeaker (Tannoy Reveal). Subjects were seated in a double-walled sound-treated booth (Industrial Acoustics Company) directly facing the loudspeaker (0° azimuth) one meter away. Subjects were tested using their clinical speech processors and settings. The output level of the amplifier was set at either 65dBor 70 dB sound pressure level (SPL) for each listening condition (CI alone, HA alone, and CI + HA) according to the Cox Loudness Rating scale (Cox, 1995) in response to 10 sentences in quiet. The output levels for each listening condition are listed for each subject in Table 1.

The subject's CI was turned offin the HA-alone condition, and his or her HAwas turned offand the nonimplanted ear was plugged with an ear plug for the CI-alone condition. These three listening conditions were evaluated in random order for each subject. Throughout this article, bimodal or EAS benefit refers to the difference between performance with CI + HA and performance with the better ear (CI alone). For the present study, all listeners showed higher performance with CI alone than with HA alone.

Data Analysis for Speech Information Transmission

Information transmission analyses were performed (G. A. Miller &Nicely, 1955). For consonant perception, three acoustic categories (nine speech cues) were analyzed: voicing (voiced and unvoiced), manner of articulation

(stop, nasal, fricative, and affricate), and place of articulation (front, middle, and back). For vowel perception, three acoustic categories (eight speech cues) were also analyzed: height of the first formant, F1 (high,middle, and low); place of the second formant, F2 (front, central, and back); and duration of sound (short and long). These speech information groups were chosen so that the frequencies important for their perception covered the range of frequencies in speech.

Vowel height refers to the vertical position of the tongue relative to either the roof of the mouth or the aperture of the jaw and is defined as the relative frequency of the F1. The F1 value is inversely related to the vowel height. Vowel backness is named for the position of the tongue during the articulation of a vowel relative to the back of the mouth and is defined as back or front according to the relative frequency of the F2. The F2 value is inversely correlated to vowel backness. Classification of these acoustic features is given in Table 2.

Results

Individual Speech Recognition Performance

Figure 2 shows individual performance scores along with mean scores (rightmost column) for the poor group on consonant (top row), vowel (middle row), and sentence (bottom row) recognition with CI + HA, CI alone, andHA alone. To make direct comparisons and be consistent with the presentation of consonant and vowel recognition scores, sentence recognition scores were plotted over three common SNRs used for all test materials. Note that the bimodal benefit for consonant recognition was fewer than 5 percentage points for all subjects across SNRs except S1 at +5 dB SNR (11.4% benefit). Similarly for vowel recognition, fewer than 5 percentage points of the bimodal benefit was observed for the majority of the cases except S5 (7% at two lower SNRs; 13% in quiet) and S10 at +5 dB SNR (8% benefit). The bimodal advantage for sentence was also fewer than 5 percentage points except S1 at +10 dB SNR (8% benefit), S5 at +5 dB SNR (16% benefit), and S7 at +10 dB SNR (19% benefit). There was a noticeable ceiling effect in sentence recognition in quiet for all subjects. As expected, there was significant performance variability among listeners. S4 and S10 are relatively high performers across test materials and SNRs, whereas S1 is a low performer for consonant and S7 is a low performer for vowel and sentence. Variability is also substantial for each listening condition. For example, for consonant recognition with CI alone, the difference between the lowest (S1 at +5 dB SNR) and the highest (S10 at +5 dB SNR) performance is approximately 45%.

Individual and mean (rightmost column) data for the good group are shown in Figure 3 for consonant (top row), vowel (middle row), and sentence (bottom row) recognition with CI + HA, CI alone, andHAalone. Note that the bimodal benefit for consonant recognition was larger than 5 percentage points for all subjects across SNRs except S3 and S9 at +10 dB SNR and in quiet. The largest benefit was observed for S6 and S8. For vowel recognition, more than 10 percentage points of the bimodal benefit was observed in four out of five subjects across SNRs. The bimodal benefit for sentence recognition was larger than 10 percentage points for all subjects except S9. Similar to the poor group, there was a clear ceiling effect in sentence recognition in quiet for all subjects. The variability for the good group is also noticeable mainly due to two poor performers (S2 and S8). For example, for consonant recognition with CI alone, the score of S2 at +5 dB SNR was only 10%, but that of the best performer (S3)was 57%.

Speech Recognition Comparisons Between Two Groups

Group mean recognition scores with standard error are presented in Figure 2 (rightmost column) for the poor-aided PTA group and in Figure 3 (rightmost column) for the good-aidedPTAgroup as a function of SNR. In general, bimodal benefit was more evident for listeners with good-aided PTA than for listeners with poor-aided PTA. We performed two-way repeated measures analyses of variance (ANOVAs) with SNR and listening condition as factors. For the poor-aided group, there was a significant effect of listening mode on consonant, $F(2, 16) = 67.3$, $p < .001$; vowel, $F(2, 16) = 17.5$, $p < .001$; and sentence recognition,$F(2, 16) = 88.3$, $p < .001$. The main effect of SNR was also significant for consonant, $F(2, 16) = 46.5$, $p < .001$; vowel, $F(2, 16) = 23$, $p < .001$; and sentence recognition, $F(2, 16) = 18.5$, $p < .001$. For the good-aided group, the main effect of listening mode

was significant for consonant, $F(2, 16) = 10$, $p < .005$; vowel, $F(2, 16) = 29.7$, $p < .001$; and sentence recognition, $F(2, 16) = 27.5$, $p < .001$. There was also a significant main effect of SNR for consonant, $F(2, 16) = 54.7$, $p < .001$; vowel, $F(2, 16) = 21.4$, $p < .001$; and sentence recognition, $F(2, 16) = 25.9$, $p < .001$. However, post hoc pairwise comparisons (Sidak method) showed that the bimodal advantage is significant for the good-aided group for vowel and sentence perception at the lower two SNRs, indicated by asterisks in Figure 3 ($p < .05$). For the poor-aided group, any pairwise comparisons were not significant for each test material ($p > .05$).

Bimodal Benefit and Aided PTA

To evaluate the influence of aided thresholds on speech perception, comparisons were made between the two groups of listeners' mean performance scores (see Figure 2, rightmost column for the poor group and Figure 3, right panel for the good group) for the HA-alone condition. We performed two-way ANOVAs with aided PTAgroup andSNRas factors. The difference in group mean was significant for vowel, $F(1, 24) = 5.44$, $p < .05$, and sentence recognition, $F(1, 24) = 13.5$, $p < .001$, but not for consonant recognition, $F(1, 24) = 3.9$, $p > .05$. The main effect of SNR was also significant for consonant, $F(2, 24) = 4.93$, $p < .05$, and sentence recognition, $F(2, 24) = 6$, $p < .05$, but not for vowel recognition, $F(2, 24) = 1.98$, $p > .05$. Post hoc pairwise comparisons (Sidak method) showed significant differences in performance for the HA-alone condition between the two groups at higher SNRs for vowel and sentence recognition and in quiet for consonant recognition, denoted by plus symbols in Figure 3 (right panel) ($p < .05$).

To evaluate the effect of aided PTA on the bimodal benefit, we performed a correlation analysis between the magnitude of the bimodal benefit and aided PTA at audiometric frequencies of 0.25, 0.5, 0.75, and 1 kHz for each speech test; these results are shown in Figure 4. The correlation analysis showed no significant association in the bimodal benefit for consonant recognition averaged across SNR, $r(10) = -.47$, $p > .05$, or at a specific SNR, $r(10) = -.25$, $p > .05$, at +5 dB; $r(10) = -.485$, $p > .05$, at +10 dB; $r(10) = -.43$, $p > .05$, in quiet. A correlation between aided PTA and the bimodal benefit for sentence recognition was not significant over SNRs ($r = -.43$, $p > .05$) or at each SNR, $r(10) = -.25$, $p > .05$, at +5 dB; $r(10) = -.54$, $p > .05$, at +10 dB; $r(10) = -.06$, $p > .05$, in quiet. Correlation between aided PTA and the bimodal benefit in vowel perception (see Figure 4, middle panel) was significant at the lower two SNRs, $r(10) = -.68$, $p < .05$, at +5 dB; $r(10) = -.64$, $p < .05$, at +10 dB, and the correlation was also significant between aided PTA and the bimodal benefit averaged across SNR, $r(10) = -.65$, $p < .05$. Further correlation measures revealed that such a bimodal benefit for vowel perception is significantly attributed to the aided threshold at 0.5 kHz, $r(10) = -.72$, $p < .05$.

Bimodal Benefit and Acoustic Features for Consonant

Figure 5 presents percent information transmitted for consonant recognition in terms of voicing, manner, and place of articulation for each group. Note that the good group transmitted most of the consonant features better with CI + HA than with CI alone, particularly for affricate and back in place. The difference in information transmitted between CI + HA and CI alone ranged from 15% to 18% for affricate and from 10% to 18% for back in place. For other features, the transmission was enhanced approximately from 5% to 10% across SNRs in the good group. The range of the feature transmission in HA alone was 20%-40% depending on SNR.

In contrast, for the poor group, the difference in percent information transmitted between CI + HA and CI alone was fewer than 5 percentage points for all features analyzed across SNRs. The amount of information transmitted by HA alone in the poor group was consistently lower than that by HA alone in the good group. On the contrary, the amount of information transmitted by either CI + HA or CI alone in the poor group was consistently higher than that in the good group. For both groups, there was no ceiling or floor effect.

Figure 6 presents a summary of the bimodal benefit in percentage points for consonant recognition in terms of voicing, manner, and place of articulation for each group. In general, the bimodal benefit is always greater for the listeners with better aided thresholds than the listeners with poorer aided thresholds for most of the features. For the poor group, a two-way repeated measure ANOVA showed that none of the acoustic features is significantly different between CI + HA and CI alone; for the good group, the bimodal benefit was significantly

attributed to low- (voicing) and high-frequency (stop and affricate) components in speech along with all three places, which requires a wide range of spectral information. Statistical details are given in Table 3. The effect of SNRfor both groups is significant for each of the acoustic features, but the pattern of the bimodal benefit for each feature is highly SNR specific. For example, the magnitude of the bimodal benefit enhanced by a voicing cue is similar at +10 dB SNR and in quiet, but the bimodal benefit aided by an affricate manner of articulation is greater in quiet and noise at +5 dBSNRthan that at +10 dB SNR.

To evaluate the effect of aided PTA on bimodal benefit, comparisons of the bimodal benefit between the two groups were made. The only significant benefit for the listeners with better aided hearing thresholds stemmed fromacoustic cues: voiced, affricate, and back in place (see Table 3, last column). Other cues did not show a significant difference between groups. The asterisk in Figure 6 indicates a significant difference in bimodal benefit between the two groups by post hoc pairwise comparisons.

Bimodal Benefit and Acoustic Features for Vowel

Figure 7 shows the results of vowel feature analyses in terms of F1 and F2 along with duration for each group. For the good group, overall, relatively good enhancement was made for all features analyzed in CI +HAcompared with CI alone. The improvement ranged from 8% to 20% depending on SNRs. Particularly central information in F2 was consistently transmitted 15% higher in CI + HA than in CI alone.

For the poor group, the transmission of the features improved fewer than 5 percentage points for all features across SNRs except for low in F1 at +5 dB SNR. The amount of information transmitted by CI + HAwas similar between the two groups, but in CI alone, the poor group transmitted higher percentage of vowel information than the good group. The amount of information transmitted in HA alone was consistently lower in the poor group than in the good group. There were no ceiling or floor effects for either group.

A summary of the bimodal advantage for vowel recognition was presented in Figure 8 in terms of F1 (first row) and F2 (second row) along with duration (last row) between the two groups. For the poor group, the transmission of speech information was not significantly improved with the bimodal mode compared with CI alone; for the good group, all of the information features known to be embedded both in low- and high-spectral components in speech, except for short-duration cues, were significantly received with the bimodal setting as opposed t°CI alone.Statistical details are giveninTable 4. In terms of an SNR effect, the bimodal benefit for the poor group was not significantly enhanced with increasing SNR for low in F1 height, central and back in F2 place, and short-duration cues. For the good group, the bimodal benefit was significantly dependent on SNR for all features.

Comparisons in bimodal benefit between the two groups showed that four acoustic features (middle height in F1, central and back place in F2, and long duration) significantly contributed to the bimodal benefit for the good group compared with the poor group (see Table 4 for statistics). Post hoc pairwise comparisons showed a significant difference in the bimodal benefit between the two groups for all features, at least at one of the SNRs, as indicated by the asterisks in Figure 8.

Relationship Between Contextual and Noncontextual Recognition

Figure 9 shows scatterplots in terms of bimodal benefit for consonant (leftpanel), vowel (middle panel), and phoneme (right panel) recognition relative to the bimodal benefit for sentence recognition. We computed the bimodal benefits for phonemes with [the square root of]CCIHAV ×CIHA [the square root of]CCI ×VCI (Boothroyd &Nittrouer, 1988), where CCIHA and VCIHA are the percent scores for consonant and vowel recognition in the bimodal mode, and CCI and VCI are the percent scores for consonant and vowel recognition in the CI-alone mode. Each open circle in Figure 9 represents an individual data point at each SNR. Linear regression analysis demonstrates that the magnitude of the bimodal benefit in sentence perception was significantly associated with the bimodal benefit for consonants ($r^2 = .56$, $p < .05$) and for phonemes ($r^2 = .60$, $p < .05$). However, the linear relationship between vowel and sentence recognition was not significant ($r^2 = .47$, $p > .05$).

Discussion

In this study, we characterized acoustic cues in speech recognition enhanced in a bimodal configuration. The bimodal benefit was greater for listeners with better aided PTA than that for the listeners with poorer aided PTA across SNR for all speech materials. The poorer aided PTA group received little bimodal benefits, probably due to HA input being at or below threshold in some or all frequencies. For consonant and vowel recognition, the specific acoustic features were responsible for the bimodal benefit regardless of low- and high-frequency components in speech. Such an enhancement in the acoustic features is significantly influenced by aided hearing threshold as well. The bimodal benefit for sentence recognition is significantly correlated with that for consonant recognition, and the correlation becomes stronger when relating the magnitude of the advantages between sentence and phoneme scores.

Mean Bimodal Benefit inQuiet and inNoise

In the present study, the magnitude of mean bimodal advantage for consonant perception for the good group in quiet and in noise is 6 and 8 percentage points, respectively (see Figure 3, rightmost column), which is comparable with the results of Dorman et al. (2008), who reported a benefit of 8% in quiet, and of Mok et al. (2010, 2006), who reported a similar range at 10 dB SNR. For vowel perception (see Figure 3, rightmost column), the amount of the bimodal benefit in the present study,7%in quiet, is lower than the 18% benefit reported in Dorman et al. (2008). The benefit for sentence recognition in the present study is 13% in noise and only 2%in quiet (see Figure 3, rightmost column). This is somewhat lower than values reported in the literature. Multiple studies reported a bimodal benefit of approximately 20% in noise at +5 dB SNR and/or +10 dB SNR (Chang et al., 2006; Dorman et al., 2008; Gifford et al., 2007; James et al., 2006; Kong et al., 2005). Dorman et al. (2008) reported that the bimodal benefit was 25% both at +5 dB and at +10 dB SNR.

The reasons for the somewhat lower values of the bimodal benefit in the present study might be due to the different use of noise maskers and/or audiometric configurations for the acoustic side. Because the hearing thresholds are widely varied across these studies, a different type of noise masker might be a source for such a difference. Speech-weighted noise was used in the present study, but single or multiple talker babble noise was used in the other studies mentioned above. Brown and Bacon (2009a) demonstrated using a hybrid configuration simulation that the performance score for a speech-shaped masker was approximately 10 percentage points lower than that for the talker babble masker.

For the poor group in the present study, both the bimodal and CI-alone performance curves are almost identical across SNR and test materials (see Figure 2, rightmost column). This suggests that no new speech information was added via HA or that speech cues provided by HA are not used by the auditory system. Little bimodal benefit for the poor group may be the result of impaired frequency difference limens in the region of elevated thresholds (Peters &Moore, 1992; Tyler, Wood, &Fernandes, 1983) and inaudible F2 or higher formants. Thus, no difference in the performance between CI + HA and CI alone suggests that HA does not add any further information regarding pitch and the first two formants when aided threshold is high enough (i.e., ≥55 dB HL at frequencies ≤1 kHz) or when the HA does not substantially improve thresholds.

Performance Comparisons for CI-Alone Condition

One interesting observation from the group data (see Figures 2 and 3) is that the CI-alone condition was consistently lower (about 20 percentage points) in the good group (see Figure 3, rightmost column) compared with the poor group (see Figure 2, rightmost column). Such a discrepancy might be simply attributed to performance variability across CI users. As shown in Figures 2 and 3, two top performers (S4 and S10) in the poor group outperformed (more than 15% higher) any of the subjects in the good group for consonant recognition. In addition, performances of the two poor performers (S2 and S8) in the good group were far below that of group mean scores. Consequently, two good performers in the poor group and two poor performers in the good group are major contributors to higher scores for the CI-alone condition in the poor group than in the good group. As mentioned in the Method section, subject S2 in the good group is only one with prelingual deafness. It is interesting to see how scores from S2 influenced the difference in CI alone between two groups.

We performed a two-way ANOVA for CI alone between two groups with and without data from S2, with group and SNR as factors.With data of S2, significant difference between two groups was observed for consonant, $F(1, 24) = 10.3$, $p < .004$, and for sentence, $F(1, 24) = 4.2$, $p < .05$, but not for vowel, $F(1, 24) = 14$, $p > .05$. In contrast, without the S2 data, the difference in CI alone between two groups was not significant for consonant, $F(1, 21) = 5.8$, $p > .05$; vowel, $F(1, 21) = 1.3$, $p > .05$; and sentence, $F(1, 21) = 0.95$, $p > .05$.

Correlation Between Aided PTA and Bimodal Benefit

The present study shows that bimodal benefit is greater for the listeners with better aided thresholds than for the listeners with poorer aided thresholds (see Figures 2 and 3). This result is consistent with the result of Moket al. (2006) but not of Moket al. (2010).Moket al. (2006) showed a significant correlation between bimodal benefit and aided threshold at 1 kHz for consonants and vowels and at 2 kHz for consonants. In contrast, Mok et al. (2010) showed a nonsignificant association between the bimodal benefit and low-frequency-aided thresholds (.25 and .5 kHz) for all CNC measures. This inconsistency might be due to the difference in hearing thresholds for subjects across studies. In addition, the study of Mok et al. (2006) was conducted in quiet with adults, and speech perception in Mok et al. (2010) was measured at +10 dB SNR with children. Ching et al. (2004) reported no significant correlation between aided threshold and bimodal benefit in sentence recognition. Chang et al. (2006) also reported in an acoustic simulation study nonsignificant correlations between aided PTA over frequencies of .5, 1, and 2 kHz and bimodal benefit even though the bimodal benefit decreased with an increase in hearing loss.

The correlation analysis in the present study (see Figure 4) shows a significant relationship between aided threshold and bimodal benefit in vowel recognition. This can be explained by Miller's vowel perceptual space theory: Pitch plays a significant role in vowel perception by interacting with the frequency of F1 to form one dimension of a three-dimensional perceptual space (J. Miller, 1989). So, we would expect that vowel recognition would be significantly improved when HA is added. F1 could provide a frequency-appropriate reference against which higher frequency information provided by the CI would be integrated. F1 could aid in perception of high- and mid-height vowels and formant transition (Strange, Jenkins, &Johnson, 1983).

The results of the present and Mok et al. (2006) studies suggest that individual variability in bimodal outcome could be partially accounted for by the differences in aided thresholds, and a better aided threshold does not necessarily result in a greater bimodal advantage for all test materials.

Information Transmission Analyses for Consonant Recognition

The results of the consonant feature analysis for the good group in the present study (see Figure 5) are consistentwith those of Kong and Braida (2011),whomeasured similar quantities with 11 bimodal users in quiet. In both studies, the HA provided the most information about nasal cues. Voicing information was similarly transmitted in CI alone between the two studies (55% in the good group of the present study and 56% in Kong &Braida, 2011). CI + HA provided a similar amount of benefit in voicing information transmitted in the two studies (58% in Kong &Braida, 2011, and 62% in the good group). For other consonant features (stop and fricative), similar percent information transmitted was observed in the two studies as well.

The result of the present study in consonant recognition also shows that speech information required for the perception of higher frequency components (i.e., affricate and back in place) was also enhanced when HA was added, particularly for the listeners with goodaided thresholds (see Figures 5 and 6). This result is consistent with those of Mok et al. (2010). This study characterized the bimodal benefits measured with 13 school-age children at +10 dBSNR(four-talker babble masker). Data were analyzed in nine phonetic categories: fricatives, sibilants, plosives, F2, bursts, semivowels, nasals, diphthongs, and F1. Mok et al. (2010) reported a relatively large bimodal advantage (5%-10%) for some of the other phoneme groups, including those that require perception of higher frequency information (e.g., fricatives, sibilants, F2). The results of the present study and Mok et al. (2010) suggest that the perception for cues embedded in higher frequencies is more important when listening in noise.

In contrast, our results are inconsistent with those of Mok et al. (2006) and of Kong and Carlyon (2007). Mok et al. (2006) tested 14 adult bimodal users for CNC word recognition in quiet and analyzed the data in terms of the same features analyzed in Mok et al. (2010). They showed that only lower frequency features such as semivowel, nasal, diphthongs, and F1 contributed to the bimodal benefit. Kong and Carlyon (2007) also reported a similar result for sentence recognition in noise, which they demonstrated by removing the phonetic cues in the HA side (preserving the F0, voicing, and temporal envelope cues) and not observing a bimodal benefit at +10 dB and +15 dB SNR. This indicates that low-frequency phonetic cues are important for bimodal benefit, particularly at higher SNRs.

There could be a few factors contributing to the unexpected results between Mok et al. (2006) and Mok et al. (2010). First, the bimodal adults in Mok et al. were tested in quiet, whereas bimodal children in Mok et al. were tested at +10 dB SNR. Combined with the result of the present study, high-frequency speech cues were used more when listening in noise. Second, the bimodal children had been using the bimodal input since a young age, whereas the bimodal adults only received CI in adulthood. Hence, it is possible that the children have learned to better integrate the signals from the two ears and that the mismatch between the ears at higher frequencies is less significant for children.

Relationship Between Voiced/Unvoiced Cue and F0

We have demonstrated in the present study that in the good group, both voiced and unvoiced information for consonant perception (see Figure 6) was significantly enhanced in the CI + HA condition in noise compared with CI alone. Previous studies in which speech information transmission in consonant perception was examined also revealed significant transmission of voicing information with bimodal setting compared with CI alone (Brown&Bacon, 2009a, 2009b). One reasonable thought related to voicing is that if F0 is one of the primary cues used by low-frequency acoustic hearing to improve electric hearing, then improvement for voiceless consonants should be minimal. The present results, however, indicate that this is not the case. These results suggest that voicing cues are not necessarily enhanced proportionally with F0 information. The results of the two previous studies support this idea as well (Brown &Bacon, 2009a, 2009b).

Brown and Bacon (2009a) showed 9 percentage points of bimodal benefit migrated by voicing cue alone under speech-shaped noise for sentence recognition using acoustic simulation. The same trend was observed with two bimodal CI users under a male and babble backgrounds (Brown &Bacon, 2009b). These results are in good agreement with the present result for voicing cue. Brown and Bacon (2009b) also showed that an additional 17 percentage points of the benefit were observed beyond voicing alone when a tone was modulated in frequency with the target talker's F0. These results suggest that the F0 cue provides more cues, not accordingly with voicing cue. However, the sample size is too small to interpret this result in a meaningful way. In addition, these two subjects in a study of Brown and Bacon (2009b) were tested in unaided condition under a male and babble background, and more importantly, no background was presented in the acoustic ear. It might be interesting to test whether F0 and temporal envelope cues are robust under a speech-shaped noise environment in the HA side.

F0 has also been shown to be important for the manner of articulation (Faulkner &Rosen, 1999). Ching et al. (2001) showed that significantly more manner information was received when listeners used bimodal hearing devices compared with using CI alone in quiet. In the present study, two manner cues, stop and affricate, were significantly better perceived only for the listeners with better aided threshold, whereas information in nasal and fricative cues was not significantly enhanced for either group.

Information Transmission Analyses for Vowel Recognition

The results of the vowel feature perception in the present study (see Figure 7) are consistent with those of Kong and Braida (2011), who evaluated bimodal benefit in terms of vowel features in quiet. CI alone provided similar information transmission in height of F1 (61% in the good group of the present study and 53% in Kong &Braida, 2011) and place of F2 (69% in Kong &Braida, 2011, and 63% in the good group) between the two studies. In CI

+ HA, height in F1 and place in F2 were similarly transmitted between the two studies. However, the HA provided height information of F1 about 46% for the good group, 27% in Kong and Braida (2011), and place in F2 about 43% for the good group, and only 4% in Kong and Braida (2011) (mainly due to the greater variability ranging from 1% to 44%). Kong and Braida (2011) also reported that only those who demonstrated a substantial bimodal benefit showed significant improvement in all vowel features tested, which is consistent with our findings.

All vowel features, except short duration, analyzed in the present study were significantly better perceived in a bimodal setting for the listeners with better aided PTA, whereas none of the features, including short duration, were significantly perceived for the listeners with poorer aided PTA (see Figure 8). For the good group, the aided threshold at the range of F2 frequencies between 1 and 3 kHz is from 40 dB HL to 80 dB HL. This finer spectral information provided by HA can aid perception of some vowels required for higher spectral components.

It is obvious that bimodal listening enhances acoustic cues in low height of F1 and high place of F2 spectral elements in vowels. Dellattre, Liberman, Cooper, and Gerstman (1952) showed a significant drop in vowel perception when any portion of the spectrum of F1 and F2 was removed. Dorman, Spahr, Loizou, Dana, and Schmidt (2005) showed that if all of the F2 information that fell under 2.1 kHz was eliminated, then there was no decrease in vowel perception with larger gaps above 2.1 kHz in frequency between CI in one ear and HA in the opposite ear using simulations. Previous studies focused on F0 as a primary source for bimodal benefit (Brown &Bacon, 2009a, 2009b; Kong et al., 2005; Kong &Carlyon, 2007; Qin &Oxenham, 2006), but the result of the present study shows that F1 and F2 are also important components for vowel perception in a bimodal setting.

Contextual and Noncontextual Comparisons in Bimodal Benefit

It is frequently stated, and maybe widely believed, that the perception of continuous speech is a complex process because the integration of perceptual cues is governed by high-level language such as lexical, morphological, syntactic, and semantic constraints (Chomsky &Halle, 1968). Figure 9 shows that the advantage of a bimodal arrangement for sentence perception is significantly related with nonsense consonant and phoneme perception. This result is consistent with one of the findings that Rabinowitz, Eddington, Delhorne, and Cuneo (1992) reported: Consonant recognition is highly correlated with sentence recognition. It is known that consonants can be more affected by removing low-frequency information, ≤0.8 kHz (Lippmann, 1996; Warren, Bashford, &Lenz, 2004). Therefore, it is possible that sentence recognition was affected as well by better spectral resolution in the low-frequency range for the better PTA group.

Cues in continuous speech can be classified into two types: acoustic and context cues. The context cues refer to redundancy, recoverable once given sufficient acoustic cues, along with the associated context information (Boothroyd &Nittrouer, 1988; Bronkhorst, Bosman, &Smoorenburg, 1993).Onthe basis of significant correlations in speech perception between contextual and noncontextual speech materials (see Figure 9), it can be stated that sentence understanding in noise can be accounted for by the acoustic cues extracted from random syllables (nonsense consonants and vowels). This result suggests the existence of such a connection between acoustic and context cues in a bimodal setting.

The Bimodal Benefit and Audibility/HA Fitting

All of the subjects in the present study have been fitted by the same protocols and same audiologists to make sure that the HA provides audible sounds. However, aided thresholds for the poor group were much poorer even though unaided thresholds were similar between groups (see Figure 1). It indicates a possibility that spectral gain prescribed to HAs might not be optimal for the poor group. This possibility is supported by the results of Ching et al. (2001). They showed that 15 of the 16 children required 6 dB more gain than prescribed (National Acoustic Laboratories-Revised, Profound) to balance the loudness of the implanted ear for a speech signal presented at 65 dB SPL. It suggests that adjustment of HA gain to match loudness in the implanted ear for the poor group can facilitate integration of speech information across ears, leading to bimodal advantage.

To test this idea, a subject (S4) in the poor group was retested with a fixed 80 dB SPL presentation level for sentence recognition in noise and quiet for the HA-alone, CI-alone, and CI + HA condition. This level provides the subject about 30-dB sensational level at frequencies between .25 and 1 kHz and about 15-dB sensational level at frequencies between 1 and 3 kHz (see aided audiogram for S4 in Figure 1). Figure 10 shows performance with a presentation level of 80 dB SPL (right panel) along with original data (leftpanel) measured at 70 dB SPL for HA alone and at 65 dB SPL for the CI-alone and CI + HA condition. No bimodal benefit was observed with the 80 dB SPL presentation level even though performance improved for HA alone at +10 dB SNR and in quiet, but not at +5 dB SNR. In contrast, the performance dramatically dropped approximately 30% due to clipping for both the CI-alone and CI + HA condition in noise, leading to bimodal interference at 80 dB SPL presentation level. This result suggests that optimal bimodal loudness balancing is needed to facilitate bimodal benefit; it is likely that some degree of bimodal benefit could be observed when 80 dB and 65 dB SPL levels for the HA side and CI side are presented.

Age Effects on Bimodal Benefit

In the good group (average age is 45), the three youngest subjects (S2: 44 years old, S6: 25 years old, and S9: 47 years old) showed the greatest EAS benefit, particularly for vowel and/or sentence recognition. S6 showed the benefit regardless of test materials, but S9 demonstrated the benefit only for vowel recognition. Two elderly subjects (S3 and S8) in the good group also showed a benefit for vowel and sentence tests. In the poor group, the youngest subject (S7: 56 years old) did not show a benefit. This inconsistent age effect is also reported in the study of Kong and Braida (2011). The four youngest bimodal subjects (<27 years old) out of 12 did not show a benefit in consonant and vowel recognition. However, substantial benefit was observed from two other subjects (64 and 57 years old) in vowel recognition.Therefore, it is unlikely that the bimodal benefit is accounted for by age only.

Limitations

In the present study, as subjects were tested in their clinical setting for each device, an optimization of an HA to complement a CI was not administrated in a systematic way. The frequency response of the HAshould be optimized for speech understanding for each subject so that HAs have enough compression capability in dynamic range. Another issue is that loudness balancing should be performed and that sounds must be maintained at a comfortable listening level for input levels when the HA is used with a CI. As described in the Method section of this article, loudness was roughly balanced by adjusting the output level of the amplifier as the most comfortable level for each listening condition (CI alone, HA alone, and CI + HA). If serious consideration for loudness balance is necessary, then a loudness-balancing procedure should be used to adjust the gain of the HA for different input levels so that loudness of speech is similar between ears. It is possible that bimodal benefit for the poor group might be enhanced with adjustment of gain for better loudness balance with CI.

Another limitation related to an HA device is unknown interactions between the bimodal benefits and HA setting parameters. Each device and model have some unique features such as different number of bands, channels, degree of compression, signal processing algorithm, and noise reduction technology along with different listening programs. All of these factors may affect their aided PTA thresholds and HA performance. Even though it is difficult to expect how these features influence the outcome in bimodal settings, it is possible that one or more aspects of HA fitting will affect their bimodal benefits. Particularly considering a situation in which a noise reduction algorithm is not used for the CI side, but is included in the HA side, the CI-alone performance could drop significantly, which could explain greater bimodal benefit in noise, but lack of the benefit in the quiet condition.

The lack of training prior to testing might be problematic, particularly for the CI-alone and HA-alone conditions-given that performance for unilateral listening conditions was commonly measured by having bimodal CI users switch offone of their devices. This arrangement generates immediate disadvantage as this configuration does

not characterize subjects' everyday listening experience and, in essence, changes how a given subject's auditory system processes cues for speech recognition. Consequently, CI-alone performance may be higher for listeners with poorer acoustic hearing threshold due to insufficient amplification in theHA side.

Conclusions

In the present study, the source of the bimodal advantage in speech perception was characterized in terms of acoustic features for consonant, vowel, and sentence recognition in noise and in quiet. Speech recognition was measured in three conditions: CI alone, HA alone, and CI + HA conditions; speech and noise were presented at 0° azimuth. Results showed that bimodal advantage for vowel and sentence recognition depends on aided thresholds at audiometric frequency below 1 kHz, especially in noise. The poorer aided PTA group received little bimodal benefits probably due to HA input being at or below threshold in some or all frequencies. The results of information transmission analyses revealed that bimodal listening helps enhance the acoustic features both in low- and high-frequency components. For consonant recognition, low-frequency voicing and high-frequency stop and affricate cues along with place cues are the main sources of the bimodal benefit for the good-aided group, whereas none of these features contribute to the bimodal benefit for the poor-aided group. Three acoustic cues-voiced, affricate, and back in place-are primary components used to differentiate the magnitude of the bimodal benefit in consonant recognition between the two aided PTA groups. For vowel recognition, low-frequency cues (F1), high-frequency cues (F2), along with long-duration cues are significant contributors to the bimodal benefit for the good-aided group, whereas none of these features are significant sources for the poor-aided group. The magnitude of the bimodal advantage between the two aided PTA groups is differentiated by middle height in F1, central and back place in F2, and long-duration cues. The enhancement of sentence recognition in the bimodal setting is significantly associated with the bimodal benefit for consonant recognition, and the correlation is stronger when relating the magnitude of the advantage between sentence and phoneme recognition (scores combined for consonants and vowels). The results suggest that aided hearing threshold should be carefully considered in order to maximize the advantage of the bimodal use in speech perception. The results also suggest that speech information processed by CI in conjunction with HA not only aided in the perception of low-frequency components in speech but also helped process some of the high-frequency components.

Acknowledgments

This work was supported by National Institutes of Health Grant 5R01DC004993. We thank our participants for their time and effort.We thank Jaesook Gho, Tianhao Li, Aiguo Liu, and Joseph Crew for their editorial assistance and valuable comments and Hou-Yong Kang for his help in data collection.

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Editor: Sid Bacon
Associate Editor: Eric Healy
Received November 18, 2010
Revision received February 8, 2011
Accepted May 15, 2011

DOI: 10.1044/1092-4388(2011/10-0325)

Publication date: Feb 2012

Year: 2012

Vocabulary and Working Memory in Children Fit With Hearing Aids

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 154-167.
ProQuest document link

Abstract: To determine whether children with mild-to-moderately severe sensorineural hearing loss (CHL) present with disturbances in working memory and whether these disturbances relate to the size of their receptive vocabularies. Children 6 to 9 years of age participated. Aspects of working memory were tapped by articulation rate, forward and backward digit span in the auditory and visual modalities, Corsi span, parent surveys, and a sequential encoding task. Articulation rate, digit spans, and Corsi spans were also administered in low-level broadband noise. CHL and children with normal hearing (CNH) demonstrated auditory advantage in forward serial recall. CHL demonstrated slower articulation rates than CNH, but similar memory spans. CHL with poor executive function presented with poorer performance on the Corsi span task. The presence of background noise had no effect on performance in either group. CHL presented with significantly smaller receptive vocabularies than their CNH peers. Across groups, receptive vocabulary size was positively correlated with digit span in quiet, Corsi span in noise, and articulation rate. In the presence of mild-to-moderately severe hearing loss, children demonstrated resilient working memory systems. For all children, working memory and vocabulary were related; that is, children with poorer working memory had smaller vocabulary sizes.

Full text: Headnote

Purpose: To determine whether children with mild-to-moderately severe sensorineural hearing loss (CHL) present with disturbances in working memory and whether these disturbances relate to the size of their receptive vocabularies.

Method: Children 6 to 9 years of age participated. Aspects of working memory were tapped by articulation rate, forward and backward digit span in the auditory and visual modalities, Corsi span, parent surveys, and a sequential encoding task. Articulation rate, digit spans, and Corsi spans were also administered in low-level broadband noise.

Results: CHL and children with normal hearing (CNH) demonstrated auditory advantage in forward serial recall. CHL demonstrated slower articulation rates than CNH, but similar memory spans. CHL with poor executive function presented with poorer performance on the Corsi span task. The presence of background noise had no effect on performance in either group. CHL presented with significantly smaller receptive vocabularies than their CNH peers. Across groups, receptive vocabulary size was positively correlated with digit span in quiet, Corsi span in noise, and articulation rate.

Conclusions: In the presence of mild-to-moderately severe hearing loss, children demonstrated resilient working memory systems. For all children, working memory and vocabulary were related; that is, children with poorer working memory had smaller vocabulary sizes.

Key Words: children, working memory, hearing aids, vocabulary

The auditory experience of children with sensorineural hearing loss (CHL) is not equivalent to that of children with normal hearing (CNH). Hearing loss reduces the quality and quantity of auditory input. Audiologic interventions may increase a child's access to the acoustic signal but cannot fully compensate for the underlying hearing loss. The inherent differences in auditory experiences may have a cascading effect on the linguistic and cognitive development of a child with hearing loss.

One potential effect is deficient vocabulary development. CHL have smaller vocabularies than their CNH peers (Blamey et al., 2001; Davis, Elfenbein, Schum, &Bentler, 1986; Gilbertson &Kamhi, 1995; Moeller, 2000). In addition to the direct reduction of access to speech input, there may also be an indirect effect of hearing impairment on vocabulary development.Working memory is essential to the word-learning process (Gathercole &Baddeley, 1989; Gupta&MacWhinney, 1997; Gupta& Tisdale, 2009) and is known to be reduced in children with profound hearing loss who wear cochlear implants (Burkholder &Pisoni, 2003). Working memory skills correlate to reading skills in CHL (Daneman, Nemeth, Stainton, &Huelsmann, 1995). Hansson, Forsberg, Löfqvist, Mäki-Torkko, and Sahlén (2004) found a significant correlation between complex working memory and word learning in 9- to 13-year-old CHL. Working memory was assessed in a reading span test, and novel word learning was assessed in a mutual exclusion test. Children with better working memory performance learned more novel words. Working memory was also correlated to receptive vocabulary size. The CHL performed the same as their CNH age-mates on working memory and word learning but exhibited significantly smaller receptive vocabulary sizes (Hansson et al., 2004). It is possible that the smaller receptive vocabulary sizes are a residual effect of delayed development of working memory. We do not know whether the working memory systems of younger children with milder hearing losses are also deficient or whether such deficits, if present, contribute to the vocabulary problems that characterize these learners. Our aim was to address these critical gaps in the literature. We asked whether mild-to-moderately severe hearing loss affects development of the working memory system and whether working memory predicts vocabulary size similarly in children with and without mild-to-moderately severe hearing loss.

Working Memory

Working memory has been described as a fractionated system, including a central executive mechanism and two subsystems devoted to storage and processing: the visuospatial sketchpad and the phonological loop (see Baddeley, 2000). The phonological loop is of particular importance as it is engaged in linguistic processing. The phonological loop consists of a phonological store and a subvocal rehearsal mechanism. The subvocal rehearsal mechanism refreshes the items in the store to maintain their integrity in working memory. The executive mechanism of working memory is often described as one of managing the processing of incoming information and prevention of the decay of item traces already in storage (maintenance). It is not fully understood how the executive system allocates resources to processing and maintenance functions. In the Baddeley (2000) model, poorer working memory performance may reflect inefficient processing, which leaves fewer resources to the maintenance of the memory traces (Towse, Hitch, &Hutton, 1998) and demands of the processing task which consumes cognitive resources that would otherwise be used for preserving the memory traces (Barrouillet, Bernardin, &Camos, 2004).

Various behavioral tasks allow indirect measurement of the working memory system. One of these is a measure of articulation rate on a sentence-repetition task. The strong correlation between articulation rate and verbal working memory suggests that the mechanism controlling articulation speed is related to the subvocal rehearsal mechanism in the phonological loop (Baddeley, Thomson, &Buchanan, 1975). Serial recall tasks are also informative. These may include forward recall tests (e.g., digit and letter span), which measure storage capacity, and backward recall and reading span tests, which measure storage capacity plus processing.

Serial recall tests have revealed relationships between working memory and language. For example, better serial recall predicts better production of syntactically complex speech in preschool children (Adams &Gathercole, 1995) and higher levels of literacy (Gathercole &Baddeley, 1993; Gathercole, Tiffany, Briscoe,

Thorn,& the ALSPAC team, 2005;Mann, Liberman, &Shankweiler, 1980; Shankweiler, Liberman, Mark, Fowler, &Fischer, 1979). A suboptimal working memory system will result in poorer integrity of memory traces involved in word learning and can thus impede development of vocabulary and literacy (see Gathercole &Baddeley, 1993).

It is concerning that children with cochlear implants exhibit working memory deficits relative to CNH on measures of serial recall (Burkholder &Pisoni, 2003). Deficits in working memory may thus be a consequence of hearing loss. As it is with CNH, digit span is highly correlated to language and reading in children with cochlear implants (Pisoni &Geers, 2000). In children with cochlear implants, better serial recall on digit span predicts better speech recognition (Pisoni &Cleary, 2003). Sensitivity of the digit span measure is strong enough that, after having controlled for such demographic variables as chronological age, communication mode (oral vs. total communication), duration of deafness, duration of use of cochlear implant, and age of onset of deafness, digit span is still significantly correlated to closed- and open-set word recognition tests.

There may also be strategic aspects of working memory where differences in children's use of this system might be evident. For example, children who are deaf use a different strategy to encode series of visual items into memory (O'Connor &Hermelin, 1973). When presented with three digits sequentially in varying positions on an array, CNH recited back the digits in chronological order, whereas children who are deaf repeated them back based on their physical position. This suggests that CNH develop a temporal (phonological loop) preference, whereas children who are deaf develop a visual (visuospatial sketchpad) preference for encoding items into memory. The encoding patterns of children with milder degrees of hearing loss is as yet unknown.

Typical adults have a robust benefit of auditory input in serial recall tasks; this is called the auditory advantage. Research participants were able to repeat back more items from a list they heard than from a list they read (Penney, 1975). Penney (1989) proposed a model of verbal memory that incorporates modality effects. In this model, information presented via audition is processed in a stream separate from information presented via vision. Both visual and auditory information end up in a phonological code; however, this information is also retained in either an acoustic code or a visual code, depending on the modality of input. The acoustic modality ismore adeptwith sequentially presented items,whereas the visual modality is more adept at simultaneously presented items. This yields the auditory advantage for forward recall that characterizes adults with normal hearing. Manipulation of items in memory, such as in a backward recall task, obliterates the auditory advantage. A review of the literature did not yield evidence confirming or denying the auditory advantage in children; however, our experimental design permitted an investigation of this phenomenon.

Working Memory in Noise

The working memory system is supported by a finite amount of cognitive resources; stress on the system may reduce performance levels. One potential stressor is noise. Noise may be a distracter in the environment. Cognitive resources would then be harnessed to inhibit reaction to the noise, allowing the listener to maintain concentration on the signal and support auditory processing (Pichora-Fuller, Schneider, &Daneman, 1995). Noise may also mask acoustic cues used to identify speech sounds. Cognitive resources would then be harnessed for decoding the message from fewer available cues (Rönnberg, Rudner, Foo, &Lunner, 2008). In noisy environments, listeners expend more resources on attending to and decoding the signal, which leaves them fewer resources to support maintenance processes. In a compromised system, such as that of a CHL, cognitive support for working memory tasks may be further impaired by this reallocation. The decrease in speech perception caused by the presence of noise has been well documented in normal-hearing populations; however, effects of background noise on the working memory of children fit with amplification have not been determined.

In adults, the complexity of background noise affects performance on serial recall tasks for phonological material (i.e., irrelevant speech effect; Murphy, Craik, Li, &Schneider, 2000). The presence of nonspeech noise does not affect word recall presumably because no phonological features are present in the noise (Salamé&

Baddeley, 1987). As the phonological similarity of the background speech babble to the target items increases, recall performance decreases (Salamé&Baddeley, 1982). Speech babble has thus been considered a more taxing distracter for the central executive, drawing resources away from the storage domains of memory to support the processing and decoding of the auditory signal. However, recall of items with low predictability may be less impervious to interference from nonspeech noise. Adults have poorer recall of nonsense syllables in the presence of nonspeech noise relative to quiet (Surprenant, 1999).

Few studies have investigated the influence of background noise on working memory in people with hearing loss. Pichora-Fuller et al. (1995) assessed working memory in older and younger participants by asking them to remember the final word of each sentence in a list while listening in varying levels of background noise. This study did not target adults with hearing loss specifically (all participants had normal hearing between 250 and 3000 Hz); however, older participants with hearing loss at frequencies above 3000 Hz were included. For the older participants, performance was significantly worse when listening in 0 dB signal-to-noise ratio (SNR) than when listening in +5 dB SNR. This difference was interpreted as evidence that resources that had been used for recall in the +5 dB SNR condition were now being reallocated for processing in the 0 dB SNR condition, to the detriment of memory performance in older adults.

In summary, the addition of random noise to a working memory task does not affect adults' performance unless the test items are of low predictability. The addition of speech babble reduces adults' performance regardless of the predictability of the test items. It is not known whether and to what extent background noise affects children's performance on tests of working memory. CHL may experience greater declines in the presence of background noise than CNH due to their already atypical auditory perception.

Current Study

In this study, we asked whether children with mildto- moderate hearing loss, like their peers who are deaf, present with deficits in working memory and whether their working memory abilities correlate with the size of their receptive vocabularies. Our predictions, listed below, pertain to differences between CHL and CNH in vocabulary, working memory capacity, and strategies for utilizing working memory.

1. In accord with previous findings, we predicted that CHL would present with smaller vocabularies than their CNH peers.
2. Given the working memory deficits that characterize children with cochlear implants, we hypothesized that milder forms of hearing loss would also impede the development of working memory. Table 1 depicts the relationship between the assessment tools, input modality, and the related components from Baddeley's (2000) working memory model. We did not predict group differences in executive function, but we did classify children in both CHL and CNH groups as having high or low executive function because of the known influence of executive ability on working memory processing.We predicted that theCHL in our sample would demonstrate phonological loop deficits and would show deficits in performance on the forward and backward digit span task and on the McGarr sentence task compared to their CNH peers. We did not predict group differences in Corsi block performance; this should not be influenced by phonological loop integrity.
3. We hypothesized that hearing loss would result in different encoding preferences. We tested this hypothesis by comparing the recall strategies of the CHL and CNH groups on the sequential encoding task of O'Connor and Hermelin (1973).
4. We hypothesized that hearing loss would impede development of the auditory advantage for serial recall. We tested this hypothesis by comparing performance on the auditory and visual modalities of the forward and backward digit span tasks.
5. We hypothesized that stressing the working memory system would impede working memory processes in real time, particularly in maintenance of item traces in storage. We tested this hypothesis by comparing performance on serial recall in noise and in quiet. We predicted that the performance of CHL would be particularly vulnerable to the presence of noise, as cognitive loading in these children may already be

disproportionately allocated to the decoding of the auditory signal in quiet.

6. Because of the hypothesized relationship between working memory and vocabulary development, we predicted that performance on the working memory measures-in particular, on the forward and backward digit span-would correlate with receptive vocabulary size.

Methods Participants

To be included in the study, CHL met the following criteria: (a) their primary means of communication was oral, (b) they were enrolled in an oral classroom, and (c) they were fit with nonfrequency compression hearing aids in both ears. Children with or without hearing loss were required to pass a vision screening (20/40 criterion) and have middle-ear admittance greater than 0.2 mmho in either ear. The University of Iowa Institutional Review Board approved the study protocol, and all participants received compensation upon completion of the study.

Participants were 18 children with mild-to-severe sensorineural hearing loss fit with bilateral hearing aids (CHL) and 28 CNH enrolled in the study. One CHL was excluded for using frequency compression amplification and one due to behavioral difficulty. One CNH was excluded for identification of unilateral hearing loss and three to better match the age range of the CHL group. The mean ages of the resulting groups- 16 CHL (6 boys, 10 girls, mean age 92;3 [year;months]) and 24 CNH (13 boys, 11 girls, mean age 94;9)-did not differ, $t(38) = 0.728$, $p = .47$. These same children participated in tasks designed to measure their access to the speech signal, results of which are reported in Stiles, Bentler, and McGregor (in press).

Table 2 shows mean and standard deviation of audiometric thresholds for the CNH and CHL groups. Groups did not differ in nonverbal aptitude as measured with the Block Design and Picture Completion subtests of the Wechsler Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1991), $t(38) = 0.108$, $p = .91$; $t(38) = 0.713$, $p = .48$, respectively.

When testing members of the CHL group, hearing aids were kept at the user settings. Real-ear measures were performed to ensure that participants had access to the average speech spectrum. All participants had functioning amplification. The hearing aid fitting of most participants was consistent with desired sensation level (DSL) targets, although some participants' fittings did not reach DSL targets. During the experiment, the examiner ensured that all children reported understanding of test instructions. The examiner made no changes to the hearing aid programming but did notify the caregiver of any concerns regarding the hearing aid fitting (e.g., output not to DSL targets) upon completion of the experiment.

Tasks

Tasks used in the experiment included the Peabody Picture Vocabulary Test-III (PPVT-III; Dunn &Dunn, 1997), which is often administered by speech-language pathologists, and working memory tasks that may typically be administered by a psychologist. All tasks were administered by the principal investigator or a trained graduate assistant. The PPVT-III was administered early in the first visit along with the WISC-III subtests and lexical tests reported in Stiles, Bentler, and McGregor (in press). Children returned within two weeks for the working memory portion of the experiment. The order of working memory tasks were sequential encoding, forward digit span, backward digit span, and Corsi span. This test order was maintained across subjects because it was the most efficient order for setting up and breaking down the various conditions. Participants took a short break between backward digit span and Corsi span tasks to allow the examiner time to set up the equipment. Total test time was approximately 2.5 hr, although this could vary depending on how soon participants reached ceiling set in the PPVT-III and memory span tasks.

Peabody Picture Vocabulary Test. Researchers assessed receptive vocabulary using the PPVT-III and following the procedures described in the test manual. Children sat opposite the examiner facing a stimulus book consisting of a series of four-alternative picture plates. The examiner gave the target word, and the participant selected the response they believed represented the target.

Six measures tapped different aspects of memory span: (a) The Learning, Executive, and Attentional Functioning (LEAF) scale (Kronenberger, 2006) provided an index of executive function based upon parent

assessment, (b) articulation rate reflected the subvocal rehearsalmechanismof the phonological loop, (c) forward digit span reflected short-term verbal memory supported by long-term lexical knowledge (digit stimuli are familiar to and rehearsed by children in serial recall tasks; Gathercole &Adams, 1994), (d) backward digit span added a "working" component by measuring the participants' ability to recall and manipulate verbal strings, (e) the Corsi span provided a visuospatial analog to the forward digit span, and (f) sequential encoding indicated whether children engage the phonological loop for a visually presented sequence of items.

LEAF. Parents described their child's executive function with the Planning and Sequential Processing subscale of the LEAF scale. Examples of items from this subscale include "Doesn't plan ahead" and "Loses track of step-by-step directions."

McGarr Sentence Repetition. The McGarr sevensyllable sentences (McGarr, 1983) were used to obtain articulation rate information. The test contains two lists of 6 seven-syllable sentences. For this task, each child wore a lavalier microphone connected to a digital audio recorder. Each child was instructed to repeat the sentence after they had finished hearing it. Participants simultaneously saw and heard each seven-syllable sentence as it was presented. Six sentences were presented in quiet and six in the presence of background noise (see below). The lists presented in quiet and noise were counterbalanced across children. We used Adobe Audition Version 1.0 software to measure sentence duration after conversion to .wav format. The mean sentence duration was calculated separately for the six sentences in quiet and the six sentences in noise for each child.

Forward Digit Span.We evaluated working memory capacity using the forward digit span task. In this task, each child repeated back a string of digits in the same order in which they were presented. Digits were presented at 1-s intervals.Within any given string, no digits were repeated. Additionally, the number "7" was excluded from presentation so that all digits were monosyllabic. Children repeated two strings at each length. Testing began with strings of three digits. If either of the 3-digit strings were repeated accurately, then the number of digits increased to 4 digits per string. This incremental growth in string length continued until both strings of a single length were repeated back incorrectly or until the child reached a ceiling of 8 digits per string, at which point the examiner terminated the procedure.

The forward digit span was administered in four conditions: auditory-quiet, auditory-noise, visual-quiet, and visual-noise. The presentation order of these conditions was counterbalanced across children within each group. In the auditory conditions, participants heard digits spoken at a rate of one per s at a level of 65 dB SPL from a monitor-mounted speaker at 0° azimuth at a distance of .5 m. In the visual conditions, digits 3 in. in height were presented sequentially at a rate of one per s, in the center of the monitor, each one replacing its predecessor. Unlike the sequential encoding task, serial order was only defined temporally; there was no variation in spatial information. In the noise conditions, background noise was presented from two speakers at ±110° azimuth at a distance of 1 m.

Scoring was adapted from the procedure used in the WISC-III. We calculated forward digit span scores with the following formula: 2 + 0.5 ×(number of correct responses). Because the forward digit span begins at three digits, the constant (2) represents the baseline span. Two strings are presented at each length; each item is worth one half point. If a participant gets no items correct, his score would be 2. If he gets both items correct at a level, his span score increases by one, as does the number of digits he will hear in the next stimulus presentation. Thus, the score approximates the maximum span length the participant can accurately recall.

Backward Digit Span. Working memory capacity and processing were evaluated using the backward digit span task. In this task, each child repeated back a string of digits in the reverse order of presentation. For example, if the stimulus were "2 - 5 - 9," then the target response would be "9 - 5 - 2." Test administration was the same as for forward digit span with one exception: Testing began with strings of two digits instead of three. As it was in the forward digit span task, the backward digit span was administered in four conditions: auditoryquiet, auditory-noise, visual-quiet, and visual-noise. Equipment setup for backward digit span was the same as for forward digit

span. Backward digit span scores were calculated as 1 + 0.5 ×(number of correct responses).

Corsi Span. The Corsi block array consists of nine cubes mounted on a board (Corsi, 1972). In this task, the examiner taps a sequence of blocks, one block per s. The child then taps the blocks in the same order in which they were tapped by the examiner. Testing begins with two trials of one block each and continues in twotrial intervals to a maximum eight-block sequence. For any given test taker, if both trials at a given level are repeated back incorrectly, then the examiner terminates the procedure.

The examiner administered the Corsi span in two conditions: quiet and noise. Corsi span scores were calculated as 0.5 ×(number of correct responses).

Sequential Encoding. We assessed phonological encoding using a test adapted from O'Connor and Hermelin (1973). The premise of this test is that children with a preference for phonological encoding will consistently repeat back visually presented items in relation to their temporal order (i.e., first to last), and children with a preference for visual coding will consistently repeat back the items in relation to their spatial location (i.e., leftto right). Three digits were presented sequentially, one per s, in each of 10 trials. Each digit appeared in the left, center, or right third of the monitor. Within a trial, no digit appeared in the same location more than once (i.e., all three locations were used in each trial), and the order of locations could be any, excluding left-middle-right. Each child was instructed to repeat back the numbers they saw at the end of each trial.

During the articulation rate, digit span, and sequential encoding tasks, children sat approximately 0.5 m in front of a monitor. A speaker was mounted below the monitor for presentation of auditory stimuli. All auditory stimuli were calibrated to 65 dBA SPL at 0.5 meters from the speaker, where the participant would be seated. The sequential encoding task was administered in quiet only. The other tasks were administered in a quiet condition and a noise condition.

Experimental Background Noise

The forward digit span, backward digit span, Corsi span, and McGarr sentence repetition tasks included the presence of background noise in at least one condition. As mentioned above, noise can be a masker, a distracter, or both. For the purposes of this study, we were interested in a noise that would not be loud enough to mask the stimuli of interest but may represent a common distraction: air conditioning noise. Tang and Yeung (2006) described the noise spectrum of an unoccupied classroom (windows closed, air conditioning on), which we replicated for this study (see Figure 1). It was not certain how CHL would perform in the presence of random noise, although performance of adults with normal hearing typically does not vary with random noise. If adults with normal hearing demonstrate poorer memory in the presence of speech babble, then it is almost certain that CHL will as well.We were more curious to learn whether CHL would suffer in the presence of a background noise typically considered innocuous.

Using Adobe Audition Version 1.0, we filtered a broadband signal to match the spectrum presented in Tang and Yeung (2006). We verified the spectrum in the soundfield of a sound-treated audiometric booth in the conditions of the study, with noise presented from the same speakers used to present noise and the microphone of a Grason-Stadler sound-levelmeter placed in the center of the booth, approximately 1 m from the speaker. A 20-min sample was generated within Adobe Audition Version 1.0 and saved to a portable digital audio player.

Results

Statistical analyses were performed using SPSS software, Version 17 (Statistical Package for the Social Sciences, 2008). Age and socioeconomic status were included as covariates in the analyses of variance because of their known relation to memory and vocabulary development (Gathercole, Pickering, Ambridge, &Wearing, 2004; Hart &Risley, 1995).

Vocabulary

Receptive vocabulary level was quantified with the PPVT-III standard scores. These results are reported in Stiles, Bentler, and McGregor (in press). Mean scores were 93.94 (SD = 13.95) for CHL and 110.00 (SD = 13.38) for CNH. As predicted, CHL had smaller receptive vocabulary than CNH, $t(38) = 3.66$, $p = .001$, $d = 1.18$.

Executive Function

Performance between CNH and CHL was not significantly different on the Planning and Sequential Processing subscale of the LEAF scale, $t(38) = 0.64$, $p = .53$. Children were classified as high or low executive function via a median split of scores for all participants. High executive function ratings were given to 7 CHL and 13 CNH, and low executive function ratings were given to 9 CHL and 11 CNH. This executive function variable was included in analyses of working memory performance.

Articulation Rate

Analysis of covariance (ANCOVA) was performed with average sentence duration as the dependent variable and group, list, and presence of background noise as independent variables. Age was found to be a significant covariate, $F(1, 79) = 13.76$, $p < .001$, with younger children demonstrating longer durations than older children. There were no significant main effects for list or presence of background noise. There was a significant main effect for group, $F(1, 79) = 13.90$, $p < .001$. Mean sentence duration was 2.26 s (SD = 0.37) for CHL and 2.01 s (SD = 0.23) for CNH ($d = -.87$). Figure 2 shows the average sentence duration in quiet and noise for each participant as a function of age. Although the group difference within our sample was only 0.25 s, the articulation rates of CHL are equivalent to rates of CNH more than a year younger.

Table 3 summarizes the scores of CHL and CNH on the digit span and Corsi span tests. Figure 3 displays the scores for CHL and CNH on forward and backward digit span by modality and by noise condition. For all digit span analyses, age and maternal education were covariates, and group, modality, presence of background noise, and executive function classification were independent variables.

Forward Digit Span

Table 4 summarizes the ANCOVA performed with forward digit span points as the dependent variable. The effect of maternal education was significant, $F(1, 159) = 8.82$, $p < .01$; higher maternal education level was associated with longer digit spans. There was no significant contribution of age. There was a significant main effect for modality, $F(1, 159) = 13.64$, $p < .001$. Digit spans were longer when stimuli were presented via the auditory modality (see Figure 4). There were no significant main effects for group, $F(1, 159) = 2.87$, $p = .09$, presence of background noise, or executive function classification.

Correlations between articulation rate and forward digit span were calculated for each group. There were no significant correlations for CNH ($r = -.11$, $p = .60$) or for CHL ($r = .04$, $p = .89$).

Backward Digit Span

We performed an ANCOVA with backward digit span points as the dependent variable. The effect of age and maternal education was not significant. There was no significant main effect for group, $F(1, 151) = 2.80$, $p = .10$, nor any other main effects nor any interactions.

Corsi Span

Table 5 summarizes the ANCOVA performed with Corsi span points as the dependent variable. Significant main effects were found for group, $F(1, 79) = 4.49$, $p < .05$, and executive function, $F(1, 79) = 4.28$, $p < .05$. CHL demonstrated shorter Corsi spans than CNH. Children with better executive function had longer Corsi spans than children with poorer executive function. No significant main effect was found for presence of background noise. A significant interaction between group and executive function was present, $F(1, 79) = 12.46$, $p < .01$. CHL with low executive function had shorter spans than CHL with higher executive function. CNH had the same Corsi span regardless of executive function (see Figure 4).

Phonological Encoding

Repetitions on the sequential encoding task that matched the temporal order of presentation were coded as phonologically biased. The number of phonologically biased responses, out of a possible 10, was calculated for each child. Mean score for the CHL group was 7.88 (SD = 2.60). Mean score for the CNH group was 8.38 (SD = 2.95). There was no significant difference in phonologically biased responses between groups (Mann- Whitney

U = 141.5, p = .14, d = .18). Both groups demonstrated high phonological bias suggesting active engagement of the phonological loop over the visuospatial sketchpad in recall of visually presented digits.

Relationship Between Memory and Vocabulary

We examined the relationship between receptive vocabulary and the working memory tasks using a correlational analysis. Including data from all participants, PPVT-III standard score was found to significantly correlate to digit span in the quiet condition (Pearson's r = .33, p <.05), to Corsi span in the noise condition (Pearson's r = .33, p <.05), and to McGarr sentence duration (Pearson's r = -.52, p = .001). However, when correlational analyses were performed separately for CNH and CHL groups, PPVT-III standard score did not correlate to any working memory task nor to sentence duration (see Figure 5). This may have been due to a lack of variance in either group, as CHL tended to cluster at the lower end and CNH at the higher end of the spectrum of PPVT-III scores.

Summary

CHL had significantly smaller receptive vocabularies than CNH. The articulation rate of CHL was significantly slower than that of CNH. Digit spans did not differ between groups. Corsi span was significantly weaker in CHL and children with low attention ratings. CHL and CNH did not differ significantly in their performance on the sequential encoding task; both groups demonstrated a phonological (nonvisuospatial) coding preference. Both groups demonstrated auditory advantage, that is, better performance for items presented via the auditory modality than the visual modality. The presence of low-level random background noise during the working memory span tasks did not cause a significant decline in performance for either CHL or CNH. Children with larger vocabularies had faster articulation rates and performed better on the digit span in the auditory-quiet condition and on the Corsi span in the noise condition.

Discussion

In this study, we examined whether 6- to 9-year-old children with mild-to-moderate degrees of hearing loss have deficient working memory and, if so, whether this deficit is associated with their smaller vocabulary sizes. With the exception of articulation rate, an indicator of subvocal rehearsal, we found no significant effects of hearing loss on the development of working memory overall. These results were similar to the results of Hansson and colleagues' (2004) study of 9- to 13-yearold children. There also was no disruption of the working memory system in a noisy environment. Despite this, CHL did show smaller vocabularies than CNH. In the following paragraphs, we discuss the resilience of these children as well as some areas of continued concern.

We hypothesized that CHL would demonstrate deficits in the phonological loop of working memory in favor of visual encoding strategies. Instead we found evidence of the phonological bias and auditory advantage in CHL. Unlike children who are deaf (O'Connor &Hermelin, 1973), CHL were attuned to the temporal sequence of visually presented items, suggesting active engagement of the phonological loop to encode these items into memory. Also, CHL, like CNH, could recite back longer strings of digits when presented in the auditory modality than presented in the visual modality. This finding suggests that the mechanism supporting the auditory advantage in working memory is present and active in children with mild-to-moderately severe hearing loss communicating orally.

The selection criterion of children educated in oral classrooms may also contribute to these results. Indeed, it was found that children with cochlear implants in oralonly programs demonstrated longer memory spans than children with cochlear implants in total communication programs (Pisoni &Cleary, 2003). Canadian children in oral education programs demonstrated similar reading spans as CNH (Daneman et al., 1995). It is possible that the oral learning environment is conducive to working memory development. Another possibility is that CHL with working memory impairments may have been previously identified with learning difficulties and placed in a total communication learning environment.

On the other hand, CHL articulated more slowly than CNH. Sentence durations of CHL in this sample were significantly longer than those of CNH. In CHL, articulation rate may vary depending on auditory feedback

experience, which allows children to self-monitor and improve their speech articulation, motor control, and intelligibility (Burkholder &Pisoni, 2003). Slower articulation rates are associated with a less efficient subvocal articulatory mechanism in working memory.With slower rehearsal, fewer items can be refreshed in the phonological loop in a given time (Cowan &Kail, 1996). Some researchers have suggested that the slower articulation rate and smaller digit spans of cochlear implant users reflect a compromised verbal rehearsal process that limits their processing capacity (Pisoni &Cleary, 2003). In our study, the difference between sentence durations of CHL and CNH did not translate to a significant group difference in digit span in a sample of this size. This may be related to the very narrow range of sentence durations found in this sample. Children with cochlear implants demonstrated a wide range of sentence durations, some as long as 6 s (Pisoni &Cleary, 2003). CHL in our study were able to articulate faster than the cochlear implant users. Although CHL andCNH differed in their mean sentence durations, the mean difference was less than a half s, and the mean durations for both groups were less than 2.5 s. This higher rate of articulation on the part of CHL may partially explain how they were able to demonstrate similar memory spans as CNH.

Another area of weakness among CHL was their performance on the Corsi span task, used to assess visuospatial short-term memory. The spans of CHL with high executive function were not different from the spans of CNH, regardless of executive function, but CHL with low executive function had significantly shorter spans than CHL with high executive function and CNH. This pattern of results was rather surprising. The Corsi span represented the one working memory test that was both the least phonological and the least auditory. We would have expected the difference in performance to appear in an auditory and phonological test, such as the digit span.

We speculate that this unexpected finding is an effect of fatigue. We administered the memory span tasks in the same order for all participants: forward span, backward span, and Corsi span. Those who found these tasks more difficult, namely CHL with low executive function, may have tired by the time the Corsi span was administered. Our results could be considered an interaction between group, executive function, and time wherein, by the time of the third task, CHL with low executive function could no longer maintain performance. In the future, administration of the tasks in counterbalanced order would enable a test of this hypothesis.

Effects of Noise

We used background noise with the intention to divert executive resources from maintaining working memory to decoding the compromised input signal. This did not occur. This may not be unusual, as previous studies in adults have failed to show a negative effect of background random noise on memory tasks (Salamé &Baddeley, 1987). The current study has extended these findings to children with and without hearing loss. Performance on the digit and Corsi span tasks was the same whether in the presence of noise or in quiet. This may be explained because either (a) the background noise was not disruptive enough to require the reallocation of executive resources in the working memory tasks, or (b) the resources necessary to decode the signal in noise are not related to the resources used in the working memory tasks. Of these two explanations, we favor the former.

In this study, the background noise was essentially low-pass random broadband noise filtered to match the spectrum of a classroomwith an air conditioner running (Tang &Yeung, 2006). This type of noise was selected for its minimal masking effect. Although this noise was audible, its energy was primarily at frequencies below 1000 Hz. Auditory digit span stimuli would have been presented at an approximate +15 dB SNR, which is considered to be a rather good SNR for a classroom(American National Standards Institute, 2002). The background noise was also unmodulated and therefore less disruptive than a modulated noise like speech babble may have been. Other studies have found that speech babble has a greater negative effect than random noise, and that random noise needs to be louder than speech noise to equally degrade working memory in adults (Andrade, 2001; Murphy et al., 2000). Future studies may systematically investigate the effect of different noise types and levels on working memory in children.

With the exception of articulation rate, CHL were not at a disadvantage for working memory compared to CNH.

We had hypothesized that CHL would have poorer performance in the presence of this background noise. Although the children's hearing aids may have included a noise reduction algorithm, it is unlikely that it was activated at the level of background noise present during the working memory tasks (Bentler &Chiou, 2006). It may simply have been that, as in adults, the background noise was not intrusive enough to affect the children's cognitive processes. Ultimately, we cannot conclude that this type of background noise is never detrimental to CHL; stimuli that are more complex or less probable than digits may take more effort to preserve in the presence of low-pass random noise, as is the case with nonsense syllables for adults (Surprenant, 1999). With the stimuli used here, however, CHL were not at any disadvantage relative to CNH. Future studies that include noise more typical of a classroom setting- that is, noise that mimics not only air conditioning but also children moving about and talking-would be valuable.

Typical vocabulary acquisition requires intact peripheral and central domains, such as hearing and working memory (Gathercole &Baddeley, 1989). Although CHL are known to have smaller vocabularies than CNH, there has not been an attempt to determine whether this discrepancy is driven only by hearing loss or whether secondary factors such as working memory may also come into play. Considering that children with profound hearing loss and children with cochlear implants demonstrate working memory deficits, it was cogent to hypothesize that children with milder degrees of hearing loss would as well and that this would impede vocabulary acquisition. In our sample, the CHL group had a significantly smaller vocabulary size than the CNH group. However, there was no evidence to support the hypothesis that this discrepancy is fundamentally related to a working memory deficit.

Conclusion

We hypothesized that CHL would demonstrate poorer working memory compared to CNH. The working memory differences we found were limited to the Corsi span (CHL with lower executive function had reduced visuospatial working memory relative to CHL with higher executive function and CNH) and articulation rate (CHL had slower rates than CNH, but no subsequent phonological working memory deficits were noted). Overall, the performance of CHL defied our expectations, as these children showed resilience in working memory, even when low-level background noise was present.

In addition to performing like their peers with normal hearing on tests of working memory, CHL and CNH were not rated differently on the parent surveys of executive function. CHL were not any more likely to be rated as having difficulties with attention and processing. We do have some evidence that, although the incidence of lower executive function (per parent rating) is not different, the effect of lower executive function may be more detrimental for CHL, as those children with both hearing loss and low executive function showed decreased performance on the final memory task of the series compared to all other children in the study. Further research may help determine whether an evaluation of attention in CHL can be used as a flag for academic risk.

Considering the similar performance of CNH and CHL, it is unlikely that the domains of working memory measured in this study are responsible for the smaller vocabulary levels of CHL.Rather, theymay simply reflect these children's reduced access to the acoustic signal, resulting in an accumulation of missed word-learning opportunities. We report evidence of this from these same participants in Stiles, Bentler, and McGregor (in press).

This research is a first step in examining working memory in CHL. In a controlled environment with stimuli of high predictability, the presence of low-pass random background noise did not reduce working memory performance for either CNH or CHL. Thus, in optimal conditions and conditions where the working memory system was slightly stressed, CHL performed like CNH. These results indicate a resilient working memory system among CHL. Given that CHL continue to demonstrate poorer language outcomes than their normal hearing peers, it is important to determine under what conditions the working memory system may break down and, as a consequence, limit language-learning opportunities for these children. Further research using stimuli with lower predictability or more speechlike background noise will help determine whether CHL continue to

show typical working memory performance under more difficult conditions. Determining the degree to which differences in working memory factor into lexical development of CHL will clarify whether and to what extent interventions focusing on working memory are appropriate for this population.

Acknowledgments

We would like to acknowledge the assistance of Joan Marttila and Laurie Cooley at Iowa Area Education Agency No. 9; Dawn Violetto at Illinois Child's Voice; and David Pisoni, Christopher Turner, Sandie Bass-Ringdahl, and Kristin Perk for their contributions and support of this study.

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Editor: Sid Bacon
Associate Editor: Emily Tobey
Received January 24, 2011
Accepted June 1, 2011
DOI: 10.1044/1092-4388(2011/11-0021)

Publication date: Feb 2012

Year: 2012

Lack of Generalization of Auditory Learning in Typically Developing Children

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 168-181.
ProQuest document link

Abstract: To understand the components of auditory learning in typically developing children by assessing generalization across stimuli, across modalities (i.e., hearing, vision), and to higher level language tasks. Eighty-six 8- to 10-year-old typically developing children were quasi-randomly assigned to 4 groups. Three of the groups received twelve 30-min training sessions on multiple standards using either an auditory frequency discrimination task (AFD group), auditory phonetic discrimination task (PD group), or visual frequency discrimination task (VFD group) over 4 weeks. The 4th group, which was the no-intervention control (NI) group, did not receive any training. Thresholds on all tasks (AFD, PD, and VFD) were assessed immediately before and after training, along with performance on a battery of language assessments. Relative to the other groups, both the AFD group and the PD group, but not the VFD group, showed significant learning on the stimuli upon which they were trained. However, in those instances where learning was observed, it did not generalize to the nontrained stimuli or to the language assessments. Nonspeech (AFD) or speech (PD) discrimination training can lead to auditory learning in typically developing children of this age range. However, this learning does not always generalize across stimuli or tasks, across modalities, or to higher level measures of language ability.

Full text: Headnote

Purpose: To understand the components of auditory learning in typically developing children by assessing generalization across stimuli, across modalities (i.e., hearing, vision), and to higher level language tasks.
Method: Eighty-six 8- to 10-year-old typically developing children were quasi-randomly assigned to 4 groups. Three of the groups received twelve 30-min training sessions on multiple standards using either an auditory frequency discrimination task (AFD group), auditory phonetic discrimination task (PD group), or visual frequency discrimination task (VFD group) over 4 weeks. The 4th group, which was the no-intervention control (NI) group, did not receive any training. Thresholds on all tasks (AFD, PD, and VFD) were assessed immediately before and after training, along with performance on a battery of language assessments.
Results: Relative to the other groups, both the AFD group and the PD group, but not the VFD group, showed significant learning on the stimuli upon which they were trained. However, in those instances where learning was observed, it did not generalize to the nontrained stimuli or to the language assessments.
Conclusions: Nonspeech (AFD) or speech (PD) discrimination training can lead to auditory learning in typically developing children of this age range. However, this learning does not always generalize across stimuli or tasks, across modalities, or to higher level measures of language ability.
Key Words: auditory learning, generalization, children, training

Auditory learning can be defined as an improvement in the ability to detect, discriminate, or categorize a sound or a set of sounds. Typically, this follows and is caused by a period of auditory training, where the listener has to repeatedly judge sounds in some way via a task. Training almost invariably results in improved performance on the stimulus encountered during training, but a question of greater practical and theoretical importance is whether the training improves performance on an untrained stimulus or task, referred to as generalization. Although a growing number of studies are now assessing auditory learning and generalization in adults (for a review, see Wright &Zhang, 2009a, 2009b), there is a relative dearth of studies examining these phenomena in children. However, this area is of particular interest because of the existence of several auditory training programs that are already being used both in research and in a clinical context, particularly in children with communication and/or learning disorders (for a review, see Moore, Halliday, &Amitay, 2009).To assist in interpreting the results of these applications, it is important that we investigate-under more controlled conditions-the factors that underlie auditory learning and, in particular, generalization in typically developing children.

Studies of auditory learning in adults have identified a number of principles. Auditory learning can be observed through the use of a variety of stimuli and across a variety of tasks (e.g., signal detection, frequency discrimination, temporal-interval discrimination, relative timing, amplitude-modulation rate discrimination, interaural level and time differences, intensity discrimination, phonetic discrimination; seeWright &Zhang, 2009a, for a review; Kraus et al., 1995; Tremblay, Kraus, Carrell, &McGee, 1997). It can occur rapidly, over the course of a single session (e.g., Hawkey, Amitay, &Moore, 2004; Ortiz &Wright, 2009), but it can also be prolonged and observed overmultiple sessions (Wright&Zhang, 2009a). It has been observed following passive exposure as well as active stimulus engagement (e.g., Amitay, Irwin, &Moore, 2006;Wright,Sabin, Zhang, Marrone,&Fitzgerald, 2010), and even following training on an impossible discrimination task in which there are no physical differences between the stimuli (Amitay et al., 2006; but see Micheyl, McDermott, &Oxenham, 2009).

Following auditory training, the extent to which generalization occurs-along with the patterns of generalization-allows us to make inferences about the components of learning as well as the neural processes affected by training. Auditory learning in adults has often been shown not to generalize (a) across stimuli when the task is held constant or (b) across tasks when the stimuli are held constant (Ortiz&Wright, 2009; for a review, see Wright &Zhang, 2009a; cf. Hawkey et al., 2004; Lakshminarayanan &Tallal, 2007). These findings have been interpreted as evidence for stimulus and task learning, respectively. There are some reports, however, of generalization of learning across both stimulus and task when all other aspects of training remain the same

(Beard, Levi, &Reich, 1995; Sireteanu &Rettenbach, 2000; cf. Hawkey et al., 2004). These findings suggest some degree of learning the more general aspects of the training procedure (termed procedural learning).

The handful of studies that have been conducted in children have shown that, as in adults, auditory learning can be observed using a variety of stimuli on a variety of tasks, including pure-tone frequency discrimination (Halliday, Taylor, Edmondson-Jones, &Moore, 2008), dichotic pitch perception (Edwards, Giaschi, Low, &Edgell, 2005), temporal-interval discrimination (Huyck &Wright, 2011), glide direction identification (Merzenich et al., 1996), and phonetic identification (Merzenich et al., 1996) and discrimination (Moore, Rosenberg, &Coleman, 2005). Learning in children has also been observed following training with single (Halliday et al., 2008; Huyck &Wright, 2011) as well as multiple (Moore et al., 2005) standards, and following single (Halliday et al., 2008) as well as multiple (Huyck &Wright, 2011; Merzenich et al., 1996; Moore et al., 2005) training sessions.

Qualitative differences in auditory learning have, however, been reported between adults and children. Halliday et al. (2008) found that 6- to 11-year-olds varied both across and within age groups, according to their pattern of learning on a frequency discrimination task. A general developmental trend of more consistent learning was obtained, but even the oldest group had mean thresholds considerably above those of an adult group. Within all age groups, however, some children performed in an adultlike fashion, whereas others showed a fluctuating pattern of learning. Recently, Huyck and Wright (2011) also reported learning on a temporalinterval discrimination task that remained immature into adolescence, beyond 14 years of age. Similarly, Sarro and Sanes (2009) showed a protracted development of auditory learning in immature gerbils. Therefore, these findings agree that auditory learning has a prolonged developmental time course.

Some evidence suggests that nonsensory factors might be particularly important for auditory learning in children. For instance, Halliday et al. (2008) found that learning was predicted not only by chronological age but also by attention and IQ. Stevens, Fanning, Coch, Sanders, and Neville (2008) reported electrophysiological evidence for changes in selective attention in 6- to 8-year-olds following a high-intensity intervention that included auditory training. Temple et al. (2003) found functional changes in brain regions associated with attention and memory in 8- to 12-year-old children with dyslexia following participation in a similar program.

The few studies that have assessed generalization of auditory learning in children have yielded conflicting results. Halliday et al. (2008) found that learning did not generalize either to a different stimulus or to a different presentation paradigm, suggesting that it was confined to the trained stimulus. In contrast, several studies reported broad generalizations of learning to higher level language assessments following auditory training in typically developing children (Moore et al., 2005) as well as in children with language and reading impairments (Habib et al., 1999; Merzenich et al., 1996; Schäffler, Sonntag, Hartnegg,&Fischer, 2004; Strehlow et al., 2006;Tallal et al., 1996; cf. Cohen, Hare,O'Boyle,& McCartney, 2005; Given, Wasserman, Chari, Beattie, &Eden, 2008; McArthur, Ellis, Atkinson,&Coltheart, 2008).

In the present study, we aimed to assess generalization of auditory learning in typically developing children assigned to one of four groups. Three of the groups received 6 hr of training over 4 weeks on either (a) a frequency discrimination task; (b) a phonetic discrimination task that had the same procedure and modality as (a) but a different task and different stimuli; or (c) a visual frequency discrimination task that had the same procedure as (a) but a different modality, task, and different stimuli. A fourth group, which served as the control, received no training. To assess learning, we examined changes in the performance of the three trained groups on their trained stimuli and tasks both during the training phase and immediately before (pre-) and after (post-) training. To assess generalization of learning, we compared the pre- and post-training performance of children on the stimuli and tasks upon which they did not receive training and on a battery of standardized phonological processing and reading fluency tests. We reasoned that if learning on any of the tasks was due to procedural factors, we would expect to see broad generalization of learning to the untrained stimuli and tasks. If, on the other hand, learning was due to each specific stimulus/ task trained, little or no generalization to the untrained

stimuli or tasks would be seen. Any other pattern of results would indicate generalization of stimulus/task learning. Either stimulus/task or procedural learning could contribute to broad generalizations to language ability.

Method

Ethics

All methods were approved by the Nottingham National Health Service Research Ethics Committee.

Participants

The parents/guardians of 94 children from years 4 and 5 (ages 8-9 years, and 9-10 years, respectively) of two mainstream primary schools in Nottingham, United Kingdom, gave written consent for their children to be included in this study. Prior to being included, children were required to (a) pass an audiometric screen in a quiet roomin their school using sound-attenuating headphones (pure-tone thresholds≤30 dBHL at 1 kHz, 2kHz, and 4 kHz, to allow for reduced sound-attenuated testing); (b) have no known physical, neurological, or psychological problems; and (c) have no previous experience of psychophysical testing. Parent/guardian responses to questionnaires indicated that four children failed to meet the second inclusion criterion, owing to diagnoses of cerebral palsy (n = 1), epilepsy (n = 1), and autism spectrum disorders (n = 2). These children were not included in the study. In addition, four children went on holiday during the training phase and, thus, were excluded from the study. This lefta total sample size of 86 children. Of these, parental/guardian reports indicated that 74 spoke English as their first language. Of the 12 children who did not speak English as their first language, nine children had been learning English for between 3 and 6 years (M = 4.17 years, SD = 1.17 years). The remaining four children were reported to be bilingual. Including these children in the analyses did not affect the results of the study.

Children were quasi-randomly assigned to one of four groups: auditory frequency discrimination (AFD group), phonetic discrimination (PD group), visual frequency discrimination (VFD group), and no-intervention control (NI group). Participant allocation was stratified according to gender (male or female), year group (4 or 5), and native English status (native or non-native). Furthermore, children who were reported to have any visual problems (n = 2; strabismus, astigmatism) were not included in the VFD group.

Participant characteristics for each of the four groups are showninTable 1. Although, in theory, randomization of participants to each of the four groups should result in similar distributions of participant characteristics across the four groups, this was confirmed using a series of analyses of variance (ANOVAs) and c2 analyses. The four groups did not differ significantly (criterion of $p < .05$) by age, $F(3, 82) = 0.19$, $p = .906$, or by nonverbal IQ, $F(3, 82) = 0.62$, $p = .606$, as assessed through use of the Matrix Reasoning subtest of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). Across the four groups, there were no differences in gender, $c2(3) = 0.36$, $p = .948$; English-speaking status, $c2(6) = 3.21$, $p = .782$; or parental education levels [mother, $H(3) = 6.16$, $p = .104$; father, $H(3) = 1.50$, $p = .682$].

Design

Great care was taken to balance the distribution of children across groups, to provide each group with a highly similar and encouraging environment and social setting, and to make the training programs procedurally similar to each other. Three (AFD, PD, and VFD) of the four groups of children completed a training program plus a pre- and post-training assessment. The NI group completed only the pre- and post-training assessments and participated in their usual classroom activities during the training phase. However, in order to control for experimenter familiarity, experimenters met with the NI group for approximately 5 min per week during the training phase. Children in the three training groups were not aware that the other groups were receiving different forms of training. Experimenters were not blind to the children's group status. However, each child was tested by a different experimenter in the pre- and posttraining phases, ensuring that experimenters at posttraining were blind to the children's pre-training scores. At each school, the three training groups were trained in separate sessions on a whole-group basis. Children were tested individually for their pre- and post-

training assessments. All testing and training were conducted in a quiet room in each of the two schools.

Training Phase Procedure

Following the procedure used by Moore et al. (2005), training comprised three 30-min sessions per week for 4 weeks. At each school, sessions for each of the three training groups took place at the same times each week. Two experimenters coordinated each training session and provided encouragement and assistance when needed. Training was delivered via a series of computerized training games (see Tasks section). Training session attendance and motivation to complete the tasks were reinforced through the use of three tactics. First, children could control the appearance (e.g., training characters, background) of each game (see Figure 1). Second, for each game, children were encouraged to record the number of tokens that they had collected on a score card. At the end of each session, the total number of games that the children had played was calculated, and children were rewarded with a sticker for every game played. Finally, a prize scheme was introduced whereby participants could claim a small prize at the end of each session (e.g., bouncy balls, stationery); a medium prize at the end of each training week (e.g., frisbees, toy cars); or a large prize at the end of the training phase (e.g., craftkits, remote-controlled cars). The NI group was also entitled to choose one or several prizes and was awarded their prizes during the post-training week.

Tasks

Child-friendly computer games (System for Testing Auditory Responses [STAR]; see Figure 2) on laptop computers were used to train performance on the psychophysical tasks. Auditory stimuli and feedback were presented binaurally via Trust HS-4100 USB headphones at a comfortable listening level. For each game, 25 trials were presented through use of a three-interval, three-alternative forced choice (3I-3AFC) oddball design. We used a fixed number of trials to ensure that children received a similar amount of exposure to each stimulus set. Each trial comprised three temporally distinct intervals that were separated by 500 ms of silence. Total trial length was kept constant at 3,300 ms. For the two groups that received auditory training (AFD and PD groups), the three intervals corresponded to three sounds (pure tones and speech stimuli, respectively). For the group that received training on a visual task (VFD group), the three intervals corresponded to three visual gratings that appeared in the center of the screen. These were preceded by the appearance of a red fixation cross (È1°) that appeared in the center of the screen for 1,000 ms. In all tasks, two intervals contained a standard tone/ phonetic contrast/spatial frequency grating, and the third randomly determined interval contained a higher frequency tone, a contrasting speech sound, or a higher frequency grating (the target). Children were instructed to choose the interval that they believed contained the "different" (target) sound/image. Participant responses were recorded via the laptop keyboard with custommade response keys. There was no time limit in which to respond, and the initiation of each new trial was selfpaced. Participants were given the opportunity to repeat a trial (up to amaximumof two times) if desired. Children received trial-by-trial feedback on their performance success.

The difference between the standard and the target stimulus (D) was controlled through the use of an adaptive staircase procedure. For the AFD task, the initial D corresponded to a 50% difference in the frequencies of the standard and target tones. For the PD task, the initial D corresponded to the two endpoints of the continuum (e.g., sound file 1 vs. sound file 94, or 100%). For the VFD task, the initial D was 100%. For the AFD and VFD tasks, D was initially halved through the use of a onedown, one-up procedure until the first incorrect response, at which point the same rule was used until the next correct response. At this point, the staircase was moved to a three-down, one-up phase targeting 79% correct on the psychometric function (Levitt, 1971). During this phase, D was multiplied or divided by a factor of 3⁄42. A similar adaptive procedure was used for the PD task, except that D (in %) was rounded up or down to the nearest sound file in the continuum. Thresholds were calculated as the geometric mean of the last two reversal points in the final adaptive rule. For the AFD and VFD tasks, thresholds are reported as DF/F (%). For the PD task, thresholds are reported as D (%).

Children in the three training groups each received training on 11 different stimulus sets that were cycled through in a fixed order. Children in the AFD group were trained on an AFD task that used the following

standard frequencies: 570 Hz, 700 Hz, 840 Hz, 1000 Hz, 1170 Hz, 1370 Hz, 1600 Hz, 1860 Hz, 2160 Hz, 2510 Hz, and 2920 Hz. These frequencies were selected so that each was in a different critical band of hearing according to the Bark scale (Zwicker, 1961), in order that each standard frequency should excite separate auditory filters. Each stimulus was a 200-ms pure tone (10-ms rise-fall times shaped with a raised cosine function). Children in the PD group were trained through the use of a subset of the phonetic contrast continua that are included in the commercially available auditory training program known as Phonomena (MindWeavers Ltd.) and were used in the Moore et al. (2005) study. Briefly, these were the continua b_d (/bi:/_/di:/), d_g (/da:/_/ga:/), e_a (/e/_/a/), er_or (/e:/_/c://), i_e (/I/_/e/), l_r (/i:/_/_/n:/), m_n (/ma:/_/na:/), s_sh (/sa:/_/ja:/), s_th (/sa:/_/0a:/), v_w (/va:/_/wa:/), and a_uh (/a/_/v/). The two endpoints of each continuum were derived by analysis and resynthesis of naturally spoken recordings of those syllables produced by a single male speaker of Southeast British English dialect. There were 94 sound files between these endpoints, which were obtained by linear prediction analysis and resynthesis of the spectral parameters of the endpoint files. The spectral parameters were 15 reflection coefficients over a 6.7-ms window, and the four voice source parameters included fundamental frequency (f0) and voicing. Children in the VFD group were trained on a VFD task with vertical, sinusoidally contrastmodulated gratings, with edge fading, at the following standard spatial frequencies (in cycles/degree [cpd]): 0.5 cpd, 1 cpd, 1.5 cpd, 2 cpd, 2.5 cpd, 3 cpd, 3.5 cpd, 4 cpd, 4.5 cpd, 5 cpd, and 5.5 cpd. Each grating was contained within a 10° circle and had an equal mean luminance to the surrounding gray area. Stimuli were presented on the screen for 600 ms, with 50-ms rise-fall times shaped with a raised cosine function.

Pre- and Post-Training Phases Procedure

The pre-training assessments were conducted for each child by one of five experimenters in the week immediately preceding the 4 training weeks. During this session, children underwent the audiometric hearing screen. They also completed a battery of psychophysical tests assessingAFD, PD, and VFD. These psychophysical tests were interspersed with a battery of psychometric tests assessing nonverbal intelligence (Matrix Reasoning subtest of theWASI), phonological processing (Nonword Repetition, Alliteration, Rhyme, and Spoonerisms subtests of the Phonological Assessment Battery [PhAB; Frederickson, Frith, &Reason, 1997]), and reading fluency (Sight Word Reading Efficiency and Phonemic Decoding Efficiency subtests of the Test of Word Reading Efficiency [TOWRE; Torgesen, Wagner, &Rashotte, 1999]). Except for the psychophysical tests that were presented in counterbalanced order, the remaining audiometric hearing screen and psychometric tests were presented in a fixed order. Each session lasted approximately 1 hr.

The post-training assessments took place during the week following the 4 training weeks and were identical to the pre-training assessments but with two exceptions. First, for psychometric assessments where two versions of the test were available, a different test version was used at pre- and post-training to minimize risk of test-retest effects. This applied only to the subtests of Sight Word Reading and Phonemic Decoding. Second, participants' hearing and Matrix Reasoning abilities were not assessed during the post-training session.

Tasks

Psychophysical Assessments

Performance was assessed through use of the computer games from the training phase. In an effort to minimize training effects during the pre-training session, children's performance was assessed on only one of the 11 available stimulus sets for each of the three training tasks-AFD, PD, and VFD. For the AFD and VFD tasks, the stimulus sets were 1,000 Hz and 2 cpd. For the PD task, we conducted a pilot test to identify a stimulus set that was not too difficult (i.e., no floor effects) but that, nonetheless, showed a robust training effect in adult listeners. The continuum that met these criteria and was therefore selected was e_a.

The psychophysical assessments were identical to those used in the training phase, with three main differences: First, prior to the administration of each psychophysical task, participants completed a short practice game in which they received five trials where D was set to the maximum initial level. In order to

proceed to the psychophysical assessments, children had to obtain four out of five correct responses on these practice trials. If this criterionwas notmet, the practice gamewas repeated (up to a maximum of four times). During the pre-training session, all children were able to proceed to the psychophysical assessments for the PD and VFD tasks. Two children (one from the VFD group, one from the NI group) did not achieve four out of five correct responses on the AFD practice game even after four repetitions, and so their AFD ability was not assessed at pre-test. The post-training AFD thresholds for these children are excluded from the analyses. All childrenmet criterion for all three tasks during the post-training assessment. Second, in the event that a child made an error during either the first or the second (easy) trial, the experimenter abandoned and restarted that assessment. This was to ensure that the child had understood the task instructions, in order for a reliable threshold to be measured. Third, to ensure that a minimum number of reversals was achieved per task, each game terminated after two reversals in the final three-down, one-up rule.

Psychometric Assessments

Nonverbal intelligence. Nonverbal ability was assessed through use of the Matrix Reasoning subtest of the WASI (Wechsler, 1999). Participants were asked to complete an incomplete matrix of patterns and abstract designs by choosing one of five response options.

Phonological processing. Phonological memory and receptive and expressive phonological processing were assessed through use of the Nonword Repetition subtest from the NEPSY (Korkman, Kirk, &Kemp, 1998). Thirteen nonsense words ranging from two to five syllables in length were presented over headphones at a comfortable listening level. Children were required to repeat each nonsense word out loud. The original items, which were delivered by a North American speaker, were re-recorded by a female native speaker of East Midlands British English dialect, in a sound-attenuated booth.

Phonological awareness was assessed through the use of three subtests of the PhAB (Frederickson et al., 1997): Alliteration, Rhyme, and Spoonerisms. The Alliteration subtest has 10 items that are divided into two parts of five items each and is graded in difficulty. For each item, children were asked to state which two of three words, read aloud by the examiners, started with the same sound. The Rhyme subtest has 12 items in Part 1 and nine items in Part 2, and it is also graded in difficulty. For each item, children were asked to state which two of three words, read aloud by the examiners, ended with the same sound. Finally, the Spoonerisms subtest is again divided into two parts and is graded in difficulty. In Part 1, examiners read a word aloud, and children were required to replace the first phoneme of that word with a specified new phoneme (e.g., "fun with a / b/ gives bun"). In Part 2, examiners read two words aloud, and childrenwere asked to exchange the initial phonemes of the two words (e.g., "fed man gives med fan").

Reading fluency. Reading fluency was assessed through use of the SightWord Reading Efficiency subtest (hereafter referred to asWord Reading) and the Phonemic Decoding Efficiency subtest (hereafter referred to as Nonword Reading) of the TOWRE (Torgesen et al., 1999). In each subtest, children were presented with a list of eight practice items and a longer list of test items that were of increasing difficulty. Children were required to read aloud as many words/nonsense words as possible in 45 s.

Data Handling Missing Data

For the pre- and post-training assessments, 12.01% of the pre- and 5.81% of the post-training psychophysical assessments were restarted, owing to early task failure. For the training games, two reversals had not been achieved by Trial 25 for 0.29% of tracks; therefore, threshold estimates were missing. This lefta total of 1,226, 1,225, and 953 threshold estimates during training for the AFD, PD, and VFD groups, respectively.

Just over half of all participantswere at ceiling during the pre-training assessment for the Alliteration subtest of the PhAB. Therefore, data for this task are included in the figures, but no further analyses are reported.

Several children (AFDgroup, n = 3; VFD group, n =1) were unable to read the practice trials of the Word and Nonword Reading subtests of the TOWRE at pre-training; therefore, the test items for these two subtests were not administered. All of these children spoke English as their first language. Although two of these four children

were able to complete the Word and/or Nonword Reading subtests, respectively, during the post-training assessment, these scores are not included in the analyses.

Data Transformation

We conducted a log10 transformation on threshold estimates for the auditory and visual FD tasks to stabilize the between-groups variance and to correct for positive skew in the distributions.

Analyses

For analyses of the training phase, the effects of training and stimulus set on thresholds were investigated for each training group using a linearmixed-models procedure, assuming a random intercept-only model structure. This permits the inclusion of threshold data for subjectswhere other thresholds are missing. All validmodels incorporating some or all of the main effects and interactions of the factor Stimulus and the covariate Training were fit, and the model minimizing Akaike's information criterion (AIC) was selected on the grounds of providing the best data fit subject to an allowance for model parsimony.

A series of ANOVAs confirmed that the four groups did not differ significantly in their performance on the psychophysical or psychometric tasks at pre-training ($p > .05$; see Table 2). In order to assess any differential improvement among the four groups between pre- and post-training, we used univariate analyses of covariance (ANCOVAs) to assess group differences at post-training, controlling for performance at pre-training (see Hatcher, Hulme, &Ellis, 1994). For the psychometric measures, all analyses were conducted on raw scores. However, for ease of interpretation, standard scores are shown in the tables and figures.

Results

Learning

We first assessed whether the three trained groups received an equivalent amount of training during the training phase. Table 3 shows the mean and range of training games played and stimulus sets repeated by children in each of the three training groups. A univariateANOVA confirmed that although there was considerable variability in the number of training games played by individual children, the three groups did not differ significantly, $F(2, 61) = 2.91$, $p = .062$.

We assessed whether the three trained groups showed significant learning on the psychophysical tasks upon which they were trained in two ways. First, the mean threshold change as a function of training is shown in Figure 3 for each of the three trained groups for each of the 11 stimulus sets. For the AFD task, thresholds of the AFD group improved significantly with training, $F(1, 17) = 43.52$, $p < .001$. Thresholds also varied as a function of stimulus type, $F(11, 186) = 9.40$, $p < .001$. However, the interaction between training and stimulus type was not significant, $F(10, 316) = 0.64$, $p = .776$, suggesting that learning was consistent across the 11 stimulus sets. For the PD task, there were significant effects of training, $F(1, 24) = 20.18$, $p < .001$, and stimulus set, $F(11, 171) = 226.69$, $p < .001$, as well as a significant interaction between the two, $F(10, 337) = 3.56$, $p < .001$. Post hoc analyses (contrast estimates) showed significant learning for the stimulus sets "a_uh," "e_a," "l_r," "s_sh," and "s_th" only ($p < .05$). Finally, for theVFDtask, there were significantmain effects of training, $F(1, 26) = 5.10$, $p = .032$, and stimulus, $F(11, 552) = 227.57$, $p < .001$, and a significant Training ×Stimulus interaction, $F(10, 493) = 1.93$, $p = .039$. Post hoc analyses showed that the gradient of the learning curve was significantly different from zero for the stimulus sets 2 cpd, 2.5 cpd, and 5.5 cpd. However, none of these stimulus sets showed a pattern that was consistent with learning, and indeed, thresholds for these stimuli appeared to worsen with training.

Second, we asked whether any of the trained groups showed pre- to post-training improvements on the psychophysical tasks upon which they were trained that were significantly greater than those of the other trained groups or of no-intervention controls (see Figure 4). The analyses supported the training data in that there were main effects of group on post-training thresholds for all of the three psychophysical tasks-AFD task, $F(3, 79) = 7.67$, $p < .001$; PD task, $F(3, 81) = 6.16$, $p = .001$; VFD task, $F(3, 81) = 5.19$, $p = .002$-once pre-training thresholds had been covaried. Post hoc analyses (least significant difference [LSD]) confirmed that

these main effects were driven by (a) the AFD group having lower (better) thresholds at post-training on the AFD task relative to the other three groups, $p \leq .001$; (b) the PD group having lower thresholds at post-training on the PD task relative to the other three groups, $p = .001$; and (c) the VFD group having higher (poorer) thresholds at post-training on the VFD task relative to the other three groups, $p < .05$. Together, these findings confirm that the two groups who received auditory training showed greater learning than the other groups on the tasks upon which they were trained, whereas the group who received visual discrimination training showed less.

Generalization

Generalization data for the nontrained psychophysical tasks are shown in Figure 4. Post hoc analyses (LSD) confirmed that none of the groups differed significantly in their post-training thresholds for any of the tasks upon which they did not receive training, once pre-training thresholds had been controlled ($p > .05$). Therefore, these findings suggest that learning did not generalize to any of the stimuli/tasks or to the modality for which participants did not receive training.

Finally, we asked whether any of the groups showed generalization of learning to the phonological processing and reading fluency tasks. Pre- and post-training scores on these tasks are shown in Figure 5. Univariate ANCOVAs indicated that, after controlling for pretraining scores, post-training scores did not differ between groups on any task except Spoonerisms-Nonword Repetition, $F(1, 81) = 0.28$, $p = .843$; Rhyme, $F(1, 81) = 1.82$, $p = .150$; Word Reading, $F(1, 77) = 0.35$, $p = .791$; Nonword Reading, $F(1, 77) = 0.25$, $p = .863$. For the Spoonerisms subtest, there was a significant effect of Group, $F(1, 81) = 2.75$, $p = .048$, although this was not significant after controlling for multiple comparisons (Bonferonni corrections for five comparisons, $p = .001$). Post hoc analyses (LSD) indicated that this effect on the Spoonerisms subtest was driven by the poorer post-training scores of the VFD group relative to those of the other three groups ($p < .05$), after pre-training scores had been controlled. These findings clearly show that none of the trained groups significantly outperformed the no-intervention controls at post-training on any of the psychometric assessments and, therefore, that learning did not generalize to significant improvements in language abilities.

Discussion

The aim of this study was to assess generalization of auditory learning in typically developing children across stimuli and tasks, across modality, and to higher level language tasks.We found that typically developing children who trained on an AFD task or a PD task showed learning on the tasks upon which they were trained, whereas children who trained on a VFD task did not. However, relative to no-intervention controls and to other trained groups, none of the trained groups showed significant generalization of learning to the psychophysical tasks and stimuli upon which they did not receive training. Moreover, none showed significant generalization to any of a battery of phonological processing and reading tests.

The findings that children showed learning on the AFD and PD tasks are consistent with previous findings from both the adult literature (e.g., Amitay, Hawkey, &Moore, 2005; Demany, 1985; Demany &Semal, 2002; Delhommeau, Micheyl, &Jouvent, 2005; Delhommeau, Micheyl, Jouvent, &Collet, 2002; Grimault, Micheyl, Carlyon, &Bacon, 2003; Irvine, Martin, Klimkeit, &Smith, 2000; Kraus et al., 1995; Tremblay et al., 1997) and the child literature (Halliday et al., 2008; Moore et al., 2005). Therefore, our results confirm previous findings that children can, in some instances, show auditory learning across multiple training sessions (Huyck &Wright, 2011; Moore et al., 2005). However, our results also add to the literature in several respects. First, they show that children of this age range can learn on a much broader set of stimuli than previously demonstrated. Second, they indicate that there may be different developmental trajectories of learning for different auditory psychophysical tasks. Although we found significant learning on both an AFD and a PD task in 8- to 10-year-old children, Huyck and Wright (2011) failed to find learning in 11-year-olds on a temporal-interval discrimination task and reported learning on the same task in only a subset of 14-year-olds. Although not all the children in our sample showed learning (as also found by Halliday et al., 2008), the significant group effects indicate that

learning can be induced on these tasks, even if it is not fully mature. Differences in the patterns of learning with age as a function of task, therefore, suggest that different underlying processes may be necessary for learning on different tasks, each of which matures at a different rate.

The current finding that learning failed to generalize to different tasks or stimuli that were either of the same or different modality suggests that the learning we observed was specific to the task or to the stimuli and was not due to procedural learning. Because we did not test generalization of learning to stimuli that were not included in the trained stimulus sets,we are unable to determine from our results whether it was task or stimulus learning that took place. This is a shortcoming of our study, but one that was due to time restrictions involved in testing children of this age range. Therefore, our results leave open two possibilities regarding what the children learned. First, it is possible that learning comprised the formation of relatively fixed and fine-grained representations of the trained stimulus sets. This would predict that the children would also have failed to show generalization to untrained auditory frequency and phonetic stimuli on the tasks on which they were trained. Alternatively, children might have learned something about the task (e.g., heightened ability to attend to the relevant stimulus dimensions) without forming stimulusspecific representations (Holt &Lotto, 2006; see also Xiao et al., 2008, for a similar argument in visual training). This would allow for the possibility that the AFD and PD groups would have showed learning on other nontrained frequencies and phonetic stimuli, respectively. Future studies that better distinguish between tasks and stimuli could help determine what sort of learning (stimulus/task) is taking place.

The apparent lack of procedural learning in this study was surprising to us, particularly given that the participants involved were children. There is considerable evidence that top-down, nonsensory factors including selective and sustained attention and working memory are major contributors to auditory perceptual discrimination and learning in children (Halliday et al., 2008; Moore, Ferguson, Halliday, &Riley, 2008). Given that procedural learning is thought to encompass the broad attentional/memory demands of the task, a strong prediction would be that it might be particularly marked in studies involving child participants. Our findings do not support this prediction. Note, however, that they also do not rule out a possible role of top-down processes in other aspects of perceptual learning in children. There now is evidence from adults to suggest that top-down processes could have an effect on stimulus and/or task learning, instead of or in addition to procedural learning (Ahissar, Nahum, Nelken, &Hochstein, 2009; Li, Piech, &Gilbert, 2004; Polley, Steinberg, &Merzenich, 2006). For instance, a recent study found evidence for auditory learning that was specific to the stimulus dimension that was attended to during training (Halliday, Moore, Taylor, &Amitay, 2011). Further research is needed to ascertain the relative contribution of top-down processes to auditory learning in children.

The learning we observed also failed to generalize to higher level measures of phonological processing and reading. Here, our findings differ from those of several previous studies showing improvements in a range of measures of language and literacy in children following auditory training (Habib et al., 1999; Merzenich et al., 1996; Moore et al., 2005; Schäffler et al., 2004; Strehlow et al., 2006; Tallal et al., 1996). One possible reason for this is that we trained children on a single stimulus type. The majority of studies have trained children on a range of different auditory stimuli, including both speech and nonspeech sounds. It could be that training on a range of different stimuli leads to a greater generalization of learning. However, this does not fit with studies that have trained on a single stimulus type and found positive effects (e.g., Habib, Davaure, Camps, Espesser, &Joly-Pottuz, 2002; Moore et al., 2005) nor with studies that have trained on multiple stimuli and have not found positive effects (McArthur et al., 2008). A second possibility is that we did not train our participants for a long enough time period. Most auditory training studies have trained their participants for longer than the 6 hr completed in the current study (ranging from 10 hr in Schäffler et al., 2004, to 25 hr in Habib et al., 2002). A third possibility is that greater improvements would have been observed had we used children with language impairment rather than typically developing children.

A challenge to the above explanations is that several design features used here (i.e., training on a single

stimulus set, for only 6 hr, with typically developing children) also applied to the study of Moore et al. (2005), where substantial pre- to post-training improvements in phonological awareness and nonword reading were reported. Nevertheless, there were a number of key differences between our study and that of Moore et al. (2005). For instance, it is possible that the variable presentation paradigm used by Moore et al. (2005) resulted in the recruitment of more cognitive resources and, therefore, a greater likelihood of generalization. It is also possible that the longer duration of the training games (60 trials each) in the Moore et al. (2005) study may have meant that children spent more time "around threshold"-that is, listening to difficult discriminations, a factor that has been shown to induce learning (Amitay et al., 2006). Finally, in the current study we used a single-blinded, randomized, controlled design, whereas Moore et al. (2005) did not. Where other randomized controlled trials have been conducted, the positive effects of auditory training on language have not always been replicated (Cohen et al., 2005; Given et al., 2008; Pokorni, Worthington, &Jamison, 2004; cf. Gillam, Loeb, Champlin, Thibodeau, &Friel-Patti, 2008). Our results suggest, at least, that auditory training does not always generalize to improvements in language and literacy in typically developing children of this age range, even when auditory learning is observed.

Children in our study failed to show learning on the VFD task. Learning has been observed in children with amblyopia using a similar task, albeit over a much more prolonged timescale (40 hr over 20 weeks; Polat, Ma-Naim, &Spierer, 2009). We present three possible explanations for our findings. The first is that there was inadequate stimulus control. Testing occurred under various ambient light levels and at different test distances, which likely resulted in variability in both the contrast of the gratings and the spatial size of the gratings at the children's eyes both between and within sessions. Consequently, children in the VFD group may have received a set of more variable stimuli during training than is necessary for learning. A second explanation is that training on the VFD task was insufficient to demonstrate learning in terms of number of trials or the sensitivity of the measurement technique. Finally, the VFD task may have been more challenging in terms of task demands than the two auditory training tasks. Although we tried to match the three training tasks, fundamental differences between the auditory and visual modalities meant that this was not strictly possible. Greater task demands could equate to either a lack of resources available for learning (cf. Amitay et al., 2005) or to less enjoyment of the task, either of which might explain our current findings.

The failure to see learning on the VFD task was unfortunate because it means we cannot rule out the possibility that auditory discrimination training failed to generalize to this task (and vice versa) not because of a lack of transfer of procedural learning but because the VFD task was not learnable. However, we find this interpretation unlikely. Should any generalization have taken place in the current study,we would have expected this to have occurred between the two tasks and stimuli that were most similar-the auditory frequency and phonetic discrimination tasks-yet we did not see this. Moreover, the VFD group showed worsening performance between pre- and post-training on the VFD task only, suggesting that changes were occurring during and following training, albeit changes that were not consistent with a conventional learning pattern.

The current data contribute to a growing body of evidence demonstrating that it is possible to induce auditory learning in children following training (Edwards et al., 2005; Halliday et al., 2008; Merzenich et al., 1996; Moore et al., 2005; cf. Huyck &Wright, 2011). We do not yet know the conditions that stimulate these processes, nor do we fully understand the components of learning in children or how learning changes during maturation. However, our results suggest that either stimulus or task learning (or a combination of both), rather than procedural learning, is likely to underlie the behavioral improvements in performance reported here. Moreover, they suggest that this learning does not always generalize to higher level measures of language and literacy.

Acknowledgments

This research was funded entirely by the intramural program of the Medical Research Council (MRC) to the MRC Institute of Hearing Research. At the time of writing, Lorna F. Halliday was funded by the Economic and Social Research Council.

We are grateful to Sygal Amitay,MRCInstitute of Hearing Research, and Stuart Rosen, University College London, for helpful comments on an earlier draftof this article; Mark Edmondson-Jones, MRC Institute of Hearing Research, for advice on statistical analyses; and Terri Lewis, McMaster University, for advice on the reporting of visual psychophysical data. Thanks toDavidMcDonald and SarahDeed for assistance with data collection. Special thanks to the children, parents, teachers, and staffat St. Margaret Clitherow and Warren Primary Schools in Nottingham.

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Editor: Robert Schlauch
Associate Editor: Beverly Wright
Received September 29, 2009
Revision received March 12, 2010
Accepted June 3, 2011
DOI: 10.1044/1092-4388(2011/09-0213)

Publication date: Feb 2012

Year: 2012

Comparing Identification of Standardized and Regionally Valid Vowels

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 182-193.
ProQuest document link

Abstract: In perception studies, it is common to use vowel stimuli from standardized recordings or synthetic stimuli created using values from well-known published research. Although the use of standardized stimuli is convenient, unconsidered dialect and regional accent differences may introduce confounding effects. The goal of this study was to examine the effect of regional accent variation on vowel identification. The authors analyzed formant values of 8 monophthong vowels produced by 12 talkers from the region where the research took place and compared them with standardized vowels. Fifteen listeners with normal hearing identified synthesized vowels presented in varying levels of noise and at varying spectral distances from the local-dialect values. Acoustically, local vowels differed from standardized vowels, and distance varied across vowels. Perceptually, there was a robust effect of accent similarity such that identification was reduced for vowels at greater distances from local values. Researchers and clinicians should take care in choosing stimuli for perception experiments. It is recommended that regionally validated vowels be used instead of relying on standardized vowels in vowel perception tasks.

Full text: Headnote

Purpose: In perception studies, it is common to use vowel stimuli from standardized recordings or synthetic stimuli created using values from well-known published research. Although the use of standardized stimuli is convenient, unconsidered dialect and regional accent differences may introduce confounding effects. The goal of this study was to examine the effect of regional accent variation on vowel identification.

Method: The authors analyzed formant values of 8 monophthong vowels produced by 12 talkers from the region where the research took place and compared them with standardized vowels. Fifteen listeners with normal hearing identified synthesized vowels presented in varying levels of noise and at varying spectral distances from the local-dialect values.

Results: Acoustically, local vowels differed from standardized vowels, and distance varied across vowels. Perceptually, there was a robust effect of accent similarity such that identification was reduced for vowels at greater distances from local values.

Conclusions: Researchers and clinicians should take care in choosing stimuli for perception experiments. It is recommended that regionally validated vowels be used instead of relying on standardized vowels in vowel perception tasks.

Key Words: dialect, identification, vowels

(ProQuest: ... denotes formula omitted.)

This study consists of two experiments with two related goals: to determine (a) the degree to which vowels in the Pacific Northwest region matched General American English vowels and (b) the degree to which acoustic dissimilarity has an effect on vowel identification accuracy. Although any number of dimensions of the speech signal may be studied to examine differences across regional dialect, we chose to make vowels the focus of this study for several reasons. They are high-intensity quasi-periodic components of the speech signal; moreover, they occupy lower frequencies (below 3 kHz) compared with many consonants that have aperiodic cues distributed in the higher frequencies (above 3 kHz). The frequency distribution and the high intensity of vowels make them important perceptual toeholds for hearers who are listening under less-than-optimal conditions, such

as in noise or with hearing loss. Vowels are also important because their formants carry information about not only the vowel's quality itself but also the flanking consonants through their formant transitions. Again, this may be particularly true under conditions of multiple distortions. Recent work by Webster (2002) indicates that as noise increases, listeners shifttheir weighting of cues away from the aperiodic cues associated with consonants, increasing their reliance on formant transitions. Accordingly, vowels represent a methodologically important object of study (e.g., Kewley-Port, Burkle,&Lee, 2007; Nishi&Kewley-Port, 2008).

The exigencies of perceptual research and especially clinical testing encourage researchers and clinicians to use stimuli that havewell-known properties-in particular, stimuli that have been widely normed. These stimuli are sometimes described as General American English. In North America, this has led to the widespread use of a relatively small set of prerecorded or synthetic stimuli drawn from well-known published data. Because the standard stimuli are taken from a small number of specific geographic regions at specific points in time, there is often a mismatch between the regional accent in the stimuli and the perceiver's regional accent. This mismatch introduces a potential problem: Even relatively subtle differences in accent may introduce a stimulusgoodness effect that varies by laboratory or clinic, depending on geographic location, and that may even vary by listener if the target population is dialectally diverse.

Regional dialect and accent effects are not uniform across the different regions in North America; neither are they uniform across speech sounds. Some accents are more similar to the standard stimuli than others, and some speech sounds vary more by region than others (e.g., Clopper, Pisoni, &de Jong, 2005; Labov, Ash, &Boberg, 2006). For example, in several dialects spoken in New England and in the northern cities, urban areas on the southern shores of the Great Lakes-such as Chicago, Illinois; Detroit, Michigan; Cleveland, Ohio; and Buffalo, New York-there is a phonemic contrast between an open-mid vowel // and a low-central vowel /a/ (as in the words caught and cot, respectively), whereas in much of the West and the South, this contrast is replaced with a single low-back vowel /A/ (e.g., Clopper et al., 2005; Eckert, 1989; Labov et al., 2006). Moreover, different dialects typically have distinct allophonic processes for otherwise similar phonemes. Take, for example, a process often referred to as Canadian raising: the diphthong phoneme /aI/ (as in "ride" [?aId] or "rise" [?aIz]) has a "raised" allophone [ÃI] before all voiceless coda consonants (as in write [?ÃIt] or rice [?ÃIs]; e.g., Vance, 1987). This allophonic variant occurs in several dialects spoken in the northern and eastern United States but not in other dialects spoken in the South and West. Thus, even with identical phonemic inventories, there may be context-specific (allophonic) differences in pronunciations of particular words or syllables.

Although not all regions have been fully documented, existing documentation indicates that regional dialects differ not only in the number of vowel contrasts and phonetic realization of vowel allophones but also in the acoustic values that phonemes have even if they are conventionally transcribed using the same phonetic symbol. Although this last point may seem obvious to researchers who are familiar with regional variation and transcription conventions, the symbols that are used to represent vowel categories are often taken as true values by researchers in clinical and psychological settings who are not trained in regional variation. As a result, it is common to assume that standardized vowels should be used in all regions of the country where the phonetic symbols match the symbols used in the standard descriptions. For example, whereas the symbol /u / is used to represent a vowel that is present as a phoneme in all dialects of North American English, the acoustic realization of this vowel varies from a high-back variant in Wisconsin to a high-central variant in southern California and parts of the Deep South (e.g., Clopper et al., 2005; Hagiwara, 1997; Jacewicz, Fox, &Salmons, 2007; Labov et al., 2006). In a study of six regional vowel systems, Clopper et al. (2005) found that each region had its own realization of the vowel system even though the vowels are typically represented with the same symbols and phonetic descriptors. Their findings led them to conclude that vowels are best characterized in terms of regional systems rather than in terms of General American English, a finding that echoed Hagiwara's (1997) observation about southern Californian English and Hillenbrand, Getty, Clark, and Wheeler's (1995) observation about regional effects in their study of southern Michigan speakers.

These findings have potentially serious implications for researchers who use speech stimuli in perception experiments or as comparison points for speech production. In the absence of acoustic validation through regional sampling, there is no guarantee that a particular phoneme's acoustic realization in North American English will be the same from one region to the next. Ignoring regional dialect and accent variation may result in regional asymmetries in category goodness of stimuli across listeners in perception studies.

Phonetic differences in stimuli may seem relatively unimportant if the task is not tapping into low-level phonetic perception, but there is evidence that accented speech may impose a processing delay or a cognitive load. For example, Clarke and Garrett (2004) found that initial exposure to foreign-accented speech introduced a temporary perceptual-processing deficit. More relevant to the current research, regional accent differences may have a cascading effect that percolates up to higher level tasks. Adank and McQueen (2007) conducted a noun-animacy (animate vs. inanimate) decision task in which listeners were presented with auditory stimuli in a familiar accent and an unfamiliar accent. Subjects' response times were slower for words presented in the unfamiliar accent. The effect persisted even when listeners were exposed to 20 min of speech in the unfamiliar accent prior to the animacy decision task, indicating a lasting effect for unfamiliar accents. Similarly, Floccia, Butler, Goslin, and Ellis (2009) found that unfamiliar accents in certain tasks impose a processing delay that is long lasting; it continues after intelligibility scores reach ceiling. To compound the problem, prosody, intonation, syntax, and lexical choice vary across regions (e.g. Grabe, 2004); therefore, using sentence-length stimuli does not necessarily solve the potential problems at the phone level and may even make them worse. In a study of cross-dialect intelligibility in noise, Clopper and Bradlow (2009) found that dialects that were more similar to General American English, which included New England, the West, and theMidland regions, were more intelligible than regional dialects that were more distant from General American English, including mid-Atlantic, northern, and southern regions. Although not all dialectal regions were equally represented-so true regional effects were not fully probed-on the whole, Clopper and Bradlow's results indicated that there is a negative effect on intelligibility of mismatch between the listener's dialect and the dialect in the stimuli in noisy listening environments.

How concerned should researchers be about the effects of regional accents on category goodness, perceptual processing, and higher level processing in perceptual research? After all, there appears to be counterevidence in that listeners seem to be able to adapt to foreignaccented speech (e.g., Clarke &Garrett, 2004; Ferguson, Jongman, Sereno, &Keum, 2010; Munro &Derwing, 1995a, 1995b). Moreover, the native dialect effects that have been observed for speech perception and processing for Dutch (Adank &McQueen, 2007), French (Dufour, Nguyen, &Frauenfelder, 2007), and English (Cutler, Smith, &Cooper, 2005; Evans &Iverson, 2007; Floccia et al., 2009) involved dialect differences that were larger than those typically observed within North America. This uncertainty about regional effects has led to a general trend in North American research to treat a common set of vowel values as "standard" North American English in perception experiments and in clinical studies. No study has directly tested the effect of dialect vowel distance (as measured using first and second formant [F1 and F2, respectively] differences between dialects) on identification accuracy; therefore, whether distance has a negative impact on vowel identification is unknown.

To test whether vowel differences that are typical in North American English interfere with vowel identification, we conducted two experiments. In the first, we investigated vowels of the region where the research took place, the Pacific Northwest (PNW), to establish whether their formant values differ from two sets of formant values of vowels that are commonly referred to as General American English: (a) Peterson and Barney (1952; PB) and (b) Hillenbrand et al. (1995; HGCW). In the second experiment, we conducted a perceptual identification task using three synthesized vowel sets that differed in spectral distance (F1 and F2 differences in a Euclidean space) from the vowels of the subjects' regional dialect (0 = PNW identical, 1 = PNW similar, 2 = PNW dissimilar) to test the effect of vowel dissimilarity distance on identification accuracy.

Experiment 1: Comparing PNW Vowels With Standard Vowels

Although all dimensions of language vary across regional dialects, vowels are particularly well documented in English and therefore most easily compared. Moreover, there is a widely used comparison metric for vowels: F1 and F2 are typically measured at midpoint or steady state. This measure was used in Peterson and Barney's (1952) study as well as Hillenbrand et al.'s (1995) research and other recent vowel studies (e.g., Clopper et al., 2005; Hagiwara, 1997).We predicted that there would be study effects such that both PB and HGCW vowels would differ from the PNW vowels. We also predicted that there would be Vowel ×Study interactions, such that PB and HGCW vowels would differ from PNW vowels in study-specific ways.

Method

Talkers

Six adult men and six adult women participated in vowel recordings. All of the talkers had grown up in the PNW (Washington, Idaho, Oregon) and were monolingual speakers of English.Talkerswho had lived elsewhere or had significant experience with other languages were excluded from participation. ThePNWwas defined broadly to include the amount of local variation that is likely to occur in an experimental or clinical population.1 None of the talkers had a history of speech therapy, and all had normal hearing, defined as pure-tone thresholds of 20 dB HL or better (see American National Standards Institute, 2004) at octave frequencies between 0.25 kHz and 8 kHz, bilaterally. All procedures were reviewed and approved by the local institutional review board, and talkers were reimbursed for their time.

Recording Procedure

Words containing eight monphthong vowels (/ i, I, e, ?, æ, A, ?, u/) were recorded using randomized word lists. The mid-back vowel /o / was excluded because it is a diphthong in the PNW region (Ingle et al., 2005). The midfront vowel /e / was included for qualitative comparison but excluded from the statistics because it was absent in the PB study. Talkers were seated in a double-walled sound-attenuated chamber during the recordings. All vowels except for /e / and /A/ were read in the /hVd/ context from a word list following the procedure of Hillenbrand et al. (1995). The vowels /e/ and /A / were spoken without the preceding /h/ in the words aid and odd due to unfamiliarity of the words hayed and hawed. The eight words were read in five randomizations to control for list effects on pronunciation, thus minimizing the need for a carrier phrase. All talkers were instructed to read the list of words at a natural pace and vocal intensity. Vocal level was monitored with a volume unit meter to ensure sufficient output levels without clipping. We used a Tucker-Davis Technologies System 2 with an AP2 sound card and a Shure BG 1.0 omnidirectional microphone for all of the recordings. Four talkers were recorded direct to disc at a rate of 44.1 kHz. The remaining eight talkers were recorded at a rate of 22.05 kHz. All recordings were quantized at 16 bits and down-sampled to 11.025 kHz prior to signal processing and acoustic analysis.

Spectral Analysis

We selected one representative token of each vowel for each talker on the basis of two criteria: (a) recording fidelity and clarity of each subject's voice without hoarseness, pitch breaks, or other disfluencies, and (b) visual inspection of the vowel for F1 and F2 steady states and accompanying pitch steady state. We determined formant steady state using a wideband spectrogram and accompanying linear predictive coding (LPC) formant track with 12 coefficients. We determined pitch steady state using an autocorrelation pitch track with a 25-ms window overlaid on a narrow-band spectrogram. A formant was considered to be steady state if a straight line could be traced through the middle 50 ms of the vowel and the pitch remained constant over the same section. Once the vowel was selected and the steady-state portion identified, the first four formants (F1, F2, F3, F4) were estimated at the center of the steady state. The F1 through F4 values and recordings had been used in a separate study on hearing aid compression (Bor, Souza, &Wright, 2008). In the current study, we used only F1 and F2. To minimize the risk of error, formant measurements were taken from an LPC spectrum overlaid on a fast Fourier transform power spectrum with a sample window of 128 points and visually compared with its broadband spectrogram. In the event that there were LPC errors for a particular talker, the number of filter

coefficients (poles) was adjusted up or down for that entire talker's set of vowel measures. The sample window of the LPC was 25 ms, and the number of coefficients ranged between 10 and 12, depending on the talker.

Results

Vowels from the PNW study were compared with HGCW and PB vowels using the F1 and F2 values. Because we had a reasonably large sample (six men and six women), we were able to make comparisons within gender rather than normalizing the data, thus preserving vowel space shape and individual vowel variability. Because there were grossly different sample sizes between studies, we used a random sample of six speakers from each of the larger studies (PB, HGCW). To ensure that there were no sampling artifacts, we plotted the mean of the resulting sample within a 95% confidence interval ellipse representing all data within gender for adults. In all cases, our sample fell near the center of the F1 ×F2 ellipse, indicating that our sample was representative of each study while still retaining variability within vowel. The results of the within-gender sample were submitted to a series of analyses of variance (ANOVAs) with F1 and F2 as dependent variables, and study (PNW, HGCW, or PB) and vowel (i, I, e, æ, A, ?, u) as independent variables. ANOVA results are presented in Table 1 (male vowels) and 2 (female vowels).

The results of the ANOVAs indicated the expected reliable effect of vowel on F1 and F2 for both men and women, indicating that in each study, the vowels were reliably separated on both dimensions. More interesting is that there was an effect of study on F2 for men and a Study ×Vowel interaction for F1 and F2 in the data for both the men and women. The interactions indicate study-specific differences for individual vowels. To probe which vowels were contributing to the interactions, we submitted the formant values to a series of Bonferroni-Dunn post hoc t tests with an alpha of .05 (corrected to .0167). For men's PNW F1 values, the vowel [æ] was different from its HGCW counterpart, but none were different from their PB counterparts. For men's PNW F2 values, the vowels [æ], [a], [?], and [u] were all different from their HGCW counterparts, and the vowels [?] and [u] were different from their PB counterparts. For women's PNW F1 values, the vowels [i], [æ], [A], and [?] were all different from their HGCW counterparts, but none were different from their PB counterparts. For women's PNW F2 values, the vowels [?], [æ], [A], [?], and [u] were all reliably different from their HGCW counterparts, and the vowels [i], [?], [?], and [u] were all reliably different fromtheir PB counterparts.

To illustrate the Study ×Vowel effects, we plotted men's and women's vowel means in Figures 1 and 2, respectively, with thePNWvowel plots overlaid onHGCW and PB vowels. Notable differences include a lowered (higher F1) and backed (lower F2) PNW /æ / relative to the HGCW counterpart, a raised (lower F1) and backed (lower F2) PNW /A/ relative to the HGCW counterpart, and a fronted (higher F2)PNW/?/ and /u/ relative to the PB and HGCW counterparts. The PNW /e/ also appears slightly raised (lower F1) and fronted (higher F2) relative to theHGCWcounterpart. Formant values are summarized in Table 3.

To investigate the relative differences further, we calculated Euclidean distances from each PNW vowel's F1 ×F2 point in the vowel space to its gender-matched counterpart from the PB and HGCW values.2 We used Equation 1 to calculate distance:

... (1)

Throughout this study, we used this formula to calculate distance. In the formula, s is the distance between points in a two-dimensional Euclidian vowel space defined by F2 on the x axis and F1 on the y axis, and where F1p is an individual PNW speaker's F1 value for a particular vowel and F1i is a comparison value for the equivalent PB or HGCW vowel F1 mean, and where F2p is an individual PNW speaker's F2 value for a particular vowel and F2i is a comparison value for the equivalent PB or HGCW vowel F2 mean. Because we were interested in relating these differences to perceptual effects, we also calculated the Euclidean distances in Bark using the formula published in Traunmüller (1990).

The results of the Euclidean distance measures are summarized in Table 4, which displays the mean distance and SDs by vowel and by study in Hz and in Bark, respectively. The distance patterns are similar in Hz and Bark because in the frequency region of F1 and F2, there is a fairly linear relationship between Hz and Bark.

Nevertheless, the transformations are presented to ease comparisons to other studies for the reader.
On the whole, the Hillenbrand et al. (1995) and the Peterson and Barney (1952) studies showed large mean distances to the PNW vowels: HGCW vowels at 333 Hz (1.67 Bark) and PB vowels at 275 Hz (1.38 Bark). Only a slight difference of 57 Hz (0.29 Bark) is seen between the average HGCW-PNW distance and the average PB-PNW distance. This accounts for the general lack of effect of study in the ANOVA. However, as indicated by the Vowel ×Study interactions and subsequent post hoc tests, in some regions of the vowel space, the PB-PNW distances are larger, whereas in others, the HGCW-PNW distances are larger: the back vowels /?, u/ show greater distances to PB, and the low vowels /æ , A/ show greater distances to HGCW. For /æ , A/, the HGCW-PNW distances are 357 Hz (1.66 Bark) and 257 Hz (1.44 Bark) greater than the equivalent PB- PNW distances. On the other hand, for /?, u/, the PB- PNW distances are 106 Hz (0.67 Bark) and 91 Hz (0.41) greater than the HGCW-PNW distances.

Discussion

The results of Experiment 1 indicate that PNW regional vowels vary, sometimes substantially, from standardized vowels in terms of their formants. They also demonstrate that neither of the standardized vowel sets (HGCWor PB) is optimal in terms of the vowel mismatch because each has vowels that show larger distances than those of the other study. This result should be unsurprising to readers who are familiar with the sociolinguistic literature. After all, nearly all of the subjects in the Hillenbrand et al. (1995) study were from regions that participate in the well-documented "Northern Cities" vowel shift. As described recently in detail by Labov et al. (2006), Clopper et al. (2005), and Jacewicz et al. (2007), the Northern Cities vowel space is characterized by large differences in the low vowels; in particular, it has a raised /æ / compared with other regions and a relatively fronted /a / vowel compared with other regions' back /A /. At the same time, much of the West is characterized by a fronting relative to other regions of the high-back vowels [?] and [u], as noted by Eckert (1989) and as documented instrumentally by Hagiwara (1997) and Clopper et al. (2005). However, in agreement with Ingle et al. (2005), neither of these back vowels in our data show as much fronting as is seen in southern California.

Given the tolerance to variation in normal speech, whether such differences will lead to errors when nonregional vowels are presented in identification studies remains to be seen. Moreover, whether dissimilarity distance has an increasingly negative impact on perception such that at greater distances, recognition accuracy declines, or whether the negative effect is equivalent across distances, also remains to be determined.We tested these questions in Experiment 2 using a forced-choice vowel identification task in which subjects identified synthetic vowels that varied by distance (as defined in Equation 1) in varying amounts of noise.

Experiment 2: Effect of Dissimilarity Distance on Vowel Identification

Method

Listeners

There were 15 listeners: 10 women and five men (M age = 24.6 years, age range: 18-38). All were monolingual English speakers who were native to the PNW. All listeners had bilaterally normal hearing, defined as pure-tone thresholds of 20 dB HL or better at octave frequencies between 0.25 kHz and 8 kHz. Subjects from the production study were excluded from the identification study. All procedures were reviewed and approved by the local institutional review board, and subjects were reimbursed for their time.

Stimuli

There were three steps to creating the stimuli, each of which we describe in more detail below. First, we chose pairs of vowels for the identification task. Second, we compared formant values from different parts of North America to determine the distance steps and to identify individual vowel formant values. Third, we synthesized stimuli using the identified formant values.

We selected two vowel pairs /æ -?, u-?/ for the task on the basis of three criteria. First, the vowels /æ -?, u-?/ represent near neighbors in the acoustic F1 ×F2 vowel space and, therefore, should be more easily confused

than more distant pairs such as /A-?, i-u/. Second, these pairs represent vowels that set the West-and, therefore, the PNW-vowels apart from other regional vowels. Third, on the basis of our review of regional vowel studies across dialect regions of North America, these pairs represent sets for which monophthongs can be identified.

After identifying the two target vowel pairs, we examined published vowel formant values in a large number of sources representing all seven dialect regions: West, North Central, Midland, South, Inland North, Mid-Atlantic, New England (as defined in Clopper et al., 2005; Labov et al., 2006; and Jacewicz et al., 2007). Using the Euclidean distance formula in Equation 1, we calculated a dissimilarity distance from the six PNW vowels to the vowels as described in Clopper et al. (2005), Labov et al. (2006), Hagiwara (2006), and Jacewicz et al. (2007). In calculating distances, we used previously published PNW values (Ingle et al., 2005) to ensure equivalency in the comparisons. After comparing all regions of North America with the PNW results, we selected two non-PNW distances that varied by a consistent amount in dissimilarity distance (values that were closest in terms of differences in F1 and F2). These were designated as either 0 (identical to PNW vowels), 1 (similar to PNW vowels; 111-176 Hz, 0.52- 0.77 Bark), or 2 (dissimilar to PNW; 276-375 Hz, 1.46- 1.70 Bark). We used published values from previous studies to preserve the greatest similarity to existing regional vowels and to ensure the maximal naturalness of the subsequent synthetic stimuli, even though this meant some variation within the Distance 1 and Distance 2 groups. The resulting distances with their regional (study-based) identifier are summarized in Table 5.

Once formant distances had been established, we used the F1 and F2 values from the published studies to create a set of synthetic stimuli at each of the three distance steps (0, 1, and 2). The stimuli were 200 ms long and had a pitch contour that began at 130 Hz and remained steady state for 50 ms, gradually falling thereafter to 90 Hz. This created a male-sounding voice. We took the F1 and F2 frequencies from the published studies, estimated F3 using published regression formulas (Nearey, 1989), and fixed F4 at 3500 Hz. We calculated formant bandwidths from the algorithm described by Johnson, Flemming, and Wright (1993). The values used to synthesize the stimuli are summarized in Table 6. To ensure equivalent signal-to-noise ratios (SNRs) across vowels, the stimuli were root-mean-square normalized following synthesis.

Procedure

Throughout the experiment, listeners were seated in a double-walled sound booth. They were first trained in the orthographic decision labels for vowels by associating visually presented words, such as bet and bat, with the orthographic decision labels. The following are the labels used in the experiment preceded by their IPA symbols: /?/ eh, /æ / ae, /?/ uh, and /u/ oo. When subjects achieved 88% accuracy in the association of the labels with visually presented words, they proceeded to the main experiment.

To measure vowel identification, we presented stimuli monaurally to the right ear via an insert earphone. Each vowel was presented in a background of a masker noise with frequency spectrum matched to the longterm spectrum across all vowels. The masker consisted of a white noise that was low-pass filtered with a 300-Hz cutofffrequency and a 5-dB-per-octave spectral slope. Vowels were presented at SNRs of +2 dB SNR, +6 dB SNR, and +10 dB SNR. In each case, the level of the vowel was fixed at 65 dB SPL, and the level of the noise was adjusted to the desired SNR.

Stimuli were presented blocked by vowel condition (front pairs, back pairs) and SNR, creating six blocks total. The order of the blocks was randomized for each subject. A block consisted of 18 randomly ordered trials (two vowels, three distances, and three repetitions). To mimic clinical (i.e., untrained) presentation, each block was presented once. Subjects responded to each trial in a two-alternative forced-choice paradigm using a touch screen. The choices were presented on the screen as buttons labeled eh or ae for the front vowel block and uh or u for the back pair block. The location of response buttons on the touch screen was randomized on each trial to minimize response bias.

Results

We analyzed the results with a three-way ANOVA with the factors distance (0, 1, or 2), SNR (+2 dB, +6 dB, or +10 dB), and vowel. The results of the ANOVA are reported in Table 7.

The effect of distance for each SNR is shown in Figure 3. In general, scores were similar between distances 0 and 1 and dropped significantly for distance 2 for all SNRs. As suggested by Figure 3, there was no effect of SNR. There was an effect of distance and a significant interaction between distance and SNR. To investigate further, we collapsed the data across vowels and conducted a post hoc analysis by comparing the distance scores within each SNR. The Distance ×SNRinteraction was due to a small difference in the magnitude of the effect whereby the difference between distances 0 and 1 approached significance for SNR 10 ($p = .087$) but not for SNR 6 and 2 ($ps = .475$ and .384, respectively). Note that for SNR 10, there was a slightly higher score at distance 1 compared with distance 0, but given the nonsignificant p value, we considered this as reflecting measurement variability. At all SNRs, there was a significant decrease in score between distances 1 and 2 ($p < .005$ in each case).We used post hoc means comparisons to examine the Distance ×Vowel interaction (see Figure 4). Post hoc analyses indicated that three of the vowels showed a significant effect of distance ($p < .005$ for ?, æ, and u). In each case, the difference between distances 0 and 1 was nonsignificant ($p > .050$), and the difference between distances 1 and 2 was significant ($p < .005$). For the remaining vowel (?), the effect of distance was not significant ($p = .107$).

Discussion

Although we focused on a specific region of theUnited States (PNW), we anticipate that the results seen here can be generalized to other regions of the country. In Experiment 2, the effect of distance 2 was robust, whereas distance 1 did not prove reliable. This may indicate that when making comparisons across dialects, small differences have little or no effect on identification, whereas larger differences have large negative effects. This finding needs to be tested more thoroughly by examining the perceptual effects of subregional or sociolectal variation within dialect-specific vowel systems.

Our production results show that grouping all of the regional accents into any one of the dialect regions (e.g., the South or West) based on overall vowel similarity creates vowel-specific mismatches: Whereas some PNW vowels are typical of other West coast varieties of English, such as the one spoken in southern California, other PNW vowels differ quite dramatically. For example, PNW /æ / shows a Euclidean distance of 157 Hz (1.06 Bark) compared with descriptions of the West in general as defined by Clopper et al. (2005) and Labov et al. (2006), or compared with regionally specific values reported for southern California (e.g., Hagiwara, 1997; Johnson et al., 1993). PNW vowels also show less extreme fronting of /u/ than seen in the generic West or in the specific Southern Californian descriptions. If the distance effects in perception found in Experiment 2 extend to other vowels as predicted, then the treatment of the entire West as a single dialect group may be too broad for many purposes, and this underscores the importance of considering regional-specific vowels rather than broad areas of the United States (e.g., the West, Midwest, South) as is typically done.

The perception results have both methodological and theoretical implications for studies of speech perception. They indicate that vowel category distances related to regional variation have a reliable negative impact on vowel identification. Stated another way, greater dissimilarity increases the risk that a vowel may be identified poorly in perception experiments; however, slight dissimilarities appear to have a negligible effect. It must be noted that in creating our stimuli, we chose a relatively modest distance for the distance 2 condition because we wanted to avoid vowels that were so different that no researcher would use them as stimuli. Accordingly, these results should represent the range of dialects that could be encountered by an individual in a realistic situation. It is important to note that these were vowels presented in isolation, and therefore the task is not directly representative of a listener's everyday experience with accent variation. Whether larger stretches of speech with context effects will showthe same reliability remains to be seen;moreover, the negative impact of dialect differences on speech perceptionmay be mitigated by a variety of factors, such as the experience of the listenerwith other accents. For example, Evans and Iverson (2004) found that listeners were able to shifttheir

perceptual targets to match that of the input accent over time. However, adaptation to an accent may require long-term exposure and may not occur for all individuals (Evans &Iverson, 2007). Sumner and Samuel's (2009) study provided evidence that there are dialect effects in both the immediate perceptual processing and long-term recall of speech stimuli. They concluded that there are individual experienced-based differences that affect one's ability to process stimuli presented in a nonnative dialect.

Research on highly proficient nonnative and bilingual listeners suggests that noise interacts with language background (e.g., Mayo, Florentine, &Buus, 1997; Meador, Flege, &MacKay, 2000; Rogers, Lister, Febo, Besing, &Abrams, 2006). In these studies, listeners appear native-like under ideal listening conditions but experience a more extreme decline in perceptual performance in noise than native listeners do. Age of acquisition also plays a role in these studies; the earlier the second language was acquired, the less noise seemed to affect their perceptual performance. The lack of interaction with noise shown in the present study may be due to an ability of native speakers to dynamically adapt to moderate levels of noise; the more extensive the experience with variation, the more robust the perceptual response in the face of noise. This is consistent with recent findings that the combined effects of dialect variation and noise on speech processing are lessened when the listener has extensive experience with a similar dialect (Clopper &Bradlow, 2009; Clopper, Pierrehumbert, &Tamati, 2010, Sumner &Samuel, 2009).

We believe that these findings also suggest that early and extensive experience with relevant variation creates a robust representation that listeners with normal hearing can draw on under difficult listening conditions, such as in background noise. Individuals with hearing loss may experience an increased difficulty adapting to dialect variability in noise because of the reduced redundancy in the received signal. There is a dearth of research on how listeners with hearing loss respond to dialect variation and other types of phonological distortion. Such work continues to be a focus of interest in our laboratories.

Conclusion

The results of the production study indicate that even when vowels are labeled with the same phonetic symbol (by convention), there can be large acoustic differences between one region's vowels and another's; moreover, there are vowel-specific effects such that some vowels are quite similar across studies and others vary widely. On the whole, the PNW vowels were more similar to the PB vowels than to the HGCW vowels, but for each of the standard vowel sets, some PNW vowels showed larger distances. When presented as stimuli in noise, vowel distance had a reliable (negative) impact on the listener's ability to correctly identify the target vowel. These findings indicate that researchers and clinicians should take care in choosing stimuli for perception experiments. We recommend that researchers use regionally validated vowels instead of relying on standardized vowels in tasks that use vowel perception.

Acknowledgments

This work was supported by Grant R01 DC60014 from the National Institutes of Health. The authors are grateful to Stephanie Bor, Star Reed, Daniel McCloy, and KerryWitherell for their assistance with stimulus preparation, data collection, and analysis.

Footnote

1Other studies of the PNW accent have defined specific neighborhood regions of the Northwest and/or specific sounds (e.g., Ingle, Wright, &Wassink, 2005; Wassink, Squizzero, Schirra, &Conn, 2009).

2For an alternative approach that incorporates consonant spectra as well, see Heeringa, Johnson, and Gooskens (2009).

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Editor: Robert Schlauch
Associate Editor: Mark Hedrick
Received October 4, 2010
Revision received March 14, 2011
Accepted June 3, 2011
DOI: 10.1044/1092-4388(2011/10-0278)

Publication date: Feb 2012

Year: 2012

Perceptual Learning of Dysarthric Speech: A Review of Experimental Studies

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Publication info: Journal of Speech, Language and Hearing Research (Online) 55.1 (Feb 2012): 290-305.
ProQuest document link

Abstract: This review article provides a theoretical overview of the characteristics of perceptual learning, reviews perceptual learning studies that pertain to dysarthric populations, and identifies directions for future research that consider the application of perceptual learning to the management of dysarthria. A critical review of the literature was conducted that summarized and synthesized previously published research in the area of perceptual learning with atypical speech. Literature related to perceptual learning of neurologically degraded speech was emphasized with the aim of identifying key directions for future research with this population. Familiarization with unfamiliar or ambiguous speech signals can facilitate perceptual learning of that same speech signal. There is a small but growing body of evidence that perceptual learning also occurs for listeners familiarized with dysarthric speech. Perceptual learning of the dysarthric signal is both theoretically and clinically significant. In order to establish the efficacy of exploiting perceptual learning paradigms for rehabilitative gain in dysarthria management, research is required to build on existing empirical evidence and develop a theoretical framework for learning to better recognize neurologically degraded speech.

Full text: Headnote

Purpose: This review article provides a theoretical overview of the characteristics of perceptual learning, reviews perceptual learning studies that pertain to dysarthric populations, and identifies directions for future research that consider the application of perceptual learning to the management of dysarthria.

Method: A critical review of the literature was conducted that summarized and synthesized previously published research in the area of perceptual learning with atypical speech. Literature related to perceptual learning of neurologically degraded speech was emphasized with the aim of identifying key directions for future research with this population.

Conclusions: Familiarization with unfamiliar or ambiguous speech signals can facilitate perceptual learning of that same speech signal. There is a small but growing body of evidence that perceptual learning also occurs for listeners familiarized with dysarthric speech. Perceptual learning of the dysarthric signal is both theoretically and clinically significant. In order to establish the efficacy of exploiting perceptual learning paradigms for rehabilitative gain in dysarthria management, research is required to build on existing empirical evidence and develop a theoretical framework for learning to better recognize neurologically degraded speech.

Key Words: dysarthria, speech perception, perceptual learning

Dysarthria, a neurological disorder of the motor speech system, manifests itself in perceptual disturbances that compromise the integrity of the acoustic signal. It commonly results in impaired speech intelligibility. Indeed, intelligibility disturbances have been classified a "hallmark" feature of this speech disorder (Tikofsky &Tikofsky, 1964; Yorkston, Beukelman, &Bell, 1988) and described as "the most clinically and socially important aspects of dysarthria" (Ansel &Kent, 1992, p. 296). As such, treatments that address improving speech intelligibility are fundamental to the successful management of dysarthria.

Speech intelligibility has traditionally been viewed as a property of the speaker (e.g., Black, 1957; Bond &Moore, 1994; Hood &Poole, 1980). Accordingly, dysarthria management has focused primarily on individual speakers themselves, with emphasis on attempts to improve speech production or equip speakers with strategies or devices to compensate for their impairments (Duffy, 2005). Recent Cochrane reviews have concluded that there are no high-level studies to support or refute the efficacy of speech treatment for progressive and nonprogressive dysarthrias (Deane, Whurr, Playford, Ben- Shlomo, &Clarke, 2009; Sellars,

Hughes, &Langhorne, 2007). Considering the clinical significance of improving intelligibility for individuals with dysarthria, it is critical that research continue to examine the outcomes of behavioral modification on speech production. However, the consideration and development of innovative new forms of treatment is also vital. Speech intelligibility is defined as "the accuracy with which a message is conveyed by a speaker and recovered by a listener" (Klasner &Yorkston, 2005, p. 127). This definition highlights the essential role of both speaker and listener in the communication process. With the speaker-listener process in mind, it was proposed that the intelligibility impairments exhibited by individuals with dysarthria may benefit from treatments that focus on the listener (Liss, 2007). Although conceptually, listener-targeted remediation in dysarthria is novel, its potential should not be underestimated. Dysarthria very rarely occurs in isolation. Physical, cognitive, and memory deficits frequently co-occur, all of which can greatly reduce the individual's capacity to learn and maintain benefits from speaker-oriented interventions (Duffy, 2005). Treatment that focuses on the neurologically intact listener (e.g., family members, friends, carers), thereby bypassing the speaker and any associated conditions that may adversely affect rehabilitation gains, may prove key to optimizing communication success in those with dysarthria.

The notion of training a listener to better understand dysarthric speech is theoretically based in the broader field of perceptual learning. When applied to speech, perceptual learning describes experience-evoked adjustments to the cognitive-perceptual processes required to recognize spoken language. In brief, these perceptual processes-lexical segmentation, lexical activation, and lexical competition-enable the listener to segment a continuous speech stream into individual words (lexical segmentation), to access the lexical items that may match these targets (lexical activation), and to select themost appropriate word for the spoken utterance (lexical competition; Jusczyk &Luce, 2002). Subsequently, word meanings are accessed, and comprehension of the utterance occurs in context. Put simply, perceptual learning implies that a listener can improve his or her ability to recognize a speech signal that is initially difficult to understand.

The past decade has seen much research focused on experimental designs that evaluate perceptual learning of speech. There is now a considerable body of evidence regarding the perceptual benefit for listeners familiarized with an ambiguous or unfamiliar speech signal (e.g., time-compressed, noise vocoded, foreign-accented; see Samuel &Kraljic, 2009). Research has also begun to investigate this phenomenonwith neurologically degraded speech. Although the body of research is small, preliminary evidence suggests that perception of dysarthric speechmay also improvewith training (e.g., Liss, Spitzer, Caviness, &Adler, 2002; Tjaden &Liss, 1995b). This highlights the potential for perceptual learning to be exploited for rehabilitative gain in dysarthria management. However, if this is to occur, a considerable amount of research is first required. This research must build on existing empirical evidence and develop a theoretical framework for a perceptual learning approach to the treatment of dysarthria.

The purpose of this review is threefold: to (a) define perceptual learning and provide an overview of the characteristics of learning within the broader category of atypical speech;1 (b) summarize and synthesize research in which perceptual learning specifically has been examined with dysarthric populations; and (c) identify future directions for this line of research with consideration of its potential role in addressing intelligibility impairments exhibited by individuals with dysarthria.

Perceptual Learning of Atypical Speech

Perceptual learning of speech is defined as "relatively long-lasting changes to an organisms perceptual systemthat improves its ability to respond to its environment and are caused by this environment" (Goldstone, 1998, p. 585) and refers to the experience-evoked capacity to retune or adapt the speech perception system. That is, when listeners are familiarized with a speech signal that is unfamiliar or ambiguous, they are able to modify their perceptual strategies for subsequent processing of the atypical speech (Samuel &Kraljic, 2009). On the basis of interactive models of speech perception, it is proposed that an individual's perceptual system is flexible and dynamically adjusts to match the information provided in the incoming signal (e.g., McClelland

&Elman, 1986).

The laboratory study of perceptual learning has revealed important information about the ways in which familiarization with atypical speech alters subsequent perception. At the phoneme level, it has been shown that perceptual shifts in phoneme category boundaries occur following experience with ambiguous tokens embedded within lexical contexts (e.g., Eisner &McQueen, 2005, 2006; Kraljic &Samuel, 2005, 2006; Maye, Aslin, &Tanenhaus, 2008; Norris, McQueen, &Cutler, 2003). For example, Norris et al. (2003) observed that when Dutch listeners were trained with an ambiguous phoneme (acoustically and perceptually halfway between /s/ and /f/) in real or nonword contexts, listeners were able to extend the boundaries of one of their internal fricative categories (/s/ or /f/) to include the ambiguous phoneme. That is, listeners' internal representations of the acoustic information constituting of /s/ or /f / shifted to accommodate the ambiguous phoneme. The nature of the learning attributed to the phenomenon of category shifting has been termed perceptual adaptation, whereby training facilitates an acoustic-phonetic remapping of phonological information at the segmental level of perceptual processing (e.g., Eisner &McQueen, 2005; Greenspan, Nusbaum, &Pisoni, 1988).

Perceptual learning effects have also been reported as improvements in intelligibility (word recognition accuracy) with atypical speech following a familiarization experience. These unfamiliar or degraded acoustic signals can vary significantly along multiple phonetic and/or prosodic dimensions to that of typically encountered speech. Intelligibility improvements have been demonstrated in listeners who received training with foreign-accented (e.g., Bradlow &Bent, 2008; Weill, 2001) and hearing-impaired speech (e.g., Boothroyd, 1985; McGarr, 1983), as well as artificially manipulated acoustic signals such as noise-vocoded (e.g., Davis &Johnsrude, 2007; Davis, Johnsrude, Hervais-Adelman, Taylor, &McGettigan, 2005), computer-synthesized (e.g., Francis &Nusbaum, 2009; Greenspan et al., 1988; Nusbaum &Lee, 1992), and time-compressed speech (e.g., Golomb, Peelle, &Wingfield, 2007; Pallier, Sebastian- Galles, Dupoux, &Christophe, 1998). As with phonemic category shiftresearch, it is postulated that the source of perceptual benefit occurs primarily at the segmental level of perceptual processing. When listeners are exposed to the atypical speech pattern, the unique and systematic acoustic-phonetic characteristics of the atypical signal are mapped onto a listener's existing phonological space, causing a shiftin perceptual representation of particular phonemes (e.g., Dupoux &Green, 1997; Francis, Nusbaum, &Fenn, 2007; Greenspan et al., 1988). This shiftis thought to benefit the cognitiveperceptual processes of speech perception, particularly lexical activation (e.g., reduced activation of a larger than necessary lexical cohort) and lexical competition (e.g., reduced competition for processing resources and increased likelihood of correct target selection), thereby yielding improved intelligibility.

On the basis of a number of findings, the most plausible account for these segmental benefits is that familiarization with the atypical signal induces an attentional shifttoward more phonetically informative acoustic cues (e.g., Francis, et al., 2007; Nusbaum &Goodman, 1994; Pisoni, Lively, &Logan, 1994). According to this explanation, training does not increase the quality or the quantity of the available acoustic information but rather directs cognitive resources to those cues considered most relevant for recognition of the unique signal. If training does in fact improve the distribution of attentional resources (i.e., increased attention toward more informative cues at the expense of less relevant information), then demands on working memory may decline, and improved recognition may result (Francis &Nusbaum, 2009).

Perceptual learning research using time-compressed speech, a signal characterized by systematic manipulation to its temporal characteristics, has demonstrated that listeners may also learn something about the global prosodic features of the speech signal-specifically, its rhythmic qualities (Pallier et al., 1998; Sebastian- Galles, Dupoux, Costa,&Mehler, 2000). The mechanism for this learning may be described as rhythmic expectancy, whereby listeners can anticipate and focus attention on high-yield aspects of the signal when they have adapted to the systematically varied rate and rhythm. Sebastian-Galles and colleagues (2000) examined perceptual learning of time-compressed speech across different language classes with distinguishably different rhythmic patterns (syllable-timed vs. stress-timed vs. mora-timed). They found that perceptual learning outcomes were

influenced by the rhythmic properties of the training signal. For example, familiarization with syllable-timed languages facilitated improved processing of other syllable-timed languages but not with signals characterized by another rhythmic pattern. This suggests that acoustic-phonetic remapping is not the only source of benefit that underlies experience-evoked intelligibility improvements and that suprasegmental learning may facilitate subsequent lexical segmentation of speech with similar rhythmic structure.

Traditionally assumed to have limited relevance to linguistic processing (e.g., Halle, 1985), a role for indexical information in perceptual learning of speech has recently been acknowledged (e.g., Loebach, Bent, &Pisoni, 2008). Nygaard, Sommers, and Pisoni (1994) found that listeners trained to identify the names of 10 unfamiliar speakers exhibited significantly greater recognition scores when presented with novel words produced by these same speakers relative to listeners presented with novel words produced by unfamiliar speakers. Similar perceptual benefits afforded by attention to indexical properties of the signal were observed with sentencelevel recognition in a follow-up study (Nygaard&Pisoni, 1998). In addition, the benefit of speaker familiarity on subsequent linguistic processing has been replicated with older individuals (Yonan &Sommers, 2000). More recently, Loebach et al. (2008) revealed that the perceptual benefit of training on indexical properties may also extend to the perception of noise-vocoded speech. Listeners engaged in a speaker identification task made significant intelligibility improvements and furthermore, the performance gains were as great as those achieved by listeners engaged in a linguistic-based transcription training task. Thus, these studies generate preliminary evidence that indexical information may also inform recognition of artificially degraded speech.

Taken together, it appears likely that multiple potential sources of perceptual learning exist. Although the evidence regarding learning sources and the relative contribution of different levels of information is limited, it may be presumed that familiarization with atypical speech enables listeners to extract something about the unusual regularities and that this facilitates improved perceptual processing in subsequent encounters. Until now, this tutorial has treated "familiarization" or "training" with atypical speech in a rather nebulous way. However, the specific ways in which listeners receive training vary on a number of levels, including familiarization material, familiarization conditions, and amount of familiarization. Such factors may or may not influence the longevity of learning and whether effects are generalized across stimuli and/or speakers. These characteristics of perceptual learning are discussed in turn.

Familiarization Material

Familiarization material describes the stimuli (usually speech) used to promote perceptual learning of the speech signal. Studies have reported that perceptual learning may be most robust when listeners are familiarized with real-word, rather than nonword, stimuli (e.g., Davis et al., 2005; McQueen &Mitterer, 2005; Norris et al., 2003). This suggests a lexical influence in perceptual learning of speech. When listeners were familiarized with an ambiguous phoneme embedded within word or nonword training material, category boundary shifts were identified only for those listeners trained with real words (Norris et al., 2003). Using noise-vocoded speech, a signal characterized by systematic manipulation to its spectral information, similar findings regarding the benefit of lexical information were reported (Davis et al., 2005). Listeners exposed to sentences containing real words demonstrated improved word recognition of the noise-vocoded speech, whereas a learning response was not identified for listeners exposed to a nonword sentence condition. When the familiarization material was further manipulated to remove sentence-level or syntactic information, it was found that sentence-level meaning did not appear crucial to perceptual learning. Specifically, listeners familiarized with syntactic prose sentences-grammatically correct sentences with real words but no sentence-level meaning (e.g., "the effect supposed to the consumer")- achieved similar perceptual learning effects as those of listeners presented with semantically coherent English sentences (Davis et al., 2005). Although this was the case, syntactic content alone did not appear to be the critical element behind perceptual learning. Listeners who were presented with jabberwocky sentences- sentences with real English function words but nonword content words (e.g., "the tekeen garung to the sumeeun")-exhibited significantly less perceptual learning than listeners trained

with sentences containing only real words. It was concluded that lexical information drove perceptual learning of noise-vocoded speech. However, both word and nonword familiarization conditions facilitated improved word recognition of noise-vocoded speech when exposure material comprised individual words, as opposed to sentencelevel stimuli previously used (Hervais-Adelman, Davis, Johnsrude, &Carlyon, 2008). Thus, lexical information may not be crucial to the facilitation of a perceptual learning response when the stimuli, as is the case with single words, can be accurately retained in short-term memory.

Familiarization Conditions

A second issue relates to the provision, or otherwise, of feedback to augment the auditory stimuli during familiarization-that is, whether knowledge of the atypical productions is required for perceptual learning outcomes to be realized. The evidence on this issue is varied. McQueen, Cutler, and Norris (2006) demonstrated that learning to categorize an ambiguous phoneme could be achieved with a simple auditory listening experience (passive familiarization). However, other studies have demonstrated that learning may necessitate more explicit familiarization, wherein listeners are provided with feedback about classification performance or written information regarding the intended lexical targets (e.g., Davis et al., 2005; Fenn, Nusbaum, &Margoliash, 2003). Learning of synthetic speech has been reported following passive experience with auditory stimuli (Koul &Hester, 2006; Reynolds, Isaacs- Duvall, &Haddox, 2002) and in studies in which a more explicit familiarization procedure has been used (e.g., Greenspan et al., 1988; Reynolds, Isaacs-Duvall, Sheward, &Rotter, 2000; Schwab, Nusbaum, &Pisoni, 1985). Studies comparing passive and explicit familiarization with noise-vocoded speech have reported superior learning when the degraded stimuli is supplemented with undistorted (auditory or written) versions of the spoken targets (Davis et al., 2005; Loebach, Pisoni, &Svirsky, 2010). In summary, it appears that perceptual learning may take place automatically when the learning entails subtle adjustments to an existing phonetic category distinction (e.g., Norris et al., 2003). However, adaptation to an entirely novel category distinction (e.g., Logan, Lively, &Pisoni, 1991) or to an acoustic signal with substantial acoustic degradation may require more explicit familiarization (e.g., Davis et al., 2005; Fenn et al., 2003).

Amount of Familiarization

The amount of familiarization listeners are afforded has also varied substantially across studies. Extremely rapid learning effects have been observed following less than 1 min of familiarization with natural changes in speech rate (e.g., Miller, 1981; Miller &Liberman, 1979) and spectral degradations (e.g., Summerfield, Haggard, Foster, &Gray, 1984; Watkins, 1981). Several minutes of familiarization enabled perceptual learning of time-compressed (Mehler et al., 1993; Pallier et al., 1998) and foreign-accented speech (Bradlow &Bent, 2008; Clarke &Garrett, 2004), whereas 25 min (Davis et al., 2005), nine 20-min sessions (Rosen, Faulkner, &Wilkinson, 1999), and four sessions of 1-2 hr (Stacey &Summerfield, 2007) of familiarization has been observed for learning to better recognize the noise-vocoded speech signal. Similar to the speculations made with familiarization conditions, as speech becomes increasingly degraded, longer periods of familiarization may be required for perceptual learning outcomes to be realized. Although there is no conclusive evidence regarding the amount of familiarization needed to achieve learning, studies to date would suggest that learning occurs relatively quickly, even for severely distorted speech.

Longevity of Learning

It appears that once learning has occurred, it can remain stable over a period of time. Eisner and McQueen (2005) observed that learning to categorize an ambiguous phoneme remained robust following a 25-min time lapse-even when passive listening to speech (which did not contain the ambiguous phoneme) occurred during the delay period. Learning effects were also reported following a lapse of 12 hr and moreover were not dependent on the opportunity for consolidation during sleep (Eisner &McQueen, 2005). In contrast, studies in which synthetic speech has been used have demonstrated the need for sleep to maintain learning effects over a 12-hr period (Fenn et al., 2003). Robust perceptual learning outcomes, measured in terms of vowel, consonant,

word, and sentence recognition, were observed 7-15 days following familiarization with noise-vocoded speech (McGettigan, Rosen, &Scott, 2008), and improved word recognition of synthetic speech was observed at a 6-months follow-up test task (Schwab et al., 1985). Although limited in terms of study numbers, preliminary evidence suggests that perceptual learning may not simply be a temporary adjustment to the listener's perceptual system. Rather, learning of the unusual regularities within the acoustic signal is long-lasting and facilitates permanent perceptual change.

Generalization of Learning

Studies have also demonstrated that perceptual learning effects can generalize between lexical items (e.g., Davis et al., 2005; Francis &Nusbaum, 2000). McQueen et al. (2006) and Norris et al. (2003) observed detectable changes in the categorization of an ambiguous phoneme in words that differed from the targets encountered during the familiarization task. This learning transfer was taken as evidence that learning may transpire at the sublexical level. Generalization of learning to untrained words has also been reported in the recognition of accented speech (Clarke &Garrett, 2004), noise-vocoded speech (Davis et al., 2005; Hervais-Adelman et al., 2008), and synthesized speech (Fenn et al., 2003; Francis &Nusbaum, 2000). Such findings further support the notion that perceptual representations may be modified, at least to some degree, at the level of the phonetic unit. Although the evidence for learning transfer across novel lexical targets is relatively robust, the support for cross-speaker generalization is less conclusive. Eisner and McQueen (2005) found that perceptual learning of an ambiguous fricative did not generalize to a novel speaker (i.e., one not included in the training condition). In contrast, Kraljic and Samuel (2006) reported cross-speaker generalization for perceptual learning of an ambiguous stop phoneme. That phoneme learning generalized across speakers in some situations, but not in others, may indicate variations in the amount of speaker-specific information afforded by particular phoneme productions (Kraljic &Samuel, 2006). Evidence of learning transfer across speakers has also been found in studies with foreign-accented speech (Bradlow &Bent, 2008; Weill, 2001) and time-compressed speech (Dupoux &Green, 1997; Kouider &Dupoux, 2005), when the speakers exhibit similar speech patterns (i.e., speech modified in the same manner). Finally, learning of vocoded speech has been found to generalize between acoustic characteristics (Dahan &Mead, 2010; Hervais-Adelman, Davis, Taylor, Johnsrude,&Carlyon, 2011). Although complete learning was achieved between different frequency regions (low-pass and high-pass filtered signals), carryover was limited between different carrier signals (noise bands, sine waves, and pulse trains; Hervais-Adelman et al., 2011) and stimuli with minimal phonetic similarity (Dahan &Mead, 2010). Taken together, the findings suggest that the ability and extent to which learning can be generalized may be dependent on the acoustic similarity between the training and testing stimuli.

Perceptual Learning of Dysarthric Speech

As the preceding discussion has established, perceptual learning research using healthy speech variants (nonnative) or laboratory-modified speech (e.g., time compressed or noise vocoded) presumes that listeners learn something about the regularities in atypical patterns and can apply that information to subsequent encounters with those atypical patterns. However, it is difficult to directly adopt this presumption when considering perceptual learning of dysarthric speech. The speech degradation that occurs in individuals with neurologic impairment is, by its nature, far from consistent. Speakers may deal with issues such as fluctuating muscle tone, inadequate respiratory support that worsens with fatigue, phonatory instability, and overarching deficits in articulatory movement coordination. Thus, although some acoustic features (e.g., hypernasality or breathiness) may be consistent and pervasive in a person's speech, others may vary widely (e.g., irregular articulatory breakdowns or variable speech rate). If we adopt the more general view of perceptual learning, we can hypothesize that those production features that are the most consistent and regular will be more "learnable." Subsequently, these features would be most salient for improving perceptual performance, relative to those aspects that are inconsistently expressed. By extension, dysarthrias with more consistent signal degradations (e.g., hypokinetic) would be expected to be more amenable to perceptual training than those with

more inherent variability (e.g., hyperkinetic). However, the role of acoustic consistency in perceptual learning remains largely untested. It may very well be that there is perceptual value in exposure to nonsystematic acoustic variation as well, even though the source of benefit could not be attributed to inducing a perceptual remapping. In this case, establishing "expectations of variability" may be the mechanism by which performance is enhanced. Recent work by Mattys and Liss (2008) has identified that words produced by a speaker with hypokinetic dysarthria were better recalled if played in the same voice, as opposed to a different voice, between the two successive blocks. This perceptual advantage of indexical consistency suggests that speakerspecific detail may inform recognition of dysarthric speech. Investigations have yet to document whether indexical information influences perceptual learning of dysarthric speech. It is imperative to establish "what is learnable" if perceptual learning is to be harnessed to build a theoretical account that supports, or otherwise, the development of listener-based treatment for the management of dysarthria.

To date, only a handful of studies have examined perceptual processing and changes to speech recognition for listeners familiarized with dysarthric speech. These are reported in Table 1.2 The majority of these studies have been clinically based and their findings largely equivocal. Although some reports have observed significant intelligibility gains for listeners familiarized with dysarthric speech (D'Innocenzo, Tjaden, &Greenman, 2006; Hustad &Cahill, 2003; Liss et al., 2002; Spitzer, Liss, Caviness, &Adler, 2000; Tjaden &Liss, 1995a, 1995b), others have not (Garcia &Cannito, 1996; Yorkston &Beukelman, 1983). Substantial variations in research designs limit the degree to which studies can be compared; however, they do provide valuable insight into variables that may influence the nature of perceptual learning with the dysarthric signal. In the following section, we summarize this body of research presented in Table 1 with regard to source(s) of learning and the variables that appear most salient in promoting improved recognition of dysarthric speech.

Learning Source

Traditionally, the dysarthrias are categorized by both type and severity, dependent on the presence of perceptual errors (segmental goodness) and patterns (e.g., speech rate and prosody, phonatory characteristics) and the degree to which these errors and patterns impact the integrity of the acoustic signal (Duffy, 2005). This conceptualization motivates the majority of studies of perceptual learning in dysarthria, wherein a wide variety of dysarthria types (flaccid, spastic, ataxic, hypokinetic, hyperkinetic, spastic-flaccid, spastic-hyperkinetic and spastic-ataxic) and severities (ranging from mild to severe) have been used. Furthermore, the few studies that have sought to identify a source of learning (i.e., "what is learnable?") have approached dysarthric speech signal characteristics in terms of segmental versus suprasegmental degradation.

To our knowledge, the first attempt to address "what is being learned" in a case of dysarthria was conducted by Tjaden and Liss (1995a). A nonnative English-speaking woman with cerebral palsy and a moderate-to-severe spastic-ataxic dysarthria provided the speech material. Normal hearing listeners transcribed her speech after first being familiarized with either her production of a read passage or with all of the words of the passage presented as a single read word list. It was expected that experience with the segmental and suprasegmental features in the read passage would be superior for perceptual learning than the single words, but ultimately both conditions benefitted intelligibility to the same degree beyond a control condition. Additional analysis confirmed that listeners learned the nonnative English regularities, such as substituting /l/ for /r/.

In subsequent work, Liss and colleagues attempted to develop dependent variables that would distinguish learning about segmental regularities from suprasegmental regularities. Liss et al. (2002) examined the lexical boundary error (LBE) patterns (errors that reflect a reliance on syllable stress contrasts to inform processes of lexical segmentation) of listeners familiarized with either ataxic or hypokinetic dysarthria. Although all listeners made the anticipated post-familiarization intelligibility gains, LBE findings revealed no significant difference in error patterns made by familiarized listeners when compared with same-signal transcriptions from nonfamiliarized listeners. It is possible that this result indicates that familiarization does not improve a listener's ability to perceive differences in syllable stress contrasts with ataxic or hypokinetic dysarthria. However, it is

also possible that the familiarization procedure used in Liss et al., just 18 phrases, was too brief to facilitate detectable changes to the processes of lexical segmentation.

In a post hoc exploration of these data, Spitzer et al. (2000) completed segmental error analysis of the listener transcripts of participants who received explicit familiarization using phrases produced by speakers with either ataxic or hypokinetic dysarthria. The authors observed changes to segmental error patterns for listener's familiarized with ataxic speech but not for those familiarized with hypokinetic speech. Listeners who heard and transcribed ataxic stimuli produced a higher proportion of target consonants in word substitutions and a lower number of substitution errors that were not phonemically related to the intended targets compared with listeners who simply transcribed the ataxic speech stimuli. Interestingly, this segmental level benefit was not enjoyed by listeners who heard and transcribed hypokinetic speech. Absence of segmental level changes for listeners familiarized with hypokinetic speech provides further support for the hypothesis that the source of learning may be dependent on type of dysarthria (Spitzer et al., 2000). However, the type of analysis used and, again, the fleeting familiarization procedure, must be considered. It is predicted that a more extensive familiarization procedure and a more elaborate multievel analysis of listener transcripts may reveal a more comprehensive picture of the cognitiveperceptual changes associated with perceptual learning of dysarthric speech. Nonetheless, present findings enable us to speculate that the source of learning is likely influenced by the characteristics of the signal to be learned.

Signal Characteristics

The importance of type and quality of signal characteristics is further supported by a number of findings in the literature. Hustad and Cahill (2003) observed immediate improvements in recognition of mildly dysarthric speech for listeners familiarized with just 10 phrases of the speech; however, at least 30 familiarization phrases were required for intelligibility gains to be realized with severely dysarthric speech. Consistent with these findings, Garcia and Cannito (1996) failed to report any intelligibility benefit for listeners who received a single 16-phrase familiarization experience with severe dysarthria. Thus, it could be hypothesized that learning to better understand severely degraded dysarthric speech may necessitate greater amounts of familiarization than that required to achieve learning of milder forms of dysarthria. When intelligibility scores of ataxic and hypokinetic speech stimuli were matched, Liss and colleagues (2002) found that perceptual benefits of familiarization were greatest for listeners who heard and transcribed phrases produced by the speakers with ataxic dysarthria. This suggests that the perceptual presentation of ataxic dysarthria may be more amenable to learning than that which characterizes hypokinetic dysarthria. Taken together, the small number of studies conducted thus far demonstrates that perceptual learning may be highly dependent on the characteristics of the signal to be learned. Although further investigation into the effect of signal type and severity on the intelligibility benefits afforded by a familiarization experience is warranted, existing literature reveals a likelihood that such a relationship exists.

Familiarization Conditions

To date, two types of familiarization conditions have been used in studies in which perceptual learning of dysarthric speech has been examined: passive familiarization (degraded signal only) and explicit familiarization (degraded signal and written transcripts of the target stimuli). A clear picture of how different conditions enhance learning outcomes when listeners are familiarized with dysarthric speech is yet to emerge (see Table 1). Some studies in which passive familiarization has been used have revealed intelligibility gains for familiarized listeners (Hustad &Cahill, 2003), whereas no perceptual benefit has been observed in other studies following a simple auditory experience with the degraded signal (Garcia &Cannito, 1996; Yorkston &Beukelman, 1983). Similarly, when explicit familiarization involving both the degraded signal and written information has beed used in studies, intelligibility gains have been documented in some (D'Innocenzo et al., 2006; Liss et al., 2002; Spitzer et al., 2000; Tjaden &Liss, 1995a) but not in others (Yorkston &Beukelman, 1983). To date, the one study in which intelligibility scores were directly compared following passive versus explicit exposure reported no

significant difference across the two familiarization conditions (Yorkston &Beukelman, 1983).

Amount of Familiarization

Conflicting findings regarding the benefit of different familiarization conditions are likely due, in part, to the varying amount of familiarization undertaken. For example, listeners who failed to exhibit intelligibility gains following passive familiarization were exposed to a short conversational sample (specific details not provided) of dysarthric speech (Garcia &Cannito, 1996). In contrast, passive familiarization to 40 phrases yielded significant perceptual gain for listeners (Hustad &Cahill, 2003). From this comparison alone, it appears that when familiarization is passive, a greater amount of training may be required for the learning response to be realized. Studies in which explicit familiarization procedures have been used indicate that amount of training may have less impact on the perceptual benefit of familiarization (see Table 1 for more details).

Listener Familiarity

Previously published studies in which intelligibility improvements for listeners familiarized with dysarthric speech have been reported have all used listeners naïve to this type of speech degradation (e.g., D'Innocenzo et al., 2006; Hustad &Cahill, 2003; Liss et al., 2002; Spitzer et al., 2000). The single study in which speech pathologists and student clinicians were used as listeners failed to observe intelligibility improvements when familiarized with dysarthric speech under either passive or explicit conditions (Yorkston &Beukelman, 1983). Thus, it could be speculated that the listeners in this study, presumed already familiar with dysarthric speech, had previously adapted to the degraded speech during unstructured interactions. Experimental studies on listeners familiarized with dysarthric speech have yet to investigate the role of listener familiarity in perceptual learning of dysarthric speech.

Developing a Perceptual Learning Approach to Management

Taken together, the small number of studies conducted thus far yield preliminary evidence that listeners can learn to better recognize neurologically degraded speech. Moreover, the studies provide insight into the possible learning sources that enable these intelligibility improvements to be realized. Improved word recognition for listeners familiarized with dysarthric speech reveals a potentially promising avenue for future intervention- that is, using a perceptual learning approach to address the intelligibility impairments that debilitate this population. Although such an approach may or may not afford clinical application to listeners already familiar with dysarthric speech, improving intelligibility for those unfamiliar with dysarthric speech, including family and friends of individuals with a recently acquired dysarthria (e.g., stroke, traumatic brain injury), holds significant value. Indeed, the importance of research into listener training was underscored almost a decade ago (Yorkston, Dowden, &Beukelman, 1992). In order to establish the efficacy of exploiting perceptual learning paradigms for rehabilitative gain in the management of dysarthria, a considerable amount of research is first required. In the subsequent section, we outline the initial steps required to develop a theoretical framework upon which future listener-targeted, perceptual learning approaches to the treatment of dysarthria can be developed. As some patterns and degrees of acoustic degradation are likely more amenable to learning than others, research in all four areas outlined below should be explored with dysarthrias of varying types and severities under comparable experimental conditions.

As a primary step, the establishment of strong empirical evidence supporting the existence of a perceptual learning effect resulting from experience with dysarthric speech is required. Although evidence of intelligibility improvements for listeners familiarized with dysarthric speech have been reported (see, e.g., D'Innocenzo et al., 2006; Spitzer et al., 2000), the absence of adequate experimental control has reduced the strength of existing findings. Research conducted thus far has attempted to assess the magnitude of perceptual learning effects by comparing intelligibility scores from listeners familiarized with dysarthric speech with nonfamiliarized listeners. In such cases, particularly where the training material affords similarities to the testing material, it is challenging to separate the perceptual improvements that result from familiarization with dysarthric speech from those that may arise simply from the familiarization experience (e.g., Hustad &Cahill, 2003; Liss et al., 2002). In order to

reliably attribute perceptual benefits to familiarization with dysarthric speech, research is required to include a control group, where listeners are familiarized with stimuli produced by neurologically intact speakers, age- and gender-matched to the speakers providing the dysarthric stimuli. Such comparisons would strengthen evidence of perceptual learning with dysarthric speech.

Once a perceptual learning effect has been established, a comprehensive picture of the cognitive-perceptual processes associated with improved recognition of the dysarthric signal is required. Common models of perceptual learning of speech assume an interactive integration of information, whereby bottom-up acoustic-phonetic information is supplemented with top-down linguistic and real-world information (Francis et al., 2007). From a theoretical vantage point, intelligibility improvements could arise from improved processing of any one, or combination, of the perceptual degradations that characterize dysarthria. To date, only two studies have begun to shed light on the possible cognitive-perceptual changes associated with intelligibility benefits following familiarization with dysarthric speech. These studies have examined source of learning from a segmental versus suprasegmental perspective and have proposed that the perceptual benefits associated with a familiarization experience may occur with improved processing of segmental information. However, evidence regarding the source of learning associated with improved recognition of dysarthric speech is limited, and present findings have not led to a clear answer. In order to provide a more complete picture of the source of learning associated with improved recognition of neurologically degraded speech, large-scale studies that consider the role of attentional mechanisms and resource allocation to linguistic (segmental and suprasegmental) and indexical features, with respect to both systematic and nonsystematic degradation, are required. Such knowledge is not only key to a theoretical framework of perceptual learning of the degraded signal but may further inform present models of perceptual processing with typical and atypical speech.

If high-level evidence regarding the perceptual benefit of familiarization with dysarthric speech is established and the source of such learning is identified, then research must seek to determine the conditions required to achieve this learning. As previously stated, a significant methodological variation across the existing research is found in the type of familiarization conditions used. There is evidence that learning may transpire automatically, as a result of passive familiarization to the degraded auditory productions (e.g., Hustad &Cahill, 2003). There is also evidence to suggest that more explicit familiarization involving supplementary written information may be required for perceptual benefits of familiarization to be realized (e.g., Liss et al., 2002). Existing research has yet to provide conclusive evidence on this matter. Accordingly, studies are needed to determine the conditions that promote improved recognition of dysarthric speech.

Clinically, the perceptual benefit of familiarization is only of functional value if improvements can persist over time. Therefore, research is also required to identify whether intelligibility improvements observed immediately following experience with dysarthric speech can remain stable over a period in which no further neurologically degraded speech input is received. Although studies of other forms of atypical speech have demonstrated that the intelligibility benefit following familiarization can continue following a significant time lapse (e.g., Lively, Pisoni, Yamada, Tohkura, &Yamada, 1994; McGettigan et al., 2008), the few studies in which perceptual learning has been examined with dysarthric speech have yet to investigate this phenomena. Bearing in mind the multiple segmental and suprasegmental distortions that characterize the dysarthric signal, improved recognition of dysarthric speech presumably involves a number of different processing levels and significant cognitive resources. Thus, investigation into the longevity of perceptual learning effects holds both clinical and theoretical significance.

Summary

The potential for perceptual learning of the dysarthric signal is considerable. If familiarization with dysarthric speech could facilitate improvements in a listener's ability to understand the neurologically degraded acoustic signal, then there is foundational evidence to support the use of perceptual learning paradigms in the development of a listener-based treatment program to address the intelligibility impairments. Primarily, a

perceptual learning rehabilitation approach would aim to increase intelligibility through improved signal processing for the trained listener. Although, ultimately, treatment that targets universal verbal interactions is the gold standard, any approach that improves communicative effectiveness affords significant clinical application. Listener training for the management of dysarthria may be particularly applicable in the following instances: when signal production does not improve with existing interventions; when speaker-oriented approaches are not recommended (e.g., in the case of flaccid dysarthria associated with myasthenia gravis); or when co-occurring physical deficits limit the utility of augmentative or alternative approaches (e.g., communication devices, gesture, etc). Moreover, treatment that targets perceptual processes may serve as an adjunct to speaker-orientated treatment to maximize performance outcomes with particular communication partners.

If we are to harness perceptual learning to build a theoretical account that supports the development of listener-based treatment for the management of dysarthria, a systematic programof study grounded in current models of perceptual processing is needed. Although a well-researched familiarization protocol with both familiar and unfamiliar listeners will ultimately be required, the initial stages of this research should establish strong empirical evidence of intelligibility improvements, investigate the source of learning, identify optimal learning conditions, and determine the longevity of learning, using listeners naïve to dysarthric speech. In this review, the notion of exploiting perceptual learning for rehabilitative gain has been framed within the context of dysarthria management, yet the scope of application is potentially much broader. Bearing in mind that the source of learning may be differentially influenced by the nature of the acoustic degradation, treatments that target perceptual processes may be extended to any situation in which intelligibility is compromised (e.g., foreign-accented speech, Deaf speech, speech processed through cochlear implants, or synthesized speech systems).

Acknowledgments

Primary support for this manuscript was provided by a University of Canterbury Doctoral Scholarship (awarded to the first author).We also gratefully acknowledge support from New Zealand Neurological Foundation Grant 0827-PG and Health Research Council of New Zealand Grant HRC09/251 (both awarded to the second author) as well as National Institute on Deafness and Other Communication Disorders Grant R01 DC 6859 (awarded to the third author).

Footnote

1Perceptual learning is reviewed with respect to experimental studies in which manipulation of the listener experience (familiarization/training) has been examined.

2Relevant studies were identified by electronic databases searches of PsycINFO, MEDLINE, CINAHL, and PubMED. The searches were composed of keywords (e.g., perceptual learning, familiarization, adaptation) paired with the term dysarthria. In addition to these electronic searches, hand searches of studies cited within an article were conducted. From this large search, those citations in which listeners were familiarized with dysarthric speech were abstracted by the first author in Table 1.

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Editor: Anne Smith
Associate Editor: Wolfram Ziegler
Received December 12, 2010
Accepted June 20, 2011
DOI: 10.1044/1092-4388(2011/10-0349)

Publication date: Feb 2012

Year: 2012

Speech Recognition Performance of Adults: A Proposal for a Battery for Telugu

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Publication info: Theory and Practice in Language Studies 2.2 (Feb 2012): 193-204.
ProQuest document link

Abstract: Speech audiometry is an essential component of the audiological test battery, as it provides information concerning one's sensitivity to speech stimuli and the understanding of speech at supra-threshold levels. With regard to the history of materials for speech audiometry, different kinds of materials have been

developed by several investigators in English and non-English languages. Several such attempts have also been made to develop and standardize materials for speech audiometry in Indian languages. With reference to Telugu (South Indian Dravidian Language) no such material is available for measuring open-set speech recognition score in adults. Telugu is mother tongue of the majority of people of Andhra Pradesh (Southern State of India) which is divided into three regions. Although, the mother tongue of majority of people of Andhra Pradesh is Telugu, some of the most familiar and frequently used words in one region may not be familiar to people belonging to other regions due to dialectal variations. The purpose of this study is to develop speech material in Telugu which can be commonly used to assess speech recognition performance of individuals belonging to three regions. Four lists of bisyllabic words in Telugu were developed and equivalence analysis of difficulty between the word lists was evaluated for three groups (from three regions) of subjects (age range of 18-25 years) with normal hearing. Subsequently, performance intensity (PI) function for each list was also measured for the three groups. The results revealed that there was no significant difference ($p<0.05$) between scores obtained by three groups for each list and between four lists for each group. The four word lists developed were found to be equally difficult for all the groups. The performance-intensity (PI) function curve showed semi linear function, and the linear portion of the curve indicated an average linear slope showing 4.64%, 4.62%, 4.52% and 4.54% increase in word recognition score per dB for list 1, list 2, list 3 and list 4 respectively and were found be in accordance with the findings of earlier studies. The four lists thus developed were found to have sufficient reliability and validity in assessing speech recognition performance.
[PUBLICATION ABSTRACT]

Full text: Headnote

Abstract-Speech audiometry is an essential component of the audiological test battery, as it provides information concerning one's sensitivity to speech stimuli and the understanding of speech at supra-threshold levels. With regard to the history of materials for speech audiometry, different kinds of materials have been developed by several investigators in English and non-English languages. Several such attempts have also been made to develop and standardize materials for speech audiometry in Indian languages. With reference to Telugu (South Indian Dravidian Language) no such material is available for measuring open-set speech recognition score in adults. Telugu is mother tongue of the majority of people of Andhra Pradesh (Southern State of India) which is divided into three regions. Although, the mother tongue of majority of people of Andhra Pradesh is Telugu, some of the most familiar and frequently used words in one region may not be familiar to people belonging to other regions due to dialectal variations. The purpose of this study is to develop speech material in Telugu which can be commonly used to assess speech recognition performance of individuals belonging to three regions. Four lists of bisyllabic words in Telugu were developed and equivalence analysis of difficulty between the word lists was evaluated for three groups (from three regions) of subjects (age range of 18-25 years) with normal hearing. Subsequently, performance intensity (PI) function for each list was also measured for the three groups. The results revealed that there was no significant difference ($p<0.05$) between scores obtained by three groups for each list and between four lists for each group. The four word lists developed were found to be equally difficult for all the groups. The performance-intensity (PI) function curve showed semi linear function, and the linear portion of the curve indicated an average linear slope showing 4.64%, 4.62%, 4.52% and 4.54% increase in word recognition score per dB for list 1, list 2, list 3 and list 4 respectively and were found be in accordance with the findings of earlier studies. The four lists thus developed were found to have sufficient reliability and validity in assessing speech recognition performance.
Index Terms-speech audiometry, speech recognition score, equivalence analysis, performance intensity function, reliability, validity

I. INTRODUCTION

Speech perception is defined as the process of decoding a message from a stream of sounds coming from the speaker (Borden &Harris, 1980). The study of speech perception is concerned with the listener's ability to perceive the acoustic waveforms produced by a speaker as a string of meaningful words and ideas (Goldinger, Pisonic &Logan, 1991). The components of speech perception and production are closely related and have been studied extensively for decades. Hearing is a vital sense that is necessary for the development and maintenance of acoustic communication skills. Hearing is the building block on which our intricate human communication system is constructed. Speech is one of the most important vehicles of human communication system. In order to hear and comprehend speech, it requires good auditory integrity. Individuals with hearing loss are bound to have difficulty in perception of speech. Therefore, it is the essential duty of audiologists to identify, evaluate and rehabilitate aurally handicapped individuals.

Aural rehabilitation refers to services and procedures for facilitating adequate receptive and expressive communication in individuals with hearing impairment (ASHA, 1984). Aural rehabilitation is designed to minimize the communication deficits caused by hearing loss. The first step in this process is a thorough evaluation of the audiological dimensions of the hearing loss. There are several clinical tests, which help the audiologist to make an accurate and effective diagnosis. The evaluation of an individual's hearing involves administering a battery of tests and these assessments collectively complement each other in defining the degree, type and configuration of hearing loss. Audiological evaluations also intend to provide information that describes the functional impact of hearing loss on communication. The principle tool used in the process of evaluating a patients auditory functioning is an audiometer. Audiometer is an electronic device that produces and delivers sounds as a stimulus to the patient and determines the intensity needed for a patient to hear those sounds. The sounds used to test a person's hearing must be clearly specified so that his hearing thresholds are both accurate and repeatable. The two most common sound stimuli used clinically to assess hearing are pure tones and speech. Each of them can provide valuable information concerning the integrity of the auditory system. Audiological assessment using non-speech signal such as pure-tones is known as pure-tone audiometry. On the other hand, audiological assessment using speech signal such as syllables, words, sentences etc. is known as speech audiometry.

Pure tone audiometry often thought of as the hearing test that involves presenting a series of pure-tones or beeps to the listener at specific frequencies to establish a person's hearing acuity. The smallest intensity of a sound (pure-tone) that a person needs to detect its presence is called his threshold for that sound. Clinically we define the threshold as the lowest intensity at which the patient responds to the sound at least 50% of the time. The hearing loss of an individual is usually defined as the average of pure-tone thresholds at 500 Hz, 1000 Hz and 2000 Hz in the better ear expressed in decibels (dB) with reference to normal thresholds. Pure-tone audiometry reveals the degree and type of hearing loss, and also facilitates the decision as to the need for further tests or medical interventions. The process of pure tone audiometry is uncomplicated and easily administered. "Identification of the stimulus by the listener presumes a relatively simple neural apparatus and the response usually raising the hand is not complex one" (Schill, 1985). Puretone audibility thresholds are an important part of many specialized procedures for testing auditory function as well as in evaluating hearing aids and other rehabilitation devices and in rehabilitation planning.

In spite of having such advantages, pure-tone audiometry alone has many limitations. Pure-tone audiometry does not provide all needed information for assessment of the auditory system. It serves the possibilities but not realities and helps in estimation only. Assessment of hearing using pure tones provide information regarding the sensitivity but not on the receptive auditory ability (Marshal &Bacon, 1981). The conventional pure tone procedures fail to provide any information about a person's ability to hear above the threshold. Pure tone audiometry can only assess the auditory system's ability to hear a simple stimulus and does not provide information about the individual's ability to understand speech. Ability to perceive pure tones does not require any psychic integration or synthesization thus the results are inadequate in the diagnosis and differential

diagnosis of various auditory disorders (Willeford, 1969; in Kholia, 2010, p. 2).

To find out the ability of a patient to hear speech involves testing him with speech stimuli, and this process is called speech audiometry. Carhart (1951) defined speech audiometry as the technique where in standardized samples of a language are represented through a calibrated system to measure some aspect of hearing ability. Speech audiometry means any method of assessing the state or ability of the auditory system of an individual, using speech stimuli or sounds as the response evoking stimuli (Lyregaard, 1976). The above two definitions are broadly similar and they emphasize that the purpose of speech audiometry i.e. to assess the ability of the auditory system to understand speech. According to James Jerger, speech audiometry is best friend in the clinic for audiological diagnosis (Kholia, 2010). Speech stimuli used in speech audiometry vary from consonants, phonetically balanced words, spondee words, digits, non-sense syllables, sentences and even continuous digit discourse. Speech sounds are more meaningful and reflect the critical activities of life and the comprehension of social communication. We live in an oral-aural society and hence the most measurable aspect of human auditory function should be the ability to understand speech. In summary speech tests are generally regarded as clinically more acceptable than pure-tone audiometry for identifying patients with poor auditory analytical capability, because they also involve the assessment of higher-level linguistic activities and the effects of contextual constraints in processing auditory information (Wang, Mannell, Newall, Zhang &Han, 2007).

II. BACKGROUND OF THE STUDY

A. Speech Recognition Score (SRS)

Speech recognition score (SRS) or word recognition score (WRS) or speech identification score (SIS) is a procedure of establishing the percentage of correctly perceived phonetically balanced monosyllabic words or consonant vowel combination presented at a comfortable supra-threshold level. Evaluating speech recognition score is a method where in the subject is presented with a series of stimuli and is asked to identify what he has heard and results are reported in terms of percentage on the basis of correctly repeated words presented to him. The phonetically balanced lists (PB lists) refer to the list of words consisting of a group of single words so selected that the frequency of occurrence of speech sounds within a group is same as the frequency of occurrence of the same sound in a language. Carhart (1965) recommended the use of monosyllabic words for discrimination test since they are meaningful to the patient and are non-redundant.

B. Clinical Functions of Speech Recognition Score

Gelfand (2007) has listed the following clinical functions of speech recognition score testing: 1) to describe the extent of hearing impairment in terms of how it affects speech understanding 2) to differentially diagnose auditory disorders by determining the anatomical site of lesion 3) for determining the needs for amplification and other forms of aural rehabilitation devices like cochlear implants, bone anchored hearing aids etc. 4) for making comparisons between various hearing aids, amplification approaches and other forms of aural rehabilitation devices 5) for verifying the benefits of hearing aid use and other forms of aural rehabilitation devices 6) for monitoring patient performance over time for either diagnostic or rehabilitative purpose.

C. Materials Available for Measuring Speech Recognition Score

With regard to the history of materials for speech audiometry testing, different kinds of materials have been developed by several investigators in English and used in clinics over a long period. The material available in English may not be appropriate for many of the world's other languages due to speaker's specific language or dialect. As it is difficult to test individuals whose native language is not English, there has been a spurt in the attempts to develop speech materials in non-English languages such as Spanish (Christensen, 1995), Italian (Bocca &Pelligrini, 1950 and Turrini, Cutugno, Maturi, Prosser, Leoni &Arslan, 1993), Portuguese (Harris, Goffi, Gygi &Merrill, 2001), Polish (Harris, Nielson, Mcpherson, Skarzynski &Eggett, 2004), Mandarin Chinese (Nissen, Harris, Jennings, Eggett &Buck, 2005), Russian (Harris, Nissen, Pola, Mcpherson, Tavartkiladze &Eggett, 2007) and Tongan (Seaver, 2008). Several such attempts have also been made to develop and standardize speech audiometric materials and tests in Indian languages including PB word list in English on

Indian population (Swarnalatha, 1972), PB word list in Hindi (De, 1973), PB word list in Tamil (Dayalan, 1976), PB words in Manipuri (Devi, 1985), PB word list in Kannada ((Yathiraj &Vijayalakshmi, 2005), PB word list in Mizo (Mangaiahi, 2009), PB word list in Rajasthani (Kholia, 2010). With reference to Telugu (South Indian Dravidian Language) no such material is available for measuring open-set speech recognition score in adults. Hence there is a need to develop such speech material and the current study aimed at developing word lists in Telugu for assessing speech recognition scores in adult subjects.

D. Telugu (a South Central Dravidian Language Spoken in South India)

Telugu is South Indian Dravidian language and has the third largest number of native speakers in India, and is 13th in the ethnologic list of most- spoken languages worldwide. It is the official language of Andhra Pradesh (state in south India), one of the largest states of India and the mother tongue of the majority of people of Andhra Pradesh. It is also spoken in such neighboring states as Karnataka, Tamilnadu, Orissa, Maharashtra and Chhattisgarh, and is one of the 22 scheduled languages of India. Niccolo Da Conti in 15th century called Telugu as the 'Italian of the East' as the words in Telugu end with a vowel sound similar to Italian. Telugu is mother tongue of the majority of people of Andhra Pradesh state. Andhra Pradesh is divided into three regions namely Telangana, Rayalaseema and Coastal Andhra. Although, the mother tongue of majority of people of Andhra Pradesh is Telugu, some of the most familiar and frequently used words in one region may not be familiar to people belonging to other regions due to dialectal variations. A number of studies on speech audiometry have indicated that the validity and reliability of speech recognition testing can be influenced by several factors, such as familiarity, words in common usage, normal sampling of speech sounds and so on. The word list developed by keeping in mind 'familiarity and commonly used' words with reference to particular region may not be useful to assess speech recognition performance in people belonging to other regions of Andhra Pradesh. Hence there is a need to develop material for assessing speech recognition score which includes words which are familiar and commonly used by people belonging to all the regions of Andhra Pradesh.

III. METHOD

Till date with reference to Telugu language no such material is available for measuring open-set speech recognition performance. The purpose of the study was to develop and evaluate word lists in Telugu for assessing speech recognition performance. In order to fulfill the aim of the study, the following method was adopted. The study was conducted in four phases:

Phase I: Development of word lists in Telugu as a test material for assessing speech recognition performance.

Phase II: Recording of the test material.

Phase III: Equivalence analysis of developed word lists.

Phase IV: Assessing performance-intensity (PI) function of normal subjects.

A. Phase I: Development of Word Lists in Telugu

The following steps were involved while developing the word lists in Telugu for assessing speech recognition performance: 1) Collection of words 2) Familiarity assessment of collected words 3) Subjective validation of words 4) Pilot study for objective validation of words 5) Construction of final word lists.

1. Collection of words in Telugu

The words were collected from different sources like periodicals, newspapers, magazines, journals, general books, phonetic books and spontaneous speech. This resulted in an accumulation of about 500 words in Telugu. The words collected were disyllabic in structure. These words were further subjected to familiarity assessment, subjective validation and objective validation in order to construct final word lists in Telugu for assessing speech recognition performance.

2. Assessment of familiarity of the collected words

The collected words were assessed for familiarity in order to ensure that the selected words were known to native speakers of Telugu and were commonly used by people belonging to different regions of Andhra Pradesh. To assess the familiarity of the selected words, a total of 90 subjects (age range of 18-25 years) from

different regions of Andhra Pradesh who are native speakers of Telugu language (Coastal Andhra, Rayalaseema &Telangana) were included. The subjects were further equally subdivided into three groups (30 subjects in each group) based on the above mentioned regions. A three point rating scale was used for familiarity rating as: most-familiar, familiar and unfamiliar. From the obtained results, the words with most-familiar and familiar rating were listed for each group (three regions). The obtained words of most-familiar and familiar rating were further assessed for homogeneity across individuals from the three regions. A hierarchical arrangement of the most-familiar and familiar rated words was done. The words with most-familiar and familiar response from the three different groups were considered for further assessment.

3. Subjective validation of test items

Validity refers to a degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. Validity is the extent to which the concept one wishes to measure is actually being measured by a particular scale. To fulfill the purpose of validity of words in the test material, content validity was carried out to the words. Content validity is based on the extent to which a measurement reflects the specific intended domain of the content (Caramines, 1991). Content validity is based on logic and expertise. This type of validity is used because this technique helps the researcher to review how the essential test items can attribute the test measures. For the purpose of carrying out the content validity, the developed familiar words were given to six experts working in the field of Speech Language Pathology, Audiology and Linguistics. The experts were explained about the purpose of test procedure and asked to respond whether the words selected would fulfill the purpose. The responses of the experts were collected as agree, disagree and suggestions. Word wise validation of the material was done. A hierarchal arrangement of the agreed words was done. The only words which were agreed by all the experts were selected for further assessment.

4. Pilot study for objective validation of test items

A pilot study is a miniature version of a study that the researcher uses to test the validity of the collected words prior to the actual study. The pilot testing involves administering the test procedure using the collected words on a sample of normal subjects and analyzing the obtained data. This was carried out to ensure whether the words collected on the basis of familiarity assessment and expert validation can fulfill the goal of the speech recognition score testing. It is important that the test procedure be given in a situation that matches the actual circumstances in which test will be done. The pilot study was intended to identify the words which would be recognized or identified by a group of normal hearing subjects at an intensity level where it is expected to be recognized or identified correctly. It is generally expected that high speech recognition scores are obtained at levels of 30-40 dB SL relative to the SRT (Gold, Lubinsky &Shahar 1981; in Silman &Silverman, 1991, p.141). Hence a presentation level of 40 dB SL with reference to SRT is used for the pilot study.

a. Subjects

A total of 45 subjects in the age group of 18-25 years with normal hearing and no speech disorders served as subjects. All the children were native speakers of Telugu language. The subjects were further equally divided into three groups (15 subjects in each group) depending on their region of Andhra Pradesh. Group I: subjects belonging to Costal Andhra region, Group II: subjects belonging to Rayalaseema region and Group III: subjects belonging to Telangana region.

b. Audiometric testing

The audiometric assessments including otoscopic examination, pure-tone audiometry, speech audiometry and tympanometry were conducted to ensure that suitable subjects with normal hearing were selected for the experimental procedures. The pure-tone average threshold (PTA) and speech recognition threshold (SRT) was obtained for all the subjects using Maico MA 53 diagnostic clinical audiometer with TDH 39 headphones. Tympanometry was carried out using Madson Zodiac 901 middle-ear analyzer.

c. Administration procedure

The subjects were tested in a sound-treated audiometric room. The examiner presented the speech stimuli

using monitored live voice, ensuring that the deflection of the VU meter was zero. A distance of 6-9 inches was maintained between the microphone and the mouth of the tester. Each subject was given following instructions in Telugu "you will listen to the words presented through headphones. Listen carefully and when you hear a word repeat the word in a loud voice". Initially ten practice items were presented in order to familiarize the subjects about the test procedure. If the subjects felt tired during the test, a short break was given. All the words obtained after subjective validation were presented at presentation level of SRT+40 dB SL. The stimulus was presented through Maico MA 53 diagnostic clinical audiometer with TDH 39 headphones.

d. Selection of words for constructing final word lists

The words which were correctly recognized or identified by each group of subjects were arranged in a hierarchical order. The words which were correctly recognized or identified by the three groups of subjects were selected for preparing final lists of phonemically balanced bisyllabic words for assessing speech recognition performance. This has resulted in an accumulation of 320 words.

e. Preparation of final bisyllabic word lists

Classical Telugu consists of 35 consonants, 10 vowels and 2 diphthongs (Ramanarasimham, 1998). When it comes to spoken Telugu the lower mid vowel /æ / is used in it (Krishnamurti, 1998). Out of the total consonants 23 are considered as core and 12 are considered as non-core phonemes (Ramanarasimham, 1998). Although such a classification of core and non-core phonemes exists in Telugu, the final word lists were prepared based on the frequencies of occurrence of the phonemes in the Telugu corpus available in Centre for Applied Linguistics and Translation Studies Language Technology Lab, University of Hyderabad, India. The phonemes which have frequencies of occurrence of equal to or more than 0.5 were only considered while preparing the final word lists. The phonemes on which the test items were constructed were based on the frequencies of occurrence of phonemes in Telugu (Rao &Thenarasu, 2007). As the number of consonantal phonemes in each word list was coming to 49 and in order to balance the each word list with 50 phonemes (consonant), phoneme /l/ was repeated in the list 1 and phoneme /t/ was repeated in list 2, list 3 and list 4 as per the convenience. A total four final word lists and one practice word list were prepared for assessing speech recognition performance. All the words were disyllabic with the CVCV structure. However, words like /uru/ 'village', /et u/ 'which side' and /edi/ 'which one' which are VCV in structure were also included in the final word lists. Due to limited number of words with /s / in CVCV structure, the word /s apu/ 'shop' is included in list 2 and list 4. Each final word list consisted of 25 words (with a total of 100 words) and a trial list consisted of 10 words. After constructing the four final word lists, each final word list was again randomized into five times forming five different lists (with a total of 20 lists) for further assessment.

B. Phase II: Recording of the Test Material

The recording was done in a sound treated room and the noise levels were maintained as per the ANSI Guidelines S3.1-1991. Each randomized word list was spoken by a female native speaker of Telugu, and was recorded using 16 KHz sampling rate and 16 bit quantization using computerized speech lab (CSL) 4500 software. The signal was digitized at a sampling rate of 16 KHZ using a 12 bit analog to digital converter housed within the computer. Each word was saved as a separate file. The recorded material was then edited to carry out noise and hiss reduction. Amplitude normalization of the signals was done using adobe audition (version 3.0) software to maintain the constant amplitude across the words. The inter stimulus interval between the two words was set to 4 seconds. A calibration tone of 1 KHz was inserted before beginning of the word list to adjust the vu meter at zero. The material was then copied onto an audio compact disc using a compact disc writer.

C. Phase III: Assessing Equivalence Analysis of Word Lists

A formal study was carried out to evaluate the equivalence between four lists and comparing the performance of three groups for each list for further performance- intensity function assessment. In order to assess the equivalence between lists the following method has been formulated.

1. Subjects

A total of 90 subjects in the age group of 18 - 25 years with normal hearing and no speech disorders served as subjects. All the children were native speakers of Telugu language. The subjects were further equally divided into three groups (30 subjects in each group) depending on their region of Andhra Pradesh. Group I: subjects belonging to Costal Andhra region, Group II: subjects belonging to Rayalaseema region and Group II: subjects belonging to Telangana region.

2. Audiometric testing

The audiometric assessments including otoscopic examination, pure-tone audiometry, speech audiometry and tympanometry were conducted to ensure that suitable subjects with normal hearing were selected for the experimental procedures. The pure-tone average threshold (PTA) and speech recognition threshold (SRT) was obtained for all the subjects using Maico MA 53 diagnostic clinical audiometer with TDH 39 headphones. Tympanometry was carried out using Madson Zodiac 901 middle-ear analyzer.

3. Administration procedure

A total of 100 words equally divided into four final lists containing 25 words in each list (list 1, list 2, list 3 and list 4) were used as stimulus. Each word list was randomized in order for 5 times to form five different lists and a total of 20 different word lists (random 1, random 2, random 3, random 4 and random 5 of list 1, list 2, list 3 and list 4). This was done to avoid order and practice effect. The developed test material was played through a CD player, which was routed through Maico MA 53 diagnostic clinical audiometer and delivered through the TDH 39 headphones. The stimulus was presented at five presentation levels (5 dB SL, 15 dB SL, 25 dB SL, 35 dB SL and 45 dB SL with reference to SRT). At each presentation level a different randomized list was used. The order of list was also changed. All the subjects were tested monaurally with four lists and ear selection was done randomly. An open set response in the form of an oral response was obtained. If the subject felt tired during the test, a short break was given. The subjects were tested in a sound-treated audiometric room. Each subject was given following instructions in Telugu "you will listen to the disyllabic words presented through headphones. Listen carefully and when you hear a word repeat the word in a loud voice". Initially ten practice items were presented in order to familiarize the subjects about the test procedure. The responses of the subjects were marked as either 0 or 1. Each correct response was given a score of 1 and an incorrect response was given a score of 0. The raw score was then converted to percentage as follows:

...

D. Phase IV: Performance-Intensity (PI) Function Testing

Performance-intensity function is a graphical representation of the percentage of words correctly identified or recognized as a function of the intensity level of the words. The group mean and standard deviation values for each list at different presentation levels were calculated. These mean speech recognition scores at different presentation levels were used to obtain performance intensity function curve of each group for four lists. Various researchers have stated that performance of the subjects vary with the level of intensity of presentation of stimulus. Therefore, in order to find out the intensity level at which the performance could be maximum, the presentation level was increased in 10 dB steps starting from the 5 dB SL. Curve estimation and regression analysis were carried out in order to find out linearity function of the performance intensity function curve and to find out the average percentage (%) increase per dB in word recognition.

IV. ANALYSIS OF RESULTS

A. Equivalence Analysis of Word Lists

Speech recognition scores were calculated for each subject of three groups at each presentation level for four lists. Inter-list equivalence analysis was carried out by calculating the mean and standard deviation values of each group score for each list at different presentation levels. The mean and standard deviation values for each list at different presentation level for three groups are summarized in table 1. It has been found that with increase in presentation level, there was a corresponding increase in mean speech recognition scores in all the groups for four lists used. Each list showed normal distribution in all the groups. The data was subjected to

ANOVA in order to find out significant difference in speech scores of each group between four lists. The results indicated that there was no statistically significant difference between scores of each group between four lists ($p<0.05$). In addition to this the group score comparison was also carried out to find out any significant difference in groups mean score between four lists. The results indicated that there was no statistically significant difference in groups mean score between four lists ($p<0.05$). Finally the mean score comparison between three groups for each list was also carried out to find out significant difference in scores of each list between three groups. The results indicated that there was no statistically significant difference in mean score of each list between three groups ($p<0.05$). Hence it can be concluded that all the four lists are equally difficult for all the groups and could be used in testing the PI-PB function.

B. Performance-Intensity (PI) Function Testing

Performance-intensity function is a graphical representation of the percentage of words correctly identified or recognized as a function of the intensity level of the words. The group mean and standard deviation values for each list at different presentation levels are summarized in table 2. These mean speech recognition scores at different presentation levels were used to obtain performance intensity function curve of each list for three groups. Figure 1 shows group mean performance intensity function curve for list 1, list 2, list 3 and list 4. The mean word recognition scores increased as the presentation levels increased and the subjects reached 100% scores at SRT+35 dB SL for all the lists. This remained unchanged thereafter at higher intensity i.e. at SRT+45 dB SL. However, the normal range of recognition scores (90%-100%) was obtained at 25 dB SL with reference to SRT for all the lists. Clinically the most commonly used sensation levels are 25 to 40 dB SL. Twenty five dB SL corresponds to beginning of the plateau at which normal hearing subjects attains scores of 90% or better on most tests, and 40 dB sensation level represents a reasonably comfortable listening level for normal hearing subjects. The results revealed a narrow standard deviation for extreme presentation levels while broad standard deviation for low and mid presentation levels. When curve estimation and linear regression analysis were carried out, the performance intensity function curve represented a semi-linear function in all the groups. The lower segments of the curves are more linear as compared to less linear higher segments. Linear regression analysis showed that the linear portion of the function indicated an average linear slop showing 4.64%, 4.62%, 4.52% and 4.54% increase per dB in word recognition for list 1, list 2, list 3 and list 4 respectively.

V. DISCUSSION

Speech audiometry testing is generally regarded as clinically more acceptable than pure-tone audiometry for identifying individuals with poor auditory analytical capability, because they also involve the assessment of higher-level linguistic functions and the effects of contextual constraints in processing auditory information. Telugu is South Central Dravidian language spoken most commonly in Andhra Pradesh a southern state in India. With reference to Telugu, only a limited number of materials have been developed for use in speech audiometry. To date no speech material is available in Telugu to measure open set speech recognition scores in adults. Hence, the current study aimed at developing speech material for assessing speech recognition performance of adults in Telugu. A number of authors have indicated that the reliability and validity of speech audiometry testing can be influenced by factors such as the familiarity, phonetic balance of the words and type of stimulus used (Mackie &Dermody, 1982; Borden &Harris, 1980 and Nissen, Harris, Jennings, Eggett &Buck, 2005).

As mentioned earlier, Telugu is the mother tongue of the majority of people of Andhra Pradesh state which is divided into three regions. Although, the mother tongue of majority of people of Andhra Pradesh is Telugu, some of the most familiar and frequently used words in one region may not be familiar to people belong to other regions. The word list developed by keeping in mind 'familiarity and commonly used' words with reference to particular region may not be effective to assess speech recognition performance in people belonging to other regions of Andhra Pradesh. Hence there is a need of material for assessing speech recognition performance which includes words which are familiar and commonly used by people belonging to all the regions of Andhra

Pradesh. Hence, by considering 'familiarity' as an important factor in developing the word list, the authors in the current study carried out familiarity assessment among the subjects with different regional background and developed four lists of bisyllabic words.

The concept of phonetic balance played a major role in the development of many speech recognition tests. The phonetically (or rather phonemically) balanced (PB) word lists are a long established tool for the study of speech intelligibility. They generally contain monosyllabic words that have been selected in such a way that the lists reflect the statistical distribution of the phonemes in that dialect. However, phonetic balance has been found to have little practical impact on the outcomes of speech recognition tests, and its clinical relevance is questionable (Carhart, 1970; In Gelfand, 2007, p.274 and Aspinall, 1973; In Gelfand, 2007, p.274). Boothroyd (1968; in Wang et al. 2007, p.1-2) did not follow the concept of phonetic balance and developed the AB monosyllabic word lists with 10 words in each list, and described the lists as isophonemic, as the thirty most common phonemes appear in each list. Martin, Champlin &Perez (2000) reported that speech discrimination scores for subjects with hearing impairment or normal hearing did not seem to be affected by whether the word list had phonetic balance or not. Hence, in terms of its relevance to speech recognition testing, the issue of phonetic balance is still an area of dispute (Nissen, Harris, Jennings, Eggett &Buck, 2005). However, the authors in the current study felt that phonemic balance is important at least for consonants.

Vowels are produced without obstruction in the airflow and perceived better than consonants because they are voiced and relatively high in intensity. Vocal tract is relatively open for them producing prominent resonance for vowels. The first two formant frequencies (F1 &F2) are essential for the discrimination of the vowel sounds. Vowels are more accessible to auditory analysis by virtue of their longer duration and may hold longer duration in the auditory memory (Stevens, 2002). On the other hand, consonants are produced with the obstruction in the airflow. Consonants are classified according to whether they are voiced or unvoiced, by manner of production (stops, fricatives, nasals etc.) and by place of production (labial, alveolar, palatal etc.). Consonant sound identification is more dependent upon the ability to receive the higher frequency components. If these are inaudible, the place of consonant articulation cannot be determined, thus precluding identification. Although, most of the consonants contain the least power than vowels, these consonants are the ones which provide the major contributions of speech intelligibility. They are affected by loss of intensity rapidly than vowels. Hence, consonants are less accessible to auditory analysis due to their brevity and relatively low intensity, and held briefly in auditory memory (Stevens, 2002). Thus it could be inferred from the above information that perception of consonants is much more complex than vowel perception, due to the low intensity, more susceptible to degradation and varied classifications. This makes it a priority to consonantal aspect of phonemic balance in the word lists. Hence, the authors in the study considered that consonantal aspect of phonemic balance is reasonable while developing the word lists.

Another important aspect is the type of speech material used for assessing speech recognition scores. Monosyllabic words are generally used for assessing speech recognition scores, because monosyllabic words are minimum meaningful unit of a language and are non-redundant. Monosyllables are adequately available in languages like English and other Indian languages, because they are both vowel and consonant ending languages. But some are vowel ending languages where the occurrence of monosyllabic words will be minimal. In such languages it is difficult to construct phonetically balanced monosyllabic word lists because of the inadequate occurrence of meaningful monosyllables. In language like Italian, bisyllabic words are most frequently used as compared to monosyllabic words for developing speech material in evaluating intelligibility function (Turrini, Cutugno, Maturi, Prosser, Leoni &Arslan, 1993). Bocca &Pelligrini (1950) and Turrini, Cutugno, Maturi, Prosser, Leoni &Arslan (1993) developed disyllabic words as a material for speech audiometry. This could be attributed to the reason that, there are very few monosyllabic words in Italian, and most of them are function words (Pagliuca &Monaghan, 2010) since Italian is a vowel ending language. Similarly in Kannada (south Indian Dravidian language) disyllabic words are used to assess speech recognition scores (Yathiraj

&Vijayalakshmi, 2005) as Kannada is also a vowel ending language.

The authors in the current study also faced difficulty in collecting monosyllabic words for constructing test material in Telugu. There are very few monosyllabic words in Telugu as compared to bisyllabic words (Rao &Thenarasu 2007). Moreover, most of the monosyllabic words in Telugu do not convey meaning when they occur in isolation. These monosyllabic words gain meaning only when they occur in combination with some other word. This could be attributed to the reason that Telugu is yet another vowel ending language like Italian and Kannada. Hence, Niccolo Da Conti in 15th century called Telugu as the 'Italian of the East' as the words in Telugu and Italian end with a vowel sound. Disyllabic words are frequently occurring minimum meaningful units of Telugu language. Hence disyllabic words were used in constructing test material for assessing speech recognition performance in Telugu. In summary speech recognition scores are the percentage of correctly identified or recognized monosyllabic words, provided the language contains adequate number of meaningful monosyllabic words. However, languages which end with vowel do not contain adequate number of meaningful monosyllabic words and hence disyllabic words can be used since they are the most frequently occurring minimum meaningful units of that particular language. Hence it can be concluded that speech recognition score is the percentage (%) of correctly identified or recognized test words which are minimum meaningful units of a language and less redundant and presented at comfortable supra-threshold level.

A total four final word lists and one practice word list were prepared for assessing speech recognition performance. All the words were disyllabic with the CVCV structure. However, words like /uru/ 'village', /et u/ 'which side' and /edi/ 'which one' which are VCV in structure were also included in the final word lists. In Dravidian languages, especially in Telugu, the words beginning with front vowels /i/, /i/, /e/ and /e/ are preceded by the palatal glide /y/ when they occur in the initial position. Similarly, the words beginning with back vowels /u/, /u/, /o/ and /o/ are preceded by labial glide /w/ when they occur in initial position. Hence, the words like /uru/, /et u/ and /edi/ are considered as [wuru], [yet u] and [yedi] respectively in this study. In order to keep the phonemic balance and due to limited number of words with /s / in CVCV structure, the word /s apu/ 'shop' is included in list 2 and list 4. It is felt that this would not present problems, as there were a total of 100 disyllabic words in the lists (see appendix).

There are four different methods commonly used to determine the reliability of tests of speech recognition, including test-retest reliability, inter-list equivalence, split-half method and inter-item consistency reliability (Mackie &Dermody, 1982). In this study, the equivalence of difficulty between four lists of Telugu bisyllabic words was evaluated. The four lists developed in the study showed normal distribution and there was no statistically significant difference found between four lists for each group at each presentation level. When the data was further analyzed to identify significant difference in mean scores of each group, it was found that there was no significant difference found between three groups for each list. Hence, the four lists were found to have equal difficulty and these word lists can be used interchangeably for any group of subjects in clinical practice.

There are three categories of methods commonly used to determine the validity of tests of speech recognition, including construct validity, criterion related validity and content validity. Criterion-related validity indicates the validity of a test predicting an individual's behavior in specified situation (Anastasi, 1968). In this study performanceintensity function curve, which is the percentage correct identification of speech stimulus as a function of stimulus intensity, was measured. The standard deviation values reduced as the presentation level was increased in the mean performance-intensity function test. The results revealed a narrow standard deviation for extreme presentation levels while broad standard deviation for low and mid presentation levels. This indicates that at higher presentation levels the subjects' performance became less variable. This may occur because, as the presentation level increases, the relevant phonetic cues would become more reliably audible to these normally-hearing subjects. As the presentation level decreased the responses from the subjects became more variable. This may occur because phonetic cues would become less reliably audible and responses would increasingly depend upon guessing the words.

The group mean slope of the linear portion of the PI-PB function for Telugu bisyllabic words shows 4.64%, 4.62%, 4.52% and 4.54% increase per dB in word recognition for list 1, list 2, list 3 and list 4 respectively. Beattie, Edgerton &Svilhovec (1977) reported a mean slope of 4.2% per dB and 4.6% per dB for English materials, the NU-6 word lists and the CID W-22 word lists respectively and for Indian materials, the authors Dayalan (1976), Devi (1985) and Kholia (2010) reported a mean slop of 3.0% per dB, 5.4% per dB and 3.7% per dB for Tamil, Manipuri and Rajasthani PB word lists respectively. The normal range of speech recognition score (90%-100%) was obtained between 25 dB SL and 45 dB SL stimulus presentation levels for all the lists. It is generally expected that high speech recognition scores are obtained at levels of 30-40 dB SL relative to the SRT (Gold, Lubinsky &Shahar 1981; in Silman &Silverman, 1991, p.141). Although, there is no other speech recognition test for adults available in Telugu language, most of the findings of the study are in line with the findings of earlier researchers.

VI. CONCLUSION

Speech audiometry is an essential component of the audiological test battery, as it provides information concerning one's sensitivity to speech stimuli and the understanding of speech at supra-threshold levels. Speech perception skills must be assessed routinely using valid and reliable clinical assessment methods suitable for native speakers of language. The current study developed four bisyllabic word lists in Telugu for assessing speech recognition performance in adults. They were found to be equally difficult, reliable and valid test material in Telugu. To continue the studies on the developed speech material, the test material can be administered on hearing impaired population and other clinical population to check the applicability. This test material can be used in selecting appropriate rehabilitative options and also to measure the efficacy of different rehabilitative devices. The same test material can be used to further develop speech in noise (SPIN) test, time compressed speech test, filtered speech test and other special test for differential diagnosis of auditory disorders.

ACKNOWLEDGEMENT

The author would like to sincerely thank the following who provided constant help in conducting this study. Our students: Phaninder, Yamini, Madhu, Nagaraju, Divya, Priyanka, Soubhagya, Anil and Srinivas and our colleagues: Prof. Umamaheswara Rao, Centre for Applied Linguistics and Translation Studies, University of Hyderabad for providing the frequency lists of Telugu and Prof. Ramanarasimham, Department of Telugu, University of Hyderabad for providing information on Telugu.

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Publication date: Feb 2012

Year: 2012

Implant helps inner-ear damage

Author: Mann, Leslie

Publication info: Chicago Tribune [Chicago, Ill] 18 Jan 2012: 5.2.

Abstract: Device stimulates inner ear rather than turning up the volume Since her teens, Lesa Merlo, of Hinsdale, had learned to compensate as her hearing declined.

Full text: Since her teens, Lesa Merlo, of Hinsdale, had learned to compensate as her hearing declined. She used the television's closed-captioning feature. She read lips and paid attention to body language. Often, it meant only being able to do one thing at a time, explained the mother of three.

Now, thanks to an implant called Esteem, Merlo can multitask. "I can make dinner and supervise homework at the same time," she said. "I don't have to stop and look directly at the children. I can hear what they're saying behind my back."

Unlike a hearing aid, which amplifies sounds, Esteem is a prosthetic inner-ear stimulator. "When I wore a hearing aid, I turned it off when I got home because all the background noise was so agitating," said Merlo, 40. "But I keep (the Esteem) on."

A controller the size of a cellphone enables her to set her Esteem to different environments, such as "home," "restaurant" or "school."

Merlo's doctor, ear surgeon Sam Marzo of Loyola University Medical Center in Maywood, has performed 40 Esteem implants since he was trained by its manufacturer, Envoy Medical Corp. in St. Paul, Minn., in 2010. He is the only Chicago-area surgeon authorized to implant the device, said an Envoy representative. Esteem was approved by the Food and Drug Administration in March 2010. (For surgeons outside Chicago, visit envoymedical.com.)

"This really fills a need for adults with moderate to severe sensorineural hearing loss," Marzo said.

The condition is caused by damage to the inner ear or to nerves from the inner ear to the brain. For patients with profound hearing loss, a cochlear implant is a better option, he said.

"Esteem is great for people who have used hearing aids but are not happy with them," Marzo said. "Aids require a lot of upkeep and need frequent battery changes. And they amplify all the noise so it's hard to filter out background noise."

Implanting the Esteem is a three-hour outpatient procedure done under general anesthesia. About two months later, when internal swelling has subsided, the doctor turns on the device.

The implant is permanent. It contains a battery that must be replaced in about seven years.

Merlo had Esteem implanted in her left ear in September. In March, she plans to have one put in her right ear.

"There are little things that I probably heard when I was younger, before my hearing loss, but I don't remember them," she said. "Since I got the implant, they're new to me. Branches tapping the windows, the breathing of the horses when I ride, different instruments in my favorite songs."

Publication date: Jan 18, 2012

Year: 2012

Heard the one about?...

Author: Padgett, Sonya

Publication info: Las Vegas Review - Journal [Las Vegas, Nev] 16 Jan 2012: D.1.

Abstract: By SONYA PADGETT LAS VEGAS REVIEW-JOURNAL There's an old joke in the auditory industry that illustrates the public relations problems - and the functional issues - related to hearing aids. [...] boomers have been a driving force behind some of the developments in high-tech hearing, experts say.

Full text: By SONYA PADGETT
LAS VEGAS REVIEW-JOURNAL
There's an old joke in the auditory industry that illustrates the public relations problems - and the functional issues - related to hearing aids.
It starts with a man telling his friend, "I just got new hearing aids."
The friend says, "Oh? What kind are they?"
The man looks at his watch and answers: "It's 3 o'clock."
Funny if you have perfect hearing. Not so funny if you've been in that guy's shoes. And it's downright disappointing if you are Brent Edwards, vice president for research at Starkey Laboratories Inc.
Starkey, the largest maker of hearing devices in the United States, held its innovation expo at The Cosmopolitan of Las Vegas last week. More than 3,000 audiologists and other hearing experts from across the country gathered to talk about the latest in hearing aids and what's on the horizon.
There was a time when that joke wasn't far from the truth and you may have had better results using an ear trumpet than a hearing aid. But those days are gone, Edwards says. Still, that news hasn't filtered out into a public that could benefit from the latest hearing aid technology.
While hearing aids have grown more effective, Edwards says, the negative reputation lingers.
The good news is that hearing aids are smaller and better than ever. They're so small that they are almost undetectable when worn in the ear. They also can help people hear better, understand speech more clearly and mask sounds such as ringing or buzzing.
Wireless technology, the same that is used in Bluetooth devices, has enabled manufacturers to address two of the biggest problems people encounter when using hearing aids: talking on the phone and watching television, Edwards says. The wireless technology allows sound to be streamed right to the hearing aid.
"This has been an evolution," says Jerry Ruzicka , president of Starkey. "Hearing aids were always analog devices. About a decade ago we started introducing digital. After that, we were able to take the next step, which was introduce software that could (program) hearing aids. Now we've taken the next step, which is to put these radios in each hearing aid."
There also have been advances in directional microphones, which are inside hearing aids and amplify sound. One of the biggest obstacles for hearing-aid wearers is communicating in a noisy environment, Edwards says. "That's a huge challenge."
These new microphones add three decibels, which translates into almost a 45 percent improvement in a wearer's ability to understand words.
Despite these advances, the average age of a person who buys a hearing aid is 69, Edwards says.
One would think that age would decrease as baby boomers age. In fact, boomers have been a driving force behind some of the developments in high-tech hearing, experts say. But there's still a resistance to hearing aids that has been difficult to overcome.
Cost may be a problem. Most insurance companies don't cover the cost of the devices, which can range from $1,000 to $4,000 each.
Deeply ingrained stigmas may be at play, too, Edwards says. If people think they are perceived as weak for needing hearing aids, they may be less likely to wear them. Also, if they feel like the hearing aids don't help, they won't wear them.
"There's a fallacy that people expect hearing aids to give the same level of improvement that eyeglasses do to

vision," Edwards says.
And that's not true. There are two kinds of hearing loss: conductive, which is the ossification of the inner ear anatomy, and sensory neural. Hearing aids and surgery can almost perfectly overcome conductive hearing loss.

Most hearing loss is sensory neural, caused by noise or aging. A hearing aid can help restore some hearing in those cases, Edwards says, but it won't be perfect.
Hearing loss can affect a person's life in more ways than one, says Loleata Wigall , audiologist who attended the expo last week. She owns a private practice in Massachusetts.
People who are losing their hearing start withdrawing from life, Wigall says.
"They sometimes think other people are talking about them. They misunderstand conversations, thinking they got it right and they didn't," Wigall says. "This can cause conflict. I think it can really affect family relationships. It can cause problems between child and parent and spouses. And it can come into play at work, too."
Even though more physicians are referring patients to get hearing tests, the majority of those who come to see Wigall did so at the insistence of their families.
Research has shown that hearing loss causes increased mental effort and distress because the brain has to work harder to understand sounds. In 2005, Brandeis University researchers found that people who suffer a hearing loss may also have poor memories. The belief is that, though they hear the information, the brain becomes taxed because it has to work harder to figure out what is speech and what is noise, Edwards says.
"You get really tired because you're straining to hear," Wigall says. "I tell people all the time, 'Don't be surprised if you have more energy after you get hearing aids.' "
People start losing their hearing at age 21, Wigall says. Baby boomers are losing their hearing faster than their parents did, mainly because we live in a noisy world, she adds. Music concerts, vacuum cleaners, anything that is so loud you have to raise your voice to be heard, can damage your hearing.
Also, diabetics are at a higher risk of hearing loss because of poor circulation. People who have had certain diseases or even taken certain medications, such as antibiotics, can be at a higher risk of losing their hearing. That includes people who received chemotherapy, Wigall notes.
Now, she counsels people to prevent hearing loss. Carry earplugs and use them. Turn the radio and television down.
Most importantly, she says, don't be afraid to get your hearing checked.
"We take hearing for granted," she says. "Often, it's so gradual, you don't even notice you're not hearing. But the rest of your family notices."
Contact reporter Sonya Padgett at spadgett@reviewjournal.com or 702-380-4564. Follow @StripSonya on Twitter.

Publication date: Jan 16, 2012

Year: 2012

Audiological and electrophysiological assessment of professional pop/rock musicians

Author: Samelli, Alessandra; Matas, Carla; Carvallo, Renata; Gomes, Raquel; de Beija, Carolina; Magliaro, Fernanda; Rabelo, Camila

Publication info: Noise & Health 14.56 (Jan 2012): 6-12.

Abstract: In the present study, we evaluated peripheral and central auditory pathways in professional musicians (with and without hearing loss) compared to non-musicians. The goal was to verify if music exposure could affect auditory pathways as a whole. This is a prospective study that compared the results obtained between three groups (musicians with and without hearing loss and non-musicians). Thirty-two male individuals participated and they were assessed by: Immittance measurements, pure-tone air conduction thresholds at all frequencies from 0.25 to 20 kHz, Transient Evoked Otoacoustic Emissions, Auditory Brainstem Response (ABR), and Cognitive Potential. The musicians showed worse hearing thresholds in both conventional and high frequency audiometry when compared to the non-musicians; the mean amplitude of Transient Evoked Otoacoustic Emissions was smaller in the musicians group, but the mean latencies of Auditory Brainstem Response and Cognitive Potential were diminished in the musicians when compared to the non-musicians. Our findings suggest that the population of musicians is at risk for developing music-induced hearing loss. However, the electrophysiological evaluation showed that latency waves of ABR and P300 were diminished in musicians, which may suggest that the auditory training to which these musicians are exposed acts as a facilitator of the acoustic signal transmission to the cortex.

Full text: Introduction

Exposure to noise of high intensity and for a long period increases the risk of permanent hearing damage. The degree of hearing loss it may cause depends on the frequency and intermittency of the exposure. [1],[2]

Even as the controversy over whether or not music causes permanent hearing loss remains, [1] many studies have presented evidence of a potential risk for hearing damage from music exposure. [1],[3],[4] This hearing loss has been referred to as a music-induced hearing loss. [5]

It is well known that the pathophysiological effects of noise act mainly on the cochlea, [6],[7],[8],[9] but some previous investigations have shown that the central components of the auditory pathways can also be affected by acoustic overstimulation. [10],[11],[12],[13]

Exposure to noise tends to cause structural and metabolic changes in the hair cells, which can subsequently degenerate. [1],[6],[7],[8],[9],[13] Additionally, it has been shown that noise exposure alters mitochondrial activity, leading to increased production of free radicals that cause changes in blood flow and neural activity that induce the death of hair cells by both necrosis and apoptosis. [9]

Once the cochlea is damaged, a sequence of events occurs in a pathophysiological cascade. In summary, decreasing cochlear input into the central auditory pathway may induce apoptosis in the neurons, which reduces cell density in the ventral cochlear nucleus. Next, the cell density and important structures of the central auditory pathway (central nucleus of the inferior colliculus, medial geniculate body, and primary auditory cortex) are also affected by overstimulation of the neurons and intense calcium influx. [13] These changes lead to toxic neurodegenerative processes and an enhanced neurotransmitter release that can induce glutamate excitotoxicity due to ionic homeostasis changes. [1],[13]

Despite the injuries that exposure to music may cause to the peripheral and central auditory pathway, clinical practice and even the research done on the subject in humans have been limited to audiological assessment. [10] However, audiological assessment is a poor indicator of the degree of damage caused to the auditory pathways. Hence, recent studies on music-induced hearing loss have adopted advanced audiological measurements (high frequency audiometry and otoacoustic emission) for the early identification of these damages, even before the changes can be detected by conventional audiometry. [1] Our study is the first in which a battery of assessments that include electrophysiological, eletroacoustic, and audiological assessments have been used to investigate the impact that exposure to music may have on whole auditory pathways.

The present study

In the present study, we evaluated peripheral and central auditory pathways in professional musicians (with and without hearing loss) compared to non-musicians. The goal was to verify if music exposure could affect auditory pathways as a whole.

Method

Participants

Professional Pop/Rock Musician Groups: The inclusion criteria adopted in this study were (a) being a professional musician, (b) being a member of a pop/rock band for more than five years, (c) having had exposure to intense sound levels from electrically amplified music for at least two hours weekly, (d) being male, (e) being between 18 and 45 years old, and (f) having an audiological threshold from 250 to 8000 Hz <40 dBNA. The exclusion criteria were (a) existing acoustic trauma, (b) exposure to noise (>80 dBA) during occupational activities from sources other than music, (c) a history of recurrent otitis media, (d) previous ear surgery, (e) conductive hearing loss and excessive ear cerumen, and (f) use of potentially ototoxic drugs.Non-musicians Group: The inclusion and exclusion criteria for the control subjects were the same, except for exposure to music considered at a professional level according to the criteria adopted for the musicians group.

Our study group of professional musicians contained 16 subjects with ages ranging between 21 and 41 years (mean, 27.10 years; SD, 6.02 years) and the control group contained 16 subjects with ages ranging between 20 to 43 years (mean, 26.87 years; SD, 7.40 years) (P value=0.936). The instruments considered in the musicians group were guitar (n=4) and drums (n=12). The mean average of weekly noise exposure to intense sound levels in the musicians group was approximately 23.1 hours over a mean period of approximately 16.3 years.

The musicians group, in turn, was classified in two subgroups: HLG - hearing loss musician group (0.25 kHz - 20 kHz), according to analysis criteria of British Society of Audiology [14] and Burguetti et al., [15] and MG - musicians without hearing loss in any frequencies (0.25 kHz - 20 kHz).

Procedures and Measures

Informed consent was obtained from each individual who participated in this study. The study was approved by the Ethics Committee of the University of São Paulo, Brazil.

All subjects were requested to complete a detailed questionnaire concerning their age, gender, education, medical history, occupational history, and the circumstances surrounding their musical activities, such as how long the subject played per day, how loud, how often, and what instruments, as well as whether or not they had used ear protection.

An audiometric assessment was conducted on all participants. Screening acoustic immittance measurements (GSI 38 Auto Tymp, Grason-Stadler, Inc., Madison, WI) and otoscopy were performed.

Pure-tone air conduction thresholds at all frequencies from 0.25 to 8 kHz and in the extended high frequencies of 9, 10, 12.5, 14, 16, 18, and 20 kHz were carried out with a GSI 61 Clinical Audiometer (Grason-Stadler, Inc., Madison, WI) using standard audiometric techniques in a sound-attenuated testing room.

Transient Evoked Otoacoustic Emissions (TEOAE) were recorded using an ILO 292 Plus OAE analyzer, v 6 (Otodynamics Ltd., Hatfield, UK), using ILO insert phones. The TEOAEs were recorded in a nonlinear mode. Under all conditions, the mean intensity of the clicks was 78 - 83 peSPL, and 200 sweeps were recorded for each ear. The response level was determined by measuring the signal-to-noise ratio with an analysis time window of 4 - 20 ms. The nonlinear transient click of 80-μ s duration was presented at a rate of 50 Hz, in alternating blocks. The individuals were tested in a sound booth, in a quiet room.

The electrophysiological tests (Auditory Brainstem Response - ABR, and Cognitive Potential - P300) were carried out in an electric- and sound-attenuated testing room. The electrophysiological assessment was done using a two-channel electroneuromyograph equipment (Biologic Traveler Electrodiagnostic Testing System; Biological Systems Corp., Mundelein, IL, USA). The individual was asked to remain with his eyes fixed on a figure positioned about five feet away during the recording of potentials, in order to control eye movement artifacts.

For the ABR, a rate of 19 clicks per second, with 0.1 μ s duration, were used with a filter slope of 12 db/octave, with the band pass filter 100-1500 Hz, and 2000 sweeps. The stimulus was 80 dBnHL. The ABR measurements were duplicated to ensure fidelity.

The oddball paradigm was used in the P300 recordings. This paradigm was based on distinguishing between a target stimulus repeated randomly (20% of the time) and the non-target stimuli, with frequent repetition (80% of the time). The subjects were asked to count the stimuli when they discriminated the target stimulus. A monaural auditory stimulus was presented. Frequencies were 1000 Hz for the frequent stimuli (non-target) and 1500 Hz for the rare (target) stimulus. The stimulus was 75 dBnHL. A rate of 1.1 tone-burst per second was used with the low filter setup in 30 Hz and the high filter in 1 Hz, and 300 sweeps.

The electrodes were positioned according to an international electrode system (IES), 10 - 20. [16] Electrode impedances were always less than 5 kΩ. Standard Bio-logic TDH49 headphones were used to deliver the sound stimuli for the electrophysiological tests.

Latency and amplitude of the waves were analyzed. The P300 were analyzed after subtracting the curves resulting from the rare and frequent stimulus (of the same ear), and were measured at the most positive point (amplitude), from 250 to 600 ms.

For the statistical analyses, the Kolmogorov-Smirnov test was applied to determine normality of the variable distribution. We used the Analysis of Variance (ANOVA) and Tukey's test for quantitative analysis and Chi-square (Fisher's exact test and Mantel-Haenszel) for qualitative analysis. The level of significance was set at 0.05. Significant values were designated with an asterisk (FNx01).

Results

There was no statistically significant difference between the right and left ears (P>0.05; ANOVA) for conventional and high frequency pure-tone audiometry, amplitudes of OAE, or the wave latencies of electrophysiological tests, for all individuals in all groups. Thus, both ears of the individuals in each group were grouped and 16 musician subject responses (32 ears) were compared with 16 non-musician subject responses (32 ears). The HLG was composed of 14 ears and the MG was composed of 18 ears.

Hearing thresholds in both conventional and high frequency audiometry

A statistical analysis performed for pure-tone thresholds revealed that values significantly differed between the three groups for 2 and 3 kHz, and for 12.5 to 18 kHz [Table 1]. The musicians groups (HLG and MG) exhibited higher thresholds than the controls, in general.

For pairwise comparison (Tukey's test), we observed the statistical significant difference for: 2 kHz NG×HLG (P=0.013); 3 kHz NG×HLG (P=0.049); 12.5 kHz NG×HLG (P=0.007); MG×HLG (P=0.001); 14 kHz NG×HLG (P=0.004); MG×HLG (P=0.001); 16 kHz NG×MG (P=0.017); NG×HLG (P=0.009); MG×HLG (P=0.001); 18 kHz NG×HLG (P=0.001); MG×HLG (P=0.001){Table 1}.

On audiometry, 7.15% of the HLG ears had hearing loss in at least one frequency (significant difference between groups). In the high-frequency audiometry, 100% of the HLG ears had hearing loss in at least one frequency (significant difference between groups) [Table 2].{Table 2}

Amplitudes of otoacoustic emissions

In transient evoked otoacoustic emissions, a statistically significant difference between the mean response (amplitude) of the three groups for all frequencies was observed [Table 3]. The HLG and MG had smaller TEOAE amplitudes when compared with the NG. For this comparison, we excluded the subjects with absent OEA.{Table 3}

For pairwise comparison (Tukey's test), we observed statistical significant difference for: 1 kHz NG×MG (P<0.001); NG×HLG (P<0.001); 1.5 kHz NG×MG (P<0.001); NG×HLG (P<0.001); 2 kHz NG×MG (P<0.001); NG×HLG (P<0.001); 3 kHz NG×MG (P<0.001); NG×HLG (P<0.001); 4 kHz NG×MG (P<0.001); NG×HLG (P<0.001); Response NG×MG (P<0.001); NG×HLG (P<0.001).

In HLG, 14.28% of the ears had absent TEOAE and 85.71% had TEOAE partially present, although a

statistically significant difference between the groups was observed only for TEOAE, which was partially present [Table 4].{Table 4}

Short and late latency responses

We compared the waves and interpeak latencies of ABR between the three groups [Table 5]. There was statistically no significant difference in any waves or interpeaks comparison between the groups.{Table 5}

For pairwise comparison (Tukey's test), we observed a statistically significant difference for: NG×MG (P=0.041).

There was a statistically significant difference between the groups [Table 6]; the MG had smaller mean latency of P300 when compared to NG and HLG.

There was a statistically significant difference for ABR alterations between groups, with more alterations in NG than in MG and HLG [Table 7]. There was statistically no significant difference between groups for the P300 (data not shown), because no P300 alterations (according to McPherson [18] normality) were observed in both groups.{Table 6}{Table 7}

Discussion

We found that musicians (HLG) had 7.15% of their ears with sensorineural hearing loss (as shown by conventional audiometry) and 100% of their ears with hearing loss in high frequencies. The values significantly differed between the three groups for 2 and 3 kHz, and for 12.5 to 18 kHz. Nevertheless, the mean values in the musicians group (MG and HLG) were worse than in the control group. This fact showed that the musicians already had some degree of peripheral damage, even though these individuals were still young.

These results agreed with other studies that found worse hearing thresholds when comparing pop/rock musicians with a control group [3] or those that found different prevalence of hearing loss among musicians from different musical genres (58% of the musicians; [20] 52.5% of the musicians; [21] 37% of the musicians; [22] 33 to 52% of the musicians, depending on the criteria of hearing loss used; [23] 49% of the musicians; [24] more than 50% of the musicians had a hearing loss of 15 dB(A) and more; [25] 42.9% of the musicians [26]). Previously, our group showed that depending on the hearing loss criteria used (different thresholds of cut off, averages of thresholds, uni-or bilateral hearing loss, etc.), [1] the prevalence of hearing loss could change, which might explain the differences observed in the previous studies.

Concerning TEOAE, the musician groups (MG and HLG) presented significantly smaller mean amplitudes for all frequencies compared to the non-musician groups. Moreover, if we considered the absent emissions and the partly present emissions together, the HLG showed 100% alteration, the MG showed 44.44% alteration, whereas, the NG showed no absent or partially present emissions.

Among the studies in which TEOAE were used to draw the audiological profile of musicians, the results varied considerably. A previous study [27] found 38% sensorineural hearing loss in high frequencies and 69% absent otoacoustic emissions in orchestral musicians. Another study [28] found 100% normal hearing, but 60% absent responses of TEOAE in rock musicians. A third study [29] observed that TEOAE was present in all evaluated singers, but with less robust responses when compared to the control group. A recent investigation [30] found nearly 21% hearing loss and 45.8% absent TEOAE in pop/rock musicians.

These values were higher than those observed in this study (12.5%, if were consider HLG and MG together). It should be noted that these studies evaluated parameters different from those evaluated in our study and did not consider the 'partially present' values, which in our study showed a high prevalence (100%). Despite these differences, our findings suggested worse function of outer hair cells (OHC) in MG and HLG, when compared with NG, suggesting cochlear damage in most of the musicians, even though this damage had not yet been seen in conventional and/or high frequency audiometry.

For the electrophysiological evaluation, we have found early responses to ABR and P300 waves in musicians. These professionals, with musical training and practice, increase the spontaneous attention to the sound and their sound discrimination abilities. [1] This fact suggests that musical training provides a better processing of

acoustic information by the central auditory nervous system. Some authors [31] have evaluated the ABR and cortical evoked responses of musicians and non-musicians and shown that musicians have earlier responses when compared to non-musicians, indicating rapid identification and perception of sound by musicians. The auditory training through the musical experience provides a neural synchrony to the auditory system as well as faster responses to the presence of sound, as has been concluded in another study, [32] which has analyzed the ABR of musicians to speech sounds.

Our results agree with those of the previous studies, although no significant differences for ABR waves were found between groups. Also, for qualitative analysis, we found that the MG and HLG had fewer individuals with alterations in ABR than the NG, a result that suggests a good integrity of the auditory brainstem response in this population.

With regard to the P300 results, although three groups showed mean values within normal limits, the MG and HLG showed a shorter latency than the NG. Some authors [33] assessed how musicians responded to pure tones, harmonics, and speech, by analyzing the components in N1, and P300 auditory evoked potentials of long latency, and compared these results with those obtained in the control group (non-musicians). They concluded that musicians regularly exposed to music showed shorter latencies for harmonic and speech stimuli, and for pure tone results they found no difference between the groups, although the musicians group had shorter latencies of the P300 wave, similar to what we found.

Thus, our findings do not support the hypothesis that the central components of the auditory pathways can also be affected by acoustic overstimulation. [10],[11],[12],[13] However, previous studies have dealt with the damage caused by noise and not the music itself. Thus, it is possible that music and noise do not act in the same way about the central auditory pathways, although both stimuli cause damage to the peripheral auditory pathways, as previously mentioned.

Therefore, alterations in otoacoustic emissions and high frequency audiometry presented by musicians with and without hearing loss showed that despite the fact that the central portion was not clearly affected by noise exposure, the peripheral portion showed that it was already affected, and these two tools could be used to predict the possible damage caused by exposure to very intense pressure levels sounds.

Musicians are different from factory workers in several areas that make the former slightly less susceptible to hearing loss. Music tends to be intermittent, with loud passages and quiet passages intermixed, while industrial noise tends to be continuous. Perhaps this intermittency makes the music slightly less damaging than an equal intensity of noise for a similar length of time. [34]

A study [35] showed that musicians who had played for less than 10 years did not develop hearing loss, whereas, 40% who had played between 10 and 19 years, and 66% who had played for more than 20 years, had developed hearing loss. However, another study [36] documented a measurable loss in the hearing function of workers in 328 construction industries in their first three years of work. Also, it is possible that a change in the circulation in the auditory pathway on a hormonal basis, if music is perceived as pleasant, makes music less damaging than noise. [34] It is well known that the impact of the perception of pleasant and unpleasant sounds may result in endocrine changes, including the production of stress hormones such as cortisol and ACTH, catecholamines, and others. [37] On account of these physiological reactions, the noise becomes detrimental to health in many ways, leading to sleep disturbance, cardiovascular disease, psychiatric symptoms, and psychosocial effects, including the discomfort with noise, reduction in performance/attention, and increased aggressive behavior. [38]

Thus, it is possible that compared to noise, music causes less harmful effects to the central auditory pathways, due to its spectral and temporal (intermittence) characteristics, as a function of hormonal changes. This function may be caused by sounds rated as pleasant or unpleasant, which may trigger negative reactions in the entire system that results in a cascade of adverse events.

Future studies with animals comparing different acoustic stimuli that resemble the characteristics of music

(spectral and temporal) are important for this hypothesis to be tested. A comparison with the effects of noise can be made by checking the effects on the peripheral and central pathways of different types of stimuli.

A limitation of our study is our small sample of musicians, which included guitarists and drummers only. This was done in an attempt to minimize the variety of different instruments and music exposure of professional musicians, as they may carry different audiological features.

An analysis of musicians showed that drummers had worse hearing thresholds and smaller TEOAE amplitudes when compared to guitar players. Drummer players present a bigger damage most likely because of the impact noise produced by the instrument. This finding has also been observed by others. [3]

Our study is the first to assess both the central and peripheral auditory pathway of professional musicians. This approach allowed us to find that music can cause damage to the peripheral auditory pathways. Additionally, music may act as a training tool for central auditory pathways, improving the processing of acoustic information to the cortex. Future studies in which more musicians playing different instruments are included will be enlightening.

However, we cannot rule out that central damage can also be caused by the music itself, when exposure occurs for long times. Thus, longitudinal studies of this kind are also needed to clarify these issues. As indicated by others, [23],[27],[39] hearing protection measures should always be taken with this group of professionals, including engineering control measures (acoustically, the sound source distance, decreased amplification, etc.), personal protection (use of protective earplugs for musicians, with uniform attenuation of frequencies), training in placement and cleaning earplugs, educational programs, audiological monitoring, and others. [23],[27],[39]

Conclusion

Our findings suggest that the population of musicians is at risk for developing music-induced hearing loss. However, the electrophysiological evaluation showed that latency waves of ABR and P300 diminished in musicians, which may suggest that the auditory training of musicians, who are exposed to sound in the profession, acts as a facilitator of the acoustic signal transmission to the cortex, that is, provides a better processing of acoustic information by the central auditory nervous system.

Acknowledgments

This study was funded by FAPESP (The State of São Paulo Research Foundation).

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Publication date: Jan 2012

Year: 2012

USPTO ISSUES TRADEMARK: BEAUSOLEIL

Publication info: US Fed News Service, Including US State News [Washington, D.C] 20 Dec 2011.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: ALEXANDRIA, Va., Dec. 20 -- The trademark BEAUSOLEIL (Reg. No. 4069144; International Reg. No 1055683) was issued on Dec. 13 by the USPTO.
Owner: Acuitis Holding SA Socit anonyme SWITZERLAND 15, ch. de la Falaise CH-1196 Gland SWITZERLAND.
The trademark application serial number 79088990 was filed on Sept. 30, 2010 and was registered on Dec. 13.
Goods and Services: Scientific apparatus and instruments, namely, telescopes and microscopes; optical apparatus and instruments, namely, optical filters, optical glasses, optical lens sights, optical scanners, optical readers, optical reflectors and binoculars; apparatus for recording, transmission or reproduction of sound or

images; blank magnetic data carriers; blank recording discs; spectacles; spectacle frames; frames and holders for spectacles; frames for spectacle glasses; sunglasses; goggles for sports; spectacle cases; surveyors' levels; correcting lenses; contact lenses; sunglass lenses; lenses for optical applications or designed to protect the eyes; eye protections, namely, safety goggles; spectacle guards; cases for contact lenses; magnifying glasses; headbands, cords, twists, chains and laces for holding glasses; containers and holders for contact lenses; apparatus and instruments for the amplification of sounds and their accessories intended for those who are hard of hearing, namely, hearing aids and batteries for use therewith; head phones; noise protective headwear; acoustic diaphragms; amplified earphones; loudspeakers; microphones; megaphones; acoustic measuring devices and apparatus; sound locating instruments, namely, sound pick-ups and sound level meters; acoustic, electric or electronic apparatus and devices to improve audition and viewing of television, radio, telephone or other audiovisual or telecommunication apparatus, namely, audio speakers and amplifiers; electrical cables and connecting cords between battery adapters and amplifying and receiving apparatus; apparatus producing oscillations, namely, oscillators

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Publication date: Dec 20, 2011

Year: 2011

Don't pump up the volume if you really love your music

Publication info: Daily Post [Liverpool (UK)] 13 Dec 2011: 10.
ProQuest document link

Abstract: Abby Davies, an audiology specialist at the charity Hearing on Action Loss Cymru, which was previously the RNID, said: The World Health Organisation has predicted that by 2030 adult onset hearing loss will be in the top 10 of disease burdens in the UK, but it's not inevitable that everyone will get hearing loss as they age.

Full text: As a generation of young people seem glued to their headphones, Madeleine Brindley examines growing concern about potential future damage to their ears A QUICK glance around any train or bus carriage will reveal most young people are sporting headphones of some shape, style and colour.

The explosion in MP3 technology means these tiny players, which are capable of storing thousands of songs and albums, have become the electronic accessory of choice.

But there are increasing fears that this so-called iPod generation are at risk of hearing damage later in life because they're exposing their ears to too much loud music.

Statistics show a staggering 41% of over-50s and 71% of people over 70 have some degree of hearing loss as a result of damage to the tiny sensory cells in the inner ear.

It is estimated there are more than 10 million people throughout the UK with some form of hearing loss - this is equivalent to about one in six of the population. About a third are of working age.

By 2031, it is estimated there will be 14.5 million people with hearing loss in the UK.

Abby Davies, an audiology specialist at the charity Hearing on Action Loss Cymru, which was previously the RNID, said: "The World Health Organisation has predicted that by 2030 adult onset hearing loss will be in the top 10 of disease burdens in the UK, but it's not inevitable that everyone will get hearing loss as they age.

"Adult onset hearing loss is caused by damage or loss of the tiny sensory cells in the cochlear; the damage means they no longer respond to certain sounds and that's when you get hearing loss.
"It tends to be the cells which respond to high-pitched sounds which are damaged which is why people often mishear the beginning and end of words. It can mean you don't hear S, T, P or F - when you miss the beginning and ends of words it can be very difficult to work out what's being said.
"The volume may be OK but the clarity isn't. People with hearing loss often feel OK but sounds aren't very clear."
She added: "The damage tends to be caused by general wear and tear but there are things you can do to help prevent hearing loss, including protecting your hearing from noisy environments."
Concern is growing about the potential damage young people are doing to their hearing by listening to too loud music, particularly via their MP3 players.
Claire Kingston, campaigns and communication manager for Action on Hearing Loss Cymru, said: "When we've done research in the past, 90% of people questioned said they had, at some point, experienced tinnitus after a night out.
"Most of us will be familiar with that muffled feeling which fades after a while after being at a pub or club or watching a live band. That muffled feeling is temporary hearing loss.
"People who listen to very loud music at high volumes over a relatively long period of time are at risk of damaging their hearing permanently.
"Our protect your hearing campaign aims to raise awareness among the younger generation about the dangers of listening to loud music over a long period of time.
"We want to see this embedded as a public health campaign in the same way that people are warned about the risks of smoking or too much sun exposure.
"People are completely unaware of how much damage they could be doing simply by listening to their MP3 player."
It has been recognised that noise above 85 decibels is harmful to hearing - a typical nightclub registers at around 100 decibels, which is the same level as the maximum volume on some MP3 players, Ms Kingston said.

"Stop-and-search research we've done among young people across the UK, including in Wales, to measure the volume of MP3 players has found that more than 50% were listening at above 85 decibels.
"We're not telling anyone to stop listening to music," she added. "But we are saying that if they want to still be listening to music when they're older, they need to give their ears a break - don't stand next to speakers; wear earplugs or the right earphones.
"Some earphones will allow outside noise to filter through, so people crank up the volume to drown it out but noise-cancelling headphones are available and are really good as they are more effective at cutting off background noise."
DJ Judge Jules has backed the Action on Hearing Loss campaign, saying: "I expose myself to a lot of loud noises and enjoy myself all the time; the problem with loud noise is that it can cause irreversible ear damage - there's absolutely no way back when it's happened. It is, however, entirely preventable.
"Music is such a fundamental part of everyone's lives that if you lose the ability to enjoy it, it's everything."
And popstar and DJ Boy George said: "'I think it would just be awful to lose your hearing. I think it would be the most difficult thing to deal with.
"I think if you've never had hearing it is a different thing, but if you've had hearing and you lose it that must be very difficult to deal with. Same as anything, losing a limb, losing your sight."
Ms Davies said: "Hearing loss has a significant personal and social impact as the loss of communication has far-reaching consequences. "It can be very isolating and excluding; people with hearing loss are more likely to withdraw from interaction with large groups of people and it can be associated with high levels of depression."

Kay Coleman, a member of the Swansea Hard of Hearing Group, said having difficulty with hearing could be "embarrassing" and isolating for sufferers, especially in social situations.
Ms Coleman, a mother of one, was fitted with a hearing aid in one ear eight years ago; she now requires them in both ears. She said: "Because my two ears were affected, one very badly, I couldn't hear very well.
"For example, I had to turn the television up quite loud, because unless you have over-ear headphones you can't insert them in to your ears which is quite a dilemma.
"I do have a small digital radio and I would use it on my good ear and then that cut out. I used to use it on the bus.
"That can be a bit isolating, in a way, and it can be a bit embarrassing because you can't hear what other people are saying."
The former nurse and nursing tutor, who is now retired, said she often struggled to keep up with conversations in social situations and at conferences and meetings for Action on Hearing Loss, for whom she volunteers.
The pensioner said she wanted to learn to lip read but there are no teachers in the area.
She added: "I came home one Sunday from church and I had bought some pots to put seedlings in.
"My son was at home and he said something to me about seedlings, but I thought he was talking about the ceiling. It just didn't make sense to me."
HOW DO YOU GET A HEARING TEST? 'It takes, on average, a decade for people worried about their hearing to do something about it.
But Abby Davies, an Action on Hearing Loss audiology specialist, said the earlier people seek help the better they can adapt to hearing aids, if they are needed.
She said: "A lot of people with hearing loss think that they can hear OK and it's other people who aren't speaking clearly.
"What they don't understand is that if they can't hear clearly they already have some hearing loss. But people will cope and muddle through for lots of different reasons, which is why it can take 10 years."
Action for Hearing Loss has developed an online hearing check, which can also be carried out over the telephone, to help people who are worried about their hearing.
Hearing tests are available privately on the high street but people can also see their GP about hearing issues, which could result in a referral to a hospital.
Ms Davies said: "The first step is to see your GP who can then refer you for a full hearing test, which will involve an audiologist going through some questions and a history before the test begins.
"Patients put on a pair of headphones and their hearing is tested across different frequencies and pitches - patients are asked to respond to beeps at medium, high and low frequencies. The beeps will get quieter and quieter until the patient no longer responds and then they will go up again, this is to establish a person's hearing threshold.
"Individuals will each have different hearing loss but it tends to follow a similar pattern by being more severe in the high pitches.
"People can also self refer themselves to a private provider, which will test hearing in a similar way but they will have to pay for any hearing aids because it hasn't been done through the NHS."
To take the Action on Hearing Loss hearing check visit www.actiononhearingloss.org.uk or call 0844 800 3838
How loud is too loud? Loudness of a sound is measured in decibels (dB). Experts agree that exposure to noise at or above 85 dB (A) can damage hearing. Some examples of average decibel levels of common noises: 20 dB (A) A quiet room at night 60 dB (A) Ordinary spoken conversation 70 dB (A) City street 100 dB (A) Pneumatic drill; maximum volume on some MP3 players 110 dB (A) Night club 115 dB (A) Rock concert 120 dB (A) Aeroplane taking off Without sound-measuring equipment, it can be difficult to know how loud the sound really is. As a rule of thumb, if you have to raise your voice to speak to someone two metres away, the noise is loud enough to damage your hearing and you should take steps to protect yourself. If the sound ever hurts your ears,

leave immediately.
How long can I listen to music for? It depends on how loud the music is.
Decibels work as ratios so the louder the volume, the less time you can listen to it without damaging your hearing. For every 3 dB (A) increase in volume, the amount of time is halved before hearing damage occurs. If a nightclub has music playing at 100 dB (A), it is only possible to listen to it for 10 to 15 minutes before the exposure becomes damaging.
Won't my ears get used to loud music? In short, no. Loud music affects everyone's hearing. Some people may be more susceptible to damage than others but it is only possible to know your susceptibility once you have damaged your hearing. It is important to take steps to prevent any damage from occurring.
What might happen if I damage my hearing? If you've been exposed to loud music, you may experience ringing in your ears. This is usually temporary and tends to go after 24 hours at most. However, continued exposure to loud music can lead to the ringing, or tinnitus, to become permanent. This has been known to affect people's lives, their ability to sleep and concentrate. You may also experience premature hearing loss. While you may not notice this straight away, it could bring on hearing loss as a result of age much quicker.

Publication date: Dec 13, 2011

Year: 2011

STUDIES WARN HEARING LOSS IS PUBLIC HEALTH THREAT

Author: Cohn, Meredith

Publication info: The Baltimore Sun [Baltimore, Md] 04 Dec 2011: A.4.
ProQuest document link

Abstract: Hearing loss is more prevalent in those with hypertension and diabetes, and among white men compared with women and African-Americans. Hearing loss generally occurs when hair cells in the inner ear responsible for converting sound into signals that go to the brain die off over time and are not replaced.

Full text: One in five Americans has significant hearing loss, far more than previously thought, according to new research that has scientists warning of an impending public health threat.
Researchers at the Johns Hopkins University say a growing number of seniors in the United States are at risk of isolation from their hearing loss and could suffer physical and mental debilitation.
"People think hearing loss is an inconsequential part of getting older," said Dr. Frank Lin, an assistant professor in Hopkins' department of otolaryngology-head and neck, who led the study. "But hearing loss is associated with a greater risk of developing dementia, and having poorer cognitive and physical functioning."
The World Health Organization says significant hearing loss is when someone is unable to hear sounds of 25 decibels or less. Lin says words sound mumbled, especially when there is background noise.
The study found that about 30 million Americans, or close to 13 percent of the population, had such loss in both ears, and 48 million, or just over 20 percent, had loss in at least one ear. Previous estimates were closer to 21 million to 29 million.
This study, published in the Archives of Internal Medicine, used data from all ages and ethnicities collected in a continuing federal research program called the National Health and Nutritional Examination Surveys.
The data showed that the risk of hearing loss doubles in a person every decade, and because more people are

living longer, there are now more people with hearing loss. Hearing loss is more prevalent in those with hypertension and diabetes, and among white men compared with women and African-Americans. The female hormone estrogen and melatonin, which colors skin, seem to be protective, Lin said.

Hearing loss generally occurs when hair cells in the inner ear responsible for converting sound into signals that go to the brain die off over time and are not replaced. Damage isn't typically seen for years and losses aren't reversible, and the only preventive step for most people is to avoid long periods of loud noises. Lin suggested, for example, that young people stay away from the loudspeakers at concerts and stop using ear buds, which allow for louder sounds when they listen to music.

Lin said only an estimated 20 percent of those who suffer hearing loss seek treatment. Others don't recognize or acknowledge a problem, especially if the loss comes gradually. People hear some sounds and fill in the gaps by asking speakers to repeat themselves, turning up the television, or reading lips and using other signals.

That's what Bob Ward did. The 66-year-old Annapolis man believes his hearing loss resulted from military service in Vietnam. About 15 years ago, he went for hearing aids.

He has since been through several pairs of increasing strength. They took some getting used to because they don't filter background noise well, but he said they helped until recently. He was finding it hard to communicate at home and at work at Pitney Bowes, where he is a director of applied technology.

"I didn't notice at first, but my wife and family noticed that I'd become rather withdrawn," he said. "I wasn't participating because I couldn't hear, and pretty soon people wouldn't even try and include me in conversation. It has a real psychological effect. I started to feel isolated."

Ward said he avoided coffee shops because he was afraid he'd be asked a question. He even began researching jobs he could do without hearing.

One day he was visiting his grandchildren's school in Washington, where about half the kids are deaf and have cochlear implants, which are surgically implanted electronic hearing devices for the more severely hearing-impaired. He was inspired to head to Hopkins to see if he would be a candidate.

And now that he's had one implant, he's begun to recognize long-ago familiar sounds, such as the clanking of his dogs' tags.

"I can have conversations that I wasn't having before," he said. "I see other people who can't hear and they give up on things. I see how it can become mentally and then physically debilitating."

Plenty of people acknowledge ignoring the problem. More than 60 percent of members of AARP reported difficulty hearing in noisy situations in a new poll by the group and the American Speech-Language-Hearing Association.

Yet only 43 percent have gone for a test, even though hearing troubles have affected relationships for many. Close to two-thirds don't believe their problem warrants treatment, and about the same percentage say lack of insurance coverage and cost are reasons not to be treated. (Hearing aids cost $2,000 to $4,000.)

That frustrates Linda S. Remensnyder, an Illinois audiologist who has consulted with Lin and has become an advocate for the hearing-impaired. She says many of her older patients have become withdrawn and debilitated by the time they get to her.

She said some diseases and treatments cause hearing loss, along with age, but she believes hearing loss also makes their physical and mental health worse.

Remensnyder has joined other audiologists and the American Academy of Audiology, the Hearing Loss Association of America and AARP to encourage regular screenings, use of hearing aids and installation of hearing loops in public places such as theaters, shops and churches. The loops magnetically transmit sounds to a wireless receiver in hearing aids, filtering outside noise.

"Patients come in here and tell me that they've stopped going to activities," she said. "We not only have to provide hearing aids but make sure venues are audible. It's an incredible issue, and if we don't get it addressed, we'll be paying for it. Maybe we can defer the onset of dementia."

Other scientists, including Dr. George Gates, a hearing expert at the University of Washington in Seattle, say they're not so sure hearing loss causes dementia. Gates says his research shows that dementia may cause hearing loss, and he is an advocate for more testing.

"What we've found is, long before anyone gets a diagnosis of dementia, their ability to hear noise is severely affected, so a hearing test may reveal people at risk of dementia long before any other test," said Gates. He added that there is no cure for dementia, but early interventions may slow the progression.

He agreed with Lin that improving hearing can stave off depression, which he said can lead to other mental and physical maladies. "There absolutely is a public health threat from hearing loss," he said.

Lin, also an assistant professor in the epidemiology department in Hopkins' Bloomberg School of Public Health, plans to continue looking at the link to physical and mental health.

He's studying the cognitive abilities in those older than 50 who have hearing loss. He's also planning a larger study that will test the cognitive and physical abilities of people with hearing loss over years. One set will get free hearing aids, intensive instruction on using them and loop systems in some public areas. The other set will just be observed (they can buy a hearing aid themselves if they want).

"No one would think of not treating their high blood pressure, but hearing loss is still perceived as not that bad for you," Lin said. "If 30 million have hearing loss and less than one in five people do anything about it, and studies show that hearing loss is associated with adverse outcomes, think of how huge a public health threat that is."

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Credit: The Baltimore Sun

Illustration

Photo(s); Caption: Bob Ward, 66, of Annapolis applied for and received a cochlear implant after he noticed that his severe hearing loss had begun to leave him feeling isolated.Dr. Frank Lin

Publication date: Dec 4, 2011

Year: 2011

More suffer from hearing loss than expected, study shows

Author: Cohn, Meredith

Publication info: McClatchy - Tribune Business News [Washington] 03 Dec 2011.
ProQuest document link

Abstract: Dec. 03--One in five Americans has significant hearing loss, far more than previously thought, according to new research that has scientists warning of an impending public health threat. Hearing loss generally occurs when hair cells in the inner ear responsible for converting sound into signals that go to the brain die off over time and are not replaced.

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"People think hearing loss is an inconsequential part of getting older," said Dr. Frank Lin, an assistant professor in Hopkins' department of otolaryngology-head and neck, who led the study. "But hearing loss is associated with a greater risk of developing dementia, and having poorer cognitive and physical functioning."

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Remensnyder has joined other audiologists and the American Academy of Audiology, the Hearing Loss Association of America and AARP to encourage regular screenings, use of hearing aids and installation of hearing loops in public places such as theaters, shops and churches. The loops magnetically transmit sounds to a wireless receiver in hearing aids, filtering outside noise.
"Patients come in here and tell me that they've stopped going to activities," she said. "We not only have to provide hearing aids but make sure venues are audible. It's an incredible issue, and if we don't get it addressed we'll be paying for it. Maybe we can defer the onset of dementia."
Other scientists, including Dr. George Gates, a hearing expert at the University of Washington in Seattle, say they're not so sure hearing loss causes dementia. Gates says his research shows that dementia may cause hearing loss, and he is an advocate for more testing.
"What we've found is long before anyone gets a diagnosis of dementia, their ability to hear noise is severely affected, so a hearing test may reveal people at risk of dementia long before any other test," said Gates. He added that there is no cure for dementia, but early interventions may slow the progression.
He agreed with Lin that improving hearing can stave off depression, which he said can lead to other mental and physical maladies. "There absolutely is a public health threat from hearing loss," he said.
Lin, also an assistant professor in the epidemiology department in Hopkins' Bloomberg School of Public Health, plans to continue looking at the link to physical and mental health.
He's studying the cognitive abilities in those over 50 with hearing loss. He's also planning a larger study that will test the cognitive and physical abilities of people with hearing loss over years. One set will get free hearing aids, intensive instruction on using them and loop systems in some public areas. The other set will just be observed (they can buy a hearing aid themselves if they want).
"No one would think of not treating their high blood pressure, but hearing loss is still perceived as not that bad for you," Lin said. "If 30 million have hearing loss and less than one in five people do anything about it, and studies show that hearing loss is associated with adverse outcomes, think of how huge a public health threat that is."
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Publication date: Dec 3, 2011

Year: 2011

Gabapentin for Tinnitus: A Systematic Review

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Publication info: American Journal of Audiology (Online) 20.2 (Dec 1, 2011): 151-8.
ProQuest document link

Abstract: The main aim of this study was to assess the effect of gabapentin on tinnitus via a systematic review. An electronic search of literature as well as a hand search were conducted. Only double-blind randomized

controlled trials (RCTs) that met all of the inclusion criteria were included in this review. The Cochrane Collaboration tool for risk of bias assessment was used to investigate the validity of the included studies. Meta-analysis was not appropriate due to inadequate details in reporting the data in the included studies. Hence, qualitative synthesis and interpretation of the data were carried out. Two studies that met the inclusion criteria were included in the review. Fourteen studies were excluded. There were substantive within-study clinical heterogeneities with regard to the baseline tinnitus handicap scores, duration of tinnitus, and severity of hearing loss in the included double-blind RCTs. The authors of both studies reported that gabapentin was not superior to placebo in their primary outcomes. However, following the assessment of risk of bias and within-study clinical heterogeneities, this review concludes that there is insufficient evidence regarding the effect of gabapentin on tinnitus.

Full text: Headnote

Purpose: The main aim of this study was to assess the effect of gabapentin on tinnitus via a systematic review.
Method: An electronic search of literature as well as a hand search were conducted. Only double-blind randomized controlled trials (RCTs) that met all of the inclusion criteria were included in this review. The Cochrane Collaboration tool for risk of bias assessment was used to investigate the validity of the included studies. Meta-analysis was not appropriate due to inadequate details in reporting the data in the included studies. Hence, qualitative synthesis and interpretation of the data were carried out.
Results: Two studies that met the inclusion criteria were included in the review. Fourteen studies were excluded. There were substantive within-study clinical heterogeneities with regard to the baseline tinnitus handicap scores, duration of tinnitus, and severity of hearing loss in the included double-blind RCTs.
Conclusion: The authors of both studies reported that gabapentin was not superior to placebo in their primary outcomes. However, following the assessment of risk of bias and within-study clinical heterogeneities, this review concludes that there is insufficient evidence regarding the effect of gabapentin on tinnitus.
Key Words: tinnitus, gabapentin, systematic review, hearing impairment

Tinnitus is the sensation of sound in the ears or head without actual acoustic stimulation. Tinnitus is most commonly associated with hearing loss (Brunnberg, Lindén-Boström, &Berglund, 2008; Dias &Cordeiro, 2008; Hiller &Goebel, 2006; Mrena, Ylikoski, Mäkitie, Pirvola, &Ylikoski, 2007; Nondahl et al., 2002; Ratnayake, Jayarajan, &Bartlett, 2009). There is not a one-to-one relationship between tinnitus and hearing loss; many people with normal hearing have tinnitus, and many people with hearing loss do not experience tinnitus. Nevertheless, the relationship between tinnitus and hearing loss has widely been acknowledged (Bauer, Turner, Caspary, Myers, &Brozoski, 2008; Moffat et al., 2009; Moore, Vinay, &Sandhya, 2010; Nelson &Chen, 2004; Nicolas-Puel et al., 2002; Ochi, Ohashi, &Kenmochi, 2003; Parra &Pearlmutter, 2007; Surr, Montgomery, &Mueller, 1985; Temmel, Kierner, Steurer, Riedl, &Innitzer, 1999).

Development in the field of neurobiology in recent decades has enabled researchers to look for the cause of tinnitus by focusing on chemical transmission at synapses in the peripheral and central auditory nervous system. Gamma amino butyric acid (GABA) is the major inhibitory neurotransmitter throughout the central nervous system and is also expressed in the inner ear (Watanabe, Maemura, Kanbara, Tamayama, &Hayasaki, 2002). When GABA binds to the GABAA receptor, it opens the associated chloride (Cl-) channels and allows flow of Cl- into the neuron. Thus, GABA hyperpolarizes the neuronal membrane and makes the cell less reactive to the excitatory neurotransmitters.

A reduction in GABA levels in the inferior colliculus was documented following noise-induced hearing loss in rats (Milbrandt, Holder, Wilson, Salvi, &Caspary, 2000). Tinnitus has been hypothesized to be the result of spontaneous hyperactivity at one or multiple levels in the auditory pathway, and this means that reduction in GABA levels could theoretically result in increased spontaneous activity in the auditory pathway and contribute

to the sensation of tinnitus. Reduction in GABA was also found following salicylate-induced hearing loss (Bauer, Brozoski, Holder, &Caspary, 2000).

Gabapentin is an anticonvulsant that is thought to increase the synthesis of GABA from glutamate and increase the concentration of GABA in the brain (Taylor et al., 1998). The side effects of gabapentin are relatively less than for other GABAergic drugs. Shulman, Strashun, Seibyl, Daftary, and Goldstein (2000) reported a significant decrease in GABAA receptor density in the medial temporal cortex in six patients with severe disabling tinnitus and hearing loss. Following this observation, they suggested the use of gabapentin for patients with severe disabling tinnitus. Zapp (2001) reported that 500 mg/day of gabapentin helped a patient to be free of tinnitus approximately 23 days/month. Shulman, Strashun, and Goldstein (2002) reported an improvement in tinnitus in 19 out of 21 patients with severe disabling central tinnitus who took a combination of gabapentin and clonazepam. In an experimental study on rats, Bauer and Brozoski (2001) reported that gabapentin reduced tinnitus induced by acoustic trauma without affecting hearing or general psychological performance.

Despite the evidence for the efficacy of gabapentin in animal studies and human case studies (Bauer &Brozoski, 2001; Shulman et al., 2002), there have been conflicting results among the controlled trials. Randomized controlled trials (RCTs) are the design of choice for examining the efficacy of a given treatment, because nonrandomized studies may exaggerate the effects of the intervention by up to 40% (Schulz, 1995). Although several independent RCT studies have been conducted to assess the efficacy of gabapentin on tinnitus, incorporating their results into practice by clinicians has been limited for the following reasons: (a) There have been conflicting findings among different RCT studies on gabapentin and tinnitus; (b) there have been variations in the quality of the RCT studies on gabapentin and tinnitus, and thus their outcomes should be interpreted in light of their methodological limitations; and (c) there has been no systematic review of the literature to consider the totality of available evidence and increase the efficient access to evidence through synthesis of results from multiple studies (Green, 2005).

The aim of this study was to assess the effect of gabapentin on tinnitus via a systematic review.

Method

Study Selection Criteria

Studies were included in this review if they were doubleblind RCTs that investigated the effects of gabapentin on tinnitus. Given the susceptibility to several types of bias (e.g., selection bias and placebo effect), studies with other designs (e.g., nonrandomized, before-and-after comparisons, case reports, and clinical observations) were excluded from this review. This is consistent with guidelines produced by the Cochrane Collaboration which strongly recommend that only RCTs be included in a systematic review (Higgins &Altman, 2008).

Participants included patients experiencing tinnitus. Studies in which patients in the experimental intervention group received orally administered gabapentin (brand name Neurontin) and patients in the control group received a matched placebo were included.

The dosage and duration of treatment were not restricted for the following reasons:

1. The dosage for gabapentin is individualized and should be based on the patient's report of tinnitus or adverse reactions (Shulman, 2008).
2. Although it has been suggested that the most effective dose for tinnitus is between 1,800 and 2,400 mg/day, there is no set dose or duration for this drug (Bauer &Brozoski, 2006).
3. To avoid significant side effects, patients should be placed on an escalating dosage scale.
4. Gabapentin bioavailability is not dose proportional. This means that as the dose is increased, bioavailability decreases. Bioavailability of gabapentin is approximately 60%, 47%, 34%, 33%, and 27% following 900, 1,200, 2,400, 3,600, and 4,800 mg/day given in three divided doses, respectively (Pfizer, 2009). Another criterion for inclusion is for the studies to employ psychometrically validated tinnitus questionnaires as outcome measures.

Search and Identification of Studies

Electronic search. A search of literature was conducted utilizing the following resources: AMED (Allied and

Complementary Medicine Database; 1985 to October 2009); British Nursing Index (1985 to October 2009); CINAHL (Cumulative Index to Nursing and Allied Health Literature; 1981 to October 2009); Embase (1980 to October 2009); Health Business Elite; Medline (1950 to October 2009); PsycInfo (1985 to October 2009); HMIC (Health Management Information Consortium); the Cochrane Ear, Nose and Throat Disorders Group Trials Register; CENTRAL (the Cochrane Central Register of Controlled Trials; The Cochrane Library, current issue); ISRCTN (the International Standard Randomized Controlled Trial Number register of clinical trials); and ClinicalTrials.gov, which is a registry of federally and privately supported clinical trials conducted in the United States and around the world.

The search strategy used the terms tinnitus AND (gabapentin OR neurontin) in titles and abstracts. To maximize sensitivity, no filters were employed in the search.

Hand search of journals and grey literature. The hand search was conducted on the following books: Andersson, Baguley, McKenna, and McFerran (2005); Henry, Trune, Robb, and Jastreboff (2007); Jastreboff and Hazell (2004); Luxon, Furman, Martini, and Stephens (2003); and Sataloff, Dentchev, and Hawkshaw (2007).

In addition, the authors of the published trials on gabapentin and tinnitus were contacted to find any unpublished studies that had not been identified by the search of published literature.

Data Collection and Analysis

Study identification. The titles and abstracts of the articles retrieved using the search strategy were reviewed. Articles that failed to meet the inclusion criteria were not reviewed (see Table 1 for the details of the inclusion criteria). The full text of articles that could not be excluded based on their titles and abstracts was retrieved and reviewed by the first author. Only studies that met all of the inclusion criteria were included in the review.

Quality assessment. The Cochrane Collaboration tool for assessing risk of bias (Higgins &Altman, 2008) was used for quality assessment in the present systematic review. The quality assessment was conducted by the first author and reviewed by the second and third authors. The Cochrane Collaboration tool for assessing risk of bias is a domainbased evaluation in which critical assessments are made separately for (a) sequence generation, (b) allocation concealment, (c) blinding, (d) incomplete outcome data, (e) selective outcome reporting, and (f) other sources of bias. All of the items included in this tool are related to risk of bias and internal validity. The application of this tool involves the following steps:

1. For each domain, there is one entry for describing what was reported to have happened in the study.
2. The second part of the tool involves assigning a judgment relating to the risk of bias for that entry. This is achieved by answering prespecified questions that are about the adequacy of the study in relation to the entry. The judgment yes indicates low risk of bias, no indicates high risk of bias, and unclear indicates unclear or unknown risk of bias (Higgins &Altman, 2008).

Results

The Search Process

Figure 1 summarizes the search and retrieval process for articles to include in this systematic review. The search process identified 16 articles. Two studies that met the inclusion criteria were included in the review. Fourteen studies were excluded. Table 2 shows the characteristics of the excluded articles and the reasons for exclusion.

Description of the Included Studies

Witsell, Hannley, Stinnet, and Tucci (2007). This was a double-blind RCT of gabapentin versus placebo. Seventynine patients met the inclusion criteria and were enrolled (53 gabapentin and 26 in placebo group). No statistically significant difference in decline in the Tinnitus Handicap Inventory (THI; Newman, Jacobson, &Spitzer, 1996) scores was detected between gabapentin and placebo groups at the corresponding intervals. There were no statistically significant changes in the Profile of Mood States (McNair, Lorr, &Droppleman, 1992) by treatment group at the end of Week 4 or any other measured intervals. Using a 10-point Likert scale, patients

reported whether their tinnitus was the same, better, or worse at the end of Week 4. Eighteen patients in the gabapentin group reported improvement, whereas only one in the placebo group noted improvement.
Piccirillo, Finnell, Vlahiotis, Chole, and Spitznagel (2007). This was a double-blind RCT of gabapentin for tinnitus. A total of 135 subjects were enrolled in the study. The change in the THI score from baseline to Week 8 for the gabapentin group was 11.3 (SD = 16.4); for the placebo group, the change was 11.0 (SD = 16.4). The difference between the groups was not statistically significant. At the end of Week 8, participants were asked to describe their overall degree of life disturbance due to tinnitus, their overall impression of change in tinnitus, and whether they would recommend the product they received to a friend. There were no significant differences in responses to these three questions between subjects in the two treatment arms. Finally, there were no considerable differences in the change in Beck Depression Inventory, Brief Symptom Inventory, and Epworth Sleepiness Scale Score following the therapy between the gabapentin and placebo groups (D. Kallogjeri, personal communication, March 8, 2010).

Quality Assessment (Risk of Bias in Included Studies)

Witsell et al. (2007). As shown in Table 3, following the assessment of risk of bias, this study was judged to be at high risk of attrition bias and reporting bias. This seriously weakened confidence in the study's results. The reasons for attrition in this study were not reported (except for only one patient). If the reasons for attrition were reported and were balanced across the groups, then the review author could have assessed whether the important bias should be expected. However, incomplete reporting of reasons for missing outcomes prevented the review author from making such assessment. In addition, the authors reported that 10 more patients were lost to follow-up. However, they did not clarify whether the missing data were distributed equally between the groups. Therefore, the final number of participants who completed the trial in each group was not clear.
In this study, the mean THI scores and their standard deviations were not reported clearly. Given the extent of the inadequate details in reporting the data, it was impossible for the review author to compute the standard deviations and other data necessary for including this study in a meta-analysis. An unsuccessful attempt was made to contact the corresponding investigator to request the missing data.
Piccirillo et al. (2007). As shown in Table 4, following the assessment of risk of bias, this study was judged to be at low risk of bias. Selection bias is unlikely to have seriously altered their results because their participants were sequentially randomized in a double-blind fashion according to a computer-generated random code. In addition, allocation of gabapentin and placebo was adequately concealed, as the research pharmacist maintained the randomization schedule and prepared the gabapentin and placebo capsules for the entire study. Plausible performance bias is unlikely to have seriously altered their results because the knowledge of the allocated intervention was adequately prevented during the study through blinding of the participants and the researchers. Finally, this study was judged to have low risk of attrition bias and reporting bias.

Discussion

The present study was designed to assess the effect of gabapentin on tinnitus by conducting a systematic review of the available research literature. As discussed earlier, doubleblind RCT is the study design that has the least likelihood of introducing any biases that can influence the results. In addition, given the subjective nature of tinnitus, there is always a high risk of placebo effect in all kind of tinnitus therapies. Therefore, it was decided to only include doubleblind RCTs in this review. Two double-blind RCTs regarding the effect of gabapentin on tinnitus were included (Piccirillo et al., 2007; Witsell et al., 2007).
The primary outcome measure of the included studies was the change in the THI scores. Using this outcome measure, both studies concluded that gabapentin was not superior to placebo. Hence, the result of this systematic review suggests that there is insufficient evidence supporting the effectiveness of gabapentin for tinnitus. Although the initial intention was to perform a meta-analysis of the results, it became apparent that this might prove unsatisfactory due to methodological limitations and the extent of the inadequate details in reporting the data in the included studies.

There are five issues that need consideration in interpreting this finding:

1. Overall quality and applicability of evidence. Although the final conclusion of the included studies was not in favor of gabapentin therapy for tinnitus, their results should be interpreted in light of their methodological limitations. Following the risk of bias assessment, the study by Witsell et al. (2007) was judged to be at high risk of attrition bias and high risk of reporting bias. This seriously weakens confidence in their results.

2. Pretreatment THI scores. The pretreatment THI scores across the gabapentin and placebo groups were relatively low in both of the included studies, making it more difficult to detect a between-group difference. This also contradicts the recommendation by Shulman et al. (2000, 2002) of using gabapentin therapy for patients with "severe disabling" tinnitus. Witsell et al. (2007) did not define any threshold for individual THI score in their inclusion criteria. The mean pretreatment THI score for patients in the gabapentin group was 37.8 (SD = 23). This means that given the wide intersubject variability, as shown by the large standard deviation, they probably included patients with a variety of tinnitus handicap ranging from no handicap to severe handicap. In the second study (Piccirillo et al., 2007), 23 patients in the gabapentin group and 18 patients in the placebo group had a THI score less than 38.

3. Large intersubject variability in tinnitus duration. There was a large intersubject variability in tinnitus duration (the length of time that a person hears tinnitus) among the subjects included in these two double-blind RCTs. In the study by Witsell et al. (2007), the inclusion criterion for tinnitus duration was tinnitus lasting more than 3 months. In the study by Piccirillo et al. (2007), the inclusion criterion associated with tinnitus duration was tinnitus lasting more than 6 months. The distribution of tinnitus duration in Piccirillo et al. (2007) ranged from 1 to 55 years. The subgroup analysis using two-factor repeated-measures analyses of variance did not show any correlation between duration of tinnitus and efficacy of gabapentin. However, lack of significant correlation in the subgroup analyses should be interpreted with caution, as the statistical power to detect a real difference is usually diminished when many subgroups are examined.

Although the relation between tinnitus duration and the extent of cortical reorganization is vague, many scientists suggest that on top of the modifications of the tonotopic map which occur immediately after peripheral damage, there are changes in the auditory cortex that take place over time (e.g., long-term synaptic potentiation or axonal sprouting; Bauer, 2004; Noreña &Eggermont, 2003; Noreña, Tomita, &Eggermont, 2003). Schlee, Hartmann, Langguth, and Weisz (2009) reported that people whose tinnitus lasted less than 4 years had marked changes in magneto-encephalography activity over the temporal cortex on the left side. However people whose tinnitus lasted longer than 4 years presented changes across a more widespread network of brain areas. This may have some clinical implications. For instance, it is possible that larger cortical reorganization subsequent to a longlasting tinnitus may be more difficult to modulate by treatment with gabapentin in comparison with less extensive cortical reorganization associated with a recent tinnitus. Therefore, lack of statistically significant improvement following gabapentin therapy in the included studies may in fact be related to the large intersubject variability in tinnitus duration.

4. Large intersubject variability in hearing levels. Loss of inhibition in the auditory cortex and down regulation of GABA is expected to happen following a peripheral deafferentation. In the animal studies that supported the effectiveness of gabapentin, tinnitus coexisted with hearing impairment that was caused directly by acoustic trauma. In addition, Bauer and Brozoski (2006) reported that gabapentin was effective in reducing tinnitus loudness and annoyance in some individuals with acoustic trauma-induced hearing loss presenting an audiogram notch between 3 and 6 kHz. Therefore, restoring GABA activity via gabapentin may be effective only in a subpopulation of tinnitus patients exhibiting some forms of hearing impairment. However, the majority of participants in Witsell et al. (2007) and Piccirillo et al. (2007) had normal hearing or mild hearing loss. This might have contributed to the lack of therapeutic effect of gabapentin on tinnitus that was reported in these studies.

5. Insensitive outcome measures. The outcome measures used in the included studies may not be sensitive enough or responsive to the prospective changes in tinnitus following a drug therapy. The primary outcome

measure at both studies included in this review was the change in the THI scores. The THI is a 25-item self-report questionnaire that assesses the impact of the tinnitus on the sufferer's life (i.e., tinnitus handicap). However, tinnitus handicap is not directly related to the severity or loudness of tinnitus (Budd &Pugh, 1996; Delb, D'Amelio, Schonecke, &Iro, 1999). This may explain the conflicting results reported by Witsell et al. (2007). In their study, there was no significant difference in the change in overall THI scores between the gabapentin and placebo groups. However, 18 patients in the gabapentin group reported improvement in their tinnitus, whereas only one in the placebo group noted improvement. This observation led Witsell et al. (2007) to conclude that the THI might not be sensitive or responsive enough to detect a measurable improvement in tinnitus levels. Piccirillo et al. (2007) also reported that the change in THI score in response to gabapentin in normal hearing subjects was not supported by other outcome measures such as the global rating of response or satisfaction with care. This observation led them to conclude that "the response to gabapentin, as measured by the THI score, does not reflect a true effect" (p. 397).

Implication for Practice

This systematic review of the literature from 1950 to October 2009 revealed that there are two double-blind RCT studies regarding the effect of gabapentin on tinnitus. The authors of both studies (Piccirillo et al., 2007; Witsell et al., 2007) reported that gabapentin was not superior to placebo in improving THI scores. As a result, it was concluded that there is insufficient evidence that gabapentin is effective for tinnitus.

Implication for Research

To accurately evaluate the effect of gabapentin on tinnitus, further studies with placebo-controlled RCT design are required. An important point to consider is the possibility that restoring GABA activity via gabapentin may be effective only in a subpopulation of tinnitus patients exhibiting some forms of hearing impairment. The efficacy of gabapentin in people with tinnitus with a duration of less than 4 years or even in people with recent tinnitus (duration less than 3 months) should also be addressed. While the link between tinnitus duration and cortical reorganization is debatable, it is possible that larger cortical reorganization may be more difficult to modulate by treatment with gabapentin in comparison with less extensive cortical reorganization. The effect of gabapentin on tinnitus itself and not on tinnitus handicap should be further investigated, though it will be harder to prove. A potential reduction in tinnitus loudness following gabapentin therapy may not necessarily have an effect on tinnitus handicap. There is little correlation between tinnitus loudness and the impact of tinnitus on daily life as measured by the THI (Ward &Baumann, 2009). Therefore, it is recommended that clinical trials should include a number of validated tinnitus questionnaires to assess the effect of interventions on tinnitus. In future studies, priority should be given to develop and use the outcome measurement tools that are responsive to the changes in tinnitus which may occur following a drug therapy.

Conclusions

Two double-blind RCTs were included in this systematic review of literature. The primary outcome measure used in the included studies was the change in the THI scores. The authors of both studies found that gabapentin was not superior to placebo in their primary outcomes. Following the assessment of risk of bias, the study by Witsell et al. (2007) was judged to be at high risk of attrition bias and reporting bias, and the study by Piccirillo et al. (2007) was judged to have low risk bias. Therefore, there is insufficient evidence supporting the effectiveness of gabapentin for tinnitus. This result should not be misinterpreted as evidence for the "ineffectiveness" of gabapentin for tinnitus.

Acknowledgments

This study was part of the first author's master of science (MSc) dissertation at the University of Bristol. We would like to thank Shahrzad Aazh, Helen Pryce, Pete Roberts, Deepak Prasher, and James Lockley for their support throughout the MSc program. We thank Jay F. Piccirillo for providing additional data concerning the Piccirillo et al. (2007) RCT on the effect of gabapentin on tinnitus. Finally, we thank Brian C. J. Moore for his valuable comments on an earlier version of this article.

Sidebar

Am J Audiol 2011;20;151-158; originally published online Sep 22, 2011;
DOI: 10.1044/1059-0889(2011/10-0041)

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Editor: Sheila Pratt
Associate Editor: Dana Boatman
Received October 11, 2010
Accepted July 1, 2011
DOI: 10.1044/1059-0889(2011/10-0041)

Publication date: Dec 1, 2011

Year: 2011

Audiovisual Cues and Perceptual Learning of Spectrally Distorted Speech

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Publication info: Language and Speech 54 (Dec 2011): 487-97.

Abstract: Two experiments investigate the effectiveness of audiovisual (AV) speech cues (cues derived from both seeing and hearing a talker speak) in facilitating perceptual learning of spectrally distorted speech. Speech was distorted through an eight channel noise-vocoder which shifted the spectral envelope of the speech signal to simulate the properties of a cochlear implant with a 6 mm place mismatch. Experiment 1 found that participants showed significantly greater improvement in perceiving noise-vocoded speech when training gave AV cues than when it gave auditory cues alone. Experiment 2 compared training with AV cues with training which gave written feedback. These two methods did not significantly differ in the pattern of training they produced. Suggestions are made about the types of circumstances in which the two training methods might be found to differ in facilitating auditory perceptual learning of speech. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract

Two experiments investigate the effectiveness of audiovisual (AV) speech cues (cues derived from both seeing and hearing a talker speak) in facilitating perceptual learning of spectrally distorted speech. Speech was distorted through an eight channel noise-vocoder which shifted the spectral envelope of the speech signal to simulate the properties of a cochlear implant with a 6 mm place mismatch. Experiment 1 found that participants showed significantly greater improvement in perceiving noise-vocoded speech when training gave AV cues than when it gave auditory cues alone. Experiment 2 compared training with AV cues with training which gave written feedback. These two methods did not significantly differ in the pattern of training they produced. Suggestions are made about the types of circumstances in which the two training methods might be found to differ in facilitating auditory perceptual learning of speech.

Keywords

audiovisual, perceptual learning, speech

1 Introduction

As we speak we produce movements in our jaw, lips, and tongue that are easily perceptible to the eye. This visual speech information gives useful sensory cues that help decode the speech that we hear, particularly in terms of features such as place of articulation, rounding, and stress (Summerfield, 1987; Dohen et al., 2004; Munhall et al., 2004). As a consequence of this, audiovisual (AV) speech, speech where a talker is both seen and heard, tends to be more perceptible than speech where the talker can only be heard. The advantages in perceiving AV speech over unimodal auditory speech are most apparent when the heard speech is either impoverished or distorted in some way (Erber, 1975; MacLeod &Summerfield, 1987; Gagné et al., 1994; Helfer &Freyman, 2005). However, advantages for AV speech presentation have been documented even under ideal listening conditions (e.g., Davis &Kim, 2004).

The visual cues in AV speech influence how speech is perceived. Such effects are demonstrated by the McGurk effect (McGurk &MacDonald, 1976; Munhall et al., 1996). In this phenomenon certain incongruent auditory and visual speech tokens, e.g., auditory /ba/; visual /ga/, when presented simultaneously, result in a percept which is a fusion of the two modalities, e.g., /ta/. Evidence suggests that this integration of visual and auditory speech cues occurs at a relatively early stage of perceptual processing (Green, 1997; Schwartz et al., 2004), and that it is largely obligatory (Soto-Faraco et al., 2004).

AV cues can also play a role in speech learning. In infants AV cues have been shown to facilitate discrimination of auditory speech contrasts (Teinonen et al., 2008). In adult populations AV cues have been shown to facilitate learning of phonetic contrasts in L2 learners of English when the contrast is one which was absent in the native language and where the contrast produces visually salient movements for English speakers (Hazan et al., 2005;

see also Hardison, 2003). Another area of perceptual learning in which AV cues might play a role is in learning to comprehend speech which has altered characteristics. Noise-vocoded speech is one particular form of altered speech which is of particular scientific interest. This is speech which has properties which reflect those of natural speech when heard through a cochlear implant device (Dorman et al., 1998). The noise-vocoding process retains the coarser spectral and temporal properties of speech while removing its finer spectro-temporal structure. For normal hearing listeners the intelligibility of this speech is partly determined by the number of frequency bands used in its production (Shannon et al., 1995). These individual bands can be considered analogous to the independent electrode channels in an implant device. If at least eight bands are used the speech can be intelligible almost immediately, even to a naïve listener. If only four or fewer bands are used then initial speech intelligibility can be rather low, but is usually improved by training (Davies et al., 2005; Hervais-Adelman et al., 2008; Rota et al., 2008).

The implant electrodes of a cochlear implant device can be inserted only part way into the cochlea. This means that the band limits of the speech-processor analysis filter driving the electrode tend to be mismatched to the characteristic frequency of the primary auditory nerve fibers which are stimulated by the electrode (see Shannon et al., 1998). The spectral envelope of noise-vocoded speech can also be shifted to simulate this basalward shift of excitation that is thought to be common with cochlear implants. The change in timbre resulting from this additional transformation of the speech signal has a generally negative effect on perceptibility. Negative effects are found on the initial intelligibility of upward shifted speech even if it is constructed using a sufficient number of bands for the unshifted speech to be readily intelligible (Dorman et al., 1997; Shannon et al., 1998; Stacey &Summerfield, 2007). However, as with unshifted speech, perceptibility is often dramatically improved when training is given (Rosen et al., 1999; Fu &Galvin, 2003; Fu et al., 2006; Stacey &Summerfield, 2007, 2008).

Rosen et al. (1999) investigated learning of this shifted noise-vocoded speech in a study which gave participants access to AV cues during training. In this study participants were trained using a connected discourse tracking task in which they attempted to repeat segments of spoken text in communication with a talker in a separate booth who could be seen (through a glass screen) but whose speech was only heard through a noise-vocoding circuit. This training was effective in improving purely auditory recognition of the altered speech: Before training participants could identify less than one percent of the keywords by ear alone in an initial test block of sentences; after twelve sessions of training they could identify nearly forty percent of the keywords. Though these effects are impressive the main object of the study was not to assess the value of AV cues in auditory learning. As a consequence of this no control training condition was given from which the specific benefit of AV cues could be determined. The current paper aims to determine the effectiveness of AV cues in driving auditory learning of spectrally altered speech. This is done by comparing training with AV cues against training conditions which are auditory only (AO) in nature. The effectiveness of training in promoting learning of spectrally distorted speech is measured by the change in performance on AO test blocks given before and after training. Experiment 1 compared the effectiveness of three training conditions: AV, AO, and AO-Natural. AV training consisted of exposure to spectrally distorted auditory speech accompanied by a video of the face of the talker producing the original speech. AO training consisted of exposure to spectrally distorted auditory speech without the video. Finally, AO-Natural training consisted of exposure to auditory presentations of natural (i.e., undistorted) speech, also without the video.

2 Experiment 1

2.1 Method

2.1.1 Participants. Forty-two participants were recruited from the student population of the University of Nottingham. Participants were paid £10 for their time. All were English native speakers. All had normal hearing (pure-tone detection threshold levels of more than 25 dB in a range of 250 to 8000 Hz) and normal, or corrected-to-normal, vision (20/20 acuity on a Snellen test). None had formerly taken part in any study involving

either perceptual learning or exposure to spectrally distorted speech.

2.1.2 Stimuli and equipment. A single male talker with a southern British accent was video recorded uttering the sentences of the BKB sentence battery (Bench et al., 1979). BKB sentences have a simple vocabulary and their use in measuring speech perceptibility is well established. Sentences contain 3 to 4 keywords (e.g., the orange is quite sweet; rain falls from the clouds). Recordings were made in a sound attenuated room. The talker was recorded using a Sony DSR200AP digital camcorder. Video was recorded at a sample rate of 25 frames-per-second and audio at 48 kHz. The camcorder was placed 1.5 m from the talker's face. The talker's face was filmed from the front with a white screen as background. Three lamps were positioned to illuminate the face in a way in which shadowing did not occur. Auditory speech was captured by a microphone attached below the talker's face and out of sight of the camera. The talker began each sentence from a neutral facial expression with both lips held together. Recordings were edited offline into separate clips of each sentence using video editing software (Final Cut Pro 4, Apple Inc., CA). During editing a 1000 ms still frame was placed at the beginning and end of each clip. This still frame was given a 500 ms fade in/out from black. The audio track was cleaned of any background noise using the noise removal algorithm in Audacity software V1.2.6 (Mazzoni et al., 2006). Routines written in Matlab were used to produce the noise-vocoding and spectral shifting of the auditory speech. The technique used was similar to that described by Rosen et al. (1999). The auditory signal was first filtered through eight sixth-order elliptical IIR input filters. Filtered waveforms were half-wave-rectified and low-pass filtered (160 Hz). Envelopes were then multiplied by low-pass filtered (10 kHz) white noise. The signal from each of the channels was then filtered by eight sixth-order elliptical IIR output filters with central frequencies which had been shifted upwards to simulate a 6 mm basilar membrane displacement. The range and central frequencies of the individual input and output frequencies are given in Table 1. The eight channels were then summed into a single digital waveform. The output auditory waveform was resynchronized with the video recording to create the AV stimulus materials for the experiment. Resynchronization of the output waveform was done by manually matching the start and end points of this waveform with that of the original recorded auditory waveform in the video file. This was done within the video editing software earlier described. After synchronization was completed the original clean auditory waveform was deleted from the video file to leave the noise-vocoded auditory waveform. This version of the audiovisual file was then converted to Apple QuickTime format for use in the experiment. The experiment was performed on a G4 Apple Macintosh computer. Video was displayed on a Macintosh plasma VDU. Sound was presented through a separate loudspeaker connected to the computer via an amplifier. Software routines written in SuperCard (V. 4.1.1, Solutions Etcetera, CA) controlled all aspects of trial randomization, stimulus presentation, and recording of typed responses. Participants typed in responses using a standard Macintosh computer keyboard. These were recorded onto the computer's hard-disk. For all participants, an initial highly intelligible noise-vocoded sentence (24 frequency bands and no frequency shift) was given as an initial practice trial. This was done to familiarize participants with the task and to ensure that the instructions were understood correctly.

2.1.3 Procedure. Experiment 1 consisted of three trial blocks, Pretraining, Training, and Posttraining. All blocks contained 76 sentences. Sentences were allocated to blocks pseudorandomly with the constraint that no sentence appeared in more than one block and that blocks all had an equal number of keywords (235). Within each block no sentence was ever repeated. Randomization of the sentence materials was done separately for each participant. All participants performed the same Pretraining and Posttraining blocks which functioned as test blocks. Participants were randomly assigned in equal numbers to one of three training groups: AV, AO, AO-Natural. For test and training blocks participants were required to listen to the speech (while also looking at the screen in the AV training condition) and type as much of each sentence as was understood into the computer using the keyboard. Participants were encouraged to guess if unsure. If they did not understand anything from a particular sentence they were told to type "I don't know". Participants pressed the return key to record their responses into the computer. The pressing of this key instigated the next trial after a 1000 ms blank interval. No

feedback was given on any trial. A five minute break was given between successive blocks.

2.2 Results and discussion

A loose-keyword scoring method (Bench et al., 1979) was used to determine performance in each block. In this method each correct keyword receives a single point, irrespective of the order that words are reported in and morphological errors are accepted as correct. The total number of keywords correct was calculated for each participant using the above criteria. Mean scores in each block are given in Table 2. These are given separately for each of the three training groups. The fourth column of this table shows the mean improvement for the three training groups calculated by subtracting the performance in the Pretraining block from that of the Posttraining block.

For the training blocks analysis showed that the number of correctly reported keywords was significantly higher in the AV condition than the AO training condition, $t(26) = 5.54$, $p < .001$; however AV training block performance was still lower than performance in the AO-Natural training block, $t(26) = 5.33$, $p < .001$. A one-way ANOVA was used to look at test block performance. This ANOVA compared the mean test improvement scores (i.e., Posttest minus Pretest) for the three training groups. This showed a significant effect of training group, $F(2, 39) = 10.7$, $p < .001$. Post-hoc testing (Studentized Newman-Keuls) indicated that this effect was the result of the AV trained group showing greater improvement across the test blocks than either the AO and AO-Natural training groups ($p < .05$); the AO and AO-Natural training groups did not differ statistically in the level of improvement produced after training ($p > .05$).

Thus, Experiment 1 showed that AV training was more effective than AO training in promoting learning of spectrally altered speech. It suggested that exposure to AV speech can drive learning at an auditory perceptual level. Experiment 2 further explored this AV training effect.

3 Experiment 2

In Experiment 1 training was evaluated only across performance on two test blocks presented before and after a single block of training. The results from this experiment therefore give little indication of the time course that training might take. Experiment 2 gave shorter but more frequent alternating training and test blocks throughout the experiment. This allowed a more continuous monitoring of the effect of training on the auditory learning of speech. Experiment 2 also had a second purpose. Previous studies have demonstrated that perceptual learning of speech can be facilitated by presenting written feedback alongside auditory speech (Davis et al., 2005; Stacey &Summerfield, 2007, 2008). Written feedback seems to benefit auditory perceptual learning because of the lexical cues it provides: no effect of written feedback is found when training uses non-word speech (Davis et al., 2005; cf. Hervais-Adelman et al., 2008).

Experiment 2 compared the AV training effect identified in Experiment 1 with training using written feedback (AO+Text). The AV and AO+Text training groups were both compared against an AO training group given as a baseline training condition. As in Experiment 1 the AO training group received only auditory speech on training blocks. The effectiveness of training was measured by changes in test block performance over the course of the experiment. Test blocks were presented as AO for all three training groups.

3.1 Method

3.1.1 Participants. Forty-five students of the University of Nottingham were selected using the same inclusion criteria as Experiment 1. Participants all received a payment of £10. No participant had taken part in Experiment 1. Participants were allocated in equal numbers to one of the three training groups using a randomization procedure.

3.1.2 Stimuli. Stimuli were recordings of BKB sentences. Recordings were of the same origin as Experiment 1: 285 recorded sentences were used, 145 of these sentences were allocated as test trial stimuli and 140 of the sentences were used as training stimuli.

3.1.3 Procedure. Training and test blocks each contained five sentences. As in Experiment 1 randomization of sentences into the test blocks was done separately for each participant. This was done with the constraint that

no sentence was presented twice to a participant and that the five sentences in each test block always contained 15 keywords. The AO and AV training trials were the same as described for Experiment 1. The AO+Text training consisted of presentations of the distorted speech simultaneously with the text of the sentence being displayed on screen. Text was presented in uppercase at 45 point in Helvetica Neue font. This text scrolled across the computer screen word by word moving from right to left. The presentation of the words was at a rate which approximated that in the recorded speech of the talker. The first block was a test block. After this alternating training and test blocks were given. The last block was also a test block. In all 28 training and 29 test blocks were given. On all trials participants were instructed to type as much as they could decipher from the presented sentence into the computer.1 They were encouraged to guess if unsure and told to type "I don't know" on trials where they were unable to guess anything of the sentence content. No break was given between any blocks though participants were informed that they could have a break at any point in the experiment by delaying pressing the return key after typing in their response to a trial. A practice sentence was given to the participant before starting the experiment as described in Experiment 1.

3.2 Results and discussion

The same loose-keyword scoring method was used as in Experiment 1. Table 3 gives the mean overall number of keywords correctly identified in each test block for the three training groups. Figure 1 shows a plot of the number of keywords recognized for individual test blocks for the three training groups.

The three groups did not initially statistically differ from one another in terms of performance on the first test block, $F(2, 42) = 2.76$, $MSE = 1.29$, $p > .05$. Performance in subsequent test blocks was analyzed by organizing the test blocks into four separate bins. The first bin contained test blocks 2-8, the second contained blocks 9-15, the third blocks 16-22, and the fourth blocks 23-29. These were then entered into a two-way mixed ANOVA, with training condition as a three-level independent factor (AO, AV, AO+Text), and training duration as a four-level related factor (bin 1, bin 2, bin 3, bin 4). There was a significant main effect of training condition, $F(2, 42) = 7.14$, $MSE = 26.30$, $p < .01$, and a significant linear main effect of training duration, $F(1, 42) = 40.63$, $MSE = 3.42$, $p < .001$. There was no significant interaction between the main effects $F(2, 42) = 0.52$, $MSE = 3.42$, $p > .05$. Post-hoc testing (Studentized Newman-Keuls) of the training condition main effect revealed that test performance with AO-distorted training was significantly poorer than with AV-distorted or AO+Text training. However, AV and AO+Text trained groups did not differ from each other statistically in test performance in this analysis ($p > .05$).

The absence of a significant interaction between the main effects suggests that differences in performance between the training groups occurred during the initial training blocks and that these differences were then maintained across the rest of the experiment. This interpretation is supported by observation of the plots of the individual test trials in Figure 1. It can be seen that, for all three training groups, the most rapid performance increases occur in the initial test blocks and begin to asymptote in later test blocks.

4 General discussion

Experiments 1 and 2 both demonstrate the effectiveness of AV training in facilitating perceptual learning of spectrally altered speech. One question concerns how this facilitation occurs. When the auditory system first encounters spectrally altered speech it presumably has some difficulty in identifying its phonetic structure: The features of the incoming speech will differ somewhat from those of stored phonetic representations. Visual speech cues may assist in this process. Visual speech contains perceptually salient cues about the phonetic structure of auditory speech, cues which tend to anticipate their occurrence in the auditory signal (Grant et al., 1998; Hazen, 2006). It has been suggested that these cues can operate by constraining the phonetic categorization of speech, for instance if speech is being articulated on the lips this indicates that a given sound is a bilabial consonant such as /p/, /b/ or /m/ (see van Wassenhove et al., 2005). By constraining the phonetic interpretation of the auditory signal in this way visual cues might simultaneously provide guidance to auditory learning mechanisms in adjusting to the characteristics of the speech. This additional guidance is likely to make

learning more successful than when the perceiver must rely on auditory cues alone. Experiment 2 also showed that AO training with written feedback produced greater learning than observed with AO speech alone, replicating several earlier findings (e.g., Davis et al., 2005; Stacey &Summerfield, 2007). This form of training was equally as successful as AV training in facilitating perceptual learning of the given speech. The two forms of training are similar in as much as they both give additional visually presented cues to disambiguate the altered speech. At a phenomenal level both methods produce an immediate improvement in the perceived clarity of the speech heard on training trials (an effect with written feedback described as "pop-out", Davis et al., 2005). However, while written feedback is thought to give top-down lexical information, visual speech is more likely to give cues which are largely bottom-up and sensory in nature. Our experiment suggests that, under the specific conditions of our experiment at least, top-down lexical guidance is as effective as guidance from visual sensory cues in facilitating auditory learning.

This similarity in the effectiveness of the two training methods is likely to be coincidental and is unlikely to hold under all circumstances. The time course of perceptual learning for noise-vocoded speech tends to be longer when the speech is created from fewer than the eight bands used in the current study. With four band noise-vocoded speech, Rosen et al. (1999) found that learning continued to some degree over sessions spanning a number of days. The two training methods may be found to differ if the auditory speech is constructed from fewer bands under conditions where learning is more protracted. It is known that AV cues benefit speech perception across a wide range of auditory conditions, even where only minimal auditory speech cues are available (e.g., Erber, 1975; Saldaña et al., 1996). It is quite possible that written feedback is more limited in the range in which it is able to guide speech perception mechanisms. To test this, further research is needed to assess the relative effectiveness of the two training methods over a varied range of noise-vocoded speech conditions. There are other factors which may be of differential importance to the two training methods. Compared to written feedback the effectiveness of AV training is likely to be more dependent on the characteristics of the talker used. It is known that talkers vary considerably in the visual intelligibility of the speech they produce (Kricos &Lesner, 1982; Lesner, 1988; Demorest &Bernstein, 1992; Daly et al., 1996). Relative to written feedback training, AV training will probably be less effective with a talker with low visual speech intelligibility. Finally, the choice of speech materials themselves might influence the relative effectiveness of the two training methods. Written feedback training depends on the lexicality of the training speech materials, no training effect occurs when the items are non-words (Davies et al., 2005). If, as suggested above, AV training depends only on sensory cues then facilitation should be found even with non-word speech materials. AV training should drive perceptual learning just as well with non-word speech materials as with speech consisting of meaningful sentences.

Further research is clearly required to understand the different circumstances in which AV speech and written text are effective. What can be concluded from the current study is that AV speech cues, at least under some circumstances, are as effective as written feedback in driving perceptual learning. Practical suggestions can be made about how this form of training might be incorporated in a clinical context. Children who are prelingually deafened often have poor reading skills, possibly as a result of a less comprehensive understanding of grapheme-phoneme relations (e.g., James et al., 2008). However, such children when fitted with implants still derive considerable immediate benefits from access to AV cues when listening to speech (Bergeson et al., 2005). Such individuals may therefore find greater benefit from training which utilizes AV cues than training which is reliant on the presentation of text or on auditory presentations alone. Research is needed which evaluates the usefulness of AV training in comparison to other methods in the context of cochlear implant rehabilitation.

5 Conclusion

AV training was shown to reliably facilitate learning of spectrally distorted speech. It is suggested that this effect is driven by bottom-up sensory guidance of auditory learning mechanisms. Under the circumstances tested AV

training was at least as effective as training giving written feedback. Further research in both normal hearing and clinical populations is needed to determine the conditions under which the two methods are most useful in facilitating learning of this speech.

Acknowledgements

Some of these data were presented at the BSA meeting Cambridge, UK, 14-15 September (2006) and at AVSP (Hilvarenbeek, Netherlands, 2007). The first author is now at Oxford Brookes University, Headington, Oxford, UK. The comments of Andrew Faulkner and one anonymous referee on previous versions of this paper are gratefully acknowledged.

Footnote

Note

1 For the training trials of the AO+Text condition this was a trivial task because participants were being presented with the sentence contents in the form of the presented text. However, by giving this task it ensured that they did attend to the written cues as they were presented on each training trial.

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Publication date: Dec 2011

Year: 2011

Taking of Marine Mammals Incidental to Specified Activities; U.S. Marine Corps Training Exercises at Air Station Cherry Point

Publication info: The Federal Register / FIND 76. 223. (Nov 18, 2011).
ProQuest document link

Abstract (Abstract): Notice; proposed incidental harassment authorization; request for comments.
RIN Number: "RIN 0648-XA800"
Citation: "76 FR 71535"
Page Number: "71535"
"Notices"
SUMMARY: NMFS has received an application from the U.S. Marine Corps (USMC) requesting authorization to take marine mammals incidental to various training exercises at Marine Corps Air Station (MCAS) Cherry Point Range Complex, North Carolina. The USMC's activities are considered military readiness activities pursuant to the Marine Mammal Protection Act (MMPA), as amended by the National Defense Authorization Act (NDAA) for Fiscal Year 2004. Pursuant to the MMPA, NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to the USMC to take bottlenose dolphins (Tursiops truncatus), by Level B harassment only, from specified activities.

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DATES: Comments and information must be received no later than December 19, 2011.

ADDRESSES: Comments on the application should be addressed to Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3225. The mailbox address for providing email comments is ITP.Laws@noaa.gov. NMFS is not responsible for email comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 10-megabyte file size.

Instructions: All comments received are a part of the public record and may be posted to http://www.nmfs.noaa.gov/pr/permits/incidental.htm without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

A copy of the application containing a list of the references used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (see FOR FURTHER INFORMATION CONTACT), or visiting the Internet at: http://www.nmfs.noaa.gov/pr/permits/incidental.htm. The following associated document is also available at the same Internet address: Environmental Assessment MCAS Cherry Point Range Operations (USMC 2009). Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for certain subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as: "An impact resulting from the specified activity that cannot be reasonably expected to, and is

not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization.

The NDAA (Pub. L. 108-136) removed the "small numbers" and "specified geographical region" limitations and amended the definition of "harassment" as it applies to a "military readiness activity" to read as follows (Section 3(18)(B) of the MMPA):

(i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Summary of Request

On September 22, 2011, NMFS received an application from the USMC requesting an IHA for the harassment of Atlantic bottlenose dolphins (Tursiops truncatus) incidental to air-to-surface and surface-to-surface training exercises conducted around two bombing targets (BTs) within southern Pamlico Sound, North Carolina, at MCAS Cherry Point. NMFS first issued an IHA to the USMC for the same activities that was valid for a period of one year, beginning December 1, 2011 (75 FR 72807; November 26, 2010).

Weapon delivery training would occur at two BTs: Brant Island Target (BT-9) and Piney Island Bombing Range (BT-11). Training at BT-9 would involve air-to-surface (from aircraft to in-water targets) and surface-to-surface (from vessels to in-water targets) warfare training, including bombing, strafing, special (laser systems) weapons; surface fires using non-explosive and explosive ordnance; and mine laying exercises (inert). Training at BT-11 would involve air- to-surface exercises to provide training in the delivery of conventional (non-explosive) and special (laser systems) weapons. Surface-to-surface training by small military watercraft would also be executed here. The types of ordnances proposed for use at BT-9 and BT-11 include small arms, large arms, bombs, rockets, missiles, and pyrotechnics. All munitions used at BT-11 are inert, practice rounds. No live firing occurs at BT-11. Training for any activity may occur year-round. Active sonar is not a component of these specified training exercises; therefore, discussion of marine mammal harassment from active sonar operations is not included within this notice.

Description of the Specified Activity

The USMC is requesting authorization to harass bottlenose dolphins from ammunition firing conducted at two BTs within MCAS Cherry Point. The authorization would be valid for a period of one year from the date of issuance. The BTs are located at the convergence of the Neuse River and Pamlico Sound, North Carolina. BT-9 is a water-based target located approximately 52 km (28 nautical miles [nm]) northeast of MCAS Cherry Point. The BT-9 target area ranges in depth from 1.2 m to 6.1 m, with the shallow areas concentrated along the Brandt Island Shoal (which runs down the middle of the restricted area in a northwest to southeast orientation). The target itself consists of three ship hulls grounded on Brant Island Shoals, located approximately 4.8 km (3 miles [mi]) southeast of Goose Creek Island. Inert (non-explosive) ordnance up to 454 kilograms (kg) (1,000 lbs) and live (explosive) ordnance up to 45.4 kg (100 lbs) TNT equivalent, including ordnance released during strafing, are authorized for use at this target range. The target is defined by a 6 statute-mile (SM) diameter prohibited area designated by the U.S. Army Corps of Engineers, Wilmington District (33 CFR 334.420). Non-military vessels are not permitted within the prohibited area, which is delineated by large signs located on pilings surrounding the perimeter of the BT. BT-9 also provides a mining exercise area; however, all mine exercises

are simulation only and do not involve detonations. BT-9 standard operating procedures limit live ordnance deliveries to a maximum explosive weight of 100 lbs TNT equivalent. The USMC estimates that it would conduct approximately 1,539 aircraft-based and 165 vessel-based sorties, annually, at BT-9. The standard sortie consists of two aircraft per bombing run or an average of two and maximum of six vessels.

BT-11 is a 50.6 square kilometers (sq km) (19.5 square miles [sq mi]) complex of land- and water-based targets on Piney Island. The BT-11 target area ranges in depth from 0.3 m along the shoreline to 3.1 m in the center of Rattan Bay (BA 2001). The in-water stationary targets of BT-11 consist of a barge and patrol (PT) boat located in roughly the center of Rattan Bay. The barge target is approximately 135 ft by 40 ft in dimension. The PT boat is approximately 110 ft by 35 ft in dimension. Water depths in the center of Rattan Bay are estimated as 2.4 to 3 m (8 to 10 ft) with bottom depths ranging from 0.3 to 1.5 m (1 to 5 ft) adjacent to the shoreline of Piney Island. A shallow ledge, with substrate expected to be hard-packed to hard bottom, surrounds Piney Island. No live firing occurs at BT-11; all munitions used are inert, non-explosive practice rounds. Only 36 percent of all munitions fired at BT-11 occur over water; the remaining munitions are fired to land based targets on Piney Island. The USMC estimates that it would conduct approximately 6,727 aircraft-based and 51 vessel-based sorties, annually, at BT-11.

All inert and live-fire exercises at MCAS Cherry Point ranges are conducted so that all ammunition and other ordnances strike and/or fall on the land or water based target or within the existing danger zones or water restricted areas. A danger zone is a defined water area that is closed to the public on an intermittent or full-time basis for use by military forces for hazardous operations such as target practice and ordnance firing. A water restricted area is a defined water area where public access is prohibited or limited in order to provide security for Government property and/or to protect the public from the risks of injury or damage that could occur from the government's use of that area (33 CFR 334.2). Surface danger zones are designated areas of rocket firing, target practice, or other hazardous operations (33 CFR 334.420). The surface danger zone (prohibited area) for BT-9 is a 4.8 km radius centered on the south side of Brant Island Shoal. The surface danger zone for BT-11 is a 2.9 km radius centered on a barge target in Rattan Bay.

According to the application, the USMC is requesting take of marine mammals incidental to specified activities at MCAS Cherry Point Range Complex, located within Pamlico Sound, North Carolina. These activities include gunnery; mine laying; bombing; or rocket exercises and are classified into two categories here based on delivery method: (1) Surface-to-surface gunnery and (2) air-to-surface bombing. Exercises may occur year round, day or night (approximately 15 percent of training occurs at night).

Surface-to-Surface Gunnery Exercises

Surface-to-surface fires are fires from boats at sea to targets at sea. These can be direct (targets are within sight) or indirect (targets are not within sight). Gunnery exercise employing only direct fire is the only category of surface-to-surface activity currently conducted within the MCAS Cherry Point BTs. An average of two and maximum of six small boats (24-85 ft), or fleet of boats, typically operated by Special Boat Team personnel, use a machine gun to attack and disable or destroy a surface target that simulates another ship, boat, swimmer, floating mine or near shore land targets. Vessels travel between 0-20 kts with an average of two vessels actually conducting surface-to-surface firing activities. Typical munitions are 7.62 millimeter (mm) or .50 caliber (cal) machine guns; and/or 40 mm Grenade machine guns. This exercise is usually a live-fire exercise, but at times blanks may be used so that the boat crews can practice their ship handling skills. The goal of training is to hit the targets; however, some munitions may bounce off the targets and land in the water or miss the target entirely. Additionally, G911 Concussion hand grenades (inert and live) are used; however, these are not aimed at targets, as the goal is to learn how to throw them into the water.

The estimated amount of munitions expended at BT-9 and BT-11 during this training can be found in Table 1 below. Historically, boat sorties have been conducted at BT-9 and BT-11 year round with equal distribution of training effort throughout the seasons. Live fires constitute approximately 90 percent of all surface-to-surface

gunnery events. The majority of sorties originated and practiced at BT-9 as no live fire is conducted at BT-11. The USMC has indicated a comparable number of sorties would occur throughout the IHA timeframe. There is no specific schedule associated with the use of ranges by the small boat teams. However, exercises tend to be scheduled for 5-day blocks with exercises at various times throughout that timeframe. There is no specific time of year or month training occurs as variables such as deployment status, range availability, and completion of crew specific training requirements influence schedules.

A number of different types of boats are used during surface-to-surface exercises depending on the unit using the boat and their mission and include versions of Small Unit River Craft, Combat Rubber Raiding Craft, Rigid Hull Inflatable Boats, Patrol Craft. They are inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion. Boat crews approach, at a maximum of 20 kts, and engage targets simulating other boats, swimmers, floating mines, or near shore land targets with 7.62 mm or .50 cal machine guns; 40 mm grenade machine guns; or M3A2 Concussion hand grenades (approximately 200, 800, 10, and 10 rounds respectively). Vessels typically travel in linear paths and do not operate erratically. Other vessels may be located within the BTs; however, these are support craft and do not participate in munitions expenditures. The purpose of the support craft is to remotely control High Speed Maneuvering Surface Targets (HSMSTs) or to conduct maintenance on electronic equipment located in the towers at BT-9. Support craft are typically anchored or tied to marker pilings during HSMST operations or tied to equipment towers. When underway, vessels do not typically travel faster than 12-18 kts or in an erratic manner.

_____Table_1--Type_and_Amount_of_Munitions_Expended_at_BT-9_and_BT-11_During
_____Surface-to-Surface_Exercises
Range_____Annual_number_of___Munitions_type_____Munitions
_____sorties__*1_____expended
_____annually
BT-9_____165_____5.56_mm_____1,468
_____7.62_mm_____218,500
_____.50_cal_____166,900
_____40_mm_____15,734
_____Grenade--Inert
_____40_mm_____9,472
_____Grenade--Live_(HE)
_____G911_Grenade_____144
BT-11_____51_____7.62_mm_____44,100
_____.40_cal_____4,600
_____40_mm_____1,517
_____Grenade--Inert
_____40_mm_____9

_____Illumination-Inert
____*1_Sorties_are_from_FY_2007_CURRS_data.

Air-to-Surface

Air-to-surface training involves ordnance delivered from aircraft and aimed at targets on the water's surface or on land in the case of BT-11. A description of the types of targets used at MCAS Cherry Point is provided in the section on BTs above. There are four types of air-to-surface activities conducted within the MCAS Cherry Point BTs: Mine laying; bombing; gunnery or rocket exercises which are carried out via fixed wing or rotary wing aircraft.

Mine Laying Exercises

Mine Warfare (MIW) includes the strategic, operational, and tactical use of mines and mine countermine measures. MIW is divided into two basic subdivisions: (a) The laying of mines to degrade the enemy's capabilities to wage land, air, and maritime warfare, and (b) the countering of enemy-laid mines to permit friendly maneuver or use of selected land or sea areas (DoN, 2007). MCAS Cherry Point would only engage in mine laying exercises as described below. No detonations of any mine device are involved with this training. During mine laying, a fixed-wing or maritime patrol aircraft (P-3 or P-8) typically drops a series of about four inert mine shapes in an offensive or defensive pattern, making multiple passes along a pre-determined flight azimuth, and dropping one or more shapes each time. Mine simulation shapes include MK76, MK80 series, and BDU practice bombs ranging from 25 to 2,000 pounds in weight, There is an attempt to fly undetected to the area where the mines are laid with either a low or high altitude tactic flight. The shapes are scored for accuracy as they enter the water and the aircrew is later debriefed on their performance. The training shapes are inert (no detonations occur) and expendable. Mine laying operations are regularly conducted in the water in the vicinity of BT-9.

Bombing Exercises

The purpose of bombing exercises is to train pilots in destroying or disabling enemy ships or boats. During training, fixed wing or rotary wing aircraft deliver bombs against surface maritime targets at BT-9 or BT-11, day or night, using either unguided or precision-guided munitions. Unguided munitions include MK-76 and BDU-45 inert training bombs, and MK-80 series of inert bombs (no cluster munitions authorized). Precision-guided munitions consist of laser-guided bombs (inert) and laser-guided training rounds (inert). Typically, two aircraft approach the target (principally BT-9) from an altitude of approximately 914 m (3,000 ft) up to 4,572 m (15,000 ft) and, when on an established range, the aircraft adhere to designated ingress and egress routes. Typical bomb release altitude is 914 m (3,000 ft) for unguided munitions or above 4,572 m (15,000 ft) and in excess of 1.8 km (1 nm) for precision-guided munitions. However, the lowest minimum altitude for ordnance delivery (inert bombs) would be 152 m (500 ft).

Onboard laser designators or laser designators from a support aircraft or ground support personnel are used to illuminate certified targets for use when using laser guided weapons. Due to target maintenance issues, live bombs have not been dropped at the BT-9 targets for the past few years although these munitions are authorized for use. For the effective IHA timeframe, no live bombs would be utilized. Live rockets and grenades; however, have been expended at BT-9.

Air-to-Surface bombing exercises have the potential to occur on a daily basis. The standard sortie consists of two aircraft per bombing run. The frequency of these exercises is dependent on squadron level training requirements, deployment status, and range availability; therefore, there is no set pattern or specific time of year or month when this training occurs. Normal operating hours for the range are 0800-2300, Monday through Friday; however, the range is available for use 365 days per year.

Rocket Exercises

Rocket exercises are carried out similar to bombing exercises. Fixed- and rotary-wing aircraft crews launch

rockets at surface maritime targets, day and night, to train for destroying or disabling enemy ships or boats. These operations employ 2.75-inch and 5-inch rockets.

The average number of rockets delivered per sortie is approximately 14. As with the bombing exercise, there is no set level or pattern of amount of sorties conducted.

Gunnery Exercises

During gunnery training, fixed- and rotary-wing aircraft expend smaller munitions targeted at the BTs with the purpose of hitting them. However, some small arms may land in the water. Rotary wing exercises involve either CH-53, UH-1, CH-46, MV-22, or H-60 rotary-wing aircraft with mounted 7.62 mm or .50 cal machine guns. Each gunner expends approximately 800 rounds of 7.62 mm and 200 rounds of .50 cal ammunition in each exercise. These may be live or inert.

Fixed wing gunnery exercises involve the flight of two aircraft that begin to descend to the target from an altitude of approximately 914 meters (m) (3,000 feet [ft]) while still several miles away. Within a distance of 1,219 m (4,000 ft) from the target, each aircraft fires a burst of approximately 30 rounds before reaching an altitude of 305 m (1,000 ft), then breaks off and repositions for another strafing run until each aircraft expends its exercise ordnance allowance of approximately 250 rounds. In total, about 8-12 passes are made by each aircraft per exercise. Typically these fixed wing exercise events involve an F/A-18 and AH-1 with Vulcan M61A1/A2, 20 mm cannon; AV-8 with GAU-12, 25 mm cannon.

Munition Descriptions

A complete list of the ordnance authorized for use at BT-9 and BT-11 can be found in Tables 2 and 3, respectively. There are several varieties and net explosive weights (for live munition used at BT-9) can vary according to the variety. All practice bombs are inert and used to simulate the same ballistic properties of service type bombs. They are manufactured as either solid cast metal bodies or thin sheet metal containers. Since practice bombs contain no explosive filler, a practice bomb signal cartridge (smoke) is used for visual observation of weapon target impact. Practice bombs provide a low cost training device for pilot and ground handling crews. Due to the relatively small amount of explosive material in practice bombs (small signal charge), the availability of ranges for training is greatly increased.

When a high explosive detonates, it is converted almost instantly into a gas at very high pressure and temperature. Under the pressure of the gases thus generated, the weapon case expands and breaks into fragments. The air surrounding the casing is compressed and shock (blast) wave is transmitted into it. Typical initial values for a high-explosive weapon are 200 kilobars of pressure (1 bar = 1 atmosphere) and 5,000 degrees Celsius. There are five types of explosive sources used at BT-9: 2.75" Rocket High Explosives, 5" Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. No live munitions are used at BT-11.

_____Table_2--Description_of_Munitions_Used_at_BT-9
Ordnance_____Description_____Net_explosive_weight
MK76_Practice_Bomb_____25-pound_teardrop-shaped__(of_signal_cartridge)
(inert)_____cast_metal_bomb,_with_a___varies,_maximum_0.083800
_____bore_tube_for_____lbs.
_____installation_of_a_signal
_____cartridge
BDU_33_Practice_Bomb_____Air_Force_MK_76_practice__same_as_above.

(inert)_____bomb
BDU_48_Practice_Bomb_____10-pound_metal_____same_as_above.
(inert)_____cylindrical_bomb_body
_____with_a_bore_tube_for
_____installation_of_a_signal
_____cartridge
BDU_45_Practice_Bomb_____500-pound_metal_bomb_____(of_signal_cartridges,
(inert)_____either_sand_or_water_____total_0.1676_lbs.
_____filled._Two_signal
_____cartridges
BDU_50_Practice_Bomb_____500-pound_metal_bomb_____same_as_above.
(inert)_____either_sand_or_water
_____filled._Two_signal
_____cartridges
MK_81_Practice_Bomb_____250-pound_bomb_____0.
(inert)
MK_82_Practice_Bomb_____500-pound_bomb_____0.
(inert)
MK_83_Practice_Bomb_____1000-pound_bomb_____0.1676_lbs.
(inert)_____configured_like_BDU_45
MK_84_Practice_Bomb_____2000-pound_bomb_____0.1676_lbs.
(inert)_(special_____configured_like_BDU_45
exception_use_only)
2.75-inch_(inert)_____Unguided_2.75-inch_____0.
_____diameter_rocket
5-inch_Zuni_(inert)_____Unguided_5-inch_diameter__0.
_____rocket
5-inch_Zuni_(live)_____Unguided_5-inch_diameter__15_lbs.
_____rocket
2.75wp_(inert)_____2.75-inch_rocket_____0.
_____containing_white
_____phosphorous

2.75HE_____High_Explosive,_2.75-inch_4.8_lbs.
_____rocket
0.50_cal_(inert)_____Machine_gun_rounds_____0.
7.62_mm_(inert)
20_mm_(inert)
25mm_(inert)
30_mm_(inert)
40_mm_(inert)
25_mm_HE_(live)_____High_Explosive_____0.269_lbs.
_____Incendiary,_Live_machine
_____gun_rounds
Self_Protection_Flare_____Aerial_flare_____0.
Chaff_____18-pound_chaff_canister___0.
LUU-2_____30-pound_high_intensity___0.
_____illumination_flare
Laser_Guided_Training_____89-pound_inert_training___0.
Round_(LGTR)_(inert)_____bomblet
_____Table_3--Description_of_Munitions_Used_at_BT-11
Ordnance_____Description
MK76_Practice_Bomb_____25-pound_teardrop-shaped_cast_metal
_____bomb_body,_with_a_bore_tube_for
_____installation_of_a_signal_cartridge.
BDU_33_Practice_Bomb_____Air_Force_designation_for_MK_76
_____practice_bomb.
BDU_48_Practice_Bomb_____10-pound_metal_cylindrical_bomb_body
_____with_a_bore_tube_for_installation_of_a
_____signal_cartridge.
BDU45_Practice_Bomb_____500-pound_metal_bomb_body_either_sand
_____or_water_filled._Configured_with
_____either_low_drag_conical_tail_fins_or
_____high_drag_tail_fins_for_retarded
_____weapons_delivery._Two_signal

_____cartridges_installed.
MK_81_Practice_Bomb_____250-pound_inert_bomb.
MK_82_Practice_Bomb_____500-pound_inert_bomb.
2.75-inch_____Unguided_2.75_inch_diameter_rocket.
5-inch_Zuni_____5_inch_diameter_rocket.
WP-2.75-inch_____White_phosphorous_7-pound_rocket.
0.50_cal_____Inert_machine_gun_rounds
7.62_mm
5.56_mm
20_mm
30_mm
40_mm
TOW_____Wire_guided_56-pound_anti-tank
_____missile.
Self_Protection_Flare._____Aerial_flare.
SMD_SAMS_____1.5-pound_smoking_flare.
LUU-2_____30-pound_high-intensity_illumination
_____flare.
Laser_Guided_Training_Round_(LGTR)_____89-pound_inert_training_bomblet.

The amounts of all ordnance to be expended at BT-9 and BT-11 (both surface-to-surface and air-to-surface) are 897,932 and 1,109,955 rounds, respectively (see Table 4 and 5 below).

_____Table_4--Amount_of_Live_and_Inert_Munitions_Expended_at_BT-9_Per_Year
Proposed_munitions_Proposed_total_____Proposed_number_of_Net_explosive
_*1_____number_of_rounds___explosive_rounds___weight_(lb)
_____having_an_impact
_____on_the_water
Small_Arms_Rounds__525,610_____N/A_____N/A
Excluding_.50_cal
.50_Cal_____257,067_____N/A_____N/A
Large_Arms_____12,592_____30mm_HE:_3,120_____0.1019
Rounds--Live_____40mm_HE:_9,472_____0.1199
Large_Arms_____93,024_____N/A_____N/A

Rounds--Inert
Rockets--Live_____241_____2.75'_Rocket:_184__4.8
_____5'_Rocket:_57_____15.0
Rockets--Inert____703_____N/A_____N/A
Bombs_and_____144_____G911_Grenade:_144__0.5
Grenades--Live
Bombs_and_____4,055_____N/A_____N/A
Grenades--Inert
Pyrotechnics_____4,496_____N/A_____N/A
Total_____897,932_____12,977_____N/A
____*1_Munitions_may_be_expended_from_aircraft_or_small_boats.
_____Table_5--Amount_of_Inert_Munitions_Expended_at_BT-11
Proposed_munitions__*1_____Proposed_total_number_of_rounds__*2
Small_Arms_Rounds_Excluding_.50_Cal____507,812
.50_Cal_____326,234
Large_Arms_Rounds_____240,334
Rockets_____4,549
Bombs_and_Grenades_____22,114
Pyrotechnics_____8,912
Total_____1,109,955
____*1_Munitions_may_be_expended_from_aircraft_or_small_boats.
____*2_Munitions_estimated_using_FY_2007_CURRS_data_on_a_per_sortie-operation_basis.

Description of Marine Mammals in the Area of the Specified Activity

Forty marine mammal species occur within the nearshore and offshore waters of North Carolina; however, the majority of these species are solely oceanic in distribution. Only one marine mammal species, the bottlenose dolphin, has been repeatedly sighted in Pamlico Sound, while an additional species, the endangered West Indian manatee (Trichechus manatus), has been sighted rarely (Lefebvre et al., 2001; DoN 2003). The U.S. Fish and Wildlife Service oversees management of the manatee; therefore, authorization to harass manatees would not be included in any NMFS' authorization and will not be discussed further.

No sightings of the endangered North Atlantic right whale (Eubalaena glacialis) or other large whales have been observed within Pamlico Sound or in vicinity of the BTs (Kenney 2006). No suitable habitat exists for these species in the shallow Pamlico Sound or BT vicinity; therefore, whales would not be affected by the specified activities and will not be discussed further. Other dolphins, such as Atlantic spotted (Stenella frontalis) and common dolphins (Delphinus delphis), are oceanic in distribution and do not venture into the shallow, brackish waters of southern Pamlico Sound. Therefore, the specified activity has the potential to affect one marine mammal species under NMFS' jurisdiction: the bottlenose dolphin.

Coastal (or nearshore) and offshore stocks of bottlenose dolphins in the Western North Atlantic can be distinguished by genetics, diet, blood characteristics, and outward appearance (Duffield et al., 1983; Hersh and Duffield, 1990; Mead and Potter, 1995; Curry and Smith, 1997). Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott et al., 1988). However, re-analysis of stranding data (McLellan et al., 2003) and extensive analysis of genetic, photo-identification, satellite telemetry, and stable isotope studies demonstrate a complex mosaic of coastal bottlenose dolphin stocks (NMFS 2001) which may be migratory or resident (they do not migrate and occur within an area year round). Four out of the seven designated coastal stocks may occur in North Carolina waters at some part of the year: The Northern Migratory stock (NM; winter); the Southern Migratory stock (SM; winter); the Northern North Carolina Estuarine stock (NNCE; resident, year round); and the more recently identified Southern North Carolina Estuarine stock (SNCE; resident, year round). Stable isotope depleted oxygen signature (hypoxic conditions routinely develops during summer in North Carolina waters) (Cortese, 2000), satellite telemetry, and photo-identification (NMFS, 2001) support stock structure analysis. Dolphins encountered at the BTs likely belong to the NNCE and SNCE stock; however, this may not always be the case. NMFS' 2010 stock assessment report provides further detail on stock delineation. All stocks discussed here are considered depleted (and thus strategic) under the MMPA (Waring et al., 2010).

NMFS provides abundance estimates for the four aforementioned migratory and resident coastal stocks in its 2010 stock assessment report. The best available abundance estimate for the NNCE stock is the combined abundance from estuarine (Read et al., 2003) and coastal (aerial survey data dating from 2002) waters. This combined estimate is 1,387 (Waring et al., 2010). Similarly, the best available abundance estimate for the SNCE stock is the combined abundance from estuarine and coastal waters. This combined estimate is 2,595 (Waring et al., 2010). The best abundance estimate for the NM stock, resulting from 2002 aerial surveys, is 9,604 (Waring et al., 2010). Using the same information, the resulting best abundance estimate for the SM stock is 12,482 (Waring et al., 2010).

From July 2004 through April 2006, the NMFS' SEFSC conducted 41 aerial surveys to document the seasonal distribution and estimated density of sea turtles and dolphins within Core Sound and portions of Pamlico Sound, and coastal waters extending one mile offshore (Goodman et al., 2007). Pamlico Sound was divided into two survey areas: western (encompassing BT-9 and BT-11) and eastern (including Core Sound and the eastern portion of restricted air space R-5306). In total, 281 dolphins were sighted in the western range. To account for animals likely missed during sightings (i.e., those below the surface), Goodman et al. (2007) estimate that, in reality, 415 dolphins were present. Densities for bottlenose dolphins in the western part of Pamlico Sound were calculated to be 0.0272/km ^{2} in winter; 0.2158/km^2 in autumn; 0.0371/km^2 in summer; and 0.0946/km^2 in summer (Goodman et al., 2007). Dolphins were sighted throughout the entire range when mean sea surface temperature (SST) was 7.60 [degrees] C to 30.82 [degrees] C, with fewer dolphins sighted as water temperatures increased. Like in Mayer (2003), dolphins were found in higher numbers around BT-11, a range where no live firing occurs.

In 2000, Duke University Marine Lab (DUML), conducted a boat-based mark-recapture survey throughout the estuaries, bays and sounds of North Carolina (Read et al., 2003). This summer survey yielded a dolphin density of 0.183/km^2 (0.071 mi^2) based on an estimate of 919 dolphins for the northern inshore waters divided by an estimated 5,015 km^2 (1,936 mi^2) survey area. Additionally, from July 2002-June 2003, the USMC supported DUML to conduct dolphin surveys specifically in and around BT-9 and BT-11. During these surveys, one sighting in the restricted area surrounding BT-9 and two sightings in proximity to BT-11 were observed, as well as seven sightings in waters adjacent to the BTs. In total, 276 bottlenose dolphins were sighted ranging in group size from two to 70 animals with mean dolphin density in BT-11 more than twice as large as the density of any of the other areas; however, the daily densities were not significantly different (Maher, 2003). Estimated dolphin

density at BT-9 and BT-11 based on these surveys were calculated to be 0.11 dolphins/km ^{2} , and 1.23 dolphins/km^2 , respectively, based on boat surveys conducted from July 2002 through June 2003 (excluding April, May, Sept. and Jan.). However, the USMC choose to estimate take of dolphins based on the higher density reported from the summer 2000 surveys (0.183/km^2). Although the aerial surveys were conducted year round and therefore provide for seasonal density estimates, the average year-round density from the aerial surveys is 0.0936, lower than the 0.183/km^2 density chosen to calculate take for purposes of this MMPA authorization. Additionally, Goodman et al. (2007) acknowledged that boat based density estimates may be more accurate than the uncorrected estimates derived from the aerial surveys.

In Pamlico Sound, bottlenose dolphins concentrate in shallow water habitats along shorelines, and few, if any, individuals are present in the central portions of the sounds (Gannon, 2003; Read et al., 2003a, 2003b). The dolphins utilize shallow habitats, such as tributary creeks and the edges of the Neuse River, where the bottom depth is less than 3.5 m (Gannon, 2003). Fine-scale distribution of dolphins seems to relate to the presence of topography or vertical structure, such as the steeply-sloping bottom near the shore and oyster reefs, which may be used to facilitate prey capture (Gannon, 2003). Results of a passive acoustic monitoring effort conducted from 2006-2007 by Duke University researchers validated this information. Vocalizations of dolphins in the BT-11 vicinity were higher in August and September than vocalization detection at BT-9, an open water area (Read et al., 2007). Additionally, detected vocalizations of dolphins were more frequent at night for the BT-9 area and during early morning hours at BT-11.

Unlike migrating whales which display strong temporal foraging and mating/birthing periods, many bottlenose dolphins in Pamlico Sound are residents and mate year round. However, dolphins in the southeast U.S. do display some reproductive seasonality. Based on neonate stranding records, sighting data, and births by known females, the populations of dolphins that frequent the North Carolina estuarine waters have calving peaks in spring but calving continues throughout the summer and is followed by a smaller number of fall births (Thayer et al., 2003).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks have a dominant frequency range of 110 to 130 kiloHertz (kHz) and a source level of 218 to 228 dB re 1 [mu]Pa (peak-to-peak) (Au, 1993) and 3.4 to 14.5 kHz at 125 to 173 dB re 1 [mu]Pa (peak-to-peak) (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fish, specifically sea trout (Salmo trutta) and Atlantic salmon (Salmo salar), in some regions (i.e., Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutierrez and Stienessen, 2004; Cook et al., 2004).

Potential Effects on Marine Mammals

As mentioned previously, with respect to military readiness activities, Section 3(18)(B) of the MMPA defines "harassment" as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine

mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

The USMC has concluded that harassment to marine mammals may occur incidental to munitions firing noise and pressure at the BTs. These military readiness activities would result in increased noise levels, explosions, and munition debris within bottlenose dolphin habitat. NMFS also considered the potential for harassment from vessel and aircraft operation. NMFS' analysis of potential impacts from these factors, including consideration of the USMC's analysis in its application, is outlined below.

Anthropogenic Sound

Marine mammals respond to various types of anthropogenic sounds introduced in the ocean environment. Responses are highly variable and depend on a suite of internal and external factors which in turn results in varying degrees of significance (NRC, 2003; Southall et al., 2007). Internal factors include: (1) Individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; (2) past exposure of the animal to the noise, which may lead to habituation or sensitization; (3) individual noise tolerance; and (4) demographic factors such as age, sex, and presence of dependent offspring. External factors include: (1) Non-acoustic characteristics of the sound source (e.g., if it is moving or stationary); (2) environmental variables (e.g., substrate) which influence sound transmission; and (3) habitat characteristics and location (e.g., open ocean vs. confined area). To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to ambient noise levels and the species' hearing sensitivity range. That is, if the frequency of an introduced sound is outside of the species' frequency hearing range, it cannot be heard. Similarly, if the frequency is on the upper or lower end of the species hearing range, the sound must be louder in order to be heard.

Marine mammal responses to anthropogenic noise are typically subtle and can include visible and acoustic reactions such as avoidance, altered dive patterns and cessation of pre-exposure activities and vocalization reactions such as increasing or decreasing call rates or shifting call frequency. Responses can also be unobservable, such as stress hormone production and auditory trauma or fatigue. It is not always known how these behavioral and physiological responses relate to significant effects (e.g., long-term effects or individual/population consequences); however, individuals and populations can be monitored to provide some insight into the consequences of exposing marine mammals to noise. For example, Haviland-Howell et al. (2007) compared sighting rates of bottlenose dolphins within the Wilmington, NC stretch of the Atlantic Intracoastal Waterway (ICW) on weekends, when recreational vessel traffic was high, to weekdays, when vessel traffic was relatively minimal. The authors found that dolphins were less often sighted in the ICW during times of increased boat traffic (i.e., on weekends) and theorized that because vessel noise falls within the frequencies of dolphin communication whistles and primary energy of most fish vocalizations, the continuous vessel traffic along that stretch of the ICW could result in social and foraging impacts. However, the extent to which these impacts affect individual health and population structure is unknown.

A full assessment of marine mammal responses and disturbances when exposed to anthropogenic sound can be found in NMFS' proposed rulemaking for the Navy Cherry Point Range Complex (74 FR 11057, March 16, 2009). That rulemaking was made final on June 15, 2009 (74 FR 28370). In summary, sound exposure may result in physiological impacts, stress responses, and behavioral responses which could affect proximate or ultimate life functions. Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The ultimate life functions are those that enable an animal to contribute to the population (or stock, or species, etc.).

I. Physiology-Hearing Threshold Shift

In mammals, high-intensity sound may rupture the eardrum, damage the small bones in the middle ear, or over

stimulate the electromechanical hair cells that convert the fluid motions caused by sound into neural impulses that are sent to the brain. Lower level exposures may cause a loss of hearing sensitivity, termed a threshold shift (TS) (Miller, 1974). Incidence of TS may be either permanent, referred to as permanent threshold shift (PTS), or temporary, referred to as temporary threshold shift (TTS). The amplitude, duration, frequency, and temporal pattern, and energy distribution of sound exposure all affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, generally, so does the amount of TS and recovery time. Human non-impulsive noise exposure guidelines are based on exposures of equal energy (the same SEL) producing equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH 1998). Until recently, previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall et al., 2007). Three newer studies, two by Mooney et al. (2009a, 2009b) on a single bottlenose dolphin either exposed to playbacks of Navy MFAS or octave-band noise (4-8 kHz) and one by Kastak et al. (2007) on a single California sea lion exposed to airborne octave-band noise (centered at 2.5 kHz), concluded that for all noise exposure situations the equal energy relationship may not be the best indicator to predict TTS onset levels. Generally, with sound exposures of equal energy, those that were quieter (lower sound pressure level [SPL]) with longer duration were found to induce TTS onset more than those of louder (higher SPL) and shorter duration (more similar to noise from AS Cherry Point exercises). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter et al., 1966; Ward, 1997). Additionally, though TTS is temporary, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). However, these studies highlight the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts.

PTS consists of non-recoverable physical damage to the sound receptors in the ear, which can include total or partial deafness, or an impaired ability to hear sounds in specific frequency ranges; PTS is considered Level A harassment. TTS is recoverable and is considered to result from temporary, non-injurious impacts to hearing-related tissues; TTS is considered Level B harassment.

Permanent Threshold Shift

Auditory trauma represents direct mechanical injury to hearing related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory trauma is irreversible and considered to be an injury that could result in PTS. PTS results from exposure to intense sounds that cause a permanent loss of inner or outer cochlear hair cells or exceed the elastic limits of certain tissues and membranes in the middle and inner ears and result in changes in the chemical composition of the inner ear fluids. In some cases, there can be total or partial deafness across all frequencies, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges. There is no empirical data for onset of PTS in any marine mammal, and therefore, PTS- onset must be estimated from TTS-onset measurements and from the rate of TTS growth with increasing exposure levels above the level eliciting TTS-onset. PTS is presumed to be likely if the hearing threshold is reduced by >/= 40 dB (i.e., 40 dB of TTS). Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals.

Temporary Threshold Shift

TTS is the mildest form of hearing impairment that can occur during exposure to a loud sound (Kryter, 1985). Southall et al. (2007) indicate that although PTS is a tissue injury, TTS is not because the reduced hearing sensitivity following exposure to intense sound results primarily from fatigue, not loss, of cochlear hair cells and supporting structures and is reversible. Accordingly, NMFS classifies TTS as Level B Harassment, not Level A Harassment (injury); however, NMFS does not consider the onset of TTS to be the lowest level at which Level B

Harassment may occur (see III. Behavior section below).

Southall et al. (2007) considers a 6 dB TTS (i.e., baseline hearing thresholds are elevated by 6 dB) sufficient to be recognized as an unequivocal deviation and thus a sufficient definition of TTS onset. TTS in bottlenose dolphin hearing have been experimentally induced. For example, Finneran et al. (2002) exposed a trained captive bottlenose dolphin to a seismic watergun simulator with a single acoustic pulse. No TTS was observed in the dolphin at the highest exposure condition (peak: 207 kPa [30psi]; peak-to-peak: 228 dB re: 1 microPa; SEL: 188 dB re 1 microPa ^{2} -s). Schludt et al. (2000) demonstrated temporary shifts in masked hearing thresholds in five bottlenose dolphins occurring generally between 192 and 201 dB rms (192 and 201 dB SEL) after exposure to intense, non-pulse, 1-s tones at, 3kHz, 10kHz, and 20 kHz. TTS onset occurred at mean sound exposure level of 195 dB rms (195 dB SEL). At 0.4 kHz, no subjects exhibited threshold shifts after SPL exposures of 193dB re: 1 microPa (192 dB re: 1 microPa ^{2} -s). In the same study, at 75 kHz, one dolphin exhibited a TTS after exposure at 182 dB SPL re: 1 microPa but not at higher exposure levels. Another dolphin experienced no threshold shift after exposure to maximum SPL levels of 193 dB re: 1 microPa at the same frequency. Frequencies of explosives used at MCAS Cherry Point range from 1-25 kHz; the range where dolphin TTS onset occurred at 195 dB rms in the Schludt et al. (2000) study.

Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). For example, Nachtigall et al. (2003) measured TTS in a bottlenose dolphin and found an average 11 dB shift following a 30 minute net exposure to OBN at a 7.5 kHz center frequency (max SPL of 179 dB re: 1 microPa; SEL: 212-214 dB re: 1 microPa ^{2} -s). No TTS was observed after exposure to the same duration and frequency noise with maximum SPLs of 165 and 171 dB re: 1 microPa. After 50 minutes of exposure to the same 7.5 kHz frequency OBN, Natchigall et al. (2004) measured a 4-8 dB shift (max SPL: 160dB re 1microPa; SEL: 193-195 dB re:1 microPa ^{2} -s). Finneran et al. (2005) concluded that a sound exposure level of 195 dB re 1 [mu]Pa2-s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

II. Stress Response

An acoustic source is considered a potential stressor if, by its action on the animal, via auditory or non-auditory means, it may produce a stress response in the animal. Here, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS) or the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer, 2005). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipids for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones, predominantly cortisol in mammals. The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal's life history stage (e.g., neonate, juvenile, adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. The stress response may or may not result in a behavioral change, depending on the characteristics of the exposed animal. However, provided a stress response occurs, we assume that some contribution is made to the animal's allostatic load. Any immediate effect of exposure that produces an injury is assumed to also produce a stress response and contribute to the allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield, 2003). If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, we assume that the exposure does not contribute to the allostatic load. Additionally, without a stress response or

auditory masking, it is assumed that there can be no behavioral change.

III. Behavior

Changes in marine mammal behavior in response to anthropogenic noise may include altered travel directions, increased swimming speeds, changes in dive, surfacing, respiration and feeding patterns, and changes in vocalizations. As described above, lower level physiological stress responses could also co-occur with altered behavior; however, stress responses are more difficult to detect and fewer data exist relative to specific received levels of sound.

Acoustic Masking

Anthropogenic noise can interfere with, or mask, detection of acoustic signals such as communication calls, echolocation, and environmental sounds important to marine mammals. Southall et al. (2007) defines auditory masking as the partial or complete reduction in the audibility of signals due to the presence of interfering noise with the degree of masking depending on the spectral, temporal, and spatial relationships between signals and masking noise, as well as the respective received levels. Masking of sender communication space can be considered as the amount of change in a sender's communication space caused by the presence of other sounds, relative to a pre-industrial ambient noise condition (Clark et al., in press). Unlike auditory fatigue, which always results in a stress response because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response, depending on the degree and duration of the masking effect. Masking may also result in a unique circumstance where an animal's ability to detect other sounds is compromised without the animal's knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case, the change in behavior is the lack of a response that would normally be made if sensory impairment did not occur. For this reason, masking also may lead directly to behavior change without first causing a stress response. Projecting noise into the marine environment which causes acoustic masking is considered Level B harassment as it can disrupt natural behavioral patterns by interrupting or limiting the marine mammal's receipt or transmittal of important information or environmental cues. To compensate for masking, marine mammals, including bottlenose dolphins, are known to increase their levels of vocalization as a function of background noise by increasing call repetition and amplitude, shifting calls higher frequencies, and/or changing the structure of call content (Lesage et al., 1999; Scheifele et al., 2005; McIwem, 2006).

While it may occur temporarily, NMFS does not expect auditory masking to result in detrimental impacts to an individual's or population's survival, fitness, or reproductive success. Dolphins are not confined to the BT ranges; allowing for movement out of area to avoid masking impacts. The USMC would also conduct visual sweeps of the area before any training exercise and implement training delay mitigation measures if a dolphin is sighted within designated zones (see Proposed Mitigation Measures section below). As discussed previously, the USMC has been working with DUML to collect baseline information on dolphins in Pamlico Sound, specifically dolphin abundance and habitat use around the BTs. The USMC has also recently accepted a DUML proposal to investigate methods of dolphin acoustic detection around the BTs. NMFS would encourage the USMC to expand acoustic investigations to include the impacts of training exercises on vocalization properties (e.g., call content, duration, frequency) and masking (e.g., communication and foraging impairment) of the affected population of dolphins in Pamlico Sound.

Assessment of Marine Mammal Impacts From Explosive Ordnances

MCAS Cherry Point plans to use five types of explosive sources during its training exercises: 2.75" Rocket High Explosives, 5" Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. The underwater explosions from these weapons would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. The shock wave and blast noise are of most concern to marine animals. In general, potential impacts from explosive detonations can range from brief effects (such as short term behavioral disturbance),

tactile perception, physical discomfort, slight injury of the internal organs and the auditory system, to death of the animal (Yelverton et al., 1973; O'Keeffe and Young, 1984; DoN, 2001).

Explosives produce significant acoustic energy across several frequency decades of bandwidth (i.e., broadband). Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band. The effects of an underwater explosion on a marine mammal depend on many factors, including the size, type, and depth of both the animal and the explosive charge; the depth of the water column; and the standoff distance between the charge and the animal, as well as the sound propagation properties of the environment. The net explosive weight (or NEW) of an explosive is the weight of TNT required to produce an equivalent explosive power. The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss). USMC conservatively estimates that all explosives would detonate at a 1.2 m (3.9 ft) water depth. This is the worst case scenario as the purpose of training is to hit the target, resulting in an in-air explosion.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. The maximum firing time is 10-15 second bursts. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics, the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. For all metrics, the cumulative impact area of an event consisting of a certain number of bursts is merely the product of the impact area of a single burst and the number of bursts, as would be the case if the bursts are sufficiently spaced in time or location as to insure that each burst is affecting a different set of marine wildlife.

Physical damage of tissues resulting from a shock wave (from an explosive detonation) is classified as an injury. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000) and gas containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible to damage (Goertner, 1982; Hill 1978; Yelverton et al., 1973). Nasal sacs, larynx, pharynx, trachea, and lungs may be damaged by compression/expansion caused by the oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Severe damage (from the shock wave) to the ears can include tympanic membrane rupture, fracture of the ossicles, damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear.

Non-lethal injury includes slight injury to internal organs and the auditory system; however, delayed lethality can be a result of individual or cumulative sublethal injuries (DoN, 2001). Immediate lethal injury would be a result of massive combined trauma to internal organs as a direct result of proximity to the point of detonation (DoN, 2001). Exposure to distance explosions could result only in behavioral changes. Masked underwater hearing thresholds in two bottlenose dolphins and one beluga whale have been measured before and after exposure to impulsive underwater sounds with waveforms resembling distant signatures of underwater explosions (Finneran et al., 2000). The authors found no temporary shifts in masked-hearing thresholds (MTTSs), defined as a 6-dB or larger increase in threshold over pre-exposure levels, had been observed at the highest impulse level generated (500 kg at 1.7 km, peak pressure 70 kPa); however, disruptions of the animals' trained behaviors began to occur at exposures corresponding to 5 kg at 9.3 km and 5 kg at 1.5 km for the dolphins and 500 kg at 1.9 km for the beluga whale.

Generally, the higher the level of impulse and pressure level exposure, the more severe the impact to an individual. While, in general, dolphins could sustain injury or mortality if within very close proximity to in-water explosion, monitoring and mitigation measures employed by the USMC before and during training exercises, as would be required under any ITA issued, are designed to avoid any firing if a marine mammal is sighted within

designated BT zones (see Proposed Mitigation and Monitoring section below). No marine mammal injury or death has been attributed to the specified activities described in the application. As such, and due to implementation of the proposed mitigation and monitoring measures, bottlenose dolphin injury or mortality is not anticipated nor would any be authorized.

Inert Ordnances

The potential risk to marine mammals from non-explosive ordnance entails two possible sources of impacts: Elevated sound levels or the ordnance physically hitting an animal. The latter is discussed below in the Munition Presence section below. The USMC provided information that the noise fields generated in water by the firing of non-explosive ordnance indicate that the energy radiated is about 1 to 2 percent of the total kinetic energy of the impact. This energy level (and likely peak pressure levels) is well below the TTS-energy threshold, even at 1-m from the impact and is not expected to be audible to marine mammals. As such, the noise generated by the in-water impact of non-explosive ordnance will not result in take of marine mammals.

Training Debris

In addition to behavioral and physiological impacts from live fire and ammunition testing, NMFS has preliminarily analyzed impacts from presence of munition debris in the water, as described in the USMC's application and 2009 EA. These impacts include falling debris, ingestion of expended ordnance, and entanglement in parachute debris.

Ingestion of marine debris by marine mammals can cause digestive tract blockages or damage the digestive system (Gorzelany, 1998; Stamper et al., 2006). Debris could be either the expended ordnance or non-munition related products such as chaff and self protection flares. Expended ordnance would be small and sink to the bottom. Chaff is composed of either aluminum foil or aluminum-coated glass fibers designed to act as a visual smoke screen; hiding the aircraft from enemy radar. Chaff also serves as a decoy for radar detection, allowing aircraft to maneuver or egress from the area. The foil type currently used is no longer manufactured, although it remains in the inventory and is used primarily by B-52 bombers. Both types of chaff are cut into dipoles ranging in length from 0.3 to over 2.0 inches. The aluminum foil dipoles are 0.45 mils (0.00045 inches) thick and 6 to 8 mils wide. The glass fiber dipoles are generally 1 mil (25.4 microns) in diameter, including the aluminum coating. Chaff is packed into about 4-ounce bundles. The major components of chaff are silica, aluminum, and stearic acid; all naturally prevalent in the environment.

Based on the dispersion characteristics of chaff, concentrations around the BTs would be low. For example, Hullar et al. (1999) calculated that a 4.97-mile by 7.46-mile area (37.1 km^2) would be affected by deployment of a single cartridge containing 150 grams of chaff; however, concentration would only be about 5.4 grams per square nautical mile. This corresponds to fewer than 179,000 fibers per square nautical mile or fewer than 0.005 fibers per square foot.

Self-protection flares are deployed to mislead or confuse heat-sensitive or heat-seeking anti-aircraft systems. The flares are magnesium pellets that, when ignited, burn for a short period of time (less than 10 seconds) at 2,000 degrees Fahrenheit. Air-deployed LUU-2 high-intensity illumination flares are used to illuminate targets, enhancing a pilot's ability to see targets while using Night Vision Goggles. The LUU-2B Flare has a light output rating of 1.8 x 10(6) candlepower and at 1,000 feet altitude illuminates a circle on the ground of 500 meters. The LUU-2 is housed in a pod or canister and is deployed by ejection. The mechanism has a timer on it that deploys the parachute and ignites the flare candle. The flare candle burns magnesium at high temperature, emitting an intense bright white light. The LUU-2 has a burn time of approximately 5 minutes while suspended from a parachute. The pyrotechnic candle consumes the flare housing, reducing flare weight, which in turn slows the rate of fall during the last 2 minutes of burn time. At candle burnout an explosive bolt is fired, releasing one parachute support cable, which causes the parachute to collapse.

Ingestion of debris by dolphins is not likely, as dolphins typically eat fish and other moving prey items. NMFS solicited information on evidence of debris ingestion from two marine mammal veterinarians who have

performed many necropsies on the protected species of North Carolina's waters. In their experience, no necropsies of bottlenose dolphins have revealed evidence of munition, parachute, or chaff ingestion (pers. comm., Drs. C. Harms and D. Rostein, November 14, 2009). However, it was noted evidence of chaff ingestion would be difficult to detect. In the chance that dolphins do ingest chaff, the filaments are so fine they would likely pass through the digestive system without complication. However, if the chaff is durable enough, it might act as a linear foreign body. In such case, the intestines bunch up on the line restricting movement of the line resulting in an obstruction. The peristalsis on an immovable thin line can cause intestinal lacerations and perforations (pers. comm., C. Harms, November 14, 2009. This is a well known complication in cats when they ingest thread and which occurs occasionally with sea turtles ingesting fishing line. The longevity of chaff filaments, based upon dispersion rates, is unclear. Chaff exposed to synthetic seawater and aqueous environments in the pH range of 4-10 exhibited varying levels of degradation suggesting a short lifespan for the outer aluminum coating (Farrell and Siciliano, 1998). The underlying filament is a flexible silica core and composed of primarily silica dioxide. While no studies have been conducted to evaluate the effects of chaff ingestion on marine mammals, the effects are expected to be negligible based upon chaff concentration in the environment, size of fibers, and available toxicity data on fiberglass and aluminum. Given that the size of chaff fibers are no more than 2 inches long, tidal flushing reduces concentration in the environment, and chaff degradation rate, the chance of chaff ingestions is unlikely; however, if swallowed, impacts would be negligible.

Given that there is no evidence that dolphins ingest military debris; dolphins in the Sound forage on moving prey suspended in the water column while expended munition would sink; the property and dispersion characteristics of chaff make potential for ingestion discountable; and that Pamlico Sound is a tidal body of water with continuing flushing, NMFS has preliminarily determined that the presence of training debris would not have an effect on dolphins in Pamlico Sound.

Although sometimes large, expended parachutes (e.g., those from the flares) are flimsy and structurally simple and NMFS has determined that the probability of entanglement with a dolphin is low. There are no known reports of live or stranded dolphins entangled in parachute gear; fishing gear is usually the culprit of reported entanglements. The NMFS' Marine Mammal Stranding Network (Network) has established protocol for reporting marine mammals in peril. Should any injured, stranded or entangled marine mammal be observed by USMC personnel during training exercises, the sighting would be reported to the Network within 24 hours of the observation.

Vessel and Aircraft Presence

The marine mammals most vulnerable to vessel strikes are slow-moving and/or spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., right whales, fin whales, sperm whales). Smaller marine mammals such as bottlenose dolphins (the only marine mammal that would be encountered at the BTs) are agile and move more quickly through the water, making them less susceptible to ship strikes. NMFS is not aware of any vessel strikes of bottlenose dolphins in Pamlico Sound. Therefore, NMFS does not anticipate that USMC vessels engaged in the specified activity would strike any marine mammals and no take from ship strike would be authorized in the proposed IHA.

Behaviorally, marine mammals may or may not respond to the operation of vessels and associated noise. Responses to vessels vary widely among marine mammals in general, but also among different species of small cetaceans. Responses may include attraction to the vessel (Richardson et al., 1995); altering travel patterns to avoid vessels (Constantine, 2001; Nowacek et al., 2001; Lusseau, 2003, 2006); relocating to other areas (Allen and Read, 2000); cessation of feeding, resting, and social interaction (Baker et al., 1983; Bauer and Herman, 1986; Hall, 1982; Krieger and Wing, 1984; Lusseau, 2003; Constantine et al., 2004); abandoning feeding, resting, and nursing areas (Jurasz and Jurasz 1979; Dean et al., 1985; Glockner-Ferrari and Ferrari 1985, 1990; Lusseau, 2005; Norris et al., 1985; Salden, 1988; Forest, 2001; Morton and Symonds, 2002; Courbis, 2004; Bejder, 2006); stress (Romano et al., 2004); and changes in acoustic behavior (Van Parijs and

Corkeron, 2001). However, in some studies marine mammals display no reaction to vessels (Watkins, 1986; Nowacek et al., 2003) and many odontocetes show considerable tolerance to vessel traffic (Richardson et al., 1995). Dolphins may actually reduce the energetic cost of traveling by riding the bow or stern waves of vessels (Williams et al., 1992; Richardson et al., 1995).

Dolphins within Pamlico Sound are continually exposed to recreational, commercial, and military vessels. Richardson et al. (1995) addresses in detail three responses that marine mammals may experience when exposed to anthropogenic activities: Tolerance; habituation; and sensitization. More recent publications provide variations on these themes rather than new data (NRC 2003). Marine mammals are often seen in regions with much human activity; thus, certain individuals or populations exhibit some tolerance of anthropogenic noise and other stimuli. Animals will tolerate a stimulus they might otherwise avoid if the benefits in terms of feeding, mating, migrating to traditional habitats, or other factors outweigh the negative aspects of the stimulus (NRC, 2003). In many cases, tolerance develops as a result of habituation. The NRC (2003) defines habituation as a gradual waning of behavioral responsiveness over time as animals learn that a repeated or ongoing stimulus lacks significant consequences for the animals. Contrarily, sensitization occurs when an animal links a stimulus with some degree of negative consequence and as a result increases responsiveness to that human activity over time (Richardson et al., 1995). For example, seals and whales are known to avoid previously encountered vessels involved in subsistence hunts (Walker, 1949; Ash 1962; Terhune, 1985) and bottlenose dolphins that had previously been captured and released from a 7.3 m boat involved in health studies were documented to flee when that boat approached closer than 400 m, whereas dolphins that had not been involved in the capture did not display signs of avoidance of the vessel (Irvine et al., 1981). Because dolphins in Pamlico Sound are continually exposed to vessel traffic that does not present immediate danger to them, it is likely animals are both tolerant and habituated to vessels.

The specified activities also involve aircraft, which marine mammals are known to react (Richardson et al., 1995). Aircraft produce noise at frequencies that are well within the frequency range of cetacean hearing and also produce visual signals such as the aircraft itself and its shadow (Richardson et al., 1995, Richardson &Wuersig, 1997). A major difference between aircraft noise and noise caused by other anthropogenic sources is that the sound is generated in the air, transmitted through the water surface and then propagates underwater to the receiver, diminishing the received levels to significantly below what is heard above the water's surface. Sound transmission from air to water is greatest in a sound cone 26 degrees directly under the aircraft. Reactions of odontocetes to aircraft have been reported less often than those of pinnipeds. Responses to aircraft include diving, slapping the water with pectoral fins or tail fluke, or swimming away from the track of the aircraft (Richardson et al., 1995). The nature and degree of the response, or the lack thereof, are dependent upon nature of the flight (e.g., type of aircraft, altitude, straight vs. circular flight pattern). Wuersig et al. (1998) assessed the responses of cetaceans to aerial surveys in the northcentral and western Gulf of Mexico using a DeHavilland Twin Otter fixed-wing airplane. The plane flew at an altitude of 229 m at 204 km/hr. A minimum of 305 m straight line distance from the cetaceans was maintained. Water depth was 100-1000m. Bottlenose dolphins most commonly responded by diving (48 percent), while 14 percent responded by moving away. Other species (e.g., beluga whale, sperm whale) show considerable variation in reactions to aircraft but diving or swimming away from the aircraft are the most common reactions to low flights (less than 500 m).

Anticipated Effects on Habitat

Detonations of live ordnance would result in temporary modification to water properties. As described above, an underwater explosion from these weapon would send a shock wave and blast noise through the water, release gaseous by-products, create an oscillating bubble, and cause a plume of water to shoot up from the water surface. However, these would be temporary and not expected to last more than a few seconds. Because dolphins are not expected to be in the area during live firing, due to monitoring and mitigation measure implementation, they would not be subject to any short term habitat alterations.

Similarly, no long term impacts with regard to hazardous constituents are expected to occur. MCAS Cherry Point has an active Range Environmental Vulnerability Assessment (REVA) program in place to monitor impacts to habitat from its activities. One goal of REVA is to determine the horizontal and vertical concentration profiles of heavy metals, explosives constituents, perchlorate nutrients, and dissolved salts in the sediment and seawater surrounding BT-9 and BT-11. The preliminary results of the sampling indicate that explosive constituents (e.g., trinitrotoluene (TNT), cyclotrimethylenetrinitramine (RDX), and hexahydro-trinitro-triazine (HMX), as described in Hazardous Constituents [Subchapter 3.2.7.2] of the MCAS Cherry Point Range Operations EA, were not detected in any sediment or water sample surrounding the BTs. Metals were not present above toxicity screening values. Perchlorate was detected in a few sediment samples above the detection limit (0.21 ppm), but below the reporting limit (0.6 ppm). The ongoing REVA would continue to evaluate potential munitions constituent migration from operational range areas to off-range areas and MCAS Cherry Point.

Summary of Previous Monitoring

USMC complied with the mitigation and monitoring required under the previous authorization. In accordance with the 2010-11 IHA, USMC submitted a final monitoring report, which described the activities conducted and observations made. USMC did not record observations of any marine mammals during training exercises. The only recorded observations--which were of bottlenose dolphins--were on two occasions by maintenance vessels engaged in target maintenance. No marine mammals were observed during range sweeps, air to ground activities, surface to surface activities (small boats), or ad hoc via range cameras. Table 6 details the number of sorties conducted, by air and water, at each target. The number of sorties conducted does not relate to the total amount of munitions expended, as the training requirements for the specific military unit conducting the sortie determine the munitions loading for the air platform or watercraft during each sortie. In addition, munitions expenditures may be determined by the loading specifications of the specific aircraft and vessels used in the training exercise.

_____Table_6--Sorties_Conducted_at_BT-9_and_BT-11		
Mission_type_____	BT-9_____	BT-11
Air-to-surface_____	1,554_____	4,251
Surface-to-surface_____	223_____	105
(water-to-water)		
Total_____	1,777_____	4,356

The total amount of ordnance expended at BT-9 and BT-11 under the 2010-11 IHA was 878,625 and 693,612 respectively (Table 7). These amounts represent 98 and 62 percent of the estimated annual maximum ordnance expenditures. The amounts of ordnance expended at the BTs account for all use of the targets. There are five types of explosive sources used at BT-9: 2.75" Rocket High Explosives, 5" Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. No explosive munitions are used at BT-11.

_____Table_7--Ordnance_Usage_at_BT-9			
_____	Total_rounds_____		Percentage_of_maximum
Munitions_____	BT-9_____	BT-11_____	BT-9_____ BT-11
expenditures			

Small_arms,____355,718_____363,899_____68_____72
excluding_.50
cal
.50_cal_____410,815_____246,255_____160_____75
Large_arms_____*1_480_____N/A_____4_____N/A
(Live)
Large_arms_____108,811_____79,531_____117_____33
(Inert)
Rockets_(Live)__*2_48_____N/A_____20_____N/A
Rockets_____185_____2,018_____26_____44
(Inert)
Bombs/Grenades_0_____N/A_____0_____N/A
(Live)
Bombs/Grenades_2,086_____1,697_____51_____8
(Inert)
Pyrotechnics___482_____212_____11_____2
Total_____878,625_____693,612_____98_____62
____*1_(All_40_mm).
____*2_(All_2.75_in).

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the "permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance." The NDAA of 2004 amended the MMPA as it relates to military-readiness activities and the ITA process such that "least practicable adverse impact" shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. The training activities described in the USMC's application are considered military readiness activities.

NMFS has carefully evaluated the applicant's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; (3) the practicability of the measure for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. NMFS has preliminarily determined that the proposed mitigation measures provide the means of

effecting the least practicable adverse impacts on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance while also considering personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The USMC, in collaboration with NMFS, has worked to identify potential practicable and effective mitigation measures, which include a careful balancing of the likely benefit of any particular measure to the marine mammals with the likely effect of that measure on personnel safety, practicality of implementation, and impact on the "military-readiness activity". These proposed mitigation measures are listed below.

(1) Range Sweeps: The VMR-1 squadron, stationed at MCAS Cherry Point, includes three specially equipped HH-46D helicopters. The primary mission of these aircraft, known as PEDRO, is to provide search and rescue for downed 2^{d} Marine Air Wing aircrews. On-board are a pilot, co-pilot, crew chief, search and rescue swimmer, and a medical corpsman. Each crew member has received extensive training in search and rescue techniques, and is therefore particularly capable at spotting objects floating in the water.

PEDRO crew would conduct a range sweep the morning of each exercise day prior to the commencement of range operations. The primary goal of the pre-exercise sweep is to ensure that the target area is clear of fisherman, other personnel, and protected species. The sweep is flown at 100-300 meters above the water surface, at airspeeds between 60-100 knots. The path of the sweep runs down the western side of BT-11, circles around BT-9 and then continues down the eastern side of BT-9 before leaving. The sweep typically takes 20-30 minutes to complete. The PEDRO crew is able to communicate directly with range personnel and can provide immediate notification to range operators. The PEDRO aircraft would remain in the area of a sighting until clear if possible or as mission requirements dictate.

If marine mammals are sighted during a range sweep, sighting data will be collected and entered into the US Marine Corps sighting database, web-interface, or report generator and this information would be relayed to the training Commander. Sighting data includes the following (collected to the best of the observer's ability): (1) Species identification; (2) group size; (3) the behavior of marine mammals (e.g., milling, travel, social, foraging); (4) location and relative distance from the BT; (5) date, time and visual conditions (e.g., Beaufort sea state, weather) associated with each observation; (6) direction of travel relative to the BT; and (7) duration of the observation.

(2) Cold Passes: All aircraft participating in an air-to-surface exercise would be required to perform a "cold pass" immediately prior to ordnance delivery at the BTs both day and night. That is, prior to granting a "First Pass Hot" (use of ordnance), pilots would be directed to perform a low, cold (no ordnance delivered) first pass which serves as a visual sweep of the targets prior to ordnance delivery to determine if unauthorized civilian vessels or personnel, or protected species, are present. The cold pass is conducted with the aircraft (helicopter or fixed-winged) flying straight and level at altitudes of 200-3000 feet over the target area. The viewing angle is approximately 15 degrees. A blind spot exists to the immediate rear of the aircraft. Based upon prevailing visibility, a pilot can see more than one mile forward upon approach. The aircrew and range personnel make every attempt to ensure clearance of the area via visual inspection and remotely operated camera operations (see Proposed Monitoring and Reporting section below). The Range Controller may deny or approve the First Pass Hot clearance as conditions warrant.

(3) Delay of Exercises: An active range would be considered "fouled" and not available for use if a marine mammal is present within 1000 yards (914 m) of the target area at BT-9 or anywhere within Rattan Bay (BT-11). Therefore, if a marine mammal is sighted within 1000 yards (914 m) of the target at BT-9 or anywhere within Rattan Bay at BT-11 during the cold pass or from range camera detection, training would be delayed until the marine mammal moves beyond and on a path away from 1000 yards (914 m) from the BT-9 target or out of Rattan Bay at BT-11. This mitigation applies to both air-to-surface and surface-to-surface exercises.

(4) Range Camera Use: To increase the safety of persons or property near the targets, Range Operation and

Control personnel monitor the target area through tower mounted safety and surveillance cameras. The remotely operated range cameras are high resolution and, according to range personnel, allow a clear visual of a duck floating near the target. The cameras allow viewers to see animals at the surface and breaking the surface, but not underwater.

A new, enhanced camera system has been purchased and will be installed on BT-11 towers 3 and 7, and on both towers at BT-9. The new camera system has night vision capabilities with resolution levels near those during daytime. Lenses on the camera system have focal lengths of 40 mm to 2200 mm (56x), with view angles of 18 [degrees] 10' and 13 [degrees] 41', respectively. The field of view when zoomed in on the Rattan Bay targets will be 23' wide by 17' high, and on the mouth of Rattan Bay itself 87' wide by 66' high.

Again, in the event that a marine mammal is sighted within 1000 yards (914 m) of the BT-9 target, or anywhere within Rattan Bay, the target would be declared fouled. Operations may commence in the fouled area after the animal(s) have moved 1000 yards (914 m) from the BT-9 target and/or out of Rattan Bay.

(5) Vessel Operation: All vessels used during training operations would abide by the NMFS' Southeast Regional Viewing Guidelines designed to prevent harassment to marine mammals (http://www.nmfs.noaa.gov/pr/education/southeast /).

(6) Stranding Network Coordination: The USMC would coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during training activities or within 24 hours after completion of training.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, Section 101(a)(5)(A) of the MMPA states that NMFS must set forth "requirements pertaining to the monitoring and reporting of such taking". The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for incidental take authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present. Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals: (a) An increase in our understanding of how many marine mammals are likely to be exposed to munition noise and explosions that we associate with specific adverse effects, such as behavioral harassment, TTS, or PTS; (b) an increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to gunnery and bombing exercises (at specific received levels) expected to result in take; (c) an increase in our understanding of how anticipated takes of individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival); (d) an increased knowledge of the affected species; (e) an increase in our understanding of the effectiveness of certain mitigation and monitoring measures; (f) a better understanding and record of the manner in which the authorized entity complies with the incidental take authorization; (g) an increase in the probability of detecting marine mammals, both within the safety zone (thus allowing for more effective implementation of the mitigation) and in general to better achieve the above goals.

Proposed Monitoring

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals expected to be present within the action area are as follows:

(1) Marine Mammal Observer Training: Pilots, operators of small boats, and other personnel monitoring for marine mammals would be required to take the Marine Species Awareness Training (Version 2), maintained and promoted by the Department of the Navy. This training would make personnel knowledgeable of marine mammals, protected species, and visual cues related to the presence of marine mammals and protected species.

(2) Weekly and Post-Exercise Monitoring: Post-exercise monitoring would be conducted concomitant to the next

regularly scheduled pre-exercise sweep. Weekly monitoring events would include a maximum of five pre-exercise and four post-exercise sweeps. The maximum number of days that would elapse between pre- and post-exercise monitoring events would be approximately 3 days, and would normally occur on weekends. If marine mammals are observed during this monitoring, sighting data identical to those collected by PEDRO crew would be recorded.

(3) Long-Term Monitoring: The USMC has awarded DUML duties to obtain abundance, group dynamics (e.g., group size, age census), behavior, habitat use, and acoustic data on the bottlenose dolphins which inhabit Pamlico Sound, specifically those around BT-9 and BT-11. DUML began conducting boat-based surveys and passive acoustic monitoring of bottlenose dolphins in Pamlico Sound in 2000 (Read et al., 2003) and specifically at BT-9 and BT-11 in 2003 (Mayer, 2003). To date, boat-based surveys indicate that bottlenose dolphins may be resident to Pamlico Sound and use BT restricted areas on a frequent basis. Passive acoustic monitoring (PAM) is providing more detailed insight into how dolphins use the two ranges, by monitoring for their vocalizations year-round, regardless of weather conditions or darkness. In addition to these surveys, DUML scientists are testing a real-time passive acoustic monitoring system at BT-9 that will allow automated detection of bottlenose dolphin whistles, providing yet another method of detecting dolphins prior to training operations. Although it is unlikely this PAM system would be active for purposes of implementing mitigation measures before an exercise prior to expiration of the proposed IHA, it would be operational for future MMPA incidental take authorizations.

(4) Reporting: The USMC would submit a report to NMFS within 90 days after expiration of the IHA or, if a subsequent incidental take authorization is requested, within 120 days prior to expiration of the IHA. The report would summarize the type and amount of training exercises conducted, all marine mammal observations made during monitoring, and if mitigation measures were implemented. The report would also address the effectiveness of the monitoring plan in detecting marine mammals.

Estimated Take by Incidental Harassment

The following provides the USMC's model for take of dolphins from explosives (without consideration of mitigation and the conservative assumption that all explosives would land in the water and not on the targets or land) and potential for direct hits and NMFS' analysis of potential harassment from small vessel and aircraft operations.

Acoustic Take Criteria

For the purposes of an MMPA incidental take authorization, three levels of take are identified: Level B harassment; Level A harassment; and mortality (or serious injury leading to mortality). The categories of marine mammal responses (physiological and behavioral) that fall into harassment categories were described previously in this notice. A method to estimate the number of individuals that will be taken, pursuant to the MMPA, based on the proposed action has been derived. To this end, NMFS uses acoustic criteria that estimate at what received level Level B harassment, Level A harassment, and mortality of marine mammals would occur. The acoustic criteria for underwater detonations are comprehensively explained in NMFS' proposed and final rulemakings for the U.S. Navy's Cherry Point Range Operations (74 FR 11057; 74 FR 28370) and are summarized here:

Criteria and thresholds for estimating the exposures from a single explosive activity on marine mammals were established for the Seawolf Submarine Shock Test Final Environmental Impact Statement (FEIS) ("Seawolf") and subsequently used in the USS Winston S. Churchill (DDG 81) Ship Shock FEIS ("Churchill") (DoN, 1998 and 2001). NMFS adopted these criteria and thresholds in its final rule on the unintentional taking of marine animals occurring incidental to the shock testing which involved large explosives (65 FR 77546; December 12, 2000). Because no large explosives (> 1000 lbs NEW) would be used at Cherry Point during the specified activities, a revised acoustic criterion for small underwater explosions (i.e., 23 pounds per square inch [psi] instead of previous acoustic criteria of 12 psi for peak pressure over all exposures) has been established to

predict onset of TTS.

I.1. Thresholds and Criteria for Injurious Physiological Impacts

I.1.a. Single Explosion

For injury, NMFS uses dual criteria, eardrum rupture (i.e., tympanic-membrane injury) and onset of slight lung injury, to indicate the onset of injury. The threshold for tympanic-membrane (TM) rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture). This value is stated in terms of an Energy Flux Density Level (EL) value of 1.17 inch pounds per square inch (in-lb/in2), approximately 205 dB re 1 microPa ^{2} - sec.

The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 26.9 lbs), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-msec (DoN, 2001). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury. This analysis assumed the marine species populations were 100 percent small animals. The criterion with the largest potential impact range (most conservative), either TM rupture (energy threshold) or onset of slight lung injury (peak pressure), will be used in the analysis to determine Level A exposures for single explosive events.

For mortality, NMFS uses the criterion corresponding to the onset of extensive lung injury. This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. For small animals, the threshold is given in terms of the Goertner modified positive impulse, indexed to 30.5 psi-msec. Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 30.5 psi-msec index is a complicated calculation. To be conservative, the analysis used the mass of a calf dolphin (at 26.9 lbs) for 100 percent of the populations.

I.1.b. Multiple Explosions

For multiple explosions, the Churchill approach had to be extended to cover multiple sound events at the same training site. For multiple exposures, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (detonation); this is consistent with the treatment of multiple arrivals in Churchill. For positive impulse, it is consistent with the Churchill final rule to use the maximum value over all impulses received.

I.2. Thresholds and Criteria for Non-Injurious Physiological Effects

To determine the onset of TTS (non-injurious harassment)--a slight, recoverable loss of hearing sensitivity, there are dual criteria: An energy threshold and a peak pressure threshold. The criterion with the largest potential impact range (most conservative), either the energy or peak pressure threshold, will be used in the analysis to determine Level B TTS exposures. The thresholds for each criterion are described below.

I.2.a. Single Explosion--TTS-Energy Threshold

The TTS energy threshold for explosives is derived from the Space and Naval Warfare Systems Center (SSC) pure-tone tests for TTS (Schlundt et al., 2000; Finneran and Schlundt, 2004). The pure-tone threshold (192 dB as the lowest value) is modified for explosives by (a) interpreting it as an energy metric, (b) reducing it by 10 dB to account for the time constant of the mammal ear, and (c) measuring the energy in 1/3-octave bands, the natural filter band of the ear. The resulting threshold is 182 dB re 1 microPa ^{2} -sec in any 1/3-octave band.

I.2.b. Single Explosion--TTS-Peak Pressure Threshold

The second threshold applies to all species and is stated in terms of peak pressure at 23 psi (about 225 dB re 1 microPa). This criterion was adopted for Precision Strike Weapons (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico (NMFS, 2005). It is important to note that for small shots near the surface (such as in this analysis), the 23-psi peak pressure threshold generally will produce longer impact ranges than the 182-dB energy metric. Furthermore, it is not unusual for the TTS impact range for the 23-psi pressure metric to actually exceed the without-TTS (behavioral change without onset of TTS) impact range for the 177-dB

energy metric.

I.3. Thresholds and Criteria for Behavioral Effects

I.3.a. Single Explosion

For a single explosion, to be consistent with Churchill, TTS is the criterion for Level B harassment. In other words, because behavioral disturbance for a single explosion is likely to be limited to a short-lived startle reaction, use of the TTS criterion is considered sufficient protection and therefore behavioral effects (Level B behavioral harassment without onset of TTS) are not expected for single explosions.

I.3.b. Multiple Explosions--Without TTS

For multiple explosions, the Churchill approach had to be extended to cover multiple sound events at the same training site. For multiple exposures, accumulated energy over the entire uninterrupted firing time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (detonation); this is consistent with the treatment of multiple arrivals in Churchill. Because multiple explosions could occur within a discrete time period, a new acoustic criterion-behavioral disturbance without TTS is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower noise levels than those that may cause TTS.

The threshold is based on test results published in Schlundt et al. (2000), with derivation following the approach of the Churchill FEIS for the energy-based TTS threshold. The original Schlundt et al. (2000) data and the report of Finneran and Schlundt (2004) are the basis for thresholds for behavioral disturbance without TTS. During this study, instances of altered behavior sometimes began at lower exposures than those causing TTS; however, there were many instances when subjects exhibited no altered behavior at levels above the onset-TTS levels. Regardless of reactions at higher or lower levels, all instances of altered behavior were included in the statistical summary. The behavioral disturbance without TTS threshold for tones is derived from the SSC tests, and is found to be 5 dB below the threshold for TTS, or 177 dB re 1 microPa ^{2} -sec maximum energy flux density level in any 1/3-octave band at frequencies above 100 Hz for cetaceans.

II. Summary of Thresholds and Criteria for Impulsive Sounds

The effects, criteria, and thresholds used in the assessment for impulsive sounds are summarized in Table 8. The criteria for behavioral effects without physiological effects used in this analysis are based on use of multiple explosives from live, explosive firing at BT-9 only; no live firing occurs at BT-11.

_____Table_8--Effects,_Criteria,_and_Thresholds_for_Impulsive_Sounds
Effect_____Criteria_____Metric_____Threshold_____Effect
Mortality_____Onset_of_____Goertner_____indexed_to_30.5__Mortality.
_____Extensive_Lung_modified_____psi-msec
_____Injury_____positive_impulse_(assumes_100
_____percent_small
_____animal_at_26.9
_____lbs)
Injurious_____50_percent_____Energy_flux_____1.17_in-lb/in2_Level_A.
Physiological__Tympanic_____density_____(about_205_dB_re
_____Membrane_____1_microPa2_-
_____Rupture_____sec)

Injurious_____Onset_Slight___Goertner_____indexed_to_13____Level_A.
Physiological__Lung_Injury____modified_____psi-msec
_____positive_impulse_(assumes_100
_____percent_small
_____animal_at_26.9
_____lbs)
Non-injurious__TTS_____Greatest_energy__182_dB_re_1_____Level_B.
Physiological_____flux_density_____microPa2_-sec
_____level_in_any
_____1/3-octave_band
_____(>_100_Hz_for
_____toothed_whales
_____and_>_10_Hz_for
_____baleen_whales)--
_____for_total_energy
_____over_all
_____exposures
Non-injurious__TTS_____Peak_pressure____23_psi_____Level_B.
Physiological_____over_all
_____exposures
Non-injurious__Multiple_____Greatest_energy__177_dB_re_1_____Level_B.
Behavioral_____Explosions_____flux_density_____microPa2_-sec
_____Without_TTS____level_in_any
_____1/3-octave_(>
_____100_Hz_for
_____toothed_whales
_____and_>_10_Hz_for
_____baleen_whales)--
_____for_total_energy
_____over_all
_____exposures
_____(multiple

_____explosions_only)

Take From Explosives

The USMC conservatively modeled that all explosives would detonate at a 1.2 m (3.9 ft) water depth despite the training goal of hitting the target, resulting in an above water or on land explosion. For sources that are detonated at shallow depths, it is frequently the case that the explosion may breech the surface with some of the acoustic energy escaping the water column. The source levels presented in the table above have not been adjusted for possible venting nor does the subsequent analysis take this into account. Properties of explosive sources used at BT-9, including NEW, peak one-third-octave (OTO) source level, the approximate frequency at which the peak occurs, and rounds per burst are described in Table 9. Distances to NMFS harassment threshold levels from these sources are outlined in Table 10.

_____Table_9--Source_Weights_and_Peak_Source_Levels
Source_type____NEW_____Peak_OTO_SL____Frequency_of___Rounds
_____peak_OTO_SL____per_burst
2.75'_Rocket___4.8_lbs_____223.9_dB_re:_1_[approx.]_1500_1
_____[mu]Pa_____Hertz_(Hz)
5'_Rocket_____15.0_lbs_____228.9_dB_re:_1_[approx.]_1000_1
_____[mu]Pa_____Hz
30_mm_____0.1019_lbs_____212.1_dB_re:_1_[approx.]_2500_30
_____[mu]Pa_____Hz
40_mm_____0.1199_lbs_____227.8_dB_re:_1_[approx.]_1100_5
_____[mu]Pa_____Hz
G911_Grenade___0.5_____213.9_dB_re:_1_[approx.]_2500_1
_____[mu]Pa_____Hz
_____Table_10--Distances_to_NMFS_Harassment_Thresholds_From_Explosive_Ordnances
_____Behavioral_____TTS_(23_psi)___Level_A_____Mortality
_____disturbance_____(13_psi-msec)__(31_psi-ms)
_____(177_dB
_____Energy)
2.75'_Rocket___N/A_____172_m_(564_ft)_47_m_(154_ft)__27_m_(89_ft).
HE
5'_Rocket_HE___N/A_____255_m_(837_ft)_61_m_(200_ft)__39_m_(128_ft).
30_mm_HE_____209_m_(686_ft)_N/A_____10_m_(33_ft)___5_m_(16_ft).
40_mm_HE_____144_m_(472_ft)_N/A_____10_m_(33_ft)___5_m_(16_ft).
G911_Grenade___N/A_____83_m_(272_ft)__21_m_(33_ft)___10_m_(33_ft).

To calculate take, the distances to which animals may be harassed were considered along with dolphin density. The density estimate from Read et al. (2003) was used to calculate take from munition firing. As described in the Description of Marine Mammals in the Area of the Specified Activity section above, this density, 0.183/km ^{2} , was derived from boat based surveys in 2000 which covered all inland North Carolina waters. Note that estimated density of dolphins at BT-9 and BT-11, specifically, were calculated to be 0.11 dolphins/km^2 , and 1.23 dolphins/km^2 respectively (Maher 2003), based on boat surveys conducted from July 2002 through June 2003 (excluding April, May, Sept. and Jan.). However, the USMC chose to estimate take of dolphins based on the higher density reported from the summer 2000 surveys (0.183/km ^{2}). Additionally, take calculations for munition firing are based on 100 percent water detonation, although the goal of training is to hit the targets, and no pre-exercise monitoring or mitigation. Therefore, take estimates can be considered conservative.
Based on dolphin density and amount of munitions expended, there is very low potential for Level A harassment and mortality and monitoring and mitigation measures are anticipated to further negate this potential. Accordingly, NMFS is not proposing to issue these levels of take. As portrayed in Table 9, the largest harassment zone (Level B) is within 209 m of a detonation in water; however, the USMC has implemented a 1000 m "foul" zone for BT-9 and anywhere within Rattan Bay for BT-11. In total, from firing of explosive ordnances, the USMC is requesting, and NMFS is proposing to issue, the incidental take of 25 bottlenose dolphins from Level B harassment (Table 11).

_____Table_11--Number_of_Dolphins_Potentially_Taken_From_Exposure_to_Explosives
_____Based_on_Threshold_Criteria
Ordnance_type__Level_B--_____Level_B--TTS___Level_A--_____Mortality
_____Behavioral_____(23_psi)_____Injurious_____(30.5_psi)
_____(177dB_re_1_____(205_dB_re_1
_____microPa(2M)-s)_____microPa(2M)-s
_____or_13_psi)
2.75'_Rocket___N/A_____4.97_____0.17_____0.06
HE
5'_Rocket_HE___N/A_____3.39_____0.09_____0.03
30_mm_HE_____2.55_____N/A_____0.05_____0.00
40_mm_HE_____12.60_____N/A_____0.16_____0.01
G911_Grenade___N/A_____0.87_____0.03_____0.01
Total_____15.15_____9.23_____0.5_____0.11

Take From Direct Hit
The potential risk of a direct hit to an animal in the target area is estimated to be so low it is discountable. A Range Air Installation Compatible Use Zone (RAICUZ) study generated the surface area or footprints of weapon impact areas associated with air-to-ground ordnance delivery (USMC 2001). Statistically, a weapon safety footprint describes the area needed to contain 99.99 percent of initial and ricochet impacts at the 95-percent confidence interval for each type of aircraft and ordnance utilized on the BTs. At both BT-9 and BT-11 the probability of deployed ordnance landing in the impact footprint is essentially 1.0, since the footprints were designed to contain 99.99 percent of impacts, including ricochets. However, only 36 percent of the weapon

footprint for BT-11 is over water in Rattan Bay, so the likelihood of a weapon striking an animal at the BT in Rattan Bay is 64 percent less. Water depths in Rattan Bay range from 3 m (10 ft) in the deepest part of the bay to 0.5 m (1.6 m) close to shore, so that nearly the entire habitat in Rattan Bay is suitable for marine mammal use (or 36 percent of the weapon footprint).

The estimated potential risk of a direct hit to an animal in the target area is extremely low. The probability of hitting a bottlenose dolphin at the BTs can be derived as follows: Probability = dolphin's dorsal surface area * density of dolphins. The estimated dorsal surface area of a bottlenose dolphin is 1.425 m^2 (or the average length of 2.85 m times the average body width of 0.5 m). Thus, using Read et al. (2003)'s density estimate of 0.183 dolphins/km^2 , without consideration of mitigation and monitoring implementation, the probability of a dolphin being hit in the waters of BT-9 is 2.61 x 10^{-7} and of BT-11 is 9.4 x 10^{-8} . Using the proposed levels of ordnance expenditures at each in-water BT (Tables 4 and 5) and taking into account that only 36 percent of the ordnance deployed at BT-11 is over water, as described in the application, the estimated potential number of ordnance strikes on a marine mammal per year is 0.263 at BT-9 and 0.034 at BT-11. It would take approximately three years of ordnance deployment at the BTs before it would be likely or probable that one bottlenose dolphin would be struck by deployed inert ordnance. Again, these estimates are without consideration to proposed monitoring and mitigation measures.

Take From Vessel and Aircraft Presence

Vessel movement is associated with surface-to-surface exercises, as described in the Specified Activities section above, which primarily occurs within BT-11. The USMC is not requesting takes specific to the act of maneuvering small boats within the BTs; however, NMFS has analyzed the potential for take from this activity. The potential impacts from exposure to vessels are described in the Vessel and Aircraft Presence section above. Interactions with vessels are not a new experience for bottlenose dolphins in Pamlico Sound. Pamlico Sound is heavily used by recreational, commercial (fishing, daily ferry service, tugs, etc.), and military (including the Navy, Air Force, and Coast Guard) vessels year-round. The NMFS' Southeast Regional Office has developed marine mammal viewing guidelines to educate the public on how to responsibly view marine mammals in the wild and avoid causing a take (http://www.nmfs.noaa.gov/pr/ education/southeast). The guidelines recommend that vessels should remain a minimum of 50 yards from a dolphin, operate vessels in a predictable manner, avoid excessive speed or sudden changes in speed or direction in the vicinity of animals, and not to pursue, chase, or separate a group of animals. The USMC would abide by these guidelines to the fullest extent practicable. The USMC would not engage in high speed exercises should a marine mammal be detected within the immediate area of the BTs prior to training commencement and would never closely approach, chase, or pursue dolphins. Detection of marine mammals would be facilitated by personnel monitoring on the vessels and those marking success rate of target hits and monitoring of remote camera on the BTs (see Proposed Monitoring and Reporting section).

Based on the description of the action, the other activities regularly occurring in the area, the species that may be exposed to the activity and their observed behaviors in the presence of vessel traffic, and the implementation of measures to avoid vessel strikes, NMFS believes it is unlikely that the operation of vessels during surface-to-surface maneuvers will result in the take of any marine mammals, in the form of either behavioral harassment or injury.

Aircraft would move swiftly through the area and would typically fly approximately 914 m from the water's surface before dropping unguided munitions and above 4,572 m for precision-guided munition bombing. While the aircraft may approach as low as 152 m (500 ft) to drop a bomb this is not the norm and would never been done around marine mammals. Regional whale watching guidelines advise aircraft to maintain a minimum altitude of 300 m (1,000 ft) above all marine mammals, including small odontocetes, and to not circle or hover over the animals to avoid harassment. NMFS' approach regulations limit aircraft from flying below 300 m (1,000 ft) over a humpback whale (Megaptera novaeangliae) in Hawaii, a known calving ground, and limit aircraft from

flying over North Atlantic right whales closer than 460 m (1509 ft). Given USMC aircraft would not fly below 300 m on the approach, would not engage in hovering or circling the animals, and would not drop to the minimal altitude of 152 m if a marine mammal is in the area, NMFS believes it is unlikely that the operation of aircraft, as described above, will result in take of bottlenose dolphins in Pamlico Sound.

Negligible Impact Analysis and Preliminary Determination

Pursuant to NMFS' regulations implementing the MMPA, an applicant is required to estimate the number of animals that will be "taken" by the specified activities (i.e., takes by harassment only, or takes by harassment, injury, and/or death). This estimate informs the analysis that NMFS must perform to determine whether the activity will have a "negligible impact" on the species or stock. NMFS has defined "negligible impact" in 50 CFR 216.103 as: "An impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number and manner of takes, alone, is not enough information on which to base a negligible impact determination. NMFS must also consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat.

The USMC has been conducting gunnery and bombing training exercises at BT-9 and BT-11 for years and, to date, no dolphin injury or mortality has been attributed these military training exercises. The USMC has a history of notifying the NMFS stranding network when any injured or stranded animal comes ashore or is spotted by personnel on the water. Therefore, stranded animals have been examined by stranding responders, further confirming that it is unlikely training contributes to marine mammal injuries or deaths. Due to the implementation of the aforementioned mitigation measures, no take by Level A harassment or serious injury or mortality is anticipated nor would any be authorized in the IHA. NMFS is proposing; however, to authorize 25 Level B harassment takes associated with training exercises.

The USMC has proposed a 1000 yard (914 m) safety zone around BT-9 despite the fact that the distance to NMFS explosive Level B harassment threshold is 228 yards (209 m). They also would consider an area fouled if any dolphins are spotted within Raritan Bay (where BT-11 is located). The Level B harassment takes allowed for in the IHA would be of very low intensity and would likely result in dolphins being temporarily behaviorally affected by bombing or gunnery exercises. In addition, takes may be attributed to animals not using the area when exercises are occurring; however, this is difficult to calculate. Instead, NMFS looks to if the specified activities occur during and within habitat important to vital life functions to better inform its negligible impact determination.

Read et al. (2003) concluded that dolphins rarely occur in open waters in the middle of North Carolina sounds and large estuaries, but instead are concentrated in shallow water habitats along shorelines. However, no specific areas have been identified as vital reproduction or foraging habitat. Scientific boat based surveys conducted throughout Pamlico Sound conclude that dolphins use the areas around the BTs more frequently than other portions of Pamlico Sound (Maher, 2003) despite the USMC actively training in a manner identical to the specified activities described here for years.

As described in the Affected Species section of this notice, bottlenose dolphin stock segregation is complex with stocks overlapping throughout the coastal and estuarine waters of North Carolina. It is not possible for the USMC to determine to which stock any individual dolphin taken during training activities belong as this can only be accomplished through genetic testing. However, it is likely that many of the dolphins encountered would belong to the NNCE or SNCE stock. These stocks have a population estimate of 1,387 and 2,595, respectively. NMFS is proposing to authorize 25 takes of bottlenose dolphins in total; therefore, this number represents 1.8

and 1.0 percent, respectively, of those populations.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that the specified USMC AS Cherry Point BT-9 and BT-11 training activities will result in the incidental take of marine mammals, by Level B harassment only, and that the total taking from will have a negligible impact on the affected species or stocks.

Subsistence Harvest of Marine Mammals

Marine mammals are not taken for subsistence use within Pamlico Sound; therefore, issuance of an IHA to the USMC for MCAS Cherry Point training exercises would not have an unmitigable adverse impact on the availability of the affected species or stocks for subsistence use.

Endangered Species Act (ESA)

No ESA-listed marine mammals are known to occur within the action area. Therefore, there is no requirement for NMFS to consult under Section 7 of the ESA on the issuance of an IHA under section 101(a)(5)(D) of the MMPA. However, ESA-listed sea turtles may be present within the action area.

On September 27, 2002, NMFS issued a Biological Opinion (BiOp) on Ongoing Ordnance Delivery at Bombing Target 9 (BT-9) and Bombing Target 11 (BT-11) at Marine Corps Air Station, Cherry Point, North Carolina. The BiOp, which is still in effect, concluded that the USMC's proposed action will not result in adverse impacts to any ESA-listed marine mammals and is not likely to jeopardize the continued existence of the endangered green turtle (Chelonia mydas), leatherback turtle (Dermochelys coriacea), Kemp's ridley turtle (Lepidochelys kempii), or threatened loggerhead turtle (Caretta caretta). No critical habitat has been designated for these species in the action area; therefore, none will be affected.

National Environmental Policy Act (NEPA)

On February 11, 2009, the USMC issued a Finding of No Significant Impact for its Environmental Assessment (EA) on MCAS Cherry Point Range Operations. Based on the analysis of the EA, the USMC determined that the proposed action will not have a significant impact on the human environment. NMFS adopted USMC's EA and signed a FONSI on August 31, 2010. NMFS has reviewed the proposed application and preliminarily determined that there are no substantial changes to the proposed action or new environmental impacts or concerns. Therefore, NMFS has determined that a new or supplemental EA or Environmental Impact Statement is likely unnecessary. Before making a final determination in this regard, NMFS will review public comments and information submitted by the public and others in response to this notice. The EA referenced above is available for review at http://www.nmfs.noaa.gov/pr/permits/incidental.htm.

Dated: November 14, 2011.

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[FR Doc. 2011-29851 Filed 11-17-11; 8:45 am]

BILLING CODE 3510-22-P

Publication date: Nov 18, 2011

Year: 2011

Noise-induced tinnitus: A comparison between four clinical groups without apparent hearing loss

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Publication info: Noise & Health 13.55 (Nov 2011): 423-31.
ProQuest document link

Abstract: The number of people with normal hearing thresholds seeking medical help for tinnitus and other hearing problems is increasing. For diagnostic purposes, existence/nonexistence of lesions or combinations of lesions in the inner ear not reflected in the audiogram was evaluated with advanced hearing tests applied to tinnitus patients with certain backgrounds, including noise exposure. For forty-six patients with pronounced tinnitus, and other symptoms, tentative diagnoses were established, including judgments of the influence of four causative factors: (1) acoustic trauma, (2) music, (3) suspected hereditary, and (4) nonauditory, for example, stress or muscular tension. They were analyzed with a test battery sensitive to lesions involving the outer hair cells, damage from impulse noise, and dysfunction of the efferent system. There were significant differences in test results between groups with individuals with the same most likely causative factor. Most patients claiming acoustic trauma had a specific type of result, 'hyper-PMTF' (psychoacoustical modulation transfer function), and abnormal test results of the efferent system. Everyone in the hereditary group had dysfunction of the efferent system. All patients working with music, except one, had some abnormality, but without specific pattern. The nonauditory group mostly had normal test results. The investigation shows that it is possible to diagnose minor cochlear lesions as well as dysfunction of the efferent system, which might be causing the tinnitus. Those abnormalities could not be detected with routine audiological tests. Malfunctioning caused by impulse noise is an obvious example of this. These findings facilitate choice of treatment, rehabilitation programs, and medicolegal decisions.

Full text: Introduction

Tinnitus following occupational noise exposure has been correlated to noise-induced hearing loss, with negligible occurrence in noise-exposed workers with normal hearing. [1],[2] However, other occupational situations have been reported in which tinnitus is a promintent symptom even with no or minor hearing impairment. One important example is musical professions [3] and another is military officers and servicemen who have been exposed to acute acoustic trauma. [4],[5]

Tinnitus is most often correlated to hearing impairment, but many tinnitus patients have no or only minor hearing loss. Savastano [6] studied tinnitus patients and reported that 57% had hearing deficits and 43% had normal hearing (pure tone average 0.5-8 kHz, <20 dB). Wiberg et al. [7] reported that young tinnitus patients (<20 years of age) had, on an average, normal hearing thresholds in the frequency range from 500 to 8000 Hz. The hearing thresholds were slightly elevated in a group of tinnitus patients of working age and still more elevated (above all in the high frequencies) in retired persons with tinnitus.

Observations about tinnitus in patients with normal pure tone audiometry raise the question about the role of the peripheral auditory system for triggering tinnitus. A significant problem is that pure tone audiometry and also other audiological tests in current clinical use are poor indicators of minor cochlear dysfunction. The rapid development of auditory physiology during the last decades provides a possibility to study very early changes of the physiological function and of the micromechanics of the cochlea. Such changes occur before pure tone thresholds are noticeably affected. [8],[9],[10]

The aim of the present study was to investigate whether some auditory physiological and psychoacoustical tests are sufficiently sensitive to detect minute cochlear lesions that cannot be diagnosed by routine clinical audiological tests. Four different clinical study groups were selected, all of them comprising individuals with disabling, persistent tinnitus, but with no or only minor pure tone threshold elevations. Two of these groups were selected since they represent aspects of occupational noise-induced tinnitus; and for comparison, two other groups were included.

Study Groups

Subjects

All subjects in the study had consulted the services of the Department of Hearing and Balance, Karolinska University Hospital, Stockholm, for persistent tinnitus. One inclusion factor was normal hearing, or at most minor hearing loss, measured with pure tone audiometry; and the pure tone average across the frequencies 500, 1000, and 2000 Hz was <20 dB hearing level (HL). Narrow mid-frequency dips (<25 dB HL) were permitted. A mild, high-frequency sensorineural hearing loss was also accepted (<40 dB HL at 4000 Hz). The high-frequency threshold average (3000, 4000, 6000 Hz) had to be <35 dB HL. Conductive hearing loss, even very mild, was an exclusion criterion. Only patients with normal otomicroscopic findings were accepted. Patients with middle ear problems, or other otological diseases, were excluded. To reduce confounding effects of aging, an upper age limit of 60 years was chosen. [11]

Four clinical study groups, based on etiology, were selected for the study. Participants of two of the groups had been exposed to noise that could have caused the tinnitus: (1) subjects with acute, intense acoustic trauma as the most likely causative factor and (2) professional and semiprofessional musicians, with music as the most likely causative factor. For comparison, two other causative groups were tested: (3) persons with suspected hereditary tinnitus and (4) persons judged to have nonauditory, cross-modal tinnitus. [12]

The intention was to study a series of consecutive patients. However, that was not possible since about half of the proposed participants abstained, many of them because they were afraid to be exposed to sound even of moderate intensity. Forty-six patients fulfilled the inclusion criteria and accepted the invitation to participate in the study. Of these patients, 17 were women and 29 men (mean age: 35 years; SD: 13 years; range: 18-59 years).

Etiological classification

All patients were examined, on a regular visit to the clinic, by a doctor specialized in ENT diseases and audiological medicine (in most cases one of the authors, U.R.). An ENT examination including otomicroscopy was performed, and a thorough, structured medical history was taken. The impact of the four causative factors was judged for each patient on an arbitrary scale: 0 = no influence; 1 = mild influence; 2 = marked influence; 3 = very strong influence. [Table 1] gives detailed information of the use of the scale. Many patients had more than one causative factor with judged influence larger than 0. Each patient was assigned to one of the causative groups mentioned above, and each of the causative groups consisted of those individuals who had their highest judged value for the corresponding causative factor [Table 1].{Table 1}

Acoustic trauma group

The acoustic trauma group included 16 subjects (12 men and 4 women) who had been exposed to sudden, intense noise. All the cases reported that the symptoms started immediately after the exposure, and none had experienced any problems before the incident. In 11 cases, the exposure was an impulse noise. Seven were military conscripts: 3 cases exposed to fine-caliber firearms and 4 cases to heavy-caliber guns. They had met with shooting accidents either because of ill-fitting ear protectors or because of service of weapons without ear protectors. The other four impulse noise exposures were blows from a hammer in a factory, a bus tire exploding at a bus stop, explosions during a chemistry lesson, and from firecrackers. The remaining 5 cases had been exposed to intense, stationary noise at 115-130 dB sound pressure level (SPL), lasting for several minutes, for example, a burglar alarm, activated by mistake, in a military rock shelter. The military impulse noise cases were tested about 3 weeks after the exposure as well as after 2-3 months. The other cases were tested 1-9 years after the exposure. The mean and median ages were 24 and 30 years, respectively.

Music group

The music group included 10 cases (4 women and 6 men), all of them working professionally with music, some of them full time (6 cases) and some part time along with other occupations (4 cases). The group included various professions: drummer, contrabassist, violinist, singer, choir leader, music teacher, and sound engineer. Hyperacusis and tinnitus were about equally common as the main symptoms. Stress and muscular tension

were commonly reported in this group. This group was the most homogeneous regarding age, with the youngest member of the group being 28 years old. Both mean and median ages were 43 years.

Hereditary group

The hereditary group consisted of 9 cases (2 women and 7 men) with suspected hereditary origin of the symptoms. The diagnosis was based on a family history of tinnitus and hearing loss (parents, children, siblings, etc.). One case had a grandmother and an aunt who had tinnitus and hearing loss. Six cases had 2 or more relatives and 4 had 1 relative with auditory symptoms. Four of the cases belonged to the same family, a father and his three sons. Minor mid- or high-frequency dips were present in 7 cases. Seven patients had nonauditory symptoms, often mild, the most common being stress and muscular tension. The mean and median ages of the hereditary group were 35 and 37 years, respectively.

Nonauditory group

A nonauditory group of 11 patients (7 women and 4 men) without any family history of hearing problems and no apparent ototraumatic events was included. Hyperacusis and tinnitus were almost equally common as the main symptoms. The symptoms defining nonauditory factors were muscular tension, neck pain, tension headache, odontological problems, intense stress, anxiety, depression, dizziness, chronic pain, and chronic fatigue. Only nonauditory factors that preceded the auditory symptoms were accepted to avoid contamination of secondary stress and muscular tension caused by auditory problems. Some of the patients played music, but none of them was a professional musician. The mean and median ages of this group were 38 and 34 years, respectively. This group, presumably with little or no evidence of cochlear damage, can serve as a clinical reference group. All patients gave their informed consent to partipate in the study, which was approved by the local ethical committee.

Methods

The patients were examined with an auditory test battery. All patients were tested with pure tone audiometry and also fixed-frequency Békésy audiometry. For the purpose of detecting minute lesions affecting the cochlea and its regulatory system, two tests were selected: Psychoacoustical modulation transfer function (PMTF) and transient evoked otoacoustic emissions (TEOAEs) with and without contralateral noise. The test time for these tests was 2-3 h.

Psychoacoustical modulation transfer function

The active nonlinear process in the cochlea is mediated by the outer hair cells (OHCs) and facilitates the perception of the complex sound patterns in speech. These patterns are characterized by rapid sound variations combined with slow modulations caused by speech syllables, words, and intonation. A measurement termed the PMTF reflects the functioning of the inner ear when handling slow intensity variations such as those of speech. PMTF measures the thresholds of brief tones placed at the peaks and in the valleys of a fully, sinusoidally intensity-modulated, octave-band noise at various sound pressure levels. [13] The test has been shown to measure more subtle qualities of hearing, and there is evidence that it reflects hair cell function, above all that of the OHCs. [14]

PMTF measurements

The measurements were performed on the ear with the most pronounced symptoms with the brief tone, 4 ms, and the octave-band filtered noise at 4000 Hz, and with a modulation frequency of 10 Hz. The noise levels were 35-85 dB SPL in steps of 10 dB. Initially, the threshold for the brief tone was measured without noise to familiarize the subject with the brief tone.

Typical PMTF results

[Figure 1] shows a few stylized, but characteristic PMTF curves.{Figure 1}

The normal PMTF curves are nonlinear, with a maximum signal-to-noise-ratio (S/N) for the peak threshold, occurring at a noise level of about 55 dB SPL. (The term peak threshold is used for the threshold of the brief tone when the tone is placed at the peak of the noise. The term valley threshold is used when the tone is placed

in the valley of the noise.) For the valley threshold, there is a corresponding maximum at about 65 dB SPL [Figure 1]a.

For a sensorineural hearing loss of cochlear origin, the nonlinearity is weaker. Both maxima have lower S/N and they occur at higher noise levels [Figure 1]b. This type of pattern indicates reduced nonlinearity.

A second type of abnormal PMTF pattern is presented in [Figure 1]c. The S/N maxima of the peak and valley threshold curves have markedly increased amplitudes and occur at the same, low noise level (35-45 dB SPL). The peak and valley curves are almost identical, which implicates that the affected ear can hardly take advantage of the silent interval around the brief tone in the valley. The term "hyper-PMTF" was coined for this pattern.

There are also intermediate varieties between normal and hyper-PMTF. A mildly abnormal variety is shown in [Figure 1]d. Like in the hyper-PMTF, the S/N maxima of the peak and valley curves are positioned at the same noise level, but here they occur at a normal noise level (>45 dB SPL), and they are not as high as in the hyper-PMTF. The level dependence for peak and valley curves is the same. At every noise level used, the S/N for the peak threshold is a roughly constant number of decibels higher than the S/N for the valley threshold.

It is evident from the examples above that there are two main types of abnormal PMTF results: The positions of the maximum peak and valley thresholds can occur at higher or lower than normal noise levels (horisontal position in graph), and the corresponding S/N maxima are then either lower or higher than normal (vertical position in graph). Therefore, the only practical way of analysis is to use a qualitative method to define certain typical patterns, for example, the hyper-PMTF. This method will be described later.

Transient evoked otoacoustic emissions with and without contralateral noise

Otoacoustic emissions (OAEs) reflect the function of the OHCs. TEOAE recordings with and without contralateral noise can be used to study the efferent system - the medial olivocochlear (MOC) system. This system is constituted by neurons in the medial olivary complex and efferent neurons passing from the vestibular nerve to the cochlea. [15] The system modulates the cochlear function by acting on the OHCs. It has been suggested that the MOC system might influence the ear's resistance to noise trauma. [16],[17],[18] In the latter study, animals with the weakest MOC control suffered the most damage when exposed to traumatizing sounds. It is also interesting to note that Veuillet et al. [19] showed results indicating that military officers with good suppression measured after acoustic trauma had a better recovery than officers with less or no suppression. Janssen et al. [20] tested ears affected with sensorineural hearing loss with tinnitus. About half of them had decreased distortion product otoacoustic emission (DPOAE/DP) levels, which is considered normal for sensorineural hearing loss, and the other half had increased DP levels, hypothesized to be generated by cochlear hyperactivity that could cause both the abnormally high DP level and the tinnitus. Similarly, we found both increased and decreased TEOAE responses in a noise susceptibility project with young conscripts (unpublished): Groups exposed to continuous noise had low TEOAE amplitudes. In contrast, a group who had been exposed to strong, but not extremely intense, impulse sounds showed increased TEOAE responses (the correlated part) and intensified chaotic activity (uncorrelated responses to stimuli, mostly regarded as noise). Obviously, this phenomenon may complicate the interpretation of what is a normal TEOAE response.

Transient evoked otoacoustic emission measurements

For the measurements, clicks with the duration of 80 μs were repeated with a frequency of 50 Hz. The standard nonlinear mode was used to enhance those components in the response, which have a nonlinear dependence on the stimulus level, and to suppress the linear components in the response. [21] To accomplish this, the polarity of every fourth click is reversed and the sound pressure of the click is increased by a factor of 3. The acoustical responses from 1000 clicks are averaged, after removal of the primary click by time-windowing technique. Half of the click responses are averaged in one buffer, the other half of the responses are averaged in a second buffer. The stimulus level is specified as so-called peak equivalent sound pressure level, peSPL. Clicks at 75 and 85 dB peSPL were used with and without contralateral broadband noise at 70 dB SPL. The

RMS values in 1000-Hz-bands for the TEOAE response (the response that is common to the two buffers, i.e., correlated to the clicks), over the interval of measurement, were used in the analyses. Also, the uncorrelated response (the difference between the contents of the two buffers) was analyzed in 1000-Hz-bands. The bands were centered around 1000, 1500, 2000, 3000, 4000, 5000, 6000, 7000, and 8000 Hz. To obtain the suppression in those bands, the differences between the decibel values of responses without contralateral noise and the decibel values of the responses with contralateral noise were calculated. Thus, a suppression value is positive when the response decreases and it is negative when it increases with contralateral noise.

Equipment

Two test systems were used. Each of them consisted of a Tucker-Davis Technologies System III with RP2.1 processing unit with 24-bits A/D and D/A. The TDT systems were controlled by personal computers. Circumaural earphones, Sennheiser HDA 200, were used for the psychoacoustical measurements. The probe system used for measuring OAEs was of type ER-10C from Etymotic Research.

Classification of measured functions

The aim of the analysis was to find out how the four causative factors might induce abnormal function of the inner ear and/or the efferent system. With only 46 test subjects in this first analysis, we had to limit the number of variables in the outcome of the measurements. One reasonable way to do that was to use visual judgements to present the results. The first author, A.C.L., working in the research laboratory situated in another part of the city, and blind to the judgements of causative factors, made all interpretations using experience from earlier test subjects and patients of various ages.

Three dependent variables were studied. Like the causative factors, these variables were classified on four-graded scales, from no abnormality at all (0) to a strongly marked abnormality (3).

Outer hair cells function

The quality of the OHC function was judged from TEOAE levels and from the nonlinearity function of PMTF. ([Figure 1]a shows a normal nonlinearity and [Figure 1]b shows a reduced nonlinearity.) The OHC function was classified as follows: 0 = normal, no abnormality; 1 = slight abnormality (mild decrease of the PMTF nonlinearity and/or weakened TEOAE responses); 2 = marked abnormality (strongly reduced PMTF nonlinearity function [Figure 1]b and weakened TEOAE responses); 3 = strongly marked abnormality (very strongly reduced PMTF nonlinearity and affected TEOAE levels).

Psychoacoustical modulation transfer function positioning

Experience suggests that a variable describing the PMTF positioning (i.e., the positioning of the maxima of the peak and valley threshold curves in the PMTF results) could be useful. The hyper-PMTF would then be the most extreme abnormality. The PMTF positioning was classified as follows: 0 = normal [Figure 1]a 1 = slight abnormality (see [Figure 1]d; identical positioning of maxima for peak and valley threshold curves at noise levels higher than 45 dB SPL, or the maximum of the valley threshold curve falls at a lower noise level than that of the peak threshold curve); 2 = marked abnormality (irregularly shaped hyper-PMTF); 3 = strongly marked abnormality ([Figure 1]c; hyper-PMTF with high maxima at 45 dB SPL noise level or lower).

Efferent regulatory function - the medial olivocochlear function

The MOC function is presumed to be expressed by the suppression effect on TEOAEs when contralateral noise is presented. It sometimes happens that a person, of any age, has increasing reponses with contralateral noise in very specific and individual frequency bands. This lack of effectiveness of the efferent system has been measured on some tinnitus sufferers. [22] General statistical analyses over all frequency bands, separately or as a total, would hide such individual abnormalities. Regarding the suppression of TEOAEs with contralateral noise, the classifications were as follows: 0 = normal; 1 = slight abnormality (decreased suppression or no suppression); 2 = marked abnormality (some increase, instead of decrease, in TEOAE responses with contralateral noise, i.e., negative suppression); 3 = strongly marked abnormality (strong negative suppression). For some ears with extremely strong uncorrelated activity in the TEOAE measurements, this deficiency in

regulation was taken into account in the classification.

Statistical analyses

The statistical analysis was performed with Statistica, release 7. Analyses of variance (ANOVAs) were performed for the four etiological groups, which were based on the most likely causative factor, versus OHC function, MOC function, and PMTF positioning. A corresponding analysis was done for groups versus high-frequency threshold average (3000, 4000, 6000 Hz). Correlations between age or pure tone thresholds, especially the high-frequency threshold average (3000, 4000, 6000 Hz), and abnormal function of the inner ear or efferent system were also looked at. Multiple analyses of variance (MANOVAs) could be performed for auditory test results versus individual causatives factors only if the causative factors were two-graded, that is, "No" - no or only mild influence, or "Yes" - marked or very strong influence. Tukey's honestly significant difference (HSD) test was used when needed.

Results

Judged causative factors and auditory test results in etiological groups

The prevalence of judged causative factors as well as the outcome of the auditory tests in the four patient groups are presented in [Table 2] and [Figure 2]. Because there were significant correlations between some pure tone thresholds and the judged OHC and MOC functions, the means and standard deviations of the pure tone thresholds at 3000, 4000, and 6000 Hz are included in the table. It is apparent that the most abnormal results of the audiological tests were seen in two patient groups: the acute noise trauma group and the hereditary group. The prevalence of marked or strongly marked abnormalities in test results was lower in the music group, and almost absent in the nonauditory group.{Table 2}{Figure 2}

About half of the test subjects, especially those with the worst hearing thresholds, presented slight OHC abnormalities manifested in PMTF curves with decreased nonlinearity and/or low TEOAE levels, but no patient in this study, considering people with normal or nearly normal hearing thresholds, had the highest degree of OHC abnormality. In contrast, there were 17 subjects with a high degree of abnormality regarding the positioning of the PMTF-curve maxima, like the hyper-PMTF, the extreme example in [Figure 1]c. For most of them, acoustic trauma had been judged to be the most likely causative factor.

Almost all hereditary cases (~90%) had a high degree of MOC abnormality. The same was the case for ~70% of the subjects in the trauma group, 50% in the music group, and ~30% in the nonauditory group.

The PMTF positioning had no significant correlation to hearing thresholds or any of the other measured functions. OHC and MOC functions were significantly correlated to each other ($P<0.01$) and to the high-frequency threshold average ($P<0.01$). There was no significant influence of age.

Group differences in auditory test results

ANOVAs were performed for the four clinical groups versus OHC function, PMTF positioning, and MOC function, with threshold average (3000, 4000, 6000 Hz) as a covariate. A following Tukey's HSD test showed a few significant and characteristic differences between the etiological groups ($P<0.05$). [Table 3] shows an overview of the significant differences between groups.{Table 3}

Regarding the PMTF positioning, the acoustic trauma group presented the most abnormal test results, and this group was significantly different from the other three groups: hereditary ($P=0.0023$), nonauditory ($P=0.0023$), and music ($P=0.016$) groups.

Regarding the MOC function, the hereditary group had the most abnormal test results, which were significantly different from those of the nonauditory group ($P=0.0011$). Also, the results of the acoustic trauma group were significantly different from those of the nonauditory group ($P=0.0032$). The results of the music group fell in between.

There was a significant difference ($P=0.032$) in the OHC function between the acoustic trauma group and the nonauditory group. However, the OHC damage was not very pronounced in any of the groups.

The nonauditory group had a better high-frequency threshold average (3000, 4000, 6000 Hz), which differed

significantly from that of the hereditary group (P=0.018), and there was a trend for a difference from the acoustic trauma group too (P=0.092). (This was analyzed with a one-way ANOVA with the said threshold-average as independent variable and group as factor, and with a subsequent Tukey's HSD test.) The age of the participants had no influence on the analyses by group.

Individual causative factors and auditory test results

MANOVAs for auditory test results versus individual causative factors could not be performed for the four-graded scales. However, MANOVAs (plus Tukey's HSD tests) with causative factors only two-graded (i.e., "No" - no or only mild influence, or "Yes" - marked or very strong influence) showed some significant differences. Individuals judged to have been markedly or very strongly influenced by acoustic trauma showed worse test results in all three auditory tests - PMTF positioning (P=0.00019), MOC (P=0.028), and OHCs (P=0.0034) - than those judged not at all or only mildly influenced. There was also a significant difference regarding the causative factor nonauditory with better PMTF positioning (P=0.0044) for subjects judged to have at least marked influence of nonauditory problems than for those without or only mild such problems. (Very few judged to have nonauditory problems were judged to have been influenced by acoustic trauma, and very few judged to have been influenced by acoustic trauma were judged to have nonauditory problems.) Regarding the causative factor hereditary, the subjects supposed to have marked or worse hereditary influence had significantly better PMTF positioning (P=0.017) and worse OHCs (P=0.017) than those judged without or with only mild hereditary influence. The average MOC result was worse for the suspected heriditary cases than for others, but not significantly so. There were no significant differences in auditory test results for the causative factor music.

Discussion

Tinnitus is a symptom, not a diagnosis. In order to be able to manage tinnitus patients properly, it is important to diagnose separate tinnitus entities. This applies especially to normal-hearing patients with tinnitus, in whom only limited diagnostic information about the state of the cochlea can be extracted from the pure tone audiogram. Nevertheless, cochlear diagnostics are regularly based on demonstration of pure tone threshold elevations. Tests based on auditory physiological principles offer a possibility to sharpen the diagnostic capability, and the hypothesis of this study is that a carefully designed physiological test battery is a means to achieve this goal. The tinnitus patients of this study were selected to represent four different causative groups, two of them related to noise exposure. They were diagnosed according to a structured medical history, and on other clinical observations not related to any of the physiological principles applied in the test battery. This allows a validation of these physiological tests.

For the patients with tinnitus that appeared after short, intense sound exposure, the acoustic trauma group, it can be assumed that they should have some damage affecting the function of the inner ear. The test results support this assumption. All patients who were judged to have suffered acoustic trauma had at least two abnormalities within the test battery. The most common marked abnormalities affected PMTF positioning plus MOC function. However, two of them had strongly affected MOC function but fairly normal PMTF positioning. The measurements of OHC function were in most cases slightly abnormal. These findings suggest a combination of inner ear damage (in spite of normal or slightly abnormal pure tone audiograms) and disturbed efferent modulation of the cochlea. The results of the acoustic trauma group are in concordance with other reports. [9],[10],[19],[23] In the study by Attias et al. involving military personnel, [9] DPOAEs could be measured on ears with hearing thresholds as high as 75 dB HL, which suggests severe damage to inner hair cells (IHCs). It has been shown that normal or near-normal thresholds in animals do not exclude damage first to IHC cochlear nerve terminals and later to IHCs. [24],[25] A large percentage of IHC afferent synapses could be damaged despite normal thresholds. Moreover, Attias et al. mention that ipsilateral enhancement of OAEs could stem from decreased MOC efferent feedback to the OHCs because of IHC damage and reduced input from the afferent arm. This agrees well with our findings of extreme TEOAE responses (or, through contralateral regulation, increase instead of decrease of TEOAEs when contralateral noise was presented) for some subjects

and also with the findings of Attias et al. [8] in tinnitus patients with normal hearing thresholds.
The group of musicians presented ambiguous results regarding the mechanisms causing the symptom. All but one had cochlear dysfunction of some kind, for example the two of them who had fully developed abnormal PMTF positioning (hyper-PMTF). The statistical analysis of this small group does not give much information regarding the possible presence of minor but typical cochlear dysfunction. This is not surprising, since there is a large variety of individual mixes of types of music exposure and other circumstances for people working with music or in rooms where music is played. A larger study in progress takes this into account.
In the nine cases, for whom heredity was judged as the main causative factor, all but one had a high degree of abnormality in efferent function, and the statistical analyses showed that the main characteristic of the hereditary group was abnormal MOC function. The MOC function was mainly judged from the contralateral suppression of TEOAEs. Especially suspected hereditary cases had strongly abnormal suppression (strongly increased response) in individual combinations of frequency bands. Overall values of suppression or prechosen frequency band do not necessarily reveal such abnormalities. One may ponder if a defect MOC, at least in a young person, might signal a hereditary defect, and that such a dysfynction may sensitize the cochlea to noise damage. The latter assumption is strenghtened by the existence of a significant correlation between the results of the MOC and OHC measurements in the study. However, a larger patient material is necessary to confirm these assumptions. To the best of our knowledge, this is the first report on a type of hereditary tinnitus, related to abnormal MOC function, and possibly resulting in decreased resistance to noise damage.
The nonauditory group represents patients with tinnitus with, presumably, unaffected cochlear function. [12],[26],[27] With a couple of exceptions, with test results hinting at acoustic trauma, the outcome of the tests in this group showed little evidence of abnormal function. The statistical analysis shows that factors triggering tinnitus in the nonauditory group should preferably be searched for outside the peripheral auditory system. Two other possible factors - the age of the participants and the presence of audiometric dips - did not predict the presence of inner ear dysfunction or abnormality affecting the efferent system.
The outcome of the test battery shows that PMTF positioning and MOC function suggests abnormalities in the group where these are most likely to appear - the acoustic trauma group. Moreover, the MOC function appears to be impaired in this group. Especially the PMTF positioning test appears to provide important diagnostic information even after relatively limited noise exposure, causing tinnitus but not pure tone threshold elevations. The test of the OHC function (TEOAEs and PMTF nonlinearity) is less important for this patient category. Still the results deviate significantly between the the nonauditory group and the acoustic trauma group [Figure 2]. The same test pattern appears in an individual analysis of no or mild influence versus marked/very strong influence of causative factors (e.g., exposure to noise). This analysis shows significantly poorer OHC function for individuals with acoustic trauma, but also for individuals with suspected heredity as a risk factor, than for individuals without these risk factors.
In this study the subjects were categorized into groups according to most likely causative factor. However, most patients had more than one judged causative factor. For some patients the results of the hearing tests point toward causative factors that were judged possible, but not judged as the most likely one. This indicates the diagnostic value of the test battery. However, it is plausible that more than one causative factor has caused a patient's tinnitus. Thus, there might be an uncertainty in interpretation of test results and a difficulty to find a one-to-one relationship between causative factor and test outcomes. The music group, at least as a group, might be an example of that.
The present study indicates that it is possible to reach a diagnostic capability of, for example, noise-induced hearing loss far beyond what is possible with pure tone audiometry only. Such a refined capacity offers possibilities to support medicolegal assessments of, for example, noise-induced hearing loss, to select appropriate treatment programs and to improve counseling for the patients.
Conclusions

The results of the present study suggest that the diagnostic capability can be improved by using modern physiological methods. Tinnitus and related symptoms can be caused by a broad variety of unrelated triggering factors. We found distinct cochlear lesions especially in cases where acoustic trauma or heredity are possible causative factors. A new entity of hereditary tinnitus with abnormal MOC function, and possibly increased sensititvity to noise, is described.

Acknowledgments

The study was supported by grants from Swedish Skandia Life, The Foundation Tysta Skolan, the Federation of Hard of Hearing People (HRF), and the Swedish Council for Working Life and Social Research. We express our gratitude also to Ann Johansson and Helena Norell, who performed the measurements, and to our test subjects. Support from Åke Olofsson was invaluable to the project.

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Publication date: Nov 2011

Year: 2011

Sustained Attention in Children With Primary Language Impairment: A Meta-Analysis

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1372-1384.
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Abstract: This study provides a meta-analysis of the difference between children with primary or specific language impairment (LI) and their typically developing peers on tasks of sustained attention. The meta-analysis seeks to determine whether children with LI demonstrate subclinical deficits in sustained attention and, if so, under what conditions. Articles that reportedempirical data fromthe performance of children with LI, in comparison to typically developing peers, on a task assessing sustained attention were considered for inclusion. Twenty-eight effect sizes were included in the meta-analysis. Two moderator analyses addressed the effects of stimulus modality and attention-deficit/hypereactivity disorder exclusion. In addition, reaction time outcomes and

the effects of task variables were summarized qualitatively. The meta-analysis supports the existence of sustained attention deficits in children with LI in both auditory and visual modalities, as demonstrated by reduced accuracy compared with typically developing peers. Larger effect sizes are found in tasks that use auditory-linguistic stimuli than in studies that use visual stimuli. Future research should consider the role that sustained attention weaknesses play in LI as well as the implications for clinical and research assessment tasks. Methodological recommendations are summarized.

Full text: Headnote

Purpose: This study provides a meta-analysis of the difference between children with primary or specific language impairment (LI) and their typically developing peers on tasks of sustained attention. The meta-analysis seeks to determine whether children with LI demonstrate subclinical deficits in sustained attention and, if so, under what conditions.
Method: Articles that reportedempirical data fromthe performance of children with LI, in comparison to typically developing peers, on a task assessing sustained attention were considered for inclusion. Twenty-eight effect sizes were included in the meta-analysis. Two moderator analyses addressed the effects of stimulus modality and attention-deficit/hypereactivity disorder exclusion. In addition, reaction time outcomes and the effects of task variables were summarized qualitatively.
Results: The meta-analysis supports the existence of sustained attention deficits in children with LI in both auditory and visual modalities, as demonstrated by reduced accuracy compared with typically developing peers. Larger effect sizes are found in tasks that use auditory-linguistic stimuli than in studies that use visual stimuli.
Conclusions: Future research should consider the role that sustained attention weaknesses play in LI as well as the implications for clinical and research assessment tasks. Methodological recommendations are summarized.
Key Words: attention, specific language impairment, meta-analysis, cognition

Children with primary language impairment (LI) appear on clinical caseloads and in the research literature under a variety of names, including specific language impairment (SLI), language disorders, and language-based learning disabilities. Consistent with a growing number of researchers, we prefer the term primary language impairmenthere, as it encompasses the subtle nonlinguistic processing weaknesses that exist alongside the defining deficits in language yet maintains the distinction between this diagnostic category and LI attributed to frank sensory, cognitive, or neurological disorders (e.g., Kohnert,Windsor, &Ebert, 2009; Tomblin, Zhang,Buckwalter,&O'Brien, 2003).For children withLI, several areas of language may be affected, including vocabulary, morphosyntax, discourse, written language, and social language (for reviews, see Leonard, 1998; Schwartz, 2009).

Although poor performance on language tasks, in the face of otherwise typical development, is considered the critical marker of LI, subtle processing inefficiencies extend beyond language to the general cognitive domain. Mounting empirical evidence points to at least three general areas of cognitive-processing inefficiency in children with LI: working memory, speed of information processing, and attention (for reviews, see Gillam, Montgomery, &Gillam, 2009; Windsor &Kohnert, 2009). The extent of these subclinical, cognitive-processing weaknesses and their relationship to the more obvious language deficits in children with LI is not yet clear. Our concern here is with attention. The high comorbidity rate between language disorders and clinical disorders of attention is robustly supported (e.g., Willinger et al., 2003). However, the connection between delayed or inefficient language and attention may extend beyond comorbidity to more subtle deficits.

We present a meta-analysis and narrative summary of the empirical literature assessing one subtype of attention, sustained attention, in children with LI. Our purpose was to synthesize the evidence that supports or refutes the existence of sustained attention deficits in children with LI. This information is needed to guide future investigations, which will, in turn, pave the way for advances in both language theory and clinical practice. To

provide the context for this systematic review, we first consider the major conceptual approaches to attention and the theoretical basis for connections between attention and language development.We then discuss the rationale for focusing specifically on sustained attention. Finally, we explain the motivation for using a metaanalysis to consider the evidence related to this potential component of the LI profile.

Models of Attention and Links to Language

Attention is a basic cognitive skill that underlies performance on most information-processing tasks. The breadth and importance of this skill has led to several distinct conceptualizations of attention, many of which directly link attention and language. We review three of the most common conceptualizations of attention. These three conceptualizations are not mutually exclusive; however, each has distinct predictions regarding the impact of attention skills on language development. Thus, we consider each model, with its implications, separately.

In the first major model, the key division of attention is between automatic (or unconscious) and controlled (or conscious) information processing. Controlled attention requires the effortful maintenance of a goal in mind and is thus closely related to executive functions (Miyake, Friedman, Rettinger, Shah, &Hegarty, 2001). It can be assessed through higher level cognitive tasks as well as working memory tasks. Controlled attention is implicated in language acquisition because a language learner must successfully focus on relevant auditory input in the face of distracting stimuli. Conscious attention to the relevant linguistic input may then activate unspecialized neurons, assisting with the learning process (seeWindsor&Kohnert, 2009, for review). In addition, children with LI may demonstrate impairments in controlled attention (Marton, 2008). The relationship between controlled attention and LI may be mediated by a common association with working memory and higher level cognitive tasks: Controlled attention can be assessed through higher level cognitive tasks and working memory tasks (Miyake et al., 2001), and evidence strongly indicates that weaknesses in workingmemory and higher level cognitive tasks are a component of the LI profile (Kohnert et al., 2009; Montgomery, 2002).

The second model conceptualizes attention as a limited-capacity system. In this model, an individual's attentional resources are allocated to tasks as needed, but problems arise when task demands exceed the individual's attentional capacity (Montgomery, Evans, &Gillam, 2009). Because the working memory system is often also conceptualized as a limited-capacity system (Just &Carpenter, 1992), attention is again closely related to working memory in this model. Language acquisition and attention are linked within this theory as well because language learners must allocate their attentional resources to incoming linguistic stimuli in order to process it. Evidence within both the working memory (Montgomery, 2002) and attention frameworks (Montgomery et al., 2009) indicate that children with LI demonstrate notable capacity limitations.

A third major approach to conceptualizing attention is to divide it into components (e.g., Gomes, Molholm, Christodoulou, Ritter,&Cowan, 2000; Mirsky, Anthony, Duncan, Ahearn, &Kellam, 1991). The purpose of such an approach is to characterize the functioning of distinct pieces of the complex attention system more precisely, allowing for more accurate identification of points of breakdown in attentional problems. In addition, neuroanatomical evidence indicates that distinct brain regions are associated with each component of attention (Mirsky et al., 1991). Component approaches differ somewhat in the way they conceptualize the critical pieces of attention. Mirsky et al. (1991) argued that there is both behavioral and neuroanatomical evidence for four distinct components of attention: focus, inwhich information is selected for processing; sustain, in which this focus is maintained over time; shift, in which attentive focus is moved to new information; and encode, in which information is mentally registered.

All components of attention have a role in language acquisition (Gomes et al., 2000). A language learnermust focus on relevant linguistic input and ignore irrelevant input. Heor shemust sustain this focus in order to take in complete input for processing. When the source of language input shifts, the language learner must also shifthis or her attention to avoid missing relevant input. Finally, he or she must attend to encoding the information in order to make it available for future use.

As with the first two attention models reviewed, empirical evidence also links weak attention skills to LI in the

component model. Initial evidence suggests that attentional shifting may be intact in children with LI (Schul, Stiles,Wulfeck,&Townsend, 2004). However, recent studies indicate that children with LI have deficits in sustained attention (Finneran, Francis, &Leonard, 2009; Spaulding, Plante, &Vance, 2008); in focus, or selective attention (Stevens, Fanning, Coch, Sanders, &Neville, 2008); and in encoding, which is similar to working memory.

Thus, from each distinct perspective, the contribution of attention to language acquisition can easily be hypothesized. In other words, it is likely that attention skills combine with other cognitive constructs (such as memory) to facilitate language learning (Windsor &Kohnert, 2009). In addition, converging evidence suggests that weak attention skills play a role in LI. These patterns support a closer analysis of subtle attention deficits as a component of the LI profile, joining more established cognitive-processing deficits such as speed of processing and working memory. However, this brief discussion of attention also underscores the difficulty of capturing the diverse conceptualizations of attention in a single, operational definition. Such an operational definition is necessary for conducting a sound systematic review and meta-analysis, as systematic reviews must focus on a concise question (Schlosser,Wendt,&Sigafoos, 2007). Thus, narrowing our view of attention to a single perspective-and, even further, to a particular subtype of attention-facilitates synthesis of a portion of the evidence for attentional deficits in LI.

In the present study, we adopt a component theory of attention and consider the specific dimension of sustained attention. The component theory of attention is designed to break attention down into discrete potential areas of deficit, which can be assessed separately (Mirsky et al., 1991). In contrast, both controlled attention and limited-capacity attention are inextricably intertwined with the concept of working memory, making assessment of attention and not working memory very difficult.

Sustained Attention

Within the component theory of attention, we focus on sustained attention as a starting point because there is reason to believe it is problematic in children with LI. Mirsky et al. (1991) define sustained attention as "the capacity to maintain focus and alertness over time, or vigilance" (p. 112). The authors of at least two separate studies claimed to have observed impaired vigilance in children with LI, with a resulting impact on task performance. Stark and Montgomery (1995) observed that children with LI who were completing a sentenceprocessing task "would sometimes gaze around the test room, play with the headphones, or slump, glassy-eyed, while the sentences were being presented" (p. 150). In addition, Helzer, Champlin, and Gillam (1996) found that children with LI and their typically developing (TD) peers had remarkably similar auditory temporal resolution skills. However, the children with LI required more trials to achieve a threshold. Because this reflects inconsistency in responses, the authors interpreted this difference as a reflection of poorer sustained attention skills among the LI group. However, sustained attention was not measured directly in either of these studies.

There has also been indirect evidence indicating that weak sustained attention skills play a role in treatment gains. Results from a large randomized trial suggest that language gains following intensive treatment programs may be related to gains in sustained attention. Gillam et al. (2008) assigned over 200 schoolage children with LI to one of four treatment conditions. All participants attended treatment for 3.5 hr per day, but participants in one condition received a control treatment not specific to language. Significant but equivalent language gains were found across the four groups, leading Gillam et al. (2008) to question whether the intensive treatment conditions caused participants to improve their information-processing skills, including sustained attention (p. 113). Implicit in this claim is the premise that children with LI have impaired sustained attention skills prior to the intervention. Two singlesubject experimental design treatment studies (Ebert &Kohnert, 2009; Gillam, Crofford, Gale,&Hoffman, 2001) made very similar inferences, hypothesizing that intensive intervention may boost language in part through sustained attention improvements. It is important to note that in these two studies, the authors used a design that limits the ability to generalize to the population and thus made weaker claims than

did Gillam et al. (2008). However, an even more important limitation of all three studies is that they lack a direct measure of attention either before or after intervention and, therefore, cannot provide direct evidence either of weak attention skills in LI or of attention skill improvements with treatment.

In addition, several recent studies have directly investigated the presence of subclinical sustained attention deficits in children with LI (e.g., Bishop&Norbury, 2005; Finneran et al., 2009; Spaulding et al., 2008). These publications highlight increasing interest in the potential relationship between sustained attention and LI. In summary, both indirect and direct evidence suggest that sustained attention skills are potentially subtly impaired in children with LI. However, single studies provide conflicting results and are not strong enough to definitively establish the presence or characteristics of such deficits. A systematic review of the topic is warranted.

A Systematic Review and Meta-Analysis of Sustained Attention in LI

The purpose of a systematic review is to identify and synthesize evidence relevant to a specific question in a transparent and an unbiased manner (Dollaghan, 2007). Systematic reviews are an essential tool for directing future research and for guiding clinical decision making (Schlosser et al., 2007). In this case, a synthesis of the evidence regarding potential sustained attention deficits in children with LI would inform the LI profile for both researchers and clinicians. Meta-analysis, a subtype of systematic review, is often valued over other types of systematic reviews because of the quantitative nature of the results (Dollaghan, 2007).

The primary purpose of this meta-analysis was to synthesize the evidence for and against sustained attention deficits in children with LI. If robust evidence of sustained attention deficits in LI is found, then a secondary purpose of the review will be to characterize these deficits. Thus, we address two specific questions:

1. Do children with LI demonstrate deficits on tasks of sustained attention?
2. What are the methodological circumstances under which these differences are most evident, in terms of task, participant, and outcome variables?

To answer these questions, we conducted a search for articles in which both children with LI and TD peers completed a task of sustained attention. We defined children with LI using conventional criteria for LI/SLI (e.g., Leonard, 1998). To define a task of sustained attention, we adopted the suggestion by Mirsky et al. (1991) that the standard task for assessing sustained attention is a continuous performance task, or CPT (cf.Williams, Stott, Goodyer, &Sahakian, 2000). The CPT assesses vigilance or sustained attention by requiring the participant to monitor a series of stimuli over time for specific target stimuli (Corkum&Siegel, 1993). Adopting a narrow definition of a sustained attention task allowed us to avoid confusing cognitive weaknesses already associated with LI, such as working memory and executive function, with sustained attention weaknesses.

Method

Inclusion Criteria

Prior to initiating the search, several inclusionary criteria for articles were established. To avoid publication and language bias (Schlosser et al., 2007), the search targeted published articles as well as unpublished theses and dissertations in the public domain, in any language. It was determined that articles would be included in the review only if they met the following criteria:

1. The inclusion of at least one group of participants with LI. A variety of terms for LI were accepted (e.g., SLI, developmental language delay, dysphasia, etc.) as long as the participants met conventional criteria for LI, including nonverbal IQ within the average range, as demonstrated by a standardized test or author report, normal hearing, no identified neurological or behavioral disorders, and delayed language development in comparison with peers that is not restricted exclusively to the phonological domain of language (i.e., speech concerns may be present but should not be the only area of language affected). Exact criteria for the definition of delayed language development differed across studies;means of meeting this criterion included using a clinical diagnosis, requiring scores on one or more standardized language tests to be well below age expectations (e.g., >1.25 SDs below the mean), and requiring a significant discrepancy between standardized language and nonverbal IQ scores. Studies were included as long as they made a case for notable delays in

language development, in order to accommodate studies that spanned a wide range of both time and geography. In addition, some studies that were reviewed did not explicitly state a method for excluding children with attentiondeficit/ hyperactivity disorder (ADHD) from their LI sample (see the Moderator analyses subsection for more details). However, studies in which all LI participants also were diagnosed with ADHD (e.g., Oram-Cardy, Tannock, Johnson, &Johnson, 2009) were excluded.

2. The reporting of new empirical data from the administration of a behavioral task. Articles in which data only from parent or teacher observations of behavior were reported were excluded on the grounds that such checklists subjectively assess overt characteristics of inattention, such as those seen inADHD. The purpose of this review was to look for objective evidence of subtle attention deficits in children with LI.

3. The assessment of sustained attention via the behavioral task using some form of a CPT, although these tasksmay be referred to by other names (e.g., go/no-go task, sustained attention task, auditory or visualmonitoring task, etc.). Specifically, the present review was restricted to tasks that required the participant to monitor a stream of stimuli. Studies in which attention was assessed using more complex cognitive tasks, such as the Wisconsin Card Sorting Test (Kongs, Thompson, Iverson,&Heaton, 2000) or Tower of London (Culbertson&Zillmer, 2001; Marton, 2008), were excluded on the grounds that performance may reflect more complex executive functions (Kohnert et al., 2009) rather than the subcomponent of sustained attention. Similarly, in order to avoid rereviewing evidence that children with LI have deficits in working memory capacity, attention tasks that were framed as assessments of processing capacity (e.g., the competing language processing task)were not reviewed.

4. The comparison of reported results of the performance of participants with LI with the performance of a group of TD peers without LI on at least one outcome measure from the task. Some authors (e.g., Finneran et al., 2009) argue that a true measure of sustained attention must capture the decrement in performance over time during an extended task, and thus simple measures of accuracy or response time from a CPT are indices of selective attention only. However, this strict definition of sustained attention appears to be adopted by a small minority of authors, and its application to populations with LI remains rare: Only two studies that reported a measure of performance decrement over time were located. Thus, a more lenient criterion for acceptable outcome measures was adopted. Physiological outcome measures such as event-related potential waveforms were not included in the review on the grounds that such measures of attention do not compare with behavioral measures of attention in a straightforward way.

5. The inclusion of the first or primary measure reported for review when more than one outcome measure was reported for a single task administration. For example, Hanson and Montgomery (2002) reported both hit and false-alarm rates for the same sustained attention task; they described the hit rate as the "primary" dependent variable (p. 84), and therefore only the hit rate data were included in the present review. This stepwas adopted to avoid overemphasizing data from a single task in the review's conclusions.

Literature Search

A systematic search for empirical articles addressing sustained attention in children with LI was conducted in January andFebruary 2010.Databases searched include ERIC, GoogleScholar, HighWire Press, Medline, PsycINFO, and Web of Science. The search term combinations language impair* and attention and language disorder and attention were applied to titles, keywords, and abstracts in each database.

A total of 1,030 articles were identified in these searches. In the first round of article evaluation, abstracts were reviewed to exclude articles that clearly did not meet the search criteria established above. In otherwords, articleswere discarded if they did not contain participants with LI (e.g., participants had acquired aphasia, autism, or another language disorder distinct from LI), did not contain empirical data, or did not report behavioral results from a task that potentially assessed sustained attention. Any article that may have contained a task meeting search criteria, including those tasks labeled using terms other than sustained attention, were retained for further review. Duplicate articles were also excluded during this stage. Following the first round of article

evaluation, 45 articles were identified for further review.

The full text of these 45 articles was obtained. In the second round of article review, the first author reviewed the text of each to verify that the article did meet all search criteria. Five articles were written in languages other than English (three in Spanish and two in German). The English and Spanish articles were reviewed by the authors, and the German articles were reviewed by a consultant fluent in German. Following the full article review, 17 articles were identified for inclusion in the analysis. These 17 articles reported performance data from children with LI and from their TD peers on 33 separate sustained attention tasks. All 33 tasks reported accuracy data; 10 tasks also reported reaction time (RT) data. Table 1 lists these 17 studies along with a summary of participants, task characteristics, and results.

Reliability. A portion of the search was reconducted by the second author in order to establish its replicability. The second author, who did not take part in the initial search, reviewed 18% of randomly selected results from the search. Agreement with the first author as to whether or not the article met search criteria was 98% for these articles, prior to conferring.

Analysis

In order to perform the meta-analysis, effect sizes for each contrast of interest (i.e., children with LI vs. TD children) were calculated for the task accuracy data from each of the 33 tasks that met search criteria. The standardized mean difference between groups (Cohen's d; Cohen, 1988) was calculated from reported or graphically displayed group means and standard deviations when possible. Three studies (Greyerbiehl, 1981; Lum, Conti-Ramsden, &Lindell, 2007; McArthur &Bishop, 2004) subdivided the LI group; for these studies, data from all LI children were pooled to create the effect of interest.When the relevantmeans and standard deviations were not reported (i.e.,Wiig &Austin, 1972), a reported F statistic was used to calculate effect size (Cooper, Hedges, &Valentine, 2009). One study (Noterdaeme, Amorosa, Mildenberger, Sitter, &Minow, 2001) containing four tasks of interest reported only group medians, statistics for a three-way group comparison, including a group with autism, and a descriptive statement that the LI group performed significantly below the TD and autism groups on the tasks of interest. This study was judged not to provide enough information to accurately calculate d; it is included in qualitative portions of the review but was excluded from the meta-analysis.

These procedures generated 29 effect sizes for analysis. Visual inspection of the distribution of effect sizes indicated an obvious outlier with a d value nearly 3 times as large as the second greatest effect size in the distribution (Wiig &Austin, 1972; d = 3.41). This study was also eliminated from the meta-analysis portion of the review.

Calculations were made assuming a fixed-effects model. Each of the 28 remaining effect sizes were converted into Hedge's g to prevent bias from small sample sizes (Cooper et al., 2009), and the inverse variance of each effect size was used to weight the relative contribution of each study to the overall effect size. The weighted average effect size across all studies was then calculated.

Moderator analyses. Two moderator analyses were also conducted. The first moderator analysis addressed the question of whether sustained attention deficits in children with LI are restricted to the auditory modality (Noterdaeme et al., 2001; Spaulding et al., 2008). Tasks were divided into three groups according to the type of stimuli used: visual, auditory-linguistic, or auditory- nonlinguistic. A distinction was made between linguistic and nonlinguistic stimuli in the auditory domain because, by definition, children with LI perform poorly on language-based tasks; a true weakness in sustained attention in the auditory modality should appear in studies in which nonlinguistic stimuli are used.

The second moderator analysis examined whether studies that state explicit criteria for ensuring that participants did not have ADHD differ from studies that do not. A number of studies found in the literature search described their participants as having no known neurological or behavioral disorders but did not describe a test for ensuring that participants did not have ADHD specifically. This group of studies was compared with those studies in which a procedure for excluding children with ADHD (e.g., a screening test, parent report, or

teacher rating scale) was described.

Finally, a qualitative synthesis of results was performed for two additional areas: RT results and task variables. In each of these areas, the number of studies that could be included in ameta-analysiswas quite small. However, both areas were of interest a priori: RT differences between LI and TD children have been robustly supported in recent literature (Kohnert et al., 2009; Miller et al., 2006), and a previous review of CPT tasks (Corkum&Siegel, 1993) indicates that key task variables may be central to interpreting results from these tasks. Therefore, the data were extracted and analyzed qualitatively in these areas.

Results

Table 2 displays the results of the overall metaanalysis and the two moderator analyses. The weighted average effect size across all studies was 0.69. This result differs significantly from zero ($Z = 13.17$, $p < .001$), indicating that children with LI perform significantly below TD peers on sustained attention tasks. The test of homogeneity of variance among effect sizes was also significant ($Q = 59.16$, $p < .001$).

The moderator analysis for modality indicated that the weighted average effect size in each of the three modalities that were analyzed (visual, auditory-linguistic, and auditory-nonlinguistic) differed significantly from zero (auditory-linguistic: $g = 0.82$, $Z = 11.34$, $p < .001$; auditory- nonlinguistic: $g = 0.61$, $Z = 5.86$, $p < .001$; visual: $g = 0.47$, $Z = 4.24$, $p < .001$). The moderating variable explained a significant amount of variance in the effect sizes ($Qb = 24.87$; $p = .02$). In other words, the modality of stimuli does affect LI deficits on sustained attention tasks. However, a significant amount of within-group variance remained in the auditory-linguistic ($Qw = 23.34$, $p < .05$) and visual ($Qw = 15.13$, $p < .05$) groups. Thus, effect sizes in these two groups differed even after accounting for the effects of stimulus modality.

We conducted post hoc contrasts between the three modalities using Bonferroni correction. These analyses indicated that only the difference between the visual and auditory-linguistic means reached statistical significance at the $p < .05$ level.

The second moderator analysis examined the difference betweenstudieswith explicitADHDexclusioncriteria and those without. The between-groups heterogeneity statistic did not reach statistical significance ($Qb = 0.59$), indicating no difference in effect size between these two groups of studies.

RT Outcomes

RT data were reported for 13 of the 33 tasks that met search criteria, providing insufficient data for quality meta-analysis (Cooper et al., 2009). Children with LI demonstrated significantly slower RTs than did their TD peers on only one of these 13 tasks: the sustained auditory attention task reported by Noterdaeme et al. (2001). Taken at face value, this seems to indicate that speed of response on CPTs is unaffected by LI, a finding inconsistent with a growing body of literature indicating small RT differences for children with LI even on relatively simple perceptual motor tasks (e.g., Kohnert et al., 2009; Miller et al., 2006). We return to this point in the Discussion section.

Task Variables

Task differences may be the source of conflicting results in studies of sustained attention (Corkum &Siegel, 1993). Although all tasks within the reviewed studies met a relatively narrow definition of a sustained attention task, they differed along several dimensions. The key variables we extracted for comparison were the percentage of stimuli that are targets and the duration of the targets. We selected these variables for review because Corkum and Siegel's (1993) review of CPTs shows that manipulation of the percentage of targets and duration of targets has a notable effect on results. Numerous other variables, such as the task duration or the interstimulus interval, have the potential to affect outcomes, but clear and consistent patterns between these variables and task outcomes have not been established (Corkum& Siegel, 1993).

Table 1 presents task features, as well as dependent variables, for each of the 33 tasks reviewed. The duration of stimuli was reported for 22 of the 33 tasks. Stimuli ranged from 75 ms to 2 s in duration. The percentage of stimuli that were targets ranged from 10% to 50% for the 23 tasks that reported the information.

Discussion

The results of the meta-analysis establish the presence of sustained attention deficits in children with LI in comparison with TD peers. The weighted average effect size across studies indicates that the task accuracy of children with LI fell more than half a standard deviation below that of their TD peers. The effect size does, however, indicate some overlap between the LI and TD populations on sustained attention tasks (Cohen, 1988).

Corrected effect sizes ranged widely across studies, from g = -0.08, indicating that LI children performed slightly better than TD children, to g = 1.41, indicating that children with LI performed nearly 1.5 standard deviations below TD peers. We explained some of the variability among effect sizes by analyzing the role of stimulus modality on effect size. One of the prominent claims in the literature reviewed here is that children with LI demonstrate sustained attention deficits specific to the auditory rather than the visual modality (Noterdaeme et al., 2001; Spaulding et al., 2008). We differentiated between linguistic and nonlinguistic stimuli in the auditory domain on the grounds that tasks using linguistic stimuli may be more indicative of language than attention deficits in the LI population.Results supported this distinction: Although stimulus modality did play a role in effect size, only the difference between auditory-linguistic tasks and visual tasks reached significance. The average effect size for auditory-nonlinguistic tasks (g = 0.61) lies closer to the average effect size for visual tasks (g = 0.47) than for auditory-linguistic tasks (g = 0.82).We note, however, that all four of the studies in which both visual and auditory tasks were administered to the samechildren revealed deficits only on the auditory tasks (Dodwell &Bavin, 2008; Noterdaeme et al., 2001; Spaulding et al., 2008; Townsend&Tallal, 1989). It is possible that the difference between auditory-nonlinguistic and visual sustained attention tasks could reach significance with more data; such a result would provide compelling evidence of modality specificity in sustained attention deficits in children with LI. In summary, there was clear evidence of poorer performance by participants with LI across all three subtypes of sustained attention tasks, although the magnitude of this difference varied.

One potential limitation of the meta-analysis is that most of the reviewed studies investigated the attentional capacities of children with LI without ensuring that those children did not also have ADHD.Without any screening for attention disorders, samples of children with LIwould be expected to contain more children with ADHD than samples of TD children, and children with ADHD would be expected to perform poorly on a task of sustained attention. The results of the second moderator analysis address this concern. The small value of the betweengroups heterogeneity index indicates that studies with and without explicit ADHD exclusion do not differ substantially from each other. This result implies that other studies did, in fact, take steps to exclude children with ADHD but did not describe them in the article, stating instead that children in the LI group did not have behavioral or neurological disorders. Thus, the conclusion that children with LI demonstrate sustained attention deficits does not appear to be driven by the presence of children with comorbid ADHD in study samples.

RT

In contrast to the accuracy data, the RT results reviewed here provide little support for the claim that children with LI performmore slowly than TD peers on tasks of sustained attention. A number of factors temper this conclusion, however. First, RT measures are conventionally determined for accurate responses only. In a CPT, although both target and distractor trials can be used to calculate accuracy measures, only target trials can be used for RTcalculations (because there is no response on a correct distractor trial). In some cases, the number of targets on which valid measures of RTcould be made was relatively small. For example, the percentage of targets in Spaulding et al. (2008) was 17%(16) per task. Finneran et al. (2009) included 40%targets, yet given the very large group difference between LI and TD peers in accuracy, the number of stimuli on which valid calculations of RT could be made would be significantly reduced.

A second factor that limits the interpretation of RT results is the lack of statistical control for developmental effects in some of the studies. For example, Buiza- Navarrete, Adrián-Torres, and González-Sánchez (2007) found no significant between-groups difference in RT on a visual sustained attention task for participants who

ranged fromage 5;0 (years;months) to 12;11 (see Table 1). The potential effect of age within each group was not investigated. It is quite possible that within-group variation related to age overwhelmed any potential betweengroups RT differences. In a study in which simple and choice visual detection tasks in 8- to 13-year-olds were investigated, Kohnert and Windsor (2004) found that age accounted for a significant 40% of the variance in RT for monolingual children with LI, and 39% for their TD peers. In addition, two of the four studies that report RT data have the youngest participants in the review. It is possible that high variability in this population contributes to the lack of significance in RT results (Spaulding et al., 2008). Finally, only four studies reported RT data for children with LI on a sustained attention task. Clearly, additional RT data are needed to confirm or refute the hypothesis that children with LI do not demonstrate RT deficits on tasks of sustained attention.

On the basis of the existing empirical literature, accuracy measures yield the most robust differences in sustained attention between children with LI and their TD peers. Furthermore, the finding of reduced accuracy on sustained attention tasks by children with LI indicates that limitations in sustained attention skills in this population are separable from more generalized slowing in information processing.

Task Variables

Additional methodological differences that may affect results are the duration of stimuli and the percentage of stimuli that are targets. These variables were not included in themeta-analysis becausemany studies did not report this information, and the information obtained could not always be easily compared (e.g., some stimuli durations were measured in syllables, and others in seconds). However, these variables may explain variability in outcomes and deserve consideration.

Corkum and Siegel (1993) suggest that tasks with shorter stimuli durations and higher percentages of targets place a greater demand on attentional resources and therefore better discriminate between children with impaired and intact attention. Corkumand Siegel reviewed only tasks with visual stimuli and concluded that 50-200 ms is an optimal stimulus duration for such tasks. In the present review, significant results were obtained using stimuli that ranged from 75 ms to 1 s in duration, suggesting that sustained attention deficits in LI are apparent under a range of task conditions. However, Corkum and Siegel's review may help explain patterns in the results that did not reach significance. At least three of the reviewed tasks using visual stimuli that did not find significant results used stimuli durations of 1-2 s (an additional three tasks did not report stimuli durations). These durations fell well outside the range of 50-200 ms and could have affected the power of those tasks to find sustained attention deficits.

The percentage of stimuli that are targets is another task variable with the potential to influence results. Corkum and Siegel (1993) argued that a higher percentage of targets increases task monotony and therefore increases the task's potency to detect sustained attention deficits. Percentage of targets does not appear to have a clear effect on the present results. Significant differences between LI and TDchildrenwere found across the range of percentage targets, from 10% to 50%. Studies with nonsignificant results also appear to be distributed across that range.

Finally, as noted in the Results section, another task variable-such as task duration-could affect outcomes. Significantwithin-group variability remained in two of the three groups of studies after accounting for the effect of stimulus modality. Either of the two task variables reviewed here could explain some of this variability, as could another variable that was not highlighted by Corkum and Siegel (1993). It will be important for future work in this area to describe all task parameters to illuminate the relationship between task variables and outcomes.

Potential Biases

Thepotential for source bias is a general concernwith any systematic review (Schlosser et al., 2007). Publication bias is a particular concern; it is possible that the weighted average effect size found here is artificially inflated because studies in which smaller, nonsignificant effect sizes were found were not published. However, several considerations reduce the likelihood of significant publication bias in this study. Three of the 15 studies included

in the final meta-analysiswere, in fact, unpublished work (Greyerbiehl, 1981; Redey-Nagy, 2009; Townsend &Tallal, 1989). In addition, the sustained attention task was not the primary focus of many of the studies found in the literature search. Instead, the task was a component of a larger battery of tests (e.g., Arboleda-Ramírez et al., 2007; Buiza-Navarrete et al., 2007), a subcomponent of a single task (Lum et al., 2007), or an assessment used to predict performance on a separate task of interest (e.g., Dodwell &Bavin, 2008; McArthur &Bishop, 2004). Consequently, the publication status of these articles was unlikely to be driven by the significance of the sustained attention task, or lack thereof.

We also attempted to minimize language bias, as we sought studies published in any language, and source bias, as we searched a variety of databases. However, the possibility of relevant data that was not uncovered by the search must be acknowledged as a limitation.

Conclusions and Implications

We adopted the component theory of attention and selected evidence on a single subtype of attention within this theory to review. On the basis of this review, it appears that deficits in sustained attention are part of the LI profile. The evidence for sustained attention deficits in children with LI affects both clinical practice and research. Clinicians should be aware of the potential for decreased attention to task over time when administering and interpreting assessments of children with LI. Test results obtained from lengthy sessions may be negatively affected by attention skills.

Researchers should also be aware of the potential impact of sustained attention deficits on task performance. Children with LI have been found to demonstrate deficits relative to TD peers on a wide variety of cognitive tasks. The vast majority of these tasks contain a component of sustained attention, in that performance will suffer if task vigilance is not maintained. Thus, the presence of sustained attention deficits among participants with LI raises the possibility that poor task performance in LI groups is driven at least in part by attention. Given the theoretical basis for attention's impact on language learning, the possibility that attention weaknesses make a causal contribution to LI cannot be discounted. The claims that language gains following treatment may be driven in part by improvements in attention also support this possibility.

Results of this review provide a number of additional guidelines for future investigations of sustained attention in children in LI. Specific criteria for excluding children with ADHD should be articulated. Both visual and auditory attention should be investigated in tasks, using nonlinguistic stimuli to decouple basic cognitive functions from language demands. Additional RT data are needed to verify the apparent equivalence of LI and TD children in sustained attention RT; studies in which RT is calculated should include enough target trials to obtain reliable RT means. In addition, statistical calculations in these studies should control for the contribution of participant age, particularly when they include children across a wide and very dynamic period of cognitive development. Finally, it will be essential for future work to consider the skills of children with LI in other areas of attention. This review focused on a small subset of attention in order to facilitate feasibility, but the hypothesis that attention deficits in the LI population extend to other attentional components (such as focus, shift, or encode) remains untested.

Acknowledgments

Support for manuscript preparation was provided by National Institute on Deafness and Other Communication Disorders Grant 1R21DC010868. A portion of this study was presented at the 2010 annual convention of the American Speech-Language-Hearing Association.

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Editor: Janna Oetting
Associate Editor: Marc Joanisse
Received August 21, 2010
Revision received December 1, 2010
Accepted February 24, 2011
DOI: 10.1044/1092-4388(2011/10-0231)

Publication date: Oct 2011

Year: 2011

Bimodal Hearing and Speech Perception With a Competing Talker

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1400-1415.
ProQuest document link

Abstract: The objective of the study was to investigate the influence of bimodal stimulation upon hearing ability for speech recognition in the presence of a single competing talker. Speech recognition was measured in 3 listening conditions: hearing aid (HA) alone, cochlear implant (CI) alone, and both devices together (CI + HA). To examine the use of low-frequency cues, the competing masker voice was manipulated with respect to fundamental frequency (F0) and formant frequencies. Twelve implanted adults were included in the study.

Group results revealed only a relatively small benefit of CI + HA compared with the CI alone. A detailed analysis of errors, which was assumed to be an indicator for the release from masking, revealed that this benefit was not attributed to improved target-masker segregation. The variable determined to be responsible for segregating target and masker talkers was a large difference in F0 of the voices. This held true for all CI alone, HA alone, and CI + HA listening conditions. Bimodal hearing improved overall speech recognition of both the target and the masker. No evidence for better target- masker separation with bimodal fitting could be found.

Full text: Headnote

Purpose: The objective of the study was to investigate the influence of bimodal stimulation upon hearing ability for speech recognition in the presence of a single competing talker.
Method: Speech recognition was measured in 3 listening conditions: hearing aid (HA) alone, cochlear implant (CI) alone, and both devices together (CI + HA). To examine the use of low-frequency cues, the competing masker voice was manipulated with respect to fundamental frequency (F0) and formant frequencies. Twelve implanted adults were included in the study.
Results: Group results revealed only a relatively small benefit of CI + HA compared with the CI alone. A detailed analysis of errors, which was assumed to be an indicator for the release from masking, revealed that this benefit was not attributed to improved target-masker segregation. The variable determined to be responsible for segregating target and masker talkers was a large difference in F0 of the voices. This held true for all CI alone, HA alone, and CI + HA listening conditions.
Conclusions: Bimodal hearing improved overall speech recognition of both the target and the masker. No evidence for better target- masker separation with bimodal fitting could be found.
Key Words: bimodal hearing, hearing aid, cochlear implant, informational masking, fundamental frequency, formant frequencies

In many communication settings, people are exposed to speech from multiple concurrent talkers (e.g., in a cocktail party situation). Typically the listener does not need to attend to all talkers but only to one target talker selectively. In this case, the competing talkers are a distraction and prevent the listener from receiving the relevant information from the target talker. Two types of masking are involved in these listening situations and determine the recognition of the target speech signal. Energetic masking (EM) occurs when the spectral energy of a masking signal overlaps with the energy of a target signal so that proportions of the speech signals are inaudible at the periphery of the auditory system (i.e., at the basilar membrane). Informational masking (IM) describes the disturbances that contextual information has on the detection and discrimination of target components in a complex sound. The additional information is irrelevant for the listener and therefore interfering (Leek, Brown, &Dorman, 1991). IM is based on two important effects. The first effect is called stimulus uncertainty and corresponds to the listener's inability to ascertain which elements belong to the target signal and which belong to the masker signal. The second effect is referred to as target-masker similarity, which is related to spectral, temporal, and intensity similarity between target and masker signals. Both effects are interrelated (Durlach et al., 2003).

Normal hearing (NH) people are usually able to segregate concurrent talkers. This ability is based on auditory grouping mechanisms (Bregman, 1990). Brungart (2001) examined the effects of signal-to-noise ratio (SNR) and different masker voices on the perception of a target sentence masked by a single competing talker in NH subjects. The results indicated that performance was enhanced with increasing differences between target and masker, producing a release from IM. Darwin, Brungart, and Simpson (2003) confirmed the results of Brungart and provided more detailed information. They examined the influence of the fundamental frequency (F0) and of the vocal-tract length, influencing formant frequencies (Fn) on the NH subjects' ability to attend to one of two competing speech signals. Differences in F0 produced greater improvements in segregating the competing

talkers than did differences in Fn. The benefit of a joint change of F0 and Fn components exceeded the additive benefit of both speech cues alone. This is referred to as a super-additive effect. However, manipulating F0 or Fn artificially did not improve performance as much as using talkers of different gender with inherently different F0 and Fn components, as found by Brungart.

In contrast to NH subjects, listeners with a cochlear implant (CI) have great difficulties in situations with competing talkers. Stickney, Zeng, Litovsky, and Assmann (2004) measured speech recognition in CI listeners with maskers consisting of a competing sentence. The performance of CI users deteriorated significantly in this condition compared with their performance in quiet. This deterioration in complex listening situations is attributable to the limited spectral, temporal, and intensity resolution available in CIs. Because of these technical restrictions, CI users do not show advantages from temporal or spectral gaps in competing signals to obtain release from masking (Nelson, Jin, Carney, &Nelson, 2003). Because of the reduced spectral information, CI listeners mainly rely on the information of the amplitude envelope of the signals. However, these envelopes are disrupted when introducing competing signals. The information from the amplitude envelope of the speech signal is therefore not reliable; hence, speech recognition is strongly affected by fluctuating maskers (Nelson &Jin, 2004).

Because of the limited resolution of acoustic cues, CI users have only restricted access to the relevant information of low-frequency voice cues, such as F0 and Fn, needed to identify talkers (Vongphoe &Zeng, 2005). Better spectral resolution, especially in the low frequencies, might facilitate the identification and therewith the segregation of competing talkers (Qin &Oxenham, 2006; Turner, Gantz, Vidal, Behrens, &Henry, 2004). As many unilateral CI recipients have residual hearing ability for the low frequencies in the non-implanted ear, the use of acoustic amplification transmitted via a hearing aid (HA) in this ear in combination with the electrical stimulation from the CI ear may be of further benefit. This is referred to as a bimodal fitting. The improvement of hearing performance through bimodal stimulation may be attributed to complementarity of the information provided from both devices. TheHAamplifies and transmits the low frequencies and complements the highfrequency information delivered via the CI contralaterally (Ching, van Wanrooy, &Dillon, 2007).

Listening with both ears is also potentially advantageous, as it may make additional information available through binaural processing, such as binaural redundancy. ForNHpeople, this can lead to an improvement in their speech reception threshold of 1-2 dB. However, for CI users, this effect is inconsistent, with subjects varying in their ability to use binaural redundancy cues (Ching, van Wanrooy, Hill, &Dillon, 2005). Compared with hearing with the CI alone, researchers have demonstrated that the addition of acoustic amplification contralaterally improved speech understanding in quiet (Dooley et al., 1993; Hamzavi, Pok, Gstoettner, &Baumgartner, 2004) and in noisy (Ching, Incerti, &Hill, 2004; Morera et al., 2005) environments as well as sound localization ability (Dunn, Tyler, &Witt, 2005; Tyler et al., 2002).

Zhang, Dorman, and Spahr (2010) determined the minimum amount of low-frequency acoustic information needed to achieve better speech recognition in bimodally fitted CI listeners. The recognition of words in quiet and sentences in noise was evaluated, with the acoustic stimuli presented to the non-implanted ear being either low-pass filtered or unfiltered. Both word recognition in quiet and sentence recognition in noise improved because of the added low-frequency information, even when the acoustic information was limited to a 125-Hz low-passed signal. Therefore, Zhang et al. concluded that the F0 and therewith the improved representation of voicing can account for themajority of the speech recognition benefit.

Similarly, Kong, Stickney, and Zeng (2005) examined how residual low-frequency acoustic hearing in the contralateral non-implanted ear can provide essential information for pitch perception and, in turn, can improve speech perception in CI listeners over the CI-alone condition. They investigated speech recognition in a competing-talker situation for listening with the CI alone, the HA alone, and CI + HA. Although speech was completely unintelligible with the HA alone, the combination of CI and HA showed significantly better results compared with the CI-alone condition, especially in high SNRs above 10 dB. They showed that this

improvement was considerable if the masker was a female talker whose voice pitch and spectral characteristics differed greatly from the male target talker. In general, the beneficial effect of bimodal hearing over CI alone was pronounced when the competing voices differed not only in frequency cues but also in intensity level.

In contrast, a subsequent study of Kong and Carlyon (2007) demonstrated different effects. The authors examined the contribution of F0 and low-frequency phonetic cues to speech recognition in simulated combined acoustic and electric hearing. According to their definition, low-frequency phonetic cues comprise the first formant, formant transitions, and manner and place of articulation of consonants. The combined hearing advantages found in this study persisted at low SNRs below 5 dB when the F0 cue was removed from the acoustic simulation. These advantages disappeared at higher SNRs at 10 dB when F0 cues were preserved but low-frequency phonetic cues were removed. The authors concluded that F0 information was not sufficient to improve speech recognition in the presence of speech maskers but that the low-frequency acoustic stimulus contained information other than F0 that enhanced speech recognition when combined with information in the electrical stimulus. Likewise, Brown and Bacon (2009) examined the contribution of low-frequency speech cues in simulated electric-acoustic hearing. The low-frequency acoustic signal was replaced by a sine wave that was modulated in frequency, in amplitude, or in both. Their results revealed that F0 and the amplitude envelope contributed to better understanding in simulated electric-acoustic stimulation conditions. Nevertheless, the observed benefits were not due to a better segregation.

The above-mentioned studies focus on the effects of real or simulated bimodal hearing when speech maskers are used but do not explicitly address the problem of IM. Using the same sentence in all masker conditions (i.e., Kong et al., 2005) reduces the effect of stimulus uncertainty, whereas using reversed speech as a masker (i.e., Kong &Carlyon, 2007) omits information and reduces the effect of target-masker similarity. Therefore, the contribution of irrelevant information might be small in those cases.

The underlying mechanisms for segregating competing talkers with combined acoustic and electric hearing and the impact of the F0 representation are still a controversial issue. Hence, the present study supplements this discourse by examining the contribution of a contralaterally fitted HA in adult CI users to speech understanding in a situation with one competing talker. Although a single-talker masker is not the masker type producing the most effective IM (Cullington &Zeng 2008), it was used to put particular focus on the adverse effect provided by the masker. Therefore, a detailed analysis of the proportion of response errors caused either by confusion of target and masker signals or substitutions was conducted. Following Brungart (2001), the analysis of different error types is regarded as an important parameter for the assessment of IM.

To evaluate the influence of different voice parameters, the voice of the masker talker was manipulated with respect to F0 and Fn. As such, parameters regarding target-masker similarity and stimulus uncertainty were controlled. To focus on voice pitch and Fn, intensitylevel differences between target andmaskerwere not varied. The rationale behind thismethodwas to assesswhich voice parameters are used to obtain release from IM.

It is hypothesized that bimodal stimulation through bimodal fitting can improve speech understanding for speech against a background with one competing talker compared with the CI-alone condition. This is in part due to the effect of complementarity between the information provided through the two devices as described above (Ching et al., 2007). Furthermore, it is suggested that the additional low-frequency information provided through the HA worn in the contralateral ear enables CI users to better segregate competing talkers, making available cues considered essential for the recognition of individual voice cues (Ching et al., 2007). As a consequence, it is anticipated that target-masker similarity is reduced, yielding release from IM that should be apparent in a lower proportion of confusion errors observed.

Method

Subjects

Subjects were recruited from the Cochlear Implant Centre of the University of Cologne. Twelve postlingually deafened adultCI users-sixwomen and six men, with ages ranging from 18 to 72 years (M= 56 years)-

participated in the study. Table 1 displays demographic information of all CI recipients.
All subjects had residual hearing in the contralateral non-implanted ear and continued wearing their HA on a daily basis afterCI activation. Figure 1 shows their (a) unaided hearing thresholds in the non-implanted ear and (b) their aided hearing thresholds in the non-implanted ear as measured in the free-field for warble tones. Their unaided thresholds in the non-implanted ear showed moderate to profound flat or ski-slope hearing losses for frequencies of 250-4000 Hz. The mean unaided thresholds for all subjects, calculated across frequencies from 250 Hz to 4000 Hz, ranged between 70 and 94 dB HL. In contrast, aided thresholds showed mild to severe hearing loss levels with relative flat configurations across the frequency range up to 1000 Hz. The mean aided thresholds for all subjects, calculated across frequencies from 250 Hz to 4000 Hz, ranged between 41 dB HL and 57 dB HL for the HA ear. Thresholds in the aided CI condition were relatively flat between 30 and 40 dB HL, with two outliers: one at 70 dB HL and one at 15 dB HL for the frequencies 250 Hz and 6000 Hz, respectively. Mean aided thresholds for the CI ear calculated across frequencies from 250 Hz to 6000 Hz ranged between 30 dB HL and 39 dB HL.
For the study, the subjects used their daily settings in their CI and HA without any additional fine-tuning performed prior to testing outside of loudness balancing between the two devices. HAs were previously adjusted by an acoustician according to the recommended procedure described in Ching, Hill, Dillon, and van Wanrooy (2004). To ensure that the CI and HA produced similar loudness percepts, an adaptive categorical loudness scaling procedure was performed (Brand &Hohmann, 2002). Speech-shaped noise with a bandwidth of 85- 5500 Hz with varying intensity across stimuli was presented via loudspeaker. Subjects were asked to estimate the loudness of each stimulus on an 11-point response scale, with categories ranging from inaudible to too loud.
On the basis of their estimations, hearing thresholds and loudness growth could be determined per individual. Differences in hearing thresholds between HA and CI did not exceed 10 dB for any subject. Mean difference across individuals was 4.8 dB. Loudness growth functions of the two devices were comparable. Moreover, loudness scaling revealed that the stimuli used in this study were audible for each subject, as thresholds were observed at least 20 dB lower than the stimulus level.
All subjects achieved a speech understanding of at least 90% in quiet with the CI alone when measured with the Oldenburg Sentence Test (OlSa; Wagener, Brand, &Kollmeier, 1999) at an overall level of 70 dB SPL. This was used as subject inclusion criteria for the study. The study tasks are clinically known to be demanding tests of audition for the CI listeners. To avoid floor effects that would be observed at an SNR of 0 dB for poor to average performers, we only included "good" CI performers with speech recognition scores of 90% or higher in quiet only. Speech understanding in quiet with the HA alone was above 50% at 70 dB SPL in all subjects. Therefore, the patient population was rather different compared with patients participating in other studies.
All subjects gave written consent prior to their participation. The study protocol was in accordance with the Declaration of Helsinki and was approved by the ethics committee of the University of Cologne. Subjects were reimbursed for travel expenses.

Stimuli

The stimuli were derived from the OlSa. This speech material consists of five-word nonsense sentences (name-verb-number-adjective-noun), such as "Stefan [name] sieht [verb] acht [number] nasse [adjective] Sessel [noun]" ("Stefan sees eight wet armchairs"). For each lexical position, 10 possible words exist that are combined at random, yielding a high number of different sentences. Utterances of theOlSawere recordedwith a male speaker. In the competing-talker condition, stimuli consisted of two simultaneous sentences from the OlSa. This sentence test is appropriate to measure tasks with a single competing talker or multiple competing talkers for several reasons: An important advantage in view of IM is that a key word can be defined to indicate the target sentences. On the basis of a preceding study, the key word chosen was "Stefan," which revealed the lowest risk of confusion with the other names (Pyschny, Landwehr, Walger, von Wedel, &Meister, 2009). A further

advantage is that the sentences do not contain additional attributes that allow perceptual streaming, which might be used as an a priori cue to separate the target from the masker. Moreover, predictability of single words in a sentence is very low (Wagener et al., 1999).

The superimposed masker sentences were similar in length to the target sentences but contained randomly selected words other than those used in the respective target sentence. No sentence was used more than once within the test lists. Four different lists with 15 stimuli each were generated for the actual test. Because of the low predictability of the OlSa, it is possible to present test lists repeatedly to the subjects (Wagener et al., 1999). Masker sentences were modified with respect to F0 and Fn using a script (Darwin et al., 2003) based on the signal processing softwarePraat (Boersma&Weenink, 1996). The F0 of the masker was raised by 40 Hz or 80 Hz, whereas the target talker remained at 100 Hz. By shortening the vocal tract length of the masker, Fn were increased by 8% or 16% so that all higher Fn were changed to the same degree. This is based on the average formant-frequency ratio between female and male voices (Peterson &Barney, 1952). Moreover, modifications in F0 and Fn were combined. The smaller difference in F0 (40 Hz) was combined with the smaller difference in Fn (8%), and the greater difference in F0 (80 Hz) was combined with the greater difference in Fn (16%). Because they produced an unnatural ratio of F0 and Fn, the conditions DF0 + DFn = 40 Hz + 16% and DF0 + DFn = 80 Hz + 8% were not used for the masker voice. Masker sentences were not changed with respect to the level, yielding an SNR of 0 dB in all conditions to consider effects only related to F0 or Fn. An implementation of alternative SNRconditions would have introduced another additional acoustic factor that CI recipients may have been able to use to further separate the target from the masker stimuli (Pyschny et al., 2009).

Procedure

Subjects were evaluated under three listening conditions: CI alone, HA alone, and CI + HA together. Pre-testing began with three lists of 10 sentences each presented in quiet at an overall level of 70 dB SPL for the CI-alone and HA-alone conditions. The testing in quiet allowed the subjects to become accustomed to the voice of the target talker. Furthermore, subjects became familiar with the limited word material of the OlSa, whereby learning effects were minimized prior to recording performance scores. Only speech understanding scores for the third list were recorded to represent performance in quiet for each subject. Afterward, a training session with 20 superimposed sentences was conducted to familiarize subjects with the competing-talker condition prior to recording test scores. Subjects used the CI + HA combination in the training session. Feedback about the correctness of their responses was given during training. Sentence pairs used during the training session were not reused for the test session.

In each test run, sentence pairs were preceded with a 1-kHz pure-tone stimulus of 500 ms in duration to draw the subjects' attention to the upcoming stimulus. The presentation order of the stimuli was randomized within every test list. The subjects' task was to reproduce thewords fromthe target sentence indicated by the name "Stefan." The investigator kept track of the subjects' answers and entered them into the computer. All words except the key word subject name "Stefan" were included in the percent-correct score calculation, with a total score possible of 60words for each of the four test lists. The tests included seven different target-masker conditions (DF0 = 40 Hz, 80 Hz; DFn = 8%, 16%; DF0 + DFn = 0 Hz + 0% [unprocessed], 40 Hz + 8%, 80 Hz + 16%). For each condition, two test lists were applied. Thus, 42 measurements (7 target-masker conditions ×2 test lists ×3 listening conditions) were conducted. The measurement conditions were performed in randomized order to minimize bias from sequence of testing or learning effects. The sequence of hearing devices was randomized too. Two test lists were measured with one hearing device condition before switching the hearing device to avoid permanent alternating.

All tests were performed in a soundproofed booth (2.9 m ×4 m) via a single loudspeaker (Event Electronics, 20/20bas V2) placed in front of the subject at a distance of 1.2 m. The combined signals were presented at an overall level of 70 dB SPL measured at the subject's head. Testing was split into two sessions that took place within 1 week. Each session lasted approximately 3 hr, including individual breaks.

Analysis

Having different masker sentences for each target sentence allows analyzing different effects. Basically, there are two main types of errors that can appear in a listening situation with two simultaneous talkers. On the one hand, errors result from a confusion of target and masker words-for example, "Stefan sieht acht nasse Sessel," and "Britta kauftneun grobe Autos," resulting in "Stefan sieht acht nasse Autos" ("Autos" instead of "Sessel")-which are referred to as A-type errors. On the other hand, there are non-confusions that are either close acoustic approximations to the target words ("Messer" instead of "Sessel") or errors of omission (e.g., the subject said nothing or "I don't know"), which are referred to as B-type errors. The amount of A-type errors is an indication of the ability to separate target from masker and addresses IM in terms of both target-masker similarity and stimulus uncertainty (Brungart, 2001). In contrast, B-type errors also occur when noise is used as a masker and may therefore relate more to EM effects or signal degradations (Brungart, 2001). Statistical analysis was conducted with the SPSS statistical analysis program PASW 18. Target speech recognition and the two types of errors were expressed as percentage of correct and incorrect responses, respectively. Data were arcsine transformed, and one-way analyses of variance (ANOVAs) with repeated measures were conducted for the hearing devices (CI,HA, and CI +HA) and for the different target-masker conditions (ΔF0, ΔFn, and ΔF0 + ΔFn). Wilks' lambda was used as global test statistic. Further multiplepaired comparisons were performed. The p values were Bonferroni adjusted (significance level = .05/3 = .017). The experimental design was not multifactorial, as two target-masker conditions were discarded (ΔF0 + ΔFn = 40 Hz 16%, and ΔF0 + ΔFn = 80 Hz 8%). Thus, a multifactor ANOVA was not feasible.

Results

Target Speech

Figures 2A-2C show mean scores (%) of the 12 CI recipients for speech recognition as a function of HA alone, CI alone, and CI + HA at an SNR of 0 dB. Panel A shows scores for differences in F0 of target and masker. Panel B shows scores for target and masker differing in Fn. Panel C shows scores for DF0 + DFn. Error bars represent ±1 SD from the mean. For better comparison, the unprocessed condition is displayed in all panels. For hearing devices, Figures 2A-2C display that with the HA alone, subjects achieved speech recognition scores across the different target-masker conditions withmean values ranging from22%to 33%and relatively large standard deviations ranging between 14%and 26%. This large standard deviation is due to the fact that three subjects were not able to understand target speech with their HA alone in the competing-talker condition. In contrast, using CI +HA, as well as using the CI alone, yielded higher recognition of the target sentences. The largest bimodal benefit (12% for the mean) over the CI alone was measured in the DF0 = 80 Hz condition (see Figure 2A). Collapsed across subjects and all target- masker conditions, the mean difference between performance with the CI alone and CI + HA was only 6%. Nevertheless, the data suggest that the observed bimodal benefit increases with increasing differences in F0 (40Hz, 80 Hz in Figure 2A) and in F0 + Fn = 80 Hz + 16% (see Figure 2C). Interestingly, applying differences in Fn in the masker had the tendency to reduce recognition of the target speech, especially in the CI-alone condition.

Looking at the individual results (see Appendix A) revealed that speech recognition varied across subjects in all listening conditions. Although in the HA-alone condition three subjects demonstrated 0% intelligibility (S 02, S 05, and S 07), a bimodal benefit over the CI alone was measured for two of these subjects (S 05 and S 07). Two subjects (S 03 and S 09) revealed very good speech recognition ability in the HA-alone condition that partly exceeded speech recognition with the CI alone. Their results with CI + HA were not better than with the HA alone. The remaining subjects showed similar results for both devices alone or showed better results with CI alone compared with HA alone. Those subjects revealed better results for CI + HA predominantly in the situations with large differences in F0 between target and masker. Although a uniform pattern could not be observed, all subjects showed similar trends in performance, resulting in a significant effect for the group mean performance differences that were discussed above. It is important to note that our subjects were not typical CI

users.

Statistical data are shown in AppendicesBand C. In Appendix C, only statically significant values are shown. As the main focus of the hearing device conditions is on the comparison of CI alone versus CI + HA, those results are described in detail. Results for the different target- masker conditions are also described in detail only for CI alone and CI +HA. Comparisons of the target-masker conditions were only done within each voice parameter-for example, ΔF0 = 40 Hz versus 80 Hz-and not across voice parameters-for example, ΔF0 = 40 Hz versus ΔFn = 8%.

Statistical data showed that performance was significantly superior with CI + HA compared with CI alone in the following test conditions: DF0 (40 Hz, 80 Hz) and ΔF0 + ΔFn = 80 Hz + 16% (see Appendix B). Modifications of the masker voice presented a significant effect of F0 on speech recognition for both the CI alone and CI + HA. Scores increased when F0 of the masker was changed by 40 Hz or 80 Hz. Applying differences in Fn in the masker (see Figure 2B) had the tendency to reduce recognition of the target speech in the CI-alone condition. The combination of differences in both F0 + Fn, displayed in Figure 2C, revealed a significant effect only for listening in the bimodal condition for F0 + Fn = 40 Hz + 8% compared with the unprocessed condition (see Appendix C).

Error Patterns

Figures 3A-3C show the mean distribution of the listeners' confusion errors (A-type errors) in percentages as a function of HA alone, CI alone, and CI + HA for the different target-masker conditions: DF0 (Panel A), DFn (Panel B), and DF0 + DFn (Panel C). Figures 4A-4C display the mean distribution of the listeners' non-confusion errors (B-type errors) in percentages as a function of HA alone, CI alone, and CI + HA for the different target- masker conditions: DF0 (Panel A), DFn (Panel B), and DF0 + DFn (Panel C). Error bars represent ±1 SD from the mean. For better comparison, the unprocessed condition is displayed in all panels.

Across all target-masker conditions, listening with the HA alone produced very high B-type errors approximating 60% (see Figures 4A-4C). In contrast, the proportion of A-type errors (see Figures 3A-3C) remained small across the various target-masker conditions. A-type errors were considerably larger when using the CI alone or CI + HA. In these two hearing device listening conditions, the amount of A-type errors differed considerably across the various target-masker conditions. Unlike A-type errors, the proportion of B-type errors was rather stable across the various target-masker conditions but was consistently lower for the CI + HAlistening condition than for the CI-alone condition.

A-type errors. Significant effects for A-type errors between the CI alone and CI + HA were found only in the unprocessed condition (see Appendix B). Changing the masker voice in F0 significantly affected A-type errors in all three hearing device conditions. The DFn induced an increase of A-type errors for the CI alone, especially in the ΔFn = 16% condition. The combination of ΔF0 + ΔFn had a significant impact on the amount of A-type errors only in the CI + HA listening condition, as can be seen in Appendix C.

B-type errors. Between the hearing devices CI alone and CI + HA, a significant effect appeared only in the ΔF0 = 80 Hz test condition (see Appendix B). There were no significant differences between target-masker conditions for B-type errors (see Appendix C).

In summary, significant differences in target speech recognition scores between CI-alone and CI + HA listening conditionswere observed for the testmaterial condition with differences in F0 and great differences in F0 + Fn. No significant differences in A-type errors were observed. In contrast, B-type errors were significantly different between the CI-alone and CI + HA listening conditions when changing F0 to a great amount.

In view of the effect of manipulations in the masker voice, the insertion of differences in the F0 between talkers yielded higher speech recognition scores as well as significant reductions of A-type errors in the CI-alone and CI + HA listening conditions. Large modifications in Fn of the masker speech reduced scores, especially in the CI-alone listening conditions.

Discussion

The aim of the present study was to investigate the influence of bimodal hearing on speech perception with a single competing talker applying various modifications to select acoustic cues. Special focus was on the contribution of IM and on the benefit that can be drawn from the acoustic information provided through the HA to assist the listener to separate competing talkers. It was hypothesized that the addition of theHA leads to improved speech understanding and to an improved ability to segregate two competing talkers auditorily. Therefore, in examination of the results, an analysis of the type of errors was performed. To further explore which of the low-frequency cues in voices help to separate target and masker signals predominantly, sentences with isolated manipulations of F0 and Fn components were superimposed.

The results revealed that understanding of the target talker tends to improve in the CI + HA listening condition compared with the CI-alone condition. However, the effect of the additional information provided through the HAwas relatively small, reaching statistical significance in the test conditions with manipulations in ΔF0 and with large modifications in ΔF0 + ΔFn only.

Kong et al. (2005) reported a significant superadditive effect of CI + HA in bimodally fitted subjects. The HA-alone condition led to 0% speech recognition, whereas the combination of CI + HA significantly improved performance over the CI alone. Nonetheless, this suggested an additive benefit of the HA when used in combination with the CI. Such a super-additive effect could only be observed in two of our subjects. Those two subjects did not understand anything in the competingtalker situation with the HA alone. The remaining patient population differed from those described in the former articles by understanding at least parts of the sentences in the competing-talker situation with the HA alone. Therefore, a comparison with the literature should be treated with caution. Nevertheless, the ability to understand speech with the HA could be an explanation for the missing super-additive effect.

Turner et al. (2004) reported similar results as Kong et al. (2005). They investigated people receiving electric-acoustic stimulation in the same ear, who are likely to benefit from the same mechanisms as people with bimodal fitting in which two ears are involved. However, improved performance was observed only when target and masker signals differed in frequency characteristics and in intensity level. In Kong et al.'s study, the largest benefits observed when using CI + HA were found for high SNRs, but differences markedly decreased for SNR = 0 dB, which is in line with our results.

Kong et al. (2005) proposed that the observed improvement in target recognition in the CI + HA listening condition compared with the CI-alone condition was attributed to an enhanced ability to separate target and masker signals. However, in their study, target-masker similarity was low, as the same masker sentence-which was well-known to the subjects-was used throughout testing. Therefore, confusion between target and masker was unlikely. Thus, it is not clear whether the improvement was exclusively due to a better ability to separate the two competing signals.

In the present study, no evidence for better target- masker separation with bimodal fitting was found. This was evaluated with an analysis of response errors. A-type errors are an indication for difficulties in separating target and masker voices, whereas B-type errors are an indication for the overall speech recognition, including target and masker (Brungart, 2001). If the combination CI + HA had yielded more release from IM than the CI alone, a lesser amount of A-type errors would have demonstrated that the HA helped subjects to separate the competing talkers. A better segregation should yield better target word understanding because of lower stimulus uncertainty. However, this was not observed; accordingly, a release from IM was not the effect by which scores of CI + HAwere improved over CI-alone scores.

In contrast, a lesser amount of B-type errors without a decrease in A-type errors would have indicated that the HA helped to improve overall recognition but not the ability to separate. This might be an explanation for the finding that the A-type errors even increased slightly with CI + HA in some conditions: If speech recognition increases in general, and it is not possible to separate target from masker signals (as with 0 Hz + 0%), the amount of confusions will increase as a consequence. This might be more related to EM than to IM. It was

observed that the amount of B-type errors for the CI + HA listening condition compared with the CI-alone condition was lower in all test material conditions and reached significance in the DF0 condition of 80 Hz. This could be explained by the fact that an HA provides more low-frequency information than a CI (Cullington& Zeng, 2011). Providing voice-pitch information transmitted via the HA complements the higher frequencies delivered via the CI. Because of voice pitch, the access to voiced and voiceless information in the speech signal is improved. This can be used by the listener to improve speech recognition of the target talker. This explanation is based on the findings of other studies, which showed that even unintelligible low-frequency sound improved performance when frequencies were limitedly transmitted below 150 Hz (Cullington &Zeng, 2010).

Another explanation for the decrease in B-type errors and therewith the increase in speech recognition could account for complementary speech information. Mok, Grayden, Dowell, and Lawrence (2006) tried to determine speech information obtained from an HA that is additive to the speech information of the CI. Adding the HA to the CI improved the perception of lower frequency phoneme groups, such as diphthongs, semivowels, and nasals. The auditory system seemed to be able to combine the speech information coming from the two different hearing devices. With this explanation in mind, the decrease in B-type errors in our study would be rather due to a phonemic summation (eventually because the resolution of the first formant might be improved by the additional HA) than a release from EM.

Generally, the finding that the amount of B-type errors decreased in the CI + HA condition compared with the CI-alone condition suggests an advantage associated with binaural redundancy and summation. The only factor that reduced the amount of A-type errors observed in our study was the difference in F0. A difference of 80 Hz between the target and masker signals led to a significant decrease in the A-type errors observed. This held true for all three listening conditions (CI alone, HA alone, and CI + HA), supporting the assumption that subjects have the ability to separate competing talkers when presenting large differences in F0 even with the CI alone. It could be expected that A-type errors would have emerged more clearly if overall there were less potential for B-type errors, for example, with more favorable SNRs. However, results of a former study (Pyschny et al., 2009), which investigated the effect of SNR in speech recognition situations with a competing talker, did not support this assumption.

Nevertheless, it has to be kept in mind that for both CI and HA users, overall EM has a greater detrimental effect on speech recognition even for much better SNRs (Qin &Oxenham, 2003). This might be due to the restricted access to relevant speech information in CIs.

Although the beneficial effect of F0 differences in the separation of target and masker could be anticipated, the findings regarding modifications of Fn were unexpected. Kong et al. (2005) showed a beneficial effect for the CI + HA listening condition, especially when the male target talkerwas superimposed by a femalemasker. In this condition, the difference regarding F0 and Fn was considerably large. Applying these findings to our manipulations of these voice cues, we would have expected that the combination of DF0 and DFn should have led to an even bigger improvement compared with changes in either F0 or Fn alone. However, the present study does not support this claim.

In contrast, changing Fn of the masker signal alone even had a negative influence on target word recognition in the CI-alone listening condition. The effect was found only when the difference in Fn was expanded by 16%. No such effect appeared when the difference in Fn was expanded by 8%. Darwin et al. (2003) found that small changes in Fn (8% or less) did not improve speech recognition in NH listeners. The authors assumed that the difference in Fn of 8% might be too small to perceive as a change in the talkers' identity. Because of the restricted representation of spectral speech cues in CIs, this holds true for our experiment.

Changing Fn did not reduce speech recognition in the CI + HA condition. Again, this could be explained because of the effect of phonemic summation. Additive complementary speech cues, transmitted via the HA, were missing, and the target was not recognized correctly with the CI alone.

Furthermore, the degraded speech recognition with large difference in Fn might be related to findings of

Cullington and Zeng (2008), who used child voices as a masker signal. They investigated speech recognition of CI users with varying numbers and types of competing talkers. CI users benefited from voice pitch differences between target and masker signals, with female talkers providing significantly less masking than male talkers. However, child talkers produced more IM than the other talkers, although their voice pitch was much higher than that of the female talker. Cullington and Zeng tried to determine the cues that could cause this high masking effect-such as talking rate, variation in F0 within a sentence, and temporal envelope modulation characteristics-but no correlation could be found. Child voices exhibit not only higher F0s but also higher Fn. Changing Fn only while keeping F0 constant makes a voice more "childlike." The results of the present study suggest that compared with the unprocessed condition, IM even increased when only the Fn were changed, whereas changing only the F0 yielded a release from masking. Hence, an explanation for the higher IM produced by the child talker in Cullington and Zeng's study could be due to their higher Fn.

Changing only Fn makes the voice also sound somewhat unnatural and draws the listener's attention to the masker's voice,which is referred to as odd-sex distraction (Brungart, Simpson, Ericson, &Scott, 2001). Odd-sex distraction is a special form of IM in which a prominent masker causes the listener's attention to be drawn away from the target. This occurs only when the overall levels of the talkers are nearly equal so that the listener must rely entirely on vocal characteristics. However, odd-sex distraction cannot entirely explain why speech understanding for CI as well as for CI + HA listening conditions for signals presented with differences in both F0 + Fn components remains poorer than speech understanding in the presence of a competing signal with a 80-Hz difference in the F0 alone (see Figure 1). The combinedmanipulation ofF0 andFn corresponds most closely to a change from a male voice to a female voice. Stimuli do not sound unnatural when the configuration of the changes in F0 and in Fn matches (Darwin et al., 2003), as is the case in our study.

The F0 contributed significantly to a release from masking in all three listening conditions, as shown in the analysis of the A-type errors. However, no significant advantage could be shown for the CI +HAcondition over the CI-alone condition, as separation of the talkers is obviously possible to a certain degree with the CI alone. Adding the HA does not significantly reduce the A-type errors observed.

Kong and Carlyon (2007) tried to answer the question of which low-frequency cues are responsible for the combined hearing advantages with simulations of CI processing and low-frequency hearing. They found that information of the low-frequency region like voicing and information of the amplitude envelope provided benefit in combined hearing. They suggested that the amplitude envelope might help listeners by indicating when to listen or "glimpse" the target. Hence, glimpsing might at least partly explain the effects of F0 if it is assumed that the F0 might provide an indication of when to listen, much like that provided by the amplitude envelope.

Li and Loizou (2008) examined glimpsing in the context of combined acoustic and electric hearing. They pointed out an effect that is related to a low-frequency SNR advantage when speech is corrupted by interferers with low-pass spectral characteristics as competing talkers. During voiced speech segments of the target, the masker reveals on average a lower level in low-frequency bands than in the high-frequency range. According to the authors, this holds especially true if target and masker differ greatly. This resembles the results found for the F0 difference of 80 Hz between target and masker in our study. They explained that F0 cues might be helpful in combined acoustic and electric hearing to indicate when to listen into the dips and thus detect male and female talkers in a competing-talker situation. The mechanisms of glimpsing might be an important aspect of improving speech recognition with a bimodal fitting. However, it is not entirely clear how far glimpsing and segregation are related. Brown and Bacon (2009) stated that both F0 and envelope cues might provide an indication when to listen into dips. This would assume that the listeners first have to segregate target and masker on the basis of F0, which is not supported by our results. Thus, further examinations designed to address this issue might be necessary.

In conclusion, the effects of low-frequency acoustic hearing with HA complementing the high-frequency information provided via CI were small in our study, as well as the effects of changing the F0 or the Fn of the

masker. This might be in part due to the fact that most of our subjects were good HA-alone performers.
The assumption that bimodal hearing yields better separation of target and masker and thus reduces effects relevant with IM could not be proven. A large difference in F0 (i.e., 80 Hz) between target and masker was the only parameter for decreasing the A-type errors, but this applied similarly for both the CI and CI + HA listening conditions. Adding changes in Fn even increased the probability of mixing up words from target and masker signals. A consistent, albeit nonsignificant, effect of the HAwas that the amount of B-type errors was reduced for the CI + HA condition compared with the CI-alone condition. This might be an effect of complementary speech information or, according to Brungart (2001), rather a release from EM. In the present study, however, adding the HA is not the mechanism responsible for a release from IM.

Acknowledgments
This research was supported by Cochlear Deutschland GmbH &Co. KG. (See Pyschny, Landwehr,Walger, vonWedel, and Meister [2008] for the presentation of this project at the German Society of Audiology conference [June 2008]). We thank the cochlear implant subjects for their time and dedication. We also thank H. Cullington for providing valuable comments. Finally, we thank Guy Lightfoot and Josephine Wyss for proofreading the article.

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Editor: Robert Schlauch
Associate Editor: Christopher Turner
Received July 30, 2010
Revision received January 9, 2011
Accepted January 21, 2011
DOI: 10.1044/1092-4388(2011/10-0210)

Appendix

(ProQuest: Appendix omitted.)

Publication date: Oct 2011

Year: 2011

Visual Cues and Listening Effort: Individual Variability

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1416-1430.

Abstract: To investigate the effect of visual cues on listening effort as well as whether predictive variables such as working memory capacity (WMC) and lipreading ability affect the magnitude of listening effort. Twenty participantswith normal hearingwere tested using a paired-associates recall task in 2 conditions (quiet and noise) and 2 presentation modalities (audio only [AO] and auditory-visual [AV]). Signal-to-noise ratios were adjusted to provide matched speech recognition across audio-only and AV noise conditions. Also measured were subjective perceptions of listening effort and 2 predictive variables: (a) lipreading ability and (b) WMC. Objective and subjective results indicated that listening effort increased in the presence of noise, but on average the addition of visual cues did not significantly affect the magnitude of listening effort. Although there was substantial individual variability, on average participants who were better lipreaders or had larger WMCs demonstrated reduced listening effort in noise in AV conditions. Overall, the results support the hypothesis that integrating auditory and visual cues requires cognitive resources in some participants. The data indicate that low lipreading ability or low WMC is associated with relatively effortful integration of auditory and visual information in noise.

Full text: Headnote

Purpose: To investigate the effect of visual cues on listening effort as well as whether predictive variables such as working memory capacity (WMC) and lipreading ability affect the magnitude of listening effort.
Method: Twenty participantswith normal hearingwere tested using a paired-associates recall task in 2 conditions (quiet and noise) and 2 presentation modalities (audio only [AO] and auditory-visual [AV]). Signal-to-noise ratios were adjusted to provide matched speech recognition across audio-only and AV noise conditions. Also measured were subjective perceptions of listening effort and 2 predictive variables: (a) lipreading ability and (b) WMC.
Results: Objective and subjective results indicated that listening effort increased in the presence of noise, but on average the addition of visual cues did not significantly affect the magnitude of listening effort. Although there was substantial individual variability, on average participants who were better lipreaders or had larger WMCs demonstrated reduced listening effort in noise in AV conditions.
Conclusions: Overall, the results support the hypothesis that integrating auditory and visual cues requires cognitive resources in some participants. The data indicate that low lipreading ability or low WMC is associated with relatively effortful integration of auditory and visual information in noise.
Key Words: listening effort, vision, background noise

Speech recognition is important for verbal communication in everyday life. Recognizing spoken words is a complicated task that relies on bottom-up, datadriven processing of the acoustic features of speech (e.g., Foss &Blank, 1980) and top-down, conceptually driven processing of the meaning and context of the stimuli (e.g., McClelland&Elman, 1986; Samuel, 1996). Indeed, both processes are thought to coexist, likely functioning in parallel (Dell &Newman, 1980; Newman &Dell, 1978; Tyler, Voice, &Moss, 2000). As a result of this set of intertwined and sometimes redundant processes, adequate speech recognition is commonly maintained even when the acoustic signal is degraded, as in the case when a listener is in background noise; however, perceptual success in challenging environments may come at the expense of increased demand on cognitive resources. This is important because increased demand may leave fewer cognitive resources available for interpreting, integrating, or responding to information during a conversation. Listeners may have substantial difficulty remembering information presented earlier in a conversation or learning new information. In addition, over time, depleted cognitive resources may lead to increased mental fatigue.

Listening Effort

The cognitive resources allocated for speech recognition are often conceptualized as listening effort (Fraser, Gagne, Alepins, &Dubois, 2010; Hicks &Tharpe, 2002). As cognitive demands increase, so too does listening

effort. Because cognitive capacity is limited (Kahneman, 1973), an increased demand level means that fewer resources are available for tasks such as rehearsal, recall, environmental monitoring, or following conversations (Kahneman, 1973; Kantowitz, 1974; Moray, 1967).

The ease of language understanding (ELU) model (Rönnberg, 2003; Rönnberg, Rudner, Foo, &Lunner, 2008) provides a conceptual framework for understanding listening effort. The model suggests that language serves as the input to a listener's memory buffer, which rapidly and automatically binds phonological, semantic, syntactic, and prosodic information. This bound information forms a mental representation of language and is then compared with long-term memory stores. If the language representation matches information in long-term memory, the listener can successfully and easily perceive the language input. Conversely, if there is a mismatch between the mental language representation and long-term memory, a listener must exert explicit processing to achieve understanding. In other words, working memory resources must be allocated to successfully perceive a message if the input is degraded in some way and thus does not match information stored in long-term memory. Thus,within the context of the ELUmodel, listening effort is the increase in cognitive resources necessary to resolve ambiguity between the language mental representation and the long-term memory store of a listener.

Listening effort can be measured objectively and subjectively. The underlying rationales for the objective measures are that, as listening effort increases, more cognitive resources are necessary for a listener to recognize speech. Because these resources must be devoted to speech recognition, there are fewer available for rehearsal or recall of items in a list or for responding to a secondary task. Listening effort has been measured objectively by fewer words recalled (McCoy et al., 2005; Murphy, Craik, Li, &Schneider, 2000; Rabbitt, 1968; Tun, McCoy, &Wingfield, 2009), fewer details remembered about a passage (Schneider, Daneman, Murphy, &See, 2000), and by decreased performance (Fraser et al., 2010;Rakerd, Seitz,&Whearty, 1996;Tun et al., 2009) or slowed reaction times on a secondary task (Hicks &Tharpe, 2002; Tun et al., 2009). Furthermore, because the pupils become more dilated under conditions of increased cognitive demand, listening effort also has been measured by assessing pupil dilation (Engelhardt, Ferreira, &Patsenko, 2009; Kramer, Kapteyn, Festen, &Kuik, 1997; Piquado, Isaacowitz, &Wingfield, 2010; Zekveld, Kramer, &Festen, 2010). Listening effort can be quantified subjectively by asking people their subjective impressions about the degree to which they exerted effort or work to understand speech (Gatehouse&Noble, 2004; Kramer, Kapteyn,&Houtgast, 2006). Although all of these methods purport to measure the same underlying construct, the relationship between the indices has not been fully investigated; that is, listening effort may be reflected by varying degrees according to the test methodology used because differences between methodologies remain unclear.

Despite these differences in methodologies, there is some consistency across studies of listening effort; specifically, with changes in background noise level, speech recognition performance and listening effort have both been shown to change. For example, when speech recognition performance gets worse, listening effort increases, as evidenced by fewer words recalled (Murphy et al., 2000), increased pupil dilation (Zekveld et al., 2010), and increased reaction times on a secondary task (Downs, 1982). However, listening effort is not always tied to speech recognition. In cases where speech recognition performance was relatively unaffected by changes in background noise (e.g., speech recognition performance is around 80%-100%), some investigators have reported that listening effort also increased (Fraser et al., 2010; Pichora-Fuller, Schneider, &Daneman, 1995; Rabbitt, 1968; Surprenant, 1999). For example, Surprenant (1999) reported that listeners recalled fewer words as the signal-to-noise ratio (SNR) worsened from quiet to +10 dB and then again to +5 dB, but speech recognition performance was not affected by the changes in background noise. Therefore, measuring listening effort, in addition to speech recognition performance, is important when investigating the effects of background noise on a listener.

Role of Vision

Until recently, listening effort had been measured only for auditory-only (AO) stimuli; in other words, situations in

which listeners are unable to see the talker's face. Although the underlying mechanisms for AO presentations are becoming better understood, it is important to examine listening effort for signals that provide auditory and visual cues. Most listeners use visual information when communicating in daily life, and speech recognition in auditory-visual (AV) conditions has been shown to be significantly better than performance in AO conditions. This visual benefit is particularly important in difficult listening situations and for listeners with impaired hearing. The addition of visual cues improves speech recognition performance over a wide range of SNRs (Erber, 1975; Grant, Walden, &Seitz, 1998; O'Neill, 1954; Sumby &Pollack, 1954), showing maximum AV benefits of 30% to 40% at intermediate SNRs (Ma, Zhou, Ross, Foxe, &Parra, 2009; Ross, Saint-Amour, Leavitt, Javitt,&Foxe, 2007). Furthermore, visual cues can improve one's speech recognition threshold (the level required for 50% correct speech recognition) by approximately 4 to 6 dB (MacLeod&Summerfield, 1990; Middelweerd &Plomp, 1987); however, only limited data are available regarding the effect of visual cues on listening effort.

There are several possible factors that lead to speech recognition benefit from the addition of visual cues. These include redundancy, complementary cues, enhanced detection, and focused attention. In listening situations when the auditory signal is audible (e.g., in quiet for listeners with normal hearing), the auditory and visual cues available provide redundant speech language information. Although this redundancy leads to only small improvements in speech recognition (Grant et al., 1998), there may a cognitive advantage resulting from the addition of redundant visual information. For example, Reisberg, McLean, and Goldfield (1987) tested the ability of listeners with normal hearing to shadow (repeat aloud) English sentences and found that, for grammatically complex sentences, visual cues improved the ability to shadow the sentences. Furthermore, foreign language students' abilities to shadow a native speaker of the language were improved when visual cues were provided (Reisberg et al., 1987). These results suggest that the addition of redundant visual cues from the talker's face may reduce listening effort and allow listeners to perform better on a cognitively demanding task. Although there is no direct evidence to support this hypothesis, electrophysiological data suggest that, in quiet, response latencies are shorter for AV signals than for AO signals (vanWassenhove, Grant,&Poeppel, 2005), implying that visual cues may speed processing. If cognitive processing is quicker, cognitive demands might be less and listening effort may be reduced in quiet with visual cues present.

Once noise is introduced, however, the additional visual cues may become less redundant with the auditory signal and become more complementary. A listener can take advantage of both the auditory and visual signals, which work in tandem to provide information for speech recognition. For example, place-of-articulation cues can be conveyed accurately by means of lipreading (Sumby& Pollack, 1954) but are easily disrupted auditorily by noise (Miller &Nicely, 1955). Furthermore, voicing and nasality cues are acoustically robust (Binnie, Montgomery, &Jackson, 1974; Miller &Nicely, 1955) but are nearly impossible to distinguish visually (Walden, Prosek, &Worthington, 1974). Therefore, we hypothesized that additional listening effort may be required for AV conditions if listeners are forced to integrate complementary information from two sensory modalities.

Another factor contributing to enhanced speech recognition in noise with the presence of visual cues is enhanced speech detection. In noise, when the acoustic information and visual information are coincident, speech detection thresholds are 1 to 2.5 dB better than when only the acoustic information is present or when the acoustic and visual information are incongruent (Grant, 2001; Spence, Ranson, &Driver, 2000). This effect in the speech domain is similar to the cuing effect in the psychoacoustic literature reported for simple stimuli (e.g.,Watson& Nichols, 1976). The primary utility of enhanced speech detection is for perception of voicing cues. Although voicing cues are acoustically robust (Binnie et al., 1974), as the SNR worsens, voicing cues become difficult to distinguish by means of audition alone. The presence of visual cues allows for enhanced speech detection by providing spectro-temporal information to the listener, who is then cued to attend to the voicing information (Schwartz, Berthommier, &Savariaux, 2004). As the SNR worsens, if listeners must utilize this information while at the same time integrating information from two sensory modalities, it is possible that the addition of visual cues will require an increase in listening effort in noisy situations.

The final factor contributing to AV benefit, focused attention, may have a positive effect on listening effort in noise by reducing the required extra effort as compared with the previously discussed factors. Focused attention may help in two ways: (a) by improving detection and (b) by improving the ability to ignore distracters. In terms of detection, visual cuing can improve target detection by reducing uncertainty in a signal (Egan, Greenberg, &Schulman, 1961; Egan, Schulman,&Greenberg, 1961; Green &McKeown, 2001; Hubner &Hafter, 1995). Adding visual cues to an auditory signal can also focus one's attention to help ignore distracters (Spence et al., 2000) by providing the illusion of spatial separation (Driver, 1996). It is well known that spatial separation enhances speech recognition (Broadbent, 1958; Cherry, 1953; Spieth, Curtis, &Webster, 1954). Spence et al. (2000) presented target words behind listeners and distracting words in front of listeners at 38° from midline. When the talker's face was presented in the same location as the distracting words, listeners had more difficulty shadowing the target speech. This result suggests that visual cues draw attention to the distracting words and away from the target words. In an extension of this finding, one might expect that providing visual cues that are coincident with a relevant message could focus attention on the relevant message and help listeners ignore distracting signals. Therefore, one might also expect that providing visual cues in the presence of background noise would reduce listening effort by reducing the cognitive demand of segregating target speech from background noise.

In summary, two plausible yet contrasting hypotheses may be proposed in relation to the addition of visual cues and cognitive resources in noise. AV presentation in noise may reduce one's listening effort by focusing attention on the target and helping to segregate the target speech and background noise; conversely, integrating complementary audio and visual cues may require additional listening effort at poor SNRs. There currently are converging lines of evidence to support the second hypothesis, at least in the presence of background noise. First, the authors Larsby, Hallgren, Lyxell, and Arlinger (2005) found that, while listening in noise, participants performed better on several cognitive tasks when visual cues were available. However, reaction times for these tasks were slower inAV conditions than inAOconditions, suggesting that although visual cues helped improve performance, processing the additional visual information required additional cognitive resources. These findings suggest that simultaneously processing auditory and visual cues requires additional cognitive resources. Second, research on audiovisual integration using the McGurk illusion (McGurk &MacDonald, 1976) suggests that attentional resources are necessary to bind multisensory features (Alsius, Navarra, Campbell, &Soto- Faraco, 2005). Finally, and more directly, Fraser et al. (2010) tested listening effort using a dual-task paradigm in noise usingAVandAOstimuli. Their results indicated that, for a fixed speech recognition performance level,AV stimuli resulted in greater listening effort. Furthermore, for a fixed SNR, AV stimuli resulted in better speech recognition than AO stimuli, but listening effort was the same across stimuli. In total, these results suggest that simultaneously processing auditory and visual stimuli in noise requires cognitive resources.

Studies to date have examined main effects for groups of participants; however, the impact of visual cues on listening effort may be different for different individuals. Specifically, an individual's working memory capacity (WMC) or lipreading abilities may affect the listening effort required when processing AV speech information. Several researchers have reported that individual differences in WMC can account for variability in reading comprehension (Turner &Engle, 1989) and the ability to ignore distracters (Conway, Cowan,&Bunting, 2001; Thompson, Garcia, &Malloy, 2007). Likewise, WMC may be related to a listener's susceptibility to the presence of noise in a recall task or to the ability to utilize visual cues to reduce listening effort.

Furthermore, there is substantial intersubject variability in lipreading benefit in untrained listeners, especially in adverse listening conditions (Erber, 1969, 1975; Rigo, 1986). For some listeners, lipreading may be easier or more automatic, and automatic processes are thought to require fewer cognitive resources (Hasher &Zacks, 1979). Listeners who have better lipreading ability may require fewer cognitive resources to integrate audio and visual stimuli, perhaps resulting in reduced listening effort; conversely, listeners for whom lipreading is more

difficult will likely require more cognitive resources to integrate audio and visual stimuli in order to perceive a coherent message. Indeed, previous research suggests that individuals who derive more benefit from vision on a speech recognition task are less susceptible to speech recognition decrements experienced with the addition of a secondary task (Rigo, 1986).

The purpose of this study was to investigate whether factors such asWMCand lipreading ability could be used to predict the effect that the addition of visual cues has on listening effort in individual listeners with normal hearing in quiet and in noise.

Method

To test listening effort, we used objective and subjective measures. The objective measure was a pairedassociates recall task, based on a paradigm developed by Madigan and McCabe (1971) and applied by Murphy et al. (2000) and Heinrich, Schneider, and Craik (2008). In this paradigm, a participant is presented with a list of five pairs of words sequentially, with a few seconds between each word pair. Immediately after presentation of a list, a participant is presented with the first word (probe) of one of the five pairs. The participant's task is to recall the word that was paired with the probe word. When performance across many trials is plotted as function of serial position, the results follow a pattern similar to a typical serial position curve, with the most recent words easier to recall and the first words more difficult (Heinrich et al., 2008; Madigan &McCabe, 1971; Murphy et al., 2000). The task is an objective measure of listening effort because, as listening effort increases, fewer resources are available for rehearsal and recall of words. The first three serial positions are the most sensitive to changes in cognitive demands because they were presented earlier and are thus more difficult to recall, whereas the last two serial positions are easier to recall and less reflective of listening effort (Heinrich et al., 2008; Murphy et al., 2000). As a subjective measure, we asked participants in this study to rate their perceived listening effort after each trial.

Participants

Twenty participants with normal hearing (<25 dB HL at audiometric frequencies 250-8000 Hz) ages 19 to 44 years (M = 27.9) took part in this study. Participants reported no history of otologic or neurological disease and demonstrated near-normal corrected binocular vision (better than 20/25 via Snellen chart; Hetherington, 1954). No participant had a history of formal lipreading training as determined by self-report. Participants were all highly educated, with an average of 19.65 years of school completed. They were volunteers and were not compensated for their time. Testing occurred over two test sessions, each lasting approximately 1.5 to 2 hr. Test sessions were separated by at least one full day. All testing was completed in accordance with Vanderbilt University's institutional review board's policies regarding human participants in research.

Stimuli

Recall task. Speech tokens were monosyllabic words spoken by a female talker. The words used were those in published or commercially available word lists, including words from the Central Institute for the Deaf W22 (Hirsh et al., 1952), Northwestern University Auditory Test No. 6 (Tillman &Carhart, 1966), Kindergarten Phonetically Balanced Word Lists (Haskins, 1949), and the Pediatric Speech Intelligibility Test (Jerger, Lewis, Hawkins, &Jerger, 1980). The speech tokens were recorded in a professional television studio with a professional quality video camera and a shotgun microphone (Sennheiser K6). The recordings were digitized (sampling rate: 41000 Hz, 29.97 frames per second) and edited to be single tokens each approximately 1,700 ms in length and all with the same average root-mean-square level. Pilot testing with listeners with normal hearing allowed the 480 words to be rank ordered on the basis of their intelligibility in noise. All of the words were ranked twice, once in an AO condition (-3 dB SNR) and once in an AV condition (-7 dB SNR). For each modality, we used 400 of the easiest words to create 40 trial lists consisting of five pairs of words each. All words in a given trial list were chosen to be approximately equal in difficulty. Probe words were chosen to be balanced for difficulty across serial position.We created two condition lists (List A and List B) with 20 trial lists in each, balanced for word difficulty. For half of the participants, List Awas used for the noise conditions. During

testing, speech stimuli were presented at 65 dBA.

A four-talker babble was created to serve as a competing noise. Four female talkers were recorded individually using anomnidirectional microphone (EarthWorks) placed approximately 20 cm from the speaker's mouth in an anechoic chamber. The four female talkers were different from the female talker used for the speech tokens. Each talker read passages from the Connected Speech Test (Cox, Alexander, &Gilmore, 1987), a speech recognition test that contains topic-specific passages derived from a children's encyclopedia. The average root-meansquare level of each sentence was matched across all speakers and all sentences. Sentences within each passage were kept together, and the passage order across the four talkers was randomized so that talkers were never reading the same passage at the same time in the final mix. The recordings for all four talkers were mixed and stored as a single-channel .wav file.

Subjective ratings. In addition to the objective measure of listening effort (recall performance), a subjective measure of perceived effort was recorded. Immediately after each trial, participants were asked the degree to which they had had to "put in effort to hear what was said." Participants were instructed to respond on an 11-point scale with endpoint anchors of 0 (no effort) to 10 (lots of effort). This is similar to a question from theSpeech, Spatial and Qualities of Hearing Scale (Gatehouse &Noble, 2004). Before testing started, participants were instructed to answer this question after each trial. Their verbal responses after each trial were recorded by the experimenter. If a participant failed to provide a subjective rating, the experimenter prompted the participant, who responded before the next trial was initiated. Because of a protocol change, only the final 15 study participants reported their subjective ratings.

Predictive variables. We measured performance on two predictive variables: (a) lipreading skills and (b)WMC. We evaluated each individual participant's lipreading skill using the Revised Shortened Utley Sentence Lipreading Test (ReSULT; Updike, 1989). The ReSULT is a shorter version of the Utley Sentence Lipreading Test (Utley, 1946) and was designed to test lipreading ability quickly and reliably. The ReSULT contains two sets of 10 sentences spoken by a female. Participants watch the speaker on a computer monitor but do not hear the speech. After each sentence, the participant's task is to repeat aloud what the speaker said. Participants earn 1 point for each word repeated correctly and do not receive credit for words repeated in the wrong order. The maximum possible scores are 43 and 46 on the first and second lists, respectively. Participants practiced using the first list of sentences (Form A) and were then tested using the second list (Form B). Because Form A was tested first, it was considered practice; we used the results of Form B for all analyses.

We used an automated operation spantask (AOSPAN) to measure WMC (Unsworth, Heitz, Schrock, &Engle, 2005). The AOSPAN is a dual-task paradigm designed to measure WMC and has been shown to be correlated with higher level tasks such as reading comprehension (Turner &Engle, 1989; Unsworth et al., 2005). During the AOSPAN, participants are presented with an equation on a computer screen (e.g., [6 + 5]/2) and instructed to read and solve the equation. The participant is then presented with a possible solution on a new screen and asked to make a judgment about the correctness of this solution by using a mouse to click either "True" or "False" on the computer screen. After a choice is made, the participant is shown a letter that is to be committed to memory. After the presentation of a set of equation- letter pairs, the participant is asked to recall as many of the letters as possible. At the time of recall, a 4 ×3 matrix of letters is presented to each participant, whose task is to select the letters presented in order, using the mouse. After a practice session, set sizes vary from three to seven (three trials with each set size presented randomly). All equations include addition or subtraction inside a set of parentheses, followed by multiplication or division. Each participant receives two scores: (a) an absolute score (total number of letters recalled from perfectly recalled sets) and (b) a total score (number of letters recalled from all sets). For both scores, the total possible is 75. Because the absolute score and total scores likely measure the same underlying construct (WMC), and because the absolute score is amore traditional scoringmethod (Unsworth et al., 2005), we used the absolute score for all analyses.

Test Environment

During testing, the participants were seated in the center of a sound-attenuated booth. A 24-in. LCD video monitor placed on top of a loudspeaker (Tannoy System6) was positioned 1.5 m from the participant. All stimuli were presented via the same loudspeaker/monitor system. For recall testing and SNR setting, Presentation software (Neurobehavioral Systems v. 14.2) on a personal computer outside the test booth delivered themonosyllabic tokens via custom programming. The audio output was routed to an audiometer (GSI 61) for level control and then to the loudspeaker. The background noise, if present, was delivered to the test loudspeaker from a CD player (Sony CDP-CD315) via the other channel of the audiometer. For lipreading testing, the ReSULT was played from a Panasonic DVD player and delivered to the monitor inside the test booth. For WMC testing, the AOPSAN task was administered via E-Prime (Psychology Software Tools v. 2.0) using custom programming (Unsworth, Heitz, Schrock, &Engle, 2005).

Procedure

During the initial evaluation, we collected individuallevel variables, including hearing status (pure-tone audiometric thresholds), corrected binocular visual acuity (Snellen chart), WMC (AOSPAN), and lipreading ability (ReSULT). These data were collected in quiet with no background noise present. Also during the initial visit, the SNR used for testing was set individually for each participant. Although the SNRs were set to equate performance in theAOand AV conditions, it is reasonable to expect changes in listening effort because listening effort is not always tied to speech recognition performance (e.g., Fraser et al., 2010; Rabbitt, 1968; Surprenant, 1999). To set the SNR for testing, we created four AO lists and four AV lists, each composed of 60 words. Because the information had been collected and rank ordered by difficulty, it was possible to ensure that all eight lists were approximately equally intelligible. At a givenSNR, the speech recognition of 60 wordswas tested. The initial SNRs were +4 dB and 0 dB for the AO and AV conditions, respectively. We then adjusted the SNR to more closely approximate speech recognition of 75%, and 60 more words were tested. We made SNR adjustments by adjusting the level of the noise in 1- to 4-dB steps, depending on a participant's performance. A 1-dB change in SNR typically resulted in a 10% change in speech recognition performance for both AO and AV stimuli. If performance was at 75% (±5%), we used 120 more words to confirm the performance level; otherwise, the SNR was adjusted again and the speech recognition of 60 more words was tested. If necessary, the final 60 words were used to confirm the appropriate SNR setting. We used the same procedure with AO and AV stimuli. Because the SNRs used for testing were chosen individually to match speech recognition performance in the AO and AV conditions, the paired-associate recall task was completed at the same speech recognition performance level for AO and AV stimuli (see Table 1). The average SNR used in the AO conditions was 2.5 dB (minimum = 0 dB, maximum = 5 dB). The average SNR used in the AV conditions was -2.15 dB (minimum = -4 dB, maximum = 0 dB). Because the level of the speech stimuli was fixed at 65 dBA, the background noise varied from 60 to 65 dBA for the AO conditions and 65 to 69 dBA SPL for the AV conditions. During a second visit on a subsequent day, participants completed paired-associates word recall testing in quiet and in the presence of noise for AO and AV presentations. Test orderwas counterbalanced across participants both by presentation mode (AO, AV) and by noise level (quiet, noise). All participants completed a practice condition, first in quiet and then in noise (six trials each). The practice wordswere not presented again during testing. Thepresentation mode of the practice was determined by the first test condition; for example, if the first test condition was AV quiet, the mode of presentation for practice was AV.

During a trial of the recall task, five pairs of words were presented consecutively, with a 4-s interpair interval and 100-ms interword intervals. During list presentations, participants were also asked to repeat the words as they were presented. In this manner, a word that was misheard could still be correctly recalled and the intelligibility of lists could be assessed. For example, if a participant said "hog" when the correct word was dog, but recalled hog, this was scored as a correct recall. Because the SNRs were chosen to maintain relatively good speech recognition performance, even in noise, no participant failed to respond immediately after a word presentation. Immediately after the participant's repetition of the fifth word pair, a 500-ms, 1000-Hz warning tone was

presented, the noise (if present) was removed, and the first word from one of the five pairs was presented. The participant was then asked to recall the second word of the pair. There was no time limit for recall. After the participant recalled (or reported that he or she could not recall) the second word in a pair, he or she verbally reported the subjective rating for listening effort for the trial. Then the next trial was initiated by the experimenter.

There were four experimental conditions (two presentationmodes and two noise levels). In each experimental condition, 20 trials of five word pairs were presented. Therefore, for each serial position in each experimental condition, four trials were presented. The order of the probe word's serial position was randomized within a given condition.

Results

Recall

Before conducting the analyses, we converted recall performance scores from percentage correct to rationalized arcsine units (RAUs) according to the equations found in Studebaker (1985). The average recall performance (in RAUs) for all four conditions and all participants as a function of serial position is presented in Figure 1. To evaluate the effect of noise and visual cues, we performed an analysis of variance (ANOVA) with three within-subject factors: (a) serial position (1-5), (b) noise (present or absent), and (c) visual cues (present or absent). It revealed a main effect of serial position, $F(4, 76) = 35.77$, $p < .001$, partial $\eta 2 = .462$, and a main effect of noise, $F(1, 19) = 49.67$, $p < .001$, partial $h2 = .121$. There was no main effect of visual cues, and there were no significant interactions. To follow up the significant main effect of serial position, we performed multiple pairwise comparisons using linear contrasts with Bonferroni adjustments to control for familywise error rate (Dunn, 1961). The results of these analyses revealed that recall performance in the fifth serial position was better than in all other serial positions ($p < .001$) and that recall performance was significantly better in the fourth serial position than in Positions 2 and 3 ($p < .001$). Furthermore, there were no significant differences between recall performance among the first three serial positions. Taken together, these results indicate that recall performance was better in quiet than in noise and was better in the fourth and fifth serial positions. They also suggest that the presence of visual cues did not affect recall.

Recognition. An ANOVA with three within-subject factors-(a) serial position (1-5), (b) vision (present, absent), and (c) noise (present, absent)-revealed a significant main effect of noise, $F(1, 19) = 252.91$, $p < .001$, partial $h2 = .499$, but no main effect of visual cues or serial position. There were no significant interactions. These results indicate that the trials were of approximately equal intelligibility across serial position. Indeed, average performance at any serial position varied by no more than 2.2% and 4.5% within the quiet and noise positions, respectively (see Table 1); therefore, differences in serial position recall were not due to lists being differentially difficult to understand. In addition, word recognition performance was similar in theAOand AV conditions.

Subjective ratings. In addition to using recall performance as an indication of listening effort, participants were asked to give a subjective rating of listening effort after every trial. Although they were asked to rate an entire trial (i.e., effort for all 10 words), their ratings were recorded and scored while maintaining the serial position information for the probe words. Maintaining and evaluating the potential effects of serial position was important to ensure that the trials were equally difficult in terms of perceived listening effort. If there were differences in perceived listening effort or speech recognition across trials that probed different serial positions, then the effect of serial position on the recall task would be more difficult to interpret.

We used nonparametric analyses (FriedmanANOVA) for the subjective data. Due in part to the fact that an omnibus nonparametric statistic does not exist that allows for evaluation of main effects and interactions, we made an a priori decision to complete separate Friedman ANOVAs to evaluate serial position, vision, and noise. For these analyses, we corrected the p value for familywise error rate of multiple comparisons by dividing the initial value of p (.05) by the number of comparisons (eight; Dunn, 1961); therefore, $p < .00625$ was defined as significant. These eight planned comparisons reflected all main effects and interactions among serial position,

modality, and noise conditions; specifically, we evaluated the effect of serial position in each of the four modality and noise combinations (AO quiet, AO noise, AV quiet, AV noise).We also evaluated the effect of background noise for each of the modalities (AO and AV) and the effect of vision for each of the background noise conditions (quiet and noise) to test for any significant interactions.

The average subjective ratings of listening effort as a function of serial position is displayed in Figure 2. The analysis results revealed no significant effect of serial position in any of the four conditions (AO quiet, AO noise, AV quiet, AV noise) and no effect of visual cues in either quiet or noise; however, there was a significantmain effect of noise without visual cues, $F(1, 14) = 109.19$, $p < .0001$, and with visual cues, $F(1, 14) = 112.62$, $p < .0001$. The results support the objective data in that presence of visual cues did not influence listening effort, but the addition of background noise increased listening effort. The results also suggest that the effects of serial position evident in the recall task were not the result of differentially difficult trials and thus the lists were balanced. Therefore, the effects of serial position on the recall task are due to the increased cognitive demand on the earlier serial positions, and the recall task and speech recognition task were testing two separate constructs (listening effort and speech recognition ability, respectively).

Individual Variability

Despite the lack of a significant main effect of vision on recall performance, there were large individual differences in benefit from visual cues (see Figures 3 and 4). Consistent with the purpose of this investigation, we measured two predictive variables-WMC and lipreading ability-to examine whether these factors might account for some the individual differences in recall performance. We used the absolute AOSPAN score (total number of letters recalled from perfectly recalled sets) and the results from FormB on the ReSULT for the analyses. In the case of both lipreading ability and WMC, we calculated a correlation between predictive variables and average benefit from visual cues in the first three serial positions. Benefit from visual cues was defined as the difference in recall performance (RAUs) between the AV and AO conditions for the first three serial positions only. We chose the first three serial positions because they are thought to be indicative of listening effort (Heinrich et al., 2008; Murphy et al., 2000). A higher benefit from vision score indicates that a participant correctly recalled more words in the AV modality than in the AO modality.We performed correlation analyses between each predictive variable and the benefit from vision in quiet as well as in noise. For each of the four correlation analyses (lipreading and recall in quiet, lipreading and recall in noise, WMC and recall in quiet, WMC and recall in noise), a linear regression line was fitted and tested for significance at the .05 level. The results of the correlation analyses between lipreading ability and benefit from vision revealed no significant relationship in quiet ($r2 = .02$), but there was a significant relationship between lipreading ability and benefit from visual cues in noise ($r2 = .284$), $F(1, 18) = 7.154$, $p < .05$. Although there remains considerable individual variability, these results suggest that listening effort in a noisy background was reduced more for participants who were better lipreaders with the introduction of visual cues (see Figure 3).

In addition to lipreading, we investigated the correlation between WMC and recall benefit from vision (in quiet and in noise; see Figure 4). Correlation analyses revealed no significant correlations between WMC and recall benefit from visual cues in quiet or in noise ($r2s = .01$ and $.15$, respectively). Although the correlation was not significant, inspection of Figure 4 reveals a trend for people with high WMC to benefit more from visual cues in noise.

One of the reasons for the lack of significant correlationmaybe the large intersubject variability, as evidenced in Figure 4. For example, for three participants, the average benefit from vision on the recall task was 51.45, but their AOSPANscores were 16, 62, and 57. Therefore, the participants ranged widely in their WMC but were able to derive the same benefit from vision in the recall task. An additional reason that the correlation was not significant may be that the relationship between WMC and benefit from vision is not linear. Other authors have suggested that there may be a certain threshold level of WMC necessary for successful speech recognition, and if that level is not met, then listeners must rely on other communication or coping strategies for successful

speech recognition (Lyxell, Andersson, Borg, &Ohlsson, 2003). A similar relationship may hold for benefit from vision in a recall task.

To investigate this potential effect further, wedivided the scores into two groups: (a) Participants with scores 38 and below (n = 7) were categorized as having low WMC, and (b) the remaining 13 were placed in the high-WMC group. This division was based on average data reported by the test developers, who reported an average score of 37.5 in a group of 296 participants ages 18 to 35 (Unsworth et al., 2005). The average benefit from vision in quiet and noise as a function of WMC group is shown in Figure 5.We conducted an ANOVA on these data with one within-subject variable (recall benefit from vision in quiet and in noise) and one between-subjects variable (low or high WMC). The results revealed no main effect of WMC or noise, but there was a significant interaction betweenWMCand noise, $F(1, 18) = 4.851$, $p < .05$, partial $h2 = .434$. Follow-up analysis (Tukey's honestly significant difference test) revealed a significant difference between benefit from vision in quiet and in noise only for participants with high WMC ($p < .05$). These results indicate that, as a group, individuals with highWMCwere able to derive more recall benefit from visual cues while listening in noise than in quiet. In contrast, the recall benefit from visual cues was the same in quiet and in noise for participants with low WMC.

On the basis of the lipreading and WMC results, we thought it would be interesting to determine whether the relationship between each of these factors and recall benefit was due to a relationship between them; however, a correlation analysis revealed no significant relationship between lipreading ability andWMC($r2 = .022$, $p > .05$). This lack of relationship is consistent with previous literature indicating that lipreading ability in quiet is not related to cognitive capacity or other verbal reasoning abilities (Lyxell &Rönnberg, 1989, 1993; Summerfield, 1991) and suggests that the benefits to recall from good lipreading ability and high cognitive capacity were independent. We also thought it would be interesting to determine whether differences between individuals could account for differences in speech recognition. Correlation analyses revealed that there was no relationship between speech recognition performance (RAUs) in the AV condition and lipreading ability ($r2 = .024$, $p > .05$). Finally, we also wanted to determine whether differences in recall performance were related to differences in speech recognition. A correlation analysis revealed no significant relationship between benefit from vision on the recognition and recall tasks in quiet ($r2 = .027$, $p > .05$) or in noise ($r2 = .013$, $p > .05$). In total, these nonsignificant relationships suggest that speech recognition performance (in RAUs) or benefit from vision for speech recognition (in dB) did not influence performance or benefit from vision in the recall task. Furthermore, individual differences in speech recognition ability, WMC, and lipreading ability were independent fromeach other. Although these results are somewhat inconsistent with previous studies that have shown a relationship between speech recognition in noise and WMC (e.g., Lunner, 2003) or lipreading ability (e.g., Erber, 1969, 1975), these previous studies tested participants over a wide range of SNRs and speech recognition abilities. Conversely, participants in the current study demonstrated a relatively narrow range of speech recognition performance, due in part to the study's design.

Discussion

Effect of Noise

The results of this study indicated that the presence of a four-talker babble increased listening effort, as indicated by poorer recall in the presence of noise (see Figure 1). It is not likely that the poorer recall is an artifact of poorer speech recognition performance, because participants were given credit for recalling a word that they misheard. In this way, speech recognition performance might be affected by background noise, but recall performance could theoretically be perfect. Thus, the poorer recall demonstrated when background noise was introduced likely reflects increased listening effort. Furthermore, the subjective ratings of listening effort were consistent with the objective measures of listening effort. Raters consistently rated the conditions with noise as requiring more listening effort (see Figure 2). These findings are consistent with previous work suggesting that the presence of noise increases listening effort (Heinrich et al., 2008; Murphy et al., 2000;

Rabbitt, 1968). Despite some differences in methodology, the current findings are similar to those reported by Murphy et al. (2000). In general, the recall performance by serial position functions was similar, and the effect of noise was more visible at earlier serial positions than later serial positions (e.g., approximately 17 average points at Positions 1 and 2 and approximately 5 points for Position 5 in both studies).

Some differences between results exist, however. Recall performance was approximately 30 points better in all serial positions in the current study in both quiet and in noise, perhaps as a result of different stimuli. The monosyllablic words in the current study were shorter than the multisyllabic words used by Murphy et al. (2000), and perhaps the shorter length facilitated recall. Furthermore, participants in the current study were familiarized with the words because we had conducted initial speech recognition testing to find each individual's SNR. Finally, in the current study participants were asked to repeat the words during testing so speech recognition as well as recall could be measured. This process may have facilitated recall through forced rehearsal, whereas recall was the only task participants performed in the experiments reported by Murphy et al. (2000).

Effect of Vision

On average, results from the recall task indicated no significant effect of visual cues on listening effort (see Figure 1). Furthermore, subjective ratings indicated that, when absolute performance levels were matched, perceived listening effort was independent of visual cues (see Figure 2). These results are inconsistent with previous reports of increased listening effort in AV conditions when speech recognition performance is fixed between AO and AV stimuli (Fraser et al., 2010). Although the reasons for the differences between results are unclear, they may be due to differences in methodology. First, we used open-set monosyllable speech stimuli, whereas Fraser et al. (2010) used closed-set sentence stimuli. Furthermore, we did not measure the speed of participants' responses, whereas Fraser et al. measured reaction time for speech recognition and the secondary task, both of which were slower in the AV than the AO modality. Perhaps the recall task we used was less sensitive to measures of listening effort because participants' responses were not timed. However, visual cues did affect listening effort for some individuals, so the paired-associates recall task is not likely insensitive to listening effort. Given these differences, further work aimed at directly examining the specific methodologies most sensitive to visual cues and listening effort may be worth pursuing.

Individual Variability

Individual data indicated there were significant relationships between each of the two predictive variables (lipreading ability and WMC) and listening effort with the introduction of visual cues. Although there was significant variability in the data (see Figures 3 and 4), there were some interesting significant effects, and these effects were dependent on the presence or absence of noise. In quiet, there were no effects of lipreading ability or WMC. Coupled with no average main effect of visual cues in quiet, these results suggest that visual cues did not affect listening effort in the quiet conditions we evaluated. These results are somewhat inconsistent with previous studies that show improved cognition in quiet with visual cues present (Reisberg et al., 1987). It is possible, however, that the present task was not difficult enough in quiet to require participants to utilize visual cues. For example, Reisberg et al. (1987) found that participants were better able to shadow speech in their nonnative language if visual cues were present. In this case, visual cues may enhance performance by providing additional information about the foreign language. Conversely, in the current study speech recognition in quiet with no visual cues was nearly perfect for all participants. Therefore, the addition of the visual cues did not facilitate speech recognition because the words were already easily identifiable and thus vision provided no further cues. Indeed, many participants reported looking at the video monitor during AV conditions in quiet but not actually paying attention to the monitor, despite specific instructions to attend to the monitor. If the video monitor were not being used by the participants, no effect of visual cues would be expected.

Conversely, in noise, participants needed to utilize the video monitor to achieve similar speech recognition performance at the more difficult SNR. This experiment was designed to lead to similar speech recognition performance in the AV and AO conditions. In the presence of matched performance, the poorer SNR in the AV

condition suggests that participants clearly demonstrated speech recognition benefit from the visual cues. Despite this benefit to speech recognition, there was no significant main effect of visual cues on recall performance. Although there was no significant main effect of visual cues, there were large individual differences, suggesting the possibility of increased or decreased listening effort as a result of visual cues in individual listeners. On the basis of the interactions between the two predictive variables and the benefit from vision, we hypothesize that these individual differences can be explained in terms of processing efficiency; specifically, individuals with high WMC were able to derive more benefit from visual cues in noise than in quiet, whereas listeners with low WMC were not. Therefore, individuals who had more available cognitive resources were able to use visual information to reduce listening effort for audiovisually presented speech, in contrast to individuals with less overall capacity and/or poorer processing efficiency for visual cues. We propose that listeners need sufficient cognitive resources to utilize visual cues, but if a listener has enough resources, visual cues may provide better signal representation. Consistent with the ELU model (Rönnberg, 2003; Rönnberg et al., 2008), improved signal representation is expected to facilitate recall and lead to decreased listening effort. As noted earlier, listeners with better lipreading ability experienced less listening effort with visual cues than without (see Figure 3). For people who are better lipreaders, utilizing visual cues is more automatic and the AV signal is better represented. Because automatic processes require fewer cognitive resources (Hasher &Zacks, 1979), we propose that people who are better lipreaders are likely to have more remaining cognitive resources available for processing and integrating the auditory and visual signals. Therefore, people who are good lipreaders can make use of the additional information that visual cues provide. Conversely, people who struggle with lipreading need to use more of their pool of limited cognitive resources to extract visual information and then also integrate the complementary cues to achieve a strong signal representation. Consistent with this hypothesis, the poorest lipreaders demonstrated substantially more listening effort when visual cues were present in noise than the best lip readers (see Figure 3).

Although the relationship between lipreading ability and listening effort has not been reported on previously, earlier work suggests that individuals who are better lipreaders derive more AV benefit on speech recognition tasks (MacLeod &Summerfield, 1990). On the basis of this previous work, one might be concerned that recall benefit was driven by differences in speech recognition performance; however, a correlation analysis revealed no significant correlation between lipreading ability and AV speech recognition benefit (dB) in noise ($r^2 = .0015$). Furthermore, a correlation analysis revealed no significant correlation between lipreading ability and AV speech recognition performance (RAUs) in noise ($r^2 = .0239$). Therefore, differences in AV speech recognition benefit did not contribute to differences in AVrecall benefit as a function of lipreading ability in the presence of background noise.

Another indication that a better signal representation yields reduced listening effort if cognitive resources are sufficient comes from an examination of the relationship betweenWMC and AV recall benefit in noise; specifically, when the participants were divided into two groups on the basis ofWMCsize asmeasured by theAOSPAN, on average participants who had higher WMCs exhibited more AV benefit in noise than in quiet. No such difference was found for the group of listeners with low WMCs. We propose that participants with higher WMCs had more cognitive resources available for integrating auditory and visual information. Because they were able to better integrate the auditory and visual stimuli, the signal representation was better, and thus listening effort was decreased. Conversely, listeners with more limited cognitive capacity did not have sufficient resources to utilize the better signal representation provided by the AV stimuli. For these listeners, there was no difference in AV recall benefit between quiet and noise. Providing visual cues did not improve listening effort, potentially because listeners did not have sufficient resources to integrate the audio and visual signals to enhance representation and reduce listening effort. Similar to lipreading ability results, this effect of WMC was not driven by differences in AV speech recognition benefit. On average, AV speech recognition benefit in noise was small and similar between groups (1.80 and 1.83 RAUs for those in the low- and high-WMCgroups,

respectively); thus, it is unlikely that differences in speech recognition benefit drove differences in recall benefit between the two groups.

Individual results suggest that listening effort was decreased in noisy environments by the presence of visual cues for some listeners.However, this benefit required greater cognitive resources, and despite significant variability those individuals who exhibited large WMCs or were good lipreaders were more likely to make use of the better signal representation of the AV stimuli in noise; that is, despite the fact that no significant effect of visual cues on listening effort was measured, on average, these data indirectly suggest that cognitive resources are necessary to use visual cues because listeners with limited resources were unable to benefit from visual cues. This conclusion is consistent with the findings of Fraser et al. (2010), who demonstrated an increase in listening effort with the addition of visual cues in a dual-paradigm task (a speech recognition primary task and a vibro-tactile secondary task). Although the findings of both studies support the notion that cognitive resources are required to use visual cues, we propose that the impact that this increased demand on cognitive resources has on listening effort depends on the methodology implemented; specifically, the effect of visual cues may be manifested as an increase in measured listening effort as demonstrated by Fraser et al., or a benefit from vision that is apparent only in listeners with sufficient resources, as demonstrated in the current study.

Conclusions

Consistent with the results of Murphy et al. (2000), noise increased listening effort across both AO and AV conditions, as indicated by better recall performance and lower ratings of effort in quiet than in noise (see Figures 1 and 2).

Visual cues did not affect listening effort (objectively or subjectively) in quiet (see Figures 1 and 2). Furthermore, there was no correlation between the predictive variables and benefit from visual cues in quiet.

On average, there was no main effect of visual cues on objective or subjective measures of listening effort (see Figures 1 and 2). However, there was some support for the hypothesis that processing visual cues during a speech recognition task requires cognitive resources; specifically, individuals with less overall cognitive capacity or poorer lipreading ability were not able to take advantage of available visual cues to reduce listening effort (improve word recall) for audiovisually presented speech in noise. Although there was substantial intersubject variability, the results indicate that listeners who were more efficient or effective lipreaders were more likely to benefit fromvisual cues than their counterparts who were poor lipreaders. Furthermore, listeners with highWMC were more likely to derive AVrecall benefit in noise, whereas those with lowWMC did not, on average, demonstrate this benefit. In total, these results suggest that listeners with sufficient cognitive resources can make use of visual cues to reduce listening effort.

Acknowledgments

We thank D. Wesley Grantham and Daniel Ashmead for their helpful comments and insights throughout the development and execution of this project.

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Editor: Robert Schlauch
Associate Editor: Jean-Pierre Gagne
Received June 7, 2010
Revision received October 27, 2010
Accepted February 2, 2011
DOI: 10.1044/1092-4388(2011/10-0154)

Publication date: Oct 2011

Year: 2011

Age-Related Benefits of Digital Noise Reduction for Short-Term Word Learning in Children With Hearing Loss

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1448-1463.
ProQuest document link

Abstract: To determine the rate of word learning for children with hearing loss (HL) in quiet and in noise compared to normalhearing (NH) peers. The effects of digital noise reduction (DNR) were examined for children with HL. Forty-one children with NH and 26 children with HL were grouped by age (8-9 years and 11-12 years). The children learned novel words associated with novel objects through a process of trial and error. Functions relating performance across trials were calculated for each child in each listening condition and were compared. Significant effects were observed for age (older >younger) in the children with NH and listening condition (quiet >noise) in the children with HL. Significant effects of hearing status were also observed across groups (NH >HL), indicating that the children with HL required more trials to learn the new words. However, word learning improved significantly in noise with the use of DNR for the older but not for the younger children with HL.

Hearing aid history and signal-to-noise ratio did not contribute to performance. Word learning was significantly reduced in younger children, in noise, and in the presence of hearing loss. Age-related benefits of DNR were apparent for children over 10 years of age.

Full text: Headnote

Purpose: To determine the rate of word learning for children with hearing loss (HL) in quiet and in noise compared to normalhearing (NH) peers. The effects of digital noise reduction (DNR) were examined for children with HL.

Method: Forty-one children with NH and 26 children with HL were grouped by age (8-9 years and 11-12 years). The children learned novel words associated with novel objects through a process of trial and error. Functions relating performance across trials were calculated for each child in each listening condition and were compared.

Results: Significant effects were observed for age (older >younger) in the children with NH and listening condition (quiet >noise) in the children with HL. Significant effects of hearing status were also observed across groups (NH >HL), indicating that the children with HL required more trials to learn the new words. However, word learning improved significantly in noise with the use of DNR for the older but not for the younger children with HL. Hearing aid history and signal-to-noise ratio did not contribute to performance.

Conclusion: Word learning was significantly reduced in younger children, in noise, and in the presence of hearing loss. Age-related benefits of DNR were apparent for children over 10 years of age.

Key Words: children, hearing loss, noise reduction, word learning

(ProQuest: ... denotes formula omitted.)

Learning new words is a critical accomplishment of childhood that lays the foundation for language and literacy development. A broad and deep vocabulary allows children to speak effectively, read comprehensively, and write meaningfully. Although a number of factors are known to promote the learning of new words (e.g., age of the child, size of the child's vocabulary, similarity of the new word to other known words), hearing loss (HL) has been shownto pose a significant barrier. This notion is supported by evidence relating the severity of a child's HL to the size of his or her vocabulary (Briscoe, Bishop, &Norbury, 2001; Fellinger, Holzinger, Beitel, Laucht, &Goldberg, 2009; Kiese-Himmel, 2008; Sarant, Holt, Dowell, Rickards, &Blamey, 2008; Wake, Hughes, Poulakis, Collins, &Rickards, 2004). It has been shown that, on average, the vocabulary of school-aged children with mild-to-moderateHLis 2-3 years behind that of children with normal hearing (NH; Pittman, Lewis, Hoover, &Stelmachowicz, 2005). The effect of severeto- profound HL is an even slower rate of vocabulary development that further widens the gap between children with HL and children with NH over time (Blamey et al., 2001). Taken together, it appears that mild-to-moderate degrees of HL delay vocabulary development, whereas more severe HL impairs it. Although the differences between chronological and vocabulary age may be negligible at younger ages, concerns for social, academic, and mental health problems (Fellinger et al., 2009) can occur for children with HL who are chronologically 12 years of age but have the vocabulary of a 9-year-old.

Unlike the disordered word learning of children with specific language impairment (SLI), the basis of poor word learning in children with HL appears to be the result of their impaired peripheral auditory systems. Specifically, word learning in children with SLI has been attributed, in large part, to impaired working memory (Alt, 2010). On the other hand, research has shown that the working memory of children and adults with HL is independent of hearing loss (Hansson, Forsberg, Lofqvist,Maki-Torkko, &Sahlen, 2004; Lyxell, Andersson, Borg, &Ohlsson, 2003; Zekveld, Deijen, Goverts, &Kramer, 2007).One could argue, however, that a degraded representation of a new word also affectsworking memory. Degraded perception of speech has been shown to cause poor phonological processing in children (Briscoe et al., 2001) and may prevent the cognitive processes that are triggered when a new word is perceived (see, e.g., Storkel &Lee, 2011). For example, the words hat, sat, and

fat may be well-known to a child with HL, but each word contains low-level, high-frequency voiceless fricatives that may be difficult for a child to differentiate, even with amplification. Perception of a new word such as shat may be confused with these known words, thus resulting in misperception rather than a trigger for word learning. Therefore, the threshold for identifying a word as new is higher in children with HL. Even when a word is recognized to be new, multiple repetitions may be necessary to form a sufficient representation in order to differentiate it from other known words. This was demonstrated in children with HL and in children with NH who were asked to learn nonsense words that were subtly degraded by narrowing the bandwidth of the signal to that of typical hearing aids (Pittman, 2008). Word learning for both groups was significantly reduced, suggesting that a degraded signal can interfere with the word-learning process, even for children with NH.

Whereas standardized tests are used to quantify children's receptive and expressive vocabularies, paradigms focusing on the speed and accuracy ofword learning have been developed to determine those conditions that promote or impede the word-learning process (Akhtar, 2005; Akhtar, Jipson, &Callanan, 2001; Dollaghan, 1985; Lederberg, Prezbindowski, &Spencer, 2000; Rice &Woodsmall, 1988). One such paradigm was used in a recent study to examine the effects of certain hearing aid characteristics on receptive word learning in children with HL compared to children with NH (Pittman, 2008). In this paradigm, nonsense words are assigned to novel objects that have no common name. Children play a computer game that requires them to learn the names of the objects through a process of trial and error. On each trial, the children listen to a novel word and then select an object. Reinforcement is awarded for correct selections only, providing the children with the information needed to learn. At the end of the test (about 15 min), a function representing the children's increasing performance over 100 or more trials is generated to determine the number of exposures needed to achieve a criterion level of performance. With this paradigm, the effects of hearing loss and listening conditions on the rate of word learning may be examined. For example, noise is considered to be one of the most adverse listening conditions for hearing aid users (Kochkin, 2002). One form of hearing aid technology that has the potential to benefit children with HL when they are in noise is digital noise reduction (DNR). The goal of this technology is to improve listening comfort and preserve or improve the perception of speech. The advantages of examining the effects of DNR on auditory skills such as word learning over traditional speech perception measures are many. First, perception of the novel words does not require previous knowledge of or experience with the language. Second, a period of acclimatization with a particular form of signal processing is not necessary. Third, considerable data may be collected in a short period of time. And finally, word learning-similar to speech perception-has high face-validity in pediatric populations.

DNR

Chung (2004) provides a thorough description of the signal detection, analysis, decision rules, and execution of DNR in commercially available hearing aids. In general, alterations to the output of the hearing aid occur in selected frequency bands or over the entire frequency spectrum when steady-state noise is detected at the input to the hearing aid. Themanner in which noise reduction is achieved varies across hearing aid makes and models (Hoetink, Korossy, &Dreschler, 2009), but the most common approach is an overall decrease in output. The effects ofDNRare also more pronounced for steady-state noise than for speech signals because steady-state noise is more easily detected and managed byDNRalgorithms (Bentler &Chiou, 2006; Ricketts &Hornsby, 2005).

Despite the reduction in overall amplification, research has shown that speech perception in noise and speech reception threshold withDNR are well preserved in adults (Auriemmo et al., 2009; Bentler,Wu, Kettel, &Hurtig, 2008; Nordrum, Erler, Garstecki, &Dhar, 2006; Peeters, Kuk, Lau,&Keenan, 2009; Ricketts&Hornsby, 2005; Stelmachowicz et al., 2010). Similar results were found in two studies conducted inchildren. Stelmachowicz and colleagues (2010) examined speech perception in 16 children between the ages of 5 and 10 years with mild to moderately severe HL. The authors used behindthe- ear hearing aids having DNR technology that uses a modified spectral subtraction algorithm performed independently in 16 frequency bands. The aids were fit to

each child according to DSL targets (Scollie et al., 2005; Seewald, Moodie, Scollie,&Bagatto, 2005) and were verified using real-ear measures. The children's perception of nonsense syllables, monosyllabic words, and sentences in noise was examined as a function of age and DNR (activated vs. deactivated). Main effects of age and stimulus condition were observed; however, no effect of noise reduction was found. As with adults, the results suggest that children's performance with DNR is preserved despite the reduction in overall amplification. Auriemmo et al. (2009) reported similar results for speech recognition in 19 children with mild to moderately severe sensorineural HL between the ages of 6 and 12 years. The authors used behind-the-ear hearing aids employing a multichannel adaptive DNR algorithm that reduced the gain independently in 15 frequency bands. The overall signal-to-noise ratio (SNR) benefit provided by directional microphones, as well as the benefit of DNR in quiet and at three SNRs (+5 dB, 0 dB, and -10 dB), was determined. Although a significant SNR improvement was observed for the directional microphone condition over the omnidirectional condition, no differences in performance were observed with the use of DNR. Also, standardized tests of language development revealed that the children were not adversely affected by adaptive directional microphones and DNR after using the technology for a 1-year period.

Although it appears thatDNRpreserves speech perception in children and adults, a significant weakness of previous studies is that the parameters of the acoustic signal provided by DNR were not reported-that is, the amount by which the amplified signal was attenuated by DNR and the signal level relative to the noise were not reported. It is possible that little effect was observed because little noise reduction occurred. It is also possible that DNR imposed significant reductions on the amplified signal but performance was preserved due to the redundancy of speech. It has been well established that speech perception is robust and can withstand substantial degradation of the speech signal with little effect on perception (Remez, Pardo, Piorkowski, &Rubin, 2001; Walden, Prosek,&Worthington, 1975).Whenperception is further supported by the context of the message, the listener's familiarity with the speaker, and his or her knowledge of the topic, the listener with HL is better able to fill in the missing auditory information to perceive the message with confidence. However, the benefits of DNR may not be as apparent for auditory tasks that are not supported as well as speech perception. For children, learning new words is one such task-one of the most important auditory tasks that they must perform in order to communicate effectively.

The purpose of the present study was twofold. First, the impact of noise on children's ability to learn new words was determined for children with NH and children with HL. It was hypothesized that learning would decrease in noise for both groups-and more so for the children with HL. Second, the impact of DNR on word learning in children with HL was examined. It was hypothesized that the reduction in overall amplification imposed by DNR would slow the learning rate in noise. To capture the known effects of age on word learning, two age groups of children were recruited (ages 8-9 years, ages 11-12 years). These groups represent the period of greatest vocabulary growth (Anglin, Miller,&Wakefield, 1993; Johnson &Anglin, 1995), a period in which Bloom (2001) estimated that approximately 12 new words are learned per day (p. 44). It was hypothesized that word learning would be directly related to receptive vocabulary over and above hearing status.

Method

Participants

Forty-one children with NH (22 boys, 19 girls) participated in this study. Children were recruited on the basis of chronological age to form two age groups: a younger group consisting of 20 children between the ages of 8 and 9 years (M = 9;0 [years;months], SD = 0.7, range = 8;1- 9;11) and an older group of 21 children between the ages of 11 and 12 years (M = 11;11, SD = 0.65, range = 11;0- 12;11). On the day of testing, all children had hearing thresholds ≤20 dB HL bilaterally at octave frequencies between 0.25 kHz and 8 kHz. Normal middle-ear status was confirmed with acoustic immittance measures. These children served as the control group.

Children with HL were enrolled in the study if they were eligible for monaural or binaural amplification. The experimental group comprised 26 children (11 boys, 15 girls) with mild to moderately severe HL. Thirteen

children were between the ages of 8 and 10 years (M = 9;1, SD = 0.55 range = 8;1-9;11), and 13 were between the ages of 11 and 12 years (M = 11;11, SD = 0.66, range = 11;0-12;11). It was confirmed, through t tests, that there were no differences in age between the NH and HL groups for the younger, $t(31) = -0.662$, $p = .50$, and older, $t(32) = 0.304$, $p = .763$, children. Average age of HL identification was 3;1, with a range of 0 (birth) to 6 years of age. All but one of the children wore personal hearing aids. For those children having personal hearing aids, average age at amplification was 4;4, ranging from 6 months to 8 years of age. Length of amplification for these children ranged from 1;6 to 11;0, with an average of 5;11. Only one child wore hearing aids havingDNR enabled in a dedicated program.

On the day of testing, the participants received a full hearing evaluation, which included otoscopy, tympanometry, and pure-tone air- and bone-conduction audiometry. Children whose hearing thresholds were unchanged since their last hearing evaluation did not receive boneconduction testing. Table 1 contains the hearing thresholds of each child in the younger and older groups at octave frequencies between 0.25 kHz and 8 kHz. The children's gender, chronological age, type of hearing loss in each ear, and ears amplified during testing are also provided. Figure 1 shows the hearing thresholds of each child as a function of frequency for the right and leftears in the upper and lower panels, respectively. Average hearing levels (± 1 SD) for the younger group (filled symbols) and older group (open symbols) are shown in each panel. On average, the hearing thresholds were similar through 1 kHz, with somewhat poorer thresholds occurring at higher frequencies for the older children. The variability in HL configuration across children is typical of this population and is consistent with that reported in previous studies in this age group (Auriemmo et al., 2009; Delage &Tuller, 2007; Gravel, Fausel, Liskow, &Chobot, 1999; Jerger, Martin, Pearson, &Dinh, 1995; Jutras &Gagne, 1999; Scollie, Seewald, Moodie, &Dekok, 2000; Stelmachowicz et al., 2010; Stelmachowicz, Pittman, Hoover, &Lewis, 2002; Stelmachowicz, Lewis, Choi, &Hoover, 2007). Acoustic immittance was consistent with the middle-ear status of each child. All of the children (NH and HL) were enrolled in the grade that was appropriate for their age in public elementary schools or through home schooling.

Prior to testing, the receptive vocabulary of each child was determined using the Peabody Picture Vocabulary Test-III (Form IIIB; Dunn& Dunn, 2006). Recall that standardized measures of receptive vocabulary can reveal the long-term effects of childhood HL when compared to those ofNH peers (Blamey et al., 2001; Pittman et al., 2005). Figure 2 shows the results of the PPVT-III as a function of chronological age for the children with NH (filled symbols) and the children with HL (open symbols). PPVTage, standard score, and raw score are shown in the upper, middle, and lower panels, respectively. Asterisks indicate the children with HL who did not have a bilateral sensorineural hearing loss and who may be identified from Table 1 using the chronological age. For example, two children aged 8;11 scored similarly on the PPVT-III, even though one child had a moderateto-profoundmixed loss and the other had amild conductive loss. These results show that the receptive vocabulary of the children withNH is greater than that of the children with HL, with some overlap between the two. A two-way analysis of variance (ANOVA) confirmed significant main effects of age, $F(1, 63) = 38.203$, $p < .001$, and hearing status,$F(1, 63) = 16.917$, $p < .001$. The lack of an Age ×Hearing Status interaction, $F(1, 63) = 0.941$, $p = .336$, indicates a similar difference in vocabulary level for each age group. The difference is on the order of 3 years, which is consistent with previous studies (Pittman et al., 2005; Stelmachowicz, Pittman, Hoover, &Lewis, 2004).

Amplification

Each child was fitted with behind-the-ear hearing aids for use during the experimental tests (see Table 1). The DNR feature in this hearing aid consists of two independent DNR algorithms that operate simultaneously in each of 16 channels (see Mueller, Weber, &Hornsby, 2006, for a full description). The first is a modulation detection algorithm that causes the gain within each channel to be reduced when steady-state noise is detected. Gain is reduced independent of the signal level in the channel and can be adjusted with the manufacturer's programming software. The second DNR algorithm employs technology similar to aWiener filter,

which calculates the SNR and filter coefficient for each channel by tracking the envelope of the signal within the channel. This feature operates continuously regardless of the input signal (speech or noise) to the channel. Direct measures of the DNR feature in the hearing aids used in the present study showed an attack time of 3.2 s after the onset of steady-state, broadband noise and activated at input levels as low as 40 dB SPL. Effective gain reduction for the 50 dB SPL noise level employed during the word-learning tasks was 7 dB when set to maximum noise reduction.

The hearing aids were fitted using the child's personal earmolds. Four children did not have their personal earmolds with them at the time of testing, so temporary molds (Comply, Snap Tips) were used. The hearing aid manufacturer's software was used to program and finetune the devices based on the simulated real-earmeasures (SREM) performed with the Verifit (Audioscan, VF-1) hearing aid test system. Following the manufacturer's instructions, individual real-ear-to-coupler differences- as well as the child's hearing thresholds- were obtained and were entered into the Verifit. The output of the hearing aids was adjusted to within 5 dB of the targets prescribed for average (65 dB SPL) and soft(50 dB SPL) conversational speech by the Desired Sensation Level (DSL [i /o] 5.0) fitting algorithm (Scollie et al., 2005; Seewald et al., 2005). Real-ear measures were obtained for the first five children to confirm that the SREM procedure provided an accurate estimate (± 2 dB) of realear amplification. Thereafter, all hearing aids were programmed using the SREM function only.

For this investigation, two active programs were created in each hearing aid. In Program 1, all advanced signal-processing features offered in the hearing aid were disabled, including Speech and Noise Management (DNR), Sound Smoothing (reduction of impulse noises), eWind Screen (reduction of wind noise), and Feedback Blocker (feedback management). In Program 2, all advanced signal-processing features remained disabled with the exception of the Speech and Noise Management feature, which was set to maximum. The Speech-in- Noise-Only option, which activates the noise reduction feature only when both speech and noise are present, was disabled. This caused the hearing aid to activate the DNR feature whenever noise was detected, regardless of whether speech was present. The output of each program was equated to provide the same audibility in quiet with or without DNR activated.

The user controls for this hearing aid included a program button and a volume control. The hearing aids were set to indicate when it was in Program 1 or 2 by generating one or two beeps, respectively. The beeps were set to occur at a frequency and output level that was audible to the child. The range of the volume control was set to 0 (i.e., deactivated), which meant that it served as an on/offswitch only.

Prior to testing, each child was familiarized with the hearing aids and was trained to select the required program when directed to do so. Because all but one of the children were experienced hearing aid users, they required minimal orientation to the device. This experience allowed them to focus their attention on the "program" button, which was new to many of them. The children were required to indicate the number of beeps that they heard when the hearing aids were changed from one programto the next. Because the hearing aidswere equipped with a feature that linked the two hearing aids (E2E), changing the program in one hearing aid also changed the program in the other aid, causing the child to hear one or two beeps in each ear at nearly the same time. Most of the children were able to perceive the correct number of beeps generated by the hearing aid in each ear, whereas some did not. For those children, the examiner adjusted the hearing aids during testing. All other children adjusted the hearing aids by pressing the program on both aids.

Stimuli

Three sets of five nonsense words were created for this study. The words are listed in Table 2 with their orthographic and phonetic transcriptions from which the positional and biphone probabilities were calculated (Vitevitch &Luce, 2004).1 All of the words were two syllables in length and were pronounced with the stress on the first syllable, as is typical of two-syllable English words. The words within each list contained the same two vowels in the first and second syllables so that learning would depend on the perception of the lowerlevel consonants rather than the louder vowels. Consonant phonemes that occur frequently in English (Denes, 1963)

were represented multiple times within each list. In this way, the words contained both unique and similar acoustic phonetic information, requiring the children to use more than one phoneme to identify any given word (Pittman, 2008; Stelmachowicz et al., 2004).

Stimuli were spoken by a female talker with a standard American English dialect. Recordings were made at a sampling rate of 22.050 kHz using a microphone with a flat frequency response to 10 kHz. The words were concatenated (removing all silent gaps), equated for root-mean-square level, and saved in separate audio files. Periods of silence were added to the beginning and end of each file so that each file was 2000 ms in duration. For the experiment, the words were mixed with a continuous, steady-state, broadband noise having a flat frequency spectrum ranging from 0.2 kHz to 10 kHz. Stimuli were presented in the sound field at an overall level of 50 dB SPL at the calibrated position and at an SNR of 0 dB. This speech and noise level was sufficient to activate the DNR feature but was low enough to minimize the incidence of compression limiting. In a sound-treated room, 50 dB SPL is equivalent to quiet conversational speech. The children's task was to learn the set of words presented in quiet and another set of words presented in noise. The children with NH learned two sets of words (one in quiet and one in noise), whereas the children with HL learned three sets of words (one in quiet, one in noise, and one in noise with theDNR activated). The word lists were counterbalanced across listening conditions, and the order of testing was counterbalanced across children.

DNR

Figure 3 shows the amplified waveforms for one child (15 stimuli). The stimuli and noise are shown with DNR off(upper panel) and with DNR on (lower panel). Although the nominal SNR was 0 dB for this experiment, the effective SNR for each child with HL can differ because of noise introduced by the hearing aid during amplification. Therefore, the effective SNR received by each child with HL was calculated with and without the DNR feature engaged. An inversion technique described by Souza, Jenstad, and Boike (2006) was used to separate the speech signal from the noise. This procedure requires three audio files containing (a) the speech and noise stimuli as they were used in the study (original speech + original noise), (b) the noise inverted and mixed with the original speech (original speech + inverted noise), and (c) the speech inverted and mixed with the original noise (inverted speech + original noise). The audio files were routed to a hearing aid test chamber (Verifit [Audioscan, VF-1]) where the output of the hearing aid was captured in a 2-cm3 coupler (Frye, HA-2) with an appropriate adaptor for a probe microphone (Etymotic, ER-7C). The output of the probe microphone was routed to a SoundDelux soundcard in a desktop computer. Custom software was used to play the stimuli and record the output simultaneously. The recorded audio files were imported to an audio editor program (Adobe Audition, Version 1.5). Effective SNR was determined by mixing the first recorded audio file (original speech + original noise) with each of the other two files. Mixing caused the original and inverted components to cancel, whereas the amplitude of the in-phase component was doubled (6 dB). The overall level of the long-term average spectrum of the isolated speech and noise components was then calculated after applying a 6-dB correction. These measures revealed a decrease of 5.1 dB for the younger children and 5.3 dB for the older children when the DNR feature was engaged.

Figure 4 shows the effective SNR of the stimuli that each child with HL received from the hearing aid with and without DNR for the 8- to 9-year-olds (upper panel) and for the 11- to 12-year olds (lower panel). Overall SNR for the right and lefthearing aids were averaged, with the exception of the three children who were aided monaurally. The children are listed in order of overall SNR achieved with DNR from least to greatest. This order was also used in Table 1 so that overall SNR could be compared to the children's hearing thresholds. The effective SNR ranged from -8.4 dB to 4.2 dB across conditions for the nominal 0 dB SNR presentation. Overall SNR improved when DNR was activated for all but a few children. The average effective SNRwithoutDNRwas -1.7 dB and -2.6 dB for the younger and older children, respectively. When DNR was activated, the average effective SNR was 0.6 and -0.3 dB for the younger and older children, respectively, for an average improvement of 2.3 dB for both groups. No correlation was found between overall SNR and pure-tone average hearing

thresholds (averaged across ears) with DNR activated, r = .291, p = .150, or when DNR was deactivated, r = .215, p = .291.

Dynamic Word Learning Task

The children's task was to learn the object or character to which a nonsense word belonged using an interactive computer game that promoted learning through a process of trial and error. During the game, a nonsense word is randomly selected and presented to the participant. He or she must then select one of five buttons displayed on the leftside of a computer screen. Each button displays a picture of a nonsense object or character having no common name. Reinforcement for accurate selections is provided via a video game displayed on the right side of the computer screen (e.g., a piece of a puzzle was added to a picture). Reinforcement is not provided for incorrect responses. This trial-and-error process required the children to remember both their correct and incorrect selections in order to advance through the games.

Three sets of five pictures each were used and are displayed in Figure 5. Each set of pictures was internally consistent and represented toys, flowers, and aliens. In the event that a picture-word association was more salient than another or that one picture was simply more appealing to the children than the others, the nonsense word associated with each picture was systematically alternated across children, and the pictures were counterbalanced across word lists. This reduced the impact of possible picture or word preference by distributing the effect across listening conditions.

Procedure

All testing was conducted in a sound-treated booth in the presence of two examiners. The first managed the experimental equipment and monitored the child's performance. The second examiner familiarized the child with the game and remained with the child during testing. The child was seated at a small table approximately 1 m from a loudspeaker at 0° azimuth. The stimuli were presented through the loudspeaker using custom software on a standard desktop computer. Although the temporal parameters of the experiment were controlled by the laboratory software, the children's responses were self paced-that is, a stimulus file was presented (2,000-ms duration), the children responded at their own pace (15-s response window), reinforcement was provided when appropriate, and the next stimulus was presented after a short delay (1,000 ms).

A brief practice session involving simple shapes associated with three nonsense words was used to familiarize the children with the task. The following instructions were given to the child:

You are going to hear some silly names. Your job is to choose the picture on the screen that has that name by touching it with your finger or clicking on it with a mouse. If you choose the right picture, the game on the screen will play. If not, nothing will happen, and you will hear the next silly name. Don't be surprised if it takes a little while to figure out the name that goes with each picture.

Five repetitions of each word were randomly presented to the children for a total of 15 trials (< 2 min). When the children were comfortable with the game format, testing for the experimental conditions proceeded. Each word was presented 20 times for a total of 100 randomized trials (5Words ×20 Repetitions). Testing lasted approximately 10 min per listening condition. Children were provided breaks as necessary and were paid for their participation according to the procedures outlined by the Institutional Review Board at Arizona State University.

Analysis

To characterize each child's word learning in the quiet and noise listening conditions, the trial-by-trial data were reduced to 10 bins of 10 trials each. Each trial was considered to be either correct or incorrect, and the proportion of correct responses within each block of 10 trialswas calculated.For example, if a child responded correctly to two of the 10 trials, the score for that bin was 0.20. Figure 6 shows the data for an 11-year-old child with NH learning in the quiet listening condition. The trial blocks are labeled according to the midpoint of the block (e.g., 15 is the midpoint between Trials 10 and 20). The data were then fit with the following exponential growth function:

... (1)

where Pc is the probability of a correct answer, 1 - 0.8 reflects chance performance for this task (20%), e is 2.718. . ., n is the midpoint of the trial block (5, 15, 25, etc.), and c is the time constant of the process. When n = 0 (beginning of the test), Pc = 0.2, with the curve growing from that raised floor in a smooth fashion to 1.0. When the number of trials equals the time constant (n = c), performance is approximately 70% (70.57%) correct. This was accomplished by adjusting estimates of c to minimize the sum of the squared deviations between the observed data and the points predicted. The dashed line in Figure 6 represents the point at which n = c (or, 70% correct). In this example, 67 trials were required to achieve the criterion level of performance. The advantage of using this approach was that all data points in the learning process contributed to the determination of the learning function and the time constant. The learning functions enabled individual and group performance to be evaluated across trials, whereas the number of trials needed to achieve the criterion performance provided a tangible point of reference with which to characterize the effects of hearing status and listening condition.

Results

Recall that the first goal of this study was to determine the impact of noise on children's ability to learn new words. Figure 7 shows proportion correct as a function of trial for the children with NH. Results for the 8- to 9-year-old children are shown in the upper panel, and results for the 11- to 12-year-old children are shown in the lower panel. The filled and open symbols are average proportion correct for each trial block in the quiet and noise listening conditions, respectively. The average learning functions (± 1 SE) are also shown for the quiet (solid line) and noise (dashed line) listening conditions. Although the performance of the younger children was poorer than that of the older children, little difference was observed between the quiet and noise listening conditions for both groups. Figure 8 shows proportion correct as a function of trial for the children with HL using the same convention as that used in Figure 7. Overall, performance was similar across age groups, with better performance in quiet and poorer performance in noise.

Effects of hearing status and listening condition were determined using repeated measures ANOVAs. Listening condition (quiet, noise) and trial block were entered as within-subjects factors, and hearing status (NH, HL) and age group (8-9 years, 11-12 years) were entered as between-subjects factors. The variable trial block did not meet the assumption of homogeneity of variance according to Mauchly's test of sphericity (Mauchly, 1940). The degrees of freedom were adjusted using the Greenhouse-Geisser correction for this and all other analyses. Significant main effects were observed for hearing status, $F(1, 58) = 5.073$, $p = .028$, $\eta 2 = .08$, $\beta = .601$; age group, $F(1, 58) = 5.595$, $p = .021$, $\eta 2 = .088$, $\beta = .643$; listening condition, $F(1, 58) = 7.606$, $p = .008$, $\eta 2 = .116$, $b = .774$; and trial block, $F(1.157, 67.094) = 259.54$, $p < .001$, $h2 = .817$, $b = 1.0$. Significant interactions were also observed for Listening Condition ×Hearing Status, $F(1, 58) = 4.432$, $p = .040$, $h2 = .071$, $\beta = .544$;HearingStatus ×TrialBlock,$F(1.157, 67.094) = 4.466$, $p = .033$, $\eta 2 = .071$, $b = .588$; and Listening Condition ×Trial Block, $F(1.554, 90.120) = 4.997$, $p = .015$, $h2 = .079$, $\beta = .727$. All other interactions were not significant. These results indicate that, overall, performance improved significantly with each exposure to the words (main effect of trial block), the children with NH learned significantly faster than did the children with HL (main effect of hearing status), the older children learned faster than did the younger children (main effect of age group), and learning proceeded faster in quiet than in noise(main effect of listening condition). The significant Listening Condition ×Hearing Status interaction indicates that the effects of noise and hearing loss combined to further reduce the performance of the children with HL relative to that of the children with NH.

The second goal of the present study was to determine the impact of DNR on word learning in children with HL. Figure 9 shows proportion correct as a function of trial for the children with HL using the same convention as that used in Figure 8, with the results of the noise reduction condition included. These results show that the performance of the younger children was the same in noise with and withoutDNR,whereas the performance of the older children in noise improved with the use of DNR. Separate repeated measures ANOVAs were

conducted for each age group to determine whether the learning functions for the noise and noise reduction listening conditions differed significantly. For both analyses, trial blocks and listening condition (noise, noise reduction) served as within-subjects factors. The analysis for the younger children revealed a significantmain effect of trial block, $F(9.000, 12.091) = 28.182$, $p < .004$, $h2 = .701$, $\beta = .998$, but not for listening condition, $F(1, 12) = 0.124$, $p = .731$, indicating that learning in noise was unaffected by DNR. For the older children, however, the analysis revealed significant main effects of both trial block, $F(9.00, 13.76) = 50.685$, $p < .001$, $\eta 2 = .809$, $\beta = 1.0$, and listening condition, $F(1, 12) = 4.881$, $p = .047$, $\eta 2 = .289$, $\beta = .528$, indicating that word learning in noise significantly improved with the use of DNR. These results suggest an age-related benefit of DNR for word learning in children with HL. Specifically, DNR had little effect on learning for children younger than 10 years but contributed significantly to word learning in children older than 10 years.

Because word learning is governed largely by a child's receptive vocabulary, the data were also examined as a function of their performance on the PPVT-III to better appreciate the effects of hearing status and listening condition. Recall that, in addition to fitting the children's data with a learning function, the analysis also provided an estimate of the number of trials needed to achieve 70% correct performance. Figure 10 shows the number of trials required by the children with NH (upper panel) and the children with HL (lower panel) as a function of vocabulary age. The parameter in each panel is listening condition. In this configuration, lower values indicate faster learning. Data points representing >500 trials to criterion were truncated. Also note that the range of vocabulary ages differed across groups, with lower vocabulary ages for the children with HL. Regression functions for each listening condition are shown as solid and dashed lines. The results for the children with NH are consistent with a number of previous studies showing that word learning proceeds more rapidly as vocabulary knowledge increases. Also, the impact of noise on this group had little effect on their rate of word learning. The results for the children with HL show that their word-learning rate was more variable overall and decreased (more trials required) in noise relative to quiet. The use of DNR, however, improved word learning and somewhat restored the relation between age and vocabulary knowledge for these children. These data indicate that for children with mild to moderately severe HL, learning rate slowed when the acoustic signal was degraded by noise but improved to rates similar to those in quiet with the use of DNR.

Factor Analysis

Although these results suggest that the age-related benefit observed withDNRmay be due to the vocabulary knowledge of younger and older groups, other factors may have contributed to the children's performance as well, particularly given the heterogeneous characteristics of this group of children. Two factor analyses were performed to identify other characteristics that might predict which children with HL are more likely to benefit from DNR. For both analyses, Varimax rotations with Kaiser Normalization were performed, yielding two-factor solutions having Eigenvalues greater than 1.Within each solution, factor loadings greater than .80 were considered salient to the interpretation of each principal component. The resulting factor scores were correlated (Pearson's r) to the children's word-learning rate. The time constant c from Equation 1 was log-transformed and was used to represent the rate of word learning (recall that 1/c is equal to the number of trials required to reach criterion performance).

In the first analysis, seven variables representing different characteristics of the children with HL were entered: three variables associated with hearing history (age at identification of HL, age at amplification, and years of hearing aid use); overall SNR in noise without DNR; receptive vocabulary (PPVT-III age); hearing level of the right and leftears (average of 2 kHz, 4 kHz, and 8 kHz); and chronological age. The analysis reduced the data to three principal components, accounting for a total variance of 85%. The principal components were found to correspond to the children's hearing history (age of identification, age at amplification, and years of hearing aid use), which accounted for 44% of the variance; age (chronological and vocabulary age), which accounted for 28% of the variance; and overall SNR, which accounted for 13% of the variance. Pearson's r correlation coefficients revealed a significant relation between word-learning rate and age, $r = .354$, $p = .049$, but not for

hearing history, r = .249, p = .126, or overall SNR, r = -.241, p =.134. The second analysis was the same as the first, with one exception-the overall SNR achieved with DNR was entered, and the overall SNR without DNR was removed. The analysis again reduced the data to three principal components, accounting for a total variance of 85%. The principal components were found to correspond to the children's hearing history (age of identification, age at amplification, and years of hearing aid use), which accounted for 44% of the variance; age (chronological and vocabulary age), which accounted for 27% of the variance; and overall SNR, which accounted for 15% of the variance. Pearson's r correlation coefficients again revealed a significant relation between word-learning rate and age, r = .480, p = .020, but not for hearing history, r = .049, p = .837, or overall SNR, r = -.199, p = .361. These results confirmed that although the children differed along a number of parameters, word learning in noise with and without DNR was significantly related to participants' chronological and vocabulary age.

Discussion

The purpose of the present study was to determine the rate of word learning in quiet and in noise for younger and older children with HL compared to their agematched, NH peers. Of particular interest were the effects of DNR on word learning in noise for the children with HL. Performance for the multitrial, dynamic, wordlearning task showed significant effects of age for the children withNHbut not for the children withHL. Closer examination of the results revealed that, in quiet, the performance of the older children with NH was well above that of all other groups and that the performance of the remaining three groups was similar. That is, the learning rate across groups was the same with the exception of the older children with NH. These results are consistent with the vocabulary age of each group (see Figure 10). Vocabulary age was similar across groups with the exception of the higher vocabulary age of the older children with NH, who consequently learned the new words faster. These results are also in agreement with the factor analysis showing that learning rate was significantly related to vocabulary knowledge.

Conversely, significant effects of listening condition (quiet vs. noise) were observed for the children with HL but not for the children with NH. In noise, the performance of the children with NH was unchanged, whereas the performance of the children with HL decreased significantly. That is, more trials were required to learn the words presented in noise than in quiet. These results are consistent with the known effects of noise on amplification and on the perception of speech in noise by children with HL (Crandell, 1993). Therefore, these results may explain, in part, why the overall vocabulary knowledge of these children was poorer than that of their agematched peers. Specifically, the acquisition of new vocabulary may be slowed in noise, reducing the value of each exposure to a newword. Over time, one would expect that the effect would become cumulative and would result in significantly reduced vocabulary knowledge for older children with HL. But this does not appear to be the case. What, then, keeps children with mild-to-moderate HL from continuing to lose ground in vocabulary development as they mature? One possibility is that children with HL are provided with-or seek out-additional exposures to a new word (e.g., verbal repetition, rehearsal, orthographic representation) in order to adopt that word into their vocabularies. These and other possibilities are areas for further research that may advance our understanding of the relation between hearing loss and critical auditory tasks such as word learning.

DNR

With the use ofDNR, the performance of the younger children with HL was unchanged, whereas the performance of the older children improved significantly. Factor analyses confirmed that characteristics of HL in children (e.g., degree of HL, hearing history) did not contribute significantly to performance. Also, word learning was not related to the overall SNR of the stimuli in noise with or without DNR, which varied as much as 10 dB across children in each age group and for both noise conditions. Onemight expect that the children receiving amore favorable SNR would enjoy a faster word-learning rate, but this was not the case. Instead, word learning was, again, related to the vocabulary knowledge of the children.

Another possible contributor to the age-related benefits of DNR is that the older children with HL were better able to perceive the nonsense words in noise. A number of studies have shownthat the speech perception of children withNHimproves in noisewith age (Elliott, 1979; Fallon, Trehub, &Schneider, 2002; Nozza, Rossman, Bond, &Miller, 1990; Scollie, 2008; Wilson, Farmer, Gandhi, Shelburne, &Weaver, 2010). Although the relation between age and speech perception in noise is less well defined for children with HL (Scollie, 2008; Stelmachowicz et al., 2007), age appears to be a strong predictor of performance (Gravel et al., 1999; Stelmachowicz, Pittman, Hoover, &Lewis, 2001). Even so, the effect of age was observed only when the children learned the words in noise when the DNR was activated. Perhaps the improvement in overall SNR(average of 2.3 dB), the reduction in overall stimulus level (average of 5.3 dB), and the older children's greater vocabulary knowledge provided the conditions necessary for the benefits of DNR to become apparent. If so, one might expect that the use of DNR for older and younger children with HL would increase the instances of tolerable noise levels and promote better word learning.

As for the younger children with HL, word learning did not improve with DNR, but it was not adversely affected, either. This result is consistent with other studies of DNR in children with HL (Auriemmo et al., 2009; Pittman, 2011; Stelmachowicz et al., 2010) and suggests that although DNR may not facilitate improved performance for auditory tasks in noise for this age group, performance is maintained. It is possible that these children may also benefit from increased listening comfort, although the long-term effect(s) ofDNRon communication is a question for further research.

Implications of the Present Study

The results of this study suggest that DNR may provide amplification with which children can tolerate and learn in noise. This notion is supported by research showing that children with HL prefer amplification with more gain in quiet listening situations and less gain in louder, noisier listening conditions (Scollie et al., 2010). Without DNR, these preferences may be satisfied through the use of a volume control on the hearing aid or the use of multiple programs that differ in overall output. Although school-age children and adolescents are able to make appropriate volume control and programming selections (Scollie et al., 2010), younger children may not. The advantage of DNR is that it can be configured to automatically activate in the presence of noise, it requires little to no intervention by the child, and it maintains optimal amplification in quiet and in noise. Without DNR, the only recourse that a child may have against the aversive effects of noise is to remove the hearing aid(s) altogether.

Limitation of the Present Study

DNR systems differ substantially across makes and models of hearing aids. The results for the present study are based on one type of noise reduction at one SNR (0 dB) in one competitor (broadband noise). The benefits of DNR to word learning would likely differ under other presentation conditions and for other types of DNR. This places pediatric audiologists in a difficult position. They must rely on research regarding specific DNR processors thatmay be outdated due to the rapid development of new technologies and the time-consuming process of pediatric research. Instead, they may wish to refrain fromusing new technologies with children until sufficient evidence is available orwhenmethods such as rapid word learning are developed for clinical use to verify the benefits ofDNRand other forms of advanced signal processing.

Acknowledgments

Sincere thanks are extended to Samantha Gustafson, Sara Bos, Kristi Petersen, Devin Anderson, and Christine Page for their help during data collection and analysis; Bob Fanning and Tom Powers for their help with early versions of the article; Bill Cole for his assistance with hearing aid analyses; Lylis Olsen, ShelbyWilla, and the audiologists at Phoenix Children's Hospital and Children's Rehabilitative Services for their help with participant recruitment; and, most of all, the children and their families for sharing their precious time. This study was funded by a grant from the American Speech-Language- Hearing Association Foundation (Clinical Research Award).

Footnote

1Phonotactic and biphone probability is the likelihood of certain phoneme sequences occurring in a particular order within a given language (Vitevitch, Luce, Charles-Luce, &Kemmerer, 1997; Vitevitch, Luce, Pisoni, &Auer, 1999). Research has shown that word learning in children is faster for higher probability words (Storkel, 2001, 2003).

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Correspondence to Andrea Pittman: andrea.pittman@asu.edu
Editor: Sid Bacon
Associate Editor: Pam Souza
Received December 7, 2010
Revision received February 28, 2011
Accepted March 16, 2011
DOI: 10.1044/1092-4388(2011/10-0341)

Publication date: Oct 2011

Year: 2011

The MOC Reflex During Active Listening to Speech

Author: Garinis, Angela C; Glattke, Theodore; Cone, Barbara K

Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1464-1476.
ProQuest document link

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Full text: Headnote
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Conclusion: The findings support the theory that cortical mechanisms involved in listening to speech affect cochlear function through the MOC efferent system.
Key Words: Click-evoked otoacoustic emissions (CEOAEs), contralateral suppression, efferent system, medial olivocochlear bundle (MOCB), medial olivocochlear (MOC) reflex, attention
The role of the efferent auditory system in auditory perception can be investigated at cochlear and brainstem levels by recording click-evoked otoacoustic emissions (CEOAEs). Recent investigations (de Boer &Thornton, 2007, 2008; Harkrider &Bowers, 2009) report that efferent (descending) contributions affect cochlear responses early in processing and are indicative of "top-down" influences. Researchers have hypothesized that the auditory efferents, including corticofugal and brainstem portions, have an initial role in tuning the cochlea to sounds critical for speech understanding (Dolan &Nuttall, 1988; Kawase, Delgutte, &Liberman, 1993;Winslow &Sachs, 1988), and thus, perception and learning.
The medial olivocochlear (MOC) efferent loop affects cochlear function via the contralateral MOC reflex (Guinan, 2006). Interneurons in the contralateral cochlear nucleus receive input from auditory nerve fibers, then cross the brainstem in the ascending tract and innervate ipsilateral MOC neurons (Rasmussen, 1946). These neurons then descend to the ipsilateral cochlea through the uncrossed olivocochlear bundle (Liberman, 1988a, 1988b) and terminate near the base of the outer hair cells (OHCs). Efferent fibers hyperpolarize OHCs, subsequently reducing their motility. The reduced OHC motility, in turn, is thought to reduce the vibration of the basilar membrane, and thereby attenuate the cochlear amplifier effect.
Many characteristics of the MOC reflex have been determined through research using electrical neuronal stimulation in experimental animal models, such as the cat or guinea pig (Galambos, 1956; Liberman &Brown, 1986). Results from these investigations demonstrate that the MOC reflex provides sharply tuned frequency-specific feedback that inhibits the gain of the cochlear amplifier (Guinan, 2006; Liberman &Guinan, 1998). This effect has been suggested to protect from acoustic trauma (Reiter &Liberman, 1995), aid in selective attention (Scharf, Magnan, &Chays, 1997), and reduce masking (May &McQuone, 1995).
In humans, the MOC reflex has been investigated using recordings of otoacoustic emissions (OAEs) during the simultaneous presentation of contralateral broadband noise (e.g., Abdala, Ma, &Sininger, 1999; Berlin, Hood, Hurley, &Wen, 1994; Collet, 1993; Collet et al., 1990). The presence of this noise will often reduce the amplitude and change the phase of the response (Guinan, 2006) in relation to the baseline recording. In normally hearing adults, the reduction in CEOAE amplitude is on the order of 1.0-1.5 dB (Berlin et al., 1994). This reduction begins within 100 ms after the activation of the suppressor and subsides once the suppressor has ceased. This effect is thought to be a product of the MOC reflex's influence on cochlear output. The strength of the MOC reflex has been shown to vary among individuals (Backus &Guinan, 2007), and the mechanisms underlying this variability have not yet been elucidated.
MOC effects have been linked to selective attention and listening in noise (e.g., de Boer &Thornton, 2007; Froehlich,Collet,&Morgon, 1993; Giard, Collet, Bouchet, &Pernier, 1994; Giraud et al., 1997; Khalfa, Micheyl,

Veuillet, &Collet, 1998; Kumar &Vanaja, 2004; Perrot et al., 2006). MOC reflex measurements during directed attention tasks suggest that the cortical efferent system modulates the cochlea. For example, de Boer and Thornton (2007) measured CEOAE contralateral suppression during passive visual, active visual, and active auditory attention conditions. In the active auditory task, participants detected tone pips within the CEOAEevoking click train while broadband noise was presented in the opposite ear. A reduced suppression effect was observed in the active listening compared with the passive listening condition. The effect of attention on the MOC reflex was observed by measuring changes in the slope of the CEOAE amplitude input-output (I-O) function. When attention was directed to the stimulus ear, the I-Ofunctionhadthe same shapeas inthequiet condition; that is, there was a release from suppression. In the other attention conditions, the slope of the I-O function was reduced. This finding suggested that the MOC activity, specifically, suppression, was inhibited due to top-down influences during focused attention to the stimulus ear.

In contrast, Froehlich et al. (1993) and Maison, Micheyl, and Collet (2001) conducted investigations in which listeners directed attention toward the contralateral ear, that is, the suppressor side, and an increase in suppression was observed. More recently, Harkrider and Bowers (2009) reported unique findings, in that suppression was reduced when participants attended either to the click stimulus or to the contralateral broadband noise. Taken together, these studies demonstrated that active listening produced modulation of the MOC reflex as reflected in the CEOAE amplitude response compared with passive listening.

Few studies have reported findings on the laterality of MOC effects (Khalfa &Collet, 1996; Khalfa, Morlet, Micheyl, Morgon, &Collet, 1997, Philibert, Veuillet, &Collet, 1998). These investigations have shown that noise presented to the leftear during stimulation of the right CEOAE produced greater contralateral suppression effects than the reverse situation. This finding has been interpreted as evidence for a more efficient right MOC reflex, or a right-ear advantage. This asymmetry of CEOAE suppression owing to the MOC reflex effects has also been reported to exist in infants older than 36 weeks of age, indicating maturity of the efferent system leading toward the development of a right-ear advantage (Morlet et al., 1999). The source of this subcortical asymmetry has not been confirmed.

These investigations provide supportive evidence that the MOC reflex may be lateralized in nature, and that the corticofugal pathway activated during attentive listening may modulateMOC activity. However, it is not clear whether or how the effects of listening to speech may influence the MOC reflex ear differences, that is, their lateralization due to cortical control. Establishing the MOC's role in hearing and perception is important for identifying mechanisms critical for speech understanding in noise.

Purpose of the Present Study

The purpose of this study was to evaluate MOC effects while participants listened for speech in noise and to determine whether these effects are lateralized. Determining the scope of cortical modulation of the periphery would enhance our current understanding of auditory processing insofar as cortical function (e.g., listening to speech) may transformthe cochlear response to specific acoustic cues critical for speech understanding. A further motivation for this study came from the finding that adults with learning disorders exhibit a laterality of their MOC reflexes that was different from typical learners (Garinis, Glattke, &Cone-Wesson, 2008). This finding suggested that ear differences in efferent function might be a marker for an auditory-processing disorder. Lagacé, Jutras, and Gagné (2010), for example, found that speech-in-noise perception is often disordered in those with auditory-processing disorder, and others (Tervaniemi &Hugdahl, 2003) found that the right-ear advantage was diminished. The present study was undertaken to assay the effect of the MOC reflex during listening for speech in noise in the right versus the leftear. The hypotheses of this study were that (a) cortical processes engaged during active listening to speech in noise increase the suppressive effect of the MOC reflex observed as a change in CEOAE amplitude and (b) MOC reflex effects lateralize and support a rightear advantage for listening to speech. Investigating how active listening affects the MOC reflex provides insight to the descending cortical control of the central auditory system on the periphery.

Method

Participants

Women with normal hearing (M = 24.6 years of age; range = 20-33) were recruited for this study. Participants were allowed to participate if they met the following criteria: (a) were 18-38 years of age, (b) had normal tympanograms using a 226-Hz probe tone, (c) had ipsilateral and contralateral broadband noise (BBN) acoustic reflex thresholds≥60-dB SPL, (d) had normal pure-tone thresholds for 500-4000 Hz for both ears, (e) had CEOAEs present for a 60-dB p.e. SPL click for both ears, (f) had no recent history of using medications that would increase lethargy or affect cognitive function, and (g) were righthanded. Twenty participants were tested, and 13 were used in the data analyses. The criteria used to exclude data were CEOAE response amplitudes less than 6 dB in four out of five 1/3-octave bands centered at 1.0, 2.0, 3.0, 4.0, or 5.0 kHz in response to an 80-dB p.e. SPL click. A pilot study indicated that very few men in the age range of 20-33 years were able to meet the fifth criterion. It is well established that there are gender differences in the prevalence and amplitude of otoacoustic emissions (McFadden, 2009). The decision to use only female participants was made in order to control for these gender differences.

Tympanometry and Acoustic Reflex (AR) Tests

A Grason-Stadler GSI-33 middle-ear analyzer was used to perform tympanometry and ipsilateral and contralateral AR threshold tests. Tympanograms were acceptable if they demonstrated a tympanometric peak pressure of ±50 daPa and static peak compensated acoustic admittance of 0.3-1.5 mmhos. Ipsilateral AR thresholds are those for which the response is obtained from the same ear to which the eliciting stimulus is presented. Contralateral AR thresholds are those for which the response is obtained from the ear contralateral to the ear to which the eliciting stimulus is presented. The AR threshold for both testing conditions was defined as the lowest level of the BBN activator needed to elicit a .03-mmhos decrease in middle-ear admittance on two consecutive trials. Thresholds were tested using BBN stimuli so as to determine whether the contralateral noise used in the experimental paradigm would activate the AR. The initial presentation level was at 75-dB SPL, and levels were increased or decreased by 5-dB increments until the AR threshold was detected. The maximum level used for this test was 110-dB SPL to avoid exposure to excessive levels of noise. Participants were excluded if AR thresholds for BBN activators were <60-dB SPL.

CEOAE Stimuli and Tests

CEOAEs were recorded using the Otodynamics ILO-88 otoacoustic emissions (OAE) analyzer, version 4.2 B software. Participants were first tested for their CEOAE response using an 80-dB p.e. SPL "nonlinear" click train. The ILO "nonlinear" click stimulus consists of three in-phase 80-ms square wave clicks followed by a fourth out-of-phase click with a 10-dB higher level. The click rate is 50 Hz. This stimulus pattern is often used in emission testing to reduce stimulus artifact that could contaminate the desired CEOAE response (Hood, Berlin, Hurley, Cecola, &Bell, 1996). The emission waveform was recorded over a 20-ms epoch, at a digitization rate of 25 kHz. Each sample is averaged in one of two memory buffers, A or B, in alternating fashion for each click train.

If a response was present for the 80-dB condition, then the stimulus level was reduced to 60-dB p.e. SPL, and the participant was retested using a "linear" click train. The Institute of Laryngology and Otology (ILO) "linear" click train has four clicks of the same phase and sound pressure level (Velenovsky &Glattke, 2002) and is often used for CEOAE tests using stimulus levels less than 80-dB p.e. SPL. Whereas the "nonlinear" click train is used to reduce the stimulus artifact, it is also known to diminish response amplitude as it subtracts out the "linear" portion of CEOAE amplitude growth. The "linear" click train was used to obtain a better estimate of the CEOAE amplitude for the contralateral suppression conditions. The use of the "linear" click train is recommended in contralateral suppression experiments (Hood, 2007).

ACEOAEwas considered present if a response spectral peak was apparent at ≥3 dB above the noise floor for 1/3-octave bands in the 1.0 kHz-5.0 kHz range, had a response amplitude of 6-dB SPL, and had a wave

reproducibility of >85%for at least 4/5 bands. Response amplitude was estimated in two ways. First, response, or "R" amplitude, is defined as the overall level of the correlated portions of the two CEOAE waveforms held in memory buffers, A and B. For every stimulus, samples of CEOAE are allocated to the two buffers in alternating fashion. Second, A + B is the average amplitude of the waveforms stored in buffers A and B. The difference waveform, A - B, gives an estimate of the noise floor. Wave reproducibility is calculated as the point-to-point correlation of the waveforms stored in two memory buffers, A and B.

Contralateral Noise Stimuli

All participants who had CEOAEs at 60-dB p.e. SPL and met the response criteria were then tested for contralateral suppression effects in three separate noise conditions. Each noise condition was preceded by a "no noise" or control condition, for a total of seven recordings per ear (three noise, four control). The following noise conditions were measured for each participant:

* BBN alone: 60 dB SPL of continuous BBN was presented to the contralateral ear during CEOAE recordings.
* BBN + W: Spoken words were embedded in 60-dB SPL continuous BBN, at a signal-to-noise ratio (SNR) of -3 dB relative to the noise and at an interstimulus interval that averaged 1,500 ms. Participants were required to attend to the words and classify them as animal or food items using a two-interval forcedchoice button press response. This was the active listening condition.
* BBN + BW: The same words as in the previous condition were played backwards and embedded in the 60-dB SPLcontinuousBBNat an SNRof -3dBrelative to the noise. This was a passive listening condition.

Stimuli for each noise condition were constructed using MATLAB 7.4 R2007a. The BBN was then scaled so that its root-mean-square (RMS) value was 3 dB (or 1.414 ×mean) greater than the words spoken by male and female voices. This audio scaling procedure was used for both the BBN +Wand BBN +BWconditions. All stimuli for the noise conditions were played through a Maico MA 41 portable audiometer and presented to the contralateral ear at 60-dB SPL via an ER-10 insert earphone.

Calibration

All stimuli were calibrated using a Larson Davis System 824 SPL analyzer with a 1⁄2-in. microphone Model #2540 configured in a 2-cc coupler. The click stimuli were calibrated using the peak-to-peak equivalent method of equating the amplitude of a click to that of a 1000-Hz pure tone and measuring the SPL of the pure tone (Glattke, 1983).

Experimental Procedure

All tests were conducted in a sound-insulated chamber. Participants first had pure-tone threshold tests for the frequencies of 500-4000 Hz using a Maico MA 41 portable audiometer. Those who met the hearing threshold criteria (reported above) also completed tympanometry, AR threshold tests, and CEOAE tests. Only those participants who had CEOAEs present at 60-dB p.e. SPL bilaterally went on to complete the experiment testing for the MOC reflex using a CEOAE contralateral suppression paradigm.

All sevenCEOAEtests (four in quiet, three with contralateral noise) were completed for both the right and leftears separately, with the order of noise conditions randomized for each ear, and the order of ear tested randomized across participants. Participants were instructed to remain still and quiet throughout the experiment in order to avoid displacement of the ILO probe in the ear canal.

Strict criteria were used to control for noise and reduce its contamination in the experimental conditions. First, the "stability" of the stimulus, as determined by ILO software, was maintained at 70% or better. This software feature records the stimulus level in the ear canal at the onset of testing and subsequently monitors the level throughout the acquisition period (Glattke &Robinette, 2007). If the stability fell below that level during a test, then that trial was aborted and restarted. Second, an amplitude-based artifact rejection level of 35-dB SPL was used throughout testing. Third, the responses were sampled until 1,600 artifact-free samples were obtained in each test condition. Given the strict artifact rejection criterion and the oversampling used to reduce the noise levels in the averaged sample, each trial took, on average, 4 min. With seven trials for each ear, the CEOAE

experimental protocol took about 1 hr to complete for each participant.

A control trial was run after each noise condition. That is, the stability of the CEOAE amplitude, reported as bothR andA + B, and the noise (A - B) were measured with clicks alone (no contralateral noise) in order to ensure that the CEOAE amplitude and noise were constant throughout the experiment.

For the active listening (BBN + W) condition, the Direct RT-v.2007 (Jarvis, 2007) software program was used to monitor responses and measure accuracy throughout testing. It was possible for the investigator to monitor the response accuracy (the categorization of spoken words as food or animal) during the test and obtain a running score. If response accuracy fell below 85%, the trial was aborted and repeated after reinstructing the listener.

Data Analyses

CEOAE "R," A + B, and A - B amplitudes were measured. These values are calculated by the ILO-88 software in dB SPL (re: 20 mPa). Response amplitude is defined as the overall level of the correlated portions of the A and B memory waveforms. "A + B" amplitude is the RMS amplitude of the A and B memory waveforms, and "A - B" is the RMS amplitude difference between the A and B waveforms (Glattke &Robinette, 2007).

The strength of the MOC reflex using CEOAE contralateral suppression was measured in two ways: First, the difference between response amplitude in quiet and response amplitude with contralateral noise was calculated for each of the quiet (control) and noise (suppression) conditions. Second, the RMS amplitude of the difference waveform, in dB, obtained by subtracting the waveform in noise from the waveform in quiet was calculated using the EchoMaster 312 software program (Wen, Berlin, Hood, Jackson, &Hurley, 1993). The RMS amplitudes of the difference waveforms were analyzed in 2-ms time increments over a 12-ms response window, commencing at 6 ms after the click onset.

Differences inCEOAEresponseamplitude for each test condition and for each ear were analyzed using repeated measures analyses of variance (ANOVAs). Paired t tests were used in further analyses of the differencewaveforms among three noise conditions from right versus leftears.

The Human Subjects Protection Program for social and behavioral sciences at the University of Arizona approved this experiment.

Results

CEOAE Amplitude

There are two ways in which amplitude can be calculated. First, the value "R" (in dB SPL), calculated by the ILO-88 software, is the overall level of the correlated portions of the two waveforms (A and B) that are obtained during response recording (alternate sweeps are assigned to an A or a B memory buffer). Second, the summed average of the responses in the A+B memory buffers is calculated. The two estimates of CEOAE amplitude for all control (quiet) and test (noise) conditions are shown in Table 1. CEOAE response amplitudes in quiet were larger for the right ear (M= 12.62 dB SPL, SD = 3.42) compared with the leftear (M = 11.12-dB SPL, SD = 3.60). It should be noted that there were no statistically significant differences between the "R" and "A + B" estimates of CEOAE amplitude.

The amplitude estimates for the four control conditions for each ear were subjected to a paired t test to determine whether the ear-related amplitude differences were significant. The results of this test indicated a mean difference of 1.5 dB between the right and leftears, and this was statistically significant, $t(51) = 5.36$, $p < .0001$.

We also calculated the A - B values, that is, the residual noise amplitude estimates. The ILO-88 software estimates the noise amplitude as the difference between the averaged responses (waveforms) held in the A and B buffers. These estimates are shown in Table 1 for each of the control conditions.We used paired t tests to determine whether there were right- versus left-ear differences in noise level. The mean difference was -0.04, and this was not statistically significant, $t(51) = -0.29$, $p = .77$.

The results of the analyses of CEOAE amplitude in the quiet conditions indicate that the right-ear CEOAE amplitudes are larger than those for the leftear. They also suggest that there are no ear differences with respect

to noise contamination that could contribute to the right-ear amplitude advantage. That is, it is possible that one ear might be noisier than another, owing to anatomic and physiologic asymmetries in noise sources (e.g., heart, lungs, airway, and movement during testing). As all CEOAE amplitude estimates are essentially response + noise estimates, it is important to show that noise was controlled in these experiments. By using a strict artifact rejection criteria and by averaging 1,600 responses, the noise levels were equivalent for the two ears and across the four control conditions.

We also evaluated CEOAE amplitude estimates for each of the contralateral noise conditions. Themean, standard deviation, and range of response (R) and A + B amplitude estimates in each noise condition are shown in Table 1. Figure 1 displays the mean response amplitude as a function of condition (quiet or noise) for each ear. The introduction of contralateral noise caused a reduction in CEOAE amplitude, which was 2.65 dB for the right ear and 2.57 dBfor the leftear. In all noise conditions, the right-ear response amplitudes were larger than those of the leftear, $F(1, 12) = 35.1$, $p < .0001$. The CEOAE right- versus left-ear amplitude difference found in quiet is maintained in the suppressed condition.

During the active listening task, participants were required to make a two-alternative forced-choice (2AFC) response by depressing a response button as theMOC reflex was measured. It might be anticipated that this would increase the noise and thus contaminate amplitude estimates. A repeated measures ANOVA revealed no statistically significant differences in noise amplitude estimates as a function of condition.

The noise amplitude estimates do not appear to vary as a function of listening condition, and an ANOVA for the effect of condition or ear on noise levels does not allow rejection of the null hypothesis, $F(1, 2) = 0.56$, $p = .57$. Again, with the strict artifact rejection criteria and the oversampling, we controlled noise contamination across all experimental conditions.

A primary focus of this investigation was to determine whether listening to speech would modulate the MOC reflex. The CEOAE amplitude estimates for each listening condition are shown in Figure 1. Differences in the amount of suppression for passive (BBN, BBN +BW) versus active listening (BBN+W) were not evident in the CEOAEamplitude estimates. Theamount of suppression or the amplitude difference between no-noise and noise conditions was, on average, 2.6 dB for both the right and leftears. For example, the right-earCEOAEamplitude in quiet was 12.6 dB, and with a BBNsuppressor, 9.95 dB, a change of 2.65 dB, whereas for the left-ear amplitudes, they were 11.04 dB SPL in quiet and 8.47 dB SPL with contralateral BBN, a difference of 2.57 dB.

CEOAE RMS Amplitude Differences

We also calculated CEOAE contralateral suppression as the RMS amplitude of the waveform derived from the CEOAE obtained in quiet minus the CEOAE obtained when contralateral noise was present. We used the CEOAE obtained in the quiet condition preceding each noise condition for these measures of suppression. We analyzed the RMS amplitude of the difference waveform, in dB, in 2-ms intervals, using the 6- to 18-ms poststimulus portion of the waveform. The 6- to 18-ms epoch has been shown to reflect maximum suppression effects (Hood et al., 1996), and the mean RMS amplitude of the difference waveforms for this epoch is shown in Figure 2. For right-ear responses, the mean amount of suppression in this epoch was 3.14 dB (SD = 1.7) for the BBN condition, 3.11 dB (SD = 1.8) for BBN + BW, and 3.32 dB (SD = 1.9) for BBN + W. For left-ear responses, the amount of suppression was 2.8 dB (SD = 1.8) for BBN, 2.7 dB (SD = 1.9) for BBN + BW (SD = 1.9), and 3.0 dB (SD = 1.8) for BBN + W. We used the amplitudes of the difference waveforms (between 6 and 18 ms) in paired t tests to evaluate the differences in RMS amplitude (suppression) that occurred as a function of noise conditions. These comparisons made were for BBN versusBBN+ W,BBN versusBBN+BW, andBBN+Wversus BBN + BW. Greater suppression was evident in the active listening (BBN + W) condition compared with the passive listening conditions: BBN, $t(12) = 2.311$, $p < .05$; and BBN + BW, $t(25) = 2.667$, $p < .05$. There were no statistically significant differences in the amount of suppression for the two passive listening conditions, BBN versus BBN + BW, $t(12) = 0.667$, $p = .51$. This was a different result than was found for the analysis of whole

wave amplitude (see the previous section). Because this second analysis focused on the portion of the waveform in which suppressive effects were largest, it was possible to discern a difference in suppression related to active versus passive listening conditions.

There were no ear differences in the amount of suppression when considered as the RMS amplitude (in dB) of the difference waveform, or the difference in whole wave amplitudes in quiet versus noise conditions. Yet, the left-ear CEOAE amplitudes were significantly lower than those for the right ear in all conditions (quiet or contralateral noise). This suggested that there was a difference in the relative size of the suppression effect. That is, in all conditions, the right-ear CEOAE is, on average, 1.54 dB larger than those from the leftear. If the MOC reflex produced exactly the same fractional change in CEOAEs from both ears, then the values from the right ear would be 1.54 dB larger than those from the left; however, they are only 0.4-0.5 dB higher (see Figure 2). This implies that the efferent effect in the right ear is actually nearly 1 dB less than in the leftear. Another way to calculate this effect is to convert values from decibels (which expresses a ratio of two pressures on a log scale) to absolute pressure. The RMS amplitude of the difference waveform was converted from dB to absolute pressure using a 20-mPa reference. Similarly, the response amplitudes shown in Figure 1 and Table 1 were also converted to absolute pressure using the same reference. For each participant, the difference waveform pressure was divided by the whole wave pressure in order to normalize the relative amount of pressure (amplitude) change in the various noise conditions. So, for example, using one participant's response amplitude estimates, CEOAE amplitude in the no-noise condition was 16.15 dB. The RMS difference waveform (no-noise response-BBN response) had amplitude of 3.14 dB. Converting both values to pressure 3.14 dB = 28.71 mPa, and 16.15 = 128.39 mPa. The ratio of the pressure of the difference waveform and the pressure of the responsewaveform, 28.71 mPa/128.39 mPa = 0.22. So, the normalized amplitude change (suppression) was 22%. This was done for every participant individually (not just the group means).

The results of these transforms are shown in Figure 3. The values on the ordinate are the ratio of pressure change when the pressure differences are considered as a proportion of the whole wave pressure. The relative amount of pressure change (suppression) was greater for the leftear (noise right) for all conditions. On average, the relative amount of suppression was 44% for the leftear and 38% for the right ear.

Time Course of Suppression

We measured the amount of suppression as a function of time by considering the average amount of suppression in each 2-ms interval in the 4- to 18-ms interval of the CEOAE waveform. The mean values for each listening condition are plotted in Figure 4. In general, there is a linear growth in amplitude of the difference waveform (i.e., the amount of suppression) at a rate of 0.2 dB/ms over the 6- to 18-ms waveform analysis window, from 1.75 dB to 4.25 dB. The cochlear site of CEOAE generation is thought to be reflected time-domain waveform (Kemp, 2002; Norton &Neely, 1987). The earlier portion of the waveform contains high-frequency response components and the later portions, low-frequency components. Converting the time-domain waveform to a spectral analysis suggests greater suppression in the 1500- to 2000-Hz region compared with the high (4000-5000 Hz) region.Acomplementary interpretation is that all MOC effects on transient responses grow with time after the acoustic stimulus (Guinan &Cooper, 2008), no matter what their frequency content.

AR Thresholds

We performed ipsilateral and contralateral AR thresholds tests for all participants. Two participants had no measurable ARs for either ear at the maximum stimulus level of 110 dB SPL. The mean ipsilateral AR threshold was 72 dB SPL (SD = 7.97) for left-ear responses and 71.5 dB SPL (SD = 8.0) for right-ear responses. The mean contralateral reflex threshold was 76 dB SPL (SD = 8.7) for the right ear and 75 dB SPL (SD = 5.0) for the leftear. A two-way ANOVA indicated there were no significant differences in AR thresholds as a function of ear (right vs. left) or contralateral versus ipsilateral activation stimulation modes. It is important to note that the mean AR threshold for a BBN activator was 12 dB SPL above the noise levels used for the CEOAE suppression conditions.

Discussion

In the present study, we investigated the effects of listening to speech and laterality on the MOC reflex using a CEOAE contralateral suppression paradigm. We predicted that a stronger MOC reflex (more contralateral suppression) would be evident during active listening to speech, when compared with responses from the passive, contralateral BBN and BBN +BWlistening conditions. We also hypothesized that laterality effects would be present, with right-ear responses showing greater MOC activity reflecting a right-ear advantage at the level of the cochlea. The results supported the first hypothesis in that more suppression was evident in the active listening condition than in the passive listening conditions. This effectwas evidentwhen the portion of the response waveform most sensitive to suppression effects, at 6-18 ms, was analyzed. The second hypothesis was only partially supported. Right-ear CEOAE amplitudes were larger than left-ear amplitudes in all conditions. The amounts of suppression, measured as the CEOAE amplitude differences in dB, for quiet versus contralateral noise conditions, were not different for the right versus the leftears. When the noise-induced amplitude decrements (in the 6- to 18-ms waveform interval) were recalculated in absolute pressure change and normalized by each listener's CEOAE amplitude in quiet, the relative change in amplitude was proportionally greater when noise was presented to the right ear and the effect measured for a probe in the leftear.

Effects of Listening to Speech on the MOC Reflex

The phenomenon of contralateral CEOAE suppression has been linked to the function of the contralateral MOC reflex loop located in the caudal pons (Berlin et al., 1994; Collet, 1993). The MOC reflex, as it has been termed, is thought to be responsible for these changes in OAE amplitude. Measurement of MOC reflex during active listening, using an OAE contralateral suppression paradigm, provides evidence of cortical influences upon the periphery. The findings of the present study are in line with past research: Specifically, a 2- to 3-dB SPL reduction in CEOAE amplitude was evident in all contralateral noise conditions, indicative of MOC influence on OHC output. Most important, the greatest amount of contralateral suppression was evident while actively listening to speech.

The active listening condition required semantic knowledge in order to classify the spoken words as animal or food items. This requires a greater cognitive demand than the tone detection tasks used in previous research. For example, Froehlich et al. (1993) found a reduction in CEOAE amplitude when an attention task was used during CEOAE measurement. Participants pressed a button when the desired auditory toneburst (2800 Hz) was detected during the train of clicks used to evoke the CEOAE. A significant decrease in CEOAE amplitudewas measured in the 1920- to 2880-Hz response band during the attention task, but not during passive listening. Maison et al. (2001) used a CEOAE contralateral suppression paradigm, with the target stimulus embedded in the suppressor noise, to examine attention effects on the MOC reflex. The contralateral noise condition resulted in greater suppression of theCEOAE. In contrast, de Boer and Thornton (2007) found the least amount of suppression during an active listening task in comparison to passive auditory, passive visual, and active visual tasks. In the active listening task, participants detected tone pips embedded in the CEOAE-evoking click train while noise was presented to the other ear. Their attention paradigm was similar to that used by Froehlich and colleagues; however, listeners in the de Boer and Thornton study were required to direct attention to the probe (ipsilateral) ear instead of the nontest (contralateral suppressor) ear. This change in task may explain the difference in findings. More recently, Harkrider and Bowers (2009) found that CEOAE amplitudes increased slightly during active listening, indicating a release from suppression, when the participant attended to either the probe or suppressor ear. Their listening task differed for the two ears, however. When attending to the probe ear, the participants were required to count the number of pulse trains that they heard. This required vigilance to the probe stimuli, unlike other paradigms in which the target stimuli (tone pips) were embedded with the probes. When attention was directed to the suppressor (contralateral ear), listeners were told to listen for speech embedded in noise, although none was present. There are substantial differences in the methods investigators

have used to engage active listening or attention while recording CEOAEs. It may be that task difficulty influences the MOC efferent reflex (suppression) effect. This is suggested by de Boer and Thornton (2008), who showed that listeners who successfully learned to perceive speech in noise also showed changes in the amount of the suppression measured while listening to speech in noise.

The present work is consistent with previous studies suggesting that active listening modulates cochlear output through the MOC reflex. Attention directed to the probe ear from which CEOAEs are being measured appears to cause some release from suppression (e.g., de Boer &Thornton, 2007), whereas directed attention to the suppressor ear appears to enhance the suppressive effect (Maison et al., 2001; see also present results). There also appears to be some frequency selectivity of the suppression effect during active listening in that it was only possible to discern an increase in suppression when CEOAEs were filtered, that is, when the 6- to 18-ms portion of the waveform was selected for detailed analyses.

TheMOCreflex effectively reduces the output of the cochlea and raises the threshold for increased firing of auditory nerve fibers (Guinan, 2006). The psychophysical equivalent of this may be the "central masking" effect, whereby psychophysical thresholds for pure tones are increased 5-7 dB when low-level noise is introduced to the contralateral ear (Mills, Dubno, &He, 1996; Zwislocki, 1972). However, the introduction of noise would also raise the neural threshold for signals presented to the suppressor ear. Guinan suggests that the activation of the MOC reflex in a noisy environment, that is, when noise is presented binaurally, enhances the dynamic range by a mechanism known as "MOCB unmasking." Unmasking occurs because MOC efferents can inhibit the response to a noise masker, thus subsequently increasing the audibility of transient sounds like speech. Thus, the activation of the MOC efferents of the masked or suppressor ear serves to improve the dynamic range and SNR for that ear. The amount of suppression in the contralateral ear is something of an epiphenomenon for the effect of interest, which is the enhancement of SNR for the ear that is listening in a noisy environment. In the case of the present experiment, suppressor noise and words were played to one ear, and the CEOAE amplitude was monitored contralaterally. A stronger MOC reflex was evident during active listening in this condition. The MOC reflex is bilateral, and so evidence of increased suppression in the probe ear indicates that that suppression is increased in the suppressor ear, reducing the masking effects of the BBN, and perhaps improving the SNR for the target words.

This theory ofMOCefferent function has been borne out by the results of Kumar and Vanaja (2004), who reported that stimulation of the efferent system by use of contralateral noise was associated with an improvement in speech identification scores while listening in a noisy environment. As further proof of MOC involvement in improving speech-in-noise understanding and corticofugal connections, de Boer and Thornton (2008) found correlations between activation of the MOC reflex and phoneme-in-noise discrimination abilities in a group of normally hearing adults. Those with the poorest abilities on the first day of training and who subsequently showed the most improvement after training also showed an increase in MOC activity with training. Findings from these investigations provide evidence that MOCBmediated activity supports speech-in-noise perception.

Studies in which experimental animals are used have revealed that neural firing in response to tone bursts at mid-high frequencies is strongly affected by (electrical) activation of the MOC reflex (Liberman &Guinan, 1998). In a noisy environment, the activation of MOC efferents would be expected to result in greater antimasking properties in this frequency range. In humans, greater suppression is observed in the 6- to 18-ms portion of the CEOAE response (Collet et al., 1990; Hood et al., 1996), which corresponds to the 1 kHz-4 kHz frequency range (Kemp, 2002; Norton &Neely, 1987). Again, in a noisy environment, the activation of the MOC efferents could subsequently enhance mid-high frequency sound information for cortical processing (Giraud, Collet, Chéry-Croze, Magnan, &Chays, 1995). This improvement in SNR produced by MOC activation is thought to improve the understanding of speech (Kawase et al., 1993; Kawase &Liberman, 1992; Liberman, 1988b) and perceptual intensity discrimination (Micheyl, Perrot, &Collet, 1997) in the presence of ambient noise. Although

the broadband nature of MOC reflex activation has recently been demonstrated (Lilaonitkul &Guinan, 2009) for passive listening conditions, it is possible that frequency-specific effects are engaged during active listening. The present investigation supports the theory of top-down modulation, that is, corticofugal influences, on the peripheral auditory system, particularly while listening for speech in noise. Participants had greater suppression in the active attention listening condition compared with the passive listening (BBN or BBN + BW) conditions. Even more compelling is the complexity of the attention task used. In past investigations, the attention task was usually detection of tonebursts embedded in noise, or a sham speech condition (Harkrider &Bowers, 2009). We used semantically meaningful stimuli in the present study requiring directed attention during MOC reflex testing. We found more contralateral suppression in this investigation during active listening condition when participants were asked to respond to semantically meaningfully stimuli.

The present results may be a reflection of cortical influences on the periphery that are specific to language. The ability to categorize between food versus animal items required a semantic understanding of speech stimuli, and an ability to categorize words. It may be that cortical efferents from left-hemisphere language centers, such as planum temporale (Alain, 2007; Zheng, 2009) and that project to brainstem were more strongly activated forBBN+W. Although theMOCefferents have a primarily inhibitory function once stimulated, input from the cortex may adapt the amount of inhibition occurring at the level of the cochlea. The present findings provide evidence for an adaptiveMOC function via cortical inputs. Thus, the type of stimuli used to engage attentionmay influence the magnitude of this effect. An investigation of MOC reflex during active listening using nonsense words and nonspeech items with temporal and spectral complexity appears warranted to further clarify the role of corticofugal modulation of cochlear function.

Lateralities (or Asymmetries) in the Auditory System

Lateralities, or asymmetries, in the auditory system have been established at peripheral, brainstem, and cochlear levels. At the cochlear level, asymmetries have been established for OAE responses (Khalfa &Collet, 1996; Morlet et al., 1999; Sininger &Cone-Wesson, 2004): OAEs for the right-ear OAEs are consistently larger than for the left. This was also observed in the present investigation with larger response amplitudes for right-ear CEOAEs versus left-ear responses in all conditions. Several theories have been proposed for this asymmetry, including anatomical differences in cochlear structure and/or differences in afferent and efferent innervations (Xiao &Suga, 2005). For example, gender differences in CEOAE amplitudes have been observed pertaining to cochlear structure and function (McFadden, 2009). Male versus female differences in cochlear length have been cited as a factor contributing to OAE differences observed in females versus males (Bowman, Brown, &Kimberley, 2000; Don, Ponton, Eggermont, &Masuda, 1993; Morlet et al., 1996). Investigations of animals have indicated that longer cochleae appear to have more inner and outer hair cells than do shorter cochleae (Bohne&Carr, 1979). It may be that cochlear length contributes directly to the number of sensory cells aligning the basilar membrane. The number of hair cells may have a direct effect on OAE asymmetries observed. A thorough understanding of the anatomical and the physiological mechanisms contributing to asymmetries of OAE amplitudes remains elusive at present. The contribution of the MOC efferents to these asymmetries is yet unknown. The results of the present study are in conflict with past work regarding asymmetries observed during contralateral CEOAE suppression. Khalfa and Collet (1996) reported greater suppression for CEOAEs evoked from right (, 1.4 dB) versus left(, 0.7 dB) ears in the presence of 30-dB SL contralateral noise. In the present study, an equal amount of suppression, , 2 dB, was observed for right- and left-ear responses. Again, differences in methodology likely contribute to differences in results. In the present study, we used 60-dB SPL of contralateral BBN to stimulate efferent effects, whereas Khalfa and Collet's noise levels were 30 dB SL. Also, only right-handed women were tested in the present investigation, whereas males and females participated in the Khalfa and Collet experiment. In that men and women show differences in CEOAE amplitude (McFadden, 1993; McFadden, Martin, Stagner, &Maloney, 2009), this may also pertain to suppression effects, and so the present results would vary from those studies in which both genders were used

as participants. Both the present investigation and Khalfa et al. (1998) are in agreement that CEOAE amplitude asymmetries observed in quiet do not predict the size of the MOC suppression effect. The present study showed that CEOAE amplitudes in quiet were larger from rightcompared with left-ear responses. The amount of suppression, measured as the difference in response amplitude or the amplitude of a difference waveform, was equivalent for the right and leftears. Yet, when considered as a normalized proportion of the unsuppressed response, the leftear had greater contralateral suppression than the right ear. The greater suppression for the leftear, effectively decreasing the neural input to higher levels of the auditory system, would result in an advantage for information from the right ear (e.g., words embedded in suppressor noise). This would result in a "right-ear advantage" in this type of listening situation.

There are a number of complexities, however, in determining whether one ear demonstrates an "advantage" over the other. Right-ear CEOAE amplitudes are larger in all listening conditions. If suppressor noise is presented to the leftear with the probe stimulus in the right, is there relatively less effect because the output of the leftear is lower to begin with? Is the larger proportional suppression observed when noise is right and probe is leftdue to the effect of the "stronger" right-ear response to the noise suppressor or the weaker left-ear response to the probe? Further experimentation is needed to evaluate the absolute and relative amount of suppression measured when the ears are tested with probe stimuli that yield equal amplitude responses.

AR

ARs, another indicator of efferent function, were measured for each participant. All participants had AR thresholds that exceeded the level of BBN noise used to produce suppression (60-dB SPL). It is not possible to completely rule out the contribution of ARs to the CEOAE effects obtained. It is well established that the stapedius muscle effects cochlear input and output at levels of stimulation that are well below those that cause a change in middle-ear impedance (Eliasson &Gisselson, 1955; Simmons&Beatty, 1962). Concomitant recording of CEOAEs with acoustic reflectance measures may shed light on the contribution of the stapedius muscle reflex to cochlear input-output functions.

Conclusions

The MOC reflex is modulated by active listening requiring attention to semantically meaningful speech. This finding provides evidence of descending cortical control at the cochlear level and suggests that the efferent systemmay have a role in filtering irrelevant acoustic informationwhenattention is directed to speech.Whether or not the same effects would be found for active listening to temporally and/or spectrally complex nonspeech stimuli should be tested empirically. A direct comparison of suppression effects during active listening to probe versus suppressor ear and also for conditions in which noise may be present in both ears would contribute to the understanding of MOCB mechanisms subserving auditory attention, specifically for "figure-ground" problems such as speech perception in noise.

The experimental protocol used for the present investigation of CEOAE suppression has also been used for recording auditory brainstem responses and obligatory cortical auditory-evoked potentials to determine whether the effects of contralateral suppression and active listening observed at the cochlear level were evident at higher levels of the auditory system. The findings will be presented in a subsequent article.

Acknowledgments

Andrew Lotto, Brad Story, David Velenovsky, and Mark Bergstrom provided useful discussion, critique, and technical assistance for this investigation and present article. We gratefully acknowledge their contributions. Portions of this work were presented at the Association for Research in Otolaryngology (ARO), 31st Annual Midwinter Meeting (February 2008; Phoenix, AZ) and at the American Auditory Society Annual Meeting (March 2008; Phoenix, AZ).

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Editor: Robert Schlauch
Associate Editor: Stanley Gelfand
Received August 13, 2010
Revision received December 20, 2010
Accepted March 17, 2011
DOI: 10.1044/1092-4388(2011/10-0223)

Publication date: Oct 2011

Year: 2011

Evaluation of a Telephone Speech-Enhancement Algorithm Among Older Adults With Hearing Loss

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.5 (Oct 2011): 1477-1483.
ProQuest document link

Abstract: In this study, the authors evaluated a processing algorithm aimed at improving speech recognition via the telephone among older adults with sensorineural hearing loss (SNHL). Thirty older adults with SNHL participated. Speech recognition was measured in quiet using the Modified Rhyme Test (MRT; Kreul et al., 1968) and the Speech Perception in Noise (SPIN; Bilger et al., 1984) sentences, and in noise using the Quick Speech in Noise (QSIN; Killion et al., 2004) test. Each test was presented via the telephone with and without processing. Significant improvements in recognition performance due to processing were observed for the SPIN and QSIN. The improvement on the QSIN was significantly greater than on the MRT and SPIN, likely because the MRT and SPIN sentences were presented in quiet, whereas the QSIN was presented in noise. Significant improvements in recognition performance were observed for both an offline version and a real-time version of the algorithm relative to the unprocessed condition, although no difference was noted between the 2 versions. Results indicate that preprocessing the acoustic signal is a viable method of improving speech recognition via the telephone. The algorithm has the potential to benefit older adults with SNHL who struggle to communicate via the telephone with or without hearing aids.

Full text: Headnote
Purpose: In this study, the authors evaluated a processing algorithm aimed at improving speech recognition via the telephone among older adults with sensorineural hearing loss (SNHL).
Method: Thirty older adults with SNHL participated. Speech recognition was measured in quiet using the Modified Rhyme Test (MRT; Kreul et al., 1968) and the Speech Perception in Noise (SPIN; Bilger et al., 1984)

sentences, and in noise using the Quick Speech in Noise (QSIN; Killion et al., 2004) test. Each test was presented via the telephone with and without processing.
Results: Significant improvements in recognition performance due to processing were observed for the SPIN and QSIN. The improvement on the QSIN was significantly greater than on the MRT and SPIN, likely because the MRT and SPIN sentences were presented in quiet, whereas the QSIN was presented in noise. Significant improvements in recognition performance were observed for both an offline version and a real-time version of the algorithm relative to the unprocessed condition, although no difference was noted between the 2 versions.
Conclusions: Results indicate that preprocessing the acoustic signal is a viable method of improving speech recognition via the telephone. The algorithm has the potential to benefit older adults with SNHL who struggle to communicate via the telephone with or without hearing aids.
Key Words: hearing impairment, speech recognition, telephone
For older adults, communication via the telephone may be complicated by reduced audibility of the telephone signal due to hearing loss (Cruickshanks et al., 1998).This complication can be further exacerbated by two limitations inherent to telephone communication itself: a limited acoustic signal from the telephone and total reliance on the auditory signal due to a lack of visual cues.The frequency response range of a landline telephone is commonly accepted as 300-3300 Hz (Rodman, 2003). The reduced bandwidth of the telephone signal results in missing acoustic energy needed to correctly recognize speech. The dynamic range of the telephone is also limited in that an amplified acoustic signal will likely be peak clipped, thereby introducing nonlinearity and/or distortion. In addition, communication via the telephone forces the listener to rely solely on the auditory signal without the benefit of visual cues. Considerable improvement in speech recognition occurs when visual speech cues are available to supplement the auditory information (Helfer, 1998; MacLeod &Summerfield, 1987). The lack of visual cues, reduced audibility due to hearing loss, and a limited acoustic signal all interact, causing difficulty understanding speech over the telephone.
Existing options available for improving the audibility of the telephone signal for listeners with hearing impairment (HI; e.g., amplified telephones, telephones with a volume control, hearing aids with and without telecoils) are dependent on their use by the individual with HI. Another option is to preprocess the acoustic signal before it reaches the listener with HI. The option of amplifying the telephone signal through preprocessing is particularly relevant for community service agencies (e.g., community assistance programs) and medical organizations (e.g., telehealth) that experience difficulty communicating with older adults with HI. The idea of preprocessing a telephone signal is not new. For example, Terry et al. (1992) used digital signal processing to provide frequency shaping and compression to improve the audibility and intelligibility of the telephone signal for listeners with HI. Results revealed significant improvements in speech intelligibility for the frequency shaping with and without compression compared with the control condition. Terry et al. also obtained preference judgments regarding processing strategies presented through the telephone. The majority of subjects preferred a form of preprocessing over linear amplification. The results from Terry et al. suggest that preprocessing of the telephone signal is a viable method of improving speech recognition for listeners with HI.
The Departments of Speech andHearing Science and Electrical and Computer Engineering at The Ohio State University have collaborated to develop a computerbased telephone speech-enhancement algorithm (TSEA; Komattil, 2004; Natarajan, 2002; Poling, 2004; Sheffield, 2000). The TSEA is based on a hearing aid compressionprocessing algorithm aimed at preserving spectral contrast within the speech signal (Tejero-Calado, Rutledge, &Nelson, 2001) that was chosen, in part, to amplify the signal without introducing peak clipping. Motivation for development of the TSEA stems from the need to improve telephone communication between community service agencies (e.g., community assistance programs, telehealth) and older adults with HI. In a community assistance program situation, the TSEA is intended to be activated on the "counselor end" in order to assist with speech recognition on the "client end." The TSEA can also be implemented in this manner within the emerging telehealth domain, which has become increasingly utilized over the past decade (Koch,

2006). Difficulty communicating with health care professionals via the telephone has been reported as a concern by older adults (Iezzoni,O'Day, Killeen,&Harker, 2004). The ability of a health care professional to enhance the speech signal via the telephone has the potential to greatly improve communication with older adults with HI. The purpose of the present study, therefore, was to evaluate the effectiveness of the TSEA at improving speech recognition of older adult listeners with HI via the telephone in a group of older adults with sensorineural hearing loss (SNHL). A secondary purpose of the study was to compare telephone recognition performance between the original offline version of the algorithm and an updated version that can be run in real time.

Method

Subjects

Thirty older adults (16 female, 14 male), ranging in age from 55 to 70 years, participated in the present study. Twenty of the subjects (11 female, 9 male) participated in Experiment 1, and all 30 participated in Experiment 2. Inclusion criteria included (a) a bilateral, moderate to severe SNHL (i.e., air and bone conduction thresholds within 10 dB at 250-4000 Hz); (b) normal otoscopic findings; (c) tympanometry within normal limits (Wiley et al., 1996); and (d) English as a first language. Figure 1 presents mean pure-tone thresholds for all subjects. All subjects were recruited from The Ohio State University Speech-Language-Hearing Clinic research database and employee e-mail advertisements. The present study was approved by the Behavioral and Social Sciences Institutional Review Board at The Ohio State University.

TSEA

The TSEA is based on a hearing aid compressionprocessing algorithm (Tejero-Calado et al., 2001) adapted by Natarajan (2002) for the present study. The TSEA is a multichannel compression algorithm aimed at preserving spectral contrast within the speech signal. The processing reduces the typical amplitude variations in speech, allowing relatively low-amplitude consonant sounds to be amplified to audible levels while higher amplitude vowel sounds remain comfortably loud. It also preserves the spectral contrast by maintaining spectral peak-to-valley ratios between loud and softvariations in speech. Specifically, the speech signal sampled at 8000 Hz is split into frames of 32 ms with 50% overlap between the frames. Each frame is then passed through a Hamming window, and a 512-point fast Fourier transform is used to compute the spectral content of each frame. Further processing of the frame is done only if the spectral content of the frame is above a noise threshold.

Each non-noise frame is divided into three channels on the basis of its spectral content. The gain applied to each channel is computed independently from the input audiogram and the frequency response characteristics of the telephone1 receiver so as to raise the signal level above the threshold of audibility while maintaining the spectral peak-to-valley ratio. In a given channel, let DNH and DHI be the dynamic ranges of a listener with normal hearing (NH) and a listener with HI, respectively. Assume that the relative threshold of the listener with HI is T and that the relative SPL in the channel before gain is SN. Gain (g) is computed as g=DHI/DNH, and the relative sensation level (SL) is computed as SLHI = g ×SLNH + T. The determination of gain by the algorithm is further illustrated in Figure 2. Specifically, the unprocessed (original) spectrum is shown as a dashed curve, and the processed spectrum is shown as a solid curve. The threshold of audibility for the average hearing loss implemented by the algorithm is depicted as a solid line. Point A in Figure 2 at approximately 2000 Hz would be audible for a listener with normal thresholds, but it falls below the threshold for the average listener with HI. At 2000 Hz, the algorithm calculates a ratio of the dynamic range of the HI ear (DHI) to the dynamic range of the NH ear (DNH). Then, the level of A is expressed in dB SL (above normal threshold). The algorithm determines the desired SL for the HI ear as SLHI/SLNH = DHI/DNH. To determine the gain to be applied to level A, the value of A is multiplied by DHI/DNH and is added to the threshold value at 2000 Hz. Thus, A* = (DHI/DNH) ×A + threshold.

To avoid any audible distortion due to discontinuities in the signal, the gain variation between adjacent frames is smoothed. The processed speech is synthesized by performing an inverse fast Fourier transform, and the

individual frames are recombined by an overlap add method to smooth the discontinuities at the frame boundaries. Compression characteristics of the TSEA included (a) an attack time of 5 ms with a release time of 100 ms and (b) a compression threshold of 50 dB SPL. There is no fixed compression ratio in the TSEA. Rather, the compression ratio is determined frame by frame on the basis of the input signal.

For the purposes of the present study, average hearing thresholds were used to define the gain within each channel of the algorithm. The intended purpose of the TSEA is to enhance the speech signal before it reaches the listener with HI, and the device would therefore be activated by a service provider. In this scenario, the service provider would have no prior knowledge of the individual's audiogram. Therefore, the average audiogram was based on hearing thresholds (250-8000 Hz) compiled from 100 individuals over the age of 60 years tested at the Columbus Speech and Hearing Center (Columbus, OH) between 1996 and 2000 (see Figure 1).

There are two versions of the TSEA: (a) Version 1, a preliminary version coded in MATLAB that cannot be run in real time, and (b) Version 2, written in C code to run on a real-time signal processing server platform developed by FutureCom Technologies. Specifically, the real-time signal processing system was an implementation of the algorithm on telephone interface cards as part of a commercial interactive voice response platform.

Stimuli

Speech recognition was measured in each of the following categories: (a) phoneme discrimination, (b) word recognition, and (c) sentence recognition. Phoneme discrimination was measured with the Modified Rhyme Test (MRT; Kreul et al., 1968). The MRT is a closed-set, 50-item test, with each item consisting of a set of six monosyllabic words that vary in either the initial or final consonant. Word recognition was measured with the revised Speech Perception in Noise (SPIN) test sentences (Bilger, Nuetzel, Rabinowitz, &Rzeczkowski, 1984). The SPIN includes eight lists of 50 sentences, with each list divided into 25 high-predictability and 25 low-predictability sentences. Although the SPIN was designed to be given in the presence of background noise, the sentences were given in quiet for this experiment. In addition, for the purposes of the present study, the number of correct responses was collapsed across SPIN sentence type to determine an overall percent correct. And finally, sentence recognition was measured with the Quick Speech-in-Noise (QSIN) test (Killion, Niquette, Gudmundsen, Revit, &Banerjee, 2004). The QSIN is a test of speech recognition in background noise (i.e., four-talker babble). Multiple signal-to-noise ratios (SNRs) are used to determine a measure of SNR loss. Specifically, six sentences are presented, each at a different SNR. The SNRs decrease in 5-dB steps from 25 dB to 0 dB for each successive sentence. Listeners are asked to repeat the entire sentence, and five key words are scored. For the purposes of the present study, the number of correct responses was collapsed across all SNRs to determine an overall percent correct.

Recordings of each speech test (MRT, SPIN, and QSIN) were obtained from commercially available CDs. The audio files for each test were extracted from their respective CDs, digitized at a sampling rate of 44.1 kHz (quantization bit rate of 16), and down-sampled to 8 kHz to be compatible with the TSEA. The stimuli were then stored on a desktop PC hard drive.

Procedure \ For Experiment 1, speech recognition was measured for the three tests (MRT, SPIN, and QSIN) under two listening conditions-unprocessed and processed-with the offline version of the TSEA. The order of test delivery (type of test) was randomized, and the listening conditions (unprocessed vs. processed) were counterbalanced to minimize order effects. The MRT and the SPIN test were presented in quiet, with 50 trials per condition. The QSIN was presented as intended, in a multitalker babble with six sentences (30 key words) per condition. For Experiment 2, speech recognition was measured using the QSIN under three listening conditions: unprocessed, processed with Version 1 (original), and processed with Version 2 (real time). For Experiments 1 and 2, the QSIN sentences were processed through the algorithm, and the multitalker babble was mixed with the speech after processing. The decision not to process the multitalker babble was based on

the assumption of noise present on the HI listener's end. The multitalker babble was attenuatedmanually (PA4 attenuator, Tucker Davis Technologies) between each sentence to create the various SNRs (25-0 dB). All speech stimuli as well as the multitalker babble for the QSIN were presented (a) through an Audigy 2NX sound card (Creative Technology) from a desktop PC that was coupled to a portable telephone interface (Microtel, Gentner Communications Corporation); (b) through a telephone landline; and (c) to a telephone receiver (Model T-905C, Cortel). Participants were seated in a sound-treated booth (Model 402ATR, IAC) and were familiarized with each test before administration. All stimuli were presented to the ear that the listener used for everyday telephone communication. Subjects responded verbally to the speech stimuli, and their responses were recorded as percent correct or incorrect. All speech-recognition testing was completed unaided.

The unprocessed speech stimuli were digitized at the 8-kHz sampling rate to match the sampling rate used on the telephone network. To maximize waveform fidelity and minimize quantization errors, the sample amplitudes were normalized. For each sample, the peak value of the amplitude was rescaled so that it was just less than the maximum output available from the sound card. This resulted in an average presentation level of 70-74 dB SPL. The presentation levels were monitored acoustically from the telephone receiver placed directly over the external ear canal on the pinna of a Knowles electronics manikin for acoustic research (KEMAR) and held in place with adhesive strapping. The compressive processing of these speech samples reduced the peak factor of eachwaveform.Thus,when the processed waveform was normalized before being delivered to the telephone network, the average level measured was 82-85 dB SPL.

Results

Experiment 1. Table 1 includes Ms and SDs for recognition performance for the three speech tests (MRT, SPIN, and QSIN) across the two listening conditions (unprocessed and processed). As seen in Table 1, small improvements in telephone speech recognition due to TSEA processing were seen for the phonemediscrimination task (MRT) and the word-recognition task (SPIN). The greatest improvement occurred for the sentence-based speech-in-noise task (QSIN).

The percentage data were transformed into rationalized arcsine units before statistical analysis (Studebaker, 1985). To determine whether the TSEA resulted in a significant ($p < .05$) improvement in telephone speech recognition, the transformed data were subjected to a twoway repeated measures analysis of variance (ANOVA) with processing condition and speech type as withinsubjects factors. Results revealed a significantmain effect for processing condition, $F(1, 19) = 100.7$, $p < .05$. Post hoc Bonferroni t tests revealed significant improvements in telephone speech recognition for the SPIN and the QSIN due to the processing algorithm. The difference in phoneme discrimination between the unprocessed and processed conditions for the MRT was not significant. The ANOVA also revealed a significant main effect for speech type, $F(2, 38) = 144.5$, $p < .05$. Post hoc Bonferroni t tests revealed significantly better processed recognition performance for both the MRT and SPIN as compared with the QSIN. The difference in processed performance between the MRT and SPIN was not significant.

Mean difference scores (processed vs. unprocessed) were also calculated (see Table 1) and compared across the three speech types using a one-way ANOVA. Results revealed a significant main effect, $F(2, 57) = 24.9$, $p < .05$. Tukey's honestly significant difference post hoc analysis revealed significantly more improvement in QSIN performance relative to both MRT and SPIN performance. No significant differences were found in improvement between the MRT and SPIN.

Experiment 2. Table 2 includes means and SDs for the QSIN across the three listening conditions: unprocessed, processed with Version 1, and processed with Version 2. As can be seen in Table 2, both versions of the TSEA resulted in improved sentence recognition as compared with the unprocessed condition. The difference in speech recognition performance between the algorithm versions, however, was minimal (63.8% and 69.0%, respectively).

In order to determine whether the improvement in sentence recognition differed across conditions, the

arcsinetransformed (Studebaker, 1985) data were subjected to a one-way ANOVA. Results revealed a significant main effect of condition, $F(2, 87) = 30.4$, $p < .05$. Tukey's honestly significant difference post hoc analysis on the effect of condition revealed significant ($p < .05$) improvements between the unprocessed condition and the two algorithm versions. Significant differences in recognition performance were not present between the two algorithm versions ($p > .05$).

Discussion

The purpose of Experiment 1 was to evaluate the effectiveness of a processing algorithmdesigned to enhance communication via the telephone. Results of Experiment 1 revealed significant improvements in speech recognition due to processing by the TSEA. Specifically, mean performance improved by 10.9% for the SPIN test and 31.9% for the QSIN test. Mean performance improved by 4.7% for the MRT; however, this difference was not significant. Similar results were reported by Terry et al. (1992), who used frequency shaping to improve audibility of a speech signal filtered to mimic the frequency response of a telephone (i.e., 300-3000 Hz). The authors reported improvements in phoneme discrimination on the order of 11.8% for frequency shaping alone and 15.8% for frequency shaping plus compression in a group of listeners with SNHL. The results from the present study and those from Terry et al. (1992) suggest that preprocessing the speech signal is a viable method of improving speech recognition via the telephone.

The amount of improvement observed in the present study was not equal across the levels of speech assessed (i.e., phoneme, word, and sentence). Specifically, the difference in mean improvement due to processing between the MRT and the SPIN test was not significantly different. However, the QSIN test resulted in significantly greater improvement due to processing than either the MRTor the SPINtest.Agreater improvement due to processing on theQSIN test is unsurprising given that it was presented in the presence of multitalker babble. The fact that equal amounts of improvement due to processing were not seen across the three levels of speech tested may be a reflection of different levels of test difficulty.

As part of the development of the TSEA, Version 1 tested in Experiment 1 was programmed in C code to run in real time on a signal processing server platform developed by FutureCom Technologies (i.e., Version 2). It was expected that no differences would be observed in speech recognition performance between the two versions of the TSEA. Results of Experiment 2 verified that, indeed, similar levels of improvement were observed for both versions of the TSEA relative to the unprocessed condition. Performance differences between the two algorithm versions were small and not significant. Version 2 of the TSEA, therefore, was as effective at improving speech recognition via the telephone as the original algorithm. Version 2 has the added benefits of real-time implementation and multichannel capabilities. Specifically, the speech signal can be processed as it is presented or spoken. In addition, this real-time system is capable of handling multiple calls simultaneously.

The ability to communicate effectively via the telephone in today's society is vital formanyreasons, including avoiding isolation, maintaining independence, and ensuring safety and security (Dimmick, Sikand, &Patterson, 1994; Murphy, 1999). The issue of effective telephone communication takes on even greater importance when considering the evolution of telehealth. Telehealth allows in-home patient care by health care providers, overcoming common issues for older adults such as difficulty with transportation (Mormer &Mack, 2003; Wakefield, 2003). Many older adults with hearing loss, however, have expressed concerns regarding their ability to effectively communicate about their health care via the telephone (Iezzoni et al., 2004). Options for improving telephone communication currently focus on the HI user's end (i.e., amplified telephones or hearing aids). The success of these strategies, however, depends on the individual with HI having knowledge of and access to such devices. The focus of the present study, therefore, was to examine the efficacy of a system that can be implemented by community service agencies and health care providers that routinely communicate with older adults with HI. The development of a preprocessing algorithm such as the TSEA is an important first step toward the long-term goal of providing improved communication via the telephone for older adults with HI. Other telecommunication technologies, such as mobile telephones and voice-over-Internet protocols (VoIP),

such as Skype, also may potentially benefit from a preprocessing algorithm. Mobile telephone signals can be affected by the same limited bandwidth as landline telephone signals and may therefore benefit from a preprocessing strategy such as the TSEA. VoIP technology, on the other hand, takes advantage of web camera technology, allowing the listener to use lip and facial cues during communication. A preprocessing strategy such as the TSEA may not be as beneficial in this situation. Future research efforts will also be aimed at evaluating the algorithm with additional communication technologies, such as mobile telephones and VoIP.

Acknowledgments

Funding for this project was provided by the Franklin County Office on Aging, an Ameritech Faculty Research Grant, a National Institute on Aging Phase I Small Business Innovation Research grant, and a Battelle Endowment for Technology and Human Affairs award. Portions of this research were presented at the 1999 and 2000 Acoustical Society of America meetings (Columbus, OH, and Atlanta, GA, respectively) and the 2007 Ohio Audiology Conference (Columbus, OH). We would like to thank FutureCom Technologies (Gahanna, OH) for their contributions to this project.We would also like to thank Evelyn Hoglund for her helpful comments on an earlier draftof this article.

Footnote

1The frequency characteristics of the telephone network used in the present study were measured using a type 2 frequency response in which the input varied in order to achieve a constant output. The output was set to the maximum possible before clipping occurred. The frequency response characteristics of the telephone network were incorporated into the algorithm with the average audiogram in order to shape the output.

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Associate Editor: Stanley Gelfand
Received June 26, 2010
Revision received January 3, 2011
Accepted February 25, 2011
DOI: 10.1044/1092-4388(2011/10-0181)

Publication date: Oct 2011

Year: 2011

Endangered and Threatened Wildlife and Plants; Partial 90-Day Finding on a Petition To List 404 Species in the Southeastern United States as Endangered or Threatened With Critical Habitat

Publication info: The Federal Register / FIND 76. 187. (Sep 27, 2011).

Abstract (Abstract): Notice of petition finding and initiation of status review.
CFR Part: "50 CFR Part 17"
Citation: "76 FR 59836"
Document Number: "Docket No. FWS-R4-ES-2011-0049; MO 92210-0-0009"
Page Number: "59836"
"Proposed Rules"
SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce a partial 90-day finding on a petition to list 404 species in the southeastern United States as endangered or threatened under the Endangered Species Act of 1973, as amended (Act). Based on our review, we find that for 374 of the 404 species, the petition presents substantial scientific or commercial information indicating that listing may be warranted. Therefore, with the publication of this notice, we are initiating a status review of the 374 species to determine if listing is warranted. To ensure that the review is comprehensive, we are soliciting scientific and commercial information regarding these 374 species. Based on the status reviews, we will issue 12-month findings on the petition, which will address whether the petitioned action is warranted, as provided in section 4(b)(3)(B) of the Act. Of the 30 other species in the petition, 1 species--Alabama shad--has had a 90-day finding published by the National Marine Fisheries Service, and 18 species are already on the Service's list of candidate species or are presently the subject of proposed rules to list. We have not yet made a finding on the remaining 11 species, but anticipate doing so no later than September 30, 2011.

Full text: Source: DEPARTMENT OF THE INTERIOR (DOI)
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EFFECTIVE DATE: To allow us adequate time to conduct a status review, we request that we receive information on or before November 28, 2011. The deadline for submitting an electronic comment using the Federal eRulemaking Portal (see ADDRESSES section below) is 11:59 p.m. Eastern Standard Time on this date. After November 28, 2011, you must submit information directly to the Regional Office (see FOR FURTHER INFORMATION CONTACT section below). Please note that we may not be able to address or incorporate information that we receive after the above requested date.

ADDRESSES: You may submit information by one of the following methods:
(1) Electronically: Go to the Federal eRulemaking Portal: http://www.regulations.gov. In the Enter Keyword or ID box, enter Docket No. FWS-R4-ES-2011-0049, which is the docket number for this action. Then click on the Search button.
(2) By hard copy: Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS-R4-ES-2011-0049; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042-PDM; Arlington, VA 22203.
We will not accept e-mail or faxes. We will post all information received on http://www.regulations.gov. This generally means that we will post any personal information you provide us (see Request for Information section below for more details).
FOR FURTHER INFORMATION CONTACT: Janet Mizzi, Chief, Division of Endangered Species, Ecological Services, Southeast Regional Office, U.S. Fish and Wildlife Service, 1875 Century Blvd., Atlanta, GA 30345; by telephone at 404-679-7169; or by facsimile at 404-679-7081. If you use a telecommunications device for the deaf (TDD), please call the Federal Information Relay Service (FIRS) at 800-877-8339.
SUPPLEMENTARY INFORMATION: When we make a finding that a petition presents substantial information indicating that a species may be warranted for listing, we are required to promptly review the status of the species (status review). For the status reviews to be complete and based on the best available scientific and commercial information, we request information on the 374 species from governmental agencies, Native American tribes, the scientific community, industry, or any other interested parties concerning the status of the species. We seek information on:
(1) The species' biology, range, and population trends, including:
(a) Habitat requirements for feeding, breeding, and sheltering;
(b) Genetics and taxonomy;
(c) Historical and current range, including distribution patterns;
(d) Historical and current population levels, and current and projected trends; and
(e) Past and ongoing conservation measures for the species, its habitat, or both.
(2) The factors that are the basis for making a listing determination for a species under section 4(a) of the Act (16 U.S.C. 1531 et seq.), which are:
(a) The present or threatened destruction, modification, or curtailment of its habitat or range;
(b) Overutilization for commercial, recreational, scientific, or educational purposes;
(c) Disease or predation;
(d) The inadequacy of existing regulatory mechanisms; or
(e) Other natural or manmade factors affecting its continued existence.
(3) The potential effects of climate change on the species and their habitat.
If, after the status review, we determine that listing any of these species is warranted, it is our intent to propose critical habitat under section 4 of the Act, to the maximum extent prudent and determinable at the time we propose to list the species. Therefore, we also request data and information on:
(1) What may constitute "physical or biological features essential to the conservation of the species," within the geographical range currently occupied by the species;
(2) Where these features are currently found;
(3) Whether any of these features may require special management considerations or protection;
(4) Specific areas outside the geographical area occupied by the species that are "essential for the conservation of the species;" and
(5) What, if any, critical habitat you think we should propose for designation if the species is proposed for listing, and why such habitat meets the requirements of section 4 of the Act.
Please include sufficient information with your submission (such as scientific journal articles, other supporting

publications, or data) to allow us to verify any scientific or commercial information you include.
Submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination. Section 4(b)(1)(A) of the Act directs that determinations as to whether any species is an endangered or threatened species must be made "solely on the basis of the best scientific and commercial data available."
You may submit your information concerning the status reviews or the 404 species by one of the methods listed in the ADDRESSES section. If you submit information via http://www.regulations.gov, your entire submission--including any personal identifying information--will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on http://www.regulations.gov.
Information and supporting documentation that we received and used in preparing this finding is available for you to review at http://www.regulations.gov, or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Southeast Ecological Services Regional Office (see FOR FURTHER INFORMATION CONTACT).
Background
Section 4(b)(3)(A) of the Act requires that we make a finding on whether a petition to list, delist, or reclassify a species presents substantial scientific or commercial information indicating that a petitioned action may be warranted. We are to base this finding on information found in the petition, supporting information submitted with the petition, and information otherwise available in our files. To the maximum extent practicable, we are to make this finding within 90 days of our receipt of the petition, and publish our notice of this finding promptly in the Federal Register .
Our standard for substantial scientific or commercial information within the Code of Federal Regulations (CFR) with regard to a 90-day petition finding is "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted" (50 CFR 424.14(b)). If we find that substantial scientific or commercial information was presented, we are required to promptly conduct a species status review, which we subsequently summarize in our 12-month finding.
Petition History
On April 20, 2010, we received, via electronic mail, a petition from the Center for Biological Diversity (CBD), Alabama Rivers Alliance, Clinch Coalition, Dogwood Alliance, Gulf Restoration Network, Tennessee Forests Council, West Virginia Highlands Conservancy, Tierra Curry, and Noah Greenwald (referred to below as the CBD petition) to list 404 aquatic, riparian, and wetland species from the southeastern United States as endangered or threatened species and to designate critical habitat concurrent with listing under the Act. The petition clearly identified itself as a petition, was dated, and included the identification information required at 50 CFR 424.14(a). On April 21, 2010, via electronic mail to Noah Greenwald at CBD, we acknowledged receipt of the petition. On May 10, 2010, the Southeast Region of the Service, to which the petition had been assigned, provided additional formal written acknowledgement of receipt of the petition.
The petitioners developed an initial list of species by searching NatureServe for species that "occur in the twelve states typically considered the Southeast, occur in aquatic, riparian, or wetland habitats and appeared to be imperiled." Species were considered imperiled if they were classified as G1 or G2 by NatureServe, near threatened or worse by the International Union for Conservation of Nature (IUCN), or a species of concern, threatened, or endangered by the American Fisheries Society.
NatureServe conservation status ranks range from critically imperiled (1) to demonstrably secure (5). Status is assessed and documented at three distinct geographic scales: Global (G), national (N), and subnational (S) (i.e., state/province/municipal). Subspecies are similarly assessed with a subspecific (T) numerical assignment. Assessment by NatureServe of any species as being critically imperiled (G1), imperiled (G2), or vulnerable (G3)

does not constitute a recommendation by NatureServe for listing under the Act. NatureServe status assessment procedures have different criteria, evidence requirements, purposes, and taxonomic coverage than government lists of endangered and threatened species, and therefore these two types of lists should not be expected to coincide. For example, an important factor in many legal listing processes is the extent to which a species is already receiving protection of some type--a consideration not included in the NatureServe conservation status ranks. Similarly, the IUCN and American Fisheries Society do not apply the same criteria to their ranking determinations as those encompassed in the Act and its implementing regulations.

On May 7, 2010, the Service received correspondence from the Southeastern Fishes Council, dated May 2, 2010, with an explanation of its involvement in formulation of the petition. The Council was contacted by CBD, which solicited the Council's involvement in the preparation of the subject petition. The Southeastern Fishes Council's members provided expertise in review of the CBD's list of fishes in the draft petition.

On May 27, 2010, the Freshwater Mollusk Conservation Society submitted a letter to the Regional Director, Fish and Wildlife Service, Southeast Region, in support of the CBD petition's inclusion of a large number of freshwater mollusks. On September 1, 2010, and again on October 1, 2010, CBD forwarded to the Regional Director, Service, Southeast Region, a letter of support for the subject petition from 35 conservation organizations.

The CBD submitted supplemental comments and information on October 6, 2010, in support of protecting the Panama City crayfish (Procambarus econfinae) under the Act. On December 13, 2010, we received a second petition, from Wild South, to list the Carolina hemlock (Tsuga caroliniana), as endangered and to designate its critical habitat. We acknowledged receipt of the petition in a letter dated December 20, 2010, and identified it as a second petition for the same species' as Tsuga caroliniana was one of the species identified in the CBD petition.

The CBD petition included 404 species for which the petitioners requested listing as endangered or threatened under the Act, and designation of critical habitat concurrent with the listing. It is our practice to evaluate all species petitioned for listing for the potential need to emergency list the species under the emergency provisions of the Act at section 4(b)(7) and as outlined at 50 CFR 424.20. We have carefully considered the information provided in the petition and in our files and have determined that emergency listing is not indicated for any of the 404 species in the petition.

The petition included 18 species that were already on the Service's list of candidate species at the time of receipt of the petition, including five that have since been proposed to be listed as endangered. A candidate species is one for which we have on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher priority listing actions. We may identify a species as a candidate for listing based on an evaluation of its status that we conducted on our own initiative, or as a result of making a finding on a petition to list a species that listing is warranted but precluded by other higher priority listing actions. Of the 404 species that are the subjects of the petition, 18 had already been placed on the candidate list as a result of our own review and evaluation. These include: sicklefin redhorse (Moxostoma sp. 2 (the 2 refers to one of two species within the genus that have not yet been officially classified)), laurel dace (Phoxinus saylori) ((currently proposed for listing as endangered (June 24, 2011; 75 FR 36035)), spectaclecase (Cumberlandia monodonta) ((currently proposed for listing as endangered (January 19, 2011; 76 FR 3392)), narrow pigtoe (Fusconaia escambia), round ebonyshell (Fusconaia rotulata), southern sandshell (Hamiota australis), sheepnose (Plethobasus cyphyus) ((currently proposed for listing as endangered (January 19, 2011; 76 FR 3392)), fuzzy pigtoe (Pleurobema strodeanum), southern kidneyshell (Ptychobranchus jonesi), rabbitsfoot (Quadrula cylindrica cylindrica), tapered pigtoe (Fusconaia burkei), Choctaw bean (Villosa choctawensis), rayed bean (Villosa fabalis) ((currently proposed for listing as endangered (November 2, 2010; 75 FR 67552)), black mudalia (Elimia melanoides), Coleman cave beetle (Pseudanophthalmus colemanensis), Black Warrior waterdog (Necturus

alabamensis), and Yadkin River goldenrod (Solidago plumosa). We proposed to list the snuffbox (Epioblasma triquetra) as endangered on November 2, 2010 (75 FR 67552).

We conduct a review of all candidate species annually to ensure that a proposed listing is justified for each species, and reevaluate the relative listing priority number assigned to each species. We also evaluate the need to emergency list any of these species, particularly species with high priorities. Through this annual review we also add new candidate species and remove those that no longer warrant listing. This review and reevaluation ensure that we focus conservation efforts on those species at greatest risk first.

Because we have already made the equivalent of a 90-day and a 12-month finding on the species listed above, and they have already been identified as warranting listing, including five that we have proposed to list as endangered, we find the petition provides substantial scientific or commercial information indicating that these species may be warranted for listing.

The CBD petition includes one species, the Alabama shad (Alosa alabamae), that falls under the jurisdiction of the NMFS. According to the 1974 Memorandum of Understanding regarding jurisdictional responsibilities and listing procedures between the Service and NMFS, the NMFS has jurisdiction over species which either (1) Reside the majority portion of their lifetimes in marine waters, or (2) are species which spend part of their lifetimes in estuarine waters, if the majority portion of the remaining time (the time which is not spent in estuarine waters) is spent in marine waters. Based on this definition, NMFS has jurisdiction for the Alabama shad, and, accordingly, NMFS provided a letter to the Service, dated April 30, 2010, proposing to evaluate the subject petition, for the Alabama shad only, for the purpose of the 90-day finding and any required subsequent listing action. The NMFS published the 90-day finding for the Alabama shad on February 17, 2011 (76 FR 9320), and in that document announced its finding that the petition did not present substantial scientific or commercial information indicating that listing may be warranted for the Alabama shad.

Previous Federal Actions

A large number of the petitioned species have previously been considered for listing under the Act and were at one time or another assigned status as a category 1, 2, or 3C candidate species. A category 1 candidate species was one for which the Service had substantial information on hand to support the biological appropriateness of proposing to list as endangered or threatened, and for which development and publication of such a proposal was anticipated. A category 2 candidate species was one for which there was some evidence of vulnerability, but for which additional biological information was needed to support a proposed rule to list as endangered or threatened. A category 3C candidate was one that was proven to be more widespread than was previously believed and/or those that were not subject to any identifiable threats. These categories were discontinued in 1996 (December 5, 1996; 61 FR 64481) in favor of maintaining a list that only represented those species for which we have on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher priority listing actions.

The Service was previously petitioned to list two of the subject petitioned species, the Say's spiketail dragonfly (February 15, 1994) and the orangefin madtom (October 6, 1983), as endangered species. We published 90-day findings for Say's spiketail dragonfly on October 26, 1994 (59 FR 53776), and the orangefin madtom on January 16, 1984 (49 FR 1919), respectively, and 12-month findings on July 17, 1995 (60 FR 36380), and July 18, 1985 (50 FR 29238), respectively. Similarly, we previously proposed to list as endangered the Barrens topminnow (December 30, 1977; 42 FR 65209). However, that proposal was never finalized.

_____Table_1--Previous_Federal_Register_Notices_Addressing_the_Petitioned_Species
FR_Citation_____Publication_date_____Action
74_FR_57804_____11/9/2009_____Endangered_and_Threatened

		Wildlife_and_Plants
		(ETWP):_Review_of_Native
		Species_That_Are
		Candidates_for_Listing_as
		Endangered_or_Threatened;
		Annual_Notice_on_Findings
		on_Resubmitted_Petitions;
		Annual_Description_of
		Progress_on_Listing
		Actions;_Proposed_Rule.
61_FR_64481	12/5/1996	ETWP;_Notice_of_Final
		Decision_on
		Identification_of
		Candidates_for_Listing_as
		Endangered_or_Threatened.
61_FR_7596	02/28/1996	ETWP;_Review_of_Plant_and
		Animal_Taxa_That_Are
		Candidates_for_Listing_as
		Endangered_or_Threatened
		Species;_Proposed_Rule.
60_FR_36380	7/17/1995	ETWP;_12-Month_Finding
		for_a_Petition_To_List
		the_Say's_Spiketail
		Dragonfly_as_Endangered.
59_FR_58982	11/15/1994	ETWP;_Animal_Candidate
		Review_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
59_FR_53776	10/26/1994	ETWP;_90-Day_Finding_for
		a_Petition_To_List_the
		Say's_Spiketail_Dragonfly

		as_Endangered.
58_FR_51144	9/30/1993	ETWP;_Review_of_Plant
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
56_FR_58664	11/21/1991	ETWP;_Annual_Description
		of_Progress_on_Listing
		Actions_and_Findings_on
		Recycled_Petitions.
56_FR_58804	11/21/1991	ETWP;_Review_of_Animal
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
55_FR_17475	4/25/1990	ETWP;_Annual_Description
		of_Progress_on_Listing
		Actions_and_Findings_on
		Recycled_Petitions.
55_FR_6184	2/21/1990	ETWP;_Review_of_Plant
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
54_FR_554	1/6/1989	ETWP;_Review_of_Animal
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
53_FR_52746	12/29/1988	ETWP;_Findings_on_Pending
		Petitions_and_Description
		of_Progress_on_Listing

		Actions.
53_FR_25511	7/7/1988	ETWP;_Findings_on_Pending
		Petitions_and_Description
		of_Progress_on_Listing
		Actions.
52_FR_24312	6/30/1987	ETWP;_Findings_on_Pending
		Petitions_and_Description
		of_Progress_on_Listing
		Actions.
51_FR_996	1/09/1986	ETWP;_Findings_on_Pending
		Petitions_and_Description
		of_Progress_on_Listing
		Actions.
50_FR_39526	9/27/1985	ETWP;_Review_of_Plant
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
50_FR_37958	9/18/1985	ETWP;_Review_of
		Vertebrate_Wildlife.
50_FR_29238	7/18/1985	12-Month_Finding_on_a
		Petition_To_List_the
		Orangefin_Madtom.
50_FR_19761	5/10/1985	ETWP;_Findings_on_Pending
		Petitions_and_Description
		of_Progress_on_Listing
		Actions.
49_FR_21664	5/22/1984	ETWP;_Review_of
		Invertebrate_Wildlife_for
		Listing_as_Endangered_or
		Threatened_Species.
49_FR_2485	1/20/1984	ETWP;_Findings_on_Pending

		Petitions_and_Description
		of_Progress_on_Listing
		Actions.
49_FR_1919	1/16/1984	ETWP;_90-Day_Finding_on_a
		Petition_To_List_the
		Orangefin_Madtom.
48_FR_53640	11/28/1983	ETWP;_Supplement_to
		Review_of_Plant_Taxa_for
		Listing_as_Endangered_or
		Threatened_Species.
47_FR_58454	12/30/1982	ETWP;_Review_of
		Vertebrate_Wildlife_for
		Listing_as_Endangered_or
		Threatened_Species;
		Notice_of_Review.
45_FR_82480	12/15/1980	ETWP;_Review_of_Plant
		Taxa_for_Listing_as
		Endangered_or_Threatened
		Species;_Notice_of
		Review.
44_FR_70796	12/10/1979	ETWP;_Notice_of
		Withdrawal_of_That
		Portion_of_Our_June_16,
		1976,_Proposed_Rule_That
		Has_Not_Yet_Been
		Finalized.
44_FR_44418	7/27/1979	ETWP;_Reproposal_of
		Critical_Habitat_for_the
		Barrens_Topminnow.
44_FR_12382	3/6/1979	ETWP;_Withdrawal_of
		Proposed_Critical_Habitat
		for_the_Barrens

			Topminnow.
43_FR_21702	5/19/1978		ETWP;_Proposed_Endangered
			Status_and_Critical
			Habitat_for_Two_Species
			of_Turtles_(Key_Mud
			Turtle_and_Plymouth
			Red-bellied_Turtle).
43_FR_17909	4/26/1978		ETWP;_Final_Rule_and
			Summary_of_General
			Comments_Received_in
			Response_to_a_Proposal_To
			List_Some_1700_U.S.
			Vascular_Plants.
42_FR_65209	12/30/1977		ETWP;_Proposed_Endangered
			Status_for_the_Barrens
			Topminnow.
41_FR_24524	6/16/1976		ETWP;_Proposed_Endangered
			Status_for_Some_1700_U.S.
			Vascular_Plants.
40_FR_27824	7/1/1975		Acceptance_of_Smithsonian
			Report_As_a_Petition_To
			List_Taxa_Named_Therein
			Under_Section_4(b)(2)_of
			the_Act_and_Intention_To
			Review_the_Status_of
			Those_Plants.

Species Information

The petition identified 404 aquatic, riparian, and wetland species from the southeastern United States as needing protection under the Act. This list included 15 amphibians, 6 amphipods, 18 beetles, 3 birds, 4 butterflies, 9 caddisflies, 83 crayfish, 14 dragonflies, 48 fish, 1 springfly, 1 fairy shrimp, 2 isopods, 4 mammals, 1 moth, 48 mussels, 6 non-vascular plants, 13 reptiles, 44 snails, 8 stoneflies, and 76 vascular plants. Of these 404 species, 374 species are addressed in this finding (listed in Table 2 in the Summary of Threats as Identified in the Petition section below). We have not yet made a finding on the following 11 species: South Florida rainbow snake (Farancia erytrogramma seminola), Sarah's hydroptila caddisfly (Hydroptila sarahae), Rogue

Creek hydroptila caddisfly (Hydroptila okaloosa), Florida brown checkered summer sedge (Polycentropus floridensis), Florida fairy shrimp (Dexteria floridana), Ouachita creekshell (Villosa arkansasensis), crystal darter (Crystallaria asprella), spotted darter (Etheostoma maculatum), Florida bog frog (Rana okaloosae), Greensboro burrowing crayfish (Cambarus catagius), and Blood River crayfish (Orconectes burri).

The nature of this petition finding, that is, the large number of species evaluated, necessitates our limiting a discussion of species information to a general one; only where there is a clarification necessary do we provide specific species information below.

The petition identified 15 amphibians and requested that they be added to the List of Endangered and Threatened Wildlife (List). Thirteen of these are subjects of this finding, including the following: Streamside salamander (Ambystoma barbouri), one-toed amphiuma (Amphiuma pholeter), hellbender (Cryptobranchus alleganiensis), Cumberland dusky salamander (Desmognathus abditus), seepage salamander (Desmognathus aeneus), Chamberlain's dwarf salamander (Eurycea chamberlaini), Oklahoma salamander (Eurycea tynerensis), Tennessee cave salamander (Gyrinophilus palleucus), West Virginia spring salamander (Gyrinophilus subterraneus), Georgia blind salamander (Eurycea wallacei, formerly known as, and identified by petitioners as, Haideotriton wallacei), Neuse River waterdog (Necturus lewisi), Gulf hammock dwarf siren (Pseudobranchus striatus lustricolus), and patch-nosed salamander (Urspelerpes brucei). The Black Warrior waterdog (Necturus alabamensis) is already on the Service's candidate species list. The seepage salamander, Oklahoma salamander, Tennessee cave salamander, West Virginia Spring salamander, Georgia blind salamander, Neuse River waterdog, hellbender, and Gulf hammock dwarf siren were previous C2 candidates for Federal listing, until that category was discontinued in 1996.

Chamberlain's dwarf salamander is given a NatureServe global ranking of G5; however, its status in Georgia is S1, indicating it is considered critically imperiled in that State. The streamside salamander is given the G4 conservation status by NatureServe; however, it is considered critically imperiled (S1) in West Virginia, imperiled (S2) in Tennessee, and vulnerable (S3) in Indiana. The one-toed amphiuma maintains a global G3 ranking by NatureServe; however, it is also considered critically imperiled by NatureServe in Mississippi, Alabama, and Georgia, and vulnerable in Florida. The Tennessee cave salamander maintains a NatureServe global ranking of G2 with State rankings of S2 (AL and TN) and S1 (GA). The hellbender maintains a NatureServe global ranking of G3. Its State status ranges from S1 to S3. The subspecies bishopi, or Ozark hellbender, was proposed for Federal listing as endangered on September 8, 2010 (75 FR 54561). The Cumberland dusky salamander and Georgia blind salamander each have a NatureServe conservation status of imperiled (G2), with State rankings varying from possibly extirpated, to critically imperiled, to imperiled. The seepage salamander, Oklahoma salamander, and Neuse River waterdog each have a NatureServe global conservation ranking of G3, with individual State rankings of S1 to S3. The West Virginia spring salamander and patch-nosed salamander each have a NatureServe conservation ranking of G1. The Gulf hammock dwarf siren is given a NatureServe global ranking of T1. The dwarf siren has not been documented since its description in 1951.

The petition identified six amphipods and requested that they be added to the List, including the following: Florida cave amphipod (Crangonyx grandimanus), Hobbs cave amphipod (Crangonyx hobbsi), Cooper's cave amphipod (Stygobromus cooperi), tidewater amphipod (Stygobromus indentatus), Morrison's cave amphipod (Stygobromus morrisoni), and minute cave amphipod (Stygobromus parvus).

These six amphipods are each assigned a NatureServe Global ranking of either G2 or G3, indicating they are considered imperiled or vulnerable across their entire range. Cooper's cave amphipod, tidewater amphipod, Morrison's cave amphipod and the minute cave amphipod were each previous Service category 2 candidate species for listing (species for which there was some evidence of vulnerability, but for which additional biological information was needed to support a proposed rule to list as endangered or threatened).

The petition identified 18 beetles and requested that they be added to the List. Seventeen of these are included

in this finding, including the following: Cobblestone tiger beetle (Cincindela marginipennis), Avernus cave beetle (Pseudanophthalmus avernus), Little Kennedy cave beetle (Pseudanophthalmus cordicollis), New River Valley cave beetle (Pseudanophthalmus egberti), Cumberland Gap cave beetle (Pseudanophthalmus hirsutus), Hubbard's cave beetle (Pseudanophthalmus hubbardi), Hubricht's cave beetle (Pseudanophthalmus hubrichti), Crossroad's cave beetle (Pseudanophthalmus intersectus), Madden's cave beetle (Pseudanophthalmus limicola), Dry Fork Valley cave beetle (Pseudanophthalmus montanus), Natural Bridge cave beetle (Pseudanophthalmus pontis), South Branch Valley cave beetle (Pseudanophthalmus potomaca), overlooked cave beetle (Pseudanophthalmus praetermissus), Saint Paul cave beetle (Pseudanophthalmus sanctipauli), silken cave beetle (Pseudanophthalmus sericus), Thomas's cave beetle (Pseudanophthalmus thomasi), and Maiden Spring cave beetle (Pseudanophthalmus virginicus). The Coleman's cave beetle (Pseudanophthalmus colemanensis) is already a Federal candidate species.

These cave beetles are locally endemic to small cave systems in Virginia, West Virginia, and Tennessee. Sixteen of them are afforded a NatureServe ranking of G1, with a population size of 1,000 or fewer, and many have not been documented since their description. One cave beetle, the South Branch Valley cave beetle, has a slightly wider range and is afforded a NatureServe ranking of G3. All of these beetles were previous category 2 candidates for Federal listing, until that category was discontinued in 1996.

The petition identified three birds and requested that they be added to the List, including the following: MacGillivray's seaside sparrow (Ammodrammus maritimus macgillivraii), Florida sandhill crane (Grus canadensis pratensis), and black rail (Laterallus jamaicensis). MacGillivray's seaside sparrow and the Florida sandhill crane are given a NatureServe ranking of T2, while the black rail is more widely distributed and given a NatureServe ranking of G4. The black rail is a previous category 2 candidate species.

The petition identified four butterflies and requested that they be added to the List, including the following: Linda's roadside-skipper (Amblyscirtes linda), Duke's skipper (Euphyes dukesi calhouni), Palatka skipper (Euphyes pilatka klotsi), and rare skipper (Problema bulenta). Linda's roadside skipper and the rare skipper are afforded a NatureServe ranking of G2. Duke's and Palatka's skippers are afforded NatureServe rankings of T2 and T1, respectively. The rare skipper was previously considered a category 2 candidate, until that category was discontinued by the Service in 1996.

The petition identified nine caddisflies and requested that they be added to the List. Six of these are included in this finding, including the following: Logan's agarodes caddisfly (Agarodes logani), Sykora's hydroptila caddisfly (Hydroptila sykorae), Morse's little plain brown sedge (Lepidostoma morsei), little oecetis longhorn caddisfly (Oecetis parva), Setose cream and brown mottled microcaddisfly (Oxyethira setosa), and three-toothed triaenodes caddisfly (Triaenodes tridontus).

Of these caddisflies, two are assigned a NatureServe ranking of G1, and four are assigned a G2. There is very little known about these species except that they appear to be very narrow endemics. The little oecetis longhorn caddisfly and three-toothed triaenodes caddisfly are previous category 2 candidate species.

The petition identified 83 crayfish and requested that they be added to the List. Eighty-one of these are included in this finding: Bayou Bodcau crayfish (Bouchardina robisoni), Dougherty Plain cave crayfish (Cambarus cryptodytes), Obey crayfish (Cambarus obeyensis), cypress crayfish (Cambarellus blacki), least crayfish (Cambarellus diminutus), angular dwarf crawfish (Cambarellus lesliei), Big South Fork crayfish (Cambarus bouchardi), New River crayfish (Cambarus chasmodactylus), Chauga crayfish (Cambarus chaugaensis), Coosawattae crayfish (Cambarus coosawattae), slenderclaw crayfish (Cambarus cracens), Conasauga blue burrower (Cambarus cymatilis), Grandfather Mountain crayfish (Cambarus eeseeohensis), Elk River crayfish (Cambarus elkensis), Chickamauga crayfish (Cambarus extraneus), Etowah crayfish (Cambarus fasciatus), Little Tennessee crayfish (Cambarus georgiae), Piedmont blue burrower (Cambarus harti), spiny scale crayfish (Cambarus jezerinaci), Alabama cave crayfish (Cambarus jonesi), Greenbrier cave crayfish (Cambarus nerterius), Hiwassee headwater crayfish (Cambarus parrishi), pristine crayfish (Cambarus pristinus), Chattooga

River crayfish (Cambarus scotti), beautiful crayfish (Cambarus speciosus), Broad River spiny crayfish (Cambarus spicatus), lean crayfish (Cambarus strigosus), blackbarred crayfish (Cambarus unestami), Big Sandy crayfish (Cambarus veteranus), Brawley's Fork crayfish (Cambarus williami), mimic crayfish (Distocambarus carlsoni), Broad River burrowing crayfish (Distocambarus devexus), Newberry burrowing crayfish (Distocambarus youngineri), burrowing bog crayfish (Fallicambarus burrisi), speckled burrowing crayfish (Fallicambarus danielae), Jefferson County crayfish (Fallicambarus gilpini), Ouachita burrowing crayfish (Fallicambarus harpi), Hatchie burrowing crayfish (Fallicambarus hortoni), slenderwrist burrowing crayfish (Fallicambarus petilicarpus), Saline burrowing crayfish (Fallicambarus strawni), Crested riverlet crayfish (Hobbseus cristatus), Oktibbeha riverlet crayfish (Hobbseus orconectoides), Tombigbee riverlet crayfish (Hobbseus petilus), Yalobusha riverlet crayfish (Hobbseus yalobushensis), Calcasieu crayfish (Orconectes blacki), Coldwater crayfish (Orconectes eupunctus), Yazoo crayfish (Orconectes hartfieldi), Tennessee cave crayfish (Orconectes incomptus), Sucarnoochee River crayfish (Orconectes jonesi), Kisatchie painted crayfish (Orconectes maletae), Mammoth Spring crayfish (Orconectes marchandi), Appalachian cave crayfish (Orconectes packardi), Shelta cave crayfish (Orconectes sheltae), Chowanoke crayfish (Orconectes virginiensis), Hardin crayfish (Orconectes wrighti), Orlando cave crayfish (Procambarus acherontis), Coastal flatwoods crayfish (Procambarus apalachicolae), Silver Glen Springs crayfish (Procambarus attiguus), Jackson Prairie crayfish (Procambarus barbiger), Mississippi flatwoods crayfish (Procambarus cometes), bigcheek cave crayfish (Procambarus delicatus), Panama City crayfish (Procambarus econfinae), Santa Fe cave crayfish (Procambarus erythrops), spinytail crayfish (Procambarus fitzpatricki), Orange Lake cave crayfish (Procambarus franzi), Big Blue Springs cave crayfish (Procambarus horsti), lagniappe crayfish (Procambarus lagniappe), coastal lowland cave crayfish (Procambarus leitheuseri), Florida cave crayfish (Procambarus lucifugus), Alachua light-fleeing cave crayfish (Procambarus lucifugus alachua), Florida cave crayfish (Procambarus lucifugus lucifugus), Shutispear crayfish (Procambarus lylei), Miami cave crayfish (Procambarus milleri), Putnam County cave crayfish (Procambarus morrisi), Woodville Karst cave crayfish (Procambarus orcinus), pallid cave crayfish (Procambarus pallidus), Black Creek crayfish (Procambarus pictus), bearded red crayfish (Procambarus pogum), regal burrowing crayfish (Procambarus regalis), Irons Fork burrowing crayfish (Procambarus reimeri), and spider cave crayfish (Troglocambarus maclanei).

The petition identified the Florida cave crayfish twice in its list of 404 species, once at the species level, Procambarus lucifugus, and once at the subspecific level, Procambarus lucifugus lucifugus. We include both in this finding with the intent that a further status review will assess the status at both the species and subspecies levels.

We received an amended petition from CBD providing supplemental comments in support of listing the Panama City crayfish. The petition identified threats from habitat loss and degradation, predation, overharvest from collections for use as fishing bait, drought, its limited range and isolated distribution, pollution from pesticides and fertilizers, invasive species of introduced crayfish, and the inadequacy of existing regulatory mechanisms. The Panama City crayfish only occurs in Bay County, Florida, where it is considered a species of special concern by the State of Florida. The Service has worked with the State and the St. Joe Company to develop a Candidate Conservation Agreement with Assurances, but the Agreement has not been finalized.

Almost all of the petitioned crayfish are restricted to narrow ranges encompassing small cave or stream systems, which places them in the G1 or G2 NatureServe ranking due to their restricted ranges. Two exceptions to this are the Woodville Karst cave crayfish (Procambarus orcinus), which receives a G3 ranking, and the regal burrowing crayfish (Procambarus regalis), which is given a G2G3 ranking. Their narrow ranges make these crayfish vulnerable to any event that would result in habitat degradation. A number of the crayfish (26) were previously considered category 2 candidates until that category was discontinued by the Service in 1996.

The petition identified 14 dragonflies and requested that they be added to the List, including the following: Say's spiketail (Cordulegaster sayi), Cherokee clubtail (Gomphus consanguis), Tennessee clubtail (Gomphus

sandrius), Septima's clubtail (Gomphus septima), Westfall's clubtail (Gomphus westfalli), purple skimmer (Libellula jesseana), Mountain River cruiser (Macromia margarita), southern snaketail (Ophiogomphus australis), Edmund's snaketail (Ophiogomphus edmundo), Appalachian snaketail (Ophiogomphus incurvatus), Calvert's emerald (Somatochlora calverti), Texas emerald (Somatochlora margarita), Ozark emerald (Somatochlora ozarkensis), and yellow-sided clubtail (Stylurus potulentus).

The Service was previously (February 15, 1994) petitioned to list the Say's spiketail dragonfly as an endangered species. We published a 90-day finding on October 26, 1994 (59 FR 53776) indicating that because the species was already a category 2 candidate for listing we would proceed with a full status review. The 12-month finding was published on July 17, 1995 (60 FR 36380). The Service found that listing the species was not warranted but retained the designation of the Say's spiketail as a category 2 candidate species. An additional eight of the petitioned dragonflies held previous designations of category 2 candidate species, including the Cherokee clubtail, Tennessee clubtail, Septima's clubtail, Westfall's clubtail, Mountain River cruiser, Edmund's snaketail, Appalachian snaketail, and the Texas emerald. The NatureServe global ranking of the petitioned dragonflies ranges from G1, critically imperiled, to G3, vulnerable.

The petition identified 47 fish (not including the Alabama shad (Alosa alabamae), which has already been the subject of a 90-day finding by NMFS) to be added to the List. Forty-three of these are included in this finding, including the following: Northern cavefish (Amblyopsis spelaea), bluestripe shiner (Cyprinella callitaenia), Altamaha shiner (Cyprinella xaenura), Carolina pygmy sunfish (Elassoma boehlkei), Ozark chub (Erimystax harryi), Warrior darter (Etheostoma bellator), holiday darter (Etheostoma brevirostrum), ashy darter (Etheostoma cinereum), Barrens darter (Etheostoma forbesi), smallscale darter (Etheostoma microlepidum), candy darter (Etheostoma osburni), paleback darter (Etheostoma pallididorsum), egg-mimic darter (Etheostoma pseudovulatum), striated darter (Etheostoma striatulum), Shawnee darter (Etheostoma tecumsehi), Tippecanoe darter (Etheostoma tippecanoe), trispot darter (Etheostoma trisella), Tuscumbia darter (Etheostoma tuscumbia), Barrens topminnow (Fundulus julisia), robust redhorse (Moxostoma robustum), popeye shiner (Notropis ariommus), Ozark shiner (Notropis ozarcanus), peppered shiner (Notropis perpallidus), rocky shiner (Notropis suttkusi), saddled madtom (Noturus fasciatus), Carolina madtom (Noturus furiosus), orangefin madtom (Noturus gilberti), piebald madtom (Noturus gladiator), Ouachita madtom (Noturus lachneri), frecklebelly madtom (Noturus munitus), Caddo madtom (Noturus taylori), Chesapeake logperch (Percina bimaculata), coal darter (Percina brevicauda), Halloween darter (Percina crypta), bluestripe darter (Percina cymatotaenia), bridled darter (Percina kusha), longhead darter (Percina macrocephala), longnose darter (Percina nasuta), bankhead darter (Percina sipsi), sickle darter (Percina williamsi), broadstripe shiner (Pteronotropis euryzonus), bluehead shiner (Pteronotropis hubbsi), and blackfin sucker (Thoburnia atripinnis). The NatureServe global ranking of these fish ranges from G1 to G4.

Since receipt of the CBD petition, the laurel dace was proposed for listing as endangered (75 FR 36035; June 24, 2010). The sicklefin redhorse has already been found to be warranted for listing and is a current Federal candidate species.

On December 30, 1977, the Barrens topminnow was proposed for listing as endangered with critical habitat (42 FR 65209). On March 6, 1979, the critical habitat portion of the proposal was withdrawn due to the procedural and substantive changes made to the Act in 1978 (44 FR 12382). On July 27, 1979, the Service published a reproposal of critical habitat for the Barrens topminnow (44 FR 44418). A final listing was never published, and the species was subsequently classified as a category 2 candidate for Federal listing until that category was discontinued in 1996.

On October 6, 1983, the Service was petitioned to list the orangefin madtom and a substantial finding was published on January 16, 1984 (49 FR 1919). On completion of the status review on October 12, 1984, a 12-month finding was made that listing the orangefin madtom was warranted but precluded by other efforts to revise the Lists. This finding was announced in a July 18, 1985, Federal Register notice (50 FR 29238). The

species remained a candidate species until its removal from the candidate list in 1996.
In addition to the above species, 24 of the petitioned fish were at one time candidates for listing under the Act. The peppered shiner, paleback darter, and Ouachita madtom were category 1 candidates (47 FR 58454). However, they were subsequently removed from the candidate list. Twenty-one of the petitioned fish were category 2 candidates for listing, including the following: Northern cavefish, bluestripe shiner, Carolina pygmy sunfish, Warrior darter, holiday darter, ashy darter, Barrens darter, candy darter, egg-mimic darter, striated darter, trispot darter, Tuscumbia darter, robust redhorse, Ozark shiner, Carolina madtom, frecklebelly madtom, Caddo madtom, bluestripe darter, longhead darter, longnose darter, and Halloween darter.
In 1995, the Service entered into a cooperative voluntary partnership, the Robust Redhorse Conservation Committee, to conserve the robust redhorse through a Memorandum of Understanding between State and Federal resource agencies, private industry, and the conservation community. In 2002, the Service entered into a Robust Redhorse Candidate Conservation Agreement with Assurances with the Georgia Department of Natural Resources and the Georgia Power Company to restore the species to the Ocmulgee River.
The petition identified one springfly, the Blueridge springfly (Remenus kirchneri), and one moth, the Louisiana eyed silkmoth (Automeris louisiana), and requested that they be added to the List. These species hold NatureServe global rankings of G2.
The petition identified four mammals and requested that they be added to the List, including the following: Sherman's short-tailed shrew (Blarina carolinensis shermani), Pine Island oryzomys or marsh rice rat (Oryzomys palustris, pop. 1), Sanibel Island oryzomys or marsh rice rat (Oryzomys palustris, pop. 2), and insular cotton rat (Sigmodon hispidus insulicola). All four of these mammals are afforded a ranking of G1 or T1 by NatureServe. The insular cotton rat was previously a category 2 candidate species but was removed from the candidate list in 1996 when the category was discontinued.
The petition identified two isopods and requested that they be added to the List: The Caecidotea cannula (no common name) and Rye Cove isopod (Lirceus culveri). These isopods are given NatureServe rankings of G2 (Caecidotea cannula) and G1 (Rye Cove isopod). Both species were former category 2 candidates for listing, until that category was discontinued in 1996.
The petition identified 48 mussels and requested that they be added to the List. Thirteen species of mussels identified in the petition are not evaluated in this finding; twelve have previously been found by the Service to warrant listing, and one, the Ouachita creekshell (Villosa arkansasensis) has not yet been evaluated. Thirty-five of the petitioned species are included in this finding, including the following: Altamaha arcmussel (Alasmidonta arcula), southern elktoe (Alasmidonta triangulata), brook floater (Alasmidonta varicosa), Apalachicola floater (Anodonta heardi), rayed creekshell (Anodontoides radiatus), western fanshell (Cyprogenia aberti), southern lance (Elliptio ahenea), Alabama spike (Elliptio arca), delicate spike (Elliptio arctata), brother spike (Elliptio fraterna), yellow lance (Elliptio lanceolata), St. Johns elephant ear (Elliptio monroensis), inflated spike (Elliptio purpurella), Tennessee pigtoe (Pleuronaia barnesiana), Atlantic pigtoe (Fusconaia masoni), longsolid (Fusconaia subrotunda), Waccamaw fatmucket (Lampsilis fullerkati), Tennessee heelsplitter (Lasmigona holstonia), green floater (Lasmigona subviridis), Cumberland moccasinshell (Medionidus conradicus), Suwannee moccasinshell (Medionidus walkeri), round hickorynut (Obovaria subrotunda), Alabama hickorynut (Obovaria unicolor), Canoe Creek pigtoe (Pleurobema athearni), Tennessee clubshell (Pleurobema oviforme), Warrior pigtoe (Pleurobema rubellum), pyramid pigtoe (Pleurobema rubrum), inflated floater (Pyganodon gibbosa), Tallapoosa orb (Quadrula asperata archeri), salamander mussel (Simpsonaias ambigua), purple lilliput (Toxolasma lividus), Savannah lilliput (Toxolasma pullus), Alabama rainbow (Villosa nebulosa), Kentucky creekshell (Villosa ortmanni), and Coosa creekshell (Villosa umbrans).
These mussels have NatureServe rankings ranging from G1, critically imperiled, to G3, vulnerable, with one mussel, the round hickorynut, having a ranking of G4, apparently stable. The Atlantic pigtoe, Waccamaw fatmucket, Tennessee heelsplitter, green floater, Suwannee moccasinshell, Tennessee clubshell, warrior pigtoe,

salamander mussel, purple lilliput, Savannah lilliput, and Kentucky creekshell, are previous category 2 candidates for listing, but were removed when the category was discontinued in 1996.

The snuffbox (Epioblasma triquetra) and rayed bean (Villosa fabalis) were proposed for listing as endangered on November 2, 2010 (75 FR 67552). The spectaclecase (Cumberlandia monodonta) and sheepnose (Plethobasus cyphyus) were proposed as endangered on January 19, 2011 (76 FR 3392). The other eight are current candidates for Federal listing and subjects of a draft proposed rule to list, including the narrow pigtoe (Fusconaia escambia), round ebonyshell (Fusconaia rotulata), southern sandshell (Hamiota australis), fuzzy pigtoe (Pleurobema strodeanum), southern kidneyshell (Ptychobranchus jonesi), rabbitsfoot (Quadrula cylindrica cylindrica), tapered pigtoe (Fusconaia burkei), and Choctaw bean (Villosa choctawensis).

The petition identified six non-vascular plants and requested that they be added to the List of Endangered and Threatened Plants, including the following: Fissidens appalachensis (Appalachian fissidens moss), Fissidens hallii (Hall's pocket moss), Megaceros aenigmaticus (hornwort), Phaeophyscia leana (Lea's bog lichen), Plagiochila caduciloba (Gorge leafy liverwort), and Plagiochila sharpii ssp. sharpii (Sharp's leafy liverwort). The NatureServe Global ranking for these plants ranges from G2, imperiled (Fissidens appalachensis, Fissidens hallii, Phaeophyscia leana, and Megaceros aenigmaticus), to G3, vulnerable (Plagiochila caduciloba), to T3, vulnerable (Plagiochila sharpii ssp. sharpii). Plagiochila caduciloba and Plagiochila sharpii ssp. sharpii held prior Federal category 2 candidate status, but were removed from that list when we discontinued use of the category 2 and 3C lists in 1996.

The petition identified 13 reptiles and requested that they be added to the List. Twelve of these are subjects of this finding, including the following: Kirtland's snake (Clonophis kirtlandii), western chicken turtle (Deirochelys reticularia miaria), Florida keys mole skink (Eumeces egregius egregius), Barbour's map turtle (Graptemys barbouri), Escambia map turtle (Graptemys ernsti), Pascagoula map turtle (Graptemys gibbonsi), black-knobbed map turtle (Graptemys nigrinoda), Alabama map turtle (Graptemys pulchra), Lower Florida Keys striped mud turtle (Kinosternon baurii, pop. 1), Florida Panhandle Florida red-bellied turtle (Pseudemys nelsoni, pop. 1), northern red-bellied cooter (Pseudemys rubriventris), and Lower Florida Keys eastern ribbonsnake (Thamnophis sauritus, pop. 1).

The Kirtland's snake, Barbour's map turtle, Escambia map turtle, and Pascagoula map turtle have a NatureServe conservation status of G2, with State rankings varying from possibly extirpated, to S1, to S2. The black-knobbed map turtle has a NatureServe ranking of G3. The Alabama map turtle has a NatureServe ranking of G4, but State rankings vary from S1 to S3. The Florida Keys mole skink and Lower Florida Keys eastern ribbonsnake are given a NatureServe global ranking of T1. The western chicken turtle is considered secure by NatureServe with a global ranking of T5. The Lower Florida Keys striped mud turtle and the Florida Panhandle population of the Florida red-bellied turtle are given a T2 NatureServe ranking. We proposed to list the striped mud turtle as endangered on May 19, 1978 (43 FR 21702) but never finalized the listing. The species was placed on the category 2 candidate list on December 30, 1982 (47 FR 58454). The northern red-bellied cooter is given a NatureServe ranking of G4 or apparently stable with State rankings ranging from S2 (imperiled) to S5 (stable). In addition to the striped mud turtle, Kirtland's snake, Florida Keys mole skink, and Barbour's map turtle were each prior Federal category 2 candidate species. The black-knobbed map turtle was a prior category 3C candidate species (taxa that were proven to be more widespread than was previously believed and/or those that were not subject to any identifiable threat).

The petition identified 44 snails and requested that they be added to the List, of which 43 are subjects of this finding, including the following: Manitou cavesnail (Antrorbis breweri), Blue Spring hydrobe snail (Aphaostracon asthenes), freemouth hydrobe snail (Aphaostracon chalarogyrus), Wekiwa hydrobe snail (Aphaostracon monas), dense hydrobe snail (Aphaostracon pycnus), Clifton Spring hydrobe snail (Aphaostracon theiocrenetum), acute elimia (Elimia acuta), mud elimia (Elimia alabamensis), ample elimia (Elimia ampla), Lilyshoals elimia (Elimia annettae), spider elimia (Elimia arachnoidea), princess elimia (Elimia bellacrenata),

walnut elimia (Elimia bellula), prune elimia (Elimia chiltonensis), cockle elimia (Elimia cochliaris), cylinder elimia (Elimia cylindracea), nodulose Coosa River snail (Elimia lachryma), round-rib elimia (Elimia nassula), caper elimia (Elimia olivula), engraved elimia (Elimia perstriata), compact elimia (Elimia showalteri), elegant elimia (Elimia teres), cobble elimia (Elimia vanuxemiana), Ichetucknee siltsnail (Floridobia mica), Enterprise siltsnail (Floridobia monroensis), pygmy siltsnail (Floridobia parva), Ponderosa siltsnail (Floridobia ponderosa), Wekiwa siltsnail (Floridobia wekiwae), spiny riversnail (Io fluvialis), Arkansas mudalia (Leptoxis arkansasensis), spotted rocksnail (Leptoxis picta), smooth mudalia (Leptoxis virgata), knobby rocksnail (Lithasia curta), helmet rocksnail (Lithasia duttoniana), Ocmulgee marstonia (Marstonia agarhecta), beaverpond marstonia (Marstonia castor), Ozark pyrg (Marstonia ozarkensis), magnificant rams-horn (Planorbella magnifica), corpulent hornsnail (Pleurocera corpulenta), shortspire hornsnail (Pleurocera curta), skirted hornsnail (Pleurocera pyrenella), domed ancylid (Rhodacme elatior), and reverse pebblesnail (Somatogyrus alcoviensis).

These 43 snails each maintain a NatureServe ranking of either G1, critically imperiled, or G2, imperiled. Several are previous Federal category 2 candidates, including the magnificent rams-horn, beaverpond marstonia, Ocmulgee marstonia, and the skirted hornsnail, until that category was discontinued in 1996.

The petition identified eight stoneflies and requested that they be added to the List, including the following: Virginia stone (Acroneuria kosztarabi), Sevier snowfly (Allocapnia brooksi), Smokies snowfly (Allocapnia fumosa), Karst snowfly (Allocapnia cunninghami), Tennessee forestfly (Amphinemura mockfordi), Louisiana needlefly (Leuctra szczytkoi), Smokies needlefly (Megaleuctra williamsae), and lobed roachfly (Tallaperla lobata). The Virginia stone and Karst snowfly are assigned a NatureServe global ranking of G1, critically imperiled. The Sevier snowfly, Smokies snowfly, Tennessee forestfly, Louisiana needlefly, Smokies needlefly, and lobed roachfly are assigned NatureServe global rankings of G2.

Lastly, the petition identified 76 vascular plants and requested that they be added to the List of Endangered and Threatened Plants, of which 75 are included in this finding, including the following: Aeschynomene pratensis (meadow joint-vetch), Alnus maritima (seaside alder), Amorpha georgiana var. georgiana (Georgia leadplant or Georgia indigo bush), Arnoglossum diversifolium (variable-leaved Indian-plantain), Balduina atropurpurea (purple balduina or purple disk honeycombhead), Baptisia megacarpa (Apalachicola wild indigo), Bartonia texana (Texas screwstem), Boltonia montana (Doll's daisy), Calamovilfa arcuata (rivergrass), Carex brysonii (Bryson's sedge), Carex impressinervia (impressed-nerved sedge), Coreopsis integrifolia (ciliate-leaf tickseed), Croton elliottii (Elliott's croton), Elytraria caroliniensis var. angustifolia (narrowleaf Carolina scalystem), Encyclia cochleata var. triandra (Clam-shell orchid), Epidendrum strobiliferum (Big Cypress epidendrum), Eriocaulon koernickianum (small-headed pipewort), Eriocaulon nigrobracteatum (black-bracked pipewort), Eupatorium paludicola (a thoroughwort), Eurybia saxicastellii (Rockcastle wood-aster), Fimbristylis perpusilla (Harper's fimbristylis), Forestiera godfreyi (Godfry's privet), Hartwrightia floridan (Hartwrightia), Helianthus occidentalis ssp. plantagineus (Shinner's sunflower), Hexastylis speciosa (Harper's heartleaf), Hymenocallis henryae (Henry's spider-lily), Hypericum edisonianum (Edison's ascyrum), Hypericum lissophloeus (smooth-barked St. John's-wort), Illicium parviflorum (yellow anisetree), Isoetes hyemalis (winter or evergreen quillwort), Isoetes microvela (thin-wall quillwort), Lilium iridollae (panhandle lily), Lindera subcoriacea (bog spicebush), Linum westii (West's flax), Lobelia boykinii (Boykin's lobelia), Ludwigia brevipes (Long Beach seedbox), Ludwigia spathulata (spathulate seedbox), Ludwigia ravenii (Raven's seedbox), Lythrum curtissii (Curtis's loosestrife), Lythrum flagellare (lowland loosestrife), Macbridea caroliniana (Carolina birds-in-a-nest), Marshallia grandiflora (Large-flowered Barbara's-buttons), Minuartia godfreyi (Godfrey's stitchwort), Najas filifolia (narrowleaf naiad), Nufar lutea ssp. sagittifolia (Cape Fear spatterdock or yellow pond lily), Nufar lutea ssp. ulvacea (West Florida cow-lily), Nyssa ursina (Bear tupelo or dwarf blackgum), Oncidium undulatum (Cape Sable orchid), Physostegia correllii (Correll's false dragonhead), Potamogeton floridanus (Florida pondweed), Potamogeton tennesseensis (Tennessee pondweed), Ptilimnium ahlesii (Carolina bishopweed), Rhexia parviflora (small-flower meadow-beauty), Rhexia salicifolia (panhandle meadow-beauty), Rhynchospora crinipes (hairy-peduncled beakbush),

Rhynchospora thornei (Thorne's beakbush), Rudbeckia auriculata (eared coneflower), Rudbeckia heliopsidis (sun-facing coneflower), Salix floridana (Florida willow), Sarracenia purpurea var. montana (mountain purple pitcherplant), Sarracenia rubra ssp. gulfensis (Gulf sweet pitcherplant), Sarracenia rubra ssp. wherryi (Wherry's sweet pitcherplant), Schoenoplectus hallii (Hall's bulrush), Scuttelaria ocmulgee (Ocmulgee skullcap), Sideroxylon thornei (swamp buckhorn or Georgia bully), Solidago arenicola (southern racemose goldenrod), Sporobolus teretifolius (wire-leaved dropseed), Stellaria fontinalis (water stitchwort), Symphyotrichum puniceum var. scabricaule (rough-stemmed aster), Thalictrum debile (southern meadowrue), Trillium texanum (Texas trillium), Tsuga caroliniana (Carolina hemlock), Vicia ocalensis (Ocala vetch), Waldsteinia lobata (lobed barren-strawberry), and Xyris longisepala (Kral's yellow-eyed grass). One of the species petitioned, Solidago plumosa (Yadkin River goldenrod), is already a current Federal candidate species and is, therefore, not considered in this finding.

On December 11, 2010, the Service received a second petition from Wild South to list Tsuga caroliniana (Carolina hemlock) as endangered under the Act and to designate critical habitat. On December 20, 2010, we provided a response to the petitioners acknowledging receipt of the petition and identifying it as a supplementary petition as Tsuga caroliniana was also included in the CBD petition to list 404 southeastern U.S. species. Wild South provided additional information on the species' life history, status and threats.

Of the 75 vascular plants identified above, 46 held previous Federal candidate status, prior to 1996 and the discontinuance of the category 2 and 3C classifications. These include the following: Alnus maritima (seaside alder), Amorpha georgiana var. georgiana (Georgia leadplant or Georgia indigo bush), Balduina atropurpurea (purple balduina or purple disk honeycombhead), Baptisia megacarpa (Apalachicola wild indigo), Bartonia texana (Texas screwstem), Calamovilfa arcuata (rivergrass), Carex impressinervia (impressed-nerved sedge), Croton elliottii (Elliott's croton), Elytraria caroliniensis var. angustifolia (narrowleaf Carolina scalystem), Eriocaulon koernickianum (small-headed pipewort), Fimbristylis perpusilla (Harper's fimbristylis), Hartwrightia floridan (Hartwrightia), Hexastylis speciosa (Harper's heartleaf), Hymenocallis henryae (Henry's spider-lily), Hypericum edisonianum (Edison's ascyrum), Hypericum lissophloeus (smooth-barked St. John's-wort), Illicium parviflorum (yellow anisetree), Lilium iridollae (panhandle lily), Lindera subcoriacea (bog spicebush), Linum westii (West's flax), Lobelia boykinii (Boykin's lobelia), Lythrum curtissii (Curtis's loosestrife), Lythrum flagellare (lowland loosestrife), Macbridea caroliniana (Carolina birds-in-a-nest), Marshallia grandiflora (Large-flowered Barbara's-buttons), Minuartia godfreyi (Godfrey's stitchwort), Najas filifolia (narrowleaf naiad), Nufar lutea ssp. ulvacea (West Florida cow-lily), Nyssa ursina (Bear tupelo or dwarf blackgum), Physostegia correllii (Correll's false dragonhead), Potamogetan floridanus (Florida pondweed), Rhexia parviflora (small-flower meadow-beauty), Rhexia salicifolia (panhandle meadow-beauty), Rhynchospora crinipes (hairy-peduncled beakbush), Rhynchospora thornei (Thorne's beakbush), Rudbeckia auriculata (eared coneflower), Rudbeckia heliopsidis (sun-facing coneflower), Salix floridana (Florida willow), Sarracenia rubra ssp. wherryi (Wherry's sweet pitcherplant), Scuttelaria ocmulgee (Ocmulgee skullcap), Sporobolus teretifolius (wire-leaved dropseed), Stellaria fontinalis (water stitchwort), Thalictrum debile (southern meadowrue), Trillium texanum (Texas trillium), Vicia ocalensis (Ocala vetch), Waldsteinia lobata (lobed barren-strawberry), and Xyris longisepala (Kral's yellow-eyed grass). The NatureServe global ranking of these 75 species ranges from subspecies T1, to T2, to T3 status and species G1, to G2, to G3, and G4.

Evaluation of Information for This Finding

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations at 50 CFR 424 set forth the procedures for adding a species to, or removing a species from, the Lists of Endangered and Threatened Wildlife and Plants (Lists). A species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1) of the Act:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;
(D) The inadequacy of existing regulatory mechanisms; or
(E) Other natural or manmade factors affecting its continued existence.
Listing actions may be warranted based on any of the above factors, singly or in combination.
In considering what factors might constitute threats, we must look beyond the mere exposure of the species to the factor to determine whether the species responds to the factor in a way that causes actual impacts to the species. If there is exposure to a factor, but no response, or only a positive response, that factor is not a threat. If there is exposure and the species responds negatively, the factor may be a threat and we then attempt to determine how significant a threat it is. If the threat is significant, it may drive or contribute to the risk of extinction of the species such that the species may warrant listing as endangered or threatened as those terms are defined by the Act. This does not necessarily require empirical proof of a threat. The combination of exposure and some corroborating evidence of how the species is likely impacted could suffice. The mere identification of factors that could impact a species negatively may not be sufficient to compel a finding that listing may be warranted. The information shall contain evidence sufficient to suggest that these factors may be operative threats that act on the species to the point that the species may meet the definition of endangered or threatened under the Act.
In making this 90-day finding, we evaluated whether information regarding threats to the 374 species, as presented in the petition and other information available in our files, is substantial, thereby indicating that listing any of the species in the petitioned action may be warranted. Our evaluation of this information is presented below. Our review of the species varied significantly depending on the amount of information presented in the petition and the amount of information available in our files. Because so little information was available in our files for many of these rare, locally endemic species, the information below summarizes only the information in the petition, unless noted otherwise.
Factor A. The Present or Threatened Destruction, Modification, or Curtailment of the Species' Habitat or Range
The petition states that all species, except for one (Oncidium undulatum, Cape Sable orchid) identified in the petition are threatened by the present or threatened destruction, modification, or curtailment of their habitat or range. According to the petition, aquatic and riparian habitats in the Southeast have been extensively degraded by direct alterations of waterways such as impoundment, diversion, dredging and channelization, and draining of wetlands, and by land-use activities such as development, agriculture, logging, and mining (Benz and Collins 1997; Shute et al. 1997). More than one-third of the petitioned species have experienced drastic range reductions, and up to a 90 percent range loss for many of the petitioned mussels and snails (Pyne and Durham 1993; Neves et al. 1997; NatureServe 2008). According to the petition, because many of the aquatic species in the Southeast are very narrow endemics or have experienced a dramatic range reduction, remaining populations are now susceptible to extinction from even relatively minor habitat losses (Herrig and Shute 2002). The petition asserts that habitat loss and degradation are driving the decline of reptiles, mollusks, and other aquatic taxa. Buhlman and Gibbons (1997) found that 36 percent of analyzed imperiled aquatic reptiles are threatened because of the "continuing, cumulative abuse sustained by river systems," and that at least 22 southeastern reptile taxa have declined due to degradation of rivers and streams. Habitat degradation and fragmentation is also asserted to be the primary cause of imperilment for southeastern mollusks (Neves et al. 1997; Lysne et al. 2008); mammals (Harvey and Clark 1997); fish (Warren et al. 1997); and plants (Stein et al. 2000).
Physical Alteration of Aquatic Habitats
Impoundment
According to the petition, nearly half of the petitioned species are threatened by impoundment, including 83 percent of the fishes and 67 percent of the mollusks. Dams modify habitat and aquatic communities both upstream and downstream of the impoundment (Winston et al. 1991; Mulholland and Lenat 1992; Soballe et al.

1992). Upstream of dams, habitat is flooded and in-channel conditions change from flowing to still water, with increased depth, decreased levels of dissolved oxygen, and increased sedimentation. Sedimentation alters substrate conditions by filling in interstitial spaces between rocks, which provide habitat for many species (Neves et al. 1997). Downstream of dams, flow regime fluctuates (with resulting fluctuations in water temperature and dissolved oxygen levels), the substrate is scoured, and downstream tributaries are eroded (Schuster 1997; Buckner et al. 2002). Negative "tailwater" effects on habitat extend many kilometers downstream (Neves et al. 1997). Dams fragment habitat of aquatic species by blocking corridors for migration and dispersal, resulting in population isolation and heightened susceptibility to extinction (Neves et al. 1997). Dams also preclude aquatic organisms from escaping polluted waters and accidental spills (Buckner et al. 2002).

As of the early 1990s, there were 144 major reservoirs in the Southeast, including 26 in Tennessee, 19 each in Alabama and North Carolina, and 17 in Kentucky (Soballe et al. 1992). There are 36 dams on the mainstem and major tributaries of the Tennessee River (Neves et al. 1997), resulting in the impoundment of more than 20 percent of the Tennessee River and its major tributaries (Shute et al. 1997). The Tennessee and Cumberland River drainages have approximately 70 major dams and reservoirs (Buckner et al. 2002). Waterways in Alabama have also been extensively impounded, with 16 major lock and dam structures on six rivers, 21 hydroelectric power dams, and over 20 public water supply impoundments (Buckner et al. 2002). The Coosa and Tallapoosa Rivers in Georgia and Alabama have been ranked among the most imperiled rivers in the nation due to damming (Buckner et al. 2002).

The petition asserts that, in addition to rivers, damming of streams and springs is also extensive throughout the Southeast (Etnier 1997; Morse et al. 1997; Shute et al. 1997). Noss et al. (1995) reports that practically every stream in the Mississippi Alluvial Plain has been channelized, levied, or hydrologically altered. Small streams on private lands are regularly dammed to create ponds for cattle, for irrigation, for recreation, and for fishing, with significant ecological effects due to the sheer abundance of these structures (Morse et al. 1997).

In Florida and other Southeast States, impoundment of large coastal tributaries has severely curtailed fish spawning runs (Gilbert 1992). Impoundment blocks migratory routes of fish and covers spawning habitat with silt (Etnier 1997). According to the petitioners, dams and the resultant substrate changes have imperiled disproportionately high numbers of benthic fishes (Warren et al. 1997).

Changes in the fish community jeopardize the survival of mussels because mussels are dependent on host fish to successfully reproduce, with some species of mussels being dependent on specific species of fish (Bogan 1993, 1996). If the fish species upon which a mussel is dependent to host its larvae goes extinct, then the mussel becomes "functionally extinct," even when there are surviving long-lived individuals (Bogan 1993). Impoundments can also separate mussel populations from host fish populations, resulting in the eventual extinction of the mussel species (Bogan 1993, 1996). The loss of mussels can in turn negatively affect fish, because some species of fish use empty mussel shells as nest sites (Bennett et al. 2008).

The petition claims that impoundments are also one of the primary reasons for the decline in crustaceans in the Southeast (Schuster 1997), in aquatic insects (Herrig and Shute 2002), and in forest-associated bird species, particularly for species with narrow niches and low tolerance to disturbance (Dickson 2007).

Dredging and Channelization

According to the petition, dredging and channelization are extensively employed throughout the Southeast for flood control, navigation, sand and gravel mining, and conversion of wetlands into croplands (Neves et al. 1997; Herrig and Shute 2002). Many rivers are continually dredged to maintain shipping channels (Abell et al. 2002). Dredging and channelization modify and destroy habitat for aquatic species by destabilizing the substrate, increasing erosion and siltation, removing woody debris, decreasing habitat heterogeneity, and stirring up contaminants that settle onto the substrate (Hart and Fuller 1974; Williams et al. 1993; Buckner et al. 2002; Bennett et al. 2008). Channelization can also lead to headcutting, sedimentation, and actual removal of mussels

from their beds during dredging operations (Hart and Fuller 1974; Williams et al. 1993).
The petition also claims that dredging and channelization also threaten imperiled fish, reptiles, crustaceans, and other species. Dredging removes woody debris, which provides cover and nest locations for fish such as the frecklebelly madtom (Bennett et al. 2008). Flood control projects and channel maintenance operations in Mississippi threaten aquatic species in the Yazoo Basin (Jackson et al. 1993), including the petitioned Yazoo crayfish. Dredging and channelization are also known to be the primary reason for imperilment of southeastern crustaceans (Schuster 1997), and to contribute to the decline of southeastern turtles (Buhlmann and Gibbons 1997). Many of the imperiled turtle species, including the highly imperiled map turtles, are threatened by the removal of woody debris, on which they depend for basking.
Water Development and Diversion and Decreased Water Availability
According to the petition, in the Southeast, demands for freshwater for electricity production, irrigation, agriculture, and industrial and residential development are increasing (Herrig and Shute 2002; Hutson et al. 2005; Lysne et al. 2008). Limited water supply is already a source of conflict in Tennessee, Alabama, and Georgia in particular, where rapidly growing metropolitan areas such as Atlanta, Birmingham, and Nashville have drastically increased the demand for water for residential and industrial uses (Buckner et al. 2002). The construction of numerous large Confined Animal Feeding Operations throughout the Southeast has led to an increased demand for inter-basin water transfers (Buckner et al. 2002). Increasing drought due to global climate change is expected to exacerbate the threat of limited water availability to aquatic and riparian species in southeastern States (Karl et al. 2009). Water demands to support gas-fired steam plants for electricity generation have increased in the Southeast. These plants require millions of gallons of water per day, and return only roughly one-fifth of that water back to the waterways, and even this water tends to be thermally polluted and may be inadequate to meet the dissolved oxygen needs of aquatic species (Buckner et al. 2002).
The petition also asserts that surface diversion of streams threatens southeastern aquatic species (Etnier 1997; Abell et al. 2000; Buckner et al. 2002; Herrig and Shute 2002), and that an increasing threat to southeastern species is the growing practice of damming small headwater streams to supply water for municipalities (Buckner et al. 2002). Water withdrawals reduce base flows, decreasing habitat availability for aquatic species, and the reduced water volume also increases the concentration of pollutants, posing another threat to species (Abell et al. 2000; Herrig and Shute 2002).
According to the petition, in addition to rivers and streams, many southeastern springs have been drastically altered to supply water for human uses (Etnier 1997). Spring development and diversion can alter flow regime and water quality parameters, lead to substrate disturbance and erosion, and alter the substance and composition of vegetative cover with resultant effects on freshwater fauna (Shepard 1993; Frest and Johannes 1995; Frest 2002). An additional threat to southeastern species is groundwater overdraft (pumpage of groundwater in excess of safe yields), which threatens spring flow and species that are dependent on consistent spring flow conditions (Strayer 2006). The petitioners also assert that the dewatering of groundwater systems in the Southeast threatens rare species of isopods, amphipods, fish, crayfish, and amphibians that are dependent on stable spring and cave environments (Herrig and Shute 2002).
Loss of Wetlands
According to the petition, through the mid-1980s, wetlands were lost in the Southeast as a rate of over 385,000 acres per year (Hefner and Brown 1984). In Florida alone, more than 9 million acres of wetlands had been lost by that time (Cerulean 1991). In Arkansas 6 million acres of Mississippi Delta wetlands had been converted to agricultural use by the mid-1980s (Smith et al. 1984). In the Lower Mississippi Valley Region, more than one-third of existing wetlands were destroyed from 1950 to 1970 (Mitsch and Gosselink 1986), with over 185,000 acres of wetlands continuing to be lost annually through the mid-1980s in this region (Tiner 1984). In Tennessee, up to 90 percent of upland wetlands on the Highland Rim have been destroyed, as have more than 90 percent of Appalachian bogs in the Blue Ridge Province (Pyne and Durham 1993). The destruction of

pocosins (evergreen shrub bogs) has been extensive throughout the Southeast, with greater than 90 percent loss in Virginia, nearly 70 percent loss in North Carolina, and nearly 70 percent loss on the Southeastern Coastal Plain (Noss et al. 1995).

The petition asserts that loss, degradation, and fragmentation of wetland habitat have negatively affected numerous southeastern freshwater species, and natural wetland habitats continue to be lost, placing more species at risk (Dodd 1990; Benz and Collins 1997; Semlitsch and Bodie 1998; Herrig and Shute 2002). Vegetated permanent wetlands are among the most jeopardized habitats in the Southeast, with the result that fish families that are dependent on these habitats are disproportionately imperiled, such as the pygmy sunfishes (Etnier and Starnes 1991; Cubbage and Flather 1993; Dickson and Warren 1994; Warren et al. 1994). According to petitioners, wetland destruction has also destroyed habitat for many bird species (Dickson 1997); aquatic reptile species that depend on standing water habitats (Herrig and Shute 2002),; and amphibians (LaClaire 1997), such as the Gulf Hammock dwarf siren (Amphibia Web 2009). Because many reptile and amphibian populations exist as metapopulations that rely on habitat connectivity to maintain genetic structure and provide recolonization opportunities in the event of localized extirpations, habitat fragmentation and isolation threaten their regional persistence by cutting off opportunities for migration and dispersal and by magnifying the likelihood of inbreeding depression and reproductive failure due to random environmental perturbation (Buhlmann and Gibbons 1997; Semlitsch and Bodie 1998).

Land Use Activities That Decrease Watershed Integrity

The petition asserts that southeastern aquatic species are threatened not only by direct physical alteration of waterways, but also by activities in the watershed that directly or indirectly degrade aquatic habitats such as residential, commercial, and industrial development; agriculture; logging; mining; alteration of natural fire regime; and recreation. Land use activities can alter water chemistry, flow, temperature, and nutrient and sediment transport, and can interfere with normal watershed functioning (Folkerts 1997).

Residential and Industrial Development and Human Population Growth

According to the petition, development threatens two-thirds of the petitioned species. The primary threat to the petitioned dragonfly, the purple skimmer, is lakeshore development. The Waccamaw fatmucket, a petitioned mussel, is threatened primarily by increasing development in its watershed. Also, according to the petition, the Carolina pygmy sunfish, Chauga crayfish, and many other petitioned species are also threatened primarily by development.

The human population nearly doubled in the Southeast between 1970 and 2000 (Folkerts 1997). Southeastern states continued to experience significant human population growth from 2000 to 2007, with the population of Georgia increasing by 17 percent, Florida by 14 percent, North Carolina by 13 percent, South Carolina by 10 percent, Virginia by 9 percent, and Tennessee by 8 percent (U.S. Census Bureau 2009). Metropolitan areas in the Southeast are among the fastest growing in the nation (Dodd 1997).

Population growth threatens biodiversity through an increased demand for food, water, and other resources. The strong geographic focus of development around freshwaters concentrates human ecological impacts on freshwater ecosystems more than on any other part of the landscape (Strayer 2006). Throughout the Southeast, increased development is creating water supply problems, stressing available water resources, and polluting aquatic habitats (Seager et al. 2009). Global climate change is expected to lead to fluctuating water supplies in the Southeast, and in conjunction with increasing human demand for freshwater, to place many aquatic at heightened risk of extinction (Karl et al. 2009).

The petition asserts that urbanization and residential, commercial, and industrial development threaten aquatic species in both direct and indirect ways. Habitat is directly lost and fragmented through land conversion and through water withdrawal and diversion (Benz and Collins 1997). Predation increases as populations of pets and synanthropic species ecologically associated with humans increase (Marzluff et al. 2001). Point-source pollution from industry and runoff from parking lots, roofs, roads, and lawns degrade water quality and have

lethal and sub-lethal effects on aquatic species. Urban runoff is associated with declines in macroinvertebrate diversity and with decreased mussel growth rates, and urban land use classes are associated with impairment of fish and macroinvertebrate communities (Soucek et al. 2003; Carlisle et al. 2008). Amphibians and reptiles are particularly threatened by development. Siltation and leachate from road runoff can be lethal to larval amphibians and other aquatic organisms (Dodd 1997). The construction of roads increases mortality and leads to population isolation and the disruption of the metacommunity structure on which the long-term population persistence of many herptile species depends (Buhlman and Gibbons 1997). Noise and light from roads and developments can interfere with behavior patterns and disrupt breeding and feeding activities, particularly for amphibians (Dodd 1997). Amphibian species' richness is lower in urbanized areas, as many species cannot persist in urbanized sites (Delis 1993; Herrig and Shute 2002).

According to the petition, habitat loss and degradation due to development is generally permanent and poses an increasing threat to southeastern aquatic species. Folkerts (1997) reports that particularly in the Southeast, development threatens aquatic species more than in other areas due to lax enforcement of environmental laws in the region.

Recreation

According to the petition, the increased human population is increasing the demand for recreational developments and activities. Housing developments, strip malls, and resorts are being constructed in very rural areas, and small towns are now burgeoning in previously undeveloped areas in the Southeast including, the Knoxville-Chattanooga suburban corridor, on the Cumberland Plateau, in the Cahaba River headwaters outside Birmingham, and in the Mobile-Tensaw Delta (Buckner et al. 2002). Many rapidly developing small communities are constructing dams on headwater streams, often in areas that were recently remote and inaccessible, with resultant impacts on aquatic species (Buckner et al. 2002). The development of housing and recreational facilities on lakeshores and in riparian areas results in the degradation of water quality and aquatic habitat (Tennessen 1997). For example, Morse et al. (1997) report the loss of rare stonefly species in a stream in North Carolina following the development of summer homes.

The petition asserts that recreational developments and activities threaten aquatic species by fostering air and water pollution, litter, and potentially high densities of recreationists (Houston 1971; White and Bratton 1980). Recreation can cause trampling of organisms and vegetation (Little 1975). Local habitat changes caused by trampling include simplification of vegetation and soil compaction, which can result in overall loss of habitat diversity (Speht 1973; Liddle 1975). Off-road vehicle use can lead to severe degradation of aquatic and riparian habitats through trampling of organisms, destruction of vegetation, erosion, and degraded water quality (Wuerthner 2007). According to the petitioners, off-road vehicle use threatens imperiled mussels (Hanlon and Levine 2004) and reptiles (Herrig and Shute 2002). Southeastern aquatic species are also alleged by the petitioners to be threatened by other forms of motorized recreation, such as motorized boats and jet skis, which cause oil and gas contamination and bank erosion (Buckner et al. 2002). Garber and Burger (1995) also document the extirpation of a turtle population in a protected area due to occasional poaching.

Decreased water quality, trampling, or other recreational impacts purportedly threaten 22 percent of the petitioned species including the Bigcheek cave crayfish, Blue Spring hydrobe snail, and small-flower meadow-beauty.

Logging

The petition asserts that southeastern aquatic and riparian species are threatened by the loss of forests and the negative effects of these losses on water quality and aquatic habitats that result from logging activities and canopy removal. The Southeast now supplies nearly 70 percent of the nation's pulp and paper products (Buckner et al. 2002). According to Folkerts (1997), the rate of deforestation in the Southeast at that time exceeded that of any tropical area of comparable size. The Tennessee, Cumberland, and Mobile basins have experienced a drastic increase in large clearcutting operations and chip mills, with 1.2 million acres of forest

being cut annually to supply 150 regional chip mills, two-thirds of which have been built since the 1980s (Buckner et al. 2002). In the area surrounding Great Smoky Mountain National Park, the rate of logging doubled from 1980 to 1990 (Folkerts 1997). Of the 70 million acres of longleaf pine forest which once covered over 40 percent of the Southeastern Coastal Plain, only 1 to 2 percent remains, and the remnant acreage is fragmented and "poorly-managed" (Noss et al. 1995; Dodd 1997). Clearcutting on the Coastal Plain has affected "virtually every aquatic habitat in the area" (Folkerts 1997).

According to the petition, logging has many direct and indirect negative effects on aquatic biota across taxa. Erosion from poor forestry practices degrades water quality (Williams et al. 1993). Increased sedimentation from logging can suffocate aquatic snails and their eggs, preclude their ability to feed, and extirpate populations (Frest and Johannes 1993). Increased sedimentation is also harmful to freshwater mussels (Neves et al. 1997). Clearcutting and conversion of deciduous forests to pine plantations increases sedimentation and reduces the input of large woody debris and leaf litter into streams, which are necessary to provide microhabitat and food for aquatic organisms (Morse et al. 1997; Herrig and Shute 2002). Clearcutting can lead to the disappearance of caddisflies and mayflies, with ramifications at higher levels of the food web (Morse et al. 1997). Amphibian diversity and abundance is reduced by clearcutting and the conversion of deciduous forests to pine plantations (Dodd 1997; Herrig and Shute 2002). Aquatic-breeding amphibians, which depend on ephemeral ponds or which are dependent on forested habitats to complete their life cycle or both, are particularly threatened by logging activities (Dodd 1997). Herbicides used after timber harvests also negatively affect amphibians and other aquatic organisms (Dodd 1997; Herrig and Shute 2002).

According to the petition, 51 percent of the petitioned species are threatened by logging. Logging is the primary threat to the newly discovered patch-nosed salamander, and to many of the petitioned crayfishes, including the Irons Fork burrowing crayfish, Kisatchie painted crayfish, and pristine crayfish. The petitioners assert that logging also threatens the petitioned dragonflies, including Westfall's clubtail and the Ozark emerald.

Agriculture and Aquaculture

According to the petition, southeastern aquatic species are also threatened by the loss and degradation of habitat due to poor agricultural practices. Intensive agriculture began in the Southeast in the 1930s, and agriculture continues to extensively impact southeastern aquatic ecosystems (Neves et al. 1997). The petitioners assert that agriculture in the Southeast has a tremendous impact on aquatic habitats both due to the extent of farmland and to farming practices (Buckner et al. 2002; Herrig and Shute 2002). In the Tennessee, Cumberland, and Mobile River basins, for example, farms cover nearly half the landscape. Throughout the Southeast, fields are commonly plowed to the edges of waterways, causing sedimentation and bank collapse and facilitating the runoff of fertilizers and pesticides (Buckner et al. 2002). Both traditional farming practices and confined animal feeding operations contribute to water quality degradation and the imperilment of indigenous biota in the Southeast through erosion, sedimentation, and chemical and nutrient pollution from point and non-point sources (Patrick 1992; Morse et al. 1997; Neves et al. 1997; Herrig and Shute 2002).

According to the petition, 50 percent of the petitioned species are threatened by conversion of their habitat to agricultural use or by agricultural runoff, including the striated darter, Logan's agarodes caddisfly, Sevier snowfly, and Tennessee clubtail. Agricultural land uses have been associated with impairment of fish and macroinvertebrate communities (Herrig and Shute 2002), communities of freshwater mollusks (Williams et al. 1993; Neves et al. 1997), and threats to imperiled amphibians (Herrig and Shute 2002).

Many of the petitioned species are allegedly threatened from confined animal feeding operations (CAFOs), including the Carolina madtom, corpulent hornsnail, and the Neuse River waterdog. Confined animal feeding operations and feedlots have caused extensive degradation of southeastern aquatic ecosystems (Neves et al. 1997; Buckner et al. 2002; Mallin and Cahoon 2003). The number of CAFOs in the Southeast has increased drastically since 1990, as livestock production has undergone extensive industrialization (Buckner et al. 2002; Mallin and Cahoon 2003). Alabama and Arkansas are now the nation's leading poultry producers, with Florida,

Georgia, and Kentucky also among the top 10 States for poultry production (U.S. Census Bureau 2009). Poultry CAFOs are also abundant in North Carolina, Mississippi, and Virginia (Mallin and Cahoon 2003). There are extensive swine CAFOs in the North Carolina Coastal Plain, and North Carolina is now the nation's second largest pork producer (Mallin and Cahoon 2003; U.S. Census Bureau 2009). Confined animal feeding operations threaten aquatic species both because of the vast amounts of fresh water necessary to support their operation and due to pollution (Buckner et al. 2002). Confined animal feeding operations house thousands of animals and produce a large amount of waste, which enters the environment either by being directly discharged into streams or constructed ditches, stored in open lagoons, or applied to fields in wet or dry form (Buckner et al. 2002; Mallin and Cahoon 2003; Orlando et al. 2004). Confined animal feeding operation wastes contain nutrients, pharmaceuticals, and hormones, and result in eutrophication (a choking of waters by excessive algae growth which has been stimulated by fertilizers or sewage) of waterways, toxic blooms of algae and dinoflagellates, and endocrine disruption in downstream wildlife (Mallin and Cahoon 2002; Orlando et al. 2004).
Both livestock holding lots and landscape grazing degrade habitats in the Southeast, according to the petitioners (Buckner et al. 2002; Herrig and Shute 2002). Several southeastern States produce large amounts of cattle and horses feeding them via both grazing and holding lots (Buckner et al. 2002; U.S. Census Bureau 2009). Livestock are generally allowed to wade directly into streams, trampling habitat and resulting in erosion and nutrient contamination (Buckner et al. 2002). The effects of livestock grazing on stream and riparian ecosystems are well documented and include negative effects on water quality and quantity, channel morphology, hydrology, soils, instream and streambank vegetation, and aquatic and riparian wildlife (Belsky et al. 1999). According to Frest (2002), snails and their habitats are harmed through direct trampling, soil compaction, erosion, water siltation and pollution, and drying up of springs and seeps. The petitioners claim that 14 percent of the petitioned species are threatened by grazing, including the Virginia stone (stonefly), Barrens darter, Cherokee clubtail (dragonfly), and many plants, including the eared coneflower.
The petition alleges that aquaculture poses an additional threat to aquatic species in the Southeast. According to Tucker and Hargreaves (2003), catfish farming is the largest aquaculture enterprise in the United States, with 95 percent of production occurring in Alabama, Arkansas, Louisiana, and Mississippi. Similarly, crayfish farming in Louisiana is the nation's second largest aquaculture enterprise, with over 49,000 hectares of crayfish ponds (Holdich 1993). According to the petitioners, aquaculture threatens aquatic habitats through habitat conversion; the withdrawal, diversion, or impoundment of natural waterways to support operations; and the release of effluent to waterbodies (Naylor et al. 2001). Water quality degradation threatens southeastern aquatic insect populations (Herrig and Shute 2002). Impoundments and diversions alter water chemistry and flow, and can be detrimental to native mollusks and fishes (Morse et al. 1997; Neves et al. 1997). The construction of shrimp farms in wetlands and estuaries also destroys and degrades habitat for native aquatic species (Hopkins et al. 1995).

Mining and Oil and Gas Development

According to the petition, mining for coal, gravel, limestone, phosphate, iron, and other raw materials poses a dire threat to many aquatic species in the Southeast (Dodd 1997; Buckner 2002), and 29 percent of the petitioned species are threatened by mining and oil and gas development. Extensive strip mining for coal occurs in West Virginia, Kentucky, Virginia, Tennessee, and Alabama (Dodd 1997). As of 2004, more than 1.1 million acres of land in Appalachia were undergoing active mining operations (Loveland et al. 2003), and the EPA projects that from 1992 to 2013, 761,000 acres of Appalachian forest will be lost to surface coal mining (Pomponio 2009). Up to 23 percent of the land area of some counties in Kentucky and West Virginia has been permitted for surface coal mining (U.S. Government Accountability Office 2009). Mining increases the potential for extreme flooding events, and reclamation does not restore pre-mining hydrologic characteristics or ecological functions (Townsend et al. 2009).
Mining often occurs directly through streams or ponds, and mine wastes are pushed directly into streams and

rivers (Dodd 1997; EPA 2005). From 1992 to 2002, more than 1,200 miles of Appalachian streams were buried or degraded by mountaintop removal coal mining (EPA 2005). This figure does not incorporate the thousands of miles of downstream reaches that have been substantially degraded by sedimentation and chemical pollution from coal mining (Palmer and Bernhardt 2009; Pomponio 2009; Palmer et al. 2010). According to the petitioners, in the Clinch and Powell watersheds of southwestern Virginia, where the highest concentration of imperiled species in the continental United States occurs (Stein et al. 2000), there were 287 active coal-mining point source discharges as of 2002 (Diamond et al. 2002), which are degrading habitat for imperiled species (Ahlstedt et al. 2005). The petitioners allege that 30 of the petitioned species are specifically threatened by mountaintop removal.

Coal mining negatively impacts aquatic species through direct habitat destruction, decreased water availability, variations in flow and thermal gradients, and chronic and acute pollution of surface and ground water (FWS 1996; Neves et al. 1997; Houp 1993; Pond et al. 2008; Palmer and Bernhardt 2009; Pomponio 2009; Wood 2009; Palmer et al. 2010). Pollution from mining adversely impacts invertebrates and vertebrates, and leads to less diverse and more pollution-tolerant species (Naimo 1995; Cherry et al. 2001; EPA 2005; Lemly 2009; Pomponio 2009). The petitioners allege that surface coal mining and associated road building increase human access to imperiled species, which can lead to poaching and contribute to the spread of invasive species (FWS 1996). Surface coal mining also causes long-term changes in land use and local ecology, and threatens the long-term viability of populations due to habitat fragmentation (FWS 1996).

The petition alleges that coal mining negatively impacts diatoms (a major group of algae) and macroinvertebrates (Serveiss 2001; Locke et al. 2006; Carlisle et al. 2008; Pond et al. 2008), amphibian diversity and abundance (EPA 2005; Wood 2009; Palmer and Bernhardt 2009), and the index of fish biotic integrity (Diamond and Serveiss 2001). The petition states that coal mining is also reported to cause reproductive failure in riparian birds (Lemly 1985; Ohlendorf 1989).

According to the petition, other forms of mining and oil and gas development are also causing severe degradation of aquatic habitats: In-stream gravel mining and rock removal fragment and destroy habitat for aquatic insects, crayfish, mussels, and fish (Buckner et al. 2002); and sand and gravel mining have been associated with both on- and off-site mussel extirpation (Hartfield 1993), and with decreased downstream mussel growth rates (Yokley 1976). The petitioners allege that many species are threatened by sand and gravel mining, including the cobblestone tiger beetle, bluestripe darter, hellbender (salamander), and many mussels and snails. Historic phosphate and iron mines resulted in precipitous declines in mussel populations (Ortmann 1924). Mining of industrial minerals such as kaolin, mica, and feldspar also results in loss and degradation of habitat for aquatic species (Tennessee Valley Authority 1971; EPA 1977; Duda and Penrose 1980). The petition alleges that kaolin mining threatens the petitioned mussel, the Alabama spike, and the petitioned fish, the robust redhorse, and that oil and gas development threatens many of the petitioned mussels.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The petition stated that all 15 amphibians petitioned (13 of which are subjects of this finding) were threatened by overutilization for commercial, recreational, scientific, or educational purposes; in addition this factor threatens 1 beetle (Cobblestone tiger beetle), 2 birds (Florida sandhill crane and black rail), 1 butterfly (rare skipper), 1 crayfish (Big Blue Springs Cave crayfish), 2 dragonflies (Septima's clubtail and Appalachian snaketail), 5 fish (northern cavefish, Carolina pygmy sunfish, robust redhorse, orangefin madtom, and bluehead shiner), 6 mussels (brook floater, brother spike, Suwannee moccasinshell, Tennessee clubshell, warrior pigtoe, and pyramid pigtoe), 11 reptiles (Kirtland's snake, western chicken turtle, Florida Keys mole skink, Barbour's map turtle, Escambia map turtle, Pascagoula map turtle, black-knobbed map turtle, Alabama map turtle, striped mud turtle--lower Florida Keys, Florida red-bellied turtle--Florida panhandle, and northern red-bellied cooter), and 7 vascular plants (Baptisia megacarpa, Epidendrum strobiliferum, Hymenocallis henryae, Illicium parviflorum, Lilium iridollae, Oncidium undulatum, and Sarracenia purpurea var. montana).

The petition alleges overutilization is the primary threat for the hellbender salamander, which is commonly killed by fishermen. Collection for the pet trade threatens a few of the petitioned fishes, crayfishes, and amphibians. Historical overuse greatly threatened many of the petitioned mussels, fishes, and the Florida sandhill crane. Throughout the Southeast, reptiles are exploited for use as pets or food, or are killed for recreational purposes, which may all cause significant population declines. The petitioners allege that many southeastern turtle species, such as the Florida red-bellied turtle, Pascagoula map turtle, Barbour's map turtle, and black-knobbed map turtle, are threatened by over-collection because they are commonly harvested for food, the pet trade, or recreation. Several southeastern turtle species are being driven to extinction by unregulated commercial harvest. The petition alleges that the States of Arkansas, Kentucky, Georgia, Louisiana, and Tennessee allow unlimited harvest of freshwater turtles. The international trade in turtles for use as food, as pets, or in traditional medicine is extensive and largely unregulated (Buhlman and Gibbons 1997; Sarma 1999). Records indicate that the trade in live turtles from the United States to China is thousands of tons per year. The Tennessee Wildlife Resources Agency reports that more than 25,000 turtles were reported as harvested in Tennessee from 2006 to 2007. Overutilization of imperiled turtle species is especially problematic because the reproductive success of long-lived reptile species is dependent on high adult survivorship, and population declines occur when adults are harvested (Brooks et al. 1991; Heppell 1998; Pough et al. 1998; Congdon et al. 1993, 1994).

Over-collection and recreational killing are also a threat to some southeastern snake and lizard species (Gibbons et al. 2000; Herrig and Shute 2002). The Kirtland's snake, and the Florida Keys mole skink are all threatened by over collection (NatureServe 2008).

The petition alleges that southeastern mussels are also threatened by overutilization, although to a lesser extent than in the past (Neves et al. 1997). The harvest of southeastern mussels for commercial purposes is well documented (Anthony and Downing 2001; Williams et al. 2008). Mussels are collected for their pearls, meat, and shells, and many populations of mussels have been depleted by harvest in the last 200 years (Strayer 2006). Although mussel fisheries targeted abundant species, the historical bycatch of rare species was likely substantial (Strayer 2006). Mussel collections declined by mid-century, but a resurgence in the commercial harvest has occurred since the 1960s to supply nucleus seeds for the cultured pearl trade (Ward 1985; Williams et al. 1993). In 1991 and 1992, 570 tons of shells were harvested from the Wheeler Reservoir on the Tennessee River (Williams et al. 2008). Most harvested mussels are common species, but bycatch remains a threat to native mussels.

Imperiled native mussels are threatened not only by the amount of harvest, but also by the method used to collect shells, which when conducted non-selectively, can result in substantial bycatch of non-target species and juveniles (Williams et al. 1993). Although unwanted mussels are thrown back, Sickel (1989) found that mortality of undersized mussels that are thrown back may be as high as 50 percent. Very rare species of mussels are also threatened by over-collection from shell collectors and biologists for biological collections. Overutilization for biological collections may have contributed significantly to the decline of the Suwannee moccasinshell (NatureServe 2008).

Other southeastern taxa are also threatened by overexploitation, including fish, amphibians, crayfish, butterflies, and plants. Amphibians are threatened by over-collection for use as food, for the pet trade, and for the biological and medicinal supply markets (Dodd 1997; Amphibia Web 2009). Southeastern fish and crayfishes are vulnerable to overutilization. Crayfishes are threatened by collection for use as bait or food (Herrig and Shute 2002). The Carolina pygmy sunfish (Elassoma boelhkei) is threatened by over-collection for the pet trade (NatureServe 2008). Collection of invertebrates for bait or the pet trade can deplete populations (Strayer 2006). Collection also threatens the rare skipper (Problema bulenta) (NatureServe 2008). White et al. (2002) documented the removal of an entire population of Panhandle lily (Lilium iridollae) from the Conecuh National Forest by horticultural collectors.

The petition alleges that the impacts of overutilization compound the threats facing imperiled southeastern

species whose populations have already been reduced due to habitat loss or other factors. Overutilization may drive species that are already struggling to survive to extinction.

Factor C. Disease or Predation

The petition stated that disease or predation threatened 11 amphibians addressed in this finding (streamside salamander, one-toed amphiuma, hellbender, Cumberland dusky salamander, seepage salamander, Chamberlain's dwarf salamander, Oklahoma salamander, Tennessee cave salamander, West Virginia Spring salamander, Georgia blind salamander, and Neuse River waterdog), 3 birds (MacGillivray's seaside sparrow, Florida sandhill crane, and black rail), 8 fish (Carolina pygmy sunfish, candy darter, paleback darter, Shawnee darter, Barrens topminnow, robust redhorse, Carolina madtom, and bluehead shiner), 1 mammal (Sherman's short-tailed shrew), 6 mussels (Tennessee heelsplitter, Cumberland moccasinshell, Tennessee clubshell, Tennessee pigtoe, purple lilliput, and Savannah lilliput), 6 reptiles (Kirtland's snake, Barbour's map turtle, Escambia map turtle, Pascagoula map turtle, Florida red-bellied turtle, and northern red-bellied cooter), and 6 vascular plants (Lilium iridollae (Panhandle lily), Najas filifolia (narrowleaf naiad), Rudbeckia auriculata (eared coneflower), Schoenoplectus hallii (Hall's bulrush), Sideroxylon thornei (swamp buckhorn or Georgia bully), Tsuga caroliniana (Carolina hemlock)).

Disease

According to the petition, the spread of disease has contributed to the decline of aquatic species globally and in the southeastern United States (Daszak et al. 1999; Corser 2000; Gibbons et al. 2000; Cunningham et al. 2003). Amphibians, in particular, have been decimated by the spread of disease (Kiesecker et al. 2004). Numerous diseases are contributing to amphibian declines, including infections of fungi (Batrachochytrium dendrobatidis "chytrid"; Saprolegnia), ranavirises, iridovirises, mesomycetozoea, protozoa, helminthes, and undescribed diseases (Dodd 1997; Daszak et al. 1999; Briggs et al. 2005; Davis et al. 2007; Peterson et al. 2007). Chytrid fungus affects not only frogs but has also now been reported in both aquatic and terrestrial salamanders (Davidson et al. 2003; Cummer et al. 2005; Padgett-Flohr and Longcore 2007). The decline of map turtles, musk turtles, snapping turtles, and pond turtles is partially attributable to disease (Dodd 1988; Buhlmann and Gibbons 1997). Southeastern freshwater fishes are also threatened by diseases, which are being spread by aquaculture operations and in shipments between fish hatcheries (Kautsky et al. 2000; Naylor et al. 2001; Strayer 2006; Green and Dodd 2007).

The petition alleges that other threats exacerbate the vulnerability of southeastern aquatic fauna to disease and population decline. The hellbender, which is threatened by both habitat loss and overuse, is also threatened by disease. Reptile declines have also been attributed to disease (Diemer Berish et al. 2000; Gibbons et al. 2000). In freshwater fishes, stress-related diseases are prevalent in polluted rivers, where chronic, sub-lethal pollution has increased the susceptibility of organisms to infection (Moyle and Leidy 1992).

Predation

According to the petition, predation threatens several of the petitioned species, including reptiles, amphibians, birds, plants, fishes, crayfishes, and mollusks. Heavy predation of turtle nests by raccoons can be a primary factor limiting recruitment of imperiled turtle populations (Browne and Hecnar 2007). At least two of the petitioned bird species are threatened by predation. MacGillivray's seaside sparrow is threatened by predation from rice rats (Post and Greenlaw 1994). The black rail is threatened from predation from various species during high tides, when the rails are forced away from cover (Evans and Page 1986). Two of the petitioned plant species are threatened by predation. Hall's bulrush is threatened by predation from mute swans and Canada geese (McKenzie et al. 2007). The Panhandle lily is threatened by predation from cattle grazing and potentially by insect herbivory (Barrows 1989). Southeastern fishes, amphibians, and crayfishes are threatened by predation from native and nonnative fishes and crayfishes (NatureServe 2008). The streamside salamander is threatened by predation from fish, flatworms, and water snakes (Petranka 1983; AmphibiaWeb 2009). Predation can contribute heavily to the decline of imperiled mussels because of their restricted distributions and small

population sizes (NatureServe 2008, Rock pocketbook species account). Imperiled southeastern mussels are threatened by predation from fishes, muskrats, raccoons, otter, mink, turtles, and some birds (Neves and Odom 1989; Parmalee 1967; Snyder and Snyder 1969). A number of fish species, including catfishes (Ictalurus ssp. and Amieurus ssp.) and freshwater drum (Aplodinotus grunniens) consume large numbers of unionid mussels at certain life stages (NatureServe 2008). As populations of imperiled mussels continue to decline, predation becomes an increasing threat. For example, the only viable population of the Savannah lilliput in North Carolina is threatened by predation from raccoons (Hanlon and Levine 2004). According to the petition, the petitioned fish, Barrens topminnow, is threatened by predation from introduced mosquitofish.

Disease and predation, alone and in conjunction with other factors, pose serious threats to the survival of many of the petitioned species and are magnified by other environmental stressors such as habitat loss, pollution, invasive species, and climate change (Gibbons et al. 2000; Pounds et al. 2006).

Factor D. The Inadequacy of Existing Regulatory Mechanisms

The petition states that inadequate regulatory mechanisms threaten all the petitioned species, with the following five exceptions: Linda's roadside-skipper, least crayfish, Broad River spiny crayfish, Chowanoke crayfish, and Tallapoosa orb.

Inadequacy of Existing Federal Regulatory Mechanisms

According to the petition, the Federal Clean Water Act (CWA) (33 U.S.C. 1251 et seq.) provides a basic level of water quality protection for imperiled southeastern species, but is inadequate to ensure their continued survival. Pollution from point and non-point sources is causing ongoing degradation of water quality, current water quality standards are not effectively protecting sensitive species or sensitive developmental stages of species, and loss of stream and wetland habitat continues. The Environmental Protection Agency (EPA) and individual States regulate point sources of pollution under the National Pollution Discharge Elimination System (NPDES), under which point sources are licensed and maximum pollutant discharge concentrations are set. The NPDES system is not adequate to protect the petitioned species from the negative effects of pollution because permits may be issued with few restrictions, cumulative effects of all the point sources within a watershed are not taken into consideration when permits are issued, and State governments often lack the resources or political will to monitor and enforce permits (Buckner et al. 2002).

The petition claims that existing regulations are also inadequate to protect aquatic species from non-point sources of pollution such as agricultural, residential, and urban runoff. Agricultural runoff accounts for over 70 percent of impaired U.S. river kilometers, yet is largely exempt from permitting requirements (Neves et al. 1997). Existing regulatory mechanisms are also inadequate to protect southeastern aquatic species from accidental spills from retention ponds, which are used to store wastes from agriculture, coal-fired power plants, coal mining, and other activities (Herrig and Shute 2002), and to prevent the continued loss of stream and wetland habitat from fills. In Appalachia, from 1992 to 2002, the EPA permitted the filling of more than 1,200 miles of headwater streams for surface coal mining activities (EPA 2005). The permitted filling of streams for surface coal mining is causing permanent downstream pollution and loss of biodiversity (Neves et al. 1997; Pond et al. 2008; Pomponio 2009; Wood 2009; Palmer et al. 2010).

The permitted filling of wetlands is also ongoing. While section 404 of the CWA sets as a goal no net loss of wetlands, this is not a required outcome of permit decisions (Connolly et al. 2005). In fiscal year 2003, the U.S. Army Corps of Engineers issued 4,035 permits for the destruction of natural wetlands, while denying only 299 permits (Connolly et al. 2005). Lost wetlands are required to be replaced by mitigation wetlands, but mitigation wetlands often differ in structure, function, and community composition from the natural wetlands that are destroyed (Holland et al. 1995). Mitigation requirements are also not strictly enforced. Mitigation is rarely effective in preserving biodiversity (Cabbage et al. 1993; Water Environment Federation 1993). Many species of amphibians, reptiles, and insects require both wetland and upland habitat to complete their life cycles, and wetland protection criteria do not protect the upland habitats these species need to survive (Dodd 1997).

The petition alleges that the Surface Mining Control and Reclamation Act of 1977 (SMCRA) (30 U.S.C. 1201 et seq.) does not adequately protect aquatic species due to increased demands for coal, lax enforcement of environmental laws, and deference to economic development over species' protection. Sedimentation from active mines is a primary contributor to the decline of mollusks due to water quality degradation, shell erosion, and reproductive failure (Anderson 1989; Houp 1993; Neves et al. 1993). Reclamation required under SMCRA is not rigorously enforced (Ward 2009), and even when reclamation is conducted, it has not resulted in the restoration of pre-mining hydrologic characteristics or ecological functions (Townsend et al. 2009).

The petition alleges that management of National Wildlife Refuges, National Recreation Areas, National Forests, and Wild and Scenic Rivers fails to adequately protect the petitioned species for a variety of reasons, including lack of fiscal resources, threats from climate change, invasive species, recreation, poaching, and conflicting resource mandates (such as timber production and recreation).

Inadequacy of Existing State Regulatory Mechanisms

According to the petition, some of the petitioned species are listed as endangered or threatened by State fish, wildlife, and game departments, but State endangered and threatened species designations generally do not provide species with meaningful regulatory protections or with any habitat protection. Many of the species petitioned are classified as Species of Conservation Priority or Species of Greatest Conservation Need under State Wildlife Action Plans or Wildlife Conservation Strategies. These documents provide a framework for conservation, but are not regulatory documents and do not contain mandatory or enforceable provisions to protect species or their habitats. Further, the implementation of conservation strategies is dependent on the cooperation of resource managers and stakeholders, making their implementation and effectiveness uncertain. State conservation priorities and initiatives are also sharply limited by funding, with charismatic and game species generally receiving the majority of resources, and the focus generally being on vertebrates, which makes these priorities and initiatives inadequate to protect imperiled invertebrate species. Additionally, some States have regulations to protect some wildlife from direct take, but these regulations are not comprehensive, are generally poorly enforced, and are not adequate to protect wildlife from other threats (FWS 1997).

Other Regulatory Mechanisms and Protections

According to the petition, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) conveys some degree of protection to a few of the petitioned species listed under it, but it is inadequate to ensure their continued survival. For example, highly sought-after species such as rare map turtles are threatened by the international pet trade despite being protected under CITES (NatureServe 2008). Likewise, habitat preserves alone are insufficient to protect imperiled species. While habitat protection is an essential component of species' preservation, threats from a host of other factors, including climate change, poaching, pollution, and genetic isolation due to lack of habitat connectivity, influence habitat conditions and the success of the preservation efforts.

Land Ownership Patterns

The majority of land in the Southeast is privately owned. Private land use is either not regulated or only loosely regulated throughout much of the region (Buckner et al. 2002). According to the petition, most southeastern forests are in private ownership, and forestry best management practices to control erosion and protect aquatic resources are not mandated or voluntarily followed in the majority of southeastern forests. In addition, extensive clearcutting and poor logging practices threaten aquatic resources due to sedimentation, landslides, and degraded water quality (Buckner et al. 2002).

Factor E. Other Natural or Manmade Factors Affecting the Species' Continued Existence

The petition states that other natural or manmade factors, including pollution, global climate change, drought, invasive species, and synergies between multiple threats, threatened 13 of 15 amphibians, 1 amphipod (tidewater amphipod), 1 beetle (Avernus cave beetle), 3 birds (MacGillivray's seaside sparrow, Florida sandhill crane, and black rail), 4 butterflies (Linda's roadside-skipper, Duke's skipper, Palatka skipper, and rare skipper),

2 caddisflies (Morse's little plain brown sedge and setose cream and brown mottled microcaddisfly), 43 of 83 crayfish, 3 dragonflies (Cherokee clubtail, Septima's clubtail, Appalachian snaketail), 43 of 47 fish, 3 mammals (Pine Island oryzomys or marsh rice rat, Sanibel Island oryzomys or marsh rice rat, insular cotton rat), 1 moth (Louisiana eyed silkmoth), 35 of 48 mussels, 3 non-vascular plants (Fissidens appalachensis (Appalachian fissidens moss), Fissidens hallii (Hall's pocket moss), and Phaeophyscia leana (Lea's bog lichen)), 9 reptiles (Kirtland's snake, western chicken turtle, Florida Keys mole skink, Escambia map turtle, Pascagoula map turtle, black-knobbed map turtle, Alabama map turtle, striped mud turtle, northern red-bellied cooter), 27 of 44 snails, 1 stonefly (Smokies needlefly), and 31 of 76 vascular plants.

Pollution

According to the petition, pollution threatens two-thirds of the petitioned species, including 81 percent of the wildlife. Southeastern waterways are degraded by point and non-point source pollution from a variety of sources including agriculture, forestry, urban and suburban development, coal mining, and coal combustion wastes. Non-point source pollution, or runoff, is difficult to document, but its impact on aquatic species is both pervasive and persistent (Schuster 1997). Non-point source pollution is the most common factor adversely impacting the nation's fish communities, with more than 80 percent of fish negatively affected (Judy et al. 1982). Both non-point and point source pollution are pushing southeastern aquatic species towards extinction by carrying sediments, contaminants, nutrients, and other pollutants into waterways.

Sedimentation, Contamination, and Nutrient Loading

The petition alleges sedimentation is one of the primary causes of habitat degradation in southeastern waterways (Neves et al. 1997). Sedimentation and siltation result from a variety of activities including agriculture, forestry, development, and mining, with silt reaching the waterways during both ground-disturbing activities and storm events (FWS 2000). Suspended sediments threaten the entire aquatic community, from fish to invertebrates to birds.

In the Southeast, sedimentation is responsible for nearly 40 percent of fish imperilment problems (Etnier 1997). It both directly and indirectly adversely affects fish. Suspended sediments cut and clog gills and interfere with respiration. Sedimentation blocks light penetration, which interferes with feeding for species like minnows and darters, which feed by sight (Etnier and Starnes 1993). For species that feed by flipping over rocks and consuming the disturbed insects, sedimentation increases the embeddedness of rocks, making them more difficult to move and decreasing habitat suitability for aquatic invertebrate prey (Etnier and Starnes 1993). Sedimentation also interferes with feeding behavior for nocturnal feeders like catfish and imperiled madtoms, which catch aquatic insects by relying on the sensitivity of their barbells and on chemoreceptors, both of which are negatively affected by sedimentation (Todd 1973; Buckner et al. 2002). Benthic species require specific substrate conditions for spawning, feeding, and cover, all of which are degraded by sedimentation (Etnier and Starnes 1993; Warren et al. 1997). When sedimentation fills in the crevices between and beneath rocks, it decreases the availability of cover for resting and predator evasion (Herrig and Shute 2002). Madtoms, darters, suckers, and some minnows deposit their eggs on or near the substrate, and sedimentation interferes with their reproduction both by decreasing habitat suitability and by directly smothering eggs. Benthic fishes are also negatively affected by toxins stored in sediments (Reice and Wohlenberg 1993). Ultimately, excessive sedimentation can eliminate fish species from an area by rendering their habitat unsuitable (FWS 2000). Similarly, excessive sedimentation has strong, persistent, negative effects on freshwater invertebrates (Strayer 2006). Siltation is one of the primary factors implicated in the decline of freshwater mollusks (Williams et al. 1993). Suspended sediments have both direct and indirect negative effects on mollusks. Sedimentation clogs the gills of mollusks and can cause suffocation (FWS 2000). Sedimentation reduces feeding efficiency both by interfering with respiration of filter feeders and by coating algae, which snails scrape from rocks (FWS 2000). Decreased visibility due to sedimentation can interfere with mussel reproduction by making it difficult for host fishes to detect glochidia (Neves et al. 1997). Sedimentation also reduces substrate suitability (Herrig and Shute

2002).
The petition also alleges that aquatic insects are threatened by excessive sediment levels. Stoneflies (Plecoptera) and mayflies (Ephemeroptera) are intolerant of siltation and disappear from impacted streams (Morse et al. 1997). Increased siltation impacts the ability of dragonflies and damselflies to survive (Morse et al. 1997). Caddisflies, which require spaces among rocks for shelter and stable surfaces for grazing, are also negatively impacted by siltation (Morse et al. 1997). Sedimentation and other pollutants from mountaintop-removal coal mining operations are extirpating aquatic macroinvertebrate communities. In some streams that drain mountaintop-removal operations, entire orders of Plecoptera and Ephemeroptera have been extirpated (Wood 2009). Sedimentation is also negatively impacting rare ground-water inhabiting species of isopods and amphipods (Herrig and Shute 2002).
According to the petition, in addition to sediments, contaminants such as heavy metals, pesticides, and persistent organic pollutants threaten aquatic species. In a nationwide assessment of streambed sediment contaminants, the EPA found that 43 percent of sediments are probably associated with harmful effects on aquatic life or human health, and that 6 to 10 percent of streambed sediment is sufficiently contaminated to cause significant lethality to benthic organisms (EPA 2004b). Southeastern rivers are laden with a variety of toxic chemicals, with the lower Mississippi River receiving contaminants from half the continent (Folkerts 1997). Contaminants have both lethal and sub-lethal negative effects on aquatic species and may interfere with immunity, growth, and reproduction (Colborn et al. 1993; Gibbons et al. 2000). Selenium contamination from surface coal mining is causing teratogenic (developmental malformations) deformities in larval fish (Palmer et al. 2010). The negative effects of many contaminants will persist for centuries (Folkerts 1997).
Aquatic species are threatened both by chronic low-level contaminant pollution and acute exposure from accidental spills. For example, in 2009, a wastewater spill from a coal mine on the West Virginia-Pennsylvania border killed all the fish, salamanders, and mussels in 35 miles of 38-mile-long Dunkard Creek (Hopey 2009). Endemic species are particularly at high risk from accidental spills. Because many aquatic species exist only in small, isolated populations, a single spill event could drive a species to extinction.
The petition alleges that contaminants threaten all taxa of aquatic species. Declines in many fish species are attributed to chronic, sub-lethal pollution, which causes reduced growth, reduced reproductive success, and increased risk of death from stress-related diseases (Moyle and Leidy 1992). Cave fishes and other species that are directly dependent on groundwater levels are disproportionately threatened by contaminants that become concentrated if there is a reduction in the volume of springflow (Herrig and Shute 2002). Chemoreception in blind cave fishes can be disrupted by contaminants from surface aquifer recharge areas (Herrig and Shute 2002). Chronic low-level exposure to contaminants may be preventing the recovery of imperiled species of mollusks (FWS 1997). Juvenile mussels are sensitive to heavy metals and other pollutants (Naimo 1995; Neves et al. 1997). Amphibians are particularly sensitive to contaminants as all life stages are sensitive to toxins (AmphibiaWeb 2009). Many substances can be toxic to amphibians including heavy metals, pesticides, phenols, fertilizers, road salt, mining waste, and chemicals in runoff (Dodd 1997). Changes in pH can adversely affect amphibian eggs and larvae, and can inhibit growth and feeding in adults (Dodd 1997). Amphibians are threatened by accidental and intentional pesticide treatments.
Contaminants negatively impact aquatic species at the level of individuals, populations, and species. Fish, turtles, and other aquatic animals assimilate pesticides, heavy metals, and other persistent pollutants into their tissues (Buhlman and Gibbons 1997; de Solla and Fernie 2004). Animals at higher levels of the food chain can accumulate considerable levels of toxins. Significant concentrations of numerous contaminants have been detected in southeastern freshwater turtles including pesticides such as: aldrin, chlordane, dichlorodiphenyltrichloroethane (DDT), dieldrin, endrin, mirex, nonachlor, and toxaphene; and metals such as: Aluminum, barium, cadmium, chromium, cobalt, copper, iron, lead, mercury, molybdenum, nickel, strontium, and zinc (Meyers-Schoene and Walton 1994). Contaminant exposure can disrupt normal endocrine functioning,

threatening reproduction and survival (Colborn et al. 1993). Turtles exposed to polychlorinated biphenyls (PCBs) have exhibited sex reversal and abnormal gonadal development, and alligators exposed to various contaminants have shown altered testosterone levels and gonadal abnormalities (Guillette et al. 1994, 1995). Water snakes in wetlands that have been contaminated with coal ash exhibit altered metabolic activity (Hopkins et al. 1999). Endocrine disruption caused by contaminants can lead to demographic shifts in aquatic reptile populations (Gibbons et al. 2000). Bioaccumulation of contaminants has contributed to the decline of map turtles, musk turtles, snapping turtles, and pond turtles (Buhlmann and Gibbons 1997).

The petition alleges that nutrient loading also threatens southeastern aquatic species. Excessive nitrates and phosphates entering waterways from point and non-point sources can lead to algal blooms, eutrophication, and depleted dissolved oxygen, which can be lethal to aquatic organisms (Mallin and Cahoon 2003). Some algal blooms are toxic and can cause direct mortality. The toxic dinoflagellates (Pfiesteria piscicida and P. shumwayae) have bloomed downstream of CAFOs in the Neuse, New, and Pamlico River estuaries in North Carolina (Mallin and Cahoon 2003). Even at sub-lethal levels, nutrient loading threatens aquatic species via many mechanisms. For example, excessive phosphate levels, especially in combination with the herbicide atrazine, have been shown to increase nematode infections in amphibians, leading to amphibian deformities (Johnson and Sutherland 2003; Rohr et al. 2008).

Sources of Nutrients, Contaminants, Sediments, and Other Pollutants

The petition claims that agriculture, forestry, urban and industrial development, coal mining and processing, and coal combustion all contribute to nutrient loading, contaminants, sediments, and other pollutants that make their way into southeastern waterways. In the Southeast, agricultural fields are commonly plowed to the edge of rivers and streams, which results in erosion and stream bank collapse and deposits tons of soil into waterways annually. Agricultural runoff carries sediment, pesticides, fertilizers, animal wastes, pathogens, salts, and petroleum particles into waterways.

The petition claims that atrazine is the most commonly detected pesticide in U.S. waters and is pervasively found in surface waters of the southern States, with the chemical being detected in every watershed sampled (EPA 2007; Wu et al. 2009). According to the petition, concentrations of atrazine in various southeastern waterways exceed levels harmful to non-vascular plants and aquatic biota (U.S. EPA 2007; Wu et al. 2009). The toxic and endocrine-disrupting effects of atrazine are well established (Wu et al. 2009) and include detrimental reproductive effects.

According to the petition, animal holding lots and CAFOs produce animal wastes that may be discharged directly into streams applied to agricultural fields, or stored in lagoons (Buckner et al. 2002). These wastes contain enormous amounts of nitrogen and phosphorus, and these nutrients enter the environment and contribute to the eutrophication of waterbodies via runoff, via volatilization of ammonia, or by percolating into groundwater (Mallin and Cahoon 2003). Extreme weather events, lax management, and lagoon ruptures have led to acute pollution events from CAFOs, which have resulted in fish kills and algal blooms (Mallin and Cahoon 2003). Decaying carcasses from these operations also produce a significant source of nutrient pollution. In addition to nutrient loading, CAFOs release pharmaceuticals (growth promoters and antibiotics) and hormones (estrogens and androgens) into aquatic habitats (Orlando et al. 2004). These have led to endocrine disruption in female turtles (Irwin et al. 2001), and disruption of the reproductive biology of fathead minnows (Pimephales promelas) (Orlando et al. 2004).

The petition asserts that wastewater from aquacultural facilities also contributes significant amounts of sediments, nutrients, pharmaceuticals, and pathogens to southeastern aquatic habitats (Tacon and Forster 2003). Catfish farms, trout farms, and shrimp and crayfish ponds all release nutrients to aquatic habitats when they are drained or flushed during large rain events (Tucker and Hargreaves 2003; Morse et al. 1997; Holdich 1993).

According to the petition, pollution from forestry and silviculture affects the Mobile Basin. Logging and effluent

from pulp mills contribute sediments and herbicides to waterways, degrading habitat for aquatic organisms. Erosion from deforestation and poor forestry practices increases silt loading and makes stream bottoms unstable, both of which threaten mollusks and other aquatic organisms (Williams et al. 1993). Herbicides used to kill hardwoods and herbaceous vegetation may be harmful to amphibians and other species (Dodd 1997), and some herbicides are toxic to algae and interfere with aquatic ecology (Austin et al. 1991).

Urban and industrial development is also cited in the petition as contributing to pollution of southeastern aquatic habitats. Point source pollution from manufacturing sites, power plants, and sewage treatment plants is a major cause of aquatic habitat degradation (Morse et al. 1997). Non-point source pollution in the form of runoff from urban and industrial areas contributes sediment, contaminants, nutrients, and other pollutants that can be harmful to aquatic organisms and their habitats, including petroleum particles, highway salts, silt, fertilizers, pesticides, surfactants, and pet wastes (Neves et al. 1997; Buckner et al. 2002).

The petition states that coal mining and processing are a major source of pollution in West Virginia, Kentucky, Tennessee, Virginia, Alabama, and Georgia. Contaminants from coal mining and processing include sediments, metals, hydraulic fluids, frothing agents, modifying reagents, pH regulators, dispersing agents, flocculants, and media separators (Ahlstedt et al. 2005). Sediments, heavy metals, and other pollutants from mining are one of the causal factors in mussel declines (Houp 1993; Neves et al. 1997; Locke et al. 2006). Heavy metals, including aluminum, cadmium, copper, iron, manganese, mercury, selenium, sulfate, and zinc, are released into the environment and act as metabolic poisons in freshwater species (Earle and Callaghan 1998), and cause weight loss, altered enzyme activity and filtration rates, and behavioral modifications (Naimo 1995). The effects of metals on mussel feeding, growth, and reproduction can result in significant consequences for mussel populations, and Naimo (1995) concludes that the chronic, low-level exposure to toxic metals is partially responsible for the widespread decline in species diversity and population density of freshwater mussels. Selenium is particularly prevalent in coal effluents and is associated with deformities and reproductive failure in aquatic species (Lemly 2009; Pomponio 2009).

The petition also asserts that pollution, including sediments, metals, acids, and other substances, in drainage from abandoned mined lands negatively impacts aquatic species in a variety of ways from acute toxicity to physical impacts from solid precipitants (Cherry et al. 2001; Soucek et al. 2003). Surface waters receiving mine discharge commonly have extremely low pH levels, below 3.0, with toxic impacts extending several miles downstream (Soucek et al. 2003).

Coal combustion produces nitric and sulfuric acids, mercury, and coal ash, that all negatively impact aquatic species (Fleischer et al. 1993). Nitric and sulfuric acids released from coal-fired power plants cause acidification of water bodies. Streams and lakes in Great Smoky Mountains National Park and elsewhere have been degraded by acid precipitation (Morse et al. 1997). Phytoplankton is negatively affected by acidification, which has ramifications throughout the food web (Dodd 1997). Acid precipitation harms caddisflies and stoneflies (Morse et al. 1997). The petition claims that several of the petitioned insects, including the Smokies snowfly and Smokies needlefly, are threatened by acid deposition. Acidity in aquatic habitats can also result in direct amphibian mortality, and plays a major role in limiting amphibian distribution (Dodd 1997).

Coal combustion also releases mercury into the environment. Atmospheric deposition of mercury is responsible for the contamination of most waterways. In a U.S. Geological Survey study that examined mercury in fish, sediments, and water drawn from 291 rivers and streams, detectable mercury contamination was found in every single fish sampled (Scudder et al. 2009). The highest concentrations among all sampled sites occurred in fish from blackwater coastal-plain streams draining forested lands or wetlands in Louisiana, Georgia, Florida, and North and South Carolina, and from basins in the west with gold or mercury mines or both. Mercury levels in fish at over 70 percent of the sites exceeded the levels of concern for the protection of fish eating-mammals.

The combustion of coal produces over 129 million tons of solid waste, or coal ash, annually (Eilperin 2009). Coal ash contains concentrated levels of chlorine, zinc, copper, arsenic, lead, selenium, mercury, and other

toxic contaminants, and improper storage of coal combustion waste has resulted in pollution of ground and surface waters (EPA 2007b). There are 44 coal ash ponds in Kentucky alone. Hopkins et al. (1999) reported behavioral, developmental, and metabolic abnormalities in amphibians and reptiles in wetlands that have been contaminated with coal combustion waste in South Carolina.

Global Climate Change and Drought

According to the petition, global climate change threatens all of the petitioned species. Climate models project both continued warming in all seasons across the Southeast, and an increase in the rate of warming (Karl et al. 2009). The warming in air and water temperatures will create stress for fish and wildlife. Increasing water temperatures and declining dissolved oxygen levels in streams, lakes, and shallow aquatic habitats will lead to fish kills and loss of aquatic species diversity (Folkerts 1997; Karl et al. 2009). Climate change will alter the distribution of native plants and animals and will lead to the local loss of imperiled species and the displacement of native species by invasives (Karl et al. 2009).

Climate change will increase both the incidence and severity of droughts and major storm events in the Southeast (Karl et al. 2009). The percentage of the Southeast region experiencing moderate to severe drought has already increased over the past 3 decades (Karl et al. 2009). The threat to aquatic ecosystems posed by drought is magnified both by climate change and by human population growth. Decreased water availability coupled with human population growth will further stress natural systems. Drought, and increased evaporation and evapotranspiration due to warmer temperatures, will lead to decreased groundwater recharge and potential saltwater intrusion in shallow aquifers in many parts of the Southeast, further exacerbating threats to aquatic organisms (Karl et al. 2009).

Intense drought and increasing temperatures resulting from climate change will cause the drying of water bodies and the local or global extinction of riparian and aquatic species (Karl et al. 2009). Declines of mollusks as a direct result of drought have already been documented (Golladay et al. 2004; Haag and Warren 2008). Populations of amphibians dependent on consistent rainfall patterns for breeding, such as those that breed in temporary ponds, could be extirpated by drought (Dodd 1997). Amphibian declines are already linked to climate change globally (Pounds et al. 2006) and in the southeastern United States (Daszak et al. 2005).

The warming climate will likely cause ecological zones to shift upward in latitude and altitude, and species' persistence will depend upon, among other factors, their ability to disperse to suitable habitat (Peters and Darling 1985). Human modifications to waterways, such as dams, and changes to the landscape, including extensive development, will make dispersal of species to more suitable habitat difficult to impossible (Strayer 2006; Buhlman and Gibbons 1997; FWS 2009). Many species of freshwater invertebrates are likely to go extinct due to climate change (Strayer 2006). Freshwater mussels and snails are capable of moving only short distances and are unlikely to be able to adjust their ranges in response to climatic shifts (FWS 2009). The petitioners allege that deteriorating habitat conditions and obstacles to dispersal place all of the petitioned species at risk of extinction due to global climate change.

According to the petition, several of the coastal petitioned species are threatened by sea level rise and increased storm intensity resulting from global climate change, including the Florida Keys mole skink, MacGillivray's seaside sparrow, and Louisiana eyed silkmoth.

Invasive Species

The petition alleges that invasive species are a major threat to native aquatic plants and animals in the Southeast, and a known threat for 96 of the petitioned species. Invasive species negatively affect native species through competition, predation, and disease introduction. Introduced Asian carp, which are used to control trematodes in catfish ponds, have become established in rivers throughout the Mississippi Basin, where they consume native mollusks and compete for resources with native fishes (Naylor et al. 2001). There are at least 30 species of invasive fish in the Tennessee and Cumberland River basins, including carp, alewife, rainbow and brown trout, striped bass, yellow perch, nonnative forms of muskellunge, and walleye (Etnier 1997). Nonnative

mosquitofish (Gambusia holbrooki) have been widely introduced for vector control and now compete with native species for resources (Buckner et al. 2002). Game fish, such as trout and bass, have been widely introduced and prey on native fish, invertebrates, and amphibians (Herrig and Shute 2002; Kats and Ferrer 2003; Strayer 2006). Native fish fauna in southern Florida have been displaced by tropical species, and more than 60 indigenous southeastern fish species have been introduced to drainages where they are not native (Warren Jr. et al. 1997).

According to the petition, freshwater mollusks are threatened both by invasive fish and invasive mollusks. The introduction of nonnative fishes such as the round goby has indirect negative effects on native mussels due to negative impacts on their host fishes (NatureServe 2009). The invasion of nonindigenous mollusks is one of the primary reasons for the decline of freshwater mussels (Williams et al. 1993). Invasive mussels can reach densities of thousands per square meter, outcompeting and literally covering native species (Williams et al. 1993).

The zebra mussel has been detected in Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Tennessee, Virginia, and West Virginia (NatureServe 2009). Zebra mussels infest most major Mississippi River tributaries, including the Ohio, Tennessee, Cumberland, and Arkansas Rivers (NatureServe 2009), and are expected to spread to all the navigable rivers in the Southeast, as well as tributary reservoirs and smaller streams (Jenkinson and Todd 1997). Zebra mussels and other invasive mollusks compete with native mussels for food and space, attach to native mussels and weaken or kill them, and alter the suitability of the substrate for native species (Herrig and Shute 2002). Where zebra mussels establish large populations, they are likely to destroy native mussels and snail populations (Jenkinson and Todd 1997).

The petition alleges that native southeastern mollusks are also threatened by the invasion of the Asian clam. Asian clams spread rapidly throughout every major drainage in the South following their introduction in the 1960s. Asian clams compete with native mussels for space and food.

The petition asserts that other southeastern taxa, in addition to fish and mollusks, are also threatened by the spread of invasive species. Native crayfish are threatened by invasive mussels, which can attach to their exoskeletons, and by invasive species of crayfish and fish, which compete with and prey on native crayfish (Schuster 1997). Nonnative crayfish are commonly introduced via "bait buckets." Several species of nonnative snails have also invaded the Southeast (Neves et al. 1993). Native amphibians are threatened by invasive fish and invasive amphibians, which can act as predators, competitors, and disease vectors (Dodd 1997). Additionally, the petition asserts that exotic cattle egrets, armadillos, and wild hogs can "exact a substantial toll" on amphibians (Dodd 1997). Fire ants also threaten amphibians, as they have been known to kill metamorphosing individuals (Freed and Neitman 1988).

According to the petition, many invasive plant species are wreaking havoc on aquatic habitats in the Southeast. Species such as Myriophyllum spicatum (Eurasian watermilfoil), Alternanthera philoxeroides (alligatorweed), Hydrilla verticillata (hydrilla), and Eichhornia crassipies (water hyacinth) are thriving in aquatic and wetland habitats and negatively impacting native species (Folkerts 1997; Buckner et al. 2002). Invasive plants displace native plants, alter substrate availability for aquatic invertebrates, and interfere with the food web (Folkerts 1997). Invasive plants threaten several of the petitioned plants, including Baptisia megacarpa (Apalachicola wild indigo), Ptilimnium ahlesii (Carolina bishopweed), and Hexastylis speciosa (Harper's heartleaf).

Outbreaks of invasive and native forest-destroying insects have weakened and killed trees in riparian areas and reduced nutrient inputs to aquatic systems (Morse et al. 1997). The petitioned Tsuga caroliniana (Carolina hemlock) is threatened by hemlock woolly adelgid (Adelges tsugae). Streamside habitat degradation due to exotic pests also threatens aquatic insect populations in the Southeast due to altered microhabitat conditions (Herrig and Shute 2002).

Inherent Vulnerability of Small, Isolated Populations

According to the petition, 224 of the petitioned species now exist in primarily small, isolated populations, which

heightens their risk of extinction. Small, isolated populations are vulnerable to extirpation due to limited gene flow, reduced genetic diversity, and inbreeding depression (Lynch 1996). Population isolation also increases the risk of extinction from stochastic genetic and environmental events, including drought, flooding, and toxic spills (FWS 2009). Habitat modification and cumulative habitat degradation from non-point source pollution are also major threats for species that exist in isolated populations. Due to blocked avenues of dispersal or limited dispersal ability, isolated populations gradually disappear as habitat conditions deteriorate (FWS 2000).

Synergies and Multiple Causes

The petition alleges that the risk of extinction for the petitioned species is heightened by synergies between threats as most species face multiple threats and these threats interact and magnify each other. Across taxa, interactions among threats place southeastern aquatic biota at increased risk of extinction. Reptiles are threatened by habitat loss and degradation, invasive species, pollution, disease and parasitism, unsustainable use, global climate change, and synergies between these factors (Gibbons et al. 2000). Freshwater snails are threatened by the combined effects of habitat loss, pollution, drought, and invasive species (Lydeard et al. 2004). Likewise, amphibians are imperiled by multiple, interacting threats. Stress from the effects of increased UV-b radiation, pollution, and climate change has made amphibians more vulnerable to the spread of disease (Gendron et al. 2003; Pounds et al. 2006). The interaction between climate change and compromised immunity due to various stressors threatens both amphibian populations and entire species (Green and Dodd 2003). Similarly, threats to freshwater fish are "many, cumulative and interactive," and fish extirpation is nearly always attributable to multiple human impacts (Warren et al. 1997). Any factor that causes the decline of the host fishes on which mussels depend for reproduction also threatens the mussels, which themselves face multiple threats including impoundment, pollution, and invasive species (Neves et al. 1997). The petition claims that because of the multifaceted ecological relationships among species, the extirpation of a species can have effects that cascade throughout the community, highlighting the need to protect entire communities simultaneously.

Summary of Threats as Identified in the Petition

_____Table_2--Threats_for_the_374_Species_as_Classified_by_the_Petitioners
Scientific_name____Common_name_____Taxon_____Factor
_____A___B___C___D___E
Ambystoma_barbouri_Streamside_____Amphibian_____X___X___X___X___X
_____Salamander
Amphiuma_pholeter__One-Toed_Amphiuma_Amphibian_____X___X___X___X___X
Cryptobranchus_____Hellbender_____Amphibian_____X___X___X___X___X
alleganiensis
Desmognathus_____Cumberland_Dusky__Amphibian_____X___X___X___X
abditus_____Salamander
Desmognathus_____Seepage_____Amphibian_____X___X___X___X___X
aeneus_____Salamander
Eurycea_____Chamberlain's_____Amphibian_____X___X___X___X___X
chamberlaini_____Dwarf_Salamander

Eurycea_tynerensis_Oklahoma_____Amphibian_____X___X___X___X___X
_____Salamander
Gyrinophilus_____Tennessee_Cave___Amphibian_____X___X___X___X___X
palleucus_____Salamander
Gyrinophilus_____West_Virginia____Amphibian_____X___X___X___X___X
subterraneus_____Spring_Salamander
Eurycea_wallacei___Georgia_Blind____Amphibian_____X___X___X___X___X
_____Salamander
Necturus_lewisi___Neuse_River_____Amphibian_____X___X___X___X___X
_____Waterdog
_____(salamander)
Pseudobranchus____Gulf_Hammock_____Amphibian_____X___X_____X___X
striatus_____Dwarf_Siren
lustricolus
Urspelerpes_brucei_Patch-nosed_____Amphibian_____X___X_____X___X
_____Salamander
Crangonyx_____Florida_Cave_____Amphipod_____X_____X
grandimanus_____Amphipod
Crangonyx_hobbsi___Hobb's_Cave_____Amphipod_____X_____X
_____Amphipod
Stygobromus_____Cooper's_Cave____Amphipod_____X_____X
cooperi_____Amphipod
Stygobromus_____Tidewater_____Amphipod_____X_____X___X
indentatus_____Amphipod
Stygobromus_____Morrison's_Cave___Amphipod_____X_____X
morrisoni_____Amphipod
Stygobromus_parvus_Minute_Cave_____Amphipod_____X_____X
_____Amphipod
Cicindela_____Cobblestone_Tiger_Beetle_____X___X_____X
marginipennis_____Beetle
Pseudanophthalmus__Avernus_Cave_____Beetle_____X_____X___X
avernus_____Beetle

Pseudanophthalmus__Little_Kennedy____Beetle_____X_____X
cordicollis_____Cave_Beetle
Pseudanophthalmus__New_River_Valley__Beetle_____X_____X
egberti_____Cave_Beetle
Pseudanophthalmus__Cumberland_Gap____Beetle_____X_____X
hirsutus_____Cave_Beetle
Pseudanophthalmus__Hubbard's_Cave____Beetle_____X_____X
hubbardi_____Beetle
Pseudanophthalmus__Hubricht's_Cave___Beetle_____X_____X
hubrichti_____Beetle
Pseudanophthalmus__Crossroad's_Cave__Beetle_____X_____X
intersectus_____Beetle
Pseudanophthalmus__Madden's_Cave_____Beetle_____X_____X
limicola_____Beetle
Pseudanophthalmus__Dry_Fork_Valley___Beetle_____X_____X
montanus_____Cave_Beetle
Pseudanophthalmus__Natural_Bridge____Beetle_____X_____X
pontis_____Cave_Beetle
Pseudanophthalmus__South_Branch_____Beetle_____X_____X
potomaca_____Valley_Cave
_____Beetle
Pseudanophthalmus__Overlooked_Cave___Beetle_____X_____X
praetermissus_____Beetle
Pseudanophthalmus__Saint_Paul_Cave___Beetle_____X_____X
sanctipauli_____Beetle
Pseudanophthalmus__Silken_Cave_____Beetle_____X_____X
sericus_____Beetle
Pseudanophthalmus__Thomas's_Cave_____Beetle_____X_____X
thomasi_____Beetle
Pseudanophthalmus__Maiden_Spring_____Beetle_____X_____X
virginicus_____Cave_Beetle
Ammodrammus_____MacGillivray's____Bird_____X_____X____X____X

maritimus_____Seaside_Sparrow
macgillivraii
Grus_canadensis____Florida_Sandhill__Bird_____X____X____X____X____X
pratensis_____Crane
Laterallus_____Black_Rail_____Bird_____X____X____X____X____X
jamaicensis
Amblyscirtes_linda_Linda's_Roadside-_Butterfly_____X_____X
_____skipper
Euphyes_dukesi_____Duke's_Skipper____Butterfly_____X_____X____X
calhouni
Euphyes_pilatka____Palatka_Skipper___Butterfly_____X_____X____X
klotsi
Problema_bulenta___Rare_Skipper_____Butterfly_____X____X_____X____X
Agarodes_logani____Logan's_Agarodes__Caddisfly_____X_____X
_____Caddisfly
Hydroptila_sykorae_Sykora's_____Caddisfly_____X_____X
_____Hydroptila
_____Caddisfly
Lepidostoma_morsei_Morse's_Little____Caddisfly_____X_____X____X
_____Plain_Brown_Sedge
Oecetis_parva_____Little_Oecetis____Caddisfly_____X_____X
_____Longhorn
_____Caddisfly
Oxyethira_setosa___Setose_Cream_and__Caddisfly_____X_____X____X
_____Brown_Mottled
_____Microcaddisfly
Triaenodes_____Three-toothed_____Caddisfly_____X_____X
tridontus_____Triaenodes
_____Caddisfly
Bouchardina_____Bayou_Bodcau_____Crayfish_____X_____X
robisoni_____Crayfish
Cambarus_____Dougherty_Plain___Crayfish_____X_____X

cryptodytes_____Cave_Crayfish
Cambarus_obeyensis_Obey_Crayfish____Crayfish_____X_____X___X
Cambarellus_blacki_Cypress_Crayfish__Crayfish_____X_____X
Cambarellus_____Least_Crayfish___Crayfish_____X_____X
diminutus
Cambarellus_____Angular_Dwarf____Crayfish_____X_____X
lesliei_____Crayfish
Cambarus_bouchardi_Big_South_Fork___Crayfish_____X_____X___X
_____Crayfish
Cambarus_____New_River_____Crayfish_____X_____X
chasmodactylus____Crayfish
Cambarus_____Chauga_Crayfish___Crayfish_____X_____X___X
chaugaensis
Cambarus_____Coosawattae_____Crayfish_____X_____X___X
coosawattae_____Crayfish
Cambarus_cracens___Slenderclaw_____Crayfish_____X_____X
_____Crayfish
Cambarus_cymatilis_Conasauga_Blue___Crayfish_____X_____X
_____Burrower
Cambarus_____Grandfather_____Crayfish_____X_____X___X
eeseeohensis_____Mountain_Crayfish
Cambarus_elkensis__Elk_River_____Crayfish_____X_____X___X
_____Crayfish
Cambarus_extraneus_Chickamauga_____Crayfish_____X_____X___X
_____Crayfish
Cambarus_fasciatus_Etowah_Crayfish___Crayfish_____X_____X___X
Cambarus_georgiae__Little_Tennessee__Crayfish_____X_____X___X
_____Crayfish
Cambarus_harti____Piedmont_Blue____Crayfish_____X_____X___X
_____Burrower
Cambarus_____Spiny_Scale_____Crayfish_____X_____X
jezerinaci_____Crayfish

Cambarus_jonesi____Alabama_Cave_____Crayfish_____X_____X___X
_____Crayfish
Cambarus_nerterius_Greenbrier_Cave___Crayfish_____X_____X___X
_____Crayfish
Cambarus_parrishi__Hiwassee_____Crayfish_____X_____X___X
_____Headwater
_____Crayfish
Cambarus_pristinus_Pristine_Crayfish_Crayfish_____X_____X
Cambarus_scotti____Chattooga_River___Crayfish_____X_____X___X
_____Crayfish
Cambarus_speciosus_Beautiful_____Crayfish_____X_____X___X
_____Crayfish
Cambarus_spicatus__Broad_River_Spiny_Crayfish_____X_____X
_____Crayfish
Cambarus_strigosus_Lean_Crayfish_____Crayfish_____X_____X
Cambarus_unestami__Blackbarred_____Crayfish_____X_____X___X
_____Crayfish
Cambarus_veteranus_Big_Sandy_____Crayfish_____X_____X
_____Crayfish
Cambarus_williami__Brawleys_Fork_____Crayfish_____X_____X
_____Crayfish
Distocambarus_____Mimic_Crayfish____Crayfish_____X_____X___X
carlsoni
Distocambarus_____Broad_River_____Crayfish_____X_____X
devexus_____Burrowing
_____Crayfish
Distocambarus_____Newberry_____Crayfish_____X_____X
youngineri_____Burrowing
_____Crayfish
Fallicambarus_____Burrowing_Bog_____Crayfish_____X_____X
burrisi_____Crayfish
Fallicambarus_____Speckled_____Crayfish_____X_____X___X

danielae_____Burrowing
_____Crayfish
Fallicambarus_____Jefferson_County__Crayfish_____X_____X___X
gilpini_____Crayfish
Fallicambarus_____Ouachita_____Crayfish_____X_____X___X
harpi_____Burrowing
_____Crayfish
Fallicambarus_____Hatchie_Burrowing_Crayfish_____X_____X___X
hortoni_____Crayfish
Fallicambarus_____Slenderwrist_____Crayfish_____X_____X___X
petilicarpus_____Burrowing
_____Crayfish
Fallicambarus_____Saline_Burrowing__Crayfish_____X_____X___X
strawni_____Crayfish
Hobbseus_cristatus_Crested_Riverlet__Crayfish_____X_____X
_____Crayfish
Hobbseus_____Oktibbeha_____Crayfish_____X_____X
orconectoides_____Riverlet_Crayfish
Hobbseus_petilus___Tombigbee_____Crayfish_____X_____X
_____Riverlet_Crayfish
Hobbseus_____Yalobusha_____Crayfish_____X_____X
yalobushensis_____Riverlet_Crayfish
Orconectes_blacki__Calcasieu_____Crayfish_____X_____X
_____Crayfish
Orconectes_____Coldwater_____Crayfish_____X_____X___X
eupunctus_____Crayfish
Orconectes_____Yazoo_Crayfish____Crayfish_____X_____X
hartfieldi
Orconectes_____Tennessee_Cave____Crayfish_____X_____X
incomptus_____Crayfish
Orconectes_jonesi__Sucarnoochee_____Crayfish_____X_____X___X
_____River_Crayfish

Orconectes_maletae_Kisatchie_Painted_Crayfish_____X_____X
_____Crayfish
Orconectes_____Mammoth_Spring___Crayfish_____X_____X___X
marchandi_____Crayfish
Orconectes_____Appalachian_Cave__Crayfish_____X_____X
packardi_____Crayfish
Orconectes_sheltae_Shelta_Cave_____Crayfish_____X_____X___X
_____Crayfish
Orconectes_____Chowanoke_____Crayfish_____X_____X
virginiensis_____Crayfish
Orconectes_wrighti_Hardin_Crayfish___Crayfish_____X_____X
Procambarus_____Orlando_Cave_____Crayfish_____X_____X
acherontis_____Crayfish
Procambarus_____Coastal_Flatwoods_Crayfish_____X_____X
apalachicolae_____Crayfish
Procambarus_____Silver_Glen_____Crayfish_____X_____X___X
attiguus_____Springs_Crayfish
Procambarus_____Jackson_Prairie___Crayfish_____X_____X___X
barbiger_____Crayfish
Procambarus_____Mississippi_____Crayfish_____X_____X___X
cometes_____Flatwoods
_____Crayfish
Procambarus_____Bigcheek_Cave_____Crayfish_____X_____X
delicatus_____Crayfish
Procambarus_____Panama_City_____Crayfish_____X_____X___X
econfinae_____Crayfish
Procambarus_____Santa_Fe_Cave_____Crayfish_____X_____X
erythrops_____Crayfish
Procambarus_____Spinytail_____Crayfish_____X_____X
fitzpatricki_____Crayfish
Procambarus_franzi_Orange_Lake_Cave__Crayfish_____X_____X___X
_____Crayfish

Procambarus_horsti_Big_Blue_Springs__Crayfish_____X___X_____X
_____Cave_Crayfish
Procambarus_____Lagniappe_____Crayfish_____X_____X___X
lagniappe_____Crayfish
Procambarus_____Coastal_Lowland__Crayfish_____X_____X
leitheuseri_____Cave_Crayfish
Procambarus_____Florida_Cave_____Crayfish_____X_____X___X
lucifugus_____Crayfish
Procambarus_____Alachua_Light____Crayfish_____X_____X___X
lucifugus_alachua__Fleeing_Cave
_____Crayfish
Procambarus_____Florida_Cave_____Crayfish_____X_____X___X
lucifugus_____Crayfish
lucifugus
Procambarus_lylei__Shutispear_____Crayfish_____X_____X
_____Crayfish
Procambarus_____Miami_Cave_____Crayfish_____X_____X
milleri_____Crayfish
Procambarus_____Putnam_County____Crayfish_____X_____X
morrisi_____Cave_Crayfish
Procambarus_____Woodville_Karst__Crayfish_____X_____X
orcinus_____Cave_Crayfish
Procambarus_____Pallid_Cave_____Crayfish_____X_____X___X
pallidus_____Crayfish
Procambarus_pictus_Black_Creek_____Crayfish_____X_____X
_____Crayfish
Procambarus_pogum__Bearded_Red_____Crayfish_____X_____X
_____Crayfish
Procambarus_____Regal_Burrowing__Crayfish_____X_____X
regalis_____Crayfish
Procambarus_____Irons_Fork_____Crayfish_____X_____X___X
reimeri_____Burrowing

_____Crayfish
Troglocambarus_____Spider_Cave_____Crayfish_____X_____X
maclanei_____Crayfish
Cordulegaster_sayi_Say's_Spiketail___Dragonfly_____X_____X
Gomphus_consanguis_Cherokee_Clubtail_Dragonfly_____X_____X___X
Gomphus_sandrius___Tennessee_____Dragonfly_____X_____X
_____Clubtail
Gomphus_septima____Septima's_____Dragonfly_____X____X_____X___X
_____Clubtail
Gomphus_westfalli__Westfall's_____Dragonfly_____X_____X
_____Clubtail
Libellula_jesseana_Purple_Skimmer____Dragonfly_____X_____X
Macromia_margarita_Mountain_River____Dragonfly_____X_____X
_____Cruiser
Ophiogomphus_____Southern_____Dragonfly_____X_____X
australis_____Snaketail
Ophiogomphus_____Edmund's_____Dragonfly_____X_____X
edmundo_____Snaketail
Ophiogomphus_____Appalachian_____Dragonfly_____X____X_____X___X
incurvatus_____Snaketail
Somatochlora_____Calvert's_Emerald_Dragonfly_____X_____X
calverti
Somatochlora_____Texas_Emerald_____Dragonfly_____X_____X
margarita
Somatochlora_____Ozark_Emerald_____Dragonfly_____X_____X
ozarkensis
Stylurus_____Yellow-sided_____Dragonfly_____X_____X
potulentus_____Clubtail
Amblyopsis_spelaea_Northern_cavefish_Fish_____X____X_____X___X
Cyprinella_____Bluestripe_shiner_Fish_____X_____X___X
callitaenia
Cyprinella_xaenura_Altamaha_Shiner___Fish_____X_____X___X

Elassoma_boehlkei__Carolina_Pygmy___Fish_____X___X___X___X___X
_____Sunfish
Erimystax_harryi___Ozark_chub_____Fish_____X_____X___X
Etheostoma_____Warrior_Darter___Fish_____X_____X___X
bellator
Etheostoma_____Holiday_Darter___Fish_____X_____X___X
brevirostrum
Etheostoma_____Ashy_Darter_____Fish_____X_____X___X
cinereum
Etheostoma_forbesi_Barrens_Darter___Fish_____X_____X___X
Etheostoma_____Smallscale_Darter_Fish_____X_____X
microlepidum
Etheostoma_osburni_Candy_Darter_____Fish_____X_____X___X___X
Etheostoma_____Paleback_Darter___Fish_____X_____X___X___X
pallididorsum
Etheostoma_____Egg-mimic_Darter__Fish_____X_____X___X
pseudovulatum
Etheostoma_____Striated_Darter___Fish_____X_____X___X
striatulum
Etheostoma_____Shawnee_Darter___Fish_____X_____X___X___X
tecumsehi
Etheostoma_____Tippecanoe_Darter_Fish_____X_____X___X
tippecanoe
Etheostoma_____Trispot_Darter___Fish_____X_____X___X
trisella
Etheostoma_____Tuscumbia_Darter__Fish_____X_____X___X
tuscumbia
Fundulus_julisia___Barrens_Topminnow_Fish_____X_____X___X
Moxostoma_robustum_Robust_Redhorse___Fish_____X___X___X___X___X
Notropis_ariommus__Popeye_Shiner_____Fish_____X_____X
Notropis_ozarcanus_Ozark_Shiner_____Fish_____X_____X___X
Notropis_____Peppered_Shiner___Fish_____X_____X___X

perpallidus
Notropis_suttkusi__Rocky_Shiner_____Fish_____X_____X___X
Noturus_fasciatus__Saddled_Madtom____Fish_____X_____X___X
Noturus_furiosus___Carolina_Madtom___Fish_____X_____X___X___X
Noturus_gilberti___Orangefin_Madtom__Fish_____X___X_____X___X
Noturus_gladiator__Piebald_Madtom____Fish_____X_____X___X
Noturus_lachneri___Ouachita_Madtom___Fish_____X_____X___X
Noturus_munitus____Frecklebelly_____Fish_____X_____X___X
_____Madtom
Noturus_taylori____Caddo_Madtom_____Fish_____X_____X___X
Percina_bimaculata_Chesapeake_____Fish_____X_____X___X
_____Logperch
Percina_brevicauda_Coal_Darter_____Fish_____X_____X___X
Percina_crypta_____Halloween_Darter__Fish_____X_____X
Percina_____Bluestripe_Darter_Fish_____X_____X___X
cymatotaenia
Percina_kusha_____Bridled_Darter____Fish_____X_____X___X
Percina_____Longhead_Darter___Fish_____X_____X___X
macrocephala
Percina_nasuta_____Longnose_Darter___Fish_____X_____X___X
Percina_sipsi_____Bankhead_Darter___Fish_____X_____X___X
Percina_williamsi__Sickle_Darter_____Fish_____X_____X___X
Pteronotropis_____Broadstripe_____Fish_____X_____X___X
euryzonus_____Shiner
Pteronotropis_____Bluehead_Shiner___Fish_____X___X___X___X___X
hubbsi
Thoburnia_____Blackfin_Sucker___Fish_____X_____X___X
atripinnis
Remenus_kirchneri__Blueridge_____Fly_____X_____X
_____Springfly
Caecidotea_cannula_None_____Isopod_____X_____X
Lirceus_culveri____Rye_Cove_Isopod___Isopod_____X_____X

Blarina_____Sherman's_Short-__Mammal_____X_____X___X
carolinensis_____tailed_Shrew
shermani
Oryzomys_palustris_Pine_Island_____Mammal_____X_____X___X
pop._1_____Oryzomys_or_Marsh
_____Rice_Rat
Oryzomys_palustris_Sanibel_Island____Mammal_____X_____X___X
pop.2_____Oryzomys_or_Marsh
_____Rice_Rat
Sigmodon_hispidus__Insular_Cotton____Mammal_____X_____X___X
insulicola_____Rat
Automeris_____Louisiana_Eyed____Moth_____X_____X___X
louisiana_____Silkmoth
Alasmidonta_arcula_Altamaha_____Mussel_____X_____X___X
_____Arcmussel
Alasmidonta_____Southern_Elktoe___Mussel_____X_____X___X
triangulata
Alasmidonta_____Brook_Floater_____Mussel_____X___X_____X___X
varicosa
Anodonta_heardi____Apalachicola_____Mussel_____X_____X___X
_____Floater
Anodontoides_____Rayed_Creekshell__Mussel_____X_____X___X
radiatus
Cyprogenia_aberti__Western_Fanshell__Mussel_____X_____X___X
Elliptio_ahenea____Southern_Lance____Mussel_____X_____X___X
Elliptio_arca_____Alabama_Spike_____Mussel_____X_____X___X
Elliptio_arctata___Delicate_Spike____Mussel_____X_____X___X
Elliptio_fraterna__Brother_Spike_____Mussel_____X___X_____X___X
Elliptio_____Yellow_Lance_____Mussel_____X_____X___X
lanceolata
Elliptio_____St._John's_____Mussel_____X_____X___X
monroensis_____Elephant_Ear

Elliptio_____Inflated_Spike____Mussel_____X_____X___X
purpurella
Fusconaia_masoni___Atlantic_Pigtoe___Mussel_____X_____X___X
Fusconaia_____Longsolid_____Mussel_____X_____X___X
subrotunda
Lampsilis_____Waccamaw_____Mussel_____X_____X___X
fullerkati_____Fatmucket
Lasmigona_____Tennessee_____Mussel_____X_____X___X___X
holstonia_____Heelsplitter
Lasmigona_____Green_Floater_____Mussel_____X_____X___X
subviridis
Medionidus_____Cumberland_____Mussel_____X_____X___X___X
conradicus_____Moccasinshell
Medionidus_walkeri_Suwannee_____Mussel_____X___X_____X___X
_____Moccasinshell
Obovaria_____Round_Hickorynut__Mussel_____X_____X___X
subrotunda
Obovaria_unicolor__Alabama_____Mussel_____X_____X___X
_____Hickorynut
Pleurobema_____Canoe_Creek_____Mussel_____X_____X___X
athearni_____Pigtoe
Pleurobema_____Tennessee_____Mussel_____X___X___X___X___X
oviforme_____Clubshell
Pleurobema_____Warrior_Pigtoe____Mussel_____X___X_____X___X
rubellum
Pleurobema_rubrum__Pyramid_Pigtoe____Mussel_____X___X_____X___X
Pleuronaia_____Tennessee_Pigtoe__Mussel_____X_____X___X___X
barnesiana
Pyganodon_gibbosa__Inflated_Floater__Mussel_____X_____X___X
Quadrula_asperata__Tallapoosa_Orb____Mussel_____X
archeri
Simpsonaias_____Salamander_Mussel_Mussel_____X_____X___X

ambigua
Toxolasma_lividus__Purple_Lilliput___Mussel_____X_____X___X___X
Toxolasma_pullus___Savannah_Lilliput_Mussel_____X_____X___X___X
Villosa_nebulosa___Alabama_Rainbow___Mussel_____X_____X___X
Villosa_ortmanni___Kentucky_____Mussel_____X_____X
_____Creekshell
Villosa_umbrans____Coosa_Creekshell__Mussel_____X_____X___X
Fissidens_____Appalachian_____Non-Vascular___X_____X___X
appalachensis_____Fissidens_Moss___Plant
Fissidens_hallii___Hall's_Pocket_____Non-Vascular___X_____X___X
_____Moss_____Plant
Megaceros_____Hornwort_____Non-Vascular___X_____X
aenigmaticus_____Plant
Phaeophyscia_leana_Lea's_Bog_Lichen__Non-Vascular___X_____X___X
_____Plant
Plagiochila_____Gorge_Leafy_____Non-Vascular___X_____X
caduciloba_____Liverwort_____Plant
Plagiochila_____Sharp's_Leafy_____Non-Vascular___X_____X
sharpii_ssp._____Liverwort_____Plant
sharpii
Clonophis_____Kirtland's_Snake__Reptile_____X___X___X___X___X
kirtlandii
Deirochelys_____Western_Chicken___Reptile_____X___X_____X___X
reticularia_miaria_Turtle
Eumeces_egregius___Florida_Keys_Mole_Reptile_____X___X_____X___X
egregius_____Skink
Graptemys_barbouri_Barbour's_Map_____Reptile_____X___X___X___X
_____Turtle
Graptemys_ernsti___Escambia_Map_____Reptile_____X___X___X___X___X
_____Turtle
Graptemys_gibbonsi_Pascagoula_Map____Reptile_____X___X___X___X___X
_____Turtle

Graptemys_____Black-knobbed_Map_Reptile_____X___X_____X___X
_____Turtle
Graptemys_pulchra__Alabama_Map_____Reptile_____X___X_____X___X
_____Turtle
Kinosternon_baurii_Striped_Mud_____Reptile_____X___X_____X___X
pop._1_____Turtle--Lower_FL
_____Keys
Pseudemys_nelsoni__Florida_Red-_____Reptile_____X___X___X___X
pop._1_____bellied_Turtle--
_____FL_Panhandle
Pseudemys_____Northern_Red-____Reptile_____X___X___X___X___X
rubriventris_____bellied_Cooter
Thamnophis_____Eastern_____Reptile_____X_____X
sauritus_pop.1____Ribbonsnake--
_____Lower_FL_Keys
Antrorbis_breweri__Manitou_Cavesnail_Snail_____X_____X___X
Aphaostracon_____Blue_Spring_____Snail_____X_____X___X
asthenes_____Hydrobe_Snail
Aphaostracon_____Freemouth_Hydrobe_Snail_____X_____X
chalarogyrus_____Snail
Aphaostracon_monas_Wekiwa_Hydrobe___Snail_____X_____X
_____Snail
Aphaostracon_____Dense_Hydrobe____Snail_____X_____X___X
pycnus_____Snail
Aphaostracon_____Clifton_Spring___Snail_____X_____X___X
theiocrenetum_____Hydrobe_Snail
Elimia_acuta_____Acute_Elimia_____Snail_____X_____X___X
Elimia_alabamensis_Mud_Elimia_____Snail_____X_____X___X
Elimia_ampla_____Ample_Elimia_____Snail_____X_____X___X
Elimia_annettae___Lilyshoals_Elimia_Snail_____X_____X___X
Elimia_arachnoidea_Spider_Elimia____Snail_____X_____X___X
Elimia_____Princess_Elimia___Snail_____X_____X___X

bellacrenata
Elimia_bellula_____Walnut_Elimia_____Snail_____X_____X
Elimia_____Prune_Elimia_____Snail_____X_____X___X
chiltonensis
Elimia_cochliaris__Cockle_Elimia_____Snail_____X_____X___X
Elimia_cylindracea_Cylinder_Elimia___Snail_____X_____X___X
Elimia_lachryma____Nodulose_Coosa____Snail_____X_____X___X
_____River_Snail
Elimia_nassula_____Round-Rib_Elimia__Snail_____X_____X___X
Elimia_olivula_____Caper_Elimia_____Snail_____X_____X___X
Elimia_perstriata__Engraved_Elimia___Snail_____X_____X___X
Elimia_showalteri__Compact_Elimia____Snail_____X_____X___X
Elimia_teres_____Elegant_Elimia____Snail_____X_____X___X
Elimia_vanuxemiana_Cobble_Elimia_____Snail_____X_____X___X
Floridobia_mica____Ichetucknee_____Snail_____X_____X___X
_____Siltsnail
Floridobia_____Enterprise_____Snail_____X_____X
monroensis_____Siltsnail
Floridobia_parva___Pygmy_Siltsnail___Snail_____X_____X
Floridobia_____Ponderosa_____Snail_____X_____X___X
ponderosa_____Siltsnail
Floridobia_wekiwae_Wekiwa_Siltsnail__Snail_____X_____X
Leptoxis_____Arkansas_Mudalia__Snail_____X_____X___X
arkansasensis
Leptoxis_picta_____Spotted_Rocksnail_Snail_____X_____X___X
Leptoxis_virgata___Smooth_Mudalia____Snail_____X_____X___X
Lithasia_curta_____Knobby_Rocksnail__Snail_____X_____X___X
Lithasia_____Helmet_Rocksnail__Snail_____X_____X
duttoniana
Lo_fluvialis_____Spiny_Riversnail__Snail_____X_____X___X
Marstonia_____Ocmulgee_____Snail_____X_____X
agarhecta_____Marstonia

Marstonia_castor___Beaverpond_____Snail_____X_____X___X
_____Marstonia
Marstonia_____Ozark_Pyrg_____Snail_____X_____X
ozarkensis
Planorbella_____Magnificent_____Snail_____X_____X___X
magnifica_____Ram's-horn
Pleurocera_____Corpulent_____Snail_____X_____X___X
corpulenta_____Hornsnail
Pleurocera_curta___Shortspire_____Snail_____X_____X
_____Hornsnail
Pleurocera_____Skirted_Hornsnail_Snail_____X_____X
pyrenella
Rhodacme_elatior___Domed_Ancylid_____Snail_____X_____X___X
Somatogyrus_____Reverse_____Snail_____X_____X
alcoviensis_____Pepplesnail
Acroneuria_____Virginia_Stone____Stonefly_____X_____X
kosztarabi
Allocapnia_brooksi_Sevier_Snowfly____Stonefly_____X_____X
Allocapnia_fumosa__Smokies_Snowfly___Stonefly_____X_____X
Allocapnia_____Karst_Snowfly_____Stonefly_____X_____X
cunninghami
Amphinemura_____Tennessee_____Stonefly_____X_____X
mockfordi_____Forestfly
Leuctra_szczytkoi__Louisiana_____Stonefly_____X_____X
_____Needlefly
Megaleuctra_____Smokies_Needlefly_Stonefly_____X_____X___X
williamsae
Tallaperla_lobata__Lobed_Roachfly____Stonefly_____X_____X
Aeschynomene_____Meadow_Joint-_____Vascular_Plant__X_____X___X
pratensis_____vetch
Alnus_maritima_____Seaside_Alder_____Vascular_Plant__X_____X
Amorpha_georgiana__Georgia_Leadplant_Vascular_Plant__X_____X

var._georgiana_____(GA_Indigo_Bush)
Arnoglossum_____Variable-leaved___Vascular_Plant__X_____X___X
diversifolium_____Indian-Plantain
Balduina_____Purple_Balduina___Vascular_Plant__X_____X
atropurpurea_____(Purpledisk
_____honeycombhead)
Baptisia_megacarpa_Apalachicola_Wild_Vascular_Plant__X___X_____X___X
_____Indigo
Bartonia_texana___Texas_Screwstem___Vascular_Plant__X_____X
Boltonia_montana___Doll's-Daisy_____Vascular_Plant__X_____X
Calamovilfa_____Rivergrass_____Vascular_Plant__X_____X
arcuata
Carex_brysonii_____Bryson's_Sedge___Vascular_Plant__X_____X___X
Carex_____Impressed-nerved__Vascular_Plant__X_____X___X
impressinervia_____Sedge
Coreopsis_____Ciliate-leaf_____Vascular_Plant__X_____X
integrifolia_____Tickseed
Croton_elliottii___Elliott's_Croton__Vascular_Plant__X_____X
Elytraria_____Narrowleaf_____Vascular_Plant__X_____X
caroliniensis_var._Carolina
angustifolia_____Scalystem
Encyclia_cochleata_Clam-shell_Orchid_Vascular_Plant_____X_____X
var._triandra
Epidendrum_____Big_Cypress_____Vascular_Plant__X___X_____X___X
strobiliferum_____Epidendrum
Eriocaulon_____Small-headed_____Vascular_Plant__X_____X
koernickianum_____Pipewort
Eriocaulon_____Black-bracket_____Vascular_Plant__X_____X___X
nigrobracteatum___Pipewort
Eupatorium_____A_Thoroughwort___Vascular_Plant__X_____X___X
paludicola
Eurybia_____Rockcastle_Wood-__Vascular_Plant__X_____X___X

saxicastellii_____Aster
Fimbristylis_____Harper's_____Vascular_Plant__X_____X
perpusilla_____Fimbristylis
Forestiera_____Godfry's_Privet___Vascular_Plant__X_____X____X
godfreyi
Hartwrightia_____Hartwrightia_____Vascular_Plant__X_____X
floridan
Helianthus_____Shinner's_____Vascular_Plant__X_____X
occidentalis_ssp.__Sunflower
plantagineus
Hexastylis_____Harper's_____Vascular_Plant__X_____X____X
speciosa_____Heartleaf
Hymenocallis_____Henry's_Spider-___Vascular_Plant__X____X_____X
henryae_____lily
Hypericum_____Edison's_Ascyrum__Vascular_Plant__X_____X
edisonianum
Hypericum_____Smooth-barked_St._Vascular_Plant__X_____X
lissophloeus_____John's-wort
Illicium_____Yellow_Anisetree__Vascular_Plant__X____X_____X
parviflorum
Isoetes_hyemalis___Winter_or_____Vascular_Plant__X_____X
_____Evergreen
_____Quillwort
Isoetes_microvela__Thin-wall_____Vascular_Plant__X_____X____X
_____Quillwort
Lilium_iridollae___Panhandle_Lily____Vascular_Plant__X____X____X____X
Lindera_____Bog_Spicebush_____Vascular_Plant__X_____X____X
subcoriacea
Linum_westii_____West's_Flax_____Vascular_Plant__X_____X
Lobelia_boykinii___Boykin's_Lobelia__Vascular_Plant__X_____X____X
Ludwigia_brevipes__Long_Beach_____Vascular_Plant__X_____X
_____Seedbox

Ludwigia_____Spathulate_____Vascular_Plant__X_____X
spathulata_____Seedbox
Luwigia_ravenii____Raven's_Seedbox___Vascular_Plant__X_____X____X
Lythrum_curtissii__Curtis's_____Vascular_Plant__X_____X
_____Loosestrife
Lythrum_flagellare_Lowland_____Vascular_Plant__X_____X
_____Loosestrife
Macbridea_____Carolina_Birds-___Vascular_Plant__X_____X____X
caroliniana_____in-a-nest
Marshallia_____Large-flowered____Vascular_Plant__X_____X
grandiflora_____Barbara's-buttons
Minuartia_godfreyi_Godfry's_____Vascular_Plant__X_____X
_____Stitchwort
Najas_filifolia____Narrowleaf_Naiad__Vascular_Plant__X_____X____X
Nuphar_lutea_ssp.__Cape_Fear_____Vascular_Plant__X_____X____X
sagittifolia_____Spatterdock_or
_____Yellow_Pond_Lily
Nuphar_lutea_ssp.__West_Florida_Cow-_Vascular_Plant__X_____X
ulvacea_____lily
Nyssa_ursina_____Bear_Tupelo_or____Vascular_Plant__X_____X____X
_____Dwarf_Blackgum
Oncidium_undulatum_Cape_Sable_Orchid_Vascular_Plant_____X_____X
Physostegia_____Correll's_False___Vascular_Plant__X_____X
correllii_____Dragonhead
Potamogeton_____Florida_Pondweed__Vascular_Plant__X_____X
floridanus
Potamogeton_____Tennessee_____Vascular_Plant__X_____X____X
tennesseensis_____Pondweed
Ptilimnium_ahlesii_Carolina_____Vascular_Plant__X_____X____X
_____Bishopweed
Rhexia_parviflora__Small-flower_____Vascular_Plant__X_____X____X
_____Meadow-beauty

Rhexia_salicifolia_Panhandle_Meadow-_Vascular_Plant__X_____X
_____beauty
Rhynochospora_____Hairy-peduncled___Vascular_Plant__X_____X
crinipes_____Beakbush
Rhynchospora_____Thorne's_Beakbush_Vascular_Plant__X_____X
thornei
Rudbeckia_____Eared_Coneflower__Vascular_Plant__X_____X____X____X
auriculata
Rudbeckia_____Sun-facing_____Vascular_Plant__X_____X
heliopsidis_____Coneflower
Salix_floridana____Florida_Willow____Vascular_Plant__X_____X____X
Sarracenia_____Mountain_purple___Vascular_Plant__X____X_____X
purpurea_var._____pitcherplant
montana
Sarracenia_rubra___Gulf_Sweet_____Vascular_Plant__X_____X
ssp._gulfensis_____Pitcherplant
Sarracenia_rubra___Wherry's_Sweet____Vascular_Plant__X_____X
ssp._wherryi_____Pitcherplant
Schoenoplectus_____Hall's_Bulrush____Vascular_Plant__X_____X____X____X
hallii
Scutellaria_____Ocmulgee_Skullcap_Vascular_Plant__X_____X____X
ocmulgee
Sideroxylon_____Swamp_Buckhorn_or_Vascular_Plant__X_____X____X
thornei_____GA_Bully
Solidago_arenicola_Southern_Racemose_Vascular_Plant__X_____X____X
_____Goldenrod
Sporobolus_____Wire-leaved_____Vascular_Plant__X_____X
teretifolius_____Dropseed
Stellaria_____Water_Stitchwort__Vascular_Plant__X_____X____X
fontinalis
Symphyotrichum_____Rough-stemmed_____Vascular_Plant__X_____X
puniceum_var._____Aster

scabricaule
Thalictrum_debile__Southern_____Vascular_Plant__X_____X___X
_____Meadowrue
Trillium_texanum___Texas_Trillium____Vascular_Plant__X_____X___X
Tsuga_caroliniana__Carolina_Hemlock__Vascular_Plant__X_____X___X
Vicia_ocalensis____Ocala_Vetch_____Vascular_Plant__X_____X___X
Waldsteinia_lobata_Lobed_Barren-_____Vascular_Plant__X_____X___X
_____strawberry
Xyris_longisepala__Kral's_Yellow-____Vascular_Plant__X_____X
_____eyed_Grass
___Factor_A:_Present_or_threatened_destruction,_modification_or_curtailment_of_its_habitat_or_range.
___Factor_B:_Overutilization_for_commercial,_recreational,_scientific,_or_educational_purposes.
___Factor_C:_Disease_or_predation.
___Factor_D:_Inadequacy_of_existing_regulatory_mechanisms.
___Factor_E:_Other_natural_or_manmade_factors.

Evaluation of the Information Provided in the Petition and Available in Service Files

We reviewed and evaluated 374 of 404 species in the petition, as well as the additional information contained in the second petition for the Carolina hemlock and the supplemental information provided for the Panama City crayfish. Due to the large number of species reviewed, we were only able to conduct cursory reviews of the information in our files and the literature cited in the petition. For many of the narrowly endemic species included in the 374 species, we had no additional information in our files and relied solely on the information provided in the petition and provided through NatureServe.

Finding

On the basis of our evaluation under section 4(b)(3)(A) of the Act, we determine that the petition presents substantial scientific or commercial information that listing 374 species (listed in Table 2) as endangered or threatened under the Act may be warranted. This finding is based on information provided under Factors A, B, C, D, and E. Because we have found that the petition presents substantial information indicating that listing may be warranted, we are initiating status reviews to determine whether listing these species under the Act is warranted.

In addition, we find that the petition presents substantial scientific or commercial information indicating that listing 18 species that are current candidate species or the subjects of proposed rules to list may be warranted. The 18 species (listed with details in the Petition History section) are sicklefin redhorse, laurel dace, spectaclecase, narrow pigtoe, round ebonyshell, southern sandshell, sheepnose, fuzzy pigtoe, southern kidneyshell, rabbitsfoot, tapered pigtoe, Choctaw bean, rayed bean, black mudalia, Coleman cave beetle, Black Warrior waterdog, Yadkin River goldenrod, and the snuffbox. As a warranted determination for listing has already been made for these species, we will not be initiating status reviews for these species at this time. Further information on the assessments for these 18 species can be found at http://ecos.fws.gov/tess_public/.

The "substantial information" standard for a 90-day finding differs from the Act's "best scientific and commercial data" standard that applies to a status review to determine whether a petitioned action is warranted. A 90-day

finding does not constitute a status review under the Act. In a 12-month finding, we will determine whether a petitioned action is warranted after we have completed a thorough status review of the species, which is conducted following a substantial 90-day finding. Because the Act's standards for 90-day and 12-month findings are different, as described above, a substantial 90-day finding does not mean that the 12-month finding will result in a warranted finding.

We previously determined that emergency listing of any of the 404 petitioned species is not warranted. However, if at any time we determine that emergency listing of any of the species is warranted, we will initiate an emergency listing at that time.

The petitioners requested that critical habitat be designated concurrent with listing under the Act. If we determine in our 12-month finding, following the status review of the species, that listing is warranted, we will address the designation of critical habitat in the subsequent proposed rule.

References Cited

A complete list of references cited is available on the Internet at http://www.regulations.gov and upon request from the Southeast Ecological Services Regional Office (see FOR FURTHER INFORMATION CONTACT).

Authors

The primary authors of this document are the staff members of the Southeast Region Ecological Services Offices.

Authority: The authority for this action is Section 4 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)

Dated: September 12, 2011.

Rowan W. Gould,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2011-24633 Filed 9-26-11; 8:45 am]

BILLING CODE 4310-55-P

Publication date: Sep 27, 2011

Year: 2011

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360 Audiologist is a hearing hero for artists, fans

Author: Barnes, Michael

Publication info: Austin American Statesman [Austin, Tex] 13 Sep 2011: D.1.
ProQuest document link

Abstract: "Without any protection at all and noise levels exceeding 100 decibels for longer than one hour, then they are susceptible to permanent hearing loss," Estes says. Estes became fascinated with the relatively young field of audiology on a sports field, where her boyfriend - now her husband of 14 years - played high school baseball.

Full text: Michael Barnes AMERICAN-STATESMAN; Soriya Estes founded the HEAR program, which will hand out 5,000 pairs of earplugs at this weekend's music festival.

When Soriya Estes visits the Austin City Limits Music Festival this week, the audiologist will worry about ears. "Without any protection at all and noise levels exceeding 100 decibels for longer than one hour, then they are

susceptible to permanent hearing loss," Estes says. "Anywhere close to the chair line, you are already close to 100 decibels. And (guests) aren't there for just an hour. They are there all day. For three days."

The owner of Estes Audiology and founder of the HEAR program that helps professional musicians has come up with a partial solution for music lovers during the fest. Her practice will pass out 5,000 pairs of foam plugs in reusable cases that snap onto any bag. The free earplugs will be available at the HAAM - Heath Alliance for Austin Musicians - table in the ACL Cares area.

"It's just really important to have that hearing protected," she says. "Even if you don't have the hearing loss at that time, studies show that, when age factor kicks in, it's going to go quicker."

Estes, 36, is one of that rare breed who has always known what she would do. Born in Perry, Okla., she grew up in nearby Tonkawa, alongside members of the tribe that formerly populated Central Texas. ("I've never lived more than 20 miles off Interstate 35 all my life.") Her mother, DeAnna Smith, worked as a hospital administrator and now manages Estes' practice with offices in Georgetown, Kyle and New Braunfels. Her father, Iranian-born Majid Hamidi, owned restaurants and has since retired to Henderson, Nev. (Her first name, pronounced Sor-EYE-ya, is borrowed from Persian royalty.)

"Growing up, I never felt that different," she says of her Iranian ancestry. "The very first time I ever had a concern was after the Oklahoma City bombings. I was in college at Oklahoma State. Before they knew who did it, my father called and said 'Don't go to class today.' I thought: 'Wow. My name could ignite prejudice.'"

The same anxiety followed 9/11, says Estes, who grew up Christian.

Estes became fascinated with the relatively young field of audiology on a sports field, where her boyfriend - now her husband of 14 years - played high school baseball.

"There was a pitcher in the playoffs who was in a zone: Killing it, killing it, killing it during a championship game," she recalls. "I looked over at his coach, who was signing to him. You didn't see deaf students incorporated in the mainstream back then, not in a small town. It was one of those quirky little moments."

She sat down with the deaf player's family and started researching audiology. From that point, she never deviated, studying first at Oklahoma State University, then the University of Texas and - long-distance - finishing her doctorate at Pennsylvania's Salus University.

She and her husband, Brian Estes, who serves as business development director for a precast concrete company, settled in Austin, where they are raising two young daughters. After teaming with an ear, nose and throat specialist to build a practice in New Braunfels, she worked for Phonak Hearing Systems, a global hearing-aid manufacturer. Estes Audiology was born in 2005. (A fourth office is planned for Austin.)

So what causes hearing loss?

"Noise," she says. "That's one of the leading causes in people under 65. The mistake is thinking: 'Hearing loss means I'm old.' It affects all ages, mainly because of noise."

A recent study shows that the incidence of hearing loss in teens is on a sharp rise.

"I thought: Holy cow! We are trying to educate hunters and musicians. We are forgetting teens," she says. "Go to the mall and you see all the teens with iPods in the hands and in their ears. We are not doing a good enough job of looking at that."

Very high numbers of active-duty soldiers are coming home with noise-induced hearing loss, too.

Variable hearing loss can be experienced by anyone who attends a concert or a dance club. (Just ask your social columnist. If he can hear you.) This is called a "temporary threshold shift."

"You have these tiny, thin, upright hair cells," Estes says. "Repeated beatings tend to make them not stand up straight all the time."

Less glamorously, allergens can inflame the middle ear for temporary loss. That condition is treated with allergy medications.

Musicians and music lovers tend to suffer from permanent damage at different pitches inside the snail-like inner ear spiral.

"The hairs here look like keys on a keyboard," Estes says. "Every center is a pitch. High-frequency keys on the outside go first. Low-frequency hairs - protected, hidden, warm, fuzzy - they go last."
The music clan tends to ignore such hearing loss, hoping it will go away.
"During early hearing loss, people tend to 'squint' for a little bit," Estes says. "Ray Wylie Hubbard would say: 'I find my ears are squinting. I have to squint to hear people.'"
So how did the HEAR program start four years ago? Estes: "I was getting ready for work one day. Tim Taylor, local attorney and HAAM board member, was promoting HAAM benefit day on the radio. I thought: 'There's the Seton part of HAAM (general medical) and the SIMS part (mental health care and addiction recovery). Where's their hearing health care? Wait a minute. We are talking about musicians. This doesn't make sense.'"
She contacted Taylor, who talked to HAAM executive director Carolyn Schwarz, who in turn surveyed her members. The vast majority requested hearing health care.
"Screen, educate and protect are the three missions," Estes say of the HEAR sessions. Eighty musicians may sign up at one time. Estes closes down her practices and they meet at a central location. Musicians learn about their hearing levels and types of exposure. Then the audiologists take silicon castings of each ear, sending them to labs to make custom ear plugs with filters that allow all frequencies to be evenly attenuated, so sound quality is not compromised when volume is reduced.
Musicians pay $25 for a pair that would usually cost $150.
Estes: "It is so rewarding when we can actually tell most of the musicians they have normal hearing or they are doing the right thing by beginning to protect their ears."
mbarnes@statesman.com

Publication date: Sep 13, 2011

Year: 2011

Concert sound, anywhere

Author: Gugliotta, Guy

Publication info: International Herald Tribune [Paris] 07 Sep 2011: 13.
ProQuest document link

Abstract (Abstract): Acousticians have been designing concert halls for more than a century, but Dr. [Chris Kyriakakis] does something different. He shapes the sound of music to conform to the space in which it is played. The goal is what Dr. Kyriakakis calls the "ground truth" -- to replicate the original in every respect. "We remove the room," he said, "so the ground truth can be delivered."
"Hearing aids are not the same as glasses," said Dr. [Andrew J. Oxenham], at the University of Minnesota. "It's never been just about hearing sound, it's also about understanding sound and separating it from background noise. We can help with microprocessors. Without them it would have been impossible."
"The technology is really being strained," said Dr. [William M. Hartmann], at Michigan State. Because of psychoacoustics, "we know so much more, and therefore we can do so much more," but "there is so much more to do."

Full text: Psychoacoustics is the key to replicating the ear's experience of live music.
There is, perhaps, no more uplifting musical experience than hearing the "Hallelujah" chorus from Handel's

"Messiah" performed in a perfect space. Many critics regard Symphony Hall in Boston -- 70 feet wide, 120 feet long and 65 feet high -- as just that space.

On the other side of the United States however, a visitor led into the pitch-blackness of Chris Kyriakakis's audio lab at the University of Southern California to hear a recording of the performance would have no way to know how big the room (which in metric measurements is 21.3 meters by 36.5 meters by 19.8 meters) was.

At first it sounded like elegant music played in the parlor on good equipment. Nothing special.

But as engineers added different combinations of speakers, the room seemed to expand and the music swelled in richness and depth, until finally it was as if the visitor were sitting with the audience in Boston.

Then the music stopped and the lights came on. It turned out that the Immersive Audio Lab at U.S.C.'s Viterbi School of Engineering is dark, a bit dingy, and only 30 feet wide, 45 feet long and 14 feet high.

Acousticians have been designing concert halls for more than a century, but Dr. Kyriakakis does something different. He shapes the sound of music to conform to the space in which it is played. The goal is what Dr. Kyriakakis calls the "ground truth" -- to replicate the original in every respect. "We remove the room," he said, "so the ground truth can be delivered."

Dr. Kyriakakis, an electrical engineer at U.S.C. and the founder and chief technical officer of Audyssey Laboratories, a Los Angeles-based audio firm, could not achieve his results without modern sound filters and digital microprocessors.

But the basis of his technique is rooted in the science of psychoacoustics, the study of sound perception by the human auditory system. "It's about the human ear and the human brain, and understanding how the human ear perceives sound," Dr. Kyriakakis said.

Psychoacoustics has become an invaluable tool in designing hearing aids and cochlear implants, and in the study of hearing generally. "Psychoacoustics is fundamental," said Andrew J. Oxenham, a psychologist and hearing expert at the University of Minnesota. "You need to know how the normally functioning auditory system works -- how sound relates to human perception."

The field's origins date back more than a century, to the first efforts to quantify the psychological properties of sound. What tones could humans hear, and how loudly -- or softly -- did they need to be heard?

Pitch could be measured in hertz and loudness in decibels, but other phenomena were not so easily quantified. Human hearing can discern the movement of sound with a surprising degree of accuracy. It can distinguish timbre -- the difference between a clarinet and a saxophone. It can remember patterns of speech -- to immediately identify a friend in a phone call years after last hearing the voice. And a parent's ear can effortlessly sift the faint sound of an infant's cry from the blare of a televised football game.

Finally there were the imponderables, things humans do with their hearing simply because they can. "Everyone knows the sound of a bowling ball as it rolls down the alley," said William M. Hartmann, a Michigan State University physicist who is former president of the Acoustical Society of America. "What is it about that sound that we can identify?"

For much of the 20th century, engineers devoted themselves to developing acoustical hardware like amplifiers, speakers and recording systems. After World War II, scientists learned how to use mathematical formulas to "subtract" unwanted noise from sound signals. Then they learned how to make sound signals without any unwanted noise.

Next came stereo. By recording two tracks, engineers could localize sound for the listener. "Simple enough," said Alan Kraemer, chief technological officer for the audio company SRS Labs, based in Santa Ana, California. "If something's louder on one side, you'll hear it on that side."

But stereo had no real psychoacoustics. It created an artificial sense of space with a second track, but did so by dealing with only one variable -- loudness -- and enhanced human perception simply by suggesting that listeners separate their speakers.

The digital age changed all this, allowing engineers to manipulate sound in ways that had never been tried

before. They could create sounds that had never existed, eliminate sounds they did not want and use constant changes in filter combinations to deliver sound to listeners with a fidelity that had never before been possible.
Digital technology has led to innovations that have been critical in improving sound reproduction, in tailoring hearing aids to the needs of individual patients and in treating hearing impairment and developing cochlear implants -- tiny electronic devices linking sound directly to the auditory nerve of a deaf person.
"Hearing aids are not the same as glasses," said Dr. Oxenham, at the University of Minnesota. "It's never been just about hearing sound, it's also about understanding sound and separating it from background noise. We can help with microprocessors. Without them it would have been impossible."
Despite recent advances, however, psychoacoustics has shown engineers that they still have a long way to go. No machine can yet duplicate the ability of the human ear to understand a conversation in a crowded restaurant. People with cochlear implants have "a terrible time" with background noise, Dr. Oxenham said. They also have trouble with pitch perception and distinguishing the sounds of different instruments. "Hearing loops," which are transmitters that broadcast sound signals directly to a receiver in a hearing aid, are catching on in concert halls, places of worship and even subway booths.
"The technology is really being strained," said Dr. Hartmann, at Michigan State. Because of psychoacoustics, "we know so much more, and therefore we can do so much more," but "there is so much more to do."
One factor that slows the pace of innovation, Dr. Hartmann suggested, is that the human auditory system is "highly nonlinear." It is difficult to isolate or change a single variable -- like loudness -- without affecting several others in unanticipated ways. "Things don't follow an intuitive pattern," he said.
For the unsophisticated listener, top-of-the-line sound equipment by itself seems good enough, but it is not nearly the same as the psychoacoustically adjusted version. A video of the Eagles singing "Hotel California" sounded nice to a visitor until Audyssey's hardware director, Andrew Turner, pointed out that there was no bass when the volume was low. He flicked a switch and the bass returned, enriching the music with startling impact.
"At the concert itself, where there was a big room with a lot of high-volume sound, you could hear the low tones," he said. "But here in the studio, your brain is filtering them out as irrelevant at low volume. So you have to restore them.
"It's pure psychoacoustics."

Publication date: Sep 7, 2011

Year: 2011

Sound, the Way the Brain Prefers to Hear It

Author: Gugliotta, Guy

Publication info: New York Times , Late Edition (East Coast) [New York, N.Y] 06 Sep 2011: D.1.
ProQuest document link

Abstract: [...] there were the imponderables, things we do with our hearing simply because we can. Digital technology has led to innovations that have been critical in improving sound reproduction, in tailoring hearing aids for individual patients and in treating hearing impairment and developing cochlear implants -- tiny electronic devices linking sound directly to the auditory nerve of a deaf person.

Full text: CORRECTION APPENDED

LOS ANGELES -- There is, perhaps, no more uplifting musical experience than hearing the "Hallelujah" chorus from Handel's "Messiah" performed in a perfect space. Many critics regard Symphony Hall in Boston -- 70 feet wide, 120 feet long and 65 feet high -- as just that space.

Some 3,000 miles away, however, a visitor led into the pitch-blackness of Chris Kyriakakis's audio lab at the University of Southern California to hear a recording of the performance would have no way to know how big the room was.

At first it sounded like elegant music played in the parlor on good equipment. Nothing special. But as engineers added combinations of speakers, the room seemed to expand and the music swelled in richness and depth, until finally it was as if the visitor were sitting with the audience in Boston.

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The field's origins date back more than a century, to the first efforts to quantify the psychological properties of sound. What tones could humans hear, and how loudly or softly did they need to be heard?

Pitch could be measured in hertz and loudness in decibels, but other phenomena were not so easily quantified. Human hearing can discern the movement of sound with a surprising degree of accuracy. It can distinguish timbre, the difference between a clarinet and a saxophone. It can remember patterns of speech, to immediately identify a friend in a phone call years after last hearing the voice. And a parent can effortlessly sift the sound of an infant's cry from the blare of a televised football game.

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It was this anomaly, in part, that led Dr. Kyriakakis in the 1990s to venture into psychoacoustics. He, his U.S.C. film school associate Tomlinson Holman, and their students were trying to improve the listening qualities of a room by measuring sound with strategically placed microphones.

"Often our changes were worse than doing nothing at all," Dr. Kyriakakis recalled. "The mic liked the sound, but the human ear wasn't liking it at all. We needed to find out what we had to do. We had to learn about psychoacoustics."

The trick was to establish a baseline for what sounded best, and there was no guidebook. So Dr. Kyriakakis and his students went to Boston Symphony Hall in 1998 to conduct a series of sound tests and to record the "Messiah."

At that time, acousticians had long known that a shoebox-shaped concert hall like Boston's offered the best sound, but what was important for Dr. Kyriakakis was to know why the human ear and the human brain that processed the signal felt that way.

Back in Los Angeles, his team began a series of simple experiments. Listeners were invited into the labs to hear the Boston tests and music and to rate the sound, using a scale of 1 to 5. Researchers shifted the sound to different combinations of speakers around the room.

Statistics showed that speakers directly ahead, combined with speakers 55 degrees to either side of the listener, provided the most attractive soundstage. The "wide" speakers mimicked the reflection from the side walls of the concert hall by causing the sound to arrive at the listener's ears milliseconds after the sound from the front. Sound from other angles did not have as great an effect.

Next, the team asked listeners what combination of speakers gave the best impression of "depth of stage." Here again, statistics showed a clear preference for speakers in front of listeners and high above them. This sound -- also slightly delayed -- gave the ear and the human brain a sense of where the different instruments were on a bandstand.

With these results as his template, Dr. Kyriakakis founded Audyssey. His idea was to make dens and living rooms sound like concert halls and movie theaters. Microprocessors made it possible to filter sound to minimize

distortion and add the delays that make the music sound nearly perfect to the human ear from anywhere in the room.

Audyssey's first product, MultEQ, started with a five-speaker configuration, but for a full concert-hall-like effect, it now offers what Dr. Kyriakakis calls an "11.2" system: three speakers in front of the listener; two elevated speakers; two wides; two speakers slightly behind the listener, and two speakers directly in back. Audio-video receivers with Audyssey's latest MultEQ technology cost $1,000 to $2,000.

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Correction: September 7, 2011, Wednesday

This article has been revised to reflect the following correction: A picture in some editions on Tuesday with an article about advances in psychoacoustics was published in error. It showed the Boston Symphony Orchestra performing at Carnegie Hall in Manhattan -- not at Symphony Hall in Boston, which is regarded by many critics as an acoustically perfect space.

Photograph

Harmony: The Boston Symphony Orchestra, Top, at Carnegie Hall -- A Less Ideal Space Than Its Own Home. Above, Tyson Yaberg of Audyssey Laboratories Listened to an Experimental System. (Photographs by Joe Kohen for the New York Times; David Ahntholz for the New York Times)

GRAPHICS: Tuning A Room: Researchers studying how the brain perceives sound have developed technology to improve the soundscape of a room. (Source: Audyssey) (D4)

Company / organization: Name: University of Southern California; NAICS: 611310;

Publication date: Sep 6, 2011

Year: 2011

Marian Anderson and "Sonic Blackness" in American Opera

Author: Eidsheim, Nina Sun

Publication info: American Quarterly, suppl. Special Issue: Sound Clash: Listening to American Studies 63.3 (Sep 2011): 641-671,857.

ProQuest document link

Abstract: [...] my question is the following: given that all American classical singers are trained in a musical culture that, equally for all of them, is bound to a secondary (European) culture, and given classical music's minimal indulgence of individual style, what singles out African American classical singers as nonetheless inhabiting a particularly "black" voice? [...] no ear is innocent.

Full text: The Saints were supposed to be Spaniards [wrote Time Magazine about Four Saints in Three Acts,] but Virgil Thomson had chosen Harlem Negroes because of their diction. White singers, he feared, would act foolish and self-conscious chanting such lines as "Let Lucy Lily Lily Lucy Lucy let Lucy Lucy Lily Lily Lily Lily Lily let Lily Lucy Lucy let Lily. Let Lucy Lily."

-"Music: Saints in Cellophane," Time Magazine

A great diva with a long career behind her was singing Tosca at the Met in 1961. Her dresser asked her whether she had yet heard Leontyne Price, who had just made her unmatched debut as Leonora in Il Trovatore. "Ah, yes," purred [the diva]. "Price. A lovely voice. But the poor thing is singing the wrong repertory!" The dresser registered surprise. "What repertory," he asked, "should Price be singing?" The great diva smiled a knowing smile. "Bess," she purred. "Just Bess."

-Martin Bernheimer, "Yes, but Are We Really Colour Deaf?," Opera

On a cloudy January 7 in 1955, the golden-red auditorium glowed with expectation. On the dark, gaping stage beyond the proscenium, Marian Anderson took her position as the gypsy sorceress Ulrica in Giuseppe Verdi's Un Ballo in Maschera.

The curtain rose . . . and I was there on the stage, mixing the witch's brew, [Anderson recalls]. I trembled, and when the audience applauded and applauded before I could sing a note I felt myself tightening into a knot. . . . and things happened to my voice that should not have happened. . . . my emotions were too strong.1

The emotional power of this moment is not surprising. At the time of Anderson's debut, the Metropolitan Opera, the largest and most prestigious opera house in the United States, had been exclusively white for its entire seventytwo- year history. Most people felt in 1955 that despite her brief tenure (only eight performances over two seasons) Anderson's hiring was a decisive moment on the path toward desegregating classical music; it was celebrated as a new chapter in American racial relations and policies. As the New York Times noted, it would "open doors" for "other Negro singers."2 In fact, Anderson's triumphant debut was one of many concrete manifestations of incremental improvements for which the civil rights movement had fought long and hard. Many of the conditions that Anderson had to overcome to reach this pivotal moment gradually improved for later generations of African American singers. However, while the second half of the twentieth century saw American opera houses decisively integrated, the black performer is yet consistently viewed as peculiar. While descriptions of her visual appearance have been toned down through the decades, the timbre of her voice has routinely (if often admiringly) been characterized as "black."

Racialized Voice

Several opera scholars discuss the visual appearances of African American singers in terms of casting. Rosalyn Story investigates the ambiguous feelings expressed by many African American singers toward George Gershwin's black-cast-only opera Porgy and Bess (1935) and its racial typecasting. Lisa Barg describes how the first casting of Virgil Thomson's Four Saints in Three Acts (1934) relied on preconceptions that tended to exoticize African American performers.3 And Jason Oby's important bouquet of interviews reveals that it is easier for African Americans to succeed as baritones or basses, because the roles written for these vocal types are typically villains. There is also considerable resistance to casting African American tenors as romantic leads, which could entail their playing opposite white love interests.4 However, while much research exists on racialized language perception and casting, there is no thorough investigation of the oddly discerning listening practice that so readily identifies certain classical voices as "black," that specifically locates blackness in timbre- the characteristic sound of the voice.5

The identification of a person who has mastered Western classical vocal production and repertoire as black requires a very different conceptual process than does the identification of a popular-music singer as a member of a racial category.6 In popular genres, vernacular languages and pronunciation styles are used to tag performers with social distinctions.7 In other words, contextual or linguistic information is available in popular music genres and can be used to position the singer. The resultant identification is not primarily about race per

se; it involves, for instance, geographic and social location, which often coincide with racial divisions. In contrast, not only does classical repertoire feature narrowly defined conventions of pronunciation, timbre, and stylistic range determined by a work's historical period, geography, and composer, but the notated compositions also dictate fixed pitches and durations for syllables and pauses, which therefore must be produced in the same way by each singer.8 Unlike popular music genres in which individual style is encouraged, taking liberties with pronunciation is not rewarded in the classical vocal world.

It is not an exaggeration to say that the classical singer is defined by adherence to these established aesthetic, technical, and stylistic conventions, and that it is through the characteristic vocal timbre resulting from adherence to the aforementioned conventions that a voice is recognized as a "classical voice."9 Without these vocal qualities the singer is simply not considered a classical singer by the opera community. Hence my question is the following: given that all American classical singers are trained in a musical culture that, equally for all of them, is bound to a secondary (European) culture, and given classical music's minimal indulgence of individual style, what singles out African American classical singers as nonetheless inhabiting a particularly "black" voice? We must take this distinction to be based on an assumption that the black body is intrinsically different from the white body and that even when emitting a timbre recognized as classical, the resonance of a singer's black body is evident. In interactions with recording media the black voice has indeed been viewed as distinct. "Negroes [record] better than white singers, because their voices have a certain sharpness or harshness about them that a white man has not," the trade paper Phonogram reported in 1891.10 This fundamental physiological difference-"there is a peculiar vibrating quality in the negro voice, due, perhaps, to a peculiar arrangement of the vocal chords [sic], which is not found in the white race"-was clearly expressed in a 1903 Washington Post article.11 However, my research on vocal morphology concludes that there are no more similarities within a so-called racial group than there are differences between groups.12 Therefore the distinction must lie beyond the sound itself.

Linguistic research forcefully demonstrates that nonsonic information plays a crucial role in how we perceive voices and determine racial identities in general. Asked to rate the comprehensibility and intelligence of a lecture recorded by a native speaker of American English, paired with a photo of either an Asian-looking or a Caucasian-looking lecturer, listeners gave lower ratings to the recording paired with the Asian-looking lecturer. Since the same recording accompanied both photos, researchers concluded that the listeners expected the Asian-looking lecturer to speak in accented, simplified English, and therefore heard her speech that way.13 Additionally, the participants in this study listened with the assumption not only that the voice discloses the speaker's racial category but also that the Asian lecturer was less intelligent. Considering how the study was designed, it becomes clear that the participants listened with their eyes and judged intelligence with their prejudices.

Examples from outside the laboratory, illustrating people's propensity for this type of judgment, are not hard to come by. American equal-rights activists have shown that landlords make decisions based on potential renters' vocal accents, tending to decide against tenants whose accents reflect "undesirable" populations-that is, black and Latino, according to the study.14 The American legal system also assumes that every voice is tied to an unambiguously raced or unmarked body. In 1999 the Kentucky Supreme Court ruled that since witnesses' recognitions of female voices are admissible as evidence, "we perceive no reason why a witness could not likewise identify a voice as being that of a particular race or nationality, so long as the witness is personally familiar with the general characteristics, accents or speech patterns of the race or nationality in question."15 In this decision voice is established as unambiguously representative of a stable body.16 In summary, both visual information and accent are relied on to determine people's racial category.

Blackness and Vocal Timbre

It is presumably such a stable, inescapable body that the critic Geerd Heinsen hears. About Cynthia Clarey's voice in Les Contes d'Hoffmann, he writes that its "tone quality [is] too Negroid for the French vocal line," adding

hastily that his judgment was merely "a matter of taste."17 In The Singing Voice Robert Rushmore writes, "I think today that if he did not know, a perceptive listener would instantly recognize the voice of Leontyne Price as belonging to a black."18 Did Heinsen's and Rushmore's "perceptive listeners" base this distinction on listening only, or was their hearing influenced by nonsonic aspects?

A popular narrative attests that African American singers arrive at a distinctly "black" version of the classical timbre by first working with spirituals. Two celebrated African American opera singers, Simon Estes and Barbara Hendrix, do indeed cite their experience with spirituals as influential on their growth as classical singers. Specifically, Hendrix attributes her ability to express suffering in Mozart arias to her embodied understanding of spirituals. In contrast, the first African American Metropolitan Opera coach, Sylvia Lee, hired in 1950, said about the African American soprano Martina Arroyo's attempts at spirituals that she had never heard such white spirituals in her life.19 Lee subsequently coached Arroyo in that repertoire in the same way she coached diction and phrasing in German lieder. Thus while some singers acknowledge spiritual singing as an important stage in their artistic development, others were not brought up with the spiritual and were in fact "illiterate" in the idiom, having to learn it like any other vocal style as part of a professional repertoire. Nonetheless, the claim that the distinguishable African American operatic vocal timbre is conditioned by spiritual-singing is relentless. Based on the studies mentioned earlier, one may suspect that this narrative's persistence stems from unspoken beliefs about a uniform black culture, that the black body is distinct from the white body and thus possesses a different vocal timbre.20

In the twenty-first century, many of us believe such racist attitudes outmoded. Yet in 2007 the African-American soprano Hope Briggs was fired by the San Francisco Opera at the eleventh hour from the role of Donna Anna in Don Giovanni, sparking a storm of protest letters and articles claiming that her dismissal was a reaction to her race.21 General Director David Gockley's official announcement was that Briggs's voice "was not ultimately suited for this role in this production."22 Yet both the San Francisco Chronicle and the New York Times published reports from unnamed sources within the opera house that stated that Briggs had sounded fine at the final dress rehearsal.23 These articles raised serious questions as to the relevance of Briggs's race to Gockley's decision, highlighting the generally precarious position of African American opera singers.

As Arroyo demonstrates, the African American vocal apparatus possesses no physical features that would account for the perception of its "black" vocal timbre.24 Nor do socialization and acculturation quite make sense as explanations for lingering dialects or accents, vis-à-vis vocal virtuosi who routinely sing in languages of which they are not native speakers. Moreover, listeners have been known to misjudge singers' or actresses' races-Marilyn Horne as black, Arroyo as white.25 In these cases timbral blackness is not the resonance of a particular type of body; instead it resonates in the listener's ear.

By locating blackness in timbre, audiences and critics alike were able to name racial difference while they acknowledged, seemingly without conflict, impeccable vocal runs and otherwise flawless delivery. In her discussion of the use of hip-hop in film soundtracks, Mendi Obadike discovers that sound may summon the presence of blackness even without the attendance of black bodies-a phenomenon that she terms "acousmatic blackness." This concept may help us theorize how black vocal timbre is constructed and perceived in the voices of African Americans in general, and in those of African American opera singers, who otherwise adhere to the strict sonic and stylistic formulae of classical music, in particular.26 As Obadike argues that hip-hop music may summon the presence of blackness without an accompanying black body, in the case of African American opera singers I suggest that acousmatic blackness-the perceived presence of the black body in a voice that otherwise meets all of the standards of a professional classical voice-is called into presence in an otherwise idiomatic classical voice. Today, when the identification of race in strongly visual terms and discrimination on visual bases are both taboo and unlawful, blackness is subsumed into sound and vocal timbre, the disparagement of which can readily be clothed as a personal sonic (not necessarily conscious racist) preference. Ironically, as Jennifer Stoever notes, because critical race studies focus on the visual realm, they

risk overlooking the potential for racism in other sensory realms.27 The traces of racialized timbre that my investigation uncovers in the seemingly integrated and progressive environment of the musical arts indicate the power that whiteness still wields.

In what follows I move backward in time from Anderson's debut. I first call to mind earlier performance contexts that laid the foundations for the association of black voices with certain repertoire. African American singers performed classical music in the same spaces and on the same programs as minstrel repertoire, burlesque shows, and spirituals; thus perceptions of classical performances by African Americans became inextricably linked to these genres. Second, I engage Jon Cruz's work on how abolitionists listened to slave song, examining his notion of ethnosympathy to understand how provisional subjectivity was granted to slaves and what this meant to how they and subsequent African Americans were heard. Third, I revisit two American operas from the early twentieth century, Four Saints in Three Acts and Porgy and Bess, which formally reenacted prevalent white views of African American identity and performance skills. Having unpacked the cultural baggage at play in the years leading up to the pregnant moment recalled at the opening of this article, I return to Anderson's story. And finally, in light of the surge of African American operatic divas who entered the scene during the 1960s and 1970s, I look closely at the frayed edges and visible seams of the integrated stage. Taking Anderson as a focal point for reflection on how listeners approach the black voice, this essay descends into the deep veins of racial history that run through American culture and examines the listening ears they have produced. By investigating the evocation of blackness within the very narrow timbral ideal of classical vocal music, I hope to uncover the complex and historically bound process of listening to voices. Thus this article aims to foreground the practice of listening to opera in the United States as exemplary of listening as a socially and culturally bound undertaking, rather than as immanent and neutral.28 Listening in to how we listen to voices may reveal deep-seated feelings about body and race that persist in today's United States.

Early African American Classical Singers

In the nineteenth century Elizabeth Taylor Greenfield (1820s-1876), a freed slave, and Matilda Sissieretta Jones (1869-1933) were among the first African American singers to perform classical repertoire for large interracial audiences, winning national and international acclaim.29 Their performance practices and receptions by audiences-where listeners based their opinions on related artists' work and on the work of white artists in blackface-colored later reception of African American classical singers.30 Greenfield was largely an autodidact, as no voice teacher during her era would have staked his reputation on a black singer. A generation later, improved race relations enabled Jones to train. But beyond this, her experiences and Greenfield's bore similarities, many based in hardship resulting from the racial climate and white audiences' limited perceptual frameworks. Both singers had to either perform in segregated venues, with black audience members relegated to separate balconies, or sing for all-white gatherings. According to Story, for audiences of the day, the sight of a white usher accompanying Greenfield to the stage was so jarring that, judging by their reactions, the viewers might have been watching a "carnival freak show."31 The New York Herald (1854) described one escort who "seemed afraid to touch her with even the tips of his white kids, and kept [the performer] at a respectable distance, as if she were a sort of biped hippopotamus. The audience laughed at the attitude of the gentleman usher and still applauded with all their might," treating the performance as a "super minstrel show."32

The public's piqued awareness of Greenfield's and Jones' physical appearances are clear from their sobriquets. Greenfield performed under the name of the Black Swan, most likely a reference to her Scandinavian vocal contemporary Jenny Lind, endearingly called the Swedish Nightingale, while Jones was dubbed Black Patti, a play on the moniker of Adelina Patti, a contemporary Italian diva. Both nicknames imply that the American women were their namesakes' lesser counterparts.

Music critics also applied derogatory racial epithets to Greenfield's and Jones' physical appearances, overlooking their musical abilities, including instrumental proficiency.33 The Cincinnati Enquirer called Greenfield the "African Crow," the Detroit Daily Advertiser a "woolly headed, flat nose[d] negro woman, and no

one would suppose there was any more enchantment . . . in her than a side of leather."34 Certainly some critics were aware of their racist biases. An Ohio journalist wrote: "We know the natural prejudice [sic] that we all have against [Greenfield's] color . . . and it is very difficult to divest one's self entirely of them and criticize fairly and justly in such a case."35 In the same spirit, another critic reported that "upon the suggestion of another . . . we listened to her without looking toward her during the entire performance of 'The Last Rose of Summer' and were at once satisfactorily convinced that her voice is capable of producing sounds right sweet."36 Elsewhere, Greenfield's voice was lauded for its "naturalness," as though it were somehow primal, primitive, untouched by cultivation.37 Knowingly or otherwise, these journalists acknowledged that historical-cultural lenses influenced how they heard Greenfield's voice. Despite such self-awareness on behalf of a few reporters, when Jones was presented to the public a generation later, the singer's physique continued to fascinate white audiences. Jones's attributes were logged with the most embarrassing details. "Her teeth," a journalist reports, "would be the envy of her fairer sisters and the despair of dentistry. Her rather thin lips are fond of exposing heir [sic] even row of teeth."38

The dissonance felt by many members of the public when confronted with the unfamiliar sight and sound of a black person singing classical music was too much to overcome. The solution for which many reached, it seems, was to categorize these performances as minstrel shows rather than artistic experiences-attempting to deny that African American voices were suitable for classical music qua classical music. Although audiences shamefully deprecated Greenfield's and Jones's visual appearances, critics could not help but be in awe of their voices. Nevertheless, much like participants in the above-mentioned linguistic experiment, in which listeners' perceptions of a recorded voice were deeply affected by visual cues, audiences' limited exposure to the sounds of black classical singers, via performance genres and repertoire predicated on stereotypical and deprecating depictions, caused them to project their expectations of blackness onto those performers' operatic vocal timbres.

Greenfield's voice rivaled that of her contemporary, the world-renowned Lind, reaching to a high E above high C. Unlike Lind, Greenfield also reached a low G in the bass clef. In 1852 the Toronto Globe not only rhapsodized about "the amazing power of [Greenfield's] voice, the flexibility and the ease of execution," but also reported that the "higher passages were given with clearness and fullness, indicating a soprano of great power."39 Although Jones was intermittently criticized for her lack of training, she was also reputed to have "great range," "power," "sweetness and smoothness" of tone, "distinct enunciation," with compliments for the "ease and naturalness with which she handled the voice."40 Both Greenfield and Jones performed in a wide range of genres. Although Greenfield was noted for her performances of George Handel, Vincenzo Bellini, and Gaetano Donizetti, audiences frequently requested such repertoire as Steven Foster's "Old Folks at Home." Jones also offered a collection of favorites from the operatic repertoire-arias from Robert le Diable, L'Africaine, Rigoletto, La Traviata, and more-mixed with popular ballads such as "Home Sweet Home" and "Swanee River." She also sang a "stammering" song, "Wait 'til the Clouds Roll By," and an early "coon song," the Paul Allen 1883 hit "A New Coon in Town."41 Even though minstrel vocal style was timbrally close to bel canto style and for the most part given voice by white performers, Greenfield's and Jones's repertoire lists conform to white audiences' expectations of black voices.42

In the nineteenth century the classical repertoire seemed an anomalous choice for black singers. Audiences' expectations posed perennial challenges to Greenfield's and Jones's obvious desire to be taken seriously as artists while also having to consider the reality of earning a living. An overbalance of classical music seemed improperly "serious" for, and probably unmarketable to, the burlesque venues in which African American artists were typically able to perform. Moreover, although during Jones's lifetime the African American baritone Theodore Drury headed a black opera company (with which she did not perform), there were hardly any opportunities open to black singers in the world of "art" music.43 As Graziano points out, few companies were willing to pay black artists enough to make a living.44 Lacking "serious" performance outlets, African American

singers were primarily relegated to minstrel songs, popular songs, and spirituals.

In Jones's case, difficulties in finding enough opportunities and willing coworkers to sustain an operatic career forced her to reevaluate the direction of her line of work. In 1896 she rejoined the minstrel circuit after a hiatus as the lead singer of Black Patti's Troubadours.45 The Troubadours offered a rousing and popular "Operatic Kaleidoscope" that included scenes from such operas as Carmen, Faust, Il Trovatore, La Bohéme, and Rigoletto while conforming to the minstrel-show format.46 But although she appreciated the Troubadours as an outlet for her operatic skill, Jones always preferred concert venues. "There are so many things in vaudeville performance to distract the attention of the audience," she said, "that they are not in a proper frame of mind to enjoy straight singing."47 In her own way Greenfield, too, was reconfined to the minstrel show, as she became the inspiration for the minstrel "wench" character Lucy Neal-implying that audiences made little distinction between a blackface performer in an Italian burlesque opera and an African American singer performing classical repertoire.48 Even with superb reviews and calls for listening beyond racial difference, neither Greenfield nor Jones was able to shed the acousmatic blackness that their audiences heard over and above their otherwise celebrated renditions.

In summary, nineteenth- and early twentieth-century audiences dealt with the shocking phenomenon of black classical singers by, mentally or in practice, rerelegating the singers to stereotypical black roles. Even when they were included in classical performances, these singers' vocal abilities and timbres were impossible for white audiences to assess independently of visual and other contextual information. Visual blackness was projected onto timbre, resulting in the perception of sonic blackness. To gain a greater understanding of the historically racialized operatic voice in the United States, I now turn to an even earlier node in the history of the black body and its voice, where a different form of acousmatic blackness may be found.

"Ethnosympathetic" Ears

In 1845 Frederick Douglass, emancipated slave, author of the first well-known ex-slave autobiography, and one of the foremost leaders of the abolitionist movement, asked his readers to pause and listen to the songs of the slaves. In their "songs of sorrow" a listener would hear "tales of woe," for "every tone was a testimony against slavery."49 Douglass's audience did listen, and by the end of the Civil War voices and melodies once considered noise were heard as song and were used by abolitionists as symbolic weapons against slavery. The sociologist Jon Cruz describes this as a "new mode of hearing," possible only under the assumption that slaves possessed an inner life.50 Cruz terms this mode of reception ethnosympathy: a humanitarian pursuit of classifiable subjects. In this perceptual mode, the spiritual was recognized as a clear cultural expression, the form preferred for blacks by "white moral and cultural entrepreneurs." The ability of whites to hear the cries to God embedded in spirituals indicated a mature cultural interpretation of a vocal culture that, until then, had been impenetrable.51

Such unprecedented interest in slaves' songs constituted a break from the previous perceptual framework that classified black song as alien noise. The combination of white efforts to convert slaves to Christianity (under the assumption that blacks, like whites, were created and loved by God) and whites' growing appreciation of slaves' religious songs gradually "granted [slaves] a new subjectivity" within white discourse.52 It also functioned as a vehicle for sympathetic whites, particularly abolitionists, to further imagine slaves as culturally expressive subjects. "Cultural authenticity," Cruz writes, "was the key to subject authenticity."53 In other words, evidence that slaves were not only capable of worship but also of cultural exchange, was taken as proof that they possessed agency and emotion-that they were human subjects, not mechanisms or animals. Hearing enslaved voices with ethnosympathetic ears allowed listeners to discover an "underlying authenticity of subjects through their cultural practices," a perception arguably carried over into conceptions about African Americans singing classical music.54 Possibly ethnosympathy underlies the prevailing preference, among audiences, for spirituals paired with classical repertoire, as well as discourse that attributed the emotional capital present in interpretations of classical music to a natural aptitude for spirituals.

The changing perception of the slave voice, from noisy and incomprehensible to lamenting and expressive, can be observed in later dynamics as blackness of skin and hair are displaced to the aural sphere and often referred to by placeholder terms indicating exceptional emotional expressivity. When the Fisk Jubilee Singers introduced spirituals to the concert circuit in the 1870s, the performers' vocal presentations were praised as "plaintive and touching," "thrilling with their weight of sorrow," and having "an indescribable pathos."55 An anonymous reviewer described the voices as being "so full of character and so full of color, and so little originality is met with these days that their strangeness is agreeable."56 As Julia Chybowski observes, this language echoes that of the abolitionists, especially that of Harriet Beecher Stowe, who sponsored many of Greenfield's British appearances. Greenfield's reception in America and Britain would influence that of the Fisk Jubilee Singers.57 For her British listeners, Greenfield embodied American slave culture. Audiences were "charmed by her perceived musical humanity" and "[Anglo-European] musical achievement."58 A review of Jones echoes both abolitionist accounts of slaves' voices and reviewers' sketches of the Fisk Jubilee singers:

In every note Mrs. Jones sang in her concerts here that one quality was unfailingly present. In the arias, in the ballads comic or sentimental, it was noticeable, and it soon became evident that it was the most individualizing element in the voice, and that no amount of schooling or training could create it. Not that one would desire to have it eradicated. It is the heritage the singer has received from her race, and it alone tells not only of the sorrows of a single life but the cruelly sad story of a whole people. . . . the tones of the negro voice are totally devoid of the humorous quality. The song that is sung may be comic but the voice itself never ceases to be plaintive. This is true of Mrs. Jones, and is it not equally true of every negro singer in every place and under every condition?

In the Washington Post's 1903 consideration of the "Negro voice," we find sentiments and language resonating with earlier descriptions of slaves; African Americans, such as Greenfield and Jones, who tried their luck as concert singers; and later the Fisk Jubilee Singers. The voice is heard as "absolutely unique and indescribable," with a "remarkable quality" that would be "lessened by cultivation." This unique quality arises from a "music almost as old as the world, for it has been chanted in the wilds of Africa to the accompaniment of rude drum and punctured reed ever since human beings could articulate. It still retains much of its original savagery, and when sung with the peculiar timbre which is the especial attribute of the negro's voice it produces an effect which sets the nerves tingling."60

Just as the perceptual filter of ethnosympathy changed the way abolitionists heard slaves' voices, we can see that the modern assumption of acousmatic blackness, applied to African Americans singing classical repertoire, offers African Americans a place in this normative cultural space while maintaining their difference. Might the persistent association of black classical singers' voices with the sound of the spiritual be an updated form of ethnosympathy?

To summarize the discussion so far, operatic acousmatic blackness arose from several historical and cultural turns. White audiences first perceived the black body in performance as enslaved and subhuman through distorted, derogatory images brought to life by, among other cultural-social forces, minstrel performances. Because of how such imagery colored whites' perceptions of the first African American classical performers, it was difficult if not impossible for them to advance their careers without reinforcing the stereotypes, as Jones's return to the minstrel stage attests. Even when black voices won the ethnosympathy of white listeners, their acceptance as subjects was contingent on blacks' distinctiveness from other members of society.

Along with its complex history, acousmatic blackness has significantly influenced the trajectory of subsequent African American singers' careers, including Anderson's, as well as characterizations and vocal writing in original American opera. I suggest that this particular trajectory, which also played a role in how Anderson developed vocally, has proved difficult for subsequent African American singers to escape. It is to that story, and to an exploration of how American opera deals with the idea of blackness and produces acousmatic blackness, that I now turn, considering the racialization of the voice in performance and uncovering the

relationships between performance, body, and race in American opera in the twentieth and early twenty-first centuries.

Racial Sentiments in All-Black Casting

Characterization and vocal writing in early American opera were not far removed from African American performers' burdensome roles in burlesque, vaudeville, and minstrel shows. Premiered in 1934 with an all-black cast, Thomson's opera Four Saints in Three Acts is described by Barg as rehearsing "romantic racialist discourse on black sound."61 There are a few explanations of Thomson's choice in circulation. Carl Van Vechten quoted the composer on tone quality: "[Negro singers] alone possess the dignity and the poise, the lack of self-consciousness that proper interpretation of the opera demands. They have the rich, resonant voices essential to the singing of my music and the clear enunciation required to deliver Gertrude [Stein]'s text."62 In an interview, he shared that they had a "more direct and unself-conscious approach to religious fantasy."63 Thomson also related that the idea for an all-black cast came to him in 1932-33, after he attended a Harlem performance featuring Jimmy Daniels as host and entertainer.

I turned to Russell, realizing the impeccable enunciation of Jimmy's speech-in-song, and said, "I think I'll have my opera sung by Negroes." The idea seemed to be a brilliant one; Russell, less impressed, suggested I sleep on it. But next morning I was sure, remembering how proudly the Negroes enunciate and how the whites just hate to move their lips.64

Here it seems Thomson was attracted to what he viewed as the "racial qualities" of Daniels's voice. Yet another story relays how he conceived the idea for an all-black cast while attending DuBose and Dorothy Heyward's play Porgy in Princeton.65 Whichever inspirational moment came first, these tales convey Thomson's fascination with the black voice and body, his recognition of and pleasure in the "grain" of the black voice.66 But he expressed his approval in patronizingly loud praise that, to Barg, masks a "deeper racial logic, one with considerable historical precedence in cultural commentary about black singing." 67

The material from which this racial "logic" was bred is also evident in the public discourse surrounding Four Saints. After opining that the conceptual strength of Thomson's opera consisted in its resistance to traditional "reason and logic," one critic observed that it "is doubtful if white singers could have given the core, with its strange alternation of comedy and exaltations, the flavor it requires."68 Another review found that "the players from Harlem . . . speak their lines without spoofing them, and lend a poignant dignity to even some of the most absurd moments of the text."69 W. J. Henderson agreed that the "spell" of the production was "to be found in the natural talent of Negroes for playing seriously like a lot of children." The cast, he wrote, "knelt and rolled their eyes toward stage heaven, genuflected, saint before saint with the deepest gravity, and sang their nonsense syllables with as much faith and devotion as they might have sung, 'It's me, Lord, standin' in the need of prayer.'" And, he added, "[Ma]ybe it was meant to be a burlesque on 'grand opera.' If so, it is a gorgeous success."70

One contemporary humorist parodied the opera by writing a parody of a spiritual: "Nobody knows the opera I seen; nobody knows but Gertrude."71 Additionally, commentators ran with the idea that Gertrude Stein's libretto played with racialized speech. Stein's nonsensical use of the name Lucy does indeed carry references to two minstrel songs, one of which features a Lucy, the ur-wench of minstrelsy.

Let Lucy Lily Lily Lucy Lucy let Lucy Lucy Lily Lily

Lily Lily Lily let Lily Lucy Lucy let Lily. Let Lucy Lily.72

At least two of the most popular songs in minstrel repertoire referred to this stock character. "Miss Lucy Long" was a love song with a twist of humor, while "Miss Lucy Neal" was a sentimental "plantation song" with a tragic ending. And if indeed Greenfield was the inspiration for the character of Lucy Neal, an early African American singing classical repertoire but perceived as burlesquing opera is also invoked here. Over and over, in the conception and production of Four Saints in Three Acts and in the discourse surrounding the opera, we observe free uses of preconceived modules of blackness as imagined in voice and body, minstrelsy, and the spiritual, as

well as the parodying of black language and pronunciation.

Premiering one year after Four Saints, Porgy and Bess stipulated a similar cast. George Gershwin's folk opera in three acts (with a libretto by DuBose Heyward and lyrics by Heyward and Ira Gershwin) has been a mixed blessing for African American singers ever since. "Thank God, I never had to sing Bess," the Metropolitan Opera soloist and long-time executive director of the Harlem School of the Arts Betty Allen said. She continued, "I never had to sing Aida. I was really against the typical casting that had nothing to do with your voice, or your type, but just to do with your dark skin. What's that?"73 Allen's sigh not only indicates relief at avoiding what some African American singers call the "Porgy and Bess curse" but also points to the larger issue of racialized casting in opera.74 In 1985, when the Metropolitan Opera mounted a fiftieth-anniversary production of Porgy and Bess, the employment rate of African American singers rose to 25 percent, compared with only 2 percent in the 1970-71 opera season. In 1989, when Porgy and Bess was not produced, the employment rate dropped to 14 percent.75 These statistics imply that there is only a decent amount of work for African American opera singers when Porgy and Bess is mounted. Regarding the depiction of African Americans in Porgy, Edward Said declared, "It is so condescending. These are not real characters. These are folklore characters, harmless in some ways, distant. . . . A natural sense of rhythm; they eat watermelon-all the clichés that go back to Al Jolson."76

Overall, while operas such as Four Saints in Three Acts and Porgy and Bess help launch careers and secure work for African American singers, they are also double-edged swords, working against efforts to integrate American opera in earnest. These operas reproduce stereotypical ideas about African American culture, music, and voice, and oblige African American performers to be molded into "natural" portraits of the stereotypes, which the performers themselves thereby unwillingly reinforce. Since American opera (and not only minstrel, vaudeville, burlesque, or spiritual concert performances) presented African American singers in what may arguably be described as compromising roles, the question becomes whether African Americans could be cast and perceived beyond such stereotypes in opera and classical performance.

Anderson: The Door Opens

Anderson (1897-1993), the granddaughter of a freed slave, was born into a Philadelphia working-class family. Biographies of her early life tell of a young girl feverishly absorbing music with the help of communities that recognized and supported her talent and dedication.77 Her church community, the Union Baptist Church in Philadelphia, embraced and supported her vocal talent, inviting her to sing solos during services. But racism and financial difficulties obstructed her efforts to obtain musical training. Even when the congregation offered to pay for her tuition at a local music school, she was turned away: the school "[didn't] take colored."78 It proved impossible for Anderson to study with a white teacher, who would have had more performing experience and professional connections to offer. Years went by with help from various black teachers and choir directors, but it was not until 1919 that she found her first long-term instructor, one who possessed the competence she deserved. He was the Russian Jewish Philadelphian Giuseppe Boghetti (born Joe Bogash), graduate of the Royal Conservatory in Milan, a mentor with whom Anderson maintained contact throughout her life. With Boghetti she expanded her vocal technique and repertoire, and developed the desire to perform opera.79 During the initial phase of her career (1915-27) Anderson toured the American South. But, growing steadily impatient with the restrictions imposed on black traveling musicians by Jim Crow laws, and with an increasing desire to delve deeply into the German lieder repertoire, she set out in 1927 for London, and a year later had her London debut.80 Despite her recent training with some of the foremost European vocal pedagogues, critics in London were far from impressed. Although her "warm and rich tone" is mentioned by one reporter, others noticed a certain "naive appeal in her readings that compensated for occasional lack of subtlety."81 One wrote that "her voice has the peculiar timbre common to colored vocalists"; another opined more harshly that "the 'scoop' is evidently a racial fault, for it fell into place as the natural thing in some Negro spirituals."82 These journalists questioned her delivery of classical repertoire while noting that what they heard as vocal flaws in that

genre seemed to suit her realization of spirituals.

Like American reviewers, London critics typically insisted on a connection between African American timbres and spirituals, questioning any black singer's choice to attempt anything but the latter. Before Anderson, the African American tenor Roland Hayes experienced considerable resistance to his performance of lieder. And years after Anderson's debut the Paris critic Mercer Cook dryly wrote, regarding a skimpily attended American performance of Four Saints in Three Acts, that had it offered a program of spirituals "the theater would have been packed for months."83

Vincent Sheean's reception of Anderson's performance of spirituals in Salzburg is not unusual and echoes the London critics' sentiments:

In the last group she sang a spiritual, "They crucified my Lord, and he never said a mumblin' word." Hardly anybody in the audience understood English well enough to follow what she was saying, and yet the immense sorrow-something more than the sorrow of a single person-that weighted her tones and lay over her dusky, angular face was enough. At the end of this spiritual there was no applause at all-a silence instinctive, natural and intense, so that you were afraid to breathe. What Anderson had done was something outside the limits of classical or romantic music: she frightened us with the conception, in musical terms of course, but outside the normal limits, of a mighty suffering.84

Recalling the "collective sorrow" that reviewers heard in Jones's voice, Sheean evokes the same sentiment for which abolitionists reached as, for the first time, they grasped the humanity and subjectivity of slaves. But even Sheean's favorable review insists on the spiritual as the root of African American expressivity. Anderson's attitude toward repertoire was very open and exploratory. Her repertoire encompassed all of the major arias suitable for her fach, including some for soprano.85 She went on to develop programs of Finnish, French, German, Italian, Norwegian, Spanish, and Swedish art and folk songs, always ensuring that she would sing something by a national composer on her concerts throughout Europe. When she was invited to sing a recital at the White House she was asked to sing a set of spirituals only-yet, characteristically, she insisted on including a few pieces by Franz Schubert.86

Although she was arguably one of the most gifted singers of the twentieth century-of whom Arturo Toscanini said, "What I heard today one is privileged to hear only in a hundred years"-in the public's mind Anderson's artistic career was often overshadowed by her assigned role as a "tattered social symbol."87 While her appearance at the 1939 Lincoln Memorial on Easter morning, where she sang for over seventy-five thousand people including President and Eleanor Roosevelt, became an iconic moment for the civil rights movement, her symbolic role in the movement ran counter to her own intention to be a classical musician. It is likely that acousmatic blackness, fostered by persistent connections between Anderson's abilities and spirituals, served to propagate her symbolic image, as did her Metropolitan Opera debut as a gypsy sorceress.

Racialized Casting

After Anderson's door-opening performance at the Metropolitan Opera, a relatively large number of African Americans won operatic roles. Dorothy Maynor, Leontyne Price, Arroyo, Grace Bumpry, and Shirley Verrett triumphantly sang on both American and European stages. But however much they were recognized as divas, attitudes toward color always haunted them. For example, critics credited Price's voice with "an unmistakably individual fragrance-husky, musky, smoky, misty (on a bad day foggy!)-and palpitating pagan sexiness. It is not the voice of a good girl."88 And, like Anderson, Price ultimately lamented, "Whenever there was any copy about me, what I was as an artist, what I had as ability, got shoveled under because all the attention was on racial connotations."89 While these artists were hired alongside whites, their color was a novelty that outshone their vocal ability.

We have seen that African Americans have been constrained and limited in terms of performance opportunities. It would seem that these obstacles had been overcome once the operatic glass ceiling was shattered, but while these singers were now offered opportunities beyond characters who parodied black speech and sound, a

curious pattern also emerged.

The term typecasting refers to an actor's strong association with a character he or she has played, with a certain type of character, or with the idea that his or her personal appearance and demeanor lend themselves to a particular kind of role. Rosalyn Story refers to the "maid/slave-girl/gypsy syndrome" as a form of racialized typecasting.90 As I have shown, the black body in opera has been so consistently associated with certain categories of roles that this association amounts to typecasting of African Americans in the role of the other: Japanese war bride slowly going insane, enslaved Ethiopian princess, gypsy seductress, a liminal figure: the cripple, and so on. For example, with her 1946 debut at the New York City Opera, Camilla Williams was the first female African American to receive a contract with a major American opera company. (While she preceded Anderson, Anderson's debut eclipsed hers in symbolic importance.) Williams was hired to sing the title role, a Japanese war bride, in Madame Butterfly. One year earlier, Robert (Todd) Duncan became the first African American member of the New York City Opera, signed as the hunchback actor Tonio in Ruggiero Leoncavallo's I Pagliacci. Price, who might be considered the first African American diva after debuting in the role of St. Cecilia in the premier of Virgil Thompson's Four Saints in Three Acts, went on to sing the role of Bess. However, her versions of Aida and Cleopatra (a role written for her by Samuel Barber) are the interpretations with which her audience came to identify her most strongly. In effect, each of these African American opera singers were "plugged into" the standard repertoire's liminal roles.

As African American singers were integrated into standard repertoire, their visual appearance underwent debate. The critic Bernard H. Haggins recounts a 1974 performance of Don Giovanni at the Met: "Price's superb singing as Donna Anna up to the concluding florid last [sic] passages of 'Non mi dir,' which she managed in a sort of vocal shorthand that implied the notes she didn't sing." Haggin continues: "Price presented with her Donna Anna the same obtrusive incongruity as previously with her Leonora in Il Trovatore and her Pamina in the Magic Flute but not with her Aida. When I look at what is happening on stage my imagination still cannot accommodate itself to a black in the role of a white."91 And as I have shown, one diva imagined Price, despite her celebrated voice, to be appropriate only for the role of Bess. While we know that realism in terms of age and body size is routinely violated in opera, a so-called realistic hue of skin casting was apparently a crucial point on which many audiences were unable to suspend disbelief.

Although he has sung at major opera houses across the world, one of the most celebrated African American baritones, Simon Estes, has encountered obstacles throughout his career because of the practice of racialized casting. At Bayreuth, Estes sung the title role of the Flying Dutchman (1978) with great success, as well as Amfortas in Parsifal (1982). However, when Sir Georg Solti and Sir Peter Hall assembled their new Ring (1983), Estes's audition for the role of Wotan was rejected. Stephen Fay writes that Hall "might indeed have been troubled by the idea of a black Wotan surrounded by a large family of white singers. . . . he did not object in principle to a black Wotan, as long as there were black singers among his daughters, but he felt that Estes' audition had relieved him of the need to make such a choice."92 Despite denials by Hall and Solti, who claimed that the decision was based purely on his vocal abilities, Estes publicly claimed that the unfavorable casting decision was racially based.93 The implication is that racial conflicts which, in late twentieth-century culture, were unable to be tackled head-on, could be freely discussed under the auspices of vocal aptitude (as was the case with Hope Briggs).

For a Glyndebourne Festival production of Don Giovanni, Director Sir Peter Hall ignored suggestions that he hire Leonora Mitchell for the role of the Spanish aristocrat Donna Anna. Her presence, he said, would "ruin the realism and social structure which were to form the very heart of the production." 94 Mitchell responded: "You'd think people wouldn't even consider all that any more. They just shouldn't be saying that somebody doesn't look the part when certain singers are 350 pounds fat. Now are they gonna play a nice young Donna Anna?" Cynthia Clarey was turned down for a role when a director claimed he wanted to do an "authentic" production of a particular opera. "If the director feels that way, fine," said Clarey. "I don't like it-it's a job that I could have had.

But if he really feels that way, I think I'd be a lot happier not doing it."95 Such subtler forms of discrimination are difficult to pinpoint. "Opera is such a subjective art," said Mitchell, that "they can always hide behind words like 'She's just not my type.'" In so many ways opera is the art of disbelief: the stories are mythical and fantastical; plots turn on the inability to recognize one's wife only because she wears somebody else's clothes; and narrative flow is suspended in time by arias that meditate on a singular feeling over improbably long stretches of time. Yet, when it comes to the question of integrated racial hiring, a production calling for demographic "authenticity" is often a key objective. Might directors be wary of the influence of a visually raced body on the way audiences will hear the voices in the production?

In more recent opera journals and reviews, there seem to be fewer public conflicts of this nature; but there are also considerably fewer black major opera stars today than there were in the golden age, beginning with Price and continuing through the 1980s.96 The latest highly exposed and publicly debated incident of which this author is aware is Briggs's 2007 dismissal from the San Francisco opera.

Conclusion: Listening to Opera in the United States

In choosing Anderson, years beyond her vocal prime, to break the color barrier, the Metropolitan Opera presented a figure who symbolized quiet perseverance and patience. Listeners could therefore hear Anderson through the "new mode of hearing," ethnosympathy.97 Although Patricia Turner lauds the Metropolitan director Rudolf Bing for his astuteness in casting Anderson as Ulrica, a role that did not require a young, fresh-sounding voice, it was, to one reporter, a belated and "tardy tribute to [Anderson's] rank and achievement as an artist of international fame."98 Moreover, the role portrayed a gypsy, internationally imagined as other; and the year-1955-coincides with the decade in which amateur minstrel performers finally put down their cork.99 I wonder if this role led audiences to again connect the voice of Anderson with the sight and therefore with the sound of the other, thus confirming the otherness of blackness, as did Jones's and Greenfield's often-compromised performance opportunities. Would "the door," as the New York Times dubbed Anderson's Met debut, open only for those who could credibly be heard through the conceptual filter that registers blackness?

While race relations and human rights in the United States have certainly changed tremendously since the nineteenth century, each listening moment carries with it the resonance of the past. Opportunities for African American classical performers have improved incrementally, from the days of the minstrel and burlesque circuits through exotic and stereotypical characters in blackonly operas written by white composers, typecasting as others in integrated opera houses, and, finally, a larger range of operatic characters distinguished by "individual" and particularly expressive voices. Each period deposited a new perceptual layer, adding to the sediment from which American audiences' ears are molded. As a result, while the discourse surrounding the black voice has been reorchestrated, an underlying motive persists. Political correctness has shifted the color line into the micro-audible sphere-the phenomena that blackness in timbre cannot technically be heard with the naked ear, yet people think they can hear it100-suggesting that timbre is still acceptable to recognize as distinctly black, while skin color and speech are not.101 As I have shown, timbral assessment along these lines may be cloaked in language concerning taste and aesthetic preference, distinctions sanctioned and valued in the opera world.

What, then, is "sonic blackness"? It is not a single phenomenon, but might be a combination of interchangeable self-reproducing modes: a perceptual phantom projected by the listener; a vocal timbre that happens to match current expectations about blackness; or the shaping of vocal timbre to match current ideas about the sound of blackness.102 "Sonic blackness" is not the unmediated sound of essential otherness or the sound of a distinct phenotype. In an interesting parallel, Aleksandr Pushkin opens Eugene Onegin with women singing while picking strawberries: in fact, their mistress has ordered them to sing so that they cannot eat the strawberries.103 Each servant-woman's voice becomes the mechanism through which her mistress guards her property. Similarly, in the world of opera, an artificial belief that timbre evokes blackness consistently becomes a way to maintain otherness and thus maintain whiteness, with its accompanying privileges.

As Ronald Radano affirms, it is because we continue to believe in racial differences that we "enact those differences in sound."104 Acousmatic blackness is timbral blackness that occurs largely in the listening ear-indeed independent of the actual timbre-and seems to arise when a given timbre fulfills expectations or ideas about blackness. In contrast, whiteness as a timbral quality is not openly discussed in the operatic world. Rather, its presence is dormant- envisioned as the normative unmarked, only drawing forward when forced to confront the other. However, claims of black essence are necessarily supported by an assumption of white essence-a distinction that will not fade until "white society" fully and completely renounces racial categorization. "It's up to you," James Baldwin observes. "As long as you think you're 'white,' I am going to be forced to think I'm 'black.'"105

In Ruth Frankenberg's study of whiteness, an interviewee told her that as a "white girl," she had "nothing"-no culture, no people; being white was like being cultureless.106 Another woman remarked that in the sixties, when slogans such as "Proud to be Black" or "Proud to be Hispanic" appeared, it was "popular" to be proud of your ethnicity. Even feminists could say that they were proud to be women, but still most Americans had nothing to be proud of in this regard. The women in the study linked whiteness to capitalism, viewing nonwhite cultures as unsoiled and unspoiled, and unconsciously drawing on colonial discourse in which the West stands for progress and industrialization while others occupy themselves with tradition and culture.107 "When whiteness qua whiteness does come into focus," Richard Dyer writes, "it is often revealed as emptiness, absence, denial or even a kind of death."108

By maintaining the black body as distinct from the white body, the African American opera singer's voice seems to offer a promise of nonwhite vitality and the possibility of filling a void in white culture. In the words of Radano, "If Euro-Americans 'won the race' in economic terms, they also-many believe- paid the price with their souls."109 In this equation opera capitalizes both on the assumption that black bodies and voices are forms of otherness and on the hope that the introduction of difference into opera may help revitalize standard repertoire. The prevalent ability to detect acousmatic blackness, or racialized vocal timbre, demonstrates that listening does not connote passive reception of information and is not a neutral activity. Rather, in listening we participate in social processes both embedded in and producing cultural forms. Consequently, no ear is innocent. Each cochlea curls around its past, and this past resonates with the present. The ways in which Americans hear black voices are tethered to century-old beliefs about black bodies, and thus listening to opera in the United States is an archeological endeavor. Only by educating ourselves about the complex set of practices that constitute listening can we emerge from layers of perception molded by the values, ideologies, fears, and desires carried by our forebears and liberate our hearing from the cultural commodity of blackness.

Footnote

Notes

Deep gratitude is extended to Tildy Bayar and Mandy-Suzanne Wong for reading and providing feedback, as well as to Kara Keeling, Josh Kun, and an anonymous reviewer for American Quarterly for their insightful comments. I would also like to express my appreciation to Joseph Bristow, Robert Fink, Charles Kronengold, Susan McClary, and Jonathan Sterne for crucial insight and suggestions.

1. Quoted in Bruce Burroughs, "Indian Summer: Marian Anderson Profile," Opera News 69.3 (2004): 61.
2. Olin Downes, "A Door Opens: Marian Anderson's Engagement by 'Met' Should Help Other Negro Singers," New York Times, October 17, 1954.
3. Lisa Barg, "Black Voice/White Sounds: Race and Representation in Virgil Thomson's Four Saints in Three Acts," American Music 18.2 (Summer 2000): 121-61.
4. Jason Oby, Equity in Operatic Casting as Perceived by African American Male Singers (Lewiston, N.Y.: Edwin Mellen Press, 1998). See also George Shirley, "The Black Performer," Opera News, January 30, 1971, 6-13.
5. Richard Powers's radiant novel In the Time of Our Singing (New York: Farrar, Straus and Giroux, 2003)

powerfully portrays the personal triumphs and tragedies of an American mixed-race family, as they intersect with those of the nation from 1955 to 1992. Whereas music and singing bind the entire family together through the upbringing of three children, the oldest son is an exceptionally gifted singer who trains at Juilliard and goes on to an international career with his brother as accompanist. The book sensitively portrays the hardships that might have been experienced by any interracial family in mid-twentieth century America, and it also vividly conveys the particular complexities experienced by the oldest son, who is perceived as black (although he is also half German Jewish), while undertaking training and pursuing a career as a classical singer.
While eldest son Jonah's brilliant New York debut is described by the book's narrator, his younger brother and accompanist Joseph, as transcendent-beyond time and race-the fictional New York Times reviewer could not but cap an otherwise congratulatory review by concluding that Jonah was "one of the finest Negro recitalists this country has ever produced." When Jonah finally receives an offer from the Metropolitan Opera, it is in the role of a nameless "Negro" in a contemporary production. Discouraged, he leaves for Europe, where he enjoys a successful career as a tenor. But it is when Jonah enters the world of early music, a movement then in its infancy, he is able to experience a (musical) era predating the racial discord experienced by his Jewish German father before he fled Europe and endured by his African American mother and their interracial family.
Additionally, the book is fascinating in that voice lessons, vocal anatomy, and musical form are described in the minutest and most accurate detail (as a person trained in the classical vocal tradition I recognized every intrigue and technical point).
6. While identification of race in relation to popular music genres is entangled in racial stereotypes, it is not completely arbitrary (the music industry has worked to create links between race and genre for marketing purposes). For a discussion of genre and race in contemporary musical life, see David Brackett, "Questions of Genre in Black Popular Music," Black Music Research Journal 25.1-2 (2005): 73-92.
7. Jonathan Greenberg provides an interesting discussion of three phonemes with strong racial (black) and geographic connotations, and Ethel Waters's manipulation of these phonemes and related racial expectations. Greenberg, "Singing Up Close: Voice, Language, and Race in American Popular Music, 1925-1935" (PhD diss., University of California, Los Angeles, 2008): 200-247.
8. Language acquisition is an integral part of voice training. In addition, singers learn the International Phonetic Alphabet (IPA) so they can read, transcribe, and reproduce the phonetic realization of any language.
9. In brief, timbre refers both to the overall sound that enables us to distinguish one instrument from another and to the different sounds within a single instrument. This composite sound is made up of different partials, or frequencies. In classical vocal production a concentration of partials around 3,000 Hz-known as the singer's formant-is favored. This creates the characteristic "ring" in the voice (the intense "core") and enables it to cut through and be heard over the massive sound of a symphony orchestra. Many vocal pedagogical texts feature in-depth discussions of the physics and vocal training that go into its production. Two classic texts include Johan Sundberg, The Science of the Singing Voice (DeKalb: Northern Illinois University Press, 1987); and William Vennard, Singing: The Mechanism and the Technic (New York: Carl Fischer, 1968).
10. Quoted in Tim Brooks and Richard K. Spottswood, Lost Sounds: Blacks and the Birth of the Recording Industry, 1890-1919 (Urbana: University of Illinois Press, 2004), 30.
11. Quoted in Jacob Smith, Vocal Tracks: Performance and Sound Media (Berkeley: University of California Press, 2008), 135.
12. Not only is it difficult to distinguish race physically or anatomically, but it is also just as difficult to distinguish a male voice from a female one based on a given vocal apparatus. This suggests that much of the difference between male and female voices is acquired. See Suzanne G. Cusick, "On Musical Performances of Gender and Sex," in Audible Traces: Gender, Identity, and Music, ed. E. Barkin and L. Hamessley, 25-48 (Los Angeles: Carciofoli Verlagshaus, 1999); and Nina Sun Eidsheim, "Voice as a Technology of Selfhood: Towards an Analysis of Racialized Timbre and Vocal Performance" (PhD diss., University of California, San Diego, 2008), 1-

27, 20-66.
13. D. L. Rubin, "Nonlanguage Factors Affecting Undergraduates' Judgments of Nonnative English- Speaking Teaching Assistants," Research in Higher Education 33.4 (1992): 511-31.
14. John Baugh, "Linguistic Profiling," in Black Linguistics: Language, Society, and Politics in Africa and the Americas, ed. S. Makoni (London: Routledge, 2003), 155-68.
15. Clifford v. Kentucky, 7 SW 3d 371. Supreme Court of Kentucky (1999). Arguably the police officer in this example relied mainly on accent, as opposed to timbre, which is the focus of this study. However, vowel variations are the basis for timbre and accents, and I use this example not to make a point about vocal timbre but to illustrate the belief that the voice is intimately tied to the essential, social identity of the speaker's or singer's body.
16. The countless examples that disprove this assumption include two contemporary actresses, Anna Deavere Smith and Sarah Jones, who have made their names based on their vocal acrobatics while traversing a stunning range of characters and accents in their one-woman shows. In Bridge and Tunnel (2004) Jones's voice moves seamlessly between the emotional range and wit of an elderly Jewish woman, a young hip-hop artist, and a proper British lady. Vocal parodying and disguise turn on the thrill and amazement of the ability to take a voice where the body cannot follow. More than what the character says, it is the transgression of passing between timbres that gives rise to the excitement. Many plots are based on the ability to pass vocally, from the world of opera-Mozart's Susanna in The Marriage of Figaro- to film, Eliza in Pygmalion (both are class transgressions).
17. Quoted in Martin Bernheimer, "Yes, but Are We Really Colour Deaf?," Opera 36 (July 1985): 758. Clarey's debut took place December 16, 1984.
18. Robert Rushmore, The Singing Voice, 2nd ed. (1971; New York: Dembner Books; distributed by W. W. Norton, 1984), 130-31. To the contrary, Verrett shared in an interview: "When I first heard Marilyn Horne sing she was auditioning for a conductor at the Hollywood Bowl at the same time I was there. I didn't know her, and I thought it was a black singer singing. When I found out it was a white person I said, 'Hmmm, there goes that.' But that doesn't happen very often, I do admit. It's very rare when I would mistake a white singer for a black singer, but I have mistaken black singers for white singers many times, especially the lighter voices. When you get down to the mezzo voices, the dramatic soprano voices, somehow the weight of the voice gives it away." Rosalyn Story, And So I Sing: African-American Divas of Opera and Concert (New York: Warner Books, 1990), 187.
19. Interview in Aida's Brothers and Sisters: Black Voices in Opera, VHS, directed by Jan Schmidt-Garre and Marieke Schroeder (West Long Branch, N.J.: Kultur Video, 2000).
20. Cornelia Fales has elucidated the question of timbre and listener projection of what is sounded. In her discussion on the "whispered inanga" musicians of Burundi, she concludes that listeners project the hearing of a melodic line that in fact is not sounded. See Cornelia Fales, "The Paradox of Timbre," Ethnomusicology 46.1 (2002): 56-95.
21. Briggs had already sung the final dress rehearsal before she was notified that she was no longer "desired" in the role.
22. Joshua Kosman, "Company Fires Soprano from Production at 11th Hour-Director Defends Decision," San Francisco Chronicle, June 2, 2007, http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2007/06/02/DDGU5Q63821.DTL (accessed June 5, 2007).
23. Ibid.; Daniel J. Wakin, "Questions Are Raised about Firing of Soprano," New York Times, June 2, 2007, http://www.nytimes.com/2007/06/02/arts/music/02oper.html (accessed June 5, 2007).
24. For a thorough discussion of vocal timbre, race, physiology, and training, see Eidsheim, "Voice as a Technology of Selfhood," 1-27, 30-66.
25. See note 20.

26. Mendi Obadike, "Low Fidelity: Stereotyped Blackness in the Field of Sound" (PhD diss., Duke University, 2005), 135-77.
27. Jennifer Lynn Stoever, "The Contours of the Sonic Color-Line: Slavery, Segregation, and the Cultural Politics of Listening" (PhD diss., University of Southern California, Los Angeles, 2007), 30.
28. Others have written about listening as a socially and historically bound process, including Veitl Erlmann, Reason and Resonance: A History of Modern Aurality (Brooklyn: Zone Books, 2010), about a shift in its relation to rationality; Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction (Durham, N.C.: Duke University Press, 2003), in relation to sound reproduction; and Stoever, "Contours of the Sonic Color-Line," on listening to race through textual sources.
29. Later in life, during her time in England, she was invited to study with Sir George Smart, the queen's organist and music director. Arthur R. LeBrew, The Black Swan, Elizabeth Taylor Greenfield Songstress (Detroit: La Brew, 1969), 18.
30. In his discussion of recording media's influence on the voice, Jacob Smith cites both class and technology as reasons why minstrel, folk, and traditional material were sung and recorded by operatic voices. For the former, Smith draws on Robert Toll's Blacking Up (New York: Oxford University Press, 1974), writing, "Minstrel troupes such as the Ethiopian Serenaders 'sought the respectability of "high" culture,'" and William Howland Kinney's Recorded Music in American Life (New York: Oxford University Press, 1999), who has argued that folk material was sung with an operatic approach because of the prominence of European classical music on the phonograph market. Related to this, we recall that black voices-because of the "sharpness or harshness that the white man's has not" (quoted in Smith, Vocal Tracks, 136)-were thought to be better suited for recording. This could not, however, have been believed in earnest, as most minstrel recording artists were white. According to Smith, only George Washington Johnson and Bert Williams were substantially recorded and widely distributed during this era.
31. Story, And So I Sing, 21.
32. New York Herald, April 1, 1854, quoted in Vera Brodsky Lawrence and George Templeton Strong, Strong on Music: The New York Music Scene in the Days of George Templeton Strong (New York: Oxford University Press, 1987), 413.
33. Greenfield also received letters from supporters with detailed advice "respecting [her] dress." One recommendation was to dress with "great modesty and with much simplicity" and goes into details: "Wear nothing in your hair, unless it be a cluster of white flowers in the back; never wear coloured flowers, nor flowing ribbons. Let your dress be a plain black silk, high at the back of the neck, and open in the front about half way to the waist: under this, war a square of lace, tarltan [sic], or muslin, doubled and laid in folds to cross over the breast." The letter continues another two long paragraphs and is signed "Your friend, E.S.M." Quoted in William S. Young, The Black Swan at home and abroad; or, A biographical sketch of Miss Elizabeth Taylor Greenfield, the American vocalist (Philadelphia: W. S. Young, 1855), 11.
34. Both quotations from Story, And So I Sing, 23.
35. Ibid., 25.
36. Ibid.
37. Julia Chybowski, "The 'Black Swan' in England," American Music Research Center Journal 14 (2006): 8-25. About British audiences, Chybowski writes: "Audiences went to Greenfield's performances looking and listening for what they expected based on Greenfield's former slave identity-an untrained musicality that accentuated the bodily aspects of the voices as the natural human instrument. Reviews of Greenfield's performance characterize her voice as 'wholly natural,' and as 'lacking the training and exquisite cultivation that belongs to the skillful Italian singer'" (15).
38. Both quotations from Chybowski, "'Black Swan' in England," 4.
39. Quoted in James M. Trotter, Music and Some Highly Musical People (Boston: Lee and Shepard; Charles T.

Dillingham, 1881), 78.
40. Quoted in John Graziano, "The Early Life and Career of the 'Black Patti': The Odyssey of an African American Singer in the Late Nineteenth Century," Journal of the American Musicological Society 53.3 (October 2000): 571. For a number of those reviews, see Graziano, "Early Life and Career," 543-96; and Trotter, Music and Some Highly Musical People, 66-87.
41. Graziano, "Early Life and Career," 565. For a list of Jones's repertoire, see Graziano, "Early Life and Career," 589-91.
42. Smith, Vocal Tracks, 154, 140-41.
43. Ibid., 568.
44. Ibid., 587.
45. In 1889 Jones had performed with the Georgia Minstrels at the Dockstader's Theater in New York. Graziano provides an astute analysis of the reasons why Jones returned to minstrelsy. See Graziano, "Early Life and Career," 585-89.
46. These include minstrel and vaudeville artists like the comedy team Ernest Hogan, Bert Williams, and George Walker, and the composers Bob Cole and Billy Johnson.
The Troubadours were often seen as more sophisticated than other touring minstrel shows. For example, the Detroit Free Press proclaimed: "These 'Troubadours' undoubtedly boast more black talent than any other like enterprise that ever was brought to public notice." The Daily News added: "Without exception the Black Patti Troubadours company is the best colored theatrical organization that has visited this city. Every member of it seems to be a star." Both quotations from Story, And So I Sing, 16.
47. Author unknown, New York Dramatic Mirror, January 11, 1896.
48. Eric Lott, Love and Theft: Blackface Minstrelsy and the American Working Class, Race, and American Culture (New York: Oxford University Press, 1993), 235.
49. Jon Cruz, Culture on the Margins: The Black Spiritual and the Rise of American Cultural Interpretation (Princeton, N.J.: Princeton University Press, 1999), 3.
50. Ibid., 1.
51. Ibid., 119.
52. Ibid., 4.
53. Ibid., 7.
54. Ibid.
55. "Amusements," New York Times, January 31, 1875; quoted in Stoever, "Contours of the Sonic Color- Line," 1.
56. Anonymous review, February 2, 1875; quoted in Stoever, "Contours of the Sonic Color-Line," 8.
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58. Ibid., 14.
59. Author unknown, Chicago Tribune, January 8, 1893.
60. "Negroes as Singers," Washington Post, April 25, 1903, 6; quoted in Smith, Vocal Tracks, 136.
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70. W. J. Henderson, "American Opera Keeps Struggling," American Mercury (May 1934): 104-5.
71. F. P. A., Herald Tribune, February 22, 1934; quoted in Steven Watson, Prepare for Saints: Gertrude Stein, Virgil Thomson, and the Mainstreaming of American Modernism (New York: Random House, 1998), 344.
72. Thomson, Four Saints in Three Acts, 47.
73. Interview in Aida's Brothers and Sisters.
74. Oby, Equity in Operatic Casting.
75. Story, And So I Sing, 183-84.
76. Interview in Aida's Brothers and Sisters. However, Bobby McFerrin, singer, composer, conductor, and son of Robert McFerrin, the first male to sing at the Metropolitan Opera, believes that Gershwin should be applauded for his attempt at creating an African American story. Interview in Aida's Brothers and Sisters.
77. Marian Anderson, My Lord, What a Morning: An Autobiography (New York: Viking Press, 1956); Allan Keiler, Marian Anderson: A Singer's Journey (New York: Scribner, 2000); Victoria Garrett Jones, Marian Anderson: A Voice Uplifted (New York: Sterling Publishing, 2008).
78. Quoted in Keiler, Marian Anderson, 30.
79. Ibid., 47-48.
80. London seemed friendlier for blacks. Anderson's longtime friend and informal mentor, Roland Hayes, had experienced great success there a few years earlier, including performing for the king and queen. Keiler, Marian Anderson, 68.
81. London Times, June 16, 1928; quoted in Keiler, Marian Anderson, 79.
82. Ibid., 80.
83. See Keiler, Marian Anderson, 78; and Mercer Cook, "The Negro Spiritual Goes to France," Music Educators Journal 40.5 (1954): 48.
84. Vincent Sheean, Between the Thunder and the Sun (1943; New York: Kessinger Publishing, 2005), 25.
85. For a list of Anderson's repertoire, see Keiler, Marian Anderson, 337-52.
86. Keiler, Marian Anderson, 166.
87. Anderson's long-time accompanist Kosti Vehanen recorded Toscanini's remark. Kosti Vehanen and George J. Barnett, Marian Anderson: A Portrait (Westport, Conn.: Greenwood Press, 1970), 130. Bogle is quoted in Patricia Turner, "Marian Anderson," in Notable Black American Women, ed. J. C. Smith and S. Phelps (Detroit: Gale Research, 1992), 18. Bogler and Keiler regretted that Anderson's artistic achievements were dwarfed by her image as a "tattered social symbol" (Bogle, quoted in Turner, "Marian Anderson," 18; Keiler, Marian Anderson, 7).
88. Quoted in Bernheimer, "But Are We Really Colour-Deaf?," 759-60. For a discussion about the visual descriptive language of voices of singers, please see Eidsheim, "Voice as a Technology of Selfhood."
89. Quoted in Bernheimer, "But Are We Really Colour-Deaf?," 760.
90. Story, And So I Sing, 184.
91. Bernard H. Haggin, Music and Ballet, 1973-1983 (New York: Horizon House, 1984), 105-6. In 2004 the Royal Opera House famously fired the American soprano Deborah Voigt from the role as Ariadne. Having lost a substantial amount of weight, she has been singing with critical acclaim for several major opera houses in the United States and was rehired by the Royal Opera House. However, some critics wonder whether her weight loss has lead to her "vocal decline." Peter Davis, "Deborah Voigt's New Problem," May 1, 2006, http://nymag.com/arts/classicaldance/classical/reviews/16855/ (accessed July 1, 2010).
92. Stephen Fay, The Ring: The Anatomy of an Opera (Dover, N.H.: Longwood, 1984), 61.
93. Ibid. Estes later sang Wotan in Berlin to favorable critiques.
94. Story, And So I Sing, 189.
95. Ibid.

96. The expatriate Jessye Norman seems to be an exception, with much-compared with any other opera star of her caliber-of her idiosyncratic repertoire independently selected.
97. Cruz, Culture on the Margins, 1.
98. Turner, "Marian Anderson," 17; Downes, "Door Opens," X7.
99. Clayton W. Henderson, "Minstrelsy, American," in Grove Music Online. Oxford Music Online, http://www.oxfordmusiconline.com/subscriber/article/grove/music/18749 (accessed March 29, 2011).
100. Entering public discourse in 1903, W. E. B. Du Bois's concept of the "color-line" has engendered much discussion of race in visual terms. However, Jennifer Stoever-Ackerman notes that the visible color-line is imbricated with an aural dimension, which she terms the "sonic color-line." Jennifer Stoever-Ackerman, "Splicing the Sonic Color-Line: Tony Schwartz Remixes Postwar Nueva York." Social Text 28.1 (2010): 59-85.
101. Timbre seems to be unmediated. Its racialization is a testament to the persistent notion of inherently racially different bodies. The notion of race is so strong in music (and in its association with genre) that even vocal synthesis software is created and sold as having a black soul voice. See Nina Eidsheim, "Synthesizing Race: Towards an Analysis of the Performativity of Vocal Timbre," TRANS-Transcultural Music Review 13 (2009), http://www.sibetrans.com/trans13/art06.htm (accessed January 1, 2010).
102. An ethnographic study of classical voice teachers and their students reports that proper training will "free" and unleash young nonwhite singers' true, natural voices-resulting in vocal timbres that cannot but express their ethnic origins. This idea may have arisen from the example set by the casting choices made possible when the "door" opened for nonwhite opera singers, exemplifying Ruth Frankenberg's study of whiteness and a fear of what opera-which many have considered the pinnacle of Western art-might succumb to. See Eidsheim, "Voice as a Technology of Selfhood," 30-66, 239-72; and Nina Eidsheim, "Modern Vocal Pedagogy, Race, and the Aesthetic of Vocal Timbre," in Changing the Subject: Difference in Musical Scholarship, ed. Olivia Bloechl, Jeffrey Kallberg, and Melanie Lowe (forthcoming).
103. Slavoj Zizek and Mladen Dolar, Opera's Second Death (New York: Routledge, 2002), 105.
104. Ronald Michael Radano, Lying up a Nation: Race and Black Music (Chicago: University of Chicago Press, 2003), xiii.
105. Interview with James Baldwin in the documentary The Price of the Ticket, VHS and DVD, directed by Karen Thorsen (1989; New York: Nobody Knows Productions in association with Maysles Films, Inc., WNET/New York, and American Masters, 1990).
106. Ruth Frankenberg, White Women, Race Matters: The Social Construction of Whiteness. (Minneapolis: University of Minnesota Press, 1993), 122, 196.
107. Ibid., 200.
108. Richard Dyer, "White," in The Matter of Images: Essays on Representations (London: Routledge, 1993), 141.
109. Radano, Lying Up a Nation, 24.

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Appendix

Appendix

To hear some of the examples mentioned in this article, please see the list below for suggested recordings (available online or as CDs).

Marian Anderson as Ulrica at Sounds of the Met.

Please go to Example 97 to hear:
Marian Anderson; Dimitri Mitropoulos: Un Ballo in Maschera, Re dell'abisso. RCA Victor LM-1911; MET 220CD
Portraits in Memory: Marian Anderson. URL:
http://www.metoperafamily.org/metopera/history/sounds/index.aspx
Recordings of Marian Anderson singing arias, lieder, songs, and spirituals at the Internet Archive. URL:
http://www.archive.org/details/MarianAnderson-01-05
Leontyne Price as Aida on the Met Player Video.
A video of Price's last Metropolitan Opera performance (1985) is available to view using the Met Player Video for a small fee. URL: ht tp: / /www.me t ope r a f ami l y. o r g /me t _pl a y e r / c a t a l o g /de t a i l . aspx?upc=811357011799
Four Saints in Three Acts (original cast).
Thomson, Virgil. Four Saints in Three Acts. (Abridged by the composer.) Starring Beatrice Robinson-Wayne, soprano, and Edward Matthews, baritone, with supporting soloists, chorus, and orchestra, the composer conducting. Recorded 1947. BMG 09026-68163-2. 1996, Compact disc.
Porgy and Bess (original cast).
Gershwin, George. Porgy and Bess. Selections. Recorded 1942. MCA Records MCAD 10520. MCA 1992, Compact disc.
Simon Estes as the Flying Dutchman.
Der Fliegende Holländer; from the Bayreuther Festspiele 1985. DVD. Composed by Wagner, Richard; directed by Harry Kupfer, 1985. Hamburg: Deutsche Grammophon.
Leontyne Price as Donna Anna.
Mozart, Wolfgang Amadeus. 1960. Don Giovanni: RCA Victor. LM 6410. Audio Recording."

Publication date: Sep 2011

Year: 2011

Study on the Four-channel Skin-hearing Aid Based on Morse Codes

Author: Li, Jianwen; Hou, Yuanyuan; Li, Jianghong

Publication info: Computer and Information Science 4.5 (Sep 2011): 111-115.
ProQuest document link

Abstract: To enhance the identification capacity of the skin-hearing aid for voice signals, the four-channel skin-hearing aid based on Morse encoding method is proposed in this article, which can overcome many disadvantages such as low identification rate and bad anti-jamming capability existing in analog variable pressure skin-hearing aid. By processing voices, seeking the corresponding Morse code of voice signals, establishing the skin response voltage sequence by the Morse encoding, stimulating the skins by this voltage sequence, and making the skins to more clearly feel different signals of voice, the identification rate of skin hearing can be enhanced obviously. [PUBLICATION ABSTRACT]

Full text: Headnote
Abstract
To enhance the identification capacity of the skin-hearing aid for voice signals, the four-channel skin-hearing aid

based on Morse encoding method is proposed in this article, which can overcome many disadvantages such as low identification rate and bad anti-jamming capability existing in analog variable pressure skin-hearing aid. By processing voices, seeking the corresponding Morse code of voice signals, establishing the skin response voltage sequence by the Morse encoding, stimulating the skins by this voltage sequence, and making the skins to more clearly feel different signals of voice, the identification rate of skin hearing can be enhanced obviously.

Keywords: Morse codes, Voice model, Variable pressure skin-hearing aid

1. Introduction

Deaf-mutes' hearing and talking is one big problem in the world, and to solve this problem, people used various method and aid tools such as hearing-aid, electric cochlea, and speech-reading, which are helpful for deaf-mutes' hearing and talking, but there is no one method which can solve this problem perfectly. Though the variable pressure skin-hearing aid prevented by Professor Li Jianwen in Shaanxi University of Science &Technology (Li, 2004, P. 66-69) could achieve certain effect for the hearing, but it is still not ideal for the voice identification. To improve the voice identification effect in the skin hearing, several key approaches in the variable pressure skin-hearing aid are improved in this article.

Frist, the pronunciation of Chinese language is classified. Second, the voice base based on intelligent voice identification is established by the computer voice identification technology. Third, the exterior voice signals are converted into the digital signals and the corresponding relationship with the voice model base is established. Fourth, the corresponding relationship between the voice model and the Morse code is designed. Fifth, the four-channel Morse encoding method is designed. Sixth, the output signals such as point and line in Morse codes are confirmed. Seventh, the identified voice information output is exported as the analog current signals based on Morse encoding principle. Finally, the voice identification of deaf people's hearing based on the voice model is realized.

2. Principle of the Four-channel skin-hearing aid

The multi-channel skin-hearing aid based on Morse codes is mainly composed by the microphone, the filter, the ADC and DAC, the voice processor, the audio-frequency amplifier, the small-power transformer, and the planar electrode (seen in Figure 1).

Microphone: Acquire voice signals and convert the signals to analog current signals.

Filter: Identify the environmental voices, increase the voice signals, and eliminate the noise signals.

ADC/DAC: The digital signals are better than the analog signals in the identification degree, the anti-jamming capacity, and the establishment of voice model, so the analog signals should be converted to the digital signals for processing.

Process [arrow right] Voice base [arrow right] Morse codes: Provide the digital signals corresponding with inputs, based on Morse encoding.

Power transformer: Increase the voltage signals to the secure range in which people can feel (Li, 2006, P. 253-257).

Planar electrode: Stimulate the nerve of skin.

3. Design scheme

3.1 Establishment of the voice model of computer voice identification technology

At present, the voice identification technology has been a comprehensive technology including acoustics, linguistics, digital signal processing, and statistical pattern recognition (Wang, 2009, P. 28-30). The modern v system based on the voice identification technology has been applied in many scenes successfully, and the technologies adopted in different tasks are different. The theoretical research thought of the multi-channel skin-hearing aid based on Morse codes includes classifying the deaff languages, establishing a set of voice model base according with daily standards, and then providing the voltage sequence based on Morse codes by checking corresponding Morse codes and combining with the response of skin for the planar electrode voltage, and hearing voice by this sequence.

3.2 Corresponding relationship between voice base and Morse codes

Morse code is a kind of signal code with break (Li, 2011, P. 5-10), and it expresses different English characters, numbers, and punctuation marks through different sort orders. Generally speaking, any code which can express the written characters by the signals with variable length could be called as Morse code. Aiming at the deaff voice identification, the new Morse encoding method respectively encodes the initial consonants and the final sounds (seen in Figure 2 and Figure 3). This experiment selects four channels as the output of signals, which corresponds with the searching algorithm, and the programming result shows that the binary tree four-depth algorithm could quickly and exactly find the corresponding signals, and the amount of channel is closely related with the depth.

The sequence table of Morse encoding is seen in Table 1, and expect that both a(-E-E) and b(-EE-) are specified codes, other codes correspond with the binary tree searching algorithm.

3.3 Implementation method

The signals with different voltages produced by the analog signal producer are used to stimulate the skin, and when the voltage equals to 100V, the identification effect is good, and the test report for the deaf-mute is seen in Table 2.

4. Tests and conclusions

The deaf-mute male who is 50 years old is selected as the test object, and the electrode is wear at the front of the left arm, inside of the wrist. 100V simulation voltage is selected to achieve good perception effect, and to distinguish the long and the short obviously, large numbers of tests show that the best durative time to feel the short is 0.02s, and the best durative time to feel the long is 0.05s. With the help of the skin-hearing aid, the deaf could identify simple voice signals through about 2 hoursf training. Through about 50 times of test, for ten numbers from 0 to 9, except 4 and 7 could not be identified well, which correct recognition rate was only 60%, other numbers could be identified well, with the correct recognition rate above 86%. The voice identification is the process with continual studying and training, and through long-time training, the deaf could obtain good voice identification capability with the help of the skin-hearing aid. The test result shows that the four-channel skin-hearing aid based on Morse code proposed in this article has good voice identification effect.

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Received: June 23, 2011 Accepted: July 13, 2011 doi:10.5539/cis.v4n5p111

Publication date: Sep 2011

Year: 2011

Decibels and Dollars: A Look at Hearing Aid Features Across Price Points

Author: Ingrao, Brad

Publication info: Hearing Loss Magazine 32.5 (Sep/Oct 2011): 30-33.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: I want to thank Dr. Mark Ross for his tireless efforts over the past 18 years writing about research and technology developments in technology for Hearing Loss Magazine. His words have been ones to live by professionally and personally since before I completed my bachelor's degree in communication disorders. I have been extremely fortunate to have him as a friend and mentor since we met at the HLAA Convention in Phoenix in 1997. I am honored and humbled to have been asked by HLAA and the RERC on Hearing Enhancement to write on research and technology following Marks very well-deserved retirement.
- Brad Ingrao, Au. D.
What Exactly is a Hearing Aid Anyway?
The first hearing aids, like those described in Mark Ross' article "From a Body Hearing Aid to Cochlear Implant" Hearing Loss Magazine, July/ August 201 1) were little more than miniature public address systems. The amplifiers were fairly simple and had a limited frequency (pitch) range. They contained basic tone controls, but often over- or under- amplified areas of hearing loss. In order to hear well, people with hearing loss needed to manually adjust the volume control to try to match the sounds environment. They made life markedly better for people with hearing loss, but were far from ideal.
Modern digital hearing aids are built around tiny computer chips called DSPs (Digital Sound Processors). These, in combination with improved microphones and speakers (sometimes called receivers) allow hearing aids to amplify a wider range of pitches with far less distortion than their predecessors. Using computer software, they can be very finely tuned to the individual's hearing loss and even include memories, analyzers and sub-miniature radio stations. They automatically measure the surroundings and adjust volume and, in some cases, microphone behavior, many times per second. All of this technology comes at a price, and anyone who has researched hearing aids knows that the range of prices is large and the choices numerous.
Why an Article on Hearing Aid Features and Price?
In the July/ August 201 1 issue of Hearing Loss Magazine, HLAA Executive Director Brenda Battat described an HLAA initiative to make hearing aids more affordable. An important part of the transparency she calls for in her editorial is a better understanding of the features available in hearing aids at different price points. When we spoke at the recent HLAA Convention in June, she asked me to address this, so here goes. By the way, the second part of Brenda's transparency concern is addressed in the Stephanie Sjoblad, Au. D. and Barbara Winslow Warren, Au. D. article "Unbundling: A Way to Make Hearing Aids More Affordable?" on page 1 8 of this issue of Hearing Loss Magazine.
This article will define the basic functions in hearing aids that address these common needs as well as providing a few of the more common brand names for these features. Following that, we will look at the current offerings by the top six manufacturers and give you an idea of what features you should expect in several price

categories.

Channels

The human inner ear, or cochlea, contains tens of thousands of tiny sensory hair cells that convert sound waves into nerve impulses that our brains perceive as sound. These are organized like a piano keyboard with each "key" being a critical band of hair cells. When we develop hearing loss, some of the keys become less effective and sound softer and less distinct in pitch. Hearing aids attempt to compensate for this by adding more volume. If the added volume is provided by pressing hard on the weak keys with trained and skilled fingers, the correction will be precise and the overall sounds will be mostly satisfactory. If, however, the volume is added by pounding on the keys with an open hand, the result is imprecise, noisy and generally unpleasant.

In hearing aids, the DSP's amplifier is divided into several specific areas of pitch (frequency), each of which can be adjusted independently. One would think that the more the better, which is true to a certain extent. More channels do assist with some automatic features like feedback reduction (see below for more on that), but clinical research doesn't really bear out the need for more than five or six channels. The location of these channels relative to your hearing loss is more important than the absolute number.

Compression

Since the mid-1980s, hearing aids have attempted to correct the distortion of loudness perception inherent in sensorineural hearing loss (recruitment) by adding more amplification (gain) for soft sounds and less for loud sounds. The most effective form of this is called Wide Dynamic Range Compression (WDRC). Nearly all hearing aids today have at least two WDRC compressors in each channel for speech level sounds and one to control the maximum loudness of the hearing aid. Depending on your hearing loss, having more of these compression controls might allow you to hear more sounds more comfortably and accurately. As with channels, some hearing aids use these compression circuits to assist with noise and feedback reduction.

Multiple Memories

Most of us dont live only in one sound environment. As "smart" as current hearing aids are, they can't predict everything. In addition, certain special situations, such as listening in a hearing loop, on the phone or with an FM system, require very specific hearing aid settings. Most hearing aids allow the audiologist or hearing aid provider to assign these settings to memories that can be accessed with ear level or remote controls.

"Wireless Connectivity"

The newest trend in hearing aids is to use a very short range wireless radio called Near Field Magnetic Induction (NFMI). This is not the same as the traditional magnetic inductance used by the telecoil. Hearing aids use NFMI to share information between hearing aids, or to send and receive information with a gateway device. The ear-to-ear NFMI can be used to make volume and program changes happen in both ears with a single sided adjustment or to assist with directional microphone or noise reduction settings. NFMI to and from gateway devices allow the hearing aids to interface with Bluetooth and 900 MHz telephone and audio devices.

Addressing Feedback

At their very basic core, hearing aids are miniature public address systems. Just like the PA at a county fair, if the microphone and speakers get too close, the amplified sound loops through the system again and again until you hear a high pitched squeal. In hearing aids, this occurs when the sounds delivered into the ear escape, usually through a vent, and then reenter the microphone.

In the old days, we fixed feedback by reducing the size of the vent, reducing the output of the hearing aid or by adding acoustic filters to the sound pathway (earmold, speaker tube, etc.) until the feedback stopped. Today, most manufacturers include a feedback test in their hearing aid fitting software to "search and destroy" feedback.

Currently, hearing aids with automatic feedback management use one of two approaches to manage feedback: Notch filtering systems measure the specific pitch where feedback occurs, then the DSP reduces the amplification at that frequency only. This leaves the overall amplification intact and just removes the very narrow

"notch" in pitch that is causing the feedback.

The other is ? phase reversal system. Much like noise cancelling headphones seen on airplanes, phase reversal systems detect feedback and then tell the hearing aid to produce a sound exactly opposite in phase, which cancels the feedback out. This takes a second or two, so there will still be some feedback, but they do a good job. The more channels in a hearing aid, the more precise these automatic feedback systems can be.

Hearing Better in Noise

In 20 years of practicing audiology, I have almost never encountered a person whose hearing aids were unable to help them hear well in a small, quiet room with carpet, drapes or no air conditioning. On the other hand, almost all of my hearing aid patients complain that no matter how much they spent on their hearing aids, they still struggle in noisy and reverberant rooms. People with hearing loss need speech to be much louder than other sounds in order to understand well. A high signal-to-noise ratio is the best way to deliver improved speech understanding in less than ideal settings.

While nearly all hearing aids have some kind of noise reduction the best evidence available shows that directional microphones provide the best signal-to-noise ratio for ear level devices. The ideal solution in noise is a remote microphone connected to the hearing aid (Hearing Assistive Technology), but that is a topic for another time.

Nearly all current behind-theear hearing aids and larger in-the-ear hearing aids include or can be made to include directional microphones. The most notable difference across different price points is how different hearing aids control the microphones in an attempt to deliver optimal signal-to-noise ratio, and therefore, better understanding in noise and reverberation.

Control vs. Convenience

One of the buzz words in hearing aids today is "automatic." Some people can do very well with a fully automatic hearing aid assuming they spend most of their time listening to one or two kinds of sound in the same setting. The more common reality is that people with hearing loss, especially well informed, proactive people like HLAA members, are out and about listening and living in many complex environments. They need to be able to tell their hearing aids how to behave rather than the other way around.

Let's Go Shopping!

Hearing aid pricing is a bit tricky to discuss in a national magazine since prices are somewhat indexed to the local cost of living. A recent review of available products from GN ReSound, Oticon, Phonak, Siemens, Starkey and Widex found at least one product in the following price points with these features:

Entry Level (Under $1,000 per hearing aid)

* Wide Dynamic Range Compression in at least four channels and two loudness levels
* Directional Microphone with basic automatic operation
* At least two memories (programs)
* Telecoil (Behind-the-Ear and larger In-The-Ear models)
* Notch filtering feedback management

Mid Range ($1,000 to $2,500 per hearing aid)

* Wide Dynamic Range Compression in at least four channels and two loudness levels
* Directional Microphone with basic automatic operation
* At least four memories (programs)
* Telecoil (Behind-the-Ear models)
* NFMI connectivity for volume, program control and Bluetooth gateway
* Dynamic feedback management
* Noise reduction

Advanced ($2,500 to $3,000 per hearing aid)

* Wide Dynamic Range Compression in at least six channels and two loudness levels

* Directional Microphone with two or three modes of operation
* At least four memories (programs)
* Telecoil (Behind-the-Ear models) with selectable orientation
* NFMI connectivity for volume, program control and Bluetooth gateway
* NFMI for directional microphone adjustment
* Dynamic feedback management
* Noise reduction

Premium (over $3,000 per hearing aid)

* Wide Dynamic Range Compression in at least eight channels and three loudness levels
* Directional Microphone with two or three modes of operation
* At least four memories (programs)
* Telecoil (Behind-the-Ear models) with selectable orientation
* NFMI connectivity for volume, program control and Bluetooth gateway
* NFMI for directional microphone adjustment and noise reduction
* Dynamic feedback management

So7 What's the Best Hearing Aid?

As Mark Ross has written many times, finding your ideal hearing aid solution isn't about the product, but rather the process. The hearing aid and its features are only as good as they are appropriate for your needs. Further, the person fitting them must have the skill to make the hearing aid work for you, and have a personality that is compatible with you and your needs. Being an informed and critical consumer allows you to always get the best bang for your buck.

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Brad Ingrao, Au. D., has been an audiologist for 20 years, but surrounded by hearing loss all of his life. His uncle, son and most of his friends have a hearing loss. He was an early adopter of the Internet and has contributed to several hearing listservs for more than 15 years, as well as lecturing and publishing internationally on hearing loss, hearing aids, earmolds and assistive technology. A long time supporter of HLAA, he has written for Hearing Loss Magazine, given webinars and presented at HLAA annual conventions. Dr Ingrao is currently in private practice in St. Petersburg and Largo, Florida and may be reached via e-mail at doc@e-audiology.net.

This article was developed under a grant from the Department of Education, NIDRR grant number H133EO80006. However, the contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the federal government.

Publication date: Sep/Oct 2011

Year: 2011

Posters

Publication info: International Psychogeriatrics, suppl. International Psychogeriatric Association Reinventing Aging 23.S1 (Sep 2011): S139-S400.

Full text: (ProQuest: ... denotes non-US-ASCII text omitted.)

PS01.01

Guidelines for the management of aggression in dementia: The missing links

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Objective: To develop a conceptual framework for computerised clinical guidelines on the management of aggression in patients with dementia.

Method: A concept map was developed of the key ideas and themes found in research papers, clinical guidelines and practice recommendations that focus on the management of aggression, the elderly and dementia. These concepts were used as criteria to evaluate the comprehensiveness and completeness of current clinical guidelines on the management of aggression in dementia.

Results: Eleven key concepts were identified in the literature as important in the management of aggression in dementia: (1) the clinical and demographic characteristics of the individual, (2) the environment where the patient receives care, (3) the personal experience and life story of the patient, (4) the characteristics of the aggression, (5) the theory of causation underpinning the treatment of aggression, (6) the goals of the treatment plan, (7) the characteristics of pharmacological interventions, (8) the characteristics of non-pharmacological interventions, (9) evidence based recommendations, (10) endorsement by health care services and medical and nursing colleges, and (11) the process of updating the guidelines. Fourteen clinical guidelines published since 2005 were included in the evaluation. Links between concepts and their representation in the text of the guidelines were assessed as strong, moderate, weak or absent. The most strongly represented links in the guidelines were the pharmacological management of aggression depending on its presentation, and the consideration of individual factors in managing aggression. These links were well represented and weak only in two out of fourteen guidelines. The role of the environment, non-pharmacological approaches and the goals of treatment were moderately represented in x guidelines. A consideration of theoretical approaches to causation was weakly represented, and a consideration of the patient's individual life story was weak or absent in nine out of the fourteen guidelines. The provision of details of updating the guideline was absent in eleven out of fourteen guidelines, which was quite alarming given the importance of managing the mental health of fragile elderly patients. Ten out of the fourteen guidelines were endorsed by a professional college or health service.

Conclusion: The overall mapping reveals that there are too many links missing in the majority of published guidelines which casts a doubt over their usefulness in clinical practice. This is of particular importance when we consider that one of the aims of clinical guidelines is to strengthen the transfer of knowledge from research to clinical practice.

PS01.03

The role of the dopaminergic system in apathy in Parkinson's disease and Alzheimer's disease: An experimental approach

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Background: Apathy is characterized by a loss of initiation and motivation, decreased social engagement, and

emotional indifference. Apathy is a frequent neuropsychiatric syndrome in Parkinson's disease (PD) and Alzheimer's disease (AD), and it has a negative impact on cognitive and motor performance, everyday functioning, prognosis, and quality of life of both the patient and caretaker. Little is known about the pathophysiology of apathy in PD and AD and no effective treatment is available to date. Dopaminergic circuits have been associated with self-reward and initiation and it has been suggested that dopaminergic medication may be useful to reduce apathy. Knowledge of the involvement of the dopaminergic system in the pathogenesis of apathy in PD and AD may open the road for new treatment options.

Objective: To examine the role of the dopaminergic neurotransmitter system in the pathophysiology of apathy in patients with Parkinson's disease (PD) and Alzheimer's disease (AD).

Methods: In a randomized, double-blind, placebo controlled, crossover design 23 PD patients and 23 age, gender and education matched healthy controls were challenged with methylphenidate, pramipexole or placebo on three different testing days. Twelve AD patients (inclusion still ongoing) received only a methylphenidate and placebo challenge. The main study parameters were the performance on neuropsychiatric and neuropsychological tests for all groups, including assessments of cognitive status, mood, apathy, and an observation of spontaneous self-reward behaviour. These outcome measures were assessed on each of the testing days, both before and after the pharmacological challenge.

Results: Data will be analysed soon and results will be presented at the IPA congress. We expect that PD and AD patients suffering from apathy can be primarily triggered with methylphenidate, an agent that stimulates dopaminergic circuits, and in the PD group, that pramipexole will have the same effect. In a between subject comparison, we expect patients to score worse than control subjects on measures for apathy and depression. We also expect patients to perform less well on neuropsychological tasks, which are mainly measures of executive functioning. These deficiencies are expected to improve after challenge with pramipexole or methylphenidate. In a within subject comparison it is expected that the improvement in score on the different measures will be greater after the methylphenidate and pramipexole challenge than after the placebo condition.

Discussion: The role of the dopaminergic system in the pathogenesis of apathy in PD and AD will be discussed. In addition, the relevance for healthcare will be evaluated and some recommendations for future research will be given.

PS01.04

The impact of antipsychotics and neuropsychiatric symptoms on quality of life for people with dementia living in nursing homes

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Background: Neuropsychiatric symptoms (NPS) and antipsychotic drugs (AP) are both thought to have a negative effect on quality of life (QoL). The aim of this study was to establish whether AP use has a negative effect on QoL independently from NPS.

Method: longitudinal cohort study of 290 dementia patients living in 9 different nursing homes in Netherlands. The measurements were repeated with a 6-month interval over a two-year period. Patients were considered for inclusion provided they: (1) met the Diagnostic and Statistical Manual of Mental Disorders fourth edition (DSM-IV) criteria for dementia, (2) had no history of life-threatening disease at the time of inclusion, and (3) resided in the nursing home for at least four weeks. Patients with severe stage of dementia (Global Deterioration Scale (GDS) = 7) at baseline and patients who reached GDS stage 7 during the two year follow up period were excluded from the analysis. QoL and NPS were assessed with the Qualidem questionnaire and Neuropsychiatric Inventory- Nursing Home Version (NPI-NH) respectively. Our longitudinal dataset include 5 assessments of each patient, with concomitant four intervals during which QoL, AP use and NPS and other variables may change. To correct for the dependency between the observations within a patient (intra-patient correlation was expected >0), GEE was used. Influence of change in AP use on change in QOL of life and

development of QoL in time was studied with two different GEE models with simultaneous correction for other possible predictor variables such as NPS, cognition, ADL, age, gender and use of other psychotropic medication Model 1: The first model was used to estimate the relationship between changes in QoL (as outcome) and AP prescription pattern. A categorical variable 'AP -prescription pattern' comprises 4 possible categories depending on the use of antipsychotics at each 6 month interval: 1) patient that did not receive AP at two subsequent measurements, 2) patients received AP at two subsequent measurements of a 6-month interval, 3) patient that used AP at the beginning of the interval and was AP-free at the end of the interval, 4) patients that did not use AP at the beginning of the interval and received AP at the end of the interval. This model allows to detect whether changes in QoL depend on AP prescription or change in AP use. Model 2: The second model estimates QoL (as outcome variable) in relationship to the variable time and AP use, comparing development of QoL in time between patients constantly using AP during the whole follow up (chronic AP users) and patients who stayed AP free during the whole follow up period (no-users). This model allows to detect whether QoL develops differently between patients that used AP chronically and patients that had never used AP (at any time point) after correction for other covariates i.e. NPI-NH total score, SIB-s, ADL total score, age and gender.

Results: AP prescription patterns did not have a statistically significant influence on change in QoL, whereas change in NPI-NH total score was a consistent predictor of change in QoL (Model 1). Development of QoL in time in chronic AP-users did not differ from AP-free patients, except for the Qualidem sub-scale restless tense behavior (Model 2). Restless tense behavior in AP-free patients improved compared to a slight deterioration in chronic AP users. This effect did not turned out to have a significant influence on total quality of life. Discussion: AP use does not necessarily have a detrimental effect on QoL in patients with dementia. Instead, NPS have a consistent negative effect on QoL. Cautious use of AP for treatmant of NPS might be justified when used carefully while monitoring benefits and avoiding side-effects.

PS01.05

The effects of introducing a nursing guideline on depression in psychogeriatric nursing home residents

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Introduction: The prevalence rate of depression in psychogeriatric nursing home residents with dementia is recently estimated at 19% (Verkaik et al., 2009). Comorbid depression in dementia has been associated with decreased quality of life, greater health care utilization and higher mortality rates. The effects of introducing an evidence based nursing guideline on psychogeriatric nursing home wards were studied. The guideline is based on the BehaviorTherapy_PleasantEvents, developed and studied by Teri et al. (1997) for people with dementia still living in the community. BehaviorTherapy_PleasantEvents follows the Integrative Theory of Depression and the Pleasant Events Schedules developed by Lewinsohn et al. (1985). The Pleasant Events Schedules aim at breaking into the depression cycle specifically at the point at which depressed individuals experience fewer activities as pleasant, engage in pleasant activities less frequently, and therefore obtain less positive reinforcement than other individuals. The Pleasant Events Schedules aim at increasing pleasant activities and positive interactions with the environment. Besides increasing pleasant events, a second aim of the BehaviorTherapy-PleasantEvents is reducing unpleasant events for people with dementia. For our nursing guideline we adapted the method of Teri et al. to the context of residential care provided by certified nurse assistants (CNAs) in collaboration with other caregivers. For the introduction of the guideline into the psychogeriatric nursing home wards a specific training program was developed in which the nursing teams learned how to apply the guideline to their own residents. The objective was to study the effects of the introduction of the nursing guideline on depression in demented nursing home residents of psychogeriatric wards.

Methods and Materials: A multi-centre (n = 9) controlled intervention study with randomization at ward level (n = 18) with pre-test, post-test and follow-up measurements was used. Participants were 97 residents of psychogeriatric nursing home wards that met the following inclusion criteria: (1) Diagnosis of dementia (all types) (APA, 1996); (2) Severity of dementia from "age associated memory impairmentâ[euro] to "moderately severe dementiaâ[euro] (Global Deterioration Scale stages 2 to 6: Reisberg et al., 1982). (3) Diagnosed with depression in dementia according to the Provisional Diagnostic Criteria for depression of Alzheimer's Disease (PDC-dAD:Olin et al., 2002). Primary outcome was severity of depression measured with the MDS/RAI-Depression Rating Scale and the Cornell Scale for Depression in Dementia. Control measures (covariates) are gender, marital status, duration of residence in the nursing home, care dependency, cognitive impairment, and medication use (antidepressants, antipsychotics, benzodiazepines and ACE-inhibitor/β-blockers).
Results: A significant treatment effect was obtained for depression on the MDS/RAI-Depression rating scale (DRS). In the experimental group depression severity reduced from 4.56 (±0.35) to 3.91 (±0.35) at post-test to 3.79 (±0.38) at follow-up. In the control group depression severity at pre-test is 3.84 (±0.52), at post-test rises to 4.61 (±0.57) and than decreases to follow-up to 4.07 (±0.61). The differences are quadratic because of the rise and fall of depression severity in the control group. The treatment effect was not significant on the Cornell Scale, although the trend in the experimental group shows a reduction of depression from 11.42 (±0.62) at baseline to 10.31 (±0.57) at post-test, to 9.96 (±0.66) at follow-up. The trend in the control group first remains at the same level from pre-test to post-test (11.48 ±0.90 to 11.46 ±1.12) and then drops to 9.93 (±1.18). The success of the guideline introduction was studied and was found to be good on three of the participating wards, on four it was moderately successful and on two not successful.
Conclusions: This study shows significant reductions in depression severity by introducing a nursing guideline on psychogeriatric nursing home wards. Better compliance with the guideline could probably enlarge the effects. Some ways to achieve this are: (1) additionally train non-certified nurse assistants, and (2) emphasize necessary conditions for successful introduction of the guideline to nursing team managers.
This study was funded by ZonMw, The Netherlands organization for health research and development (project nr. 5401.0001)

PS01.06

Non-pharmacological intervention in Alzheimer's disease: Benefits of aerobic exercise on neuropsychiatric symptoms and caregiver burden: A randomized controlled trial

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Overview: Abstract Neuropsychiatric symptoms highly prevalent among Alzheimer's disease (AD) patients and represent a source of caregiver's burden with a shorter time to institutionalization and an increase in suffering of caregivers or relatives. Currently there is a significant increasing effort in order to clarify the impact of physical exercises, as a non-pharmacological intervention, on reducing the patient's suffering and on alleviating the caregiver's burden. Pharmacological interventions for patients with behavioural disturbances in Alzheimer's disease at present are only symptomatic, although treated patients have shown significant benefits compared to those without treatment. Improving the management of Alzheimer's disease patients with neuropsychiatric symptoms such as agitation, aggression, depression, apathy, and other psychopathological phenomena, involves attenuating the frequency and severity of these disturbances.
Aims: To examine the effects of a six-month aerobic exercise on neuropsychiatric symptoms from patients with Alzheimer's disease, as well, the impact of exercise on alleviating caregiver's burden.

Methods: This controlled trial involved 32 community patients and their respective caregivers coming from two university centers in Brazil. The aerobic exercise program was performed during a six-month period, 60 minutes three times per week. Patients were divided into two randomized groups: 16 with motor intervention and 16 sedentary (five sedentary patients were excluded because of clinical intercurrences). Aerobic exercises and functional balance were conducted during six months, 60 minutes three times per week. Main exercise program involved walking, dancing, and exploring upper and lower limbs driven to enhance flexibility, strength, agility, and to improve functional balance. These motor components seem to be important for maintaining functional capacity of patients with AD. We evaluated psychopathological features of patients using Neuropsychiatric Inventory (NPI) and Cornell Scale for Depression in Dementia. Caregivers were evaluated concerning burden and stress through NPI-Distress and Burden Interview.
Results: The aerobic exercise program during a six-month period was effective in decreasing neuropsychiatric symptoms in patients with AD and reduced caregivers burden. Patients from exercise group presented significant reduction in (Neuropsychiatric Inventory (F:11.12; p = 0.01) and Cornell Depression scale (F:11.97; p = 0.01). Caregivers whose patients participated in intervention program had their burden and stress significantly decreased when compared to caregivers whose patients were sedentary (NPI-Distress (F: 9.37; p = 0.01) and Burden Interview (F: 11.28; p = 0.01). However, in the sedentary group, these symptoms slightly increased, and respective caregivers had their burden unchanged. Patients who participated in aerobic exercise had improvement on several domains from Neuropsychiatric Inventory, for instance in irritability, anxiety, apathy/indifference, and appetite alterations when compared to sedentary. On the other hand, differences between groups could be attributable to the reciprocal influence of two factors: the reduction in symptoms among patients who participated in aerobic exercise and the increase of these symptoms in the sedentary group. Concerning the procedures as described in the methods section, the raters completed the scales considering the patient and the caregiver together or separated, according to specific situations, such as emotional condition or behaviour control. Despite these procedures could interfere with accuracy of quality of measurements, the raters engaged themselves in order to avoid the emotional influence from patient or caregiver in the results. Regarding the number of patients, there was a small sample size mainly in sedentary group, which substantially reduces its statistical power and capacity of generalization.
Conclusions: An aerobic exercise program, during six months, contributed to reduce neuropsychiatric symptoms in patients with Alzheimer's disease and to attenuate caregivers' burden. Irritability, anxiety, apathy, and appetite alterations were the mainly improved psychopathological manifestations. Aerobic exercise contributed to reduction in neuropsychiatric symptoms of Alzheimer's disease patients and attenuated caregivers' burden.
PS01.07
Evaluation of psychogeriatric characteristics of frail elderly benefiting from innovative home care services: A Belgian follow up study
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Overview: Background In order to expand the types of home care services funded by the government, the Belgian National Institute for Health and Disability Insurance (NIDHI) wishes to evaluate innovative projects in this sector. This evaluation will examine a large variety of initiatives in the elderly care with the main common objectives of keeping frail elderly at home, maintaining or improving their quality of life and preserving their autonomy. This paper shows research which is based on the evaluation project called Protocol 3, a collaboration project between the NIDHI and a consortium of four Belgian universities (UCL, KULeuven, UA and Ulg). In Protocol 3 there are 66 innovative projects which started in 2010. These projects are clustered according to the type of main intervention they provide: case management, night care, alternative housing, occupational therapy at home, psychological support for elderly and informal helpers, etc. Over three thousand frail elderly clients will be followed up closely during a period of 4 years, from 2010 until 2013. According to the inclusion criteria, these clients should be frail and at risk for institutionalization.

Methods: In the paper we show the preliminary results of the first data collected from 56 innovative projects providing care to 998 frail elderly clients (mean age 80.8 years old, 66.3% female). The presentation will show analysis of data collected from 66 projects and more than 1500 clients. Most of the variables are measured using the interRAI Home Care instrument. The interRAI instruments are standardized, evidence-based and internationally validated assessment tools. Other complementary internationally validated scales such as the WHOQOL-8 and the Zarit Burden scale (12-item) were selected to complete the evaluation. In this presentation, we will focus on the follow up of the results from the interRAI HC instrument and on how psychogeriatric characteristics evolve over time. Moreover, the analysis will also indicate whether there are significant differences between the characteristics of the elderly across projects.

Results: The preliminary results from the interRAI Cognitive Performance scale (CPS2) show that 47.1% of elderly in the study show cognitive impairment of mild (12.0%), moderate (15.1%) and severe or very severe intensity (20.0%). This scale has been validated with the MMSE scale. The interRAI Depression Rating Scale (DRS) shows that 27.7% of the elderly have signs of depression. Construct validity of this scale was assessed by comparing it with the Hamilton Depression Rating Scale and the Cornell scale. In addition, 37.4% of the clients in the study reported to withdraw from activities of interest such as planned activities or being with family or friends. The Clinical Assessment Protocol (CAP) 'Activities' is one of the output variables of the interRAI instruments. This indicator identifies elderly with some cognitive capacity who have either withdrawn from activities or who are uneasy entering into activities and social relationships. This CAP shows a very high risk for 30.4 % of the elderly in the study and provides advices to caregivers on how to set goals of care to improve their clients' activity involvement. The analysis of these and other characteristics is important to have insight in the situation of the frail elderly. In addition, an important evaluation will be the comparison between elderly across projects. This will allow us to identify whether specific projects are more suitable for a certain elderly profile.

Conclusion: This paper focuses on some psychogeriatric characteristics of frail elderly benefiting from innovative home care projects in Belgium. The scores of the interRAI CPS and DRS scales show that cognitive decline and depression are a large problem in this study population. Moreover, a large percentage of elderly clients report to be less or not involved in activities which they used to be part of. The follow up of these and other determinants will give us insight on how elderly psychogeriatric characteristics evolve over time. The analysis will also point out the differences between the characteristics of the elderly across projects and will indicate whether innovative programs have an impact on frail elderly who are at home. The use of a comprehensive geriatric assessment such as the interRAI HC helps to evaluate these determinants and control for the presence of premorbid history, functional deterioration and other significant variables. Researchers intend to show the evolution of psychogeriatric characteristics and to analyze how co-morbidity affects these characteristics.

PS01.08

Methylphenidate in apathetic persons with dementia of the Alzheimer type (DAT): Impact on function, caregiver burden and cognition

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Background: Apathy is the most common behavioral problem reported in persons with DAT. Apathy is characterized by indifference, disengagement, passivity, and loss of enthusiasm, interest, empathy and interpersonal involvement. Apathy has profound consequences for both patients and caregivers leading to an increased reliance on family members for ADLs, higher caregiver burden and ultimately to institutionalization. There are no currently approved treatments for apathy. The purpose of this study was to evaluate apathetic patients with DAT treated with methylphenidate (MPH) in a randomized controlled trial. Reported here are outcomes of the trial related to cognition, caregiver burden and function.

Methods: Patients with mild to moderate DAT who had apathy scores on the Apathy Evaluation Scale (AES) of >40 entered into the study after informed consent was obtained. A thorough history was gathered including baseline demographics, and measurements included the Apathy Evaluation Scale (AES), Clinical Global Impression (CGI, CGI-S), Mini-Mental State Examination (MMSE), Modified Mini-Mental State Examination (3MS), Executive Interview (EXIT-25), Activities of Daily Living (ADL), Zarit Burden Scale (ZBS) and Instrumental Activities of Daily Living (IADL). Patients were randomly assigned to placebo or MPH initially dosed at 5mg BID and titrated to 10mg BID at two weeks. Follow up visits were scheduled at 4, 8, and 12weeks. Study medication was then stopped and subjects returned for one additional visit at week 14. Data with a normal distribution were analyzed using a repeated measures mixed model. ADL was transformed to a binary variable and analyzed with a generalized linear mixed model. Bonferroni corrections were made to adjust for multiple comparisons.

Results: A total of 60 male patients were enrolled and one patient was excluded in each arm of the study leaving a total of 29 patients in each group. Mean age was 76.6 (±7.9) years. Patients who received MPH showed significant improvement on a global measure of function (CGI) and global severity (CGI-S) at the end point of active study that did not persist after a two-week follow-up. Subjects receiving MPH also showed significant improvement on the MMSE and 3MS compared to the placebo group at week 12 that did not persist after drug discontinuation. There were significantly more subjects with ADL deficits at baseline in the MPH group. The percent of subjects with any ADL deficits did not differ significantly at study end point. IADLs were not significantly different at baseline and did not show any significant difference between groups at any time point though IADLs significantly improved from baseline in the MPH group. ZBS scores likewise did not differ at any time point between the two groups though those in the MPH group showed a trend for improvement at week 12 compared to baseline. MPH was well tolerated in this population. No patient discontinued the study due to adverse effects.

Conclusions: MPH treatment was associated with improved ratings of global function as well as improvements in brief cognitive measures that did not persist after treatment discontinuation. Measures of ADL, IADL and caregiver burden did not differ between groups but all showed evidence of positive change from baseline within the MPH group. None of these effects persisted beyond a two-week discontinuation period. MPH may offer significant benefits for apathetic persons with DAT beyond a direct effect on apathy.

PS01.09

Classification of delusions in Alzheimer's disease

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Objectives: A wide range of delusions can be observed in the course of Alzheimer's disease (AD). Many AD patients experience more than two types of delusions at the same time. On the other hand, AD patients with delusion do not experience all of the different kinds of delusion, and the frequency of each type of delusion differs. Delusions in AD may be classifiable and distinguishable symptoms. The aims of this study were to classify delusions in AD and to investigate the effects of cognitive impairment on each classified delusion group.

Methods: Eighty seven consecutive probable AD patients showing delusion were recruited for this study (mean age = 75.7 ±6.8, male: female = 22: 65). Delusion was evaluated using the Neuropsychiatric Inventory (NPI). In the NPI delusion subscale, eight different types of delusions were evaluated in a manner of present or absent. The eight delusions were: delusion of persecution, delusion of theft, delusional jealously, phantom boarder symptom (PBS) (belief that unwelcome guests are living in his/her house), belief that one's spouse or others are not who they claim to be, belief that his/her house is not his/her home, delusion of abandonment, and delusion relating to the television, which is a belief that television or magazine images and reports are actually present in the home. A factor analysis was performed to classify the eight types of delusions. After the factor analysis, multiple regression analyses were performed to investigate the effects of specific cognitive impairment, which was assessed by the Mini-Mental State Examination (MMSE), on each classified delusions.

Table 1.

Factor loadings for delusions according to Neuropsychiatric Inventory in the AD patients

Significant loadings (≥0.30) were entered into the factor.

Results: The factor analysis of the eight different delusions in the 87 AD patients with delusion classified the delusions into three factors and an independent category (Table 1). The delusions that were loaded into Factor 1 were: belief that his/her house is not his/her home, PBS, delusion of abandonment, and belief that one's spouse or others are not who they claim to be. The delusions that were loaded into Factor 2 were: delusion relating to the television and delusion of persecution. The delusions that were loaded into Factor 3 were delusion of abandonment and delusional jealously. Delusion of theft was not loaded into any of these factors, so it was regarded as an independent delusion. The multiple regression analyses showed significant associations between the factor scores of Factor 1 and the scores of MMSE constructional praxis ($\beta = -0.255$, df = 82, $p = 0.033$) and between the factor scores of Factor 2 and the scores of MMSE short-term memory/working memory ($\beta = -0.306$, df = 82, $p = 0.032$), but not between the factor scores of Factor 3 and any of the specific MMSE subgroup scores. In this study, delusion of theft was not classified into any factors, so that we could not assess the effects of cognitive impairment on delusion of theft. Discussion Factor 1 was regarded as delusional misidentification, and it was related to the impairment of constructional praxis, in which visuospatial perception plays a role. The patients with Factor 1 seem to misidentify objects, people, and home, so that they cannot obtain familiarity with the environment. Delusion of abandonment may subsequently emerge since the patients cannot receive familiarity with the loved ones and home due to delusional misidentification. The common feature of Factor 2 is awareness of persecution, and it was related to the impairment of short-term memory/working memory that interferes with information processing. AD patients can more successfully retrieve personal experiences arousing emotion, especially a fear, than the surrounding knowledge such as when and where the experiences were gained. In the patients with Factor 2, the loss of the information source can make the patients sense as if irrelevant events happen nearby, and then such irrelevant things can be sources of fear. A thought of being abandoned is the common feature of Factor 3, and it was not associated with any domains of cognitive dysfunctions. The thought of being abandoned in aged people is related to feelings of inferiority due to senescence and dependence on the spouse. Factor 3 may be related to feelings of inferiority due to the disease and the rejections of dependence on the spouse. Delusion of theft was not loaded into any of the three factors, and the factor loading of delusion of theft was negatively high on axes of Factors 1 and 2. It seems that delusion

of theft is phenomenologically deviated from Factors 1 and 2.

PS01.10

The care for person with dementia: The role of an Alzheimer's special care unit for the management of BPSD

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Background: In the last decades there is a constant increasing in with the incidence of Dementia and Alzheimer disease; the natural course of the disease is associated with the presence of behavioural and psychological symptoms (BPSD), that are the major cause of burden both for the patient and for the family caregiver: Although home care may be the preferred choice for many families, staying at home may not be a realistic option for many persons with dementia, especially in the late stages of the disease or in the presence of BPSD. Thought there are no RCT's comparing Alzheimer Special Care Units (SCUs) to traditional nursing homes (NHs), many observational studies reported the benefit of a caring program that include the staff training, special planning, an adapted physical environment, and caregivers involvement. Our SCUs, founded in 2001 in the setting of a traditional NH, has peculiar characteristics, such as the adoption of a person centred approach and organizational program, use of comprehensive geriatric assessment tailored on residents with dementia and BPSD, training for formal careers oriented to learn specific stimulation techniques (occupational activity, ROT) and to prevent burn-out.

Methods: Admission criteria to SCUs are: BPSD difficult to manage at home despite the use of multiple pharmacological or non pharmacological attempts (presence of BPSD of clinical relevance; NPI, Neuropsychiatry Inventory >28/144, or NPI single item = 12, except for depression and apathy), Burden and significative distress of family caregiver as a consequence of the care of person with dementia (evaluated with RSS 16-30, Relative Stress Scale), moderate to severe cognitive impairment (MMSE <20, Mini Mental State Exhamination), independent walk (Tinetti scale >18/28). Length of stay in the SCU range from 3 to 6 months, during this period the activity of the staff, (medical, nursing, formal careers, psychologists) is oriented to support residual skills, management of BPSD using psychosocial interventions as "Snoezelenâ[euro], "occupational therapyâ[euro] and reminiscence therapy) aimed to reduce psychotropic medications and physical restraints, sustain familiars and planning with them and social services the return at home after discharge.

Results: From October 2008 to march 2011 41 persons (71%W, 29%M, mean age 80,9±5,9) affected by Alzheimer disease (CDR 3-4), with severe BPSD were consequently admitted in the SCUs located in "CISA Nursing Homeâ[euro]. Median length stay was 115,1±68,3 days. Comparisons from admission to discharge showed an unvaried cognitive and functional profile, in view of a significant decreasing in BPSD (NPI at admission 44,4±15,5, NPI at discharge 30,8±11,9, $t = 4,34$, $p<0,001$). The improvement of the behavioural symptoms is not explained by a significant increasing in psychotropic medications (number of drugs at admission 5,2±3,1, number of drugs at discharge 5,3±2,4 $t = 0,13$, p = n.s.). We also observed a decrease in use of benzodiazepines and typical antipsychotic drugs, although there's no statistical significant difference. At discharge 68 % of patient returned at home, at follow-up 62% still at home after 6 month and 47% after one year.

Conclusion: Thought there are conflicing data about the efficacy of SCUs toward traditional NHs in the management of BPSD, our experience, suggests that specifics person centred programs in a adapted environment, together with caregivers involvement, seems to be a useful and effective model of care for persons with dementia and severe BPSD. Further studies are needed, in particular RCT, to confirm the results.

PS01.11

The management of BPSD in Alzheimer's special care unit: A case report

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Overview: In the last decades there is a constant increasing in elderly people with Alzheimer dementia; the natural course of the disease is associated with a number of specific complications such as behavioural and psychological symptoms (BPSD), that constitute a major burden both to the patient and to the family: Alzheimer Special Care Units (SCUs) compared with traditional nursing homes (NHs) have the benefit of a caring program that include the features of trained staffing, special programming, a modified physical environment, and family involvement. Our SCUs, founded in 2001 in the setting of a traditional NH, has peculiar characteristics, such as the adoption of a person centred management and organizational program, use of comprehensive geriatric assessment customized on residents with dementia and BPSD, training of formal careers oriented to learn specific stimulation techniques (occupational activity, ROT) and to prevent burn-out. One of the most important aim of this unit is building a personalized protected discharge project that can last peacefully for a long time.

Case Report: A 68 year old married man is admitted in Mirandola's Alzheimer Special Unit care for behavioral disturbances that include repeated aggressions towards his family, sleep and food disorders, hallucinations, anxiety and wandering. His NPI (neuropsychiatric inventory) value was 110/140. It was impossible to measure his cognitive impairment. He was dependent in every daily activity but he was able to walk by himself. The patient's birth and early development were unremarkable. In his medical history we can find only hypertension and gastritis. At the age of 62, the patient, who was just in retirement, began to present memory loss and language disorders. In January 2010 his cognitive and behavioral impairment began to got worse and worse and his family (two sons and his wife who had cancer) decided to hospitalize him in mental health district of a general hospital. Afterwards he was transferred to a Alzheimer hospital Special Unit care and then he went back to home with the diagnosis of Alzheimer' disease. Unfortunately his family wasn't able to aid him because of his behavioral disorders, anorexia and some new medical conditions like a bad diarrhea. We decided to hospitalize by our SCUs. He was treated with pharmacologic (quetiapine, memantine and lormetazepam) and psychosocial interventions (sessions in Alzheimer's special garden and in snoezelen room during day and night time) with incomplete benefit. At his arrival the all unit was upset: hours, activities and environmental spaces were totally changed to handle his behavioral disorders. We observed him, made a complete geriatric assessment and the staff filled in detailed forms to assess if every therapeutic step was or not helpful. Sleep and food disorders got better after one month but physical aggression was present particularly with other patients noises and during personal hygiene's moment. Moreover the patient was oversensitive to antipsychotic drugs developing instability and rigidity before to have some therapeutic success. We also worked hard with the relatives: many psychological counselling and meeting were made to understand their will and help them to accept the illness and learn to nurse him properly. Although they wished to have him at home they also were really afraid of his behavior. At last they decided to want him at home again, attended by a 24 hours private assistant. We also make some home visit and give them some environmental suggest ion to decrease his behavioral disorders that they welcome. They also decided to separate their big house in two different flats: one for the ill wife and one for the patient and his assistant to permit the wife to rest. His assistant attended the unit for one month before the discharge to know the patient and the all unit team taught her to nurse him properly. At the discharge his NPI index was 65/140. He took risperidone (0,75 mg) and lormetazepam (2mg) and the assistant and the family is

able to nurse him.

PS01.12

Using spontaneous occupational opportunities to promote engagement of people with BPSD in residential care

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Background: Up to 90% of people with dementia experience behavioural and psychological symptoms of dementia (BPSD) during the course of their illness. The presence of these symptoms can be due to unmet needs for engagement in meaningful occupation. However, with the progression of dementia, engaging in occupation can become more difficult requiring significant carer support and intervention. Despite this need for carer facilitated engagement, residential aged care facility care workers often have very limited time and few resources to enable them to provide those with dementia with opportunities for engagement outside of personal care activities. Establishing fixed activity opportunities within the environment that do not require carer set up has been suggested as a possible avenue for providing and increasing volitional and facilitated engagement for people with dementia. However, little is known about the impact such opportunities have on BPSD and carers. Aims: This project aimed to evaluate the impact fixed environmental opportunities for spontaneous occupation within a psychogeriatric nursing home had on the BPSDs of residents and their carers.

Methods: This project was conducted in a psychogeriatric nursing home in Melbourne, Australia which accommodated 30 older people with moderately severe to severe BPSD or severe and persistent psychiatric symptoms. The environment within the nursing home was modified to incorporate fixed occupational based opportunities that reflected the interests and occupational histories of the residents. 'Activity stations' were developed including a men's shed, baby nurseries, a sewing and craft area, an ironing centre, a multisensory room, a sensory bathroom, a resident's care, music areas, a tranquillity garden, raised garden beds and golfing and basketball areas. In addition, sensory activity boards and activity pods filled with various multisensory activities were installed throughout the corridors and communal areas of the facility. Demographics and BPSD levels of residents with dementia were compared across three time points, prior to the environmental changes in December 2005 and following the environmental changes, in March 2009 and again in November 2010 to assess sustainability of the projects results. Care workers were surveyed concerning their use and observations of resident engagement with the occupation based opportunities.

Results: No significant differences in the demographics, age and sex, were identified between the groups compared across the three time intervals permitting further statistical comparison between the groups to be made. Significant and sustained reductions in total BPSD scores were found following the environmental changes. Further analysis of the individual components of the BPSD scale revealed significant reductions in aimless wandering and delusions and significant improvements in activity initiation, all of which were sustained. The majority of care workers rated the occupational opportunities as beneficial in managing resident's BPSD with most reporting that these opportunities were easy for them to use with residents. High levels of utilization of the activities were reported for both residents and care workers.

Conclusion: This study suggests that the provision of fixed occupational opportunities within a psychogeriatric residential care setting can assist with improving engagement and reducing some aspects of BPSD. The opportunities appear to provide a medium for activity provision that is acceptable to care workers, easily utilized and identified as beneficial with BPSD management.

PS01.13

Risk factors for delusional jealousy in patients with dementia in Japan

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Background: Delusional jealousy, sometimes referred to as Othello syndrome, pathological jealousy or morbid

jealousy is a symptom in which a person holds a delusional belief that their spouse or sexual partner is unfaithful. It is often associated with dementia, alcoholism and delusional disorder. Delusional jealousy in dementia is critical as it often leads the patients to violence to their caregivers and is known to be hard to manage. Few investigations have addressed the risk factors of delusional jealousy in dementia.
Purpose: We examined the risk factors for delusional jealousy in patients with dementia.
Method: Study participants were consecutive outpatients who were referred for evaluation to Dementia Clinic of the Department of Neuropsychiatry, Kumamoto University Hospital, from April 2007 to March 2010. All underwent a battery of routine screening blood tests, standard neuropsychological examinations, including the Mini-Mental State Examination (MMSE) and Clinical Dementia Rating (CDR). In addition, brain MRI or CT, and 123I-IMP SPECT studies were performed. The clinical, neuropsychological, and neuroimaging data collected prospectively in a standardized fashion were entered into the Kumamoto University Dementia Follow-up Registry. We assessed the presence of delusional jealousy by using subquestions from the delusion subscale of the Neuropsychiatric Inventory (NPI). Of 319 patients satisfied the DSM-III diagnostic criteria for dementia and living with their spouse, 12 had delusional jealousy. Additionally 7 caregivers of patients who visited hospital continuously were interviewed about patients' sexual activities. All the procedures followed the clinical study guidelines of the Ethical Committee of Kumamoto University Hospital Before caregivers according to the Declaration of Human Rights, Helsinki, 1975.
Results: Of 12 (3.8%) patients with delusional jealousy, 9 (5.6%) were female and 3 (1.9 %) were male patients. The mean age was 76.7 (±3.5), the mean MMSE score was 18.4 (±6.3) and CDR score of 0.5, 1, 2 was 3, 6, 3, respectively. 6 patients with delusional jealousy were Dementia with Lewy bodies (DLB) patients, 4 were Alzheimer's disease (AD) and 2 were vascular dementia (VAD), while delusional jealousy couldn't be found in other types of dementia. Fourteen point seven % of DLB, 8.7% of VAD and 2.5% of AD had delusional jealousy. In past medical history, 10 of 12 patients had hypertension. Of 10 patients except VAD, 8 patients had white matter T2 hyperintensities, 4 patients had lacunar infarction in the basal ganglia and 3 patients had those of thalamus on MRI. Ten of 12 patients had frontal, 8 of 12patients had temporal and 8 of 12 patients had occipital hypoperfusion on SPECT. In 7 patients to whose family we interviewed about sexual function, 6 patients had no sexual relationship with their spouse because of their spouse's sexual dysfunction for several years. Another one patient had become hypersexual and asked her husband for sexual relationship frequently from around the same time as occurring delusional jealousy.
Conclusion: These results indicated that delusional jealousy in patients with dementia relates to diagnosis of DLB, history of hypertension, associated with white matter lesions, loss of sexual relationship.
PS01.14
Mirror sign as a cause of phantom boarder delusion in a patient with right occipito-temporal hypo-metabolism
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Overview: Mirror sign refers to the inability to recognize one's self-image in the mirror. We report a patient displaying a mirror sign leading to the development of phantom boarder delusion. "Ms. MVâ[euro] was an 85-year old woman with no psychiatric history, who had been living alone for the past three years. She was admitted to an old age psychiatry ward after caregivers heard her talking to her mirror reflection. The patient also showed a phantom boarder delusion and was convinced a woman dressing like herself lived in her house at the patient's expenses. During admission, the delusion was not manifest during daily activities but emerged after explicit questioning. The patient then explained she had no idea where the woman came from, but she had the same name as her and dressed just like her. Therefore the patient had repeatedly asked her to dress differently, so people would be able to tell them apart. When MV was positioned in front of a tilted mirror, reflecting her whole body except the face, she reported seeing herself in the mirror. However, as soon as the

mirror was repositioned to also reflect her face, MV suddenly reported the woman appeared. She failed the mirror mark test (Amsterdam, 1972), but passed when the mark was placed on another person next to her, confirming that MV was unconscious of her own face. There were no visual or auditory hallucinations or clinical features of Parkinsonism. The patient complained about impaired vision, but ophthalmologic testing showed no deficits. Neuropsychological testing revealed moderate deficits of memory, executive functioning, language and visuospatial perception. Detailed investigation of face- and object perception commonly used in prosopagnosia evaluation (Van den Stock, van de Riet, Righart, &de Gelder, 2008) showed apperceptive object agnosia. The patient was impaired at familiarity judgments of faces that were unfamiliar or famous, but also faces of family members and herself. The patient consequently classified recent photographs of herself (taken during admission) as familiar, but she identified the person as 'the woman following her'. Also when showing recent group photographs of her family, the patient explained that 'the woman even went so far she posed in pictures of her family'. Structural imaging with MRI showed cortico-subcortical atrophy. In agreement with accumulating evidence that visual self-recognition primarily involves the right hemisphere, functional imaging with FDG-PET in MV showed clear right-hemispheric lateralized occipito-temporal hypo-metabolism, suggestive for posterior cortical neurodegeneration. Furthermore, an fMRI face localizer experiment showed activation of the left but not the right fusiform face area (Figure 1). Although not definitely demonstrated, the observations are highly suggestive for a causal relationship between the mirror sign and the phantom boarder delusion. Based on this observation, evaluation of mirrored self recognition is advisable in patients presenting with phantom boarder delusion.

PS01.15

A comparison of the validity of the Cornell Scale and the MADRS in detecting depression among memory clinic patients

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Overview: Background Depression is common among patients with cognitive impairment. About 40% of the patients visiting a memory clinic in Oslo have symptoms of depression. Depression may be difficult to diagnose and several diagnostic tools are in use. Aim To examine the validity of the Cornell scale for Depression in Dementia (CSDD) and the Montgomery-Aasberg Depression Rating scale (MADRS) using two different sources of information in a outpatient population visiting a memory clinic for assessment of possible dementia.

Methods: In this study 125 memory clinic patients were examined. A nurse interviewed the caregiver (mostly a spouse) about signs of depression using the CSDD. Depressive symptoms in the patients were evaluated by a physician with the MADRS scale. A psychiatrist interviewed the patients blind to the results of the CSDD and the MADRS and diagnosed depression (or not) using the ICD-10 and DSM-IV criteria.

Results: Of the 125 patients, 64 (51.2%) were men and 61 (48.8%) were women. The mean age was 67.4 years (SD: 9.2) with a mean age for men and women of 68.2 years (SD 8.8) and 66.5 years (SD 9.4), respectively. The majority were married (85.6%) and they had, in average, 13.5 years of education. The mean IADL score was 11.4 (SD: 5.1).The caregivers were mostly spouses (71.3%,) or a child (14.8%). Of the whole group, 15.2% had a CDR score of zero, 45.6% a CDR score of 0.5, 31.2% of 1, and 8% a CDR score of 2. The mean MMSE score was 25.5 (SD: 4.6), and 68% were capable of drawing a clock correctly (mean score 3.9 out of 5 points possible). The CSDD was applied among 121 patients and the mean score was 6.8 (SD: 4.9). The MADRS was applied among 98 patients and the mean score was 8.5 (SD: 6.7). Both scales were used in 94 patients, and the mean scores of the two tests did not differ among them compared to the 125 and 98, respectively. Of all 125, 48 persons (38.4%) had a history of depression, and 31 (25%) used antidepressants at time of assessment. Assessment by the psychiatrists revealed that 51 patients (40.8%) had depression according to the criteria of ICD-10, most of them depression of mild degree (33 of the depressed), and 34 (27.2%) had a

major depressive disorder according to the DSM-IV criteria as well. In the further analysis the patients were dichotomized into to groups; 55 demented and 70 not demented (SCI = 29, MCI = 41) according to their clinical diagnoses. There were more depressed patients in the not demented group compared to the demented group, 35 (48.6%) versus 16 (30.2%) respectively (P-value 0.018). ROC analyses were performed. For the evaluation of CSDD the AUC was 0.73 (95% CI 0.63-0.82) using the ICD-10 criteria, and 0.68 (95% CI 0.57-0.79) by using the DSM-IV criteria for the whole group. Using the ICD-10 criteria by evaluating the MADRS the AUC was 0.88 (95% CI 0.81-0.95) for the whole group. When we used the DSM-IV criteria, the AUC was 0.84 (95% CI 0.76-0.92). Comparing the two groups (demented or not demented) there were no significant changes in the results for the CSDD nor the MADRS neither using the ICD-10 criteria nor using the DSM-IV. The best cut off for the CSDD was 5/6, and for the MADRS the best cut off was 6/7.

Conclusion: This study shows that both the CSDD and the MADRS are suitable as screening tools for depression among memory clinic patients even though the MADRS seems better in this less demented group of outpatient population.

PS01.16

Intact recognition of emotional signals displayed by the face and body in patients with early probable Alzheimer's disease

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Adequate recognition of the emotions and intentions of the people we interact with are important for successful social functioning. There is evidence that the ability to decode emotional signals produced by the face decreases in normal aging (Ruffman, Henry, Livingstone, &Phillips, 2008) and this decrease has been linked to social functioning. Previous studies using different task settings have indicated that recognition of facial expressions is impaired in patients with probable Alzheimer's disease (Hargrave, Maddock, &Stone, 2002) and that this deficit decreases the quality of life, independently of the cognitive deficits (Phillips, Scott, Henry, Mowat, &Bell, 2010). However, emotions are also expressed by other modalities than the face and we have previously shown that subjects are able to recognize emotional expressions displayed by the whole body (Van den Stock, Righart, &de Gelder, 2007). In the present study, we performed two experiments to investigate recognition of emotional expressions produced by either the face or the body in a group of patients with probable Alzheimer's disease (N = 12) and a group of control subjects (N = 15) that were matched on age, gender and educational level. In experiment 1, participants were presented three facial expressions (anger, disgust, fear, happiness, sadness or surprise) in a triangular arrangement. The three images were always of three different identities of the same gender. One of the bottom expressions was the same as the one on top. Participants were instructed to indicate which of the two bottom faces displayed the same emotion as the one on top. The design was set-up to minimize cognitive demands and verbal processing. We used a similar design in experiment 2, but with whole body expressions (anger, fear, happiness, sadness and neutral) instead of facial expressions. The face of the whole body stimuli was blurred, so no emotional information conveyed by the facial expression was visible. In contrast with previous studies, the results show no significant difference on any type of emotional expression between patients with probable Alzheimer's disease and control subjects, both in accuracy and response time data and when matching either facial or bodily expressions. These findings indicate that in the presence of mild to moderate cognitive deficits, the ability to process socio-emotional signals is preserved in the early stage of Alzheimer's disease.

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PS01.17

The system for classification of in-patient psychiatry (SCIPP) assists in the identification of high risk seniors

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Overview: Background System for the Classification of In-Patient Psychiatry (SCIPP) grouping methodology and Case Mix Index (CMI) values, categorize patients into statistically and clinically homogeneous groups based on the collection of clinical and administrative data. Adjusting for patients of different levels of acuity forms the basis for healthcare organization comparisons and case mix adjusted resource utilization. This exploratory study used data from 102 intake or quarterly Resident Assessment Instrument Mental Health (RAI-MH) assessments and reported falls and aggression from a hospital patient safety database on all patients in a tertiary seniors' mental health care setting over a 120 day period. Based in London, Ontario, Canada, Regional Mental Health Care London is a large tertiary care hospital that provides diagnosis, assessment, and treatment of patients with severe mental illness and dementia with challenging behaviors. Diagnostic groups were coded as part of the RAI protocol. Residential Assessment Instrument mental Health (RAI-MH) is designed to support care planning, outcome measurement, quality improvement and case mix based funding applications for all patients in Ontario, Canada hospitals with designated adult in-patient mental health beds. Regional Mental Health Care has instituted a Institutional Patient Safety and Reporting System that is an electronic database where staff report on patient safety incidents such as falls, medication errors, elopement from the hospital, and aggressive behaviours (such as physical aggression) . Assessing the viability of SCIPP (Includes diagnostics, clinical scales and behavioural factors in differentiating various patient groups) grouping methodologies, RAI-CMI and their accompanying indicators as indicators for facilities to effectively plan, monitor and manage the services they provide. This poster will evaluate the relationship between these groups and care needs of high risk senior patients

Results: There were 477 aggressive incidents involving 52 individuals and 126 falls concerning 40 individuals. Average age was 72.3 years (range 48 to 91) and males comprised 54.9%. Congruence of (SCIPP) general categories with diagnostic groups was 95.8%, 81.3% and 71.0% agreement with Cognitive, Schizophrenic and Mood Disorder Groups, respectively. The average number of reported incidents for aggression and falls were Cognitive (10.4, 3.2), Schizophrenic (4.3, 4.0) and Mood (5.0, 2.4) Disorders groups, respectively. Highest SCIPP codes involved with aggressive incidents were 2oda1, 2odb1and 1szpcb1subgroups representing 66.9% of all reported aggressive behaviour. First two groups are Organic Disorders with poor ADLs and depression and poor ADLs with aggression. The third group is Schizophrenia and Other Psychotic Disorders with depression and poor hygiene. This subgroup had the highest average fall rate representing 50% of all reported falls. SCIPP analyses demonstrated good levels of agreement with diagnostic categories and its ability to identify high need responsive behaviour subgroups. The SCIPP codes and their corresponding CMI's do accurately reflect inpatient population of older individuals with mental illness .The group predicted to have problems with aggression do appear in the patient safety database with frequent aggression. SCIPP can also provide a mechanism for programs to pre-identify patients who fall and act aggressively. SCIPP enhances the ability for programs to adjust practice and treatment patterns and improves our understanding of seniors utilizing tertiary care mental health services.

PS01.18

Agitated older people: An inpatient audit

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Background: Disturbed and violent older people in inpatient psychiatric settings pose a serious risk to themselves, other service users and staff members. Behavioural and Psychological Symptoms of Dementia (BPSD) are very common and occurs in 90% of patients across the course of their illness. The use of antipsychotic medication in those with dementia is associated with significant morbidity and mortality. The Mental Health National Service Framework, UK, stipulates that staff should be competent to assess the risk of violence, manage individuals who may become disturbed or violent to ensure patient and staff safety.
Aims: The aim of the audit was to assess the non-pharmacological management of older people who showed disturbed or violent behaviour on inpatient units. We assessed staff's ability to undertake the prediction, prevention and post-incident review of disturbed or violent behaviour as well as their training in managing such incidents.
Standards: Standards were taken from National Institute of Clinical Excellence (NICE) Clinical Guideline 25: The short-term management of disturbed or violent behaviour in psychiatric inpatient settings &Emergency Departments and The Royal College of Psychiatrists National Audit of Violence. The standards were: * Risk should be assessed or reviewed at admission and include violence to others * Observation skills should be used to recognize, prevent and manage disturbed behaviour * De-escalation techniques should be employed before other intervention * A post-incident review should take place as soon after the incident as possible, but in any event within 72 hours of the incident ending * Staff should receive training in the management of the disturbed or violent patient Method: Incidents of aggression and violence are recorded on incident report forms. We analysed all incidents happened in January and February 2010 on all Old Age Psychiatry wards of 2 hospitals of Trust. We checked the patient's electronic and paper record for details of the management of the incident. We checked staff training records on the wards to discover who had received appropriate training to manage such incidents. Results: 51 incident forms indicating disturbed or violent behaviour were completed showing 14 patients as the instigators. Risk assessment was completed in 50% on admission. The risk of violence or disturbed behaviour was assessed in 92% and action was planned and implemented in 71% during their admission. Post-incident reviews were completed after 15% incidents, of which 10% were within 72 hours of the incident. 76% of the staff members had been trained in conflict resolution, 72% in breakaway, 32% in equality and diversity awareness, 56% in incident/risk management, 52% in Deprivation of Liberty Safeguards, 60% in basic life support and (24%) in person centred care.
Recommendations: The use of a comprehensive risk assessment followed by a plan must be an absolute pre-requisite for the recognition, prevention and therapeutic management of violence. Post-incident review following all serious incidents should take place within 72 hours with the aim of learning lessons, supporting staff and patients and encouraging therapeutic relationship. Training in interventions used for short term management of disturbed or violent behaviour should be a priority to safeguard both staff and service users.

PS01.19

Anti-psychotic use in the management of BPSD

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Overview: Background It is estimated that over 80% of people with dementia experience one or more recurrent or persistent symptoms known as behavioural and psychological symptoms of dementia (BPSD). In the UK there is no drug licensed specifically for BSPD. Drug treatments are therefore unlicensed. The Committee on Safety of Medicines (CSM) issued guidance on 9 March 2004 advising that Risperidone and Olanzapine should not be used for treating behavioural symptoms of dementia. There has been concern over inappropriate prescribing of anti-psychotics. Psycho tropics are associated with falls, fractures, confusion, hospitalisation and death. NICE UK states that people with dementia who develop non-cognitive symptoms or behaviour that challenges should be offered a pharmacological intervention in the first instance only if they are severely distressed or there is an immediate risk of harm to the person or others. Approaches that may be considered

include aromatherapy, multisensory stimulation, therapeutic use of music and/or dancing, massage.
Aims: To review antipsychotic prescribing patterns in our practice locally for BPSD, compare our standards with NICE guidelines and suggest ways of improving our practice Methods An Audit of 50 randomly selected case notes of patients (residing in own homes and nursing homes) who have a diagnosis of Dementia. Patients diagnosed with clinical dementia (F00/F01/F02) using ICD1O classification aiming for a 50/50 distribution between home care and 24 hour residential/nursing care were included in the audit. Patients with co-morbid psychotic illness and Lewy Body Dementia were excluded.
Results: 34% of the patients have been prescribed anti-psychotics in this audit. Result show 40% of nursing home patients with Dementia are on antipsychotics in this audit which is less when compared to that reported by Soyinka &Lawley (54%) (Psychiatric Bulletin, May 2007, 31, 176-178). Agitation and physical aggression seem to be the main indications for prescribing anti-psychotics in patients residing at residential homes.
Recommendations: Clear documentation in the case notes/letter to General Practitioner regarding the indications for the use of anti psychotics in BPSD. Consider non pharmacological interventions in all cases of BSPD. Re-audit in 12 months to assess improvement in practice in accordance with NICE guidelines.
PS01.20
Pharmacotherapy audit meetings (PTAMs) using quality circles: A cost-effective strategy to improve guideline adherence in nursing homes? Study protocol
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Background: The use of medication is high in Dutch nursing homes. Dutch nursing home residents use on average 7 different medicines on a daily basis. Especially, psychotropic drugs are often and chronically prescribed, mostly for behavioural problems and psychiatric symptoms in dementia (BPSD). More than 70% of the residents is using at least one psychotropic drug for more than 80% of their nursing home stay. This high prescription rate is not in line with international and national guidelines on dementia management, which all recommend a very restricted use of psychotropics for BPSD. There is also large inter-doctor variation in prescription of psychotropics between elderly care physicians, indicating variable guideline compliance. Pharmacotherapy audit meetings (PTAMs) working with quality circles seem to be effective in Dutch primary health care to improve adherence to pharmacologic guideline recommendations, but have not been studied or introduced in nursing homes thus far.
Objective: To study whether introduction of working with quality circles in PTAMs in the nursing home setting improves guideline adherence with regard to the prescription of hypnotics and antipsychotics in nursing homes in comparison with usual practice. Cost-effectiveness will also be evaluated and a process-analysis will be carried out.
Design, Study Population: The study will be a cluster-randomized trial with 26 PTAMs consisting of physicians, pharmacists, and nursing staff members. Both the intervention and the control group will consist of 13 PTAMs. INTERVENTION PTAMs of the intervention group will be trained and intensively supported in working with quality circles during their meetings for one year. Quality circles are defined as a cyclic method in which evidence-based information about prescription is provided to the participants and feedback on individual prescription is given. Participants discuss this information, reflect on the prescription data and make general treatment agreements. In consecutive meetings the results are evaluated by using prescription data. This can result in adjusted treatment agreements if target goals are not achieved. PTAMs using quality circles can be seen as a multifaceted implementation strategy. In this study the national guideline for problem behaviour of the

Dutch Society of Elderly Care Physicians (Verenso) will be the source for evidence-based information about prescription of hypnotics and antipsychotics.

Outcome Measures/Process-Evaluation/Economic Evaluation: The primary outcome is the percentage of residents using hypnotics and antipsychotics. Guideline adherence will also be measured by other prescription indicators like chosen drug, dosage, and treatment duration. Some of the costs that will be included are costs of the intervention, hospital admissions, and drug costs. In the process evaluation facilitators and barriers for the implementation of quality circles will be determined.

Sample-Size Calculation and Data Analysis: Based on a mean PTAM-size of 10 physicians, two times 13 PTAMs are necessary. Multilevel logistic regression and generalized estimated equations will be used for statistical analyses.

Conclusion: It is expected that implementation of PTAMs working with quality circles will improve guideline adherence with regard to the prescription of hypnotics and antipsychotics in nursing homes.

PS01.21

CAVIA: Continuity of ambulant care after admission to a nursing home for people with dementia and behavioural and psychiatric problems

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Background: The presence of behavioural and psychiatric problems in community dwelling people with dementia often requires out-reaching mental health services. At the time of admission to a nursing home this type of care usually is discontinued and replaced by nursing home care. The discontinuity in mental health care and transition entails a risk of relapse that can negatively impact the wellbeing of the person with dementia and his informal caregiver. Continuing mental health care after admission to a nursing home, including transfer of relevant information on previously applied effective interventions to the nursing home care professionals, might improve the wellbeing of, and quality of care for, both people with dementia and their informal caregivers. Therefore, the regional mental health service in the South-Western region of Amsterdam developed a new intervention: Continuity of ambulant mental health care after admission to a nursing home. The intervention consists of a follow-up visit of a social psychiatric nurse, who helps to detect changes in mental health and behavioural problems, empowers informal caregivers after this life-event, and offers information and consultation to the responsible nursing home carer.

Objectives: To evaluate changes in behaviour and wellbeing of, and quality of care for, people with dementia and their informal caregivers while implementing the intervention continuity of ambulant mental health care after admission to a nursing home. To investigate positive and negative aspects of the follow-up visit of the social psychiatric nurse after admission of the person with dementia in the nursing home from the perspective of people with dementia, informal caregivers and professional caregivers, and to study whether this follow-up visit influences the care plan. To investigate facilitators and barriers for continuing ambulant mental health care after nursing home admission.

Methods: A social psychiatric nurse visits the nursing home between 5 and 7 weeks after admission for mental health evaluation of both the person with dementia and the informal caregiver, for evaluation of the care plan and for offering consultation for the responsible nursing home carer. Data will be collected with standardized questionnaires (i.e. MMSE, NPI-Q, CANE, QOL-AD) and by a clinical assessment by the social psychiatric nurse before and 6 weeks after nursing home admission among 30 people with dementia and their primary caregivers. Evaluation of handover information and the care plan is performed by a standardized set of criteria. Qualitative research is conducted using semi-structured interviews with key figures in the implementation of the intervention to get insight in facilitators and barriers of continuing ambulant mental health care after nursing

home admission. These interviews cover topics on microlevel (such as motivation of personnel), mesolevel (consequences for cooperation with other organizations) and macrolevel (finances and legislation). Key figures are patients, informal caregivers, professional caregivers, managers and health care insurers.
Analysis: Descriptive analyses on changes in behavioural and psychiatric problems and well-being and care needs in people with dementia after admission to a nursing home. Qualitative analyses on written reports of the semi-structured interviews by coding and analysing text fragments containing facilitators and barriers for implementing this new intervention for continuity of ambulant mental health care in the nursing home.
Expected Results: We expect that continuity of ambulant mental health care after nursing home admission will help to detect changes in mental health status and problems in provision of care and that the exchange of information between mental health care professionals and nursing home professionals will improve the continuity of care for people with dementia. This may lead to an improvement of care, wellbeing and quality of life in people with dementia and their informal caregivers.

PS01.22

Barriers and facilitators to interventions for behavioral symptoms of dementia in long-term care: A qualitative study from Canada

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Introduction: Behavioral and psychological symptoms of dementia (BPSD) are common among older adults in long-term care (LTC) and lead to impairment in patient quality of life and increased caregiver distress. A number of non-pharmacological and pharmacological interventions have been investigated for the treatment BPSD. However, little is known of factors that may serve as barriers or enablers to the implementation of interventions for BPSD in LTC settings.
Methods: The study population included workshop attendees at the Canadian Coalition for Seniors' Mental Health meeting held in Halifax, Canada in September, 2010. The workshop provided background on the prevalence and importance of BPSD in LTC. Participants then formed small groups consisting of between 8 - 10 individuals and discussed enablers and barriers to the provision of pharmacological and non-pharmacological interventions for BPSD in the LTC setting. Worksheets were distributed to the groups on which summary responses were recorded. Content analysis of the worksheet responses was then undertaken independently by three members of the research team to identify common themes. These themes were then summarized and highlighted using illustrative quotations.
Results: A total of 13 worksheets were completed by workshop participants. Several common themes were identified. Enablers of non-pharmacological interventions for BPSD in LTC included: innovative approaches to delivery of care; support from administration and consultants from external agencies; acquisition of skills and knowledge; and opportunities for collaboration with co-workers and families. Conversely, challenges to the implementation on non-pharmacological interventions included: fears or resistence to changing existing practices; lack of access and training in non-pharmacological interventions; lack of flexibility in provision of care; and, limited forums for broad-based collaboration in LTC. Enablers of use of medications included: widespread availability; being able to see effects quickly; and alignment with current models of care. Barriers to the use of medications included: being seen as a "quick fixâ[euro]; concerns regarding adverse events; and difficulty in assessing response to therapy.
Conclusions: In this qualitative study of LTC providers, several themes were identified as being barriers or enablers to the provision of interventions for BPSD in LTC. Many factors seen as enablers or barriers were related to the institutional culture of LTC suggesting that efforts to improve access and implementation of

interventions need to consider the dynamics of the LTC work environment. A call for greater education and knowledge of non-pharmcological interventions and the importance of collaboration were also identified. Future studies of BPSD in LTC should take these factors into consideration when implementing treatments for this condition.

PS01.23

Optimization of psychotropic drug prescription in nursing home patients with dementia: a study protocol

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Background: Nursing home patients with dementia use psychotropic medication more frequently and longer than appropriate according to guidelines (1). Moreover, there is a large variance in psychotropic drug use (PDU) between different nursing homes. Hence, PDU is a quality indicator in nursing home care. However, the knowledge about factors related to appropriate prescription of psychotropic drugs is scarce, whereas the need to optimize psychotropic drug prescription is high. Objective: (1) To examine the quality of prescription and to identify factors related to the prescription of psychotropic drugs in nursing home patients with dementia, and (2) to study the effect of a multidisciplinary structured repeated medication review on the appropriateness of this prescription.

Study Population: Subjects will be recruited from 36 dementia special care units of 12 nursing homes, 6 with high rates and 6 with low rates of psychotropic drug prescription according to the quality indicators as measured by the Dutch Healthcare Inspectorate. For the first objective, 540 nursing home patients with dementia and 70 to 100 nurses/physicians of the 36 dementia special care units will be included. For the second objective, 360 nursing home patients and 50 to 70 nurses/physicians of 24 from the 36 dementia special care units will be included, in equal proportions from either of the 6 nursing homes.

Design &Methods: For the first objective, a cross-sectional observational study will be conducted. Dependent variables in this study are the frequency and appropriateness of psychotropic drug prescription. Appropriateness is assessed using a checklist based on a Dutch guideline for problem behavior (2). Both patients' correlates (neuropsychiatric symptoms, use of physical restraints/psychosocial interventions/other drugs, demographics), and environmental correlates (physical and psychosocial environment, organizational culture, workload, job satisfaction, characteristics of staff) are studied. Quantitative as well as qualitative methods are applied. For the second objective, a subsequent 18-month cluster-randomized controlled pragmatic trial with 6-monthly measurements will be conducted. Randomization is on the level of nursing home. The intervention group receives 4 education and training sessions, carried out by the Dutch Institute for Rational Use of Medication, and will conduct a structured 3-monthly repeated medication review by the physician, pharmacist and nurse. The control group receives care as usual. Primary outcome is the frequency of appropriate psychotropic drug prescription. Secondary outcomes are: frequency of psychotropic drug prescription, neuropsychiatric symptoms, quality of life, adverse events, cognition, activities of daily living, motor symptoms, falls, mortality, drug-related hospital admissions, and co-morbidity. Data will be analyzed using multilevel regression analysis. Process analysis is carried out for facilitators and barriers regarding introduction of the medication review.

Conclusion: This protocol is expected to provide further insight in the factors related to the appropriate prescription of psychotropic drugs, and to provide a method for increasing the quality of prescription in nursing home patients with dementia.

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PS01.24

A pilot study of the effect of music therapy on neuropsychiatric symptoms in dementia

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Background: It's known that neuropsychiatric symptoms are one of the most common problems of patients with moderate to severe dementia. Behavioral problems such as agitation, disinhibited behavior, shouting and wandering, often mean a great psychological distress for the patient and a heavy emotional burden for her/his surroundings. Music therapy (MT) is a promising non-pharmacologic approach for neuropsychiatric symptoms in dementia. MT may reduce depression or mood swings, anxiety, agitation, diminish or make bearable pain, come to acceptation, enriching interpersonal relationships, enhance communication, draw up a balance of life and enabling closure. There is relatively few data available about the effect of MT on cognitive and neuropsychiatric symptoms in dementia.

Goal of the study: The goal of the present study is to examine the effects of MT on global cognitive functioning and neuropsychiatric symptoms in patients with moderate to severe dementia. An additional question is whether MT reduces the emotional burden of the nursing staff.

Methods: Twelve out of sixty-one patients of psycho-geriatric wards of the nursing home Vreugdehof in Amsterdam appeared to have severe neuropsychiatric symptoms, causing a burden on the nursing staff. They were diagnosed with Alzheimer's disease, vascular dementia or mixed dementia. The assessment of global cognitive functioning, neuropsychiatric symptoms of the patients and burden of the nursing staff took place before and after the intervention period of 6 months. The patients were randomly divided in 2 groups, six patients in the "music groupâ[euro] and six patients in the control group. Frequency of the intervention included two weekly individual music therapy sessions of approximately 30 minutes. The patients in the control group followed their usual activities. Global cognitive functioning was assessed by the Mini mental state examination (MMSE). The neuropsychiatric symptoms of the patients and burden of the nursing staff were assessed with the Neuropsychiatric Inventory Questionnaire (NPI-Q). The person who did the assessment was not blinded for the study design.

Results: One patient of each group died during the intervention period. Consequently, the analysis was performed over 10 patients with 5 patients of each group. Global cognitive functioning F statistics showed that the mean MMSE score of the experimental group differed significantly from the mean MMSE score of the control group after music therapy ($F(1,8) = 8{,}21$, $p = .02$). The mean scores suggest that the experimental group had a higher MMSE score after MT than the control group. Severity of the neuropsychiatric symptoms of the patients Similar to the MMSE, F-statistics showed that the severity of the neuropsychiatric symptoms declined significantly in the experimental group, compared to the control group ($F(1,8) = 5{,}68$, $p = .04$). Burden of the nursing staff The decrease in the burden of the nursing staff after the MT intervention showed a trend ($F(1,8) = 3{,}31$, $p = .11$). **Conclusion:** The results of this pilot study suggest that music therapy may have positive effects on global cognitive functioning and neuropsychiatric symptoms in patients with dementia. The effect of MT on the burden of the nursing staff was not significant. These findings should be considered with caution, in view of the small number of participants. However, the results do warrant more extensive research into the effect of MT on cognitive and neuropsychiatric symptoms in dementia.

PS01.25

Overlooked inappropriate sexual behaviors and dementia in Japanese care system

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Background: In Japan, long term care system (LTS) for fragile elder lies has started in 2000. Although in LTS assessment, inappropriate behaviors were should be examined but there was neglected or avoided so long. Recently inappropriate verbal and physical sexual behaviors are among the least common of these actions,

they can be profoundly disruptive to caregivers (spouse, institutional staff) and other individuals in the immediate surroundings. And less common than other behavioral issues, such as aggression and agitation, hypersexuality presents complex logistical and ethical problems for care stuff. In addition substantial mental and physical harm can occur secondary to these behaviors.

Objective: We investigated the actual inappropriate sexual behaviors in Japanese LTS system and the physical and mental burden of institutional staff from inappropriate sexual behaviors of elderliness. We wish to describe overlooked inappropriate sexual behaviors in Japanese LTS and suggest resolution for these problems.

Methods: We have investigated sexual behaviors in Japanese LTS from November to December in 2009 by mail. We have recruited 1134 care stuff in Kochi prefecture and they have returned 743(65.5%) by mail. Our questionnaire contains age, sex, type of occupation (Nurse, license nursing care worker etc), experience period of elder lies care, present mental state (GHQ-12), exposure of inappropriate sexual behaviors, classification of inappropriate sexual behavior, impact of experience (IES-R: Impact of experience stress Revised), existence of dementia, diagnosis of dementia.

Ethical issues: This research has permitted from clinical research committee of Kochi Medical School (NO:20-95) in 2008.

Results: Exposure of inappropriate sexual behaviors was 50.2% (373/743). And in these cases, Ratio of existence of dementia was 62.7% (234/373). From characteristic data, Alzheimer's disease was 86,Vascular dementia (VD):63,No-dementia:84. We analyzed 3 groups between characteristic data. There were no statistically significantly differences about experience period of elder lies care, GHQ score between AD and VD groups. And Control Group scores of IES-R were statistically significantly higher than other groups (AD, VD group). We classified 319 inappropriate sexual behaviors (ISB). There were 3 types, direct ISB (physical body touch, etc): 214, verbal ISB (obscene language, etc): 109, visual ISB (masturbating without shame, etc): 88. We make clear that there is various types of inappropriate sexual behaviors and these are not rare in Japanese LTS at all.

Conclusions: However, some sexual behaviors are stressing for the spouses, mainly women spouses. In nursing homes or long term care facilities, expressing sexuality by demented subjects and dealing with inappropriate sexual expression are source of concerns for the nursing staff, other residents, and families. Information about sex and dementia and a psycho-educational approach can decrease the strain of families and caregivers.

PS01.26

Unravel the meaning of the behavioural and psychological symptoms of dementia in clients with dementia in Hong Kong: A practical concern

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Overview: One of the main effects on caregivers and caregiving is to cope with Behavioural and Psychological Symptoms of Dementia (BPSD) in dementia care. There is no exception in Hong Kong. Family caregivers often complain about their care recipients with presenting behavioural problems represented by a breakdown of mental, psychological and physical health, abuse and disability, and eventually early institutionalization. In view of the continuing rise on the prevalence of dementia and great demand on the caring role by the family in community, it is essential to explore the pattern of behaivoural and psychological symptoms of dementia amongst the Chinese with dementia. The long term strategy pertinent for the family caregivers to cope with BPSD is a pressing need to be developed, so that with appropriate interventions, people with dementia like other elderly people, could enjoy "ageing in placeâ[euro] in their home environment. The present project, which was funded by the Chua Foundation (2010-2011), aimed to develop an understanding of the type of behaivour known as BPSD presented by the Chinese with dementia and to adopt a family-centered approach to explore the social and cultural context relative to the interpretation of BPSD by family caregivers in Hong Kong. The

principle on caregiving is that the social and culture context are believed to be embedded into the caregiving process. The process of caregiving involves different levels of interpersonal intimacy between the caregiver and the care recipient as well as the supporting members within the family. In order to understand the effects of family dynamics and social cultural factor on the caregiving process, the use of narrative approach is necessary in an attempt to explore the family relations, perception and attitudes towards dementia and the use of effective coping strategies. A total of 50 cases were referred to the Centre for Behavioural Management for professional help from April 2010 to February 2011. The sources of referral came from family caregivers and professional agents. Home assessment was conducted on all cases. While quantitative data including social demographics, level of stress, caregiving burden, frequency and type of behaviour, use of drugs, and health status by way of standardized measurement scales, qualitative data was obtained through family interviews followed by in depth analysis to enable understanding about the onset and duration, the interpretation of BPSD, family relations, family support network and use of coping strategies. A case manager was responsible for monitoring individual case and coordinating the provision of services for individual family. All cases were regularly reviewed to evaluate the effectiveness of the approach towards the identified problems for intervention. The preliminary findings indicated that most of cases under study have already developed BPSD at different stages of the condition. Of the 50 families, majority of them did not pick up the behavioural problems at early stage thus delayed their seeking for help. About one-third had behaviour problems occurred even before the diagnosis of dementia. The outcome of the interview showed that dementia has brought traumatic experiences amongst the family caregivers especially those with a long history of family mental health issues or unresolved family conflicts. Multivariate analysis will be adopted to look at the associating factors and the main effects for the outcomes of home care; and content analysis to interpret the family dynamics, interpersonal relationship, attitudes towards the caregivers and caregiving and the coping strategies with BPSD between 'Children Caregivers' and 'Spouse Caregivers' will be carried out.

PS01.27

Grip on challenging behavior (GOCB): A multidisciplinary care program for the management of behavioral problems

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Background: Behavioral problems are a major concern in the care for nursing home residents with dementia. They have a substantial effect on the quality of life of residents and the workload and satisfaction of care personnel. The presence of multidisciplinary care teams in Dutch nursing homes offers ideal preconditions to manage BP effectively. Yet BP are still very common in Dutch nursing homes. A protocol for multidisciplinary treatment of BPs is missing in most nursing homes. In close cooperation with care professionals we developed a care program for the management of behavioral problems that is based on current national and international guidelines. The program structures the management of behavioral problems by using structured forms and by determining which discipline is responsible in every step of the program. The program does not offer new treatment as it is focused on the process of managing behavioral problems.

Intervention: The care program was developed through meetings with care professionals and experts who had developed guidelines for managing behavioral problems. Before the first meeting, the researchers made a draft of the care program, based on national and international guidelines on managing behavioral problems in dementia. In three meetings, the set-up of the care program, the structure of the program and the forms that were to be used in the program were discussed. After each meeting, the researchers adjusted the original draft. The resulting care program consists of four steps: Detection, Analysis, Treatment and Evaluation. Detection takes place both in daily care practice and through a 6 monthly screening (NPI-Q). When (symptoms of)

behavioral problems are detected, the second step, analysis, commences. The nurse assistant fills in a structured analysis form which is sent to a psychologist or an elderly care physician-depending on the most likely cause according to the nurse assistant. Also using a pre-structured analysis form, the psychologist and/or the elderly care physician continue the analysis. Analysis focuses on finding modifiable cause(s) of the behavioral problems and is done multidisciplinary: the psychologist, elderly care physician and nurse assistant consult each other about their findings. In step three, interventions are chosen by the multidisciplinary team, targeted at the found cause(s) of the behavioral problems. The care programme stresses the use of psychosocial interventions and restricts pharmacological or restraining interventions to a minimum. The physician or psychologists registers the chosen treatment on a structured form, together with de defined treatment goal. On the back of the form, the current situation with regard to the treatment goal is valued with a number between 1 and 10 (1: goal not attained at all; 10 goal fully attained). On the form it is also registered when the evaluation takes place and who will evaluate the treatment (step 4). For evaluation a flow diagram is used to determine if the treatment goal was achieved, if all interventions were properly carried out and if continuation of treatment is necessary. Also, the current situation regarding the treatment goal is again valued with a number between 1 and 10 to determine if any improvement has taken place. This structured evaluation enables timely adjustments of the treatment plan or a new analysis when necessary.

Implementation: The nursing home staff receives five hours instruction about the care program, divided in two sessions of 2,5 hour. In the first session, background information regarding behavioral problems is discussed including the outline of the care program, with the complete team (care personnel, psychologist, physician). In the second session, care personnel gets to practice with the different forms that are used in the program. In a separate session, physicians and psychologists receive background information specified for their discipline and practice with the care program. The process of implementing and using the care programme will be evaluated. The researchers will do regular checkups on the implementation of the care program. Qualitative interviews will be held with key figures in the nursing homes to explore to which degree and in which way the care programme is being implemented.

PS01.28

Treatment intervention in nursing home versus hospital admission for patients with BPSD in dementia: A pilot study

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Introduction: Behavioural and psychological symptoms in dementia (BPSD) is a common clinical picture in patients with moderate to severe dementia. These patients are usually in need of long term treatment and diffentiated health care services. Treatment of BPSD should be done on the most cost-efficient level of care, since hospitalisation per se does not change the course of this disorder. The most common manifestations of BPSD may be devided into three symptom clusters: - Hyperactivity including increased aggression, psychomotor agitation, irritability and lack of social inhibition - Psychotic symptoms including hallucinations and delusions - Affective symptoms including depression, anxiety and apathy.

Research Questions: The aim of this pilot study was to examine the clinical effects of an ambulant treatment intervention in the patient's nursing home compared to hospital admission. - Is there a difference in redorded BPSD before and after treatment intervention and after two months follow-up? - Is there any difference in treatment outcome between patients admitted to hospital and patients treated in their nursing homes? - Is there a difference in NPI-reported load among the caregivers before and after the intervention in the nursing homes and at two months follow-up? - Is there a difference in NPI-reported load among the caregivers when the intervention was performed in the nursing homes compared to when the patient was hospitalized? **Material and**

methods: Patients referred for admission to psychogeriatric hospital from nursing homes in the period 1. september 2008 - 31. december 2009, were randomized to either hospital admission (the control group n = 7) or ambulant intervention in nursing home by hospital employees (the intervention group n = 8). Registratrion of severity and distress level of behavioural and psychological symptoms of dementia (BPSD) was done at baseline (T1), by the end of the intervention (T2), and two months post intervention (T3) using the Neuropsychiatric Inventory (NPI). The ambulant treatment was manualized and consisted of one weekly treatment visits during a five week period by a medical doctor being specialist in geriatric psychiatry and a psychiatric nurse with special competence in geriatric psychiatry. Besides directing the mode of treatment, the intervention consisted of supervision, counselling and teaching the caregivers about medication and how to approach the patients. Efficacy and identification of negative side-effects of previous and current pharmacological treatment was evaluated in cooperation with the nursing home doctor. Current medication with no detectable clinical benefits or with a potensial for worsening the BPSD were terminated. Ad hoc communication by telephone between visits was an option. **Results:** We found a statistically significant reduction in BPSD in both treatment groups, but no significant difference between the groups. However, there was a significant reduction in NPI-reported distress by the caregivers in the intervention group.
Conclusion: Our results indicate that an ambulant treatment intervention in nursing home corresponds to the effect of a hospital admission for patients with behavioural and psychological symptoms in dementia. Further, the caregivers experienced less distress in the intervention. Due to rather limited number of patients, no firm conclusions may be drawn from the study.

PS01.30

Family meetings for caregivers of dementia patients: The one-year effects of a randomized controlled trial

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Background: Family members of persons with dementia provide, often at great personal cost, provide much of the care for older adults with dementia in the community (Cohen 2000). These family caregivers have an extremely high risk of developing an affective disorder, such as major depression and anxiety disorder (Cuijpers 2005, Schulz 1999). Prevention of affective disorders in caregivers may prolong the period until institutionalisation while maintaining a comparable or better quality of life for the caregivers. Family meetings appear to be among the most powerful psychosocial interventions to reduce affective disorders in caregivers.
Objectives: To compare the 1-year effects of family meetings and usual care among the primary caregivers of community-dwelling dementia patients Methods In this randomized controlled trial a total of 192 primary caregivers and their community dwelling dementia patients were recruited by memory clinics, specialized mental health care centres, general practices and home care organizations in the Netherlands and randomized to the intervention (n = 96) or usual care (n = 96) group. Caregivers in the intervention group were offered 4 family meetings during 12 months with their family and close friends. The main outcomes were the 1-year incidence of anxiety and depressive disorders (Mini-International Neuropsychiatric Interview) and the severity of anxiety and depressive symptoms (CES-D and HADS-A) in the primary caregiver. Caregiver burden and quality of life were measured as secondary outcomes. Intention-to-treat as well as per protocol analyses are performed. Results We are currently analyzing the data. Results will be available at the conference Conclusion: We are currently analyzing the data. Conclusions will be available at the conference.
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PS01.31

Predictors of burnout in Brazilian familial caregivers of patients with dementia

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Introduction: Familial caregivers of demented patients suffer from high levels of burden of care, but the literature regarding the prevalence and predictors of burnout in this group is scarce. Burnout is a syndrome that appears in response to chronic interpersonal stressors at the occupational environment. It is composed by three dimensions: emotional exhaustion (EE), depersonalization (DP) and reduced personal accomplishment (RPA). Caregivers of dementia patients constitute a group particularly vulnerable to burnout. We aim at investigating the associations between burnout and both caregivers' and patients' sociodemographic and clinical characterisitics.
Methods: A sample of 145 patient and caregiver dyads were consecutively examined at the Center for Alzheimer's Disease and Related Disorders of the Institute of Psychiatry (IPUB), at the Federal University of Rio de Janeiro (UFRJ). Patients had a diagnosis of Alzheimer's disease (61.4%), Vascular Dementia (17.2%) or Mixed Dementia (21.4%). Familial caregivers were older than 18 years-old and had at least weekly face-to-face contact with the patient. The majority of the caregivers were children (52%), followed by spouses (30%), and other family members (18%). Caregivers answered the Maslach Burnout Inventory, Beck Depression Inventory, Beck Anxiety Inventory and a Sociodemographic Questionnaire. Patients were assessed with the Mini Mental State Examination, Functional Activities Questionnaire, Neuropsychiatric Inventory and Clinical Dementia Rating. T-Test and Mann-Whitney analyses were performed as an initial comparison of patients' and caregivers' sociodemographic and clinical characteristics according to burnout dimensions. Spearman's rank correlation was used to assess the relationship among burnout dimensions and caregivers' clinical variables. Using linear regression analyses we investigated which caregivers' and patients' variables best predicted burnout dimensions. All variables which showed to be statistically significant in bivariate analysis were included in the linear regression analyses with backwards stepping.
Results: Our sample of familial caregivers of dementia patients exhibited a moderate burnout level. High levels of EE was present in 42.1%, and of DP in 22.8% of our sample. RPA was present in 38.6% of the caregivers. Cut-off scores for high EE, DP and RPA consisted of 26 or more, 9 or more and 33 or less, respectively. EE associated significantly with female gender ($p < 0.05$), depression, anxiety, psychotropic use, history of psychiatric treatment, and physical morbidity ($p < 0.01$). We also found a significant association between emotional morbidity, including sadness, irritability, anxiety, insomnia, fatigue ($p < 0.01$), and wish to die and EE ($p < 0.05$). DP associated significantly with irritability and depression ($p < 0.05$). RPA associated significantly with sadness, insomnia and fatigue ($p < 0.01$). The backwards linear regression modeling showed that the presence of any emotional symptom ($\beta = 0.16$, $p < 0.05$), particularly irritability (ß = 0.29, $p < 0.01$), and depression ($\beta = 0.38$, $p < 0.01$) remained as significant predictors of caregiver's EE. None of the patients' and caregivers' variables predicted DP and RPA in our sample.
Discussion and Conclusion: EE is the core burnout dimension and the most widely reported one. Caregiver's strenuous physical and emotional demands can exhaust their capacity to be involved with the needs of the patients. The presence of emotional morbidity, particularly irritability and depression, should always be part of the caregiver's evaluation in the dementia treatment plan. Individual strategies focusing on reducing emotional morbidity in familial caregivers may help improve their engagement in dementia care.
PS01.32
Elderly care: The interRAI-instruments in Belgium - Feasibility to use BelRAI across settings (home care, nursing home care and acute hospital care)
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Motivation: Fragmentation of elderly care is a common problem in many countries. Moreover the care for frail elderly is not sufficiently based on structured and standardized planning for health and wellbeing. To address these problems the interRAI-instruments are customized to the Belgian situation. This comprehensive geriatric assessment is called BelRAI. Caregivers from home care, nursing home care and acute hospital care use the interRAI-instruments on a web-based application, which allows working interdisciplinarily and improves communication. Therefore, the expertise of all the caregivers can be integrated. Another advantage of this system is the standardized and structured way of documenting the information on elderly across the different settings and across time. Furthermore, the output of the interRAI-instruments gives information about the health condition and the social situation of the elderly. Additionally, it gives direction to adjust the planning for health and wellbeing. This leads to a better quality of life and a better quality of care for frail elderly. However, the system has its disadvantages too. For example filling out the interRAI-instruments can be time consuming. But the most difficult challenge is the following paradox: on the one hand the BelRAI system leads to better communication and collaboration in health care, but on the other hand communication and collaboration are preconditions for a good functioning of BelRAI.
Problem Statement: In Belgium a pilot study is conducted. The aim of this study is to determine the conditions in which using the interRAI-instruments is feasible for organizations in home care as well as in residential care and hospital care. For each setting, we specifically wish: 1. To evaluate which output is used and how it is used; 2. To determine the motivating and the demotivating factors for using BelRAI; 3. To determine which preconditions should be fulfilled for successfully using BelRAI. Subsequently we want to compare the results across settings. Moreover, more insight in the different adjustment processes is needed.
Methods: Four Belgian partnerships (Kortrijk-Roeselare, Denderregio, Eupen, Huy-Herstal) participated in the project. Each partnership consisted of 3 different settings (home care, nursing home care and hospital care). A selected group of caregivers from these partnerships were trained by the researchers. Data was gathered by: 1. Qualitative methods such as focus groups, interviews and observations; 2. Quantitative methods such as the database of BelRAI and questionnaires. The qualitative data were obtained at three levels: micro level (caregivers in the field using BelRAI), meso level (management of individual service organizations) and macro level (steering committee of the partnership). Results Use of the BelRAI output changed over time in different ways across settings. Each organization had its own learning process. Finding enough and the appropriate time to deliberate about the output, finding how to translate the output information into an action plan, finding the best way in which to inform other caregivers about the output are examples of this learning process. The comprehensiveness en structuredness of the interRAI-instruments were an important motivating factor. Caregivers were convinced of the need to document information about elderly in a standardized and structured way. Demotivation was caused by unfulfilled preconditions on a more organizational level. Examples of preconditions are: 1. Regular contact between caregivers who have to fill out the interRAI-instrument; 2. To be able to organize multidisciplinary deliberations at regular intervals about the output of the interRAI-instruments to adjust the planning for health and wellbeing of the clients; 3. A good communication network inside the organization as well as outside the organization. In the nursing home care several preconditions were already fulfilled on a daily basis. That made the adjustment to BelRAI relatively easier in comparison with the other settings. Nursing home care already experienced the advantages of using BelRAI in an early stage, while the other settings used their efforts to create the right preconditions.
Conclusion: To counteract fragmentation of elderly care, in order to improve quality of life and quality of care for frail elderly, multidisciplinary use of BelRAI across settings is necessary. To experience the advantages of

BelRAI certain preconditions should be fulfilled, like the useful output to adjust planning for health and wellbeing, These preconditions are not equally present across settings. More information about those preconditions will be described in the paper and presentation.

PS01.33

Identifying subgroups of informal caregivers of persons of dementia at increased risk for developing depression

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Background: Depression in informal caregivers of persons with dementia is a major, costly and growing problem. However, it is not yet clear which caregivers are at increased risk for developing depression. This could provide valuable knowledge to identify target groups for prevention.

Objectives: To identify target groups of informal caregivers of persons with dementia for prevention of depression such that optimal health gains are generated in an efficient and cost-effective way.

Methods: In this prospective cohort-study with 18 months follow-up a total of 725 caregivers providing care for a relative with dementia who were without depression at baseline were recruited by for the REACH study from multiple community sites and health and social agency settings. Depressive symptoms were measured every six months with the self reported Center for Epidemiologic Studies - Depression Scale (CES-D). Incidence of 'depression' was defined as 1) absence of depression at baseline (CES-D).

PS01.34

Counseling dementia caregivers: Are we tailored enough to the individual needs and timing?

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Introduction: In Bruges (Belgium) a small team of 5 counselors (Foton) offers different forms of support to persons with dementia and their family caregivers. One of those is dementia counseling at home. The team asked for a first evaluation of their pioneer work. Research questions were: - Which guiding principles underpin their counseling work? - How can this counseling work fit into current care policy and practice in Belgium? - Which family caregivers use this counseling and how do these users evaluate the work of the counselors? In this presentation we focus on question 1 and 3.

Methods: Document analysis and interviews with the main counselors were used to conceptualize the dementia counseling model used by Foton. All family caregivers and persons with dementia who used dementia counseling at least once in 2009 were invited to participate (N = 82). Semi-structured interviews were conducted with the 34 family caregivers who consented. The interview questionnaire consisted of four parts: 1. Care needs of the person with dementia (a.o. ADL/IADL) and use of professional and informal care 2. Satisfaction with dementia counseling, a new instrument based on the targets the Fotonteam sets for itself: give information, care coordination, give advice, emotional support, the family perspective, relief of burden, formal way of relating. In 50 items caregivers rate the importance and realization of these aspects. Satisfaction means that important aspects are realized. Discrepancy scores are calculated and studied. 3. Self-perceived health, burden of care (SPICC, Pot et al. 1995) and relationship quality (Spruytte et al. 2002) 4. Sociodemographic characteristics.

Results: We described their working model as being 'demand-oriented, holistic, easily accesible, contextual, nonviolent and empowering, collaborative and specialist'. By their way of working, the counselors explicitly intend to respond as much as possible to individual needs of family caregivers, in terms of content as well as in terms of form or timing. For some family caregivers, it may be sufficient to have one good talk with the

counselor about managing the finances, for other family caregivers several themes of interest pass by in the flow of multiple visits. We compared the working model of Foton with the evidence-based supporting interventions of Mittelman et al. (2004) and with the concept of dementia case management (Robinson e.a., 2010). The empirical research reveals that the Fotonteam reaches a wide variety of family caregivers. Positive is that they also attain families who are in the beginning of the care process, even before the dementia is diagnosed or when no other professional caregivers are involved. The satisfaction instrument showed that family caregivers were most satisfied with 'being heard' and with 'getting information and advice tailored to my needs'. Two aspects were less realized, but found important: 'obtaining help with care coordination' and 'getting advice on how to handle behavioral and mood problems'.

Discussion: In the international literature, the evidence for psychosocial interventions for dementia caregivers is growing. We were able to show that this specific format of individual dementia counseling at home is an important method for supporting family caregivers, especially when no other professional care is already present. We hypothesize that the non-structured, but very demand-oriented way of working of the team under evaluation, explains the high satisfaction of family caregivers. We are aware of the methodological weaknesses of this study including the absence of a control group, or a pre-post-test design. However, we believe our research revealed the importance of creating various dementia supporting strategies, emphasizing a demand-oriented way of working. It's a challenge to conceive dementia counseling as a necessary individualized supporting strategy, alongside other more structured interventions such as group counseling, psycho-education or case management.

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PS01.35

Supporting family carers and people living with dementia in the community

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Overview: Delaying admission to residential care is only one of a number of goals of family carers and people living with dementia. The present study was part of an evaluation of the Australian Government's Extended Aged Care at Home Dementia program in which we asked: What were carers' goals for support? What services were put into place to assist carers? What behavioural and psychological symptoms of dementia were most problematic to carers? What was the outcome of supports received? We surveyed 349 clients with dementia and conducted telephone interviews with 71 carers at commencement of community supports and then again every three months until discharge from the service. A battery of assessment scales was completed by clients' case managers and family carers. The mean age of clients surveyed was 81.6 (SD 7.9); 93% of clients were aged over 70 years. Sixty four percent of clients were female, and male clients were significantly younger than female clients overall. Seventy percent of clients lived with their family carer, and of those clients who lived alone, the majority had a family carer living elsewhere. Fifty seven percent of carers were female, usually daughters or daughters in law. The most common goals for receiving community support services were assistance with personal care, and respite for the carer - few carers identified delaying admission to residential care or avoiding admission to hospital as a goal. Other goals identified were: Help with activities of daily living

and personal care; help with showering; social support, company for the care recipient; assistance with behavioural symptoms; and help with incontinence issues. Substantial increases in support were found for: social support, on-call access, continence management, behaviour management and counselling/support. Three quarters of carers received assistance with personal care duties. In home respite was used by over half of clients at all time points, and residential respite increased markedly just before discharge. When analysing behavioural and psychological symptoms of dementia, we found that the most common symptoms (occurring on average several times a day) among clients (n = 349) were: required prompting to undertake activities of daily living (73.6%); asked repetitive sentences or questions (62.4%); was uncooperative or unwilling to participate (50.7%); was restless or fidgety, always moving around (49.1%); was up at night (48.3%). Behaviours that were perceived as most problematic were: Required prompting to undertake activities of daily living (Mean 2.98, SD .812, n = 213); Tried to get out inappropriately (Mean 2.98, SD 0.845, n = 50); Was up at night (Mean 2.98, SD 0.951, n = 148); Was uncooperative or unwilling to participate (Mean 2.91, SD 0.805, n = 149); Screamed, shouted or howled (Mean 2.88, SD, 0.871, n = 32). Over time, quality of life improved as measured by the DEM-QOL Proxy, and the improvement was statistically significant. At the second interview, most carers thought that EACHD had improved the area of concern that they had identified at commencement of EACHD. In conclusion, the services provided were targeted to specific goals that were not always related to admission to residential care. Rather than focusing narrowly on whether admission to residential care will be delayed by provision of community care services, it needs to be recognised that clients and their carers may be seeking access to community care to achieve a range of alternative goals, and that they can benefit from receipt of community care in a number of ways. Services that address the most problematic behavioural and psychological symptoms as perceived by carers would improve quality of life for carers and people living with dementia even further.

PS01.36

A behavioral health education series for older adults and their caregivers

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Overview: Repeatedly as multidisciplinary professionals we are concerned about the individual patient we serve - especially as we consider their behavioral health needs and needs to facilitate mental vitality. In our efforts to understand the intricacies of the science underlying the psychiatric conditions of individuals living with psychopathology, dementia or Alzheimer's disease, we can easily loose sight of the many questions the individual, their caregiver or family members may have. The Caregiver Education Series, is a series of eight specific modules designed to enhance the coping of the caregiver and family members through scientific and educational resources. Each therapeutic workbook and accompanying CD provides an overview of information about a specific neurological or behavior aspect of a psychiatric disorder and provides the opportunity for the individual to develop an individualized action plan to better cope and adapt. The series designed through the use of the Self Efficacy Model (Bandura, 2005) and Prohaska and DiClemente's Stages of Change (1988) theoretical frameworks also utilizes a behavioral health education approach in the development of the series. Behavioral health literacy refers to understanding how the lack of knowledge and awareness about mental health is related to myths about self-reliance, susceptibility and treatment. The behavioral health literacy approach also called "mental health literacyâ[euro] by Jorm and colleagues who defined it as "knowledge and beliefs about mental disorders which aid their recognition, management or preventionâ[euro]. It is also crucial to identify within patients/consumers as this plays a critical role in their receptivity to interventions. An initial step towards meeting the behavioral health literacy needs within an older adult target group was to create awareness and understanding among older adults and their caregivers about mental health disorders. These disorders and this "improved literacy levelâ[euro] can affect both older adult treatment and treatment options that they may seek out, if properly educated. Thus, this project aimed to develop an effective intervention through some educational tools which can promote an understanding of various mental health issues and topics that are important to the older adult and their caregivers. The tools, consisting of an educational CD and accompanying

workbook, will prepare people to develop a personal care plan for themselves, or encourage them to seek additional mental health resources through their primary care providers, as need be, through the use of the Health Belief Model. The goal of this intervention was to provide health information which will help consumers and their families make informed health decisions and seek care based on informed decision making. Some of the module topics include Understanding the Care giving Role; Care giving and Depression; Care giving and People with Alzheimer's Disease; Care giving and People with Dementia. This presentation will showcase the specific modules of the series, and provide some preliminary data on the efficacy of this intervention as measured by various psychometric scales including the Care giving Burden scale, Compassion Fatigue and Satisfaction Scale and Center for Epidemiologic Study Depression Inventory. Preliminary data suggest that these tools have demonstrated some positive impact in improving caregiver burnout and decreasing depression levels for users.

PS01.37

Psychological distress and health-related quality of life in co-habiting family members of people with mild cognitive impairment

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Background: Mild cognitive impairment (MCI) is sometimes regarded as transitional phase between normal cognitive ageing and dementia. Family members of people with MCI - while not 'caring' for the older person per se - often take over more complex activities of daily living (ADLs) for them or support them on a regular basis. Despite much research regarding burden and distress in dementia caregivers, little is known about psychological outcomes for family members of people with MCI and factors that influence these. AIMS: To investigate rates and predictors of psychological distress and health-related quality of life (QoL) in co-habiting family members of older people classified as having MCI as compared to cognitively intact controls. METHODS: Cross-sectional analysis of baseline data of the Memory and Ageing Study (MAS), a large, population-based longitudinal study of people aged 70 to 90 (we will refer to them as the participants) and their informants (i.e. someone who knows them well and has at least one hour contact per week) in suburban Sydney. The outcome measures were the Kessler Psychological Distress Scale (K10) and the Assessment of Quality of Life (AQoL). Separate stepwise linear regression models were applied to establish independent predictors of K10 and AQoL total scores. Aside from MCI status (0 = cognitively intact controls, 1 = MCI) the following characteristics were entered as predictors: demographics and physical disability of participants and family members, participants' performance on six neuropsychological tests, neuropsychiatric symptoms (NPS) and family members' distress associated with NPS, participants' impairment on instrumental ADLs as well as objective burden (i.e. burden related to providing help with specific tasks such as running errands, managing finances or making medical decisions). Due to limited sample sizes, we did not control for different MCI subgroups (i.e. amnestic vs non-amnestic MCI, single domain vs multiple domain MCI). To increase statistical power only variables significantly associated with the outcomes in bivariate correlations were included in regression models.

Results: Of 1037 participants recruited into MAS, 327 (32%) had co-habiting family members as informants. For the current study, only those 327 dyads have been included. The majority of family members were spouses (88.3%) and female (65.7%). The MCI prevalence in participants was 33%. Family members' psychological distress was generally low (M = 12.87, SD = 3.158). Only 4.6% had elevated clinically significant K10 total scores (K10>20) at baseline. Health-related QoL was also generally good (M = 0.813, SD = 0.154; on a scale from 0 to 1, higher numbers indicating better QoL). MCI family members and family members of cognitively intact participants did not differ significantly regarding psychological distress or health-related QoL (ANOVA: F = 2.459, p = .118; F = 1.605, p = .206, respectively). Family members' psychological distress was predicted by their health-related QoL, objective burden and distress associated with NPS; those factors together accounted

for 53% of K10 variance (adjusted R^2 = 0.526). Health-related QoL overall was associated with family members' physical disability and psychological distress (together explaining 57% of AQoL variance; adjusted R^2 = 0.585). Post-hoc analysis revealed that AQoL sub-scales (i.e.'independent living', 'social life', 'mental health', 'coping', 'pain' and 'sensory perception') were mainly predicted by characteristics of family members such as their physical disability, age or psychological distress. However, the 'independent living' sub-scale (i.e. extent to which someone can manage ADLs independently) was additionally associated with participant's age and objective burden while the 'social life' domain (i.e. level of satisfaction of and extent to which relationships with significant others are affected by one's own physical health) was also linked to the severity and frequency of NPS.

Limitations: Results were limited by cross-sectional design as well as a lack of variability in psychological distress and health-related QoL.

Conclusion: In this population-based sample, living with an older person meeting research criteria for MCI did not affect family members' psychological health in a negative way. Neuropsychological test performance of the participants did also not affect their family members' distress or QoL levels. However, other aspects reflecting decline or impairment in participants such as objective burden related to helping participants with certain tasks, the frequency and severity of NPS as well as distress caused by NPS significantly predicted psychological outcomes of family members. Longitudinal follow-up will investigate whether further cognitive and functional decline in the participants is linked to development of psychological distress and health-related QoL in their family members.

PS01.38

Guiding practices for the nursing home transition of people with dementia and their family carers

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Introduction: The (possible) institutionalisation of a person with dementia often is a wrenching issue. The decision-making regarding nursing-home placement may be hindered by a negative view of nursing-home care, reluctant relatives, or feelings of guilt. We developed a practice guide for professionals to facilitate the transition process of people with dementia from home to nursing-home or small-scale living facility. The practical recommendations are based on the literature and on empirical evidence.

Methods &Materials: First, literature was reviewed for studies examining the transition from home to nursing-home. In addition, qualitative interviews were held with 26 informal caregivers (children or partners) of a person with dementia about their experiences, needs and expectations regarding nursing-home placement. Data were analysed with the constant comparative method using Atlas-ti, and then translated into practical recommendations for transitional care.

Results: The practical recommendations for transitional care address the period before institutionalisation, the day of admission and the period after institutionalisation. A successful transition starts with timely discussion of the possibility of moving into a nursing-home or a small-scale living facility with the persons with dementia and their caregivers, in order to prevent a hasty decision in a crisis situation. Regular discussion of the pros and cons of institutionalisation may promote readiness and reduce reluctance. Oral and written information and the opportunity of visiting some homes, or even a trial stay, will facilitate informed choice about future living arrangements. The admission to a nursing-home should be made an informal event without unnecessary administrative procedures. A personal welcome, including a small welcome gift in the room, and having the room ready and furnished with familiar objects may ease the transition. At the day of admission, special attention must be paid to the informal carers' concerns and distress, especially when the time has come to say goodbye and leave their relative behind. After institutionalisation, professionals should maintain frequent contact with the family carers, particularly in the first two or three months after placement. The experiences and expectations of the informal carers around family participation should be explored, and counselling should be

provided to carers to help them resolve any ambivalent feelings or depression. Finally, both people with dementia and their carers will need support to give new meaning to their lives, individually as well as a couple. **Discussion:** This practice guide offers practical recommendations that professionals need to ease the transition of people with dementia and their family carers facing institutionalisation. Involvement of key service providers and representatives of persons with dementia and their family caregivers will encourage widespread adoption and implementation of the protocol.

PS01.39

Discharge planning for dementia patients from psycogeriatric hospital to nursing homes: Are we delivering best practice? A participatory action research project

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Overview: Health and social care services to the mentally ill elderly occurs increasingly in home living arrangements and nursing homes, and with shorter assessment in specialist services. To ensure proper professional patient care between specialist health and community care, it is important to strengthen interactions across services both at admission and discharge. A person centered approach may include observations and assessments of the severity of dementia, capacity, presence of functional abilities, the individual's physical and mental status and discussions of concrete measures and individual plans. The study explores how the discharge of people with dementia from the psychogeriatric specialists to nursing homes can be improved and quality assured, and at the same time generate knowledge of the possibilities and challenges involved in carrying out quality processes within these contexts. On these grounds the study is inspired by participatory action research in their own organization. The empiric research processes involves a multidisciplinary group and includes doctors, nurses, occupational therapist and nurses from 5 sheltered units in nursing homes and from psychogeriatric specialist services over a period of two years. The planning and implementation of coordinated interactions at discharge takes place in parallel with data generation. Lessons from the interaction analyzed continuously in interdisciplinary network group, as a starting point for new initiatives and improvements. The results include the learning processes of interaction, and testing and evaluation concrete measures to strengthen the knowledge base in the interaction by discharge. The study also explores how learning and transformative processes evolved over time, within the resources available in the hospital and nursing homes settings. The study gives voice to an important quality improvement approach in the communities of practice, involving collaboration between interdisciplinary personnel and leaders in specialist services and personnel in nursing homes in the action, learning and development processes.

PS01.40

The perception of informal caregivers about a day care unit for people with Alzheimer's disease

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Overview: The family burden due to Alzheimer's disease is known to be a problem of public health: there is a decrease in the number of young caregivers in comparison to the increasing number of elderly people with Alzheimer's disease. Moreover, there is only a few public institutions that satisfy both caregivers' needs as well as the needs of Alzheimer's disease patients. The Alzheimer's disease is a progressive pathology and seriously debilitating disease, making the patient more and more dependent on others in all of his levels of occupation. This is then a serious challenge not only for the patient as it is for the people responsible for his care. The role of such caregiver toward this elderly person, inflicted by cognitive impairment, is greatly affected in particular in the cases of dementia. The complexity of such care is, therefore, dramatically increased. Caring for an elderly with dementia has been one of the major points of stress and burden for caregivers. It is, then, due to these aspects that caregivers are normally said to be the "hidden patientsâ[euro] as they themselves reflect the need for outside help and support regarding their own health and well-being. The act of caring for these patients in

their own homes is significantly different in the way they lead their occupational patterns. Which is to say, the caregivers are put into situations of occupational imbalance and into an enormous physical and psychological burden. Thus, this work has its primary goal, to understand the perception of the informal caregivers in relation to the integration of these people in the day care units. As well as, to discern if the day care units are a good strategy for the improvement of the emotional and occupational stability of the caregivers. Concerning the data collection of empirical information, we find ourselves in a mixed method, which was built in the procedures of quantitatively and qualitatively research. In these guidelines, we administer on 10 informal caregivers, in the initial first 6 months before and after their relatives were integrated in the day care unit "Memoria de Mimâ[euro], the instruments "Zarit burden interviewâ[euro] and the "Brief World Health Organization Quality of Life Assessment Instrument (WHOQOL-bref)â[euro]. The purpose is to understand the impact of these care units in the emotional balance and subjective perception in their quality of life. Meanwhile, interviews have been made so as to comprehend what if, any impact these care units have on the caregivers' occupational balance. The results show that there is a decrease in the emotional balance and an improvement in the subjective perception of the quality of life on the caregivers. It also shows, a pattern of adjustable occupational balance and an enhancement of their own well-being. Although this is an exploratory study, these conclusions seem to show the importance of these social answers to the people with dementia and their caregivers.

PS01.41

Can assistive technology reduce family caregiver burden?

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Overview: Australia is facing an ageing population and increasing costs of care. Rapidly developing applications of technology for the care of older people provide intriguing possibilities in the world of care, evidenced by an ever-increasing number of 'technological solutions' market place to address care issues. A new Australian study, funded by the Australian Government Department of Health and Ageing, utilised an iterative case study methodology to examine if assistive technology (AT) can be effective to relieve burden of family caregivers in the community, when AT is prescribed after a comprehensive needs based assessment. Assessment included caregiver burden, caregiver and care recipient physical, social, cognitive and environmental factors and how these factors interface with properties inherent in technologies. Family caregivers of 121 care recipients in receipt of Australian Government funded community and caregiver respite services were invited to participate in the project. A total of 77 caregivers consented. Comprehensive needs based assessment identified caregiver stress associated with personal hygiene care tasks (29.9%), domestic tasks (29.9%) fear of falls (15.6%) transfers to or from bed (14.3%) and respite or social needs (11.7%) as the most common of the 25 different issues identified. Project staff reviewed assessment information and identified potential technologies that may address individual needs. Solutions were discussed with caregivers prior to trial. 55 caregivers agreed to trial between 1- 4 technologies. 22 caregivers either elected not to trial the identified product, and were utilized as a control group of convenience. All participants continued to receive usual community care. Ninety-one products were deployed, comprising 20 different types of technology. Cost of products was $A92,300 (mean $1,015 per item) and required 108.6 hours (mean = 5.6 hours) of project staff time to install, train and support the caregiver in its use. Caregiver burden and psychological wellbeing was assessed at baseline, 6 and 12 weeks after deployment of technology. Instruments used were the Zarit Burden Inventory (Zarit,1980), and 12-item General Health Questionnaire (Goldberg and Williams, 1988). Caregivers set individualised goals for each technology deployed, and rated the attainment of goals at 6 and 12 weeks post deployment, based on Goal Attainment Scaling (GAS) methodology (Kiresuk, et. al. 2009). In GAS, a score of 50 indicates the goal (in this case, the expectation of AT satisfactorily addressing the identified need) has been met; a higher score indicates the goal has been exceeded. Mean scores of the Zarit Burden Inventory decreased from baseline and again at 12

weeks, though no significant difference was found when compared to the 22 caregivers who did not elect to trial technologies. The GHQ decreased at both time points from baseline, but likewise no significant difference was found. 112 of the 119 GAS scores (94.1%) were rated at 50 or higher (mean = 53.3, range 25.2 - 74.81). Caregivers with multiple goals had a mean GAS of 51.3 (range 25-70) with 79.2% of caregiver having a score of 50 or above. When caregivers who received $A1,500 or more in products (n = 29; mean = $A2,735) were compared to those receiving less than $A1,500 (n = 24; mean $A329) an independent samples t-test showed the low cost group to have great Goal Attainment (t = 2.21; df = 50.8; p.

PS01.42

Coping strategies and psychological morbidity in family carers of people with dementia: A systematic review and meta-analysis

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Background: Carers for people with dementia experience high levels of anxiety and depression. Coping style has been associated with carer anxiety and depression with indication that dysfunctional coping is associated with being more anxious and depressed, but there have been conflicting findings about the relationships between other specific coping styles and psychological morbidity. In addition, previous reviews did not evaluate the influence of stressors, such as the severity of dementia or neuropsychiatric symptoms which might elicit both coping behaviour and predispose carers to anxiety and depression. We therefore systematically reviewed and meta-analysed the relationships between coping and anxiety or depression among family carers of people with dementia.

Method: We performed an electronic search up to March 2010 for peer-reviewed publications using the keywords: dementia and carers and coping and (depression or anxiety), supplemented by hand-search. We included primary studies that reported a measure of statistical association between coping style and psychological morbidity among family carers of people with dementia. Studies reporting data on carers of people without dementia were excluded, unless they separately reported results for dementia carers. Three authors independently rated study validity using standardised checklists and divided studies into 'higher quality' and 'lower quality' on this basis. We examined the measures of coping used and re-classified them into three categories to ensure comparability between studies: these were problem-focused coping, acceptance and emotional support, and dysfunctional coping. We tabulated the individual study findings, as to whether each coping style was positively, negatively or not significantly associated with morbidity. We included studies that controlled for severity of dementia or neuropsychiatric symptoms in their regression analyses in a meta-analysis. We calculated weighted mean correlations (WMC) for the relationships between coping and psychological morbidity, using a random effects model.

Results: From 5396 publications identified by the systematic search, we included 28 cross-sectional and 7 longitudinal studies that met the inclusion criteria. There were no observable differences between higher and lower quality studies in the direction and statistical significance of findings. Eleven studies controlled for the predetermined confounders and were included in the meta-analysis. Dysfunctional coping correlated with higher levels of anxiety (WMC = 0.39, 95% CI 0.28-0.50; N = 688) and depression (0.46, 0.36- 0.56; N = 1428) cross-sectionally, and with depression 6 and 12 months later (0.32, 0.10- 0.54; N = 143). Acceptance and emotional support correlated with less anxiety (-0.22, 95% CI -0.26 to -0.18; N = 628) and depression (-0.20, -0.28 to -0.11; N = 848) cross-sectionally; and predicted anxiety and depression a year later in the only study to measure this. Problem-focused coping did not correlate significantly with psychological morbidity.

Limitations: Just under a third of the identified studies provided extractable data for meta-analysis, including only two longitudinal studies.

Conclusions: There is good evidence that using more dysfunctional and less acceptance and support styles of coping are associated with more anxiety and depression cross-sectionally, and preliminary evidence from longitudinal studies that they predict this morbidity. This is the first review of carer coping in dementia to use meta-analysis, taking into account the influence of stressors, and a common classification system for different coping measures. Our findings would support the development of psychological interventions for carers that aim to modify coping style by increasing emotional support and acceptance coping, and decreasing dysfunctional coping.

PS01.43

Caregiver burden: Unwanted effects of home caring

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Introduction: Growing elderly population brought about a significant increase in the number of patients with dementia as well as caregiving problems all over the world. Although Turkey is a developing country, due to increasing life expectancy, the prevalence of Alzheimer's Disease is increasing. Caregiver burden also rises as an important and serious public health concern. Unlike the United States and European countries, in Turkey only few Alzheimer's patients stay in nursing homes. To institutionalize a demented old family member is not well-accepted socially and patient's care is usually provided by one of the family members. Caregivers may experience physical, personal, social, financial, emotional difficulties and they are at the risk of psychiatric and medical morbidities and burden. We aimed to evaluate the relationship between care giver burden, depression and status of the patient in terms of daily activities and the dementia severity.

Method &Patient Selection: 90 caregivers of 90 patients diagnosed AD according to the DSM-IV criteria were included in the study. 30 patients were mild stage, 30 moderate stage and 30 advanced stage patients. A questionnaire detailing socio-economical data was filled out. Minimental status examination (MMSE) and Daily Living Activities Scale (DLAS) was administered to the patients. DLAS is 15 item inventory consisting of 8 basic activities and 7 instrumental activities. Caregivers were evaluated with Zarit Caregiver Burden Scale (ZCBS) and Beck's Depression Inventory (BDI). Spearman correlation analysis was performed to analyze the possible interactions of the caregivers burden and patients daily activities.

Findings: The range of MMSE scores of the AD patients with mild, moderate and advanced disease stages were 20-26 (mean: 22.73 ±1.76), 12-19 (mean 15.63 ±2.13), and 0-9 (mean: 5.83 ±3.24), respectively. 77.8% of the caregivers(total of 70) were female and 22.2% male (20 participants). The mean age of the caregiver group was 53.8 years (range 22-75 years of age). 50% of the caregivers (n = 45) were daughters,30% (n = 27) spouses,11.1% (n = 10) sons, 6.7% (n = 6) daughter-in-laws and 1.1%(n = 1) was a sibling. 43.3% of the caregivers performed this duty for more than 5 years. 85.6% of the caregivers provided their service 7 days a week and 45.6% more than 6 hours a day. The mean Zarit Caregiver Burden Scale (ZCBS) score of the group was 14.41±10.22. 50 participants (55.5%) had scores equal to or more than 12. The mean Beck's Depression Inventory score of the caregivers was 9.26±7.47 and 25 participants scored 14 or higher. Positive correlations between ZCBS and the basic items of self-dressing (rho = 0.35, p< 0.01), personal hygiene (shaving and combing) (rho = 0.27, p <0.05), waking up and going to bed (rho = 0.25, p <0.05), incontinence (rho = 0.28, p <0.01) of the DLAS were noted. Statistically significant positive correlations were present between the ZCBS and all of the instrumentation items of DLAS.

Conclusion: As the AD progresses, the decline in the daily living activities of the patients demands more time spent for the caregiver with them. With increased length of time spent with the patients, there is an increase in the caregiver burden as well. Our study shows that Turkish caregiver population demonstrates serious caregiver burden in 50% of the cases and significant depressive symptoms in one third of the cases. These data suggests urgent support programs for caregivers, daycare centers for AD patients, and professional aid systems for

families are mandatory.

PS01.44

Being responsible for an adult presenting an intellectual disability: Life experience, challenges and difficulties encountered by aging parents

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Overview: Because of the increase of life expectancy of people with or without an intellectual disability, it is current to see nowadays 65 years old seniors and over having the charge of a 50 years old adult and more, presenting an intellectual disability. For several seniors, their parenting role can be very demanding since constant monitoring might be necessary in order to avoid accidents at home, ensure control and assistance for hygiene, dressing and eating as well as taking care of their child's medical follow-up. All these tasks are likely to evolve according not only to the age of the person presenting an intellectual disability but also to the variations in the health status of the aging parents. In this context, it is easy to imagine that parents 65 years old and more having the responsibility of a child presenting an intellectual disability face several challenges. Certain studies on this subject name as the prevalent difficulty the parallel aging of both the parent and the child which could lead to a situation of cumulated handicap. Having charge almost for life of a child presenting an intellectual disability therefore represents an important source of stress for aging parents 65 years old and over. As well, they are concerned for the future of their child after their death or when they won't have the physical capacities or health to take care of that child. In order to learn about the experiences of elderly people having charge of an adult presenting an intellectual disability, a quantitative study was conducted in the Saguenay - Lac-St-Jean (Québec, Canada) region. The eight participants are 65 years old and over, and are the legal guardians of their impaired child. Semi-directed interviews averaging 90 minutes were done and allowed to shed light on the main difficulties experienced daily by these elders as well as the challenges they must meet to assume their responsibilities. Within the framework of this communication, information will also be provided regarding the repercussions caused by having charge of an adult presenting an intellectual disability on the health, personal, social and professional life of the parents as well as the concern of these parents about the assumption of responsibility of their adult child once they cannot assume their role anymore.

PS01.45

Can affection become a burden? Caregiver profile in a Brazillian sample of patients with dementia

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Introduction: Population ageing increases the prevalence of diseases related to senescence, such as dementias1. Dementia syndromes are usually progressive diseases and the increasing dependence of these patients requires a growing effort from closest caregivers. About 70% of patients with dementia live at home and almost 75% of caring is provided by the family 2. Studies have reported that familial environment might have influence on elder's behavior3.

Objective: Describe the profile of the dementia caregivers with and without burden, assessed before a Psycho-educational intervention from the Old Age Research Group from the Institute of Psychiatry from University of São Paulo - Brazil.

Method: A structured questionnaire was applied to collect: socio-demographic data and information about the caregiver responsibilities; relationship with the patient; frequency, duration and dealing forms of the caring; if he/she lived with the patient and the knowledge about dementia prognosis. Burden was assessed by the Brazillian version of the Zarit Caregiver Burden Interview. A descriptive data analysis was performed showing frequencies and percentages of categorical variables as well as mean and standard deviation for continuous

variables.

Results: The thirty-three dementia caregivers were predominantly women (88%), concluded high school (69%) and were elder (48%), which might explain the fact that most of them were in medical treatment (64%); 94% were relatives of the patient (54% children and 40% spouse), 70% lived with him/her, they spent 15 (±9) hours a day taking care of the patient and did not receive any payment for it. Moreover they had their own responsibilities such as: 27% took care of their children who were dependent on caring; 42% were employed (71,4% of those worked 20 hours a week or more); 79% were responsible for the housework; 76% took care of the patient for less or 4 years and 24% took care for more than 4 years. Two groups were compared according to the total score of Zarit, Caregivers with Burden (group A, N = 25) and Caregivers without Burden (group B, N = 8). No significant socio-demographic difference was found between the groups. However, in the multiple alternative question "Why do you take care of this patient?â[euro], 77% of group A chose the answer "because he/ she is the reason of my lifeâ[euro], while half of the group B selected the alternative "because I just like him/ herâ[euro]. The intensity of the feelings and affection for the patient might influence the way of caring; 44% of the group A reported that they "did not feel calm while taking careâ[euro], but all of subjects from group B (100%) said they "did feel calmâ[euro]. When having to deal with a patient's solicitation, most caregivers in both groups reported that they "tried to hear him/ her because I noticed that was beneficial for the patientâ[euro], however for 24% of the group A mention that it "became tiresomeâ[euro]. About the attitude they took when noticing that the patient was getting nervous or agitated, 52% (group A) "tried to calm him down by talking, but did not know how to deal with it, because it did not always workâ[euro], while 62,5% (group B) just "turned the TV on or tried to distract the patient with somethingâ[euro]. When questioned about the knowledge about the prognosis of the disease, 80% (group A) and 62,5% (group B) knew the "dementia progressive characterâ[euro]; nevertheless, 37,5% of group B believed that "the scenario would keep stableâ[euro].

Conclusion: Brazilian elderly population is growing considerably and, similarly to other countries, ageing is associated to the increase of the prevalence and incidence of dementia. In this study, most of the caregivers were informal (relatives), live with the patient and almost half of them were elders, which is consistent with other studies. The presence of burden was not associated with any objective variable however it was related to caregiver subjective aspects. Caregivers with burden presented a more intense affection for the patient and more difficulty in dealing with caring, despite of having more knowledge about the prognosis of the disease when compared to the group without burden. These findings need to be further addressed to understand the meaning and the importance of such feelings expressed by dementia caregivers.

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PS01.46

Caring for the caregivers: Depression symptoms in a Brazillian sample of patients with dementia

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Introduction: Informal caregivers allow demented patients to live at home, keeping them near to their families and their usual environment, and also avoid public costs with long-term care at nursing homes. Notwithstanding, caregiving might have serious adverse consequences for their health. It is known that depression is one of the main risks that may affect caregivers. For patients with dementia, some studies suggest that the frequency of depressive symptoms is related to factors such as gender, ethnicity, poorer health, fewer financial resources, the relationship between the patient and the caregiver, the presence of behavioral symptoms in dementia, the

patient's dependence level for daily living activities and cultural factors.
Objective: Describe the profile of the caregivers of patients with dementia and identify depressive symptoms, assessed before the Psychoeducational intervention at the Old Age Research Group from the Institute of Psychiatry, University of São Paulo - Brazil. Method: A structured questionnaire to collect sociodemographic data and the profile of the caregiver was applied. Depression was assessed by the Brazillian version of the Beck Depression Inventory (BDI). A descriptive data analysis was performed showing frequencies and percentages of categorical variables as well as mean and standard deviation for continuous variables. Results: The thirty-one caregivers of patients with dementia were all predominantly informal (97%), women (87%), white (61%) married (80%), concluded high school (61%) and the mean age was 57.5 (±14.2). 55% were patient's children and 42% were wives or husbands. 74% lived with him/her and have been taking care of the demented patient for 2 years or more (58%). Most of them were in medical treatment (68%) and 13% were treated for depression. BDI identified that none scored for severe levels of depression, although 52% caregivers presented mild to moderate symptoms. This result indicates that almost 40% of those who presented some degree of depressive symptoms are not being treated. This information gets more concerning once the caregivers who scored the higher levels in BDI did not correspond to those who are being medically treated for depression.
Conclusion: Caregivers of demented patients are good helpers on treating and maintaining them safe and well. However, this occupation might have a negative impact on own caregivers' health, such as developing depressive symptoms. In this study, more than half of the caregivers presented mild to moderate level of the disease, and most of them were not having medical treatment. It suggests that a number of them is neglecting their own needs, which may even impair their caring of demented patients. This study confirms the recommendation that further researches are necessary to understand how mental illness can affect caregivers' life and develop effective interventions that prevent can adverse consequences of caring.
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PS01.47
Proposal of a psycoeducational program for informal caregivers: Cuidar em casa (taking care at home)
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Overview: The psycho-educational programs are an important intervention to informal caregivers. The psycho-educational interventions have both the component of provision of information and a psychological approach to caregiver distress (Reinhard et al., 2008). Psycho-educational programs are one of the most common types of interventions that address caregiver well-being, they normalize caregiving experiences and make a support system (set of connections) among participants (Sörensen et al., 2002)
Method: The QoL55+ was a diagnostic study made in the city of Guimarães that allowed characterizing the people with 55+ and their needs. Based on this diagnose and in the literature review, the project Cuidar em Casa (Caring at Home) was designed in partnership with a NGO with the objective to reduce the risks associated with informal caregiving. The project develops in three action areas: development and promotion of psycho-educational programs for Informal Caregiver; creation of a scholarship for volunteers to replace the informal caregivers (when they are attending the program to relieve the caregiver); dissemination of macro information on the provision of informal care. The psycho-educational program Cuidar em Casa has the following inclusion criteria: being caregiver of a person with 60+, dependent on ADL's or/and AIDL's, without any external formal support, and availability to attend to the sessions of the program. Two training programs were organized: i) create a volunteering group to substitute the informal caregivers during the sessions of the

program and ii) train professionals (psychologists, social workers and nurses) able to boost capable of orienting the program. The program was released in the community through the media, flyers in key points like primary health care centers and municipalities, and through the priests. Informal caregivers were informed about the schedule of the program and called for a pre-test evaluation one week before the start of the program. The evaluation procedure was organized as follows: - pre-test evaluation: one week before the start of the program. The evaluation protocol encompasses: CUIDE and attachments (SF-12v2; GHQ 12; PAC and CSI) - pos-test evaluation: in the last session of the program. The evaluation protocol includes only the attachments; - follow-up: 8 weeks after the end of the program, using the same protocol as in post-test; - second follow-up: 6 months after the end of the program, by phone; The group had 8 participants, all female, aged 24 to 62 years with an average age of 46 years. The education level of caregivers varies between 4 and 12 years and they spent 10,6 hours average in care.

Results: The psycho-educational program Cuidar em Casa has 7 sessions with 2 hours, once a week, with the following themes: 1. Understanding aging; 2. Care for the Elderly I; 3. Care for the Elderly II; 4. How to act in urgent/emergency situations; 5.Leisure and stimulation; 6. Caring for the Caregiver; 7. Support in the community and end of the program. Sessions have a similar structure, divided into 4 moments: i) presentation session and its objectives, ii) educative support; iii) emotional support, iv) homework and end of the session. The program was conceived in a very interactive philosophy, where the informal caregivers have an active participation, with activities planned to facilitate sharing of feelings and experiences, and the acquisition of knowledge need to improved the care give at home. Running of sessions is assured by a coordinator (psychologist) and one or two professionals specialized in the theme of session, trained previously. Conclusion This program is of great importance because there is lack of support of this kind for informal caregivers. When caregivers are inquired about their participation into psycho-educational program, they have referred that program has reduced distress and burden effects. In generally, caregivers have mentioned positive effects. In the end of this program we hope that participants minimize bad feelings through share and standardization of feelings and experiences, developing skills to reduce stress, promoting feelings of self-esteem and self-control and recognize the need for assistance.

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PS01.48

Medication use in a large sample of nursing home patients with dementia

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Introduction: Because of their multiple comorbid conditions, nursing home patients with dementia are at high risk of polypharmacy, which in turn is an important factor for adverse drug reactions and drug-drug interactions. Especially in patients with advanced dementia, there is a debate about the appropriateness of certain drugs like lipid lowering agents or acetylcholinesterase inhibitors. A recent US study in patients with advanced dementia found a mean of 5.9 medications of which 37.5% was considered "never appropriateâ[euro].

Objectives: To study medication use in dementia patients residing in nursing homes and the association of gender, age, duration of stay, and severity of dementia. Methods: Cross-sectional study in 59 dementia special care units in 25 nursing homes. Patients with dementia according to DSM-IV criteria were included. Drugs were classified using the Anatomical Therapeutical Chemical classification. Gender, age, duration of stay in the nursing home, and dementia severity, assessed with the Global Deterioration Scale, were used as correlates.

(Logistic) regression analysis was used to study the association between the correlates and medication use. **Results:** The sample consisted of 1319 dementia patients. The mean number of drugs used was 4. Only 3.9% of the population used no drugs at all, 54.6% was prescribed 1-4 drugs, 35.9% 5-8 drugs, and 5.7% was prescribed 9 or more drugs. Drugs for the alimentary tract and metabolism, blood and blood forming organs, cardiovascular system, and nervous system (psychotropics) were prescribed most frequently. Medication use was associated with age, duration of stay and severity of dementia. Patients aged 65-74 years and 75-84 used more drugs than patients ≥85 years. Patients with a duration of stay ≥3 years or GDS stage 7 use less drugs as well. Conclusion: Medication use in this sample was comparable with other Dutch studies, but lower than in the US. Despite these figures, there still is a need to critically review medication on a regular basis, especially on the issue of appropriateness. **References:** Tjia J, Rothman MR, KIely DK et al. Daily medication use in nursing home residents with advanced dementia. J. Am Geriatr Soc 2010; 58: 880-8.

PS01.49

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PS01.50

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PS01.51

Living positively with dementia: A review of qualitative studies

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Overview: Living Positively with Dementia: A Review of Qualitative Studies Wolverson, E. L.; Clarke, C.; and Moniz-Cook, E.[2]; Department of Clinical Psychology and Psychological Therapies, Hertford Building, The University of Hull, Hull, HU6 7RX, England[2] Hull Memory Clinic, 39-41 Coltman Street, Hull, HU3 2SG, England **Background:** Existing phenomenological and lived experience research in dementia has tended to focus on the inevitable losses and negative experiences that often occur as the condition progresses. The extent to which people living with dementia might have positive experiences in spite of, or even because of there dementia, and retain important strengths remains unclear and controversial. Some researchers and clinicians have questioned whether positive experiences in dementia are even possible; with positive emotions have been called a façade; denial; a defense mechanism; or even the result of a lack of awareness. In light of this controversy and the potential conceptual, clinical and psychosocial importance of documenting the subjective experience of dementia in all its variations, this paper reviews and examines the current qualitative research evidence relating to positive lived experience in dementia.

Aims: To review and synthesise reports of positive experience, strengths and capabilities in literature relating to the lived experience of dementia. To identify the particular virtues and character strengths experienced and reported by people living with dementia. To explore how researchers have conceptualized reports of positive lived experience in dementia where they exist in the literature.

Method: We conducted a systematic search for qualitative research concerning positive lived experiences in dementia, using MEDLINE, CINAHL and PsychINFO. In addition, manual searches were conducted of the reference lists of all included articles. A focused hand search was also performed in the journal Dementia. The research findings of included studies were synthesized using the Character Strengths and Virtues system (CSV; Peterson &Seligman, 2004) as a guiding framework. Results: A total of 28 studies were included in the review and each contained evidence of positive experiences in the lived experiences of people with dementia, though this was frequently not the primary focus of the studies. Particular strengths and positive experiences that consistently emerged in the literature included those related to wisdom, as dementia appeared to allow people to develop a wider perspective on life which they were able to share with others. Strengths related to courage were also evidence in the will to accomplish goals in the face of internal and external opposition. Strengths

related to humanity, love and kindness were also evident. The strength of transcendence was also apparent, as for some dementia allowed them to learn more about life and themselves and consequently was regarded as a life enhancing experience.

Conclusions: The literature revealed that the experience of dementia is not wholly negative. People with dementia demonstrate strengths of character and report positive experiences, often as a direct result of their dementia. Whilst these positive experiences exist within the literature, they appear to have been somewhat overlooked by researchers. Positive subjective experiences in dementia highlight the strengths and capabilities that are retained by those affected and should therefore be examined closely as part of a broader effort to challenge the stigma and stereotypes associated with the condition. Future research needs to examine these character strengths and experiences more specifically and identify factors that promote well-being in dementia.

PS01.52

Plasma homocysteine and MTHFRC677T polymorphism as risk factors for incident dementia

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Background: Elevated total plasma homocysteine (tHcy) has been associated with increased risk of dementia although data derived from cross-sectional, case-control and cohort studies has produced mixed results. A handful of clinical trials have investigated the association between tHcy lowering treatment and cognitive decline in non-demented older people, and their results have also been equivocal. The C677T polymorphism of the 5,10 methylenetetrahydrofolate reductase gene (MTHFR) increases tHcy and provides a means of studying the association between tHcy and dementia whilst not being as susceptible to the common biases and confounding of observational studies. We designed this longitudinal study to determine if high tHcy and the MTHFR C677T polymorphism increase the risk of incident dementia amongst older men.

Methods: We studied 4 227 men aged 70-89 years from the Health in Men Study (HIMS) cohort and established the diagnosis of dementia (International Classification of Diseases - 10th edition) using morbidity and mortality records. Information on tHcy, MTHFR gene status, lifestyle and clinical variables were obtained using postal and face-to-face assessments. We initially compared men with high tHcy (>15 μmol/L) to those with normal tHcy (≤15 μmol/L). Cox proportional-hazards regression models were used to examine the relationship between incident dementia and high tHcy, as well as the association between incident dementia and the MTHFR polymorphism (CC homozygotes as reference group) whilst adjusting for a variety of potentially confounding variables know to be associated with dementia. Results Men with high tHcy were 1.5 years older (t = -11.89, p 15 μmol/L) had lower mean HDL (t = 5.27, p 15 μmol/L (adjusted HR 1.36 95% CI 1.03-1.81, p = 0.032). Men with the TT genotype had a HR of dementia of 1.25 (95% CI 0.81-1.92, p = 0.403). We estimated that the study would need 6336 men (631 with the MTHFR TT genotype) to declare as significant an association of this modest effect size (HR = 1.25) between the MTHFR C677T polymorphism and incident dementia.

Conclusions: The results of this prospective study are consistent with a causal link between high tHcy and incident dementia and the observed associations were independent of risk factors commonly associated with dementia such as age, education, smoking, alcohol use and vascular risk factors. The study lacked power to determine an effect of the MTHFR genotype. The nature of observational evidence however makes it difficult to draw any firm conclusions regarding causality. Therefore we would argue that the best way to establish whether tHcy lowering therapy can indeed prevent dementia would be by means of an adequately powered, large randomised trial of older people with high tHcy being supplemented with B vitamins over an extended period of

time.

PS01.53

Hard economic times and dementia care by families: Cross cultural perspective

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Introduction: Dementia is a progressive cognitive decline, which affects not only the individuals but also the families and communities. The National Dementia Strategy depicted the current figures of dementia in UK to be 700,000 and the Alzheimer's society came up with the figures of 750,000 people who suffer from dementia (Alzheimer's Society, 2010). The Strategy also talks about the cost to UK economy being £17 billion a year and as the projections estimate that within next 30 years the dementia population will double to 1.4 million, trebling the cost of dementia care to £50 billion a year (National Dementia Strategy, 2009). In different parts of world mainly in Asian countries and some European countries traditional joint family systems exists and people take pride in living and being part of such society. The traditional role of family looking after their elders in UK sounds strange and assumed to be nonexistent but it is found that family carers of people with dementia save the UK over £6 billion a year (Dementia UK report, 2007).

Aims: To find out whether providing quality dementia care in patient's homes with the help of families and informal carers would be much cheaper in these hard economic times.

Methods: The authors searched the journals electronically for phrases like dementia and family care, community support and economic burden of dementia. We searched the journals with the help of NHS library; articles, which were only abstracts were manually searched at the Library and if, not found were not included in the study. The authors then identified 33 articles, which were relevant to the aims of the review. After carefully reviewing all of them 23 were selected to be included in the review. The authors then subdivided the articles into epidemiological studies, economic studies and social care studies.

Results: The total cost of dementia care to the UK economy is £17.03 billion, which equates to £25,472 per person per year. Annual cost of dementia care per patients is: Community (mild dementia - £16,689, moderate - £25,877, severe - £37,473) and Care home - £31,296. If patients with dementia are kept in a home environment it will lead to lesser public and private expenditure on institutional care due to a possible delay in the need for it. It has been estimated that informal carers save the state between £15 and £24 billion per year by supporting dependents who would otherwise be institutionalized. There are a number of reasons why people in some countries provide care for elderly: Joint family system, sense of responsibility, social norms of respecting and caring for elderly, economic strains and lack of resources. 'Job satisfaction' and 'Companionship' were the two very positive aspects to caring their spouses with Alzheimer's disease in a cross-national study. They gained satisfaction from making their spouse as comfortable as possible. They had to learn new skills to deal with difficult situations and were happy with the achievement. 16% were satisfied for 'doing their best' for their partners. 12% felt that they can make a return for care and affection given in the past and this played a major part in the motivations. Staying together was the most rewarding aspect for 15% of spouses, 16% patients appreciated the effort that their spouses are putting for the care and that was the motivation for the carers to go on. Singing, playing jokes and any other pleasurable activity was found to be cherishing.

Conclusions: In hard economic times families and informal carers provide the personalized and high standard service. Dementia patients do value this service and are better looked after by family members and informal carers, though this will depend on the stage of dementia and presence of BPSD. Family members feels comfortable and satisfied in providing care for their loved ones. Families are committed to this job but would need support and timely help when needed.

PS01.54

Review of pharmacological vs. non-pharmacological management of behavioral and psychological symptoms of dementia (BPSD)in care homes: Experiences from Care Home Inreach Program (CHIP) Project

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Introduction: In care homes Priebe, Saidi, Want, Mangalore and Knapp, (2009) found that most patients receive support with activities of daily living, they are involved in some sort of occupational activities and 52% have a care coordinator in a community mental health team. Priebe, at al. (2009) have concluded that quality standards may have to be defined and applied to ensure that all patients in housing services (care homes, supporting housing services) receive appropriate care, they also expressed the need of more input from mental health services for the rehabilitation and recovery of patients. Behavioural and Psychological symptoms of dementia (BPSD) affect 83% of dementia patients (IPA, 2002), more than 80% of patients with Alzheimer's disease (Mega, Cummings, Fiorello and Gornbein, 1996). This will cause a considerable caregiver burden among people looking after dementia patients (Teri, 1997). It has been estimated that 180,000 people with dementia are treated with antipsychotic medication across the England every year. Of these, up to 36,000 will experience some benefit. But the use at this level equates to an additional 1,620 cerebrovascular adverse events and to an additional 1,800 deaths per year (Banerjee, 2009).
Aim: To provide an in-reach service to care homes and to analyze the impact of this service at the end of six months. Review the literature for care of dementia in care homes with respect to antipsychotic use and non-pharmacological approach in management of BPSD. METHODS Three doctors - Consultant, Specialist Registrar and Staff Grade were part of the Multi Disciplinary Team (MDT) providing the inputs in four care homes. All doctors had more than 5 years experience of working in Psychiatric services. All four Community Psychiatric Nurses (CPN) from the CMHT taking part in the project were qualified, well trained and experienced in dealing with dementia and BPSD. The team Psychologist was the part of this project and was actively involved in training staff members in management of BPSD. A two / three member team provided the service which included a doctor, Community Psychiatric Nurse (CPN) and Psychologist.
Results: The knowledge of common mental health problems and dementia increased in care home staff at the end of CHIP Project by a margin of 7% and 11%. Confidence in managing behavioural problems increased by 9% among cares home staff at the end of project. 65% of care home staff felt a need for education and awareness, practical problem solving and counselling in managing BPSD. Care home managers pointed at four themes regarding the weakness in managing behavioural problems of dementia: 1. Lack of training, need of regular psychiatric input. 2. Not able to cater for more challenging patients. 3. Management of physically aggressive patients. 4. Delay in medication management by professionals in crisis. CHIP achieved regular monitoring of psychotropic medications, were able to discharge 14 out of 63 existing patients in four care homes, psychoeducation was provided for staff and families. CHIP provided guidance on following non-pharmacological techniques: relaxation techniques, distraction techniques, reality orientation, reminiscence work, needs led therapy, music therapy, person centered approach, behavior therapy: Antecedent Behavior Consequence (ABC), dolls therapy and snozelen therapy. Some staff comments: "Valued the service, CHIP is a much needed service in all care homesâ[euro]. "Training component was liked by all the staff who attended, more such formal training sessions are neededâ[euro]. "Staff felt more confidant in dealing with behavioral issues in dementia patients, they felt more supported by the regular follow up visitsâ[euro]. "Continuity of patient care is maintained and regular follow ups will keep a check on medication specially anti psychoticsâ[euro].
Conclusions: Antipsychotic use in care homes is high and there is need for regular monitoring of these medications. Care home staff need regular support from a specialist in reach service which could be delivered by the extension of existing CMHT models. The need for psychiatrists, psychologists and psychiatric nurses as part of in reach service is vital as it instills confidence in the care home staff to manage difficult behaviours. Education, awareness, teaching and training of care home staff is needed. Various non-pharmacological

approaches for BPSD management must be tried as the evidence for only one model of treatment is not robust. It is possible to reduce number of referrals from the care homes, monitor medication side effects and improve confidence of care home staff in managing patients with BPSD by providing in reach service as a team. More empirical research with appropriately powered studies is needed in this area to draw conclusions of its long term effectiveness.

PS01.55

Perspectives on physical activity programs for older adults with and without cognitive impairment (FABSQual: Fitness for the Ageing Brain Qualitative Study)

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Overview: There is increasing research evidence to support the benefits of physical activity on improving, protecting or slowing deterioration of cognition in older adults. The purpose of this paper is to describe: (a) the attitudes, beliefs and barriers towards physical activity of older adults with and without cognitive impairment and (b) their opinion of the attributes of the ideal physical activity program. Eight focus groups and four individual interviews with a total of 50 older adults aged from 62-92 years (mean age 73 years) with no cognitive impairment (n = 14), subjective memory complaints (n = 19), mild cognitive impairment (n = 6) and Alzheimer's disease (n = 11) were conducted. Eighty-six percent of our participants currently exercise regularly. This was a stratified purposive convenience sample that was recruited from participants in the Australian Imaging Biomarkers and Lifestyle Flagship Study of Ageing (AIBL). Transcribed results were analysed thematically with the aid of the NVivo software program. The analysis focused particularly on investigating similarities and differences between participants with and without cognitive impairment. Confirming previous research, this study found that older adults generally had a positive view of physical activity and believed that physical activity was beneficial to cognition. Barriers to physical activity were similar to previous research including "physical problems/disabilityâ[euro], "motivation/personalityâ[euro] and "environmentâ[euro]. Participants preferred to find out about physical activity programs through advertising or their general practitioner. Generally, they did not mind who they exercised with, but they emphasised that the setting, type of exercise, frequency, duration and cost needed to be tailored to the individual. In particular, respondents indicated that cost should be "tailoredâ[euro] or "subsidisedâ[euro] given the benefits of the program to the individual and society. Some preferences and themes were more prominent for participants with cognitive impairment. These included the barriers of "memoryâ[euro] and "lack of companionâ[euro]; memory problems and lack of somebody to assist makes participating in a program more difficult for someone with cognitive impairment. There was also a preference for "accessibleâ[euro] settings and "simple/light/safeâ[euro] activities. Additionally, females were more likely to emphasise the importance of social aspects of physical activity which is consistent with previous research. Whilst there has been research into physical activity in older adults, there has been little research specifically addressing this with cognitive impairment. This study provides important insights into the attitudes, beliefs, barriers and types of physical activity program for older adults, particularly from participants with cognitive impairment. This information can be used to inform further research, including investigating the perspectives of carers and families. Ultimately, it can be used to guide efforts to translate research evidence of

the benefits of physical activity, specifically for cognitive and mental health, into population wide programs for older adults with the potential for significant public health benefits.

PS01.56

Predictive factors for the objective burden of informal care in people with dementia: A systematic review

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Background: Informal care plays a substantial role in the provision of total care in dementia. Informal caregivers often experience subjective and objective burden. Subjective caregiver's burden refers to how an informal caregiver experiences the caregiving task and how informal caregiving is influenced by characteristics of the patient (such as behavioural or cognitive problems), characteristics of the caregiver (such as gender and age) and the social context (such as social support and family help). The objective burden of caregivers refers to aspects like the amount of time spent on caregiving and the type and number of caregiving tasks that are performed, which may significantly affect the costs related to informal care. Several reviews have been published concerning predictive factors of subjective burden; however, such a review is lacking regarding objective burden.

Objectives: 1) To give an overview of the predictive factors that are associated with the objective burden of informal care; 2) to discuss whether these factors are similar to the predictive factors of subjective burden; and 3) to examine whether they are influenceable. Design Literature was systematically searched in a number of international databases. Two independent reviewers scored titles, abstracts and full articles. Methodological quality and level of certainty were assessed.

Results: Ten studies were identified as relevant for the purpose of this review. A total of 39 predictive factors were described in these studies. Three factors (behavioural problems, (I)ADL-impairments and cognition) were considered to be predictors of the objective burden. Three factors were not related, 12 were potential predictors and the results of the remaining 22 factors remain inconclusive due to a lack of evidence (n = 19), or contradictory findings (n = 3). Conclusion Objective burden is associated with a variety of factors, reflecting its complex nature. Objective and subjective burden are two different relevant aspects of informal care and it is important to distinguish between them. Interventions aimed at countering behavioural problems and (I)ADL-impairments could reduce objective burden.

Future plans: Based on factors emerging from the review, construct validity and responsiveness for several different methods to measure and value informal care will be examined. The results of this study will provide us with more insight regarding the best method for the measurement and valuation of informal care in patients suffering from dementia or another cognitive disorder and their caregivers.

PS01.57

The features of verbal and visual cognitive impairments in mild to moderate semantic dementia

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Background: Semantic dementia (SD) is a clinical syndrome due to marked focal atrophy in the anterior, bilateral, though usually asymmetrical temporal lobes, characterized with selective degradation of semantic knowledge. With regard to features of the language disturbance in SD, word-finding pauses and semantic errors may be prominent with preservation of syntactic constructions1). However, there are a few studies about the features of cognitive impairments from the viewpoint of asymmetrical temporal lobe atrophy.

Objective: The aim of this study is to compare features of cognitive impairments between in mild to moderate SD patients with predominantly left temporal lobe atrophy (SD-L) and with predominantly right temporal lobe atrophy (SD-R), using standard cognitive tasks.
Method: Participants: Study participants were 7 SD-L cases (mean age; 69.1 years, female/male; 4/3, mean education; 11.4 years, mean MMSE score; 13.9, CDR grade 0.5/1/2; 3/4/0) and 5 SD-R cases (mean age; 69.0 years, female/male; 3/2, mean education; 11.6 years, mean MMSE score; 20.2, CDR grade 0.5/1/2; 1/3/1). They were selected on the basis of inclusion and exclusion criteria from the patients who had been given a medical examination at Dementia Clinic of Kumamoto University Hospital. All of these patients were examined by senior neuropsychiatrists and were given routine laboratory tests and neuropsychological examinations. In addition, MRI or CT, and SPECT were done. The inclusion criteria of SD was based on the consensus criteria for frontotemporal lobar degeneration (FTLD) 2).
Assessment: We assessed their semantic memory by using verbal tasks including naming, picture-word matching, repetition task (single-word, sentence), reading aloud of proverb (complete sentences, meaning), and visual tasks including face recognition (naming, pointing), famous buildings recognition (naming, pointing), and assessed their working memory by digit span (forward and backward) and arithmetic.
Result: There were no significantly differences in the scores of all verbal tasks, although the scores of SD-L were lower than those of SD-R. The score of SD-L group was significantly lower than that of SD-R only in the sentence repetition performance ($p = .004$). In visual tasks, only famous buildings recognition showed significant higher score of SD-L groups than SD-R group (p

PS01.58

Psychotropic drug prescription in nursing home patients with dementia: Influence of environmental correlates and staff distress on physician's prescription behavior

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Introduction: Psychotropic drugs are frequently used for the treatment of neuropsychiatric symptoms (NPS) in nursing home patients with dementia. The efficacy of psychotropic drugs in patients with dementia is questionable, with potentially harmful side-effects. Thus, it is important to know why psychotropic drugs are prescribed at such high rates. Psychotropic drug use (PDU) have been found to be associated with the degree of NPS. 1)
Objective: The aim of the study was to examine whether staff distress and aspects of the nursing home environment were associated with PDU in patients with dementia.
Methods: Cross-sectional study in 1289 nursing home patients with dementia (n = 1289), from 56 Dementia Special Care Units (SCUs) in the Netherlands. Patients with dementia according to DSM-IV criteria were included. The primary outcome was PDU, which was classified using the Anatomical Therapeutical Chemical classification. Potential correlates of PDU were staff distress, environmental correlates (i.e., the number of patients per unit or per living room, staff:patient ratio, and the presence of a walking circuit), and patient factors (i.e., gender, age, dementia severity, and NPS). Multilevel logistic regression analysis was used to estimate the relative contributions of predictor variables in explaining PDU psychotropic drug use.
Results: SCU rates of overall PDU were 66%, and for individual drug classes were 37% for antipsychotics, 28% for antidepressants, 16% for anxiolytics and 15% for hypnotics. PDU differed considerably between SCUs: 36-94% of all patients were on some psychoactive medication, 7-69% on antipsychotics, 0-53% on anxiolytics, 0-57% on hypnotics, and 8-52% on antidepressants. Nurses often experienced symptom related distress if patients were agitated (532/756 patients = 70%) and less frequently if patients were apathetic (143/431 patients = 33%). Staff distress, aspects of the physical nursing home environment and patient's neuropsychiatric

symptoms were independently associated with PDU. Staff distress of patient's agitation was associated with antipsychotic and anxiolytic drug use (OR 1.66, 95% CI [1.16-2.36] and 1.62, [1.00-2.61], respectively). SCUs with more patients per living room had higher hypnotic drug use (OR 1.08, 95% CI [1.02-1.14]). Low staff:patient ratio was associated with high antidepressant drug use (OR 0.13, 95% CI [0.04-0.47]). The effects of nursing home environment on study outcome were smallest for antidepressant use (intra-SCU correlation 0.005) and highest for hypnotic use (intra-SCU correlation 0.171).

Conclusions: Staff distress and other environmental aspects are independently associated with PDU. Antipsychotic and anxiolytic drugs were more often prescribed to agitated patients if its staff were distressed compared to staff reporting no significant distress. Antidepressant drug prescription was related to patient factors and the number of staff per patient. Hypnotic drug prescription was, to a lesser extent, explained by NPS but was more strongly associated with the number of patients per living room. These findings raise questions about the appropriateness of psychoactive drug prescriptions in nursing home patients with dementia. Staff education aimed at increasing their knowledge of potentially harmful adverse effects of psychotropic drugs would be an effective intervention to ultimately reduce the inappropriateness of psychotropic drug prescription.

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PS01.59

NPI-NH factor structure in nursing home patients across countries

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Background: Neuropsychiatric symptoms - frequently present in patients with dementia - is an umbrella term for a variety of symptoms such as aggression, psychosis, agitation, apathy, and depression. Neuropsychiatric symptoms can be measured with the Neuropsychiatric Inventory (NPI), a rating scale with 12 neuropsychiatric symptoms, for which different versions are available for different settings. Several factor analytic studies have been conducted in various settings (hospitals, within the community and long-term care institutions) over a wide range of countries with different symptom clusters as a result. This inconsistency may be related to different samples in various countries with different types of dementia, severity of cognitive decline, and rates of psychotropic drug use. In the European Alzheimer Disease Consortium, it has been tried to combine NPI data of dementia outpatients samples across different countries, resulting into four symptom clusters: hyperactivity, psychosis, affective symptoms, and apathy (Aalten et al., 2007). The purpose of this study is to examine the Neuropsychiatric Inventory-Nursing Home Version (NPI-NH) factor structure in aggregated Norwegian and Dutch samples of nursing home patients with dementia.

Norwegian and Dutch samples of nursing home patients

Abbreviations: GDS = global deterioration scale, CDR = clinical dementia rating scale, MMSE = mini-mental state examination, SIB-s = severe impairment battery- short version, NPI-NH = neuropsychiatric inventory-nursing home version.

Methods: Study population: 4216 participants from different study cohorts of 1612 Dutch elderly (Waalbed-1, Waalbed-2) and 2604 Norwegian elderly (PSiN, ReDiN, CoMiN). All patients resided in nursing homes and had a clinical diagnosis of dementia, established with either DSM-IV-TR criteria or Clinical Dementia Rating Scale (CDR> 0.5). Neuropsychiatric symptoms were measured with the NPI-NH across dementia stages. The NPI-NH

includes 12 symptoms: delusions, hallucinations, agitation, depression, anxiety, apathy, irritability, euphoria, disinhibition, aberrant motor behaviour, night-time disturbances, and eating abnormalities. The measurements of baseline characteristics, dementia type and stage, and psychotropic drug use vary among datasets (see table 1). Data-analysis: The factor structure of the NPH-NH was evaluated using exploratory factor analysis (in SPSS). Factors with eigenvalues >1 were extracted and orthogonally rotated to achieve a simple structure (varimax rotation). Items with factor loadings (a measure indicating correlation) >0.4 were considered to be relevant. The highest factor loading of a particular NPI-NH item determined to which factor the item was assigned.

Results: Results of the factor structure will be presented at the IPA congress.

Discussion: To our knowledge, this factor analytic study is based on by far the largest nursing home sample, allowing for comparison of symptom associations across countries. Knowledge about the underlying behavioural dimensions is useful for further categorization of symptoms, which may have important pharmacological treatment implications.

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PS01.60

Prospective study on the use of rivastigmine patch in Alzheimer's dementia in routine clinical setting

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Overview: In this naturalistic longitudinal observational study we wanted to evaluate the safety, tolerability and efficacy of the rivastigmine patch in patients with early and late onset moderate Alzheimer's dementia (AD) in routine clinical setting. This study was conducted in the department of old age psychiatry at Shelton Hospital; Shrewsbury. The rivastigmine patch is the first trans-dermal treatment for probable Alzheimer's disease and dementia associated with Parkinson's disease.

Methodology: We had all patients diagnosed with moderate dementia of Alzheimer's type according to ICD10 (International Classification of Disease, 10th edition) and as laid down by NICE (National Institute of Clinical Excellence) guidelines. We undertook review of patients at baseline and then at intervals of 3 and 6 months and aimed at least 2 assessments for each patient. Each review consisted of making an assessment of improvement on global, functional and behavioural domains using MMSE (Mini Mental State Examination), BADLS (Bristol Activities of Daily Living skills) scores, patient and carer feedback and clinical judgement. We collected data over a period of 18 months from May 2008-October 2009, from first 30 patients with a diagnosis of moderate Alzheimer dementia, who were started on rivastigmine patch. 29 patients were newly diagnosed with Alzheimer's disease. Our sample comprised of 33% (n = 10) of early onset (median age 59.5, range 52-64 yrs) and 67% (n = 20) late onset (median age 79, range 65-88 yrs) Alzheimer's dementia. 53% of participants were women. Our primary outcome measure was safety and tolerability measured by incidence of adverse events and discontinuation due to any reason. As secondary outcome measure, we examined overall relative improvement on global, functional and behavioural domains.

Summary of Results: 1. Adverse events were reported in 6 (20%) of the patients. 2. Treatment discontinuation was needed in 3 (10%) patients due to adverse events. 3. Patch site skin reaction was observed in 3 (10%) patients and 2 of them needed discontinuation of patch. 4. Overall relative improvement in cognitive functioning was observed in 20 (66%) patients whereas 10 (34%) patients showed a relative decline. Discussion: A patch formulation of rivastigmine produces dual inhibition of acetyl cholinesterase (AchE) and butyrylcholinesterase (BuchE) and offers many potential advantages over oral formulation. It helps to avoid the rapid fluctuations of plasma drug concentration over 24 hours providing a smoother pharmacokinetic profile. This mechanism of

drug delivery has several other benefits to patients and carers, such as: (a) Simple one step titration to the maximum dose with convenient once daily dosing (b) No requirements for the patients to swallow or take medication with a meal, hence being convenient to patients with swallowing problems. (c) Visual reassurance to carers that the medication has been administered, thus improving compliance. (d) Shows good overall adhesiveness and skin tolerability when used on upper back, chest or upper arm whereas thigh and abdominal application appear to provide lower plasma levels although highest patch adhesiveness. (e) A simple treatment option for patients with multiple medications making one less number of tablets. Clinical trial has already shown that caregivers of Alzheimer's disease patients prefer rivastigmine patch to oral treatment. Our clinical experience suggests that the most common form of skin reaction is erythema caused by removal of the patch which normally resolves after a short period of time. Therefore it is recommended to rotate the daily application site to minimize skin irritation.

Conclusion: Rivastigmine patch may provide a treatment option for those patients who require a change in their current oral cholinesterase inhibiter therapy due to either safety or tolerability concerns. Patch form may also provide a treatment option for those patients who require a change in their current oral cholinesterase inhibitor therapy due to safety or tolerability concerns.

Conflict of Interest: This study is independent of any industrial (pharmaceutical) influence and was not funded. However findings have been presented at the educational meetings sponsored by Novartis Pharmaceuticals with honorarium paid to one of the authors.

Note: This study has been published as Original Article in Dement Neuropsychol 2010 September; 4(3): 245-249.

PS01.61

Canadian Dementia Knowledge Translation Network (CDKTN): Improving the quality of life for those with dementia and their care partners through exchange and translation of knowledge and research

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Background: The current health care systems are increasingly challenged and family members are struggling in their roles as caregivers during this time of escalating numbers of people with dementia. Often informal care partners, or those unfamiliar with dementia, have little understanding of the symptoms and behaviour to expect. An additional challenge for both formal and informal care partners, of individuals with dementia, is timely access to research-based evidence, practices, services, resources and supports within their communities. A great deal of quality dementia-related research has been and continues to be conducted. To facilitate effective knowledge translation, the Canadian Dementia Knowledge Translation Network (CDKTN) was established as a network for making users aware of knowledge and facilitating its use to improve the health of Canadians suffering from Alzheimer's Disease and dementia. CDKTN helps researchers, students and practitioners translate their work into practice and pass it on to those who need it most - patients, families and care partners. At the Canadian Dementia Knowledge Translation Network (CDKTN), members strive for creative ways to approach and engage researchers and knowledge users so research is translated into effective care strategies and best practices. These knowledge translation (KT) activities provide opportunities for individuals to explore their awareness of Alzheimer's disease to increase their understanding of disease symptoms, best practices and supports.

Methods: CKDTN members provide the vehicle for identifying and resolving gaps between research and practice, prevention, treatment, care and support. Three areas of focus include: Education and Training in Knowledge Translation which develops specific training programs that bridge knowledge and training gaps, while complimenting existing models. Dementia Resource and Knowledge Exchange targeting frontline professionals across a clinical-policy-social spectrum and focusing on knowledge exchange and sharing of dementia resources among national network partners. Person and Care Partner Centred Knowledge Translation focused on improving the quality of life for persons with dementia, their families and care partners This sharing of knowledge and resources, linking people and ideas enables CDKTN to engage in a dynamic

and interactive relationship in which research is enriched by input from knowledge users. Knowledge users are engaged and actively involved in both the research and the KT&E process, from the identification of research priorities to the translation, exchange, use and evaluation of new knowledge generated by research. By bringing together researchers, students and practitioners, CDKTN helps researchers translate their work into practice and pass it onto those who need it most - Patients, families and care partners.

Results: The latest results are a collection of stories about real people in our communities, defined by dementia and Alzheimer's Disease that provide real insight and focus on providing persons with dementia and their care partners access to timely knowledge. This knowledge empowers them to use new care techniques, by sharing experiences and posing questions they want answers to. Building and not duplicating on existing scientific, clinical and social excellence in partnership with the Alzheimer Society of Canada, the knowledge translated for the user community includes: - Music and lyric development: Songs by local song writers/musicians describing dementia behaviour, symptoms, challenges, treatment development. - Video: Stories describing the development of dementia treatment, work and life of a leading Geriatrician - Brochure: "Staying Active in Later Lifeâ[euro] describing the benefits of exercise and healthy living - Filmed narratives for web content: Describing personal family experiences at various stages of Alzheimer's and the disease symptoms (French and English films)

Conclusion: CDKTN's application of research findings for new KT approaches stimulate discussions of how research can be effectively utilized to become part of dementia care that supports and improve the quality of care for people with dementia, their families and other partners in care.

PS01.62

Essential patient characteristics required for a computer model of dementia management

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Background: Randomised controlled trials have long been used as a primary tool for investigations in medicine and health sciences. However with recent advancements in computer technology the prospect of conducting virtual experiments became quite realistic. This virtual approach could bring not only savings in time and money but also offer environment in which large number of plausible scenarios regarding impact of therapeutic interventions could be tested without usual limitations of randomised controlled trials (RCTs). In order to build a computer model of dementia management in which virtual patients are the main active objects, we developed a blueprint for such patients corresponding to three main processes occurring in dementia: aging, cognitive decline and events associated with behavioural and psychological symptoms of dementia (BPSD).

Aim: Develop a comprehensive list of characteristics describing patients with dementia and associated behavioural and psychological symptoms. Evaluate the consistency and frequency in reporting of each of these characteristics and compare them with the requirements of our computer modelling framework. Provide recommendations regarding minimum datasets describing patient's characteristics in dementia research.

Methods: A detailed review of 110 published RCTs s on the management of dementia and BPSD was undertaken. Lists of RCT publications were obtained from references of systematic reviews. All sections describing the methodology and results of each paper were analysed by two independent reviewers. They examined each publication variables used to describe patients participating in the studies. A list of key concepts was created based on frequency and consistency of reported characteristics. Clusters of patient characteristics were presented in a form of hierarchical concept map and visualized as a network graph.

Results: Reported characteristics of patients with dementia were spread very unevenly in published literature.

Socio-demographic characteristics such as age and gender were reported most consistently but current place of living was reported in only 25 % of publications. Other characteristics such as level of education or marital status were also inconsistent (31% and 11% accordingly). Surprisingly, characteristics which may be considered essential descriptors of the person with dementia such as duration of dementia or age at onset were only reported in 23% and 12% of publications. Age when the patient was first diagnosed with dementia was provided only in 8% of RCTs. A large number of health related characteristics were reported infrequently and some of them were only remotely related to any of the three dimensions of the model, which were aging, cognitive decline and BPSD. That included height, income and blood pressure. Important health variables such as comorbid conditions, history of depression or chronic health status were provided infrequently (13%, 10% and 5%). Furthermore, there were only a limited number of studies (one in three) which reported changes in patient's characteristics over time.

Conclusion: Even well designed randomised controlled trials provided limited reporting in regards to key patient's characteristics. Differences in reporting made RCTs difficult to compare and to generalize. Therefore interpretation of outcomes of RCTs may be difficult due to inability to generalize such outcomes to other groups of patients and environmental settings. A minimum dataset should be considered in reporting dementia research.

PS01.63

Services to people with early onset dementia (EOD) and their families

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Overview: In 2008 The Ministry of Health and Care Services presented a Government's Dementia Plan for Norway containing strategies as well as specific initiatives for the period until 2015. The Dementia Plan is based on recognition that current care services are inadequately developed and adapted to persons with dementia. This means that in the coming years changes within the care services are necessary in terms of skills, organization and physical form. The Dementia Plan consists of projects concerning various user groups and topics, including: - Schools for family caregivers and support groups - Day program for persons with dementia - Evaluation and diagnosis -The usefulness of milieu therapy and milieu treatment - Persons with minority language backgrounds who develop dementia - Persons with dementia with a Saami background - People with early onset dementia with dementia The Norwegian Centre of Dementia Research was asked to carry out the three year developmental program (2009-2011) for people with early onset dementia and their families. An earlier Norwegian study showed that with a few exceptions there are no suitable services available for persons with early onset dementia and their families. The reality for most families is a public service system that doesn't take responsibility and offer help (Haugen, 2006; Rosness, Haugen og Engedal, 2008). The objective of the program is to learn more about the stress experienced by children and spouses of younger persons who develop dementia, survey and implement measures that gives spouses and children more accurate information about dementia disorders and develop appropriate models for evaluating and following up younger persons with dementia. The program is to contain a survey and evaluation of experience in Nordic countries with various forms of group-based services, day programs and round-the-clock services specially adapted to younger persons with dementia, compile data on children and adolescents with a parent with dementia and find out which measures improves the quality of life of the family. Furthermore, the program is to contain a test of assistive devices for younger persons with dementia. The program consists of four projects: - Interviews with 25 persons with early onset dementia, 50 spouses and 25 children covering topics of: experience with and evaluation of the service, psychological and social challenges and emotional stress and burden. - An evaluation of models for diagnosing early onset dementia in the specialist health service. - A survey of experiences in Norway with various forms of group-based services, day programs and round-the-clock services specially adapted to people with early onset dementia. - Test of assistive devices for persons with EOD. Conclusions Our study shows so far that with a few exceptions there are not suitable services available for younger persons with

dementia and their families. There is a need for better coordination between the specialist health service and municipal health and care services to provide respite care. It is particularly important that the specialized health care are involved in counselling and support to the persons with dementia and the caregivers in the early phase of the disease.

PS01.64

A study on the effectiveness of a psycho-educational group intervention for Asian family caregivers of clients with dementia

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Background: With an increasing life expectancy, the number of people suffering from dementia in globally will rise to about 115.4 million by 2050. It is projected that in the 21st century the majority of the world's older people will be living in Asia. Aim of the study: To examine the effectiveness of a psycho-educational group programme in helping family caregivers of clients with dementia to cope better with caregving, when compared with routine community care.

Design: A randomized controlled trial. Setting and subjects: 76 family caregivers who are primary caregivers of persons with a diagnosis of dementia at mild to moderate stage were recruitd from the community centres in Singapore. Interventions: Control group: Participants receive usual outpatient services and community services .

Experimental Group: Participants receive usual care plus a 24-hour psychoeducation programme. Outcome measures: Data were collected at the baseline, 3-month, and 9-month after the intervention by the following instruments: * Family Burden Interview Schedule * Family Crisis Oriented Personal Evaluation Scales * General Self-efficacy Scale * World Health Organization Quality of Life Scale-Brief Version * General Health Questionnaire * Social Support Questionnaire * Modified Family Support Services Index Data analysis: Repeated measures MANOVA for differences of outcomes between the two groups in: the pre-test and 3 post-test mean scores (i.e. measured immediately, 3 months and 9 months after intervention); and post-hoc comparisons for results of those with significant differences between groups.

Discussion &Conclusion: The presentation will highlighted the preliminary findings of the study. This presentation will also examine the global issues of family caregiving for older persons with dementia from an Asian perspective, and the specific way that culture could influence family caregivers' burdens which could play an important part in the development of a holistic model for family-centred care. The results of this study can inform health professionals whether this model of intervention can be effective in helping families of clients with dementia. An effective community care of clients with dementia needs to involve healthy family members as carers.

PS01.66

Structure of mental dysfunction in elderly subjects with dementia residing in nursing homes: An analysis using the mental function impairment dcale

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Background: Currently, little is known about the relationship or interactions between various mental dysfunctional disorders and other simultaneously occurring dysfunctions in elderly subjects with dementia. A clearer understanding of this may help to ameliorate the disorderly structure of this condition and help predict ways to cure and care for those affected. The present study characterized the structure of mental disorders according to the level of severity, the affinity, and how they are influenced by various mental disorders in elderly subjects with dementia.

Participants: Study participants included 33 elderly subjects with dementia (mean age, 81.5±7.5 years) with no other complications or mental diseases who resided in nursing homes.

Methods: The Mental Function Impairment Scale (MENFIS) was used as an indicator, and included scores for cognitive dysfunction (7 items, as follows: temporal disorientation, locational disorientation, short term memory

(STM), long term memory (LTM), judgment, expression of intentions, and conversation comprehension dysfunctions), motivational disorders (3 items, as follows: spontaneity, vigor, and interest dysfunctions), and emotional disorders (3 items, as follows: stability, propriety, and multiplicity dysfunctions). I employed the MENFIS to interview at least two care workers or nurses who cared for the participants on a daily basis. Scores were analyzed by ANOVA, multiple comparisons (Ryan's test), cluster analysis (Ward's clustering method) and multiple regression analysis (stepwise method, adjusted R-square >0.50).

Results: Cognitive dysfunctions were grouped into a cluster including STM dysfunction and disorientations as well as a cluster including judgment, conversation comprehension, expression of intentions, and LTM dysfunctions. Emotional disorders were grouped into a cluster including stability and propriety dysfunctions. Motivational disorders were separated into spontaneity and vigor dysfunctions. In addition, multiplicity (emotional disorder) and interest (motivational disorder) were grouped as a mixed cluster. The most severe cognitive dysfunctions were STM dysfunction and temporal disorientation.

PS01.67

Mood disorder and cognitive impairment of hospitalized elderly: Predictors of their functional decline?

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Overview: This prospective cohort study set-out to examine the presence of a mood disorder (anxiety and depression) and cognitive impairment of older adults hospitalized in acute medical wards and their effect on functional outcome. The study was performed in a 900-bed teaching hospital in Israel and 417 older (≥70) (mean age of 78.6) patients hospitalized for a non-disabling condition were studied. The outcome of functional change at one month post-discharge from pre-morbid baseline was examined. It was hypothesized that those with cognitive decline A regression model was examined to predict the factors for the change in function controlling for demographic and health characteristics, presence of a mood disorder, functional status prior to admission and cognitive impairment detected during hospitalization. At time of admission, using the cutoff score of 8/10 on Pfeiffer's SPMSQ, 27% were found to have some cognitive impairment. However at discharge, now using the MMSE instrument which is a broader screening instrument for cognitive assessment and using a score of less than 24/30 defining cognitive impairment, 55% percent of the subjects were found at discharge to have cognitive impairment. With regard to mood disorder, 26.3% had anxiety defined by a score of ≥24/40 on Short Anxiety Screening Test and 16.4% were diagnosed with depression with a score of ≥70/100 on the Short Interviewer-assisted Depression Rating Scale. The average pre-morbid Barthel Index (BI) score was 88.4, indicating minor to moderate dependency. However at discharge the average BI had dropped to 64 indicating functional dependency. 95.4% had a decline in their function at discharge from pre-morbid state and after one month BI had increased to mean of 76 but still 94.5% had continuing decline in function. The regression model showed that as expected the pre-morbid ADL function was the main predictor of dependency after one month and explained 43% of the variance but cognitive impairment also explained some 7% of the variance and finally the Charlson's co-morbidity index added another 5% to the model. This study reinforced the fact that many of elderly admitted to hospital have some cognitive impairment and showed that further cognitive decline occurred during hospitalization. Complicating this is the known fact that the medical staff often misses the diagnosis of cognitive decline/impairment in elderly in-patients. This then becomes a major factor in the discharge plan when one realizes that prior to admission 85% of subjects were living at home, usually with their spouses or families.

PS01.68

Examining the usability of a new software technology platform for cognitive and physical training in elderly

people with and without cognitive impairment

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Introduction: Globally, the number of healthy older adults, elderly with cognitive impairment and with dementia is projected to significantly increase, both in terms of overall numbers and as a proportion of the population. United with the substantial amount of care this population requires, computer-based interventions become a promising solution to maintain and improved wellbeing with few professional and technical requirements. Long Lasting Memories (LLM) is a newly integrated ICT platform which combines cognitive exercises with physical activity in the framework of advance technologies. Cognitive exercises are provided by GRADIOR specialised software and physical training is based on FitForAll, a game platform that permits exercise through the Wii Balance Board low-cost platform. Although further applications for older adults have been designed, few of them have been analyzed in terms of their usability in elderly population with and without cognitive impairment.
Objectives: To analyze the usability of LLM cognitive (Gradior) and physical training applications in Spanish population. Method: 80 elderly recruited from a residential facility consented to participate in a pilot test of the cognitive and physical intervention LLM platform. 40 non-demented elderly, 22 subjects that met the DSM-IV criteria for Mild Cognitive Impairment and 18 who met the criteria for dementia (mean age = 75,9 years, SD = 8,4, age range = 60-92 years) received 1 hour of physical training and 35 minutes of cognitive training, 3 times a week, during 12 weeks program. At 8 week intervention they were assessed trough a specifically designed questionnaire that included aspects of their perception of the platform. A descriptive study of the results was performed.
Results: 73,33 % of the participants perceived LLM platform as beneficial (60%) to very beneficial (13,33 %)for them. 91,1% reported they enjoyed (58,62%) and totally enjoyed (34,48%) the sessions. 63,33% of the participants found the instructions of the software clear (20%) to very clear (43,33%) and understandable, but 40% of them expressed that was difficult (36,67%) or very difficult (3,33%) to learn how to use LLM and 56,67% perceived the platform as difficult (40%) to very difficult (16,67%) to use without help; Nevertheless, all the participants expressed they would be able to use the program alone if they have it at home. All the users agreed they would characterize LLM software as "warm and friendlyâ[euro] and would recommend the program, 70% reported that it met (56,67%) to totally met (13,33%) their expectations and the majority of them indicated they wish to continue using the platform after 12 weeks study.
Discussion: Primary results, supported by participant's perception of the platform over the trials, indicate that healthy elderly and older adults with mild to moderate impairment could be benefited by LLM cognitive and physical training software. Reviewing aspects of usability have significant implications in the development of new computer-based programs, helping in the design of an effective technology method, which improves mental skills in elderly population.

PS01.69

Symptom profiles of people seeking online dementia information prior to a dementia diagnosis

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Background: SymptomGuide(TM) is a web-based profiling tool that is used to identify the symptoms that are troublesome to a patient and then each symptom is tracked over the course of their dementia. Since its launch in 2007 until January 4, 2011, 989 online users have built symptom profiles and 364 users indicated the profilee had no diagnosis of dementia. It is well recognized that dementia remains under-diagnosed, especially at its mildest stages. The profile of needs of these patients is not well understood. Many people now go online to seek information about dementia, representing a possible means of understanding profiles of need.

Methods: The website www.demenitaguide.com offers the use of SymptomGuide(TM) which provides information on 61 dementia symptoms and the corresponding hundreds of plain-language descriptors that are easily understood by patients, families and caregivers. Here we describe caregiver-reported symptoms for website users in relation to a validated staging algorithm.
Results: Of 989 SymptomGuide(TM) users who completed symptom profiles, 364 (37%) reported that the person they cared for had not been diagnosed with dementia. Of these 364, a staging algorithm could not classify 45 patient profiles (12%; chiefly due to too few symptoms having been reported). Of the remaining 319, 168 profilees (46 % of the 364 who were without a diagnosis) met a profile compatible with "Cognitive Impairment - No Dementiaâ[euro] of which the most common subtype was "Mild Cognitive Impairmentâ[euro] (N = 118; 32% of the profiles of people not diagnosed with dementia). Amongst the 151 people in whom no dementia diagnosis was reported (41% of the no diagnosis group), 128 (35% of those reporting no diagnosis) had mild dementia. The remaining 23 profiles were chiefly compatible with moderately severe dementia. People who were reported to have dementia were equally likely to have been women (61% vs. 66%) but were older (75 ±12 years vs. 69 ±15 years).
Conclusions Amongst people who have caregivers sufficiently concerned about their cognitive functioning to complete a detailed online profile of symptoms, almost half appear to have dementia, chiefly mild dementia. An approximately equal proportion have mild cognitive impairment. Such opportunities as may exist to retard symptomatic disease progression in such people are hampered by the absence of a diagnosis.
PS01.70
The dementia workforce: Patients and carers views on workforce skills
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Background: As part of a project to map the education available to the dementia workforce and to develop core competencies for the dementia workforce in the West Midlands, United Kingdom, we carried out a consultation exercise with people with dementia and their carers about their perceptions and experiences of workforce skills. A member of the team attended four face to face meetings with users and/ or carers: two cafés, a carer support group and a memory group (attended by people living with a dementia). Two people living with a dementia were interviewed in greater depth. This work was commissioned by the Workforce Deanery of the West Midlands Strategic Health Authority and the full project report 'Final report: NHS West Midlands Clinical Care Pathways Project (Dementia) May 2010' is available at http://www.staffs.ac.uk/assets/NHS_west_midlands_clinical_care_pathways_project_250810_tcm44-32416.pdf. We report here on the consultation with patients and carers.
Method &Results: At the meetings people were asked to talk (or give written feedback) on the following four areas: * What skills have you found to be missing in people working with you? * What do you value in people from health and social care working with you? * What do you find people working with you from health and social care do well? * What do you find people working with you from health and social care do badly? In total 60 individuals contributed (58 at meetings and 2 in-depth interviews): 47 patients and carers contributed in cafés plus 11 carers at a carers group and 11 people with dementia at a memory café. Direct quotations were recorded in conversations. The two in-depth conversations were recorded and, where participants in the consultation preferred, comments were contributed in writing. 1. What skills have you found missing in people from health and social care working with you? 2. What skills do you value in people from health and social care working with you? 3. What have you found workers in health and social care do well? 4. What have you found workers in health and social care do badly? All the contributions were subjected to thematic analysis.
Discussion: We concluded that patients and carers have knowledge and expertise relating to the education and training of members of the dementia workforce and that ways of using their skills in workforce development

should be explored. Patients and carers bring distinct and important perspectives to our understanding of workforce skills. Their feedback highlights the importance of relationship-centred aspects of the care of people with dementia and their families. We also recommend the involvement of patients and carers at all levels in training and education related to dementia. This is very powerful and sends an important message to trainees/ students. Ways of involving and learning from both patients and carers should be explored and developed by all organisations providing training and education for the dementia workforce.

PS01.71

Impact of Alzheimer's disease into lexical semantic abilities

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Introduction: The slow and yet constant evolution on dementia of the Alzheimer type (DAT) has become the major problem of our society and the disorders in the lexical semantic abilities are often cited in the second stage of the DAT. Objective: The disorder or decline of these functions may have a profound impact on daily life activities. Therefore, this study aims to evaluate the decline of these processes experienced by DAT patients. **Methodology:** The research aims to exam this disease by submitting 20 DAT patients, at an early stage of illness, to cognitive tests, along with a longitudinal study of the control group with matched subjects. In order to test the "encoding and lexical semantic levelâ[euro] the "verbal fluency testâ[euro] was used (letter initial fluency and semantic fluency); "narrative discourseâ[euro] and "oral and written descriptive discourseâ[euro] and "nominationâ[euro] (classical and description according to the model nomination). In order to measure the "codingâ[euro], there were used "words listâ[euro]. In order to evaluate these exams, two levels of analysis were considered: a traditional approach (on the group) and an analysis on interindividual differences. For the statistical treatment we used the SPSS software 10,0 version; correlation, test X2 and ANOVAs were calculated.

Results: The statistical analysis made possible to categorize three types of patient groups showing a great heterogeneity among them. The DAT patients show a decline in lexical semantic abilities, especially under time limits and when the task is more complex thus requiring further attention. There is also an evidence of semantic loss, a loss of precise concepts and decline of executive function. The performance of DAT is better in the lexical evocation in the meaningful contexts and not time limit. The decline does not depend only on the person but also on the type the task (narrative or descriptive discourse), contexts (word with and without context) and aids (oral and visual).

Conclusion: The study of the results showed that the lexical semantic declines in the DAT are not only quantitative but also qualitative. The decline of encoding is generally lined to a disorder in the semantic organization, especially when facing complex information or when the information contains a lot of details, which worsens it under time limits. These declines show difficulty to access the lexical semantic stock that converts into an anomia affecting spontaneous expression on the DAT patients.

PS01.72

Person-centred care among nursing home patients: A 16 months single blinded randomised controlled intervention study

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Background: The prevalence of dementia in Norwegian nursing homes is about 80%, and most of the patients have dementia of moderate or severe degree. Neuropsychiatric symptoms such as agitation and aggression are common. Meta-analyses have shown that psychotropic drugs have limited effect in treating these patients. Thus, there is a need for knowledge of non-pharmacological methods of treatment and care for these patients, that can reduce agitation. Person centred care (PCC) The VIPS-framework (Brooker 2007) sums up PCC as it is described by Kitwood (1997): V- Value base that asserts the absolute value of all human lives I - An individualised approach, recognizing uniqueness P- Understanding the world from the perspective of the person

with dementia S- Promotion of positive social environment The VIPS-framework as a basis for discussion of concrete patient situations in staff meetings with a set structure, designated roles and a user manual is one of the two methods used in this intervention. The other method is Dementia Care Mapping (DCM) which uses observation based on PCC as basis for feed-back to improve care. Few randomised controlled studies have been carried out to study the effects of these two methods. One exception is the recently controlled intervention study by Chenoweth et al (2009) that showed a decrease in agitation using PCC as a method to reduce neuropsychiatric symptoms in nursing home patients. Our hypothesis is that both the VIPS-method and DCM will be more effective than an educational program about dementia in reducing agitation. The effect of using the VIPS framework and DCM will be equal. Design and methods This is a single blinded randomized controlled study in l4 nursing homes with 657 demented patients and their staff taking part in a 16 months intervention trial with 3 arms. After baseline measurements they were randomised at nursing home level to receive PCC using the VIPS methods, DCM or an educational program that consisted of six films of 25 minutes duration about different aspects of dementia. The study started February 8th 2011 and only demented patients with a Clinical Dementia Rating Scale (CDR) score of 1 and above are included. Effects in patients will be measured using the Brief Agitation Rating Scale (BARS), Neuropsychiatric Inventory (NPI-Q), Cornell scale for depression in dementia, Quality of life in Alzheimer's disease (QUALID), Clinical Dementia Rating Scale (CDR), physical self maintenance scale (P-ADL) and Lawton maintenance scale. Use of psychotropic drugs and diagnoses will also be measured. Effects at staff level will be measured by the PCC Assessment Tool (P-CAT), Stress of Conscience Questionnaire, Nordic Questionnaire for Psychological and Social Factors at Work in addition to age, gender, education and position in nursing home, type and size of wards. Preliminary results at baseline Baseline information were collected in 635 patients with mean age 86,6 (sd = 7,0), 67 % were women. Using the CDR assessment 7,8% had a score of 1 35,6% had a score of 2 49,1% had a score of 3. Mean scores: BARS 19.6 (sd 9.57) Cornell 7.5 (sd 5.1) QUALID 21.7 (sd 7.0) NPI-Q 3.6 (sd 2.5) P-ADL 18.9 (sd 5.5) After baseline measurements 219 patients were randomized to the VIPS-method group, 216 to the DCM group and 222 to the educational program group. The table shows the characteristics of the patients in the three arms. The patients of the 3 groups differ in scores regarding age, gender, BARS, Cornell, QUALID, NPI-Q, P-ADL and Cornell in these preliminary results.

Group differences

The patients of the 3 groups differ in mean scores regarding age, gender, BARS, Cornell, QUALID, NPI-Q, P-ADL and Cornell in these preliminary results.

PS01.73

Regional dementia networks: Development and evaluation

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Background &Objectives: To improve the quality of complex, multidisciplinary dementia care, a higher level of integration is needed. Therefore a program was launched setting up the infrastructure for integration of dementia care on the level daily care, the National Dementia Program. The present study investigates the impact of this program on quality and integration of care, work conditions, client centeredness of care and competences in dementia care as appraised by the professionals.

Research Design: Cross-sectional survey conducted in 2009.

Setting: Community care.

Participants: The study population consisted of healthcare providers (Nurses, general practitioners, specialists, social/spiritual workers, managers, elderly advisors, paramedics and volunteers) involved in dementia care from six regions participating in the National Dementia Program in the Netherlands.

Methods &Materials: Questionnaires were developed in order to assess improvements in: quality and integration of care (4 items), work conditions (5 items), client centeredness (14 items based on the community

care problem areas defined by the program) and collaborative dementia care competences: the 'Shared Competence in Multidisciplinary Dementia Care' questionnaire (19 items). For all six regions, data were collected at the end of the program. Data were analysed with SPSS 16.00.
Results: 205 questionnaires were sent.107 healthcare providers returned the questionnaires, an overall response rate of 43%. Participants experienced a major improvement in integration of dementia care and moderate changes in work conditions. Improvement in the client centered approach: 86% of the professionals reported improved familiarity with a number of clients' problems such as feelings of guilt and shame for having to call in additional help. Of these professionals, 40% found that the program helped them deal with these problems. Furthermore, 50% of these professionals reported improvement in their possibilities to refer clients. Our competence questionnaire showed that participants, especially nurses, appraised an improvement on their collaborative dementia care competences due to the program.
Conclusions: Professionals experienced a number of improvements in dementia care which they ascribed to the National Dementia Program: 1. quality and integration of care, 2. client centeredness, and 3. dementia care competences.
Key Words: dementia, integrated care, professional competences, client centeredness.
PS01.74
Implications of executive function and divided attention on the gait in patients with amnestic mild cognitive impairment and patients with Alzheimer disease
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Background: The march has been considered by many authors as a highly automated motion, which only required minimum levels of cognition. Therefore, few studies have addressed the altered forms of gait as a predictor of cognitive decline associated with neurodegenerative diseases that occur with dementia. In this sense, NINCDS - ADRDA for probable diagnosis of Alzheimer disease (AD) suggest that "the problems of movement and gait in patients in early stages of dementia, would point to a diagnosis uncertain or unlikely AD (1). However, recent studies have shown that patients with cognitive impairment (especially those with impaired executive functions) may present early clinical manifestations of alterations in gait and balance, showing a greater willingness to falls. Some studies suggest that walking speed decreases in AD patients while performing other tasks (verbal), which could be associated with attentional deficits.
Objective: Authors intended to investigate the relationship between deficits in executive functions and divided attention with gait (mobility, balance and falls) in patients with Amnesiac Mild Cognitive Impairment (MCI-A) and in patients with AD (CDR stage 1) and compared with participants without cognitive impairment, control subjects (CS). Method: 90 adults were studied after the protocol approval by the Hospital Ethic Committee (30 with DA, 30 with MCI - A and 30 CS). The psychiatrist and the neuropsychologist settle the final diagnosis together during a multidisciplinary meeting according to the diagnostic criteria of the 10th version of the International Classification of Diseases (ICD-10 (2)). The instruments for assessment used was: Mini Mental State Examination (MMSE) (Guerreiro et al., 1994), Clock Test (Cacho et al., 1999), Clinical dementia Rating (CDR) (3), General Scale of Golberg (4), WCST - Wisconsin Card Storting Test (5) Digit Span, Category Fluency Test, Berg Balance Scale (Berg et al., 1992), Time Up &Go Mod: (Mathias, Nayak, e Isaacs, 1986). For the control subjects we included FAQ - Questionnaire of Functional Activities (Pfeffer, 1982).
Results: Patients with AD have greater deficits in executive functions and in divided attention than patients with MCI- A, and these deficits are lower in older people without cognitive problem; Patients with AD has a greater deficit in gait than patients with MCI - A and these deficits are lower in older people without cognitive problems. Measurement of executive function and divided attention is particularly good at predicting falls and contributes to the existence of disturbances of gait and balance in patients with AD.

Conclusion: This study attempts to relate concepts of gait and cognitive function and it is part of a general concern for understanding the problem and its contours. Authors intend to examine and challenge the idea that walking is an automatic movement that does not require high levels of cognitive input, look for evidence suggesting that cognitive deficits.

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PS01.75

Dementia in the movies: Portrayal of professionals and life in an institution

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Background: Although dementia is affecting more than 30 million people worldwide, negative stereotypes about the consequences of dementia are still highly prevalent. Research shows that the general public's knowledge and beliefs about dementia need enhancement and that persons with dementia and their caregivers experience stigma. Stigma is also attached to nursing homes and those who work in them. It has been shown that the portrayal of psychiatric illnesses in movies and on television influences the public's perception and contributes to the stigmatization of these illnesses. Yet, little is known about the quality of the depiction of dementia in the movies, including the portrayal of professionals and life in an institution.

Aim: to study the portrayal of the professional environment of persons with dementia in recent motion pictures by considering the following questions: 1) how person-centered do professionals interact with and talk about the person with dementia, and 2) what institutional policies are displayed?

Method: Motion pictures were sought on the Internet Movie Database. Using the search terms 'dementia', 'Alzheimer's disease' and 'senility', the titles and keywords were searched up to March 1, 2010. Only movies released in or after 2000 were retained. Inclusion criteria were: 1) (possible) dementia is a theme, which is clear because it is mentioned in the movie; 2) there is interaction between the person with dementia and professionals; 3) the person with dementia is older than 65; 4) the movie is accessible for a large audience, which was operationalized as 'released in the USA and either the United Kingdom or the Netherlands'; 5) the movie could be obtained by the authors. This selection procedure resulted in 10 films: Son of the Bride, Iris, The Notebook, Aurora Borealis, Away from her, The Savages, Is Anybody There?, Choke, Black, and Diminished Capacity. Independently, both authors watched all movies, selected relevant scenes and described observational information; one of them literally wrote down the dialogue of the relevant scenes. After having seen each movie, the researchers independently scored behavior of professionals on the elements of positive person work and malignant social psychology, as follows from Kitwood's conceptual framework of personhood. Also, they noted displayed information about institutional policies. Then, they discussed their scoring and reached consensus on differences of opinion.

Results: 1) The ten movies contain positive as well as negative interactions, but more malignant strategies than positive person work. Positive Person Work: most movies show 'recognition'. 'Play' is also often seen. Malignant Social Psychology: the two most often shown aspects are 'infantilization' and 'objectification'. 2) This question was applicable in eight movies. In general, the material environment of the institutions shown is agreeable. Yet, five films show one or more extraordinary policies. For instance, in two movies the person with dementia is chained to his bed (in one of these even with an iron chain!). In another two the husband is forbidden to visit his

wife, which, in one of these, concerns the first 30 days of her stay. Also, in three movies, people with mild dementia live on the first floor. The second and third floor are mentioned as floors for 'the more progressed' and patients on these floors are shown sitting apathetic in wheel chairs, in their pajamas. The contrast with the first floor is sharp.

Conclusion: In most movies the depiction of professionals is twofold: all movies show positive person work as well as malignant social psychology aspects. In general, the latter seem to surpass the former. The depiction of institutions is double too. Although in most the atmosphere is rather good, five movies show negative stereotypes. The depiction of attitudes and behavior of professionals caring for older people with dementia is ambiguous and could be reinforcing stigma.

PS01.76

The utility of the social vulnerability scale as a predictor of financial capacity in dementia patients

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In legal terms, capacity refers to understanding, appreciation, reasoning, and expressing a choice - i.e. a person's ability to understand the nature and appreciate the effect of their decisions, freely and voluntarily make decisions and communicate the decision in some way. Management of finances is a complex instrumental activity of daily living that impacts on a person's independence and quality of life, and is therefore a crucial issue of autonomy for older people. However, determining the point at which an older person with cognitive impairment is no longer capable of managing their finances can be a difficult task for healthcare and legal professionals, and distressing for family members and friends involved [1]. Currently there is no gold standard assessment for evaluating financial capacity, and issues pertaining to the degree of impairment that constitutes incapacity remain largely unresolved. In addition, a variety of intra-individual factors that may influence ability to manage financial affairs have been largely ignored in the research literature. When the decisional capacity of an older person to live independently and manage their finances is questioned, capacity has typically been determined on the basis of neuropsychological assessment and clinical judgment. As the process of determining functional ability on the basis of cognitive test scores is inferential, this approach has significant limitations. Further, assessments have focused predominantly on memory and executive tasks which may not be sensitive to degeneration in other brain regions responsible for social cognition and emotion - namely the orbitofrontal cortex. Damage to this brain region can result in marked changes in personality and emotional reactivity, inappropriate affect, poor insight, and difficulty with pragmatics of conversation. Affected individuals may experience a significant breakdown in everyday social conduct, despite being able to continue to perform in the normal range on intelligence and executive functioning tests. Additional information pertaining to the older person's everyday behavioural functioning can improve the validity of the assessment beyond simple cognitive testing. Social vulnerability is an important salient issue for older people. The term social vulnerability refers to a person's degree of susceptibility to exploitation. Various factors can promote social vulnerability, particularly negative changes in social support, a need for social approval, or underlying personality characteristics. However, cognitive deficits associated with memory, executive functioning and social reasoning that result from dementia and stroke can significantly increase the risk of exploitation for older people [2]. The current study investigated the utility of the Social Vulnerability Scale-15 (SVS-15) [3] in a neuropsychological assessment battery as a predictor of intact financial capacity with a community sample of 56 healthy older people and a clinical sample of five (data collection underway) older adults with a diagnosis of dementia. The assessment

battery, designed with clinical practicality and ecological validity in mind, included the Financial Competence Assessment Inventory (FCAI), Addenbrooke's Cognitive Examination (ACE-R), and mood measures: Geriatric Depression Scale (GDS) and Geriatric Anxiety Inventory (GAI). Informant measures included assessment of instrumental activities of daily living, mood and social vulnerability. The SVS-15 is a fifteen item validated informant scale that assesses a person's perceived vulnerability to exploitation where higher scores are indicative of more vulnerability. Informants rate responses on a five-point scale regarding the frequency to which the person exhibits the specific behaviour, ranging from 0 (never) to 4 (always). Preliminary analyses for the healthy older people suggest that financial debt management (r = -.29), perceived (informant rated) psychopathology - severity of delusions (r = .27) and anxiety (r = .42), as well as the older person's self-reported mood (r = .32) were associated with increased social vulnerability. The five clinical cases are discussed in terms of how the SVS-15 relates to performance on a standard neuropsychological and financial capacity instrument. The current findings elucidate the degree to which social vulnerability relates to financial management in older people with and without cognitive impairment. We discuss the important implications of failing to consider social vulnerability in assessing financial capacity in those who may be at an increased risk for social and or financial exploitation.

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Elders who receive in-home health care compared to elders who receive social care

* Indep samples t-test, ** Chi-square

PS01.77

Promotion of activity program for elders with dementia in private residential care homes

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Background: Among 35200 elderly residing in private residential care homes for the elderly (PRCHEs) in HK, around 32% are suffering from dementia. Leisure activities have been reported to reduce the risk of dementia and maintain function in many studies but due to a lack of the necessary skills among their staff, provision of activity for demented elders is limited in PRCHEs. A new integrated activity program was developed to help carers of PRCHEs to conduct activities for their demented elders. The program comprises 12-sessions of integrated activities for the demented residents with participative training of one carer who had not received formal dementia care training from each PRCHE.

Objectives: To study the effect of an integrated activity program on carers' burden and their attitude in running and sustaining activity programs for demented elders in PRCHEs. Methods: Six PRCHEs were recruited to participate in the study. In each PRCHE, demented elders were randomly assigned to join a 12-sessions activity program (intervention) or receive usual care (control). Carers' burden in taking care of the subjects and their attitude in running and sustaining activity program for demented elders, evaluated by semi-structured interviews, before and after the intervention were compared.

Findings: Five out of six homes (83%), involving 63 demented elders and 5 carers were able to complete the 12-sessions intervention. All five homes were able to sustain the activity program for at least six months afterwards. Significant reduction in perceived burden was observed among carers taking care of demented elders in the intervention group ($F = 15.7$, $p = 0.013$) after the intervention but not among carers of the control group. Though not statistically significant, carers of both groups had positive changes in attitude towards

running and sustaining activities for demented elders after participating in the program.
Conclusion: A purposeful integrated activity program could help to reduce carers' burden in taking care of demented elders and it is possible for non-professional staff in PRCHEs to sustain the program after training.
PS01.78
Depression and dementia among elderly receiving in-home health care and social care
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Background: Increase in the number of elderly persons put heavy strains on the provision of sufficient and good services to these elderly. Among 641 000 Norwegian elderly above 66 years, 165 000 receive some kind of public in-home health care or social service and 41 000 live in nursing homes. From earlier studies we know that the prevalence of dementia is 12% in the population over 70 years of age (Ott et al. 1995). In the same age group the prevalence of major depression is about 4% at disorder level and 12-19% at symptom level (Rosenvinge &Rosenvinge 2003). Studies have reported prevalence rates of depression of 20% at disorder level and 40-50% at symptom level in persons with dementia. Few studies have examined the prevalence of the two conditions among home-dwelling elderly receiving in-home health care and social care. We expect that the prevalence of both disorders is higher than in the general population of elderly persons because this group of elderly are disabled. Health care are mostly help with personal activities of daily living (PADL) and assistance in somatic health problems. Social care is mostly practical assistance such as help with household work, to do the shopping and other instrumental activities of daily living (IADL).
Mean NPI-score, Cornell-score and ADL-scores by mental capacity according to IQCODE and MMSE. N = 650
Aim: To examine the prevalence of depression and dementia among people 70 years or older who receive public in-home health care and social care. Methods The subjects, 650 persons over the age of 70, were recruited from urban and rural municipalities in the eastern part of Norway. They were randomly selected for this study and are representative to the Norwegian population above 70 years receiving public in-home health care and social care. Of them, 68.7% were females; mean age was 83 years (SD 5.4). All participants were evaluated with the Cornell Scale for Depression in Dementia (CSDD), the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and the Mini Mental State Examination (MMSE). According to Jorm (2004) we combined the score on IQCODE and MMSE to define participants with a possible dementia disorder. Participants with a score 3.44 or higher on IQCODE and 24 or less on MMSE were defined to have dementia. According to a recent Norwegian validity study of the CSDD elderly with a score of 8 or higher were defined as depressed (Barca et al. 2010)
Results: We divided the participants into two groups, those who received social care only (n = 205), and those who received in-home health care (many of them also received social care) (n = 447). Dementia was more prevalent among those who received in-home health care than those who only had social care (see table). Among participants with possible dementia disorder 62 persons (32%) also had depression, regardless of service received. There were significantly more depressed elderly who received health care compared to the group who was offered social care. However among participants with dementia the prevalence of depression was the same irrespective of group. Still 10.3% of depressed elders and 10.8% of elders with dementia were solely offered social care from their municipality.
Conclusion: This study shows that both depression and dementia are common among elderly who receive some kind of public assistance in their daily life. Many elderly with a possible dementia disorder also have depression. The difference in prevalence of depression between the two groups are probably mainly due to the difference in prevalence of dementia. Professional caregivers need knowledge of these two disorders to better

meet the elderly needs.

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PS01.79

The agreement between MMSE and IQCODE

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Introduction: More than 150 000 Norwegians receive some kind of public health or social service. Previous research indicates that less than 50% of persons with dementia receiving in-home nursing care have a dementia diagnosis. An efficient screening tool that can bee used by in-home nurses and social workers are needed. Two widely used screening tools for detecting dementia are the Mini Mental State Examination (MMSE) and the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). The MMSE is a questionnaire test, while the IQCODE is a proxy rated instrument where family members or other persons who know the patient well, answer questions about the patient's decline in function due to cognitive abilities. Jorm (2004) suggests that a combination of these two instruments is useful for detecting dementia. He recommends that persons that have a score of 3.44+ on IQCODE or 24 or below on MMSE should be investigated further. Neuropsychiatric Inventory (NPI) is an instrument for screening of psychological and behavioural symptoms in dementia and Cornell is a well known proxy rated screening tool for depression in dementia, but can also be used for non-demented elderly (Alexopoulos 1988). Lawton (1969) has developed two scales for describing the activity of daily living (ADL) one for instrumental ADL (IADL) and one for self-maintaining (PADL).

Aim: To investigate the agreement between MMSE and IQCODE Methods A random sample of 650 persons 70 years or older, in 16 municipalities who receive health or social services from the municipality, were included. Information was collected by means of NPI, Cornell, and the two Lawton scales. Cognitive function was assessed by the IQCODE and MMSE and cut offs of 3,44+ or <25 was defined as dementia, on the two scales respectively.

Results: We found a moderate agreement between the scores on MMSE and IQCODE (Kappa = 0.53; p

PS01.80

Artists and dementia: A case study exploring the impact of dementia in the life of an accomplished artist

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Background: An internet search on dementia and art brings up a list of sites which use art as a creative medium for people living with a dementia. What of artists who develop dementia? What do we know of how their illness affects their art? We know that changes, presumed due to early Alzheimer's disease but prior to its diagnosis, have been detected in the novels of a renowned author (Garrard, Maloney et al. 2005), and it would seem likely that it might be possible to do something similar by looking at the works of an artist. Similarly changes in artistic style have been documented after 'minor posterior stroke' (Annoni, Devuyst et al. 2005). A detailed case study (Liu, Werner et al. 2009) documents how a man with fronto-temporal lobar degeneration and amyotrophic lateral

sclerosis who had no previous involvement in visual art developed a compulsion for painting: his art became simpler and more geometric as his illness progressed. Similarly after sub-arachnoid haemorrhage obsessive prolific artistic output has been described, including both poetry and visual art production (Lythgoe, Pollak et al. 2005). An accomplished artist who developed a fronto-temporal dementia exhibited changes in her work which became 'intensely emotional and impressionistic, with less detail' and this was attributed to the release of creativity and originality (Mell, Howard et al. 2003). Method and results We describe a case study of an accomplished painter who developed a dementia, diagnosed as Alzheimer's disease. The painter and his wife were interviewed as part of another study and agreed to talk about the changes in his painting and paintings. Discussion The case study raises a number of questions which we plan to investigate further: (1) Can changes be detected in someone's art prior to a dementia being diagnosed? If so how do they relate to the neuropsychological deficits associated with the illness? (2) The retention of skill and interest - what value does this have for the painter as a form of expression of identity? (3) What awareness does the person with dementia or/and their primary carer have of how the person's previously held skills have changed? (4) What perceptible change in form and structure of the composition can be identified from a visual analysis? (5) What other changes in artistic endeavour can be identified? For example we have identified a phenomenon of the person with dementia continuously returning to the composition, could one effect of dementia be to remove or diminish in some way the artist's previous ability to accept that a piece would never achieve the quality for which he strives?

PS01.81

Effectiveness of cognitive and physical training programs based on new software technologies in patients with mild dementia, Mild cognitive impairment and healthy elderly: Long Lasting Memories (LLM) platform

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Introduction: Long Lasting Memories (LLM) is an integrated ICT platform which combines cognitive exercises with physical activity in the framework of advance technologies. LLM aims to deliver an effective solution against age-related cognitive decline, and to allow the recovery of higher cognitive functions in people who show cognitive impairment related to Mild Cognitive Impairment and Mild Dementia. Cognitive exercises are provided by GRADIOR specialised software which offers a structured evaluation and neuropsychological rehabilitation system. Physical Training is based on FitForAll game platform that can help elderly people to exercise through an innovative, low-cost ICT platform, such as Wii Balance Board. Objectives: To determine the effectiveness of LLM cognitive and physical training program in the improvement of mental capacities in non impaired elderly, mild cognitive impaired and mild dementia subjects.

Method: Volunteer sample of 86 participants was recruited from residential facilities, community centers and memory clinics. 44 healthy elderly, 24 subjects that met the DSM-IV criteria for Mild Cognitive Impairment and 18 who met the criteria for dementia (mean age = 75,9 years, SD = 8,4, age range = 60-92 years) were administered LLM during 12 weeks program. 49 subjects formed the control group (mean age = 79 years, SD = 6,48, age range = 62-94,). Mixed models analysis of variance (ANOVA) and paired t-test were calculated.

Results: Digit Span test score (Digit Span subtest of the Wechsler Adult Intelligence Scale-III) for the LLM group increased significantly during the intervention period, whereas the scores for the control group decreased. Two sample t-test showed a significant group difference at the post measurement ($t = -2.01$, $p = .049$) and no difference in pretest ($p = -.54$, $p = .56$). Participants significantly improved subscores of episodic verbal learning and memory (Hopkins Verbal Learning Test; immediate recall $t = 2.68$, $p = .011$; long delayed recall $t = 3.36$, $p = .002$; recognition $t = 2.43$, $p = .02$.) and general mental functioning (Mini Mental State Examination).

Discussion: Primary results support the effectiveness and usefulness of LLM cognitive and physical training in

improving cognitive skills. LLM is a promising solution for aged related decline and the rehabilitation of higher cognitive functions, maintaining wellbeing of the elderly with few technical requirements.

PS01.82

Health self-perception of dementia family caregivers: Socio-demographic and clinical factors

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Background: With the increasing life expectancy worldwide, dementia is becoming a major public health challenge, especially in developing countries like Brazil. An important but yet not well explored topic is how family dementia caregivers perceive their own health. Few studies have established the poorer health perceived of family caregivers when compared with caregiver groups for non-demented patients.

Objective: To investigate health perception of caregivers and its association with socio-demographic and clinical data.

Methods: A convenience outpatient sample (n = 137) of family caregivers and demented patients dyads were consecutively examined in a cross-sectional design from January 2008 to March 2010 at the Center for Alzheimer Disease and Related Disorders, Institute of Psychiatry (IPUB), Federal University of Rio de Janeiro (UFRJ), Brazil. Subjects with dementia aged 60 years or more were assessed with Mini-Mental State Examination, Functional Activities Questionnaire, Neuropsychiatric Inventory and Clinical Dementia Rating. Family caregivers over 21-years-old who had the major responsibility for providing care (for at least 10 hours a week) answered Socio-Demographic Questionnaire, Beck Depression and Anxiety Inventories, Zarit Burden Interview and Maslach Burnout Inventory. The present study was approved by the Ethics Committee of IPUB/UFRJ and all participants signed informed consent. Data were analyzed using SPSS statistical package 17.0 and Stata 9.0 (StataCorp, College Station, Tex.). T-test was employed to compare groups with and without self-reported physical and emotional problems. One-way Anova and Tukey's tests analyzed the relationship of subjective health status to socio-demographic and clinical variables. Logistic regression models were carried out to evaluate which clinical variables best predicted the poor health perception status.

Results: Gender proportions of caregivers differed considerably, the majority being females (80.3%). Most were married (55.5%), more than 80% were children and spouses of the patients and almost half were of higher educational level (46.0%). Caregivers' mean age was 56.8 (SD = 14.0) years and the mean time of care was 3.9 (SD = 2.7) years. The majority of demented patients were females (65.6%), with 4-8 years and over 8 years of education (87.3%), almost half were married (47.4%) and the mean age was 76 (SD = 6.9) years. Most patients were at CDR = 1 stage (n = 57; 41.6%), followed by CDR = 2 (n = 49; 35.8%) and CDR = 3 (n = 31; 22.6%). The majority of caregivers reported health self-perception as "very good/goodâ[euro] (54.7%), followed by "regularâ[euro] (34.3%) and "very bad/badâ[euro] (10.9%). The presence of physical (53.3%) and emotional (78.1%) problems was emphasized by the greater part of caregivers. The most prevalent types of physical and emotional problems were pain syndrome (50.6%) and anxiety (56.2%), respectively. "Very bad/badâ[euro] health profile was reported by older caregivers who presented higher symptoms of depression, anxiety, burden and emotional exhaustion. The presence of physical and emotional problems was associated with the same variables mentioned above. Caregivers with physical problems were older than those without, but no significant age differences were found for those with or without emotional problem. A multiple logistic regression analysis was performed with all statistically significant variables during the bivariate analysis. The backwards modeling

showed that only anxiety (β = 0.0, p

PS01.83

Becoming a person with dementia - a systematic review: Exploring older peoples' experiences in the transition from cognitive impairment to receiving a diagnosis of dementia

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Background: Wide variations exist in the diagnosis and disclosure of dementia despite international consensus recommending early diagnosis. Reported advantages to more timely diagnosis include an end to uncertainty, enabling people to receive pharmacological treatments and access psychological and rehabilitation therapies in addition to information and support, and to engage in future care planning discussions about legal, financial and care issues. In England, the National Dementia Strategy recommends early assessment of memory problems through memory clinics; however little is known about the experiences of people who accessing such services in their transition from being a person with memory problems to one living with a diagnosis of dementia. Aim: This study aimed to better understand the experiences and needs of an individual in their transition from having cognitive impairment to becoming a person with dementia, through a systematic review and qualitative study. This poster will focus on the methods, results and conclusions of the systematic review.

Methods: This review updated an earlier systematic review (2004,) on the topic of disclosure of the diagnosis of dementia, which identified the need for further evidence synthesis focused purely on the experiences of the individual with dementia and their families. Key electronic databases including Medline, CINAHL, Web of Science and EMBASE were searched; this was supplemented by hand searching of reference lists and contact with experts in the field. Abstracts, and then full papers, were independently assessed by two reviewers, with disagreements resolved through discussion or a third reviewer. Data extraction and quality assessment followed best practice guidance. As the majority of included papers included qualitative data, data synthesis was via a narrative review.

Results: 35 papers were included; 15 focused on carers only, 11 included both people with dementia and family carers and 9 solely on the person with memory problems. 18 reported research from Europe and 17 from the USA/Canada. Twenty two papers reported qualitative studies and 8 employed a mixed methods approach. Only 2 papers, reporting data from the same study, included empirical evidence on the actual process of diagnostic disclosure. Two papers explored the effects on the person with dementia's health. The vast majority of people with dementia wished to know their diagnosis and many cannot recall their actual diagnosis after disclosure; the term 'Alzheimer's disease' has more negative connotations than the word 'dementia'. The key challenges for the person diagnosed with dementia were coming to terms with losses on multiple levels; psychologically, socially and functionally. Although there may be initial short-term distress, the majority of people with dementia do not appear to experience long term negative effects on their mental health. For family carers, becoming the main decision-maker and adjusting to increased responsibility were concerns. In terms of the nature and amount of information provision around receiving a diagnosis of dementia, only 1 of the included studies explored the views of people with dementia in this area.

Conclusions: This review found that research is slowly emerging which represents the voices of people with

dementia and their family carers about receiving a diagnosis of dementia. There was consensus that diagnostic disclosure should be an ongoing process with the provision of support and information tailored to individual needs. Despite family carer concerns that disclosure of the diagnosis might affect a person's health and wellbeing, there is no evidence to data that disclosure leads to long term negative effects. However professionals need to identify those individuals and families who are experiencing ongoing difficulties in coming to terms with living with dementia and who may require additional specialist psychological support.

PS01.84

Sexuality, ageing and dementia

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Overview: Although there is evidence that sexual activity decreases in frequency with age, more recent birth cohorts of older adults are reporting more frequent sexual activity, more positive attitudes and higher satisfaction with sexuality (Beckman, Waern et al. 2008). It would seem likely, given changes in sexual practice over recent decades, that this will continue and that sexuality and its impact on well-being will become more important in people entering later life in the coming years. However we also know that sexuality and ageing is an area that healthcare staff still find uncomfortable to talk about with older people (Gott, Hinchliff et al. 2004). Attitudes towards residents' sexuality in residential and nursing staff differed between occupational groups (eg managers compared with nurses and care assistants) and those who have spent less than 5 years in the work were more negative in attitudes than those who had worked in the area for longer (Bouman, Arcelus and Benbow, 2007). Terminology and classification of sexually inappropriate behaviours in association with a dementia is inconsistent in the literature and terms like 'inappropriate' are difficult to operationalise, leaving considerable room for differences in application. Much of the literature on treatment of sexually inappropriate behaviours in dementia is based on case reports and dominated by pharmacological treatments. Tucker (2010) reviewed the literature and suggested a management flow chart (Tucker 2010) but there is a need to extend our understanding of the role of non-pharmacological treatments and the ways in which organisational policies, procedures and training impact on this area. There are also ethical dilemmas and conflicts in dealing with these issues. Actions needed to improve sexual health in older people with dementia include the following: * Professional bodies to include sexuality, ageing and dementia on their training curricula * Education and training programmes to include knowledge, attitudes and practice relevant to sexuality, ageing and dementia * More work on the impact of environmental issues * More work on consent issues including the balance between autonomy and protection; previous attitudes of people living with a dementia in relation to present attitudes; family and staff attitudes in relation to the attitudes of people living with a dementia. * Investigation of ethical decision making frameworks.

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PS01.85

Dementia and creativity

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Introduction: Dementia and creativity may seem contradictory terms, opposites, however many observations, even in severe institutionalized older people, indicate that patients with dementia are able to demonstrate creative and innovative characteristics. Despite limited brain activity, it can still be possible to express creativity.

Cognitive or emotional pain sometimes seems to imprison creativity or in other cases offers ideas and themes of rebirth and freedom of creative expression. Being creative may develop positive trends that are able to stem losses and enhance capacities. Within cognitive decline there are many examples of creative expression that demonstrate the desire to communicate deep thoughts and emotions.

Discussion: Some examples of dementia and creativity. William Utermohlen, an Anglo-American painter, stricken by Alzheimer's disease, continued to compose portraits following the inexorable progression of his decay (Crutch, Isaacs &Rossor 2001); he has witnessed the decline of his cognitive functions, maintaining until the end a kind of artistic core. In his last paintings the human figure crumbles, vanishes up to the last self-portrait that seems to reflect a loss identity, the image of a ghost that recalls 'The blue phantom' by Wols, just as a previous portrait evokes "Head of a hostageâ[euro], by Jean Fautrier. Utermohlen follows his dramatic existential adventure in a series of portraits. The ability to capture self-image, self-essence remains; the insight, despite the severity of the disease, is maintained; Utermohlen seems aware - at least in emotional terms - of what is happening to him. The cognitive deconstruction does not eliminate the possibility of being conscious and creatively expressing his feelings. Hyperbole and metaphor are two universal laws of art (Ramachandran 2003). Through hyperbole we may grasp the salient traits of a figure, the caricature of a face, as we can see in many contemporary paintings and in Utermohlen's portraits. In his verbal and non-verbal communication and his behavior, a patient with dementia appears to represent himself as hyperbole and takes the others as hyperbolic expression. In metaphors two unrelated concepts are combined to highlight certain aspects of both. Many great works of art are full of metaphors with multiple levels of meaning. During his illness, Utermohlen paints a man with his arms moving, disjointed, uncoordinated with the rest of the figure; perhaps a metaphor between the artistic expression of disintegration and the creative research of a new organization. In old age, Immanuel Kant presents signs of cognitive decline (de Quincey 1827). The German philosopher appears to be aware of his disorder, taking refuge in the past and expressing the pain of changes, the need to secure environmental and emotional reference points. His decline continues relentlessly, but he keeps his style, his elegance, his cultural achievements, and he accurately speaks about the gas and the Kepler's law of planetary motion. A few days before his death, he addressed his doctor with words of appreciation and gratitude. Kant, despite the relentless decline of his cognitive functioning, captures moments of cultural lucidity, and above all tenderness. In his last days, sick, not self-sufficient he reserves his final creative acts for the dignity of his knowledge, of his feelings of gratitude, understanding, humanity and affection. Cognitive mind is gone, but the soul of its history remains until the end. Cary Smith Henderson (1998), a professor of history, writes an important journal, expressing his feelings on his experience with Alzheimer's disease. Some people mistakenly think that a patient with dementia has no ability and emotional sensitivity. Even in advanced stages of the disease, the patient is able to grasp the meaning of situations and relationships; despite the difficulties and communication problems, he continues to have feelings and ideas that he would like to share with others, as Smith Henderson says.

Conclusions: Patients with dementia remember, think, communicate, understand and want to be understood, have feelings, can always be creative. In the words, artistic expressions and behaviors of a patient with dementia, we must always seek and find their way. Dementia may be a 'hyperbole', a creative 'metaphor' for life and the story of a man.

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PS01.86

The development of institutional services facilitated for persons with dementia in Norway

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Overview: The development of institutional services facilitated for persons with dementia in Norway Øyvind Kirkevold, Arnfinn Eek Background The care of the elderly in Norway is within the jurisdiction of the municipalities which provide social services (practical help and housing), health care services (mainly in-home nursing) and institutional care (mainly nursing homes). In the 1980s special care units for persons with dementia (SCU) emerged as a specialized service. The experiences with the SCUs were mainly positive compared with regular units. Since the proportion of people with dementia in Norwegian nursing homes is high (about 80%) it has been recommended that the municipalities should facilitate SCUs in the nursing homes. A survey of the municipal health services for persons with dementia in the municipalities in 1996/1997 showed that only 13.3 percentages of the beds in the nursing homes was in SCUs. During the 1990s a new type of service became more frequent; namely group livings for persons with dementia. The survey from 1996/1997 showed that in the whole country, was 856 beds in group livings. Due to the low total number of services specially facilitated for persons with dementia, the central authorities in Norway wanted to follow the development in this field.

The development of institutional services facilitated for persons with dementia in Norway

(1) Based on information from 397 of 430 municipalities (2) In the 397 municipalities that answered, total for Norway 69,600

Aim: On behalf of the Directorate of Health, the Norwegian centre for Aging and Health monitor the development on the municipal services for persons with dementia, focusing on SCUs and group livings. Method On five occasions (1996/1997, 2000/2001, 2004/2005, 2008 and 2011), a detailed questionnaire was send to all Norwegian municipalities. The questionnaire contained questions about the services for persons with dementia and covered information about number of beds, staffing and the formal qualification of the staff. Additionally, demographic data for each municipality was collected from Statistics Norway. The expected amount of persons with dementia in each municipality was calculated from the profile of the elderly population combined with the results from epidemiological studies of the prevalence of dementia. The municipalities who did not respond to the first posting were contacted by telephone, and the questionnaire was filed in as a telephone interview. The same procedure was used to fill in missing data.

Results: In this paper the results from the first four occasions are presented, the dataset from 2011 will be added for the conference presentation. Coverage In 1996/1997, 70 % of the municipalities had at least one SCU and 13.3 % of the beds in Norwegian nursing homes were in SCUs. In 2008 this 87 % of the municipalities had such services representing 23.2 % of the beds in the nursing homes. The number of beds in group livings for persons with dementia have increased from 856 in 1996/1997 to 1,686 in 2008 (even though the 2008 numbers are based on 397 of 430 municipalities). In 2008, 23 % of the municipalities had at least one group livings. The mean size of both SCUs and group livings was, in 2008, eight beds. This is about the same as found in the earlier surveys. Staffing SCUs have in average three patients per carer on an ordinary weekday day-time shift. In the weekends and evenings it averages out to four patients per carer. These numbers have been quite stable during the whole period, but there exists great variation between the wards. In the group livings, the number of patients per carer is marginally higher (3.5 on weekday day-time shift and 4.5 on weekend and after noon shifts). A high proportion of the staff is working part time; by merging the part-time positions to full-time positions, we have calculated the education level of the staff. In the SCU 26 % of the positions were filled by staff with a college education (e.g. registered nurses [RN]) and 62 % were filled by staff with a relevant high school education (most auxiliary nurses [AN]) and 12 percentages had no relevant education. In the group livings the distribution was 18 % of RNs, 68 % of ANs and 14 % without relevant education.

Conclusions: There has been a slow but steady increase in the number of institutional places facilitated for people with dementia during the last decade.

PS01.87

Association between apolipoprotein E ε4 and survival following onset of Alzheimer's disease in Korean elderly

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Background/Objectives: The ε4 allele of apolipoprotein(APOE) has associated with an increased risk and earlier onset of Alzheimer's disease(AD), but whether it affects mortality in patients with the disease is not consistently confirmed. This study aimed to assess the effect of APOE ε4 allele on mortality in patients with AD. Methods: APOE genotyping had been performed on 200 patients recruited from patients with probable AD registered in the Dementia and Age-associated Cognitive Decline Clinic of an university hospital and in a service program for the early detection and management of dementia in the community between 1996 and 2004. All the subjects had been examined according to the protocol of the Korean Version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD-K) at baseline. Subjects were dichotomized into 88 patients with and 112 patients without at least one ε4 allele. Cox's proportional hazards regression models were used to identify the effect of the selected variables including the ε4 allele on mortality.
Results: Forty patients with and 49 patients without the ε4 allele were had died by December 2008. Median survival from onset of AD did not differ by the ε4 allele carrier status(10.2 years in the ε4-positive group, 9.1 years in the ε4-negative group). There were no differences between ε4-positive and ε4-negative group in age at baseline, sex, education, age at onset, duration of AD, severity of dementia. Significant factors that affects mortality during the follow-up included age at baseline and age at onset. Adjusting for age at baseline and age at onset, the presence of an ε4 allele did not show increased risk of mortality (RR = 0.98, 95% CI = 0.64-1.49) and the risk of effect of the ε4 allele not vary by age, sex, education in this sample. Conclusions: This study provide the first information about the effect of the ε4 allele on mortality in oriental elderly with AD. The APOE ε4 allele was not associated with mortality in patients with AD.

PS01.88

Persons with early onset dementia - experiences of living with dementia: A qualitative study

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A Möller

Background: Persons diagnosed with dementia disorders before the age of 65 are often referred to as 'younger people with dementia', 'people with early onset dementia' or 'persons with EOD', the latter which is the abbreviation used in this text. There is no Norwegian prevalence study but it is estimated that up to 1,400 Norwegian citizens suffers from EOD. In accordance with the recommendations of the Norwegian Directorate for Health and Social Affairs, these individuals are usually examined within the specialist health care services, mainly in memory clinics. Studies confirm that persons with EOD will need more help and assistance specific to their age group as the disease progresses. Persons with EOD and their families often fall through the net of services provided because services for families with a person with dementia are in general set up to meet the needs of the elderly people. Studies also show that the few services that are set up for persons with EOD are based on health personnel's subjective thoughts about what persons with EOD and their families are in need of and are not necessary in accordance with the subjective needs of persons with EOD and their families. Psychosocial interventions for carers considered being promising approaches as means of reducing the burden on carers of dementia sufferers in general and later studies show that persons with EOD should be included and be provided with their own groups for likeminded, but experiences and guidelines for such groups is there very little research to find. It is documented that persons with dementia can express their perceived needs of different kinds and expresses how it is to live with dementia; something that is also described through paintings

and poetry. Therefore, we wanted to carry out this research for the purpose of developing services for persons with EOD based on having discerned what their needs truly are and thus what services are most beneficial. There are limited studies on this topic; studying persons with EOD's experiences of living with dementia and their need of adequate services to meet their specific needs.
Aim: The aim of this study was to find out how people diagnosed with dementia experiences living with dementia and hopefully make implications for practice and develop services further.
Method: A qualitative method, grounded theory, with depth-interviews, was used in this study. Four Norwegian Old Age Psychiatric hospitals/memory clinics in the Southern part of Norway were contacted and asked to recruit participant to this study; a task they performed via telephone or when the informants had a follow-up set up at their respective hospital. A total of 20 informants from 54 to 67 years, which eight of them were women were interviewed during 2010-2011. The informants brought with them different experiences of living with dementia. The informants time of diagnose was from four months to three years back in time.
Findings: Two of the persons who were asked to participate refused to and other findings and conclusions of this study will be presented at the congress.

PS01.89

Immigrant religion indigenous culture: South Asian experiences of dementia in the UK

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This poster presents details of an ongoing PhD research project, funded by a scholarship from the Centre of Ageing and Mental Health, Staffordshire University. Background In the U.K. Black and Ethnic Minority (BME) communities are most at risk for developing vascular dementia and experience a higher rate of young onset dementia (under 65 years), as compared with the majority ethnic population (RCP, 2009, p12). Despite this, BME dementia patients access health services and receive diagnoses later in their disease progression and are less likely to access anti-dementia medication or partake in research trials and care (Mukadam et al, 2011). Current clinical assessments may be 'culturally biased' (DoH Standard 7, 2001). The Western tradition to seek clinical intervention in the case of physical or mental illness highlights the discrepancy between indigenous U.K. culture and immigrant religious practices and rituals. A prominent theme emerging from existing research, not yet directly addressed, is the impact of spirituality and religiosity on dementia; in terms of perceiving the illness, accepting the illness, coping with the illness and accessing services (Milne and Chryssanthopoulou, 2005). This offers one explanation for why barriers exist for BME dementia patients accessing services. The behavioural manifestations of dementia affect religious ritual: For example, incontinence impeded Muslim home prayer as the house was considered 'dirty' (Bowes and Wilkinson, 2003). The stigma associated with mental illness negatively affected religious practices such as arranged marriage. Communication and translation issues manifested both in clinical communication and in support services. Cultural barriers to day-care and residential services were evident through inappropriate food or lack of observation of particular religious rituals associated with mealtimes (Patel et al., 1998). Mainstream dementia services appear ill-equipped to respond to the needs of ethnic minority individuals (Bowes and Wilkinson, 2003). Further study is needed to elucidate the role that religion and culture play in the help-seeking pathway for dementia, and to improve equity of access to healthcare services. The present study aims to improve knowledge of the interaction between health and religion in order to improve care provision. Aims of the investigation The main aims of this research project are: * Identify and analyse how religiosity and culture influences the experiences of care and coping for South Asian individuals with dementia, in the UK. * Discover and evaluate the potential deficits in - and benefits of - existing dementia care provided for South Asian groups. For the purposes of this study, the term 'South Asian' reflects the geographical location of an individual who descents from the region of south Asia: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka; either from birth, as a first generation immigrant to the United Kingdom, or is born in the UK from immigrant parents of South Asian descent. The terms 'Immigrant' and 'Indigenous' refer to religion, with religion as one aspect of culture. 'Immigrant' is not a definition of the

individual. Rather, it is their religious beliefs and associated practices that are immigrant to the cultural setting they are now living within. For example, the indigenous religion of the United Kingdom is Christianity. The culture of the United Kingdom is Christianity-orientated. Religious traditions such as Hinduism, Islam, Buddhism, and Sikhism are immigrant religions in to the indigenous culture of the U.K. Objectives of the project Research and critically evaluate the views and experiences of religiosity on dementia from the perspectives of: * The South Asian dementia patient * The dementia carer * The N.H.S. healthcare professional * The non-N.H.S. voluntary organisation worker * The religious leader Method The study is based on a qualitative design incorporating semi-structured interviews, to be analysed using grounded theory, across four phases: * Phase 1 (PILOT): T1 * Phase 2: T1 + 3 months * Phase 3: T1 + 6 months * Phase 4: T1 + 9 months Predicted Outcomes and Benefits: Increasing knowledge of the effect of immigrant religious beliefs and practices on dementia experiences will improve care provision in the indigenous U.K. culture. It will promote a positive shift in research from an ethnocentric perspective of dementia by raising awareness of, and sensitivity to, alternative cultural groups in dementia populations with a view to educating care providers and develop 'culturally competent practice' (LaFontaine et al, 2007).

PS01.90

"Caring &Innovatingâ[euro]: A community mental health project for older people

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R Encarnação

T Salgado

T Santos

I Varandas

The population living in Portugal increased by 6.9% in the last 16 years, but growth in the age group over 65 years (65 +) was 34.6%, having risen from 14.0% (1,328,036) to 17.6% (1,787,344). As for the population 85 years and over (85 +), almost doubled. In 1991 1.0% (91,058) and it was estimated that 173,164 individuals reside in 2007 with 85 (1.7% of total population). By 2040 people aged 65 + and 85 + are respectively 28.8% and 3.8% of residents. The evidence of the growing importance that the age group over 65 years will possess, with special emphasis on the subgroup of "very elderlyâ[euro], which will lead to greater attention being given to the problems of the elderly in order to make it a better match quality of life. This improvement involves, first, recognizing the specific nature of their needs, which, through ensuring better health care, meant that in countries with higher socio-economic development were being set up their own services for the elderly, whether in health care or from social support, to respond to the changing needs of the elderly and their carers. The absolute increase in the number of very elderly patients, coupled with the increased incidence of degenerative processes in this age group, leads to increasing weight whatsoever the elderly with mental health problems, disease of great potential for addiction and highly disruptive of the social matrix in which patients are located. The increasing prevalence of dementia, a result of aging and the significant growth of the incidence rate with age, has attracted a special attention to this risk group, given the marked dependence of these patients suffer and the high social costs resulting therefore. Moreover, the growing concern with individuals, moving services and / or professional assistance center and strong emphasis on community-based interventions, has led in recent years the relationship between the various providers, bringing together the nature of health interventions and social, using, where available, the cooperation of families. The sharp increase in social expenditure, health and social security in focus leads to solutions that are sought alternatives to institutionalization which prove to be advantageous with regard to their cost-effectiveness. The integration of care that is intended by the decentralization of mental health services and liaison with the multidisciplinary primary health care and community structures, will result in a more comprehensive and rigorous clinical situations, as well as the definition / implementation of intervention plans best suited to the actual needs of the target population - the

elderly with mental health problems and their carers. The articulation and decentralization of mental health care will allow a greater accessibility of the elderly to care. In turn the work home strongly enrich this process to suit the more severe situations reducing all costs and inconvenience of a shift of the elderly and their caregivers, enabling closer care. Simultaneously the maximum transfer of skills for primary care technicians, as well as information and training of caregivers of the elderly will allow the extension of stay of elderly people in their social and family environment, promoting their independence, their quality of life by preventing or delaying its institutionalization. All these actions will enable a sustainable improvement in quality of care, providing professional and informal carers of lasting skills. The Community Mental Health Team is made up of a partnership between the Hospital Magalhães Lemos Department of Psychogeriatry and two Primary Health Care Community Centres in the area. It is developed at Community level by linking it with all existing structures and should be part of the intervention plan as needed by the wearer. This team will work continuously, based on activity around (business community), approaching the patients, their families and caregivers, promoting good practices of care, adequate health monitoring, supervising the adherence to proper treatment plan, promoting programs rehabilitation and active aging for users and psycho-educational programs for caregivers.

PS01.91

The impact of daydreaming on recently encoded information in older adults: A study with the diversion paradigm

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Introduction: The decline in memory performance is a common complaint in the elderly. The memory problems are mainly related to the ability to learn new information to be retrieved some time later (Dening, Jacoby, Oppenheimer &Thomas, 2008). The results of several empirical studies suggest that the ability to inhibit irrelevant information improves along childhood and early adolescence, but suffers a significant decrease in older adults (Soriano &Bajo, 2007). Some studies report that our wandering mind leads us to forget information encoded immediately before this lapse of attention (Delaney, Sahakyan, Kelley &Zimmerman, 2010). The wandering of the mind can operate over diverse topics, including concerns and events in the past, present or future, as well as unrealistic fantasies (Klinger as cited in Zimmerman, Sahakyan, Kelley &Delaney, 2010). In general, the occurrence of mental tasks has a cost in the performance of current activity. Several studies have shown that when the mind wanders the detection of the stimulus is poor, the encoding is superficial, reading comprehension is compromised and event memories are impaired (McSpadden, Schooler &Smallwood, 2002). Based on this kind of data it has been developed an operative task called the diversion paradigm (Delaney, Sahakyan, Kelley &Zimmerman, 2010). In this paradigm the daydreaming is simulated through instructions for thinking about autobiographical memories. These memories are diverse and include personal experiences and the emotion that accompanied them. So, when people divagate on an event they mentally travel and they are immersed in this context. It is possible that some of these daydreaming activities interfered with mnemic function. The change in context seems to explain the effect of the diversion paradigm (Sahakyan &Kelley, 2002).

Objectives: To observe if older adults instructed to think about autobiographical memories (diversionary thought) have a decreased recall performance of information recently encoded. So, it will be compared the memory performance of those older adults with an equivalent group performing other kind of distracting task without the personal information and diversionary thought. To contribute for the study of forgetting in older adults without cognitive impairment and depressive symptomatology.

Hypotheses: Two hypotheses are considered: (1) thinking about a past personal event (diversion group) leads to a larger decrease in recall of the first word list in comparison with the distracting task of speed reading a text (control group), and (2) an arithmetic task doesn't interfere with the recall of the second word list, i.e., average

memory performance in both groups is not different.
Method Participants: Eighty older adults (40 in each group), aged 65 to 69 years with an educational level ranging from three to nine years, living in the community and without cognitive impairment and depressive simptomatology.
Materials: Two lists of 16 unrelated words each. Procedure: In diversion group the participants are instructed to study two lists of words for a memory test. After List 1 presentation they are instructed to think about a recent party in which they went and then during 45 seconds the participants describe this party. Following the List 2 presentation the participants performed an arithmetic task of backward counting during 90 seconds. At the end, the participants first recall the maximum number of words they can remember from List 1 and then the words of List 2. In the control group the same procedure is applied but the diversionary thought is replaced by a speed reading test.
Expected Main Results: It is expected that in the diversion group (diversionary thought) the recall of List 1 is lower than in control group (fast reading test). Concerning the recall of List 2, the same performance level is expected in both conditions (diversion group and control group).
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PS01.92
The influence of leisure activities on dementia prevalence in elderly community subjects
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Recent literature has been shown the protective effects of leisure activities on cognitive decline. In addition, a few studies support the protective effects of cognitively stimulating activities like reading or playing chess. Prevention of dementia with potential preventive strategies is of high importance to reduce the individual risk. They seem to reduce the dementia risk by enhancing cognitive reserve and improving the functional capacity of older adults. Many studies have showed this relationship, as well the improvement of quality of life in this population. The present study aims to determine the prevalence of dementia and the association with leisure activities in a sample of elderly subjects, from Sao Paulo city, State of Sao Paulo, Brazil.
Cross-sectional study of a randomized community sample of 1,563 elderly subjects aged 60 years or older. The following instruments were used: a questionnaire with seven items about having the habit of leisure activities (reading newspaper, reading books, watching TV, going to the museum, listening radio, playing games and going to the cinema); The Cambridge Mental Disorders of the Elderly Examination (CAMDEX), and a socioeconomic questionnaire.
The univariated analysis indicated independent factors associated to dementia. After adjusting for all the variables, the multivariate analysis showed an association with watching TV (OR = 0.8; p = 0.015), reading newspaper (OR = 0.5; p = 0.033), reading books (OR = 0.7; p = 0.002), and not going to the museum (OR = 1.8; p<0.001). After adjusting for age, gender and educational level, the influence of these variables on dementia prevalence was maintained. There was no association between dementia prevalence and going to the cinema, playing games and listening radio.
Many authors believe that leisure activities could help people on having a successful ageing, although the concept of this term is not really clear. Variables like reading, playing and going out seem to be related to a

great increasing in the quality of life. In our sample, dementia prevalence in elderly subjects was associated with many leisure activities. It seems that these activities are also related to an increasing in cognitive performance on the aging process. We believe that those activities could be stimulated perhaps at lower costs, enhancing cognitive performance and leading to the prevention of dementia and a better quality of life among older people. Potential benefit of leisure activities could be expected and explored by further research.

PS01.93

Shared decision making in care networks of persons with dementia

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People with dementia and their family caregivers are continuously faced with changes regarding different aspects of their daily living situation e.g. care arrangements, housing, daily activities, financial and legal management. These changes require decisions to be made by people with dementia, their informal caregivers and professional caregivers involved. Each participant takes up his or her own role within the decision making process. Up until now little attention has been paid to shared decision making (SDM) in the field of dementia care. However, people with dementia and their family caregivers experience little involvement in the decisions that are taken over time. Professionals, in particular case managers, find it difficult to implement shared decision making in this patient group. This symposium is a collaboration between Windesheim University of Applied Sciences and Rotterdam University of Applied Sciences and reports on design and results of three different studies on daily life issues and related decision making processes in care networks of people with dementia. The first two studies (presentations 1, 3, 4 and 5) are part of a research program on SDM involving a longitudinal study using semi-structured interviews with care network members as well as the development of a decision aid for people with dementia and their relatives and its implementation in SDM processes. The research program will result in a dementia decision aid and provide SDM tools for care professionals and professional education relating to the care of people with dementia. Finally, the data will be used to improve theoretical models on SDM in care networks. The research program is carried out by the Research Group Innovation in Elderly Care from the Windesheim University of Applied Sciences together with the Centre of Expertise Innovations in Care from the Rotterdam University of Applied Sciences. The third study (presentation 2), from Rotterdam University of Applied Sciences, has a case-study design studying 15 care networks of people with dementia using semi-structured interviews. The following papers will be presented during the symposium: 1. Shared decision making in people with dementia and their caregivers This presentation focuses on aspects which influence (shared) decision making processes within networks of people with dementia. 2. Relationships between people with dementia, their informal caregivers and home care nurses. Who is director of care in a network of people with dementia influences care relationships between people with dementia, their family caregivers and home care nurses. This presentation will elaborate on this issue. 3. Developing a decision aid for people with dementia and their relatives: a study into Shared Decision Making in care networks This presentation focuses on the development of a decision aid, a flexible and dynamic it-application, which facilitates the SDM process involving persons with dementia, their informal caregivers and care professionals. 4. Strategies to ensure successful research with people with dementia People with dementia are often not involved as participants within (qualitative research). Most research is based on the proxy reports of informal and formal caregivers. It remains uncertain if these reports represent the perceptions of people with dementia themselves. This presentation discusses our experiences with interviewing persons with dementia. 5. Involvement of people with dementia in the development and implementation of supportive it applications: a systematic review of the literature To increase the usability of interventions and user satisfaction, it is important to involve people with dementia in the development of interventions. This presentation gives an overview of the extent to which people

with dementia are involved in the development and implementation of supportive it applications, the strategies used to involve them, and the results of these strategies.

PS01.94

The evolution of memory disorder in the elderly people: Do you recover, will remain stationary or dementia?

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Introduction: Even though most than a hundred years have passed since we know Alzheimer's disease today it's considered as the human's frightful flagellum. While most of mental disease seem to be losing its evilness, the neurocognitives disorders caused by Alzheimer's disease, far from attenuating has duplicated its appearance every each five years. And its symptoms are still being more depriving. So, in opposition to the rest of the illness that affects the nervous system and the psychic apparatus, which due to the new treatments has been attenuated the clinical forms of Alzheimer's disease. With its severe pronostic and the illness evolution, haven't been soften.

Hypothesis: Our intention is firstly, share some concepts to consider Alzheimer's disease as a cruel illness that can reach all the elderly people around the world. Secondly, to analyze the different forms of presentation than can mask a clinical state. Which many times could end-up in dementia? And will soon destroy the whole psychic apparatus of a person.

Methods: present our study group in the four institutional medical centers, with ambulatory patients, who consult about a cognitive disease. We describe the evolution trough time, taking into account the pharmacological treatments. We included 850 patients with diagnosis the Mild Cognitive Disorder and 348 patients with diagnosis the Alzheimer's disease (DSM IV-TR criteria).

Results: the importance of the early detection of memory disorder, as one of the first signs of alarm which give us the opportunity to intervene therapeutically in on time.

Conclusions: We can recognize the Mild Cognitive Disorder as a clue which reveal a first therapeutic instance probably in efficacy in this cruel evolution towards dementia.

Discussion: In the presence of a disorder of memory in the elderly people, with the possibility of evolving towards dementia, we prefer to begin drug therapy early, preventive character.

PS01.95

Delirium superimposed on dementia in an elderly Nigerian man: A case report and challenges

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A Olasore

Dementia was thought to be rare in Africa. Documentation of aging-associated dementia is still quite low in black Africa despite projections of future increment resulting from population aging and increasing cardiovascular risks. Many subjects with dementia present primarily to the neuropsychiatric practices because of behavioral and psychological symptoms of dementia. Occasionally, delirium can superimpose on dementia. Delirium in a patient with dementia is a problem that may have serious complications and poor prognostic implications. It may alter the clinical course and trajectory of cognitive decline and physical functioning but largely poorly recognized by physicians and nurses in older hospitalized patients. Delirium is superimposed on dementia when an acute stage in mental status (characterized by fluctuating course, inattention, disorganized thinking or altered level of consciousness) occurs in a patient with preexisting dementia. The immature and aging brains are particularly predisposed to delirium especially in the context of a preexisting brain condition. Dementia is a well documented risk factor for development of delirium and is often under-reported and under-treated. Behavioral and cognitive changes in patient with dementia are often attributed to diurnal variation of symptoms (sundowning) or underlying dementing illness itself rather than to a superimposed delirium. Though relatively little is known about the pathogenic mechanism in delirium versus those in dementia, both delirium

and dementia have been shown to share several pathophysiological features including deficit in cholinergic neurotransmission, decreased cerebral metabolism and an inflammatory response. The elderly often have a number of concurrent illnesses (co-morbidity) and may require polypharmacy which may lead to a greater chance of problems arising because of drug interactions and to a higher rate of drug induced problems in general. The clinical and economic implications for the early recognition of delirium superimposed on dementia are considerable. In the management of this condition, we need to bring together clinical as well as ethical issues because they both come into play with respect to the outcome. The management involves among other things, assessment of possible contributory factors which may lie in the nature of the syndrome, in the environment and in the individual with the diagnosis. Thus concurrent physical health problems should be identified. Sources of physical discomfort should be sought and medication side effects should not be underestimated. Possible concurrent psychological and psychosocial contributory factors should be highlighted as well as understanding the individual's pathoplastic reactions to circumstances. The availability, nature and quality of carers as well as their current ability to cope with the needs of the person with the syndrome will shape behavior patterns. The characteristics of the care environment (physical space, comfort and adaptations to promote independence) should be considered. A number of ethical issues arising from this case along with the underlying philosophy should be discussed. We hereby report the diagnostic, environmental, psycho-pharmacological, psycho-social and medico-legal challenges in the management of a 73 year old retired male nigerian secondary school principal with delirium superimposed on dementia, behavioral and psychological symptoms of dementia and co-morbid medical conditions in a monospecialized psychiatric hospital setting: The neuropsychiatric hospital, Aro, Abeokuta, Ogun state, southwest geopolitical zone of Nigeria, sub sahara Africa.

PS01.97

How are relationships negotiated by people with dementia after they have received an early diagnosis of their condition? A comparison between young onset dementia and later onset dementia

Edward Tolhurst, Staffordshire University, Stafford, Staffordshire, United Kingdom

This presentation is based upon a nascent qualitative study which is exploring how support might be tailored to meet the variable requirements of people with dementia of different ages. The majority of people with dementia are older adults. However, a significant number have young onset dementia: in the UK approximately 16,000 younger people (aged under 65) have dementia, although it is estimated that the actual figure may be up to three times higher. There is a very limited number of research studies which compare the impact of young onset dementia with the impact of later onset dementia. In particular, there is scant qualitative research which draws comparison between the subjective experiences of younger and older dementia sufferers. An in-depth qualitative study comparing young onset dementia and older onset dementia thus will provide a crucial addition to the corpus of dementia research. Different life stages are likely to intersect with the experiences of people with dementia as they negotiate relationships with family members. The actual and perceived differences between these life stages may also impact upon the person with dementia's negotiations with health/social care organizations. This study will thus explore whether assumptions of age-based differences in needs could generate less favourable outcomes for people with dementia and their families. In addition it will consider how health/ social care agencies might support families consistently with regard to the impacts of dementia without generalising input to a degree which marginalises the specifics of age-based requirements. Younger people may face many of the same challenges as older people with dementia but could have additional needs as a result of early onset. For example, the less typical timing of the condition could present organizational and societal barriers as a result of the cultural association of dementia with old age. For example, because of dementia and age correlating at a relatively premature life stage, services may not be age-appropriate and social responses could be predicated upon additional ignorance and disquiet. It's also possible that younger people with dementia are disproportionately likely to have certain practical matters to consider, such as

employment. In addition, the atypical early timing of young onset dementia may place additional emotional stress upon the family as a result of the shock of diagnosis. There is also an increased likelihood that the family will include dependent children; dementia therefore has an impact upon the whole family to an extent that it may not when an older person develops the condition. Older people with dementia are also likely to have particular issues which intersect with their condition. For example, they are more likely than young people to have additional health problems. Furthermore, the person with dementia's partner could be experiencing health problems which impacts upon their capacity to provide care, whilst their children are more likely to be independent and geographically dispersed. There is therefore increased likelihood that a person with later onset dementia will experience social isolation, in comparison with a person with young onset dementia. This suggests that there are likely to be emergent distinctions between the experiences of people with young onset dementia and those with older onset dementia. However, there is also likely to be substantial variation of experience within these two groups. Age may have a palpable intersecting impact upon the person with dementia's relationships, but this impact will be mediated by manifold contextual and dispositional factors. A key aim set out in the UK's Dementia Strategy is to provide diagnosis of the condition as soon as possible following onset; this is so that the person with dementia has optimum opportunity, whilst they have capacity, to make choices which will influence their future care. Recognition of the similarities and differences between those experiencing young onset dementia and those with later onset dementia can help to ensure that this strategic rhetoric is increasingly complemented by professional support and service delivery.

PS01.98

Familiarity and domesticity: The Eval'zheimer® way of life

Kevin Charras, Fondation Médéric Alzheimer, Paris, France

Introduction: This presentation will focus on the results of a controlled randomized trial to evaluate the impact of a psychosocial model of intervention proposed to improve the quality of life of institutionalized people with dementia: Eval'zheimer ®. People with dementia are particularly sensitive to their social and physical environment and are easily disoriented by changes in and/or non-familiarity of their proximal environment. In addition, congruency between social and physical environment is essential in order to promote well-being and adapted behaviors for institutionalized people with dementia and their carers. Stability and familiarity of the environment, of the care practices and of the activities of daily living in special care units for people with dementia stand for some of the fundamental characteristics promoting their well being. Eval'zheimer ®is a psychosocial model of intervention intended to fit caring practices and environmental design to institutionalized people with dementia. This model is based on the general finding that non-pharmacological factors such as interior design and architectural characteristics of environments can help reduce symptoms of people with dementia. Thus Eval'zheimer treats several conceptual aspects in order to provide people with dementia with residential satisfaction. The model not only adopts a person centered care and personhood approach but also incites carers to consider these people as elderly alter-egos that need to be accompanied more thoroughly throughout their daily life.

Method: A controlled randomized trial on 8 special care units - 4 took part in the intervention group and 4 took part in the control group - in France enabled us to evaluate the model of intervention in terms of quality of life of institutionalized people with AD. The model was implemented in the intervention group only. The environmental design intervention did not exceed the amount of 7.000 [euro] per special care unit of the intervention group for refurbishing. Consent was given for 63 participants to take part in the evaluation, all were cognitively impaired with an average MMS score of 7,25 and length of institutionalization of 2,64 years. Data was collected by independent evaluators before the intervention and three months after the end of the intervention. Quality of life was measured with the validated French version of the Quality of Life in Alzheimer's Disease Scale (QoL-AD) and residents were also weighted before and after the intervention. An ANOVA with repeated measures was processed for the statistical analysis.

Results: The general results of this study showed an overall tendency of improvement of quality of life for the intervention group compared to the control group. More interesting were the comparisons within the experimental group concerning differences in care practices as sharing the meals between the caregivers and the residents, implementing night-shifts, or not wearing uniforms. Beyond the fact that these practices enhance significantly the global score of the QoL-AD for the residents and more specifically the living situations item, it is interesting to observe that the quality of life indicators fluctuate according to the implementation or not of these factors. For example, the items of the QoL-AD that fluctuate significantly when implementing nightshifts are living situations, self and fun, whereas the items that fluctuate significantly when implementing not wearing uniforms are mood, living situations, friends and Self. Discussion: One of the conclusions that can be drawn from this evaluation is the fact that the implementation of the model of intervention seem to benefit the well-being and quality of life of residents living in special care units. More specifically, these results suggest that specific care plans that take in account a human-environment approach and implement familiar care modalities relevant to daily activities and routines linked to "realâ[euro] life, can enhance quality of life issues for residents with AD.

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PS01.99

Presentation of Geriatric Mobile Team (GMT) integrates in the audomarois geriatric network

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In agreement with the French legislation i.e. the ministerial decree concerning the gerontologic die of Mars 2007, the Plan ALZHEIMER 2008-2012, the plan solidarity Large Old 2007-2012; a Mobile Unit of Geriatrics or U.M.G (GMT) was created at the Hospital of Saint OMER in Pas-de-Calais (62) located in the north of France meadows of the Belgian border, to 60 km of Lille, the capital of Flandres. The hospital serves a population summons all rather rural with 116.000 inhabitants including 8000 of more than 75 years (Saint OMER is an agglomeration of 60.000 inhabitants). In addition to the service of U.MG., the hospital also has a service of short stay geriatric, a memory center, a SSR geriatric, an EHPAD, a Long geriatric stay, a cardiologic service SSR, a SSR rehabilitation, departments of surgery visceral and traumatologic, services of medicines: cardiology, pneumology, oncology, day and week hospital, alcoology, in of course services of pediatry and gynéco-maternity. The UMG was created on June 1, 2009 and is composed of 1 specialist geriatric physician, 1 framework nurse in common with the memory center and the short stay geriatric, 1 nurse coordinator, 1 psychologist, 1 neuropsychologist in common with the memory center, 1 social worker in common with the services of medicine, 1 secretary in common with the short stay geriatric. These various workers were trained by the medical colleges of Lille and Lyon (departments of Geriatrics and gerontology, Memory Center Regional). The UMG exempts into intra-hospital, as extra-hospital, the gerontologic good practices near medical staffs (councils, formations) concerning the take-care of the traditional syndromes geriatric: temporo-space confusion, malnutrition, the fall, social insulation, ill-treatment, dependence. Their places of intervention are the various hospital services of medicine and surgery of the CHRSO, also the 12 old people's homes of the SAINT OMER canton: EHPADS of Helfaut, Arpage de Saint Omer, Longuenesse, ARQUES, AIRE sur la Lys, Audruicq, Gonnehem, Arneke, Houchy les Hesdin, Fruges, ECQUES, ESQUERDES. (others are in the course of

convention) The UMG also evaluates the elderly using validated scales that this team controls perfectly. These various sphere of activities are: the memory with the MMS of Folstein and the CLOCK test, the nutrition with the Mini nutritional assessment (MNA), the fall with the go test of Mathias and the Tinetti, the depression with the GDS of Sheik and Yesavage, the dependence with the ADL, the IADL of Lawton, the GIR of scale AGGIR, the vision, the hearing with the structured evaluation, the parents depression and the ill-treatment with the N.P.I. The UMG prepares the home returns after hospitalization. They work in close cooperation with the services of home care, the home medical care (HAD), the CLIC integrated for this year into the MAIA (information cell for the elderly), the families, the Conseil Général, the social town services and health insurance cases. The UMG prevents and avoids the elderly hospitalizations. In operating process, the UMG can be seized by telephone (+33321887348), by fax (+33321887349), by e-mail; by the patient himself, by his attending physician, by other specialist physicians (rheumatologist, dermatologist, surgeons,. . .), by the doctors coordinators of the old people's homes, by the families, the social workers, the courts, the administrative supervisions, the municipalities, the Conseil Général always nevertheless with the agreement of the patient. For the year 2010 one counts 175 interventions including 110 in the Old people's homes and 65 in the hospital. For 2011 the activity will be higher by six times because a new physician was engaged with the service Short stay geriatric making a geriatric physician to work practically full-time to the UMG. The UMG also works in network with the CLIC (information near the elderly), Conseil Général (MAIA), the health insurance cases, the family benefit cases, the pension funds, home care associations, the municipalities, the social workers services, the court, the administrative supervisions of which ARS . The UMG takes part with all these partners in the development of a gerontologic project suggested to the patient, within the framework of ethics.

PS01.100

Changing opinions on designing the optimal environment for persons with dementia

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Although AD (Alzheimer's Disease) is increasingly referred to as a 'visuo-cognitive' disorder among researchers, this definition and conceptualization has not yet been widely disseminated to those involved in assessing dementia, designing dementia care environments, planning, and providing care. Many existing dementia care design concepts have come about in response to generalist knowledge, for example, that older persons have 'poor vision', as well as characteristic so-called 'challenging or disruptive' behaviours that must be contained. The new view and conceptualization of AD, increases the specificity of our understanding of the difficulties experienced, in a way which requires re-thinking and even re-defining behaviour changes in dementia, as well as care interventions for those changes. Combining the above insights, offers scope for increased innovation in the design of dementia care environments to help overcome and compensate for known visuo-perceptual difficulties and the resultant 'relatively normal' adaptive behaviour. Factors driving current changes in care environments and systems comprise: 1. Changing 'institutional' aspects of the care environment * Traditional combi- care homes still are (mostly) large scale institutions that look like hospitals * Some four-bedded rooms are still in existence, and although the majority of daytime is spent with other residents in one of several large dayrooms/lounge kitchen areas, by modern standards there is considered to be too little personal space and activities. The modernization of nursing home long-term care environments will result in: . Down-scaling of large institutions to small scale - sheltered housing facilities (well dispersed in the region and (or) proximate to a 24-hour care-institution).each person having a private small apartment providing individual space and more independent living, to enable them to maintain their lifestyles and to undertake daily activities that fit in their former life habits. The new style nursing homes, as institutions, will be: a modern nursing facility, functioning as a real care expertise centre - offering specialized, chronic dementia care, for those who actually need more intensive institutional psycho geriatric care, because of the intensity of their problems - offering additional (complementary) care and service to 'small scale living facilities' and people still

living in the community. This is part of a transparent dementia-care-chain: "a chain of interlinked dementia care servicesâ[euro]. 2. Improving quality of nursing home care for persons with dementia A Dutch national program for improving dementia care ("the National Dementia Programâ[euro]), is helping regions to build their own 'dementia-care-chain pathways'. This includes the goal of achieving more 'demand driven care', to ensure better incorporation of the individual's personal perspective in nursing home settings and: - A structural and national monitoring of the prevalence of relevant medical and nursing problems in the chronic care sector - Improving quality of residential/nursing home care for persons with dementia The national program on quality improvement of chronic care is called 'Care for the Better' - Implementation of transparent indicators of quality of care. - Implementation and confirmation of quality control systems Scientific assessment of the complex multi-dimensional needs of nursing home residents has been scarce; up till now there exists little information on quality of care and quality of life of nursing home residents in the Netherlands (and Europe), which is recognized and various programs to investigate the needs are now been developed An overview of realizable futuristic designs of environments for people with dementia will be shown, taking many of the above mentioned considerations into account. Organizing optimal dementia care in general, and achieving adequate residential/nursing home/community-based care, for people with dementia also requires more scientific research - basic research as well as management research on how to best attain transformations in care

PS01.101

Family caregiver perspectives on quality of life and care of elderly people with dementia in small-scale and traditional long-term care settings in the Netherlands and Belgium

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Introduction: Caring for a family member with dementia affects the quality of life of residents as well as family caregivers. As the disease of the family member with dementia progresses, the psychological, practical and financial burdens may increase. Family caregivers of relatives with dementia experience lower quality of life and psychological adaptations need to be made in order to cope with the changing relationship between them and their relative. Usually, home care is preferred over residential care, but for a substantial number of persons in the later stages of dementia staying at home is no longer possible and admission into a long-term care setting is inevitable. In general, two types of long-term care settings exist in residential dementia care. Traditionally, residents live in large groups in nursing home wards. Caregiving is primarily based on an institutionalized medical and nursing approach with a number of different caregivers executing differentiated tasks and less attention for the living environment and welfare. Over the last decade, criticism about this model, consisting of arguments against the rigid organization, the more cure than care based culture and the mainly supply-oriented approach towards the care giver, has been growing. In reaction, many large nursing homes are transforming their traditional care model to a more home-like approach, by developing small-scale living facilities. In small-scale living facilities residents live in smaller groups (6 to 16) with a smaller number of different caregivers and care giving, based on a more home-like, holisitic and person-centred approach, in which social interaction and activities of daily life are of central importance. It is our hypothesis that in small-scale living facilities family caregivers will come into contact with fewer professionals, who know their relative better, as compared with traditional nursing home settings. As a consequence of the different care model, we expect that social relations between the family and the professional caregiver are likely to be more profound in small-scale living facilities than in larger, traditional nursing homes, resulting in more satisfaction of family caregivers. The aim of this study was to provide insight into family caregiver perspectives on the relationship between family caregiver, professional caregiver and elderly resident, as well as on their perspective of the quality of life of their relative

with dementia in both traditional and small-scale long-term care settings in the Netherlands and Belgium. This study was a part of a broader research project on quality of life for elderly residents and their professional and family caregivers.

Methods &Materials: A questionnaire (37 items) was administered to 64 family caregivers of residents with dementia in traditional and small-scale long-term care settings at two measurement moments (at baseline and after 12 months) in the Netherlands and Belgium. Four topics of interest were covered in the perspective of the family caregiver: The relationship between family and resident, the family perspective on the treatment by professional caregivers, the relationship between family caregiver and professional caregiver, and the family perspective on 'Quality of Life' of the resident. Analyses were conducted using Mixed Models analysis and logistic regression.

Results: On the whole, a lot of similarities were found in how family caregivers of persons with dementia perceive the care their relative receives and in how these family caregivers experience their relationship with staff. However, three significant setting differences emerged. The study showed that, compared to traditional settings, family caregivers in both countries with a relative living in a small-scale setting had more contact with the professional caregivers and were more satisfied about this contact. They stated that the professional caregivers in small scale facilities show better listening skills and show more respect for the relative with dementia. They also experienced that more attention was paid to the feelings of themselves as family caregivers. *Conclusion* Shifting long term care from a mainly medically-oriented institutional model to a more holistic small-scale and person-centred model shows promising results for family. In coming to a more individualized care for persons with dementia, this study underlines the importance of integrating the family perspective in order to ameliorate quality of care. Suggestions for future research and practice are given.

PS01.102

Quality of life of residents with dementia in small-scale living facilities versus traditional long-term care settings in the Netherlands and Belgium

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Introduction: The considerable increase of the number of people with dementia worldwide implies an increasing demand for residential care. In general, two types of settings exist in long-term residential dementia care. Traditionally, residents live in large groups in nursing home wards. Caregiving is primarily based on an institutionalized medical and nursing approach with a number of different caregivers executing differentiated tasks and less attention for the living environment and welfare. Over the last decade, criticism about this model, consisting of arguments against the rigid organization, the more cure than care based culture and the mainly supply-oriented approach towards the care giver, has been growing. In reaction, many large nursing homes are transforming their traditional care model to a more home-like approach, by developing small-scale living facilities. In small-scale living facilities residents live in smaller groups (6 to 12) with a smaller number of different caregivers and care giving, based on a more home-like, holistic and person-centred approach, in which social interaction and activities of daily life are of central importance. The assumption, that this approach will improve quality of life (QoL) of older persons with dementia, is often made by the care organizations, politicians and other policymakers. However, little scientific evidence is available yet supporting this assumption. Therefore, the research question of our study is: Which elements affect the quality of life of elderly residents with dementia in small-scale and traditional long-term care settings in the Netherlands and Belgium? Because of the different vision on care and the approach to residents in the two types of settings, the expectation is that

there will be both similarities as well as differences regarding aspects of quality of life of residents and perspectives of family and professional caregivers. However, family and caregiver perspectives are beyond the scope of this paper. Differences related to residents between the two types of settings are expected in social interaction, maintenance of independent activities and self-image. Social interaction is expected to differ because of the more profound contact between caregiver and resident, as well as among residents in small-scale settings. Because the emphasis is on continuing to perform activities independently, the assumption is that residents in small-scale settings will be able to care for themselves and stay active in daily life longer. In turn, both aspects may lead to a more positive self-image in small-scale wards than traditional wards over time.
Methods &Materials: The study had a quasi-experimental longitudinal design with a time interval of one year, with three measurement moments. A contextual model was developed, incorporating nine aspects of quality of life (QUALIDEM scale, nine subscales), as well as behavioral characteristics (NPI-NH, CSDD), behavioral interventions (Use of restraints and medication) and social interaction (RISE, visits) of persons with dementia. Data from 179 residents living in small-scale or traditional settings in five different nursing homes in the Netherlands and Belgium were obtained by means of observations by nurses, nursing assistants or psychologists. The data constituted a hierarchically multilevel data structure: observations across time were nested within persons, which were subsequently nested within settings. Accordingly, the data were analyzed using Hierarchical Linear Modeling techniques, in which the primary analyses were three-level models and each quality of life subscale was analyzed separately. *Results* Small-scale living settings appeared to have some beneficial QoL-related effects on residents. QoL decreased for traditional Dutch settings on the aspects of 'Negative Affect' and 'Caregiver Relationship', whereas these remained stable over time in the small-scale settings in both countries, as well as the Belgian traditional wards. Traditional wards also showed some beneficial effects on residents. In Belgium QoL increased on the aspect of 'Feeling at Home' in traditional wards, whereas in other wards this remained stable. Furthermore, on the aspects of 'Social Relations' and 'Positive Affect' traditional wards remained stable, whereas small-scale ward in the Netherlands showed a decrease. Furthermore, residents in all wards, except the Belgian small-scale wards, remained stable on 'Restless Behavior' over time. In the Belgian small-scale settings QoL significantly decreased on the aspect of 'Restless Behavior'.
Conclusion: Both type of setting (small-scale or traditional) as well as living in a Dutch or Belgian setting affects the quality of life of elderly residents with dementia. Fewer differences were found than expected. However, the differences that were found came up to our expectations about the benefits of small-scale living.

PS01.103

Abstract withdrawn

PS01.104

Abuse of elderly people with demention syndrome

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A Mitevska

Overview: A memory disorder is one of the most striking symptoms of dementia. There is a weakness of memory and inability to remember the fresh happenings The memories of the past are usually well preserved and fresh in the memory In the course of the disease can often be monitored decay of memory from new to old happenings Falling ability of logical reasoning and the ability of generalization, differentiation, synthesis and analysis. Abstract concepts are lost. In such a situation dementnion people can become victim to: - Part of family -close-relative -man (woman who helps him for money or keep the person) -a distant relative - neighbor - Bill Collecte - Social Worker - anyone who is close to the old person
Goals: The recognition of the problem of abuse of elderly anddementni beings for their existence and safer living in their home environment as part of overall social life of the same Methods- History-often patients themselves are telling them what happened before being placed in the Gerontology Institute: - Heather history

(close relatives, neighbors say the events at the home of the old person as disinterested observers noted) chat with social services (application and research of social services obtained knowledge of any abuse of the old person by another person) The inability to cope with everyday problems: pazaranje, cleaning, cooking, lack of communication company confidence they give the person who felt the closest currently considering the disease fromthat suffering.

Results: How are people abusing demention Financial-by deducting pension (whether by way of deprivation oflegal capacity in demention or forced the withdrawal of money) By moving the housing space in which the old person previously lived (often under the motive that will care for the old person, their relatives or someone close moves into the apartment) care about the old runs short, and after that of how to obtain knowledge thatcare and servicing is difficult to stay Mon homes or in geriatrics The seizure of property under no compulsion to keep often if the oldperson is guarded by someone using the threat that no longer held, it will leave you alone, forced to sign a contract for life support killing him the property - The seizure of property along the way life support contract - With housing in a nursing home and selling houses (there are cases when to undertake ill people, but since a few weeks would fatigue keeping them housed in Gerontology Institute and the property they use. In these cases the old pension often is sufficient to pay the expenses of accommodation. -Sexual abuse especially among women. Part of the female gender in a way that is sexually abused for monetary compensation or any purpose In the eight years of monitoring patients who are cared for in Gerontology Institute from any cause of 28 patients 4 are materially abused. Shopping-in long conversations with families and abused and have come to the knowledge of their abuse, which because of fear of being abandoned by the person who looks not tell of their suffering. The accommodation in Gerontology Institute and long termtreatment and support call they felt free and safe to say though some of their previous experiences when they were alone and unattended dequate court was often a mediator of resolving property abuse.

PS01.105

Mental capacity and deprivation of liberty of the elderly in Western Australia: Is there a problem?

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Deprivation of liberty of the elderly in Western Australia: Is there a problem? Mental Health and Guardianship law in Western Australia (WA) has evolved progressively from English common law. How successful this has been is the subject of a PhD research proposal which examines the historical basis of this evolution, the extent of divergence from English and European law, and the degree to which WA law and procedures comply with natural justice, Human Rights expectations and policies in other jurisdictions. New laws dealing with the issues of mental capacity have been introduced in the United Kingdom which greatly impact on the elderly, particularly those lacking mental capacity to consent to treatment or to deprivation of their liberty. At the present time WA has no Human Rights Act, nor does it appear there is any interest from any of the political parties in raising the subject. Although a Human Rights Bill was proposed in 2007, it was dropped in favour of awaiting the outcome of proposed Australian Federal initiatives. Australia is a signatory to the Convention on the International Protection of Adults signed at The Hague in January 2000. The adequacy of current WA law and procedures to protect the elderly with mental illness or those lacking mental capacity is an appropriate and timely area for this presentation. This paper will outline the current legal position, illustrate the extent of divergence from European and English legislation which has emerged with passage of time, and indicate the direction of research which is planned to examine the medical and legal issues affecting the elderly in WA. Subsequent research will consider whether or not sufficient safeguards exist to ensure at the very least some parity with current European and English standards, and whether elderly Western Australians are well served by current legislation and procedures.

PS01.107

'Oh it's wonderful when it actually works!' Ethics of surveillance technology in the residential care for people with dementia and intellectual disabilities: Findings from an ethnographic field study

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Background: Traditional institutionalised care for people with dementia and intellectual disabilities is shifting more and more towards small scale living arrangements where surveillance technology is becoming increasingly important. This technology has as its aim to increase safety and quality of life and can also serve as an alternative to the more traditional 'hard' forms of freedom restriction. However it is still not clear what the ethical and practical implications of these interventions would be in a formal residential care setting. What is more, it is often in relation to people with cognitive impairment that the use of surveillance technology provokes conflicting reactions. In summary: the field lacks a clear normative framework when it comes to these developments.
Aim: The goal of this research is therefore to develop a multidisciplinary guideline for the responsible (and restrictive) treatment and use of freedom restriction and surveillance technology in the care for people with dementia and intellectual disabilities. In this guideline the emphasis will thus lie in the prevention of restraints, the application of (technological) alternatives, and the ethical role of surveillance technology.
Method: For this research a multi-step approach is chosen, including 1) literature review; 2) concept mapping; 3) survey among care providers; 4) participant observation in identified 'best practices'. So far several articles have been published, including a literature review and an article on concept mapping. The two concept mappings were conducted with ethicists and care professionals from the field, on the basis of which a survey was sent to care providers in the Netherlands. 'Best practices' were then selected for additional ethnographic research consisting of open interviews and participant observation. A normative analysis will also be made. In this presentation the focus will be on preliminary findings of an ethnographic field study carried out in 2 different care homes. Ethnographic research allows the researcher a more comprehensive perspective than other forms of research and is appropriate to behaviours that are best understood in their own environment. With this specific method a good insight can be gained into the 'local logic' of a (care) practice, i.e. the manner in which the daily doings of care providers are embedded in a sum of considerations which are not always in accordance with norms or policy regulations given from above.
Results: Among the central topics that evolved in the ethnographic field study were: ethical and (im)practical aspects of surveillance technology; motivation and application of restraints; and the effects of small scale living on primary care. Although the use and application of surveillance technology has as its aim to enhance safety and quality of life of the resident, it was not always clear to the actual users of the technology that these aims were met. Next to the potential benefits of surveillance technology, the application of surveillance technology can lead to more dependence on technology, a false sense of security and was seen to be used as supplemental rather than as an alternative to classic forms of restraint.
Conclusion: When it comes to (views on) the application of technology, there appears to be an inherent duality, rooted in the conflict of providing more safety versus (respecting) the autonomy of the resident. What is more, elaboration on this ethical issue has proven to be very difficult. Implementation of surveillance technology in residential homes for people with dementia or intellectual disabilities often precedes policy. However, the ethical and practical viability of surveillance technologies remains unclear, in particular to those who (have to) make use of surveillance technology the most, namely the nurses.

PS01.108

Cross cultural dementia screening: New test for non-western migrants. The first results of the SYMBOL study

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Background: In the 60s and 70s many low educated immigrant workers came to Europe. In the Netherlands, these immigrants mostly came from Turkey and Morocco. These elderly migrants will form a substantial part of the Dutch elderly society in the next decades. Cognitive decline and dementia are difficult to evaluate in elderly migrants because of their different cultural background, language barrier and low level of education. Commonly

used cognitive screening instruments are therefore not applicable for non-Western migrants. The newly developed Cross Cultural Dementia screening (CCD) exists of four subtests, which evaluate memory, executive functions and psychomotor speed. Although the test material is nonverbal, test instructions are given by computerized voice samples in the patients' own language. Turkish, Moroccan Berber, Moroccan Arabic and Dutch versions of the test were validated in earlier research. International research shows that the prevalence of dementia is higher in ethnic minorities (Rosenbaum, 2008). Aims of the Symbol study are to determine prevalence of dementia and other health outcomes among elderly migrants in the Netherlands and to evaluate the effect of a tailored intervention for demented subjects and their caregivers. Another aim is to standardize the CCD. Methods: Symbol is a population-based study. We started data collection via general practitioners in May 2010, and we have tested (n = 850) Turkish, Moroccan Berber, Moroccan Arabic and Dutch elderly participants. Beside the cognitive test, information concerning depressive symptoms (GDS-15), Activities of Daily Living (Katz ADL index score), loneliness (de Jong Gierveld scale) and health related quality of life (EQ-5D) were collected. The CCD and health questionnaires were administered by trained psychology students and/or neuropsychologists. Results: We will present preliminary data on the prevalence of dementia and other outcomes in the different groups. The normative results of the CCD (means and standard deviations) for the different age and education samples will be presented as well. Conclusions: With use of the CCD, we can detect memory problems and dementia in subjects with different cultural backgrounds, with little or no education. This enables future application of the CCD in daily clinical practice. Reference Rosenbaum, B., Kristensen, M., Schmidt, J. (2008). Dementia in elderly Turkish immigrants]. Ugeskr Laeger, 8, 170(50):4109-13. Danish.

PS01.109

Profile of mental health problems in aged presenting to a tertiary centre in India

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Introduction: The first psycho-geriatric hospital was established in India in 2005 heralding the beginning of geriatric mental health services in the country. There is no other such service in the country till date and therefore, no data regarding the profile of mental health problems in older adults presenting to a tertiary centre exists. Like elsewhere in the world, the population of those over the age of 60 years is increaseing, consequent to which the mental health problems are on the rise as well. There are no formal psychiatric services for this specific population in India, thus precise data on prevalence rates of various disorders is unknown. Albeit, there are few community surveys in rural and urban areas looking at prevalence rates in different parts of the country. The present study is an attempt to find out the profile of mental health problems in the only psycho-geriatric hospital in India. This data will be useful for planning future services in the country.

Methodology: The study included all the patients who attended the outpatient clinic in the Geriatric Mental Health Department at Chatrapathi Sahuji Maharaj Medical University, Lucknow, India in the year 2010. Information on referral pattern, socio-demographic details, psychiatric diagnoses, educational status, individual stressors and comorbidity .was obtained.

Results: The results have been presented in terms of psychiatric diagnoses prevailing in this population. There were 391 patients in all, 64.96% were males, 35.03 % were females, 27.87% of population was illiterate, 38.61% of population was educated up to high school and 30.17% of the population was above high school; 20.97% of patients were self referrals, 0.51% was referred by general practitioners and 2.55% were referred by other sources; 15.08% of patients reported some kind of stressors and 84.0% did not report any kind of stressors, and 13.29% of patients reported having co-morbid substance abuse. Conclusions: The results have been discussed mainly in terms of the profile of psyhiatri disorders with different age groups, gender and educational status.

PS01.110

Neuropsychological intervention for a patient with semantic dementia: A case study. Improving naming and semantic knowledge of foods

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Background: Semantic Dementia is a commonly accepted term for a subtype of frontotemporal dementia. The condition is characterized by progressive loss of semantic knowledge, both verbal and non-verbal. However, the most common presenting symptoms are in the verbal domain, where patients with semantic dementia loose the semantic meaning of words, especially nouns, and, as a consequence, presents with anomia as a dominating symptom.

Method: This case study describes an intervention program based upon individualized goal-oriented neuropsychological rehabilitation. NN, a 64 year old woman, former office assistant, with semantic dementia, was participating in this program. NN was diagnosed with semantic dementia six months before the intervention program started. Also, her husband participated in the program, which included caregivers. One of the main goals of including caregivers in the program was to introduce methods of supporting patients' rehabilitation process, with the aim of improving transference of the outcome of the rehabilitation process into the daily life of patients and caregivers. Initially the patients' personally relevant goals of rehabilitation was identified. The process of rehabilitation was focused upon implementing personally relevant and useful strategies and methods, addressing these goals. As part of the method, her husband, as a caregiver, also took an active part in the identification of individualized goals and relevant strategies/methods of rehabilitation. The patient and her husband identified her fading semantic knowledge and naming of foods as a main goal of improvement. Her daily living was affected by fading of knowledge and anomia in many domains, but the domain of foods was particularly challenging in many ways; the patients fading knowledge of foods resulted in her eating a decreasing variety of foods, she found it very difficult to shop for foods, and she only cooked 3 different dishes. Her husband gladly took over the cooking, but the couple had increasing frustrations over difficulties of communicating about foods and her increasing unwillingness to eat foods she no longer had knowledge of. An intervention program was designed with the aim of halting and/or decelerating the effects of progressive anomia and reduction of semantic knowledge of foods. A neuropsychological examination showed that the patient still had a well preserved ability of learning new knowledge. She also had good personal skills of being well structured and working in a systematic way. The patient was presented with daily homework of rehearsing naming and relevant semantic knowledge of different foods. Pictures, names and semantic information were presented for her on a set list, which could ensure errorless learning. She was also participating in activities of shopping for foods and cocking food - these activities was managed by her husband, but she participated. While they were cooking she made her own personal diary of which ingredients they used in the hot meals her husband cooked. These activities were introduced to make her more personally aware and active towards what kind of ingredients their food contained. The rehabilitation program was conducted within an 8 weeks period. It was conducted at a Danish out-patient memory clinic, and was managed by a clinical neuropsychologist.

Results: The patient and her husband both expressed that they were happy about the rehabilitation program. They both enjoyed the common activities of shopping for foods and cooking. The husband described that his wife was decreasingly skeptical about foods. He could introduce a growing variety of ingredients in their daily diet, with her being interested and understanding the dishes they had. So, he sensed at growing knowledge of the different foods he presented for her. It was also registered that the patient had an increasing ability of naming and had relevant knowledge of foods. At the beginning of the rehabilitation program the patient could name and had relevant semantic knowledge of 14/43 of the kind of food ingredients that was presented for her by picture and written material. Also, she had relevant knowledge, but could not name 12/43 kinds of food. She could neither name nor give relevant semantic knowledge of 17/43 kind of foods. By the end of the 8 weeks training session this had increased, she could then both name and had semantic knowledge of 33/43 kind of foods. She also had relevant knowledge of 3/43 kind of foods. She could neither name nor had relevant

semantic knowledge of 7/43. At the time of follow up, 6 weeks after the rehabilitation program had ended, this had changed to 21/43, 20/43 and 2/43 indicating the systematic rehearsal is crucial to keep the levels of re-learned semantic knowledge and naming in patients with semantic dementia.

PS01.111

Episodic memory in patients with the temporal variants of frontotemporal lobar degeneration and Alzheimer's disease

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Background: The medial temporal lobe is affected is the first stages of Alzheimer's disease (AD). Episodic memory (EM) impairment in AD is associated with the degree of medial temporal lobe atrophy (MTA). Semantic dementia (SD), a clinical variant of frontotemporal lobar degeneration (FTLD) is associated with prominent left anterior temporal atrophy with asymmetrical left MTA. In the right temporal variant of FTLD, described as right temporal lobar atrophy (RTLA), there is predominant right temporal atrophy with asymmetrical right MTA. Semantic memory (SM) is impaired in SD and to a lesser extent in RTLA. Impairment of EM is an important hallmark of AD, but it also occurs in SD and RTLA, although in the latter two disorders the relation with MTA is unclear. In this study, we compared the severity of EM and SM impairment between AD, SD and RTLA in subjects with the same degree of MTA.

Methods: Consecutive patient with SD and RTLA were recruited from the database from the Alzheimer Center of the VU University Medical Center. Patients with SD and RTLA were matched, each with two AD patients, for MTA, age, sex and education level. Patients were diagnosed in a multidisciplinary consensus meeting according the prevailing criteria. MTA was measured using a visual rating scale. EM was tested with the Visual Association Test (VAT) and SM with animal fluency and the VAT naming test. Comparisons of EM and SM were made for SD versus AD patients and RTLA versus AD patients with the Mann-Whitney U test, and for SD, RTLA and all AD patients using Kruskall-Wallis test and afterwards Mann-Whitney U.

Results: 27 SD and 11 RTLA patients were matched with 76 AD patients. No significant differences were found in mean age, sex, education level and MTA. VAT recall was more impaired in AD versus SD patients ($p<0.001$) and in AD versus RTLA patients ($p = 0.009$). This was confirmed when all AD patients were compared with SD ($p = 0.001$) and RTLA ($p<0.001$). (Figure) SM was more affected in patients with SD than in patients with AD (VAT naming $p<0.001$ and animal fluency $p = 0.001$). Compared with RTLA and all AD both VAT naming ($p<0.001$ versus RTLA and $p = 0.001$ versus AD) and animal fluency ($p<0.001$ versus both RTLA and AD) were impaired in SD patients. (Figure)

Discussion and conclusion: EM impairment measured by VAT recall is more explicit in AD patients compared with subjects with SD or RTLA despite equal MTA. Therefore, EM dysfunction cannot entirely be clarified by MTA. SM was above all compromised in SD patients. We could confirm the different cognitive profile of RTLA in comparison with SD patients, measured by VAT picture naming and animal fluency. Despite we did not match for dementia severity, the MMSE scores were about in the same range.

The relatively preservation of EM in SD and RTLA compared with AD in patients with equal MTA suggests that probably different networks are involved in AD versus the temporal variants of FTLD. The use of functional imaging may further explain the role of different networks in EM and SM.

PS01.112

Mild Cognitive Impairment of vascular and non-vascular etiology: Evaluation of executive control function and memory subtypes

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Background: Mild Cognitive Impairment (MCI) has been proposed as a transitional stage between normal aging and all types of dementia. Vascular Mild Cognitive Impairment (VaMCI) refers to cognitive difficulties that arise from Cerebrovascular Disease (CVD), which confers a high risk for progression to Vascular Dementia (VaD). In most studies, cognitive evaluation remains as the gold standard for the diagnosis of MCI. It has been suggested that executive function (EF) and other functions related to prefrontal cortex and its connections may be cognitive markers for Vascular Cognitive Impairment (VCI), whereas non-vascular MCI (NV-MCI) may present memory impairment as a major feature.
Objective: This cross-sectional study aims to examine differences among healthy elderly controls and patients with VaMCI and NV-MCI in performances in EF and memory tests.
Methods: 34 elderly outpatients (mean age: 72.35 ±7.94 years; 61.76% female; mean schooling: 9.73 ±4.18 years) were consecutively assessed at the Centre for Alzheimer Disease and Related Disorders (CDA), Federal University of Rio de Janeiro (UFRJ), Brazil, between October 2008 and February 2011.
Patients and controls were examined by a multidisciplinary team, comprising psychiatrists, neurologists, one radiologist and one neuropsychologist. Subjects who fulfilled criteria for dementia or those who had history of alcohol or drug abuse, psychiatric disorders, diagnosis of major depressive episode according to DSM-IV-TR at the moment of evaluation, non-corrected sensorial disorders, exposure to neurotoxic substances and cranioencephalic traumatism were excluded from the study.
Cognitive assessment included the Cambridge Cognitive Examination (CAMCOG), Mini-Mental State Examination (MMSE), CLOX, semantic verbal fluency (category animals) and Trail Making Test (TMT) A and B. Memory subtests in CAMCOG were divided into different subtypes, as follows: Immediate Recall, Spontaneous Recall, Cued Recall, Semantic Memory, and Working Memory. Depressive symptoms were measured with Cornell Depression Scale. Pfeffer's Functional Activities Questionnaire (FAQ) was administered to informants in order to identify evidence of functional decline. All subjects underwent MRI scan of the brain. The modified Fazekas scale was applied to measure white matter hyperintensities. Hippocampal atrophy was quantified using De Leon score.
The diagnosis of MCI was made according to Petersen's criteria. VaMCI patients were identified as those who presented white matter hyperintensities score = />2 on Fazekas scale. Subjects scoring <2 were considered as presenting NV-MCI. The control group did not present evidence of cognitive and functional impairment.
Data were analyzed using SPSS statistical package 16.0. Univariate Analysis of Variance (ANOVA) was carried out to assess significant mean differences for "Ageâ[euro] and "Schoolingâ[euro], followed by post-hoc Tukey analysis. Pearson's Chi-square analysis was performed to evaluate differences in the distribution of gender among the three groups. ANOVA was performed to assess differences among groups in the cognitive evaluation.
Results: Sample was divided into 3 groups: NC (n = 8), VaMCI (n = 16) and NV-MCI (n = 10). Proportion of male and female subjects did not differ significantly among the groups. There was no significant difference in "ageâ[euro] and "schoolingâ[euro] among groups. Mean scores in MMSE showed significant differences between NC and VaMCI. CAMCOG scores presented significant differences between NC and VaMCI, and between NC and NV-MCI. VaMCI performed significantly worse than NC in TMT B and Abstract Thinking Tasks. Abstract Thinking also distinguished NC from NV-MCI. Spontaneous Recall was the only subtest that allowed differentiation between VaMCI and NV-MCI, and also showed impairment in VaMCI in relation to NC. NV-MCI performed worse than NC in Cued Recall test. Semantic memory discriminated VaMCI from NC. Both VaMCI and NV-MCI performed significantly worse than NC in total Memory scores.

Conclusion: In our study, VaMCI subjects presented impairment in functions related to the prefrontal cortex, such as EF and abstract thinking in comparison to controls. Syndromes of disconnection of frontotemporal circuits caused by CVD were also associated to Semantic Memory impairments. NV-MCI individuals performed worse than controls in Cued Recall tests, which is in accordance with previous studies. CAMCOG's Memory total score could not distinguish VaMCI from NV-MCI. Studies have associated impairments in Spontaneous Recall to the severity of subcortical ischaemic lesions in individuals with vascular cognitive impairment.

PS01.113

Mild cognitive impairment and euthymic bipolar disease: similar cognitive profiles

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Background: Mild cognitive impairment (MCI) is associated with cognitive impairment in multiple cognitive domains, with the specific cognitive domains affected forming the basis for criteria used to categorize the various types of MCI. Although MCI was initially described as referring to an objective decline in memory associated with advancing age, this narrow definition representing amnestic MCI has subsequently been revised and it is now clear that a multi-domain form of MCI is frequently present. While cognitive impairment in bipolar disorder is well documented, the degree of this impairment has not been compared directly to that of MCI, nor has the impairment of particular cognitive domains been well-characterized. Using the Mindstreams computerized cognitive assessment battery, this study compares the neuropsychological function of euthymic bipolar patients to those with mild cognitive impairment as well as healthy controls.

Methods: The patient group consisted of 58 volunteers with Bipolar I disorder as diagnosed by DSM-IV critera based on chart review and clinical interview, fully euthymic for at least one month before inclusion, ranging in age from 18 to 66, recruited from the ambulatory out-patient Mood Disorders Clinics at the Beersheva Mental Health Center. Patients were recruited sequentially without regard to subjective complaints relating to cognitive function. Patients with serious physical illness or substance abuse were excluded. All subjects provided their written informed consent for participation in the study. Data for 51 of the 58 bipolar patients were included in the final analysis. Three patients were excluded due to technical problems, two patients dropped out at the beginning of the computer testing phase, one due to cheating on one task and the other who was unable to understand test instructions adequately. All subjects underwent comprehensive neuropsychological evaluation by means of the Mindstreams computerized cognitive Global Assessment Battery (NeuroTrax Corp., NJ). Cognitive data were compared to those of subjects with mild cognitive impairment as well as cognitively healthy individuals tested with the same battery. The Mindstreams battery covers a wide range of cognitive domains, and is available in English, Spanish, Russian, and Hebrew. Administration time is 45-60 minutes, and all subjects completed the battery in their primary language. Measures of accuracy and response time are obtained on each of 10 tests, including (among others) a Go No-Go task, a version of the Stroop Interference test, finger tapping, a catch game, and simple mathematical calculations, language, visual-spatial and motor tasks. Scores are normalized (mean of 100 +/- SD of 15 points) according to stratifications of age and education. Normalized subsets of outcome parameters were averaged to produce seven summary scores, each indexing a different putative cognitive domain. The domains included memory, executive function, verbal, attention, information processing speed, visual-spatial and motor skills. A Global Cognitive Score (GCS) is computed as the average of these index scores. This study was approved by the Ben-Gurion University Ethical Committee of Human Experimentation, in accordance with the Helsinki Declaration of 1975. Results: Final analyses were based on 51 bipolar patients, 162 with mild cognitive impairment and 495 healthy subjects.

PS01.114

Sleep quality and one-year incident cognitive impairment in community-dwelling older adults

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Overview: Neuropsychiatric symptoms may be early signs of dementia and might precede cognitive decline. This study investigates whether sleep quality, in older men and women with intact cognitive functioning, is associated with one-year incident cognitive impairment.
Method: The data come from a population-based prospective cohort study, l'Étude sur la santé des aînés (Study on elders' health; ESA study). The sample used comprises 1665 participants without cognitive impairment, aged 65 to 96, and recruited from the community-dwelling population of the province of Québec, Canada. Data were obtained from the participants during two in-home semi-structured interviews separated by 12 months. Sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a short questionnaire measuring sleep quality in the last month by the sum of seven subscales measuring different components of sleep: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. Each component is reflected by a score ranging from 0 to 3, where 0 indicates no difficulty. Cognitive functioning was measured by the Mini-Mental State Examination (MMSE). Incident cognitive impairment was defined as a loss of at least two points on the MMSE between baseline and follow-up in addition to a score, at follow-up, lower than the 15th percentile according to normative data. Many variables were also assessed and considered as potential confounders: age, education level, baseline MMSE score, psychotropic drug use, anxiety and mood disorders, cardiovascular conditions, and chronic diseases. Psychotropic drug use was assessed using public medical records and was defined as at least one prescription during the year between the baseline and the follow-up interviews. Clinical and subclinical symptoms of anxiety and mood disorders at baseline were assessed using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria. A cardiovascular condition score was computed using data from public medical records and by asking participants at baseline if they had high blood pressure, diabetes, and heart diseases. The score was the total of these three health problems. The number of chronic diseases was measured by asking participants at baseline if they had any of the following chronic health problems: arthritis or rheumatism, eye diseases, backache or spinal problems, digestive problems, thyroid disorders, other metabolic disorders, anemia, hypercholesterolemia, asthma or emphysema or chronic bronchial diseases, liver diseases, kidney or urinary problems, skin diseases, and migraine or frequent headaches.
Results: Thirty-seven men (7.3%) and sixty-eight women (5.9%) had incident cognitive impairment. The association between sleep quality (PSQI total score and each PSQI component score) at baseline and incident cognitive impairment were assessed by odds ratio adjusted for potential confounders computed by logistic regressions. Since significant sex interactions were observed for sleep duration ($p = .017$) and habitual sleep efficiency ($p < .001$) scores, analyses were conducted for men and women separately. PSQI total score was significantly linked with incident cognitive impairment (odds ratio: 1.16, 95% CI: 1.05-1.29) in men, but not in women (1.03, 0.96-1.10). When examining each component of the PSQI, sleep disturbances score (1.98, 1.22-3.22) in women whereas sleep duration (1.93, 1.27-2.95) and habitual sleep efficiency (1.93, 1.41-2.64) scores in men were significantly associated with incident cognitive impairment.
Conclusion: Sleep quality in elders should receive particular attention by clinicians since poor sleep quality can be an early sign of cognitive decline. Further studies should examine whether the poor sleep quality preceding cognitive decline is the consequence of particular sleep disorders or an underlying neurodegenerative disorder.
PS01.115

Neuropsychological assessment of subjective memory complaints in nondemented elderly with or without objective cognitive impairment

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Background: Subjective memory complaints (SMCs) are common in the elderly and may hold value as a predictor of dementia. However, previous studies of SMCs often included those with mild cognitive impairment (MCI). Little is known about SMCs without objective memory impairment.
Method: The participants included 75 outpatients of the memory clinic at Keio University Hospital (39 females; all age> = 65 years, mean age = 75.5±6.3 years) who complained of subjective memory decline without clinically evident dementia. All the participants received brain MRI and neuropsychological assessments including Rey auditory verbal learning test (RAVLT), Rey-Osterrieth complex figure test (ROCFT), logical memory subtest of WMS-R (LM), modified Stroop test (mST), trail making test (TMT) and verbal fluency test (VFT). The geriatric depression scale (GDS) was used to evaluate mood status. The participants were divided into subgroups of 48 persons with MCI (22 females; mean age = 75.0±6.0 years, CDR = 0.5 and MMSE> = 24), and 27 persons with pre-MCI (17 females; mean age = 76.3±6.9 years, CDR = 0 and MMSE> = 27). The pre-MCI was further subdivided into two subgroups of the better memory persons (delayed recall of LM> = 8) and the poorer memory persons (delayed recall of LM<8).
Results: No significant differences were obtained between MCI and pre-MCI in age (75.0±6.0 years in MCI and 76.3±6.9 years in pre-MCI, respectively), education (13.6±2.5 years and 14.1±2.5 years, respectively), GDS scores (4.76±3.1 and 3.8±2.6, respectively), and Z-score of MRI (1.27±0.70 and 0.99±0.55, respectively). In addition, better memory and poorer memory subgroups of pre-MCI were also equivalent in age, education, GDS scores and the degree of hippocampal atrophy. Neuropsychological assessment demonstrated that pre-MCI group showed significantly higher scores in memory (delayed recall of RAVLT and LM) and frontal function (mST, TMT, and VFT) than MCI group. Further analyses of pre-MCI individuals revealed that the better memory subgroup tended to have better frontal functions as well including TMT and VFT.
Conclusions: The pre-MCI persons performed better in memory and frontal function than those with MCI. In addition, better memory pre-MCI persons tended to show better frontal functions than poorer memory pre-MCI persons. Age, education, mood status and hippocampal atrophy are not predictors of cognitive impairments or pre-MCI to MCI progression.

PS01.116

Treatment with association between galantamine and escitalopram in mild cognitive disorder and depression

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Introduction: To evaluate the efficacy of galantamine and escitalopram association in patients with Mild Cognitive Disorder and Depression. So there is a possible relation between the deficit in executive and cognitive cerebral function and depression or relation between the serotonin system and cholinergic system in relation with disease comorbidity cognitive-depression. Galantamine in its pure form is a white powder. Galantamine is a competitive and reversible cholinesterase inhibitor. It reduces the action of AChE and therefore tends to increase the concentration of acetylcholine in the brain. It is hypothesized that this action might relieve some of the symptoms of Alzheimer's.The atomic resolution 3D structure of the complex of galantamine and its target, acetylcholinesterase, was determined by X-ray crystallography in 1999. There is no evidence that galantamine

alters the course of the underlying dementing process. Galantamine has also shown activity in modulating the nicotinic cholinergic receptors on cholinergic neurons to increase acetylcholine release. Along with other cholinergics or acetylcholinesterase inhibitors such as Huperzine A, galantamine also has been used as nootropic or "brain enhancerâ[euro] to enhance memory in brain-damaged adults. Escitalopram is an antidepressant of the selective serotonin reuptake inhibitor (SSRI) class. It is approved by the U.S. Food and Drug Administration (FDA) for the treatment in adults with major depressive disorder, generalized anxiety disorder, and social anxiety disorder. Escitalopram is noted for its high selectivity of serotonin reuptake inhibition and has side effects typical for the SSRI class.

Hypothesis: To evaluate the therapeutic response in patients with comorbility between Mild Cognitive Disorder and Depression in treatment with Galantamine (acetylcholinesterase inhibitor) with Escitalopram (Selective serotonin reuptake inhibitors) and the two drugs associated.

Methods: A group of 705 patients with symptoms of Mild Cognitive Disorder and Depression (DSM IV-TR criteria) were separated in 3 groups of 235 patients. Each group received different treatment in a 12 months period: Group 1: Galantamine 16 mg/day. (Extended release capsules: 16 mg.) Group 2: Escitalopram 10 mg/day. Group 3: both drugs, same dose.

Results: The therapeutic response evaluated in Hamilton Scale for Depression (HAM-D), Montgomery and Äsberg Depression Rating Scale (M.A.D.R.S.), Mini Mental State Examination (M.M.S.E.) and Global Clinical Impression (G.C.I.) scores during 12 months. In the third group who received the two drugs associated, had much better response than the others and "brain enhancerâ[euro].

Conclusion: The group who received the association of the cholinergic agent Galantamine with antidepressant (SSRIs) Escitalopram had a relevant satisfactory therapeutic response: the best result, so there is a possible relation between the deficit in cholinergic systems and depression.

Discussion: Could be cerebral cholinergic systems deficit a generator of Depressive Disorder?

PS01.117

Malnutrition in care home residents with dementia: A complex problem

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Background: Despite the fact that malnutrition is a major problem in all health care settings all over the world, there is still insufficient awareness for its early detection and treatment in daily practice.This also counts for the care home sector. In The Netherlands, the prevalence of malnutrition has become an official outcome indicator of the quality of nursing home care. During the last 5 years several national care improvement programs have been carried out to enhance the overall quality of care in care homes. Within these programs, extra attention has also been paid to achieve a better nutritional care for care homes residents. This presentation specifically focuses on the problem of malnutrition in demented nursing home residents by addressing the following research questions: 1.What is the prevalence of malnutrition in Dutch nursing home residents in 2010 and what is the trend in the prevalence of malnutrition in this specific target group since 2006? 2.What's the prevalence of swallowing respectively chewing problems in malnourished demented nursing home residents? 3.What is the relation between both comorbidity and care dependency and malnutrition prevalence in demented care home residents? 4.Which developments have been taken place in the extent of nutritional screening and treatment of malnourished nursing home residents with dementia? Answering of these questions is possible in a valid way because in The Netherlands, since more than 10 years, an annual national prevalence study (LPZ) is carried out, which measures the prevalence, prevention, treatment and quality indicators of relevant care problems, like pressure ulcers, malnutrition, incontinence and falls in different health care settings, including the care home sector.

Methods: The Dutch LPZ (National Prevalence Measurment of Care Problems) is an annual, independent,

multi-centre, cross-sectional, multimodule, point prevalence study in which a standardized 3-level questionnaire is used to measure the prevalence of malnutrition. On patient level demographic data, (co)morbidity, care dependency, nutritional screening activities and treatment interventions are measured. Malnutrition as such is measured by assessing BMI, undesired weight loss and nutritional intake. To obtain an objective assessment of every patient, two health care professionals (nurses, dieticians or doctors) evaluate each patient. Of these two, one works on the patient's ward and one is an independent professional from another ward. Interrater reliability has been found to be good (Cohen's kappa of 0,87). At institutional and ward level structural and process indicators of nutritional care are assessed. For this presentation the data from 2010 of a nationally representative sample of care homes are used, including 6785 care home residents. For the trend analysis data from 2006-2010 are used. The LPZ is approved by the Medical Ethics Committee of Maastricht University Medical Centre.

Results: In 2010, 6785 care home residents participated in the malnutrition module of LPZ, of which 3562 (52%) suffered from dementia. The prevalence of malnutrition in the residents with dementia was 22,2% whereas this was 20,7% in the total care home population. Comorbidity and care dependency were both positively associated with malnutrition. The higher the number of diseases and the higher care dependency, the higher the prevalence of malnutrition. The prevalence of swallowing problems respectively chewing problems in malnourished residents with dementia was 10,6% and 11,9%. Comparing 2006 and 2010, significantly more care home residents with malnutrition were screened for their nutritional status in 2010 and also the extent of nutritional intervention was considerably higher in 2010. This also counts for malnourished residents with dementia. Looking to the overall care home population, the prevalence of malnutrition (2006-2010) shows a gradual but progressive decline over the years, while the malnutrition prevalence in demented residents remains rather stable.

Conclusion: Malnutrition is a relevant and important problem in demented care home residents and requires sufficient awareness from health care professionals. Of course, attention has to be paid to providing both adequate nutritional care as well as oral health care. Nevertheless, solving this problem seems to be rather complex. That malnutrition prevalence, despite increasing nutritional attention in daily practice, remains the same over the years, raises the question whether the phenomenon of Alzheimer cachexia should receive renewed scientific attention, because this might explain the possible therapeutic resistance and the potential untreatable nature.

PS01.118

EXBELT: Belt Restraint Reduction in Psychogeriatric Nursing Homes

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Background: The use of physical restraints still is common practice in nursing home care of older people with dementia. Physical restraints are defined as any limitation in an individual's freedom of movement and include for example belts, full-enclosure bedrails, and infrared warning systems. Although reports of restraint prevalence internationally varies from 15 to 66%, ranges of restraint prevalence in Dutch nursing homes is between 41 to 64%. Recent prevalence measures in the Netherlands have shown that 10% to 14% of nursing home residents are restrained with belts. Since physical restraints have been shown to be an ineffective and even hazardous measure, interventions are needed to reduce their usage. Several attempts have been made to reduce the use of physical restraints. However, the success rate of these interventions has been inconsistent. We developed a new multi-component intervention (EXBELT) comprising an educational intervention for nursing home staff in combination with a policy change (belt use is prohibited by the nursing home management), availability of a nurse specialist as consultant, and availability of alternative interventions.

EXBELT is primary focused on reducing the use of belt restraints. We tested the effectiveness of EXBELT by addressing four questions: 1. Does a tailored multi-component intervention (EXBELT) result in a reduction of belt use in nursing homes? 2. Does EXBELT reduce the use of other types of physical restraints and psychoactive drug use? 3. Does belt elimination result in an increase of falls and fall-related injuries? 4. Does EXBELT prevent the use of belts in newly admitted residents?

Method: The EXBELT program has been evaluated in a quasi-experimental longitudinal study. A total of 26 wards from 13 Dutch psychogeriatric nursing homes, including 714 cognitively-impaired residents, were assigned to the intervention or control groups. The primary outcome measure was belt restraint use; this was measured at baseline, and after four and eight months of follow-up. Belt use and other types of physical restraint use was recorded by a single trained observer, blinded to group assignment, four times during a 24-hour period using an observation tool. Data on psychoactive drug use were collected from the residents' medical records. Falls and fall-related injuries were recorded using the register of falls that Dutch nursing homes are required to maintain. Only complete sets of data from residents were used and analyzed according to the intention-to-treat principle. We used chi-square tests for categorical variables and independent-samples t-tests for outcome variables at interval and ratio level. In addition, generalized estimating equations (GEE) techniques were used to estimate the effect on the main outcome variable (belts use) while adjusting for baseline characteristics and dependence among measurements (age, gender, psychoactive drug use, falls and nursing home).

Results: A total of 714 residents were eligible for participation in this study and informed consent was obtained from the legal representatives of 520 residents. After eight months of follow-up, 115 residents had dropped out. Main reason for drop-out was death. Complete data were available (all three measurements) for 405 residents and were used in the analyses. Results show significant between-group differences with regard to the use of belts at eight months (19% in the control and 9% in the intervention group; odds ratio = 0.44; $p = 0.006$). The use of full-enclosure bedrails and sleep suits was also reduced after eight months in favor of the intervention group ($p = 0.001$ and $p = 0.006$, respectively). No significant differences were found regarding the number of residents who sustained a fall, fall-related injuries (including fractures), and use of psychoactive drugs. During the period between baseline and four months follow-up, 104 residents were newly admitted. Of these, 49 were present at both follow-up measurements and their legal representatives agreed on participation. At 8 months, 20% of the 'new residents' in the control group used belts and 0% in the intervention group ($p = 0.01$). There was no increase in the use of other physical restraints, psychoactive drugs use, falls and fall related injuries in the intervention group.

Conclusions: This study shows that reduction and prevention of belt use is attainable, without an increase of psychoactive drug use, falls and fall-related injuries. However, we should be careful about attributing the success of EXBELT to specific components of the intervention. The success of the intervention lies in the combination of all components of EXBELT, including the education program which in fact provides the foundation for the all other interventions.

PS01.119

Changes in liver enzymes in the use of neuroleptics in old age

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Overview: Organic anxiety disorder characterized by mood swings, often in the direction of euforic, irritability, insomnia, verbal conflicts with other patients. Changing affects directly caused by brain or other somatic distress The patient is impatient, interfere with patients in the room so often in conflicts with them. In this way most often intherapeutic targets and we use haleperidol respiridon as neuroleptic. Using ciljanin neuroleptic symptoms on the patients withdrawn rapidly. Aim of the work - to see what effect have neurolepticite, haleperidolrespiridon and on hepatic function in elderly patients in value, whether given changes in hematological status, the status of proteins, fats and enzymes.

Methods: Retrospective examined are: 120 Patientes, 82 Women and 38 Man.They are from 65 till 87 years old.In a period of 3 years they are taking continuous tablets haloperidol and risperidon - Because it is an old population of patients each month makes a complete blood count with the investigation of enzyme status due tochanges in hepar ASAT, ALAT, LDH and CPK, complete protein status of the total direct and indirect bilirubin Control group patients who do not receive neuroleptic. Result - The results are presented according to age, sex of the patient, how long it took neuroleptic, whether at the same time and took another neuroleptic. The results saw that no significant changes in liver enzymes

Conclusion: The results show that no changes in liver enzymes so that the choice of drug and dose which is made in the treatment ofanxiety disorder is organic fine against age. Treatment is given for several months with the aim of losing sympotmatology. Often the neuroleptic off, but in cases where it is not possible to leave maintenance dose.

PS01.120

The Rapid Assessment, Interface and Discharge model (RAID): An innovation in mental health

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Overview: Outline of the RAID model *£1.2 million pounds was made available for an 18 month pilot Liaison Psychiatry service, launched in December 2009. *The service consists of a 24 hour, single point of contact, multidisciplinary, multi-subspeciality, team operating under a single management and clinical structure.

Aim: To demonstrate that comprehensive, rapid response Liaison Psychiatry can reduce costs by improving quality of care and service delivery. *The team provides specialist assessment and management of mental health, substance misuse and psychological needs in all patients over 16yrs. *The future funding of the team is dependent upon research and evaluation demonstrating cost reduction and quality improvement. *This service has received accreditation from the Psychiatric Liaison Accreditation Network (PLAN) (Royal College of Psychiatry). *The team has the won the prestigious Health Service Journal (HSJ) award for innovation in mental health (2010). Objectives of the new service *To improve access to prompt skilled mental health assessment and treatment, including early intervention, promoting recovery and well-being *To provide equitable treatment in response to the patient experience rather than being designed on the basis of professional training or subspecialty. *Responding to the social determinants of mental illness and previously marginalised and difficult to reach populations who often present in crisis to an acute medical hospital. *To provide one point of contact and access for all the acute general hospital referrals in relation to specialist assessment of mental health, substance misuse and psychological needs, including those for older people. *The service has an emphasis on rapid response, with 1 hour response target for all referrals received from accident and emergency and 24 hour for all referrals received from the wards. *To facilitate early but effective discharge from hospital for patients seen by the team.

Method: Cost was examined in terms of length of stay, re-admissions and admission avoidance for three subject groups: 1.Patients directly seen by RAID. 2.RAID influence patients (not directly seen by RAID but managed by acute colleagues that had received training/support from RAID) 3.A retrospective control group The method used to calculate length of stay was Retrospective Matched Control Study; Length of stay has been compared through a paired matching between the RAID group versus the Retrospective control group and the RAID influence group versus the Retrospective control group. The groups were matched for; age, sex, period of admission, HRG code, main diagnosis and ICD-10 codes Quality was measured through questionnaires, training evaluation and team functioning e.g. response time targets using a 'Discharge Outcome Form'.

Results: External validators of quality within the pilot period included PLAN accreditation and RAID winning the

Health Service Journal award for innovation in mental health 2010. Length of stay was reduced by 14,156 bed days over an 8 month period equivalent to 60 beds per day (or 3 wards). Estimated cost savings £4.5 million over 12 months. Results showed a decrease in re-admissions from 15 per 100 (controls) to only 4 per 100 for the RAID group. 1200 readmissions were saved over an 8 month period, estimated cost savings of £5.4 million over a 12 month period. Admission avoidance was significantly increased with 202 patients discharged at the point of MAU after RAID involvement, saving £454,500.

Discussion: Data was independently collected and analysed regarding cost savings and focused on three areas: reduced length of stay, reduced re-admissions and admission avoidance at the point of the medical assessment unit (MAU). Combined saving are estimated at 10 million. In addition, a high level of quality was evident as the team proved to provide a rapid response.

Conclusions: This study shows that the RAID model is effective in rapid response, reducing length of stay, readmission and admission avoidance of patients with mental illness in acute hospital. Savings are shared between acute hospital and primary care trusts.

PS01.121

The RAID liaison psychiatry model: Older adults in an acute hospital, how can quality and outcomes be improved?

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Overview: Older adult referrals make up a substantial part of the workload of the RAID team. The national dementia strategy (NDS) has outlined several key objectives for patients with dementia, including early diagnosis, intervention, information, easy access to care, support and advice and good quality of care within general hospitals. Research suggests that over a third of people with dementia who go into hospital from living in their own homes are discharged to a care home, leading to poorer outcome for patients. This service evaluation aimed to examine the service provided, readmission rates, length of stay and discharge destination of older adults referred to the RAID team.

Aim: Research suggests that over a third of people with dementia who go into hospital from living in their own homes are discharged to a care home, leading to poorer outcome for patients. The aim was to examine the service provided and discharge destination of older adults referred to the RAID team.

Method: ICD 10 diagnosis, discharge destination and clinic data for all older adult referrals was collected. External data from the information technology department was requested regarding discharge destination and diagnosis of dementia in the hospital in general. Teaching and training provided was evaluated using questionnaires.

Results: An increase in the diagnoses of vascular and unspecified dementia was observed, with a 22% increase compared with the number of patients diagnosed in the same month in 2008/09, before RAID. Of the patients diagnosed with dementia, 27% of patients, carers, family or staff were given education regarding dementia and 60% of patients were either signposted or directly referred onto other services by the RAID team. Teaching was provided regarding dementia, delirium, depression, dignity, psychosis and managing challenging behaviour and was well received by staff, with staff feeling their practice would be improved. Over 7 months clinic appointments were offered to 32 patients with a 53% attendance rate. Of patients that had originally come from their own home, 47% of patients in a control group (pre-RAID), 47% from an influence group (a parallel group, influenced by teaching, training and presence of the RAID team) were discharged home compared with 80% of older adult patients seen by RAID.

Discussion: Overall, the implementation of the RAID Liaison Psychiatric model has increased the identification of ICD 10 diagnosis, demonstrated reductions in readmissions and length of stay. Furthermore, teaching and

training provided improved staff knowledge and practice. Lastly, the majority of patients who had contact with the RAID team were more likely to be discharged to their own homes than all other older adult patients, improving outcomes for the patients. Although the savings to the wider health economy have not been calculated, this is an area where further analysis is currently being undertaken.

Conclusion: Findings suggest that the implementation of the RAID model has facilitated patients to return to their home after their stay in hospital, has increased awareness and diagnosis of dementia in the acute hospital through providing education, referral and outpatient clinics to patients over the age of 65 years and has had a positive impact on readmission rates and length of stay, with associated cost benefits.

PS01.122

How to redesign a dementia service

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The global economic impact of dementia can bankrupt healthcare systems. Dementia spend amounts to one percent of global Gross Domestic Product. 70% of the costs are incurred in Western Europe and North America. There will be an 85% increase in costs by 2030. International trends suggest that dementia healthcare planners need to focus on certain interventions including prevention, timely intervention, integrated pathways, 'reframing' and dementia friendly communities. A case is made as to why 'more of the same' is unsustainable. In England, reasons why there needs to be urgent change include a widening of inequalities, quality variations are unacceptable, systems are too complex for patients to navigate, insufficient investment in prevention, and service costs which are rising faster than income. In other words we continue to procure services that don't work, and our public have little confidence in our healthcare services for dementia. There are only limited options to change this, including reducing costs, or service redesign. A new initiative in England to address this coined QIPP, which stands for Quality, Innovation, Prevention and Productivity, will form the new 'evidence' complementing evidence based medicine. QIPP will assist us to address the biggest challenge of this decade. To improve the quality of our dementia services, with less funding. To do so we must consider a number of innovations including doing new things, stopping ineffective older practices, and doing things early or 'upstream'. This entails change on an industrial scale. Transformational change and not accidental or incremental change. Transformational change involves reconceptualisation &discontinuity from the initial system, is radical rather than incremental, and often involves risk. The West Midlands Dementia Strategy is a blue print for an English region with six million inhabitants. The strategy's vision, standards, recommendations and 'products' incorporate an unique integrated pathway with innovative transformational service redesigns. This pathway template can be adopted easily and is already successfully incorporated into many local services 2 years into implementing our strategy. This ground breaking pathway incorporates a number of 'attachments' to ensure that it is self propelling and well balanced. These include a tariff to incentivise prevention/early interventions, workforce recommendations, a peer review quality assurance system, and appropriate metrics. Three examples of 'upstream interventions' from our pathway include: 1) a 'Digital Ecosystem' including apps, digital transactions, signposts, blogs, resident on-call and resources aimed at both service users and the public. 2) a prevention and early intervention programme aimed at starting at age 50, and includes risk stratification tools, preventative interventions and monitoring systems. The savings incurred from delaying the onset of dementia in a very complex modelling paper (submitted for publication) have been costed and make a compelling case to urgently consider this as an approach that is difficult to ignore. 3) a dementia awareness pack for schools, available and downloadable now on our digital platform. The pack includes 4 films, a PowerPoint presentation and a lesson plan for school children aged 13 years old. Lastly, there is increasingly useful European research on framing and reframing in dementia. This will help us pitch our message accurately contrary to what is happening now. There is a strong case for rebranding dementia. Such innovations will contribute to underpinning a contemporary dementia service and should be incorporated in national dementia plans. The key to a dementia pathway is diagnosis. We add to this that the entire pathway will be out of balance

without the appropriate 'upstream' interventions. A number of recommendations can be drawn at the close of this talk to guide service redesign globally.

PS01.123

Exploring the potential of volunteers in aged care facilities

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Background: Recent literature reviews have shown that sensory interventions (e.g. aromatherapy and hand-massage), one-to-one social interaction, music, recreation therapy and videotapes of family members were successful in reducing behavioural and psychological symptoms of dementia. The largest effects were found when treatments were tailored to the backgrounds, interests and skills of participants, such as Montessori-based activities. Despite this evidence base, personalised one-to-one activities are rarely implemented in practice. Difficulties with implementation may be related to the activities' time-consuming nature, low staff numbers and lack of training in nursing homes. Family carers often wish to remain active in the lives of relatives after they move to long term care facilities, but they seldom implement activities as part of their visits. The aim of this descriptive study was to explore the experiences, characteristics, motivations and interest in innovative methodologies of volunteers in aged care facilities (ACFs).

Methods: We invited all ACFs (n = 23) in the Melbourne south-eastern metropolitan area (Australia) to participate in the study. Seventeen managers/ directors of nursing and a sample of 40 volunteers across the facilities were interviewed. The interviews were taped and transcribed. The interviewer also provided summaries for every interview. Two independent researchers categorised the replies per theme and discussed discrepancies to reach acceptable agreement.

Results: Six out of 23 facilities (26%) did not employ volunteers. The other facilities worked with between 1 and 18 volunteers with an average of five per site. The majority of volunteers had initiated contact with facilities to inquire about providing assistance or were recruited using local media. Volunteers often had a relative living in the facility or were looking for useful ways to utilise their time after retirement. The main motivations for volunteering were: contributing positive experiences to people's lives, sharing conversation, Christian values and using and developing one's skills. Their top five activities with residents included outings, walks, one-to-one conversations, craft groups and games such as bingo. Volunteers often developed friendships with residents and were frequently perceived by staff as a highly valued extra pair of hands. However, some volunteers imposed more work on staff, for example, because they were in need of company themselves or became overly familiar with residents. On the other hand, volunteers across facilities expressed a preference for more task and role clarity. Often volunteers and sometimes staff members felt that volunteers were more aware of particular clients' needs as some had been working at facilities for a long time, which at times contrasted with the frequent turnaround of staff. A large majority expressed an interest in learning new methods to interact with residents.

Discussion: This study showed that a large majority of ACFs engage with multiple volunteers. Their presence is generally perceived as positive by both volunteers and facilities. Most volunteers expressed interest to learn new, innovative ways of interacting with individuals with dementia. Thus, this group is a potentially large resource to implement a more ambitious range of activities where volunteers could be asked to engage with residents in evidence-based activities designed to improve residents' mood and alleviate agitation.

PS01.125

The relationship between care practice organization and quality of care in long term care facilities in Europe

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Background: Care practice in long term care differs across countries in Europe. In the northern European countries health care policies focus on demand-oriented health care, while health care in the southern European countries tends to be more supply-driven. These differences in health care policies are also reflected

in long term care practice, size, and organization of facilities: In southern European countries relatively more large size institutional facilities provide care to the elderly, as in the north relatively smaller facilities, or small scale living facilities, situated in the community, provide long term care. The European Observatory on Health Systems and Policies supports and promotes evidence-based health policy-making through comprehensive and rigorous analysis of the dynamics of health care systems in Europe. Until now no international studies have been executed to explore intercultural differences in long term care organization and services, and its' implications. It is not known what these country specific differences in long-term care practice organization imply for the quality of care in facilities. In this study we explore the question whether cultural differences in care practice organization are reflected in the quality of care provided in long term care facilities in Europe. Differences between European long-term care facilities and the relationship between country specific organizational characteristics of long-term health care on patient outcomes will be studied. Methods: This study is part of the Services and Health for the Elderly in Long TERm care (SHELTER) study, that aims to validate the Minimum Data Set (MDS) for long term care residents (interRAI-LTCF) as a methodology to assess the provision of care in long term care in Europe. The study will lead to the first, cross-national European database of long term care residents (Shelter database) containing information that was previously not available on residents typology and outcomes, quality measures and services characteristics. The SHELTER study takes place from January 2010 until December 2011. Longitudinal data on patient health status were collected by trained nurses. The assessment period was one year and patient information was collected at baseline, after 6 months, and after 12 months. At baseline 4156 patients were included, from 59 long term care facilities. The study took place in the Czech Republic, the United Kingdom, Germany, Finland, France, Israel, Italy, and the Netherlands. Patient health status was comprehensively assessed with the interRAI-LTCF and registered in the digital SHELTER database. Patient assessment with the interRAI-LTCF provide quality indicators (QIs), and validated scales on patient functioning, like: Cognitive Performance Scale (CPS), three Activities of Daily Living scales (ADL), Depression Rating Scale (DRS), Revised Index for Social Engagement (RISE), and Changes in Health, End-stage disease and Symptoms and Signs (CHESS). Reasons for patient discharge were also registered. At baseline a separate, standardized form was send to participating facilities to collect information on facility size, units, ownership, staff formation, staff education, services, and care processes. Results: We will report on preliminary results of country specific differences in long term care in Europe, on benchmarking of QIs on a country level. Preliminary results on the relationship between facility characteristics and patient outcomes shall also be presented.

PS01.126

A clinical dashboard within older persons mental health services

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Overview: The aim is to describe the findings from a study investigating staff attitudes towards a new clinical dashboard system that had been implemented within Older Persons Mental Health Services, Northumberland Tyne and Wear NHS Foundation Trust (NTW). Criteria to achieve accreditation with the Royal College of Psychiatry Accreditation for Acute Inpatient Mental Health Services - Older People's Services (RCPsych AIMS-OP) metrics were also tracked.

Introduction: The 'clinical dashboard' is a toolset of visual displays developed to provide clinicians with the

relevant and timely information they need to inform daily decisions that improve quality of patient care. The clinical dashboard provides clinicians with easy access to multiple sources of data being captured locally, in a visual, concise and usable format. The sources for the data included the electronic patient record used within NTW. The development of clinical dashboards was a key component from the National Health Service (NHS) Next Stage Review and the Health Informatics Review. Dashboards display locally relevant information alongside national metrics in a visual display. NTW was the mental health pilot site in the NHS Connecting for Health Clinical Dashboard Pilot programme (January 2009- November 2010), which was successfully implemented. To develop the metrics for the pilot close cooperation between; clinical team members, NTW management, NTW informatics, members of the NHS North East Strategic Health Authority informatics team and the national clinical dashboard team was required. It involved the use of a number of different sources to deliver the metrics. Two workshops were used to develop the metrics. The first workshop involved a multidisciplinary team representing clinicians from the areas, involved in the pilot. The second workshop involved the clinical lead, Informatics and management representation. The second workshop incorporated clinician's suggestions the NTW Trust Contract, the Commissioning for Quality and Innovation (CQUIN): indicators and RCPsych AIMS-OP list into this list of metrics

Aims &Method: To explore the experiences and attitudes of mental health professionals to a new clinical dashboard system. A questionnaire was completed across three clinical areas within involved in the Clinical Dashboard mental health pilot. Also baseline measures from the RCPsych AIMS-OP were tracked.

Results: Members of staff completed the questionnaire 3 months after the initial implementation. Providing timely access to information, increased levels of communication, information sharing, and staff awareness, and improvements in data quality were identified as potential benefits. Within the pilot, we have shown a 10% reduction in length of stay on the pilot wards. Two of the RCPsych AIMS-OP metrics improved: a recorded Multidisciplinary Team Meeting (MDTM) and recorded falls assessment (FA) with a subsequent in improvement in quality. The numbers of MDTMs' increased from 54% at baseline to 94% at 6 months. The numbers of FAs' increased from 0 % at baseline to 82% completed at 6 months.

Clinical Implications: The clinical dashboard has a number of benefits within older adult mental health services. The clinical dashboards' potential to improve quality programmes, e.g. RCPsych AIMS-OP, is evident within 6 months of commencing the pilot. Future plans involve a NTW roll out, via the NTW improving teams programme and include; patient view, my dashboard view, workforce view and quality and performance view.

PS01.127

Clinical leadership in psycho-geriatric service delivery: A UK perspective

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Introduction: The needs of the aged are increasing, yet our financial resources may not suffice to meet the demand. Rather than succumbing to the inevitable spending cuts of an unpredictable economy, there may be an argument to explore the value and benefits of clinical leadership in the existing models of service delivery available today. 'Clinical Organizational Leaders' has been outlined as a priority in several recent health care welfare reform policies and the current modernization agenda in the National Health Service (U.K.). But there is a sense that although clinical leaders are ad hoc and inherent, they are on the decline. The 'Leadership' initiative is important in the field of psycho-geriatrics given the various changes this specialty has undergone over the years. The most prominent change has been an increase in the focus on community based treatment models and functional teams such as community mental health teams, home treatment teams and crisis teams. This in turn has led to the closure of in-patient wards, the consequences of which has led to staff changes, poor staff morale, staff recruitment and retention problems. Challenges, Costs and Benefits of Clinical Leadership Many older patients with mental health problems have severe long-standing psychopathology and complex social needs. A key leadership challenge in this speciality is to bring relevant services including both health and the voluntary sector together at the right time based according to patient need, ensuring a smooth transition

along a specific patient pathway. The biggest benefit of clinical leadership could be that this may have a direct implication in improving performance indicators or clinical outcomes in health care. Benefits of improved performance of health care institutions can be learned from a number of pioneering institutions such as 'Kaiser Permanante' in the United States and from research evidence in the United Kingdom. Making clinician doctors as organizational leaders will raise the profile of medical leadership in the NHS, something which is lacking currently. Leadership can be seen as the answer to recruitment and retention problems of the most valuable asset within this specialty which invariably are the dedicated staff whose contributions can never be understated. Perhaps the biggest challenge or cost in achieving our aim towards clinical leadership would be a change in the conventional view amongst ourselves that clinicians are responsible for patient care where as the managers or administrators are responsible for the organisational changes. Or in other words creating a culture of "we are in this togetherâ[euro] is the task ahead.

Conclusion: Clinical leadership will be the stepping stone towards delivering high quality psychogeriatric services in the future. As a profession we need to think more about leadership and encourage a culture of developing leadership in clinicians who can lead. The benefits of making clinicians organisational leaders far outweigh the costs involved in making them. Therefore leadership programmes should be made a part of basic clinical and higher psycho geriatric training. Leadership in the context of psycho geriatrics cannot be understood from an individualistic approach alone. Rather a 'distributed leadership' model may be the answer in such a complex speciality given the various skills required to run a successful service. This will also enable frontline clinicians to make decisions locally in line with the organisational aims without excessive beaurocracy. 'Measurability' of an effective clinical leadership continues to be debatable. But the focus should be on the impact 'Leadership' makes, such as clinical outcomes and patient satisfaction.

PS01.128

Service Evaluation: Impact of routine specialist assessments over a two years period in Elderly Mentally Infirm (EMI) care home vs. standard care

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Overview: Lightmoor View Care Home is a 75 bedded nursing home for the elderly in Lightmoor, Telford. The home provides facilities mainly for elderly mentally infirm (EMI) residents suffering from dementia. Residents at this care home have access to regular monthly input by specialist mental health services. This input was in the form of regular monthly clinics held at the care home by a consultant psycho-geriatrician during two years period from April 2008 to April 2010. Care home staff had opportunity to timely discuss their resident's problems with the specialist mental health team with regular follow-ups. Our intention was to offer best management in the community, so preventing mental health crisis and hospital admission. Two years outcome from this care home regarding mental health crisis and subsequent admission to local psychiatric hospital were compared with St Georges Park, another EMI nursing home in the same locality. Instead of having a regular monthly clinic, patients were only seen on ad-hoc basis with no routine follow ups by consultant psycho-geriatrician during the same period.

Study Objective: We wanted to ascertain if routine specialist assessments in the community prevented psychiatric crisis and in-patient admission to a local psychiatric facility, Shelton Hospital.

Methodology: Adopting a single point of access system for referrals, during this time period, Lightmoor View Care Home residents were referred to psycho-geriatrician by general practitioners. Residents were assessed by the consultant once a month with nursing staff and carers/ relatives. During those consultations, management plans were formulated, specifying therapeutic interventions. These care plans were shared between the care home, psycho-geriatric team and the general practitioner, highlighting effective co-management of residents'

problems. Mental Health Act Section 117 aftercare meetings were also held with the relevant social workers. Throughout, residents received no formal community mental health team input; however some were seen by a memory clinic nurse.

Results: Over a period of 2 years, in total 89 referrals (64 females; 25 males) were received from the Lightmoor View Care Home either by correspondence or over the phone. Prior to each visit, a consultation was made with the care home staff. Residents referred were between 60-95 years of age and had a formal diagnosis of Dementia. Analysis of the data revealed that the maximum (49%) of referrals was for medication review whereas 33% referrals were for advice over management of challenging behaviour. 18% referrals were for other reasons such as respite management, review of mental state, capacity assessment and Mental Health Act section 117 aftercare reviews. Out of 89 referrals, from the Lightmoor View Care Home, we had only 2 in-patient admission compared to St Georges Park EMI Nursing Home, from where we had in total 9 in-patient admissions over the same period.

Discussion: Provision of a timely routine specialist assessment service at the care home prevented crisis from arising and kept in-patient admission rate very low compared to the care home where this service was not available. This also helped to prevent the multiple accommodation moves. Residents therefore had a better quality of life, staying, within their familiar environment. Feedback about the services, from carers/relatives was also positive. One of the critical observations was the positive impact to service users, carers and staff of timely intervention, education, reassurance and availability of an integrated infrastructure of support to bridge social and health care gaps. The importance of early intervention which includes supportive diagnostic and therapeutic interventions cannot be ignored. It could be argued that the threshold for complex behaviours is raised as a direct result of effective joint working.

Conclusion: We believe, it is imperative that specialist care is provided to care home residents in partnership with general practitioners and social services to improve the quality of life for people suffering from dementia. This is in line with the National Dementia Strategy (1) and the Darzi Review (2) recommendations.

References: 1. Darzi, A. (2008). High Quality for All: NHS next stage review final report. London NHS, June 2008. 2. Department of Health. (2009). Living well with dementia: A National Dementia Strategy.

PS01.129

Why are antipsychotics and benzodiazepines used in nursing homes and what are the roles of health care professionals and relatives when they are used?

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Background: It is well established that psychotropic medication, in particular, benzodiazepines and antipsychotics, is over-used in many nursing homes. A preliminary cross-sectional study of over two thousand Tasmanian nursing home residents during 2006, found that over half were taking regular doses of an antipsychotic and/or a benzodiazepine. The present study aimed to investigate why these drugs are prescribed and define the roles of health professionals and relatives when these medications are used. Such information is vital for our understanding of psychotropic medication utilisation and is also necessary to shape interventions aimed at reducing inappropriate use.

Method: A qualitative methodology was adopted using semi-structured interviews with ten registered and enrolled nurses, five GPs, five pharmacists and ten relatives from five nursing homes in Hobart, Tasmania. Data was analysed thematically with the assistance of NVivo8 software.

Results: Emerging themes suggest that GPs rely almost exclusively on nursing staff for the assessment of behavioural and psychological conditions in nursing homes, and often feel pressured to prescribe psychotropic medication by them. GPs had mixed beliefs about the effectiveness of antipsychotic and benzodiazepine medication to treat BPSD. Among nursing staff there were also mixed opinions about the effectiveness of psychotropic medications to manage old age mental health conditions, with some of the nurses commenting

that these medications made residents considerably more 'settled' and improved their quality of their life. In contrast, other nurses questioned whether these medications made much difference in a significant number of residents. Nurses appeared to have a strong influence in psychogeriatric management and many felt that assessment of mental health conditions was their role, despite limited training. Many nurses recalled instances of poor communication between GPs and nursing staff around medication use. This issue was often related to poor GP access to nursing homes. The majority of health professional respondents were not aware of specific guidelines relating to psychotropic use or good-practice management of psychogeriatric conditions, with regular review and dose reduction of psychotropics, as recommended in national and international guidelines, occurring very infrequently. Most of the health professionals stated that they were reluctant to alter psychotropic medication doses or taper use for fear that behavioural symptoms would escalate. The majority of health professionals acknowledged that more one-to-one interaction with residents and non-pharmacological strategies would reduce psychotropic usage. However, in the current environment with staffing and resource limitations, the ability to provide personalised care to residents was restricted. Relatives were generally supportive of GP and nursing staff decisions to use psychotropic medication. In many cases they had managed the mental health conditions of their relatives for many years prior to nursing home admission and they were relieved to hand over medical care to health professionals. Relatives were mostly informed retrospectively about changes to psychotropic medications by nursing staff and did not appear to influence decisions to use these medications. Pharmacists had limited impact on psychotropic medication usage and reported resistance to recommendations to reduce use from both GPs and nursing staff.

Conclusion: Guidelines on the management of psychogeriatric conditions need active promotion. Training on non-drug management of old age mental health conditions and the risks and benefits of psychotropic use is required for nursing staff, in particular, who largely appear to influence use. The involvement of nursing staff in medication review processes is vital. Increased staffing and effective strategies to promote review of antipsychotic and benzodiazepine medications are required to reduce the high rate of use in this setting.

PS01.130

A critical analysis of adult safeguarding practices in NHS mental health services

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Overview: A critical analysis of adult safeguarding practices in NHS mental health services This poster presentation will feature a PhD research project designed to explore adult safeguarding practices in NHS mental health services. It will briefly review existing literature relevant to this area, highlighting the immediate need for empirical research. This will be followed by an overview of the proposed methods of data collection and analysis for the study. Finally, the concluding section of the poster will provide an outline of the expected uses and benefits of the findings of this study. Safeguarding is the U.K's response to abuse and neglect, which involves a national effort to implement policies, procedures, and practices within our national services to ensure the adequate protection of vulnerable people. Since its inception, many services appear to have embraced the concept of safeguarding, with evidence highlighting improvements to practice in services for children, older adults and adults with learning disabilities. However, despite the vulnerability of some mental health service users, as highlighted within the 'No Secrets' guidance 2000, mental health services appear to be resistant to change and 'reluctant to tackle the problem of abuse' (Williams &Keating, 2000, p32). As the number of reported cases of adult abuse in mental health continues to rise, it is clear that a critical examination of adult safeguarding practice in mental health services is paramount. The prevailing body of literature that examines adult protection work or safeguarding adults practice focuses predominantly on learning disabilities services. Consequently, explanations offered for the neglect to adult protection work in mental health, tend to be based on commentary unsupported by empirical data. Indeed few studies have been identified that empirically explore adult protection work or safeguarding adults practice in a mental health setting. A study carried out by Brown &Keating (1998) identified resistance of mental health staff to adult protection work, revealing that participants

viewed the application of generic adult protection policies and procedures as inappropriate within a mental health setting. In addition a number of barriers to adult protection work perceived to be specific to mental health settings were identified. A more recent study carried out by Rees &Manthorpe (2010) found that in general the development of adult protection practice, policy and legislation in a small number of residential adult mental health and learning disability units, was perceived to have had a positive impact. However, the data gathered revealed a disruption to the provision of services in addition to the increased levels of stress reported by residents, staff and managers as a result of the newly implemented policies. These studies highlight the challenges faced by mental health staff when attempting to integrate adult protection practice and policies within already established structures and suggest a 'translational gap' between policies and procedures and their practical application (Tansella &Thornicroft, 2009). It is therefore suggested that in-depth exploration of the implementation, development and use of current adult safeguarding practices in mental health services is required. This will provide an advanced understanding of keeping adults safe in mental health care and help to bridge the gap between adult safeguarding policy and practice in mental health services.

PS01.131

Working group for clinical excellence in a department of old age psychiatry

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Background: Implementing evidence-based care in clinical practice is a highly prioritised area of modern medicine. In the Norwegian South-Eastern Health Authorities region a substantial amount of professional and financial resources has been targeted against such implementation. The evidence for such implementation is scarce, and there are, to our knowledge, no established model for this. The result is that a variety of models for implementing evidence based practice have appeared. We want to present current experience with a working group in the department of Old Age psychiatry. The working group was started in 2007. The aim was to establish a common clinical practice throughout the Department's units, which are spread over a geographical area equivalent to the size of Denmark, using evidence based knowledge and clinical experience. Four groups were formed. The groups were multidisciplinary, comprising consultant psychiatrists, psychologist and the clinical developers from each of the different clinical units. This allowed each unit to pose relevant clinical questions. Methods for evidence based data collection could be used in everyday clinical practice. By involving key people from each unit, we had wanted to implement new practice more easily. The four areas of clinical focus were: 1. Dementia, diagnosis and treatment. Relatives/carers of patients with dementia. 2. Dementia, effects of non pharmacological interventions in BPSD. 3. Anxiety and affective disorders. ECT. Treatment combinations. Effect of different psychotherapies. 4. Delirium. Psychosis, if not previously diagnosed dementia.

Methodology: Initially, the members of the working group were trained in techniques for retrieving scientific literature, the grading of evidence and critical appraisal of articles. The members were also trained in formulating precise questions, using the PICO-approach (Patient-Intervention-Control-Outcome) on the basis of relevant clinical situations. Guidelines and systematic reviews in the targeted fields are preferred, although these may be missing in many fields of old age psychiatry. In such cases single interventions, reviews and case reports are appraised critically. The working group does not aim at developing systematic reviews; rather systematically identify current knowledge within the field. Recommendations, with respect to each clinical question, are documented using special forms developed by the working group and published on the hospital's intranet, thus available for all employees within the Hospital Trust,. Considerable efforts have been carried out in order to implement the recommendations in the wards. The group's work is regularly evaluated. The members filled out a questionnaire prior to the start in 2007, and again in 2010 in order to measure the members' experience with, and attitude to, the working group.

Results: To date the working group has published six unique recommendations for the department. These are: 1. The Treatment of Delirium 2. Bright Light Therapy in Dementia 3. The Validity of Lawton's I-ADL-scheme 4.

Clock Drawing Test - Which Model Should Be Preferred? 5. Maintenance Treatment in Geriatric Depression 6. Delusional Jealousy in Non-Demented Patients and its Prognostic Impact on Developing Dementia After three years the members have become more trained in retrieving relevant literature, and consider they more qualified in finding literature that answers their clinical questions. They also use significantly more of their time at work on retrieving evidence and using evidence-based databases. The recommendations from the working group are only known to a small extent among the employees within the department. This remains the main obstacle of the group's work.

Conclusion: All the groups have provided recommendations within their clinical areas. The groups' members have experienced increased competency, and spend more time on evidence based knowledge. The attitude within the working group has remained positive throughout the period. The main challenge is to implement the recommendations in the wards, and integrate these in clinical practice. The medical staff has been more able to implement recommended changes in practice. It remains a challenge to implement recommended changes for nursing staff in the wards. We need to know more about the factors for successful implementation of evidence based practice and the barriers that create resistance to change.

PS01.132

Caregiver burden and utilization of social welfare services of elderly dementia patients in Korean long-term care insurance system

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Background: In 2010, the prevalence of dementia reaches 8.76% of elderly population which has been rapidly increased in Korea. The rapid increase of dementia patients raises many social issues with the conspicuous trend toward nuclear families and the participation of social activities of women which decreases the ability to help fragile elderly in their families. Therefore the Korean Government has been carried out the long-term care insurance system since July 2008. This study aims to evaluate caregiver burden and utilization of social welfare services of elderly dementia patients in Korean Long-term Insurance System.

Table 1.

Results

For details of Clustering see Figure 1

Methods: Among 4,542 elderly persons who carried out neuropsychological test and were evaluated by psychiatrists at the centers for dementia at Seoul, 684 persons were received the evaluation with grade assessment tools of Korean Long-term Care Insurance System. They were classified as 76 normal persons, 101 persons with high risk for dementia,; and 507 dementia patients. We analyzed the data of 145 dementia patients who completed MMSE-KC, CDR, caregiver burden scale of centers for dementia, and ADL score, cognitive function score, behavioral change score, nursing score, and rehabilitation score in Korean Long-term Care Insurance System.

Results: 1. We performed multiple regression analysis using caregiver burden as a dependent variable, and cognitive function, severity of behavioral symptoms, ADL, IADL and demographic data as independent variables. It revealed that only behavioral symptoms influenced on caregiver burden of dementia patients significantly. 2. We cannot found any variable influencing on the reimbursement expenditure of long-term-care insurance with multiple regression analysis with the same independent variables. 3. Utilization of social welfare services of dementia patients was higher than that of normal elderly and dementia high risk group. There were tendencies that normal elderly and dementia high risk group made good use of at-home services and dementia patients liked to use home-helper services and long-stay facilities. 4. Whereas many of severe dementia patients used at home services, a few of mild dementia patients were admitted to the long-stay facilities.

Conclusions: Taking consideration into the significant influence on the caregiver burden, the behavioral symptoms of dementia patients should be reflected on the reimbursement expenditure of long-term-care insurance. Various at home service programs are needed for severe dementia patients and long-stay facilities should be built for mild dementia patients.

PS01.133

Standardization of mental health clustering within Psychiatry of Old Age Services (POAS)

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Overview: Standardisation of Mental Health Clustering within Psychiatry of Old Age Services (POAS) Background Provider NHS Trusts within the UK are currently paid through block contracts which often fail to reflect the quality / complexity of the care delivered. Payment by Results (PbR) is a different way of funding providers in order to provide the right care to service users. Within Psychiatric services, PbR will be guided by Mental Health Cluster Outcomes. The Mental Health Clustering Tool (MHCT) version 1.0 (January 2010) incorporates a large number of items from the Health of the Nations Outcomes Scales (HoNOS) and the Summary of Assessments of Risk and Need ^{2} (SARN) (Self et al. 2008) in order to provide the information necessary to allocate individuals to Mental Health Clusters. The local service expectations for use of the Mental Health Clustering Tool have recently been clarified. HoNOS has only been used regularly for the last three months and the future financial implications have raised concerns with regard to possible inter-team scoring discrepancies.

Aim: This study aims to provide an exercise for the individuals within the North Shields POAS Team to test, improve and standardise their inter-rater reliability with respect to: a) The items of HoNOS used in Mental Health Clustering b) The subsequent Clustering Outcomes.

Method: Six service users were selected from the team's current caseload with a range of diagnoses/ clinical problems to encompass the heterogeneity of our patient group. The six 'Initial Assessment Letters' of those patients were anonymised and copied. In January 2011, each clinical team member (n = 10) were given these six anonymised service user letters, and based on those letters only, completed paper HoNOS and electronic clustering via a training system. Nine were returned. The team met to discuss the results to provoke debate and develop a process of standardising their scoring and improving inter-rater reliability.

Results: See Table 1 below. As per Table 1, HoNOS scoring elicited a wide range of scores from the individuals in the clinical team. The clustering outcomes were more consistent for the service users with organic diagnoses Care Cluster 1 Common Mental Health Problems (Low Severity) 2 Common Mental Health Problems (Low Severity with greater need) 3 Non Psychotic (Moderate Severity) 4 Non-psychotic (Severe) 5 Non-psychotic Disorders (Very Severe) 6 Non-psychotic Disorder of Over-valued Ideas 7 Enduring Non-psychotic Disorders (High Disability) 8 Non-Psychotic Chaotic and Challenging Disorders 9 Blank Cluster 10 First Episode Psychosis 11 Ongoing Recurrent Psychosis (Low Symptoms) 12 Ongoing or recurrent Psychosis (High Disability) 13 Ongoing or Recurrent Psychosis (High Symptom &Disability) 14 Psychotic Crisis. 15 Severe Psychotic Depression 16 Dual Diagnosis 17 Psychosis and Affective Disorder - Difficult to Engage 18 Cognitive Impairment (Low Need) 19 Cognitive Impairment or Dementia Complicated (Moderate Need) 20 Cognitive Impairment or Dementia Complicated (High Need) 21 Cognitive Impairment or Dementia (High Physical or Engagement) Figure 1

Conclusions: Despite using the same baseline information, this study showed considerable inter-rater differences in HoNOS scoring and subsequent Clustering. The individuals were from a number of different specialities and had different experience and training. Therefore they would have varied subjective assessments of risk. However, the MHCT being comprised of validated standardised risk assessment tools should overcome this. Therefore the team are not using the tool correctly. In order to provide service users with the highest standard of care possible this needs urgent review.

Recommendations: In the team meeting - on feeding back of at least one new assessment per week, the team

will individually practice scoring and clustering that service user. This will immediately be discussed by the team to come to a consensus score and cluster outcome. Two of the team will focus their knowledge to become MHCT champions to guide these discussions. The study will be repeated after three months (April 2011) to re-review the team's inter-rater reliability. The exercise will be repeated with all of the other teams within the local service.

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PS01.134

An evaluation of antipsychotic prescribing patterns pre and post RAID using pharmacy dispensing records

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Background: A new psychiatry liaison team was initiated in City Hospital, Birmingham, in December 2009. The team consists of mental health nurses, psychiatrists, psychologists and social workers and is referred to as the Rapid Assessment, Interface and Discharge (RAID) team. This study looks at the effect of RAID on antipsychotic prescribing by comparing the dispensing of antipsychotic medication, to hospital patients, pre and post RAID. The study also sought to determine which patients were referred to RAID, by looking at differences between patients seen by RAID and the wider population of patients taking antipsychotic medication.

Objectives: 1. To compare prescribing pre and post-RAID for three variables: * Use of agents (typical v. atypical) * Prescription of more than one antipsychotic drug (polypharmacy) * Patient age 2. To compare patients who were seen by RAID to those who were not (i.e. unseen) for three variables: * Use of agents (typical v. atypical) * Prescription of more than one antipsychotic drug (polypharmacy) * Patient age

Methods: Pharmacy dispensing records from Sandwell and West Birmingham Hospitals were used to provide data for drugs dispensed from City Hospital, during November 2008 to November 2010. Drugs included for analysis were those listed in BNF Chapter 4: Psychotropics.Results were filtered to remove antidepressant and antimanic drugs. Levomepromazine and prochlorperazine were also removed due to common use as antiemetics at City Hospital. The data was sorted by date to separate pre-RAID (before 01/12/2009) and post-RAID (from 01/12/2009). A list of patient hospital numbers were provided for all the patients RAID had seen during the period of study. The post-RAID population was then split into 'unseen' (i.e. all patients not seen by RAID) and 'seen' (i.e. all patients seen by RAID). The data provided information for dispensing events (DE), this data was sorted to determine the number of patients. Patients were grouped by; use of agents (typical v. atypical), polypharmacy, age of patients and diagnostic category. Data was compared using Pearson's Chi square test for categorical data and Student t test for continuous data.

Results: Data initially consisted of 16,599 DE. After removing DE for other hospitals (Sandwell and Rowley), 8,689 DE remained. Antidepressants, antimanic, levomepromazine and prochlorperazine were then removed leaving a total of 2, 092 DE during the time period. Pre-RAID data consisted of 1,078 DE for 432 individual patients. Post-RAID data consisted of 1,013 DE for 407 individual patients. The 407 post-RAID patients consisted of 138 patients seen by RAID and 269 patients in the 'unseen' cohort. The proportion of patients prescribed typical antipsychotic medication reduced post-RAID (163 of 432 patients v. 114 of 407 patients, X2 =

7.73, df = 1, p = 0.005). However no significant difference was found between seen by RAID and unseen groups (33 of 138 patients v. 79 of 269 patients). 45 patients were prescribed more than one antipsychotic pre-RAID and 28 patients post-RAID (n.s.). 21 of the 28 were seen by the RAID team. The mean age of patients was 66 years (s.d = 19.6) pre-RAID and 65 years (s.d = 19.4) post-RAID (n.s). The mean age of patients in the unseen cohort was 66 years (s.d = 19.5) and 65 years (s.d = 19.2) in the seen by RAID cohort (n.s).
Conclusions: Since the inception of RAID, the proportion of typical antipsychotic agents prescribed has declined. Polypharmacy was lower in our study population compared to a previous UK study (Paton et al, 2008). Post-RAID the percentage of patients dispensing multiple antipsychotic medications declined further however, the result did not reach statistical significance. This may be due to the already low rate of polypharmacy in our population. The age of patients prescribed antipsychotic medication did not significantly change pre and post-RAID and no significant difference was found between the unseen and seen cohorts. Thus, suggesting that RAID is not targeting a specific age group of patients. In future, RAID could target patients that are elderly or are dispensed multiple antipsychotic medications to further enhance the prescribing of antipsychotic medication at City Hospital.

PS01.135

Teaching and training of acute hospital staff in mental health in older adults

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Overview: Stigma towards people with mental health difficulties has been well researched and documented, with these attitudes also present among the health professionals. Staff report feeling that they lack the skills to manage patients with mental health difficulties and they linked this to a gap in knowledge. As part of a new way of working in mental health in an acute hospital a liaison psychiatry team has provided teaching to acute colleagues. Aiming to improve understanding and reduce stigma of mental health conditions. Teaching for acute staff has been provided in the following areas: * 4D's training: Dementia, Delirium, Depression and Dignity (full 2 days training) * Ageing Brain: signs and symptoms of dementia (3X 1.5 hours). * Person centred care: managing people with dementia (3X 1.5 hours). * Challenging behaviour in dementia: dealing with challenging problems on the ward and case discussion (3X 1.5 hours). * Psychosis and depression (3×1.5 hours)
Aim: The aim of this evaluation was to examine staff satisfaction with the training and the impact they feel it will have on their future practice. Method Training was evaluated using questionnaires, which were completed and returned by staff trained after each session. The questionnaire included three open ended questions, two questions which required a response on a 5 point likert scale and two questions requiring yes, no or neutral responses.
Results: A total of 158 staff were trained. 95 completed questionnaires were collected from staff trained, with the largest percentage trained being from nursing backgrounds (22%). 83% felt that the training enhanced their knowledge, 91% felt that it was highly relevant and 92% felt that it would improve their practice. The mean rating was 4.7 (with 5 being excellent), with responses ranging from 3 (neutral) to 5 (excellent). Staff commented that the training was 'interesting', 'informative' and 'enjoyable'. Staff felt that their practice would be improved through having more confidence, awareness, understanding and willingness to deal with mental health difficulties. Sample of feedback from teaching evaluation: * 'A lovely insight from a very experienced practitioner' (27) * 'It will allow me to communicate better with patients diagnosed with dementia e.g. finding out their likes and dislikes, how they feel etc' (22) * 'A greater understanding and improved knowledge will enable me to give better nursing care' (60) * 'Very interesting I found the examples and scenarios interesting, time went quickly' (23) * 'I think it will improve my practice to deal with patients and learn to understand them better' (7)

Findings Training provided to acute staff regarding mental health was well received, they felt that it was relevant, enhanced their knowledge and would improve their practice. Given that previous research has suggested that staff feel they lack the skills to manage patients with mental health difficulties, training is an important part of reducing stigma and empowering staff. Training such as that provided by RAID is beneficial both to staff dealing with patients with mental health difficulties and to the patients themselves, hopefully reducing the associated stigma and fear that has been reported by staff in previous research.
Conclusion: RAID has provided a range of training relating to mental health difficulties in older adults for acute staff, which will hopefully enable staff to feel more able to manage patients with such difficulties.

PS01.136

Audit of mental health related four hour breaches in the accident and emergency department of an inner city acute general hospital

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Overview: The Rapid Assessment, Interface and Discharge (RAID) model is a unique service offering a comprehensive range of mental health specialities within one multidisciplinary team, so that all patients over the age of sixteen can be assessed and treated, signposted or referred appropriately regardless of age, address, presenting complaint, time of presentation or severity. The RAID model was launched in December 2009 and on average receives around 250 referrals per month. This service has received accreditation from the Psychiatric Liaison Accreditation Network (PLAN) (Royal College of Psychiatry). The team has the won the prestigious Health Service Journal (HSJ) award for innovation in mental health (2010). Research and recent guidance have highlighted the need for services in acute hospitals to address the needs of patients that self harm, have substance misuse issues and mental health difficulties commonly associated with older adults, including dementia. A service evaluation was carried out of the RAID model from three different perspectives one of which was response times.
Aim: To examine factors associated with failure to meet the four hour target in Accident and Emergency (A&E) related to mental health, and the impact of the implementation a 24 hour liaison psychiatry service (RAID) on the average number of breaches. RAID aims to see all patients referred from A&E within one hour of referral and provide an effective and efficient service to patients of any age with mental health difficulties. Method Data collected included number of breaches, factors contributing to the breach, date and time. December 2009 to August 2010 was audited, including the period from March 2010 when the service began providing 24 hour cover.
Results: There was a reduction in mental health related breaches. The highest number of mental health related breaches was recorded in December 2009 (27) and the lowest number was recorded in August 2010 (8), with a 70% decrease between these months. The mean number of mental health related breaches in the pre-24 hour period was 21 compared with 15 in the months since the service began operating over 24 hours. Prior to March 2010 home treatment would assessed at the hospital out of hours, subsequently RAID were onsite and able to assess and signpost patients in a more timely manner. On only two occasions did RAID fail to meet their 1 hour response target. Findings Findings suggest that the implementation of a rapid response liaison psychiatry team reduced the number of breaches that were mental health related, with particular benefit seen since the 24 hour service was launched. A combination of factors contributed to breaches including incompatibility of targets between teams e.g. home treatment teams have a four response target after liaison psychiatry refer to them, patients being intoxicated, medical delays and patients from outside the local area requiring psychiatric admission.

Conclusions: The RAID service successfully reduced the time patients with mental health related issues had to wait to be seen in an acute hospital setting. This suggests that having such a service can improve the efficiency of patient care and hospital resources. Furthermore, these findings indicate that with a continued presence of the team, patient care could be improved greater over time.

PS01.137

Discharge delays in the elderly from Birmingham City Hospital

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A Tejani

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Background: Elderly people (over 65 years old) make up 7.7% of the population and they are the major users of the NHS. In 2003, the hospital admission rate for over-65s was about 1 in 5 people and they have the longest inpatient stays in hospital. There has been much concern since the inception of the NHS that elderly people occupy hospital beds inappropriately and this may be related to a number of factors. It is estimated that 30% of hospital discharge delays are due to non-medical reasons. Efficient discharge planning and implementation is important in older patients to prevent adverse outcomes and to prevent readmission. Due to the sustained pressure on the NHS and on caregivers from the rising numbers of hospital admissions, efforts are being made to understand and reduce costly discharge delays. As no local data is available, a study was planned to determine why discharge planning from hospital for elderly patients is delayed.

Aims: To survey the reasons for delayed discharge in elderly patients in hospital. Also aim to look at the correlation between patient demographics, social circumstances, admission and medical care.

Method: An unblinded randomised selection of patients aged over 65 was obtained at City hospital, Birmingham over one day. Information concerning patient demographics, reasons for admission, current medical status and discharge plan were obtained from electronic and paper patient documentation.

Results: Altogether, the details of 96 in-patients were collated. Majority of the patients were 81-85 years old (33%) and male (55%). Majority of them were located on two non-acute elderly care wards in the hospital (35%). The vast majority of them were transferred from Accident and Emergency (83%) and were self-referred. Most of them were admitted to hospital because of a neurological condition (23%) mainly constituting of stroke and worsening confusion. However, 9% of patients were inappropriately admitted with unspecific complaints, for example, inability to cope. Only 40% of the patients were still present in the hospital because they were not medically fit to go home. Of the rest of the patients, 33% were awaiting assessment from other healthcare professionals, 10% were awaiting transfer to a rehabilitation ward, 10% of patients were awaiting a social support package, 5% were awaiting transfer to a care home, and 2% were due to be discharged later in the day. A spearman's correlation showed a significant positive correlation between gender and reason for being in hospital ($r(96) = 0.17$, $p<0.05$). Significant correlations were also observed between age and speciality ($r(96) = 0.18$, $p<0.04$) and as would be expected reason for admission and diagnosis ($r(96) = 0.44$, $p< 0.00$), route and time of admission ($r(91) = -0.26$, $p<0.01$) and diagnosis and speciality ($r(96) = 0.59$, $p<0.00$).

Conclusions: A staggering 60% of patients were medically fit for discharge, yet were still within hospital. This has been shown to correlate with poor patient outcomes and poor patient satisfaction. It was also interesting to note that 9% of patients were admitted with non-specific complaints.

PS01.138

Abstract withdrawn

PS01.139

Streeton Cottage: Australia's first residential service dedicated to caring for younger people living with dementia

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The prevalence of dementia in Australia is expected to rise from 257,000 to around 1 million by 2050. Of these, about 5% of all cases are projected to be younger onset (Access Economics, 2010). Currently, there may be around 12,500 Australians living with younger onset dementia of which 5,000 are estimated to live in the state of New South Wales. There is lack of recognition of younger onset dementia by health professionals and - even if recognised - there are very few service or support options available. Frequently, people living with younger onset dementia "fall between the cracksâ[euro] of aged care, mental health and disability services. HammondCare, an Australian independent Christian charity, opened a 16-place dedicated younger onset dementia long-term residential (14 places) and residential respite (2 places) service in Horsley, a community about 100 kilometres south of Sydney, in January 2010. Known as "Streetonâ[euro] cottage, the service is purpose built and comprises one house of a cluster of six stand-alone house aged care complex. Streeton functions as a normal domestic home, where residents can participate in all activities of daily living, including cooking, shopping, cleaning, laundry, gardening and leisure pursuits. The house design is based on evidence based design principles, including good visual access to promote wayfinding, reduction of extraneous stimulus to reduce confusion, and highlighting needed features to promote independence in self care and ADLs. Family members are encouraged to interact with residents as if Streeton were their own home. For example, spouses will stay overnight. There is no set program of activities at Streeton, and residents are supported to participate in normal, age-appropriate community activities. Activities include shopping; community college classes; volunteer office work; gym workouts; library visits; movies; beach visits; picnics and shopping. Diagnoses of residents are varied and include Alzheimer's Disease; dementia associated with Huntington's Disease; dementia secondary to alcohol abuse, carbon monoxide poisoning and unspecified neuromuscular disease. Challenges of this model include catering for the needs of a wide variety of ages in the cottage (range 36-69 years) and a wide variety of functional abilities and social interests of residents; the rapid decline of residents; the needs of families coping with dementia in middle age (including significant financial and social implications for families); insufficient staff available under an aged care funding model to cater for the greater energy and social needs of residents. This presentation will give a virtual guided tour of the house and elaborate on the outcomes of the first twelve months of operation.

PS01.140

Patient centred care pathway: Perspective of younger people with dementia service in Shropshire

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Background: A carepathway was devised for Younger People with Dementia (YPwD) Service in Shropshire by the Audit leads in January 2009. This was based on an "Integrated carepathway for Young Onset Dementia in the West Midlandsâ[euro] from 2006. This audit will monitor if the standards agreed in the pathway are being met by the service for YPwD in Shropshire. AIMS To ascertain if the pathway standards are being met for everyone referred to the service. An action plan will be derived to improve any service deficits highlighted by the audit.

Methodology: The referrals from April 2009 - March 2010 were used. During this time there were 72 client referrals. There were 7 pathway standards that the results of this audit were based on: Referral / Allocation meeting held within 3 weeks of receiving referral. Full booking of assessment visit within 24 hours of allocation (date to treat) by telephone or letter as per policy. Initial assessment completed within 3-6 weeks of allocation. Brain scans (CT or SPECT) completed within 8 weeks of request. Follow-up appointments arranged within 4 weeks of receiving scan results. Visit from key worker within 2 weeks of diagnosis been given.

Anticholinesterase medication commenced within 2 weeks of diagnosis (if appropriate).

Results: The results show the majority of clients, 70 (97%) achieved the service standard of having an allocation meeting within 3 weeks of initial referral being received. The majority of clients 59 (83%) achieved the service standard of having full booking of assessment visit within 24 hours of allocation (date to treat) by telephone or letter as per policy. A total of 58 (83%) achieved the service standard of having an initial assessment visit within 3 weeks of initial referral. Just under half the clients, 33 (46%) achieved the service standard of receiving a brain scan and having results within 8 weeks from initial request. Over a third of clients, 26 (36%) achieved the service standard of having a follow-up appointment arranged within 4 weeks of receiving scan results. There were 16 (22%) clients who were recorded as meeting the standard of a visit from their Key-worker within 2 weeks of a diagnosis of dementia being given. Of the remaining 56 (78%) clients, 37 (51%) had been discharged, 9 (13%) had ongoing assessments and were awaiting results, 5 (7%) had been referred to other services and 5 (7%) cancelled appointments and therefore disengaged from the service. Lastly, out of the total 72 there were 15 (21%) clients who were deemed to be appropriate for Anticholinesterase medication and the treatment for all began within the standard 2 weeks from diagnosis.

Recommendations: To improve communication with the Radiology department at both, Royal Shrewsbury Hospital (RSH) and Princess Royal Hospital, Telford (PRH) for scan information with a view to eventually accessing scan results electronically. Revisit the audit tool to see if it can be improved for future use. Re-audit in September 2011. To investigate and secure neuropsychometric services to aid the diagnosis of complex presentations of memory problems. Change practice in line with Memory Service National Accreditation Programme (MSNAP) where all necessary information for assessment is received before a client is seen by the service.

Conclusions: The majority of clients referred to the service received delivery of a smooth, timely assessment which met the carepathway standards. Factors outside the control of the service were sometimes the cause of standards not being met e.g. the waiting time for brain scan results. Further delays in diagnosing clients were occasionally due to the fact that clinics were only held every 2 weeks (although local clients are seen at home) and the lack of neuropsychometric testing within Shropshire.

PS01.141

Metformin use and cognitive function among older community-dwelling diabetic patients

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Background: Type 2 diabetes is associated with cognitive dysfunction. Diabetic patients are more likely to experience cognitive decline and at greater risk of developing vascular dementia or Alzheimer's disease. Their association could be due to hyperinsulinemia and hyperglycemia arising from insulin resistance (IR). Insulin sensitizer such as Rosiglitazone was found to be protective against cognitive decline. Metformin is an insulin-sensitizing biguanide with potent antihyperglycemic properties and commonly used in diabetic patients. But very few study examined the effect of metformin treatment on cognition in older diabetic patients.

Objective: To explore the cross-sectional and prospective associations of metformin usage with cognitive impairment. We hypothesized that duration of metformin use prior to baseline assessment would be inversely associated with cognitive impairment.

Method: A total of 375 diabetic patients aged 55 and over were selected from the cohort of Singapore Longitudinal Aging Study (SLAS) who had been followed up for 4 years. Cognitive function was assessed by Mini-Mental State Examination (MMSE) and lower score on the MMSE (maximum score 30) indicates poorer performance. Cognitive impairment was determined from the cut-off of 23/24. Information on metformin use was collected from self-reports and physical inspection of pill bottles, boxes, packets, diaries and other materials to assist recall. In this study, one variable of 3 mutual exclusive categories was defined based on duration of

metformin use: no use, duration of use≤6 years, duration of use>6 years. Logistic regression was used to examine the cross-sectional association between duration of metformin use and cognitive impairment at baseline. The longitudinal relationship between duration of metformin use and cognitive impairment was estimated by generalized equation modelling (GEE) method.

Results: The mean age of the 375 diabetic patients was 67 years (range 55-93). 59% were female, 62% had a primary or lower education and about 15% had cognitive impairment at baseline. The average diabetes duration was 9 years (range 0.5-40) and about 56% used metformin. Patients with metformin use of >6 years were oldest and had longest diabetes duration. Other characteristics were not significantly different across the 3 duration groups. After controlling for age, education, cardiovascular conditions and other confounders, cross-sectional data indicated that patients treated by metformin over 6 years were at lower risk of cognitive impairment than non-users. (OR = 0.35,95%CI 0.18-0.68) But there was no significant difference in the risk of cognitive impairment between metformin users of ≤6 years and non-users. Similar results were obtained from prospective data as well.(OR = 0.39;95%CI 0.16-0.95)

Conclusion: In summary, we found that long-term metformin treatment appears to be independently associated with better cognitive function in patients with diabetes. The mechanisms of the association are still unclear. We need to conduct further research to verify the potential mediating effects of IR and hyperglycemia. However, data from the study have clinical implication in older population. Metformin treatment might be effective in preventing cognitive decline in addition to treatment of diabetes.

PS01.142

Effect of shunt operation on idiopathic normal pressure hydrocephalus patients in reducing caregiver burden: Evidence from SINPHONI

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Background: Patients with idiopathic normal pressure hydrocephalus (iNPH) are often given shunt operations to reduce the triad symptoms (cognitive impairment, gait disturbance and urinary disturbance). However, for some iNPH patients, symptoms do not improve after shunt operations. In addition, even in patients where improvements are observed, the symptoms do not always disappear completely. Moreover, for some iNPH patients, shunt operations can increase caregiver burden, because a shunt operation can reduce apathy, which is often observed in iNPH patients, but not necessarily reduce cognitive impairment or gait disturbance. Such patients could have an increased risk of falling, leading to an increase of caregiver burden. A multicenter prospective cohort study, called the study of idiopathic normal pressure hydrocephalus on neurological improvement (SINPHONI) (ClinicalTrials.gov, NCT00221091, http://www.clinicaltrials.gov/ct/show/NCT00221091?order=1), was conducted in Japan between 2004 and 2006 to examine the therapeutic outcome of installing a shunt with a programmable valve in iNPH patients. The study was limited to patients with specific magnetic resonance (MR) imaging features of iNPH, including ventriculomegaly with narrowing of high-convexity and medial subarachnoid spaces. In that study, the caregiver burden was evaluated before and one year after the shunt operation. In this presentation, we analyzed the caregiver burden data of SINPHONI to answer two questions: whether shunt operations lessen caregiver burden in general and how changes of the triad symptoms after the shunt operation contribute to the change in caregiver burden.

Methods: In 81 iNPH patients, caregiver burden was evaluated with the Zarit Burden Interview (ZBI) and each of the triad symptoms were evaluated with the iNPH grading scale (iNPHGS) before and 1 year after the shunt

operation. The ZBI has two subscales: the personal strain (PS) and role strain (RS) factors. The PS factor indicates how personally stressful the experience is. The RS factor indicates the constraints on everyday life that occur due to being a caregiver. The total score, and PS and RS factors of the ZBI were compared between before and one year after the shunt operation using the Wilcoxon signed-rank test. In the preliminary analyses, the relationships between changes in the ZBI scores one year after shunt operation and changes of the iNPHGS scores one year after shunt operation were quantified with Spearman's rank correlation coefficients. In the primary statistical analysis, the specific effects of change in the triad symptoms one year after shunt operation on change of caregivers' burden one year after the shunt operation were examined by using categorical regression analysis.

Results: In the ZBI, the PS factor and the total score significantly improved after the shunt operation but the RS factor did not. Categorical regression analysis demonstrated that the improvement in each of the iNPHGS scores significantly contributed to the improvement of the ZBI total score and PS factor independently. The improvement of cognitive impairment also contributed to the improvement of ZBI RS factor and was the major contributing factor to the improvement of caregiver burden.

Conclusions: Shunt operations reduced the burden on caregivers of iNPH patients. Caregiver burden was decreased by improvements in each of the triad symptoms, but mostly by the reduction of cognitive impairment.

PS01.143

Passive movement therapy in severe paranoia: A multi-center randomized clinical trial

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Purpose: Motor dysfunctions are frequently seen in all types of dementia, especially in the advanced stages. In 90-100% of people in the advanced stages of dementia paratonia, a distinctive form of hypertonia, is notably present. It results in a characteristic bed posture of flexed arms and legs and an uplifted head floating above the pillow. It is also accompanied with pain and affects mobility and quality of life. Paratonia results in decreasing abilities of the patient and consequently an exponentially increase of the caregiver burden.

Relevance: Passive movement therapy (PMT)is the main therapy applied by physiotherapists in nursing homes to decrease this high muscle tone and to sustain range of motion of the affected joints. The objectives of this study were to investigate the effect of PMT after two and four weeks of treatment in severe paratonia. Furthermore, we studied the effect of PMT on caregiver's burden and on the experienced pain of patients during morning-care. Participants: For this study 19 physical therapy departments of nursing homes in the Netherlands were approached. Participants were included when; 1) they met the DSM-IV-TR Criteria for dementia and 2) had moderate to severe paratonia. Patients were excluded when: 1) they were prescribed antipsychotic medication; 2) they received PMT less than four weeks prior to trial start; 3) had an unstable health problem prior to admission or during the trial and 4) showed signs of challenging behaviour towards the therapist and/or the intervention. Participants were only included after written proxy consent.

Methods: A multi-centre single-blinded RCT. Participants were randomly assigned to either a PMT or control group. The PMT group received PMT 3 times a week during 4 weeks. The control group received no PMT. The primary outcome variable was severity of paratonia as assessed at baseline, after 2 and 4 weeks of PMT, measured by the Modified Ashworth Scale (MAS). Secondary outcomes were clincial change measured with the Clinical Global Impression (CGI), the carer's burden (modified patient specific complaints, PSC) and level of pain during morning care (Pain Assessment Checklist for Elderly with Limited Ability to Communicate, Dutch version, PACSLAC-D).

Analysis: The MAS, PACSLAC-D and PSC were investigated using multi-level mixed linear analysis, the CGI

with cross-tabulation chi-square analysis.
Results: Hundred and ten participants from 12 Dutch nursing homes were enrolled, of whom 101 patients participated in the study; data from 47 patients in the PMT group and 54 controls were analysed. The mixed model showed that PMT had no statistically significant effects either on the muscle tone of both arms (ß = 2.01, sd = 1.17, p = .09) nor in both legs (ß = 1.37, sd = 0.76, p = .08) after two and four weeks. The PMT group showed also no effect on the carer's burden (CGI, PSC) nor on the experienced pain during morning care (PACSLAC-D) .
Conclusions: PMT has no beneficial effects. It is recommended to search for other, preferable preventive, interventions. Implications: PMT is not recommended as intervention in severe paratonia.

PS01.144

Ten-year trends in benzodiazepine use in the Dutch population

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Background: Benzodiazepines are widely used in the treatment of anxiety complaints, nervousness and sleep problems. Although people may benefit from their anxiolytic and hypnotic effects, when used for a longer period (more than two months) benzodiazepine use may lead to addiction problems, with withdrawal symptoms, diminishing effect and difficulty in discontinuing treatment. Particularly in later life, benzodiazepines have serious adverse effects, such as an increased risk of mobility and ADL problems, falling and a negative effect on cognitive functioning. In the past decades knowledge on adequate treatment of affective disorders and awareness of the negative consequences of long-term benzodiazepine use increased. Therefore, a decrease in benzodiazepine use is expected, particularly in prolonged use. The aim of this study was to assess time trends in benzodiazepine use.
Methods and material: Data from the Longitudinal Aging Study Amsterdam (LASA) were used to investigate trends in benzodiazepine use between 1992 and 2002 in two population-based samples aged 55-64 years ((LASA-1, n = 874 and LASA-2, n = 919). The data from both samples were pooled and the factor 'time' was added. Differences between the two samples with respect to benzodiazepine use and associations with sociodemographic (sex, level of education, income), physical health (chronic disease, functional limitations) and mental health characteristics (cognitive impairment, depression, anxiety, sleep problems, alcohol use and antidepressant use) were described and tested with chi-square tests and logistic regression analyses.
Results: Benzodiazepine use showed no major difference between the two samples with 7.8% in LASA-1 and 7.9% in LASA-2 (p = 0.90), nor did separate rates of tranquillising agents (3.7% and 4.8% resp., p = 0.24) and sleeping pills (4.6% and 3.9% resp, p = 0.49). In both samples the majority of the benzodiazepines was used for a long period. In LASA-1 26% was used during a month to a year, and 69% was used longer than one year. In LASA-2 these percentages were 15% and 80%. Use of short-working benzodiazepines without pharmacologically active metabolites increased from 56% in LASA-1 to 65% in LASA-2. In the pooled sample, benzodiazepine use was significantly higher in women, and in the respondents with chronic physical disease, functional limitations, cognitive impairment, depression, anxiety, sleep problems and when using an antidepressant. Benzodiazepine use was lower in respondents with higher education, higher income and with higher alcohol use. In the multivariate regression analyses, controlling for all covariates including time, benzodiazepine use was found to be associated with female sex, and with the presence of one or more chronic diseases, depression, sleep problems and antidepressant use.
Conclusion: It was concluded that benzodiazepine use in this middle-aged population sample remained stable from 1992 to 2002, with a majority of long-term use, despite recommendations in the guidelines for short-term

use. Benzodiazepine use remained higher in women, and in respondents with low education, low income, chronic physical disease, functional limitations, depression, anxiety complaints, sleep problems and in those using an antidepressant. More attention should be paid to reduce benzodiazepine use in the middle-aged, in order to diminish its increasing negative effects on health and functioning when getting older. In the case of long-term use, discontinuation programs with a tapering-off procedure may be helpful.

PS01.145

Influence of Ketamine on the ECT outcome: Case series

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Introduction: In patients with major depression, electroconvulsive therapy is the most effective treatment currently approved by the FDA. Methohexital is the most common anesthetic used for the procedure since it interferes less with seizure duration and recovery time is relatively short.1-3 We describe four patients whose depression was not adequately treated with ECT using methohexial as the general anesthetic but whose depression quickly resolved when the anesthetic was replaced with ketamine. Possible explanations of the enhanced efficacy of ECT with ketamine as the induction agents are offered.

Case description: Description of 4 patients with recurrent severe major depression will be provided. Patients underwent ECT treatments with methohexital and after initial partial improvement failed to stay in remission. After methohexital was replaced with ketamine patients went into sustained remission.

Sample Case: The patient is a white male with a long-standing history of severe recurrent major depressive disorder with psychotic features. Because of a lack of response to medications, he agreed to undergo ECT. The patient had 12 right unilateral treatments three times weekly with an electric charge of 288 mC, 6 times above seizure threshold. Methohexital was used as the anesthetic. His symptoms of depression, included sadness, tearfulness, decreased interest, low motivation, fatigue, decreased appetite, fragmented sleep tendency to isolate, and staying in bed most of the time. By the patient's estimation, his depressive symptoms improved 60-70% at the end of his course of ECT treatments. He then continued with maintenance right unilateral ECT treatments, initially weekly (3 treatments) and then every 2 weeks (1 treatment). He stopped taking his psychotropic medications due to insurance issues. His depression worsened despite a gradual increase of electric charge to 576 mC. At maintenance treatment # 5, the anesthetic was changed to ketamine. Immediately after that treatment his symptoms of depression, by his estimation improved 60 %. This improvement was maintained for the three day interval until his next ECT treatment. Depression improved by 70% after the next treatment 6 days later. The patient has continued receiving weekly right unilateral ECT maintenance treatments with ketamine and an electric charge 576 mC and remains in remission after 8 treatments.

Discussion: In our case series, ketamine was shown to significantly enhance the effectiveness of ECT in 4 patients with severe depression. We offer couple of explanations for this increased efficacy of ECT therapy with ketamine as the anesthetic. First, recent experimental treatments done at NIH have demonstrated that ketamine vs placebo has been shown to significantly improve treatment-resistant major depression within 2 hours of single continuous infusion in a double blind crossover study. These effects lasted up to one week after the single dose 5. Thus ketamine may possess antidepressant properties. Second, ketamine enhances seizure quality during ECT. In a retrospective study comparing ketamine to methohexital, patients who received ketamine had longer seizure duration, greater midictal amplitude and a trend towards greater post-ictal suppression, features which are consistent with a better response to ECT. 4 Ketamine can be associated with certain side effects that might not be seen with methohexital including greater increases in heart rate and blood pressure. Adults might also experience unpleasant dreams as well as greater nausea and vomiting; though based on our albeit brief experience when using the drug for patients with depression who are managed with ECT, the relief experienced from resolution of depressive symptoms far exceeds discomfort from side effects. Based on our initial observations, ketamine should be considered for ECT particularly when there is little or no

relief of depression when other anesthetics are used. More controlled studies are needed.
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PS01.146
Self injurious behavior associated with depression: Response to electroconvulsive therapy
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Background: ECT may be useful in treatment self injurious behavior (SIB) associated with treatment-resistant schizophrenia and psychosis in persons with mental retardation (Dean CD, 2000; Bates WJ et al., 1982). Methods: Caucasian female underwent ECT for major depressive disorder, severe, recurrent, without psychotic features, accompanied with severe SIB. Patient was treated with right unilateral ECT.
Results: Patient received 8 treatments while inpatient and her SIB as well as her mood had begun to improve. During the 9th treatment, patient sustained a prolonged (more than 3 min) seizure followed by a much brighter affect and no reports of SIB for 10 days. Patient did outpatient weekly maintenance ECT after discharge from the hospital. Two weeks after discharge from the hospital patient began to report worsening mood, and a return of cutting behaviors. Outpatient weekly maintenance ECT treatments continued and over the next 5 weeks patient became significantly less depressed with no reports of self harm. After those 5 weeks of remission patient missed scheduled ECT treatments for 2 weeks. Within a week after her last treatment she experienced a return of depression and SIB that lasted for two weeks. Subsequently patient then agreed to resume ECT with the frequency of once a week for 2 weeks and than twice a week for 1 week. Her mood improved and SIB subsided. She continued with weekly maintenance ECT for two month period free from SIB and thoughts.
Conclusions: ECT may help treating SIB associated with major depression.
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PS01.147
The design of a two phase, repeated crossover study with dose escalation on Delta(9)-tetrahydrocannabinol (Delta-THC) in behavioral disturbances in dementia
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Introduction: Dementia is a common chronic condition, with predicted increasing prevalence. Nearly all subjects with dementia will experience neuropsychiatric symptoms (NPS). This causes significant burden for the individual subjects and their caregivers. Current drug treatment has only modest efficacy and important side-effects. Formulations with Δ9-tetrahydrocannabinol (THC), the psycho-active compound of cannabis, are currently being registered for spasms in multiple sclerosis and other diseases, and may have beneficial effects on NPS. Study objectives: The primary objective is to evaluate the efficacy and safety of Namisol® (a tablet with

THC) on NPS in dementia, for subjects with mild to moderate dementia, compared to placebo. Secondary objectives are: To evaluate the efficacy on the secondary characteristics (e.g. caregiver burden) compared to placebo To determine the pharmacokinetic profile of THC and its metabolite 11-OH-THC and the relationship between plasma concentrations of THC and 11-OH-THC and clinical effects in these subjects. To evaluate the safety and tolerability of THC. To evaluate long term safety and tolerability of THC in an extension study. To perform a concurrent validation of the (Dutch) clinician version of the Neuropsychiatric Inventory (NPI-C) against the proxy based version of the NPI.

Methods Design: Phase II pilot study, single-center, repeated cross-over, double blinded randomized trial. Consisting out of 6 blocks of 2 weeks, after 3 blocks (period A) the dose will increase after safety evaluation by a Data Safety Monitoring Board. Each block consists out of active treatment and placebo, within between a wash-out period. After the two treatment periods, subjects will proceed to a 6 months extension phase if THC was safe and effective. Participants: 25 subjects with mild to moderate dementia and NPS and a completed NPI with a minimum mean score of 10 (or at least 1 item with high frequency and severity) on two time points before randomization Amonth other in- and exclusion criteria, patients and caregivers must give written informed consent. Intervention: Namisol® in doses of twice daily 0,75 mg tablet (period A) and twice daily 1.5 mg (period B) THC oral tablets. Placebo of twice daily 0,75 mg and twice daily 1.5 mg oral tablets Outcomes The NPI was selected as primary outcome measure.The NPI-C is an extension of the original NPI and will be used as secondary outcome measure in this study As a general rule for the NPI, a decrease in 4 points or a 30% reduction in NPI-baseline score is regarded as minimal clinically relevant change. Other secondary outcomes are CMAI, Zarit Burden scale, mobility, pharmacokinetics. Subjects will be observed during the hospital admission as part of the safety assessment using electrocardiograms (ECG), vital signs, limited physical examination (only auscultation of the heart, if indicated standard physical examination will be performed), and using the Delirium Observation Screening Scale (DOS), Visual Analogue Scale (VAS) Bowdle for 'feeling high', and observation checklist for side effects.

Statistical Analysis: Main outcome, mean differences between THC and placebo in NPI score, will be analyzed per period, using a random effects repeated measures linear model with fixed factors block and treatment. The study is registered at ClinicalTrials.gov.

PS01.148

Efficacy and tolerability of galantamine and galantamine combined with nimodipine in mixed dementia: A 24-week, randomized, placebo-controlled exploratory trial (The REMIX study)

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Background: Galantamine (GAL) is the only cholinesterase inhibitor approved for treatment of patients with Alzheimer disease (AD) with cerebrovascular disease (CVD) or mixed dementia. However, the drug's effects on quality of life (QoL) and cognitive speed have not been investigated so far in this population. Moreover, the combination of GAL with nimodipine (NIM), a calcium channel antagonist which may have some positive effects

in patients with subcortical vascular dementia according to previous clinical trials, has not been explored in terms of efficacy and tolerability.
Objective: To investigate and to compare the effects of GAL + placebo (PLA) and GAL + NIM on QoL and on performance on computerized cognitive tests, as well as to assess treatment tolerability.
Methods: This was an exploratory study involving 11 centers in Brazil. Patients fulfilling DSM-IV diagnostic criteria for dementia and NINDS-AIREN diagnostic criteria for AD with CVD were selected for the study. Patients had to present mild to moderate dementia, with MMSE scores ranging from 10 to 26, both inclusive. Patients were randomized to two treatment arms, one with GAL + PLA and the other with GAL + NIM. GAL dose was started at 8 mg QD, with monthly increments up to 24 mg QD. NIM dose was 30 mg TID throughout the study; PLA was also given three times a day. The duration of the trial was 24 weeks. The primary efficacy measures were the performance of patients on a computerized neuropsychological battery (CNTB), which includes tasks assessing attention and memory (both verbal and visual, with determination of reaction times and percentage of correct responses), and the scores on a QoL measure (QoL-AD), at the end of the 24th week of treatment. Secondary efficacy measures were performance in the Alzheimer's disease Assessment Scale-Cognitive Subscale (ADAS-Cog), Clinician Global Impression of Change (CGI-C) and in the Neuropsychiatric Inventory (NPI). Tolerability was assessed through the rate of adverse events and serious adverse events.
Results: Twenty one patients were randomized to treatment and received at least one dose of the proposed drug regimen, being 9 in the GAL + NIM group and 12 in the GAL + PLA group. No differences between the two groups were observed in relation to age, educational level and gender distribution. MMSE scores were similar between the two groups on baseline. The same occurred for CNTB measures, QoL, ADAS-Cog and NPI scores. No significant difference was observed between the two treatment groups on any measure of the CNTB and also on QoL-AD. Significant improvement in patients' evaluation of their own QoL was observed considering both treatment groups on week 24 in comparison to baseline ($p = 0.027$). As for the secondary efficacy measures, no difference between the two groups was observed in relation to ADAS-Cog, CGI-C or NPI, although significant improvement in ADAS-Cog scores was observed taking together both treatment regimens at the end of the trial in comparison to baseline ($p = 0.029$) and also a trend for improvement in the NPI ($p = 0.096$). MMSE scores also improved for both groups at week 24 in relation to baseline ($p = 0.01$). Adverse events were predominantly mild to moderate; six patients discontinued treatment due to adverse events (three in each group).
Conclusions: In this exploratory randomized, placebo-controlled, clinical trial, GAL proved to be safe and efficacious in improving QoL of patients with mixed dementia, in addition to its already known cognitive benefits. The combination of GAL to NIM did not demonstrate any apparent advantage. However, due to the small sample of patients evaluated, further studies are necessary before drawing definitive conclusions on this issue.
PS01.149
Survey of timing of use of PRN Benzodiazepines
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Introduction: It is well known that Benzodiazepines are known to cause various adverse side effects like falls, dizziness and fractures among elderly. In particular, it has been associated with 50% increase in risk of hip fracture in the elderly.(Cumming RG,2003). It is also to be noted that Benzodiazepines are one of the two classes of drugs prescribed on an as and when required (PRN) basis. The above two factors combined gave rise to the present audit topic. Aim and Objectives Aim The aim is to estimate the frequency of use of PRN benzodiazepines in an inpatient setting. In particular the timings were to be looked into to get feedback on clinical management issues.
Objectives: 1. Estimate the primary indication. 2. To estimate use of non-pharmacological measures before administration of benzodiazepines. 3. To examine for a specific care plan on the use of PRN medication. 4. To estimate the frequency and timing of use of PRN medication. 5. To estimate the duration of use of PRN

medication.

Method: Audit Sample: The audit included all inpatients in an Old age psychiatry ward. We included those who had four weeks of inpatient admission and examined the first four weeks only as we estimated the maximum use to happen during the first few weeks. Data Collection **:** The data were gathered using a data collection tool designed specifically for the project. For this audit, the data were collected by the audit lead. Data Analysis: The data collection tool was created with FORMIC software which supports automated data capture. The completed forms were scanned and analysed by Clinical Audit Support staff. Data analysis was performed using Microsoft Excel and carried out collaboration with the audit lead.

Results: * Primary indication for use of PRN Benzodiazepines was Agitation (in 90%). * PRN Benzodiazepines were used only in 19 out of 54 patients. * However, only 1 out of these 19 patients had a specific care plan mentioned in the case notes about PRN Benzodiazepine use. * Out of a total of 64 times Benzodiazepines were used, a vast majority of them (41 occassions) were used between 9PM and 6AM, indicating either reduced staff or significant worsening of behavioural and psychological issues at night time. * It was prescribed for less than four weeks in a majority of patients(14 patients).

Recommendations: 1. The risk of falls as well as the cardiovascular, respiratory and hepatic status of the patient should be considered before prescribing PRN benzodiazepines. The findings from question 7 is the basis for such recommendation. 2. There should be a specific care plan on the use of PRN benzodiazepines- indicating the estimation of risk(falls, cardiovascular and respiratory symptoms), the intended purpose of use(agitation, anxiety etc), the intended outcome (i.e., documented reduction in anxiety or agitation- the use of scales to objectively measure these rather than subjective opinion of clinical staff). This is based on findings from ouestions 3,2 and 7. 3. It would be very useful if there were to be specific handover to night time staff on the use of PRN benzodiazepine. This is based on finding from objective question 4.

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PS01.150

A project for preventing vascular dementia by increasing the awareness of cardiovascular risk factors among primary care health professionals

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Overview: In England the National Dementia Strategy has as its first objective the need to improve public and professional awareness and understanding of dementia, including the need to promote the prevention of dementia. Evidence suggests that up to 50% of dementia cases will have a vascular component (i.e. vascular dementia or mixed dementia) and it is well established that "What's good for your heart is good for your health.â[euro] There are at last 700,000 people with dementia in the UK, and that this costs society about £17 Billion per year. In the next 30 years these numbers are projected to double, and the costs to triple. On a positive note the National Dementia strategy also points out that if we could delay the onset of dementia by an average of just 5 years then its incidence could be reduced by 50%. There is a clear and urgent need to look at ways that we could reduce the numbers of new cases of dementia occurring and there is a wealth of evidence suggesting that a key strategy for preventing or minimising dementia is by promoting better cardiovascular health. Given that existent pubic health messages and campaigns on diet, smoking, the benefits of exercise, and cardiovascular health have been positively received and have made a significant impact on behaviour, then including information about the likelihood of a decreased risk of vascular and mixed type dementia in such initiatives may help increase the impact of such campaigns overall. In summary, our risk of dementia may be reduced if we protect our general health, e.g. by eating a healthy diet, stopping smoking, exercising regularly, drinking less alcohol and generally protecting the brain from injury. In keeping with the ethos and aims of the

Foresight: Mental Capital and well being programme, this project describes an an educational initiative to increase the awareness of the cardiovascular risks for dementia in primary care health professionals working across the life course.

Objectives: 1.To increase awareness of the cardiovascular risks for dementia in the widest possible range of health professionals working in primary care. 2. To increase the inclusion of the cardiovascular risks of dementia in health promotion campaigns and initiatives wherever relevant. 3. To increase awareness among the general public of the cardiovascular risks associated with dementia. The project objectives will be achieved between April 2010 and March 2011 through the use of: 1. Free 'Master-classes' delivered to up to 40 primary care professionals by nationally recognised dementia experts on dementia and cardiovascular risks. 2. An'online' Distance Learning Module delivered to up to 40 primary care professionals via the 'Blackboard' Virtual Learning Environment. There will be no charge to the 'end user' for this module. 3.The design, authoring and creation of an innovative portfolio of briefing materials;including 'fact sheets' and a prototype IPhone/IPad application (subject to Apple Quality Assurance processes and technical and copyright constraints) on the prevention of Vascular Dementia in North Staffordshire. 4. The utilization of local media (television, radio, community oriented web sites, newspapers and magazines) to publicise the links between cardiovascular disease and dementia (see 3 above). The project which is a partnership between North Staffordshire Combined Healthcare NHS Trust and Staffordshire Universities Centre for Ageing and Mental Health will be evaluated with a view to sustaining its key messages beyond the life of the project. It would be anticipated that the distance learning component of this project would become a continuing part of the portfolio of modules offered by Staffordshire University beyond the life of the project itself.

PS01.151

Cost of dementia: Household cost for an Indian family

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The Gross Domestic Product (GDP) of any country is affected by the loss of productivity due to health issues among its people. This is often referred to as 'Cost of Illness (COI). COI is a very important factor that drives the policies, program, development of services, building up of capacity and human resources in any country. Cost of Illness can be divided into medical and non-medical expenditure. It is also classified as Direct Cost, Indirect Cost and Intangible Cost. The Out of Pocket cost (OOPs) that includes expenditure of consultation, hospitalization, medication, secondary and tertiary intervention and paid care come under the rubric of direct cost. Losses of productivity, loss of opportunity, loss of wages due to care giving are usually considered under indirect cost. Pain and suffering due to the illnesses and care-giving are the 'intangible' and if assigned a value come under 'intangible cost'. This is rather difficult to calculate as it depends on the sociocultural, spiritual aspects of the person who is ill and also the carer. Dementia is a chronic degenerative disease with a deteriorating course. Advances in medical technologies, and changing demography of the world has made dementia a cognizable condition in all countries - either developed or developing nations. Cost of Dementia is very a complex one as it affects the family, society and the country more than the other illnesses. The repercussions are both at the microeconomical and macroeconomical levels of economy of a country. The global cost of dementia is 604 billion US dollars. Most of the work on the cost of dementia is from developed countries like North America (Wimo and Prince 2010). This needs to be seen in the light of the fact that 14% of the persons with dementia live in developing nations but the cost of dementia in these countries account for only 1% of the total cost (Wimo and Prince 2010). Lack of awareness and non-availability of medical, psychosocial and welfare facilities in these countries make their 'direct cost' low; care being provided for informally by the family members 'indirect cost' or 'social cost' often are not recognized, calculated and reported. There are 3.7 million Persons with Dementia currently in India. With the changing demography this is expected to double in the next two decades (ADI 2009). However there is very little work on the Cost of Dementia in India. There is no

prospective work in this area. Care is usually informal and not accounted for in the cost. This is evident in the reporting of work by the 10/66 Dementia Research Group from India (Prince 2009) The authors who are part of a Geriatric Psychiatric set up in an urban hospital setting in southern India have attempted to calculate the direct and indirect costs of care of dementia for families caring for persons with dementia. The methodological framework of the calculation of the cost of dementia for an average Indian family where one of the members is suffering from dementia would be presented in the poster. Both direct and indirect costs have been assigned in the care of dementia and the cost of dementia calculated thereof.

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PS01.152

Aging and chronic diseases of the airways. Information project supporting prevention

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Chronic diseases are a major cause of death and disability worldwide. Without action, deaths from these diseases will increase by 17% over the next ten years [1]. Ageing is an important marker of the accumulation of the modifiable risks for chronic disease. The impact of risk factors increases over the life course [2, 3, 4]. Major risk factors for these diseases are known, and if these were eliminated, at least 80% of heart disease, stroke and type 2 diabetes would be prevent and over 40% of cancer would be prevented too [1, 2]. Among chronic diseases increasing worldwide, 210 million people have chronic obstructive pulmonary diseases (COPD), one of the five leading causes of death, and, 300 million people have asthma [5], with a major burden on individuals and societies [6]. In this context, a research project: "Chronic Diseases of the Airways: Contents and Tools for Productive Interactions between Empowered Patients and Proactive Professionalsâ[euro] will be presented [7, 8, 9, 10]. This project is part of the Harvard Medical School Portugal Initiative and aims to develop health information and interactive tools on various aspects of chronic airways diseases, both for patients and for physicians. The multidisciplinary team comprises scientists from several areas, including Allergy&Clinical Immunology, Pulmonology, Psychiatry and General Practice, who has experience in patient education, behavioural change, e-health, content production and online health, health care and patient-centered training for health professionals [4, 11, 12, 13].

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PS01.153

Abstract withdrawn

PS01.154

Validity of the Dutch HoNOS 65+

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Background: The Health of the Nation Outcome Scales for older adults (HoNOS 65+) is developed to evaluate whether mental and social functioning of older adults in mental health care improves over time and is internationally used to evaluate outcome of mental health care. The HoNOS 65+ is an observation scale and consists of twelve domains to be measured, which can be divided into four subscales. The aim of this study is to test internal consistency of the Dutch version of the HoNOS 65+ and its purposed subscales, as well as construct validity for a variety of diagnostic groups.

Method: Data were gathered as part of the Mental Health care Monitor Older Adults (MEMO), a large-scale monitor to assess quality of care in the Netherlands. The sample consisted of the HoNOS 65+ at intake of 767 clients attending the outpatient clinic of old age psychiatry of 14 mental health care organizations throughout the country. Clients with a primary diagnosis of a neurodegenerative disease (mainly cognitive disorders or dementia) are excluded.

Results: Internal consistency of the HoNOS 65+ was reasonable, although it's one-dimensionality is not clear. Subscales to evaluate outcome of care could not be identified. Construct validity appeared to be good for a variety of diagnostic groups. Also a medium and significant negative correlation was found with the Global Assessment of Functioning (GAF).

Conclusion: To evaluate outcome of care, the individual items of the HoNOS 65+ should be used preferably.

PS01.155

Abstract withdrawn

PS01.156

Factors associated with subjective memory complaints in urban community-dwelling elders in Japan: A community-based cross-sectional study

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Aim: Memory complaints are common among the elderly. Some complain that their memory has deteriorated, whereas others complain that they are anxious about their forgetfulness, although it is unrelated to any actual decline in memory. This study aimed to clarify related factors between these two different subjective memory complaints among elderly individuals.

Method: We conducted a community-based, cross-sectional study that included 3827 subjects living independently in Chiyoda Ward, located in the middle of Tokyo. Participants were aged 65 or older with birthdays between April and September. A self-administered questionnaire was sent to all subjects that met entry requirements. The questionnaire included items concerning subjective memory complaints, sociodemographic factors, and health-related variables. Social network was assessed by the Japanese version of LSNS, mental well-being by WHO-5, depressive symptoms by GDS, daytime sleepiness by ESS, and IADL by the TMIG Index of Competence. Memory complaints were assessed by two items. Being worried about forgetfulness was rated with the question "Are you worried about forgetfulness?â[euro] Subjective worsening of memory was rated with the question "Do you find your memory has gotten worse in the last 6 months?â[euro] Associations were evaluated using chi-square test and univariate and multivariate logistic regression analyses were performed.

Results: A total of 2405 participants (910 males and 1495 females) returned the questionnaire (response rate = 62.8%). [1] Being worried about forgetfulness The prevalence rate was 65.4% in total, 61.0% for males, and 68.3% for females. It was significantly higher in females than males ($\chi 2 = 11.03$, $p = 0.001$). Univariate analysis identified that female gender (OR = 1.45, 95%CI 1.217-1.73), higher age (OR = 1.32, 95%CI 1.09-1.60), not working (OR = 1.22, 95%CI 1.01-1.48), social network (OR = 0.96, 95%CI 0.95-0.97), subjective perception of poor health (OR = 2.61, 95%CI 2.06-3.31), heart disease (OR = 1.54, 95%CI 1.06-2.24), pain (OR = 1.98, 95%CI 1.48-2.64), low mental well-being (OR = 3.11, 95%CI 2.45-3.96), depressive symptoms (OR = 3.62, 95%CI 2.68-4.88), daytime sleepiness (OR = 2.39, 95%CI 1.66-3.44), and impaired IADL (OR = 1.79, 95%CI 1.41-2.26) were significantly associated with being worried about forgetfulness. When associated factors detected in univariate analysis were entered into the multivariate analysis, female gender (OR = 1.48, 95%CI 1.07-2.04), low mental well-being (OR = 2.21, 95%CI 1.45-3.36), depressive symptoms (OR = 2.03, 95%CI 1.27-3.25), and low IADL (OR = 1.67, 95%CI 1.11-2.52) were independently associated with being worried about forgetfulness. Stratified analysis by gender indicated that associated factors for males were low mental well-being (OR = 1.94, 95%CI 1.78-3.49) and depressive symptoms (OR = 2.02, 95%CI 1.04-3.94), and those for females were living alone (OR = 1.87, 95%CI 1.15-3.04), low mental well-being (OR = 2.88, 95%CI 1.51-5.51), and depressive symptoms (OR = 2.30, 95%CI 1.15-4.62). [2] Subjective worsening of memory The prevalence rate was 45.8% in total, 44.3% for males, and 46.8% for females. There was no significant gender difference in prevalence rate ($\chi = 1.12$, $p = 0.305$)Univariate analysis identified that higher age (OR = 3.29, 95%CI 2.50-4.32), low educational level (OR = 1.57, 95%CI 1.19-2.05), living alone (OR = 1.32, 95%CI 1.08-1.61), not working (OR = 1.25, 95%CI 1.04-1.50), social network (OR = 0.96,95%CI 0.94-0.97), subjective perception of poor health (OR = 2.27, 95%CI 1.86-2.77), cancer (OR = 1.60, 95%CI 1.11-2.31), heart disease (OR = 1.54, 95%CI 1.12-2.13), low mental well-being (OR = 2.53, 95%CI 2.07-3.09), depressive symptoms (OR = 2.72, 95%CI 2.14-3.44), daytime sleepiness (OR = 2.67, 95%CI 1.96-3.64), and impaired IADL (OR = 1.90, 95%CI 1.54-2.35) were significantly associated with subjective worsening of memory. When all associated factors detected in univariate analysis were entered into multivariate analysis, subjective worsening of memory was independently associated with higher age (OR = 2.79, 95%CI 1.49-5.20), depressive symptoms (OR = 2.09, 95%CI 1.41-3.10), and daytime sleepiness (OR = 2.31, 95%CI 1.36-3.94). Stratified analysis by gender indicated that associated factors of subjective worsening of memory for males were higher age (OR = 2.95, 95%CI 1.07-8.19), pain (OR = 2.70, 95%CI 1.28-5.67), daytime sleepiness (OR = 3.68, 95%CI 1.79-7.57), and impaired IADL (OR = 1.85, 95%CI 1.12-3.06); depressive symptoms were the only associated factor for females (OR = 3.21, 95%CI 1.87-5.53).

Conclusion: Subjective memory complaints are associated with overall mental health status. However, factors associated with memory complaints differ based on the type of subjective complaint. Being worried about forgetfulness was not related to age, whereas subjective worsening of memory was. Gender differences were found in the prevalence rate of being worried about forgetfulness, but not with associated factors; the opposite

was seen for subjective worsening of memory. Being worried about forgetfulness may have a high prevalence in women with low mental well-being living alone, and subjective worsening of memory might be found in a depressed woman or an older man with physical disabilities who nods off during the daytime.

PS01.157

Psychiatric troubles in long term care residents: The problem of double care demanding patients

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Introduction: Long Term Care Residents needing both psychiatric care and nursing home care for either physical illnesses or dementia combined with psychiatric disorders or severe behavioural problems are referred to as Double Care Demanding patients, or DCD patients. The results of a survey conducted in 2007 within all Dutch Nursing Homes showed that the quality and availability of mental health services to assess and to support the management of DCD cases can be criticized. Most professionals recognized easily the problem of a growing number of patients whose needs can't be covered adequately by either one of the two health care providers (Nursing homes and Mental Health Institutions). Eight percent of nursing home residents in the Netherlands were reported to be DCD patients. Given that -in 2003- there were 330 nursing homes in the Netherlands, with more than 58,000 beds (26,000 in somatic wards, primarily for patients with physical, problems and 32,000 in psychogeriatric wards for patients with dementia), it is assumed that there may be about 4640 DCD-residents, about 15 per nursing home. This number is likely to be higher, for instance because it does not include DCD residents from mental health hospitals who also need physical care. The survey also showed that the organization of mental health care for nursing home residents varies largely. Collaboration with mental health care institutions was not automatically realised, while the amount of qualified psychologists and psychiatric nurses in nursing homes was limited. Specific staff education in how to handle behavioural problems in DCD patients was only poorly provided. Nursing home staff expressed a clear need for improving their skills in recognizing mood disorders and behavioural problems. These findings are disquieting with regard to the quality of care for DCD patients. In addition we are currently investigating the care delivered to DCD patients treated within Dutch psychiatric hospitals. Mental health institutions have long been inadequately equipped to cover the needs of their patients with regard to somatic and nursing care, as was concluded in the important 1999 report of the Dutch Inspectorate of Health "Somatic care in Mental Hospitalsâ[euro]. In an update five years later, the Inspectorate concluded that the quality of somatic care in mental health institutions had improved, although the stages of development differed from institution to institution. A positive development that could be reported was that several mental health institutions now had specialised somatic nursing teams. The existence of these teams improved the quality of integrated care. This development possibly opens new opportunities for DCD patients who need integrated and combined physical, nursing and psychiatric care.

Method: We are conducting a structured survey within all Dutch psychiatric hospitals with an old age psychiatry unit to establish the quality and availability of physical and nursing care for DCD patients. In the questionnaire several topics are addressed: * The different models of mental- and physical health services for DCD patients. * The collaboration with nursing home physicians or nursing home nurses. * The availability of a specialized team within the psychiatric hospital to serve all the needs of these DCD patients. * The existence of specific treatment units within the old age psychiatry unit for these patients.

Results: The preliminary results of our survey will be presented on the IPA conference 2011 in Den Haag.

PS01.158

Barriers of antipsychotic discontinuation among older adults: A focus group discussion study

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Background: Antipsychotic agents are often chronically used for the treatment of behavioural and psychological symptoms in older adults with dementia. However, the effectiveness of antipsychotic drugs is limited and there is great concern about severe adverse effects including a higher risk of mortality with long-term use. Although evidence-based guidelines stimulate short-term use and discontinuation, antipsychotics are still widely used chronically and off-label in older adults.
Objective: The aim of this study was to investigate the potential barriers associated with antipsychotic discontinuation, portrayed by geriatric care professionals.
Methods: For a multidisciplinary, semi-structured focus group (n = 16) discussion, clinical pharmacologists, general practitioners, medical coordinators, pharmacists, headnurses, nurses, and nurse assistants were included. All participants were specialised in geriatric care and/or affiliated to nursing homes. The topics for discussion were identified in advance and included initiation, reassessment, discontinuation of antipsychotics and barriers of discontinuation efforts in clinical practice. Discussions were audio-taped, transcribed and analysed according to qualitative content analysis.
Results: The main actors of clinical practice in nursing homes (i.e. nurses and physicians) had different perspectives on the topic. Behavioural and psychological symptoms of dementia (BPSD) were the most important and off-label indication for using antipsychotic in nursing home residents. Physicians were aware of the chronicity of antipsychotic utilisation as well as the general lack of regular reassessment of antipsychotic prescriptions. However, these issues were not perceived as a matter of concern. Physicians indicated that they strive to provide a low but effective dose to resolve the disruptive behaviour. They consciously do not consider to discontinue or lower the dose further because they believe that the positive effect of antipsychotics outweighs potential side effects. Nurses and nurse assistants pointed out that they are often asking the physician to initiate antipsychotics because of behavioural problems. The severity of initial disruptive behaviour is an important barrier for any antipsychotic discontinuation attempt. There was a general fear that antipsychotic discontinuation may lead to more intensive observation, which might result in a higher workload. Also, the lack of regular visits and clinical evaluation of the nursing home resident by physicians was a matter of concern for nurses. Physicians as well as nurses mentioned a lack of knowledge with regard to the success rate and adverse drug reactions associated with the discontinuation of antipsychotics. In the best interest of the resident, both family and caregivers want to keep the resident at ease. The only alternative for antipsychotic treatment is physical restraint, which would affect the residents' dignity and quality of life. The input of other disciplines (e.g. clinical pharmacologists and pharmacists) mainly revealed their strong knowledge, and awareness of the need of antipsychotic discontinuation attempts. They were less familiar with the interaction between nurses and physicians on the floor, indicating the need for multidisciplinary collaboration in clinical practice, especially when addressing antipsychotic discontinuation attempts.
Conclusion: There was a general lack of knowledge among the main practitioners (i.e. physicians and nurses) regarding chronic use, off-label use and potential risks associated with antipsychotic utilisation in older adults. Attitude problems with regard to antipsychotic discontinuation also formed a strong barrier. Any discontinuation program will need to address these barriers, incorporating a multidisciplinary approach.

PS01.159

Barriers to discontinuation of chronic use of benzodiazepines in Belgian nursing home residents: A focus group study

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Background: Chronic benzodiazepine (BZD) use is prevalent in more than half of the Belgian nursing home residents. International guidelines discourage this long-term use, due to risk of hangover effects, sedation and

falling in this age group. The rapid establishment of tolerance after 3 to 4 weeks, and the presence of withdrawal symptoms make benzodiazepines not a suitable drug class in older adults. Moreover, there might be an association between chronic BZD use and cognitive impairment.

Objective: The aim of this study was to explore the indications of this drug class, the willingness to discontinue chronic benzodiazepines use, and the perceived barriers associated with discontinuation.

Methods: A multidisciplinary focus group (n = 16) including clinical pharmacologists, general practitioners (GP), medical coordinators, pharmacists, head nurses, nurses and nurse assistants, all specialized in geriatric care discussed several topics according to a structured plan. After an introduction about the prevalence of the BZD in Belgian nursing homes, they discussed indications, chronic prescribing, discontinuation of BZD and barriers to this discontinuation. Discussions were audiotaped, transcribed and analysed according to qualitative content analysis.

Results: Physicians and nursing staff had similar views in the investigated topics, but physicians and pharmacists used more clinical arguments and nursing staff more practical arguments in defense of their attitude. Among the participating care givers, insomnia rather than anxiety or other indications, was the best known indication for benzodiazepines. The inappropriateness of prescribing benzodiazepines chronically was known among the GP's. Most of the time older adults enter a nursing home with a legacy of long-term BZD use, which makes it that more difficult to initiate a withdrawal process. Physicians also acknowledged they felt pushed by the resident himself and the family to prescribe these sleeping pills. Non pharmacological treatments, such as good sleep hygiene, could be an alternative to sleeping pills, but nurses consider this to be more time consuming. The physicians were aware of the need to systematically reassess chronic prescriptions, but expressed little intention to change prescribing habits. Among nurses lack of time, lack of interest and the multitude of different GP's visiting the nursing home were cited as possible explanations for not reassessing chronic prescriptions systematically. Fear of withdrawal symptoms was another reason why discontinuation of these drugs is not often initiated. To start a withdrawal process there must be a mutual agreement between the GP, nursing staff and the resident. Informing the resident about the effects of discontinuation and convincing him could be profitable, but can be time consuming. When a discontinuation process is started, the care giving staff should be informed about possible withdrawal effects. A gradual decrease is not easy as package doses of benzodiazepines for discontinuation are not on the market. A clear reduction scheme must be set up and adapted doses must be prepared by the pharmacist. The input of other disciplines (e.g. clinical pharmacologists and pharmacist) revealed a profound knowledge with regard to the risks associated with chronic benzodiazepine use. However, they were less familiar with the interaction between nurses, physicians and the resident on the work floor, indicating the need of more multidisciplinary collaboration to address benzodiazepine discontinuation. Discussing possible arguments to persuade residents to stop their sleep pill use revealed a lack of convincing material. Neither positive arguments of a withdrawal, nor negative effects of chronic use were considered to be sufficiently persuasive.

Conclusion: Insomnia was among physicians, nursing staff and pharmacists the best known indication for benzodiazepine use. Care givers frequently referred to patients explicitly indicating their need for sleeping pills, resulting in a low willingness to reduce and discontinue this chronic BZD use. To be successful, the withdrawal initiation must be supported by the GP, the nursing staff, the patient himself and the family. Fear of increased workload and the lack of willingness among patients are the most important barriers associated with discontinuation of benzodiazepines. Any implementation program to promote discontinuation of BZD will need to address these barriers.

PS01.160

Is there a faster decline in cognitive performance in bipolar elderly? A five year follow-up study

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Objective: Older individuals with bipolar disorder may exhibit greater cognitive decline over time compared to mentally healthy elderly. This cognitive impairment seems to be rather consistent over a relatively short time of two years. In this study we aimed to investigate neurocognitive performance in bipolar disorder over a period of five years.
Method: Comprehensive neuropsychological tests were applied to 15 euthymic bipolar elderly outpatients with bipolar disorder and to a age and education-matched group of matched sample of 15 comparison subjects without mood disorders or memory complaints at baseline and five years later. Neuropsychological tests were grouped in four cognitive domains: Attention, Learning and memory, Executive functioning and Verbal fluency. Illness characteristics such as age of onset and medication were derived from patient interviews and hospital medical records. At baseline and follow-up two five later, current depressive symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D) and current mania symptoms with the Young Mania Rating Scale (YMRS).
Neuropsychological functioning and change in cognitive functioning over time was compared. Differences between groups were tested with independent samples t-tests. Two-tailed comparison with conventional significance levels ($p<.05$) were used. Effects sizes were calculated by means of Cohen's d. When significant group differences were found Pearson's product moment correlation coefficients were employed to analyse relationships between test performances and illness factors.
Results: The first results on all neurocognitive measures at baseline and at follow up compared to the healthy elderly will be presented.
Conclusions: A better understanding of the course of cognitive impairment in older bipolar patients may contribute to optimizing the treatment of bipolar disorder.
PS01.161
Long-term digital mobile phone use and cognitive decline in the elderly
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Background &Objectives: The widespread use of digital mobile phones has raised questions of the deleterious effects of electromagnetic fields (EMF) exposure on cognitive health of users. Existing evidence on the short-term effects of EMF associated with digital mobile phone use on cognitive functions is conflicting and inconclusive and research on the long-term exposure to EMF on cognition is lacking. In this study, we investigated the associations between frequent digital mobile phone use and global and domain-specific cognitive changes in older persons, a vulnerable group experiencing age-associated cognitive decline.
Methods: 877 non-demented Chinese participants in the Singapore Longitudinal Ageing Studies cohort were assessed on the frequency of digital mobile phone use, neurocognitive performance and confounding variables at baseline, and neurocognitive performance at follow-up after 4 years. The frequency of digital mobile phone use was measured on a 3-point Likert scale (0 = "never or rarelyâ[euro], i.e. less than one call per week; 1 = "sometimesâ[euro], i.e. one call or more per week but not daily; 2 = "oftenâ[euro], i.e. daily).
Global cognitive functioning was assessed using the Mini-Mental State Examination (MMSE) (Folstein et al. 1975). Cognitive functioning on domains of attention, memory, learning, executive function and processing speed was assessed using a separate standardised battery of neuropsychological tests. These tests included: Digit Span (Wechsler, 1997), Spatial Span (Wechsler, 1997), Rey Auditory Verbal Learning Test (RAVLT) (Rey, 1964), Visual Reproduction (Wechsler, 1997), Categorical Verbal Fluency and Design Fluency (Delis, Kaplan &Kramer, 2001). Baseline information on potential confounders that was collected included age, gender,

education, cigarette smoking and alcohol drinking habit, depression and leisure time activities. Information on cardiovascular risk factors and diseases (hypertension, diabetes, ischemic heart disease, congestive heart failure, atrial fibrillation, and stroke) using self-reports of physician diagnoses, cardiac procedures and surgeries, interviewers' verification of medication packages, and measurements of blood pressure, ECG, fasting blood glucose and lipids were also collected. Participants' APOE genotyping was also identified by polymerase chain reaction or PCR amplification, followed by restriction endonuclease digestion of the PCR product. Participants with the APOE-4 allele (2/4, 3/4, 4/4) were classified as carriers, and those without it (2/2, 2/3, 3/3) as non-carriers.

Results: Regular digital mobile phone users were significantly more likely to be younger, male, better educated, and were more active in physical, social and productive activities, and showed significantly better neurocognitive performance in crude analyses. Multivariate analyses of baseline cross-sectional data adjusting for the influence of confounding variables showed that occasional or daily versus non-users showed significantly better MMSE global (27.9 versus 28.0 versus 28.2, p trends = 0.032) and executive function z-scores (-0.6 versus -0.1 versus 0.6, p trends = 0.031). Longitudinal analyses showed consistent but statistically non-significant results.

Conclusions: Digital mobile users were typically self-selected to possess characteristics favouring better cognitive functioning and concomitantly demonstrate better performance on cognitive tasks. Crucially, the findings showed that there was no significant deleterious effect of digital mobile phone use on cognitive functioning in older people. Findings suggest, however, that digital mobile phone use may have an independent facilitating effect on global and executive functioning.

PS01.162

Verbal fluency in Alzheimer's disease, Parkinson's disease, and major depression

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Objective: Few studies have compared verbal fluency in Alzheimer's disease (AD), Parkinson's disease (PD), and Major Depression (MD) separately. This study aimed to compare verbal fluency among in AD, PD, and MD, and to assess which sociodemographic and clinical factors are associated with the scores.

Methods: Patients from an outpatient university center with a clinical diagnosis of AD according to NINCDS-ADRDA, of PD according to the United Kingdom Parkinson Disease Society Brain Bank and the Unified Parkinson's disease rating scale (UPDRS), and of MD according to DSM-IV criteria were included. In order to stage severity of each disorder, the Brazilian validated versions of the Hoehn &Yahr scale (stages 1 to 3), of the Hamilton Depression scale (cutoff scores- mild: 8-13; moderate: 14-18; severe: 19-22), and of the Clinical Dementia Rating (stages 1 to 3) were used for PD, MD, and AD, respectively. All subjects were assessed with a sociodemographic interview as well as with the Mini Mental State Examination (MMSE), digit span subtest of the WAIS-R, and the verbal fluency test, animal category. We fitted four types of regression models for count variable: Poisson model (PRM), negative binomial model (NRBM), zero-inflated Poisson model (ZIP) and zero-inflated negative binomial model (ZINB). Tests, plots and fit statistics were carried out and the ZINB model was the one with best results.

Results: One hundred-three patients were examined. Most patients were women and had less than 9 years of education. The mean MMSE of the AD patients was the lowest, significantly different from the other diagnoses ($p < 0.001$). The mean Digit Span and verbal fluency of the AD patients were smaller than the ones for those with MD and PD ($p < 0.001$). Verbal fluency test was different between diagnoses groups. The average number

of words listed was much lower for AD patients (7.2 words) than for those presenting MD (14.6 words) and PD (15.7 words) (KW test = 32.4; p <0.01). MD and PD groups had an average increase of 44% (ratio of means [ROM] = 1.44) and 48% (ROM = 1.48) in the number of words listed during one minute compared to those with AD. This association was independent of age, education, severity and attention. The severity degree within each diagnosis category was also associated to verbal fluency in an inverse direction. Severe cases, independently of diagnosis, age and education, experienced a 26% (ROM = 0.74) reduction in the number of words listed when compared to mild ones. The performance in the digit span test was associated with verbal fluency. We found a 62% reduction in the chance of not being able to list at least one word for each point in the digit span test (OR = 0.38).

Conclusions: The performance in verbal fluency of AD patients was significantly lower than the ones observed both in PD and in MD patients. Our results also showed that disease severity impacts directly on verbal fluency, regardless of the diagnosis, age, educational level, and gender. Overall, patients in the more severe stage, but not those in the mild and moderate ones, presented a decrease in the number or generated words. Moreover, attention and concentration seem to have an important role on the performance, as the digit span test not only reduces the chance of not being able to say at least one word, as it increases the average number of listed words.This study shows that the verbal fluency test would be able to better characterize these three entities even at later stages of the disease. We have also found that even at the more severe stages, differences in semantic verbal fluency are present.

PS01.163

Negative and positive psychosocial long-term effects of a flood on people 50 years old and over

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In July 1996, floods disrupted the lives of thousands of elderly living in rural and urban communities in the Saguenay area of Quebec. Social workers, psychologists, nurses, city workers and volunteers of the Red Cross and other organizations were involved to bring support to the disaster victims during and after the floods. Despite all the support they received, the elderly who lost their home and all their possessions, as well at those who had damage to their homes or were evacuated as part of preventive measures, experienced a variety of difficulties during this disaster as well as in the months and the years following this event. Moreover, a good number of victims suffered health problems that appeared following their exposure to the disaster and also displayed psychological problems. This poster aims to share these situations, first by presenting information on the various studies conducted by our research team in the years following the flood; then, information is provided on: 1) the state of post-disaster mental health of urban and rural flood victims in comparison with non-victims and 2) the different types of positive or negative effects of the flood experienced by the victims in different aspects of their life.

In order to better grasp the difficulties experienced by the flood victims as well as the medium and long-term repercussions of the July 1996 flood on the bio-psycho-social health, different studies (n = 3) combining quantitative and qualitative approaches were conducted in rural and urban settings. The two first study consisted of administering a questionnaire containing primarily closed-ended questions to 124 elderly victims and 107 elderly non-victims living in an urban and rural setting, two or three years after the flood. The third study provides the opportunity for the same questionnaire to be administrated height years after the July 1996 flood, to 62 victims and 44 non-victims living and to conduct semi-directed interviews with 16 victims whose primary residence was lost or damaged. The primary objective of this longitudinal research was to confirm whether the differences between victims and non-victims were still present in the urban and rural setting alike. The results of this longitudinal study show that in spite of the mid and long term presence of negative effects on the psychological health of the participants, the health of the study subjects improved over time (less significant differences between disaster victims and non disaster victims over time and higher score on the various

measurement scales used in this study). On the level of the changes brought in their personal values, some study subjects noted positive aspects to the flood. They realized that unsuspected qualities and forces lived in them, enabling them to solve their problems and defend their interests against authorities sometimes recalcitrant to recognize the needs of disaster victims. The various studies undertaken with the victims and non-victims of the July 1996 flood demonstrate that this type of disaster can have mid- and long-term negative repercussions on the psychological health of an individual, while also bringing some positive and negative changes on different aspects of people's life.

PS01.164

Need fulfillment and well-being in the nursing home: A comparison of perspectives of residents, staff and observers

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Introduction: Quality of life and well-being in nursing homes are becoming more important in research and practice. One of the main influences on residents' well-being is the interaction with their professional caregivers. During these interactions staff can either support or hinder the fulfillment of residents' psychological needs. In this study, self-determination theory was used to examine the fulfillment of three basic psychological needs that are related to well-being, i.e. relatedness, autonomy and competence. Relatedness refers to feeling connected to others or having a sense of belongingness. Autonomy refers to the experience that one can make own choices and decisions and Competence refers to feeling effective in performing actions. Need fulfillment in general and in the caring relationship were examined as well as residents' well-being. The perspectives of residents, staff and observers were compared using both questionnaires and video-observations.

Methods: In this study, 35 newly admitted residents of somatic care units in seven nursing homes in the Netherlands participated. These are residents with physical illness and relatively intact cognition. The residents completed a questionnaire concerning the fulfillment of the needs of relatedness, autonomy and competence in general.

Video-observations were collected during morning care, using a handheld camera. After the video-observations, the residents were interviewed about the fulfillment of the three needs during the video-observation and during care routines in general. The extent to which professional caregivers provide support for relatedness, autonomy and competence was rated by two independent observers using observation scales developed by the authors for the purpose of the research project.

Furthermore, residents' well-being was investigated with the Geriatric Depression Scale nursing home version and the Satisfaction with Life Scale. The caregivers (N = 31) who participated in the video-observations completed a short questionnaire including 4 items about the residents' mood. The observers rated residents' mood on three affect scales. Interrater reliability for the need support scales as well as the affect scales was high.

All scores were transformed to scales ranging from 1 to 10. The different perspectives were compared by using the mean scores as well as the correlations between the different ratings.

Results: Need fulfillment during the videotaped morning care was rated very high by residents (8.7 for each of the three needs). The observers noticed more nuances; their ratings were moderately high (between 6.6 and 7.0). When residents were asked to compare their need fulfillment during the video-observation with need fulfillment during other care routines, their ratings were clearly lower (6.9 for relatedness and 7.3 for autonomy and competence during care in general). The mean ratings of residents concerning their general need fulfillment were 7.8, 7.3, and 4.6 for relatedness, autonomy, and competence, respectively.

The correlations between observer ratings of need fulfillment and residents' ratings of need fulfillment during the video-observation were .36 for relatedness, .29 for autonomy and .21 for competence. Furthermore, observer ratings were related to residents' need fulfillment in general and in the caring relationship, with the highest correlations for autonomy.
Residents scored 4.0 on depressive feelings and 6.9 on satisfaction with life. Caregiver ratings of residents' mood were 3.7 for sadness, 3.0 for fear, 2.1 for impatience and 6.4 for cheerfulness. Observer ratings of residents' mood were 3.9 for sadness and fear, 2.1 for negativity and 5.4 for positivity. The correlations between resident and staff ratings were between .10 and .23, between resident and observer ratings between .10 and .30 and between staff and observer ratings between .20 and .64.
Discussion: The perspectives of residents and observers concerning need fulfillment were only low to moderately related. Concerning residents' well-being the results suggest that the perspectives of staff and observers were more closely related with each other than with the perspective of residents. Our findings indicate that the perspective of residents is relatively independent and unique. In general, residents rate their need fulfillment higher than the observers. This could be due to social desirable answering, lowering of expectations after moving to the nursing home or because older people might have a different viewpoint on psychological needs. For future research and practice it is of importance to gain more insight in the discrepancies between perspectives, for instance during focus groups with residents, caregivers and researchers.

PS01.165

Feasibility of Euroqol-5D in nursing home residents and comparison of three perspectives of reporting quality of life

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Background: The European Quality of Life-5 Dimensions (EQ5D) is often used for calculation of utilities that are needed to determine quality adjusted life years in economic evaluation of health care interventions. Although the number of economic studies in nursing homes (MHs) is growing, little is known about the feasibility of the EQ5D in NH residents. Many residents have such cognitive and/or medical problems that they cannot be interviewed. In those cases, proxies are often asked to assess the residents' quality of life. Proxies can report from two perspectives: their own and that of the resident. This can result in different utility scores, and these utilities may also differ from utility based on scores reported by residents. Comparison of utilities based on EQ5D scores from different perspectives has not yet been performed in NHs.
Objectives: (1) to evaluate EQ5D feasibility in NH residents with and without dementia, and (2) to compare utilities calculated using EQ5D scores from three perspectives: as reported by the resident self (client-client utility, Ucc), as reported by proxy from a resident perspective (proxy-client utility, Upc) and from a proxy perspective (proxy-proxy utility Upp).
Method Design: Cross-sectional. Participants were recruited from 33 Dutch NH units (16 dementia special care). No exclusion criteria were applied. Informed consent was provided by residents or their legal guardians, depending on residents' cognitive capacity.
Procedure: To score EQ5D, MSc psychology students interviewed residents (client-client) and caregivers (proxy-client, and proxy-proxy).
Statistics: Feasibility was determined by the percentage of complete data. Utilities were calclulated using the Dutch tariff based on the time trade-off method. Paired t-tests were performed to compare utilities.
Results: One third (32%) of the 467 recruited residents were male; mean age was 80.5 years (SD = 10.3). Of 205 residents without dementia, 32 (16%) could not be interviewed because of cognitive or language problems (n = 14), refusal (n = 10), medical condition (n = 5) or other reasons (n = 3). Of the 262 residents with dementia,

103 (39%) could not be interviewed due to cognitive or language problems (n = 85), refusal (n = 11), medical condition (n = 3) or other reasons (n = 4). Of the 173 interviewed residents without dementia and 159 residents with dementia, five (3%) and 13 (8%), respectively, had missing scores for at least one of EQ5D dimensions. Caregivers were not able to score at least one dimension in four (2%) residents without dementia and three (1%) residents with dementia for the proxy-proxy index, and in 12 (6%) residents without dementia and 29 (11%) with dementia for the proxy-client index.
In non-dementia, utilities (value (SD/N)) were as follows: Ucc = .45 (29/168), Upp = .43 (.26/ 201), and .Upc = .45 (.30/193). In dementia, utility scores were Ucc = .70 (.31/146), Upp = .42 (.25/259), and Upc = .54 (.32/233). Residents with dementia had higher Ucc ($t(312) = -7.5$, $p<.001$), and Upc ($t(424) = -3.0$, $p<.001$) than residents without dementia.
In residents without dementia, pairwise comparison did not reveal any significant differences between Upp, Upc, and Ucc. In residents with dementia, Ucc was .21 points (SD = .31) higher than Upp ($t(144) = 7.9$, $p<.001$), and .11 (SD = .32) points higher than Upc ($t(144) = 3.9$, $p<.001$). Upc was .09 points higher than Upp ($t(231) = 5.7$, $p<.001$). Furthermore, the difference between Ucc and Upp was larger than the difference between Ucc and Upc ($t(143) = -4.5$, $p<.001$).
Conclusion: Feasibility of the EQ5D was acceptable in NH residents when EQ5D was scored by proxies. There were slightly more missing scores for the proxy index from a resident perspective (proxy-client) than from a proxy perspective (proxy-proxy). Feasibility of the client-client index may be considered acceptable in residents without dementia because most of them could be interviewed without missing scores. In contrast, almost half of the residents with dementia had missing scores or could not be interviewed. Therefore, a proxy score may be the only available score for a large part of this population. It is important to consider that, in contrast to non-dementia, utilities obtained using EQ5D scores from different perspectives in dementia differed significantly from each other. Residents with dementia scored their own quality of life higher than their caregivers did, whereas proxy utilities were closer to the residents' utilities when caregivers were asked to score EQ5D from the resident's perspective rather than from their own perspective.

PS01.166

Social determinants and mental health for the elderly: A model for categorizing determinants

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Introduction: In 1948 the World Health Organization (WHO) defined health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.â[euro] Beyond this, the WHO specified that mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. A strategic approach in 2007 documented the developments concerning policies to build up the focus of strategy on core issues, on health in all aspects and facets, and in addressing global health tasks and issues. These three elements are also found within the proposal for a Program of Community Action in the Field of Health for 2007- 2013, adopted by the EU commission in May 2006. Core issues are protection and improvement of health across the EU, as for example to improve prevention, to support citizens and patients, to provide easier access to health care services and to improve information, to promote health and help to address social key determinants (see Health in Europe). Mental health and mental illness are many-faceted and related to physical, psychological and social, family, and societal factors. In this context, the aspect of the social determinants of health is perhaps the most complex and challenging of all (Tsouros, 2003). The social determinants of health have been described as 'the causes of the causes'. They are the conditions that influence the health of individuals and populations. The world is rapidly ageing. Good health among older people is increasingly important, enabling the older adults to stay active for longer. But the elderly constitute a group in which environmental and social factors contribute greatly to active and healthy aging in societies worldwide. There will be more elderly people with their special needs such as protection from physical,

financial, psychological abuse and neglect. Aim: To introduce and reflect the widely cited Dahlgren and Whitehead's model of health determinants relating to social determinants. To introduce the social determinants approach to health constructs health as an outcome of a range of upstream, mid-stream and downstream factors of health for the elderly (Dahlgren and Whitehead 1993).
Content: The model is helpful since it illustrates how various and important health influencing factors are embedded within broader aspects. Summary: The poster aims to raise awareness of health influencing factors and may highlight social determinants that currently influence elderly people with a mental disease in the context of emerging evidence and practices to promote mental health (WHO, 2004) and the WHO' concepts of prevention of 2004. The concept of prevention is best defined in the context of levels, traditionally called primary, secondary and tertiary prevention. The poster may be helpful for scientists, practioners, and policy-makers to improve Mental Health for the Elderly. One aim is to ensure that older people are able to live independent lives. This includes living in their own homes for as long as possible.

PS01.167

Social determinants of health and promotion of mental health in old age: The role of policies

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Social determinants of health (SDH) are the conditions in which people are born, grow, live, work and age and which are shaped by the distribution of money, power and resources at global, national and local levels. SDH are the conditions in which people are born, grow, live, work and age and which are shaped by the distribution of money, power and resources at global, national and local levels. A list of these social determinants should include at least: - Cultural and spiritual references - Discrimination and stigma - Education and literacy - Employment and working conditions - Financial resources including - Food and housing security and quality - Health system - Inequalities - Justice system, including respect of Human Rights - Physical environment - Social status and security - Social, political and physical exclusion and marginalization - Violence, abuse, neglect, abandon These social determinants are associated with mental disorders by contributing to its onset or course. Social determinants may play a role as risk factors for mental health (unemployment, poverty, inequalities, stigma and discrimination, poor housing, poor early years experience, violence, abuse, drug and alcohol abuse, poor general health, caring duties), while others may be protective factors (employment, social protection, resilience, social networks, positive community engagement, positive spiritual life, hope, optimism, good general health, good quality parenting, positive relationships in childhood). By acting on SDH, it is possible to contribute to a better subjective mental health and well-being of people, to build the capacity of communities to manage adversity, and to reduce the burden and consequences of mental health problems. Disadvantages because of mental health problems damage the social cohesion of communities and societies by decreasing interpersonal trust, social participation and civic engagement. SDH are primarily responsible for disparities in health. They are influenced by policies choices which influence the development of public service systems. These systems, in their turn, shape the social determinants of health through the development of programmes, resource allocations and organization of services. The influence of negative social determinants of health often is caused by bad political choices and the consequent unequal distribution of resources. The establishment of good policies is the first step to produce changes. The goal of this poster is to describe how the interaction between social determinants and mental health and well-being of older persons were considered on recent selected statements, policies, declarations or other public health documents with the aim to promote a better mental health. These documents were grouped in four levels. Those promoting a better health and well-being (i) for all; (ii) for older persons and during the ageing process, (iii) for persons with mental disorders, and (iv) for older persons with mental disorders. The growing mental health needs of an ageing population may require additional policies, in particular for care and treatment, the promotion of healthy lifestyles and supportive environments. But the most important for the implementation of the presented texts are the political will and courage to induce changes.

References: Commission on Social Determinants of Health (2008). Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva, World Health Organization.

PS01.168

Happy makers make the difference in small scale living for persons with dementia

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Background: The number of older persons in our society increases rapidly the following years. The number of persons with dementia increases simultaneously and our ideas about quality of care and quality of life change. The concept of large scale nursing homes does not fit the needs of most persons with dementia. In Rotterdam, the Netherlands, Endeldijk started, a small scale living facility for persons with dementia. Alongside new ideas about involving the neighbourhood they developed a new function, an unique new staff member "the happy makerâ[euro]. A person solely focused on the well-being of the residents without any tasks related to Activities of Daily Living. The Rotterdam University of Applied Sciences was asked to evaluate this initiative. Objectives To evaluate the small scale living facility Endeldijk from the perspective of: * the residents; * their family caregivers and * the nursing staff.

Methods: A mixed method design was used. With the Qualidem quality of life of the residents (n = 26) was measured. Furthermore, observations took place and family caregivers were interviewed (n = 24). They were asked about their satisfaction and involvement with care. The nursing staff including the happymakers (n = 14) was interviewed about their experiences with working at Endeldijk. Two measures were conducted: at baseline and after 6 months.

Results: Almost all residents had severe cognitive disorders. It appeared that residents communicated frequently with each other and with the staff. Residents were helping each other with household activities and were in general in a good mood. Some residents were restless at moments without arranged activities. The residents' relatives appreciate the way the staff approaches the residents and the way family caregivers are involved in care of their relative. However, communication and participation are too much dependent of the individual nursing assistant. A less positive aspect of care mentioned by family caregivers is the minimum amount of times the residents come outside for a walk or enjoying fresh air. The "happy makersâ[euro] were evaluated positive, but their function name was changed. Every staff member wanted to be called happy maker so it not felt fair towards the other staff members.

Conclusion: Endeldijk offers comfortable living for persons with dementia. Residents seem to be relatively satisfied. They enjoy doing activities together. The residents' relatives are satisfied about the concept of small scale living and the "happy makersâ[euro] but they would like to see improvement of the communication between the nursing staff and themselves in order to improve continuity of care.

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PS01.169

Development of the Korean quality of life scale for elderly with dementia (KoQoLD)

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Objective: In Korea, the quality of life in elderly with dementia is apt to be neglected. For improving quality of life in elderly with dementia, it has to start with developing valid and reliable quality of life scale for them. The Quality of Life is considerably different on cultural and social backgrounds. We developed the Korean specific quality of life scale for elderly with dementia focusing on the community dwelling elderly with impaired cognition.

Methods: 45 items about the Quality of Life in Korea were collected through references and internet searching, and we drew up the preliminary questionnaire with these 45 items. Through pilot study of 132 elderly people

who were dwelling in Hanam-si, Korea, we shortened our questionnaire to 28 item-questionnaire. As a part of Hallym Aging Study 2007 in Chuncheon-si, Korea, 545 elderly people were interviewed and applied the shortened instrument with 28 items. Hallym Aging Study is prospective cohort study on aging since 2003, and whole study participants at 2007 were 702. The subjects were divided into cognitively impaired group and cognitively intact group using Korean-Mini Mental State Examination (K-MMSE). We chose some items which showed high correlation with EuroQol 5D, Visual Analogue Scale (VAS) and Physical Component Summary (PCS) and Mental Component Summary (MCS) of 12-Item Short-Form Health Survey (SF-12). We modified the questionnaire to 16 item-questionnaire with each five score-scale (much satisfied- satisfied- fair- not satisfied- not much satisfied). We named the questionnaire 'the Korean Quality of Life Scale for Elderly with Dementia (KoQoLD).' We analyzed the validity and reliability of the KoQoLD.

Results: The final 16 items were Instrumental activities of daily living (IADL), activities of daily living (ADL), occupation, meeting family, making a call with family, family structure, positive emotion, past experience, self esteem, cognitive function other than memory domain, accessibility to medical facility, taking medication, leisure activities, pain, physical health state and sleep. For concurrent validity, we did correlation analysis of KoQoLD with EuroQol and MCS and PCS of SF-12. The correlation amount is more than moderate with all of them. Especially MCS of SF-12 was highly correlated with KoQoLD, and it meant the scale reflected subjective Quality of Life properly. Factor analysis revealed five factors- functional (IADL, ADL and occupation), familial (meeting family, making a call with family and family structure), psychological (positive emotion, past experience, self esteem and cognitive function other than memory domain), social (accessibility to medical facility, taking medication and leisure activities), and physical factors (pain, physical health state and sleep)- that explained 62.22% of the total variance. KoQoLD had moderate test-retest reliability($R = 0.595$, $p<0.01$). The internal consistency (Cronbach's alpha) of the scale was 0.855.

Conclusion: We developed the KoQoLD for Korean specific Quailty of Life scale for elderly with cognitive impairment with adequate validity and reliability. Relationship with family members and self esteem rather than sight, hearing and transportation seemed to be important for quality of life of elderly with impaired cognition. The limitation of this study is that the subjects were not limited to diagnosed dementia patients. Further studies are warranted on this scale with hospital-based patients, and we have to develop modified scale for patients with severe dementia.

PS01.170

Acceptability and usability of a tangible surface to explore cognitive status: The MIDAS project

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Introduction: It is a fact that elderly have been in contact with new technologies, around 20 % of people over 65 have a computer at home and use internet. Knowing that information about daily tasks and home performance can be useful to track cognitive status, in e.g. through cognitive games scores and other activities, we developed a computer based system (majook) which is based on existing validated tests.

Objective: To test the acceptability, ergonomics and usability of the first version device.

Methodology: As part of the MIDAS (Multimodal Interfaces for Disabled and Aging Society) project, we propose the majook system which is computer based and offers a set of 19 selected questions (out of 150) to evaluate cognitive performance. The person answers on a tangible surface that recognizes objects by placing a cube. To evaluate satisfaction the System Usability Scale (SUS) and other adapted questions were used.

Results: 20 persons did participate, mean age was 60 and they were divided in two groups, 10 younger adults and ten older persons. This later group (mean age 74years) had 8 male participants and their mean MMSE was

27. Concerning the acceptability, the device was well accepted. Most comments were on the timing, misunderstanding of questions and level of difficulty. Mean SUS score was 81.2/100 for all participants, and this score do correlate to non answered items (68%). When comparing performance scores between the two groups, seniors had lower scores, 59.4% succeeded compared to 90.6% from younger adults. These rates of success do correlate to socio cultural level, cognitive capacities, time to answer, and learning feasibility from the SUS.

Discussion: Independently of performance in memory tasks, majook seems to enhance executive dysfunctions and speed processing commonly observed in elderly patients. The usability of such device for self cognitive assessment seems to be effective even if we must validate it with a face to face assessment. It could help to early detection of cognitive problems since scores should be tracked by the general physician or geriatrician.

Conclusion: The Majook system could be an eligible new technology for cognitive assessment and training in frail elderly at home.

PS01.171

A tangible surface to facilitate communication and filling a pillbox, possible use for patients with cognitive impairment: The MIDAS project

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Introduction: Medication adherence starts by a properly filled pillbox, especially for persons with some memory impairment and for those with poly medication. This task depends partially on cognitive performance and therefore assisting persons living alone who have light impairment is crucial. But also the need to contact the health professionals in case of doubts regarding medication is important and this action should be simplified to avoid errors or time consumption. Therefore as part of the MIDAS (Multimodal Interface for Disabled and Aging Societies) project we tested a tangible surface which was developed on a multi touch support and that also offers a simplified communication via internet.

Objective: To test the acceptability and ergonomics of a tangible surface which recognizes medication boxes to help filling a pillbox and which simplifies communicating via internet.

Methodology: Volunteers over 60 tried after signing an informed consent the prototype. First they used freely the table and then they followed simple instructions corresponding to predefined scenarios. The table guides the person with images and easy instructions showing how to fill in a weekly pillbox. In case the patient needs help, the table which is online enables the person to contact his physician by email using a simplified interface. At the end participants were asked to fill the System Usability Scale (SUS)

Results: Until now we have results from 14 participants, mean age 79.6 years. Seven are men. Half of them live in an elderly home, 4 are in patients in rehabilitation and 3 visitors in the ward. Five of them have a computer. Only one person did not succeed to fill the pillbox alone, she needed constantly little indications, so we did a MMSE which was 23/30 but her clock test showed important apraxia. All persons managed to write a small message and 4 needed aid to send it. Nobody found the magnifying glass easy to use. All appreciated the simplified information about medications and visualizing the medication boxes pictures to better recognize them. Two persons have a nurse coming daily to assist them with medication intake. Most persons do not imagine such a system in their own homes in the near future (too big and expensive).

Discussion: Most participants felt confident with the system, once they got some little instructions. The discovery period was not useful, because only 3 persons started touching the table spontaneously. Even if they managed to follow the tasks, persons believe that you need to be cognitively fit to do so. But after observing their performance, we think that if we modify the system according to their inputs, we might have a version ready to be tested by persons with mild cognitive impairment. In fact the system demands little learning as stated by

participants, which enables the success for both tasks tested, the filling of the pillbox and also sending an e-mail. The use of internet was a nice surprise for most of them. These results are encouraging and we will modify the identified ergonomic errors and propose the table to persons with mild impairment.

Conclusion: simplified systems can be attractive and user friendly to seniors. The multi-touch table was well accepted and appreciated. Input from future users might be very valuable to better adapt the system to persons with cognitive problems.

PS01.172

Successful augmentation of seizure induction with oral theophylline in electroconvulsive therapy for depression

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Introduction: To optimize the effectiveness of electroconvulsive therapy (ECT) for the treatment of mood disorder or psychosis, it is essential to induce adequate seizures at stimulus intensity above "therapeutic threshold,â[euro] which means 50% to 150% above seizure threshold in bilateral electrode placement. Because the elderly patients often have higher seizure thershold, inadequate seizures including missed or abortive ones more easily occur with pulse-wave stimulation. When only inadequate seizures are induced at a maximum intensity, augmentation of seizure induction is necessary. In Japan, unfortunately, sine-wave stimulation is still used instead of pulse-wave stimulation. More important is, however, the induction of adequate seizures by pulse-wave stimulation, which is considered standard. We describe a case of successful augmentation of seizure induction with oral theophylline in pulse-wave after sine-wave ECT for depression.

Case Report: The patient was a 73-year-old woman. At the age of 65, she was diagnosed as major depression and given several kinds of antidepressants, but her symptoms did not improve. Five years later, she was admitted to a hospital and well treated with pulse-wave ECT. After a half year of continuation ECT, only missed seizures were induced at maximum intensity. A sine-wave apparatus was used instead and induced seizures again. Two years later, ECT was discontinued for some reason and she relapsed into severe depression although daily given fluvoxamine 150mg, bromazepam 4mg, and hypnotics. She was admitted to our hospital. Full blood test, cranial CT, electroencephalography and cardiac ultrasound revealed no organic abnormalities. Acute ECT was started at three times a week. Thiamylal at 200-250mg was intravenously administered as an anesthetic agent, succinylcholine at 60mg as a muscle relaxant and flumazenil at 0.5mg as a preanesthetic agent. A sine-wave stimulation of an alternating current of 115 volts for 7 seconds was done. Adequate seizures, defined as an electroencephalographical occurrence of not only a seizure exceeding 20 seconds but also a greater postictal suppression, were induced until seizures were missed at 120-130 volts for 7-9 seconds at the fifth and sixth sessions. Then, sustained-released theophylline at 200mg was orally administered the night before the subsequent sessions. Seizures were adequately induced again without tachycardia or other toxicity. Her symptoms markedly improved, and after discharge, she received continuation ECT every four weeks with oral theophylline. Several months later, the apparatus was successfully switched to a Thymatron System pulse-wave apparatus with a pulse width of 0.5ms and a pulse frequency of 70Hz. Stimulus dose was 504.0 millicoulombs at maximum in the bifrontal electrode placement, using the same dosage of thiamylal, succinylcholine and flumazenil. From then, she was well treated with the pulse-wave stimulation. Serum theophylline levels drawn on the mornings of the sessions ranged between 6.0 and 10.0 mg/L.

Discussion: There have been several reports on augmentation of seizure induction in ECT with oral theophylline. In our case, it appears noteworthy that theophylline augmented seizures until the wave mode could be successfully switched from sine-wave to pulse-wave. According to the APA Task Force Report on ECT, thoephylline will increase seizure duration but will not facilitate seizure adequacy, as there is little relationship between seizure duration and clinical outcome. In fact, however, the method in this case produced

adequate seizures that led to favorable clinical results. Moreover, it was safe, probably because serum levels were under therapeutic range (10-20mg/L) for pulmonary disorder, although theophylline might have induced status epilepticus when administered at levels in this range. Our case suggests that oral theophylline administration needs to be reappraised for seizure augmentation in ECT.

PS01.173

Bipolar disease and cognitive dysfunction

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Cognitive dysfunction in bipolar disorder is being considered at present as a core feature in this disease, with a great psychosocial and functional impact. The cognitive impairment seems to reflect trait or state of affective manifestation, both in the acute phases and in remission. The degree of impairment is related to the iatrogenic effects of medication and also with residual mood symptoms (Quraishi et al 2002; Goldberg et al, 2008). The possible evolution and/or overlap with the behavioural symptoms of organic dementia allow their categorization, according to some authors, as bipolar disease type VI (Akiskal et al, 2005; Manove et al, 2010). We present two clinical cases, of two 73-year-old women with different clinical features. The first case is a woman diagnosed with Bipolar Disease when she was 32 years old. At the age of 71 years she started to present difficulties in doing her daily activities. She was evaluated in a Psychogeriatric consultation, with severe cognitive impairment identified and she begun treatment with cholinesterase inhibitors. The second one is a woman without a psychiatric past, who presented, at 62 years old, psychological symptoms (hypomania, lack of inhibition and insomnia) as well as some deficits in her immediate memory and in complex daily activities. When treated for Bipolar disorder the behaviour improved, although cognitive deficits worsened, becoming progressively more dependent (Goldberg et al, 2009). In clinical practice it is very difficult to differentiate the cognitive dysfunction associated with dementia from that linked to the evolution and treatment of Bipolar disorder, or even from these two overlapping clinical situations in these elderly patients (Wingo et al, 2009; Demily et al, 2009). A rigorous clinical evaluation of the patient's cognitive deficits, past psychiatry treatment, premorbid personality and psychiatric history as well as family history were essential for determining adequate diagnosis and effective therapeutic strategies (Yatham et al, 2010; Fernandes et al, 2010).

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PS01.174

Animal Assisted Therapy (AAT) in the Nursing Home: Important implications for enhancing quality of life in older

people

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Animal-Assisted Therapy (AAT) is an alternative therapeutic modality that can be used to promote quality of life and positive health benefits in older people, through providing relaxation and pleasure, or incorporating activities into physical therapy or rehabilitation. It is well documented that animals are beneficial to older people in a variety of settings. When considering factors that impact on the quality of life of older people, attachment to pets is one factor that is critical to consider from a psychological perspective; Pets can be central to an older person's life, and it is often the case that the pet is their family. Pets provide many of the emotional and psychological benefits that are associated with close human relationships. Specifically, relationships between animal companions and mood, enhanced social interaction and perceived quality of life, decreased loneliness and agitation associated with dementia are reported in the literature. Allowing animals into the nursing home can provide a sense of feeling needed and loved, a central focus to daily routines (self care and pet care), increased prosocial behaviour, decreased agitation in nursing home settings, promote emotional well-being and self efficacy, and importantly, highlights the relationship between allowing pets and the flexibility of the nursing home environment. In addition, the relationship between an older person and a pet may be linked with memories of a deceased spouse, absent family members, or special personal memories. Pet ownership is also associated with better adjustment to major stressful life events such as spousal bereavement and coping with major health problems in later life. Recent advances in the pet therapy literature and the acknowledgement of the important therapeutic benefit that companion animals can have on emotional wellbeing and social support in older age has led to an increased number of aged care facilities incorporating companion animals in some manner into their facility. A wide range of animals can be used including cats, dogs, birds, fish, horses and even goats, and the animals can be matched to suit the older persons' activity level. However, despite the numerous documented benefits, although they acknowledge the important role that pets can play in later life and are open to the prospect, many nursing homes and aged care facilities report that it is simply impractical to bring pets in. Specifically, in nursing homes where behavioural and mood problems are often rife in people with dementia and severe cognitive decline, staff may be hesitant to bring animals in for fear of burdening staff, inadvertent harm to residents, or even harm to the animal. Here, robotic animals have been shown to be beneficial. Robotherapy is a relatively new innovation, where mechanical dogs such as AIBO that perform most of the actions of real dogs, robotic cats that purr and meow and even robotic ponies have been trialled in aged care facilities with promising results. The benefits are reportedly similar to real animals, in that residents display improvements in mood, social interaction, and emotional wellbeing, and reductions in loneliness, anger and behavioural problems - and the potential for harm to the older person and the animal is significantly reduced. Robotic animals have also been shown to be beneficial in treating children with developmental problems such as autism and Asperger's syndrome, where they too may have a lack of emotional regulation and an incomplete understanding of how to appropriately interact with real animals. Thus, this could be taken as evidence to suggest that these robotic animals may be useful in a similar manner, as an adjunctive approach to enhancing the quality of life of older people residing in aged care when it may not be feasible to have real animals in the facility.

PS01.175

Information and communication technology-based interventions for Spanish and Chinese speaking Alzheimer's caregivers

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Despite numerous interventions being developed in the past decades for dementia caregivers, ethnic minority

family caregivers do not benefit from this progress, mainly because these interventions are not culturally appropriate, cannot reach the users, and are too costly to be available and sustainable. Some studies showed that insufficiently met needs among the caregivers can be alleviated or even met by using Information and Communication Technology (ICT), yet very few interventions target at Spanish or Chinese speaking populations. To overcome these "implementation gapsâ[euro], two culturally-sensitive educational and support online programs were developed for Spanish or Chinese speaking family caregivers respectively. Each website includes a combination of texted-based educational information, expert opinions, caregiver stories, educational tools and an online community. Formative evaluations on context-rich caregiver stories and interactive features of the web-based interventions were completed. Based on the results, contents were edited with more appropriate literature level and the functions of the websites were improved to be more user-friendly. After that, family caregivers who speak Spanish and Chinese as native languages were recruited for randomized controlled trials: the participants in the experimental group used the online intervention while the control group received only text-based materials like brochures. Pre- and post- intervention assessments were conducted for both groups to examine the effectiveness of the intervention programs by investigating the changes of caregivers like knowledge gains, caregiving skills improvement, etc. Preliminary findings confirmed the wide-spread global needs in these two under-served populations for such services. Beneficial effects of the web-based interventions on participants were observed (1). The most mentioned strains and challenges as caregivers were the overall fear about the future and financial constraints on continuing to care for the relative with Alzheimer's. The most common negative feelings among caregivers were sense of loss, helpless, and disoriented. (2). The fact that the sites were available in their native languages was said to be the most useful features by both ethical groups. The most useful sections picked by the participants were noticing symptoms, understanding stages, and dealing with behavioral problems. Among the Spanish participants, 87% could read and understand the information on the website, 71% found the website easy to use and 71% would like to keep using it. Among the Chinese participants, 96% could understand the information, 89% could find the information they needed, 72% thought it was easy to use, and 92% would recommend it to others. (3). ICT-based intervention was effective in transmitting information about Alzheimer's disease to the under-served minority groups and creating an additional support system. Comparing the post-evaluation to the pre-evaluation, the majority of participants in the experimental group for both populations showed significant improvement in the knowledge of Alzheimer's disease, the care-giving skills for Alzheimer's patients, and the awareness of available resources and services. Among the Spanish population, before the online intervention, 35% knew what Alzheimer's disease is, 30% knew where to find information about the disease, 17% knew what services are available, and 9% knew how to manage the difficult behavior of a person with the disease. After the online intervention, the numbers increased to 95%, 91%, 87% and 83% respectively. (4). Participants in the experimental groups also showed increased level of self-care, emotional management, and the positive attitudes towards being a caregiver. Among the Chinese population, almost all the participants expressed relief after using the website, especially reading other caregiver's stories. (5). Both Spanish and Chinese speaking caregivers place considerable emphasis on family harmony and cohesion and would not like to let anyone outside the family take care of the relative with Alzheimer's. Thus, any intervention targeting these populations must address this core value and clear social and emotional division between "insidersâ[euro] and "outsiders.â[euro] Further efforts should focus on developing more specific information in various formats and providing customized care-giving guide for ethnic minority groups.

PS01.176

An inventory of two years geriatric liaison psychiatry at a university hospital

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Background: Mental disorders are common among elderly people and therefore require special attention on geriatric wards. Medical teams on geriatric wards often lack skills, confidence and/or knowledge for adequate psychiatric assessment and care, especially with more complex psychiatric disorders. This leads to underdiagnosis and undertreatment, increased caregiver stress, longer stays at the hospital and a higher socio-economical burden. Therefore, we installed a geriatric psychiatry liaison team (GPLT) operating in geriatric wards at the University Hospitals of Leuven (Belgium). The GPLT consists of a psychiatric nurse, a resident in psychiatry and a consultant in geriatric psychiatry. The aims of the team are diagnostic evaluation and treatment, if needed referral to psychiatric inpatient unit or outpatient care and sensibilisation and education of the geriatric teams.
Aim: Given the paucity of data on the value and need for a geriatric liaison-psychiatry, we made a quantitative inventory of 2 years of work carried out by the GPLT. Methodology: We quantified descriptively the numbers of GPLT consults and the numbers of referrals to specialized psychiatric in- and outpatient treatment relative to the total number of admissions to our geriatric wards between 2008 and 2009. We also studied the nature and prevalence of the psychiatric disorders of patients that were assessed.
Results: 4966 patients were admitted to the geriatric wards between 2008 and 2009. The GPLT was consulted for 1007 patients, i.e. in 20.3% of the admitted patients. Of these, 352 (35.0%) were referred to a specialized inpatient geriatric psychiatry unit and 156 (15.5%) to an outpatient geriatric psychiatry clinic for further specialized diagnostic and therapeutic evaluation. Delirium was present in 65 (6.4%) cases, mild cognitive impairment or dementia in 394 (39.1%), mood or anxiety disorder in 219 (21.7%), adjustment disorder in 47 (4.7%), personality disorder in 30 (3%), psychotic disorder in 24 (2%) and substance abuse in 12 (1.1%).
Conclusion: Our data suggest that a significant number of patients admitted to geriatric wards may benefit from the inception of a GPLT. The number of referrals to specialized psychiatric care indicates that a GPLT is valuable in building bridges between geriatric medicine and psychiatry in order to optimize integrated care for the elderly.

PS01.177

An intensive community team in aged persons mental health

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Background: In the UK and USA the move to community based treatment in mental health has been growing steadily since deinstitionalisaton began in the 1950s. Initially most community based treatment services were step-down, sub-acute or primary health care services. However there is growing trend to deliver more acute or intensive health care services in the community. In adult crisis intervention teams have reduced admissions, costs and stigma, though early claims were possibly overstated. There is widespread agreement among health providers that when given the choice, most patients and families preferred home-based treatments. Similar studies have not been conducted in aged psychiatry. Nothing is known of the efficacy of aged psychiatry intensive community treatment teams. It cannot be assumed that aged care programs will work as well as those for younger adults. Older clients are more likely to be cognitively impaired, have multiple medical co-morbidities, greater functinal incapacity and take larger numbers of medical and psychiatric medications that increase the risk of falls and other mishaps. Very old depressed men are at greater than average risk of suicide and many of those with chronic psychoses have limited family supports. Specialist, intensive mental health programs for older people therefore warrant independent scrutiny. This is the description of such a service that was set up in the outer Eastern suburbs of metropolitan Melbourne. The aged persons mental health service has a catchment population of around 110,000 people 65 years and over.
Method: The rationale for setting up the new team, the principles of the new team, service activity and findings from an evaluation of the team are described.Intensive community treatment is provided during an acute episode of mental illness as an alternative to hospitalisation, as a less restrictive option. An acute episode of treatment can include a pre and post hospitalisation course of intensive community treatment in addition to a

hospital stay. At the time of the inital assessment, the expectation must exist that the Intensive Community Team will achieve outcomes comparable to those of an inapatient admission. It must be possible for intensive treatment in the home to be provided in a manner that assumes the safety of the patient and other. Both the patient and thier family must express a preference for the treatment in the home as an alternative to hospitalisation. There will be a twenty-four hour response to patients and families or carers on the program. The cooperation of the patient's general practitioner is required for intensive community treatment to be offered.
Conclusions: The program was found to provide substantial support and patient benefit. Intensive Community Treatment does not replace the need for acute inpatient beds but it does provide an opportunity for some patients to be managed in their homes who otherwise would have been admitted and it also has the potential of reducing the length of stay of a number of patients.The Intensive Community Team is now an integral and important part of the continuum of services provided by the Eastern Health's aged person's mental health service.

PS01.178

Involving families in institutional dementia care: Benefits of therapeutic family-staff partnerships

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Background: International research acknowledges the increasing prevalence of dementia is causing unprecedented family caregiver burden, complicated by delayed diagnosis, lack of information and access to services. Family involvement is a multidimensional construct embracing dementia-specific psychosocial support, person-centred care and the changing role of families as the syndrome advances. There is also increasing evidence that in the early stages of the syndrome lack of specialised support from staff in the care of the person with dementia can directly impact on the level of distress experienced by the family caregiver during and after institutional placement, resulting in an increase, rather than decrease in family caregiver burden. One means to improve knowledge and develop cooperative roles between family and staff caregivers is the family-staff partnership, defined as a dynamic, therapeutic relationship that requires articulation of common care goals, the exchange of knowledge and clarification of care roles, thus improving satisfaction and reducing stress for all.

Aim: of this research was to examine family involvement as partners with staff in the care of their relative with dementia in institutional long-term care and to measure its benefits. This was achieved by implementing and evaluating a family-staff partnership model of care based on negotiation of therapeutic activities for the person with dementia. This study was a partial replication of the Family Involvement in Care (FIC) education intervention and evidence based partnership model developed and conducted in the US with successful care outcomes. Theoretical frameworks for the intervention are derived from person-environment fit and role theory.
Methods: The mixed method, sequential two-phase design of this study consisted of a pre-intervention and post-intervention phase, using a purposive sample of ten family participants to explore and evaluate family caregiver experiences before, during and after the nine month partnership. The sample for this quasi-experimental trial consisted of 57 family and 58 staff caregivers of residents with moderate to severe dementia across a control and intervention site in Australia. Between group and within group effects were analysed using ANOVAS at <0.05 level of significance.
Results: Pre-test comparisons showed no significant group differences in knowledge, stress or satisfaction measures for families and staff. Post-test beneficial intervention effects associated with family caregivers' knowledge of dementia were found ($p<.001$). However post-test family measures showed decreased satisfaction with management effectiveness [$t(29) = 2.64$, $p<.05$] and with staff caregivers [$t(55) = 2.18$, $p<.05$] compared to the control site. Post-test staff measures showed increases in staff stress due to residents' inappropriate behaviour [$t(30) = -2.10$, $p<.05$] and perceived lack of organisational resources available to care

for the residents, compared to the control site [t(56) = -3.71, p<.01]. At the post-intervention interviews family caregivers identified two obstacles to the benefits of their involvement in the partnership; loss of their allocated staff member due to structural changes within the institution, and environmental changes for their relative during the nine month period of the study. Although these influences were reflected in decreased family caregiver satisfaction at the intervention site, family caregivers described the benefit of their partnership with staff as being an improvement in their relatives' well- being as a direct consequence of their increased involvement. They acknowledged the benefit of family involvement in care of people with dementia, agreeing that the success of family-staff partnerships relied on support from management of family caregiver roles as part of standard care.

Conclusions: The post-intervention family interviews indicated that the FIC partnership can improve family caregiver involvement, which may in the long-term reduce psychosocial effects of caregiver burden. However, these findings firstly highlight the difficulties in establishing an intervention in institutional long-term care without strong support from organisational management and secondly in maintaining the intervention long enough to establish measurable beneficial psychosocial effects that reflect changes in family caregiver burden.

PS02.01

Pessimism and self perception of health in Portuguese old people

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Background: Portuguese people are well known by their nostalgia, present in the national song -fado - which means fate or destiny. In previous studies we notice that people are frequently resigned with their status (e.g. Paúl et al. 1999). They attribute their life condition, namely health, to destiny or god's will, and this makes them passive and not engaged in preventive behaviors or active life styles. Human behavior is organized around the pursuit of goals. Pessimism is a negative expectancy toward future, leading people to doubt about the attainability of goals and so impairing efforts to move into action. Considering the maintenance of health a major goal, will pessimistic people perceived their health better or worse than non pessimistic ones. Self perception of health is considered a good predictor of morbidity and mortality in old people and reflects either real health, with people assessing their health as worse when having more diagnosis or a more negative attitude towards health (e.g. Paúl et al., 2007). Objective to check the association between pessimism and self-perception of health

Method: This research is part of an extensive Portuguese project on active ageing (DIA Project) with adults aged 55+ years living in the community (N = 1322). Pessimism is assessed with LOT-R (Scheier &Carver, 1992). We begin by doing exploratory factor analyses of principal components using the 6 items of LOT-R as four items are filler items and are not used in score (Scheier, Carver and Bridges, 1994) and contrarily to the authors we obtain 2 factors with 3 items each, explaining 57.8% of variance, similarly with the results of Sultan and Bureau (1999) in a French population. The items that constitute the factor of pessimism are: 3 'If something can go wrong for me, it will'; 7. 'I hardly expect things to go my way'; 9. 'I rarely count on good things happening to me'. After words we have done a multinominal regression using self-perception of health (with three levels; reference category good and very good health) as dependent variable, and pessimism, age and gender as predictors.

Results: There are 29% of people that reported their health as bad or very bad. Amongst them the percentage of pessimists is around 40% which is significantly different from the amount of pessimists reporting good or very good health except for the item 3. Being pessimist raises 1.3 times the probability of bad or very bad self perception of health (OR = 1.29, 95%, CI 1.19-1.39).

Conclusion: Considering that pessimism is a particular kind of thinking; we may conclude that pessimists tend to assess their health as worse than not pessimists. As subjective health is generally recognized as a predictor of morbidity and mortality (e.g. Fernández-Merino, et al., 2000; Jang, 2004), pessimists are at higher risk in what

concerns health outcomes, probably by having inadequate life style. One remaining question is whether we will be able to intervene in pessimism in order to encourage people in controlling their health behavior and not only suffer the fated life course. References: Jang, Y., Poon, L., Kim, S-Y &Shin, B-K (2004). *Self-perception of aging and health among older adults in Korea*. *Journal of Aging Studies*, 18, November 2004, Pages 485-496. Fernández-Merino, M. Rey-García, J., Tato, A., Beceiro, F., Barros-Dios, J., Gude, F. (2000). *Self-perception of health and mortality in elderly from a rural community.* Atencion primaria, 25 (7), 459-463 Paúl, C. Ayes, S. &Ebrahim, S. (2007). *Disability and Psychosocial Outcomes in Old Age, Journal of Aging and Health*, 19(5), 723-741. Paúl, C., Martin, I. M.R. Silva, M, Silva, M. Coutinho, P. &Sequeiros, J. (1999) *Living with Machado-Joseph disease in a small rural community of the Tagus valley Community Genetics,* 2 190-195. Scheier, M., &Carver, C. &Bridges, M. (1994). *Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the life orientation test, Journal of Personality and Social Psychology, 6,* 1063-1078. Scheier, M., &Carver, C. (1992). *Effects of optimism on psychological and physical well-being: Theoretical overview and empirical update. Cognitive Therapy and Research*, 16, 201-228 Sultan S. &Bureau B. (1999), *Which optimism in health psychology? European Review of Applied Psychology,* 49, 43-51.

PS02.02

Psychological distress and loneliness in Macaronesia Islands

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Background: Mental health problems are increasing (WHO, 2002). Reducing suffering and dependence is a priority requiring on understanding of psychological distress's determinants. Risk of depression is a problem in later life (Paúl; Ribeiro, 2008) associate to loneliness, illness and disability. Loneliness seems to involve the manner in which the person perceives, experiences and evaluates his/her isolation and lack of communication with other people (Victor, et al. 2000).Studies point that loneliness and psychological distress are mostly underestimated because chronic illness gain relevance. Madeira and Azores are considered by the EU ultra-periphery regions because of the level of development and isolation. We want to know if there are differences in psychosocial variables in old age between Portuguese mainland and the islands and if Macaronesia Islands are distinct.

AIM 1- Determinate prevalence of psychological distress and loneliness in Macaronesia Islands, (b) identify factors related to psychological distress and loneliness.

Methods: DIA Project (POCTI/PSI/56505/2004): Cross-sectional study Samples Community dwellers aged 65 and plus living in Madeira (RAM) n 235 and Azores (RAA) n 98. Women RAM:62,6%, RAA 77,6,%; married RAM 48,1%, Widow RAA 58,2%; illiterate RAM 41,7%, RAA basic school 77,6%; mean age RAM 70.4, SD 6,94;(65-99), RAA mean age 74.6, SD 6,38;(65-90).

Instruments: Questionnaire GHQ-12 Scale- Goldberg &Hillier, 1979; Loneliness Scale- Paúl et al., 2006). We use the shorter version recommended for older people (cut point value of 4 to select cases with Psychological Distress (Bowling 1991;Paúl, 2006). The loneliness item was developed by Victor, (Victor et al. 2000) Data analysis Descriptive and inferential analysis using t test; qui square test

Results: Distress prevalence in RAM is 20, 9% and in RAA is 27,7% (Portugal value is 26,7%); Loneliness prevalence in RAM is 11,9% and in RAA 23,5%; (values in the study in Portugal 19,1%) There are differences in psychological distress and loneliness (RAM $p < 0,001$, RAA $p = 0,006$) on average those who have psychological distress have more loneliness. In both islands there are significant differences in psychological distress by gender with women having higher values (RAM $p = 0,03$, RAA $p = 0,006$); and by illness, with people with more diagnoses being more distressed (RAM $p = 0,001$; RAA $p < 0,001$). Only in RAM there are differences with living with children and alone ($p < 0,001$); be older ($p < 0,001$); having restrictions in mobility and ADL ($p < 0,001$); and sleep problems ($p < 0,001$). Loneliness is related to cohabitation (RAM $p<0,001$; RAA $p =$

0,001) and weak health (RAM p = 0,008, RAA p<0,001). There are significant differences between the Regions (RAM and RAA) in loneliness (p = 0,001), with people in RAA feeling more loneliness.

Discussion and Conclusions: There are differences between RAM and RAA. RAA presents worse conditions for old people than RAM. People in Azores islands lived more isolated in the archipelagos disperse in 9 islands, in smaller communities and with less frequency of social contacts Women, illiterate people, people living alone, and with psychological difficulties, seem to be more vulnerable, and loneliness had a relationship with health and cohabitation.

We can intervene to foster social support and to prevent loneliness increasing wealth and wellbeing by paying particular attention to vulnerable groups, offering counselling to old people and families, encouraging to social participation and health promotion.

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PS02.03

To what extent are a persons' resources a protective factor for negative outcomes of frailty

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Background: As life expectancy increases and fertility rates are declining, the populations of most countries in the world are ageing rapidly. Frailty is an increasingly common condition in older people. It is however not an inevitable part of aging. An aging (frail) population is associated with increased health service utilization and related costs. In the last few years frailty is acknowledged to be not only a biological or physiological state but more a multidimensional concept in which psychological and social domains of human functioning are taken in to account as well. In addition, it is believed that a measure of frailty that integrates physical, psychological and social functioning (i.e. a diverse range of deficits) is a better predictor for adverse outcomes than chronological age. Still, even with this multidimensional concept, frailty is often conceptualized in terms of (personal) deficits. However, the level of frailty can also be perceived as a complex interplay between personal deficits and personal resources. We studied whether personal resources such as educational level, financial situation, and living alone situation, moderate the negative outcomes of personal deficits on two potential adverse consequences of frailty: self-perceived health and receiving professional care.

Method: Logistic regression analysis was performed using data from a cross-sectional survey, designed by the Public Health Service in the South of the Netherlands. The questionnaire was sent to a representative sample (of the municipal registrar's office) of people aged 70 and over. Deficits (multimorbidity, difficulty performing ADL activities, psychological distress, loneliness) and resources (educational level, financial situation, living

arrangement) were related to self-perceived health and receiving professional care.
Results: Descriptive characteristics of the study population showed that the sample (N = 5912) included 44.3% men and 55.7% women with a mean age of 78 years. In our sample 59.9% of the participants (N = 3540) rated their health as good to excellent, 40.1% of the participants (N = 2372) rated their health as moderate to bad. Professional care was received by 28.2% of the participants (N = 1669). Within our sample 58.2 % of the participants (N = 3440) suffered from multimorbidity. Difficulties performing ADL activities was reported by 24.2% of the participants (N = 1432). A total of 441 participants (7.5%) suffered from psychological distress. Loneliness was reported by 10.1 % of the participants (N = 597). When looking at the personal resources we found that 85.7% of the participants (N = 5067) had no financial problems. Living alone was reported by 38.5% of the participants (N = 2276). A high level of education was reported by 10.6% of the participants (N = 628). We found that the effect of ADL activities on self-perceived health was modified by educational level ($p<.01$) (which indicated a stronger relationship for those with higher education) and living alone situation ($p<.05$) (which indicated a stronger relationship for those living alone). The effect of psychological distress on receiving professional care was modified by educational level ($p<.05$) (which indicated a stronger relationship for those with higher education). The main effects in the final model for both deficits and resources largely remained significant.
Conclusion: We conclude that the selected personal resources only partly moderate the impact of personal deficits on adverse outcomes. However, when looking at preventing adverse outcomes of frailty it seems plausible to not only look at personal deficits but to take personal resources into account as well.

PS02.05

Web-based assessment and cognitive interventions in the aging workforce

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The project 'Web-based assessment and cognitive interventions in the aging workforce' is part of the 'Healthy cognitive aging' program, in collaboration with academic partners in Amsterdam (VU, UvA) and Nijmegen (UMCN). We hereby present our project design. Background As people age, they increasingly encounter difficulties regarding changes in cognitive abilities such as memory, executive functioning and processing speed (Schaie, 1994). In the aging workforce, this is reinforced by the increase in productivity and the great appeal on intellectual abilities in many worktasks. As a consequence, people may experience an increased workload, decreased job satisfaction and mental exhausion which could eventually lead to increased absenteeism. Although cognitive aging is inevitable, enormous variability exist between individuals. The degree in which people experience difficulties partly depends on how the individual adapts to his or her changed cognitive reserve, their concern about mental health for the future (Mol, et al., 2008), knowledge about cognitive aging (metacognition) (Commissaris, et al., 1996), and the mediating effect of depressed mood (Valentijn, et al., 2005). The aim of this project is to get better insight into predictors and modifiers of cognitive complaints in people between 40 and 65 years old and the development of an individually tailored intervention program aimed at improved coping with cognitive changes, effective strategy use, and enhanced self-efficacy (McDougall, 2009; Valentijn, et al., 2005; Van Hooren, et al., 2006; West, et al., 2007). Objectives - To identify the prevalence of cognitive complaints in the aging workforce - Develop a web-based screening instrument to identify people at risk for developing cognitive complaints - Adjustment of available cognitive therapy techniques to a web-based intervention program - Implementation of two randomized controlled trails to investigate the effectiveness of the developed intervention program Method On the basis of available knowledge about (cognitive) aging an online screening instrument will be developed which adresses cognitive functioning, physical and mental health, personality characteristics and socio-demographic variables. This screening instrument will be tested on a small scale in a sample of employees from a midsize business. After this, it is

used as a tool for case-finding to identify people at risk for developing cognitive complaints. The intervention program will be based on available 'evidence-based' cognitive therapy techniques and will be adjusted for extensive use on the internet. The intervention program includes coping with cognitive changes, metacognition, and self-efficacy. Identified risk factors by the online screening instrument will be adressed in the intervention program which results in an individually tailored intervention program. Two randomized controlled trails will be done to investigate the effectiveness of the intervention program in different target groups; medium vs highly educated group (n = 3*50) and low versus highly educated group (n = 3*100). Forthcoming results Results of the randomized controlled trails include both objective and subjective cognitive measures (perceived subjective cognitive complaints, metacognition, and self-efficacy), perceived physical and mental health, and absenteeism. Mood and personality factors will be examined as effect modifiers. References: Commissaris, K., Verhey, F. R., *&Jolles, J. (1996). A controlled study into the effects of psychoeducation for patients with cognitive disturbances. Journal of Neuropsychiatry and Clinical Neurosciences,* 8(4), 429-435. - McDougall, G. J. (2009). *A framework for cognitive interventions targeting everyday memory performance and memory self-efficacy. Fam Community Health,* 32 (1 suppl), S15-S26. - Mol, M., Ruiter, R., Verhey, F., Dijkstra, J., &Jolles, J. (2008). *A study into the psychosocial determinants of perceived forgetfulness: implications for future interventions. Aging &Mental Health.*, 12(2), 167-176. - Schaie, K. W. (1994). *The course of adult intellectual development. American Psychologist,* 49(4), 304-313. - Valentijn, S. A., van Hooren, S. A., Bosma, H., Touw, D. M., Jolles, J., van Boxtel, M. P., et al. (2005). *The effect of two types of memory training on subjective and objective memory performance in healthy individuals aged 55 years and older: a randomized controlled trial. Patient Education and Counseling,* 57(1), 106-114. - Van Hooren, S. A. H., Valentijn, S. A. M., Bosma, H., Ponds, R. W. H. M., van Boxtel, M. P. J., I., R., et al. (2006). *Effect of a structured course on goal management training in older adults: a randomised controlled trial. Patient Education and Counseling, 65(*2), 205-213. - West, R. L., Bagwell, D. K., &Dark-Freudeman, A. (2007). *Self-efficacy and memory aging: the impact of a memory intervention based on self-efficacy. Aging, Neuropsychology, and Cognition,* 15(3), 302-329.

PS02.06

Memory complaints in older workers with different job characteristics

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Introduction: Memory complaints are experienced at all ages and become more prevalent at higher age. If persons are still employed at higher ages, memory complaints may be noticed even sooner. Older workers depend more on their memory because of their responsibilities in work compared to unemployed age peers. To our knowledge, no studies have examined memory complaints in older workers. With the recent public debate and actual policy reforms concerning the retirement age in western countries, it seems imperative to prevent or to improve memory complaints. The goal of our study is to examine the cross-sectional and longitudinal (three years follow-up) association between (1) employment and memory complaints and (2) job characteristics and memory complaints.

Methods: Subjects were participants of the Longitudinal Aging Study Amsterdam (LASA) aged 55-64. To test the association between (1) employment status (employed if paid job of ≥8 hours per week) and subjective memory complaints (yes/no), respondents were selected with memory data available at t1 (n = 1937). Respondents with memory data available at both t1 and t2 were selected to study the longitudinal effect of employment status on memory complaints (follow-up of three years), stratified for persons with (n = 1318) and without (n = 353) memory complaints at t1. To test the association between (2) job characteristics and memory complaints subjects were selected who had a paid job of ≥8 hours per week at t1 and had memory data available at t1 (n = 506; cross-sectional). Again, to study the longitudinal effect on memory complaints the analysis were stratified for persons with (n = 97) and without (n = 409) memory complaints at t1. Studied job characteristics were hours of work per week, job prestige (13 - 87 (high)), job demands (heavy mental, light

mental, mixed, light physical and heavy physical), job class (elementary (11) - science managers (98)). Logistic regression analysis was applied. The confounding influence of age, sex, education, MMSE, depressive symptoms (ces-d), mastery, self-efficacy, neuroticism, number of chronic diseases, stroke and cardiovascular diseases was studied.

Results: Of the 1937 respondents studied at t1, 409 (21.1%) respondents had memory complaints. 132 (6.8%) respondents had memory complaints and a paid job of ≥8 hours per week. After three years, 187 (14.2%) developed memory complaints. Having a paid job at t1 compared to not having a paid job at t1 was not associated with having memory complaints at t1 or t2. Adjusted analysis showed that persons who were employed and had a higher job class at t1, were more likely to have memory complaints at t1 compared to employed persons with lower job class (OR = 1.02; CI = 1.00-1.03). Persons with memory complaints at t1 who performed a job with higher job class (OR = 1.05; CI = 1.02-1.08) or job prestige (OR = 1.05; CI = 1.02-1.09) were more likely to have memory complaints at t2. Moreover, persons with memory complaints at t1 who performed a job with light (OR = 0.13; CI = 0.02-0.65) or heavy physical demands (OR = 0.10; CI = 0.03-0.44) were less likely to have memory complaints at t2 compared to persons with heavy mental demands, whilst persons with light mental (OR = 0.32; CI = 0.07-1.46) or mixed (OR = 1.06; CI = 0.10-11.47) job demands did not differ compared to high mental job demands.

Conclusion: Employed persons with high job class were more likely to have memory complaints. Moreover, persons with high job class, high job prestige and high mental job demands were more likely to have memory complaints after three years, but only if they had memory complaints at baseline. This suggests that persons with more employment responsibilities are more likely to have memory complaints and after three years still have memory complaints. Job class, job prestige and job demands may be useful to determine who is at risk for memory complaints and therefore may benefit from a cognitive intervention.

PS02.07

The Zimbardo Time Perspective Inventory: Focusing in Portuguese old people

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Background: Time perspective is considered a fundamental process in individual and social functioning. Zimbardo's Time Perspective model is based in the Lewinian tradition[1] and is a nonconscious process of attribution of temporal frames to the ensemble of social and personal experiences of the subject. This process contributes to provide order, meaning and coherence to these events[1,2]. Concepts related with time perspective, like finitude[3] are very relevant in old age, and there is a lack of research in this age group using the Zimbardo Perspective.

Objectives:)to assess Time Perspective in Portuguese Older People using the Zimbardo Time Perspective Inventory-ZTPI[1]; ii)to compare Older's People Time Perspective with Time Perspective of younger ones people.

Methods: This cross sectional research was conducted with two age groups. The first, ≤35 years (N = 40) mean age 19.4 (SD 3.7) and the second group, 65 + years (N = 26) mean age 73.5 (SD 5.9). People less than 35 years old are mainly single (97.5%) and 2.5% are married. 67.5% of subjects in this group are women; level of education: 92.5% 10-12 years, 2.5% 5-9 years and 5.0% >12 years. In the group 65+ years old, 38.5% are women, 23.1% are illiterate, 50% had 1-4 years of education, 19.2% 5-9 years, and 7.7% >12 years.

To measure time perspective we used the Portuguese Version of the ZTPI[2] a well known widely used instrument. The ZTPI has 56 items distributed by 5 factors: i) Hedonistic-Present (HD), ii) Past-Negative (PN), iii) Future (F), iv) Present-Fatalistic (PF) and v) Past-Positive (PP), a similar factorial structure of the original version[4].

First we performed a descriptive analysis of the scores of each of the subscales of the ZTPI for each group, and then a T-Test for unpaired samples to verify if there were differences in subscales between the two groups.

Results: The ≤35 group scored higher in F (mean 3.69) and PP (mean 3.65) followed by PH (mean 3.52), PN

(mean 2.74) and PF (mean 2.31). The 65+ group also scored higher in F (mean 3.59) and PP (mean 3.52), followed by PH (mean 3.30), PF (mean 3.11) and PN (mean 2.90). The profile of both groups is identical in what concerns the order of the time orientation, although PN seems more relevant for younger people as it appears in fourth place, instead of fifth place in the older group.
When comparing both samples we observe statically significant differences in PF ($p<0.001$), with people 65+ years being more present-fatalistic oriented.
Conclusions: Comparing with national data (normative sample 18-53 years old)[4] scores are identical for young people, but there are some interesting differences with the scores of our older age group, in PN and particularly in PF, with old people being more fatalistic oriented. This may be explained by the fact that old people cannot control their health and age related declines, which is to be studied in future research. The TP orientation profile in old people is close to the Balanced Time Perspective profile, an optimal time perspective[5]. These data can also be explained by the Socioemotional Selectivity Theory[3] that stresses the importance of positive emotions in old people for adaptation during the aging process.
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PS02.08
Active aging and the role of age
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Background: The lively contemporary debate on the active ageing concept and its related aspects has lead researchers to consider different perspectives in the understanding of optimal or successful functioning among old individuals. Along with the need for more research on the best measures to capture such definitions, a need for a deeper insight on objective and subjective definitions of "active ageingâ[euro] has been stated (Bowling, 2008; Stenner et al. 2011). Moreover, the role of age has been increasingly considered as a fundamental issue since it is one of the most frequent significant correlates of the various definitions of successful ageing (Depp &Jeste, 2006). May there be a particular dependability on health factors, social dynamics or on psychological well-being for the very old, the fact is that there is a need to unravel the construct in specific late-life age groups and to provide more empirical data on which to build research.
Objective and Methods: This study is based on previous work on the operationalization of the World Health Organization's (WHO) Active Ageing model groups of determinants (physical environment, social determinants, economic determinants, health and social services, behavior determinants and personal determinants) by means of a protocol to measure which variables contribute the most for an active ageing process (Paúl. Fonseca &Ribeiro, 2007). In this study we used the achieved optimal model (Paúl, Ribeiro &Teixeira, submitted) where we have used exploratory and confirmatory factor analysis that revealed six components referring to (i) health, (ii) psychological component, (iii) cognition, (iv) biological component, (v) social relationship and (vi)

personality. Considering the original sample comprising 1322 adults aged 55+ years living in the community [55-101 years old], of whom 426 individuals were 75 years old and over, multi-group analysis of structural invariance was used to test whether observed differences in the structural weights across age group were statistically significant.

Results and Discussion: Results from the multi-group analyses indicate that assuming an unconstrained model to be correct, the measurement weights for the two age groups were statistically different from one another ($\chi 2 = 79.2$, df = 16, p = <.001). These findings, discussed in light of previous work from the authors and recent literature on personal assets for positive ageing, add evidence to the particular value of psychological functioning in enabling an active engagement with later life. The need for more investigation on subjective aspects of ageing actively is also highlighted. References: Bowling, A (2008) *Enhancing Later Life: How Older People Perceive Active Ageing? Aging and Mental Health* 12(3): 293-301; Deep, C.A. &Jeste, D.V. (2006). *Definitions and predictors of successful aging: a comprehensive review of larger quantitative studies. Am J Geriatr Psychiatry,* 14 (1), 6-20; Paúl, C., Fonseca, A. &Ribeiro, O. (2007). *The Protocol of Assessment of Active Ageing (P3A), 9th European Conference on Psychological Assessment - Thessaloniki, Greece* [Abstract]; Paúl, C., Ribeiro, O. &Teixeira, L. (submitted). *The WHO Active Aging model: empirical findings from a Portuguese study;* Stenner, P., McFarquhar, T. &Bowling, A. (2011). *Older people and 'active ageing': subjective aspects of ageing actively.* Journal of Health Psychology, XX(X), 1-11.

PS02.09

Childhood trauma and maltreatment and risk of dementia among former forced child laborers in Switzerland

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Case reports and a recent study in US Veterans (Yaffe, Vittinghoff, Lindquist, Barnes, Covinsky et al., 2010)point to the fact of an increased risk of developing dementia among traumatized individuals or persons with Post-traumatic Stress Disorder (PTSD). Impaired cognition or mild cognitive impairment is regarded as associated states to increased risk of dementia or Alzheimer's. However, little empirical knowledge exists about Post-traumatic Stress Disorder as a risk factor for developing dementia. We investigate forced child laborers (FCL; German: 'Verdingkinder') in Switzerland. Forced child labor were mostly orphans or children of divorced parents who were separated from their families and publicly offered to interested families to use their labor due to legal regulations from 1800 to 1970. During the forced child labor time a majority of them suffered from severe maltreatment or traumatic experiences. 150 former forced child laborers are investigated with an age range of 70 to 95 years (Up to date [March 2011] N = 78). They served as forced childhood laborers between 1925 and 1975. Gender proportion is balanced. Assessments include Childhood trauma and aversive experiences list, Post-traumatic Stress Disorder ('classic' and 'complex' forms), Geriatric Depression Scale and SIDAM scales (Structured Interview for the Diagnosis of dementia of the Alzheimer type, Multi-infarct dementia and dementias of other etiology;). It comprises a brief structured clinical interview, a range of cognitive tests (e.g. including the Mini-Mental State (Folstein et al. 1975)) which constitute a short neuropsychological battery and a section for clinical judgment and third party information. All items rely on DSM-III-R and ICD-10 algorithms. The SIDAM has a high overall test-retest reliability which equally holds true on the diagnostic, criterion and item level. It is a brief (on average of 28 min), practical and easily scored diagnostic instrument, which reliably separates subjects with DSM-III-R and ICD-10 dementia from those without such a disorder. Cross-sectional results from the first assessment time point will be presented. We expect a mediated (by PTSD diagnoses) relationship between childhood maltreatment or trauma and various indicators of cognitive decline or dementia. Further analyses will include mediator models of 'motivational reserve capacity' (Forstmeier &Maercker, 2008) and 'socio-interpersonal context model' (Maercker &Horn, subm). Forstmeier, S. &Maercker, A. (2008). *Motivational reserve: Lifetime motivational abilities contribute to cognitive and emotional health in old*

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PS02.10

Biomarkers in dementia: The Dutch Parelsnoer Initiative on neurodegenerative diseases

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Background: The Dutch Parelsnoer Initiative (www.Parelsnoer.org) is a unique collaboration between the eight Dutch University Medical Centers (UMCs) in which clinical data and biomaterials from patients suffering from one of nine chronic diseases are collected according to harmonized protocols. The aim of the Parelsnoer Initiative is to set up a nationwide biobank infrastructure that will be used for scientific research related to early diagnostics, improvement of treatment and to encourage the development of new products. Neurodegenerative diseases form one of the nine disorders studied in the Parelsnoer Initiative. The Parel (Pearl) Neurodegenerative Diseases (PND) focuses on the role of biomarkers in the early diagnosis and in monitoring the course of neurodegenerative diseases, in particular in AD. Here we describe the methods and the general set-up of the PND.

Methods: The PND is a 2-year follow-up study of 800 patients. Inclusion criteria are: patients referred to a memory clinic of an UMC with subjective and/or objective cognitive complaints, a Clinical Dementia Rating (CDR) scale of 0, 0.5, or 1 and a Mini Mental State Examination (MMSE) of ≥20. This implies that most patients will be mentally competent. Patients with vascular dementia are excluded. At baseline, all patients are subjected to a standardized examination, including: general information, medical history, MMSE, CDR, Neuropsychiatric Inventory, Geriatric Depression Scale, Disability Assessment for Dementia, Quality of life, a neuropsychological test battery, blood samples, MRI and CSF (in case of informed consent). Clinical data are collected at 1 and 2-year follow-up. Blood, CSF and MRI will be repeated at the 2-year follow-up only.

Results: Data collection is still ongoing until the end of 2011. At this moment about 600 patients have been included and the 1-year follow-up has started. Specific research questions are being proposed and it is expected that issue of the first data will be in the summer of 2011.

Conclusion: The PND is a large Dutch network collecting clinical data, MRI, blood and CSF of 800 patients with subjective and/or objective cognitive impairments. This unique dataset makes it possible to perform nationwide high quality research into biomarkers and prognostic factors in dementia.

PS02.11

Involvement of puromycin-sensitve aminopeptidase in metabolism of tau protein in cultured cells

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The microtubule associated protein tau is a major component of neurofibrillary tangles in brains suffering from tauopathies including Alzheimer disease (AD), frontotemporal dementia, corticobasal egeneration, and progressive supranuclear palsy. And a hereditary dementia disease, FTDP-17 (frontotemporal dementia and parkinsonism linked to chromosome 17) is caused by mutations of a gene coding tau protein, therefore one part of neurodegenerative dementia is caused by tau. Tau protein is predominantly expressed in neurons, where it is believed to play major regulatory roles in microtubule assembly for the organization and integrity of the cytoskeletal network. Tau protein has an ability to promote microtubule assembly, and this activity is regulated by phosphorylation that impairs the ratio of microtubule assembly. In tauopathies including AD, tau protein is hyperphosphorylated, ubiquitinated and accumulated in brains, however mechanisms of the accumulation is still unclear. The ubiquitin proteasome system is one of the major systems for protein quality control in eukaryote and neurodegenerative diseases are characterized by aggregates and inclusions of aberrant proteins. Therefore proteasome might be one of the most important key players in degradation of aberrant proteins. Previously the mechanisms of degradation of tau protein were investigated employing several proteasome inhibitors including MG-132 and lactacystin. After treatment of cell with MG-132 or lactacystin, changes of tau protein levels were not observed. These studies suggest that tau might be degraded by other mechanisms than proteasome in cultured cells. Cathepsin family is also one of the most prominent proteases to degrade aberrant protein, and works in an organelle called as lysosome. The lysosome is known to fuse with autophagic vesicles, in which aged organelle and aberrant proteins are accumulated. Dysfunction of cathepsins and autophagy has been reported to cause neurodegeneration, however its relevance with tauopathies is unclear. A recent genetic screening study employing Drosophila, identified puromycin-sensitive aminopeptidase (PSA) as a potent modifier of tau-induced pathology and suggested PSA as a possible tau-degrading enzyme. These results suggested that PSA might be involved in proteolysis of tau protein in living cells and regulation of tau protein levels. To clarify the involvement of proteases in degradation of tau protein, some of protease inhibitors; lactacystin and MG-132; inhibitors to proteasome, CA-074Me; an inhibitor to cathepsin, and puromycin; an inhibitr to PSA, were employed in SH-SY5Y human neuroblastoma cells. Pulse-chase experiments showed that proteolysis of tau protein in SH-SY5Y cells, was attenuated when the cells were treated with 200 nM of puromycin. Increased tau protein levels were also observed in SH-SY5Y cells treated with siRNA to PSA for inhibition of expression of PSA. Those data suggest that PSA is a protease which catalyzes tau protein predominantly in SH-SY5Y cells. And the enzyme might have a crucial role in development of tauopathies.

PS02.12

The arabic version of the CERAD neuropsychological forms including the MMSE

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Aim: develop the Arabic version of the CERAD including Arabic translation and adaptation of the CERAD neuropsychological forms to be suitable for use in the Arabic Egyptian language, according to linguistic, education levels and cultural background of the Egyptian elderly The study went through two stages Stage 1: translation and adaptation to the Egyptian language and culture Stage 2: testing the reliability and validity of the Arabic version of CERAD and MMSE Stage 1: Translation process to achieve a satisfactory and accurate Arabic translation of the original English version of CERAD including the MMSE Translation back translation 1. The original English versions of the CERAD and MMSE were translated into Arabic by the bilingual research committee. Each one made separate translation then they all revised all the translations and then agreed on a proposed conjoint translation 2. The proposed translation was revised by an independent bilingual translator to achieve accuracy in translation 3. The revised translation was given to another bilingual translator to translate it back into English 4. During the process of translation - back translation, the linguistic ambiguity has been minimised to be understandable by the Egyptian literate and illiterate elderly Stage 2: the proposed version of CERAD neuropsychological forms were applied on 2 groups of Egyptian illiterate elderly one group with

dementia and one without dementia where validity and reliability tests were applied Test retest reliability of the Arabic MMSE for subjects with and without dementia MMSE item Normal Dementia Orientation to Time .87 .90 Orientation to Place .83 .93 Total for orientation .88 .96 Registration .91 .92 Attention .86 .79 Recall .93 .87 Naming ability .94 .93 Repitition .73 .78 Verbal command .96 .86 Obey simple verbal order .93 .56 Say a sentence .92 .75 Copy a diagram .92 .64 Total language items .96 .69 Total MMSE .93 .91 MMSE Arabic version Validity using internal validation and criterion relation Criterion relating validation Internal consistency validation No dementia Dementia No dementia Dementia Orientation to Time .52 .51 .42 .66 Orientation to Place .53 .65 .52 .68 Registration .81 .73 .62 .46 Attention .51 .57 .66 .67 Recall .52 .49 .56 .58 Naming two objects .73 .68 .57 .47 Repetition .61 .58 .73 .87 Command .53 .52 .64 .63 Listen and obey .81 .79 .83 .82 Say a sentence .72 .67 .54 .71 Copy a polygon .73 .81 .64 .61 Total language .57 .73 Total MMSE * * .71 .76 Test Retest Reliability of the Arabic CERAD neuropsychological forms for subjects with and without dementia Normal Dementia J1 .92 .85 J2 .94 .86 J3 .93 .91 J4 .78 .78 J5 .85 .74 J6 .79 .73 J7 .87 .75 J8 .82 .67 CDR .94 .95 BDS .96 .94 Internal validity of the Arabic CERAD neuropsychological forms for subjects with and without dementia Normal Dementia J1 .81 .85 J2 .74 .86 J3 .71 .76 J4 .62 .59 J5 .71 .81 J6 .66 .65 J7 .87 .77 J8 .72 .68 CDR .82 .79 BDS .73 .75 According to test retest reliability and internal consistency and criterion relating validity, The translated adapted versions of the MMSE and the CERAD neuropsychological forms are valid and reliable and are suitable for use in Egypt.

PS02.13

Type 1 cannabinoid receptor and amyloid PET imaging in patients with Alzheimer's disease

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Objective: The neuronal expression of type 1 cannabinoid receptors plays an important role in learning mechanisms such as long term potentiation. Expression of CB1-receptors in microglia is associated with an anti-inflammatory effect in the brain. Both mechanisms may play a role in the pathogenesis of Alzheimer's disease. To date, CB1- receptors have only been studied in post-mortem brain of patients with Alzheimer's disease (AD), suggesting changes in areas of beta-amyloid peptide (Aβ) deposition and glial activation. The cerebral CB1R distribution has been successfully quantified in vivo in the human brain by using positron emission tomography (PET). In this study, we want to investigate CB1R availability in vivo in patients with AD in relation to amyloid deposition and cognitive parameters.

Methods: Ten patients with probable AD (3 men, 7 women; age range 58 to 81 years) and 7 elderly healthy volunteers (HV) (3 men, 4 women; age range 61 to 79 years) underwent [18F]MK-9470 PET and [11C]PIB PET scans to assess CB1R availability and amyloid deposition, respectively. Parametric [11C]PIB SUVR (regional standardized uptake value) images were coregistered to [18F]MK-9470 FUR (fractional uptake ratio) images, subsequently coregistered to individual MPRAGE MRI scans and spatially normalized to standard Montreal Neurological Institute (MNI) space. We performed whole brain voxel-based group comparisons of CB1R availability and amyloid deposition between AD patients and HVs. We further correlated CB1R availability with cognitive measures (among others, Mini-mental State Examination (MMSE), Auditory-Verbal Learning Test (AVLT) and California Verbal Learning Test (CVLT) and with regional PIB binding.

Results: In the voxel-based group analysis, there was a decreased relative CB1R availability in the right mid- and superior temporal cortex in AD patients. There were no differences in global CB1R availability between AD patients (cortical grey matter FUR 35.3±6.0 (mean±SD)) and HVs (37.3±6.3; $p = 0.51$). We found significant positive correlations between relative CB1R availability and MMSE in a cluster extending from the left parahippocampal gyrus to the left fusiform gyrus, between relative CB1R availability and AVLT delayed recognition (d-prime) in a cluster covering the right post- and precentral gyrus and between relative CB1R

availability and total learning of the CVLT in the left superior temporal cortex. As expected, global [11C]PIB SUVR values were significantly increased in AD patients (SUVR 1.6±0.2) compared to HV (1.2±0.1; p <0.001). The right temporal region that showed diminished CB1R availability in AD patient was associated with increased PIB binding, but no significant correlation was found between PIB binding and CB1R availability.
Conclusion: Using in vivo PET imaging, we found differences in relative CB1R binding between AD patients and HVs. We also found correlations between CB1R availability and measures of episodic memory. Although the region that showed diminished CB1R availability in AD patient was associated with increased PIB binding, we did not find a significant correlation between PIB binding and CB1R availability. This is -to the best of our knowledge - the first demonstration of an in vivo disturbance of the endocannabinoid system in Alzheimer's disease. Further study and analysis are needed to further elucidate the relevance of this altered CB1R availability in AD patients.

PS02.14

Stigma in Iranian family caregivers of people with Alzheimer disease

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Introduction: The increasing number of aging population has made Alzheimer's disease (AD) as an urgent public health challenge. Family members as nonprofessional caregivers playing a significant role in delivering care to elders. Iran's population is about 70 million, of whom 5.2% are over 65 years. According to Iran Alzheimer Association (2010) there may be nearly 212000 people living with dementia in Iran at the moment. Respect for old people is very important in Iranian culture, but unfortunately Iran Alzheimer Association (IAA) is the only voice for people with all kinds of dementia, notably AD and also, their caregivers in Iran. While Iranian family members of patients with AD are providing care during course of disease, there are limited facilities for some of them. The experience of care giving is deeply cultural-dependent and context has an important impact on this experience. So understanding experiences of caregivers in their contexts reveals their feelings, difficulties and rewards.
Objectives: The aim of this study was to understand and interpret lived experiences of Iranian family caregivers of Alzheimer's patients. **Method:** A qualitative study was conducted using Heiddegerian hermeneutic phenomenology approach. A purposive sample of ten metropolitan family caregivers registered to the IAA was interviewed. The participants were nine women and one man aged between 25 and 67 years. Interviews were audio-taped and transcribed; data were analyzed by Van Manen methodology.
Results: According to our findings, eight main themes emerged that "stigmaâ[euro] is one of the most important of themes. This theme is supported by two sub-themes: "shame for the abnormal patient's behaviorâ[euro] and "fear of others' judgmentâ[euro]. It should be noted that the first sub-theme indicates the intrapersonal aspect of the theme and the second indicates interpersonal aspect.
Conclusion: The findings suggest the necessity of continuous support, training and educating for family caregivers of Alzheimer's patients by nurses and other healthcare providers. Also, we recommend managing stigmatic beliefs by increasing public knowledge about AD to general population.

PS02.15

Recording time perception (TP) changes in Alzheimer's disease (AD): Preliminary findings and implications for care

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Recording Time perception (TP) changes in Alzheimer's Disease (AD): preliminary findings and implications for care Background: Although very severe disruption of temporal processing, (even up to loss of time perception for more than 80 years) has been observed in people with AD, the smaller increments of time perception

changes, and [combinations of] specific deficits leading up to such dramatic disability have been poorly studied and documented. Researching TP includes a consideration of 'time', 'timing', the learning and coordination of 'timing mechanisms', changes in simple and complex reaction times, and the maintenance and updating of a variety of 'internal representations of time'. For example, the physiology of the 'timing-integration' of neurally controlled functions can be permanently changed/distorted in various illnesses- markedly so in AD. What is so challenging about studying changes TP in AD, is that it is requiring researchers to: . find ways of documenting different types of incremental changes in TP across the entire illness process so it can be better studied . consider the links between the changes in various various time- related phenomena (time, timing, reaction time, subjective time perception, and TP) and changes in other cognitive abilities, . to define TP, and various types of TP abilities, more accurately, based on a better understanding of the specific cognitive abilities, component systems, cell networks and substrates that contribute . make observations and comparisons about what happens to TP in normal aging, and specific dementing illnesses. Research aims of the pilot TP in AD study: . to collect evidence of 'changes in TP' in people with various types of dementia, as it occurs over several years using the CITPOT tool . to describe the rates and patterns of change in TP in AD, compared with other types of dementia . to look for evidence of different types of TP systems, and whether any types are preserved Methods: The authors searched the literature for items related to time, time perception. This included gerontological psychological, biological and neurological literature for descriptions of [changes in] timing and timing mechanisms, simple and complex reaction time, and time perception, in normal elderly and dementia populations. They also searched the dementia-care literature, for descriptions of and theories about changes in TP, including recommended strategies for communicating with people with dementia whose TP is permanently changed such that they do not know how old they are, where they are, who is alive or dead - young or grown-up. The authors developed the CITPOT Tool (Changes In Time Perception Over Time), to enable the recording changes in TP over time in people with various types of dementia. The CITPOT tool enables the recording of changes in TP from two sources: . by noting changes in responses to time-related questions on repeated administrations of the MMSE, . by recording carer/giver observations of evidence of changes in TP, as they occur in daily interactions with the people with dementia and notice obvious difficulties and inaccuracies. Data is being collected both, as part of ongoing clinical assessment, prospectively (from several residential and nursing homes sites in the Netherlands and UK), and retrospectively (from data collected with participants in anti-dementia drug trials of long- duration at the MARC centre). Patients with specific diagnoses of dementia who are on anticholinesterase drugs will be compared with those on placebo. Examples of people with AD, vascular dementia, and PD with AD, and some rarer types of dementia are being collected. Data Analysis: Analysis will look for overall patterns of change between the groups studies: . to see if these patterns are related to the type of dementia, the age of onset . to see if there are different patterns in TP change between different types of dementia. Findings of the pilot study: Early findings of the CITPOT tool are showing different patterns of TP change in AD versus vascular dementia groups. There is some early evidence for different rates of change in TP, between drug and placebo groups. Conclusions: More accurate detection of the earliest TP changes, and its 'rate of progression' of may offer a variety of benefits. It could provide an inexpensive, non-invasive way of assessing the early stages of illness, provide a new tool for measuring the efficacy of interventions (drug and interpersonal), and be useful for inclusion in assessments and care-dossiers/plans of people with dementia in the community and in care settings.

PS02.16

Contribution of executive functioning and memory to rule induction in healthy older people and patients with MCI or AD

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Background: Inductive reasoning is the cognitive process of drawing inferences from given information, by considering and evaluating possible alternative categorization rules. In healthy individuals this process is known to depend on executive functioning and, to a lesser extent, memory. We explored individual contributions of executive functioning and memory to rule induction in normal and pathological ageing, through administration of a newly developed task to healthy controls and patients with mild cognitive impairment (MCI) or Alzheimer's disease (AD).
Table.
Results: comparison between healthy subjects and MCI or AD patients
Z-scores for the domains of memory and executive functioning are based on standard cognitive tests; normalized scores of the experimental task are based on the number of trials needed to produce eight consecutive correct answers (inverse values: higher score corresponds to better performance).
Methods: 20 healthy older volunteers (mean age 66±13 years) and 27 patients (mean age 77±9 years) participated. Patients were recruited from a memory clinic, diagnosed with amnesic MCI or AD, according to established diagnostic criteria. Patients with an MMSE score 1 were excluded. Memory was assessed with the immediate and delayed recall score of the Rey Auditory Verbal Learning Test. Executive functioning was assessed with the Trail Making Test B/A ratio and the Stroop test Card 3/2 ratio. Raw test scores were standardized into z-scores and a composite score was calculated for tests composing Memory and Executive functioning. For the experimental rule induction task participants were instructed to sort stimuli by pressing a left or right button, based on feedback. The numbers of trials needed to produce eight consecutive correct answers were recorded. The task included three rule induction conditions of increasing complexity. In the first condition, which had a low memory and executive functioning load, participants were instructed to sort two stimuli by one characteristic (i.e. colour: a white balloon corresponded to the left button, a purple balloon to the right button). In the second condition, four stimuli were to be sorted by that same characteristic, denoting specifically an increase of memory load relative to condition one (a yellow or orange pepper corresponded to the left button, a green or red pepper to the right button). In condition three, four stimuli were to be sorted by two characteristics, leading to an additional increase of executive functioning load relative to condition two (colour and size: a small pink flower or a large blue flower corresponded to the left button, a small blue flower or a large pink flower to the right button). Thus, the second and third condition had an equally high memory load (in both conditions 4 different features had to be memorized), the first condition a lower load. The third condition additionally had a high executive load, which was low in condition 1 and 2. For people with intact cognition, the difference score between condition 3 and 2 was hypothesized to reflect the executive component in rule induction. **Results:** Patients had significant lower z-scores than controls for the memory and executive functioning composite scores. Moreover, patients needed more trials on condition 2 and 3 of the inductive reasoning task, but the difference score between conditions 3 and 2 did not differ between the groups (see Table). In controls, both memory ($\beta = 0.43$, p
PS02.17
Quantitative motor assessment in patients with mild to moderate Alzheimer's disease (AD)
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Motor signs of AD include problems with speech/facial expression, rigidity, balance, posture/gait, bradykinesia,

tremor, incoordination, apraxia, and dysarthria. Even early-stage AD is characterized by motor impairment and slowing in a stage-dependent manner (Goldman et al., 1999). Information about the phenomenology of the motor signs in AD is important as they may predict cognitive decline (Chui et al., 1994), institutionalization (Lopez et al., 1997), cost of care (Scarmeas et al., 2004) and death (Mitchell &Rockwood, 2000). Compared with AD patients without motor signs, AD patients with motor signs have an average $7,394 higher annual total cost of care (a 1-point increase in a motor signs scale has been associated with an annual increase of $827 in costs of care) (Murman et al., 2003). There is large variability in reported frequencies: in a review of clinical series published over 10-years, frequency of motor signs in AD ranges from 6% to 50% (Ellis et al., 1996). Much inconsistency in the literature derives from methodologic differences including variable definitions of motor signs, use of standardised scales vs clinical evaluation, and inclusion of subjects at varying stages of disease. Motor signs of AD are generally treated dichotomously (present or absent), and research has relied heavily on clinician rated scales, limiting information about the full range of motoric changes that occur over time in AD. Current clinical rating scales lack sensitivity, have floor or ceiling effects, and require long observation periods to show changes. There are no known currently used objective quantitative assessments of motor signs in AD. The neurophysiological paradigm in this study has been successfully correlated with clinical stage in patients with other neurodegenerative disorders, including Amyotrophic lateral sclerosis, Multiple Sclerosis (Reilmann et al., submitted), and Huntington's disease (HD). Gordon and colleagues (2000) examined precision grip in HD, and found that force variability was correlated with functional capacity and motor performance. Reilmann et al. (2010) found increased grip force variability in premanifest HD gene carriers and correlation of grip force variability with both the disease-burden score and scores on rating scales, suggesting a strong genotype-phenotype correlation. Similarly, Reilmann et al. (2010) found that measures of variability of tongue protrusion forces and contact time distinguished controls, premanifest, and symptomatic HD groups. Findings were reproduced in a blinded analysis across four centers of a HD biomarker study, with premanifest deficits in tongue force variability detectable in gene carriers two decades before disease onset (Tabrizi et al. 2009). Tapping variability also distinguished between HD groups and correlated with disease burden, clinical motor phenotype, gray and white matter atrophy, and cortical thinning (Bechtel et al., 2010), which was also observed with tongue protrusion forces (Reilmann, pers. comm.). Aims: Isometric motor tasks are used as a quantitative measure for the assessment of motor phenotype in AD. We hypothesize that motor impersistency may be a feature of AD. Methodology. 20 participants diagnosed with mild to moderate AD, both women and men (MMSE 10-24), and 20 cognitively healthy and age-matched controls will complete: -MMSE -Clinical Dementia Rating Scale -Unified Parkinson's Disease Rating Scale -Isometric grip force analysis task in precision grip between thumb and index finger. -Isometric grip force matching task (isometric force persistency). -Transducer based tapping tasks assessing isometric force of the index fingers -Isometric tongue force analysis task. Analysis. Comparison of groups using one-way ANOVA using Bonferroni corrections and Scheffe post-hoc tests or nonparametric Mann-Whitney U tests; parametric Pearson tests or nonparametric Spearman rank tests will analyze correlations of measures with the task and other measures. Results will be expressed in means, standard deviations, box-whisker plots of the median, quartiles, and range. OUTCOMES. This project represents the use of a novel paradigm to quantitatively assess motor signs in AD. Assessment of the variability of tongue protrusion forces, grip force, and tapping will provide objective and quantitative measures that (1) provides much needed empirical data on the motor symptoms of AD and help elucidate a motor pattern, and (2) correlates with illness severity (as assessed by the UPDRS and CDR, and thus may be a measure of disease progression). Knowledge of the phenomenology of motor signs in AD is important, given their predictive ability for rates of cognitive decline and mortality and their association with increased costs of care. This knowledge, in addition to improvements in the efficiency and precision of objective measurements of disease progression in individuals with AD, could lead to techniques that are better able to assess disease progression and measure effectiveness of therapeutic interventions.

PS02.18

Comparison of measurements of medial temporal lobe atrophy in the prediction of AD in subjects with MCI

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Introduction: Medial temporal lobe atrophy (MTA) predicts Alzheimer's disease (AD) in subjects with mild cognitive impairment (MCI). MTA assessment may be used for the selection of MCI subjects in AD trials. There are several methods to assess MTA ranging from qualitative rating to manual volumetric measurements. Predictive accuracy may depend on the method and on whether the method requires standardisation of the scan protocol. The aim of the present study was to investigate wich MTA assessment could best predict AD-type dementia in subjects with MCI in a multicentre and single-centre study.

Methods: We selected subjects with MCI from 2 cohorts: the DESCRIPA multicentre study (n = 270), which used different scanners and scan protocols and a single-centre study from the VU University medical centre (n = 156), which used the same scanner and protocol. Four MRI-measures were compared: volumetric manual hippocampal measurement, volumetric automated atlas based hippocampal measurement (LEAP), qualitative visual rating, and volumetric measurement of the lateral ventricle. All volumetric measurements were corrected for intracranial volume and pooled for left and right side. Outcome was the area under the curve (AUC) of a ROC curve for predicting progression to AD-type dementia after 2 years.

Results: Patients were on average 70.8 years of age in the single-centre study and 70.4 years of age in the multicentre study. The percentage of female participants was higher in the multicentre (57%) than in the single-centre study (40%). MMSE-scores of both cohorts were comparable: single-centre study (26.7) and multicentre study (27.1). In the multicentre study, the AUC was 0.72 for the manual hippocampal measurement, 0.72 for the LEAP measurement, 0.67 for the qualitative rating, and 0.56 for the lateral ventricle measurement. In the single-centre study, the AUC was 0.67 for the manual hippocampal measurement, 0.69 for the LEAP measurement, 0.61 for the qualitative rating, and 0.61 for the lateral ventricle measurement. Sensitivity of manual hippocampal measurement was slightly higher (sens = 0.71-0.79) than automated LEAP measurement (sens = 0.61-0.67) in both cohorts. Specificity, OR and HR was higher for the LEAP measurement in the multicenter study (Table 1). The best cut-point on the LEAP volume to predict AD-type dementia as determined by the Youden index was similar in the multicentre study (5374 mm3) and single-centre study (5431 mm3).

Conclusion: Hippocampal volume is better in predicting AD compared to a qualitative rating or measurement of the lateral ventricle. It seems that the presence of atrophy doubles the risk for AD. Both hippocampal measures yielded similar predictive accuracy in the multicentre and single-centre study. The LEAP measurement may be preferred in multicentre studies as it demonstrated good accuracy in discriminating between MCI progressors and non-progressors. Moreover, the measurement was stable across different cohorts, was automated, and

was able to determine consistent cut-off points.
Youden cut-off points and predictive values
Des: Descripa multicentre study
PS02.19
Atypical focal presentations of Alzheimer's disease: A case report
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Background: Alzheimer's disease (AD), typically, presents as an early amnesic syndrome with other cognitive deficits manifesting as disease progresses. Atypical presentations of AD, such as posterior cortical atrophy (PCA) and progressive non-fluent aphasia (PNFA), are increasingly recognised especially in younger people. Differentiating AD from other types of dementia, especially frontotemporal dementia (FTD) is important not least because in FTD, acetylcholine esterase inhibitors are ineffective and may cause agitation. European guidelines recommend functional neuroimaging with FDG-PET scans when diagnosis is in doubt.
Case Study: Our patient was 54 years old when she developed gradually progressing visual and language problems as described in her own words: "I first noticed I couldn't read the clock whilst working at the hospice. I was frightened and thought I had a brain tumour. I couldn't add up properly, I wasn't writing or spelling in my usual manner, my writing was no longer in a straight line and I could no longer read the newspaper. I couldn't see things which my family would point out. My vocabulary had changed, words became difficult to format and I couldn't say the right word. I demoted myself to health care assistant but found I couldn't dress patients, putting their clothes on back to front. I was frightened to share my fears with my family. Eventually I became so stressed that I had to give up workâ[euro]. She initially presented to an optician who detected a right-sided hemi-anopia and referred her to neurology and ophthalmology. The poster will describe the results of the ophthalmology and neurology assessments including CSF assay, EEG, CT head, and MRI head (Figure 1) which showed slight asymmetrical enlargement of the occipital horn of the left lateral ventricle felt to be a normal variant, rather than ex-vacuo dilatation secondary to focal parenchymal atrophy, as there was no disproportionate sulcal widening in the parietal and occipital lobes on the left compared to the right. The poster describes results of a speech and language therapy assessment which suggested PNFA and a neuopsychology assessment which suggested PCA. After four years of onset, an FDG-PET/CT scan (Figure 2) showed substantially reduced glucose metabolism, bilaterally, in the occipital, parietal and temporal cortices with relative preservation of uptake in the frontal cortices, basal ganglia and posterior fossa. Appearances strongly favoured AD over FTD. The poster describes how the ending of diagnostic uncertainty, commencement of Donepezil and appropriate psycho-social support has improved our patient's quality of life.
Discussion: PCA, first described in 1985, is characterised by progressive decline in higher visual functioning and literacy skills. Clinical features may include visuospatial and visuoperceptive deficits like apraxia, visual agnosia, visual field defects, alexia, Balint's syndrome (optic ataxia, ocular apraxia, simultanosagnosia, environmental agnosia), Gerstmann's syndrome (acalculia, agraphia, finger agnosia, right/left disorientation) with relative preservation of memory, language and insight in the early stages. It usually affects younger patients, with clinicopathological studies showing AD as the commonest cause, hence its synonym 'visual variant AD'. Other causes include stroke, tumour, Dementia with Lewy Bodies, corticobasal degeneration, and prion disease. Neuroimaging studies have shown posterior atrophy bilaterally, usually more severe on the right, with preservation of median temporal structures. Asymmetrical left-sided involvement, like in our patient, is rare and may account for her co-existing non-fluent aphasia. The phenotypes of FTD are behavioural variant FTD and the primary progressive aphasias of PNFA and semantic dementia. PNFA is the most heterogeneous with clinicopathological studies showing that a high proportion has AD pathology. Recent reviews have sub-classified PNFA into an 'agrammatic' variant, characterised by speech apraxia and expressive grammar

problems, and logopenic progressive aphasia (LPA), characterised by slow rate of speech and naming problems, as in our patient .The former is associated with FTD pathology while the latter with AD pathology. Volumetric MRI studies have shown asymmetrical left sided atrophy in both, localised to the inferior frontal regions in the 'agrammatic' variant and to the posterior temporal regions in LPA.

Key Learning Points: 1.Patients presenting to opticians or primary care with complex visual problems in the absence of primary ocular pathology should be referred for specialist investigation. 2. Atypical focal presentations of Alzheimer's disease, such as PCA and LPA, can occur, and even co-occur, especially in younger patients. 3. Functional neuroimaging to support diagnosis in dementia should become widely available. 4. Sub-type diagnosis in dementia is important to access current and future disease-specific treatments as well as support services.

PS02.20

Comparative assessment of clinical efficacy after 12-Month clinical trial of Donepezil between the patients with pure Alzheimer's disease and mixed dementia

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Background: Alzheimer's disease (AD) and vascular dementia (VaD) are recognized as the two most frequent causes of dementia. AD is characterized by deficient cholinergic innervation of the cerebral cortex and subcortical structures and VaD is dementia associated with cerebrovascular disease. Most studies focus on AD and VaD as separate clinical entities, yet there is increasing evidence that the brain lesions associated with each pathological process occur together. This co-occurrence of AD and VaD pathology is referred to as mixed dementia (MD).

Objectives: The purpose of this study was to compare the efficacy of donepezil treatment between patients with pure Alzheimer's disease (AD) and Mixed dementia (MD) during a 12-month trial. Methods: A total of 139 patients were recruited for this 52-week study. Patients were attending the Clinical Trial Program of the Samsung Medical Center Geropsychiatry Clinic. All patients met NINCDS-ADRDA criteria for probable AD and MD patients met the additional following criteria: Hachinski Ischemic Score (HIS) = 5~6; evidence of significant small vessel disease (grade 2 suggested by Fazekas et al.) on magnetic resonance imaging (MRI) finding. The effect of donepezil on cognitive function was measured using Alzheimer's Disease Assessment Scale-cognitive subscale-preliminary Korean version (ADAS-cog-K). Patients' activities of daily living using the Seoul-Instrumental Activities of Daily Living (S-IADL) and Seoul-Activities of Daily Living (S-ADL); behavioral symptoms using the Korean version Neuropsychiatric Inventory (K-NPI) were measured at baseline, 13-weeks, 26-weeks, 39-weeks and 52-weeks. We defined the responsive patients to donepezil at those who showed a cognitive improvement or no change during the first six-month clinical trial.

Results: 84 pure AD patients and 34 MD patients were available for intent-to-treat (ITT) last observation carried forward (LOCF) analysis. 83 patients completed the study and 35 discontinued their treatment before week 52 because of stopping treatment (n = 22), poor drug compliance (n = 3), death or poor physical condition (n = 5), refer to other institute (n = 5). There was no significant difference between two groups in sex, education years, duration of illness, dementia severity, whereas MD patients are significantly higher in age and hypertension rate. There was no significant difference between two groups in mean change from baseline in the total ADAS-cog-k, S-ADL, S-IADL and K-NPI scores at 52-week. Both groups demonstrated deterioration of S-ADL and S-IADL. The NPI scores did not significantly change in both groups ($p>.05$). Based on the operational criteria, 60.7% of pure AD patients and 58.8% of MD patients were responders to donepezil.

Conclusion: MD patients had similar levels of efficacy with pure AD patients and donepezil was well tolerated in both groups. These results suggest that donepezil is an effective and well-tolerated treatment for MD patients as well as for pure AD patients.

PS02.21

Early onset Alzheimer patients show distinct regional changes of oscillatory brain dynamics

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Background: Early onset AD patients often show a different clinical profile with more focal disturbances like aphasia and apraxia than late onset AD patients. They also show a different distribution of structural and functional brain changes. Large-scale neuronal activity can be measured with electroencephalography (EEG), spectral analysis describes the amount of activity in different frequency domains. The hallmark spectral analysis finding in EEG data of AD patients is a diffuse slowing of activity. The aim of the present study was to examine differences in oscillatory brain dynamics in diferent brain regions between early and late onset AD patients.

Method: We examined resting state EEGs of 320 probable AD patients and 246 controls. Subjects were categorised into a young (≤65 years) and old (>65 years) group. Of each EEG, artefact free epochs were selected and relative power in the delta, theta, alpha and beta band was calculated. First, the effect of age on global relative power was tested for each frequency band separately, by two-way analysis of variance (ANOVA). Subsequently, the effect of age on relative power in different brain regions (frontal, temporal, central and parieto-occipital) was examined using ANOVA for repeated measures. To examine the association between relative power and cognitive function, linear regression was performed.

Results: Globally, early onset AD patients showed a lower alpha power ($p<0.05$) than late onset AD patients. In controls, there was no age effect on relative power in any frequency band. Subsequently, using ANOVA for repeated measures we found an interaction between age and brain area in all frequency bands (p for interaction <0.05) in AD patients. In early onset AD patients alpha power was decreased in all brain areas, but this was most pronounced in the parieto-occipital region. Early onset AD patients had lower beta power in frontal, central and parieto-occipital regions. The late onset patients had lower power in the temporal regions. Increased delta power in early onset AD was most pronounced in posterior regions. Early onset AD patients had higher theta power than late onset in frontal, central and parieto-occipital regions, but not in the temporal regions. Linear regression showed a stronger association between relative beta power and MMSE-score in early onset AD than in late onset AD.

Conclusion: The results of this study give further evidence for biological differences within the group clinically diagnosed as AD. We show that besides different cognitive profiles, there also exist differences in oscillatory brain function between early onset and late onset AD, defined by an arbitrary age cut off. These findings further our knowledge into the phenotypical heterogeneity of AD that goes beyond age and argue for a different underlying pathophysiology in some AD patients.

PS02.22

Comparison of diagnostic and medico-social pathways followed by patients suffering from familial or sporadic young onset Alzheimer's disease

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Background: Young onset Alzheimer's disease (AD) patients are defined by the onset of the disease before 65 years. They are estimated around 32000 in France. Their demographic, medical and medico-social characteristics are unknown but previous data showed that the initial symptoms are often attributed to psychological or psychiatric conditions causing a delayed diagnosis. Moreover, young AD disease patients pose

specific problems concerning socioprofessional and familial impact because they are still active, often with dependent children at home. Otherwise, hereditary forms of AD, which represent less than 1% of all AD, are more frequent in young patients. The presence of at least two first degree relatives with AD before 60 in a family suggests an autosomal dominant form of the disease and justifies the search for a mutation in the genes PSEN1, PSEN2 and APP. These mutations represent 80-90% of cases of autosomal dominant forms of AD. A National Reference Centre for young patients suffering from AD or related disorder (CNR-MAJ) has been set up (Mesure 19 of France's 2008-2010 National Alzheimer's plan) in order to improve the knowledge and the management of these patients. In this purpose, information on the diagnostic and medico-social pathways of sporadic and familial form of AD is collected. The objective of this study was to compare on the basis of this data the medical and medicosocial pathways of familial and sporadic young onset AD.

Method: We collected information on the diagnostic and medicosocial pathways followed by all consecutive, volunteer young patients referred to the Lille, Rouen, and Paris memory clinic for Alzheimer's disease (i.e. prevalent and incident cases) with onset before the age of 60. Patients who had at least one first degree relative with AD before 60 were included in the group of familial form of AD and had a genetic analysis. This threshold of 60 years was chosen because in France, under-60 patients are not eligible for the state support given to over-60s. The information was collected with a medicosocial questionnaire completed by the caregiver and reviewed during a structured interview and a medical questionnaire completed by a neurologist.

First results: In 18 months, 118 patients were included in the study: 23 patients had a familial form of AD (FAD) (8 women/15 men) and 95 patients had a sporadic form of AD (SAD) (51 women/44 men). There was no difference between both groups regarding the median age at first symptoms (51 years for FAD and 52 years for SAD) and the MMSE score at the inclusion (12 for FAD and 14 for SAD. Among patients with FAD, one had a ApoE3/4 status, one a ApoE4/4 status, one a mutation of APP gene, one a mutation of PSEN2 gene and 5 patients had a mutation of PSEN1 gene. Median delay between first symptoms and first visit to a specialist was the same in both groups (3,5 for FAD and 3,8 for SAD). Patients with FAD tended to report more often a memory disorder as initial symptom (87%) than patients with SAD (69%) ($p = 0,05$). However, depression was the first diagnosis established in both groups (34% for the FAD and 42% for the SAD). 78% of caregivers report an impact on their lives in the FAD group against 36% in patients with SAD ($p = 0,0003$), especially in terms of professional consequences and health. Thus, 39% of the caregivers of FAD patients took a treatment as a consequence against 16% in the SAD group ($p = 0,01$). Medico-social aid appeared to be more frequent in patients with FAD than in patients with SAD, for example, nursing services at home (13% for FAD versus 1% for SAD) ($p = 0,02$) and physiotherapy (21% for FAD versus 5% for SAD) ($p = 0,02$).

Conclusion: In this study, although the characteristics of patients suffering from FAD and SAD were similar in term of age and severity of the disease, consequences for the caregivers were more important in FAD patients, that could be linked to the impact of a hereditary disease. In addition, medico-social support was more elaborate in patients with FAD who may also benefit from familial experience.

PS02.23

Determinants of care costs of patients with dementia or cognitive impairment

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Introduction: Dementia causes a high burden on patients, caregivers and societies. Decision analytic models to support allocation of resources are often developed making use of cost-of-illness (COI) studies. Several reviews on COI studies have been performed in the field of Alzheimer's and related dementias. The total annual costs of care per person suffering from Alzheimer's disease (AD) and other dementias show a considerable amount of variation, ranging from [euro]6,614-[euro]64,426 in Northern and Western European countries. These estimates

are highly variable due to care setting and methodological issues. We aim to explore variables for explaining the variation of (formal and informal) health care costs of cognitive disorders, using a broad spectrum of variables; including patient, caregiver and social context variables.
Methods: A bottom-up COI study design was used in which a societal viewpoint and a validated method to measure and value informal care was applied. General practitioners were asked to refer all 55 years or older patients, suspected of having dementia or a cognitive disorder, not living in a nursing home and not suffering from an acute disorder. Volumes of resource use during the one year follow-up period after the diagnosis were measured and multiplied by the cost price per resource unit. Informal care activities were assessed using a survey that had been developed for the measurement of informal care and valued according to the proxy good method. Data were analyzed using univariate, multivariate and forward regression analyses.
Results: Average one-year health care sector costs were [euro]26,140 ($34,505 or £17,775) and [euro]11,931 ($15,749 or £8,113) for patient and family. The overall results of the analyses indicated that MMSE and SPPIC were significant predictors of the one-year square root total care costs. Patient gender and IADL were important variables in both the multivariate and forward analyses for explaining one-year square root total care costs.
Conclusions: Using the 12 month follow-up data of 219 patients with cognitive disorders, four variables were the most relevant predictors of annual care costs of patients suffering from dementia or a cognitive impairment: severity of cognitive function, experienced caregiver burden, patient gender and functional ability. These results are robust as three different analytic methods and a broad spectrum of disease severity variables and patient and informal caregiver social context variables were used and their relative effect on care costs. The findings stress the need for multi-component decision models and correspond to current recommendations for decision analytic modeling to include cognitive function, functional ability and behavior. In particular, this study adds the recommendation to include patient gender and caregiver burden to fully reflect the heterogeneity of the disease progression. The results of this study may improve decision models and help policy makers to allocate scarce health care resources more efficiently.

PS02.24

Clinical validation of the dementia risk assessment: An internet-based tool

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It is widely accepted that the early detection of Alzheimer's disease (AD) and other dementias can lead to more effective interventions and the limiting of morbidity. This has led to increased efforts to promote screening of at-risk populations, especially during primary care appointments. At-risk individuals would include those over age 75 as well as those with a positive family history of dementia or other established risk factors. Many of the newer and most promising methods of detecting very early dementia or risk of developing dementia involve invasive or expensive procedures. Examples include genetic testing, examination of cerebrospinal fluid, new neuroimaging modalities, and lengthy neuropsychological assessments. Investigators at the Johns Hopkins School of Medicine and the Copper Ridge Institute have developed a very brief assessment of risk factors and cognitive performance that does not require an in-person interview, physical examination, or biological sampling. This new assessment is the Internet-based Dementia Risk Assessment (DRA), a tool that is entirely automated. Brandt &Rogerson (2011) recently described the subject characteristics and responses of the first 500 persons who completed the DRA. The predictors of impaired memory test performance were advanced age, male sex, complaint of severe memory impairment, and presence of hypertension. This poster will describe a clinical validation study of the DRA. The study is currently underway at two outpatient memory clinics at retirement communities in Maryland: Copper Ridge (in Sykesville) and William Hill Manor (in Easton). At each clinic, new patients are requested to complete the DRA at home prior to their first visit or, in some cases, at the time of the visit. They are then requested to bring a copy of the printed report from the DRA to their clinic visit. At that visit, they and/or their legally authorized representatives also give informed consent for the research team to have access to their medical records to record the results of their subsequent neuropsychiatric work up

[including Mini-Mental State Exam (MMSE) score] and cognitive disorder diagnosis. As of this submission, the "proxy reportâ[euro] of the DRA has been completed regarding 23 patients. Three patients were subsequently diagnosed with mild cognitive impairment, 11 with possible or probable AD, and 3 with another form of dementia. The mean age of the patients was 79.0 (SD = 7.6) and their average MMSE score was 20.5 (SD = 6.3). Five of the 23 were men and 16 were rated by their proxies as displaying severe memory loss. Mean score on the Informant Questionnaire on Cognitive Impairment in the Elderly (IQCODE) was 4.3 (SD = 0.5), indicating moderate to severe cognitive decline in everyday life. Eight patients completed the "self reportâ[euro] of the DRA. Three were ultimately diagnosed with MCI, and one each was diagnosed with AD, another dementia, and major depression. One person was deemed cognitively normal and one person was not diagnosed. The mean MMSE score of these patients was 24.4 (SD = 6.0). Score on the experimental memory test embedded into the DRA was 0.26 (SD = 0.31), much lower than the average for older adults found in the initial standardization study (mean = 0.66, SD = 0.30). The memory test score correlated moderately with the MMSE (r = .34), although the very small sample precludes statistical significance. These preliminary data suggest that the DRA holds promise in the identification of cognitive disorders diagnosed by the "gold standardâ[euro]: formal evaluation by a geriatric neuropsychiatrist, including supporting laboratory and imaging studies. Data collection is ongoing, and updated results will be presented in the poster. Reference Brandt, J. &Rogerson, M. (2011). Preliminary findings from an Internet-based dementia risk assessment. Alzheimer's &Dementia, e-published ahead of print, 1-7.

PS02.25

Characteristics of hearing loss in patients with Alzheimer's disease and its effect on cognitive function

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Introduction: Approximately 70-90% of patients with dementia suffer from hearing loss. Few studies reveal the characteristics of hearing acuity in patients with Alzheimer's disease (AD). Some studies have referred for the relationships between hearing loss and sources for leading to dementia (Lin et al., 2011) or cognitive function in patients with AD (Uhlmann et al., 1989), but no studies clear for the effect of hearing loss on the particular domains of cognitive functioning.

We try to make clear for the characteristics of hearing acuity in patients with AD and how hearing loss effects their cognitive function.

Subjects: The patients included a total of 52 individuals (38 women) who were diagnosed with probable AD by the NINCDS-ADRDA criteria. Their mean age was 84.3±7.0 years, mean Mini-Mental Status Examination Japanese (MMSE-J) score was 17.2±4.3, mean total years of education was 8.0±2.4 years and mean illness duration was 5.1±3.8 years.

We excluded severely demented patients (MMSE-J score<10) due to low reliability of the hearing test. We also didn't include patients who wore hearing aids.

Methods:

We conducted a pure-tone air conduction hearing test with an audiometer (MADSEN MIDIMATE 602) and the MMSE-J for cognitive function to each patient. The instructions were made enough sound for patients to hear easily.

1)We calculated the hearing threshold levels at 0.5,1,2 and 4kHz for each patient and grouped the results by age (70, 80, 90 years).

2) The pure-tone average (PTA) represented the subject's hearing threshold levels at 0.5, 1 and 2kHz for the better ear. Then, we calculated the correlation between PTA and MMSE-J total sore.

3)On the basis of PTA, patients were divided into the Hearing Impaired(≥41dBHL) and Hearing Unimpaired

(≤40dBHL) groups. Then, we performed a non-paired t-test to clarify the difference in MMSE total score and 11 subtests score (Sugishita,2001). SPSS 16.0J for Windows was used to analyze the differences between groups on the dependent measures; the level of significance was set at $p < 0.05$.

Results:

1) The hearing threshold levels at 0.5, 1, 2 and 4kHz were as follows; 70-year group was 49.0±17.8dBHL, 49.2±12.5dBHL, 55.1±19.6dBHL and 57.9±16.4dBHL, 80-year group was 47.3±15.3dBHL, 48.7±15.3dBHL, 54.7±14.7dBHL and 64.7±13.6dBHL, 90-year group was 53.9±11.7dBHL, 54.3±13.0dBHL, 62.7±15.4dBHL and 70.0±18.4dBHL.

2)PTA did not correlate with MMSE-J total score ($r = -2.00$).

3)No significant difference in MMSE-J total scores observed between the Hearing Impaired (17.0±4.5) and Hearing Unimpaired (17.9±3.6) groups. However, as for 11 subtests, it showed significant differences between Hearing Impaired and Hearing Unimpaired for delayed recall (0.7±1.0, 1.5±1.0, $p = 0.04$) and repetition (0.5±0.5, 0.9±0.3, $p = 0.02$) subtests between the two groups.

Discussion:

The hearing threshold levels at each frequency of patients with AD showed a close similarity at 0.5 and 4kHz compared to that of normal elder (Yanagida,1996), while it was greater at 1 and 2kHz. This study suggested that patients with AD had a pattern of greater hearing loss for the primary speech range, that is, 1 and 2kHz. We think the presence of hearing loss tends to increase the effort of requirement to recognize speech, so, keeping short-term memory for delayed recall or repetition is inhibited. Higher IQs elder can prevent such an effect (Dickinson et al., 1991). We showed that patients with AD suffer from hearing loss became to be low conditions for delayed recall or repetition. So, we suggested hearing loss has relationship with the adverse effect of the memory function not total cognitive function of patients with AD.

PS02.26

Effects of calpain on an animal model of tauopathies

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β-Amyloid (Aβ) plaques and neurofibrillary tangles (NFTs) are neuropathological hallmarks of Alzheimer's disease (AD). It is generally believed that tau abnormalities induced by Aβ accumulation promote the disruption of neuronal function and structures, leading to cell death. But the relationship between the two lesions remains unclear. It has been reported that the alteration of enzymatic proteolysis is implicated in the mechanisms of chronic neurodegenerative diseases such as AD. Calpain is calcium-activated intracellular cystein protease. Various studies have revealed the elevation of calpain activity in chronic neurodegenerative diseases including AD. Because tau, one of the cytoskeltal components, is a substrate for calpain, it can be hypothesized that activation of calpain induced by Aβ neurotoxicity causes tau hyperphosphorylation, leading to dysfunction of tau and cytoskeletal disturbances. In the present study, in order to confirm whether or not calpain has any effect on tau lesions, we generated double transgenic mice which overespressed the shortest human tau isoform and lacked calpastatin, the only endogeneous calpain-specific inhibitor. Mice lacking calpastatin did not show any difference pathologically compared with wild type mice under normal conditions. Because the major pathology found in the tau transnige mice used here (PrP T44) is the presence of tau-immunopositive spheroids in the

spinal cord, we sought to determine whether calpain would have any effect on the number of spheroids. In the older bigenic mice, the number of tau-positive spheroids increased than that of PrP T44 mice. In brains of PrP T44 mice, NFT-like intraneuronal tau-positive lesions in the hippocampus and the entorhtinal cortex area start to appear at 18 months of age, and never seen in wild type littermates. In brains of double transgenic mice, there was no obvious alteration in the manner of appearance of those NFT-like inclusions. We investigated the activity of calpain in brains of mice using an antibody against calpain-cleaved carboxyl-terminal 148-kDa fragment of αII-spectrin. Activation of calpain was detected in double transgenic mice along aging compared with PrP T44 mice. But cell death was not detected by caspase-3 staining or terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL). These results suggest that calpain may have some influences on tau-related neurodegenerative mechanisms, though it does not cause obvious neuronal death in our mouse model of tauopathies.

PS02.27

Comparative assessment of clinical efficacy between the naive and the switching group to Donepezil: 12 months prospective study

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Background: The three commonly used cholinesterase inhibitors (CHEIs) are donepezil, rivastigmine, and galantamine. The different pharmacologic characteristics of these CHEIs may influence individual treatment response. Switching to another CHEIs once the original drug is ineffective is a reasonable option that may either stabilize or improve the clinical course of the patients. Objectives: The purpose of this study was to compare the efficacy between switching patients with Alzheimer's disease (AD) from galantamine or rivastigmine to donepezil because they were not responding adequately, and naive patients with AD who initiated therapy with donepezil.

Methods: A total of 108 patients were recruited for this 52-week study. Patients were attending the Clinical Trial Program of the Samsung Medical Center Geropsychiatry Clinic. All patients met NINCDS-ADRDA criteria for probable AD. Patients were excluded if they had evidence of neurodegenerative diseases other than AD. The effect of donepezil on cognitive function was measured using Alzheimer's Disease Assessment Scale-cognitive subscale-preliminary Korean version (ADAS-cog-K). Patients' activities of daily living using Seoul-Activities of Daily Living (S-ADL) and the Seoul-Instrumental Activities of Daily Living (S-IADL); behavioral symptoms using the Korean version Neuropsychiatric Inventory (K-NPI) were measured at baseline, 13-weeks, 26-weeks, 39-weeks and 52-weeks. We defined the responsive patients to donepezil at those who showed a cognitive improvement or no change during the first six-month clinical trial.

Results: 86 naive patients and 22 switching patients were enrolled in the study. 74 patients completed the study and 34 discontinued their treatment before week 52. There was no significant difference between two patient groups in demographic data, baseline characteristics and dementia severity except duration of illness. The total ADAS-cog-K scores were not significantly different from baseline after 52 weeks of treatment in both groups. Both groups demonstrated deterioration of S-ADL and S-IADL at 52 weeks. The NPI scores did not significantly change in both groups. Based on the operational criteria, 61.6% of the naive group and 54.5% of the switching group were responders to donepezil.

Conclusion: The switching group had similar levels of efficacy with the naive group who initiated therapy with donepezil. These results suggest that patients not responding adequately to rivastigmine or galantamine may improve or stabilize after switching to donepezil and prior medication does not effect donepezil's efficacy.

PS02.28

Relationship of leisure activities and Alzheimer's disease

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Background: In the last decades there has been an increasing of old people in the Portuguese population. Alzheimer's Disease is the most common cause of dementia. Cognitive Reserve is a hypothetical construct that has been used to inform of cognitive aging. The leisure activities provide the maintenance or the increase of Cognitive Reserve throughout life. Participation in leisure activities has been associated with a lower risk of dementia (Scarmeas, N. et al., 2001, Verghese, J. et al., 2003, Stern, Y, 2006, Helzner, E. P. et al., 2007). Objective: The aim of this study was to examine the relation between leisure activities and the risk of Alzheimer's Disease.

Methods: The participants in this study were 60 patients diagnosis as probable AD (46 F, 14 M), recruited in Psychogeriatrics, Hospital Magalhães Lemos, Oporto and 30 healthy elderly participants were used as controls, matched for gender, age, schooling and civil status. This group was enlisted at the same geographical area covered by the Hospital Magalhães Lemos, in Oporto. All Alzheimer's Disease (AD) patients met the criteria set by the Diagnostic and Statistical Manual of Mental Disorders (4 th edition) and the National Institute of Neurological Communicative Disorders and Stroke Alzheimer's Disease and Related Disorders Association for probable AD. All subjects were given the Mini Mental State Examination (Folstein et al., 1975), the Clinical Dementia Rating (Hughes et al., 1982), the Barthel Index (Barthel,1965), the Lawton and Brody's Index (Lawton, 1969) and frequency of participation in leisure activity throughout life (questionnaire answered by the patient and/or caregiver). All participants, be them AD patients or controls, were free of severe medical conditions other than those pertinent to the study.

Results: The group of Alzheimer's Disease patients got a lower frequency (mean = 17,17) of participation in leisure activity than the control.

Conclusion: The Alzheimer's Disease patients got the lowest participation in leisure activities comparing with the control group. The data suggest that engagement in leisure activities may reduce the risk of incident dementia.

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PS02.29

The efficacy of treatment of addition in Alzheimer's disease: Rationale for combination therapy with Galantamine and Memantine

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Introduction: Considering the moderate clinical state the Alzheimer's Disease, without therapeutic response or poor therapeutic response with an anti dementia agent, we try improvement the therapeutic response with 2 drugs association. Galantamine is a reversible, competitive cholinesterase inhibitor that also allosterically

modulates nicotine acetylcholine receptors. Cholinesterase inhibitors inhibit (block) the action of acetylcholinesterase, the enzyme responsible for the destruction of acetylcholine. Acetylcholine is one of several neurotransmitters in the brain, chemicals that nerve cells use to communicate with one another. Reduced levels of acetylcholine in the brain are believed to be responsible for some of the symptoms of Alzheimer's disease. By blocking the enzyme that destroys acetylcholine, galantamine increases the concentration of acetylcholine in the brain, and this increase is believed to be responsible for the improvement in thinking seen with galantamine. To evaluate the efficacy, safety and tolerability of galantamine associated with in Alzheimer's disease. Memantine is a low-affinity voltage-dependent uncompetitive antagonist at glutamatergic NMDA receptors. By binding to the NMDA receptor with a higher affinity than Mg2+ ions, memantine is able to inhibit the prolonged influx of Ca2+ ions, which forms the basis of neuronal excitotoxicity. The low affinity and rapid off-rate kinetics of memantine at the level of the NMDA receptor-channel, however, preserves the physiological function of the receptor, as it can still be activated by the relatively high concentrations of glutamate released following depolarization of the presynaptic neuron. The interaction of memantine with NMDA receptors plays a major role in the symptomatic improvement that the drug produces in Alzheimer's disease. Moreover, there is no evidence as yet that the ability of memantine to protect against NMDA receptor-mediated excitotoxicity has a disease-modifying effect in Alzheimer's, although this has been suggested in animal models. Hypothesis: The efficacy, safety, and tolerability of cholinergic agent: GALANTAMINE (with a dual mechanism of action on the cholinergic a system) and moderate affinity NMDA-receptor antagonist: MEMANTINE, were assessed taking into account the profile of patients with neurocognitive disorder: Alzheimer's disease, from the clinical aspects and the different classifications.

Methods: The experience included 428 patients who were enrolled in a prospective, observational, multicenter, and open-label study to receive 16 mg/day of galantamine and 30 mg/day of memantine for 12 months of treatment of addition.

Results: The therapeutic response was measured using the Mini Mental State Examination (MMSE), Clinical Dementia Rating (CDR), Alzheimer's Disease Assessment Scale (ADAS-GOG), Functional Activities Questionnaire (FAQ) the Clinical Global Impression Scale (CGI) and the UKU scale of adverse effects. Taking into account the efficacy, safety and adverse events of the treatment, the final results of the study showed that galantamine with addition memantine improve cognition, behavioural symptoms, and the general well-being of patients with cognitive impairment: Alzheimer's disease. The incidence of adverse events was not significant and a very good profile of tolerability and safety was observed.

Conclusion: At the conclusion of this session, we should be able to demonstrate with use the association memantine - galatamine in neurocognitive disorder: Alzheimer's disease, improve cognition, behavioural symptoms, and the general state recognized as neurocognitive disorder.

Discussion: Suggest that before Alzheimer's Disease continues evolution to a severe state, the pharmacological use this association to slowing or stopping the dementia process.

PS02.30

Changing practice to reduce admissions for people with dementia

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There is a general move towards trying to reduce hospital admissions for people with dementia and to reduce length of stay in hospital. Many new developments in older people's mental health services have aimed to improve care and reduce length of stay. However, there is very little research on what might reduce inpatient bed use. The objective of this study was to reduce the need for psychiatric inpatient beds for older people by developing and testing a new model of service which emphasised working more closely with general practitioners and care homes. The new model of service was implemented over a three year period in one sector and at the end of the time the bed use was compared with other similar sectors in the region. It involved close working links with GPs/practice nurses and a "same day responseâ[euro] to patient queries from G.Ps

where possible. Regular talks at GP practices to improve quality of referrals and GP confidence in managing psychiatric disorders in addition to Face to face discussions with GPs (eg referral for acute confusion) was regularly done. Close working links were developed with local care homes including training of care home staff and case discussions. Overall the system drastically reduced the number of admissions for older people with dementia and other mental health problems and if the practice is innovative it is less about any particular thing and more about combining all the elements in a systematic way so that each provide an incremental benefit and result in a service for the community which helps to minimise the risk of admissions for people and in doing so, helps to maintain and support them at home. The model could potentially be applied to many other services and across a range of specialties, particularly for older people and those with long term conditions who may be at more risk of admission. The key elements of the model were access/support, training/development and liaising-providing the missing link. The number of admissions per 10,000 elderly was only 16 per year (other consultants 19-50 per year) and the length of stay was 29 days (other consultants 37to 89 days). Occupied bed days were under 500 per year compared to 1000 to 1800 for the other consultants. The new model enabled the identification of difficulties before reaching crisis point. Use of beds was reduced to 33% of the other consultants and the model was popular with GPs and care homes. Draper B (2000) The effectiveness of old age psychiatry services. International Journal of Geriatric Psychiatry, 15, 8, 687-703.The number of admissions for people with dementia from a population of 10,000 elderly was reduced to 4 admissions in a year. In the current financial climate there is increasing need to not only save money but provide more efficient systems of care and the advantages of reducing bed use and supporting more patients in the community become very apparent.

PS02.31

Neuropsychological, functional and demographic characteristics in Alzheimer's disease patients

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Background: Alzheimer's disease (AD) is a progressive neurodegenerative disorder that is characterized by deterioration of cognitive and funcional abilities. Objective: The aim of this study was to describe the clinical and demographic profile AD patients at a specialized hospital in Portugal.

Methods: Sixty subjects with probable diagnosis of AD (46 F, 14 M), recruited at the Hospital Magalhães Lemos in Oporto, Portugal, took part in this study. All patients fulfilled the criteria of both the Diagnostic and Statistical Manual of Mental Disorders (4 th edition) and the National Institute for Neurological and Communicating Disorders and Stroke/Alzheimer's Disease and Related Disorders Association for probable AD. Functional and neuropsychological abilities of patients with probable AD diagnosis were revaluated at 36 and 54 months. All participants answered a structured questionnaire and were given the Mini-Mental State Examination (Folstein et al., 1975), the Clock-Drawing Test (Strub &Black, 1977), the Clinical Dementia Rating (Hughes et al., 1982) and a battery of neuropsychological tests adapted from the Lisbon Screening for Dementia Assessment (Garcia, 1984). Functional abilities were assessed with two Activities of Daily Living (ADL) Scales: the Barthel's Index (Barthel, 1965) and the Lawton and Brody's Index (Lawton, 1969). **Results:** Participants were 76,7% women, had a mean age of 80,48 years, a mean educacional level 4,23 years and mean dementia duration of 6,52 years. 58,3% was married, 40,0% widower and 1,7% single. At the first evaluation 86,7% were classified as CDR = 1 and 13,3% as CDR = 2. After 36 months 41,7% were classified as CDR = 1, 46,7% as CDR = 2 and 11,7% as CDR = 3. After 54 months 31,9% were classified as CDR = 1, 44,7% as CDR = 2 and 23,4% as CDR = 3. Significant differences between the first and the second evaluations were observed (by comparing mean scores of MMSE, Clock Drawing Test, Barthel Index, Lawton and Brody's Index, BLAD) and between the second and the third evaluations.

Conclusion: Analysis data showed a cognitive and functional decline along 54 months. This study is in agreement with what is known about AD that is characterized by progressive cognitive deterioration, together with declining activities of daily living. Reference: American Psychiatric Association (2002). DSM-IV-TR. Manual

de diagnóstico e estatística das perturbações mentais. 4 edição, texto revisto, Lisboa; Berr, C., Wancata, J. &Ritchie, K. (2005). *Prevalence of dementia in elderly in Europe. European Neuropsychopharmacology*, 15, 463-471; Cummings, J. L. (2004). *Alzheimer's Disease. The New England Journal of Medicine,* 351, 56-67.; Fratiglioni, L., Launer, L. J., Andersen, K., Breteler, M.M., Copeland, J.R., Dartigues, J. F., Lobo, A., Martinez-Lage, J., Soininen, H., &Hofman, A. (2000). *Incidence of dementia and major subtypes in Europe: A collaborative study of population-based cohorts. Neurologic Diseases in the Elderly Research Group. Neurology,* 54 (11 Suppl 5):S10-5.; Jalbert, J. J., Daiello, L. A. &Lapane, K. (2008). **Dementia of the Alzheimer Type. Epidemiologic Reviews,** vol. 30, 15-34.; McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., &Standlan, E. M. (1984). *Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology,* 34, 939-944.; Ritchie, K., &Lovestone, S. (2002). *The dementia, The Lancet,* 360, 1759-1766.;Villareal, D. T. &Moris, J. C. (1999). *The Diagnosis of Alzheimer's Disease. Journal of Alzheimer's Disease* 1, 249-263.

PS02.32

Psychiatric symptoms remaining after traumatic experiences during World War II in Dutch-Ontarian applicants for an insurance compensation assessment

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Purpose: Estimation of the current prevalence of psychiatric symptoms in applicants for an assessment whether they meet criteria for financial compensation related to the Wet Uitkeringen Vervolgingsslachtoffers (WUV) or Wet Buitengewoon Pensioen (WBP), which are intended to support war victims if needed.

Methods: Twenty-five applicants (16 females, 9 males; age 72 ±6 years; Mini Mental Status Examination score 28 ±1) each underwent a Structured Clinical Interview for DSM-IV-TR Axis I Disorders, as well as social work, general medical, neurologic and geriatric psychiatric interviews, during the period from October 2004 until June 2009. Of the applicants, 16 had been in Japanese Concentration Camps in Indonesia, 3 had been in hiding in the Netherlands because they were Jewish, 2 were children of Jewish parents who deceased in Extermination Camps in Germany or in Poland, 2 were children of resistance fighters in the Netherlands who had been punished by the Germans, one was a Dutch resistance fighter, and one had been sexually abused by a Jewish person in hiding in the Netherlands. The current prevalence of DSM-IV-TR Axis I Disorders was assessed. Limitations related to these psychiatric symptoms were also assessed quantitatively and qualitatively for the following categories derived from the classification for impairments used by the American Medical Association (AMA): (1) daily activities; (2) social functioning; (3) concentration, perseverance and tempo; and (4) adaptation to stressful circumstances

Results: The most common current DSM-IV-TR Axis I Disorders in this population were: Posttraumatic Stress Disorder (60%), Major Depressive Disorder (52%), Specific Phobias (48%), Social Phobia (36%), Generalized Anxiety Disorder (32%), Depressive Disorder Not Otherwise Specified (24%), Panic Disorder with or without Agoraphobia (24%), Agoraphobia without Panic Disorder (20%), Dysthymic Disorder (16%), Eating Disorders (16%), Pain Disorders (12%), Anxiety Disorder Not Otherwise Specified (8%), Bereavement (8%), Alcohol Abuse or Dependence (8%), Alcohol-induced Mood Disorder (4%), Benzodiazepine Dependence (4%), Nicotine Dependence (4%), Opioid Dependence (4%), Bipolar II Disorder (4%), Somatization Disorder (4%), Anxiety Disorder due to a General Medical Condition (4%), and Adjustment Disorder with Anxious Mood (4%). On average 4 DSM-IV-TR Axis I Disorders (range: 0-9) were diagnosed per applicant. The probable impact of these psychiatric symptoms on limitations in the AMA categories mentioned above will be presented at the conference.

Conclusion: Psychiatric symptoms are still currently active in a substantial proportion of Dutch-Ontarian applicants for World War II victim insurance compensation. This is in agreement with previous reports of active

psychiatric symptoms that remain, recur or relapse long after the psychological trauma had been incurred during World War II (Bergherr et al. 1997). In some of the applicants, these psychiatric symptoms were connected to considerable functional limitations. Reference: Bergherr T, Bremner JD, Southwick SM, Charney DS, Krystal JH. *Neurobiological Perspectives on Trauma and Aging. Journal of Geriatric Psychiatry* 1997; 30(1):27-59.

PS02.33

Ptophobia and fall-related psychological concerns

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Ptophobia and fall-related psychological concerns Ângela Santos and Oscar Ribeiro, *Universidade de Aveiro, Aveiro,* Portugal **Introduction:** Ptophobia (phobic fear of falling) is widely found in the elderly and isn't a unique phenomenon of people with a history of falling. It causes several physical consequences and activity restriction in older adults and may be responsible for the development of depressive and anxiety symptoms, social isolation and psychological stress which may, in turn, adversely affect both autonomy and independence (Delbarere et al., 2010). Ptophobia is a psychological phenomenon, and, accordingly with this, there should be given more attention to the specific constructs associated with it. In this sense, Hadjistavropoulos and colleagues (2011) had recently offered a new theoretical model of fear of falling, falls efficacy and falls, presenting the recurrent use, yet conceptually problematic, of those two first terms in a interchangeably way. In this context, the need to analyze and better understand the psychological and psychiatric correlates of Ptophobia arises, including such particular aspects as geriatric anxiety symptoms and perceived control over falling. **Objectives:** The present study aims to investigate the relationship between Ptophobia, falls-efficacy, perceived control over falling and anxiety in a sample of older individuals. Associations of these variables with balance and functional status, falls history as well as with personal info and living conditions (geriatric institution vs community) were also studied.

Methods: Data from a cross-sectional study of elderly persons from the northern part of Portugal was considered. The sample consists of 100 participants, 67women, with the mean age of 80.80 years (SD 7.54). All participants answered a questionnaire with socio-demographic information, that included the Perceived Control Over Falling Scale (Lawrence et al., 1998), the Portuguese version of the Geriatric Anxiety Inventory (Ribeiro et al., 2011), the Falls Efficacy Scale (Melo, 2001), and the Performance Oriented Mobility Assessment (Petiz, 2002). Information was also obtained on the functional status, on the presence of fear of falling (though a categorical approach: "Are you afraid of falling?â[euro]) and falls history. Chi-squares and t-test analyses were performed to study the associations. **Results:** A high number of participants revealed having fear of falling (81%), presenting, in general, worse results in terms of falls efficacy, self-perceived control and balance than those who didn't present fear of falling. No differences were found on geriatric anxiety symptoms. Fear of falling is significantly more present in women (94%), in those participants living in geriatric institutions (89.8%) and in the elderly persons who felt (89%). When compared to women, men presented higher falls efficacy (M = 65.17) and self-control over falling (M = 16,18) as well as higher values of balance (M = 20.16) (p 0.05). The high levels of falls efficacy are associated with high levels of self-perceived control over falling, better balance and with a lower prevalence of anxiety symptoms. Moreover, the reduced prevalence of anxiety symptoms is significantly associated with higher self-control, which is associated with a higher balance. **Conclusion:** As in previous findings (e.g. Legters, 2002), female participants reported more fear of falling than men. Those participants who use technical assistance in their mobility, who live in institutions and who had felt had been more afraid of falling. However, most of participants who don't use any technical assistance, who live in the community or never felt also had high prevalence of fear of falling. These findings reinforce the fact that Ptophobia isn't an exclusive phenomenon of post-fall cases. Reference: Delbaere, K. et al (2010). Determinants of disparities between perceived and physiological risk of falling among elderly people: cohort study. BJM;

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PS02.34

Escitalopram in the treatment of non-depressed elderly patients with generalized anxiety disorder

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Background: Anxiety disorders, particularly generalized anxiety disorders (GAD), are prevalent disorders in the elderly. Despite high prevalence, little data are available on the clinical characteristics and treatment approach to GAD in the elderly. Selective serotonin reuptake inhibitors (SSRIs) are currently the recommended first-line treatment in adults with GAD. However, only limited number of randomized, placebo-controlled trials utilizing SSRIs have been conducted in older GAD patients. Further, these trials either did not exclude subjects with concurrent major depression or were conducted among patients with a wide range of anxiety disorders. 1, 2 This double blind, placebo controlled trial assessed the efficacy of escitalopram in non-depressed elderly subjects with a primary DSM-IV GAD diagnosis.

Methods: Forty, non-depressed Veteran and non-Veteran GAD elderly patients (ages >60 years old; CGI-S >4; HAM-A total score >20; MADRS50% reduction in HAM-A total score, and Sheehan Disability scale scores were also assessed.

Results: Fourteen of 20 escitalopram and 16/20 placebo patients completed treatment. Mean endpoint dose for escitalopram was 14.5mg/day (SD = 6.5). Response rates (as defined by final CGI-I scores of 1 or 2) for the LOCF sample were 60% (95% CI: 36.1% to 80.9%) and 35% (95% CI: 15.4% to 59.2%) in the escitalopram and placebo groups respectively (p = 0.10). Among study completes response rates were 78.6% (95% CI: 49.2% to 95.3%) and 43.8% (95% CI: 19.8% to 70.1%) in the escitalopram and placebo groups respectively (p = 0.054). HAM-A total and psychic subscale change scores and HADS-A change scores at endpoint were numerically higher but not statistically significant in the escitalopram group compared with placebo. The most common adverse events included fatigue, somnolence, dizziness, diarrhea and nausea.

Conclusions: Although relatively small, this controlled trial indicates that escitalopram may provide a modest improvement of core GAD symptoms in older patients without concurrent depression. References: 1. Lenze EJ, Rollman BL, Shear MK, Dew MA, Pollock BG, Ciliberti C, Costantino M, Snyder S, Shi P, Spitznagel E, Andreescu C, Butters MA, Reynolds CF 3rd. *Escitalopram for older adults with generalized anxiety disorder: a randomized controlled trial. JAMA.* 2009 Jan 21;301(3):295-303. 2. Lenze EJ, Mulsant BH, Shear MK, Dew MA, Miller MD, Pollock BG, Houck P, Tracey B, Reynolds CF 3rd. *Efficacy and tolerability of citalopram in the treatment of late-life anxiety disorders: results from an 8-week randomized, placebo-controlled trial. Am J Psychiatry.* 2005 Jan;162(1):146-50. Funding source: Unrestricted Investigator-initiated grant from Forest Laboratories, Inc

PS02.35

Biomarkers: The weight of the evidence

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Background: The AAA and NIA have proposed new diagnostic criteria, incorporating biomarkers, for Alzheimer's disease. The Cochrane Dementia Group sought to systematically review the quality of the literature on biomarker use for diagnostic prediction of Alzheimer's disease and other dementia disorders in mild cognitive impairment (MCI).
Methods: MEDLINE was searched covering January 2000 to September 2010, and results screened for the inclusion criteria: * Biomarker of interest used (abeta, tau, PET, or sMRI) * MCI at baseline * Longitudinal design From each potentially relevant paper obtained, the following was extracted: * Participant numbers with MCI at baseline * Confirmation of longitudinal aspect * Subject numbers who "convertedâ[euro] to dementia * Whether it included data from which the test's diagnostic sensitivity and specificity could be calculated. Each primary study then underwent a QUADAS assessment, evaluating the strength of the study and highlighting any inherent biases.
1. 123 primary studies, from 17344 references retrieved, met the inclusion criteria. 2. From papers clearly reporting it, the total number diagnosed with MCI at baseline who converted to clinical dementia was 2689 across all biomarkers considered. 3. Only 6% of studies included 500+ patients. 4. 50% clearly reported conversion to dementia over time (though follow-up times varied greatly). 5. In 63% it was unclear whether decisions about conversion to dementia were made without knowledge of scan/test. 6. From all studies of PET based amyloid imaging that reported conversion total number of subjects converting was only 35.
Discussion: The quality of reporting in such studies raises the possibility substantial biases may be present. Critical evaluation of the evidence base for diagnostic biomarkers is of major importance to the field of dementia. Without it, there is a risk that future clinical care and research will be built on assumptions about diagnostic validity which are wrong.

PS02.36

The relationship between homcysteine and incident dementia in elderly African Americans and elderly Nigerians

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Introduction: Homocysteine is a biomaker that has been shown to be a risk factor for dementia and Alzheimer's disease in various studies. However there is no known study on this relationship in Africa.
Aim: The aim of the study is to look at baseline homocysteine levels and incident dementia in two populations, African American and Nigerians.
Method: This report is from the longitudinal study on risk factors for dementia and Alzheimer's disease in the Indianapolis -Ibadan Dementia Research Project. This report includes the 2001, 2004, and 2007 waves of the study. Blood samples were collected in 2001 for measuring levels of homocysteine, folate and vitamin B12. The project consisted of a screening phase, with the Community Screening Interview for Dementia (CSI-D). It also had a clinical assessment phase. Scores on the CSI-D were classified into good, intermediate and poor performance for selecting subjects for clinical assessment. Diagnoses were made based on individual clinical examination with physical and neurological examination, modified CERAD neuropsychological battery, and

structured informant interview for history, symptoms, and daily function. Multivariate logistic regression models were used to examine the association between homcysteine, folate, and vitamin B12 and dementia. Proportional odds ratios were used to examine the association between homocysteine with folate, vitamin B12 and other demographic characteristics.

Results: Analyses included 800 subjects from Indianapolis who were diagnosed either incident dementia in (2004, 2006, or 2007) or CSI-D good performance in 2007. In Ibadan there were 606 subjects either with incident dementia or good performance in 2007. In the final model for Indianapolis higher baseline levels of homocystiene were associated with increased probability of developing dementia ($p = 0.022$). Low level of education was also a risk factor for incident dementia (OR 0.857, $p = 0.001$). Subjects who had higher BMI measured in 2001 were less likely to become demented, (OR 0.940, $p = 0.0013$). Gender and age were not significant risk factors. Results for incident Alzheimer's disease were similar to those for dementia. For the Yoruba subjects in Ibadan, higher baseline levels of homocysteine were also associated with increased probability of incident dementia ($p = 0.027$). For each additional year of age from baseline, the odds for dementia increased by 8.7% ($p = 0.001$). Female gender, and lack of education were associated with dementia risk. Results for Alzheimer's disease were similar.

Conclusion: Higher baseline levels of homocysteine conferred risk for incident dementia and Alzheimer's disease in the African Americans and the Yoruba Nigerians, populations living in very different environments. In the African Americans low level of education was a risk factor for dementia, and those with higher BMI at baseline were less likely to develop dementia. In the Yoruba, female gender, lack of education, and increasing age were risk factors for dementia and Alzheimer's disease. Supported by NIA grant RO1 AG009956-15.

PS02.37

ALOIS the next phase: A comprehensive study-based register of diagnostic studies

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Background: ALOIS is a freely available, comprehensive register of dementia studies which was launched at ICAD in 2009 by the Cochrane Dementia and Cognitive Improvement Group (CDCIG). The register is 'study-based' which means that references about the same trial have been grouped under one parent record. ALOIS now holds details of over 4200 treatment trials. The site receives on average around 3500 page views per month. Users can view key details about a study such as number of participants, intervention duration, outcomes, dates of study, any study IDs, all related references. ALOIS is maintained by a group of graduate level volunteers, many of whom are, or were, caregivers of patients with dementia. They are supported by the Cochrane editorial unit. ALOIS is a valuable resource for the teaching of evidence-based dementia The Cochrane Dementia Group CDCIG is now undertaking a programme of reviews of studies of diagnostic tests. This complements the existing portfolio of reviews about treatments. ALOIS is now being developed to support these reviews of diagnostic tests.

Methods: There are two key strands to creating a comprehensive register of studies of diagnostic test accuracy (DTA): 1. Systematic identification of studies for inclusion: * A sensitive search strategy was designed and was run in MEDLINE to retrieve articles published between 2000 and 2010 in which cross-sectional diagnosis of dementia or prediction of progression to dementia were outcomes. * A team of paid assessors then screened the results. They identified any potential reference to studies of cross-sectional or longitudinal design in which diagnosis of dementia or cognition was an outcome/significant aspect * The resulting references were then examined and divided according to diagnostic method/test and study design * Studies of biomarkers as predictors of progression from MCI to dementia were then examined in more detail. Full papers were obtained and the following information extracted: Participants and their health condition at baseline Conversion figures and accuracy data if given * Efforts were also made to identify 'primary publications' and to group other

references about that study together 2. Refining the user-interface: This phase involves consultation with researchers, funders, and CDCIG authors to establish: * Key details of studies they would like extracted * How they would like to be able to search for the studies on ALOIS (eg by index test; by clinical setting; by cohort etc) * What they would like to be able to do with their search results.

Results: The Diagnostic Test Accuracy arm of ALOIS will be launched in July 2011. It will be a valuable resource that will enable users: * To search by cohort and by individual analysis within cohorts * To search by study setting (community, primary or secondary care) and by index test (for example episodic memory tests, CSF abeta, PIB, ApoE, MRI etc). * To view multiple publications about the same cohort grouped under one parent record with primary papers within that record highlighted clearly * To link straight to related open access papers, reviews and relevant Cochrane DTA reviews CDCIG will expand its existing, comprehensive library of pdfs of all reports of dementia related interventions to include reports on diagnostic test accuracy.

Conclusion: The systematic expansion of ALOIS to include studies of diagnostic test accuracy is an important move in the effort to provide review authors, researchers and other stakeholders with easy access to content-rich comprehensive information about studies. CDCIG continues to welcome contributions to the maintenance of ALOIS from students, researchers, and graduate level caregivers.

PS02.38

Anxiety in dementia: A qualitative exploration of patients' experiences of anxiety and cognitive-behavioral treatment

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Coexistent anxiety creates significant additional burden for people with dementia, as it is associated with increased behavioural problems and limitations in activities of daily living (Teri et al., 1999), increased disability in social functioning (Schultz et al., 2004), and increased risk of nursing home placement (Gibbons et al., 2002). Among younger adults with anxiety disorders, cognitive behavioural therapy (CBT) is the psychosocial treatment of choice, and recent data also suggest the utility of CBT for anxiety in later life (Wetherell et al., 2005). However, studies to date have typically excluded patients with cognitive impairment. Research on psychotherapy for this group of participants is strongly warranted, and a multi-method approach to evaluation of psychotherapy is recommended and sought after in the domain of clinical research (Klein and Elliot, 2006). Qualitative data material may provide much needed insight into how persons with dementia experience their anxiety, as well as a better understanding of the mechanisms or processes that may be helpful for reducing anxiety. In a pilot study, we examined the feasibility and potential of CBT for co-morbid symptoms of anxiety in patients with dementia. The CBT treatment, based on a treatment manual (Kraus et al., 2008), was tried out with six patients. The participants were assisted by collateral through the entire intervention. In addition to assessing the outcome of the study quantitatively with rating scales and self-report questionnaires, we also used semi-structured qualitative interviews in order to explore the participants' subjective experience of anxiety and the treatment. Through the interview we sought to answer the following questions: 1. How did the participant experience the psychological distress when he/she first started the treatment? 2. How did the participant experience the treatment process? 3. How does the participant experience changes that resulted from the treatment? The interviews were analyzed using Interpretative Phenomenological Analysis (IPA). An IPA analysis takes an insiders perspective in that the researcher seeks to understand how the participant experiences and makes sense of his or her own life (Smith, 2008). We also compared the individual accounts in order to identify patterns of commonalities and differences in how the intervention and outcome was experienced. For this aim, we used the method of systematic text condensation (Malterud, 2001). The analysis of the interview transcripts were technically carried out with the assistance of Nvivo 8 software (QSR, 2008). Participants' descriptions of the treatment process and outcome clustered around several themes. The meaning patterns and themes that were developed from the interview data will be described, and the interrelationships

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PS02.39

Confusion Assessment Method: Preliminary results of Portuguese validation study

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Delirium is a common condition in the elderly, affecting up to 30% of all hospitalized older patients (Saxena et al., 2009). It is also associated with multiple adverse outcomes that have been well documented, such as increased length of hospital stay, function and cognitive decline, institutionalization and mortality (Siddiqui et al., 2006; Cole et al., 2009). However, poor recognition remains the single greatest obstacle to both clinical and research efforts in Delirium. This situation has been related to its fluctuating nature and overlap with Dementia and Delirium, as well as to the scarcity of suitable screening instruments in general hospitals, fundamental for early detection and timely management (CCSMH, 2006; NICE, 2010). The Confusion Assessment Method - CAM (Inouye et al., 1990) is a widely used Delirium screening instrument, based on Diagnostic and Statistical Manual/DSM III-R (APA, 1987) criteria. It can be readily applied in routine clinical settings by non-psychiatric medical or nursing staff. The aim of the present study is to assess the psychometric proprieties of the Portuguese version of CAM. This cross-sectional study was carried out on consecutive elderly patients (≥65 years) (n = 150) within 24 hours after admission in the sub-intensive care unit of Emergency and in the sub-intensive care unit of the Surgical Service of S. João Hospital, in Oporto (Portugal). Patients in mutism or those who scored 11 or more in the Glasgow scale were excluded. A blinded assessment was conducted by a psychiatrist, as the reference rater using the Delirium criteria of DMS-IV-TR (APA, 2002) and by a psychologist, using the Portuguese translation of CAM (Martins et al., 2010). This instrument was stemmed from CAM long version (with 9 items), after permission from the author (Inouye, 1990), with the translation according to guidelines suggested by The Translation and Cultural Adaptation group (Wild et al., 2005). The preliminary results will be presented, namely the ecological, face and content validity of the Portuguese version of CAM. References: 1. American Psychiatric Association (2002). *Diagnostic and Statistical Manual of Mental Disorders.* 4rd ed.-Text Review (DSM-IV), Washington, D.C.: Author. 2. American Psychiatric Association (1987). *Diagnostic and Statistical Manual of Mental Disorders.* 3rd ed.-Text Review (DSM-III-TR), Washington, D.C.: Author. 3. CCSMH - Canadian Coalition for Seniors'Mental Health (2006). *National Guidelines for Seniors'Mental Health - The Assessment and Treatment of Delirium.* Toronto: CCSMH 4. Cole, M. G., Ciampi, A., Belzile, E., &Zhong, L. (2009). *Persistent delirium in older hospital patients: a systematic review of frequency*

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PS02.40

Recognition of delirium in a teaching hospital

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Background: Delirium is one of the most common acute medical presentations, and yet is under-recognized. Inouye (1994) found delirium was unrecognized by 65% of physicians. Delirium presenting with acute agitation is often misdiagnosed as primary psychiatric disease, and when it present with confusion is often attributed to a dementing illness, with the reversible nature of the cognitive impairment overlooked. Kishi (2007) concluded that the consulting physicians of patients with delirium often incorrectly turn to past psychiatric diagnoses and/or are distracted by the presence of pain and, thus, fail to accurately diagnose delirium. Only 28% of cognitively impaired elderly emergency department patients had any documentation of mental status impairment (Hustey 2002) . Inouye (2001) investigated nurses recognition of delirium and its symptoms and concluded that nurses often missed delirium when present, but rarely identified delirium when absent. The aims of this study were to determine the recognition rate of delirium by medical and nursing staff and to determine factors associated with the recognition of delirium.

Methods: Over a six month period all referrals to the palliative medicine and psychiatry of the elderly services of a tertiary referral hospital were screened using the Confusion Assessment Method and The Delirium Rating Scale. The referral letter and cases notes (medical and nursing) of 121 patients diagnosed with delirium were reviewed. Demographic clinical details were gathered. Data was analysed using PASW (v 18). Median and interquartile range were reported for continuous variables. Frequencies were reported for categorical variables. Pearson's chi squared tests were performed.

Results: The median age was 79, and 47.1% were male. Delirium was cited as the reason for referral in 5.8% of cases. The most frequent reasons for referral were for "Palliative care inputâ[euro] (22.3%), depression (20.7%), agitation/behavioural disturbance (15.7%) and psychosis (11.6%). More than one reason for referral may have been included on the referral letter.

A diagnosis of Delirium was documented in 15.7% of referral letters, 37.2% of medical notes and 32.2% of nursing notes.There was an association between recognition of delirium and hyperactive subtype of delirium (X2 4.021, p<0.045), referring speciality (X2 13.131, p<.041) alcohol related delirium (X2 4.021, p<.045), documentation of in the medical notes of disorientation (X2 4.06, p< .044) and delusional beliefs (X2 3.902 p<0.048) and documentation in nursing notes of emotional lability (x2, p<0.02).

Discussion: Despite its high prevalence delirium remains under-recognised and misattributed by both nursing

and medical staff. Alcohol-related delirium and hyperactive delirium were more likely to be recognised. Educational interventions and the use of screening tools must be considered to improve the detection of delirium. References: Hustey FM, Meldon SW. *The prevalence and documentation of impaired mental status in elderly emergency department patients. Ann Emerg Med.* March 2002;39:248-253.] Inouye, S. K. (1994). *"The dilemma of delirium: clinical and research controversies regarding diagnosis and evaluation of delirium in hospitalized elderly medical patients.â[euro] Am J Med* 97(3): 278-88. Inouye SK, Marquis Foreman D.;. Mion, L; Katz K,; Cooney, *L Nurses' Recognition of Delirium and Its Symptoms: Comparison of Nurse and Researcher Ratings. Arch Intern Med.* 2001;161:2467-2473. Kishi, Y . Kato, M., Okuyama, T, Hosaka, T ., Mikami, K, Meller, W., Thurber, S, Kathol, R. *Delirium: patient characteristics that predict a missed diagnosis at psychiatric consultation . General Hospital Psychiatry* 29 (2007) 442-445

PS02.43

Does moderate alcohol consumption protect against late-life depressive symptoms? A 16 year longitudinal analysis of a nationally representative older US population

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There is growing evidence supporting the positive effects of moderate alcohol consumption and various health outcomes, such as reduced risk for cardiovascular diseases, cognitive impairment, and mortality. However, there is also evidence that having a problem drinking history predicts an increased risk for the onset of depression at 6-year follow-up (Odds Ratio [OR]: 1.67, 95% Confidence Interval [CI] 1.02, 2.74, Perreira &Sloan, 2002), functional decline, psychiatric problems, and memory decline. Using the Health and Retirement Study, a nationally representative sample of older adults aged 55 and over (N = 7,656), from 1992 to 2008, latent growth curve analysis is used to longitudinally examine the relationship between past and current alcohol consumption with incidence of late-life depression based on both the Center for Epidemiological Studies-Depression (CES-D) and the Composite International Diagnostic Interview (CIDI). The CES-D questions were asked of the participants whether much of the time during the past they felt the following nine symptoms: depressed, enjoy life, sad, trouble getting going, a lot of energy, everything was an effort, sleep was restless, happy, and lonely. Participants answered with a yes or a no response. The CIDI questions included the following symptoms: losing interest, feeling tired, lose appetite, concentrating, feeling down on yourself, appetite increased, trouble falling asleep, often had trouble falling asleep, and thoughts about death. There is a significant positive relationship between the past alcohol consumption of beer, wine, or liquor with increasing levels of feeling depressed in the past two weeks ($b = 0.02$, $p<.001$). There is also a significant positive relationship between the current number of alcohol beverages consumed per day in predicting increasing levels of feeling depressed in the past two weeks ($b = 0.07$, $p<.001$). Details regarding the longitudinal prediction of past and current frequency of alcohol use and late-life depressive symptoms experienced by older adults over 16 years of data are presented while considering confounding effects of common co-morbidities found among older adults, which include cardiovascular diseases and risk factors, cancer, diabetes, and lung diseases.

PS02.45

Trends in antidepressant use in the older population: Results from the LASA-study over a period of ten years

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Background: Depression is an important disorder in later life. Biological treatment and psychotherapy appear to be effective in older people. However, several studies show undertreatment, varying from no treatment at all to non-therapeutic dosages of antidepressants or too early discontinuation of medication. In the past twenty years, antidepressant use in adults has increased, mainly due to a rise in SSRI-use. Such data are not available for older adults. This study investigates time-trends in antidepressant use in an older, population-based sample over a period of ten years.

Methods: Data from the Longitudinal Aging Study Amsterdam were used to investigate trends in antidepressant use from 1992 through 2002 in a population-based sample aged 65-85 years. Data were collected every three years. The numbers of respondents available for this study were 1847 (T1), 1294 (T2), 1099 (T3) and 1119 (T4). At every cycle antidepressant use was measured. The factor 'time' was brought into the four study-samples as a covariate. Depression was investigated with the Center for Epidemiologic Studies-Depression scale followed by a diagnostic interview based on DSM-III. Differences between the four cycles with respect to antidepressant use and associations with depression, sociodemographic factors (sex, age), physical health (chronic disease, functional limitations) and cognitive impairment were described and tested with chi-square tests and logistic regression analyses.

Results: The proportion of respondents who were depressed remained rather stable over ten years. In the full sample, antidepressant use increased from 2% to 6%. The increase in antidepressant use over time was statistically significant at T3 (OR = 1.99; CI = 1.28-3.11) and T4 (OR = 2.72; CI = 1.79-4.14) compared to T1. The largest increase was found in the subgroup with subthreshold depression, with a rise from 2% to 12%. In the major depressive disorder subgroup, antidepressant use showed an increase from 15% to 30%, but no statistical significance was reached, probably due to the small numbers for antidepressant use in this subgroup (OR = 2.48; CI = 0.72-8.58). This increase was larger in the older old than in the younger old. The increase was mainly due to a rise in SSRI-use. TCA-use showed a relative decrease from 68% of total antidepressant use at T1 to 37% at T4. SSRI-use showed a relative increase from 13 % of total antidepressant use at T1 to 49% at T4. Lithium-use showed a relative decrease from 13% to 8%. The use of atypical antidepressants showed some variation in this period, but overall change was small (from 5% to 7%). Daily TCA-dosages often were too low; dosages of the other antidepressants seemed to be sufficient. A statistically significant association was found of antidepressant use with depression (OR = 2.51; CI = 1.79-3.54), functional limitations (OR = 1.91; CI = 1.30-2.80) and cognitive impairment (OR = 1.76; CI = 1.14-2.72). No association was found for sex, age and chronic physical illness.

Conclusions: Antidepressant use in older people increased over the past twenty years. This corresponds with the increase that is found in younger adults in this period. The increase in antidepressant use was mainly due to a sharp rise in SSRI-use, whereas TCA-use and use of other antidepressants remained rather stable. Daily dosages of antidepressants had become more adequate. In the subgroup with a major depressive disorder, treatment with antidepressants was doubled. However, even in 2002 only 30% of those with major depressive disorder used antidepressants, which is still a minority.

PS02.47

Determinants of depression in older people from the English Longitudinal Studying of Ageing (Wave1 - Wave 3)

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Introduction: Depression is common in older people. Cross-sectional population studies often suffer from unobserved individual heterogeneity (e.g. genetics or unobserved predisposition to adopt healthy lifestyle) contaminating the estimate of social inequalities on well-being. Therefore, longitudinal population studies that investigated predictors of depression in the elderly are sparse or lacking. In addition, accurate estimates of risk factors for depression using large epidemiological studies may help to develop services for older people in the community.

Aims: We examined the effect of socio-demographic characteristics, lifestyle choices, smoking status and their impact on depression in non-institutionalised older people in six-year follow-up. Method English Longitudinal Study of Ageing is current and ongoing longitudinal population studies in England over three waves (2002 = 9,953; 2004 = 8,411; 2006 = 8,411) were recruited. The study collected data on the personal, economic, psychological, and social circumstances of aging from a national sample of the non-institutionalised adults aged

50 years or more living in England. Depression was measured using the center for epidemiologic studies depression scale (CES-D). We used random effect Poisson model to analyse data, which accounts of individual heterogeneity and non-linear scale of depression. It is robust to attrition if the data is missing at random. Significance was set at p <0.05.

Results: The mean (standard deviation) age of 11,284 subjects was 65.1 (10.2) years. The age range was 50 to 90 years. Fifty-five percent (n = 6,209) of the sample were women. Sixty-eight percent (n = 7,627) of the sample were married and 27% were divorced or separated. A significant proportion (44%, n = 4964) of the sample had no formal educational qualifications from accredited courses. Determinants of depression using CES-D as the dependent variable were: female gender (beta = 0.24, p <0.0001), younger age (beta = -0.06, p <0.001), self-reported health (beta = -0.40, p <0.0001), separation/divorce (beta = 0.288, p <0.0001), monthly income (beta = -0.076, p = 0.01), accumulated wealth (beta = -0.064, p = 0.01), current smoker (beta = 0.08, p = 0.01 and position on socioeconomic ladder (beta = -0.008, p = 0.001).

Conclusion: Female gender, younger age, poor self-health reported status, family disruption, active smoking and income were predictors of depression. Studies are needed in how to address these socio-economic related factors, social habits and smoking to improve the well-being of older people.

PS02.48

Early and late onset depression: Differential symptomatology, characteristics and risk factors?

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Objective: Knowledge of differences between early onset depression (EOD) and late onset depression (LOD) could be important for diagnostics and treatment of depressive disorders in older persons. In previous research focusing on differences in depressive symptoms between EOD and LOD, results have been inconsistent. Besides a possible differential symptomatology of EOD and LOD, there may be psychiatric characteristics and psychosocial/somatic factors which differentiate LOD from EOD. This study was designed to examine the extent to which depressive symptoms, psychiatric characteristics, and psychosocial/somatic factors differ as a function of age of onset in a large adult cohort with current major depressive disorder. Its results will provide a more complete overview of the phenomenological differences between EOD and LOD.

Methods: Baseline data, collected during 2004 through 2007, were from 1,104 participants with a current major depressive disorder participating in the Netherlands Study of Depression and Anxiety. Participants were between 18 and 65 years and recruited from the general population, primary care and mental health organizations. DSM-IV diagnoses, the nine DSM-IV depression symptoms and age of first depression onset were assessed with the Composite International Diagnostic Interview (CIDI). Linear and logistic regression analyses were performed by using a continuous age of onset as well as a dichotomous age of onset indicator (cut-off 40 years).

Results: A higher age of onset was associated with: less feelings of sadness (p<.001), less diminished concentration (p = .02), less suicidal thoughts (p = .001) and decreased appetite/weight loss (p = .01). Using a dichotomous age of onset indicator (cut-off 40 years), feelings of sadness were less often observed in LOD than in EOD (p<0.05).

Also several psychiatric characteristics, and psychosocial/somatic characteristics were different: longer duration of symptoms (p<.001), an earlier personal history of depressive episodes (p<.001), childhood events (p<.001), a family history of depression (p = .03), and high neuroticism (p<.001) were less often present at a higher age of onset. These results remained significant using a dichotomous age of onset. In addition, a comorbid GAD was more often observed in EOD than LOD.

Posthoc analyses were conducted, only including persons aged 40 years and older so that the age distribution of EOD and LOD groups would be much more equal. Results of associations between symptomatology, psychiatric characteristics, and psychosocial/somatic factors with EOD versus LOD in these posthoc analyses

were very similar to the results based on the full sample.
Conclusion: This study found phenomenological differences between EOD and LOD in a large cohort of persons with a current MDD. The results suggest that EOD and LOD can be seen as partially distinct phenomena. Feelings of sadness, diminished concentration and suicidal thoughts were significantly less prevalent at a higher age of onset, whereas decreased appetite/weight loss was more prominent at a higher age of onset. In addition, EOD seems to be characterized by a more chronic character (longer duration of symptoms, more often earlier episodes) and a higher personal vulnerability (more family history, more childhood trauma, more neuroticism).
When performing diagnostics it is important to take into account that some symptoms may not occur as much in LOD whilst a diagnosis may be present. Additionally, the personal vulnerability and the more chronic character of EOD are important factors to keep in mind for prevention and treatment strategies.
PS02.49
'Lust for Life': Implementation of a programme to detect, prevent and cure late life depression
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Introduction Background: (Sub)clinical depression is common in community dwelling elderly: prevalences range between 30 to 35%. Unfortunately, the majority of (sub)clinically depressed elderly persons go undetected and untreated, despite the fact that effective treatment for depression is available at low costs. However, it is unknown if large scale detection, prevention and treatment of depression is effective, and which implementation strategy should be adopted.
Objective: We aim to develop an effective implementation strategy for an integrated stepped care programme to improve detection, prevention and treatment of (sub)clinical depression in primary care by providing simple but effective interventions. A secondary objective of this study is to determine the clinical and economic effectiveness of the programme provided.
Methods Participants: Over 10,000 elderly of 65 years and older in general practices and from a home care organisation in Amsterdam and West-Friesland will be screened for (sub)clinical depression using the Patient Health Questionnaire-9 (PHQ-9) and the MINI International Neuropsychiatric Interview. We expect 450 elderly diagnosed with (sub)clinical depression to take part in the study.
Design: Participating general practices will be randomly assigned to four clusters: all general practices (N = 16) will eventually work according to the implementation programme. During the waiting period, standard care is provided. By spacing starting dates three to six months apart, we will be able to evaluate our implementation strategy in the first cluster, and -if necessary- adjust the strategy in the following cluster(s). Thus, this design enables the optimisation of the implementation for large scale detection, prevention and cure of depression in elderly, and secondly, the determination of the clinical and economic effectiveness of the programme.
Intervention: The stepped care programme will be offered by trained nurse practitioners to prevent clinical depression in older people with subclinical depression, and to treat depression in those with a full blown depressive disorder. To optimise treatment adherence and a better sense of mastery, participants are encouraged to choose the treatment that suits them best. The programme starts with a first visit by the nurse practitioner, who provides psychoeduation and encourages participants by means of motivational interviewing techniques to choose from: Step 1: Bibliotherapy or an exercise program; and Step 2: Problem Solving Treatment (PST) or Life Review; and Step 3: Treatment in an out-patient clinic as long as remission has not been achieved.
Evaluation: The implementation strategy used will be evaluated by performing qualitative interviews and focus groups with participants, nurse practitioners and general practitioners after the implementation of each step of the programme. Information on participants' perceived need for care, motivating and impeding factors, and

experiences with the programme will be enquired. If necessary, the implementation strategy will be adjusted and implemented in the next cluster.

Conclusions: This is the largest European implementation trial aimed to detect, prevent and treat depression in older persons using an integrated stepped care programme. The design of this study will enable the researchers to evaluate whether simple but effective interventions can be implemented on a relatively large scale in the Netherlands. Findings on the screening procedures will be present in June 2011; results on the development of the implementation strategy and the clinical and economic effectiveness of the programme will become available in 2012.

PS02.50

Relationship between apathetic symptoms, depressive symptoms and executive cognitive functions in Dutch nursing home residents

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Background: Depressive symptoms (DS) and apathetic symptoms (AS) are the most prevalent neuropsychiatric symptoms in nursing home residents with a cumulative prevalence of up to 80% in clients with dementia. They lead to impaired daily living and high caregiver's burden. They are not easily differentiated in clinical practice, although correct diagnosis and understanding of symptoms are crucial for adequate (pharmacological) treatment, psycho education and customized care. Previous studies, all carried out with Alzheimer Disease patients (either outpatients, patients of a dementia clinic, or drawn from a university database), showed that executive cognitive functions (ECF) are different for clients with DS and clients with AS suggesting that ECF may help distinguishing AS and DS. Although results have been inconsistent, examining ECF in relation to AS and DS may be a way to better distinguish between the two groups of symptoms. To our knowledge, this is the first study investigating the association between AS, DS and ECF in nursing home residents.

Objectives: To explore whether there is a difference in the relationship between AS and ECF on the one hand and DS and ECF on the other hand in nursing home residents. Methods. A total of 514 Dutch nursing home residents of 33 randomly assigned departments of ten nursing homes participated in this cross-sectional study. The study was part of a larger, ongoing study of the multidisciplinary care program 'Act in case of depression'.

Measures: The abbreviated Apathy Evaluation Scale AES-10, specifically targeted at nursing home residents, was used to examine AS. DS were measured with the Cornell Scale for Depression in Dementia (CSDD). ECF were examined with the Frontal Assessment Battery (FAB), an easy to use instrument assessing frontal lobe functions. Data collection consisted of structured interviews with the clients' professional caregivers (AES-10, CSDD) or residents (FAB) by MSc psychology students.

Results: Of 514 participants, 68.7% (N = 353) were female, the mean age was 79.74 ranging from 32 to 98 years. In addition, 58.4% (N = 300) had some type of dementia. Dementia was significantly associated with AS, DS and ECF and was included as a confounder in regression analyses. FAB was completed for 209 residents (missing data mostly due to severe cognitive or medical problems), AES-10 for 466 and CSDD for 511 residents. Analyses were performed after excluding cases with missing data. AS and DS were weakly correlated (N = 464, r = .36, p

PS02.52

Acute exercise improves cognition in major depressed elderly: Effect of dual tasks

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Introduction: Cognition is commonly altered in depression with impaired in attention, memory, visuospatial capacities and executive processing. Physical exercise has a positive effect on the brain, and may even act as an add-on treatment of Major Depression. However, activities which demand divided attention when performed in daily life (e.g. walking) pose an increased risk of falls and impaired cognition during the task. Dual-task performance (motor and cognitive activity) has been studied in a series of neuropsychiatric disorders and in normal subjects, although there are few data on depression in the elderly. In addition, it is not known the effects of acute cardiovascular exercise on cognitive function during and after an aerobic session in these subjects. The goal of this study was to assess the acute effect of physical exercise on cognitive function of depressed elderly patients in a dual-task experiment.
Methods: A series of elderly subjects (n = 10) diagnosed with Major Depression according to DSM-IV criteria with mild to moderate severity (using Hamilton Depression Scale) who were already participating in an exercise program for at least six months were included in this study. Digit Span Test (Forward and Backward) and Stroop color-word Test (congruent and incongruent) were used to assess cognitive function. The elderly walked on an electric treadmill for 30-minutes at 65%-75% maximum heart rate and underwent the same cognitive testing pre, during, immediately post, and 15 minutes after an exercise session. In the control session, the same cognitive tests were done, but without exercise training. Results. The patients showed a mean age of 71.5 (SD = 6.0) years and a mean HAMD score of 14.1 (SD = 3.8). In control session the Digit Span Test did not change in both Forward ($p = 0.069$) and Backward ($p = 0.857$). Although the congruent subitem of Stroop color-word did not present any statistically significant difference ($p = 0.062$), the incongruent task showed a difference among the moments ($p = 0.015$), with improvement in post vs pre test ($p = 0.005$) and a trend to improvement at the during vs pre moments ($p = 0.059$).In exercise session the Digit Span Test did not change in both Forward ($p = 0.692$) and Backward ($p = 0.569$). The Stroop color-word Test showed improvement in moments post 15 vs pre test ($p = 0.009$) and post 15 vs. during test ($p = 0.013$) at the congruent subitem, whereas in the incongruent trial there was improvement in post vs pre test (0.017), post 15 vs. pre test ($p = 0.005$) and post 15 vs post test ($p = 0.028$). Also, there was a trend toward improvement in post 15 vs. during test ($p = 0.059$).
Discussion: To the best of our knowledge, this is the first research to look into this issue using a dual-task paradigm (motor and cognitive stimuli). We have found an improvement in attention and inhibitory control but not in working memory after a 30-minutes moderately intense walk on a treadmill. These data suggest that cognitive function of depressed elderly is not impaired during and after an acute session of physical exercise, especially attention and inhibitory control. The improvement in attention and inhibitory control immediately after exercise in depressive and healthy subjects has been already attributed to the acute release of neurotransmitters, and to the higher levels of neurotrophic factors. Higher levels of BNDF immediately after exercise may enhance neurogenesis, neuronal plasticity, learning abilities, memory, and mood. Dual-task may be a safe and useful tool to assess motor and cognitive activity of daily life in major depressed elderly.

PS02.53

Is Serum Pro-BDNF (Brain Derived Neurotrophic Factor) a candidate marker for depression susceptibility and antidepressant treatment?

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Background: Clinicians managing depressed patients are faced with two major difficulties. First, around 40% of the depressive patients show no response to any antidepressants. Second, about 4 to 6 weeks are needed to

assess the therapeutic responsiveness of a given antidepressants. Such a time lag of 4 to 6 weeks is known as contain the several signal transduction pathways and neurotrophic or depressed events in post-synapse after targeting antidepressant to monoamine transporter, primary target of most antidepressants. Therefore, we would study such signaling events to predict the treatment responsiveness to antidepressant s via biological markers representing patients' clinical status. The 'neurotrophin hypothesis of depression' is based on the correlations between stress or antidepressant treatment and down- or up-regulation, respectively, of brain-derived neurotrophic factor (BDNF). The role of BDNF has been mainly known, implicating in the hippocampal neurogenesis after antidepressant administration. It has been reported that serum BDNF content in depressed patients is related to depression etiology and antidepressant treatment, but the results are controversial. BDNF is synthesized as a precursor pro BDNF, and then it is proteolytically cleaved in order to generate mature BDNF (mBDNF). The mBDNF binds to its receptor tyrosine kinase (TrkB) to generate the neurotrophic effect on neuronal cells. Recent studies found that proBDNF before processing is related to apoptosis by binding to p75 NTR (neurotrophin receptor) and may facilitate long-term depression.

Hypothesis: The two forms of BDNF (pro- and total-) are related to the opposite effects on patients' outcome such as depressed symptom and antidepressant effect in elderly depressed patients during antidepressant treatment.

Methods: Forty-five elderly patients, diagnosed as major depression according to criteria for depression of DSM-IV, entered a 6 week clinical trial with antidepressants by clinician's choice and documented the several clinical variables and plasma drug concentrations. At six weeks, responder was defined as 50% decrease in17-item Hamilton scale for depression (HAM-D) score. Patients and 29 normal volunteers were drawn peripheral venous blood between 9~12 a.m before and after 6 weeks of drug treatment. After platelet activation for 30min in room temperature, serum was purified by centrifugation at 3000rpm for 15min. Serum proBDNF immunoreactivity was determined by western blot and total BDNF (tBDNF; proBDNF and mBDNF) content was detected by BDNF Emax Immunoassay System (Promega). Comparison between two groups was analyzed using t-test or Mann-Whitney test in SPSS ver.10.1.

Results: There was no difference of characteristics between normal volunteer and depressed patients, and between responders and non-responders. Serum proBDNF immunoreactivity and total BDNF content was increased in normal volunteer than depressed patients before antidepressant treatment (Mean±SE, proBDNF, 50.9±1.53 vs. 45.8±1.19, $p = 0.012$ by t-test, tBDNF: 17.7±0.41 vs. 14.8±0.46, $p = 0.000$ by Mann-Whitney test). After 6 week of antidepressant administration, only proBDNF immunoreactivity was increased in patients ($p = 0.013$, by Wilcoxon signed ranks test).

Conclusions: Our results suggest that serum proBDNF is possible to be candidate marker for susceptibility of depression and antidepressant treatment. However, we didn't fail to find the evidence that proBDNF and mBDNF have opposite effects on patients' behavioral outcome. Further studies should elucidate the exact mechanism of the two types of BDNF related to depression etiology and antidepressant action in peripheral blood of depressed patient. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MEST, R0A 2007-000-20129-0) and by a grant of the Korea Health 21 R&D project, Ministry for Health, Welfare and Family Affairs, R.O.K. (A030001)

PS02.54

The Socioemotional Selectivity Theory: Findings from the Belgian Ageing Studies

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Introduction: Older adults are often confronted with experiences of loss, especially with physical health problems. In early adulthood, there is an interconnection between physical and mental health; so one would expect that when people are getting older, there will be a decline in subjective well being. However; there

seems to be no more depressive feelings among older adults. This is the so called paradox of ageing: despite the fact that older people experience more losses; they are as happy as younger adults. One of the possible explanations of this phenomenon lies within the Socioemotional Selectivity Theory (SST; Carstensen, 1993). The assumption of this theory is that as time horizons shrinks, or when boundaries on time are perceived, as is typically the case when people get older, people prefer present oriented goals related to emotional meaning over future oriented goals aimed at expanding knowledge. Because older adults place a high value on emotional satisfaction, they spend more time with familiar individuals with which they have rewarding relationships. So smaller social networks are preferred over contacts with novel social partners. The theory postulates that when there is an emotional rewarding social network; there is a high degree of subjective well being and less depressive feelings. In this exploratory study we want to see whether we could find evidence for the SST in the data of the Belgian Ageing Studies.

Methods: The data were gathered within the Belgian Ageing Studies (BAS). 64277 older adults living self-reliantly in the Flemish part of Belgium filled in a questionnaire consisting of themes of neighbourhood features, physical health, wellbeing, volunteering, . . . As these studies were not designed to specifically measure the assumptions of the SST; we operationalised our research question into the following questions: 1) Are there indeed few negative feelings among older people? 2) Do older people prefer personal relations over personal accomplishments and personal growth? 3) Is lack of emotional rewarding social contacts a better predictor of the presence of depressive feelings than physical health problems?

Results: 1) Are there indeed few negative feelings among older people? Yes Approximately 93% of the older adults reported not to be "unhappy or depressedâ[euro]. When we look at different age categories, we can see that more than 90 percent of older adults does not report depressive feelings, regardless of age. 2) Do older people prefer personal relations over personal accomplishments and personal growth? Yes Older adults prefer personal relations over personal growth and personal accomplishments as their sources of meaning. As are personal growth and accomplishment are concerned, there is a linear decrease over age. 3) Is lack of emotional rewarding social contacts a better predictor of the presence of depressive feelings than physical health problems? Yes According to a binary logistic regression analysis, lack of emotional rewarding social contacts (it is loneliness/isolation) is a better predictor of the presence of depressive feelings than physical health problems, financial problems and housing problems.

Conclusions: We find evidence for the SST in the BAS data. An intact social network with close and warm interpersonal relations may serve as a buffer against stressors. However, a limitation of the study is that we have no comparison group of younger adults. Moreover there might be a bias of who filled in the questionnaires; it may be the case that those older adults with severe depressive symptoms have not filled in the survey. Furthermore; future studies should also take place in nursery homes as we know that depressive feelings are very common there.

PS02.55

Prevalence and influence of psychiatric co-morbidity on rehabilitation outcome for older hospital inpatients

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In the field of geriatric rehabilitation, any factor that may influence an individual's ability to benefit from the rehabilitation admission is of great interest, and this has resulted in a drive to investigate which patient comorbidity factors may influence both participation and progress. Research investigating the prevalence and impact of psychiatric co-morbidities in geriatric rehabilitation patients is limited. It has rarely studied a full range of psychiatric illness, and has delivered ambiguous findings in relation to rehabilitation outcomes.

Objectives: To characterise the psychiatric comorbidity of a group of older subacute inpatients and then determine whether their psychiatric comorbidity affected rehabilitation outcomes, with the hypothesis that greater severity of symptoms will be associated with a longer subacute stay, poorer ratings of quality of life and

reduced functional improvement. 88 older subacute inpatients were recruited for this prospective study. Psychiatric comorbidity was defined according to a participants' performance on four inventory scales: the Geriatric Depression Scale (GDS), Geriatric Anxiety Inventory (GAI), Brief Psychiatric Rating Scale (BPRS) and Health of the Nation Outcome Scale 65+, while rehabilitation outcome referred to the participants' length of stay and their performance at discharge on the EuroQol-5D health-related quality of life questionnaire and Barthel Index. The mean age of the patients was 78.5 years, and the mean length of the subacute stay was 23.1 days. 68% of the patients scored in the clinical range on at least one of the four scales assessing psychiatric comorbidity at admission, with 51% in the clinical range for GDS, 32% for the GAI, and 43% for both the BPRS and HoNOS65+. The decrease in scores by the time of discharge was significant for all four scales. Linear regression analyses pointed to a trend for depressive symptoms at admission to be an influential but nonsignificant predictor of rehabilitation outcome. However, an interesting significant correlation was found between the length of the previous acute admission and GDS score on admission to the subacute unit. The study demonstrated that a high prevalence of psychiatric symptoms was identified upon admission to the subacute units, with a significant decrease by the time of discharge. Overall, the pattern of change suggested a process of improvement for the majority of patients occurring during their rehabilitation period. However, participants showed considerable individual variation during this period with some participants showing no change and a small proportion showing a worsening of their scores. The study also pointed to the emotional vulnerability of patients during longer stays in acute care and is suggestive of increased support to assist them in coping with this stage of their treatment. The psychiatric comorbidity scales did not significantly predict the selected measures of rehabilitation outcome. This may be due to many factors including the size of the variable effects under study being inherently small with considerable symptom heterogeneity (mental and physical), the use of dimensional psychiatric scales such that their adverse psychological state was symptomatic, not syndromal, or the fact that length of stay was influenced by many factors other than achievement of rehabilitation goals. The study highlighted depressive symptoms at admission as being the most relevant in contributing negatively to the rehabilitation of the older patient in subacute care. This finding suggests a need for early assessment and identification of depressive symptomatology to enable patients to optimise their uptake of rehabilitation therapies and to minimise the likelihood of adverse affective states arising from having a prolonged illness. Future longitudinal research on the prevalence and impact of psychiatric comorbidity on functional and other outcome variables during the Acute and Subacute inpatient stays and into the post-discharge period would be extremely valuable. This will assist to elucidate the range of factors at each stage of the patient's journey that are significant for their eventual outcome from an episode of illness or injury involving hospitalisation.

PS02.56

Influence of educational background on neuropsychological tests in depressed elderly patients: Case of São Paulo

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Introduction: Brazil is experiencing a similar boost in the proportion of elderly people (60 years and more) as other countries. Consequently, there is an increasing interest in studying mental disorders in the elderly, among which depression is considered as a serious public health problem because it is the most frequent cause of emotional suffering and reduced quality of life. Therefore, it is crucial to investigate the neuropsychological profile of older adults with depression, which can help the diagnosis and to distinguish it from the early stages of dementia of the Alzheimer's type. Moreover, some studies suggest that verbal fluency test (VFT) is an important measure to evaluate cognitive performance in depression, since verbal fluency impairment reflects general executive problems in this population. However, previous studies have shown that the performance on VFT is

significantly influenced by years of education in the normal elderly population. Hence, in order to examine the utility of the VFT as a tool for screening for depression in older adults, it is necessary to study the effect of educational background on VFT. This relation is particularly important in developing countries like Brazil, since its population has a heterogeneous educational level. Objective The aim of this cross - sectional study was to investigate the influence of education background on the performance of elderly people with depressive disorder in verbal fluency tasks (letter and category fluency). Methods The study was conducted at the Institute of Psychiatry, University of São Paulo School of Medicine, Hospital das Clínicas. The study sample consisted of 79 outpatients with depressive disorder. All of the individuals evaluated were aged 60 or older. We stratified the sample by level of education: low = 0 - 8 years of schooling (mean age 71,3 (±6,1) years and 4,2 (±2,1) years of schooling); high = 9 or more years of schooling (mean age 70,9 (±9) years and 14,1 (±3,0) years of schooling). Evaluations consisted of psychiatric assessment, laboratory tests and cognitive assessment. The patients were asked to generate as many words as possible belonging to a category "animalâ[euro] and beginning with "Fâ[euro], "Aâ[euro] and "Sâ[euro] letters. All statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) software and the performance of a verbal fluency tasks was correlated with educational level. Results We found a significant correlation (Pearson Correlation) between both verbal fluency tasks and lower educational level, which was not observed in individuals with higher educational background. Moreover, regardless the level of education, letter fluency test scores were more influenced by years of education than category fluency test scores. Conclusion The results of this study underline the importance of considering the education background in the analysis of cognitive performance in depressed elderly people, especially when these individuals have a low educational level. In addition, the outcomes suggest that letter fluency task is more sensitive to years of education than category fluency taks. Consequently, there is a need for new cognitive tests in which level of education has a reduced impact on the results.

PS02.57

Cognitive and fine motor function in depressed elderly patients

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Introduction: Psychomotor retardation (PR) is one of the core features in depression (DSM-IV-TR). Also aging in itself causes slowing (Pier et al., 2001). It has been shown that PR in depression is different from age related slowing (Bonin-Guillaume S. et al., 2008). Furthermore, more pronounced PR in geriatric depression has been hypothesised, because of an -at least- additive effect of age and depression (Pier et al., 2004). In this study, the effects of aging and depression on psychomotor and cognitive functioning will be examined in a group of depressed elderly patients.

Objective: Psychomotor retardation in normal aging is qualitatively different from that associated with depression. The cognitive factor of psychomotor retardation in old age is essentially a limited short-term memory capacity and an impaired set-shifting in the executive function. In depression, updating is the most important deficit in the executive function (posterior parietal cortex and caudate of the superior frontal sulcus). Depressive deficits cause a disturbance in compensatory mechanisms of normal aging. **Methods:** A group of 20 non-demented late-life depressed elderly is compared to a matched control group of healthy elderly to whom a battery of tests (Geriatric Depression Scale GDS, State and Trait Anxiety Scale STAI, Mini Mental State Examination MMSE, Widlöcher PRS, computerized simple and complex figure copying tasks CL CC, Fitts, Symbol Digit Substitution Test SDST, Strooptest, Trailmaking A &B TMTA TMTB and Wisconsin Card Sorting Test WCST) with questionnaires as well as neuropsychological and fine motor skill-tests was administered. A computerized method of recording and analyzing writing and drawing behavior was used. For this purpose, subjects were asked to copy figures from a computer screen with use of a special pressure-sensitive pen and a digitizer.

Results: Preliminary data about the comparison of the controls and the depressed elderly, more specifically the effect of depression on cognition and motor skills in later life will be presented as follows: both groups show age related slowing in copying complex figures. Yet, automated processes go off slower with the depressed elderly in comparison with the healthy elderly. Initiation time and reinspection time remain unaffected with healthy elderly copying 'concepts'. Initiation time and reinspection time become longer, however, when copying random patterns. With elderly depressed patients, initiation time and reinspection time are dependent on the degree of abstraction of the pattern to be copied (Pier et al., 2004). Differences in short term memory, updating behavior, integration of automated processes and motor adjustments are apparent. References: Bonin-Guillaume, S., Hasbroucq, T. &Blin, O. (2008). *[Psychomotor retardation associated to depression differs from that of normal aging]. Psychologie et Neuropsychiatrie du Vieillissement,* 6(2), 137-144. Pier, M.P., Hulstijn, W., &Sabbe, B.G. (2004). *Psychomotor retardation in elderly depressed patients.* J Affect Disord, 81 (1), 73-77. Pier, M.P., Hulstijn, W., Sabbe, B.G., &&Horstink, M. (2001). Motor *slowing in major depression, Parkinson's disease and normal aging*. In R.G.J. Meulenbroek and B. Steenbergen (Eds.), Proceedings of the tenth biennial conference of the International Graphonomics Society (pp. 197-202). Nijmegen: IGS.

PS02.58

A comparative study of late onset and early onset depression

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Depression in Late Life is a very heterogeneous condition. Evidence is accumulating to indicate that First Episode Depression in the elderly is different from depression in the young and is associated with more neurodegenerative changes in the form of cerebrovascular accidents, cerebral hyper intensities, neuropsychological dysfunction.

The Study: Aim: This study was carried out to find the difference between Late Onset Depression (LOD and Early Onset Depression (EOD) with an age cut off of 50 years.

Location: Geriatric Clinic of the National Institute of Mental Health and Neurosciences, Bangalore India - a hospital based study. **Methodolog:** 20 subjects with Late onset Depression and 20 subjects with Early onset Depression were compared on Cognitive Functions and Executive Functions. Cognitive functions were assessed using Hindi Adaptation of the Mini Mental Status Examination (HMSE) (Ganguli et al 1995). Executive Functions were assessed using Trail Making, Stroop Test, Wisconsin Card Sorting Test (WCST) and Delayed Learning Test.

Results: Late onset Depressives had significantly more cognitive deficits than EODs but did not have dementia ($p = 0.008$). LODs significantly took more time than the Early Onset Depressives on Trail Test A ($p = 0.032$), first two trails of the Stroop Test ($p = 0.004$ &0.017). There were significant differences between the two groups on WCST - Percent errors ($p = 0.016$), % perseverative response ($p = 0.005$), % perseverative responses ($p = 0.002$), % conceptual level responses $p = 0.016$), number of categories completed ($p = 0.008$), trials to complete first category (0.001). However there was no difference the between the two groups on their working memory ability measured by Delayed Word Learning ($p = 0.181$). The above results indicated that the Late onset Depressives of his study had difficulty in selective attention, sequencing, cognitive flexibility, speed of attention, abstraction, maintaining mental set in comparison to a control population with Early onset Depression. The differences between the two groups were not due gross cognitive deficits of the late onset depressives measured by the HMSE. This study indicates the differences between late onset depression and the early onset depression which are probably neurodegenerative in nature and documented by other researchers also in the West. (Alexopoulos 1993, 1997, 2002; Katz et al 2001). This is one of the first studies from India focussing on this issue of Late onset depression. This has clinical implications of early identification of depression in old age and effective intervention to prevent dementia. References: 1. Alexopoulos GS, Meyers BS, Young RC et al (1993) *The course of geriatric depression with 'reversible dementia'. American J Psychiatry* 150, 1693-1699. 2.

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PS02.59

Major depressive disorder in long-term care facilities: A report from northern Thailand

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Overview: Introduction and objectives Depression is a common mental illness among Thai elderly; however, little is known about major depressive disorders (MDD) in long-term care facilities (LTC). This study aimed to investigate the prevalence of MDD and suicidal behavior among Thai residents in a LTC facility.

Method: This was a cross-sectional study carried out in a LTC facility in northern Thailand. In early 2011, a care team conducted annual mental illness screening and monitoring among the residents of the LTC facility using the Mini International Neuropsychiatric Interview (MINI), the Geriatric Depression Scale-15 (GDS-15), the patient and caregiver versions of the Cornell Scale for Depression in Dementia (CSDD-p and CSDD-c), the Core Symptom Index-17 (CSI-17) and MMSE-Thai 2002.

Results: There were 109 patients at this LTC facility in 2011, and 81 residents agreed to participate in the study. The mean age was 76.96 years old (63-94, SD 7.17), and among the group, 55.6% were female, 6.2% were married and 84% had an education spanning not more than 6 years. In addition, 45.7% (37/81) were illiterate. When using the MMSE Thai 2002, 34.6% were found to have dementia, and when using MINI, 19 (23.5%) residents met the criteria in terms of experiencing current major depressive episodes. Twenty-six residents (32.1%) were reported at risk of suicide, of which the majority was in the low risk group. Among all the residents (with or without dementia), CSDD-p, CSDD-c, total GDS-15 and total CSI-17 proved useful tools for predicting MDE ($p = 0.000$, $p = 0.043$, $p = 0.001$ and $p = 0.000$ respectively), though among the residents with dementia, CSDD-p and the GDS-15 were found to be the best predictors ($p = 0.013$ and $p = 0.043$ respectively).

Conclusion: Nearly a quarter of the elderly Thai residents in the study LTC facility were found to suffer from a major depressive disorder. A suicide risk was thus reported for a third of all residents, though most of the cases were in the low risk category. GDS-15, CSI-17 and both versions of CSDD were found to be good predictors of major depressive episodes, while among the residents with cognitive impairment, GDS-15 and the CSDD-patient version were found to be the best predictors. Further studies with a larger sample size would be warranted to make these findings more precise and universal.

PS02.60

Plasma adiponectin is elevated in the elderly with subsyndromal depression

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Background: Recently, adiponectin, an anti-inflammatory, anti-athrogenic and anti-diabetic adipokine, has attracted considerable attention as a means of explaining the link between depression and metabolic disorders. However, the association of adiponectin with depression warrants investigations of several additional aspects; 1) the association of adiponectin with depression was not observed in Asian populations, 2) association of adiponectin with depression has been barely studied in geriatric populations, 3) association of adiponectin with subsyndromal depression (SSD) has never been studied, 4) gender dimorphism in the association of adiponectin with depression has not been investigated yet. Aims: we investigated the association of plasma adiponectin with both syndromal and subsyndromal depression in an elderly Korean population, and examined

whether the association is dimorphic by gender.
Methods: We measured plasma adiponectin concentration of 785 Korean elders aged 65 years or older (MDD 41, minor depressive disorder [MnDD] 46, SSD 61, normal control 637). We diagnosed MDD and MnDD according to the DSM-IV criteria, and SSD according to an operational criteria as follows: 1) Two or more concurrent symptoms of depression listed in the criterion A of DSM-IV major depressive episode criteria during the same 2-week period; 2) At least one of the symptoms must be 'depressed mood' or 'anhedonia'; 3) Each depressive symptom should be present 'more than a half of day' or 'more than seven days during two weeks'; 4) Do not meet criteria for the diagnosis of MDD and MnDD. The Korean version of the Geriatric Depression Scale (GDS-K) and 17-item Hamilton Depression Scale (HAMD) were also administered to evaluate depressive symptoms.
Results: Plasma adiponectin level was different between diagnostic groups (df = 3, F = 4.928, p = .002). Plasma adiponectin level of the SSD patients was higher than that of the non-depressed controls (12.48 ±8.38 μg/ml versus 9.27 ±6.21 μg/ml, p = .001, Tukey's posthoc comparison). However, plasma adiponectin level of the MnDD and MDD patients was not different from that of the non-depressed controls (p >.1, Tukey's posthoc comparison). The elevation of plasma adiponectin in SSD patients was significant in men (p = .002, Tukey's posthoc comparison) but not in women. In the subjects without depressive disorders defined in the DSM-IV criteria, i.e. the SSD group and the NC group, plasma adiponectin level was positively correlated with the HMAD score, an objective measure for depressive symptoms (Pearson's correlation coefficient = .156, p <.001) and the GDS score, a subjective measure for depressive symptoms (Pearson's correlation coefficient = .117, p = .002). However, in the MDD and MnDD groups, plasma adiponectin level was correlated neither with the HAMD score (Pearson's correlation coefficient = -.066, p = .546) nor with the GDS score (Pearson's correlation coefficient = .009, p = .936). When men and women were analyzed separately, the correlations of plasma adiponectin level with the HAMD and GDS scores were significant only in men without MDD or MnDD (Pearson's correlation coefficient = .211, p <0001 for HAMD, Pearson's correlation coefficient = .116, p = .037 for GDS). **Conclusions:** Circulating adiponectin concentration was elevated in SSD, which may be a part of compensation mechanism for mood.

PS02.61

Strategy of buspirone augmentation of antidepressant medications in the elderly

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Purpose: Buspirone is an azaspirodecanedione that acts as a partial serotonin agonist at the 5-HT1A receptor. In North America, it has been available since the 1990's as a nonbenzodiazepine anxiolytic. It may have antidepressant properties when used alone in patients with major depression. Buspirone has also previously been reported to be an effective augmenting agent of antidepressant medication. The purpose of this presentation is to report on an open label study of buspirone augmentation in a group of elderly depressed individuals who were not responding to several trials of antidepressant medications.
Methods: A retrospective chart review was undertaken of patients diagnosed with DSM-IV major depression who were treated as outpatients.
Results: The five patients in this study had previously failed multiple trials of antidepressant medication. Augmentation of several different types of antidepressants led to a significant improvement in three of the five patients. Buspirone was well tolerated but one patient did become hypomanic.This 82 year old gentleman with three sons and a cognitively impaired wife was referred for outpatient care of his depressive and anxiety symptoms. He desribed being depressed, unhappy, and "neuroticâ[euro] since childhood. Over the previous two years he had become much more depressed, anxious, unable to cope with his wife, and had sleep, energy, and appetite disturbance. He had one impulsive overdose thirty years ago and saw a psychiatrist for depression when the patient was forty. He had a depressive episode four years ago which responded well to nortritpyline. He had been admitted to a geriatric psychiatry day program at that point in time. Past medical history included

surgical resection of gastric carcinoma five years ago, skin cancer lesions on his face, glaucoma, hypertension, gout and a TURP. His brother had also struggled with depression and anxiety symptoms. The patient's medications included entrophen, allopurinol and atenolol. He was born in Toronto, Canada and he had four sisters and one brother. He described an unhappy childhood and felt like a "loserâ[euro] for most of his life. He reported that his family was not affectionate and that he felt unloved. At twenty four he married but had not enjoyed this relationship very much over the years. He had his own textile business but lost most of his assets in stock market ventures and failures. There had not been any clear history of sustained hypomanic symptoms. The provisional diagnosis was Dysthymic Disorder and Major Depression. He had not shown improvement to 3 month trials of nortritptyline 50 mg qam and qhs, doxepin 100 mg qhs or luvox 150 mg qhs. After five months on luvox 150 mg qhs and oxazepam 30 mg qhs, his sleep had improved but mood remained low. Buspirone 5 mg tid was added next and within three days he became elated, hyperenergized, grandiose (believing that his creative writing was special, that it would somehow be published and that he would make a lot of money) and dressed in very bright clothes which were out of character for him. When the buspirone was discontinued and lithium therapy suggested, he became more irritable, paranoid and litigious. He terminated therapy but did resume care with a series of other physicians. Within a few months, he did have a return of his depressive symptoms.

Conclusions: Augmentation strategies of antidepressant medication have been used by many clinicians, but it remains unclear what factors would be helpful in predicting a positive therapeutic response.Despite the limitations of the study design, our work does support previous experience that buspirone may be considered as an augmenting strategy for antidepressant medications in older adults who may have partial response to monotherapy treatment with antidepressants.

PS02.62

Factor structure and measurement invariance of the Geriatric Depression Scale-15

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Background. The Geriatric Depression Scale (GDS; Brink, Yesavage, Lum et al., 1982) was designed to measure depression in older adults. The 30-item GDS, with its "yes/noâ[euro] format, has gradually become a gold standard measure in the screening of depression in the geriatric population (Adams, 2004). The 15-item short form of the GDS, the GDS-15 (Sheikh &Yesavage, 1983), has been also widely used by clinicians and researchers. However, its factor structure was reported differently in a number of studies, ranging from 1-4 factors. In this study, we aimed at exploring the Thai version of GDS-15 with regard to its factor structure in a community-based, nonclinical elderly sample. In addition, Measurement Invariance was applied to see whether differences in depression scores by gender are due to true gender differences or to item bias.

Methods:. 213 subjects (M age 67.42, S.D. 7.6) voluntarily participated in this study. All completed the Thai version of Geriatric Depression Scale-15(TGDS-15) as a screening for depression. The sample consisted of 213 adults ages 60 to 94 years (M = 67.44, SD = 7.6) who completed the GDS-15 (Yesavage et al., 1993). The sample included 78 men and 135 women. Two gender-based groups were formed so the measurement invariance of the GDS-15 across gender, age and education could be tested. Multi-group confirmatory factor analyses (MG-CFA) using Robust Maximum Likelihood estimation were conducted to test for the measurement invariance of the GDS-15 across gender. The differences in overall fit of these models were then statistically compared to determine the best fitting model. The fit indices used were the comparative fit index (CFI; Bentler, 1990) and the root mean square error of approximation (RMSEA). CFI with values above .90 indicates a good fit; the higher the better. An RMSEA value at or below .05 would indicate a good fit of the data to the model, whereas a value between .05 and .08 would be considered acceptable. For evaluating the difference between nested models, a CFI less than -.01 was recommended in order for the measurement invariance to hold (Hu &Bentler, 1999).

Results:. Thai version of GDS-15 yielded a Cronbach's alpha of 0.85. Exploratory factor analysis extracted 3 factors i.e. Factor 1 positive feeling toward life (item 7,11,5,1,13), Factor 2 Hopeless/worthless (item14,12,8,3,4, and 15 Factor 3 withdrawal/worrisome -item 9, 2, 6, and 10. Factor loadings ranged from 0.653 to 0.859 in Factor 1, 0.486 to 0.795 in Factor 2, and 0.519 to 0.601 in Factor 3. Confirmatory factor analysis revealed a good fit model of 3-factor solution with $\chi 2$ 147.57, df = 87, TLI = 0.93, CFI = 0.94, RMSEA = 0.057 (90%CI 0.41 to 0.73), SRMR = 0.067. The GDS-15 met the criteria of strict measurement invariance across gender. Thus, it appears that the gender differences on depression scores on the GDS-15 reflect true differences in depression levels between men and women and not just measurement artifact.
Conclusion:. Contrast to the previous studies, the Thai version of GDS-15 revealed a 3-factor solution. Even though, the GDS is commonly used among elderly with depression in various cultures and settings. It's difficult to explain the discordance of factor structure across studies. Further investigation need to be carried out.

PS02.63

The association of SSRI use and stroke in geriatric population

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Background: Stroke causes both physical and mental health deterioration and is a second major leading cause of death worldwide. Selective serotonin reuptake inhibitor (SSRI) exposure has also been shown to increase the risk stroke in postmenopausal women and elderly in the past. The risk has also been investigated in a few general populations. As SSRIs are equally common used in Taiwan, we evaluated a possible risk of SSRI exposure in stroke in the geriatric population, which is both risky for stroke and depresssion.
Methods: This is an 8-years retrospective observatory study. In this study, subjects were included if they were aged 20 or older in January 1, 2001. Subjects were defined to have SSRI exposed when received SSRI prescription (paroxetine, fluoxetine, sertraline, citalopram, escitalopram or fluvoxamine) for at least two consecutive months during January 1, 2001 to December 31, 2007. All subjects should meet the criteria of older than 65 years while recruited into this analysis. The related background information and birth month were recruited from a random 1 million subjects sampling from Taiwan National Health Insurance Bureau (NHIB) database between the year 2000~2009. All cases of stroke were defined as ICD 430 to 438, which was ever seen in the NHIB database during the selected period.
Results: Subjects with SSRI exposure were more likely to be older and female, and had a diagnosis of diabetes mellitus (DM), hypertension, hyperlipidemia or chronic renal disease (CKD) than those without. The Survival analysis showed a greater probability of stroke in subjects with SSRI exposure, and around 1 in third stroke events occurred in the first year after SSRI exposure. SSRI exposure, age, sex and clinical comorbidities had independent contributions to stroke, in which SSRI exposure had the strongest effect near 2.6 fold to get the stroke after adjusted for all abovementioned factors.
Conclusions: SSRIs invoked stroke may involve an 5-HT increment in the cytoplasm of platelets and thus disturb the hemostasis. We conclude that use of SSRIs might increase the risk of stroke across age strata. Currently, SSRIs are still practically safe to most users, providing precautious measures are given. Also, it should be reminded of a possible population difference in the risk of stroke induced by SSRI exposure. The clinicians should use SSRI in geriatric people with more cautions.

PS02.64

Depressive symptom profiles and the association with location and progression of cerebral changes on MRI. The SMART-Medea study

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Objective: With increasing age, atrophy and cerebral small-vessel changes, characterized by white matter lesions and lacunar infarcts, are common findings on magnetic resonance imaging (MRI). Although often asymptomatic, these changes have been associated with an increased risk of cognitive impairment and late-life depression. The 'vascular depression' hypothesis proposes that small-vessel and atrophic changes predispose to late-life depression by disrupting emotion-regulating prefrontal structures or their modulating pathways, with motivational symptoms as dominant feature. Direct evidence supporting this hypothesis is however scarce, because few studies examined whether specific locations of small-vessel and atrophic changes were associated with characteristic depressive symptoms. Most studies examining locations of cerebral changes on MRI did not assess individual depressive symptoms, but an overall depressive symptom score. On the other hand, studies that did identify individual depressive symptoms, only investigated associations with lesion severity and not location. In addition, a direct relation between cerebral changes on MRI and a distinctive depressive symptom profile would be more likely if greater disease activity, characterized by an accelerated progression of small-vessel and atrophic changes, increases the risk of motivational or mood symptoms, but this has not yet been investigated. Therefore, we examined whether location and progression of white matter lesions, lacunar infarcts and atrophy were associated with an increased risk of motivational and mood symptoms.

Methods: Data were used from 589 participants aged 50 or older in the Second Manifestations of ARTerial disease-Memory, depression and aging (SMART-Medea) study. 1.5T MRI was performed at baseline and after 3.9±0.4 years follow-up. Brain volumes, including white matter lesions and atrophy measures, were obtained using an automated segmentation programme. The number and location of lacunar infarcts were rated visually. Depressive symptoms were assessed with the Patient Health Questionnaire-9 (PHQ-9) and were dichotomized into presence or absence of symptoms. The following symptoms were defined as motivational symptoms: anhedonia, energy loss, concentration problems and psychomotor retardation. Depressed mood, appetite disturbance, feelings of guilt and suicidal thoughts were defined as mood symptoms. Because most individual depressive symptoms were commonly reported (>10%) we used log binomial regression analyses to calculate relative risks instead of odds ratios, with MRI parameters as the independent variables and depressive symptoms as the dependent variables, adjusted for age, sex, education and vascular risk factors.

Results: Mean age was 63±8 years and 18% of the sample was female. Median PHQ-9 score was low (median 1, 10-90th percentile 0-8), but most individual symptoms were frequently reported, ranging from 4% for suicidal thoughts to 49% for energy loss. Periventricular white matter lesion volume (per SD increase) was associated with appetite disturbance (RR = 1.20, 95% CI 1.03-1.40), whereas deep white matter lesions increased the risk of anhedonia, concentration problems and appetite disturbance (figure 1). Greater progression of total white matter lesion volume was associated with an increased risk of anhedonia (RR = 1.53, 95% CI 1.14-2.06), concentration problems (RR = 1.66, 95% CI 1.23-2.23), psychomotor retardation (RR = 2.53, 95% CI 1.48-4.33) and appetite disturbance (RR = 1.71, 95% CI 1.14-1.55). Location of lacunar infarcts in deep white matter was significantly associated with an increased risk of psychomotor retardation (RR = 3.08, 95% CI 1.76-5.39), energy loss (RR = 1.36, 95% CI 1.09-1.69) and depressed mood (RR = 1.59, 95% CI 1.04-2.44), whereas lacunar infarcts located in the thalamus were associated with psychomotor retardation only (RR = 2.90, 95% CI 1.42-5.90). Subcortical atrophy (per SD increase) was associated with energy loss (RR = 1.10, 95% CI 1.01-1.20), feelings of guilt (RR = 1.28, 95% CI 1.04-1.57) and suicidal thoughts (RR = 1.61, 95% CI 1.05-1.41), and cortical atrophy with anhedonia (RR = 1.18, 95% CI 1.02-1.37). Progression of lacunar infarcts and atrophy was not associated with an increased risk of depressive symptoms.

Conclusions: Our findings suggest that disruption of frontal-subcortical pathways by white matter lesions and lacunar infarcts increases the risk of a symptom profile that is mainly characteristic of motivational problems, thereby providing support for the 'vascular depression' hypothesis. In addition, greater progression of white

matter lesion volume increased the risk of mainly motivational symptoms, suggesting that greater white matter lesion volume is not only associated with, but could be a preceding mechanism contributing to the increased risk of motivational symptoms. Atrophy measures had a more global effect, and were associated with motivational as well as mood symptoms.

PS02.65

The association between depression and family relationships in elderly

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Depression is not an inevitable outcome of aging, but is a disorder of the brain that arises in the context of the medical illnesses and psychosocial stressors that accompany aging. Late-life depression encompasses both patients with the late-life onset of depression (after age 60y) and older adults with a prior and current history of depression. Among the ageing population, anxiety and depression are currently the most prevalent mental health problems. Because of the importance of relationships in the life of elderly, the loss of family support and disruptions in close relationships may play a role in elderly greater propensity toward depression. In this study, we examined the association between depression in older adults and several aspects of relationships with close family members. Methods: This investigation represents an analytical cross sectional, case control study carried out at the Department for Geriatric Psychiatry of Psychiatric Hospital Skopje. The study included 120 older adults, in two examined groups. One experimental group comprising of 60 patients suffering from unipolar depression, diagnosed in accordance with the 10-th International Classification of Mental and Behavioral Disorders diagnostic criteria, without a history of other psychiatric disorders or dementia, compared against the control group of community-dwelling older adults without a history of depressive symptoms or other psychiatric disorders or dementia. There was no significant statistical difference in the sex proportion in both groups ($p>0.05$). The included patients were with average age of 70.43+/-6.63 years; and for the control group with average age of 71.12+/-6.49 years. We tested the difference in the average age between the first and the second group, and for the level of $p>0.05$ it is statistically insignificant, i.e. the examinees do not differ significantly in relation to the age. Investigated data were taken by means of questionnaire, designed for that aim. The Geriatric Depression Scale was used to measure depressive symptoms. Outcome measure was a score of >10 on the 30-item Geriatric Depression Scale. The mean score in the Geriatric Depression Scale of the experimental group was 24.08 +/-3.67, whereas of the control group was 3.67+/-3.09, for the t-value 23.92 and $p = 0.00000$. The scores in the Geriatric Depression Scale revealed statistically significant difference between experimental and control group. Results: About the relations in the family 50% of patients against 85% subjects from control group responded that there are harmonious and tolerant relations in their family. Actually not tolerant and conflictual family relations were more common for the patients in the experimental group (25.67%) against examinees in the control group (10%). The distribution of examinees in experimental and control group in regards to quality of family relations has confirmed a statistically significant difference (D max = 0.37; p

PS02.66

Changes in depression and physical functional and quality of life over 12 months among community-dwelling depressed older persons

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Introduction. Depression is associated with significant functional disability. Cross-sectional studies do not unravel the complex temporal relationships involving concomitant factors like medical comorbidity and cognitive impairment. A limited number of longitudinal studies have shown that depressed older persons report more physical disability over time. Depressive symptoms vary in intensity and duration over time, and few longitudinal studies have investigated the impact of changes in depression status on physical functional decline and quality of life over time in older persons. Aims. The present study aimed to investigate whether 12-month changes in depressive symptoms was associated with corresponding changes in physical functioning and quality of life of

community-dwelling depressed elderly, independently of medical comorbidity and impaired cognitive functioning.

Method: In a community-based screening programme of 4633 older persons aged 65+, 370 (8%) older persons who reported depressive symptoms (GDS≥5) were followed up at 12 months. Baseline and 12 month follow up assessments included Geriatric Depression Scale (GDS-15) for depressive symptoms, instrumental and basic activities of daily living scales (IADL and ADL) for physical functioning and SF-12 for quality of life. Baseline co-variables included Mini mental State Examination (MMSE) for cognitive functioning, number of chronic medical comorbidities, and sociodemographic characteristics. Improvement in depression status was denoted by a positive change value of GDS scores (baseline minus 12 month), improved physical functioning by positive change value of IADL/ADL scores (12 month minus baseline) and improved quality of life by positive change value of SF 12 (12 month minus baseline).

Results: At baseline, the mean age of the older persons with depressive symptoms (GDS≥5) was 73.1 years (S.D = 8.1), 54.9% were female; mean GDS scores was 8.09 (S.D = 2.39), MMSE mean scores was 23.8 (S.D = 4.4), IADL mean score was 24.5 (S.D = 4.6), and ADL mean score was 18.76 (S.D = 3.04). After adjustment for baseline functional status, MMSE, chronic medical illnesses and other socio-demographic variables, positive change in depressive symptoms (baseline minus 12 month) was significantly associated with positive change (12 month minus baseline) in physical functional status (ß = 0.32, S.E = 0.07, p <0.001) and SF 12 (12 month minus baseline) (ß = 0.81, S.E = 0.10, p <0.001),. Higher MMSE scores at baseline was also independently associated with improvement of functional status (β = 0.21, S.E = 0.08, p = 0.01). Older age was negatively associated with improved physical functioning scores (ß = -0.09, S.E = 0.04, p = 0.02) and improved SF 12 scores (ß = -0.14, S.E = 0.05, p = 0.008). Men were significantly less likely to show improvement in SF 12 quality of life (β = -1.86, S.E = 0.92, p = 0.04).

Conclusion: In depressed elderly, improvement in depressive symptoms was associated with improvements in physical functional status and quality of life.

PS02.67

Age-related differences in anaphor resolution are revealed by event-related potentials and low resolution brain electromagnetic tomography

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"Anaphor resolutionâ[euro] is the process by which one of the full noun phrases preceding a referentially deficient expression (an "anaphorâ[euro], e.g. a pronoun) is selected as the antecedent of that anaphor, thus establishing a reference for an otherwise referentially defective expression.

Objectives: We used ERPs and Standardized Low Resolution Brain Electromagnetic Tomography (sLORETA) to study the age-related differences occurring in the early(a) and later(b) stages of anaphor resolution. In (a) the antecedent-pronoun dependency is formed and syntactic structure plays a key role, either allowing low processing cost binding at the syntactic level, or forcing a more costly dependency formation at the discourse level. In (b) repair/enrichment processes may occur (e.g., pragmatic meaning-modulations). We hypothesized that, for the elderly, syntactic processing is well preserved, while pragmatic processing is hindered, namely inferences based upon breaches of pragmatic principles. Such inferences require, for the pragmatic anomaly to be detected, that the reader/listener predicts the writer/speakerâ[euro]s choice of the particular type of pronominal expression that would conform to the pragmatic principle at stake. We tested our hypotheses by comparing ERP markers of discourse dependency formation (N400) and meaning enrichment (P600), in young and older adults; we further compared the aforementioned age groups wrt sLORETA reconstructions of localized differences in brain activity, elicited by two contrasting anaphor resolution contexts. **Methods Participants:** 20 older adults (60-80 year old), 20 young adults (19-26 years old). **Materials:** Gender agreement

in 48 pairs of Portuguese complex sentences was manipulated to cause pronoun resolution either with the c-commanding NP (1: low cost syntactic dependency formation; breach of Griceâ[euro]s maxim of manner - an explicit pronoun occurs instead of the Portuguese null/silent pronoun (pro), the most economic and common choice for this syntactic context) or with the NP in a genitive recess (2: high cost discourse dependency formation; no breach of pragmatic principles), e.g. (1) [[The butler]MASC of [the countess]FEM](i)MASC quarreled with the servant to whom he(i)MASC had lent some money. (2) [[The employee]FEM of [the butcher](i)MASC]FEM quarreled with the client to whom he(i)MASC had sold spoilt sausages.

Results: An enhanced Late Positivity and selective activation of right BA 9 and BA31 emerges in type (1) sentences for the young adults, indexing the additional effort required to compute the pragmatic inference conveyed by the breach of Griceâ[euro]s maxim of manner. The absence of this effect in the elderly group suggests a failure in predictive processing, resulting in the lack of basis for the pragmatic inference. Older adults show instead a N400 and selective activation of right BA 18 for type (2) sentences, indexing the contrast with facilitated dependency formation in type (1) sentences, in which the pronominal form, void of pragmatic import for this group, can be fully processed at the syntactic representation level. Type (2) sentences, in contrast, require the dependency to be formed at the discourse representation level, thus motivating the N400 effect and right BA18 recruitment. In the young adultsâ[euro] group, the clash between the expected null pronoun and the explicit one that in fact occurs in type (1) sentences, leads the processor to shift resolution to the discourse level, where the unexpected binding will be visible to the pragmatic module.

PS02.68

Association study of APOE 4 allele and dementia in a Singaporean Chinese population

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Background: The 4 allele of apolipoprotein E (APOE) is the only confirmed genetic risk factor for Alzheimer's disease (AD). APOE is a polymorphic protein regulating the transport of cholesterol and the metabolism of lipoprotein particles. The interaction of APOE and the low-density lipoprotein (LDL) receptor determines the homeostasis of cholesterol and triglycerides. However, variability in the strength and type of association between AD and APOE polymorphisms among ethnic groups has been reported. The association of APOE 4 allele with AD or non-AD dementia was weaker for African-Americans than for Hispanics and whites, and was not found in native Nigerians. Furthermore, the association of the APOE 4 allele with vascular dementia (VaD) is still controversial. At present, the strength of association of the APOE 4 genotype with dementia in Singaporean Chinese is unknown. In this case-control study, we examined the association between APOE 4 allele status and the risk of AD and non-AD dementias in a Singaporean Chinese population.

Methods: We studied 153 patients with dementia (87 AD, 19 VaD and 47 mixed dementia) from the Memory Clinic of the Department of Geriatric Medicine in the Alexandra Hospital and 153 age- and sex-matched healthy controls from the Singapore Longitudinal Ageing Study (SLAS), respectively. APOE genotyping from blood samples was done using the deoxyribonucleic acid (DNA) polymerase chain reaction (PCR) amplification and single nucleotide extension technique. Patients with either one or both 4 alleles were considered as 4 carriers. APOE 4 allele prevalence was compared by Chi-square test. Odds ratios (ORs) of association between APOE 4 status and dementia were calculated in conditional logistic regression models.

Results: Of the 306 participants, 182 (59.5%) were women; mean age was 74.3 (range = 55-89). Compared with normal controls, more demented patients had less than 6 years of education (88.2% and 59.5% respectively, $P<0.001$).

Altogether, 52 of 153 dementia patients were APOE 4 carriers (34.0%). No significant difference of APOE 4 prevalence was observed between AD and VaD/mixed group (35.6% and 31.8%, $p = 0.622$). Between AD patients and healthy controls, the prevalence of APOE 4 carriers was significantly different (35.6% and 17.2%, p

= 0.005). The OR adjusted for education of the association of APOE 4 carriers with AD was 2.41, 95% C.I. 1.10-5.28, p = 0.01. Among the VaD/mixed dementia patients and controls, there was no significantly difference of APOE 4 prevalence between the two groups (31.8% and 21.2%, p = 0.168). No significant association of APOE 4 allele with VaD/mixed dementia was found (OR = 1.78, 95% C.I. 0.78-4.02, p = 0.279).
Conclusions: Although associated with AD among Singaporean Chinese, the effect of APOE 4 in increasing the risk of AD was not strong as that observed in Western populations. No significant association was observed with non-AD dementia. More studies with larger sample sizes on Chinese, Malays and Indians should be done.
PS02.69
The association between paraoxonase 1(PON1) gene 192Q/R polymorphism and Alzheimer's disease and non-Alzheimer's dementias in a Singaporean Chinese population
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Background: The association of human paraoxonase 1 (PON1) gene polymorphism and risk of developing dementia is of particular interest. PON1 participates in the prevention of low-density lipoprotein (LDL) peroxidation which is thought to be the mechanism by which high-density lipoprotein (LDL) exerts its anti-atherogenic activity. It is also a potent cholinesterase inhibitor and a Ca2+-dependent arylesterase, providing protection against organophosphate poisoning and metabolization of environmental neurotoxins which might be responsible for neurodegeneration with ageing such as Parkinson's disease. To date, eleven case-control studies have investigated the relationship between PON1 polymorphism at 192 Q/R and Alzheimer's disease (AD) or dementia and the results have been inconsistent. In this study, we aimed to examine the possible association of 192 Q/R polymorphism in the PON1 gene with dementia in a Singaporean Chinese population.
Methods: 153 demented patients (87 AD, 19 vascular dementia and 47 mixed dementia) and 153 age- and sex-matched healthy controls were recruited from Memory Clinic of the Department of Geriatric Medicine in the Alexandra Hospital and the Singapore Longitudinal Ageing Study (SLAS), respectively. Multiplex PCR was performed to detect the PON1 gene 192 Q/R polymorphism. Allelic frequencies were estimated by the allele counting method. Genotype and allele frequencies were compared by chi-square test. Odds ratios (ORs) of association between PON1 gene 192 Q/R polymorphism and dementia were calculated in conditional logistic regression models.
Results: The PON1 genotypes were in Hardy-Weinberg equilibrium. Among AD patients (n = 87) and age- and sex-matched controls (n = 87), there was no significant difference in the PON1 192 Q/R genotype distribution and allele frequencies. In addition, no statistically significant association of PON1 gene polymorphism and AD was found between AD patients and controls. Among non-AD dementia patients (n = 66) and age- and sex-matched controls (n = 66), a significant difference in the PON1 genotype total distribution was observed (29 R/R, 33 Q/R, 4 Q/Q; 32 R/R, 22 Q/R, 12 Q/Q respectively, p = 0.042); likewise, the presence of at least one R allele was significantly different (93.9 % and 81.8% respectively, p = 0.033). In conditional logistic regression model, a positive association of R alleles carrier status (QR or RR) and non-AD dementia was observed (unadjusted OR = 3.67, p = 0.046; education-adjusted OR = 3.75, p = 0.083); Q/Q genotype was associated with lower risk of non-AD dementia (unadjusted OR = 0.27, P = 0.046; education-adjusted OR = 0.27, p = 0.083). The analyses were stratified by Apolipoprotein E (APOE) allele 4 status (4 carriers/non-carriers). Among non-4 carriers, there was a significant difference of the presence of at least one R allele (R/R or Q/R) between non-AD dementia patients and matched controls (95.6% and 80.0% respectively, P = 0.024). R allele frequencies was significantly higher in non-AD dementia patients than in controls (72.2% and 52.2% respectively, P = 0.006). Conditional regression failed to show a significant association between PON1 gene 192Q/R polymorphism and the risk of non-AD dementia in non-4 carriers. No significant results were observed

for APOE 4 carriers.

Conclusion: We found that in Singaporean Chinese, the PON1 192Q/R genotype distribution was significantly different between non-AD dementia patients and controls and these patients showed greater frequency of at least one R allele (R/R or Q/R). In particular, the PON1 R allele was significantly more frequent among non-AD dementia patients who were APOE 4 non-carriers. However, we did not find a significant association between PON1 192Q/R gene polymorphism and AD/non-AD dementia. Larger case-control studied should be conducted to confirm the association of PON1 gene polymorphism and dementia subtypes.

PS02.71

Cognitive function domains associated with components of low extremity function in Korean aging population

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Background: Previous studies showed that cognitive decline was associated with physical performance decline. However study that investigated the association between domains of cognitive function and components of low extremity function is hardly found, especially for Asian, although it is important to elucidate the way these two functions affect each other.

Method: The Short physical performance battery (SPPB) and Korean version of Mini-Mental Status Exam (MMSE-K) were performed on random sample nested in the KLoSA panel, a national representative sample of aging people in Korea. Univariate analysis of correlation between components of SPPB (balance, gait speed, chair standup) and domains of MMSE (orientation to time, orientation to place, attention and calculation, registration and recall, understanding and judgment, executive function) was performed calculating Pearson correlation coefficient. And then multiple regression analysis was performed adjusted for age, sex, educational level.

Results: Of 516 participants, about forty-two percent (266/516) were male. And mean age was 63.80 ±10.10. In univariate analysis, SPPB total score was significantly correlated to MMSE total score and score of all domains ($p < 0.05$). Balance was correlated to orientation to place, attention and calculation, and executive function significantly ($r = 0.159$, 0.165 and 0.158, respectively, $p < 0.05$ for all). Gait speed was correlated to orientation to time, attention and calculation, understanding and judgment, and executive function significantly ($r = 0.185$, 0.347, 0.090 and 0.316, respectively, $p < 0.05$ for all). And Chair standup was correlated to orientation to time, attention and calculation, understanding and judgment, and executive function significantly ($r = 0.105$, 0.387, 0.125 and 0.277, respectively, $p < 0.05$ for all). In multiple regression analysis, SPPB total score was associated with attention and calculation ($\beta = 0.058$, 95% confidence interval (CI) 0.034 - 0.081), and executive function ($\beta = 0.097$, 95% CI 0.036 - 0.157). Furthermore, attention and calculation ($\beta = 0.010$, 95% CI 0.001 - 0.020 for balance, $\beta = 0.014$, 95% CI 0.004 - 0.024 for gait speed, and $\beta = 0.034$, 95% CI 0.020 - 0.049 for chair standup) and executive function ($\beta = 0.026$, 95% CI 0.004 - 0.048 for balance, $\beta = 0.033$, 95% CI 0.008 - 0.058 for gait speed, and $\beta = 0.037$, 95% CI 0.001 - 0.074 for chair standup) were associated with all components of SPPB. Additionally, Orientation to place was associated with balance ($\beta = 0.122$, 95% CI 0.042 - 0.202), Orientation to time was associated with gait speed ($\beta = 0.048$, 95% CI 0.004 - 0.092), and Understanding and judgment was associated with chair standup ($\beta = 0.164$, 95% CI 0.019 - 0.309).

Conclusion: Attention and calculation, and executive function were the most prominent predictors for low extremity function and its each component in this Korean aging population. Future research should focus on these two cognitive function domains to elucidate link of cognitive function with physical performance and risk of fall.

PS02.72

Compensatory systems in Alzheimer's disease interventions: From memory books to SenseCam

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Background In Alzheimer's disease (AD) memory deficits are emphasized as the primary symptoms and the most disruptive for the patients' wellbeing. With this concern there has been a large effort to develop interventions to implement early with these patients (Clare, 2000). Recent studies have been conducted to evaluate the most effective techniques of memory training, like learning without errors, spaced retrieval and auto-generation of cues (Clare &Woods, 2004). Despite the effectiveness of these techniques, some limitations were also outlined. The excessive focus on the training of internal memory resources was one of those limits that sensitized the researchers to study additional and complementary procedures. In this context, the focus has shifted to the compensatory rehabilitation, mainly the development of external memory strategies. The wide range of literature on external memory aids for AD described the effectiveness of memory book training as a source of cues for memory retrieval (Schmitter-Edgecombe, Fahy, Whelan &Long, 1995; Sohlberg &Mateer, 1989). Early studies stated that helping the patient to write a standardized diary would be useful because it helps in recalling important events, compensating for prospective memory deficits, making the patient a more active listener and facilitating encoding process via multisensory modalities (hearing, vision, motor skills). However, there were identified some limits: extensive training; preserved awareness about the memory deficits and a greater motivation of the patient. Several researchers (cognition scientists, computer scientists) have joined with the aim of developing new and more effective methods of compensatory memory for dementia interventions. An innovative device, the SenseCam, has attracted the attention of the researchers. This Microsoft's device is a camera built to pick up digital records of the day from the point of view of the wearer, by capturing a large number of images and logging of sensor data. It consists in a passive memory capture approach that offers to the user a more integral awareness of past actions with residual input from him (Hodges, S., Williams, L., Berry, E., Izadi, S., Srinivasan, J., Butler, et al., 2006). The capture is unintentional, becoming similar to the real human memories. However, as researchers highlight, this device creates cues, not memories itself. This presentation concentrates in a specific issue of a major research project titled "Memory stimulation in Alzheimer's disease: The role of SenseCam in a comprehensive memory training programâ[euro]. In this issue, we focus on the differential cognitive basis of the two external memory aids: memory book and Sense Cam. Consequently, we intend to evaluate their efficacy.

Methods: Two groups of 20 mild AD patients each compose the study sample. One of the patients group will write with assistance a memory book/diary, and the patients of other group will wear the SenseCam. The intervention will last six weeks, and each patient meets the psychologist twice a week during one hour per session. Memory book: Motivational training for the regular use of the book; presentation of the diary with defined features (place where the event took place, emotional impact, etc.) to fill with the events occurred during the day; require the help of the patient caregiver to remember him to fill the diary daily. At the sessions with the psychologist will be administered recall tests. SenseCam: Presentation of the device to the patient and to his/her caregiver; Teaching the caregiver to show the SenseCam pictures to the patient every two days; Application of recall tests at the sessions with the psychologist. For the objective assessment of memory gains with the use of each method, a comprehensive memory assessment battery will be applied before the intervention, immediately after and six months follow up. The battery includes the following testes: Rivermead Behavioral Memory Test - 3 (Wilson, et al., 2008); Pyramids and Palm Trees Test (pictures version; Howard &Patterson, 1992); Time based prospective memory tasks (two) from CAMPROMT (Wilson et al., 2005); Autobiographical Memory Test (Williams &Broadbent, 1986). Additionally, functional status and well-being measures will be collected (IAFAI; Sousa et al., 2008, and WHOQOL-OLD; M. Power et al., 2005).

Anticipated outcomes: We expect that SenseCam will allow higher recall levels than the memory book method because it provides strengthen cues and consequently this device will contribute to a greater sense of wellbeing of the patients. In addition, we also anticipate that the patients wearing the SenseCam will have a better autobiographic performance. We discuss the explanations concerning the basis of this expected outcome, from

the analysis of the neurocognitive characteristics of the both methods as "cue creatorsâ[euro].

PS02.74

Abstract withdrawn

PS02.75

Mini Mental State Examination (MMSE): Probably one of the most cited papers in health science

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The standard MMSE was published in *Journal of Psychiatric Research* in 1975 and is still in use, with only minor subsequent modifications done by the authors. The MMSE has demonstrated validity and reliability in psychiatric, neurological, geriatric, and other medical studies. The test was designed to measure orientation, comprehension, recall, reading, writing, and drawing tasks (viseospatial tasks). The form also includes alternative item substitutions for administration in special circumstances (spelling test in stead of calculation in case of dyscalculia). The MMSE has been translated into more than 35 authorized foreign language editions. Materials and methods Citation on this specific scientific paper was searched for in commercially available databases. The bibliometric measurements were done in commercial databases provided by the university library. All citations of the paper between 1975 and 2006 were downloaded from Web of Knowledge produced by the Institute for Scientific Information (ISI). Analysis were done by the programmes provided in the Web of Knowledge This short paper (poster) investigated the article by Folstein et al. previously published in Journal of Psychiatric Research as a method paper. It has been cited in an unusually high number. In November 2008 other researchers had cited the paper more than 21,900 times. Compared to other papers this is by far the most cited paper in neurology, psychiatry and geriatrics. It is discussed if it is the most cited paper in medical science. The Mini Mental State Examination (MMSE) is one of the most ever cited research papers in medical science. It is most probably going to be applied to more and more specialities in the future, since geriatric problems are increasing in many ways. Folstein M F, Folstein S E, McHugh P R. *"Mini-mental stateâ[euro]. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res* 1975; 12:189-198.

PS02.76

When the mind drifts: The mnemic impairment effect of daydreaming in healthy older adults

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The cognitive deficits of older adults have been a subject of special concern during the last decades. The aging reveal dissociative phenomena between declining areas and preserved areas of memory. One of the mechanisms underlying the memory deficits in older adults is the decreasing of inhibition efficiency. A study on control strategies with list-method directed forgetting in young and older adults showed forgetfulness among the younger but not the in older adults, which is consistent with the decreased inhibition efficiency. However, when the instructions were revised to downplay their concerns about memory and the experimenter provided a strategy that induced a mental context change - specifically, engaging in diversionary thought - older adults showed significant directed forgetfulness as well as the younger adults (Sahakyan, Delaney, &Goodman, 2008). Daydreaming transport us mentally to another place and time, but many diversionary thoughts are similar in content to the thoughts that we create when we try to forget something. Thereby, previous studies showed that daydreaming can induce an amnesic effect when we try to remember the previously encoded information. A recent study has also showed that the contents of daydreams affect the ability to access a recently-acquired memory (Delaney, Sahakyan, Kelley, &Zimmerman, 2010). Apparently, the context change explains these results, the directed forgetting and even the mind wandering paradigm effect. The diversionary thought starts a new mental context in which the next items are encoded, in other words, the new context match better to the learning context of the second word list than of the first word list. The main aim of this study is to explore the mind wandering paradigm effect in a group of old, healthy Portuguese people. The sample consists on a group

of 80 healthy older adults aged from 65 to 69 years old, 40 of which compose the control group. The evaluation protocol includes the mind wandering paradigm, as well as a screening cognitive test (Addenbrooke's Cognitive Examination - Revised), a visual episodic memory task (Visual Association Test), a measurement of attention and mental flexibility (Trail Making Test A and B), a processing speed task (Digit Symbol-Coding from WAIS-II), a verbal intelligence task (Vocabulary from WAIS-III) and a depression scale (Geriatric Depression Scale -30). In order to test the hypothesis that thinking about past autobiographical events (diversionary thought) induce greater memory impairment in comparison with a control distractive task, the participants in diversionary thought condition were instructed to think about their childhood home after the List 1 presentation and before List 2 presentation. In the control condition the procedure was the same but diversionary thought was replaced by a test of speed reading. It is expected memory differences between the groups. Thus, the diversionary thought group will remember less words of the List 1 in comparison with the control group, in support of a context-change effect. It is also expected that List 2 recall does not depend on the group, i.e., memory performance on List 2 will not be influenced by the type of treatment applied to the List 1. All of us have heard that older adults live in the past. Knowing the adverse effect of the diversionary thought when recalling information recently encoded is needed, this study alerts to how important it is to promote strategies that enable older adults to engage only in the present learning context, at least, immediately after the encoding of relevant information.
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PS02.77

The impact of cognitive status on neuropsychiatric profile and outcomes in Parkinson's disease

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Background: Neuropsychiatric complications are common in Parkinson's disease (PD) without dementia, as well as in PD with frank dementia (PDD). The diagnosis of "mild cognitive impairmentâ[euro] in PD (PD-MCI) has only recently been described and the specific profile of neuropsychiatric problems, quality of life and disability in this population is as yet unclear. Objective: To compare the frequency, magnitude and profile of neuropsychiatric symptoms (NPS) in PD, PD-MCI and PDD as well as to compare the impact of these diagnoses on the outcomes of quality of life and level of disability.

Methods: Participants with PD and no cognitive impairment (n = 45), PD-MCI (n = 59), and PDD (n = 25) were assessed using the 12-item Neuropsychiatric Inventory (NPI), a quality of life scale (PDQ-8) and on disability ratings (Unified Parkinson's Disease Rating Scale, ADL subscale; Schwab and England scale). All were recruited from local neurology clinics in UK and met strict clinical diagnostic criteria for idiopathic PD. PDD was diagnosed according to MDS criteria and MMSE <26. PD-MCI was diagnosed in participants with at least 1 abnormal cognitive domain (>1.5 SD below the mean in healthy controls) and MMSE ≥26.

Results: Over 70% of each of the three PD groups reported at least one NPS in the past month. In those with PDD, 72% reported the presence of three or more NPS. The proportion of those with clinically significant NPS (total NPI score ≥4) increased from 49% in PD to 61% in PD-MCI to 76% in PDD. In the PD group, sleep disturbances were the most commonly reported NPS (60%) followed by anxiety and depression. In the PD-MCI group, the profile was similar, with sleep (56%), anxiety (37%) and depression (33%) being common. Apathy increased markedly from 20% in PD to 39% in PD-MCI and 52% in PDD, as did psychosis, which increased from 11% in PD to 18% in MCI-PD to 60% in PDD. The magnitude of NPS (frequency x severity) did not differ significantly between groups. Total NPI score was associated with greater dopaminergic load, longer duration of disease, lower MMSE and more severe disease stage. Both quality of life and disability were significantly worse in the PDD group compared to PD as well as PD-MCI.

Conclusion: NPS in PD-MCI and PDD are more common than in non-PD MCI and other dementias respectively. In PD, the frequency of NPS increases as cognitive impairment worsens, with symptoms being most common in PDD. Apathy and psychosis in PD-MCI are more common than in non-PD-MCI increase markedly as cognitive stage worsens. Cognitive status is associated with worse quality of life and greater disability.

PS02.78

Old age and dental problems

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Introduction: Despite being a risk group for dental problems, older people have a low dental attendance. According to McGrath and Bedi (1998), they generally recognise the importance of oral health but only attend the dentist in response to pain, resulting in emergency treatment. Many studies have explored the reasons that prevent older people to make and attend dental appointments. Borreani et al. (2008) have identified five groups of barriers to dental care in older people: cost, fear, accessibility, availability of dental treatment and personality of the dentist. Among these factors, fear of dental treatment seems to have a significant impact on older people's opinions, behaviours and choices. Traumatic past experiences have been shown to be significantly associated with dental fear, however there are also strong associations between dental anxiety and negative perceptions of dental experiences as uncontrollable, unpredictable, dangerous and disgusting (Armfield, 2010).

Objectives and Methods: This research aimed to explore older people's views on dental treatment focusing on emotional reactions, attitudes and opinions towards dental care, with a particular interest on the individual strategies used to overcome dental problems. Thirty-eight older people (18 male and 20 female; 19 up to 70 years old and 19 over 70 years old) were recruited in day centres and dental practices located in a suburb of Milan and in a small city in northern Italy. All participants were over 65. We used a qualitative approach with semi-structured interviews to investigate older people's views on dental care. Participants were interviewed by the researcher, using a questionnaire with open and closed questions and two self-rating scales to measure their level of anxiety and depression.

Results: This research confirmed that avoidance can be a strategy used to cope with dental anxiety and that negative past experiences at the dentist can strongly influence personal attitudes towards dental care and dental attendance. Participants offered a number of suggestions to increase the attendance level in older people, which included the use of relaxation techniques like yoga and autogenic training, finding a calm dentist, using dental anaesthesia. The study highlighted differences among male and female participants. In general, men seemed less scared of the dentist. It was easier for women to recall negative experiences at the dentist that significantly affected them. The episodes mainly referred to cases of malpractice which resulted in them looking for a new dental practitioner. Female participants seemed to have a stronger preference for a male dentist. Women found it harder to identify the scariest part of the treatment, while this was clear to most men interviewed. Male participants were more afraid of going to the dentist than to the surgeon while it was the opposite for their female counterparts. When asked if they had found any methods to overcome their fear, most women declared that they did not find any useful strategies. The research also underlined some differences among the two age groups (up to 70 and over 70). In general, people in the younger group seem to be more anxious at the thought of going to the dentist and having dental treatments. A few participants belonging to the older group highlighted the great improvements made to dental techniques that became less painful over the years that reduced the pain of dental treatment. **Conclusions:** This research, along with other studies (Cesa-Bianchi and Cristini, 2009), highlights the importance of communication and the use of a sensitive approach that should be tailored considering the general needs of older people, taking also into account the uniqueness of each individual. One recommended way to achieve this is through a training aimed to increase awareness of older people's needs and their dental problems. References Armfield JM. (2010). *Towards a better understanding of dental anxiety and fear: cognitions vs. experiences. European Journal of Oral Sciences* 118:

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PS02.79

Two improved cases with diffuse Lewy body disease (DLBD) and cardiac autonomic disorder (CAD)

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Background: Patients with diffuse Lewy body disease (DLBD) have constantly cardiac autonomic disorder (CAD) and carry a high risk of sudden disturbance of consciousness. CAD effects cardiac dynamism and causes orthostatic hypotension, transient ischemic attack (TIA), cerebral infarction, and tachyarrhythmia. Metaiodobenzylguanidine (MIBG) scintigraphy detects over 90 % of CAD in DLBD patients. However, MIBG scintigraphy is one of difficult examinations for patients with cognitive deficits. Two DLBD patients were treated their CAD, referring to their ECG and vital signs. They also showed the betterment of their psychiatric symptoms, after this treatment.

Case Study: A 84-year-old female with Parkinson's syndrome was introduced to our hospital because of fluctuating cognition (FC). EEG detected FC with the alpha waves of basic activity mixed by theta trains. Her MMSE score was 25/30 and MRI showed diffuse cortical atrophy without localized findings. ECG showed sinus rhythm with 75 of pulse and 378 ms of QT time. However, she often felt vertigo, orthostatic hypotension, and headache. 5mg of furosemide per day was started, and then her subjective symptoms were decreased. Her motivation, viscosity, and FC were improved after about 6 months. She reduced her HAM-D score from 17 to 0. A 81-year-old male was suffered from dementia with FC, REM sleep behavior disorder (RBD), and visual hallucination of persons. He twice experienced the sudden disturbance of consciousness with pallor of the face and unclear speech. The dose of furosemide was increased from 5 mg to 20. The low dose of chlorpromazine and levomepromazine, totally 12.5 mg, were administered to raise his pulse a little. The variance of pulse, in short, fluctuation of pulse, was reduced from 90.76 to 55.84. The pulse itself was increased from 61.4 to 67.5 ($p<0.05$). He reduced FC and his changeable mood and improved MMSE score from 11 to 19.

Conclusion: A diuretic was administered for the treatment of two DLBD patients with CAD to reduce cardiac burden. Its reduction makes the cardiac status without orthostatic hypotension or tachyarrhythmia. After this treatment, the patients felt better subjectively. Their psychiatric symptoms were reduced and cognition changed stable. CAD can be presumed by lower pulse, QT time of ECG, BNP or Schellong test. In addition, the subjective symptoms of vertigo, unsteady headache, and orthostatic hypotension help consider CAD in DLBD patients. DLBD patients frequently have a tendency of heart failure or cardiac hypertrophy with MIBG findings. We often experienced the deterioration that FC was accompanied with CAD, such as the fluctuation of pulse, orthostatic hypotension, and disturbance of consciousness. There are many cases clinically that the worse body status is, the worse cognition is. The treatment of CAD may make the body status more stable and lead to the improvement of psychiatric symptoms or cognitions in DLBD patients, because DLBD patients have a tendency to be suffered from CAD. The medication against cardiac burden is diuretics or antihypertensive agents. Because the problem is CAD, the attempt of a small amount of administering to the subjective symptoms might be useful. The medication against bradycardiac change is anti-cholinergic agents. However, they might worsen cognitive functions, such as learning or memory. We administered the very low dose of chlorpromazine and levomepromazine, totally 12.5 mg to the DLBD patient. It is equivalent to 0.125 mg of haloperidol. It may be considered to be smaller than the amount that changes his cognition worse and his MMSE score was improved.

PS02.80

Dimensions of apathy in Parkinson's disease without dementia: Clinical correlates and impact

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Background: Apathy can occur in a significant proportion of Parkinson's disease (PD) sufferers even in the absence of dementia. Apathy has three key dimensions, emotional blunting, lack of initiative, and lack of interest. These dimensions may be differentially associated with clinical variables in PD and may impact differently on PD sufferers and their caregivers. The objective of this study was to evaluate the clinical profile and impact of apathy in PD with particular emphasis on the individual dimensions of apathy.
Methods: 91 non-demented PD participants were evaluated with the Apathy Inventory (AI), which assesses the three dimensions of apathy. Those with clinically significant apathy (n = 32) were compared to those without (n = 59) on key demographic and clinical variables as well as the impact on disability, quality of life and carer burden. Within the apathy group, a subsequent comparison of those with clinically significant emotional blunting (n = 22) and those with only diminished interest and/or initiative (n = 10) was undertaken. Linear regression models predicting apathy overall were created.
Results: Those with apathy were significantly more depressed, and had greater levels of executive dysfunction compared to those who had no apathy. The group with apathy and emotional blunting was primarily associated with high levels of depression. The group with only diminished initiative and/or interest were primarily associated with older age and age of disease onset, later stage of disease, worse motor function, depression and attention and executive dysfunction. 54% of the variance predicting apathy overall was accounted for by depression, executive dysfunction (set shifting), sleep impairments and appetite impairments. Those with apathy, in particular emotional blunting, had significantly worse HRQoL ($p<0.001$), greater levels of disability ($p<0.001$), and greater carer burden ($p = 0.001$) compared to the non-apathy groups.
Conclusion: In non-demented PD, apathy, particularly with emotional blunting, is associated with depression and cognitive dysfunction. It also impacts significantly on PD sufferers and carers, whereas apathy without emotional blunting impacts less.

PS02.81

Neuropsychiatric symptoms, functional abilities and caregiver burden in dementia with Lewy bodies and Alzheimer disease

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Background: Dementia with Lewy bodies (DLB) is considered the second most common cause of degenerative dementia after Alzheimer's disease (AD) in elderly people. Previous studies which examined the profile of cognitive impairments of DLB and AD have shown that visuospatial function and attention were more severely impaired in patients with DLB than in those with AD. However, there have been few studies that compared neuropsychiatric symptoms and functional abilities between DLB and AD and their influence on caregiver distress.
Purpose: To evaluate neuropsychiatric symptoms, functional abilities and the caregiver burden in patients with DLB and AD. **Subjects:** The subjects are consecutive patients with probable DLB (Consensus criteria for DLB, 2005) and probable AD (the NINCDS-ADRDA criteria), who visited to Kumamoto university hospital outpatient dementia clinic between April 2007 and September 2010. All patients were comprehensively examined, including routine laboratory tests, standardized neuropsychological and neuropsychiatrical examinations, MRI or CT brain scan, and SPECT. Patients excluded from the study were 1)those who were diagnosed as possible DLB, 2)those who had no reliable caregiver, and 3) those in institutionalization. All the procedures followed the clinical study guidelines of the Ethical Committee of Kumamoto University Hospital. Before entering this study, written informed consent was obtained for all patients and their caregivers according to the Declaration of

Human Rights, Helsinki, 1975. **Assessments:** Cognitive function was assessed using the Mini-Mental State Examination (MMSE). Neuropsyhiatric symptoms were assessed by using the Neuropsychiatric Inventory (NPI). Functional abilities were evaluated by Physical Self-Maintenance Scale (PSMS) and the Instrumental Activities of Daily Living scale (IADL). On IADL scale male patients were assessed by only five items in the view of the sex differences in premorbid housekeeping skills. The care burden of primary family caregivers was measured by using the Japanese version of the Zarit Caregiver Burden Interview (J-ZBI). Statistical analysis: Each score was compared between DLB and AD groups by Student t-test. On the score of IADL male and female patients were analyzed separately. **Results:** Sixty-three patients with probable DLB (31 males and 32 females, mean age±S.D.: 78.6±5.2 years) and 186 patients with probable AD (65 males and 121 females, 74.5±8.9 years) were enrolled in this study. In DLB and AD groups, the mean MMSE scores±S.D. were 19.3±5.0 and 19.3±4.7, respectively ($p = 0.96$). This result indicates that the two groups have the same degree of cognitive decline. The mean NPI total score was significantly higher in DLB group (15.4±13.2) than in AD group (10.4±13.1) ($p = 0.009$). In regard to functional abilities, DLB group scored worse than AD group in PSMS, male IADL, and female IADL scales (4.1±2.0 vs. 5.1±1.3, respectively in PSMS, $p<0.001$; 2.7±1.3 vs. 3.6±1.2, respectively in IADL of male patients, $p = 0.002$; 5.2±2.0 vs. 5.9±1.8, respectively in IADL of female patients, $p = 0.04$). The mean ZBI score was significantly higher in DLB group (27.1±14.7) than in AD group (21.3±14.9) ($p = 0.009$). **Discussion:** This study suggests that DLB patients have more neuropsychiatric symptoms and more serious functional deficits, and cause a higher degree of caregiver distress than AD patients in the same degree of cognitive decline. These findings suggest the possibility that both neuropsychiatric disorders and functional disabilities may influence the degree of caregiver distress in DLB.

PS02.82

Sleep talking in dementia with Lewy bodies

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Background: In current criteria for the clinical diagnosis of dementia with Lewy bodies (DLB), REM sleep behavior disorder (RBD) was given greater diagnostic weighting as suggestive of the DLB diagnosis. RBD is a sleep disorder characterized by loss of normal voluntary muscle atonia during REM sleep associated with complex motor behavior while dreaming. The Presence of REM sleep without atonia on polysomnography is required for the clinical diagnosis of RBD. However, it is difficult to confirm RBD in patients with DLB, because it might be tough to perform polysomnography in dementia patients. Patients with RBD often present sleep talking and behavioral abnormalities while sleeping. The interview about these symptoms may contribute to diagnosis of DLB.

Objective: The aim of this study was to investigate the prevalence of sleep talking and abnormal sleep behavior in the patients with DLB, and to examine whether these symptoms might be useful to differentiate DLB from AD.

Methods: Study participants were selected from the outpatients who visited to dementia clinic of the Department of Neuropsychiatry, Kumamoto University Hospital, from May 2007 to June 2010. All underwent a battery of routine screening blood tests, standard neuropsychological, and neuroimagings including brain CT or MRI and SPECT. The subjects were 30 patients with DLB (mean age ±SD was 78.0 ±4.3 years, 17 men and 13 women, mean MMSE score ±SD was 18.4 ±3.3) and 30 patients with AD who were matched to those with DLB, one to one, on the basis of age, sex, and MMSE score (mean age was 79.2 ±3.4 years, mean MMSE score was mean 20.6 ±2.8). The diagnosis of DLB was based on the criteria for probable DLB of the consensus criteria for clinical diagnosis in DLB international workshop (McKieth et al. 1996). The diagnosis of AD was based on the criteria for probable AD of the NINCDS/ADRDA diagnostic criteria (McKhann et al., 1984). We performed the following semi-structured interview to their reliable informants concerning the frequency of sleep talking, the

volume of sleep talking, and the appearance of movements or behavior while asleep. In this study, we defined the presence of sleep talking as the occurrence at least once a month, the loud sleep talking as louder voice than that in usual conversation, and the abnormal movements or behavior while asleep as standing or wandering while asleep. We compared the prevalence of sleep talking, loud sleep talking, abnormal movements or behavior while asleep between DLB and AD groups by using Fisher's exact tests.

Results: In 21 patients with DLB (70%) and three with AD (10%), sleep talking occurred. In six patients with DLB and one patient with AD, sleep talking was seen every night. In 16 patients with DLB (53%) and three patients with AD (10%), loud sleep talking occurred. Four patients with DLB (13%) shouted while sleeping, although no patient with AD did. In five patients with DLB (13%) and one patient with AD (3%), abnormal movements or behavior while asleep were seen. Sleep talking and loud sleep talking were seen more frequently in DLB patients than in AD patients ($p < 0.01$). Otherwise, there was no significant difference in the frequency of abnormal movements or behavior while asleep between DLB group and AD group ($p = 0.19$).

Conclusion: Sleep talking occurs more frequently in patients with DLB than in patients with AD. Sleep talking more than once a month had moderate sensitivity (70%) and high specificity (90%) for diagnosis as DLB differentiated from AD. The present results suggest that the interview of sleep state may be a very convenient tool to distinguish DLB from AD.

PS02.83

Changes in the Government Certified Index Score and requisite costs for Long-Term Care Insurance System among community-dwelling demented elderly in Japan

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Background: The presence of dementia is strongly related to a decline in the level of daily functioning, have influence on their physical condition, require more caregivers' burden, and even affect vital prognosis of elderly people. In order to reduce family caregivers' burden of the disabled elderly, a new public long-term care (LTC) insurance system was launched from 2000 in Japan. Services are allocated based on the Government-Certified Index (GCI) score range from 0 to 5, which indicates the amount that can be spent. However, there have been few longitudinal studies involving changes in the GCI score and requisite costs for care insurance system of demented elderly. Furthermore, there have been no studies comparing such changes in GCI score and requisite costs, specially related to the causes of dementia.

Method: An epidemiological survey was conducted in Itoigawa City, a rural area of Japan in 1998-1999, and 271 subjects were diagnosed as having dementia. We confirmed age, sex, MMSE score, CDR score, causes of dementia, and coexisting physical diseases. After LTC insurance system was launched from April 2000, we tracked the GCI score and payment amounts from the government every month through December 2007.

Result: Among 271 demented elderly, 209 (77%) were certified to require care insurance. Thirteen of them did not receive any payment. Only 49 (23%) out of 209 were alive after 8 years of follow-up. Mean age at 2000 was 84.5 years old, 57 (27%) of them were male, mean Mini-Mental State Examiation (MMSE) score was 15.7, Clinical Dementia Rating (CDR) ratio was 78:72:59 (1:2:3), among 209 certified demented elderly. The most common cause of dementia was Alzheimer's disease (AD) (53%) followed by vascular dementia (VaD) (23%) and other causes of dementia. An average cost (total payment amount from the government) was 7,39 million JPY (0-28,9 million JPY). There was no significant difference between the mortality rate between AD and VaD. However, VaD patients tended to spend a longer duration in GCI 1, GCI 4 and GCI 5 stage than AD patients. AD patients required an average of 6.74 million JPY and VaD patients required an average of 9.35 million JPY. VaD patients required more costs than AD patients in every GCI score.

Conclusion: Our results indicate that causes of dementia affect the requisite costs of care insurance system, and government should consider these factors in order to reduce the costs.

PS02.84

How nursing teams learn and innovate

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The continuous development of health-care innovations forces nursing teams to adapt to changes and to implement innovations within their daily nursing practices (Blakeney et al. 2009, Holleman et al. 2009, Carman et al. 2010). However, reports in the literature show that there are major difficulties in the implementation of these innovations as evidence-based practices and clinical guidelines (Grol &Grimshaw, 2003, Van Achterberg et al. 2009). This presentation proposes a contingency perspective on team learning and innovation in nursing teams. More specifically, an empirical examination of a new model of ambidextrous team learning in nursing teams and the examination of the relation between ambidexter team learning and the implementation of innovations in nursing teams will be presented. In origin, health care organizations enhanced nursing teams to produce nursing care in a specific health care setting. Nowadays, nursing teams also have to be innovative and adapt to a diversity of innovations. Transferring research on ambidexterity, team learning, and innovation to nursing teams has opened the perspective that nursing teams are becoming ambidextrous. Raisch and Birkinshaw (2008) defined ambidextrous as the ability of a team to manage simultaneously production-oriented and development-oriented processes (Raisch and Birkinshaw 2008). Nursing teams actively try to implement innovations such as clinical guidelines, patient-centered care or changed organizational structures (Grol et al., 2007, Van Achterberg et al., 2008). The implementation of an innovation in a nursing team requires attitudinal and behavioral changes from the individual nurse in order to reframe the innovation into their own daily routines. In organizational literature, the attitudinal and behavioral changes of the individual nurses are defined as the outcomes of learning processes. To examine and express new behavior, individual nurses in teams activate learning in team learning activities as experimenting, using feedback for improvement and challenge one another for new viewpoints (Timmermans et al. 2011). Throughout the team learning activities, the individual nurses in the teams, and so the teams, transfer their practice. Team learning leads to become more efficient over time, acquire and apply new skills and change values, norms and procedures (Chan 2003, Edmondson et al. 2007). This presentation contributes to theory and practice through two complementary propositions. Team learning is presented as a facilitator for the implementation of innovations in nursing teams. Second, this presentation will synthesize contingency perspectives on team learning and innovation and will present study results on the fit between different team learning processes and the implementation of different types of innovations. Literature: Blakeney, B., McCarthy, C., &Coakley, E. 2009, *"Unlocking the power of innovationâ[euro], OIJN: The Online Journal of Issues in Nursing,* vol. 14, no. 2. Carman, J. M., Shortell, S. M., Foster, R. W., Hughes, E. F. X., Boerstler, H., O' Brien, J. L., &O'Connor, E. J. 2010, "Keys for successful implementation of total quality management in hospitalsâ[euro]**,** Health Care *Management Review*, vol. 35, no. 4. Chan, C.C. (2003), *"Examining the relationships between individual, team and organizational learning in an Australian hospitalâ[euro], Learning in Health and Social Care,* Vol. 2 No. 4, pp. 223-235. Edmondson, A.C., Dillon, J.R. and Roloff, K.S. (2007), *"Chapter 6: Three perspectives on team learning--outcome improvement, task mastery, and group processâ[euro], The Academy of Management Annals,* Vol. 1, pp. 269-314. Grol, R. &Grimshaw, J. 2003, *"From best evidence to best practice: effective implementation of change in patients' careâ[euro], The Lancet,* vol. 362, no. 9391, pp. 1225-1230. Raisch S and J Birkinshaw. 2008. *Organizational ambidexterity: Antecedents, outcomes, and moderators. Journal of Management 3*4: 375-409. Timmermans, O., Elseviers, M. Van Linge, R., Van Petegem, P., Dekenens, J. 2011,*â[euro]Team Learning and team composition in nursingâ[euro], Journal of Workplace Learning,* accepted Van Achterberg, T., Schoonhoven, L., &Grol, R. 2008, "Nursing *Implementation Science: How Evidence-Based Nursing Requires Evidence-Based Implementationâ[euro], Journal of Nursing Scholarship,* vol. 40, no. 4, pp. 302-310.

PS02.85

Audit comparing risk assessment and management of falls between an organic and functional ward in old age psychiatry

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Introduction: Falls are a leading cause of morbidity and mortality on inpatient wards. Within psychiatry this is a particular problem on psychogeriatric wards. The recent report by the National Patient Safety Agency (1) highlighted the risks of falls on inpatient wards and some of the problems relating to identifying serious injuries that may occur. These delays in treatment were often due to inadequate observation and examination immediately after a fall, so as well as auditing risk assessment of falls I will also look at acute management of falls, and long term management as laid out in NICE guidance.(2) The audit compares a functional and organic old age psychiatry ward. Method The two wards audited were based in Nottinghamshire Healthcare Trust and neither ward had resident medical cover out of hours. My standards were based on local guidelines relating to assessment of risk factors and on NICE guidance relating to long term management. This included risk assessment on admission, care plans, how the multidisciplinary team manages falls and whether referral to a specialist falls service has been considered. All standards were set at 80%. I also collected data on acute management of falls to ascertain what the practice was and whether any injuries were sustained by the patient. I manually collected data from multidisciplinary notes. I included all patients who had been admitted to both wards over the previous 3 months. Results The notes from 31 patients from the functional ward and 18 from the organic ward were included. There were 23 falls over the 3 month period on both wards. 33% of patients had a fall on the organic ward compared to 19% on the functional ward. Four of the total falls resulted in emergency transfer to A&E, all from the organic ward, one of whom sustained a fractured neck of femur. Two of the falls on the functional ward required x-rays but these were not done as emergencies. Patients on the functional ward were more likely to have a risk assessment completed (80% compared to 38%), were more likely to have no previous risk factors for falls (22% compared to 5%), and were less likely to have a history of falls (16% compared to 55%) Only two patients who fell had discussions documented in their notes regarding further management. Only 1 patient from the functional ward and 1 from the organic ward were referred to the specialist falls service. There was no consistent approach to acute management of falls. Only five falls on the organic ward (29%) and one (16%) on the functional ward were not discussed with a doctor at the time they happened. Where the doctor was informed they came to assess in 20% of cases on the organic ward and 50% on the functional ward. Implementation of monitoring and levels of observation including physical observations was quite variable. Conclusions and Recommendations Both wards fell short of the standards of 80%. The higher rate of falls on the dementia ward may be related to a number of factors. They are more likely to have physical health problems and polypharmacy. The design of the two wards was also different, with the functional ward having a more open design and the organic ward having a nurse's station in the corner of the ward leaving a large part of the ward not open to clear observation. Less risk assessments were completed on the organic ward which may be related to heavier work load but may also mean that less weight was given to identifying and managing these factors. This has implications for managers and for staff training on completing these risk assessments, awareness of what are risk factors for falls and in considering ward design on organic wards which are higher risk for falls. There was high variability in falls management, possibly because of the lack of guidelines or lack of confidence of psychiatry trainee's in managing physical health problems. One of the recommendations following this would be to implement such guidance and update training for juniors on call who are managing patients who've fallen. This would also fit in with the National Patient Safety Agency's call for all trusts to have clear guidance on these points. 1. *Rapid Response Report NPSA/2011/RRR001 Essential Care After an Inpatient Fall* Jan 2011 2. *NICE guidance CG21 Falls: Full Guideline*

PS02.86

BDNF altered in rat footshock acute stress model for depression

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Background: Brain-derived neurotrophic factor (BDNF) is a neurotrophin related to neuronal survival and plasticity. Several Studies have been showed that BDNF surum/plasma levels are lower in untreated patients with major depressive disorder (MDD) than in health control. Animal study demonstrated stress reduced the BDNF gene expression in hippocampus in glucocorticoid receptor impaired mice while no effect in wild-type mice.

Objectives: To explore the BDNF plasma level and BDNF mRNA expression in blood and brain in the acute stressed rats by footsshock. METHODS: Sixteen Sprague-Dawley (SD) rats were randomly attributed to acute stress group and control group. Eight rats in acute stress group were exposed to foots shocks which last for 40 min (0.8mA, 3-6 secs foots shock with 2-8 secs rest intervals), once per day for 3 days. Every day animal behavior in open field was measured. The last day animals were sacrificed. The blood and brain were taken to measure the BDNF level (plasma) and BDNF expression. Plasma BDNF level was measured with Enzyme0linked immunosorbent assay (ELISA) and BDNF mRNA expression was tested with TaqMan probes.

Results: At baseline, behavior data in open field were not different between two groups. With footshock procedure, stressed rats reduced their behavior with time. After 3 days exposed to foot shock, rats' behavior in open field was significantly reduced compared to the baseline, such as total time mobile (95.31±61.45 vs 134.37±59.51 secs, $P<0.01$) and number of line crossings (519.86±163.43 vs 858.625±235.89, $P<0.05$). Plasma BDNF level in acute stress rats was not significantly different from that in control (198.07±72.92pg/ml vs 321.34±213.05 pg/ml, $P = 0.19$), while BDNF mRNA expression in blood in stressed rats was significantly lower than that in control (0.64±0.29 vs 1.23±0.36, P0.01). Between stressed and control rats, BDNF mRNA expression in hippocampus, striatum and raphe nuclei were not different significantly. However, BDNF expression in frontal lobe was lower in stressed rats than in control, which nearly achieved statistical significant (Please see table 1)

Table 1.

BDNF compared between footshock stress rats and control rats

Conclusion: BDNF mRNA expression in acute stress rat may reduce in blood while increase in animal's frontal cortex. KEY WORD: neurotrophic factor; stress; depression; animal The study was supported by The Ministry of Science and Technology of the People's Republic of China (Project No. 2008ZX09312-003) and Shanghai Science &Technology Committee (Project No. 09411965600)

PS02.89

Rural determinants of mental health and older adults: A case for multidisciplinary collaboration?

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With nearly half of the world's population inhabiting rural areas (according to the United Nations, 49.4 percent), there is a need to consider how the social determinants of a rural environment impact mental health outcomes for older adults. The demographics of a rural environment present unique challenges and strengths for maintaining mental health, but that challenge is magnified for older adults who live in rural areas. This poster presents what it means to live and grow older in a rural community and how multidisciplinary collaboration within the rural context influences mental health for people during their later years. Social determinants of health, which include the physical environment, economics, social support, and lifestyle all play roles in the mental health of older individuals living in rural communities. This poster presentation describes what is unique about the role that social work can play within the therapeutic process by taking the vantage point that identifies the importance of social determinants and attending to the specific needs of a neglected population. This

presentation will also showcase some of the unique ways social workers can utilize the strengths of the rural setting to build and improve mental health outcomes for older adults. This is however challenging endeavor, as psychiatric resources are often thin, or non-existent. Furthermore, the availability of a trained workforce means limited access to mental health treatment and access to advances in psychiatric service delivery such as telemedicine and mobile psycho geriatric specialists. This limited service availability to older adults living within rural communities is also impacted by stigma, beliefs about help seeking, and lifestyle. Social workers can serve as brokers and advocates to bridge these gaps, and to interface with other members of an multidisciplinary team. It has been documented that social determinants impact one's mental health, and impact mental health outcomes for older adults. These social determinants include economics, behavior/lifestyle, genetics, environment, and social networks. While there is significant documentation within the literature to suggest that these factors have a major influence on one's health, the literature summarized in various reports exploring mental health conditions, etiology and epidemiology (WHO, 2008; USDHHS, 2000) also suggests that these factors individually or in combination also contribute to one's mental health. Despite this, without a multidisciplinary approach, nor intervention from social work specialists, limited advances will take place within rural settings, nor will these same social determinants play a role in older adults and mental health outcomes in rural communities, as they do in urban settings. Practitioners can take advantage of the unique strengths that a rural social support system can offer. Understanding how lifestyle, social supports, health education, and access to advances in psychiatric service delivery outcomes is a central role of social workers within a multidisciplinary team. A major key to understanding how to improve mental health outcomes for rural dwellers is through understanding the unique role that social workers can play as part of a multidisciplinary team. These unique features will be addressed as a first step in designing solutions. An exploration of how rural determinants play a role in the outcomes of one's mental health among older adults will be addressed in an effort to make the case for multidisciplinary collaboration within the psychiatric interventions delivered. Lastly some specific options for improving service delivery in rural communities through the use of social work interventions will be showcased.

PS02.90

Charles-Bonnet Syndrome: A retrospective chart review

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Background: Charles Bonnet Syndrome (CBS), characterized by the presence of complex visual hallucinations in people who have preserved insight and cognition, is frequently reported in the elderly with visual impairment. Despite existing diagnostic criteria, clinical manifestations are varied and dynamic, which makes accurate diagnosis difficult to establish. We aimed to describe demographic and clinical characteristics of persons with Charles Bonnet Syndrome through a retrospective chart review, and explore factors associated with mortality.
Methods: This was an IRB approved retrospective study. Institutional clinical databases were queried to identify medical records during a 12-year period from January 1, 1996 through 31 December, 2008 that contained the search term "Charles Bonnet.â[euro] Electronic medical records were reviewed until January 31, 2011, and demographic and clinical information were collected. Medical burden was measured using the Cumulative Illness Rating Scale (CIRS) and Charlson Comorbidity Index (CCI) scores. Kaplan-Meier mortality curves for each factor were compared using log-rank test. Cox proportional hazard model was used for multivariate analysis and hazard ratio (HR) and its 95% CI were given. SURVEXP SAS macro was used to calculate expected survival probabilities for a group of individuals based on age, calendar year, sex and race.
Results: Seventy-seven persons retrospectively identified to have a history of CBS were included in this study. Participants had a mean age of 79.47 (range 31-100), were predominantly Caucasian (97%), and the majority were female (73%) and retired (87%). Visual hallucinations were present in all subjects, of which 85% were complex visual hallucinations. 37 deaths (48%) occurred within 5 years. Using Cox proportional hazard model,

three characteristics were each significantly associated with mortality: age 75-84 (HR = 3.34, p = 0.029), age >85 (HR = 4.58, p = 0.007), renal disease on CIRS (HR = 3.39, p = 0.012). Neither the CIRS nor CCI medical burden scores were associated with overall mortality. Compared to total US population if age and gender were matched, our CBS study group had a higher mortality (p<0.0001).

Conclusions: Our study group of patients with a history of CBS had a high mortality rate that was highly associated with older age and renal disease. There was lack of evidence to associate overall medical burden with mortality. Larger studies are needed to further explore this finding.

PS02.91

Implementing the National Pain Guideline at a geriatric hospital ward: Not as easy as 1-2-3

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Background: Recently, a National Pain Guideline on pain recognition and management was implemented in all hospitals in the Netherlands. Aim of this guideline is to improve early recognition and better treatment of pain in patients by daily monitoring of pain scores, particularly in postoperative patients. It has been reported that over 65% of elderly hospitalized patients experience pain. Pain is underestimated and undertreated in elderly in general. In elderly patients suffering from cognitive decline pain is also an important causal factor of behavioral problems and symptoms of dementia (BPSD). The preferred instruments for pain measurement in the National Pain Guidelines is the Numerical Rating Scale (NRS) However, the use of NRS is difficult for patients with cognitive decline. Observational pain scales as the PAIN-AD validated in nursing homes might also be a useful alternative in hospitalized elderly patients with cognitive decline.

Aim of the Study: To determine whether daily monitoring of pain scores in geriatric patients by our nursing staff could be achieved using the NRS or PAIN-AD. Furthermore, to assess if there was a difference in global cognitive function between the NRS and PAIN-AD group. Finally, we recorded number and changes of prescription of analgesics during the study.

Material and Methods: Before onset of the study all nursing staff and medical staff were instructed about the study protocol by the investigators. All patients admitted to the geriatric ward of a teaching hospital during a six week period from December 1st 2010 until January 15th 2011 were prospectively monitored for presence of pain by the nursing staff. The PAIN-AD scale was used by the nursing staff if in their opinion patients were unable to give a numerical score due to cognitive decline or confusion. Number of prescribed analgesics per patient were recorded at admission and at the end of the study duration or discharge from hospital. The number of changes in prescribed analgesics was also recorded. For each patient global cognitive performance was measured by Mini Mental State Examination (MMSE). Statistical analysis by comparisons of the mean (SPSS 11).

Results: 30 patients were admitted to the geriatric ward during the study period. The majority of patients were women (N = 12, 60%). Mean age was 83.8 (SD 7.4) years. Mean duration of stay was 16.8 (SD 7.8) days. Patients unable to give a numerical score (N = 8, 27%) had lower MMSE scores (mean 15 points, SD 3.8) compared to MMSE scores of able (N = 22, 73%) patients (mean 21 points, SD 3.7, P = 0.011). NRS score at time of admission was 2.8 points (SD 2,8) and improved with -1.4 points (mean, SD 3.5) points. PAIN-AD score improved from 3.1 (mean, SD 2.6) points to 2.5 (mean, SD 3.2) points. In PAIN-AD patients the number of analgesics at the end of the study period was higher (mean1.8, SD 0.5) required more changes during admission (mean 3.3 changes, SD 1.8). In NRS patients mean number of analgesics was 1,0 (mean, SD 0.7) after 2.0 (mean, SD 1.4) changes. Monitoring of pain was only achieved in 52% of the days that patients were admitted.

Conclusion: First, despite instruction of nursing staff and medical staff, daily monitoring of pain could not be

achieved. Second, use of NRS was possible in patients with mild global cognitive decline (MMSE 21 points) and in patients with more pronounced global cognitive decline (mean MMSE ≤15) PAIN-AD was the preferred instrument for pain measurement by the nursing staff. Finally, in patients with pronounced global cognitive decline adequate pain management required more changes and higher number of analgesics, possibly as a result of using an observational scale to monitor pain in this patient group.

Future perspective: The National Pain Guideline focuses on pain management in postoperative patients and might oversee the specific needs of geriatric and neurological (aphasia) patients admitted to hospital. Further study is needed to evaluate the most adequate pain monitoring instrument in hospitalized geriatric patients to ensure adequate pain management.

PS02.92

Diogenes syndrome: A systematic literature and case review

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Background: Diogenes Syndrome (DS) as a possible geriatric syndrome presents a growing interest internationally for its relevance in both clinical and social areas. There are, however, some inconsistencies in its definition and diverse findings as to its etiopathogenesis. Many theoretical explanations have been presented but none is recognized as sovereign due to the great diversity associated with the phenomenon and the difficulty in studying this population. The objective of this systematic review is to provide an analysis of case reports presented in scientific journals and raise awareness among professionals for this syndrome.

Methodology: The literature on DS was comprehensively reviewed and its quality of data assessed in three domains: appropriateness, feasibility and meaningfulness on the approach of the DS. B-ON, ISI Web of knowledge, EBSCO and ProQuest databases (1966-2010) were searched using "Diogenes Syndromeâ[euro] as the main keyword in English and non-English languages. Additionally, associated terms (e.g. extreme self-neglect) were combined, selecting relevant papers and frequently cited references. The literature that hasn't been formally published (grey literature) was also searched through the google search button. Some key authors were contacted to assist the selection of literature as well as in its clarification. The absence of an operational definition of Diogenes Syndrome or similar terms was the main criterion for the exclusion of articles. A total of 112 articles were considered, including 33 case reports, 21 reviews, 19 observational studies, 21 letters to the editor, 10 editorials and abstracts, and 8 guidelines. Several letters to the editor (6) and reviews (5) presented also case descriptions, which lead to an overall of 67 cases. A grid was developed for the categorization of the case reports, and the analysis set out main clinical features as well as socio-demographic variables. A comparative analysis of data presented in previous studies to assess significant trends that reaffirm the existing scientific knowledge or orient new posts was also performed. A peer-reviewed protocol guided the entire process.

Results: A highly heterogeneous description of cases was found, with individuals aged between 22 and 92 years, predominantly female (2/3), single (44%) or widowed (25%) and living alone (64%). Most cases reported old people (84%). DS was presented as having a long course of progressive decline, with an average of 8 years of evolution. Rare have been the reports of a precarious financial position which did not explain the poverty situation in which individuals lived. Living in an apartment in an urban environment was an important fact (74% of the reports present this information). This review highlights the presence of at least three DS characteristics: (i) social withdrawal (97%), (ii) physical self-neglect (92.5%), (iii) and domestic squalor (89.5%). The most common referral agents were neighbours (62%) and the main reasons for referral were emergencies due to falls and electrolyte imbalance (42%) and severe environmental degradation (35%). Predisposing and precipitating factors presented as triggers to SD were also analyzed and included dementia (19%), OCD (15%), personality disorder (15%), delusional disorder (11%), mental retardation (10%) and major depressive disorder (10%); other factors included life stressful events (45% referring to the loss of a close one, 16% to DS by proxy and 12% to

retirement) and premorbid personality traits (40%). Single and divorced individuals were presented as having previous psychopathological conditions with strong influence in the course of DS - these two groups included persons aged <60 year (16%), reflecting an early presentation of DS. About 33% of the cases, mostly old and very old widowers, showed primary DS.

Discussion: Social withdrawal appears to be the most important factor in the course of DS. It is usually a source of anguish and an indicator of quality of life reduction, and it is the main reason for not detecting the signs of risk of DS, limiting a preventive potential. For this reason, the hoarding behaviour, although not always mentioned in the case reports, is referred to as one of the main indicators for its referencing. The presentation of the DS at an early age has a different range of predisposing and precipitating factors from those that are presented at advanced ages. There are strong reasons to believe that DS should be mainly considered as a geriatric syndrome.

PS02.93

Depression and lesion location among stroke survivors in Ibadan, Nigeria

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Background: The widely disseminated findings in the 1980s of increased frequency of depression in stroke patients with left hemispheric lesion is probably the most robust clinicopathological corellations reported in psychiatry. The success of these findings may be because association betweem specific clinical symptomatology and lesion location are rare in psychiatric disorders. As iconic as these early studies suggesting a lateralised emotional response to brain injuries are, their findings have not been replicated consistently. There are no previous reports of such clinicopathological corellations among African stroke survivors to our knowledge. Objective To determine the predictive values of neuroradiological characteristics of stroke lesions on poststroke Major depression diagnosed according to the Diagnostic and Statistical Manual (DSM IV) criteria among stroke survivors in Nigeria. **Method:** A sample of convenience of 30 stroke survivors attending rehabilitation at the University College Hospital (UCH), Ibadan were studied. The neuroradiological characteristics of the stroke lesions were documented using Computerised Tomography (CT) or Magnetic Resonance Imaging (MRI) scan techniques, while the presence of Major depression meeting DSM IV criteria was assessed using the Schedule for Clinical Assessment in Neuropsychiatry (SCAN). The predictive values of the neuroradiological characteristics on the diagnosis of Major depression were determined using a logistic regression model.

Result: Nine (30.0%) out of the total of 30 stroke survivors met DSM IV criteria for Major depression. Major depression in stroke survivors had significant association with female sex after logistic regression analysis (p = 0.04., O.R = 6.4., 95% C.I = 1.16-35.44). However, hemispheric lateralisation, intrahemispheric lesion location, type of lesion, or type of stroke did not significantly predict a diagnosis of depression meeting DSM IV criteria after logistic regression analysis. These variables were however associated with various degrees of risk of developing poststroke Major depression meeting DSM IV criteria (Left sided lesion; p = 0.69., O.R = 1.38., 95% C.I = 0.29-6.60., Anterior axis lesions; p = 0.23., O.R = 2.0., 95%C.I = 0.64-6.22., Subcortical lesions; p = 0.17., O.R = 3.13., 95% C.I = 0.62-15.79). This risk was highest when haemorrhagic stroke was involved (Intracerebral haemorhage; p = 0.13., O.R = 4.0., 95% C.I = 0.66-24.37., Subarachnoid haemorhage; p = 0.10.,O.R = 10.0., 95% C.I = 0.67-149.04)

Conclusionâ[euro] Lesion location alone may not explain the high prevalence of depression among stroke survivors. The occurrence of depression among stroke may ultimately be determined by a combination of psychosocial, historical, and other biological factors. This conclusion is similar to those reported in western societies.

PS02.94

Seeing shapes and hearing textures: Two neural categories of touch

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Background: Touching for shape recognition has been shown to activate occipital areas in addition to somatosensory areas. In this study we asked if this combination of somatosensory and other sensory processing areas also exist in other kinds of touch recognition. In particular, does touch for texture roughness matching activate other sensory processing areas apart from somatosensory areas? We addressed this question with functional magnetic resonance imaging (fMRI) using wooden abstract stimulus objects whose shape or texture were to be identified. The participants judged if pairs of objects had the same shape or the same texture.

Method: We included 16 right-handed students (21-29, average 25 years old) who performed two fMRI tasks (texture recognition or shape recognition) and then filled out a questionnaire about their performance on the tasks. The experiment included several phases: an instruction on which task to perform, an instruction delay, initial exploration of stimulus, a memory delay, and a probe recognition phase with response. The stimuli were cut wooden abstract shapes, four shapes covered with four grades of sandpaper resulting in 16 unique shape/texture combinations. Each object was replicated in six exemplars, producing a total of 96 stimuli. The stimuli were presented by a robotic turntable in the scanner, and the participants used their right pointing finger to follow either the contour or texture roughness of an object in order to decide whether the sensed feature of an object is identical to or different from that of the previous object. Hence our participants carried out similar tasks for recognition of shape and texture.

Results: The participants recognized shapes better than textures (91% vs, 85%, $t = 2.8$, $p<.05$), yet the participants did not express difficulty in discriminating the textures. Most participants reported having used strategies in remembering the stimuli, they categorized the stimuli for roughness and named them subconscious, and formed mental images and named or labelled the shapes.

We found that the activated brain areas for texture and shape matching have similar underlying structures, a combination of the primary motor area and somatosensory areas. The shape task activated more regions than the texture task particularly during the memory delay between two touch phases, and especially in the occipitotemporal area. shape specific local maxima were found in areas that have been reported as visual object shape- or size-related [23, 24, 25], including bilateral superior parietal lobule, (SPL; BA7, BA5), bilateral precuneus (BA7) and middle frontal gyrus, (BA 6). Activations during the memory delay also included the left and the right inferior temporal gyrus (BA 37) within the area LOtv, which is associated with touch and/or visual shape recognition. The left interior prefrontal cortex, LIPFC, (BA47) was differentially more activated during texture recognition than during shape recognition. The LIPFC is preferentially involved in retrieval of relational information and error estimation in simple quantitative (arithmetic) tasks, in addition to semantic processes. Greater activation for the texture task also occurred in the left associative auditory cortex (BA42) during the initial exploration of the stimuli.

Conclusion: We suggest that texture roughness is recognized in a framework of ordering. Left-lateralized activations favouring texture might reflect semantic processing associated with grading roughness quantitatively, as opposed to the more qualitative distinctions between shapes.

PS02.95

Qualitative changes in ^{18} F-FDG PET-CT scans to predict the conversion of Mild Cognitive Impairment cases to Alzheimer's Disease

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Introduction: Mild Cognitive Impairment (MCI), considered as a prodromal state to dementia is characterised by a decline in cognitive functioning which is more prominent than normal aging but not severe enough to be classed as dementia. Increasing attention is focussed on identifying cases with MCI which has proved particularly challenging and requires assessment tools or biomarkers that are sensitive to subtle changes in cognition and neuro degeneration. ^{18}F-FDG PET-CT has consistently shown to detect reduced cerebral metabolic rate of glucose in MCI patients compared to age matched normal controls. Studies have largely focussed on standardised automated quantitative analysis and statistical mapping using techniques such as voxel-based analysis and analysis of regions of interest in established regions of parieto-temporal, posterior cingulate gyrus and medial temporal cortices. While these processes may offer an objective analysis, qualitative analysis of individual cases in multiple regions helps in detection of distinctive features that ordinary clinicians can apply in everyday practice. Longitudanal studies with serial scans focussing on the regions of reduced cerebral metabolic rate of glucose offer more insight into the progression of disease and help in predicting cases of MCI that are like to convert to dementia

Aims and Objectives: The objective of the present study is to qualitatively identify and analyse reduced cerebral glucose metabolism in multiple regions of the brain with the help of ^{18}F-FDG PET-CT scan and to identify regions of brain that are most likely to predict onset of Alzheimer's Disease through sequential yearly scans. We are presenting preliminary findings on 11 subjects who are clinically categorised as having Mild Cognitive Impairment through comprehensive neuropsychological testing. All the 11 subjects had two ^{18}F-FDG PET-CT scans one year apart and underwent neuropsychological testing prior to the two scans. All the subjects had their PET-CT scans reported by a consultant Radiologist, an expert in Nuclear Medicine (S.H.)

Results: Of the 11 subjects, 6 remained clinically stable in neuropsychological cognitive assessments and 5 showed a decline in their cognitions after the first scan. Of the 6 stable subjects, the first ^{18}F-FDG-PET CT scan was reported as having established Alzheimer's Disease in two subjects, three as Normal and one as Vascular Dementia. Of the 5 subjects that showed decline in cognition, two had Normal scans, one each of Alzheimer's Disease, Vascular Dementia and Mixed Dementia. Of the 5 subjects that showed clinical decline in their cognitions, reduction of activity either unilaterally or bilaterally was found in Medial Frontal, Anterior Parietal and Medial Temporal lobes in all the subjects. 4 of the subjects had reduction in Superior Temporal lobe. Reduction in Posterior Parietal, Lateral Temporal, Posterior cingulate gyrus and General Frontal was seen in two subjects and Superior Parietal region reduction was only seen in one subject. Precuneus, Posterior Frontal, Medial and Lateral occipital activity reduction was not seen in any of the subjects. Maintenance of activity in Angular gyrus was seen in 4 subjects and in the Sensorimotor cortex in 2 subjects. Of the 6 subjects that were stable in their cognitions clinically, all the subjects had reduction in activity either unilaterally or bilaterally in Anterior Parietal and Superior Temporal regions and Medial Frontal activity reduction was seen in 5 subjects. Medial Temporal lobe activity reduction and maintenance of activity in Angular gyrus was seen in 4 subjects. Reduction in Superior Parietal, Lateral Temporal and Posterior Cingulate gyrus is seen in 3 subjects **Conclusion:** Reduction in Parieto-Temporal lobe activity appears to be a consistent feature in people with MCI. The current sample is too small to draw any definitive conclusions from other regions of the brain. Qualitative changes in ^{18}F-FDG-PET CT scans can be useful method for clinicians in everyday practice to predict cases that are likely to progress to dementia.

PS02.96

Amyloid imaging with [11C]SB-13 PET in patients with mild Alzheimer's disease: A test-retest reliability study of distribution volume ratio estimates

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Background: The purpose of this study is to assess the reliability of in-vivo beta-amyloid imaging with [11C]SB-13 positron emission tomography (PET) in patients with mild Alzheimer's disease (AD). The validity had been previously assessed by comparison with [11C]PIB PET (Verhoeff et al. 2004).
Methods: Ten mild AD patients (7 males, 3 females; age 72 ±13 years; MMSE scores 22.3 ±2.9) each underwent a magnetic resonance imaging (MRI) scan and two 90-minute PET scans following about 370 MBq intravenous administration of [11C]SB-13. The test-retest intervals for the PET scans were 42 ±17 days. Regions of interest were created using a semi-automated brain region extraction from the MRI images, which were then coregistered with the PET images. Distribution volume ratios (DVRs) were calculated by adding 1 to the following estimates of the beta-amyloid binding potential (which is proportional to the product of the density of the beta-amyloid binding sites and the affinity of [11C]SB-13 for these sites): (1) Lammertsma's simplified reference tissue models version 0 (SRTM) and version 2 (SRTM2), and the 4-parameter reference tissue model (4PTRM); or (2) Ichise's noninvasive multilinear reference tissue models version 0 (also called Ichise's non-invasive plot or MRTM0), version 1 (MRTM), and version 2 (MRTM2). Coefficients of variation (COVs: [standard deviation / average] * 100%) for the DVRs were calculated. **Results:** Average ±standard deviation of the COVs for of the [11C]SB-13 PET DVRs for all brain regions combined for the 10 mild AD patients were 3.6 ±3.5% (SRTM), 7.1 ±10.8% (SRTM2), 3.3 ±2.5% (4PRTM), 2.0 ±0.9% (MRTM0), 4.0 ±3.2% (MRTM), and 4.6 ±4.6% (MRTM2).
Conclusions: Our preliminary data suggest that [11C]SB-13 PET DVRs are reliable in mild AD patients. Research is ongoing to compare which DVR provides optimum effect sizes reflecting the ability to distinguish mild AD patients from controls. Reference: Verhoeff NPLG, Wilson AA, Takeshita S, Trop L, Hussey D, Singh K, Kung HF, Kung MP, Houle S. *In vivo imaging of Alzheimer disease β-amyloid with [11C]SB-13 PET. Am J Geriatr Psychiatry* 2004; 12: 584-595.

PS02.97

Stressful and non-stressful testing environments in relation to hippocampal volume, stress hormone levels, and memory performance among young and older adults

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Background: It is generally believed that with aging, memory performance degenerates. Such impairments may be related to decreases in hippocampal volume (HV), a structure involved in memory and stress regulation. Moreover, higher levels of stress hormones (cortisol) impair cognitive performance in laboratory contexts. It is, however, unknown whether testing environments themselves might function as stressors. Goals: A) to compare cortisol levels in the testing environment and basal levels at the corresponding time of the day. B) to compare memory performance of older and young adults when tested in testing environments manipulated to induce higher or lower distress for each age group, C) to assess whether HV is associated with memory in both environments, D) to investigate whether cortisol levels are associated with HV in the different environments.
Methods: Thirty two healthy older adults (ages 60 to 75) and twenty eight young adults (ages 18 to 35) were each tested in two different environments: 1) Montreal Neurological Institute (MNI - stressful for older adults, non-stressful for young) on university grounds, PM testing by a young graduate-student; 2) Douglas Hospital (DH - non-stressful for older adults, stressful for young) AM testing by an older adult in an environment familiar to older adults. Declarative memory tasks and salivary cortisol were repeatedly assessed in both environments.

MRI scans were performed for HV measures. Baseline cortisol levels were obtained through sampling over two days in participants' natural (home) environments.
Results: A) T-tests showed that in the non-stressful testing environment for older adults (MNI), their cortisol levels were significantly higher than their afternoon basal levels at home. This difference was not observed among young adults. B) One-way ANOVAs revealed that in the non-stressful environment for older adults (DH), their forgetting rate was equivalent to that of young adults. By contrast, they were more forgetful in the stressful environment (MNI). C) Correlations revealed that HV was associated with memory only in the stressful environment, among older adults. D) Correlations showed that HV was associated with cortisol when older and young adults were tested in stressful environments for their respective age groups. This association was not observed in non-stressful environments.
Conclusions: Our results demonstrate that in the stressful environment for older adults, they secreted higher levels of cortisol compared to their basal levels and their HV is associated with memory performance. Only in the non-stressful environment, older adults show equivalent forgetting rate to young adults. For both older and young adults, HV is associated with cortisol levels in the stressful environment. Considering that older adults may be more susceptible to stress-induced memory impairments, these findings highlight the importance of the stressful nature of testing environments, which can artificially obscure interpretations of age-related memory impairments.

PS02.98

Altered brain white matter integrity in carriers of the APO E epsilon4 allele with late onset depression: A risk for Alzheimer's disease?

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Background: The apolipoprotein E (APOE) epsilon 4 gene has been considered to be the major genetic risk factor for Alzheimer's disease (AD). The effect of APOE polymorphism on brain white matter integrity still remains unclear in late-onset depression (LOD). The aim of the study is to investigate the relationship between the alteration of white matter integrity and the effect of APO E4 gene in the patients with LOD and elucidate the effect of APO E4 in the LOD patients as a risk factor of AD. **Methods:** A total of 60 patients with LOD and normal controls were investigated with tract based spatial statistics (TBSS) which is a newer voxel based diffusion tensor imaging analysis method. We tested for differences in white matter integrity among the LOD patients without APOE4 allele (n = 20), with APOE4 allele (n = 20) and healthy elderly controls (n = 20).
Results: The results showed a decline in fractional anisotropy (FA) and increase of mean diffusivity (MD), a marker for white matter integrity, in the posterior corpus callosum and posterior cingulate of LOD patients with APOE4 allele compared to LOD patients without APOE4 allele. In addition, decline in FA and increase of MD in anterior cingulate, orbito-frontal gyurs and anterior corpus callosum were observed in the LOD patients without APOE4 allele compared to the controls. More extensive white matter integrity alteration in anterior corpus callosum, posterior corpus callosum, right hippocampus, anterior and posterior cingulate were also observed in the LOD patients with APOE4 allele compared to controls.
Conclusion: Our findings support the hypothesis that the LOD with APOE4 genotype might be associated with alteration of white matter integrity in the posterior portion of brain in LOD and increase the risk of AD in LOD patients

PS02.99

White matter changes in late-life depression: A diffusion tensor imaging study

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Background: Late-life depression (LLD), often defined as depression in people over the age of 60, is common and associated with disability and cognitive impairment with high probability of relapse. There is now growing evidence that vascular lesions may also increase an older individual's risk of developing depression. Several studies have identified white matter changes in LLD, including increased volumes of white matter hyperintensities (WMH) on magnetic resonance imaging (MRI) and microstructural abnormalities determined by diffusion tensor imaging (DTI). DTI measures the diffusion of water in biological tissue. If there is mobility of water molecules in all directions, diffusion is described as isotropic, whereas if mobility is restricted in any direction, diffusion is anisotropic. Measures most commonly derived from diffusion data include fractional anisotropy (FA) and mean diffusivity (MD). FA quantifies the directionality of local tract structure, while MD measures the overall displacement of water molecules. Typically, DTI abnormalities are represented by reduced FA and/or increased MD. At present, DTI studies have used mainly region of interest (ROI) procedures to quantify FA in LLD. A relatively new technique has now been developed for the analysis of DTI datasets, an automated tract-based spatial statistics (TBSS) method that potentially improves the objectivity and interpretability of DTI analyses. To our knowledge this is the first DTI study using the TBSS approach to investigate white matter abnormalities in LLD and similarly aged healthy individuals.
Methods: Thirty eight patients (age >60 years) with a history of a current or previous major depressive episode (DSM-IV criteria) were recruited with a group of 30 healthy older individuals with no psychiatric history. Subject assessments included family history of depression, previous psychiatric history, medical history and current medication. Depression severity was rated using the Montgomery-Asberg Depression Rating Scale (MADRS) and the 30-item Geriatric Depression Scale (GDS). All participants underwent DTI on a 3.0 Tesla Achieva MR scanner following clinical and cognitive assessments. Diffusion images were acquired with FLAIR weighting to reduce the influence of CSF. Acquisition parameters were repetition time (TR) = 7000 msec, echo time (TE) = 68 msec, inversion time (TI) = 2200 msec. SENSE factor = 2, slice thickness = 2.5 mm, field of view 260 ×260 mm, acquisition matrix 120 mm ×93 mm. Two b values: 4 acquisitions with b = 0 sec.mm-2, and 30 gradients (1 acquisition each) with b = 1000 sec.mm-2, with gradient directions uniformly spaced around a sphere. The Functional MRI of the Brain (FMRIB) software library (FSL v 4.01) was used to process the raw DTI data generating aligned FA and MD images. Voxelwise analysis of FA and MD parameters were carried out using TBSS. Group differences in DTI parameters and associations with clinical features were examined using permutation-based nonparametric procedures (randomise v.2.1). For such analyses, 5000 permutations were generated with age included as a nuisance variable, producing uncorrected and familywise error (FWE) corrected statistical maps. Analysis threshold of was set to $p \leq 0.05$.
Results: Compared to controls, uncorrected maps revealed patients with LLD exhibited lower FA in white matter regions of bilateral frontal, right temporal and midbrain relative to older healthy subjects. Specifically, frontal white matter structures included bilateral middle frontal gyrus (left: $p = 0.027$, right: $p = 0.035$) as well as left superior ($p = 0.033$), medial ($p = 0.044$) and inferior ($p = 0.046$) frontal gyri. In addition, temporal white matter structures included the middle ($p = 0.032$), fusiform ($p = 0.035$) and parahippocampal ($p = 0.035$) gyri. Regional differences in FA and MD (FWE corrected); between LLD and healthy older individuals did not reach statistical significance. Regressing out the effects of age, associations between FA and MD imaging data on depression variables (GDS, MADRS, age at depression onset, duration of depression) in LLD were also investigated (uncorrected and FWE corrected), yielding no significant results ($p > 0.05$).
Conclusion: Findings are suggestive of loss of integrity in white matter fibres within frontal, temporal and midbrain regions, increasing the evidence that implicates disruptions to the limbic-orbitofrontal networks in the pathogenesis of LLD. However, as results did not survive strict control for multiple comparisons, they should be considered tentative and replication in larger cohorts is needed.

PS02.100

BDNF mRNA expression in rat hippocampus elevated in the chronic mild stress model for depression

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Background: Brain-derived neurotrophic factor (BDNF) is a neurotrophin related to neuronal survival. Several Studies have been showed that BDNF surum/plasma levels are lower in untreated patients with major depressive disorder (MDD) than in health control. Animal study demonstrated stress reduced the BDNF gene expression in hippocampus in glucocorticoid receptor impaired mice while no effect in wild-type mice. OBJECTIVES: To explore the BDNF plasma level and BDNF mRNA expression in blood and brain in the chronic unpredictable mild stress (CUMS) rat.

Methods: Sixteen Sprague-Dawley (SD) rats were randomly attributed to CUMS group and control group. Rats in CUMS group were exposed for 6 weeks to a variety of mild unpredictable stressors applied in a random order. The following stressors were applied: water deprivation for 16 hours following with 1 hour empty drinking bottle, food deprivation for 24 hours, swimming in water 0°C for 5 min, swimming in water 45°C for 5 min, footsshock for 2.5 min, soiled bedding for 24 hour, restrained fro 3 hour, clapped tailed for 3 min. Each rat in both groups were feed separately At baseline and endpoint, sucrose preference and weight were calculated, open field test were applied. Animals were sacrificed the blood and brain were taken to measure the BDNF level (plasma) and BDNF expression. Plasma BDNF level was measured with Enzyme0linked immunosorbent assay (ELISA) and BDNF mRNA expression was tested with TaqMan probes.

Results: At baseline, the weight, sucrose preference, and behavior data in open field were not different between two groups. After 6 weeks exposed to stressor, rats' weight and sucrose preference were lower than the control (516.60±21.04g vs 427.43±19.66g, 73%±10% va 60%±14%, $P < 0.05$ respectively). In open field, the behavior of stressed rats increased significantly compared to the control rats, such as total time mobile (234.38±123.61 secs vs 114.39±53.82 secs, $P < 0.05$) and rotations of the animal's body (12.50±5.18 vs 7.71±3.15, $P < 0.05$). Plasma BDNF level in CUMS rats was not significantly different from that in control (105.58±51.22pg/ml vs 150.61±123.18 pg/ml, $P = 0.33$). For the BDNF mRNA expression, between CUMS rats and control rats those in blood((1.92±2.72 vs 1.51±1.25, $p = 0.56$), raphe nuclei (7.09±7.87 vs 44.46±83.65, $p = 0.80$), front cortex (3.58±3.19 vs 2.41±4.57, $p = 0.27$) and striatum (2.26±3.68 vs 4.25±4.76, $p = 0.30$) were not different, nevertheless, BDNF expression in hippocampus of CUMS rats were higher than that in control, the different nearly achieved statistical significant (6.24±8.82 vs 1.22±1.53, $p = 0.06$).

Conclusion: Chronic mild stress may increase BDNF mRNA expression in hippocampus in rat. The study was supported by Shanghai Science &Technology Committee (Project No. 09411965600) and Shanghai Jiao Tong University, School of Medicine (Project No. BXJ0938)

PS02.101

Berkson's bias: The differential hospital admission rate bias

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Objective/Introduction: The concept of Berkson's bias is reviewed in this poster. Berkson's bias often gives problems in case control studies. A more descriptive name is the 'hospital admission rate bias'. Berkson's bias was first described for case control studies in 1946 [1]. It is produced when the probability of hospitalisation of cases and controls differ, and it is also influenced by the exposure. It is the distortion of the odds ratio, or the hazard ratio that is described as Berkson's bias.

: A search for literature in Medline and EMBASE with keywords: 'Berkson's bias', 'Berkson's fallacy' or 'Berkson's paradox' and 'differential hospitalisation rates'. In Web of Science® a search for Berkson's original article [1] was performed to search for 'Times cited'.

Results: Psychiatry is more prone to comorbidity, and therefore more often will have to quote Berkson's article in the discussion of these matters (psychiatry, 31% of all, and clinical neuroscience, 11%). The most important contribution was made by Boyd in a lucid analysis, giving a mathematical and graphical explanation to the problem [2].

Conclusion: Berkson's bias is a phenomenon that can never be fully avoided in case control studies when involving hospital-based settings. This means, that discussion of whether or not Berkson's bias is present in a given case control study should be avoided. The important question is, if it is possible to design a means of measuring the size of Berkson's bias in an actual study. After this is established it is much simpler to test whether the claimed association in a case control study exists in spite of Berkson's bias. What to look for in studies prone to Berkson's bias is discussed. Key words: affective disorders, Berkson's bias, case control studies (1) Berkson J. Limitations of theapplication of fourfold table analysis to hospital data. Biometrics Bull 1946; 2:47-53. (2) Boyd AV. Testing for association of diseases. J Chronic Dis 1979; 32(9-10):667-672.

PS02.102

Psycogeriatric profile of a patient attending a psychiatric department

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According to data from literature, the elderly are: *a growing population, with significant psychiatric morbidity with major consequences * a population less studied in psychiatric research * are a vulnerable population at risk, which has specific needs and problems so should be a priority group in the provision of mental health care; So it is necessary to improve the delivery of caring for this specific population and bring them to the needs. It is therefore essential to know the reality (problems and needs) of the population that one attends. So the decision of the purpose of this study was to assess the psychogeriatric profile of a patient attending a psychiatric department. Knowing our reality, the reality of the patients we serve at our psychiatric care, we can plan structures that can respond to their needs. The general aim of this study is to understand the socio-demographic and clinical characteristics of patients older than 65 years, who attend the psychiatric department of a general hospital. We had as specific aims: *To determine the percentage of older patients who come to the psychiatric service and know their sociodemographic profile and clinical profile. * What are the most common diseases. * To know the frequency of mental illness depending on age. * What are the main problems presented by these patients and their severity. * What is the percentage of patients at risk of suicide. * Identify socio-demographic or clinical differences between patients with higher or lower risk of suicide. * Identify differences in the profile of patients according to groups of mental illness. It is a cross-sectional descriptive study, with data collected over a one-year period from the medical records of patients 65 years old or older who came to a psychiatric consultation. The data collected included socio-demographic variables, clinical variables, and data obtained using the SAD PERSONS scale for assessing the risk of suicide, and the HoNOS scale. The study includes 291 elderly patients who account for 17.7% of the population attending this service. Most of the sample either had no psychiatric history or have only had psychiatric symptoms after the age of 65. Mood disorders (depressive episodes) and Organic disorders (dementias) predominated; with the first predominating from 65 to 84 years, and dementia after that. A significant psychiatric comorbidity was found and is associated with an increased risk of psychiatric hospitalization and previous suicide attempts. An important finding of this study is that 11% of patients had an elevated risk of suicide; if to these we add those who had only increased risk of suicide, the total is 61% of the sample. Statistically significant variables associated with increased risk include being male, having a history of suicide attempts, recent hospitalization, and the presence of neurodegenerative disorders. Patients with an elevated risk have a corresponding increase in the HoNOS scale, predominantly in the clinical and social subscales. Therefore, we concluded that a significant percentage of elderly patients need specialist psychiatric care, and have specific needs, so it becomes essential to have specialized services organized around the characteristics of this group and to promote the training of geriatric psychiatry professionals.

PS02.103

Cognitive associations of benzodiazepine use in older adults

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Use of prescription medications for various conditions is highly prevalent in older adults, often leading to the use of multiple medications. The resulting polypharmacy is widely recognized as a risk factor for many negative outcomes, but less is known about the risks of specific types of medication upon cognitive functions. Benzodiazepines are commonly prescribed for the treatment of anxiety and insomnia, among other conditions. While dependency with continued use has been the subject of much concern over this type of medication, other literature has suggested an increased risk of cognitive impairment with chronic use of benzodiazepines. The nature of the cognitive changes and the domains of cognitive function most likely to be affected have differed across various studies. Here we describe the associations between measures of various domains of cognitive functioning and benzodiazepine use in 2879 older Canadian adults from the Canadian Study of Health and Aging (CSHA; 64.3% female, mean age 81.0 years, SD = 7.44). These people underwent a comprehensive medical and psychosocial evaluation that included a record of medications used, in addition to a complete personal and medical history. The CSHA was a community-based epidemiological study of the prevalence of dementia and its associated risk factors in over 10,000 Canadians. Benzodiazepines were classified according to their half-life: short (under 12 hours), medium (12 to 40 hours) or long half-life (over 40 hours); 35 elderly people were excluded since they were taking more than one class of benzodiazepine. A comprehensive neuropsychological battery that assessed the major domains of cognitive functioning was administered to all participants who completed the CSHA clinical assessment. Neuropsychological test scores for the domains of short- and long-term memory, abstract reasoning, judgement, visuoconstruction, and language formed were the primary independent variables, while gender, age, and years of education were used as covariates in logistic regression models predicting use of each class of drug. Education was not a significant covariate for any analysis. Gender proved to be a significant covariate in the case of the medium-half life drugs, but not for the other two classes. Age was a significant covariate for the majority of test scores for the short and long half-life drugs. After controlling for the covariates, the results showed a broader range of cognitive impairments with the use of short half-life benzodiazepines than with the medium half-life or the long half-life benzodiazepine compounds. Six cognitive measures, assessing abstract reasoning and comprehension, verbal fluency, verbal memory, and visuoconstruction skills (Block Design), showed poorer performance among those who used short half-life benzodiazepines, two measures, those of abstract reasoning and comprehension, showed impaired performance by those using medium half-life benzodiazepines, and three measures, for abstract reasoning, verbal memory, and visuoconstruction skills, showed lower performance by those taking long half-life benzodiazepines. Wechsler Similarities, the measure of abstract reasoning, was the only showing significant differences common across all three drug class models. Results are discussed in terms of both the relative extent of lower neuropsychological test scores and the context of increasing evidence of impaired functioning associated with benzodiazepine use.

PS02.104

The psychogeriatric inhospital consultations

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Introduction: The Italian population is aging rapidly as in all industrialized societies: the number of over 65 subjects will proliferate to 34.5% in 2051, with increasing costs of 61%. The half of hospitalizated patients is over 65 years old and the percentage of psychiatric consultations for elderly patient is increasing from 20 to 50%. The clinical characteristics of these patients consist of psychosomatic and somato-psychiatric comorbidity with aspects of social frailty (WHO hypercomorbidity) and of complexity for more and more severe physical and mental needs. AIM: To describe the psychogeriatric activity (965 consultations) carried out in the S. Orsola-Malpighi University Hospital of Bologna from 2000 to 2010 and to analyze various aspects of the inhospital consultation process (reason of request, type of diagnosis, comorbidity, interventions).

Case Study: The age range of the patients is 61-99 years old, the half of the subjects is over 80 y. and the 55% is represented by females. The majority of requests came from the Internal Medicine Depts (64.7%) and secondly from the Specialist Wards (32%).
Results: Regarding the evaluated requests, the Mini Mental State Examination showed a mean score of 17.5 ±10.2. The primary reason of requests was to support colleagues during the diagnostic process (65%), in second instance for pharmacological therapy adjustment (multiple drugs with side effects and adverse reactions, anti-psychotics prescriptions), then for not self-sufficiency certification and promotion of local services of social care (depression and loneliness). To make an accurate clinical diagnosis it was necessary more time availability in order to listen to the patient, the family and sometime the private caregiver too. For these reasons a third or fourth anamnesis was carried out. It is worth pointing out that the comorbidity in these patients is composed by neuropsychiatric pathology (dementia, depression, delirium, Parkinson disease, seizures, chronic mental disorders) associated with the somatic one (TIA, stroke, syncope, falls, heart failure, arrhythmia, thyroid dysfunction, decompensated diabetes). The majority of the diagnosis reported was represented by cognitive impairment (37.7%), delirium (19.9%), depression (13%), agitation and behaviour disorders (10.3%). The primary interventions after the diagnosis were drug therapy adjustment (75%) associated in selected cases to environmental treatment, additional appropriate diagnostic investigations (17.6%), and the creation of an assistance community-hospital network. Comorbidity (CIRS), drug politheraphy (number of drugs ≥4) and malpractice were noteworthy points for their progressive increase in our frail and complex elderly population.
Conclusions: In psychogeriatrics, in our opinion, it is necessary to evaluate the patient as a whole bio-psycho-social entity in order to perform an accurate clinical differential diagnosis (listening skills and collection of complete medical and neuropsychiatric history). Accordingly the intervention on psychological and environmental factors might play a role as important as drug treatment. The continuing care process is a priority for improving the disease management pathways together with better communication among specialists in order to avoid the so-called "interprofessional wanderingâ[euro]. From our experience, the family interview became essential when there was a difficult interpretation of the hospital admission reasons. Furthermore it emerges from the study the lack of preparation on behalf of the sanitary operators and their inadequate organization skills, last of which it is the missing priority approach towards the type of environment, even if recommended, for the management of the BPSD. Our consultation experience is fully reflected in the words of D. Folks published on International Psychogeriatric Association Bulletin Editorial (2004): "the psychogeriatrics isâ[euro] good medicine ", which can give relief to our patients, their families and also to colleagues who have requested our intervention.â[euro]

PS02.105

Prevalence and course of neuropsychiatric symptoms in geriatric patients with stroke: a dutch multicenter study

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Objective: The aim of this study was to investigate the prevalence and course of Neuropsychiatric symptoms (NPS) in geriatric patients admitted to skilled nursing facilities (SNFs) for rehabilitation after stroke.
Design: This study was part of the Nijmegen Geriatric Rehabilitation in AMPutation and Stroke study (GRAMPS), which is a longitudinal, multicenter, observational study of geriatric patients admitted to SNFs for rehabilitation after either stroke or lower-limb amputation. Data of one hundred forty five patients with stroke were collected from January 2008 until January 2009 in 15 Dutch SNFs.
Measurements: NPS were assessed with the Neuropsychiatric Inventory - Nursing Home version (NPI-NH) with measurements at baseline and admission. The prevalence and course of NPS were described in terms of cumulative prevalence (symptoms either on admission or at discharge), conversion (only symptoms at discharge), remission (only symptoms on admission) and persistence (symptoms both on admission and at discharge) for patients who were discharged to an independent living situation within one year after admission

and patients who stayed in the SNF for long term care.

Results: Eighty percent had have a first-ever stroke and almost 75% were successfully rehabilitated. Overall, the most common NPS were depression, eating changes, night time disturbances and anxiety. Patients who were not discharged after one year showed significantly higher frequencies of hallucinations, delusions, agitation, depression, disinhibition, irritability and night time disturbances than those who could be discharged to an independent living situation within one year. Depressive symptoms either on admission or at discharge were more present in patients who stayed in the SNF. Depressive symptoms disappeared in an equal proportion for patients who were discharged and patients who stayed in the SNF. Night time disturbances (either on admission or at discharge) were more present in the patients who stayed in the SNF after one year, than those who were discharged to an independent living situation after one year. Eating changes were twice as much present in patients who stayed in the SNF than patients who were discharged to an independent living situation. On admission, half of patients who stayed in the SNF had minimally one symptom and at discharge it was two thirds.

Discussion: The overall prevalence of NPS in this study was lower than reported by other studies in different settings. High prevalence of NPS occurred in patients that could not be discharged. This finding suggests that NPS should be optimally treated to ensure a good outcome of rehabilitation. Whether and to which extent cohesion exists between different NPS is unknown. It is possible that sleep disturbances, reduced appetite and anxiety are all symptoms of the same underlying process: mood disorder. To determine whether depression is an independent predictor of negative rehabilitation outcome, research in this geriatric population is necessary. It is possible that patients that cannot be discharged to an independent living situation are more likely to become depressed. Dealing with an unexpected negative outcome from rehabilitation, and admission to a long term care facility can be difficult. Therefore, the possible association between disability and depression would be an interesting topic for further research.

PS02.106

Small-scale, home-like dementia care environments: Effects on nursing staff

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Introduction: Currently, there is a trend in long-term dementia care towards deinstitutionalization. Traditional large-scale nursing homes are transformed into or replaced by small-scale and homelike facilities. In these facilities, a small number of residents live together in a homelike environment. Nursing staff is part of the household. Residents are encouraged to participate in daily household activities, emphasizing normalization of daily life with person-centered care. This cultural change emphasizes values such as quality of life, wellbeing, preserving autonomy and enabling residents to maintain their own lifestyle. Nursing staff employed in these facilities have different (e.g. more integrated) roles and tasks compared to staff employed in traditional larger facilities. Despite the increase of small-scale facilities, relatively little is known about the effects of its work environment on nursing staff's well-being (such as job satisfaction). This study investigates the effects of working in small scale living facilities on staff's job satisfaction and motivation.

Methods: In a quasi-experimental study, two types of long-term institutional nursing care conditions were included: 28 small-scale living facilities and 21 regular psychogeriatric nursing homes wards. At baseline and at follow-ups after 6 and 12 months nursing staff were assessed using self-report questionnaires. A total of 305 employees were enrolled in the study: 114 working in small-scale living facilities (intervention group) and 191 in regular wards (control group). The primary outcomes were job satisfaction and job motivation. Secondary outcomes included several job characteristics (such as job autonomy, workload, perceived social support and

physical demands) and burnout symptoms. Data were analyzed using multi-level analysis.
Results: Groups were comparable on baseline characteristics, except that nursing staff members working in small-scale living facilities were employed shorter and were more often women compared with staff working in regular wards. In the total group of employees no significant differences were found on job satisfaction and job motivation. Subgroup analysis showed that staff working in the most typical small scale living facilities were more satisfied ($p<.01$) and motivated ($p<.05$) than staff working in most typical regular wards. These differences were present at baseline and remained stable over time.
Conclusion: On the main outcome measures job satisfaction and job motivation no convincing effects were found. Differences in the subgroup analysis suggests that the degree of small-scale organizational climate may affect outcomes. With the changing role of nursing staff, more insight is required in their skills and competencies. Furthermore, future research should focus on how to provide adequate training and education. This is essential for future dementia care, since there is a critical shortage of well-trained and highly educated nursing staff specialized in geriatric and dementia care.

PS02.107

Person-centered attitude, job demands and resources of healthcare staff: The relationship with staff well-being

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Objectives The last decades, nursing home care for people with dementia increasingly focuses on the person rather than the disease. Person-centered care is not only assumed to increase the quality of life of residents with dementia, but also the well-being of healthcare staff. It is assumed that a more person-centered attitude has a positive effect on job satisfaction. On the other hand, organizational barriers can cause strain when staff cannot do what they think is best for the residents. This study focuses on the relationship of the person-centeredness of healthcare staff providing nursing home care for people with dementia and their perceived demands and resources, on staffs' wellbeing (job satisfaction, intention to leave, emotional exhaustion and personal accomplishment). Results on this relationship are presented.
Methods: This study uses data from the Living Arrangements for people with Dementia (LAD-) study. This is a nation-wide study of a wide range of living arrangements (n = 136) providing nursing home care for people with dementia in the Netherlands. To gain insight into staff wellbeing 15 randomly selected nursing staff members have been asked to fill in a self-report questionnaire on their attitude toward people with dementia (ADQ), job characteristics, job satisfaction, intention to leave (LQWQ), emotional exhaustion and personal accomplishment (Dutch version of MBI: UBOS). A total of 1147 healthcare staff participated, resulting in a response of 59%.
Results: Healthcare staff were on average 43 years old. Most of the healthcare staff (74%) had educational level 3, this is equivalent to certified nursing assistants (CNA), and worked between 16 and 24 hours per week (33%). Multilevel linear regression analysis showed that a more person-centred attitude toward people with dementia of healthcare staff is related to more job satisfaction and more personal accomplishment. On the other hand, results showed that healthcare staff with a more person-centred attitude experience more exhaustion at high levels of demands and are more likely to leave the job when they experience low levels of social support from their supervisor than healthcare staff with a less person-centred attitude.
Conclusion: Healthcare staff with a more person-centered attitude were found to be more satisfied with their job and felt more professionally competent. In addition, this study shows that when the job environment is demanding and non-supportive, healthcare staff with a person-centered attitude are at a higher risk of becoming emotionally exhausted and are more likely to leave the job. This indicates the importance of creating a work environment in which healthcare staff feels supported by their supervisor and do not experience too much pressure in order to maintain healthy staff with a person-centered attitude to successfully provide person-centered care for people with dementia.

PS02.108

Survey of psychiatric nursing staff experience of and attitudes towards a psychiatric intensive care unit (PICU) for older men in a Scottish health region

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Background &Aim: The Scottish Government's national mental health benchmarking project defined PICUs as: ". . .a multi-disciplinary team with specialised training; the ratio of nursing staff will be higher than a general psychiatric ward. The service is recovery focused; it provides intensive treatment and interventions to patients who present an increased level of clinical risk and require an increased level of observation.â[euro] (Scottish Government, 2008). Fife, a region in Scotland with a population of 360,000, has a ten-bed PICU for males over the age of 65 years, or younger if the primary diagnosis is of dementia, that was established in 2002 and provides a function for the older adult population similar to PICUs for general adults (Stevenson et al., 2007). The study aim was to examine psychiatric nurses' views on criteria for psychiatric intensive care for older adults by comparing acute and PICU staff in the older adult services.

Methods: Questionnaires, which were sent to all nursing staff working in mental health NHS admission wards for older adults in Fife, examined: staff demographics; experience of working in PICUs; personal experience of physical harm from patients; likely responses to assist in PICU and other non-PICU wards; role in deciding admissions and discharges from PICU; and, reasons for admission to the PICU. Questionnaires for staff in the PICU unit included an additional question that enquired of possible reasons for refusing admission or transfer to the PICU. Statistical analyses were performed.

Results: A 75% response rate (45 staff from older adult (OA) and 11 staff from PICU ward) with 86% staff female, majority trained, 75% with more than 5 years' experience. The majority of staff considered PICUs to be necessary, many felt safer at work as a result of such a unit, but a minority reported that the presence of a PICU deskilled staff on OA wards in managing behavioural disturbances in patients. Of responders, 77% had experienced physical harm from patients, 20% requiring time-off work as a result. In comparison to the PICU staff, OA staff considered they had a less active role in deciding admissions to and discharges from PICU; considered that there were always adequate intervention trials prior to PICU referral; considered that they should assess for suitability for transfer back to OA wards from PICU. The main reasons for considering referral to PICU by both staff groups were physical violence, absconding, disinhibited and threatening behaviours. Many staff in both groups did not feel adequately trained to work in such a PICU environment, and some did not feel adequately professionally supported.

Conclusions: High numbers of staff working in older adult mental health services experience physical harm from patients, and for some patients their behaviour secondary to mental disorder warrants their transfer to a more intensively staffed unit PICU. There are many views shared by nurses on the positive aspects of a PICU, but there are differences between staff working in OA wards and staff in PICU when considering assessment of patients being referred to and being discharged from the PICU. The aging population is likely to impact on the need to further consider such specialist units, and an understanding of differences in nursing perceptions and attitudes towards such units may be of value.

PS02.109

Geriatric mental healthcare: Towards an understanding of nurses' most important caring behaviours

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Aim: Caring is a universally accepted and expected concept of nursing no matter what practice setting. To strengthen the empirical foundation of caring it is worthwhile to know not only what healthcare consumers regard as important caring behaviours but also what nurses perceive these as being. Nurses' perceptions of caring have been shown to differ in various clinical settings. Previous studies on perceptions of caring

behaviours have been undertaken with nurses in acute medical/surgical care, rehabilitation, oncology, in-patient psychiatric and residential aged care settings but not with the highly specialized area of geriatric mental health. The aim of this study was to determine the ranking of the importance of caring behaviours for geriatric mental health nurses. The research question addressed was: Which caring behaviours are perceived by geriatric mental health nurses as being most important in making older people with a mental health disorder feel cared for?

Method: The study design was cross-sectional. In 2010, a convenience sample of members of a national psychogeriatric nurses association was surveyed using the Caring Assessment Report Evaluation Q-sort questionnaire (CARE-Q). The CARE-Q has established reliability and validity. Participants were prompted with the phrase 'In order for the older person to perceive that she/he gets good caring, how important is it that you perform the following behaviours?' to rank the importance of 50 caring behaviours on a seven-point Likert scale ranging from '1' (least important) to '7' (most important). The 50 items constitute six sub-scales in the CARE-Q. The sub-scales are 1) accessible, 2) explains and facilitates, 3) comforts, 4) anticipates, 5) trusting relationship and 6) monitors and follows through. Socio-demographic data was also collected.

Results: Forty-six registered nurses working in geriatric mental health care participated. This sample size met the requirements of a power analysis. The geriatric mental health nurses ranked 'listening to', 'talking with' and 'allowing the older person to express their feelings about their disorder and treatment fully, and treat the information confidentially' as the most important caring behaviours. The nurses identified the behaviours of 'suggesting questions for the older person to ask their doctor' and 'volunteering to do little things for the older person, e.g. getting a cup of tea, posting a letter' as being the least important in making older people feel cared for. The subscales of comforts and monitors/follows through were ranked as being more important than the accessible and explaining and facilitating subscales. However the median scores for all subscales were greater than six (seven-point Likert scale) indicating that all caring behaviours were considered important overall. The CARE-Q showed good internal consistency when used with this clinical specialty of nurses.

Conclusion and Clinical Implications: This study used the CARE-Q to identify the perceptions of geriatric mental health nurses of the most and least important caring behaviours. It is very important that nurses are aware of what behaviours they perceive as constituting caring. Through this awareness, they will be more able to enact and validate caring behaviours so that the interactions between nurses and the older people they care for are effective and meaningful. Future, complementary research will determine which geriatric mental health nurse caring behaviours are perceived by older people who have a mental health disorder as being most important in making them feel cared for and make comparisons with the nurse responses. The overall intention of this research program is to enhance nurses' receptiveness to the care needs of older people and improve the provision of person-centred care in the geriatric mental health care setting.

Table of correlations

PS02.110

Quality of life and depression in nursing home patients with dementia

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Background: Quality of life (QoL) is an established outcome measure for people with dementia. In order to develop interventions to improve QoL in people living in nursing homes, we need to investigate which clinical factors predict changes in QoL. Previous research has found an association between QoL and depression in non-demented patients as well as patients with mild dementia. It is reasonable to assume there is also a strong connection between quality of life and depression/depressive symptoms among nursing home patients with moderate and severe degree of dementia. However, this can be difficult to prove as patients with moderate, and especially severe dementia will have difficulties in expressing both their opinion about quality of life and feeling of sad mood. In this situation we often have to rely on proxy information.

Objectives: The aim of this study is to compare quality of life and depressive symptoms and investigate whether gender, age, degree of dementia, physical disability and aggression influence on this comparison. Method The study has a cross sectional design. Data was collected in January 2011 from 17 different nursing homes, and include 695 patients with scores between 0 and 3 on the Clinical Dementia Rating scale (CDR). The Quality of Life in Late-Stage Dementia (QUALID) Scale was used to measure quality of life, the Cornell scale for depression in dementia (Cornell) was used to measure depression and Physical self-maintenance scale (P-ADL) was used to measure ADL. The Brief agitation rating scale (BARS) was used to measure agitation. Demographic characteristics were collected form the patients records.
Results: The preliminary analysis includes 428 patients. 302 (70,6 %) were women. The patients had a mean age of 86 (SD = 8.2) years, range 47-105. Mean Cornell score was 7,9 (SD = 5,4), range 0-28. Mean QUALID score was 22,0 (SD = 7,1), range 11-47. Mean BARS score were 20,2 (SD = 9.9). Mean P-ADL score was 18,6 (SD = 5,1). 12 patients scored 0 (2,8%) at CDR, 18 (4,2 %) scored 0,5, 38 (8,9%) scored 1, 152 (35,5%) scored 2 and 208 (48,6%) scored 3 at the CDR. In a correlation analysis the highest correlation was found between QUALID score and Cornell scale score 0.645. See table for all correlations.
Conclusion: Quality of life in nursing home patients are affected by degree of depression, impairment in activities of daily living and degree of agitation.

PS02.111

End-of-life care for people with dementia living in a care home

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End-of-life care for people with dementia living in a care home Dementia is associated with a variable but shortened life expectancy meaning death may occur unexpectedly or without end of life care being planned. While many people with dementia and their relatives would prefer them to receive palliative and non-intrusive interventions, if possible at home, rather than in hospital, this decision has not been made explicit for most people with advanced dementia before death. Thus hospital transfers are common near the end of life. Planning for end of life care in advanced dementia, particularly in care homes, is an area which requires further development. At present there are no interventions in this field which have either decreased inappropriate interventions or improved family satisfaction or psychological health. The project therefore aimed to put in place and evaluate an intervention for staff to enable relatives to plan end-of-life care for people with dementia living in care homes. We interviewed staff, residents and relatives before and after a 10 session educational intervention aimed at teaching staff through problem and case based learning about making advance written end of life care plans for people with dementia by consulting with family and the resident as far as possible. We aimed to evaluate its implementation and effectiveness for the residents, relatives and staff. This presentation reports on staff attitudes, knowledge and psychological health. We aimed to ascertain if the intervention increased staff ability to discuss end of life care and lead to more effective care giving. We also aimed to look if the intervention increased the quality of life and care for the residents receiving end-of-life care and their families. Participants were all from a 120-bed North London nursing home. Staff complete a General Health Questionnaire (GHQ28), a Job Content Survey (JCQ) and a qualitative interview to explore staff's feelings around end of life care and current practice around end of life in the home. Topics covered in the qualitative interview included: decision making, communication, support, staff beliefs around death and dying, training and current practice. The qualitative interview also explored staff's confidence and satisfaction with end of life practice. Pre-intervention interviews found barriers to a successful intervention included; care staff, nurses and doctors did not see themselves as a team and communicated poorly with relatives about approaching death,

often thinking it was the job of someone who was more senior in the hierarchy. Staff used opaque euphemisms and worried about being blamed for messages about residents impending death so did not give them and being vulnerable as foreigners. They were often unaware of the existence or had concerns about validity of advance care plans about whether earlier decisions around end of life for people with dementia would be invalidated by relatives changing their minds and therefore did not implement them. They knew of the religious rituals around death, but frequently misunderstood religious tradition and ideas .14% of staff scored on the GHQ as being likely to have significant psychological symptoms. Staff were slightly more satisfied with their jobs than their American counterparts but reported higher psychological job demands. We are now in the process of the post-training evaluation to ascertain whether the training changes attitudes and increases support and control and decreases demand. The staff GHQ-28 will also be compared pre- and post intervention

PS02.112

Impact on residents with mild dementia of frequent death in aged care facilities

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Background: Residents in aged care facilities are exposed to death more frequently than people living in the general community. While the effects of frequent deaths on staff are well documented little is known about the effects on residents, particularly those residents with dementia.

Aims: This project aimed to investigate the impact of frequent deaths on residents with mild dementia living in aged care facilities, particularly in relation to grief and depression. Methods: Residents with psychogeriatric assessment scale scores (PAS) of between 4-9, and facility staff, were recruited from three residential aged care facilities. Interviews were conducted with 23 residents about their experience of grief and loss due to deaths of fellow residents. Twenty five staff were interviewed about their perceptions of the impact of deaths on both themselves and the residents. Interview responses were thematically analysed using NVivo.

Results: There was evidence of depression and grief in the residents; however there was little evidence that deaths of other residents were significantly impacting on them. More importantly, loss of lifestyle in the transition from home to residential aged care and previous deaths of family members were the reasons for grief cited by both staff and residents. There was also evidence of poor socialisation in many of the residents.

Discussion: The most unexpected outcome was the mismatch between resident and staff views on the impact of deaths. In addition there seemed less than ideal communication and acknowledgement of deaths to residents, perhaps due to a higher level of death anxiety in the staff compared to the residents. These issues have been further developed as foundational evidence for a staff education program.

PS02.113

Quality improvement in palliative dementia care

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It is an intriguing question why available knowledge on palliative dementia care is not used, even when there is evidence of its effectiveness in helping to solve problems. Implementation research has developed models for stepwise implementation but it is still unclear which strategies are effective in what kind of situations and which factors influence the effectiveness of implementation strategies. A first step in the implementation process is to translate evidence and best practices into quality indicators. In this presentation this first step in the implementation process will be described: the development and validation of quality indicators in palliative care for cancer and dementia patients. These quality indicators are the base of the European IMPACT project (IMplementation of quality indicators in PAlliative Care sTudy) (2011-2015). In February 2011 we started this 7th

framework project, with partners from 10 European countries, and in cooperation with an expert in Australia. Unique in this project is the focus on both cancer and dementia. Moreover, the project group represents all relevant professionals that are involved in palliative care for these patient groups: GP, nurse, medical oncologist, psychiatrist, social worker, psychologist, sociologist, researcher, radiotherapist etc. Two international networks will join their expertise and efforts in this study: the pan-European research group on detection and timely INTERvention in DEMentia (Interdem) network and the European Association of Palliative Care (EAPC) network. The quality indicators relate to all settings involved in palliative care: community care, hospices and inpatient care. The development of the quality indicators for psychosocial dementia care and for palliative cancer care included the use of a modified RAND Delphi procedure with experts to reach consensus on a set of quality indicators. Regarding dementia care, a retrospective cohort study using medical records was also conducted to study the feasibility. For dementia care 27 quality indicators have been selected, for palliative cancer care 67. Examples of quality indicators for palliative cancer care are: * All health and social care professionals should have standardized learning objectives for continuing basic training in palliative care (education and training). * The following treatments should be available for a palliative patient 24 hours a day, 7 days a week: Opioids and other controlled drug (all settings). * Family members and friends should be able to visit the dying patient without restrictions of visiting hours (caregivers, inpatient settings). Examples of quality indicators for psychosocial dementia care are: * The diagnosis of dementia should be discussed with the person with dementia (diagnosis). * The patient file should include information on: life history, social and family circumstances and needs and preferences (inpatient settings). * Caregivers of people with dementia should be offered: respite or short-break care and other psychosocial interventions, tailored to their needs and preferences.(community care and caregivers). Making one set of quality indicators developed for two diseases offers the opportunity to benefit from the knowledge gained in two fields that are segregated until now, but that have a lot in common. Next steps in the IMPACT study will be the stimulation of the implementation process by concentration on: the organization of palliative care, the development of a set of setting-specific implementation strategies including an interactive website, the evaluation of the use of the selected strategies to implement quality indicators with regard to adherence to the quality indicators, factors influencing the effectiveness of the implementation strategies. The final aim of IMPACT is to develop optimal strategies for implementing quality indicators to improve the organization of palliative cancer and dementia care in Europe. These strategies should be applicable across diverse healthcare settings.

PS02.114

Spiritual end-of-life care in nursing homes: An exploratory study among physicians

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Objective: The aim of this study is to explore how Dutch physicians conceive spirituality at the end of life and their role in spiritual care giving in nursing homes, their perceptions of if and how they coordinate spiritual care giving, whether and how they collaborate with other caregivers, and to identify possible barriers and facilitators of spiritual care giving by elderly care physicians.

Method: A focus group study was conducted among Dutch elderly care physicians, because of its suitability to explore the complex and understudied area of physicians' perceptions of spirituality and spiritual care giving. Three focus group discussions were conducted, with six to eight individual physicians participating in a single group discussion, to allow for sufficient variability in perceptions. The transcripts of the focus group discussions were analyzed qualitatively and coded by two researchers independently (MJG, MTM). The process of analyzing incorporated an iterative process of reading and rereading the transcript to code the transcript and identify emergent themes.

Results: The following themes emerged: Spirituality, the role of the physician in spiritual care giving, spiritual care in dementia, the importance of rituals and tokens in spiritual needs, and the role of the physicians' spirituality, In this study the physicians' concept of spirituality was primarily limited to religious aspects. Participants mentioned several aspects related to spiritual wellbeing, such as peace, readiness to die and comfort. Many participating physicians did not consider spiritual care giving at the end of life their responsibility and stated this explicitly. This was related to a barrier in spiritual care giving: lack of time and lack of competence. Some physicians however considered the assessment of spiritual needs as a part of their professional responsibility. Spiritual care giving in dementia was considered to be difficult, because of the impossibility of (verbal) communication with the residents. Religious rituals, and the participation in them by residents (including residents suffering from dementia) was considered to be an accessible and supporting way in relieving spiritual needs, such as in completion of life, the acceptance of death and to promote a peaceful end of life. Some physicians were very explicit about their own spirituality, and its effects on clinical work and interaction with nursing home residents. The spirituality of the physician sometimes appeared to be helpful, but could also be a barrier in the communication with the residents. Other topics that emerged from the study were: the multidisciplinary nature of spiritual care giving, the role of the nurse and their importance in assessing spiritual needs and the role of the pastor, social workers and psychologists in providing spiritual care.
Discussion: Although the elderly care physicians initially limited their association of spirituality to religion, when invited to talk about spiritual wellbeing, they mentioned the full breadth of the concept of spiritual wellbeing as reported in recent literature. To improve patient care, residents' spiritual wellbeing may need to be brought more directly to the attention of physicians. The barrier in spiritual care giving: lack of time and lack of competence is concurrent with a qualitative US physician group study by Chibnall et al., that identified the same barriers in psychosocial and spiritual care giving by physicians. Our results also contain descriptions in which the participating elderly care physicians exemplified that they did not have the tendency to avoid psychosocial and spiritual issues. Schols et al contrasted the position of on-staff elderly care physicians in Dutch nursing homes with the situation inmost of the western countries, including the United States and other European countries, in which medical care is provided by family care physicians or by consulting of medical specialists. This exceptional medical situation in Dutch nursing homes was underlined in an article by Conroy et al., which compared the medical services in Dutch and English nursing homes. Hence, these elderly care physicians are responsible for care planning and palliative care giving, including spiritual care giving and eventually referral more specialized care givers, e.g. chaplains or other spiritual counsellors. After their residency, elderly care physicians in the Netherlands take a three year vocational training to prepare for their clinical practice ina nursing homes. The specific training and tenure of physicians may help address psychosocial and spiritual issues, which are important issues in end of life care.

PS02.116

Effect of cognitive training with reading aloud and simple arithmetic on transfer of cognitive function

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Previous studies failed to indicate cognitive training on transfer of cognitive function. Many studies trained

memory function such as episode memory or working memory. Although they showed direct effect on trained function, they did not indicate transfer effect (Ball et al., 2000; Craik et al., 2007). However, some studies have pointed to two specific elements of engagement that might be responsible for cognitive gains: complex video game and multi-modal stimulation. Basak et al. (2008) presented evidence that performing complex video game would be responsible for improved performance on such tasks as fact recall or word recall. Noice and Noice (2009) trained the theatre instruction over four weeks, and found that acting group improved significantly from pretest to post test in word recall, pose comprehension, digit-span ability, and problem-solving. Due to greater increase of baby boomer, expectation to cognitive training would be stronger than now. However, tasks like theatre instruction or performance of complex video game need much effort and then might not be suitable for almost all of old adults. This kind of constraint would make training over long period hard. So, cognitive training which any person performs without difficulty would be expected. The purpose of this study was to examine cognitive training with reading aloud and simple arithmetic on transfer effect of memory and inhibition. Such cognitive training was proposed by Kawashima et al. (2005) who showed that the intervention group by reading aloud and simple arithmetic kept similar scores in MMSE after one year although the control one indicated significant decrease in the same period. However, this research has some weak points. The first was to use the aged with dementia as subjects. Previous studies suggested that even trained function would disappear after ending the training in these people. So, to assess transfer effect it is necessary to train not non-dementia or MCI but health old adults. The second was measures in their research. Kawashima et al. (2005) measured MMSE, which is fairly general cognitive function. To assess transfer effect, we need to use other critical measures such as working memory and inhibition. Participants in the present research were 103 community-dwelling volunteers between 61 and 84 years old, Kyoto, Japan. Forty eight participants were assigned to the learning group, and fifth one was done to the control group, respectively. There were no differences between the learning and control groups in age, year of education, and scores of MMSE. Learning task. Simple arithmetic and Japanese language sentences were used as the materials in the training program. We prepared a wide variety of materials, which were used for everyday learning from 3-year-old children to fourth grade elementary school students. Study design. Each person participated training sessions for about one and half years. They are given cognitive tests (short-term memory, working memory, stroop test, and SRC task) on four times; pre-test, after about six and twelve months, and post-test. Training. Each participant was given materials on reading aloud and simple arithmetic like addition and subtraction with one or two digits in a room of Ritsumeikan University. In the task of reading aloud, he or she read aloud sentences written on three or four A4 sheets of papers. In the arithmetic task, they answered each ten problems written on four or five A4 sheets of papers. They were given positive feedback after completing each task. Training session was about 20 minutes for each person. The session was held once a week, and participants were given homework of three days. Training lasted one and half years. The control group was given tests same to the training one at the similar time. Results and Discussion. As results of ANOVA to each test, the obtained results were fairly similar across four one; All interaction between group and test time were significant over level of 5 %. These significant interactions indicated that training group indicated significant increase over one and half years except SRC task. In addition, the control group showed significant decrease over years in all tasks. These results suggested that cognitive training with reading aloud and performing simple arithmetic produced strong transfer effect in cognitive function for health older adults.

PS02.117

Is 'RedUSing' antipsychotic and benzodiazepine use in nursing homes sustainable: A 12-month follow-up of an intervention trial

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Background: 'Reducing Use of Sedatives' (RedUSe) was a controlled trial conducted in 25 nursing homes for 6 months throughout 2008-9. Thirteen nursing homes participated as the intervention group and twelve homes participated as the control group. Nursing homes in the intervention group received a series of strategies, including audit and feedback, nursing staff education and a dedicated psychotropic review; which led to a significant reduction in the prevalence and a significant increase in the number of dose reductions of antipsychotics and benzodiazepines. Aim: To assess the long-term impact of the 'RedUSe' project on antipsychotic and benzodiazepine prevalence and dosage.

Methods: Data on antipsychotic and benzodiazepine prevalence at each of the participant nursing homes was collected 12 months after the RedUSe project was completed. Mean doses were calculated by converting daily doses of antipsychotics and benzodiazepines to mean chlorpromazine and diazepam equivalents. The psychotropic prevalence rates and mean daily dosage equivalence of antipsychotics and benzodiazepines at the 12-month follow-up measure were calculated, grouped and then statistically analyzed. This data was then compared to data collected from these nursing homes at baseline and trial endpoint. Antipsychotic and benzodiazepine prevalence and mean daily dosage equivalence outcomes over the 3 data collection periods (baseline, trial endpoint and 12-month follow-up) were analysed using two-way (group and time) repeated measures analyses of variance (R-ANOVA), with post-hoc analyses to examine any significant differences across individual time points.

Results: A total of 1578 residents from the 25 participant nursing homes were audited for the 12-month follow-up measure. Overall, when comparing baseline to the follow-up measure, the prevalence of benzodiazepine use and mean daily diazepam equivalence in intervention nursing homes decreased by 25% and 24%, respectively. [benzodiazepine prevalence: 32.8%(baseline) to 23.9%(12-month follow-up)]. However, neither benzodiazepine prevalence, nor mean daily diazepam equivalence altered significantly in control nursing homes over the same period of time. The antipsychotic prevalence rate in the intervention nursing homes returned to baseline level by the 12-month follow-up following an initial decrease in usage throughout the RedUSe trial. [antipsychotic prevalence: 20.3%(baseline) to 20.0%(12-month follow-up)]. In control homes, antipsychotic use increased slightly throughout the trial period but then decreased significantly during the 12 months following the RedUSe project. The mean daily chlorpromazine equivalence in intervention homes remained relatively constant across all three data collection points. However, mean daily chlorpromazine equivalence in control nursing homes rose markedly in the 12 months following the RedUSe project. Discussion: The effect of the RedUSe intervention on the prevalence of benzodiazepine use was sustained 12 months post-intervention. In contrast, the effect of the RedUSe intervention on antipsychotic prevalence was not sustained with prevalence rates returning to pre-trial levels. It appears that dosages of benzodiazepines in intervention nursing homes continued to be reduced the year following the RedUSe intervention. One of the main educational messages of the RedUSe project was to gradually reduce psychotropic doses with the aim of tapering off use so it was pleasing to see that a reduction in dosing was still occurring in the absence of active intervention strategies. The rate of benzodiazepine and antipsychotic use declined in control homes the year following RedUSe; which could possibly be due to media attention associated with the RedUSe trial, and active promotion of appropriate psychotropic use by health educators in the control location.

Conclusion: In the twelve months following the RedUSe project, benzodiazepine prevalence and mean daily diazepam equivalence continued to decline in intervention nursing homes, resulting in an overall reduction of 25% from baseline in both values. However, the effect of the RedUSe intervention on antipsychotic prevalence and dosage was not sustained. Continual intervention strategies are needed to help nursing homes maintain low rates of antipsychotic use or reduce antipsychotic use further.

PS02.118

Skills training and re-skilling for carers of people with dementia: A European lifelong learning project delivering online training in dementia care

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Background: The European Union (EU) faces challenges in relation to its demographic future. Currently the estimated number of people with dementia in the EU is 10 million, and it is predicted that this number will increase to 14 million in the next 20 years. People with dementia are being cared for by informal car-ers, who are often elderly people with limited resources. They care for their loved ones at home to the best of their ability, with varying levels of financial and professional support. In some countries carer support is well developed, consisting of accessible services, allowances and care structures, however in other countries it is virtually inexistent. The EU population is decreasing, and in 2006, for the first time in post war history, births did not outnumber people that had died. Thus, the EU faces a future with more people with dementia and relatively less professional carers to provide support. After being diagnosed with dementia, many families try to care for their relative in their own home as long as possible. Healthcare policies in many EU countries also aim to keep people with dementia in their own homes for as long as possible. Since many relatives do not have the time, or resources to commit to full time care of the person with dementia, in some countries low-cost carers from other countries are hired to provide 24/7 support. Elsewhere relatives provide the care for persons with de-mentia and are eventually formally paid by care services to do so. Nevertheless, whether a relative, temporary staff, staff with a different language background or newly employed social care staff, all face the challenge of trying to gain an appreciation of how to best provide care to persons with dementia.
Aim: To improve the quality of care for community dwelling people with dementia, carers should be properly skilled. The 'Skills Training and Re-skilling for Carers of People with Dementia' (STAR) project aims to address this issue by developing, providing and evaluating online training in several European coun-tries for anyone caring for a person with dementia.
Method: The STAR project focuses on creating content and a methodology that will be distributed via an e-learning portal accessible via the Internet, TV and smart mobile phones to carers of people with de-mentia. This solution will assist carers to not only up-skill their vocational training by participating in courses and for example by learning from educational videos on caring for people with dementia, it will also facilitate communication between carers in online communities facilitated by STAR. The key value of STAR is that it aims to maximize the availability of training and information provision through sup-porting a mix of platforms and content adapted to the languages and situation in each country. Within the STAR project the first task relates to an analysis of the state of the art regarding existing educational materials. Following this a methodology will be developed that will aim to make existing and newly developed content more accessible for users, by focusing on short and simple modules. The materials will be developed in a multimedia style, making them applicable for digital television, the Internet and mobile phones. After implementation of the methodology and content, the e-learning por-tal will be evaluated in a user pilot starting in September 2012. Volunteer carers, or people who wish to equip themselves with skills from four countries (Italy, the Netherlands, Sweden and the United King-dom) to be able to work in this challenging new employment area, will be recruited to utilise the system for a period of at least nine months. Their experiences with the system will be recorded by means of (online) semi-structured interviews and tests. Results The consortium will analyse the collected data during the pilot, and finalise the adaptation of the mate-rials in preparation of a public EU-wide launch of the platform. Thanks to partners that already offer vocational training in healthcare, certification may be provided to carers when successfully passing

examination of their knowledge.

Conclusion: The platform to be developed by the STAR project intends to provide opportunities for education, col-laboration, discussion and sharing experiences between users (carers of people with dementia), while supported by dementia experts from all over the EU. Experts from all countries are welcome to join the pan-European expert network at www.startraining.eu that will support the national communities. The project started in December 2010 and will finish in November 2013.

PS02.119

Using theatre to explore long-term care home health care provider needs

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Background: Providing optimal care for long-term care home (LTCH) residents with responsive behaviours is challenging. The literature suggests that, in Ontario, LTCH healthcare providers (HCPs) who care for residents with responsive behaviours are especially concerned about the accessibility and availability of external resources, notably during crisis situations. To mitigate this situation, many Ontario LTCH HCPs regularly receive training designed to increase their awareness of such resources as well as their knowledge base. Yet, the frequency of reported responsive behaviors has not decreased. Although a large body of literature exists on how to best care for older adults living in LTCHs with responsive behaviours, there is limited information on the front-line HCP perspective. To gain insight into this perspective and to help develop better knowledge exchange (KE) initiatives, from June to November 2008, 106 front-line staff from 12 LTCHs participated in 18 audio-taped focus groups. Data were transcribed verbatim and, using guidelines suggested by Krueger (1998) and a thematic approach, six themes were identified (place, organizational structure, relationships, consequences, information/ communication/technology, and resources). These themes and the verbatim responses were used to develop a short (25 minute) play, All Behaviour Has Meaning. Study Goals The goals of this subsequent study, "Using Theatre to Explore Long-Term Care Home Healthcare Provider Needs,â[euro] were to investigate the use of theatre as a knowledge exchange strategy and to provide a venue for LTCH interdisciplinary team development and discussion. **Methods:** The first draft of All Behaviour Has Meaning was reviewed by the study investigators and front-line HCPs for content validity. Subsequently, the play was read by actors to the study investigators, revised further, and then rehearsed with actors. Concurrently, a facilitation guide designed to promote critical reflection was developed. The combination of the play and a facilitator guided discussion were then field-tested at two sites (a LTCH that did not participate in the parent study (LTCH group) and at a rehabilitation hospital among staff who regularly consult with front-line LTCH HCPs (tertiary care group)). Focus groups were conducted following the play and facilitated discussion. Observations, recorded by three field observers, were collated and an iterative approach was used to identify themes. The study was approved by the Research Ethics Board at The University of Western Ontario.

Results: At the LTCH test site, nine people (two managers, two registered staff and five non-registered staff) saw the play and participated in the facilitated discussion (30 minutes) as well as the focus group (30 minutes). Participants indicated that their daily lived experiences were well represented by the actors and their script. When asked about their emotional reaction to the presentation, one participant indicated, "it's difficult working in this fieldâ[euro] partially because of the "constant change.â[euro] Another participant asked, "How do you manage your anger and frustration?â[euro] Also, it appeared that the play had the effect of illuminating for participants some taken-for-granted practices: when asked if the play had changed their thinking, one participant indicated "This [play] brings you out of the routine - brings you to the heart and centre.â[euro] Another stated: "This needs to be done [i.e., performed] home wide - on each unit.â[euro] The tertiary care group, which consisted of six clinicians, two administrators and one scientist, further verified that the play

accurately depicted the lived experiences of LTCH HCPs. As one participant said, "the play gets at points that many care providers face every day - they're frustrated.â[euro] When asked if the play had changed their thinking, one participant indicated (and others agreed) that the play highlights the "need for purposeful meetingsâ[euro] that address the challenging issues faced by LTCH HCPs. Discussion The field-testing of the play and the facilitated discussion suggests that its characters and content closely reflect the lived experiences of those working in LTCHs. The combination of the play and facilitated discussion created space for critical reflection and validation. Few participants mentioned lack of knowledge as a barrier to optimal care provision, but pointed instead toward organizational structures and processes that limit collaboration among care providers.

Conclusions/Next Steps: Overall, we found that using theatre as a mechanism for KE with LTCH staff particularly fruitful and worthy of continued investigation, particularly as it relates to generating the conditions for improvements to work and residential life in LTCHs. The play provides LTCH HCPs behaviors to model and so may promote actual change. Results also suggest that strategies need to be targeted to the audience. It is hoped that the play will be videotaped and the CD and the facilitator guide shared with LTCHs across the province.

PS02.120

Sex differences in schizophrenia risk across the age span: An individual participant meta-analysis of 117,000 incident cases

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Context: Understanding the developmental timing of schizophrenia onset and its window of sex disparity may help to characterize underlying processes of vulnerability. The sex differences in schizophrenia onset suggests oestrogen-protective factors in women. However, studies show that environmental, social and premorbid neurodevelopmental factors also could influence the different men-women onset peak in schizophrenia. And finally, the observed men-women differences of schizophrenia expression may be secondary to methodological artifact such as criterion or sample bias. Hence, the extent to which sex differences in timing of schizophrenia onset are inherent to the disorder remains unclear.

Objective: To quantify schizophrenia incidence by age and sex using a comprehensive systematic review and individual participant meta-analysis

Data sources and study selection: PUBMED, EMBASE and PsychINFO databases were searched between January 1950 and December 2009. Schizophrenia incidence studies that covered a broad age span were included. **Data extraction** Numerator and population data were extracted by age, sex and, if possible, study period. Original data was requested from the authors in case of insufficient availability of data to calculate age- and sex-specific incidence rates. Forty-three independent samples met inclusion criteria, yielding 117,645 incident cases of schizophrenia for analysis.

Data synthesis: Incidence rate ratios (IRR) with their 95% confidence intervals (CI) were computed by age and sex from negative binomial regression models. Men had a 1.2-fold (95%CI: 1.02-1.35) greater risk of schizophrenia than women. For men incidence peaked at age 20-29 years (IRR: 2.37, 95%CI: 1.65-3.40). Women showed a peak at age 20-29 years (IRR: 2.08, 95%CI: 1.52-2.84) and 30-39 years (IRR: 2.01, 95%CI: 1.42-2.85). This peak was followed by an age-incidence decline up to age 60 that was stronger in men than in women ($\chi 2 = 50.8$; P

Conclusions: Robust sex-differences exist in the distribution of risk for schizophrenia across the age span, suggesting that men and women have different susceptibility to schizophrenia at different stages of life. The

finding of an absence of a second risk peak in women at menopausal age questions the dominating view on the role of estrogen in the pathofysiology of sex-differences in the age distribution of schizophrenia in later life. The reduction in hypothesized estrogenic protective effects would be expected to impact psychosis expression close to the menopause rather than well beyond this period. Taken together, although estrogen may impart sex differences throughout life it is unlikely that the estrogen hypothesis can account for the marked sex differences and the relatively high proportion of women with onset of schizophrenia in late life. Instead, other risk or protective factors may be at work. The onset in later life may represent a final common pathway of various disease processes of different etiology including hormonal changes, differential exposure to risk and possibly neurodegenerative conditions in very old age. In conclusion, this study offers an unique opportunity to study the risk distribution by age and sex more accurately and sets the black box open to new hypotheses of the origin of schizophrenia.

PS02.121

Trials and tribulations of treatment resistant psychosis in the elderly: A case series

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Background: Psychosis in later life is a heterogenous condition surrounded by several nosological controversies regarding its relationship to schizophrenia.[1] A confluence of factors associated with ageing, such as vulnerability to the adverse effects of medications, somatic co-morbidities and social and functional disability, conspire to present a number of treatment challenges in this setting. Thus, treatment resistance (referring to patients whose positive symptoms of schizophrenia have not responded to treatment- usually involving two trials of medications at adequate dose and adherence) [2] is not uncommon. Yet, the options for dealing with treatment resistance in older people with psychosis have not been well-studied.

Methods: A descriptive case series of consecutive patients with treatment resistant psychosis in older life admitted to a psychogeriatric inpatient unit serving a culturally and linguistically diverse catchment area in Sydney, Australia, will be presented. Modes of treatment (including non-pharmacological and pharmacological options), comorbidities, complications and outcome will be reported. A video presentation of a case of an older woman with early- onset schizophrenia, Parksinson's disease and Madopar-induced psychosis treated with Clozapine and bilateral ECT will highlight these issues.

Results: Presentations were often florid and associated with risk conferred by suicide attempts and violence directed to others, sometimes to partner. Non-English speaking backgrounds complicated assessments. Initial management with emergency sedation was often required. Treatment-resistance occurred in a range of contexts, including early and late-onset schizophrenia, dopa-induced psychosis and alcohol hallucinosis/delusional disorder. Treatment options ranged from second generation antipsychotics, ECT, depot medication and Clozapine, with simultaneous support for hydration and nutrition, prophylaxis for venous thrombosis/embolism and family therapy. Although a minority were single with no offspring, in most cases complex family issues relating to having a parent or spouse with a long- term mental illness needed to be addressed. These included supporting over- parentified single children, multi-sibships in conflict and facilitating rapproachement with alienated children. Treatment complications included Q-T prolongation on ECG, falls, hypotension, extrapyramidal symptoms, hyponatreamia, sedation and aspiration. Consultant geriatric input or co-management was often required. Neuropsychological testing, risk, capacity/consent and functional assessment guided placement decisions. Most patients improved with treatment but the time course to recovery was protracted, residual impairments were common and many required residential placement. Risk assessment was often factored into decisions regarding placement, and although decision-making capacity in regards to accommodation and finances was often borderline or compromised, facilitated or assisted decision-making was encouraged where possible.

Conclusions: Trials of different medications, use of clozapine and ECT and significant medical co-morbidity are

to be expected in treating patients with late-onset psychosis. Treatment intolerance in one shape or form is the norm and probably leads to "treatment resistanceâ[euro]. While recourse to therapeutic nihilism would be not unexpected, this case series suggests that symptomatic improvement is the rule rather than the exception. Clearly, more empirical work on the management of such patients is needed to formulate treatment guidelines in this area. References [1] Hassett, A., Ames D.,M Chiu E. (2005) Psychosis in the elderly Taylor &Francis: Abingdon. [2] Pantelis C., Lambert TJR. (2003) Managing patients with "treatment-resistantâ[euro] schizophrenia Medical Journal Australia. 178 (9 Suppl); s62-s66.

PS02.122

Individualized music - an implementation program

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Introduction: Individualized music is a method based on assessment of personal music preference in nursing home residents followed by implementation of pre-recorded music programs played daily, supplemented by singing based on preference assessment tailored to the individual's preferences and needs. The method individualized music has been delineated by Linda Gerdner (Gerdner, 2000) and other researchers (Tang &Vezeau, 2010) from the early 90's. It has been specified and empirically tested in the PhD "Integrated music in nursing homes - an approach to dementia careâ[euro] (Myskja, 2011). Individualized music has especially shown promise in agitation among nursing home residents. Two dementia wards in a Norwegian nursing home have been extensively educated in the method, applied it over time specifically on general and procedure-related agitation. Due to the general success of the development of this method, a teaching program within a municipal region in another part of Norway was instigated. The project aim was to implement and evaluate effects of the method individualized music and its perceived effect during a one year period.

Method: The implementation program included teaching, both nursing students and nurses'aide students were given to times three hours general teaching program, followed by hands-on education in the wards of the five nursing homes in the regions (n = 468). Staff in nursing homes was also taught through a short teaching program and hands-on teaching. These students applied the method on agitated residents measured by 24-hours agitation sheets. A control group with agitation was not given individualized music, but general attention during the same time period through conversation and games.

Results: The method individualized music reduced baseline of 3.4 hours/24 hours to 1.1 hours compared with 3.3 hours/24 hours to 3.1 hour in the control group, $p < 0.05$. Qualitative analysis based on observational studies, interviews and videotaping, showed that the method was easy to learn for students and with a minimum of guidance was transposed into clinical skills in the meeting with patients. Students also made independent observations, contributing to development of method, for instance evaluating the correct use of music and media in living-rooms with several residents. International guidelines indicate that psychosocial treatment strategies should be the primary treatment for symptoms of dementia.

Conclusion: There is today no consensus in the form of application of psychosocial strategies. Individualized music as a concrete expression of a psychosocial strategy has shown itself to be consistent, practicable, effective, cheap and simple to use pro integration with medical treatment and other psychosocial strategies and with a high level of patient staff and family satisfaction. Gerdner, L. A. (2000). *Effects of individualized versus classical "relaxationâ[euro] music on the frequency of agitation in elderly persons with Alzheimer's disease and related disorders. International Psychogeriatrics,* 12(1), 49-65. Myskja, A. (2011). *Integrated music in mursing homes - an approach to dementia care. Unpublished Monograph,* University of Bergen, Bergen. Tang, H. Y. J., &Vezeau, T. (2010). *The Use of Music Intervention in Healthcare Research: A Narrative Review of the Literature. Journal of Nursing Research,* 18(3), 174.

PS02.123

Strategies for improving communication with individuals of Alzheimer's disease who have hearing difficulty

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Approximately 70-90% of individuals with dementia are estimated to have hearing problems. Hearing difficulty hinders dementia individual's daily communication in the course of medical treatment, rehabilitation and care activities. However, only a few studies have investigated strategies for improving communication with individuals of dementia who have hearing difficulty.
Objective: This study explored characteristics of communication problems of patients with Alzheimer's disease (AD) who have hearing difficulty, and proposed strategies for improving communication with such individuals. Participants The participants included 75 individuals (54 women) who were diagnosed with probable AD according to the criteria of NINCDS-ADRDA. Their mean age was 83.0 (+/-8.0)years, and mean MMSE score was 16.1 (+/-5.5).
Method: 1) Auditory test: Applying hearing thresholds at 0.5 kHz, 1 kHzand 2 kHz by using the audiometer (MADSEN MIDIMATE 602), the participants were classified into four groups of different pure-tone average: i.e., "normalâ[euro] less than 25 dBHL, "mildâ[euro] impairment 26-40 dBHL, "moderateâ[euro] impairment 41-60 dBHL and "severeâ[euro] impairment 61-80 dB HL. We found no significant difference in MMSE scores among the four groups. 2) Language test: The participants were given the communication screening test (Iiboshi et al., 2007), which was comprised of four aspects of language (auditory comprehension, reading comprehension, speech and writing). 3) Word recognition test: The participants were given the word recognition test, which included 20 words from the list of 67-S words (Japan Audiology Society, 2000). A speech therapist (ST) spoke words in a normal tone, had the participants listen to these words and repeat them. Each participant listened to the words in two different ways, i.e., with watching or without watching the ST's mouth movements during speech.
Results: 1 The two-way (4 levels of hearing difficulty; normal, mild, moderate or severe x 4 aspects of language; auditory comprehension, reading comprehension, speech or writing) ANOVAs showed main effect of language aspects [F(3,69)ï¼421.17, p = .00]. In addition, an interaction between the levels of hearing difficulty and the aspects of language was also significant [F(3,71)ï¼43.11, p = .03]. For the normal, mild and moderate groups, auditory comprehension, reading comprehension and speech aspects were relatively spared and significantly higher than writing aspect. However, for the severe group, the reading comprehension aspect was significantly higher than writing aspect only. 2) The two-way (4 degrees of hearing difficulty; normal, mild, moderate or severe x 2 mouth movement; with or without watching) ANOVAs showed main effect of mouth movement [F(1,73)ï¼434.57, p = .00]. An interaction between the levels of hearing difficulty and the mouth movement was also significant [F(3,71)ï¼412.27, p = .00]. It was indicated that the effect of watching the speaker's mouth movements was particularly remarkable for the moderate and severe groups.
Discussion: Among the four groups of different hearing difficulty, the AD individuals with normal, mild and moderate hearing difficulties showed relatively spared auditory comprehension, reading comprehension and speech, which were useful starategies for improving communication. However, those with severe hearing difficulty showed a unique pattern in that their reading comprehension was higher than the other language aspects. Hence, use of letter language is expected to improve comprehension of AD individuals, especially those with severe hearing difficulty. In addition, this study proved that watching the speaker's mouth movements may improve the individual's word recognition. This procedure would be a useful and effective strategy for AD individuals, particularly for those with moderate or severe hearing difficulty.
PS02.124
Sydney Multisite Intervention of LaughterBosses and ElderClowns (SMILE): Results from a clustered randomised controlled trial

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Design: The Sydney Multisite Intervention of LaughterBosses and ElderClowns (SMILE) is a clustered randomised controlled trial of humour therapy in residential aged care.
Aim: The aim of the study was to examine the effects of humour therapy on resident mood, social engagement, quality of life, agitation and behavioural disturbance. Intervention: The intervention comprised 1-day training for a staff member nominated by the facility to act as the LaughterBoss for that facility. The training was addressed how to incorporate humour into daily care practices. The LaughterBoss partnered with an ElderClown (a performer experienced in using humour in health care settings) to engage residents through humour using music, mime, props and other techniques. ElderClowns visited facilities over 12 weeks for humour therapy sessions lasting two hours on each visit, weekly for 12 with each facility receiving a minimum of 9 sessions. LaughterBosses were encouraged to continue use humour techniques between ElderClown visits and after these sessions had ceased. **Sample:** Three hundred and ninety-nine residents were recruited from 35 residential aged care facilities. Facilities volunteered to participate and were included if they provided full-time residential aged care at either hostel or nursing home level within the greater Sydney area to older persons with dementia or other age associated conditions. Residents were included who resided permanently within a pre-defined area of the facility; had lived within the facility for more than 3 months; were not too aggressive, floridly psychotic, receiving palliative care, or vegetative; could provide informed consent or had a guardian who could consent for them, had pre-morbid English language skills sufficient to participate in an interview.
Randomisation: Facilities were stratified based on size and level of care (hostel or nursing home) and randomised to either intervention (17 facilities) or control (18 facilities) groups. Assessment: Researchers blind to treatment assignment collected information at baseline (week 0, n = 399), post-intervention (week 13, n = 372) and at follow-up (week 26, n = 272 to date). Data were collected through resident and staff interviews and from resident charts. The main outcome measures were the Cornell Scale for Depression in Dementia (CSDD), dementia related quality of life measured with the DEMQOL resident and proxy versions, the social engagement subscale of the Multidimensional Observation Scale for Elderly Subjects (MOSES), the Cohen-Mansfield Agitation Inventory (CMAI), and the Neuropsychiatric Inventory Nursing Home version (NPI). Demographic and clinical information were also collected. Post hoc qualitative interviews were undertaken with LaughterBosses.
Analysis: An intention-to treat approach was used. Multilevel models were used to test the interaction between treatment and time taking into account clustering of residents within facilities. Analyses were conducted using linear mixed-effects models in SPSS 18.0.
Results: Residents who dropped out of the study had higher levels of depression, cognitive impairment and agitation at baseline. Follow-up data for eight facilities has not yet been collected. Analysis of all currently available data showed that there were significant improvements on in agitation scores across time for the humour therapy group relative to controls. However there were no significant time by group interactions on the other outcome measures. Within the subsample of intervention facilities, there were significant facility by time interactions on the MOSES, DEMQOL-proxy and a trend for the CMAI. The full dataset for all 35 facilities will be presented in September.
Conclusions: Humour therapy seems to reduce the level of agitation of aged care residents, but did not affect mood, quality of life or other behavioural symptoms. There were differences between the facilities on the effectiveness of the intervention. Differences in the penetration of the intervention between facilities will be

discussed.

PS02.125

Influence of adherence to a systematic care program for caregivers of dementia patients

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Not much attention is usually given to the most obvious reason why support programs in dementia research are not effective: health professionals' adherence to the intervention protocol. Therefore, we evaluate the influence of adherence to the intervention protocol for caregiver and patient outcomes on the Systematic Care Program for Dementia (SCPD) study in community mental health care. Basically, the SCPD consisted of training health professionals in the systematic assessment and interpretation of caregiver problems and in strategies to deal with deficiencies. The SCPD training consisted of three sessions of 2 hours each. One meeting was used to explain the program, and two meetings were used for evaluating the use of the program and for preparing suggestions about how to hand over the responsibility for care after the health service's work was completed. The SCPD can be used in the health professional's first consultation with a patient-caregiver dyad entering the community mental health service. It might prevent overburdening caregivers who have made no request for treatment of their own problems. The intensity of the interventions is left to the discretion of the health professionals. Data were drawn from the SCPD study - a single-blind, multicentre, cluster-randomized, controlled trial. Six community mental health services across the Netherlands and forty-eight health professionals treating 125 patient-caregiver dyads who were referred to the community mental health service because of suspected patient dementia participated. We used multivariate regression analyses to assess the influence of adherence. The dependent variables were the sense of competence, caregiver's depressive symptoms, caregiver's distress due to patient's problem behavior and its severity. The main independent variables were adherence to the SCPD intervention protocol and the intensity of the SCPD interventions. The follow-up lasted 12 months. Studying adherence to the intervention revealed that, at follow-up, caregivers treated by adhering professionals had a better sense of competence than caregivers treated by nonadhering health professionals [b 6.48, 95% confidence interval (CI) 0.001 - 12.95, t = 2.01, df = 47.81, p = 0.05]. Moreover, the caregiver sense of competence in the control group tended to be greater than that of caregivers assigned to health professionals who did not adhere to the intervention protocol (b 5.64, 95% CI -0.76 to 12.04, t = 1.77, df = 49.93, p = 0.08). The pattern in differences in the sense of competence due to health professionals treatment differences was consistent with that of the other clinical outcome measures, although the numbers were not statistically significant. This suggests that caregivers treated by health professionals adhering to the intervention protocol or health professionals in the control group were less overburdened than caregivers treated by nonadhering health professionals i.e., they had fewer depressive symptoms and less distress, and they perceived less severe behavioral problems in patients. In addition to those results, it revealed that the SCPD intervention was not intensive enough, even for dyads treated by health professionals who adhered to the intervention protocol. Compared to the literature the number of counseling sessions in successful interventions was much higher (at least 10 professional - caregiver contacts or sessions) versus 3.37 (SD 2.79, range 1-15) counseling sessions in the SCPD study over 12 months. One reason for this was that the intensity was not standardized beforehand, and it depended on the health professionals' judgment, the optimization the flexibility of the SCPD to individual caregiver needs, and the acknowledgement of the health professionals' expertise. Our study has some limitations. The study sample consisted of a selective subgroup of patient-caregiver dyads and health professionals due to attrition. However, it is unclear whether this selection influenced the results. Furthermore, the possibility of contamination due to a transfer of patient-caregiver dyads

and knowledge exchange between health professionals in the intervention and control groups could have taken place. We checked whether the health professionals in the intervention groups discussed the intervention with health professionals in the control group, and, given their answers, we conclude that they did not. In sum, our study shows that future controlled trials of daily clinical practice should not overlook the influence of adherence to the intervention protocol on outcomes. Furthermore, the intensity of a program is crucial and should not be left to the discretion of health professionals.

PS02.126

The Enriched Opportunities Programme for people with dementia living in extra care housing: A randomised cluster controlled trial of a complex psycho-social intervention

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The Enriched Opportunities Programme (EOP) is a multi-level psycho-social intervention focusing on improved quality of life for people with dementia and other mental health problems. EOP was developed from utilising a review of the published literature, expert opinion from practice, service user perspectives and an action research programme in four practice development sites (Brooker &Woolley, 2007; Brooker, Woolley &Lee, 2007) including three specialist nursing homes and one extra care housing scheme. In line with the Medical Research Council (MRC) sequential framework for developing and evaluating complex interventions these exploratory studies helped us to further develop the intervention and plan this definitive evaluative study. On the basis of this we are able to define the key components of a replicable intervention and a feasible protocol for comparing the intervention to an appropriate alternative.

We compared the experience of people living with dementia and other mental health problems in extra care housing schemes that utilised EOP with schemes that employed an active control intervention. The provision of extra care housing (similar to assisted living in the US) has been put forward as a means of improving the quality of life for older people living with long term conditions, such as dementias (Department of Health, 2005; 2009). The only UK longitudinal study looking at how people with dementia fared in extra care housing over a three-year period showed that residents with dementia and their relatives were very positive about extra care as an experience (Vallelly, Evans, Fear &Means, 2006). Despite this, over half were admitted to other care settings during the first two years. Reasons for moving on were given as challenging behaviour, conflicts with staff and other residents, and increased distress.

In the study described here, ten extra care housing schemes were cluster randomised to receive either the EOP intervention or an active control intervention for an 18 month period. Residents with dementia or other significant mental health problems (20-30 per scheme) were assessed on a number of outcome measures at baseline, six months, one year and 18 months. The primary outcome measure was quality of life. Self reported depression was an important secondary outcome. The EOP participating residents rated their quality of life more positively over time (4.0 [SE 0.6] units; 14% $p<0.001$) than the active control (1.3 [SE:0.6] units; 4% $p = 0.003$). There was also a significant group-time interaction for depressive symptoms ($p = 0.003$). The EOP participating residents reported a reduction of 25% at both 6 and 12 months and a 37% reduction at 18 months (all $p<0.001$). EOP residents were less likely than residents in the active control sites to move to a care home or to be admitted to a hospital inpatient bed. They were more likely to be seen by a range of community health professionals. Improvements in the use of health care resources in the EOP resulted in significant cost savings (National Audit Office, 2010). The Enriched Opportunities Programme had a positive impact on the quality of life of people with dementia in well-staffed extra care housing schemes. References: Brooker, D. &Woolley, R. (2007) *Enriching Opportunities for People living with Dementia: The Development of a Blueprint for a Sustainable Activity-Based Model of Care. Aging and Mental Health*. 11(4): 371-383. Brooker, D., Woolley, R. &Lee, D. (2007) *Enriching Opportunities for People living with Dementia in Nursing Homes: An evaluation of a multi-level activity-based model of care. Aging and Mental Health* 11(4): 361-370. Department of Health (2005)

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PS02.127

Promoting accessible and appropriate activity engagement for people in residential aged care facilities in Melbourne, Australia

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Background: People with dementia experience progressive deterioration in their functioning which can make engaging in meaningful activities difficult. With disease's progression, increased demand is placed on carers to select and facilitate activity engagement in a manner that affirm identity, provide meaning and opportunities for self expression and utilizes remaining abilities (Hellen, 1998; Westphal, 2010; Perrin et al., 2008). Whilst literature supports the centrality of activities to the quality of life of those with dementia, research indicates that within residential aged care, this need for engagement is largely unmet (Hancock, et al., 2006; Kuhn, et al., 2004; Logsdon et al., 2007). Various reasons have been cited including lack of carer training, limited knowledge, time constraints and limited access to appropriate resources and expertise (Kuhn et al., 2004; Marcy- Edwards et al., 2005). In response to several of these identified needs, an innovative program called the Leisure Resource Library was developed in Melbourne, Australia using philanthropic grant funding and community input. The library, which is the first of its kind in Australia, is managed by the St Vincent's Aged Person's Mental Health Service and operated with the assistance of dedicated volunteers who assist with the library's day to day running. The Leisure Resource Library seeks to address the limitations impacting on the provision of meaningful activities for people with dementia in residential aged care by providing facilities with access to a range of leisure activity resources, education and access to experienced Allied Health and nursing expertise. Aim: This project evaluated the effectiveness of the Leisure Resource Library in addressing some of the identified limitations residential aged care facilities experience in providing people with dementia with meaningful engagement.

Methods and Results: Residential aged care facilities who are members of the Leisure Resource Library were surveyed in 2009, 2010 and 2011 to identify the usefulness of the service in meeting the engagement needs of their residents with and without dementia. Informal feedback was also collected from members and recorded verbatim by St Vincent's Aged Person's Mental Health Service staff and volunteers. Responses from facilities identified high rates of satisfaction with the service as well as increases in their accessibility and utilisation of leisure activity resources and education.

Conclusion: A library service containing leisure activities appropriate for older people with dementia in residential aged care together with education and accessible expertise can increase accessibility to and utilisation of meaningful activity, provide opportunities for capacity building in carers and assist carers in translating knowledge concerning meaningful engagement into practice. Exploration of the suitability of this model of activity provision for people with dementia living in the community is also warranted. References: Hancock, G.A., Woods, R., Challis, D., &Orrell, M. (2006). *The needs of older people with dementia in residential care. International Journal of Geriatric Psychiatry,* 21: 43-49. Hellen, C.R. (1998). *Alzheimer's Disease: Activities focused care* (2nd Ed). Butter-worth-Heinemann: MA. Kuhn, D., Fulton, B.R. &Edelman, P. (2004). *Factors influencing participation in activities in dementia care settings. Alzheimer's Disease Quarterly,* 5: 144-152. Logsdon, R.G., McCurry, S.M. &Teri, L. (2007). *Evidence-based interventions to improve quality of life*

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PS02.128

"Looking for meaningâ[euro]: A preventive life review course for long-term care residents

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Background: Older adults living in nursing homes or homes for the Aged have a higher risk to become depressed (Jongenelis et al., 2005). "Looking for meaningâ[euro] is an evidence-based prevention course for community-dwelling older adults with depressive symptoms, based on life review (Pot et al., 2010). An adjusted version for older adults with severe mental disorders has been developed to assist them in developing a coherent, meaningful life-story and to improve their life satisfaction (Willemse et al., 2009). The purpose of the current pilot study was to evaluate if this adjusted course is suitable for older adults living in nursing homes and homes for the Aged. Another purpose was to see if the course has an impact on depressive symptoms, psychological wellbeing and quality of life. Intervention: The adjusted intervention consists of 12 weekly sessions of 1.5 hours. Each session has a structure in which life review, dialogue and creative expression alternated.

Method: The pilot project was conducted in 2009-2010 in four nursing homes and four homes for the Aged in the Netherlands. The residents participated in eight different groups, each consisting of 5-8 persons. People with cognitive impairments were excluded from this study. The intervention was carried out by a psychologist and an activity therapist. To evaluate the effects of the intervention on depressive symptoms, psychological wellbeing and quality of life three questionnaires were used; The Geriatric Depression Scale-8 (GDS-8), Philadelphia Geriatric Center Morale Scale (PGCMS) and the Euroqol-5 (EQ-5D). Data were collected at baseline and one week after the last session.

Results: At baseline the sample consisted of 42 females and 13 males. Due to death and physical illness 44 participants completed the course. Results of the pilot evaluation show that the intervention had a significant effect on the GDS-8 ($p<0.001$) and the PGCMS ($p<0.001$), but no significant effect on the thermometer of the EQ-5D ($p = 0.186$). Which subgroups benefit more or less from this course was also investigated.

Discussion: "Looking for meaningâ[euro] seems to be suitable course for older adults living is nursing homes and homes for the Aged. It also seems to have an impact on depressive symptoms and psychological wellbeing.

PS02.129

Psychological outcomes of life story work for community-dwelling seniors

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Background: Use of the life story approach in elderly care has become popular in recent years. Life story work (LSW) has been found to result in positive changes such as increased insight into self and increased hopefulness. Yet, strong evidence of the benefits of LSW is lacking. This study aims to examine whether the LSW of community-dwelling elderly would lead to a higher level of life satisfaction and an increased sense of self-esteem and well-being.

Methods: Members of 17 community and daycare centers who are (i) aged 60 or above, (ii) able to understand and speak Cantonese, (iii) able to see and hear without or with aids, (iv) without any active major psychiatric illnesses, acute or unstable chronic medical conditions, or active psychosocial crises are eligible as participants.

Because members of community centres tend to know each other, the participating centres instead of individual members will be randomly assigned to the experimental or control group to avoid cross contamination. The control group have planned social activities designed in the same manner as the intervention group except that participants do not talk about their life stories. In this proposal, 'life story' refers to a facilitated written account of an individual's life. Participants in the intervention group work with trained volunteers to produce their life story book through four to six semi-structured sessions either at the senior's home or at the social centers. The outcome measures include: (i) The Life Satisfaction Scale (LSI-A); (ii) the Rosenberg's Self-Esteem Scale (RSES); (iii) the General Health Questionnaire; and (iv) the Geriatric Depression Scale (GDS). Immediate outcomes (T1) of the LSB intervention will be compared against the baseline (T0), and measurements taken three months (T2) and six months (T3) postintervention.

Results: Twenty-six intervention group and 32 control group subjects have been recruited at the moment. Preliminary data analysis using generalized estimating equation finds that only 'time' significantly affected the outcome scores of GDS ($p = 0.000$), LSI-A ($p = 0.000$), and RSES ($p = 0.000$). Friedman's test shows that RSES significantly changes from T0 to T1 ($p = 0.033$) and from T0 to T3 ($p = 0.003$) for both groups. The study is still in progress.

Discussion: Upon completion of the project, the findings are expected to help clinicians to better understand the psychological outcomes of LSW for seniors in the community. If the life story approach can produce better psychological outcomes for seniors, then it is worthwhile promoting in the care of elderly people.

PS02.130

Barriers and facilitators to implement evidence based psychosocial care in dementia: A focus group approach using multinational and multidisciplinary expert groups

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Introduction: Optimizing quality of life of both patients and carers is an important treatment goal in dementia care and psychosocial interventions have shown to be effective treatment options. Several European countries have presented dementia strategies which include statements about the use of this type of interventions. However, the widespread availability of evidence based psychosocial care is not guaranteed throughout Europe. To facilitate the implementation of psychosocial care a set of content and face valid quality indicators was developed. The purpose of this study was to explore barriers and facilitators for implementing the set of quality indicators for psychosocial interventions in various countries.

Methods: A qualitative study was conducted which included a purposive sample of 27 experts from nine European countries (Denmark, Norway, France, the Netherlands, Germany, Poland, Italy, Spain and the United Kingdom) and the disciplines of clinical psychology, general practice, geriatric medicine, old age psychiatry, medical sociology, nursing and dementia research. These experts met face-to-face and were divided over three groups to discuss the barriers and facilitators for implementing the set of quality indicators across and within countries during 2 focus group sessions of 1.5 hour each. The interview guide for the focus groups included barriers and facilitators regarding people with dementia and their informal carers, collaboration between professionals, and national health care systems. Focus groups were taped and data was transcribed verbatim. The data were analyzed inductively with ATLAS.ti version 6.2, using the Framework approach.

Results: Two themes relevant to the implementation of the set of quality indicators emerged. These two themes were barriers and facilitators for the implementation across and within countries. Among the facilitators were incentives such as money for the correct use of the quality indicators or a quality certificate, the European consensus about the set of quality indicators, the right time to introduce the quality indicators because of the growing evidence base and attention for psychosocial care, and increased involvement of patients and carers in the care process. Among the barriers were the lack of specificity of some quality indicators, the access to quality indicator data for quality comparison between or within countries, and the motivation of professionals in

dementia care. Some of the issues that were raised were found to be both a barrier and a facilitator. This was related mostly to differences in the organization of dementia care between countries. Among these were national and local policies and the applicability of the quality indicators to all patients with dementia.
Conclusion: The barriers and facilitators that were found in this study indicate that there is not one standard implementation strategy that can be used across all countries. Barriers and facilitators do not only differ between countries but also within countries, depending on how dementia care is organized. National and local governments can increase success of the implementation process, for instance by introducing incentives or the inclusion of quality indicators in national and local health care laws. Professionals can improve the quality of dementia care by using the quality indicators because it increases the involvement of the patient and carer in the care process and the attention for the needs and wishes of the patients themselves.

PS02.131

Elder abuse in Poland

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Typically, elder abuse include physical abuse, neglect, or a deprivation of care that results in physical harm or pain/or mental suffering. Neglect may be defined as both passive and active neglect.It is generally agreed that abuse of older people is either an act of commission or of omission(in which case it is usually decribed as "neglectâ[euro]) and that it may be either intentional or unintentional. Poland is a country with a rate of demographic aging similar to other developed nations. In 1999, the percentage of persons 60 years and older constituted 15,2 percent of the total populations; is expected to rise dramatically to 20% by 2020.It is important that in Poland as well as in another Eastern European countries as a result of changes from planned to market economies, many older people have been left without a retirement income and the health and welfare services that were provided by the former communist regimes. The complexity of elderly's life situations in Poland increases the probability that they will be subject to neglect and abuse.A research study conducted to ascertain the causes and extent of elder abuse in Poland found the cases of violence against the aged are probably often and the family bonds are still maintained. Polish gerontological literature has not be defined abuse and neglect with regard to the elderly people. In this situation is difficult to estimate the extent of this problem in Poland. Individual studies only marginally suggest the existence of this fenomenon. According to this investigations, the following factors take part in elderly abuse: *the increased rate of aging of the ruled society(16,5%) compared to the urban society(12,8%)-a result of intensive migration process *the influence of the residence on the creation, course on results of family conflicts *in cities neglect and abuse of the elderly are more frequently(a results of a shortage of flats, lack of specified social roles for old age, their dependency in terms of care and help, and alcohol abuse) *difficult economic situation for retired people The kind of elder abuse.The abuse is generally divided into the following categories: 1.physical abuse- the infliction of pain or injury, physical coercion or physical or drug-induced restrain 2.psychological or emotional abuse- the infiltration of mental anguish 3. financial or material abuse-the illegal or improper exploitation or use of funds or resources of the older person.Some authors include financial exploitation as a important part of the elderly abuse 4. sexual abuse - non-consensual sexual contact of any kind with the older person. 5.neglect -the refusal or failure to fulfil a caregiving obligation.This may or may not involve a consious and intentional attempt to inflict physical or emotional distress on the older person. 6.isolations from family It is interesting that no clear correlation between the occurence of the family conflicts and social class and education was found. Knowledge about the problems of elder abuse in Poland as not satisfactory until now is currently under discussion and new concept of this phenomenon will be prepared.

PS02.132

Improving patient compliance and mental health outcomes: Health behavior and its foundations which undergird patient compliance

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Patient compliance can be the key to successful treatment interventions. Older adults however may have their own set of psycho-social factors which will play a role in patient compliance and ultimately successful treatment outcomes. This presentation will explain specific health promotion theories which have been developed through Health Behavior specialists, and then explore how these theories can be used to both understand and improve patient compliance when treating older adults for mental health issues. The Health Belief Model (Rosenstock &Becker, 1974), Stages of Change Framework (Procheska and DiClemente, 1983) and Health Model for Perceived Self Efficacy (Bandura, 2005) will be showcased. The Health Belief Model (Rosenstock, 1974, Becker, 1974) helps explain the role of lifestyle based upon human motivation. Perceived seriousness and perceived susceptibility play a role into how people handle and attend to factors which promote or detract from optimal mental health conditions. Although the model is comprised of six major components which drive health behaviors, the most significant two components rely upon how an older adult will perceive the seriousness of a potential mental diagnosis, and how susceptible they perceive themselves as being threatened with the adverse health outcomes without treatment. Cues to action also will contribute to overall success with interventions in the model. Prochaska &Diclemente (1983) identified six stages of change which impact one's readiness to participate in change regarding smoking behavior. While their original work examined one's behaviors in relation to addiction behavior, the stages of pre-contemplation, contemplation, preparation, action, evaluation and termination are relevant in how people participate in their own self care and within treatment for mental health disorders. The continuum of readiness for intervention and potential compliance can be identified along these defined stages in the change process. Identifying where older adults are along this continuum is relevant for predicting compliance among older adults. Social learning theory or social cognitive theory (Rosenstock, Strecher &Becker, 1988) theorized that learning and behavior is a result from events or a series of reinforcements and expectations. Individual behaviors are guided by individual expectations, but ultimately may be controlled by external expectations, or expectations from others. Internal and external locus of control will have an impact on one's behavior, however the expectations of others will greatly influence the outcome (Rosenstock, Strecher &Becker, 1988). Bandura (2005) built upon the components of social cognitive theory to evolve a model of self-regulatory behavior. The health promotion literature has well documented the success or failure of health interventions targeting mental health based upon these theories. Unfortunately, some cultures or settings utilize the notion that one is personal responsible for their own health and mental health and shift the burden of responsibility for mental health on the individual, rather than the state, or government. Thus, any deficits or maladaptive behavior is a result of the individual and their lifestyle, which results in a societal perspective of "blaming the victimâ[euro] (Ryan, 1976), rather than understanding the individual and what programmatic interventions could improve mental health outcomes. Within this presentation, each model will be described, and through the use of case studies, the components of the models will be showcased to explain how the use of these health behavioral frameworks can be used to help demystify the process of psychiatric intervention for patients, improve mental health outcomes and improve patient compliance, This presentation will also address how the use of health promotion frameworks/theories can improve patient behavioral health literacy related to their mental health issues, with the ultimate goal of patient compliance.

PS02.133

Transition from regular day treatment in the nursing home to Low-threshold Psychogeriatric Day treatment plus informal caregiver support in the community

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Background: In the past fifteen years Meeting Centres for people with dementia and their informal caregivers have been meeting a significant need. Repeated research showed that the Meeting Centres have more positive effect on the behaviour and moods of people with dementia, the sense of competence of their informal carer,

and on delay of nursing home admission. To date, only a few nursing homes in the country have utilized this knowledge by transforming (part of) their p.g. day treatment into a low-threshold p.g. day treatment (LPD), or meeting centre. Apparently the transformation of the intramural p.g. day treatment that is completely embedded in the nursing home organization into a low-threshold extramural p.g. day treatment in the community, with intensive cooperation with care and welfare organizations, is no simple task. In order to stimulate the transition nationwide, research on a regional level would provide insight into the surplus value of the transition (on a micro, meso and macro level), and into the factors that facilitate or impede the transition, thereby gaining insight into how the transition may be realized successfully at a nationwide scale.
Goal of Implementary Study: To evaluate on a regional level the transition from regular psychogeriatric day treatment in the nursing home to Low-threshold Psychogeriatric Day treatment in the community, which can also include, if so desired, Support for informal Carers, based on the Meeting centres Model (LPD-plus CS). Supplementary to the Meeting centres the LPD-plus CS will serve not only couples of people with dementia and their informal carers, but also single persons with dementia and persons with dementia whose informal carer does not want support. The research, that is carried out in the framework of the transition project Continuity of Care in Dementia in the Amsterdam region, will provide insights required for the nationwide dissemination and implementation of the LPD-plus CS. These insights pertain to: a) the surplus value of LPD-plus CS as compared to regular day treatment, at the micro, meso and macro levels; b) insight into facilitating and impeding factors for implementation at the micro, meso and macro levels, and successful implementation strategies based on which a practical guide for the implementation of LPD-plus CS will be composed.
Method: Four regular p.g. day treatments in Amsterdam nursing homes are transformed into LPD-plus CS. Before and after the transformation both quantitative and qualitative research will be conducted according to a pretest-posttest control group design. In order to establish the surplus value of LPD-plus CS at the micro level, two measuring moments (after 1 and after 6 months) will be used to investigate whether on average the users of the LPD-plus CS (post-transition), in comparison with the group of regular day treatment users and their informal carers (pre-transition), utilize the care sooner and for a longer period of time, and experience better quality of life; the people with dementia suffer fewer behaviour and mood problems; and their informal carers (if present) gradually experience less burden and feel better able to cope with the care (for a longer period of time) (delayed nursing home admission). At the meso level it will be studied whether and how the cooperation with care and welfare organizations in the community changes after the transition, and at the macro level cost effectiveness will be investigated. By means of interviews with key figures in the transition process the transition will be investigated for facilitating and impeding factors for implementation at the micro, meso and macro level. A theoretical model that was developed in earlier research will be used for composition of the interviews and analysis. Based on this model a scenario will be formulated for the transformation of regular p.g. day treatment into LPD-plus CS. RESULTS: First results of a pilot study executed in the period of June 2010 to June 2011 will be presented. In this study the transition of a psychogeriatric day care into a low-threshold day care plus caregiver support was realised, the surplus value was investigated and interviews with key figures resulted in a list of facilitators and barriers of the transition.
Conclusion: The results of this pilot study will be used in the implementation study to optimize the transition from four regular day treatments in the nursing home to four Low-threshold Psychogeriatric Day treatment-plus informal caregiver support in the community. The project is started in February 2011 and will finish in January 2014.

PS02.134

The self-efficacy based memory training program for healthy elderly with subjective memory complaints

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Objectives: According to the increase of the older people, the need for effective methods to maintain or improve cognitive functions in the elderly becomes increased. However, there are few effective non-pharmacologic and cognition based treatment for preventing and improving cognition. The present memory training program that we used was multistrategic memory training, including a metamemory approach and memory self efficacy concept. The term "metamemoryâ[euro] includes knowledge, perception, and beliefs about their own memory and the memory system. Metamemory emphasis on self-reflective and control processes in learning, and people's knowledge about their memory and cognitive process. This kind of concept was also used in the term "memory self-efficacyâ[euro] as a specific dimension of metamemory.Recent studies indicate that metamemory process, including memory monitoring, judgments of learning and control process, can enhance the effectiveness of learning. We hypothesized that this multistrategic memory training with a metamemory approach may improve cognitive performance of untrained areas as well as memory ability. Specialized and self-efficacy based cognitive enhancing method may contribute to prevent elderly cognitive decline by aging and dementing illness. Here, we aimed to provide the effective memory training program for normal healthy older people so as to improve cognition or prevent disease causing dementia.

Methods: Multistrategic memory training program (MMTP) based on memory self-efficacy theory was developed by psychiatrists and psychologists in accordance to Korean situation. We applied the MMTP to the community-dwelling healthy elderly with subjective memory complaints. 70 Participants were randomized to receive the intervention with non-treatment 53 controls. This program consists of 10 sessions and has once a week schedule. Comprehensive neuropsychological tests for pre-treatment and post-treatment were compared by well-trained psychologists between two groups.We selected appropriate items from the Elderly Memory Disorder Scale (EMS). To assess memory function, we administered the Elderly Verbal Learning Test (EVLT) and the Simple Rey Figure Test (SRFT). In addition, short-term delayed free and cued recall of the learning word lists and long-term (20 min) delayed cued recall and recognition tasks are included. In the SRFT, copying tasks, immediate recall tasks and tasks on delayed recall and recognition after 20 min are included. To evaluate attention and executive function, we used the Digit Span Test (DST), the Spatial Span Test (SST), the Phonemic Fluency Test (PFT) and the Categorical Fluency Test (CFT). The Subjective Memory Complaints Questionnaire (SMCQ) was used to evaluate subjective memory functioning. The Korean version of the Geriatric Depression Scale, Short Form (SGDS-K) was used to evaluate depression.

Results: There were significant effects favoring the intervention group on verbal memory subtests, including short term delayed free ($p<0.05$) and cued recall ($p<0.05$) as well as long-term delayed free ($p<0.05$) and cued recall ($p<0.01$). Significant effects on the visuospatial memory subtest and SRFT recognition ($p = 0.01$) indicate greater improvement in the intervention group. On the attention and verbal fluency, there were significant effects favoring the intervention group on visuospatial span forwards ($p<0.05$) and Categorical Fluency Test ($p<0.005$). In general linear model analysis, the changes of baseline and post-treatment scores in participants were significantly higher than in controls in verbal short-term delayed cued recall ($F = 4.85$, $p<0.05$), verbal long-term delayed free recall ($F = 4.48$, $p<0.05$), and delayed recall of visual memory ($F = 4.985$, $p<0.05$) We excluded the effect of changes in depressive symptoms on cognitive performance.

Conclusion: It seems that MMTP has an effect on the improvement of cognitive performance in the normal older adults. This multistrategic and memory self-efficacy based approach may be an effective tool for preventing cognitive decline and dementia like disease in the elderly.

PS02.135

Neuropsychological rehabilitation for people with prodromal and early stage Alzheimer's disease

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Neuropsychological rehabilitation for people with prodromal and early stage Alzheimer's disease Background: There is a growing interest as to how methods of non-pharmacological intervention can be offered to people

with dementia and their caregivers, with the purpose of relieving symptoms and improving quality of life. At the Copenhagen Memory Clinic at Rigshospitalet, Copenhagen University Hospital, we are offering a program of neuropsychological rehabilitation to people with prodromal and early stage Alzheimer's disease. Neuropsychological rehabilitation is a holistic method concerned with improving cognitive, emotional, psychosocial, and behavioral deficits caused by brain malfunction, and has traditionally been develop within the field of acquired brain injury. Our pilot study is conducted with the aim of applying this method to patients with progressive neurodegenerative diseases, and their caregivers, in the setting of an out-patient memory clinic. Method The program is based upon individualized goal-oriented rehabilitation. Initially the patients' personally relevant goals of rehabilitation are identified. The process of rehabilitation is focused upon implementing personally relevant and useful strategies and methods, addressing these goals. Subsequently the training and implementation of individualized strategies and methods are conducted within a group of patients. These group sessions have the advantage of conducting rehabilitation within a real-life setting of interaction, communication, patient-to-patient feedback and support. Parallel to the group training, patients also receive individual support and challenges that bring the strategies and methods of rehabilitation into their daily life. The effectiveness and suitability of the individualized strategies and methods are being evaluated during the rehabilitation process, and are adjusted, if necessary. Also, caregivers are included in the process of rehabilitation. They take part in the identification of individualized goals and relevant strategies/methods of rehabilitation. They also participate in caregiver group sessions, where they are introduced to methods of supporting patients' rehabilitation process, with the purpose of improving transference of the outcome of the rehabilitation process into the daily life of patients and caregivers. The caregiver group sessions also have the purpose of psycho education and caregiver support. Caregivers are defined as the closest relative to the patient, a person who has a frequent contact with the patient and takes an active part in the patients' daily life. However, the caregiver is not necessarily living with the patient. The rehabilitation program is conducted within a three months period, and is managed by a clinical neuropsychologist. Results 8 patients and 8 caregivers are included in the pilot study. The outcome of the pilot study is evaluated on several variables. As a primary outcome measure, it is being evaluated to what extend the patients' subjective goals for their individual rehabilitation process is achieved. A brief battery of neuropsychological tests is conducted to describe the patients' cognitive profiles; however, it is not presumed that the rehabilitation process will have an effect on cognitive functions, as measured by traditional neuropsychological tests. Pre- and post intervention levels of quality of life and symptoms of depression are also measured, both for patients and caregivers. Pre- and post intervention levels of caregivers strain is also evaluated. Specific results from the pilot-study will be available in June 2011.

PS02.136

SenseCam intervention based on Cognitive Stimulation Therapy framework for early-stage dementia

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Estimates suggest that Ireland will have 50,000 people with dementia by 2016 and over 100,000 by 2036. Combined with European total costs estimated in 2005 at [euro]130 billion. As dementia is incurable there is a real need to develop innovative approaches that improve mental health of the people with dementia. Using technology is one way of developing such approaches. This research explores intervention which uses Microsoft SenseCam images within the principles of Cognitive Stimulation Therapy (CST) to engage people with early stage dementia in meaningful discussion. This SenseCam intervention, like the CST approach, is aimed at general enhancement of quality of life and global cognitive and social functioning. SenseCam is a lightweight wearable digital camera which passively takes images of the wearers' activities throughout the day. It does not have a viewfinder or a display that can be used to frame photos; instead SenseCam is fitted with a wide-angle (fish-eye) lens that maximizes its field-of-view. This ensures that nearly everything in the wearer's view is

captured by the camera. SenseCam also contains a number of electronic sensors, including light-intensity, a passive infrared (body heat) detector, accelerometers, and a temperature sensor, which are used together to automatically trigger a photograph to be taken. SenseCam takes about 3,000 images a day. Aspects of CST to be adopted in this intervention include: focus on strengths and abilities and carefulness to avoid situations which erode self-esteem; and a framework of 14 sessions of themed activities run over a seven week period. The sessions have some basis in reminiscence. As remembering is an act of communication, meaningful discussion about memories from one's life is the key to social interaction, enjoyment, interpersonal bonds, increased contribution and engagement. Reminiscence relies heavily on generic images to generate discussion. In this instance the images derived from SenseCam are personal to the individual and always relate to individual's own life, and to that of one's family. They encourage romanticizing about everyday life events, finding sentimentality in unexpected events and portraying personality. SenseCam images have also been found to improve memory in patients with memory impairments hence this technology has potential as a memory training technology although this is not the central focus of this study. In this research three individuals with early stage dementia who have a carer will be recruited. They will be asked to wear SenseCam while they go about their everyday life, for the duration of seven weeks. During which the therapist and the researcher will call at pre-arranged appointments twice a week, 45 minutes each. Throughout these sessions the therapist will view the images and engage the participant in discussions about the images using software which automatically structures the thousands of SenseCam images captured each day, into "eventsâ[euro]. The event-based browsing software developed in the CLARITY centre allows huge amounts of SenseCam data to be navigated easily. The researcher will observe the therapist and participant engaging in CST, noting reflections in the journal regarding the process of administration, participant enjoyment and any other comments. The primary aim is to explore responses of individuals with dementia to viewing images derived from Microsoft SenseCam, secondary aims include exploring whether the images enable rich opinion based discussion, under what conditions, and whether discussing such images is meaningful and enjoyable to individuals. A broad range of measures and qualitative data will be collected to evaluate the extent to which the images from an individual's own life generate discussion, and such discussions affect quality of life, communication skills and carers' strain for example. Currently, people with dementia and their families in Ireland rarely receive any intervention in the early stages of the disease; participation in this study will provide free intervention for both the person with the dementia and their carer. It is possible that there will be direct benefits to the person with dementia and the carer in terms of improved cognitive or psychosocial well-being. Indirectly this will contribute to the currently small literature base on meaningful interventions in the early stage dementia care. This poster will present a flavor of the initial results of these case studies and demonstrate the SenseCam interface being used with clients.

PS02.137

Happiness, health, religiosity and gender differences among the elderly

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Manu, the ancient law giver, in his Dharmasastra divided the human life span into four stages - brahmacharya (student life), grihastha (family life), vanaprastha (in young old stage moving to forest) and finally sanyasa (asceticism). Aging is a universal, continuous and insidious process, beginning with conception and ending with death. What is understood as "old ageâ[euro]. Demographic ageing is a global phenomenon. In the words of Seneca; 'Old age is an incurable diseaseâ[euro], but more recently, Sir James Sterling Ross commented: "You do not heal old age. You protect it; promote it; you extend itâ[euro]. Therefore old age should be regarded as a normal, inevitable, biological phenomenon. Religion is important social and psychological factors in the human society at different age levels. Happiness may be conceptualized as the ultimate aim of practicing psychology, as well as a main topic in, and a suitable subject for psychology. Yet, during several decades in its history, psychology focused more on negative emotions, such as depression and anxiety, than on positive emotions,

such as happiness, well-being, and satisfaction. Hence, the present study was to investigate whether religiosity and gender have significant contribution on happiness and health among elderly people. Therefore, The sole aim of the present research paper was to test for an association between, happiness, health, and religiosity among male and female elderly. The following psychological tools were used in the present study: Oxford Happiness Questionnaire by Steve Wright, Mental Health By Jgdish &Srivastava and Religiosity Scale by Bhushan. A stratified random sampling technique was used to collect data from 400 participants, age ranges of 60-70 years were randomly selected and aforesaid tools were administered respectively. Their attained scores were statistically analyzed and found that males had a significantly higher self-rating mean score of happiness and mental health than females, while females had a significantly higher religiosity mean score than their male counterparts. Similarly, it has also been proved that religiosity increased with age among both male and female. Further it has also been found that happiness, religiosity and health are positively correlated to each other irrespective of male and female. Numerous empirical studies have demonstrated that people, who are religiously devout and committed to their tradition, excluding extremists, tend to enjoy better psycho-physical health. Therefore, the relations between happiness and health, both physical and mental, may be hypothesized on solid grounds, inasmuch as bad physical or mental health may have an adverse effect on feeling happy. * &** Asst Professors of Psychology, Government Post graduate College, Sector-46, Chandigarh - INDIA, Postal Code- 160047

PS02.138

Psycho social determinants of mental health in older adults

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Although the WHO has identified specific behaviors which fall within the diagnostic categories for mental health and mental illness, some specific perspectives view mental health, mental illness and mental vitality a fluid, rather than static concept The former United States Surgeon General, Dr. David Satcher identified one's mental health as one's psychological state which was on a continuum, and fluctuated based upon a variety of factors, both internal and external to the person (USDHSS, 2000). These internal and external factors comprise one's psycho social determinants of mental health. Although the field of psychology and behavioral science has identified numerous theories which help build an understanding of the psychological factors which impact mental health, others have defined social determinants of health and mental health (LaLonde, 1981; WHO,2008; Bahrer-Kohller, 2011). This poster will address the social determinants of health and how these interplay within one's psyche to impact one's mental health. These social determinants include economics, behavior/lifestyle, genetics, environment and social networks. Economics Economic factors include the interplay between common mental disorders and poverty, and continue to substantiate the role that economics plays in promoting mental health. Although studies suggest that poverty is associated with poor mental health, there is some debate about which factors actually contribute the most to one's mental health. Factors such as food insecurity, financial stress and housing may play a larger role than social class and socio-economic status. Increasingly, with limited incomes and challenges to one's economic situation at the given time, economic factors will play a role on an older adult's mental vitality. Behavior/Lifestyle The health behavior literature, which has studied the interplay between one's help seeking behavior and one's lifestyle on mental health outcomes, have contributed greatly to our understanding of the relationships between behavior/ lifestyle and mental health. Behavior can also include addictive behaviors such as substance use, substance misuse and other addictive behaviors such as gambling and hoarding. Adaptive behaviors and coping strategies also contribute to one's overall mental health, and these too are antecedents of mental vitality in older adults. Genetics/Human Biology Early scientific studies to understand schizophrenia through twin studies helped lead rise to the interplay between genetics and psychopathology. These early studies have continued to be substantiated and continue to help reinforce the linkage between genetics and mental health disorders such as depression, schizophrenia or bi-polar disorder (de Lara et al., 2010; Meyer-Lindenberg, 2009; Sprangers, M. et al., 2010; Toulopoulou et

al., 2010). More recently, findings are also suggesting genetic linkages between cognitive disorders, dementias and Alzheimer's diseases. Environment The context of one's environment has also long been linked to one's overall health and subsequently, an older adult's mental health. Numerous publications have identified the linkages between one's physical environment and mental health, as well as one's neighborhood environment and its relationship to mental health outcomes (Andrersson, Bjorngaard, Kasperson, Wang, Skre &Dahl, 2010; Jackson, Langille, Lyons, Hughes &Martin, 2009). Environmental toxins and pollutants can also have an impact on an older adult's mental health, although we are only beginning now to discover the linkages between environmental toxins and mental health outcomes in older adults. Social networks Lastly, social networks and supports play a pivotal role as a social determinant to one's mental health. Peer support and group intervention strategies have been well documented within the literature as strategies to help facilitate stronger mental health outcomes during intervention trials. The literature also strongly supports social support to alleviate isolation, and loneliness among older adults, with the goal of improved mental health outcomes. While there is significant documentation within the literature to suggest that these factors have a significant upon one's health, the literature also suggests that these factors individually or in combination also contribute to one's mental health, and each component along with it's component parts will be explored to help inform how psycho-social determinants will play a critical role in defining and impacting mental health of older adults.

PS02.140

Self-management and mental health

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Background: Self-management has become a broad generic term to refer to interventions that aim to train health service users and enable them to actively solve problems and improve their self-regulation and -efficacy. If self-management strategies are successfully learned or changed, individuals (re-)gain their ability to manage their lives without external professional support services. Self-management interventions were originally established for a number of long-term medical conditions. Numerous well-established self-management intervention programs exist for patients with chronic somatic conditions. Their use is today regarded as evidence-based. Only recently, self-management programs have begun to involve people with psychiatric diagnoses.

Objective: This presentation gives an overview of current needs and devolopments of self-management in the context of mental health. In light of a brief analysis of current health policy trends in the mental health field, scientific studies that use self-management interventions in a mental health context are being reviewed. Special attention is given to randomized controlled trials using self-management interventions. In addition, theoretical and practical limitations, as well as the potential of self-management in mental health conditions are being discussed.

Results: The promotion of mental health and the prevention of mental illness form part of national policy in many countries. Self-management in this context is a focus of current initiatives by the WHO and national health programs in many countries. For example, the WHO and the European Commission are currently co-funding a project aimed at improving strategies and actions to empower people with mental health problems. This underpins the need and developmental potential for self-management programs in the mental health field. Theoretically, self-management in the context of mental health involves 1) coping and managing the stressors of daily life in healthy people, 2) preventing and managing milder psychiatric conditions, 3) self-management programs targeting on people diagnosed with relatively severe psychiatric disorders. All of these aspects are represented in the current scientific literature. In comparison to the situation in chronic somatic conditions, studies focusing on self-management interventions in the mental health field are still scarce. Relatively few studies that focus on primary prevention were identified. Although the use of self-management strategies in milder psychiatric conditions is theoretically useful and promising, the majority of already published studies were noted to focus on more severe psychiatric conditions. This finding may reflect international trends of de-

institutionalization. To date, various self-management programs have been developed and scientifically evaluated. Such studies have included patients with a range of psychiatric conditions, for example schizophrenia, mood disorders, and posttraumatic stress disorder. Rather than focusing on a particular diagnosis, some of these studies have used symptom-oriented or rather individualized interventions, and first results from such studies are promising.

Conclusions: Self-management in mental health conditions is relatively new. From already published studies, evidence is beginning to accumulate that self-management is a feasible and effective strategy in mental health conditions. In the future, more self-management initiatives and trials in the mental health field should focus on primary prevention in both adolescence and more advanced age.

PS02.141

DEMENTELCOACH: Effect of telephone coaching on informal and professional carers of community dwelling people with dementia

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Background: Taking care of a community dwelling person with dementia is often a burdensome task for informal carers. Intervention studies showed that carer support can alleviate the experienced burden and feeling of competence. Though a lot of effective support services are available, many carers hesitate to use them. The project Dementelcoach provides emotional, social and practical support by means of telecoaching. The telecoaches are specially trained professional caregivers with experience in the field of psychogeriatrics. The study evaluated the impact of this intervention on informal carers and the trained telecoaches.

Objectives: Main aim of the study was to gain insight into the effectiveness of the Dementelcoach intervention on the burden and health problems of informal caregivers as well as on their satisfaction with the telecoaching. Secondary, the effect of the intervention (including the training) on the professional carers' work satisfaction, work experience and self-esteem were investigated. Finally, the type of support delivered during the telephone coaching was investigated.

Methods: The telephone coaching was offered once in every two to three weeks during a period of 20 weeks. A pretest-posttest control group design was used to evaluate the effect on the informal carers. Three groups were compared: a group who received telephone coaching, one who received telephone coaching in combination with respite care (i.e. day care for the person with dementia) and a group who received respite care only. To evaluate the effect on the professional carers a randomised controlled trial was applied to compare a group that provided care as usual with a group that, besides usual care, provided telephone support. Outcome measures for the informal carer were: carer burden and health complaints. Outcome measures for professional carers were: work satisfaction, work experience and self esteem. To investigate the type of support offered by the telecoaching all support provided by the coaches was registered and a questionnaire on client satisfaction was administered to the informal carers. **Results:** The results show a significant difference in feelings of competence between the groups of informal carers after 20 weeks: The group who received telecoaching in addition to day care felt more competent than the group who received telecoaching only or day care only. There was also a significant decrease in health complaints within the group of caregivers that received telecoaching in combination with day care. Satisfaction with the intervention was high among all informal caregivers. Informal caregivers mentioned they valued the listening ability of the coaches, the flexibility of time of care, the acknowledgement of their problems and the support and positive feedback their received. The type of support that was most often provided was "emotional supportâ[euro] and "information and adviceâ[euro]. With regard to the professional caregivers, no significant differences in work satisfaction, work experience and self esteem were found between the experimental and control group.

Conclusion: Telecoaching according to the principles of Dementelcoach combined with respite care is more effective in reducing burden and health complaints in informal caregivers of community dwelling people with

dementia, than telecoaching or day care only. Informal caregivers received most often emotional support and information and advice during the intervention. Telecoaching doesn't seem to have impact on the worksatisfaction or self esteem of the professional carers.

PS02.142

Abstract withdrawn

PS02.143

Daily life study of community-dwelling elderly couples in the context of dementia: Description of an Experience Sampling Method (ESM)

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Introduction: Dementia is an important vulnerability factor for elderly people and their caregivers. Spouses represent the majority of family caregivers in dementia (Thomas et al., 2004). This disease affects the interactions between elders and spouses and disrupts their daily life routines. Nowadays, it exists some difficulties for responding specifically to the needs and expectations of the caregiving dyad. Also, it seems necessary to study the expression of their vulnerabilities in daily life. The present researches, based on the study of vulnerability factors, are currently using single moment-time assessments. However, emotional impact of most of daily experiences does not exceed more than a few hours. Furthermore, the interactions between the emotional state and the activities or behaviors are happening very fast and also depend on the context and the subject's characteristics (Swendsen, 1997, 1998). The objective of this work is to describe the Experience Sampling Method (ESM) to study the daily functioning and life habits of elderly couples in the context of dementia.

Method: Our sample had been recruited within a large French cohort, followed during four years. The participants were retired farmers over 70 years, living in community in the South West of France. Inclusion criteria were: (1) living in the community, (2) living with his or her spouse, (3) speaking French and (4) having a diagnosis of dementia. Exclusion criteria were: (1) Having severe hearing problems, (2) having severe health disease and (3) having a MMSE (Mini Mental State Examination, Folstein et al., 1975) score less or equal than 16. Both the retired farmer and their spouse were willing to participate in our study, were able to communicate by phone and able to provide consent. Written informed consent was obtained from retired farmers and their spouses. The sample is composed of sixty-five couples, divided in two groups. Group1: "demented older person-caregiverâ[euro]. Group 2: Control group "participant without major cognitive disorder-spouseâ[euro]. Diverse socio-demographic and clinical characteristics of Group 2 were paired to Group 1. We used ESM method that consists to gather data by repeated phone interviews proposed five times per day during four days. The data concern: the emotional state of the subjects (sadness, anxiety, etc.), their behaviors, activities, some of their life habits (drug or alcohol consumption), minor life events and coping strategies associated. These data will be crossed with some of the results selected from a psychological and health evaluation that took place during the cohort follow-up. Expected results The analyses will allow us to study: 1) Socio-demographic characteristics of elderly couples depending on the group they belong ("demented older person-caregiverâ[euro] vs control group), 2) their strategies used to cope with everyday difficulties and 3) whether the extent of the stability or repetition of behaviors, activities and daily life experiences affect their momentary emotional state and psychological well-being. Gaining insight into the issues within community dwelling elderly couple in the context of dementia will help to suggest better targeted support and care.

PS02.144

A pilot study to explore the value and applicability of Integrated Group Psychotherapy to depressive Chinese elders

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Background: Group psychotherapy is increasingly recognized as a useful modality in treating depressive patients. However its applicability and value to Chinese clients has been frequently questioned especially for those who are older and less acculturated. Many believe that Chinese culture discourages revealing of deeper feelings and emotions, and that the concern of losing "faceâ[euro] may also inhibit Chinese clients' willingness to disclose their problems in group situation. Meanwhile, there is little evidence demonstrating the therapeutic efficacy of language-and-culturally-appropriate group psychotherapy for elderly Chinese immigrants. In an attempt to address these questions, a pilot study was conducted to explore the potential and applicability of group psychotherapy, employing an integrated model (Leszcz, 1997), in the treatment for Chinese elderly with depression. The pilot also aimed at identifying the cultural adaptations required for and the variation on depression related themes brought up in a Chinese-speaking psychotherapy group.
Methods: 22 community-dwelling Chinese elderly were referred from different sources, including family physicians and community agencies, to join the psychotherapy group.12 met admission criteria based on Geriatric Depression Scale (GDS-15) score and suitability conditions specified by the American Group Psychotherapy Association's practice guideline. Of the 12 accepted, 3 failed to show up for the 1st meeting and 2 dropped out within the first 2 sessions due to reasons, such as, inability to travel outside home due to physical frailty, need to travel outside province, or perceived incompatibility to group treatment. The remaining 7 clients went through the 12-week intensive group treatment and then continued with monthly maintenance sessions for another 3 months. Apart from the GDS-15, the Patient Health Questionnaire Somatic Symptom Subscale (PHQ-15) and the Rosenberg's Self Esteem Scale (SES) were used as outcome measures and administered at intake as well as at the end of both the intensive and maintenance treatment phases. Meanwhile, as the group progressed, process measures including the Group Climate Questionnaire Short Form (GCQ-S) and the Therapeutic Factors Inventory - Cohesion Domain (TFI-S:C) were administered to yield an understanding of the core mechanisms of actions which took place within the group and to assess their possible relationship to therapeutic outcomes. All measures used in this study were translated into Chinese, and most of them had been previously validated in Chinese populations.
Results: Of the 7 clients who completed the treatment, all except one, have achieved reduction in GDS-15 score after the 12-week intensive group therapy. Among them, 3 were considered non-depressive and one was marginally depressed based on their GDS-score. The GDS group average decreased from 10 (SD = 1.63) at baseline to 6.3 (SD = 3.50) at the end of intensive treatment, then to 5.29 (SD = 3.54) at post-maintenance treatment. There were also measurable improvements in somatic symptoms, as reflected by reductions in PHQ-15 scores, experienced by 6 group members including the one who had no change in GDS score over the 12-week period. As a group, the PHQ-15 mean went from 10.14 (SD = 4.60) at baseline, to 7.00 (SD = 3.51) at the12th week, and then to 5.86 (SD = 3.34) after the maintenance phase. Whereas, the changes in Rosenberg's SES among group members were found to be less consistent. 4 achieved higher scores and the remaining have obtained reduced scores over the same period. The group mean of the TFI-S:C moved from 5.43 (SD = 0.83) measured at the 5th session, to 6.36 (SD = 0.98) at the 12th session and was maintained at about the same level during the maintenance phase. The trend of TFI-S:C resembled the moving pattern of Engagement subscale of GCQ-S, but was in a mirror pattern of the movement of the Conflict subscale of the same measure. In program evaluation, this group of clients rated group discussion, psychoeducation and personal sharing as the three most valued elements during the group process. All of them considered the emphasis on confidentiality and the discussion on how it should be maintained as extremely important.
Conclusion: Based on information reflected by process measures and program evaluation completed by clients,

this group of Chinese seniors appear to be receptive to this form of group psychotherapy. The outcome of this pilot study suggests that this specific, time-limited group therapy may hold promise as an effective treatment modality for Chinese elders, though more rigorous studies involving randomized control group, larger sample size, and longer follow-up period are needed to determine its value and therapeutic benefits for Chinese patients.

PS02.145

Competitive Memory Training (COMET) for treating depression and rumination in depressed older adults

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Depression is a highly prevalent psychiatric disorder in later life that is associated with substantial costs and burden, and excess mortality rate. The prevalence of depression is expected to increase, especially in older adults. Rumination is one of the key cognitive aspects of depression. Rumination is defined as the tendency to experience intrusive, repetitive and negative cognitions about symptoms of depression, and the possible causes and consequences of these symptoms. Rumination predicts the onset, duration, relapse and severity of depression. Furthermore, rumination has a negative impact on thought content, impedes problem-solving skills and mediates the predictive effect of other known risk factors of relapse. Rumination is an important factor in late life depression (as well as in adult patients). Several treatments have been developed that target rumination, including meditation, attention training techniques acceptance and commitment, and rumination-focused cognitive behaviour therapy (RFCBT) for residual depression. Also concreteness training (CNT). Purdon (2004) reports that treating rumination is difficult, e.g. whereas meditation and attention training seem promising interventions, both have only moderate effects. In the present study the effectiveness of a new, time-limited transdiagnostic training was adapted to treat depression by focusing on rumination in older patients. The supposed mechanism of change is by inhibiting access to dominant dysfunctional attitudinal styles and meanings by facilitating access to more functional attitudes and meanings. According to Brewin (2006), cognitive therapy does not directly modify negative information in memory but rather influences the relative retrievability of the different meanings that emotional concepts are associated with. Strengthening the retrievability of functional representations that are in retrieval competition with dysfunctional negative representations is considered to be the core activity of all effective psychological treatments. Competitive Memory Training (COMET) for rumination is aimed at helping patients to distance themselves from their worries and to let their ruminations go. In COMET for depressive rumination, instances are identified in which patients have proven to be able to 'let things go'. Then, the experience of 'letting go' is made more emotional salient by having patients imagine these successful instances, by adapting a bodily posture and facial expression that enhances the experience of 'letting go' and by (sub)vocalizing their abilities to 'let go'. A total of 93 patients (over 65 with major depression and suffering from rumination) were treated in small groups according to the COMET protocol in addition to their regular treatment. Patients were randomized to two treatment conditions: 7 weeks of COMET + treatment as usual (TAU) versus TAU only. COMET + TAU showed a significant improvement in depression and rumination compared with TAU alone. This study illustrates that the transdiagnostic COMET protocol might also be successful in treating depression and rumination in older adults. At the end patients that received TAU + COMET ruminated less and were less depressed than the patients in TAU alone. Furthermore a mediation analysis will be discussed as well as strengths, weaknesses and possible implications of the study. As COMET for depressive rumination is only one of the applications of the transdiagnsotic COMET protocol attention will also be given to the other COMET protocols and their efficacy in treating psychopathology.

PS02.146

Learning to live with MCI: Results of a group intervention for MCI patients and their significant others

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Background: Individuals with Mild Cognitive Impairment (MCI) and their care partners have to deal with an uncertain prognosis and face a multitude of memory-related and psychosocial consequences. This study examines the efficacy of a 10-session newly developed comprehensive group program aimed at MCI patients and their care partners that comprises elements of psychoeducation, cognitive rehabilitation and cognitive behavioural therapy. Aim was to evaluate the quantitative and qualitative effects of the program in the individuals with MCI and their care partners in a controlled design. Additionally long term effects were examined for the MCI patients and their care partners after 6 to 8 months after completion of the program.

Participants and methods: In a mixed-method design pre- and post-treatment quantitative and qualitative data were collected in the care partners of 93 MCI patients and 85 care-partners, with 30 patients and 27 partners having first been assigned to a waiting list, thus serving as their own control group. Besides evaluating the program, the dyads assessed their Well-being (RAND-36), Distress (GDS-15), and Acceptance and Helplessness (ICQ), and the care partners their Sense of Competence (SOC). Results of the RAND-36, ICQ, IQCODE, GDS-15 and SOC at follow-up were compared with the post-intervention assessment.

Results: Linear mixed model analyses of the patients' data showed that acceptance had increased more in the intervention group compared to the waiting-list period ($p = 0.034$). Treatment responders demonstrating a clinically significant effect on acceptance and two of three secondary outcome measures had higher baseline levels of helplessness and fewer self-reported memory complaints in daily life than patients who did not improve. Distress and general well-being showed no changes in both the MCI Patients nor in their care partners. Analyses in care partners yielded discrepant findings. Whereas the linear mixed-model analyses of the quantitative data did not reveal statistically significant differences between the control and intervention condition, the qualitative results showed that at program completion the care partners reported significant gains in knowledge, insight, acceptance and coping skills. Forty-seven MCI patients participated in the follow-up assessment and 47 significant others. Our findings showed that the increased level of acceptance in the MCI patients was maintained at follow-up, with an increased insight into their cognitive decline compared to post-intervention assessment ($p<0.001$). In both the patients and the significant others, helplessness and wellbeing were worse at follow up ($p<0.05$), and burden of care-giving increased in the significant others ($p<0.05$).

Conclusion: The intervention helped the patients deal better with their uncertain future in that they were overall better able to accept their condition, with especially the female patients showing a decrease in helplessness cognitions. The caregivers' results showed that, although no statistically significant changes were found on the measures of well-being, distress, burden or illness cognitions, the qualitative data suggest that the MCI program facilitated the process of learning to live with or care for a loved one with MCI. Suggestions for program adjustments and alternative outcome measures are discussed. The follow up results indicate a need for extension of the support after completion of the program, for example by providing regular booster sessions.

PS02.147

The development of a Cognitive Behavioural Therapy (CBT) manual: A pilot randomised control trial of CBT for anxiety in people with dementia anxiety

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Anxiety is common in people with dementia, with prevalence estimated from 5-21% for anxiety disorders, and up to 71% for anxiety symptoms (Seignourel et al., 2008). In addition to excessive worries and fears, anxiety may physically manifest as agitation, motor restlessness, day/night disturbance and aggression. It has been associated with high physical dependency and problems in the patient/carer relationship (Orrell and Bebbington 1996), decreased independence and limitations in activities of daily living (Porter et al., 2003), increased behavioural problems (Teri et al., 1999), and increased admissions to nursing care (Gibbons et al., 2002). There is currently limited understanding of psychological approaches to anxiety in dementia, which can lead to

inappropriate and sometimes problematic use of pharmacological interventions (Moretti et al., 2006). Cognitive Behavioural Therapy (CBT) for anxiety in people with dementia has been investigated in four small studies. Clinically meaningful reductions were found in anxiety, in addition to improvements in mood and participation in pleasurable activities, and reduction in alcohol intake, night wakenings, and collateral distress (Kipling et al., 1999; Koder, 1998; Kraus et al., 2008; Paukert et al., 2010). As the feasibility of CBT in people with anxiety and dementia has been demonstrated, it is clear the formal development of a cognitive behavioural intervention is required. This presentation will describe the development of a CBT manual for adults with dementia and anxiety. This took place in five key stages:- identification of key themes in anxiety for people with dementia derived from the literature- identification of relevant cognitive and behavioural techniques for this population- expert consultation- consensus consultation with thirty professionals and service users- field testing with five clients with anxiety and dementia. We will also summarise the manual and the CBT approach for this population. This includes the process of developing collaborative formulations, session preparation and outlines, and worksheets and psycho-education resources available for each session. Preliminary outcomes and feasibility findings from field testing will be presented. The development of this manual is the foundation for a pilot randomised control trial of CBT for people with anxiety and dementia, beginning in mid 2011. CBT for anxiety in people with dementia could lead to significant benefits, including the reduction of excess disability, and reduced costs to the NHS, through a reduction in GP visits, decreased use of medication and admission to care homes. In addition, manualised CBT for this population provides the opportunity to standardise the intervention process, and improve the quality of psychosocial care.

PS02.148

Delusional parasitosis among the elderly: Report of a clinical case

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Delusional parasitosis consists of a pathological conviction, and without an objective basis, of a skin infestation by small parasite animals. Already in 1892, the French dermatologist Thibierge was referring to the subjective and irreducible belief of certain patients being infected with scabies, a phenomenon he called "acarophobiaâ[euro]. The first reference to the term "deliriumâ[euro] appears in 1930 in a work by Mallet and Malet. The authors describe a case which they classified as "coenesthetic deliriumâ[euro] after having eliminated the existence of a manic-depressive, toxic, or paranoid element and of obsessive coenesthetic sensations.In 1932, Borel and H. Ey describe a case in which they stress the existence of a "dominant ideaâ[euro] and consider that the anxiety and phobic terror were primitive and determined real visual and haptic hallucinations. In 1938, in a famous monograph, the Swedish psychiatrist Ekbom, elaborating on the presentation of seven clinical cases of his series, made reference to this syndrome as a particular frame which does not resemble any of the psychopathological syndromes described, affecting mainly pre- senile aged women, complaining of itching or tingling, symptoms that, due to a misunderstanding, led the patients to assume a skin infestation delusion, with chronic course and spontaneous remissions, which he called "pre-senile delusion parasitosisâ[euro] (Ekbom, 1938). Years later, the American dermatologists Wilson and Miller called this syndrome "delirium of parasitizationâ[euro] (Wilson, Miller, 1946). The studies that have occupied themselves in detailing the symptoms and causal correlations of these delusions discuss wether the priority lies with the delusion itself, with skin hallucinations, or with misinterpreted sensations. Whatever the original perceptual experience, its interpretation is based on a modification of the patient's own bodily, sensory and vital feelings (Alonso-Fernández, 1976). In certain cases, the delusional belief is expanded, allowing for visual and acoustic hallucinations. Delusional parasitosis often emerge symptomatically, grounded on a psychosis already

in progress (secondary), which can give way to diverse forms of etiopathogeny, evolution and course. It can also manifest itself as an exclusive and primary psychotic change, as a systematized chronic delirium of skin zoopathic theme, assuming a paranoid or confabulatory-paraphrenic form.One can only speak of "primary delusional parasitosisâ[euro] (Lorenzi &Ganne's, 1975) after excluding an underlying real infection or a medical or psychiatric condition. It can also arise as folie àdeux or folie àtrois or by proxy. Skin delusions of parasitization, being relatively rare, occur mainly during involution. The authors propose the study of psychopathology, the main interpretive theory, prevalence, course, differential diagnosis, prognosis and treatment of this syndrome among the elderly. For this purpose, they discuss the case of a 72 year old patient, with a psychiatric record of bipolar affective disease type I, with a long history of evolution and several psychiatric hospitalizations. The patient was admitted in the Department of Psychogeriatric Department due to her elation of mood, delusions of persecution and mystical content; at night-time she suffered from severe insomnia, psycho-motor agitation and also runaways from home. The recent appearance of delusional parasitosis in the patient's psychiatric record stands out, leading to self-mutilations of the scalp with itchy lesions due to itching. Hallucinatory activity was not detected. She possesses a broad-based apraxia of gait that was analyzed by Neurology and which is attributed to the vascular lesions (subcortical multi-infarcts) identified in the skull-brain CT scan. Thus, the behavioral changes also arise in the context of vascular dementia. The authors conclude that delusional parasitosis are not a nosographic entity, but a psychopathological syndrome. Among the elderly, they manifest themselves most oftenly in the context of an underlying psychiatric illness, as a single and primary frame and usually evolve with a high degree of systematization of delusions. Relatively homogenous in content and form so as to form the unique syndrome that we are concerned with, the delusions of parasitization are nonspecific in their aetiology, pathogenic processing and evolution. The cases of paranoid clipping are the most serious, chronic and resistant to therapy. The authors also state that when the syndrome manifests itself during the evolution of a base-psychosis, treatment with Pimozide (typical antipsychotic) seems to achieve good results. Finally, the authors suggest an integrated interpretation of the origin of this syndrome: the feeling of skin infestation would constitute a general form of disturbance in the sense of Barahona-Fernandes (Barahona-Fernandes, 1979), which, updated under the light of biographical events, in pathological context, would model itself within the dependence of the basic psychopathological structure of the subject.

PS02.149

Comparison of older adults vs. working adults presenting with overdose at city hospital

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Introduction: It is known that a single elderly male; living on his own, is at high risk of committing more serious suicide attempt (Bock &Webber 1972, Dennis &Lindsay 1995, Bateman &Sandilands 2007), they would also tend to complete the attempt more often (Catell, 2000). AIMS To compare the profile of older adults with working adults who attend the poisons unit after overdose.

Methods: The data was collected retrospectively from the patient case notes, all patients of 50 years or older admitted to poisons unit from April 2009 to March 2010 were compared with people younger than 50 years. The data collection tool was designed to cover three aspects: socio-demographic details, over dose/suicide related themes, assessments and record keeping in case notes. While collecting the data attention was given to intent to die, accidental/deliberate, presence of psychiatric disorder, previous suicidal attempts, referral to psychiatric services and cognitive impairment. Case notes were also checked for precipitants, circumstances and potential reasons for overdose. We also included similar number of younger adults who were admitted to poisons unit during the specified time.

Results: It was found that 87% of patients have taken deliberate overdose, 63% have a clear intent to die of

which 75% were among 50 years and above and 50% were among 50 years and below, though 63% were discharged within one day of admission. All 14 out of 14 (100%) under 50 year olds and 11 out of 16 (69%) above 50 year olds have taken deliberate overdose. Reasons for overdose as given by patients were recorded and multiple reasons were found in 40% of patients followed by other reasons (23%). Multiple reasons included relationship difficulties, pain, debts, feeling low / depressed, argument, bereavement and stress. Other reasons included low mood, accidental / by mistake, unemployment, housing issues, bereavement, alcohol issues, feeling low / depressed, argument, family issues and work issues. Past history of suicide attempt and overdose was found in 40% and 37% of patients respectively. Paracetamol was the most common medication for overdose (26.6%), psychiatrists saw 67% of cases after referral, psychiatric diagnosis was recorded in 67%, psychiatric history and mental state examination (MSE) was recorded in 70%. Cognitive impairment was found in 13% of cases but in 47% it wasn't recorded. 63% cases were just observed without any medical treatment and 30% were provided with medical treatment and observation as a part of management plan for overdose. Older adults will attempt overdose deliberately and would have clear intent to die. There is a need to understand the overdose pattern in the elderly with respect to types of medications used and prescription given to them.
Discussion: We found that paracetamol is the most commonly used drug (26.6%) in overdose and similar findings were reported in other studies (Shah, et. al., 2002). The use of drugs associated with significant toxicity should be avoided in older patients at risk of self-harm, though our data suggests that only 33% of cases have taken overdose of prescribed medication. (Doak, et al., 2009). In our sample we found 31% of above 50 year olds have taken accidental overdose and 69% have taken deliberate overdose compared to 100% of below 50 year olds who took deliberate overdose. 70% of our sample needed psychiatric assessment and psychiatrist assessed 67% of them. 23% had history of depression, 7% had alcohol related disorders (psychiatrist's assessment found 40% alcohol related problems) and 50% had no past psychiatric history. In yet another study done in acute hospital admissions for elderly people it was found that 21% had no psychiatric history (Lamprecht, et al., 2005).
Conclusion: Older adults will attempt overdose deliberately and would have clear intent to die. There is a need to understand the overdose pattern in the elderly with respect to types of medications used and prescription given to them. There is a significant psychiatric morbidity among patients who overdose and appropriate psychiatric liaison services are needed to manage patients.

PS02.150

CLOX predicts social functions of elderly patients with chronic schizophrenia

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Background: It is critical to assess the cognitive functions of the patients to decide whether they can live in community because social functions are related to cognitive functions. The Brief Assessment of Cognition in Schizophrenia (BACS) is widely used as a measurement of cognitive functions of patients with schizophrenia. However, since it takes time and requires concentration, it can be burden for elderly patients. Therefore, a brief and easy assessment test for cognitive functions in schizophrenia is needed. The Clock Drawing Test (CDT) is a brief cognitive screening test widely used in assessment of patients with dementia. Considering the property of CDT, it would be also applicable for elderly patients with schizophrenia. CLOX, developed by Royall, is one of the scoring methods of CDT that covers wide range of cognitive functions. CLOX1 is an unprompted task that is sensitive to executive control, and CLOX2 is a copied version.
Objectives: We examined whether CLOX can be used as a cognitive screening tool for elderly patients with

schizophrenia.

Subjects: Subjects were 45 elderly patients with chronic schizophrenia who had been hospitalized in a psychiatric hospital over a year (26 men and 19 women, mean age 55.0 ±11.2 years old, mean duration of illness 30.9 ±11.4 years). Three patients could not complete BACS because they lost their concentration during the long test time. We therefore excluded their data out of the following analyses. METHODS: We investigated their sociodemographic data and assessed cognitive functions with BACS, CLOX, and MMSE. We also assessed their social functions with Life Skills Profile (LSP) and psychiatric symptoms with Positive and Negative Syndrome Scale (PANSS). First, Spearman's rank correlation analyses were performed to investigate correlations between CLOX1, CLOX2, BACS composite score, and MMSE. Second, we performed multiple linear regression analyses to identify the variables that predicted LSP. Total LSP score were used as the dependent variables, and considering multicollinearity, the following candidate factors were used as independent variables: CLOX1 score, CLOX2 score, total PANSS score, and sociodemographic data (gender, age, education, length of hospitalization). This study was approved by the ethics committee in Gojouyama Hospital. We obtained informed consent from all participants.

Results: When Spearman's rank correlation analyses were performed, both CLOX1 and CLOX2 scores were significantly correlated with BACS composite score (CLOX1: $r_s = 0.361$, $p = 0.019$, CLOX2: $r_s = 0.475$, $p = 0.001$) and MMSE score (CLOX1: $r_s = 0.426$, $p = 0.005$, CLOX2: $r_s = 0.579$, $p < 0.001$). Multiple linear regression analyses revealed that only a higher CLOX2 score predicted a higher total LSP score ($\beta = 0.455$, adjusted $R^2 = 0.187$, $F = 10.441$, $p = 0.002$).

Conclusions: We found that CLOX1 and CLOX2 were highly correlated with BACS and CLOX2 performance predicted social functions in elderly patients with chronic schizophrenia. Though CLOX2 is less sensitive to executive function than CLOX1, it reflects attention, verbal memory, visual memory, and working memory better than CLOX1. Our results suggest that higher social function may be related to these cognitive functions rather than executive function and CLOX2 can be a useful tool for medical staffs who want to assess cognitive functions of elderly patients with schizophrenia to promote their discharge.

PS02.151

Schizophrenia spectrum disorders in later life: Prevalence and distribution of age at onset and sex in a Dutch catchment area

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Background: In keeping with the general aging of the population, there is a rapid increase of elderly patients with schizophrenia. As in other psychiatric disorders, elderly patients with schizophrenia represent those that have had this disorder for the larger part of their life, as well as patients with a more recent onset. The prevalence of schizophrenia in later life is affected by both outflow of early onset patients, due to recovery and excess mortality, and inflow of patients with a later age at onset. This makes it likely that characteristics of elderly patients differ markedly from younger patients.

Design Case register Study Participants: We assessed the one-year prevalence of schizophrenia and spectrum disorders and their distribution according to age group, age at onset and sex in an epidemiological sample of elderly patients, in contact with the Mental Health Organization GGZ inGeest in a psychiatric catchment area in Amsterdam, the Netherlands. Diagnoses included were schizophrenia, schizoaffective disorder and delusional disorder.

Setting: The psychiatric catchment area of the southern district of Amsterdam is a geographically well-defined urban area comprising 17.5% of the total Amsterdam population. The district includes a variety of

neighbourhoods, ranging from lower-class housing to upper-class residences, and is highly urbanized. On January 1, 2008 25.631 (19.6%) of the catchment area inhabitants were aged 60 years and over, approximating the proportion of elderly (20.8%) in the general Dutch population. The proportion of women in the catchment area aged 60 years and over (58.8%) was slightly higher than in the general Dutch population (54.9%). The average income of catchment area inhabitants aged 65 years and over (20.100 Euro/year) came close to the average income of the same age group in the general Dutch population (20.700 Euro/year)
Results: 183 patients were included. Median age was 67 years (range 59-95), median age at onset was 34 years (range 15-88). The one-year prevalence of all disorders was 0.71%, subdivided in 0.55% for schizophrenia, 0.14% for schizoaffective disorder and 0.03% for delusional disorder. The one-year prevalence of early-onset schizophrenia was 0.35%, of late-onset schizophrenia 0.14% and of very-late-onset schizophrenia-like psychosis 0.05%. The estimated prevalence of schizophrenia among women (0.68%) was almost twice as high as the estimated prevalence among men (0.35%). Women outnumbered men markedly in the prevalence estimates for most diagnostic subgroups, including early-onset schizophrenia.
Conclusions: In this service-based sample of elderly patients, we found the prevalence of schizophrenia to be well within the range reported for younger populations. This underlines the clinical relevance of this disorder in later life and argues against the idea that schizophrenia becomes less important as the population ages. Our estimates for schizophrenia and spectrum disorders will be a lower bound of the true prevalence in the community, as it is suggested that more than half of all individuals with serious mental illness are not connected to mental health care, either because they failed to seek treatment or because they disengaged from treatment. The considerable proportion of patients with a later age at onset and the strong female preponderance are distinguishing characteristics with clinical implications. The fact that over 70% of our sample lived independently highlights the importance of a societal orientation for service provision, giving priority to interventions that support independent functioning.

PS02.152

Long-term efficacy and safety of Zolpidem extended-release 12,5 mg, administered for six months in old patients with chronic primary insomnia: A randomized, double-blind, placebo-controlled, parallel- group, multicenter study

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Introduction: Being primary insomnia in older people, a condition so common that can impair the patient's general condition, considering a specific pharmacological and early treatment.
Hypothesis: To evaluate long-term efficacy and safety of zolpidem extended-release, in old patients for chronic primary insomnia.
Method: Multicenter, randomized, double-blind, placebo-controlled, parallel group. Population: Outpatient with aged more of 65 years. Diagnosis: DSM-IV criteria for chronic primary insomnia. Treatment: Single-dose zolpidem extended-release 12.5 mg (n = 128) or placebo (n = 127), self-administered every night.
Results: Patient's Global Impression (PGI) and Clinical Global Impression-Improvement (CGI-I) were assessed every 4 weeks up to six month. Patient Morning Questionnaire (PMQ), recorded daily, assessed subjective sleep measures-sleep onset latency (SOL), total sleep time (TST), number of awakenings (NAW), wake time after sleep onset (WASO), and quality of sleep (QOS)-and next-day functioning. Zolpidem extended-release also was statistically significantly superior to placebo at every time point for PGI (Items 1-4) and CGI-I (P <0.0001, rank score), TST, WASO, QOS (P <0.0001), and SOL (P <or = 0.0014); NAW (Months 2-6; P <0.0001). Sustained improvement (P <0.0001, all time points) was observed in morning sleepiness and ability to concentrate (P = 0.0014, month 6) with zolpidem extended-release compared with placebo. Most frequent adverse events for zolpidem extended-release were headache, anxiety and somnolence to the morning. No rebound effect was observed during the first 3 nights of discontinuation.

Conclusions: These findings establish the efficacy of dosing of zolpidem extended-release 12.5 mg for up to 6 months. Treatment provided sustained and significant improvements in sleep onset and maintenance and also improved next-day concentration and morning sleepiness.
Discussion: In the presence of primary insomnia in older people, considering a specific pharmacological and early treatment to prevent sleep disturbance that could lead to an unfavorable outcome in any brain function, affecting the general welfare of the patient.

PS02.153

Effectiveness of the "better sleepâ[euro] training course for elderly with sleeping problems

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Background: Temporary sleep problems exist in one third of the Dutch population and the prevalence of chronic sleeplessness is 4 % among male and 8 % among female. There are indications that there is a strong increase of sleep disorders among elderly, up to 59%. Within our department for mental health care for the elderly the number of patients presenting with sleep disorders is relatively large. Many of these patients use sleeping medication. Literature shows that chronic sleep problems can induce depression. Our department developed a training course ("better sleepâ[euro]) that focuses on aspects like: sleep hygiene, mulling, relaxation and information about sleep medication. The course is a six weeks course, with one session of two hours per week in which fixed topics are discussed following a fixed scenario. Participants are patients of our department as well as people who registered after having read an announcement in the local media.
Aim of the study: To measure the effectiveness of the course "better sleepâ[euro] for elderly.
Method: A total of 57 persons in 6 groups participated in the study of which 42 could be included while the data of the 15 others were not complete. Sixteen persons were diagnosed with mild or moderate depression, 19 persons were meeting the criteria for the diagnosis primary insomnia, and 7 with anxiety disorder, somatisation or another diagnosis. Participants were asked to fill the SCL-90-R before and after the course, as well as a semi structured questionnaire. Total end scores and sub-scores from before and after the course were analysed. Effects of the course on medication use were evaluated through a semi structured questionnaire.
Results: The mean end score of the SCL-90-R participants decreased significantly. Scores on sub-scales decreased also. Patients with the diagnosis depression improved even more than the patients with primary insomnia on both the depression scale and the sleeping scale. The relaxation and breathing exercises contributed most to the improvement perceived by the participants.
Conclusion: The course helps to improve sleep. Patients report better sleep and fewer complaints after having attended the course. Depressive patients improve more than patients with primary insomnia on the SCL-90-R. The training course is an effective addition to our treatment for patients suffering from sleep disorders, specifically for depressed patients.

PS02.154

Prevalence of insomnia symptoms in elderly patients with mild cognitive impairment

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Introduction: Sleep disturbance is one of the non-cognitive symptoms of mild cognitive impairment (MCI), which clinicians regard as being on the presumed continuum from normal aging to dementia. Although several studies have addressed the higher prevalence of sleep disturbances in MCI compared to normal aging, no previous study has investigated the prevalences of insomnia's various symptoms according to the DSM-IV criteria (difficulty in initiating sleep [DIS], difficulty in maintaining sleep [DMS], early morning awakening [EMA], and non-restorative sleep [NRS]), which have differing clinical implications.
Methods: We evaluated 256 community-dwelling elderly for various clinical characteristics via structured interviews. To evaluate their depressive symptoms, we used the SGDS-K (the Korean version of the Geriatric

Depression Scale, Short Form). We evaluated their cognitive functions using the Korean version of the Consortium to Establish a Registry for Alzheimer's Disease Assessment Packet (CERAD-K) and assessed their insomnia using a questionnaire based on the DSM-IV diagnostic criteria. To rule out depression, we excluded participants who scored 8 or higher on the SGDS-K. We regarded participants scoring below 1.5 SD from the normative value (by age, sex, and education) on any CERAD-K subtest (except trail-making test B) as having MCI.

Results: After excluding the persons who had dementia or depression, we analyzed the data from 163 participants. Of these, we diagnosed 65 as having MCI, while 98 were normal. The prevalences of DIS, DMS, EMA, NRS, and any insomnia symptom were 21.5%, 29.2%, 13.8%, 20.0%, and 43.1%, respectively, in the MCI participants. Corresponding prevalences in the normal elderly were 11.2%, 15.3%, 11.2%, 11.2%, and 24.5%. Participants with MCI showed a significantly higher prevalence of DMS ($p = 0.032$) and any insomnia symptom ($p = 0.013$) than did normal participants. The difference between the groups for DIS was marginally significant ($p = 0.074$). The MCI patients' prevalence of diagnostic insomnia (any insomnia symptom with a moderate to severe daytime disturbance), which was 6.2%, was similar to that for the normal elderly (5.1%).

Conclusions: In line with previous studies, elderly patients with MCI showed a higher prevalence of insomnia symptoms than did the normal elderly. However, when we considered specific symptoms of insomnia, the difference was only valid for DMS. This finding suggests that, for MCI patients, clinicians can consider DMS a more specific symptom of insomnia than other insomnia symptoms. Further research could clearly confirm this association, and studies with a greater number of participants would overcome the current study's limitation.

PS02.155

What drives a person to a suicide attempt in later life? An explorative study

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Introduction: Suicide in later life is a considerable health problem worldwide and is highly prevalent in industrialized countries. Suicide rates in older age groups are at least as high as in younger age groups (McKeown et al., 2006); especially men over 75 years are particularly vulnerable. A suicide attempt (SA) is a strong predictor of completed suicide (CS) in later life. In contrast to increasing rates of completed suicides with increasing age, suicide attempts in older age occur less frequently, suggesting an increase of lethality of SA (Dombrovski et al., 2008). There is also growing evidence that suggests that SA and CS in later life can be considered as a single syndrome, implying that SA should be interpreted as a failed CS. Literature on SA in later life however is rather limited and often descriptive in nature, using cross-sectional designs. SA in later life has been found to be strongly correlated with the presence of a major depressive episode. A somatic condition, particular personality traits or a history of previous suicide attempts (Hawton et al., 2006; Wiktorsson et al., 2010) are important predictors of a SA as well. Other risk factors include being unmarried, being widowed, living alone and low educational attainment. Despite the fact that many elderly are confronted with the abovementioned risk factors, only a small minority of them, even when depressed, actually manifests suicidal behavior. Preliminary studies suggest that a more qualitative, person-centered approach may be needed in order to identify proximal psychological factors preceding a suicide attempt in older age. Such a methodological approach should be considered as complementary with quantitative approaches. Therefore, we developed a qualitative research design aiming to explore which psychological factors and reflections about life play a part in the decision making process towards a SA in later life.

Material and Methods: Qualitative data were gathered by means of in-depth interviews with eight older psychiatric inpatients (65+), recruited from the department of old age psychiatry (University Hospitals Leuven), who attempted to complete suicide. Interviews took place within 30 days following the SA and were audio-visually recorded. The study design was approved by the Ethical Committee of the University Hospitals Leuven,

Belgium. Grounded theory was the method used to analyze the data.

Results and Discussion: Experiences of the interviewees describing their decision process leading to a suicide attempt could be broken down in two major segments: (a) the content of thoughts, feelings and considerations about life and (b) the experience of the physical state one was in. With regard to the first segment "life and the self were felt as being disrupted by the experience of a lossâ[euro] and "the feeling of being on one's own in lifeâ[euro] were dominant constructs. Interviewees reported that they were confronted with a loss of a loved one or with an important issue at some stage in later life, and experienced this loss as a complete disruption of the former life: life after the loss was perceived to be inferior compared to life prior to the loss. Both the casualness of life and the foundation it was once built on seemed to have disappeared completely. Data suggested that life of the suicide attempters was disrupted by the loss, causing the interviewees not being able to connect with the way of living they were used to. At the same time they felt they were on their own in life, left to their own devices after the loss, no longer connected to others, or no longer sharing with others. A lack of feeling of reciprocity in relationships with others was also reported. With regard to the second segment, another important experience described by suicide attempters was the particular physical state they were in at the time of the decision of the SA. A "complete bodily exhaustionâ[euro], "a physical experience of anxietyâ[euro] and "feelings of confusionâ[euro] were described as important constructs. Both the content of their thoughts and feelings as their physical state seemed quintessential components of the SA decision process. It appeared that older suicide attempters decided to end their life due to the combination of a current, negative evaluation of the quality of life, and the lack of control over physical experiences disturbing their daily life. The psychological constructs revealed by this explorative qualitative approach may yield important insight in the relation between the confrontation in life with the aforementioned risk factors on the one hand and the actual decision to attempt to complete suicide on the other.

PS02.156

Senior suicide: A multidisciplinary intervention strategy

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Senior suicide is a tragic ending of life and is a cause of considerable devastation for families, caregivers and health professionals. In fact, every 90 minutes in America, 16 of those age 65 or over completes suicide while suicide victimizes approximately one million people in the world per year. This poster/paper, based on a review of national and international literature focusing on global elder suicide statistics and the main factors associated with elder suicide, will showcase how an act of suicide is a complex phenomenon involving the interaction of multiple psychological, physical and social factors operating at a crucial moment in the life of a vulnerable elderly person. Risk factors and barriers for medicine and gero-psychiatry will be explored as a venue for multidisciplinary collaboration. An educational intervention strategy for multidisciplinary collaboration will be presented. Lastly, some helpful tools for assessing seniors at risk for suicide will be offered as well as recommendations regarding outreach to elderly as they may be most susceptible to social isolation and loneliness. Suicidal behavior in elders, most always undertaken with great intent and lethality, is a serious problem in societies the world over. According to Szanto, (2003), the elderly population has the highest suicide rates in almost all countries in the world where data are available. Generally speaking, suicidal rates increase in both men and women and overall rates among those 75 years of age and older are approximately three times those aged 15-24 years (Vikram, 2005). A recent cross-national study of 87 countries reports that elderly suicide rates are the lowest in the Caribbean, central America, and Arabic countries, and the highest in central and eastern European countries (Shah, Bhat, McKenzie &Koen, 2009). This study also shows that suicide rates in males aged 65 - 74 are the lowest in Mediterranean (Greece, Spain and Italy) and western European (Ireland, Netherlands and United Kingdom) countries and the highest in central and east European (Austria, Bulgaria, Estonia, Hungary, Lithuania and Slovenia). A similar pattern is observed in males aged 75 + years,

females aged 65 - 74 years and females aged 75 + years (Shah et al., 2009). The observations of suicide rates being higher in males than females for both the age bands, and higher in the 75 + years age-band than the 65 - 74 years age band in both genders, are consistent with the literature (Shah &De, 1998; Diekstra, 1989). Table 1 (Shah et al., 2009) presents suicide rates in males and females in age bands 65 - 74 years and 75+ years by quartiles and EU countries. Rogers (2010) identifies individual factors that may contribute to suicide which include Biological Factors, Predisposing Factors, Proximal Factors and Immediate Triggers. Biological Factors encompass family risk, brain chemistry, gender and psychological problems. Among the Predisposing Factors are psychiatric disorders, substance abuse, personality profile, and severe illnesses. Hopelessness, intoxication, impulsiveness, aggressiveness and severe/chronic pain are considered to be the Proximal Factors. Immediate Triggers can be public humiliation, access to weapons, severe defeat, a major loss and/or a worsening prognosis (Kepner, n.d.). Socio-cultural factors such as race, ethnicity, religion, and economic conditions, among others may also contribute to suicide risk (Goldsmith et al., 2002). Given the alarming facts about suicide and it's lethality in older adults, an educational tool for professionals working as part of the care team was developed to provide an evidence based approach to understanding and responding to older adults in need. This tool, is a strategy which social workers can use to educate other members of the older adults' multidisciplinary team about the risk factors and intervention strategies for suicide/prevention in older adults.

PS02.157

Prevalence and correlates of suicidal thought and self destructive behavior among an elderly hospital population in Iran

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Background: Suicide among elderly people is an important mental health issue. Increase in rate of suicide in the presence of medical condition has been consistently reported. As a significant proportion of older adult have at least three or more medical conditions, it is not clear what factors could increase suicide in the elderly medically ill population. Elderly inpatients as a subpopulation of aged people with medical condition might be at greater risk for suicide there are few studies investigating suicide ideation and behavior in inpatient older adults. Given that older people may present suicide ideation in indirect way, current study designed to investigate the prevalence of suicide ideation and indirect self destructive behaviors among a sample of hospital population of aged individuals.

Method: A cross sectional study was conducted between July 2009 and Sep 2009. 650 elderly inpatient screened from various medical services in teaching hospitals affiliated to Shiraz University of medical sciences in Iran. Suicide ideation and behavior was measured by using Beck Suicidal scale Inventory (BSSI) and harmful behavior scale (HBS). Co relational analysis was employed to detect correlation of suicide to various demographic and clinical variables. Further regression analysis was used to test the predictability power of each variable. Analyses were done in Microsoft SPSS 15.

Result: 650 subjects participated in the study, 8o subjects were excluded because of frailty, poor medical condition and history of current psychiatry disorders and 570 patients left for analysis. In preliminary descriptive analysis it was found that 21.6 % of the study sample had suicide ideation. Moreover at least one deliberate harmful behavior was detected in 14.4% of subjects. Further explorative analysis showed a significant correlation between suicide ideation and harmful behaviors ($r = .503$, $p = .001$). Depressive symptoms, burden of medical conditions, marital status, history of substance use and history of traumatic life event was positively correlated to both suicide ideation and harmful behavior. And the level of perceived social support and education were negatively correlated to suicide ideation and behavior. In regression analysis, depressive symptoms, history of traumatic events, poor social support, and duration of hospital stay and burden of medical condition were predictor of suicide in inpatient elderly individuals. From demographic variables living without spouse and unemployment were predictors of more suicide ideation and behaviors. **Discussion:** Suicide ideation and behavior in inpatient elderly is an important mental health issue. Some of elderly patients may

present their suicide trend in indirect self destructive behaviors. In the presence of medical conditions, various psychosocial and clinical variables could increase the risk of suicide. Depressive symptoms predict more suicide ideation and behavior. Multi domain prevention program is needed to reduce suicidal risk in older adults in particular those suffering from medical conditions.

PS02.159

Physical examination of elderly mental health service users: A clinical audit

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Introduction: Elderly mental health patients often have a multitude of co-morbidities that need addressing on admission to hospital. Routine physical examination is necessary in order to establish a baseline of observation and to determine if there are any other causes of deterioration in their mental health2,3. Another important aspect to examine is the extent and quality of the physical examination4. It is imperative that an examination is carried out within 24 hours of admission, and if this is not possible, within a reasonable time frame. This audit was carried out at an inpatient psychiatric hospital in Shropshire - UK. Standards/Criterion: 1. The Royal College of Psychiatrists recommends that "allâ[euro] inpatients in psychiatric hospital should have routine physical examination within 24 hours of admission1. 2. Our Trust uses a structured proforma setting standards required for recording "fullâ[euro] physical examination for "everyâ[euro] patient at admission. We wanted to determine extent of physical examination recorded using a 30 points scoring system based on Trust proforma. Objectives: To determine whether we achieve 100% on above criterion.

Methods: A retrospective analysis of case notes of inpatients admitted between 1st and 15th November 2010 was carried out. We audited four old age psychiatric wards which included one ward for young people with dementia (YPwD) service. Forty sets of case notes were available for analysis at the time of audit. Clerking in documentation at time of admission was examined to ascertain if a physical examination had taken place within 24 hours of admission. If not, had there been a statement as to why this had not happened. To determine the extent of the physical examination, 30 points scorning system was devised using the local Trust proforma. (table 1)

Table 1.

Breakdown of 30 points scorning system (extent of examination recorded)

Results: 100% of the patient case notes audited used Trust recommended proforma to record physical examination. 88% clients had physical examination within 24 hours of admission. Remaining 12% had their physical examination at some point during their stay after 24 hours. Only 40% cases had routine blood tests on admission. Our 30 point scoring system revealed that there was a wide variation in the extent of the physical examination recordings. All case notes audited scored within a range of 7-26. It meant that all patients had only partial physical examination and none actually had "fullâ[euro] physical examination recorded as was required from by the Trust proforma. In any of the case notes there was an explanation as to why a full examination was not conducted at time of admission or within 24 hours of admission. Among the individual systems examined, all patients had their chest auscultated; cardiovascular system was examined in 80% patients with other systems having a wide range of completeness. Neurologically, most patients had a gross examination of their gait, pupils, speech and hearing. Examination of fundi, cranial nerves, sensory system, muscle power, tone, reflexes and co-ordination however were rarely performed.

Discussion: The difference in the scoring of systems may be because the cardiovascular system is one of the very first systems on the proforma to be examined. **Conclusion:** Although more than 2/3 patients had physical examination within 24 hours of admission but it is very concerning that all were incomplete and none had a thorough physical examination as required from the Trust proforma. Also only less than half had routine bloods done at time of admission. Also less than half of patients had routine bloods taken on admission. This is a very

important aspect as psychotropic drugs can have a variety of side-effects and need regular blood monitoring. Without having any baseline blood tests, it can be difficult to monitor side-effects. Recommendations: 1. To highlight findings of this audit to current and prospective junior doctors with emphasis on "completenessâ[euro] of examination and on "sending blood testsâ[euro] at time of admission. 2. To re-audit in 6 months to complete audit cycle. 3. To repeat same audit using same scoring system on a larger sample including general adult psychiatric wards over a long time scale. **References:** 1. CR154. *Good psychiatric practice,* 3rd edition. London: Royal college of psychiatrists, 2009 2. Felker B, Yazell JJ, Short D. 1996; 47:1356-63. 3. MoosR, Mertens JR. *Patterns of diagnoses, comorbidities, and treatment in late-middle-aged snd older affective disorder patients: comparisons of mental health and medical sectors. J Am Geriatr Society* 1996; 44:682-8 4. Garden G. *Physical examination in psychiatric practice. Advances in psychiatric treatment* 2005; 11:142-9

PS02.160

Using e-learning to build capacity for disaster resilience: The "Frailty, Dementia and Disastersâ[euro] Project

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Emergencies and disasters are increasing worldwide, secondary to factors including climate change, human pressures on the environment and infrastructure failure. Mounting evidence internationally suggests that older people suffer disproportionately in disasters as a consequence of largely remediable factors that cross the four pillars of emergency management: preparedness, response, recovery, and mitigation/prevention. Frailty and dementia are specific risk factors for heightened vulnerability, leading to increased risk for isolation, suffering and death in emergencies and disasters. Vulnerable groups are often neglected in emergency preparedness initiatives and sidelined in community recovery and rehabilitation activities post-disaster. An emerging consensus suggests that health care providers can contribute to disaster resilience for vulnerable groups at each phase of the emergency management cycle, but only if they have the requisite knowledge, tools and resources. Evidence suggests that for the most part, they do not. The overall goal of this knowledge translation initiative is to contribute to international efforts to reduce the disproportionate vulnerability of older adults in emergencies and disasters. The project involved the development, evaluation, and dissemination of an e-learning tool entitled "Frailty, Dementia and Disasters: What Health Care Providers Need to Knowâ[euro]. Key literature on geriatric emergency preparedness and response issues, including the roles and responsibilities of health care providers, was identified and synthesized in consultation with the International Working Group on Health Providers convened by the Division of Aging and Seniors, Public Health Agency of Canada (PHAC). Content was piloted in a facilitated workshop in the province of Ontario (central Canada). A Canada-wide health provider reference group provided feedback on the transition from a traditional powerpoint presentation to an e-learning format. The evaluation process included facilitated review of the English version of the program by health care providers in two in-person workshops in Yukon Territory (northern Canada) and of the French version of the program in two in-person workshops in the province of Quebec (central Canada; French speaking). An on-line review was conducted by health care providers in British Columbia (western Canada). A technical advisory group consisting of representatives from PHAC and the Canadian Dementia Research and Knowledge Exchange (CDRAKE) network provided expert guidance for web based dissemination. The learning objectives of the e-learning resource are to help health care providers, administrators and policy makers understand the: * disproportionate vulnerability of older adults who are frail and those who have dementia, in emergencies and disasters; * components of the emergency management cycle and how they apply to this target population; * best practice resources that can be used to improve emergency preparedness, response, recovery and mitigation; and * role of health care organizations and providers in emergency management for older adults who are frail and those who have dementia. The "Emergency Management Frailty, Disasters and

Dementia: What Health Care Providers Need to Knowâ[euro] eLearning program is hosted with open access on www.dementiaknowledgebroker.ca, a platform facilitated by CDRAKE - the knowledge exchange theme of the Canadian Dementia Knowledge Translation Network (CDKTN). The program consists of four modules, as follows: * Module 1: Emergency Management. This module provides an introduction to the vulnerability of older people who are frail and those who have dementia in disasters. * Module 2: Emergency Preparedness. This module uses an extreme weather scenario to illustrate what can happen when a health care provider doesn't pay attention to emergency preparedness and how to help clients and their caregivers prepare for an emergency. * Module 3: Response. This module invites learners to reflect on how health care providers can contribute to the response component of the emergency management cycle and become aware of two best practices - Psychological First Aid and the SWiFT triage tool. * Module 4: Recovery and Mitigation. In this module, learners learn about the importance of addressing the recovery challenges of older adults, reflect on how care providers can contribute to mitigation activities, and are encouraged to complete an Emergency Management Action Plan. This project was completed with funding awarded to Maggie Gibson, Veterans Care Program, St. Joseph's Health Care London, London, Ontario, Canada, from the Canadian Dementia Knowledge Translation Network (CDKTN) and the Alzheimer Society of Canada (ASC) Education and Training Knowledge Translation Award Program, with financial and technical support from the Public Health Agency of Canada.
PS02.161
The Balloon-and-Brick Mission: Looking for sources and strengths in the nursing home
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Disturbing behaviour in the nursing-home is the product of coping with a changing brain and a changing environment. Restoring equilibrium is the main goal of the individual client. Although the presentation of coping-techniques of (especially recently admitted) clients should be considered as a healthy effort to adapt to a new situation, the angry or anxious behaviour itself is rapidly considered to be ineffective and interfering with the routine on the ward. The focus of the nursing-staff is directed to the form -the unbalancing and disturbing nature- of the behaviour and not to the function itself. Conscientious observation and well-considered interaction with the client are repressed by the urge to diminish the negative impact of the behaviour on the client and/or others. Immediate causes might be easily overlooked and will continue to exist. In a training-programme for teams of nurses on psychogeriatric and psychiatric wards of our nursing-home, we try to explore and develop tools to search for sources and strengths. Not only within the clients, to help them discover and translate their needs and wishes, but also within the nurses themselves, to enhance their skills and their -and the clients'- quality of life, thus creating parallel processes. For our training, we use the ABC-cognitive behavioral and mediation techniques (Hamer and Voesten, 2006), the Strengths Model (Rapp and Goscha, 2005) and the Plan for Early Detection of Signals and Symptoms (Van der Werf, Huiberts and Goedhart, 1998). The clinical gerontologist, familiar with both clients and team members, is functioning as the Trainer. The team is challenged to contribute to the content and development of the education-programme and to immediately integrate the newly acquired knowledge and skills while working with the clients. One hypothesis is that, by discovering and using "Uplifting Balloonsâ[euro] and avoiding and eliminating "Weighing Bricksâ[euro] in thought, feeling and action of both clients and nursing-staff, we can diminish the use of behavioral disturbance oriented medication. In 2008-2009, three pilots were carried out by one Trainer/clinical gerontologist in our institution. The results led to the assumptions that the method was effective for our clients and their families, welcomed by teams and staff, more Trainers were needed and that not only psychologists could function as such. In 2010, ten ABC-Trainers were educated within our institution, to teach and train teams at different locations at the same time, to maximize the effect. In fact, as is often the case in ABC-Training, not only nurses but all staff-members dealing with clients on a daily basis participated. To create a solid theoretical and client-oriented base within our nursing-home, each of the Trainers will educate at least two teams a year. The recent 108 evaluations (February 2011) resulting from the first ten team-trainings show that ABC-Training leads to a better

understanding of the clinical picture, more detailed observations, a rise in client-focused attention and a different perspective towards sources within the client and/or the environment. Furthermore, there were reports of increased feelings of control over the work situation and of heightened work-satisfaction within the team. Whether the use of behaviour-related medication can be diminished will be examined next year. Interaction, new ideas and fun are considered as essentials of both the training and the Balloon-and-Brick Mission in our nursing-home. -in memory of Roz Seath-

PS02.162

Auditing the response time by a new liaison psychiatry service in assessing patients admitted to a general hospital following overdose

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Aims: It is estimated that 140-150 000 present to accident and emergency with Deliberate Self Harm (DSH) each year in the UK [1]. Failing physical and mental make this an important concern for elderly patients with this population being shown to favour overdose as the main method of DSH [2]. We evaluated the success of the new Liaison Psychiatry service at City Hospital (Birmingham) in adhering to their policy of conducting initial psychiatric assessment of patients admitted with overdose within 24 hours of referral from the medical team. We then explored subsequent outcomes including length of stay and use of psychiatric interventions and also considered the influence of age and its associated co-morbidities.

Methods: All patients over 16 years referred to the Rapid Assessment, Interface and Discharge (RAID) liaison psychiatry team following admission with overdose between June 1 and August 31 2010 were studied. Principal outcome was to ascertain percentage of referrals seen within the target response time. Other outcomes explored included reasons for delay, length of stay following assessment, prevalence of older age in those with longer hospital stays, new psychiatric diagnosis and interventions and signposting for further mental health involvement.

Results: 244 consecutive overdose patients were recruited of whom complete follow up information was available on 203 (43% were male, median age = 32). In total, 27 (12.9%) had delayed (>24 hours) psychiatric assessment. Those patients were more likely to also have a later discharge defined as length of stay post assessment ≥3 days (8/27 vs 12/182; Odds Ratio (95%CI) 6.0 (2.2-16.4)). Amongst the later discharge group (20 patients), the median age was greater in those who also had a delayed assessment (68 yrs vs 35 yrs, Mann Witney U p = 0.004). Those being referred out of hours were also at greater risk of having longer length of hospital stay (18 / 90 vs 11 /113; Odds Ratio (95% CI): 2.32 (1.03 - 5.02). Patient education (44 patients) was the most common intervention. Most common post discharge follow up was with GP (65 patients).

Conclusions: These data confirm that the large majority of those admitted with overdose and referred to this liaison psychiatry service are seen within 24 hours. However, those in which assessment was delayed are at greater likelihood of having a longer length of stay in hospital post-psychiatric assessment. Medical morbidity delaying both assessment and discharge is likely to be a key factor, most obviously demonstrated by the older age of this sub-group. Other explanations include referral occurring out-of-hours - RAID operates 24/7 but with reduced staff at these times. Continued close adherence to the 24 hour response policy is required, and this may help minimise length of stay.

PS02.163

Design and acceptance of technology in dementia care

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Background: In the Netherlands, there is a growing interest for gerontechnology, especially for assistive technology in dementia care. In this study the Rotterdam University of Applied Sciences was asked to help with assistive technology for monitoring residents with dementia, during the evening and night shift in a new small scale living project. In nursing homes infrared sensors are often used to alert staff at night in case a patient needs assistance, for example because of a high risk of falling. The frequency of false positive alarms is an often heard complaint, because infrared sensors detect also non-alarming movements. In small scale living for dementia patients, the group living homes are mostly not connected to each other and each resident has got an own bedroom. At night, often one nursing-assistant is responsible for four homes and thus the time to respond to an alarm will increase. Also other risks like agitation, panicking and wandering, require attention. Consequently, the potential of assistive technology can hardly be ignored. However, the acceptance of technology, especially where privacy issues are concerned, is problematic. In a recent other project for small scale living, no cameras in bedrooms were used as it was assumed that this would violate privacy issues. But there was no evidence supporting this. The main question in this study was: Is acceptance of an integrated system including PDAs, sensors, microphones and cameras in bedrooms of the residents, especially by care professionals and family members of residents, feasible? Objective Designing, developing and implementing an accepted and effective monitoring system. **Methods:** Value sensitive design was used in a human centered design process for developing a new monitoring system. An exploratory survey on values and acceptance took place before a performance test of the prototype in a nursing home. In focus groups important values in small scale living were explored before implementing the system in practice. The system was evaluated by interviewing management, staff and family members of residents.
Results: Contrary to often heard resistance to new technology, it was noticed that there was no resistance of users during the test or implementation of this new system. In the test environment all staff members and family members found the use of cameras in the bedrooms acceptable. The monitoring system has been successfully implemented in the new small scale living project for people with dementia. The evaluation of the monitoring system in practice was positive. Worth stating are the positive effects on trust in care professionals, on capacity and autonomy of staff. Our study also confirmed the findings of Wu et al. (2008), that support of the management, which was clearly the case here, and the established relationship and trust between nursing staff and residents and trust between nursing staff and the relatives of a resident are major determinants for technology acceptance.
Conclusions: We learned that using Value Sensitive Design and a human centered approach benefits the adaptation of new technology. The positive effects on staff and residents are promising. References Friedman, B., Kahn, P.H. and Borning, A. (2002) *Value Sensitive Design: Theory and Methods. UW CSE Technical Report* 02-12-01, University of Washington, Dept. of Computer Science &Engineering, Seattle, WA. Harper, R. et al. (2008) *Being Human: Human-Computer Interaction in the Year 2020.* Microsoft Research Ltd, Cambridge. Schikhof, Y. et al. (2010) *Who will watch (over) me? Humane monitoring in dementia care,* Int. J. of Human-Computer Studies 2010, 410-422. Wu, J.H. et al.(2008) *Testing the technology acceptance model for evaluating healthcare professionals' intention to use an adverse event reporting system. International Journal for Quality in Health Care, Advance Access,* January 25, 1-7.

PS02.164

Aging well: Examples from history

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On the basis of positive psychology, psychogerontology emphasizes some elements related to an appropriate and creative way of getting old (Cesa-Bianchi &Cristini 2009, Cristini et al. 2011). Psychomotility helps us to prevent potentially dangerous conditions and health risks. Regardless of their status cognitive skills can be exercised: cognitive training is useful in preventing decay, in maintaining and improving the state of cognitive function The adoption of a healthy lifestyle, defined also as a balance between different daily activities, is an ancient message, but it is still relevant today. This can be combined with the possibility of having appropriate social relationships, but it can also be considered as an element of their promotion. History confirms this reality, providing us evidences from the past. At the end of the nineteenth century, Alfonso Corradi (1833-1892), an illustrious Italian pharmacologist and medical historian, dealt with the subject of longevity, bringing current information about the characteristics of cases from the past. Even the biographies of older people recorded and analyzed, can give us a better understanding of "ageing wellâ[euro]. We present some Italian cases from the past, in a time-span ranging from the Renaissance to the late nineteenth century (Cornaro 1558, Corradi 1887). The first example leads us back to the Renaissance, in Florence during the thirteenth century. Bonaccorso di Pietro Velluti lived for 120 years, until 1296, fighting, trading, and although after the age of 100 he had lost many cognitive abilities, he remained in good physical health. He died of a trivial domestic incident, related with the inability of maintaining normal daily physical exercise: motor impairment can be assumed as a contributory cause of his death (Corradi 1887). The second example is Luigi (Alvise) Cornaro (1482-1566), a Venetian nobleman and talented architect, who proposed a way of life characterized by moderation, simplicity, closeness to nature, social relationships, intellectual exercise and curiosity. The perfect age is over 80 years, with a good quality of life. The Treaty of Cornaro was published more than 50 times between 1558 and 2004 (Cornaro 1558). The third example regards a century-old Sardinian: he was a priest and died in 1857 at the age of 104. He led a physically and psychologically active life, taking care of the interests of villagers and traveling on horseback through Sardinia. When he lived for a period in the city of Turin, far away from his rural environment, and abandoned the healthy lifestyle he was used to, he quickly became ill and died (Porro et al. 2009). The final example concerns elderly patients in nursing homes: despite being frail, a certain level of creativity is always maintained and their biographies deserve to be recorded and retained. Now, a reflection regarding historians. In the twentieth century, some historians (Mirko Drazen Grmek (1924-2000), Simone de Beauvoir (1908-1986) George Minois) confronted the problem of old age (Grmek 1965, de Beauvoir 1970; Minois 1987). These examples helped to illustrate that psychogerontology is well rooted in solid facts and knowledge from the past. The past gives us indications that we still follow. This is an invitation to continue on our path to achieve a certain quality of life even for the weakest and most frail people. References Cesa-Bianchi M., Cristini C., Vecchio sarà lei! Muoversi, pensare, comunicare, Napoli, Guida, 2009. Cornaro L., Trattato de la vita sobria [. . .], In Padova, appresso Gratioso Porchacino, 1558. Corradi A., Della longevità in relazione alla storia, all'antropologia ed all'igiene, Annali Universali di Medicina e Chirurgia. Parte Originale, vol. 281, settembre 1887, pp. 161-199 Cristini C., Cesa-Bianchi M., Cesa-Bianchi G., Porro A., L'ultima creatività. Luci nella vecchiaia, Milano, Springer, 2011. Grmek M. D., Le vieillissement et la mort, In: Encyclopédie de la Pléiade, Biologie, Volume publié sous la direction de Jean Rostand, de l'Académie Françasise, et d'Andrée Tétry, Paris, Gallimard, 1965, pp. 777-829. de Beauvoir S., La vieillesse, Paris, Gallimard, 1970. Minois G., Histoire de la vieillesse en Occident: de l'Antiquité àla renaissance, Paris, Fayard, 1987. Porro A., Cesa-Bianchi G., Cristini C., Franchini A. F., Lorusso L., Falconi B., *To be a centenarian 160 years ago: between history and story, The Journal of Nutrition, Health &Aging,* 13, suppl 1, 2009, p. S317

PS02.165

The aging of persons with chronic mental illness: A case study review

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This poster demonstrates the issues persons with chronic mental illness encounter as they age and experience declining health. A multiple case analysis is used to identify the issues that affect both a patient's mental and

physical health. Case study analysis is uniquely suited for contributing to the knowledge base of mental health practitioners by demonstrating unique and complicated outcomes, which can occur as persons with chronic mental illness age. Unlike large, randomized controlled studies, case study analysis aids in viewing the uniqueness of individuals and captures important cases that may otherwise be excluded from study. Where as quantitative studies serve an important function, there is also value in the qualitative study that rings true to the real life practice situations we face everyday as we serve our patients. Five cases are closely examined for that which is common amongst them and for case and diagnosis specific problems. Each case was explored for mental health and physical health outcomes. The analysis included an exploration of factors which helped and factors which hindered positive mental and physical health outcomes. Criteria for inclusion in the study were the diagnosis of a chronic mental illness, aged 60 or older and facing medical health crisis or requiring acute medical health intervention. The first case is of a woman, aged 64 with bipolar disorder going into kidney failure. The second case is of a man, aged 60 with schizophrenia and type II diabetes requiring a second amputation. The third case is of a man, aged 75, with bipolar disorder and prostate cancer. The fourth case is of man, aged 76 with a history of chronic alcoholism, and bone cancer. The fifth is a case is of a woman, aged 66, with chronic depression and congestive heart failure. Four of the patients lived in rural settings in the United States, one in a metropolitan area. The patients chosen for the study had varying degrees of social support. The man with the bipolar disorder and the woman with depression were married. The man with alcoholism was living with his grandson and the man with schizophrenia was living with his mother. The woman with bipolar disorder was homeless. Each case identified problems in managing care between multiple physicians, and coordination of on going mental health treatments along with acute and ongoing medical treatments. Each case identified interactions between mental health management and outcomes and the patient's response to medical treatment. In specific situations, the patient's mental health directly influenced their ability to follow through with physical health management. There were two cases where the patient's behavior was interpreted by health practitioners as intentional and deliberate as opposed to simply the manifestation of their mental illness. This interpretation had a direct impact upon the quality of care the patient received in medical settings, one in an emergency room and the other in the hospital. Social support, stigma associated with mental health problems, accessing resources for managing both mental and physical health, and caregiver strain were also identified as significant factors influencing outcomes. Implications for practice with the aging of persons with chronic mental illness are presented.

PS02.166

Integrated community dementia care (ICDC) in the Netherlands: Towards a better organization of physical and social environments for patients with dementia that closely meet their needs

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This presentation will give the facts on the development of programmed improvement of community dementia care in the Netherlands over the last decade as well as an outlook on the upcoming one. The four presentations will explain on items of special interest. The first one is an exploration of what good integrated dementia care will include, and who will be involved. The second one is a research project on a model of the development of integrated care. The third is the coming about of integrated dementia care in the Netherlands, and the fourth one is a standard of good community dementia care. In the beginning of the 2000nds, the Netherlands national Alzheimer association (Alzheimer Nederland, AN) showed that a larger part of dementia patients in the community and their informal carers received no care, or too little or too late. Therefore, the Ministry of Health, Wellbeing and Sports in 2005 initiated a national programme to improve community dementia care. The programme (known by its acronym LDP) turned out to be very successful. In 57 regions (loosely defined adherence areas, together covering almost all of the country) various stakeholders joined together in regional co-operative projects aiming at improving dementia care. An innovative element was that the demands of

people in need of care were charted beforehand and declared leading. On the average, in every region almost four improvement actions have been implemented, varying from information points to the introduction or reinforcement of case management and agreements on referrals. It was understood that better integration between independent care providers is the core of good dementia care. The Ministry decided to follow up the LDP and to start a new and larger project, that in the end should introduce fully fletched integrated community dementia care in all regions. In 2008 the Ministry of Health, wellbeing and Sport initiated its Programma Ketenzorg Dementie (National Programme on Integrated Community Dementia Care). A directive on funding integrated dementia care was issued. It specified for regions and care offices the conditions under which regions could receive funding for integrated dementia care. A number of elements were required, like case management, involvement of the regional AN department, a full coverage care package, agreements on referrals, and a transparent organisation with an action plan and a budget plan. it was attempted to (further) improve dementia community care in 16 front running ex LDP-regions where case management (or the like), early recognition, public information, assessment teams, and support for informal carers was already in place. In addition, all 16 regions established a regional organisation of integrated dementia care, and they drafted action plans and budget plans; this enabled the regional financier of LTC (vis. the AWBZ care office) to fund integrated care rather than separate treatments of individual patients, as was usual. Bottle necks for integration in this stage were lack of data on demand and use of care, lack of commitment of funders of primary care (care insurers) and of social support (local authorities), and the prevailing definition of fundable long term care which made funding of case management problematic. Next, the number of regions was extended on a voluntary basis to 59 (of possible 65). The aim was to include all dementia care providers within the regional integrated framework, rather then have them work in isolation and on their own account. A second aim was to offer in each region a fully fledged dementia care package with no omissions. A third aim was to include all three main funding sources: LTC insurance, health care insurance and local authorities (for funding of social support). Meanwhile, Vilans has taken an important role in supporting activities, like the organisation of meetings for project managers where they can learn from each other and information is given about recent changes in laws or research findings, research on the development stages of integrated care, the development of a dementia care guideline/standard (that states the details of what good dementia care would include) and of indicators of good dementia care (structure, process and outcome). Vilans also holds the positions of the linking pin between government and professionals working every day with people with dementia and their caregivers. Several other institutes have developed a patients monitor to assess the effects of dementia care on patients and research is done on effectiveness of casemanagement (a funders' interest). The research on development stages of integrated care and the development of a care standard of dementia will be presented.

PS02.167

Success factors for living arrangements for people with dementia

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Objective: Living arrangements providing nursing home care to people with dementia vary to a great extent in terms of how they provide care, their staff ratios, staffs' wellbeing, residents' quality of life and quality of care. The quantitative Living arrangements for people with dementia study (LAD-study, n = 136) showed that some living arrangements had a positive score on all outcomes, while for others the opposite was true. The objective was to gain insight into the 'secret' of good care in five types of living arrangements for people with dementia in the Netherlands.

Method: A qualitative study as part of the Living Arrangements for people with Dementia Study (LAD-Study). Out of this study we selected ten arrangements, 6 best practices and 4 worst practices. The settings were three traditional large scale nursing homes with special care units for dementia, a large scale special care unit for dementia in a residential home, a group living home care facility with more than 36 residents, and four with less

than 36 residents, and a farm with care for people with dementia and people with learning disabilities. In each facility we conducted three focus groups with managers/physicians/psychologists/ allied health professionals, with nursing assistants/activity therapists, and with family members. To observe the quality of life of the residents we made use of Dementia Care Mapping. In each facility six people were observed by trained researchers in the living room for six hours. Every five minutes the researchers made notes about behavior and mood of the residents and about interactions with nursing assistants (personal detractions - staff behaviors that undermine personhood - and positive events - which enhance personhood-). Data were analyzed with the constant comparative method with use of MaxQdata.

Results: Out of the analysis ten factors for success came up. Among others five factors were subtracted which were crucial for success: 1. A clear philosophy of care which is used as a guideline for practice and policy and is continuous in discussion, 2. Managers who give structure and support and who function as role models 3. Recognition of nursing staff as professionals, giving them control over their work and involving them in the development of new ideas and policies and offering them continuous education, 4. Nursing staff experience no time pressure and is able to set their own time schedule during the day, 5. Team cohesion; commitment of team members with each other, with the residents and with family members. Other factors for success had to do with person centered care, meaningful activities, family support, volunteers and the environment.

Conclusion: Good care in living arrangements for people with dementia is above all a combination of philosophy, management with respect to the content of care, and special attention for nursing staff, Is has less to do with staff ratio or with larger or smaller scale of the care facility, although a good staff ratio and a smaller scale make it easier to meet the conditions for success.

PS02.168

Heatwave mortality and morbidity among older people with mental illness and dementia

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Heatwaves have always been a threat to human survival. Climate change estimates suggest warming of 3-7 degrees Centigrade by 2100. If coordinated effective global action is taken the minimum increase is expected to be at least 2 degrees. It is very likely there will be an increased frequency and severity of heatwaves in coming years as a result. One upper end prediction is that there may be 3 significant heatwaves in many temperate regions per year if predicted warming comes to pass. During these heatwaves there will be peaks of temperature exceeding previous experience eg. Russian heatwave of 2010 resulted in averages 14 degrees above normal summer averages. Heatwaves will affect human health by direct temperature related events. Increased ambient temperature affects human physiology and may cause specific heat related pathological states including heat exhaustion and heat stroke, consequent dehydration and acute renal failure. In addition, heatwaves are associated with increases in morbidity and mortality in other illnesses. Ageing brings particular changes to these processes. The direct effect of heatwaves in developed countries is most severe amongst the elderly. The ageing of the population will significantly increase the size of the risk group for heat related mortality and morbidity. Elderly patients living in aged care facilities or nursing homes have been shown to carry a large proportion of the increased risk of mortality. This is particularly the case where such facilities are not air conditioned. Elderly patients taking antidepressants and antipsychotics have an increased risk. Some evidence exists that mentally ill patients constitute a particular risk group for heat related mortality. There is some evidence of increased suicide rates in heat waves. As well, there are concerns that behavioural changes affecting many elderly mentally ill would put them at risk of not mitigating the risk from heatwaves. The literature is based mainly on retrospective analyses of individual heatwaves such as Chicago 1995, the European event of 2003 and Victorian of 2009. These analyses have shown increases in mortality rates above that normally expected. It is difficult to quantify the degree of this increased risk as acclimatisation to heat is a major factor in mortality. Acclimatisation has both biological and sociological components. Studies examining hopital

presentation during heatwaves will also be reviewed The characteristics in length, severity and timing of heatwaves which particularly impact mortality will be explored. We will attempt to quantify risks for the elderly mentally ill during heatwaves on what information is currently known. One estimate is that every degree of temperature rise centigrade above a threshold temperature for a particular city correlates with a 3% increase in mortality. Attempts to mitigate the effects of heatwaves have been proposed in several countries and adopted in some cities e.g. Chicago. We will discuss evidence of efficacy for these programmes and propose practical steps that may be taken in services for the elderly mentally ill to both prepare for and respond to heatwaves. Links to guidelines are provided. There is a particular concern of security of electricity supply during heatwaves where air-conditioning forms the basis of mitigation efforts. A poorly acclimatised psychogeriatric population could be at extreme risk in a heatwave if extended blackouts occur. Likewise, large sections of the elderly population in much of the world will not have access to air-conditioning.

PS02.169

Medical care in nursing homes in The Netherlands: Specialist medical education and training of the elderly care physician

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Medical care for the elderly in the Netherlands Dutch nursing homes employ physicians who have completed a three year specialist training programme to become a qualified nursing home physician, called Elderly Care Physician (ECP). In the field of medical care for the elderly, ECP's work together with general practitioners, geriatricians and (old age) psychiatrists. Next to the medical care for nursing home patients, ECP's also make home-calls for the frailest elderly, for instance as a consultant, or assisting in the case-management of community dwelling dementia patients. The training program The competencies of the ECP are based on the 7 competencies as described by the CanMeds*. The education takes place during a three year course at one of three universities in The Netherlands: Amsterdam (VUmc), Nijmegen and Leiden. The training is received during consecutive periods in teaching nursing homes, teaching hospitals and teaching out-patients psychiatry clinics for the aged, mainly dementia patients. In the nursing home, the trainees participate in the medical care for patients on several wards: psychogeriatric wards, somatic wards, rehabilitation wards and day-care units. The education is given one day a week by university teachers, themselves ECP's and also by psychosocial teachers. The teaching groups consist of 12-15 ECP's-in-training with their own teachers. The teachers also take charge of coaching their pupils in finding their role as a specialist in this field. Part of the educational sessions is a scientific training, during which performing a small research project is obligatory. Ample information on both structure and content of the training will be presented. This training program ensures competent medical care for the elderly within reach of community services connected to the scientific and academic spheres through a geriatric network. *) CanMEDS 2000: Extract from the CanMEDS 2000 Project Societal Needs Working Group Report Medical Teacher Jan 2000, Vol. 22 *)The CanMEDS initiative: implementing an outcomes-based framework of physician competencies. Frank JR, Danoff D. Med Teach. 2007 Sep;29(7):642-7.

PS02.171

Cognitive decline in elderly bipolar patients

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Objective: Findings from epidemiological studies suggest that depression or depressive symptoms may be a risk factor for development of cognitive decline or dementia. There is also some evidence that individuals with bipolar disorder develop dementia at a higher rate than expected compared to healthy subjects. We aimed to

investigate neurocognitive performance in bipolar disorder over a period of two years.
Method: A comprehensive neuropsychological testbattery was applied at baseline and two years later to 64 euthymic elderly outpatients with with bipolar-I and bipolar-II disorder (mean age = 68.35, range 60-90 years) and to a demographically matched sample of 42 healthy elderly. Neuropsychological tests were grouped in four cognitive domains: Attention, Learning and memory, Executive functioning and Verbal fluency. Illness characteristics such as age of onset and medication were derived from patient interviews and hospital medical records. At baseline and follow-up two years later, current depressive symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D) and current mania symptoms with the Young Mania Rating Scale (YMRS). A cerebrovascular risk score was determined as follows: respondents were asked whether they currently or previously had any of the following chronic diseases or disease events: disease of circulatory system (myocardial infarction, angina pectoris, heart failure, cardiac dysrhytmia), hypertension, history of ischemic attack or stroke and diabetes.
Results: There were no significant differences in premorbid IQ, education or vascular risk factors between bipolar patients and control subjects, patients with bipolar disorder were significantly younger than controls and included more males. Although the bipolar group had significantly higher YMRS scores than the comparison group on both measurements, the scores were below cut off point at each time point and the level of mood symptoms among bipolar patients was very low. The bipolar group did not differ on CES-D scores from the comparison group on T1 and T2, but both the patient group and the comparison group had higher CES-D scores after two years. The scores however indicated low depressive symptoms at both time points. In order to compare changes over time for each cognitive domain a group by time repeated-measures MANCOVA was performed controlling for the covariates (premorbid IQ and age). At baseline and at follow up bipolar patients performed worse on all neurocognitive measures compared to the healthy elderly. However, there was no significant group-by-time interaction between bipolar patients and the comparison group. Multivariate logistic regression analysis controlling for age and premorbid intelligence showed that more manic symptoms were significantly associated with a greater decline on memory.
Conclusions: Although older bipolar patients have worse cognitive function than normal controls they did not have greater cognitive decline over a period of two years. None of the demographic or illness characteristics were associated with cognitive decline in the domains of attention, executive and language functioning. Only manic symptoms predicted cognitive decline in memory. The finding that bipolar patients do not have a faster rate of cognitive decline may be due to the shorter interval between baseline and follow up than in other studies. Maybe more time is necessary to detect a faster rate of cognitive decline in patients with bipolar disorder. By nature of the design of this study and due to old age not all subjects completed follow up. Prospective studies following bipolar samples within the broad range of the spectrum are awaited with detailed description of drug treatment and clinical features.

PS02.172

Implementation of an effective community occupational therapy program for adults with dementia and their primary caregivers: Design of a cluster randomized controlled trial

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Background: In 1998 a community occupational therapy in Dementia (COTiD) program was developed. This program was proven to be cost-effective in improving clients daily functioning, caregivers' competence, and in improving both their quality of life. However, a pilot study showed that implementation needed attention as only 20% of the trained occupational therapists (OTs) were using the program or only parts of it in practice. Objective As implementation of cost-effective interventions is crucial for improving actual patient care the primary goal of the current study is to evaluate the effects of a combined implementation strategy compared to an educational

strategy only. The primary objective is to compare the strategies based on OTs' adherence to the COTiD program, community OT use, and the cost-effectiveness.
Methods Design: In this study a cluster randomized controlled design is used. All measures on professional and client-caregiver level are conducted at baseline, 6 months, and 12 months. Data was collected during a period of two years and 3 months. Participants: Each cluster consists of two OTs, one manager and at least one physician. A total of 45 clusters were included in the study with a total of 93 occupational therapists, 50 managers, and 89 physicians. Clusters were distributed over the two interventions at random by a statistician.
Intervention: OTs in control clusters received a three-day post-graduate course in theory and intervention skills of the COTiD program (the usual strategy). OTs in experimental clusters receive a two-day implementation training, coaching on the job, regional meeting, access to an electronic patient record system, and a discussion platform in addition to the three-day post-graduate course. Physicians and managers in the experimental clusters were provided with information on the COTiD program using newsletters and a website and were motivated through at least one telephone call. Outcome measures: Adherence of OTs to the COTiD program is defined as 'the degree to which OTs intent to treat clients with dementia and their caregivers according to the COTiD program'. Vignettes are used to collect these data as they seem to be more valid compared to questionnaires and more feasible than Standardized Patients or observations. Vignettes are simulations of realistic events used to obtain participants' knowledge, attitudes, or opinions on how they would behave in a theoretical situation. Previous studies showed that vignettes provide sufficiently valid data to measure adherence and were found to be sensitive to variation in setting and suitable for creating a sufficient case-mix. Two vignettes were created and formatted into an electronic survey system. Vignette data are quantified using a standardized scoring system. This system will assist in producing an adherence percentage between 0 (no adherence) and 100% (complete adherence). Use of community OT is defined as the number of clients with dementia referred to community OT according to the COTiD program (either specific or non-specific) compared to the total number of referrals of people with dementia to community OT services. Specific referrals are those in which the name of the program is mentioned (e.g. OT according to the COTiD program). Non-specific referrals contain a referral question in which the physicians requests evaluation, therapy, or advice concerning daily activities in the home environment of the client and/or caregiver. Referrals only concerning advice regarding an aid are solely included in the total number of referrals collected. To collect this data participating OTs were requested to send copies of all referrals concerning community OT for people with dementia and/or their caregiver to the research team. To evaluate the cost-effectiveness of the two implementation strategies regarding OT adherence to the COTiD program, incremental cost-effectiveness ratios are determined expressed as cost per extra percentage adherence. Secondary outcome measures are managers, physicians and OT knowledge on the COTiD program as well as treatment outcomes on client-caregiver level and cost-effectiveness regarding client-caregiver outcomes.
Data analysis: Random effects regression models will be used to evaluate differences in adherence and in use of community OT between the experimental and control group. Baseline scores are used as covariates and type of setting and OT will be used as random factors.
Results and Conclusion: Currently data is collected and analyzed. Preliminary results on outcomes on professional level will be available at the time of the conference.

PS02.173

Quality indicator development for an occupational therapy intervention at home for people with dementia and their caregivers

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Background: Dementia is one of three major diseases with regard to health care consumption in developed countries and is a major cause of disability and burden of care in older adults. A community occupational therapy (COTiD) program was proven to be effective in improving clients' daily functioning, caregivers' competence, and the quality of life of both client and caregiver (Graff et al., 2006; 2007). In addition, the intervention was cost-effective. Adherence of OTs to the COTiD program in treating clients with dementia and their caregivers is essential to reach optimal benefits with regard to both treatment outcomes and healthcare costs. To be able to evaluate the adherence, measurable criteria are necessary. Therefore quality indicators should be developed for the COTiD program.
Objective: The goal of this study is to develop a set of quality indicators to evaluate the quality of the occupational therapy treatment for people with dementia and their informal caregiver according to the COTiD program.
Methods: The RAND / UCLA Appropriateness Method was used as a guideline in the development of the set of quality indicators (QI). A list of indications was developed through evaluation of the COTiD program manual and the literature on which this program is based. This list of indications was evaluated by a group of six experts who provided the research team with their feedback and suggestions. A conceptual set of indicators was created using this information. To create a set of indicators that are most relevant and necessary in the execution of occupational therapy according to the COTiD program, a new group of experts was asked to rate the relevance and necessity of each indicator on a 9-point scale. The relevance scale ran from least relevant (1) to most relevant (9). The necessity scale from not necessary (1) to undoubtedly necessary (9). This information was used to create a final set of conceptual indicators. Indicators with a median lower than 7 or indicators on which raters did not agree were removed unless they were perceived as necessary for delivering proper care. The feasibility of the final set of conceptual indicators was evaluated by reviewing 30 at random selected client records. Records from OT treatments conducted during the study of Graff et al. (2006) are used. These records were expected to be most complete and treatments were expected to be most accurate as they were executed by experts. During the evaluation of records the presence of each indicator was scored ("clearly presentâ[euro], "uncertainâ[euro], or "not presentâ[euro]). The last step was to verify with the experts whether they agreed with the final set of indicators that resulted from the record evaluation.
Results and Conclusion: The literature search followed by a meeting with the six experts resulted in a conceptual set of 28 process indicators and 3 structure indicators. Three examples of process indicators are "Information on the possibilities and barriers of the physical and social environment regarding meaningful activities is collectedâ[euro], "The treatment goals are formulated together with both the client with dementia and the caregiverâ[euro], and "Advice and solutions for improving daily activities meaningful to the client and caregiver are tested within practice.â[euro] One example of a structure indicator is "The occupational therapist is able to execute the entire therapy at the clients' home environmentâ[euro]. Currently we are working on creating a final and more concise set of indicators. The development of quality indicators is important to make the key elements of the OT treatment for people with dementia and their caregivers visible. In addition the use of these quality indicators provides insight in the quality of OT care and on aspects of care that require improvement. However, quality indicators need to be updated as new data becomes available, for it to remain a proper evaluation tool. Key references: - Graff, M.J.L., Vernooij-Dassen, M.J.F.J., Thijssen, M., Dekker, J., Hoefnagels, W.H.L., &Olde Rikkert, M.G.M. (2006). *Community occupational therapy for dementia patients and their primary caregivers: a randomized controlled trail. BMJ*, 333, 1196 [BMJonline 2006, doi:10.1136/BMJ 39001.688843.BE] - Graff, M.J.L., Vernooij-Dassen, M.J.F.J., Thijssen, M., Dekker, J., Hoefnagels, W.H.L., &Olde Rikkert, M.G.M. (2007). *Effects of community occupational therapy fon quality of life and health status in dementia patients and their primary caregivers: a randomized controlled trail. Journals of Gerontology Series A:*

Biological Science and Medical Science, 62(9), 1002-1009

PS02.174

The longitudinal relationship of pain and depression in the older population

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Background: Pain and depression are both common and associated with eachother in old age, but the temporal relationship remains unknown. Longitudinal studies examining whether pain precedes depression have produced mixed results. Even more inconsistencies have been reported for studies examining the effect of depressive symptoms on the develoment of pain over time. These inconsistencies may be explained by methodological limitations like small sample sizes, inadequate confounder control, and/or use of non-validated measurement instruments. Moreover, nearly all studies were limited to a short duration of follow-up up to 3 years or a maximum of 1 or 2 follow-up measurements.

Objectives: To overcome these problems, we have examined the longitudinal relation between pain and depression within the Longitudinal Aging Study Amsterdam (LASA). Our objectives were to examine to what extent pain in the elderly predicts the development of depression and to what extent depressive symptoms in the elderly population predicts the development of chronic pain.

Methods: LASA is an ongoing prospective, population based cohort study with a 12-year follow up and 3 years intervals among persons aged 55 through 85 years at baseline within 11 municipalities in the Netherlands. Incident depression defined as crossing the cut-off of 16 and showing a relevant change (≥5 points) on the Center for Epidemiological Studies - Depression scale (CES-D) among non-depressed participants at baseline. Incident pain was defined as a score of 2 or higher on pain scale of the Nottingham Health Profile (NHP) in pain free participants at baseline. Multiple cox-regression analyses with time-dependent covariates were performed including incident pain and depression as the dependent variable, respectively.

Results: In non-depressed participants (n = 1455) a higher level of pain increased the risk of becoming depressed during follow-up (univariate Hazard Ratio (HR) = 1.19 (95% Confidence Interval (CI) = 1.10 - 1.28, p <.001), which remained significant when corrected for age, sex, education, cognitive functioning, medication use, smoking, alcohol use, BMI, functional limitations and chronic conditions. The predictive value of pain with respect to depression was also found when looking at the mean symptom severity over time and/or the fluctuation of pain over time suggesting a robust relationship. In the pain-free participants (n = 1107), depressive symptoms at baseline increased the risk of incident pain with a HR of 1.03 (95% CI = 1.01-1.05, p = .005), which remained significant after correction for sex, education, cognitive functioning, medication use, smoking, alcohol use, BMI. Nevertheless, this relationship became insignificant after additional correction for functional limitations and chronic diseases. When included depressive symptoms as a time-dependent variable, depression still predicted pain (after full correction for confounders), which indicates that depressive symptoms do have only short-term effects on the incidence of pain.

Conclusion: Among community-dwelling older people, pain precedes the onset of clinically relevant depressive symptoms. The effect of depression on the development of pain, however, was less clear. Moreover, these latter effects seemed to be mediated by functional impairment and the number of comorbid chronic diseases.

PS02.175

An investigation into the use of computerised technology for the assessment of hand motor impairment in Alzheimer's disease

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Rational and Aim: There is growing evidence that individuals with mild cognitive impairment and early

Alzheimer's Disease experience subtle motor impairment (Aggarwal, Wilson, Beck, Bienias &Bennett, 2006; Scherder, Dekker &Eggermont, 2008). Specific characteristics of this impairment can aid in the process of differentiating between the various subtypes of preclinical dementia (Kluger, Gianutsos, Golomb, Ferris &Reisberg, 1997). In spite of such evidence, motor function is one area of cognitive functioning that is not comprehensively examined as part of the routine clinical assessment for diagnosis of early AD and MCI. This might be due to the fact that there are currently no quick, practical and easy to administer motor test that is also sensitive enough to be able to identify subtle motor impairment. The present study aims to investigate the feasibility of assessing hand motor impairment in AD with an iPad, striving to exploit the features of the iPad namely the multi-touch technology and the 3-axis accelerometer sensor, in the assessment of elderly individuals.

Method: Individuals with AD and controls completed a battery of cognitive tests, including a newly developed measure of motor skill. The new measure was similar in concept to the "finger mazeâ[euro] test used in previous research (Grosse &Wilson, 1991) and used accelerometer based technology (iPad) in order to recognize tilt movements. Participants were required to repeat the test several times before and after a 20 minutes delay. The results were analysed in order to investigate between group's differences in motor performance, learning and retention. Participants were also asked to provide feedback on their experience of using the iPad.

Results: Between group analyses highlighted that AD participants had significantly lower motor performance times in comparison to normal controls ($p = .001$). AD participants were however able to learn the motor task and significantly improved as a result of learning, in a similar manner to controls (all $p < .025$). Between groups investigation of the difference in amount of overall improvement revealed that in spite of performing significantly slower, AD participants improved significantly more ($p < .05$). Analyses indicated a negative correlation between motor performance and cognitive status. Participants in the study were able to use the iPad irrespective of disease severity. On average they reported that the experience of using an iPad pleasant, and were overall willing to use the iPad in the future if required to do so.

Conclusion: The study supported the view that AD is associated with motor slowing and that individuals with AD are relatively unaffected in their ability to acquire motor skills. The findings provide encouraging support for the hypothesis that differences in motor performance can be validly and accurately measured with the aid of new technology, and that this method is suitable for the assessment of elderly individuals. More work is required in order to control for some methodological issues encountered in this study and to further determine how other characteristics of motor function such as: movement jerk or profiles of motor trajectory could be measured using this type of technology. References: Aggarwal, N.T., Wilson, R.S., Beck, T.L., Bienias, J.L., &Bennett, D. A. (2006).Motor Dysfunction in mild cognitive impairment and the risk of incident in Alzheimer's Disease. Archives of Neurology, 63, 1763-1769. Grosse, D.A., &Wilson, R. S. (1991). Maze learning in Alzheimer's Disease. Brain and Cognition, 15, 1-9. Kluger, A., Gianutsos, J.G., Golomb, J., Ferris, S.H., George, A.E., Franssen, E., &Reisberg, B. (1997). Patterns of motor impairment in normal aging and mild cognitive impairment and early Alzheimer's disease. Journal of Gerontology: Psychological Sciences, 52B, 28-39. Scherder, E., Dekker, W., &Eggermont, L. (2008). Higher-level hand motor function in aging and (preclinical) dementia: its relationship with (instrumental) activities of daily life - a mini review. Gerontology, 54, 333 - 341.

PS02.176

Managing radiation therapy for psychogeriatric patients

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A diagnosis of cancer is stressful and psychologically devastating for any person, not only for the patient, but for those who are caring for that person as well. When that person has an existing mental health condition it is even more distressing. The psychogeriatric patient deserves the same respect and retention of dignity as anyone

else. "It is not about choosing to live or die - it is about how we dieâ[euro] Dr Sue Edelman makes the point in her book Change your Thinking. Mental health issues may involve anxiety, hearing voices, physically inappropriate behaviour, self harm, grandiose ideas, flight of ideas, chronic depression to name just a few. The decision to give radiation therapy to a patient with any of these conditions presents major challenges and the administration of treatment needs to be carefully considered from a number of perspectives to ensure optimum outcomes. Older patients typically have skin like 'tissue paper' and the side effects of radiation therapy can be considerably worse in the psychiatrically disturbed patient who does not realise the need to care for the treated area. The psychogeriatric patient may not even be able to comprehend that they have an illness and so legal rights &dignity are two of the issues that are paramount if treatment is to proceed. For example, an elderly patient with a psychogeratric illness can result in late diagnosis eg lung cancer. In this instance, the need, prognosis, ability of the patient to cope with side effects, ability to follow precise instructions, benefits, effect on dignity, palliative or active and skin integrity, all need careful consideration before proceeding to radiation treatment. Pain in the psychogeriatric patient is often masked by their mental health symptoms. Even at a late stage this pain can sometimes be relieved to a degree with palliative radiation therapy This presentation will address the various issues associated with the successful administration of radiation therapy along with the fine balance needed to produce an optimum outcome for the psychogeriatric patient so that dignity &quality of life are preserved together with a maximisation of clinical effective treatment. Interviews were conducted with specialist staff in a specialised psychogeriatric unit in Sydney that has to prepare patients for radiation therapy and also with senior radiation therapists at a major radiation therapy department in a large Sydney teaching hospital. Administration of radiation therapy needs extra attention in assessing the suitability of the patient for treatment. With this in mind, trial runs of treatment are sometimes conducted in the psychogeriatric inpatient unit to assess the relative ability of the psychogeriatric patient to lie still and follow precise instructions. The nursing staff in a psychogeriatric hospital and/ or the carers of the patient at home need to be aware of the after care instructions for protecting the skin around the treatment area A draft protocol has been developed so that all radiation therapy departments and Psychogeriatric units are able to access these guidelines to best ensure an optimal outcome for an otherwise difficult treatment scenario. The protocol includes suggestions for the following: ·Guardian issues ·Power of Attorney ·Legal enforcement ·Consent issues ·Different body sites ·Sensitivity ·Dignity ·Skin integrity ·Sedation / General Anaesthetic This presentation demonstrates that with some careful planning, along with family &legal involvement, it is possible to effectively treat a psychogeriatric patient who requires radiation therapy.

Publication date: Sep 2011

Year: 2011

Bone-Conducted Hearing Assessment with 80-Hz Multiple Auditory Steady-State Responses to Brief Tones in Adults with Normal Hearing

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Publication info: ORL : Journal for Oto - Rhino - Laryngology and Its Related Specialties 73.5 (Sep 2011): 253-9.

ProQuest document link

Abstract: Objective: To investigate interactions (if any) in the bone-conduction auditory steady-state response (BC ASSR) between multiple brief tones presented simultaneously. Methods: 500-, 1,000-, 2,000-, and 4,000-

Hz brief tones, repeated at a rate of 77-101 Hz, were presented using a B-71 vibrator. BC ASSR thresholds and amplitudes at 50 dB nHL were measured in two conditions where the stimulus was either presented alone or together with other stimuli. Results: Significantly larger amplitudes in the single-stimulus condition were found at 50 dB nHL. However, there was no significant threshold difference between single- and multiple-stimulus conditions. The BC ASSR thresholds (means ± SD) at 500, 1,000, 2,000, and 4,000 Hz were 96.7 ± 9.7, 75.3 ± 11.5, 65.6 ± 7.4, and 57.8 ± 7.2 dB re 1 μN ppe, respectively. Conclusion: Interactions occurred in the multiple-stimulus condition at high presentation levels, but not at threshold levels. The results of the present study imply that BC ASSR thresholds to multiple brief-tone stimuli can be assessed at the same time, at least in normal-hearing adults. [PUBLICATION ABSTRACT]

Full text: Original Paper
ORL 2011;73:253259 DOI: 10.1159/000330040
Received: March 15, 2011
Accepted after revision: May 25, 2011
Published online: August 11, 2011

Bone-Conducted Hearing Assessment with80-Hz Multiple Auditory Steady-State Responses to Brief Tones in Adults with Normal Hearing

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Key Words
Bone-conduction auditory steady-state response [H11554] Multiple brief tones [H11554] Thresholds

AbstractObjective: To investigate interactions (if any) in the bone-conduction auditory steady-state response (BC ASSR) between multiple brief tones presented simultaneously. Methods: 500-, 1,000-, 2,000-, and 4,000-Hz brief tones, repeated at a rate of 77101 Hz, were presented using a B-71 vibrator. BC ASSR thresholds and amplitudes at 50 dB nHL were measured in two conditions where the stimulus was either presented alone or together with other stimuli. Results: Significantly larger amplitudes in the single-stimulus condition were found at 50 dB nHL. However, there was no significant threshold difference between single- and multiple-stimulus conditions. The BC ASSR thresholds (means 8 SD) at 500, 1,000, 2,000, and 4,000 Hz were 96.7 8 9.7, 75.3 8 11.5, 65.6 8 7.4, and 57.8 8 7.2 dB re 1 [H9262]N ppe, respectively. Conclusion: Interactions occurred in the multiple-stimulus condition at high presentation levels, but not at threshold levels. The results of the present study imply that BC ASSR thresholds to multiple brief-tone stimuli can be assessed at the same time, at least in normal-hearing adults.

Introduction

Frequency-specific air- and bone-conduction (AC/ BC) thresholds are essential for the diagnosis of and intervention for hearing loss. These can be obtained by behavioral pure tone audiometry in adults and older children who are able to cooperate during the testing procedure. In infants, young children, and those who cannot be tested behaviorally, the tone/auditory brainstem response (ABR) is the method of choice. However, only one frequency can be tested at a time when brief-tone ABRs are used, and the presence or absence of a response needs the testers subjective judgment, which could introduce bias. Auditory steady-state responses (ASSRs) elicited by sinusoidal amplitude-/frequency-modulated (AM/FM) tones are currently of great interest. ASSRs that are amplitude-modulated at the rate of 70110 Hz (also referred to as 80-Hz ASSRs [1]) are unaffected by the state of arousal and can be reliably recorded in infants and young children. One of the

advantages of using ASSRs is that they may be more time-efficient because the responses to multiple simultaneous stimuli can be recorded provided
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2011 S. Karger AG, Basel 03011569/11/07350253$38.00/0
Accessible online at: www.karger.com/orl
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the stimuli are repeated at different rates. The responses are assessed by measuring the spectral component corresponding to the repetition rate in the frequency domain. The presence or absence of a response is objectively detected on the basis of statistical tests which can reduce the potential bias of subjective interpretation. Studies have shown that the ASSR is a promising tool for evaluating hearing sensitivities in adults and children with normal hearing or sensorineural hearing loss [24].

In the studies of BC ASSR, sinusoidal AM or AM/FM tones are commonly used. A few studies have reported BC ASSR thresholds in normal-hearing adults [2, 5, 6]. Although the results varied due to the different methodologies adopted, such as the place where bone vibrator was placed (forehead vs. mastoid) and whether the ears were occluded, a trend towards poorer thresholds at 500 Hz was indicated by all these studies. In subjects with simulated conductive hearing loss, Dimitrijevic et al. [2] assessed the physiological-behavioral differences and found that they were no more than 25 dB across audiometric frequencies. Jeng et al. [7] reported the estimated ASSR air-bone gap was strongly correlated with that ob-served for behavioral tests. Studies of ASSRs to BC stimuli in adult patients with profound sensorineural hearing loss revealed that artifactual responses occurred at relatively low levels for the low frequencies (about 4050 dB HL in AM tones), which means BC stimulation may be appropriate only for subjects whose hearing loss was less than moderate [7, 8] . Small and Stapells [9] reported BC ASSR thresholds of 14, 2, 26, and 22 dB at 500, 1,000, 2,000, and 4,000 Hz, respectively, for normal-hearing post-term infants and found age-related frequency-dependent differences in BC ASSR thresholds [10] and interaural attenuation differences in infants compared to adults [11].

Although Mo and Stapells [12] reported that brief tones, which are less frequency-specific than tonal stimuli, did not result in greater ASSR amplitudes, good correlations of AC thresholds between ASSR and behavioral testing in young children with sensorineural hearing loss have been shown [13]. Moreover, at least one ASSR device that uses brief-tone stimuli (Intelligent Hearing System, IHS, Smart EP-ASSR) is now commercially available. It is therefore necessary to investigate BC ASSR thresholds to brief tones, which was the first objective of this study.

It is possible for the auditory modality to record responses to multiple stimuli at the same time [14], which would potentially decrease the recording time. However, this technique is only more efficient than the traditional single-stimulus technique if any reduction in amplitude
of the responses caused by the simultaneous presentation of the stimuli is less than the reduction in the EEG noise. Significant amplitude reductions when multiple stimuli are presented simultaneously are referred to as interactions. These interactions have both physiological and clinical considerations. A few AC ASSR studies investigated several parameters that may cause interactions when multiple stimuli are presented simultaneously [5, 1517]. These studies indicated that there were no interactions among the responses at moderate (60 dB SPL), low (30 dB SPL) and threshold levels, provided each carrier frequency was at least one octave apart and modulated at rates above 70 Hz. However, at higher intensities (greater than 70 dB SPL), responses to different stimuli interfered destructively, resulting in attenuation of the response amplitude [12, 16]. There has been no

published study investigating the interaction of BC ASSR in multiple simultaneous presentations. Whether interactions are also found for multiple simultaneous stimuli for ASSR to BC stimuli, and what the interaction pattern is like (if present), are unknown. Therefore, the other objective of the present study was to investigate potential interactions in the BC ASSR to brief tones.

Methods

Subjects

A group of 12 subjects with air-conduction pure-tone thresholds from 250 to 8,000 Hz within 20 dB HL participated in this study. There were 5 males and 7 females aged from 21 to 23 years old with an average age of 21.7 years.

Stimulus

The stimuli were Blackman-windowed 500-, 1,000-, 2,000-and 4,000-Hz brief tones generated by the IHS Smart EP-ASSR system. The stimuli had no plateau, and had rise and fall times of 4 ms (total duration of 8 ms) for 500-Hz brief tones and 2 ms (total duration of 4 ms) for 1,000-, 2,000- and 4,000-Hz brief tones; these were modulated at rates of 77, 87, 93, and 101 Hz, respectively. An alternated stimulus polarity was used to elicit the ASSRs. The B-71 bone vibrator was held in place by an elastic band with mean force of approximately 500 g. For the single-stimulus condition, one brief tone was presented at a time, whereas for the multiple-stimulus condition, four stimuli were presented at the same time.

Calibration

Stimuli in the single-stimulus condition were calibrated using a Brel and Kjaer Model 2218 sound level meter and Model 4930 artificial mastoid. The bone vibrator was coupled to the artificial mastoid with 500 g of force. Peak force levels were measured and then peak-to-peak force levels were obtained by subtracting 3 dB from the peak force level. The maximum output limit of the bone vibrator at each frequency was determined by checking for the

consistency between the incremental increases in force level with that of the dial reading and visual inspection for peak clipping of the waveforms on an oscilloscope. The maximum limits were the maximum level where neither disproportional increments in the output nor peak clipping of the stimuli occurred (fig.1). The constituent stimuli in the multiple-stimulus condition were adjusted to be the same intensity as those in the single-stimulus condition.

ASSR Recording

ASSRs were recorded using the IHS Smart-ASSR system. The non-inverting electrode was placed on the high forehead, while the inverting electrode was at the mastoid ipsilateral to the stimuli. An electrode on the low forehead served as the ground. All inter-electrode impedances were below 3 k [H9024] at 1,000 Hz.

The EEG was filtered using a 30300 Hz filter (12 dB/octave), and amplified with a gain of 100,000, then processed using an A/D rate of 20 kHz. Each sweep lasted 1,024 ms and was rejected if its amplitude exceeded 830 [H9262]V. Sweeps were averaged in the time domain and this average was submitted to fast Fourier transform (FFT) for every 20 sweeps. Amplitudes were measured baseline-to-peak and expressed in nV. The F ratio was calculated to estimate the probability that the ASSR amplitude at the repetition frequency of each stimulus was significantly different from the average amplitude of noise at the same frequency as well as at its adjacent 85 Hz side bins. The response detection for a recording epoch of the system was based on the F ratio. If the F ratio, compared to the critical values for F(2, 10), was significant at a level of p ! 0.05 and the noise levels at the repetition frequency and its 85 Hz side bins were less than 50 nV, the response was considered to be present. The response was considered to be absent if p 10.05. The recording was stopped when the background noise was less than 15 nV and the number of sweeps was at least 240. This required at least 4 min

of recording per condition.

Test ProcedureAll of the tests were carried out in a sound-attenuated booth with background noise less than 30 dBA SPL. The total testing time was approximately 2 h. At the beginning, pure-tone air-conduction thresholds were obtained to ensure the subjects had normal hearing. They were then instructed to relax or sleep on a bed. Their ears were unoccluded and an elastic band was used to hold the vibrator at the temporal bone (12 cm superior and posterior to auricle). This place was chosen to separate the electrode from the vibrator as far as possible so as to avoid stimulus artifacts at high presentation levels. A pilot study as well as the study of Small et al. [18] showed that there was no significance difference in behavioral test results with the vibrator placed either at the mastoid or higher on the temporal bone. The measurements at each frequency, both in the single- and multiple-stimulus conditions, started at 50 dB nHL and were then decreased in 5-dB steps. The threshold was the lowest level at which a response was detected.

The procedures of the present study were approved by the Research Ethics Board of the Capital Medical University. The subjects signed a consent form before commencing an experiment, and were paid an honorarium at the end of the session.

The normal hearing levels to the brief-tone stimuli of the present study were set by a preliminary experiment which is shown in

figure 1 . According to the study of Small and Stapells [8], the stimulus and recording parameters must be carefully selected (i.e. ap-

propriate A/D rate, alternating polarity which is supposed to cancel out the stimulus artifact and so on) to avoid spurious responses. The lowest levels that artifactual responses to BC brief tones occurred at each frequency (fig. 1) were obtained by testing a group of 21 profoundly hearing-impaired children (aged 539 months) with the same stimuli and the same recording condition [19] . Since they were well above the presentation level of 50 dB nHL, spurious responses were not expected to be a problem in the present study.

Data Analyses

BC ASSR thresholds and amplitudes at 50 dB nHL were compared across frequencies and between single- and multiple-stimulus conditions. Comparisons were made using two-way (frequency ! condition) repeated-measures ANOVA. The criterion for statistical significance was p ! 0.01 for all comparisons. Neuman-Keuls post hoc comparisons were performed for significant main effects and interactions.

Results

The means 8 SD of BC ASSR amplitudes at 50 dB nHL in single- and multiple-stimulus condition are shown in figure 2 . The ANOVA showed a significant difference between single- and multiple-stimulus conditions (F = 18.3;d.f. = 1, 11; p = 0.001). There were also significant differences among frequencies (F = 11.6; d.f. =

140
120
120.5 115 112 105.5
x x x x
Forcelevel (dB re1 N ppe)
100
111.4
96.7 97.6
83.1
80
61.4
60
46.7 47.6
58

40
33.1
42.5
20
31
36.5
0
500 1,000 2,000 4,000
Frequency (Hz)
Fig. 1. The stimuli parameters and some relevant data used in the present study. d = ANSI (1996) 0 dB HL for pure tones (vibrator placed at mastoid and ears unoccluded). _ = Normal hearing levels for the brief tones. X = Presentation level of 50 dB nHL where the interaction of the responses to multiple simultaneous stimuli were studied in the present study. y = Levels for spurious responses of the stimuli in the present study [19] . The spurious response did not occur even when the maximum limit was reached at 500 and 2,000 Hz. ! = Maximum limits at each frequency of the device used in the present study.

Single Multiple
120
100
Thresholds(dB re1 N ppe)
80
60
40
20
0 0 1,000 2,000 4,000
500
Frequency (Hz)
140 Single Multiple
120
100
Amplitude (nV)
80
60
40
20
0 0 1,000 2,000 4,000
500
Frequency (Hz)
Fig. 2. Brief-tone ASSR amplitudes (mean 8 SD) at 50 dB nHL in single- and multiple-stimulus condition (n = 12). Significantly larger amplitudes were found in the single-stimulus condition at 500 and 1,000 Hz, but not at 2,000 and 4,000 Hz.
Fig. 3. BC ASSR thresholds (mean 8 SD) to brief tones in the single- and multiple-stimulus conditions (n = 12). There was no significant difference between these two conditions.
3, 33; p = 0.000). There was no significant condition ! frequency interaction (F = 3.0; d.f. = 3, 33; p = 0.044). Post hoc comparisons indicated that the amplitudes in the single-stimulus condition were larger than those in

the multiple-stimulus condition for both 500 (p = 0.0029) and 1,000 Hz (p = 0.0005).
The mean
8 SD of BC ASSR thresholds in the single-and multiple-stimulus conditions are shown in figure 3 . ANOVA showed no significant threshold difference between single- and multiple-stimulus conditions (F = 4.8; d.f. = 1, 11; p = 0.052). However, there was significant difference among frequencies (F = 70.5; d.f. = 3, 33; p = 0.000). There was no significant condition ! frequency interaction (F = 0.7; d.f. = 3, 33; p = 0.543). Post hoc tests indicated the highest threshold was at 500 Hz (p ! 0.0001 for all the paired comparisons of 5001,000, 2,000 and 4,000 Hz).

Discussion

BC ASSR Interactions in the Multiple-Stimulus Condition

In normal-hearing subjects, it is known that both cochleae are activated by BC auditory stimuli. This was confirmed by Small and Stapells [6] who compared the amplitudes of BC stimuli with those of binaural presentation of AC stimuli. Based on these findings, the BC ASSRs in the present study likely reflect contributions
from both cochleae. To obtain responses from an individual cochlea, masking applied to the non-test ear is needed.

In the present study, as expected from the results from a previous AC ASSR study [17], non-significant threshold differences between single- and multiple-stimulus conditions were found, which indicates that interactions did not occur at levels near the threshold. However, at 50 dB nHL for the multiple-stimulus condition (regarded as a high level because the maximum output is approximately 60 dB nHL), interactions did occur as shown by amplitudes that were significantly smaller compared to the single-stimulus condition. These results can be explained by the cochlear filter model proposed by Lins and Picton [15]. According to their model, the cochlea acts like a series of bandpass filters. The basilar membrane and outer hair cells perform a frequency place analysis of incoming sounds: higher frequencies activate the lower part of basilar membrane, while low frequencies activate the apical part. Low-level multiple stimuli with frequencies separated by more than the bandwidth of the cochlear filter should not interact. Louder stimuli should interact more than softer ones because the bandwidth of the cochlear filter enlarges with increasing stimulus intensity. Moreover, very loud stimuli should interact even when the frequencies of multiple stimuli are quite different because the cochlear filter becomes wider at high presentation level. The model can also be applied to AC ASSRs where interactions are not observed at threshold, low (30 dB

Table 1. Across-study comparison of BC ASSR thresholds (dB re 1[H9262]N)

Stimuli	Vibrator placement	Occluded/ unoccluded	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz
Present study brief tones	temporal	unoccluded	96.7	75.3	65.6	57.8
Small and Stapells [6]1 sinusoidal AM tones	mastoid	unoccluded	80	68.5	49	53.5
Lins et al. [5] sinusoidal AM tones	forehead	occluded	89	72	51	55
Dimitrijevic et al. [2] sinusoidal AM/FM tones	forehead	occluded	90	61	41	49
Jeng et al. [7] sinusoidal AM tones	forehead	occluded	106	76	72	74

T hresholds for AM tones have been converted to dB re 1 [H9262]N according to ANSI 3.43.
1 Derived from table 7 where thresholds have been corrected to account for forehead-mastoid differences and for occlusion effects.

SPL) and moderate (60 dB SPL) levels, but at a high level (75 dB SPL) [12, 1517].

For the interaction pattern for AC ASSRs, John et al. [16] studied the interference by comparing the amplitude of 1,000- and 2,000-Hz AM tones in a single-stimulus condition to those of a multiple-stimulus condition. They found that the response amplitudes to these two stimuli were significantly attenuated by the presence of other stimuli at different carrier frequencies at a high intensity (75 dB SPL, approximately 65 dB sensation level). Mo and Stapells [12] confirmed this interaction pattern at 2,000 Hz; however, such an effect was not seen at 500 Hz. They suggested that the presentation level may not have been high enough for this frequency to cause interactions due to the presentation of multiple stimuli.

For BC ASSRs at a level of 50 dB nHL (approximately 50 dB sensation level), significantly attenuated amplitudes were found at 500 and 1,000 Hz in the multiple-stimulus condition compared to the single-stimulus condition. There was no such significant amplitude change at 2,000 and 4,000 Hz. Therefore, two major differences between the interaction pattern for AC ASSR and that for BC ASSR were found. First, the interactions for BC ASSR occurred at a level 15 dB lower than that of AC ASSR. Second, interactions occurred at 500 and 1,000 Hz rather than at 1,000 and 2,000 Hz, which is unexpected based on what would be predicted from findings from AC ASSR studies. One possible reason might be the presentation level difference of the two studies. Provided a 75 dB SPL (about 65 dB sensation level) of multiple simultaneous stimuli in AC is intense enough to result in response interaction at 1,000 and 2,000 Hz, but not at 500 Hz, it is likely in the present study, a 50-dB nHL (approximately 50 dB) sensation level might be too soft to cause any interaction. The present interactions at 500 and 1,000 Hz

were due to some features related to the BC mechanism; for example, the vibrators mechanical distortion at high levels (such as 50 dB nHL) and low frequencies. However, if this had been the case, this effect would not have been shown in the present study because both single- and multiple-stimulus conditions have the same issue. Another reason accounting for the different interaction pattern might be related to the fact that much more energy (27 dB) is required to drive the oscillator at 500 Hz compared with 2,000 Hz [20] . Furthermore, the bone conduction mechanism, recognized as being initiated by three basic processes (distortional, inertial and osseotympanic mechanisms) [21] and fluid mechanisms [22] , is quite complex and requires further clarification.

BC ASSR Thresholds across Studies

There are a few BC ASSR threshold studies in normal-hearing subjects which used sinusoidal AM or AM/FM tones [2, 57] (table1). In addition to using different stimuli, they varied in vibrator placement (mastoid vs. forehead) and occluded versus unoccluded ears. When compared to the study with the same condition (mastoid vibrator placement and with ears unoccluded) [6], as shown in table 1 , the threshold differences across frequencies were 17, 6, 17, and 4 dB, with the poorer thresholds reported in the present study. The largest threshold differences are found at 500 and 2,000 Hz. We propose that the different stimuli used in these two studies might have contributed to the difference between ASSR thresholds at 500 and 2,000 Hz. Small and Stapells [23] used sinusoidal AM tones, which have a longer duration (approximately 10 ms) than the brief tones (duration of 8, 4, 4, and 4 ms at 500, 1,000, 2,000, and 4,000 Hz, respectively) used in the present study. It is well recognized that the stimuli with a longer duration would result in lower thresholds

due to temporal integration. However, the stimulus duration difference still cannot fully explain the large difference at 500 and 2,000 Hz. When comparing the behavioral thresholds for these two types of stimuli, a 17-dB difference at 2,000 Hz is found (fig.1), which may explain the physiological threshold difference. As for the difference at 500 Hz, it could not be the resonance characteristics of the skull, which may be 20 dB or more across different skulls [24, 25], because there is no specific change in behavioral thresholds to these two stimuli (fig.1). It also could not be the ambient noise in the sound-attenuated booth, because it would affect the behavioral thresholds in the same way (fig.1). We think that the intrinsic variability of the brief-tone thresholds

for 500 Hz may be a factor that requires further investigation.

There are other considerations that may contribute to the generally poorer thresholds in the present study. One possibility is the noise levels used for the stopping criteria. The noise level of a recording decreases when the averaging continues provided the subject stays quiet and relaxes all the way through the test. Lower noise levels means that there is more chance that a small response will be detected, thus resulting in a better threshold. The noise criterion used to determine the absence of a response in Small and Stapells [6] was 11 nV, whereas 15 nV was used in the present study. Additionally, the equipment used in the present study was the IHS system, whereas the Rotman MASTER system was used by Small and Stapells [6] . Each system has adopted a different response detection algorithm, which may also contribute to any differences. The IHS Smart-EP ASSR determines response presence in a manner similar to the MASTER technique [26] , but with two primary differences. First, the IHS system uses a smaller number of noise bins (10 vs. 120), and thus a smaller number of degrees of freedom in the resulting F test. Second, it calculates two measures of noise: the first using the noise side bins similar to MASTER and the second using noise at the modulation rate calculated from an FFT of the time-domain plus-

minus noise estimate. The plus-minus noise estimate is essentially the difference between two replicate time-domain waveforms, and has been used in many studies as an estimate of residual noise in the ABR [27] and recently with the ASSR [13]. The IHS use of this extra noise estimate for the ASSR is unique, with the result that two measures of response signal-to-noise ratio are calculated, both of which must be significant for the system to decide response present. This criterion may be a little conservative and could result in worse thresholds. Therefore, differences in BC ASSR thresholds across studies should be interpreted cautiously because of these sources of variability in their methodology.

The present study shows similar results to previous BC ASSR studies and supports the use of multiple simultaneous stimuli to elicit BC ASSRs to brief tones, at least in normal-hearing adults. Further studies of patients with different kinds of hearing impairment are required to assess its clinical utility.

Conclusions

For BC ASSRs to brief tones: (1) At a presentation level of 50 dB nHL, interactions occurred among the responses for 500 and 1,000 Hz. However, such interactions were not found at threshold levels. (2) The mean 8 SD of thresholds at 500, 1,000, 2,000, and 4,000 Hz were 96.7 89.7, 75.3 8 11.5, 65.6 8 7.4, and 57.8 8 7.2 dB re 1 [H9262]N ppe, respectively. The results of the present study support the proposal that BC ASSR thresholds to multiple brief tones can be assessed at the same time, at least in normal-hearing adults.

Acknowledgements

We are grateful to Dr. David Stapells and Dr. Susan Small for their valuable help with stimulus calibration and to Dr. Small for editing this paper.

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80-Hz Bone-Conducted ASSR in Normal-Hearing Adults
ORL 2011;73:253259 259

Publication date: Sep 2011

Year: 2011

Detection improvement for neonatal click evoked otoacoustic emissions by time-frequency filtering

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Publication info: Computers in Biology and Medicine 41.8 (Aug 2011): 675-686.
ProQuest document link

Abstract: This study employed a time-frequency filtering technique to improve click evoked otoacoustic emission (CEOAE) detection at lower frequency bands, and hence to reduce the number of referral cases in neonatal OAE screening. Using this approach the detectability of CEOAEs, in terms of lower frequency SNRs and whole wave reproducibility, was significantly improved. Evaluations of screening outcomes demonstrated this method significantly reduced the overall referral rate, by 2.5 percentage points in initial CEOAE hearing screening. This approach may have potential application in OAE technology and in neonatal hearing screening programmes.

Full text:

Total ears (*N*=1113)	**Pass (*n*=1031)**	**Refer (*n*=82)**	**CEOAE**
84.4±18.1	88.4±7.8	33.5±29.6	**Denoised CEOAE**
87.8±17.5	91.7±6.0	38.3±32.3	***Δ* (percentage points)**
3.4	3.3	4.8	***p***

Table 1 - Whole reproducibility (%) (mean±SD) for original CEOAE and denoised CEOAE in different groups. *Note: Δ* denotes the mean improvement in reproducibility.

1kHz	**1.4kHz**	Pass (*n* =1031)	Pre-denoising
3.69±4.71	0.94±4.95	Post-denoising	1.69±4.87
-0.17±5.00	*Δ*	2.0	1.11
p	<0.05	<0.05	Refer (*n* =82)
Pre-denoising	2.53±4.46	-0.31±5.04	Post-denoising

0.51±4.61	-1.51±5.12	*Δ*	2.02
1.2	*p*	<0.05	<0.05
Total (*N* =1113)	Pre-denoising	3.60±4.70	0.84±4.97
Post-denoising	1.60±4.86	-0.27±5.02	*Δ*
2.0	1.11	*p*	<0.05

Table 2 - Mean (±SD) noise level (dB) for original and denoised CEOAE recordings at 1 and 1.4kHz frequency bands in different groups.
Note: Δ denotes the differences between pre- and denoising on mean noise level.

1kHz	**1.4kHz**	Pass (*n* =1031)	Pre-denoising
4.76±4.56	10.25±5.52	Post-denoising	3.07±4.71
9.77±5.65	*Δ*	1.69	0.48
p	<0.05	<0.05	Refer (*n* =82)
Pre-denoising	0.33±4.19	-1.36±4.30	Post-denoising
-1.46±4.38	-2.31±4.34	*Δ*	1.79
0.95	*p*	<0.05	<0.05
Total (*N* =1113)	Pre-denoising	4.43±4.68	9.39±6.22
Post-denoising	2.73±4.84	8.88±6.39	*Δ*
1.7	0.51	*p*	<0.05

Table 3 - Mean (±SD) signal amplitude (dB) for original and denoised CEOAE recordings at 1 and 1.4kHz frequency bands in different groups.
Note: Δ denotes the differences between pre- and denoising on mean signal amplitude.

1kHz	**1.4kHz**	Pass (*n* =1031)	CEOAE
1.07±5.00	9.31±6.87	Denoised CEOAE	1.38±5.35
9.95±7.04	*Δ*	0.31	0.64
p	<0.05	<0.05	Refer (*n* =82)
CEOAE	-2.2±2.76	-1.04±3.40	Denoised CEOAE
-1.97±2.92	-0.80±3.69	*Δ*	0.23
0.24	*p*	<0.05	<0.05
Total (*N* =1113)	CEOAE	0.83±4.95	8.55±7.22
Denoised CEOAE	1.13±5.28	9.15±7.40	*Δ*
0.3	0.6	*p*	<0.05

Table 4 - Mean (±SD) SNRs (dB) for original and denoised CEOAEs at 1 and 1.4kHz frequency bands in different groups.

Note: Δ denotes the mean improvement in SNR.

Freq. bands (kHz)	CEOAE pass	CEOAE refer	Kappa value (κ)	1
Denoised CEOAE pass	315 (28.3%)	41 (3.7%)	0.89	Denoised CEOAE refer
12 (1.1%)	745 (66.9%)	**1.4**	Denoised CEOAE pass	841 (75.6%)
32 (2.9%)	0.91	Denoised CEOAE refer	4 (0.4%)	236 (21.2%)

Table 5 - Relationship (numbers of ears and percentages) of CEOAE screening outcomes between pre- and post-denoising at 1 and 1.4kHz frequency bands for overall data (*N* =1113 ears).

CEOAE pass (*n*=1031)	CEOAE refer (*n*=82)	Denoised CEOAE pass (*n*=1058)
1031 (92.6%)	27 (2.5%)	Denoised CEOAE refer (*n*=55)

Table 6 - Relationship (numbers of ears and percentages) of CEOAE screening outcomes between pre- and post-denoising (*N* =1113 ears).

1

Introduction

The otoacoustic emission (OAE) response is the acoustic energy produced by the mechanical action of the outer hair cells, and is measured from the outer ear canal by a sensitive microphone [1]. As the OAE test is quick, objective and noninvasive, this measurement has been widely used in universal neonatal hearing screening (UNHS). Click evoked otoacoustic emission (CEOAE) measurement, as one type of OAE, is evoked using a broad bandwidth click stimulus which consequently stimulates a wide frequency region of the cochlea in a single measurement. CEOAE testing has been especially applied as a general tool for newborn hearing screening. Despite great achievements having been made in recent years, some practical aspects of OAE assessment still remain to be explored. One important area for further OAE research is to develop more rapid, reliable screening techniques and refine screening algorithms and equipment [2,3].

As the evoked OAE signal has a small amplitude, typically from the -20 to 20dB SPL range, noise often obscures recorded CEOAEs, particularly for lower (from 500 to 1500Hz) frequencies [4-8]. Previous strategies for noise reduction were mainly conducted in either the time or frequency domain only, such as signal averaging [1,9-11], artifact rejection by derived nonlinear mode [12], time window adjustment [13-15], band filtering [16,17], and an adaptive noise canceling (ANC) technique [18]. Although time-domain signal averaging has become the basic method to improve signal-to-noise ratio (SNR) in current CEOAE recording systems, this technique needs increased test time in noisy environments to collect more responses for averaging. This requirement is not consistent with the main imperative of decreasing screening time (and hence data acquisition time) in neonatal hearing screening programmes. Also, Berninger [9] found that increasing the number of averages does not result in a significant improvement in SNRs at low frequency regions. In addition, although a shorter time window and/or high-pass filtering have been commonly applied to reduce low frequency noise in currently available CEOAE equipment, these methods still have limitations in achieving clearer CEOAE detection in low frequency ranges. This is partly due to the fact that these processes are conducted in either the time or

frequency domain, which makes it hard to achieve an optimal analysis compromise when considering the entire noise effects in the joint time-frequency domain. It was reported that the mean prevalence rate of observed CEOAEs at a 1kHz center frequency was below 40%, even in a group of neonates who, overall, passed UNHS [8]. This drawback may constrain the utility of CEOAE measures in the accurate assessment of certain hearing disorders, such as those involving low to mid frequency hearing loss [19-21]. As to its application in UNHS, the low prevalence rate of observable CEOAE responses in the low frequency range may also adversely influence the overall pass rate and/or false positive rate of hearing screening. Therefore, the above concerns lead to the need to consider alternative signal processing methods to overcome the effects of noise on recording CEOAE responses.

As CEOAEs are time-varying signals with frequency dispersion along time, several time-frequency analysis (TFA) techniques, such as short-time Fourier transform (STFT) [22-24], Wigner-Ville distribution (WVD) [25,26], matching pursuit (MP) [27,28] and wavelet transform (WT) [29-34], have been proposed to represent the characteristics of a CEOAE signal in the joint *t* -*f* domain. Among these TFA methods, WT technique was demonstrated to have better *t* -*f* resolution for CEOAE signal analysis than the STFT and other algorithms [31,35-37]. In addition to its power in signal analysis, WT method is also useful for the detection and estimation of noisy signals. The denoising procedure for a discrete wavelet transform (DWT) is mainly described as having three steps [38,39]: first, to decompose the signal with a selected suitable mother wavelet and selected levels of decomposition; then to determine the corresponding coefficients at each level which are considered as noise contributions, and eliminate such coefficients which are below a certain threshold of magnitude; finally, to compute an inverse wavelet transform using the modified coefficients to obtain a new version of the original data. With CEOAE recordings, the WT algorithm can be used to decompose the original signals into a series of scales. At different scales, adjustable time windows were employed to account for the most probable locations for CEOAE components [13,15,34,40].

Motivated by the concept of a DWT denoising process for CEOAEs, a two dimensional (2D) *t* -*f* filtering method based on the *t* -*f* characteristics of normal neonatal CEOAE responses was proposed in this study. Unlike DWT-based denoising that decomposes the signal into different scales, a 2D *t* -*f* filtering technique has been introduced to perform a *t* -*f* mask to separate and then filter the signal and noise directly in the *t* -*f* domain. That is, once the "*t* -*f* signal subspace" is determined, the components that lie outside this region can be viewed as "*t* -*f* noise subspace" and be suppressed. Or, if the *t* -*f* patterns of noise are known, the noise components in specific *t* -*f* areas can be identified directly and set to zero. Therefore, regional noise will be substantially reduced in the *t* -*f* domain, and the denoised signal can be derived by means of an inverse *t* -*f* transform [41,42]. The 2D *t* -*f* filtering approach has been applied to many signal processing areas [43] and was found to be an efficient tool for SNR enhancement [42]. However, no known work has been undertaken that makes use of this technique for CEOAE signals or in relation to CEOAE hearing screening. The aims of this study were to develop a *t* -*f* filtering method for denoising neonatal CEOAE recordings in lower frequency ranges (<1.5kHz), and then to evaluate the denoising performance of this procedure with a large CEOAE screening data set.

2

Materials and methods

2.1 Subjects

A total of 557 neonates (1113 ears, including 557 left ears and 556 right ears) from well-baby nurseries were enrolled at the Henan Provincial People's Hospital, China. The mean age at test was 3.3 days (SD=1.3). 53.9% of ears were male and 46.1% were female. All the neonates were recruited into the research program after parents elected to participate on a voluntary basis. Written informed parental/legal guardian consent was obtained prior to subject enrollment in the research project. None of the newborns had any risk factors for hearing disorder.

A valid, passing CEOAE-only response measurement was one that fulfilled the following CEOAE criteria:

stimulus stability≥75%; whole wave reproducibility≥70%; at least three of five test frequency bands centered at 1, 1.4, 2, 2.8 and 4kHz with SNR≥3dB [44]. Similar criteria have been used by other researchers [45-47]. According to the conventional, clinical CEOAE screening outcomes, 1031 ears from 1113 ears passed the initial CEOAE measurement and 82 ears required referral.

2.2 Apparatus and parameters

All the measures were recorded in a non-sound treated room adjacent to the nursery ward. The average ambient room noise level with OAE equipment in operation was under 45dBA. Neonates were tested while in natural sleep or a quiet state. CEOAE data were collected using the Echoport ILO 292 USB system with V6 software (Otodynamics Ltd., UK) installed in a laptop computer. All the CEOAE stimulus and response levels were recorded by a standard ILO system clinical neonatal probe, which was calibrated before every test session.

CEOAE measurement used the ILO system default nonlinear "QuickScreen" acquisition mode, which has been commonly employed in UNHS programmes. To elicit the CEOAE response, alternating click stimuli driven by a biphasic triangular pulse of 300μs duration were presented at a repetition rate of approximately 78 clicks per second. A recorded stimulus level of 75-80dB equivalent sound pressure level (peSPL) in the ear canal was considered acceptable for CEOAE measures.

The recordings were filtered with the ILO 292 USB system default procedure (a single order HP reverse filter at 300Hz, then a second-order band filter from 400Hz to 6400Hz). CEOAE recordings from the ILO USB system were digitized at a rate of 20,000samples/s, resulting in 256 sampled points, windowed 12.8ms. Around the first 2-3ms of the 12.8ms analysis window was eliminated to reduce the contribution of possible stimulus artifact to the average response waveform. The CEOAE response stopping criteria required a minimum of 70 OAE sweeps to be averaged. If no clear response (low amplitude of the signal and/or high noise level) was noted at 70 presentations, up to 260 responses were obtained. The noise rejection level was generally set lower than 8mPa (52dB SPL). The recorded overall noise level and response level were 10.2±3.3dB SPL and 18.6±9.6dB SPL, respectively.

2.3 Time-frequency analysis and denoising algorithm

The details of the temporal analysis and frequency analysis by the ILO system are presented in the Appendix. The principal steps for low frequency noise reduction were to (1) map the original CEOAE recordings on the t-f domain by CWT, (2) localize the specific area of lower frequency noises on the t-f domain and decay them using a 2D t-f filter, then (3) reconstruct the processed signals using an inverse continuous wavelet transform (ICWT). A flowchart for this process is shown in Fig. 1 and the details of this process are described below.

Step 1: map the original CEOAE recordings

As the presence of CEOAEs in the ILO system is determined by identification of waveforms in two buffers, the averaged recording A and B (containing noise components and CEOAE signal) is mapped separately into the t-f domain by CWT in order to be further compared with the original CEOAE calculated by the ILO system. Comprehensive descriptions of WT for OAE recordings have been given by several researchers [29,31,32]. This study uses CWT to describe CEOAE recording $x(n)$, $x=A$ or B , by , where n and f are the time and frequency index, respectively. $\psi(\cdot)$ is the mother wavelet function with central frequency $f0$. The mother wavelet function $\psi(\cdot)$ used in this study was proposed by Tognola et al. [31,48], and is a modulated cosine function . The TFA of CEOAEs have been shown to achieve the best results when $\beta=4$ and $\alpha=20$ are used [31,48]. The squared magnitude of $P(n, f)$ is called the scalogram. At different frequencies, WT uses the wavelet function with different window sizes, which are obtained by scaling the wavelet function in the frequency domain, to yield an adaptive t-f resolution. The adaptive window size is obtained by shifting the mother wavelet function in the time domain and scaling the mother wavelet function in the frequency domain.

Step 2: reduce the lower frequency noise

It has been demonstrated that for different components of a CEOAE response an intimate relationship between

latency and frequency exists: the higher the frequency the shorter the latency [49,50-53]. The latency is defined as the time when the absolute value of the wavelet coefficient reaches its maximum [54]. The definition for ear-averaged latency is ear-average of the individual latencies (*k* of total *nk* ears) at a particular frequency band *fi* [52]_[Formula omitted. See PDF]

For adults, the frequency components of CEOAEs at 1-1.5kHz show longer latencies, compared to higher frequency ranges [28,31,48,55]. A similar pattern was also found in neonatal ears [50,51,53]. With regard to CEOAE latency between normal and hearing impaired ears, a significant difference has been observed in both adult [56,57] and neonatal ears [50,52,53].

The estimated noise component *xN* (according to the temporal definition of the ILO system) can also be transformed into the *t* -*f* domain by CWT. Fig. 2 demonstrates that noise is always located at lower frequency ranges, and features with frequency dispersion along the time axis are not evident.

According to the above *t* -*f* features of CEOAE signals and the noise distribution on the *t* -*f* domain, a 2D filtering in the *t* -*f* domain was then considered to achieve noise reduction in the lower frequency ranges. Fig. 3a refers to previous work based on data from 200 normal neonates with CEOAE responses at all five centered frequency bands having SNR≥3dB [33]. The relationship between latency and frequency for normal full term neonatal CEOAEs was fitted by an exponential mode of curve estimation: , where *f* in kHz and *b* 0=9.71, *b* 1=-0.14. The statistical parameters for this curve estimation are R^2=0.91, df=7, *F* =70.82 and Sig=0.00. According to this equation, the latencies corresponding to center frequencies at 1, 1.4, 2, 2.8 and 4kHz were calculated at around 8.42, 7.96, 7.31, 6.52 and 5.5ms, respectively. Based on the *t* -*f* distribution $P(n, f)$ of $x(n)$, we aim to preserve the desired signal components and remove unwanted noise contribution by applying a mask function P [variant prime]$(n, f)=P(n, f)W(n, f)$, where $W(n, f)$ is a 2D mask function having an approximate rectangular shape in the *t* -*f* domain, as shown in Fig. 3b. In the present study, the mask function $W(n, f)$ is defined as[Formula omitted. See PDF]where *ncutoff* and *fcutoff* are, respectively, cutoff time and frequency, while Δn and Δf are used to generate a smoothed buffer area in the mask function to avoid a hard window edge and spurious high-frequency components during the signal reconstruction. Here, the parameters of Δn and Δf, are set as 1 and 200, respectively.

As seen from Eq. (2), the principal step of the proposed 2D *t* -*f* filtering method is to find a specific *t* -*f* area where the noise components dominate the energy power compared to the signal components, and then to use a 2D mask to cutoff these noise components in the *t* -*f* area.

Considering that the significant frequency components of noise are generally below 1.5kHz [4-8], the frequency cutoff threshold *fcutoff* of the 2D *t* -*f* filtering was set as 1.5kHz. On the other hand, the cutoff time of the *t* -*f* area can be determined as the time instant before which the difference in proportion of noise energy and signal energy is maximum. Since the aim was to find a *t* -*f* area which contains as much noise energy as possible and as little signal energy as possible, there was a need to further study the energy distributions of the signal and noise in the lower frequency area. If the signal distribution is relatively concentrated compared to low frequency noise, we could choose a cutoff value as close as the start time point of a signal in order to keep more expected signal and cut more expected noise. To choose an optimal cut-off value in the time domain, the normalized ear-averaged energy distributions along with time (before the energy peak locations) for signal and noise components in the frequency band below 1.5kHz were estimated. This normalized energy distribution along the time axis was calculated as the time instants where the ear-averaged energy in the *t* -*f* domain reaches a series of proportions of the peak energy value. Based on 200 normal CEOAE recordings with SNR passing at all five test frequency bands centered at 1, 1.4, 2, 2.8 and 4kHz [33], Fig. 4 illustrates the normalized ear-averaged energy distributions of signal and noise, and it provides a rough description of their energy distributions in the low frequency range (<1.5kHz) along the time axis. As seen from Fig. 4, for example, the ear-averaged energy peak (100% of the peak energy value) of signal components is located around 8.42ms, and the 10% of the peak energy of the signal is around 4.02ms. It was also found that the start time of 1% of peak energy for noise was

around 0.5ms. This may indicate that low frequency noise should exist over the whole time-axis area. The relationship between the normalized energy and time can be fitted by cubic curve estimation and the functions for signal and noise are also illustrated in Fig. 4. As the basic principle for denoising is to cut-off a greater proportion of noise and retain useful information as much as possible, the maximum difference between the energy proportion of noise and signal which was calculated to be around 5.0ms was selected as cutoff time (*n cutoff*) in the 2D mask function. In addition, the literature on *t* -*f* characteristics of neonatal CEOAE recordings has also noted that the latencies of lower frequency components (below 1.5kHz) of CEOAE were generally longer than 7ms [49,50-53]. In other words, the 1-1.5kHz frequency components of normal neonatal CEOAE signals may only rarely have shorter latencies than 5ms. Therefore, 5ms might be a reliable value to cutoff a greater proportion of "true" noise in the lower frequency range, and also avoid substantial signal energy loss.

Step 3: reconstruct the CEOAE signals

The above processed CEOAE signals in *A* and *B* buffer are finally reconstructed into the time domain by ICWT from the denoised *t* -*f* distribution *P* [variant prime](*n* , *f*)[Formula omitted. See PDF]

Then, the corresponding parameters in either time or frequency domain can be further recalculated and compared to the original recordings created by the ILO system.

2.4 Evaluation and statistical analysis

In this study, all raw CEOAE data obtained by ILO V6 software were offline transferred into MATLAB programs (Mathworks MATLAB software version 7.0), which were developed in-house for further signal processing. The performances of the proposed 2D denoising method were mainly evaluated by means of the following quantitative parameters in classifying the pass and refer groups: the whole wave reproducibility in the time domain, and the SNRs of CEAOEs in the frequency domain. These parameters have been widely used clinically as the key indices for pass/fail criteria in UNHS programmes. To provide an easy and direct comparison for clinicians, the present study finally transferred the processed data from the *t* -*f* domain into waveform and conventional power spectrum displays to illustrate the results. Calculation of signal, noise and SNR values was performed identically for pre- and post-denoising waveforms. Evaluations in the frequency domain were carried out using a half-octave band power spectrum display with frequencies centered at 1, 1.4, 2, 2.8 and 4kHz.

At different frequency bands, the differences between pre- and post-denoising for the recorded noise level, signal amplitude and SNRs were compared using a paired-samples *t* -test. As whole waveform reproducibility data were not normal distributed, the statistical evaluation used nonparametric Wilcoxon tests. The χ^2 -test was applied to compare the changes in the overall pass rate for CEOAE screening. Statistical analyses were performed using SPSS for Windows version 12.0 software and statistical significance was set at $p < 0.05$.

3 Results

3.1 Analyses for whole wave reproducibility

Whole wave reproducibility was computed by correlation between waveforms derived from the two memory buffers. The Wilcoxon test analyses indicated that whole wave reproducibility was significantly improved after *t* -*f* denoising in each group (overall data: $z = -27.7$, $p < 0.05$; pass group: $z = -27.8$, $p < 0.05$; refer group: $z = -5.3$, $p < 0.05$) (Table 1). The mean improvement in reproducibility was 3.8 percentage points in each group.

3.2 Comparison of noise, signal and SNRs pre- and post-denoising at lower frequency bands

The pre- and post-denoising results for noise level at lower frequency bands are illustrated in Table 2. The statistical analysis with paired *t* -tests indicated that noise level at 1 and 1.4kHz frequency bands were significantly reduced after denoising in each group [overall data: at 1kHz: $t(1112)=68.6$, $p < 0.05$; at 1.4kHz: $t(1112)=49.3$, $p < 0.05$. Pass group: at 1kHz: $t(1030)=65.8$, $p < 0.05$; at 1.4kHz: $t(1030)=47.0$, $p < 0.05$. Refer group: at 1kHz: $t(81)=19.4$, $p < 0.05$; at 1.4kHz: $t(81)=15.5$, $p < 0.05$].

The pre- and post-denoising results for signal amplitude at lower frequency bands are shown in Table 3. The statistical analysis with paired *t* -tests indicated that the signal at 1 and 1.4kHz frequency bands was also

significantly reduced after denoising in each group [overall data: at 1kHz: t (1112)=60.6, p <0.05; at 1.4kHz: t (1112)=36.7, p <0.05. Pass group: at 1kHz: t (1030)=58.2, p <0.05; at 1.4kHz: t (1030)=36.2, p <0.05. Refer group: at 1kHz: t (81)=17.2, p <0.05; at 1.4kHz: t (81)=12.3, p <0.05].

To investigate whether the denoised CEOAE signals were clearly associated with the originals at lower frequency bands, a scatterplot was drawn (Fig. 5). At both 1 and 1.4kHz, the points fit the linear regression line well. The statistical analysis showed that the signals pre- and post-denoising were significantly correlated [overall data: at 1kHz: r =0.981, p <0.05; at 1.4kHz: r =0.998, p <0.05. Pass group: at 1kHz: r =0.961, p <0.05; at 1.4kHz: r =0.994, p <0.05. Refer group: at 1kHz: r =0.95, p <0.05; at 1.4kHz: r =0.974, p <0.05].

Using the 2D t -f filtering method, the overall mean SNRs at 1 and 1.4kHz center frequency bands were improved by 0.3 and 0.6dB, respectively. Despite the values of SNR changes being low compared to the changes in signal amplitude and noise level, the proposed denoising protocol achieved the goals of significantly improving SNRs [at 1kHz: t (1112)=-8.06, p <0.05; at 1.4kHz: t (1112)=-23.13, p <0.05]. The improvements of SNRs were also significant in both pass and refer groups in the above two frequency bands [in pass group, at 1kHz: t (1030)=-8.01, p <0.05; at 1.4kHz: t (1030)=-23.3, p <0.05; in refer group, at 1kHz: t (81)=-1.24, p <0.05; at 1.4kHz: t (81)=-2.77, p <0.05] (Table 4). Fig. 6. illustrates in detail the denoising performance of one original referred CEOAE recording. The results clearly show that the whole wave reproducibility was improved from an initial 65.6% to 76.1% (over the pass threshold) when denoising was performed. Also, all five frequency bands passed the SNR criterion with SNR≥3dB after denoising and the case would be reclassified into the pass group.

3.3 Analyses for screening outcomes

The relationships of individual CEOAE screening outcomes pre- and post-denoising are shown in Table 5. For the overall data, there was 95.2% (28.3%+66.9%) and 96.8% (75.6%+21.2%) agreement between the pre- and post-denoising results at 1 and 1.4kHz, respectively. In addition, 41 ears (3.69%) at 1kHz and 32 ears (2.89%) at 1.4kHz had a CEOAE fail result but the post-denoising program gave a pass result. Table 5 also shows that, 12 ears at 1kHz and 4 ears at 1.4kHz had a pre-denoising CEOAE pass but the denoising processing gave failed results.

As to the overall pass rate for CEOAE screening before denoising, 1031 ears (92.6%) from 1113 neonatal ears fulfilled the pass criteria and 82 ears (7.4%) required referral. Among these ears, 64 ears failed both whole wave reproducibility and SNR criteria, and 18 ears failed either reproducibility or SNR parameters. Using the t -f denoising, 27 additional ears from 82 CEOAE failed data would pass screening after denoising. Therefore, a total of 55 ears would fail the denoised CEOAE screening finally (Table 6). The referral rate for screening after using t -f denoising is 4.9% and was therefore significantly reduced--by 2.5 percentage points--compared to the rate for conventional CEOAE screening [χ^2 (1, N =2226)=5.67, p <0.05]. Clinical CEOAE rescreening (before discharge or within one month post-discharge) confirmed that 18 out of 27 ears that failed conventional screening and passed after denoising also passed at the second conventional screening occasion. The remaining 9 ears in this category could not be followed up. Detailed information on follow-up testing of the subject group and the improvement in screening outcome for the relevant ears is summarized in Fig. 7.

4 Discussion

This study proposed a 2D t -f filter to improve the precision of CEOAE detection in lower frequency ranges, and concurrently reduce the referral rate in initial CEOAE neonatal hearing screening. To our knowledge no study has reported the effect of such denoising techniques on large-scale neonatal CEOAE screening data sets.

In general, filtering is a commonly used method in the frequency domain to either reject or pass signals whose frequencies fall in a specified band or whose frequencies are above or below specified limits [58]. If the signal and/or noise components have specific patterns in the t -f distribution, a denoising technique based on TFA methods would be very useful. As random noise tends to spread evenly into the entire t -f domain, while the

signal energy usually concentrates in a relatively small region [42], the signal and noise may be separated and to be further filtered directly in the *t*-*f* domain. The key concepts of this method can be described as: (1) decompose the noisy signal into the *t*-*f* domain via one of the TFA methods; (2) define the *t*-*f* signal subspaces and unwanted noise region and (3) apply a mask function to filter out noise.

Using *t*-*f* filtering, the regional SNR may be substantially improved in the *t*-*f* domain, and the denoised signal can be transformed from the *t*-*f* domain back to either time or frequency domains.

As for the CEOAE signal, it is often intimately related to the click stimuli and the different frequency components appear with relatively fixed latency. The competing noise is generally unrelated to the stimulus. Thus, an application that utilizes this difference to separate the signal and noise in *t*-*f* domain, in order to improve the SNRs in particular lower frequency bands, may be of value.

The denoising procedure involved an important step that was to select a "suitable" cutoff threshold to balance the trade-off in the results. If the chosen values for these threshold parameters are too small, then the noise will still be the dominating factor in the lower frequency regions. If the selected parameter values are too large, then the signal contents will be overly reduced. In this study the designed *t*-*f* filtering system had cutoff thresholds for time and frequency of 5ms and 1.5kHz, respectively. The frequency components of noise superimposed on the CEOAE recording located at 0-1.5kHz with 0-5ms latencies was assumed to be the "true" noise and then reduced by the 2D *t*-*f* filtering acting across both time and frequency. Although the *t*-*f* characteristics of real CEOAE data may differ from case to case, a mask (window) function determined based on the averaged data should also be effective, as has been shown by the experimental results.

A total of 1113 neonatal CEOAE data were used to evaluate denoising performance. The results demonstrated that the proposed *t*-*f* denoising approach significantly improved the detectability of CEOAE recordings. In the refer group, overall whole wave reproducibility was increased by 4.8 percentage points, but the mean value was still very low and did not meet the pass criterion of 70% reproducibility. This result implies that the 2D *t*-*f* filtering technique improves the whole reproducibility of the recordings without altering the basic features of the responses. Similar to the results for whole wave reproducibility, the changes for SNR in the refer group did show an improvement difference at 1 and 1.4kHz frequency bands, but the mean value of SNR was still low. The denoising process did not bring abnormal benefits to mean SNR value at these two frequency bands for the referral cases.

The individual screening outcomes showed that no screening results changed from pass group to refer group after denoising, which implies that the initial referral rate for CEOAE screening was not increased using the *t*-*f* filtering approach. At lower frequency bands, however, a total of 16 ears from 1113 data (1.4%) were found that initially passed the SNR criterion but decreased to be lower than 3 dB after denoising. This may because the denoising procedure extracted the noise together with additional CEOAE signal in the same *t*-*f* region. Another reason may originate from the signal definition in the ILO system, as it is possible that the ILO system treats some "true" noise as CEOAE signal when the noise components at a specific frequency area are similar for both *A* and *B* buffer waveforms. All these 16 ears were from the clinical pass group and would not have transferred to the refer group after denoising, as they still met the pass criteria of SNR≥3dB in at least three of five frequency bands as well as having whole wave reproducibility≥70%. Although SNRs for these 16 passed ears were reduced, 6.6% (3.7+2.9%) of all ears would have passed at 1 and/or 1.4kHz with better SNR results after denoising. Hence, CEOAE detectability was improved at the above two frequency bands using the *t*-*f* filtering method.

As to the overall pass rate for CEOAE screening, the proposed method was shown to be a promising approach to increase the pass rate and reduce false positive cases in neonatal CEOAE screening, although the sensitivity and specificity of this denoising approach could not be evaluated due to constraints in our ability to monitor later diagnostic test results. From Fig. 7, it also can be found that the ears that failed CEOAE screening by either whole wave reproducibility or SNR clinical criteria often had a clear denoised response and were reassigned to

the pass category after denoising. For the 64 ears that failed both reproducibility and SNR parameters, the *t* -*f* filtering approach only passed 9 ears. This indicates that the proposed *t* -*f* denoising method would generally not pass cases that had very poor CEOAE recordings. The proposed method therefore has important clinical implications. For example, the National Bureau of Statistics of China in 2007 estimates 15.89 million neonates are born in the 31 cities/provinces of China each year. [1] If the referral rate (by ear) is calculated as 7.4%, about 2.35 million ears may fail first time CEOAE screening. Based on the above results, which indicate that 32.9% of the conventional referral cases would pass after denoising, the proposed approach would result in nearly 773,150 additional ears passing initial screening. This would greatly reduce the heavy follow-up burden on the health care system of rescreening and/or diagnostic assessment and also decrease anxiety in many families.

5

Summary

A 2D *t* -*f* denoising technique that incorporates a CWT method was presented and then evaluated in this study. using this approach, the detectability of neonatal CEOAEs in terms of SNRs in lower frequency ranges and whole wave reproducibility was improved, and low-frequency noise was reduced. Evaluations of screening outcomes demonstrated this method significantly reduced the overall referral rate by 2.5 percentage points in first time CEOAE hearing screening. Clinical application of the technique may reduce the heavy follow-up burden associated with neonatal hearing health care. In addition, the denoising processing was fast and easy to implement, and the whole procedure could be incorporated in CEOAE recording devices, or could be conducted offline. Thus, the proposed 2D denoising protocol has potential application in OAE technology as a means of enhancing the quality of recorded CEOAE responses, and reducing referral cases and hence false positive rates, in neonatal hearing screening programmes.

Conflict of interest statement

None declared.

Acknowledgments

The authors wish to thank Mr. Oliver Brill and the scientists of Otodynamics Ltd. (UK) for their generous assistance in providing detailed OAE parameters and algorithms for the ILO system. We are grateful to Chris X.G. Wang, Dr. S.C. Chan and the anonymous reviewers for their invaluable comments on an earlier version of the manuscript. The work was partially supported by a Grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (HKU7434/04M).

Appendix

Temporal analysis by ILO system

The CEOAE response can be displayed as the time-averaged waveform after the onset of the transient stimulus. In the default ILO nonlinear mode, the CEOAEs are acquired from trains of four click stimuli. Three of these four stimuli are presented in one phase with the same amplitude and the fourth is presented in opposite phase at a level that is three times greater than each of the three previous stimuli. For each sweep, the ILO system distributes and stores the averaged response for one stimulus train into memory buffer *A* and the response for the other group of stimuli is stored in buffer *B* , and each buffer consists of 256 points. The final averaged waveform stored in *A* and *B* buffer is the averaged results of the total number of presentations.

The usual clinical parameters of whole CEOAE response level and noise level (mPa) in the time domain were estimated and calculated using the root mean square (RMS) values provided by the ILO instrumentation from the averaged data in the two buffers. The CEOAE response level (mPa) is defined as the RMS of the average of the corresponding *A* and *B* responses. The estimate of noise level (mPa) *xN* is defined as the RMS of the difference between the *A* and *B* responses . Whole wave reproducibility is an important parameter which is often used clinically as a quality index of the recorded OAE. In the ILO system, whole wave reproducibility is calculated as the cross-correlation coefficient between the averaged *A* (*n*) and *B* (*n*) waveforms (Eq.), where *n* =1,2, ..., *T* (256) indicates different samples. Whole wave reproducibility represents the similarity between the

two memory buffer data sets during data collection. If the waveforms from the two buffers are quite similar, these particular waveforms are regarded as a true response, while the difference between the two waveforms is assumed to be noise. Generally, a CEOAE response is considered to be present when the whole wave reproducibility exceeds a threshold of 70%

Frequency analysis by ILO system

The OAE frequency spectrum display was created using a fast Fourier transform (FFT). In the ILO system, the cross power spectrum of the *A* and *B* waveforms is considered as an estimate of CEOAE amplitude (Eq.), and the auto power spectrum of the (*A* -*B*)/2 waveform represents an estimate of the noise level (Eq.). The data can be analyzed using both a broadband display and a non-overlapping half-octave band mode which has been widely accepted for clinical work. In ILO V6 software, the center frequencies are set at 1, 1.4, 2, 2.8 and 4kHz in half-octave band mode. The half-octave band calculation sums frequency regions 1/4 octave above and below the center frequencies.

The SNR in each of the bands is defined as the difference between the signal and noise values (dB) at a specific frequency band

Pref in Eqs. (5) and (6) is the standard pressure level=2×10^{-5} Pa.

Footnote

1 http://www.stats.gov.cn/tjsj/ndsj/2007/indexce.htm.

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Publication date: Aug 2011

Year: 2011

Vowel Identification by Listeners With Hearing Impairment in Response to Variation in Formant Frequencies

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.4 (Aug 1, 2011): 1211-1223A.
ProQuest document link

Abstract: This study examined the influence of presentation level and mild-to-moderate hearing loss on the identification of a set of vowel tokens systematically varying in the frequency locations of their second and third formants. Five listeners with normal hearing (NH listeners) and five listeners with hearing impairment (HI listeners) identified synthesized vowels that represented both highly identifiable and ambiguous examples of /I/,

/.../, and /.../. Response patterns of NH listeners showed significant changes, with an increase in presentation level from 75 dB SPL to 95 dB SPL, including increased category overlap. HI listeners, listening only at the higher level, showed greater category overlap than normal and overall identification patterns that differed significantly from those of NH listeners. Excitation patterns based on estimates of auditory filters suggested smoothing of the internal representations, resulting in impaired formant resolution. Both increased presentation level for NH listeners and the presence of hearing loss produced a significant change in vowel identification for this stimulus set. Major differences were observed between NH listeners and HI listeners in vowel category overlap and in the sharpness of boundaries between vowel tokens. It is likely that these findings reflect imprecise internal spectral representations due to reduced frequency selectivity.

Full text: Headnote

Purpose: This study examined the influence of presentation level and mild-to-moderate hearing loss on the identification of a set of vowel tokens systematically varying in the frequency locations of their second and third formants.

Method: Five listeners with normal hearing (NH listeners) and five listeners with hearing impairment (HI listeners) identified synthesized vowels that represented both highly identifiable and ambiguous examples of /I/, /?/, and /?/.

Results: Response patterns of NH listeners showed significant changes, with an increase in presentation level from 75 dB SPL to 95 dB SPL, including increased category overlap. HI listeners, listening only at the higher level, showed greater category overlap than normal and overall identification patterns that differed significantly from those of NH listeners. Excitation patterns based on estimates of auditory filters suggested smoothing of the internal representations, resulting in impaired formant resolution.

Conclusions: Both increased presentation level for NH listeners and the presence of hearing loss produced a significant change in vowel identification for this stimulus set. Major differences were observed between NH listeners and HI listeners in vowel category overlap and in the sharpness of boundaries between vowel tokens. It is likely that these findings reflect imprecise internal spectral representations due to reduced frequency selectivity.

Key Words: sensorineural hearing loss, speech perception, speech sound

(ProQuest: ... denotes non-US-ASCII text omitted.)

Vowel perception by listeners with hearing loss is reported to be robust and only affected by themost severe losses (Nábe?lek, Czyzewaski,&Krishnan, 1992; Owens, Talbott, &Schubert, 1968; Pickett et al., 1970; Van Tasell, Fabry, &Thibodeau, 1987). The shape of the frequency spectrum is one of the prime determinants of vowel identity (Peterson &Barney, 1952), especially the location of peaks in the spectrum corresponding to vocal tract resonances, or formants (Molis, 2005). When vowel errors are noted, they are usually systematic confusions of adjacent categories that have similar formant frequencies (Hack &Erber, 1982; Owens et al., 1968; Richie, Kewley-Port, &Coughlin, 2003; Van Tasell et al., 1987). A potential source of these confusions is the loss of spectral contrast in the internal cochlear representation of the vowel spectra (Leek, Dorman, &Summerfield, 1987).

Changes in the function of the auditory periphery caused by hearing impairment include reduction of sensitivity and frequency selectivity, resulting in smaller amplitude differences between the peaks and valleys in the internal representation of the vowel spectra (Leek et al., 1987; Moore, 1995). Across-frequency masking patterns using vowels as maskers show less resolution of the frequencies associated with formant peaks in the maskers for listeners with hearing impairment (HI listeners) than for listeners with normal hearing (NH listeners; Bacon &Brandt, 1982; Sidwell &Summerfield, 1985; Van Tasell et al., 1987). Turner and Henn (1989) assessed frequency resolution and vowel recognition and determined that the poorer performance of HI listeners on

identification of vowels was related to their poorer frequency selectivity. In another study of spectral peak resolution by HI listeners, Henry, Turner, and Behrens (2005) reported a significant, albeit weak, relationship between discrimination of rippled noises-characterized by peaks and valleys in their spectra-and vowel and consonant identification. Performance was not significantly related to absolute thresholds. These authors also remarked that whereas speech understanding in quiet is not highly dependent on good frequency resolution, speech perception in background noise may be.

Impairments in frequency resolution produce a reduction in spectral contrasts that define the formant frequencies of vowels in the cochlear representation, resulting in a flatter-than-normal excitation pattern and reducing or eliminating the representation of spectral peaks required for vowel identification (Alcántara&Moore, 1995; Leek et al., 1987; Leek &Summers, 1996). NH listeners typically require less contrast between spectral peaks and valleys for accurate identification or discrimination of synthetic, vowel-like stimuli than do HI listeners (Dreisbach, Leek,& Lentz, 2005; Leek et al., 1987; Leek &Summers, 1993, 1996), although the amount of this difference varies depending on a number of other stimulus and listener factors. The difference in performance between the two groups of listeners reflects the smearing and flattening of the internal spectrum. Leek et al. (1987) noted, however, that most naturally produced vowels in real-life environments havemore spectral contrast than has been tested in these studies.

The goal of this study was to measure the effect of hearing loss on identification of vowels that may or may not be good category tokens. If vowel identification performance is assessed only with single, unambiguous vowel category tokens, much of the difference in vowel recognition between the two listener groups will be masked, and any difficulty that HI listeners have with vowel perception will be underestimated. Here, vowel identification by NH listeners and HI listeners was measured for a densely sampled stimulus space encompassing three vowel categories. The stimuli varied systematically in their second and third formants and represented either unambiguous examples of the response categories (defined as those consistently labeled by NH listeners) or ambiguous vowels that could reasonably be identified as belonging to multiple response categories by NH listeners. The relatively dense and quasiuniform sampling of the stimulus space allowed for comparison of the identification response patterns (a) of NH listeners at different presentation levels and (b) between NH listeners and HI listeners across a range of stimuli. In addition, in order to gauge the influence of impaired frequency resolution on vowel identification, excitation patternswere constructed based on estimates of auditory filter bandwidths of theHI listeners as a model of the internal spectral representation of the stimuli.

Method

Listeners

Five NH listeners (one man and four women) and five HI listeners (two men and three women) served as paid participants. No attempt was made to control for dialect differences. NH listeners ranged between the ages of 27 and 58 years (M= 46 years). HI listeners ranged between the ages of 61 and 80 years (M= 72 years) and had mild-to-moderate sensorineural hearing loss in the test ear (i.e., air-conduction thresholds between 30 dB HL and 65 dB HL at audiometric frequencies from 0.25 kHz to 4 kHz, air-bone gaps of ? 10 dB from 0.5 kHz to 4 kHz, and a normal tympanogram). Figure 1 shows individual air-conduction thresholds for the HI listeners and average thresholds of the NH group, along with standard errors of the mean. All listeners provided written informed consent.

Vowel Identification Task

Stimuli. The stimuli for this study were used previously to explore vowel categorization by NH listeners and are described in greater detail elsewhere (Maddox, Molis, &Diehl, 2002; Molis, 2005). Briefly, the stimuli were 54 vowels with five steady-state formants, synthesized using a cascade resonance synthesizer implemented on aPC(Klatt&Klatt, 1990).The second and third formant frequencies (F2 and F3) varied in equal 0.4-Bark steps: 9.0-13.4 Bark (1081-2120 Hz) for F2 and 10.0-15.2 Bark (1268-2783 Hz) for F3. Exemplars of the American English vowel categories /I /, /?/, and /?/ can be found in this stimulus region. All stimuli had the same first,

fourth, and fifth formant frequencies, had the same fundamental frequency contour and duration (225 ms), and were normalized for equal root-mean-square (RMS) amplitude.

Procedure. Listeners were tested individually in a sound-attenuated room. Stimuli were presented monaurally over Beyer DT-100 headphones in blocked conditions of 75 dB SPL and 95 dB SPL for NH listeners and 95 dB SPL for HI listeners. Three of the NH listeners heard the 95-dB stimuli first, and two heard the 75-dB stimuli first. For each condition, two blocks of seven replications each (14 total)were presented (756 trials/listener) with a short break between blocks. On each trial, listeners were asked to identify a stimulus by pressing one of three response buttons on a button box labeled with the key words hid, hood, and heard.They were assured that there were no "right" or "wrong" answers and were encouraged to label ambiguous stimuli as the category that they felt was the most appropriate.

To verify that items in the stimulus set were reasonably discriminable, three of the HI listeners and all five NH listeners completed a preliminary discrimination task. Three stimuli from the extreme corners of the stimulus space, representing one instance of each of the three possible response categories, were selected and presented to listeners in 30 randomized pairings (including identical pairs) at a level of 95 dB SPL. Listeners were asked to indicate with a button press whether the stimuli in each pair were the same or different. All listeners were able to discriminate between the stimuliwith at least 80% accuracy.

Statistical analyses. The number of times a listener chose each response category out of 14 trials was used as an estimate of the probability of the listener's vowel identification at each F2 and F3 combination. The statistical objective was to model these probabilities in the F2/F3 plane. The approach taken was to treat this as a response surface regression problem (Neter, Kutner, Nachtsheim, &Wasserman, 1996). Thus, tests could be conducted of the effect of either presentation level (level-effect model) or listener group (group-effect model) on the shapes of the mean choice probability surfaces for each response category at each F2/F3 combination. Furthermore, tests of differences at particular F2/F3 values could be conducted based on linear contrasts of the fittedmodel (leveleffect or group-effect).

For each general model (level-effect or group-effect), the selection probabilities for each of the vowel categories (/I /, /Ω/, or /3/) were modeled using multivariate response regression (Hastie, Tibshirani, &Friedman, 2009). This is analogous tomultivariate analysis of variance (MANOVA), with the exception that the F2 and F3 valueswere treated as continuous covariates instead of categorical predictors. An arcsine transform [Y' = arcsine(proportion)1/2] was used in order to stabilize the variance of the proportional data (Neter et al., 1996). To allow for variability among listeners' response profiles, the models also included random effects. Specifically, we modeled the mean arcsine square-root proportion of each listener's responses that identified each stimulus as one of three vowel category options (/I /, /Ω/, or /3/) using a general linear mixed model. The level-effect and group-effect models were each composed of three surfaces, one per response category. Each surface was composed of the fixed effects in the second-order response surface with F2, F3, F2 ×F3, F22, and F32 values. Presentation-level or listener-group effects and their interactionswith response surface terms were included in the level-effect and group-effect models, respectively. Randomcoefficients for the response surface components were included to allow for individual variability around the overall response surface. Correlation among the three response category surfaces was modeled using an unstructured covariance model for the residuals, which is identical to the MANOVA approach. The level-effect model fit to the NH subjects' data included 36 fixed-effects parameters and nine covariance parameters (total = 45 parameters) to model the 1,080 recorded responses. The group-effect model fit to the full sample included 36 fixed-effects parameters and 16 covariance parameters (total = 52 parameters) to model the 1,620 recorded responses in both the NH listeners and HI listeners.

Using the level-effect or group-effect model, respectively, tests of presentation-level effects within the NH group and tests of differences between listener groupswere made using the likelihood ratio statistic (L). For example, an omnibus test (Neter et al., 1996) of any presentationlevel effects on the overall response surface among NH

listeners is equal to 2(log-LFull - log-LNo Level Effects), where log-LFull and log-LNo Level Effect are the log-likelihoods of the fitted multivariate response regression models with and without the level effects, respectively. Under the null hypothesis of no level effect, this statistic has a c2 distribution with degrees of freedom equal to the difference in the number of parameters between the full model and the model without any level effects. This statistic formally tests whether the model has a significantly poorer fit to the data if one ignores all effects of level amongNH listeners. A similar omnibus test for listener group differenceswas constructed by replacing the level effect with the group effect in the likelihood ratio statistic.

Measurement of Auditory Filters and Excitation Pattern Construction

Auditory filters were measured for the HI listeners at center frequencies of 1000 Hz and 2000 Hz using a notched-noisemasking method (Glasberg&Moore, 2000; Rosen &Baker, 1994). Filters at 500 Hz were also measured for two listeners (HI1 and HI4).Masked thresholds were submitted to a rounded exponential (ROEX) modeling procedure to extract equivalent rectangular bandwidths (ERB) of the measured auditory filters (Patterson, Nimmo-Smith, Weber, &Milroy, 1982).

Stimuli. Tones of 500 Hz, 1000Hz, and 2000 Hz were used as signals. Steady-state durations of the tones were 300 ms, including 50-ms cosine-squared rise-and-fall ramps. The notched-noise maskers were created by adding together two bands of noise located on either side of the signal frequency. The width of each noise band was 0.4 times the signal frequency, and the bands were generated digitally for each noise presentation. Maskers were 400 ms in duration. When the signal was present along with the masker, it was temporally centered within the masker duration.

Thresholds at each signal frequency were measured in eight notched-noise conditions, with the maskers either centered symmetrically around the signal frequency (six maskers) or asymmetrically with one band closer to the signal frequency than the other (two maskers). Each notched-noisemasker was constructed by adding together two noise bands, one on either side of the signal frequency, with a given frequency difference between the signal frequency and the near edge of each noise band. These values are expressed as normalized frequency (|Df /fs|), which is defined as the absolute value of the ratio of the deviation of the near edges of the maskers from the signal frequency (Df) and the signal frequency (fs). Values of |Df /fs|were 0, .05, .10, .20, .30, and .40 on each side of the signal frequency for symmetric notches. The two asymmetric notched noises were placed at |Df/fs| = .2 and .4.

Instrumentation. Pure-tone signals were generated by a Tucker-Davis Technologies (TDT) waveform generator (WG1) and were gated on and off through a TDT SW2 cosine switch. Noises were constructed digitally and played through a TDT DD1 D-A converter, with a sample rate of 40,000 samples/s. Signals and noises were separately attenuated and played to listeners monaurally over a Beyer DT-100 earphone.

Procedure. Masked thresholds were measured for each listener with eight notched-noise maskers at two or three signal frequencies. All thresholds at one signal frequency were measured before beginning testing on the next frequency, determined randomly for each listener. The signal level for each set of notched noise maskers was either 70 or 80 dB SPL, determined individually for each listener, depending on the quiet threshold level for the signal frequency. For all cases except one, if the quiet threshold was greater than 30 dB HL, the higher signal levelwas used. In one case, at a signal frequency of 500 Hz, an 80-dB signal was used even though the quiet threshold was only 25 dB HL. The masker level varied over trials according to an adaptive track.

The listener was seated in a sound-treated booth, wearing earphones and facing a touchscreen response terminal. The threshold measurement procedure was a single-intervalmaximumlikelihood procedure, originally described by Green (1993), modified as described in Leek, Dubno, He, and Ahlstrom (2000). Briefly, each trial consisted of the presentation of the notched noise and, with an 80% probability, the signal tone. On each trial, the listener was asked to indicate whether or not a tone was heard within the masking noise by touching a marked area on the terminal. After each trial presentation, a set of candidate psychometric functions was calculated based on the response to that trial and all previous trials in the block. The noise level on the next trial

was taken fromthe 70% correct performance point on the candidate function that most closely reflected the data collected so far within the block. As the block continued, and more data became available, the choice of the successful candidate psychometric function converged on the one most likely to account for the data. At the end of the block of trials, the level of noise necessary to produce 70% correct detections of the signal at the specified level was calculated from the final estimated psychometric function, and this value was taken as the threshold estimate for that block of trials. The average of three such measurements was taken as the final threshold value for that experimental condition. If the SD across the three estimates was larger than 5 dB, that set of thresholds was abandoned, and a second set of three thresholds was measured. Typically, a set of three threshold estimates could be measured using this procedure in under 5 min.

Filter characteristics were estimated using a oneparameter ROEX(p) fitting procedure described by Patterson et al. (1982). The slope parameter, p, was allowed to differ on each side of the filter to permit asymmetric filters to be specified.The iterative procedure finds the best-fitting set of parameters to define the ROEX function given all eight threshold measurements for each center frequency. The frequency response of the earphone was taken into consideration in the fitting procedure. Comparison of the predicted thresholds based on the fitted filter parameters to the actual data indicated that the filters were well fit, with an average RMS difference between the thresholds predicted by the fitted filter and the observed thresholds of about 1 dB. The ERB for each filter was calculated from the slopes of the filters determined by the fitting process.

Results

Vowel Identification

Presentation level. The vowel identification response patterns were similar among theNHlisteners; therefore, their pooled identifications at each presentation level are shown in Figure 2. The response counts for each vowel category are displayed in separate panels and are arrayed according to F2 and F3 frequencies expressed in Bark. In each panel, observed response frequencies are displayed in terms of bubble size-that is, larger bubbles indicate higher response counts,whereassmaller bubbles indicate less frequent responses. The light gray lines indicate the locations of linear boundaries between categories arising from the identifications by a previous NH listener group listening at 70 dB SPL (Maddox et al., 2002) and are included to provide landmarks for comparison.

At the lower presentation level (left column), response distributions were similar to those for a different group of NHlisteners (Maddox et al., 2002; Molis, 2005)- the three vowel categories were concentrated in three distinct regions of the stimulus space. At the higher presentation level (right column), the response regions expanded slightly as the overlap between categories increased.

Although there is no accepted goodness-of-fit test for continuous, multivariate outcomes modeled with random effects, the goodness-of-fit of multivariate response surface models can be verified through visual inspection of a graphical representation of the average observed selection rate and the predicted selection rate. This evaluation carried out for the three response categories among NH listeners at low and high presentation levels revealed that therewas considerable overlap between the predicted and observed responses, indicating that the overall model fit was quite good and the overall pattern of responses at each stimulus level was well described by the model.

The model results were used to compute the likelihood ratio statistic for the null hypothesis of no level effects on the category response surfaces. The result is a statistic of 40.3, on 20 degrees of freedom ($p = .004$), indicating that there were significant differences in the response surfaces for the two presentation levels among the NH listeners.

Listener group. The HI listeners' response patterns were more diverse than those of theNH listeners; therefore, their response counts are presented individually in columns in Figure 3. The gray lines, reflecting the performance of another NH listener group, show the same category boundaries as Figure 2. The high-frequency puretone average of thresholds at 1, 2, and 3 kHz (PTA123) is also indicated for each listener. For the most

part, the category identifications of HI1 and HI2 were concentrated in separate regions of the stimulus space, similar to the NH listeners but with more overlap between the categories. For the remaining HI listeners, there appeared to be even greater overlap among identifications of the three vowel categories, with quite variable responses in some of the categories for a few listeners (e.g., HI4 /I / and HI5 /3/).

The goodness-of-fit of the multivariate response surface model to the response category probabilities among both the HI listener group and the NH listener group at the 95-dB presentation level was verified graphically. The model showed reasonably good fit to the data for both listener groups. The likelihood ratio test yielded a statistic of 161.4 on 16 degrees of freedom ($p < .001$); therefore, there is strong evidence that NH listeners and HI listeners differed in their vowel identification surfaces over these F2 and F3 combinations.

In order to visualize the differences in the group threedimensional (3-D) response surfaces (F2 ×F3 ×Response Probability), the predicted response category probabilities were plotted as two-dimensional (2-D) equiprobability contours. The relationship between a 3-D response surface and its 2-D representation is shown in Figure 4. On the right is a plot of a fitted response surface for the NH listeners' /?/ response, and on the left is the projection of this surface onto the stimulus space. Lines on both plots connect formant values for which the predicted response probability is equal. Because the response surface is steeply sloping fromthe region of highest to lowest response probability, the equiprobability contours appear relatively closely spaced in the 2-D representation.

Figure 5 shows contour plots of the predicted probabilities for the three response categories. The response probabilities of the NH listener group are presented in the left column, and those of the HI listener group are on the right. This figure depicts the major difference between HI and NH listeners-HI listeners have more flattened response surfaces over the entire F2/F3 plane than do NH listeners. This flattening is observable by two characteristics of the response probability contours for all three categories: The maximum predicted probabilities of the HI listener group are not as great as those for the NH listener group (e.g., the predicted response probabilities of the HI listeners for /I / and /?/ never reach .9 as they do for the probabilities of theNHlisteners), and the equiprobability contours are more spread out for the HI listeners than for the NH listeners, indicating more gradual slopes of the HI listeners' response surfaces.

The difference in the predicted selection rates between the HI listeners and NH listeners at each point on the F2/F3 space was assessed by means of tests derived from linear contrasts of the parameters in the fitted model. This resulted in 162 tests (54 per response category), which had considerable risk of Type I error. In order to address this, a false discovery rate (FDR) p value adjustment was used to guarantee that the proportion of Type I errors was no greater than .05 (Benjamini &Hochberg, 1995; Verhoeven, Simonsen, &McIntyre, 2005). This procedure is much less conservative than the usual Bonferroni adjustment and allowed identification of regions in the stimulus space where differences between HI listeners and NH listeners lay. For each response category, stimuli for which the predicted response probabilities were significantly different (FDR-adjusted $p < .05$) between the two listener groups are indicated by symbols placed at the F2/F3 stimulus locations on the panels depicting the responses of the HI listeners on Figure 5.

The predicted response probabilities for /I / are shown in the top panels of Figure 5. There was little difference in the overall shape of the response surfaces for this category. For both listener groups, the greatest response probability was in the upper right corner, where F2 and F3 had the highest values. There was no significant difference between the two groups for the stimuli located where the probability of an /I / response by HI listeners was at least .8. However, the point-by-point analysis reveals that there were significant differences across the portion of the stimulus space where the probability of an /I / response by HI listeners was between .2 and .8 (15 of 54 stimulus comparisons). This is a result of the overall attenuation of the response surface for theHI listeners- the range between the highest and lowest probabilities is reduced. There were no differences in the areas of lowest response probability.

The predicted response probabilities for /3/ are shown in the middle panels of Figure 5. Again, the maximum

response probabilities were in roughly the same location for the two groups, and there were not significant differences at the peak probability regions. For this category, the significant differences are in a boundary region between high and low response probability (13 of 54 stimulus comparisons). As for the /I/ response, there were no differences in the regions of lowest probability for high values of F3.

The biggest differences in the shapes of the response surfaces were observed for /?/ (the bottom panels of Figure 5). For this category, there was a noticeable shift in the highest probability response between the two groups from the extreme lower left for the NH listeners to a region with a higher F2 and F3 for the HI listeners. This pattern is observable in the raw data for a number of the HI listeners (see Figure 3). The shift in response pattern between the two groups resulted in significant differences at the locations of the peak in response for the NH listeners as well as for a large region of the stimulus space where the probability of an /3/ response was low for the NH listeners (34 of 54 comparisons).

Auditory Filter Shapes and Excitation Patterns

Figure 6 displays estimates of auditory filter bandwidth for each HI listener at the frequencies tested and the best linear fits to these estimates. The line connecting the filled symbols indicates the auditory filter bandwidth estimates calculated for NH listeners at similar presentation levels reported by Glasberg and Moore (1990), showing that filters typically broaden with increasing frequency with a slope of about 0.11. Listener HI2 had a shallow slope (0.07); however, the bandwidths were broader than normal. For the remaining four HI listeners, filters broadened with frequency at a faster rate than for NH listeners, with slopes ranging from 0.29 to 0.80. The two listeners whose filters were also measured at 500 Hz (HI1 and HI4) had near-normal bandwidths at that frequency.

The auditory filtermeasurementsmay be used to calculate excitation patterns in response to the vowel stimuli, following procedures described byGlasberg and Moore (1990). For this analysis, the equations estimating the changes in ERB with auditory filter center frequency for each listener, shown in Figure 6, were used to construct a bank of auditory filters ranging from about 200 Hz to about 5000 Hz. For simplicity, only symmetric auditory filters were used in this analysis. Each of the 54 stimuli was processed through the simulated filter banks of the individual listeners.No accommodation wasmade within the excitation pattern calculation for changes in bandwidth with level because the nonlinearity simulated by varying the bandwidth with level is essentially lost in the cochleae of HI listeners (Moore, 2007).

Figure 7 compares the estimated excitation patterns above 600 Hz for a simulated NH listener (solid black line) and for two of the HI listeners, one with relatively little hearing loss (HI1, dashed black line) and one with more hearing loss (HI4, dashed-dotted black line). Although only frequencies in the region of about 600-5000Hz are considered here, the NH excitation pattern for frequencies below 600 Hz is included as a reference (solid gray line). Shown are (a) a stimulus most often identified by NH listeners as /I/ (high F2/highF3); (b) a stimulus most often identified byNHlisteners as /?/ (low F2/high F3); and (c) a stimulus most often identified by NH listeners as /3/ (low F2/low F3).

Formant peaks for F2 and F3 are easily identified through visual inspection of the excitation patterns of the simulated NH listener; however, the locations of the formant peaks in the excitation patterns of the HI listeners are not as easily determined. This is a reflection of the broader HI auditory filters. The lack of clear definition of formant peaks in the F2/F3 region probably is largely responsible for the generally poorer and less consistent identifications of the vowel sets.

Discussion

In this study, listeners labeled both clearly identifiable and ambiguous exemplars from three vowel categories. The category responses of the NH listeners at the 75-dB presentation level were confined to generally nonoverlapping regions of the stimulus space. This finding is consistent with data from previous studies of NH listeners in response to these stimuli (Maddox et al., 2002; Molis, 2005). Response overlap among categories increased significantly with an increase in presentation level to 95dB. The purpose of collecting data at the

higher level was to facilitate comparisons with the HI listeners, who required this level in order to ensure audibility of the stimulus set. However, when the response patterns of the HI listeners were compared with those of the NH listeners at this presentation level, differences were still observed between groups. Although HI listeners' responses to the "best" category examples-those selected most often by NH listeners-were broadly similar to those of NH listeners, their response areas were less compact, and there was greater category overlap. The increased overlap was a result of increased variability of the responses of the HI listener group and was observable in two characteristics of the fitted response probability surfaces for all three categories: the maximum response probabilities were not as high and the response surfaces were not as steep for the HI listener group as for the NH listener group. For two of the vowel categories, /I/ and /?/, the two listener groups did not differ where the predicted response probabilities were the highest or were very low. Differences between the two groups' responses occurred primarily in the boundary regions between the categories. For the remaining category, /?/, an overall shift in the response pattern of the HI listeners resulted in more widespread differences between the two groups.

Possible Influences on Vowel Perception

There are several possible sources of any of the differences observed between the two listener groups' response patterns, including formant audibility, presentation level, frequency selectivity, and age.

Formant audibility. The overall presentation level for the HI listeners was 95 dB SPL. It was assumed that at this level, F2 and F3 would be audible for most listeners; however, some frequencies could have been inaudible to some of the HI listeners for some of the stimuli. The peak in the excitation pattern for each tone at threshold was compared with the excitation level at that frequency for the excitation patterns of each stimulus and listener as described earlier. If the excitation in the formant regions for the stimuli was greater than the excitation level of the tone threshold, it was assumed that those formants were audible. This analysis revealed that F2 was always audible for every HI listener, and F3 was always audible for four of the five HI listeners. For the remaining HI listener (HI3), F3 was inaudible for three of the stimuli with a low F2 and a high F3, identified as /?/ by NH listeners. However, the probable inaudibility of F3 for these stimuli would not necessarily be crucial to the identification of /?/. Estimates of the effective F2 (Carlson, Fant, &Granström, 1975; Carlson, Granström, &Fant, 1970) have shown that back vowels such as /?/ can be well approximated by F1 and F2 alone. For stimuli in which F2 and F3 were relatively close-less than 2.6 Barks apart-both formants were audible for all HI listeners. This was true even when both formants were high in frequency-as for /I /-because the levels of closely spaced formants generally increase with increasing proximity (Fant, 1967). Nevertheless, although F2 and F3 remained audible for all listeners, performance for /I/ was very poor for listeners HI3 and HI4. Considered together, these observations indicate that specific formant audibility was not clearly predictive of identification performance and likely would not alone account for the findings of this study.

High presentation level and frequency selectivity. It is possible that the high presentation level itself had a negative impact on performance for the HI listeners. Previous studies have found that high presentation levels are associated with decreased word and sentence intelligibility in quiet and in noise (French &Steinberg, 1947; Molis &Summers, 2003; Speaks, Karmen, &Benitez, 1967). However, studies that have specifically addressed vowel perception have found no detrimental effect of increased level. Coughlin, Kewley-Port, and Humes (1998) reported that young NH listeners could identify four target vowels presented at 70 or 95 dB SPL with near-perfect accuracy. Elderly HI listeners performed better for vowel identification at 95 dB SPL than at 70 dB SPL-perhaps an effect of reduced audibility at the lower level. In a subsequent study, neither an overall increase in presentation level from 60 to 95 dB SPL, nor shaped gain that was designed to keep the stimuli 15 dB above threshold, influenced vowel identification byHI listeners (Richie et al., 2003). It should be noted, however, that the response categories in each of these studies were represented by single vowel tokens.

In the present study, vowel categorization for the NH listeners changed significantly when the presentation level was raised from 75 to 95 dB SPL. And, in fact, their performance at the high level qualitatively resembled the

performance of theHI listeners in certain respects:The category overlapwas increased, and boundariesweremore gradual than for the lower presentation level. These changes are consistent with a reduction in spectral contrast caused by smearing of the peaks and valleys in the excitation patterns for NH listeners at high levels (e.g., Leek et al., 1987; Leek &Summers, 1996). The loss of spectral contrast is due to broadening of auditory filters as normal cochlear processing becomes more linear at high stimulus levels. A major characteristic of HI listeners is also a linearized system. Therefore, the patterns of responses for both the NH listeners at high levels and the HI listeners are likely due-at least, in part-to the same underlying reduction of cochlear nonlinearity, although to a greater extent for the HI listeners than for the NH listeners.

All of the HI listeners had impaired frequency selectivity over at least a portion of the relevant frequency range, as demonstrated by their broader auditory filter bandwidth estimates (see Figure 6). Depending on the severity of the hearing loss, individual formant peaks can be either minimally identifiable or almost totally absent in the excitation patterns. For instance, in the excitation patterns based on the auditory filter estimates forHI4-the listener with the broadest filter estimates- there was very little differentiation for these stimuli in the F2/F3 frequency region. This listener's auditory filter bandwidth estimated at 2000 Hz was more than four times greater than for a normal auditory filter. The excitation patterns shown in Figure 7 illustrate the effect of the broad auditory filters in the frequency region of F2/F3. The formant peaks in that frequency region are clearly apparent for NH listeners as well as for listener HI1, whose auditory filters were just over twice as broad as normal.Although somewhat smoothed by the poorer-thannormal frequency resolution, HI1's excitation pattern still reflects at least the second formant, although the higher formants are more problematic. In contrast, the excitation pattern modeled after listener HI4's auditory filters is almost flat in the F2/F3 region.

Age. The average age of the HI listener group was greater than that of the NH listener group (72 years vs. 46 years). Previous research indicates that after controlling for amount of hearing loss, vowel perception does not differ between older and younger listeners. Richie et al. (2003) compared the performance of a group of young HI listeners matched with a group of elderly HI listeners from an earlier study (Coughlin et al., 1998) and found no difference in vowel identification between the two listener groups when vowel categories were represented by single tokens. However, Nábe? lek (1988) found that age was significantly correlated with vowel identification for stimuli degraded by noise and reverberation, but not in quiet. Although in this study, listeners performed the task without the penalizing effects of noise and reverberation, a case might be made that the stimuli presented here were, in some respects, "degraded." These stimuli were presented with only static spectral information, with none of the other cues to vowel identity available from speech context, formant dynamics, or vowel duration. Moreover, task uncertainty was increased through the inclusion of ambiguous stimuli that could reasonably be identified as belonging to multiple response categories. The relatively advanced ages of the HI listeners might have contributed to the present findings, particularly related to these more "cognitive" degradations of the stimuli, perhaps analogous to effects of the acoustical distortions created by noise and reverberation. It would be interesting to determine the similarities in type and degree of performance deficits related to these two very different types of perceptual degradations (cognitive vs. acoustical), although the present data do not address that question.

Possible Implications of Ambiguity in Vowel Perception

The potential consequences for HI listeners of imprecise or ambiguous vowels encountered in everyday communication may be, at best, uncertainty about vowel identity and, at worst, misperception of vowel categories. In addition to simply misunderstanding, a consequence of increased perceptual uncertainty may be increased attentional effort required to process speech. In such cases, more emphasis must be placed on top-down processing as the importance of context becomes more critical. This may result in extra cognitive processing load, even if the word is eventually correctly recognized due to top-down processing. Pichora-Fuller, Schneider, and Daneman (1995) reported that elderly listeners with and without hearing loss made more use of contextual information in identifying sentence-final words presented in background noise. Further, elderly

listeners had poorer recall of thewords that they had identified. Pichora-Fuller et al. concluded that extra cognitive resourceswere needed to process speech in noise because of deficits in central processing associated with aging and that the combined effects of hearing loss and age resulted in even more effortful communication in background noise.

The increased ambiguity of vowels that are not "good" tokens, as used here, may add to the extra cognitive load required of HI listeners to support the accurate and timely analysis of everyday speech sounds.Rakerd, Seitz, andWhearty (1996) obtained measures of listening effort for HI listeners listening to speech while concurrently performing a digit memorization task. The speech listening effort was greater for HI listeners. The authors argued that a greater cognitive contribution was required for the HI listeners. Similarly, Gatehouse and Gordon (1990) reported that HI listeners had to expend greater cognitive effort to match performance on speech listening tasks than NH listeners. It appears, then, that HI listeners may have to work harder to listen to ongoing speech than NH listeners with intact auditory systems well adapted to their native speech.

Conclusion

By employing a densely sampled stimulus set, we were able to demonstrate significant differences in vowel identification patterns due to increases in presentation level for NH listeners and for listeners with hearing loss when compared withNHperformance. For themost part, vowel tokens that were highly identifiable by NH listeners were also categorized consistently by listeners with hearing loss. However, more ambiguous vowels showed different patterns of response for HI listeners relative to performance by NH listeners. In particular, HI listeners demonstrated greater overlap among response categories to different tokens and less regularity in responses over repeated presentations. A number of factors may have contributed to difficulties in ambiguous vowel identification by HI listeners, including a loss in frequency selectivity, leading to smoothing of the internal representation of the spectrum.

Acknowledgments

This research was supported by National Institute on Deafness and Other Communication Disorders Grant R01 DC 00626. Some support for preparation of this article was provided by the Department of Veterans Affairs. Portions of this work were carried out while we were affiliated with the Army Audiology and Speech Center, Walter Reed Army Medical Center, Washington, DC. The opinions or assertions contained herein are our private views and are not to be construed as official or as reflecting the views of the Department of Veterans Affairs, theDepartment of the Army, or the Department of Defense.

Portions of this research were presented at the 146th meeting of the Acoustical Society of America, held in Austin, Texas, in November 2003 (and published in The Journal of the Acoustical Society of America, Volume 114, p. 2359), and at the March 2006 meeting of the American Auditory Society, held in Scottsdale, AZ.

We would like to thank Van Summers and Frederick Gallun for their helpful suggestions and discussions as well as Garnett McMillan for statistical assistance.

Sidebar

Vowel Identification by Listeners With Hearing Impairment in Response to Variation in Formant Frequencies
Michelle R. Molis, and Marjorie R. Leek
J Speech Lang Hear Res 2011;54;1211-1223; originally published online Feb 4,2011;
DOI: 10.1044/1092-4388(2010/09-0218)

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Editor: Robert Schlauch
Associate Editor: Kathryn Arehart
Received October 1, 2009
Revision received May 1, 2010
Accepted December 14, 2010
DOI: 10.1044/1092-4388(2010/09-0218)

Publication date: Aug 1, 2011

Year: 2011

Perceptual Adaptation of Voice Gender Discrimination With Spectrally Shifted Vowels

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.4 (Aug 1, 2011): 1240-1245A.
ProQuest document link

Abstract: To determine whether perceptual adaptation improves voice gender discrimination of spectrally shifted vowels and, if so, which acoustic cues contribute to the improvement. Voice gender discriminationwas measured for 10 normal-hearing subjects, during 5 days of adaptation to spectrally shifted vowels, produced by processing the speech of 5 male and 5 female talkers with 16-channel sine-wave vocoders. The subjects were randomly divided into 2 groups; one subjected to 50-Hz, and the other to 200-Hz, temporal envelope cutoff frequencies. No preview or feedback was provided. There was significant adaptation in voice gender discrimination with the 200-Hz cutoff frequency, but significant improvement was observed only for 3 female talkers with F^sub 0^ >180 Hz and 3 male talkers with F^sub 0^ <170 Hz. There was no significant adaptation with the 50-Hz cutoff frequency. Temporal envelope cues are important for voice gender discrimination under spectral shift conditions with perceptual adaptation, but spectral shift may limit the exclusive use of spectral information and/or the use of formant structure on voice gender discrimination. The results have implications for cochlear implant users and for understanding voice gender discrimination.

Full text: Headnote

Purpose: To determine whether perceptual adaptation improves voice gender discrimination of spectrally shifted vowels and, if so, which acoustic cues contribute to the improvement.
Method: Voice gender discriminationwas measured for 10 normalhearing subjects, during 5 days of adaptation to spectrally shifted vowels, produced by processing the speech of 5 male and 5 female talkers with 16-channel sine-wave vocoders. The subjects were randomly divided into 2 groups; one subjected to 50-Hz, and the other to 200-Hz, temporal envelope cutoff frequencies. No preview or feedback was provided.
Results: There was significant adaptation in voice gender discrimination with the 200-Hz cutoff frequency, but significant improvement was observed only for 3 female talkers with F^sub 0^ >180 Hz and 3 male talkers with F^sub 0^ <170 Hz. There was no significant adaptation with the 50-Hz cutoff frequency.

Conclusions: Temporal envelope cues are important for voice gender discrimination under spectral shift conditions with perceptual adaptation, but spectral shift may limit the exclusive use of spectral information and/or the use of formant structure on voice gender discrimination. The results have implications for cochlear implant users and for understanding voice gender discrimination.
Key Words: perceptual adaptation, voice gender discrimination, spectrally shifted speech
Cochlear implants (CIs) have been relatively successful as auditory prosthetic devices, allowing people with sensorineural deafness to recover partial hearing. CI users achieve a high level of speech recognition performance in ideal listening environments but have difficulties with pitch-related listening tasks (e.g., musicmelody recognition, speaker/voice identification, tone recognition). CI devices in their current configuration generally provide userswith spectrally shifted and/or distorted signals,with limited spectral and temporal resolution. Due to reduced spectral resolution, harmonic complex tones are not available for the perception of pitch. CI users rely mainly on tonotopic information and temporal envelope cues for pitch-related perception (Moore &Carlyon, 2005).

Previous CI simulation studies have investigated the relative contribution of spectral information and temporal envelope cues to pitch-related perception (Fu, Chinchilla, &Galvin, 2004; Kong, Cruz, Jones, &Zeng, 2004; Kong &Zeng, 2006; Xu, Tsai, &Pfingst, 2002). However, most of these studies used tonotopically matched CI simulations. In the real world, CI users usually receive tonotopically shifted and distorted signals, due to device- or patient-related factors. For some CI users, however, pitch perception based on tonotopic information can shift as much as two octaves over a period of several years (Reiss, Turner, Erenberg,&Gantz, 2007). Therefore, it is necessary not only to understand the relative importance of spectral information and temporal envelope cues to pitchrelated perception under tonotopic distortion but also to investigate the effects of perceptual adaptation. The present study examined perceptual adaptation of voice gender discriminationwith spectrally shifted vowels. Voice gender discrimination is a pitch-related perception task. Previous studies of normal-hearing (NH) listeners showed that fundamental frequency (F0) and formant structure are major factors for voice gender discrimination (Bachorowski &Owren, 1999; Fellowes, Remez, &Rubin, 1997) and that F0 is somewhat more important than formant structure (Hillenbrand &Clark, 2009). Similarly, previous studies using acoustic CI simulations found that both temporal envelope cues and spectral cues supported voice gender discrimination. However, their relative importance was affected by spectral resolution, spectral mismatch, and the range of intertalker F0s (Fu et al., 2004; Fu, Chinchilla, Nogaki, &Galvin, 2005; Gonzalez &Oliver, 2005). According to Fu et al. (2005), temporal envelope cues play an important role in voice gender discrimination when the F0s of male and female talkers are widely separated, especially with reduced spectral resolution or spectral mismatch; however, spectral information becomes more important when the range of intertalker F0s is small. Furthermore, for a small intergender F0 difference, voice gender discrimination performance declines after an octave upward spectral shift, even with temporal envelope cues. To evaluate the relative contribution of temporal envelope and spectral cues to voice gender discrimination under tonotopic distortion after perceptual adaptation, we used stimuli that were generated from a set of vowels with a small intergender F0 difference and that varied in the amount of spectral and/or temporal information. The present study addressed two specific questions: (a) Can shortterm perceptual adaptation improve pitch-related perception under spectral mismatch? (b) Do temporal envelope cues or tonotopic information contribute more strongly to the improvement?

Method

Subjects

TenNHsubjects (5 males and 5 females, 18-33 years old) participated in the study; all were native speakers of American English. All subjects had pure-tone thresholds better than 20 dBHLat octave frequencies of 125-8000Hz. None of the subjects had prior experience with acoustic CI simulations. The Institutional Review Board of St. Vincent Medical Center approved the involvement of human subjects in the present project. All subjects gave informed consent.

Speech Materials

Twelve medial vowels, presented in the format of /h-V-d/ (had, head, hod, hawed, hayed, heard, hid, heed, hud, hood, who'd, and hoed), were used as speech stimuli. Five male and five female talkers were selected from speech samples recorded by Hillenbrand, Getty, Clark, and Wheeler (1995) and were similar to those in Talker Set 2 of Fu et al. (2005). The F0s of the five male (M1 ~ M5) and five female (F1 ~ F5) talkers overlapped within the range of È150-200 Hz (see Table 1). The mean F0 values of male and female talkers differed by 10 Hz, which is small relative to the mean difference between F0s of natural male and female talkers (~90 Hz).

Signal Processing and Test Conditions

We used 16-channel sine-wave vocoders to generate speech stimuli, in order to reduce floor effects of limited spectral resolution on voice gender discrimination. Voice gender discrimination by CI users was more consistent with acoustic CI simulations produced by sine-wave vocoders than by noise-band vocoders (Fu et al., 2004), and 16 spectral channels were required for good voice gender discrimination with insufficient temporal envelope cues (Fu et al., 2005).

The speech signal input into the 16-channel sinewave vocoder had an acoustic frequency range of 200- 7000 Hz and was band-pass filtered into 16 channels after pre-emphasis. Table 2 shows the corner and center frequencies of the 16 analysis filters (fourth-order Butterworth filters). The spatial distribution of center frequencieswas calculated according toGreenwood's (1990) function, assuming a 35-mm-long cochlea. In each channel, the temporal envelope was extracted by half-wave rectification and a low-pass, fourth-order Butterworth filter. The cutoff frequency of the low-pass filters was 50 or 200 Hz, removing or preserving the higher rate temporal envelope cues, respectively. The temporal envelopes in each channel were then used to modulate sine-wave carriers that were either tonotopically matched or shifted relative to the analysis bands (seeTable 2). For the shifted condition, the frequency range of the overall carrier bands was 683-7408 Hz, simulating a 16-mm implanted electrode array. The lowest frequency channel was upwardly shifted by 6.2 mm, close to the moderate shift condition (6 mm) tested by Li, Galvin, and Fu (2009), which showed that vowel recognition could be improved for this shift condition with eight spectral channels and without explicit training. Finally, the modulated carriers were summed and normalized to have the same long-term root-mean-square as the input speech signal.

Procedure

The 10 subjects were randomly divided into two groups: Group 1 (four subjects) learned voice gender discrimination with spectrally shifted vowel tokens without the higher rate temporal envelope cues (50-Hz cutoff frequency); Group 2 (six subjects) learned voice gender discrimination with spectrally shifted vowel tokens with temporal envelope cues (200-Hz cutoff frequency). Subjects were seated in a sound-treated booth and listened to the speech stimuli via a loudspeaker. The presentation level of all speech stimuli was 65 dB SPL. Voice gender discrimination was measured using a two-alternative forced choice paradigm. A vowel token was randomly selected from the stimulus set (12 Vowels ×10 Talkers = 120 Vowel Tokens) and presented to subjects, with no repetition. Following the presentation of each test token, subjects responded by clicking one of two response buttons, labeled "male" and "female." No previewor feedback was provided. There were 120 tokens in each trial, and performance was quantified as the percentage of correct responses.

To lessen the effect of the top-downprocess, the adaptation protocol used an unsupervised, 5-day learning paradigm, similar to the protocol used by Li et al. (2009). Pre-adaptation baseline measures of voice gender discrimination were obtained on Day 1, for both spectrally matched and shifted vowel tokens, with temporal envelope cues and without temporal envelope cues. During the pre-adaptation measurement session, voice gender discriminationwasmeasured for spectrallymatched vowels prior to spectrally shifted vowels. Performance was remeasured for all baseline conditions immediately after the 5-day adaptation phase. During the postadaptation measurement session, voice gender discrimination was measured for spectrally shifted vowels prior to spectrally matched vowels. To allow subjects in Group 1 to adapt to spectrally shifted vowels

without temporal envelope cues (50-Hz cutoff frequency), we tested the spectrally shifted vowels with the 200-Hz cutoff frequency first, followed by the spectrally shifted vowels with the 50-Hz cutoff frequency. For subjects in Group 2, the test order was reversed. During the 5-day adaptation period, Group 1 was tested daily using only spectrally shifted vowels with the 50-Hz cutoff frequency, andGroup 2was tested daily using only spectrally shifted vowels with the 200-Hz cutoff frequency. Five trials were administered daily. No preview and no feedback were provided during the adaptation period.

Results

Subjects were able to partially adapt to spectrally shifted speech with temporal cues up to 200 Hz for voice gender discrimination (Group 2) but not to the shifted speech without the higher rate temporal envelope cues (Group 1). Mean performance for Group 1 on Days 1-5 ranged from 58% to 62% (see Figure 1) and showed no significant improvement in voice gender discrimination during the adaptation period: one-way repeated measures analysis of variance (ANOVA), $F(4, 12) = 1.815$, $p = .191$. Consistent with the overall performance, there was no significant improvement in voice gender discrimination for any individual talker during the adaptation period across the four subjects in Group 1 (see Table 1). In contrast, the mean performance of Group 2 gradually increased from 60% correct on Day 1 to 73% correct on Day 5 (see Figure 1), showing significant improvement during the adaptation period: one-way repeatedmeasures ANOVA, $F(4, 20) = 9.115$, $p < .001$. The significant change occurred by Day 3, after which there was no further improvement. Despite the overall improvement, one-way repeated measures ANOVAs showed that voice gender discrimination performance significantly improved for only six out of 10 talkers (see Table 1). On Day 5, performance was positively correlated with the F0 value for the five female talkers ($r = .963$, $p = .008$) and negatively correlated with the F0 value for the fivemale talkers ($r = -.886$, $p = .045$).

We used t tests to compare performance between groups under specific test conditions; we used paired t tests to compare pre- and postadaptation performance within the group and performance within the group under different spectral shift conditions. Significance of differences was accepted at $p < .05$. The pre-adaptation baseline performances of Groups 1 and 2 were not significantly different (see Figure 2) for all conditions. Group 1 showed no significant change between pre- and postadaptation performance for all test conditions. OnDay 5, performance for the spectrally shifted condition with temporal envelope cues was still significantly poorer than performance for two spectrally matched conditions, and there was no significant difference between the two spectrally matched conditions. Group 2 showed improvement in postadaptation performance for spectrally shifted speech, both with and without temporal envelope cues. However, the mean pre-adaptation performance of Group 2 for spectrally shifted speech without temporal envelope cues was È6% lower, and postadaptation performance was only È1% higher than for Group 1. Thus, the significant improvement observed under this condition might be attributable to the pre-adaptation measurements being made prior to the spectrally shifted condition with a 200-Hz cutoff frequency and/or to intersubject variability within a small group of subjects. There was no significant change in performance after adaptation for the spectrally matched condition with temporal envelope cues. However, when temporal envelope cues were removed, postadaptation performance under the spectrally matched condition declined significantly compared with pre-adaptation performance. It is possible that the improved performance of Group 2 during the adaptation process came from the use of shifted temporal envelope cues and that adapted subjects had difficulty using only spectral information, especially when measured after the spectrally shifted conditions. After the 5-day adaptation period, performance for the spectrally shifted condition with temporal envelope cues was not significantly different than for the spectrally matched condition with or without temporal envelope cues.

Discussion

Results of the present study showed that listeners were able to adapt to spectrally shifted speech for voice gender discrimination only when temporal envelope cues were present; the exclusive use of spectral cues for voice gender perception was limited by spectral mismatch, even after unsupervised, short-term perceptual

adaptation. Moreover, the postadaptation performance of subjects in Group 2 for spectrally shifted conditions with temporal envelope cues was positively correlated with F0 for five female talkers and negatively correlated with F0 for five male talkers. This suggests that after the 5-day adaptation period, temporal envelope periodicity cues played a primary role in discriminating voice gender of spectrally shifted vowels. Temporal envelope cues are important to voice gender discrimination when there is a large difference in F0s between male and female talkers, especially with limited spectral resolution or with spectral mismatch (Fu et al., 2005). Results presented herein demonstrated that with perceptual adaptation, temporal envelope cues are also important when there is tonotopic mismatch or a small range of F0s, even though the importance of temporal envelope cues is lessened under these conditions (Fu et al., 2005). These results also suggest that with sufficient perceptual adaptation, temporal envelope cues are somewhat independent of tonotopic information for voice gender discrimination or pitchrelated perception.

Although subjects showed the ability to adapt to spectrally shifted speech with a 200-Hz cutoff frequency without explicit training, it was unclear whether subjects made use of temporal envelope cues with temporal mechanisms or spectral mechanisms. As discussed by Gonzalez and Oliver (2005), gender discrimination performance is better with sine-wave vocoders than with noise-band vocoders, partly because amplitude modulation detection is easier with sine-wave carriers than with noise carriers (Kohlrausch,Fassel,&Dau, 2000;Viemeister, 1979) and partly because sine-wave vocoders introduce resolved side bands. The side bands centered at sinewave carriers may provide F0 information-that is, spectralmechanismsfor voice gender discrimination.Although sine-wave vocoders were used in the present study, it is likely that subjects mainly used temporal mechanisms to improve performance. The first five channels of the 16-channel sine-wave vocoder were comparable to the F0 range of the talkers, which may have inhibited the side bands needed for spectral mechanisms. A recent study also suggested that sine-wave vocoders with high temporal cutoff frequencies provided more periodicity and intonation information than did noise-band vocoders (Souza &Rosen, 2009). Subjects in the present study did not adapt to spectrally shifted speech for voice gender discrimination. These results and results of previous studies showed that without spectral mismatch, 10- to 16-channel spectral bands alone provide sufficient information for good voice gender discrimination (Fu et al., 2005; Gonzalez&Oliver, 2005). However, voice gender discrimination dramatically dropped after spectral shifting, even after short-term unsupervised perceptual adaptation. Thus, the exclusive use of spectral information for voice gender identification is limited by spectral shift, at least with reduced spectral resolution and/or with short-term perceptual adaptation, suggesting that some factors related to tonotopic cues affect voice gender discrimination and perceptual adaptation. It is possible that subjects identified spectrally shifted speech with an upward shift of spectral profiles as female. However, confusion matrix analyses displayed no obvious shift in "female" response. Alternatively, spectral profiles may support voice gender discrimination by providing perception of sound quality or formant structure. Spectral shift may affect perception of the sound quality or the formant structure, thereby affecting voice gender discrimination. For pitch-related perception, furthermore, the rate of adaptation to changes in sound quality or formant structure may be slower than the rate of adaptation to shifted temporal envelope cues. Thus, there was no significant adaptation to shifted spectral information within the 5-day adaptation period without temporal envelope cues. In contrast, Reiss et al. (2007) found that tonotopic information-based pitch perception could shift up to two octaves over years, possibly due to long-term, higher-level changes. More feedback may facilitate adaptation to changes of sound quality or formant structure.

Results of the present study provide insights into voice gender discrimination by human listeners and have implications for CI users. While F0 has already been shown to be somewhat more important than formant structure (Hillenbrand &Clark, 2009), results presented herein show that voice gender discrimination can use F0 independently of tonotopic information after short-term unsupervised adaptation. However, the results also indicate that the relative roles of F0 and formant structure can be affected by the F0 of the talkers, as voice gender discrimination by Group 2 improved only for male talkers with F0 <170Hz and for female talkers with F0

>180 Hz. The 170- to 180-Hz range is the median F0 of natural male and female talkers and appears to be the dividing line for F0-based voice gender discrimination. Formant structure might be more important for voice gender discrimination for a female talker with F0 <180 Hz and a male talker with F0 >170 Hz. However, the use of formant structure in voice gender discrimination may be limited by spectral shift and/or limited spectral resolution. For CI users, who have difficulties in pitch-related listening tasks and in speech recognition in background noise, results of the present study indicate that spectral mismatch might be another factor, in addition to the limited spectral and temporal resolution, affecting performance of CI users in complex, pitch-related perception tasks. Thus, more independent channels, more precise frequency-to-place mapping, or explicit training in the exclusive use of tonotopic information will be helpful for CI users faced with complex, pitch-related perception tasks.

Acknowledgments

This research was supported by National Institute on Deafness and Other Communication Disorders Grant DC004792. We would like to thank all subjects for their time and attention.

Sidebar

Perceptual Adaptation of Voice Gender Discrimination With Spectrally Shifted Vowels

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J Speech Lang Hear Res 2011;54;1240-1245; originally published online Dec 20, 2010;

DOI: 10.1044/1092-4388(2010/10-0168)

This information is current as of August 19, 2011

This article, along with updated information and services, is located on the World Wide Web at:

http://jslhr.asha.org/cgi/content/full/54/4/1240

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Editor: Robert Schlauch
Associate Editor: Christopher Turner
Received June 17, 2010
Revision received November 18, 2010
Accepted November 18, 2010
DOI: 10.1044/1092-4388(2010/10-0168)

Publication date: Aug 1, 2011

Year: 2011

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Publication info: Multimedia Tools and Applications 54.2 (Aug 2011): 291-319.
ProQuest document link

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is composed of a MLP classifier followed by a Hidden Markov Model (HMM), providing a good trade-off solution between complexity and classification accuracy rate. The goal of the proposed approach is to perform a robust discrimination among speech/nonspeech parts of audio signals in commercial digital hearing aids, the computational cost being a critical issue. For the experiments, an audio database including speech, music and noise signals has been used.[PUBLICATION ABSTRACT]

Full text: Multimed Tools Appl (2011) 54:291319 DOI 10.1007/s11042-010-0523-1

Low-complexity F0-based speech/nonspeech discrimination approach for digital hearing aids

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Published online: 12 May 2010 Springer Science+Business Media, LLC 2010

Abstract Digital hearing aids impose strong complexity and memory constraints on digital signal processing algorithms that implement different applications. This paper proposes a low complexity approach for automatic sound classification in digital hearing aids. The proposed scheme, which operates on a frame-by-frame basis, consists of two stages: analysis stage and classification stage. The analysis stage provides a set of low-complexity signal features derived from fundamental frequency (F0) estimation. Here, F0 estimation is performed by a decimated difference function, which results in a reduced-complexity analysis stage. The classification stage has been designed with the aim of reducing the complexity while maintaining high accuracy rates. Three low-complexity classifiers have been evaluated (tree-based C4.5, 1-Nearest Neighbor (1-NN) and a Multilayer Perceptron (MLP)), the MLP being chosen because it provides the best accuracy rates and fits to the computational and memory constraints of ultra low-power DSP-based hearing aids. The classification stage is composed of a MLP classifier followed by a Hidden Markov Model (HMM), providing a good trade-off solution between complexity and classification accuracy rate. The goal of the proposed approach is to perform a robust discrimination among speech/nonspeech parts of audio signals in commercial digital hearing aids, the computational cost being a critical issue. For the experiments, an audio database including speech, music and noise signals has been used.

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Keywords Fundamental frequency estimation Automatic sound classification
Digital hearing aids Difference function Multilayer perceptron
Hidden Markov model

1 Introduction

Hearing losses affect about 13% of the population in most developed countries. Approximately 90% of those with hearing impairments could benefit from modern hearing aids [8]. Furthermore, about 25% of those who own hearing aids do not wear them because of irritating and unpleasant whistles and/or other amplified noises caused by the surrounding background noise they encounter in their everyday life. This astonishing irregular use of hearing aids arises from a variety of reasons. The problem becomes more accentuated because understanding speech with background noise is much more difficult for hearing-impaired people than for healthy listeners [22].

Research in digital hearing aids can improve the quality of life of many people. Approaches in signal processing

research on digital hearing aids fall into four areas, which cover signal acquisition, amplification, transmission, measurement, filtering, parameter estimation, separation, detection, enhancement, modeling, and classification. The first area uses advanced signal processing techniques to characterize and compensate for various hearing impairments, such as loudness and frequency selectivity loss. The second area consists of effective target signal enhancement and noise reduction, which includes adaptive microphone array technologies, spectral subtraction algorithms, and blind source separation and classification methods. The third area focuses on the real-world use of hearing aids and addresses issues such as flexibility, convenience, feedback cancelation, and artifact reduction. The fourth area is devoted to expanding hearing aid technology into devices that are also able to perform other functions, such as mobile phones and music players. In this area, issues such as echo cancellation, bone conductive microphones, and wireless voice link are of interest [21]. The signal processing research in this work falls into the second area.

Hearing aid users can improve perceived signal at different listening conditions if a variety of amplification schemes are available in digital hearing aids [16, 17]. Some modern digital hearing aids allow the user to manually select among different programs depending on the acoustic environment the user is in. The problem here is that the user has to recognize the acoustic environment and selects the best-suited program using a switch on the hearing device or with some kind of remote control. This approach commonly exceeds the abilities of most hearing aid users (especially the elderly), in particular for the smallest In-The-Canal (ITC) or Completely-In-the-Canal (CIC) hearing aids.

The previous paragraph shows the need for hearing aids that are able to automatically classify the acoustic environment the user is in. Hearing-impaired people are willing to use hearing aids that allow to automatically classify different acoustic environments. However, few hearing aids on the market can perform classification and adaptation tasks. These advanced functionalities, when incorporated to hearing aids, can improve speech intelligibility, which increases the comfort level of hearing-

impaired people, allowing them to lead a normal life. Furthermore, recent studies [7] suggest that automatic switching is deemed useful by most of hearing-impaired people, even if its performance is not completely perfect.

Because of the limitations imposed by the hardware requirements, (computational speed, memory need and power consumption) and other practical factors, the development and implementation of signal processing techniques for digital hearing aids has been a challenging and active research area over the last decade. In particular, developing an automatic sound classification system for digital hearing aids is a really complex and challenging goal mainly due to the just mentioned limitations. Digital hearing aids must work at very low clock frequencies in order to reduce power consumption and thus increase battery life. From this constraint, a upper bound in the number of operations per second is derived. Therefore, signal processing techniques and algorithms must be tailored for properly classifying audio signals while using the minimum possible number of operations.

In last years, some contributions have been made regarding the problem of sound classification in digital hearing aids [1, 3, 4, 8, 14, 23]. Nordqvist and Leijon propose in [23] a HMM-based sound classification algorithm for hearing aids. The algorithm only uses modulation characteristics of the signal, being implemented in a DSP-based hearing device. Three listening environment categories are considered for testing: speech in traffic noise, speech in babble, and clean speech. In [8], a sound classification system for acoustic environment recognition in hearing aids is proposed. The system distinguishes four sound classes (clean speech, speech in noise, noise and music) using a set of features inspired by auditory scene analysis. The work in [1] is centered on exploring proper training algorithms for Multi-Layer Perceptrons (MLP) to be used within digital hearing aids. The training methods explored in [1] are Gradient Descent, Levenberg-Marquardt and Levenberg-Marquardt with Bayesian Regularization. The work in [3] deals with feature selection for improving sound classification in

hearing aids. A genetic algorithm with restricted search is evaluated for feature selection, showing promising results. The approaches proposed in [4] and [14] discriminate among speech and nonspeech classes using neural network (NN) classifiers specifically tailored to be implemented in hearing aid devices. In the former approach, the NN is tailored by properly reducing the numbers of neurons without degrading the classification performance. In the latter, the activation function of each neuron is severely simplified, and the effects of the finite-precision of the DSP are taken into account to optimally quantize the parameters of the network.

The short-term goal of this work is the design of an efficient automatic speech/non-speech discrimination system that can be programmed in a low power DSP-based hearing aid. Although many other variations, apart from speech and nonspeech, exist in the auditory environment, discrimination between speech and nonspeech is a crucial task in hearing aids. As explained in [4], intelligibility of speech (in presence or not of background noise) and its discrimination from nonspeech sounds (whose amplification is unpleasant and irritating) are the two most important aspects for hearing aid users. An automatic speech/nonspeech discrimination system can clearly assist the hearing device in satisfying both needs, by automatically selecting an amplification program on speech (improving intelligibility) and a attenuating program on nonspeech (improving comfort). It is clear, however, that the identification of more specific acoustic environments, such as speech in noise or music, is an important and desirable feature, since it enables the automatic selection of

amplification schemes specifically fitted to those listening conditions. Nevertheless, an efficient speech/nonspeech discrimination approach is also very appreciated by hearing aid patients, specially if it provides a robust performance. For this reason, the design of algorithms for discriminating between speech and other sounds in hearing aids is the subject of recent and active research [4, 5, 14].

In response of such need, the goal of the proposed approach is to perform a robust discrimination among speech/nonspeech parts of audio signals in commercial digital hearing aids. The system, that operates on a frame-by-frame basis, is basically composed of a feature extraction stage (analysis stage) and a classification stage.

Signal feature extraction is typically performed by Fourier transform computation of windowed audio frames [13, 15, 32]. Recently, signal features have been extracted from the output of a weighted overlap-add (WOLA) filter-bank in DSP-based hearing aids [1, 3]. In this work, signal features are extracted from F0 estimates provided by a decimated difference function, which results in a reduced-complexity analysis stage. F0 estimation can also be employed for other concurrent applications in digital hearing aids, such as adaptive filtering, noise cancelling, speech enhancement and speech separation [6, 20].

In order to approach the global long-term goal of improving speech intelligibility, it is important to select a suitable classifier. The ideal candidate in hearing aid applications should require as low complexity as possible while maintaining a high enough classification accuracy rate. As shown in Section 4, the classification stage is composed of a MLP classifier followed by a Hidden Markov Model (HMM) [28, 29]. A feasible alternative to the MLP classifier is the tree-based C4.5 classifier [26, 27], which also fits to the complexity and memory constraints, but with lower accuracy rates. The HMM postprocessing step incorporates memory into the system, avoiding occurrence of isolate errors. Combination of MLP and HMM provides a good tradeoff solution between complexity and classification accuracy rate.

The main contribution of this work is the proposed low-complexity and high-accuracy approach for speech/nonspeech discrimination in a DSP-based hearing aid. The main novelties of the paper are: (1) The decimated difference function for F0 estimation; (2) The two-stage cascaded classification scheme (MLP classifier + HMM) for speech/nonspeech discrimination in a DSP-based hearing aid.

The paper is structured as follows. Section 1 outlines the problem of automatic sound classification in digital hearing aids, briefly describes some recent approaches for the problem and state the main contribution and novelties of the paper. Problem statement, including design constraints, data structure and windowing scheme,

is described in Section 2. Section 3 describes in detail the main components of the proposed approach. In Section 4, the experimental setup is explained and different results are shown. Finally, Section 5 is devoted to summarize the main conclusions of the work. Future works are also pointed out.

2 Problem statement

2.1 Design constraints

As mentioned, DSP-based hearing aids generally have strong constraints in terms of computational capacity and memory. These constraints mainly arise from the

small size of digital hearing aids, specially for the smallest In-The-Canal (ITC) or Completely-In-the-Canal (CIC) models. The smallest the hearing aid is, the strongest the constraints are. Note that the DSP in a digital hearing aid usually has to integrate not only the CPU core but also A/D and D/A converters, a filter-bank, RAM, ROM and EPROM memories and input/output ports. DSP-based hearing aids contain a small battery for supplying energy to the DSP, which also influences in the aforementioned constraints. The hearing aid has to work at very low clock frequencies in order to reduce power consumption and thus extend battery operating time.

There are on the market hearing aids with less restrictions, such as Behind-The-Ear (BTE) and In-The-Ear (ITE) hearing aids. They allow implementation of more powerful signal processing algorithms at the expense of a higher size. Anyway, computational capabilities of ultra low-power DSP have increased in the last few years, allowing implementation of new signal processing algorithms in digital hearing aids [1, 30].

In this work, we propose a low-complexity speech/nonspeech discrimination approach, specifically tailored to be implemented in a low-power DSP-based hearing aid. In order to explore the feasibility of the proposed approach to be used in a realistic hearing device, a commercial DSP for hearing aids has been considered in our study. Here, Toccata PlusTM flexible DSP system for hearing aids from On Semiconductor has been chosen as a reference [24, 25]. This platform is employed by several manufacturers as the core part of their hearing aid devices, being considered as representative of state-of-the-art low-power signal processors. Furthermore, as mentioned in [14], most of the hearing aids currently available on the market integrate a processor with similar computational speed (up to 2.56 MIPS). Only the latest hearing instruments are based on more advanced DSP platforms (such as the Orelal 4500 Series or the EzairoTM 5900, both from On Semiconductor), offering a computational capacity that does not use to exceed 5 MIPS [25]. For this reason, in recent works, the Toccata Plus DSP system (or similar) has also been considered as a reference to design sound classification algorithms for digital hearing aids [2, 11, 12, 14].

Toccata Plus block diagram is shown in Fig. 1. The processing elements of the entire system are: (a) the RCore, a fully programmable DSP core; (b) the WOLA

Fig. 1 Toccata plus block diagram

Filterbank coprocessor, a dedicated configurable processor that transforms the audio signal to the time-frequency domain. The system also integrates other components, such as A/D and D/A converters, RAM memories (8-Kwords for data and 12-Kwords for program instructions) and several input/output interfaces.

The RCore processor is the main element of the system. This processor executes all algorithms implemented on the device, including the signal processing stages that compensate the hearing losses. The RCore processor can operate at three configurable clock frequencies in the Toccata Plus platform: 1.28, 1.92 and 2.56 MHz. Since the processor is able to execute one instruction per clock cycle, a configurable computational power of 1.28, 1.92 or 2.56 MIPS is provided by the DSP.

In Section 4, it will be shown how the computational cost of the proposed low-complexity speech/nonspeech discrimination approach matches to computational constraints of the chosen DSP-based hearing aid.

2.2 Data structure and windowing scheme

In this work, an analysis window of 20 ms (W=320 samples at fs=16,000 Hz sampling rate) is defined. This

value will be later justified (see Section 3.1). A texture window of approximately 1 s (50 analysis windows) is also defined. Overlapping with a hop size of 160 samples (half-window overlapping) is performed, which results in 99 short-time frames for the 1 s-length texture window.

Since F0 estimation is performed frame-by-frame using the 20 ms-length analysis window and half-window overlapping, a 99-length low-level feature vector L is defined for the 1 s-length texture window. From vector L, containing F0 estimates, a high-level feature vector H is also defined for the 1 s-length texture window. Features in vector H, providing valuable information about the time evolution of F0 estimates within the texture window, are applied to the classification stage in order the system to decide whether the analyzed 1 s-length frame belongs to the speech class or the non-speech one.

Instead of using typical statistical features (mean, standard deviation, skewness, etc.), eight features with musical meaning are here considered [31]. They are briefly described in Section 3.2. Therefore, the 99-length low-level feature vector L, containing F0 estimates, is transformed into a lower dimensional high-level feature vector H, containing eight music-related features to be applied to the classification stage.

The texture window is shifted by 250 ms, which entails updating feature vectors L and H every 250 ms. Hence, decisions about the class the current frame belongs to are taken every 250 ms. Lower values of the texture window shift allow to reduce the time during which the system stands at a erroneous status at the expense of increasing the computational cost. Figure 2 shows the windows scheme from which the input values to the classification stage are computed.

To complete this section, it is worth mentioning that complete implementation of the proposed speech/nonspeech discrimination approach into the hearing aid itself is out of the scope of this paper. Performance results, shown in Section 4, were obtained by computer simulations. Moreover, complexity values of the proposed approach (expressed in MIPS) are also shown in Section 4 not only for the overall system but also for each constituent stage.

Fig. 2 Example illustrating how to compute the input values to the classification stage

3 System description

A block diagram of the proposed low-complexity and high-accuracy approach for speech/nonspeech discrimination to be implemented in a DSP-based hearing aid is depicted in Fig. 3. The input audio signal is analyzed using the analysis window and half-window overlapping for F0 estimation. At each texture window, F0 estimates are processed to compute high-level music-related features, which are then applied to the classification scheme. The classification scheme consists of two constitutive elements that operate in series. First, a low-complexity classifier evaluates the high-level music-related features and computes the probability the current audio frame to be speech or non-speech. The HMM postprocessing step is included to provide valuable information from past audio frames to the classification stage. Therefore, the proposed classification scheme, composed of a low-complexity classifier followed by HMM postprocessing, incorporates memory to the speech/nonspeech discriminator, which allows to increase the classification accuracy rate, as shown in Section 4.

Next, the main blocks of the proposed approach for speech/nonspeech discrimination in a DSP-based hearing aid are described.

3.1 Decimated difference function for F0 estimation

F0 can be estimated in both time and frequency domains. The autocorrelation function (ACF) (and its modifications) is the generalized way of computing the fundamental period in the time domain [10]. ACF-based algorithms tend to estimate an integer multiple of the fundamental period, because the analyzed signal is also periodic for all integer multiples of the fundamental period. However, the main inconvenient of time-domain algorithms is their inability of handling multiple F0

Fig. 3 Block diagram of the proposed approach for speech/nonspeech discrimination in hearing aids

estimation (a very common situation in western music). In general, multipitch signals are not periodic anymore, while time-domain algorithms are just based on periodicity.

However, frequency domain algorithms are more robust for multipitch estimation [18]. Frequency-based techniques perform pitch estimation from the Fourier transform of audio signals, which is composed of a train of delta functions for real-world periodic signals. Frequency-based algorithms search for delta functions equidistant in frequency to estimate F0. Although some multipitch estimators are able to detect more than one F0 present at the same time, multipitch estimation is still an open research field [9, 19].

Taking complexity constraints into account, F0 estimation in digital hearing aids should be performed at the lowest possible computational cost. A very simple method to estimate the fundamental frequency of signal x(n) relies on the following property: a periodic signal fulfills x(n) = x(n + 0), 0 being the period. However, the same property is also fulfilled for all integer multiples of the fundamental period. This property is exploited by the difference function df(n,), which can be defined as follows [10]:

df(n,) =

W1

[summationdisplay]

l=0

(x(n + l) x(n + l +))2 (1)

where n is the time index, the delay of the difference function and W the length of the analysis window. The minimum value of difference function df(n,) arises

at the fundamental period (and its integer multiples) of signal x(n). The difference function is directly related with the ACF function, r(n,), in the following way [10]:

df(n,) = r(n, 0) + r(n, 0) + 2r(n,) (2)

Complexity of the difference function is proportional to analysis window length W and sampling frequency fs of the input audio signal. As stated in [10], parameter

W should be chosen at least as high as the maximum fundamental period to be estimated. This requirement implies high complexity to compute difference function df(n,), specially when dealing with low pitched signals, such as speech. In our implementation, the analysis window length has been fixed to 20 ms, which allows to estimate fundamental frequencies above 50 Hz.

In [33], a low-complexity method for F0 estimation in digital hearing aids is proposed. The proposed method computes the difference function at some outputs of the filterbank incorporated into the DSP-based hearing aid, showing promising but not good enough results. Complexity reduction for difference function computation can also be achieved by decimating the input audio signal. In this way, the number of sums and multiplications for each index value is reduced according to the decimation factor.

In this work, we intend to reduce the complexity of the difference function as much as possible, while maintaining the estimation accuracy. The solution here proposed is to redefine the difference function by applying a decimation factor, which results in the so-called decimated difference function:

ddf(n,) =

S1

[summationdisplay]

l=0

(x(n + d(W,)l) x(n + d(W,)l +))2 (3)

where S is the number of samples used to compute the decimated difference function and d(W,) the applied decimation factor. In order to use the same window length W when computing ddf(n,) for all delays, the decimation factor must be function of window length W and delay , as expressed in (4):

d(W,) =
W 1
S 1
(4)
Note that (4) is derived by supposing that the highest delay for ddf(n,) must be less or equal than W S. Moreover, the decimation factor, as defined in (4), avoids
sample selection out of the current audio frame.
Figure 4 illustrates the influence of the decimation factor when evaluating the decimated difference function for any index value.
Decimated difference function ddf(n,) requires S subtractions, S multiplications and S 1 additions for each output value. Therefore, computation of each output
value is now directly proportional to parameter S. A trade-off solution between complexity and estimation reliability can be achieved by properly selecting parameter S, as seen in the results.

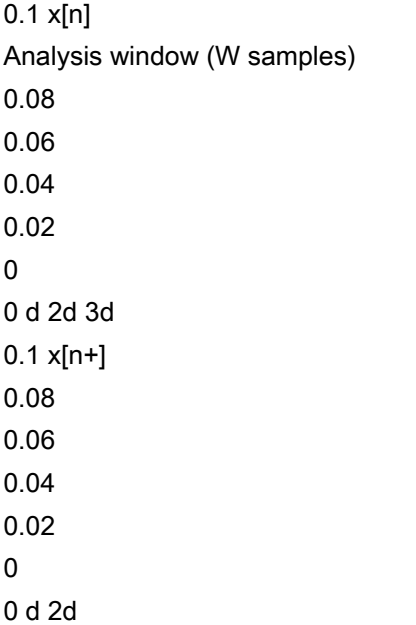

Fig. 4 Example illustrating how the decimated difference function is computed for a given index value. Samples considered for computation are depicted in black. As illustrated, the decimation factor allows to select S equally spaced samples within the analyzed audio frame
A modification of difference function df(n,) is proposed in [10], aiming to avoid typical errors in estimating the fundamental period. For this reason, cumulative mean normalized difference function cmdf(n,) is defined as follows:
cmdf(n,) =
df(n, ())
[summationtext]
j=1
(5)
The cumulative mean normalized difference function is introduced [10] in order to better discriminate the fundamental period from its integer multiples. All these periods lead to local minima of the difference function. However, the cumulative mean normalized difference function reinforces the local minimum due to the fundamental period in relation to its integer multiples. As a consequence, cumulative mean normalized decimated difference function cmddf(n,) has been here considered:
cmddf(n,) =

ddf(n, ())
[summationtext]
j=1
df(n, j)
(6)
Computation of cumulative mean normalized decimated difference function cmddf(n,) does not almost increase implementation complexity. In addition to operations of function ddf(n,), it requires a multiplication, a division and a summation to compute each output value. Summarizing, S subtractions, S + 1 multiplications, S additions and one division are required to calculate each output value of function cmddf(n,).
However, the complexity of function cmddf(n,) for all time and delay values is too high to be implemented in ultra low-power digital hearing aids and should be reduced. It is expected that decimation in both dimensions has great impact on the final complexity. Nevertheless, function cmddf(n,) should be decimated according
ddf(n, j)

to the application we are dealing with. Logically, all n values at a high enough sampling rate (fs = 16, 000 Hz) are not required to obtain good speech/nonspeech
discrimination results. With regard to delay, it initially ranges from = 4 to =
W S, W being the length of the analysis window. Delays from = 1 to = 3 lead
to inaccurate estimations for low frequency signals, because the shifted signal is very similar to the original one [10]. As a consequence, the upper bound for F0 estimation is fixed to fs/4, fs being the sampling frequency of the input signal.
In our implementation, the 20 ms-length analysis window contains W = 320
samples at fs = 16, 000 Hz sampling rate. Further, half-window overlapping is
performed, which involves evaluating function cmddf(n,) each Th = 10 ms. Taking
into account that WS3Th delays (or samples) per second are evaluated by function cmddf(n,) at a given time n0, it can be calculated the number of sums, multiplications and divisions per second required by our F0 estimation method. Therefore, the complexity requirements of function cmddf(n,) are the following:
2S(WS3)
Th sums (additions and subtractions) per second.
(S+1)(WS3)
Th multiplications per second.
WS3
Th divisions per second.
The overall complexity of function cmddf(n,) can be expressed as (2S+4)(WS3)Th
MIPS by taking MAC operations into account.
In Section 4, the system performance has been assessed with different values of parameter S in order to find a good balance between complexity and accurate rate in the speech/nonspeech discrimination system.
Next, the method for estimating the fundamental frequency at time n0 from function cmddf(n,) is described:
1. For all possible values of index, the minimum value of function cmddf(n0,) is calculated.
2. This minimum value is compared with a threshold in order to discriminate between voiced and unvoiced frames [10]. When it is far from zero, the signal frame is not periodic and the fundamental period can not be estimated. Otherwise, the signal frame is labeled as voiced and the fundamental period is estimated. The threshold is here fixed to 0.15 [10].
3. When the current audio frame is labeled as voiced, the estimated fundamental period is the delay 0 for which function cmddf(n0,) takes the minimum value.
Finally, the method provides three values for the current audio frame:

The estimated F0. It is the inverse of the estimated fundamental period (F0 =
10).
Aperiodicity, denoted as Ap0. It is defined as the value of function cmddf(n0,) at the estimated fundamental period (Ap0 = cmddf(n0, 0)). F0 estimation is not
valid when this parameter is above 0.15, the analyzed signal being considered to be unvoiced. A normalized measure of aperiodicity (ranging from 0 to 1) can also be used. Power of the windowed discrete-time signal, denoted as P. When this parameter is below a threshold (215 for normalized signals), the signal is considered to be a silence.

3.2 Music-related features computed from F0 estimation
When dealing with speech signals, F0 estimates match to a characteristic pattern for most of the analyzed signals. Speech signals contain voiced frames (near-periodic) and unvoiced frames (aperiodic), which alternate in time. In most of languages, words are composed of voiced and unvoiced phonemes, which results in several voiced-unvoiced boundaries within a word. Good F0 estimates are accomplished for voiced frames, while it has no sense F0 estimation for unvoiced frames. Moreover, voiced speech frames have a time-varying F0, because the pitch changes when voiced phonemes are pronounced. Instead, music and noise (nonspeech) signals show a quite changing behavior. There is no a generic pattern for such signals. It depends on several factors, such as the music genre, polyphony, instruments involved, type of noise, etc [31]. However, two specific patterns can be identified in music signals:(1) F0 does not almost change when only one musical note is played at any time (near-steady state within the same note); (2) Step-wise changes often happen when passing from a musical note to another. Noisy environments, in turn, tend to remain unvoiced most of the time, although they often exhibits short pitched parts, or long pitched parts with near-steady F0 (for instance, in pitched stationary noises).
In general, although there is no a generic pattern for nonspeech sounds, they differ from speech signals in two main aspects: (1) the absence of intonation (i.e. the time-varying F0 that arises from the pronunciation of voiced phonemes), and (2) the absence of the typical alternation of voiced and unvoiced frames that results from the articulation of words (composed of voiced and unvoiced phonemes). In order to better illustrate these differences, Figs. 5 and 6 are included. In Fig. 5 an example
Speech signal
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
time (seconds)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
time (seconds)
0 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
time (seconds)
Fig. 5 F0 estimate for a representative speech signal of 1 s. a Normalized waveform; b Estimated F0. The thick line corresponds to the segments that are classified as voiced; c Aperiodicity. The dashed line represents the boundary to classify the signal frames as voiced or unvoiced
a
0.4
0.2
0
0.2
0.4
0.6
4

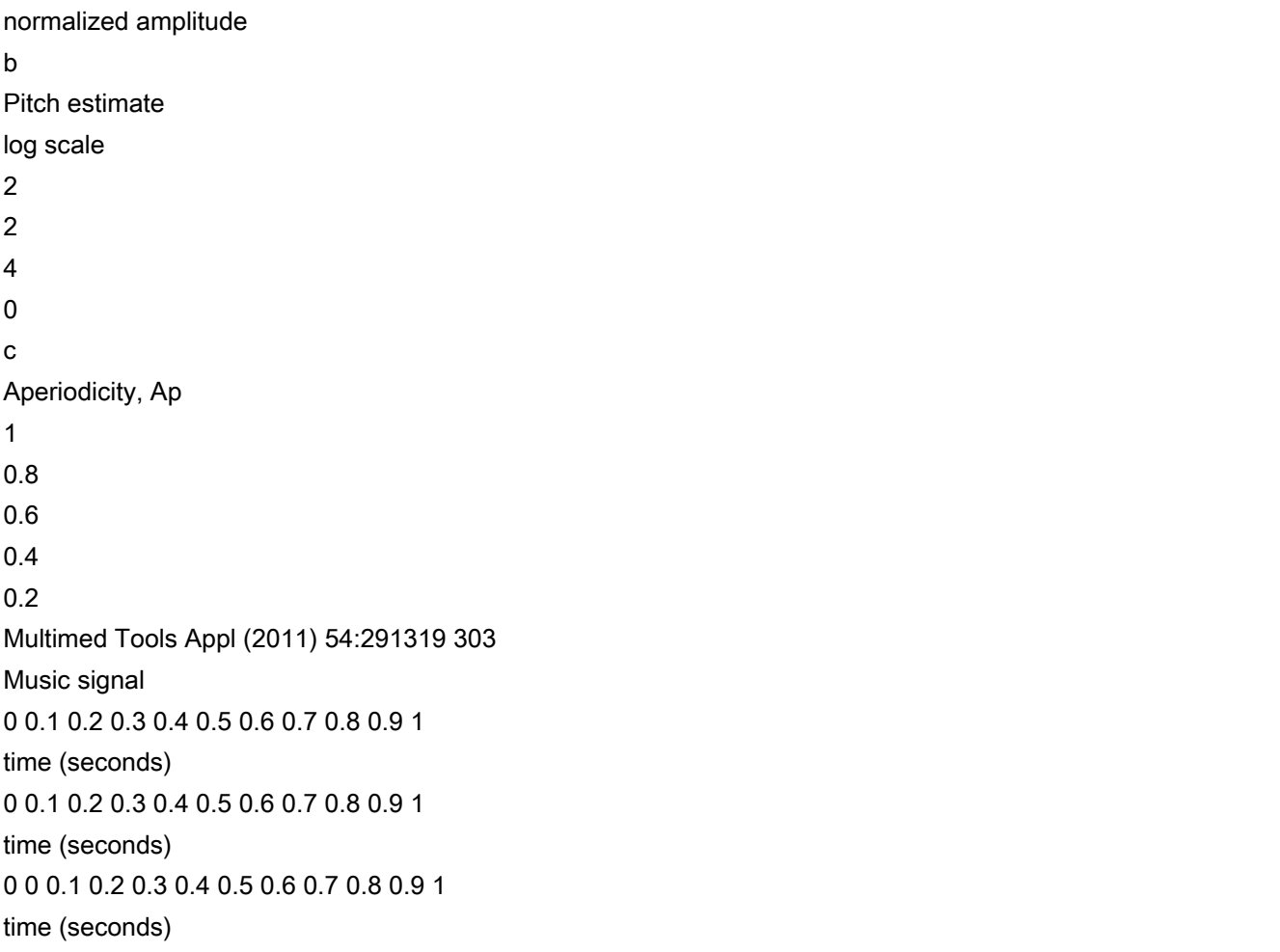

Fig. 6 F0 estimate for a music signal of 1 s. a Normalized waveform; b Estimated F0. The thick line corresponds to the segments that are classified as voiced; c Aperiodicity. The dashed line represents the boundary to classify the signal frames as voiced or unvoiced

of F0 estimation for a representative speech signal is shown. As can be seen, F0 estimation (in voiced frames) slowly varies in terms of the speakers intonation, and the Ap0 sequence exhibits large variations between voiced and unvoiced frames. Figure 6 shows the F0 estimated for a music signal. As can be seen, F0 estimation is nearly-steady in voiced frames, and the Ap0 sequence exhibits smaller variations than those observed in speech signals.

In order to capture these main differences, a set of musically-inspired features derived from F0 were proposed in [31] for speech/music discrimination. Here, we employ these features for speech/nonspeech classification in hearing aids.

Next, the set of F0-based features, proposed by Ruiz-Reyes et al. in [31], is briefly defined:

1. Dynamic range of aperiodicity (DAp). It is defined as the difference between the maximum and minimum values of the normalized aperiodicity (Ap) within the current texture window.
2. Average of F0 estimates (F0av). It is defined as the mean value of F0 estimates at the current texture window.
3. Dynamic range of F0 estimates (DF0). It is defined as the difference between the maximum and minimum values of F0 estimates within the current texture window.
4. Maximum note duration (NDmax). It is defined from the number of consecutive analysis windows comprising the longest musical note within the observation interval (the current texture window).

0.5
normalized amplitude
b
Pitch estimate
0
1
2
3
4
log scale
c
Aperiodicity, Ap
0.8
0.6
0.4
0.2

5. Number of notes (Nnote). It is defined as the number of different notes contained within the observation interval (the current texture window). From F0 estimates in the observation interval, we compute how many different notes are detected.
6. Voiced ratio (V R). It is defined as the ratio between the number of voiced frames and the total number of frames within the observation interval. This parameter informs us about the percentage of frames in which F0 is properly estimated at each observation interval.
7. Average value of the aperiodicity (Ap0av). Mean value of the normalized aperiodicity at the current texture window. It is only defined for voiced frames, and informs us about the periodicity of voiced frames.
8. Aperiodic power (Apw). It is defined as the ratio between the power of unvoiced frames and the total power at the current texture window. It informs us about the percentage of power due to unvoiced frames.
To illustrate the discrimination ability of some of these features, Fig. 7 is included. The normalized histograms in Fig. 7 correspond to features Nnote and Apw when
they are computed using both the proposed F0 estimation method and the YIN algorithm. In subplots (a) and (c), high values of parameter Nnote are obtained for
speech signals, because F0 estimates change with the speakers intonation. Rather, lower values of parameter Nnote are usually obtained for nonspeech signals, because
F0 estimates remain steady in variable-length intervals. As shown in subplots (b) and (d), parameter Apw (aperiodic power) is usually low for speech signals, because unvoiced frames have typically less power than voiced frames. This situation does not happen for noise or music signals.
Further details about the motivation of the F0-based features and their typical behavior when classifying speech/non speech can be obtained in [31].
0 0 5 10 15 20 25
a
Nnote computed by cmddf(n,)
0 0 0.2 0.4 0.6 0.8 1
c
Nnote computed by YIN
0 0 0.2 0.4 0.6 0.8 1
SPEECH MUSIC

Fig. 7 Normalized histograms of features Nnote and Apw for both speech and nonspeech in the following cases: a feature Nnote is computed using the proposed method for F0 estimation; b feature Apw is computed using the proposed method for F0 estimation; c feature Nnote is computed using the YIN algorithm; d feature Apw is computed using the YIN algorithm

When all analysis windows in a texture window are labelled as either unvoiced or silence, the previously described features have no sense, and a boolean flag is activated to inform the classification stage about it.

The required complexity for computing the just-described features is much lower than the computational cost of the proposed method for F0 estimation. The main reason is that music-related features are computed each 250 ms, while F0 estimation is performed each 10 ms. Complexity values of music-related features are shown in Section 4 (Table 3), being derived from feature definitions in [31].

3.3 Low-complexity classifier

To achieve high accuracy rates, the classifier parameters are previously found by performing a training process with a suitable sound database. After training, the classifier is able to classify new input patterns with satisfactory results. There exist a high number of approaches for pattern recognition, each one with different characteristics in terms of performance and complexity. Among them, several low-complexity classifiers have been proposed in the literature for automatic sound classification in digital hearing aids [1, 8]. For such application, it is crucial not only to achieve a high accuracy rate, but also to keep the computational and memory requirements as low as possible.

In this work, two different classifiers have been considered for evaluation: Multilayer Perceptron (MLP) and the

tree-based C4.5 classifier. The choice of the MLP classifier, among a variety of algorithms proposed in the literature, is motivated by the fact that Neural Networks (NNs) have proven to exhibit a proper learning behaviour for sound classification problems. As pointed out in [1, 7] and [4], NNs are able to achieve very good results in terms of classification accuracy rate when compared to other widely used algorithms, such as rule-based classifiers, the Fisher linear discriminant, the k-Nearest Neighbor algorithm or Bayesian classifiers. Furthermore, in [31], it was proved that NNs, evaluated over the set of music-related features employed in this work, provided better accuracy rates than other recent and powerful classification schemes, such as Support Vector Machines (SVM).

A feasible alternative to the MLP classifier, mainly when accounting for the computational cost, is the tree-based C4.5 classifier. Although well-known, this classifier has not been yet investigated for sound classification tasks, and thus no performance results have been reported in the literature on this particular issue. For this reason, and attracted by its low computational requirements, we have evaluated the C4.5 classifier along with the MLP, with the aim of choosing the optimal solution for its application in hearing aids. In addition, both classifiers have also been compared with the classic k-Nearest Neighbor (k-NN) algorithm, which is commonly used in the literature for comparison purposes [1, 8]. Here, given its high computational and memory requirements, the k-NN classifier is only considered as an anchor, and not as a feasible option to be implemented in a hearing aid device.

Next, the three considered classifiers are briefly described:

k-Nearest Neighbor classifier (k-NN). The k-NN classifier needs to store in memory the whole training set to compute all possible distances, thereby requiring high computation time and memory. Although the k-NN classifier involves high computational cost, it is typically used as an anchor for comparison with

feasible classifiers [4]. In this work, a 1-NN classifier is considered as an anchor for comparison purposes

MultiLayer Perceptron (MLP). In this work, a three-layer MLP with eight input neurons, eight hidden neurons and two output neurons is considered for evaluation. Such a network requires 80 multiplications and additions to provide an output value. Moreover, it requires 90 memory-words to store the MLP parameters (the weights of the links and the neuron bias values). An additional number of operations equal to 200 is also required to compute the sigmoid activation function at hidden and output layer neurons (20 operations per neuron) [2]. MLPs have been previously used for automatic sound classification in digital hearing aids [1]. Tree-based C4.5 classifier. It builds decision trees from the training set using the concept of information entropy [26]. Given a set T of training vectors, the attribute and splitting value that provide the highest normalized information gain (difference in entropy) are used to divide set T into two subsets, TL and TR. The same process is recursively applied on each subset until a stopping criterion is satisfied. As a result, a binary tree with n nodes and l leaves is obtained. For each node, two values are memory-stored: an index identifying the attribute and the splitting value for that attribute. For each leaf, two values are also stored: the class (or decision) associated to the leaf, and a probability value of right classification. Therefore, 2n + 2l memory words are required to store the whole tree in the device. Once the tree is built, the complexity of the classifier is proportional to the tree depth (a tree depth equals to D involves D comparisons to classify a new instance).

Complexity information regarding the three low-complexity classifiers to be evaluated is reported in Section 4 (Table 4). The complexity values in Table 4 arise from the performance of each considered classifier.

3.4 HMM postprocessing stage

As defined in [29], a Hidden Markov Model (HMM) is a double stochastic process with an underlying stochastic process that is not observable, but can only be ob-served through another set of stochastic processes that produce the sequence of observations. In other words, an HMM is a mathematical description of a system which may be described at any time as being in one of a set of N distinct states, and which changes its state at discrete times according to certain probabilities. The model is named hidden since the state of the model, q(t),

at a given time instant t, is not directly observable. Instead, only an indirect output value, o(t), which is a probabilistic function of the actual state, can be observed. HMMs constitute a useful tool for modeling time-varying processes, being widely used in applications such as speak recognition or speaker verification [28].
Although the probabilities returned by the classifier can be directly used to take a final decision, usually the decision sequence contains isolated errors. These errors are specially undesirable, because they make the device to change its hearing program for short time intervals, severely reducing the comfort level experienced by the user. Typically, the environment surrounding the user exhibits a rather steady behavior; a given state (lets say speech) is held for a certain period of time, and then, at a certain instance, the environment changes to another state (lets

say nonspeech), which in turn remains steady during another time interval. In order to incorporate this inherent temporal information into the speech/nonspeech discrimination problem, we model the environment with an HMM, which postprocesses the probabilities returned by the classifier.
In the proposed approach, a two-states HMM is employed, where each state corresponds to a different sound class (state 1 for speech and state 2 for non-speech). Therefore, there are only four transition probabilities, which correspond to the following state transitions: speech/speech, speech/nonspeech, nonspeech/speech, nonspeech/nonspeech. The model receives as input data (observation) the sequence of probabilities computed by the classifier, O = {pj(1), pj(2), pj(3), ..., pj(T)}, and
provides the optimal state sequence Q = {q(1), q(2), q(3), ..., q(T)} associated to the
received observation. Estimation of the optimal state sequence (optimal path) is accomplished by the Viterbi algorithm [28].
Once the classifier provides probabilities pj for the current texture window, HMM post-processing has to immediately make the final decision. No backtracking has to be performed for retrieving previous states, since they were already estimated at previous texture windows.
Although the Viterbi algorithm usually performs accounting for information from past signal frames, more accurate results can be achieved by incorporating some future information to the model. However, the accuracy gain is achieved at the expense of increasing the system delay. In Section 4, the proposed low-complexity speech/nonspeech discrimination approach is evaluated when HMM postprocessing is performed for different delay values. Moreover, influence of the delay on the considered application (automatic sound classification in digital hearing aids) is further discussed.
It can be demonstrated that HMM post-processing involves low computational and memory requirements, being negligible with respect to those of the F0 estimation stage. Complexity values of HMM post-processing are included in Section 4 (Table 4). However, in order to make the paper as concise and clear as possible, justifying complexity values is out of the scope of this work.

4 Experimental setup and results

4.1 Experimental setup

The sound database used for the experiments consists of 2,936 files, with a length of2.5 s each one. The coding parameters of the audio files are the following: 16,000 Hz sampling frequency and 16 bits per sample. The audio files belong to the following categories: 1,964 speech files, 366 noise files and 606 music files. The first category is subdivided into two classes: speech in quiet and speech in noise. The speech in noise files have different SNR values, ranging from 0 to 20 dB. Noise files include the following classes: aircraft, bus, cafe, car, kindergarden, living room, nature, school, shop, sports, traffic, train and train station. Finally, music files include two classes: vocal music and instrumental music. This database has been previously used for automatic sound classification in digital hearing aids [1, 3].
The classification results are calculated using a ten-fold cross-validation evaluation, where the dataset to be evaluated is randomly partitioned so that 10% is

used for testing and 90% is used for training. The process is iterated with different random partitions and the results are averaged. The results presented in this section are obtained with 50 iterations. This ensures that the calculated accuracy will not be biased because of a particular partitioning of the whole dataset for training and testing.

In the experimental setup, system parameters are configured as follows:

F0 estimation.

20 ms-length analysis window. Half-window overlapping. It implies that F0 estimates are obtained each 10 ms.

F0 estimation ranges from 50 Hz to fs/4 = 4 kHz.

Music-related features computation.

1 s-length texture window. The texture window comprises L = 99 analysis
windows. The texture window is shifted each 250 ms.

Low-complexity classifier.

The simplest possible configuration is used for the k-NN classifier. Therefore, the considered classifier is 1-NN (only one nearest neighbor).

A three-layers configuration with eighteighttwo neurons is considered for the MLP-based classifier. A sigmoid activation function is applied to neurons at hidden and output layers.

The C4.5 algorithm is executed with the following configuration values: minimum number of instances per leaf equal to 2 and confidence factor equal to 0.25. These values are recommended in [26].

HMM filtering.

Prior probabilities are fixed to 0.5 (speech and nonspeech probabilities are supposed to be the same).

It is supposed that state transitions happen each 120 s on average. From this value, the transition matrix is derived.

The last block is disabled when testing on the above described database, because audio files are too short to get advantage of HMM postprocessing. However, a signal of about an hour has been recorded from a radio broadcasting program (with speech and non-speech parts) to demonstrate the effectiveness of HMM filtering.

4.2 Accuracy results

First, we are going to assess the proposed F0 estimation method for different values of parameter S, with the aim of obtaining an optimum value. Table 1 shows the mean accuracy rates provided by the proposed speech/nonspeech discrimination approach (excluding HMM postprocessing) for different values of parameter S and different classifiers. Results in Table 1 are particularized for each sound class, so that the columns Speech and Non-speech express, respectively, the percentage of speech and nonspeech texture windows correctly classified. The column Global expresses the global accuracy rate, i.e. the percentage of texture windows (either speech or nonspeech) correctly classified. Table 1 also shows the performance of the proposed

Table 1 Assessing the proposed F0 estimation method for different values of parameter S and different classifiers

F0 estim. method	Accuracy rate with MLP (%)			Accuracy rate with C4.5 (%)			Accuracy rate with 1-NN (%)		
	Global	Speech	Non-speech	Global	Speech	Non-speech	Global	Speech	Non-speech
S = 10	87.54	89.35	83.88	85.73	89.05	79.01	81.28	86.99	69.73
S = 20	88.54	89.85	85.88	86.58	89.03	81.63	83.75	88.29	74.57
S = 30	88.76	89.59	87.07	87.46	89.24	83.86	85.14	89.11	77.12
S = 40	89.17	89.86	87.77	87.73	89.53	84.09	86.12	89.85	78.59
S = 50	89.42	89.63	88.98	87.99	88.93	86.09	86.01	88.84	80.29
S = 100	89.01	89.06	88.89	88.25	89.03	86.67	87.33	89.04	83.88
YIN algorithm	90.13	90.03	90.35	88.95	89.64	87.56	88.41	90.01	85.18

Comparison with the YIN algorithm

approach when F0 is estimated by the YIN algorithm [10]. Comparison with the YIN algorithm aims to evaluate the accuracy loss due to the decimated difference function (proposed F0 estimation method).

From Table 1, it can be stated that nonspeech frames are more frequently mis-classified than speech frames when using low values of parameter S. Nonspeech frames have a more heterogeneous nature that speech ones (different levels of polyphony and different pitched and non-pitched instruments). This property makes nonspeech frames more sensitive to F0 estimation errors due to low values of parameter S. However, the speech class exhibits a more steady performance with respect to parameter S. With higher values of S, the global accuracy rate is increased and classification errors are more fairly distributed among speech and nonspeech classes.

The global accuracy rates in Table 1 are also shown in Fig. 8 to better understand the performance of function cmddf(n,) with respect to parameter S. As shown in Fig. 8, global accuracy rates tend to grow as parameter S is increased, regardless of the considered classifier.

Fig. 8 Function cmddf(n,): global accuracy rates vs. parameter S

89

88

87

86

85

84

83

82

81 10 20 30 40 50 60 70 80 90 100

Number of samples (parameter S)

91

90

Accuracy rate (%)

cmddf + MLP

cmddf + C4.5

YIN + MLP

With regard to the classifier, the following comments arise from Fig. 8. MLP achieves the best results for all values of parameter S, followed by the tree-based C4.5 algorithm and the 1-NN classifier. These results are in line with other related previous works, where neural networks have demonstrated to achieve higher accuracy rates than other classifiers [1, 8].

Another meaningful result that arises from Fig. 8 is the following: the accuracy loss between the decimated difference function (proposed F0 estimation method) and the YIN algorithm is reduced to 0.5% in the best case (MLP and S = 55). This

result evinces the good performance of the proposed F0 estimation method when combined with MLP for speech/nonspeech discrimination in digital hearing aids.

4.3 Complexity evaluation

In order to choose an optimum value of parameter S and the more suitable classifier for the application we are dealing with, system complexity requirements must be taken into account. In such sense, Table 2 shows the number of instructions required to implement the proposed F0 estimation method for different values of parameter S in ToccataPlus DSP system from On Semiconductor. In Table 2, complexity of the decimated difference function (proposed F0 estimation method) is only considered. Complexity details of such function are

included in Section 3.1. The results in Table 2 are obtained by supposing that ToccataPlus DSP system for hearing aids is able to perform a simple operation (summation, MAC, multiplication, division) in one single instruction.

Complexity requirements for the remaining stages of the proposed low-complexity speech/nonspeech discrimination approach, namely, music-related features computation and classification, are summarized in Tables 3 and 4.

Table 3 shows the number of operations per texture window required to compute each one of the music-related features. In Table 3, complexity values are expressed as a function of parameter L, which denotes the number of F0 estimates within a single texture window. According to the experimental setup, L = 99. The number of instructions per second, as stated in the last column, is obtained by supposing that music-related features are computed four times per second (texture window is shifted by 250 ms), and that the logarithm operation takes 16 instructions in the processor.

Table 4 shows the complexity requirements of each considered classifier. It also shows the complexity of HMM post-processing. The following assumptions were made for the three considered classifiers:

Complexity of the MLP is obtained by supposing that activation function at each neuron takes 20 instructions [3].

Table 2 Complexity of decimated difference function (proposed F0 estimation method) for different values of parameter S

F0 estimation method Instructions per second

Proposed one, S = 10 736,800 (0.73 MIPS)

Proposed one, S = 20 1,306,800 (1.30 MIPS)

Proposed one, S = 30 1,836,800 (1.83 MIPS)

Proposed one, S = 40 2,326,800 (2.32 MIPS)

Proposed one, S = 50 2,776,800 (2.77 MIPS)

Proposed one, S = 100 4,426,800 (4.42 MIPS)

YIN algorithm 20,415,200 (20.41 MIPS)

Table 3 Complexity requirements of music-related features

Feature Sums per Multiplications Comparisons Logarithms Instructions texture or divisions per texture per texture per second window per texture window window window (L = 99)

DAp 1 0 2L 1 0 792

F0av L 1 1 0 0 396

DF0 1 0 2L 1 0 792

NDmax L 2L L L 7,920

Nnote 0 0 L(L1)

2 0 19,404

V R L 1 1 L 0 792

Ap0av L 1 1 0 0 396

Apw L 1 1 0 0 396

All 5L 2 2L + 4

L2

It is supposed that the decision tree depth for the C4.5 classifier is D = 12.

Actually, the tree depth depends on the training process, and can not be a priori configured. However, during the training process, 12-depth decision trees were very often obtained. That is the reason for choosing D = 12 as a suitable value

for the tree depth. Complexity of the 1-NN classifier is proportional to the size of the training set, which consists

of T = 18, 500 feature vectors for the considered database.

From Table 4, it results that MLP and C4.5 classifiers lead to a low computational cost compared to 1-NN classifier. Although complexity of C4.5 classifier is much lower than that of MLP, the complexity values in both cases are negligible compared to those of the F0 estimation stage. Therefore, the classification stage of the proposed approach can be regarded as a low-complexity stage, even when implemented with a neural network. Taking into account that MLP provides higher accuracy rates than C4.5 with a reduced complexity, we have chosen MLP as the optimum classifier for the application we are dealing with.

The main conclusion from Tables 2, 3 and 4 is the following: the complexity of the proposed speech/nonspeech discrimination approach for hearing aids is mainly due to the F0 estimation stage. The remaining stages do not almost increase system complexity, as shown in 3 and 4. Note that all stages are executed each 250 ms, except the F0 estimation stage, which is executed each 10 ms. Therefore, the value of parameter S has a great impact on the overall complexity of the proposed approach and must be properly chosen to match the overall complexity to ToccataPlus DSP systems constraints.

Table 4 Complexity requirements of the classification stage. Comparison between the three considered classifiers

Classifier Sums per Multiplic. MAC Comparisons Instruct. decision per decision per decision per decision per second

MLP 0 0 80 0 1,120 C4.5 0 0 0 D 48 1-NN 8T 0 8T T 1 1,257,996

HMM 0 6 0 3 36

2 + 11L2 2 L 30,888

Fig. 9 Complexity requirements of the proposed approach as a function of parameter S

Figure 9 shows the overall complexity of the proposed approach for speech/nonspeech discrimination in digital hearing aids as a function of parameter S. The overall complexity results in Fig. 9 are obtained under the assumption that classification is performed by a MLP-based classifier.

As shown in Fig. 9, complexity values higher than 45 avoids the algorithm to be implemented on the chosen device (ToccataPlus DSP system for hearing aids), because the algorithm complexity outperforms the maximum computational capacity of the DSP system. Moreover, parameter S must be below 20 when operating at 1.28 MIPS is intended for ultra low-power consumption in order to extend the battery operation time.

An adequate selection of parameter S can be made by analyzing Figs. 8 and 9. From these figures, it results that a good choice for parameter S is around 30 samples. Higher values (S >30) do not almost improve the accuracy rate while complexity is meaningfully increased.

4.4 Evaluation of HMM postprocessing

For assessing the benefits of HMM postprocessing, a one hour-length radio broadcasting program that alternates speech and nonspeech intervals was downloaded (http://www.rtve.es/resources/mp3/2/0/1222050144702.mp3 Web End =www.rtve.es/resources/mp3/2/0/1222050144702.mp3). The resulting file is first classified by the MLP-based classifier. The result is then filtered by the HMM stage with different delay values. Table 5 shows

the improvement in the classification accuracy rate when HMM filtering is included in the proposed scheme. Moreover, Table 5 also shows how delay influences the classification accuracy rate. Delay values ranging from 0 to 2.5 s are here considered.

The global accuracy rate is increased about 1% when HMM postprocessing is incorporated into the speech/nonspeech discrimination scheme. Higher accuracy rates can be achieved if a certain decision delay is allowed. However, the accuracy rate increases with the decision delay until an upper bound is reached (95.23% for

4.5

4

Overall complexity of the system (MIPS)

2.56 MIPS

1.92 MIPS

1.28 MIPS

Table 5 Performance evaluation of the HMM postprocessing stage.Comparison for different delay values

Classification scheme	Accuracy	Decision rate delay (s)
MLP	92.86%	0
MLP + HMM (no delay)	93.87%	0
MLP + HMM (1 window-shift)	94.56%	0.25
MLP + HMM (2 window-shifts)	94.93%	0.5
MLP + HMM (3 window-shifts)	95.09%	0.75
MLP + HMM (4 window-shifts)	95.17%	1
MLP + HMM (5 window-shifts)	95.20%	1.25
MLP + HMM (6 window-shifts)	95.21%	1.5
MLP + HMM (7 window-shifts)	95.21%	1.75
MLP + HMM (8 window-shifts)	95.21%	2
MLP + HMM (9 window-shifts)	95.22%	2.25
MLP + HMM (10 window-shifts)	95.23%	2.5
MLP + HMM (infinite delay)	95.23%	

the selected one hour-length file). As shown in Table 5, a decision delay of about 1 s can be chosen as an optimum value.

The results in Table 5 are obtained when S = 30 is chosen. Therefore, the accurate rate is somewhat higher for the one hour-length file (92.86% with MLP) than for the audio database containing 2.5 s-length files (88.76% with MLP). The results in Table 5 highlight how critical the considered sound database is for speech/nonspeech discrimination.

As explained in Section 3.4, HMM postprocessing avoids that speech/nonspeech decision bounces in consecutive texture windows. In order to illustrate the benefits of HMM postprocessing, Fig. 10 is included.

normalized amplitude

0.4

0.4

0.2

0.2

0

0 5 10 15 20 25 30 35 40

Nonspeech

MLP decisions

Speech

0 5 10 15 20 25 30 35 40
Nonspeech
HMM decisions (no delay)
Speech
0 5 10 15 20 25 30 35 40
Nonspeech
HMM decisions (1 second delay)
Speech
0 5 10 15 20 25 30 35 40
time (seconds)
Fig. 10 An example of speech/nonspeech discrimination before and after HMM processing. In the upper subplot, a transition between nonspeech (grey line) and speech (black line) is depicted. The second subplot shows the decisions taken by the MLP-based classifier. The third subplot shows the decisions after HMM postprocessing (with no delay). Finally, in the bottom subplot, the decisions taken by the HMM model operating with 1 s-delay are depicted

As seen in Fig. 10, HMM postprocessing performs time-filtering on decisions taken by the classifier, thus providing a more stable output. This property makes HMM postprocessing very useful in digital hearing aid applications, because switching between speech/nonspeech decisions in short intervals causes annoying effects to hearing aids users. Time-filtering is more effective when the model operates with a certain delay, since the output is computed considering some future decisions. In the example of Fig. 10, it is shown how HMM postprocessing with 1 s-delay eliminates all isolated errors at the expense of increasing the system latency in responding to environment transitions.

For the application we address in this paper (speech/nonspeech discrimination in hearing aids), a few seconds delay is often considered as an acceptable latency. For instance, the approach proposed by Nordqvist and Leijon [23] takes about 210 s to change its output after a transition from one listening environment to another occurs. In the approach by Bchler et al. [8], the output of the classifier is observed over a certain time (typically, 10 s), and the class that more often appear in the time interval is taken as a result.

4.5 Comparison and discussion

Several approaches dealing with the problem of speech/nonpeech discrimination in hearing aids have been proposed in the literature [24]. The approach in [3] employs a pattern classifier with two layers, where the first layer classifies the audio signal into speech or nonspeech using a set of features selected by a genetic algorithm. For this approach, an accuracy rate of about 93% is reported. In [2], speech/nonspeech discrimination is performed using a set of several spectral features, obtaining an accuracy rate equal to 86.7%. The speech/nonspeech discriminator described in [4] makes use of a tailored NN to perform the sound classification, reporting an accuracy rate of about 90% with a NN of moderated complexity. These results evidence that the proposed approach is competitive in comparison with recently published algorithms dealing with the same problem. In addition, apart from these quantitative comparisons, several qualitative advantages can be appreciated in our approach.

In our approach, we have focused on the efficient computation of a general purpose feature, namely fundamental frequency, and on its application for sound classification in hearing aids. It is widely known that F0 has a broad range of applications in digital processing of audio signals [10]. In the context of hearing aids, several concurrent applications can benefit from an efficient estimation of F0, such as speech enhancement, noise cancelling or adaptive filtering, which are topics of great interest for improving the comfort level of hearing aids users. Supposing that all these applications were based on F0, the computational effort due to F0 estimation would be shared by all of them, and the additional cost due to sound classification can be considered

negligible with respect to the global computational cost. Further, in our approach, sound classification is conducted over long-term F0-based features, which leads to a very low complexity.

Another advantage of the presented algorithm relies on its flexibility. In the proposed approach, F0 estimates are provided by a decimated difference function, which depends on parameter S to select different levels of complexity. With more powerful computational resources, higher values of S can be selected, thus obtaining better results. Moreover, the proposed approach is not at all dependent on the

decimated difference function, and other methods for F0 estimation (for instance, YIN) might be used if strong hardware constraints were not imposed. In the future, as the memory and computational power increases in low-power DSPs , more accurate F0 estimation methods will be available to be implemented in digital hearing aids.

In summary, we may point out the following advantages of the proposed approach:(1) it achieves accuracy results that are in line with previous published works, (2) it is based on an efficient F0 estimation, which is a desirable feature for other concurrent applications in hearing aids, and (3) it is feasible approach to be implemented into current hearing devices, and flexible enough to provide a better performance if higher computational resources are available.

5 Conclusions and future work

In this paper a low-complexity speech/nonspeech discrimination approach for digital hearing aids is proposed. The proposed approach mainly relies on a low-complexity method for F0 estimation, which consists on computing a decimated difference function. The proposed speech/nonspeech discrimination scheme is completed with a feature extraction stage (music-related features), a low-complexity classifier and a HMM postprocessing. The complexity of the proposed discrimination approach is mainly due to the F0 estimation stage. The remaining stages do not almost increase system complexity.

Classification accuracy rates are analyzed together with the complexity requirements in order to select the more appropriate classifier and an optimum value of parameter S. In such sense, a MLP-based classifier is selected, and S = 30 is a good

trade-off value between accuracy and complexity. The proposed speech/nonspeech discrimination scheme is feasible to be implemented in ultra low-power DSP-based digital hearing aids by choosing the suitable configuration setup. Parameter S must be below 20 when operating at 1.28 MIPS is intended in order to extend the battery operation time (ultra low-power consumption).

The accuracy loss between the decimated difference function (proposed F0 estimation method) and the YIN algorithm is reduced to only 1% in our configuration setup (MLP and S = 30). This result evinces the good performance of the proposed

F0 estimation method when combined with a MLP-based classifier for speech/ nonspeech discrimination in digital hearing aids. The global accuracy rate is increased about 1% when HMM postprocessing is incorporated into the speech/ nonspeech discrimination scheme. Higher accuracy rates can be achieved if a certain decision delay is allowed. From experimental results, a 1-s delay is chosen as an optimum value, the classification accuracy rate being about 95%.

Fundamental frequency estimation has a wide range of potential applications in digital hearing aids. Speech intelligibility improvement in digital hearing aids from F0 estimation will be explored in the next future.

Acknowledgements This work was supported by FEDER, the Spanish Ministry of Education and Science under Project TEC2006-13883-C04-03 and the Andalusian Council under project P07-TIC-02713. We would like to thank E. Alexandre for sharing with us the database designed for digital hearing aid applications.

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Publication date: Aug 2011

Year: 2011

FEASIBILITY OF ULTRA LOW ENERGY DEVICES AND APPLICATIONS

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Publication info: Acta Technica Napocensis 52.3 (2011): 1-9.
ProQuest document link

Abstract: In this paper the results of an extensive literature study on Ultra-Low-Power (ULP) electronics is presented. It discusses an emerging application area, which is characterised by very strong power requirements, called ULP electronics. It aims to evaluate possible applications to derive the requirements that emerging trend in circuits must meet and to recognise as far as possible the challenges, which have to be faced. At first few selected applications which would at most benefit from an ULP design approach, are presented as example. Finally few examples of realized circuits in the market as well as in the literature are given. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract In this paper the results of an extensive literature study on Ultra-Low-Power (ULP) electronics is presented. It discusses an emerging application area, which is characterised by very strong power requirements, called ULP electronics. It aims to evaluate possible applications to derive the requirements that emerging trend in circuits must meet and to recognise as far as possible the challenges, which have to be faced. At first few selected applications which would at most benefit from an ULP design approach, are presented as example. Finally few examples of realized circuits in the market as well as in the literature are given.

Keywords: Ultra-low-power electronics, low-power electronics, biomedical electronics, wireless sensor network.

I. INTRODUCTION

The intensive integration of system-on-chip and the growth of the portable applications' market drive the research of solutions alternative to the standard circuit design that can be capable to further reduce the power

consumption of the entire electronic system.
The research should include all aspects to be realized on the chip, i.e. all aspects of the system should be developed according to low voltage requirements. The digital components, the RF (Radio Frequency) interfaces as well as the analog front-end.
Next to the general low power circuits, there is an emerging product application area characterized by even stronger power requirements, the so-called ULP Electronics. This report is focused on this area. It aims to evaluate possible applications, to derive the requirements that future circuits must meet and to recognize, as far as possible, the challenges which have to be faced.
In this paper, at first, a literature survey on possible ultra low power applications is presented and then the state-of-the- art development of these circuit solutions is introduced.
For each design approach, first the basic concept is shortly described, then the major benefits and drawbacks are presented. Numerous references is given for the further deepening.
A clear border between Low-Power and Ultra-Low- Power circuits is difficult to be set, since the power consumption is strongly dependent on other requirements of the circuit. A widely accepted barrier is 100 μW average power, since below this value it becomes possible for the circuits to harvest their energy solely from the environment [1].
One can envision tiny portable vibration detectors containing an RF interface that could be used in a security situation or in a military environment to monitor access and activity. Such systems could be placed easily and operate over long periods of time. Data entry and equipment control might also be performed in the field using movement and gestures detected by accelerometers.
Sports monitors are already becoming available, fitted onto sport shoes or attached to laces. They will now be available for longer operation. For example, a monitoring accelerometer within ski bindings that causes them to release safely when required is now possible. Performancemonitoring wrist watches will be available not only to monitor movement, but also other body parameters such as blood glucose and cholesterol. Clothing will also be manufactured to detect tiny pressure changes useful in virtual reality scenarios. Measurement of body gait and posture could reduce common complaints, such as backache, as well.
In the medical field, implantable accelerometers are already available in pacemaker applications for adjusting the frequency of stimulations. Other measurements, such as ventricular pressure, may become possible.
Internal tracking of tumors using inertial capacitivebased sensors is another real application undergoing trials. Developments of such devices could be inserted into other organs to aid surgery or radiation therapy. Sensors will also be implanted in the surgical and neurological tools to report on a surgeon's progress and technique.
Multi-sensor patches that measure several body parameters will become available. In fact, the whole drug delivery system-measurement, control and drug delivery- could be incorporated into a tiny portable instrument.
Furthermore, the integration of capacitive chemical sensors and a low-power ASIC will enable highly portable environmental detectors. They could be placed in any situation to monitor for environmental incidents. Equally, low-power inertial and vibration sensors could be mounted within buildings to monitor structural movements, which will aid and reduce the cost of maintenance and inspection. Their use could be of particular interest in zones of high seismic activity. Low-power vibration sensors could also be used to monitor misuse of equipment to reduce warranty liability.
Finally, when supply requirements are this low, the possibility to completely power the device using energyscavenging means becomes possible. Energy-harvesting techniques that convert vibration, heat or light into useable energy will become more prevalent. In many cases, the requirement for batteries will disappear.

II. APPLICATION STUDY

Ultra Low Power (ULP) circuits can be applied in a wide range of applications. Some of these applications are already available and they would benefit from a more parsimonious power consumption. The development of some others is instead hampered by the limited amount of available energy. Some of these applications are

reported in Figure 1. On the x-axis is reported the operating frequency of the system, while on the y-axis an indication of the complexity of the circuit is given. Such values are only qualitative since they strongly depend on the chosen implementation.

II.1 HANDHELD UNITS

Most of the handheld applications require a relative high power, since some of their components cannot be easily scaled in power, i.e. displays or communication blocks. However, the system would benefit from an ultra-low-power design of some of their digital blocks to reduce the overall power consumption of the circuit, since these applications are mostly battery operated power consumption of the circuit, since these applications mostly are battery operated.

Examples of handheld systems are: Personal Digital Assistants (PDAs), Location and positioning system (GPS), Industrial and manufacturing automation, Distributed robotics.

II.2 MEDICAL APPLICATIONS AND HEALTH-CARE MONITORING

Large part of the ultra-low power research is focusing on medical applications, since the quality of life and on the clinical practice would largely benefit by the development and improvement of the technology in this area. Furthermore, the medical market is one of the more rapidly increasing electronic markets. Many medical applications are power limited. There are two major categories:

* the portable applications: the battery operating time is a major figure-of-merit of these systems. A more efficient logic would lead to a more convenient compromise between battery size and computational complexity.

* the sensor networks: each node must operate at a low-power level to obtain an overall low power system. Since the charge or the replacement of the battery of a large number of nodes is unfeasible, especially for large networks the system should be energetically self-sufficient.

The requirements for medical sensors depend on the specific application, (e.g. intensive care, home care [4] or emergency care [5]) since each application is characterized by different specifications of the sensor network infrastructure [6]. A quite general list of considerations that the designer of a medical sensor network should take in mind is proposed below:

* Many medical sensors are rather small. In many applications the communication block necessary to connect the single node to the network is the most expencive one with regard to the required power consumption.
* The data transfer presents not a high density nor a high data rate. Since the energy needed for the activation of the communcication blocks is a significant part of the energy required for the communcation itself, the transmission of parity bits or redondant information is usually beneficial without introducing significant additional costs. In many medical systems, the communication must be ensured in every moment, to garantee the possibility of react to allarm situations.
* The system must be capable of tracking the signal, also in case the patient is moving. This feature is the most important innovation with respect to the simple diagnostic methods used so far.
* The personal medical data must be crypted to preserve the privacy of the patient [7].
* Since the medical data are very different in nature (therefore the sampling frequency may vary from few Hz to kHz) and the number of bits may range from only a few to 24, data aggregation may be not always convenient.

The applications in the medical environment may be divided in three large groups: monitoring systems, hospital medical instrumentation and implantables.

Monitoring Systems

Nowadays, portable medical applications can be found everywhere. Many of your relatives and friends will own battery powered medical applications such as blood pressure meters, cholesterol meters, blood glucose meters, body fat analysers or digital pulse or heart rate monitors. Most, if not all, will have a digital thermometer. These all have something in common. There are five system level blocks: power or battery management; sensor element(s); amplification and A/D conversion of the sensor inputs; control and data processing; and some type

of display (see figure 1). In general, these are battery operated, MCU (Micro Controller Unit) controlled handheld devices that take measurements using various sensors. Obviously, the implementation of these blocks will differ greatly with the sensing, processing and information display demands of the meter type and feature set.

Monitoring of blood pressure: Due to the variability of blood pressure, a diagnosis of hypertension or the evaluation of the effect of treatment is often difficult to make on the basis of single ambulatory blood pressure reading.

In the past, two protocols where mainly used:

- a set of clinic blood pressure readings, so that the physician could estimate the typical value during a normal day or
- the ambulatory blood pressure monitoring (ABPM), a 24- hour ambulatory measurements.

Both solutions are time and cost expensive, so a third solution is becoming more popular: the self blood pressure monitoring (SBPM). The development of low cost and simple use electronic devices, based on the oscillometric technique, has given a relevant impulse for the discussion of this protocol. Physicians are looking for a higher standardization of the instrumentation to better estimate the error introduced by the semiautomatic elaboration done by the instrument during the measurement. Especially for hypertensive patients the instrument should be equipped with a memory to store data until the following clinic visit. The size of the device should be reduced to allow the patient to carry it over the entire day so that pressure measurements can be taken also during the stressful daily activities as well as during sleeping. This data is understood to be of increasing importance in the prediction of cardiovascular risk. The usefulness of telemetry is still under evaluation [8].

Monitoring of the insulin level: Diabetes is a wide spread chronic disease, that requires several daily controls of the sugar level. Especially in the diabetes of type one, that affects children and young people, the monitoring of the sugar level during the diet and lifestyle adjustments is critical, and the fluctuations of the insulin level in the blood are quite dangerous since they may cause permanent damages. To avoid the frequent finger pricks, implantable biomedical sensors are explored, that allow frequent measurements of the sugar level without blood sampling. With an implantable sensor a rate of one measure every 5 minutes could be achieved, so that the sugar peak of a diabetic person could be controlled with the same time constant of the biological regulation of an healthy person. Such constant control is otherwise unrealistic. In the future, implantables capable of delivering the sufficient insulin level are desired. Nowadays some sensor-delivering implantables are in production stage, but the maturity of these products is far from a sufficient high reliability level [9, 10, 11].

Monitoring of pH values: The ambulatory 24h esophageal pH monitoring is increasing in popularity to measure esophageal exposure to gastric juice and to document the presence of gastroesophageal reflux disease, particularly before surgical therapy. Esophageal pH probes are usually well tolerated, but caused belching and coughing during the early part of the monitored period [12]. A continuous 24-hr intra-gastric pH-metry produces a quantity of data that must be evaluated. To improve the clinical usefulness of experimental data, algorithms to post-process such data must be capable of removing artifacts, interference, and noise usually superimposed onto the fundamental signal recorded by the measuring equipment.

An example of such algorithm is described in [13]. It is based on the comparison of the signal received from two different channels.

Monitoring of Heart Rate and Electrocardiograph (ECG): The monitor of the HR (Heart Rate) is a simple application that measures the heart signal only to elaborate the heart frequency. It is not used for critical patients, but mostly for controlling their physiology over relative long periods of time or in particular conditions. It is preferred to the ECG since it is a more simple and less invasive measurement, that however gives sufficient indications of eventual pathological conditions. Example applications are the study of the heart rate fluctuations during the muscular exercise [14], monitor of the heart rate during the administration of sedatives in pediatric or aged patients. There are two types of ECGs: One uses 12-15 sensors for a very short measurement window

(less than one minute). The continuous ECG, instead, monitors the activity for a long time: hours or days. This second ECG is typical for surgery, intensive care, or for 24-hours monitoring. Typical values are sampling 500 Hz/20- bit, computing fc< 10kHz [15, 16, 17].

Electroencephalographic (EEG): It is the neurophysiologic measurement of the elec- trical activity of the brain by recording voltage differences between different electrodes placed on the scalp. EEG is used to monitor and to make the diagnosis of epilepsy, syncope, sleep disorders, coma and brain death. The presence of artifacts requires elaborated post-processing. Ultra low power solutions are desired to be able to realize portable instrumentation for long-run measurements.

Hospital Medical Instrumentation

Monitoring of the inhaled and exhaled airflow and blood oxygen saturation systems (Sp02): Such monitoring techniques are necessary during surgery or for the diagnosis of sleep disorders such sleep apnea. The sensors may measure the airflow itself or the amount of oxygen in the blood. Some airflow monitors presents sophisticate spectrography filters to analyze the different air components of the exhaled air- flow. Such technique is often used during surgery to identify not only the correct respiration of the patient but also to ensure a constant level of the sedative. The blood oxygenation is monitored in patients with inadequate pulmonary ventilation, with degenerative muscular diseases or in the emergency care and during surgery. It is often a optical system, and the first prototypes date back to the 1930s. The sensors are usually applied to a finger, or to the ear [18]. In modern Sp02, sophisticated DSP are necessary to cancel measurement artifacts associated with the patient's movement [19, 20].

Electromyographic (EMG): It is the measurement for evaluating and recording physiologic properties of muscles at rest and while contracting. An electromyograph detects the electrical potential (ca. 70mV) generated by muscle cells when these cells contract, and also when the cells are at rest. In contraction of skeletal muscle a delay exists between the onset of electrical activity and measurable tension, this delay ranges between 30 and 100 ms [21]. Thus, in rapid movements electromyographic (EMG) activity may have terminated before the force can be detected. Abnormal results of the EMG may be caused, among others, by denervation, dystrophy and paralysis. Nowadays the most reliable procedure to perform EMG is with needle electrode inserted through the skin into the muscle tissue, but is painful to the patient, and the muscle may feel tender for a few days. The needleless EMG is performed with surface electrodes, which give much less accurate results due to the higher level of disturbance from the surrounding environment. An increase in the density of the sensors and more elaborate algorithm could make the results of this less invasive procedure more accurate.

Implantables

Artificial retina: an array of 1600 sensors is implanted on the retina tissue. Each sensor has around 100 electrodes. The signals are sampled 4-5 times in a second and the information is transfered to the DSP through a multiplexer operating at 40kHz [22].

Hearing aids: Huge market, it is estimated that 15-20% of the population in the western society suiers in some degree of hearing disability, but only ca. the half of them is willing to accept to wear an aid. The higher reluctance to wear hearing aids is found to be in the metropolitan area among the population with an higher family income [23]. The hearing aids can be divided in:

Behind The Ear aids (BTE): used for mild to moderate hearing loss, the BTE aids have a small case that fits behind the ear. BTEs are robust devices, therefore are usually chosen for children. They present not only the microphone input but also an inductive input, helpful for telephone, conference and classrooms. These aids leave the ear canal in part open, so listeners may still utilize their residual natural hearing, to perceive the lower frequencies.

In The Ear aids (ITE): they can be used in mild to severe hearing losses. Due to the high amplification and to the close distance between earphone and microphone, great eiort in the regulation and the cancellation of the signals must be made to avoid squealing/whistling due to unwanted feedback signals.

Completely In the Canal aids (CIC): they are small and almost invisible. They can be used for mild and sometimes moderate losses. CICs are not recommended for people with good residual low frequency hearing, since these patients would hear their own voice resonate in the head, due to the complete occlusion of the channel.
Bone Anchored Hearing Aids (BAHA): they are surgically implanted systems that use bone transmission as a pathway for sound to travel to the inner ear, bypassing the external auditory canal and middle ear. A titanium implant is surgically embedded into the skull with a small abutment exposed outside the skin. A sound processor sits on this abutment and transmits sound vibrations to the external abutment of the titanium implant. The implant vibrates the skull and inner ear, which stimulates the nerve fibers of the inner ear, through an array of up to 24 electrodes. It is meant for severe-profound deafness (> 90dB).
Wireless Hearing Aids: More economic and user friendly solutions are explored to address the younger and more demanding market affected by mild hearing loss. These products apply many known solution in the field of standard wireless communications and digital signal processing techniques, they are not so strongly affected by the battery life time and offer not only an hearing aid but also radio and telephone communication performances [24, 25].
The electronics of the hearing aids can be divided in 4 blocks:
i. the input block receives the input signal from the microphone or the inductive receiver. In this block there is the first amplification stage, the dynamic compression of the received signal to adjust the dynamic voltage of the signal, and a second amplifier. In many applications a first filter against the background noise is also implemented at this level. The first amplifier is a low input noise block and usually its gain is directly controllable by the end-user.
ii. the filter block is capable of eliminating the undesired signal components. Its transfer function is usually programmable to better fit with the user remaining hearing capability. This filter must be capable of opposing the occurrence of echo signals [26].
iii. the output block amplifies the signal and transmits it to the ear phone. The amplifier of this stage is usually operating in class D, since it must control a transducer, and it must be capable of adapting to the battery voltage level.
iv. the control block takes care of the system parameters, such as the power level. It ensures the optimum functionality also during the battery discharge, it regulates the frequency the clock oscillator, it includes a communication block to exchange data during the programming phase when the earing aid is fit to user specific needs.
Since power dissipation is a major concern of hearing aids, weak inversion is chosen as operating regime in several implementations [27].
Pacemakers: A pacemaker is a medical device designed to regulate the beat-rhythm of the heart. Such an implant may be necessary either when the heart's native pacemaker is not fast enough or when the electrical impulses from the native pacemaker cannot propagate to the lower chambers (ventricles) of the heart. A pacemaker consist of one or more pacing wires within the chambers of the heart. One end of each wire is attached to the muscle of the heart, while the other end is screwed into the pacemaker generator. The pacemaker generator is a hermetically sealed device containing a power source and the control IC. The CRT (Cardiac Resynchronization Therapy) is the pacemaker that stimulates both ventricles, there are some more complex devices that regulate also the upper chambers (atrias). Modern pacemakers sense the heart's native electrical rhythm, and if it is absent for a certain time period, the device will stimulate the heart with a stronger impulse.
Many modern pacemakers include also the function of implantable cardioverter-defibrillator, i.e they are capable to give an electroshock up to 15-20 seconds, in case the ventricles of the heart go faster than the set rate. The research of pacemaker aims at better low power algorithms to better recognize tachycardia, or fibrillation event

in the very early stage, in order to avoid too often high energy controlling pulses and to insure a more regular rhythm. Furthermore it should be able to automatically recognize the patient's activity and to adapt to his/her needs. A longer battery life is also desired.
Deep Brain Stimulation (DBS): The DBS is a neurosurgical procedure to implant electrodes or stimulators, into nuclei within the brain, especially for the treatment of movement disorders. Post-operatively, activation of these electrodes results in alleviation of symptoms, specifically, stimulation of the motor thalamus (Vim) for tremor, stimulation of the subthalamus (STN) for Parkinson's disease, and internal segment stimulation of the globus pallidus (Gpi) for Parkinson's disease, dystonia or dyskinesias [28].
Primarily, there are two types of Parkinson's disease (PD) patients who may benefit most from deep brain stimulation:
- patients with uncontrollable tremor for which medications have not been effective
- patients with symptoms that are well treated with medications but who experience severe motor fluctuations, including wearing offand dyskinesias, despite attempts to control such fluctuations with changes in medications.

DBS is also used to treat Essential Tremor which is the most common movement disorder. In many cases, the tremor is mild enough to be effectively treated with medication. However, in cases where the tremor is severe, it can be disabling. The patient may need help with dressing (buttons), hygiene (shaving), etc., or have spills when eating or drinking. When Essential Tremor is this severe, then DBS becomes an option. Tremor is the only symptom in Essential Tremor, unlike Parkinson's. Therefore, the relief of marked Essential Tremor by DBS can make the patient functionally normal with significant improvement to their quality of life.
The FDA has recently approved the use of DBS for the treatment of dystonia, a relatively uncommon but disabling movement disorder. Dystonia is a condition characterized by abnormal postures and twisting movements. Torticollis is an example of dystonia characterized by twisting movements of the neck. A number of studies have demonstrated the efficacy of DBS for dystonia. Therefore DBS is now an option when medical therapy fails.
High frequency stimulation (>100Hz) during physiologic localization of specific thalamic nuclei demonstrated marked tremor suppression. However, the first therapeutic usage of electrical stimulation in deep brain structures dates back to the 1950s when Heath implanted electrodes to treat chronic pain. In 1987 Benabid demonstrated that DBS placed in the Vim was highly effective in alleviating various forms of medically refractory tremor including parkinsonian tremor, essential tremor, and intention tremor. In 1995 Vim-DBS gained approval in Europe, Canada, and Australia to treat tremor in PD and ET. The FDA gave its approval in 1997.
Two decades ago, neurologist Mahlon DeLong recognized that a deficiency of dopamine makes certain areas of the brain fire offexcessive electrical energy and cause motor disorders. That observation laid the groundwork for new surgical treatments for Parkinson's disease. As further understanding of the pathophysiology of the basal ganglia evolved after the development of the primate model for PD with the discovery of the neurotoxin, MPTP, lesioning and stimulation of deep structures such as GPi and STN predominated. In 1998 in Europe, Canada, and Australia approved GPi-DBS and STN-DBS as a therapy for not only tremor of PD, but also all cardinal symptoms of PD such as rigidity, bradykinesia, and dyskinesias. Recently, in January 2002, the FDA extended the use of DBS to treat medically refractory PD. With the advancements in surgical technique and improved physiologic and radiographic targeting, DBS has evolved to be a safe and efficacious therapy for patients with refractory forms of PD and tremor. Benefits of DBS over lesioning procedures include reversibility, adjustability, and a lower rate of permanent side effects with bilateral procedures.
Microelectrode recording, or MER, is the most precise method of localizing the surgical site. MER is used to further define the image-derived target. Because not all brains are the same, the information obtained from MER gives a more accurate target for final DBS placement. As the microelectrode passes along its trajectory, the doctor is able to visualize and hear the neuronal activity from different areas of the brain. The patient also is

able to hear brain activity and discussions of the neurophysiology team throughout the surgery.
Some requirements of the DBS system:
- The microelectrode drives a current of 5 - 100μA at 300Hz.
- The operating frequency range: 0.1Hz-10kHz
- Voltage signal sensitivity of the sensors: from 50μV to 50mV
- Operating time: 5ms/every second
- Power consumption: 1mW per cycle 0.65μW per stimulation per electrode
- Actual max. amplitude of the voltage stimulus: 10V
- Actual max. amplitude of the current stimulus: 1mA
- Dimensions:
now: 50cm3
2-3 years: 10 - 30cm3
5-10 years: 10mm3
- Most common commercial product: Bion (Boston Scientific- Advance Bionics)
Implantable drug delivery systems (IDDS). In the past, drugs were frequently administered orally, as liquids or in powder forms. To avoid problems incurred through the utilization of the oral route of drug administration, new dosage forms containing the drug were introduced. As time progressed, there was a need for delivery systems that could maintain a steady release of drug to the specific site of action. Therefore, drug delivery systems were developed to optimize the therapeutic properties of drug products and render them more safe, effective, and reliable. The oldest type of IDDS is based on drug suspended in a slow-release solid polypeptide carrier. The speed of the drug release depends on both the solubility and diffusion coefficient of the drug in the polymer, the drug load, as well as the in vivo degradation rate of the polymer. More complex IDDS are the implantable pump systems, where the release of the drug is controlled by an IC that regulate the flow rate in relation with the setting operated by the physician. The major advantages of these systems include targeted local delivery of drugs at a constant rate, less drug required to treat the disease state, minimization of possible side effects, and enhanced efficacy of treatment. Also, these forms of delivery systems are capable of protecting drugs which are unstable in vivo and that would normally require a frequent dosing intervals. Due to the development of such sustained release formulations, it is now possible to administer unstable drugs once a week to once a year that in the past required frequent daily dosing. Preliminary studies using these systems have shown superior effectiveness over conventional methods of treatment. However, one limitation of these newly developed drug delivery systems is their cost that restricts their use in the standard therapeutic practice. The new generation of implantable is desired to be coupled with electronic sensing and actuator systems, for a precise, timed and/or targeted delivery of drugs [29].
Network Sensing
A wireless micro-sensor network consists of tens to thousands of distributed nodes that sense and process data and relay it to the end-user. Applications for wireless sensor networks range from military target tracking to industrial monitoring and home environmental control. The distributed nature of micro-sensor networks places an energy constraint on the sensor nodes. Typically, this constraint is imposed by the capacity of the node's battery. For this reason, a lowpower sleep mode is present in most micro-sensor networks [30]. A 1cm3 lithium battery can continuously supply 10μW of power for five years [31]. The ZigBee Alliance, a consortium formed in 2002, is developing an industry standard for wireless networking of remote monitoring, control, and sensory nodes [32]. Some example applications are:
- smart house: temperature, position, humidity, light, wind sensors
- acoustic sensors, transducers
- movement, seismic vibration sensors
- stress/strain sensors

- gas sensors
- detect/track threats systems

Sensitive elements:

- sense amplifier
- memory cells
- analog front-end (< 5 μW/channel)

Trade-offs for ULP Circuits

In the following some of the performances/choices that may be considered in the design are reported, as guideline to identify the best trade-offfor the ULP circuits.

- low power: clock vs. event driven processing, synchronous vs. handshaking
- power management: sleep mode but with awareness and short wakeup times
- distributed arithmetic logic units to perform on-situ preprocessing and/or data compression
- hierarchical processing structure
- efficient communication protocol for limited data rates
- development of special materials to fulfill application specific requirements (e.g. bio-compatible, flexible materials)
- many ULP application are size limited, but on the other size, to be able to apply very low supply voltages, some parallelism could be beneficial. The best compromise is application specific
- continuous time, real time: the choice depends on the application but also on the circuit implementation
- robustness of the circuit against parameter variations. For ULP digital circuits the worst case dimensioning leads often to a too large oversizing, more realistic results may be obtained with Monte Carlo analysis
- interference, noise are increasing factors of concern in such difficult environment
- capability of dynamical system reconfiguration
- high-independent subsystem, to enable simple protocols for the idle state
- power optimized software: hardware-software co-design is essential to obtain the most efficient system
- heating of the surrounding environment (for implantable <80mW/cm2).

III. APPLICATION EXAMPLES

In this last chapter some ULP prototypes in literature, or ULP products already available on the market, are reported as examples of applications operating with such small power consumption. These applications have been chosen among the many available, for the interesting discussion with which they have been presented, or for the particular market that they serve.

III.1 AUDIO APPLICATION

In [36] an Ultra Low Power DSP for audio application is presented. It is realized in a 0.35μm technology node characterized by a VT = 0.35V . The circuit operates with a VDD = 1.25V and a current of 90μA. To achieve low power consumption a customized design has been made, so that only the time critical computation is executed in the high speed core. Thanks to the full custom design, the building blocks of the DSP could be layouted to reduce the number of gates and therefore the power dissipation. A careful positioning of the registers in the signal paths reduces the propagation of eventual glitches. The DSP has a power management unit to suspend the processor during the idle phase. The building cells are optimized to minimize power and area.

Sensor Network

Architectural and Design Considerations in [1], the design of a sensor node realized at the MIT is presented. The goal was to operate with less than 100 μW. Dynamic voltage scaling and power switching is applied also for the circuit operating in weak inversion, to reduce the power consumption during the low activity operation modes and to limit the effect of parameter variations. In this work it is pointed out how for ULP applications much effort must be focus on 'power awareness' [37] that is on the capability of the system to reconfigure itself as a function of the required performances.

Node Processor

In [35] an asynchronous processor for on-situ elaboration of sensors data is presented. The energy consumption of this dedicated hardware is of the order of pJ/operation. The processor operates between 0.6 and 1.8V supply voltage. It presents a sophisticate wakeup circuit, that improves the efficiency of its power management unit. The software/hardware co-design is essential to obtain the best performances.

Smart Dust

A micro-controller for Smart Dust wireless sensor network is presented in [38]. It consumes less than 12pJ/instruction and includes architectural features to reduce the energy consumption in normal tasks. It is realized in high independent subsystems that can be switched offindependently in case their functionality is not needed, multiple busses, processor halt-mode, one cycle instructions. A ring oscillator with switchable stages is realized, so that the operating frequency may be modified between 5.6MHz and 13.7MHz. The main oscillator runs at 100kHz and the nominal supply voltage is 1V.

III.2 MEDICAL APPLICATIONS

Cochlear Prosthesis

In [39] an implantable cochlear prosthesis system is presented. It is realized in a 0.8µm technology node and the circuit operates with a supply voltage of 4V and with a total power consumption of 126µW (not clear how the 'typical case' is defined). The interesting thing is that the filters operate in sub-threshold regime, although the supply voltage is high and the robustness requirements are strict in medical applications.

ADC for Pacemaker

In [40], the authors present an ADC for implantable pacemaker. It has been realized in a 0.35µm technology node, it operates with a supply voltage between 1.8V and 2.8V, and its overall current consumption is 2.9µA. Since the input signal has a low frequency, the system may operate with a central frequency between 70 and 100Hz. The sampling frequency of the 8 bit, 3rd order delta-sigma converter is set to 8kHz. The ADC is a switched capacitance circuit. The circuit operates in weak inversion, and the architecture is current based. In this operating conditions, the device dimensioning is proved to be not so critical. The following two products are from the company Toumaz Technology Ltd. that developed ULP medical systems.

Wireless Sensor Interface

The SensiumTM TZ1030 is an ULP wireless sensor interface platform for a wide range of medical applications [41]. The device includes a reconfigurable sensor interface, digital processor and RF transceiver with a transmission distance of 3m. On-chip program and data memory permits local processing of signals, reducing the transmit data payload.

The SensiumTM may provides ULP monitoring of ECG, temperature, blood, glucose and oxygen levels. It can also interface to 3 axis accelerometers, pressure sensors, or it may monitor temperature on chip or on an external sensor. It operates with a supply voltage between 1.0 and 1.5V, and its transceiver consumes 2.5nW at 1.0V.

ECG Module

The SensiumTM TZ1038 ECG is an ULP non-intrusive wireless ECG and temperature sensor module, which provides continuous monitoring and analysis of the individual's heartbeat and temperature [42]. The ECG Sensium comprises 3 elements: a wearable ECG sensor module with ULP Zoum transceiver, a temperature sensor and an SD card with in-built Zoum transceiver for receiving the ECG and temperature data. The ECG Sensium module is attached to the body with a plaster. The SD card plugs into a standard PDA running Windows Mobile 5. Received ECG and temperature data are processed and displayed on the PDA and a sophisticated arrhythmia detection algorithm continuously analysis the received ECG. The ULP Zoum transceiver and ECG interface enable the ECG Sensium to be made in a small non intrusive form factor whilst providing continuous monitoring for typically 5 days. The ECG sensor presents a 35Hz bandwidth, a 50-60Hz notch filter. The sensitivity of the measurable signal voltage is between 500µV to 10mV.

IV. CONCLUSIONS

In the previous chapters we have shown several application domains where the power consumption is one of the mayor design concerns. A short overview on some of the standard low-power circuit design techniques have been proposed. However some of the application areas that are under investigation require power consumption levels that may not be achieved through the straight forward implementation of these techniques.

In our belief they can be addressed introducing circuits or part of the circuit operating in sub-threshold regime.

ACKNOWLEDGEMENT

This paper was supported by the College of Engineering, funded by the SMVDSB.

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Publication date: 2011

Year: 2011

Inside the Violence: An interview with the playwright

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Publication info: American Theatre 28.6 (Jul/Aug 2011): 70-87.
ProQuest document link

Abstract: [...] my very first play was called La Dueña, and it took place injalisco, Mexico. For the scenes that happen in Spanish (which are most of them, actually) what I tried to do was just dial up the English and dial down the Spanish. Since I was translating for an American authence, I had to use little devices, like the switching on and off of lights to mark the changing of the language. El Nogalar focuses on the threat of this crime element - let's call it the drug cartels, though it's much more complicated than just drug cartels, because it's so threaded and interwoven now with society. There are checkpoints; there are these informal curfews when we know the capos are out, or they go to restaurants around that time.

Full text: Many of your plays take place on the border between the L'. S. and Mexico, but El Nogalar is the first one that takes place on the Mexican side. What inspired you to cross the border? And how was the experience different from writing plays set on the American side?
Actually, my very first play was called La Dueña, and it took place injalisco, Mexico. But this is the first one set on that side that I've written as an adult. Chekhov is what led me to write in the north of Mexico. Chekhov is not "South Texas" to me. The class, the language, the silence of the comedy, the tragedy - all of it is very Mexican. I wanted to use four languages: English, Spanish, Espanglés and Spanglish. For the scenes that happen in Spanish (which are most of them, actually) what I tried to do was just dial up the English and dial down the Spanish. Since I was translating for an American authence, I had to use little devices, like the switching on and off of lights to mark the changing of the language. That's the kind ofthing I'm sure I'm going to he playing with in this play for a while.
You've said you envision El Nogalar as part of a trilogy of plays set on the border. What are the other two plays

\ou're envisioning, and how does El Nogalar ñt in? This border trilogy that I'm imagining, it's not dealing with the same family or the same characters - it's just a closing in on this crime element that all of Mexico is suffering from. I'm concentrating on the border because it seems to he a hot spot.

El Nogalar focuses on the threat of this crime element - let's call it the drug cartels, though it's much more complicated than just drug cartels, because it's so threaded and interwoven now with society. T he second play will lie about a family that hasn't seen its son for4H hours. Ten years ago that would just mean he stayed out partying too long, but now 4S hours of not seeing someone means something else, so the family is dealing with the fear that perhaps they have been targeted. I expect that the third play is going to be more open: It will be based on the Arabian Nights, and it is inside the anatomy of a kidnapping. Two girls who are kidnapped will stay alive by telling these kind of American pop-culture telenovela stories. So, in the trilogy, we get closer and closer to the violence until we're inside it.

When Nogalar came out, a lot of people were asking me to speak as si une kind ut expert on violence mi the border, but I'm not. 1 just have a family that lives on the border. People keep asking me, "So, what is the answer? How will it get solved?" I don't know! If politicians and heads of state don't know, a little playwright's not going to know. They're not political, these plays. I mean, they are political, hut they're not taking a political stand, necessarily.

Class plays a role in a lot of your work. In Il Wogalar, we're watching a family of privilege being confronted with the limitations of their privilege, and how the nature of their power has changed.

Sure, Nogalar is about a family that came from privilege, but it's also about the maid and the former servant. This crime element is the great equalizer. Things used to affect the lower class more because they were on some sort of a front line. For years, we've been hearing about the "women of Juarez" - they are all poor, brown, young worker women who are found dismembered, raped. But now, it's every woman, every man who has to worry. Everybody is affected. There are checkpoints; there are these informal curfews when we know the capos are out, or they go to restaurants around that time. Nobody can go to the bars; that nightlife is gone. That affects the economy - and so much else.

What did filtering this particular story through Chekhov's Cherry Orchard open up for you, and how did it limit you?

The women of The Cherry Orchard have stayed with me since the first time I read it in class. These women are my tías, my cousins - I know these women. That's why there's only one man in this version of The Cherry Orchard; I adore the stories of women. Sometimes I find myself apologizing for it.

The structure of the play is kind of loyal, at the top, to The Cherry Orchard, and then after scene seven I kind of take out the seams, add some stuff. When I let myself go a little more, Dunia came out as a character in a different wav, and now 1 wonder what would have happened it I had just let myself do with all the characters the same thing I did with Dunia. This was a great learning experience for me.

You've gone from creating work collectively in 50seat storefront theatres to seeing your plays in larger theatres like the Goodman and Steppenwolf. What's been different about the experience of self-producing your w ork in a smaller space and what's happening for you now?

There's no better training than putting up a show for your own company and trying not to go broke. That is practical training at its best. I haven't been "in development" a lot. This has been the first year that I've had workshops and readings and stuff like that. With Teatro Luna, we had this criteria we created for ourselves: 90 minutes and the girls all had to like it. They were blunt. They would be like, "Mm, that's stupid, that doesn't work." Nobody knew the dramaturgical way to be like, "Well, perhaps if you try out..." So you develop, not a thick skin, but an understanding that, okay, nothing's precious. When I come in the room now to workshop, I work so fast! What Teatro Luna gave me was the swagger and courage to make broad strokes - and it's okay, you can just delete them later. I'm not a real big thinker - I'm a feeler.

The Goodman was just plain fantasy. At the same time as I was doing El Nogalar, I was directing Kara I

Iartzler's No Roosters in the Desert at Prop Thtr, a storefront space. My lighting designer tor Roosters, Mac Vaughey, was the assistant lighting designer to Jesse Klug for Nogalar. One day at the Goodman, Mac was like, "I need you to see something, Tanya." He took me behind the scrim and was like, "Do you see the hundreds of lights? No storefront has as many lights as this eye alone." I was in love with the images that Jesse was creating. It was amazing to sit in that tech, to get to be around it with a director's eye. The fact that we could have trees! And this was the Owen, which is the smaller of Goodman's two spaces, and it was, like, the fanciest thing to me. It was just on a bigger scale, with everything that entails.

It was different, though, because it's a lonelier process. I know most playwrights would be like, "No duh. That's just the process of play writing." But for 10 years at Teatro Luna, it was a group process. With El Nogalar, my role was done after a point. In a lot of ways, in the process of Nogalar, I spoke out too late, because I didn't know I could. Sometimes I don't know how to be in the room. I still sometimes help the stage manager, I'm like, "I'll help you set up the chairs!" She's like, "You don't need to do that."

What do you think it means to be a Chicago playwright? Is there something that distinguishes C hicago playw rights troni those in another part of the country?

You know, I'm so pro-Chicago that 1 have tunnel vision. I adore this town. Everybody keeps asking me if I'm going to move to New York, and I'm like, "Why?" In Chicago, I feel needed. Even if that's not true, I feel included. People in this community saw something in me, and they were like, "Let's nurture it." I don't have amazing reviews all around, but the press is often like, "This is problematic, but we can't wait to see what she does next." And the cover of Time Out Chicago - the scrappy, storefront aesthetic got me on that cover. The fact that we respect and honor the storefront - I feel like that is why I am here right now. I need to always be of both worlds. Being at the Goodman, that was like straight-up fantasyland. But even the Goodman, for the most part, is made up of a lot of storefront artists; storefront is in the veins of Chicago theatre. It feeds itself. It's a self-sustaining ecology.

CHARACTERS

MAITÉ: The matriarch of the Galván family, returning to Los Nogales after a 15-year absence.

VALERIA: Make's oldest daughter from her first marriage. Had spent most of her life at hoarding school and university until she came back to settle in Los Nogales.

LÓPEZ: A former field worker of Los Nogales who has made good by earning himself a new fortune. A great navigator of the times.

ANITA: Matte's youngest daughter from her second marriage. Has lived in the U.S. most of her life. A hybrid. Lost.

DUNIA: A maid, the last one left in Los Nogales.

PLACE

The estate of Los Nogales in Nuevo León, México, and its adjacent nogalar (pecan orchard).

TIME

The present.

NOTE ABOUT THE LANGUAGE

This play takes place in México and should actually he in Spanish, for the most part, except that some of die characters speak English. The text can't just exist in English because the hybridity of the tongue is important on the border. Spanglish and Espanglés can only exist when engendered by the two mother tongues and so the play has two settings - two stations as it were: there is the Real World, where characters speak whatever they speak, and then there's the Translated World, where light and sound sort of turn the dial up on the English. Every time a character changes the light source (also when they switch on a light) the language is affected. You'll see. Also, "*" denotes a place of overlapping dialogue. The next line must come in at the "*". Please observe.

BY TANYA SARACHO

SCENE ONE

The master bedroom. A bit tattered now but one can see its former glory. A big ornate bed is the centerpiece of the room. Natural light; however much is able to seep in through the closed drapes.

Dunia is in the middle of changing the bed. She sprays air freshener as she goes in the closet to put away clean, fancy dresses, which she inspects. She comes outside and sprays some more. She is about to leave when she remembers tu take Milites earrings and bracelets out oj her pocket and very carefully put them back in their proper place. As she is doing this, López enters, carrying a book.

LÓPEZ: ¿QUE HACES, DUNTA?* [WHATARE VOU DOING, DUNIA?] ¿Que tanto buscas, ¿eh? [What are you doing here in the dark, bub?]

DUNIA (Quickly, startled): Ay, CHIHUAHUAS. ¡Me espantaste! [Oh, Jeez! You spooked me!]

LÓPEZ: A verda', mente cochambroza.* ¿Que tanto esculcas? [Ah, you see, guilty mind. What is it you're looking for?]

DUNIA: ¿Mente que? iLa tuya fíjate! iGuilty what? Up yours.'/ She throws something at him.

LÓPEZ: ¿Que buscas? [What are you looking for?]

DUNIA: iCaliate tu! ¡A ver sacate de aqui! iShut up! Gome on, get out of here!]

Dunia threatens to throw something else; López ducks. He clicks on the light [Translated World].

LÓPEZ: Hey, why is everything in this house always pitch dark?* Don't you think it's a little...

DUNIA: My chest is thumping. Look at that, tun-tun, tun-tun. Beat.

LÓPEZ: Hey, you're not mad at me anymore! You're talking to me again.

Dunia remembers that she's supposed to be ignoring him. Oh, shoot. A gesture.

LÓPEZ: See, I still don't understand what I did wrong! I said, "Right now is not a good time to let her go work on die border." It's die truth. You go work in one of those maquilas and what will happen?* Oh, man, I don't even want to think about it. You're better oft staying here for now.

DUNIA: My mom was this close to letting me go too! Tbk close. Oh, I hate you so much! Everybody wants me to be here stuck to a post. My worst nightmare is me growing old here, nailed to one of those damn pecan trees out there. I hate you so much.

LÓPEZ: Don't say dial, Dunia. (Beat) You know, I kind of have a duty* to -

DUNIA: A duty to nothing.

LÓPEZ: I only said that to your mother for your own good. A young woman alone on the border -

DUNIA: I was going with Neli, the two of us together, I wasn't going alone.

LÓPEZ: Neli? That little thing with the scared little pigeon eyes?! Like sending two baby calves to a slaughter house. Like putting a sign on your forehead, "Come kidnap me and rape me. cut me into little pieces."

DUNIA: ...I hate you so much.

LÓPEZ: Ah, Dunita. (lome on.

Dunia opens the curtains; the Nuevo León hills and an orchard of pecan trees is revealed, sun-beaten but splendid.

DUNIA: If Valeria walks by anil sees us in here in die Lady's room she's going to say something. Especially with us using up the electricity in the middle of the day. Well, she might not say something to you, but to me, she will say something.

LÓPEZ: It's a sad state of affairs when the Galváns have to save their pennies and watch how much light they fucking use.

DUNIA: Well, it's a sad world right now.

LÓPEZ: That it is. (Beat) So why is your mom so formal with me all of a sudden? Last time I came to your house to visit with her, she was really quiet. She was just different. You too. Being so formal with me. Everybody's being so formal with me lately.

DUNIA: ...
LÓPEZ: What is that face? I'm one of us, Dunia.
DUNIA: Is that right?
LÓPEZ: What do you mean "is that right?" Am 1 the guy who... who taught you how to swim when you were this big? Am I the guy who -
DUNIA: My brother taught me how to swim.
LÓPEZ: Your brother and who else? (Beat) Your brother and who else?
Beat.
DUNIA: You.
LÓPEZ: So why is everyone treating me differendy then?
DUNIA: Well, why do you walk around like someone put a crown on your head?
LÓPEZ: A crown? You got it all wrong, little girl. I don't wear the crown. I'm just the court fool trying to keep the balls up in the air.
DUNIA: Well, you must be a very funny fool for the king on that hill to keep you around then and not cut off your head.
LÓPEZ: Come again?
DUNIA: Nothing.
LÓPEZ: Is that what people think ot me?
DUNIA: I better finish spraying. The whole upstairs smells like a funeral home. (Starts to go)
LÓPEZ: Fine. Then if you won't keep me company, I'm going to sit in this chair and read this book. I came up CO get one of these books they have up in the study. But I thought I remembered there being more books.
DUNIA: Valeria put most of them in boxes. Who's there to read them now?
LÓPEZ: She's probably read them all. She's smart that way.
He settles in the chair to read.
DUNIA: So you're set on reading in this room then?
LÓPEZ: Yes, is that a problem?
DUNIA: No, no. I mean, if you want to sit in your dirty boots in the Lady's room,* then you go ahead and sit, you know?
LÓPEZ: My boots are not dirty... You like these boots? I just got them last week. You like these boots, don't you?
DUNIA: I thought by now, you'd be at tbe airport in Monterrey waiting for them, not sitting around reading hooks but what do I know.
LÓPEZ: Their flight's delayed. Apparently, New York is under 20 centimeters of snow. Can you believe that? 20 centimeters.
DUNIA: Yes, I saw it on the television.
LÓPEZ: That doesn't even seem possible to me.
DUNIA: Oh, snow is like nothing to them up there.
LÓPEZ (Takes out BlackBeny and looks at flight information): Then tell me why their phones are down and why this flight is two hours late, if it's like nothing to them, huh?* (Looking for flight information) it says here it won't land for two more hours.
DUNIA: Show-oft. You see how you are? Always showing oft your new things.
LÓPEZ: Oh this? You like rhis, huh? You want one of these don't you?
DUNIA: Show-off.
LÓPEZ: See, you can look up the w eather and flight into. You can lookup just about anything. (Handing it to her) Go ahead, look. (She won't take it, but she wants to) It has a camera. And a chatting thing.
DUNIA (Snatches itfi'om him): Let me see that thing! The things they invent nowadays. If one's got the money to

buy it, you can have jtist about anything you want.
LÓPEZ: Money is not everything.
DUNIA (Lowers her voice): Ooh, you know who you sound like?
LÓPEZ (Lowers his): No I don't. I won't ever end up worried about what lights I turn on and off. And do you know why? Because I save. I save and I plan. I don't just go around wiping my ass with money like these people do!
DUNIA (About BlackBeny): Oh, you don't wipe your ass with your money? Look at you in your new snakeskin boots. (Beat) I don't know much, but I'd be afraid to be such a show-off around here. Find yourself shot in the back of the head. End up with your head on a post by the highway.* Aren't you scared of them, Memo? They change their mind on a whim.
LÓPEZ (A shift, he's not joking anymore): Hey! Stop talking like that. You understand me, you stop talking like that. What happened to your brother - Martin was my friend, Dunia.
DUNIA: I know.
LÓPEZ: He was my friend.
DUNIA: Well, your friend went and got himself killed by the Maña.
LÓPEZ: Don't say that word out loud, Dunia!
DUNIA: Weil, he did. Got his head peeled like an apple.* Pur ir on a stick like a lollipop.
LÓPEZ: I mean it. Don't be joking like that! What's wrong with you? What is. ..You need to learn to have more respect for. ..for things. How are you going to joke like that about your own brother?* Oh, man. ..that little head of yours.
Beat.
DUNIA: What else can you do but joke? What are we all going to do? Spend the day crying? Well, no. Nobody around here cries either. They don't even let us cry. We all just walk around like we're a movie on mute. You can see people's mouths moving but all you hear is the static.
LÓPEZ: I think you're a little affected in the head, baby girl. Maybe you should go talk to Father Miguel.
DUNIA: Fadier Miguel is the biggest Mafioso in this town! Well, besides that man on tbe hill up there.
LÓPEZ: I'm telling you Dunia, your mouth is going to get you in a -
DUNIA: Why are you the only one they leave alone, Memo?
LÓPEZ:...
DUNIA: All the men your age. Killed. Why Memo?
Beat.
LÓPEZ: Because I know when to keep my mouth shut which is not something I can say for you, little girl.
DUNIA: So that's all it takes to be best of friends with the Maña? That doesn't seem so hard to do.
LÓPEZ: For you that'd be an impossible thing to do. I need to buy you a zipper to sew on that little mouth of yours.
DUNIA: I'm going to figure out a way, Memo.
LÓPEZ: Oh, no. Listen to me, don't go diinking that you're smarter than everybody else because you're not, you're just a silly little thing and I'm telling you, it will end up bad for you. Are you listening to me?
DUNIA: ...
LÓPEZ: This is not a game.
DUNIA: I know this is not a game! Why do you always think I'm just so stupid? I know it's not a game. But people have to do something.
LÓPEZ: Dunia!
DUNIA: Wait, I'm not trying to be a hero. I don't mean something like that! Believe me I'm not trying to end up dismembered by a landfill. All I'm trying to do is learn to swim in it like you. Without drowning.
LÓPEZ: Understand that in all of this, there is no way for girls like you to "figure it out." Women are zeros, you

untierstand me? Zeros to the left. 1 don't want to have to start worrying about you, you hear me Dunia? I already got these rucking women coming in today and I'm going to have enough with making them get that they just can't come in here and parade about the way they used to. I'm going to have a hard enough time making them understand that we are under an occupation. (Beat) Fuck, my stomach. Fuck. (Beat) I send Make email after email explaining the situation. I mean, I'm explaining it the best way I know how. With no flowery language. I am bluntly telling her that it is life or death here and even· time, either she ignores it as in she won't even reply to my fucking email or she just sends some reply asking about the river or the fucking pecan orchard or some silly-ass shit like, "Does Mrs. Garcia still make the pecan candy we love so much?" This is some serious fucking shit we are dealing with here and she keeps replying with questions about pecan candy! (Beat) Maybe I'm just not explaining it to her correctly. But doesn't she watch the news?!

DUNIA: Who would believe the news? To me, when I see it, it all seems like a movie. They say on the news, "Two men found shot to death by Los Nogales," then I walk outside and sure enough, there they are: two corpses by the gates. And neither the thing I'm looking at with my own eyes, nor the television showing close-ups of their dead bodies - neither of those things seem real to me. Who believes us when we tell them?

LÓPEZ: Well, she better believe it or she will lose the little she's got left. If we don't negotiate now while while I got...77»t· Man on the Hill in a good mood, they will just come dowTi from the mountains and take it all by force. Why am I telling you this? This is none of your business.

DUNIA (She starts to exit): And really, it's none of yours either. ..ifyou think about it.

She exits.

SCENE TWO

López settles into the chair again.

LÓPEZ (To himself): You're right about that. This is none of my fucking business. Ah, my fucking stomach. They need to make an actual medicine that works. (Takes out some Mexican antacid) You know why I end up worrying about other people's shit? Because people don't know w hen to shut the fuck up around here, that's why. If I have nothing to say, I don't open my mouth. That has been my greatest gift. Zip it. Laugh when everyone else is laughing, even if you don't understand the joke, laugh anyway. And then shut your mouth. Nowadays if someone sees you open your mouth, even to take a breath, a black truck with tinted windows will come driving down the road and carry you off to the most unfortunate corners ot the hills. So everybody should just shut their mouths. 1 IaIf the shit people say is stupid anyway. Half the shit that people write too. (Looking down at his book, leafing it) People and their words. Words are for idle people. People who don't have to earn a living. (Long pause as he decides on a page and attempts to read; he then becomes distracted by the room) This was the last room I got to see inside this house... we were never allowed upstairs. Well, the playroom, we were only allowed inside the playroom if we were bringing things up or moving furniture, but never the master bedroom. I always thought this room would be bigger, with draperies everywhere and maybe with gold things on the walls or something. But when I finally made it upstairs and came in to see it... (Beat) Yeah, you always think things are better on the other side when the door is closed on you. You imagine it in your head with more color or something. Like this bed. Everyone talked about this bed so much... the Poifirio Diaz bedl It belonged to Porfirio Diaz... Poifirio Diaz himself slept on it! So you think "Oh, well the bed of a president must be better and bigger than normal people's beds, you know?" It must be embedded with gold, dripping with diamonds and shit. But then you finally see the bed and well, it's just a bed. It's a nice bed. It's big and with a nice design. But it remains just an old bed.

He goes to it and tests it. Bounces on it a bit then lies on it; book on his chest.

LÓPEZ: The Porfirio Diaz bed...

He begins to doze off.

SCENE THREE

Valeria is in the playroom, at least we think it's the playroom, because it seems to also seive as some kind of

storage room. There are boxes evetywhere, and things under sheets and tarps. One of those covered treasures is a rustic rocking horse, made of porous pecan wood. Valeria is sitting with these covered artifacts, looking out the -window, fingering a ring of keys. The lights are not on, and the only light coining in is natural light seeping through the windows. Dunia entas canying the rag and spray bottle she had with her in the master bedroom. She clicks on the lights iReal World: Spanish/English].
VALERIA: ¡CUANTAS VTCES LES TENGO QUE DECIR QUE NO PRENDAN LA LUZ* SI TODAVÍA HAY LUZ AFUERA! [HOW MANY TLMES DO I HAVE TO IFLL YOUNOT TO TURN ON THE LIGHTS IF THERE IS STILL LIGHT OUTSIDE.']
DUNIA: ¡Ay, oiga! iAy, no asuste! iYa pues, Ia apagamos entonces! iOh, don't scare me! Alright then, we'll turn it off then!] (Makes a big gesture of turning off the light [Translated World/) There, I .ight off. Dunia holds onto the threshold, reluctant to enter.
VALERIA: How many times do I say it? We don't need all the lights in the daytime. (Notices Dunia hasn't come in) What are you doing?
DUNIA (Shakes her head to say "nothing"): ...
VALERIA: Duniacomehere.
DUNIA:...Huh?
Dunia goes to Valeria.
VALERIA: What did you do to your face?
DUNIA: Nothing.
VALERIA: What did you do?
DUNIA: I didn't do anything to my face.
VALERIA: You look like a cockroach in a bakery.
DUNIA: I just put on a little powder.
VALERIA: You look like you dunked your head in Hour.
DUNIA (Politely): I do not. My cousin Mila brought it from McAllen from a department store. It's made for my color.
VALERIA: Yes, but you have to go and test die colors on your face, she can't just read a color that sounds like it might go with your skin and hope it works. You have to try it on.
DUNIA: Mila and I are the same color, and it looks perfect on her. I don't think it looks bad. Beat) Just that nobody around here ever fixes themselves up so you're not used to it.
Beat.
VALERIA: Well, you look ridiculous.
DUNIA: Well... (Better she shut her mouth)
VALERIA: The flight is delayed. Now they'll get here when it's dark anil we'll have to drive through their checkpoints in the dark - because now these people have decided to erect checkpoints wherever they please! Oh, God I did not want to drive back in the dark.
DUNIA: Yeah, Memo told me the airplane is delayed two hours.
VALERIA: I Ie did? Is he here? (Dunia nods) You shouldn't call him that.
DUNIA: Evenbody calls him that.
VALERIA: Yes, but 1 don't think he likes it anymore. I think he wants us to call him by his name now.
DUNIA: That is his name. That's what anyone's ever called him and now he wants us to start calling him sometJiing else?
VALERIA: Just say Guillermo. Better yet, call him Mr. López.
DUNIA: I'm sorry, but I'm not going to call him Mr. López. You know what Mr. López is doing right now? Mr. López is currently in the master bedroom snithng around.
VALERIA: He's what?

DUNIA: I found him there roaming like he was Peter through his house.
VALERIA: What is he doing up here?
DUNIA: That's what I wanted to know. He said he was looking for a book to read. I Ia! Like he's ever read a book in his life.
VALERIA: Dunia.
DUNIA: I'm sorry but you know you think the same as me. I'm just saying what I see.
VALERIA: Well. ..stop seeing things. ..and go and tell him that. ..ah, go anil ask him it he wants a drink.
DUNIA: You go ask him. (A lookfiam Valeria) I mean, maybe you should ask him, you know? So the two of you can -
VALERIA: So we can what?
DUNIA: You know... so you two can talk.
VALERIA: And what will I say to him? I'm already thinking about this agonizing drive we're going to take to Monterrey. He never says a word!
DUNIA: I don't know. ..maybe ask him to teach you again about how to chat on the computer.
VALERIA: No. We treat him as if he sdii worked here. And it's absolutely embarrassing. We should have the money to have people do these things. (Beat) What are you looking at me like that for? Dunia makes an "Fm not looking at you" gesture.
VALERIA: You look ridiculous with your hair like that.
DUNIA: Like how? This is how they wear it on MTV.
VALERIA: You watch the Satellite too much.
DUNIA: Not anymore. No more Satellite. Now how else am I going to learn about the world in this little town?
VALERIA: Enough talking! Go and make sure you sweep all around the house. Especial!}' the porch.
DUNIA: Fulgencio already went around doing diat in the morning.
VALERIA: Poor old man, you let him bend his back to do that?
DUNIA: He wanted to do it. You know he's hungry for something to do. He sits by the front door like this (Demonstrates) just looking ahead like one of those London soldiers.
VALERIA: Still you should supenise him so he doesn't break a hip. (Beat) Should I change? Maybe I should change into something else. No, this is fine.
DUNIA: Maybe put on something more lively?
VALERIA: Like what?
DUNIA: I don't know. Like with color. Or like with flowers or something.
VALERIA: I'm not going to go around looking like I belong in a circus, thank you ven' much. No, I think this will be fine...
Valeria exits.
DUNIA (To herself: Please, they wouldn't even let you sell tickets at the areas. You'd depress the clowns, make the monkeys cry. Please. God, if I ever look like that when I'm her age and let all this go to waste (Referencing her body) shoot me like that, in my head.
She shoots her head with her finger.
SCENE FOUR
López enters.
LÓPEZ: I fell asleep in there. That Porfirio Diaz bed is a trap.* You sink right in.
DUNIA (Under her breath): ...Shameless. So shameless.
LÓPEZ: 1 low long was I down for? Why didn't you wake me up?
DUNIA: Oh. now I'm your alarm clock too? You weren't even asleep for 10 minutes you just -
A great commotion is heard. Il e hear dogs barking, car doors opening and closing, a bag being dropped and just the general feel of an arrival. López goes for his piece. Yes. old boy is packing. OKf But just don V make a

big deal out of it ever. This is just -what the men do now. Dania notices.
DUNIA: NO. I think thatls them. Pur that thing away!
LÓPEZ: How is that them? That can't be them, their flight is -
DUNIA: I don't know, but I think it is!
López hides the gnu again and runs down the stairs. On the way down, he meets Valeria on the landing, -who's just appeared. They kind of awkwardly greet each other and he exits out the front door. It has staited to get a little dark without us noticing iStill Translated World].
VALERIA (Overlapping)'. Memo, I didn't know you -I mean Guillermo. Oh yeah. Go, go.
LÓPEZ: Eh, I'm going to help with the -
There are no lights on inside the house, but something's going on outside with the car's headlights and dusk. Dunia puts down the rag and the Febreze bottle and as she 's about to go out the door, Valeria stops her. All this happens fast and has a tinge of chaos.
VALERIA: What's going on?
DUNIA: I think it's them. I think they got here early after all.
Beat.
VALERIA: But they were delayed two hours! (Dunia shrugs her shoulders) Well, go help them with their things! And turn on the lights for God's sake!
Dunia tarns on the lights iReal World: Spanish/English],
DUNIA: ¿Ah, si ahora si prendemos la luz perda'? iOh yeah, now we do turn on the lights, hub?]
VALERIA: iÁndale ve! [Go already!]
Valeria comes down the steps slowly as we hear the next exchange of voices coming from outside.
LÓPEZ (Overlapping): iA ver, Fulgencio! Las maletas. Yo les ayudo con esto, no se preocupen, yo les ayudo.
MAITÉ (Off): Memo! ¿Eres tu Memo? No te reconosco... An is, do you remember Memo? Dios Santo, look at my orchard Anita! I feel like running* por El Nogalar this instant. Y estos perros? I don't recognize these dogs. Oh, your allergies are going to kill you if he's an insidedog, Anita.
ANITA (Off): Mom, seriously don't start with that. Mom . . . Mom please don't start. Jesus Christ! Can you just stop airing crazy and come inside with us please? Can somebody please go make sure she doesn't fall flat on her ass please? However you say it... ve con ella! Please.
Anita enters the foyer. Dunia trails her with bags.
ANITA: Oh, God. ..it's just like. ..like a fuckingfreak show everywhere we go. And there goes that little old man chasing after her. He's going to break something.
DUNIA: Salio volando Ia Señora, fl'he Señora took off'flying.j
Beat.
ANITA: Yeah.
Beat.
VALERIA: Anita.
ANITA: Oh, my God, Vale. (They hug long and hard) Vale...
VALERIA: Parale si no voy a llorar, eh. [Stop or VU start ciying, eb.j
ANITA: Vale...
VALERIA (tenderly): ¿Ya, no? Aiuta... (They have a little moment. These sisters haven't seen each other in a while) ¿Y Mam? iAnd Maini?!
ANITA: She ran off like a maniac of course. Oh, God Vale, she kept crying and acting crazy at the stopover in Houston so I gave her a little pill to calm her down hut I think it just made her more crazy.
VALERIA: ¿Como que se fue corriendo? She can't go out like that when it is getting dark.
ANITA: Well, I don't know, (io get her then.
VALERIA: Ay, J a empezamos. /Miorita regreso. Dunia, lleva esto para arriba, porfavor. iAh, here we go. I'll be

right back. Dunia. take this upstairs please.]
DUNIA: Si para alia iba. iYeah, that's where I was going]
VALERIA: Ya estas en casa, hermanita. fi'ou are home, litte sister]
She exits.
ANITA: Am I? I guess this is home now, huh?
A pause. Anita contemplates the house. The exhaustion is super evident; she is mad tired. After a while she notices Dunia.
ANITA: Hola.
DUNIA: Hello.
ANITA: Nice. Hi. (Beat) Warning, hola is as much as you're going to get from me, OK? My Spanish is. ..No hablo el Español muy -
DUNIA: Ah, don't worry. Do not worry you. I have been practicing very much.
Beat.
ANITA: Great. Awesome. I mean, I'll understand everything you say, I just can't. ..Yeah. (Beat) I'm beyond tired. Do you know which room I'm -
DUNIA: Oh, yes. Come, te instalamos in the pink room. Vale she said the pink room.
ANITA: I don't care where you put me at this point, as long as there's a freakin' bed.
DUNIA: Ah, pues Ia Señorita Valeria. This is the room of boxes now.
ANITA: The room of boxes? Why is this the room of... Oh, I can't think about it right now. I'm seriously dying of exhaustion. I just want a bed and I want sleep.
DUNIA: You would like a coffee?
ANITA: No, diank you, Dunia. Then I won't sleep. I want to actually sleep.
DUNIA: I can't. ..even laugh that you are here. You left when you were more young but I have very pretty memories of when we played.
ANITA: What? You don't have to Speak...] mean, you can say it in Spanish. I understand everything. I just... I'm self-conscious about my accent.
DUNIA: No, you are my only opportunity to practice. I tell you thai I want to have a proficiency.
ANITA: Alright, you can practice with me so you can have your proficiency.
DUNIA: Oh, that's very good. I have not before told you but I want to leave from here and go to live in the United States.
ANITA: Why? Don't you know we're all coming back? I'm hunirrv. I want some flautas. The food is like one of my constant... it's the thing I remember the most. And this room. Will you go and ask what's her name for me, please Dunia?
DUNIA: The cook, Tere? Ya no esta Tere. /Tere is not here anymore./
ANITA: Where did she go?
DUNIA: Se murio - ah, she died the last year.
ANITA: Oh, no. That's terrible. Nobody tells me these things.
DUNIA: Yes, the last year. Of neumony. (Beat) Pulmonv?
ANITA: That's so sad.
DUNIA: Yes.
Beat.
ANITA (About a typical Mexican toy): Wow. Look at this thing. I always used to get these ribbons tangled when I was a kid. God, it's like time skips over this house. Everything stays the same.
DUNIA: Not everything. Everything is different now. In die town, in Los Nogales. It is different.
ANITA: Different how?
DUNIA: I let Valeria or somebody tell. Wait a minute, I will get the hang. You know I wasn't waiting until you

come so I practice the English.
ANITA: Look how tall the trees look from here.
DUNIA: Yes, they are tall now. Nobody who cut them.
ANITA: They're not as green as I remember. Even though I never thought. ..I never thought this orchard was much to look at. It was tun to hide in and run through, but. ..but it's what we've got, right? (Beat) Oh, my God I'm exhausted.
DUNIA: Entonces is good you come early verdad?
ANITA: Totally. We would have been like stranded for two hours if it wasn't for that guy Pedro who was so sweet to bring us all the way home. (She's uncovered a doll) Oh, my God. This was my doll!
Bear.
DUNIA: Pedro Treviño?
ANITA: Yeah, that's his name, right? Pedro. The teacher guy. (Beat) Rosita! This doll's name was Rosita!
DUNIA: Pedro Treviño is not a teacher guy anymore.
Valeria has entered. She's not too happy with Dunia's talk of Pedro.
VALERIA: Dunia. A Alami se le antojo cafe. Con canela, como Ie gusta. Andale. [Go make the coffee, go on. Marni has a taste for it - Go.]
DUNIA: Voy. [Going]
Dania exits with a knowing look to Anita.
VALERIA: No la aguanto. Es insoportable. [I can't stand her. She is insufferable.]
Beat.
ANITA: Look, Vale! This was my favorite doll.
VALERIA: They are all here. Every one.
ANITA: Why are they all in boxes? Why does this make me want to cry?
VALERIA: You are tired.
ANITA: We haven't slept. Maini was on an up the whole way.
VALERIA (Lovingly grabbing her face, petting her hair): You are home, hermanita - Look at you, Anis. You are here.
ANITA: Yeah.
VALERIA: 1 know it has been so very hard for you this year. Let me tell you, it was the loneliest Christmas here.

ANITA: See. ..don't say those things to me, Vale. It makes me feel guilty for getting to be over there, closer to Mami.
VALERIA: No, no te lo digo por eso, chiquita. [No. that's not why I say it, baly girl.] It's just the way it is, right? I am just... I am just happy to .see you. It has been such a long rime without seeing you.
ANITA: Vale, you see me when we Skype.
VALERIA: Oh, I hate that thing.
ANITA: It was a hot mess, Vale.
VALERIA: No. me lo imagino. iNo, I can imagine]
ANITA: No one has gotten any sleep with this big final opus of a fight she had with you know who.
VALERIA: Te hacemos un tesito. [We can make you a bit of tea.]
ANITA: No, Vale. I'm trying to tell you that she's not OK. I don't see her for almost six months, we hardly talk on the phone even and then out of the blue, one day she comes to get me at school. She comes on a random Tuesday with no warning. Wild-eyed and super hyper and she just goes and pulls me out of school, just like that. We drive into New York and her mouth doesn't stop. We get there and she's living - because I don't know if you know, Yale, but she lost the loft downtown. She sold it and still managed to have no money for my tuition. You think I don't know that this is why she took me our of school?

VALERIA: Anis
ANITA: Why is she always a fucking mess?! She lost her passport, now the cell phone, we almost didn't have money to get here. We had to fly economy class!* I don't even want to tell you where we were staying. This man she's living with, he pretends to be this intellectual, but he's just a fucking meathead. He treats her like a servant. He says things about her being Mexican. Things like I've never heard before about us. People don't talk about us that way.
VALERIA: I'm sorry, Anis. Please, don't tell me these things.
ANITA: He does. When he says the word "Mexican" it sounds like he's saying a bad word. Like he's saying "shit" or something. I don't know how to explain it.
VALERIA: You know he means other kind of Mexicans. You know what he means. He doesn't mean us.
ANITA: Fucking idiot. (Pause) \ralc, I think Maini stays because she has no other place to go.
VALERIA: No me digas eso, porfavor.
ANITA: I'm worried, Vale. He took all our money.* He drained her. Oh, don't cry Vale. I'm not saying it so you'll cry. I'm saying it because I haven't been able to talk to anyone about this. I'm saying it because, because I'm home right? I'm home and just want to sleep for two days and go back to being myself. Go back to not worrying about anything.
VALERIA (Starts to cry): I know. ..I know. You should rest.
Beat.
ANITA: Has he proposed to you?
VALERIA: Quien?
ANITA: What do you mean "quien"? Memo. (Valeria shakes her head) Well, what are you waiting for?
VALERIA: What can 1 do? Propose to him myself? Oh, the whole thing is so embarrassing. Every woman we know is married, it seems. I'm the only. ..hasta a Dunia le han propuesto matrimonio. [Even Dunia has had offers of marriage.] She's got an accountant, a butcher and a man who fixes cars after her. Like flies she's got them after her. ¿Y yo? I do not even have this one man that everyone says... this one man who is the whole reason I stayed in Los - Oh, it makes me sick to be around him. I start shaking. I don't know if it's anger or just pure - I don't know.
ANITA: He loves you, Vale. It's always been so obvious. And the way he's kept watch over you and over Los Nogales. It's obvious.
VALERIA: Is it? If it is so obvious, what is he waiting for? No, he doesn't even notice I am alive. No se. ..When Papi died, I came here because there was something safe about knowing Memo would be around but
ANITA: Ok, let's not talk about dads in this room. It makes me miss mine. Why do men die?
A moment of tenderness between them.
VALERIA: Sometimes I think I imagined the whole thing. All those letters.
ANITA: Letters are so romantic. Who writes letters anymore?
VALERIA: Well, he wrote letters. The entire time I lived in England, he wrote me. He wrote me these long - well, I've shown you, these long nonsense letters that maybe you'd think a fourth grader had written, but to me they were... they were Los Nogales to me. Pedacitos de el, de esta tierra, del aire. (Beat) Ey, Anita, porfavor no le comentes - don't tell Marni about the letters, OK?
ANITA: OK.
VALERIA: She's always been strange about Memo... I don't know.
ANITA: Yeah, I know.
VALERIA: I'm not imagining it, right?
ANITA: But he's like doing really well, right? Isn't he like a big*. ..That's good for you, Vale. He'll take care of you.
VALERIA: Yes, he owns a lot of property now. A lot. He can't even look at me in the face, how is going to then

take care ot me?
Maite calls out as she 's racing up the stain.
MAITÉ: iNIÑAS! ¿NENAS DONDE SE METIERON? iNIÑAS! [GIRLS! WHERE DID YOU GOi GIRLS!]
Matte' enters out of breath. Her boots are muddy and her hair a bit disheveled but she is a vision. She is quite beautiful. Regal in an approachable sort of way.
MAITÉ: There you are, mi Vale. Vale, the nogalar is completely dry! Hasta de noche se puede uno dar cuenta de lo seco que están esos arboles. iMy pecan trees are completely dry! Even at night you can see how dry they are.) My mother would weep right now !
VALERIA: Marni como quieres que -
MAITÉ: iAY, MIS HTJAS! (Contemplates both her daughters) Dios Mio, ya paresco La Llorona, (-orne here, Vale. Ven te digo. Mis dos hijas together at last. How long since you saw each other? Over a year?
VALERIA: Three years, Mam.
MAITÉ: Three whole years! Mi pobre, Valeria, tan demacrada. iMy poor Valeria, so weathered.] Look at these bags under your eyes, mi Vale. I have an excellent cream for this. Don't you worry. (Hugging Valeria) But why so skinny? Look at her tiny little wrists, Anita. Estas hecha un hueso, Vale. It's all my fault. I'm starving you aren't I?
VALERIA: Pues, tu si que te ves hermosa. Mamá. Como siempre. [Well, you do look beautiful, Mont. Like always.]
MAITÉ: iDe que hablas, estoy hecha un asco! [What are you talkingabout. I'm disgusting!] Look at me. I'm all w rinkles and sagging skin.
VALERIA: No, you look amazing, Maini.
MAITÉ: We do look like we could be sisters, don't we?
ANITA: Maini, your boots. They're full of mud.
MAITÉ: Oh, they're just boots! Ay, here. I'll take them off. Probably should throw them away, they're all wet. I think they're mined.
VALERIA: No, Mamá.* We'll clean them.
MAITÉ: iPero ve esto porfavor! iMi cuarto de jugetes! Mi niñez. [But will you look at this! My playroom! My childhood./ ¿Pero porque lo tienen en este estado, Valeria Guadalupe? iBut why do you have it in this state, I aleña Guadalupe'] This is an apocalyptic disaster zone!
She begins to uncover things, quite dramatically. Valeria and Anita react vocally: "Mama, pot favor el polvo." 'Jesus, Mom. My fucking allergies," etc.
MAITÉ: Awake! Awake my friends! iEs hora de despertarse] iIt's time to wake up!]
She has uncovered all but one treasure. She becomes distracted ly some dolls.
MAITÉ: Mis muñecas. Look at this, Ana Maria. This was one of my first dolls. They don't make dolls like this anymore. (She unearths an even older doll) Hello old friend. Have you been forgotten under all this dust? (She is on the floor with an armful of dolls)
ANITA: Mom, I think that one was mine.
MAITÉ: Really? Well, here you go then. Now you two are reunited. (Beat) Wait. WTiere's the...where's my horse. Donde esta el caballito de Madera -
She unearths a beautiful brown rocking horse, a bit weathered but still showing some signs of its fanner majesty.
ANITA (Under her breath): Oh, fuck. Tavito's horse.
MAITÉ: No. Not Gustavito's horse. This was my grandfather's horse. My great-grandfather had it made for him from two nogales. I never told you that, did I? Pecan is not good for these kinds of things, too porous, pero el bisabuelo wouldn't hear "no." We've been a family who hasn't understood the word "no." He was always so proud of this orchard, of those trees and - Look at you my old friend. (Some ciying) WeVe gotten old haven't

we? Forgotten, tu y yo. I wish you would have seen this in all its glory, Anis.
ANITA: I remember the horse. Mom.
MAITÉ: I used to play for hours in this room. This room was glorious. We had an entire wall of music boxes because my mother - 1 wonder if there are any of them left. She collected them from her trips to Europe and South America. She had one from Martinique con una negrita asi. ..que se movía asi. ..(She does a (inick hip dance) Why do we forget the things that matter? Look at this place now. It breaks my heart in two. Is there any going back now?
Beat.
VALERIA: You must be so tired...
MAITÉ: Anis... (Beat) Mi bolsa porfavor.
ANITA: No, Marni. She wants to take some pills that make her loopy and I already gave her something I shouldn't have. She should just go to bed.
VALERIA: ¿Porque mejor no te duermes, Mamá? ßlliy don't you go to sleep instead. Mom?]
MAITÉ: I'm not tired. 1 could do jumping jacks right now.
Dunia enters with coffee.
MAITÉ: Ah, Dunia. Pero no puede ser lo cuanto has crecido Dunia. [Ah. Dunia. But it can't be, how much you've grown Dania./ (To Anita and Valeria) She was this big when I left. Y tan guapa Dunia. iNow she's a full grown woman, and so attractive Dania.]
DUNIA: Favor que usted me hace. [You're too kind.]
MAITÉ: Just look at her.
ANITA: Maini, don't drink the coffee please. You won't sleep.
MAITÉ: Dunia, estas dos aburridas me quieren mandar a la cama, pero que se vayan muchísimo a la chingada.]Dunia, these rwo bores want to send me to bed, but they1 can go straight to hell.] You go to bed, you old ladies. The night is for the living!
DUNIA: El Señor 1 ,ópez Ia esta esperando abajo. ¿Que disque que tiene que hablar con usted muy urgentemente? /Mr. López is waiting for von downstairs. He said something about needing to speak to yon urgently?]
MAITE (To Valeria): Who?
VALERIA: Memo. Guillermo López, Marni.
MAITÉ: Ah, Memo! Yes! (Quick beat, it's something) Ese Memo. Howhandsome he's gotten. Envarnecio, eh. iHe's filled out, eh.] (To Valeria) iVderia, mas vale que te pongas las pilas, mi amor! [Valeria, you better get with it, my love!] I want to be a grandma before I'm too old. A ver que quiere el distinguido Señor López. /Let's go see what the distinguished Mr. López wants.]
They exit. Beat.
VALERIA: Why did she act as if she didn't remember Memo at first?
ANITA: Prepare yourself again for the mysteries of Marni. Speaking of Memo, why did he leave us stranded at the airport? If it hadn't been for that Pedro* we would still be there.
VALERIA: Memo didn't leave you stranded; we thought you were coining in later. You know, I have a strong feeling that it wasn't a coincidence that Pedro was there. He was waiting for you. Pedro is not. ..Pedro is Maña. Es un sicario and a ven dangerous man to have around.
ANITA: Maña like the... ?
VALERIA: YES.
ANITA: My brother's teacher is now Maña?
VALERIA: YES!
ANITA: He doesn't look Maña.
VALERIA: And what does Maña look like?

ANITA: Like, you know... like with dark sunglasses and guns. Like Scartace.
VALERIA: Por Dios, .Ana Maria! Claro que no.
ANITA: Like scary. Pedro didn't look scan to me.
VALERIA: Well be scared. We are all contaminated here. They look like you and me now. The economy has made good boys, from good families todos mañosos. And the nacos too of course. The ones who've been waiting to have a little something, the ones who grew up with nothing, those are the bloodiest and most cruel. Anita, let's do this tomorrow. Please. There's a lot to say and a lot to plan.
ANITA: I don't understand anything.
VALERIA: I know you don't. Tomorrow. For tonight, just... duerme con los angelitos. /Sleep with the angels./
ANITA: Yeah, fine. I'm not. ..I'm not going to worry about it tonight. (Staits to go) I am exhausted. I feel 40-years-old all of a sudden.
VALERIA: 40 is not so old.
ANITA: What are you talking about, 40 is ancient.
Anita exits.
VALERIA: ¿Y veintinueve?
Valeria is left staring, sadly taking in the nursery. She then snaps out of it and remembers the electricity is being wasted. She abruptly turns off the light. We see the orchard and hills in the moonlight as she exits.
SCENE FIVE
López enters. He's carrying his keys and his Black Berry. He clicks on the electronic auto-start key to unlock his Escalade, but doesn't go. The headlights have come on. He pops an antacid in his mouth.
LÓPEZ (To himself): Fucking shit. (Beat) I just made no sense. I sounded like a fucking idiot just now. Moron! Malte comes down, looking all. ..she comes down and I start stuttering. I can look at (mato straight in the face and not stutter once but this woman conies down the stairs and I can't say consonants all of a sudden. And the way she just looked at me. Like she's about to pet her little dog. Why am I even here panting, offering my help? Letting her give me those looks that - (Beat) But at least she looked at me, right? My God, she hasn't changed a bit. If anything she's more beautiful now. God, her eyes. Those lips. A person can't make sense in front of someone like that. It's like you're in front of a. ..(Beat) What if] just go in there and try to explain it again to her. Draw it in crayons for her so she understands that she will lose everv-fucking-thing she owns it she doesn't jump on this because the clock is ticking on their offer. Five years ago this offer might have been ridiculous, but the way things are today, it is as generous as it's going to get. The fact that she even gets an offer is short of a miracle really! Every other piece of land around here has just been taken by force. I need to paint a picture for her that breaks it all down. And I'm going to need to get Chato something big. iPad. Yeah, I'll get him a couple of iPads. (Beat) Tomorrow. Tomorrow I'll come and explain it better. (His BlackBerry rings) Ah, fuck me. Fuck me. Hello? iEy, Chato! How are.. .what? 1 know, I'm a motherfucker. I'll come to the next one. You know poker's not my thing, you guys will just clean me out anyway but. . .Who? ( )h, yeah, she's here, they're all back. Yeah, I was going to go get them myself but your boy Pedro gave them a ride. Oh, well, thank you for that. That was very nice of you to send an escort - What? Yes. Thank you. (Beat) No, I didn't get a chance to. Maybe we should give her a little bit of time to say hello and good-bye to things. Ah, NO PLEASE CHATO. Let me. As a personal favor to me. Yes. I'll get it all sorted out. Thank you, Chato. Oh, hey 1 know we were talking about those i Pads the other day and Fd love it if you let me bring you a couple, you know for you and your kid. Yeah, you know the iPad 2's that just came out? Yeah. Come on, after all you've... Yeah, I know. You're right, Chato. I'm a motherfucker. (Laughs a little too loud) Yeah, alright. Tomorrow then. Alright then. (He hangs up) Fucking shit.
He clicks his Escalade's auto-start and exits to get into his truck. Sounds of him driving away. Kindafast.
SCENE SIX
The next morning. Valeria enters the master bedroom looking for Mai té. The bed is unmade and one suitcase

looks gutted, open-faced.
VALERIA: Marni... (Beat) ¿JVlamita? No te quiero despertar pero ten ha dejado este señor como diez mensajes... Marni? iMommy? I don't want to wake you but this man has left you like IO messages.]
Anita storms in and throws herself on the bed.
ANITA: IfI wasn't starving to death I would have stayed inside that purple bed all day and all night and all day and all night and. ..can we talk about what a good night's sleep I had? Aid can we also talk about how freakin' comfortable this bed is? Oh, my God I could just melt right now. Melt into the Porfirio Diaz bed. I wonder if Porfirio Diaz snored when he slept on this bed. He might have snored and drooled himself because it is so fucking luscious!
VALERIA: Why do people say this was Porfirio Diaz's bed?
ANITA: What?
VALERIA: I hear people say that sometimes.
ANITA: This wasn't Poifirio Diaz's bed?
VALERIA: No! Why would people think that?
ANITA: Everyone calls it the Porfirio Diaz bed. For as long as I can remember.
VALERIA: This is from the times of Porfirio Diaz. De esa epoca. But he didn't actually sleep on this bed. Who started that rumor?
ANITA: My world is shattering. So this wasn't his - he never actually slept on this bed?
VALERIA: Ana Maria. Marni told you this, didn't she? ¿Porque inventa cuentos? iWhy does she invent tall tales?] She's always making up stories.
ANITA: So no Porfirio Diaz?
VALERIA: No.
ANITA: How depressing! And this whole time I would talk about it like it was part of history. Like he was part of our family or something.
VALERIA: Por Dios, Anita.
ANITA: This shows you I know nothing. My whole world is one big giant lie. (Beat) Where is Marni, that big fat liar?
VALERIA: Yo juraba que estaba aqui en su recamara. [I more she was in here.]
ANITA: Check the closet.
VALERIA: Como que "check the closet?" ¿Que va a estar haciendo en el closet? [What is she going to be doing in the closet?]
Beat.
ANITA (Laughing): Hey, you never know writh Maini.
VALERIA: ¿Donde estara? [Where could she be?]
ANITA: Vale, are we going to be homeless?* Maini doesn't know if we have money to keep this place.
VALERIA: Ay, Ana don't say those things.
ANITA: Are we?
VALERIA: I don't know. Not if Memo helps us.
ANITA: You think Maini will take his money, Vale? You know she's particular.
VALERIA: You mean she's too proud? No, why wouldn't she take his money?
ANITA: I don't know. Because she says that he's mixed up in all that nonsense with those people. The drug people.
VALERIA: He's not mixed up with... Of course she'll explain it to you like that! Is this what she said to you? It's always absolutes with Marni. It's so easy to look at it from up there and take a black-andwhite picture of it, isn't it? Ana, it's so much more complicated than that. The only reason I can still live here without being bothered is because ot Memo.

ANITA: What about our friends? They can help us.
VALERIA: What friends?
ANITA: Grandfather was governor. We must still have some friends.
VALERIA: There are no friends left, Anita! All the people like us sold their lands and moved to Monterrey a long long time ago or you know. ..were burned and shot out of their homes. Se ha puesto tan feo. [It's gotten so ugly.]
ANITA: You are becoming as dramarama as Marni. I swear.
VALERIA (She starts to ay a little bit): You don't fully comprehend what is happening here, Ana Alaria! And 1 don't know if I have the energy to explain it. They've taken our México. They've taken our every days, our nights.
ANITA: Oh, don't start crying. I'm sorry, Vale. You're right, I'm totally not understanding what's it's been like to stay here.* I'm sorry.
Beat.
VALERIA: It's not the staying here...
ANITA: See, I'm worthless. Now I made you cry.
VALERIA: I get like this lately. No me hagas caso. [Don't pay me any mind./ (Beat) How I wish you didn't have to worn' about all this. How I wish we could marry you off to a proper Mexican.
ANITA: Who wants to be married to a proper anything right now? Please.
VALERIA: Well, some women do.
Matte enters, she's wearing running gear, her hair is in a pony tail.
MAITÉ: There is not one human being in this entire house that can make me some breakfast and a cup of coffee?
VALERIA: Ay, es que Tere falleció. iOh, it's because Tere died.]
MAITÉ: I know, God rest her soul. She was a good cook.
VALERIA: Where did you go, Marni?
MAITÉ: Oh, 1 just had the most wonderful jog around die orchard. Cruze todo el nogalar, then I went jogging up the side of the mountain.
VALERIA: Marni, you can't go up to the hills anymore. It's not safe.
ANITA: Oh, she won't listen. She'll run in those skimpy shorts even during the winter. She just likes to show off her butt.
MAITÉ (Lightly): Huerca malcriada... (Beat) But it's true. I will not let myself go, mi amor. Plus, for my sanity, I've got to run. And don't think that now that I'm back to take the reins of this place I will stop running, eh. I'm going to have us all running here. Get rid ofthat little cottage cheese you were developing at school, Anita.
ANITA: Mom!
Beat.
MAITÉ: You know what? I think I want to eat al fresco today.
VALERIA (To Maité): ¿Quieres- desa}imar huevos o quieres ya almorzar algo mas fuerte?
MAITÉ: Pedro's here.* He was following me.
VALERIA: Ay, Dios Santo.
MAITÉ: At first I thought I was imagining it. "Who is this following me?" I thought. And then I turn and it was Pedro, right where the river turns.* I yell, "Ándale! You want to race? I'm warning you that I'm fast!" But he just stood there, just... And then he fell to his knees like if someone had taken die batteries out of his back. I hadn't noticed where he was standing.
VALERIA: .Maini, te hizo algo? iMotu, did he do something to you?]
MAITÉ: He was standing right where he was when he took Gustavo from. . .In that exact same place by the edge of the water. . .he was carrying my baby boy in his arms. His wet little body across Pedro's amis. 15 years

I went away so I wouldn't have to think ofthat day. (Breaks down a little bit) Why didn't I think Fd see ghosts? You anil Pedro are the only ones who saw, Ana Maria.
ANITA: Don't. Stop, Mom.* Seriously.
MAITÉ: Le tengo mucho carino a Pedro. He's a good boy. What am I saying? He's a man now.
VALERIA: Marni, don't get confused about Pedro. He is a beast, not a man.
MAITÉ: Our lives were so different then. Things made sense. People knew their place and you knew where you belonged. Our lives were simple. And then I don't know what happened. These past 15 years since I've been gone I find die world so confusing. The world is now a version I don't recognize. We don't belong up there, we don't belong down here. Where do we fit? No encajamos. There's no place for people like us in the world anymore. The world is made of newmoney, of Facebook money.
Beat.
VALERIA: Maini, we have to have a conversation about Pedro.
MAITÉ: Oh, I don't want to hear nonsense and chisme right now, Valeria. You know what? I think I want to go put some flowers in Gustavito's tomb. What do you say Alita, want to come put flowers in your brother's tomb?
Beat. Anita doesn't answer.
VALERIA: I will go with you.
MAITÉ: You'll have to see his tomb sooner or later, Anita.
ANITA: No I won't.
VALERIA: What did Memo want to talk about? Ls he going to help us?
MAITÉ: iAli, no quiero tocar ese tema! I don't want us spending any time thinking about it. I just got here and I'm already bombarded with Memo and his asinine offers to lend us money* which will do I tlon't know what exacdy! I'm bombarded with Valeria's rants about the Mafia y no se que tanta cosa...
VALERIA: Did he offer to lend us the amount? Mamá? He's going to lend us money?
MAITÉ: Si, se ofreció.
VALERIA: Then that's great. This is great news, right?
MAITÉ: I don't want to talk about this, niñas! Why do people insist on ruining my day talking about this?!
Matte abruptly gets up and goes to the windows. She starts to open the curtains in the most dramatic of manners.
MAITÉ: ¿Que no entienden las dos? This land is sacred! Mira ven para* aca Anita!
VALERIA: Mamá!
ANITA: Mom, you're so hardcore right now. Chill!
MAITÉ: Look at those trees! Vean nadamas ese huerto. iLook at that pecan orchard, just look at that orchard./ LOOK AF IT! There is nothing more beautiful in the whole world to me. My mother is still walking in that nogalar. Our line has passed down through the women. Who in this country can say that?
ANITA: What? That the men always die?
MAITÉ: No, that we live if it lives! How could I slice the flesh ofthat orchard and sell it by the pound? For what? So that these filthy men can come and rape my trees to plant their. . . whatever it is they want to plant on my side of the mountain. (To Valeria) ¿Memo te ha comentado algo a ri? /Has Met/to told you anything?]
Valeria nods her head.
MAITÉ: So he and you have talked. What do you think of this... offer?
VALERIA (Cautious): I think that we are lucky to even have a choice.
MAITÉ: You call this a choice?! Ana Maria, do you know what this borrowed money would be for? Do you know that what these locusts want is a levy - let's call it rent - to be able to stay in our own house?
ANITA: Shut up what!?
MAITÉ: We would be allowed to stay in the house. But they would require unrestricted use of the orchard.
VALERIA: Mother, it's either we accept this and keep the house or we lose it all and we are homeless. I don't

like it anymore than you do, but if you'd seen how badly things have -
MAITÉ: I know how things are, Valeria! This was my house before you claimed it as yours.
VALERIA: "Before I claimed it as mine?!"* Claimed it?! I was TOLD to come here! iTu me lo informaste, Mamá!
ANITA: OK, hold on. An I not understanding something? I thought we owed money to a bank. Wait, shut up! Listen! I thought we owed money to the bank.
VALERIA: They are the bank now, Ana Maria.
ANITA: Who?
VALERIA: Mamá, if we don't sell it to them, they will just take it. You're not understanding.
MAITÉ: YOU ARE NOT UNDERSTANDING. This is my mother's house. My grandmother's pecan trees. I want to vomit just thinking about it.
VALERIA: And your daughter's pecan trees! You don't have to tell me, I have been sitting here like a guard dog for five years, Mamá. A mi no me lo tienes que explicar.
Beat.
ANITA: So what would happen to the nogalar?
MAITÉ: Wlio knows? Clear it, build a runway for their planes? Build a narco mansion with an eight-car garage? ¿Te lo imaginas? iCanyon imagine?} Why don't they cut out the flesh from my back instead, cut that before I let them cut down one tree.
VALERIA: They'll cut more than that, Mamá. Tu decides.
MAITÉ: I will not even consider the notion! ¿Me entiendes? Y se acabo el tema. iBasta! iDo yon understand tue? Subject closed. Enough!] Do not bring this up to me again. ,Me voy a dar un baño. [Tm going to take a shower.]
She goes to the bathroom.
MAITÉ (Off): Towels?!
VALERIA: Debe de haber... I'll go get you some!
Valeria exits.
MAITÉ: (Off): iEs un desmadre en esta casa! iThis house isa messi]
Anita is left alone. Beat.
ANITA: Is nobody going to feed me?!
She shuffles out.
SCENE SEVEN
A day later. The playroom. López 's head is under a big cabinet: he is fixing a drawer. Dunia enters. She's eating a messy pecan candy (Besos Indios).
DUNIA: MEMO!
López hits his head when Dunia calls out his name.
DUNIA: Aguas, que te sale un chichon, eh. [Watch it, you'll get a bump.]
She turns off the light iTranslated World].
DUNIA: You can't have the light on like this; you know who will come on her broomstick.
LÓPEZ: Don't be ridiculous, how am I supposed to fix this in pure darkness?
DUNIA: Don't exaggerate. Look at all this sun.
LÓPEZ: Turn it back on.
DUNIA: You turn it on.
LÓPEZ: I'm not playing with you.
DUNIA: I'm not playing with you.
LÓPEZ: Little brat. -Always been a little brat.
DUNIA: Hey, I'm just the enforcer. I'm a good girl, I do what I'm told.
LÓPEZ: Good girl my left... ear. What is that you're eating? Gross. (Beat) Always- like a little kid...

DUNIA (She fully enters the room): So when are these wedded nuptials supposed to happen, huh? We're all waiting to buy the present already. I was going to get you matching belt buckles.
LÓPEZ: I'm almost positive that you have something better to do than to be talking nonsense to me.
DUNIA: No,
He goes back under the cabinet.
LÓPEZ: There's nothing you should be doing right now? Helping somebody with something?
DUNIA: Nope. Everybody's gone. They went off to the cascade.
LÓPEZ (Comes back up and hits his head): Ah, fuck. (Beat) They left already?
DUNIA: They left already.
LÓPEZ: I was going to take them, I told them I would take them. That I'd go with them.
DUNIA: Well, they left you.
A moment as Dunia sucks on her pecan candy, its a little messy.
LÓPEZ: Ugh, go find something to do.
DUNIA: Hey, don't get angry at me because they left you. I didn't leave you. (Beat) They left me too, you know. We went this morning from: "Oh, yes, let's all go bathe in the cascade) Lets' have a picnic!" To: "Pack our things in the car Dunia, see you tonight when we get back." What kind of wishy washy thing is that? So annoying, all of them. Like nothing or nobody matters but them. (Beat) Remember when you and Martin and everybody used to go to cascade for the day?
LÓPEZ: When did they leave?
DUNIA: Not 20 minutes ago. You didn't hear them? I was wondering why you kept working on that thing.
LÓPEZ: The screws are oxidized. The nails too. This diing is really old, I don't want to cause too much damage so I was* taking my time.
DUNIA: Can I ask you a question, Memo? (Beat) Why are vou fixing their cabinet?
LÓPEZ: Go make me something to eat, will you.
DUNIA: You act like the foreman, always writh your tools. You're not a carpenter anymore.
LÓPEZ: Hey, what you learn early in life, you never forget. That's why you should learn something useful, little girl.
DUNIA: I just don't understand it.
LÓPEZ: Go get me something to eat, Dunia. (She offers him a pecan candy) Don't be sassy. You know I don't have a sweet tooth. Go make me something salty. Those gorditas your mom makes, can you make those?
DUNIA: I'm just never going to understand it. Is it because you want to impress Valeria? Listen, you don't have to work too hard with her. (Beat) WeW. I don't want to make your head swell. But what do you see in her anyway?
Beat.
LÓPEZ: Her eyes. They're like her mother's but deeper. She's got the kindest eyes ot any woman. She's a good person.
DUNIA: So what are you waiting for?
LÓPEZ: You know what? I'm going to finish this later. Your yapping is giving me a stomachache. I liked it better when you weren't taiking to me. (Beat) Come on. I'm kidding. I'm just hungry here, but you won't feed me so I'm leaving. (He starts to go)
DUNIA: Wait, don't go. I don't want to stay all here. . .by myself. Stay and keep me company. I came up to ask you a question anyway, a favor.
LÓPEZ: What is it now?
DUNIA: Will you teach me the Internet?
LÓPEZ: What do you mean? Show you how to use it?
DUNIA: Yes, will you teach me how it works? I want to know how to work it.

LÓPEZ: I don't know. You'd be trouble on the Internet. Next thing we know you'll sell yourself off as an Order Bride. End up in Russia or some place. Married to some old pen'ert.
DUNIA: You can do that?
LÓPEZ: IIhhmm...the Internet is too dangerous for you. Or better yet, you're too dangerous for the Internet.
DUNIA: You know what? Forget it. I thought maybe you of all people would want me to learn something new.. .do something with myself. People just want to keep you down and keep you stupid. Everybody saying the same thing. "Stop dreaming so much, Dunia." Everyone's got a plan for you when you had no say in making it. People writing out your story before you even have a chance to pick up a pen and write something yourself. People are like flies in a jar.
LÓPEZ: Did you say "flies in a jar"?
DUNIA: I thought maybe you of all people would let me at least thinkabout... wanting to think
LÓPEZ: Flies in a jar, huh?
DUNIA: Just forget it.
LÓPEZ: Alright, I'll teach you! I'll teach you. Oh, man you're like a little tiger, aren't you? You turned into a little tiger right before my eyes and I hadn't even noticed.
DUNIA: Shut up.
LÓPEZ: I'll help you. Come on.
DUNIA: Really?
LÓPEZ: Yeah, come on, let's go. We'll start with Google. (Beat) Oh, man. We are all going to regret this aren't we?
They exit.
SCENE EIGHT
The next day. Just outside the house, on something like a porch. Late afternoon. Valeria's been trying to make cabrito, she's a little sweaty, wearing an apron. Trying not to be a hot mess.
VALERIA: Dunia! Dunia! Where the devil are you? Dunia! I swear... she turns more and more unruly with each day... DUNIA!
Dunia enters.
DUNIA: I'm not deaf. I kept saying that "I'm coming. I'M COMING.* I'm coming." You can't hear me because you keep shouting, "DUNIA! DUNIA!"
VALERIA: Where in the devil did you go and hide? I've been calling you - looking for you all over the house. You know there's only you and Fulgencio now. But he can barely stand. STOP DISAPPEARING.
DUNIA: I've been here.
VALERIA: Do not tell me lies.* Where were you?
DUNIA: I'm not. (To herself) Shoot me in the head.
VALERIA: I'm not going to tell you again about how you talk to me. I demand that you treat me as 1 should be treated.
Beat.
DUNIA: Did you need me for something?
VALERIA: You know, this past month you've developed a smart mouth on you and started running off to who-knows-where. Where do you go?! Do your job!
DUNIA: I'm sorry. Fm here now.
VALERIA: Dunia, it you end up in a ditch somewhere -
DUNIA: I will never end up in a ditch.
VALERIA: Dunia, do not tempt fate. (Beat) You think that I don't like ou or that I don't worry about you.
DUNIA: You worry about me?
VALERIA: Dunia. Yes, of course, I worry about you.

DUNIA: .Maybe better to worn about yourself in this house all alone.
VALERIA: Well, I'm not all alone anymore, am I? We have two very demanding guests who have insisted that we make them goat. In the traditional buried style, no less. Ah, this heat! It's cooking my brain!
DUNIA: It's because you're right by the fire.
VALERIA: I know.
DUNIA: Memo's here already. He seemed very excited about the goat. Right outside the gates.
VALERIA: Did he stay out there talking to those men again?
DUNIA: Yeah, but it's just Pedro. Just them two out there. Oh, and the Señora Make.
VALERIA: What!
DUNIA: The Señora Make. She's out there with them two. She brought out a tequila and they're there drinking it. They've almost gone di rough the whole barrel.
VALERIA (Frozen in a panic, pause before she says to herself): ...Please God, protect us...
DUNIA: They're fine. They're not doing anything. They were all three of them laughing and even singing a couple of songs. They were talking about the government* and who knows what.
VALERIA: The what? Oh, God no no no...
DUNIA: They're fine. Nothing bad is happening.
VALERIA: OF COURSE SOMETHING BAD IS HAPPENING! I'm making the fucking goat! Why my mother got it in her head to eat goat, I will never know. Wasn't she a vegetarian? In my life have we ever inaile goat. In my life!
DUNIA: It smells good though. You're good to make it for them. You are.
Beat.
VALERIA: I think it's smoking too much. I wouldn't know, I've never seen it made. Five years ago, I never would have been here making goat. Five years ago, someone... Tere or someone. ..would have been making the goat and I would have been sitting by the gates enjoying aged tequila with everybody... Wait, no I wouldn't. Proper guests don't sit by the gates drinking anejo. This can't be a good thing this little party of theirs out there.
Anita enters.
ANITA: OK, it I have to watch Marni accidentally pull up her skirt again to fan herself when she laughs, when she's really just showing off her legs, I will proceed to barf. She's over there flirting with those two. Oooh, what's that smell, it smells so good.
VALERIA: It's not ready. At least, I don't diink it is... Is Alami talking to Pedro? (Anita nods) She shouldn't be talking to Pedro at all.
ANITA: No, it's fine. They're going down memory lane.
VALERIA: Ah, Alami thinks she can just let down her hair and say any old thing. I should go get her.
ANITA: Don't. She's laughing and not inventing dramas. Gambling relaxes her.
VALERIA: What do you mean gambling? With money?
ANITA: I think. ..yeah, with money. Oh, what. Don't get crazy.
VALERIA: She's over there gambling our money away?! Is she simple in the head?! Please tell me because I need to know! Doesn't she see that I'M THE ONE WTTO HAS TO MAKE THE GOAT?
She takes off' her apron and starts to exit to go ¿lo some damage control.
ANITA: The what?
VALERIA: Dunia, watch the goat.
Valeria exits.
DUNIA: Watch the goat? What am I watching it do?
ANITA: Why does she keep it so dark out here too? WTiere are the lights, Dunia? For out here?
DUNIA: Right here.
She turns on the lights outside. They nicely light up the porch. Something dreamy about them [Real World].

DUNIA: Si es que a ella le duele el codo. Every thing hurts her elbow. No, that is not die manner how you say it in English. Flow do you say que es bien tacaña? [How do you say that she's stingy?] How do you say in English?
ANITA: Stingy. She's not stingy', she just needs to keep us all... Hey! Hello. Pedro?
DUNIA: Pedro que?
ANITA: He was basically twitching tor you. Couldn't concentrate on what he was saying.
DUNIA: Yes, he twitches but that's because se mete that míenla. (She pretends to sniff cocaine) Ay, el es un... he's such a dumb. Killing his neuronas. Neuronas are neurons?
ANITA: Brain cells. 1 don't think he's dumb at all. A little tweaked-out though maybe.
DUNIA: Not dumb pero. ..Es que parece moco. FIe doesn't leave me in peace, he's a piece of gum in my shoe. I'm hoping que se Ie pase and moves on to pursuing another girl. It gives me a little bit of fear to say no to him since he does have a little bad temper.
ANITA: You know I used to have a crush on him, right?
DUNIA: Oh, I'm sorry.
ANITA: Oh, please, no. ..like when I was 10. When I was Iu!
DUNIA: Pos, he does not match you. You're not of the same... son "de distintas sociedades" como dice Selena.
ANITA: That is the stupidest thing I've ever heard.
DUNIA: You didn't like Selena?
ANITA: No, just the whole...
Beat.
DUNIA: Tienes razon. iYou're right.] Pedro is not so bad idea for now. He is better than the dumb one I was going out with before, more handsome than this poor little counter I was going with. Is diat how you say contador?
ANITA: Isn't it accountant?
DUNIA: Ah, yes. Accountant. Not counter. Si, ese era todo un ñoño. Wlio wants a ñoño? How you say ñoño?
ANITA: I don't know ah, mama's boy? No, I don't know.
DUNIA: I need a real man. Who wants a ñoño like that? bnaginate. We will start getting into kissing and he will faint and have an attack from excitement. Asi que lo pusimos de patitas en la calle. iSo we kicked hint to the curb. I Good-bye, baby.
ANITA: How do you do it? I wish I had your... I don't know how you call it. 1 turn stupid in front ot guys. They scare me. Everything scares me lately. (Beat) I need a pedicure.
DUNIA: Men are easy. There is not one easier animal on the planet than a man.
ANITA: Oooh, Dunia.
DUNIA: I'm not being a bad person when 1 say this. So yes las feministas who like to say progressive things on the morning shows. They will speak to us about equality and things like this. Pero no. Men are stupid animals. They are smart, but they are stupid animals. Esto de lidiar con ellos es fácil. iDealing with them is easy.] But only if you have... moneda con que negociar. iCurrency to trade.]
ANITA: What does that mean?
DUNIA: You have to have... something they want. Aid no I'm not talking about sex. Thar on\y lasts three minutes and that's all you got. You lose them after they're done. No, I'm talking something else. Like to possess. Men like to know they are masters and owners of you. And you must let them know that this is so. Even if it is a lie.
ANITA: Nobody will be the master and owner of me, Dunia.
DUNIA: Then you will never find happiness with a man. (Quickly and pleased) LIy, my English has gotten so good since you came this week.
ANITA: What you are saying is so backwards it's not even funny. It you knew what you sound like-

DUNIA: No, tor pretend. You only must let them think that you are something to be won. You make a face at me, but you profoundly you know it is true. This is what our mothers and grandmothers teach us from always and we stop listening because we say we arc modern, but they are always correct.
ANITA: My mother never taught me anything like diat. But that's not saying much. My mother hasn't really tried to teach me much of anything. (Beat) God, she's a mess. I don't want to be a mess... I thinkthat if 1 would have grown up properly, you know, here in this house, in one place like I was supposed to. With my dad and my mom, not troni boarding school to boarding school, I think - (Beat) I'm talking too much.
DUNIA: No, para nada. Yo soy una tumba. iNo. not at all. Let it all out. I'm a tomb.]
Dunia zips her mouth.
ANITA: I love my mother.
DUNIA: I know. Even not being here 15 years everybody loves your mother. She was the most beautiful girl in these parts everyone says.
ANITA: I know! Trust me, you do not have to remind me. That's what everyone's told me ever since I can remember. So shitty to always have to be compared to her. Poor \7ale really hated it. Because she was first and when she wasn't... you know, when she wasn't all like my mom and likc.sparkly, then everybody just kind of gave up on her. It's like everybody just kind of gave up on her early on. But me? Everyone has such high expectations from me. About whom I'll marry and who my friends will be, it's all so paralyzing. But where I've ended up there isn't this Mexican prince I'm going to meet, with the right pedigree and the right credentials. (Beat) What is the right pedigree anyway? What are people holding on to? This country - I'm sorry but from where I stand it looks like it's falling apart. Just like this house; it's falling apart. And I'm going to say something really shitty but. ..I kind of don't care if we keep this place. That's shitty to say, but what does it really mean to me, you know? I don't feel welcomed here. Everything - even those trees look at me with resentment. So fuck it. I know I'm being shitty right now. But ever since we got here, everyone's shoving the whole "you're home" thing down my throat...I don't know. I guess 1 am being a little shitty.
Matte and laleria enter. Poor Vale. She's on the verge of tears.
MAITÉ: Esos dos quedaron pero bien. ..They are completely and absolutely gone. I mean, I don't believe we will get them to come to the house for dinner tonight. They will probably pass out. (Beat) Oye, que bien se expresa Pedro, no? Fle's smart and eloquent and I like how he talks. But our poor Memo. The words he uses. What a little dummy, Dios Mio. (Beat) That smells delicious, Vale!
VALERIA: Marni, yo que tu no me comería ese cabrito, I don't think 1 prepared it properly. [Mom, if I were yon I wouldn't have any ofthat goat. I don 't know if I prepared it correctly.]
Matte sits down.
MAITÉ: Nonsense, it smells wonderful!
ANITA (Fo Valeria): What's the matter with you?
VALERIA (Bursting into tears): Nothing.
MAITÉ: Dios, siempre de Magdalena. iGod, always a weeping Magdalena./ Valeria, you're a puddle of tears everywhere you go. I am so sorry. I should have consulted you. Here, let's go get my purse and have you hold it. I don't ever want to see it. From now on you keep it. Mi amoretto, please stop crying. You're going to make me feel so guilty.
VALERIA: I just don't understand you. It's like vou don't care.
MAITÉ: Sweetheart, of course I care. What are you talking about?
VALERIA: Maini, no tenemos ni para la luz. [Mom, we don't even have enough to pay the light bill.] They're going to cut it any moment. (Beat) Dunia, nos puedes dejar solas porfavor? [Dunia. will you leave us please?]
MAITÉ: No, Dunia is family, verdad Dunia? No seas grocera, Vale. Just say it. Estamos en confianza. /Don't be rude. Vale. We're among friends.]
VALERIA: We can barely pay Dunia!

ANITA: Are we serious?
MAITÉ: Anita, it's not as bad as all that. Valeria is always enveloped in a cloud of despair. No lo tomes tan en serio. /Don't take it so seriously.]
ANITA: Vale, for real?
VALERIA: We owe everybody. And there's nothing, nothing left.
MAITÉ: Jesus Christ! Such drama.
ANITA: Marni, are you listening? They're going to cut oft" the electricity! We can't even afford the necessities, like Dunia. Like a cook to cook this thing...
MAITÉ: Memo will help us. El nos va a prestar una cantidad, va me* lo prometió. [He 's going to lend us a sum, he s already promised./
ANITA: Oh, thank God.
VALERIA: De verdad? (Beat) You're going to accept their offer and let him give you the money?
MAITÉ: Sure. Yes. I'm speaking with him tonight, tomorrow. I'll speak with him.
VALERIA: Ay, gracias a Dios.
MAITÉ: Girls, everything will work itself out, I'm sure of it.
ANITA: Mom, this is not something that you can just make up a story about, like with my tuition. This is serious shit. Are you really talking to him? I know how you are!
MAITÉ: Anita, tomorrow I'll talk to him, te parece? We will come to an agreement. OK? I just don't want everyone to get so worked up and worried and bursting into tears at the drop of a hat and full of ulcers and wrinkles because then we'll never be able to marry you off. Please, Vale. Please, for me. You want me to do a little dance for you? Mira te bailo para que sonrías. Cual te bailo? iLook Til dance for you so that you smile. Which one should I dance for you?)
ANITA: Great, now she's going to start dancing. Here we go...
MAITÉ (Singing): El sauce y la palma... (To Dunia) Ándale Dunia, canta conmigo iCome on Dania, sing with me.] (Singing;)
El sauce y la palma
se mecen con calma
sus hojas se visten
de una cara azul
Que hermoso sombrio
del sauce y la palma
alma de mi alma
que linda eres tu
Beat.
MAITÉ: My mother would sing that song up and down the corridors of this house. Tan alegre, mi madre. [Such a happy woman, my mother./ Because back then there was nothing to worry about. We had the sky and the air and the world and it was all ours, and there was nothing to worry about. Eran tiempos tan bellos. iAnd you felt such peace throughout this land./ (Beat) Baila conmigo, Ana Maria. [Dance with me, Ana Maria.]
ANITA: Sorry, no. How do you even dance to that?
MAITÉ: You are no daughter of mine. Vale? Bailamos? No esta, menos. [Want to dance? No, much less this one.] My two daughters the statues. Tu Dunia. Ándale, tu si que eres alegre, fion Dunia, you are a happy sou/./ Dunia dances with her throughout the next exchange. Dunia hums the song.
MAITÉ: Antes habia un conjunto por aqui, they used to come and play or your dinners or parties. We should have a party.
DUNIA: Ay, si. Eso estaría muy bien, oiga. iOh, yes. That would be very nice.]
VALERIA (Under her breath): ...Nadie vendría. [No one would come.]

MAITÉ: What did you say?
Make and Dunia continue to dance.
VALERIA: No one would come, Mamá. There's no one left and if there is someone left, we probably owe them money so they wouldn't want to come. That's just the truth! Nadie vendría! /No one would came./ The cabrito stmts to smoke and spark. The women react. It has a little bit of a firecracker effect. Valeria is hysterical. Anita tries to help. They are running around and very vocally collaborating in the extinguishing of the fire. Make develops a slow-rising laughing jit as the women run around to put out the sparks. They calm the sparks and smoke and all we hear is Matte laughing a cackle. Is she ciying too? IMjo knows, but she's going through a Thing. More laughter. The women are astounded, staring at her.
MAITÉ: .. .ITS. . .IT'S ALL GOING UP G? FLAMES. DO WT FLAVE INSURANCE?. . .MAYBE. . .MAYBE THAT'S THE ANSWER. QUE SE ENCIENDA TODO! HASTA EL NOGALAR! Everything...
(Laughter) It's all going up in flames...
All we hear is her laughter. The others are dumbfounded. Smoke.
SCENE NINE
Outside. López is by a make-shift camp fire, out by the gate. There is a sea of bottles of Negra Modelo and Pacifico and a barrel of tequila. He starts to put into a trash bag, the trash that their little gathering has produced.
LÓPEZ: See, this is good. This is progress. (Drinks from his beer) What is all they're burning over there? (He waves away smoke) This is progress. We are not reduced to being fucking animals when we hold civilized, what, discourse. Civilized discourse. Malte has always been so civilized. (Beat) It's funny. When I was a kid, you wouldn't have dared to sit by a fire, out in the open, criticizing the government. But now, nobody cares. What are they going to do to us? This government is a pack of toothless dogs now. Yeah, they can bark, but who are they going to bite? Those rabid wolves up on that mountain? I don't think so. (Beat) "The world of men is a broken toy," like Pedro just said. Smart guy, that guy. I'm glad it's htm they have on watch. It could have been anybody Chato put on Los Nogales. And in these times of the Four Horsemen. In these times, decent men turn into beasts. Beasts that have been watching you, waiting to descend to pillage and burn everything to ash. I've seen them do it. This place doesn't deserve that end. Am I the only one who still loves those trees? (Beat) My life is written out in the bark of those pecans. That orchard is the first thing I can remember. .Vie running around with no shoes, carrying those baskets of pecans back to the silos. (Beat) Oh, man. Beer and tequila don't mix. (A queasy moment) When I was like, I don't know how old, old enough to feel like I was a full-grown man, my father gave me one of those heatings that break off a bit of your soul. The old man was taking out a whole day of frustrations on my back. Going at it hard as he could with that wdiip when out of nowhere Make appears and pushes him off me. She gives him one hard slap on his leather face. She curses something at him and then drags me with her to the silos. She says, "Don't cry little man." I'm standing there in front of her, bleeding, shaking. And slowly, very slowly she takes off my shirt. Then she starts to hose me down. "Don't cry, little man," she says even when I had stop crying. (Beat) Shit, after that, I followed her like a puppy. Too old to be doing that and I know her parents had said something to her. Well, because she was just divorced and with a kid and well, it wasn't proper. But she didn't care and I didn't care. W^e went everywhere together. We. ..(Beat) One day, I guess it was when her father found her the new husband. That day she took me from cracking pecans, and. . .she just took me by the river to this little wall the bank makes. She'd been crying. She said, "Take off your clothes, little man." Oh, man, I took off my pants so fast. Almost fell in the water. She starts laughing and takes off her dress. I have never... I have never seen something more beautiful in my whole life. With that light that day. With the sun on her. And all of her just standing there. And me tangled on the ground with my fucking pants. She says, "Stay there, little man. You can look at me, but you can't touch." So I freeze there. Looking. For I don't know how long. Then she pulls up her dress and runs. She ran so fast, so fast that she left her sandals there. When I went up to the house to give them to her the next morning they said she was gone. That

she'd gone off to live in Monterrey where she was going to be married. Just like that, they took her away from me. (Beat) Me and these trees, we're the only ones who remember. Right by that river there. Not far from the bank. "You can look, but you can't touch."

López throws the trash bag down, which he's been ho/ding. He fumbles for his Escalade keys and presses the auto-start. He stumbles off.

SCENE TEN

Valeria is in the playroom. She's wearing her version of a party dress. We can hear the music from the party outside. She s pacing.

VALERIA: This music!

Matté enters, helping Anita into the room. Anita is a little drunk; she's carrying a bottle of tequila and is protesting as Matte tries to take it away. Ma te finds Anita s drunkenness amusing.

MAITÉ: A ver. Dame esto. Give me that. Ana Maria.* Look at her, who knew she was such lightweight.

ANITA: This tequila is a hundred years old.* Can you believe it? One hundred years...

MAITÉ: She got into your fathers anejo. I just took it out so we could toast, no so you would - Calmadita.* Let's sit you down right here.

ANITA: Now, you don't want to dance, Maini?

MAITÉ: Let's get you some water. Valeria, pásame ese botella porfavor. Valeria serves Anita some water.

VALERIA: What is taking Memo so long?! He left in the afternoon. I wish he'd just call. 1 Ie could call us and let us know- something. God, please be alright. Si algo Ie pasa. ..No, he'll be line. I les fine.

MAITÉ: Of course he'll be fine. Why wouldn't he be fine? I think all this will be pretty standard. I le'll make them our offer and lend us the money ever)' month until we get up on our feet.

VALERIA: And what's the plan then, Mamá? T) get up on our feet?

A sobering moment between .1 laité ami I alerta as Anita attempts to stand up and dance.

ANITA: Let's get up on our feet and dance! I may not be able to talk Mexican but I can dance Mexican, look!

MAITÉ: Here, let's drink. A ti solo te damos un dedito, Alis, porque si no - * But we should toast. 1 brought it out so we would toast. (Grabs the tequila) Valeria's father brought this for me from Jalisco when we got married. We will drink it in a proper glass, not in one of those horrendous shot glasses the gringos drink out of. This is sipping tequila. No chaser here.

ANITA: Just a little finger. Just this much, look, this much.

Beat. Maité has served I'aleria a glass, she refuses.

VALERIA: No thank you.

MAITÉ: It's your father's tequila, Valeria.

Valeria takes it.

MAITÉ: To the women.

ANITA: And dancing.

MAITÉ: Valeria?

VALERIA: To home.

MAITÉ: Yes, to our nogalar. The most beautiful orchard in all of México.

Anita: Aaajua!

They drink and have some laughter and levity. A car is heard outside in the mitist of the music.

VALERIA (She looks out the window): It's Memo!

MAITÉ (To Valeria): No, let me. Stay here.

Maité runs out. The song changes from a lively cambia to a corrido, "No WAf las mujeres quedan. "

ANITA: There's a lot of dudes downstairs. What, don't we know any women?

VALERIA: I told Maini no one would come. We have no friends left. Puros nacos y narcos, Ana Maria. Those are wolves downstairs. Ten years ago the governor would have been downstairs. Senators and proper people.

Ahora nadamas ve esto. Que vergüenza. [How embarrassing.] Oh, God! What could Memo be telling her? I'm going downstairs.
ANITA: Valeria, wait. Will you teach me how to dance to this song? Nobody's ever taught me. There are so many things I know halfway. Like I know the beginning or the ending, but I don't know the middle. I'm a halt person, Vale. I walk around incomplete. My tongue is a half tongue, my brain too. I'm a half thing.
VALERIA: Mi pobre Anita. (A moment of tenderness) You know. I have a suspicion that we were meant to be happy people but it just didn't pan out that way, did it?
ANITA: We are happy people now. Memo is fixing everything.
Maité shrieks offstage. She is throwing curses at López and hitting him. he 's trying to calm her. This is all in Spanish.
ANITA: Whoa, what was that?
VALERIA: NO, DONT GO. Dios Santo.
Maité runs upstairs in a fit to the master bedroom. Ike girls follow her into that room. She is madly taking things out of the closet, starting to pack. She is making guttural noises like a beast. She's a red-eyed beast right now.
VALERIA: ¿MAMÁ, QUE TE DIJO?
ANITA: Marni, what happened?
MAITÉ: iNefasto! (Beat) iPelele!* (Beat) iCabrón hijo de su puta madre!
VALERIA: ¿Mamá, que paso con Los Nogales?
MAITÉ: What Los Nogales!
VALERIA: iMamá porfavor! ¿Que paso?
MAITÉ: We have no Nogales, Valeria! It's all gone!
ANITA: But Memo went to talk to them for us.
MAITÉ: Did he? Or did he go talk to them for him?
VALERIA: Mamá...
MAITÉ: ¿Sabes que hizo ese hijo de puta? Your Memo, tu Memin Pinguin, bought it whole. Thev wouldn't take a monthly payoff so El Señor López bought it himself! This whole time walking around here, en confianza*. Us treating him like family! iES UNAPINCHE VIBORA!
VALERIA: No*. No. No...
ANITA: Memo? Why would he do that?
MAITÉ: WTIY WOULD HE DO THAT? Because he's waited 20 years to do that, that's why.
Maité is a fiend packing -while Valeria talks:
VALERIA: I mean, if we get married, maybe we can just stay here, you know? Mejor no me Adelanto. Does this mean we have a bit of money, now? Yes, this means that we'll be able to at least live on it for a time. We could get a flat in Monterrey and I'll figure out what to do. I will. ..I will get a job. I can translate, I'll do that. I know four languages and how to do accounting. Fm sure I can find something. Anita, you will go to school somewhere in Monterrey and everything will be alright. Don't cry, Anis. Todo va a estar bien.
ANITA: Why would he do that to us? I don't understand...
MAITÉ (Fhis is a different Maité, no theatrics here): That little man. Ese pinchee indio pata rajada.* Fhis man who wouldn't have been allowed to set a foot inside this house now owns my nogalar!
VALERIA: MAMA! No digas burradas! FIe must have done this for a reason. I trust him.
MAITÉ: Don't trust in this hijo the puta so much, mi hija. You don't know this man the way I know this man.
ANITA: Maini, please stop talking right now.
MAITÉ: You think he's the Memo who fixed our cars when you were growing up? The Memo who built those benches on the porch? The Memo who was ready and willing to lend a helping hand whenever you called him? You think that's who this Memo is?
ANITA: Maini, please!

MAITÉ: You better thank the heavens that he was never interested enough to marry you, Valeria.
ANITA: Mother, stop! I fucking mean it, don't be a fucking bitch right now.* If you do this, I swear I'll never fucking speak to you again.
MAITÉ: What?! You would let your sister marry a man who's been absolutely obsessed with her mother for, what. 20 years? You'd want that for your sister? A man who followed me to Monterrey when I was marrying your father and stood outside of our new house for almost a fucking month just looking up at our window. Anywhere I went, there he was. Salivating for me, like a little animal. Devouring me with those two eyes. I had to convince your father to move us to (ìuadalajara to get away from him because he was absolutelv obsessed with me. He's been obsessed with me for 20 fiicking years. This little man. This little animal! And now he owns my orchard! I Ie finally got what he's always... Ahora es amo y patron de Los Nogales. [Now he's lord and master of Los Nogales.]
ANITA: You're unbelievable.
MAITÉ: Ay, ya. Era hora de que Io supiera. iOh, enough. It -was time you knew the truth.]
Valeria goes to her mother. She takes off the keys from her waist and throws them on the floor. She is stone. Nothing left.
ANITA: Vale...
Valeria darts a look at Anita and exits.
ANITA (Fo Maité): You're a hateful person. A mean bitch, that's all you are.
Maité is a sitting lump on the /lour.
ANITA: Yoy ..you don't even care what happens to the three of us, do you?
Anita exits, following after Valeria. Maité is left there. So alone.
SCENE ELEVEN
López is outside. He's obviously been celebrating. He carries a flashlight and a bottle of tequila. He's elated beyond words and doesn't know what to do with himself, he points at the sky with the flashlight, all around him. at his face. A million thoughts run through his head. The large flashlight starts to go out on him.
LÓPEZ: iPuta madre!
Dunia enters as the light of the flashlight dies [Translated World].
DUNIA: It's alright. You don't need that. The stars shine bright enough for you tonight.
LÓPEZ: Don't they?
DUNIA: You're going to have to sleep here, you know? You're in no state to drive home.
LÓPEZ: Look at them stars.
DUNIA: Although, what am I saying? You get to sleep here from now on if you want. I just heard.
LÓPEZ: No one would shake my hand.
DUNIA: How are they going to shake your hand and the Galván women are all still here?
LÓPEZ: I tried to warn them...
DUNIA: Of what? That you were planning to screw them out of house and home?
LÓPEZ: Don't say diat like that -
DUNIA: Wait, I didn't mean it like that.
LÓPEZ: Just don't say it that way. That's not how it was. I went to Chato and repeated even- word Maité said, like a parrot. But he was not in a good mood. I Ie just... I knew as soon as I got there that things wouldn't - I said, we will give you rhis much if you let them stay. FIe laughed in the way he laughs right before he's going to shoot somebody. So that's when I blurt out, "Chato, I'll give you mv warehouses and the three gas stations. I'll give you half of everything I own if you let me keep the nogalar." Well, he stopped laughing then. (Laughs) It was like someone else was speaking through my mouth. Next thing I knew. Los Nogales was mine. (Beat) Los Nogales is mine, Dunia. Can you believe that?
DUNIA: No.

LÓPEZ: But she, she won't hear of it. She won't even consider stav ing here. 1 would let her stay here. My father. ..if my father could see me now. If my grandfather, who didn't even speak Spanish. 1 Ie spoke in dialect. He was a poor Indian from the mountains, if my grandfather could see me now. Oh, man, I'm not breathing right. There's like* a boulder on my chest.
DUNIA: Here, sit down.
LÓPEZ: No. Fmalright...
DUNIA: Here, just sit down. Sit down I say.
They struggle but he sits.
LÓPEZ: When did you get to be so bossy?
DUNIA: Now I'm bossy because I don't want you to tall on vour big ugly face?
LÓPEZ:... Yes.
DUNIA: Fine, then I'll be bossy. Are you feeling better?
LÓPEZ: I'm fine.
Pause.
DUNIA: Are you still. ..you and Valeria? Do you think she'll still...
LÓPEZ: Oh, shit. I better go find her.
DUNIA: I hope Valeria still wants to be your wife.
LÓPEZ: God, I hope so too.
DUNIA: But do you think... I mean, do you diink she would now? Marry you? After what you did to them?
LÓPEZ: ...
DUNIA: Valeria, she can't stand beside you. Even if she wanted to. She's not like you.
LÓPEZ: Valeria's a saint. Ah, man. I should go talk to her. (Getting up to go)
DUNIA: No, no, wait. Wait. ..Right now she needs to be up there with her mother and Ana. Leave her alone tor a bit. Trust me, you're probably the last person she wants to see right now.
LÓPEZ: Don't say that. I need to talk to her.
DUNIA: Ialk to her later. 'Ialk to her tomorrow. Look up at these stars with me. You know, you're right. They seem brighter tonight tor some reason. (They contemplate for a bit) You know, you shouldn't feel bad. All you've tried to ilo is help her out - You were ready with your opened wallet.
LÓPEZ: I know! I was going to lend them the money. Shit, I would have given them the money. Here, take it.
DUNIA: I know you would have.
LÓPEZ: But they didn't listen.
DUNIA: They didn't listen and now look what happens. But diat's a lesson tor them, not for you.
He turns to really look at her for the first time.
LÓPEZ: How old are you? You sound like a full grown adult right now.
DUNIA: Guillermo López, I've been grown fora while now, you know : (Beat) They deserve it a little bit, if you ask me.
LÓPEZ: Don't say shit like that.
DUNIA: Lh. they don't deserve it? Even just a little?
LÓPEZ: No.
Somehow, who knows how, Dunia will end up on López 's lap by the end of the following It takes her the whole monologue to rope him in.
DUNIA: OK, maybe you should feel a little bad because they trusted you and here you went and did this thing to them. But I don't feel bad, not one little bit. These people, they've been the keepers of something that maybe wasn't theirs to keep in the first place. And we all let them have it. We even kept it for them, even as the Maña got stronger and stronger all around us. They didn't have to deal with their brothers being shot, with their houses being burned. It fills me with poison to think that they can leave and come back whenever they want,

when we've had to stay here guarding their things. It's never cost them anything. Well it's costing them now, isn't it? Now they'll be just like everybody else.
LÓPEZ: I think if I don't talk to Valeria now, she will not -
Dunia kisses López. He's a little stunned, but it's not unwelcome.
DUNIA: Someone should take care of you. Stand beside you.
She. holds out her hand to shake his.
LÓPEZ: What are you doing?
DUNIA: I'm shaking your hand.
A moment. He shakes her hand. She pulls him and kisses him again.
DUNIA: You did a brave thing. Memo. WTio better than you to make something of this place?
LÓPEZ: Right? This is what I was trying to explain to Maité but she kept hitting my face.
DUNIA: El Nogalar is in good hands.
LÓPEZ: Yes. Exactly. I'll keep it safe until this whole occupation passes over. I know how to keep it safe.
DUNIA: No, don't do that, Memo! Don't be their little guard dog anymore. This is all yours now.
LÓPEZ: 1 know! Fuck. It's mine. Fuck.
DUNIA: .Memo, maybe the right idea now is not to leave up north anymore. We keep looking up, in hope ot miracles, but maybe the miracies ire right here beneath our teet. No one ever thought you would be the owner of Los Nogales. Not in a million years!
LÓPEZ: No, nobody.
DUNIA: And look at you now?
LÓPEZ: Yeah, look at me now...
DUNIA: Going up to the other side. Maybe that's what people had to do before, but now it's different. Maybe what we should be doing is staying here and looking down at our feet. Looking at our hands. Staying here to take what hasn't ever been ours but which has always belonged to us.
LÓPEZ: She said, "You can look but you can't touch."
DUNIA (Kneeling between hklegs, grabbing dirt): She did. And now look at us. Just look at us. (Grabbing handfuls of dirt) We can touch.
She is between his legs, he can V help but be aroused. I mean, she 's right there. It's obvious what she's suggesting, 'i'hey kind of go at it on the ground. Dunia is in control, but she lets him have his way a couple of times as the lights go down. An interpretive sound of trees falling. Now don V go cueing chainsaws because it's not literal. Just make me feel trees aie falling. Along with the tipper class. Ting. Ting. TONG. Good-bye to the bed of Porfirio Diaz.
FIN

Sidebar

ABOUT THE PLAY El Nogalar was originally commissioned by Teatro Vista in Chicago (Edward Torres, executive artistic director) and made its world professional premiere at Goodman Theatre in Chicago (Robert Falls, artistic director; Roche Schulfer, executive director). It opened on April 4, 2011. The production was directed by Cecilie D. Keenan; set design was by Brian Sidney Bembridge, costume design was by Christine Pascual, lighting design was by Jesse Klug, music composition and sound design was by Joe Cerqua; the dramaturg was Kristin Leahey; the production stage manager was Rita Vreeland and the stage manager was Kimberly Osgood. The cast included Charin Alvarez (Maité), Sandra Delgado (Valeria), Carlo Lorenzo Garcia (López), Bert Matias (Fulgencio). Christina Nieves (Anita) and Yunuen Pardo (Dunia). Playwright's dedication: "This play is for México. For the North."

Sidebar

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ABOUT THE PLAYWRIGHT Tanya Saracho was born in Sinaloa. México, and is a resident playwright at Chicago Dramatists (emeritus), a resident playwright at Teatro Vista, a Goodman Theatre Fellow at the Ellen Stone Belie Institute for the Study of Women and Gender in the Arts and Media at Columbia College Chicago, an artistic associate with About Face Theatre, the founder of the ÑProject and co-founder and former artistic director of Teatro Luna. Her plays include Enfrascada (Clubbed Thumb Summerworks, 2011); El Nogalar, inspired by The Cherry Orchard (Goodman Theatre, 2011); an adaptation of The House on Mango Street (Steppenwolf Theatre SYA, 2009); Our Lady of the Underpass (Teatro Vista, 2009); Surface Day (Steppenwolf/CCHF, 2008); Jarred (A Hoodoo Comedy) (Teatro Luna, 2008); Kita y Fernanda (16th Street Theatre, 2008) and Quita Mitos (Teatro Luna, 2006). Saracho is a winner of the Ofner Prize, given by Goodman Theatre; a recipient of an NEA Distinguished New Play Development Project Grant with About Face Theatre; and a 3Arts Artists Award. Saracho is currently working on two Mellon Foundation commissions for Steppenwolf Theatre, an adaptation of a Sor Juana Inés de la Cruz play for Oregon Shakespeare Festival, and a historical fiction piece about a transgendered Civil War soldier titled The Good Private for About Face Theatre. Directing/ co-directing credits include: Jarred, Lunatic(a)s, S-E-X-Oh!, The Maria Chronicles, Generic Latina, SOLO Latinas, SOLO Tu and Déjame Contarte. Tanya is also a proud Chicago actor whose voice can be heard on radio and television commercials.

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Publication date: Jul/Aug 2011

Year: 2011

Effects of Ototoxic Drugs on Corti's Explants: Experimental Study

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Publication info: Applied Medical Informatics 29.3 (2011): 25-30.
ProQuest document link

Abstract: Hearing loss represents one of the most frequent human disabilities. Hair cells, the primary sound receptors located in the inner ear are extremely sensitive, but also very fragile. The destruction of these cells in humans or in any other mammal is not followed by replacement, and therefore a permanent hearing loss

results. Neonatal mousse CD1(P0-6) were sacrificed according to the legal standards and ethics. After manual dissection of the cochleae, the entire spiral ganglion was dissected from the modiolus. The explants were treated with gentamicin, followed by incubation for 48 hours at 37°C. Normal and damaged outer hair cells (OHC) or inner hair cells (IHC) were then counted to allow for statistical comparisons between groups. A total of 20,100 outer hair cells from 64 cochleae and 4 groups were analyzed. At 3 mM of gentamicin the hair cells were almost complete damaged. The main type's alteration in the damaged outer or inner hair cells was absence of hair. The mean difference between the damaged or not damaged OHC/IHC was statistically significant ($p<0.001$). In our study we did not observe more damage in the basal cochlear turn when compared to the second turn. No statistically significant difference was found between the first cochlear turn of subjects on these groups, and turns 2 and 3, respectively. Progressive doses of gentamicin cause increased numbers of damaged outer and inner hair cells with absence of hair (the most frequent finding).

Full text: Headnote

Abstract

Introduction: Hearing loss represents one of the most frequent human disabilities. Hair cells, the primary sound receptors located in the inner ear are extremely sensitive, but also very fragile. The destruction of these cells in humans or in any other mammal is not followed by replacement, and therefore a permanent hearing loss results.

Material and Methods: Neonatal mousse CD1(P0-6) were sacrificed according to the legal standards and ethics. After manual dissection of the cochleae, the entire spiral ganglion was dissected from the modiolus. The explants were treated with gentamicin, followed by incubation for 48 hours at 37°C. Normal and damaged outer hair cells (OHC) or inner hair cells (IHC) were then counted to allow for statistical comparisons between groups.

Results: A total of 20,100 outer hair cells from 64 cochleae and 4 groups were analyzed. At 3 mM of gentamicin the hair cells were almost complete damaged. The main type's alteration in the damaged outer or inner hair cells was absence of hair. The mean difference between the damaged or not damaged OHC/IHC was statistically significant ($p<0.001$).

Discussion: In our study we did not observe more damage in the basal cochlear turn when compared to the second turn. No statistically significant difference was found between the first cochlear turn of subjects on these groups, and turns 2 and 3, respectively.

Conclusion: Progressive doses of gentamicin cause increased numbers of damaged outer and inner hair cells with absence of hair (the most frequent finding).

Keywords: Hearing loss; Cochleae; Spiral ganglion; Ototoxic; Hair cells.

Introduction

Hearing loss represents one of the most frequent human disabilities [1]. It is estimated that one person in ten is directly affected, and nearly 40 percent of the population has a hearing-impaired friend or family member [1]. Hearing aids and cochlear implants have helped a lot of patients until now, but the scientific community believes that a real potential to cure deafness is available and should be pursued.

Hair cells, the primary sound receptors located in the inner ear are extremely sensitive, but also very fragile and susceptible to many types of damage including noise, aging, infection, ototoxic medications, and trauma as acquired causes of deafness and genetic conditions [2]. All the inner ear cells, including the supportive cells, are completely developed before birth. Subsequent to their destruction in humans or in any other mammal, these cells are not replaced and, therefore, permanent hearing loss results [2].

The possibility to re-grow certain human cells has recently become a clinical reality. For example, it was shown that skin cells can be cultured and grown in the laboratory and used to resurface burns. [3] At this very moment,

we know that new hair cells can be developed under certain laboratory conditions. The search to identify and optimize these particular conditions and, to characterize the factors involved in the cell regrowth regulation is the heart of many research projects throughout the world. We intend to follow these research lines to bring our contribution to this scientific area

Material and Method

The animal procedures were approved by the institutional review board of the "Iuliu Hatieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania. The study was conducted between January 2008 and December 2008. Thirty- two neonatal mousse CDl (PO-6) (Center for practical aptitudes and skills of the University of Medicine and Pharmacy, Cluj-Napoca) were sacrificed according to the legal standards and ethics, deeply anesthetized and decapitated [4]. After removal of the mandible and the skin, the skull was opened along the midline, separated into two halves and the brain was removed. Following removal of the temporal bone the bullas were opened under Stereomicro s cop e in PBS (Sigma) sterile solution (Figure 1).

Further dissection of the sixty-four cochleaes for attaining spiral ganglion cells and modiolus was carried out by opening the bony cochlear capsule carefully and exposing the cochlear parts of the membranous labyrinth. After removal of the spiral ligament the organ of Corti with the stria vascularis was separated from the spiral ganglion and the modiolus. Finally, the entire spiral ganglion was dissected from the modiolus, followed by transferring them to transparent membrane Millicell, 12mm - Millipore. The cultures were incubated for 30 min at 37°C with 5% CO2 on DMEM milieu (Sigma) with following contains: 6g/L glucose, 5% fetal bovine serum, 10µg/ml transferrin, 25µg/ml insulin, 60µ? putresceine, 3OnM selenium, and 3OnM progesterone. The Corti' s expiants were maintained in these conditions for one month without any infections (Figure 2).

The expiants were treated with gentamicin, twelve for each concentration of aminoglycoside, followed by incubation for 48 hours at 370C. Sixteen expiants were considered as witness. We used the following concentrations of gentamicin: O. ImM, 0.5 mM, 1 mM and 3mM, respectively.

To appreciate the ototoxic effect of gentamicin the Corti's expiants were colored with tetrametylrodamine B isotiocianat (TRITC) (phaloidine extracted from Amanita 'Phalloides) (Sigma), followed by incubation for 15 min with PBS-Triton XlOO 1%. The fixed cultures were exposed to 50µg/ml phaloidine-TRITC for 45 min at 2O0C and washed with PBS.

After previously mentioned processes were completed, the specimens were taken to a scanning Zeiss microscope with reverse phase (AxioObserver Zl), with HBOlOO fluorescent lamp and filters for TRITC (544 nm excitation and 572 nm emission). The images were taken with monochrome AxioCam MRm and processed with Axiovision 4.6 software. Hair cell integrity was defined based on the analysis of their stereocilia. Hair cells with perfect stereocilia were considered healthy. Hair cells with missing or deformed stereocilia were considered damaged. Normal and damaged outer hair cells (OHC) or inner hair cells (IHC) were then counted to allow for statistical comparisons between groups. The percentage of normal and damaged hair cells in the first three turns of each cochlea was recorded for each group.

Descriptive statistics and statistical analyses (mean values and their 95% CI, analysis of variance and Mann-Whitney U test) were performed using SPSS version 13.

Results The mean number of OHC decreased to 38 cells /µ?? at 0.1 mM gentamicin, and IHC were not affected by this dose (Table 1). If we increased gentamicin dosage to 0.5 mM we observed a massive loss of OHC cells, but only a small part of IHC was damaged. At 3 mM of gentamicin the hair cells were almost completely damaged. (Figures 3 and 4) A total of 20,100 outer hair cells from 64 cochleae and 4 groups were analyzed, averaging 335 outer hair cells per cochleae.

In terms of hair cell architecture, the main types of alteration in the damaged outer hair cells were absence of hair (the most frequent finding), distorted pattern from V to V, hair cell tumefaction and fusion. Damage severity decreased in intensity from the first and second turns to the apex and from the first row of outer hair cells to the third. The apical turn was not considered as it processes lower frequency, and ototoxic drugs affect mainly

higher frequency ranges. This turn also presents naturally disarrayed hair cells, which hinders thorough anatomic assessment.

The mean difference between the damaged and undamaged OHC was statistically significant (Anova one-way test, df=3, F= 3.465, p=0.0182). The mean difference between the damaged or not damaged IHC was statistically significant (Anova one-way test, df=2, F= 5.770, p= 0.008). Statistical analysis was also done on the findings from the first cochlear turn of subjects on these groups, and tests were repeated for turns 2 and 3. Likewise, no statistically significant difference was found between groups (Mann-Whitney U test, p=0.65 for first cochlear turns; p=0.83 for second turns; p=0.36 for third turns).

Discussion

Although reliable data on drug-induced hearing loss in the world's population are not available, we know that deafness amounts to a significant occurrence, mainly in cases where aminoglycosides and chemotherapy drugs are used in a continuous fashion. Additionally, drug-induced hypoacusis is irreversible and introduces severe social and psychological burdens in the lives of patients and that if their families. Therefore, more research on ototoxicity and interventions to protect the inner ear are required.

Aminoglycosides are the most studied ototoxic drug, whether it is for historical reasons or clinical relevance. [1, 2] Many reports were published on aminoglycoside ototoxicity and they provide significant knowledge on inner ear anatomy, physiology, and biochemistry, thus opening the path for the development of less toxic drugs and more effective means of protecting and preventing damage against the organ of Corti.

According to Oliveira and Bernal [2], the damage introduced by aminoglycosides in the organ of Corti affects mostly the outer hair cells and progresses towards the base and then the apex of the cochlea. In the basal turns, the first row of OHC is the first to be damaged, followed by the second and third rows. The sequence of damage coincides with the height of outer hair cells, being the basal turn the first to be damaged, followed by the second, third, and then the apical cells. The stria vascularis may also be involved, and marginal cells may be structurally affected.

The identification of sensorial cell and organ of Corti endogenous defense mechanisms in the form of antioxidant and detoxification enzymes catalase, superoxide-dismutase, glutathioneperoxidase, reductase, S-transferase, and glutathione, gave a fresh breath to the research done on ototo xicity and inner ear protection, notably on protection against oxygen-reactive substances [5, 6].

We looked at a total of 64 cochleae and 20,100 OHC (mean 335 OHC per cochlea). In our study, differently from the cited publications, we did not observe more damage in the basal cochlear turn when compared to the second turn. This is possibly due to the high degrees of damage found in these groups, as this pattern is lost with damage progression and cochlear turns with about 100% damaged OHC in all three rows are found.

Morphological analysis showed that the most frequent OHC damage type was the absence of stereocilia, followed by stereocilia deformity (fusion and tumefaction). This finding is consistent with other publications in the literature [7-9].

We believe that studies on the endogenous defense mechanisms adopted by the hair cells of the organ of Corti done concurrently with genetic research [10, 11] and functional assessments form the rational path towards achieving concrete results that will enable us to better manage damage and prevent inner ear toxicity.

Conclusion

Progressive doses of gentamicin cause increased numbers of damaged outer and inner hair cells with absence of hair (the most frequent finding). Damage severity decreased from the first and second turns to the apex and from the first row of outer hair cells to the third. No statistically significant difference was found between cochlear turns.

Financial Disclosure

This work was supported by CNCSIS grant, PN-II-ID-PCE-2008-2, project code ID 2620.

Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contributions

All authors equally contributed to draft the article.

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Received: 26 March 2011 /Accepted: 11 August 2011 / Published online: 22 September 2011

Publication date: 2011

Year: 2011

Progress in Vibrotactile Threshold Evaluation Techniques: A Review

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Publication info: Journal of Hand Therapy 24.3 (Jul-Sep 2011): 240-55; quiz 256.
ProQuest document link

Abstract: Vibrotactile threshold (VT) testing has been used for nearly a century to investigate activation of human somatosensory pathways. This use of vibrotactile stimuli provides a versatile tool for detecting peripheral neuropathies, and has been broadly used for investigation of carpal tunnel syndrome. New applications include investigation of drug-induced neuropathies and diabetes-related neuropathies. As a feedback device, the vibrotactile stimuli could be used as an information delivery system for rehabilitative feedback devices for upper limb musculoskeletal disorders or as information channels for the visually impaired. This review provides a comprehensive review of the advancement in VT measurement techniques over time and a comparison of these techniques in terms of various hardware features used and the testing protocols implemented. The advantages and limitations of these methods have been discussed along with specific recommendations for their implementation and suggestions for incorporation into clinical practice.

Full text:

Classification Basis	Type of MR	Comments	Location
Superficial skin	MC	Located under the fingerprint ridges of hand, these receptors adapt rapidly and offer high sensitivity to mechanical stimuli.	MD
Slowly adapting response formed by clusters of these structures.	Deep subcutaneous tissue	PC	Similar to Meissner's corpuscles in morphology, larger but less densely distributed.
RE	Senses skin stretch.	Adaptation rate	Slowly adapting

MD	Receptors can sense changes in stimulation over time and space. Rapidly adapting receptors stop firing when stimulus is constant, whereas slowly adapting receptors gradually adapt to a signal. When referring to adaptation rate, MDs are also called SA-I, REs are called SA-II, MCs are called RA-I, and PCs are called RA-II.	RE	Rapidly adapting
MC	PC	Excitation frequency	≤6.3Hz
MD	Frequencies listed are ranges that can be used if a single frequency is used for the test. If multiple frequencies are used, then the discrete frequencies recommended to be used are 3.15, 4, or 5Hz for MD; 20, 25, or 31.5Hz for MC; 100, 125, or 160Hz for PC. Note that REs are primarily active in sensing skin stretch and are not clinically useful for detecting a frequency response. This is likely due to their large size (five times larger in area than MD).	16-32Hz	MC
≥100Hz	PC	Function	Form and texture
MD	Sensitive to spatial features of an object such as edges, curvature, and orientation.	Low frequency skin motion perception, grip, fluttering	MC

Provides feedback for gripping objects in hand and stroking or brushing of an object against the hand.	High frequency vibration	PC	Accounts for human ability to sense high frequency vibrations by evoking action potential for every cycle.
Perception of hand conformation and deep tissue strains	RE	Responsible for sensations perceived when the skin is stretched and the shape of the hand is changed.	Resolution
Fine	MC	Resolution is dependent on the size of receptive field and the density of receptors present in the area of stimulation.	MD

Table 1 - Classification of MRs[10,11,14]

MR=mechanoreceptor; MC=Meissner's corpuscles; PC=Pacinian corpuscles; RE=Ruffini's endings; MD=Merkel disk.

Parameter Affecting VT	Effect on VT	Studies	Hardware
Probe diameter	Decreased VT with increase in contact area.	[22,37]	Surround
Absence of surround has been shown to cause an increase in VT at lower frequencies and a decrease in VT at higher frequencies.	[39,52]	Testing procedure	Vibration frequency

Choice of testing frequency affects temporal summation of PC channel.	[97]	Amplitude	Correlation shown to exist between amplitude and perceived pitch of vibration.
[98]	Contact location	No apparent effect on lower frequencies (with small contact area) but at higher frequencies, all locations except extreme tip of the finger shows decreased VT.	[22,37,40,99]
Adaptation (training) frequency	Adaptation frequency (in the form of continued stimulation) has been shown to affect VT and the preactivation of MRs has been shown to stimulate the MRs to actively sense the variation in stimulus frequency.	[66,69-71,100]	Wrist posture
Flexion of wrist may cause exaggerated CTS symptoms due to increased CT pressure.	[55,57,101-106]	Subject's characteristics	BMI
Obese subjects may have decreased sensory conduction.	[43,51]	Age	Elevated VT with age possibly due to decrease in sensory input to brain.

[5,38,42,43,96,107]	Alcohol and tobacco use	VT lower for drinkers than nondrinkers, with VT of drinkers highest among heavy drinkers (>180 drinks/d)	[5,43,48]
Skin temperature	VT appears to increase with decreasing skin temperature. ISO 13091-1 recommends maintaining skin temperature in the range of 27-35°C and the testing room temperature in the range of 20-30°C.	[5,22,34,43,108,109]	Skin hydration
No apparent effect of hydration level on VT was found but the perception of texture of a surface may be altered by hydration and skin condition.	[44]	Gender	Females tend to have a higher perceived intensity of vibration stimulus than males. It was also found that discomfort associated with vibration may also be higher for females as compared with males.
[5,49]	Upper limb disorders	Increased VT was reported for subjects with musculoskeletal disorders.	[73]

Menstrual cycle	VT tends to be higher during menstruation and lower during nonmenstruation.	[45]	Preexisting conditions
Preexisting neuropathies, exposure to vibration, musculoskeletal disorders, diabetes, peripheral neuropathies, and excessive burns have been shown to affect VT.	[23,24,58,63]	Psychophysical algorithm	Method of limits/Von-Bekesy/staircase

Table 2 - Factors Affecting the VT

PC=Pacinian corpuscles; VT=vibrotactile threshold; MR=mechanoreceptor; CT=carpal tunnel; CTS=carpal tunnel syndrome; BMI= body mass index.

Reference	Frequency (Hz)	Application
[41]	31.5 and 125	VT and normative data from five European centers.
[80]	31.5 and 125	VT for Malaysian population.
[111]	4, 32, and 125	Nerve conduction and sensorineural function in dental hygienists.
[112]	120	VT of computer users and nonusers.
[56]	100	Sensory perception in female computer users and nonusers.
[81]	25, 40, 80, 100, 150, 250, and 300	VT for patients with trigeminal neuralgia.
[75]	30 and 200	Tactile perception in subjects with hypersensitivity to touch.
[82]	8, 16, 31.5, 63, 125, 250, and 500	Using VT for early detection of peripheral neuropathies.
[46]	8, 16, 31.5, 63, 125, 250, and 500	VT for various neuropathies.
[96]	120	VT for peripheral nervous system damage caused by neurotoxins.

[113]	4, 6.3, 20, and 32	Changes in VT to diagnose peripheral neuropathy by focusing separately on different mechanoreceptive channels over time.
[59]	16, 32, 63, 125, 250, and 500	Exposure to hand-arm vibration and elevated VT.
[114,115]	20-3,000	Peripheral neuropathy in subjects exposed to hand-arm vibration.
[83]	4, 25, 31.5, 63, 125, 250, 400, and 500	VT perception and hand-arm vibration syndrome in Poland.
[116]	125	Use of thermotactile testing for vibration-induced neuropathy.
[117]	120	Use of vibrometry methods for detection of CTS.
[118]	1, 10, and 300	Effectiveness of VT diagnostic method for CTS.
[119]	120	VT for detection of CTS (sensitivity and specificity measured).
[120]	120	Changes in vibrotactile threshold and the effect of keyboard usage in subjects experiencing repetitive strain injury.
[74]	100	Effect of upper limb disorders on VT.
[43]	120	Covariates of VT including skin temperature, height, and age.
[42]	100	Changes in vibrotactile sensitivity with age and other factors including BMI, height, and glucose level.
[121]	30 and 200	Effect of age on vibration detection threshold.
[122]	31.5 and 125	Change in normal values of vibrotactile and thermotactile thresholds between males and females with age.
[45]	120	Effect of menstruation on vibrotactile threshold.
[51]	Two ranges: 2-20 and 10,000-20,000	Effect of obesity on sensory nerve-response amplitudes.
[76]	20, 50, 100, and 200	Vibrotactile frequency discrimination in hairy and glabrous skin.
[77]	20, 80, and 160	Detection of vibration threshold on hairy and glabrous skin.
[44]	1, 10, 100, and 250	Effect of immersing skin in water on VT.
[123]	100	Effect of time on sensory perception on computer users.
[37]	8, 16, 31.5, 63, 125, and 250	Effect of location of measurement on the VT.

[38]	10, 25, 50, 80, 120, 160, 200, 250, 320, and 400	Effect of a rigid surround for spatial summation.
[18]	0.4-500	Receptors for tactile sensations at different frequencies.
[124]	5, 6.3, 8, 10, 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, and 400	Effect of local vibration on vibrotactile perception.
[125]	50	Effect of rapid displacements of skin on sensory perception.
[79]	16, 31.5, 63, and 125	Dependence of psychophysical method on VT.
[40]	31.5, 63,125, and 250	VT using two methods of controlling the contact of probe on skin.
[69]	25 and 200	Effect of preexposed skin to the two-point stimulus discrimination.
[126]	25 and 200	Ability to distinguish between two-point stimulus on skin.
[127]	10 and 25	Multipoint stimulus using portable tactile device.
[84]	25 and 200	Effect of two-site vibrotactile stimuli at variable distances.
[32]	8, 16, 33, 65, 125, 250, and 500	Use of vibrograms for assessing vibrotactile perception.
[6]	8, 16, 33, 65, 125, 250, and 500	Use of digital vibrograms as tools for sensory testing.
[128]	30, 60, 120, 240, and 480	Validation of high-resolution vibrometry for CTS detection.
[73]	Learning 100, testing 31.5, 63, 125, and 250	Validation of device to measure VT in asymptomatic population.
[129]	120	Validation of a portable device to measure VT with age and gender.

Table 3 - Frequency Selection and Applications of VT Testing

VT=vibrotactile threshold; CTS=carpal tunnel syndrome; BMI=body mass index.

Reference	Psychophysical Method	Description of Study
[42]	MOLs	Amplitude changed in steps of 0.5μm, at 100Hz.
[121]	MOLs	Amplitude changed in steps of 0.17μm at 200Hz and 1.03μm at 30Hz.
[74]	MOLs	Amplitude increased in steps of 0.01μm at 100Hz.
[75]	MOLs	Amplitude decreased in steps of 1μm at 200Hz, 3μm at 30Hz.

[59]	MOLs	Amplitude increased and decreased at the rate of 3dB/sec.
[113]	MOLs	Amplitude increased and decreased at the rate of 2dB/sec.
[51]	MOLs	Six tests, with amplitude rates between 0.1 and 130μ/sec, with 4-sec interval.
[37]	Von-Bekesy	Amplitude increased at the rate of 5dB/sec before the first response, followed by 3dB/sec after the first response.
[83]	Von-Bekesy	Amplitude increased and decreased at the rate of 4dB/sec before the first response, followed by 2dB/sec after the first response.
[80]	Von-Bekesy	Amplitude increased and decreased at 3dB/sec, ISO 1309-I equipment.
[73]	Von-Bekesy	Amplitude increased and decreased at the rate of 5dB/sec; frequencies included 31.5, 63, 125, and 250Hz.
[40]	Von-Bekesy	Amplitude: initial rate was 5dB/sec, and testing step rate was 3dB/sec.
[122]	Von-Bekesy	Amplitude rate of 3dB/sec; measurements taken for at least six reversals.
[77]	Von-Bekesy	Various durations (100, 400, 800msec), and step sizes at different frequencies (for hairy or glabrous skin: 14.6 or 4.6μm at 20Hz, 5.0 or 1.2μm at 80Hz, 1.7 or 0.4μm at 160Hz).
[46,82]	Von-Bekesy	Standardized frequencies in one-octave bands used, with every frequency tracked for 35sec (audiometry techniques used).
[81]	Von-Bekesy	Use of Von-Bekesy attenuator to drive Goodman's V-47 vibrator.
[44]	Two-alternative forced choice	Amplitude decreased by 1dB after three correct responses and increased by 1dB after one incorrect response.
[18]	Two-alternative forced choice	Amplitude decreased/increased by 1dB/sec for correct/incorrect responses.
[127]	Two-alternative forced choice	Interprobe distance varied (5, 10, 20, and 30mm).
[43]	Two-alternative forced choice	Amplitude decreased by 10% after two out of three correct responses.
[76]	Two-alternative forced choice	Three trials at each frequency (20, 50, 100, 200Hz) repeated every 5sec, with a 1-sec vibration train superimposed on a 1-mm step.
[38]	Three-alternative forced choice	Amplitude decreased by 3dB until two reversals, then by 2dB until the third reversal, then by 1dB after three consecutive correct responses.
[41]	MOLs, Von-Bekesy	MOLs: 5dB step; Von-Bekesy: amplitude rate: 3dB/sec.

[79]	Forced choice, Von-Bekesy	Forced choice: amplitude decreased by 2dB after three correct responses and increased by 2dB after one incorrect response. Von-Bekesy: amplitude testing rate of 5dB/sec and initial rate of 3dB/sec.

Table 4 - Psychophysical Testing Protocols Used for VT Testing
MOL=method of limit.

Frequency	Intermittent	Continuous	Testing Requirements	Desired Mechanoreceptor
Primary; Others	Burst; Quiescent	Duration; Rest	Testing frequency	Merkel discs
4.0; 3.15 or 5.0Hz	<10sec; ≥0.6sec	≤50sec; ≥30sec	Meissner's corpuscles	31.5; 20 or 25Hz
<10sec; ≥0.6sec	≤50sec; ≥30sec	Pacinian corpuscles	125; 100 or 160Hz	0.6-10sec; ≥0.6sec
≤50sec; ≥30sec	Probe[low *] and Surround[dagger]	Edge Radii	Diameter	Gap
Surround Force	0.2mm≤*r* ≤0.7mm	4.0±2.1mm	1.5±0.6 mm	0.7-2.3N
Subject	Room Temperature	Skin Temperature	Support	20-30°C

27-35°C	Forearm, hand, finger, seat with back rest	Psychophysical Algorithm	An up-down variant[double dagger] or Von-Bekesy	([dagger]) Surround: may be omitted. ([double dagger]) Both method of limit and forced-choice method can be implemented as a variation of up down (i.e., amplitude decreased or increased corresponding to correct or incorrect answers).

Table 5 - Relevant ISO Recommendations, Adapted from Table 1 in Ref. 34

Reference	Yr	Authors	Device Used	Probe	Use of Surround, Temperature Maintained, Contact Force, etc.
[130]	2010	Brammer et al.	Tachometer	3mm	No surround, skin temperature maintained at 27°C, contact force 0.05N
[131]	2009	Wu et al.	PVC polymer probe with computer-aided displacement-controlled protocol	4mm	No surround, different probe-skin contact angles used
[61,132]	2007 and 2009	Duke et al. and Temlett	Biothesiometer (Cleveland, OH)	13mm	No surround, essentially an improved electronic tuning fork
[122]	2008	Seah and Griffin	HVLab Tactile Vibrometer (HVLab, UK)	6mm	Surround, skin temperature maintained between 27 and 35.2°C, contact force 2N
[42]	2008	Deshpande et al.	Medoc VSA 3000 (Advance Med. Systems, MN)	1.25 cm	Tested on feet, temperature maintained at 32°C, amplitude 0.5μm
[113]	2007	Brammer et al.	Tachometer	3mm	No surround, skin temperature maintained at 27°C, contact force 0.05N
[55]	2007	Sesek et al.	VT tester	1mm	Surround (2cm), hemispherical cover for testing different finger locations
[76]	2006	Mahns et al.	Perspex probe with feedback-controlled mechanical stimulator	4mm	Index finger secured with plasticine, forearm secured in plastic chamber
[75]	2006	Blakemore et al.	Model 101 (Ling Dynamic Systems, UK)	N/A	Waveform amplified by Stereo Amp (Marantz PM520DC)
[74]	2006	Laursen et al.	Vibrameter (Somedic, Sweden)	13mm	At room temperature 22-23°C, hand rested on rice pillow, 650g pressure
[37]	2006	Whitehouse et al.	HVLab Tactile Vibrometer (HVLab, UK)	1mm 6mm	At room temperature 23±2°C, mean finger temperature 32.8°C, 2N force maintained, subjects exposed to 70dB white noise, 5 different test sites, 1-mm gap for 1-mm probe, 2-mm gap for 6-mm probe.
[111]	2006	Cherniack et al.	Laboratory tachometer (meets ISO-13091-1)	3mm	Static force of 0.05N, calibrated using reference signal

[49]	2006	Neely and Burstrom	Modified version of Von-Bekesy audiometer (Brüel &Kjær 1800/WH 1763, Denmark)	N/A	No surround, arm abduction 0° and arm flexion 180° (ISO 5349-1), frequencies generated by Ling Dynamic System 406 vibrator
[83]	2005	Harazin et al.	P8 Pallestheisometer (EMSON-MAT, Poland) Vibrotactile meter MCW 2K (Poland)	5mm 10mm	No surround, contact force: 0.1N Surround: 16mm, contact force: 2N
[51]	2005	Miscio et al.	Medoc TSA ii-2001 and VSA 3000 (Advance Med. Systems, MN)	N/A	Amplitude 0.1 and 130μm, temperature maintained at 32°C
[123]	2005	Pilegaard and Jensen	Vibrameter (Somedic, Sweden)	13mm	Constant probe pressure 650g
[84]	2005	Tannan et al.	Two CS-525 vertical displacement stimulators (CantekMetatron Corp., Canonsburg, PA)	N/A	Two-point stimulators with range of separation 0-40mm (each independently controlled)
[69]	2005	Tommerdahl et al.	CS-525 vertical displacement stimulator (CantekMetatron Corp., Canonsburg, PA)	8mm	Surround
[112]	2005	Sanden et al.	Vibrameter (Somedic, Sweden)	13mm	Pressure display: 8.1N/cm^2 , 0.4N maintained by subjects
[80]	2004	Daud et al.	HVLab Tactile Vibrometer (HVLab, UK)	6mm	Surround: 10mm
[41]	2003	Lindsell and Griffin	HVLab Tactile Vibrometer (3/5 locations) Self built system (1 location) Brüel &Kjær shaker (1 location)	6mm 1.26 mm 6mm	Contact force: 1N, push force: 2N Contact force: 0.2N, no surround Contact force unspecified, no surround
[47]	2003	Roberston et al.	Acrylic probe (Ling Dynamic Systems, UK), Frequency gen. E326A (Grason-Stadler, WI)	2mm	Forces monitored by force transducer (Brüel &Kjær Model 8001, Denmark)
[116]	2002	Sakakibara et al.	Vibrometer AU-02B (Rion, Japan)	N/A	Contact force: 0.5N
[62]	2002	Hillstrom et al.	Oticon-A bone-conductors (hearing aids)	1.6cm	Tactors covered in foam, plus pink noise via headphones
[56]	2002	Jensen et al.	Vibrameter (Somedic, Sweden)	13mm	Contact force: 650g wt.
[73]	2001	Wild et al.	HVLab Tactile Vibrometer (HVLab, UK)	6mm	Surround: 10mm

[44]	1998	Verrillo et al.	Shaker beneath a rigid surface as in ref. 16	3.7mm	Skin temperature monitored by thermistor embedded in rigid surface
[120]	1998	Greening and Lynn	Vibrameter (Somedic, Sweden)	1cm	Contact force: 50g wt.
[45]	1997	Espritt et al.	Vibratron-II (Physitemp Inc., Clifton, NJ)	N/A	Contact force: 0.1N, tests conducted at room temperature
[119]	1995	Gerr et al.	Vibratron-II (Physitemp Inc., Clifton, NJ)	1.4cm	Calibrated using GY-125-10 accelerometer (Kulite Corp., NJ)
[128]	1995	LaCourse and Miles	Two speakers mounted axially and back to back in closed chamber	2.54 mm	Probe: blunt pin, amplitude ±20μm resolution
[43]	1994	Gerr and Letz	A prototype of Vibratron-II (Physitemp Inc., Clifton, NJ)	N/A	Probe: hardened rubber postprotruding through a plexiglass plate
[59]	1992	Virokannas	Modified equipment from Brüel &Kjær (Denmark)	2.6mm	Contact force: 0.2N, temperature monitored by thermocouple (YSI 400-series probe, Yellow Springs Instrument, USA) to above 28°C
[46,82]	1992	Lundborg et al. and Lundstrom et al.	Refinement of system in ref. 30 and ref. 6	2.5mm	Contact pressure: 3.5N/cm^2
[133]	1987	Brammer and Pyykko	Custom equipment with accelerometer, device shielded by Faraday cage	N/A	Amplitude: 35dB, finger restraint used, finger motion calibrated
[6,32]	1986 and 1987	Lundborg et al.	Modified Von-Bekesy audiometer (Brüel &Kjær 2850, Denmark	2.5mm	Probe had a 5mm^2 tip
[124]	1985	Lundstrom	Vibrations from a shaker driven by power amp and controlled by computer	2.5mm	Contact pressure: 0.8N/m^2 , accelerometer mounted between shaker and probe
[77]	1985	Hamalainen et al.	Brüel &Kjær 4810 minishaker (Denmark)	2mm	Calibrated by piezoelectric accelerometer (Brüel &Kjær 4339)
[78]	1981	Rhodes and Schwartz	Pallometer head and vibratable probe as in ref. 134	6mm	Surround: 8mm, contact force: 100g
[81]	1977	Verrillo and Ecker	Von-Bekesy attenuator driving a Goodman's V-47 vibrator	9.6mm	Calibrated by an accelerometer, subject and device inside a sound- and vibration-isolated booth

Table 6 - Comparison of Equipment Parameters Used for VT Testing

VT=vibrotactile threshold.

Human skin is able to respond to a myriad of sensations due to the presence of a very specific but diverse assortment of sensory receptors. These receptors provide a unique way of sensing explicit stimuli, converting

signals as diverse as light wavelengths, chemicals, and pressure waves into colors, taste, and sounds. The aim of this article is to begin by understanding the concept of how a human brain perceives touch and vibration and build up to comprehending the use of this sensation (or an abnormality in sensation) to evaluate peripheral neuropathies. Devices that can evaluate the sense of touch and vibration will be discussed and compared in terms of specific features such as hardware construction, frequencies at which the tests are performed, and the methods of psychophysical testing. A brief background of neurology and psychophysical testing is provided to make this literature review useful for readers with diverse backgrounds.

New applications of nerve health evaluation using vibrotactile testing include investigating peripheral sensory neuropathy in individuals who have received drugs with neurotoxic potential for treatment of cancer (e.g., taxanes, cisplatin) and inflammatory conditions such as arthritis. [1,2] In cancer treatment, neuropathy is often a dose-limiting complication. It is possible that continual monitoring with vibrometry might allow oncologists to be more confident in providing aggressive, efficacious treatment. In addition, use of quantitative vibrometry may allow closer monitoring of insulin-resistant and type 2 diabetic patients to promote lifestyle changes that can slow, stabilize, or even reverse peripheral nerve damage. Vibrometry may also contribute to translational investigations of drug treatments for diabetic neuropathy.

A traditional vibrometry application is the evaluation of carpal tunnel syndrome (CTS), a well-known upper extremity musculoskeletal disorder that results from compression of the median nerve in the human hand,[3,4] and thus most of the literature on vibration and touch testing has focused on the detection of CTS. Compared with clinical standards for testing for CTS, such as nerve conduction velocity (NCV) tests, ultrasound, or magnetic resonance imaging (MRI), vibrotactile testing is a low-cost and fast method, which provides the ability to cost-effectively evaluate nerve health on a regular basis in the workplace. [5-7]

The availability of low-cost components to build devices that can provide a specified vibrotactile feedback enables new opportunities for rehabilitation such as feedback devices for upper limb musculoskeletal disorders,[8] use of vibrotactile feedback for manipulating objects in a virtual environment for physical rehabilitation, and using vibrotactile feedback as a mobility aid for the visually impaired.[9]

Tactile Perception in the Human Hand

The human hand has sophisticated mechanisms for sensing stimuli such as pain, temperature changes, joint position, and mechanical deformation of the skin. Sensory receptors are responsible for the initial interaction with the stimulus before it is transformed into an electrical signal coded to be transmitted by afferent nerve fibers to the central nervous system. [10,11]

Each sensory receptor is sensitive to a distinct type and pattern of energy and responds to a selective amount of stimulus for activation. Irrespective of the type of stimulus energy experienced by a sensory receptor, the stimulus is converted to an electrical signal (i.e., action potential discharge) that is then conducted through the central nervous system, illustrated schematically in Figure 1. Thus, all sensory receptors share a common mode of sending and processing signals. The human brain processes information from not just one, but many such sensory receptors when presented with external stimuli. [10,11] Although human beings experience a wide range of sensations such as colors, tastes, and tones, these are all the result of perceptions formed by the brain based on the transduction of an external stimulus received by the sensory receptors. Each sensory receptor processes information from a given stimulus in four different ways--modality, location, intensity, and timing. Vision, touch, taste, smell, and hearing have been identified as basic sensory modalities. [11]

Vibration and touch are both forms of tactile stimulation, as both produce distortion of the cutaneous surface. These distortions of the skin generate waves that are transmitted through the skin that are analogous to tremors traveling through the earth's crust. [12] When these distortions reach the membrane of a mechanoreceptor (MR), the membrane is also distorted causing stretch-sensitive ion channels to open and allowing ions to flow across the receptor membrane and to produce membrane depolarization that generates action potentials, which travel to the sensory cortex and produce a tactile sensation that could be either a touch or vibration depending on the

type of receptor being activated. There are a variety of MRs within and just below the skin that respond to such displacements. Each receptor has unique filtering characteristics that allow it to respond preferentially to different types of distortion and produce sensations ranging from touch (low frequency displacement), to "flutter vibration" (moderate frequency) to "vibration" (high frequency). [13]

Tactile perception can be understood by considering the aspects of basic categories of information conveyed. Modality refers to the type of stimulus that a receptor can sense and respond to. Cutaneous modalities corresponding to tactile perception include touch, warming, cooling, pain, and itch, where submodalities of touch include texture, edges, and rigidity. Four types of MRs--Meissner's corpuscles, Merkel cells, Pacinian corpuscles (PCs), and Ruffini endings--are responsible for sensing these submodalities. Because these receptors are present in dense population throughout the hand, the location of touch is sensed by the active receptors not only at a given time, but also over a period of time. The action potential frequency and discharge duration produced by the active receptors signals the intensity and duration (defined by when the receptors start firing to when they stop) of the stimulus. [10,11,14,15]

The location and morphology of an MR determines the particular type of response that will be generated when activated by a stimulus that is in the adequate range to excite the receptor. MRs can be classified in several ways depending on features such as location, function, resolution, and adaptation rates. [10,11,14,16-18] These are summarized in Table 1.

A direct consequence of the varying adaptation rates of MRs is the ability of these receptors to act as filters to a range of frequencies. This property results in the ability of these receptors to respond to external stimuli in a manner that is unique and distinguishable for each type of receptor, especially at lower stimulus intensity. For instance, although a stimulus frequency range of 5-50Hz appears to excite all MRs, it appears that PCs get excited more effectively in a stimulus frequency range of 100-300Hz. [10,14,19] This type of quantitative sensory testing can be used as a means to identify earliest signs of nerve damage.[20-25] Thus, it is important to understand the parameters that affect this type of screening method for peripheral neuropathies to design an appropriate sensory test.

The Vibrometry Technique for Evaluating Nerve Health

Tests conducted for training the deaf to identify and interpret sounds by using the sense of touch have been used since the early 1920s.[26] The methodology of understanding auditory capacity of human beings was applied to the response elicited by a vibrating stimulus against the skin. It was hypothesized that just as a human ear can discern several frequencies within 10 octaves, the sense of touch should also have a range of frequency that can be felt. [26-28] The choice of frequencies for testing was purely experimental and was not based on the specific range of frequency that is now known and documented to excite a unique type of receptor. These early tests indicated that custom-designed hardware was necessary to understand the realm of touch sensitivity [26,29] in contrast to the simple tuning fork approach (derived from auditory tests) used in early experiments to investigate the range of frequency that could be felt by a human hand.[30]

Audiometry refers to tests of hearing ability, and the instrument used to conduct these tests is an audiometer, which provides different frequencies and pitches as a stimulus for the subject.[28] Because testing the sense of touch originated from hearing tests, it was aptly called vibrometry and the instruments that have been used were given a general name of vibrometers.[5,6,26,30-32] In the following sections, the fundamentals of vibration measurement, the features of a typical vibrometer, the various parameters that can affect the results, and the different testing protocols that have been used will all be discussed in detail.

Measurement of Vibration

Vibration can be thought of as an oscillatory motion of a body about an equilibrium point, and can be periodic or nonperiodic. For the purpose of this review, only sinusoidal (periodic) vibration will be discussed because it has been successfully used to excite all types of MRs. Because sound (pressure) waves are generated by an oscillating body, sound and vibration studies have been frequently analogous. This analogous nature of

audiometry and vibrometry has been a key factor in the development of vibrometric devices and measurement practices. [33]

The amplitude of a sound wave is typically reported in pressure units (Newton per square meter, N/m^2), with the decibel (dB) used to provide a measurement of relative intensity of a pressure wave when compared with a reference level. Use of dB is practical when the ratio between two amplitudes is of more significance than absolute amplitude value and for audiometric measurements, the decibel reference level is the assumed minimum threshold of hearing ($0.00002 N/m^2$).

Unfortunately, early vibrometeric measurements borrowed the use of the dB scale, which has led to a great deal of confusion. Vibrometry results that are reported in dB often refer to a change in intensity, with "low intensity" meaning a larger amplitude, and "high intensity" meaning a smaller amplitude. The use of dB units, originally intended to measure sound and pressure waves are somewhat unintuitive when applied to measuring and quantifying vibration. Measuring the amplitude of sound corresponds to a change in pressure with each oscillation, whereas measuring the amplitude of a vibration refers directly to the peak-to-peak distance of the oscillation about a fixed reference point. Also, the variation in amplitudes that can be detected on skin occurs over a relatively small range, which does not necessitate the use of a logarithmic scale to visualize changes. Lately, the trend for reporting vibrometric measurements has been toward using the displacement of vibrating body from a fixed reference. This displacement, commonly reported in micrometers, is equal to one-half the amplitude of the oscillation, and thus provides a more insightful parameter for estimating threshold of vibration perception. [5] When compared with older studies that use dB, the amplitude in dB can be calculated from the ratio of the square of the measured amplitude (A 1) to the square of a selected reference amplitude (A 0), as in Eq. 1.[Formula omitted. See PDF]

Vibrometer Features

The international standards for mechanical vibration[34,35] provide recommendations for the various components and aspects of a vibrometer. The components of a vibrometer include a stimulator for producing vibration stimulus, a probe that transmits the vibration stimulus to the finger and is in direct contact with the subject's finger, and an optional firm surround encircling the probe to provide a finger rest, as shown in Figure 2. An optional finger or hand support (not shown in Figure 2) may also be included. In addition, a sensor for accurately determining the vibrating probe's position is desirable for correctly identifying the threshold of perception.

Parameters Affecting Vibrotactile Threshold Testing

The vibrotactile threshold (VT) is defined as the smallest displacement that can be detected by the individual undergoing a test. For a given individual, the VT varies depending on the type of hardware used, the psychophysical testing protocol used, the personal characteristics of the subject tested, and the testing procedure adopted. To account for the changes in the VT and to be able to use this tool for testing purposes, it is essential to understand the individual effect of these parameters. [36] The many factors affecting VT are detailed in Table 2.

The probe configuration, which includes the actual size and shape, and the location, affects the VT considerably. Because excitation of MRs is achieved directly by the stimulating probe, it is not surprising that the population of the MRs excited corresponds to the size of the probe. Increasing the size of contact decreases the VT because the sensitivity of the MRs increases when a larger population is excited. [37,38] In addition, because some MRs are "edge detectors" (i.e., type I slowly adapting receptor), they are likely to exhibit enhanced activation by a probe with greater edge-to-surface area ratio.[10,14] Also, the probe size can alter the types of MRs that will be excited by a device at a particular frequency, so a careful selection of an appropriate probe size is necessary.

The surround for the probe affects the VT further by effectively limiting the area of stimulation. In other words, the vibration supplied by the probe is not transmitted to the entire finger, but the area within the surround. A

decrease in the gap between the surround and the probe simulates an increased probe size and a corresponding increase in the VT is observed. [37-41]

The vibrotactile sensitivity shows a notable decline with age, resulting in a significant increase in VT, and thus, age must be accounted for during a VT evaluation.[5,42] Personal characteristics that have been frequently reported to affect the VT are skin temperature, skin hydration, and menstrual cycle.[41,43-45] The effect of skin temperature on VT has been studied by varying the skin temperatures in a controlled manner and recording the VT at each temperature; the temperature effect increases with an increase in the stimulus frequency of the stimulus.[5] However, studies often fail to mention whether or not a fixed limb temperature was maintained.[6,32,46,47]

The effects of alcohol consumption on neurological perception is complex, with all drinkers having slightly lower VT compared with nondrinkers, and heavy drinkers (those consuming >180 drinks per month) having the highest VT among all drinkers; however, significant associations between VT and alcohol consumption have not been identified. [48] Gender affects the perceived stimulus intensity, with females showing a greater vibrotactile sensitivity at high frequencies than males, and sensitivity to change in a stimulus more apparent at certain frequencies (31.5, 63, 125Hz) in females than males.[43,49,50]

Obesity has been suspected as a factor leading to altered metabolism causing slower motor latencies, and eventually leading to peripheral neuropathy.[51] Body mass index (BMI) and the VT have been shown to have a significant correlation.[5,43] However, in some studies focused on BMI, gender was not found to affect the slope of decline in vibrotactile sensitivity with age.[5,42] Such contradictory study results in the literature emphasize the need for standardization of testing devices and protocols so that any actual differences can be more clearly attributed to subject characteristics rather than differences in equipment or protocols. [5,41]

The frequency of stimulation used for testing determines the type of MR excited (Table 1). MRs are differentiated by the size of receptive fields and other distinctive features (e.g., shape, size, and locations). This results in the selective excitation of PCs at frequencies above 100Hz. Merkel discs are active below 6.3Hz, and Meissner's corpuscles are activated between16 and 32Hz. [6,10,14,18] These unique properties of individual MRs have been used to develop vibrometry techniques to identify information about the innervating nerve.[52-54] For an impaired nerve, the VT is increased, meaning that a larger displacement is necessary for sensation to be observable by the individual. It is important to note, however, that although VT may be increased, the etiology may vary significantly for different conditions. For instance, low sensitivity of MRs originating from degeneration of distal axons may cause an increase in VT in the case of dying-back neuropathies such as diabetes and chemically induced neuropathies. In contrast, the VT may be increased in the case of CTS because action potentials are blocked at the area of entrapment of the median nerve, whereas the MRs may retain full sensitivity as long as they receive adequate blood flow. [55,56]

This feature can be exploited to examine and evaluate nerve health and MR response of a subject. For instance, clinical symptoms of neuropathies caused by hand-arm vibration syndrome (HAVS) can be similar to the symptoms of CTS. Careful VT testing can be used to distinguish between these, because an increase in the VT at a frequency of approximately 256Hz is indicative of early CTS. [57-59] Identification for HAVS requires testing at multiple frequencies (e.g., 8, 16, 32.5, 65, 125, 250, and 500Hz).[15,60] A "tactilogram" or "vibrogram" can be drawn by plotting the testing frequency on the X-axis and the VT expressed in dB on the Y-axis. For a normal subject, the trend is typically almost a straight line parallel to X-axis for frequencies between 8 and 125Hz interrupted by a peak in the range 125-250Hz due to a higher perception of PCs as compared with other types of MRs. [32] However, for a subject exposed to HAVS, the distinctive peak within the frequency range of 125 and 250Hz starts becoming smaller to almost flat depending on the extent of exposure.[59,61]

The range of frequencies that has historically been used is broad (Table 3). Some studies used a stimulus picked randomly from a particular frequency range for testing the subjects.[46,62] It appears that often the choice of testing at a particular frequency is dependent on the hardware limitations. For instance, due to such equipment constraints, several studies have performed tests at 100 and 120Hz.[12,63-65] These frequencies appear to have

been implemented because they are related to the operating frequency of the supply voltage (50Hz with a 220V supply, 60Hz with a 110V supply). Thus, selection may have been more of an "engineering convenience" than a scientifically driven decision.

The effect of continued stimulation has been shown to elevate VT and this phenomenon has been referred to as "vibration adaptation."[30,66] Adaptation to a frequency offers an insight in the mechanism and scope of receptor ability of detecting a vibration stimulus. Because the magnitude of a stimulus and the perceived intensity during recovery from an adaptation frequency follows the same law (Stevens' power law [67]) that governs a test frequency response for a receptor, it appears that the role of adaptation is not a reflection of fatigue of receptor system.[66,68] Providing an adapting frequency (i.e., a different frequency than that used for testing) before the actual test improves the ability of the receptors to discriminate between frequencies. This has been credited to the "preactivation" of mechanosensory channels, which then respond more actively as the variation in stimulus is decreased. [53,66,69-72]

Psychophysical Testing Protocol Used

Psychophysics is a branch of psychology, first developed by Gustav Theodor Fechner, which explores the relationship between a particular physical stimuli and the way it is perceived by a subject. A stimulus that can be objectively identified and perceived must have a threshold, meaning that below a certain threshold, the stimulus cannot be perceived, while above the threshold the stimulus can be perceived. Several methods have been developed to test stimulus perception. [21,41,73] For VT testing, the protocols that have been used most frequently in the literature are method of limits (MOLs),[5,21,41,42,46,74-78] and the Von-Bekesy algorithm, which is a type of MOL, [37,40,46,77,79-83] and the forced-choice method (FCM).[21,37,41,69,74,84] MOL can be either ascending or descending, where the stimulus is gradually increased to the point of detection or decreased to the point of no perception, respectively. In the Von-Bekesy algorithm, continuous stimulation is applied with varying amplitude. The test is started at a selected frequency with large amplitude so the subject can easily detect the stimulus. The amplitude of the stimulus is then reduced in steps until it is no longer detectable. At this point, the staircase is reversed starting with a subthreshold amplitude and increased until detected, until the threshold is isolated. [34,79] In FCM, the subject is presented with the stimulus in predefined intervals of time and the subject is asked to identify the particular interval in which the stimulus occurred. Studies involving these different testing protocols are summarized in Table 4.

The choice of testing protocols has typically been dependent on the type of equipment used, with MOL used most frequently. It appears that protocols for commercially available VT equipment have often been selected based on the time efficiency and not the efficacy of the protocol. Using older equipment, a drop of 3-6dB was found between the MOL and Von-Bekesy protocols, with FCM lower than the threshold obtained by Von-Bekesy by a drop of 2.2dB. The lower thresholds identified with FCM may be due to the subject finding it easier to differentiate between signal and no signal than to identify the signal as it gets smaller or larger, or may be due to the response characteristics of MR system. [79]

The presence of bias related to MOL and FCM has been recognized but this bias has not been empirically estimated.[5,79] A consensus has not been reached on recommendation of one particular procedure, so equipment should provide sufficient flexibility in testing protocol because it is difficult to directly compare results when different testing methods are used.

Comparison of Techniques Currently in Use

Originally developed from audiometric testing devices used to screen the extent of hearing damage, the early vibrometry devices used in the 1970s show clear modifications of the audiometric devices that inspired this field. [24,31,39,85] The stimulus was delivered in the early devices by shakers, and amplifiers remained common for both vibrometric and audiometric devices. The Brüel &Kjær vibration exciter and power amplifiers were used in later (but still relatively early) commercial VT testing devices. [6,32] Sensortek Inc., Somedic Sales, HVLab developed and marketed other more recent commercially available VT testing equipment.

It is evident from this literature review that VT evaluation techniques are still not completely standardized although international standards exist (ISO-13091-1 and ISO-13091-2).[34,35] The relevant recommendations are summarized in Table 5.

Variations in testing protocols, contact conditions, hardware, and several other parameters make it very difficult to directly compare results from different studies. To compare devices and their specifications, Table 6 shows a detailed summary of the equipment parameters of existing devices used for VT testing. Systems in use have many variations in the type of hardware geometry, testing protocol, and testing frequency used. Certain devices offer more range of testing frequencies than others. The probe size and geometry also differ greatly from device to device as does the way in which the probe is interfaced with the subjects' fingers. In addition, probes differ not only in size, but also in the presence or absence of a firm surround.

Limitations of VT Testing

Advancement of a scientific technique is aimed toward not just a better understanding of the fundamental science behind it, but also acknowledging the associated limitations, and this review would not be complete without a thorough discussion of the limitations of VT testing. It is important to note that because the gold standard (for diagnosing CTS) NCV testing measures electrophysiological health of a nerve while the VT testing evaluates the sensory function the results from such tests cannot be directly compared. Other challenges, discussed in more detail in this section, include the challenge in selectively exciting and in fully understanding MR responses, the expense of available VT equipment, and the broad variety of features and lack of standardization in existing devices.

Although the classification of MRs in Table 1 describes the response from a particular type of MRs for VT testing, MRs may be stimulated at a frequency above or below the frequency range associated with it as long as the amplitude is appropriately adjusted. Early theories on the mechanism of perception of touch by neurophysiologists such as Ernst Weber, Max von Frey, Johannes Miller, Alfred Goldscheider, Magnus Blix, and Henry Donaldson, to name a few, were faced with criticism based on lack of anatomical evidence and assigning a receptor only one specific function. For instance, Max von Frey initially suggested the model of skin to be similar to a "mosaic of sensory spots" for touch, cold, warmth, and pain. It was later found that that there are several types of receptors that work together rather than in isolation. [86] Thus, it appears that the simultaneous excitation of several types of MRs may affect VT testing results depending on the testing parameters used. In addition, some MRs have been characterized in great detail at lower frequencies, not all MRs have been explored completely, and work remains to complete investigating MR response at high frequencies (>250Hz). The classification of MRs based on frequency of excitation should be used as a reference while keeping in mind the relative and approximate nature of the information.

Although current units for VT testing have costs similar to NCV units, this is mainly due to development costs vs. capital costs and operating costs of a commercially available unit. As VT testing moves from the laboratory into the clinic, economies of scale will drive costs for the VT units down. Operating costs for the VT are very low with no consumable components and the ability to conduct the tests on-site very quickly and with immediate results that require little interpretation. These aspects make the VT an attractive means of workplace surveillance. Although an agreed upon standard has not yet been determined, relative comparisons can be made within individuals. Once a baseline threshold has been determined for an individual, patients can be routinely evaluated and compared against their personal baselines.

The comparison of existing VT testing devices (Table 6) makes it clear that there are large variations used in testing parameters and hardware. This variation makes it difficult to identify one device over another as optimal, and is further complicated by many devices lacking or having poor force control or other inherent inaccuracy of hardware. [87] The importance of force control in sensory testing is necessary for the reliability and repeatability of results.[87-90] Methods to quantify sensory function exist without a general consensus and efforts have been made to develop a well-rounded set of tests to assess clinically relevant aspects of somatosensory function.[91] A study

conducted by Bell-Krotoski and Buford to quantitatively measure and simulate force applied by the most commonly used sensory testing instruments (Semmes Weinstein monofilaments were simulated as a paper clip and vibration instruments were simulated as a tuning fork; customized strain gauges were used to measure the applied force) demonstrated that the paper clip had higher reliability than the tuning fork. [88] A wide range of force signals, such as were produced by the hand-held tuning fork, are incapable of selective stimulation of just one type of MR.[92] Although these are certainly drawbacks of the VT test, it is important to recall that two-point discrimination tests have also been critiqued by Lundborg and Rosen[93] for the lack of standardized testing protocol for how much pressure should be applied for testing. Providing an elaborate description of testing protocol for evaluating studies including the starting distance used, number of times the test was performed, use of blunted end needle, and the amount of pressure applied has been emphasized. [93,94] In summary, because most devices currently in use for sensory testing provide a unique set of hardware, software, and testing protocol, it important to conduct dedicated studies to compare results from different devices and algorithms.[95]
To address these challenges, three laws of measurement have been described by Buford[92] for improved objective measurement of sensory function in clinical setting. The first law (law of perturbation) describes that care should be taken to not affect the signal of interest while it is being measured. As discussed above, because the dynamics of hand-held devices are likely to be affected by the user, stationary devices should be used. The second law (law of selectivity) states that the method of measurement should selectively measure and respond to only to the desired signal. Many existing VT testers are likely to excite numerous MRs although it is generally desired that only one type of MR be stimulated. The third law (law of precision and variance) emphasizes the importance of knowing the extent of variance of the function being measured to determine the precision of the device measuring it. As described above, a complete understanding of MR response at frequencies greater than 250Hz remains a research topic. Dyck et al. [95b] have provided comprehensive and controlled data on human sensory function that has been used for the evaluation of variance in human sensory function for clinical testing of tactile function. Attention to these laws of measurement can benefit the hand therapist in evaluating the results of VT testing.

Clinical Applications

The VT test has many relevant applications for clinical hand therapy practice. Longitudinal studies are recommended to prospectively study the VT in environments that have relatively high rates of hand/wrist disorders. Such studies would help elucidate how well the VT correlates over time with the development of hand/wrist disorders. These studies should include and account for occupational exposures and personal characteristics. Multiple VT protocols with varying frequencies, forces, presence or absence of a surround, etc. should be compared to determine the most optimal and cost-effective protocols for VT surveillance. Until the limitations described previously have been addressed, of course, the VT should be thought of as a compliment to NCV and MRI, rather than as a replacement for them.
It is understood that the VT, NCV, MRI, and other evaluation methods are not measuring the same thing. However, each can be used independently to monitor for changes that might be indicative of the development of a hand/wrist disorder. In this respect, the VT has the advantage of portability and a simpler testing protocol with less need for medical expertize for interpretation (as is needed with NCV and MRI). When changes are detected, referral to a medical expert would be appropriate. Medical professionals would determine the need for further testing, which could include more sophisticated means of evaluation such as NCV or MRI. Although multiple tests could be used to provide medical experts with a more complete view of a patient's condition, only the VT represents a simple means of workplace surveillance that could be used noninvasively and with minimal interruption to work flow.
As these limitations are resolved, there are many applications in which VT testing can be implemented in the hand therapy clinic. First, when compared with conduction velocity measurement, the VT test is quick, does not require electrode placement, and in addition because it is noninvasive and non-noxious, patients will not mind

being retested as often as necessary. The only costs are for the equipment and there are no disposable costs. When used under physician supervision (especially certified hand and/or microsurgeon), reimbursement is often possible. Secondly, because the result of a VT test is a quantitative assessment, there are many areas in which the VT test could be used to improve the treatment of patients. For instance, the VT test can be used to compare baseline pretreatment or presurgery with posttreatment outcomes, and thus it can be used to compare efficacy of different treatment outcomes to determine which treatment is best. Similarly, it can be used in outcomes-based management to quantitatively document results following a therapy protocol. Thirdly, for hand therapy clinicians who see patients with nerve issues related to employment, VT tests have several workplace applications. Quantitative assessment of sensory threshold can help in making return-to-work decisions and in providing a justification of those decisions. Because elevated sensory threshold can be linked to job function, it can help justify worker compensation or disability claims. Repeated testing using appropriate, randomized protocols can help in distinguishing malingering scenarios. Quantitative assessment can help in making therapy decisions such as what form of therapy seems to work best for specific patients with specific injuries or in specific work environments such as choosing between the use of nonsteroidal anti-inflammatory drugs, physiotherapy, and splints.

Use of VT testing for evaluation, screening, and diagnosis of a wide range of conditions has been reported in the literature. Specific examples include detection of neurotoxicity to peripheral nervous system by Gerr et al. with high reliability using Vibratron-II (Sensortek Inc., Clifton, NJ). [96] Identifying changes in threshold by a change in the shape of a "normal" vibrogram by Lundstrom et al.[82] has showed the clinical utility of VT testing. More recently, Sesek et al.[55] described the use of VT testing by establishing a baseline for normal threshold for an individual and comparing subsequent changes in the threshold after wrist bending, and observing that the change in VT before and after wrist bending provocation is more significant in subjects showing signs of CTS than in normal subjects. Although further research is needed, this result suggests that the wrist bending provocation in conjunction with VT testing may provide a rapid method of identifying patients in the early stages of CTS.

Conclusion

The existing equipment for testing the VT has progressed from a very primitive form of testing based on protocols intended for conducting hearing tests to commercially available products with varying degrees of portability and versatility. Immense variation in probe sizes, equipment geometries, and testing protocols are evident in the literature. The biggest weakness of both the literature in this area and the commercially available equipment is the lack of standardization of these features. It is very difficult if not impossible to compare a VT obtained from two different probe sizes, stimulus protocols, and types of equipment. Although it has been shown that the effect of a surround is appreciable, the use of surround with the probe is not consistent across studies. Although the effects of limb temperature and surrounding environmental conditions are well documented, studies often do not report limb temperature, or whether a fixed limb temperature was maintained. In addition, decibels (dB) were used to characterize sinusoidal stimuli in early devices, but have been replaced by micrometers in recent devices, an improvement that allows direct analysis of results. Further research is required for a complete understanding of MR response, particularly at high frequencies above 250Hz.

The literature does provide strong evidence that VT evaluation is an important and useful tool for investigating early nerve damage. For maximum flexibility in evaluating changes in nerve health, VT equipment should provide the ability to adjust probe size, firm surround, and testing frequency. More thorough research is required to determine the most appropriate protocols for the evaluation conducted; ideally VT equipment should provide a choice of protocols. Further development of VT techniques--such as the wrist bending provocation proposed by Sesek et al.--could provide improved methods of evaluating nerve damage at a very early stage. [55] This will enhance new applications including investigation of neuropathies resulting from neurotoxic drug treatments or diabetes, and use of vibration in feedback devices for rehabilitation and treatment. Once the limitations of

equipment variation and high cost (due to limited availability rather than inherent components) are overcome, there are many ways in which VT equipment can enhance a hand therapy equipment, including providing a quantitative method of regular evaluation, which can be used throughout therapy, to investigate alternative therapies or pre- and postintervention, and to assist in a variety of work-related issues such as justifying worker claims or return-to-work decisions.

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Quiz: Article #196

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#1. Vibrometer components usually include

a. a stimulator

b. a probe

c. a surround

d. all of the above

#2. The study design is best described as

a. survey of a clinical technique

b. a prospective investigation

c. a systematic review

d. a randomized clinical trial

#3. The greatest weakness of the literature and the commercially available equipment is the

a. lack of standardization of both

b. difficulty in obtaining both items

c. impracticality of both

d. non-existent reliability and validity data of both

#4. Vibro tactile threshold testing traditionally has been used in evaluation of

a. sensorimotor deficits

b. peripheral neuropathies

c. nerve lacerations

d. CNS disorders

#5. The literature provides significant evidence that VT techniques may be useful in the investigation of early nerve damage

a. false

b. true

When submitting to the HTCC for re-certification, please batch your JHT RFC certificates in groups of 3 or more to get full credit.

Footnote

This project was supported in part by a University of Utah Seed Grant. The authors do not have any conflicts of interest.

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Publication date: Jul-Sep 2011

Year: 2011

Auditory Processing Disorder and Auditory/Language Interventions: An Evidence-Based Systematic Review

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Publication info: Language, Speech & Hearing Services in Schools (Online) 42.3 (Jul 1, 2011): 246-264A.
ProQuest document link

Abstract: In this systematic review, the peer-reviewed literature on the efficacy of interventions for school-age children with auditory processing disorder (APD) is critically evaluated. Searches of 28 electronic databases yielded 25 studies for analysis. These studies were categorized by research phase (e.g., exploratory, efficacy) and ranked on a standard set of quality features related to methodology and reporting. Some support exists for the claim that auditory and language interventions can improve auditory functioning in children with APD and those with primary spoken language disorder. There is little indication, however, that observed improvements are due to the auditory features of these programs. Similarly, evidence supporting the effects of these programs on spoken and written language functioning is limited. The evidence base is too small and weak to provide clear guidance to speech-language pathologists faced with treating children with diagnosed APD, but some cautious skepticism is warranted until the record of evidence is more complete. Clinicians who decide to use auditory interventions should be aware of the limitations in the evidence and take special care to monitor the spoken and written language status of their young clients.

Full text: Headnote

Purpose: In this systematic review, the peer-reviewed literature on the efficacy of interventions for school-age children with auditory processing disorder (APD) is critically evaluated.
Method: Searches of 28 electronic databases yielded 25 studies for analysis. These studies were categorized by research phase (e.g., exploratory, efficacy) and ranked on a standard set of quality features related to methodology and reporting.
Results: Some support exists for the claim that auditory and language interventions can improve auditory functioning in children with APD and those with primary spoken language disorder. There is little indication, however, that observed improvements are due to the auditory features of these programs. Similarly, evidence supporting the effects of these programs on spoken and written language functioning is limited.
Conclusion: The evidence base is too small and weak to provide clear guidance to speech-language pathologists faced with treating children with diagnosed APD, but some cautious skepticism is warranted until the record of evidence is more complete. Clinicians who decide to use auditory interventions should be aware of the limitations in the evidence and take special care to monitor the spoken and written language status of their young clients.
Key Words: auditory processing disorder, auditory intervention, spoken language disorder, primary language disorder

As Richard (2011) indicated in her prologue to this clinical forum, there is a long, contentious history involving both the identification and treatment of children with auditory processing disorder (APD) by professionals in communication sciences and disorders. Despite this history of debate and disagreement, children with APD are regularly identified and treated by audiologists and speech-language pathologists (SLPs), and claims of success for treatments of many types abound. However, no systematic reviews of the treatment literature in this area have been published to date. The purpose of this systematic review is to examine and critically evaluate the literature on interventions that target the spoken and written language problems, as well as the possibly even more basic auditory processing problems, of children and youths with diagnosed APD.

Because of the disagreement that exists concerning the diagnosis of APD, we cast a broad net for our review by considering all treatment studies involving school-age children with diagnosed APD, regardless of the criteria used to make the diagnosis. Auditory interventions are often used to treat children with spoken language disorder who have not been diagnosed with APD. Therefore, we also included studies in which auditory interventions were used to address the spoken and written language abilities of children with primary language disorders.

There is no consensus in the field of speech-language pathology regarding criteria for distinguishing auditory interventions from language interventions, and many available tools have features of both types of treatments. For our review, auditory treatments were identified by their principled and progressive manipulation of the auditory components of speech and nonspeech stimuli, such as rate, interstimulus interval, frequency, intensity, and presence of background noise. This contrasted with programs judged to be spoken language interventions, which manipulate language form, content, and use rather than acoustic features of speech and nonspeech stimuli. Using this basic distinction, Fast ForWord (Scientific Learning Corporation, 1998), a popular computer-based intervention, was considered to be an auditory intervention because it manipulates the rate and intensity of various speech components of a circumscribed set of frequently repeated linguistic and nonlinguistic stimuli. On the other hand, even though two of its computer-based games increase complexity primarily by manipulating background noise and the duration and intensity of formant transitions, Earobics (Cognitive Concepts, 1997), another popular computer-based intervention, was considered to be a language rather than an auditory intervention. This is because its other four games predominantly manipulate language components such as consonants, vowels, syllables, and their written analogues as parts of words rather than the acoustic features of the stimuli (Diehl, 1999).

To conduct the systematic review, five clinical questions were developed using the PICO (patient, intervention, comparison, outcome) format that is commonly used in evidencebased searches (Dollaghan, 2007; Sackett, Straus, Richardson, Rosenberg, &Haynes, 2000). All questions deal with the effects of auditory or language interventions on auditory, language, and academic outcomes for school-age children.

1. What are the effects of auditory interventions on children with a diagnosis of APD?
2. What are the effects of auditory interventions on children with diagnoses of both APD and spoken language disorder?
3. What are the effects of language interventions on children with a diagnosis of APD?
4. What are the effects of language interventions on children with diagnoses of both APD and spoken language disorder?
5. What are the effects of auditory interventions on children with a diagnosis of spoken language disorder?

METHOD

A systematic search of 28 electronic databases was conducted by the American Speech-Language-Hearing Association's (ASHA's) National Center for Evidence-Based Practice in Communication Disorders (N-CEP) from March 2008 to June 2008 using key words related to central auditory processing or auditory processing interventions (see Appendix A). Studies were considered for review if they were published in a peer-reviewed journal from 1978 to 2008, were written in English, and contained original data pertaining to one or more of the five clinical questions. We included studies of school-age children, 6 to 12 years old, with the diagnosis of APD and/or primary spoken language disorder. We excluded studies of auditory interventions with participants described simply as having reading or learning disabilities (i.e., without APD or spoken language disorder) or if the participants had autism or autism spectrum disorder, hearing loss, or cognitive disability as defined by an IQ <70. Only studies of active, direct treatment approaches designed to influence children's ability to process speech and language were considered; passive methods that compensate for children's auditory processing problems, such as preferential seating and the use of frequency modulated (FM) systems, were excluded from the search. We also excluded studies of mixed treatment regimes, vestibular interventions, and pharmacological interventions.

Accepted studies were categorized into one of four stages of clinical research-exploratory, efficacy, effectiveness, or cost-benefit research/public policy-using the decision tree depicted in Figure 1. Exploratory studies generally involve relatively few participants and have purposes such as assessing the feasibility of a treatment or evaluating the sensitivity of measurement instruments. They contain few or no controls to infer a relationship (or nonrelationship) between the treatment and outcomes. This contrasts with efficacy studies, which are controlled, quasi-experimental or experimental attempts to determine whether the treatment causes an outcome. They are generally carried out under conditions unlike those of most clinical contexts, so the investigators can keep a watchful eye on controlled parameters of the study. Effectiveness studies may contain pre-post or between-group designs, but they usually take place after efficacy studies have already determined that the tested intervention is efficacious, and they are expressly designed to assess the effects and/or efficacy of the approach under more typical clinical conditions. Cost-benefit research/public policy studies also typically occur following efficacy studies. They are designed to calculate the costs of the target intervention, often in comparison with the costs of standard care.

Each eligible study was evaluated for methodological quality and was classified by stage of research using ASHA's levels-of-evidence scheme (Mullen, 2007). The initial review was conducted by two N-CEP reviewers (TF and TS), blinded from one another's results, who appraised each study independently. Another author was then assigned to review the initial N-CEP evaluation. Any discrepancies between the N-CEP reviews and the other author's evaluations were discussed and resolved by consensus. The studies accepted were evaluated by the entire group of authors on seven quality indicators: study protocol, blinding, sampling/allocation, treatment fidelity, statistical significance, precision, and intention to treat. A point was awarded for the specific quality

indicator if it met the following criteria:

* Study protocol-The design of the study was described in sufficient detail that it could be replicated.
* Blinding-Testers and/or test scorers-coders were masked with respect to the child's experimental group assignment.
* Sampling/allocation-Participants were selected at random or were assigned randomly to groups, with a clear description of the blinding procedures.
* Treatment fidelity-The manner for determining that the described intervention was actually implemented throughout the study was clearly described.
* Statistical significance-A statistical test of either pre-post or between-group gains following treatment was reported, or data that allowed statistical tests to be performed were provided.
* Precision-An effect size, such as d, was reported along with confidence limits surrounding d or data sufficient to calculate d and confidence limits around it (e.g., a t or F statistic).
* Intention to treat-There were no dropouts from the original group assignments, or itwas clear that all analyses were performed using data with the participants in their originally assigned groups.

Efficacy studies could obtain a maximum quality score of seven. However, exploratory studies, which have designs in which intention-to-treat analysis is not relevant, could receive a maximum quality score of six.

The presence and direction of statistical effects are reported in the appendices. Studies that included at least one statistically significant outcome (a = .05) favoring the experimental treatment condition were awarded a plus sign (+). Studies reporting one or more nonsignificant statistical tests, indicating no treatment comparison effects, were awarded a zero (0). Finally, studies that observed one or more negative outcomes, indicating significantly weaker posttreatment performance relative to controls, were awarded a minus sign (-). Studies in which the experimental hypotheses were tested using more than one dependent variable were eligible for all three signs.

Treatment effects are reported in the appendices in the form of d and confidence limits surrounding d when they were either presented in the report or calculable. When not reported by the investigators, effect sizes were calculated either from group means and standard deviations or from the report of a statistical test of the contrast at issue (e.g., t) using D-Stat (Johnson, 1997). Confidence limits surrounding d also were calculated, where possible, to illustrate the precision of the estimate of effect size. The lower boundary of this confidence interval is its most important feature. If this boundary is above zero, the investigator can conclude with confidence that the true treatment effect is indeed positive. Studies reporting one or more such effects received a plus sign in the appendix. If the lower boundary of the confidence interval was below zero for one or more tests, a treatment noneffect could not be reliably ruled out. In these cases, a zero was entered in the table. Finally, it is possible for the entire confidence interval to fall below zero, indicating that the true treatment effect is highly likely to be negative, giving the advantage to the control group. One or more such findings resulted in the entry of a minus sign in the table.

RESULTS

The findings from the systematic search are provided in Figure 2. The two N-CEP reviewers independently evaluated a total of 192 citations based on their titles and abstracts. Of those, 32 were preliminarily accepted based on the inclusion criteria. Upon review of the full text of these articles, nine articles were rejected principally for three reasons: Six studies did not target the population or intervention under review, two did not provide sufficient or original data for analysis, and one was not published in a peer-reviewed journal. This left a total of 23 articles that referenced 25 studies included in the final analysis.

Outcomes of Interventions for Children With APD

The literature search yielded only six studies that reported the outcomes of auditory or language interventions for children who had been diagnosed as having APD, with or without comorbid spoken language disorder (clinical questions 1-4). Therefore, these studies are considered together as a group.

Appendix B provides a summary of the type of treatment evaluated along with the type of outcome measured (i.e., auditory, written language and achievement, spoken language), research phase represented by the study, numbers and ages of participants (including experimental and control groups), details of intervention intensity, and study outcomes. The bases for diagnosis of APD in these studies generally was teacher concern for listening and related academic abilities or low overall performance on one or a battery of tests, usually including the Staggered Spondaic Word Test (SSW; Katz, Basil, &Smith, 1963), the SCAN-C Test for Auditory Processing Disorders in Children-Revised (Keith, 1999), and tests of speech in noise. The six studies included 121 children, with the largest share participating in Jirsa's (1992) efficacy trial of a traditional auditory intervention (N = 40) and Yencer's (1998) trial of auditory integration training (AIT; N = 36).

The interventions, in the order of their presentation in Appendix B, included "traditional listening" treatments, AIT, Fast ForWord, and Earobics. Detailed descriptions of these approaches are beyond the scope of this review. Briefly, traditional listening treatments include speech-in-noise training, auditory recognition, and auditory discrimination to improve comprehension. AIT uses filtered music to stimulate the auditory system to enhance listening skills. Fast ForWord is a set of computer-delivered games that use acoustically modified stimuli to improve spoken language processing. Earobics is a set of computer-delivered games that are designed to improve children's listening, memory, and phonological awareness skills.

Traditional listening treatments. Four articles presented studies that evaluated the effects of traditional listening interventions on children identified as having APD. Each article reported auditory outcomes, such as those measured by the SSW and SCAN-C, or auditory neurophysiological responses, like the P300. Three articles-English, Martonik, and Moir (2003), Putter-Katz et al. (2002), and Miller et al. (2005)-were exploratory studies that did not contain control groups or other features to enable clear inferences of treatment efficacy. All three of these research articles had positive auditory outcomes. Only one efficacy study (Jirsa, 1992) evaluated the effects of a traditional auditory training approach on the participants' behavioral and auditory electrophysiological responses. Outcomes were positive for P300 amplitudes and latencies and on several behavioral measures, but this study received a quality score of only 2 points, rendering claims of efficacy tentative. The only assessments of treatment gains on written language or achievement scores were reported in the Miller et al. series of case studies. Participant 3 made no gains in these areas, but Participant 6 exhibited significant improvements in spelling.

AIT. A single study, the efficacy trial reported in Yencer (1998), evaluated the effects of AIT on school-age children with APD. Statistical tests involving 26 dependent behavioral and physiological variables yielded no differences to distinguish the experimental group from the controls following the intervention. It should be pointed out that the AIT method provided in the Yencer study differed from the AIT method proposed by Berard (1982), and the participants' APD were relatively mild. For this group of children with APD, the study indicated that the AIT approach did not yield significant improvement of auditory function.

Fast ForWord. Only two articles (Deppeler, Taranto, &Bench, 2004; Miller et al., 2005), both of which were exploratory by design, reported studies of Fast ForWord for children with APD with or without spoken language disorder. Six of the eight children studied by Deppeler et al. (2004; age 6-9 years) showed significant improvement on at least one of the auditory measures (SSW or AB words in noise [Boothroyd, 1968]), but only one child maintained the improvement after 1 year. Two children exhibited reliable positive gains on spoken language measures, but three children showed significant negative changes. The significant auditory gains in the absence of improvement in language and academic performance were consistent with the findings for Participants 1, 4, and 8 in Miller et al. (2005).

Earobics. The only article to report on the outcomes of a language intervention on school-age children with identified APD is that of Miller et al. (2005; Participants 5 and 9). For Participant 5, no significant improvement was observed on either reading or spelling, both of which were areas of pretreatment weakness, or on a nonword repetition task, which was within the typical range before the intervention. Participant 9 showed

significant improvement on spelling and nonword repetition tests, both of which were areas of pretreatment weakness. No improvement was observed on the reading tests, although performance was within normal limits on these tests before intervention.

Appendix C provides details of the methodological quality and stage of research of the six studies addressing the first four questions, none of which earned more than 4 quality points. The most common quality issues were failure to keep testers and coders blind to the children's treatment condition; failure to assign participants randomly to treatment condition; and failure to report on the methodological strategies for monitoring and improving the reliability and validity interventions, referred to as treatment fidelity. Exploratory studies that used predetermined statistical criteria for identifying reliable outcomes were assigned a point for statistical significance. For example, Miller et al. (2005) calculated 90% confidence intervals based on available psychometric information for each standardized test they used. Changes that exceeded the 90% limits were considered statistically reliable. Thus, studies reported in this article were assigned a point for reporting on the statistical significance of their outcomes.

Outcomes of Auditory Interventions for Children With Spoken Language Disorder

The most productive searches for this systematic review concerned the effects of auditory interventions on children who had been identified with spoken language disorder but no identified auditory disorders (i.e., Group 5 questions). Seventeen of the 23 total articles included in the review addressed these questions. Note that the Merzenich et al. (1996) and Tallal et al. (1996) articles each included two studies. Of the 17 articles, one was a single case study exploring the outcomes from a traditional listening program. The vast majority of articles in this area examined the effects of Fast ForWord or early Fast ForWord prototypes. Six articles, involving 266 different children, examined the auditory outcomes of Fast ForWord. Ten articles, including a total of 443 children, evaluated the effects of Fast ForWord on children's spoken language. Two more articles, including an additional 82 children, reported studies of interventions that were inspired by Fast ForWord and included Fast ForWord-like acoustic modifications. This breakdown by intervention type and study methodology is represented in the summary of articles found in Appendices D and E.

Participants with spoken language disorder in these studies were identified using a broad range of tests, but children generally met predetermined criteria for language impairment, such as ≥1 SDs below the mean on at least one subtest of a standardized language test. Two studies required the participants to have significant deficits in language comprehension (Bishop, Adams, &Rosen, 2006; Cohen et al., 2005). Most participating children had already been diagnosed as having language impairments and were receiving services from an SLP and/or a reading specialist. Children did not have general cognitive impairments, but some studies included children with nonverbal IQ scores between 70 and 85, qualifying them as having "nonspecific" language impairments rather than specific language impairment (Weismer et al., 2000). Most studies involved English-speaking American children; however, Bishop et al. (2006), Cohen et al. (2005), and Crosbie and Dodd (2001) included English-speaking children from England, Scotland, and Australia, respectively, and Segers and Verhoeven's (2004) participants spoke Dutch.

Traditional auditory discrimination training. Only one study, the case report of Crosbie and Dodd (2001), reported on the results of a traditional auditory discrimination approach with a school-age child with language disorder without a diagnosis of APD. This child made significant improvements on sound discrimination tasks but exhibited no noteworthy gains on measures of language. This was an exploratory case study that provided only preliminary information on treatment efficacy.

Fast ForWord:Auditory effects. As shown in Appendix D, there were five exploratory studies that evaluated the auditory outcomes of Fast ForWord and its early prototypes. These studies ranged in quality from 1 to 5. In addition, two efficacy articles met the criteria for Question 5. One of these, Alexander and Frost (1982), was an auditory intervention that involved acoustic modifications of syllable stimuli in a discrimination training task. It was included as a Fast ForWord study because it clearly was inspired by the experimental work and theory that

underlies Fast ForWord (e.g., Tallal &Piercy, 1973a, 1973b, 1974), and because it used the Tallal Repetition Test (Tallal &Piercy, 1973b) as its outcome measure of temporal processing. The second efficacy article reporting on the effects of Fast ForWord on auditory abilities, Gillamet al. (2008),was one of only two articles evaluated that received 7 of 7 quality points. It was a direct comparison of Fast ForWord to another computer-based intervention, a traditional language intervention, and an attention control group.

All but one of the five exploratory studies observed some positive auditory outcomes from Fast ForWord. The early studies of Merzenich et al. (1996) reported dramatic gains in the processing of rapidly presented auditory stimuli. The one study that did not find a positive outcome, Thibodeau, Friel-Patti, and Britt (2001), had the highest quality rating of the six exploratory studies (5 out of 6 available points). The two participants with the lowest scores in language and the poorest results on the frequency sweep detection and backward masking tasks exhibited the smallest gains on these measures following the intervention.

In the efficacy study of Alexander and Frost (1982), the authors reported a significant improvement in syllable sequencing at two testing points. However, in both cases, one-tailed tests revealed outcomes only at the .15 level. In addition, the similarity of stimuli used in the training and the outcome measure cast further doubt on the authors' interpretation of the results.

In a more recent, high-quality study of Fast ForWord, Gillam et al. (2008) reported statistically reliable pre-post gains on a backward masking task that requires temporal processing of the sort targeted by Fast ForWord. Yet the gains in backward masking were no greater for Fast ForWord than for two other language interventions or an attention control condition containing no special auditory or language manipulations. Furthermore, there were no interactions involving backward masking threshold and treatment, indicating that the children with lower backward masking scores did not exhibit greater improvement in backward masking if they received Fast ForWord rather than one of the other treatments.

Fast ForWord: Spoken language and phonology effects. Eleven studies examined the language outcomes associated with Fast ForWord. The Fast ForWord implementations of Loeb, Stoke, and Fey (2001) and Cohen et al. (2005) differed in a key way from typical administrations. Both of these interventions were implemented in the children's homes with their parents as monitors and assistants, rather than at school or in the laboratory.

Six of the 11 studies were classified as exploratory. The Stevens, Fanning, Coch, Sanders, and Neville (2008) study, although designed as a quasi-experimental efficacy trial, was rated as an exploratory study because the comparison group included only typically developing children. These six studies had quality scores of 3 or 4 (see Appendices D and E). Most of these studies reported one or more positive outcomes from the Fast ForWord intervention. Two pre- post group studies (Stevens et al., 2008; Tallal et al., 1996, Study 1) reported large gains on standardized measures of receptive language. Other studies found limited or no significant gains on receptive and expressive measures for some children (e.g., Agnew, Dorn, &Eden, 2004; Loeb et al., 2001), and some studies observed significant decrements in performance on one or more standardized measures for some children (e.g., Friel-Patti, DesBarres, &Thibodeau, 2001; Loeb et al., 2001).

The five efficacy studies, with quality scores from 3 to 7, exhibited sharp contrasts in their outcomes (see Appendices D and E). Tallal et al. (1996, Study 2) showed the most positive outcome but had a quality score of only 3 out of 7. The study by Pokorni, Worthington, and Jamison (2004) was slightly higher in quality due to its blinding of testers from the children's experimental condition assignments. After participating in a summer program of either Fast ForWord, the Lindamood Phoneme Sequencing program (LiPS; Lindamood- Bell Learning Center, 1999) or Earobics, children in the LiPS group had higher scores on the Blending Phonemes subtest of the Phonological Awareness Test (Robertson &Salter, 1997) than children in the other two groups. No across-group differences were found on any of the remaining four phonological awareness and language tests. Furthermore, the Fast ForWord group exhibited no statistically reliable gains over time on any of the five language measures.

The two most rigorous studies included in this review, Cohen et al. (2005) and Gillam et al. (2008), reported

large gains on standardized measures of phonological awareness and language following the treatment period. The gains made by the Fast ForWord groups were no different, however, from the gains made by groups receiving equally intensive language interventions or groups who did not receive language intervention. Of nine secondary measures assessed by Cohen et al., the Fast ForWord group outperformed controls (who received no experimental language intervention) on only one measure (rhyming) at the 6-month posttest. Similarly, the Fast ForWord group studied by Gillam et al. outperformed the academic enrichment control group on only one measure, the Blending Phonemes subtest from the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, &Rashotte, 1999) immediately after the test and again 6 months later, at which time they also significantly outperformed the traditional language intervention group.

Fast ForWord: Written language effects. Three studies of Fast ForWord, Loeb et al. (2001), Agnew et al. (2004), and Pokorni et al. (2004), examined written language outcomes associated with the intervention. In the exploratory study of Loeb et al., three of the four children completed Fast ForWord and received pre- and postassessments of reading skill using the Woodcock Reading Mastery Tests-Revised (Woodcock, 1987). Looking at data across subjects, there was no consistent pattern of change and little evidence to suggest any significant effect on prereading and reading skills. Similarly, Agnew et al. observed no gains in nonword reading despite having found evidence for a positive auditory treatment effect.

The results of the efficacy study of Pokorni et al. (2004) were consistent with the lack of effects reported by Loeb et al. (2001) and Agnew et al. (2004). None of the three interventions tested-Fast ForWord, Earobics, and LiPS- yielded any significant group changes in the children's passage comprehension, word attack, or spelling, as evaluated by the Woodcock Language Proficiency Battery- Revised (Woodcock, 1991).

Language-oriented interventions with acoustic modifications. Two interventions studied by Bishop et al. (2006) and Segers and Verhoeven (2004) were designed to directly influence children's performance in grammatical comprehension and phonological awareness, respectively. In this respect, they could be considered language interventions. They are included in this section of this review as auditory interventions because for each intervention, speech stimuli were presented with graded, experimenter-manipulated acoustic modifications, using algorithms similar to that of Fast ForWord. Each study was designed to evaluate the impact of the graded acoustic manipulations of the speech signal on the children's auditory processing and language performance. The treatment regimens were also much less intensive than Fast ForWord.

The intervention of Bishop et al. (2006) was designed to facilitate children's rapid responses to increasingly more grammatically complex sentences. In the acoustic modification condition, the stimuli were presented with increasingly less acoustic modification. Therefore, Bishop et al. anticipated possible effects on two auditory processing and five language tests. They found no significant treatmentrelated group differences on either a measure of speech discrimination or nonspeech frequency sweep discrimination or on any of the measures of grammatical and narrative production/comprehension. Similarly, Segers and Verhoeven (2004) reported no posttreatment differences between treatment (acoustic modification) and control groups (no acoustic modification) on their five phonological awareness tasks. In fact, when the scores for all five phonological awareness tasks were combined into a single outcome variable at the end of the treatment period, it was the group who received training with natural speech rather than the group with the acoustic modifications that statistically significantly outperformed the no-treatment control group.

DISCUSSION

We initiated this systematic review by seeking all published, peer-reviewed articles that reported on evaluations of defined auditory or language interventions from any phase of investigation (i.e., exploratory, efficacy, or effectiveness) for school-age children who had been diagnosed with APD, using a broad, inclusive definition of APD. Because auditory interventions often are recommended for children with spoken language disorder, we also included investigations of the effects of auditory interventions with this population. This section summarizes our efforts to address a set of four clinical questions targeting auditory and language interventions for children

with APD and a fifth question pertaining to auditory interventions for children with spoken language disorder. Additionally, future research and clinical directions are recommended.

Interventions for Children With APD

The search to address the four questions about intervention for school-age children with APD yielded only six studies. Four of these studies were exploratory, and two focused on treatment efficacy. None of the six studies received more than 4 points in the 6- or 7-point quality appraisal system. All six studies reported outcomes for auditory measures, but only two reported on spoken or written language outcomes.

From this small set of studies, there is weak evidence to suggest that intensive, short-term interventions (i.e., traditional auditory interventions, Fast ForWord, and Earobics) may be associated with improved auditory functioning among school-age children who meet broad criteria for APD, with or without accompanying spoken language disorder. There is less evidence that these same interventions affect the spoken and written language performance of children with APD. In fact, the only two articles that reported language outcomes of intervention with this group of children both presented sets of case studies and observed a mixture of significant positive and negative results across case study participants.

Although only a single qualifying efficacy study on AIT was identified, the results of that study indicate that AIT is not efficacious for school-age childrenwith APD. In a recent systematic review of AIT studies, Sinha, Silove, Wheeler, and Williams (2006) came to a similarly negative conclusion regarding the use of this treatment for children with autism. This evaluation is consistent with ASHA's position statement on AIT, which states that "AIT has not met scientific standards for efficacy that would justify its practice by audiologists and speech-language pathologists" (ASHA, 2004, p.1).

Auditory Interventions for Children With Spoken Language Disorder

The search for studies of auditory interventions for school-age children with spoken language disorder (Question 5) yielded 17 articles. These articles included 19 studies that examined the outcomes of a listening/ auditory discrimination program (1 study), Fast ForWord (16 studies), and language-based interventions that used Fast ForWord-like acoustic modifications of all language stimuli (2 studies). No firm conclusions can be made concerning the listening/auditory discrimination program(Crosbie &Dodd, 2001), although findings of positive auditory outcomes and limited language outcomes are compatible with the results of the previously described studies evaluating outcomes of traditional auditory interventions for children with APD.

The results of seven exploratory and efficacy studies on the auditory effects of Fast ForWord led to the conclusion that children with spoken language disorder who receive Fast ForWord may generally be expected to improve their performance on various auditory processing tasks; however, the relationship of these gains to the auditory intervention is not clear (see Gillam, Crofford, Gale, &Hoffman, 2001; Gillam et al., 2008; Marler, Champlin, &Gillam, 2001; Thibodeau et al., 2001). The Gillam et al. (2008) study, in particular, provides high-quality evidence that the positive auditory outcomes associated with Fast ForWord can be achieved with interventions that do not specifically target auditory abilities. In addition, children with deficits in temporal processing, as measured by backward masking thresholds, did not profit more from Fast ForWord than from any other intervention. These studies provide little evidence that Fast ForWord's acoustic modifications of speech and nonspeech stimuli are responsible for improvements in children's auditory function.

Similarly, there is little support for the effects of Fast ForWord's acoustic modifications when the goal is to facilitate language learning among children with language disorders who have not been identified as having APD. The largest and most rigorous efficacy studies of Fast ForWord have found either no improvements on language measures (Pokorni et al., 2004) or gains similar to other, equally intensive language interventions and control conditions with no auditory or language manipulations (Cohen et al., 2005; Gillam et al., 2008). The evidence suggests that the acoustic modifications found in Fast ForWord and similar speech modification interventions generally are not responsible for improved spoken language performance for children with language disorders.

Similar outcomes were obtained for two interventions that presented language stimuli with Fast ForWord-like graded acoustic modifications (Bishop et al., 2006; Segers &Verhoeven, 2004). Neither of these studies observed gains associated with the treatment that exceeded improvements of participants serving in the no-treatment control condition.

The effects of Fast ForWord on the academic outcomes of children with spoken language disorder had not been examined adequately at the time this review was performed. The three existing studies that were included, however, showed that Fast ForWord did not consistently yield significant changes in the reading profiles of children with spoken language disorder.

Future Research and Clinical Directions

To fill the precipitous gaps in understanding APD and its treatment, programs of thematically coherent research are needed. These programs should begin with small-scale but rigorous studies within which participants are carefully evaluated using a comprehensive battery of conventional tests of APD as well as more sophisticated neurophysiological indices, including Bio-Mark (see Cunningham, Nicol, Zecker, Bradlow, &Kraus, 2001; Russo, Nicol, Zecker, Hayes, &Kraus, 2005; Warrier, Johnson, Hayes, Nicol, &Kraus, 2004), and psychoacoustic measures, such as the backward masking and frequency discrimination threshold tests used by Bishop et al. (2006), Thibodeau et al. (2001), and others.

It is well known that children who have been diagnosed with APD frequently have spoken and written language disorders (Sharma, Purdy, &Kelly, 2009) that may or may not be causally associated with the APD. When the language characteristics of children in APD study samples are unknown, as was the case in four of the six studies of children with APD examined in this review, study results are confounded and difficult to interpret. Therefore, it is critical that the language skills of children are carefully and comprehensively evaluated before and after intervention is provided in APD treatment studies. This will make it possible to examine treatment-related gains in language ability and evaluate the moderating and mediating influences that language disorder could have on various types of auditory treatment outcomes.

With detailed information from high-quality exploratory studies of well-described samples, researchers can develop hypotheses about which auditory training approaches are most appropriate for children who are exhibiting specific auditory, spoken and written language, and learning profiles. Ultimately, interventions that appear to be efficacious in smaller studies must be tested in larger, well-controlled and hypothesis-driven experimental trials that compare their efficacy with that of other auditory and language interventions (Robey, 2004). Ideally, these studies would include relatively homogeneous samples of school-age children with APD. A more realistic alternative may be to allow language and auditory characteristics to vary at baseline and to account for these differences using statistical techniques such as multiple regression and analysis of covariance.

Currently available evidence on the efficacy of interventions for school-age children with APD provides little direction for clinicians who are working with children with identified APD. However, in light of the demand for addressing this population, a few recommendations seem warranted at this time. Because language disorders are so common among children with APD (Sharma et al., 2009), it is critical that clinicians administer comprehensive language evaluations to children with APD to rule out or identify specific aspects of language disorders. When language problems exist, intervention targeting the deficits should be implemented, with an awareness of how language deficits change over time. Research on such treatments for school-age children with language disorders is also limited, although the available evidence is generally encouraging (Cirrin &Gillam, 2008).

In conclusion, in this systematic review, we found no compelling evidence that existing auditory interventions make any significant contributions to auditory, language, or academic outcomes of school-age children who have been diagnosed with APD or language disorder.We were in unanimous agreement, however, that this finding should not be taken as the final word about the effectiveness of auditory interventions. Future studies will

hopefully fill the gaps in the literature and provide more definitive conclusions and recommendations. In the meantime, clinicians who choose to continue using auditory interventions should do so in conjunction with interventions that target specific language, communication, and academic goals. Ideally, clinicians and researchers should work together, sharing ideas and experiences, to develop and evaluate the efficacy of interventions that make real differences in the lives of children with APD and their families.

ACKNOWLEDGMENTS

This review was developed by the American Speech-Language- Hearing Association (ASHA) Committee on the Role of the Speech- Language Pathologist in Identifying and Treating Children With Auditory Processing Disorders, which included all authors. Additional members of the committee (2007-2009) were Sally Shaywitz (consultant) and Lynn E. Snyder (2007). Brian B. Shulman served as the monitoring officer in 2007-2008; Julie Noel served as the monitoring officer in 2009. ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP) collaborated with the committee, assisted with the systematic review and appraisal of the literature, and contributed positively to this report. N-CEP staff members who participated in this work were Hillary Leech, Rebecca Venediktov, and Rob Mullen.

Sidebar

Auditory Processing Disorder and Auditory/Language Interventions: An Evidence-Based Systematic Review

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Lang Speech Hear Serv Sch 2011;42;246-264; originally published online Sep 15, 2010; DOI: 10.1044/0161-1461(2010/10-0013)

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Editor: Marilyn Nippold
Associate Editor: Ilsa Schwarz
Received March 3, 2010
Accepted July 21, 2010
DOI: 10.1044/0161-1461(2010/10-0013)

Appendix

(ProQuest: Appendix omitted.)

Publication date: Jul 1, 2011

Year: 2011

Spoken Language Processing Model: Bridging Auditory and Language Processing to Guide Assessment and Intervention

Author: Medwetsky, Larry

Publication info: Language, Speech & Hearing Services in Schools (Online) 42.3 (Jul 1, 2011): 286-296A.
ProQuest document link

Abstract: This article outlines the author's conceptualization of the key mechanisms that are engaged in the processing of spoken language, referred to as the spoken language processing model. The act of processing what is heard is very complex and involves the successful intertwining of auditory, cognitive, and language mechanisms. Spoken language processing disorders occur when a breakdown in any of these mechanisms impacts an individual's ability to effectively process and use the information that is heard. The symptoms vary depending on the underlying deficit(s). The primary purpose of this article is to provide the reader with a basic understanding of these mechanisms, and, in turn, enable readers to (a) review the literature concerning processing disorders with discernment and (b) have a foundation for developing a test battery to derive composite profiles of individuals' processing abilities. A review of the literature, overview of the spoken language processing model, and suggested approach to diagnostic assessment are presented. Spoken language processing can break down due to a myriad of underlying causes. Central auditory nervous system deficits can impact not only the initial processing of stimuli but possibly the development of effective language skills. On the other hand, deficits in various cognitive and language mechanisms can similarly impact the auditory processing of speech stimuli. Therefore, it is critical to understand how these mechanisms interact and contribute to the processing of speech stimuli.

Full text: Headnote

Purpose: This article outlines the author's conceptualization of the key mechanisms that are engaged in the processing of spoken language, referred to as the spoken language processing model. The act of processing what is heard is very complex and involves the successful intertwining of auditory, cognitive, and language mechanisms. Spoken language processing disorders occur when a breakdown in any of these mechanisms impacts an individual's ability to effectively process and use the information that is heard. The symptoms vary depending on the underlying deficit(s). The primary purpose of this article is to provide the reader with a basic understanding of these mechanisms, and, in turn, enable readers to (a) review the literature concerning processing disorders with discernment and (b) have a foundation for developing a test battery to derive composite profiles of individuals' processing abilities.
Method: A review of the literature, overview of the spoken language processing model, and suggested approach to diagnostic assessment are presented.
Conclusion: Spoken language processing can break down due to a myriad of underlying causes. Central auditory nervous system deficits can impact not only the initial processing of stimuli but possibly the development of effective language skills. On the other hand, deficits in various cognitive and language mechanisms can similarly impact the auditory processing of speech stimuli. Therefore, it is critical to understand how these mechanisms interact and contribute to the processing of speech stimuli.
Key Words: auditory processing, intervention, spoken language processing, cognition

In the 1970s, a number of audiology researchers proposed that central auditory dysfunction is a disorder in processing and using auditory information that, in turn, could result in children exhibiting learning disabilities and language disorders (Keith, 1977). There were other researchers, however, who disagreed with this premise and questioned whether central auditory processing disorder (CAPD) was even a meaningful concept (Rees, 1973, 1981). Rees (1981) suggested that an individual's difficulties in articulation, language development, or reading acquisition could not be explained simply on the basis of underlying auditory processing deficits and questioned whether CAPD was an actual disorder or merely a reflection of a language disorder that was manifested when stimuli were presented auditorily. In general, language processing proponents contend that very little information is gleaned from the acoustic signal, and that most language processing, even for auditorily

processed signals, involves higher level linguistic and cognitive knowledge that is applied to incoming acoustic signals (Kamhi, 2004; Nittrouer, 2002).

On the other hand, there are those who propose that auditory processing disorder (APD) does exist and can be isolated (Bellis, 2010; Jerger, 1998; Rawool, 2006a, 2006b). Jerger (1998) suggested three lines of converging evidence in support of relatively pure auditory perceptual disorders. First, there is significant audiological evidence from children and adults with known lesions of the central auditory system. This includes studies of (a) individuals with temporal lobe lesions involving the primary auditory processing region who exhibit listening deficits in the ear contralateral to the side of the lesion (Bocca, Calearo, &Cassinari, 1954; Katz &Pack, 1975; Musiek, 1983) and (b) individuals with damage to the interhemispheric auditory fibers of the corpus callosum who exhibit significant difficulty processing competing auditory stimuli (Barmiou, Musiek, &Luxon, 2001; Clarke, Lufkin, &Zaidel, 1993). Considering this evidence, when similar symptomatology is observed in children with listening problems, it is reasonable to suspect a problemin auditory processing. The second line of evidence involves numerous in-depth studies of children and adults who reported an apparent inability to hear well in difficult listening situations, yet with no report of concomitant speech/language deficits (Gatehouse, 1991; Jerger et al., 1991). The third piece of evidence to consider is the unique listening problems of elderly persons, which in at least some cases are due to agerelated changes in the central auditory system (Frisina &Frisina, 1997; Rawool, 2006a, 2006b).

The lack of a clear definition as to what constitutes APD led to a number of task forces convening to develop consensus statements and establish best practice principles related to its diagnosis and management. Two of these task forces were convened by the American Speech-Language-Hearing Association (ASHA), first in 1995 (ASHA, 1996) and subsequently 10 years later (ASHA, 2005). In the intervening period, there was also a gathering of 14 scientists and clinicians who examined similar issues (Bruton conference; Jerger &Musiek, 2000). Essentially, these task forces defined auditory processing as the deployment of auditory mechanisms responsible for a number of behavioral phenomena, including sound localization and lateralization, auditory discrimination, auditory pattern recognition, temporal aspects of audition, and auditory decrements with competing/degraded acoustic signals.

In its most recent attempt to achieve consensus regarding auditory processing, the second ASHA task force (2005) sought to reconcile the importance/prominence of auditory processing with the recognition that complete modality specificity (i.e., without influence/interactions from any other modality) as a diagnostic criterion is neurophysiologically untenable. The task force stated that APD was best viewed as a deficit in the neural processing of auditory stimuli that may coexist with, but is not the result of, dysfunction in other modalities. In other words, APD cannot be attributed to higher order language, cognitive, or related confounds (e.g., language disorders, language processing disorders, or autism), although it may lead to or be associated with difficulties in higher order language, learning, and communication function (Bellis, 2010).

Although consensus statements exist, this does not mean that there is consensus within the audiology community regarding the underlying processes that make up auditory processing and the test battery approaches to be applied. Katz et al. (2002) critiqued the recommendations from the Bruton conference because of its strong emphasis on electrophysiologic approaches. The authors indicated that there was little evidence that auditory brainstem-evoked response or middle latency response measures can delineate APD in children. As referenced by Kamhi (2011, p. 266) to Burkard's foreword in Cacace and McFarland's text on APD, There is currently great divisiveness in the field of audiology concerning CAPD. There is no broadly accepted definition of CAPD. No one really knows what causes CAPDIthere is no clear consensus concerning the battery of tests that lead to a diagnosis of CAPD. Similarly, there is no widely accepted auditory (re)habilitation programIto help those with CAPD.

The spoken language processing model that I have developed is an attempt to address the dilemma created by this lack of consensus (Medwetsky, 2009) and refers to my conceptualization of the mechanisms engaged in

the processing of spoken language. Please note that it is not the only model that has been proposed to examine APD. For example, the Bellis and Ferre model (Bellis, 2003) and the Buffalo model (Katz, 1992) refer to two approaches that were developed to guide testing for ascertaining underlying auditory deficit(s) in relation to functional behavioral deficits. However, both of these models consist of describing discrete behavioral functions/deficits based on their neuroanatomical and neurophysiologic underpinnings. On the other hand, the spoken language processing model conceptualizes the various stages in which acoustic information is processed and transformed into linguistic information that can be used and retained by the listener. Except for the earliest stages, subsequent processing of speech engages both cognitive and linguistic mechanisms. By being aware of the various mechanisms that are engaged in the processing of speech, one can use this knowledge to craft a test battery for examining where an individual may be breaking down, and, in turn, develop individualized interventions to address the specific deficit areas. Therefore, philosophically, we need to ascertain our goal when examining an individual who exhibits difficulty in the processing of speech. We can limit ourselves to delineating those mechanisms that can be attributed only to or almost exclusively to auditory processing (which is approximately the first 250 ms postonset), or adopt a view that considers all of the factors that may be involved in the normal processing of speech. I strongly feel that any approach to assisting individuals with some form of listening difficulty should be one that is pragmatic, with the primary goal being to help these individuals address their needs in their everyday listening environments.

The remainder of this article will attempt to address three main goals:

* provide an overview of the auditory, cognitive, and language mechanisms engaged in the processing of spoken language;
* show how deficits in the various stages of processing can be manifested; and
* provide a framework for developing an effective interdisciplinary test battery.

Overview of Spoken Language Processing Mechanisms

Acoustic signal transduction. The initial stage of spoken language processing involves multiple transformations of the incoming auditory signal, ultimately resulting in the stimulation of corresponding inner hair cells of the cochlea with subsequent neural discharge in the attached afferent nerve fibers. As the neural signals are transmitted via the auditory nerve and subsequent brainstem pathways, they engage various types of neurons that respond to different acoustic features. As long as the neuronal regions are intact and firing synchronously, a high-fidelity replication of ever-changing frequency and intensity information in the temporal domain will be created. The brain also extracts phase information by comparing timing and intensity information arriving from both ears, thereby providing precise information relative to the sound source. The neural impulses are ultimately relayed to the primary auditory processing regions (Heschl's Gyri) in both the left and right hemispheres. However, the primary neuronal types differ in the two hemispheres. Meyer et al. (2005) and Zaehle, Wüstenberg, Meyer, and Jancke (2004) showed that the left hemisphere preferentially extracts rapidly changing/short duration information, whereas the right hemisphere is more adept at extracting slower changing information. For the majority of individuals, this results in (a) segmental analysis occurring in the left hemisphere, and (b) suprasegmental analysis occurring in the right hemisphere (Abrams et al., 2008).

Decoding. The incoming neuroelectric patterns are compared with neuronal clusters in long-term memory (LTM) that are residing in a resting state (i.e., are not firing with sufficient intensity to be in one's consciousness). One factor influencing whether an LTM representation is activated is the degree to which an individual allocates attention to the task at hand. Attentional processes play a key role in the initial activation of neuronal units from LTM by destabilizing neurons (i.e., lowering the activation thresholds) of the "target" receptors, thereby increasing the ease to which the corresponding neurons can be stimulated.

The speed and accuracy to which the corresponding LTM templates are activated depends on how well the templates are represented and organized in LTM. In the left hemisphere, this involves the process of matching the acoustic input with its lexical (i.e., word) representation, known as lexical decoding. The speed/accuracy in

which these activations occur is referred to as lexical-decoding speed. An individual's lexicon is organized on the basis of its phonemic representations, completeness of semantic attributes (including physical properties that the word represents, semantic category), semantic relations, and syntactical properties (Caramazza, 1997; Levelt, 2001). Lexical organization affects one's processing speed/accuracy as well as how quickly one can retrieve words during expressive formulation. At the same time the lexicon is processed in the left hemisphere, the suprasegmental aspects of the incoming stimuli are being analyzed/processed in the right hemisphere.
Short-term memory (STM). Neuronal representations that are activated sufficiently from their resting state result in the conscious perception of information. This activated state is referred to as STM. Neuronal regions representing a particular unit of information (e.g., number, word, concept) are in an active firing state for approximately 2s before they decay to a degree that the information is no longer within the individual's consciousness (Baddeley, Thomson, &Buchanan, 1975). However, by engaging some aspect of attention (e.g., subauditorization, visualization, analysis of content), the individual can sustain the firing level of the neuronal representation above its resting state and maintain the information in STM. This process is known as maintenance attention (Cowan, 2001).
The number of units in one's STM at any one point in time is commonly referred to as one's STM span. Cowan (2001) proposed that young adults have an STM capacity of approximately four chunks; that is, the number of neuronal regions that can maximally fire at any one point in time is four. The limiting factor is time. Attempts to exceed this capacity of four units would fail due to system limitations in shifting attention to more than four regions without one region fading from an active state. This limitation, however, does not limit recall at four informational units. Strategies such as chunking allow the individual to group elements into bigger units. Although the phone number 585/ /555/ /11/ /22/ consists of 10 digits, it can be grouped into four chunks.
Because STM is dependent on time, any factor that affects processing time will influence the total amount of information recalled. Factors include word frequency (frequently used words can be processed more quickly than infrequently used words; Hulme et al., 1997) and word pronunciation. Sub-auditorization depends on how quickly one can state the word to oneself; therefore, factors such as the number of syllables and articulatory difficulty can impact subauditorization speed (Baddeley et al., 1975; Schweickert &Boruff, 1986). One's ability to allocate attention effectively will also affect the ease with which items/information can be maintained in STM (Cowan, 2001). For example, when one "absent mindedly" places car keys in a unique spot, it may be difficult to locate those keys later due to insufficient attentional allocation at the time.
Attentional allocation. Because human beings have a limited capacity for processing incoming stimuli, it has been proposed that the importance of attentional allocation is to limit the amount of information that can be processed (or stored) at any one point in time (Kahneman, 1973; Windsor &Hwang, 1999). Attentional allocation allows the individual to focus selectively on a limited amount of information (and, in competing situations, to block out irrelevant stimuli), thereby maximizing the extent to which target information is processed and stored. Maintenance attention is important at the later stages of processing for preserving information in STM.
Selective attention. Selective attention is defined as the ability to selectively focus on one stream of information while ignoring or blocking out competing, irrelevant stimuli. The actual mechanisms that are engaged differ based on the type of noise that must be ignored. One type of noise is often referred to as shower noise. This type of noise consists of energy in a wide range of frequencies with no relationship between the various components within the stimulus (i.e., it is a random signal). A second type of competing noise consists of speech stimuli, whereby the listener may find him- or herself trying to listen to a "target" talker in the face of competing talkers, with the "irrelevant" stimuli being similar in acoustic attributes to the desired signal. Speech-in-noise refers to the ability of a listener to filter speech that is embedded in a nonlinguistic, shower-type noise. The discrepancy in the acoustic characteristics of these two disparate streams allows the listener to process the target speech stimulus as long as a number of underlying acoustic and neurophysiologic conditions are sufficiently in place. Factors include the following:

* Speech-to-noise ratios across the various critical bands: The latter refers to the frequency bandwidths of auditory filters corresponding to specific areas along the basilar membrane. As long as there are positive speech-to-noise ratios in a sufficient number of these critical bands, the listener may be able to process the target speech stimuli.
* Frequency resolution: The degree to which an individual can distinguish different frequency components within a complex signal, such as a speech stimulus.
* Temporal resolution: The minimum time interval that allows an individual to detect changes in stimuli; often assessed using gap-detection tests, the listener must indicate the presence of a gap between two tones or the presence of a gap within a noise.

Attentional mechanisms can exert their influence at the earliest stages of auditory processing by modifying cochlear micromechanics, probably via the medial efferent system that innervates the outer hair cells (Giard, Collet, Bouchet, &Pernier, 1994; Maison, Micheyl, &Collet, 2001). This allows the individual to selectively process the acoustic attributes of interest while filtering out irrelevant acoustic information.

Selective attention in the presence of shower noise is not solely dependent on central auditory nervous system (CANS) mechanisms. Bell and Wilson (2001) found that high-use words produced in quiet and noise were more easily processed than low-use words, and that there was a perceptual advantage for phonetically unique words (i.e., words having a phonetic composition unlike other words in the English language, making it harder to confuse them with other words). Bradlow and Alexander (2007) compared speech recognition performance of native and proficient nonnative listeners under less than optimal speech-in-noise conditions. Bradlow and Alexander manipulated sentences by varying the degree of last word predictability (by altering semantic and syntactic sentence structure) and how the productions were spoken (ordinary vs. clear speech). The authors found that native listeners benefited when either source of enhancement was present (i.e., high predictability or clear speech), whereas nonnative listeners did better only when both sources of enhancement were present. The Bell andWilson and Bradlow and Alexander studies underscore that speech-in-noise performance can be impacted at processing levels higher than the CANS (e.g., phonemic, lexical representation, or semantic/ syntactic level).

Listeners often have to attend to a talker in environments that have competing talkers (e.g., class setting, restaurant, party). Filtering mechanisms successfully applied to nonlinguistic noise would not be effective when the competing stimuli consists of linguistic information-especially if the competing talkers were of the same gender because filtering out the speech of the competing talker would affect the processing of speech from the target talker as well. In these instances, the human auditory system takes advantage of the regularities in sound to perceptually separate competing stimuli into different acoustic streams-a process known as auditory scene analysis (Bregman, 1994; Cusak, Deeks, Aikman, &Carlyon, 2004). This ability relies on the probabilities of co-occurrences in sounds (such as spatial source location, spectral and suprasegmental composition, and temporal onsets/offsets) to group acoustic elements into separate streams, thereby allowing the listener to select one or more streams and reject others. Medwetsky (1994), using competing sentences, found that the spatial location of sound sources was the most effective cue in separating the acoustic streams. In the absence of spatial cues, talker-gender differences allowed listeners to perform nearly as well. Even in situations in which both types of cues were absent, giving the listener the topic of the preferred signal resulted in individuals being able to recall target sentences with a fair degree of accuracy if the sentence length was short (i.e., no more than 5-6 words in length).

Auditory-linguistic integration. Integration is defined here as the ability to combine information from different sensory sources/processing regions into unified percepts. Auditory-linguistic integration entails the processing of the segmental aspects of speech as well as its suprasegmental (prosodic) aspects. For most individuals, suprasegmental information is thought to be processed in the right hemisphere, in parallel to the segmental information that is extracted in the left hemisphere (Meyer et al., 2005; Zaehle et al., 2004). Somehow, both the

segmental and suprasegmental aspects are combined; presumably by involving corpus callosal transfer of information between the hemispheres, allowing the individual to process both the words and rhythm of a language. This allows the listener to derive the semantic intent in cases where the meaning of the spoken sentence relies on more than just the spoken words. Examples include "That's a book." versus "That's a book?" (sentence meaning differs based on rising/falling fundamental frequency contour); "Look out the window" versus "Look Out! The Window" (differences in stress and insertion of pausing in the second phrase, adding to the urgency of what has been said); "The farmer out' standing in the fieldI." versus "The farmer outstanding' in the fieldI" (changing the stress on the first to that of the second syllable changes the meaning from the farmer being out in the field to that of being a leader in the field). Only by processing both the segmental and suprasegmental aspects in parallel and integrating both sources of information is the individual able to correctly derive the intent of the message being conveyed.

Sequencing. Not only does information have to be processed and activated from LTM to STM, but it must also somehow be tagged regarding its order of occurrence (Gillam, Cowan,&Day, 1995). The lateral prefrontal cortex is involved in formulating and carrying out plans and sequences of actions (Romine &Reynolds, 2004), including the representation and construction of language sequences (Fuster, 2001). Gelfand and Bookheimer (2003) also suggested a role for the posterior portion of Broca's area in subvocal articulation, which contributes to the ability to maintain phonologic sequence within phonologic working memory.

Phonological awareness/phonics development. Because much of what was discussed in the systematic review in the clinical forum (Fey et al., 2011) focused on phonological awareness/phonics intervention (i.e., Fast ForWord [Scientific Learning Corporation, 1998], Earobics [Cognitive Concepts, 1997]), an extensive discussion of this topic is presented here.

Spectrographic analysis of connected speech shows that speech is just that: It is connected in a continuous stream with few clear boundaries between words or sounds. Yet, because of the knowledge of the linguistic/phonemic code within one's language, an individual can discern each word clearly as well as segment the specific phonemes within a word. This is thought to occur because at the level of auditory cortex, there are neuronal regions that respond to the ratio of the formant frequencies in speech stimuli, such as F2/F1 (Naatanen, 1999). This contrasts with neuronal regions that may respond only to nonlinguistic changes (or to specific phonetic features, rather than to the entire phonemic/acoustic aspects). The ensuing phonetic traces that are presumably created during one's development serve as recognition templates in speech perception. Each speech stimulus presumably activates its closest phonemic trace (template). This enables one to correctly perceive the speech sounds uttered, be it across gender and individual differences or coarticulatory variations. There are likely many phonemic trace alternatives within the same phonemic category; ultimately, however, the conscious perception of the phoneme is categorically based. That is, despite the many phonetic feature variations, the brain eventually develops categorically based, languagespecific phonemic boundaries. Any acoustic variation across the categorical boundary is perceived as belonging to another phonemic category (Naatanen, 1999). Syllables and words appear to have their own traces, whereby the phonological representations are combined to activate their corresponding syllables/words.

Research from a number of sources (Dehaene-Lambertz, 1997; Naatanen, 1999; Sharma &Dorman, 1999) supports the existence of language-specific phonemic memory traces in which the mechanisms for their activation are independent from more generalized, nonlinguistic acoustic stimuli. It is the development/distinctiveness of these LTM phonemic traces that accounts for categorical perception (i.e., an inability to perceive within-category differences) and results in individuals being unable to discriminate between different phonetic representations within a phonemic category, yet discriminate accurately across phonemic boundaries.

There a number of implications of these research findings. First, phonemic representations are shaped by the acoustic characteristics associated with the specific categorical boundaries that correspond to the phonemes

within a language. This would suggest that developmental delays/deficits impacting accurate auditory transmission of speech stimuli may negatively influence the development of language-specific phonemic memory traces. Second, developmental timelines/ outcomes may differ between neurons that respond to simpler acoustic changes versus neuronal clusters comprising composite phonemic representations. For example, Johnson, Nicol, Zecker, and Kraus (2008) determined that the brain stem response to nonspeech sounds matures earlier in life than responses to speech sounds. Therefore, it is possible that test results using nonlinguistic stimuli (such as assessing onset/offset detection, duration, and intensity for stimuli such as clicks or tone bursts) could fall in the normal range, and neuronal clusters representing phonemic memory traces could still be impaired in their ability to accurately represent the various categorical phonemic boundaries. Third, studies examining gap detection or the perception of tonal stimuli in the presence of noise may not be stimulating neuronal regions representing phonemic information. This suggests that individuals could exhibit normal psychoacoustic findings yet have abnormal phonological awareness/phonics skills.

Some exciting research has recently been carried out by Kraus and colleagues from the Northwestern University neuroscience laboratory using an electrophysiologic procedure known as BioMark (currently unavailable as a commercial instrument in the United States; Skoe &Kraus, 2010). Unlike traditional brainstem-evoked response recordings using clicks or tone bursts, BioMark uses a complex speech syllable (/da/) that reflects the acoustic and phonetic characteristics of speech sounds (i.e., initial plosives) that typically present difficulties for populations with language disorders. Timing measures obtained from the speech auditory brainstem response provide insight into the accuracy with which the brainstem nuclei are synchronously responding to the acoustic stimuli. Johnson, Nicol, and Kraus (2005) and Wible, Nicol, and Kraus (2005), among others, have found that approximately one third of children with learning problems exhibit a unique pattern of auditory neural activity that easily distinguishes them from the larger population of children with learning problems. These children are unable to accurately encode the /d/, indicating a neural timing deficit for short-duration, rapidly changing speech stimuli.

Recently, Banai et al. (2009) found a significant correlation between subcortical auditory function (using the BioMark procedure) and reading ability and phonological awareness abilities. Specifically, Banai et al. found that poor timing of subcortical auditory encoding was characteristic of the children who read poorly and performed below average on tasks of phonological awareness, whereas the good readers were characterized by more temporally precise encoding and robust representation of harmonics. These studies suggest that BioMark, which can be administered even to infants, may be able to help separate children with learning disabilities and whose underlying cause of their difficulty is ineffective temporal processing/encoding of speech patterns from those whose learning difficulties may be due to other causes. Going forward, BioMark may be able to provide an objective measure for determining who may benefit from auditory training focused on improving the ability to process speech, as well as exploring the relationship between subcortical encoding and reading/phonological awareness performance, before and after training.

Summary of the key processes as conceptualized in the spoken language processing model.

* Incoming auditory stimuli are converted via multiple transformations to neuroelectric patterns that are compared to patterns stored in LTM.
* Linguistic information (i.e., phonemes, words, semantic relations, syntax) is processed in the left hemisphere, and the suprasegmental aspects are processed in the right hemisphere.
* If there is a match and sufficient attention, the LTM representation is activated (the activated state referred to as STM or conscious memory). This process, known as decoding, must be done quickly/accurately.
* Information can reside in STM for a very short period of time (approximately 2s) unless attention is directed to maintain the stimuli in STM.
* The linguistic representations are somehow integrated with the suprasegmental features "on the fly."
* The processed information must be maintained in the same order as presented.

* Individuals must often listen in the presence of competing noise. In order to attend to "target speech stimuli" in a shower-type noise, the brain analyzes the competing acoustic streams and filters the speech from the noise. In the case of competing talkers, the listener primarily relies on spatial separation and fundamental frequency differences to selectively attend to the target talker and block out the competing talker(s).
* A separate process that evolves over time is the establishment of individual sound families (phonemes) and their symbolic representations.

Synopsis of what has been presented and its implications. The processing of spoken language entails the intertwining of auditory, cognitive, and language mechanisms that are often engaged simultaneously. Consistent with statements from the ASHAWorking Group on Auditory Processing Disorders (2005) and the American Academy of Audiology (AAA) Task Force for Developing Guidelines for the Diagnosis, Treatment and Management of Children and Adults With Central Auditory Processing Disorder (Musiek et al., 2010), it appears that there is no such thing as "pure auditory" processing. Attentional mechanisms (a cognitive function) appear to influence auditory processing as early as the cochlea. Language components such as phonemic representations, lexical representation/organization, semantic relations, and syntax influence processing speed. However, this does not mean that one can dismiss the importance of auditory mechanisms to the overall processing of speech stimuli. To propose that one's spoken language processing and academic difficulties are due solely to cognitive/languagebased mechanisms ignores the tremendous importance of auditory processing. CANS integrity and synchrony allows for (a) key acoustic features to be processed/extracted accurately by neurons in the left hemisphere that are engaged in phonemic trace development and phonemic matching (one key component of lexical activation from LTM), as well as coding of suprasegmental aspects by neurons in the right hemisphere; (b) precise localization/separation of sound sources that, in turn, allows one to attend to a target talker in the face of competing talkers; and (c) interhemispheric transfer across the corpus callosum of auditory-linguistic information, which somehow allows the individual to combine the suprasegmental information in the right hemisphere with the linguistic, segmental information in the left hemisphere.

Breakdowns can occur in any of the various processing stages:

* Initial auditory transmission of the acoustic signal, an extreme example being neural dys-synchrony; in this disorder, there is normal cochlear integrity but the neural pathways leading to the cortical processing regions are unable to process speech effectively.
* Temporal resolution, especially in the ability to process short-duration, rapidly occurring acoustic changes of actual speech stimuli. This is the underlying basis of Tallal et al.'s (1996) hypothesis underlying specific language impairment (SLI).
* Lexical-decoding speed, resulting in difficulty keeping up with the material being presented by the talker.
* Interhemispheric transfer of information, affecting the successful integration of the suprasegmental aspects processed in the right hemisphere with the linguistic aspects (i.e., phonemes, lexemes, semantic and syntactic relations) processed in the left hemisphere. An example of a significant intercallosal deficit is that exhibited in autism (Vidal et al., 2006), while milder deficits may impact an individual's ability in social settings because of difficulty perceiving the talker's intent via prosodic cues or misreading facial cues/body language (the latter being processed in the right hemisphere and needing to be integrated with the linguistic information).
* Sequencing, maintaining the order in which information has been presented.
* STM retention; deficits can result in what is referred to as fading memory, characterized by ineffective attentional allocation resulting in earlier presented information fading rapidly from STM (Medwetsky, 2006).
* Selective auditory attention, be it in the presence of shower noise or competing talkers; note that individuals with an auditory-linguistic integration deficit typically exhibit poorer left ear performance on tests involving competing speech stimuli presented dichotically (Medwetsky, 2009).

The influence of cognitive/language mechanisms on spoken language processing can be minimized when conducting an assessment. BioMark is one promising procedure that may be able to provide an objective

measure for examining the CANS's response to speech stimuli (Skoe &Kraus, 2010). Behavioral procedures that minimize cognitive/ language influences include the following:

* dichotic digit testing (minimal language load),
* gap detection (involving pure tones, or tones presented in notched noise), and
* frequency or tonal pattern perception. By comparing the findings on a nonverbal task (such as humming the tonal patterns presented-a pattern perception response based on right hemisphere processing) to a verballabeling task (labeling the tonal patterns processed- example /low, low, high/ based on retrieving verbal labels from the left hemisphere to identify the tonal pattern processed in the right hemisphere), one can obtain information regarding interhemispheric processing.

The fact that spoken language processing difficulties can be due to a myriad of causes makes it incumbent on the clinician or researcher to identify the specific breakdowns if successful intervention is to take place. It is not enough to label an individual with APD, SLI, or, dyslexia because the processing difficulties may be due to different underlying deficits. Consequently, any intervention based on a global diagnosis may or may not work for a specific individual, depending on the alignment of the intervention and the specific processing difficulties being encountered.

On a side note, there are children who struggle academically and exhibit processing-related issues (such as difficulty understanding verbal directions, inability to keep up with the material being presented, confused appearance), yet a speech-language evaluation has not revealed any deficit. This does not mean that there aren't any processing-related issues present. Tests typically deployed in a "basic" speechlanguage test battery may not always be sensitive enough to determine spoken language processing deficits, such as difficulties with rapid lexical processing, fading memory, or sequencing. However, testing by an audiologist may reveal that deficits are indeed present. Audiologists have access to audiometric tests (i.e., tests best administered via the use of an audiometer that can control presentation levels) that can assess temporal resolution, lexical-decoding speed, the presence of fading memory, auditory-linguistic integration, speech-in-noise, and selective and divided auditory attention (i.e., the ability to process and recall two or more stimuli presented simultaneously). If processing difficulties are ascertained by the audiologist, this may result in a subsequent referral for "higher order " language testing. For example, the SLP may be able to delineate whether the lexical-decoding speed difficulty exhibited in the audiological test battery is due to difficulties in the area(s) of phonemic representation, lexical categorization, semantic or syntactic relations, or world knowledge. Thus, an interdisciplinary team approach can systematically ascertain the specific underlying spoken language processing deficits, and, in turn, develop intervention strategies that can effectively address the issues.

Understanding Spoken Language Processing as a Lens to Reviewing the Literature

Knowledge of the mechanisms underlying spoken language processing allows for a critical review of the literature relative to research findings and claims. For example, a major portion of the research regarding intervention reported in this clinical forum (Fey et al., 2011) involved studies of Fast ForWord. The systematic review found that Fast ForWord does not significantly improve performance or reveal superior results over other approaches when applied to individuals "globally" identified with APD or SLI. However, the information I have presented would suggest that individuals with APD (as well as those described as exhibiting SLI) are heterogeneous populations, whereby underlying difficulties may be due to deficits in any of the various processing mechanisms I have outlined in the spoken language processing model. The Fast ForWord program that was developed by Tallal et al. (1996) was based on the premise that temporal resolution deficits underlie SLI, which subsequently drove the timing/acoustic modifications within the Fast ForWord program. However, only some of the individuals identified with APD or SLI, in fact, may have temporal-processing difficulties and, therefore, benefit from Fast ForWord intervention. Therefore, a focus of future research using Fast ForWord would be to identify those individuals with SLI (or APD) who exhibit poor temporal resolution and determine if Fast ForWord subsequently improves the processing skills of this subpopulation. Based on a review of the

literature, Medwetsky (2007) proposed that any improvements subsequent to Fast ForWord intervention would likely be in the area of phonological awareness.

Another contentious issue is the relationship of temporal processing (e.g., as assessed on backward masking or gap-detection tasks) to phonological awareness. Some researchers (e.g., Mody, Studdert-Kennedy, &Brady, 1997; Nittrouer, 1999) have questioned how temporal resolution can underlie phonological awareness deficits when performance on psychophysical measures does not indicate such difficulties. On the other hand, the spoken language processing model I proposed would suggest that deficits in temporal resolution can indeed impact the establishment of stable phonemic categories, and, in turn, the development of phonological awareness and phonics skills. Support for this assumption is found in the work by Hautus, Setchell, Waldie, and Kirk (2003), who suggested that an early deficit in temporal acuity may be antecedent to language-related problems (particularly those related to phonological processing) that may persist after the primary auditory processing deficit has resolved. Hautus et al. found that 6- to 9-year-olds with dyslexia exhibited a significant deficit on a gap detection test relative to age-matched controls, but this deficit was not observed in groups of older individuals with reading impairment (ages 10-11, 12-13, and adults 23-25 years).

Using the Spoken Language Processing Model to Guide Assessment

By carefully selecting tests that address the various processing mechanisms encompassed by the spoken language processing model, clinicians can derive a test battery that allows them to obtain comprehensive profiles of their clients' processing strengths/weaknesses. For those interested in various "auditory" test battery approaches, including my test battery, the reader is referred to Chapter 27 (Tillery, 2009) in the Handbook of Clinical Audiology. Clinicians who would like to review various assessment instruments available to SLPs for assessing spoken language processing are referred to Chapter 28 (Medwetsky, Riddle, &Katz, 2009) in the Handbook of Clinical Audiology. This chapter provides an overview of various tests that SLPs can use to assess processes such as phonologic and morphologic skills, lexical-decoding speed, auditory-linguistic integration, organization/sequencing, and working memory.

It is important to note that a key component of any spoken language processing assessment is a comprehensive hearing evaluation, including pure-tone audiometry, speech reception thresholds, word recognition testing in quiet, tympanometry, and acoustic reflex testing. In certain cases (such as possible neural dys-synchrony), the results may suggest the need for otoacoustic emissions and auditory brainstem response testing. Hearing loss can impact a person's ability to process information easily/accurately; hence, it is critical to rule out a possible hearing loss as an underlying cause of processing difficulties.

Conclusion

It appears that "pure" auditory processing does not exist. However, this does not imply that auditory mechanisms or situational demands do not significantly influence the processing of spoken language. Although language components obviously play a key role, they cannot account for all of the difficulties that might be experienced by individuals in everyday listening settings. For example, even though one's lexicon, semantic relations, or syntactical structures may be poorly organized, the individual's difficulties may be manifested only in certain difficult listening situations, such as when the information is presented in difficult acoustic environments (e.g., with much reverberation and/or noise being present). Second, internal factors such as reduced frequency/temporal resolution, decreased ability to localize incoming stimuli, inefficient interhemispheric transfer of auditory-linguistic information, and reduced speech-in-noise or binaural separation abilities may affect one's ability to transmit speech stimuli effectively to the language processing regions. Therefore, one cannot minimize the importance of auditory transmission of incoming speech stimuli and the impact of any such deficits on subsequent processing, and possibly the degree to which it may even influence initial language development.

On the other hand, spoken language processing tasks engage linguistic (not auditory) representations by approximately 250 ms postonset, and cognitive mechanisms appear to play a role as early as cochlear

processing and subsequently in maintaining the information in STM. In addition, poor performance on tests such as speech-in-noise may not always be due to auditory processing mechanisms but to impoverished language representations in LTM. Even backward and forward masking, often thought within the audiology profession to be auditory processes (i.e., a function of frequency/temporal resolution), involve the formation of STM traces and their resistance to decay to prior or subsequent stimuli.

Because individuals with APD, SLI, or a learning disability appear to comprise heterogeneous populations, one must carefully ascertain the specific underlying deficits before initiating any intervention. Therefore, application of any intervention without careful delineation of the subpopulations will undoubtedly result in nonsignificant group effects, though the findings may reveal benefit for certain individuals whose disorder is amenable to the specific intervention undertaken. Going forward, researchers should not include individuals with globally defined deficits but rather should carefully select subpopulations relative to the interventions chosen. Consequently, before Fast ForWord or any other direct intervention is dismissed as being ineffective, studies should be conducted with individuals whose deficits the interventions are most likely to address and determine from the evidence if the intervention does indeed result in the desired benefit.

In summary, the spoken language processing model attempts to examine how auditory, cognitive, and language processes interface. The model serves as a basis for crafting a comprehensive test battery to determine if processing deficits are present and their specific nature, and, in turn, guide management. It is my hope that this article will result in a greater consensus as to how we can best address the processing issues confronting those we serve.

Sidebar

Spoken Language Processing Model: Bridging Auditory and Language Processing to Guide Assessment and Intervention

Larry Medwetsky

Lang Speech Hear Serv Sch 2011;42;286-296
DOI: 10.1044/0161-1461(2011/10-0036)

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Editor: Marilyn Nippold
Associate Editor: Ilsa Schwarz

Received May 15, 2010
Revision received November 15, 2010
Accepted May 3, 2011
DOI: 10.1044/0161-1461(2011/10-0036)

Publication date: Jul 1, 2011

Year: 2011

Hearing speech in music

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Publication info: Noise & Health 13.53 (Jul 2011): 277-85.
ProQuest document link

Abstract: The masking effect of a piano composition, played at different speeds and in different octaves, on speech-perception thresholds was investigated in 15 normal-hearing and 14 moderately-hearing-impaired subjects. Running speech (just follow conversation, JFC) testing and use of hearing aids increased the everyday validity of the findings. A comparison was made with standard audiometric noises [International Collegium of Rehabilitative Audiology (ICRA) noise and speech spectrum-filtered noise (SPN)]. All masking sounds, music or noise, were presented at the same equivalent sound level (50 dBA). The results showed a significant effect of piano performance speed and octave (P<.01). Low octave and fast tempo had the largest effect; and high octave and slow tempo, the smallest. Music had a lower masking effect than did ICRA noise with two or six speakers at normal vocal effort (P<.01) and SPN (P<.05). Subjects with hearing loss had higher masked thresholds than the normal-hearing subjects (P<.01), but there were smaller differences between masking conditions (P<.01). It is pointed out that music offers an interesting opportunity for studying masking under realistic conditions, where spectral and temporal features can be varied independently. The results have implications for composing music with vocal parts, designing acoustic environments and creating a balance between speech perception and privacy in social settings.

Full text: Introduction

Music is an increasingly prevalent component of the acoustic environment. Although it is normally played for pleasure and entertainment, it has a wide range of effects on the human mind and body - general physiological and possibly pathogenic effects, therapeutic and pain-relieving effects; [1],[2] and it can be hazardous to the ear (review [3]). On the psychosocial level, it is possible to identify three types of music-listening situations:

Active listening: You choose to listen to music - in your home, on a dance floor or in a concert hall; or as art, entertainment, for relaxation, etc. Music has a positive value.

Positive background: You are surrounded by music while involved in another activity - at work, when driving, shopping, visiting a restaurant, etc. The music may influence your activity, feelings and behavior, but it is not disruptive or disturbing. You accept it, feel neutral or comfortable.

Disturbing and annoying environment. The music disrupts, disturbs and annoys you; it interferes with your present situation and you wish it would stop.

Some aspects of all three situations are the focus of the present investigation, and one general ambition is also to gather systematic empirical information on how music with different features interferes with understanding of

running speech (or more formal recitations). There is a long tradition explaining how to compose and arrange music so that vocal parts and individual instruments are perceived in the orchestral background. Few scientific studies, however, have analyzed the relation between music features and speech masking. This topic has bearing on music as such but perhaps even more bearing on music as part of our general environment.

When the Department of Restaurant and Culinary Arts at Orebro University built up its restaurant education program - a program designed to reflect a tradition of good restaurant-management and craftsmanship - five dimensions and five guidelines were formulated in relation to the Room, the Product, the Meeting, the Atmosphere and the Management control system. [4] The influence of music on these dimensions of restaurant visits has received very little attention in research, with the exception of purchase behavior and atmosphere, which have been studied by North and Hargreaves. [5] A restaurant conversation is the most obvious activity (Gustafsson et al.[4]) in which the acoustic environment has an impact. The atmosphere affects the encounter/the activity, generating the emotional basis for the interaction between the dinner participants. The individual preferences of the guests are of great importance; as is the general context of the dinner, whether it is a dignified celebration or a casual party.

The encounter is by definition built on communication, which is a multidimensional phenomenon. [6] One important component is verbal communication. The restaurant environment should therefore ensure the fulfillment of at least two important conditions:

It should be easy to hear members of your own party.

It should not be easy for people at surrounding tables to overhear your conversation, and vice versa.

The music played at the restaurant thus plays at least three roles for the communication among the guests:

To create a contextually relevant and positive acoustic atmosphere.

To interfere with relevant speech, neither for individuals with normal hearing (NH) nor for the large number of people [7] with hearing impairment (HI).

To prevent perception of irrelevant speech.

The latter two concern the masking effect of music on speech perception.

Interestingly, there are very few publications addressing these issues. The reason is probably at least partly related to the difficulty of defining music in acoustic terms. Music can cover the whole acoustic spectrum and range from just audible to painful. Tsaneva [8] investigated the effects of pop music, classical music and pop music played backwards, all at 65 dBA, on the perception of monosyllables. She found no difference between the music pieces in terms of masking ability, provided the signal-to-noise ratio was the same. Rhebergen et al.[9] found that a specific piece of music had an intermediate masking effect on speech, between that of frog song and construction noise. Music may also interfere with speech perception as "an irrelevant signal" in the same manner as speech itself has been found to be an irrelevant interfering factor (e.g., [10]). An interesting finding was presented by Russo and Pichora-Fuller. [11] They found that word identification was better in the presence of familiar music than unfamiliar music or babble noise. This was only the case for young listeners, not for older ones. Trained musicians had better speech-in-noise performance than did non-musicians, as well as better frequency discrimination and working memory. [12]

In the area of speech, hearing and audiological science, practically all masking studies have focused on the perception of speech masked by synthetic noise or combinations of interfering speech. We have found no earlier studies on the masking effect of music on speech perception in relation to music features and hearing status. The music used for such a masking experiment has to be designed on the basis of current knowledge of auditory masking, with both the above-mentioned aspects in mind: Hearing relevant speech and not being distracted by irrelevant speech.

The literature on masking is extensive, and only a few aspects will be mentioned here. Masking means making a target sound (signal, often speech) inaudible (complete or total masking); or less audible, i.e., weaker (partial masking). A sound (a masker) that covers the spectrum of the target sound and that occurs at the same time

causes direct, simultaneous masking. The masker, however, can cause masking even before it actually starts (backward or pre-masking) and, more importantly, after it has terminated (forward or post-masking). In addition, the masking effect can spread outside the physical spectrum of the masker. This spread of masking is most important towards higher frequencies (upward spread of masking) and to a lesser extent towards lower frequencies (downward spread of masking). The upward spread of masking increases at higher masker levels. The temporal effect of masking is most marked at and near the masker frequency, but it is also spread outside this range. A review on speech intelligibility in noise is provided by Bronkhorst. [13] The terminology of masking is, however, not unambiguous. For instance, the term "amount of masking" has two meanings: The level of the masker and the shift in the hearing threshold caused by the masking sound. Therefore, in the present article, "masking delivered" is suggested as a synonym for the level of the masker, and "the amount of masking produced" denotes the amount of shift in the hearing threshold caused by the masker.

These basic psychoacoustic properties also apply to masking of speech in realistic conditions, where the masker is music, speech from one speaker or several other speakers, or ambient noise. The masking effect of any sound is also highly dependent on the hearing status of the listener, whether he/she has NH or HI. Persons with HI need a higher signal-to-noise ratio than do individuals with NH. [14] Given that a large proportion of adults have HI, studies including subjects with HI are not solely of academic interest. This group must also be considered by those who wish to reach an audience including individuals over 60 years of age. [7]

A series of realistic masking noises has been constructed and evaluated within the International Collegium of Rehabilitative Audiology (ICRA) [15] and distributed widely. The material contains nine noises with spectra shaped by the long-term average spectrum for male or female voices, with the individual talking in a normal, raised or loud voice. The time course is shaped by one, two or six speakers. The envelope of the speech spectrum-weighted noise is thereby modulated with a peak at 4 Hz for the one-talker condition and practically unmodulated for the six-talker condition. [15]

As described above, the temporal fluctuations are simulated in the ICRA noises, but the spectral fluctuations in natural speech are not maintained. This is a deliberate simplification but also a potential limitation. By playing music at different speeds and in different octaves, one can circumvent this limitation. The effect of both temporal and spectral fluctuations can be maintained and manipulated selectively while the masker (music) is still perceived as music. Thus, the use of especially composed and systematically designed music as a masker of speech may be of interest from both a practical and a theoretical point of view. The focus of the present study is to highlight the importance of hearing speech in music, and music as a practically and theoretically important masker. In order for the results to achieve high everyday validity, the dependent variable was running speech rather than words or artificial sentences.

The overriding question of the present study is: How should music be designed to allow speech to be heard - or to prevent it from being heard? The specific question is: How does the masking effect vary when a masking piano piece is played at different tempi and in different octaves, for individuals with NH and for those with HI?

Methods

Participants

The participants consisted of two groups of young subjects, one comprising individuals with NH (n=15) and the other (n=14) comprising individuals with varying degrees of sensorineural HI [Table 1]. All participants were white-collar workers, and most had a university education. The age of the first group was 20-39 years; and of the second group, 18-38 years. The age range of the subjects with HI was chosen to match that of the NH group so as not to introduce confounding differences in cognitive abilities. The obvious drawback of this selection method is that the HI group was less representative of the majority of HI subjects, who are older, on an average. The hearing thresholds of the NH group were 20 dBHL (ISO 389) or better between 0.25 and 4.0 kHz. All 14 subjects with HI had attended clinical audiological rehabilitation programs, and all but one used hearing aids.{Table 1}

The audiometric features of the 14 subjects with HI are shown in [Table 1]. In [Table 1], the order of the subjects is identical to the order of the arrows in [Figure 1], including information on hearing aid status. The hearing aids were fitted using standard procedures and the fitting programs provided by the manufacturers, and were worn during the tests, thereby increasing the everyday validity of the measurements.{Figure 1}

For the 13 subjects with bilateral HI, the thresholds were as follows:

M3 (the average value for the better ear at the frequencies 0.5, 1.0, 2.0 kHz, i.e., conventional Pure Tone Average, PTA) was in the range 6.7-75.0 dBHL. Mean value was 46.3 dBHL (SD=17.2 dB).

M4 (average for the frequencies 0.5, 1.0, 2.0, 4.0 kHz) was in the range 22.5-72.5 dBHL, and the mean was 49.5 dBHL (SD=14.2 dB).

M5 (average for the frequencies 0.5, 1.0, 2.0, 3.0, 4.0 kHz) was in the range 29.0-71.0 dBHL, and the mean was 50.9 dBHL (SD=13.3 dB).

The subject (Subject 9) with unilateral HI had the following thresholds on the affected ear: M3=58.0 dBHL; M4=57.5 dBHL; M5=57.0 dBHL.

Equipment and test conditions

The tests were performed in the acoustic environmental room (3 mX3.4 m; height, 2.4 m) at Ahlsın Research Institute [16] ; the room's reverberation time is 0.2 second. The room is equipped with 12 loudspeakers (Bose, model 101, Music monitor in circular arrangement, radius=1.4 m), and the masking sound and the target sounds were presented through a loudspeaker at zero degrees azimuth.

The subject was instructed to adjust the level of the target sound and to indicate when he/she could just follow the conversation ["just follow conversation" (JFC) method]. [16],[17],[18] For the present purpose, the JFC method was preferable to the conventional "speech reception threshold" (SRT) methods, because it is quicker and has greater face validity. This was a critical advantage in light of the large number of threshold determinations needed in the present study design. On the other hand, no comparisons with SRT estimations based on articulation index (AI) or speech intelligibility index (SII, e.g. [19]) could be made. Such comparisons require a different study design and a new set of data.

Calibration of the masker and test sound in the acoustic environmental room was performed using a Larson and Davies sound-level meter and a Bruel and Kjaer 2209 sound-level meter. The audiometric thresholds were obtained using standard clinical procedures with audiometers calibrated according to ISO 389.

Test material

The target sound (the signal) was a male voice reading a story in Swedish from the Swedish book "The Wonderful Adventures of Nils Holgersson" by S. LagerlΦf (standardized by Borg et al.[16]). The long-term (first 3 minutes, male reader) spectrum of the target test-reading is shown in [Figure 2].{Figure 2}

The masker was a pentatonic piano composition in five beats per bar [Figure 3], specially composed for this experiment (by S-R E). In order to achieve a homogenous flow of tones, on an average, five tones were played within each bar. This simplified the procedure of adjusting the level of the target sound. The melodic range of the piano piece was limited to one octave (for example, the piano key f in the third octave to f in the fourth). The piece was played in four different octaves [octave 2 (O2) to octave 5 (O5)] and at three speeds: Slow (s), M=60 (M - Metronome speed, beats per minute); medium (m), M=120; and fast (f), M=180. With this design, it is possible to measure masking in relation to frequency range (octave) and speed.{Figure 3}

The physical acoustic features of the piano music are shown in [Figure 4]. The left side shows the time course of the sound level for the music in the fifth octave and at the three different speeds.{Figure 4}

The time gaps are more pronounced for the slow speed diagram, which may allow for better sound perception during the gaps. In addition (not shown), the sound level had a slower decay and thereby shorter or nonexisting gaps between the piano key strokes when played in the lower octaves.

The right side of the figure shows the average acoustic spectrum of the first minute of the composition, played in octaves O2 to O5 at medium tempo. The sound level for all 15 maskers was the same, 50 dBA-equivalent level

(well above the hearing threshold for all subjects, as the subjects with HI used their hearing aids in the test situation). Observe the upward shift of the low-frequency skirt of the spectrum from O2 to O5. In the O2 and O3 diagram, the sound level is clearly higher in the lower-frequency region than for the spectrum of the higher octaves, which may indicate more masking of speech for the piano piece played in the lower octaves.
In addition to the 12 piano maskers, three standard maskers were also included. Two ICRA (International Collegium of Rehabilitative Audiology [15]) noises were selected, consisting of two- and six-person babble noise (tracks 5 and 8 of the ICRA-CD, normal vocal effort). ICRA noises are artificial noise signals with speech-like temporal properties, used for speech-perception studies and hearing-instrument assessment. In addition, one SPN (speech spectrum-filtered noise; cut-off at 1.0 kHz, -12 dB/oct [20]) was used from a standard clinical diskette, CA Tegnır AB, Stockholm, Sweden.

Procedures

After ear inspection and verification of normal eardrum status, a standard clinical audiogram was obtained. The subjects with HI used their hearing aids in the tests [Table 1]. In the masking measurements, the subjects were seated in the test room and instructed about the test conditions and the JFC method. The participants adjusted the target reading until it was possible to just follow the conversation, without necessarily hearing every word. The different maskers were presented in random order to prevent a learning effect. [21] Each masker was repeated twice, in descending order (O5 fast tested first) and ascending order (O2 slow tested first). If the masked threshold differed by 5 dBA or more, the masker was presented once more. The subjects were allowed to take the time they needed to assess their JFC threshold. At the end of the session, the subjects were asked whether or not they thought the music was enjoyable or annoying.

Statistical procedures

Standard parametric methods were used: The Student t test and Pearson correlation coefficient (r). Also nonparametric tests were used with SPSS versions 15 and 17: Mann-Whitney U test and Spearman rho. Repeated measurement ANOVA (RM-ANOVA) and t test were used for assessment of significance of octave and tempi effects on JFC thresholds, and the role of hearing status. To test for violation of sphericity, the Mauchly's Test of Sphericity was used. Huynh-Feldt correction was used if sphericity could not be assumed.

Ethics

The study was approved by the Regional Ethics Committee, Uppsala, Sweden (Reg. no. 2007/141).

Results

Masked JFC thresholds for the NH group (mean+-SD) and for two typical individuals are shown in [Figure 5] for the piano piece played in octaves O2 to O5 at slow speed. As seen in the figure, the masking effect decreases as the frequency of the piano piece is increased, that is, when it is performed in a higher octave. There is no individual peak indicating a possible preferred combination of speed and octave.{Figure 5}

The average masked JFC thresholds (+-SEM, standard error of the mean; see figure legend) for the groups of subjects with NH and HI are shown in [Figure 6]. The vertical axis indicates the level of hearing threshold in dBA. The 15 different maskers are specified along the horizontal axis of the diagram. First from the left is the value of the hearing threshold with no noise (no masker). Then there are the values for the 12 pieces of piano music (more precisely, 12 versions of the piano piece of [Figure 3], starting with the piece in the second octave played at the slow tempo, O2s, followed by the piece in the same octave played at the middle tempo, O2 m. The last of the piano pieces is in the highest octave played in fast tempo, O5f. Finally there are values for the two ICRA noises and the SPN. The three speeds (tempi) are identified by the three lines: Continuous line for slow speed, long dashes for medium speed, and short dashes for fast speed.{Figure 6}

Two tendencies are clear, but more pronounced for the NH group. First, the masked threshold decreases when the octave of the music piece increases, by 3.5 dB/octave. For all tempi, the octave is a significant factor for both subjects with NH and subjects with HI (e.g., RM-ANOVA $F(2.0,42)=110$; $P=0.000$ Huynh-Feldt correction, for slow speed for subjects with NH).

Second, the masked threshold increases with increased speed, by 1.5 dB per increment of 60 beats per min. Speed was found to have a significant effect for all octaves for the NH subjects (RM-ANOVA P< 0.002, Huynh-Feldt correction, independently of octave). For the subjects with HI, speed had a significant effect (RM-ANOVA P< 0.01, Huynh-Feldt correction, for octaves O2, O4 and O5) for all octaves except O3.

To summarize, the fast piano music played in the lowest octave gives the highest masked thresholds, whereas the slow piano music played in the highest octave gives the lowest masked thresholds, both for subjects with NH and for those with HI. Furthermore, the masked threshold for the ICRA noise and the SPN is higher than that of the O2f piano music (for NH: P< 0.01; for HI: P< 0.05, Mann-Whitney U test).

The variation in masked threshold between the different masking conditions is much greater for the subjects with NH than for the subjects with HI. The difference between the lowest and the highest masked thresholds (for O5s and O2f, respectively) was significantly greater for subjects with NH than for those with HI (P<0.01, df=27 equal variances assumed, t test).

The two piano pieces that masked the most and the least are shown in [Figure 1], left and right, respectively. In [Figure 1] (left), the piano piece is played in the second octave at fast tempo (O2f). In [Figure 1] (right), it is played in the fifth octave and at slow tempo (O5s). The figures show how each individual JFC threshold is affected by the two different maskers. The two groups of horizontal arrows represent the two groups of subjects. The group of 15 arrows in the upper part of the figure shows the results for the individuals with NH. The group in the lower part represents the individuals with HI, who are presented in the same order as in [Table 1]. The horizontal axis gives the JFC threshold value in dBA. The left point of the arrow indicates the JFC threshold without masker, and the right point, the arrowhead, indicates the JFC threshold when masked by the piano music; and the length of the arrow indicates the amount of masking produced.

As seen in the figure, the amount of masking produced is generally greater for the NH group than for the group with HI. Within the groups as well, there is a relationship between the amount of masking produced (raise of-increase in the JFC threshold, length of the arrow) and the unmasked JFC threshold: The lower the unmasked threshold, the larger the amount of masking produced. For the subjects with HI, the correlation is significant (rho =-0.89, P<.01 for O2f; nonsignificant for O5s). For the NH subjects, there was no correlation, and some subjects showed a markedly larger amount of masking produced than the majority (e.g., NH subject number 13 in [Figure 1], octave O5s). Individual threshold criteria probably play an important role in the explanation of such differences (see further in "Discussion" Methodological aspects").

The music was perceived as annoying by 3 of the subjects with NH and by 5 of those with HI (a nonsignificant difference).

In summary, the masking effect (masked threshold and amount of masking produced) of the tested piece of piano music increased with increasing tempo and decreasing octave.

Discussion

Methodological aspects

The choice of JFC as a dependent variable was motivated by the higher validity of everyday conversation as compared to monosyllables or synthetic sentences. Also favorable was the large number of measurements in the present study design. A comparison between JFC and 50% SRT determinations [17] shows about 3 dB higher thresholds for JFC than for 50% SRT for subjects with NH; and about 1.5 dB, for subjects with HI. Larsby and Arlinger [22] found a considerably larger difference, a 10.5 dB higher signal-to-noise ratio for the JFC than for the 50% SRT method pooled over subjects with NH and HI and different masker noises. An analysis of individual correlations showed that there was no significant correlation between JFC thresholds and 50% SRTs in a steady noise masker; and a moderate correlation with speech maskers, 0.71-0.79.

The differences between SRTs and JFC thresholds, as well as the individual differences in masked thresholds in the NH subjects of the present study [Figure 1], may reveal other interesting aspects of communication and failures in communication. For example, the amount of masking produced in one of the NH individuals

(represented by the third arrow from the bottom in the right column of [Figure 1]) is much greater than that produced in the others. The audiogram for this susceptible individual is normal (M5: 5 and 7 dBHL). This individual is one of three in the NH group who were annoyed by the piano music during the test. Thus, this observation indicates the importance of emotional components. Furthermore, the JFC method entails the possibility of an influence of an individual threshold criterion. It is probable that the NH subjects with great masking produced (long arrows in [Figure 1]) have high demands on signal quality before they feel they can just follow the conversation. In some, but not all cases with HI, both unmasked and masked thresholds are elevated. Among the subjects with HI, there are also cases for which the thresholds are unexpectedly high, or low, in relation to their audiograms. Because the subjects with HI used hearing aids, no detailed analysis can be made for those cases in the absence of data on free-field thresholds with hearing aids.

An obvious disadvantage of the above-mentioned lack of agreement between JFC thresholds and SRTs is that it becomes difficult to compare the present threshold data with the data obtained when applying different AI models with the present music maskers. Furthermore, in the test situation, the subjects with HI used their hearing aids in order to achieve a high everyday validity in the findings. This also made application of AI and SII models more complicated (see below, in section "Consideration of Speech Intelligibility Index models").

Music as masker

The reason why the speech-masking effect of music has not previously been investigated is at least partly related to the difficulty of defining music in acoustic terms. Music can cover the whole acoustic spectrum and range from just audible to painful. Obviously, no general conclusions can be drawn about music, except for the effect of sound level. Therefore, we were presented with a challenge some years ago when a young subject with HI asked, "Why do you use speech as a masker? It's music that keeps us from hearing." This question gave the idea to start an investigation on the masking effect of music. Our ambition has then been to find out the answer to the following question: How can a piece of music be created to cause minimum versus maximum masking, while still maintaining the same level, a similar character and being perceived as music?

The spectrum of the music of the lowest octave (O2) overlapped with the speech frequencies and had a considerable masking effect on vowels and low-frequency consonants [Figure 4] and spectra in Lide'n (accent egu) work. [20] Considering the upward spread of masking, the high-frequency consonants are also influenced. Music played in the higher octaves, on the other hand, only influenced part of the highest speech-frequency range. Therefore, it has less influence on perception of speech (a small influence on the JFC threshold).

The dependence of the masking effect on the level of the unmasked threshold is clear: The lower the threshold, the larger the increase during masking. This is compatible with recruitment and other masking data. For the NH group, the importance of other factors is also evident. The individual's threshold criterion has an obvious influence. A person requiring that most of the words be clearly heard will have a higher JFC threshold than a person who feels a low percentage is enough. A person who is familiar with the text is also likely to indicate a lower JFC threshold than a person for whom the text is new. Furthermore, cognitive capacity is important, particularly for listening in fluctuating noise. [23] The benefit of fluctuation of the masking noise is much less for subjects with HI than for those with NH (first shown by Carhart and Tillman [24]). High age also decreases the listener's ability to utilize the silent periods. The advantage of having a young study group, as in the present study, is that it minimizes the confounding effect of low and variable cognitive capacity. An emotional component might have influenced one NH subject (Subject no. 13 in [Figure 1]) with an exceptionally large shift, and this observation merits further investigation.

The observed decrease in the masking effect when the peak of the spectrum of the masker was shifted from the lower to the higher part of the speech spectrum is compatible with the fact that the upward spread of masking is more pronounced than is the downward spread (de Marı and RΦsler, [25] and others). The lower masking effect of O3 compared to O2 is, however, somewhat surprising, as O3, too, covers most of the important middle and high frequencies of the target speech, as shown in [Figure 4].

The different presentation speeds correspond to differences in the periods of low sound level (silent intervals) between the piano key strokes. The length of these silent intervals depends on the octave, the lower tones having a longer duration and shorter pauses. For the O5 octave [Figure 4], the silent interval is more than 0.5 second at low speed. At high speed, the sound level seldom reaches baseline, and there is virtually no silent period. This can be compared with the data on ICRA noise as described by Wagener et al.[26] In the original recording with one male talker, the pauses were up to 2 seconds long. In a revised version of the ICRA noise, Wagener et al.[26] tested 250-millisecond and 62.5-millisecond pauses. They found that the masking effect increased for the shorter pauses.

Consideration of speech intelligibility index models

As mentioned in the section "Methodological aspects", the AI and SII models cannot be applied to the present masking data, because different dependent variables are used: JFC and 50% correct response. Furthermore, AI and SII are valid only for low-probability test material (SRT), whereas JFC is based on high-probability material. JFC thereby has superior everyday communication validity than SRT. The problem becomes insurmountable given the poor correlation between the variables, [22] and complicated by the use of hearing aids by the subjects with HI. However, some comparisons can be made at a semi-quantitative level.

The extended speech intelligibility index (ESII) is constructed to predict SRT in masking noises, which vary in both the spectral and temporal domain. [9],[19] It can be deduced from the data in the study by Rhebergen et al.[9],[19] that the ESII model gives a better prediction in time-varying masking noise than does the conventional SII model. Intermittent noises with longer silent intervals gave less masking than did noises with short intervals, and low-frequency and wide-band noises gave a larger amount of masking than did high-frequency time-varying noises. At this crude level of comparison, the present data with piano music as the masker give the same pattern of results as that expected from ESII.

Applications

The present results can be considered when designing music for dining and restaurants. One can focus on either maximum speech intelligibility at a certain table, or a high level of privacy, i.e., masking away the speech coming from other tables in the restaurant. The extreme condition is maximum masking in order to minimize verbal interaction. This may lead to maximal intake at the bar or minimal eating time in the lunch restaurant. The present results clearly indicate that one should select low-frequency, fast music for a decrease in speech intelligibility, and high-frequency, slow music for optimal speech reception. In addition, the overall intensity can of course be varied, creating, together with frequency and tempo, a wide range of possibilities to tailor music optimally for various communication purposes.

The higher masked thresholds for the subjects with HI (also when using hearing aids [Figure 1] and [Figure 6]) and the associated higher risk of becoming fatigued emphasize the importance of focusing on the acoustic features of social settings. Restaurant owners should be encouraged to create areas with different acoustic conditions. The guest with HI should be specific and expressive when selecting a restaurant.

In composing music, there are also a number of obvious general problems concerning masking between different instruments, which will not be discussed here. Only the role of a possible hearing impairment of the composer or the performer may be considered. As is shown in the present study, the masking pattern of one musical sound source (the piano) is altered for listeners with HI. This may influence the creation as well as the performance of music. One direct application of the present results is in relation to the music accompanying vocalists - often the piano, but also an entire orchestra, e.g., in opera performances. A composer with a sensorineural HI may prefer a slower tempo or a higher octave for the accompanying instruments than would a composer or performer with NH. In this way, the audience may enjoy more of the singer's articulation. The masking problem is, however, mutual. It is not only the music that can mask the perception of the voice. The singer's own voice can mask other non-vocal as well as vocal sounds for the audience, and in the singer's own ear [27] as well as in the ears of companion singers, e.g., in a choir. [28]

Conclusions

The piano composition had the greatest masking effect when played at a high speed in a low octave and the least masking effect when played at a slow speed in a high octave, even though the equivalent level was the same (50 dBA). The masked threshold was higher for the hearing-impaired than for the normal-hearing subjects, but the difference in the masked threshold between different octaves and tempi of the masking piano music was smaller. The everyday validity of the results was increased by using JFC thresholds. The present article points out the importance of creating a balance between speech, singing and accompanying instruments in order to optimize the hearing of speech in music - at the opera and concerts, as well as at restaurants.

Acknowledgments

This study was supported by grants from Swedish Council for Working Life and Social Research (FAS, Forskningsr[Epsilon]det fΦr Arbetsliv och Socialvetenskap), the University Hospital of Φrebro and Φrebro University. Thanks to Christina Bergkvist for performing the measurements.

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Publication date: Jul 2011

Year: 2011

Periodic Early Childhood Hearing Screening: The EHDI Perspective

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Publication info: The Volta Review 111.2 (Summer 2011): 195-208.
ProQuest document link

Abstract: State coordinators of early hearing detection and intervention (EHDI) programs completed a strengths, weaknesses, opportunities, and threats, or SWOT, analysis that examined 12 areas within state EHDI programs. Concerning periodic early childhood hearing screening, 47 coordinators listed 241 items and themes were identified within each SWOT category. A threats, opportunities, weaknesses, and strengths, or TOWS, analysis yielded 12 recommendations that focused on similar themes. Out of these 12 recommendations, 3 distinct strategies emerged: 1) increase education of parents and professionals about risk factors for later onset

hearing loss and hearing monitoring; 2) integrate data systems accessible by professionals that are capable of processing risk factors and multiple hearing screenings; and 3) collaborate with early childhood programs to coordinate follow-up, improve data submission, and conduct periodic hearing screenings. Addressed appropriately, these recommendations can improve periodic early childhood screening within state EHDI programs. [PUBLICATION ABSTRACT]

Full text: Headnote

State coordinators of early hearing detection and intervention (EHDI) programs completed a strengths, weaknesses, opportunities, and threats, or SWOT, analysis that examined 12 areas within state EHDI programs. Concerning periodic early childhood hearing screening, 47 coordinators listed 241 items and themes were identified within each SWOT category. A threats, opportunities, weaknesses, and strengths, or TOWS, analysis yielded 12 recommendations that focused on similar themes. Out of these 12 recommendations, 3 distinct strategies emerged: 1) increase education of parents and professionals about risk factors for later onset hearing loss and hearing monitoring; 2) integrate data systems accessible by professionals that are capable of processing risk factors and multiple hearing screenings; and 3) collaborate with early childhood programs to coordinate follow-up, improve data submission, and conduct periodic hearing screenings. Addressed appropriately, these recommendations can improve periodic early childhood screening within state EHDI programs.

Introduction

In 2007, early hearing detection and intervention (EHDI) programs in 43 states and territories reported that 1.2 out of every 1,000 newborns screened were diagnosed with a permanent childhood hearing loss (Centers for Disease Control and Prevention [CDC], 2010a). However, the prevalence of hearing loss nearly doubles by school age (Bamford, et. al., 2007). In addition, approximately 75% of children experience otitis media by the time they are 3 years old (National Institute on Deafness and Other Communication Disorders [NIDCD], 2010), and a mild conductive hearing loss may occur when middle ear fluid is present (Fria, Cantekin, &Eichler, 1985). In the United States, 97% of newborns have their hearing screened, most during birth admission, using otoacoustic emissions (OAE) or automated auditory brainstem response (AABR) screening technology (CDC, 2010b). However, there is no comparable universal 2nd tier screening system to identify postnatal hearing loss during the early childhood years. Consequently, many young children may not have another hearing screening until long after the newborn period and in some cases not until school.

The American Academy of Pediatrics (AAP, 2008) recommends an objective hearing screening for newborns and 4 year olds, with a risk assessment and appropriate follow-up at periodic examinations between those ages. Medicaid's Early Periodic Screening, Diagnosis, and Treatment (EPSDT) program for children requires states to develop their own hearing screening periodicity schedule that meets "reasonable standards of medical practice" in consultation with recognized medical organizations (U.S. Department of Health and Human Services [DHHS], 2005).

Guidelines developed by the Joint Committee on Infant Hearing (JCIH, 2007) regarding hearing surveillance, screening, and evaluation after the neonatal period include:

* Monitoring auditory skills, middle-ear status (using pneumatic otoscopy and /or tympanometry), and developmental milestones consistent with the AAP periodicity schedule.
* Administering a validated global screening tool at age 9, 18, and 24-30 months, or sooner if there are parent or physician concerns about hearing abilities or language development.
* Referral to an audiologist and /or speech-language pathologist if the child does not pass the speech/language part of the screening; if there are physician or parent concerns about hearing, speech, or language; or if there are risk factors for later onset hearing loss.

The Part C early intervention program and the Part B preschool special education program, authorized by the individuals with Disabilities Education Act (IDEA), is another system where hearing screening and evaluation occur for some young children. It is estimated that over 12% of young children have developmental delays and would, therefore, be eligible for Part C early intervention services (Rosenberg, Zhang, &Robinson, 2008). Both Part C and Part B programs require an evaluation for each child to determine eligibility for services. In a survey of these programs, Part C programs reported that 28% of the children were screened using OAEs, a technique that screens the peripheral auditory system at the level of the cochlea; only 14% received a complete audiological evaluation (Eiserman &Shisler, 2010). The use of family questionnaires and non-calibrated noisemakers, regarded as inappropriate according to existing guidelines for hearing screening (American Speech-LanguageHearing Association, 1997), were used more frequently. A higher percentage of 3- to 5-year-old children in Part B programs received objective screening and evaluation. Although only 17% received an audiological evaluation, 46% of the children were screened using pure tone audiometry and 22% were screened using OAEs (Eiserman &Shisler, 2010).

The Early Head Start and Head Start (EHS/HS) program, with an annual enrollment of more than 900,000 children ages birth to 5 years (DHHS, 2010), is another program where children receive a hearing screening. A hearing screening within 45 days after enrollment into the EHS/HS program is required by the Head Start Performance Standards (DHHS, 2009). The Early Childhood Hearing Outreach (ECHO) initiative at the National Center for Hearing Assessment and Management (NCHAM) began training EHS/HS programs in 2002 to update their hearing screening practices through the use of OAE screening and a specified follow-up protocol. More than 200 EHS/HS programs in 21 states have adopted the ECHO model, and more than 90,000 young children have been screened. Approximately 1.5 of every 1,000 young children in the EHS/HS program have been identified with a permanent hearing loss, and 18 per 1,000 have been identified with otitis media (Eiserman, Hartel, Shisler, Buhrman, White, &Foust, 2008).

The purpose of this study was to complete a systematic review using a strengths, weaknesses, opportunities, and threats, or SWOT, and a threats, opportunities, weaknesses, and strengths, or TOWS, analysis to determine current EHDI practices related to periodic early childhood screening, and to identify recommendations to improve program effectiveness in this area.

Methods

Fifty-one state EHDI coordinators were asked to complete an online survey. Related to periodic early childhood screening programs, the survey asked the EHDI coordinator to report at least 1 item in the following four areas to assist with strategic planning: strength, weakness, opportunity, and threat. The responses obtained were reviewed by a panel of experts in the field and categorized into common themes in each of these four strategic planning areas. To generate recommendations from the SWOT analysis, a TOWS matrix was used to match identified strengths with opportunities (S-O strategy), strengths with threats (S-T strategy), weaknesses with opportunities (W-O strategy), and weaknesses with threats (W-T strategy). For an in-depth review of the methodology, the reader is referred to White and Biaiser, 2011.

Results

Forty-seven state EHDI coordinators (92%) completed information about periodic early childhood screening in the SWOT questionnaire. The respondents generated 68 items in the strength category, 62 items in the weakness category, 51 in the opportunity category, and 60 in the threat category for a total of 241 responses. Based on the responses, several specific themes were generated for each category: 9 for strengths, 7 for weaknesses, 7 for opportunities, and 7 threats (Table 1). Each category also had a miscellaneous section that included no comment, N /A, or items that did not fit within the themes identified.

Strength Characteristics

The three most frequently cited strengths were protocols, policies, and procedures (26%), screening outreach efforts (19%), and awareness and resources (10%) (Table 2). Twenty-six percent of respondents reported that

their state had policies and procedures that focused on following up with children considered at risk for later onset or progressive hearing loss. Respondents also noted that they notify families directly about the risk factors, contact the infant's primary health care provider, work with the audiologist in an ongoing process, and coordinate with the early intervention system in their state to recommend and /or arrange for additional hearing screening and monitoring. In addition, one program indicated that the state has the capacity to collect data for children up to 6 years old. Another EHDI program has a state-wide outpatient hearing screening initiative.

Screening outreach efforts were also identified by 19% of respondents as a strength. Hearing screenings in community programs, such as EHS/HS, early intervention programs, Parent As Teachers organizations, early care and education settings, and health clinics (public and community), were all mentioned. One state EHDI coordinator indicated having 42 screening sites across the state with the capacity for OAE, immittance, pure tone audiometry, and otoscopy.

Increasing the awareness of later onset hearing loss and resources was viewed as a strength by 10% of respondents. Specifically, EHDI coordinators indicated that education of professionals about risk factors for later onset and progressive hearing losses has increased awareness and encouraged parents to monitor their child's hearing. The development of materials specifically for birthing facilities, primary care practitioners, and /or audiologists on periodic early childhood hearing screening was also mentioned.

Other areas identified as strengths included data tracking systems (7%), governance, administration, and personnel (7%), legislation (4%), funding (4%), and professional training (4%). Data tracking systems that were capable of recording risk factors for later onset and progressive hearing losses were considered to be a strength. One respondent indicated that the EHDI data system contributed to child health records. Program factors that strengthened periodic early childhood hearing screening were the availability of staff to follow-up and the organizational structure of the EHDI program. One EHDI coordinator listed having trained screening personnel as an advantage to support periodic early childhood hearing screening.

Weakness Characteristics

The three most frequently cited weaknesses were periodic early childhood hearing screenings not provided through the EHDI system (23%), protocols, policies, and procedures (19%), and data management and tracking (18%) (Table 3). Twenty-three percent of respondents reported that their EHDI program does not provide periodic early childhood hearing screenings and, if administered, it is scattered and inconsistent throughout the state.

Protocols, policies, and procedures were identified as a weakness by 19% of EHDI coordinators. Specifically, coordinators listed the inconsistent identification and reporting of risk factors for later onset or progressive hearing loss; periodic hearing screening was not routinely completed because re-screening was not conducted at the recommended ages or because patients did not return for the appointment; and failure to report risk factors or screening results for this age group to the state EHDI program.

Issues with data tracking and management were also noted as a significant weakness by 18% of respondents. Factors contributing to loss to follow-up from newborn hearing screening (e.g., changing addresses, phone numbers, and primary care physicians) prohibited some respondents from implementing an early childhood hearing screening program. Some coordinators reported that the limited capacity of the state EHDI data system to gather and process results for this age group was also a weakness. Many EHDI coordinators also indicated that they do not have the data management system to track this population.

Other identified weaknesses include professional education (10%), staffing limitations (6%), and legislation (3%). Specifically, EHDI coordinators reported that physicians did not know the risk factors for hearing loss, how to refer for follow-up testing, and had a lack of buy-in to monitor hearing. Staff limitations included a shortage of providers who accept Medicaid, a lack of staff follow-up for missed appointments, and excessive time spent on data entry, which prevented focus on periodic early childhood hearing screenings. EHDI coordinators also reported that the lack of a legislative mandate on reporting risk factors and delayed onset/progressive hearing

losses was considered a weakness.

Opportunities for EHDI Programs

The three most frequently cited opportunities were data management systems (22%), education and training of parents and professionals (20%), and collaboration (12%) (Table 4). Related to data management systems, 22% of EHDI coordinators reported either developing or modifying their existing data management system to include risk factor variables, progressive hearing losses variables, and periodic early childhood hearing screening results as a child ages. Integrating or linking data management systems to community providers (e.g., audiologists, primary care physicians) were also listed as opportunities. In addition, some respondents were considering integrating automatic reporting of when a child should have another hearing screening into the data management system.

Twenty percent of respondents reported opportunities to educate and train parents and professionals in periodic early childhood hearing screening. Specifically, EHDI coordinators indicated they had opportunities to provide training to physicians and medical homes about JCIH guidelines, the importance of hearing and developmental screenings, and the impact of unidentified hearing loss. They were also reaching out to families to educate them on risk indicators for hearing loss.

Collaboration, especially with programs that were beginning to conduct OAE hearing screenings throughout early childhood, was an opportunity noted by 12% of the EHDI coordinators. Items listed under this theme included the ECHO initiative with EHS/HS programs and better collaboration with primary care physicians through the AAP, as well as Parents As Teachers and early intervention programs.

Protocols, policies, and procedures (13%) offered opportunities for some EHDI programs to further develop periodic early childhood hearing screening. Using the NICHQ's Learning Collaborative project, respondents indicated that their programs have either revised or will be revising their protocols and procedures. Other opportunities included adding risk factors to the dried blood spot filter paper test, re-structuring short-term follow-up, establishing timelines for screening, and sending reminder letters to families and the medical home/primary care physician.

Other opportunities mentioned by EHDI coordinators included mandating reporting of risk factors and all screening/test results for children birth to 3 years of age (2%), and the provision of hearing screening equipment for usage by field staff to follow this population (2%).

Threats to EHDI Programs

The three most frequently cited threats were funding (30%), staff limitations (18%), and protocols, policies, and procedures (12%) (Table 5). Of note, 27% of the respondents had no comment or did not know of any threats to periodic early childhood hearing screening. Related to funding, 30% of EHDI coordinators expressed concerns regarding financial constraints, budget cuts, reduction in health care coverage, an increase in the uninsured population, and inadequate funding to support tracking children at risk for hearing loss or later onset of hearing loss.

Eighteen percent of respondents noted staff limitations as a threat, including a lack of resources, time constraints to continuing the ECHO project, staff turnover, and multiple data system tracking results. Twelve percent of respondents identified non-compliance with the recommended monitoring guidelines, inability to track families over a 3-year period due to relocations and /or name changes, and lack of documentation as threats to protocols, policies, and procedures. Respondents also noted that the modification of screening guidelines by the JCIH (from monitoring every 6 months to one evaluation prior to 30 months; 2007) increased the likelihood of not maintaining contact with the family.

Difficulty in educating and framing parents and professionals about monitoring hearing through periodic screening was identified by 8% of EHDI coordinators. Specifically, coordinators expressed difficulty in reaching a sufficient number of primary care physicians through framing efforts, a concern that parents may not understand the role of hearing in their children's development, and difficulty educating parents to follow through

on recommendations. Additional threats included periodic early childhood hearing screenings considered a low priority by parents and primary care physicians (3%) and access to appropriate care (2%).

TOWS Analysis Matrix

By applying the TOWS analysis matrix to the themes identified in the SWOT analysis, specific recommendations, or "strategic options," were derived from the internal and external environmental factors identified by the EHDI coordinators. By systematically pairing the four categories of the SWOT analysis, recommendations can be derived to maximize resources and effect positive change. Based on the SWOT themes, 12 individual recommendations were made (Table 6). To maximize opportunities, identification of strengths can lead to positive change (S-O strategy). For example, increasing collaboration with early childhood programs serving young children, ages birth to 3-years-old, can help strengthen follow-up efforts and improve data submission. By pursuing opportunities, weaknesses can be minimized (W-O strategy). For example, increasing educational efforts for primary care physicians about risk factors identified in the JCIH 2007 position statement and the recommended monitoring for hearing loss when risk factors are present. Identification of ways to use strengths can ultimately reduce vulnerability to threats (S-T strategy). For example, reduce follow-up staff workload by modifying existing data systems to efficiently generate reminders to primary health care providers and families of hearing monitoring screenings/evaluations due to risk factors. Finally, establishing defensive plans will help to prevent weaknesses from making programs susceptible to threats (W-T strategy). For example, develop data sharing agreements to increase the reporting of risk factors and 2nd tier hearing screenings from a variety of providers. Out of these 12 recommendations, 3 distinct strategies emerged for improving periodic early childhood screening. Specifically, states should: 1) increase education of parents and professionals about risk factors for later onset hearing loss and hearing monitoring; 2) integrate data systems accessible by professionals that are capable of processing risk factors and multiple hearing screenings; and 3) collaborate with early childhood programs to coordinate follow-up, improve data submission, and conduct periodic hearing screenings.

Limitations

Limitations of this study include those inherent in the application of SWOT/ TOWS analysis when applied to rapidly changing conditions. SWOT analysis is a subjective tool that explores conditions that are perceived rather than objectively measured. In this sense, the SWOT analysis is influenced by the perspectives of those who completed the surveys as well as those who analyzed the responses. Furthermore, SWOT analysis characterizes the situation at a specific point in time. In addition, SWOT analysis, as applied here, resulted in overlapping themes within a category. For example, protocols, policies, and procedures could be identified as a strength, weakness, opportunity, or threat. Similarly, themes regarding data systems and education /training were identified in three of the four categories (see White &Biaiser, 2011, for additional information regarding the selection of SWOT/TOWS for this study and further comment regarding interpretation and application of findings).

Summary

Programs are at different levels of developing the various components of the EHDI system. Some programs have been in existence for nearly 20 years, while others are barely a decade old. Some do not have state legislation and regulations, while others do; however, the statutes and regulations vary among those programs. Some programs have received federal funding to develop the capacity of their EHDI systems and data systems, although length of funding and funding amounts have varied. It should not be surprising that programs are on a continuum of experience with regard to periodic early childhood hearing screening. This is reflected in the degree to which EHDI data systems in different states are capable of recording and tracking risk factors for later onset and progressive hearing losses as well as hearing screening beyond the newborn period.

It is also not surprising that much of the focus of this area was on identification, reporting, and follow-up with risk factors for later onset or progressive hearing loss since risk factors have been addressed in the position

statements of the JCIH since 1973 (JCIH, 1973). To a lesser extent, the more recent focus on screening and surveillance for hearing loss in the medical home (JCIH, 2007) is reflected in fewer comments regarding more routine periodic screening for hearing loss throughout early childhood. In the periodic hearing screening area of the SWOT analysis, a number of EHDI coordinators had "no comment," or provided comments that were highly individualized or tangential to the area and thus classified as "miscellaneous." The percentage of EHDI coordinators with "miscellaneous, or no comment" items in each area were: strengths - 16%; weaknesses - 21%; opportunities - 27%; and threats - 27%.

In summarizing the SWOT and TOWS analyses based on the 241 items contributed by the EHDI coordinators, the following global recommendations emerge regarding periodic early childhood screening:

* Education for providers, including hospital staff, audiologists, and, especially, primary care physicians, should focus on the risk factors for later onset and progressive hearing loss and recommended monitoring protocols. Approaches to increasing parental awareness of risk factors for hearing loss, the role of hearing in the child's development, and the importance of periodic hearing screening throughout early childhood should be further developed.
* Data systems need ongoing development to allow access to a child's hearing health record by primary care physicians and audiologists, to allow the reporting of risk factors, hearing screening, and evaluation results by health and intervention providers based on data sharing agreements, to link or integrate with other child health and intervention data systems, and to efficiently generate reminders for providers and parents consistent with a recommended protocol.
* Collaboration is needed with health, intervention, and educational programs that provide services to young children to coordinate follow-up efforts, to improve data submission, and to conduct periodic objective hearing screenings after being trained with available resources.

Finally, the degree to which the "early adopters" - those states that were among the first to begin implementing specific activities and now view these as strength areas - can share their experiences, both positive and negative, with programs that are just beginning to consider working in a particular area may facilitate the development of effective and efficient systems at the local, state, and national levels.

Acknowledgements

The work reported in this article was funded in part by the Maternal and Child Health Bureau under Cooperative Agreement # U52MC04391 with the National Center for Hearing Assessment and Management at Utah State University. The opinions expressed in the article are those of the authors and do not necessarily reflect those of the Bureau.

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Publication date: Summer 2011

Year: 2011

USPTO ISSUES TRADEMARK: SENS TECHNOLOGY BY SENSEAR

Publication info: US Fed News Service, Including US State News [Washington, D.C] 20 June 2011.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: ALEXANDRIA, Va., June 20 -- The trademark SENS TECHNOLOGY BY SENSEAR (Reg. No. 3976574; International Reg. No 1034008) was issued on June 14 by the USPTO.
Owner: Sensear Pty Ltd COMPANY AUSTRALIA 197-199 Great Eastern Highway Belmont AUSTRALIA WA6104.
The trademark application serial number 79080840 was filed on Jan. 22, 2010 and was registered on June 14.
The description of the mark registered is "Color is not claimed as a feature of the mark. The mark consists of the stylized wording "SENS" above the stylized wording "TECHNOLOGY by Sensear"."
Goods and Services: Apparatus for reproduction of sound; apparatus for sound level measurement, namely, handheld electronic units for adjusting sound levels in hearing aids; apparatus for sound transmission; digital sound processors; ear protectors against sound, namely, ear plugs for soundproofing and electronic ear muffs for sound proofing; sound processors; sound receiving head sets, namely, hearing protection headsets not for medical use; anti-noise headphones for noise suppression; anti-noise filters; apparatus for measuring noise, namely, sound level meters; electronic noise cancellation headphones; noise canceling headphones; noise suppression headphones; noise headphones with electrical components; ear plugs not for medical purposes; electronic ear muffs for soundproofing not for medical purposes; earphones other than hearing aids for the deaf; hearing aids, other than for the deaf; ear protecting devices, namely, ear plugs and electronic ear muffs for soundproofing; ear protectors, namely, ear plugs and electronic ear muffs for soundproofing; speech communications apparatus for speech recording and replaying for use in noisy environments; speech processors; computer software, namely, speech processing software comprising speech recognizers, signal processor control software, software to interact with signal processors, sound processing software, signal processing software, software for sound enhancement, software for filtering, reduction or elimination of extraneous sound and noise, software for storing, collating and processing speech and other sound signals; blank electronic chip cards, not for computers; chips, not for computers, namely, integrated circuits; central processing unit boards, not for computers; circuit boards, not for computers. the foregoing excluding cellular or mobile telephones, embedded software appearing as a feature on cellular or mobile telephones for recording, transmitting, processing, and reproducing sound, images or data based on choice of mood
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Publication date: Jun 20, 2011

Year: 2011

Noise-Induced Hearing Injury and Comorbidities Among Postdeployment U.S. Army Soldiers: April 2003-June 2009

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Publication info: American Journal of Audiology (Online) 20.1 (Jun 1, 2011): 33-41.
ProQuest document link

Abstract: To evaluate noise-induced hearing injury (NIHI) and blast-related comorbidities among U.S. Army soldiers in an effort to understand the morbidity burden and future health service requirements for wounded war fighters returning from the Central Command Area of Responsibility, predominantly from Iraq and Afghanistan deployments. Inpatient and outpatient records with diagnosed NIHI or blast-related comorbidities (e.g., significant threshold shift [STS], noise-induced hearing loss, tinnitus, sensorineural hearing loss, eardrum perforations, mild traumatic brain injury, and posttraumatic stress disorder) were extracted for active duty soldiers returning from combat deployments. Records were limited to those within 6 months of the soldier's return date from April 2003 through June 2009. To account for changes in STS coding practice, STS rates observed after October 1, 2006, were used to extrapolate prior probable postdeployment STS. Statistically significant increases were observed for tinnitus, dizziness, eardrum perforations, and speech-language disorders. The combination of observed and extrapolated STS yielded a conservative estimate of 27,427 cases. Estimates can be used to forecast resource requirements for hearing services among veterans. This article could serve as a guide for resourcing and innovating prevention measures and treatment in this population. Data provided may also serve as a baseline for evaluating prevention measures.

Full text: Headnote

Purpose: To evaluate noise-induced hearing injury (NIHI) and blast-related comorbidities among U.S. Army soldiers in an effort to understand the morbidity burden and future health service requirements for wounded war fighters returning from the Central Command Area of Responsibility, predominantly from Iraq and Afghanistan deployments.

Method: Inpatient and outpatient records with diagnosed NIHI or blast-related comorbidities (e.g., significant threshold shift [STS], noise-induced hearing loss, tinnitus, sensorineural hearing loss, eardrum perforations, mild traumatic brain injury, and posttraumatic stress disorder) were extracted for active duty soldiers returning from combat deployments. Records were limited to those within 6 months of the soldier's return date from April 2003 through June 2009. To account for changes in STS coding practice, STS rates observed after October 1, 2006, were used to extrapolate prior probable postdeployment STS.

Results: Statistically significant increases were observed for tinnitus, dizziness, eardrum perforations, and speechlanguage disorders. The combination of observed and extrapolated STS yielded a conservative estimate of 27,427 cases.

Conclusions: Estimates can be used to forecast resource requirements for hearing services among veterans. This article could serve as a guide for resourcing and innovating prevention measures and treatment in this population. Data provided may also serve as a baseline for evaluating prevention measures.

Key Words: noise-induced hearing injury, mild traumatic brain injury, posttraumatic stress disorder, blast trauma, speech-language disorders

Since October 2001, nearly 1.9 million U.S. troops (the majority being U.S. Army soldiers) have been deployed to the Central Command Area of Responsibility, primarily in Iraq and Afghanistan (Institute of Medicine, 2010). Some have deployed in support of these operations multiple times, with each deployment involving its own associated risks of noise and blast exposures. Both of these conflicts have been associated with exposure to high-intensity combat operations, improvised explosive devices, and other battlefield noise hazards (Casscells, 2007).

A study among veterans found hearing loss to be the most common service-connected reason for disability (Fausti, Wilmington, Helt, Helt, &Konrad-Martin, 2005). Noiseinduced hearing loss (NIHL) has also been identified as the fourth leading cause for medical referral for combatants returning from deployment, and among

those referred nearly one quarter have documented hearing loss (Schulz, 2004). Meyer, Chen, McDonald, and Cherry (2002) reported that Britishmilitary personnel were at higher risk for NIHL (28.3 per 100,000) compared to civilianworkers in Great Britain (1.93 per 100,000). Humes, Jollenbeck, and Durch (2006) reported that the U.S. military services' hearing loss prevention efforts were inadequate from World War II to the time of the report. A Cochrane systematic review of 19 occupational hearing loss prevention intervention studies found most to be of low quality (Verbeek, Kateman, Morata, Dreschler,&Sorgdrager, 2009).

Noise-induced hearing injury (NIHI) has been reported as the most common single injury in blast exposure, primarily due to blast overpressure (Gondusky &Reiter, 2005). For the purposes of this article, NIHI is a general category that includes individual International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (U.S. Department of Health and Human Services, 2008) or aggregates of specific ICD-9-CM codes (see Table 1). NIHI includes codes for significant threshold shift (STS), NIHL, acoustic trauma, sensorineural hearing loss (SNHL), tinnitus, and tympanic membrane perforation. One patient may be diagnosed with one of these codes by several different providers. STS is diagnosed by an audiologist when an average change in either ear occurs at 2000, 3000, and 4000 Hz from the audiometric baseline (U.S. Department of Defense, 2004). A significant change in hearing can occur with all thresholds remaining within the "normal" category. According to the Department of Defense (2004), only a physician is authorized to diagnose NIHL. However, an audiologist can diagnose a loss as sensorineural. A code of "acoustic trauma" may be diagnosed at the lowest echelon of care on the battlefield without an audiogram to validate the presence of change or abnormality in hearing. Codes for tympanic membrane perforation and tinnitus can also be entered by providers other than those who diagnose hearing loss. Therefore, all of these diagnoses have been included in the analysis under the umbrella of NIHI. Increased rates of NIHI have been reported among soldierswho have returned fromIraq and/orAfghanistan deployments as compared with their nondeployed counterparts (Jordan, Lee, &Helfer, 2009).

Another common combat-related health outcome that gained increased attention in early 2006 (and was coined the wars' "signature injury") is traumatic brain injury (TBI; Wilk et al., 2010). The U.S. Military Health System (MHS) defines TBI using the following criteria: confusion, disorientation, slowed thinking, weakness, loss of balance, change in vision, praxis, paresis or plegia, sensory loss, and aphasia (Casscells, 2007). An estimated 20% of soldiers with blast injuries suffer from acute TBI (Tanielian &Jaycox, 2008). According to data from the U.S. Army Medical Department (2009), 33% of patients who needed medical evacuation for battle-related injuries from theater toWalter Reed Army Medical Center in 2008 had TBI. The vast majority (È89%) of TBI among soldiers is classified as concussions or mild TBI (mTBI), with the remainder classified as moderate, severe, or penetrating. However, among those hospitalized for TBI, moderate to severe forms are obviously more likely, as is evidenced by a study conducted by Wojcik, Stein, Bagg, Humphrey, and Orosco (2010). The group found that less than 1% of inpatient TBI admissions during deployment in Iraq and Afghanistan were mTBI. Medical record reviews for incident diagnoses indicative of TBI have demonstrated that 28,946 service members were affected in 2009 alone, among whom 18,917 (66%) were Army members (Armed Forces Health Surveillance Center, 2010). All this suggests more reason to investigate the relations among NIHI, mTBI, and comorbidities.

NIHIs are often seen in conjunction with blast exposure with or without reported TBI. For example, incidence of eardrum perforations associated with blast exposure in civilians and soldiers with evidence of, or verified, TBI ranges from 7% to 32% (Cave, Cornish, &Chandler, 2007; Gondusky &Reiter, 2005; Lew, Jerger, Guillory, &Henry, 2007; Xydakis et al., 2007). In studies of blast exposure without mention of TBI, incidence of eardrum perforations ranges from 18% to 84% (Kerr &Byrne, 1975; Pahor, 1981; Walby &Kerr, 1986; Yetiser &Ustun, 1993). Chart reviews comparing thresholds in individuals with blast-related and non-blastrelated TBI revealed that thresholds in the group with blastrelated TBI were about 10 dB worse on average (Lew, Cifu, et al., 2007). Hearing losses were mostly sensorineural (47% and 58% in non-blast- and blast-related groups, respectively),

although conductive (11% and 8% in non-blast- and blast-related groups, respectively) and mixed (8% and 19% in non-blast- and blast-related groups, respectively) hearing losses were also identified. Chart reviews of patients with blast-related injuries from Iraq and Afghanistan wars also identified elevated postdeployment thresholds; about 60% of the charts reported hearing loss secondary to blast exposure, almost 50% of which was sensorineural (Cave et al., 2007). Other blast exposure studies have reported high incidence of hearing loss, ranging from 10% to 97% (Kerr &Byrne, 1975; Pahor, 1981; Walby &Kerr, 1986; Yetiser &Ustun, 1993) with various rates of recovery, and those with the most hearing loss having residual hearing loss for months postinjury.

Emerging research supports that those diagnosed with TBI with a loss of consciousness are more likely than those without loss of consciousness to suffer from conditions such as balance problems, headaches, depression, posttraumatic stress disorder (PTSD), memory problems, and tinnitus (Hoge et al., 2008). Close associations between tinnitus and PTSD among patients at U.S. Department of Veterans Affairs (VA) hospitals have also been documented (Fagelson, 2007). Research indicates that PTSD may impinge upon how auditory stimulation is processed (Lewine et al., 2002; Metzger et al., 2008; Paige, Reid, Allen, &Newton, 1990). Provided that TBI and PTSD are strongly correlated (Hoge et al., 2008), the relationships among audiologic and otologic effects of blast injury and TBI and PTSD deserve further investigation and consideration in terms of current efforts to improve health care for uniformed service members and veterans.

Because there is ample evidence of combat-related damage to the auditory system and to hearing, the next question is whether hearing in general is being adequately monitored in returning troops. One study examining audiology clinic visits compared to postdeployment health assessments found a low rate of audiology referrals for returning soldiers who described symptoms of tinnitus and dizziness along with exposure to loud noise and vibration, indicating that the mandatory postdeployment health assessment is not the most appropriate source for tracking audiology referrals for returning soldiers (Helfer, Jordan, Lee, &Pietrusiak, 2008). One option to improve identification of soldiers who should be referred for audiologic evaluation and to find those at risk for NIHI would be to evaluate pre- and postdeployment monitoring audiometry results for STS.

Efforts that should improve deployment-related STSmonitoring capabilities began in September 2006 when an All Army Activities message mandating predeployment hearing tests was disseminated throughout the U.S. Department of the Army. A Hearing Readiness Module was introduced into the Army's Medical Protection System that was fed audiometric data and hearing loss profile outcomes from the Defense Occupational Environmental Health Readiness System-Hearing Conservation, which is the Department of Defense central data repository for monitoring audiometry.

The Hearing Readiness Module scored soldiers' hearing readiness for deployment as ready or not ready. This information was sent to soldiers through their individual Army Knowledge Online Internet accounts (under "my hearing readiness") as well as to unit commanders whose units were likewise rated as ready or not to deploy depending on the number of soldiers assigned to the different categories of hearing readiness.Many installation-based audiologists began to perform postdeployment hearing tests using the Defense Occupational Environmental Health Readiness System-Hearing Conservation. This module created a data-tracking system and rendered hearing readiness mandatory with an enforceable surveillance system. To deploy or participate in favorable action, including annual leave, a soldier's readiness must be up-to-date.

The Department of the Army disseminated a message in July 2006 that described the occurrence of TBI and its effects on war fighters. Two years after this message was disseminated, the results of TBI screenings were reported in the Medical Surveillance Monthly Report (Armed Forces Health Surveillance Center, 2008). The report described deploymentrelated TBI hospitalizations and outpatient visits between January 2003 and August 2008, showing an increase in TBI cases from July 2006 and peaking in July 2007. The average monthly number of hospitalized TBI cases within the U.S. active duty military ranged from 25 to 38 in 2003-2006 and increased to 55 in 2007 before declining to 33 in 2008. Similar trends were noted when examining outpatient encounters,

with the average number of monthly TBI cases ranging from 14 to 25 during 2003-2006 before increasing to roughly 63 during 2007 and then declining to 37 in 2008. The Army had the largest number of TBI cases during the period of the report, which is expected given that the Army deploys more personnel. These estimates pale in comparison to those generated by Tanielian and Jaycox (2008). Based on randomly selected phone interviews, they estimated that 300,000 U.S. troops from all uniformed services returning from Iraq and Afghanistan had mTBI that went undetected and untreated between October 2001 and September 2007.

In January 2008, the postdeployment health assessment instrument (DD Form 2796) was revised to include questions related to screening for TBI, PTSD, and hearing loss (Department of Defense, 2008). Jaffee and Meyer (2009) described recent Department of Defense initiatives related to TBI and PTSD, particularly with regard to repeat deployers' increased risk for either of these injuries. Iverson, Langlois, McCrea, and Kelley (2009) reported the significant challenges associated with postdeployment screening for mTBI. MacGregor et al. (2010) described problems with identifying psychological correlates to TBI, primarily with differential diagnosis. Terrio et al. (2009) reported on a brigade combat team returning to Fort Carson, CO, and the proportion of soldiers having at least one clinician-confirmed deployment-acquired TBI and related comorbidities including PTSD.

While it is thought that NIHI and TBI might be positively correlated, there are several variables that make it difficult to reliably establish such a relationship, including differences in the case definition of TBI and the interaction of TBI with other comorbidities such as PTSD. The current analysis is an attempt to define the nature and magnitude of deploymentrelated noise or blast exposures and health outcomes (NIHI and comorbidities). Potential comorbid disorders to NIHI (besides TBI) include dizziness and imbalance disorders, speech and language disorders, and PTSD (Helmick, Parkinson, Chandler, &Warden, 2007; Scott, Vanderploeg, Belanger, &Schoelten, 2005). The goals of the current study are threefold:

1. to investigate relationships among NIHI otologic pathologies,mTBI, PTSD, and speech-language pathologies;

2. to estimate the number of undiagnosed returning soldiers who may have suffered NIHI or related comorbidities;

3. to recommend data-driven approaches to improving surveillance, research, prevention, and rehabilitation practice strategies for blast trauma and noise-exposed veterans.

Method

In accordance with guidance from the Institute of Medicine (1999) concerning evaluation of public health performance, postdeployment soldier health studies at the U.S. Army Public Health Command (Provisional) Institute of Public Health routinely use multidisciplinary teams with subject matter expertise including clinical practice, epidemiology, and biostatistics. Since 2004, the postdeployment NIHI team has performed studies with a view to developing standard NIHI postdeployment surveillance procedures using ICD-9-CM codes (Helfer, Jordan, &Lee, 2005; Jordan et al., 2009).

The ICD-9-CM codes that were included in the current analyses were selected from an as yet unpublished 2010 NIHI and comorbidity watch list of major ICD-9-CM diagnostic groups. The watch list includes ICD-9-CM codes associated with NIHI, mTBI, and other comorbidities of interest for epidemiological surveillance.

Development of the watch list began in 1997 at the U.S. Army Center for Health Promotion and Preventive Medicine, a predecessor organization to the U.S. Army Public Health Command, with later collaborative input from military, VA, and civilian audiologists, as well as other clinical specialties (Helfer et al., 2005; Helfer, Shields, &Gates, 2000; Jordan et al., 2009). In 2006, input was solicited from speechlanguage pathologists and other health care specialists working with patients with NIHI, TBI, and blast trauma. Some of the specialists includedArmymedical personnel (physicians and others) returning from Iraq and Afghanistan deployments and other health care providers who performed postdeployment physical exams. Speech-language pathologists working in the MHS and VA, as well as at the National Office of the American Speech-Language-Hearing

Association (ASHA), also provided ICD-9-CM codes associated with TBI and head trauma.

The ICD-9-CM codes of interest for NIHI and comorbidities studied are shown in Table 1. These included 388.10- 388.12 and 794.15 for NIHL and STS, respectively. The MHS uses the ICD-9-CM code 794.15 idiomatically to represent STS. It was established as a placeholder for an important outcome (change in hearing thresholds) for which there was not yet an assigned code. This code was published in the MHS coding guidelines manual in January 2005 and has been used as the standard for coding STS since then (Unified Biostatistical Utility Working Group, 2009).

The population of interest included all active duty Army personnel returning from the war zones from April 2003 (second quarter [Q2] of 2003) through June 2009 (Q2 2009). Cases were defined as any returning soldier within the study population who presented for care of an incident injury during his or her deployment period, or within 6 months of his or her return, for one of the NIHI codes or a related comorbid condition. At least one diagnosis for each category of injury was required (see Table 1). Inclusion in multiple injury categories was allowed for each person. Multiple deployments of the same person were treated as unique events not correlated with previous outcomes. Army Reserve and National Guard personnel were not included due to limitations in obtaining medical information following demobilization after return from deployment. Quarterly rates were calculated using the number of cases that returned during a 3-month (quarter of a year) period divided by the total number of returns from deployments that occurred among the study group within the same time period.

Medical encounter information was obtained using the MHS Data Repository, which contains ICD-9-CM data. The MHS Data Repository contains records of all medical encounters covered under theDepartment of Defense TRICARE medical health plan. This includes treatment at a military treatment facility or reimbursable care by a civilian provider but does not contain VA health information. All relevant ICD-9-CM diagnostic information from each encounter was included. Deployment information was captured using the Defense Manpower Data Center Contingency Tracking System and used to define the study population. Deployments occurring within 21 days of another deployment were combined into a single deployment. Deployment records were matched with the medical encounter data to define cases within the population.

The authors had conducted preliminary exploratory studies of ICD-9-CM NIHI and comorbidities rates to derive the most meaningful rate comparisons for the current study (Helfer, Jordan, Lee, &Pietrusiak, 2008, 2009). The preliminary rate comparisons were derived from a systematic literature review and coding guideline discussions with clinicians evaluating and treating soldiers returning from Iraq and Afghanistan. Rates were calculated for NIHI including NIHL, STS, SNHL, tinnitus, and eardrum perforations, as well as dizziness and imbalance disorders, speech-language disorders, mTBI, and PTSD.

The authors examined postdeployment incident rates among the various NIHI, mTBI, and comorbidity diagnoses. There was a dramatic increase in STS due to new coding efforts after January 2006. Allowing three reporting quarters for the new coding to filter through the process, STS rates were averaged from October 2006 through June 2009 to get an average rate (3,361/100,000). Assuming that rate was relatively steady throughout all years and the only change was due to the new coding guideline, this average rate was applied to populations prior to and including the third quarter (Q3) of 2006 to estimate STS counts that may not have been reported or coded properly.

Alinear regression was fit to determine whether there were statistically significant changes over the study period for ICD-9-CM code diagnostic groups NIHL, tinnitus, dizziness, eardrum perforation, and speech-language disorders. These code groups had much lower prevalence than those shown in Figure 1: STS, SNHL, mTBI, and PTSD.

Results

Table 2 presents a demographic summary of Army active duty return deployers for the study period. Figure 1 shows postdeployment rates of STS, SNHL, mTBI, and PTSD, as a function of quarter (from the first quarter [Q1] through fourth quarter [Q4]) per calendar year. The rate of mTBI varied from 800 per 100,000 in Q2 2003

to a peak of 10,270 per 100,000 in Q1 2009. PTSD climbed from a low of 654 per 100,000 in Q2 2003 to a peak of 4,040 per 100,000 in Q3 2007. SNHL increased from 811 per 100,000 in Q2 2003 and remained fairly steady at approximately 2,200 per 100,000 between Q4 2004 and Q2 2009.

STS rates were less than 20 per 100,000 until Q1 2005 and then gradually increased to a high of 594 per 100,000 in Q3 2006. From there, the rate increased and remained somewhat constant with an average of 3,361 per 100,000, and reached a peak of 5,000 per 100,000 in Q2 2009. The ICD-9-CM code for STS within the MHS (794.15) was not published until January 2005. Therefore, it appears that it took several quarters until the code was fully implemented. Based on this assumption and methods described above, the estimated total underreporting of STS for April 2003 through September 2006 was 14,381. This increased the total STS cases reported from the actual 13,046 to an estimated grand total during the study period of 27,427.

A linear regression demonstrated a significant increasing slope over the study period for tinnitus, dizziness, eardrum perforations, speech-language disorders, SNHL, PTSD, STS, and mTBI (see Table 3). Some of these diagnostic code groups had much lower rates than the code groups represented in Figure 1 (STS, SNHL, mTBI, and PTSD). This finding implies that these diagnostic code groups were increasing over the study period at an estimated rate of 8.4 per 100,000 per quarter for eardrum perforation to 329 per 100,000 per quarter for mTBI. The NIHL code group in Table 1 showed no significant changes over the period of the study. It remained at an average rate of 462 per 100,000 per quarter.

Discussion

Figure 1 presents some of the most interesting findings of the study. There was a dramatic increase of postdeployment STS, mTBI, and PTSD rates beginning in Q3 2006 and reaching peaks and troughs starting in Q3 2007. A number of factors contributed to these surges.

In the case of STS, the Army-wide message of September 2006 mandated predeployment hearing tests. When the Hearing Readiness Module was introduced into the Army's Medical Protection System, compliance with monitoring audiometry increased as the result of this new accountability for hearing readiness by individual soldiers and troop commanders.

Due to the allotment of additional resources to enable Army audiologists to meet the predeployment requirement, these resources rendered postdeployment audiograms possible at some installations. Soldiers with postdeployment audiograms showing changes in hearing levels consistent with STS would more likely be referred to audiology for further workup and potential referrals.

Furthermore, ICD-9-CM guidelines for coding STS had been available from the MHS coding guidelines manual (annually updated) since January 2005 (Unified Biostatistical UtilityWorking Group, 2009). This standard reference helped to increase the accuracy and quality of NIHI and STS coding for postdeployment audiometry and audiology examination outcomes entered into the MHS databases used for public health analyses including the current study.

The grand total estimate of active duty soldiers returning from Iraq and Afghanistan with STS from Q2 2003 through Q2 2009 would be useful to the military, VA, and civilian health systems to estimate resource requirements for providing quality hearing services to these war fighters in the coming years. The estimated grand total number in the current report is 27,427. This estimate is very conservative. It does not include Army National Guard and Reserve soldiers or Marine, Navy, Air Force, and Coast Guard service members (active duty or Guard or Reserve). The Army's low monitoring audiometry compliance rate prior to October 2006 is another significant factor influencing this estimate.

The mTBI time series rate results in Figure 1 are consistent with earlier reports that mTBI patients went undetected and therefore unreported in the earlier years of the conflicts in Iraq and Afghanistan. It was not until the Q3 2006 time frame, after the TBI Army-wide message, that the Army began to focus attention on TBI as the "signature wound" of these conflicts.

As mTBI became a focus of attention, the ICD-9-CM codes and the incidence rates increased dramatically in

the following months. In January 2008, the postdeployment health assessment form was revised to include questions about blast exposures and symptoms such as altered state of consciousness, dizziness or imbalance, or ringing in the ears and related symptoms. Soldiers filling in these exposures and symptoms were more likely to be referred for evaluation of mTBI.

The PTSD rates shown in Figure 1 began to increase at the same time as the mTBI rates. These two were reported to be closely associated in returning troops (Hoge et al., 2008). Prior to June 2006, the SNHL rates were closely associated with PTSD rates. When the PTSD rates began to increase, the SNHL rates continued at a constant rate of approximately 2,000 per 100,000.

Tinnitus and dizziness are often mentioned as symptoms or comorbidities of TBI by clinicians evaluating and treating these patients. The rates of tinnitus and dizziness significantly increased over the period evaluated. These increases may be associated with the increases in STS rates due to increased postdeployment monitoring audiometry.

The rates for the NIHL ICD-9-CMcodes group were fairly flat throughout the study period. NIHL may have been underreported or alternatively reported as SNHL. The rates of SNHL in returning soldiers would indicate as much. The eardrum perforation and healed perforation rates were generally low but increased throughout the period of the study. The rates of speech-language disorders increased rapidly starting in Q4 2006. This may be an indication of an increased appreciation of the relationship of TBI with co-occurring speech-language processing and cognitive disorders from blast exposures.

The strengths of this study included the following: The data extracted from theMHS Data Repository consisted of all medical encounters of active duty military personnel. All medical encounters were subject to standardized and routine record keeping and coding. The data collected came from a large patient population (approximately 1.3 million active duty personnel have access to MHS care). The data captured care received both within and outside of theMHS (purchased care). The study population (active duty personnel) had equal access to care that prevents attrition of data that may occur within other health care systems, especially since soldiers are required to have at least two postdeployment health care encounters with a provider. For those with multiple deployments, deployment-related injuries were recorded as distinct to the corresponding deployment. Deployment status and dates were confirmed by reference to personnel deployment records to integrate medical and personnel data to build the postdeployment cohorts for the study.

The limitations of the study included the following: Medical data on the soldiers receiving care in the theater of operations were not available. National Guard and Reserve medical data following demobilization were incomplete, so prevalence of deployment-related NIHI and comorbidities in these populations is unknown. Many postdeployment National Guard and Reserve soldiers receive care from the VA; those medical records were also not available for the current study. There is also a question of the coding accuracy of the NIHI and other diagnoses. Where the diagnoses were correct, the person entering the ICD-9-CM code(s) may not have entered the most specific or accurate code. It is also possible that the more serious injuries may not be coded for things such as hearing until well after recovery. Postdeployment health assessment nonreferrals to audiology for soldiers with symptoms of NIHI, mTBI, and comorbidities would mean that some postdeployment incident injuries were not recorded.

Key findings of the current study included the following: Between Q2 2003 and Q3 2006, STS rates were very low and most likely represented underreporting of the true incidence. Postdeployment STS rates increased in a surge that just preceded the surge in mTBI rates circa Q3 2006; the cause of the STS surge more than likely included the new Hearing Readiness Module and improved ICD-9-CM coding. The July 2006 TBI Army-wide message appears to be a significant factor in the increased rate of postdeployment TBI diagnoses. Soldiers who were symptomatic of NIHI and mTBI on the postdeployment health assessment had very low referral rates to audiology. Deployed National Guard and Reserve soldiers would seem equally at risk for NIHI and TBI as their active duty counterparts, but they do not always have the same long-term access to MHS health services; data

on those Army National Guard and Reserve soldiers who sought care through the VA were not available for analysis. The limitations of the study indicate a very conservative estimate of NIHI reported from the available data for the study period. These results also indicate an underreporting of mTBI and PTSD.

The results of this study can inform preventive medicine of the new updated prevalence baseline for formulating NIHI prevention and intervention strategies and resetting progressbased metrics of effectiveness and efficacy. It can also inform clinical practice to expect increased caseloads for hearing services in future years. This applies particularly to the military and VA health systems with expected "spillover" into civilian community practices. Finally, it can inform the research community of needed studies to advance the knowledge base of best practices for screening, evaluation, and treatment of noise- or blast-exposed military service members and veterans.

In summary, our recommendations include the following:

Short term. At the beginning of initial entry training (basic combat training), soldiers should be fitted and issued the combat arms earplugs to train with and build confidence in this equipment that enhances communication and provides hearing protection from weapons fire. In addition to being issued hearing protection devices, soldiers also need increased awareness, knowledge, and encouragement to employ hearing protective behaviors and strategies when exposed to noise. There needs to be increased implementation of effective hearing loss prevention training programs for all military personnel. Compliance with these preventive measures needs to be systematically tracked and enforced to support their efficacy. Pre- and postdeployment monitoring audiometry needs to continue for all troops, with appropriate referrals for those showing significant shifts in hearing related to individual deployments (see Department of the Army, 2009, regarding postdeployment audiograms). Clinical practice guidelines should include postdeployment audiology exams and follow-up for blast-exposed troops with consideration of referral to speech-language pathology and other specialties. Annual postdeployment reporting for NIHI and identified blast trauma comorbidities should be established. The 2008 ICD-9-CM code for acquired central auditory processing disorder should be incorporated into the NIHI TBI ICD-9-CM watch list to be evaluated for 2008 forward.

Medium to long term. The military (MHS) and VA health systems need to develop an integrated blast trauma registry that includes audiometric record and hearing clinical data standards and coordinated data exchange between the health systems. National Guard and Reserve soldiers' postdeployment health care access needs to be improved, including better coordination between the military and VA health systems. Sensorimotor integration deficit ICD-9-CM codes need to be added to the watch list for future evaluation and reporting of risk rates for these deficits. Clinical practice guidelines need to be regularly updated based on emergent published best practices for evaluation and treatment of veterans returning from deployment, including multidisciplinary evaluation where indicated.

We recommend that a follow-up study examine rates of two or more co-occurring ICD-9-CM code groups in individual soldiers and evaluate most closely associated ICD-9-CM code groups. A separate study needs to be conducted for Army National Guard and Reserve soldiers' incidence and prevalence of postdeployment NIHI and comorbidities to better serve this population. Predeployment and postdeployment electronic audiograms need to be analyzed based on integration with personnel data to confirm periods of deployment in relation to audiometric threshold shifts and hearing loss profile changes. Audiometric data pattern analysis can give further details of audiometric data outcomes of NIHI patterns in different soldier populations (Adera, Amir, &Anderson, 2000a, 2000b;Adera,Donahue,Malit,&Gaydos, 1993a, 1993b; Adera &Gaydos, 1997; Adera, Gullickson, Helfer, Wang, &Gardner, 1995). Repeat deployers need to be studied for risk of permanent damage due to repeated exposures per deployment. This would help set limits on the number of exposures and deployments before soldier health is compromised. Auditory fitness for duty needs to be studied in relation to the Army's hearing loss profile system and the hearing readiness classifications in the Army's Medical Protection System (Tufts, Vasil, &Briggs, 2009). Further studies are needed on comorbidities to TBI including speech-language or

cognition disorders, as well as sensori-integration deficits in relation to NIHI. Postdeployment health assessment data need further analysis for soldiers reporting tinnitus and dizziness with noise and vibration exposures as candidates for further evaluation for NIHI, mTBI, PTSD, and comorbidities. Such studies could help to develop embedded heuristics in the electronic postdeployment health assessments regarding the relationships among NIHI, mTBI, and comorbidities. This would assist primary providers with decision-aiding information about referrals to specialty clinics based on returning soldiers' self-reported symptoms.

Acknowledgments

The opinions or assertions contained herein are the views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army, the Department of Defense, the U.S. Government, or any of the institutional affiliations listed. We offer special acknowledgements to additional Army audiologist soldier medics for their recent selfless service in the Central Command Area of Responsibility including LTC Allan White, Medical Operations Officer, Kansas National Guard Reserve; CPT Jillyen Curry-Mathis; CPT Leanne Cleveland; LTC Marjorie Grantham; CPT Mike Murphy; and our coauthor CPT Kara Cave. We acknowledge Kyle Dennis of the VA and Bob Fifer of the University of Miami (FL) Medical School. These audiologists for the past few years have shared their extensive knowledge of audiology ICD-9-CM and Current Procedural Terminology coding. We acknowledge CDR Michael Hoffer of the Naval Medical Center, San Diego, CA, for providing dizziness or imbalance codes for the NIHI TBI ICD-9-CM watch list. We acknowledge Celia Hooper, ASHA past Vice President for Professional Practices in Speech- Language Pathology, and the ASHA National Office Speech- Language Pathology staff for providing ICD-9-CM speech and language pathology codes of interest.We acknowledge Paula Myers, Micaela Cornis-Pop, and Lisa Brenner of the VA as well as Lisa Newman of Walter Reed Army Medical Center for their review and comments on the NIHI and comorbidity ICD-9-CM watch lists. We also wish to acknowledge Deanna Harkins of the U.S. Army Public Health Command (Provisional) for reviewing the manuscript.

Sidebar

Noise-Induced Hearing Injury and Comorbidities Among Postdeployment U.S. Army Soldiers: April 2003 June 2009

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Am J Audiol 2011;20;33-41; originally published online Apr 7, 2011; DOI: 10.1044/1059-0889(2011/10-0033)

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Editor: Sheila Pratt
Associate Editor: Gabrielle Saunders
Received August 13, 2010
Accepted March 2, 2011
DOI: 10.1044/1059-0889(2011/10-0033)

Publication date: Jun 1, 2011

Year: 2011

Survey of the Diagnosis and Management of Auditory Processing Disorder

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Publication info: American Journal of Audiology (Online) 20.1 (Jun 1, 2011): 48-60.

Abstract: A survey of audiologists' diagnosis and intervention protocols for auditory processing disorder (APD) was conducted to determine current protocols and compare results with published recommendations. A survey was distributed by mail to 515 American Speech-Language-Hearing Association audiology members who listed APD as an area of expertise and via e-mail to Educational Audiology Association members. The survey was completed by 195 audiologists. The majority of respondents reported using auditory processing (AP) test batteries selected based on clinical experience, review of the literature, and attendance at professional conferences. The most popular tests were dichotic, monaural low-redundancy speech, and temporal processing tests. Treatment and management recommendations were usually customized for each patient based on deficits found in behavioral AP testing. The majority of respondents indicated that audiologists are responsible for APD diagnosis (97%) and recommendation of treatment/management (81%); in contrast, only 40% of respondents indicated audiologists were responsible for providing treatment/management. Audiologists are selecting AP test batteries based on the age and case history of the patient, which is in accordance with recent national guidelines. Audiologists are primarily responsible for APD diagnosis and recommending treatment/management. APD treatment is provided by speech-language pathologists, educators, and audiologists.

Full text: Headnote

Purpose: A survey of audiologists' diagnosis and intervention protocols for auditory processing disorder (APD) was conducted to determine current protocols and compare results with published recommendations.
Method: A survey was distributed by mail to 515 American Speech-Language-Hearing Association audiology members who listed APD as an area of expertise and via e-mail to Educational Audiology Association members. The survey was completed by 195 audiologists.
Results: The majority of respondents reported using auditory processing (AP) test batteries selected based on clinical experience, review of the literature, and attendance at professional conferences. The most popular tests were dichotic, monaural low-redundancy speech, and temporal processing tests. Treatment and management recommendations were usually customized for each patient based on deficits found in behavioral AP testing. The majority of respondents indicated that audiologists are responsible for APD diagnosis (97%) and recommendation of treatment/management (81%); in contrast, only 40% of respondents indicated audiologists were responsible for providing treatment/management.
Conclusions: Audiologists are selecting AP test batteries based on the age and case history of the patient, which is in accordance with recent national guidelines. Audiologists are primarily responsible for APD diagnosis and recommending treatment/management. APD treatment is provided by speech-language pathologists, educators, and audiologists.
Key Words: auditory processing, auditory processing disorder, APD battery

Auditory processing (AP) is the ability of the central nervous system (CNS) to use auditory input. More specifically, it "refers to the perceptual processing of auditory information in the CNS and the neurobiological activity that underlies that processing and gives rise to electrophysiological auditory potentials" (American Speech-Language- Hearing Association [ASHA], 2005, p. 2). When this ability is impaired, the result is an auditory processing disorder (APD). APDs are manifested in various ways including difficulty listening in challenging listening environments, difficulty localizing sound sources, and difficulty processing rapid acoustic stimuli. An APD can affect an individual's listening, spoken language comprehension, and learning (ASHA, 1996); thus, it is an important disorder to diagnose and treat. An APD often coexists with other disorders that have similar characteristics such as attention deficit disorder, learning disabilities, speech and language

disorders, and hearing loss (Jerger &Musiek, 2000). Because of the many common characteristics across these comorbid disorders, differential diagnosis of APD can be difficult.

One key factor that complicates the differential diagnosis of APD is the lack of normative data on many commonly used behavioral APD tests (Emanuel, 2002). Another factor that influences the accuracy of APD diagnosis is that there is no "gold standard" for the selection of individual behavioral diagnostic tests or the series of tests that identify APD in patients without a documented lesion in the central auditory pathways. Several investigators have reported adult case studies in which brain-imaging techniques have confirmed the existence of lesions that affect the central auditory pathways, auditory cortex, or its association areas in patients who have performed poorly on various behavioral AP tests (e.g., Musiek &Baran, 2004; Musiek &Pinheiro, 1987). However, most children diagnosed with APD do not have localized pathologies that can be identifiedwith brain-imaging techniques.

Despite several published technical reports and guidelines for the assessment of AP, there appears to be a lack of consensus among both researchers and clinicians regarding the tests that should be part of a basic AP battery. In 1996, ASHA published a position paper which stated that APD must be viewed from a multidisciplinary standpoint when making a differential diagnosis and that a minimum test battery should be conducted for differential diagnosis of APD. The position paper did not specify which AP tests should be administered as part of the minimum test battery. In 2000, a group of audiologists convened to discuss the current status of APD assessment. The Bruton Conference, as it is most commonly known, suggested that the minimum test battery include the following AP tests: performance-intensity function for word recognition, a dichotic task, a duration pattern sequence test, a temporal gap detection test, and electrophysiological tests such as auditory brainstemresponse (ABR) and middle latency response (MLR; Jerger &Musiek, 2000).

The most recent guidelines, published by ASHA (2005) and the American Academy of Audiology (AAA, 2010), have indicated that APD assessment should not be driven by a minimum test battery, but instead the test battery should be based on the individual's case history and other information provided to the audiologist. Collectively, these two professional organizations recommended several test principles that should be applied when determining the composition of an AP test battery. These principles include the following concerns: (a) AP assessments should be multidisciplinary; (b) diagnosis and management of APD should be guided by the case history and diagnostic findings; (c) diagnostic AP test batteries should include both verbal and nonverbal stimuli to assess different levels of the central auditory nervous system (CANS); (d) the AP test battery should examine different processes, regions, and levels of the CANS; (e) behavioral AP tests and any screening tools (including questionnaires) should be well validated, have good test-retest reliability, and demonstrate high sensitivity and specificity; (f) AP testing should be completed within a reasonable period of time (e.g., 1 hr per AAA, 2010); (g) the audiologist needs to be sensitive to subject-related attributes of the individual that may influence his or her test performance such as chronological and mental age, attention to task, fatigability, and native language; and (h)AP testing should not be test driven but rather motivated based on the referring complaint.

To date, only four studies have focused on surveying clinical practices in AP testing (Chermak, Silva, Nye, Hasbrouck, &Musiek, 2007; Chermak, Traynham, Seikel, &Musiek, 1998; Emanuel, 2002; Martin, Champlin, &Chambers, 1998), and these studies had a fairly small number of responses regarding AP diagnostic protocols and almost no reportable data for APD management. Furthermore, none of these studies specifically targeted audiologists who routinely assessed APD. Therefore, the usefulness of the responses may have been limited by the number of audiologists in these samples and by the number of respondents with little or no APD-related experience.

Given the dearth of knowledge regarding common audiologic practices with APD patients, this study was conducted to survey the diagnostic and intervention protocols of audiologists involved with APD patients. Specifically, the current investigators were interested in determining whether audiologists are using an AP test battery approach and, if so, how audiologists are determining which tests to give. Are clinicians utilizing a

minimum AP test battery (e.g., Bruton Conference recommendations; Jerger &Musiek, 2000), or are they complying with more recent clinical guidelines that focus on selecting a test battery more focused on the individual patient's symptoms? Are audiologists providing recommendations for intervention following APD diagnosis, and if so, what types of intervention are they recommending? What professionals are responsible for recommending the intervention strategies and/or implementing these strategies? Lastly, how many audiologists are using generic intervention recommendations versus the number who provide individualized management recommendations for patients?

Method

A survey titled "A Survey of the Diagnosis and Management of (Central) Auditory Processing Disorders (APD)" was developed (see Survey section below) and mailed to 515 audiologist members of ASHAwho listed APD as an area of expertise. The web address of an online version of the survey was also provided in the printed material for participants who preferred electronic submission. In addition to the ASHA sample, the survey was distributed via e-mail to the Educational Audiology Association (EAA) e-mail list. The e-mail included a direct link to the electronic survey and instructions on how to obtain a paper copy, if preferred. Potential respondents were given 12 days to complete the survey. At the conclusion of the 12 days, another e-mail was released on the EAA e-mail list, extending the survey deadline an additional 5 days. None of the EAA participants requested a paper copy. EAA (2008) describes itself as "an international organization of Audiologists and related professionals who deliver a full spectrum of hearing services to all children, particularly those in educational settings." For this study, an assumption was made that educational audiologists would be more likely to be involved with pediatric APD testing and management than audiologists who worked in other specialty fields. Therefore, educational audiologists were included as part of the target population. EAA is composed of 1,000 members, and approximately 20% of those members are active on the e-mail list (EAA, personal communication, 2008), yielding approximately 200 potential recipients of the e-mail. It was impossible to estimate how many of these recipients were actually involved in APD testing and/or management; thus, the estimate of 200 is likely on the high end. Because the number of ASHA members who are also members of EAA and are active on the e-mail list is unknown, an exact number of distributed surveys cannot be determined; however, it can be estimated that a maximum of 715 surveys were distributed.

Survey

The survey was developed based on a review of two published APD surveys: Emanuel (2002) and Chermak et al. (2007). A number of similar questions were included in the current survey to directly compare the results of the current study with those of previous studies (e.g., demographic questions and questions regarding specific tests used). The majority of the questions were dissimilar so as to provide more extensive data on previously unexplored areas of practice, including how tests were selected and who provides APD intervention. The survey included six sections: pretesting, screening, test battery, specific tests, management, and demographics. The survey questions and a summary of the responses to each question are included in the enhanced online content associated with this article at http://aja.asha. org. The printed version of the survey consisted of 27 closed set questions and 10 "additional comments" boxes following pertinent questions. The online version consisted of 37 questions, because each comment box was required to have a separate number. Surveys received in the mail were entered into the Survey Monkey database, and all data were analyzed together.

The Towson University Institutional Review Board for the Protection of Human Subjects reviewed this study and classified it as exempt.

Results

A total of 195 responses were received; 75 responses were received via the online survey, and 120 surveys were received in the mail. Based on the number of surveys mailed (515) and the estimated maximum number of surveys distributed (715; see above), the response rate was estimated to be between 27% and 38%. Since only ASHA members received the paper survey, the response rate for ASHA was at least 23%; however, the exact

number could not be determined because ASHA members could also complete the survey electronically.
A summary of the data most relevant to the research questions is provided here. Note that not all respondents completed each question; thus, some of the percentages seen here and in the enhanced online content are based on a subset of respondents and not the total number of surveys.

Demographics

Most of the respondents were female (87%), and the highest earned degree was split almost equally between master's degrees (49%) and doctoral degrees (51%). The majority of respondents, together accounting for 82%, worked in schools, private practices, hospitals, or university clinics. The vast majority of respondents reported that they tested children from ages 7 to 17 years (>90% for age group categories 7-10, 11-14, and 14-17 years). In addition, a majority of respondents (63%) tested adults (18 and older). A smaller group of respondents (30%) reportedly tested children younger than 7.

Pretesting

Almost all of the respondents (n = 192, or 99%) indicated that they required basic audiometric evaluation prior to conducting APD testing. Of these respondents, the majority indicated they required pure-tone audiometry (100%), tympanometry (97%), speech recognition thresholds (92%), word recognition scores (WRS; 90%), acoustic reflex thresholds (69%), otoacoustic emissions (58%), andWRS in noise (54%). Relatively few required acoustic reflex decay (14%) and performance intensity functions (2%).

Respondents were asked whether they distributed questionnaires to the teacher and/or parent: 193 answered the question relative to the parent, and 190 answered relative to the teacher. Of these respondents, 75% and 65% indicated that a questionnaire was distributed to the parent or the teacher, respectively. Thus, the majority of the respondents were using questionnaires as part of their APD protocols. The most popular questionnaires used were Fisher's Auditory Problems Checklist (Fisher, 1976; 63%), the Children's Auditory Performance Scale (CHAPS; Smoski, Brunt, &Tannahil, 1998; 51%) and the Screening Instrument for Targeting Educational Risk (Anderson, 1989; 39%). Fewer than 20% chose any other specifically listed questionnaire; however, 31% selected "other" and specified that they used a sitegenerated questionnaire.

The respondents were asked to indicate other professionals from whom they "preferred" or "required" evaluations prior to diagnosis. The specific subspecialties selected were speech-language pathologist (SLP; n = 176, 90% of total survey sample), psychologist (n = 168, 86%), education specialist (n = 163, 84%), neurologist (n = 61, 31%), and otolaryngologist (n = 50, 26%). The majority of respondents who answered this question "required" a speech-language evaluation (46% preferred; 54% required); for all other professionals, the majority selected "preferred" as follows: psychologist (64% preferred; 36% required), education specialist (63% preferred; 37% required), neurologist (93% preferred; 7% required), and otolaryngologist (88% preferred; 12% required).

The majority of respondents (95%) indicated that they conducted a case history. Of these, most used either a case history form created on-site (60%) or an informal case history interview (59%). Very few (5%) reported using a published case history form.

Screening

The majority of the total respondents (98%) answered the questions regarding screening procedures, and about half (52%) reported that they did APD screening. The majority (69%) of respondents who screened for APD used the SCAN-A: Test for Auditory Processing Disorders in Adolescents and Adults (Keith, 1994) or SCAN-C: Test for Auditory Processing Disorders in Children-Revised (Keith, 2000b); 56% used questionnaires instead (or in addition). A third reported using classroom observation (33%), and 25% selected "other." The only common write-in response for this question was speech-in-noise testing, which was selected by nine respondents (9% of the respondents who answered this question). Very few other tests were selected from the listed items (11% dichotic digits [DD] and 5% Random Gap Detection Test [RGDT]; Keith, 2000a), and no other screening tools were listed by more than one person. Three respondents indicated that they used a speech-language

evaluation as part of the screening process, but there were no other mentions of multidisciplinary test result reviews by any participants.Note that the newest versions of the SCAN-A and SCAN-C-the SCAN-3:A and the SCAN-3:C (Keith, 2009a, 2009b), which include Gap Detection, Auditory Figure Ground, and Competing Words screening portions- were not available at the time this survey was conducted.

Test Battery

Respondents were asked whether they used an APD test battery; 97% (n = 181 of the 187 who answered the question) indicated they did. Respondents who answered yes were then asked what specific factors (i.e., case history and age) determined the test battery they used. The types of test batteries that were rated by respondents are listed in Table 1 along with the number of respondents who selected each rating. The number of respondents who rated each type of battery varied from 110 to 155. It is reasonable to assume that participants who provided an answer for some but not all categories most likely never used the items they did not rate; however, it is not possible to know for sure. Therefore, percentages for each response category within a row are reported based on the total number of respondents who rated each category (i.e., the total number of responses for each row). The highest rating (always, often, sometimes, or never) selected for each type of test battery is highlighted in bold in the table.

Examination of Table 1 indicates that the largest number of total responses (n = 155) occurred for "A set minimum battery for all patients with additions based on individual case history and age." Within this category, the majority of respondents (53%) indicated that they always used this approach, and 27% indicated that they often used this approach. Thus, most respondents (80%) had a set minimum battery that was quite flexible based on the individual patient. The smallest number of total responses (n = 110) occurred for "A set minimum battery for all patients with additions based just on individual case history." Within this type of response, the largest category of response was "never" (37%) followed by "sometimes" (28%). "Never" was also selected most often as the rating for the categories of "Battery completely based on case history considerations" and "Preset (C)APD [central auditory processing disorder] battery for all patients regardless of age or case history."

Respondents were asked how they selected their test battery, and 168 respondents provided answers (respondents could select more than one answer). Of these respondents, the majority selected their test battery based on clinical experience (57%). Other common responses included a review of literature (45%), ASHA technical reports (40%), seminars/ workshops on APD (36%), clinical site (31%), and Bruton Conference (Jerger &Musiek, 2000; 26%). The only fairly common write-in response was the BuffaloModel (Masters, Stecker, &Katz, 1998; 5%).

A total of 186 respondents indicated the average number of tests they administered during their test battery. The majority of these reported 4-6 tests (n = 108, 58%) followed by 6-9 tests (n = 52, 28%), 1-3 tests (n = 27, 15%), and 10+ tests (n = 9, 5%). Respondents were expected to select only one category; however, 10 respondents selected two.

Respondents were asked to indicate the frequency of use (always, often, sometimes, or never) for specifically named AP tests within common test categories. Table 2 lists the ratings for specific tests of dichotic listening, monaural lowredundancy speech, temporal processing, binaural interaction, and electrophysiology. There were 27 specifically named tests across these categories. The number of respondents who rated each test varied from 88 (MLR) to 179 (Staggered Spondaic Word test [SSW]; Katz, 1962), with a mean of 138 respondents. Table 2 shows the number of respondents who selected each rating for the specific test and the percentage of respondents (based on the number of respondents for the row). The most commonly occurring rating for each test is highlighted in bold. Note that all of the bold responses in Table 2 are either "always" or "never," indicating a somewhat polarized response for each test (although the largest response did not always indicate the majority of respondents). Note also that the tests in which the majority of respondents selected "always" generally had higher response rates than tests in which the majority selected "never." The nine tests in which "always" was the most common response had between 150 and 179 respondents (M = 158), and the 18 tests in which

"never" was the most common response had between 88 and 154 respondents (M = 128), suggesting, as mentioned previously, that some respondents skipped portions of the question rather than selecting "never." Although this cannot be assumed in the analysis, it is likely that the percentage of "never" responses for these tests was actually higher than these data indicated.

The tests most often rated as "always" were the SSW, DD, SCAN-A/SCAN-C, and Competing Sentences Test (CST; Willeford, 1978) in the dichotic category; the SCAN-A/ SCAN-C and Speech-In-Noise (SIN) Test (Etymotic Research, 1993) in the monaural low-redundancy speech category; and a pitch pattern test (PP; e.g., Pinheiro, 1977) in the temporal processing category. The most common rating was "never" for all of the listed binaural interaction and electrophysiology tests.

Figure 1 illustrates the number of respondents who indicated they "always" or "often" used the tests listed in the survey, in order from most to least. Percentages were not used for this overall comparison due to the variability in the number of respondents who answered each question. The most popular tests overall were the SSW, PP, SIN,DD(e.g.,Musiek, 1983), and the SCAN-A/SCAN-C.

Professional Issues in Diagnosing APD

The respondents were asked to indicate whether their ability to diagnose APD was limited by state law, school regulations, reimbursement, or other reasons. Respondents were allowed to select multiple responses. Sixty-eight respondents indicated one or more limitations. The most common limitations selected by these respondents included school regulations (41%), reimbursement (37%), time (10%), and test availability (9%).

The respondents were asked to indicate who was qualified to make a diagnosis of APD. The majority (97%) of the 190 respondents selected "audiologist." Other responses included SLP (16%), psychologist (7%), educator (5%), and otolaryngologist (3%). Some respondents (8%) indicated "other." The only fairly common write-in response was "multidisciplinary team" (6%).

Management

In the section of the survey titled "Management," respondents were asked a series of questions regarding common practices for follow-up for patients diagnosed with APD. Note that the terms management and treatment were used in the survey questions, and there was no mention of the term intervention. Differences in the meaning of these terms are addressed below in the Discussion section. The first question asked respondents to rate how frequently they used each of several types of APD "management recommendations" listed in the survey. These data are shown in Table 3. The largest number of respondents (51%) indicated they "always" used a customized list not based on a profile, and just over a third (38%) indicated they "often" used a list based on a diagnostic profile.

The next two questions in this section asked respondents to indicate who was responsible for recommending and who was responsible for providing APD "treatment plan/ management strategies," respectively. Note that respondents could select more than one person for these responsibilities. These data are shown in Figure 2, along with the data from the APD diagnostic question in the listed categories. Examination of Figure 2 reveals that the majority of respondents to the first question (81%) indicated that the audiologist was responsible for recommending an APD treatment plan/ management strategies, although over a third selected SLP (40%) and multidisciplinary team (36%). The majority of respondents who selected "multidisciplinary team" indicated that the team should include an audiologist, SLP, primary classroom teacher, education professional, school psychologist, and parents. In contrast, the majority of respondents indicated that the provision of treatment/management was considered to be the responsibility of the SLP (74%) and education professional (52%). Professionals selected by over a third of respondents included the classroom teacher (40%), audiologist (40%), and multidisciplinary education team (39%). Respondents indicated that the "multidisciplinary team" should consist of all the professionals listed previously, plus occupational therapists.

The next intervention question asked respondents, "If you provide recommendations for treatment for (C)APD, which of the following do you recommend?" The survey then included a checklist of specific recommendations

broken down into three categories: environmental modifications, remediation strategies, and compensatory strategies; the categories were completed by 187, 174, and 159 respondents, respectively, and these data are shown in Figure 3. All specifically listed items under the category of environmental modifications were selected by the majority of respondents including preferential seating (95%), gaining the student's attention prior to speaking (91%), repeating or rephrasing information (89%), personal FM systems (85%), preteaching new concepts or vocabulary (83%), sound-field FM systems (72%), modifying classroom activities (72%), and the use of a note taker (70%). About a quarter of the respondents (22%) selected "other"; common write-in responses included individualized recommendations based on the needs of the child.

Under the category of remediation strategies, the majority recommended Earobics (70%; www.earobics.com), auditory closure activities (70%), phoneme training (60%), and temporal training (51%). Slightly less than half of the respondents who answered this question recommended Fast ForWord (44%; www.scielearn.com) and prosody training (44%), and about a third recommended Lindamood-Bell training materials (37%; www.lindamoodbell.com). "Other" was selected by 21% of respondents, but no specific intervention strategy was selected by more than 5% of the overall respondents for this question. Note that the specifically listed remediation strategies were selected by fewer respondents than any of the environmental modification recommendations.

Under the category of compensatory strategies, the majority recommended active listening skills training (82%), metamemory skill training (73%), and context derived vocabulary building (52%). About half of the respondents recommended assertiveness training (47%), and about a third recommended discourse cohesion devices (39%) and cognitive behavior modification (34%).

Respondents were asked to indicate factors that limited their ability to provide treatment recommendations for APD. A total of 101 respondents indicated one or more limitations. The largest responses from this group indicated that they were limited by school district policy or procedures (46%) and lack of training (46%). About a quarter of the respondents indicated time (28%), individual school policies/procedures (26%), and reimbursement (19%).

Respondents were asked to indicate factors that limited their ability to provide direct treatment for APD. A total of 139 respondents provided one or more limitations. The largest responses were reimbursement (40%), lack of training (32%), school district policies (30%), time constraints (22%), and individual school policy (12%).

Comparison With Bruton Conference (Jerger &Musiek, 2000) Minimum Test Battery

The Bruton Conference (Jerger &Musiek, 2000) document was selected by 43 respondents in response to the question regarding how the test battery was selected. An analysis of the individual responses from these respondents indicated that only six respondents (14%) actually selected all of the test categories required to meet the minimum test battery recommendations listed in that document; in all other cases, electrophysiological tests were omitted.

The ASHA APD technical report (ASHA, 2005) and the AAA clinical practice guidelines for APD (AAA, 2010) recommend that audiologists use a test battery that is individualized and based on the patient's case history. The current data indicate that the vast majority (80%) of audiologists are following this recommendation by always or often selecting a test battery that is modified by age and case history.

Discussion

The current study included 195 completed surveys from a sample of audiologists who specified APD as a specialty area and/or were members of the EAA. This makes it the largest survey of current APD diagnosis and management practices available to date and the only survey that has been specifically targeted to audiologists who specialize in AP or who are likely to do so. It must be noted that there was no measure of expertise; these are self-reported experts. Therefore, this fact needs to be considered when interpreting the results.

The results indicate that the majority of respondents did the following: screened for APD; required audiologic testing prior to APD diagnostic testing; completed a case history for each individual; used questionnaires;

required speechlanguage pathology evaluations; and conducted dichotic, monaural low-redundancy speech, and temporal processing tests. The majority of respondents indicated that audiologists were responsible for diagnosing APD (97%) and for recommending treatment/management (71%), but providing treatment/ management was the responsibility of SLPs (74%) and educators (52%). Slightly less than half (40%) of the respondents indicated it was audiologists' responsibility to provide treatment/management.

Pretesting

The majority of the respondents asked the child's parent (75%) and/or the teacher (65%) to complete a questionnaire, with more than half of the respondents selecting the Fisher's checklist and the CHAPS. These data are similar to those reported by Emanuel (2002) in which 75% of the total sample reported using questionnaires, and the two most popular questionnaires were the Fisher's checklist and the CHAPS. These findings do not agree with the findings from Chermak et al. (2007); in that study, only two (12%) and four (24%) of the respondents indicated that they used the Fisher and the CHAPS checklists, respectively. However, in the Chermak et al. study, only 17 respondents answered the question, and the survey was not targeted to audiologists most likely to have an expertise in AP testing. In contrast, there were 53 respondents to this question in the Emanuel (2002) study and almost 200 in the current study. Thus, from both the current study and the Emanuel (2002) study, it appears that the use of questionnaires, especially the Fisher and the CHAPS, is fairly common.

In the current study, the purpose of the questionnaire was not thoroughly examined. Questions related to the use of questionnaires were included in the "pretesting" section of the survey; however, they may have been selected by respondents who used them for purposes other than screening. TheEmanuel (2002) study listed questionnaires in their own separate category, while in the Chermak et al. (2007) study, questionnaires were listed in a question along with behavioral and physiological tests. Thus, it is still unclear whether audiologists are using questionnaires for screening, diagnosis, or intervention. The AAA (2010) clinical practice guidelines state that questionnaires used for screening "generally have poor specificity, tend to over-refer, and have not been validated" (p. 13); however, respondents may be using them as part of the case history to develop an appropriate battery of tests for that individual, which would be appropriate under the new guidelines. Future studies should probe how audiologists are using questionnaires for AP patients.

The vast majority of respondents indicated that they would like to have evaluations completed by professionals in other disciplines prior to their AP diagnostic testing. The three most often selected specialty areas were speech-language pathology, psychology, and special education. The large number of respondents who would prefer not to diagnose without information from other specialties indicates that audiologists prefer not to work in a vacuum but instead want to be part of a larger, multidisciplinary (but not physician-based), diagnostic process for AP. These results are similar to those found by Emanuel (2002). In her study, 40%-50% of respondents indicated their "standard" evaluation (which was comparable to the "required" category in the current study of 36%-54%) included evaluations by SLPs, special educators, and psychologists, but very few required evaluations by physicians.

Test Battery

The vast majority (97%) of respondents indicated that they use a test battery approach when conducting APD testing. The reported test batteries most often consisted of four to six tests, which should meet the AAA (2010) task force's recommendation of approximately 1 hr for testing, depending on the tests that are selected and assuming the basic audiologic evaluation does not occur on the same day. The AP test battery is most often selected based on clinical experience and/or a review of the literature, which, in theory, means that audiologists are using best practices combined with good clinical judgment. Respondents most often reported that they "always" or "often" use a set minimum battery for all patients and make additions based on individual case history and age. Thus, they have a core group of tests that they give to each patient while still maintaining the flexibility necessary to individualize the assessment to the patient, a recommendation that was stated in the

most recent guidelines by both ASHA (2005) and AAA (2010).

More respondents indicated that they select their test battery based on ASHA technical reports (40%) rather than the Bruton Conference (Jerger &Musiek, 2000) proceedings (26%), and very few are actually following the complete Bruton Conference recommendations, because electrophysiology is not usually assessed. These findings were similar to the earlier findings reported by Emanuel (2002) in which none of the respondents followed the Bruton Conference recommendations, primarily because electrophysiological tests were omitted. Based on the current survey, it appears that audiologists are not relying on a recommended test battery; instead, two thirds of the respondents reported selecting their test battery using multiple sources, such as a combination of clinical experience, seminars on AP, and/or a review of literature.

The most often administered categories of tests were dichotic tests, monaural low-redundancy tests and temporal processing tests. Across all categories, the most popular tests were the SSW, PP, SIN, DD, SCAN-A/SCAN-C, CST, low pass filtered speech, and RGDT. Table 4 lists the findings from the current study and the findings from the four prior surveys for the tests specifically listed in the current study. The table is organized into the various categories of AP assessment (i.e., dichotic tests, monaural low-redundancy tests, temporal processing tests, binaural interaction tests, auditory electrophysiological tests, and a multiple-category test). The numbers highlighted in bold for each AP category represent the most popular tests-that is, those used by approximately 50% or more of the participants in the current study.

Examination of this table indicates that the highest ranked tests from the current study were also among the highest ranked tests for all of the prior surveys. Two exceptions to this pattern were for the PP and the RGDT. The PP was the highest ranked test (82%) in the current study as well as in the Emanuel (2002) study. However, this test was only used by 12% and 19% of the respondents in the Chermak et al. (2007) and Chermak et al. (1998) studies, respectively. In the current study, the RGDT was used by approximately 50% of the respondents, which is a substantial increase over the 6% reported in the Chermak et al. (2007) study. This finding is likely due to the fact that the RGDTwas relatively new at the time of the Chermak et al. (2007) study, and that survey was not specifically targeted to audiologists with self-professed expertise in APD.

The results in this table also reveal that relatively few participants (30% or fewer) used any of the binaural interaction tests or auditory electrophysiologicalmeasures as part of their APD assessment. This finding was evident in the current study as well for the data reported by the four earlier survey studies. The only exception to this was that Chermak et al. (1998) reported that 59% of their participants used ABR testing. It is unclear from their survey whether this percentage of respondents was using ABR for AP assessment or for other purposes.

The SCAN-A/SCAN-C test was one of the most popular AP tests in the current study. The popularity of this test was also demonstrated by survey data from Emanuel (2002) and Chermak et al. (1998). This test was originally published as a screening tool, and early versions of this test had been rated as inefficient at diagnosing APD (Chermak et al., 1998) and somewhat unreliable (Amos &Humes, 1998). Emanuel (2002) hypothesized that audiologists continued to use the SCAN-A/SCAN-C because the test material, which is professionally packaged and includes well-documented normative data and printed response forms, makes the test easy to administer and interpret. Recently, the SCAN-A/SCAN-C test has been substantially modified and is now known as the SCAN-3:A/SCAN-3:C (Keith, 2009a, 2009b). It now includes three screening tests (Gap Detection, Auditory Figure Ground, and CompetingWords), four diagnostic tests (Filtered Words, Auditory Figure Ground, Competing Words, and Competing Sentences), and two supplementary tests (Auditory Figure Ground and Time Compressed Sentences). Additional modifications, which have purportedly made the SCAN-3:A/SCAN-3:C much more psychometrically sound than previous versions, include (a) the normative data were collected on a very large sample (n = 775 including 525 children age 5.0-12.11 years); (b) the data were collected by 109 professionals (SLPs, audiologists, and psychologists) across a broad geographic region; (c) the sample represented appropriate gender, race/ethnicity, and socioeconomic statistics based on U.S. Census data; and (d) several validity and reliability studies were conducted which demonstrated that the test has good test-retest

reliability (.78 and .77 for SCAN-3:A and SCAN-3:C, respectively), high internal consistency (.93 and .91 for 3:A and 3:C, respectively), and high interscorer agreement (.98 for 3:A and 3:C; data cited in Andrews &Castilleja, 2007).

Lastly, the data in Table 4 suggest that a number of the tests in each of the three popular AP test categories are rarely used, as reflected by respondent rates ranging from 7% to 40%. This pattern is true for the results not only of the current study but also the earlier survey studies. Possible reasons for the low popularity of these tests include the following:

1. Many of these tests have multiple versions, and when clinicians order these tests from various manufacturers, there is a lack of data available regarding the appropriate normative data for each version.
2. Some clinics/audiologists develop their own normative data that may or may not reflect sound psychometric principles.
3. Information on how stimuli were created, what types of populations were sampled for developing norms, and how large these samples were is often not available to the clinician. These practices can lead to considerable confusion for the clinician regarding the appropriate use and interpretation of the test findings.

Management

Only four studies to date have focused on surveying clinical practices in AP testing, and these studies had little reportable data for APD management. Martin et al. (1998) stated that they asked one "subjective in nature" question on audiologic management, and the few audiologists who responded indicated that they generally referred AP patients elsewhere. Chermak et al. (1998) asked two questions. The first question asked where respondents would refer patients after AP diagnosis, and their results indicated primarily to an SLP (22%), another audiologist (17%), or a teacher (11%). The second question asked where respondents would refer patients if they suspected CANS problems, and their results indicated primarily an ENT (29%), neurologist (23%), or neuro-otologist (19%). Emanuel (2002) did not include any questions on management. Chermak et al. (2007) asked eight questions on intervention, but six of the questions were only answered by one respondent. The remaining two questions asked whether the respondent provided treatment/management to APD patients (94% of the 17 respondents said no) and how often particular specialists should conduct specifically listed treatment/management options (n = 17-25, depending on the treatment; see below for further discussion). Thus, one of the strengths of the current survey is that the information was obtained from a large sample on follow-up procedures following a diagnosis of AP.

In the current study, the vast majority of respondents (97%) indicated that audiologists should be the professionals to diagnose APD; a much smaller group (16%) indicated that SLPs were also qualified to diagnose APD. When the question shifted into treatment/management, a slightly larger number but still not a majority of respondents (40%) selected SLPs as responsible for recommending treatment/management, with the majority of respondents (81%) indicating that audiologists had this responsibility. When asked who was responsible for actually providing treatment/management, the response pattern shifted such that 40% selected audiologists, and the majority of respondents selected SLPs (74%) and educators (52%).

It is commonly reported that audiology began as a therapybased profession in the rehabilitation of soldiers returning fromWorldWar II with hearing loss. As the field has evolved, it has expanded into many areas of audiologic and balance diagnosis and treatment, with a large focus on the fitting of advanced technology. The focus on therapy appears to have become distinctly deemphasized in general audiologic practice. The current survey provides evidence for this shift in the area of AP. Specifically, many more respondents indicated that audiologists were responsible for diagnosis of APD than indicated that audiologists were responsible for providing treatment/management. The majority of respondents indicated that provision of ADP therapy/management was under the purview of SLPs and educators. With this said, 40% of the respondents did indicate that audiologists should be responsible for providing treatment/management, so it appears a sizable percentage of audiologists have not given up the AP therapy aspects of the profession.

In this survey, respondents were far less likely to recommend specific therapies for APD compared with non-therapybased recommendations such as environmental modifications and compensatory strategies. This is consistent with the findings of Chermak et al. (2007); in their study, the majority of respondents indicated that SLPs were responsible for providing therapy-based intervention (specifically, metalinguistic, metacognitive, and cognitive strategies; auditory training; and computer-based therapy tools); in contrast, the majority of their respondents indicated that audiologists were responsible for providing non-therapy-based management (specifically, assistive listening devices and environmental modifications).

In the current survey, all of the audiologists who responded to the questions regarding the various types of recommendation strategies selected multiple recommendation strategies, suggesting audiologists are providing patients with a number of options to address APD. The fact that more items were selected from the environmental strategies list (e.g., preferential seating or sound-field FM system) than from the remediation strategies or compensatory strategies lists suggests either a comfort level with these recommendations or, possibly, the view from some respondents that audiologists who are not providing treatment/management should not be prescribing specific therapy techniques that other professionals will use with patients. This is a common medical model, in which a recommendation is made for therapy, with specific strategies left to the expertise of the therapist. Since fewer than half of the respondents indicated that providing therapy/management was the responsibility of the audiologist, this response pattern is not unexpected. For the audiologists who did recommend remediation and compensatory strategies, the most commonly recommended were Earobics; skills training in the areas of auditory closure, phoneme and temporal training, active listening, and metamemory; and context derived vocabulary training. Some respondents commented that they did not have the time or training to provide APD treatment, while others indicated reimbursement was a deterrent.

Not only is audiology historically a therapy-based profession, an examination of the current scopes of practice for both AAA (2004) and ASHA (2004) indicates that audiologists are responsible for diagnosis and management of APD. Specifically, ASHA (2004, p. 6) states that the audiologist is responsible for the "evaluation and management of children and adults with auditory-related processing disorders," and AAA's scope of practice (2004, p. 3) states that "the audiologist is an integral part of the team within the school system that manages students with hearing impairments and students with auditory processing disorders." Although providing therapy is not specifically articulated, "management" may include all aspects of intervention including environmental modification, compensatory strategies, and remediation. Thus, the audiologist's involvement in the provision of services to children and adults diagnosed with APD may include all aspects of care. The finding that the majority of respondents felt the SLP was responsible for providing therapy/ management to APD patients may reflect the protocol at their facility or a number of factors limiting service provision. This is supported by the number of respondents who indicated that their ability to provide services was limited by reimbursement issues (40%), lack of training (32%), school district policies (30%), time constraints (22%), and individual school policies (12%).

The present survey found that most audiologists do not use either a published or a site-generated preprinted list of management recommendations; instead, themajority of respondents (75%) indicated they always or often create a customized list of management recommendations based on the findings of diagnostic tests. The majority (58%) indicated they always or often use a preprinted list based on diagnostic profile; however, the option of a customized list based on diagnostic profile was not included in this survey. Therefore, it is possible that audiologists use a profile diagnosis with an individualized list of recommendations and thus selected always/often for both categories. Optimally, recommendations should be developed specifically for each patient based on the deficits identified in the test battery (ASHA, 2005), and this is what the results suggest that the majority of audiologists are doing. With that said, just over a third of respondents always/often provide a preprinted list, which suggests a large number of audiologists do not provide individualized recommendations, unless their preprinted list includes a place for checkmarks to indicate which specific recommendations apply to

that particular patient, an option not specified on the questionnaire and thus not possible to determine from the data.

Note that in the survey reported here (created in 2007 and disseminated in 2008), the term management was selected as part of the title, as the heading for one section of the survey, and in many of the survey questions (similar to questions by Chermak et al., 2007, which was used as a model for the current survey). The term treatment was also included, but the term intervention was not used. When respondents were asked to indicate which recommendations they made for AP follow-up, the categories of environmental modifications (e.g., preferential seating and FM systems), remediation strategies (e.g., Fast ForWord and Earobics), and compensatory strategies (e.g., active listening skills training and cognitive behavior modification) were provided on the survey. According to AAA (2010, p. 6):

Intervention is an encompassing term referring to one or more actions taken in order to produce an effect and alter the course of a disease, disorder, or pathological condition. Treatment is any specific procedure used to prevent, remediate (i.e., cure), or ameliorate a disease, disorder, or pathological condition. Management refers to compensatory approaches (e.g., strategies, technologies) used to reduce the impact of deficits that are resistant to remediation.

Therefore, in future surveys, the term management should be replaced with intervention, and compensatory strategies should be replaced with management to follow more current terminology.

Summary

The results of this large-scale survey suggest several exciting trends regarding the diagnosis and management of APD. It appears that clinical audiologists who are self-reported experts in AP are taking a relatively consistent approach toward the diagnosis of APD. This approach includes screening for APD, requiring a complete audiologic test battery prior to administering behavioral AP tests, completing a thorough case history including both parental and teacher input for the pediatric population, and conducting a variety of behavioral AP tests that aim to assess different AP skills and different levels/regions of the peripheral auditory nervous system and CANS. Secondly, the audiologists who participated in this study reported that their APD assessment procedures often included input from multidisciplinary specialists including SLPs, psychologists, educational specialists, neurologists, and otolaryngologists. The input from this team of professionals as well as input from a child's parents are integral to planning appropriate management/intervention strategies for the individual and his or her family.

In the past decade, the field has seen considerable progress in the development of more rigorous and psychometrically sound behavioral AP test materials, such as the RGDT (e.g., Muluk, Yalcinkaya, &Keith, in press; Yalcinkaya, Muluk, Atas, &Keith, 2009), the Gaps-In-Noise test (e.g., Musiek et al., 2005; Shinn, Chermak, &Musiek, 2009; Weihing, Musiek, &Shinn, 2007), and the SCAN-3:A/SCAN-3:C (e.g., Andrews &Castilleja, 2007). Published data have been made available regarding how the stimuli were developed for these tests, how normative data were collected, and who is an appropriate age group and/or clinical population for this type of testing. Continued advancement with this type of in-depth information is needed to ensure that AP tests are applied to appropriate populations and yield information that is reliable and valid.

The results of the current study suggest that the majority of audiologists involved in AP testing believe diagnosing APD and making recommendations for treatment/management are the responsibility of the audiologist. In contrast, the majority of respondents indicated that provision of therapy/ management is the responsibility of SLPs and educational specialists. With that said, 40% of the respondents indicated audiologists are responsible for providing therapy/management; therefore, a fairly sizable number of audiologists still feel audiologists should be providing therapy/management. Many of the audiologists in the current study indicated that their ability to provide therapy/management is restricted by reimbursement issues and inadequate training. If APD therapy is to remain within the scope of practice for audiologists, university program directors should improve APD therapy training, and audiology professional associations should advocate for improved

reimbursement of APD therapy. To improve training for audiologists who are currently practicing, hands-on AP therapy should be a focus of national and statewide professional conferences and intensive seminars. In addition, audiologists need to continue toworkwith colleagues in hearing science, cognitive neuroscience, and neurobiology, as these professions continue to learn how the brain processes both verbal and nonverbal stimuli at different levels and regions of the CANS. Multidisciplinary neuroscience must continually be considered and, if appropriate, incorporated into the development of improved screening and diagnostic tests for assessing AP skills as well as intervention strategies to address APD.

Sidebar

Survey of the Diagnosis and Management of Auditory Processing Disorder

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Am J Audiol 2011;20;48-60; originally published online Apr 7, 2011; DOI: 10.1044/1059-0889(2011/10-0019)

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Editor: Sheila Pratt
Associate Editor: Debbie Moncrieff
Received May 10, 2010
Accepted March 25, 2011
DOI: 10.1044/1059-0889(2011/10-0019)

Publication date: Jun 1, 2011

Year: 2011

Targeting Hearing Health Messages for Users of Personal Listening Devices

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Publication info: American Journal of Audiology (Online) 20.1 (Jun 1, 2011): 69-82.
ProQuest document link

Abstract: To summarize the literature on patterns and risks of personal listening device (PLD) use, which is ubiquitous among teenagers and young adults. The review emphasizes risk awareness, health concerns of PLD users, inclination to take actions to prevent hearing loss from exposure to loud music, and specific instructional messages that are likely to motivate such preventive actions. We conducted a systematic, critical review of the English-language scholarly literature on the topic of PLDs and their potential effects on human hearing. We used popular database search engines to locate relevant professional journals, books, recent conference papers, and other reference sources. Adolescents and young adults appear to have somewhat different perspectives on risks to hearing posed by PLD use. Messages designed to suggest actions they might take in avoiding or reducing these risks, therefore, need to be targeted to achieve optimal outcomes. We offer specific recommendations regarding the framing and content of educational messages that are most likely to be effective in reducing the potentially harmful effects of loud music on hearing in these populations, and we note future research needs.

Full text: Headnote

Purpose: To summarize the literature on patterns and risks of personal listening device (PLD) use, which is ubiquitous among teenagers and young adults. The review emphasizes risk awareness, health concerns of PLD users, inclination to take actions to prevent hearing loss from exposure to loud music, and specific instructional messages that are likely to motivate such preventive actions.
Method: We conducted a systematic, critical review of the English-language scholarly literature on the topic of PLDs and their potential effects on human hearing. We used popular database search engines to locate relevant professional journals, books, recent conference papers, and other reference sources.
Conclusions: Adolescents and young adults appear to have somewhat different perspectives on risks to hearing

posed by PLD use. Messages designed to suggest actions they might take in avoiding or reducing these risks, therefore, need to be targeted to achieve optimal outcomes. We offer specific recommendations regarding the framing and content of educational messages that are most likely to be effective in reducing the potentially harmful effects of loud music on hearing in these populations, and we note future research needs.

Key Words: hearing health messages, MP3 players, noise-induced hearing loss, personal listening devices

It is well established that permanent noise-induced hearing loss (NIHL) can result from exposure to any sound that is sufficient in intensity and duration. The damage is typically to the inner ear and, although somewhat dependent on the susceptibility of individual ears, is largely preventable (Clarke &Bohne, 1999). In fact, exposure to excessive levels of noise is the leading preventable cause of sensorineural hearing loss (Rabinowitz, 2010).

In recent years, recreational activities have gained attention as a leading cause of NIHL, and personal listening devices (PLDs), which are used primarily for the reproduction of music, have been the focus of intensive research. Although the public generally associates sensorineural hearing loss with aging, this problem may now be affecting younger generations due to exposure to various recreational activities, including PLD use. A recent study (Shargorodsky, Curhan, Curhan, &Eavey, 2010), in which 1988-1994 data from The Third National Health and Nutrition Examination Survey (NHANES III) and 2005-2006 data from the NHANES were compared, concluded that the prevalence of hearing loss among U.S. adolescents ages 12-19 years increased from 14.9% in 1988-1994 to 19.5% in 2005-2006. Although the increased hearing loss observed in the 2005-2006 cohort was typically unilateral and only slight or mild in degree, it was high-frequency in nature and statistically significant. Following a similar analysis of the same prevalence data, using comparable inclusionary criteria but slightly different definitions of pure-tone average, Henderson, Testa, and Hartnick (2011) found no indication of an increase in overall noise-induced threshold shifts (NITSs) in the 2005-2006 cohort when compared with the 1988-1994 cohort. Female youths, however, when compared with their male counterparts, were similarly exposed to recreational noise, were less prone to use hearing protection, and showed an increased prevalence of NITSs. Shargorodsky et al. (2010) and Henderson et al. (2011) conjectured that loud music may be a possible contributing factor for the increased prevalence. They noted that despite a greater awareness of music-induced hearing loss in recent years, adolescents and young adults tend to underestimate the warning symptoms of hearing loss following exposure to loud music and to exhibit a relative lack of concern for such symptoms.

Despite data such as these, it must be acknowledged that researchers hold divergent views about the extent to which the prevalence of hearing loss and changes in hearing sensitivity-and specifically changes in NIHL-have occurred over the past several decades. Except in cases in which there were substantial asymmetries in the threshold data, the audiometric data analyzed in the two studies mentioned above generally were not subjected to a retest, thus making it impossible to determine whether the observed threshold shifts were temporary or permanent. Schlauch and Carney (2011) employed computer simulations to estimate false-positive rates for protocols that use notched audiograms to signify NIHL; the authors argue that the NHANES III data for children ages 6-11 years are consistent with their simulations and suggest no significant NIHL in this young subgroup. They also found that pass-fail data suggested by expert clinicians, when applied to the NHANES III data, yielded unacceptably high false-positive rates. They speculated that earphone reference levels, audiometric variability at 6 kHz, failure to repeat and average threshold measurements, and the identification of unilateral hearing loss as associated with NIHL are methodological problems that may lead to high false-positive rates. The presence of disease entities, the technological sophistication of test equipment, advances in medical and surgical treatments for conductive hearing loss, and the effectiveness of hearing conservation programs are all factors, singly or in combination, that may affect prevalence data across generations (Hoffman, Dobie, Ko, Themann, &Murphy, 2010). Unfortunately, these factors limit our ability to draw definitive conclusions about changes in the prevalence of hearing loss from such comparisons.

Before PLD use can be clearly linked to an increased incidence of NIHL, many issues remain to be resolved. A reasonable position to take on this controversial subject is that expressed by Fligor (2009a), who indicated that while most peer-reviewed studies have revealed that the average PLD user is not at risk for NIHL, one should not ignore the needs of the others who are at risk. Today, there is a continuing concern that the ubiquitous nature of PLDs may increase the risk to hearing, as evidenced by reports in the current literature and the popular media. Although not necessarily a precipitating factor, the fact that PLDs are highly portable and currently capable of storing up to 40,000 songs and playing for up to 36 hr on a fully charged battery serves as a predisposing condition to reinforce this concern. For those who are at risk, audiologists and other professionals need to convey messages about hearing health risks and self-protective behaviors as well as to conduct research on the appropriateness of targeted messages aimed at preventing or reducing any deleterious effects of PLDs on hearing.

The goal of this article was to provide a comprehensive review of literature that addresses a risk issue which has reemerged due primarily to the patterns of use of PLDs and attitudes expressed by young people that they are invulnerable to hearing loss from such use. To this end, we conducted a systematic review of the English-language scholarly literature on the potential risks to hearing posed by the use of PLDs. Coverage included the primary peer-reviewed literature, as well as books and book chapters, recent conference papers, online journals, technical reports, and standards. The latter materials were reviewed because of their potential supplementary value in providing a framework for understanding the current public and professional discourse surrounding this controversial topic. Our search method involved the use of popular database search engines, including Academic OneFile, CINAHL Plus, Google, Google Scholar, MEDLINE (on FirstSearch), OmniFile Full Text Select, and ProQuest. References in the included studies were manually searched for additional resources. Relevant search terms were used to locate materials associated with damage risk criteria, patterns of PLD use in young adults and adolescents, and the effect of different earphone types on output levels and preferred listening levels. Also, we searched for materials that provided a theoretical framework as to why some young people engage in risky behavior, as well as recommendations regarding specific messages that might be communicated to them to raise their awareness of the risks of hearing loss from PLD use and to motivate them to take precautions that effectively reduce those risks. The above topics compose the major sections of our review.

Our knowledge of PLD usage and the extent to which it raises the risk of hearing loss has been derived from a combination of survey and experimental research. Surveys have typically provided information about patterns of use, risk awareness, degree of concern about consequences, and types of behaviors in which individuals are willing to engage to avoid or lower hearing health risks. Experimental studies have typically provided information regarding the actual output levels of PLDs, listening levels that young adults prefer under real-world conditions, and whether or not these levels are capable of inflicting hearing impairment. Reflecting the technological changes over the past several decades, experimental investigations have been conducted on the auditory effects of exposure to loud music, played through earphones, using stereo receivers (MacLean, Stuart, &Stenstrom, 1992;Wood &Lipscomb, 1972), portable radios and personal cassette players (Bradley, Fortnum,&Coles, 1987; Catalano&Levin, 1985; Hellström, 1991; Hellström &Axelsson, 1988; Katz, Gerstman, Sanderson,&Buchanan, 1982;Meyer-Bisch, 1996; Pugsley, Stuart, Kalinowski, &Armson, 1993; Rice, Rossi, &Olina, 1987; Turunen-Rise, Flottorp, &Tvete, 1991; Wong, Van Hasselt, Tang, &Yiu, 1990), compact discs (Fligor &Cox, 2004), and more recently, MP3 players (Atienza et al., 2007, 2008; Danhauer et al., 2009; Farina, 2007; Fligor &Ives, 2006; Hammershøi, 2007; Hodgetts, Rieger, &Szarko, 2007; Hoover &Krishnamurti, 2010; Keith, Michaud, &Chiu, 2008; Kumar, Mathew, Alexander, &Kiran, 2009; McNeill, Keith, Feder, Konkle, &Michaud, 2010; Peng, Tao, &Huang, 2007; Portnuff &Fligor, 2006; Punch et al., 2009; Rabinowitz, 2010; Shah, Gopal, Reis, &Novak, 2009; Snowden &Zapala, 2010; Torre, 2008; Vogel, Brug, Hosli, van der Ploeg, &Raat, 2008; Vogel, Brug, van der Ploeg, &Raat, 2007; Vogel, Verschuure, van der Ploeg, Brug, &Raat, 2009;

Williams, 2005; Zogby International, 2006a, 2006b). The literature does not provide a consensus view regarding a causative relationship between PLD use and hearing loss, although many investigators have concluded that PLDs, especially as used by many teenagers and young adults, present a substantial risk of hearing loss or are a probable contributing factor to hearing loss over the lifespan. Representative survey and experimental studies reported in the peer-reviewed literature on the relationship between the use of PLDs and hearing loss are summarized in Table 1.

Damage Risk Criteria: What Levels and Durations Are Unsafe?

Our knowledge of vulnerability to NIHL comes largely from reports of associations between measured levels of various occupational noises and audiometric hearing loss. Decades of research have revealed that both the level and duration of noise are the two major determinants of hearing impairment. Together, these elements form the basis for damage risk criteria. Measures of exposure levels have traditionally used the dBA scale of sound level meters. This scale is intended to filter, or exclude, lower frequencies to which the ear is relatively insensitive. The National Institute for Occupational Safety and Health (NIOSH) has established the criteria most often used today to predict the damage resulting from exposure to various levels of occupational noise, and these criteria are commonly used to assess the level of risk from exposure to many types of environmental noise, including music from PLDs. NIOSH (1998) specifies recommended exposure limits that allow an individual to be exposed continuously to an 85-dBA noise source over an 8-hr period before that source is considered to be a significant contributor to NIHL. Such a noise or an equivalent-level intermittent noise-expressed as a time-weighted average and measured in equivalent continuous sound level (Leq) in decibels over an 8-hr period-is regarded as a 100% dose. A 3-dB timeintensity trading relationship is assumed, such that a noise level of 88 (85 + 3) dBA is allowable for 4 hr, 91 (88 + 3) dBA is allowable for 2 hr, and so on. As applied to PLD listening, once a given output level of music is known, the following formula can be used to calculate the exposure time at which a 100% dose is reached:

T = 8/2^sup (L - 85)/3^

(where T is the exposure time, in hours, to reach 100% dose, and L is the measured output level in dBA). Exposures beyond a 100% dose are considered likely to induce hearing loss.

A notable number of researchers have attempted to determine the maximum PLD volume settings or output listening levels that are safe, based on the above or a derivative formula. Because the reference microphone for quantifying the degree of risk from occupational noise has typically been placed at ear level, with the listener absent, a sound-field equivalent correction factor should be made to output levels of PLD earphones to reflect the fact that these measurements are often made near the eardrum, either in the listener's ear canal or in an artificial ear or acoustic manikin, as opposed to outside the head (Fligor, 2009b; Hammershøi, 2007; Keith et al., 2008; Shotland, 1996). These corrections should also be assumed to differ slightly for different earphone types (MacLean et al., 1992). In general, the research to date has underutilized these sound-field equivalent corrections, with the net result being that the literature falls somewhat short in providing definitive information on damage risk from PLD use.1

Portnuff and Fligor (2006) determined damage risk using five MP3 players from three manufacturers and expressed their measurements in sound-field equivalent levels. They incorporated stock (earbud) earphones and four additional models of earphones with each player, and measured across five popular music genres. For maximum volume settings, they found periods of up to only 18 min/day to be safe. Regardless of earphone type, no limit was recommended at volume control settings below 60%; at 60%, no limit was recommended for earbuds or supra-aural earphones. At higher volume settings, specific limits ranged from 3 min to 20 hr, depending on earphone type. They found no significant differences across genres of music.

Hodgetts et al. (2007) found that maximum output levels of the MP3 player they studied could be used for only 1-15 min/day with earbuds and supra-aural earphones. Ninety percent of college students in Torre's (2008) study indicated that they used their PLDs at medium or loud volume settings, which corresponded to sound

pressure levels of 72 and 88 dB, respectively. At self-identified typical and worst-case volume settings whose sound levels were established experimentally, and at self-reported duration of daily use, none of the university students in a study by McNeill et al. (2010) exceeded the NIOSH (1998) damage risk level of 85 dBA (Leq8). Nineteen of the 28 students, however, reported at least one symptom of possible NIHL, with tinnitus reported by 10 students. Atienza et al. (2007, 2008) determined output levels produced by an Apple iPod Nano at various volume settings, concluding that users could safely listen at their preferred levels with supra-aural earphones or earbuds at full volume for slightly over 1 hr/day. Fligor (2009b) suggested a rule of thumb that limits the volume control of earbuds to 80% of maximum if the listening time is 90 min or less per day. He notes, in addition, the difficulty of linking qualitative descriptors, such as those used in surveys, to specific output levels.

Relatively few studies have included actual measurements of hearing sensitivity in PLD users. Ahmed and colleagues (2007) studied 24 college students whose patterns of PLD use were judged to be potentially hazardous only for a minority; there was no audiometric indication (through 14000 Hz) of early hearing loss in any of the students. Shah et al. (2009), in a study of PLD use, conducted pure-tone screening on 94 undergraduate students, graduate students, and faculty and staff. Hearing loss was found in only a small percentage of their sample, mostly in the faculty and staff. Hearing sensitivity, however, was not associated with the number of PLDs used, amount of time of PLD use, or hearing-related symptoms. An earlier study by Meyer-Bisch (1996) found that two thirds of 1,364 individuals who were regularly exposed to loud music from cassette players, rock concerts, and discotheques exhibited worsened high-frequency pure-tone hearing thresholds. That is, there was a small but statistically significant elevation of thresholds in individuals whose exposures to loud music were greater than 7 hr weekly, compared to those who were exposed for 2-7 hr weekly. Kumar et al. (2009) found normal audiometric thresholds in 70 adults who had used PLDs for over 2 years, as well as in 30 nonusers of PLDs. They also found, however, a positive correlation between hearing thresholds and music levels and a negative correlation between music levels and distortion product otoacoustic emission (DPOAE) amplitudes and signal-to-noise ratios, leading them to conclude that listening to music through PLDs at higher intensities may cause subtle preclinical damage to the auditory system that could result in permanent hearing loss later in life. It is important to note that Lapsley Miller, Marshall, Heller, and Hughes (2006) reported that DPOAE amplitudes were more sensitive to NIHL than pure-tone hearing thresholds.

Peng et al. (2007) conducted conventional and extended high-frequency audiometry (10-20 kHz) on two groups: 120 college students who were users of PLDs and 30 normal hearing young adults who were nonusers. They found hearing thresholds in the 3000-8000-Hz frequency range to be significantly increased (>25 dB HL) in the PLD listeners, detecting impaired hearing in 14% of the 240 ears studied. Results of these latter two studies suggest that high-frequency audiometry may be a good early indicator of cochlear hearing loss due to noise exposure.

Patterns of PLD Use in Young Adults and Adolescents

In this section, we explore PLD use patterns and how they differ for young adults and adolescents. We give special attention to risk awareness, hearing health concerns, and susceptibility to behavioral changes that reduce risks to hearing, as these factors are especially pertinent to the development and dissemination of health-related messages.

Young Adults

For years, college students have represented a major consumer group in which the downloading of MP3 music and the use of MP3 players are widely popular. As early as 2000, Latonero reported that 69% of college students were downloading MP3 music, and a recent study (Danhauer et al., 2009) reported that almost 94% of college students owned a PLD capable of downloading music. In developed countries, PLD use appears to be a global phenomenon. In a study of 1,512 Dutch adolescents (Vogel et al., 2009), for example, 90% reported listening to PLDs through earphones.

Hoover and Krishnamurti (2010), in a survey of college students who were frequent users of MP3 players, found

that two thirds used their device for 3 or more days/week, more than three fourths used their MP3 player for 2 hr/day or less, and about half listened at 50% of the maximum volume setting or less. Users reported walking or commuting on campus as the most frequent daily activities associated with PLD use, noting that they listened at increased volume settings when necessary to overcome background noise. Exercising was reported as the most frequent weekly activity associated with PLD use. About a third of the college students who frequently used MP3 players reported occasionally using them at maximum volume settings. The authors expressed concerns regarding college students' occasional use of MP3 players at full volume and their reduced environmental awareness.

In another study of college students (Punch et al., 2009), 83% reported using an MP3 device for listening to music, mostly with earbuds or supra-aural (over-the-ear) headphones. More than 75% of users reported using their devices daily or several times per week, with roughly half reporting daily use. About two thirds of MP3 users indicated that they listened to the device for 1 hr or more per day. Over half reported that they sometimes or often used their MP3 device to block background noise (58%) and that they were somewhat or very concerned about losing their hearing from PLD use (55%). Generalizing from their sample, the researchers estimated that about 6% of college students listened to MP3 players at volume settings sufficiently high to put them at risk for hearing loss. Fligor (2007) indicated that this percentage ranged from 5% to 15%, depending on the listening environment, with higher volume levels being common in noisy surroundings. Torre (2008) found that over 90% of the college student participants in his survey used a PLD, with almost 90% reporting listening at either a medium or loud volume setting and over 50% reporting listening between 1 and 3 hr/day. McNeill et al. (2010) reported, in a small sample of college students, the median frequency and duration of use to be 6.5 days/week at 2 hr/day.

In a cross-sectional convenience sample of 94 adults (18 to 65 years old) at a university recreation center (Shah et al., 2009), the majority expressed concern about hearing loss (85%) and were willing to protect their hearing by using lower volume settings (77%), and more than half mistakenly felt that NIHL is a medically reversible condition. Many (40%) expressed a desire for their family physician to be more concerned about their hearing, a finding supported by other studies (Chung, Des Roches, Meunier, &Eavey, 2005; Quintanilla-Dieck, Artunduaga, &Eavey, 2009).

Adolescents

The downloading of digital music has become increasingly popular among younger groups. Snowden and Zapala (2010) found that the majority of middle schoolers they surveyed listened to their iPods at unsafe levels. They described middle schoolers as inaccurate judges of the intensity of their selected PLD volume levels, prone to risking NIHL, and failing to see their behavior as risky. Although teenagers (Zogby International, 2006b) and college students (Snowden &Zapala, 2010) reported similar degrees of willingness to reduce their volume settings and listening time, the college students indicated a greater willingness to purchase special earphones, in an effort to protect their hearing, than the teens. The adults in the Zogby International (2006b) study indicated that they were less likely than the teens or the college students to take any preventive actions.

Vogel et al. (2008) obtained qualitative information from focus group discussions of adolescents age 12 to 18 years who were enrolled in prevocational and pre-university education programs. Although these students appeared to be generally aware of the risks of hearing loss from exposure to loud music, they expressed low personal vulnerability to musicinduced hearing loss and a low likelihood that they would take protective precautions. Most adolescents in that study, especially the male students and students from prevocational schools, indicated that they often played their MP3 players at maximum volume, expressed a low personal vulnerability to music-induced hearing loss, and demonstrated poor receptivity to any interference with their music-listening habits. The authors recommended that interventions should target students from prevocational schools and focus on increasing adolescents' knowledge of the risks of loud music and how to protect themselves. Their findings are consistent with the observation that some adolescents do not think consciously

about their MP3-related listening behavior and are likely, left to themselves, to engage in risky listening behaviors and are unlikely to seek protection (Kasper, 2006).

The existence of gender, race, and ethnicity differences in patterns of PLD usage has not been explored extensively, but preliminary data suggest directions in which to aim health communication messages. In adolescents (ages 12-19 years), girls have been found to listen to MP3 music more often than boys, but boys listened at louder levels, making both genders vulnerable to hearing loss (Vogel et al., 2009). Vogel et al. (2007) identified young people who are male and/or of lower economic status or education level as target groups at which hearing loss prevention messages should be aimed. Their findings are consistent with the survey results reported by Shargorodsky et al. (2010). The latter researchers found the prevalence of hearing loss not to differ significantly by age, race, or ethnicity in either the 1988-1994 or 2005-2006 surveys, described earlier.

In their study of middle schoolers, Snowden and Zapala (2010) reported that some students practiced monaural earbud use and sharing an earbud with a friend. The authors suggested that this practice may result in monaural volume levels that exceed those in either ear when listening binaurally, thus increasing the potential for hearing damage. They, along with Vogel et al. (2008), recommended that manufacturers of PLDs should limit the output of their units in future models. That strategy has already been adopted in France, where the maximum output is limited to 100 dB SPL (Dance &Wash, 2008). Snowden and Zapala noted that PLDs could be made safer by developing applications using visual indications of safe and unsafe volume levels and that such applications should be accompanied by education.

Based on a total of 2,500 completed MTV.com survey questionnaires (Quintanilla-Dieck et al., 2009), hearing loss was found to be considered a problem by 32% of respondents, even though nearly half admitted experiencing symptoms such as tinnitus or hearing loss after loud music exposure. Most respondents reported that they learned about prevention of hearing loss mainly through the popular media, indicating that they would adopt ear-protective behavior if urged to do so by health care professionals.

Effects of Earphone Types

Currently, three types of earphones-earbuds, supraaural, and inserts-are widely available commercially. Over half (50%-92%) of PLD users report using conventional stock or extended-range earbuds (Danhauer et al., 2009; Hodgetts et al., 2007; Hoover &Krishnamurti, 2010; Punch et al., 2009).Different earphone styles are known to produce different output levels at the same volume settings (Atienza et al., 2007, 2008; Fligor &Cox, 2004; Fligor &Ives, 2006; Hodgetts et al., 2007; Portnuff &Fligor, 2006). Measured output levels of earbuds are capable of producing 5-6-dB higher levels than supra-aural earphones (Portnuff &Fligor, 2006), and insert earphones are typically capable of producing higher levels than either supra-aural earphones or earbuds (Atienza et al., 2007, 2008; Keith et al., 2008; Rabinowitz, 2010). Fligor and Ives (2006) have stated that preferred listening levels for different styles of earphones should not be expected to be different for the different styles. Hodgetts et al. (2007), however, found preferred listening levels under noisy conditions to be higher with earbuds than with supra-aural earphones, and Atienza and colleagues (2007, 2008) found the opposite. In the latter study, the mean preferred output level was highest for supra-aural earphones, next highest for earbuds, and lowest for insert earphones under quiet, lownoise, and high-noise conditions. Under the high-noise condition, insert earphones were preferred at a 7-dB lower level than with earbuds and at a 12-dB lower level than with supra-aural earphones. These differences in output capabilities very likely reflect differences in the degree to which the different styles occlude the ear canal. This explanation is consistent with the observation that insert earphones have the highest noise-attenuating characteristics, supra-aural earphones have the least, and earbuds have intermediate noiseattenuating properties. Users of PLDs tend to raise the volume setting as background conditions become more distracting (Airo, Pekkarinen, &Olkinuora, 1996; Atienza et al., 2007, 2008; Danhauer et al., 2009; Hodgetts et al., 2007). Because listeners tend to use them at lower output levels, insert earphones offer the safest option, especially in situations in which awareness of environmental noise and hearing or understanding conversations are not critical.

A few investigators have measured the maximum output of PLDs. Keith et al. (2008) measured maximum output levels of nine different models of PLDs and 20 earphones of various types, and found them to range from 101 to 107 dB SPL. Portnuff and Fligor (2006) found maximum levels to range from 96 to 105 dBA. Atienza et al. (2007, 2008) measured levels at the eardrum, using an acoustic manikin, showing maximum levels ranging from approximately 90 to 98 dBA across supra-aural, earbud, and insert earphones. These levels are above those capable of inducing hearing loss when used for prolonged periods, as explained above.

Unfortunately, earphones designed to reduce background noise through active noise cancellation have been found to result in preferred output levels in noisy background conditions that are only slightly lower than with traditional earphones (Hodgetts et al., 2007). Fligor and Meinke (2009) have reported that roughly 5% to 10% of users listen at high levels, regardless of background noise, concluding that the use of noise-canceling or sound-isolating earphones will not necessarily reduce the risk to hearing. Adolescents are prone not to use noise-limiting earphones (Vogel et al., 2009).

Framework for Health Risk Messages

A compelling theoretical framework for developing and communicating messages as part of public information campaigns to prevent hearing loss from PLD use is the Protection Motivation Theory (PMT; Rogers, 1983; Rogers &Prentice- Dunn, 1997). PMT is one of several theories proposed to understand how people choose to behave when faced with various threats, including threats to health. An underlying assumption of these theories is that if people can be motivated to perform adaptive behaviors over maladaptive ones, risk conditions can be identified and prevented. As with other such theories, PMT is based on the idea that motivation toward protection results from a perceived threat and a desire to avoid a potentially negative outcome. It also contains a costbenefit analysis component in which the individual weighs the expected benefits of taking a precautionary action against the costs of taking that action. PMT is unique among similar models-including the well-known Health Belief Model (Janz &Becker, 1984; Rosenstock, 1990)-in that it is organized around "two processes that attempt to match the cognitive processes that people use in evaluating threats (the threat-appraisal process) and in selecting among coping alternatives (the coping-appraisal process)" (Floyd, Prentice-Dunn, &Rogers, 2000, p. 409). PMT appears to be the only such model to incorporate self-efficacy as a separate component, which has been shown to be an important influencing agent in motivational, cognitive, and affective processes (Bandura, 1992; Floyd et al., 2000). Sutton (1982) showed, through a meta-analysis conducted on studies of fear-arousing communications published between 1953 and 1980, that increases in the perceived level of fear consistently resulted in increases in acceptance of the proposed adaptive behavior or intention and that increments in perceived response efficacy increased the intentions to select the adaptive response. In a later meta-analysis, Floyd et al. (2000) demonstrated a moderately strong relationship between increases in threat severity, threat vulnerability, response efficacy, and self-efficacy in facilitating adaptive intentions or behaviors. Conversely, they found adaptive intentions or behaviors to increase with decreases in maladaptive response rewards and adaptive response costs. They concluded that PMT may be useful as a framework for developing individual and community interventions.

In a study of tobacco use in young children, adolescents, and young adults age 10-20 years, Sturges and Rogers (1996) found PMT to be valid in these populations. In general, the children did not show many of the hypothesized informationprocessing deficits related to health threats and how to cope with them, but the theory was found to be effective in explaining children's behavior when they understood the coping strategies and believed they could implement them. The authors suggested that children, and especially younger children, should be taught what actions are best in dealing with health risks and how they can effectively execute those actions.

With respect to our current goal of targeting specific health messages for PLD users, PMT helps to address several basic questions: For those who may be at risk of hearing loss from the use of PLDs, what are the specific health and social consequences of engaging in risky behaviors, what strategies and specific behaviors

are effective in eliminating or reducing those risks, and how might those strategies be implemented in ways that increase the probability of adaptive behaviors and decrease the probability of maladaptive ones?

To develop effective interventions for influencing young people to use PLDs safely, Vogel et al. (2007) hypothesized, based on PMT, that if an individual has the ability and selfconfidence to engage in a specific adaptive response (selfefficacy) or believes that the adaptive response is effective in warding off a threat (response efficacy), there will be a positive motivation to perform that adaptive response. For PMT to hold, the threat must be perceived as severe and as having a high personal relevance to which one is vulnerable. If either self-efficacy or response efficacy is low, there will be a low compliance to recommendations to engage in the adaptive response. The probability of an adaptive response is decreased by the perceived rewards of a maladaptive one. Vogel et al. (2007) cited an example of a person who finds listening to loud music during exercise to be both motivating and enjoyable. Such a person might well be willing to risk hearing loss to conform to stylistic norms and youthful images of attractiveness and healthy bodies. Information campaigns aimed at raising awareness of the seriousness of a threat (i.e., using PLDs at high levels can result in irreversible hearing loss) might effectively change listening habits.

Results of a socially oriented public health media campaign by Beaudoin and Thorson (2007) showed that influencing social indicators among adults can effectively advance youth health outcomes. They found that media campaign exposure was positively associated with beliefs about youth development and behaviors toward youth development. Both outcome measures increased significantly over time with the dissemination of the campaign's television and newspaper advertisements and increased only among respondents who were exposed to the media campaign. Such campaigns can influence the two social indicators, which, in turn, can be expected to have a positive effect on attitudes and behaviors related to youth development.

Conveying Targeted Hearing Health Messages

Among others, Henderson et al. (2011) have indicated that hearing conservation programs aimed at young children and teenagers improve knowledge about the dangers of noise and positively affect their behavior. Clearly, health communication messages should be aimed at preventing or minimizing hearing damage by targeting adolescents (teenagers and middle schoolers) and young adults (including college students), while realizing that these two groups may expose themselves to different degrees of risk, primarily due to differences in awareness of risk and personal vulnerability. In this section, we offer recommendations regarding strategies and specific types of messages that we believe should be conveyed to young adults and adolescents regarding hearing health risks from PLD use. While most of these recommendations follow naturally from our literature review, some are speculative and, therefore, warrant further research to test their effectiveness. (Research needs are addressed in the final section of this article.)

First and foremost, all messages should be conveyed via age-appropriate media. These media should include public service announcements on TV, radio (including satellite radio), and online newspapers and blogs, as well as advertisements or public service announcements in magazines and newsletters, and on Internet sites. Messages should be aimed at educating and informing adolescents and young adults about the potential consequences of PLD use on hearing, and they could consist of written articles and postings and links to websites such as YouTube and YouTube Direct. To maximize impact, the messages should feature spokespersons from the health professions and, at some level of involvement, age-appropriate peer groups. For adolescents, attitude shifts toward hearing-healthy behaviors are likely to require multimodality interventions (Griest, Folmer, &Martin, 2007).

Parents and teachers play important roles in modifying and intervening in children's lives and promoting safe listening practices. It is important, therefore, that accurate and relevant messages be directed to them so they are optimally equipped to inform their children and students about the potential risks of PLDs.

Messages should emphasize the gradual, incipient, invisible, and medically and surgically irreversible (permanent) nature of NIHL; signs of potential damage to hearing, such as the frequent need to ask for

repetition in conversational speech; and the negative consequences of hearing loss on safety and on communication, including the effect of hearing loss on maintaining relationships with friends and family. Adolescents, in particular, should be informed that NIHL is usually slow to develop and shows no symptoms until it becomes substantial and permanent.

A major message to instill in all PLD users is that intensity and listening duration are the two most critical factors leading to NIHL. The danger can be reduced, therefore, either by turning down the volume or by listening for shorter periods of time. A good rule of thumb (Fligor, 2009b) is to limit PLD volume to 80% of the maximum dial setting if the listening time is 90 min or less per day, and to limit volume to no more than 60% of the maximum setting for longer listening times.

Adolescents should be informed that tinnitus, or ringing in the ear, may be a warning sign to turn down the volume or to stop listening for a while. Other warning signs are difficulty understanding conversations or difficulty hearing background noises.

The potential advantages and disadvantages of using insert earphones, as opposed to earbuds or supra-aural earphones, should be stressed, especially to young adults. Insert earphones can protect against background noises, resulting in less need to turn up the volume. Inserts should not be used, however, when hearing conversation or background noise is critical. A recommendation to use insert earphones should be accompanied by a reminder that there are some situations requiring alertness to background noises for reasons of personal safety. Adolescents should be warned that turning up the volume to block out environmental noises can be extremely dangerous, such as when crossing a busy street. Young people of driving age should be warned of the dangers of wearing earphones of any type when operating a motor vehicle.

Members of our profession should advocate that manufacturers include warnings on PLDs or device packaging about listening to loud music, and should advocate to physicians and other medical personnel that they should routinely convey health communication messages regarding PLD use during patient visits. Pediatricians as well as family medicine and primary care physicians are in key positions to provide basic information on the preventability and negative consequences of NIHL, as well as the identification and referral of patients with suspected hearing loss. These medical personnel can be a major influence in preventing NIHL. They need to consider PLD use as a high-priority health issue and discuss the health risks of PLDs in consultations with their younger patients.

Based on a Zogby International (2006a) survey and on the work of Vogel et al. (2007), several subgroups of young people should be specifically targeted. Males may be especially prone to NIHL through loud music from PLDs, and they should be warned about the need to keep volume levels low or moderate. Young people of Hispanic or Latino descent, as well as other minority groups, should especially be warned regarding listening to music that is too loud. Hispanic teens have been shown to use PLDs for longer periods and at higher volume settings than the general population of teenagers, and Hispanic adults appear to be experiencing higher rates of hearing loss than non-Hispanic adults, Hispanic teens, and teens in general (Zogby International, 2006a). Preventive efforts should also target adolescents in prevocational educational programs and those who are not living with both parents (Vogel et al., 2007).

Children, young adults, and parents should be alerted that PLDs are not the only potential source of preventable hearing loss. Adolescents, in particular, should be taught the negative consequences of hearing loss, healthy listening behaviors, and possible preventive measures that will protect their hearing throughout their lives. Messages regarding the need to wear ear protection when working at noisy jobs, performing noisy household activities, or participating in recreational activities-including attendance at rock and other music concerts-are crucial in protecting hearing throughout the lifespan. Where rock concerts are concerned, information should be provided about the commercial availability of musician's earplugs.

Adolescents should be warned that listening to a PLD earphone in only one ear may increase the likelihood of hearing loss in that ear because monaural listening requires a higher intensity than binaural listening to achieve

the same loudness. Because PLDs do not have to be loud enough to be heard by others to damage hearing, adolescents and young adults should be informed that warnings by parents or others to turn down the volume may not be sufficient to prevent hearing loss. Children and their parents can engage in selfcontained programs that are already available, such as Listen To Your Buds (American Speech-Language-Hearing Association, 2010), Dangerous Decibels (www.dangerousdecibels. org; Griest et al., 2007), and Wise Ears! (National Institute on Deafness and Other Communication Disorders, 2010). These programs offer tips and activities designed to conserve hearing and prevent hearing loss. The Dangerous Decibels campaign teaches safe listening practices and has been used successfully in children in Grades 4 through 7 (Griest et al., 2007). Delivering these messages to our youth will allow them to enjoy the benefits of PLD technology while avoiding the potentially deleterious effects of noise-induced hearing impairment.

Future Health Risk Communication Research Needs

Clearly, studies of the effectiveness of various media used in implementing the above messages and strategies, singly or in combination, need to be conducted. Definitive studies of pre- and postintervention knowledge, attitudes, and behaviors regarding PLD use, measured through surveys and experimental measurements of preferred use levels, are greatly needed. Future studies should investigate the role of parent monitoring and habit strength, as well as factors that motivate and serve as barriers to the safe use of PLDs. Relationships between hearing health risk campaigns and the degree to which affected populations comply with recommendations should be determined using a variety of attitudinal and behavioral outcome measures. Future research efforts generally should rely less on convenience sample surveys and more on purposive and stratified random sampling techniques, as well as on experimental designs. Theory-based longitudinal studies of frequent users of PLDs are needed to determine the sociodemographic and psychosocial factors that successfully predict strategies and measures that effectively prevent hearing loss. As appropriate, these investigations should include standard and high-frequency audiometric testing. Another significant need is for large-scale prevalence studies of hearing loss, whether from noise or other causes, to include retests of audiometric thresholds and other audiologic data. Such results would allow a determination of whether NIHLs were temporary or permanent. Finally, given the known association between hearing loss and other conditions and behaviors that are broadly detrimental to health-including smoking, lack of exercise, poor dental health, diabetes, and cardiovascular disease (Shah et al., 2009)-risk-assessment studies of these factors might also incorporate exposure to recreational noise and amplified music.

Acknowledgments

We wish to acknowledge the members of an undergraduate honors seminar at Michigan State University who participated in a series of related research projects that inspired this article, including the following students: Alexandra Artymovich, Hazel Atienza, Sameer Bhagwan, Tori Frost, Minyoung Jeong, Alicia Kramer, Fan Lin, Allan Morris, Daniel Pabst, Neil Patel, and Amy Warren. Two student facilitators, Emilie Sweet and Nathan Williams, also made significant contributions. We gratefully acknowledge the Office of the Provost and the Honors College of Michigan State University for administrative and budgetary support. We also thank Brad Rakerd and Kami Silk for commenting on early drafts of the manuscript.

Sidebar

Targeting Hearing Health Messages for Users of Personal Listening Devices

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Am J Audiol 2011;20;69-82; originally published online Apr 7, 2011; DOI: 10.1044/1059-0889(2011/10-0039)

Footnote

1Levels in the ear canal are known to be at least slightly higher than those existing near the entrance of the ear canal, around 7 dBA higher (Keith et al., 2008). Data that do not incorporate a sound-field equivalent correction factor, therefore, are likely to overestimate damage risk.

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Editor: Sheila Pratt
Associate Editor: Jeffrey DiGiovanni
Received October 5, 2010
Accepted March 20, 2011
DOI: 10.1044/1059-0889(2011/10-0039)

Publication date: Jun 1, 2011

Year: 2011

Energized: Part I of IV

Author: Lerner, Edward M

Publication info: Analog Science Fiction & Fact 131.6 (Jun 2011): 8-47.
ProQuest document link

Abstract: A short story is presented.

Full text: Headnote

Even-maybe especially-when problems have become overwhelming, don't expect agreement on what to do about them. . . .

PROLOGUE

Saturday, February 22, 2020

Earth hovered, almost at full phase, breathtakingly magnificent. Distance concealed the works- and blights - of man, and the globe seemed pristine. Its oceans sparkled. Its cloud tops and icecaps glistened. And it was huge: The natural moon, had it been visible, would have appeared only about one-hundredth as wide.

Earth seemed close enough to touch through the exercise room's tinted dome, but Gabriel Campbell held firmly to the handles of the stationary bicycle. Not that he relied on the strength of his grip: He wore a seatbelt, too, and straps bound his feet to the pedals. This world had too little gravity to notice.

His eyes alternated between the vista overhead and the image of Jillian, his fiancée, which he had taped to the bike's digital readout. Strawberry-blond hair cascaded down her neck and shoulders. Freckles lay scattered across that most adorable, pert little nose. Her clear green eyes - and more so, her smile - all but outshone the Earth.

He was here, on Phoebe, to make a future for both: the Earth and the love of his life. In just one more month, he would go home. Then he and Jillian would marry and they would never be apart again.

Basking in earthlight, his legs pumping furiously on the bike, Gabe was pleasantly tired, professionally fulfilled, emotionally satisfied - unaware that before two hours had passed, he would be dead.

Phoebe completed an orbit around the Earth in just less than six hours, and as Gabe pedaled, darkness crept across the face the world. The changing phase of the Earth told him he had been working out for almost two hours.

Sweat soaked his Minnesota Twins T-shirt, and still ahead of him was a stint on the not quite weight machine: the resistive exercise device. Without exercise, muscles atrophied and bones lost mass in Phoebe's minuscule gravity. Four hours of daily workout were mandated, but he would have worked out anyway. He patted Julian's picture. "I'll be plenty fit for you when I come home." Fit, and horny as the devil.

And with no way up here to spend a dime, he would have banked six months' salary with which to build their future. The pay was damned good, too, much higher than anything he could get on the ground. He tried not to think of the premium as hazardous-duty pay.

The bike whirred. A damper raided in the ventilation system. Voices, indistinct, blended with dueling music players. And then, from the comm unit clipped to his sleeve, soft chimes. Gabe tapped the unit. "Campbell."

"We've got a bot in trouble," Tina Lundgren said, her voice throaty. She was deputy station chief of Phoebe base and in command on the night shift. Not that day or night had any meaning here. The station followed Eastern time for the convenience of folks on the ground. "In sector twelve. "

"And it's my turn to go outside." Hell, Gabe was happy to go out. Only a handful of geologists had ever left Earth, and be was one of them. Had there been any way to get Julian up here, he would want to stay forever.

"What's the problem?"

"Stupid bot tangled itself up in a rock jumble. Otherwise, it's healthy."

Likely a thirty-second task, after an hour or so to suit up and trek halfway across the moonlet. Good deal.

Tina contacting him meant that he was in charge of the excursion. But no one went outside alone- too many things could go wrong, Gabe asked, "Who else is on call tonight?"

"Thaddeus and Bryce. Shall I give one of them a holler for you?"

"I'll take Thad. Newbie could use the practice." Gabe eased off his pedaling. "And no, don't call. I'm in the gym. I need to cool off first." Outside was not the place to get stiff and inflexible.

After winding down for a few minutes, Gabe unstrapped his slippers from the pedals, unbelted, and, carefully dismounting, firmly planted a slipper on one of the deck's Velcro strips. Trailing damp footprints, he crossed the

exercise room, the Velcro pads on the soles of his slippers zip-zipping with each step.
At the hatchway he took hold of the handrail that ran along the corridor ceiling. The Tarzan swing was the quickest way through the station. Many of his crewmates would be asleep, and he kept a Tarzan yell to himself.
Thaddeus Stankiewicz was not in his quarters, the tiny common room, or the even tinier sanitary facilities. When Gabe tried the machine shop, the hatch squeaked on its hinges.
Thad was new to Phoebe and micro-gee; his surprised twitch launched him from his stool and scattered whatever he was working on. Gabe saw cordless soldering pistols, metal tubes, metal rods, wire coils - and, writhing free at the end of its oxygen and acetylene hoses, a cutting torch tipped with blue flame.
Gabe leapt, catching the torch by a hose and with his other hand giving Thad a firm shove clear. The push - equal and opposite reactions - brought Gabe to a near halt at mid room, above the deck. About a foot: Call it thirty seconds hang time. That was plenty long to give Thad a tongue-lashing for his carelessness.
Newbie looked so flustered that Gabe relented. He killed the torch and merely glared as Thad, who by then had grabbed a bench edge, began gathering parts (of what?) and cramming them into his pockets. Stankiewicz was short, broad-shouldered, and intense. His thick black eyebrows and deep-set eyes made him seem perpetually brooding. He wore a standard station jumpsuit, the royal-blue version, with its integral Velcro slippers.
Finally touching down, Gabe slid his foot until it engaged a Velcro strip. "What are you working on?"
Thad shrugged, looking uneasy. Embarrassed? "Personal project."
The station offered precious litde privacy, so Gabe let it go. "A surface rover got stuck. You and I are up to extract it."
"Okay." Thad kept grabbing and stowing the scattered pieces of his project. "Almost done."
"Leave that, Newbie. We have a job to do."
They made their way to the main air lock. The closer they got, the more dark streaks and splotches marked the gray metal panels that lined the corridor. You couldn't help but track Phoebe's dust and grime into the station, and once inside, the stuff found its way everywhere. The crew vacuumed endlessly, but it was a losing battle.
Their spacesuits were filthier than the interior halls and no longer permitted in most of the station. Once you couldn't change in a closet-sized cabin, bracing yourself between opposing walls, the best place to suit up was inside the air lock.
In dthe air lock, back to back and studiously ignoring each other, the two men stripped. Even more studiously they ignored jostling and brushing into each other.
The body suits fit snugly against bare skin. Donning a very elastic body suit in the allbut-nonexistent gravity was like squirming into a sausage casing - underwater. Every nudge and bump sent them careening off bulkheads and decks and each other. Still, these mechanical counterpressure suits beat the hell out of bulky, pressurized spacesuits. Gabe had tried an old-style suit once in training. It was easier to get into, but way more massive. Inertia varied with mass, not weight, and fighting that much inertia was exhausting.
Gabe finally wriggled into his suit and helped Thad finish getting into his own. "Check me out, " Gabe said. He launched himself, with a bit of practiced footwork, into a slow, midair pirouette.
"You look fine," Thad said.
The answer had come too quickly. Anywhere that the suit failed to settle securely into place, fluid would pool beneath. Gaping was the major issue with the skin suits, with the crotch area especially problematical. It wasn't as if Gabe wanted another guy checking out his crotch, but he wanted even less to have blisters down there from an ill-fitting suit. "Check it again," he snapped.
Done properly, spacesuit checkout took time. Eventually, though, their suits were wrinkle-free and without sags or pouching. They mounted and sealed the compression neck rings to which their helmets would attach. They slipped on their backpacks and checked readouts for everything: oxygen, heating, sensors, radio, batteries. Their helmets and air hoses were locked into place.
They stowed their indoor clothes, Thad's pockets clanking, in lockers near the air lock; they buckled on tool

belts and tether reels, stuck emergency maneuvering guns in their holsters, and pulled on gloves and boots. Ready at last, Gabe configured the airlock controls for surface access.
"Oscar, end-to-end system check," Gabe said. Status messages, the text all green, scrolled down the inside of his helmet visor. He had named the voice-activated user interface Oscar as a nod to the suit in Have Spacesuit, Will Travel, a book he had loved as a child- and because, crammed into this suit, he knew how a sardine must feel.
"Comm check, Thad," Gabe radioed on the public channel.
"Back at you," Stankiewicz said.
Gabe called, "Tina? Two robot wranglers set to go outside."
"Happy trails," Tina answered, yawning. "Stay in touch."
"Roger that." Gabe tapped the airlock control panel. Pump noises faded as air was sucked into holding tanks. He felt the first stirrings of warmth from the heating elements in the thermal layer of his suit. Light poured inside as the outer hatch opened. Shrunken to a crescent, the Earth still shone more brightly than a full moon. For now, the moon itself remained hidden behind the Earth.
Newbie gestured at the ladder. "Age before beauty."
"Pearls before swine."
Gabe grabbed the ladder rails and climbed. He paused on the third rung, with only his head and shoulders above the surface. The horizon was freakishly close. Despite earthlight, the landscape was only a dim presence, less reflective than asphalt. Without its coat of rocks, soot, and hydrocarbons, Phoebe's ice - the ice they were here to mine, the ice that could change everything- would have streamed off as a spectacular comet tail.
His grandparents still talked about where they were, what they had been doing, when they first heard that President Kennedy had been shot. For his parents' generation, and even for some of Gabe's own, the event seared into the collective consciousness was 9/11. The World Trade Centers crashing down had marked Gabe too- he had been sixteen that day- but the news that had truly marked him, had changed everything for him, even more than 9/11 or the Crudetastrophe, had come a mere five years ago.
As though it were yesterday, he remembered: a rumor at first, run rampant on the blogosphere, then the hastily called presidential address. A space rock, a big one, was headed Earth's way. It was not dinosaur-killer sized, not quite, and the likelihood it would hit Earth was only one in a thousand - but no sane person would leave home against those odds, let alone bet the future of civilization. The rock had to be deflected, and despite its many woes only the United States had the capability to tackle the job.
But the excitement, the game changer, was this: Rather than deflect the rock away, NASA would undertake to aim it more precisely at Earth. To ensure capture of the object. To exploit its resources and forever change space exploration.
And to hell with whether anyone else thought this was a bad idea. Gabe had never encountered much in the way of presidential leadership. It was exhilarating.
He had long ago lost his youthful interest in the space program. Decade after decade of pointlessly circling the world, scarcely skimming the top of the atmosphere: What was the point? No one cared anymore.
But suddenly there was a reason. Saving the planet. Maybe, in the process, pulling the country out of an economic abyss. And to be honest- adventure. Faster than the president could finish speaking that night, Gabe had vowed he would be an astronaut. Somehow.
That rock - only it had turned out to be far more complex and interesting, a dormant comet - was now Earth's second moon. Was Phoebe. And once again, be was about to explore its ancient surface.
"The view here is less interesting," Thad radioed from the bottom of the air lock.
"Sorry." Gabe unreeled four feet of tether, clipping its carabiner around the staked cable labeled "sector twelve." He clipped a second tether to the guide cable before grabbing handholds outside the hatch and pulling himself

up and out. He waited ten feet along the cable until, gopherlike, Thad's head and shoulders appeared.
"Two tethers," Gabe reminded the newbie.
It was easier by far to fall off this toy world than to cross it. Phoebe was roughly a sphere a mile and a quarter across- where rough better described the body than sphere. It was round in the sense that a popcorn ball was round, with stony lumps taking the place of popped kernels and veins of frothy ice- and in spots, only vacuum - taking the part of molasses. And in the sense that a popcorn ball remained a ball after it had been whacked a bit, dented here, flattened there. Phoebe was less a single object than a rubble pile loosely bonded by its mutual gravity. If its orbit had dipped much lower, the tidal forces from Earth's gravity would have ripped the little moon to shreds.
"Two tethers," Thad repeated. "Done. After you, Pearl."
Gabe pulled himself hand over hand along the cable, coasting above the inky surface. His eyes insisted he was soaring up a cliff face. Gravity's feeble tug told his inner ears he was falling into the cliff face. His gut wished eyes and ears would come to some agreement.
After twenty yanks Gabe stopped pulling. "Coasting," he radioed the newbie.
"Thanks. The view from behind is unattractive enough without climbing up your butt."
Gabe slowed with gentle hand pressure against the cable at the first glint ahead of a piton anchored in the rock. Carefully he undipped one carabiner and snapped it back onto the cable on the opposite side of the ring. He did the same with his second tether. He made sure Newbie followed the same fail-safe procedure before resuming the trip to sector twelve.
The surface lights, antennae, and trash dump of the station dropped behind the too close horizon. But a status icon in his HUD shone a steady, reassuring green, confirming connectivity with Tina and the command center. The metal guide cable did double duty as an antenna.
Every hundred or so feet a piton interrupted their glide, and in such short increments they made their way toward sector twelve. After ten minutes Gabe checked in with Tina. Twice he saw survey robots - their silvery, octopoid shapes unmistakable - creeping along the surface. The second bot's instrument suite must have sensed a buried ice seam, because the machine was staking a radio beacon. Had Gabe cared to tune to the proper frequency, he would have heard soft beeping from the marker.
Ice meant water. Water meant oxygen and hydrogen. And water, oxygen, and hydrogen already in near-Earth orbit- not lofted from Earth's surface or the permanently shadowed polar craters of the distant moon at the cost of thousands of dollars per pound-were dearer than gold or platinum. So, too, whatever mineral wealth could be wrung from the rocks of Phoebe. On scheduled outings, he continued to survey for exploitable resources.
It was said: low Earth orbit is halfway to anywhere in the solar system. That was a metaphorical truth, almost poetic. Half the work of going anywhere in the solar system was expended fighting Earth's gravity. Building power sats with Phoebe's mineral resources, beaming down solar energy to an energy-starved world, would be only the beginning. Phoebe would be the gateway to the planets.
Away from the station the moonscape dissolved into a shadowy sameness. They passed the pilot distillery sited at a safe distance from the habitat. Parallel glints revealed pipes snaking across the dark surface, delivering water, oxygen, and hydrogen to the base.
Gabe played tour guide, pointing out the little world's interesting features. "On our left, the thermal nuclear rockets that nudged Phoebe into orbit." He glanced at his Geiger counter, even though workers had long since recycled the uranium fuel rods in the base power plant. No matter how many powersats got their start here, Phoebe, forever behind its sunshield, would stay nuclear. "And on our right, the Grand Chasm. It's no great shakes by Earth standards, but relative to Phoebe, it's huge."
"Uh-huh," Thad said.
Newbie had been moody since they left the station. As for what preoccupied him; Gabe could only guess. Maybe no more was at work here than that Thad- like most of the crew - was an engineer, without interest in

Phoebe itself. When Thad deigned to interrupt the travelogue, it was always with practical questions. About pressure suits, their related gear, and how soon anyone would come after them if comm should breakdown... Fair enough. Knowing the limitations and vulnerabilities of the equipment could save a person's life. Although Gabe wished he could share the excitement of discovery, the rocks were not going anywhere. Maybe Newbie would lighten up after he got more comfortable with his equipment.

They glided past the infrared telescope. Good, Gabe thought: we're halfway there. About all he understood about IR astronomy was that hot objects emitted infrared, so you wanted your infrared instruments kept cold to minimize their own intrinsic thermal noise. Behind its sunshield, Phoebe was about as cold as anywhere in Earth's neighborhood ever got. The 'scope's cryocooler, powered by the base nuclear reactor, kept the IR sensor colder still.

He slowed or stopped whenever a surface feature caught his eye, but even a cursory look said most of these rocks were yet more carbonaceous chondrites and silicates. Two bits of stone he could not immediately identify went into his sample bag, for tests back at the station.

He was curious about this tiny world, even if there was no point in discussing it.

Isotope dating of previous samples said Phoebe was more than four billion years old. So why did it still exist? Its desiccated, rocky crust was not that impressive as an insulator. Had it always followed the orbit in which it had been discovered, swooping inside Earth's own orbit, Phoebe's ice would have sublimated long ago, its rocky remains dispersed into a short-period meteor shower. Of course if it had always followed that orbit, the Near Earth Object survey would have spotted Phoebe years earlier. Or Phoebe would have smacked Earth before anyone even knew about deatii from the sky.

So Phoebe had had another orbit, an orbit more distant from the sun. Planetary astronomers had yet to work out Phoebe's original path and what planetary close encounter might have sent Phoebe diving at the Earth. Gabe guessed there was a Nobel waiting for whoever figured it out.

As the Earth waned and the landscape faded into darkness, he had Oscar project a topo map on his HUD. The blinking red dot had them most of the way to the green dot representing the stranded bot. Pits and ravines, ridges and rocky jumbles leapt out of the map image. He tugged his tethers once, twice for reassurance.

"Let's stop for a minute," Gabe called. New Earth was imminent, and Newbie was in for a treat. "Watch the limb of the planet."

Earth's crescent became the thinnest of arcs, then disappeared.

A pale, shimmering arch - part rainbow, part oil slick - emerged from the darkness. Phoebe's sunshield. The free-flying Mylar disk that hovered above Phoebe warded off the sunlight that might yet boil away precious ice as boots and robot tentacles and, eventually, mining operations scraped through the insulating surface layers. The shield's sun-facing side reflected most of the light that hit it. What little sunlight penetrated the shield-the bit they could see- was scattered by the backside's granular coating.

For an endless moment the arch, large but faint, was the brightest object in the sky. Then the trailing edge of the shield, too, slid into the Earth's shadow, abandoning the sky to stars like chips of diamond.

Now the sole clue to Earth's presence was a hole in the star field. Even with eyes fully adjusted to the darkness, from this altitude Gabe could not spot any city lights. He could pretend that all was well below, that the world was not divided between energy haves and have-nots.

"Show's over," Gabe said. He switched on his helmet lights. An instant later, Thad activated his own. "Pretty cool, though, don't you think?"

Thad only grunted.

"So, Thad. What were you making in the shop?" Gabe was just making conversation. Skimming the pitch-black rock face in the near-darkness was eerie.

He felt a tap-tap on his calf and twisted around. Thad had only one hand on the guide cable, waggling his other hand. Two fingers were raised.

"Oscar, private channel two," Gabe ordered. "Okay, Thad. What's going on?"
"Private channel two," Thad repeated. Finally, he added, "You'll keep this to yourself, right?"
"If that's what you want."
Hand over hand, they went. A rim of sunshield reappeared just before the Earth returned as a new crescent. Gabe doused his helmet lights. On his HUD the red and green dots were converging. Another few minutes and they would veer from the guide cable.
Eventually Gabe prompted, "Well?"
"Okay. I put my life in your hands." Thad sighed. "I have a thing for Tiny."
Tina Lundgren was big for an astronaut, even a male astronaut. The nickname was inevitable-and you used it within her earshot at your own peril. Gabe had to admit that, in an Amazonian kind of way, she was sexy. And she was one of only two women, and the only unmarried woman, on Phoebe. Gabe understood Thad wanting this conversation on a private channel.
Having bared his soul, Thad went on and on about Tina's womanly charms.
"Uh-huh," Gabe finally interrupted. "And you were cutting pipe as an outlet for your unrequited love?"
"Not exactly. " A rueful laugh. "I'm making a still. Whether or not homebrew appeals to her, I figure it won't go to waste."
"Does she know how you feel?" Gabe asked.
"Not from me! Not yet. Frankly, the woman scares the crap out of me. Maybe that's why I have to have her."
To their left, a ghostly plume: an ice pocket flashing to steam bursting from the ground.
Behind its sunshield Phoebe should be colder than the night side of the moon: For two weeks out of four, every part of the moon but a few deep polar craters felt sunlight. But shield or no, some sunlight did reach Phoebe. No software was perfect, and occasionally the sunshield - tugged by Earth, Moon, and Phoebe, pushed by the solar wind and by sunlight itself, balancing the many conflicting forces with its own feeble thrusters- drifted out of position. Whenever that happened, sunlight beat directly on the surface. Even when the shield balanced perfectly, the traces of sunlight penetrating the shield scattered in unpredictable ways. Earthlight and moonlight were, in the final analysis, echoes of sunlight. And heat leaked from the underground base and its nuclear power plant. All that energy mingled, meandered, and reradiated in unpredictable ways.
And so, seemingly at random, little geysers. The vapor was too diffuse to do any harm. Most times. If you were unlucky, a geyser could sweep you right off Phoebe.
"A still," Gabe repeated, his thoughts divided between the plume, already trailing off, the topo map on his HUD, the landscape sliding by inches beneath his visor, and the conversation. Ethyl alcohol boils at a lower temperature than water, so alcohol fumes waft up a still coil before water vapor. You separated out the early condensate. But up comes of having gravity. "Will a stiil even work in Phoebe's grav-"
Too much happened at once, the sequence unclear:
-A sharp tug on Gabe's backpack.
- Thad saying, "Wrong answer."
-A power alarm.
-A second yank.
-Helmet lights and HUD going dark.
-A hard shove forward.
Gabe twisted around. Earthlight showed Thad a good twenty feet away, receding. Just staring. And bulging from the mesh pouch of Thad's tool belt: two battery packs.
Without power for his suit's heating elements, Gabe would freeze within minutes. Already the cold seeped into him, body and thoughts turning sluggish. He got his feet beneath him, even as he ripped lengths of tether from their reels. He leapt.
His right foot slipped on loose gravel and he sailed far to the side.

The shorter tether pulled him up short. Its yank started him spinning even as the tug started him back toward the surface. Too slowly. He took the maneuvering pistol from its holster- but it slipped from fingers already numb with cold. As he drifted down he managed to grip a rock outcropping.
All the while, maintaining his distance, Thad watched. Stared.
"Why?" Gabe screamed. Not that his radio worked without batteries. Not that his shout could cross the vacuum. "Why are you doing this?"
Maybe his murderer read Gabe's lips. Whatever the reason, Thad shrugged.
Gabe advanced. Thad retreated.
As cold became all, as consciousness faded, the last thing Gabe saw was the waxing crescent Earth.
Earth no longer seemed close enough to touch.
"He just went nuts!" Thad said once more.
With minor variations the words had become his mantra. First with Tiny, when he had called in from across Phoebe about the "accident." Over and over with Bryce Lewis and Alan Childs after they joined Thad on the surface. And now hopefully for the last time, in the station's comm-gear-packed command center, with Lyman Hsu, the dour station chief.
"Details, please." Hsu rubbed his pencil-thin mustache as he spoke.
Thad ignored the request. "You should have let me go with the other guys. You can't imagine what it was like." I damn well hope you can't imagine it. He struggled to understand it.
"You'd been outside long enough for one day. You know the rules."
Because their utility craft were little more than flying broomsticks: compressed-air bottles, saddles, and minimal controls mounted to latticework frames. A counter-pressure suit was your only protection.
"But I don't have to like the rules," Thad said. Which, emphatically, he did not. What if he had overlooked something? Joining the rescue team might have given him a chance to cover his tracks.
"Details," Hsu prompted.
"You heard Gabe switch to private channel two." It had all come down to Gabe taking his cue, because everything on the public channel got recorded. Sooner or later, he would have figured out what Thad was building. Certainly the bullshit about Tiny and making a still for her would not bear scrutiny. That fable was all Thad could come up with on the spot, blather to occupy Gabe's mind until they got farther from the station.
"When I linked in, Gabe was already mid-rant. He missed Julian, unbearably. He knew- but couldn't explain how- that she was cheating on him. He loved her and needed her and couldn't bear for anyone else to be with her. He would show her. And then" - Thad paused dramatically - "he undipped his tethers."
"And you. . . ?"
"What do you think, Lyman? I tried to talk sense into him, damn it."
"And not a word of this reported to base."
"I didn't dare switch channels! There was no telling what Gabe might do if I wasn't on. If I didn't respond when he expected an answer."
"And he jumped anyway."
"As I keep telling you," Thad said.
He had never been much of a basketball player. On a good day, his vertical leap was two feet. On Phoebe, that was more than enough leg strength to vault two men and their gear past escape velocity. He had let go of the body, untethered, before coming to the end of his own fully unrolled tethers. After the ropes pulled him short with a jerk, Thad had watched the corpse recede into the darkness.
Hsu tipped back his head, staring through the command-center dome. "He had second thoughts."
"What do you mean?" Thad asked.
"Every indication is that Gabe froze to death. But when Tina and Lewis found Gabe, the suit heater was on. He must have been in late-stage hypothermia by then, half delirious. It's a marvel his suit still recognized his voice."

Hsu sighed. "By then it was too late."
The heaters kicked back on once Thad replaced the batteries. Not done till Gabe was unequivocally dead.
"It's a shame," Thad said, meaning it. Gabe was not a bad guy, only in the wrong place at the wrong time.
"A damn shame."
Silence stretched awkwardly. After a while Thad said, "It's been a hell of a day. I'd like to . . . hell, I don't know what." Except that he knew damn well. He had to finish what Gabe had interrupted, and get everything stashed away. At least then the man would have died for a reason. "Something other than relive this disaster."
Hsu nodded. "Sounds like a good idea. Get some sleep."
"I will," Thad said. And wondered if he could.
CONVICTION
2023
Monday, April 10
Marcus Judson slipped into the back of the downtown Baltimore hotel ballroom more than an hour late. Though the room was packed, it did not seem like anyone was having a ball. Certainly not his colleagues huddled at the speakers' table at the opposite end of the room.
He surveilled from behind a freestanding sign that read The Power of Powersats: a Town Meeting. From the way Jeff Robbins, one of the EPA representatives on the dais, blotted his face with his handkerchief, the townsfolk bore, however metaphorically, torches and pitchforks.
The PowerHolo orientation spiel (of which Marcus was thoroughly sick, after many such gadierings) ran about thirty minutes. That meant the Q&A session had just begun. It did not bode well to find Jeff already wound so tight. Plenty of head-in-the-sand types in the crowd, then. Damned Luddites.
Marcus hated being such a cynic - but he was more this way every day.
This could have been any public meeting room anywhere. High ceiling. Cheap carpet and cloth-covered walls to muffle the audience noises. Sidewalls comprised of narrow segments that, folded into accordion pleats, would open into other, similar rooms for additional space. Recessed ceiling lights. Amplifier and loudspeakers deployed across the foot of the dais. HoIo projection console.
Men and women filled the rows of chairs, and yet more people had queued up in the aisles for turns at the audience microphones. At the right-hand mike, a tall, balding man, his sleeves rolled up, was gesturing grandly.
Marcus had arrived too late to catch the man's point. If he had a point. They often didn't.
"... would be a better use of public land," the balding man finally concluded.
"Thank you for your comment, " Lisa Jackson began. As she - as all the panelists - had been trained. "We agree that parks are important. That said, so is a sufficiency of electrical power. We at the Department of the Interior must consider both."
The novelty of powers at town meetings was long past; the room's lone tripod-mounted camera might feed only the municipal Internet server. With no media visible the protocol would have been the same, because half the audience sat holding comps or phones or datasheets. Any slip-up would be on YouTube within minutes. So all panelists were trained in changing the subject. Better a non-answer than an impolitic one.
If inconvenient questions were to be evaded, what was the point? Why hold these town meetings at all? Marcus had asked, and his question, evidently, was also impolitic. "It's policy," a long-ago boss had once told Marcus in similar circumstances. "It doesn't have to make sense."
But coaching by a NASA spin doctor was not what had made Marcus a cynic.
He half listened, half pondered how and when to move to the front of the room. On the dais, behind the long, skinny table and its billowing, ruffled skirt, sat eight chairs: two places each for Interior, Energy, the EPA, and NASA. The lone unoccupied seat was Marcus's.
With Lisa expounding from five chairs away from the empty seat, this seemed as good a time as any for Marcus to claim his spot.

He edged through the least crowded aisle, murmuring apologies as he went, answering dirty looks by tapping the NASA ID badge clipped to his suit lapel. I'm with the government. I really am here to help.
Once through the crowd, he slid into the empty chair at the speakers' table.
Ellen Tanaka, NASA program manager for the powersat- and Marcus's boss - looked weary. They all did. Her eyes, too myopic for LASIK, were owl-like behind thick, round lenses. She covered her mike with a hand. "Good of you to join us," she whispered.
That he had texted ahead changed nothing. Everyone had made the drive that morning from somewhere in metro DC. She would not want to hear about the rain, the line at the gas station, or signals flashing red throughout Fairfax County because the traffic management system had crashed or been hacked. He would not have, either.
"Car trouble," he mouthed. "Sorry."
Lisa was still answering the balding man. "We'll be using property already dedicated to power generation, in this case for ground-based solar power. In particular, we'll retrofit selected solar farms with arrays of short antennas suited to receiving power downlinks. Land recycling, if you will - very environmentally correct. The antennas will be vertical, scarcely blocking any sunlight to the solar cells on the ground. So, you see, the powersat demonstration does not preempt any parkland."
"But that land shouldn't be wasted on-" "Thank you for your comment," Ellen interrupted. "I'm afraid that's all the time we have with so many others still waiting." She pointed to the head of another line, where a middle-aged woman, rail thin, her face tanned and leathery, clutched a folded sheet of paper. The woman wore the judgmental expression of a Resetter. "Yes, ma'am?"
Marcus and Ellen took turns moderating these meetings, because NASA's part of the solar-power-satelite project drew the fewest questions. Public comments mostly concerned public safety, energy policy, and land use. Never mind, Marcus thought, that Powersat One, the full-scale demo system nearing completion, would be the largest structure ever built. Or that NASA was constructing PS-I in space, where neither night nor weather could interrupt the sunlight streaming onto its solar cells.
But all that dependable- and desperately needed - solar energy became useful only when it reached the ground. And once brought to Earth, the power had to be distributed far and wide. Terrestrial solar farms already had connections to the national power grid. Siting the downlink antennas amid the ground-based solar farms just made sense.
To Marcus, anyway.
"About that downlink," the thin woman began, frowning. "'Downlink' sounds like an Internet connection, and that's more than a little disingenuous. Your downlink is nothing so benign. You're talking about microwaves. A gigawatt or so of microwaves. If you turn on that satellite, it'll roast anyone unlucky enough to encounter the power beam."
"No, it won't," someone muttered from down the table- and a mike picked it up.
Marcus leaned forward to see who had gone off-script. Apparently Brad Kaminski, from DOE. He was clutching his mike stand, and a bit red in the face.
"Um, thank you for your comment," Brad backtracked. "Yes, downlinks from the power satellite will use microwaves. That's for a good reason: Earth's atmosphere is transparent to microwaves. By beaming microwaves, we can harvest most of the power on the ground.
"But as for safety, ma'am, there is no cause for concern. The beam is strongest at its center. By the edge - "
"How strong?" someone in the crowd hollered.
"About like direct, overhead sunlight," Brad said. "By the edge of the- "
"Like a second sun beating down on you," the woman at the mike said. "That should be healthy."
Brad persisted. "By the edge of the collection area, a zone miles across, the beam has attenuated to well within public safety standards."

The woman laughed humorlessly. "You expect the birds to mind your fences?"
From deep within the crowd, a snort. "Lady, do you have any idea how many birds get chopped up by wind generators?"
"Forget the damned birds!" someone shouted back from across the ballroom. "Just keep the lights on and my car charged."
Taunts and insults erupted, on every side of the issue. Cameras big and small pointed to memorialize the chaos. It took Ellen several minutes to restore order
In order that more decorous criticisms could resume. That powersats were: unsafe, unnecessary, or poor investments. That if only everyone conserved, instead of wasting resources on foolishly audacious projects, it would be better for the United States and the entire Earth, too. That the country could extract additional energy from the tides, or build more wind farms, or re-shingle more roofs with solar cells, or grow more biomass, or ... do anything other than the powersat project.
And from the opposite end of the opinion spectrum: That the wind did not always blow when people need power. That-duh!- the Sun did not shine at night or do much for snow-covered roofs. That sunlight beating down on Arizona did nothing for New England. That people shrieking "energy sprawl" against a few square miles to be used for East Coast microwave downlinks fooled no one by suggesting new high-voltage power lines could be built across the continent from solar farms in the southwestern deserts. That the NIMBYs had even less credibility proposing huge new storage systems to save solar power for exploitation at night. And that if the tree-huggers did not wise up, civilization would grind to a halt. Shivering in the dark.
Since the Crudetastrophe, oil was scarce and painfully expensive. That did not make gasoline any less essential. There simply was not enough electrical power generation to cope with the hurried - and ongoing - switchover to plug-in cars; if there had been, the overburdened power grid could not reliably distribute the added load. Marcus did not bring up any of that. No one on the panel did. They were not permitted to say anything verging on politics, geo- or other.
Do it all, Marcus wanted to shout, but that was yet another truth no one on the panel was permitted to speak. Any other means of power generator, distribution, or conservation was someone else's project.
From time to time it was his turn to field a harangue. He dutifully thanked whomever for their comment and, all too often, parroted some preapproved, eminently inoffensive platitude. And began to wonder if there was any way he could not have become cynical.
If he hadn't been already.
A young woman in a Johns Hopkins sweatshirt reached the front of a comment line. An engineering student, Marcus suspected, because she asked about the radiation environment in space gradually degrading solar cells. When he thanked her for the question, he really meant it. He was an engineer too.
He talked about radiation hardening, onorbit repair methods, and opportunities for in-space remanufacturing. He reviewed the deleterious effects of weather on terrestrial solar cells. This, finally, was a question he could answer without breaking protocol - not to mention an interesting topic - and he pretended not to notice his boss's sidelong glances until she tap-tapped her mike to cut him off. It was almost noon and they were, "regrettably nearly out of time."
Two more danced-around questions and the ordeal was over. Until two days hence, in another city. Marcus forgot which, and it hardly mattered.
This was no way to save a country.
Long after Marcus and his colleagues had collected their things and were ready to hit the road, many of their audience still milled about, arguing in animated clumps. The stragglers showed no sign of clearing the aisles. The wall behind the dais had two camouflaged service doors. Marcus opened one a few inches and peeked out. He found the service hallway empty and, apart from the distant, muffled clatter of pots and pans, quiet. "Shall we?" he suggested to his colleagues.

No one argued.
In the austere corridor, her shoes clicking on the tile floor, Ellen limped along beside Marcus. She had not quite recovered from a skiing accident the previous winter. Ellen was tall to begin with; in heels, she was almost his height. "Not fun, Marcus, but we need public support. It's going to be a big change."
"Understood," he said. And still a waste of their time.
"Not everything can be as fascinating as radiation-hardening techniques for solar cells. " With a laugh, she changed the subject. "What's the car problem?"
"The circuit breaker in my garage tripped overnight." The overtaxed grid, sagging and surging, was beyond anyone's ability to predict-and with every new electric car on the street the load became a little greater, a bit more mobile, and that much less predictable. "The breaker must have popped right after I got home and plugged in the car, because I had about zero charge this morning."
"And you had to buy gas? Ouch. Well, you must have had ration credits left. That's something."
Double doors swung open into the service corridor, the kitchen noises swelling, and waiters rushed toward them bearing lunch trays. Marcus stepped aside.
Twenty bucks and change per gallon. That ridiculous line at the pump. Ration credits he had been saving for a vacation. None of it bore dunking about.
"And Marcus. . ."
The pregnant pause. Her charcoal-gray power suit. Heels. She was way overdressed for the morning's public flogging. "Where are you off to, boss, and what do you need me to cover for you?"
She grinned. "Clearly we've worked together too long. The administrator called last night. He wants a program update today. Hence, you'll be taking my place at this afternoon's interagency coordination session.
I'll mail the minutes from the last session." When the administrator of NASA called, you went. Still . . . "Isn't that task force all career civil servants?"
Which Marcus was not. He was a SETA contractor: systems engineering and technical assistance. Fortunate SETA contractors got involved in everything their government counterparts did. Unfortunate SETA contractors took meeting minutes and fetched coffee. Lucky or not, they spent most of every workday stymied and snubbed by the contractors from the big aerospace corporations who did most of the actual R&D.
If you had to have a supervisor, Ellen was as good as ttiey came. Kendricks Aerospace, prime contractor for the demonstration powersat, balanced the scales. Most Kendricks engineers on the project detested Marcus. Not personally, or even professionally - they would have hated anyone looking over their shoulders. Asking questions. Making suggestions. Auditing their work. Highlighting risks. He got the disdain they would not dare exhibit toward Ellen.
When had he last been able to do, not merely review?
"Trust me," Ellen said. "You won't be the support contractor to sit in."
"What's my goal?"
"Answer questions and take notes. Beyond information exchange, these meetings don't specific goals." She paused. "If anyone tries to pin you down to something uncomfortable, you can plead lack of authority."
Because he had no authority. God, he loathed meetings.
They exited the service area into a carpeted corridor. A wall sign pointed the way to the main lobby. They continued walking. "Okay," Marcus said, "where is this meeting?"
"DOE in Germantown. Nancy Ramirez's office."
Reflexively, Marcus began guesstimating the miles added to today's commute. He must have winced.
"I'd reimburse you for the gas if I could," Ellen said.
But more than that, she had the look that said I wish there were something I could do for you. At least she had stopped asking if he "wanted to talk about it." Because he really, really did not.
As for NASA reimbursing him for the gas, he understood: Her hands were tied. Space Systems Science,

Marcus's direct employer, had bid for the SETA contract at Goddard Space FUght Center without reimbursement for local travel. Shifting local travel costs onto the staff kept the hourly rates a few cents lower. It hadn't much mattered, when Marcus took this job. He had lived only a couple of miles from GSFC then. He told himself he might not have a job if SSS had pursued the work less aggressively.

He told himself lots of things. Other things he just refused to think about.

"But maybe," Ellen added hopefully, "your car charged up during the meeting."

"I wouldn't complain." Even at the hotel's exorbitant parking-plus hourly rates.

But in the two hours he had spent at the town meeting, his car would not have taken much of a charge. The Jincheng was overdue for a battery-pack replacement - which would run him about half of what a new car would cost. New car or new battery? He would put off buying either for as long as he could, rather than support the lithium cartel. Bolivia and Chie, curse them, controlled half the world's lithium supply. Every lithium-ion battery bought anywhere propped up prices for the cartel.

Supporting the Russian oil cartel this morning felt just as crappy.

In the hotel garage, the eight panelists fanned out toward their various vehicles. Coming straight from home, only three had managed to carpool. "Have a good meeting," Marcus said as he and Ellen paused by his car.

"You too," she said. "And don't do anything I wouldn't."

"You should have thought of that earlier. " Smiling, she kept walking.

Marcus's car had accepted scarcely a tenth of a recharge, about what he expected. The car would switch to its little gas engine well before he reached his meeting.

"Destination: Department of Energy, Germantown complex," he announced, backing out of his parking spot.

The console beeped and a reasonable-looking map appeared in the main dashboard display. He tapped the ACCEPT key.

Once he merged into the clotted traffic of 1-695 he activated autodrive, and the car guided itself to the rear of an auto platoon. He found himself nose-to-tail with a late-model blue Toyota. Seconds later, a white cargo van filled his rearview mirror. The van was too close to make out the company logo on its hood.

He had more pressing things to read than logos. Marcus dismissed the map to check and Ellen had already forwarded the he needed. But he had driven too many years before autodrive to conwhile cars not two feet apart joined departed the platoon, and when to both sides, bumper to bumper, eighteen-wheelers blotted out the sky.

With only the ride to prepare, he opaqued windows and began skimming.

He had also been around long enough to expect recession to reduce traffic. Not since Crudetastrophe. Without funding for highways crumbled faster than diminished.

Marcus began reading Ellen's annotated minutes. He stopped noticing (Around accidents? Potholes? The crossing the road? Through the windows, he could not tell.) and from one freeway to the next. The noises faded....

A pop-up usurped the dashboard screen. red letters announced: Power alert. text, scrolling, gave the particulars: a line severed from the NantuckSound wind farm. Terrorism neither indinor ruled out.

Marcus rapped the screen to acknowledge again to retrieve a list of related headlines. The list expanded faster than he could tap through to even a smattering of the articles. Scattered secondary outages across Massachusetts as generators, distribution stations, and power lines overloaded and shut down. Sporadic blackouts predicted throughout New England, possibly rippling down the East Coast, while the grid rebalanced, or until the wind farm's underwater high-voltage line could be repaired. The schedule of preemptive brownouts. Talking heads blathering about unsafe, indefensible infrastructure. Resetter groups saying the same, more nastily. Predictions, into the tens of thousands, how many cars would fail to recharge overnight. The certain spike tomorrow in East Coast gas prices, a buck or more per gallon, when all those cars headed for the pumps. The stock market tanking.

Multiple groups and causes claimed responsibility.
Cursing them all, he went back to Ellen's notes. Too soon, the dashboard trilled: time to disengage autodrive. He took back control and made his way to the DOE parking lot. The charger-equipped slots were all occupied. Sighing, Marcus got out of his car. Another damned meeting. He wondered if ever again he would get to do something.
Wednesday, April 12
"Good afternoon," Dillon Russo told the latest earnest entrepreneur to pass through his office that day.
They were all earnest. It took more than earnest to set yourself apart. He had been merely earnest once. Then he had gotten savvy. And shorted a portfolio of mortgage-backed securities before the markets realized that sub-primes were toxic. And so, became very rich.
And so, here he was....
Who is this woman? Courtney something. One more engineer and MBA, yadda yadda yadda. Dillon had already forgotten her last name. If it mattered, he could find the name in her leave-behind or on his calendar. He did not foresee it mattering.
Speed dating, venture-capital style was a lot like speed dating of the social kind, only even more demeaning. Dillon allotted each petitioner a half hour: fifteen minutes for the pitch, ten for Q&A, and five alone, afterward, to organize any notes he had taken. The lone note for Courtney read not on your life, jotted down before, earnestly asserting her appreciation for his time, she all but backed out of his office.
He dropped her leave-behind into a drawer. She had brought the day's fifth pitch for enhanced cellulosic biofuel production. Her process involved platinum nanoparticles, lots and lots of them, employed as catalysts. As though, even in a world starved for energy, that could make any kind of economic sense.
It hardly mattered. Fail or succeed, anything anyone could hope to accomplish with biofuel synthesis was mere tinkering at the margins. He only cared about opportunities that could make a real difference.
Another make-us-both-a-pile-of-money pitch would come through his door in about four minutes. He used a half minute to get out from behind his desk and stretch. The rest he would spend admiring Central Park, thirty-eight stories below.
At least the biofuel types had done enough homework to know that his interests lay in eco-friendly opportunities. Ditto Noah, the gangly, pinch-faced man pitching virtual-reality tools for high-end telecommuting and Suresh, with a new wrinkle in fuel cells. Those who had not done their homework, who wasted his time with trivial visions for the next big social network or junk food, got the hook. Fast.
Dillon watched a line of mounted police watch a mass gathering down in the park. In theory demonstrations were legal in Central Park, but permits remained hard to come by and the crowd swirled and surged in a pretense of spontaneity. He never could judge crowd sizes, not even from his bird's-eye view. A thousand? Two? It did not help his estimating that the crowd shifted restlessly. When, all but inevitably, the cops dispersed the demonstrators, a new flash mob would simply converge elsewhere in the park.
Permit or no, frequent arrests notwithstanding, the Resetters demonstrated daily in the park. Applauding, if not the Crudetastrophe itself, the resulting economic slowdown - and, with it, the reduced use of fossil fuels - as benefits to the environment and the planet. Opposing new energy infrastructure as only repeating past environmental insults.
Dillon could sympathize with their opinions. But to expect civil disobedience and petty vandalism to change anything? Such naïveté sadly amused him.
Someone rapped firmly on his door.
"Come in," he called.
A blond woman strode in, wearing a severely tailored dark-blue suit. She was short, compact, and very serious.
"Mr. Russo," she began, speaking quickly, not yet halfway to his desk. Very focused. Focused beat the hell out of earnest. "I'm Kayla Jorgenson, of Jorgenson Power Systems. Thanks for seeing me. You won't be sorry."

I'll be the judge of that. "Have a seat, Kayla."
Handing him a brochure, she launched into her pitch. "What the world needs, more than anything, is clean, affordable electrical power generation. We had sporadic petroleum shortages before the Crudetastrophe. Electric cars - not that anyone can produce them fast enough - help only to the degree there is electricity to recharge their batteries. Too often, there isn't."
Focused and aware. Dillon began leafing through her brochure.
She did not let his page flipping distract her. "Why I'm here, in a phrase: ocean thermal energy conversion. OTEC is conceptually very simple - and a vast untapped resource. Any heat engine turns heat energy into mechanical work by exploiting a temperature differential. Steam engines are heat engines, the high temperature that drives them coming from fire heating a boiler.
"Now consider the ocean. The tropical ocean's surface can approach human body temperature, and yet around a half mile below, where sunlight never penetrates, the temperature is scarcely above freezing! Tremendous power-generating potential exists in the differential between the hot and cold layers of the ocean - and with no energy source involved but sunlight.
"I would guess you've been pitched concepts for harvesting wave power. The energy OTEC can theoretically harvest is greater by an order of magnitude. The challenge is in efficiently and affordably ..."
Did Kayla ever stop for air? His wife, while playing her French horn, did somettiing she called circular breathing. What, exactly, Crystal did eluded him- surely the windpipe worked in only one direction at a time- but somehow she could sustain a note indefinitely.
Just as, somehow, Kayla kept up her patter. "... and while the theoretical efficiency of a heat engine operating with such a small temperature difference is about seven percent, past OTEC trials have achieved only one or two percent. With our proprietary technology, we can ..."
Dillon took down his first note. This could be real. He did not begrudge Kayla her full fifteen minutes. "So you're going to save the world," he probed.
"Hardly. We need many ways to generate power, Resetter fanatics notwithstanding. OTEC can be one method. It should be one, in the tropics, anyway. " She rattled off more of OTECs virtues. Finally, she took a breath. "Will Russo Venture Capital Partners back us?"
"I'll have to touch base in-house." That was a stall, because as principal partner Dillon's was the only opinion that mattered. He only took aboard investors cowed by his reputation, being especially partial to the pension funds of small towns in flyover states. Well, there was one exception, but Yakov's interests were . . . different.
Yakov was different: fascinating and worldly-wise. If Yakov sometimes demanded more involvement than Dillon's usual partners, he also brought resources none of Dillon's other partners could offer.
Kayla persisted. "If you have further questions ... ?"
"But I will admit to being intrigued." Dillon spared her the briefest of smiles. "Perhaps sometime I could tour your prototype. " "Absolutely! Her discipline finally slipped. With a grin, she whipped a folded datasheet from her jacket pocket. "Let's set that up now."
"We're about out of time," he countered. "I'll be in touch."
She all but floated from his office- at die last, as naïve as any of the day's supplicants. As naïve, in her own way, as the Resetter activists whom she disdained.
Nodding welcome to yet another earnest entrepreneur, Dillon thought: That's how I can do what I do.
Thursday, April 13
Valerie Clayburn glowered at her datasheet. Neither it nor the wildly colored globe it projected deserved her wrath- but they were here. Telecommuting was fine in its place, but much of her job demanded the personal touch.
And with that moment of resentment, she felt rotten, as though she were shortchanging the sick little boy in the next room.

Not that Simon sounded sick. He was making the deep-in-his-throat revving and growling noise that all little boys make- to the amusement and consternation of their mothers- whether playing with cars, G. I. Joes, or toy dinosaurs.

She had three sisters. None of them ever made sounds like her son and his friends did.

She had once found Simon galloping in circles "flying" a toy stuffed rabbit, its floppy ears bent sideways like wings, making those same annoying/adorable noises. Something she and her sisters would never have thought to try. He had been about three. Smiling at the memory, she went to check on him.

She found him deep in his toy box, playthings strewn about his bare feet. From the doorway to his bedroom, the little-boy noises sounded a bit different than usual. Deeper. Phlegmy. "Back in bed, kiddo," she commanded.

"But Mom. I was only-"

"Doesn't matter," she said. "Pick a toy and get back under the covers."

He emerged from the toy box, one hand clutching little cars and the other action figures. Testing the limits. She let it pass. "Bed. Now. Move."

He dumped his double handful of toys on his blanket. "I have to go to the bathroom."

Predictable. As he passed her in the doorway she felt Simon's forehead: still warm. His blond hair was dark with sweat. The jungle-camouflage pajamas (little boys!) he wore were snug and inches too short, but he would not give them up until she replaced them. If he would only stay in bed, the bare ankles and wrists would hardly matter.

Heading off an "I'm thirsty" stall, she topped off the orange juice in the glass on his nightstand while he dawdled in the bathroom.

With a struggle, she got him into bed. "Tuck me in?" he asked.

"Sure, pumpkin."

Simon made a face. He was nine, too old and rough-and-tough to be anyone's pumpkin.

Not so. She half tucked, half tickled until he giggled. "Now stay in bed," she ordered.

She returned to the kitchen. Elbows on the table, chin in her hands, glower reemerging, she resumed her staring contest with the slowly turning globe.

Saturn's largest moon: Titan.

This was not how any human would - or could - behold Titan, its dense atmosphere all but opaque to visible light. Only radio-frequency waves pierced the perpetual shroud to reveal the tumultuous surface of one of the most interesting - and, in some ways, most Earthlike- bodies in the solar system.

The holo orb was all swathes, indeed layers of swathes, like a world made of papiermâché. Each strip was a separate radar study, some undertaken from Earth, others from fly-bys years earlier by the late, lamented Cassini probe. Swathes varied in color, a distinct hue assigned to represent each radar wavelength. Dark and light shades showed what polarization had been used, the choice optimized for sensing smooth or rough features.

Despite appearances, the mosaic was not constructed from photographs, because radar did not "see" as a camera would. Behind the imagery lay complicated mathematics, embodied in even messier software, that reconstructed topographic features from Doppler shifts, the slightest differences in round-trip signal delays, and echo strengths. (Not that the echoes were strong: At their closest, Earth and Saturn were about eight hundred million miles apart.) Fortunately she had reached the stage in her career when grad students handled the programming scut work.

All those swathes and the riot of colors would have suggested to most people that Titan had been well mapped. Not so. Valerie was no casual observer, and her eyes went straight to the problem areas, mostly adjacent swadies that failed to align. Oh, nearby swadies might appear to match, were meant to overlap, but that could not just be assumed. Scanning a particular bit of Titan from across the solar system was tricky.

Stuck home for the day, if not the rest of the week, eyeballing strips for common features was something she

could do. And deucedly difficult.
Titan was a dynamic place, its surface sculpted by erosion and weather, its methane lakes ever shrinking and expanding, its orbit tweaked and tugged in a complex dance by sixty-plus lesser moons, the entire world tidally flexed by Saturn's immense gravity. Software tried, with mixed success, to align radar images. Human eyes were still the best at matching multiple views of a canyon or lakeshore or hill captured at different resolutions, at different times, from different angles. Nor did the hills always stay put between radar studies. Dunes hundreds of feet tall and hundreds of miles long- dunes not of sand, but of exotic hydrocarbons (looking, the one time a probe had landed to look, like wet coffee grounds - drifted with the seasons. The marvel was that Valerie and her grad students had stitched together even this poor semblance of a topo map.
Here and there, maddeningly, areas remained pitch black. Not yet scanned. Titan Incognita.
Water bottle in hand, she stared at the tan layer- what there was of it. The latest survey had produced hardly any data. No data she might have chalked up to bad aim, but the bit that had come in confirmed proper aiming, and diagnostics confirmed correct operation of the receiver.
So what had happened? A software glitch that somehow discarded the radar echoes? Always possible, but she had seen nothing indicative of mishandled data. Radio interference that perfectly canceled the signal but did not reveal itself? Very implausible.
It took a while for the penny to drop. It took an hour of calculations, punctuated by two quick peeks in on Simon, asleep amid a jumble of toys, to work out the geometry and confirm her suspicions.
There had been interference, all right: The signal bleeping blocked, after a round trip of almost two billion miles. By Phoebe's sunshield.
Of course the Moon, the first-and-real Moon, sometimes got in the radar telescope's way - but on its stately orbit Luna crossed the plane of the ecliptic, potentially blocking the line of sight to other targets in the solar system, only once every couple weeks. Phoebe and its sunshield whizzed around the Earth in less than six hours!
Damnation, she knew that. Phoebe and its shield were small, but her luck was bound to run out.
As it had.
Valerie sighed. She could plan future observations around them, but what a nuisance. Long-term, the observatory needed to reprogram ASTRID- astronomer's integrated desktop- to keep Phoebe-compromised observations from ever getting scheduled. And
And it had not been a penny that had dropped before. Wrong metaphor. A shoe had dropped. No, a big honking boot. And now, so did the other one.
Phoebe was not the big problem. The big problem was everything that Phoebe portended ....
Marcus loitered in a vending room, sipping a cup of lousy coffee, savoring the break from an interminable meeting. Sunlight streamed through the room's window wall, which offered an otherwise uninspiring view of an interior courtyard.
A predisposition to fog from off the Potomac had given this neighborhood its name, but diplomatic obfuscation was what preserved the label. To most of the world, Foggy Bottom meant the State Department, in whose blocky headquarters Marcus had unhappily spent his afternoon. Ellen had gotten a call just as the meeting started. She left, giving him only a you-know-how-it-is shrug for explanation.
Today was nonetheless a change of pace, because this meeting involved international whining. As the demo powersat approached completion, more and more countries were objecting to powersats as weapons of mass destruction.
And so Marcus had gotten to explain microwave downlinks to a roomful of Foreign Service Officers. Yes, the beam carried a lot of power. That was the project's purpose: bringing power to the ground. And of course the beam was concentrated, to minimize the dedicated collection area on the ground.
Then it had been on to safety interlocks. Every collection station had a guide beacon that the power satellite used as its target. If a collection station detected the power beam slipping off-center, off went the beacon and

the satellite ceased transmission.
"Target?" an FSO had repeated.
"A poor choice of words, " Marcus had answered. He wasn't a diplomat. Aimed would be no better. "Directed. The satellite directs the beam at the collection station."
"And beams only at collection stations?" another FSO had asked. "My online identity has been hijacked twice, and you wouldn't believe what a pain in the posterior that was. So you'll understand ttiat I'm just a tad skeptical about how secure any system is."
"Yes, only at collection stations. " In his mind, Marcus had added an exclamation point. And speculated about birthdays and children's names used as passwords. "Downlink coordinates are hard-coded into the powersat. By design, we can only update coordinates physically, on PS-I itself. To update the list of authorized collection stations, we'll dispatch a robot probe."
"Switchable on and off. The downlink point commanded from the ground."
Who wants a system that can't be turned off? "The idea," Marcus had explained, "is to deliver power where it is most valuable, and that varies. It could be the DC area in summer, and maybe only in the hottest part of the day when the use of air conditioning peaks. It could be Fargo in winter, during a cold snap, when the demand surges for heat. Or filling in when some wind farm lacks wind. Or anywhere an equipment failure creates a power shortfall. And by beaming to the downlink station nearest the point of need, we reduce stress on the national grid."
"If I may summarize," the first FSO had jumped back in. What the hell? Were they tag-teaming him? "A gigawatt of focused energy 'directed' at the ground. Steerable beams. It could be a weapon."
"And any satellite launch could become a ballistic missile aimed at the ground," Marcus had snapped in frustration, only to be told he was not being helpful.
To the degree Marcus had ever had control of the session, that was when he lost it. From then until the break, the FSOs had revisited, with painful circumlocution, perhaps every criticism anyone ever made about the U.S., back to those (idiots, in Marcus's opinion) who had objected to American unilateralism in the capture of Phoebe. Diverting a space object, let alone using a nuclear-powered thruster for the dormant comet's final orbital insertion, could be construed as a violation, at least in spirit, of the Outer Space Treaty. (Excuse me: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.)
In what universe was doing nothing, and maybe having Phoebe hit Earth, the preferred course? The same universe, evidently, where one listened to members of the energy cartels, and the cartels' most dependent and coercible customers, and Third World ankle biters who did not care how bad things got for them as long as they could get in a dig at the United States, and
Marcus stopped himself mid-mental rant. Reliving the experience accomplished nothing. Besides, his geopolitical opinions were doubtiess as well-founded as the engineering opinions of a roomful of diplomats.
"Hey.Judson."
Marcus turned around. One of the FSOs stood in the break-room entrance. Somebody Ryerson. No, Ryerson Smith. "Yes?"
"We're ready to resume," Smith said.
Yay! "Okay. I'll be right-"
When Marcus's cell rang, the caller was not in his directory. He did not recognize the number that came up instead of a name. Not even the area code. "I should get this," he said.
"You know where to find us." Smith headed down the corridor.
Taking the call, Marcus did not recognize the face projected from the cell display. She wasn't someone he would forget, not with those high cheekbones, chiseled features, hazel eyes, and full lips. Her hair, a rich brown, worn shoulder length, nicely framed her face. Forty-ish: about his age. And she looked mad.

Mad about what? he wondered. He said, cautiously, "Hello."
"Marcus Judson?"
He nodded.
"Valerie Clayburn. I'm calling about the powersat."
While she spoke he had queried her area code. West Virginia? "Did you see me on the 3-V news?" he guessed. Damn town meetings.
"Hardly," she snipped. A bit of glower added, aren't we full of ourselves. "I Googled 'powersat NASA program manager' and got your boss. She gave me this number. "
"I'm due back in a meeting, Ms. Clayburn. May I ask what this is about?"
"It's Dr. Clayburn, and I'm calling to schedule a meeting."
Doctor of what? But Ellen had vetted the woman, supposedly, and he had a flexible day coming up. "I have some time open next Monday morning. Will fifteen minutes suffice? Telecon, or will you be coming to my office in Maryland?"
"Fifteen minutes?" She laughed. "Not even close, and anyway, you need to come out here. But Monday works. "
"Why there- and where is that, by the way?"
"Here is the Green Bank Observatory. And why here? Trust me, it'll make sense when you see the place."
Could she be any stingier with information? He had neither the time nor the inclination to play twenty questions.
"I've got to go," he told her. I'll get back to you."
"I'll be here," she said, and broke the connection.
His datasheet folded in quarters because that took less effort than clearing the table, eating (and trying not to taste) a nuked frozen dinner, Marcus sampled the news. In one window headlines scrolled, an all-too-familiar litany of scattered blackouts, spot gasoline shortages, and layoffs. The Russian-led cartel had announced a production cut, sending of futures up ten dollars a barrel. A credit-rating service and a large hospital chain were the latest to disclose that hackers had compromised their customer files. Across the Middle East and Central Asia, more terrorist bombings and sectarian slaughter. In a streaming-video window - for the third day, but still telegenic- squadrons of Resetter activists disrupted construction of a new offshore liquefied-natural-gas terminal near Newark.
Enough, he decided. A few sharp taps on the periphery of the datasheet banished the depressing news and put a virtual keyboard in their place. He started to surf.
The Green Bank Observatory was in Green Bank, West Virginia, which was in the middle of nowhere. Deeper into the middle of nowhere, nonsensical as that was, than he had guessed. Run by the National Science Foundation.
And Valerie Clayburn, Ph.D.? He found her, too. More than enough to beg the question what an up-and-coming astronomer wanted with him. Presumably not for any insight he might offer into distant galaxies or dark energy, or whatever was the hot topic in radio astronomy these days.
Marcus went for a walk to clear his head. The evening breeze was pleasantly cool. Lawn sprinklers muffled the drone of traffic. In most front yards, the cherry trees were in bloom, just past their peak. Even in the many yards with for sale and foreclosure signs. And overhead ...
Urban glow and the crescent moon had all but washed the stars from the sky. Phoebe was too dark to see even during the rolling blackouts. Phoebe's sunshield was for the moment essentially edge-on to him, and so also invisible. But The Space Place sparkled, the brightest "star" in the sky; it put even Venus to shame. The orbiting hotel complex, its surface silvered for cooling, was its own best advertisement.
When he won, say, two lotteries, or struck oil in his backyard, he would be sure to book a stay.
As for the nearly completed powersat, Marcus searched in vain. Alas. He would have welcomed some evidence that his life entailed more than meetings and talk.

When he had called Ellen from his car to ask about her curious referral- and to vent about that afternoon's waste of time at State- his boss, in very few words, speaking more in sorrow than in anger, had shocked Marcus into silence. Hours later, her rebuke still stung: "Have you considered the possibility that someone else might know something?"

Yeah, he had. Only cynic that he had become, it had been a while. Since Lindsey.

By the dim glow of a neighbor's post lamp he texted the enigmatic Dr. Clayburn. CU Monday a.m. around 11.

Monday, April 17

The road trip to Green Bank began painlessly enough, the morning warm and sunny. The observatory banned electric vehicles because they might cause interference, so Marcus had a government motor-pool car and full tank of gas. The car's data link kept dropping out. After twenty miles he gave up on his e-mail.

The first half of his drive, more than a hundred miles, was Interstate, and autodrive did all the work. Leaving behind the DC-area sprawl the scenery was gorgeous, especially as he crested the Blue Ridge, the Shenandoah Valley, lush and green, stretching before him. The sky was a beautiful clear blue. Radio blasting, he drummed on the dashboard to the beat of the music, trying to ignore the many tasks he could, and perhaps should, be attending to at the office. He wondered what he would do when he arrived early.

He got off the Interstate near Harrisonburg. Almost at once he encountered the billboard: not digital, but an old-style, inkand-paper signboard, sun-faded.

The sky, the Tower,
We lust for power.
The Flood, the Burn,
We never learn.
Reset.
Repent.

"The Burn" was not bad- poetically speaking - for the Crudetastrophe. Marcus could not come up with a biblical-sounding term for powersat, either. "We never learn" rang all too true, although his take on the lessons to be learned and the poet's clearly differed.

US 33-W narrowed to two lanes, soon ran out of embedded sensors for autodrive, and lost its shoulders to narrow some more. Sturdy trees crowded right up to the pavement. He slowed way down, and his fretting changed to showing up late. The "towns" along the "highway" became smaller and smaller, and the houses scattered between towns ever shabbier.

Until there were no towns. He guessed he had missed the West Virginia border. By then he was well into the Appalachians, deep within the George Washington National Forest. Negotiating switchbacks. Up and down steep grades, many of them miles long. As were - whenever gaps opened among the trees- the luxuriant wooded vistas. Stunning. Fantastic.

The Blue Ridge? By comparison (at least where he had crested it), that was a speed bump.

And despite Marcus's best intentions, he thought, Lindsey would have loved this drive.

For a long time, he and Lindsey had been great together.

Almost always they had fun. Even when they didn't, when the world made one of them sputter, the other would find the silver lining, or the amusing absurdity of it all, or a way to put matters into perspective. They both liked scenic drives and country inns. They liked hiking and canoeing, classical music and experimenting with exotic cuisines. They learned together to scuba. They mocked the same bad movies.

More than anything, she always knew the right thing to say.

"I know your brother is a slacker, " she had once said, driving home from a miserable dinner out with his parents.

Had Marcus not already loved Lindsey, those few words would have done the trick.

It was nothing against Sean. His older brother was who he was. Sliding through life on charm and modest

ambitions somehow worked for him.
But growing up, "It's not what you know, it's who you know," had suited Marcus about as well as, "Why can't you be more like your brother?"
As a kid, Marcus could never understand why their parents tolerated Sean's mediocre grades and goofing off. The folks did not much like their jobs, but they were far from lazy. Dad was a lawyer and the Washington lobbyist for a national association of rural electrical utilities. Mom was a realtor and had an MBA. Not until well into high school had Marcus seen the bigger picture. Wheedling legislative favors, unloading money pits onto unsuspecting buyers, and coasting through school had something in common. All were ways to game the system. And that apparently was what impressed his parents.
Marcus could never bring himself to see things their way. He wanted to learn, not just make good grades. To make a difference, not a living. To change the world, not game it.
Sean put in four years in general studies at a party college. He went on to become the one-man HR Department at a small company - gloating, to parental approval, that the position lacked quantifiable responsibilities.
Marcus earned a math degree at the University of Virginia and a Master's degree in systems engineering from MIT. He went on to do contract work at NASA where, with luck and if he did things right, maybe he could change more than one world.
What he could not change was his parents' attitude. Their only feedback on Marcus's choices was that he worked too hard, that he let Space Systems Science and NASA take advantage of him. Sean said the same, only more bluntly: "You're a sucker, bro."
But Lindsey got him. He thought he got her.
Ready to move in together, the big question had been: where? His apartment was in Greenbelt, Maryland, near Goddard. Hers was in the City of Fairfax, Virginia, near the insurance company where she worked (and not far, as it happened, from the house where he had grown up). Neittier apartment was big enough for two, not unless at least one of them shed a lot of possessions. Nowhere in the middle appealed to either of them.
He suggested they find a place near her work, and she countered with moving near his. She was so solicitous about what his commute might become, so sympathetic, that it drove him to insist on northern Virginia. Together they found the townhouse in Reston, a beautiful place with a private dock on Lake Anne. He bought a canoe. It was going to be her moving-in present.
Reston would mean an easy twenty-minute commute for Lindsey, and he was thrilled for her. "To return the favor" she insisted that he buy the townhouse solo. The equity growth would all be his - the slow, grinding decline in house prices had to end someday - and she would spare him the complications of entwining their finances. Though he did not follow her logic- there was no hurry, but marriage was the obvious next step - he went along. That Marcus own the place was obviously important to her.
Because for Lindsey, moving in together had become Plan B. Because she was in the running to open and manage a new regional office, in Seattle. She kept that possibility to herself until, two days after closing on the townhouse, her promotion came through. By the end of that week she was off to the Left Coast, for the opportunity she "couldn't not take."
You understand, Marcus. Right? And you own a house now, so be glad.
It hadn't helped Marcus's newfound cynicism that Lindsey's manipulations impressed Sean. As in, "You're a sucker, bro."
West Virginia Route 28, when Marcus finally came to it, was as isolated and unused as the crumbling road that had preceded it. For no discernable reason the national forest he had yet to leave had changed names from George Washington to Monongahela.
He knew he was close when radio reception went to hell. Guessing what he would find, he checked his cell: no service. So he must have zipped past a second road sign unawares: announcement of the National Radio Quiet Zone.

GPS satellites paid no heed to a terrestrial ban on transmission, though, and his nav system worked fine. He spotted the modest sign for the National Radio Astronomy Observatory where he expected, just before the unincorporated town of Green Bank.

A few low buildings clustered near the observatory entrance. As he passed the Science Center, the two cars and one yellow school bus in its parking lot seemed forlorn. He parked outside the L-shaped building Valerie Clayburn's acknowledging text message had indicated.

He was a half hour early.

Bright white dish antennas, one after another, receded into the distance. None stood close enough to offer any sense of scale. So how big were they? Rather than kill time at the Science Center among grade-schoolers, why not find out? He could not have asked for a nicer day for a stroll.

His first stop: the trio of signposts abutting the parking lot. Ambling over, curious, Marcus found placards for the sun, Mercury, and Venus. Earth had a sign not far away. Touring the scale model of the solar system would take him out to the big antennas. He walked to "Mars," only a few steps from "Earth."

Past "Mars" he came to a tollgate-like barrier across the road. Boldly lettered signs announced Diesels only beyond this point and Turn off your digital cameras. A well-trodden footpath circumvented the gate and he kept going. By the time he spotted the Jupiter sign, the first big antenna had caught his interest. It had a descriptive sign too. The dish was forty-five feet across! How big were the antennas in the distance?

Marcus understood the scale of the solar system - intellectually. Hiking it, even at a 1:3,000,000,000 scale, was something else again. "Pluto" and the last of the big dishes were still more than a mile away. He turned around without ever seeing the sign for Uranus.

Valerie's office in the Jansky Lab overlooked the parking lot, and she glanced out her window whenever she heard a car. Firsttime visitors tended to arrive very early or very late. No one's intuition about the drive was any good untU they had made the trip once. Twice cars came, and both times technicians she knew got out. A third car brought one of her grad students.

Rapt in her work she must have missed a car, because the next time she checked outside a man wearing a suit and tie was striding toward the building. Looking down from the second floor, she could not see his face, but it had to be Judson. No one but gowies dressed so formally, and then only on a first visit.

Scientists dressed casually. Today she wore jeans, a random T-shirt, and a plaid flannel overshirt. When the Nobel Committee called, she would shop for a dress. Maybe.

Shutting her office door behind her, Valerie bounded down the stairs. The man with the charcoal suit was in Reception, signing for a visitor badge. "Marcus?" she called out.

The man turned, and she recognized the face from last week's conversation. Judson, all right.

He had clear blue eyes, wavy black hair (at the moment wind-stirred) gone gray at the temples, a strong jaw, and, despite the early hour, hints of a five o'clock shadow. A bit guarded in his expression, perhaps, but fair enough: She had been less than forthcoming. Forty or so, she estimated. Not Hollywood handsome, but handsome enough. Not that that mattered. He was about six-two and broad-shouldered. Maybe a few pounds over his ideal weight, but he carried it well. Other than overdressed, he seemed, all in all, like an everyday sort of guy.

"I'm Marcus," he agreed, extending his hand. "Hello, Valerie."

"Thanks for coming." She hesitated. This was a person in front of her, not some bureaucratic abstraction.

But neither were powersats abstractions.

"Valerie?" he prompted.

"Right." She took his hand, casting off her doubts. "Welcome to the National Radio Astronomy Observatory, NRAO. We'll start with a tour. The things we need to discuss will make more sense with some background."

"What else have you planned?"

"The weekly technical lunch discussion among the professional staff, always fascinating, and we'll wrap up with

a quiet conversation in my office." A long and pointed conversation.
"Okay. Lead on."
Following her outside, he seemed surprised at her beat-up old Volkswagen Jetta.
"Because it's a diesel model," she explained. "We only take bikes and diesels near the dishes. Anything else would mean RF from spark plugs or electric motors. And the older the car, the better. New cars have electrical everything, from locks to clocks to seat positioners. Makes them noisy."
"The instruments are that sensitive?"
Wait till you see the dishes up close, she thought. A short drive brought them to the internal gate. She got out of the car to swipe her ID badge through the reader. Just past the gate, she pulled onto the shoulder. "That's one of our smaller telescopes. Forty-five feet across."
"I know. I walked around for a bit."
"How far did you get?"
"Half past Saturn before I turned around. Any farther and I would have been late."
She pulled the Jetta onto the shoulder near each telescope to share some of its background. Near one dish, bikes leaned against a trailer: the mark of grad students at work. She took Marcus inside the cramped maintenance trailer for a peek at the equipment - and at the quarter-inch steel walls shielding the dish from the electronics.
Back in her car, as she started to describe the first eighty-five-footer, the Science Center's white diesel tour bus lumbered past, "This is part of a three-telescope interferometer. An interferometer -"
"Synthesizes data from multiple instruments into one image. The composite has the resolution of an instrument the size of the separation between instruments. Same principle as synthetic aperture radar. " He grinned. "I'm an engineer, and I come prepared."
Valerie knew the former. She had hoped for the latter - and that he would be openminded. Only then did it occur to her to ask how open-minded she was.
It was not the time to second-guess herself. And anyway, he would get much the same message from many of the staff. All the more important that she get him to lunch on time. . . .
"Let's skip to the main event, " she said. Because the big dish will knock your socks off.
When she next parked, Marcus, his eyes round, rushed from the car. Everyone did. She gave him time to take it all in: the world's largest birdbath, atop an intricate lattice pyramid, above a round trolley base with sixteen enormous wheels. In addition to a standalone trailer, a built-in shielded room high above the ground held many of the onsite controls. The instrument arm, jutting out from and over the dish, made the telescope that much more impressive.
"The Green Bank Telescope," she began, pointing up at the enormous paraboloid dish. "Completed in 2000, the GBT replaced the smaller big telescope that collapsed under its own weight from metal fatigue in 1988. The dish's signal-collecting surface measures one hundred meters by one hundred ten meters - longer in both dimensions than a football field. Only that's not a surface, but 2,004 small aluminum surfaces. Automation tilts and warps each panel in real time as the structure moves, to compensate for sagging, thermal grathents, and wind."
"Damn, that's big. What happens if lightning strikes?"
"It happens about four times a year, without incident. The GBT weighs more than sixteen million pounds, about the same as nineteen loaded and fueled jumbo jets. When lightning does strike, that's a lot of metal, with all its metal wheels firmly pressed against the well-grounded steel track. The track is lots of metal too: a circle sixty-four meters in diameter."
She resumed her script. "When tipped such that the instrument arm reaches its highest position, the GBT stands taller than the Statue of Liberty. This is the world's largest fully steerable radio telescope."
Hand to his forehead, shading his eyes, Marcus countered, "Surely Arecibo is bigger."

Because everyone knew the observatory at Arecibo, Puerto Rico. Filmmakers loved it. The first time she remembered seeing the Arecibo dish was in some old James Bond flick. Goldeneye, maybe.

Arecibo's dish was three hundred meters across, its aluminum panels suspended over a mesh of steel cables to form a single surface: way too massive to move. To aim the Arecibo telescope - to the extent it could be aimed- you positioned its suspended instrumentation module using the cables that spanned the dish. None of which mattered. If she failed, Arecibo would face the same problems as Green Bank.

Valerie limited herself to, "Bigger, but not fully steerable." She pointed at the GBT's base, where the mammoth wheels engaged the circular steel track. "As opposed to our big scope. This whole structure can rotate up to forty degrees a minute, versus one-fourth degree per minute needed to keep pace with Earth's rotation. The dish can tip up and down at as much as twenty degrees per minute. That instrument turret at the end of the arm holds up to eight independent instrument modules, each-"

"Back up, " Marcus said. "Those tipping and turning rates. You're telling me that the GBT can track planets, asteroids, even close-orbiting satellites. Stars and galaxies only move with the Earth's rotation. " She must have looked surprised because he added, "Remember who I work for?"

"Right. And sorry."

"Except asteroids and most planets don't emit radio waves. In the middle of the quiet zone, where my cell phone has no service and NRAO won't even permit digital cameras up close, I can't believe the observatory is pumping out radar pulses so you can read the echoes. "

He was quick, which was promising, and he seemed engaged in what she'd had to show him. But around the eyes she saw a touch of . . . something. Suspicion? Was she that transparent, or was it something else?

"You're correct," she said. "Arecibo transmits and Green Bank reads the faint echoes. We could transmit ourselves" - she pointed up at the instrumentation arm- "by replacing one of the receiver modules with a transmitter, but that would hardly be radio quiet. My work involves the radar mapping of Titan, and we partner with Arecibo to do it."

"Titan? Just how sensitive is this scope?"

"If there were a cell phone on Titan, with the GBT I could listen to the call." Barring other complications, and that topic was coming. "We need to move along, Marcus. The weekly science lunch is not to be missed."

Especially because you are on deck.

Patrick Burkhalter toted his cafeteria tray to the residence hall's second floor, where he found the social lounge half filled. Many of his colleagues were already seated and eating. Others surrounded Valerie Clayburn and her guest, meal trays in hand, intercepted before they could find a table. With maybe eight thousand people in the entire county, everyone welcomed new faces. But visitors and outsiders comprised very different categories, and after eight years here Patrick remained an outsider.

"Hey," he offered as he took an empty seat. Tamara Miller glanced his way, nodded, and went back to her conversation with Liam Harris. Something about intergalactic dust.

Patrick went to work on his country-fried steak, mashed potatoes, and gravy. His choices would do nothing for his waistline or his cholesterol, but who did he have to impress?

Or to live for? That was a thought depressing enough to make him set down his fork.

Their guest got perhaps two minutes with his lunch before Valerie began tapping her water glass with a butter knife. "Hi, everyone. We have a visitor, as you may have noticed."

Not to mention that she had put out the word to make sure the tech staff all came today. Would she get the outcome for which she so obviously schemed? In Patrick's experience, manipulating scientists and engineers worked about as well as herding cats.

"Hello," the chorus rang out raggedly, from around the collection of short, narrow tables arrayed in a U.

Valerie said, "Our visitor, Marcus Judson, works at NASA Goddard on the demonstration powersat project. I'm hoping he'll tell us about it."

Patrick refocused on his lunch while others murmured their encouragement.
Judson kept his response short, and Patrick approved. You didn't know you were today's featured attraction, did you?
"So what do you think, folks?" Valerie prompted. "How will powersats affect us here?"
And the games began.
"A powersat is a huge noise generator, " Aaron Friedman said. "And because it's skybased, that's noise from which we can't hide."
"The power beam is focused." Judson slid away his tray, the meal all but untouched, clearly perceptive enough to see what was coming. "The downlink won't come anywhere near here."
"Doesn't matter," Aaron persisted. "Well, aiming will help, but not enough. The satellite shapes the beam with phased-array techniques, right? So there are unavoidable side lobes to the main beam. That's basic math. Even sixty dB down, there'll be a lot of noise."
Engineers and astronomers set aside lunches to argue about phased arrays: their pointing accuracy and failure modes, die frequency distributions apt to show up within the noise, and whether sixty decibels was the expected attenuation for a side lobe. Of course even sixty dB down from one gigawatt left a kilowatt of noise.
Judson kept thanking people for their comments. Mostly he let the staff argue among themselves, jotting notes on paper napkins- and looking ticked off.
This was not a mugging, exactly. More like an intervention, or maybe an inquisition. When Patrick tried to catch Valerie's eye, she looked away.
Patrick knew all about inquisitions by die tech staff. That had been his introduction to Green Bank, too, if for a different reason. Judson would go home with only bad memories to show for the day. Whereas he . . .
He still bore the scars. Patrick was more ttian qualified to coordinate routine maintenance and teach visiting astronomers to operate the gear, so it hadn't been entirely a pity appointment. More like an I'll owe you one arrangement between execs at the apex of Big Science.
After the Jules Verne probe went missing, JPL wanted Patrick gone. NASA did, too, but even more, they wanted to put a halt to the embarrassing publicity. No matter what anyone suspected, they could only prove that he had cut procedural corners to upload an emergency maneuver. That die distant probe went silent days later could have been pure coincidence.
And so Patrick had made clear what would keep him from giving interviews and suing for wrongful termination. He required ongoing access to a big dish - somewhere.
Without too much torture of the English language, Green Bank was somewhere.
And so he went in one not-so-easy step from the principal investigator of a major interplanetary probe to lowly observatory staffer. Training and maintenance offered plenty of opportunity to use radio telescopes without grant applications sure to be rejected.
He used the big dishes every chance he could get.
After the divorce- no way would Anna move here from Pasadena - what else did he have to do?
He had sworn to Anna that things would turn out all right. That maybe this had happened for a good reason. He would not have trusted him, either, especially given how little he had been able to explain, but it still hurt diat she hadn't. More than anything, he missed the kids. He wondered if Rob and Clarissa would ever understand, or forgive him for the divorce.
When Patrick tuned back to the present, Judson remained in the hot seat. Only the objections varied: from powersats, miles across, getting in the way of observations, to the heat they would reradiate as infrared, to minutiae of RF interference. Some people argued for the joy of arguing. Par for the course here, but Judson could not know that.
Along the way, an admin slipped into die lounge and handed Valerie a folded sheet of paper. Another joy of life in the quiet zone: runners instead of cell phones. Valerie grimaced at whatever she found written, dashed off

her own note, and handed it to Judson, then rushed off.
By the time the hyperbole reached, "Powersats will mean the end of astronomy until" - yeah, right! - "someone builds an observatory on the far side of the moon," Patrick had had enough.
"There's more to life than astronomy," he snorted. Too bad Valerie had left. If anyone needed the reminder, she did. But for Simon, she might never go home. "And life takes power, people. Lots and lots of power."
Turning, Tamara gave Patrick an Et tu, Brute stare, but from across the room a couple of engineers nodded.
"We learned to live with DirecTV," Ernesto Perez conceded.
To which someone snapped, "Yeah, by giving up listening on those frequencies."
Rekindling the debate, from which it took the tech director noisily sliding back her chair to bring a halt.
At least, Marcus thought, tucking his notes from the lunch into his shirt pocket, one secret of the Universe had been revealed. Town meetings were not the worst way to spend a day.
If he had correctly parsed Valerie's scrawl, she was retrieving a sick kid from school and going home for the rest of the afternoon. One scribble might have said "single mom," to explain her disappearance. It was too bad about her son, but Marcus was happy to make a quick getaway.
Only driving home, as much as he tried to enjoy the Appalachian scenery, he couldn't. Ellen's recent rebuke kept nagging at him: Have you considered the possibility someone else might know something?
If he could get past Valerie bushwhacking him, she had given him a lot to ponder.
Wednesday, April 19
Marcus poked at a telecom console, setting parameters for the upcoming conference call, and thinking: all meetings are not created equal. He was in a mundane conference room at Goddard, deep within suburban Maryland, but this call was out of this world.
Whatever grief the week might bring him, the progress review reminded him why everything else was worth it.
Landscape undulated over the conference table, sliding past as a distant camera swiveled on its post. Somewhere behind the camera, the full moon was about to set; Phoebe's hills and structures cast long, knife-edged shadows. To his right, in the tourist bot preserve, the Grand Chasm gaped: a vast, inky blackness. The dazzling "star" just above the eerily close horizon was The Space Place, almost two hundred miles ahead of Phoebe in its orbit.
Ellen limped into the telecom room, bearing Starbucks. Despite physical therapy, her leg still bothered her. She set a cardboard cup on the table beside him.
"Thanks," he said, concentrating on the final link left to configure. "That said, you have no respect for tradition. "
She laughed. "Okay, who confirmed for today's session?"
He gestured at the holo. "The usual folks on the far end, though Dartene Stryker is at the powersat. She'll call in from there."
"How far is the far end today?"
As distant as it could be. "As the neutrino flies" - right through the Earth, without noticing - "it's about thirteen thousand miles. Relayed through two geosynch comsats and then down to Phoebe, call it a half second."
She closed the door and settled into a chair. "Who's joining from on the ground?"
"Phil and Bethany." Phil Majeski was the prime contractor's program manager. Bethany Taylor was Phil's chief engineer. Both disdained SETA contractors. "Phil's netting in from corporate. Bethany called to say she's stuck at a subcontractor's facility. Resetter picketing, unrelated to us- something about shale-oil gasification in Wyoming. I'm linking her in now." Marcus waved a wireless key fob at the sensor in the comm console. The authentication LED blinked green. "Ready."
"Let's go."
Marcus shrank the Phoebe image to one-fourth size, then switched views from the surface to the base's little common room, where three men sat waiting. As they and Ellen swapped greetings, Marcus connected the other locations.

"Everyone have the agenda?" Ellen asked. She started through her list.
The comm console took notes, but speech-recognition software glitched under the best of circumstances. These weren't. Merely this many people in one conversation sometimes confused the software. With the comm delay between Earth and Phoebe, people spoke over each other as often as not, and echo suppression was less than perfect. Noise suppression filtered out the drone of Phoebe's ventilation fans, but not the random clatters of- well, Marcus did not always know what.
So Marcus took notes, too.
Lots of notes. Hydroponics yields in Phoebe's still experimental gardens. Performance data on the thrusters that would slowly lift the powersat, its construction now almost complete, to its operational orbit. Final integration tests on the microwave transmission arrays. Production data on Phoebe's automated factories, churning out solar cells (and in smaller quantities, other electronics), structural beams, and water and oxygen for the construction crew. Defect and repair rates. Assembly anecdotes - but not many, the process having become routine. Assembly statistics.
PS-I had just topped two million pounds! How amazing was that? The late, unlamented International Space Station had massed only about one third as much, and its on-orbit assembly had required more than a decade. But the ISS had been lugged up to orbit piece by piece, battling Earth's gravity all the way - for more than a thousand dollars for every pound. For a powersat fabricated on Earth, launch costs alone would rival construction costs for a coal power plant of equivalent capacity.
But most of PS-I 's ingredients came from Phoebe's mines. And that was why- while there would never be another big tin-can space station - tens of powersats would join PS-I. Even combined, all those powersats would scarcely touch Phoebe's trillion-ton mass.
Motion in one of the four holos kept drawing his eye. Darlene Stryker, in her skintight counter-pressure suit. She floated above the vast plain of the powersat, the nearest safety-and-inspection camera following her as she drifted at the end of her tether. As the camera tracked her, coworkers - most many-tentacled robots, one human and space-suited like her- passed in and out of the background. He did not see any of the hoppers that shuttled workers the fifty miles from Phoebe to the construction site on the powersat.
Two million pounds was an abstraction. But two miles square, more or less: that was real. That he could feel. Marcus admired the plain of solar cells aglitter in the moonlight. PS-I seemed to stretch on and on forever.
"Okay," Ellen said at last. "Good session, folks. Bethany, I'll look forward to your update on getting the backup water recycling system back to nominal. For next week's meeting?"
"No problem," Bethany said. "Chances are you'll have something in your e-mail by the day after tomorrow. "
"Excellent." Ellen stood. "That should do it, then."
"One thing," Marcus said. The words just popped out. Something about PS-I stretching into the distance. Something about defects, and big engineering, and his subconscious at work.
Phil Majeski scowled, putting his whole face to work: brow furrowed, eyes narrowed, lips pursed. Phil was no fan of support contractors.
"What is it, Marcus?" Ellen sounded surprised. He usually held any comments until after the meeting.
What indeed? Big engineering. What else was big? The solar farm he and Ellen had toured. Square miles there, too, of solar cells, plus the rectifying antennas newly added to receive the microwave downlink from PS-I. The Green Bank Telescope, the collection area of its dish a "mere" two-plus acres. Eavesdropping on phone calls out near Saturn.
Then he had it: the flip side of the powersat, from this vantage unseen. The microwave transmission arrays. No one had ever deployed such a large phased-array transmitter, whether using solid-state masers or tube-based amplifiers coupled to microwave antennas. Nothing ever built even came close. PS-I incorporated both types of arrays, each in several design variations. The separate arrays would operate standalone or in unison, allowing side-by-side comparisons. In every case, many thousands of transmitters . . .

"The failure rates on the klystrons and masers?" Marcus began cautiously.
"What about them?" Bethany said. "We covered that. They're all testing well within contract specs."
"Understood. But when won't at least one tube or maser be out of spec? Pumping out microwaves at unintended frequencies?" Because the focused, steerable power beam resulted from exactly controlling- individually and in real time - the many thousand transmitters. The math of phased arrays was a thing of beauty, the choreography of constructive and destructive interference among transmitters. Only waves at the wrong frequency would not interfere properly, would not aggregate into a controlled beam. Wrong frequencies were just . . . noise. "A single misbehaving klystron- out of thousands- is like a whole TV satellite transmitting on an unauthorized frequency. "
"Which is why," Bethany snapped, "when a klystron goes out of spec, we'll power it down. Powersat-resident maintenance robots and spare parts, remember?"
And if, in the meanwhile, the interference obliterates an interstellar observation years in the planning, or the faint echoes of a radar beam bounced off Titan?
"Maybe the radio astronomers have a legitimate concern," Marcus said. "How soon will PS-I detect and adapt to an out-of-tolerance transmitter?"
"Soon enough," Bethany came back, only without her usual cockiness.
Ellen heard the uncertainty too. "As I recall, Kendricks signed up to a requirement to minimize RF interference with ground-based systems."
"We all have a schedule requirement, " Phil rebutted. Schedule was the blunt instrument with which Congress beat up NASA, and NASA the contractor. But deadlines could work both ways. "Surely schedule takes precedence over hypothetical failure modes."
"And suppose that such a hypothetical failure occurs?" Ellen persisted. "What operational tests do you have planned to demonstrate PS-I 's corrective action?" Pause. "Marcus, would you check that for me?"
"Sure, Ellen," Marcus said.
He was all but certain that the test-case database contained nothing relevant. And that Kendricks's award fee for the calendar quarter would take a hit if Ellen wrote up the finding as a critical deficiency. And that Phil, who as the Kendricks program manager got a slice of the award fee, would share die pain.
Phil sighed. "It won't be necessary, Ellen. Transmitter failure and response sounds like another set of simulations we should run. "
"And also," Marcus added, "simulations with randomly spaced pairs of transmitters gone rogue at the same time." Twisting the knife, but also being practical. "Dealing in such large numbers, two near-concurrent faults are bound to happen. "
Because what the hell. Phil hated him anyway.
Toe tapping aimlessly (and occasionally kicking the ethernet cable), Valerie pondered an empty screen. She was so tempted to roll up her datasheet, but at week's end the application window closed for observing time on the big dish. Miss the cutoff- or fail to make a strong case- and she would have to wait four months to reapply. She and a few hundred other needy applicants.
By her side at the dinette table, Simon worked on a school assignment. Or, to judge from his fidgeting, not. At least while she sat there, the IM window on his datasheet remained closed. "How's the assignment coming?" she asked.
He countered with, "What's for dinner?"
Not encouraging while Simon still toyed with his midafternoon snack, and with a big stack of homework due the next day. "Want me to take a look? Need some help?"
"Nah." Fidget, fidget.
She looked anyway. The top window in his datasheet was a social studies unit called The Great Oil Shock. There had been, she read furtively, "an unexpected drop-off in production among some of the world's largest oil

suppliers." Very PC: Something had happened. Not something anyone caused to have happened.
Not that she would want to try explaining the Crudetastrophe to a nine-year-old, but it was no mere "drop-off," and someone had most definitely caused it. Even though who, and what had happened October 12, 2014, remained a closely held secret of the Restored Caliphate.
But far more was known than the sanitized children's lesson Valerie was surreptitiously slamming. . . .
Oil prices surged in the weeks following Simon's birth. Valerie scarcely noticed, let alone registered that the jump supposedly was a big deal. With a colicky newborn to care for, who had time to sleep, much less to surf? Or, for that matter, to drive? She had nowhere to go for the next few months, and work, when she did go back, was in biking distance. And hallelujah for teachers: Keith had the summer off too. If the world chose to have a crisis - and when was it not on the verge of one?- she figured the world could muddle through without her. And, anyway, didn't energy prices yo-yo every few years?
The world did have a crisis without her.
That August the Caliph's Guard declared to the world that it had deployed atomic devices deep within the country's main petroleum reservoirs. To deter aggression by its enemies - variously: counter-revolutionary elements, apostate neighboring regimes, the Zionist entity, and hostile Crusader powers - the Guard vowed to deny their oil for all time if blasphemers impinged on the Caliph's holy sovereignty.
Still, she scarcely noticed. Simon was all of three months old. Keith was up to his eyeballs in last-minute lesson plans. After two years as a substitute, he had just gotten an appointment to teach economics at the Pocahontas County High School. She and Keith both struggled to make childcare arrangements so she could get back to work at the observatory. The scattered few minutes she could spare from family, if only to clear the cobwebs from her brain, she spent poring over the latest exosolar planet surveys.
If none of that had been happening in her life, she still would not have understood what insanity drove the Guard to trigger its nukes. To this day, perhaps no one knew outside the regime's inner circles. And maybe not even them. After the explosions, Guard factions had turned on one another, and on foreigners, in an orgy of blame, purges, and executions.
But however mysterious the Crudetastrophe's origins, its consequences were all too clear:
- Radiation tainted petroleum reserves measuring in the billions of barrels, the contamination spreading into neighboring states' oil fields. Whether the reservoirs were always linked deep underground or the atomic blasts had opened fissures between once distinct reservoirs - experts disagreed - petroleum exports abruptly ceased from across a wide area.
-Regional antagonisms erupted into open warfare.
-Oil-field destruction and shipping blockades spread far beyond the Restored Caliphate's borders. Economies collapsed across the Middle East.
-The price of petroleum tripled.
The supply and price shocks plunged most of the world into deep recession. Unlike the oil embargos of 1967, 1973, and 1979- their extent and duration limited, ultimately, by the suppliers' dependence on oil sales - the Crudetastrophe was irreversible. Many onetime exporters could not resume production as fervently as they wished to.
China's and Japan's export-driven economies collapsed further and faster than most. Almost overnight, China and Japan were selling U.S. treasury bonds rather than buying them. Interest rates soared, currencies deflated, and countries reneged on their debts.
Stagflation, Keith said. Stagnation and inflation together.
Nine years later, The Great Stagflation still raged. But not everywhere -
The Crudetastrophe explosions had not affected Russia's vast oil and gas reserves. Russia emerged from the crisis as a petro-superpower, controlling unprecedented wealth, snapping up American treasury bonds at firesale prices, and vying for global economic hegemony.

And as chaos spread across the Middle East, Keiths Marine Corps reserve unit was called up ....
"Mom. Mom. Mom!"
Valerie shook off the old, sad memories to find Simon squinting at her suspiciously. "What is it?"
"What is for dinner?"
She was in no mood to cook. "Frozen pizza." As Simon beamed approval- not exactly a compliment to her culinary skills- the phone rang.
Life without cell phones was liberating. But only corded phones? Shaking her head at the primitiveness of it all, Valerie took the three steps to her ancient, corded landline phone. Simon was squirrelly today. If she took the call on her datasheet he would be out of his chair like a shot to mug for the webcam.
"Valerie?"
She could not place the voice. "Yes?"
"Marcus Judson." Pause. "Is this a bad time?"
In hindsight, she had not handled his visit very wisely. It was hard to imagine this call ending well. "Now is fine. What's up?"
"You and your cronies gave me something to think about. And the thing is . . . you're right. There might be a problem. "
The well-stretched cord would reach well into the dining room. She went; Simon followed; she shooed him back.
"Your assignment," she mouthed. "Go on, Marcus."
"It's not like I think we should stop work on the powersat, but there could be complications. There might be problematical failure modes we need to work around. " When he started explaining phased arrays to her, she interrupted. "Remember who / work for?"
"Touché." He coughed. "I meant to ask, Valerie. How's your son feeling?"
"Thanks for asking. Simon has progressed to the malingering stage." And unless he is bleeding from the ears in the morning, he's going back to school.
"Okay, here's the thing. We never had our one-on-one discussion, and I'd also like to collect input from specialists there to fold into a failure-mode simulation. What if I come back out, say, Friday the twenty-eighth?"
"That would work." But there was something else in his voice. A hesitance. He wouldn't. Would he? "Was there something else?"
"Yeah ... I wondered if I could take you out to dinner afterward. "
Crap, he would. She hadn't dated but once or twice since Keith thed. For the longest time, she hadn't been ready. After, Simon and work consumed her time. Anyway, she was content with things the way they were. Or was it resigned?
Had she wanted to, who was there to date, anyway? Coworkers? Uh-uh.
If she told Marcus no, then what? A sudden loss of interest in radio astronomy? He did not seem like the punitive type. Hell, she had sandbagged him. Maybe he meant only a dinner of colleagues.
As her thoughts churned, the silence stretched.
"Or not," Marcus said. "I thought we might hit it off, but maybe you're seeing someone. Or whatever. Forget I asked. It has no bearing on my returning to Green Bank. I do need to talk with the experts."
"No," Valerie said, surprising herself, "asking is fine." Reassuring which of them? "And dinner does sound like fun."
Friday, April 28
Astronomers, engineers, and programmers wandered in and out of the Green Bank social lounge, where the atmosphere was more like an after-hours bull session than an inquiry. For long-scheduled observing time or to handle other commitments, Marcus told himsetf every time someone left. But despite the informality- or, perhaps, because of it- the notes file on his datasheet grew voluminous. His fingers ached from so much typing on its virtual keyboard. One thing this gathering was not: a DC-style, stultifying meeting.

Phil Majeski's simulation team would have its hands full in the coming weeks.
Valerie Clayburn was among the nomads, leaving Marcus to wonder how they would synch up for dinner. Whenever she popped in he treated her like anyone else - this was work, not a date, and her coworkers were all around, too - while second-guessing himsetf whether he was being too distant.
Why, but for a getting-back-on-the-horse-that-threw-you theory, had he asked her out?
Because Lindsey - the horse who had thrown him - was three months gone. Because life went on. Because Valerie was smart, intriguingly intense, and, despite her apparent efforts not to show it, hot.
"... until they're in the way. "
They? Marcus had let his mind wander. Again. "Say that again?"
"Are we going too fast?" Tamara Miller asked. "Moving targets. How will we know where they are until they're in our way?"
Going too fast would serve as an excuse. Marcus opened a datasheet window for the auto-transcription function. With everyone chiming in at will, the voice-recognition output was half gibberish, but half was more than he had processed over the past few seconds. He skimmed. Aha. Migration.
All powersats, not just PS-I, would be built near Phoebe and its mines and factories. After completion and checkout, the powersats would be boosted - slowly, because tiiey were so massive - to their final destinations. In geosynchronous Earth orbit, GEO, tiiey would be all but stationary overhead.
"So your concern," Marcus inferred, "is the trek to GEO, with the powersat's orbit spiraling out till it arrives. "
Tamara nodded. "Yeah. How will I know when and where it's going to get in my way? Or maybe they, if there may be more than one powersat migrating at once."
"Not just us," Valerie said, back again. "Optical astronomer, too. And pity the poor Earth-based infrared astronomers. A structure that's miles square soaks up a lot of sunlight."
"Kind of the idea," Marcus said, getting laughs. "But I see your point. You need a way to plan around the powersats even before they settle into geosynch. I can recommend an Internet application anyone can access for tracking and orbital predictions. And real-time position, too, as determined by GPS. Okay?"
"What about flight plans?" Tamara countered. "Shouldn't powersats be in FAA files?"
Marcus took notes. "Probably a good idea." And around Phoebe and The Space Place, essential for safety too.
"Real-time access," Ernesto Perez added, "so we can input the powersat orbital predictions into our scheduling software."
When Valerie disappeared again, around four p.m., Marcus tiiought maybe she had left to change clothes. (He planned to change, but after his first visit he had known to leave coat and tie in the car.) When she reappeared half an hour later, though, she still wore the same blue jeans and tan sweater. Even in sneakers, she was almost his height. He guessed she was about five foot ten.
She could wear a flour sack and be gorgeous. As for his coat and tie, they could stay where they were.
Five-ish, Aaron Friedman left with a parting shot of, "See you later, Valerie."
Marcus waited for her to correct her colleague. She did not. He thought he had asked Valerie out. On a date. Had "can I take you out to dinner?" somehow changed meanings during his time with Lindsey?
Shit, he was not ready for this.
The two of them finally had the lounge to themselves. "Ready for dinner?" he asked.
She smiled awkwardly. "Sure. That'll be nice."
"I'll need you to suggest someplace to eat."
"Not hard." She smiled again, and this time it came across more sincere. "We don't have many to choose among."
They headed in his car for Durbin, only slightly less tiny than Green Bank. Instead of making get-acquainted chat (not that he seemed to remember how), he focused on the narrow, twisty roads. The ten-mile, thirty-minute drive took most of his attention.

Unless dimness counted as décor, the family restaurant and bar had none. Several people he recognized from today's meeting, including Aaron Friedman, occupied stools at the bar. Banter with the bartender suggested they were regulars. That was one mystery solved, anyway. As for Valerie's expectations for the evening? Time would tell.

Compared to the afternoon's free-for-all, the conversation once he and Valerie were seated felt stiff. His scars were too fresh. Her scars, whatever they were, seemed to run deeper. He called it a toss-up who felt more ill at ease.

Ruling out shoptalk might have been a mistake. What did people talk about on first dates? He couldn't remember. The short menus, when the waitress brought them by, offered few possibilities to eat or discuss.

"How old is your son?" he asked as they waited for their appetizers. "Simon?"

Getting the name right got him another of those too-rare natural smiles. "Simon. He's nine. Precocious guy, in a mischievous kind of way. Reminds me . . ."

Of his father, Marcus filled in the blank. It felt too soon to ask. All he came up with, gracelessly, when enough time had passed was, "What have you read recently for fun?"

She named two novels he had never heard of, but he asked about them anyway. The waitress arrived with their entrées and the conversation trailed off again. This evening was a disaster.

Valerie told herself she should be home with her son. Only she knew that for a lie: Simon did just fine with babysitters, had more or less adopted Brianna as his big sister. Lying to yourself is never a good sign.

Her head was not in the game.

She found little to say when Marcus asked about favorite movies and music, or volunteered his own. When he launched into gadgets-about which, as an engineer, he was predictably enthusiastic- she shot that down too. Sorry even as she said it, she disgorged some inanity about devices that would not function in the quiet zone or were a pain tethered to an ethernet cable.

And when he unintentionally brought Keith to mind, she shut down even more.

She should have asked around about first-date topics. Clearly, she would not need to ask about second dates.

"Will you excuse me? I should check on Simon," she said.

"Sure." Reflexively reaching for his cell, Marcus laughed at himself. (She liked that in a guy. Too bad she was such a failure at this.) "I guess the restaurant has landlines you can use."

"For regulars, the house phone. It's behind the bar." She stood. "I'll be right back."

She found Patrick Burkhalter holding down a barstool. The rest of the Green Bank regulars appeared to have left.

Patrick must not have shaved that day. She thought he had worn the same pants and shirt the day before. He was heavier every time she saw him, his clothes tighter, his gut bulging over his belt. The mound of buffalo wings in front of him would do nothing to reverse the trend. And he drank alone far too often. Poor guy: No one to go home to.

"How's the big date going?" Patrick asked her.

"Just colleagues," she said. After the fact, if not by original intent. "Hand me the phone?"

To judge by the giggling in the background when Brianna answered, Simon was doing fine.

Patrick was nursing a beer with one hand, prodding his datasheet with the other. An ethernet cable snaked behind the bar from the datasheet. Something about Patrick tickled at the back of her mind.

Damn! Maybe she had gadgets to share after all. And they were wireless in a big way.

Black, sterile landscape hung in a shallow arc before Marcus. Up close, churned ground. In the left distance, a range of low hills. Straight ahead, receding into the distance, a pockmarked plain. In the right distance, rippled terrain that blended into more hills.

Phoebe, as he had never experienced it.

He and Valerie sat side by side on her living-room couch, an ordinary game controller in front of each of ttiem

on the coffee table. "What do you tiiink?"
Marcus hardly minded being invited inside after dinner - but he was more than a little surprised. She had insisted she had something to show him. What was this about? "Interesting," he offered neutrally.
"Give it a shot," she said.
He glanced down at his game controller. Landscape shifted as his head moved. Infrared laser beams shining into his eyes and sensors tracking eye motions from the reflections. He looked up and the landscape shifted again. "The hills to my extreme left and right look alike."
"Identical, in fact. The bot's full-circle view is compressed into ninety degrees, because you, unlike the bot, can't see three-sixty. To your far left and far right, about ten degrees of landscape overlap for continuity. You get used to it."
Marcus had never seen the attraction of the Phoebe tourist bots. Moon bots, maybe. Over the years robotic lunar landers had deployed those to far-flung and quite varied terrain. The catch was cost: Lunar bots were expensive. Once an armchair explorer sent a lunar rent-a-bot over a cliff or into a crevasse- that was that. And because of the comm delay to/from the moon, accidents did happen. And so, time on lunar bots did not come cheap.
Lose a bot on tiny, nearby Phoebe- much less likely, anyway, given the shorter comm delays - and often someone could retrieve it. Recoverability made armchair exploration of Phoebe affordable.
But Marcus "saw" PS-I and Phoebe almost daily, with clearance to operate the surfacecamera systems. (Not bots, though. For security purposes, work bots could only be accessed with much higher clearance than he had, and then only from local terminals.) He had come to think of the rent-a-bots creeping about parts of Phoebe's surface - when, from time to time, they strayed outside the tourist zone - as so much optical clutter.
Still .. .
He swept a hand across his controller. Gesture-sensing logic read the motion - more clever processing of infrared reflections. With an all but imperceptible delay the landscape slid to his right as the bot turned. Motion somehow emphasized the duplicated scenery at the extremes of the holo.
If he recalled correctly, and the fast response suggested he did, Phoebe was all but overhead at the moment.
He swept his hand back - and nothing happened.
"Hold your fingers together," Valerie said, "so you don't clutter the IR reflections. Fingers don't control individual tentacles."
Walking by gesture would be a great user interface. If his hand had eight opposable fingers. If the round-trip delay, ping-ponged through comsats, though far more manageable than in the lunar case, did not sometimes approach a full second. "Walking" involved a joystick and then only indicated a general direction. The bot's onboard nav software figured how to locomote across the landscape.
He swept his hand again, keeping his fingers straight, still, and together. This time, the landscape shifted as he expected. "I don't get it. Exploring Phoebe seems like the last thing that would interest you."
"Patrick, a guy I work with, was into these bots right after Phoebe rentals came online." She seemed about to say more, and to reconsider. "I tried to interest Simon in remote-controlled exploration. Any kid his age is going to spend time in VR, and this seemed much more civilized than the usual shoot'em-ups."
"How'd that go over?"
"About as well as you'd expect. "
Marcus kept gesturing, the landscape swaying in response. "Am I ready to take a step?"
"Uh-huh. Let's find a pair of bots somewhere interesting." She did something with her controller and a translucent pop-up materialized over the landscape. "Okay, here's an idle pair of bots near the Grand Chasm. You take bot 327." With a gesture, she changed the scene.
He had seen the Grand Chasm often enough, but never like this. Never so vast. What had changed?
The horizon was way too close.

"These bots can't be more than a foot tall," he said. "I'm used to watching from the safety cameras, atop eight-foot posts. "
"Size isn't everything," she said. And blushed.
Marcus pretended not to notice, guessing the words had just slipped out. If Valerie was one for flirting or double entendres he had yet to see it.
He waggled a tentacle at her bot. "So, come here often?"
Laughing, she managed to make her bot shrug. "Only twice, both times long ago."
"Hmm. Maybe this can be our place." The line felt hokey, and yet like the first uncontrived comment he had managed all evening.
They each arched a tentacle over the raUing to peer into the abyss, where scree piles dotted the dark, undulating depths. He saw bots stranded partway down and the tentacle tips of others peeking out from beneath piles of rubble. Trapped before the barrier went up, or did tourists climb their bots over the railing?
The chasm sides looked unstable, but exactly how treacherous were they? Marcus needed several tries to grasp and drop a stray pebble over the railing. Under Phoebe's scant gravity, the rock more floated than fell. Finally, picking up speed, it struck a canyon wall and triggered a slow-motion rockslide.
Few people had ever entered the Grand Chasm, and- as much as geologists ached to explore Phoebe's most prominent feature -none had gone down very far. Too dangerous, the risk assessments always concluded. Even flying in, a hopper's exhaust could start an avalanche. Some day, perhaps, when mining was less of a priority, the staff could tunnel into the bottom of the rift.
Someday remained distant.
Marcus had long suspected an excess of caution after the early- and unrelated- incident during the establishment of Phoebe base. One geologist had already died on Phoebe, and NASA was determined not to see more.
Now, in eerie silence, as the slo-mo rockslide went on and on, Marcus reconsidered.
Only how was he seeing this? Not sunlight- ever. Not earthlight, given the minimal comm delay. Phoebe had to be more or less overhead at the moment, deep inside Earth's shadow. Moonlight? The Moon was just past first quarter. The light it cast would strike obliquely, the shadows pointing in one direction - only the shadows around the bots pointed every which way. That suggested artificial lighting, yet he saw neither lamps nor spodights.
He gave up trying to work it out. "I'm confused. Where is our light coming from?"
"Not light. Not as you mean it, anyway. The bots use lidar."
Like radar, only based on laser beams. "So this is all computer-synth imagery?"
"Uh-huh." She stood and stretched. "I feel like coffee. How about you?"
"Sure." He followed her into the kitchen, where a pair of binoculars sat on the counter near the back door.
"Wildlife?" he guessed, pointing.
"Stargazing." She finished putting up the pot of coffee and grabbed the binocs. "Come outside."
The night was cool and cloudless. After the moon, waxing gibbous as he had remembered, The Space Place, playground of petrocrats, kleptocrats, and the otiier superrich, was the brightest object in the sky. Only this was a sky unlike any he had seen in a long time. Far from big-city lights, the stars blazed. Thousands of them.
"Try these." She handed him the binoculars -
Through which countless more stars shone. And there, aglow in infrared from the residual heat of their last passes through sunlight, tiny shapes: an oval, a rectangle, and, the brightest of the three, a not-quite-round pearl. Phoebe's sunshield and PS-I, seen at a bit of an angle, and The Space Place. Phoebe itself was too dark and cold to spot even with thermal imaging.
Her hand was on his back, turning him. "Now look. No, up a little. A little higher."
"At what?"
"You'll know it when you're there. "

The Milky Way looked like spilt milk - with a scattering of diamond chips.
"Wow," he said. "Thanks." He slowly turned, taking in the grandeur of the night sky. He eventually thought to offer Valerie her binocs. To the naked eye the night now seemed blacker than ever. "It's very dark out here."
"Oh, crap!"
Huh? "What's wrong?"
"You didn't plan to drive back tonight, did you? If you think it's dark here ..."
Think how dark it will be in the forest, crossing die mountains, he completed. "Not a problem. I have a room for the night in the observatory residence hall. You don't need to chase me off just yet."
"That's good." A sudden, unexpected peck on the cheek suggested she meant it. "And if you'd like, how about you come by in the morning for breakfast?"
Turning, slipping his arms around her waist, Marcus said, "I'd like that a lot."
Monday, May 8
From the secluded anonymity of a black stretch limo, shared only with a longtime assistant, Yakov Nikolayevich Brodsky watched urban streets slip past.
He always enjoyed visiting Chicago. With its extensive expatriate community, he dined well here, on everything from Mini to borscht to stroganoff. The finest elaborate banquet cost less than a passable snack in Moscow - Because few here could have afforded Moscow prices.
And so, in a very different way he relished the signs of America's decline. The weed-choked medians. The empty stores and shuttered factories. The would-be day laborers milling about in a 7-Eleven parking lot. Most of all he enjoyed the waiting lines and pergallon prices as they passed neighborhood gas stations.
What a difference a decade could make.
The limo sped downtown amid an escort of blue-and-white Chicago police cruisers. Lights flashing, they crossed under the rickety elevated-train tracks that demarcated the Loop.
"We're almost there, sir," the driver announced soon after. "Five minutes."
A driver! How quaintiy decadent. But doubtless the driver with whom he had been provided also spied on him.
"Very well."
Yakov savored, too, Chicago's distinctive architecture. Perhaps his favorite example was the masterpiece that came into view as the motorcade turned onto Jackson Boulevard.
For decades the Chicago Board of Trade BuUding had towered over everything else in this city. From the speeding car, alas, Yakov could not fully appreciate the edifice's art deco distinctiveness. He could scarcely even see the three-story statue of Ceres, goddess of agriculture, which crowned the building's peak.
This building projected a confidence and a presence, embodiment of a bygone era, of an American century. Not so the many modern glass-and-steel skyscrapers: Their drab and boxy exteriors served only as metaphors for the hollowed-out American economy.
Police had cleared the street and sidewalk in front of the Chicago Board of Trade Building and were keeping scores of picketing protesters behind sawhorse barricades. American grain for Americans many placards read. Stop burning food another popular sign demanded.
Inwardly, he smiled.
As the limo pulled up to the curb, eight serious men and women in somber garb marched from the main entrance. Yakov waited for the driver to open his door.
"Welcome, Yakov Nikolayevich!" one of his greeters declared, a hand outstretched. "You honor us by your visit.
"
"Hello, Roland," Yakov acknowledged. Roland Johnston was chief executive officer of the CBOT. Yakov would deal with no one lesser.
"I trust your flight was satisfactory?"
"Very comfortable. Thank you." Washington, to which Yakov was posted as Deputy Trade Representative, was

only a short hop away. Shorter, in fact, than he would have wished. He so seldom found the opportunity to fly his Learjet. "My assistant, Irina Ivanovna Chesnokova."
"Ms. Chesnokova." Roland introduced his aides and hangers-on, and then, with a quick gesture toward the protest, suggested proceeding inside. "I apologize for the ruckus."
"Democracy," Yakov said. They could decide whether he intended sympathetic understanding or ironic dismissal. "Very good. I would like to see the trading floor." The pits of the original trading floor, alas, had been filled with concrete, the new area turned into mundane offices. A travesty, Yakov thought. "And the electronic trading facilities, of course."
"Naturally," an aide agreed. The corner of a folded datasheet peeked from a pocket of her jacket.
The Americans would give him the grand tour, fawn over his every word, then wine and dine him. When he completed his business, their limo would whisk him back to the airport. And between?
Between - to the certain dismay of the demonstrators outside, and countless others of similar opinion - his hosts would do everything in their power to expedite his purchase of corn and wheat. Two million metric tons of each, with intimations of yet larger purchases to follow.
They would bow and scrape and cut corners on his behalf, because he did not need their help. He could, he would suggest obliquely, shift much of his purchasing to the Canadians and Australians. His minions could quietly accumulate much of his stated need in smaller lots, through Internet trading and via pliant third parties, before anyone would see the pattern.
Only he wouldn't. Visibility, not secrecy, suited his purpose. That so rarely happened.
Ethanol substituted for gasoline. Higher grain prices made ethanol more expensive and less competitive. The mere specter of higher grain prices would spook oil markets around the globe. Whatever few extra dollars he might spend on grain- which, with great magnanimity, Russia would distribute to her friends in the Third World- would be more than repaid in higher energy prices.
Roland Johnston was by then extolling the virtues of some recent upgrade to his organization's electronic-trading mechanism.
Yakov just nodded. If anything important came up, Irinushka could summarize later for him. She had already asked several probing questions about the measures taken to assure the integrity of data in their computer systems.
The men among Johnston's staff crowded around her, drawn to her classical beauty, vying to impress. Some must suppose she frowned in concentration at their wit or wisdom, or struggled with English jargon, for their speech had gotten louder and slower. And she, never giving any sign, would despise them for their vanity and condescension.
She had been born deaf. She had neither heard nor spoken until she was five, after receiving the cochlear implants masked by her long, flowing, red hair. When too many people spoke at once, or in chaotic environments like the trading floor, the din sometimes confused the implants' noise filters and speech-discrimination circuits.
Despite everything, she understood more than the fawning, self-important young men could imagine.
"Are you seeing what you wanted?" Johnston asked.
Yakov nodded. "This is a very worthwhile visit."
How strange it was to accomplish grand strategy by means as prosaic as buying corn. Because deputy trade representative was only his cover for his true position: a senior agent of the Federal Security Service.
Russia's interests often required methods more subtle - or far more dramatic,
Saturday, May 13
"What do you think, Professor?" Eric the bartender asked.
Patrick looked away from the 3-V in the corner. "I think the Yankees will win in a blowout."
Eric laughed. "That's a given. No, I wondered if you were ready for another."

It was Patrick's turn to laugh. "No, that's a given."
"I like the way you think, Professor. Be right back."
Three people sat along the bar and a few couples at scattered tables: Saturday night in Outer Nowhere. No families with children, thankfully. He still found families hard to take.
Eric reappeared with a fresh, foaming pint. "Your beer, Professor."
"Thanks." Taking a long slow sip, Patrick returned his attention to the ballgame.
He took no offense at Professor. Eric called anyone from NRAO that. In the winter, when this ski-resort bar would be hopping, Eric's patrons were "Sport." Except any ski bunnies who Eric was hitting on. Them he promoted to "Sportette."
Snowshoe was far enough from Green Bank to keep Patrick's coworkers to a minimum. Alas, because the resorts offered most of the area's finer dining, that niinimum was not zero. As, captured in the behind-the-bar mirror, the approaching man and woman reminded him.
"Hi, Patrick," a familiar voice called cheerily.
Swiveling on his stool, Patrick thought Valerie Clayburn and her NASA friend made a cute couple. Both wore casual slacks and knit shirts: dressed up for her and down for him. "Hi, Valerie."
"Marcus Judson. Patrick Burkhalter." To Patrick, Valerie added, "You remember Marcus visiting us for a staff lunch?"
The name? That, Patrick had forgotten. But Marcus himself, after the reception she had arranged for him? No way. The wonder was that Marcus had gotten past it. Hopefully he had seen through to the good person underneath. Though maybe he just had eyes in his head.
Too much information. "Of course. Hello," Patrick said.
"Pleased to meet you. You're the guy who put Valerie onto Phoebe bots, right?"
Patrick shrugged. "You make it sound like I encouraged her."
Eric sauntered over, a napkin over his arm. "What can I get you, Professors?"
"Two glasses of the house Merlot, Eric," Marcus answered.
"You've been promoted to a regular," Patrick said. And quickly: Valerie's ambush had been only four weeks ago. "Feel honored."
"Patrick is an astronomer too," Valerie said.
"Astrophysicist," Patrick corrected.
Marcus rubbed his chin, brow furrowed. "There's a difference?"
"A big one." Valerie grinned. "Say I'm on a plane. If I feel sociable, I'm an astronomer. Everyone loves astronomy. When I want to read in peace, I'm an astrophysicist.
"Marcus, I'll get us a table. Patrick, will you join us for dinner?"
Which part of astrophysicist was unclear? "I don't plan to stay late tonight," Patrick lied.
Besides, Valerie did not need a chaperone. Patrick wondered if Judson would become a regular with her too. Everyone would know when Judson stopped getting a room in the Res Hall for his weekend visits. Green Bank was a small town, and the observatory staff was even timer.
"If you change your mind, " Valerie persisted, then strode off for the dining room.
Eric ambled back, setting down two wineglasses. "I started you a tab, Professor."
"Thanks." Judson picked up the glasses, took a step away from the bar, and stopped. "Tough break," he said softly.
The Tigers had just left two men stranded on base. "Jankowski is on fire this season," Patrick said. "ERA of what, around two-nine?"
"That's not what I meant."
"Aren't you on a date?" Patrick asked. He turned, pointedly, back to the Yankees/Tigers game.
If there was one thing Patrick could not abide, it was sympathy.

Valerie slid back her plate, pleasantly full. "That was excellent."
"That was a salad," Marcus said, as though disagreeing. He had had a sirloin with a loaded baked potato, and all that remained on his plate was a sprig of parsley. Maybe only half a sprig. "How about some dessert?"
He ate like a force of nature, but if she skipped dessert so would he. "I'd split one." One bite was splitting. "What do you recommend?"
"Pretty much any of the desserts." As in: you pick. Because you studied the dessert choices before you ever looked at entrées. And because you're going to be eating most of it.
Why was dating so complicated?
"How about the death-by-chocolate cake, then. With a scoop of ice cream?"
"That sounds good." And maybe two bites.
"So, about Patrick."
She had wondered when Patrick would come up. "He's a planetary astronomer. I think you two would get along. He's not always so . . ."
"Cranky? Surly? Belligerent?"
"I was going to say gruff." The waitress came by to clear the dinner plates and took their dessert order. Valerie figured she could change topics! Patrick was so . . . sad. "Simon came home from school today with the funniest story. "
"Hold that thought. I have a question about him. Patrick, I mean. What was with the disclaimer when I mentioned Phoebe bots?"
"Honestly? I don't know. It's odd. He used to rent bots quite often. But it's true that he didn't encourage me to try bots myself. "
The waitress returned with their coffees, their dessert, and two forks. Marcus moved the plate into the center of the table. "What does he do at Green Bank?"
"Mostly maintenance, and some training of visiting astronomers. With authorization you can schedule observations over the Internet, but we don't give out those codes to anyone till they've trained onsite." Three bites, she decided, taking a fork. "Do you know his history?"
"Yeah." Marcus's eyes widened with his first bite of cake. "Not the kind of incident I would forget. Ex-JPL. Broke basic ops protocol, and in the process lost a deep-space probe."
"I think that's oversimplified." She fidgeted with her napkin, searching for the right words. Patrick had confided in her, just a little, once when she had really needed the distraction. "Suppose he had gone through channels, that he had submitted a proposed maneuver. Suppose that while he waited for a review committee to approve, the spacecraft got whacked by an oncoming rock." The inward-streaking pebble that, Patrick had said, could not be found in what remained of the final telemetry after his hasty upload. "Would that be better?"
"No one second-guesses waiting for channels. " Marcus, wearing a sudden sour expression, set down his fork. "And when something was everyone's responsibility, that makes it no one's fault. Okay, I might have acted too. More carefully, I would like to think. And without wiping the comm buffer afterward to try to cover my tracks. "
"He's my friend, Marcus." And loss of Patrick's family, career, and the respect of his peers was too steep a penalty.
Patrick had been in her office the day two marines in full dress blues showed up. As Patrick had been there for her for long days after. Merely, quietly, there, not driven off, as were so many, by the embarrassment of not knowing what to say.
A good man hid beneath all that rancor. She felt Patrick's pain.
And in a rush, her own. She still missed Keith terribly. She wished her son could have known his father, taken away when Simon was just learning, stumblingly, to walk. But in an instant, a roadside bomb in Afghanistan had changed . . . everything.
What was she doing on a date?

Keith would want her to get on with her life, but she felt miserable. She tried to keep the turmoil off her face and knew she had failed.
"Sorry, " Marcus said, looking confused at her mood swing. "Are you all right?"
"Just . . . distracted."
"Do you want to talk about it?"
"No," she insisted.
Marcus took the hint. "So Patrick doesn't observe anymore?"
She wrung her napkin some more. "Not officially." Because Patrick's proposals for time on the scopes seldom got approved. "But training involves targets, and he picks the aim points. His students end up tracking lots of objects in the outer asteroid belt. "
"Outer belt," Marcus repeated. "Meaning?"
"Beyond the ice line. Distant enough from the Sun that ice doesn't melt or sublimate."
"Listening for the beacon of the Verne probe, you mean. After, what, eight years?"
"Nine," she corrected. How absurd were the odds Patrick would ever hear it? Space was big. And who knew if the lost spacecraft even still functioned? "I know. It's sad."
"Poor guy."
The waitress topped off their coffees. Valerie wrapped her hands around her cup to warm them. Not that the room was cold.
"I think I should be getting you home, " Marcus said. "You look . . . tired."
She opened her mouth, but an explanation refused to come. Dragging out the evening would not be fair to him.
"You're right," she managed at last. "Sorry."
The drive home to Green Bank continued in awkward silence. She broke it by babbling about how in I960 Green Bank hosted one of the first academically respectable SETI meetings. SETI was one of Patrick's avowed passions, and she launched into describing the transmitter module- never installed, of course - that he had designed and built in his spare time for the big dish. He often puttered after hours in the electronics shop.
Only no one she knew believed Patrick gave a flying fig about SETI, or that he had spent months getting ready to send a reply to some hypothetical aliens. What everyone understood- and no one would ever raise with Patrick- was the thing for which he did prepare: the day he detected the Verne probe's beacon. Each year, as that hope seemed more forlorn, he spent less time tinkering with the idle transmitter.
Her voice trailed off. She and Marcus completed the drive in uncomfortable silence.
They finally turned into her driveway. Light flickered in the windows, Brianna watching 3-V. Then a little figure bounded past the living-room window: Simon, wide awake. Valerie fancied she heard little-boy engine noises. The dashboard clock, as she sneaked a peek, read 8:46. She was pathetic.
"I'm sorry," she told Marcus, yet again, as he walked her to her door. "I'm not fit company tonight. May I call you in the morning? Maybe we can go for brunch. "
"Sure. I can stay till noon or so. Big meeting Monday to prepare for. "
He didn't offer details and she didn't ask. The powersat, quite accidentally, had brought them together. It would not keep them together. It was, like Keith, a subject they did not discuss.
The two unmentioned elephants in the room.
On the porch, Marcus gave her a perfunctory kiss goodnight. "Will you be okay?"
"Sure." She forced a smile. Someday.
Thursday, May 18
Slicing the tops off whitecaps, a sleek, thirty-foot hovercraft raced along the Santa Barbara Channel. In the distance, rugged and pristine, stood one of the islands of Channel Islands National Park. Santa Cruz Island, if Dillon correctly remembered the map. The sky was almost painfully bright. Sun sparkled off the waves.
"Southern California hardly counts as the tropics," Kayla Jorgenson shouted over the roar of the engine. Her tan

Dockers, starched blue blouse, and L. L. Bean windbreaker might as well have been a business suit. She had pulled her hair back into a short ponytail. Only white knuckles as she clenched the handrail betrayed nerves.
"This time of the year surface-water temperature only approaches sixty degrees, so the test bed won't reach the output levels the system would achieve near the equator. We still get a temperature differential, with respect to the bottom of the intake pipe, better than twenty degrees. The results we're measuring match our simulations quite well. That said, to unambiguously prove the technology, we would like to deploy a full-scale demo system somewhere warmer. "
If we get the money, she managed to convey without uttering the words.
Dillon tugged his cap lower. Despite RayBans and the cap's long visor, he squinted against the glare. He was a captive audience on the small boat, and Kayla was not one to waste face time. He remembered his first impression of her: focused.
They could have choppered to the demo site a lot faster, but after criss-crossing the country, flying from one cash-hungry startup to the next, Dillon had opted for sunshine and sea breezes. His face turned toward the afternoon sun, closing his eyes, he thought tanned thoughts.
He was exhausted. Already that week he had toured a lithium-ion automotive battery plant in Saginaw, a superconducting-cable company outside Chicago, a scale-model geothermal power plant in Nevada, and, only the day before, a Silicon Valley semiconductor design shop with some ideas for improving solar cells. The score so far for the week: dud, promising, dud, and scary. Cortez Photovoltaic used chemical dopants and industrial processes that made him nervous as hell. An anonymous tip to the EPA should slow that bunch for a while.
"Besides the convenient location," Kayla kept going, inexorably, "reusing the drilling rig really slashed our upfront costs. All we had to do was lower pipe, something any oil platform is already configured to do. If we extend this concept to . . ."
When Dillon next opened his eyes, the platform, which had been only a dot on the horizon, had swelled into a massive, looming construction.
Oil drilling in the Santa Barbara Channel: madness. Merely to see this oil rig filled him with rage, but he bottled the anger. He could almost wish the Crudetastrophe had tainted the reservoir deep beneath his feet.
Like the drilling platform itself, ocean thermal energy conversion was an enormous undertaking. He felt the throb before he heard it. As they raced toward the old oil platform, the pulsing grew and grew.
"You'll want these," Kayla said. Her left hand came out of her jacket pocket with two pairs of earplugs. "Anti-noise. They cancel repetitive low-pitched sounds like what our big pump makes. "
Not much use to fish, porpoises, or whales. They were screwed. One of the staff engineers Dillon had tasked to vet Jorgenson's pitch had brought up the noise issue. Her guesstimate was that underwater noise from an OTEC plant would exceed ambient levels for a good mile from the platform.
The Santa Barbara Channel was summer home to about ten percent of the world's blue-whale population. What about them?
But Kayla was right about the earplugs. The throbbing all but disappeared once Dillon had his pair in place.
She was still pitching OTEC when the hovercraft, settling into the water, coasted up to the platform's floating dock. The oil platform - an all-but-incomprehensible maze of girders and pipes, catwalks and steel plates- loomed over Dillon. High above, enormous derricks reached far out over the channel.
Twenty feet above the waves, where a spidery catwalk hugged one of the platform's massive support posts, a worker in hard hat and orange coveralls stood waiting. Projecting outward and upward, held almost vertical by taut steel cables, was what could only be a raised gangplank.
Kayla shouted out a string of numbers, and the roustabout released the brake of a winch. With a whirr of gears the gangplank pivoted and began to descend. The floating dock bucked and slued as, with a thud, the foot of the ramp struck.
"Nice drawbridge." Dillon gestured at ocean all around. "And one hell of a moat."

"We don't want uninvited guests, obviously," Kayla said. "We change pass codes daily."
As the dock's wobble dampened out, Coverall Guy loped down the gangplank to meet them. While he and crew secured the hovercraft, Dillon kept looking around. A wiremesh cage bobbed nearby, buoyed by pontoons at the corners. Peering over the hovercraft's side, wondering what the enclosure was and how deep it extended, he was startled by dark, darting shapes within. They had to be two feet long, at least.
"What are those?" he asked, pointing.
"Alaskan sockeye salmon, " Kayla said, grinning at his double-take. "Some of the cold water we've brought to the rig gets vented through the aquaculture units. That should be good for some extra income from the local seafood joints. We're thinking we might farm Maine lobsters in another cage. "
While the chilled water spewing from the rig did what to the indigenous species? Fish farming was not the insult to nature of many ventures he saw, and the shadow of an oil platform was hardly a native habitat, but still the caged salmon saddened him.
Dillon followed Kayla up the gangplank, rising and falling with the floating dock, to the lowest catwalk. From there their route was hand over hand, rung by rung, straight up the massive pillar. When they reached the bottom deck he tried not to look through the metal grating to the surging waves far below.
The next visit, if there was one, he would take the chopper!
From the bottom deck they climbed endless flights of stairs, not stopping until the helipad level. Barrels and bulky gear lay scattered across the helipad. To deter unauthorized landings? "You really don't want visitors, do you?"
Kayla just shrugged.
He grabbed his cap as a wind gust snatched it from his head. Vibrations his earplugs would not let him hear crept up his legs, shaking his entire body.
The California coast sprawled in the distance. Kayla, who had saved her breath for the long climb, resumed her spiel. "Lots of oil platforms are like this. Near enough to land for easy resupply In water deep enough to offer a significant temperature differential. Generating power by dropping pipe here is less disruptive than laying pipe from shore out to deep water."
Compared to some projects Dillon had assessed, this was environmentally sound. Sun would heat the surface waters no matter what. It would be better that obscenities like this platform had never been built, but at least with OTEC the platforms might contribute clean power.
Except that nothing built on a scale this monstrous could ever be benign . . .
"This pilot project will generate, if I remember correctly, five megawatts?" Dillon asked. "How do you deliver the power to where it will be used?"
"Converted to microwaves." She gestured across the helipad to a sturdy metal tower studded with antennae directed to points around the compass. "The smaUll dishes will beam power to nearby drilling platforms, which will no longer need diesel generators to have electricity. The big dish" - which was not all that big- "will beam to the receiving antenna under construction on Santa Cruz Island. I guess visitors at the Nature Conservancy's research center aren't ready to give up supercomputers and hairdryers.
"The microwave tech isn't much different from how the NASA powersat will transmit power to the ground, except that we aren't pushing the state of the art. We're dealing with megawatts, not gigawatts, and sent over a much shorter distance."
Powersats: The most mega megaproject of them all. If Kayla understood what mattered to Dillon- and, of course, she could not possibly - she would have picked a different example. Likening her endeavor to powersats had turned his stomach.
In her ignorance, she kept talking. "Of course not every OTEC facility will use beamed power. Where we lack a line of sight to land, and maybe for really large-scale generators, we expect to run marine power cables. You know, like the big offshore wind farms use."

And Dillon suddenly knew exactly what monkey wrench to throw into these particular works. "I have interests in a superconducting-cable start-up." Even though the bunch in Illinois did not yet know it. They had been eager enough to get some of his money.
"Zero-resistance underwater cables to the power grid on shore. Of course, that would be great." Kayla hesitated. "At the capacities we'll need, superconducting cable is experimental at best. We've got a lot on our plates as it is."
"No, this could work," Dillon said firmly. "Look, I'll put my cards on the table. One-of-a-kind investments aren't worth my time. I look for synergies, win-win situations. Here we have one. The other bunch would get an impressive, real-world demonstration. You would get first crack at a more efficient way to bring OTEC power ashore."
"Does this mean my company has your backing? That you will invest?"
Dillon gazed out across the Santa Barbara Channel, saying nothing, the breeze whipping his hair. She could do the math.
She straightened, squaring her shoulders. "If you back Jorgenson Power Systems at the funding levels we've discussed, we'll assess our fit with your other company. "
"That's all I'm asking."
Because commercializing technology of this scale would involve several more rounds of capitalization. Getting follow-on investments was all but impossible without the tangible endorsement - second-round buy-in - of the earlier investors. So: Kayla 's people would factor the new technology into their plans. Just as, when Dillon called to dangle a bit of venture capital, the Chicago bunch would swallow hard and agree to a marine deployment- desate the complexities that would introduce - for their first big field trial.
With a few million bucks of other people's money, he would tie both ventures in knots.

Publication date: Jun 2011

Year: 2011

Test of Spanish sentences to measure speech intelligibility in noise conditions

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Publication info: Behavior Research Methods (Online) 43.2 (Jun 2011): 459-467.
ProQuest document link

Abstract: This article describes the development of a test for measuring the intelligibility of speech in noise for the Spanish language, similar to the test developed by Kalikow, Stevens, and Elliot (Journal of the Acoustical Society of America, 5, 1337-1360, 1977) for the English language. The test consists of six forms, each comprising 25 high-predictability (HP) sentences and 25 low-predictability (LP) sentences. The sentences were used in a perceptual task to assess their intelligibility in babble noise across three different signal-to-noise ratio (SNR) conditions in a sample of 474 normal-hearing listeners. The results showed that the listeners obtained higher scores of intelligibility for HP sentences than for LP sentences, and the scores were lower for the higher SNRs, as was expected. The final six forms were equivalent in intelligibility and phonetic content. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract This article describes the development of a test for measuring the intelligibility of speech in noise for the Spanish language, similar to the test developed by Kalikow, Stevens, and Elliot (Journal of the Acoustical Society of America, 5, 1337-1360, 1977) for the English language. The test consists of six forms, each comprising 25 high-predictability (HP) sentences and 25 low-predictability (LP) sentences. The sentences were used in a perceptual task to assess their intelligibility in babble noise across three different signal-to-noise ratio (SNR) conditions in a sample of 474 normal-hearing listeners. The results showed that the listeners obtained higher scores of intelligibility for HP sentences than for LP sentences, and the scores were lower for the higher SNRs, as was expected. The final six forms were equivalent in intelligibility and phonetic content.

Keywords Speech perception * Auditory perception * Intelligibility * Masking noise

The assessment of speech intelligibility plays an important role in fields such as audiology, psychoacoustics, and telecommunications, among others. The use of sentence materials to test speech intelligibility has many advantages over using other types of speech stimuli, such as words or syllables, because sentences are more representative of real everyday communicative situations than are words or syllables. On the other hand, these types of stimuli have some disadvantages. For example, if the experimenter uses different experimental conditions, such as different signalto- noise ratios (SNRs) or other listening conditions, the same speech materials cannot be repeated with the same listener.

To address this issue, Kalikow, Stevens, and Elliot (1977) developed a test of speech perception in noise (SPIN) consisting of eight lists of sentences equivalent in intelligibility and tested in different conditions of background babble noise. Thus, an experimenter can select some of these lists and use them in different experimental listening conditions simulating those encountered in everyday speech communication.

The SPIN sentences have another valuable characteristic. Each 50-sentence list contains 25 high-predictability (HP) sentences and 25 low-predictability (LP) sentences. The HP sentences are constructed in such a way that the final word can somehow be predicted by the preceding context, and the LP sentences are constructed in such a way that the final word cannot be predicted by the context. Each HP sentence has its corresponding LP sentence, so that the same final word appears in both the HP sentence and its corresponding LP sentence. The listeners must respond by providing the final word or key word. Comparing the performance of individuals on the recognition of these two types of sentences makes it possible to assess the separate effects of auditory acuity and linguistic knowledge, expressed as the capability of using the preceding context to recognize the final word. Thus, the contribution of either sensory or cognitive processing to the total score obtained by the listener can be estimated by comparing performances on the HP and LP sentences. The assumption is that the HP sentences produce higher scores than do the LP sentences, especially in adverse listening conditions. In these situations, when the acoustical cues and bottom-up processing are not enough to accomplish speech perception, top-down processing (linguistic knowledge or the use of context) can facilitate this identification.

The evaluation of speech intelligibility is especially important in adverse listening conditions that simulate everyday listening situations, such as background noise at different signal-to noise levels (Dubno, Ahlstrom, &Horwitz, 2000; Gordon-Salant &Fitzgibbons, 1999, 2001, 2004; Gordon-Salant, Fitzgibbons, &Friedman, 2007; Humes, Burk, Coughlin, Busey, &Strauser, 2007; Kalikow et al., 1977), fast speech (Gordon-Salant &Fitzgibbons, 1999, 2001, 2004; Gordon-Salant et al., 2007; Humes et al., 2007), same versus different speakers' voices (Goy, Pichora-Fuller, van Lieshout, Singh, &Schneider, 2007), or some speech distortions such as jitter (Pichora-Fuller, Schneider, MacDonald, Pass, &Brown, 2007) or noise-vocoded speech (Sheldom, Pichora-Fuller, &Schneider, 2008).

Another area in which the measurement of speech intelligibility is especially relevant is clinical audiology. The SPIN test has demonstrated its clinical utility in measuring the effects of linguistic cues on speech discrimination in studies by Bilger, Nuetzel, Rabinowitz, and Rzeczkowsky (1984) and Hutcherson, Dirks, and Morgan (1979) for listeners with sensorineural hearing loss or in the study by Del Dot, Hickson, and O'Connell (1992) for

listeners using hearing aids.

There are many other situations in which testing the effects of linguistic knowledge is a relevant issue. For instance, the study by Elliot (1979) evaluated from what age children are able to use contextual or linguistic cues to achieve speech perception in noise, while the study by Mayo, Florentine, and Buus (1997) determined how age of acquisition influences second-language speech perception. In the latter study, differences in the recognition of HP and LP sentences, especially in noise conditions, would indicate the degree to which the nonnative listeners had mastered the ability to profit from the semantic and syntactic information provided by the context.

Another research area of interest is the recognition of speech in noise in elderly listeners. The differences these listeners show for the HP versus LP sentences have been extensively studied (Dubno et al., 2000; Gordon-Salant &Fitzgibbons, 1997; Perry &Wingfield, 1994; Pichora-Fuller, 2008; Pichora-Fuller, Schneider, &Daneman, 1995; Sommers &Danielson, 1999; Wingfield, Tun, &McCoy, 2005). In these listeners, decreases in sensory information due to loss of hearing acuity, especially in adverse listening conditions, can be compensated by information provided by the context (Pichora Fuller, 2008).

Thus, the SPIN test has been applied to a variety of experimental conditions and types of listeners in the English language, and it has proved to be a useful tool in psycholinguistics, psychoacoustics, and audiology.

The objective of the present study was to develop a test to measure the intelligibility of speech in noise for the Spanish language similar to the test developed by Kalikow et al. (1977) for the English language in an experiment conducted to measure the intelligibility of a pool of sentences with different signal-to-noise ratios (SNRs). These sentences were used in a previous study (Cervera &Gonzalez- Alvarez, 2010). In that study, six lists of HP sentences were first generated. These lists had equivalent predictability for the final word. They were also equivalent in length, phonetic content of the sentence, and frequency of the final word. In addition, each HP sentence had its corresponding LP sentence generated by using the same final word but with an LP preceding context, producing six corresponding LP lists.

In the present study, our aim was to assess the intelligibility of these sentences in normal-hearing listeners in three different SNR conditions (0 dB, +5 dB, and +10 dB) using babble noise. We hypothesized that the performance of the listeners on the HP sentences would be higher than the performance on the LP sentences. At the same time, among the three SNR conditions, the +10-dB SNR condition would produce higher scores than the +5-dB SNR condition, and the latter would produce higher scores than the 0-dB SNR condition.

The ultimate objective was to create a set of final lists (hereafter referred to as forms) of equal intelligibility to be used as a test of speech intelligibility in noise for the Spanish language. These forms consist of 50 sentences each (25 HP and 25 LP). The forms must also have equivalent phonetic content, because this characteristic is very important in audiology.

Method

Participants

The participants in the experiment were 474 undergraduate students, 394 from the University of Valencia and 80 from the University of Jaume I. Of these students, 291 were female and 183 were male. Their ages ranged from 21 to 30 years, with a mean age of 23.1 years (SD = 2.6). They received partial credit for a course requirement. None of the participants reported having any hearing or language problems, and they were native speakers of Castilian Spanish.

Stimuli

The stimuli consisted of 150 HP sentences and 150 LP sentences. These sentences were generated in a previous study (Cervera &Gonzalez-Alvarez, 2010). The HP sentences consisted of sentences whose final word was in some way predictable from the preceding context, with values of between 10% and 90% predictability (e.g., "Ata el regalo con una cinta"; "Tie the present with a ribbon"). The 150 sentences were grouped in six lists so that the predictability of all of the six lists was equivalent. These lists were also equivalent in length (all of

them had from seven to ten syllables), phonetic content (with regard to both the whole sentence and only the last word or key word), syllabic structure, word stress, and frequency of the final word.

In addition, each HP sentence had its corresponding LP sentence, generated using the same final word, but with an LP preceding context. An example would be "Ahora voy a decir cinta" ("Now I am going to say ribbon"). Thus, six lists of 25 HP sentences and six lists of 25 LP sentences were created.

These lists were recorded by a native Castilian Spanish female speaker who was accustomed to recording for experimental or clinical purposes. The speaker was required to repeat each sentence 3 times. In addition, the duration of the utterance had to be from 1,800 to 2,000 ms. The clearest production of each sentence recording was selected. The recording took place in a soundproof room, using a Sennheiser HMD 224 microphone set at 15 cm from the lips and directly digitalized in the computer using an Edirol UA-5 sound card, with a sampling frequency of 11.025 kHz, and then the signal was low-pass filtered at 5.5 kHz to prevent aliasing.

The speech materials were edited with Adobe Audition sound editor software. First, each sentence was excised from the recorded list of sentences, creating WAV files of 1,800- 2,000 ms of duration. Visual inspection of the waveform and the spectrogram was used to determine optimal points at which to excise the sentence. Then the intensity of each stimulus was also adjusted so that it would have an equal rootmean square (RMS) across the entire sentence. The final words of the sentences were also equal in intensity.

To create the masking condition, we used babble noise. The babble noise was generated by mixing 12 voices (six males and six females) reading a text. The recording conditions and digitalization of the signal were the same as in the case of the sentence stimuli. The babble noise was mixed with each sentence, creating each of the three SNR conditions, 0-dB, +5-dB, and +10-dB SNR, by manipulating the overall RMS of both the signal and the babble noise. These manipulations were performed using Adobe Audition Pro software.

Procedure

The six lists of HP sentences and the six lists of LP sentences were presented in three different conditions of background noise (0-dB, +5-dB, +10-dB SNR) to a group of 474 listeners. Each individual was presented randomly with one of the following combinations of the HP and LP lists: list 1 (HP) with list 2 (LP), list 2 (HP) with list 3 (LP), list 3 (HP) with list 4 (LP), list 4 (HP) with list 5 (LP), list 5 (HP) with list 6 (LP), and list 6 (HP) with list 1 (LP). By means of these combinations, each participant was presented with both HP and LP sentences, but with no repetition of the final word of the sentence. At the same time, each individual was presented with only one of the three SNR conditions randomly. Thus, 79 individuals completed each of the six list combinations described above. Of each of these 79 participants, 26 of them were presented with the 0-SNR condition, 26 of them were presented with the +5-SNR condition, and 27 of them were presented with the +10-SNR condition.

The listeners participated in the experiment in a soundattenuated laboratory with six cabins. Each cabin contained a Pentium PC with Sennheiser headphones. Before the experiment began, participants were instructed to listen to the sentence and enter the last word of the sentence, using the computer keyboard. The administration of the stimulus and the registration of the responses made by the listener were performed by a Java program developed specifically for this experiment.

Results

Percent correct scores

Figure 1 shows the mean scores (expressed in percentages) obtained by the listeners on the perceptual test for both the HP and the LP sentences in the three conditions of background noise, 0 dB, +5 dB, and +10 dB SNR. For each condition of SNR and for HP and LP sentences, the percentiles of the data obtained by the listeners were calculated as well (see Table 1).

As can be observed in Fig. 1, the HP sentences presented higher perceptual scores than did the LP sentences, as was hypothesized. At the same time, the perceptual scores were higher for the highest SNR condition, +10 dB, followed by the +5-dB condition, and the lower scores correspond to the 0-dB condition, as was

hypothesized.

With the aim of testing whether the differences between the LP and the HP sentences and the differences in the three conditions of SNR were significant, we submitted the data to a two-way ANOVA with percentage of correct scores obtained on the intelligibility test as a dependent measure and type of sentence (HP or LP) and the three SNR conditions (0 db, +5 dB, and +10 dB) as factors or independent variables.

We found significant main effects of type of sentence, $F(1) = 3{,}005.19$, $p < .01$, $\eta 2 = .11$, and SNR condition, $F(2) = 2{,}234.43$, $p < .01$, $\eta 2 = .16$. The interaction was also significant, $F(1, 2) = 77.66$, $p < .01$, $\eta 2 = .007$. A posteriori comparisons of the levels of the SNR factor, by means of the Tukey test, showed significant differences between 0 and +5 dB ($p < .01$), 0 and +10 dB ($p < .01$), and +5 and +10 dB ($p < .01$).

To confirm that the six HP sentence lists did not differ statistically on their intelligibility values, a one-way ANOVA was conducted with correct scores (expressed in percentages) as a dependent variable and list the sentences belonged to (list) as an independent variable with six levels. The results showed no significant effects of list, $F(5) = 2.14$, $p > .05$, $\eta 2 = .069$. Thus, the six HP sentences lists did not differ on their percent correct scores.

The same analysis was carried out for the LP sentences. Responses on the intelligibility test (expressed in percentages of correct scores) were used as a dependent measure. A one-way ANOVA was performed with list the sentences belonged to (list), with six levels, as a factor. We found no significant effects of list, $F(5) = 1.48$, $p > .05$, $\eta 2 = .04$. Thus, the six lists of LP sentences did not differ with regard to their percent correct scores.

Creation of final forms

The second step was to create final forms that would contain both HP and LP sentences. These forms were the result of combining one of the HP sentences lists with one LP sentence list in the following manner: list 1 (HP) with list 2 (LP), called form 1; list 2 (HP) with list 3 (LP), called form 2; list 3 (HP) with list 4 (LP), called form 3; list 4 (HP) with list 5 (LP), called form 4; list 5 (HP) with list 6 (LP), called form 5; and list 6 (HP) with list 1 (LP), called form 6. Thus, the final test instrument contains six forms of 50 sentences each. Within each form, the order of presentation of the HP and LP sentences was randomized. This manner of presentation is the same as that used in the SPIN sentences by Kalikow et al. (1977).

Previously, we confirmed that the HP lists were equivalent in their percent correct scores, as were the LP lists. The next question was to find out whether the final six forms (resulting from the combination of one HP sentence list and one LP sentence list) continued to be equivalent in percent correct scores and phonetic content (the predictability of the final forms did not have to be measured, because this characteristic concerns only the HP sentences and it was tested in the previous study by Cervera &Gonzalez-Alvarez, 2010).

Percent correct scores of the final forms of the test The means and standard deviations of the percent correct scores obtained in the present experiment, for each of the six final forms of sentences across the three SNR conditions, were calculated (see Table 2). In order to have forms that were equivalent in their percent correct scores, a one-way ANOVA was conducted with values of intelligibility (expressed as percentages of correct scores) as a dependent variable and form the sentences belonged to as an independent variable with six levels. The results showed no significant effects of the form to which the sentences belonged, $F(5) = 1.49$, $p > .05$, $\eta 2 = .25$. Thus, it can be concluded that the six final forms of sentences (containing 25 HP and 25 LP sentences) did not differ in their percent correct scores.

Phonetic content of the final forms of the test Another aim of the present study was for the final forms of 50 sentences to have similar equivalent phonetic content. The phonetic counts in each phonetic category were performed separately for the last word of the sentences and for the whole sentence (the preceding context plus the last word). In these counts, only content words (verbs, nouns, and adjectives) were taken into account, while articles, prepositions, and adverbs were not considered. The phonetic counts were calculated by counting the number of occurrences of segments in each phoneme class (occlusives, fricatives, nasals, liquids, and vowels). Phonetic counts were performed by the authors, who had training in this task.

A distribution of frequencies for each phoneme class was obtained for each of the 300 sentences (150 HP sentences and 150 LP sentences), for the whole sentence and for the final word in the sentences alone. Table 3 shows the number of occurrences of each phoneme class for each of the six final forms.

In order to test whether all the forms had equivalent phonetic contents, a chi-square analysis was performed. Two separate tests were performed, for the final words or key words alone and for the whole sentences. Phoneme class (occlusives, fricatives, nasals, liquids, and vowels) and form (six levels) were included as factors in both cases. The chi-square value was not significant for the whole sentences, $\chi 2(20) = 8.13$, $p > .05$, or for the final words of the sentence, $\chi 2(20) = 9.66$, $p > .05$. Thus, the six final forms were equivalent in their phonetic content, whether the whole sentence was considered or only the final words. Finally, the definitive forms containing both HP and LP sentences are presented in the Appendix.

Discussion

Our objective was to generate forms of HP and LP Spanish sentences equivalent in intelligibility (measured as percent correct scores obtained in the perceptual task). These types of sentences have many applications, especially in psycholinguistics and audiology. In psycholinguistics, they could be especially useful in those circumstances in which it would be interesting to assess the sensory or bottom-up processing and the cognitive (effective use of context) or top-down processing capabilities of listeners during language processing. Some examples would be elderly listeners with age-related hearing loss but with intact topdown processing skills, children learning a second language who are not yet completely able to use context to accomplish speech perception, or individuals learning a second language with different levels of language proficiency. In audiology, these sentences can be useful for evaluating hearing aids in different SNR conditions simulating a variety of everyday communicative situations.

As in the case of the SPIN sentences (Kalikow et al., 1977) for the English language, the sentences developed in the present study for the Spanish language are easy to administer. The duration is short (about 10 min per form). The response required by the listeners is simple, because he or she has to respond only with the final word of the sentence. Besides intelligibility (percent correct scores), other characteristics are also controlled, such as phonetic content, sentence length, final word stress, and final word frequency, all of which are quite relevant in audiological evaluation. The utility of the SPIN sentences (Kalikow et al., 1977) has been demonstrated by their utility in audiology and psycholinguistics. For the audiological evaluation of Spanish-speaking listeners or research conducted with Spanish-speaking listeners, it is necessary to have similar speech materials for the Spanish language.

Acknowledgments This research was supported in part by Research Grant PSI 2009-10067 (Ministry of Science and Technology of Spain).

Sidebar

Published online: 17 March 2011

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Appendix

(ProQuest: Appendix omitted.)

Publication date: Jun 2011

Year: 2011

A two-choice sound localization procedure for detecting lateralized tinnitus in animals

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Publication info: Behavior Research Methods (Online) 43.2 (Jun 2011): 577-589.
ProQuest document link

Abstract: Rats were trained in a two-choice procedure to respond in the direction of left and right sounds. Silent trials, on which no sound was presented and for which the animals received no feedback, were interspersed among the sound trials to determine each animal's natural side preference. Following training, the rats were exposed to a loud tone in the ear opposite their side preference. A shift in responding on the silent trials to the side of the exposed ear indicated that the animals were hearing a sound in that ear (i.e., tinnitus). Simulating lateralized tinnitus by presenting a low-level, continuous sound on one side also caused the rats to shift their responding on the silent trials to that side. Sham exposures indicated that halothane/nitrous oxide anesthesia could reinstate tinnitus in animals that had previously tested positive for it. Exposing rats to loud tones of various frequencies indicated that frequencies near the limits of the rat's hearing range were less likely to cause tinnitus than tones in the midrange. [PUBLICATION ABSTRACT]

Full text: Headnote

Abstract Rats were trained in a two-choice procedure to respond in the direction of left and right sounds. Silent trials, on which no sound was presented and for which the animals received no feedback, were interspersed among the sound trials to determine each animal's natural side preference. Following training, the rats were exposed to a loud tone in the ear opposite their side preference. A shift in responding on the silent trials to the side of the exposed ear indicated that the animals were hearing a sound in that ear (i.e., tinnitus). Simulating lateralized tinnitus by presenting a low-level, continuous sound on one side also caused the rats to shift their responding on the silent trials to that side. Sham exposures indicated that halothane/nitrous oxide anesthesia could reinstate tinnitus in animals that had previously tested positive for it. Exposing rats to loud tones of various frequencies indicated that frequencies near the limits of the rat's hearing range were less likely to cause tinnitus than tones in the midrange.

Keywords Tinnitus * Anesthesia * Noise exposure * Sensorineural threshold shift * Lateralization * Operant

behavior * Rat

Tinnitus refers to the perception of sound in the absence of any corresponding acoustic stimulation; the word itself is from the Latin word for ringing (tinnitus), because the perceived sound is often tonal in nature (see, e.g., Loeb &Smith, 1967; Martines et al., 2010). Although there are a number of causes of tinnitus, two of the more common ones are exposure to loud sound and the ingestion of large doses of ototoxic drugs such as quinine or salicylate, the latter being the active ingredient of aspirin (e.g., Bauer &Brozoski, 2008). In recent years, there has been increased interest in tinnitus, primarily with the goal of finding a treatment for it, although an understanding of how tinnitus arises in the auditory system would also give insight into the neurological basis of the perception of sound. Such studies are best conducted on animals, creating a need for tests that can determine whether an animal has tinnitus.

The usual procedure for assessing animals for tinnitus involves training them on an auditory discrimination task, exposing them to a tinnitus-inducing agent, and testing them to determine whether their performance has changed in some way that suggests they now have tinnitus. The first animal test for tinnitus, developed by Jastreboff, Brennan, Coleman, and Sasaki (1988), involved allowing thirsty animals to drink in the presence of an external sound and training them to stop drinking when the sound is turned off by following sound-off intervals with a foot shock; finding that animals given sodium salicylate or other tinnitusinducing agents are less likely to stop drinking when the external sound is turned off suggests that the animals are hearing sound in the absence of any physical stimulus- that is, they have tinnitus (Jastreboff et al., 1988). Most tests developed since then have also involved training animals to discriminate the presence of external sound from the absence of sound, with the expectation that animals with tinnitus will respond in the absence of external sounds as if a sound were actually present (Bauer, Brozoski, Rojas, Boley, &Wyder, 1999; Guitton et al., 2003; Guitton &Dudai, 2007; Heffner &Harrington, 2002; Kizawa et al., 2010; Lobarinas, Sun, Cushing, &Salvi, 2004; Ruttiger, Ciuffani, Zenner, &Knipper, 2003; Zheng, Hooton, Smith, &Darlington, 2008). Because tinnitus-inducing agents such as loud sounds and ototoxic chemicals usually cause a ignificant hearing loss, all such procedures require controls to demonstrate that a change in an animal's response to sound versus silence is not caused by a reduced ability to hear sound.

Currently, two tinnitus tests differ from the others in the type of discrimination that an animal must make. One is a gap detection test, in which an animal detects a brief silent interval, or gap, in an ongoing sound. If tinnitus similar in frequency to the ongoing sound is present, it is expected to "fill in" the gap, causing a decrement in an animal's gap detection performance (Rybalko &Syka, 2005; Turner et al., 2006). Any accompanying hearing loss can be controlled either by inducing tinnitus in only one ear or by increasing the intensity of the ongoing sound to ensure that it is clearly audible. Although the idea that ongoing tinnitus could interfere with detecting a temporal gap in an external sound of similar spectral characteristics seems intuitive, this effect has yet to be demonstrated in humans, and the view that tinnitus can interact with the perception of external sounds was questioned many years ago (Davis, Morgan, Hawkins, Galambos, &Smith, 1950).

The other nontraditional tinnitus test is the two-choice sound localization test (Heffner &Koay, 2005). In this test, an animal is trained on a sound localization task to make a left or right response to sounds coming from its left or right side, respectively. Silent trials, in which no sound is presented and for which the animal receives no feedback as to how it should respond, are interspersed among the sound trials, and an animal's side preference on those trials is determined. The animal is then exposed to a loud sound in the ear opposite its side preference and tested to see whether it shifts its responding on the silent trials to the side of the exposed ear; doing so would indicate that the animal perceives a sound (tinnitus) that is lateralized to that side, which is conceptually equivalent to a human patient reporting the ear to which their tinnitus is lateralized. In addition to being able to indicate whether an individual animal has lateralized tinnitus, the two-choice procedure would not be expected to be confounded with hearing loss that accompanies exposure to loud sound, an expectation that has been verified by demonstrating that a conductive hearing loss caused by plugging one ear does not cause a shift in

responding on silent trials (Heffner &Koay, 2005). Moreover, because the animals are never given feedback on the silent trials, their responding to their tinnitus may not immediately habituate, making it possible to follow the time course of the tinnitus.

A key assumption of the two-choice test is that exposing an ear to a loud sound will induce tinnitus that is lateralized to that ear-that is, that the tinnitus will neither be lateralized to the unexposed ear nor be bilateral. The three available studies of sound-induced tinnitus in humans suggest that we may make this assumption (Atherley, Hempstock, &Noble, 1968; Davis et al., 1950; Loeb &Smith, 1967). Specifically, each of these studies determined the preexposure absolute thresholds of the subjects, exposed one ear to loud sounds, determined the postexposure absolute thresholds in the exposed ear, and had the subjects match the resulting tinnitus to tones presented to the unexposed ear. None of these studies mentioned the perceived locus of the tinnitus, although it would have been notable had it been lateralized to the unexposed ear. To obtain more information, I contacted Joseph Hawkins, one of the authors and a subject of the Davis et al. study, and he told me that the tinnitus they observed was always lateralized to the exposed ear (J. E. Hawkins, Jr., personal communication, February 25, 2003). Thus, the results of human studies either support or do not conflict with the conclusion that, as long as the exposing sound is presented to only one ear, the resulting tinnitus will be lateralized to that ear.

The purpose of this report is to describe a series of tests that explore the strengths and limitations of the two-choice tinnitus test. These tests include a test for the propensity of sounds of different frequencies to induce tinnitus, a simulated tinnitus test, and a test for the effect of anesthesia on the induction of tinnitus.

Method

Subjects

Thirteen male hooded rats (Rattus norvegicus; Harlan Sprague-Dawley) were used in this study. Six of the rats (Rats A-F) were exposed to loud tones and tested for tinnitus; the other 7 were used in an anesthesia control test. The animals were housed in standard solid-bottom cages with grid covers and pelleted corncob bedding (1/8-in. pellets; Harlan Teklad). The animals were given free access to rodent chow, and their body weights were measured daily. Water was available only during daily training and testing sessions. Pieces of apple were given as needed to maintain a body weight of approximately 85%-90% ad-lib weight. The use of animals in this study was approved by the University of Toledo Animal Care and Use Committee.

Behavioral apparatus

Testing was conducted in a carpeted, double-walled sound chamber (IAC Model 1204; Industrial Acoustics, Bronx, NY; 2.55 ×2.75 ×2.05 m), the walls and ceiling of which were lined with egg-crate foam; the double walls of the sound chamber prevented entry of any sounds audible to the rats. The equipment for behavioral control and stimulus generation was located outside the chamber, and the animals were observed over closed-circuit television. The chamber was carefully checked for the presence of extraneous sounds, including frequencies above the range of human hearing, using a sound level meter (described below); no extraneous sound was found. In addition, the lights within the chamber were low-wattage bulbs so that they did not have to be dimmed, since reducing the voltage of incandescent lights can cause their filaments to emit sound ("sing"). In short, there were no audible background sounds in the chamber.

The animals were tested in a cage (28 cm long ×13 cm wide ×16 cm high) constructed of 1-in. (2.54-cm) wire mesh. The cage was mounted on a table 1 m above the chamber floor. Three water spouts (rat water bottle sipper tubes) served as the response manipulanda. The spouts were mounted in a horizontal row at the front of the cage, 3 cm apart and 6 cm above the cage floor. Each spout, which had an LED mounted on it 3 cm back from the tip, was connected to a separate lick circuit. A 2-cm water bowl was mounted 3 cm above the cage floor below the center spout and was connected to a syringe pump (NE 1000, New Era, Wantagh, NY), located outside the sound chamber, with the water feeding up through a hole in the bottom of the bowl. The water reward was not delivered through the left and right water spouts, because it is difficult to dispense identical amounts, and any imbalance would bias an animal's responding to the spout that delivered more water. Water

spouts were used as response manipulanda because a thirsty animal will learn very quickly to lick a spout for water delivered into a water bowl by initially placing water in both the spout and the water bowl. Electric shock was provided by a Coulbourn AC-resistive small animal shocker connected between the side water spouts and the cage floor.

Acoustical apparatus

Sine waves were generated by a tone generator (Model 2400; Krohn-Hite, Avon,MA) and broadband noise by a noise generator (Model S81-02; Coulbourn, Lehigh Valley, PA). The signals were amplified (Coulbourn Model S82-24) and sent to one of two piezoelectric tweeters (Model KSN 1005A; Motorola, Chicago, IL) that were located just outside the cage, 90° to the left and right of an animal's head when it was licking the center spout. The training stimulus was broadband noise (60 dB sound pressure level [SPL], 43 dB above the average threshold of 3 of the rats used in this study) combined with a tone; the noise was used because it is easily localized, and tones were used because it was expected that tinnitus induced by exposure to a loud tone would be tonal (Davis et al., 1950). To accustom the rats to respond to a range of tonal stimuli, the frequency of the tone was changed each day on a random schedule among six different frequencies (10, 12.5, 16, 20, 25, and 32 kHz presented 43 - 58 dB above the average rat threshold; Heffner, Heffner, Contos, &Ott, 1994). Noise alone was presented after an animal had been exposed to a loud sound to induce tinnitus. Because the tone exposures often caused a temporary threshold shift, the intensity of the broadband noise was increased by 5 - 15 dB, as needed, to maintain good performance on the sound trials.

A simulated tinnitus test was conducted by placing a third loudspeaker at 90° to one side and presenting a 16-kHz, 1/3-octave band of noise filtered with a Krohn-Hite 3202 bandpass filter (24 dB/octave roll-off) 25 dB above the rat's absolute threshold. Noise was used because it is more easily localized by rats than tones (Wesolek, Koay, Heffner, &Heffner, 2010); it was filtered to make it distinguishable from the broadband noise used in the sound trials.

The SPL was measured using a Brüel &Kjæ r (B&K) 1/4-in (0.64-cm) microphone (Model 4135; B&K, Naerum, Denmark) and measuring amplifier (B&K Model 2608). The measuring equipment was calibrated with a pistonphone (B&K Model 4230).

Behavioral procedure

A rat was first trained to lick the center spout, an action that turned off the LED on that spout and that was rewarded by delivering water into the water bowl located below it. Next, the rat was trained to lick the center spout and then a side spout to get the water reward. Initially, the correct side response was indicated by presenting the noise/tone from the loudspeaker on that side and by illuminating the LED over the correct spout. Once the rat's performance reached 80% correct or better, both side LEDs came on to signal that a side response should now be made, without indicating the correct side. Thus, licking the center spout turned off the center LED, illuminated both side LEDs, and turned on the noise + tone signal from either the left or the right loudspeaker. Licking a side spout turned off the side LEDs, and correct responses were rewarded by dispensing 0.06 ml of water into the water bowl. Incorrect responses, on the other hand, were punished with an electric shock delivered between the spout and the cage floor; the shock levels were 1.25 mA or less and were sufficiently low that the animals never developed a fear of the spouts and continued to respond after receiving a shock. The center LED was then turned back on and the animal permitted to initiate another trial. The frequency of the tone embedded in the noise was changed from session to session to accustom the animals to respond to different tones, on the expectation that their tinnitus would be tonal.

In the final stage of training, "silent" trials were randomly inserted, on which licking the center spout initiated a trial (signaled by the side LEDs), but no sound was presented. The rat was required to make a side response, but was neither rewarded with water nor punished with a shock; thus, it received no feedback on the silent trials. Approximately 24% of the trials in a session were silent trials. At this time, a 50% feedback schedule was also instituted for the sound trials, according to which, randomly, half of the sound trials were also not followed

bywater reward or shock, regardless of a rat's side response. Instead, the side LEDs were turned off and the center LED turned back on, so that the rat could start another trial. The purpose of the 50% feedback schedule was to accustomthe rats to a partial-reward schedule so they would be less likely to learn that silent trials were never rewarded or punished. The use of the partial feedback did not affect performance on the sound trials, and responses on silent trials were generally stable.

The left-right trial sequence was determined by a quasirandom schedule (Gellermann, 1933). A correction procedure was used for those sound trials on which a rat made an error and received a shock (i.e., errors on feedback trials), in that the correct side did not change on the next trial; the results of these correction trials were not included in an animal's score. The animals were trained until they consistently performed at a level of 90% correct or better on the sound trials. The final test consisted of exposing one ear to a loud tone and then testing the rat to determine whether its responding on silent trials shifted to the side of the exposed ear. Each session lasted until the rat had received sufficient water to maintain a consistent body weight, approximately 85% - 90% of ad-lib weight, yet still be sufficiently motivated to work the next day; increasing the amount of reward resulted in an animal that would not work for water the following day. A typical session lasted about 20-30 min, during which time a rat received about 75 silent trials interspersed among over 200 sound trials.

The performance of a rat on the silent trials was scored as the percentage of silent trials on which it responded to the left side. Thus, for example, a score of 80% indicated that a rat had a left preference on the silent trials, whereas a score of 30% indicated that it had a right preference. We have found that approximately half of the animals prefer the left and the other half the right side, with the degree of the preference varying between individuals but remaining stable. To ensure that the animals' had adapted to the procedure and that their performance was stable, they were trained for 70 sessions before being exposed to a loud tone to induce tinnitus.

Following exposure to a loud tone, a rat's score on the silent trials for a session was compared with its scores on silent trials for the five sessions preceding exposure. This was done by calculating a z score for each session, using the mean and standard deviation of an animal's five preceding preexposure sessions. A positive score for tinnitus was defined as a z score equal to or greater than the .01 one-tailed criterion for the preexposure scores (i.e., M + SD * 2.33).

Inducing tinnitus

To induce tinnitus, a rat was exposed to a loud sound in the ear opposite the side that it preferred on silent trials. The rat was lightly anesthetized (2% halothane with a 1:1 mixture of nitrous oxide and oxygen), and a foam earplug was placed in its nonexposed ear, with the pinna taped over the meatus to protect it from the sound. The rat was then placed on its side with the nonexposed ear on a pad. The exposing sound was produced by a digital signal generator (Model 3525, Zonic), amplified (Model MPA, 100-W/channel, Radio Shack), and sent to a piezoelectric loudspeaker (Motorola KSN 1005A) or a midrange driver (Electro- Voice 1823M). A plastic funnel with a 4-mm inner diameter tip was attached to the loudspeaker with thermoplastic adhesive, and the tip of the funnel was placed 2 mm from the concha. The sound was measured with the 1/4-in. microphone placed 2 mm from the tip of the funnel. The animal was closely observed for the duration of the exposure to ensure that the funnel tip remained in place. The anesthesia was turned off a few minutes before the exposure ended, so that the animal was becoming conscious by the time the exposure was complete. This allowed behavioral testing to begin within 10 min following the exposure.

The exposing tones consisted of nine different frequencies that were presented at a level of 110 dB SPL for 10 min (the level of each tone above the average rat threshold is shown in Table 1). Each animal was exposed to each of the tones, so that the degree to which the tones produced tinnitus could be compared within and between animals. Because the absolute thresholds of humans exposed to similar levels of sound return to normal within 24 - 48 h (Davis et al., 1950), allowing at least 8 days between exposures seemed sufficient to minimize interactions between exposures.

Results

The following sections describe the results of the anesthesia control tests, tone exposures, and simulated tinnitus tests. The order in which the rats were exposed to the different tones and whether or not they tested positive for tinnitus are shown in Table 2.

Anesthesia control test conducted on unexposed rats

Figure 1 illustrates the performance of 7 rats on the silent trials before and after being given a sham exposure that was identical in all respects to the real exposures, with the exception that the exposing tone was not turned on. Three points can be drawn from these results. First, anesthetizing previously unexposed animals does not affect their scores on silent trials, even though testing was begun within 10 min after the anesthesia was discontinued. Second, the scores on the silent trials are relatively stable, generally remaining within one standard deviation of the baseline mean over the 23-day test period. Finally, it may be noted that these results do not entirely rule out the possibility that the anesthesia might cause tinnitus, because the test used here was designed to detect monaural tinnitus and might not detect tinnitus that is not lateralized to one side.

Effect of exposure to loud tones

Figures 2 and 3 illustrate the performance of 6 rats on the silent trials before and after exposure to a loud tone (110 dB SPL for 10 min). As can be seen, scores that were positive for tinnitus generally occurred on the day of the exposure (behavioral testing was begun within 10 min following the exposure). In addition, some animals did test positive on subsequent days, indicating that they still had tinnitus.

Exposure to frequencies from 2 to 24 kHz was more likely to result in a positive score than were exposures to higher and lower frequencies (Fig. 4). There does not appear to be any simple relationship between the sensation level (SL) of the exposing tone (its level above threshold) and the degree to which a tone causes tinnitus, since 32 kHz presented at 111 dB SL was less likely to induce tinnitus than 2 kHz presented at 88 dB SL (cf. Table 1 and Fig. 4). Instead, it appears that exposure to frequencies toward the high- and low-frequency ends of an animal's hearing range may be less likely to cause tinnitus than those in the midrange.

Effect of anesthesia on previously exposed animals

The 6 rats used in the tone exposure tests were given three sham exposures (anesthetized, but not exposed to sound). The first sham exposure was given after they had been exposed to seven tones, with the last two sham exposures given after they had been exposed twice more to loud tones (55 and 61 days after the first sham exposure, respectively). As can be seen in Table 2 and Fig. 5, 2 of the rats never tested positive (B and C), 1 tested positive once (F), and 3 tested positive twice (A, D, and E); in short, the sham trials yielded a positive score for tinnitus about one out of three times. Because the unexposed rats never tested positive for lateralized tinnitus (Fig. 1), this result suggests that the halothane/nitrous oxide anesthesia may have reinstated tinnitus in animals that had previously had it. Thus, it is possible that, after the first exposure, some of the positive scores in Figs. 2 and 3 were due to the anesthesia.

Simulated tinnitus

The effect ofmonaural tinnituswas simulated by continuously presenting a 16-kHz band of noise at 25 dB above the rat threshold. The sound was presented from a loudspeaker located on the side of the animal opposite the side it normally preferred on the silent trials. The results showed that, although all 6 of the animals shifted their responding on the silent trials on the first day, 2 of them(Rats D and F) failed to respond to it on one or more of the subsequent sessions (Fig. 6). This failure to shift on some sessions may reflect habituation to the simulated tinnitus.

Hearing loss

As noted in the Method section, the level and duration of the exposing tones (110 dB for 10 min) was chosen because the absolute thresholds of humans exposed to such tones return to normal levels within 24 - 48 h (Davis et al., 1950). However, due to time constraints, it was not possible to determine the rats' threshold shifts using behavioral tests, and physiological measures of sensorineural hearing loss, such as the auditory

brainstem response, are not sufficiently reliable to be useful (Heffner, Koay, &Heffner, 2008). However, because a sudden unilateral hearing loss will disrupt sound localization performance, an indication of the resulting hearing loss can be obtained from an animal's performance on the sound trials.

Table 3 shows the number of days following exposure before an animal's score on the sound trials returned to a level within the range of the five sessions preceding the exposure. As this table shows, the most common occurrence (38 out of 54 instances) was for an animal's score on the sound trials to drop on the day of the exposure and to return to preexposure levels on the following day (indicated by a 1 in Table 3). In 9 instances, the exposure did not noticeably affect performance (indicated by 0), whereas in the remaining 7 instances, recovery to preexposure levels did not occur until 2 days after exposure (indicated by a 2). In this respect, the recovery time for the rats' thresholds is similar to that of humans exposed to the same SPLs (Davis et al., 1950). Although these results do not prove that the animals had no residual hearing loss, they do demonstrate that any such loss had no noticeable effect on their sound localization performance. With regard to the silent trials, background sound that could have biased the animals on the silent trials to the side of the unexposed ear was eliminated by the double-walled sound chamber that prevented outside sounds from entering the chamber and by using equipment within the chamber did not produce any detectable sound.

Discussion

The two-choice sound localization test provides a conceptually straightforward test of lateralized tinnitus in animals. One of the strengths of this test is that each animal serves as its own control, making it possible to assess tinnitus in individual animals. However, no test is without its limitations, and the following discussion explores the accuracy and reliability of this test. (For brief descriptions of other animal tinnitus tests, see the reviews by Bauer&Brozoski, 2008, and Turner, 2007.)

Accuracy of the two-choice procedure in detecting tinnitus

The first requirement of any diagnostic test is accuracy- that is, it should correctly distinguish individuals that have a particular disorder from those that do not. The anesthesia control test addressed the question of whether an animal that has not been exposed to a loud sound will test positive for tinnitus. As shown in Fig. 1, none of the 7 rats tested positive on the day of the sham exposure, nor did their side preference on the silent trials vary significantly during the following 2 weeks. Thus, the possibility of a false positive result for this test appears quite low.

The probability that an animal with tinnitus would test positive on the two-choice test was addressed in the simulated tinnitus test, in which a low-level (25 dB SL), 16-kHz, 1/3-octave band noise was continuously presented on one side. As shown in Fig. 6, all 7 of the rats tested positive on the first day, indicating that the test is 100% effective in detecting the onset of simulated tinnitus, at least tinnitus that has a salience to an animal that is equal to or greater than the 25-dB SL noise used here. However, 2 of the rats (D and F) did show some adaptation to the 16-kHz noise, and failed to test positive on some subsequent days, indicating that after the first day, the detection rate of this test drops to 84%. However, it may be possible to increase the success rate by training animals prior to exposure to respond to simulated tinnitus for longer periods of time prior to exposure and by selecting animals that respond reliably to simulated tinnitus over long periods of time.

Finally, for this procedure to work as described, the tinnitus must be lateralized to one side or the other. As a result, it may not work well in cases of bilateral tinnitus, such as that induced by salicylate or other chemicals. However, since it is well established that tinnitus caused by exposing one ear to a loud sound is always lateralized to the exposed ear (Atherley et al., 1968; Davis et al., 1950; Loeb &Smith, 1967), this procedure should work well for tinnitus caused by overstimulating or otherwise damaging one ear.

Effect of anesthesia

The effect of anesthesia proved interesting, because it caused some of the previously exposed rats to test positive for lateralized tinnitus (Fig. 5), whereas none of the unexposed animals tested positive (Fig. 1). As previously noted, we cannot rule out the possibility that some of the unexposed animals might have developed

tinnitus that did not affect their responding, because it was not lateralized. Nevertheless, these results suggest that the anesthesia was not the primary cause of the tinnitus, but rather was reinstating it.

Although the anesthesia control tests suggest that up to a third of the positive scores could be due to the anesthesia, there are two reasons why the actual number is probably lower. First, the effect of the anesthesia would not be expected to occur for the initial tone exposures, and thus the first positive score for each animal is unlikely to have been the result of the anesthesia. Second, there would be instances in which both the tone and the anesthesia were sufficient to produce tinnitus.

In humans, general anesthesia is not considered to produce transient tinnitus (Schaaf, Kampe, &Hesse, 2004), possibly because, as the results here suggest, most individuals will not experience it, and it will be gone within 24 h in those that do. With regard to animal research, this finding has several implications. First, to avoid the possibility of anesthesia reinstating tinnitus, subsequent exposures to loud sound should be made with the animal restrained but not anesthetized. Second, the fact that anesthesia can reinstate tinnitus is itself of interest. For example, do anesthetics vary in their ability to reinstate tinnitus, and if so, what are the mechanisms underlying the differences? Finally, other events might be able to reinstate tinnitus, such as a brief exposure to a loud sound that, by itself, would not be expected to cause tinnitus; indeed, to avoid such a possibility, the metal lid of the animal box in which the rats in this study were weighed and transported was padded, to avoid producing the loud sounds that can occur when the lid is placed on or removed from the box.

Effect of frequency of the exposing tone

Although the order in which the rats were exposed to the different tones was not sufficiently randomized to permit a detailed comparison, it does appear that some tones were less likely to cause tinnitus than others. Whereas at least 4 of the 6 rats tested positive for tinnitus when exposed to frequencies from 2 to 24 kHz, exposure to 1 and 45 kHz caused only 2 of the 6 animals to test positive, and exposure to 32 kHz resulted in only one positive score (see Fig. 4 and Table 2). As previously noted, this result does not seem related to SL; for example, 32 kHz, which was presented at 111 dB SL, was less likely to induce tinnitus than 2 kHz, which was presented at 88 dB SL. Nor can it be easily attributed to the order in which the rats were exposed, in that some positive scores might result from the anesthesia reinstating tinnitus. This is because the 45-kHz exposures came relatively late in the series, and the 1-kHz exposure was the last one given; although the 32-kHz exposures were given relatively early in the sequence, the 2-kHz exposures were made, on average, even earlier, and they resulted in four positive scores.

Given that the highest and lowest frequencies audible to the Norway rat at a level of 60 dB SPL are 0.530 and 68 kHz (Heffner et al., 1994), it appears that frequencies within an octave of an animal's 60-dB low- and high-frequency hearing limits are less likely to produce tinnitus than frequencies in the midrange. Whether one or another midrange frequency is more likely to produce tinnitus is not yet clear.

Duration of tinnitus

For the 36 occasions on which a rat tested positive for tinnitus immediately after exposure, the animal tested positive on a subsequent day 17 times. Of these 17 instances, 11 were cases in which the rat tested positive, then negative, and then positive again. A good example of this pattern of responding is the 45-kHz exposure of Rat A (Fig. 3). Because Rats D and F showed a similar pattern of responding in the simulated tinnitus test (Fig. 6), it is possible that the tinnitus was not the element that varied, but the response of the animals to the tinnitus. One way to improve the ability of the two-choice test to follow tinnitus would be to use the simulated tinnitus test to select animals that do not habituate to the external stimulus. Another would be to train animals by occasionally rewarding them for going to the side of the simulated tinnitus prior to inducing tinnitus.

Salience of the resulting tinnitus

As can be seen in Figs. 2, 3 and 4, the degree of an animal's shift to the side of the exposed ear varied greatly, and it may well indicate the salience of tinnitus. For example, Rat A's tinnitus following its exposure to 45 kHz may have been louder than that following its exposure at 32 kHz. This relationship could be explored and

quantified by giving animals simulated tinnitus tests using a range of frequencies and intensities.

Tinnitus and stress

Because stress has been implicated as an aggravating factor, or even a cause, of tinnitus (see, e.g., Knipper, Zimmermann, &Müller, 2010), the question arises as to whether the procedures used here may have increased an animal's level of stress. One potential source of stress is water deprivation, which increases the levels of hormones and proteins (c-Fos) that are associated with stress (Arnhold, Wotus, &Engeland, 2007; Jørgensen, Knigge, Kjæ r, &Warberg, 2002). However, most studies have only looked at the initial effects of restricting an animal's water intake (e.g., 1 or 6 days as in the previously cited studies), and a longer-term study found that hormonal levels in rats on water restriction had returned to normal by 8 weeks (Sakellaris &Vernikos-Danellis, 1974). Given that the rats in the present study were on water restriction for 14 weeks before being exposed to loud sound, they had time to become adapted to the procedure.

A second potential source of stress is the shock that the animals received when they made an error on the sound trials (the use of shock was necessitated by our observation that rats do not perform well on a two-choice sound localization task if errors are not punished). Although the shock was individually adjusted for each rat to the lowest level that would maintain good performance, it would have to cause some stress to be effective. As with water restriction, the animals had 14 weeks to become adapted to the procedure.

Finally, it can be argued that the light anesthesia used to immobilize the rats during the monaural exposure to loud sound was stressful. Indeed, it is possible that the occasional reinstatement of tinnitus in some rats following anesthesia was due to the stress of being anesthetized rather than being a direct effect of the anesthesia itself. As previously noted, animals could be exposed to loud sound without anesthesia by restraining them, although they would have to be acclimated to this, because restraint itself can cause stress (e.g., Jørgensen et al., 2002)-and they would then hear the loud sound, which would also be stressful.

In short, as with an animal's life in the wild, it is virtually impossible to eliminate all potential stressors, especially in tasks that require vigilance and effort, although stress can be minimized. For example, if water restriction proves to be more stressful than food restriction, a food reward can easily be substituted for the water reward. However, a better understanding of the role of stress on tinnitus awaits studies of its effect in humans, because current knowledge is based primarily on clinical observations as opposed to empirical studies (e.g., Hébert &Lupien, 2007).

Author note I thank K. Marchetto for conducting the behavior tests and R. Heffner and G. Koay for their comments on an earlier draft of the manuscript. Also greatly appreciated were the comments of an informed and diligent reviewer. Supported by NIH Grant DC03258.

Sidebar

Published online: 17 March 2011

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Publication date: Jun 2011

Year: 2011

Evaluation of the Effect of Acetyl L-Carnitine on Experimental Cisplatin Ototoxicity and Neurotoxicity

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Publication info: Chemotherapy 57.3 (Jun 2011): 186-94.
ProQuest document link

Abstract: Introduction: Cisplatin (CDDP) is an effective and widely used chemotherapeutic agent for pediatric tumors, and ototoxicity is one of the dose-limiting side effects. Objective: It was the aim of our study to investigate the effect of acetyl L-carnitine (ALCAR) on experimental CDDP ototoxicity by audiologic tests, histomorphologic, immunohistochemical and ultrastructural examinations and to investigate the apoptotic pathways. Materials and Methods: Wistar albino rats (n = 28) were studied. Baseline audiological tests were performed in 4 groups: group 1, control; group 2, ALCAR; group 3, CDDP; group 4, CDDP + ALCAR-administered rats. Control audiological tests were performed on the 3rd day, and then the rats were sacrificed. Ear and brain specimens were examined by transmission electron microscopy, and caspase 3, 8 and 9 activities were investigated. Results: The CDDP-administered rats showed significant auditory brainstem response threshold shifts using all stimuli (clicks, 6-kHz and 8-kHz tone burst) compared with the control groups. The CDDP + ALCAR-administered rats showed significant auditory brainstem response threshold shifts by only click stimuli compared with the control groups. In the brain, spiral ganglion and organ of Corti, ultrastructural damage was prominent in group 3; the number of TUNEL (terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling)-positive cells and caspase 3, 8 and 9 immunostaining cells was significantly high in group 3. Conclusion: ALCAR improves CDDP-induced auditory impairment, and also antioxidative and antiapoptotic properties of ALCAR on CDDP ototoxicity were supported by the findings. [PUBLICATION ABSTRACT]

Full text: Experimental Chemotherapy
Chemotherapy 2011;57:186194
DOI: 10.1159/000323621
Received: April 12, 2010
Accepted after revision: August 11, 2010
Published online: April 27, 2011

Evaluation of the Effect of Acetyl
L-Carnitine on Experimental Cisplatin Ototoxicity and Neurotoxicity

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and 8-kHz tone burst) compared with the control groups. The CDDP + ALCAR-administered rats showed significant auditory brainstem response threshold shifts by only click stimuli compared with the control groups. In the brain, spiral ganglion and organ of Corti, ultrastructural damage was prominent in group 3; the number of TUNEL (terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling)-positive cells and caspase 3, 8 and 9 immunostaining cells was significantly high in group 3. Conclusion: ALCAR improves CDDP-induced auditory impairment, and also antioxidative and antiapoptotic properties of ALCAR on CDDP ototoxicity were supported by the findings.

Key Words
Cisplatin ototoxicity [H11554] Cisplatin neurotoxicity [H11554] Acetyl L-carnitine [H11554] Apoptosis [H11554] Ultrastructural findings

AbstractIntroduction: Cisplatin (CDDP) is an effective and widely used chemotherapeutic agent for pediatric tumors, and ototoxicity is one of the dose-limiting side effects. Objective: It was the aim of our study to investigate the effect of acetyl
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Introduction

Cisplatin (CDDP) is an effective anticancer agent for the treatment of children with a wide spectrum of pediatric solid tumors [1]. Platinum-based chemotherapeutics differ in effectiveness and safety. Ototoxicity, neurotoxicity and nephrotoxicity are major dose-limiting side effects of CDDP. CDDP-induced ototoxicity is character-

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2011 S. Karger AG, Basel 00093157/11/05730186$38.00/0
Accessible online at: www.karger.com/che

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ized by bilateral, usually permanent, high-frequency sensorineural hearing loss that can progress to the lower frequencies [26]. There is an individual susceptibility to CDDP ototoxicity. It has been suggested that depletion of cochlear antioxidant enzyme activities and reciprocal increase in reactive oxygen species and lipid peroxidation may lead to apoptosis within cochlear cells [79]. Cytotoxicity by the platinum derivatives was dependent on cellular accumulation of platinum and suggested to be mediated by apoptosis and necrosis [10] . Various methods have been studied in order to prevent the side effects of CDDP. Antioxidants, particularly thiol-based antioxidants, have been used to prevent CDDP ototoxicity [8, 9]. Recently, it was shown that geranylgeranylacetone had a protective effect on CDDP ototoxicity due to the induction of heat shock protein 70 and the inhibition of inflammation [11] . However, all of these agents may interfere with the antitumor effects of CDDP. Thus, new treatment strategies which will not interfere with the antitumoral effects of CDDP to limit CDDP ototoxicity are necessary.

L -Carnitine is a natural micronutrient, antioxidant and free radical scavenger. It is a cofactor required for transformation of free long-chain fatty acids into acetyl carnitines, as well as for their transport into the mitochondrial matrix, where they undergo [H9252]-oxidation
[12, 13]. Acetyl L-carnitine (ALCAR) is a short-chain ester derivative of L-carnitine, synthesized in the human brain, liver and kidney. It is a well-known neuroprotective agent and is also protective against CDDP-induced neurotoxicity [1417]. Also, it has antiapoptotic effects on various cell types [1821].

In this study, we aimed to investigate the protective role of ALCAR on CDDP-induced ototoxicity by audiologic tests, histomorphologic, immunohistochemical (IHC) and ultrastructural examinations (transmission electron microscopy), and also to investigate the apoptotic pathways.

Materials and Methods

AnimalsAdult female Wistar albino rats, weighing 200300 g, were obtained from the Laboratory Animal Science Department, Dokuz Eylul University, Izmir, Turkey. The animals were housed in controlled environmental conditions (20 8 2C, 55% relative humidity and 12-hour light/dark cycle) and had free access to pulverized standard rat pellet food and tap water. The protocol of this study has been approved by the Local Ethical Committee of Dokuz Eylul University Animal Care and Use. Animals with signs of external ear disorders, or middle ear disorders before drug injection, were all excluded from the study.

Materials

CDDP vials (50 mg/100 ml; Cisplatin-Ebewe [L50128] , Liba, Turkey) were used. ALCAR (Sigma, Germany) was supplied and freshly dissolved in normal saline with a concentration of 10 mg/ml prior to injection. Disodium ethylenediaminetetraacetic acid (EDTA) was obtained from Merck (Germany). HEPES [4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid], DTNB [5,5 [H11541][notdef]dithio-bis(2-nitrobenzoic acid)] and L-carnitine hydrochloride were purchased from Sigma-Aldrich (Germany). Acetyl coenzyme A and carnitine acetyltransferase (5 mg/ml) were supplied by Roche Diagnostics (Barcelona, Spain).

Experimental Design

Twenty-eight adult female Wistar albino rats were divided into 4 groups, as follows: group 1 (control, n = 7): saline-supplemented control rats; group 2 (ALCAR, n = 7): ALCAR-administered rats; group 3 (CDDP, n = 7): CDDP-administered rats; group 4 (ALCAR + CDDP, n = 7): CDDP-administered rats following ALCAR pretreatment.

All rats were subjected to anesthesia with ketamine hydro-chloride of 60 mg/kg/dose and xylazine hydrochloride of 5 mg/ kg/dose during audiologic testing and also during intraperitoneal infusion of fluids/drugs. Although there was free access to water, all animals were also hydrated with a daily injection of saline of 5 ml/kg for 3 days.

After hydration with saline (30 min apart), rats in groups 2 and 4 were subcutaneously injected with ALCAR (200 mg/kg), while rats in groups 1 and 3 were subcutaneously injected with the same doses of normal saline for 3 days.

Following subcutaneous injections (30 min apart), rats in groups 3 and 4 were given 1-hour intraperitoneal infusion of CDDP (16 mg/kg), and rats in groups 1 and 2 were given 1-hour intraperitoneal infusion of the same doses of normal saline only for the first day.

Auditory AssessmentAuditory brainstem response (ABR) testing was performed before administration and 3 days (72 h) after injections (fig.1). Only animals with normal otoscopy were anesthetized as described previously. ABRs were recorded using ICS Medical Charter equipment in a silent room. The insert earphone delivered sound through an extended polyethylene tube direct into the rats external auditory canal. Neonatal probe tip was used for sealing the external auditory canal. Subdermal electrodes were placed over the vertex (active), right and left retroauricular regions (negative) and on the dorsum (ground). The stimuli used were alternating clicks (with a duration of 0.1 ms) at a rate of 21.1/s, and tone bursts of 6 and 8 kHz (duration of 1 ms, 2 ms rise/fall times) at a rate of 31.1/s. Electroencephalographic activity was pre-amplified for a voltage gain of 100,000 and band-pass, analog-filtered from 100 to 3,000 Hz for click stimuli, and from 30 to 1,500 Hz for tone bursts. The number of averaged responses was 1,024, and always, each average response was replicated. Each series of stimuli started at the suprathreshold level, and tests were run from high to low levels.

Sacrifice and Tissue Sampling

The rats were sacrificed after auditory assessments were done on the 3rd day of CDDP/saline administration. All rats were subjected to anesthesia with ketamine hydrochloride and xylazine

a b

Color version available online

Fig. 1.

a Auditory evoked brainstem response by click stimuli before CDDP injection. b Auditory evoked brainstem response by 6-kHz tone burst stimuli after CDDP injection (wave V threshold is 60 dB nHL).

hydrochloride, and then sacrificed by creating hypovolemia through venosection from the abdominal vein. The tissue samples including the brain and both inner ears (hair cells and spiral ganglia) were examined by ultrastructural, IHC and morphometric methods. The Olympus BH-2 (Tokyo, Japan) and JVC TK-890E (Japan) high-resolution video cameras were used for light microscopic and morphometric examinations.

IHC Procedure

IHC examinations of hair cells, spiral ganglia and brain tissues were done. Caspase 3, 8 and 9 activities were examined by IHC methods. The avidin-biotin peroxidase system was used for IHC examination, and caspase 3, 8 and 9 activities were studied. With the IHC method, 5- [H9262]m-thick sections were cut and incubated at 60 C overnight and then dewaxed in xylene for 30 min. After dehydrating in decreasing concentrations of ethanol, sections were washed in distilled water for 10 min. Then they were treated with 10 m

M citrate buffer (Cat No. AP-9003-125, Labvision) at 95 C for 5 min to unmask antigens by heat treatment. Afterwards, slides were cooled in buffer for 20 min and washed in deionized water 3 times for 2 min. Sections were delineated using a Dako pen (Dako, Glostrup, Denmark) and incubated in 3% H 2O2 for 15 min to inhibit endogenous peroxidase activity. After being incubated with normal serum blocking solution for 30 min, sections were incubated in a humid chamber overnight at 4 C with antibodies to caspase 3 (1/100, rabbit polyclonal; sc-7148, Santa Cruz Biotechnology), caspase 8 (1/100, rabbit polyclonal; sc-6134, Santa Cruz Biotechnology) and caspase 9 (1/100, goat polyclonal; sc-7885, Santa Cruz Biotechnology). Then they were washed 3 times for 5 min with phosphate-buffered saline (PBS), followed by incubation with biotinylated IgG and then with streptavidin-peroxidase conjugate (Zymed 85-9042, Lot No. 20570999, Calif., USA). Sections were washed with

PBS and incubated with diaminobenzi-dine (DAB) substrate containing DAB (Zymed 00-2020, Lot No. 21074104, Calif., USA) for 5 min to detect immunoreactivity, and
then counterstained by Mayers hematoxylin. PBS washing was repeated 3 times, and sections were covered with mounting medium and were analyzed on a bright-field light microscope (Model BX40, Olympus, Tokyo, Japan). Control samples were processed in an identical manner, but lacking the primary antibody step [22].

TUNEL Procedure

The degree of apoptosis was assessed with the TUNEL (terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling) procedure using a commercially available in situ apoptosis detection kit. The procedure was performed using the In Situ Cell Death Detection Kit POD (Cat No. 1684817, Roche, Mannheim, Germany), according to the manufacturers protocol. Briefly, serial 5- [H9262]m-thick paraffin-embedded sections were deparafinized, rehydrated in graded alcohol, washed in distilled water followed by PBS and deproteinized by proteinase K (20 [H9262]g/ml) for 30 min at 37 C. Then the sections were rinsed and incubated in the TUNEL reaction mixture. Labeling was visualized using converter POD with 0.02% DAB and counterstained with 0.5% methyl green applied to the slides and washed with 0.5% methyl green, dehydrated and mounted. The percentage of TUNEL-positive cells was determined by counting the positive cells on 5 random fields from 5 serial sections of 5 rats in each group. The apoptotic index was defined as the number of apoptotic TUNEL-positive cells of tubules. The images were analyzed using a computer-assisted image analyzer system consisting of a microscope (Olympus BH-2) [22].

Ultrastructural ProcedureFor hair cells and spiral ganglia examinations, the temporal bones of the animals were removed, enumerated, fixed in 2.5% glutaraldehyde, then decalcified using 0.1 mol/l EDTA, sucrose and 2.5% glutaraldehyde with phosphate saline. After decalcification, inner ears were removed and embedded into resin. Then

they were postfixed in 1% osmium tetroxide with phosphate buffer for 1 h. The brain tissue samples were taken by routine ultrastructural procedure. Thereafter, all tissue samples were dehydrated in serial alcohol and then embedded in araldite. The semi-thin sections were stained with toluidine blue and examined with a photomicroscope (BH2 Olympus). After the selection of appropriate specimens, thin sections were obtained and stained with uranyl acetate and lead citrate. They were examined with an electron microscope (Carl Zeiss Libra 120) [23].

Statistical Analysis

IHC examination of hair cells and spiral ganglia was technically difficult, and the statistical analysis of the IHC examination results of these tissue samples was done from 5 rats in all groups. Five different sections with 10-[H9262]m intervals were taken from all samples, and cells were counted from 5 different fields of all sections. The brain tissue samples of all 7 rats in 4 groups were examined. The same number of serial tissue sections was examined by the same number of examination fields, and statistical analysis was done. Morphometric analysis was performed by the Leica DCM 4000 visual analysis system and by the Q WIN3 program. All statistical analyses were done using the SPSS 11.0 software program. All results are expressed as means8 SEM. The mean values of groups were compared by the Kruskal-Wallis analysis, and p ^ 0.05 was considered statistically significant.

Results

Auditory AssessmentCDDP-treated rats showed significantly higher ABR threshold levels by all stimuli (clicks, 6-kHz and 8-kHz tone burst) compared to the control groups (p ! 0.01). CDDP + ALCAR-treated rats showed significant ABR threshold shifts by click stimuli when compared to the control groups (p ! 0.01). CDDP-treated rats had significantly higher click ABR threshold levels compared with the CDDP + ALCAR group (p ! 0.01).

Mean ABR threshold shifts in the 4 rat groups are presented in figure 2 .

TUNEL ResultsThe number of TUNEL-positive hair cells was statistically significantly high in group 3 when compared to groups 1, 2 and 4 (0.096 8 0.02, 0.016 8 0.009, 0.016 80.009 and 0.024 8 0.009, respectively; p ! 0.05). There was no statistically significant difference between groups 1, 2 and 4 (p 1 0.05). The number of TUNEL-positive spiral ganglia cells was statistically significantly higher in group 3 when compared to groups 1, 2 and 4 (0.136 80.02, 0.048 8 0.014, 0.040 8 0.012 and 0.08 8 0.012, respectively; p ! 0.05). There was no statistically significant difference between group 3 and group 4 (p = 0.151). In
brain tissue, the number of TUNEL-positive neurons was significantly higher in group 3 when compared to groups 1, 2 and 4 (1.034 8 0.044, 0.097 8 0.025, 0.074 8 0.010 and 0.382 8 0.114, respectively; p ! 0.05). There was no statistically significant difference between group 1 and group 2 (p 1 0.05).

The number of TUNEL-positive cells in the brain, spiral ganglion and organ of Corti was statistically significantly higher in group 3 when compared to groups 1, 2 and 4. Although the number of TUNEL-positive cells was high in group 4 when compared to groups 1 and 2, there was no statistically significant difference.

IHC Results

IHC Examination of Caspase 3. In spiral ganglia and brain tissues, the number of caspase-3-immunopositive cells was statistically significantly higher in group 3 when compared to groups 1, 2 and 4 (p ! 0.05). There was no statistically significant difference between groups 1, 2 and 4 (p 1 0.05).

IHC Examination of Caspase 8. In spiral ganglia, the number of caspase-8-immunopositive cells was significantly higher in group 3 when compared to groups 1 and 2 (0.096 8 0.016, 0.024 8 0.009 and 0.032 8 0.014, respectively; p ! 0.05). There was no statistically significant difference between group 3 and group 4 (p 1 0.05). In brain tissue, the number of caspase-8-immunopositive cells was statistically significantly higher in group 3 when compared to groups 1, 2 and 4 (p ! 0.05). There was no statistically significant difference between groups 1, 2 and 4 (p = 0.62).

IHC Examination of Caspase 9. In spiral ganglia and brain tissues, the number of caspase-9-immunopositive cells was statistically significantly higher in group 3 when compared to groups 1, 2 and 4 (p ! 0.05). There was no statistically significant difference between groups 1, 2 and 4 (p 1 0.05).

The number of caspase 3, 8 and 9 immunostaining cells was statistically significantly increased in group 3 (CDDP group) when compared to groups 1, 2 and 4. The immunostaining of caspases is seen in figure 3 . The number of these cells was high in group 4 (CDDP + ALCAR group); however, there was no statistically significant difference between groups 1 (control), 2 (ALCAR) and 4. There was more caspase 9 than caspase 8 activity, especially in brain tissue, though there was no statistically significant difference between caspase 9 and 8 activities.

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a
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c
Fig. 2. ABR thresholds given in dB nHL. Before = Before injection; after = after injection. a Mean 8-kHz tone burst ABR thresholds. b Mean 6-kHz tone burst ABR thresholds. c Mean click ABR thresholds.
Fig. 3. OHCs of the organ of Corti and brain tissue. Immunostaining of caspases. SLig = Spiral ligament; BM = basillar membrane; arrows = OHCs. Subgroup a: caspase 3 immunoreaction. ! 1,000. Subgroup b: caspase 8 immunoreaction. !1,000. Subgroup c: caspase 9 immunoreaction. !1,000.
Ultrastructural (Transmission Electron Microscopy) ResultsThe ultrastructure of hair cells in groups 1, 2 and 4 was normal (fig.4 a, b, d). The cellular organization of supporting cells and hair cells was normal. Nevertheless, in group 4, intercellular junctions were half open. Hair cells have normal organelles and nuclei. In ultrastructural examination of group 3, mitochondria of hair cells particularly revealed effacement. In these cells, mitochondrial crystalysis and intracellular degenerative

Color version available online
Fig. 4. The ultrastructure of hair cells. a Group 1: normal hair cells (HC), inter-cellular junctions (red arrows), normal mitochondria (green arrows), cilias in apical surface (black arrows). b Group 2: normal hair cells (HC), intercellular junctions (red arrows), normal mitochondria (green arrows), cilias in apical surface (black arrows). c Group 3: degenerative intercellular junctions (red arrows), proapoptotic nuclei (blue arrows), intracellular degenerative areas (*). d Group 4: normal hair cell (HC), normal mitochondria (green arrows), cilias in apical surface (black arrow) and supporting cells (SC). N = Neuron. Colors refer to the online version only. In the printed version, red arrows are represented as long arrows; green arrows are arrowheads; blue arrows are short arrows; black arrows are open arrows.
a b
c d
10 m
areas were observed. Some cells have proapoptotic nuclei. Damage of intercellular junctions was observed (fig.4c).
The ultrastructure of spiral ganglion in groups 1, 2 and 4 was normal (fig.5 a, b, d). In group 3, changes in cell shapes and irregular cell membrane, cessation of satellite cell activity and an increase in cytoplasmic degenerative areas were seen (fig.5 c).
The ultrastructure of the brain in groups 1, 2 and 4 was normal (fig.6a, b, d). In group 3, neuronal electron densities, dilatation in endoplasmic reticulum cisternas, perivascular edema and depletion of neuropile and apoptotic neuronal glial cells were seen (fig.6 c). When the ultra-structural findings of the brain, spiral ganglion and organ of Corti were compared between groups, ultrastructural damage was prominent in group 3 rather than in groups 1 and 2. The ultrastructural damage was minimal in group 4 compared with group 3. The fine structure was similar in groups 1, 2 and 4.
Discussion
CDDP is one of the most effective and widely used cytotoxic agents for the treatment of adult and pediatric malignancies [16] . Ototoxicity, neurotoxicity and nephrotoxicity are major dose-limiting side effects of CDDP.

CDDP primarily damages the outer hair cells (OHCs) of the organ of Corti [8, 9, 2426]. With higher doses of CDDP, additional damage occurs in the auditory neurons, stria vascularis and supporting cells [27]. Various methods have been studied in order to prevent these side effects of CDDP [79, 11]. New experimental studies should be done in order to explain the mechanisms of CDDP-induced toxicity to limit them [8, 9, 11]. CDDP causes cell damage by interacting with the DNA chain and triggers some mechanisms that result in apoptosis [26, 28] . Also, it was shown that CDDP-induced toxicity could occur through oxidative stress which causes irreversible cell damage and apoptosis [7 9, 24].

Color version available online

Fig. 5. The ultrastructures of spiral ganglion. a Group 1: normal ganglion cells (GC), satellite cells (green arrows), regular cell membrane (blue arrows). b Group 2: normal ganglion cells (GC) with all organelles, regular cell membrane (blue arrows). c Group 3: ganglion cell (GC), degenerative areas in the ganglion cell (red arrows), degenerative ganglion cell (*), irregularity in the cell membrane (blue arrows). d Group 4: normal ganglion cell with all organelles (GC), regular cell membrane (blue arrows). Colors refer to the online version only. In the printed version, red arrows are represented as long arrows; green arrows are arrowheads; blue arrows are short arrows.

Fig. 6. Ultrastructure of the brain. a Normal neuron (N) and mitochondria (green arrows); inset : capillary (C), junctions between the capillary wall and neuropile (red arrow). b Neuron (N); inset: capillary (C), junctions between capillary wall and neuropile (red arrow). c Neuron (N), mitochondrial crystalysis (green arrows); inset: capillary (C), perivascular astrocytic edema (red arrow). d Neuron (N), crystal-ysis in some mitochondria (*), others normal (green arrows); inset: capillary (C), junction between the capillary wall and no perivascular edema (red arrows). Colors refer to the online version only. In the printed version, red arrows are represented as long arrows; green arrows are arrowheads; blue arrows are short arrows.

a b

20 m

c d

a b

Color version available online

c d

Several agents have been studied for the protection of CDDP-induced toxicity [79] . ALCAR is one of these agents. It is a short-chain ester derivative of L-carnitine and it is synthesized in the human brain, liver and kidney. It is a neuroprotective and antiapoptotic agent for various cell types [1421].

This is the first experimental study where the protective role of ALCAR in CDDP-induced ototoxicity was investigated by audiologic tests, histomorphologic, IHC and ultrastructural examinations, as well as apoptotic pathways. The ototoxic effects of CDDP treatment on the auditory system in rats have been observed by ABR tests. The rats showed significantly higher ABR wave V threshold levels by all stimuli (clicks, 6-kHz and 8-kHz tone burst) compared to the control groups at the 3rd day of CDDP administration (p ! 0.01). This statistical significance was consistent with findings in the literature [29]. Here, in findings which were obtained by IHC and ultrastructural examinations, we showed that CDDP causes cell and tissue damage and induces apoptosis in the brain, hair cells and spiral ganglia cells. Also, findings showed that apoptosis, cell and tissue damage were prominently reduced by concomitant administration of ALCAR and CDDP. CDDP + ALCAR-treated rats showed significant ABR threshold shifts with click stimuli results compared to the control groups (p ! 0.01). CDDP-

treated rats have significantly higher click ABR threshold levels compared with the CDDP + ALCAR group (p ! 0.01).

Apoptosis is an important way of cell death in normal and pathological processes. Apoptotic death of OHCs is a final common pathway in response to a variety of cellular stresses. CDDP ototoxicity is associated with OHC apoptosis in the organ of Corti [24] and in vivo [30, 31]. However, the intracellular pathways remain unknown. The major intracellular apoptotic pathways may be classified according to the type of pro-caspase that is activated. Three main pathways are involved in apoptosis: the extrinsic, the intrinsic and the endoplasmic reticulum stress pathway. The extrinsic pathway mediated by cell death receptors , signaling of the cell surface death receptors, results in the activation of the initiator procaspase 8 [32] . In the mitochondrial/intrinsic pathway , the activation of the initiator pro-caspase 9 is dependent on the mitochondrial signaling pathway [33, 34] . In the intrinsic/mitochondrial pathway, the release of cyto-chrome c from mitochondria leads to activation of caspase 9 and 8, respectively. Once activated, both caspases 8 and 9 further lead to the activation of caspase 3, and then to apoptosis [12, 35] . It has been reported that the inhibition of caspases may prevent ototoxic hair cell death [24, 25, 36] . In our study, apoptotic cell death was high in groups 3 and 4. When comparing these 2 groups, apoptotic cell death was significantly higher in group 3. In the organ of Corti and brain tissues, the number of caspase 3, 8 and 9 immunostaining cells was significantly increased in group 3 (CDDP group) when compared to groups 1, 2 and 4. These findings emphasize the role of the intrinsic/mitochondrial pathway and also the protective role of ALCAR in CDDP-induced apoptosis in the inner ear and brain.

Conclusion

CDDP-related hearing impairment, damage of hair cells, spiral ganglia cells, brain tissue and CDDP-induced apoptosis can be reduced by concomitant administration of ALCAR and CDDP. In this study, it was shown that ALCAR significantly improves CDDP-induced auditory impairment; also, antioxidative and antiapoptotic properties of ALCAR in CDDP ototoxicity were supported by the findings.

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Publication date: Jun 2011

Year: 2011

Cross-Frequency Integration for Consonant and Vowel Identification in Bimodal Hearing

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.3 (Jun 1, 2011): 959-980A.
ProQuest document link

Abstract: Improved speech recognition in binaurally combined acoustic-electric stimulation (otherwise known as bimodal hearing) could arise when listeners integrate speech cues from the acoustic and electric hearing. The aims of this study were (a) to identify speech cues extracted in electric hearing and residual acoustic hearing in the low-frequency region and (b) to investigate cochlear implant (CI) users' ability to integrate speech cues across frequencies. Normal-hearing (NH) and CI subjects participated in consonant and vowel identification tasks. Each subject was tested in 3 listening conditions: CI alone (vocoder speech for NH), hearing aid (HA) alone (low-pass filtered speech for NH), and both. Integration ability for each subject was evaluated using a model of optimal integration-the PreLabeling integration model (Braida, 1991). Only a few CI listeners demonstrated bimodal benefit for phoneme identification in quiet. Speech cues extracted from the CI and the HA were highly redundant for consonants but were complementary for vowels. CI listeners also exhibited reduced integration ability for both consonant and vowel identification compared with their NH counterparts. These findings suggest that reduced bimodal benefits in CI listeners are due to insufficient complementary speech cues across ears, a decrease in integration ability, or both.

Full text: Headnote

Purpose: Improved speech recognition in binaurally combined acoustic-electric stimulation (otherwise known as bimodal hearing) could arise when listeners integrate speech cues from the acoustic and electric hearing. The aims of this study were (a) to identify speech cues extracted in electric hearing and residual acoustic hearing in the low-frequency region and (b) to investigate cochlear implant (CI) users' ability to integrate speech cues across frequencies.

Method: Normal-hearing (NH) and CI subjects participated in consonant and vowel identification tasks. Each subject was tested in 3 listening conditions: CI alone (vocoder speech for NH), hearing aid (HA) alone (low-pass filtered speech for NH), and both. Integration ability for each subject was evaluated using a model of optimal integration-the PreLabeling integration model (Braida, 1991).

Results: Only a few CI listeners demonstrated bimodal benefit for phoneme identification in quiet. Speech cues extracted from the CI and the HA were highly redundant for consonants but were complementary for vowels. CI listeners also exhibited reduced integration ability for both consonant and vowel identification compared with their NH counterparts.

Conclusion: These findings suggest that reduced bimodal benefits in CI listeners are due to insufficient complementary speech cues across ears, a decrease in integration ability, or both.

Key Words: bimodal hearing, speech perception, cross-frequency integration

(ProQuest: ... denotes formulae omitted.)

Cochlear implants (CIs) have evolved from being a supplemental aid to speechreading with a singlechannel system to an auditory aid that provides sufficient speech cues for users to enjoy high levels of speech recognition without visual cues. As a result, audiological requirements for implant candidacy have been relaxed fromprofound to moderately severe hearing loss. Many recently implanted users have some degree of lowfrequency residual hearing. Patients with greater residual hearing in the low frequencies could benefit from a short-electrode CI array to preserve the residual hearing in the implanted ear (this is known as hybrid hearing). More commonly, patients with more severe hearing loss are implanted with a long-electrode array in one ear and use a hearing aid (HA) in the opposite ear (termed bimodal hearing). Although this supplement has been found to be beneficial to speech recognition when combined with electrical stimulation, the types of speech cues in lowfrequency residual acoustic hearing and the abilities of CI listeners to extract and integrate these cues with the electrical signals are not well understood.

Some studies demonstrated significantly better speech recognition performance in quiet with bimodal hearing compared with CI alone (Armstrong, Pegg, James, &Blamey, 1997; Ching, Psarros, Hill, Dillon, &Incerti, 2001; Dooley et al., 1993; Gifford, Dorman,McKarns, &Spahr, 2007; Shallop, Arndt,&Turnacliff, 1992; Zhang, Dorman, &Spahr, 2010), but others have reported no significant combined benefit in the majority of their subjects (Dunn,Tyler,&Witt, 2005;Hamzavi, Pok, Gstoettner, &Baumagartner, 2004; Mok, Grayden, Dowell, &Lawrence, 2006) and even incompatibility between the two devices in some patients (Tyler et al., 2002). Results for speech recognition in noise, on the other hand, are more consistent across studies. Many studies reported combined acoustic-electric benefit for both bimodal and hybrid hearing when both speech and noise were presented from the front (e.g., Ching, Incerti, &Hill, 2004; Dorman, Gifford, Spahr, &McKarns, 2008; Gifford, Dorman, McKarns, &Spahr, 2007; Kong, Stickney, &Zeng, 2005; Mok et al., 2006; Mok, Galvin, Dowell, &McKay, 2009; Turner, Gantz, Vidal, Behrens, &Henry, 2004; Zhang et al., 2010). However, the amount of benefit still varied among listeners. The sources of intersubject variability in bimodal/hybrid outcomes are unclear. It is often assumed that the greater the amount of residual hearing, the greater the bimodal benefit. However, Ching et al. (2004) and Gifford, Dorman, McKarns, and Spahr (2007) failed to find a significant correlation between the unaided threshold below 1000 Hz and the amount of bimodal benefit. Some researchers measured other aspects of auditory function, such as frequency selectivity and modulation detection in patients who are considered

candidates for a CI, but found no correlation between residual functional abilities and speech recognition (Gifford, Dorman, Spahr, &Bacon, 2007).

The possible underlying mechanisms for improved speech recognition performance in bimodal hearing include (a) better detection of the target speech for sentence recognition in noise by glimpsing the target during the spectral and/or temporal dips of the masker (Brown &Bacon, 2009a; Kong &Carlyon, 2007; Li &Loizou, 2008) and (b) integration of speech cues between electric stimulation and acoustic stimulation at low frequencies (e.g., Ching et al., 2001; Ching, van Wanrooy, &Dillon, 2007; Kong&Carlyon, 2007). The glimpsing mechanism has been studied in recent years; however, speech cue integration in bimodal hearing has not received much attention. In the present study, we investigated the ability of bimodal subjects to integrate speech cues across ears and across devices. The variability in the amount of combined benefit (Dunn et al., 2005; Mok et al., 2006; Hamzavi et al., 2004) could be attributed to the variability in the integration ability among CI users.

Integration of speech cues from multiple modalities or sources (Braida, 1991; Grant, 2002; Grant &Seitz, 1998; Massaro, 1987, 1998; Massaro &Cohen, 2000; Ronan, Dix, Shah,&Braida, 2004) has been researched and discussed extensively. Several quantitative models have been developed to characterize the processes of multimodal integration of speech segments and to predict integration performance based on observed performance for each separate modality. These models make predictions based on the observed confusion matrix (Miller &Nicely, 1955) for each separate source. The models assume that cues in each source are statistically independent from each other, that they combined without interference, and that no new cues arise from intersource comparisons. Among them, the PreLabeling (PreL) model of integration developed by Braida (1991) predicts combined-source scores using an "optimal" decision rule that assumes perfect integration of the cues derived from each separate source. The difference between observed combined scores and predicted combined scores obtained by this ideal observer model allows us to evaluate a listener's ability to integrate cues fromvarious sources, independent of his or her ability to extract cues from each separate source. A detailed description of the PreL model is provided in the Results section of Experiment II. Although the integration models were developed to describe perceptual integration based on audiovisual speech reception research, they have been formulated abstractly and have been shown to be capable of describing the integration of auditory cues across spectral bands (Grant,Tufts,&Greenberg, 2007; Ronan et al., 2004). In Ronan et al. (2004), the evaluation of predictions by a number of models for crossfrequency integration was performed with speech cues combined from different frequency bands. The authors first divided broadband speech into five discrete frequency bands (0-700 Hz; 700-1400 Hz; 1400-2100 Hz; 2100-2800 Hz; and 2800-4500 Hz) and then combined the bands that were adjacent to each other or remotely apart. The number of frequency bands was one of the testing variables. The authors concluded that both the PreL integration model and the fuzzy logical model of perception were able to predict performance for various combinations of frequency bands tested,with only a few exceptions.

To receive maximal benefit from multisensory or multisource stimulation, listeners need to be able to extract complementary cues from each source and to integrate the cues from all sources (Braida, 1993). The PreL model conceptualizes cue extraction and cue integration as two independent processes. Therefore, predictions from the model allowed us to examine each factor separately. The subsections that follow discuss each of the two factors.

Information Extraction

The type and amount of speech cues provided by each source of stimulation can affect the degree of combinedsource benefit. When comparing two different stimulation conditions, Grant,Walden, and Seitz (1998) demonstrated that the condition resulting in the highest recognition scores does not necessarily result in the highest combined score or the greatest improvement when combining the sources. Braida (1993) described twoextremecases: (a) the sources provide cues that complement one another and (b) the cues provided by each source are completely redundant with one another. If speech cues in each stimulation condition are

redundant, combined-source benefits will be less than if the cues are complementary.

Information Integration

Cue extraction and integration are considered independent processes in the integration models described above. According to thesemodels, it is possible tomeasure multisensory integration that is independent of abilities to extract cues from each source. In other words, listeners' ability to integrate cues in a multisource condition is not affected by the type and amount of cues extracted from each source. All other things being equal, it is assumed that greater ability to integrate speech cues from different sources will yield better performance in the combined-source condition.

Within this framework, the variability in bimodal outcomes (particularly in quiet) among CI users could be attributed to a decreased ability to extract speech cues and/or a reduced ability to integrate speech cues. This has been shown in cross-frequency integration in hearingimpaired (HI) and elderly listeners (Grant et al., 2007; Healy &Bacon, 2002; Palva &Jokinen, 1975; Turner, Chi, &Flock, 1999). Using the PreL model, Grant and colleagues (2007) examined cross-frequency cue extraction and cue integration abilities in a group of HI listeners. They reported that HI listeners showed proportionally less benefit than normal-hearing (NH) listeners when additional high-frequency cues were added to the lowfrequency speech. They attributed the reduced benefit to HI listeners' difficulty extracting cues from the highest frequency band (4762-6000 Hz) when presented concurrently with the lower frequency band (1890-2381 Hz), as well as their inefficiency in integrating speech cues across frequency regions.

The present study was the first attempt at applying an integration model to understand the process by which speech cues are integrated in combined acoustic-electric stimulation. We first measured phoneme (both consonants and vowels) recognition performance in bimodal CI listeners to examine the redundancy of speech cues extracted from electric stimulation and acoustic stimulation in the low-frequency region. Then, we used the modelbased approach to investigate and compare NH and CI listeners' ability to integrate cross-frequency speech cues.

Experiment I: Cross-Frequency Integration in NH listeners

The PreL integration model has shown the ability to predict performance for auditory-visual integration (Braida, 1991, 1993; Grant et al., 1998) and auditory integration across frequencies for consonant identification (Grant et al., 2007; Ronan et al., 2004). In this experiment, we set out to further evaluate the application of the PreL model to predict a combined-band performance that was created to simulate bimodal hearing, in which low-frequency (<1000 Hz) speech was delivered to one ear, andwideband (200-6000 Hz) vocoder-processed speech was delivered to the opposite ear.

Preliminary Study

Before the start of this experiment, we conducted a preliminary study that assessed the model fit to a unique combined-band performance that was not examined in Ronan et al. (2004). In Ronan et al.'s study, multisource speech cues came from nonoverlapping frequency bands. The purpose of this preliminary study was to demonstrate that the PreL model is capable of predicting combinedband performance when the speech signals from different frequency regions undergo different signal processing (low-pass [LP] filtering with cutoff frequency at 500 Hz and channel vocoding above 900 Hz). Because this preliminary study is not the focus of this article, a brief description of the methodology and results from our model predictions is included in the Appendix.

Method

Subjects. Eight NH subjects (7 females, 1 male) 19-31 years of age participated in the study. Six subjects participated in the consonant identification task, and six subjects participated in the vowel identification task. Four of the subjects participated in both tasks.

Stimuli. Two sets of speech stimuli were used. The first set consisted of 16 consonants (/p, t, k, b, d, g, f, θ, s, ʃ, v, ð, z, ..., m, n/) used by Miller and Nicely (1955) in the /aCa/ context. These stimuli were recorded by five male and five female talkers by Shannon, Jensvold, Padilla, Robert, and Wang (1999). The second set consisted of

nine monophthongs (/i, I, ε, æ, 3, Lgr;, u, ..., c/) in the /hVd/ context recorded from five male and five female talkers in our laboratory. All stimuli were scaled to the same overall root-mean-square (RMS) level. For each stimulus set, recordings from two male and two female talkers were used in the practice sessions, and recordings from the remaining six talkers were used in the test sessions. Three utterances of each consonant and vowel from each talker were used.

Recorded stimuli were subjected to two types of processing: LP filtering and channel-vocoding. LP was performed using Butterworth filters with a rolloff of 60 dB/octave and a cutoff frequency of 500 Hz. These LP parameters mimicked a sloping hearing loss above 500Hz, an audiometric configuration commonly seen in real bimodal CI users. Channel-vocoding processing preserved speech cues from 200 Hz to 6000 Hz. The vocoder system simulated listening with a long-electrode array CI device. In this system, broadband speech (200-6000 Hz) was first processed through a pre-emphasis filter and then band-pass filtered into four logarithmic frequency bands. The lower, center, and upper frequencies of the band-pass filters for this four-channel vocoder condition are listed inTable 1. Theamplitude envelope of the signal was extracted from each band by full-wave rectification and LP with a 400-Hz cutoff frequency. Sinusoids were generated with amplitudes equal to the RMS level of the envelope and frequencies equal to the center frequencies of the band-pass filters. The sinusoids were then summed and presented to the listeners.

Procedure. Subjects were tested in a double-walled soundproof booth. Stimuli were presented from a sound card using 16-bit resolution at 44.1-kHz sampling rate to Sennheiser HD 265 headphones. Each subject was presented with two different speech signals: low-frequency (LP speech) to one ear and vocoder speech to the opposite ear. Three types of listening conditions were tested: lowfrequency speech alone (LP-alone), vocoder speech alone (vocoder-alone), or LP and vocoder speech combined (LP+vocoder). For both consonant and vowel identification tasks, half of the subjects were presented with vocoder stimuli to the left ear and LP stimuli to the right ear; the remaining half received the stimuli on the opposite sides. All stimuli were presented at an RMS level of 70 dBA.

For each condition, listeners first received practice trials identifying the consonant and vowel with visual correct-response feedback provided. Performance usually reached a plateau (i.e., within 3 percentage points difference) within three blocks of practice. If not, additional practice was given until the criterion was met. Each subject was then tested in blocks of 96 trials (16 consonants ×6 talkers) for consonant identification, and 54 trials (9 vowels ×6 talkers) for vowel identification. Each utterance from each talker was used for three blocks of testing. Nine blocks of testing were presented in each test condition, yielding 54 trials (6 talkers ×9 blocks) per stimulus per condition per subject. No feedback was provided during test sessions. The order of presentation of the listening conditions was counterbalanced across subjects. Stimuli within each block were presented in random order. A list of 16 /aCa/ or nine /hVd/ syllables was displayed on a computer screen, and subjects responded by clicking a button corresponding to the syllable that they heard. Consonant and vowel confusion matrices were constructed from each subject's responses.

Data Analysis and Model Fits

The mean overall percent correct scores were calculated for consonant and vowel identification tasks. In addition, based on the confusion matrices of the group data, information transmission (Miller &Nicely, 1955) was computed for the features of voicing, manner of articulation, and place of articulation for consonant identification for each test condition. This was also done for the features of height, back, and tense for vowel identification. The different consonant and vowel features are listed in Table 2.

Model predictions for combined scores were made for each subject using the PreL model of integration (Braida, 1991). The model first analyzes observed confusion matrices for each separate source of information (i.e., LP speech vs. vocoder speech) and then makes predictions for the confusion matrix when these sources are presented simultaneously, using an "optimal" decision rule that assumes perfect integration of available cues in an ideal observer without any bias. The PreL model is a special form of multidimensional scaling (MDS) and a

multidimensional extension of the signal detection theory. Unlike traditional MDS, the scaled distances between stimuli in separate source spaces are converted into a common metric, d. It is assumed that there is a D-dimensional vector of cues ... associated with each presentation of one of the N possible consonants Si. The cue vector X is described by the conditional probability density

... (1)

and may be thought of as displaced fromthe stimulus center .... Corresponding to each response, there is a response center or prototype .... The decision processes assume a comparison between the stimulus attributes (i.e., the observed vector of cues X) and the response center Ri in memory. The listener is assumed to respond Rk if and only if the distance from the observed vector of cues X to Rk is smaller than the distance to any other prototype-that is, ... A listener's sensitivity d'(i, j) in distinguishing stimulus Si from stimulus Sj is given by

... (2)

where ... is the distance between theD-dimensional vector of cues generated by stimuli Si and Sj. The predictions for the multisource condition (i.e., dichotic presentation of LP and vocoder speech) are made based on the performance in the single-source conditions (i.e., LPalone and vocoder-alone). In the multisource condition, the model assumes that cues in each source are statistically independent from each other, that they are combined without interference, and that no new cues arise fromintersource comparisons. Integration of cues ismodeled by assuming that the cue densities are the "Cartesian products" of the densities corresponding to the separate sources. In the multisource condition, the cue space has dimension DAB = DA + DB, and each stimulus center Si has the coordinates

... (3)

This model for the multisource condition predicts that there is a simple Pythagorean relationship between a subject's sensitivity in themultisource condition, d'AB(i, j), and the corresponding source sensitivities d'A(i, j), and d'B(i, j):

... (4)

In this model, the configurations derived from the single-source confusion matrices determine the predicted stimulus centers for the multisource configurations. Prediction accuracy in themultisource condition also requires a specification of the response centers (i.e., the prototypes). In thePreLmodel described byBraida (1991), the response centers of the multisource condition were assumed to coincide with the multisource stimulus centers. In recent work, Ronan et al. (2004) evaluated the locations of the response centers inthe multisource case for cross-frequency consonant identification in NH listeners. In that study, cross-frequency consonant identification performance in the multiband case was made with three different assumptions of the location of the multiband response centers: PreLI0, PreLI1, and PreLIH.

PreLI0

The response centers in the multisource case are the Cartesian products of the response centers in the singlesource case. As mentioned in Ronan et al. (2004), this assumption represents a case of minimal adjustment(s) to the multisource stimulation condition, in which the response centers are located at the same locations they had in the single-source conditions. This implies thatwhen provided with multisource stimulation, listeners elicit a response that concurs with the response from a single source-that is, HA-alone or CI-alone conditions in the present study.

PreLI1

The response centers in the multisource case coincide with the multisource stimulus centers. This assumption predicts optimal integration of cues from different sources and predicts maximum overall performance. As Grant and colleagues (1998, 2007) pointed out, because the PreL model is an optimal integration model, predicted scores should always be higher than or equal to the observed scores in real listeners if no new cues arise from the simultaneous presentation of multiple sources.

PreLIH

The response centers in the multisource case are halfway between the response centers in the single-source case and multisource stimulus centers. As pointed out by Ronan et al. (2004), this represents an intermediate case of adjustment to the multisource condition in which the response centers are halfway between the response centers in Case A and Case B.

In this study, we made the predictions for the combined LP and vocoder performance using these three assumptions to examinewhere listeners place theirmultisource response centers. For example, if the listener's multisource response centers coincide with the multisource stimulus centers, the PreLI0 method and the PreLIH method will provide predictions that underestimate the observed scores, whereas the PreLI1 model will provide predictions equal to or slightly higher than observed scores. If listeners' multisource response centers are located at the same locations as in one of the single-source conditions-suggesting a potential reduced integration ability or response bias-the PreLI0 assumption will provide predictions close to observed scores, whereas the PreLIH and the PreLI1 assumptions will overpredict by a greater extent. The evaluation of the model fit with these three assumptions will be based on (a) overprediction or underprediction of the observed data and (b) the amount of error between predicted and observed scores. Given that the PreLI1 model is an ideal observer model, a model fit is expected to overestimate real human observers' scores. Thus, the model that estimates the observed scores with a smaller amount of error is considered the best fit compared with those that produce greater error between the predicted scores and the observed scores.

Results

Phoneme Identification and Information Transmission

Consonant identification. Figure 1 shows the mean overall percent correct consonant identification (left) for three listening conditions. Paired t-tests on the arcsinetransformed data revealed a significant combined benefit of 5.6 percentage points compared with vocoder alone in NH listeners, paired $t(5) = 7.37$, $p < .001$, suggesting that NH listeners are able to integrate LP and vocoder speech cues across ears.

Percent information transmission for the consonant features voicing, stop, nasal, fricative, and place of articulationwas calculated for theNHgroup data (see Figure 2, left panel). The group data were computed from confusion matrices combined across subjects. First, there was substantial cue redundancy between LP-alone and vocoderalone stimuli. Unlike the complementary cues provided by the auditory (voicing and manner of articulation) and visual (place of articulation) stimuli in combined auditory-visual stimuli, the LP speech provided cues- mostly, voicing and manner of articulation-that were largely redundant to those delivered by the vocoder speech. However, all features except for place of articulation were transmitted above 80% by the vocoder. Second, the presence of the combined benefit of LP+vocoder speech over vocoder speech alone is noticeable for voicing, fricative, and place-of-articulation features but not for stop and nasality, perhaps due to a ceiling effect. The amount of improvement ranged from 5 to 8 percentage points. This pattern of results is similar to that found in our preliminary study (see Appendix). Taken together, these results suggest that NH listeners are able to combine consonant features across ears and across frequencies to improve their overall consonant identification performance as reported in Ronan et al. (2004).

Vowel identification. Overall mean vowel identification for NH listeners was computed and compared between combined and vocoder-alone conditions (see Figure 1). Paired t-tests on the arcsine-transformed data revealed a significant combined benefit of 15.6 percentage points compared with vocoder-alone conditions for vowel identification, paired $t(5) = 9.60$, $p < .001$, suggesting that NH listeners are able to integrate LP and vocoder speech cues across ears for better identification of vowels. The amount of the combined benefitwas greater for vowel identification than for consonant identification.

Percent information transmission was computed for three vowel features (Chomsky &Halle, 1968): height (high, mid, low), back (front, central, back), and tense (tense, lax). Acoustically, the first formant (F1) is associated with the height of the vowel (F1 increases as the vowel height decreases). F1 frequencies for American vowels are generally below 1000 Hz for adult talkers (Hillenbrand, Getty, Clark, &Wheeler, 1995), which is within the

range of the LP stimuli. Results fromthe acoustical analysis of our stimuli are consistent with this finding. The second formant (F2), on the other hand, is associated with the backness of the vowel (F2 decreases as the production of the vowelmoves toward the back of the vocal tract), which normally occurs at a higher frequency region (>900 Hz; Hillenbrand et al., 1995). This wasalso confirmedbythe acoustical analysis onour stimuli. The difference between tense and lax vowels is based on an articulatory criterion of muscular tenseness or laxness. Acoustically, tense and lax vowels generally differ in terms of their durations and F1 frequencies. Figure 2 (right panel) shows the average percent information transmission for these three vowel features. It is not surprising that only a small amount of information about the feature back was transmitted by the LP speech-which only contained frequencies up to 1000Hz- below the frequency range of F2 in most vowels. About 31% of information regarding vowel height was delivered to the listeners with the LP speech. A closer examination of the confusion matrix reveals that confusions occurred more frequently between high lax vowels (e.g., /I, .../) and mid vowels (...) as well as between mid vowels and low vowels (e.g., /æ /). In these cases, the F1 frequencies of these vowels were generally closer to each other, suggesting that listeners were able to distinguish the vowel height when F1 differences were large. Information transmission for the feature tense by the LP stimuli was 74%, significantly higher than the feature vowel height. This may be because listeners can use both durational and F1 cues to distinguish tense vowels from lax vowels. Percent information transmission for the vowel feature "height" for four-channel vocoder speech was 39%, for the vowel feature "back" was 48%, and for the vowel feature "tense" was 60%.

Similar to the consonant identification results, the combined benefit of LP+vocoder speech compared with vocoder-alone is seen for the three vowel features evaluated in this study. The combined benefit was 26, 13, and 16 percentage points for the vowel features height, back, and tense, respectively. It is noted that this pattern of results is also similar to that in our preliminary study. These findings suggest thatNHlisteners are able to combine vowel features across ears and across frequencies to improve their overall vowel identification performance.

Model Predictions for NH Listeners

Integration ability across frequencies was evaluated using the PreLI0, PreLI1, and PreLIH integration models that differ in terms of the location of the response centers in the multisource condition described in Ronan et al. (2004).

Consonant identification. Predictions weremade separately for each subject and condition. We made the predictions by first fitting the vocoder-alone and LP-alone matrices in D = 3 dimensions and then predicting the scores for the combined condition from a six-dimensional (6-D) model. Figure 3 (upper left panel) shows the predicted versus observed combined-source consonant identification scores for each response center location (triangles = PreLI0; squares = PreLI1; circles = PreLIH). The unityslope line represents a perfect match between predicted and observed scores. Points falling above this line indicate that the predicted scores are better than the observed scores and vice versa. Since PreLI1 made predictions using an "optimal" decision rule that assumes perfect integration of cues from each source, predicted scores are expected to be equal to or greater than observed scores. As expected, PreLI1 constantly overpredicted the observed combined performance (by an average of 9.1 percentage points). PreLI0 consistently underpredicted the combined performance by an average of 7.2 percentage points, whereas PreLIH overpredicted the combined performance by an average of 4.6 percentage points. The deviation between predicted and observed scores, calculated as root-mean-square error (RMSE), was greater for PreLI0 (8.7 percentage points) than for PreLIH (5.1 percentage points). In general, this pattern of results is similar to those reported in Ronan et al. (2004) for cross-frequency integration (across or within the same ear) as well as those from our preliminary study for consonant identification inNHlisteners,which also showed that PreLI0 underestimated the multiband scores and that PreLIH provided better predictions compared with PreLI1 (i.e., overpredicted, to a lesser extent) for cross-frequency consonant identification. The consistent underestimation of combined performance by PreLI0 and the more accurate

predictions (i.e., smaller errors between predicted and observed scores) by PreLIH suggests thatNH listeners indeed integrated cues from both LP and vocoder speech and that the locations of the response centers in the combined condition were different from those in the original LP-alone or vocoder-alone response centers.

Vowel identification. Predictions for vowel identification were made in the same way as for consonants for each subject and combined condition. The vocoder-alone and LP-alone matrices were first fit with three dimensions; then, the combined scores were fit with a 6-Dmodel. Figure 3 (upper right panel) shows the predicted versus observed combined-source vowel identification scores for each response center location (triangles = PreLI0; squares = PreLI1; circles = PreLIH; note that some data points overlap on this graph). Consistent with consonant identification results, PreLI1 constantly overpredicted the observed combined performance (by an average of 7.0 percentage points).PreLI0 consistently underpredicted the combined performance by an average of 6.9 percentage points, whereas PreLIH overpredicted the combined performance by an average of 3.6 percentage points. The deviation (RMSE) between predicted and observed scores was greater for PreLI0 (8.4 percentage points) than for PreLIH (4.5 percentage points).This pattern of results is, again, consistent with that found in our preliminary results for the vowel identification task (see Appendix).

Experiment II: Cross-Frequency Integration in Bimodal CI Users

There has been no systematic investigation that examined CI listeners' ability to extract and integrate speech cues across electric and acoustic stimulation. Ching et al. (2001) calculated information transmission for consonant recognition but did not investigate vowel recognition. Mok et al. (2006) used consonant-nucleus-consonant (CNC) phoneme recognition scores to calculate information transmitted in individual ears and combined hearing and reported that differences in scores between bimodal hearing and CI alone were greatest in phonemes containing relatively low-frequency cues compared with phonemes containing high-frequency cues. In the present study, CI listeners were tested with the same stimuli and procedures as those used for NH listeners to facilitate comparisons of performance between the two groups. In addition, we acquired a large number of repeated measures (42-54 trials) for each bimodal CI listener per stimulus per listening condition, which was rarely done in previous studies. This was necessary in order to minimize estimation bias for the analysis of information transmission (Sagi &Svirsky, 2008).

Method

Subjects.Twelve CI subjects (C1-C12; seven females, five males) 15-69 years of age (M = 35.75 years) participated in the consonant identification task, and half of them (C2, C5, C7, C8, C9, and C12) also participated in the vowel identification task. Table 3 shows detailed demographic information for each subject, including age, onset of hearing loss, etiology of hearing loss, duration of severe to profound hearing loss prior to implantation, and the CI processor used. Seven subjects were under the age of 30 years, close to the age range of the NH subjects in Experiment I. The remaining subjects were in the age range from 46 to 69 years. Seven subjects are congenitally hard of hearing bilaterally (C4, C5, C7, C9, and C11) or were diagnosed with bilateral hearing loss at a very young age (C3 and C8) but had enough residual hearing to receive benefits from HA use before they received a CI. Of these seven subjects, three subjects (C3, C7, and C8) have hearing loss that was progressive from (a) mild to (b) severe to profound. The other four subjects had a severe hearing loss at birth (C4, C5, C9, and C11). Two subjects are congenitally deaf or acquired hearing loss at a young age in only one ear (C10 and C12). They subsequently acquired hearing loss in the other ear later in life (C10 at age 7 years; C12 at age 43 years). All subjects use oral communication and have developed normal language skills. Speech production is highly intelligible in all subjects. All subjects wore their HA in the implanted ear before their implant surgery (except for C10), and they all continued to wear their HA in the nonimplanted ear on a daily basis after implantation. Figure 4 shows the unaided (upper panel) and aided (lower panel) thresholds in the nonimplanted ear for each individual, except for Subject C6 due to lack of audiological data and lack of audiometric equipment on the day of the test. The threshold data were obtained either from subjects' most recent audiologic examination or on the same day of the testing in our laboratory. A large variability in the

amount of residual hearing was evident in this subject group. Although some subjects (e.g., C2) have mild to severe hearing loss at the low frequencies (<1000 Hz), some (e.g., C11) have profound loss even in the lowest frequencies. With amplification, all subjects have aided thresholds in the mild to moderate hearing loss range below 1000 Hz.

Stimuli and procedure. The unprocessed consonant and vowel stimuli in Experiment I were used for CI listeners. Each subject was evaluated under three listening conditions: HA-alone, CI-alone, and combined use of a CI and a HA (CI+HA). All stimuli were presented via a loudspeaker 1 m directly in front of the subject at a fixed level of 65 dBA. Subjects used their own CI and HA settings during the entire test session, except for the volume setting in the HA. Subjects adjusted the volume of their HAs until the presented stimuli reached their comfortable listening level. Those who could not achieve the comfortable level with the HA alone were asked to adjust the volume of their HA to the maximum setting before any distortion occurred. With this setting, they reported that the presented speech stimuli were just slightly below the comfortable level. The same HA and CI settings were used for the CI+HA condition for each subject. Given that the purpose of this study was to investigate listeners' ability to integrate speech cues, we used subjects' everyday device settings to minimize novelty effects, which are likely to affect integration ability.

Subjects were asked to turn off their CI when tested on the HA-alone condition. They were instructed to turn off their HA but leave their earmold in place in the nonimplanted ear when tested on the CI-alone condition. A foam earplug was inserted in the implanted ear during testing regardless of the listening condition to prevent any potential acoustic stimulation in case residual hearing was preserved in that ear. To verify that the earmold and the foam earplug provided sufficient attenuation to completely eliminate any acoustic stimulation, prior to the experiment, each subject was instructed to turn off both the HA and CI and have both the earmold and the foam earplug inserted into their ear canals. Test speech stimuli (10 tokens) were then presented at 65 dBA via the loudspeaker. Under this condition, none of the CI listeners reported hearing any sound.

As in Experiment 1, each CI listener first received practice identifying the consonants and vowels with visual correct-response feedback provided for each test condition. Performance usually reached plateau (i.e., within 3 percentage points' difference) within three blocks of practice; additional practice sessions were given until the criterion was met. After the practice sessions, each CI listener was then given nine blocks (3 blocks for each of the three utterances) of testing for each test condition, yielding a total of 54 trials (6 talkers ×9 blocks) per stimulus per condition per subject, except for subjects C1 and C6, who were tested with only seven blocks (42 trials per stimulus per condition) due to time constraints. No feedback was provided during test sessions. The order of testing for the CI-alone and CI+HA conditions was counterbalanced across subjects (i.e., half of the subjects were tested with the CI-alone condition first and vice versa). The HA-alone condition was tested last. This was done intentionally to minimize any anxiety arising if the subjects performed poorly with their HA alone.

Results

Phoneme Identification and Information Transmission

Consonant identification. Overall consonant identification was calculated for each subject and listening condition (see Figure 5, upper panel). There was a large intersubject variability in scores, ranging from a nearchance level of 15%-16% correct (C8 and C11) to a highlevel performance of 78% correct (C3) for the HA-alone condition, and ranging from 32% (C12) to 87% correct (C5) for the CI-alone condition. Two subjects, C8 and C11, could not perform the task with HA alone: Their scores were near chance levels of 16%. The majority of the subjects showed significantly better consonant identification with CI alone than with HA alone ($p < .05$), except for C4 and C12. Subject C4 showed no significant difference in performance between the HA-alone and CIalone conditions, $t(16) = 1.94$, $p = 0.07$. Subject C12 performed significantly better with HA alone than with CI alone, $t(16) = 14.18$, $p < .001$. Unlike the patterns of results obtained in NH listeners, the majority of CI listeners did not show a bimodal benefit (i.e., the CI+HA consonant identification scores were not significantly different from the scores for the better ear), except for C3. The bimodal benefit (CI+HAvs. CI-alone) noted in C3was 3.8

percentage points. Subject C9, however, showed a significant decrease in performance (4.1 percentage points) with combined CI and HA use compared with CI alone, $t(16) = 3.95$, $p < .005$. An asterisk denotes significant difference between the CI+HA score and the better-ear score.

The group mean data is also shown in Figure 5. We excluded Subject C12 in the group analysis because of her atypical pattern of results. Although consonant identification was better in the CI+HA condition than in the CI-alone condition in C12, her bimodal hearing performance was no better than her HA-alone performance. The inclusion of this subject in the group analysis could produce a false impression that there was a bimodal benefit compared with listening to a single device (HA alone or CI alone).

Percent information transmission for the consonant features of voicing, stop, nasal, and fricative as well as for place of articulation was calculated for each subject and for the group data (see Table 4). The group data were computed from confusion matrices combined across subjects, excluding Subject C12. The HA provided information about voicing and nasality but very limited information about stops, fricatives, and place of articulation. On average (excluding C12), CI alone provides 56% voicing information, which is consistent with findings reported in the literature (e.g., Ching et al., 2001; Fishman, Shannon, &Slattery, 1997). Unlike the patterns of results from NH listeners-which showed improvement in the combined conditions compared with the vocoder-alone condition on some consonant features- there was no sizable bimodal benefit for all consonant features in the CI group, except for an 8.9-point improvement in the nasality feature.

Vowel identification. Overall vowel identification scores were calculated for individual and group mean data (excluding C12) for each listening condition (see Figure 5, lower panel). Only one subject, C12, showed better vowel identification with HA alone compared with CI alone, $t(16) = 16.68$, $p < .001$. The rest of the group showed a reverse pattern. Unlike the lack of bimodal benefits for consonant identification, half of the subjects tested (C2, C5, and C8) showed a bimodal benefit of 3.5-6.8 points for vowel identification compared with CI alone or HA alone ($p < .05$). The bimodal benefit does not seem to correlate with the amount of residual hearing in the nonimplanted ear. For example, despite the fact that Subjects C8 and C9 had almost identical hearing loss from 250 Hz to 1000 Hz, Subject C8 showed bimodal benefit, and Subject C9 did not.

Percent information transmission was calculated for the three vowel features-height, back, and tense-for individual and group data (excluding C12) for each listening condition (see Table 5). The type and amount of information transmitted by the HAwere very similar to those obtained in LP-alone condition in NH listeners. CI listeners also performed similarly to NH listeners listening to four-channel vocoder stimuli. As a group (excluding C12),HA alone provided more information on the vowel height (F1; 27%) but essentially no information on the feature back (F2; 4%). CI alone provided more information on the feature back (69%) than on vowel height (53%). This suggests that HA provided complementary information to a CI for vowel identification. Independent of listening condition, vowel tense was better identified than vowel height, suggesting CI listeners' ability to use multiple cues (duration and F1) to distinguish between tense and lax vowels. The three subjects (C2, C5, and C8) who demonstrated a significant bimodal benefit were the only ones who showed better CI+HA performance compared with CI-alone performance on all three vowel features. The lack of improvement between CI+HA and CI-alone or HA-alone on vowel features height and back was seen for subjects (C7, C9, and C12) who did not show overall bimodal benefit in vowel identification.

The information transmission analysis provides one test of whether performance of the NH subjects who listened to vocoder speech is a reasonable acoustic model to approximate performance in CI subjects. The patterns of results with vocoder speech alone obtained from NH listeners for both consonant and vowel identification are consistent with those obtained with the CI listeners in this study, as well as results reported in the CI literature (Ching et al., 2001;Mok et al., 2006). For consonants, both vocoder speech and CI alone provided more information on features voicing and manner of articulation than on place of articulation. For vowels, both vocoder speech and CI alone provided more information on the feature back than on vowel height.

Model Predictions for CI Listeners

The ability to integrate electric and acoustic speech cues in CI listeners was evaluated using the PreLI0, PreLIH, and PreLI1 models, and results are compared with those obtained from NH listeners. Similar to the fitting procedures used for theNHdata, CI datawere first fit with a 3-D model on the HA-alone and CI-alone matrices and then was fit with a 6-D model for the bimodal performance for both consonant and vowel identification.

Consonant identification. Figure 3 (lower left panel) shows predictions for individual CI subjects for the bimodal hearing condition. Triangles represent predictions from PreLI0, squares represent predictions from PreLI1, and the circles represent predictions from PreLIH. Note that we were unable to model the data for Subject C2. In order to apply the model to the data, errors must be made in identifying the stimuli. This subject made no errors for one stimulus. Our modeling results show that the predictions of the PreLI0 model were either equal to or just slightly higher (1.3-4.6 points) than the combined scores for eight subjects.The PreLI0 model underpredicted the combinedscores for three subjects-C7,C8, and C11- by only 6.1, 6.3, and 9.7 percentage points, respectively. This is very different than the patterns of results seen in NH listeners, in which PreLI0 almost always underpredicted the combined score (see upper left panel of Figure 3). PreLI1 and PreLIH, on the other hand, overpredicted the combined score by a greater amount, ranging from 8.5 points (C5) to 35.2 points (C1) for PreLI1, and 5.2 points (C11) to 21.8 points (C1) for PreLIH. In sum, the data for the CI listeners, unlike those for theNHlisteners,were better fit with response centers located somewhat nearer to the original response centers in the single-source condition. This suggests that the majority of the CI listeners (except for three subjects: C7, C8, and C11) made minimal adjustment to the bimodal hearing condition, and their responses to the bimodal stimulation were similar to the responses made to theHA-alone or CI-alone condition-whichever produced higher overall performance.

Vowel identification. Figure 3 (lower right panel) shows the predicted versus observed combined vowel scores for six CI listeners usingPreLI0 (triangles),PreLI1 (squares), and PreLIH (circles) models. Although PreLI0 consistently underpredicted the bimodal performance in NH listeners, it produced mixed results for the CI listeners-an underprediction for half of the six subjects tested (C2, C5, and C8). It should be noted that the three subjects (C2, C5, and C8) for whom PreLI0 underpredicted combined scores are the same subjects who achieved significantly higher overall vowel identification scores with bimodal hearing compared with CI alone. The rest of the subjects (C7, C9, and C12) who did not receive a bimodal benefit for vowel identification were also best fit by PreLI0, in which the predictions were either equal to (C7) or just slightly higher than (2.3 points for C9 and 4.6 points for C12) the observed combined scores. This finding suggests that these three subjects may not have been able to integrate as well as the other subjects who showed significant bimodal benefit for vowel identification. Both PreLIH and PreLI1 overpredicted the combined scores for all subjects by an average of 6.6 and 9.0 percentage points, respectively.

Discussion

Information Transmission by HA and CI

Information transmitted via the HA and the CI is largely redundant for consonants. Both HA and CI provided greater voicing and manner-of-articulation information but less place-of-articulation information. Note that seven of the 12 CI subjects who were tested achieved voicing scores below 40%-considerably lower than the voicing score obtained from theNH group when only low frequencieswere presented (LP-alone condition).One possibility for the reduced HA performance is that the HA fitting in our CI subjectsmay not be optimal.More likely, the difference in the voicing score is due to the presence of severe to profound hearing loss in the CI listeners, whereas NH listeners have normal low-frequency hearing. At first, the low voicing scores in the impaired ears may seem surprising given that voicing cues are preserved at the low frequencies. However, similar results have been reported in the literature onHI individuals with substantial hearing loss at low frequencies (Boothroyd, 1984; Ching et al., 2001; McDermott, Dorkos, Dean, &Ching, 1999). McDermott et al.

(1999) tested five adults with sensorineural hearing loss on phoneme, word, and sentence recognition tasks. All subjects had moderate to profound sensorineural hearing loss from 500 Hz to 1000 Hz and a profound loss above 1000 Hz.Two subjects had a mild loss at 250 Hz, and the rest had moderate to moderately severe loss at that frequency, very similar to our CI listeners in the nonimplanted ear. With conventional amplification, three of McDermott et al.'s (1999) subjects showed voicing scores below 40%, consistent with our findings. Ching et al. (2001) investigated a group of 16 bimodal CI children (range = 6-18 years of age) who had severe to profound hearing loss in the nonimplanted ear. They reported a low voicing score in the HA-alone condition, with an average voicing score of about 36% in quiet. Careful examination of our data revealed that voicing confusions occurred mostly for fricative consonants. For example, /f/ and /θ/ were frequently misidentified as voiced stop /b/ or voiced fricatives /v, ð, z/; /s/ and /ʃ/ were misidentified as voiced stop /d/ or voiced fricatives /ð, z, .../. The reason for the poor voicing perception in our subjects is unclear.

Unlike consonants, information transmitted via the HA and the CI is somewhat complementary for vowels. The HA received mostly F1 information, but the CI received more F2 information than F1. This finding is consistent with results reported in the literature. Mok et al. (2006) tested a group of bimodalusers onCNCwords in quiet. The degrees of hearing loss in the nonimplanted ears of their subjects were similar to those in our subjects. Mok et al. (2006) reported about a 14-percentagepoint better F1 transmission than F2 on the HA side, and about an 8-percentage-point better F2 transmission than F1 on the CI side.

Bimodal Benefits

Although all NH listeners showed improved consonant and vowel identification in the LP+vocoder condition compared with the vocoder-alone condition, only a few CI listeners showed a bimodal benefit. This pattern of results has been reported previously for bimodal hearing users (Ching et al., 2001; Dunn et al., 2005; Mok et al., 2006) as well as for hybrid users for consonant identification (Reiss, Gantz,&Turner, 2008). Ching et al. (2001) reported that only three out of 11 subjects showed significant bimodal benefit for speech recognition in quiet with HAs that were adjusted to provide the target insertion gain using the prescriptive National Acoustic Laboratories (NAL-RP) method. Dunn et al. (2005) and Mok et al. (2006) reported that only four out of 12 subjects and two out of 14 subjects showed significant bimodal benefit for CNC word recognition and CNC phoneme recognition in quiet, respectively.

Reiss et al. (2008) tested consonant discrimination on 20 hybrid users. Their subjects had substantially better residual hearing than our bimodal CI subjects. Reiss et al.'s (2008) subjects were implanted with shortelectrode arrays: The most apical electrode (electrode 6) encoded frequencies down to 688 Hz, not covering the entire speech frequency range. Interestingly, the authors' results showed that only about one quarter of the subjects demonstrated substantial improvement with combined acoustic-electric (A+E) conditions compared with A-only or E-only conditions (see Figures 2B and 3A in Reiss et al., 2008) for consonant discrimination. This finding suggests that the reduced benefit observed in our bimodal users is not likely due to overlapping frequency ranges between electric and acoustic stimulation or to the severity of the hearing loss in the acoustic ear in our bimodal CI subjects.

Our modeling results and the estimates of information transmission for various consonant and vowel features provide an insight on the mechanisms that underlie this deficit. The lack of bimodal benefits for consonant identification in CI listeners can be attributed to a combination of factors, including (a) insufficient,misrepresented, or redundant information provided by an individual ear and (b) reduced ability to integrate speech cues across ears. The CI data were best fitwith the PreLI0 model that assumes a minimal adjustment in response from the single-source conditions to the multisource condition. This indicates that CI listeners performed suboptimally compared with their NH counterparts. For consonant identification, all subjects (except for C3) showed an absence of bimodal benefit, with bimodal scores essentially the same as the CI-alone or HA-alone scores-whichever was higher. For example, Subjects C4 and C10 performed similarly with HA- and CI-alone to the LP- and vocoder-alone conditions observed inNH listeners, but they did not obtain the

bimodal benefits that NH listeners did.

Although the PreLI0 model produced a good fit for many of the CI subjects for consonant identification, it slightly underpredicted the combined scores for Subjects C7, C8, and C11. However, none of these subjects showed overall bimodal benefits for consonant identification, which could be attributed to the insufficient or redundant cues provided by the HA ear to improve their performance in the bimodal listening condition. Subjects C8 and C11 achieved overall scores of 15%-16% correct, close to chance-level performance (6.25%). Subject C7 performed better than C8 and C11 with HA alone, but his performance-particularly, the extraction of voicing, stop, and fricative features-was still significantly lower than the LP-alone performance in NH listeners.

Subject C3 showed a bimodal benefit for consonant identification despite the fact that his bimodal performance was best predicted by the PreLI0 model. Unlike other CI listeners, C3 could identify consonants in the HA-alone condition with an overall score of 78% correct, 34 percentage points higher than the LP-alone score in NH listeners, whereas his CI-alone performance was comparable to the NH four-channel vocoder performance. Despite his high level of performance on the HA condition, he only received a bimodal benefit of 4.4 points. His reduced bimodal benefit may be attributed to his suboptimal integration ability to combine speech cues from both ears.

The relationship between model fit and bimodal benefit is more apparent and direct in the vowel identification task. Five of the six CI subjects tested, except for C12, had similar vowel identification performance with HA alone and with CI alone. However, only three subjects (C2, C5, and C8) showed improved overall vowel identification scores. Interestingly, these three subjects also exhibited an ability to integrate speech cues: Their combined scoreswere underpredicted by the PreLI0model.

Cross-Frequency Integration Deficits in HI Listeners

The present study shows a reduced benefit from additional low-frequency speech cues for phoneme identification in bimodal CI listeners. This finding is consistent with the findings of Grant et al. (2007), who reported that HI listeners received less benefit than NH listeners when additional high-frequency cues were added to low-frequency speech in the auditory-alone condition, but their performance significantly improved and achieved a similar level of performance as that of NH listeners when the high-frequency cues were provided visually in the auditory-visual condition. Grant et al. (2007) attributed these patterns of performance to HI listeners' reduced efficiency in integrating auditory speech cues across spectral regions compared withNHlisteners but similar efficiencies in integrating auditory-visual speech cues. In addition to the interplay between extraction and integration of cues, Grant et al. (2007) discussed other explanations that may underlie the reduced benefits of additional high-frequency speech cues in HI listeners, which may also apply to the CI population. These other explanations are briefly discussed in the subsections that follow.

Peripheral interference-masking. Cross-frequencyintegration in the same ear in HI listeners could have been adversely affected by excessive peripheral upward spread ofmasking due to the broadening of auditory filters.However, the masking effect could not explain the reduced integration ability in our bimodal CI subjects because the low-frequency and high-frequency speech cues were presented to separate ears.

Perceptual salience of additional cues. Turner and Henry (2002) reported that HI listeners can benefit from high-frequency speech cues when consonant recognition performance is relatively poor at low signal-to-noise ratios (SNRs). At this poor performance level, the additional high-frequency speech cues may help to decipher the more "difficult" features of speech. In our study, all of our CI subjects (except for C1) achieved greater than 50% consonant identification with CI alone (or with HA alone, for Subject C12). The additional low-frequency cues from the nonimplanted ear in these subjects may be insufficient to decipher the more "difficult" features, such as voicing and place of articulation. To test this hypothesis, future studies could deliver noise in the CI ear in order to decrease the CI-alone performance to below 50%; this would enable researchers to examine whether the addition of low-frequency speech cues could help improve performance. The exception from Subject C1, who achieved only 41% correct with CI alone but did not receive bimodal benefit, poses a challenge to this

explanation.

Perceptual bias. Ross, Saint-Amour, Leavitt, Javitt, and Foxe (2006) reported that auditory-visual integration is most effective for intermediate SNRs. In high or low SNRs, listeners may have a strong bias toward the cues from the dominant modality and ignore cues from the other modality instead of integrating available cues from both modalities. This form of "interference," as Grant et al. (2007) pointed out, would not be accounted for by the PreL model. Our CI listeners may have had a strong perceptual bias toward their CI ear and may have ignored cues from the HA ear because the HA provided weaker cues than the CI. However, evidence from our CI listeners who did not show ear dominance argues against this explanation. Subjects C3 and C4 showed a relatively good consonant identification score in the HA-alone condition, not significantly different than the CI-alone performance. For these two subjects, their reduced bimodal benefit is not likely to be attributed to a perceptual bias toward one ear, although it is still possible that the cues from one ear are ignored because they are redundant, as in the consonant stimuli. For vowel identification, however, half of the CI subjects showed bimodal benefit, suggesting that they did not ignore cues from the less dominant ear when the ear provided complementary cues.

Age effects and internal noise. Although we did not investigate age effects in this study, we made an effort to recruit CI subjects from different age groups, ranging from 15 to 69 years old. A study by Souza and Boike (2006) showed that age impaired listeners' ability to integrate temporal envelope cues across frequency bands for speech recognition. Seven of 12 CI subjects who were tested in the consonant identification task were under the age of 30 years-within the age range of the NH listeners. The differences in the combined benefit between the two groups cannot be accounted for by age. However, all of the younger subjects and some of the older subjects (e.g., C8 and C12) in our study had an onset of hearing loss in at least one ear at a very young age (<5 years). Although all subjects communicated orally prior to implantation and have developed essentially normal language and reading skills, it is possible that the degraded speech they received since childhood may have affected their development of a normal internal representation of the phonemes compared with their NH counterparts, which in turn might impair their ability to integrate speech cues and to identify stimuli in the combined case. The imperfections of the internal representation of the stimulus due to the excess sensory noise and memory noise (Sagi,Meyer,Kaiser, Teoh,&Svirsky, 2010) in the singlesource and/or combined-source case can also occur in postlingually deafened adults, especially after long-duration hearing loss. This form of deficit would also be viewed as suboptimal integration across frequencies and modalities. Future investigation on response error patterns to individual stimuli and detailed comparisons between the perceptual and stimulus space may provide insight into the underlying cause for the reduced bimodal benefits in CI listeners. Additionally, investigations with nonspeech stimuli and/or with different tasks may further reveal the limiting factors for cross-frequency integration in CI listeners.

Deficits in the cross-frequency processing of temporal speech cues. As suggested by Grant et al. (2007), the reduced integration efficiency for HI listeners may not be simply the product of degraded extraction or integration of cues across frequency bands but instead may be a true deficit in dealing with temporal speech cues such as those reported in Healy and Bacon (2002). Healy and Bacon presented two speech-modulated tones at 750 Hz and 3000Hz toNHand HI listeners. In one condition, the low-frequency band led or lagged the high-frequency band by 12.5-100 ms. The authors found that NH listeners could tolerate small disruptions in cross-frequency timing (i.e., 12.5ms), but performance decreased as the crossfrequency asynchrony increased. However, HI listeners' performance dropped more precipitously than that of their NH counterparts. For consonants, cross-frequency speech cues may not be presented concurrently-for example, stop voicing relies heavily on voice onset time (VOT) cues (VOT is the time interval between burst and the onset of voicing). The reduced bimodal benefit in our CI listeners may be due to their difficulty in comparing temporal speech cues across frequencies. Their ability to integrate speech cues across ears and across frequency bands could also be hindered by the processing delays between their HA and CI as well as differences in processing time

between frequency channels within a single device.

Although the deficit in spectrotemporal processing may seem a likely explanation for the integration deficits in consonant identification in CI listeners, it is still unclear how this can account for CI users' reduced bimodal benefit in vowel identification.Unlike the dynamic properties of consonants, spectral cues for vowel recognition are relatively static. In addition to durational cues (which we did not control for in this study), the identification of vowels was primarily based on the steady concurrent cues for F1 andF2 and does not require integration of cross-frequency temporal speech cues. Therefore, the lack of bimodal benefits in vowel identification may reflect a deficit in cross-frequency integration in some of our CI subjects.

In addition to the deficit in processing temporal cues across frequencies, bimodal CI users may also encounter a problem of incompatibility of the two devices, given that one ear receives acoustic stimulation and the other ear receives electric stimulation. Although all of our CI subjects reported fused auditory images and enjoyed the sound quality better when using both devices, we cannot exclude the possibility that differences in stimulation modes (acoustic vs. electric) and sound quality may also pose difficulties for integration and may create potential interference across ears.

Future Directions

The present study does not suggest that CI users do not receive bimodal or hybrid benefits. It has been well documented that bimodal and hybrid users can achieve better word and sentence recognition (e.g., Dorman et al., 2008; Gifford, Dorman,McKarns, &Spahr, 2007; Kong et al., 2005; Mok et al., 2006, 2009; Reiss et al., 2008; Turner et al., 2004; Zhang et al., 2010). For word and sentence recognition, listeners could be better able to use phonotactic, prosodic, and contextual cues when low frequencies are presented (Brown &Bacon, 2009b; Spitzer, Liss, Spahr, Dorman, &Lansford, 2009; Zhang et al., 2010).Arecent report by Zhang et al. (2010) argues that bimodal benefit for word recognition in quiet can be accounted for entirely due to the presence of fundamental frequency cues alone and that the benefit was not significantly different between conditions in which the nonimplanted ear received only very low-frequency (<125 Hz) versus wide-band speech. Also, it has been suggested that the addition of low-frequency cues can aid listeners in glimpsing the target sentence during the spectral and/or temporal dips of the masker (Brown &Bacon, 2009a; Kong &Carlyon, 2007; Li &Loizou, 2008; Zhang et al., 2010).

The lack of improvement in consonant identification in our CI listeners should not discourage the use of bimodal hearing. Most of our CI subjects exhibited severe to profound hearing loss at the low frequencies-a greater loss than that experienced by some of the CI candidates under the currentFDA guidelines for cochlear implantation. It is possible that bimodal users receive more benefits for phoneme recognition if they have more residual hearing in the nonimplanted ear. Also, our results clearly showed the benefits of using F1 cues from the HA to improve vowel identification in at least some CI listeners. F1 transitions also provide cues for consonant recognition, and the use of these cues has not been fully investigated. In addition, there is evidence in our study suggesting that listeners who have reduced integration ability could still benefit from bimodal stimulation if they receive useful cues from the HA (e.g., Subject C3). Future research could look into ways of improving HA performance in order to deliver more useful speech cues.

Conclusions

We developed the following conclusions as a result of this study.

1. The PreL model of integration is capable of predicting combined-band performance with speech signals that have undergone different signal processing (LP filtering and channel vocoding). Results of model fits for NH listeners for consonant and vowel identification were consistent with those reported in Ronan et al. (2004).
2. When tested with their everyday program/map, bimodal CI listeners received largely redundant information between the two devices for consonants. Both HA and CI provided greater voicing and manner-ofarticulation information but less place-of-articulation information. However, information received between HA and CI was somewhat complementary for vowels, with HA providing mostly F1 information and CI providing more F2

information.

3. Although NH listeners showed significant improvement in a combined LP+vocoder condition for both consonant and vowel identification, the majority of CI listeners did not show bimodal benefits compared with the performance in the better ear for consonant identification, and only half of theCI listeners showed bimodal benefits for vowel identification.

4. Predictions from the PreL model were different between NH and CI groups. NH consonant and vowel identification performance was best fit with the PreLIH assumption, in which the response centers in the multisource case were located halfway between the response centers in the single-source case and multisource stimulus centers. However, the majority of the CI data was best fit with the PreLI0 assumption, in which the response centers in themultisource case were located at the same locations they had in the single-source conditions. The differences in modeling results between NH and CI listeners suggest that CI listeners may have reduced integration ability.

5. The lack of bimodal benefits for phoneme identification in CI listeners can be attributed to a combination of factors, including the insufficient or redundant information provided by an individual ear and/or reduced ability to integrate speech cues across ears.

Acknowledgments

This work was supported by the National Organization for Hearing Research Foundation (Principal Investigator [PI]: Ying-Yee Kong) and National Institute on Deafness and Other Communication Disorders Grants R03 DC009684-01 (PI: Ying-Yee Kong) and R01 DC007152-02 (PI: Louis D. Braida). We are grateful to all subjects for their participation in these experiments. We would like to thank Ken Grant and Joshua Bernstein for their helpful comments and suggestions. We also thank Qian-Jie Fu for allowing us to use his MATLAB programs for performing information transmission analysis.

Sidebar

Cross-Frequency Integration for Consonant and Vowel Identification in Bimodal Hearing

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J Speech Lang Hear Res 2011;54;959-980; originally published online Nov 8, 2010; DOI: 10.1044/1092-4388(2010/10-0197)

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Editor: Robert Schlauch
Associate Editor: Christopher Turner
Received July 14, 2010
Accepted October 13, 2010
DOI: 10.1044/1092-4388(2010/10-0197)

Appendix

Appendix (p. 1 of 2). Preliminary study: Model predictions for nonoverlapping frequency speech cues in normal-hearing (NH) listeners.

Method

Twelve NH subjects (10 females, 2 males), 19-46 years of age (M = 24 years), participated in the study. Nine of them participated in the consonant identification experiment. Seven subjects participated in the vowel identification task. Four of these seven subjects also participated in the consonant identification task.

Two sets of speech stimuli (consonants and vowels) identical to those in Experiment 1 were used. These stimuli were subjected to low-pass (LP) filtering or channel-vocoding processing. The only difference in processing parameters between this preliminary study and Experiment 1 was that the channel-vocoding processing preserved only highfrequency cues (> 900 Hz); thus, there was no (or very minimal) overlapping in frequencies between the LP and vocoder speech. In this vocoder system, speech signal in a frequency range from 900 Hz to 6000 Hz was band-pass filtered into two, four, or six logarithmic frequency bands (corresponding to the two-channel, four-channel, and six-channel vocoders).

Experimental procedures were the same as those used in Experiment 1. Because there were three vocoder conditions (six-channel vocoder, four-channel vocoder, and two-channel vocoder), there were a total of seven testing conditions (one LP-alone, three vocoder-alone, and three LP+vocoder). Each subject was tested with the six-channel vocoder first, followed by the four-channel vocoder, and then the two-channel vocoder. The order of presentation of the listening conditions (LP-alone, vocoder-alone, LP+vocoder) was counterbalanced across subjects.

Model Predictions

Integration ability across frequencies was evaluated using the PreLI0, PreLI1, and PreLIH integration models that differ in terms of the location of the response centers in the multisource condition described in Ronan et al. (2004). Predictions were made separately for each subject, condition, and task. They were computed by first fitting the vocoderalone and LP-alone matrices in D = 3 dimensions and then predicting the scores for the combined condition from a 6-D model. Figure A1 shows the predicted versus observed combined-source consonant (upper panel) and vowel identification (lower panel) scores for each response center location (triangles: PreLI0; squares: PreLI1; circles: PreLIH). On average, PreLI0 underpredicted the combined performance by about 5 percentage points for consonant identification and 9 percentage points for vowel identification. PreLIH overpredicted the combined performance by an average of 4 percentage points for consonant identification and 3 percentage points for vowel identification. Compared to PreLIH, PreLI1

overpredicted the combined performance to a greater extent with an average of 7 percentage points for consonant identification and 4 percentage points for vowel identification. The root-meansquare- error (RMSE) of the fit was greater for PreLI0 (consonant: 6; vowel: 10) than for PreLIH (consonant: 5; vowel: 4). In general, this pattern of results is similar to those reported in Ronan et al. (2004) for cross-frequency integration for consonant identification in NH listeners, which also showed that PreLI0 consistently underestimated the multiband scores and that PreLIH provided better predictions for cross-frequency consonant identification compared to PreLI1. The consistent pattern of results from the model fits between Ronan et al. (2004) and this preliminary study suggests that the PreL model of integration is capable of predicting combined-band performance when speech signals from different frequency regions undergo different signal processing (LP filtering and channel vocoding).

Publication date: Jun 1, 2011

Year: 2011

Temporal and Spectral Cues for Musical Timbre Perception in Electric Hearing

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.3 (Jun 1, 2011): 981-994A.
ProQuest document link

Abstract: The purpose of this study was to investigate musical timbre perception in cochlear-implant (CI) listeners using a multidimensional scaling technique to derive a timbre space. Sixteen stimuli that synthesized western musical instruments were used (McAdams, Winsberg, Donnadieu, De Soete, &Krimphoff, 1995). Eight CI listeners and 15 normal-hearing (NH) listeners participated. Each listener made judgments of dissimilarity between stimulus pairs. Acoustical analyses that characterized the temporal and spectral characteristics of each stimulus were performed to examine the psychophysical nature of each perceptual dimension. For NH listeners, the timbre space was best represented in three dimensions, one correlated with the temporal envelope (log-attack time) of the stimuli, one correlated with the spectral envelope (spectral centroid), and one correlated with the spectral fine structure (spectral irregularity) of the stimuli. The timbre space from CI listeners, however, was best represented by two dimensions, one correlated with temporal envelope features and the other weakly correlated with spectral envelope features of the stimuli. Temporal envelope was a dominant cue for timbre perception in CI listeners. Compared to NH listeners, CI listeners showed reduced reliance on both spectral envelope and spectral fine structure cues for timbre perception.

Full text: Headnote

Purpose: The purpose of this study was to investigate musical timbre perception in cochlear-implant (CI) listeners using a multidimensional scaling technique to derive a timbre space.

Methods: Sixteen stimuli that synthesized western musical instruments were used (McAdams, Winsberg, Donnadieu, De Soete, &Krimphoff, 1995). Eight CI listeners and 15 normalhearing (NH) listeners participated. Each listener made judgments of dissimilarity between stimulus pairs. Acoustical analyses that characterized the temporal and spectral characteristics of each stimulus were performed to examine the psychophysical nature of each perceptual dimension.

Results: For NH listeners, the timbre space was best represented in three dimensions, one correlated with the

temporal envelope (log-attack time) of the stimuli, one correlated with the spectral envelope (spectral centroid), and one correlated with the spectral fine structure (spectral irregularity) of the stimuli. The timbre space from CI listeners, however, was best represented by two dimensions, one correlated with temporal envelope features and the other weakly correlated with spectral envelope features of the stimuli.
Conclusions: Temporal envelope was a dominant cue for timbre perception in CI listeners. Compared to NH listeners, CI listeners showed reduced reliance on both spectral envelope and spectral fine structure cues for timbre perception.
Key Words: cochlear implant, timbre, music
Cochlear implants (CIs) were originally designed to aid speech recognition for severely hard-of-hearing individuals. Recently implanted CI patients can achieve average sentence recognition scores above 80% correct in quiet (seeWilson&Dorman, 2008).While the temporal-envelope-based coding strategies can support speech recognition, it has been well-documented that these strategies do not provide sufficient information for pitch perception or music appreciation (e.g., Gfeller &Lansing, 1991; Gfeller, Turner, et al., 2002; McDermott, 2004; Kong, Cruz, Jones, &Zeng, 2004; Galvin, Fu, &Nogaki, 2007).
The spectral and temporal properties of music are complex and dynamic. Both categories of cues contribute to the recognition of familiar tunes and the appraisal of the characteristics of music. The aesthetic appreciation of music, however, is multifaceted. It does not solely depend on listeners' ability to follow the melody or pitch contours. Anecdotally, some CI listeners can enjoy music by following the musical rhythms or the lyrics, despite their inability to track many of the melodic and pitchbased characteristics. Kong et al. (2004) systematically studied CI listeners' ability to discriminate tempos, rhythmic patterns, and melodies. They reported that CI listeners were able to follow rhythmic cues for music perception, but their ability to perceivemelodies (pitch cues) was poor, similar to normal-hearing listeners listening to stimuli processed with a one-channel vocoder.
Another important characteristic of musical sounds is timbre. By definition, timbre is the perceptual attribute that distinguishes two sounds that have the same pitch, loudness, and duration (American National Standards Institute, 1973). For musical timbre, this perceptual attribute distinguishes instruments (e.g., guitar vs. piano) playing the same note with the same loudness. One approach of studying timbre perception is to evaluate listeners' ability to discriminate among or recognize musical instruments. This approach has been used extensively to investigate musical timbre perception in CI listeners (e.g., Dorman, Basham, McCandless, &Dove, 1991; Gfeller&Lansing, 1991; Gfeller, Knutson,Woodworth, Witt, &DeBus, 1998; Gfeller,Witt,Woodworth, Mehr, &Knutson, 2002; Gfeller,Witt, Adamek, et al., 2002; Schulz and Kerber, 1994; Leal et al., 2003; McDermott, 2004; Nimmons et al., 2008). In these studies, musical notes or songs played by different instruments (e.g., violin, piano, flute, etc.) were presented to CI listeners and they were asked to identify the instruments either in open set or in closed set. Across studies, CI listeners' performances were generally poorer than normal-hearing (NH) listeners, with average identification scores in the range of about 40-60% correct depending on the number of possible alternatives in a closed set compared to 90-100% correct identification obtained inNHlisteners (Schulz& Kerber, 1994;Gfelleretal., 1998;Gfeller,Witt,Woodworth, et al., 2002; McDermott, 2004; Kang et al., 2009). Another approach to study timbre perception is to evaluate listeners' subjective rating or overall appraisal (i.e., liking) of sounds; this includes subjective characteristics such as pleasantness ornaturalness (e.g., Gfeller&Lansing, 1991; Schulz &Kerber, 1994; Looi, McDermott, McKay, &Hickson, 2007), or sound quality on different perceptual dimensions, such as dull/brilliant, compact/scattered, and full/empty (Gfeller,Witt,Woodworth, et al., 2002).Results from these studies showed that, in general, CI listeners rated the sound quality lower than NH listeners (Schulz &Kerber, 1994; Gfeller &Lansing, 1991; Gfeller et al., 1998; 2000; Gfeller,Witt,Woodworth, et al., 2002). Gfeller, Witt,Woodworth, et al. (2002) reported that CI listeners rated string instruments and instruments played in the higher-frequency range as more scattered, less full, and duller when compared with NH listeners' ratings.
The present study takes another approach to investigate timbre perception in CI listeners (i.e., exploring the

timbre space). The timbre space for NH listeners has been studied extensively (e.g., McAdams et al., 1995; Marozeau, de Cheveign, McAdams, &Winsberg, 2003; Caclin, McAdams, Smith, &Winsberg, 2005). However, it has not been thoroughly examined in listeners with significant auditory impairments. In this approach, we aim to (a) derive amultidimensionalmusical timbre space for CI listeners to compare with the timbre space for NH listeners, and (b) determine the psychophysical nature of the dimensions in the CI timbre space on the basis of the acoustic parameters (temporal and spectral features of the musical instruments) described in previous studies (Krimphoff, McAdams, &Winsberg, 1994; McAdams et al., 1995; Marozeau et al., 2003; Calcin et al., 2005; Peeters, 2004). Because timbre is a multidimensional perceptual attribute, the perception of musical timbre can be represented in a multidimensional Euclidean space using a Multidimensional Scaling (MDS) technique, such that the distances among the stimuli reflect their relative dissimilarities. These perceptual dimensions are often described by terms like brightness, roughness, nasality, naturalness, or impulsiveness. Recent studies have tried to better define timbre by varying different physical parameters of acoustic signals and examining changes in perceived timbre (McAdams et al., 1995; Marozeau et al., 2003; Caclin et al., 2005,Marozeau&deCheveigne, 2007). McAdams et al. (1995) tested a large group of NH listeners (n = 98) with 18 digitally synthesized instruments. The goal of their study was to investigate the physical correlates of the most salient dimensions of timbre. Listeners were asked to make dissimilarity ratings between stimulus pairs. This study indicated that the NHtimbre space can be represented by three dimensions (3D), with each dimension associated with an acoustic feature. The first timbre dimension was highly correlated with the log-attack time of the stimuli and the second dimension was highly correlated with the spectral centroid (i.e., the spectral center of gravity) of the stimuli. The third dimension, however, was only weakly correlated with spectral flux (i.e., the fluctuation of the spectrumover time). Amore recent study by the same group of researchers (Caclin et al., 2005) investigated the psychophysical nature of timbre dimensions by varying individual acoustic properties (i.e., log-attack time, spectral centroid, and spectral flux or spectral irregularity) of harmonic complexes independently. They concluded that when attack time, spectral centroid, and spectral flux were manipulated independently in the stimuli set, the NHtimbre spacewas best fit with a two-dimensional (2D) model. While spectral flux alone contributes to timbre perception, it was not a robust cue for NH listeners to perceive differences in timbre when all three cues were present in the stimuli set. On the other hand, when attack time, spectral centroid, and spectral irregularity (differences in amplitude between adjacent harmonics) were manipulated independently in the stimulus set, the NH timbre space was best fit with a 3D model with one dimension significantly correlated with the attack time, one dimension correlated with the spectral centroid, and one dimension correlated with the spectral irregularity. Based on these results, timbre can be described as a characteristic or quality of sound that depends on both temporal and spectral aspects of sound, both independently and interdependently.

While the relative contribution of different spectral and temporal acoustic features to musical timbre perception in NH listeners is still not fully understood, it has been generally agreed upon that the temporal envelope (e.g., attack time) and spectral envelope (e.g., spectral centroid) are the dominant cues for timbre perception. Previous research has examined CI listeners' ability to discriminate (i.e., measuring just-noticeable difference) independent temporal and spectral acoustic features (attack time and spectral centroid) of the stimuli that contribute to timbre perception and found that CI listeners performed similarly to NH controls (Pressnitzer, Bestel, &Fraysse, 2005). In the present study, we replicated the experimental procedure performed by McAdams et al. (1995) to investigate the relative contribution of temporal and spectral cues to the perception of musical timbre in CI listeners. To our knowledge, our study is the first to derive timbre space in CI listeners. Based on previous findings on the ability of CI listeners to perceive temporal and spectral cues formusic perception (seeMcDermott, 2004; Won, Drennan, Kang, and Rubinstein, 2010 for review), we hypothesized that CI listeners are able to use temporal cues to perceive musical timbre, but their ability to use spectral cues is reduced; thus the timbre space in CI listeners should be different than that obtained from NH listeners.

Method

Listeners

Fifteen NH listeners (4 males, 11 females), ages 19 to 32 years served as a control group. All listeners had hearing thresholds no greater than 20 dBHLfrom 250 to 8000 Hz bilaterally. One listener had extensive musical training for over 15 years, one received some training learning the piano as a child, and the remaining listeners did not have any formal musical training.

Eight CI listeners (C1-C8, 5 males, 3 females), ages 15 to 63 years (mean = 36.75 years) participated in the study. Table 1 shows detailed demographic information for each listener, including age, onset of hearing loss, etiology of hearing loss, duration of severe-to-profound hearing loss prior to implantation, the CI processor used, and phoneme(consonant and vowel) identification scores. Half of the listeners were under the age of 30, close to the age range of the NH listeners. The remaining listeners were in the age range from 46 to 63 years old. All listeners, except for C1, were prelingually or perilingually hardof- hearing bilaterally. For these listeners, hearing loss was progressive from mild to severe-to-profound in three listeners (C4, C5, C8). The other four listeners had a severe hearing loss at birth or at a very young age (C2, C3, C6, C7). Three listeners (C1, C5, C6) used a hearing aid (HA) in the nonimplanted ear. Subject C8 was implanted in both ears at the time of the study, and the ear that received the first implant, which also yielded better speech recognition, was tested in this study. This listener was implanted with a five-channel Ineraid device and used a Geneva processor in the ear that was tested in this experiment. None of the CI listeners received formal musical training.

Phoneme recognition was evaluated on each CI listener as part of our overall assessment routines. Due to time constraints, listener C1 was only tested with consonant recognition and listener C3 was only tested with vowel recognition. Consonant recognition consisted of 16 consonants ... recorded by threemale and three female talkers (Shannon, Jensvold, Padilla, Robert, &Wang, 1999) in the /aCa/ context.Vowel recognition consisted of ninemonophthongs ... in the /hVd/ context recorded from three male and three female talkers in our laboratory. Nine blocks of testing were performed on each listener for each task, yielding a total of 54 trials per stimulus per task per listener, except for listener C1 who was only tested with a total of 42 trials per stimulus per task, due to time constraints. In our subject group, consonant and vowel identification scores ranged from39-92%(M= 60%) and 60-90% (M = 76%), respectively (see Table 1). This range of performance indicates that our sample represents a typical CI population (see Wilson &Dorman, 2008).

Stimuli

The stimuli were the digitally synthesized musical instruments used in McAdams et al. (1995), which were developed by Wessel, Bristow, and Settel (1987). These sounds were synthesized on a Yamaha TX802 FM Tone Generator. In order to reduce the session duration, only 16 out of the original 18 stimuli were selected. These 16 stimuli were bassoon (bsn), English horn (ehn), guitar (gtr), guitarnet (gtn), harpsichord (hcd), French horn (hrn), harp (hrp), obochord (obc), piano (pno), striano (sno), bowed string (stg), trombone (tbn), trumpar (tpr), trumpet (tpt), vibrone (vbn), and vibraphone (vbs). Eleven of the instruments were designed to imitate traditional western instruments (e.g., piano, guitar) and five were hybrids of two instruments (e.g., vibrone) to contain the perceptual characteristics of both instruments (see Table 2 and descriptions in McAdams et al., 1995). The hybrid instruments were designed by McAdams et al. (1995) to investigate if an instrument that is physically a mixture of two other instruments will appear in the perceptual space located somewhere between the two instruments of which it is composed. All stimuli had the same fundamental frequency (F0) 311 Hz (E-flat 4). The durations of these sounds ranged from 495 ms to 1096 ms. According to McAdams et al. (1995), these physical differences in duration across stimuli were required to produce similar perceptual duration for NH listeners. The stimuli were scaled to have equal maximum level. This specific set of stimuli was selected for the present study because it was tested extensively with NH listeners. In order to validate our derived timbre space, it was important to use the same stimuli and methods to facilitate comparisons with previous studies.

Procedure

All listeners were tested in a double-walled soundattenuating booth (8¶6µ ×8¶6µ). Stimuli were presented from a loudspeaker (M-Audio Studiophile BX8a Deluxe) one meter in front of the listeners. This loudspeaker has flat frequency response (±2 dB) from 40 to 22000 Hz. First, each listener was asked to adjust the level of individual sounds at their most comfortable listening level for equal loudness. During the loudness-balancing procedure, the bassoon stimulus was chosen as the reference sound and the listeners were asked to adjust the level of this sound to reach their most comfortable listening level. Once the level of this reference sound was determined, the listeners then adjusted the level of the rest of the stimuli to match the loudness of this reference sound. After the adjustment for each individual stimulus, the listeners played the sounds one at a time and made further adjustments as necessary if any of the stimuli sounded noticeably louder or softer than the rest. Thus, the presentational levels were different for different stimuli and for different listeners. Cochlear-implant listeners used their own normal CI settings during the entire experiment. Those who wore a hearing aid in the nonimplanted ear (C1, C5, C6) or those who had two CIs (C8) were instructed to turn off their HA but leave their ear-mold in place in that ear, or to turn off the nontest implant. A foam earplug was inserted in the implanted ear(s) or in the nonimplanted ear for non-HA users during testing to prevent any potential acoustic stimulation in case residual hearing was preserved.

Prior to the experiment, each listener was instructed that the goal of the study was to estimate the similarity of sound quality between sounds. They were told that each sound used in the experimentwas the same musical note and that the loudness should be roughly the same across sounds given that they already adjusted the level of each sound to produce equal loudness prior to the experiment.

For the experiment, listeners were first familiarized with the 16 stimuli by listening to each stimulus one at a time as many times as they wanted. Subsequently, all possible pairs of the 16 stimuli (16 ×16 = 256 pairs) were presented in random order. Subjects were instructed to judge the dissimilarity of the two sounds in each pair by adjusting the sliding bar on a computer screen. The sliding bar was marked with numbers from 1 to 10 in steps of 1, and with labels most similar next to the number 1 and most different next to the number 10. Subjects were encouraged to use the whole range of the scale. For each trial, listeners could play the pair as many times as they wanted before making a dissimilarity rating. Each listener was allowed to take a break at any time during the experiment. Before data collection, each listener received a training session that consisted of 20 randomly selected pairs to ensure that they understood the task and to practice making the dissimilarity rating. Each NH listener performed the experiment once and each CI listener performed the experiment two or three times depending on the availability of the listener. Overall, each pair of stimuli was rated 30 times by theNHgroup and 42 times by the CI group.

Acoustical Analyses

One of the goals of this study was to investigate the psychophysical nature of the dimensions of the CI timbre space. To achieve this goal, we performed acoustical analyses on the 16 stimuli used in this study, based on the descriptions in Krumhansl (1989), Krimphoff et al. (1994), McAdams et al. (1995), and Peeters, McAdams, &Herrera (2000) for harmonic signals, and mathematical formulae (see Appendix) provided by Peeters (2004). These analyses were performed to examine the following temporal and spectral characteristics of the stimuli, which have been shown in various reports (Krimphoff et al., 1994; McAdams et al., 1995; Marozeau et al., 2003) to contribute to the perception of timbre using the stimuli employed in this study:

* Log-Attack Time: Defined as the logarithm of the duration from the time at which the amplitude of the stimulus reaches its threshold (i.e., 10% of its maximum value in our calculation) to the time at which the amplitude reaches its maximum.
* Spectral Centroid: defined as the spectral center of gravity, which is calculated as the amplitude weighted mean of the harmonic peaks averaged over the sound duration.
* Spectral Spread: defined as the spread of the spectrum around its means, which is calculated as the amplitude weighted standard deviation of the harmonic peaks averaged over the sound duration.

* Spectral Flux: defined as the amount of variation of spectrum over time, which is calculated as the normalized cross-correlation between the amplitude spectra of two successive time frames.
* Spectral Irregularity: defined as the deviation of the amplitude harmonic peaks from a global spectral envelope derived from a running mean of the amplitude of three adjacent harmonics averaged over the sound duration.

In addition, the temporal feature, impulsiveness, and the spectral features, spectral centroid and spectral spread of the stimuli were computed using a perceptual-based model described by Marozeau et al. (2003). In this model, impulsiveness is calculated as one minus the ratio that is defined as the duration during which the smoothed power (instantaneous power smoothed by convolution with a 3.2-ms square window) is above 50% of its maximumvalue divided by the duration forwhich the smoothed power is above 10%. Spectral centroid and spectral spread are defined the same as above, but this computation took into account middle-ear filtering and the logarithmic band conversion to the spectrum, bymimicking the perceptual critical bands. The details of these computations can be found in Marozeau et al. (2003).

While log-attack time and impulsiveness represent the temporal characteristics (temporal envelope in particular) of the stimuli, the rest represent the spectral characteristics. The spectral information can be further divided into two categories: spectral envelope and spectral fine structure. The spectral centroid and spectral spread categorize the overall spectral shape (i.e., spectral envelope) of the stimuli averaged over time. On the other hand, the spectral irregularity (spectral fine structure) describes the relationship between individual harmonics and the global spectral envelope. Thus, in order to use this cue to perceive timbre, listeners will need to have the ability to encode the variations of amplitude between neighboring harmonics. The last acoustic parameter, spectral flux, categorizes the change of the overall spectrum over time and can be categorized as a spectrotemporal parameter.

Results

NH Timbre Space and Acoustic Correlates

The dissimilarity matrices from 15 NH listeners were analyzed using a weighted Euclidean model - Individual Differences MDS (INDSCAL) analysis (Carroll &Chang, 1970) in SPSS version 17.0. In this model, the salience of each resulting dimension in the perceptual map is weighted differently for each listener. The dissimilarity matrices were first examined in different numbers of dimensions for interpretation. The stress (a goodness-of-fit measure for MDS analysis) was calculated as a function of number of dimensions, from two to five. The goodness of fit can be evaluated by a measure of stress, which will decrease with the number of dimensions. An optimal fit is usually indicated by the presence of a kneepoint in the stress function. Our results show a decrease in stress as the number of dimensions increased, but no clear kneepoint was identified. Subsequently, we fit the data with a 3D solution based on previous experiments with the samestimuli (Krumhansl, 1989;McAdams et al., 1995). The 3D timbre perceptual map is shown in Figure 1. This map displays the relatively dissimilarity distance among the 16 stimuli used in the experiment. The overall weight for each dimension was derived from the INDSCAL analysis. Dim 1 received the greatest weight (.29) followed, by Dim 2 (.12) and Dim 3 (.10), which received weights of about one-half and one-third of that of Dim 1, respectively. These weights indicate the relative saliency of each perceptual dimension to the perception of timbre-the higher the weight, the more salient the perceptual dimension.

Results from the acoustical analyses on each of the temporal and spectral acoustic parameters described above were used to correlate with the coordinates of the 16 stimuli for each of the MDS dimensions for the 3D solutions provided by the INDSCAL analysis (Table 3). This was done to determine the psychophysical nature of each dimension. Due to the fact that some of the acoustical parameters are significantly correlated with each other in our stimuli (e.g., spectral centroid and spectral spread are significantly correlated, $r = .58$, $p = .02$) and the number of correlations examined, an a level of .01 was selected for all correlational analyses between perceptual dimensions and acoustic parameters. This value helps to reduce the chances of overinterpretation of weak correlations when the selected acoustic parameters merely covary with the true underlying parameters

(e.g., see discussion in Caclin et al., 2005).

Dimension 1 (Dim 1) was found significantly correlated with log-attack time (temporal envelope cue; r = .79, p ≤.0005); Dim 2 was significantly correlated with spectral centroid (spectral envelope cue) (r = .82, p ≤.0001); and Dim 3 was significantly correlated with spectral irregularity (spectral fine structure) (r = .60, p ≤.01). Spectral flux was not correlated (p >.05) with any of the dimensions. It isworth noting that the spectral spreadwas also significantly correlated with Dim 1 (r = -.64, p ≤.01), which seems surprising given that Dim 1 was strongly correlated with the temporal characteristics of the stimuli (log-attack time) and that it has been repeatedly reported in the literature that one of the dimensions in a 3D timbre space is a temporal dimension. Careful examination of the stimuli and the acoustic parameters revealed that spectral spread covaried to some extent with the temporal envelope of the stimuli, such as the impulsiveness of the sound (r = -.55, p ≤.05) and that the impulsiveness feature was highly correlated with Dim 1 (r = .83, p ≤.001). Other spectral parameters- spectral centroid, spectral irregularity, and spectral flux- were not correlated with the temporal envelope of the stimuli nor were they correlated with each other.

Patterns of results remained the samewhen the temporal and spectral acoustic parameters were computed with the perceptual-based model described by Marozeau et al. (2003). Figure 2 displays the relationships between the physical dimension and the perceptual timbre dimension that best represents the acoustic parameter. The solid line on some of the panels represents a regression line indicating significant correlation between the acoustic parameter and the perceptual dimension.

CI Timbre Space and Acoustic Correlates

MDS analyses were performed for CI group data using INDSCAL analysis and for individual listeners using the traditional MDSCAL procedure, implemented in MATLAB (R2009a) according to the scaling-by-majorizinga-complicated-function (SMACOF) algorithm (Borg &Groenen, 1997). For individual listeners, an average dissimilarity matrix was created by averaging the matrices from different runs (2-3 runs depending on the listener) and by folding the matrix (e.g., the pair gtn-tpt was averaged with the pair tpt-gtn) resulting in four to six estimations per pair of instruments.MDSCAL analysis was then performed on the averaged, folded matrix for each listener.

For the CI group data, the INDSCAL analysis showed no clear kneepoint in the stress function relative to the number of dimensions. Thus, a CI timbre space map was derived using a 3D solution. Similar to NH data, the overall weight was the highest for Dim 1 (.35), followed by Dim 2 (.12) and Dim 3 (.11), suggesting that similar to their NH counterparts, CI listeners relied greatly on the temporal envelope cues to perceive timbre.Unlike the NH results, in which each of the three MDS dimensions associated with one or two acoustic features, Dim 2 and Dim 3 in the CI 3D space did not significantly correlate with any of the temporal or spectral parameters under investigation. The temporal envelope feature log-attack time was strongly correlated withDim 1 (r = .88, p≤.0001; see Table 4). The spectral envelope and fine structure features, however, did not significantly correlate with any of the perceptual dimensions. These patterns of results differed considerably from those obtained in NH listeners, which suggests that the spectral cues are less salient or reliable cues to CI listeners than to NH listeners for timbre perception. In order to further investigate the psychophysical relations, the CI group data was fit with a 2D solution. In this 2D solution: (1) Dim 1 was strongly and significantly correlated (r = .88, p ≤.001) with logattack time; (2) Dim 2 was significantly correlated with spectral centroid (r = .62, p ≤.01). The overall weight for Dim 1 (.40) was considerably higher than that for Dim 2 (.17), suggesting that perceptual salience was higher for temporal envelope than for spectral envelope cues for CI listeners. (See Table 5 for perceptual weights for individual listeners.) It is noted that the correlation between spectral centroid and Dim 2 improved from .50 in the 3D solution to .62 in the 2D solution, whereas the strength of correlation between log-attack time and Dim 1 remained unchanged in the 2D solution. This shows that the fit of the model to the relevant acoustic parameters was enhanced by reducing the number of dimensions to 2D.

We then performed MDS analysis on individual CI data, using the MDSCAL model. Half of the listeners (C2, C4,

C6,C8) showed a clear kneepoint for 2 dimensions and the other half (C1, C3, C5, C7) did not show a clear kneepoint. Preliminary analyses using a 3D solution for the four CI listeners who did not exhibit a clear kneepoint, showed a lack of psychophysical correlates with the third dimension, and their patterns of results were similar to the CI group data. We subsequently fit the data with a 2D model for all CI listeners. In the 2D solution after procrustean rotation toward the overall INDSCAL solution for the CI group data, one of the dimensions significantly ($p \leq .01$) correlatedwith log-attack time for almost all subjects, except for C7 (see Table 6 for individual data). The other dimensionwas significantly correlated with the spectral envelope parameters (spectral centroid or spectral spread) in only three listeners (C3: Dim 2 and spectral centroid; C6: Dim 2 and spectral spread; C7: Dim 1 and spectral spread). The significant correlation between Dim 1 and spectral spread for listener C7 and lack of correlation with any temporal parameters (e.g., log-attack time and impulsiveness), suggests that Dim 1 is a spectral dimension for this listener. Dim 2 for listener C6, which was significantly correlated with spectral spread, was also significantly correlated with impulsiveness ($r = .69$, $p \leq .005$). Given that spectral spread and impulsiveness covary, Dim 2 could be also a temporal dimension for C6.Twolisteners (C1,C2) showed significant correlation between Dim 2 and spectral irregularity. The remaining three listeners (C4, C5, and C8) did not show any significant correlation betweenDim2 and any of the spectral parameters, suggesting that these three listeners relied mainly on temporal envelope cues to perceive timbre differences.
In summary, CI data were best described in a 2D perceptual model with one dimension representing the temporal envelope characteristic and the other dimension representing the spectral characteristic of the stimuli. With only one exception (C7), all CI listeners showed significant correlation between one dimension and the log-attack time. Only half of the listeners showed significant correlation between the one dimension and spectral parameters. It is noted that while the strength of correlation with log-attack time was strong and comparable between NH and CI listeners, correlation with spectral envelope was considerably lower in CI group data ($r = .62$) compared to NH listeners ($r = .82$), suggesting that spectral envelope cues were less reliable or salient in the CI group.
Figure 3 left panels show the 2D space for the CI group data (see Figure 3a) and the acoustic correlates to each dimension (see Figures 3b-3e). It is apparent that the correlation between Dim 1 and log-attack time is considerably higher than the correlation between Dim 2 and spectral centroid. The right panels show the 2D space (see Figure 3f) and the acoustic correlates (or lack of) for each perceptual dimension (see Figures 3g-3j) for one listener to illustrate that some CI listeners (e.g., C8 in Figure 3, right panels) relied primarily on the temporal envelope cues to perceive differences in timbre, while others (e.g., the CI group data in Figure 3 left panels) used temporal and spectral envelope cues for timbre perception. It is clear in this figure that the perceptual distance between stimuli inDim 2 was very small for listener C8 compared to the NH and CI group space.

Discussion

NH Timbre Space and Acoustic Correlates

Our results show that NH listeners used temporal envelope, spectral envelope, and spectral fine structure cues to perceive differences in musical timbre, consistent with previous findings (Krimphoff et al., 1994; Caclin et al., 2005). The third dimension, however, did not correlate with the acoustic parameter spectral flux, which was reported byMcAdamset al. (1995). It should be noted that although spectral flux was significantly correlated with Dim 3 in McAdams et al., the correlation was weak ($r = .54$). OurNHDim 3 was significantly correlated with spectral irregularity, consistent with results reported by Krimphoff et al. (1994). This difference between our results and McAdams et al.'s results could be due to a number of factors, including: (a) the use of a loudspeaker in this study instead of headphones; (b) the number of stimuli used (16 stimuli in this study as opposed to 18 stimuli in McAdams et al.); and (c) differences in analysis models (INDSCAL in this study and CLASCAL in McAdams et al.). Indeed, the lack of correlation between Dim 3 and spectral flux was also found recently by McAdams and colleagues in Caclin et al. (2005). Caclin et al. found that an MDS 2D solution provided a better

fit to their dissimilarity data and spectral flux was not correlated with any of the perceptual dimensions when attack time, spectral centroid, and spectral flux were the varying parameters in the stimuli set. They concluded that this could be due to the fact that their model of spectral flux is not perceptually relevant, or spectral flux is a less salient parameter than the other two (log-attack time and spectral centroid).

Temporal and Spectral Cues for Timbre Perception in CI Listeners

UnlikeNHresults, CI results were best represented in a 2D timbre space. The reduced number of dimensions for CI listeners could be interpreted in the followingways: (a) the relative significance of temporal and spectral cues to timbre perception is different between NH and CI listeners or (b) CI listeners may not have detected smaller perceptual differences between instruments, particularly in the spectral domain. In general, one of the perceptual dimensions in the CI 2D space can be regarded as a temporal dimension in which this perceptual dimension was highly correlated with the temporal envelope characteristics of the stimuli. The other dimension can be considered a spectral dimension, which was correlated with the spectral envelope characteristics of the stimuli. However, the weak or lack of correlation between spectral centroid/spectral irregularity and the second dimension in the CI group data suggests that the spectral cues were less reliable cues for timbre perception in CI listeners compared with their NH counterparts. Indeed, the patterns of results in the CI group data are supported by the findings from individual CI listeners, where only half of the CI listeners showed significant correlation between a perceptual dimension and spectral envelope and spectral fine structure parameters. The other half of the listeners, on the other hand, relied mainly on temporal envelope cues to perceive differences inmusical timbre.

The contribution of temporal and spectral envelope cues formusical timbre perception has also been reported previously (Gfeller et al., 1998; Gfeller,Witt,Woodworth, et al., 2002;Gfeller,Witt,Adamek, et al., 2002; McDermott, 2004; Pressnitzer et al., 2005).McDermott (2004) showed a confusion matrix from a group of CI listeners tested on a musical instrument identification task. The 16 instruments used in the study were categorized into two groups: nonpercussive single instrument and percussive single instrument. They found that more confusions were made among the instruments within the same category (i.e., percussive or nonpercussive) than between categories. Based on these patterns of confusions, they concluded that temporal envelope cues are salient cues for musical timbre perception. Pressnitzer et al. (2005) created bandpass-filtered harmonic complexes that varied in the attack time and spectral centroid independently to obtain just-noticeable difference (JND) measures from a group of CI listeners. They reported that performance was good for both attack time and spectral centroid discrimination tasks, suggesting that temporal and spectral envelope cues contributed to timbre perception in CI listeners. Unlike Pressnitzer et al.'s study, we derived timbre space and investigated the relative salience of cues for timbre perception for CI listeners. The fact that CI listeners were able to discriminate differences in spectral centroid, as reported in Pressnitzer et al. (2005), did not necessarily imply that the spectral centroid cue is a reliable or salient cue for timbre perception in CI listeners, especially when other cues (e.g., temporal envelope cues) are also available in the stimulus set. Although our findings were consistent with previous reports on musical instrument identification task, it is unclear if the patterns of results in this study can generalize to stimuli that have higher F0s. At higher F0s, the spacing between harmonics is larger, resulting in harmonics encoded in different CI channels that are farther apart compared to stimuli with lower F0s. This would affect the degree of reliability and saliency of spectral cues for timbre and pitch perception in CI listeners. Singh, Kong, and Zeng (2009) found that melody recognition improved when the set of stimuli was in a higher frequency range compared to the lower frequency ranges. In addition, Gfeller, Witt, Woodworth, et al. (2002) reported significant differences in the perception of timbre at different frequency ranges.

Unlike pitch perception, forwhich temporal and spectral envelope cues elicit only nonsalient pitch, temporal and spectral envelope cues are robust for musical timbre perception (McAdams et al., 1995). This difference could explain the relatively good performance (40-60%) in musical instrument identification compared to the close-

tochance- level performance for melody recognition in the CI listeners when the frequency difference between notes was a few semitones (see McDermot, 2004; Kong et al., 2004), due to mis- or under-representation of temporal and/or spectral fine structure cues. The reduced ability of CI listeners to utilize the fine structure cues could be attributed to both biological and device-related factors, including: electrode-to-frequencymismatch, reduced number of neural survivals resulted fromlong-duration of deafness, and the removal of fine structure of the acoustic signals in the current envelope-based speech processing strategies.

Timbre and Speech Perception in Electric Hearing

Based on the fact that the temporal and spectral envelopes contribute considerably to both speech (Shannan, Zeng, Kamath, Wygonski, &Ekelid, 1995) and timbre perception, the relationship in performance between these two measures warrants some discussion. Particularly, in quiet, consonant recognition relies heavily on temporal envelope cues and vowel recognition requires coarse spectral representation. The relationship between speech recognition and timbre perception has been investigated previously. Kang et al. (2009) found a significant correlation between consonant-nucleus-consonant (CNC) word recognition (both in quiet and in noise) andmusical instrument identification scores in a large group of CI listeners (n = 42). Gfeller et al. (1998), on the other hand, showed a lack of association between musical instrument identification scores and speech recognition scores in a group of 28 CI listeners.

In this study, we obtained consonant and vowel recognition scores (see results in Table 1) from each CI listener. Correlational analyses were performed between phoneme recognition scores and the correlation values of log-attack time with Dim 1 (temporal dimension), and correlation values of spectral centroid with Dim 2 (spectral dimension). Similar to the findings reported by Gfeller et al. (1998), we also found no significant correlation ($p > .05$) between phoneme (consonant and vowel) recognition and timbre perception on the temporal or spectral dimension. That is, listeners who achieved high levels of speech recognition (>80%) were not necessarily able to use temporal (e.g., C7) or spectral (e.g., C6) envelope cues to perceive timbre differences. In addition, the lack of correlation between timbre and speech perception in our study was consistent with the absence of relationship between rhythmic pattern recognition, melody recognition, and speech recognition reported previously (e.g., Kong et al., 2004). However, the difference between the findings in Kang et al. (2009), which showed a significant correlation between instrument identification and speech recognition, and the findings in this study could be attributed to (a) the small sample size in our data; and (b) differences in stimuli (both speech and musical) and tasks (subjective distance vs. identification).

Conclusions

The present study was designed to investigate timbre perception ability in CI listeners and to derive musical timbre space from CI listeners. This space was examined for correlations with known acoustic parameters that contribute to musical timbre perception as reported in the literature. Results showed that CI listeners, unlike their NH counterparts, were less able to use spectral cues to distinguish differences in musical timbre. In addition, no reliable relationship was found between phoneme recognition and the salience of temporal and spectral cues for timbre perception in our CI listeners.

Although we have demonstrated that CI listeners can use temporal and spectral envelope cues for timbre perception, it is still unclear how their ability to perceive differences in musical timbre affects their perception of the "pleasantness," "naturalness," "richness," or other perceptual descriptors of sounds. In order to bridge between the present work and these perceptual characteristics, future studies could examine the relationship between timbre space and subjective ratings or appraisal of sound quality.

Acknowledgments

We gratefully acknowledge the support provided by National Institute on Deafness and Other Communication Disorders Grant R03 DC009684-02 to the first author and Northeastern University Provost Faculty Development Research Grant to the first and fourth authors.We are grateful to all listeners for their participation in the experiment. We would like to thank Professor Stephen McAdams for providing the stimuli.

Sidebar

Temporal and Spectral Cues for Musical Timbre Perception in Electric Hearing
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J Speech Lang Hear Res 2011;54;981-994; originally published online Nov 8, 2010; DOI: 10.1044/1092-4388(2010/10-0196)

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Editor: Robert Schlauch
Associate Editor: Christopher Turner
Received July 14, 2010
Accepted October 15, 2010
DOI: 10.1044/1092-4388(2010/10-0196)
Appendix
(ProQuest: Appendix omitted.)

Publication date: Jun 1, 2011

Year: 2011

Audiotactile interactions in temporal perception

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Publication info: Psychonomic Bulletin & Review 18.3 (Jun 2011): 429-54.
ProQuest document link

Abstract: In the present review, we focus on how commonalities in the ontogenetic development of the auditory and tactile sensory systems may inform the interplay between these signals in the temporal domain. In particular, we describe the results of behavioral studies that have investigated temporal resolution (in temporal order, synchrony/asynchrony, and simultaneity judgment tasks), as well as temporal numerosity perception, and similarities in the perception of frequency across touch and hearing. The evidence reviewed here highlights features of audiotactile temporal perception that are distinctive from those seen for other pairings of sensory modalities. For instance, audiotactile interactions are characterized in certain tasks (e.g., temporal numerosity judgments) by a more balanced reciprocal influence than are other modality pairings. Moreover, relative spatial position plays a different role in the temporal order and temporal recalibration processes for audiotactile stimulus pairings than for other modality pairings. The effect exerted by both the spatial arrangement of stimuli and attention on temporal order judgments is described. Moreover, a number of audiotactile interactions occurring during sensory-motor synchronization are highlighted. We also look at the audiotactile perception of rhythm and how it may be affected by musical training. The differences emerging from this body of research highlight the need for more extensive investigation into audiotactile temporal interactions. We conclude with a brief overview of some of the key issues deserving of further research in this area. [PUBLICATION ABSTRACT]

Full text: Headnote
Abstract In the present review, we focus on how commonalities in the ontogenetic development of the auditory and tactile sensory systems may inform the interplay between these signals in the temporal domain. In particular, we describe the results of behavioral studies that have investigated temporal resolution (in temporal order, synchrony/asynchrony, and simultaneity judgment tasks), as well as temporal numerosity perception, and similarities in the perception of frequency across touch and hearing. The evidence reviewed here highlights

features of audiotactile temporal perception that are distinctive from those seen for other pairings of sensory modalities. For instance, audiotactile interactions are characterized in certain tasks (e.g., temporal numerosity judgments) by a more balanced reciprocal influence than are other modality pairings. Moreover, relative spatial position plays a different role in the temporal order and temporal recalibration processes for audiotactile stimulus pairings than for other modality pairings. The effect exerted by both the spatial arrangement of stimuli and attention on temporal order judgments is described. Moreover, a number of audiotactile interactions occurring during sensory-motor synchronization are highlighted. We also look at the audiotactile perception of rhythm and how it may be affected by musical training. The differences emerging from this body of research highlight the need for more extensive investigation into audiotactile temporal interactions. We conclude with a brief overview of some of the key issues deserving of further research in this area.

Keywords Auditory . Tactile . Temporal . Frequency . Audiotactile . Crossmodal similarities . Mechanoreception . Multisensory

The boundaries between hearing and touch: the foundation of an analogy

We continuously interact with environments that provide a large amount of multisensory information to our various senses. Researchers have now convincingly demonstrated that the inputs delivered by the different sensory channels tend to be bound together by the brain (see the section Research on hearing and touch: a multisensory perspective for a fuller discussion of this topic). Unlike the audiovisual and visuotactile sensory pairings, those interactions taking place at both the neuronal and behavioral level between audition and touch have, to date, been explored in far less detail (see Kitagawa &Spence, 2006; Soto-Faraco &Deco, 2009, for reviews of the extant literature). The paucity of research covering this modality pairing is rather surprising when one considers the wide range of everyday situations in which we experience-even though often in subtle and unconscious ways-the interplay between these two senses. Examples include perceiving the "auditory" buzzing and the itchy "tactile" sensation of an insect landing on the back of our neck; reaching for a mobile phone ringing and vibrating in our pocket. What is common to these situations is the exclusive-or, at the very least, predominant-reliance on cues provided by the nonvisual spatial senses. In addition to these anecdotal reports, there is a growing body of empirical evidence demonstrating the existence of important similarities between the senses of hearing and touch (e.g., Soto-Faraco &Deco, 2009).

In his pioneering early work, von Békésy (1955, 1957, 1959) drew a number of parallels between the senses of audition and touch, which turned out to be so close as to lead him to consider the sense of touch as constituting a reliable model for the study of functional features of audition. For instance, von Békésy (1955) noted that audition and vibrotaction are analogous with regard to the level of the encoding mechanisms at their respective receptor surfaces. Indeed, both the basilar membrane of the inner ear and the mechanoreceptors embedded in the skin respond to the same type of physical energy-namely,mechanical pressure having a specific vibratory rate (e.g., either touching the surface of the skin with a vibrating body or stimulating the stapes footplate of the ear determines the propagation of travelling waves; von Békésy, 1959; cf. Nicolson, 2005).

The analogies in the physiological mechanisms (see Corey, 2003; Gillespie &Müller, 2009) underlying vibrotactile and auditory perception are likely rooted in the common origins of these two sensory systems (see Soto-Faraco &Deco, 2009; and von Békésy, 1959, for reviews). From this particular point of view, many pieces of evidence might be informative with regard to the existence of favored links between hearing and touch, in both animals (e.g., Bleckmann, 2008; Peck, 1994; Popper, 2000) and humans (Marks, 1983; von Békésy, 1959). The onset of function within the systems involved in sensory processing occurs in the following order: from the somesthetic and vestibular modalities to the chemosensory (oral and nasal), the auditory, and lastly, the visual modalities (see Gottlieb, 1971; Lickliter, 2000; Lickliter &Bahrick, 2000; see also Lagercrantz &Changeux, 2009; see Fig. 1).

The order in which the modality-specific as well as multisensory neurons in the anterior ectosylvian sulcus emerge also follows a precise time course, from tactile responsive to auditory responsive, and finally, to visually

responsive neurons (Wallace, Carriere, Perrault, Vaughan, &Stein, 2006). Therefore, one cannot rule out the possibility that the line of development of the different sensory systems might not have some effect upon the successive strength, direction, and amount of reciprocal connections between them (e.g., Gregory, 1967; Katsuki, 1965; Lickliter &Bahrick, 2000).

Although the assessment of the nature of the stimulation that takes place during prenatal life, as well as the responsivity of the fetus to such stimulation, is problematic, the human fetus has been shown to respond to simultaneous stimulation in different sensory modalities since very early in development (e.g., Kisilevsky, Muir, &Low, 1992). Interestingly, the responses of the human fetus-as measured by heart rate and body movements-show an increase when stimulation is both vibratory and auditory as compared with when stimulation occurs in just one sensory modality in isolation (cf. Kisilevsky &Muir, 1991). Moreover, since the responsivity to vibroacoustic stimulation follows a specific maturational time line across gestation (Hoh, Park, Cha, &Park, 2009), any perturbation of the pattern of responses elicited by this kind of stimulation is thought to have a relevant diagnostic function during complicated pregnancies (D'Elia, Pighetti, Vanacore, Fabbrocini, &Arpaia, 2005; Morokuma et al., 2004). It is plausible that the presentation of stimuli in close temporal proximity could support the deployment during later development of the favored processing of specific co-occurring crossmodal sensory inputs (see Lecaunet &Schaal, 1996). Moreover, since the human fetus can respond to vibrotactile and acoustic information by the third trimester (Kisilevsky, 1995), whereas visual information is not fully transduced prior to birth, it is likely that crossmodal temporal synchrony is primarily experienced for the pairing of somatosensory and auditory signals (Lewkowicz, 2000).

The evidence emerging from embryology research is related with the commonality of some physical properties which, according to von Békésy (1959), are shared between audition and touch, such as pitch, loudness, volume, roughness, distance, on-and-off effects, and rhythm. For instance, in one experiment, participants were presented with a pair of clicks (one to either ear, separated by a variable time interval). As the time difference was increased from zero, the sound seemed to travel from one side of the participant's head to the other (i.e., with a leftward or rightward direction), and the participants were asked to point to the direction from which the sound seemed to come. In certain conditions, air pulses were presented across the participant's forehead. By adjusting the magnitude and timing of either auditory clicks or spatially coincident air-puffs so that the skin sensations matched the sensations produced by the acoustic clicks as closely as possible, von Békésy (1959) succeeded in demonstrating that observers found it very difficult to phenomenologically discriminate between auditory and tactile stimuli when they appeared to come from the same direction. This result points to the existence of remarkable analogies-at least under certain specific conditions of stimulus presentation- between the two senses, which could also possibly reflect how the signals from these two sensory modalities interact, at both the neural and behavioral levels.

In this review, a multisensory perspective will be adopted in order to provide an overview of those behavioral studies that have investigated interactions between auditory and tactile stimuli. The focus will be on the audiotactile interactions occurring within the temporal domain. Interest in temporal perception, both theoretical (e.g., Crystal, 2009; Droit-Volet &Gil, 2009; Gibbon, 1977; Glicksohn, 2001; Pöppel, 1997; Wittmann, 2009) and experimental (e.g., Grondin, 2010; Mauk &Buonomano, 2004), has been growing rapidly amongst the scientific community in recent years. According to certain authors, the emerging data are now consistent with humans having an amodal representation of time, one that is shared among different sensory modalities (cf. van Wassenhove, 2009). The remarks provided by van Wassenhove, though intriguing, are however currently confined to the auditory and visual modality pairing. In the present review, our aim has been to provide complementary coverage of the crossmodal nature of temporal perception by focusing on the audiotactile stimulus pairing instead.

Research on hearing and touch: a multisensory perspective

The process by which the human nervous system merges the available information into unique perceptual

events is commonly known as multisensory integration (see Calvert, Spence, &Stein, 2004, for a review). Operationally, multisensory integration has been defined at the neuronal level as "a statistically significant difference between the number of impulses evoked by a crossmodal combination of stimuli and the number evoked by the most effective of these stimuli individually" ("multisensory enhancement;" Stein &Stanford, 2008, p. 255). This principle has been derived from a large body of studies conducted on the activity of neurons in the superior colliculus (SC), a midbrain structure involved in orienting behaviors. The specificity of this structure lies in the fact that it receives unisensory inputs from vision, touch, and audition (Rowland &Stein, 2008; see Stein &Meredith, 1993, for a review). On the basis of the available neurophysiological evidence, it is known that the processes by which the inputs delivered by different sensory pathways (e.g., visual, auditory, and somatosensory) are integrated are strongly affected by the spatial attributes of stimulation (this is known as the "spatial rule of multisensory integration;" Rowland &Stein, 2008; Stein &Stanford, 2008). Multisensory neurons have multiple excitatory receptive fields (RFs), one for each modality they are responsive to. Interestingly, the RFs of different sensory modalities overlap spatially (i.e., they are in approximate spatial register). Because of this characteristic, if multisensory inputs converge in this overlapping area, as when they originate from the same (or at least proximal) spatial locations, they can sometimes result in an enhancement of the neuronal response. If, on the other hand, the stimuli derive fromspatially disparate locations, one of the stimuli may well fall within the inhibitory region of the neuron, thus determining a response depression. Moreover, multisensory enhancement is typically inversely related to the effectiveness of the single signals to be merged (this is known as the "law of inverse effectiveness;" Rowland &Stein, 2008; Stein &Stanford, 2008).

Particularly interesting in the present context, however, is the so-called "temporal rule of multisensory integration" (e.g., Calvert et al., 2004; Stein &Meredith, 1993; Stein &Stanford, 2008). Namely, only stimuli that occur in close temporal register (and hence that likely originate from the same event) result in response enhancement (i.e., evoke a rate of impulse firing that is significantly higher than the number of impulses evoked by the most effective of these stimuli when presented individually). Typically, the window of temporal tuning of multisensory neurons is a few tens to hundreds of milliseconds wide, with an optimal integration window estimated at approximately 250 ms (Meredith, Nemitz, &Stein, 1987). By contrast, stimuli separated in time just induce responses that are comparable to those evoked by unisensory stimuli (e.g., Beauchamp, 2005; Meredith et al., 1987; see also Kayser &Logothetis, 2007; van Wassenhove, 2009).

Along with the spatial rule and the law of inverse effectiveness, the temporal rule represents a core principle for the neural sensory integration processes and would possibly suggest a functional link between neuronal activity and the behavioral benefits of multisensory integration (see Holmes &Spence, 2005; Stein &Meredith, 1993; though see Holmes, 2007, 2009). Indeed, it has recently been demonstrated that multisensory integration yields a shortening of the latency between the stimulus arrival and the response elicited in an SC neuron (Rowland, Quessy, Stanford, &Stein, 2007). This very early effect parallels the so-called "initial response enhancement," according to which the response enhancement is largest at the beginning of the response (Rowland &Stein, 2008). Both of these neuronal effects trigger and speed up the process by which crossmodal sources of information are integrated as soon the inputs reach the SC. This process results in faster behavioral responses to multisensory events as compared with those evoked by unisensory events (Rowland &Stein, 2008). The links between the neuronal activity and its behavioral effects that have emerged in temporal perception tasks will be discussed more extensively in the sections that follow.

Temporal resolution and temporal order

To the best of our knowledge, one of the first attempts to assess temporal perception within hearing and touch dates back to the 1960s, when Gescheider (1966, 1967a, 1970) measured auditory and tactile temporal resolution (see also von Békésy, 1959). In a series of studies, Gescheider (1966, 1967a, 1970) demonstrated that the skin and ear differed greatly in terms of their ability to resolve successive stimuli (i.e., the temporal resolution thresholds for pairs of brief stimuli presented in rapid succession were found to be 5-10 times higher

for cutaneous stimulation than for auditory stimulation). For instance, two stimuli of equal subjective intensity were perceived as being temporally discrete if they were separated by ~2 ms for monaural and binaural stimulation, but by ~10-12 ms for cutaneous stimulation (Gescheider, 1966, 1967a). Moreover, pairs of auditory stimuli separated by less than 30 ms were perceived as being more disparate in time than pairs of cutaneous stimuli separated by the same temporal interval (Gescheider, 1970). However, when intervals greater than 30 ms were used, pairs of events in both modalities were perceived as equally separated (Gescheider, 1967b).

While Gescheider (1967a, 1967b) compared the temporal perception of auditory and tactile stimuli by testing them separately, Hirsh and Sherrick (1961) conducted the very first study to compare people's ability to judge the temporal features of stimuli presented either within or across different pairs of sensory modalities. They used the temporal order judgment (TOJ) paradigm, in which participants are presented with pairs of stimuli at various different stimulus onset asynchronies (SOAs) and have to judge which stimulus appeared first. It should, however, be noted that the issue explored by Hirsh and Sherrick in their study differs slightly from the one investigated in Gescheider's studies (1967a, 1967b). Indeed, the investigation of the perception of simultaneity or of temporal order likely activates different neuronal mechanisms, whose involvement is traditionally measured through distinct psychophysical estimates (cf. Van Eijk, Kohlrausch, Juola, &van de Par, 2010; van Wassenhove, 2009; Wackermann, 2007). The "fusion threshold" is defined as the frequency (expressed in Hz) at which observers perceive multiple events to be steady, the "simultaneity threshold" is the time interval required for two events to be correctly perceived as successive or simultaneous in time, and the "temporal order threshold" is the amount of time required for two events to be correctly ordered in time.

By measuring the just noticeable differences (JNDs, traditionally defined as the smallest temporal interval at which people can accurately discriminate the temporal order of the stimuli on 75% of the trials), Hirsh and Sherrick (1961) surprisingly found that the temporal separation required to correctly judge the temporal order was approximately 20 ms, in both unimodal (i.e., tactile, auditory, or visual; Experiments 1-3) and multisensory (e.g., audiotactile, audiovisual, and visuotactile; Experiment 4) conditions. Hirsh and Sherrick stated that: "[W]hereas the time between successive stimuli that is necessary for the stimuli to be perceived as successive rather than simultaneous may depend upon the particular sense modality employed, the temporal separation that is required for the judgment of perceived temporal order is much longer and is independent of the sense modality employed." (p. 432)

As we will see, many subsequent studies have provided evidence that has turned out to be fundamentally inconsistent with these claims (see, e.g., Fujisaki &Nishida, 2009; Spence, Baddeley, Zampini, James, &Shore, 2003; Zampini et al., 2005; Zampini, Shore, &Spence, 2003a, 2003b; see Table 1).

For instance, in one recent study, Fujisaki and Nishida (2009) addressed the question of whether people's temporal perception differs as a function of the stimulus modality pairing under investigation. In particular, the authors studied whether there is any difference in terms of the temporal resolution of audiotactile, audiovisual, and visuotactile combinations of stimuli made of either single pulses (whose frequency changed from 1.4 to 26.7 Hz) or else repetitivepulse trains (whose frequency changed between 6.25 and 356.25 Hz). In their experiment, they used a set of paradigms, traditionally used to assess temporal perception, such as a synchrony-asynchrony discrimination task, a simultaneity judgment task (SJ), and a TOJ task. In the synchrony-asynchrony judgment task, participants were presented with stimulus pairs having only one of two magnitudes of asynchrony-0 ms (synchrony) and X ms (asynchrony)- within a single block. The participants had to discriminate between the two alternatives. They were provided with trialby- trial feedback regarding the accuracy of their responses. In the SJ task, pairs of crossmodal stimuli were presented, at a range of different stimulus onset asynchronies (SOAs), using the method of constant stimuli, and the participants had to judge whether the stimuli were presented simultaneously or successively. In the SJ task, the judgments are closely dependent on the criterion adopted by the participants (i.e., their subjective "simultaneous" category), whereas in the synchrony-asynchrony task, they might decide to adjust their judgments in light of the feedback received.

The results of the synchrony-asynchrony judgment and SJ tasks, and-to a lesser extent-of the TOJ task, consistently showed that the temporal resolution of synchrony perception was significantly better for the audiotactile stimulus pairing than for either the audiovisual or visuotactile stimulus pairing. Interestingly, by applying their analysis of the data to those reported by Hirsh and Sherrick (1961), Fujisaki and Nishida (2009) found an analogous pattern of results, with the audiotactile stimulus pairing being processed with a higher degree of temporal resolution as compared with the other sensory pairings. Moreover, the fact that the superior temporal resolution reported for the audiotactile stimulus pairing in the TOJ task is smaller than in the other two tasks suggests a partial dissociation of the perception of temporal order from the perception of simultaneity (see Wackermann, 2007). Furthermore, the threshold required to discriminate synchrony from asynchrony is lower for single- than for repetitive-pulse trains. This was found regardless of the stimulus combination used, possibly suggesting that both single-pulse and repetitive-pulse thresholds for the different stimulus combination may be coded by a common mechanism governing temporal resolution. If we assume that the threshold for single pulse trains indicates the width of the window of simultaneity reflecting the temporal precision of the temporal matching process, then the higher threshold observed for repetitivepulse trains could be suggestive of an increased risk of false matching by the participants in this condition (Fig. 2).

The fact that audiotactile processing has a higher temporal resolution than that of the other stimulus modality pairings can be ascribed, according to Fujisaki and Nishida (2009), to two different explanations, which are by no means necessarily mutually exclusive. The first explanation takes into account the difference in temporal resolution that exists between the various senses. Since vision is known to have a lower temporal resolution than either audition or touch (Welch &Warren, 1980), whenever this sensory modality is involved, performance deteriorates. The alternative explanation takes into account the independent channels model proposed by Sternberg and Knoll (1973). According to their model, the perceived order of two stimuli is determined by evaluating the timing at which stimuli arrive at a central decision mechanism, or "comparator." Fujisaki and Nishida (2009) argue that the higher temporal resolution for audiotactile stimuli reflects the more rapid operation of this comparator for audiotactile pairs of signals. The supposed higher degree of similarity in the temporal profile of the auditory and tactile inputs could possibly induce a facilitation of the comparison of their temporal characteristics as compared with when matching between stimuli presented to other sensory modalities (see also Cappe, Morel, Barone, &Rouiller, 2009; Hackett et al., 2007; Ley, Haggard, &Yarrow, 2009; Wang, Lu, Bendor, &Bartlett, 2008).

Moreover, Fujisaki and Nishida's (2009) study covers the issue of the relationship between synchrony discrimination and temporal order discrimination (cf. Fujisaki &Nishida, 2010). The link between these two kinds of perception is well described by Wackermann (2007):

Temporal experience is primarily experience of succession. The relations of temporal order between events, "A occurs before B," or "A occurs after B," constitute the most elementary form of temporal judgment, preceding a metrical concept of time scale. Our notion of time as a perfectly ordered universe of events implies that any two events, A and B, are comparable as to their temporal order. If A occurs neither before B nor after B, then the events A and B are simultaneous. (p. 22)

This definition suggests that the processing of synchrony and temporal order between sensory stimuli are highly related mechanisms. However, the minimum temporal interval necessary for two stimuli to be perceived as nonsimultaneous (defined as the "fusion threshold;" Exner, 1875) does not coincide with the time interval required to indicate their relative order (what is known as the "order threshold"). This fact has been taken to suggest the existence of multiple brain mechanisms for two different aspects of temporal discrimination (i.e., one for the integration of a unitary percept, another for the determination of succession between different percepts; Hirsh &Fraisse, 1964; Piéron, 1952; van Wassenhove, 2009; see also the section Temporal synchrony and temporal recalibration).

The issue of a centralized versus distributed timing mechanism has been elegantly explored in a recent study

by Fujisaki and Nishida (2010). The authors investigated whether the binding of synchronous attributes is specific to each attribute/sensory combination, or whether instead it occurs at a more central level. By using a psychophysical approach, they measured the processing speed of the judgments of the temporal relationship between two sequences of stimuli (i.e., cross-attribute phase judgments), either within single modalities or crossmodally. The rationale was that, in those cases in which the speed of binding is high and varies as a function of different attribute combinations, the underlying mechanisms are likely to be peripheral and attribute specific. By contrast, a low and invariant binding speed is expected when considering a shared underlying mechanism. In Fujisaki and Nishida's (2010) study, participants had to perform a binding task and a synchrony-asynchrony discrimination task. In the first task, two sequences of stimuli were presented, each of which consisting of the repetitive alternation of two attributes (e.g., in the audiotactile condition, high- or low-pitched sounds were presented together with vibrations to the right or left index finger). The alternations always occurred synchronously between the two sequences, but the feature pairing varied as a function of the in-phase/reversedphase conditions. The participants had to judge which features were presented simultaneously (e.g.,whether the pitch was high or low when the right finger was vibrated). In the synchrony- asynchrony discrimination task, each stimulus sequence contained pulses at a given repetition rate, and the participants had to judge whether the pulses of the two sequences were presented synchronously or asynchronously. The results demonstrated that, whereas the temporal limit on cross-attribute binding was very low (2-3 Hz) and similar for all sensory modality combinations, the synchrony limit varied across the modality combinations (i.e., 4-5 Hz for audiovisual and visuotactile conditions, 7-9 Hz in the audiotactile condition).

Taken together, these results therefore suggest that crossmodal temporal binding and synchrony judgments are governed by different underlying neural mechanisms, with the first process being mediated by a central and amodal mechanism, whereas the perception of crossmodal synchrony appears to be mediated by a peripheral mechanism specific for each attribute combination (Weiss &Scharlau, 2011). However, according to Fujisaki &Nishida (2010), synchrony perception is also centrally represented, as demonstrated by the fact that the temporal limits of crossmodal synchrony perception are still much lower than the limits observed in the individual sensory modalities (cf. Fujisaki &Nishida, 2005). Moreover, synchrony perception is only slightly affected by the attribute combination as long as the modality combination does not change. Therefore, the authors conjectured that both the capability to accurately extract salient changes in time in each sensory channel and to compare them across sensory modalities contributes to improving synchrony judgments. In the binding task, beyond the capability to process the "when" dimension, the capability to judge which combination of stimulus attributes are presented at the same time (the "what" dimension) is also important (see Renier et al., 2009; Yau, Olenczak, Dammann, &Bensmaia, 2009). Thus, the crossmodal temporal binding and the synchrony judgment task would tap into different processes in the perception of an event, thus explaining the discrepancy in the performance observed in the two tasks. However, as pointed out by the authors themselves, the reason why the temporal limit should settle around 2-3 Hz in all of the conditions is unclear, and possibly involves a precise investigation of the timing of high-level sensory processing (Fujisaki &Nishida, 2010).

Spatial effects on the perception of temporal order

An additional aspect to emerge from the literature on TOJ tasks is that audiotactile TOJs seem to be unaffected by the spatial disparity between the stimuli being judged. In a series of experiments, Zampini and his colleagues (Zampini et al., 2005) had participants perform a TOJ task on pairs of stimuli, one tactile and the other auditory, presented at varying SOAs. The stimuli could either be presented from either the same spatial location (i.e., both on the right or the left side of the participant's body midline) or different locations (i.e., one on the right and the other on the left side of the body midline). The results revealed that, contrary to what had been observed previously for audiovisual and visuotactile modality pairings (Spence et al., 2003; Zampini et al., 2003a, 2003b), the audiotactile version of the TOJ task was unaffected by whether the stimuli were presented from the same or different locations (sides). In previous studies, participants were found to be more sensitive (i.e., the results

revealed smaller JNDs; Spence et al., 2003; Zampini et al., 2003a, 2003b) when the stimuli in the two modalities were presented from different spatial positions rather than from the same position (Fig. 3).

The null effect of relative spatial position reported by Zampini et al. (2005) suggests that the audiotactile stimulus pairing may be somehow "less spatial" than the other multisensory pairings involving vision as one of the sensory modalities. These data add to previous research documenting a reduced magnitude of spatial interaction effects for this particular pair of modalities, as compared with the audiovisual and visuotactile pairings, possibly suggesting a finer spatial resolution of visual stimuli than of the auditory and tactile systems (e.g., Eimer, 2004; Gondan, Niederhaus, Rösler, &Röder, 2005; Lloyd, Merat, McGlone, &Spence, 2003; Murray et al., 2005).

Subsequent studies have, however, partially undermined this conclusion, demonstrating instead that the spatial arrangement of the stimuli, and the portion of space stimulated, can differentially affect the nature of the audiotactile interactions that may be observed (Kitagawa, Zampini, &Spence, 2005; Occelli, Spence, &Zampini, 2008). In Kitagawa et al.'s (Experiment 1) audiotactile TOJ experiment, the participants had to judge the temporal order of pairs of auditory and tactile stimuli presented from the left and/or right of fixation at varying SOAs and report which modality had been presented first on each trial. The auditory stimuli were presented from loudspeaker cones, whereas the tactile stimuli were delivered via electrotactile stimulators attached to the participants' earlobes. The results highlighted higher sensitivity (i.e., a lower JND), for stimuli presented from different sides rather than from the same side (i.e., 55 vs. 64 ms).

The discrepancy between the results reported in audiotactile TOJ tasks for stimuli presented from the back and from frontal space (Kitagawa et al., 2005; Zampini et al., 2005) can be explained by taking into account the crucial role of vision in the processing of spatial information in frontal space (Eimer, 2004). That is, audiotactile interactions may be somewhat less "spatial" than other multisensory interactions involving vision as one of the component sensory modalities (e.g., think of audiovisual and visuotactile stimulus pairings; see Spence et al., 2003; Zampini et al., 2003a, 2003b), or when audiotactile stimuli are presented at locations in which visual cues are normally available. By contrast, the lack of visual cues, just as in Kitagawa et al.'s study, may have contributed to a better coding of auditory and tactile spatial cues, which, in turn, could have induced benefits in the processing of their temporal features.

This explanation has recently received further support from another study by Occelli et al. (2008). There, the potential modulatory effect of relative spatial position on audiotactile TOJs was examined as a function of the visual experience of the participants using the paradigm developed by Zampini et al. (2005). The results of Occelli et al.'s study demonstrated that although the performance of the sighted (blindfolded) participants was unaffected by whether or not the two stimuli were presented from the same spatial location, thus replicating Zampini et al.'s earlier findings, the blind participants (regardless of the age of onset of their blindness) were significantly more accurate when the auditory and tactile stimuli were presented from different spatial positions rather than from the same position (see Table 1). Thus, the relative spatial position from which the stimuli were presented had a selective effect on the performance of the blind, but not on the performance of the sighted participants. This pattern of results suggests that the exclusive reliance on those sensory modalities that are typically considered less adequate for conveying spatial information (see Welch &Warren, 1980) failed to induce any advantage in terms of the performance of the blindfolded sighted participants. On the contrary, visual deprivation results in an enhancement of the ability to use the spatial cues available in the intact residual senses (e.g., hearing and touch; see also Collignon, Renier, Bruyer, Tranduy, &Veraart, 2006; Röder, Rösler, &Spence, 2004; Röder et al., 1999). Taken together, these data therefore reveal that the absence of vision (Occelli et al., 2008) or of visual information, as for stimulation occurring behind a participant's head (Farnè &Làdavas, 2002; Kitagawa et al., 2005), seems to be related to more prevalent audiotactile spatial interactions than those occurring in frontal space (Zampini et al., 2005). Moreover, the processing of the spatial cues within touch and audition is improved by presenting the stimuli from that portion of space in which visual cues are

typically unavailable (Kitagawa et al., 2005; Experiment 1) or absent as a result of blindness (e.g., Collignon et al., 2006; Occelli et al., 2008; Röder et al., 2004; Röder &Rösler, 2004).

Temporal synchrony and temporal recalibration

As was already highlighted (see the section Research on Hearing and Touch: A Multisensory Perspective), multisensory integration can take place between stimuli that are not temporally coincident, but which fall within the "temporal window" of integration (Meredith et al., 1987; see also Spence, in press), thus indicating that the merging of information from different modalities can overcome the differences of the senses in terms of conduction speeds, response latencies, and neural processing times (e.g., Lestienne, 2001; Nicolas, 1997; Vroomen &Keetels, 2010). Even though its extent is still a matter of some debate (e.g., Vatakis &Spence, 2010; Vroomen &Keetels, 2010), the existence of a window of temporal tolerance has not only empirical but also theoretical implications (e.g., Pöppel, 2009; van Wassenhove, 2009). Indeed, it implies that the concept of "temporal coincidence" (or "time point;" von Baer, 1864) in perception cannot be experienced in real life, but is rather a construct coinciding not with a specific point in time, but with a window of time. It follows from this that two stimuli falling within this temporal window are likely to be bound together into a single multisensory percept (see also Pöppel, Schill, &von Steinbüchel, 1990). Next, those studies that have investigated the temporal window of integration between auditory and tactile signals will be reviewed.

One series of experiments has investigated people's perceptual sensitivity to simultaneity between haptic and auditory events and whether this would be significantly affected by the physical characteristics of the stimuli that were presented. To address this question, realistic stimulation conditions-such as a hammer hitting a surface or a drum being tapped-were followed by their auditory consequences, and were either executed (Adelstein, Begault, Anderson, &Wenzel, 2003) or filmed (Levitin, MacLean, Mathews, &Chu, 1999). Despite the high between-participants performance variability (see also Begault, Adelstein, McClain, &Anderson, 2005), in both cases, the performance metrics calculated on basis of SJ data observed were significantly different from zero. It can be noted, however, that the values reported in these studies are much smaller than the 80 ms reported in Zampini et al.'s (2005) audiotactile TOJ study. Thus, even though the optimal impression of simultaneity for auditory and tactile stimuli is not perceived when the two stimuli are presented synchronously, it would seem that the conditions of stimulation have an effect in modulating the perceived relative temporal relationship between the stimuli, as measured by JNDs in synchrony/asynchrony tasks (see also Fink, Ulbrich, Churan, &Wittmann, 2006; Vroomen &Keetels, 2010, for other factors affecting the perception of intersensory synchrony). In particular, the use of ecological stimuli, such as those used in the studies of Adelstein et al. and Levitin et al., raises the question of how causality influences multisensory integration. On the basis of a number of recent audiovisual studies, it is known that when the stimulus presented in one modality in some sense predicts the stimulus in the other, multisensory integration is often enhanced (see Mitterer &Jesse, 2010; Schutz &Kubovy, 2009; Vroomen &Stekelenberg, 2010). A similar effect may have affected audiotactile integration in the previously described studies (Adelstein et al., 2003; Levitin et al., 1999), with possibly boosted consequences (i.e., higher tendency to merge multisensory inputs) where visual cues were involved, as in Levitin et al.'s study.

Closely related to the studies just described are those that have assessed the mechanisms of temporal recalibration/ adaption between auditory and tactile stimuli (Hanson, Heron, &Whitaker, 2008; Harrar &Harris, 2008; Levitin et al., 1999; Navarra, Soto-Faraco, &Spence, 2007; Virsu, Oksanen-Hennah, Vedenpää, Jaatinen, &Lahti-Nuuttila, 2008). It has been observed that inputs from different sensory modalities that refer to the same external event (or occur at the same time) will likely reach the cortex at different times, due to differences in the speed of transmission of the signals through different sensory systems (King, 2005; Macefield, Gandevia, &Burke, 1989; Schroeder &Foxe, 2004, 2005; Spence, Shore, &Klein, 2001; Spence &Squire, 2003). It follows from this observation that our perceptual systems need to be able to accommodate a certain degree of asynchrony between the information arriving through different channels.

In the literature on crossmodal integration, it has been demonstrated that the point of subjective simultaneity (PSS; "amount of time by which one stimulus has to precede or follow the other order for the two stimuli to be perceived as simultaneous;" Spence &Parise, 2010, p. 365) measure can be significantly affected by adaptation to asynchrony (see Vroomen &Keetels, 2010, for a review). This process is typically assessed by measuring participants' perceptions of crossmodal simultaneity both before and after exposure to a constant temporal discrepancy between the stimuli that happen to be presented in the two modalities. During the exposure phase of such studies, the perception of asynchronous stimuli should be progressively realigned. As a consequence, the perception of simultaneity changes, in a way that, after exposure, the impression of asynchrony is reduced. There are two candidate mechanisms for the process of temporal recalibration: (a) The realignment of sensory neural signals in time, with the processing of one of the sensory modalities shifting in time toward the other; and (b) The widening of the temporal window for multisensory integration (see Vroomen &Keetels, 2010).

In their study, Navarra et al. (2007) investigated whether exposure to audiotactile asynchrony would induce temporal recalibration between the processing of auditory and tactile stimuli. The participants in their study had to perform an audiotactile TOJ task both before and after an exposure phase in which paired auditory and vibrotactile stimuli could be presented either simultaneously or with the sound leading the vibration by 75 ms. In the exposure phase of the experiment, in order to ensure that participants attended to both auditory and tactile stimuli, they had to perform a control task involving the detection of stimuli that were longer than the standards. Navarra et al.'s results highlighted the fact that exposure to audiotactile asynchrony induced a temporal adaptation aftereffect that influenced the temporal processing of the subsequently presented auditory and tactile stimuli. More precisely, the minimal interval necessary to correctly judge the temporal order of the stimuli was larger after exposure to the desynchronized trains of stimuli (JND = 48 ms) than after exposure to the synchronous stimulus trains (JND = 36 ms), whereas no differences were observed in the PSS (i.e., 11 vs. 5 ms). This result differs from the temporal adaptation process taking place between visual and auditory stimuli, as assessed using similar experimental methods (e.g., Fujisaki, Shimojo, Kashino, &Nishida, 2004; Vroomen, Keetels, de Gelder, &Bertelson, 2004). It thus seems that the audiotactile temporal window is flexible and can be widened in order to compensate for the asynchronies occurring between these stimuli, differently from the audiovisual condition, in which a temporal realignment process seems to take place (cf. Fujisaki et al., 2004). Navarra et al. suggested that the discrepancy between the results could be explained by considering the rare occurrence and the small magnitude of the asynchronies occurring between hearing and touch experienced in everyday life. According to this speculation, the widening of the temporal window of multisensory integration could be considered as a nonspecific mechanism that allows for the integration of-infrequentlyexperienced-audiotactile stimuli presented in close temporal proximity, and the temporal realignment as a more specific compensatory mechanism, suitable for coping with the relatively large asynchronies that may occur between visual and auditory stimuli (Navarra et al., 2007).

Contrasting results have, however, been reported recently. Harrar and Harris (2008) compared the changes in the perception of simultaneity for three different combinations of stimulus modality (i.e., audiotactile, audiovisual, and visuotactile) as a function of the exposure to asynchronous stimulus pairs, which were presented in each of the three stimulus combinations. In contrast with Navarra et al.'s (2007) results, no temporal adaptation (i.e., neither a change of the JND nor of the PSS) was observed for the audiotactile pairings following exposure to any of the three stimulus combinations. According to Harrar and Harris, this discrepancy could be attributed to methodological differences. Specifically, in their study, the tactile (not the auditory, as in Navarra et al.'s [2007] study) stimulus led within the asynchronous pairs. Moreover, the exposure sequences differed not only in terms of their duration, but also in terms of the task that participants had to perform to maintain their attention focused. Further research could therefore help to clarify whether these factors may have contributed to the conflicting results obtained in these two studies (Fig. 4).

Another interesting attempt to explore the crossmodal nature of the temporal recalibration process was reported

recently by Di Luca, Machulla, and Ernst (2009). In their study, the authors investigated whether, and to what extent, the audiovisual temporal recalibration effect transfers to the perception of simultaneity for visuotactile and audiotactile stimulus pairs. The interesting result to emerge from this experiment was that the transfer of audiovisual recalibration of simultaneity to the other pairings of stimulus modalities was dependent on the location from which the stimuli happened to be presented. Specifically, when the stimuli were presented from the same spatial location in front of participants, the audiovisual recalibration effect transferred to visuotactile stimulus pairs (and not to the audiotactile pairings). By contrast, when the auditory stimuli were presented over headphones instead (i.e., when the auditory stimuli were not colocated with the visual and tactile stimuli), the audiovisual temporal recalibration effect transferred to the audiotactile stimulus pairs (and not to the visuotactile pairings). The fact that audiovisual temporal recalibration differently affected the other two sensory pairings could be due, at least according to Di Luca et al., to the different spatial arrangement of the stimuli. More precisely, in the colocation condition, a change in the perceptual latency (and in the reaction time; RT) of the visual stimuli was observed (see Fig. 5a), whereas in the different location condition, a change in the perceptual latency (and in RT) of the auditory stimuli (see Fig. 4b) was observed instead (cf. Sternberg &Knoll, 1973).

Di Luca et al. (2009) argued that the repeated exposure to asynchronous audiovisual stimuli gave rise to the adjustment of the perceptual latency of, separately, the visual or the auditory stimulus. This, in turn, caused a recalibration of perceived simultaneity within the stimulus pairings which, as in Di Luca et al.'s study, were different from those composing the stimuli repeatedly presented during the exposure phase of their experiment. Moreover, the mode of presentation has been shown to affect which signal estimate is trusted more, and hence which signal undergoes a change of temporal latency during recalibration. In Di Luca et al.'s study, when the auditory stimuli were presented over headphones (which constitutes a nonfixed external stimulus source, since it moves when the head moves), the auditory estimate was more likely to be biased (and thus trusted less) than the visual estimate. As a consequence, in this condition, it is the auditory estimate that is temporally recalibrated toward the visual standard. This is seen as an increased transfer to the perception of audiotactile simultaneity as compared with the perception of visuotactile simultaneity. By contrast, when the auditory stimuli were spatially fixed, the visual estimate was more likely to be biased, thus giving rise to an opposite pattern of results (Di Luca et al., 2009).

The fact that temporal recalibration transfers across sensory modality (see also Nagarajan, Blake, Wright, Byl, &Merzenich, 1998, for a study investigating the transfer of temporal rate discrimination from touch to audition) leads on to the crucial question of whether the extraction of temporal rate information should be considered as being coupled to a sensory modality or whether instead it is represented amodally (e.g., see Grondin, 2010; van Wassenhove, 2009; Wittmann, 2009). Despite the remarkable body of evidence accumulated on this topic, the large degree of inconsistency, as highlighted by the data reviewed here, seems to suggest that the exact nature of the temporal features that characterize audiotactile interactions are still unresolved, and thus are certainly worthy of further investigation.

Attention and temporal perception: the prior entry effect

A number of studies have addressed the question of whether temporal perception and, in particular, the impression of temporal simultaneity/successiveness can be influenced by the attentional focus of participants. One of the best-studied attentional effects on temporal perception is the phenomenon of "prior entry" (see Spence &Parise, 2010, for a recent review). According to the law of prior entry (Titchener, 1908), the attended stimuli (or modality) will be perceived sooner than when attention is focused elsewhere (or on another modality). This effect has traditionally been assessed by means of the aforementioned TOJ task, and is measured as a significant difference in the PSS between conditions in which one of the target stimuli is attended as compared with when the other stimulus is attended instead (or when attention is divided).

Studies investigating the audiotactile prior entry effect have demonstrated that the endogenous focusing of an observer's attention on one sensory modality can effectively modulate the perceived temporal relationship

between pairs of stimuli (Sternberg, Knoll, &Gates, 1971; Stone, 1926; see also Sternberg &Knoll, 1973; Van Damme, Gallace, Spence, Crombez, &Moseley, 2009). Moreover, the focusing of a person's attention on a specific location or sensory modality, as well as toward a particular point in time, determines the relative speeding up in the processing of the auditory and tactile stimuli, as shown by Lange and Röder (2006). In their study, participants were presented with short (600 ms) and long (1,200 ms) empty intervals, marked by a tactile onset and an auditory or tactile offset marker (which could consist in a continous stimulation, or in a stimulation with a gap), and, on a block-by-block basis, were asked to attend to one interval and to one sensory modality. The participants had to decide as quickly and as accurately as possible whether the offset marker was a single or a double stimulus. The behavioral and electrophysiological results of this study demonstrated that focusing attention on a particular point in time facilitated the processing of auditory and tactile stimuli. More specifically, participants responded more rapidly to stimuli at an attended point in time as compared with stimuli that were relatively less attended, irrespective of which modality was task relevant. Moreover, an enhancement of early negative deflections of the auditory and somatosensory eventrelated potentials (ERPs; for audition, 100-140 ms; for touch, 130-180 ms) were observed when audition or touch were task relevant, respectively.

These results therefore suggest that the allocation of attention along the temporal dimension can affect the early stages of sensory processing. More interestingly, these data also demonstrate that focusing attention on a particular point in time results in the more efficient processing of stimuli presented in both audition and touch. In contrast with the results obtained in a sustained attention task, such as that conducted by Lange and Röder (2006), no modulation of sensory processing by temporal attention has been detected in a visual temporal cuing paradigm (cf. Griffin, Miniussi, &Nobre, 2001; Miniussi, Wilding, Coull, &Nobre, 1999). Lange and Röder suggested that this discrepancy between the effects seen for different modalities could be attributed to the fact that a sustained attention paradigm, such as that used in their study, could have facilitated a more stable representation of the time interval to be attended to. In this regard, their paradigm differs from the conditions in which the to-be-attended time point changes on a trial-by-trial basis (as in cuing paradigms). This, in turn, could have favored the emergence of earlier effects of temporal attention observed in their study. According to an alternative account for these data, the temporal acuity of audition and touch is simply higher than that of vision (see also Fujisaki &Nishida, 2009).

Numerosity

The decision to review those studies that have investigated numerosity judgments in the present review is supported by the functional link that exists between time and numerosity processing, as first proposed by Meck and Church (1983). In a series of experiments, these researchers demonstrated that rats automatically process duration and number when these two dimensions covary in a sequence of events (i.e., rats were equally sensitive to a 4:1 ratio for both counts and durations, with the other dimension being controlled; see also Brannon, Suanda, &Libertus, 2007, for evidence in children), suggesting that there is a similarity between the processes underlying counting and timing. Interestingly, this effect, which was first demonstrated with auditory inputs, has now been generalized to the case of cutaneous signals. Meck and Church proposed the existence of a single shared representational mechanism (i.e., an "internal accumulator") that supervises both the duration and the numerosity of the events (and, for some authors, their spatial location; see Cappelletti, Freeman, &Cipolotti, 2009; Walsh, 2003).

In a typical temporal numerosity judgment task, a sequence of stimuli (i.e., flashes, beeps, or taps) is presented, and the observer has to try and judge how many stimuli have been presented (e.g., see Cheatham &White, 1952, 1954; Taubman, 1950a, 1950b). The first study to have compared the ability of participants to perform the tactile, visual, and auditory temporal numerosity discrimination of trains of stimuli (consisting of two to nine pulses) presented from a single location at different rates (varying from three to eight pulses per second) was conducted by Lechelt (1975). His results demonstrated that there was a generalized tendency toward the underestimation of the number of pulses, and the number of errors in number assessment was more

pronounced as the number of pulses and/or the rate of stimulus presentation increased. More interestingly, in the context of the present review, was his finding that modality-specific differences were also observed. In all of the experimental conditions, the accuracy in the temporal numerosity judgment task was found to be much higher for audition than for either touch or vision.

A recent study investigated whether the combination of trains of stimuli presented simultaneously in more than one sensory modality could improve people's temporal numerosity estimates (Philippi, van Erp, &Werkhoven, 2008). In contrast with other studies (e.g., Bresciani &Ernst, 2007; Bresciani et al., 2005; Hötting &Röder, 2004; Shams, Kamitani, &Shimojo, 2000) that explored whether there was any interfering effect between sequences of stimuli, the goal of Philippi et al.'s study was to explore whether the presentation of congruent sequences of stimuli would have a beneficial effect on participants' temporal numerosity estimation judgments (see also Lee &Spence, 2008, 2009). The participants in this particular study were presented with sequences (i.e., 2 to 10) of stimuli at interstimulus intervals (ISIs) varying from 20 to 320 ms. The participants were instructed to use the multisensorially redundant information to their advantage when performing the task. Indeed, the results revealed that the degree of underestimation (which has been consistently found in previous unisensory temporal numerosity estimation judgment studies; e.g., Lechelt, 1975; White &Cheatham, 1959) and the variance in participants' estimates were reduced as compared with those in the conditions of unisensory stimulus presentation. The results of Philippi et al.'s study confirmed that visual judgments were worse than the auditory judgments, and that these, in turn, were worse than the tactile judgments (see Lechelt, 1975; White &Cheatham, 1959). Overall, the results showed that the underestimation decreased for smaller ISIs (i.e., 20 and 40 ms) in the multisensory as compared with the unisensory presentation conditions. The authors explained this result by considering that the persistence of brief stimuli hampers the clear separation between rapidly presented within-modality signals, even leading to their fusion, under conditions in which the ISIs are much smaller than the persistence of each individual signal. Of interest for present purposes, Philippi et al. (2008) observed that the difference in temporal numerosity estimation judgments between unimodal auditory or tactile conditions and the bimodal audiotactile condition differed significantly only for short ISIs (20 and 40 ms).

As already mentioned, a large number of previous studies have investigated whether, and to what extent, the presentation of incongruent task-irrelevant multisensory sequences of pulses can influence people's temporal numerosity judgments in the target modality. In the illusory flash paradigm, for instance, people are instructed to report the number of flashes presented with to-be-ignored incongruent sequences of beeps (Shams et al., 2000). The striking result to have emerged from this study was that, when presented with a single flash and multiple auditory pulses, observers typically perceived an illusory second flash. This illusory effect has been explained by taking into account the higher reliability of the auditory modality as compared with the visual modality in the temporal domain (see Shams, Ma, &Beierholm, 2005). This effect, which constitutes a robust perceptual phenomenon, has now been replicated in the audiotactile not to mention visuotactile domains (Bresciani et al., 2005; Bresciani &Ernst, 2007; Hötting, Friedrich, &Röder, 2009; Hötting &Röder, 2004). In one of their studies, Bresciani and Ernst (2007) presented series of beeps and taps and had their participants report on the number of tactile stimuli while ignoring the auditory distractors. The results revealed that participants' tactile perception was modulated by the presentation of taskirrelevant auditory stimuli, with their responses being significantly affected by the number of beeps that were delivered. Such a modulation only occurred, however, when the auditory and tactile stimuli were similar enough (i.e., had the same duration) and were presented at around the same time (see Fig. 6).

According to the maximum likelihood estimation model of multisensory integration (e.g., Alais, Newell, &Mamassian, 2010), the reliability of a sensory channel is related to the relative uncertainty of the information it conveys. The higher the relative variance of a sensory modality, the weaker its relative reliability (Ernst &Bülthoff, 2004). In another study, in order to investigate whether the auditory bias on tactile perception could be disrupted by manipulating the reliability of the auditory information, Bresciani and Ernst (2007) varied the

intensity of the beeps. The auditory stimuli were presented at either 41 or 74 dB (signal-to-noise ratio of, respectively, -30 and 3 dB). They found that the participants were more sensitive (i.e., their estimates were less variable) in counting the number of the more intense (rather than the less intense) beeps presented with the irrelevant taps. Conversely, they were more sensitive in counting the number of taps presented with less intense (vs. more intense) irrelevant beeps (see also Wozny, Beierholm, &Shams, 2008). This pattern of results could reflect the fact that the decrease in the intensity of the auditory stimuli reduced the relative reliability of the auditory modality, thus inducing differential interactions with touch as a function of the intensity of the stimuli. Taken together, these results therefore show that audition and touch reciprocally bias each other (when alternatively used as target or distractor), with the degree of evoked bias depending on the relative reliability of the two modalities (see also Bresciani, Dammeier, &Ernst, 2008; Occelli, Spence, &Zampini, 2009).

To the best of our knowledge, however, the experimental investigations published to date have not applied a multisensory perspective to the assessment of the interactions between time and numerosity (and, possibly, space). Indeed, the currently available data refer to the visual (e.g., Dormal, Seron, &Pesenti, 2006) or auditory (Droit-Volet, Clement, &Favol, 2003; Xuan, Zhang, He, &Chen, 2007) modality, and typically report that when participants perform a numerosity judgment task, temporal intervals are perceived as shorter than their veridical duration. The investigation of this topic using a multisensory approach could lead to a better understanding of the interplay occurring between the mental representation of time, space, number- and, in general, of magnitudes-in both neurologically intact individuals and ultimately in those patients suffering from parietal lesions, a topic which has been, to our knowledge, by now investigated primarily in the visualmodality (e.g., Oliveri et al., 2008, 2009; Vicario, Pecoraro, Turriziani, Koch, &Oliveri, 2008; see also Bueti &Walsh, 2009).

Audiotactile interactions based on frequency similarity

Perceptual interactions between hearing and touch are distinctive from those associations occurring between other pairings of sensory modalities (Gescheider, 1970; Soto-Faraco &Deco, 2009; von Békésy;, 1959; Zmigrod, Spapé, &Hommel, 2009, Experiment 2). As was already mentioned, auditory and vibrotactile stimuli are transduced by the same physical mechanism (i.e., mechanoreception), consisting of the mechanical stimulation of, respectively, the basilar membrane and the skin. Hence, both auditory and vibrotactile stimuli can be described according to their specific periodic patterns of stimulation (i.e., their frequency), defined as the number of repetitions of the sound waveforms (see Plack, 2004; Siebert, 1970) or of tactile pulses (see Luna, Hernández, Brody, &Romo, 2005), respectively, per unit time. Hence, it seems somehow surprising that the investigation of audiotactile interactions as a function of the frequency similarity between stimuli has rarely been carried out to date. Thus far, the focus has primarily been on the perception of lingual vibrotactile stimulation (Fucci, Petrosino, Harris, &Randolph-Tyler, 1988; Harris, Fucci, &Petrosino, 1986, 1989).

The ability of mammals to discriminate frequencies has been considered as reflecting the frequency resolution characterizing the auditory pathway at both the peripheral (i.e., the basilar membrane of the cochlea; Robles &Ruggero, 2001) and central (i.e., the primary auditory cortex; Langers, Backes, &van Dijk, 2007; Tramo, Cariani, Koh, Makris, &Braida, 2005) stages of auditory information processing. The systematic spatial mapping of frequency coding in the brain (known as tonotopy) and the filtering properties of auditory neurons and sensory receptors have been considered responsible for decoding the frequency of auditory stimulation (see Schreiner, Read, &Sutter, 2000, for a review; see also Elhilali, Ma, Micheyl, Oxenham, &Shamma, 2009; Romani, Williamson, &Kaufman, 1982; Schnupp &King, 2008). However, the tonotopic structure of the auditory system is not the only candidate for the representation of the temporal characteristics of auditory stimuli. Indeed, the activity of neurons at different stages of the auditory pathway has been shown to change as a function of the repetition rates of the auditory events being processed (see Bendor &Wang, 2007, for a review). More specifically, acoustic signals within the flutter range (10- 45 Hz) are coded by neurons that synchronize their activity to the temporal profile of repetitive signals. These neurons have been observed both along the auditory-nerve fibers and in the inferior colliculus, the medial geniculate body, and in a specific neuronal

population along the anterolateral border of the primary auditory cortex (AI; Dicke, Ewert, Dau, &Kollmeier, 2007; Oshurkova, Scheich, &Brosch, 2008; Wang et al., 2008). Other mechanisms regulate the activity of the neural population coding for auditory signals presented at higher repetition rates (i.e., above the perceptual flutter range). These neurons modify their discharge rates-not their spike timing-as a function of the frequency of the auditory events that are being processed (Oshurkova et al., 2008; Wang et al., 2008). Thus, the temporal profile of auditory stimuli appears to be represented in AI by a dual process (i.e., stimulus-synchronized firing pattern and discharge rate), each involving specific subpopulations of neurons.

The distinct neural encoding of auditory stimuli differing in frequency may also be responsible for the different perceptual impression conveyed by auditory stimuli. Indeed, when auditory events are presented at rates within the 10-45 Hz (i.e., flutter) range, the resulting percepts tend to consist of sequential and discrete sounds (i.e., acoustic flutter; Bendor &Wang, 2007; see also Besser, 1967). According to Bendor and Wang, the discrete impression of the flutter percept could be considered as the direct outcome of the synchronized responses representing the event at different neural stages of the auditory pathway. On the other hand, neurons encoding stimuli with repetition rates beyond this range do not synchronize with the stimuli, thus failing to induce the impression of discrete auditory events and instead giving rise to continuous-sounding percepts that have a specific pitch (Bendor &Wang, 2007; Hall, Edmondson-Jones, &Fridriksson, 2006; Tramo et al., 2005; Wang et al., 2008).

Interestingly, the perceptual encoding boundary for repetition rates producing low- and high-frequency stimuli seems to be analogous in both hearing and touch (i.e., ~40- 50 Hz). Just as in hearing, the sensation of flutter in touch is induced by periodic trains of impulses at frequencies between ~5 and ~40 Hz (e.g., Romo &Salinas, 2003), whereas higher repetition rates (~40-400 Hz) induce a sensation of "vibration/buzzing" (LaMotte &Mountcastle, 1975; Talbot, Darian-Smith, Kornhuber, &Mountcastle, 1968). Moreover, in the tactile domain, the identification and discrimination of stimuli differing in their frequency relies on the differential sensitivity of sensory receptors and afferent nerve fibers supplying different portions of the skin (Johansson &Vallbo, 1979a, 1979b; Morioka &Griffin, 2005). At the fingertips, the class of fibers classified as fast adapting fibers and the receptors known as "meissner corpuscles" are responsible for the processing of low vibrotactile frequencies (i.e., 5-50 Hz), whereas the pacinian fibers associated with the pacinian receptors are more sensitive to higher vibration frequencies (i.e., higher than 40 Hz; Francis et al., 2000; Iggo &Muir, 1969; Mahns, Perkins, Sahai, Robinson, &Rowe, 2006; Morley, Vickery, Stuart, &Turman, 2007; Talbot et al., 1968; Verrillo, 1985). Animal studies have suggested that one possible candidate for signalling information about the frequency of vibrotactile stimuli is an impulse pattern code, according to which the responses of rapidly adapting afferents are phase locked to the periodicity of the vibrotactile stimulus. The strict correspondence between the temporal features of the vibrotactile stimuli and the impulse patterns have not only been observed in the periphery (i.e., along the sensory nerve fibers), but also in neurons at higher levels along the ascending somatosensory pathway (Hernández, Salinas, García, &Romo, 1997; Mountcastle, Steinmetz, &Romo, 1990; Salinas, Hernández, Zainos, &Romo, 2000).

Even though the encoding of the frequency pattern of vibrotactile stimuli involves all of the stations along the somatosensory pathway, it is likely that more sophisticated processes, such as those involving the discrimination of different frequencies, occur more centrally. In primates performing a frequency discrimination task, the patterns of firing evoked in SI neurons by the comparison stimulus (i.e., usually presented second in each pair) are independent of those elicited by the standard stimulus (i.e., the first stimulus in each pair). It thus seems as though SI is an unlikely candidate for the encoding of the difference between the two stimuli (Romo &Salinas, 2003; Salinas et al., 2000). On the other hand, the fact that the response of neurons in the secondary somatosensory cortex (SII) to the second vibration is affected by the frequency of the first vibration suggests that these neurons contribute significantly to the coding of the frequency difference. Taken together, this evidence therefore suggests that, in primates at least, the perceptual comparison between different frequencies

takes place in SII. Subsequent decisional processes are thought to involve the medial premotor cortex in the frontal lobe area, whose neuronal activity significantly covaried with monkeys' perceptual reports (de Lafuente &Romo, 2005). The similarity of the performance demonstrated by monkeys and humans in detecting and discriminating between stimuli differing in frequency suggests that the neural mechanisms investigated in monkeys may be analogous to those that exist in humans (see Romo &Salinas, 2003; Salinas et al., 2000; Talbot et al., 1968). In humans, just as in monkeys, frequency discrimination does not rely exclusively on SI, but also involves downstream areas, such as SII and some regions in frontal cortex (Harris, Arabzadeh, Fairhall, Benito, &Diamond, 2006).

A recent fMRI study investigated which brain areas are involved in the discrimination of vibrotactile frequency in humans (Li Hegner et al., 2007). The participants in this study had to report whether the sequentially presented vibrotactile stimuli had the same or different frequency. The results revealed that an extended region was recruited during the performance of the task. Beyond the areas typically involved in this kind of task (i.e., SI and SII), other areas, such as the superior temporal gyrus, the precentral gyrus, ipsilateral insula, and supplementary motor area were also involved (Li Hegner et al., 2007). Interestingly, the superior temporal gyrus is known to mediate interactions between auditory and somatosensory stimuli, in both humans (Foxe et al., 2002; Schroeder et al., 2001) and monkeys (Fu et al., 2003; Kayser, Petkov, Augath, &Logothetis, 2005). Neurons in the auditory belt areas respond not only to pulsed tactile stimulation, but also to vibratory stimuli, thus suggesting that the auditory association cortex acts as a cortical location of convergence for auditory and tactile inputs during the discrimination of tactile frequency (Iguchi, Hoshi, Nemoto, Taira, &Hashimoto, 2007; Li Hegner et al., 2007; Schürmann, Caetano, Hlushchuk, Jousmäki, &Hari, 2006; see also Caetano &Jousmäki, 2006; Golaszewski et al., 2006). The evidence suggesting that the auditory areas involved in the processing of tactile stimuli are endowed with specific frequency profiles and contribute to the vibrotactile frequency discrimination processes, raises the intriguing possibility of anatomofunctional similarities between those cortical regions devoted to the processing of the periodicity of both vibrotactile and auditory stimulation.

A study by Bendor and Wang (2007) would appear to suggest that these similarities could, in fact, be the case. These authors distinguished between two populations of neurons in the auditory cortex, known as "positive monotonic" and "negative monotonic." respectively. The first population typically increased its firing rate proportional to the increase of the repetition rates of an auditory stimulus, whereas the second population showed the opposite pattern of responding (see also Wang et al., 2008). Interestingly, neurons with positive and negative monotonic tuning to stimulus repetition rate have not only been observed in the auditory cortex, but also in the somatosensory cortex beyond SI (Bendor &Wang, 2007; Salinas et al., 2000). More specifically, neurons have been detected in SII whose spike rate can be positively or negatively related to the vibrotactile stimulus frequency (Luna et al., 2005; Salinas et al., 2000). The fact that neurons showing positive and negative monotonic tuning to stimulus repetition rate can be observed in both auditory and somatosensory cortices points to a commonality in how these two sensory systems might encode variations in the temporal profile of, respectively, auditory and vibrotactile stimuli (Bendor &Wang, 2007; Wang et al., 2008; see also Soto-Faraco &Deco, 2009), possibly indicating a potential neural basis for the discrimination of frequencies delivered crossmodally (see Bendor &Wang, 2007).

Preliminary evidence from Nagarajan et al. (1998) has suggested that temporal information processing could be governed by common mechanisms across the auditory and tactile sensory systems. In their study, participants were presented with pairs of vibratory pulses and were trained to discriminate the temporal interval separating them. The results not only suggested a decrease in the threshold as a function of training, but also the generalization of the improved interval discrimination to the auditory modality. Even though the generalization was constrained to an auditory base interval that was similar to the one that had been trained in touch, these results are intriguing in suggesting that the coding of temporal intervals could be represented centrally (i.e., shared among different sensory modalities; cf. van Wassenhove, 2009, see also Fujisaki &Nishida, 2010).

Additionally, recent neurophysiological evidence in humans has demonstrated that the discrimination of vibrotactile stimuli can be improved significantly in many people simply by providing auditory feedback- with the same frequency-after the presentation of the tactile stimulation (Iguchi et al., 2007; see Ro, Hsu, Yasar, Caitlin Elmore, &Beauchamp, 2009). The investigation of the neural substrates of this effect led to the conclusion that the increase of the perceptual accuracy and the speeding up of the discrimination of the tactile frequencies were subserved by the coactivation of SII and the supratemporal auditory cortices along with upper bank of the superior temporal sulcus. The data suggest that auditory feedback could have induced a complementary processing of tactile information by means of an intervening process of acoustic imagery. The results of this study therefore add weight to previous investigations showing considerable crossmodal convergence in the posterior auditory cortex of not only tactile stimulation (e.g., Foxe et al., 2002; Kayser et al., 2005), but also of vibrotactile stimulation, in both normal hearing (e.g., Caetano &Jousmäki, 2006; Schürmann et al., 2006) and deaf (Levänen &Hamdorf, 2001) humans.

On the other hand, Yau et al. (2009) demonstrated that auditory stimuli can interfere with tactile frequencydiscrimination responses. The participants in their study had to perform a two-alternative forced choice task judging which of two vibrotactile stimuli (ranging from 100 to 300 Hz, steps of 40 Hz) had the higher frequency. Crucially, the second vibrotactile stimulus was accompanied by an auditory stimulus presented at the same or a different frequency as that of the tactile stimulus. The results revealed a decrement in task performance, but only for auditory distractors in the low frequency range. Interestingly, since the same stimulus proved ineffective in modulating an intensity judgment, and was restricted to the conditions in which the tactile stimulus was presented at- or near-the same frequency, this interfering effect is thought to be highly specific across similar frequencies. Moreover, the perceived frequency of the tactile stimulus was pulled toward that of the auditory stimulus (see also Ro et al., 2009). According to Yau et al., these results are consistent with a supramodal representation of the temporal rate of sensory inputs (cf. Fujisaki &Nishida, 2010; Jones, Poliakoff, &Wells, 2009; van Wassenhove, 2009; see also Ivry &Schlerf, 2008, and the section Conclusions and Directions for Future Research of the present review). This assumption has, however, been challenged by findings demonstrating that the "fusion threshold" differs across sensory modalities, being higher for vision (Landis, 1954) than for audition (Exner, 1875; von Békésy, 1936) and touch (von Békésy, 1959, 1963). Future investigations could possibly better assess the multisensory perception of frequency, by investigating, for instance, if and to what extent people are able to match stimuli having comparable temporal rate features within each modality, and crossmodally.

Audiotactile interactions in rhythm perception and sensorimotor synchronization

Some authors have observed that, whereas the spatial properties of the objects-typically related to visual functions-develop after birth, some temporal properties, such as synchrony, tempo, and rhythm, are experienced during prenatal life, through vestibular, tactile, and auditory stimulation (e.g., Groome et al., 2000; Woodward &Guidozzi, 1992). The different line of development of the sensory modalities would contribute in generating specific "salience hierarchies" for object/event properties, with the processing of auditory-somatosensory synchrony-such as the one elicited by the maternal heartbeat-being one of the first sensory experiences we humans are exposed to (Lickliter &Bahrick, 2000). The experimental evidence demonstrates that not only can the fetus perceive synchrony, but also that from the twentieth week of gestation, fetal motor activity exhibits synchrony with maternal heart rate activity (DiPietro et al., 2006). Moreover, it has been demonstrated that the synchrony of activity between mother and fetus experienced during uterine life significantly influences the shaping the infant's capability to perceive the alternating light-dark in the circadian cycle (Tsai, Barnard, Lentz, &Thomas, 2011), possibly representing a precursor of the mutual responsiveness typifying future social interaction (Reyna &Pickler, 2009).

Given the synchronization experienced with the mother during gestation, primarily based on biological rhythms such as heartbeat or breathing, it should not come as any surprise to find that the capability to discriminate

rhythmic sequences develops very early. In fact, it can be observed by 2 months of age (Trehub &Hannon, 2006). Moreover, infants show a very early capability to recognize and match rhythms that are experienced via multiple sensory channels (see Bahrick, Flom, &Lickliter, 2002; Bahrick &Lickliter, 2004, for evidence on audiovisual rhythm perception). A striking demonstration of this phenomenon comes from a study carried out by Phillips-Silver and Trainor (2005). Infants were trained by being bounced to an ambiguous rhythm (i.e. a rhythm without accents), with half of the infants being bounced on every second beat, and the other half on every third beat. After training, the infants exhibited listening preferences for an auditory version of the rhythm pattern, with accents that matched the way in which they had been bounced (i.e., every second or every third beat). Thus, prior motor experience affected the infants' auditory rhythm preferences. Interestingly, the same authors also observed that, in adults, the movement of the body influenced the auditory encoding of an ambiguous musical rhythm, whereas visual information had no such effect (Phillips-Silver &Trainor, 2005). Thus, it seems that in humans, musical rhythm processing is primarily based on multisensory interactions involving auditory and kinaesthetic systems, which persists for the whole life span (Repp &Penel, 2004; see also Rubinstein, Giladi, &Hausdorff, 2002, for rhythmic auditory sensory cuing in the treatment of motor impairment in Parkinson's disease, and Zatorre, Chen, &Penhune, 2007, for a review on the neural substrates of sensorimotor interactions in music).

Although motor activities often have a somatosensory component, only a few of the studies on this topic have assessed the interactions between auditory and tactile systems in rhythm perception more directly (e.g., Brochard, Touzalin, Després, &Dufour, 2008; Hatta &Ejiri, 1989). For instance, Patel, Iversen, Chen, and Repp (2005) showed that humans have no difficulty in synchronizing finger tapping with sound sequences, but failed to do the same with sequences composed of visual stimuli. On the basis of this evidence, Brochard et al. (2008) investigated whether the sensation of regular pulse is exclusively auditory or whether humans can also feel the metric structure within the somesthetic domain. Participants were asked to synchronize their finger tapping to two identical rhythmic sequences, presented via either the auditory or tactile modality (i.e., short tones or light touches of the fingertip). The results showed that participants were able to extract the metric structure from sequences presented via tactile stimulation as easily as when unimodal auditory stimulation was delivered. The finding that meter can be perceived outside of the auditory modality is consistent with the hypothesis that the representation of temporal periodicity is subserved by brain areas whose activity is modality independent. Subsequent studies have extended this suggestion by demonstrating that the neural activity evoked by either an auditory or tactile rhythmic sequence involves those areas that are primarily involved in stimulus prediction, such as the lateral and mesial premotor areas, as well as areas involved in the analysis of the temporal structure of the stimuli, such as prefrontal, occipital, temporal, and cerebellar areas (Bengtsson et al., 2009). Other research has highlighted the fact that the pattern of common activation during auditory and tactile tapping tasks included both sources that were modality independent and a source that varied with the modality of stimulation (Müller et al., 2008). In the auditory pacing condition, it was localized in the contralateral primary somatosensory cortex, whereas during tactile pacing, it was localized in contralateral posterior parietal cortex. Interestingly, the activity of this third source seems to be involved in the evaluation of the temporal features of the stimulation presented in different sensory modalities. This evidence suggests the intriguing possibility that the processing of sensory inputs with a similar temporal profile is supported by the synchronized oscillatory activities of spatially distributed neuronal population occurring in parallel at different locations in the cortex (Sannita, 2000; see also Engel, König, Kreiter, Gray, &Singer, 1991). According to this hypothesis, the nonlinear endogenous periodicity of the spontaneous oscillatory activity in the neural system is entrained to an external stimulus. This, in turn, results in the transiently activated neuronal aggregates that are separated in space and are pooled in coherent temporal patterns that are functionally related. Thus, according to the "neural resonance phenomena" view, the temporal patterns of sensory stimulation as well as of musical events are perceived because they are intrinsic to the physics of the neural systems involved in perceiving and responding to that

class of percepts (Large &Snyder, 2009).

The investigation of sensorimotor synchronization raises interesting questions relating to the topic of the present review, such as the issue of the temporal features of the interplay between perception and action. A task that has been considered as providing a suitable model to study the production of a periodic pattern of motor acts (tapping or key pressing) in synchrony with a corresponding pattern of stimuli (typically clicks or tones) is the periodic synchronization task (see Repp, 2005, for a review). In this task, the onset of the finger taps usually lead the stimulus onsets by a certain amount of time, ranging from 20 to 50 ms, giving rise to the commonly known "negative asynchrony" effect. Although the reason behind this effect is not yet completely clear, the explanation that currently has the most support claims that this error could be attributed to differences in the nerve conduction time between click and tap and their corresponding central representations (Paillard-Fraisse hypothesis; Fraisse, 1980; see also Aschersleben, 2002, for a coverage of the explanatory models of this effect). Whereas the majority of studies have investigated synchronization to unimodal (typically auditory) stimulus sequences (e.g., Elliott, Welchman, &Wing, 2009; Hary &Moore, 1987; Rivenez, Drake, Brochard, &Guillaume, 2008), a recent study attempted to assess synchronization to multisensory cues (Elliott, Wing, &Welchman, 2010). Participants tapped in time with auditory, visual, and tactile metronomic signals, under conditions of either unimodal or bimodal stimulus presentation. The study showed that when rhythmic cues are presented, the brain weights signals according to the relative reliability in the timing of events across modalities, and the movement production is optimally synchronized to the extracted signals. However, the integration between signals breaks down when there are large temporal discrepancies between cues. In that case, actions are synchronized with the cue with the highest sensory reliability. Typically, in audiovisual and audiotactile combinations, a bias toward audition is observed. This result indicates that when signals are judged as being independent (temporally separated), asynchrony is computed in relation to one of them (often to the auditory signal; Wing, Doumas, &Welchman, 2010). Interestingly, according to the results of Elliott et al.'s research (2010), the temporal window of integration between multisensory cues depends on the sensory modalities involved and the likelihood that the stimulation originates from a common source (see Aschersleben, 2002; Aschersleben &Prinz, 1995). Thus, it seems that our brain is more willing to tolerate a difference in onset time between, for example, a pair of visuotactile stimuli than between a pair of audiotactile stimuli.

Very recent findings in primate studies have shown extensive corticothalamic connections that support the existence of a circuit allowing the rapid integration of somatosensory and auditory signals-processed in remote cortical areas-and the production of a fast motor action to the combination of the two stimuli (seeWang et al., 2008; see also Lim, Bradshaw, Nicholls, &Altenmüller, 2005). For instance, a restricted thalamic area connects remote cortical areas, such as the auditory cortex, area 5, and auditory belt/parabelt areas with associative parietal areas. This pathway could provide the anatomical support for the rapid transmission of auditory and somatosensory information, converging onto the premotor cortex. (Cappe et al., 2009; see also Hackett et al., 2007).

Conclusions and directions for future research

Throughout this review, we have illustrated that the auditory-tactile linkage in the temporal domain is special in a number of important ways. The unique interplay between audition and touch is rooted in the common evolutionary origins of these sensory systems and receptors, and evolves into interactions in different domains, which have been described in the previous sections. As can be inferred from these data, the exact nature of the processes governing crossmodal temporal perception is still far from being completely clear, despite the growing number of studies on this topic, which have been reviewed here. In particular, the fact that the temporal processing of crossmodal signals from the auditory and the tactile channels is privileged-or is at least distinguishable-as compared with the other stimulus pairings, given the analogies occurring between the two sensory systems, has so far received partial support (see Fujisaki &Nishida, 2009). That said, the contradictory evidence on this topic prevents us from providing an unambiguous answer to the question of whether time is

represented centrally, in an amodal way, or is rather differently represented according to the modality of the stimuli processed. Furthermore, we are aware that some of the dimensions regarding the perception of time-such as time-duration perception-have not been covered in this review. However, rather surprisingly, it turns out that these issues have not been investigated extensively thus far in the audiotactile domain. Indeed, playing a musical instrument is a rather complex task. It requires fine temporal accuracy skills (i.e., synchronization, proficient temporal rate, and rhythm processing and reproduction) and the highly proficient coordination of motor activities (closely related with somatosensory and proprioceptive feedback; Drost, Rieger, Brass, Gunter, &Prinz, 2005; Goebl &Palmer, 2008; Huang, Gamble, Wang, &Hsiao, 2010) with their auditory outcomes. Although the consequences of musical training on audiotactile interactions have been explored at the neuronal level (e.g., Lappe, Herholz, Trainor, &Pantev, 2008; Lotze, Scheler, Tan, &Braun, &Birbaumer, 2003; Pantev, Lappe, Herholz, &Trainor, 2009; Pantev et al., 2003; Popescu, Otsuka, &Ioannides, 2004; Schulz, Ross, &Pantev, 2003), there is little behavioral evidence (though see Müller et al., 2008; Pollok, Müller, Aschersleben, Schnitzler, &Prinz, 2004).

Another dimension that is related to musical perception is temporal perception, in particular, the perception of temporal duration which, although extensively studied in the audiovisual domain (e.g., Burr, Banks,& Morrone, 2009; Ulrich, Nitschke, &Rammsayer, 2006; van Wassenhove, Buonomano, Shimojo, &Shams, 2008; Vicario, Rappo, Pepi, &Oliveri, 2009), has rarely been studied in the other sensory domains (though see Goodfellow, 1934; Schutz &Kubovy, 2009). Very recently, however, an EEG study compared the ability of sighted and blind people to discriminate the temporal duration of auditory and tactile stimuli (see van der Lubbe, Van Mierlo, &Postma, 2010). Separate tactile and auditory duration discrimination tasks were conducted, with participants instructed to recognize auditory or tactile targets that were preceded by to-be-ignored tactile or auditory cues to the same or different side as the targets (i.e., valid or invalid trials). The results revealed that the blind had superior duration discrimination abilities as compared with sighted controls. This difference was demonstrated in both the speed and accuracy of their responses. Their proficient performance was accompanied by an enlarged posterior negativity (relative to that seen in the sighted), in both tactile and auditory tasks. Since no reduced orienting effects induced by crossmodal cues were observed in the blind, it seems that changes in information processing in the early blind participants are not attributable to modifications in structures relevant for attentional orienting and alertness, but to a later-supramodal-level of processing instead.

Taken together, these findings support the hypothesis that the enhanced performance and the pattern of activations observed in the blind could reflect a modification at a higher level of information processing, instead of changes in early perceptual processes within the occipital cortex. Furthermore, these data are in line with an amodal, rather than a modality specific, temporal perception process that involves occipital areas in the blind. From these preliminary results, investigating audition and touch separately, it would appear that duration perception in these two sensory modalities could also represent a promising field to be investigated more thoroughly in future research, especially in the clinical field (Meck, 2005). A further issue worthy of investigation could be to find out whether the perception of the duration of auditory and tactile stimuli is prone to crossmodal distortion effects, analogous to what has been found between auditory and visual stimuli (e.g., Chen &Yeh, 2009; van Wassenhove et al., 2008). Moreover, the potential implementation of the experimental findings in the clinical field, such as in sensory substitution (e.g., Minagawa, Ohnishi, &Sugie, 1996), in the diagnosis (e.g., Danckert et al., 2007; Davalos, Kisley, &Ross, 2002; Gilden &Marusich, 2009; Smith, Harper, Gittings, &Abernethy, 2007), or in the treatment (Powers, Hillock, &Wallace, 2009; Thaut, 2005; Vargas &Yu, 2008) of psychiatric and neurological diseases, would be an interesting issue to be investigated in future studies.

Lastly, and as pointed out recently by van Wassenhove (2009), sensory illusions could also offer cues into the conditions under which the perception of the real can be turned into distorted percepts (mainly, but not exclusively, of a spatial nature). Indeed, in this regard, the temporal characteristics of stimulation seem to play a very important role in determining, for instance, the emergence of perceptual illusions (Eagleman, 2008; Grush,

2005), crossmodally (e.g., as in the parchment skin illusion; Guest, Catmur, Lloyd, &Spence, 2002; Jousmäki &Hari, 1998; and auditory-tactile crossmodal saltation; Trojan, Getzmann, Möller, Kleinböhl, &Hölzl, 2009), or in touch and hearing separately (e.g., as in the funnelling illusion, Chen, Friedman, &Roe, 2003; Gardner &Spencer, 1972; Sherrick, 1964; von Békésy, 1959, 1967; Watanabe, 1979; saltation; Geldard, 1985; Hari, 1995; see also Geldard &Sherrick, 1972; and chronostasis; Hodinott-Hill, Thilo, Cowey, &Walsh, 2002; Yarrow &Rothwell, 2003). The discovery of new perceptual illusory phenomena could, in the future, provide clues into the temporal features governing audiotactile interactions.

Author note We thank Paola Rigo and Tommaso Sega for preparing the figures. V.O. is supported by a Departmental Fellowship from the Department of Cognitive Sciences and Education, University of Trento.

Sidebar

Published online: 12 March 2011

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Publication date: Jun 2011

Year: 2011

Have you been turning up the volume on the TV lately? Stop saying 'Huh?' and get your hearing checked.; Surprise! Is this an earring? A phone earpiece? It's a hearing aid

Author: Anonymous

Publication info: Palm Beach Post [West Palm Beach, Fla] 31 May 2011: D.1.
ProQuest document link

Abstract: [...] Zinni recommends that anyone who suspects he or she is suffering from hearing loss do something about it-- immediately. [...] on the rare occasions when it still is, Zinni tells such patients, "A hearing aid is far less conspicuous than your hearing loss." ~steve_dorfman@pbpost.com THESE FAMOUS FOLKS WEAR HEARING AIDS Bill Clinton Don Shula Rosalynn Carter Arnold Palmer Lou Ferrigno Richard Thomas Nanette Fabray Sting Dolly Parton Mike Singletary Dr. Art Ulene EL-Egance hearing aid (shown on model in photo on Page 1D): Designed by Ryan Kirkpatrick, this equipment is part hearing aid, part jewelry.

Full text: Note: HEALTH &BEAUTY Signs you should get your hearing checked PLUS: Guide to hearing-aid styles More stylish hearing aids Page 4D

Marcia Nappi was tired.

Tired of irritating her husband by, she says, "constantly asking him to repeat everything."

Tired of missing out on conversations at the group dinners she so used to enjoy: "I could only talk to the person next to me."

Tired of no longer experiencing simple everyday joys, such as "the sounds of palm fronds blowing in the wind, and gravel shifting under my feet."

But, most of all, the part-time Jupiter resident was tired because she had to expend so much extra energy compensating for her hearing loss. "It's exhausting to try to live normally when you can't hear," she says.

So Nappi, 76, did something about it: "Twenty years ago, I got my hearing checked and began wearing hearing aids. It changed my life."

With improved hearing, Nappi began enjoying life again. But the devices weren't perfect.

"Back in those days, my hearing aids couldn't filter out background noise, so they were uncomfortable to wear in noisy environments like restaurants," she recalls.

A decade ago, she upgraded to new equipment. The technology was "much improved-- but my own voice didn't sound natural to me. Rather, I felt like I was talking into a microphone," Nappi says.

Last fall, she upgraded again-- this time, to a digital, manually adjustable model from NuEar-- and is ecstatic. "It's the truest, most natural sound in the world. They're amazing!" she gushes.

Nappi's experience is common, says Leonard Zinni, a licensed, board-certified hearing-instrument specialist and the president/owner of Advanced Hearing Center in Juno Beach.

"The technology on today's hearing aids is so far superior to what we used to have that I tell my patients, 'If it doesn't sound right, it's because it's not properly fitted or fine-tuned,'" he says.

Indeed, Zinni explains that, unlike with eyeglasses, "Hearing aids often require a gradual adjustment period-- and then ongoing evaluation. A good hearing specialist develops a relationship with his or her patients and guides them through the process."

Age-related hearing loss occurs so gradually, so insidiously, over the decades that, according to audiologist Dr. Lynn Weinberg of Professional Audiology Associates in Jupiter, "Many people do not recognize that they have hearing loss until either a family member or a friend tells them."

Weinberg notes that around one in six Baby Boomers has some hearing loss, and that, by age 65, the ratio increases to one in three.

But hearing loss impacts more than just the patient. As Zinni points out, "Your hearing loss affects everyone you come into contact with: your family, friends, co-workers, everybody."

Therefore, Zinni recommends that anyone who suspects he or she is suffering from hearing loss do something about it-- immediately.

"Reputable hearing-aid specialists will do complimentary initial exams, with no commitment required on the part of the patient," he explains.

These quick, painless exams should include a video ear inspection (to rule out any potential medical issues in the outer ear canal), as well as audiometric testing to determine what sound frequencies a patient is-- and isn't-- hearing.

Take action

What Zinni and Weinberg stress is that, left untreated, hearing loss can lead to, or exacerbate, a host of other serious conditions.

Warns Zinni: "Numerous recent studies have linked untreated hearing loss to impaired cognitive skills and a decrease in memory."

What's more, Weinberg points out, "Compromised hearing can lead to social isolation, withdrawal, depression, and even be mistaken as an early sign of dementia."

One of the biggest hurdles that those in the hearing industry face: their patients' vanity. And this vanity is on display in both genders, albeit often for different reasons: women, because of the fashion aspect; men, because they don't want to appear weak.

With today's stylish and/or virtually invisible devices, vanity should no longer be an obstacle.

But on the rare occasions when it still is, Zinni tells such patients, "A hearing aid is far less conspicuous than your hearing loss."

~steve_dorfman@pbpost.com

THESE FAMOUS FOLKS WEAR HEARING AIDS Bill Clinton Don Shula Rosalynn Carter Arnold Palmer Lou Ferrigno Richard Thomas Nanette Fabray Sting Dolly Parton Mike Singletary Dr. Art Ulene

EL-Egance hearing aid (shown on model in photo on Page 1D): Designed by Ryan Kirkpatrick, this equipment is part hearing aid, part jewelry. In addition to the ear pieces, the 'controls' come in the form of rings that the user wears on her index fingers-- and the display case doubles as a charging station for all the pieces.

Wirear hearing aid: Created a few years back by a university student in Australia, this piece is flexible, comes in several colors, and uses a 'micro fuel cell' to increase longevity.

Grandpa's bulky, manila-colored hearing aid is long gone. Today's auditory enhancers are sleek, lightweight and, to satisfy the fashion-conscious, come in a variety of colors. For more styles, log on to www.hearingaidsforwomen.com

Siemens Life hearing aid: Now you can match your outfit to your hearing aid with this line of fun, brightly colored devices.

Hear better ... and still look good!Behind the ear: The hearing technology is behind the ear, and a thin acoustical wire attaches to the canal.

Receiver in the canal: With this style, the speaker fits inside the ear canal.

In the ear: These pieces are custom-fitted to the exact ear shape of the user.
In the canal half-shell: Custom-fitted and smaller than in-the-ear pieces.
Completely in the canal: Barely visible, this is custom-fitted.
Invisible in the canal: Custom-fitted and placed so far into the ear canal that it can't be seen by anyone.
Source: www.Hearing-aid.com

Publication date: May 31, 2011

Year: 2011

Signal Processing; New Signal Processing Study Results Reported from University of Colorado

Author: Anonymous

Publication info: Electronics Business Journal (May 11, 2011): 1114.
ProQuest document link

Abstract: The researchers concluded: "The average quality ratings for music were reasonably well predicted by the hearing aid speech quality index (HASQI), but additional work is needed to optimize the index to the wide range of music genres and processing conditions included in this study."

Full text: 2011 MAY 11 - (VerticalNews.com) -- "The purpose of this study was to determine the relative impact of different forms of hearing aid signal processing on quality ratings of music. Music quality was assessed using a rating scale for three types of music: orchestral classical music, jazz instrumental, and a female vocalist," scientists in Boulder, United States report.
"The music stimuli were subjected to a wide range of simulated hearing aid processing conditions including, (1) noise and nonlinear processing, (2) linear filtering, and (3) combinations of noise, nonlinear, and linear filtering. sample: Quality ratings were measured in a group of 19 listeners with normal hearing and a group of 15 listeners with sensorineural hearing impairment. Quality ratings in both groups were generally comparable, were reliable across test sessions, were impacted more by noise and nonlinear signal processing than by linear filtering, and were significantly affected by the genre of music," wrote K.H. Arehart and colleagues, University of Colorado.
The researchers concluded: "The average quality ratings for music were reasonably well predicted by the hearing aid speech quality index (HASQI), but additional work is needed to optimize the index to the wide range of music genres and processing conditions included in this study."
Arehart and colleagues published their study in International Journal of Audiology (Effects of noise, nonlinear processing, and linear filtering on perceived music quality. International Journal of Audiology, 2011;50(3):177-190).
For more information, contact K.H. Arehart, University of Colorado, Dept. of Speech, 409 UCB, Boulder, CO 80309, United States.
Publisher contact information for the International Journal of Audiology is: Informa Healthcare, Telephone House, 69-77 Paul Street, London EC2A 4LQ, England.
Keywords: City:Boulder, State:Colorado, Country:United States, Region:North and Central America, Electronics, Signal Processing

Electronics Business Journal via VerticalNews.com.

Company / organization: Name: University of Colorado; NAICS: 611310;

Publication date: May 11, 2011

Year: 2011

Society of General Internal Medicine

Author: Anonymous

Publication info: Journal of General Internal Medicine, suppl. Supplement 26 (May 2011): 1-620.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: Society of General Internal Medicine
34th Annual Meeting Phoenix, Arizona
May 47, 2011
Building 21st Century Medicine Through Education, Research, Policy and Practice
ABSTRACTS OF SUBMISSIONS ACCEPTED FOR PRESENTATION
SCIENTIFIC ABSTRACTS
A RANDOMIZED CONTROLLED TRIAL OF SIMPLE DIAGNOSIS AND TREATMENT FOR URGENCY URINARY INCONTINENCE IN WOMEN Alison Huang 1; Rachel Hess 2; Lily Arya 3; Holly Richter 4; Leslee Subak 1; Catherine Bradley 5; Rebecca Rogers 6; Deborah Myers 7; Karen Johnson 8; Janis Miller 9; W. Thomas Gregory 10; Stephen Kraus 11; Jeanette Brown1.
1University of California, San Francisco, California ; 2University of Pittsburgh, Pittsburgh, Pennsylvania ; 3University of Pennsylvania, Philadelphia, Pennsylvania ; 4University of Alabama, Birmingham, Alabama ; 5University of Iowa, Iowa City, Iowa ; 6University of New Mexico Health Sciences Center, Albuquerque, New Mexico ; 7Brown Alpert Medical School, Providence, Rhode Island ; 8University of Tennessee Health Sciences Center, Memphis, Tennessee ; 9University of Michigan, Ann Arbor, Michigan ; 10Oregon Health Sciences University, Portland, Oregon ; 11University of Texas, Heath Sciences, San Antonio, Texas . (Tracking ID # 7411)
BACKGROUND: Urinary incontinence is a common but under-diagnosed and under-treated problem in women. The traditional extended evaluation for urinary incontinence is difficult to perform in the primary care setting, creating a significant barrier to treatment. A simple 3-item measure to diagnose and classify incontinence in women (the 3 Incontinence Questions) was developed to facilitate diagnosis and treatment of this problem. However, the efficacy and safety of using this measure to initiate treatment for incontinence are unknown.
METHODS: In this double-blind, multicenter, clinical trial, 645 ambulatory women who self-identified as having urgency-predominant
incontinence using the 3 Incontinence Questions and denied other major urologic or neurologic co-morbidities were randomized to 12 weeks of pharmacologic therapy with fesoterodine (participant-directed dosing of 4 to 8 mg daily)(N=322) or placebo (N=323). Frequency of urgency incontinence and other urinary symptoms was assessed at baseline and 12 weeks using voiding diaries in which women recorded all incontinence and voiding episodes over a 3-day period. Safety was assessed through adverse event monitoring and measurement of post-treatment postvoid residual volume (PVR), with specialist referral for PVR of 250 mL or greater or clinical

safety concern. Treatment effects on urinary symptoms and safety outcomes were examined using analysis of covariance models, with adjustment for baseline values as well as clinical site.
RESULTS: Mean (SD) age of participants was 56 (14) years, and mean (SD) baseline urgency incontinence frequency was 3.9 (3.0) episodes per day. After 12 weeks, participants in the fesoterodine group reported an average of 0.9 fewer instances of urgency incontinence, 1.0 fewer instances of total incontinence, and 0.9 fewer urgency-associated voids per day, compared to placebo (P.001 for all). Four serious adverse events occurred in each treatment group; no serious adverse events were related to pharmacologic therapy. Mean (SD) postvoid residual volume after 12 weeks was 39 (48) mL in the fesoterodine versus 31 (39) mL in the placebo group (P=.04). No participant developed a post-treatment PVR of 250 mL or greater or required specialist referral for a safety concern.
CONCLUSION: Among ambulatory women with urgency urinary incontinence diagnosed using a simple 3-item measure, pharmacologic therapy with fesoterodine resulted in a moderate decrease in urgency incontinence frequency, without causing significant urinary retention or increasing serious adverse events. These findings support the initial efficacy and safety of a streamlined diagnostic and treatment algorithm for urgency incontinence among women who are appropriate for evaluation and treatment in primary care.
S2 ABSTRACTS JGIM
SUBCLINICAL HYPERTHYROIDISM AND MORTALITY Tinh-Hai Collet 1; Jacobijn Gussekloo 2; Douglas C. Bauer 3; Wendy P.J. den Elzen 2; Philippe Balmer 4; Giorgio Iervasi 5; Anne R. Cappola 6; BjrnO. svold 7; Jose A. Sgarbi 8; Rui M.B. Maciel 9; Sabrina Molinaro 10; Alexandra Bremner 11; Patrick Maisonneuve 12; Jacques Cornuz 1; Anne B. Newman 13; Kay-Tee Khaw 14; Rudi G.J. Westendorp 15; John P. Walsh 16; Eric Vittinghoff 3; Jayne A. Franklyn 17; Nicolas Rodondi1. 1Department of Ambulatory Care and Community Medicine, University of Lausanne, Lausanne, N/A ; 2Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, N/A ;
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9Escola Paulista de Medicina, Federal University of Sao Paulo, Sao Paulo, N/A ; 10Institute of Clinical Physiology, Pisa, N/A ; 11School of Population Health, University of Western Australia, Crawley, N/A ; 12Division of Epidemiology and Biostatistics, European Institute of Oncology, Milano, N/A ; 13Department of Epidemiology, University of Pittsburgh, Pittsburgh, Pennsylvania ; 14Department of Public Health and Primary Care, University of Cambridge, Cambridge, N/A ; 15Department of Gerontology and Geriatrics, LeidenUniversity MedicalCenter, Leiden, N/A; 16Department of Endocrinology &Diabetes, Sir Charles Gairdner Hospital, Nedlands, N/A ; 17School of Clinical and Experimental Medicine, College of Medical and Dental Sciences, University of Birmingham, Birmingham, N/A . (Tracking ID # 7438)
BACKGROUND: Data regarding the association between subclinical hyperthyroidism and cardiovascular outcomes are conflicting among large
prospective cohort studies. This might reflect differences in participants age, gender, thyroid-stimulating hormone (TSH) levels or preexisting cardiovascular disease. We aimed to assess the risks of coronary heart disease (CHD) and total mortality associated with subclinical hyperthyroidism. METHODS: We searched MEDLINE and EMBASE without language restrictions, and reference lists of retrieved articles to find prospective cohort studies with baseline thyroid function assessment and follow-up of subsequent total mortality, CHD mortality and CHD events. Individual data on 49,030 participants with 458,686 person-years of

follow-up between 1981 and 2007 were supplied from 9 prospective cohorts in the United States, Europe, Australia and Brazil. We examined the risk of CHD events in 22,676 participants from 6 cohorts with available data. Euthyroidism was defined as a TSH 0.45-4.49 mIU/L and subclinical hyperthyroidism as a TSHRESULTS: Among 49,030 adults, 1,300 had subclinical hyperthyroidism (2.7%) and 47,730 had euthyroidism. During follow-up, 7,988 participants died (1,794 of CHD); 3,740 out of 22,676 participants had CHD events. After exclusion of thyroid-altering medication users at baseline (N=239, 0.5% of all participants), age and gender-adjusted risks of total mortality, CHD mortality and CHD events were increased (Table), with limited statistical heterogeneity across studies (I square=0% to 33%). Risks of total and CHD mortality were increased with lower TSH levels (Table), although borderline significant for total mortality (p for trend 0.053 and 0.01, respectively). Risks did not significantly differ by age, gender, race, or preexisting cardiovascular disease. Results were similar after further adjustment for cardiovascular risk factors.

CONCLUSION: Subclinical hyperthyroidism is associated with an increased risk of total and CHD mortality. The risks are higher with lower TSH, particularly in those with TSH below 0.10 mIU/L. Future studies should assess which conditions increase the risk of total and cause-specific mortality associated with subclinical hyperthyroidism.

Table 1:

No. outcomes / participants	TSH <0.45 mIU/L vs. euthyroidism: HR (95% CI)	TSH 0.10-0.44 vs. euthyroidism: HR (95% CI)	TSH <0.10 vs. euthyroidism: HR (95% CI)	P for trend *
Total mortality				
7'920 / 48'791	1.28 (1.09-1.50)	1.27 (1.07-1.50)	1.33 (1.02-1.73)	0.053
CHD mortality				
1'779 / 48'783	1.32 (1.02-1.72)	1.29 (0.96-1.73)	1.89 (1.12-3.19)	0.01
CHD events				
3'695 / 22'437	1.20 (0.99-1.45)	1.27 (1.03-1.56)	1.07 (0.68-1.67)	0.63

CHD: coronary heart disease; CI: confidence interval; HR: hazard ratio; TSH: thyroid-stimulating hormone.* P for trend across TSH categories (euthyroidism 0.45-4.49 mIU/L, TSH 0.10-0.44 mIU/L, and TSH <0.10 mIU/L)

DISCOVERY OF THE APPRENTICE EFFECT: FIRST YEAR STUDENTS ARE OVERWHELMED AND RETICENT. C. Smith 1;
William Hill 2; Magdalena Morris 2; Chris Francovich 3; Francine Langlois-Winkle 2; Bruce Robbins 4; Lynne Robins 1; Andrew Turner5.
1University of Washington, Boise, Idaho ; 2Boise VAMC, Boise, Idaho ;
3Gonzaga University, Boise, Idaho ; 4Boise State University, Boise, Idaho ; 5University of Idaho, Boise, Idaho .
(Tracking ID # 7471)

BACKGROUND: Studies of diagnostic reasoning have identified an intermediate effect, where mid-level learners generate more propositional assertions than novices or experts when solving clinical problems. Expert knowledge is encapsulated rather than being lost or disconnected. None of these investigations have studied premedical students. We report here on part of a larger study about the nature of expert knowledge encapsulation.

METHODS: Semi-structured interviews were audio taped for ten each of premedical students (P), first year medical students (MS1), third year medical students (MS3), second year medicine residents (R), and experienced medicine faculty (F). Simultaneously, a process observer recorded emotional tone using a validated tool. Transcripts blinded to learner level were created. Transcripts were analyzed in two ways. One team used grounded theory, identifying salient categories in the data, coming to agreement about the set of categories, and scoring each passage for these categories. Another analyst performed a propositional analysis, identifying IF-THEN assertions and organizing these into propositional maps.

RESULTS: Grounded theory analysts identified 17 salient categories in the transcript data. Inter-rater reliability after a single adjudication session was 81% and was 92% for the final analyses. The category for this analysis struggling with disease definition was scored as follows [Group (# text units)}: PM (117), MS1 (174), MS3 (17), R (24), and F (1). For example, Ill never be able to learn that muchbut something thats really helped, knowing people who have done it. I mean the fact that there are doctors, doctors exist, so it must be possible (MS1). Also, the number of text units in the categories history and disconfirming example increased with expertise, while the number in physical and tests peaked at the R level. The average number of propositions per group was as follows: PM 4.2+/2, MS12.3+/ 1.8, MS3 8.4+/3.1, R 12.4+/5.4, and F 9.6+/4.2. The word count per transcript steadily increased with expertise. Propositional maps for MS1s were blunted compared with all other groups, and focused on a desire for concreteness. For instance, I feel like labs would help a lotx-rays or CT scans (MS1). Emotional tone averaged 0.23 (aroused) for PM, -0.067 (tense) for MS1, 0.42 (alert) for MS3, 0.51 (alert) for R, and 0.78 (excited) for F. One R scored sad (recounting a patient who had recently died) and three F were the only interviewees to score calm.

CONCLUSION: Triangulation between grounded theory categories, propositional analysis, and process observation suggest that the MS1 year is particularly difficult. Much of this difficulty is due to the volume of information and the lack of an organizing conceptual structure. It is not known whether this is a developmental or curricular effect.

NO TIME TO THINK ABOUT HEATH: EXPLANATORY MODELS OF CARDIOVASCULAR DISEASE AMONG BENGALI IMMIGRANTS Mihir Patel 1; Lhasa Ray 2; Erica Phillips-Caesar 1; Carla Boutin-Foster1.
1Weill Cornell Medical College, New York, New York ; 2New York Presbyterian Hospital, New York, New York .
(Tracking ID # 7487)

BACKGROUND: Bengalis, a South Asian ethnic subgroup, make up an increasing portion of the South Asian immigrant population and have the highest prevalence, the earliest onset, and the most severe manifestations of cardiovascular disease (CVD) among all South Asian subgroups. Few studies have focused on the explanatory models of cardiovascular disease among the Bengali population. The objective of this study was to apply Kleinmans Explanatory Model of Disease as a framework to elicit perspectives on cardiovascular disease among a cohort of Bengali immigrants.

METHODS: This was a qualitative study conducted among patients of Bengali origin who were recruited from a Federally Qualified Health Center in New York City. These health centers provide comprehensive community based primary care and social services to underserved communities. Eligible patients were those identified from the practice site that were 18 or older and able to speak English. Demographic data also included years of

residence in the US and acculturation assessment. The electronic medical records were used to collect data on cardiovascular risks such as height, weight, lipid profile, and blood pressure. Individual interviews using open-ended questions based on Kleinmans model were used to identify an explanatory model of cardiovascular disease. Participants were asked to reflect on experiences that they or members of their social network (friends, co-workers, or family) had with heart disease and describe what cardiovascular disease meant to them, what they thought caused it, and how it could be prevented.
RESULTS: A total of 60 Bengali patients were interviewed with two-thirds being male patients. The average age was 43 years. The average length of time in the U.S. was 16 years and 5 months, while the Marin acculturation score averaged moderately low at 8.6. Half of subjects finished college, yet most worked in semi-skilled jobs. Two-thirds of patients were obese by BMI and 88% displayed central obesity. Fifty-nine percent were sedentary expending less than 1000 kcal of energy per week. Mean blood pressure was 111/70 mm Hg. Average total cholesterol was 172 mg/dL, mean LDL was 102 mg/dL, mean HDL was 41 mg/dL, and mean triglyceride level was 155 mg/dL.
The most frequent themes surrounding the meaning of CVD involved stress and fear. For example, one participant said, Its very very scary. If this should happen (to me) what would I do? Much of these perceptions stemmed from experiences a relative had rather than their own personal

experiences. The major themes describing causative factors included having too much stress related to work and caring for ones family as well as lack of time to practice healthy lifestyle habits. Acquiring CVD was felt to be related to hard work and not taking proper rest. I have to take care of my family in Bangladesh and here. I have to think about too much stuff. Another patient said that because of no time we dont think about health, we think about other things. Themes regarding how to prevent CVD included individual physician guidance on healthy lifestyles as well as education targeting the entire Bengali community. For example, one participant explained that others need a lot of help. They need to have a Bangladeshi doctor, diet, and exercise. Another said, Actually we should alert people, I think a talk show would be great, you know on Bengali channels.
CONCLUSION: These findings point to several culturally patterned belief systems about cardiovascular disease that need to be integrated when developing interventions or counseling individual Bengali patients about CVD. The meaning, the etiology, and the prevention of cardiovascular disease were all centered around the major theme of stress related to work and of taking care of the family in the US and back home in Bangladesh. These findings will be used to develop a community-based intervention that focuses on stress reduction, work-life balance and education about lifestyle habits.
DURATION OF THE RISK OF VTE IN US MEDICAL PATIENTS Alpesh Amin 1; Helen Varker 2; Jay Lin 3; Stephen Thompson 4; Stephen Johnston2. 1University of California-Irvine, Orange, California ; 2Thomson Reuters, Washington, District of Columbia ; 3Bruce Wong &Associates Inc., Radnor, Pennsylvania ; 4sanofi-aventis U.S., Inc, Bridgewater, New Jersey . (Tracking ID # 7502)
BACKGROUND: The risk of developing venous thromboembolism (VTE) is significantly increased in patients hospitalized for medical illness. The incidence and time course of VTE events following hospitalization for medical illness was retrospectively assessed in a large, real-world patient population. METHODS: Administrative claims data derived from the Thomson Reuters MarketScan Inpatient Drug Link File were used to identify patients with hospitalization for severe infectious disease, congestive heart failure, cancer, or chronic obstructive pulmonary disease. Included patients had been admitted to hospital between January 1, 2005, and December 31, 2008. Included patients had been continuously enrolled for >12 months prior to admission (patient history) and >180 days after admission, and were required to have received any pharmacological prophylaxis during their hospitalization. The cumulative risk and hazard of VTE measured as the number of VTE events per 1,000 person-days were established across an evaluation period of 180 days.
RESULTS: The study cohort consisted of 5,200 medical patients, with a mean (standard deviation [SD]) age of

68.9 (13.0) years and 51.0% were female. The mean (SD) length of stay in hospital was 6.5 (6.1) days, during which patients received VTE prophylaxis for a mean (SD) duration of 5.0 (4.7) days. 16.0% of patients received anticoagulation therapy within the period extending from discharge to 35 days after discharge. Appropriateness of prophylaxis was not determined. A total of 239 VTE events occurred during the 180-day evaluation period and 127 (53%) of these events occurred during the index hospitalization. The highest number of VTE events occurred during the first 9 days (71 events, 89% in-hospital; proportion of 180-day cumulative risk ~20%) and during days 1019 (64 events, 78% inhospital; proportion of 180-day cumulative risk ~52%) following index admission. VTE hazard peaked at approximately 1.7 per 1,000 person-days on the 8th day following admission, and 50% had been incurred by the 18th day. VTE frequency then further decreased
during days 2029 (17 events, 47% in-hospital; proportion of 180-day cumulative risk ~62%) and gradually declined thereafter, fluctuating at a background level of 19 events during each 10-day interval up to 170180 days.
CONCLUSION: Among the cohort of 5,200 at-risk medical patients who received pharmacological prophylaxis for VTE, 4.6% experienced an incident VTE event during the 180-day evaluation period following index hospitalization. Half of these events occurred post-discharge. The risk of VTE was highest within the first 19 days after index admission. Results from this study indicate that a non-trivial risk of VTE extends into the period after discharge. Acknowledgment: This study was funded by sanofi-aventis U.S., Inc. The authors received editorial/writing support in the preparation of this abstract provided by Tessa Hartog, PhD, of Excerpta Medica, funded by sanofi-aventis U.S., Inc.
INTERPERSONAL DISCRIMINATION AND HEALTH UTILITY SCORES AMONG BLACK AND WHITE MEN AND WOMEN IN THE UNITED STATES Janel Hanmer 1; Sherrill Sellers 2; Dasha Cherepanov 3; Dennis Fryback4. 1University of Iowa, Iowa City, Iowa ; 2Miami University, Oxford, Ohio ; 3UCLA, Los Angeles, California ; 4University of Wisconsin, Madison, Wisconsin . (Tracking ID # 7628)
BACKGROUND: Very little is known about the prevalence of discrimination across race and gender. While discrimination has been shown to impact health, no studies to date have examined the association between discrimination and health utility scores.
METHODS: We examined data from the National Health Measurement Study(NHMS), a nationally representative sample of 3844 adults aged 35 to 79 in the non-institutionalized US population. These data include self-reported lifetime and everyday discrimination as well as several health utility indexes (EQ-5D, HUI3, and SF-6D used here). Weighted health utility means and percentages for discrimination were computed separately within four gender by race subgroups. Each gender by race group was further stratified by discrimination scale scores and multiple regression to compute mean HRQOL scores adjusted for age, income, education, and chronic diseases. All analyses used survey weights to account for the sampling design of NHMS.
RESULTS: Black men reported the highest lifetime discrimination scores, followed by black women; white women tended to report the least lifetime discrimination. The distribution of everyday discrimination scores was very similar for black men and women; white mens and womens scores shifted toward the low-discrimination end of the scale compared to blacks. Health utility tended to get worse as reported discrimination increased. With a few exceptions, differences between mean health utility scores in the lowest and highest discrimination groups exceeded the 0.03 difference generally considered to be a clinically significant difference.
CONCLUSION: Persons who experienced interpersonal discrimination tended to score lower on health utility measures. Understanding the pathways by which discrimination may impact health utility scores is important if we are to improve health-related quality of life.
INCIDENCE OF CARDIOVASCULAR EVENTS FOLLOWING HOSPITAL ADMISSION FOR PNEUMONIA Eric Mortensen 1; Theodore Perry 2; Brandy Nakashima 3; Marcos Restrepo 1; Antonio Anzueto2. 1VERDICT/ STVHCS, San Antonio, Texas ; 2UTHSCSA, San Antonio, Texas ;

3VERDICT/STHVCS, San Antonio, Texas . (Tracking ID # 7793)
BACKGROUND: Studies suggest an increased risk of cardiovascular events, primarily acute myocardial infarction, around the time of hospital admission for pneumonia. Therefore we examined incident

cardiovascular events, including myocardial infarction, congestive heart failure, unstable angina, stroke, and serious cardiac arrhythmias, within 90 days after hospitalization for pneumonia.
METHODS: Using data from the administrative databases of the Department of Veterans Affairs, we examined a cohort of subjects hospitalized with pneumonia between October 2001 and September 2007. Subjects were at least 65 years of age. We examined the incidence of an inpatient diagnosis of myocardial infarction, congestive heart failure, cardiac arrhythmias, unstable angina, and stroke by ICD-9 codes excluding those with the same diagnosis prior to the admission for pneumonia. RESULTS: The cohort comprised 50,119 subjects with a mean age of77.5 years (standard deviation 6.7 years), and 98% of the cohort was male. The 90-day incidence of cardiovascular events was 1.5% for myocardial infarction, 10.2% for congestive heart failure, 9.5% for arrhythmia, 0.8% for unstable angina, and 0.2% for stroke. The majority of events occurred during the initial hospitalization for pneumonia. CONCLUSION: A clinically important number of subjects in this cohort suffered a cardiovascular event within 90 days of hospital admission, suggesting that such events may have an important role in post-pneumonia mortality. Additional research is needed to determine whether interventions may reduce cardiovascular events after pneumonia.
ADIPONECTIN AND ALL-CAUSE MORTALITY IN A COHORT OF ELDERLY PEOPLE WITH TYPE 2 DIABETES Jessica Rohman Singer 1;
Walter Palmas 1; Steven Shea 1; Jose Alejandro Luchsinger1. 1Division of General Medicine, Department of Medicine, Columbia University College of Physicians and Surgeons, New York, New York . (Tracking ID # 7871)

BACKGROUND: Nearly a quarter of Americans over the age of 60 are estimated to have type 2 diabetes. The Action to Control Cardiovascular Risk in Diabetes Trial demonstrated that tight glycemic control was associated with increased mortality, while tight lipid and blood pressure control had no association with mortality. These surprising findings raise the possibility of novel predictors of mortality in people with type 2 diabetes. We sought to explore whether insulin resistance measured by adiponectin level was related to increased mortality in people with type 2 diabetes. High levels of adiponectin are known to be associated with lower risk of developing type 2 diabetes, but no data have been published to our knowledge regarding the association of adiponectin level and mortality specifically in patients with type 2 diabetes. Data regarding adiponectin level and mortality in non-diabetic populations are inconsistent. METHODS: Participants were a subsample of 627 subjects from the Informatics for Diabetes Education and Telemedicine project (IDEATel) who were enrolled in a substudy. IDEATel was a CMS supported randomized controlled trial designed to evaluate the effectiveness of telemedicine case management in elderly Medicare beneficiaries with type 2 diabetes but without severe co-morbid disease. Subjects were enrolled in IDEATel from December 2000 to October 2005. Adiponectin was measured on frozen serum samples for all subjects and mortality data were collected from the National Death Index through 11/30/2009. ANOVA and Chi-square were used to compare relevant continuous and categorical variables across quartiles of adiponectin. Cox proportional hazards regression was performed to examine the relationship between adiponectin level and all-cause mortality adjusting for age, gender, race/ ethnicity, hemoglobin A1c, blood pressure, LDL, HDL, triglycerides, BMI, albumin/creatinine ratio, c-reactive protein, active tobacco use and medication usage, specifically thiazolidinediones (TZDs).
RESULTS: Subjects had a mean age of 72, were 70% women, 83% Hispanic and 15% African American. Compared to the lowest adiponectin quartile, those in the highest adiponectin quartile had higher HDL

(51.4+/16.7 vs. 42.7+/12.3; p< 0.001), higher log albumin/
creatinine (1.6+/0.6 vs 1.3+/0.5; p=0.0037), higher frequency of TZD use (58.6% vs. 5.8%; p<0.0001), lower triglycerides (121.6+/61.3 vs 144.6+/77.9; p=0.005) and lower CRP (0.3+/1.3 vs. 1.0+/1.3; p<0.0001). Cox regression models demonstrated that compared with those in the lowest quartile of adiponectin, those in the highest adiponectin quartile had an increased hazard of death with a fully adjusted hazard ratio of 4.0 (95% CI 1.7, 9.2); p-value=0.0003 for trend across quartiles of adiponectin level (Table 1). These results remained consistent when the analysis was stratified by age, gender and TZD usage and after excluding those subjects who died within one year of adiponectin sampling. We conducted a secondary analysis in a sample of 464 participants for whom we were able to calculate change in weight predating the adiponectin measurement. After adjustment for weight gain or loss of more than 10% of body weight, the association between adiponectin and higher mortality remained significant with a fully adjusted hazard ratio of 3.1 (95% CI 1.2, 7.9); p=0.01 for trend across quartiles of adiponectin level.
CONCLUSION: Higher adiponectin level was associated with higher all-cause mortality in a cohort of elderly people with type 2 diabetes.
Table 1:
Adiponectin Quartile Hazard Ratio (95% CI) 1 Reference2 1.5 (0.7, 3.5)3 2.8 (1.3, 6.2)4 4.0 (1.7, 9.2)p-value for trend 0.0003
A RANDOMIZED PILOT TRIAL OF A FULL SUBSIDY VERSUS A PARTIAL SUBSIDY FOR OBESITY TREATMENT Adam Gilden Tsai 1;
Sue Felton 1; James O. Hill 1; Adam J Atherly1. 1University of Colorado, Denver, Colorado . (Tracking ID # 7895)
BACKGROUND: Federal health care reform stipulates that services receiving an A or B recommendation from the U.S. Preventive Services Task Force will be covered without cost sharing. One such service is intensive weight loss counseling. Intensive counseling is costly ($1200 per person in the first year of the Diabetes Prevention Program). The need to provide treatment must be balanced against cost. A partial subsidy has been modeled as a cost-effective way to deliver obesity treatment. This pilot randomized trial tested the feasibility and initial efficacy of a partial versus a full in-kind subsidy during a short term weight loss program. We hypothesized that full subsidy of the program, as compared to partial subsidy, would lead to similar weight lossesi.e., delivering equal clinical benefit at lower cost.
METHODS: Participants were recruited from primary care practices at the University of Colorado. They had a body mass index of 3049.9 kg/ m2, plus one related medical diagnosis: 1) type 2 diabetes; 2) hypertension; 3) dyslipidemia; or 4) obstructive sleep apnea. They were randomized to receive 2 meals per day of portion-controlled food (full subsidy) or to receive 1 meal per day (partial subsidy) for a period of 14 weeks. Participants randomized to the partial subsidy condition were advised to purchase 1 meal per day of portion-controlled foods on their own. Weight loss counseling (8 visits) was provided without cost to all participants. Visits were led by a trained lay provider. Written materials were adapted from the Diabetes Prevention Program. The primary outcome was weight loss. Secondary outcomes were blood pressure, waist circumference, and health-related quality of life.

RESULTS: A total of 50 persons were randomized. Participants had an average BMI of 38.1 kg/m2 and were taking an average of 5.4 prescription medications; 50% were men and 25% were ethnic minority. Participants in the full subsidy and partial subsidy groups lost 5.9 and5.3 kg, equal to 5.3% and 5.1% of initial weight (p=0.71 for difference). No significant between-group differences were seen for changes in blood pressure, waist circumference, or health-related quality of life. Post-hoc analyses showed that two measures of adherence correlated with weight loss: 1) frequency of portion-controlled food use; and 2) days of food records kept.
CONCLUSION: Participants that paid for half of their food in an obesity treatment program lost a clinically

similar amount of weight (5.1%) as did participants that received all of their food for free (5.3%). As expected, individuals that were more adherent lost a greater amount of weight. These results suggest that a partial subsidy could be an effective method to lower the cost of obesity treatment, without reducing its efficacy. The estimated cost of treatment in the partial subsidy condition was less than the cost of 1 year of attending Weight Watchers. These results require replication in larger trials. If confirmed, the implications would be clear: more individuals can undergo treatment at a lower cost. Such a finding would be highly relevant, given the mandate of health care reform to provide obesity treatment to more people.

INCREASING RATES OF PSYCHOSTIMULANT-RELATED DEATHS Susan Calcaterra 1; Ingrid Binswanger1. 1University of Colorado, Aurora, Colorado . (Tracking ID # 7907)

BACKGROUND: Methamphetamine and other psychostimulants, like dextroamphetamine (Adderall) and methylphenidate (Ritalin), are highly addictive and widely abused. Their use has increased during the last decade in the United States. Little is known about psychostimulant-related death or predisposing risk factors to death. This study was designed to assess trends in psychostimulant-related deaths in the United States from 1999 to 2006. We expected that psychostimulant-related deaths would increase, paralleling the increased use reported in the 2005 National Survey on Drug Use and Health.

METHODS: We reviewed all deaths in the United States from 1999 2006 using death certificate data stored in the CDC Wonder Database. We determined the number of deaths, age-adjusted death rates (number deaths per 100,000 person years [p-y] and 95% confidence interval [CI]), age group, gender, race, state of residence upon death, and primary cause of death for all decedents with the ICD-10 code T43.6, poisoning by psychostimulants with abuse potential.

RESULTS: Psychostimulant-related deaths increased over a 7-year period. The death rate was 0.2 per 100,000 p-y (95% CI 0.2-0.3) in 1999 (n=700) and climbed to 0.7 per 100,000 p-y (95% CI 0.7-0.7) during 2005 (n=2023). There was a slight decline in the rate of psychostimulant-related deaths during 2006 (n=1848) to 0.6 per 100,000 p-y (95% CI 0.6-0.6). Those decedents aged 3544 years had the highest death rate among all age groups (1.4 per 100,000 p-y, 95%CI 1.3-1.4). The death rate related to psychostimulants abuse among men (0.9 per 100,000 p-y, 95% CI 0.9-1.0) was two times higher than among women(0.4 per 100,000, 95% CI 0.3-0.4). American Indians/Alaska Natives had the highest overall death rate (1.6 per 100,000 p-y) compared to Non Hispanic whites (0.7per 100,000 p-y, 95% CI 0.7-0.8). Psychostimulant-related deaths clustered in the Western United States. For instance, Nevadas death rate 3.6 per 100,000 p-y during 20052006. The most common primary cause of death in those who died with psychostimulants was accidental poisoning. The death rate from accidental poisoning involving psychostimulants increased from 0.2 to0.5 per 100,000 during the years 19992006. Other common primary
causes of death included mental and behavioral disorders due to the use of psychoactive substances, intentional self poisoning, and ischemic heart disease.

CONCLUSION: Psychostimulant-related deaths increased from 1999 2005 with a slight decrease in 2006, and was especially prominent in the Western U.S. Alaska Natives/American Indians are disproportionately over-represented in psychostimulant-related deaths. The most common cause of death was accidental overdose. Policy passed in 2005, the Combat Methamphetamine Act, which limited over-the-counter sales of pseudoephedrine and ephedrine, may account for the slight decrease in psychostimulant-related deaths seen in 2006. Further data are needed to assess this trend. Limitations in this study relate to the ICD-10 coding for psychostimulants which are not sufficiently sensitive to determine whether deaths were related to methamphetamine vs. pharmaceutical psychostimulants. Further interventions need to be developed to reduce the risk of death from psychostimulants.

ORAL HYDRATION AND ALKALINIZATION IS NON-INFERIOR TO INTRAVENOUS THERAPY FOR PREVENTION OF CONTRAST INDUCED NEPHROPATHY IN PATIENTS WITH CHRONIC KIDNEY DISEASE Roy Cho 1; Nosheen Javed 1; Darren Traub 1; Sobhan Kodali 2; Folefac Atem 3; Venkatraman Srinivasan4.

1Western Pennsylvania Hospital, Pittsburgh, Pennsylvania ; 2WPH, Pittsburgh, Pennsylvania ;
3UPMC, Pittsburgh, Pennsylvania . (Tracking ID # 7939)
BACKGROUND: The increased risk for contrast-induced nephropathy (CIN) in patients with chronic kidney disease (CKD) undergoing coronary angiography (CAG) has been established. Current and historical data on CIN prevention strategies have shown wide variation with respect to the optimal type, route and timing of these therapies. We hypothesize that oral hydration and/or oral sodium bicarbonate is non-inferior to intravenous hydration and/or sodium bicarbonate in the incidence of CIN in patients with CKD undergoing CAG.
METHODS: This is a prospective study randomizing patients with CKD undergoing CAG into 4 groups: 1) Intravenous normal saline, 2) Intravenous normal saline and intravenous bicarbonate, 3) oral hydration, and 4) oral hydration and oral bicarbonate. Groups 1 and 2 are defined as standard of care regimen. The primary endpoint is the occurrence of CIN defined as greater than 25% increase or absolute increase of 0.5 mg/dL in serum creatinine from baseline to 72 hours following exposure to radiocontrast. Secondary endpoints include the length of hospitalization and in-house mortality.
RESULTS: A total of 91 patients (p=0.05; power=0.8) were randomized into four treatment groups. There were no statistical differences in baseline demographics between the four groups. Baseline serum

creatinine and total contrast exposure was similar among the four groups. We found no statistical significance in incidence of CIN between our intervention strategy and standard of care regimen (p=0.617 and p=0.525).
CONCLUSION: Oral hydration was non-inferior to intravenous CIN prevention strategies in this single center study. These findings may support oral route as a novel approach in prevention of CIN in patients with CKD undergoing CAG.

IMPACT OF INTERNAL MEDICINE RESIDENT WORKLOAD AND HANDOFF TRAINING ON THE QUALITY OF CARE IN HOSPITALS Stephanie K. Mueller 1; Stephanie A. Call 2; Furman S. McDonald 3; Andrew J. Halvorsen 3; Jeffrey L. Schnipper 4; LeRoi S. Hicks1.
1Brigham and Womens Hospital, Boston, Massachusetts ; 2Virginia Commonwealth University, Richmond, Virginia ; 3Mayo Clinic, Rochester, Minnesota ; 4Brigham and Womens Hospital, Sharon, Massachusetts .
(Tracking ID # 7942)
BACKGROUND: Recent modifications to Accreditation Council for Graduate Medical Education (ACGME) duty hour restrictions have resulted in increased transitions of care by housestaff and variation of resident workload in clinical settings. In this study, we evaluated the association between resident workload, transitions of care training and evaluation, and patient outcomes.
METHODS: We linked the 2008 survey of Association of Program Directors of Internal Medicine (APDIM) to the 2008 Hospital Quality Alliance (HQA) and 2007 American Hospital Association (AHA) databases in order to assess if resident workload and training and evaluation of patient hand-offs are associated with outcomes of 30 day readmission rate and mortality rate for 3 conditions: acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia. Predictors of interest were residency program training and evaluation of patient hand-offs (both yes vs. no) and resident workload, characterized by

reported average maximum number of patients per intern on non-call days (maximum census) and average maximum number of patients admitted per intern on call days (maximum number of admissions) during general medicine rotations. We utilized linear regression models to examine the relationship between these predictors and each study outcome, controlling for hospitals geographic location, ownership, setting (urban versus rural), nursing intensity (nurses/1000 patient days), teaching intensity (resident/beds), presence of an ICU, and insurance mix, and the residency programs board certification three-year pass rates and affiliation with a

cardiology fellowship. RESULTS: Of the 372 internal medicine residency programs surveyed, 268 (72%) responded. Of these, 180 (67%) programs reported training housestaff in conducting hand-offs and 133 (50%) programs reported evaluating housestaff in hand-offs. The mean maximum census was 11 patients on non-call days with a mean maximum of 5 patients admitted on call days. Results of the multivariate analysis demonstrated no association between hand-off training or evaluation or resident work load on readmission rates for any condition, or mortality rates for AMI or CHF. However, programs that evaluated their residents on patient hand-offs had a significantly increased adjusted pneumonia mortality rate(11.4% versus 10.8%, p=0.03) and programs that trained their residents on hand-offs had a significantly decreased adjusted pneumonia mortality rate (10.9% versus 11.8%, p=0.005) compared with programs that did not.
CONCLUSION: In this nationally-representative study of internal medicine residency training programs and their primary affiliated hospitals, we found no association between resident workload and evaluated outcomes. There were discordant findings on pneumonia mortality rates in programs that evaluate and programs that train their housestaff on patient hand-offs. Programs that evaluate their residents on care transitions have significantly higher pneumonia mortality rates than programs that do not, possibly suggesting programs with poorer outcomes are more likely to evaluate housestaff on hand-offs. Conversely, programs that provide hand-off training show significantly decreased mortality rate for pneumonia than programs that do not. This association between care transitions training and outcomes is particularly important in todays climate of further duty hour restrictions necessitating increased hand-offs. Future work must further assess the impact of care transitions on quality of care, including process measures, in order to further characterize these findings.

PHYSICIAN COMPLIANCE WITH IMMUNIZATION IN ADULTS65 YEARS OF AGE IN AN ACADEMIC SETTING: ARE WE NEGLECTING AN OZ. OF PREVENTION? Peters Okonoboh 1; L. Mary Mathew1.
1Unity Health System, Rochester, New York . (Tracking ID # 8076)

BACKGROUND: The efficacy of vaccines in the prevention of infectious diseases is well established. Despite the obvious efficacy, the national rate of immunization remains low. In 2009, the national average for pneumococcal and Influenza vaccination were 61% and 67% respectively.
METHODS: We conducted a Quality Improvement (QI) project at the Unity Faculty Practice (UFP); a resident-run, faculty supervised ambulatory longitudinal clinic experience. This is an academic practice involving 40 medicine residents supervised by 7 faculty members. We looked at the rates of recommended immunizations in patients 65 years per ACIP guidelines , i.e. Influenza, Pneumococcal, Tetanus and Zoster Vaccinations. A retrospective review of Electronic Medical Records (EMR) of eligible patients seen at the UFP was done. The study period
spanned from 20062010; information on 259 patients were retrieved and analyzed.
RESULTS: The average rate for Pnuemovax vaccination was 70.4% with a range of 36.8% - 90%, for Influenza vaccination, the average rate was53.75% (26.3% - 90%). For Tetanus vaccination the average rate was41.25% (2.5% - 85%) while for Zoster vaccine, the average rate was18.3% (7.5% - 35%).
CONCLUSION: The QI project showed a wide variation in compliance of immunizations rates among the 7 faculty members. Despite the academic setting, the rate of immunization was well below the CDC 2010 goals of 90% for both pneumococcal and influenza vaccines. This underscores the role of the teaching attendings to remind residents about the simple, inexpensive yet powerful tools of primary prevention through immunizations. The internal medicine Residency is a period where principles of prevention and their far reaching benefits need to be enforced by the faculty. The General Medicine Faculty should serve as role models in the practice of ACIP recommendations. In this day of high technology treatment that benefits an individual patient, one cannot forget the basic principles of preventive medicine that benefits large population groups.

STUDENT HEALTH REFUGEE EDUCATION COLLABORATIVE (SHREC) Crystal A Medina 1; Eva Aagaard2.
1UC Denver SOM, Denver, Colorado; 2UC Denver SOM, Aurora, Colorado. (Tracking ID # 8085)

BACKGROUND: Refugees are recognized as one of the poorest and most medically underserved populations

in Denver. Often fleeing as a direct result of conflict or persecution in their country of origin, refugees frequently endure malnutrition, physical violence, sexual assault, psychological trauma, and severe deprivation from basic necessities before they ever arrive in the United States. Implicit in these findings is the realization that refugee healthcare cannot be effective without comprehensive culturally appropriate care. The overall purpose of the Student Health Refugee Education Collaborative (SHREC) project is to perform a comprehensive assessment of the needs of the Denver Refugee population. To date, surveys and interviews with key informants and providers have been performed. However, information was still lacking on the perceptions of the refugees themselves. Our purpose was to assess refugee perception of their health and healthcare needs and the feasibility of a student-led service learning program within this population.
METHODS: Forty-five refugees participated in five focus groups from July 2009 to October 2010. Questions focused on the refugees understanding of illness, the challenges faced in the healthcare setting and in accessing necessary services, provider-patient relationships, and major cultural and environmental influences on their overall health and healthcare. Qualitative analysis via grounded theory was used to examine the data.
RESULTS: Preliminary analysis revealed several themes including difficulty with navigating the healthcare system, the need for better access to services, a lack of understanding of western medicine, and financial challenges. Many of the refugees describe not knowing how to find their way through the healthcare system as one of their primary difficulties upon transitioning to life in the US. Long waits for appointments, inadequate follow-up, scarcity of mental health services and dental care, and the eight-month expiration period of Medicaid further limit access to care. Lack of education with reference to medical issues has kept many from seeking needed care. Several refugees felt that they would not know what questions to ask or be able to

understand what the provider was telling them even with an interpreter present. These difficulties are compounded by fear of not being able to pay medical bills. Refugees consistently welcomed the idea of medical students aiding them with some of these issues.
CONCLUSION: There is a clear role for a medical student-led service learning initiative. Efforts should focus on helping refugees to better understand western medicine and the US healthcare system, including what services are available and how medical care is paid for. In addition, students can have an important role in advocating for the needs of this population with local and national government. As a next step, we will pilot a 1st and 2nd year medical student elective in which students will learn about life as a refugee. Students will also have the opportunity to teach the refugees about western medicine and the US healthcare system. The goal of the elective will be to inform medical students about the plight of refugees and ultimately, encourage future advocacy on their behalf.

A COMMUNITY BASED HEALTH ASSESSMENT OF GERIATRIC FILIPINO AMERICANS IN CHICAGO Jane Jih 1; Carmela Estrada Bondad2. 1The University of Chicago Medical Center, Chicago, Illinois; 2Filipino American Community Health Initiative of Chicago, Chicago, Illinois . (Tracking ID # 8148)
BACKGROUND: Limited studies have investigated Filipino American health, the second largest group of Asian Americans. Several analyses, particularly in California, have shown health disparities in cardiovascular disease and cancer among Filipino Americans compared to other Asian American ethnic groups and to other racial groups. Illinois has the sixth largest population of Asian Americans and Filipino Americans are the second largest Asian subgroup in Illinois, with 56,000 living in Cook County. With under developed research and resources dedicated to Asian Americans in the Midwest, there is a need to evaluate specific health needs and disparities within these underserved communities. To guide the implementation of health education interventions in the Chicago Filipino American community, a pilot health needs assessment of Filipino and Filipino American seniors was initiated.

METHODS: A convenience sample of Filipino and Filipino American individuals aged 60 years old and older who participated in weekly activities at a Filipino cultural center was invited to participate in a 30-minute face-to-face recorded semi-structured interview. Demographic information and self-reported general medical history including preventive care was collected. Participants were asked about their perceptions of health problems in their community, availability and utilization of health resources in their community, and willingness to participate in specific types of health education activities. Participants were asked to rate their perceptions on a Likert scale. The interviews were analyzed for common themes.
RESULTS: There have been 35 participants to date, mean age 72.6 years old with 28 of the 35 participants being female. Over eighty percent of the participants had health insurance in the last year and half of the participants were seeing a physician at least once every three months. Hypertension, ophthalmological disorders, arthritis, and hyperlipidemia were the most commonly self reported health problems. Heart disease, diabetes, hypertension and hyperlipidemia were most frequently cited as somewhat of a problem or a major problem in the community by the participants. Almost one third of the participants noted depression as at least somewhat of a problem in the community while only 5 participants reported a personal history of depression. Challenges locating or
utilizing health education programs and insurance coverage was most frequently cited to be at least somewhat of a problem in the community. Almost all participants were interested in engaging in at least one of the proposed health education programs.
CONCLUSION: While this study is limited by a small sample size, cardiovascular disease has emerged as a prevalent health problem in the Chicago geriatric Filipino American community. The divergence of self reported history of depression and perception of depression as a community health problem may point to generational and cultural stigma, highlighting a significant health concern that merits further investigation and action. Although most participants were insured in the last year and seeking physician services, insurance coverage was most frequently reported as a problem in the community which needs to be explored. Community based health research in the Chicago Filipino American community supports grassroots efforts to address disparities and contributes to a growing body of literature of a traditionally understudied minority group.
PROPHYLACTIC ANTICOAGULATION IS SAFE IN PATIENTS UNDERGOING FLAP RECONSTRUCTION POST MASTECTOMY: A SINGLE-CENTER SINGLE-SURGEON RETROSPECTIVE REVIEW Diwakar Davar 1; Michael L Gimbel 1; Roy E Smith1. 1University of Pittsburgh Medical Centers, Pittsburgh, Pennsylvania. (Tracking ID # 8159)
BACKGROUND: Free vascularized flap reconstruction is frequently employed in breast reconstruction after mastectomy for oncological surgery. Flap thrombosis remains a common complication occurring in approximately 5-8% of cases and often leads to flap failure. There is no consensus on the use of peri- and post-operative anticoagulation to aid in preventing thrombosis. We report the results of a single-center single-surgeon experience in which routine anti-platelet and anti-coagulation therapy peri- and post- operatively was employed for prophylaxis for flap thrombosis.
METHODS: Initially the surgeon used no anti-platelet and anticoagulation therapy. Starting in late 2007, he started using routine peri- and post- operative anticoagulation. We retrospectively surveyed 103 patients who were operated on between 2006 and 2010. Patient details were obtained from the electronic record using the Current Procedural Terminology (CPT) billing codes for free flap breast reconstruction. Pertinent details were abstracted from the medical record.
RESULTS: Pre-operatively 40(44%) received prophylactic LMWH whilst 50(56%) did not. Post-operatively, 64(71%) received prophylaxis with either LMWH and/or aspirin whilst 26(29%) did not. No vessel thromboses were noted post-operatively. 2 patients had hematoma formation and 2 had major bleeding necessitating transfusion. Routine anti-coagulation (defined as either LMWH and/or aspirin use) was not associated with an increased incidence of bleeding events (p=0.62, Fishers exact test).

CONCLUSION: Flap thrombosis remains a complication with devastating consequences and prevention of thrombosis requires many factors -including the judicious use of anticoagulation. We conclude that the routine use of peri- and post- operative anticoagulation with either LMWH and/or aspirin is not associated with an increased incidence of bleeding complications post-operatively and is safe.
This study was not powered to statistically prove that anticoagulation in this setting prevents flap thrombosis. A prospective randomized trial to investigate this would greatly aid in defining the optimal anti-coagulation strategy in this group of patients.
S10 ABSTRACTS JGIM
DEMENTIA SCREENING IN PRIMARY CARE Becky J. Brott 1; Janet S Cellar 1; James J Lah1. 1Emory University School of Medicine, Atlanta, Georgia. (Tracking ID # 8170)
BACKGROUND: The population over age 65 is expected to double by 2030, and the prevalence of dementia will nearly triple. Diagnosing dementia by self-reported symptoms often leads to delayed and missed diagnoses. Therefore dementia screening is essential. With a declining pool of certified geriatricians to care for the growing aging population, primary care physicians (PCPs) will be increasingly called upon to diagnose dementia. The purpose of this research is to determine the rate of dementia screening and diagnosis in patients over 65 in an academic primary care clinic.
METHODS: Records of 203 patients attending a university based primary care clinic in a one month period were examined, and charts of the 49 patients over 65 were reviewed. Abstracted data included patient and caregiver characteristics, problem list, memory loss symptoms, suspicion for dementia, and dementia evaluation including screening, neuropsychological testing, specialist referral, diagnosis, and treatment. Screening tests included the Mini-Cog, Functional Activities Questionnaire (FAQ), MMSE, Clocks, and Geriatric Depression Scale (GDS). RESULTS: Mean patient age was 72 + / - 5.6, and 33 (67%) were female. None of the patients were screened for dementia. Memory loss symptoms were recorded in 11 patients (22%), 10 (20%) had suspicion of dementia, 6 (12%) were referred for neuropsychologic testing, and 8 (16%) were referred for specialists evaluation. Dementia was diagnosed by specialists in 3 patients (6%), and 1 received pharmacologic treatment. The length of the problem list correlated to symptoms of memory loss. Problem lists ranged from 116 problems, mean 4.5 + / - 2.9. Linear regression found each additional problem increased the chance memory loss symptoms by 3.9%.
CONCLUSION: None of the patients received dementia screening or diagnosis from their PCP. Ultimately, 6% were diagnosed by specialists, well below half of the estimated prevalence. The reason for lack of screening is unclear, but the lower than expected rates of diagnosis may be due to symptoms of memory loss appearing as problem lists lengthen. Without knowledge of a quick screening tool, problem list burnout likely contributes to the lack of screening and diagnosis in complex medical patients. After expanding this baseline data set, an educational intervention is planned to introduce a simple screening tool, the Mini-Cog/FAQ, and assess its impact on screening and diagnostic behaviors.
EDUCATING UNDERSERVED PATIENTS ABOUT COLORECTAL CANCER SCREENING: MULTIMEDIA VS PRINT Gregory Makoul 1;
Denise Scholtens 2; Ashley Negrini 1; Kenzie A Cameron 2; Jason Thompson 2; Adam Williams 2; David Baker2. 1Saint Francis Hospital and Medical Center, Hartford, Connecticut; 2Northwestern University Feinberg School of Medicine, Chicago, Illinois. (Tracking ID # 8326)
BACKGROUND: Colorectal cancer (CRC) is one of the most common types of cancer in the United States. Despite strong evidence and recommendations supporting CRC screening, screening rates remain low. This study focuses on comparing message-equivalent patient education programs (multimedia vs print) designed to provide patients with understandable information and motivational messages about CRC screening. Primary questions: Do messages have a different impact on knowledge and/or screening behavior when delivered by multimedia or print? Does literacy level affect response? Based on our review of the literature, we believe this

study is the first to explicitly compare the effects of message-equivalent print and multimedia materials.
METHODS: In this randomized controlled trial, patients 5080 years of age at the time of their clinic visit are assigned to one of three study arms: (1) Control/usual care; (2) Multimedia; (3) Print. The multimedia program incorporates illustrations, animations, photographs, and voice-over. Using the multimedia program as our starting point, we reverse-engineered a print version to yield materials with the same text and graphics. Lexile analysis indicates that the text is geared to a 4th
grade reading level; there are English and Spanish versions of both interventions. Study sites are 3 Midwest clinics for the poor and underserved. After engaging in an IRB-approved consent process with a bilingual RA, patients engage in a structured interview, view the randomly assigned intervention, and complete a literacy assessment (S-TOFHLA). Immediately after their doctor visit, patients have a brief follow-up encounter with the RA and receive a $10 gift card. Completion of CRC screening within 3 months of the index visit is determined using the clinic registry. If there is no record of screening completion, RAs attempt to ascertain reasons by calling patients approximately 100 days after the index visit.
RESULTS: This report includes data collected for 690 patients. Mean age was 57.7 (SD=6.4), 68% of the patients were female, 58% self-identified as Hispanic/Latino, and 53% of the surveys were conducted in Spanish. Nearly half (46%) of the patients had 8th grade education or less; 35% had inadequate health literacy. Print and multimedia interventions both led to marked increases in knowledge regarding polyp, colon, stool cards and colonoscopy. While there was very little difference in evaluation of the interventions by the adequate literacy group, subjects in the inadequate literacy group found the multimedia program more informative, believable, interesting, and understandable ($p<.05$ for each). In terms of actual screening, completion rates are low across all three arms of the study. Telephone follow-up with 241 of the patients who did not get screened provides insight: The doctor did not recommend it was the overwhelming reason for not getting screened, mentioned by 61% of the patients.
CONCLUSION: The print and multimedia interventions in this study optimize message design and include parallel content to allow direct comparison. Data collected to date indicate that, despite the demonstrated quality of both interventions across literacy levels, physician recommendation is the most powerful vector for patient uptake of CRC screening. While physicians at the study sites are periodically reminded to talk with patients about CRC screening, more robust physician-directed interventions are required to achieve the ultimate goal of markedly increasing CRC screening.
CHARACTERISTICS OF CHRONIC KIDNEY DISEASE (CKD) PATIENTS WITH DIABETES WHO HAVE CKD NOTED IN THEIR PROBLEM LIST IN A LARGE ELECTRONIC HEALTH RECORD BASED CKD REGISTRY: A CALL TO ACTION Stacey Jolly 1; Sankar
Navaneethan 1; Jesse Schold 1; Susana Arrigain 1; Welf Saupe 1; John Sharp 1; Anil Jain 1; Martin Schreiber 1; James Simon 1; Joseph Nally1.
1Cleveland Clinic, Cleveland, Ohio. (Tracking ID # 8410)
BACKGROUND: Chronic Kidney Disease (CKD) is a growing public health problem. We developed a CKD registry from our electronic health record (EHR) at Cleveland Clinic to create programs to improve CKD management including quality of care guidelines for Diabetes Mellitus (DM). We aimed to examine if differences existed in demographics and processes of care measures among DM patients with CKD based on whether CKD was listed in their EHR problem list. The problem list is readily available in the EHR, shown during each patient encounter, maintained by providers, and has been linked to information technology tools to improve patient care in our health system.

METHODS: Patients entered the registry by having two outpatient eGFRs <60 ml/min/1.73 m2 (MDRD

equation) at least 90 days apart from Jan 2005 to Oct 2010. We examined a subgroup of patients who had DM and were followed for at least a year. DM was defined by having two separate DM related ICD-9 codes noted during outpatient visits prior to or at date of entry into the registry. CKD was noted in the patients EHR problem list if CKD (defined by ICD-9 codes) was present within 1 year after date of entry into the registry. We calculated the proportion of CKD patients with DM who had CKD noted in their problem list and examined if differences in age, sex, race, insurance, eGFR at time of entry; nephrology visit and CKD labs, or medications prescribed differed between the two groups.
RESULTS: Of the 55,000 patients in our CKD registry, 8711 (16%) had DM and been followed for at least a year. 782 (9%) had CKD noted in the EHR problem list. They were younger (66 vs 70 yrs) and more likely to have a low eGFR (<45) at time of entry (79% vs 33%). Table 1 shows additional differences found between the two groups.
CONCLUSION: Among CKD registry patients with DM, failure to include CKD in the EHR problem list was highly variable based on patient characteristics and was associated with less nephrology visits and CKD laboratory measures checked and inappropriate medication use. Targeting awareness and using the EHR problem list with novel interventions may improve CKD outcomes in the clinical setting.
PHYSICIANS ON TWITTER Katherine Chretien 1; Justin Azar 2; Terry Kind3. 1George Washington University; Washington DC VA Medical Center, Washington, District of Columbia ; 2George Washington University, Washington, District of Columbia ; 3Childrens National Medical Center, Washington, District of Columbia .
(Tracking ID # 8414)
BACKGROUND: Social media is transforming the way physicians communicate with the public, bringing both challenges and opportunities for medical professionalism. Hospitals, public health departments, and other medical institutions have started to use the popular social networking and micro-blogging site Twitter as a marketing tool and a way of disseminating health information. Physicians may use Twitter to extend their web presence, communicate with patients, market themselves, or informally interact with colleagues. Yet, it is unknown how physicians are using Twitter as a communication tool. The objective of this study was to describe the characteristics of self-identified physicians on Twitter and how they use Twitter, with a specific focus on professionalism.
METHODS: Descriptive characteristics were extracted from the public profile pages of self-identified physicians with 500 or more followers on Twitter in May, 2010. Content analysis of 5156 of their postings (tweets) was performed (the last 20 available tweets at time of data extraction for each Twitter user, excluding non-English tweets). Main outcome measures included: percent of physician profiles with full name, photograph, specialty, and/or geographic location on profile; percent of tweets that were health/medical, contained a hyperlink, were personal communications or re-tweets; recommended or criticized a medical product; were self-promotional; were related to medical education; contained potential patient privacy violations, profanity, sexually explicit material, discriminatory, or other unprofessional material. Three authors pilot-coded tweets together, and through an iterative cycle, refined the coding guide until kappa >0.78 for all categories or inter-rater agreement=100% was attained. The three authors subsequently coded tweets independently, with regular team discussions. All potentially unprofessional tweets were reviewed by the entire team for consensus.
RESULTS: Of the 260 users identified, most were identified by full name (78%) and photograph (78%). 240 (92%) profiles linked to websites. Surgery (15%) and internal medicine (11%) were the most prevalent specialties represented. Of the 5156 tweets analyzed, 49% (2543) were health/medical, 21% (1082) were personal communications, 14% (703) were re-tweets, and 58% (2965) contained links. Seventy-three tweets (1%) recommended a medical product or proprietary service, 634 (12%) were self-promotional, and 31 (1%) were related to medical education. 144 (3%) were categorized as unprofessional. 38 (0.7%) tweets represented potential patient privacy violations, 33 (0.6%) contained profanity, 14 (0.3%) included sexually explicit material, and 4 (0.1%) included discriminatory statements. 55 (1%) tweets were coded other unprofessional, including 12

possible conflicts of interest, such as making unsupported claims about a product they were selling on their website or repeatedly promoting specific health products, and 10 statements about medical therapies that were counter to existing medical knowledge and guidelines.
CONCLUSION: Self-identified physicians on Twitter share medical information with the public. Ethical breaches and unprofessional content were observed. Greater education, guidelines, and accountability for health professionals are needed to maximize societal and professional benefit through engagement with social media.
IMPROVING PATIENT UNDERSTANDING OF THE DISCHARGE PLAN BY IMPLEMENTING A NEW PATIENT-CENTERED DISCHARGE PROCESS ON AN ACADEMIC SERVICE Jimmy Daniel Fernandez 1; Jennifer Caceres, MD2. 1University of Miami, Coral Gables, Florida;
2University of Miami at JFK, Atlantis, Florida. (Tracking ID # 8431)
BACKGROUND: According to a study funded by the Agency for Healthcare Research and Quality, patients are 30% less likely to be readmitted or visit the emergency department if they have a clear understanding of their discharge instructions. Despite the importance of the discharge process, very few medical residency training programs offer formal discharge planning education. We hypothesize that introducing a new discharge order form that is completed by a medical resident and reviewed with each patient as part of the discharge process will improve patients understanding of the discharge plan.
METHODS: All patients who were discharged over a 4-week period from the academic service at John F. Kennedy Medical Center were called within one week of discharge and asked if they knew their diagnosis at discharge, were clear on medications to administer, knew the side effects of any new medications, who to call with any concerns, and if a follow up appointment was made with a primary care physician prior to discharge. A new patient-centered discharge order form as part of the discharge process was introduced after the survey was completed. Medical residents were trained how to use the discharge order form during orientation to the inpatient rotation. The discharge form required a medical resident to complete and discuss each component with the patient and obtain a signature from the patient acknowledging the discussion before the order could be executed by the nursing staff. Four months after the new discharge process was implemented, the same survey was conducted over a 4-week period. Proportions before and after the intervention were compared using chi-square tests for independence.
RESULTS: Eighty-six patients were surveyed before and after the intervention (total n=172). 52.3% versus 68.6% knew their diagnosis pre-intervention and post-intervention respectively (p=0.0290). For the proportion of patients who knew what medications to take, 77.9%

versus 74.4% answered yes pre-intervention and post-intervention respectively (p=0.5914). For the proportion of patients who knew side effects of medications, 17.4% answered favorably before the intervention compared with 46.5% after the intervention (p=0.0001). For the proportion of patients who knew who to call after discharge, there was an increase from 20.9% to 45.4% after implementation of the new discharge form (p=0.0007). For the proportion of patients who had primary care physician appointments scheduled prior to discharge, there was an improvement from 41.9% to 57.0% (p=0.0474). CONCLUSION: Implementation of a new discharge order form as part of the discharge process allows medical residents to improve patients understanding of the discharge plan. There were statistically significant improvements in the following areas: knowledge of their diagnosis, side effects of medications, who to call after discharge, and appointments scheduled with a primary care physician prior to discharge.
EFFECTS OF SMOKING CESSATION AND WEIGHT CHANGE ON CARDIOVASCULAR DISEASE AMONG PEOPLE WITH AND WITHOUT DIABETES Carole Clair 1; Nancy A. Rigotti 2; Peter Shrader 1; Caroline 1; Michael S. Fox Pencina 3; James Meigs4. 1Massachusetts General Hospital, Boston, Massachusetts ;
2Harvard Medical School, Boston, Massachusetts ;
3Boston University NHLBIs Framingham Heart Study, Boston, Framingham, Massachusetts, Massachusetts ;

4General Medicine Division, Massachusetts General Hospital, Boston, Massachusetts . (Tracking ID # 8487)
BACKGROUND: Smoking cessation substantially reduces the risks of cardiovascular disease (CVD) associated with smoking among people with and without diabetes. Weight gain that follows quitting smoking may weaken the benefit of quitting on CVD risk. We have tested this hypothesis in this study.
METHODS: Among participants of the Framingham Offspring Study who were free of CVD at each baseline, we estimated 4-year risk of CVD. At each 4-year exam, self-reported smoking status (non smoking, former smoking, current smoking) was verified, diabetes (defined as fasting plasma glucose >=7 mmol/l or being on diabetes treatment) was screened and body-weight and height were measured; we calculated change in weight and in body-mass index (BMI) from the previous exam. We used three pooled logistic regression models to estimate the 4-year risk of CVD associated with smoking and diabetes status at each baseline. Model 1 adjusted for age and sex; model 2 added confounders (BMI, alcohol consumption, family history of diabetes, systolic blood pressure, HDL-cholesterol, LDL-cholesterol, triglycerides, use of anti-hypertensive or lipid-lowering medication), and model 3 added change in BMI concomitant with change in smoking status to assess its potential mediating effect on CVD. Significance was p<0.05. RESULTS: 3,142 subjects (mean age, 44 years; 52% female) were followed over 6 exams, about every 4 year, for a mean of 25 years, contributing 17,875 person-exams. Smoking prevalence decreased from 37% at the first baseline exam to 13% at the last baseline exam. Age- and sex- adjusted 4-year incidence rates of CVD were higher among smokers vs. former smokers or non smokers in people with and without diabetes (Figure 1). On average, 4-year weight gain was lower in smokers vs. non smokers (1.21 kg vs. 1.46 kg, p=0.02) whereas it was similar between former smokers and non smokers(1.45 kg vs. 1.46 kg, p=0.16). In multivariable-adjusted analysis, smokers had higher risks of developing CVD than non smokers whether or not they had diabetes. Former smokers did not have a significantly higher risk of developing CVD than non-smokers, although significant trends across smoking categories, both among people with diabetes (P=0.02) and those without diabetes (P<0.0001) suggested a dose response phenomenon. Adjusting for change in BMI did not decrease the risk estimates, suggesting that post-cessation weight change does not mediate the increase risk of CVD among both people with and without diabetes (Table 1).
CONCLUSION: Post-cessation weight gain does not alter the benefits of quitting smoking on CVD risk in people with and without diabetes.
JGIM

Table 1:
4-year risk of CVD according to diabetes and smoking status
Diabetes mellitus No diabetes mellitus
Non smokers (ref)
Former smokers Smokers
p-value*
Non smokers (ref)
Former smokers Smokers
p-value*
No. of cases of CVD
31 64 32 106 193 174
Age-Sex-adjusted OR (95%
CI)
1
1.32 (0.82-2.11)

1.96 (1.13-3.41)
0.02 1
1.17 (0.92-1.50)
2.83 (2.20-3.65)
<.0001
Multi-adjusted? OR (95% CI)
1
1.25 (0.76-2.06)
2.05 (1.13-3.71)
0.02 1
1.12 (0.87-1.44)
2.59 (1.98-3.39)
<.0001
Multi- + BMI change-adjusted OR (95%
CI)
1
1.38 (0.82-2.32)
2.15 (1.16-4.01)
0.02 1
1.10 (0.85-1.43)
2.73 (2.08-3.60)
<.0001
OR = Odds Ratio, CI = Confidence Interval, BMI = body-mass index, ref = reference* P-value for trend across smoking categories? Adjusted for baseline BMI, age (continuous), sex, alcohol consumption (continuous variable in oz/week), self reported family history of diabetes (dichotomous), HDL-cholesterol (continuous), LDL-cholesterol (continuous), Triglycerides (continuous), taking cholesterol lowering medication (dichotomous), systolic blood pressure (continuous), taking anti-hypertension treatment
(dichotomous)

DO PHYSICIANS WANT THE PATIENT-CENTERED MEDICAL HOME? Temple Howell-Stampley 1; Lynne Kirk 1; Kim Batchelor 1; Ethan Halm2.

1UT Southwestern, Dallas, Texas; 2Univ. of Texas Southwestern Medical Center, Dallas, Dallas, Texas .

(Tracking ID # 8513)

BACKGROUND: The patient-centered medical home model (PCMH) holds great promise to improve the delivery of health care. One of the many unanswered questions about the PCMH is whether physicians will accept the model. We asked physicians to identify changes they thought would improve the patient care they provide. We compared the suggested changes to the standards for the PCMH.

METHODS: We administered a 3 round iterative questionnaire to 31 faculty members practicing in an academic GIM clinic. The physicians were asked: 1) What do you do for your patients in clinic now that could be done better by someone else? 2) What do you wish could be done for your patients that is not being done now? 3) What would you like to have more time to do for your patients? 4) What information and resources would be helpful for you to care for individual patients and for your population of patients? They rated and then ranked the items generated. We received responses from 24 physicians totaling 135 items. These were sorted into 8 categories and similar items were combined into 71 items. For round 2, the physicians rated each item on a 5 point Likert scale. Those with a score of >3.2 were listed in order of their rating, resulting in 55 items. These items were independently matched by 2 of the investigators (T H-S, LK) to the National Committee for Quality

Assurance (NCQA) Physician Patient Connection (PPC) standards for recognizing medical homes. If the 2 reviewers differed on whether an item met a standard, the other investigators resolved it. For Round 3, the 55 items were combined into 26 items in 2 categories. The physicians had the opportunity to rank-order the items and include any that had been excluded by rating score.
RESULTS: Of the 55 items in the list for round 2, 46 matched a specific PPC standard. Of the remaining 9, all were matched to a PCMH principle, i.e. patient-centered, coordination of care, etc. There were no physician-generated items that did not match to a principle or standard of the PCMH. The final list included 20 items that the physicians felt should be done for their patients by others and 6 items that physicians want more time to do for their patients.
CONCLUSION: The vast majority of physician-generated ideas on how to improve care in a GIM practice match the NCQA criteria for
recognition as a PCMH. The process of letting physicians identify ways to improve practice a priori may facilitate the changes required for the development of a PCMH.
EVALUATION OF A PILOT HOSPITALIST PROGRAM AT AN ACADEMIC AFFILIATED VA HOSPITAL: IMPACT ON PATIENT OUTCOMES AND TEACHING Christine Michelle Perry 1; Simone Kanter 1; Manjulika Woytowitz 2; Tina Bronner 3; Alexander Cheung 3; Michal Hose 3; Peter Cadman3. 1Va HCS SD, La Jolla, California ; 2VA HCS SD, La Jolla, California ; 3Va HSC SD, La Jolla, California . (Tracking ID # 8523)
BACKGROUND: Literature has emerged indicating potential benefits from separating inpatient and outpatient care between collaborating groups of internists, hospitalists and non-hospitalists. In teaching hospitals that lack hospitalist systems for inpatient care, academic physicians who do little inpatient care and teaching may be conscripted for these activities for several weeks a year. Our work group evaluated whether there was a difference in inpatient outcomes and faculty teaching evaluations between a pilot hospitalist team (Pilot) and traditional attending model (Trad).
METHODS: Patients admitted to the medicine service at the VA San Diego Health Care System (VASDHS) are cared for by clinicians who spend the majority of their time in the outpatient setting. Four General Internal Medicine physicians volunteered for a pilot hospitalist program, with an increased percentage of time devoted to inpatient duties (25%). They rotated in 2-week periods covering a hospitalist ward team. While not on wards these physicians continued to engage in outpatient care for their established primary care panels. The Trad includes 3 inpatient teams of other internal medicine faculty rotating in 3.5-week long blocks. We extracted the following variables from the VA computerized patient record system: primary diagnosis, discharge diagnosis, admission date/ time, discharge date/ time and length of stay. Variables were grouped by assignment of patients to Pilot or Trad physicians and compared using student t-tests for continuous data and chi-square for ordinal data. We compared the inpatient teaching evaluations (Likert scale) from third year students and internal medicine residents from the University of California, San Diego (UCSD) School of Medicine during the first 12 months of the pilot program, using the Kruskal-Wallis equality of populations rank test for ordinal data and student t-test for resident data.
RESULTS: There was no significant difference in length of stay by group: Pilot team patients 4.5 days+/7.2 days and Trad team patients4.4 days+/5.4 days (p=.7). Readmission rates within 30 days did not vary, with 28/1224 (2.3%) of patients readmitted from the Trad team and 3/283 (1.1%) readmitted from the Pilot group (p = .19). There was no significant difference in patient outcomes between the Pilot and Trad. Teaching evaluations were significantly higher for the Pilot than Trad for both students and residents (p<.001)
CONCLUSION: A pilot hospitalist system was associated with improved ratings of both inpatient medical student and resident teaching. A potential explanation for these findings may be that the physicians in the pilot hospitalist group self selected to engage in those activities in which they excel. In this study, patient outcomes did not improve during the first year of a Pilot team compared to the Trad team. Benefit to many patient outcomes has been previously reported with hospitalist programs; many factors could account for failure to

observe such benefits here. Whether advantages of this approach will be sustained, and/or magnified with time is a matter for ongoing study.

GAPS IN THE MANAGEMENT OF POSTHERPETIC NEURALGIA IN THE ELDERLY POPULATION: THE BASIK PHN SURVEY Gregory D Salinas 1; P Holder Nevins 1; Terry A. Glauser 1; Mark S. Wallace 2; J. Chad Williamson1. 1CE Outcomes, LLC, Birmingham, Alabama; 2University of California San Diego, La Jolla, California. (Tracking ID # 8527)

BACKGROUND: Postherpetic neuralgia (PHN) is continued pain due to herpes zoster for >3 months after resolution of the dermatomal rash. While annual incidence of PHN in the United States is 100,000-180,000, there is a lack of published information regarding the knowledge, attitudes, and practice patterns of US physicians on their management of PHN.

METHODS: To identify needs of physicians managing patients with PHN, we distributed a case-vignette survey (BASIK PHN: Behaviors, Attitudes, Skills, Identified gaps and Knowledge of Postherpetic Neuralgia) to a nationally representative sample of US-practicing primary care physicians (PCPs) and neurologists. The total sample included 150 PCPs and 76 neurologists. The survey presented case vignettes representing typical patients with PHN to assess how the patient would be managed. Additional questions assessed side effect management, adherence, monitoring, and barriers to optimal patient care. One component of the study addressed the management of an elderly patient with a 5-year history of PHN and previous negative experiences with gabapentin, amitriptyline, and acetaminophen with codeine.

RESULTS: The majority of physicians chose multiple agents; most commonly used combinations were pregabalin/lidocaine patch, duloxetine/lidocaine patch, or pregabalin/duloxetine. Nearly half of PCPs would refer this patient to a neurologist or pain specialist. If the patient developed additional side effects from this medication, the majority of neurologists would switch to a different class of drugs and PCPs would refer. To manage adherence, PCPs were more likely to prefer weekly visits until the pain is controlled (p=.048), while neurologists had differing approaches (weekly visits, family accompaniment, diary). Major barriers to managing patients with PHN include patients high expectations about the level of pain relief and dose-limiting side effects.

CONCLUSION: This study highlights physician uncertainty regarding management of continued PHN in a patient with prior experience with multiple agents. Support regarding available resources and current best practices of side effect management may be useful to the practicing clinician.

THE HEALTH OF SAFETY-NET HOSPITALS AFTER MASSACHUSETTS HEALTHCARE REFORM: CHANGES IN VOLUME, REVENUE AND OPERATING MARGINS FROM 2006 TO 2009 Arun Mohan 1; Jennifer Grant 2; Maren Batalden 3; Danny McCormick3. 1Emory University School of Medicine, Atlanta, Georgia; 2Rollins School of Public Health, Atlanta, Georgia; 3Cambridge Health Alliance and Harvard Medical School, Cambridge, Massachusetts. (Tracking ID # 8579)

BACKGROUND: Prior to Massachusetts health care reform many uninsured, poor and minority patients were cared for primarily in safety net hospitals (SNH). A key element of the reform altered the financing of care for vulnerable populations by shifting government payments from safety net hospitals toward financing new subsidized private insurance for low-income residents. Little is known, however, about the impact of the reform on the use and financial performance of safety-net hospitals. Such knowledge
could help inform implementation of the Patient Protection and Affordable Care Act which is closely modeled on the Massachusetts reform.

METHODS: We used data from the Massachusetts Department of Healthcare Finance and Policy to assess the potential impact of the Massachusetts healthcare reform on changes in volume, revenue, and operating margins at SNH (n=7), pre (2006) and post (2009) reform and contrasted this with contemporaneous changes seen

among the 58 non-safety net hospitals (NSNH). We defined SNH as those with a high level of utilization by patients with Medicaid (>1 SD above the mean) and a low-level of utilization by patients with commercial insurance (<1 SD below the mean). For each outcome measure we calculated the mean percentage change at SNH and NSNH from 2006 to 2009. We then estimated the absolute difference (and 95% confidence intervals) in changes between SNH and NSNH over this time, often referred to as a difference-in-differences [DD] analysis, using the students t-test. Estimates for DD for operating margins and revenue per inpatient discharge and outpatient visit were weighted to hospital volume. Analyses using alternative definitions of SNH yielded similar results.
RESULTS: Outpatient revenue per visit declined 9.0% at SNH and increased 23.7%; at NSNH for a DD of -$174; (95% CI, -$281 to 66, p=.004), indicating a reduction at SNH compared with NSNH. Inpatient revenue per discharge declined 10.0% at SNH and increased 20.7%; at NSNH (DD=$1,050 [95% CI, -$1,455 to 644, p<.0001]) and operating margins declined 3.5% at SNH and increased 0.8%; at NSNH (DD=4.27%; 95% CI, -6.0% to 2.5%, p<.001)., There were also substantial, but not statistically significant differences for inpatient discharges (2.3% decline at SNH vs. 3.5% increase at SNSH; DD=598 [95% CI, -1,559-363, p=.22]), outpatient visits (14.7% increase vs1.6% increase; DD=45,343 [95% CI, -23,640-114,325, p=.16]), inpatient revenue (2.6% increase vs. 7.7% increase; DD=$17.0 million [95% CI, -47.9 million 14.0 million , p=.27]) and outpatient revenue (4.4% increase vs. 25.6% increase; DD=$22.3 million [95% CI, -63.4 million 18.8 million, p=.28]).We also found that in 2009, patients receiving Medicaid, self-pay, and other government insurance accounted for 40.8% of all discharges at SNH and 19.1% at NSNH, while they represented 53.4% of outpatient visits at SNH and21.8% at NSNH.
CONCLUSION: While SNH in Massachusetts continue to play a disproportionately large role in caring for disadvantaged patients, their financial performance has declined appreciably after implementation of Massachusetts health care reform compared with NSNH. If poorer financial performance lessens SNH capacity to care for vulnerable patients, this and similar reform efforts could have effects opposite to those intended.
WHITE COAT CEREMONIES: APPRECIATING THEIR FORMS AND MESSAGES Thomas Inui 1; Orit Karnieli-Miller 2; Richard Frankel3.
1Regenstrief Institute, Indiana University School of Medicine, Indianapolis, Indiana ; 2University of Haifa, Haifa, N/A ; 3Indiana University School of Medicine, Indianapolis, Indiana . (Tracking ID # 8630)
BACKGROUND: White Coat Ceremonies (WCCs) are prevalent in North America and elsewhere as a celebration of matriculation into medical school. Critics of WCCs have questioned whether these ceremonies can successfully combine professionalism and humanism elements, the appropriateness of the white coat (WC) as a symbol, and the meaningfulness of oaths of commitment early in the educational

process. We sought to explore the merits of these critiques in an empirical study of WCC forms and content.
METHODS: We developed a stratified random sample of 25 US schools of medicine conducting WCCs in 2009. On request, schools submitted written WCC programs (18), audio recordings (13), videos (4) and one written transcript. A qualitative approach including triangulating different analysis methods was used to discern the core meanings expressed in these ceremonies. The analysis processes included: content analysis of artifacts (e.g., program, photos, written materials, music); semantic analysis focused on words and phrases; content analysis focused on sentences and statements within the ceremonies (specifically statements about obligations and privileges, the meaning of WCCs, the white coat, and oaths); and narrative analysis focused on the stories recounted in the WCCs.
RESULTS: Although all ceremonies followed the same general form (formal ceremony protocol, keynote, 25 other speakers, cloaking, oath recitation), their content, messages and atmosphere varied significantly, often strongly expressing a schools mission and traditions. Ceremonies included five principal descriptions of what the WC symbolizes (commitment to humanistic professional care, a reminder of obligations and privileges,

power, students need to grow into their WC, and the WC as a mantle). Statements about obligations were three times more frequent than statements about privileges. Semantic analysis focused on 46 words and/ or phrases used frequently during the ceremonies (1472 utterances), which we mapped onto four consensus domainsprofessionalism (1104), humanism (663), morality (642) and spirituality (277). Sixteen different oaths were used in the 18 schools. All focused on dedication, commitment and responsibility, either as physicians-to-be or as students. CONCLUSION: Analysis of WCCs revealed these ceremonies to be neither about elitism nor guild status, but an occasion marking the beginning of educational, personal and professional formation processes. The ceremonies urged matriculants to become physicians worthy of trust. They centered on the person in a vocation; affirming its calling and obligations, donning a symbolic garb, joining an ancient and modern tradition of healing and immersing oneself in the traditions of a community. The articulated construct of the white coat in the WCCs situated it as a suitable symbol of humanism. The messages of the professional oaths, while encountered early in a students education, still might set the stage for mindfully grappling with challenging experiences later. We conclude that WCCs embody the longer traditions of medicine as a helping profession and communicate the importance of deserving trust over having privilege. As such they are more to be commended than criticized.

FOOD INSECURITY AND BODY MASS INDEX ARE ASSOCIATED IN YOUNG ADULT WOMEN Holly Catherine Gooding1; Courtney K Walls2; Tracy K Richmond2. 1Brigham and Womens Hospital and Childrens Hospital Boston, Boston, Massachusetts ; 2Childrens Hospital Boston, Boston, Massachusetts . (Tracking ID # 8653)

BACKGROUND: Food insecurity, defined by the United States Department of Agriculture as lack of access by all people at all times to enough nutritious food for an active, healthy life, is hypothesized to contribute to numerous health problems, including obesity. Food insecurity has been associated with an increase in weight in children

and adults, although results have been inconsistent. This study sought to identify whether food insecurity was associated with an increase in body mass index (BMI) in young adults and whether this association differed by gender or was modified by food stamp use or the presence of children in the home.

METHODS: Cross-sectional data from Wave 4 (20072008) of the National Longitudinal Study of Adolescent Health were analyzed. Survey sampling weights were applied to account for the unequal likelihood of certain subpopulations being sampled. Multiple linear regression was used to investigate the association between food insecurity and BMI in gender stratified models of young adult women (n=7279) and men (n=6804) ages 2432, controlling for age, race/ethnicity, income, education, physical activity, smoking, and alcohol use. Interaction terms were created to assess for effect modification by food stamp use or the presence of children in the home on the relationship between food insecurity and BMI.

RESULTS: Food insecurity was significantly more common in young adult women (14%) than young adult men (10%) ($p<0.001$) and in African Americans (19%) and American Indians (22%) compared to whites (11%) ($p<0.001$). Food insecure participants earned on average $28,500 less than those who were food secure and were more likely to report receipt of food stamps or public assistance. Individuals who reported food insecurity were significantly more likely to be current smokers ($p<0.001$) but less likely to consume alcohol ($p<0.001$), participate in physical activity ($p<0.05$), or have completed college ($p<0.001$) compared to those who did not report food insecurity. After controlling for these covariates, food insecure women had BMIs that were on average 0.9 kg/m2 units higher than women who were food secure. This result persisted after controlling for food stamp use in either young adulthood or adolescence. There was no effect modification by food stamp use, parenting children in the home, race/ethnicity, or income on the association between food insecurity and BMI. No relationship was found between food insecurity and BMI in young adult men.

CONCLUSION: Food insecurity is associated with increased BMI in a nationally representative sample of young adult women after controlling for age, race/ethnicity, education, income, physical activity, smoking, and alcohol

use. Food insecurity is not associated with BMI in young adult men. The relationship between food insecurity and BMI is not attenuated nor modified by food stamp use or the presence of children in the household. Providers should inquire about food insecurity, especially when treating young obese females and policy initiatives should address the role of access to healthy food in addressing food insecurity.

PREVALENCE OF RESISTANT HYPERTENSION IN THE UNITED STATES 20032008 Stephen Persell 1; Stephen Persell2. 1Northwestern University, Chicago, Illinois; Northwestern University, Evanston, Illinois. (Tracking ID # 8654)

BACKGROUND: Resistant hypertension has been defined as blood pressure that remains above goal in spite of the concomitant use of antihypertensive medications from 3 or more drug classes or who require 4 or more drug classes to reach blood pressure targets. This designation has been suggested in order to identify a high risk group for whom special diagnostic investigations or therapeutic considerations should be considered. The prevalence of resistant hypertension is unknown, but it is thought to be common.

METHODS: Data from the National Health and Nutrition Examination Survey from 2003 through 2008 were used. Non-pregnant examination participants at least 18 years of age were included. Blood pressures were measured according to a standardized protocol. For most participants, three measurements were taken and the mean of the second and third readings was used as the average. Participants with no recorded blood pressures were excluded. Participants were considered to have hyper-tension if the average blood pressure was >140/90 mm Hg (either systolic or diastolic), or they reported currently taking prescribed medication for hypertension. Blood pressure was considered uncontrolled if the average was >140/90 mm Hg (either systolic or diastolic). Medications were reviewed during home interviews and pill bottles were examined in most cases. Participants were classified as having resistant hypertension if their blood pressure was >140/90 mm Hg and they reported using antihypertensive medications from 3 different drug classes in the past month or drugs from 4 or more antihypertensive drug classes regardless of blood pressure. Drug classes included: ACE inhibitors, ARBs, beta-blockers, dihydropyridine calcium channel blockers, non-dihydropyridine calcium channel blockers, thiazide-like diuretics, loop diuretics, potassium-sparing diuretics, peripheral alpha-adrenergic receptor antagonists, central-acting and other anti-adrenergic drugs, direct vasodilators, and direct renin inhibitors. Participants with resistant hypertension were compared to drug treated participants who were controlled receiving 3 or fewer drug classes or who were uncontrolled using 2 or fewer drug classes. Analyses used weights that account for the probability of selection, and non-response. SAS survey commands to account for the complex multistage sampling design and provide accurate standard errors and tests of significance were used to produce descriptive statistics and comparisons between groups.

RESULTS: Among U.S. adults with hypertension, 8.9 percent (standard error, SE 0.6) met these criteria for resistant hypertension. This represented 12.9% (SE 1.1) of the antihypertensive-drug-treated population. Among all uncontrolled drug-treated adults, 72.4% (SE1.6) were taking drugs from fewer than 3 classes. Compared to those with controlled hypertension using 1 to 3 medication classes, adults with resistant hypertension were more likely to be older, to be non-Hispanic black, and to have higher mean body mass index (all p They were also more likely to have: micro and macro albuminuria, an estimated GFR of less than 60 ml/min, and self reported medical history of coronary heart disease, heart failure, stroke and diabetes mellitus (uncontrolled hypertension using 2 or fewer drug classes were similar. Most adults with resistant hypertension used a diuretic85.6% (SE 2.4). However of this group, 64.4% (SE 3.2) used the relatively weak thiazide diuretic hydrochlorothiazide. The study has several limitations. There is no information concerning dosage (sub-optimal doses may have been used) or adherence (some medications may have been used in the past month but not regularly). Therefore the proportion with truly resistant hypertension may be lower than what was observed.

Conversely, some uncontrolled individuals receiving 1 or 2 drugs would remain uncontrolled if 3 drugs were used; this would raise the proportion with resistant hypertension. Lastly, different results would be obtained had lower cut points for those with diabetes or renal disease, but this would have greatly complicated the comparisons between groups. CONCLUSION: Though not rare, only a modest proportion of the hypertensive adult U.S. population would be currently considered to have drug-resistant hypertension. Many more individuals with uncon-
trolled hypertension are treated with only 12 classes of medication or are taking no antihypertensive drugs. Even among those classified here as resistant, inadequate diuretic therapy may be a potential modifiable target to improve hypertension control in this difficult to control group. Drug resistant hypertensive individuals on average have more cardiovascular disease, diabetes, obesity and renal dysfunction.

EVALUATION OF THE SATISFACTION OF GIM FACULTY WITH INPATIENT WARD ATTENDING SERVICE AND THE IMPACT OF INPATIENT DUTIES ON OUTPATIENT PRIMARY CARE ACCESS FOR A PILOT PART TIME HOSPITALIST PROGRAM Christine Perry 1;

Michal Hose 1; Paul Jain 1; Simone Kanter 1; Tina Bronner 1; Manjulika Woytowitz 1; Jennifer Newman1. 1VA HCS SD, La Jolla, California. (Tracking ID # 8671)

BACKGROUND: General Internal Medicine (GIM) faculty members at the academically affiliated VA San Diego (VA SD) attend annually on the inpatient service. A survey was administered to the GIM faculty to evaluate their satisfaction with the ward attending experience. Our work group assessed a pilot program of faculty participating in a part time hospitalist program. We evaluated the impact of these inpatient commitments on the providers availability in their primary care clinic. METHODS: GIM faculty completed an on-line survey in November 2008 and July 2010 eliciting demographic data and satisfaction with the inpatient service. Reponses were tallied using Spearman rank correlation for non-parametric tests. Four GIM physicians volunteered for a pilot hospitalist program. They rotated in 2 week periods, covering one of four ward teams. When not on wards these physicians resumed outpatient care for their established primary care panels. The remaining three teams were attended in traditional fashion by internal medicine faculty rotating in 3.5-week long blocks. Information was collected on outpatient access of members of the hospitalist team from September 2009 through June 2010, as measured by days until the third next available appointment.

RESULTS: 74 surveys were completed, 36 in November 2008 and 38 in July 2010. There was no difference between the time periods regarding satisfaction of ward attending, with 26/36 faculty satisfied with ward attending (72.2%) in 2008 and 24/38 (63.2%) satisfied in 2010 (p=0.4). The most common reason for dissatisfaction was the time away from clinic (52%) and impact on outpatient access (61%). In 2008 13/36 (36%) and in 2010 12/38 (32%) of respondents cited that they felt uncomfortable or out of practice managing inpatients. All hospitalists showed a significant increase in time to 3 rd next available clinic appointments before and during inpatient service. Providers on service had peaks in their time to 3 rd next available with a maximum of 3640 days and a minimum of 2836 days. All providers were able to make significant reductions in these parameters within 21 days of returning to their outpatient duties, resulting in baseline 3 rd next available ranging from a maximum of 114 days and a minimum of 01 day. CONCLUSION: Many faculty members at the VA SD are satisfied with their inpatient ward attending service. However, inpatient service impacts outpatient clinic access. The data demonstrates that time on the inpatient service results in a decline in outpatient availability for members of the part time pilot hospitalist team. Increasing emphasis is being placed by the VA SD on outpatient primary care access. The data

suggests that a dedicated hospitalist model at the VA SD, in which inpatient and outpatient responsibilities are split between distinct but collaborating groups of internists, would serve the institutions best interests in meeting national goals in outpatient access goals. Evaluation of the impact of inpatient service on the access of both pilot hospitalist and traditional attending physicians is ongoing.

DNR DOES NOT MEAN DO NOT TREAT: DATA FROM THE FIRST US ELECTRONIC POLST REGISTRY

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BACKGROUND: The Physician Orders for Life Sustaining Treatment (POLST) form augments traditional methods for advance care planning by translating treatment preferences into medical orders. Developed in Oregon, POLST programs now exist or are developing in 33 US states and 2 other countries. POLST orders include CPR, scope of treatment, antibiotics, and artificial nutrition by tube. Scope of treatment in POLST is divided into comfort only meaning hospitalize only if comfort needs cannot be met in current setting, limited additional interventions meaning hospitalize for evaluation and treatment of medical problems but avoid ICU care, and full treatment including ICU care. The electronic POLST registry launched in December 2009 allowing emergency personnel and hospitals immediate and 24-hour access to patient POLST form information. Health professionals completing a POLST in Oregon are required (by legislative statute) to submit the form to the Registry unless the patient chooses to opt out. Thus the registry is both an innovation in advance care planning and a unique resource for understanding patient treatment preferences beyond resuscitation status.
METHODS: We analyzed all active forms signed and submitted from 12/3/09 to 12/2/10the Registrys first year of full operation. We calculated the prevalence of each POLST order to represent the pre-test probability of each preference. We calculated likelihood ratios to examine the predictive value of knowing a patients preferences for each order.
RESULTS: At the end of the first year there were 25,142 active POLST forms in the registry which is currently receiving approximately 3,000 forms per month from every Oregon county. Over 84% of POLST registrants were 65 or older (mean age=77.7 years, SD=12.9 years), and 61% are female. 72.3% of registrants had a DNR order. Of these, 49.6% of also had orders for comfort only, 43.8% had orders for limited additional interventions, and 6.6% had orders for full treatment. Figure 1 shows how many people chose each different combination of POLST orders. Table 1 shows the prevalence for each POLST order which reflect pre-test probabilities and the likelihood ratios associated with a preference for each order. Only 5.4% of registrants wanted maximum treatment in every category and only 6.6% wanted minimum treatment in every category. Thus, 89.9% of those with a DNR order want more than the minimum in at least one other category and 80.8% of those requesting CPR wanted less than the maximum in at least one other category.
CONCLUSION: The Oregon Electronic POLST Registry is a new resource for ensuring that patient preferences are available and actionable across care settings. Registry data demonstrate why clinicians should not use DNR status to infer more about patient wishes. Even for these mostly elderly patients extrapolating from a patient with a DNR order that they would want comfort measures only was almost exactly a 50/50 proposition. POLST orders for full treatment or comfort measures only have higher predictive value. See www.POLST.org for further details.

Table 1:

Category Definitions

E

Event resulted in need for treatment/intervention and temporary patient harm

HEvent resulted in initial or prolonged

hospitalization and temporary patient harm GEvent resulted in permanent patient harm HEvent resulted in near death eventI Event resulted in patient death

DISCLOSURE AND DOCUMENTATION OF UNINTENDED MEDICAL EVENTS (UMES): WHAT DO HEALTHCARE PROVIDERS BELIEVE? Vinita Singh 1; Mukta Panda 2; Christopher JL Cunningham 3; Dale C

Hetzler 4; Dan J Stanley2. 1Indiana University, Indianapolis, Indiana ;
2University of Tennessee, Chattanooga, Tennessee ; 3University Of Tennessee, Chattanooga, Tennessee ;
4Erlanger Health System, Chattanooga, Tennessee . (Tracking ID # 8728)
BACKGROUND: The AMA states it is an ethical requirement that a physician should deal honestly and openly with patients. In 2001 JCAHO added requirement to disclose unanticipated outcomes to accreditation standards. Full disclosure increases patient satisfaction and trust in physicians. Though studies suggest elements of complete disclosure, there are no national standards. Purpose: 1) Look for documentation of various elements of UMEs disclosure 2) Survey health care providers (HCPs) for their perceptions regarding UMEs disclosure METHODS: Chart review for following disclosure elements: who made and received disclosure; were persons documenting and reporting disclosure same; event facts; time from event to disclosure and documentation; locations of error and disclosure. An anonymous survey then was sent to all HCPs. RESULTS: 230 charts with reported UMEs Category E to I (derived from MERP medication scale), at a hospital system in Southeastern U.S. between 7/1/08- 6/30/09 were reviewed for documentation of minimum disclosure elements suggested by prior studies. Documentation was considered complete if it had all the elements mentioned above. 192 charts were included in study - 135 adults/ 57 pediatrics. Overall 9.89% of reviewed charts contained any disclosure documentation. Note that the absence of documentation in the chart does not mean that disclosure did not occur. This review was limited to the examination of charts for documentation of disclosure. (See table) Separate survey data was collected from a sample of physicians (n=65) and non-physicians (n=48) working within the same hospital system (total N=113, response rate 29%).(1) 68% physicians and 48% non-physicians indicated awareness of disclosure recommendations. (2) Physicians and non-physicians reported learning about disclosure recommendations from different sources. (3) 57% physicians and 35% non-physicians reported not being aware/informed of policy or guidelines for disclosure in this hospital (4) Differences were observed between physicians and non-physicians in terms of: perception of disclosure need and best person to provide disclosure in several example scenarios; importance of specific information within proper disclosure documentation; frequency with which certain factors hindered proper disclosureCONCLUSION: There is an incomplete understanding of unintended medical events, various levels of unintended medical events. This may lead to a lack of disclosure and its documentation. Developing explicit policies and structured templates coupled with multisource education of health care providers will assist in improving and promoting professional responsibility, decreasing litigation payouts and improving patient satisfaction.

Table 1:

THE IMPACT OF DIABETES MELLITUS ON SEXUAL FUNCTION IN ETHNICALLY DIVERSE WOMEN Kelli Copeland 1; Jennifer Creasman 1; Leslee Subak 1; Jeanette Brown 1; Stephen Van Den Eeden 2; David Thom 1; Alison Huang1. 1University of California San Francisco, San Francisco, California ; 2Kaiser Permamente Division of Research, Oakland, California . (Tracking ID # 8736)

BACKGROUND: Diabetes mellitus is a common chronic condition that can affect multiple dimensions of functioning and quality of life. While previous studies have indicated an over three-fold increased risk of sexual dysfunction in men with diabetes, the effect of diabetes on sexual function in women is poorly understood. METHODS: Sexual function was examined in an ethnically-diverse cohort of 2,270 women aged 40 to 85 years enrolled in the Kaiser Permanente Medical Care Program of Northern California, including 20% women with diabetes. Sexual function was assessed using self-administered questionnaire measures adapted from the validated Female Sexual Function Index. Diabetic end-organ complications were assessed by interviewer-administered questionnaires, with peripheral neuropathy assessed by the Michigan Neuropathy Screening Instrument, and kidney function assessed by measurement of serum creatinine. Use of medications, including insulin and oral diabetes medications, was assessed by direct review of medication bottles. Multivariable logistic

regression models compared sexual function outcomes (i.e., sexual desire/interest, frequency of sexual activity, overall sexual satisfaction, and specific problems such as difficulty with lubrication, arousal, orgasm, or pain) among diabetic women taking insulin, diabetic women not taking insulin, and non-diabetic women, adjusting for age, race, relationship status, menopause, body mass index, hysterectomy, oopherectomy, other medication use, and smoking. Additional multivariable models assessed relationships between diabetes-specific complications and worse sexual function among diabetic women. RESULTS: Of the 2,270 women, 139 (6%) had diabetes and were taking insulin, 347 (15%) had diabetes but were not taking insulin, and 1,784 (79%) did not have diabetes. The mean (SD) age of participants was 559.2 years and 44% (N=1006) were white, 18% (N=401) Latina, 20% (N=443) African-American, and 18% (N=401) Asian or Pacific Islander. Approximately half of women overall were at least moderately interested in sex (42% of diabetic women taking insulin, 38.1% of diabetic women not taking insulin, and 48% of non-diabetic women [P=0.02 for heterogeneity]). Of the diabetic women taking insulin, 61% reported less than monthly sexual activity, compared to 58% of diabetic women not taking insulin and 48% of non-diabetic women (P<0.01 for heterogeneity). Neither sexual interest nor frequency of sexual activity differed by diabetes category in multivariate analyses. Women with diabetes, both on insulin and not on insulin, were more likely to report low sexual satisfaction compared to non-diabetic women (OR=2.04, 95%CI=1.32-3.24 for those taking insulin; OR=1.41, 95%CI=1.03-1.93 for those not taking insulin), independent of other factors. Among sexually active women, diabetic women taking insulin were also more likely to report problems with lubrication (OR=2.48, 95% CI=1.40-4.41) and orgasm (OR=1.84, 95% CI=1.03-3.29). Among all diabetic women, end-organ complications such as heart disease, stroke, retinopathy, decreased kidney function, claudication, and peripheral neuropathy were associated with increased risk of decreased sexual function in one or more domain. CONCLUSION: Compared to non-diabetic women, women with diabetes are more likely to report low sexual satisfaction, independent of other demographic and clinical factors. Diabetic women taking insulin may also be at higher risk of specific sexual problems such as difficulty with
lubrication or orgasm. Multiple diabetic complications are associated with worse sexual functioning, suggesting that prevention of these complications may be important in preserving sexual function in diabetic women.

HYPERTENSION CONTROL IN DIABETICS IN A FEDERAL QUALIFIED HEALTH CARE CENTER

Nephertiti Efeovbokhan 1;
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(Tracking ID # 8742)

BACKGROUND: Cardiovascular disease and not hyperglycemia is the leading cause of death in patients with diabetes mellitus (DM). Hypertension is particularly burdensome in diabetic patients particularly in low income groups, where the prevalence of uncontrolled hypertension is increased. Federal Qualified Health Centers (FQHCs) are designed to provide care for low income and medically underserved populations. Objectives: 1) to determine the rate of Blood Pressure (BP) control in patients with diabetes and hypertension, and 2) to determine the predictors of BP control in this population.

METHODS: Retrospective analysis of charts of all consecutive patients with cardiovascular disease, hypertension and diabetes mellitus (DM) seen in a FQHC in Michigan from January 1, 2006 to December 31, 2008 was performed. Uncontrolled hypertension was defined as Systolic BP >130 mm Hg and diastolic BP >80 mm Hg. Multivariable logistic regression was used to assess predictors of BP control.

RESULTS: Of 212 patients identified, 154 had hypertension, 122 had DM, and 88 had hypertension and DM. Of the diabetic population,53.28 % were men, mean (SD) age was 51.0 (12.9) years, HbA1C was8.04 (2.29), LDL was 106.42 (35.52). 61.32% had a BMI >30, 38.68% had a BMI >35, 36.89% were smokers, 72.95% had Medicaid insurance,13.93% had Medicare, and 13.11% had no insurance. We found 68.18% of Diabetics with hypertension were on ACE inhibitors/ARBs, 40.91% were on BB, and 45.45% were on Diuretics. BP control was

achieved in only 31.15% of patients with DM. In the cohort of patients whose BP was controlled, 42.86% had HBA1c>=7, while in those with uncontrolled BP,63.16% had HBA1c >=7 (p-value 0.22). A logistic regression model controlling for age, race, gender, type of insurance, BMI, number of medications used for BP control, number of clinic and emergency room visits found age to be associated with BP control (estimates= 0.0540, p-value <0.05)
CONCLUSION: We found that significant number of diabetic patients with hypertension do not have their BP controlled in a FQHC. There is underuse of ACE inhibitors/ARBs for BP control in this population. Our study revealed older diabetics are less likely to have their BP controlled. This underscores the urgent need for strategies to improve BP control in diabetics in FQHCs, especially among elderly patients who have a higher risk for cardiovascular and renal complications.
URBAN WOMENS PREFERENCES FOR LEARNING OF THEIR MAMMOGRAM RESULT: A QUALITATIVE STUDY Erin N. Marcus 1;
Darlene K. Drummond2. 1University of Miami Miller School of Medicine, Key Biscayne, Florida ; 2University of Miami School of Communication, Miami, Florida . (Tracking ID # 8755)
JGIM
ABSTRACTS
S21
BACKGROUND: Research suggests that communication of mammo-gram results is suboptimal for many ethnic minority women. The goals of our project were 1. To improve understanding of low-income inner-city English-speaking womens experiences learning of their mammogram result; 2. To elicit their preferences as to how the communication of mammogram results could be improved; and 3. To gather information to help inform the development of a new tool for communicating mammogram results.
METHODS: A convenience sample of 34 women was recruited in the community to participate in 4 focus groups, each of which was led by an African-American female moderator. Themes discussed included how each woman had learned of her result, how result reporting could be improved, and what types of interventions might be effective to improve womens understanding of their results. The investigators also showed the women a typical mammogram result letter and asked for their opinions. Two investigators separately performed a thematic analysis of the transcripts using an immersion and crystallization approach.
RESULTS: 36 women participated in the study. 85 % (n=29) self-identified as African-American. 39 % (n=14) qualified for Medicaid; 36% (n=13) reported that they lacked insurance. 56 % (n=20) reported an annual income of less than $10,000. Salient themes included general dissatisfaction with how results were reported, with some women saying that they did not recall receiving a letter or receiving a call informing them of their results. Several women reported anxiety simply learning of their results, even if they were normal. Many of the women said that the result notification letter contained words they could not understand, was vague, and did not effectively convey the need for follow-up. Women expressed a preference for learning of the result directly from their physician. Women were unaware of how common it is to be called back for a repeat imaging study, and wanted to be prepared for this possibility in advance, through informational videos and pamphlets. Women expressed a preference for print materials that included pictures, testimonials, and an action plan including a hotline to call with questions.
CONCLUSION: This qualitative study of a predominantly African-American, low-income population of inner city women suggests that current methods for reporting mammogram results are flawed. Advance education about what occurs after a mammogram may improve patients understanding of their results and reduce anxiety. To increase patient satisfaction, print materials informing women of their results should incorporate photographs and testimonials and include information about where to obtain a more detailed explanation about specific results.
MEASURING BLOOD PRESSURE FOR DECISION MAKING AND QUALITY REPORTING: WHERE AND

HOW MANY MEASURES? Benjamin Powers 1; Maren Olsen 2; Valerie Smith 2; Robert Woolson 2; Hayden Bosworth 2; Eugene Oddone2. 1Duke University and Durham VAMC, Durham, North Carolina; 2Duke University Medical Center and Durham VAMC, Durham, North Carolina. (Tracking ID # 8756)
BACKGROUND: There is uncertainty about the optimal setting and number of blood pressure (BP) measurements that should be used for clinical decision making and quality reporting. We sought to compare different strategies using home or clinic BP on the certainty with which patients could be classified as in or out of control.
METHODS: We analyzed 444 veterans with hypertension receiving primary care through the Durham Veterans Affairs Medical Center and
enrolled in a telephone self-management trial over 18 months. Blood pressure was measured repeatedly by three methods: standardized research BP measurements at 6 month intervals; clinic BP measurements obtained during outpatient visits; and home BP using a monitor that transmitted values electronically. Separate random effects models were fit to all available SBP measurements during the study period for research, home, and clinic values. The models included an overall mean (i.e., no change in SBP over time), an individual-level random effect which yielded an estimated between-person variance, and a measurement error which yielded an estimated within-individual variance. Assuming a bivariate normal distributions, we calculated the probability that an individuals true SBP was out of control according to guideline recommendations (SBP >140 mmHg for clinic or study measurements, SBP >135 for home measurements) given a range of observed mean SBP. We estimated these probabilities separately based on one SBP measurements or the average of 2, 5, or 10 measurements.
RESULTS: Patients provided 111,181 SBP measurements (3218 research; 7121 clinic; and 100,842 home) over 18 months. SBP control rates at baseline (mean SBP Short-term variability was large and similar across all three modes of measurement with a mean within-individual coefficient of variation of 10% (range: 1%-24%). No single clinic SBP between 120 mmHg and 160 mmHg allowed correct classification of a patient as in or out of control with >80% certainty (Figure 1). The impact of within-individual variability could be reduced significantly by averaging multiple measurements, with most benefit accrued at 56 measurements (Figure 2).
CONCLUSION: Physicians who want to be >80% certain they are correctly classifying patients blood pressure control should use the average of multiple measurements. Hypertension quality metrics based on a single clinic measurement misclassify a large proportion of patients and could be significantly improved with the incorporation of home blood pressure.
Figure 1. Probability of correct SBP classification based on clinic measurement

TREATMENT EFFECTS OF LINACLOTIDE ON BOWEL AND ABDOMINAL SYMPTOMS OF CHRONIC CONSTIPATION: POOLED EFFICACY AND SAFETY RESULTS FROM 2 RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED PHASE 3 TRIALS Bernard J Lavins 1; Anthony J Lembo 2; Harvey A Schneier 3; Steven J Shiff 3; James E MacDougall 1; Xinwei D Jia 3; Caroline B Kurtz 1; Mark G Currie 1; Jeffrey M Johnston1. 1Ironwood Pharmaceuticals, Cambridge, Massachusetts ; 2Beth Israel Deaconess Medical Center, Boston, Massachusetts ; 3Forest Research Institute, Jersey City, New Jersey . (Tracking ID # 8757)
BACKGROUND: Chronic constipation (CC) affects between 12 and 19% of the US population and can negatively impact patients health-related quality of life. The symptoms of CC include infrequent bowel movements (BMs), hard stools, straining during defecation, a sense of incomplete evacuation, abdominal discomfort and bloating. Many patients are dissatisfied with current treatment options, primarily due to inconsistent efficacy and associated side effects. Linaclotide is a minimally absorbed, guanylate cyclase type-C receptor agonist currently being
evaluated for the treatment of CC and irritable bowel syndrome with constipation. In two multicenter, randomized, double-blind, placebo-controlled, dual-dose, parallel-group Phase 3 trials, linaclotide improved

measures of bowel and abdominal symptoms in patients with CC. Here, pooled results from the two Phase 3 CC trials are presented. METHODS: Patients included in the trials reported a history of <3 spontaneous BMs per week (SBM: a BM occurring in the absence of any laxative, suppository, or enema use during the preceding 24 hours) plus at least one of the following symptoms during at least 25% of defecations: straining, hard or lumpy stools, or a sense of incomplete evacuation, for at least 12 weeks (which need not have been consecutive) in the preceding 12 months. In addition, patients also had to report during the 2-week baseline period: <3 complete SBMs (CSBM: an SBM accompanied by a sensation of complete evacuation)/week and </=6 SBMs/week. Patients meeting these criteria were randomized to oral once daily linaclotide 133 or 266mcg, or placebo for 12 weeks. The primary efficacy endpoint was the 12-week overall CSBM responder rate (>/=3 CSBM/week with increase of >/= 1 CSBM/week from baseline for 9 of 12 weeks). In a post-hoc analysis, the change from baseline in abdominal discomfort and bloating in patients with at least moderate abdominal pain at baseline (score >/=3 on a 1 [none] to 5 [very severe] point severity scale; 23% of the Intent-to-Treat [ITT] population) was assessed. P values were calculated using a Cochran Mantel Haenszel test controlling for study and geographic region for CSBM responder rates and an Analysis of Covariance model with study, treatment group, and geographic region as factors and baseline value as covariate for change from baseline endpoints. RESULTS: In these two Phase 3 trials, a total of 1272 patients with CC were included in the ITT population and were randomized to placebo (n=424), linaclotide 133mcg (n=430), and linaclotide 266mcg (n=418). Baseline demographic and clinical characteristics were similar across treatment groups. Across both trials, approximately 70% of patients did not have a CSBM during the baseline period. For the 12-week treatment period, the overall CSBM responder rates were 4.7%, 18.6%, and 20.3% for placebo, linaclotide 133mcg, and linaclotide 266mcg, respectively (p<0.0001 for both comparisons). The weekly mean CSBM rate is displayed in Figure 1. Statistically significant separation from placebo for CSBM and SBM rates was observed within 24 hours of treatment. Secondary endpoints, including change from baseline in CSBMs, SBMs, stool consistency, straining, and constipation severity were statistically significantly improved with linaclotide 133 and 266mcg compared to placebo (Table 1). Abdominal symptoms were also significantly improved, with decrease in

bloating severity more than 2-fold greater than the placebo response; in addition, in the subpopulation with at least moderate abdominal pain at baseline, the improvement in abdominal discomfort and bloating was nearly one full unit on the 15 severity scale (Table 1, bottom). Diarrhea was the most commonly reported treatment-related adverse event, resulting in discontinuation rates of 0.5%, 4.4%, and 3.8% in placebo, linaclotide 133mcg, and linaclotide 266mcg patients, respectively, in the ITT group; discontinuation rates in the moderate to very severe abdominal pain
subpopulation were even lower, 0%, 2.0%, and 2.1% for placebo, linaclotide 133mcg, and linaclotide 266mcg, respectively.
CONCLUSION: In two large Phase 3 trials, linaclotide treatment statistically significantly improved measures of bowel and abdominal symptoms, as well as constipation severity, in patients with CC. Abdominal symptoms of discomfort and bloating were also statistically significantly improved in patients with at least moderate abdominal pain at baseline. Diarrhea was the most common adverse event.
Table 1:
Least Squares Mean Change from Baseline for Secondary Endpoints
ITT Population
Baseline (n = 1272)
Linaclotide
133?g (n = 430)

266?g (n = 418)
Placebo (n = 424)
S24 ABSTRACTS JGIM
Table 1:
RACIAL DISPARITIES IN BREAST CANCER STAGE AT DIAGNOSIS IN THE MAMMOGRAPHY ERA Neal Chatterjee 1; Yulei He 2; Nancy L Keating3.
1Department of Medicine, Massachusetts General Hospital, Boston, Massachusetts ; 2Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts ; 3Department of Health Care Policy, Harvard Medical School and the Division of General Internal Medicine, Brigham and Womens Hospital, Boston, Massachusetts . (Tracking ID # 8760)
BACKGROUND: The efficacy of mammographic screening is related to its ability to shift stage at diagnosis from distant to earlier-stage disease. Despite equivalent rates of mammography since the late-1990 s, black women have higher breast cancer mortality than white women. Since stage at diagnosis is the strongest predictor of survival in breast cancer, we sought to assess dynamic changes in stage at breast cancer diagnosis for black and white women since mammography became available.
JGIM
ABSTRACTS
S25
METHODS: Population-based observational study involving 143,249 white and 13,571 black women aged 5069 diagnosed with invasive breast cancer between 19822007 living in a Surveillance, Epidemiology, and End Results (SEER) region. We assessed odds of distant (versus local or regional) disease at diagnosis by race, adjusted for patient demographic (age, marital status, SEER region) and socioeconomic factors (area-level estimates of insurance status, education, income) known to affect stage at diagnosis. Behavioral Risk Factor Surveillance System data were used to calculate biennial mammography rates for black and white women, aged 5170, from 1990 to 2006 in all states where the SEER9 regions were located. We used logistic regression to assess the association of year of diagnosis and race with distant cancer diagnosis. Logistic regression was also used to compare linear trends in rates of distant cancer diagnosis for black and white women, before and after 1998 (a time corresponding to peak mammography for both races). Year was treated as a continuous variable and an indicator variable was included for pre vs. post-1998 to assess change.
RESULTS: Overall, 5.8% of whites and 10.2% of blacks were diagnosed with distant breast cancer. The black-white disparity in the proportion of distant cancers narrowed until 1998 (adjusted difference 0.65%), before increasing (Figure). Biennial mammography rates in the SEER9 states peaked in 2000 for both races; rates were lower for blacks than whites in the early 1990 s, but equalized by 1996 (Figure). Between 1982 and 1997, the proportion of distant cancers decreased over time for both black women (adjusted odds ratio [AOR] per year=0.973 [95% CI=0.960-0.987]) and
white women (AOR per year=0.978 [95% CI=0.974-0.984]), and the rate of decline for black and white women did not differ significantly (P for interaction=0.61). From 19982007, the odds of distant breast cancers increased more rapidly for black women (AOR per year=1.036 [95% CI=1.014-1.060]) than for white women (AOR per year=1.011 [95% CI=1.001-1.021]) (P for interaction=0.04). Sensitivity analyses using 1997 and 1999 as alternate time points did not change statistical associations. CONCLUSION: After a narrowing of the black-white disparity in the proportion of distant breast cancers diagnosed until 1998, the proportion of distant-stage cancers has since increased more rapidly in black women than white women. The narrowing of the black-white disparity coincides with peak rates of mammography for black and white women. We propose two possible explanations for our findings. First, given more aggressive tumor biology in black women, the disproportionate increase of distant disease may reflect less benefit for black women at current screening intervals (every 12 years). Second, rates of mammography have declined for both black and white women since 2000. In a background of

different tumor biology, similar decrements in screening rates may be associated with widening of the stage at diagnosis disparity. Black women may benefit more from higher absolute rates of mammography than white women. Given the marked survival difference between early and late stage breast cancer, further attention to racial disparities in stage at diagnosis is warranted.

THE METABOLIC SYNDROME IN OBESE PATIENTS WITH BINGE EATING DISORDER IN PRIMARY CARE CLINICS Katherine C. McKenzie 1; Rachel Barnes 2; Abbe Boeke 3; Inginia Genao 4; Rina Garcia 5; Matthew Ellman 4; Peter Ellis 3; Robin Masheb 3; Carlos Grilo6.

1Yale University School of Medicine, New Haven, Connecticut ; 2Yale School of Medicine, New Haven, Connecticut ; 3Yale University School of Medicine, New Haven, Connecticut ; 4Yale University School of Medicine, New Haven, Connecticut ; 5Yale University School of Medicine, Middletown, Connecticut ; 6Yale University School of Medicine, Yale University, New Haven, Connecticut . (Tracking ID # 8779)

BACKGROUND: Obesity is a heterogeneous problem, and research has highlighted the clinical significance of the subgroup of patients with binge eating disorder (BED). BED is characterized by recurrent episodes of binge eating (overeating unusually large quantities of food while experiencing a subjective loss of control) without inappropriate weight compensatory behaviors (which characterize bulimia nervosa). The distribution and nature of the metabolic syndrome in obese patients with BED is largely unknown and requires investigation, particularly in general internal medicine settings.

METHODS: A cross-sectional analysis of 81 consecutive treatment-seeking obese BED patients. Patients with and without metabolic syndrome were compared on demographic features and current and historical eating- and weight-related variables.

RESULTS: Forty-three percent of patients met criteria for metabolic syndrome. A significantly higher proportion of men (66%) than women (35%) met criteria for metabolic syndrome; patients with versus without metabolic syndrome did not differ significantly in ethnicity or body mass index. Patients with versus without metabolic syndrome did not differ significantly in binge-eating frequency, severity of eating disorder psychopathology, or depression. ANCOVAs, controlling for gender, revealed that patients without the metabolic syndrome started dieting at a significantly younger age, spent more of their adult lives dieting, and reported more current dietary restriction than patients with metabolic syndrome.

CONCLUSION: Metabolic syndrome is common in obese patients with BED in primary care settings and is associated with fewer dieting behaviors. These findings suggest that certain lifestyle behaviors, such as increased dietary restriction, may be potential targets for intervention with metabolic syndrome.

RISK OF THIAZIDE-INDUCED HYPONATREMIA IN PATIENTS WITH HYPERTENSION Alexander A. Leung 1; Adam Wright 1; Valeria Pazo 1; Andrew Karson 2; David W. Bates1. 1Brigham and Womens Hospital, Boston, Massachusetts; 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 8786)

BACKGROUND: Although hyponatremia is a well-recognized and costly complication of treatment with thiazide diuretics, the risk of thiazide-induced hyponatremia has not been defined in routine care. Thus, we designed this study to assess the risk of incident hyponatremia in patients treated with thiazides.

METHODS: We conducted an inception cohort study using a multicenter clinical research registry to identify 3238 adult outpatients that were newly treated for hypertension between January 1, 2000 and December 31, 2005 at two teaching hospitals in Boston, Massachusetts, and followed them for up to 10 years. Patients with prior hyponatremia were excluded. RESULTS: Of 152 patients exposed to thiazide diuretics (mean age 59 years), 67 (44%) developed hyponatremia, defined as serum sodium less than 133 mmol/L. Among those that developed hyponatremia with thiazides, the median time to event was 1.8 years (655 days). The adjusted rate of incident hyponatremia was 80 cases per 1000 person-years for patients treated with thiazides compared to 27 cases per 1000 person-years in those without thiazides. Patients exposed to thiazides were more likely to

develop hyponatremia (adjusted rate ratio, 3.13; 95% CI, 2.34 to 4.17) and the relative risk was similar regardless of age or sex. Similarly, the risk of hospitalizations associated with hyponatremia (adjusted rate ratio, 2.94; 95% CI, 1.97 to 4.39) and all hospitalizations (adjusted rate ratio, 1.34; 95% CI, 1.05 to 1.71) were higher in those treated with thiazides. There was no significant difference in mortality.
The number needed to treat to result in one extraneous incident case of hyponatremia in 5 years was 4.55 (95% CI, 3.36 to 7.04). CONCLUSION: Our findings suggest that the occurrence of hyponatremia and associated hospitalizations among patients receiving thiazide diuretics are common with substantial long-term risks. We found that over 4 in 10 patients exposed to thiazides develop hyponatremia when followed over a decade.
TIME-DEPENDENCY OF OUTCOME RELATIONSHIPS FOR DRUG-ELUTING STENTS VERSUS BARE-METAL STENTS Alexander A. Leung 1; Danielle A. Southern 1; P. Diane Galbraith 1; Merril L. Knudtson 1; William A. Ghali1. 1University of Calgary, Calgary, Alberta. (Tracking ID # 8787)
BACKGROUND: We previously reported outcomes on a population-based cohort that suggested that the early benefit from revascularization with drug-eluting stents attenuated over time, with perhaps even a shift toward poorer outcomes after one year. To better characterize this finding, we sought to investigate the long-term outcomes associated with drug-eluting stents compared to bare-metal stents with an analysis extending to 7 years of follow-up.
METHODS: We performed an extended analysis on a cohort of 6440 patients who underwent percutaneous coronary intervention between April 1, 2003 an March 31, 2005 using a prospective multicenter provincial clinical registry, and compared rates of death, and of death or repeat revascularization over 7 years of follow-up. We determined risk-adjusted hazard ratios at moments in time using spline analysis from Cox proportional hazards modeling.
RESULTS: During the 7 years of observation, the relative risks for death or the composite outcome of death or repeat revascularization varied over time. There was suggestion of early benefit associated with drug-eluting stents in the first year following implantation. Subsequently, at one year post-procedure and beyond, there was a shift in relative risks over time with a higher hazard for poor outcomes in drug-eluting stent patients (see figure). The adjusted relative risks early in the first year for death and the composite outcome of death or repeat revascularization were 0.26 (95% CI, 0.14 to 0.48) and 0.69 (95% CI, 0.44 to 1.08), respectively. By 7 years, the adjusted relative risks for death and the composite outcome of death or repeat revascularization rose to 1.52 (95% CI, 0.96 to 2.42) and 1.53 (95% CI, 0.96 to2.42), respectively.

CONCLUSION: Revascularization with drug-eluting stents is associated with significantly better outcomes within the first year only. Thereafter, a signal for a progressively increasing risk is seen, most notably for the composite outcome of death or repeat revascularization.
DYING ON THE STREETS Thuy Pham 1; Sara Doorley 1; Cheryl Ho1.
1Santa Clara Valley Medical Center, San Jose, California. (Tracking ID # 8875)
BACKGROUND: The Valley Homeless Healthcare Program (VHHP) was established in 2003 to provide medical and psychiatric care to the homeless of Santa Clara County. This study aims to explore VHHPs patients experiences and views on death and dying in order to implement programs that would bridge barriers to effective healthcare. METHODS: Participants were recruited from a primary care clinic for the homeless in San Jose, California. Inclusion criteria for the study included a history of homelessness, age 18 or older, ability to speak English and give written informed consent. Participants were asked to fill out a demographic survey then join a focus group to discuss their experiences with death, experiences with memorial services, utility of a memorial service, fear of death and dying, exposure and interest in advanced directive. This data was analyzed manually using a method called content analysis. RESULTS: There were a total of 30 participants,

ages 26 to 60, 21 men and 9 women. Of the 30 participants, 19 were Caucasian, 4 were African American, 6 were Hispanic, with 1 Other. The participants knew a total of 45 homeless people who died in the past year. 69% of those deaths were caused by substance abuse or violent crime. Common themes regarding fear about death and dying included physical pain and suffering, leaving a burden for the people left behind, the afterlife, no fear, dying alone and not being found. One participant said, At this moment, I dont fear death. Death will be a blessing. Another participant stated, There are more reasons to die when you are homeless because no one cares about you. One of the women said softly, I live under the freeway and am a little old woman, so its scary. Overall, 67% of the participants would want a memorial service after they die, 7% said no, and 26% were undecided. One participant said no because there would not be anything nice said. Others did not like funerals in general or did not care. 87% of the participants would find it helpful to have a discussion on how they want to be treated when they are too sick to make decisions for themselves and write down an advanced directive.
CONCLUSION: Homeless persons in the Valley Homeless Healthcare Program have frequent encounters with death and favor clinic-based end-of-life discussions and documentation as well as a memorial service. The variation in participants answers illustrates the complexity of the topic of death and dying. Therefore, further studies with more participants in different primary care clinics for the homeless are needed to validate these needs and the utility of implementing programs to address these needs.

HYPERTENSION CONTROL IN A FEDERAL QUALIFIED HEALTH CENTER IN MICHIGAN: HOW ARE WE DOING?

Ade Olomu 1;
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BACKGROUND: Rates of hypertension awareness and treatment have increased with recent reports from the National Health and Nutrition Examination survey (NHANES) estimating blood pressure control nationally at about 50%, does this hold true in our Federal qualified health centers (FQHCs)? FQHCs are designed to provide care for low income and medically underserved populations. Hypertension is particularly burdensome in low income groups, where the prevalence of uncontrolled hypertension is increased. Objectives: 1) to determine the rate of blood pressure control in a FQHC. 2) to determine the predictors of Blood Pressure (BP) control.
METHODS: Retrospective analysis of charts of all consecutive patients with hypertension, coronary artery disease and or, diabetes mellitus (DM) seen in a FQHC in Michigan from January 1, 2006 to December 31, 2008. Uncontrolled hypertension was defined as Systolic BP >140 mmHg (>130 mm Hg in patients with DM) and diastolic BP >90 mmHg (>80 mm Hg in patients with DM). Multivariable logistic regression was used to assess predictors of BP control.
RESULTS: Of 212 patients identified, 154 had hypertension, 122 had DM, and 88 had hypertension and DM. The mean age was 53.9 +11.6 years,51.3 % were men, mean BMI was 34.1 +10.5, 74.53% had Medicaid,11.32% had Medicare, 1.42% had private insurance and 12.74% had no

insurance. We found 44.81% of hypertensive patients were on diuretics,68.18% of Diabetics with hypertension were on ACE inhibitors/ARBs. BP control was achieved in 38.21 % of entire cohort and in 31.15% of patients with DM. A logistic regression model controlling for age, race, gender, type of insurance, BMI, number of medications used for BP control, number of clinic and emergency room visits found only female gender (OR=2.6, 95% CI:1.05, 6.37) to be associated with BP control.
CONCLUSION: We found that significant numbers of hypertensive patients were not adequately treated and fewer had BP controlled. Our study revealed female gender disparity and gross underuse of guideline recommended medications for BP control, especially among patients with diabetes. This underscores the urgent need for strategies to improve BP control and adherence to guideline recommendations for BP management in

FQHCs.

TOBACCO DEPENDENCE TREATMENT INTERVENTION FOR HOSPITALIZED SMOKERS: A RANDOMIZED, CONTROLLED TRIAL UTILIZING VARENICLINE Michael B. Steinberg 1; Jennifer Randall 1; Shelley Greenhaus1. 1UMDNJ-Robert Wood Johnson Medical School, New Brunswick, New Jersey. (Tracking ID # 8934)

BACKGROUND: Despite clear medical reasons to quit smoking, patients with medical illness continue to smoke at high rates. The hospital can be an important opportunity for smoking cessation interventions, but the use of tobacco treatments in this setting is limited. Previous studies indicate that intensity of treatment and quality of post-discharge follow-up are key predictors of abstinence. This study evaluates the benefit of initiating a comprehensive tobacco treatment intervention, including varenicline, during hospitalization. METHODS: Seventy-nine smokers admitted to a 584-bed university-based hospital with various diagnoses were enrolled in a randomized, double-blinded, placebo controlled trial from August 2007 to March 2009. A comprehensive treatment intervention, including varenicline or placebo and face-to-face outpatient follow-up, was utilized. Follow-up data collection occurred at weeks 4, 12, and 24. Primary outcome was exhaled carbon monoxide confirmed 7-day point abstinence at 24 weeks following discharge. Secondary outcomes included abstinence at 4 and 12 weeks following discharge; reported withdrawal symptoms; motivation to stop smoking; utilization of outpatient treatment following discharge; and composite medical outcome or death.

RESULTS: Overall abstinence for all subjects was 27% at 24 weeks. There was no difference in abstinence rates at 24 weeks between varenicline and placebo treatment groups (23% vs. 31%). There were non-significant differences in adherence to medication treatments between the varenicline and placebo groups (56% vs. 78%; p=0.12). Among subjects who were adherent to the medication protocol, there was a non-statistically higher abstinence rate at 24-week follow up in the varenicline group compared with placebo (80% vs. 56%; p=0.2). Utilization of the outpatient treatment component was quite high with40.5% of all subjects attending treatment at the Tobacco Dependence Clinic. Those subjects who attended treatment had significantly higher abstinence rates compared with those who did not attend treatment(53.1% vs. 8.5%, p There were no significant differences in motivation to stop smoking or changes in withdrawal symptoms. During the follow-up period, 23 subjects were re-hospitalized or treated in the emergency department with no significant difference between treatment groups (13 varenicline vs. 10 placebo).

CONCLUSION: Varenicline used in the hospital setting and immediately following discharge for smoking cessation appears safe, but it is unclear how effective it is when initiated in this setting. The benefit of face-to-face treatment following discharge and interventions to improve these follow-up rates may be important to achieving success in tobacco cessation for hospitalized smokers.

SCHOLARLY WORK OF CLINICIAN EDUCATOR FACULTY: A NATIONAL SURVEY OF GENERAL INTERNAL MEDICINE DIVISION DIRECTORS Hsin-Chieh Yeh 1; Amanda Bertram 1; Frederick L Brancati 1; Joseph Cofrancesco1. 1Johns Hopkins University, Baltimore, Maryland. (Tracking ID # 8947)

BACKGROUND: Although many medical schools expect clinician-educators (CEs) to produce external scholarship to earn promotion, the value of specific scholarly products and the availability of institutional support for scholarship are uncertain. We therefore conducted a national survey of GIM Division Chiefs concerning CE scholarship.

METHODS: A sampling frame for US GIM Division Chiefs was assembled from: (1) AAMC list of accredited medical schools; (2) SGIM membership directory; (3) ACLGIM membership directory; (4) GIM Division websites; and (5) telephone calls to GIM Division offices. For institutions with more than one GIM division, each Chief was surveyed. The survey included 4 sections: (1) general information; (2) rating of the importance of CE scholarly activities for promotion to Associate Professor; (3) availability of institutional research support for CEs; and (4) an open-ended hypothetical question If you had $100,000 per year to spend to enhance the scholarly productivity of your CEs, how would you spend it?.

RESULTS: Of the 134 AAMC accredited medical schools, we identified 145 Chiefs in 128 GIM divisions, excluding Johns Hopkins. To date, we received responses from 54 Chiefs (37%) from 51 institutions. There were no significant institutional differences between responders and non-responders regarding geographic region (p=0.45), number of medical students (p=0.26), or quartile of NIH research funding (p=0.47). Among responding Chiefs, median duration of service was 6 years (IQR: 311); 27% were women. They reported a median number of full-time CEs per GIM Division of 20 (inter-quartile range (IQR): 1132). 73% of GIM Divisions had a separate promotion track for CEs. The Figure illustrates the distribution of perceived importance of various scholarly activities in promotion of CEs to Associate Professor. Curriculum development and administration, presentations at national meetings and other institutions, and review articles and book chapters were all rated as most/very important or important/somewhat important by over 90% of Chiefs. The exception was publishing original peer-reviewed articles: about half of Chiefs surveyed rated these most/very important, but slightly less than half rated these not important at all. This difference was significantly associated with having separate promotion tracks: in Divisions with a separate track, 37% of Chiefs rated publishing original articles most/very important vs. 80% in Divisions without a separate track (p=0.02). Many Chiefs lacked divisional resources to promote CE scholarship, including lack of protected time (72%), project coordination (61%), overall career mentorship (46%), and statistical analysis (43%). If $100,000 per year were available to enhance the scholarly productivity of CEs, Chiefs most frequently cited the following priorities: faculty development (39%), protected time (29%), methods/statistics support (24%), project coordination/assistance (24%), and project funding (22%).

CONCLUSION: Scholarly productivity is important for promotion of CEs and there is a wide range of acceptable products. Original, peer-reviewed articles are very important in about half of GIM Divisions, but Chiefs report limited resources to facilitate original scholarship. Investment in core statistical support, faculty mentorship, and project coordination represent promising approaches to improve CE scholarly productivity.

VIEWS ON END-OF-LIFE CARE AMONG SOUTH ASIANS LIVING IN THE US Rashmi K. Sharma 1; Rashmi K. Sharma 1; Nidhi Khosla 2; James A. Tulsky 3; Joseph A. Carrese3. 1Northwestern University, Chicago, Illinois ; 2Johns Hopkins University, Baltimore, Maryland ;
3Duke, Durham, North Carolina . (Tracking ID # 8989) BACKGROUND: End-of-life care preferences vary across racial/ethnic groups and are likely influenced by cultural values and views. However, the way in which culture affects end-of-life care preferences among immigrant groups in the U.S. and their offspring is still poorly understood, especially among South Asians. Therefore, we sought to examine the values and views that influence end-of-life care preferences among first and second generation South Asians living in the United States. METHODS: This qualitative study used purposive sampling to recruit 12 first generation and 11 second generation South Asians in the mid-Atlantic region. Four focus groups (two first generation groups and two second generation groups) were conducted. Audio-recordings of the focus group sessions were transcribed verbatim, independently reviewed,
and coded by two investigators using Atlas.ti 6.0 to perform an editing style analysis. This process led to the generation of several themes and sub-themes.
RESULTS: First generation participants ranged in age from 41 to 76 years and were evenly split by gender. Second generation participants ranged in age from 23 to 36 years and included seven women and four men. All participants were highly educated, most were Hindu, and two thirds were studying or working in a healthcare field. Several themes emerged:1. Attitudes toward death and suffering-Death: Participants attributed a greater acceptance of death in South Asian culture to cultural beliefs (e.g., reincarnation).-Suffering: Most felt suffering should be treated even if it resulted from ones karma.2. Family duty: dynamics, specific roles, and expectations

-Family dynamics: Large family sizes, geographic distances, and traditional gender roles led to complex family dynamics which complicated EOL communication and decision making.

-Special roles: Traditionally, aging parents were cared for by the eldest son, but roles are changing due to education and urbanization. -Expectations: Strong sense of duty to care for family held by all, but first generation participants expected less from their children because of western emphasis on individuality. Second generation participants retained a sense of duty to care for aging parents but were concerned about resources to provide care at home.3. Self-determination and sociocultural considerations: -Information disclosure: Most preferred full disclosure. Lack of social support in the U.S. cited as a reason for preferring full disclosure in the U.S. but not in India.-Advance care planning: Patient preferences were often not discussed with family members leading to uncertainty and misconceptions. Several participants supported the use of advance directives to reduce family member decision-making burden rather than for the traditional rationale of patient self-determination.
CONCLUSION: In this study of first and second generation South Asians in the U.S., we found that many traditional cultural values, such as filial duty, greatly influenced care preferences at the end of life and retained importance across generations. Participants also described cultural challenges due to complex family dynamics, lack of explicit discussion between patients and other family members, and a tension between wanting to meet traditional expectations and an inability to do so in the face of U.S. social realities. Clinicians caring for South Asian patients at the end of life may be better able to assess care preferences after exploring the complex interplay between traditional expectations, family duty and dynamics, and specific social realities for each patient.
DISEASE PREVALENCE AND AGE DISTRIBUTION OF NEW FEMALE PATIENTS ATTENDING A GENERAL OUTPATIENT CLINIC AT A MEDICAL SCHOOL HOSPITAL IN JAPAN Yuta Sakanishi 1; Yuichiro Eguchi 2; Midori Nishii 3; Naoko Eguchi 2; Motoshi Fujiwara 3; Hitoshi Eguchi 3; Masaki Tago 3; Satoshi Matsunaga 3; Tsuneaki Yoshioka 3; Shu Soejima 3; Sei Emura 4; Shunzo 1; Takashi KoizumiSugioka5. 1Saga Medical School, Saga, N/A ; 2General Medicine, Medical School, Saga, N/A ; 3General Medicine, Saga Medical School, Saga, N/A ; 4Center for Graduate Medical Education Development and Research, Saga Medical School, Saga, N/A ; 5Community Medical Support Institute, Medical School of General Medicine, Medical School, Saga, Saga, N/A, N/A . (Tracking ID # 9024)
BACKGROUND: Information on the disease prevalences and age distributions of outpatient populations is needed to improve the quality of outpatient care and to assess the role of academic medical centers in the community. Our preliminary retrospective study investigated the age distribution of over 4,000 first-visit patients over 1 year; female patients showed bimodal peaks in their 20 s and 50-60 s, whereas the incidence of new male patients in their 60 s peaked. The aim of the current study was to identify the medical background associated with this age distribution in new female patients presenting at the outpatient clinic of a medical school hospital.
METHODS: The initial diagnosis on the first day of patient attendance was prospectively recorded in the electronic medical records, using a template, between October 2009 and June 2010. Patients with a referral form were excluded. The initial diagnoses were classified according to the International Classification of Primary Care codes (ICPC-2, Oxford University Press, 1998).
RESULTS: A total of 1,166 new female patients were enrolled during the study period. Their age distribution showed bimodal peaks in their 20 s and 50-60 s. The prevalences of the initial diagnoses classified by ICPC code were: gastrointestinal disease (13.1%), orthopedic disorders (14.3%), and respiratory diseases (11.9%). The age distributions of new female patients with gastrointestinal disease and respiratory disease showed bimodal peaks, while that for orthopedic disorders showed a single peak at over 50 years. The prevalences of initial diagnoses in the late 30 s-40 s were similar to those in other generations.

CONCLUSION: The age distribution of new female patients attending the outpatient clinic at a university hospital showed bimodal peaks for those in their 20 s and 50-60 s. This distribution was not associated with age-related disease prevalences. These results suggest that some patients have problems visiting university hospital outpatient clinics. Further studies are needed to identify the social obstacles to accessibility inpatients in their late 30-40 s, and to improve the quality of care for initial medical visits.

THE INFLUENCE OF FINANCIAL STRESSORS ON FUTURE CAREER CHOICES OF MEDICAL STUDENTS AND RESIDENTS ERIN W. KINNEY 1; PHILIP SCHERER 1; RAMYA EMBAR SRINIVASAN 1; CHRISTOPHER J. CUNNINGHAM 2; VICTOR O. KOLADE 1; Mukta Panda1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee; 2University of Tennessee Chattanooga, Chattanooga, Tennessee. (Tracking ID # 9027)

BACKGROUND: With average medical student debt surpassing $130,000 (Kerr and Brown, 2006), financial concerns are among the top stressors adversely impacting resident quality of life. Financial stress can influence ultimate career choice and may affect the quality of patient care residents provide. Financial instruction is not generally a fundamental component of medical education. This pilot study aims at assessing the need for financial education and to develop an effective, tailored curriculum to decrease resident financial stress and ultimately improve patient care. METHODS: At one academic medical center, a pre-survey was distributed to residents and medical students to assess financial knowledge and stressors using a validated stress scale. Data was collected via an online survey after informed consent was obtained. Forty-eight residents (29%) and 17 students (33.3%) consented to participate. Identifiable data was managed by a third-party consultant to ensure confidentiality and was de-identified prior to being analyzed by the study team. Data analysis was performed with descriptive statistics. RESULTS: Pre-survey results show similar resident and medical student demographics. The average resident and student owe $156,137.92 and $136,958 in student loans, respectively. More students than residents believe they will eventually practice in an academic position. 43.8% of students believe that their debt will/may influence their specialty choice. 42.1% of residents believe that their debt influenced their specialty choice. On a perceived pressure-stress scale pertaining to personal finances, resident scored 8.05/14 and students scored 8.27/14. On a perceived threat-stress scale pertaining to finances, residents scored 7.37/16 and students scored 6.53/16. 54% of residents and 12.5% of students have experience with financial education. Greater than 80% of students and residents believe it is important for residents to receive training in personal and professional finance and are interested in attending lectures addressing basic financial concepts.

CONCLUSION: Medical students and residents accrue considerable student loan debt that causes stress and may affect career choices. For instance, more students than residents wish to practice in an academic position. Residents and students alike experience significant pressure and threat stress regarding their personal finances. A larger number of residents than students received some financial education, perhaps indicating an educational void in medical school not addressed by mandatory federal loan counseling. Residents and students expressed a desire for more extensive financial preparation for medical practice and personal life. Structured financial training may alleviate financial stress during medical education and allow students and residents to make career choices based on interest and professional goals as opposed to financial constraints, potentially leading to better patient care. Kerr, J. R. and Brown, J.J. Costs of a medical education: comparison with graduate education in law and business. J Am Coll Radiol, 2006, 3(2): 122130.

A QUALITATIVE APPROACH TO ASSESSING MEDICATION-RELATED ALERTING IN ELECTRONIC MEDICAL RECORDS Shobha Phansalkar 1;
Marianne Zachariah 2; Kathrin Cresswell 3; Meryl Bloomrosen 4; David W. Bates5. 1Brigham and Womens

Hospital and Harvard Medical School, Wellesley, Massachusetts ; 2Partners HealthCare Systems, Wellesley, Massachusetts ; 3The University of Edinburgh, Edinburgh, N/A ;
4American Medical Informatics Association, Bethesda, Maryland ;
5Division of General Internal Medicine, Brigham and Womens Hospital, Boston, Massachusetts . (Tracking ID # 9038)
BACKGROUND: Improving EHR adoption represents a key initiative of the current healthcare administration. Closely tied to achieving the benefits of EHRs is the provision of clinically meaningful decision support. Medication-related decision support (MDS) has the potential to prevent harm but is often ignored by physicians due to excessive alerting. We conducted a qualitative study to explore factors related to successful adoption of medication-related alerts in EHRs.
METHODS: We conducted semi-structured interviews with 42 end-users from 6 healthcare institutions, using 4 inpatient and 8 outpatient EHRs with MDS functionalities. Thematic analysis was used to identify underlying factors which emerged from consensus between two independent reviewers.
RESULTS: Reviewers assigned 1,157 statements to 31 thematic codes associated with good inter-rater agreement [Cohens kappa=0.69], which fell into 4 constructs (Implementation, Workflow, Users Perceptions, and Alert Characteristics). Implementation considerations related to: MDS development, Implementation issues (training, users ability to customize alerts, and mechanisms to provide feedback), Knowledge source for obtaining MDS, and Institutional governance and leadership overseeing MDS. Workflow considerations related to the timing of receiving alerts and the expected response from the user. Attitudes that influenced users responses towards MDS related to alert overload and users trust in the relevance of alerts. Users identified characteristics of optimal alerts, such as informational content, design and display, types of alerts available, and ability to override them.
CONCLUSION: Without effective implementation strategies, MDS can be intrusive to the clinician workflow. This study provides insight into providers perceptions on successful adoption of medication-related alerts. Findings of the study have implications on effective design and implementation of alerts impacting provider behavior.
3-YEAR FOLLOW-UP FROM A CLUSTER-RANDOMIZED TRIAL OF A PRIMARY CARE INFORMATICS-BASED SYSTEM FOR BREAST CANCER SCREENING Steven J. Atlas 1; Jeffrey Ashburner 1; Yuchiao Chang 1; Richard Grant 1; William Lester 1; Henry Chueh 1; Michael Barry1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 9052)
BACKGROUND: We sought to increase screening for breast cancer in eligible women within one primary care (PC) practice-based research network (PBRN) through a novel system of integrated population-based surveillance that linked patients to primary care providers (PCPs) and used an informatics tool to let providers review overdue patients and initiate outreach for those selected for contact.
METHODS: We randomized 12 PC practices (4 community health centers and 8 affiliated practices) to intervention (n=6) or usual care (n=6). Women 42 to 69 years of age without prior bilateral mastectomy were eligible and linked to a specific PCP or practice (if not PCP linked). Patients overdue for screening included 1) those who had not had a mammogram in the two years prior to the start of the trial (prevalent overdue) or 2) those who became two years overdue in the year after the study start date (incident overdue). In intervention practices, PCPs (for PCP-linked patients) and case managers (CMs, for practice-linked patients) received three periodic emails during the one year trial with a direct link to a web-based informatics tool that listed their overdue patients. Providers could select patients for contact or defer patients and provide a reason. Patients selected for contact received an automatically-generated letter with information about the value of screening and how to schedule a mammogram. The tool then transferred these patients to practice delegates who called patients to schedule tests or document exclusions. After the one year study period, the informatics tool remained active, though no reminder emails were sent and the original population was not updated. We

examined time to mammography completion over a 3-year follow-up period in all overdue patients and in prevalent and incident overdue populations using Kaplan-Meier curves and Cox proportional hazards regression controlling for baseline covariates and physician/practice clustering. RESULTS: Among 32,688 eligible women, baseline mammography screening rates in intervention and control groups did not differ(79.5% vs. 79.3%, p=0.73). Overall, 9795 women were overdue for mammograms including 6697 at the start of the study (prevalent overdue: 3045 in intervention and 3652 in control practices) and 3098 during the one year trial period (incident overdue: 1442 in intervention and 1656 in control practices). Intervention patients were younger, more likely to be non-Hispanic white, and have health insurance. Most intervention PCPs (59 of 64, 92%) and all CMs (6 of 6) used the tool. Action was taken in 3415 (76.1%) intervention patients (2865 [84%] contacted and 550 [16%] deferred). Over three years of follow-up, intervention patients were more likely to have a mammogram than control patients (hazard ratio: 1.19, 95% CI: 1.10-1.29, p<0.001). CONCLUSION: We developed a novel system for breast cancer screening that included a non-visit-based informatics tool for providers to screen their overdue list for contact and follow-up by practice delegates. Over three years of follow-up, intervention patients were more likely to complete mammography screening.

CO-LOCATED PRIMARY CARE IN THE MENTAL HEALTH SETTING IMPROVES ATTAINMENT OF CARDIOVASCULAR RISK GOALS IN VETERANS WITH SERIOUS MENTAL ILLNESS Emily S Rowland 1; Paul A Pirraglia 2; Peter D Friedmann 2; Thomas P OToole2. 1Alpert Medical School of Brown University, Providence, Rhode Island;
2Providence VA Medical Center/Alpert Medical School of Brown University, Providence, Rhode Island.
(Tracking ID # 9064)

BACKGROUND: Patients with serious mental illness (SMI) are at high risk for cardiovascular complications, but may not be engaged in their medical care. The benefit of co-locating general medical services into mental health settings on cardiovascular health for those with SMI has not been determined. We examined attainment of goal lipids, systolic blood pressure, and weight among veterans with SMI prior to and after enrollment in a primary care clinic co-located in mental health. METHODS: We studied veterans with SMI with prior poor primary care engagement who were then enrolled in a co-located primary care clinic for at least one year. The four six-month observation periods were (PRE1) 12 months to 6 months prior to enrollment, (PRE2) 6 months prior to enrollment until enrollment, (POST1) enrollment until 6 months after enrollment, and (POST2) 6 months to 1 year after enrollment. Based on VA practice guidelines, we defined uncontrolled cholesterol as average low density lipoprotein cholesterol (LDL) >100 if diabetes mellitus (DM) or coronary artery disease (CAD) or >130 if not, uncontrolled systolic blood pressure (SBP) as average during the observation window >140, uncontrolled weight as average body mass index (BMI) >30, and in those with DM, HbA1c >9. For each variable, unmeasured values within an observation period were considered uncontrolled. Repeated measures logistic regression tested whether control of LDL, SBP, and BMI differed across the observation periods. RESULTS: We studied 97 veterans. Mean age was 55.310.0 years;86.6% white, 8.3% black, 4.1% other race; 41.2% were service connected at 50-100%; 5% were female. SMIs included schizophrenic(23.7%), schizoaffective (24.7%), psychotic (4.1%), personality (7.2%), bipolar (14.4%), and major depressive (37.1%) disorders; these were not mutually exclusive. Medical comorbidities included DM (15.5%), hyperlipidemia (61.9%), hypertension (46.4%), and CAD (16.5%). There was a significant improvement in attainment of goal SBP (PRE1 55.7%, PRE2 52.6%, POST1 78.4%, POST2 63.9%, p<.03) and LDL (PRE124.7%, PRE2 27.8%, POST1 38.1%, POST2 65.0%, p<.0001). Improvement in BMI was borderline significant (PRE1 34.0%, PRE2 33.0%, POST1 50.5%, POST2 42.3%, p=.06). HbA1c did not appear to change. CONCLUSION: The proportion of patients at goal for SBP and LDL increased after enrollment in a primary care clinic co-located in mental health. There was little change in the two pre-enrollment periods, suggesting the change is due to enrollment in this clinic. Our findings suggest that co-located primary care improves the cardiovascular health of veterans with SMI. As patient centered

medical homes are implemented, consideration of co-located care models for vulnerable populations such as veterans with SMI is important. Future work should involve multiple sites and a contemporaneous control group.

LIKELIHOOD OF DEVELOPING DIABETES AND CARDIOVASCULAR DISEASE IN PHENOTYPICALLY OBESE METABOLICALLY NORMAL INDIVIDUALS KoKo Aung 1; Carlos Lorenzo 1; Steven Haffner2. 1University of Texas Health Science Center at San Antonio, San Antonio, Texas ; 2No institutional affiliation, San Antonio, Texas . (Tracking ID # 9070)

BACKGROUND: We previously reported that metabolically obese normal weight (MONW) individuals, despite their normal body mass index (BMI), have a higher likelihood of developing diabetes and cardiovascular disease (CVD) by the 2005 American Heart Association (AHA)/National Heart Lung and Blood Institute (NHBLI) criteria or the 2009 harmonizing the metabolic syndrome criteria. We also found that MONW individuals have a higher likelihood of developing CVD but not diabetes by the hypertriglyceridiemic waist criteria. The objective of this study is to determine the likelihood of developing diabetes and CVD in the phenotypically obese metabolically normal (POMN) individuals among the participants of the San Antonio Heart Study.

METHODS: We analyzed the data of individuals aged 25 to 64 years who did not have diabetes or CVD at the time of enrollment in the San Antonio Heart Study. A total of 1,726 participants fulfilling this criteria completed follow-up examination. We defined normal weight as BMI below 25 kg/m2 and obesity as BMI of 30 kg/m2 and above. We defined metabolically normal individuals using different standard criteria: (a) fewer than 2 metabolic abnormalities by the 2005 AHA/NHBLI criteria,(b) fewer than 2 metabolic abnormalities by the 2009 Harmonizing the Metabolic Syndrome criteria, and (c) serum triglyceride levels <2 mmol/l and waist circumference <90 cm in men and <85 cm in women by the hypertriglyceridemic waist criteria. We performed logistic regression analysis to examine the odds of developing diabetes and CVD
in POMN individuals relative to the odds in metabolically healthy and normal weight (MHNW) individuals.

RESULTS: Among the participants who fulfilled inclusion criteria, 3.8 to 18.3% met the definition of POMN, using different standard criteria. The odds ratios of developing diabetes and CVD among POMN individuals relative to MHNW individuals are as shown in the following table.

CONCLUSION: POMN individuals have a higher likelihood of developing diabetes by all three criteria. However, a higher likelihood of developing CVD is only statistically significant in participants with the hypertriglyceridemic waist criteria probably because of the lower prevalence of POMN by the AHA/NHLBI and Harmonizing criteria.

CONTRARY TO RESIDENTAND ATTENDING PERCEPTIONS, BEDSIDE CASE PRESENTATIONS DO NOT PROLONG ROUNDS Ithan D. Peltan 1;
Hang Lee 1; Douglas E. Wright1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 9137)

BACKGROUND: Bedside teaching is an iconic form and key technique of medical education that many fear is on the decline. This method of instruction may be threatened further by impending work-hour limitations. We therefore studied teaching practices on a general medicine service. METHODS: At our institution, ward attending rounds occur each weekday morning and feature presentations (in the conference room, hallway, or at patients bedsides) of new patients admitted to the ward attending followed by bedside interviews and examination of patients by the team. A study investigator (IDP) visited each of our institutions five ward medicine teams daily to obtain the following information from one or more team members: number of admissions, number of bedside case presentations, and total and bedside duration of rounds. Data collection occurred in three blocks of consecutive weekdays between March and November 2010, totaling 100 observations of 15 distinct ward teams. To account for potential differences in team rounding practices

(interclass correlation) between data collection periods, we employed generalized estimating equations for multivariate regression modeling. Medicine attendings and residents were also surveyed regarding attitudes and perceptions of bedside rounds and bedside case presentations. Data were analyzed using paired or unpaired t-tests or Fishers exact test and reported as means and 95% confidence intervals.
RESULTS: Teams averaged 105 minutes (99111 minutes) on attending rounds each day and 35 minutes (3139 minutes) at the bedside (case presentations plus interviews and physical examinations). On average, teams spent 32% (29-35%) of rounds at the bedside and presented 34% (27-41%) of new ward admissions at the bedside. After linear regression, the number of ward admissions ($p<0.0001$) but not bedside case presentations ($p=0.55$) increased the total duration of attending rounds. By contrast, the number of ward admissions ($p<0.0001$) and bedside case presentations ($p =0.0004$) both correlated positively with the amount of time spent at the bedside. Surveys were completed by 60% of residents (N=107) and 65% of
attendings (N=68). Both groups estimated the percent of attending rounds spent at the bedside (39% and 37%, respectively) fairly accurately but overestimated the percent of bedside case presentations (47% and 52%, respectively). Residents ideal values for the percent of rounding time at bedside (41%) and bedside presentation (51%) were similar to perceived actual practice. By contrast, attendings wanted more time at the bedside (53%) as compared to perceived reality ($p<0.0001$) and to residents ideal ($p=0.0002$). Attendings would also prefer to present more cases at the bedside (70%) than residents ($p<0.001$) or than they themselves believe is done in reality ($p<0.0001$). While 67% of residents agreed or strongly agreed with the statement, Bedside presentations take longer than hallway or conference room presentations, only 40% of attendings shared this sentiment ($p=0.0003$). CONCLUSION: At our institution, the percent of time spent at the bedside during teaching rounds is stable or increased compared to published reports dating back 50 years. While residents are content with current practice, attendings want even more bedside rounding and bedside case presentation. Correcting the misconception that bedside case presentations prolong rounds might help accomplish that goal and, furthermore, help preserve the fraction of time being spent at the bedside on rounds in the face of tougher work-hour restrictions.

SUPPLEMENTING OFFICE-BASED CARE WITH A POPULATION-BASED DIRECT-TO-SMOKER OUTREACH INTERVENTION OFFERING FREE TREATMENT TO SMOKERS IN A COMMUNITY HEALTH CENTER: A RANDOMIZED CONTROLLED TRIAL

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(Tracking ID # 9139)

BACKGROUND: Tobacco remains the leading U.S. preventable cause of death. Treating tobacco use is among the most cost-effective actions in health care. Brief office-based interventions offered to all smokers are effective but clinicians do not reliably offer them. We hypothesized that

tobacco treatment use and quit rates could be increased by offering treatment directly to all smokers, apart from office visits. We tested the effectiveness of a population-based direct-to-smoker (DTS) outreach program offering free tobacco treatment to smokers in a health care system. METHODS: A randomized controlled trial of 590 smokers at 1 community health center compared usual care (n=177) to usual care plus DTS outreach (n=413). The DTS group was sent 3 monthly letters offering free phone consultation with a tobacco coordinator who offered fax-referral to the state telephone quitline and up to 8 weeks of free nicotine patches (NRT). Outcomes, assessed at 3 month follow-up, were the percent of smokers who used any tobacco treatment (counseling or meds), used NRT, used counseling, and self-reported 7-day and 30-day point prevalence tobacco abstinence.
RESULTS: 43 (10.4%) of 413 smokers in the DTS group accepted the treatment offer; 42 (98%) requested NRT

and 30 (70%) were referred to counseling. At 3-month follow-up, in an intention-to-treat analysis adjusted by logistic regression for age, sex, race, insurance, and history of diabetes and/or coronary heart disease, a higher proportion of the DTS group, compared to controls, had used NRT (11.6% vs 3.9%, OR3.47; 95%CI 1.52-7.92, p=.003), used any tobacco treatment (14.5% vs7.3%, OR 1.95, 95%CI 1.04-3.65, p=.036), and reported tobacco abstinence for the past 7 days (5.3% vs. 1.1%, OR 5.35, 95%CI 1.23-22.32, p=.026) and past 30 days (4.1% vs. 0.6%, OR 8.25, 95%CI 1.08-63.01, p=.042). The treatment offer did not increase use of counseling(1.1% vs 1.7%, p=NS) or non-NRT medication use (3.6% vs 3.9%, p=NS). Estimated marginal cost per 7-day quit at 3 months was $576. CONCLUSION: In a real-world effectiveness study, a population-based direct-to-smoker outreach offering free tobacco treatment to smokers in a community health center is a feasible, cost-effective way to increase the reach of treatment (primarily pharmacotherapy) and to increase short-term quit rates in the population.

DO ALL DIABETICS RECEIVE EQUAL CARE IN A FEDERALLY QUALIFIED HEALTH CENTER IN MICHIGAN? Manjunath Raju 1;

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BACKGROUND: Racial disparities in the quality of care of diabetic patients are well documented. Efforts to improve care of diabetes mellitus (DM) in Federally-Qualified Health Centers (FQHCs) in Michigan through the diabetes quality-improvement initiative may reduce differences in quality of care. FQHCs are designed to provide care for low income and medically underserved populations. Objectives:1) to determine the quality of care of DM patients 2) to determine racial differences in the care of diabetic patients in a FQHC that participated in diabetes quality-improvement.

METHODS: We carried out a retrospective study of 212 consecutive patients seen in a FQHC from January 2006 to December 2008. Patients medical records were reviewed for data regarding age, sex, race, smoking, blood pressure (BP) control (diabetics; BP <130/ 80 mmHg, non-diabetics; BPRESULTS: Of 212 patients identified, 154 had hypertension, 122 had DM, and 88 had hypertension and DM. The mean age was 53.9 +11.6 years,51.3 % were men, 74.53% had Medicaid, 11.32% had Medicare, 1.42% had private insurance and 12.74% had no insurance. We found that 117(55.19%) were whites and 95 (44.81%) were non-whites. There were no significant differences in baseline characteristics within these groups. Our results revealed a high prevalence of smoking (37.50% in whites, 36.21% in nonwhites), morbid obesity (39.29% white, 38.00 % non-whites, uncontrolled hypertension (68.75% whites, 68.97% non-whites), HbA1c >7(51.02% whites, 65.38% nonwhites), LDL <100 (50.98% whites, 40.43% non-whites), among the diabetics. There was underuse of evidence-based medication in both whites and nonwhites with no statistical significant differences between the two racial groups (see table 1).

CONCLUSION: We found no significant racial differences in the care of diabetics at the FQHC, but there was gross underutilization of evidence-based medications and poor control of blood pressure in both groups. There is an urgent need for strategies to improve diabetic care in both whites and nonwhites.

CRIMINAL CHARGES AND OUTCOMES OF PATIENTS ENTERING OFFICE-BASED BUPRENORPHINE MAINTENANCE THERAPY Elizabeth Edith Harris 1; Janet Jacapraro 2; Donald Jasinski 3; Darius Rastegar3. 1Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York ; 2Health Care for the Homeless, Baltimore, Maryland ; 3Johns Hopkins Bayview Medical Center, Baltimore, Maryland . (Tracking ID #

9163)
BACKGROUND: There is little data on the impact of office-based buprenorphine therapy on criminal activity. The goal of this study was to determine the impact of office-based buprenorphine therapy on rates of criminal charges, and to evaluate the treatment outcomes of subjects with prior criminal charges.
METHODS: We collected demographic and outcome data on 252 patients who were given at least one prescription for buprenorphine. We searched a public database of criminal charges and recorded criminal charges prior to and after enrollment. We compared the total number of criminal charges and drug charges 2 years before versus 2 years after enrollment.
RESULTS: Most (80%) of the subjects had prior criminal charges. These subjects had significantly less opioid-negative months than those without criminal charges (5.1 months vs. 6.7 months; p=0.028), and were less likely have >6 opioid-negative months (43.1% vs. 60.0%; p=0.032). However, there was no difference treatment retention at one year (55.4% vs. 52.0%; p=0.854). There was no difference in rates of criminal or drug charges 2 years before versus 2 years after enrollment, but subjects with >6 opioid-negative months had a significant decline in rates of criminal charges (0.67 vs. 0.43; p=0.031).
CONCLUSION: Prior criminal charges did not affect treatment retention in primary care office-based buprenophrine maintenance therapy, but was associated with lesser likelihood of abstinence from opioids. While the rate of criminal charges did not significantly decline, it did decline in a subset of subjects who were opioid-negative for >6 months.
WHATS THE IMPACT? CLINICAL VALIDITY AND UTILITY OF METREE, AN ELECTRONIC FAMILY HISTORY COLLECTION AND DECISION SUPPORT TOOL FOR PRIMARY CARE Lori A Orlando 1; Elizabeth R. Hauser 1; Carol Christianson 2; Karen P. Powell 3; Adam H. Buchanan 1; Astrid B. Agbaje 3; Vincent C. Henrich 3; Geoffrey Ginsburg4. 1Duke University, Durham, North Carolina ; 2University of North Carolina at Greensboro, Greensboro, North Carolina ; 3Moses Cone Health System, Greensboro, North Carolina ; 4Duke Unversity, Durham, North Carolina . (Tracking ID # 9169)
BACKGROUND: Recently, there has been a surge of interest for incorporating tools into clinical care that stratify patients into disease risk categories and personalize healthcare recommendations. The hope is that these tools will facilitate the generation of individualized health care plans that maximize health outcomes important to providers and patients and minimize harms. Much of the focus has been on new and emerging tools, but internists have long been taught that family health history (FH) collection is a crucial component in individualizing care. In fact, it has a key role in preventive healthcare, with guidelines often stratifying recommendations based upon factors that include FH. Additionally, it is critical to assessing risk for hereditary cancer syndromes; however, evidence to date indicates that there are considerable barriers to both collecting FH and using it in medical decision making. Developing a model for integrating FH into primary care (PC) and evaluating its impact on outcomes should be the first step in testing the cost-effectiveness of a stratified care approach.
METHODS: To overcome patient, provider, and system level barriers to integrating FH into PC, we took an implementation sciences approach to develop and evaluate a computerized FH collection and decision support tool, MeTree, in a clinical trial in 2 PC practices in Greensboro, NC. A third serves as a concurrent control. MeTree collects a 3 generation FH on 48 conditions with decision support for 4 pilot conditions: breast cancer, ovarian cancer, colon cancer, and thrombosis. Decision support focuses upon risk-based prevention strategies and identification of those at high risk for hereditary cancer syndromes (genetic counseling (GC) is recommended for these individuals). All adult patients scheduled for well-visits are invited to complete MeTree prior to their appointment; providers (PCPs) receive a provider report, pedigree, and tabular format FH, while patients receive a patient report and pedigree. This abstract describes a study of MeTrees clinical validity and utility. 100 consecutive patients FHs were reviewed by 1 PCP and 1 GC (gold standard), unfamiliar with MeTrees algorithms. A total of 7 PCPs and 4 GCs participated. Recommendations were scored according to the

following management categories: genetic counselor referral, at risk for hereditary cancer syndrome, breast MRI, breast cancer chemoprevention, ovarian cancer surveillance, early colorectal cancer screening, early and more frequency colorectal cancer screening, screening dictated by personal history of colon polyps, and genetic testing for inherited thrombophilia. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) are calculated for MeTree and PCP by comparing their recommendations to the GCs. Since categories are defined by treatment recommendations, we are able to estimate clinical utility, as well. The role of variables such as physician year of graduation and patient sex, family size, and % of family members with cancer are also evaluated.
RESULTS: In the table the first 4 rows reflect operating characteristics across a disease category, while the remainder reflects those specific to a given recommendation. There are a total of 23 false positives (FP) by PCP and 27 by MeTree; and 73 false negatives (FN) by PCP and 29 by MeTree. The greatest error rates were FN GC referrals by PCP. The yellow cells highlight performance differences between MeTree and PCP, in all but ovarian cancer MeTree has the higher sensitivity, an important trait for screening tests. Of the 38 patients with PCP errors, MeTree correctly reclassifies 10 (related to GC referrals and more intense CRC screening); 28 (65%) had errors by both. When comparing characteristics of patients with errors versus those without, age (57 SD 1.5 vs 52 SD 1.7), number of relatives (23 SD 1.1 vs 20 SD 0.6), and % of family with cancer (19% SD 1.1 vs 11% SD 1.2) were all greater. These were similar regardless of whether it was MeTree or the PCP who made the error. Younger physicians (year of graduation 1995 or later) performed better (64% correct) than older ones (45% correct).
CONCLUSION: We have developed a model for integrating risk-stratification into primary care practice that begins with demonstrating the impact of a computerized family history tool, MeTree, designed to overcome established barriers in the healthcare system. Earlier data has shown that MeTree implementation is a highly positive experience for patients and providers. The data described in this abstract suggests that MeTree is a clinically valid and useful tool, performing similarly to a physician in many areas. In addition, its clinical utility is suggested by its ability to correctly reclassifying individuals who need genetic counseling, are at risk for hereditary cancer syndromes, or need more intense colon cancer screening. Since a little over one-third of the time MeTree and PCP are each able to correctly reclassify individuals missed

by the other, they appear to complement each other well. Note that this study demonstrates an ideal performance for providers as they were not forced to face logistical pressures such as time constraints and difficulties obtaining referrals. Future study will identify MeTrees impact on physician and patient behaviors and health outcomes in the real world clinical environment.
IMPACT OF CAROTID PLAQUE SCREENING ON SMOKING CESSATION AND OTHER CARDIOVASCULAR RISK FACTORS: A RANDOMIZED CONTROLLED TRIAL Nicolas Rodondi 1; Tinh-Hai Collet 2; David Nanchen 2; Karine Giraudon 2; Pascal Bovet 2; Jacques Cornuz2. 1Department of Ambulatory Care and Community Medicine, University of Lausanne, Switzerland, Lausanne, N/A;
2University of Lausanne, Lausanne, N/A. (Tracking ID # 9170)
BACKGROUND: Few randomized studies have examined the clinical impact of atherosclerosis screening on cardiovascular risk factor (CVRF) control. Smokers may be an important target group for such screening, but it is unknown whether carotid plaque screening represents a teachable moment similar to acute cardiovascular events. METHODS: We randomly assigned 536 current smokers aged 40 to 70 years to carotid plaque screening by ultrasound vs. no screening, in addition to a comprehensive smoking cessation program for all consisting of six 20-minute individual counseling sessions and nicotine replacement therapy. Smokers with at least one carotid plaque received pictures of their own plaques with a structured explanation on the significance of plaques. To ensure equal contact conditions, smokers not
undergoing ultrasound and those without plaque received an equal 7-minute explanation on tobacco risks (in

addition to counseling sessions). The primary outcome was one-week point prevalence abstinence at 1 year. Secondary outcomes were continuous smoking abstinence from quit date to 1 year, change in Framingham risk score (FRS) and control of CVRFs. Self-reported smoking cessation was confirmed by exhaled carbon monoxide and plasma cotinine concentration.
RESULTS: At baseline, participants (mean age: 51 years, 55% women) smoked an average of 20 cigarettes per day, with a median duration of smoking of 32 years. At 1 year, quit rates were high, but did not differ between the screened group and the unscreened group (point prevalence abstinence: 25.3% vs. 22.8%, p=0.51; continuous abstinence:20.8% vs. 21.0%, p=0.95). In the screened group, abstinence rates did not differ according to the presence/absence of carotid plaques. The mean absolute risk change in FRS was +0.58 in the screened group vs. +0.21 in the unscreened group (p=0.45). Control of CVRFs (low-density lipoprotein cholesterol, hemoglobin A1C (if diabetes) and blood pressure) did not differ between both groups. In multivariate analysis, point prevalence abstinence was associated with female

gender (odds ratio [OR]=1.57, 95% confidence interval [CI]: 1.02-2.42), higher age (OR=1.06 for 1 year, 1.02-1.11) and lower duration of smoking history (OR=0.95 for 1 year, 0.91-0.98).
CONCLUSION: In long-term smokers, the addition of carotid plaque screening to a smoking cessation program was not associated with increased rates of smoking cessation or better control of cardiovascular risk factors. Further studies should examine whether carotid screening would be helpful in other situations, e.g. for smokers with shorter smoking counseling or to better target preventive medications. (ClinicalTrials.gov number, NCT00548665)
IDENTIFYING PATIENTS AT INCREASED RISK FOR NOT COMPLETING PREVENTIVE CANCER SCREENING TESTS Steven J. Atlas 1; Jeffrey Ashburner 1; Richard Grant 1; Sanja Percac-Lima 1; Adrian Zai1.
1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 9207)
BACKGROUND: Electronic clinical data sources may be useful for identifying patients at increased risk for not completing preventive cancer screening tests. As part of an effort to design a population-based, patient-centric approach to comprehensive cancer screening, we developed an algorithm to identify high-risk individuals who might benefit from tailored interventions by patient navigators.
METHODS: Using outpatient claims and scheduling system data, patient registration data, and information drawn from electronic health records, we identified all eligible female patients within one practice-based research network (PBRN) who were overdue for breast, cervical, and/or colorectal cancer screening as of December 31, 2008. We developed an algorithm to assign points representing increased risk for not completing a screening test using total number of overdue screening exams (13 exams, 1 risk point for each overdue exam), language spoken (1 risk point for non-English), appointment no-show history over the prior year (1 risk point for 1 no-show visit and 2 risk points for >2 no-show visits in the prior year), and prior screening history (1 risk point for each exam >5 years overdue). We categorized patients into low (<2 risk points), moderate (3 risk points), and high (>4 risk points) risk for cancer screening non-compliance. We then followed this patient cohort over the next year (1/1/2009-12/31/2009) and compared cancer screening test completion rates by risk category using linear trend tests.
RESULTS: Among 19,565 women overdue for breast, cervical, and/or colorectal cancer screening, 15,563 (79.6%) were overdue for one screening exam, 3366 (17.2%) were overdue for two screening exams and 636 (3.3%) were overdue for three screening exams (mean: 1.24, SD: 0.50); 1654 (8.5%) did not speak English, 1957 (10.0%) had at least 1 no-show appointment in the prior year, 764 (3.9%) had >2 no-show appointments in the prior year, 6720 (34.4%) had no prior screening history for 1 exam, and 622 (3.2%) had no prior

screening history for 2 exams. Based on our algorithm, 15,138 (77.4%) were classified as low risk, 2736 (14.0%) were classified as moderate risk, and 1691 (8.6%) were classified as high risk for screening non-compliance. Screening test completion rates over the following year were 17.5% for low risk patients, 15.9% for moderate risk patients and 12.1% for high risk patients (test for trend, pCONCLUSION: Our algorithm using variables commonly available in electronic data systems was modestly effective in prospectively identifying patients at increased risk for not completing cancer screening tests. Additional efforts are needed to identify patients within primary care networks at increased risk for non-compliance.

ELIGIBLE BUT UNINSURED: PREDICTORS OF MEDICAID TAKE-UP AMONG ADULTS Benjamin Sommers 1; Meredith Roberts Tomasi 1; Katherine Swartz 1; Arnold M. Epstein1. 1Harvard School of Public Health, Boston, Massachusetts. (Tracking ID # 9216)

BACKGROUND: Millions of Americans are eligible for public insurance coverage through Medicaid, yet are currently uninsured. The importance of solving the puzzle of why they are eligible but not enrolled is heightened by the passage of the Affordable Care Act, which will expand Medicaid eligibility in 2014 to non-elderly adults with incomes up to 133% of the Federal Poverty Level. For the impending Medicaid expansion to be effective in improving health care access and health outcomes among low-income Americans, we need to know what factors determine whether eligible individuals actually enroll.

METHODS: Our data come from two sources the Current Population Surveys (CPS) Annual Social and Economic Supplement (20052010), and a primary dataset of state-level eligibility policies assembled from previous research. Using state and year-specific eligibility criteria, we estimated Medicaid take-up rates among eligible U.S. citizens aged 1964, who have no other form of health insurance (n=36,013). Estimates were adjusted for underreporting of coverage in the CPS. We tested for statistical differences across states and years using survey-weighted chi-square tests. We used multivariate logistic regression to identify predictors of participation in Medicaid and then to generate adjusted predicted probabilities of enrollment for each variable. Covariates were demographic variables such as age, gender, and race/ethnicity; self-reported health status; state of residence; and category of eligibility (disabled, parent of dependent children, or non-disabled non-parent).

RESULTS: Nationally, among Medicaid-eligible adults with no other form of health insurance, 62.2% were enrolled in Medicaid (95% Confidence Interval 61.4-63.0%), leaving 37.8% who were uninsured. There was no significant time trend in take-up rates from 20052010, though the total number of eligible adults rose significantly in 2009 2010. Take-up rates varied significantly across states (p=0.001), and these differences remained large even after multivariate adjustment for population characteristics, with predicted enrollment rates ranging from 39.9% in Arkansas and 41.6% in Louisiana to 75.2% in Maine and78.3% in Massachusetts. In terms of individual characteristics, Medicaid participation was most likely among disabled adults (adjusted predicted probability 72.1%), less likely among parents of dependent children (53.2%), and least likely among non-disabled childless adults(40.3%; group difference p=0.001). Participation was higher among adults with fair or poor self-reported health status than those with excellent health (63.3% vs. 54.8%, p=0.001). Racial differences existed as well, with take-up highest among blacks (62.7%) and lowest among whites (57.8%, p=0.001). Take-up was higher among younger adults, single adults, those with less education, and women.

CONCLUSION: Millions of adults who are currently eligible for Medicaid remain uninsured. There is great variability in take-up rates across states that exceeds the variation from individual-level factors such as

race and health status. Participation is particularly low among healthy adults without disabilities and without children, who comprise the majority of the individuals who will become newly eligible for Medicaid under the Affordable Care Act. The success of the impending Medicaid expansion under health reform will depend on states ability to design approaches that achieve high participation rates among newly-eligible adults.

HEAT RELATED DEATHS IN THE STATE OF ARIZONA: IDENTIFYING AT-RISK INDIVIDUALS Emily

Shortridge 1; Sandipan Pati1.
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BACKGROUND: Summer heat waves are among the deadliest environmental events, and are a serious fatality risk in the state of Arizona. Normal daily maximum temperatures in Phoenix, Arizona can exceed 100Ffrom June through mid-September. Medical, social and environmental risk factors for heat-related mortality may be different between different demographic populations. The primary aim of this study is to identify differences in medical co morbidity, demographics, and other risk factors among individuals who died following exposure to heat in the state of Arizona. The results of this study help in identifying at-risk individuals who are potential targets for preventive strategies. METHODS: The target population for the study comprised individuals who had died following exposure to heat in the state of Arizona between 2002 and 2009. Data were collected from the Arizona Department of Health Services, Health Status and Vital Statistics Section. Statistical analysis was performed with SPSS 18.0. Exposure to excessive natural heat as the underlying cause of death is identified by a three-character category X 30as defined in ICD-10.
RESULTS: 975 people died following exposure to heat in last 8 years in the state of Arizona. Among the 975, 718(73%) were male. The racial composition is as follows: non-Hispanic white 164(64%), Hispanic/ Latino 561 (57%), black 27 (3%), Native American 28 (3%) and unknown race 192 (19%). Age at death was classified in 4 different groups as follows: 125 years (N=188; 21%), 26-45 years (N=346; 39%), 4665 years (N=232; 27%); greater than 66 years (N=125; 15%). Victims of heat related death were divided into three subgroups, with risk factors varying markedly between groups: Individuals attempting illegal transit across the Mexico-U.S. border, Arizona residents, and visitors to Arizona from other U.S. States or Canada for duration less than 1 year. Individuals in transit across the border accounted for the majority of the total death count at 45%. Residents comprised 29%and visitors 16%. Major risk factors for the immigrant population were dehydration and polysubstance abuse, with an unknown cause for many deaths. Risk factors for Arizona residents were polysubstance abuse, dehydration, medical co morbidity, and advanced age. The primary risk factor for visitor death was dehydration. Age at time of death was heavily subgroup-dependent, with 71% of the in-transit population fairly young, 2044 years old, at time of death. Risk factors among young and elderly residents were vastly different, with drug abuse, ethanol toxicity, and hiking contributing to deaths under age 45, and cardiovascular disease, dementia, and other neurodegenerative disease contributing to deaths over age 65.
CONCLUSION: Risk factors associated with death following heat exposure are different between individuals of different age, sex, and
residency status. Clinically, these risk factors can be used to identify most at-risk individuals, as well as probably etiologic contributors to a patients acute heat related illness.

PERSPECTIVES ON PREVENTIVE HEALTH CARE AND BARRIERS TO BREAST CANCER SCREENING AMONG IRAQI WOMEN REFUGEES Altaf Saadi 1; Barbara Bond 2; Sanja Percac-Lima2.
1Harvard Medical School, Boston, Massachusetts; 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 9238)
BACKGROUND: Since the Iraq war began in 2003, over four million Iraqis have been displaced with 13,800 Iraqi refugees admitted to the US in 2008. Little is known about preventive cancer care in this population. We identified disparities in mammography rates in eligible Arabic speaking patients (44%) compared to over 80% in English or Spanish speaking women. The majority of Arabic speaking women were refugees from Iraq. We sought to assess their perspectives on preventive care and perceived barriers to breast cancer screening.
METHODS: Patients were identified from data collected at the Massachusetts General Hospital Chelsea HealthCare Center, an urban community health center in a predominantly low-income, immigrant community. In-depth, semi-structured, one-on-one interviews were conducted with twenty Iraqi refugee women by a bilingual (English/ Arabic) medical student. Interviews were performed in Arabic, transcribed, translated and coded according to established qualitative content and thematic analysis procedures.

RESULTS: The women were on average 43 years old (range 2375). Psychosocial barriers identified included fear of pain associated with obtaining a mammogram and fear associated with receiving a cancer diagnosis. Culturally mediated beliefs that define illness as symptomatic and that do not incorporate the idea of preventive care were identified. Though modesty issues were mentioned, they were not felt to be the most significant barrier. Although some women had never heard of mammography, the majority were aware of it but believed it was necessary only when there was something wrong with the breast. Many mentioned that receiving screening was not the norm in their home countries, but they did have a heightened awareness of breast cancer, citing rising prevalence of cancer in Iraq due to the consequences of biological and chemical warfare. In addition to fear, another theme related to the health consequences of war that make day-to-day survival supersede all other concerns for these women. As one woman said: (Iraqis) are living in conditions that has (sic) forced them to forget about their own lives. Here, no. An individual will pay attention to his health more to his food, to his health, to his sleep all these things, here, you have the luxury to pay attention to. Most women spoke positively about the outreach, attention and reminders received from the health center and felt it encouraged them to follow up with appointments.
CONCLUSION: We identified factors that may impede Iraqi refugee womens ability and motivation to obtain breast cancer screening including not having experienced screening as normative in their home country, the belief that preventing disease is not the function of doctors and medicine, and psychosocial concerns such as fear of pain and fear of cancer, as well as consequences of the war. Women expressed interest

in education and outreach to help them obtain screening mammography and support community-based culturally appropriate health education and outreach programs.
ACCULTURATION AND CARDIOVASCULAR BEHAVIORS AMONG LATINO SUB-GROUPS Andrew J. Van Wieren 1; Mary B. Roberts 2; Naira Arellano 3; Edward Feller 4; Joseph Diaz5. 1Alpert Medical School of Brown University, Providence, Rhode Island ; 2Brown University/ Memorial Hospital of Rhode Island, Pawtucket, Rhode Island ; 3Injury Prevention Center at Rhode Island Hospital, Providence, Rhode Island ; 4Department of Community Health, Brown University, Providence, Rhode Island ; 5Brown University/Memorial Hospital of Rhode Island, Pawtucket, Rhode Island . (Tracking ID # 9241)
BACKGROUND: Latinos are expected to increase from 15.5 to 25% of the US population by 2050, and represent nearly 20 countries. Despite lower socioeconomic status and worse access to health care, Latinos have better overall health outcomes and longer life expectancy than non-Latino Whites. This Latino Health Paradox has been partially attributed to healthier cardiovascular (CV) behaviors among Latinos. However, as Latinos become more acculturated or Americanized, differences in some CV behaviors disappear. Despite diversity among Latinos, few studies have examined the role of country of origin in impacting associations between acculturation and CV behaviors among Latinos.
METHODS: Data from the 2005 and 2007 California Health Interview Survey (CHIS) were used to measure associations between acculturation level and smoking, diet and physical activity patterns among Latino sub-groups. To measure acculturation, we utilized a previously validated scale to categorize Latinos as low, moderate or high acculturation based on language, citizenship, birthplace and percent of life spent in the US. Using non-Latino Whites as a reference group and controlling for demographic variables, we calculated adjusted odds ratios (ORs) by acculturation level and country of origin for: never smoking, meeting American College of Sports Medicine (ACSM) physical activity and 5-a-day fruit/vegetable recommendations, and consuming any daily fast food.
RESULTS: The sample included 16,000 Latinos and 60,638 non-Latino Whites. Measured demographic variables were statistically different ($p<0.0001$) between acculturation groups. Among all Latinos, adjusted ORs

(with 95% CIs) of never smoking were 2.73 (2.43-3.08), 2.40 (2.18-2.64), and 1.35 (1.23-1.49) for the low, moderate and high acculturation groups, respectively. We found no significant differences by acculturation level for the odds of meeting either ACMS physical activity guidelines or 5-a-day fruit/vegetable recommendations among all Latinos. Adjusted ORs of consuming any daily fast food were 0.74(0.63-0.88), 1.35 (1.17-1.56), and 1.69 (1.48-1.93) for the low, moderate and high acculturation groups among all Latinos. These trends varied considerably by country of origin, however. Guatemalans, the subgroup skewed most toward low acculturation level (55.9%), showed the strongest association between increased acculturation and higher smoking rates and were the only sub-group with an increase in physical activity, but showed no association between acculturation and fast food consumption. Conversely, South Americansa group of predominantly moderate acculturation (59.3%)had high baseline smoking rates and reduced smoking with increased acculturation. Puerto Ricans, the sub-
group skewed most toward high acculturation level (75.4%), showed the strongest association between increased acculturation and higher fast food consumption.
CONCLUSION: As the US Latino population expands dramatically, the Latino Health Paradox will become increasingly important to public health. Our results indicate that country of origin impacts associations between acculturation and CV behaviors in complex ways, a finding that has implications for clinical practice and further research. Clinicians should consider both acculturation and country of origin when counseling Latino patients about CV risk to maximize cultural sensitivity and effectiveness. Although CHIS data lack generalizability to the overall Latino population, this study contributes to the limited literature on this topic and demonstrates need for further research.

UPTAKE OF AN INTERNET-BASED PATIENT PORTAL AND ETHNIC AND EDUCATIONAL DISPARITIES: THE DIABETES STUDY OF NORTHERN CALIFORNIA (DISTANCE) Urmimala Sarkar 1; Andrew Karter 2; Jennifer Liu 2; Nancy Adler 1; Robert Nguyen 2; Andrea Lopez 3; Dean Schillinger1. 1University of California, San Francisco, San Francisco, California ; 2Kaiser Permanente, Oakland, California ;
3University of California San Francisco, San Francisco, California . (Tracking ID # 9254)

BACKGROUND: Internet-based patient portals, which allow patients to access their health care system and perform selected self-management functions, will play a growing role in chronic disease care. By increasing health access, this technology has potential to ameliorate diabetes disparities, if widely used in vulnerable groups. Prior research has demonstrated that ethnically diverse, low-income patients are amenable to technologically-delivered chronic disease self-management support. However, the same populations with worse diabetes outcomes are subject to the digital divide, a lack of adequate computer/ internet access; thus, the diffusion of this innovation may actually widen disparities, as seen with prior health advances.
METHODS: We investigated uptake of an internet-based patient portal by race/ethnicity and educational attainment between January 2006 and December 2009, among an English-speaking adult, continuously insured population with diabetes receiving care in an integrated health maintenance organization. We measured the frequency of requesting a password for the patient portal, which represents intent to use the patient portal and indicates some computer access.
RESULTS: We studied 11,921 participants: 10% with less than high school education, 29% high school graduates, 27% some college, and 35% with college degree or higher educational attainment. They were ethnically diverse (27% non-Hispanic White, 13% Latino, 21% African-American, 10% Asian, 12% Filipino, 17% multi-racial/other ethnicity). Overall, intent to use the patient portal (i.e. requesting a password) increased markedly over the observation period across all educational levels and race/ethnicities, from 1,427 (12%) of participants in 2006 to 4,466 (37%) in 2009 (Figure A and B). In addition, the rate of uptake, or increase in registration over time, did not vary by educational attainment or race/ethnicity (p=0.47 and 0.66, respectively) The initial modest-sized educational gradient in intent to use the patient portal widened slightly in absolute terms by 2009, but attenuated in relative terms (Figure Panel A). In 2006, 9% of those with less than a high school

degree

requested a password, compared to 13% of those with a college degree or higher (p <0.001). In 2009, 32% with less than a high school degree had requested a password compared to 39% with a college degree or more (p<0.001). Similarly, in 2006, there were small race/ethnic differences in intent to use the patient portal, with African-American, Filipino and Latino participants least likely and Asian and White participants most likely to request a password (Figure Panel B). Relative differences narrowed over time, for all ethnic groups. Absolute differences also narrowed, except among African Americans: in 2009, Whites were most likely and African-Americans least likely to request a password (40% vs. 34%, p<0.001). CONCLUSION: We observed rapid, widespread uptake in use of the patient portal among diverse, English-speaking adults with diabetes. Those with lower educational attainment and African-Americans remained consistently less likely to register for the patient portal at each time-point, lagging in uptake by about 1 year. Expanded computer/ internet access, training in patient portal use and cultural/ educational tailoring may be required for patient-facing electronic health records to be harnessed as a means to reduce disparities.

OUTCOMES OF PREOPERATIVE EVALUATION IN PATIENTS UNDERGOING HIP FRACTURE SURGERY Geetha Selvakumar 1; Ayesha Salahuddin 1; Meghana Gopal 1; Mahvesh Mahmud 2; Muhammed Sherid 4; Habib Dakkak 4; Nael Gharbi 4; Shazel Gharbi 4; Mhd. Wisam Baqdunes 4; Harvey Friedman4. 1Saint Francis Hospital, Evanston, Illinois; 2St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9257)

BACKGROUND: Preoperative evaluation in selected patients undergoing hip fracture surgery prevents complications like MI and sudden cardiac death during the postoperative period. Orthopedic surgeries are considered as intermediate risk surgeries for the development of cardiac complications. The reported cardiac risk is generally less than five percent. Patients without major risk factors with excellent functional capacity can undergo intermediate risk surgeries without any cardiac work up with little likelihood of perioperative cardiac complications. We stratified patients
undergoing hip fracture surgery over a period of one year into high, intermediate and low risk groups and analyzed the outcomes of unnecessary preoperative cardiac work up in the low risk group.

METHODS: Retrospective chart review of all admissions for hip fractures during the year 2007 was done. A total of one hundred and twenty one charts were reviewed. The study was approved by the institutional review board. Nine patients (7.44%) belonged to the high risk group, sixty nine (57.02%) to the intermediate risk group and forty three (35.54%) to the low risk group. The following work up was done in the low risk group: echocardiogram in twenty one (48.84%), stress test in seven (16.28%), medicine consults in twenty (46.51%) and cardiology consult in ten patients (23.26%). RESULTS: The results showed that an average of 38.60% patients in the low risk group received preoperative cardiac work up. Surgery was delayed by four days due to unnecessary work up in this group.

CONCLUSION: Orthopedic surgeries in low risk patients can safely be performed without preoperative cardiac work up. Unnecessary work up in the form of echocardiogram, stress test and medicine and cardiac consults in addition to causing financial burden increase the length of hospital stay further causing an increase in healthcare cost. Adhering to the ACC/AHA guidelines for perioperative cardiac risk assessment for noncardiac surgeries will help to reduce healthcare costs and improve patient satisfaction.

SIGNAL AND NOISE: APPLYING AN AUTOMATED TRIGGER TOOL TO SCREEN FOR ADVERSE DRUG EVENTS IN THE SETTING OF OUTPATIENT CHRONIC DISEASE CARE Stacey Brenner 1; Alissa Detz 2; Claire Horton 3; Andrea Lopez 3; Nancy Jianhua Jin 1; Urmimala Sarkar1. 1University of California San Francisco, San Francisco, California ; 2California Pacific Medical Center, San Francisco, California ;

3University of California, San Francisco, San Francisco, California . (Tracking ID # 9263)
BACKGROUND: The extent of outpatient adverse drug events (ADEs) remains unclear. Information about ADEs is limited by our ability to detect and monitor these events. Trigger tools are used as a screening method to identify care episodes that may be adverse drug events, but their value in a population with a high chronic-illness burden remains unclear. We sought to determine if a six-item trigger tool would successfully identify ADEs in among a chronically ill patient population.
METHODS: We used 6 abnormal laboratory values (internationalnormalized ratio (INR) >5, serum creatinine (SCr) >2.5, blood urea nitrogen (BUN) >60, alanine aminotransferase (ALT) >84, aspartate amino-transferase (AST) >80,thyroid-stimulating hormone (TSH) undetectable while on levo-thyroxine) because they have been shown to have a high positive predictive value for detecting ADEs among older adults in outpatient care, but have not been tested in a safety net population with high burden of chronic illness. Eligible patients were included if they were >18, sought primary or urgent care within the study period (November 2008-November 2009)and were prescribed at least one medication. We then used the clinical/ administrative database to identity patients with these triggers. Two physicians conducted in-depth chart review of any medical records with identified triggers. The physicians determined 1) whether an adverse drug event did occur, 2) the stage of the medication process where the event occurred, and 3) the severity of the effect on the patient. Physician reached an inter-rate agreement of 94%.
RESULTS: We reviewed 782 triggers representing 583 patients. The mean patient age was 55 (14), 64% were male, 70% were English-speaking. The trigger tool identified 109 (14%) adverse drug events. We identified 18 ADEs that took place in the inpatient setting that were omitted from further analysis. Of the 91 ADEs included in our analysis, 49 (54%) occurred during medication monitoring, 41 (45%) during patient-self administration, and the other could not be determined. 90% posed minimal or mild harm to the patient, 8% posed moderate harm or severe harm and 1 (1%) could not be determined. 96% of abnormal INR triggers were adverse drug events, followed by 12% of abnormal BUN triggers, 9% of abnormal ALT triggers, 8% of abnormal SCr triggers, and 3% of AST triggers. CONCLUSION: When we employed an ADE screening trigger tool in a safety-net primary care clinic with a high prevalence of chronic illness, the yield was less than in the healthier population originally studied. Moreover, utility varied significantly among the 6 triggers.
While the INR >5successfully identified ADEs, concomitant chronic disease lowered the yield for other abnormal-laboratory-value triggers. Our findings imply that other tools, such as text triggers, or more complex automated screening rules which combine data hierarchically, are needed to effectively screen for ADEs in chronically ill adults seen in primary care.
FACTORS CONTRIBUTING TO OUTPATIENT DIAGNOSTIC DELAYS: A QUALITATIVE ANALYSIS OF PHYSICIAN PERSPECTIVES Urmimala Sarkar 1; Brett Simchowitz 1; Doug Bonacum 2; William Strull 3; Andrea Lopez 1; Leahora Rotteau 3; Kaveh Shojania6. 1University of California, San Francisco, San Francisco, California ; 2Kaiser Permanente, Oakland, California ; 3University of Toronto, Toronto, Ontario . (Tracking ID # 9264)
BACKGROUND: Delayed and missed diagnoses lead to significant patient harm and health care costs. The prevalence and consequence of diagnostic error remains unclear, and the complexity of the outpatient diagnostic process has left this important aspect of patient safety relatively under-studied. We analyzed transcripts from physician focus groups to understand failures in the diagnostic process.
METHODS: As part of a quality improvement initiative an integrated health system conducted physician focus groups in 2004 and 2005. Regional leadership decided whether to participate in the project, and within the three participating regions, physicians were invited to participate in focus groups via a mailed letter and email. Both primary care and subspecialty providers were included in focus groups, by design, to address the breadth of the diagnostic process. The focus groups included questions about the process of diagnosis, specific factors contributing to missed diagnosis, use of guidelines, atypical vs. typical presentations of disease, diagnostic

tools, and follow-up all with regards to delays in the diagnostic process. Focus groups were audio-taped and transcribed verbatim, and subsequently de-identified. Two investigators (BS, US) read through all six transcripts and assembled a coding scheme and a list of codes. Two investigators (BS and AL) blindly reviewed 2 transcripts achieving an inter-rater reliability score of 0.81. The rest of the transcripts were coded by one investigator (BS).
RESULTS: Six focus groups were conducted with 37 participants representing 30 physicians. A number of themes were identified that described clinicians perceptions of diagnostic delay, difficulty, and mis-diagnosis (Table). These were (1) concerns about the organization of the health system, including information availability and work flow/ processes involved in ordering diagnostic tests; (2) the effect of interactions amongst providers, including communication and shared responsibility; (3) the importance of the patients role in the diagnostic process, including factors such as language barriers and non-adherence; (4)physician characteristics affecting the diagnostic process, including cognitive factors and interpersonal responsiveness and (5) the intrinsic variability of disease presentation.
CONCLUSION: Organizational factors, interactions among health care providers, patient characteristics, provider attributes, and the intrinsic variability of disease presentation, all contribute to missed and delayed diagnosis in this focus-group study of ambulatory providers practicing in an integrated care system. In order to improve the diagnostic process, multi-modal interventions that address organizational factors, physician education and work flow, and patient barriers, are needed.

Figure: Themes and Representative Quotes
THE MANAGUA CARDIOVASCULAR HEALTH INITIATIVE: A COMMUNITY HEALTH WORKER INTERVENTION TO IDENTIFY AND MANAGE HYPERTENSION IN URBAN NICARAGUA
Christopher Michael Dodd 1; Victor Giancarlo Sal y Rosas Celi 2; Saul Contreras Martinez 3; Joshua Chen 4; Sheyla Zelaya 5; James LoGerfo 2; Thomas Gaziano 6; Stephen Symes 7; Olveen Carrasquillo8. 1Jay Weiss Center, Shoreline, Washington; 2University of Washington School of Medicine, Seattle, Washington; 3Atencion Primaria en Salud, Managua, N/A; 4Boston University School of Medicine, Boston, Massachusetts; 5University of Miami Leonard M. Miller School of Medicine, Miami, Florida; 6Harvard University School of Medicine, Boston, Massachusetts; 7University of Miami Leonard M. School of Medicine, Florida, Florida; 8University of Miami Leonard M. School of Medicine, Miami, Florida. (Tracking ID # 9272)
BACKGROUND: Chronic illnesses are emerging as the leading cause of death in developing countries. In Nicaragua the prevalence of hyper-tension (HTN) is 25% and poorly controlled. HTN is a major public health problem. Community health workers (CHW) are robust components of their health system but are primarily deployed to address infectious illnesses and maternal child health issues. In this feasibility study we determine if CHWs can 1) identify community patients with uncontrolled HTN, and 2) help address the emerging crisis of cardiovascular disease in this resource-limited country.
METHODS: We recruited 32 CHWs from a health district in Managua of 110,000 residents, of whom 50% are unemployed. After a comprehensive training, CHWs used standardized protocols and an automated BP device to do home screening in their local community. As part of our agreement with the leadership of the local health district, CHWs would also be assigned medically indigent patients treated at the local health centers or hospital with a diagnosis of hypertension crisis and in need of outpatient community follow-up.
To test the feasibility of our proposed intervention, we planned to enroll 32 patients from both referrals sources. The CHW intervention consisted of a 10 day period of home health education, assistance navigating the health system, assistance obtaining prescribed medications, and when needed, directly observed therapy. The primary outcome was change in systolic blood pressure from baseline to a measurement taken 2 months later. Although this was primarily a pilot feasibility study, we used a two-sample t-test to determine if any observed changes were statistically significant. RESULTS: During a one-week period, our CHWs screened 185 individuals. The

mean age was 49 years and 78% were female. Of these, 42% had BP >=140/90 on 2 consecutive visits and 17% had BP >=160/100. Over 90% were aware of their diagnosis, but only 70% we taking medications. For the intervention, 31 patients were selected; 12 identified by home screenings and 19 from health facility referrals. At two months we found a median decrease of 11 mmHg in SBP in these 31 patients (P=0.052). CHWs noted that at baseline most patients had poor understanding of hypertension, low adherence to lifestyle modification, and most needed assistance in obtaining medications.
CONCLUSION: We recruited and trained 32 CHWs who in one week identified 117 persons with uncontrolled BP. We showed our CHWs intervention has the potential to improve BP in this resource limited setting. The findings from this feasibility study support the need for a larger RCT.

MEDICAL STUDENT ATTITUDES TOWARDS FINANCIAL INCENTIVES IN HEALTHCARE SETTINGS April Barbour 1; Elizabeth Gray1.
1George Washington University, Washington, District of Columbia. (Tracking ID # 9276)
BACKGROUND: In an era of pay-for-performance, there has been recent interest in the impact that financial incentives play in healthcare decision-making. The AAMC and other professional societies have outlined a large body of work which debate the ethics and consequences of these types of secondary interests. No study to date has assessed whether students in their formal years of training have had any exposure to these issues or performed an assessment of their underlying attitudes towards these incentives.
METHODS: All medical students on rotation in Internal Medicine at George Washington University Hospital were invited to a 30 minute program on the impact of financial incentives in healthcare. Before the talk, a questionnaire was provided to assess baseline attitudes. These data were de-identified and aggregated for further statistical analysis. A multivariate regression analysis was done to compare the relative contribution of the student characteristics and their correlation with the survey data.
RESULTS: Less than half of the students surveyed had ever attended a class on the impact of financial incentives in healthcare. All students felt that physicians were influenced by financial pressures, and all agreed that other students were influenced in their choice of careers by salary. The students were divided on the influences of finances on their own careers. Most were unsure of that physicians should be able to invest in pharmaceutical or medical device companies. Most were also unsure of the role that financial disclosures in either patient care settings or in the evaluation of research journals.
CONCLUSION: Medical students consistently under-value the impact of financial incentives in healthcare settings. With the push towards pay for performance, the enacting of rules requiring financial disclosures in patient care, and in the evaluation of medical research, more educational opportunities should be created for medical students to be exposed to and discuss these important topics.
CALCIUM SUPPLEMENTS RAISING THE RISK OF MYOCARDIAL INFARCTION: IS THE RISK CLINICALLY SIGNIFICANT? KoKo Aung 1;
Thwe Htay1. 1University of Texas Health Science Center at San Antonio, San Antonio, Texas. (Tracking ID # 9278)
BACKGROUND: Much publicity has been given to the finding in a recent meta-analysis that individuals who took calcium supplements (without coadministered vitamin D) are associated with 27% more myocardial infarctions than those who did not. One of the limitations of conventional frequentist statistics is that even when statistically significant change of outcome is detected, we may still know little about its clinical significance. In such circumstances, Bayesian analysis provides a useful interpretation by setting the findings in the context of cautious and enthusiastic prior beliefs. The objective of this study is to determine whether calcium supplements increase the risk of myocardial infarction and cardiovascular events at the clinically significant level.

METHODS: We analyzed the data from meta-analysis using a formal quantitative algorithm using Bayes theorem. The outcome measures were myocardial infarction, stroke, composite outcome (combined myocardial infarction, stroke and sudden death) and death. We defined clinical significance as the probability of smallest clinically harmful
values of the effect. We set various thresholds for clinical significance as relative risk increase of 1%, 10%, 20%, and 27% for each outcome. We estimated the probabilities of clinically significant increased risk for each outcome from posterior probabilities for skeptical and enthusiastic priors in Bayesian model. Statistical analyses were performed using BayesLine 9.1, version 010108 (Diamond &Kaul, Los Angeles, CA). RESULTS: In the context of skeptical or cautious prior belief of calcium supplements increasing cardiovascular risk, the probabilities of 10% relative risk increase are 35%, 17%, 23% and 9% for myocardial infarction, stroke, composite outcome (myocardial infarction, stroke or sudden death) and death respectively. In the context of enthusiastic prior belief of calcium supplements increasing cardiovascular risk, the probabilities of 10% relative risk increase are 75%, 51%, 54% and 27% respectively. When the threshold of clinical significance was raised to 20% relative risk increase, the corresponding probabilities became 27%, 5%, 3% and less than 1% for skeptical prior and 54%, 15%, 9% and less than 1% for enthusiastic prior. The probability of 27% relative risk increase in myocardial infarction, as estimated by frequentist statistical methods in the original meta-analysis, is only 12% in the context of skeptical prior belief and 27% in that of enthusiastic prior belief. CONCLUSION: There is a reasonable suspicion of calcium supplements (without coadministered vitamin D) increasing the relative risk of myocardial infarction by at least 10-20%, stroke by at least 10% and combined myocardial infarction, stroke or death by at least 10%. There is insufficient evidence of calcium supplements (without coadministered vitamin D) increasing the relative risk of death by at least 10% or increasing the relative risk of myocardial infarction by at least 27%. Reassessment of the role of calcium supplements in prevention and treatment of osteoporosis is warranted. On a broader note, we would encourage a wider use of Bayesian methods in reports of clinical research to integrate statistical significance and clinical significance.

EFFECTS OF AN AUTOMATED ELECTRONIC REMINDER IN IMPROVING DIABETES CARE QUALITY IMPROVEMENT Thwe Htay 1;

Marijan Gillard2. 1University of Texas Health Science Center at San Antonio, San Antonio, Texas ; 2University of Texas health Science Center at San Antonio, San Antonio, Texas . (Tracking ID # 9285)

BACKGROUND: The rates of periodic hemoglobin A1c (HbA1c) and urine microalbumin testing, which are considered standard quality indicators for diabetic patients, were relative low in internal medicine and family practice clinics of an academic health center. The aim of this quality improvement project is to increase the HbA1c and urine microalbumin testing rates in diabetic patients in the internal medicine and family practice clinics using a computerized reminder system of the electronic medical records.

METHODS: Overall improvement plan was to increase relative testing rates of HbA1c and urine microalbumin testing rates by using a computerized reminder system. Proposed change was implemented by educating all key stakeholders including faculty physicians, clinic administrative personnel, clinic nurses and medical assistants about the purpose of the project and methods of implementation during weekly meetings and by sending e-mails to the physicians describing the details related to the project. The change was anticipated within 10 weeks after initiation of the alert system. This is the first pilot quality project using a computerized reminder system of electronic medical records in our institution.

RESULTS: There was an absolute mean difference of 15.5% and 24.7% increase in HbA1c and microalbumin testing rates after implementation

of the intervention (p=0.02 for HbA1c; p=0.0001 for microalbumin). This represents a relative increase of 40% in HbA1c testing rate and 226% in urine microalbumin testing rate after initiation of computerized reminder system. The return on investment for the computerized reminder system includes cumulative savings for

physician time, cumulative reduction in operational expenses by reducing the need of support staff to manually tract the tests and potential increase in patient care revenues. CONCLUSION: Computerized reminder system through electronic medical records improved HbA1c and urine microalbumin testing in outpatient setting. Integrating computerized reminder alert system to routine outpatient care in diabetes population not only improves the quality of care but also saves the manpower utilization by saving the time spent by physicians and support staff in tracking previous test results and determining when the tests are due.

HOMEBOUND: ACUTE CARE USE AND HEALTH CHARACTERISTICS FOR A COHORT OF CHRONICALLY ILL ELDERLY

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BACKGROUND: Over three million community-dwelling seniors have functional impairments that leave them homebound and limit their access to routine healthcare services. Functional impairments, along with poor health status, tenuous socioeconomic status, and relative difficulty accessing outpatient care, likely increase emergency department (ED) visits and hospital admissions. We conducted a study of homebound older adults to characterize their health status, functional dependence, and quality of life, as well as recent acute care usage. METHODS: We recruited homebound patients newly enrolled in two home-based care programs, the Mount Sinai Visiting Doctors (MSVD) program and the Visiting Nurse Service of New York Long-term Home Health Care Program (Lombardi). We included patients age >65 years who were English or Spanish speaking and were able to provide written consent or had a proxy to provide consent. Homebound status, extrapolated from the Medicare guideline, was defined as leaving the home infrequently and requiring assistance when leaving the home. We first characterized homebound patients with respect to number of dependencies in activities of daily living (ADL) and instrumental activities of daily living (IADL), Quality of Life in Alzheimers Disease Scale (QoL-AD), General Health Status (SF-1), and Cornell Scale for Depression (CSD). In addition, we collected self-reported visits to primary care physicians (PCP), specialist physicians, and the ED, as well as hospitalizations within the 3 months prior to MSVD or Lombardi enrollment. Finally, we examined bivariate associations between patient demographic and health characteristics and hospitalizations or ED visits. RESULTS: We recruited 65 patients; the majority was over 80 years of age (51%) and female (86%). Approximately a third were white (39%), black (37%), and Latino (35%). Forty (62%) had household income <$1000/month, 33 (51%) had received some high school education or less, and all had a home attendant or aide. The mean number of ADLs and IADLs requiring assistance was 4.1 (STD 2.2) and 5.7 (STD 1.8) respectively. For health related quality of life the mean score was 31.4 (STD 6.8) on the QoL-AD (range from 13 [least quality] to 53 [highest quality]). Patient reported a mean health status score of 3.6 (STD 1.1) on the SF-1. CSD mean score was 11.7 (STD 7.3) and 32 (49%) met criteria for probably major depression (score >10). In the three months prior to program enrollment, 32 (51%) had more than one PCP visit and 29 (47%) had visited a specialist more than once. During those three months, rates of acute care use were high: 33 (51%) reported making a
visit to the ED and 30 (46%) were hospitalized. In bivariate analysis, greater ADL impairment was associated with greater likelihood of hospitalization (4.7 mean ADLs impaired for hospitalized patients vs.3.6 mean ADL impairment for non-hospitalized patients p=.05). There was no association between age, gender, race, income, household support, PCP involvement, depression, general health status, or quality of life on either ED visits or hospitalizations.

CONCLUSION: Homebound older adults in this study have substantial physical limitations, depression, and experience high rates of acute care use. Except for increased ADL dependence, our analysisfocused on explanatory variables shown in other elderly populations to be correlated with acute care usagedid not reveal any associations. The homebound reflect a growing group of chronically medically ill elderly. To better care for

these patients and control rising costs, understanding how to prevent them from utilizing acute care services will be a health policy priority.

GROUP MEDICAL VISITS FOR ALZHEIMERS DEMENTIA PATIENTS AND THEIR CAREGIVERS Gina Fujikami 1; Steve Lai1. 1Santa Clara Valley Medical Center, San Jose, California. (Tracking ID # 9334)

BACKGROUND: Alzheimers Dementia is a growing terminal disease that affects not only the patients but also their loved ones and caregivers. Caregiver burden is common and can manifest as mental and/or physical illness as well as social and financial problems. Current outpatient models of care poorly address dementia-related issues. Outpatient group visits for a variety of chronic diseases (such as diabetes) have been studied with variable effects on costs and utilization of health care resources but with positive patient and physician satisfaction. We applied a similar model to a group of Alzheimers Dementia patients and their caregivers. Our hypotheses were that patients behavioral problems and caregiver burden would be more adequately managed and improved with a structured group medical visit facilitated by a physician and medical social worker.

METHODS: Ten patients diagnosed with Alzheimers Dementia and their caregivers from a community geriatric clinic agreed to participate in this observational study. Participants met monthly for 1.5 hours throughout the course of a year. Group medical visits began with an educational talk of interest to the group followed by a series of interval histories focused on one patient-caregiver dyad at a time facilitated by the physician and medical social worker. Caregivers filled out the Zarit Caregiver Burden Interview and Neuropsychiatric Inventory Questionnaire before and after the year-long intervention to assess caregiver stress and the severity of patients behavioral problems, respectively. Paired t-tests were employed.

RESULTS: Five patient-caregiver dyads had complete data sets. There was a trend toward decrease in caregiver burden and stress as well as in severity of patients behavioral problems at the conclusion of the outpatient group meetings although the results were not statistically significant ($p=0.43$ and $p=0.09$, respectively). 4 of the 5 dyads experienced improvement in caregiver stress and patients neuropsychiatric score. If the remaining outlier dyad was excluded, scores became statistically significant ($p=0.05$ and $p=0.02$, respectively). Even though that particular dyad experienced worsening of behavior and caregiver stress, the caregiver expressed an appreciation for the support from the group and staff. Caregivers also felt more knowledgeable about Alzheimers Dementia and about resources in the community. CONCLUSION: Outpatient group medical visits focusing on Alzheimers Dementia education and care may be beneficial for reducing both patient behavioral problems and caregiver stress. Future directions include focusing on specific ethnic groups and assessing for differences in health care usage and medical costs (financial feasibility).

SCORING HOSPITALIST ETIQUETTE Sean Tackett 1; Darlene Tad-y 2; Scott Wright1. 1Johns Hopkins Bayview Medical Center, Baltimore, Maryland; 2University of Colorado at Denver, Denver, Colorado. (Tracking ID # 9395)

BACKGROUND: As physicians are forced to spend more time in indirect patient care activities, particularly on documentation, it has become difficult to establish meaningful physician-patient relationships. Dr. Michael Kahn proposed a checklist of six etiquette-based behaviors as a strategy to improve physician rapport with patients. We hypothesized that the creation of an etiquette-based medicine (EtBM) score could allow for the grading of physician etiquette.

METHODS: Eight hospitalists were randomly selected at each of three hospitals in the Greater Baltimore area and were shadowed by a single observer during a non-admitting shift between May and June 2009. Hospitalists knew only that the observer was conducting a time-motion analysis. Each time the hospitalist entered a patients room, the observer recorded whether etiquette-based medicine behaviors were performed: (1) knocking or asking to enter the patients room, (2) introducing oneself, (3) shaking the patients hand, (4) sitting down in the

patients room, (5) explaining ones role in the patients care, and (6) asking about the patients feelings regarding the hospitalization or his or her illness. EtBM score for each physician was characterized as percentages derived by dividing the number of times EtBM behaviors were performed by number of opportunities to carry them out. Physician activities were recorded at 30 second intervals and categorized as direct patient care (e.g. time spent with patients or their families), indirect patient care (e.g. documentation, coordinating care, writing orders), other activities (e.g. walking, administrative meetings, scholarly work), and personal activities (e.g. meals, restroom breaks, personal calls). Linear regressions were used to assess whether EtBM scores were associated with physician characteristics.
RESULTS: The 24 observed hospitalists collectively saw 226 unique patients and had 389 patient encounters. The average shift length was9.9 hours (SD 1.9), and the average length of each patient encounter was 12 minutes (SD 9). Overall, 18% of hospitalists time was spent in direct patient care, 60% in indirect patient care, 13% in other activities, and 9% in personal activities. EtBM scores for the providers ranged from a low of 3% to a high of 44% (mean 19%). Physician age, gender, and experience were not associated with EtBM scores. Physicians in the top quartile for EtBM score spent more time with each of their patients than those in the bottom quartile (14 vs 12 minutes) and spent a greater proportion of their day in direct patient care (21% vs 16%); both $p<0.05$. CONCLUSION: Higher EtBM scores were more common among physicians spending more time with patients and may represent a marker of patient-centered care. However, EtBM behaviors were infrequently practiced by every hospitalist in the sample thus indicating significant room for improvement.
HYPERGLYCEMIA AND SHORT-TERM OUTCOMES IN PATIENTS WITH ACUTE PULMONARY EMBOLISM
Mean Pascual Marie 1;
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BACKGROUND: Hyperglycemia is associated with poor outcomes in acute cardiorespiratory diseases, such as myocardial infarction, heart failure, and pneumonia. The prognostic value of serum glucose at admission in patients with acute pulmonary embolism (PE) is unknown. We sought to examine the association between admission glucose levels
and mortality and hospital readmission rates for patients hospitalized with PE.
METHODS: We studied patient discharges with a primary diagnosis of PE from 185 acute care hospitals in Pennsylvania (1/2000-11/2002). Levels of admission glucose were analyzed as a categorical (smaller than or equal to 110, >110 to 140, >140 to 170, >170 to 240, >240 mg/dL) variable. The study outcomes were 30-day all-cause mortality and hospital readmission. We used random-intercept logistic regression to assess the independent association between admission glucose levels and mortality and hospital readmission, adjusting for patient (age, gender, race, insurance, severity of illness using the Pulmonary Embolism Severity Index, use of thrombolytic therapy, troponin, hemoglobin, creatinine, and sodium) and hospital factors (region, size, teaching status).
RESULTS: Among 13,621 patient discharges with PE, hyperglycemia (glucose >110 mg/dL) was present on admission in 8666 patients(63.6%). The majority (80.6%) of hyperglycemic patients did not have recognized diabetes mellitus. Patients with a glucose level smaller than or equal to 110, >110 to 140, >140 to 170, >170 to 240, >240 mg/dL had a cumulative 30-day mortality of 5.6%, 8.4%, 12.0%, 15.6%, and 18.3%, respectively (P smaller than 0.001). Compared to patients with a glucose level smaller than or equal to 110 mg/dL, the adjusted odds of dying were significantly greater for patients with a glucose >110 to 140 mg/dL (OR 1.20, 95% CI: 1.01-1.44), >140 to 170 mg/dL (OR 1.42, 95% CI:1.16-1.76), >170 to 240 mg/dL (OR 1.53, 95% CI: 1.24-1.88) and >240 mg/dL (OR 1.65, 95% CI: 1.32-2.06), with no difference in the odds of hospital readmission.
CONCLUSION: In this large, statewide sample of unselected patients with acute PE, hyperglycemia was common in patients presenting with PE and was an independent predictor of short-term mortality. Given that

hyperglycemia is a potentially harmful and correctable abnormality, whether glucose lowering with insulin has a positive clinical impact in patients with PE needs to be further examined.

COLORECTAL CANCER SCREENING: DIFFERENCES IN RURAL AND INNER CITY, LOW INCOME PATIENTS KNOWLEDGE, BELIEFS, PHYSICIAN RECOMMENDATION AND BEHAVIOR Daci J Platt 1; Connie Lea Arnold 2; Pat Bass 2; Alfred Rademaker 3; Dachao Liu 4; Michael Wolf 4; Terry C Davis2. 1LSU Health Sciences Center Shreveport, Shreveport, Louisiana ; 2Louisiana State University Health Sciences Center Shreveport, Shreveport, Louisiana ; 3Feinberg School of Medicine - Northwestern UniversityNorthwestern University, Chicago, Illinois . (Tracking ID # 9451)

BACKGROUND: Substantial evidence shows that routine screening can prevent colorectal cancer (CRC) or detect it at an early stage and potentially reduce mortality. Less than half of Americans receive CRC screening, with lowest rates among racial/ethnic minorities, low-income individuals, those with fewer years of education, and those living in rural areas. The purpose of this report is to determine differences in rural and inner city patients CRC screening knowledge, beliefs, self-efficacy, physician recommendation and previous fecal occult blood test (FOBT) completion in Federally Qualified Health Centers (FQHCs). METHODS: Eligible patients in six North Louisiana FQHCs (men and women aged 50 and over who had never been screened for CRC or were not up to date) were given a structured interview and a literacy test. RESULTS: Of the 812 patients enrolled (577 rural, 235 inner city) 79% were female, 68% African American (AA), 32% white, 33% less than a high school diploma, and 50% read on less than a 9th grade level. Patients ranged in age from 5074. Inner-city patients were more likely than rural patients to have low literacy (59% vs. 47%, p=.001) and be AA (90% vs. 59%, p<.0001). Of these, rural patients were more likely than inner-city patients to have heard of a colonoscopy (92% vs.76%, p<.0001). Yet rural patients were more likely to strongly agree they would return an FOBT kit (23% vs. 6%, p<.0001). Results remained significant after adjusting for age, race, and literacy.

CONCLUSION: Patients in rural FQHCs have more positive beliefs about the benefits of screening and greater self-efficacy about completing FOBTs than patients in inner city FQHCs, but are less likely to have been given information on FOBTs or received a physician recommendation or an FOBT kit. Greater access to CRC screening information, physician recommendations, and cost effective screening methods are needed in FQHCs, particularly those in rural areas.

SOCIAL, VOCATIONAL, AND EDUCATIONAL OUTCOMES OF OBESITY IN ADULTHOOD Arlene E. Chung 1; Gary R. Maslow 2; Asheley Cockrell Skinner 3; Carolyn T. Halpern 4; Eliana M. Perrin3. 1University of North Carolina at Chapel Hill School of Medicine, Department of Medicine, Division of General Internal Medicine &Clinical Epidemiology, Chapel Hill, North Carolina; 2University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; 3University of North Carolina at Chapel Hill School of Medicine Department of Pediatrics, Chapel Hill, North Carolina; 4University of North Carolina at Chapel Hill Department of Nutrition, Chapel Hill, North Carolina. (Tracking ID # 9549)

BACKGROUND: Adolescents who remain or become obese as they transition to adulthood (20-30 s) may be at risk for lower social, vocational, and educational outcomes. Minimal prior work has assessed a variety of such outcomes. We examined how changes in weight status from adolescence to early adulthood affect social, vocational, and educational outcomes.

METHODS: We examined data from the National Longitudinal Study of Adolescent Health Wave II (1996; 1221 years old) and Wave IV (2008; 2432 years old). Obesity was defined as age-for-sex BMI 95% or greater for those less than 20 years old and BMI 30 kg/m2 or greater for those 20 years old and up. Underweight participants were excluded from the analytic sample (BMI percentile <5%; BMI <18.5 kg/m2). We compared outcomes based on BMI trajectories: healthy weight adolescents (5-85th
percentile) who remained healthy weight (BMI 18.5-25 kg/m2) in early adulthood (healthy-healthy), healthy weight adolescents who became obese in early adulthood (healthy-obese), and obese adolescents who

remained obese (obese-obese). The following outcomes were reported at Wave IV: graduation from high school or college, ever being married, being a parent, living with a parent, having a job, receiving public assistance, and annual income. The final analytic sample (N=6,984)
was weighted to be nationally representative, and logistic regression was used to compare obesity trajectories for outcomes controlling for age, sex, parental education, and race.
RESULTS: Compared to those who were healthy weight during adolescence and remained healthy weight in early adulthood (n=3,682), those who were obese and remained obese (n=1537) had significantly lower odds (see Figure 1) of graduating college and had lower incomes and had higher odds of still living with a parent and being on public assistance. Compared to those who were healthy weight and remained healthy weight (healthy-healthy), those who were healthy weight as adolescents but became obese as adults or healthy-obese (n=1,765) had lower odds of graduating college and greater odds of being parents and being married. There were no statistically significant differences among groups in terms of employment or high school graduation. When separated by sex, differences among groups for income and being on public assistance persisted only for female participants.
CONCLUSION: Persistence of obesity into adulthood, especially for females, is related to lower educational attainment and lower income. Those who become obese in adulthood are also vulnerable. In addition to the detrimental health effects of obesity, the notable negative social, educational, and financial effects of obesity could be impacted by the prevention and reversal of obesity in adolescence and early young adulthood (1221 years old). As this age group has traditionally been difficult to reach, innovative interventions to target and motivate this age group are needed.
HOW MANY LIFE YEARS LOSS FOR MAJOR CANCERS COULD BE SAVED IN THE UNITED STATES IF WE SUCCESSFULLY PREVENT EACH INCIDENT CASE? Pang-Hsiang Liu 1; Nancy Keating2. 1Harvard Medical School, Boston, Massachusetts; 2Harvard Medical School, Newton, Massachusetts. (Tracking ID # 9556)
BACKGROUND: The standard method of computing the person-years of life lost (PYLL) provides a retrospective assessment, counting years of life lost for patients who have died rather than estimating years of life lost for incident cases. Expected years of life lost (EYLL) since diagnosis of cancer would provide another valuable measure of the burden of cancer that can be applied prospectively. The purpose of this study was to estimate the EYLL for patients with one of six types of prevalent and potentially preventable cancer in the United States and to assess the validity of the extrapolation method used among subsets of the cancer cohorts.
METHODS: Patients diagnosed with cancers of the lung, colon and rectum, liver, female breast, cervix, or prostate during 19922005 were identified from the Surveillance, Epidemiology, and End Results registries. Mortality was assessed through 2006. The lifetime survival functions for the cancer cohorts and age- and sex-matched reference populations were generated using a novel semiparametric extrapolation method with annual life tables. The average EYLL for cancer patients was calculated by subtracting the estimated life expectancy of the cancer cohort from that of the reference population. The validation of

the extrapolation of long-term survival was performed using the subcohorts of cancer patients diagnosed during 19921998. We assumed they were only followed till 1998 and extrapolated their survival to an additional 8 years using the semiparametric method. Then we computed extrapolated estimates with the observed gold standard values of the real mean survival within the 15-year follow-up, 19922006.
RESULTS: The estimated life expectancy of a cancer patient since initial diagnosis varied by cancer site from 1.93 years to 20.66 years. Liver cancer and lung cancer had a large average EYLL, 16.7 years and13.8 years respectively, which imply the corresponding life years saved if an incident case could had been successfully

prevented. With multiplication by the annual incidence counts for each cancer in 2010, lung cancer would cause the greatest subtotal of EYLL (3,066,301 years) followed by female breast cancer (1,295,664 years) and colorectal cancer (927,009 years). Validity tests indicated the relative biases of the extrapolated estimates were <3.5%.
CONCLUSION: The potential life years saved by successful prevention, in terms of EYLL since diagnosis, would be substantial for lung cancer, breast cancer, or colorectal cancer. Identifying and improving strategies for prevention of cancer remains a priority to minimize years of life lost due to cancer in the United States. Compared with the average PYLL for a particular cancer, defined by dividing PYLL by the actual number of deaths and reported by the National Cancer Institute, the average EYLL is not a measure of burden of disease for only individuals who died from that cancer but one for populations of incident cancer. Thus the measurement of average EYLL can provide an estimate of how much life is likely to be decreased by cancer on average, allowing for clearer communication with the lay public, clinicians, and policy-makers about cancer risk and life expectancy. It can also allow estimates of the health utility gained or medical cost saved if each incident case of cancer could be prevented successfully. Moreover, the extrapolation method was valid and acceptable, given that the relative biases for the estimates on the cancer subcohorts in the validation process were all less than 3.5%.
END-OF-MONTH HYPOGLYCEMIA ADMISSIONS ARE INCREASED AMONG LOW-INCOME PATIENTS
Hilary Seligman 1; Ann Bolger 1; Nancy Jianhua Jin 1; Kirsten Bibbins-Domingo1. 1University of California San Francisco, San Francisco, California. (Tracking ID # 9590)
BACKGROUND: Almost one in seven households in the United States is food insecure (at risk of going hungry because of the inability to afford food). Because assistance benefits and paychecks are often distributed on the first of the month, food insecure households often exhaust food budgets before the end of the month. Small studies have suggested that
food insecurity is associated with hypoglycemia among patients with diabetes. We hypothesized that the exhaustion of food budgets in low-income households would result in increased hospital admissions for hypoglycemia at the end of the month.
METHODS: We used administrative data on adult discharges from accredited California hospitals between the years 2000 and 2008, available from the California Office of Statewide Health Planning and Development (OSHPD). Data available included diagnosis codes, hospital admission dates, and patient demographics, including home zip code. We examined the admission date of all hospitalizations with a primary discharge diagnosis of hypoglycemia (ICD-9 251.*), and categorized them into quartiles corresponding to the first, second, third, and fourth weeks of the month. We recorded the number of hypoglycemia admissions, and the ratio of hypoglycemia admissions to total hospital admissions. We compared counts and ratios across the first, second, third, and fourth weeks of the month using logistic regression models. We looked for an interaction between week of hypoglycemia admission and patient income estimated using zip-code level data from the US Census Bureau, dichotomized at $30,000. We also looked for week-to-week variation in appendicitis (ICD-9 540.* or 541.*), which we did not expect to be influenced by exhaustion of household food budgets.
RESULTS: A total of 2,558,802 adult hospital admissions occurred in California from 20002008, of which 5461 had a primary diagnosis of hypoglycemia. Although there was no significant week-to-week variation in total hypoglycemia admissions (p=0.5), the association differed by income level (p for interaction=0.02). Among the 4915 admissions for high-income patients, there was no week-to-week variation in admissions. Among the 544 admissions for low-income patients, the average count of hypoglycemia admissions during the first, second, third, and fourth weeks of the month was 109, 114, 141, and 136 episodes (p=0.008), representing a 20% increase in hypoglycemia admissions in the last two weeks of the month. Similarly, the ratio of admissions for hypoglycemia increased significantly in the last two weeks of the month among the low-income patients (p=0.008, see Figure), with the last day of the month showing the highest number of hypoglycemia admissions

at 27 (range of all days 927, mean 18). We observed no week-to-week variation in hospital admissions for appendicitis among high or low income patients.
CONCLUSION: In low-income households, there is a significant increase in hospital admissions for hypoglycemia at the end of the month. Although these data do not allow us to directly link admissions to any single underlying cause, they suggest that hypoglycemia is a critically important safety issue among patients without adequate food access, particularly since the burden of hypoglycemia is likely much larger than reflected in the number of hypoglycemia hospital admissions.

SERUM 2-METHOXYESTRADIOL, AN ESTROGEN METABOLITE, IS POSITIVELY ASSOCIATED WITH SERUM HDL IN A POPULATION-BASED SAMPLE Christopher M. Masi 1; Louise C. Hawkley 1; John T. Cacioppo1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 9601)
BACKGROUND: Serum high-density lipoprotein (HDL) is inversely associated with coronary artery disease, ischemic stroke, and atherosclerosis in men and women. HDL provides atheroprotection by promoting cholesterol efflux from peripheral tissues, transporting cholesterol to the liver for excretion as free cholesterol or bile acids, serving as an anti-oxidant and suppressing inflammation. Serum HDL levels are higher and cardiovascular disease is less prevalent among premenopausal women compared to similarly-aged men. Among postmenopausal women, oral supplementation with conjugated equine estrogen increases serum HDL levels. Studies show that the atheroprotective effects of 17beta-estradiol (E2) are fully retained in estrogen receptor (ER) beta knockout mice and are partially retained in ER alpha knockout mice. This suggests that E2 atheroprotection may operate through receptors yet to be identified or that other factors, such as E2 metabolites, partially mediate E2 atheroprotective effects. A recent study demonstrated that subcutaneous administration of an E2 metabolite, 2-methoxyestradiol (2-MeOE2), to apolipoprotein E-deficient mice led to reductions in both total serum cholesterol and aortic atherosclerotic plaque size compared to control mice. 2-MeOE2 has no affinity for classical estrogen receptors but this metabolite inhibits HMG-CoA reductase in vitro. In vivo, HMG-CoA reductase inhibitors reduce low-density lipoprotein (LDL) and raise HDL. Given these effects, we hypothesized that serum 2-MeOE2 would be positively association with serum HDL. Such an association could shed light on the ER-independent atheroprotective effects of E2.
METHODS: Data for this study were gathered in the fifth year of the Chicago Health, Aging, and Social Relations Study (CHASRS), which is a population-based longitudinal study designed to examine the relationships between psychosocial characteristics and health outcomes among middle-aged and older adults. Participants completed surveys regarding their demographic, dietary, and exercise characteristics, as well as their medication usage. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. The following medications were classified as antihyperlipidemic agents: HMG-CoA reductase inhibitors (statins), niacin, bile acid sequestrants, and cholesterol absorption inhibitors. Serum was analyzed for E2 and 14 estrogen metabolites (EM) using mass spectrometry. EM values exhibited a positively skewed distribution and were therefore subjected to natural log (ln) transformation. Fasting HDL, total cholesterol, and triglycerides were measured using the Cholestech LDX kit (Cholestech Corporation, USA), a system that meets CDC reference standards for accuracy and reproducibility. LDL was calculated using the Friedewald equation. In year 5, we had serum EM data from 51 men and 51 women, all of whom were postmenopausal. Four women were excluded because they were taking hormone replacement therapy. Preliminary analysis revealed no correlation between 2-MeOE2 and serum HDL in men so the current analysis includes only women (N=40) who had no missing demographic, medication, EM, or cholesterol data. Ordinary linear regression analysis was used to evaluate the relationship between serum HDL and predictor variables, including age, race/ethnicity, BMI, use of antihyperlipidemic agents, and serum 2-MeOE2. A one-way t-test of significance was used given our hypothesis of a positive association between 2-MeOE2 and HDL. RESULTS: The mean age for both men and women was 57 years. Correlational analysis revealed a positive relationship between serum 2-MeOE2 and

serum HDL which approached significance among women
(r=0.307; p=0.051) but not among men (r=0.1, p >0.5). None of the other estrogen metabolites was correlated with HDL. Multivariate regression analysis of data from 40 women showed that 2-MeOE2 retained a positive association (p see attached table.
CONCLUSION: Consistent with our hypothesis, we found a positive association between serum 2-MeOE2 and serum HDL. This was true among postmenopausal women but not among similarly-aged men. Oral estrogen supplementation leads to increased HDL in postmenopausal women but the mechanism of E2 non-ER dependent atheroprotection is unknown. Our results are consistent with 2-MeOE2 inhibition of HMGCoA reductase and increased HDL production. Higher levels of serum HDL may explain the ER-independent atheroprotective effects of E2. However, our results are also consistent with the opposite effect (i.e., increased 2-MeOE2 production due to HDL). Prospective studies are therefore needed to determine the causal direction of this association. If 2-MeOE2 is found to increase serum HDL levels in vivo, further investigation of E2 metabolism (especially 2-MeOE2 production) should be pursued. A better understanding of this process could lead to new therapies for cardiovascular disease, especially among postmenopausal women.
THE ASSOCIATION BETWEEN MINOR AND MAJOR ECG CHANGES AND INCIDENCE OF CORONARY HEART DISEASE EVENTS Reto Auer 1; Douglas C. Bauer 2; Pedro Marques-Vidal 1; Javed Butler 3; Lauren Kim 4; Jacques Cornuz 1; Suzanne Satterfield 5; Anne Newman 6; Nicolas Rodondi1. 1University of Lausanne, Lausanne, N/A ; 2University of California San Francisco, San Francisco, California ; 3Emory University, Atlanta, Georgia ; 4National Institute of Aging, National Institutes of Health, Bethesda, Maryland ; 5University of Tennessee Health Science Center, Memphis, Tennessee ; 6University of Pittsburgh, Pittsburgh, Pennsylvania . (Tracking ID # 9689)
BACKGROUND: Electrocardiographic (ECG) abnormalities are common in older adults, but data on their prognostic importance to predict future coronary heart disease (CHD) are conflicting. Our goal was to determine whether baseline ECG abnormalities or development of new and persistent ECG abnormalities during follow-up are associated with increased incident CHD events in older adults, independently of traditional cardiovascular risk factors (CVRFs).
METHODS: We studied 2191 elderly men and women (age range 68 80 years, 59% Caucasian, 41% Black) from the Health, Aging, and Body Composition Study without known cardiovascular disease at baseline. During 8 years of follow-up, self-reported CHD events, defined as hospitalization for acute myocardial infarction, coronary death, angina, angioplasty of coronary arteries and coronary artery surgery, were adjudicated by review of medical records. Baseline study ECG abnormalities were classified according to the Minnesota Code as minor (minor ST-T changes) and major (major ST-T changes, Q-QS wave abnormalities, left ventricular hypertrophy, complete bundle branch block or intraventricular block, atrial fibrillation or atrial flutter). After 4 years of follow-up, 1670 participants had a second study ECG to determine the presence of new or persistent ECG abnormalities. We used Cox models to assess the value of adding ECG abnormalities to traditional risk factors for the prediction of future CHD events. Primary analyses were adjusted for traditional CVRF included in the current Framingham Risk Score (age, gender, total and high density lipoprotein cholesterol, systolic blood pressure, smoking status), as well as diabetes. We categorized 7.5-year estimates for incident CHD as low risk (0% to 7.5%), intermediate risk (7.5% to 15%), and high risk (15% or

more) to calculate net reclassification in the intermediate risk categories using Harrels C index.
RESULTS: At baseline, 276 participants had minor and 506 had major ECG abnormalities. During 8 years of follow-up, 351 participants had CHD events. Minor ECG abnormalities at baseline were associated with an increased risk of CHD (hazard ratios (HR) and 95% confidence interval [CI] 1.45 [95% CI: 1.14 - 1.85] after

adjustment for CVRFs). CHD risk was also increased among those with major ECG abnormalities at baseline (HR=1.51, 95% CI: 1.20 - 1.90) and those with any ECG abnormality defined as either minor and/or major abnormalities (HR=1.64, CI: 1.32 - 2.03). The presence of any ECG abnormality at baseline accurately reclassified 7.1% overall and 13.6% of intermediate risk participants (both P 0.005). Of the 1670 adults with a second ECG after 4 years, 208 had a new abnormality and 416 had a persistent abnormality. After adjustment for CVRFs, both new and/or persistent ECG abnormalities at 4 years were associated with an increased risk of subsequent CHD events (HR=1.67, CI: 1.31 - 2.96 and HR=1.52, CI:1.07 - 2.16, respectively).
CONCLUSION: Minor and major ECG abnormalities in elderly adults are associated with an increased risk of CHD events and provide additional risk stratification information beyond traditional CVRFs. These data suggest a potential value of including ECG findings in the overall assessment of cardiovascular risk in elderly populations.

TRAINING MEDICAL STUDENTS TO CONDUCT MOTIVATIONAL INTERVIEWING: A RANDOMIZED CONTROLLED TRIAL. Jean-Bernard Daeppen 1; Cristiana Fortini 1; Nicolas Bertholet 1; Raphael Bonvin 1; Alexandre Berney 1; Pierre-Andr Michaud 1; Carine 1; Jacques GaumeLayat2. 1Lausanne University Hospital, Lausanne, N/A;
2Lausanne University Hospital Lausanne University Hospital, Lausanne, Lausanne, N/A, N/A. (Tracking ID # 9691)

BACKGROUND: Scientific evidence for the efficacy of Motivational Interviewing (MI) can assist government agencies in recommending its use in medical settings. Research indicates that barriers exist to MI implementation among physicians, thus a strategic time to begin MI training might be during medical school. Several studies have suggested that training medical students improves their MI skills, but no randomized controlled study has addressed the effectiveness when these skills are applied. The aim of our study was to examine the effectiveness of MI training among medical students when they begin counseling patients to change certain health behaviors, such as overuse of tobacco and alcohol, lack of exercise, and unhealthy diets. METHODS: All students (n=131) in year 5 of a 6-year curriculum at Lausanne University Medical School Switzerland were randomized into an experimental (n=66) or a control group (n=65). An 8-hour training workshop was completed by 56 (84.8%) students in the experimental group. The objectives were to adopt the spirit of MI, to use open questions and complex reflections, to recognize and reflect resistance and to elicit and reinforce change talk. One week after the training, students in both the experimental (trained) and the control (untrained) group were invited to meet for 15 minutes with two standardized patients. One was a 60-year-old male with a history of severe nicotine dependence, hospitalized following a myocardial infarction, and the other was a 50-year-old diabetic female with an unhealthy diet, lack of exercise, and problems with medication compliance. Forty-one students in the experimental group and 48 in the control group (or 67.9% of the initial sample) completed these patient encounters which were tape-recorded; MI skills were coded by four blinded research assistants using
the Motivational Interviewing Treatment Integrity 3.0 (MITI). Twenty percent of these were double-coded and had intra-class correlation coefficients between 0.49 and 0.87. Mean MITI summary scores in the experimental group were compared to those in the control group. RESULTS: Superior MI performance was shown for trained versus control students, as demonstrated by higher summary scores for MI Spirit [4.0 (0.6) vs 3.3 (0.6), p<.001], % MI-adherent [80.3 (20.9) vs 47.3(23.3), p<.001], % Open questions [34.5 (11.8) vs 21.1 (7.7), p<.001], % Complex reflections [25.5 (9.9) vs 21.0 (11.6), p=.04], and ratio Reflections/Questions [0.8 (0.4) vs 0.6 (0.3), p<.001], respectively. CONCLUSION: An 8-hour training workshop for medical students with minimal clinical experience was associated with improved MI performance, as evidenced by MI spirit and behavior counts. This lends support for the implementation of MI training in medical schools.

EFFECTIVENESS OF A BRIEF SCREENING TOOL TO IDENTIFY MEDICAL STUDENTS IN SEVERE DISTRESS Lotte Dyrbye 1; Alan Schwartz 2; Steven Downing 3; Jeff Sloan 1; Tait Shanafelt1. 1Mayo Clinic,

Rochester, Minnesota ; 2Department of Medical Education, University of Illinois-Chicago College of Medicine, Chicago, Illinois ;
3Department of Medical Education, University of Illinois-Chicago College of Medicine, Chicago, Illinois . (Tracking ID # 9852)
BACKGROUND: Psychological distress is common among medical students and manifests in a variety of ways (e.g. burnout, depression, low QOL, stress, fatigue, etc.). As this distress can lead to potential dreadful personal and professional consequences and as students are reluctance to seek help there is a need for a practical screening instrument that evaluates multiple dimensions of distress simultaneously and identifies students in greatest need of individualized attention. In this abstract, we report the results from two large multicenter studies that provide validity data on such a brief screening instrument.
METHODS: The ability of the Medical Student Well-being Index(MSWBI) to identify medical students with low mental QOL(defined by having a SF-8 mental component score >1/2 standard deviation below the age and gender-matched population norm), recent suicidal ideation, or recent serious thoughts of dropping out was tested using 2 separate samples of medical students, one sample stemming from a 2007 survey completed by 2230 medical students attending 7 US medical schools and a confirmatory sample of 2682 students surveyed in 2009. RESULTS: Students with low mental QOL, recent suicidal ideation, or recent serious thoughts of dropping out were more likely to endorse each individual MSWBI item and a greater number of total items than students without such distress (all p less than 0.001). Mean mental QOL scores declined as the number of index items endorsed increased ($p<0.0001$ for both genders). The likelihood ratio(LR) for low mental QOL among students with a MSWBI score less than 4 was 0.47 as compared to a LR of 4.79 for those with a score 4 or greater. At a MSWBI threshold score of 4 or greater the sensitivity and specificity of the MSWBI for identifying students with low mental QOL or recent suicidal ideation/serious thoughts of dropping out were both 90% or higher. On multivariable logistic regression all MSWBI items were independently associated with at least one outcome. In the confirmatory sample, the MSWBI again stratified risk for all 3 outcomes with less than 10% differences in sensitivity and specificity at all score levels compared to 2007CONCLUSION: Among two large cohorts of medical students the MSWBI can identify students at risk for clinically relevant outcomes (low mental QOL, suicidal ideation, or serious thoughts of dropping out

of medical school) that warrant recognition and individualized attention. The MSWBI is a useful tool to help medical schools identify students with severe distress which may help schools allocate resources to students in greatest need of assistance.
SELF-AWARENESS OF CULTURAL COMPETENCY IN INTERNAL MEDICINE RESIDENTS: RESULTS OF A TEACHING STANDARDIZED PATIENT ENCOUNTER Patricia Thomas 1; Jorie Colbert2. 1Johns Hopkins University School of Medicine, Glen Arm, Maryland; 2Johns Hopkins University, Baltimore, Maryland. (Tracking ID # 9980)
BACKGROUND: Cultural competency is a necessary skill for all health care professionals. Despite a profusion of cultural competence curricula in health professionals education, there are few validated measures of a trainees cultural competence. We describe here the results of a teaching standardized patient encounter with a behavioral checklist and self-assessment of competence that was used for PGY-1 internal medicine residents.
METHODS: 110 interns from the Johns Hopkins Hospital internal medicine residency program completed the standardized patient (SP) encounter from July 2006 to July 2010. In the 20-minute encounter, the patient was portrayed by an African-American, who expressed both a deep spirituality and a distrust of hospice care, in the context of planning care for the terminal stage of pancreatic cancer. Residents and SPs separately evaluated the encounter using behavioral checklists, derived from literature review of both cultural competence and palliative care communication. Descriptive statistics were used to summarize performance scores. Separate one-way ANOVAs were conducted on test scores for intern year and training month; a 2(student gender) x 2

(SP gender) ANOVA was conducted on test scores to assess gender effects. RESULTS: Cronbachs alpha for the 16-item SP checklist was 0.78. Total scores ranged from 5.50 to 16.00 with a mean of 12.59 (SD=2.28). We found no correlation between performance on the SP checklist and cohort year, month of training, intern gender, or intern-SP gender interaction. Most interns had had prior exposure to cultural competency training, but on average rated themselves 4.44 out of 8 total points for cultural competence skill. When compared with SP scores, 88% of interns underpredicted their cultural competence ability. There was a significant difference in performance between those who over predicted and those who underpredicted their ability. Interns who underpredicted their ability had an average checklist score of 13.17 (SD=1.66) vs. those who overpredicted their ability, average checklist score of 8.35 (SD=1.94), $p<0.001$.

CONCLUSION: The use of an end-of-life scenario enhanced our ability to teach cultural competence in a new context. The checklist proved to be a reliable instrument. In addition to communications skills training, cultural competency education efforts should focus on self-awareness
and situational awareness skills, which appears to be in need of development at least through the PGY1 year.

HEALTH NUMERACY AND LITERACY INFLUENCE MOTIVATIONAL
IMPACT OF DIABETES GENETIC RISK TESTING Jason L. Vassy 1;
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BACKGROUND: Type 2 diabetes (T2D) genetic risk testing has been proposed as a tool to motivate lifestyle modification (LM) for T2D prevention. We hypothesized that health literacy and numeracy influence the interpretation of individual T2D genetic risk. METHODS: We recruited 129 primary care patients at high risk for T2D and assessed their health literacy [Rapid Estimate of Adult Literacy in Medicine (REALM)], genetic literacy [Rapid Estimate of Adult Literacy in Genetics (REAL-G)], and health numeracy (Schwartz, et al. 1997). We assessed participants current motivation to adhere to LM and asked them how these attitudes might change in response to hypothetical higher and lower T2D genetic risk results, using a 5-point Likert scale ranging from much less motivated to much more motivated. We used Fisher exact testing to examine whether anticipated response to genetic risk results varied with literacy and numeracy.

RESULTS: Participants had a mean age of 58 years, 59% were male, 89% were Caucasian, and 81% had greater than high school education. Sixty-seven percent reported very high motivation to prevent T2D. Despite high prevalence of health literacy (93% at high school reading level), many participants had limited numeracy (32%) and genetic literacy (37%). They uniformly reported that higher genetic risk results would increase their motivation for LM (98% reporting increased motivation). In contrast, response to lower genetic risk results varied by participant numeracy and literacy (Figure). Participants with limited numeracy were more likely to predict increased motivation by lower genetic risk results than those with adequate numeracy (65% vs. 44% reporting increased motivation, $p=0.009$). We observed a similar difference in response to lower genetic risk results when contrasting lower vs. higher genetic literacy ($p=0.05$) and lower vs. higher health literacy ($p=0.08$) but not high school or less vs. college education ($p=0.28$).

CONCLUSION: Health numeracy plays a key role in the interpretation of personal genetic risk information. In this fairly educated and motivated patient sample with high health literacy, limited health numeracy was prevalent and influenced how subjects interpreted lower genetic risk results. Numeracy assessment may help tailor the motivational counseling accompanying the delivery of personalized genetic risk information.

VARIATION IN TRIAGE PRACTICES AMONG VETERANS ADMINISTRATION HOSPITALS Lena M Chen 1;

Marta Render 2; Anne E. Sales 2; Edward H. Kennedy 3; Wyndy L. Wiitala 4; Timothy P. Hofer4. 1Ann Arbor Veterans Affairs Medical Center and Division of General Medicine, University of Michigan, Ann Arbor, Michigan ; 2VA Inpatient Evaluation Center, Cincinnati, Ohio ; 3Veterans Affairs Health Services Research and Development Center of Excellence, Ann Arbor, Michigan ; 4Veterans Affairs Health Services Research and Development Center of Excellence; Division of General Medicine, Department of Internal Medicine, University of Michigan, Ann Arbor, Michigan . (Tracking ID # 10014)

BACKGROUND: Variation in the use of critical care for patients at the end of life has been described and identified as a major source of rising health care costs. However, such patients make up only a fraction of all hospital admissions, and hospital triage practices are central to appropriate resource use for all patients. No prior work has examined variation in hospital triage practices within a national healthcare system, and among a broad array of medical patients. In this context, we examined three questions using Veterans Administration (VA) data: 1) on average, does the probability of triage to the intensive care unit (ICU) increase as a patients predicted mortality on admission increases?, 2) among patients with high predicted mortality, how much do hospitals vary in their use of the ICU?, and 3) among patients with low predicted mortality, how much do hospitals vary in their use of the ICU?

METHODS: We used retrospective data from the VA Inpatient Evaluation Center (IPEC), which collects clinical information for inpatient admissions from all VA hospitals, and has developed a validated model for assessing risk of mortality using this data. We constructed a cohort of adult admissions to any VA acute care hospital between July 2009 and June 2010. We included the first admission for all non-surgical patients who were admitted from the Emergency Department or Outpatient Clinic. We excluded VA hospitals with less than 10 ICU admissions. For each admission, we estimated predicted mortality using the IPEC validated inpatient severity score (ISS), based on clinical, laboratory, and demographic variables collected in the 24 hours surrounding admission. We measured the proportion of patients that each hospital admitted directly to the ICU, stratified by categories of ascending mortality risk.

RESULTS: During the study period, 283,976 unique non-surgical patients were admitted to 120 VA hospitals. Of these patients, 31,073(10.9%) were initially admitted to the ICU and 252,903 (89.1%) were admitted elsewhere. Predicted mortality varied by initial triage assignment: direct ICU admissions (ISS=0.082, 30-day mortality=7.7%), and non-ICU ward admissions (ISS=0.042, 30-day mortality=3.5%). Increased predicted mortality was directly associated with an increased likelihood of ICU admission (ascending categories of predicted mortality: 9%, 12%, 14%, 19%, and 28%). At all levels of predicted mortality, hospitals varied significantly in the proportion of patients directly admitted to the ICU. In the lowest category of predicted mortality, 1-49% of patients were admitted to the ICU; in the next highest, 3-50%, then 0-55%, 0-52% and 0-72%.

CONCLUSION: For a broad array of patients at all levels of predicted mortality, hospitals vary widely in their use of critical care, suggesting that there are opportunities for improved efficiency. The causes and consequences of this variation remain to be explored.

PAIN AND DISABILITY IN ELDERS James Andrews 1; Irena Stijacic Cenzer 2; Ed Yelin 3; Kenneth Covinsky2. 1University of California, San Francisco, Burlingame, California ; 2San Francisco VA Medical Center, San Francisco, California ; 3University of California, San Francisco, San Francisco, California . (Tracking ID # 10056)

BACKGROUND: Pain is a risk factor for functional disability in elders. Cross-sectional studies have demonstrated strong relationships between pain and disability. This prospective study aimed to determine if pain predicted the development of disability over time.

METHODS: Our subjects included 12,739 participants over 60 years-old in the 1998 wave of the Health and Retirement Study, a nationally representative sample of community-living adults who are interviewed biannually. Our primary predictor variable was significant pain (report of often being troubled by pain that is moderate or

severe most of the time). Our primary outcome was time to development of disability in activities of daily living (ADL) or death over 10 years. ADL disability was defined as needing help performing any ADL: bathing, dressing, transferring, toileting, eating, or walking across a room. All participants were free of ADL disability in 1998. We used a discrete time survival model to adjust for these potential confounders at baseline: demographic factors (age, race, gender, marital status, education, income), baseline functional status (ADL difficulty, difficulty walking up stairs or more than several blocks), and comorbidity (7 chronic health conditions). RESULTS: At baseline, 2,303 (18.1%) subjects had significant pain. Subjects with pain differed markedly from those without at baseline. Subjects with pain were more likely (all pCONCLUSION: Although many studies have shown strong cross-sectional relationships between pain and disability, after adjusting for baseline functional status, pain does not predict the development of ADL disability.

PHYSICIAN PATIENT-SHARING NETWORKS ARE ASSOCIATED WITH COST AND INTENSITY OF CARE IN US HOSPITALS Michael Lawrence Barnett 1; Nicholas A Christakis 2; Alistair James OMalley 2; Jukka-Pekka Onnela 2; Nancy Lynn Keating 2; Bruce Evan Landon2.

1Harvard Medical School, Brookline, Massachusetts; 2Harvard Medical School, Boston, Massachusetts. (Tracking ID # 10060)

BACKGROUND: Substantial variation exists in the cost and intensity of care received by patients treated by physicians affiliated with different US hospitals. There is currently no consensus on the mechanisms that underlie such marked variation in health care delivery across the US. Using measures from the discipline of network science, we assessed how the organization of patient-sharing networks of physicians affiliated with hospitals might contribute to this variation. We hypothesized that network measures reflecting poorer coordination of care within hospital-affiliated networks would be associated with higher costs and care intensity. METHODS: We performed a cross-sectional analysis of Medicare administrative data from 2006 for patients in 51 hospital referral regions (HRRs), resulting in a sample of 61,461 physicians affiliated with 528 hospitals caring for 2.6 million Medicare patients. We constructed hospital-affiliated physician networks based on shared patients and measured aspects of the structure of these hospital networks including the median number of connections per physician and the relative centrality of primary care or specialist physicians in the hospital network. We then used multivariate linear regression to assess the relationship between network structural measures and total health care spending and care intensity (including both inpatient and ambulatory care) in the last 2 years of life for Medicare patients, controlling for a number of hospital characteristics. RESULTS: The typical physician in an average-sized hospital was connected to 187 doctors for every 100 Medicare patients shared with other doctors. In larger hospitals, the typical physician was connected to 281 other doctors per 100 Medicare patients. An increase of one

standard deviation (SD) in the median number of connections per physician was associated with a 17% increase in total Medicare spending, 17% more hospital days, 36% more ICU days, and 37% more specialist visits (all pCONCLUSION: Hospital-affiliated physician network structure has a significant relationship with care patterns for Medicare patients. Hospitals with more specialist-focused networks and those with doctors who have higher numbers of connections to other physicians have higher costs and more intensive care. These results highlight the importance of physician relationship networks and provide support for the hypothesis that poorer coordination of care is associated with greater spending and care intensity.

MAPPING PHYSICIAN NETWORKS WITH SELF-REPORTED AND ADMINISTRATIVE DATA Michael Lawrence Barnett 1; Bruce Evan Landon 2; Nancy Lynn Keating 2; Alistair James OMalley 2; Nicholas Alexander Christakis2. 1Harvard Medical School, Brookline, Massachusetts;

2Harvard Medical School, Boston, Massachusetts . (Tracking ID # 10061)

BACKGROUND: Relationships between healthcare providers are essential to a functioning health care system and form the basis for the referral and information exchange networks in health care. These networks can be

analyzed using tools from the discipline of network science, yielding potentially valuable insights into the emergence of local health care practice patterns and diffusion of health care practices. However, network data are not readily available and require meticulous collection of information on hundreds or thousands of relationships between providers. Potentially, administrative claims data can be used to infer physician networks by linking physicians if they share patients. We designed and implemented a novel web-based survey to assess if connections between physicians based on shared patients in administrative data correspond with professional relationships between physicians.
METHODS: We performed a web-based survey of physicians affiliated with a large academic and community physicians organization. We used 2006 Medicare data from a 100% sample of patients in the Boston hospital referral region to measure patient sharing between physicians in our sample. Physicians were eligible for the survey if they were members of the physicians organization, filed claims for Medicare patients in 2006, and practiced in an office-based patient care specialty. The survey asked respondents about referral and advice relationships with physician colleagues. Respondents were asked to give names of physicians they referred to in addition to being presented with an individualized roster of physicians names with whom they did and did not share patients based on Medicare data. Relationships measured by this questionnaire were compared with relationships assessed by patient sharing, measured using 2006 Medicare data.
RESULTS: In total, we received responses from 386 of 616 eligible physicians (response rate 63%). The probability of two physicians having a recognized professional relationship increased with the number of Medicare patients shared in the administrative data, to a maximum of 82% of relationships recognized by respondents when sharing 9 patients with other physicians (Figure 1). The area under the curve (AUC) of the ROC curve when considering the number of patients shared physicians as a diagnostic test to predict any relationship between physicians was 0.73 (95% CI: 0.70-0.75). Primary care physicians (PCPs) were more likely to recognize relationships than medical or surgical specialists ($p<.001$).
CONCLUSION: Patient sharing identified using administrative data is an informative diagnostic test for predicting the existence of relationships between physicians. In addition, we find that primary care physicians are more likely to recognize relationships with other providers than specialists, a finding consistent with PCPs role as care coordinators. These findings validate a method that can be used for future research to map and study networks of physicians.
HIV AND THE HOMELESS: THE EFFECTS OF HOUSING STATUS ON HIV DISEASE PROGRESSION AND HEALTHCARE ACCESS Sarah Shelby 1; Cheryl Ho 1; Edward Brooks 1; Dean Winslow 1; Ahmad Kamal 1; Sara Doorley1. 1Santa Clara Valley Medical Center, San Jose, California. (Tracking ID # 10072)
BACKGROUND: The question of how housing status influences HIV control and healthcare access has yielded conflicting results. Several studies have shown that homeless HIV positive patients tend to have more poorly controlled CD4 counts and viral loads while other studies have shown no difference. Prior studies have also demonstrated variability in healthcare access patterns. This study was performed to compare CD4 count, viral load, and health care utilization patterns of the homeless and housed HIV positive patients who attend the Partners in AIDS Care and Education (PACE) Clinic, which is the HIV primary care clinic for Santa Clara County in San Jose, CA.
METHODS: This study was a retrospective, observational study of patients who attended PACE Clinic in 2009. Of the 1200 patients who attend PACE clinic, 33 patients were identified as being homeless and 66 patients were chosen by a random number generator from the remaining stably housed patients at PACE clinic as a control. Data was obtained from the AIDS Regional Information and Evaluation System ARIES database of California as well as county medical records regarding clinic attendance, ED visits, CD4 counts, viral load, and number of lab tests in 2009. SPSS was used to test for significant differences between the homeless and the housed population of HIV positive patients.
RESULTS: Homeless subjects had a lower mean CD4 count than housed subjects (351 vs. 494, $p=0.007$ by the

t-test) as well as a lower rate of undetectable Viral Load (36% vs. 65%, p=0.007 by the chi-square test). Homeless patients had more ED visits by the Wilcoxon Rank Sum Test (p=0.002) and a lower retention rate in the PACE Clinic (33% vs. 59%, p=0.02 by the chi-square test). However the total number of clinic visits per patient was not different between the homeless and housed populations at PACE (p=0.09 by Wilcoxon Rank Sum Test).

CONCLUSION: In our patient population, housing status significantly influenced HIV control (estimated by CD4 count and viral load) and healthcare access. In the homeless patients, CD4 counts were lower and viral loads were less likely to be undetectable. Increased ED visits in the homeless patients, coupled with similar number of clinic visits, may indicate that these patients have a more complicated HIV course for socioeconomic reasons, and that this population may benefit from an increased frequency of clinic visits. Perhaps these patients had more difficulty making their scheduled appointments and would benefit from the walk-in clinic model that has worked for local homeless clinics. Further research is needed to determine what barriers to better HIV control exist for the homeless HIV positive patients of Santa Clara County, and what could be done to overcome these barriers in the future.

TARGETING SCARCE CLINICAL RESOURCES IN REAL-TIME: AN EMR-BASED INTERVENTION TO REDUCE HEART FAILURE READMISSIONS Ruben Amarasingham 1; Parag Patel 2; Kathy Toto 1; Timothy Swanson 1; Lauren Nelson 1; Billy Moore 1; Ying Ma 1; Christopher Clark 1; Kashundra Foreman 1; Kristin Alvarez 1; Anita Rahman 1; Ethan Halm2. 1Parkland Health &Hospital System, Dallas, Texas; 2University of Texas Southwestern Medical Center, Dallas, Texas. (Tracking ID # 10078)

BACKGROUND: 30-day readmission for heart failure (HF) has gained widespread attention as a federal pay-for-performance measure. Current approaches to improve readmission performance recommend intensive clinical and case management interventions for all patients admitted with HF, an organizational posture difficult to sustain for many institutions, particularly safety net hospitals. In this study, we test a novel, multi-disciplinary approach to reduce HF readmissions that tailors the intensity of the intervention to the risk of the patient using a real-time electronic predictive model.

METHODS: We conducted a prospective cohort study to assess the impact of the intervention on rates of readmission for adult inpatients admitted with HF between December 1, 2008 and December 1, 2010 at Parkland Memorial Hospital, an 800-bed safety net hospital in Dallas, TX. During the intervention period (December 1, 2009 to December 1, 2010), a software platform we developed stratified all admitted HF patients on a daily basis according to their risk for 30-day readmission using a previously published electronic predictive model. The electronic platform calculated the risk of readmission using clinical, social, behavioral, and utilization data that it self-extracted from the hospital electronic medical record (EMR) within 24 hours of admission. HF patients in the 2 highest quintiles of risk were immediately assigned to an intensive set of evidence-based interventions designed to reduce readmission including: a) detailed clinical assessments, patient coaching and discharge planning by a HF nurse practitioner, pharmacist, nutritionist, and case manager; b) a follow-up nurse phone call within 48 hours of discharge (D/C); c) outpatient case management for 30 days including home visits; d) a cardiology appointment with a HF specialist within 7 days of D/C; e) and a primary care appointment within 30 days of D/C. HF patients in the lower 3 quintiles of risk received less intensive discharge planning, and no involvement of the HF clinicians, case managers, or home visit nurses. Readmission for any cause and to any hospital within 30 days of discharge was collected for all patients. We calculated both crude and adjusted readmission rates before and after the intervention. Adjusted analyses controlled for: 1) patient clinical and SES factors, and 2) the change in readmission rates among patients hospitalized for 2 concurrent control conditions (acute myocardial

infarction [AMI] and pneumonia [PNA]), allowing for adjustment of secular readmission trends at the institutional level.
RESULTS: There were 779 HF admissions (1435 for AMI or PNA) in the pre-intervention period and 753 HF admissions (1446 for AMI and PNA) in the post-intervention period. The pre- and post-populations were similar across clinical and socio-demographic variables. Although the clinical and case management interventions were restricted to patients in the top 2 quintiles of calculated risk, the overall unadjusted readmission rate for HF declined from 20.2% in the pre-intervention period to 16.0% in the post-intervention period (p=.04). In contrast, the readmission rate for PNA and AMI did not change (12.0% vs. 13.9%, p=0.34). In the final adjusted analysis, the readmission rate for patients with HF was significantly lower in the intervention period (15.7% vs.21.5%; adjusted incidence rate ratio, 0.72 [95% CI, 0.55 to 0.95]; p=.02). A sub-group analysis revealed that the intervention was especially effective among Medicare recipients, with a decline in overall adjusted readmission rates from 24.5% (similar to the mean incidence nationally) to 13.5% (within the top decile nationally; aIRR=0.57, CI,0.55-0.99; p=.05). There was no corresponding change in readmissions among Medicare patients with AMI and PNA (12.0% vs 13.0%; p=.80). CONCLUSION: A novel, electronic strategy that carefully directs scarce clinical resources to highest risk patients significantly reduced 30 day readmission rates among patients with HF at a large, safety net hospital. Real-time electronic predictive models may allow institutions to concentrate resources more effectively, enabling more powerful interventions in an era of constrained resources.
REDUCTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS THROUGH A BUNDLED INTERVENTION IN A COMMUNITY HOSPITAL Karen Ann Clarke 1; Bonnie Norrick 2; Kirk Easley 1; Yi Pan 1; David Tong 1; Alan Wang 1; Pennie Hill 2; Jason Stein1. 1Emory University, Atlanta, Georgia; 2West Georgia Health, LaGrange, Georgia. (Tracking ID # 10083)
BACKGROUND: Urinary tract infections (UTIs) are the most common type of hospital-acquired infection, and 80% are associated with indwelling urinary catheters. The relatively high frequency of catheter-associated UTIs (CAUTIs) leads to clinical and financial concerns for both patients and hospitals. Since Medicare and other payers no longer cover the costs of treating CAUTIs, the development of cost-effective strategies to reduce their incidence has received increased attention.
METHODS: We retrospectively examined the effect of a bundle of four evidence-based interventions, introduced in staggered fashion, upon the incidence of CAUTIs in a 276-bed community hospital. Rates of CAUTI per 1000 catheter days were estimated and compared using exact methods based on the Poisson distribution. The first intervention was the exclusive use of silver alloy catheters in the acute care areas of the hospital, the use of which had been sporadic in the hospital over the previous 3 years. The second intervention was a new securing device to limit movement of the indwelling catheter after insertion. The third intervention consisted of repositioning the catheter tubing if it was found to be touching the floor. A two-month run-in period began when the first intervention was started in January 2009, and ended when the routine use of the second and third interventions was introduced the following month. The fourth intervention, which was implemented in October 2009, was the removal of indwelling urinary catheters on postoperative day 1 or 2, for most surgical patients.
RESULTS: For the 3 month baseline (October 1-December 31, 2008) before the run-in period, the mean rate of CAUTI per 1000 catheter days was 5.2, and that for January 1-February 28, 2009 was 6.5. For the

7 months after full implementation of the first three interventions (March 1 - September 30, 2009), the mean rate of CAUTI per 1000 catheter days was 3.1, which was a nonsignificant reduction compared to January 1-February 28, 2009 (p=0.09). For the seven months after the implementation of the fourth intervention (October 1, 2009 - April 30, 2010), the mean rate of CAUTI per 1000 catheter days decreased
further to 1.5, which was significantly lower than the rate for January 1-February 28, 2009 (p=0.009).

CONCLUSION: A bundle of four evidence-based interventions reduced the incidence of CAUTIs by two-thirds in a community hospital. These relatively simple interventions should be easily sustainable and could be readily transferable to other hospitals.

Table 1:

Incidence Rate of CAUTIs per 1000 catheter days from October 2008 to April 2010

Time interval	Oct-Dec 2008	Jan-Feb 2009	Mar-Sep 2009	Oct 2009-Apr 2010
CAUTI rate (per1000 catheter days)	5.2	6.5	3.1	1.5

UTILITY OF SELF-REPORT AND ELECTROCARDIOGRAM Q-WAVES FOR ESTIMATING MYOCARDIAL INFARCTION PREVALENCE: AN INTERNATIONAL COMPARISON STUDY Daniel Turner-Lloveras 1; Aayla Khan 2; Walter Palmas 3; Dirk DeBacquer 2; Andrew Moran1.
1CUMC, New York, New York; 2CUMC, New York, New York; 3CUMC, New York, New York. (Tracking ID # 10088)

BACKGROUND: Self-report of physician diagnosis and electrocardiogram (ECG)-Q waves are common survey measures of prior myocardial infarction (MI) prevalence but each has limited accuracy. Both represent low-cost methods for assessing ischemic heart disease burden, especially in low resource settings. The objective of this study is to assess relative prevalence of self-reported prior MI and ECG Q-waves (ECG-MI) in populations and population sub-groups with varying MI incidence.

METHODS: Prior MI self-report and ECG-MI (Minnesota ECG codes 1.1 and1.2) were analyzed in men and women age 4574 years in two large population-based samples: pooled Belgian surveys (19781998, N=29,419) and U.S. National Health and Nutrition Examination Surveys (19761994, N=11,107). Self-reported MI and ECG-MI were also compared in men and women aged 4059 years among U.S. and Belgian surveys and in selected eligible studies representing seven other nations (United Kingdom, Russia, Lithuania, Belarus, India, Turkey and Ghana).

RESULTS: Self-reported prior MI prevalence was 1.5-2.6 times higher than ECG-MI in Belgian and U.S. men aged 4574 years and women 5574 years. Self-reported MI was less prevalent than ECG-MI in women lower than ECG-MI in U.S. African American men aged 45 74 years (1.2 compared with1.7 in Whites). In the nine nation comparison, there was no consistent relationship between self-reported MI and ECG-MI (Figure). ECG-MI was generally highest relative to self-report in lower ischemic heart disease incidence nations.

CONCLUSION: Self-reported MI and ECG-MI prevalence may only be reliable in higher ischemic heart disease incidence groups. Limited accuracy of self-report and ECG-MI should lead to a search for better MI prevalence measures. In assessing the burden of ischemic heart disease, current survey prevalence measures cannot substitute for population incidence and mortality surveillance.

MULTI-SESSION SELF-CARE TRAINING IMPROVES KNOWLEDGE, SELF-EFFICACY AND SELF-CARE BEHAVIORS FOR LOW AND HIGH-LITERACY PATIENTS WITH HEART FAILURE George Mark Holmes 1; Darren Andrew DeWalt 2; David Baker 3; Dean Schillinger 4; Victoria Hawk 2; Bernice Ruo 5; Kirsten Bibbins-Domingo 4; Morris Weinberger 2; Aurelia Macabasco-OConnell 6; Kathleen Grady 6; Kimberly Broucksou 2; Brian Erman 2; Michael Pignone2. 1University of North Carolina, Chapel Hill, North Carolina ; 2UNC, Chapel Hill, North Carolina ; 3Northwestern University, Chicago, Illinois ; 4UCSF, San Francisco, California ; 5Northwestern University, Evanston, Illinois ; UCLA, Los Angeles, California . (Tracking ID # 10092)

BACKGROUND: Heart failure (HF) self-care training reduces heart failure-related hospitalizations but the optimal amount of support is not clear. We conducted a multi-site randomized trial comparing a single session only (SS-only) vs. a teach to goal (TTG) multisession educational and self-care support program for improving

key knowledge and skills for effective heart failure self-management.
METHODS: We randomized ambulatory patients with symptomatic HF from 4 academic medical centers to: 1) a single face-to-face one hour educational session with a focused self-care curriculum (SS-only) or 2) TTG: the same single session plus 58 telephone education sessions over the next month and continued calls every 2 to 4 weeks for 12 months that taught to knowledge and behavioral goals. Educational sessions were designed to overcome literacy-related barriers to effective self-care. We stratified randomization by literacy status (adequate or inadequate/marginal). Outcomes were assessed at baseline (pre-randomization) and 1, 6, and 12 months, for measures of three key domains: disease-specific knowledge, self-efficacy, and self-care. Generalized estimating equations (accounting for within-individual correlation across the different collection periods) were used to estimate the difference in changes due to the intervention.
RESULTS: 605 participants were randomized: 302 to the SS-only group and 303 to the TTG group. The mean age was 61 years; 48% were female; 38% African-American and 16% Latino; 26% had less than a high school education; 69% had ejection fraction less than 0.45; 31% were NYHA class III or IV; 37% had low literacy. Response rates were approximately 88%, 90% and 83% in the 1, 6, and 12-month follow-up surveys respectively and did not differ between 2 study arms. Members

of the SS-only group experienced improvements in all three measures between baseline and the 1-month follow up. The TTG group improved all three measures 60% to 136% more than the SS-only group at 1 month (all p-values less than 0.05), and these differences were preserved at 6 and 12 months (Figure). Although those with low literacy had lower scores for all four measures at baseline, the improvements were similar for both low and high literacy groups.
CONCLUSION: A literacy-sensitive, multi-session teach to goal self-care training intervention appeared to improve the knowledge and skills considered necessary for effective self-management of heart failure more than a single educational session, and did so similarly for low and high literacy groups.
DRUG-RELATED RISK FACTORS FOR DEATH AFTER RELEASE FROM PRISON: A NESTED CASE CONTROL STUDY Ingrid A Binswanger 1; Patrick J Blatchford 1; Traci E Yamashita 1; Marc F Stern2. 1University of Colorado Denver, Aurora, Colorado; 2University of Washington, Tumwater, Washington.
(Tracking ID # 10117)
BACKGROUND: International studies have shown former prisoners to be at high risk for death after release from prison, particularly from drug-related causes such as overdose. Despite this, little is known about whether substance use-related factors, identified in prison, are associated with death after release from prison. Thus, the objective of this study was to examine the substance use-related risk factors for all-cause and overdose death after release from prison.
METHODS: We conducted a case control study nested within a retrospective cohort study of inmates released from the Washington Department of Corrections from 19992003. Cases (n=443) were individuals who died after release from prison, based on matching with the National Death Index. Controls (n=443) were selected using risk set sampling (i.e. at risk at the time the case died relative to release), and matched to cases by age and gender. Correctional medical, pharmacy, and substance abuse records were abstracted using a structured data abstraction tool. We compared cases and controls in the following factors, as recorded in prison charts prior to the release: lifetime substance dependence based on DSM-IV criteria, history of injection drug use, narcotic prescriptions received in the 60 days prior to release, and known HIV or AIDS. Data were analyzed using conditional logistic regression. Analyses were adjusted for race/ethnicity and length of incarceration (factors previously shown to be associated with mortality), and having children and marital status (measures of social support). A separate model examined overdose cases (n=103) compared with controls (n=103) with the same

covariates.
RESULTS: Together, cases and controls were predominantly male (88%) and had an average age of 41 years. Substance dependence was recorded in 53%, injection drug use in 41%, narcotic prescriptions in 5%, and HIV/AIDS in 1%. Injection drug use (odds ratio [OR] 1.84, 95% confidence interval [95% CI] 1.34, 2.52) and HIV/AIDS (OR 10.02, 95% CI 1.24, 81.01) were associated with increased odds of all-cause mortality. Substance dependence (OR 0.90, 95% CI 0.67, 1.22) and narcotic prescriptions (OR1.13, 95% CI 0.59, 2.17) were not associated in the adjusted model. Having children was protective (OR 0.70, 95% CI 0.51, 0.95) but marital status was not associated. The only substance use-related factor associated with overdose mortality was injection drug use (OR 7.28, 95% CI 2.84, 18.68). CONCLUSION: Injection drug use history was an independent risk factor for all cause and overdose mortality after release from prison and HIV/AIDS was a risk factor for all-cause mortality. We were surprised that substance dependence was not independently associated with either outcome. Substance dependence, as ascertained by correctional staff, may
be insufficiently sensitive to identify high-risk groups of inmates given its high prevalence in this population. The lack of association of pre-release narcotic prescriptions with mortality may provide some reassurance to correctional physicians who treat pain. Further work to identify risk factors for death which can be easily ascertained in prison and more narrowly define the population at risk is necessary, but, in the meantime, injection drug users may be considered a target group for interventions to reduce mortality after release from prison.

FOOD INSECURITY AND GLYCEMIC CONTROL AMONG PATIENTS WITH DIABETES Hilary Seligman 1; Elizabeth Jacobs 2; Nancy Jianhua Jin 1; Andrea Lopez 1; Alicia Fernandez1. 1University of California San Francisco, San Francisco, California; 2Rush, Chicago, Illinois. (Tracking ID # 10128)

BACKGROUND: Food insecurity refers to the inability to reliably afford safe and nutritious food. Almost 15% of households in the US are food insecure. In addition to reductions in the quantity of food consumed, food insecurity is also associated with a reduction in the quality of food consumed, with a shift in intake toward inexpensive, calorically-dense foods (added fats/sugars, refined carbohydrates) which raise blood glucose. We hypothesized that food insecurity would therefore be associated with poor glycemic control among adults with diabetes. METHODS: We examined the association between food insecurity and glycemic control in a cross-sectional, observational study of 711 English-and Spanish-speaking patients with type 2 diabetes. All patients were receiving ongoing care in safety-net health clinics in San Francisco or Chicago. Participants were enrolled and completed questionnaires between June 2008 and July 2009. We assessed food insecurity using the short form of the Food Security Survey Module. Our main outcome measure was poor glycemic control, which we defined a priori as HbA1c greater than or equal to 8.5%. We compared baseline characteristics using chi-square tests and used generalized regression models to determine whether an association existed between food insecurity and glycemic control. We subsequently determined whether difficulty following a diabetic diet, diabetes-specific self-efficacy, or diabetes distress mediated observed associations. RESULTS: The prevalence of food insecurity in our sample was 46%. Food insecure participants were younger than food secure participants (53 vs 56 years, pCONCLUSION: Food insecurity is a strong predictor of glycemic control and thus may contribute to inequities in diabetes-related complications. Translation of diabetes interventions into low-income settings should specifically address participants limited financial ability to afford diabetes-appropriate foods.

THE USE OF LOWER QUALITY ENDPOINTS AND OF RELATIVE (VERSUS ABSOLUTE) RISK REPORTING IN PUBLISHED RANDOMIZED TRIALS Michael Hochman 1; Danny McCormick2. 1UCLA, Santa Monica, California; 2Cambridge Health Alliance, Cambridge, Massachusetts. (Tracking ID # 10131)

BACKGROUND: Because of their potential to generate erroneous conclusions and distort study findings, concerns have been raised about the use of surrogate endpoints, composite endpoints, multiple primary endpoints, disease-specific mortality as an endpoint, and relative (rather than absolute) risk reporting in clinical

studies. METHODS: We analyzed of all randomized medication trials published in the six highest impact general medicine journals between June 1,

2008 and September 30, 2010 to determine the prevalence of the use of surrogate endpoints, composite endpoints, multiple primary endpoints, disease-specific mortality as an endpoint, and of relative risk reporting. In addition, we examined whether a trials funding source and outcome(i.e. positive vs. negative results) is associated with the use of these endpoints or with relative risk reporting.
RESULTS: We identified 316 medication trials, of which 116 (37%, 95% CI, 31%-42%) used a surrogate primary endpoint, 106 (34%, 95% CI, 28%-39%) used a composite primary endpoint, and 48 (15%, 95% CI, 11%-20%) used multiple primary endpoints. Among 118 trials in which the primary endpoint involved mortality, 32 (27%, 95% CI, 19%-36%) used disease-specific mortality rather than all-cause mortality. Among 157 trials with positive results, 69 (44%, 95% CI, 36%-52%) reported these results in the abstract exclusively in relative terms. Trials using surrogate endpoints and disease-specific mortality as an endpoint were more likely to be commercially funded compared to those not using these endpoints. In addition, trials using surrogate endpoints were more likely to report positive results while those using mortality endpoints were less likely to be positive.
CONCLUSION: Trials published in high impact medical journals frequently use surrogate endpoints, composite endpoints, multiple primary endpoints, and disease-specific mortality as an endpoint, and frequently report results exclusively using relative numbers.
PERSISTENCE WITH ADJUVANT HORMONAL THERAPY IN OLDER BREAST CANCER SURVIVORS Tyler Hedin 1; Changbin Guo 1; Ann Nattinger1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10132)
BACKGROUND: Breast cancer survivors with hormone receptor positive disease are typically prescribed tamoxifen or an aromatase inhibitor (AI) as adjuvant hormonal therapy for a 5-year course to reduce the likelihood of recurrence. Despite its benefit in breast cancer patients, prior studies on tamoxifen have found sub-optimal rates of adherence to the prescribed 5-year course. Less is known about adherence rates in patients using an AI. This study aims to identify the extent of non-persistence to adjuvant hormonal therapy among older breast cancer survivors as well as examine self-reported reasons for non-persistence.
METHODS: We recruited 3083 Medicare breast cancer patients who underwent initial surgery in 2003 and resided in California, Florida, New York, or Illinois. Four survey waves between 2005 and 2008 assessed receipt of hormonal therapy (HT) as well as demographic, social, and treatment factors. Stage 1 or 2 subjects who initiated HT within 1 year of surgery (n=1402) were included. In accordance with the International Society for Pharmacoeconomics and Outcomes Research Medication Compliance and Persistence Work Group, patients were defined as persistent if HT was utilized for at least 5 years from the initiation of therapy without a gap in treatment of more than 60 days. A multinomial model was constructed to determine which demographic factors were associated with which self-reported reasons for non-persistence. RESULTS: Of the 1402 breast cancer survivors studied, 325 (23%) discontinued their HT within 5 years of their surgery. Reasons for nonpersistence were provided by 280 (86%) of those discontinuing therapy early. The most common reason for non-persistence was side effects (47% of subjects), followed by belief they had finished therapy (17%), physician-directed discontinuation (15%), and cost (8%). Thirteen percent had other reasons for discontinuation and were excluded from the multinomial analysis. Factors associated with reasons for nonpersistence were age (p=0.025), marital status (p=0.015), household income (p=0.045), and supplemental insurance in addition to Medicare (p=0.047). The multivariate model concurrently controlled for each of
these factors, enabling comparisons to those discontinuing due to side effects. Older subjects (>75 years) were more likely to discontinue treatment due to physician direction (p=0.01) or completion of treatment (p=0.04) than due to side effects. Married subjects were less likely to discontinue due to cost (p=0.05) than due to side effects. Higher income subjects were less likely to discontinue due to cost or completion of treatment (p=0.04)

than due to side effects. Subjects with no supplemental insurance were more likely to discontinue due to cost (p=0.06) than due to side effects. Race, marital status, education, stage of disease, co-morbidities, and type of surgery were not significantly associated with specific reasons for non-persistence.
CONCLUSION: This study confirms that a substantial minority of patients are failing to remain on adjuvant HT for the standard duration of 5 years. Most women discontinued due to perceived side effects. Cost was a particular issue for those who were older, unmarried, poorer, and with poorer insurance coverage. Some women believed they had completed treatment prior to 5 total years of therapy. Identifying the predictors and reasons for early discontinuation of treatment is essential to formulating intervention strategies to improve persistence.
PAGE ME IF YOU NEED ME - DYSFLUENCY ON ROUNDS (THE WRONG MESSAGE) Lawrence Loo 1; Nishant Puri 1; Douglas Hegstad 1; Anas Kawayeh 1; Daniel Kim1. 1Loma Linda University School of Medicine, Loma Linda, California. (Tracking ID # 10138)
BACKGROUND: Effective July 1, 2011, the Accreditation Council for Graduate Medical Educations (ACGME) new common program requirements call for enhanced supervision and communication to ensure patient safety while maintaining a humanistic training environment. The Institute of Medicines (IOM) report on Resident Duty Hours stresses that resident supervision is key to achieving these goals. Discrepancies exist between what residents and attending physician perceive as adequate supervision. Part of this discrepancy is attributable to the differences among attending physicians and the mixed messages sent to residents that result in dysfluency on rounds and the establishment of an organizational hidden curriculum. We sought to illuminate these differences among attending physicians and characterize the variety of messages sent to resident physicians in order to assess their impact on resident supervision and communication. METHODS: To document the current practices in a University based categorical Internal Medicine (IM) residency, 79/88 categorical IM residents (90% response rate) and 35/82 (43 %response rate) attending physicians were surveyed about their current attitudes and routine behaviors regarding resident supervision. Using an audience-response system for immediate feedback and discussion, resident and attending physicians were polled separately and asked to respond to three different measures of resident supervision including: (1) six commonly encountered clinical care situations that involved patient safety issues; (2)nine frequently used phrases by attending physicians before leaving the hospital on call days; and (3) six sets of different personality types of attending physicians encountered in the training program. Results comparing and contrasting the differences and similarities were presented at a departmental academic affairs meeting to facilitate discussion and highlight discrepancies as preparatory background in developing a uniform residency policy to meet the ACGMEs call for enhanced supervision. RESULTS: Clear differences in the perception of resident supervision were found between resident physicians and attending physicians in commonly encountered clinical care situations that involved patient safety. For example, notification of the attending physician of an unexpected pneumothorax requiring chest tube placement was desired by 85% of the attendings but only 31% of residents said they would call

their attending (see Figure 1). Common phrases such as page me if you need me resulted in 50% of residents rarely or never calling their attending physicians, 41% sometimes calling and only 9% of residents responding to mostly or always calling their attending physician. Any reference made by the attending physician to having other activities to do while on call (e.g. dinner engagement) or when they slept, only lessened the frequency of calls by the residents. While personality types of the attending physicians (e.g. friendly versus strict and intimidating) affected communication frequency, the phrase I want to be called on all patients you admit or have a change in status significantly changed the behavior of the resident physician to call their attending. (see Figure 2) CONCLUSION: Our results confirm prior studies that attending physicians generally would like more

communication and closer supervision than routinely perceived by resident physicians. Significant discrepancies exist among attending physicians regarding the need for communication and frequency of resident supervision. The accompanying mixed messages create an organizational hidden curriculum that creates dysfluency on call days and confusion among residents. These differences must be brought to light, acknowledged, and vetted before developing a uniform departmental approach to meet the ACGMEs enhanced supervision policy to ensure patient safety while maintaining quality resident education. Our simple and easy to use tool highlights these differences and serves as a basis for this initial and fundamental discussion to occur. Clear and unambiguous phrases such as I want to be called on every patient admission should be included in departmental policies designed to ensure patient safety and consistent resident supervision.

A MULTISITE RANDOMIZED TRIAL OF A SINGLE- VERSUS MULTI-SESSION LITERACY SENSITIVE SELF-CARE INTERVENTION FOR PATIENTS WITH HEART FAILURE. Darren A DeWalt 1; David W Baker 2; Dean Schillinger 3; Victoria Hawk 1; Bernice Ruo 2; Kirsten Bibbins-Domingo 3; Morris Weinberger 1; Aurelia Macabasco-OConnell 4; Kimberly Broucksou 1; George Mark Holmes 1; Kathleen L Grady 5; Brian Erman 1; Michael Pignone1. 1University of North Carolina, Chapel Hill, North Carolina ; 2Northwestern University, Chicago, North Carolina ; 3University of California, San Francisco, San Francisco, North Carolina ; 4University of California, Los Angeles, Los Angeles, California ; 5Northwestern University, Chicago, Illinois . (Tracking ID # 10142)

BACKGROUND: Heart failure (HF) self-care training reduces HF-related hospitalizations and appears to do so more for patients with low literacy. However, the optimal components and structure of the training are not clear. We conducted a multisite randomized trial comparing a literacy sensitive single educational session only (SS-only) with a multi-session teach to goal (TTG) educational and self-care support program, and tested whether the effects differed by literacy.

METHODS: We randomized ambulatory patients from 4 academic medical centers who had symptomatic HF (NYHA class II-IV) to: 1) a single session, face-to-face one hour educational session with a health educator and a focused curriculum of key self-care information alone (SS-only); or 2) the same single session plus a multi-session phone-based support (58 sessions over the next month and continued calls every 2 to 4 weeks for 12 months) that reinforced learning goals and behaviors (TTG). The education tools and strategy were designed to reduce literacy-related barriers to self-care. We stratified randomization by literacy using the short Test of Functional Health Literacy in Adults with inadequate and marginal defined as low literacy. The primary outcome was combined all-cause hospitalization or death. The secondary outcome was HF-related hospitalization determined by blinded adjudication of medical records. We used negative binominal regression to examine the differences between groups. We adjusted for differences in baseline HF quality-of-life, social status, and use of ACE/ARB, and tested for effect modification by literacy. We present incidence rate ratios (IRR) for all patients and stratified by literacy with IRRs less than 1 favoring TTG.

RESULTS: 605 participants were randomized: 302 SS-only and 303 TTG. Mean age was 61 years; 48% were female; 38% African-American and 16% Latino; 26% had less than a high school education; 69% had ejection fraction less than 0.45; 31% were NYHA class III or IV; and 37% had low literacy. Overall the number of all-cause hospitalizations and deaths and HF-related hospitalizations did not differ between the two groups (SS-only=224 hospitalizations and 16 deaths, with 87 HF-related; TTG=244 hospitalizations and 11 deaths, with 83 HF-related) (Table). However, low literacy was a statistically significant effect modifier for HF-related hospitalization (p=0.014), with fewer HF-related hospitalizations observed among those in the TTG group; effect modification by literacy was more modest for the combined incidence of all-cause hospitalization or death (p=0.131).

CONCLUSION: Overall, the multi-session TTG intervention and the SS-only intervention had similar effects on the incidence of all-cause hospitalization and death. However, TTG appeared to be more effective than SS-only in reducing the incidence of HF-related hospitalization for patients with low literacy, but not for those with higher

literacy. A single training session may be sufficient for those with higher literacy, but more sustained and intensive support may be required to reduce HF hospitalizations for patients with low literacy.

INFORMATION NEEDS AND SIGN-OUT UTILIZATION HABITS OF CROSS COVERING PHYSICIANS.

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BACKGROUND: Patients who are cared for by covering physicians have higher adverse event rates and increased delays to treatment. These adverse events can be the result of inaccurate or inadequate sign-out. However, the actual data needs of covering physicians, and where they obtain these data, are currently unknown.

METHODS: During a four-week period from July 7 to August 3, 2010, interns on general medical services were asked to prospectively record data about their cross cover experience during a traditional 30 hour on-call shift. Each intern was provided with a pocket card and asked to record data directly on the card, which was collected the next day. Each time the intern was contacted regarding a patient received during sign-out (one call), the intern was asked to record who initiated the contact(i.e., nursing, patient), what the situation was about (i.e. medications, test results), where the intern found the desired information (i.e. written sign-out, Electronic Medical Record[EMR]), whether all required data was located, whether the call was anticipated by the primary team, whether the call could have been anticipated by the primary team, and if the received sign-out was sufficient. Each intern was eligible to participate once during the study period.

RESULTS: A total of 14/24 (58%) of eligible interns completed data collection, with 123 unique calls recorded. Interns were able to find all desired information for 91% of calls. Information was found most often in the written sign-out (44%), followed by the EMR (24%), and verbal sign-out (21%). Questions regarding orders (25%) were most common, followed by medications (20%), plan of care (17%), and test results (11%). Interns sought information in different places depending on the questions they were asked. Interns were more likely to use the written sign-out rather than the EMR when asked about medications or test results, and were equally likely to use the written sign-out or the EMR for questions regarding orders and plan of care (P=0.01). Nursing staff were responsible for 89% of calls. Interns judged 66% of all events as possible to anticipate, yet only 40% of all events were anticipated by the primary team. Calls regarding plan of care and medications were most likely to be anticipated, whereas events regarding test results were least likely to have been anticipated (p=0.009).

CONCLUSION: Even with widespread EMR usage, covering physicians remain most likely to reference information received during physician-to-physician sign-out. With 2/3 of cross cover calls being predictable, accurate sign-out remains vital to safe patient handoff and should include an emphasis on expected overnight events.

ASSOCIATION OF HIV STATUS AND NON-AIDS COMORBID DIAGNOSES IN A COHORT OF OLDER HIV-INFECTED AND AT-RISK MEN

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BACKGROUND: The prevalence of non-AIDS comorbid conditions in HIV-infected individuals is rising in the United States. To-date, prevalent non-AIDS conditions have been described in specific HIV-infected populations (U.S. Veterans, for example) and factors associated with incidence of several non-AIDS conditions (for example pulmonary disease, non-AIDS malignancies) have been identified. This study defines the prevalence and incidence of several non-AIDS conditions, including cardiometabolic comorbidities, in a unique urban cohort of older men, and compares factors associated with developing these conditions in subjects with well-controlled HIV, poorly-controlled HIV and those uninfected but at-risk for HIV.

METHODS: We analyzed prospective, standardized interview and laboratory data from The Cohort of HIV At-risk Aging Mens Prospective Study (CHAMPS), a study of HIV-infected and at-risk men, 49 years of age and

older, conducted from 20012006 in the Bronx, New York (n= 643). HIV status was defined as negative if participants reported never having a diagnosis of HIV at study entry, well-controlled if patients were HIV-positive with an undetectable HIV viral load at study entry, and poorly-controlled if patients were HIV-positive with a detectable HIV viral load at study entry. Study outcome diagnoses of hyperlipidemia, hypertension, chronic liver disease and diabetes were self-reported at baseline and 6-month follow-up interviews over the study duration. Baseline prevalence of these outcomes was calculated using cross-sectional frequency analysis. Kaplan-Meier analyses were performed to determine diagnosis incidence and unadjusted hazard ratios across all three HIV status groups. Cox proportional hazard regressions were performed to determine significant differences in and factors associated with the probability of developing outcome diagnoses, adjusting for baseline age, race and use of HAART.
RESULTS: Mean age of participants was 55 years (SD 5), 53% identified as Black, mean highest grade completed was 12th (SD 3), 78% had Medicaid. Fifty-six percent (n=360) were HIV-infected at study entry. Of these, 39% had well-controlled HIV. At baseline, participants with well-controlled HIV were more likely than poorly-controlled to have had an AIDS diagnosis (53% vs. 32%, p Baseline prevalence of non-AIDS diagnoses varied significantly across study groups only for hyperlipidemia: 28% of HIV-negative participants reported hyperlipidemia vs. 33% of well-controlled HIV-infected participants and 18% of poorly-controlled participants (p 0.015). Cumulative incidence rates of hyperlipidemia were 36%, 39% and 29% (HIV at-risk group, the well-controlled group and the poorly-controlled group respectively). Cumulative incidence rates of hypertension were 20%, 22% and 21%; of chronic liver disease: 20%, 21% and 26%; and of diabetes: 15%, 16% and 13%. At 1 year, the unadjusted probability of developing hyperlipidemia was 22% (95% CI 16%-29%), 29% (95% CI 19%-68%) and 25% (95% CI 17%-32%) in the HIV at-risk group, the well-controlled group and the poorly-controlled group respectively; of developing hypertension: 10% (95% CI 4%-11%), 10% (95% CI 3%-17%) and 10% (95% CI 4%-16%); of developing chronic liver disease: 17% (95% CI 11%-28%), 12% (95% CI 5%-19%) and 22% (95% CI 15%-29%); and of developing diabetes: 10% (95% CI 5%-14%), 8% (95% CI 3%-14%), 10% (95% CI 5%-14%).

There were no statistically significant differences in the probability of developing any non-AIDS comorbidity across study groups over total study follow-up. In Cox regression models, black race was associated with probability of developing a diabetes diagnosis (HR 2.9, 95% CI 1.2-7.3, p 0.024) and age was associated with incident diagnosis of chronic liver disease (HR 0.95, 95% CI 0.9-1.0, p 0.049).
CONCLUSION: Chronic non-AIDS comorbidites were common in the HIV-infected older men in this study. HIV status, control and baseline use of HAART were not associated significantly in this cohort with incidence of reported hyperlipidemia, hypertension, chronic liver disease or diabetes. These findings support generally recommended standard screening and interventions for non-AIDS conditions in patients with poorly-controlled as well as well-controlled HIV infection, and thus highlight the growing complexity of providing effective primary care for HIV-infected individuals. These results also suggest that additional work should explore the interplay of factors beyond medication effects that contribute to the development of non-AIDS conditions in HIV-infected adults.
POTENTIAL PREVENTABILITY OF ADVERSE DRUG EVENTS INVOLVING MULTIPLE DRUGS USING PUBLIC CLINICAL DECISION SUPPORT RULES Joshua Colin Feblowitz 1; Adam Wright 1; Shobha Phansalkar 2; David W Bates3. 1Brigham &Womens Hospital, Boston, Massachusetts ; 2Brigham and Womens Hospital and Harvard Medical School, Wellesley, Massachusetts ; 3Brigham &Womens, Boston, Massachusetts. (Tracking ID # 10188)
BACKGROUND: Medications represent a major source of potential harm to patients. Dosing errors, medication

interactions, allergies and supratherapeutic effects can all lead to adverse drug events (ADEs). Unfortunately, ADEs occur frequently, negatively affecting both the quality and efficiency of medical care. The burden of ADEs is substantial; they are associated with increased length of stay, increased costs and increased mortality. The goal of this study was to determine the frequency of potential and actual ADEs involving multiple drugs in the community hospital setting.
METHODS: In a prior multi-center, retrospective cohort study, records were reviewed for 1,200 randomly selected hospitalizations (200 per site). This sample was drawn from 109,641 hospitalizations (January 2005 through August 2006) at six 100300 bed community hospitals in Massachusetts without CPOE. Overall, 180 ADEs and 552 potential ADEs were identified. We re-analyzed these data to determine the frequency of potential and actual ADEs involving multiple drugs. We defined an ADE involving multiple drugs as an injury or adverse response resulting from the administration of a combination of two or more medications. Specific categories of ADEs analyzed include those resulting from drug-drug interactions (DDIs), therapeutic duplications (TDs), drug duplication (DDs) and combined nephrotoxicity (CN). One reviewer assessed the dataset to identify ADEs involving multiple drugs and another reviewer assessed the dataset for pADEs involving multiple drugs. The primary outcome measure of this study was the frequency and type of both actual and potential ADEs involving multiple drugs. RESULTS: During the study period there were 17 ADEs involving multiple drugs (1.4 per 100 admissions). We identified instances of therapeutic duplication, drug duplication, and drug-drug interaction, including two instances where both TD and DDI occurred. Seven multi-drug ADEs involved opioids, 5 involved benzodiazepines, and 5 involved cardiovascular drugs (Table 1). In addition, 146 potential ADEs (12.2 per 100 admissions) involving multiple drugs were identified (Table 1). In contrast with ADEs, most pADEs (85.6%) involved drug duplication. Notably, 110 out of 146 potential ADEs (75.3%) involved an excess dose
of acetaminophen and, of these, 105 (95.5%) involved the use of a combination drug containing acetaminophen with an opioid. The single most common pADE was a combination of acetaminophen and acetaminophen/oxycodone (n=51).
CONCLUSION: Multi-drug adverse events represent a notable proportion of all ADEs and pADEs and a significant threat to patient safety. Actual multi-drug adverse events most commonly involved interactions between different drugs (especially opioids, benzodiazepines and cardiac medications). In contrast, the vast majority of pADEs were related to drug duplication. In addition, a very high proportion of multi-drug pADEs were associated with acetaminophen, especially acetaminophen-containing opioids. More robust measures for detection and prevention, such as computerized provider order entry (CPOE) with medication decision support are needed to identify such errors before they can result in ADEs.
Table: 1
Category ADEs PADEs Drug-drug interaction 11 17 Therapeutic duplication 7 3Drug duplication 1 125 Combined nephrotoxicity 0 2 Total 19 147 Unique Events 17 146
CONTINUITY OF CARE: ASSURING POST-DISCHARGE WARFARIN MONITORING Denice Arthur 1; Chepkorir Maritim 1; Brent Petty2. 1The Johns Hopkins Hospital, Baltimore, Maryland; 2Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 10190)
BACKGROUND: Warfarin is among the drugs most frequently associated with adverse effects. The interface between inpatient status and discharge to home is a transition point where coordination of follow-up for patients discharged on warfarin is essential. Successful coordination of this transition is also relevant to the emphasis on improved anticoagulation care as a national patient safety goal. Errors at this transition of care can have catastrophic results.
METHODS: We reviewed the records of all adult patients discharged our hospital over a 6-week period with warfarin listed as a discharge medication. At eight days or more after discharge, we searched the hospitals laboratory test database to see if the patient had been back to a hospital clinic where prothrombin time/INR

testing had been conducted. When such test results were not found, we contacted the patients follow-up provider (using a telephone script for systematically collecting data) to determine if the patient had been tested for prothrombin time/INR within seven days following discharge and if the result was available.
RESULTS: A total of 323 patients were reportedly discharged on warfarin. Of these, 72 were excluded (22 who were discharged to rehab, long-term care or prison, 19 whose providers offices did not return our calls, 13 who were not actually discharged on warfarin, 10 who had died, 5 whose follow-up provider was not adequately identified in the record, and 3 international patients who had returned to their foreign countries). Of the remaining 251 patients, 147 (59%) had a documented INR result within seven days of discharge. Of the 104 patients who did not have an INR within seven days of discharge, 39 (38%) failed to make a follow-up appointment and 18 (17%) failed to keep their appointment for follow-up testing. Therefore, 55% of failures were related to patient-

controlled factors. For 43% of the failures, either the clinic visit occurred without an INR being checked or it occurred more than seven days after discharge. An unintended benefit of the telephone contact was improved relationships with post-discharge providers, as we found that some providers were not already aware of the patients hospitalization and the need for timely follow-up.
CONCLUSION: Our data demonstrate a need for improved transition of care for patients discharged on warfarin. Implementing changes in practice to achieve this goal will decrease the risk of adverse events associated with warfarin therapy, whether they be related to subtherapeutic or supratherapeutic results. In particular, interventions to increase the awareness in patients of the existence and importance of arranged follow-up testing appear most likely to improve performance in this area.
BARRIERS TO BREAST CARE FOR UNDERSERVED WOMEN Pamela Ganschow 1; Joann Elmore 2; Arthur Evans 3; Monica Peek1. 1Rush University Medical Center/Stroger Hospital, Chicago, Illinois ; 2University of Washington, Seattle, Washington ; 3Weil Medical Center, New York, New York . (Tracking ID # 10196)
BACKGROUND: Underserved women are at increased risk for diagnostic delays during evaluation of breast abnormalities. Patients perceptions of reasons for these delays are poorly understood. The objective of this study was to identify patients perceptions of evaluation time and barriers to care, and to examine the association between identified barriers and delay time, among women with suspicious breast findings who use a safety-net health care system.
METHODS: We conducted a prospective study of 270 predominantly English- and Spanish-speaking women (minimum age 30 years) undergoing non-operative breast biopsy between 2006 and 2009 at a large public hospital. The hospital receives referrals from over 210 affiliated primary care clinics serving uninsured and under-insured patients. At the time of biopsy or before disclosure of results, in-person interviews were conducted to gather information on demographics, socioeconomic status, clinical history, self-reported personal and system reasons for delays in care, and patients perceptions of their evaluation time. Time to biopsy was defined as the time from initial detection of the breast abnormality to initial biopsy and evaluation time was defined as the time from first contact with the health care system to the date of initial biopsy. The clinical history including date and mode of detection (e.g., self- or image-detected) and all healthcare visits for the breast problem were verified through medical record abstraction. We used a CDC recommended 60-day benchmark for defining appropriate evaluation time. Univariate and multivariate analyses with backwards elimination were performed using quantile regression to examine differences in median time to initial biopsy by patient characteristics, mode of detection, and personal and system reasons for not seeking evaluation sooner.
RESULTS: The mean age was 51 years; 49% were Black, 36% were Hispanic, 74% were uninsured, and 39% reported no access to a regular provider. Among the 270 women, 47% had self-detected breast abnormalities and 53% had abnormalities detected by imaging. Median time to biopsy was 120 days (IQR: 62202) and median evaluation time was 92 days (IQR: 42174). These median times did not differ significantly by mode of

detection. For 64% of women, evaluation was delayed by >60 days and over 50% of these women did not perceive this as too long. The most common personal reasons for delays were fear of having breast cancer (46%), fear of evaluation or treatment (46%), financial concerns or lack of insurance (43%), and belief that the problem was not serious (37%). The most common system reasons
reported were difficulties obtaining a clinic appointment (40%) and having one or more appointments rescheduled by the doctor or clinic (36%). After controlling for covariates, only the system reason of having appointments rescheduled by the doctor or the clinic was associated with a statistically significant increase in the median time to initial biopsy of 54 days (95% CI: 3177 days; p<0.001). Having a family history of breast cancer was associated with a statistically significant decrease in the median time to biopsy of 36 days (95% CI: 12 60 days; p=0.004).
CONCLUSION: Significant diagnostic delay times persist among underserved women with breast abnormalities. While many barriers to care were reported by women, few were associated with a longer time to biopsy. Potential interventions to decrease delay times include alleviating system factors that lead health care facilities to reschedule patient appointments and increasing patient awareness of acceptable evaluation times for breast problems through messaging and education.
SERUM CALCIUM LEVELS ARE ASSOCIATED WITH NOVEL CARDIOMETABOLIC RISK FACTORS IN THE POPULATION-BASED COLAUS STUDY Idris Guessous 1; Olivier Bonny 2; Fred Paccaud 3; Vincent Mooser 4; Gerard Waeber 5; Peter Vollenweider 2; Murielle Bochud3. 1Unit of population epidemiology, Geneva, N/A ; 2Lausanne University Hospital, Lausanne, N/A ; 3University Institute of Social and Preventive Medicine, Lausanne, N/A ; 4GlaxoSmithKline, Philadelphia, Pennsylvania ; 5Lausanne University Hospitals, Lausanne, N/A . (Tracking ID # 10201)
BACKGROUND: Increased serum calcium concentration has been associated with high blood pressure, impaired glucose tolerance, and dyslipidemia. More recently, increased serum calcium concentration has been described as a feature of the metabolic syndrome. Cardio-metabolic components not classically included in the metabolic syndrome have been associated with the risk of cardiovascular disease and include components related to adiposity, blood lipids, and insulin resistance. In addition, factors related to inflammation and oxidative stress have been recently associated with the metabolic syndrome. For example, observations suggest that serum levels of uric acid, homo-cysteine or gamma-glutamyltransferase might be linked to the metabolic syndrome. While associations of serum calcium with the conventional components of the metabolic syndrome on one hand, and of non-conventional cardio-metabolic risk factors with the metabolic syndrome on the other hand have been explored, the relationship between serum calcium and non-conventional cardio-metabolic risk factors has not been characterized in the general population. We analyzed the association of albumin-corrected serum calcium with conventional and a broad range of non-conventional cardio-metabolic risk factors in the Swiss population-based CoLaus study. METHODS: The CoLaus study is a population-based study including Caucasians from Lausanne, Switzerland. The metabolic syndrome was defined using the Adult Treatment Panel III criteria. Cardio-metabolic components that are not included in the metabolic syndrome were defined as non-conventional cardio-metabolic risk factors and classified into the following four groups: (i)Adiposity: fat mass (kg), leptin (ng/mL);(ii)Blood lipids: LDL-cholesterol (mmol/L), LDL size (angstrm), apolipoprotein B (mg/dL); (iii)Insulin resistance: fasting insulin (microU/ mL), adiponectin (microg/mL); (iv)Inflammation-oxidative stress: ultra-sensitive CRP (mg/L), serum uric acid (micromol/L), homocysteine (micromol/L), gamma-glutamyltransferase (UI/L). For the non-conventional cardio-metabolic risk factors score, subjects in the upper tertile of the risk factor were assigned a value of 1, whereas subjects in the first and second tertiles were assigned a value of 0 for each non-conventional

cardio-metabolic risk factor positively correlated with cardiovascular disease, and vice versa for non-conventional cardio-metabolic risk factors negatively correlated with cardiovascular disease. Positive and negative correlations were based on the existing literature. Only non-conventional cardio-metabolic risk factors that showed a statistically significantly trend with calcium in quintiles analyses were entered into the non-conventional cardio-metabolic risk factors score. We used adjusted standardized multivariable regression to compare the association of each cardio-metabolic risk factor with albumin-corrected serum calcium. We assessed associations of albumin-corrected serum calcium with the cumulative number of non-conventional cardio-metabolic risk factors.
RESULTS: We analyzed 4,231 subjects aged 35 to 75 years. Albumin-corrected calcium levels increased linearly with the number of conventional cardio-metabolic risk factors (p for linear trend <0.001) (figure 1), independently of BMI. Respectively 465 (11.0%), 783 (18.5%), 837 (19.8%), 750 (17.7%), 592 (14.0%), 443 (10.5%), 249 (5.9%), and 112 (2.6%) had 0, 1, 2, 3, 4, 5, 6, or 7+ non-conventional cardio-metabolic risk factors. The mean number of non-conventional cardio-metabolic risk factors per subjects was 2.7 (SD=1.83). Albumin-corrected calcium levels increased linearly with the number of non-conventional cardio-metabolic risk factors (p for linear trend <0.001) (figure 2), independently of the metabolic syndrome and BMI. Among conventional and non-conventional cardio-metabolic risk factors, the strongest positive associations were found for factors related to oxidative stress (acid uric, homocysteine and gamma-glutamyltransferase). Adiponectin had the most important negative association with albumin-corrected serum calcium.
CONCLUSION: Serum calcium was associated with the metabolic syndrome and with non-conventional cardio-metabolic risk factors independently of the metabolic syndrome. Associations with acid uric, homocysteine and gamma-glutamyltransferase were the strongest. Although the associations with blood pressure, insulin resistance and dyslipidemia have been previously described, we are not aware that this was reported for serum uric acid, homocysteine, or gamma-glutamyltransferase levels in a large-scale population-based sample. These novel findings suggest that serum calcium levels may be associated with cardiovascular risk via oxidative stress.
ADVANCES IN MEASURING CULTURALLY COMPETENT CARE: A CONFIRMATORY FACTOR ANALYSIS OF THE CAHPS-CC IN A SAFETY-NET POPULATION Hilary Seligman 1; Rachel Judith Stern 2; Alicia Fernandez 1; Elizabeth Jacobs 3; Torsten Neilands 1; Robert Weech Maldonado 4; Adam Carle 5; Judy Quan1.
1University of California San Francisco, San Francisco, California ; 2UCSF School of Medicine, San Francisco, California ; 3Rush, Chicago, Illinois ;
4University of Alabama at Birmingham, Birmingham, Alabama ;
5Cincinnati Childrens Hospital Medical Center, Cincinnati, Ohio . (Tracking ID # 10205)
BACKGROUND: The Agency for Healthcare Research and Quality (AHRQ) developed the Consumer Assessment of Healthcare Providers and Systems (CAHPS) as a patient-administered assessment of healthcare quality in diverse settings. Health plans (public and private) are required to report CAHPS data to the federal government as a quality of care metric. While CAHPS has been extensively validated among insured patients, it is less clear how it performs with ethnically diverse, uninsured populations. Adding a culturally competent care domain makes CAHPS more relevant to diverse, uninsured, safety-net, and other vulnerable populations, and may inform the development of interventions to reduce healthcare inequalities. Therefore, the Consumer Assessment of Healthcare Providers and Systems Cultural Competency survey (CAHPS-CC) was developed as a supplement to CAHPS, with the intention that it would be broadly administered with the CAHPS survey. We examined CAHPS-CCs suitability for administration in a safety-net setting.
METHODS: We performed exploratory factor analyses and confirmatory factor analysis for ordered categorical measures of the CAHPS-CC to describe the measurement structure of the question set and identify subscales. Our sample included 600 patients with type 2 diabetes receiving primary care in safety-net clinics in Chicago and the San Francisco Bay Area. We used Cronbachs alpha to assess internal consistency and multinomial

logistic regression to assess the extent to which culturally competent care explained global physician ratings. RESULTS: A seven-factor model demonstrated satisfactory fit (RMSEA=0.43; CFI=0.96; TLI=0.96). Three domains showed excellent internal consistency positive provider communication (Cronbach alpha=.82),

trust (Cronbach alpha=.77), and health promotion (Cronbach alpha =.72). Three domains showed reliability below our a priori cut point equitable treatment (Cronbach alpha=.69), alternative medicine (Cron-bach alpha=.52), and shared decision-making (Cronbach alpha=.51) but these were all 2-item scales (for which lower scores are expected). The negative provider communication and equitable treatment domains had adequate reliability among English speakers but poor reliability among Spanish speakers. CAHPS-CC domains accounted for 5.9% (alternative medicine) to 26.2% (positive communication behavior) of the variance in global physician ratings.
CONCLUSION: CAHPS-CC is suitable for broad-scale administration among patients, particularly English-speakers, receiving care in safety-net settings. The provision of culturally competent care is instrumental to patient satisfaction in this population, as demonstrated by the high impact of CAHPS-CC subdomains on global physician ratings. CAHPSCC may be used to target quality-improvement efforts focused on providing culturally competent care.
DEVELOPMENT AND VALIDATION OF THE SAFETY NET MEDICAL HOME SCALE Jonathan Birnberg 1; Melinda Drum 1; Elbert Huang 1; Lawrence Casalino 2; Sarah Elizabeth Lewis 1; Anusha Vable 3; Hui Tang 4; Quinn Michael 7; Deborah Burnet 1; William Summerfelt 5; Marshall Chin1.
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BACKGROUND: Existing tools to measure patient centered medical home (PCMH) adoption are not designed for longitudinal research evaluations in safety-net health centers. Therefore, we developed the Safety Net Medical Home Scale (SNMHS).
METHODS: The study sample included 65 safety net clinics in5 states (ID, CD, MA, OR, PA). To create our scale, we began with the Commonwealth Fund Organizational Survey of Federally Qualified Health Centers. Surveys were completed by clinic leadership with help from other clinic staff. The survey includes 92 items covering access to care, language services, quality improvement, and patient information systems. Using a consensus process, we mapped survey items onto the domains of the NCQA Physicians Practice Connections-PCMH TM
instrument and an External Coordination domain. Next, we identified core items representing greater importance to the PCMH concept. Core items were differentially weighted by rescaling these items to have potential range of 0 to 2, while all other items were rescaled with a potential range from 0 to1. Rescaled weighted items in the domain were summed, and the total was rescaled to have a potential range 0 to100 (worst to best). The total SNMHS score was the mean of the 6 domain scores. To test for reliability, we calculated Cronbachs alpha within each domain and for the total scale. We tested for convergent validity with two survey tools. The Assessment of Chronic Illness Care (ACIC) measures adoption of the Chronic Care Model. The Patient Centered Medical Home Assessment (PCMH-A) measures PCMH readiness. We correlated the total SNMHS score with the total ACIC and PCMH-A scores. RESULTS: Response rate was 100%. The conceptual mapping yielded 52 items (16 core items) organized into six domains: Access and Communication (12 items, 4 core), Patient Tracking and Registry (7 items, 3 core), Care Management (8 items, 2 core), Test and Referral Tracking (4 items, 2 core), Quality Improvement (10 items, 2 core), External Coordination (11 items, 3 core). The mean SNMHS score was
61SD 13. Among the subscales, External Coordination (6616) and Access and Communication (6514) had the highest mean scores, while Quality Improvement (5517) and Care Management (5516) had lower mean scores.

The SNMHS demonstrated high internal consistency reliability: Total Score (Cronbachs alpha=0.84), Access and Communication (alpha=0.68), Patient Tracking and Registry (alpha=0.89), Care Management (alpha=0.60), Test and Referral Tracking (alpha=0.73), Quality Improvement (alpha=0.73), External Coordination (alpha=0.78). Total SNMHS score correlated with the total ACIC score (R=0.64, p<0.001) and the total PCMH-A score (r=0.56, p<0.001). CONCLUSION: The Safety Net Medical Home Scale provides a comprehensive measurement of medical home adoption and demonstrated reliability and convergent validity.

MANAGEMENT OF UNCONTROLLED HYPERTENSION IN THE OUTPATIENT SETTING Salma Baksh 1; Ahmed Shawkat 1; Christian Glaser 1; Ahad Lodhi 1; Cleopatra Laicer 1; Alyson 1; Dina CapalongoDobracki2. 1Crozer Chester Medical Center, Upland, Pennsylvania; 2Crozer Chester Medical Center Crozer Chester Medical Center, Upland, Upland, Pennsylvania, Pennsylvania. (Tracking ID # 10220)

BACKGROUND: Hypertension is an important cause of morbidity and mortality. Approximately 65 million Americans are affected. It causes increased disease burden including stroke, myocardial infarction, heart failure and chronic kidney disease. The JNC guidelines recommend strict blood pressure control especially in patients with diabetes and chronic kidney disease. Although weight loss, exercise and diet modification is encouraged medical therapy is frequently required. Up to one fourth of American adults are on medications to treat hypertension.

METHODS: We retrospectively collected data from our office electronic medical records (EMR). We screened and included all patients seen between January 2008 and March 2010 with a diagnosis of hypertension and one uncontrolled blood pressure measurement (>140/90) during a single office visit. Patients with a normal blood pressure, newly diagnosed hypertension and patients in the EMR, not seen by our practice were excluded.

RESULTS: 207 charts were reviewed and 161 patients included. 59% were female and 41% were male. Mean BMI was 34.1. Out of 161 patients 69 (43%) had stage 2 hypertension. 25% (n=40) had diabetes, 9% (n=15) had chronic kidney disease and 7% (n=11) had congestive heart failure. 87% of diabetics, 80% of patients with chronic kidney disease and 82% of patients with congestive heart failure were on Angiotensin Converting Enzyme-Inhibitors or Angiotensin Receptor Blockers. 64% patients with congestive heart failure were on beta-blockers. Blood pressure was not re-checked by a physician in 54% of all patients and 33% of stage 2 hypertensives. Hypertension was not addressed in 19% of the total study group and in 12% of patients with stage 2 hypertension. Of the 81% of patients in whom hypertension was addressed, 24% were non compliant, 7% had life style modification recommendations, 40% had no intervention documented and only 17% had a follow up appointment within 2 months. On reviewing charts of patients with stage 2 hypertension (n=69), it was noted that 17 patients were inappropriately on 1 (n=15) or zero (n=2) medications for their blood pressure and 52 were on 2 or more antihypertensive medicines. CONCLUSION: We conclude that blood pressure is not re-checked at each visit by physicians. Stage 2 hypertensives were not identified, received in-adequate therapy and were not followed up appropriately. Appropriate anti-hypertensive medications were being used for the co-morbid conditions, but not all the time.

SUBSTANCE ABUSE TREATMENT OUTCOMES IN PATIENTS WITH OPIOID DEPENDENCE AND CHRONIC PAIN IN AN OFFICE BASED BUPRENORPHINE TREATMENT PROGRAM Aaron Fox1; Nancy L. Sohler 2; Angela Giovanniello 3; Chinazo Cunningham1. 1Division of General Internal Medicine, Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York ; 2Sophie Davis School of Biomedical Education, City University of New York, New York, New York ;
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BACKGROUND: Patients with substance use disorders report high levels of physical pain. However, current

data is conflicting as to whether chronic pain affects substance abuse treatment outcomes. Office based buprenorphine therapy is a new paradigm for treatment of opioid dependence, and the impact of co-morbid chronic pain on buprenorphine treatment outcomes is not well understood. Clinical guidelines cite chronic severe pain as a relative contraindication to buprenorphine treatment, since buprenorphine is a partial opioid agonist. Instead, treatment with methadone, a full opioid agonist, is recommended for patients with chronic severe pain. However, evidence supporting these recommendations is lacking. To examine the association between pain and buprenorphine treatment outcomes, we compared the proportion of treatment failures in opioid dependent patients with and without chronic pain who received primary care based buprenorphine treatment.
METHODS: We conducted a longitudinal cohort study of opioid-dependent individuals who initiated buprenorphine treatment at an urban community health center. Participants were interviewed at baseline, and 1, 3, and 6 months after initiating buprenorphine treatment. Questionnaires included demographic information, substance use, depressive symptoms, health status, and presence and severity of pain. The primary outcome was treatment failure, defined as self-reported use of opioids (heroin, methadone, or opioid analgesics) in the 30-day period preceding the 6 month follow-up visit. The main predictor variable was presence of chronic pain, defined as a score of 5 or greater on a scale from 110 on the Brief Pain Inventory at every study visit. We used logistic regression models to test whether treatment failure was associated with chronic pain, adjusting for baseline opioid use.
RESULTS: Of 84 participants, the median age was 44, and most were male (73%), Hispanic (69%), unstably housed (61%), and had used heroin in the 30 days prior to initiation of buprenorphine (67%). These characteristics were similar in the 31 (37%) participants with chronic pain and the 53 without chronic pain. The groups with and without chronic pain differed on a number of factors measured at baseline, including history of injection drug use (68% vs. 42%, p<.05), problematic alcohol use (50% vs. 15%, p<.01), sedative use (29% vs. 8%, p<.01), and opioid analgesics use (48% vs. 15% p<.01). Of these covariates, only sedative use was associated with treatment failure in bivariate analysis. At 6 months of follow-up, 25 participants (30%) experienced treatment failure. Adjusting for baseline opioid use, there was no difference in opioid use at 6 months between those with and without chronic pain (OR=1.05, 95% CI: 0.37 - 3.00). Further adjustment for other covariates associated with treatment failure, such as sedative use at baseline, did not alter this finding.
CONCLUSION: Over one-third of participants in this cohort of opioid dependent patients receiving buprenorphine treatment at an urban health center experienced chronic pain. Despite greater use of other substances at baseline and additional factors that may predict treatment failure, substance abuse treatment outcomes did not appear to differ between patients with chronic pain and those without chronic pain. Our study was limited by its lack of a comprehensive measure of pain severity, relatively small sample size, and limited power to detect small difference between groups. While these findings are exploratory, they suggest that buprenorphine treatment for opioid dependence may be effective even in patients with chronic pain. Future research that examines buprenorphine treatment outcomes among patients with chronic pain is warranted.
A METHOD AND KNOWLEDGE BASE FOR AUTOMATED INFERENCE OF PATIENT PROBLEMS FROM STRUCTURED DATA IN AN ELECTRONIC MEDICAL RECORD Adam Wright 1; Justine Pang 1; Joshua Colin Feblowitz 1; Francine Maloney 2; Allison Wilcox 4; Harley Ramelson 1; Louise Schneider 1; David Bates1. 1Brigham &Womens Hospital, Boston, Massachusetts; 2Partners HealthCare, Boston, Massachusetts.
(Tracking ID # 10232)
BACKGROUND: An accurate and up-to-date problem list represents the cornerstone of the modern electronic health record (EHR). Problem lists serve a wide variety of roles in facilitating care by providing a succinct clinical picture of each patient, facilitating communication, and enabling the delivery of clinical decision support (CDS). Yet, despite their importance, problem lists are often inaccurate, incomplete and poorly maintained. Given this fact, researchers have turned to a variety of alternate sources for problem information, using natural language

processing (NLP) techniques to interpret free-text patient information and data mining strategies to identify data predictive of patient problems. The primary goal of this study was to develop and validate methods of automatically inferring problems from clinical and billing data and to generate a knowledge base designed for this purpose. METHODS: We identified target conditions and designed and validated a set of rules for identifying patient problems based on medications, laboratory results, billing codes and vital signs. In designing these rules, we incorporated a previously-developed database of medication-problem and laboratory-problem associations created using data mining techniques. A preliminary list of problems was chosen on the basis of several criteria including: 1) pay-for-performance (P4P) initiatives at the study site, 2) problem-dependent CDS rules in the sites EHR and 3) relevant medication-problem and laboratory-problem associations identified during the previous project. A preliminary set of rules was then developed for testing with input from a physician panel. We then tested multiple versions of each rule on a training set of 100,000 patient records to assess their performance and calculated the specificity, sensitivity and positive and negative predictive values for each. Based on these results, the panel selected a set of final rules, which was validated on an independent sample of 100,000 records.
RESULTS: Seventeen rules were developed for inferring patient problems. Final rules used coded and free-text problem recognition as well as: billing codes, medications, laboratory data and/or vitals to infer patient problems. When applied to the training set, the average sensitivity and PPV for all seventeen rules was 86.4% and 91.1% respectively. Subsequent analysis using an independent validation set showed high sensitivity (average: 83.9%) and PPV (average: 91.7%) for

most rules. For each problem, we also assessed the accuracy of two simpler classes of rules: problem list-only and billing code-only rules. The results of this analysis showed that these rules were more sensitive than the problem list alone and had better PPV than billing codes alone. CONCLUSION: We developed and validated a set of rules that identifies patients likely to have a particular problem. These data show that problems can be accurately inferred, and that the performance of the
rules exceeds that of standard sources. These rules had high sensitivity and specificity and, in our population, also high PPV and NPV. Problem inference rules such as ours have a variety of potential applications, including: alerting clinicians to potential gaps in the problem list, identifying research cohorts, calculating quality measures, selecting patients for care management programs and designing clinical decision support.
TEMPORO-SPATIAL SURVEILLANCE OF INFLUENZA-LIKE-ILLNESS: PRELIMINARY RESULTS FROM THE IDAHO INFECTIOUS DISEASE REPORTING NETWORK Andy Wilper 1; William Weppner 2; Kai Elgethun 3; Denny Stevens2. 1University of Washington School of Medicine, Boise, Idaho ; 2Boise VAMC, Boise, Idaho ; 3Boise State University, Boise, Idaho . (Tracking ID # 10243)
BACKGROUND: Current influenza like illness (ILI) monitoring in Idaho is based on syndromic surveillance using laboratory data combined with periodic person-to-person reports collected by state workers. This system also relies on voluntary reporting from physicians, schools and other institutions. Electronic medical records (EMRs) offer a method of obtaining data in an automated fashion. The Veterans Administration EMR (CPRS) captures real-time visit information, vital signs, ICD-9, pharmacy and lab data. EMR surveillance has been utilized for syndromic surveillance on a regional level. Funds supporting expansion of EMRs offer increased ability for use in biosurveillance. The addition of temporo-spatial modeling may improve identification of clusters of cases. This abstract reviews our efforts to develop a real time system of
identifying ILI in Idaho using VA data and temporo-spatial techniques. METHODS: The Boise Veterans Affairs Medical Center (VAMC) provides care to over 20,000 veterans living in Idaho with clinics in Boise, Caldwell, Twin Falls, Salmon, ID and Burns, OR. Using retrospective data from the Veterans Integrated Service Network 20 (VISN 20) data warehouse for the 20082009 influenza season, we identified ILI cases from these clinics using ICD-9 codes collected as weekly counts. Duplicates and incompletes were removed; zip code was

extracted; clusters less than 5 per zip code were suppressed. We used SatScan v9.0.1 for cluster analysis with MonteCarlo simulation for an expected incidence based on distribution of sample overtime and space; geographic extent of cluster was not limited. We used ArcMap 10 for visualization based on US Census Map data. The VA Puget Sound IRB approved this study.
RESULTS: We identified one primary and one significant secondary cluster ($p<0.05$) of ILI (Figure 1). The relative risk was 7.8 for ILI in the primary cluster identified in southeast Idaho over a month-long period 7/17/09 to 8/20/09. The secondary cluster in west central Idaho occurred over a shorter two week period in January. These results were

shared with Idaho Public Health District directors, who confirmed the existence of an ILI cluster in southeast Idaho; the site of the primary
cluster. We sampled a small percent of the state population; women and children are underrepresented.
CONCLUSION: Retrospective data obtained from VA electronic health records appears to be useful in locating ILI outbreaks in space and time. Further work is needed to evaluate the ability of our system to identify outbreaks in real time, and to determine the extent to which our system may complement existing surveillance techniques. Temporo-spatial modeling may also have applications in monitoring the spatial distribution of the incidence and control of chronic diseases.
WHAT ACCOUNTS FOR THE GAP: THE CONTRIBUTION OF DIFFERENCES IN PATIENT PREFERENCE AND CLINICAL APPROPRIATENESS TO RACIAL DIFFERENCES IN PERFORMANCE ON AMBULATORY CARE QUALITY MEASURES Muriel Jean-Jacques 1;
Stephen Persell 1; Jason Thompson 1; Romana Hasnain-Wynia 1; David Baker1. 1Northwestern University, Chicago, Illinois. (Tracking ID # 10248)
BACKGROUND: The Institute of Medicine has defined healthcare disparities as racial or ethnic differences in healthcare that are not due to differences in clinical appropriateness or patient preferences. However, it is usually impossible to distinguish healthcare differences from true disparities in clinical practice because we lack sufficient data on clinical appropriateness and patient preferences. As part of the UPQUAL (Using Precision Performance Measurement to Conduct Focused Quality Improvement) initiative, simple tools were introduced into the electronic health record (EHR) at an urban academic general internal medicine practice to allow physicians to efficiently enter medical or patient reasons why quality measures are not satisfied (medical and patient exceptions)
into coded fields of the EHR. This provided a unique opportunity to examine the contribution of patient preference and clinical appropriateness to racial differences in the receipt of healthcare services.
METHODS: We examined differences in the percentage of black and white patients with documented medical or patient exceptions for 12 ambulatory care quality measures as of January 1, 2011. The quality measures addressed coronary heart disease, hypertension, diabetes, and the receipt of preventive services. Medical exceptions included medical contraindications to care guidelines (e.g. drug intolerance). Patient exceptions included patient refusals. We calculated performance for each quality measure with and without the incorporation of data on medical and patient exceptions. Comparisons between white and black patients were done using Pearsons chi-square test.
RESULTS: Among black patients, the rates of documented medical or patient exceptions ranged from 1.1% (screening or treatment for diabetic nephropathy) to 11.9% (pneumococcal vaccination if >or=65 years old). Among white patients, the range was 0.8% (screening for cervical cancer) to5.6% (LDL control in patients with diabetes). The percentage of patients who declined recommended care differed between black and white patients for 2 measures: cervical cancer screening (1% vs. 0.5%, respectively; p=.03) and pneumococcal

vaccination (11% vs. 3%; p<.001). The percentage of patients with documented medical exceptions differed between black and white patients for 2 measures: antiplatelet therapy for patients with coronary heart disease (4% vs. 2%; p=.03) and pneumococcal vaccination(0.7% vs. 0.1%; p=.003). Without the incorporation of data on clinical appropriateness and patient preference, performance for pneumococcal vaccination was significantly lower for black vs. white patients (82% vs.

91%, p<.001); when documented medical and patient reasons were included in the numerator, performance was identical (94%). The incorporation of medical and patient exceptions did not affect racial differences in performance for other measures.

CONCLUSION: Overall, the rates of patient and medical exceptions were low with few racial differences. This suggests that differences in patient preference and clinical appropriateness are relatively small contributors to racial differences in performance for most ambulatory care quality measures. However, blacks were much more likely to decline pneumococcal vaccination, and accounting for this significantly affected the measured racial difference in performance. A set of simple tools can facilitate the capture of data on clinical appropriateness and patient preference into coded fields of the EHR, and this approach may help us to better understand whether apparent differences in care are due to either of these factors.

RELATIONSHIPS BETWEEN SOCIAL RESOURCES AND HEALTHFUL BEHAVIORS: DOES AGE MATTER?

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BACKGROUND: The benefits of healthful eating and physical activity accrue to people of all ages. While greater access to social resources is associated with these behaviors, whether the associations differ by age is unknown.

METHODS: We analyzed data on 2440 participants, age 1893 years, using baseline survey data from Healthy Directions, an urban primary care-based multiple risk behavior intervention trial. We examined cross-sectional relationships between participants social resources and their self-reported total weekly physical activity and daily fruit and vegetable intake. We measured social resources using responses to 9 items (each on a 5-point Likert scale) from the Chronic Illness Resources Survey (CIRS), representing the surveys organizational, friends and family and neighborhood subscales. We measured physical activity using items from the CDCs Behavioral Risk Factor Surveillance Survey, and fruit and vegetable intake using the National Cancer Institutes 5 A Day for Better Health tool. We then used multivariable linear regression, adjusted for sex, race, education, income, BMI and self-reported health status, and evaluated associations overall and within 4 age groups: 1834, 3549, 5064 and 65+ years. RESULTS: Among the 2440 participants, 66% were female; 45% were non-white, and 60% had at least a college degree. Mean (SD) for age was49.4 (15) years, for physical activity was 346 (304) minutes/week, for daily fruit and vegetable intake was 3.4 (2.4) servings, and for CIRS score was 9.8 (5.7) on a 036 point scale. CIRS scores were slightly lower among older than younger adults (see Table, p=0.04). In multivariable analyses, CIRS score was directly associated with total physical activity(14.8 additional minutes of exercise/week per 1-point increment in CIRS score [95%CI 12.6-17.0]) and with fruit and vegetable intake (0.11 additional servings/day [95%CI 0.09 - 0.13]). We did not observe effect modification of the association of total CIRS score with physical activity by age group (interaction p=0.83), but the association for fruit and vegetables did differ by age group (see Table, interaction p=0.04). CONCLUSION: Greater support from local organizations, friends, family members, and neighbors was associated with higher physical activity levels and fruit and vegetable intake. Among older participants, CIRS scores were lower and associations of CIRS score with fruit and vegetable intake were stronger. Thus a need may exist for more health promotion programs that improve access to social resources, especially in middle-age and older adults.

PHYSICIAN COMMUNICATION BEHAVIORS DIFFER BY BMI KimberlyA. Gudzune 1; Mary Catherine Beach 1; Lisa A Cooper1. 1The Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 10253)

BACKGROUND: Physicians weight bias may contribute to obesity-related health disparities by impairing patient-physician communication. However, whether these negative attitudes influence physicians interpersonal communication during patient encounters is unknown. Previous studies have shown that patient-centered communication behaviors are positively associated with adherence and satisfaction, while more paternalistic or biomedical behaviors demonstrate the opposite. In this study, we examined the relationship between patient body mass index (BMI) and physician communication behaviors. Given the psychosocial origins of obesity bias, we hypothesized that higher patient BMI would be associated with
decreased patient-centered communication behaviors including rapport building and patient counseling, while biomedical behaviors like data gathering would not be influenced by a patients weight status. METHODS: We used baseline data from the Patient-Physician Partnership Study. The study sample included 40 urban primary care physicians and 226 of their patients. Each patient had a patient-physician encounter audio-taped, which was then analyzed using the Roter Interaction Analysis System to determine counts of communication behaviors. These encounters were a part of ongoing care. The outcomes were physician behaviors including data gathering, rapport building and patient counseling. The independent variable was measured patient BMI. In order to account for clustering of patients by physician, we used multilevel Poisson regression models to calculate incidence rate ratios evaluating the association between BMI and the physician communication behaviors. All models were adjusted for

patient age, patient sex, patient race, number of co-morbidities, as well as physicians number of years in practice and specialty. Given the multiple comparisons, we defined a significant p-value to be RESULTS: The mean (SD) patient BMI was 32.8 (8.0) kg/m2. Patients mean (SD) age was 61.7 (12.2) years with 65% female and 60% black, while physicians were 54% female and 53% white. Mean (SD) visit length was 15.5 (7.2) minutes and did not vary significantly by BMI. Table 1 shows that physicians data gathering behaviors were similar across BMI groups. However, physicians demonstrated less rapport building with the overweight and obese groups. Physicians
also provided less patient counseling for these higher BMI groups as compared to the normal range group, especially in the lifestyle/ psychosocial realm.

CONCLUSION: We found that physicians demonstrated fewer patient-centered behaviors including rapport building and counseling to patients with overweight and obesity. As these patient encounters were part of ongoing clinical care, the limited rapport building and counseling may suggest an impaired patient-physician relationship and reduced quality of care for a variety of health outcomes between obese patients and their primary care physicians.

THE IMPACT OF HEALTH INSURANCE REFORM ON INSURANCE SWITCHES: ARE WE CHURNING? Karen Freund 1; Amresh D Hanchate 1; Alexis P Isabelle 1; Richard Kalish 1; Alok Kapoor 1; Sharon Bak 1; Marc Flore 1; Rebecca Grochow 1; Swati Shroff 1; Tracy Battaglia1.

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BACKGROUND: The intent of health insurance reform is to improve care through the expansion of access to care. In 2006 the Massachusetts Health Reform Legislation sought to improve access to care by increasing insurance coverage. In order to address the impact of the 2006 legislation on access to care, we must first characterize the impact of the legislation on insurance coverage and stability. To this end we compared 6 categories of insurance coverage (Private, Medicare, Medicaid, Commonwealth Care, other Government,

uninsured) and the frequency of insurance switches between these categories before and after insurance reform. METHODS: We analyzed billing data from 4 Community Health Centers around a specific health care event that required ongoing health care utilization, namely an abnormal breast or cervical cancer screening exam from 200405 (pre reform) and again from 20072008 (post reform). We observed insurance claims for eighteen months before and after the abnormal screening exam, and then evaluated insurance coverage and frequency of health insurance switches. Aggregating number of switches at the patient level, we compared rates of insurance switches between pre and post reform periods using a Poisson regression model, adjusted for the number of months of patient care observed, age, and health center. As the Massachusetts health reform resulted in a new subsidized insurance program (CommonwealthCare), and as this was unavailable in the pre reform period, switches involving CommonwealthCare complicate pre and post reform comparisons of rates. For a clearer assessment we performed two analyses: first, where switches involving CommonwealthCare were counted as a unique change and second, where these were not counted as a unique change. Defining switches to uninsured status as an unfavorable outcome, we also compared the rates of unfavorable switches pre and post reform. RESULTS: We examined 776 women, 269 women in the pre reform period and 507 women in the post reform period. Subjects had an average age of 35 (13) years and were 60% white, 27% black, 9% Hispanic, and 3% Asian. The mean period of documented patient observation in
health center records was 23 months and included on average 14 visits. At the time of the abnormal screening exam in the pre reform period, 40% of women were uninsured, 32% had private and 28% had public insurance. In the post reform period the percent uninsured declined from 40% to 18%. In the combined pre and post reform periods, 353 (45%) had at least one switch in insurance. The adjusted annual rates of insurance switches were0.44 (95% CI=[0.39, 0.50]) in the pre reform period and 0.57 (95% CI=[0.52, 0.62]) in the post reform period when CommonwealthCare was a unique category. Under this definition, the post reform rate of switches was 29% higher than that for pre reform ($p<0.002$). When CommonwealthCare was not counted as a unique category, the adjusted annual rate of insurance switches was 0.45 (95% CI=[0.41, 0.50]) and the post reform rate of switches was 5% higher ($p=0.57$). The adjusted annual rate of unfavorable switches with pre reform=0.17 (95% CI=[0.13, 0.20]) and post reform=0.19 (95% CI=[0.16, 0.21]), indicated no significant difference. CONCLUSION: Limitations of the study include the inability to assess the length of non coverage between switches or to identify switches which occurred between health care visits. We are also unable to adjust for temporal confounding in insurance status due to the economic downturn and loss of employer based coverage. Overall our results show a major increase in the proportion of women with insurance at the time of cancer screening after insurance reform but no reduction in the instability of insurance coverage as indicated by the number of women switching to an uninsured state.

AVOIDING THE AVOIDABLE: QUALITY CARE FOR COMORBID CONDITIONS IN CANCER SURVIVORS

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BACKGROUND: Previous research has demonstrated differences in the quality of preventive care received by cancer survivors. Building on this research, we analyzed the occurrence of avoidable outcomes in cancer survivors compared to non-cancer controls.

METHODS: Using the SEER-Medicare linked database, we used 7 avoidable outcome indicators of quality care established by Asch et al. (2000) and previously implemented by Earle et al. (2004) to compare the quality of care received by cancer survivors and non-cancer controls. Cancer patients diagnosed with breast, prostate, or colorectal cancer in 2004, who were age >=66 at diagnosis, enrolled in fee-for-service Medicare during the study period, and survived at least 3 years from diagnosis were eligible. We frequency matched controls who

met the same eligibility criteria as cases, with the exception of a cancer diagnosis. The avoidable outcome indicators were evaluated during the first part of the transition to survivorship (days 3661095 from diagnosis). Logistic regression compared rates of avoidable outcomes between cases and controls, while adjusting for sociodemographic characteristics.
RESULTS: A total of 8,661 cancer cases (53% prostate, 22% breast, 26% colorectal) were matched with 17,322 controls. In analyses combining all three cancer types, no differences were found on 3/7 indicators, and cancer cases were less likely than controls to experience avoidable outcomes on 4/ 7 indicators ($p<0.05$) [see Table]. The differences were most pronounced for prostate (3/7 indicators) but less so for breast (2/7 indicators). There were no differences between colorectal cases and controls.
CONCLUSION: These data suggest that follow-up for a cancer diagnosis may be associated with improved care for comorbid conditions. Further research should investigate more specifically how survivorship care translates into improved performance on avoidable outcome quality indicators.
Table: 1
Avoidable Outcomes for All Cancer Types Combined
% of Eligible Controls
%of Eligible Cases
PHYSICIAN INCENTIVES TO IMPROVE QUALITY AND DELIVERY OF HIGH QUALITYAMBULATORY MEDICAL CARE Tara F. Bishop 1; Alex D. Federman 2; Joseph S. Ross3. 1Weill Cornell Medical College, New York, New York ; 2Mount Sinai Medical Center, New York, New York ; 3Yale University School of Medicine, New York, New York . (Tracking ID # 10281)
BACKGROUND: Financial incentives for quality and public reporting are mechanisms used to promote high quality medical care. We sought to determine the association between incentives for quality and high quality ambulatory care.
METHODS: We performed a cross-sectional study using data from the 2006 and 2007 National Ambulatory Medical Care Survey. We included ambulatory visits by adult, non-pregnant patients to generalists and internal medicine specialists practicing in non-federally funded, non-hospital-based ambulatory practices in the U.S. We examined the association between 3 physician incentives for quality (financial compensation partially based on quality, financial compensation partially based on satisfaction, and public reporting of performance measures) and 12 measures of high quality ambulatory care. The 12 measures of high quality care were categorized by patient diagnosis and visit type. We examined 4 measures during preventative care visits: smoking cessation counseling for smokers, body mass index (BMI) screening, weight reduction counseling for overweight patients, and urinalysis not performed or ordered. We examined 1 measure of high quality diabetes care: blood pressure measurement of less than 130/ 80 mmHg. We examined 2 measures of high quality heart failure care: prescription of either angiotensin converting enzyme inhibitor (ACE-I) or angiotension receptor blocker (ARB) therapy and beta-blocker therapy. We examined 2 measures of high quality coronary artery disease care: prescription of oral antiplatelet therapy and beta-blocker therapy. Finally, we examined 3 additional measures: no prescription of antibiotic therapy for upper respiratory infection, prescription of anticoagulation therapy for patients with atrial fibrillation, and 3 prescription of bronchodilator therapy for patients with COPD. For each measure, we excluded patients for which the quality measure might be contra-indicated or not applicable. We used multivariable logistic regression to assess the independent effect of physician incentives on the delivery of each of the 12 quality indicatorsRESULTS: Overall, 20.8% of visits were to physicians whose financial compensation was partially based on quality, 17.7% of visits were to physicians whose financial compensation was partially based on patient satisfaction, and 10.0% of visits were to physicians who publicly reported performance measures. Quality of ambulatory care varied: weight reduction counseling occurred in 12.0% of preventative care visits by obese patients whereas urinalysis was not performed in 93.0% of preventative care visits. In multivariable analyses, there were no statistically significant associations between financial incentives

for quality and delivery of high quality care for any of the 12 measures, nor for 11 of the 12 measures when examining the association with financial incentives for satisfaction; the exception was an association with BMI screening in preventative visits (Adjusted Odds Ratio (aOR)=2.45, 95% confidence interval [CI] 1.3-4.6, p=0.005). There was also no statistically significant association between public reporting of performance measures and delivery of high quality care for 11 of 12 measures; the exception was weight reduction counseling for overweight patients (aOR=2.05, 95% CI1.2-4-3.4, p=0.007).
CONCLUSION: We found no consistent association between incentives for quality and 12 measures of high quality ambulatory care. Our finding that on a national level financial incentives and public reporting were not associated underscores concerns about the potential impact of current quality incentive programs for improving health care quality in the U.S.
Adjusted p-value
>=3 cardiovascular ED visits among patients with angina
8.1 5.3 0.03
Respiratory admission for patients with COPD
46.9 39.0 <0.0001
Respiratory admission for patients with emphysema
56.8 48.4 0.03
Non-electiveadmission for CHF 36.9 32.1 0.002 Perforatedgallbladder amongpatients withcholelithiasis
0.4 0.3 0.99
Lung abscess or emphysema in pneumonia patients
1.6 0.9 0.33
Admission for hyperosmolar or ketotic coma among diabetic patients
0.2 0.3 0.79

COMPARATIVE EFFECTIVENESS AND SAFETY OF MEDICATIONS FOR TYPE 2 DIABETES: AN UPDATED SYSTEMATIC REVIEW INCLUDING NEW DRUGS AND TWO-DRUG COMBINATIONS Wendy L Bennett1; Nisa Maruthur 1; Sonal Singh 1; Jodi B Segal 1; Lisa Wilson 1; Ranee Chatterjee 1; Spyridon Marinopoulos 1; Milo Puhan 1; Padmini Ranasinghe 1; Lauren Block 1; Wanda Nicholson 2; Susan Hutfless 1; Eric B Bass 1; Shari Bolen3. 1Johns Hopkins University, Baltimore, Maryland ;
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BACKGROUND: Given the increase in medications for type 2 diabetes, clinicians and patients need information about their effectiveness and safety to make informed choices. We conducted an update and expansion of a systematic review to include new medication classes and 2-drug combinations.
METHODS: We searched the MEDLINE, EMBASE, and Cochrane Central Register of Controlled Trials databases from inception through April 2010 for original English-language articles and sought unpublished data from the FDA and others. Our search strategy combined terms for type 2 diabetes and medications. We selected studies in adults with type 2 diabetes that assessed intermediate outcomes (hemoglobin A1c (HbA1c), lipids, weight), long-term clinical outcomes (e.g., cardiovascular disease) and harms (e.g., hypoglycemia) in head-to-head comparisons. We included FDA-approved diabetes medications (metformin, 2nd-generation sulfonylureas, thiazolidinediones, meglitinides, DPP-4 inhibitors and GLP-1 agonists) used as monotherapy or in 2-drug combinations with either metformin or a thiazolidinedione, as well as insulin in combination with oral medications. Two reviewers serially extracted data from each article using standardized protocols. We conducted random-effects meta-analyses when there were at least 3 trials sufficiently homogenous.

RESULTS: 140 RCTs and 26 observational studies from 166 articles were included. Evidence was graded as low or insufficient for long-term clinical outcomes of all-cause mortality, cardiovascular disease, nephropathy and neuropathy. Metformin alone relative to the combination with rosiglitazone, was associated with a lower risk of fatal myocardial infarction (pooled RR 0.50, 95% CI 0.1-3.0), but event rates were low (3 cases), with imprecise estimates. Most medications lowered HbA1c by about 1%, but metformin was more efficacious than the DPP-4 inhibitors by about 0.4%. Combinations of metformin, sulfonylureas, and thiazolidinediones had similar efficacies in lowering HbA1c. Metformin decreased weight relative to thiazolidinediones (mean difference 2.6 kg) or sulfonylureas (mean difference 2.7 kg). Metformin lowered LDL relative to pioglitazone, sulfonylureas, and DPP-4 inhibitors by about 14, 10 and 5 mg/dL, respectively. Pioglitazone increased HDL more than rosiglitazone, metformin, or sulfonylureas. A higher risk of mild to moderate hypoglycemia was seen with sulfonylureas compared with metformin alone (RR 2.6, 95% CI 1.3-5.4), metformin plus a premixed insulin compared with metformin plus basal insulin and combination of metformin plus a sulfonlyurea compared with metformin plus a thiazolidinediones (RR of 6.4, 95% CI 3.3-12.5). Thiazolidinediones were associated with a non-significant increased risk of congestive heart failure relative to sulfonylureas (pooled 1.6, 95% CI1.0-2.8), and bone fractures relative to metformin. Diarrhea occurred more often for metformin compared with thiazolidinedione users and risk of lactic acidosis was not increased for metformin compared with sulfonylurea users.
CONCLUSION: Comparisons of 2-drug combinations showed little to no difference in HbA1c reduction, but some combinations increased risk for adverse events, like hypoglycemia with sulfonylureas and weight gain with thiazolidinediones. DPP-4 inhibitors improved HbA1c to a lesser extent than metformin, but when added to metformin, improved HbA1c without additional hypoglycemia. Long-term benefit and harms of diabetes medications are unclear. Results of our meta-analyses can be used to give patients more specific estimates of the comparative effectiveness and safety of the drug choices.

EFFECTIVENESS OF A PRIMARY CARE PHYSICAL ACTIVITY INTERVENTION FOR OBESE, MIDDLE-AGED WOMEN: 12-WEEK RESULTS FROM THE HEALTHY BODIES, HEALTHY HEARTS STUDY

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BACKGROUND: Physical inactivity is a significant risk factor for cardiovascular disease and remains highly prevalent in women, especially in middle-age and beyond. Healthy Bodies, Healthy Hearts (HBHH) is a randomized, controlled physical activity (PA) intervention delivered in coordination with primary care and intended to increase leisure physical activity levels and decrease weight and waist circumference (WC) in obese, inactive middle-aged women.
METHODS: We recruited 99 inactive women aged 4565 with BMI greater than or equal to 30 from 3 primary care clinics and randomized them to a 12-week, in-person activity intervention program (IP) or to an education-only, at-home(AH) group. Weekly IP sessions were 30 minute discussions followed by 30 minutes of moderate group PA; AH group received a 12-week self-guided manual based on the American Heart Associations Choose to Move program. Assessments were conducted at baseline and 12 weeks. Leisure physical activity levels were measured with the one-month version of the Modifiable Activity Questionnaire. Weight and waist circumference were measured by a trained research assistant following a standardized protocol. Differences in measures by group between baseline and 12 weeks months were analyzed with a t-test or rank-sum test using an intention-to-treat principle. Missing data was imputed with the last observation carried forward method. RESULTS: Data from 98 women was available for analysis. At baseline, mean (SD) age was 53.9 (5.4) years and 37% were black. Mean weight was 92.3 (17.7) kg, mean BMI was 34.7 (5.9), and mean WC was 105.7(11.4) cm. Median leisure PA level was 2.8 MET-hr/week (IQR 12.0). 68 (69%) women attended 12-week follow-up visit, with black women and women in AH group being more likely to be lost to follow-up. At 12 weeks, women in the IP group

had significantly greater increases in PA levels (6.3 vs. 0 MET-hr/week; p=0.001) than those in AH group. Women in IP group had modest decreases in weight (1.5 vs. -0.9 kg; p=0.19) and waist circumference (2.2 vs. -1.2 cm; p=0.15) that were not significantly different when compared to those in the AH group. CONCLUSION: The HBHH intervention was successful in increasing the physical activity levels of obese, inactive middle-aged women. However, no significant changes in weight or waist circumference were observed. It remains to be seen whether the increases in PA will be sustained in longer-term follow-up and whether the HBHH intervention could be replicated in other primary care settings.

CHRONIC DISEASE AND THE MEDICAID EXPANSION UNDER HEALTH REFORM: UNMET MEDICAL NEEDS AMONG UNINSURED ADULTS Benjamin Sommers 1; Katherine Swartz 1; Arnold Epstein1. 1Harvard School of Public Health, Boston, Massachusetts. (Tracking ID # 10297)

BACKGROUND: The Patient Protection and Affordable Care Act expands Medicaid eligibility as of 2014 to all adults with incomes up to 133% of the federal poverty level, with the promise of increasing access to care for millions of uninsured individuals. Appropriate policy planning in the areas of provider workforce and budgeting will be critical. Such planning requires estimates of the chronic disease burden and need for increased medical services among uninsured adults who will become eligible for Medicaid under health reform.

METHODS: Our analysis uses nationally-representative data from the Medical Expenditure Panel Survey (MEPS) Household Component 20042008. Our sample contains all adults aged 1964 without any health insurance, who have family incomes below 133% of the poverty level, meaning that they will be eligible for Medicaid in 2014 (n=11,279). We linked household data on income, demographics, and health care utilization with the MEPS Medical Conditions Files, which provide detailed information on self-reported conditions by ICD-9 code. We calculated survey-weighted means to estimate the prevalence of chronic diseases (including hypertension, diabetes, HIV, obesity, and schizophrenia, among others) in this population. We then compared each individuals health care utilization with national guidelines for needed therapeutic services and monitoring (e.g. at least two visits a year for hypertensive patients to monitor blood pressure according to JNC-7), and calculated the number of adults who received suboptimal care. Then we constructed a measure called a visit deficit to estimate how many additional outpatient encounters each year would be needed to provide guideline-consistent medical care (assuming multiple conditions could be addressed at the same visit), and how many additional health care providers would be needed to provide this care. RESULTS: Among uninsured adults who will be eligible for Medicaid under health reform, 51.5% reported at least one chronic medical condition, and 22.5% reported two or more. The most common conditions were obesity (27.3%), hypertension (17.6%), dyslipidemia(11.3%), depression (9.5%), asthma (9.3%), and diabetes (5.5%). 61.3% of adults with chronic conditions had received suboptimal care in the previous 12 months, with an average visit deficit of 1.16 visits per person. This translates into an additional 7.8 million visits nationally per year to provide appropriate monitoring and follow-up, corresponding to roughly 3500 additional health care providers who will be necessary in order to care for the chronic conditions among these adults.

CONCLUSION: Chronic disease is common among uninsured adults who will be eligible for Medicaid under health reform beginning in 2014. Though some of these eligible adults may not end up enrolling in Medicaid, overall our analysis probably underestimates the actual chronic disease burden given that we are using self-reported health measures and many of these conditions are likely still undiagnosed in this population. The majority of adults in our sample did not receive even the minimally recommended care for their chronic conditions. Effective outreach, appropriate case management, and significant increases in the number of Medicaid providers will be necessary to ensure that health reform leads to higher quality care for low-income adults with chronic disease.

SYSTEMATIC REVIEW OF CLINICAL PRACTICE GUIDELINES ON THE PHARMACOLOGIC TREATMENT OF TYPE 2 DIABETES MELLITUS: ARE GUIDELINES EVIDENCE-BASED? Wendy L Bennett

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BACKGROUND: With eleven classes of glucose-lowering medications available for the treatment of type 2 diabetes, clinical practice guidelines help inform treatment decisions. We conducted a systematic review of clinical practice guidelines addressing glucose-lowering pharmacologic therapies for type 2 diabetes to assess the quality of methods and whether they incorporate available evidence.
METHODS: We searched 2 general electronic databases (MEDLINE and Cumulative Index to Nursing &Allied Health Literature), 3 guideline-specific databases from the U.S., Canada and United Kingdom, and hand-searched the websites of 15 professional and guideline development organizations from July 2007 to March 2010. We chose this time frame because the field of diabetes is rapidly evolving and in July 2007, the Agency for Healthcare Research and Quality published a large comparative effectiveness systematic review on diabetes medications. Titles and abstracts were assessed by 2 independent reviewers, and data abstracted sequentially by 2 reviewers. Using the 2007 review, we developed a list of 7 evidence-based conclusions and then assessed whether the guidelines addressed and endorsed these conclusions. We also assessed the basis for their recommendations. Two independent reviewers rated guideline quality using the Rigor of Development (Rigor) and Editorial Independence (Independence) domains from the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. The kappa score for agreement on quality items was 0.60. RESULTS: Of the 609 titles identified, 12 guidelines, including 3 updates, contained in 20 different publications, met our inclusion criteria. Six guidelines were peer reviewed and the majority used a combination of expert opinion and literature review, including use of published systematic reviews to make recommendations. Eight guidelines agreed with the conclusion from the 2007 review that metformin is favored as first line agent. However, the two guidelines from the Joslin Clinic did not favor any one drug over another. Ten guidelines endorsed the conclusion that thiazolidinediones are associated with higher rates of edema and congestive heart failure. Two guidelines did not address any of the 7 evidence-based conclusions, and 3 guidelines endorsed all seven conclusions. In the Rigor domain, two guidelines received the highest score (4 on a scale of 14) for the item, systematic methods used to search for evidence and three for the item, clearly described methods for formulating recommendations. The range in the Rigor domain summary scores (0%=lowest to 100%=highest) was 14-100%. The National Institute for Health and Clinical Excellence guideline was the only guideline to receive the maximum score. In the Independence domain, 5 guidelines received the highest score for the item, conflicts of interest ofmembers have been recorded. The range in this domains summary scores was 8-100%. The Canadian Diabetes Association was the only guideline to receive the maximum score.

CONCLUSION: Clinical practice guidelines on pharmacologic treatment of type 2 diabetes were generally consistent with available evidence. Few guidelines used rigorous guideline development methods, including systematic searches forevidence,peer review prior to publication, and recording of conflicts of interest by group members. Professional organizations need to advocate for more consistent standards to improve guideline quality.
DECLINES IN PHYSICIAN ACCEPTANCE OF MEDICARE AND PRIVATE COVERAGE Tara F. Bishop 1; Alex Federman 2; Salomeh Keyhani2. 1Weill Cornell Medical College, New York, New York; 2Mount Sinai Medical Center, New York, New York. (Tracking ID # 10315)
BACKGROUND: A number of anecdotal reports assert that physicians are accepting fewer Medicare patients. Using data from a national survey of physicians we examined trends in physician acceptance of new patients with different types of insurance.

METHODS: Using data from the National Ambulatory Medical Care Survey (NAMCS) we examined trends in physician acceptance of new patients by insurance type from 2005 to 2008. The NAMCS is a nationally representative survey administered by the Centers for Disease Controls National Center for Health Statistics (NCHS). It contains information about physicians practicing in non-federally-funded, non-hospital-based offices throughout the United States. The fields of anesthesiology, radiology, and pathology are excluded. Our sample included all physicians who accepted new patients. We excluded obstetricians and pediatricians from our analysis of Medicare acceptance. The outcome variable was percentage of physicians who accepted new patients with Medicare, Medicaid, private capitated insurance, and private non-capitated insurance. We used multivariable linear regression to look at trends in physician acceptance of new patients by insurance type while controlling for physician and practice characteristics. We also examined acceptance of insurance stratifying physicians by specialty and practice type.
RESULTS: During the study period, there was a decline in the percentage of solo practices from 39.5% in 2005 to 32.1% in 2008 (p=0.007 for trend across years). Similarly, the number of practice owners declined over the time period (73.5 % in 2005 vs. 67.4% in 2008, p=0.006 for trend across years). There were no other significant changes in practice characteristics over the study period. Almost 95 % of ambulatory care physicians accepted new patients in 2005. This ratio did not change between 2005 and 2008. Among physicians who accept new patients, there was a small but significant decline in acceptance of new Medicare patients (95.5% in 2005 to 92.9% in 2008, p=0.01 for trend across years). In analyses stratified by physician characteristics, this decline remained significant for physicians in private practice(95.5% in 2005 vs. 93.0% in 2008, p=0.01). There was a larger decline in acceptance of privately insured non-capitated patients (93.3% in 2005 vs. 87.8 % in 2008, p between 2005 and 2008. In stratified analyses, this decline in acceptance of privately insured patients remained significant for primary care physicians (97.3% in 2005 vs. 89.9% in 2008, pRates of acceptance of new Medicaid and private capitated patients were lower overall but also showed a decline over the study period.
CONCLUSION: While reports in the literature and press highlight physicians dissatisfaction with Medicare, we found only a small decline in physician acceptance of Medicare patients between 2005 and 2008. In contrast, the decline in physician acceptance of non-capitated privately insured patients was more pronounced. These findings suggest that even patients who have health care coverage may have difficulty accessing care. . It is likely that improvements in reimbursement and expansion of primary care capacity will be needed to reverse these trends.
PHYSICIAN PERSPECTIVES ON THE ROLE OF MENTAL ILLNESS IN THE CARE OF COMPLEX PATIENTS - IT MAKES EVERYTHING MORE DIFFICULT! Danielle F Loeb 1; Elizabeth A. Bayliss 2; Carey Candrian 3; Ingrid Binswanger4. 1University of Colorado Denver, Denver, Colorado ; 2Kaiser Permanente, Institute for Health Research, Denver, Colorado ; 3University of Colorado Boulder, Boulder, Colorado ; 4University of Colorado Denver, Aurora, Colorado . (Tracking ID # 10332)
BACKGROUND: Patient complexity is often defined by the presence of multiple chronic conditions. Mental illness, specifically, has not been emphasized in current definitions of complexity used in research and policy initiatives. Although mental illness is known to have negative effects on comorbid medical illness such as diabetes or heart disease, the contribution of mental illness to patient complexity has not been examined closely. Since primary care physicians are largely responsible for the care of complex patients, we sought to explore the perceptions of internal medicine primary care physicians regarding the role of mental illness in patient complexity.
METHODS: This qualitative study utilized open-ended in-depth interviews that explored physician perceptions of patient complexity in their clinical practices and the significance of mental illness in the care of complex patients. We recruited 15 physicians from 2 university clinics and 3 community health clinics using email notices sent to all physicians in the practices. We then sampled physicians to achieve an even distribution with respect to gender, years in practice, and practice site. Physicians brought de-identified notes from 3 patients they

considered complex and were asked to refer to these notes in the interview. Interview transcripts were coded and analyzed utilizing a team-based general inductive approach. RESULTS: Emerging themes included: 1) mental illness plays a major role in patient complexity; 2) poorly controlled mental illness greatly impacts treatment of medical illness; 3) physicians perceive inadequate resources for the diagnosis and treatment of serious mental illness; and4) physicians expressed a feeling of being overwhelmed in providing care for patients with active mental illness. Physician quotations that illustrate themes are described in Table 1.
CONCLUSION: General internists perceived that mental illness contributes significantly to patient complexity. Current definitions of complexity may not adequately account for the role of mental illness in patient complexity. This study was limited by its small sample size, but these results nonetheless suggest the need to re-evaluate the role of mental illness in definitions of complexity that are employed in clinical, research and policy initiatives.

PATIENT AGE, COMORBID BURDEN, AND THE USEFULNESS OF HEART FAILURE GUIDELINES Michael Steinman 1; Carolyn Peterson 1; John Harlow1. 1San Francisco VA Medical Center, San Francisco, California. (Tracking ID # 10334)
BACKGROUND: Clinical practice guidelines have been criticized for paying insufficient attention to the unique needs of patients with advanced age and multiple comorbid conditions. However, little is known about how clinicians perceive the usefulness of practice guidelines across different types of patients.
METHODS: We conducted telephone interviews with staff physicians and nurse practitioners at 4 VA medical centers (1 per US census region) as part of a larger study evaluating physician reasons for not prescribing guideline-recommended medications to patients with heart failure. Respondents were asked to rate the usefulness of national heart failure guidelines for different types of patients on a five-point scale, with anchors of 1 (not useful) to 5 (extremely useful). We then asked respondents to elaborate on their responses in an open-ended format. Using a grounded theory approach, a random subset of 20 transcripts was reviewed to develop a taxonomy of major themes; each interview was subsequently coded for these themes.
RESULTS: Among 139 clinicians contacted, 68 (49%) completed the interview. Half (50%) were men, 80% were general internists or family practitioners, and respondents had a mean of 20 (+/10) years since professional school graduation. On a 5-point scale assessing the usefulness of practice guidelines for heart failure, the mean response was 4.4 (+/0.7) for patients age 65 years with few comorbidities, 4.2 (+/0.8) for patients age 65 years with multiple comorbidities, 3.9 (+/1.0) for patients age 80 with few comorbidities, and 3.5 (+/1.2) for patients age 80 years with multiple comorbidities (P<.001). The difference in perceived usefulness varied more by patient age than by the degree of comorbid burden (mean difference 0.6 in younger vs. older patients, vs. 0.3 in subjects with few vs. many comorbidities, P=.04). Analysis of a random selection of 20 interviews revealed 4 themes underlying the perceived utility of guidelines across different patient types: (a) patients clinic and pharmacologic complexity; (b) life expectancy and expected benefit; (c) patient preferences and adherence; and (d) the evidence basis of guidelines. Among 12 interviewees who gave different ratings for the 4 patient types, 11 cited reasons related to complexity, 5 cited reasons related to life expectancy and benefit, 2 cited preferences and adherence, and 1 cited evidence. In contrast, among 8 interviewees who gave the same rating for all patient types, 6 cited reasons related to evidence, and none cited the 3 other themes.
CONCLUSION: Clinicians perceive heart failure guidelines to be substantially less useful for patients with older age and greater comorbid burden. Concerns about the clinical and pharmacologic complexity of these patients and the expected benefits of drug therapy were commonly invoked as reasons for this skepticism.
Table: 1
Physician's Illustrative Quotes on theRole of Mental Illness in Patient Complexity Theme Illustrative Quote
Mental illness plays a major role in patient complexity
"It [mental illness] makes everything more difficult...All things are magnified...All things..." (participant # 11) "And so when someone has a severe mental health problem, even if they have pneumonia or an infection, or heart

failure or something else, if we don't deal with that mental health problem, then that is going to make treating even an acute problem very difficult ..." (participant # 7)
Poorly controlled mental illness greatly impacts treatment of medical illness
"But I think mental illness...is very interwoven into how patients kind of adopt the sick role ...because their ability to really...take the reins of their illness can be curtailed by their mental issues... patients like that, when they develop a chronic disease - even something like obesity, their ability to kind of say I'm going to really kick this and I'm going to start exercising. I'm going to change my diet. Sometimes the activation energy to embark on that is so high for them...." (participant #13)
"[E]ven if I had 70 minutes on that one patient ... who has the paranoid problem, I still wouldn't know what's going on...Every appointment I send these urgent referrals to psychiatry. 'Please see this patient. Help me. Tell me what's going on. Cause I just don't know...' " (participant # 5)
Physicians "And...it made me realize that expresseda feeling ofbeingoverwhelmed inproviding carefor patients withactive mentalillness
all of her other complaints probably were actually due to her schizophrenia...and the reason she hadn't taken her blood pressure medication, the reason she hadn't followed up with her specialist is all actually because she had untreated schizophrenia for about 10 years. So that was a little scary." (participant # 6)
Inadequate resources for the diagnosis and treatment of serious mental illness

THERES MORE TO THIS PAIN THAN JUST PAIN: HOW PATIENTS UNDERSTAND THE MANAGEMENT OF CHRONIC PAIN Marianne S Matthias 1; Edward J Miech 1; Elizabeth Sternke 1; Laura J Myers 1; Christy Sargent 1; Matthew J Bair2. 1Roudebush VA Medical Center, Indianapolis, Indiana; 2Roudebush VA Medical Center, Carmel, Indiana. (Tracking ID # 10338)
BACKGROUND: Pain is among the most commonly reported symptoms in primary care, with over half of adults suffering from chronic or recurrent pain. In this study we sought to elicit primary care patients experiences with a stepped-care intervention for chronic musculoskeletal pain.
METHODS: We conducted in-depth qualitative interviews with veterans who participated in the intervention arm of a randomized controlled trial for chronic pain management at a VA Medical Center. The stepped-care intervention consisted of analgesic treatment coupled with pain self-management strategies in step 1, followed by 6-sessions of cognitive behavioral therapy (CBT) in Step 2. A nurse care manager delivered all aspects of the intervention via telephone. For this study, patients were asked open-ended questions about the intervention and their experiences during the trial. Interviews were audio-taped, transcribed, and checked for accuracy. Sampling continued until theoretical saturation was reached. We used emergent thematic analysis to understand and interpret the data. The analytic team met weekly to identify and discuss salient themes. Discrepancies were resolved by consensus. RESULTS: Patients (N=17) were 24 to 58 years old; two were women, and all had moderate to severe chronic musculoskeletal pain. Through participation in the intervention, particularly CBT, patients described a process of figuring out their pain. Patients reported developing a greater awareness of factors that alleviate or exacerbate their pain, and the relationship between their psychological state and pain. As an example of the latter, one participant commented that he learned to recognize Okay, Im in pain. How do I feel? Am I stressed? Am I anxious? Am I down about something? Am I feeling good?I think theres probably a relevant relationship between the way we feel and our pain. Through controlling your feelings and your thought process, you could probably have an influence on your pain level. Another patient noted, Theres more to this pain than just pain. Theres the mental part of it, the part that makes you depressed, cause when youre depressed its like you have pain inside and out. Patients also described learning that successful pain management takes time. One patient explained how CBT helped him to understand the longitudinal nature

of pain management: I didnt think I was showing improvement butI just was in too much of a hurryI wanted things right now and I didnt realize it was gonna take time. So that is where I had somebody that refocused me back on what I needed to work on.
CONCLUSION: This study illustrates that how patients understand and think about pain can have an important influence on their experience of pain. By increasing patient awareness of situational and psychological triggers of pain, and understanding that controlling chronic pain is oftentimes a gradual process, patients may be better positioned to cope with and self-manage their pain.
PHYSICIAN UTILIZATION OF SMOKING CESSATION TREATMENTS IN A PRIMARY CARE SETTING Gloria Sung 1; Michael Steinberg2.
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BACKGROUND: Even brief interventions by physicians increase patients smoking cessation, but physician treatment remains sub-
optimal. Electronic medical records (EMRs) have the potential to increase physician adherence to health guidelines and could improve tobacco dependence treatment.
METHODS: A cross-sectional EMR chart review was conducted at a University internal medicine practice from January 2001 to June 2009. Data were collected regarding gender, age, tobacco consumption, comorbidities, office counseling, referral to tobacco programs, and prescription of pharmacotherapies.
RESULTS: 277 patient charts were evaluated, with slightly more women (53%) and ages ranging from 20 to 93 (mean 52). Patients smoked a mean of 15 cigarettes per day for 27 years. In terms of treatment delivered, 89% of smokers received counseling in the office, 41% were referred to cessation services, 11% received nicotine replacement therapies (NRT), and 12% received non-nicotine cessation medications. Women had a higher trend to be referred to cessation programs than men (46% vs. 35%; p=0.06). Smokers age 5164 were referred more (56%) while those 35 or younger (28%) and 65 and older (32%) were referred less (p Smokers of 20 or more cigarettes per day were more likely than those who smoked less than 10 cigarettes per day to be referred to cessation programs (51% vs. 28%; p Smokers with anxiety disorders were more likely to receive NRT than those without anxiety (20% vs. 9%; p=0.04) and were more likely to be referred to a cessation program (55% vs. 38%; p=0.05). Smokers with hypertension were prescribed NRT non-statistically less often (6.5%) than smokers without hypertension (13%) (p=0.095).
CONCLUSION: While physicians in this setting had fairly high rates of counseling and referral, treatment was lower among younger and older smokers, smokers of fewer cigarettes per day, and those without comorbid psychiatric conditions. Having an EMR system may have facilitated documentation of patient smoking status and provision of counseling and referral. Primary care providers should continue to be encouraged to utilize proven tobacco treatment resources in all groups of smokers.
PREDICTORS OF WEIGHT LOSS SUCCESS IN PRIMARY CARE: AN EVALUATION OF THE FRESH START PROGRAM Sharon J Herring 1;
Adrienne Freidl 1; Stephanie L Ward 2; Gary D Foster1. 1Temple University School of Medicine, Philadelphia, Pennsylvania; 2Bravo Health, Philadelphia, Pennsylvania. (Tracking ID # 10341)
BACKGROUND: Despite data suggesting that modest weight loss, between 5-10% of body weight, can prevent or delay the onset of diabetes and hypertension, few primary care practices have the resources to adequately manage obesity. To serve the needs of our obese, primary care patients, we developed a weight loss-focused practice as an extension of our primary care services in 2009. We evaluated predictors of 3-month weight loss success, defined as at least 5% weight loss.
METHODS: The generalist-led Fresh Start program used a combination of behavioral skills training and goal setting along with pharmacotherapy to promote patient weight loss. At their initial visit, obese patients were asked to choose 23 obesogenic behavior change goals that were concrete and easily self-monitored, such as

Walk 10,000 steps every day, Avoid sugar-sweetened beverages, and Eat breakfast every day. Every 24 weeks thereafter, patients returned for monitoring of goal adherence and weight change. The addition of FDA-approved weight loss drugs and calorie counting were based on physician clinical judgment and patient preference. 104 patients were seen at our practice in urban Philadelphia and eligible for 3-month follow-up between July 1, 2009 and July 31, 2010. We reviewed sociodemographic and weight data from 51 (49%)

patients who returned for 3-month follow-up; the remaining 53 (51%) patients were lost to follow-up and therefore not included in this analysis. Using chi-square tests and multivariable logistic regression, we identified patient characteristics that were associated with a 3-month weight loss of at least 5%.
RESULTS: The majority of patients were female (82%), privately insured (73%), non-smokers (90%), non-depressed (63%), and previously participated in a weight loss program (88%). Mean age was 50.1 (SD 12.6) years and baseline BMI 41.4 kg/m2 (SD 8.5). 25% (n=13) lost at least 5% of initial body weight. Compared with those who did not achieve weight loss success at 3 months, successful losers had fewer previous weight loss attempts (1.4 vs.2.3, p=0.07), came to more visits (3.7 vs. 3.3, p=0.27), and were less likely to be female (69% vs. 87%, p=0.15), current smokers (0% vs. 13%, p=0.17), or have had bariatric surgery (0% vs. 16%, p=0.13). We did not find differences in weight loss success by insurance type, baseline BMI, depression history, or initial behavior change goals. Multivariable analyses revealed similar results. Mean weight loss was8.4 kg (SD 3.8) among successful losers, whereas it was only 1.6 kg (SD 2.8) among those who did not achieve weight loss success at 3 months (p<0.0001).
CONCLUSION: Primary care-based weight loss programs show promise for clinically significant weight loss among participants with 3 months of follow-up. Consistent with clinical trials for weight loss, novice dieters and male patients were more likely to achieve weight loss success. Overall attrition rates at 3 months were high, however, illustrating the need for greater efforts to expand program reach.
COMORBIDITY AND OUTCOMES IN SEVERE SEPSIS Sarah Eileen Weigel Prebil 1; Annette Esper 2; Greg Martin2. 1Emory University, Atlanta, Georgia; 2Division of Pulmonary, Allergy, and Critical Care Medicine, Emory University, Atlanta, Georgia. (Tracking ID # 10342)
BACKGROUND: Sepsis is a major health concern with increasing incidence, being the 10th leading cause of death in the US and a source of racial, gender and regional health disparities. We sought to determine the impact of acute illness severity and co-morbid medical conditions (CMMCs) on outcomes in severe sepsis patients in an urban intensive care unit.
METHODS: Prospective cohort study of adult patients receiving intensive care at Grady Memorial Hospital between 2007 and 2010 who met the ACCP/SCCM definition of severe sepsis. Data collected included demographics, APACHE and SOFA scores, sources of sepsis, CMMCs and clinical outcomes during hospitalization. Univariate analyses were performed with alpha=0.05.
RESULTS: 225 patients with severe sepsis were identified, 75% of whom had septic shock. 80% were black, 18% were white, and 63% were males. The mean APACHE II and SOFA scores were 24.9 (+/7.82) and 10 (+/3.84), respectively. Blacks had higher APACHE and SOFA scores than whites (26 vs. 22, p=0.02 and 10 vs. 8, p=0.006); there were no differences by gender. The mean number of comorbid conditions was1.35 (SD+/1.15), with 76% having at least one CMMC and 37% of patients having >1 CMMC. The most common CMMCs were diabetes (31%), chronic alcohol abuse (24%), and HIV (21%). White patients had a higher rate of alcoholism and cirrhosis compared to blacks (21% vs. 39% and 17% vs. 6%, p=0.01, respectively). Females had a higher incidence of diabetes (41% vs. 23%, p=.006) and a lower incidence of alcoholism (24% vs. 29%, p=0.05) compared to males. There were no differences in the number of comorbid conditions when stratified by gender or race. The 28-day mortality for the entire cohort was 23%, with a greater mortality observed in males when compared to females (27% vs. 16%, P=0.04). There was no difference in mortality by race. The presence or number of CMMC was not associated with ICU or hospital length of stay (LOS), development of

acute lung injury, or mortality, when compared to patients without CMMC.
CONCLUSION: Although other disease states are known to be associated with co-morbid medical conditions, in our cohort of patients, the presence of comorbidity did not influence mortality, hospital or ICU LOS, or the incidence of development of respiratory organ dysfunction. Further studies are needed to evaluate other factors that may explain the disparities in sepsis-associated mortality.
PATIENT RACE, PERCEPTIONS OF RACISM IN HEALTHCARE SETTINGS, AND PHYSICIAN TRUST Leslie R. M. Hausmann 1; C.
Kent Kwoh 1; Michael J. Hannon 1; Said A. Ibrahim2. 1VA Pittsburgh Healthcare System, University of Pittsburgh, Pittsburgh, Pennsylvania ;
2Philadelphia VA Medical Center, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania . (Tracking ID # 10346)
BACKGROUND: Discrimination in health care is more often perceived by African Americans than by whites and could underlie race differences in physician trust. We examined whether perceived institutional racism alone or in combination with personal experiences of racial discrimination in healthcare settings contributes to differences in physician trust between African American (AA) and white patients.
METHODS: The sample included AA (N=127) and white (N=303) patients being treated for osteoarthritis in Veterans Affairs orthopedic clinics. We used surveys to assess perceptions of racism in the healthcare system (institutional racism), personal experiences with racial discrimination in healthcare settings (personal racism), and patient demographic and clinical characteristics. Physician trust was assessed after patients met with an orthopedic surgeon. We used linear regression to examine whether race was associated with physician trust and whether institutional racism, personal racism, or the two combined explained the association between race and trust.
RESULTS: AA patients reported lower physician trust compared to white patients (Beta=1.20, 95% CI=2.30,-0.10). In separate models, perceptions of institutional racism (Beta=0.94, 95% CI=1.71,-0.17) and personal racism (Beta=2.78, 95% CI=4.59,-0.97) each predicted lower trust and removed the association between race and trust. Additional analyses indicated that only patients who perceived both types of racism reported lower trust than those who perceived neither type of racism (Beta=3.10, 95% CI=5.07,-1.13), and that institutional and personal racism combined explained the relationship between race and trust.
CONCLUSION: In this sample, lower physician trust among AA versus white patients was explained by perceptions of institutional racism and personal experiences of racism in healthcare settings. Efforts to foster minority patients trust in physicians may need to address issues of perceived and/or actual racial discrimination in the healthcare system.
QUALITY OF CARE OR QUALITY OF REPORTING? CHALLENGES FOR CANCERTREATMENT REPORTING. Nina A Bickell 1; Jill Wellner 2; Kezhen Fei 3; Rebeca Franco 3; Ann S McAlearney4. 1Mount Sinai School of medicine, New York, New York ; 2Veterans Administration, Fairfield, Connecticut ; 3Mount Sinai School of Medicine, New York, New York ;
4Ohio State University, Columbus, Ohio . (Tracking ID # 10347)
BACKGROUND: Complete and accurate data are essential to inform quality improvement initiatives. In 2007, the American College of

Surgeons (ACoS) began to request that hospitals report adjuvant treatments delivered beyond their walls. Yet, there is little incentive for community-based physicians to supply this information to hospital registries. We undertook this study to ascertain differences in level of treatment reporting by community vs hospital-based oncology practices to the hospital tumor registry in hospital applying for ACoS accreditation.

METHODS: We compared adjuvant breast cancer treatments reported to a hospital tumor registry (TR) during 200709, the same years a research study at that academic center collected adjuvant treatment data. Radiation (RT) for women undergoing lumpectomy, chemo- &hormonal therapy (HT) for women with a stage 2 or 3 breast cancer were obtained from the tumor registry (N=550) and the research study (N=116). Community vs hospital-based status was determined from directory searches and consultation with active
members of the faculty. Bivariate comparisons were performed with chi square analyses.
RESULTS: Treatment rates from Tumor Registry vs research study were: RT post lumpectomy (BCS) 22% vs 81%; chemotherapy 18% vs 79%; &HT 1% vs 89%. The table below compares treatment rates reported from community vs hospital-based oncologists to the TR and from the research study:CONCLUSION: Our findings suggest that the quality of breast cancer care is good but the quality of reporting is poor. Reporting rates to the tumor registry are uniformly low for adjuvant treatments, especially hormonal therapies, delivered in community-based sites. As payment is increasingly tied to performance, hospitals must overcome barriers to cancer treatment measuring &reporting, particularly among community-based physicians who have little incentive to report.

FACTORS ASSOCIATED WITH EASE OF IMPLEMENTATION IN A STATEWIDE INTERVENTION Marshall Fleurant 1; Rachel Kell 2; Chelsea Jenter 3; Lynn A. Volk 4; Fang Zhang 1; David Bates 3; StevenR. Simon5.
1Harvard Pilgrim Health Care Institute, Boston, Massachusetts ;
2Massachusetts eHealth Collaborative, Waltham, Massachusetts ;
3Brigham and Womens Hospital, Boston, Massachusetts ; 4Partners HealthCare System Inc.,, Wellesley, Massachusetts ; 5VA Boston Healthcare System, Boston, Massachusetts . (Tracking ID # 10353)
BACKGROUND: The Federal government has set 2014 as a target date for widespread electronic health record (EHR) adoption and meaningful use. However many are skeptical that we can successfully achieve meaningful use by this time. Prior studies have consistently identified a set of factors correlated with higher rates of EHR adoption: larger practice size, hospital association, presence of computerized systems other than EHR, availability of financial resources, physician ownership of the practice, and younger physician age. Between 2005 and 2009 the Massachusetts e-Health Collaborative (MAeHC) installed EHRs into physicians offices throughout three communities in Massachusetts. In this study, we aimed to identify factors associated with the ease of EHR implementation.
METHODS: In 2005 (baseline) and 2009 (follow-up) we surveyed physicians (N=560) who participated in the MAeHC pilot. For this study, we limited our sample to 163 physicians who completed the survey at both time points. Our main outcome, ease of implementation, was the answer to the following question: Was the implementation process for your EHR: a.) Very Difficult, b.) Somewhat Difficult, c.) Not Difficult. We used Chi-Squared analysis or Fishers exact tests to
identify categorical predictors; T-test and/or Wilcoxon Rank Sum Test to identify continuous predictors associated with the ease of EHR implementation. We also calculated an EHR usage score and used it as a predictor in our model. The usage score was calculated as the proportional use of a specific EHR function divided by the number of available EHR functions. We included self-reported elements of organizational culture into our analysis. (See Table A.) All variables found significant at pRESULTS: The overall response rate for the baseline and follow-up surveys were 77% and 68% respectively. Most physicians reported that the EHR implementation process was very difficult (35%), or somewhat difficult (54%), while 12% indicated that it was not difficult. On bivariate testing we found that the ease of implementation was associated with mean EHR usage score (p=.05) and baseline physician ownership (p =.02). Physicians who felt that the office staff are innovative (p=.02) and physicians who indicated that their office evaluated quality improvement efforts (p=.02) were also significantly associated with perceived ease of EHR implementation in 2009. In our adjusted analysis we found that the physicians who were owners of the practice (odds ratio [OR] 0.5, 95% confidence interval [CI] 0.2-1.0) and physicians who felt the office staff were innovative (O.R 0.4, 95% CI 0.2-0.8) were significantly less

likely to view the implementation process as difficult. (See Table B) CONCLUSION: Physicians who reported that their office staff is innovative and those who had ownership of the practice were more likely to view the EHR implementation process as not difficult. Interventions to promote EHR adoption may consider targeting practices that do not perceive themselves as innovative and those without physician ownership with special attention and tailored support.

HEALTH CARE RENOUNCEMENT FOR ECONOMIC REASONS IN SWITZERLAND Hans Wolff 1; Jean-Michel Gaspoz 2; Idris Guessous3.
1University Hospitals of Geneva, and Faculty of Medicine, University of Geneva, Geneva, Switzerland, GENEVA 4, N/A ; 2University Hospitals of Geneva, and Faculty of Medicine, University of Geneva, Geneva, Switzerland, Geneva 14, N/A ; 3University Hospitals of Geneva, and Faculty of Medicine, University of Geneva, Geneva, Switzerland, Geneva, N/A . (Tracking ID # 10355)

BACKGROUND: Most societies elaborate ways to contain increasing health care expenditures. Switzerland, which ranks second in the list of the most expensive health care systems in the world, has universal health-insurance coverage, permitting access to a broad range of services. Patients are largely satisfied with the health care they receive. However, out of pocket payments and cuts in the catalogue of reimbursed services are used as cost-containment measures in Switzerland. Ensuring socioeconomic equity and responsiveness of the health care system is often considered a high priority in health policy making, as lack of access and responsiveness may cause or at least reinforce any socioeconomic gradient in health. Health care renouncement for economic reasons may worsen chronic diseases and increase the risk of complications and hospitalization. Aims of the study were to estimate the extent of health care renouncement for economic reasons in Switzerland and to identify associated factors.

METHODS: A population-based cross-sectional survey (20082009) of a representative sample in the canton of Geneva, Switzerland (Bus Sante study). Health care renouncement, income level categories, education, occupation, insurance status and cardiovascular co-morbidities were
collected using self-rated questionnaires. Because dental care was not part of the compulsory health care insurance, associations were also assessed after excluding dental care from the definition of health care renouncement.

RESULTS: Seven-hundred sixty five men and 814 women aged 35 74 years participated for this survey, corresponding to participation rates of the 20082009 population samples of 51% and 54%, respectively. 14.5% (229/1579) (95%CI 12.7-16.2) renounced health care for economic reasons. Among those who renounced health care (N=229), 74% renounced dental care, 37% physician consultation (22% specialist, 15% general practitioner), 26% health devices (e.g. glasses or hearing device), 13% medication, and 5% surgery. Income was negatively correlated with health care renouncement (r=0.18, p-value<0,0001; table 1): each decrease in income level category provided a 48% increased risk of renouncing health care for economic reasons (OR 1.48, 1.31-1.65), while it was also associated with a significantly increased burden of cardiovascular disease or risk factors (r=0.12, p<0.0001; figure 1). This association remained when dental care was excluded from the definition of health care renouncement. During the previous 12 months, 5% of the participants were not able to pay at least once their health insurance premiums.

CONCLUSION: Renouncing care for economic reasons is not uncommon in Switzerland and concerns almost one sixth of the population. More than 30% of the lowest income group renounced health care for economical reasons in the previous year. The poorest are 13 times more likely to renounce health care than the richest. Health care renouncement may worsen health status of a substantial part of the Swiss society.

Table 1 Adjusted Odds Ratio (OR) and 95% Confidence Intervals (CI) for risk of health care renouncement for economic reasons by income during the previous 12 months among a representative sample of 35 to 74 year old citizens of the canton of Geneva, Switzerland (2008-9)

*Odds ratios are adjusted for smoking, age, gender, CV comorbidity, Swiss citizenship, education, occupation, and deductible level

PREVALENCE OF LOW HDL AND ITS ASSOCIATION WITH BMI IN A NON-DIABETIC VA POPULATION Wei Gu 1; Ronna Mallios 2; Sean McFarland 3; Jian Huang4. 1UCSF Fresno education program, Fresno, California; 2UCSF, Fresno, California; 3VACCHCS, Fresno, California;
4UCSF Fresno education program, Fresno, California. (Tracking ID # 10362)

BACKGROUND: Low HDL value is an independent predictor of cardiovascular disease (CVD). Recent evidence suggests the association between CVD and elevated triglycerides (TG). However, the contribution from low HDL with co-existing high TG is not well studied. We determined the prevalence of low HDL (less than 40 mg/dl) with normal and elevated TG (less than versus more than or equal 150 mg/dl) in a VA population, its association with BMI and other lipid components, including total cholesterol (TC) and LDLMETHODS: A retrospective chart review was conducted on 10107 non-diabetic patients at VACCHCS. Patients were divided into three groups:1) normal HDL (more than or equal 40 mg/dl) and normal TG. 2) isolated low HDL with normal TG; 3) low HDL with elevated TG. Comparisons of the mean BMI, lipid components and the TC/HDL and TG/HDL ratios were analyzed by ANOVAs. T-test of lipid parameters was performed between those with and without anti-lipid agents.

RESULTS: Mean values were: age 54.7; BMI 28.9; TC 186.8; LDL 108.2; HDL 42.4; TG 133.5; 98% males; 38% on anti-lipid medications. BMI, lipid components and the ratios of TC/HDL and TG/HDL among three groups are shown in the table. Anti-lipid agents did not affect the lipid analysis.

CONCLUSION: There was more isolated low HDL than low HDL with high TG in our non-diabetic population. Increasing BMI was significantly associated with both low HDL groups. Compared to normal group, the ratios of TC/HDL and TG/HDL were significantly higher in patients with low HDL, especially those with low HDL and high TG. TC values were significantly different in normal HDL and low HDL groups, but did not correspond well to TG values. We may need to include TG value when studying the impact of low HDL on CVD. Prospective studies in an age and gender diverse population are warranted.

PROSPECTIVE COMPARISON OF SCORES AND CLINICAL JUDGMENT TO PREDICT MAJOR BLEEDING IN PATIENTS RECEIVING ORAL ANTICOAGULANTS Jacques Donze 1; Nicolas Rodondi 2; Pierre Monney 3; Gerard Waeber 3; Jacques Cornuz 2; Drahomir Aujesky4.
1Brigham and Womens Hospital, Boston, Massachusetts ; 2Department of ambulatory and community care, Lausanne, N/A ; 3University of Lausanne, Lausanne, N/A ; 4University of Bern, Bern, N/A . (Tracking ID # 10370)

BACKGROUND: The benefit of oral anticoagulant therapy in preventing thromboembolism must be weighed against the risk of bleeding. Clinicians often use subjective clinical judgment to estimate a patients bleeding risk. As a decision aid, several objective clinical scores that predict the risk of bleeding in patients treated with oral anticoagulants have been developed. These include the Outpatient Bleeding Risk Index (OBRI) for unselected patients and the Shireman, HEMORR2HAGES, and HAS-BLED scores for patients with atrial fibrillation, the most common indication for oral anticoagulation. We sought to compare the performance of these 4 clinical scores and clinical judgment in predicting the risk of major bleeding in a cohort of patients receiving oral anticoagulants.

METHODS: We prospectively enrolled consecutive patients receiving oral anticoagulants at the department of medicine and ambulatory and community care of a Swiss university hospital (January 2008 to March 2009). The outcome was the first major bleeding event within 12 months of enrolment. We classified patients into three

classes of bleeding risk (low, intermediate, and high) according to each score and the treating physicians clinical judgment with regard to bleeding risk. The treating physicians had an average clinical experience of 4 years (SD 3.4). We assessed the discriminatory power to predict major bleeding by calculating the area under the receiver operating characteristic (ROC) curve of each score and clinical judgment.
RESULTS: We enrolled a total of 515 anticoagulated patients (mean age =71.2 years; female gender=36.1 %). The incidence of major bleeding was 6.8% (35/515) at 12 months. The major bleeding rates varied from3.0% to 6.2% among patients at low-risk of bleeding and from 4.5% to16.7% among patients at high-risk of bleeding using the various scoring systems and clinical judgment. The discriminative power of the 4 clinical scores and clinical judgment to predict major bleeding did not differ significantly and was generally poor, with areas under the ROC curve ranging from 0.54 to 0.58 (P=0.89; Table). In the subgroup of 314 patients with atrial fibrillation, the 12-month incidence of major bleeding was 6.4% (20/314). The discriminative power of the 4 scores and clinical judgment was similarly poor, with areas under the ROC curve from 0.51 to 0.59 (P=0.82; Table).
CONCLUSION: Our results indicate that neither clinical judgment nor clinical scores have sufficient power to discriminate between anticoagulated patients who are at high-risk of major bleeding and those who are not. New, accurate risk stratification methods with sufficient discriminative power to predict the risk of bleeding in patients under oral anticoagulants are needed.
RACIAL VARIATION WITH FACTOR V LEIDEN MUTATION Rosa M Michel Ortega 1; Amy Hughes 1; Javier Munoz 1; Adepeju Jinadu 1; Amr Hanbali 1; Philip Kuriakose1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 10375)
BACKGROUND: A mutation in the factor V gene (factor V Leiden) has been shown to be related to abnormal blood clotting. The factor V Leiden allele is present in about 5% of Caucasian individuals and even less commonly found in people of African and Asian descent, suggesting a single origin of the mutation. Despite the low prevalence of the mutation (near 1%) in African-Americans, the test is frequently performed by internists and specialists during the work-up of thrombophilia. We examined the associations between factor V Leiden mutation and venous thrombosis among African-Americans at our tertiary care center in the city of Detroit, with particular emphasis on whether a positive test resulted in a change in the patients management. METHODS: This retrospective chart review descriptive study comprised a population of 1,850 patients with venous thromboembolism (VTE) obtained by ICD code at our institution from January 2005 to January 2009.
RESULTS: Out of 1,850 patients with VTE, 104 patients comprising all ethnicities were tested for factor V Leiden mutations. Out of those 104 patients tested for factor V Leiden, 94 patients (90.3%) were negative for the mutation and 10 patients (9.6%) were positive (Table 1). Patients across all ethnicities with positive test results exhibited a heterozygous factor V Leiden mutation with no cases of homozygous mutations being seen. Most of the cases (70%) were not requested by a hematologist and were instead more commonly ordered by the internist. Of note, the immediate management of each particular patient did not change based on the results of the factor V Leiden testing (100%). We then further examined the patient population in regards to ethnic distribution. The ethnic distribution of our patient population (Algorithm 1) included 1060 African-Americans, 682 Caucasians, 30 Asians, 18 Hispanics and 12 Middle Eastern patients. Race was documented as other or not specified in 48 patients. Out of 1,060 African-Americans with VTE, 53 patients were tested for factor V Leiden gene mutation and only 3 cases (0.2%) were heterozygous for such mutation. As noted above, no homozygous factor V Leiden cases were detected irrespective of the ethnic group studied.
CONCLUSION: Ethnic stratification is important in developing cost-effective selective screening programs to identify individuals at risk for thrombophilia. There is little evidence that the identification of inherited thrombophilias, such as factor V Leiden gene mutation, dictates a change in management of duration of anticoagulant therapy for patients with VTE. This fact seems to be particularly true in the African-American population due to its very low incidence. Careful history and physical exam remain the most important tools to decide the management of patients with VTE surpassing any laboratory testing including factor V Leiden gene

mutation.
Table 1
Clinical score All
patients (n=515)
Patients with atrial fibrillation
(n=314)
Area under the ROC curve (95% CI)
Table 1
0.56 (0.50, 0.62) 0.58 (0.50, 0.66)
Shireman score 0.57 (0.48,
0.55) 0.56 (0.44, 0.67)
HEMORR2HAGES score 0.58 (0.50,
0.67) 0.59 (0.48, 0.70)
HAS-BLED 0.54 (0.46,
0.61) 0.58 (0.48, 0.67)
Clinical Judgment 0.55 (0.46,
0.65) 0.51 (0.38, 0.64)
Patient Race Setting Request by 1 Caucasian Outpatient Hematology2 Caucasian Outpatient Internist3 Caucasian Inpatient Internist
4 African-
American Outpatient Hematology5 Caucasian Inpatient Neurology
6 African-
American Outpatient Internist
7 African-
American Inpatient Nephrology8 Caucasian Outpatient Hematology9 Middle-Eastern Outpatient
Outpatient Bleeding Risk Index

Algorithm 1. Ethnic distribution of 1,850 patients with venous thromboembolism (VTE).

INTEGRATING PATIENT-REPORTED INFORMATION INTO AN ELECTRONIC MEDICAL RECORD TO ENSURE SAFE PRESCRIBING TO WOMEN OF CHILDBEARING POTENTIAL Sanithia Williams 1; Rachel Hess 1; Sara M Parisi 1; Steven Handler 1; Grant Shevchik 2; Wishwa Kapoor 1; Eleanor Bimla Schwarz1. 1University of Pittsburgh, Pittsburgh, Pennsylvania; 2UPMC, Pittsburgh, Pennsylvania. (Tracking ID # 10376)

BACKGROUND: Certain medications should not be used by women who are pregnant or breastfeeding. Primary care providers are charged with counseling women about the risks that may be posed by medication use, however, it is challenging for clinicians to routinely assess womens pregnancy intentions, use of contraception, and lactation status. METHODS: We developed a system that uses wirelessly-networked tablet computers to allow women to enter pregnancy, contraception and lactation information which is then automatically extracted and transferred into the patients electronic medical record prior to their visit with a primary care provider. We implemented this system at two community-based primary care practices in Western Pennsylvania. RESULTS: Over a 7-month period, 962 female patients entered pregnancy, contraception, and lactation information that was extracted from a tablet computer into their patient record prior to their visit with a provider at two community-based primary care practice in Western Pennsylvania. On average, these female patients were 35 (+/10) years
old. Introduction of this system did not significantly increase wait times at the clinics front desk. Information that

might affect prescribing decisions was entered by 360 (37%) women. Current pregnancy or an effort to conceive was reported by 40 (4%) of women, while another 33 (3%) stated they wouldnt mind becoming pregnant. Among the 856 (89%) who stated they were not trying to become pregnant, 60 (7%) were using no method of contraception while 214 (25%) were relying on relatively ineffective, behavioral or barrier methods of contraception. Thirteen women (1%) reported currently breastfeeding an infant. Notably, only 10 women (<1%) selected the prefer not to answer option when the tablet stated, Some of the medicines that your doctor may prescribe can be harmful during pregnancy. We feel it is important to understand each patients plans and risks for pregnancy. Are you currently pregnant or trying to become pregnant?
CONCLUSION: Systematic collection of patient-reported reproductive health information in the primary care setting is feasible, acceptable to women, and has the potential to reduce unsafe prescribing to women of childbearing age.

MULTISOURCE EVALUATIONS OF RESIDENTS FROM THE VIEWPOINT OF THE EVALUATORS Susan Michelle Nikels 1; Suzanne Brandenburg2. 1University of Colorado Hospital, Denver, Colorado; 2University of Colorado, Denver, Colorado. (Tracking ID # 10385)

BACKGROUND: Multisource evaluations of residents are required by the Accreditation Council for Graduate Medical Education (ACGME), but there are no previous studies indicating the best way to collect this data from a range of healthcare professionals with varying amounts of contact and diverse types of interactions with residents. The purpose of this study is to gather input from non-physician continuity clinic staff (nurses, medical assistants and administrative staff) regarding their comfort with and ability to assess various aspects of resident performance and behavior.
METHODS: Based on the input of a focus group, we prepared and distributed an anonymous survey to the non-physician staff at 6 Internal Medicine Residency Continuity Clinic sites all associated with the University of Colorado Internal Medicine Residency program. The survey was designed to gather opinions on what competencies the staff members think they are qualified to assess and have adequate opportunity to observe in the residents with whom they interact. Respondents completed a 16-question survey about their participation in resident evaluations. They were asked about their perceptions of resident evaluations using a 4-point response scale (1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree). Questions addressed respondents age, degree, position, years experience, experiences providing feedback to residents and preferences regarding frequency and method of providing feedback. One item asked respondents how well they could evaluate 12 resident behaviors using a 3-point response scale (1 = not able to evaluate; 2 = somewhat able; 3 = very well). Based on an exploratory factor analysis of these behaviors (principal axis extraction with varimax rotation) we developed three scales: Professional Behavior, Medical Knowledge and Judgment, and Patient Interaction. Because the number of items differed for each scale, item means were calculated. Descriptive analyses were conducted to characterize the sample, beliefs about participation in resident evaluations and experiences providing feedback to residents. To examine whether respondents differed in their ability to evaluate the three types of resident behavior, paired t-tests comparing nurses and other clinic staff were estimated.
RESULTS: There were 61 responders to our survey consisting of nursing staff, medical assistants and administrative staff of the 6 participating internal medicine outpatient clinics. Among the responders, nurses tended to be older and have more job experience. Overall, the clinic staff agreed that it was important to formally evaluate the residents (86.9% agree or strongly agree), although the nurses tended to more strongly agree. When asked how well they could evaluate 12 resident behaviors, all staff were more likely to feel they could evaluate professional behaviors very well (62.1% respect to staff; 61% professional dress/attire; 54.2% communication skills with staff; 43.9% ability to work as part of a team). Although overall respondents were not comfortable evaluating medical knowledge and judgment (45.6% felt not at all able to assess adequacy of

medical knowledge; 41.1% not at all able to evaluate clinical judgment), nurses were more comfortable than other staff members in evaluating these competencies. Limited contact with the residents was cited by 85.7% of respondents as the biggest barrier to evaluating the residents. Lack of confidentiality was not a significant concern in the evaluation process (1.8%). Significant feedback is still given verbally rather than on formal written evaluations.
CONCLUSION: Non-physician clinic staff members agree that it is important to evaluate residents and they feel secure that evaluations are handled confidentially. Clinic staff members are most comfortable providing feedback on professional behaviors and significantly less comfortable giving feedback on medical knowledge. Nurses are more confident providing feedback on clinical judgment and medical knowledge than other staff members. How much of this is related to age and job experience is unclear. A significant amount of feedback is provided verbally to residents and/or to the attending physicians supervising the residents but not necessarily captured in a formal written evaluation process as required by the ACGME. Future work should look at ways to capture real time verbal feedback and attempt to standardize the competencies we ask our non-physician staff members to evaluate.

INFLUENCE OF DEBT AND ANTICIPATED INCOME ON MEDICAL STUDENT CAREER CHOICE IN INTERNAL MEDICINE Martha Grayson 1; Dale Newton 2; Lori Foster Thompson3. 1Albert Einstein College of Medicine, Bronx, New York ; 2Brody School of Medicine, East Carolina University, Greenville, North Carolina ; 3North Carolina State University, Raleigh, North Carolina . (Tracking ID # 10397)
BACKGROUND: Recent studies suggest that increasing debt and desire for higher incomes may be influencing medical student career choice. This study examines career decisions of students who begin medical school intending to pursue careers in Internal Medicine. The objectives were to determine how debt, the self-rated importance placed on income, and future income projections relate to intentions to pursue a subspecialty in Internal Medicine (IMSS) rather than General Internal Medicine (GIM). The anticipated salary changes were also examined for those students switching out of Internal Medicine.
METHODS: Students at New York Medical College and Brody School of Medicine at East Carolina University were surveyed annually at matriculation (M1) and just prior to graduation (M4). The data set included 17 consecutive years of M1 surveys and 16 years of M4 data. The overall response rate was 81%. The responses of students who expressed an interest in Internal Medicine at either M1 or M4 were analyzed. Additional analyses focused on the subset of students who expressed an interest in Internal Medicine at M1 and subsequently completed a follow-up survey at M4, yielding paired data that enabled the investigation of trends over time. Overall, the analyses examined the relationships among the following factors: reported debt (in dollars), anticipated income 5 years after residency (in dollars), student reported influence/ importance of income on career choice (Likert scale rating), association of self-rated importance of income with anticipated income, and stated career choice.
RESULTS: 239 M1 students expressed interest in GIM; 404 in IMSS. By graduation, these numbers changed to 277 and 343 respectively. The trends in Table 1 were identified. Longitudinal changes in anticipated income were also documented. Students aspiring to GIM at M4 expected $139 K ($14 K more than what they anticipated at M1); those aspiring to Internal Medicine subspecialties expected $179 K (up $43 K from what they anticipated at M1); those who switched out of Internal Medicine expected $207 K (up $62 K from M1).
CONCLUSION: Both debt and expected income may push medical students initially interested in General Internal Medicine towards a career in a subspecialty of medicine or to a career in another specialty outside of Internal Medicine. Changes in the payment system to more properly reimburse general internists may be needed to attract talented students whose financial concerns may otherwise discourage them from pursuing a generalist career. Since concern about debt is associated with career choice, new loan forgiveness programs linked to practice in General Internal Medicine should also be developed as a method to assist in sustaining the numbers of students choosing this career path.

A POSITIVE PHQ-2 DEPRESSION SCREEN AMONG HOSPITALIZED HEART FAILURE PATIENTS IS ASSOCIATED WITH LOWER LEVELS OF QUALITY OF LIFE AND PREDICTS ELEVATED 12-MONTH MORTALITY RISK
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BACKGROUND: Heart failure (HF) affects over 5.7 million Americans, with over 660,000 newly diagnosed cases, 290,000 deaths, and $37 billion in treatment costs incurred yearly. One potential contributor to poor outcomes is unrecognized depression. An American Heart Association (AHA) Science Advisory has advocated routine screening of cardiovascular disease patients for depression to identify those who may require further assessment and treatment with use of the two-item Patient Health Questionnaire (PHQ-2) at a minimum (Circulation, 2008; 118:1768). Yet, the value of a positive PHQ-2 screen among HF patients is unknown.
METHODS: We administered the PHQ-2 to HF patients (ejection fraction (EF) <40%) with NYHA class II-IV symptoms prior to discharge from 4 Pittsburgh-area hospitals. We defined a positive depression screen as one or both PHQ-2 items endorsed affirmatively (In the past two weeks have you: (a) had little interest or pleasure doing things; or (b) felt down, depressed or hopeless; PHQ-2 (+)), and a negative screen as both items endorsed negatively (PHQ-2 ()). According to prespecified sample size calculations, we oversampled PHQ-2 (+) to PHQ-2 () patients. Then, at baseline, we collected sociodemographic and clinical data, and later contacted patients or their designated secondary contacts (e.g., spouse, adult child) via telephone to ascertain vital status. Later, a study physician blinded as to subjects baseline PHQ-2 status reviewed each report of death, including hospitalization records and death certificate, and assigned a cause of death. We evaluated differences between study cohorts defined by PHQ-2 status for statistical significance using t- and chi-squared tests for baseline data, and log-rank tests for 12-month incidence of all-cause and cardiovascular mortality calculated from Kaplan-Meier analyses with Cox models to adjust for baseline covariates.
RESULTS: Over a 16-month period ending 4/09, 610 HF patients consented to our screening procedure; 526 (86%) were both NYHA and PHQ-2 eligible; and 473 (90%) met all other study requirements. Compared to PHQ-2 () patients (n=101), PHQ-2 (+) patients (n=372) were younger (65 vs. 70), more likely to have NYHA III/IV symptoms (67% vs. 39%), and reported lower levels of physical (SF-12 PCS: 30.7 vs.34.3) and mental health-related quality of life (SF-12 MCS: 44.4 vs.58.5) (all p<0.002). However, they were similar on other baseline clinical and sociodemographic characteristics (e.g., 65% male, 85% White, 41% diabetic, 25% mean EF). We confirmed vital status on all 473 study patients (100%) as of 12/31/09 and identified 83 deaths, including 55
(66%) for cardiovascular causes. At 12-months follow-up, 20% of PHQ-2 (+) vs. 8% of PHQ-2 () patients had died (p=0.007), and PHQ-2 (+) status remained associated with both increased all-cause (hazard ratio (HR): 3.0 (95% CI: 1.4-6.4); p=0.004) and cardiovascular mortality (HR:2.6 (1.1-6.3); p=0.03) even after adjustment for age, gender, EF, NYHA class, diabetes, hyponatremia, ACE-I/ARB use, antidepressant use, and a variety of other baseline covariates.
CONCLUSION: Among hospitalized HF patients, a positive PHQ-2 depression screen prior to discharge home is associated with lower levels of HRQoL and elevated mortality risk at 12-month follow-up. While our findings support the AHA Science Advisory for HF patients, clinical trials remain necessary to determine whether effective depression treatment can improve health-related quality of life and reduce mortality in this medically ill population.
PATIENT AND SERVICE LEVEL ASSOCIATIONS WITH THE QUALITY OF END OF LIFE CARE AT AN

ACADEMIC MEDICAL CENTER Anne Walling 1; Karl Lorenz 2; Steven Asch 2; Neil Wenger1. 1University of California, Los Angeles, Los Angeles, California; 2VA Greater Los Angeles Healthcare System, Los Angeles, California. (Tracking ID # 10415)

BACKGROUND: Little is known about what influences the quality of end of life care. We evaluated the relationship between patient clinical and demographic characteristics and inpatient clinical service with the quality of end of life care among patients dying in the hospital. METHODS: Medical records were abstracted for 496 adult decedents hospitalized for at least 3 days between April 2005 and April 2006. Sixteen of the Assessing Care of Vulnerable Elders (ACOVE) quality indicators (QIs) that focus on end of life care (communication and symptom management) were measured and an overall patient-level quality score was calculated. Because patients triggered different QIs with varying pass rates, the observed quality score for each decedent was compared against the expected score of a hypothetical patient who had triggered the identical QI pattern to compute an observed-minus-expected score. Bivariate relationships between quality and patient characteristics (age, sex, race, ethnicity, religion, insurance status, marital status, pre-hospital venue, mental status on admission, and presence of end stage disease on admission) and clinical service were studied. Because specific end stage disease was highly correlated with clinical service (cancer and oncology service, liver disease or transplant with liver service, all rs>0.6 and ps<0.001), we evaluated the association of quality with patient characteristics and clinical service in separate regression equations. Published literature suggests that a minimally clinically significant difference in quality is approximately 510%. RESULTS: In bivariate analyses, patients with advanced cancer and patients admitted to the oncology service received significantly higher quality scores and lower quality was associated with Hispanic ethnicity, being considered for transplant, not having religion documented in the medical record, admission to the liver service, and admission to a

surgical intensive care unit. In a linear regression model that included all patient characteristics, patients who were considered for transplant during the admission received lower quality end of life care. Adjusting for all other variables, patients considered for transplant received 7% lower quality score compared to patients not considered for transplant (p=0.02). Lack of documentation of a patients religion in the medical record was associated with a 10% lower quality score compared to Christian/Protestant patients (p=0.02). In a linear regression model that included all patient services, patients cared for by a surgical intensive care unit received 9% lower quality compared to patients on a medical service (p=0.03).

CONCLUSION: This analysis identified factors associated with lower quality inpatient end of life care that can be targeted for quality improvement. Potential organ transplant recipients and patients admitted to the surgical intensive care unit at the facility studied are at particular risk for lower quality treatment at the end of life. The role of attention to religion and whether similar influences exist at other hospitals merits study.

THE ROLE MODELS OF BEDSIDE TEACHERS: A QUALITATIVE ANALYSIS Jed Gonzalo 1; Briar Leigh Duffy 2; Dario Torre 3; David Elnicki4. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts ; 2University of Pittsburgh/VA Pittsburgh, Pittsburgh, Pennsylvania ; 3University of Pittsburgh, Pittsburgh, Pennsylvania ; 4University of Pittsburgh, Wexford, Pennsylvania . (Tracking ID # 10422)

BACKGROUND: The attributes of excellent physician role models include teaching that is focused on the importance of the doctor-patient relationship, competence in the clinical setting, and spending time with learners while conducting rounds on the wards. Although bedside rounds have traditionally been integral to teaching services, their frequency has decreased, despite learner and patient preferences for this method of rounding. In a changing healthcare environment, where pressure for clinical productivity leads to reduced teaching time at the bedside, it is important to explore the opinions of experienced bedside teachers about what constitutes a quality bedside teacher. Therefore, we sought to identify characteristics perceived by bedside teachers to be associated with quality bedside teachers.

METHODS: Using purposeful sampling, we identified 11 academic institutions and a site principal investigator at each location to identify physicians who perform bedside rounds according to a pre-determined definition and actively serving as inpatient attending on teaching services. From February to November of 2010, 2 investigators conducted digitally-recorded, semi-structured, one-on-one telephone interviews, each lasting 1 hour, and consisting of open- and closed-ended questions pertaining to prior education on bedside rounds and the role models whom they identified as quality bedside teachers. Each interview was transcribed verbatim and an inductive thematic qualitative analysis was completed coding the transcripts for emerging themes. Participant comments were reviewed multiple times, coded into themes, and reduced to 5 categories. Quality control was maintained with 2 independent researchers coding the data, verifying codes, and developing the category system. The Institutional Review Boards at all institutions approved the study.
RESULTS: Ten institutions completed IRB submission and identified a minimum of 3 participants for inclusion. We completed thirty-four interviews, the majority with assistant professors (44%). The participants averaged 13.7 years of academic experience and 18 weeks on the teaching services with housestaff over the previous 2 years. Most participants did not receive formal education on bedside rounds during residency (85%), fellowship (79%), or faculty time (65%). All participants identified a physician whom they labeled as an equality bedside teacher. In response to why they were considered an equality bedside teacher, 5 thematic categories were identified: modeling of clinical actions, modeling compassionate patient-physician interactions, interactive teaching by engaging all participants, patient-centered teaching, and integration of knowledge and clinical practice.
CONCLUSION: The professional development of the bedside teachers was positively impacted by physicians who taught at the bedside, as all participants identified a quality bedside teaching role model. The characteristics of excellent role models have been shown to include spending time on rounds with housestaff and demonstrating the physician-patient relationship, both of which were reiterated in our study. In addition, the specific attributes identified in quality bedside teaching role models embody the integration of the patient and learner at the bedside. With the downward trend in bedside rounds, the opportunities to model humanistic, patient-centered learning, which are more difficult to demonstrate in the classroom, are being lost. Faculty development efforts to promote bedside skills with these patient-centered attributes may assist in developing the next generation of quality bedside teachers.
ASSESSING VARIATION IN PPI DISCONTINUATION IN VA LONG-TERM CARE Amy Linsky 1; John A. Hermos 2; Michael Shwartz 3; James L. Rudolph4. 1Boston Medical Center and Center for Organization, Leadership, and Management Research, VA Boston Healthcare System, Boston, Massachusetts ; 2Massachusetts Veterans Epidemiology Research and Information Center, VA Cooperative Studies Program, VA Boston Healthcare System, Boston, Massachusetts ; 3Center for Organization, Leadership, and Management Research, VA Boston Healthcare System, Boston, Massachusetts ; 4Geriatric Research Education and Clinical Center, VA Boston Healthcare System, Boston, Massachusetts . (Tracking ID # 10429)
BACKGROUND: Proton pump inhibitors (PPI) are commonly prescribed medications that are often initiated and continued without clear indication, contributing to overmedication. We previously determined that within Veterans Affairs (VA) long-term care facilities, patient characteristics were only weakly associated with PPI discontinuation within 180 days of admission, but we did not account for variability between facilities. Our current objective is to analyze PPI discontinuation across these VA facilities and to determine the amount of variability accounted for at the patient- and facility-levels.
METHODS: We linked national VA administrative and pharmacy data with Minimum Dataset patient assessments to identify patients admitted to VA long-term care in 2005 who were prescribed an oral PPI within seven days of admission, stayed a minimum of seven days, and were not receiving hospice care. This yielded 9,589 patients (baseline PPI users) across 115 facilities. Our primary outcome was PPI discontinuation within 180 days of admission, with an intermediate assessment at 28 days. Facility-level characteristics included

annual admissions and average daily census (size). Patient-level characteristics included age, sex, pre-admission PPI prescriptions and hospitalizations, number of medications, functional status, and comorbidities. Facility-level prevalence of baseline PPI use equaled the number of baseline PPI users relative to number of admissions. Facility-level PPI discontinuation equaled the number of discontinuations relative to the number of baseline PPI users. Descriptive statistics summarized facility-level characteristics. Separate simple linear regressions associated both baseline PPI prevalence and discontinuation with both facility admissions and size. Hierarchical linear models, which account for the clustering of patients within facilities, partitioned the variation in PPI discontinuation across patients and facilities.
RESULTS: The 115 facilities had a mean of 311 annual admissions (SD 221) and an average daily census of 104 patients (SD 64). At the facility-

level, the median proportion of baseline PPI users was 28% (IQR 21-35%). There was no statistically significant association between prevalence of baseline PPI use and facility size. At the facility-level, within 28 and 180 days of admission, the median proportions of baseline PPI users with a discontinuation were 10% (IQR 5-15%) and 34% (IQR 20-45%), respectively. In separate linear regression models, greater discontinuation was associated with more admissions (28 days, p=0.003; 180 days, p=0.002) but not with facility size (28 days, p=0.63; 180 days, p=0.81). Within 180 days, we identified that 7% of the total variance in PPI discontinuation occurred between facilities, of which 13% was due to facility size. The remaining 93% of the variance occurred within facilities, of which 5% was due to the included patient characteristics. Within 28 days, the variation in PPI discontinuation was similarly partitioned across patients and facilities.
CONCLUSION: A greater proportion of variability in PPI discontinuation was found within facilities compared to between facilities, but the patient- and facility-level characteristics we analyzed explained little of the variance in PPI discontinuation. Therefore, other factors associated with medication discontinuation need to be identified in order to better address overmedication among elderly long-term care residents.

HOSPICE CARE AND RESOURCE UTILIZATION IN MEDICARE BENEFICIARIES WITH HEART FAILURE

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BACKGROUND: Hospice use is increasing in the heart failure population, but its effect on both the cost and intensity of care in this population has not been well examined. We evaluated whether use of hospice care was associated with decreased expenditures and other markers of resource utilization among Medicare beneficiaries with heart failure near the end of life.
METHODS: Using a national 5% sample of Medicare claims data, we performed a cross-sectional analysis of resource utilization among beneficiaries during the last six months of life. We included all beneficiaries over the age of 65 with a heart failure diagnosis who died in 2007. The diagnosis of heart failure was established using the International Classification of Diseases, Ninth Revision (ICD-9) code 428 listed as either a hospital discharge diagnosis or in at least two physician claims in the year preceding the last six months of life. Beneficiaries were considered to have hospice enrollment if Medicare had reimbursed at least one day of hospice services during the last six months of life. Markers of resource utilization included total Medicare expenditures, number of hospitalizations, and number of intensive care unit (ICU) days. We also evaluated performance of certain procedures, including cardiac catheterization, non-invasive ventilation, and mechanical ventilations. We used negative binomial regression models to compare costs, hospitalization rates, and ICU days between hospice and non-hospice beneficiaries, adjusting for covariates, including age, gender, race, geographic location, comorbidities, and prior hospitalizations. Log-linear regression models were used to

compare utilization of procedures between hospice and non-hospice beneficiaries with adjustment for covariates.
RESULTS: Of the 16,613 beneficiaries who died with heart failure in 2007, 6,436 (38.7%) received hospice care during the last six months of life. Hospice care was more common in women, older patients, residents of the South or Midwest regions, and in patients with cancer or dementia. The mean total medical expenditures during the last six months of life were $31,793 (SD 25,691) among beneficiaries with hospice care, in comparison to $34,067 (SD 40,561) among beneficia-
ries without hospice care. However, after adjustments for covariates, hospice care was associated with 4% higher expenditures (cost ratio 1.04, 95% CI 1.01-1.07; p=0.02). The most important confounders appeared to be age, race, and geographic location. Expenditures related to hospice services accounted for 23% (mean $7,462) of total expenditures among individuals who had received hospice care. Hospice use was associated with lower rates of hospitalization (adjusted incidence rate ratio (aIRR) 0.87, 95% CI 0.84-0.89) and ICU days (aIRR 0.68, 95% CI 0.63-0.73). Hospice use was also associated with performance of fewer medical procedures, including cardiac catheterization (adjusted prevalence ratio (aPR) 0.63; 95% CI 0.52-0.75), noninvasive ventilation (aPR 0.67; 95% CI 0.57-0.79), and mechanical ventilation (aPR 0.33; 95% CI 0.29-0.37). CONCLUSION: Despite lower rates of hospitalization, ICU days, and invasive procedures, hospice care was associated with higher expenditures for heart failure patients following adjustment for covariates. Within Medicare, financial savings related to reduced intensive medical care appears to be offset by the expenditures related to hospice care itself. Hospice for heart failure patients should focus on quality of life and patient preferences; cost savings should not be expected.
MOVING INTO TEAM-BASED CARE: FIRST STEPS TOWARDS THE PATIENT-CENTERED MEDICAL HOME IN A UNIVERSITY-BASED PRACTICE Rita S. Lee 1; Kelly J. White 1; Susanne Felton 1; Amy G. Huebschmann1. 1University of Colorado, Denver, Colorado. (Tracking ID # 10442)
BACKGROUND: There is a national movement to transform primary care practices into patient-centered medical homes (PCMH). One of the 7 joint principles of the PCMH is that the personal physician leads a team of individuals at the practice level to collectively take responsibility for the ongoing care of patients. Thus, a necessary step to become a PCMH is to organize physician-led teams. Academic general internal medicine practices struggle to achieve team-based care due to a lack of dedicated funding or protected time to develop this infrastructure. We piloted a model of team-based care in a University-based general internal medicine practice. Our goals were to increase provider, staff, and patient satisfaction, and to improve patients continuity of care. METHODS: Our team-based care pilot included 9 providers (8 physicians, 1 physician assistant), 1 nurse (RN), and 2 medical assistants (MA) approximately 1/3 of the practice. We held 1-hour team meetings twice per month for the first 3 months and monthly thereafter. The team identified areas for improvement and devised strategies to achieve organized team-based care. To optimize team efficiency, we increased RN and MA duties within the scope of their practices. Ten months after initiating the team pilot, we assessed provider, staff, and patient satisfaction. All providers (n=29) and staff (n=27) were surveyed anonymously regarding overall job satisfaction, time spent on paperwork and phone calls, and collaboration with RNs, MAs, or clinic administrative staff. Telephone surveys of a random sample of 40 patients were also conductedwith half followed by providers in the team-based pilot. Survey questions addressed ease of appointment scheduling, availability of appointments, and seeing the provider of their choice. Differences between team and non-team provider, staff, and patient satisfaction were analyzed using the Cochran-Mantel-Haenszel test. Continuity of care measures were assessed as the percentage of visits with a single provider or only team providers over comparable pre-intervention and post-intervention time periods and analyzed using the Chi-Square test.
RESULTS: We found no statistically significant differences between team and non-team providers for overall job satisfaction, amount of time spent doing paperwork, time spent on phone calls, control over work environment, and collaboration with nurses or clinic administrative staff. Team-based providers reported a greater level of

satisfaction in collaborat-

ing with medical assistants as compared to non-team providers (p=0.01). There were no significant differences in any patient satisfaction measures in team vs. non-team patients. There was no significant difference in continuity of care measures pre- and post-intervention. CONCLUSION: Moving from a clinical practice that is autonomously provider-driven to provider-led team-based care is feasible in a University-based general internal medicine practice without adversely impacting patient, provider, or staff satisfaction. Using the lessons learned from the team pilot and the data gathered, we expanded the team model to the entire practice. The transition into teams has been facilitated by moving in a thoughtful, staged, and data-driven manner.

A COMMUNITY-BASED, CULTURE-CENTERED APPROACH FOR DEVELOPING EFFECTIVE HEART DISEASE PREVENTION MESSAGES FOR RACIAL/ETHNIC MINORITIES Namratha R Kandula 1; Neerja Khurana 1; David Baker 1; Sara Glass 2; Quinn Stephens 1; Manasi Tirodkar 3; Gregory Makoul4.
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BACKGROUND: Despite increasing calls for coronary heart disease (CHD) prevention efforts to target minorities, little is known about how best to target CHD prevention messages to different racial/ethnic groups. We used a community-based, culture-centered approach to develop a multimedia CHD prevention education program (PEP) targeted to South Asian (Asian Indian and Pakistani) immigrants, a group that has higher rates of CHD than other U.S. racial/ethnic groups. METHODS: The PEP included six, 5-minute video modules (brief text, narration, simple graphics, and photographs) about CHD, risk factors, and prevention. The PEP content was developed from formative qualitative and quantitative interviews with South Asians, health communication and behavior theory, and CHD prevention guidelines. Both surface structures (e.g. language, foods) and deeper structures (e.g. health beliefs, values) of South Asians socio-cultural context were integrated into the PEP. Prototype modules were shown in focus groups to English and Hindi-speaking community members recruited from a Federally Qualified Health Center and 2 South Asian community centers in Chicago. Participants commented on the content, clarity, and cultural-appropriateness of each module. Twenty focus group discussions (n=120) were conducted. Audio-taped discussions were transcribed, translated, and back-translated. In this iterative process, emergent thematic categories were organized using theoretical constructs underlying the PEP; the PEP was revised based on focus group themes, and then re-shown in focus groups. Here, we present focus group data related to the first module, What is Heart Disease? RESULTS: Participants mean age was 51 years (range 2075), and 66% were women. All were immigrants and had lived in the U.S. an average of 13 years. Sixty percent spoke English, and 66% were college graduates. To capture audience attention and increase perceived susceptibility to CHD, the initial opening statement in the first module was, Heart attack is the number one killer of Indians and Pakistanis. Most participants said this statement was too strong and direct; one participant stated, This looks like a bold attack because you are pinpointing one community. Others agreed, noting, Heart attacks happen in all communities. The opening statement has now been modified to: Heart attack is the number one killer of people around the world. Studies show that Asian Indians and Pakistanis are more likely to have heart attacks than people from other communities. Participants also said that the opening image, of an older South Asian woman, did not capture the heterogeneity among South Asians and therefore, made them feel that they were not at risk. To address this, we added a diverse montage
of South Asians to the PEP. This image was more positively received and as one participant said it conveyed, Anyone of us can have a heart attack. Finally, the prototype PEP briefly addressed the belief that stress causes CHD because this theme had been important in formative interviews; the PEP tried to emphasize that CHD is caused by clogged blood vessels, not stress. Focus group participants said this was ineffective: You are trying

to address the myth here, but since the myth is so deep rooted and strongly believed, that just one sentence will not take it away. The revised PEP explains the relationship in more detail, acknowledges the role that stress can play in CHD, and now also includes an additional seventh module on stress management and health. CONCLUSION: A community-based, culture-centered approach to developing CHD prevention messages for South Asians led to key lessons that can guide the development of health messages for other minorities: the communitys negative reaction to the opening statement illustrates the potential tension between how researchers and communities conceptualize cultural-targeting; the importance of capturing the heterogeneity within a minority group; and incorporating, rather than negating community beliefs about disease etiology. As a next step, we will be testing whether or not the PEP can engage South Asian patients and motivate CHD prevention behaviors.

REHOSPITALIZATION RATES AND ASSOCIATED COSTS IN US MANAGED CARE PATIENTS WITH ATRIAL FIBRILLATION/ATRIAL FLUTTER Alpesh N. Amin 1; Mehul Jhaveri 2; Jay Lin3. 1University of California-Irvine, Orange, California ; 2sanofi-aventis U.S., Bridgewater, New Jersey ; 3Bruce Wong &Associates, Radnor, Pennsylvania . (Tracking ID # 10462)

BACKGROUND: Atrial fibrillation (AF) and atrial flutter (AFL) affect ~3.2 million individuals in the US, and are the leading cause of hospitalization for cardiac arrhythmia. AF/AFL impose high costs on the US healthcare system, with inpatient care being the principal cost driver. Novel antiarrhythmics show promise in reducing the risk of cardiovascular (CV) hospitalization in AF/AFL patients. However, the cost burden of AF/AFL is due not only to the initial CV hospitalization, but also to subsequent readmissions.

METHODS: In this retrospective cohort study, patients hospitalized with a primary diagnosis of AF/AFL were identified from the IMS PharMetrics Patient-Centric database (Jan 2007-March 2008). Non-AF/AFL controls were matched (1:1) to AF/AFL patients on age, gender, region, and health plan enrollment status. The date of the first qualifying (index) hospitalization of the AF/AFL patient served as the index date for the control patient. All patients had to have ~12 months continuous pre- and post-index enrollment. Rehospitalization patterns were assessed over the 12-month post-index period, and costs of initial and subsequent AF/AFL-related hospitalizations were compared. RESULTS: Overall, 5,091 patients (mean age 67.1 years; 56.8% men) were included in each cohort. AF/AFL patients had higher rates of CV comorbidity than controls. Compared with the control cohort, the AF/ AFL cohort had a significantly higher rate of all-cause rehospitalization (OR 6.4, 95% CI 5.5-7.5; P<0.0001) and CV-related rehospitalization (OR 9.2, 95% CI 7.6-11.0; P<0.0001), after adjusting for differences in comorbidity. Cumulative readmission rates for the AF/AFL cohort over the post-index period are summarized (Table). The first readmission with a primary diagnosis of AF/AFL involved a longer hospital stay than the index hospitalization (mean 4.5 vs 3.9 days; P<0.05) and higher costs (mean total charge US$ 32,132 vs 26,669; P<0.001). CONCLUSION: Hospitalized AF/AFL patients experience high rates of CV and AF/AFL-related readmission, particularly within the first 30 and 90 days. Subsequent AF/AFL-related readmissions incur higher costs than the initial AF/AFL hospitalization.

PROVIDING SHELTER FROM THE STORM: CHARACTERISTICS OF INFORMAL CAREGIVERS FOR THE HOMEBOUND ELDERLY Ania Wajnberg 1; Kristofer L Smith 1; David Russell 2; Joseph Ross 3; Alex Federman1. 1Mount Sinai School of Medicine, New York, New York ;
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BACKGROUND: Informal caregivers, defined as unpaid friends or family members who arrange or oversee needed services because of functional disabilities, provide the majority of support for homebound adults. Caring for homebound adults may expose informal caregivers to considerable physical and emotional stress. We

therefore conducted a survey of informal caregivers of the homebound elderly to examine their level of caregiver burden, depression and satisfaction with care. METHODS: Between June and November 2010, we recruited home-bound patients newly enrolled in two home-based care programs, the Mount Sinai Visiting Doctors (MSVD) program and the Visiting Nurse Services of New York Long-term Home Health Care Program (Lombardi). We included patients aged >65 who were English- or Spanish-speaking, were able to provide consent, and had difficulty leaving their homes. All enrolled homebound patients were screened for the presence of an informal caregiver. Caregivers were surveyed and characterized with respect to socio-demographic characteristics, employment status, and time spent in the caregiving role. Caregiver burden was measured using the Zarit Burden Scale with severe burden defined as a total score >24 points; presence of depression was measured using the Center for Epidemiologic Studies Depression scale (CES-D) with definite depression defined as a total score greater than 9. Caregiver level of satisfaction with the medical care the patients they cared for were receiving was measured using the Patient Satisfaction Questionnaire 18 (PSQ-18). RESULTS: Of 65 homebound patients interviewed, 37 (52%) identified informal caregivers and we recruited 34 caregivers (92%) for interviews. Of the caregivers interviewed, a large majority were female (74%) and were adult children of the patient (77%). Twenty three (68%) lived with the patient. Fifteen (44%) were working full time (>40 hours/week), and 4 (12%) worked part time. Six (18%) were retired, and 6 (18%) were unemployed. Eighteen (53%) had been caring for their relative/friend for over 5 years and 11 (32%) for 25 years. The majority (61%) reported spending over 20 hours per week caring for their relative/friend. On the Zarit burden scale, 12 (35%) met criteria for severe caregiver burden, and on the CES-D, 32% met criteria for definite depression. In terms of satisfaction with medical care for their relative/ friend, the mean score was 63 (SD 13, range 3888) on the PSQ-18 (range from 18 [least satisfied] to 90 [most satisfied]).
CONCLUSION: A high proportion of caregivers of homebound elderly patients meet criteria for severe burden and depression. As the number of homebound seniors grows, it will be increasingly
important to identify interventions for caregivers that can decrease burden and lessen the societal impact of illness and unemployment in the caregiving population.

ELECTRONIC PRESCRIBING WITH FORMULARY DECISION SUPPORT REDUCES PATIENT COPAY AMOUNTS Joshua Pevnick 1;
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BACKGROUND: Given the many types of health insurance that a patient may have, and the different preferred medications that each insurance company may offer, it can be difficult for a prescribing physician to know which medication will be least expensive for a given patient. Such knowledge is particularly important because lower out-of-pocket medication costs are associated with improved patient medication adherence. Several commercially available electronic prescribing (eprescribing) systems include formulary decision support that provides physicians with patient-specific formulary information. This information can be used to reduce patients out-of-pocket costs. Prior studies have shown that usage of e-prescribing with formulary decision support (EWFDS) is associated with increased prescribing of generic and lower formulary tiered medications. In this study, we examine actual copay data to measure the effect of EWFDS on patient copays. Furthermore, this analysis concentrates on smaller physician practices, which face the greatest challenges in the drive to increase health information technology (HIT) use.

In late 2004, a statewide Blue Cross Blue Shield insurer led an initiative to offer subsidized EWFDS to high volume prescribers. In a prior publication, we identified 297 primary care physicians (PCPs) who participated in this initiative by adopting this e-prescribing system during 2005. They were compared with 1892 PCPs who were also offered the system during this time period, but did not adopt it. In this study, we compare the

pharmacy claims of these PCPs assigned health maintenance organization and point-of-service primary care patients. METHODS: We analyzed pharmacy claims for drugs dispensed during 1/1/03-7/31/06. After examining the distribution of copays, we conducted bivariate analyses to measure the associations between patient copays and several physician, patient, and claim-level characteristics. We then used a difference-in-differences robust regression (DIDRR) approach to examine changes in copay amounts before and after PCPs began to use EWFDS. Adopting PCPs were categorized into three levels of e-prescribing usage (020%, 2050%, and >50%); a fourth group was comprised of non-participating PCPs. Because there was no

date of e-prescribing adoption for non-participating PCPs, we assigned each non- participating PCP a synthetic adoption date by random sampling with replacement from actual adopting PCPs adoption dates. Finally, we constructed a multivariate model using pharmacy claims as the unit of analysis. Because the intervention was not randomized, a participation variable was included to account for otherwise unmeasured baseline and persistent differences between the participating and non-participating PCPs. To measure the effect of EWFDS, we included extent of e-prescribing usage as the covariate of interest in the model. Robust regression was used to reduce sensitivity to outlying data points, which are common in cost analyses. Furthermore, several drug classes with extremely high costs were excluded. The analysis was adjusted for MD-level and patient-level covariates.

RESULTS: Of the 297 participating PCPs, 287 had a total of 19,907 primary care patients, who had a total of 0.5 million pharmacy claims. Of the 1892 non-participating PCPs, 1798 had 115,823 primary care patients with 2.9 million claims. 88% of PCPs practiced in groups of 5 or fewer physicians. The median copay was $10 (IQ range $5-$25). The distribution was positively skewed (mean $29.53, SD $272.58). Bivariate analyses showed copays to be negatively correlated with usage of EWFDS, later dates, extent of PCP prescribing with this insurer, and patient age, but positively correlated with median incomes of zip codes of patient homes and PCP offices ($p<0.0001$ for each correlation).

The DIDRR analysis showed that copays of non-participating PCPs primary care patients were $2.04/claim lower during the period after the synthetic start date of EWFDS, compared with decreases of $2.12/ claim for patients of 176 PCPs with 0-20% usage ($p=0.11$ when compared to non-participating PCPs before/after change), $2.93/claim for patients of 63 PCPs with 20-50% usage ($p<0.0001$),and only $1.80/ claim for patients of 48 PCPs with 50-100% usage ($p=0.01$). This model did not include other covariates.

The multivariate model estimated that a change from 0 to 100% EWFDS usage was associated with a copay decrease of $0.76. This decrease was mildly tempered by an estimate that copays were $0.06 higher for PCPs who participated in the e-prescribing initiative. Copays decreased by $0.13 for each later month during the time period studied. Although each 10 years of increasing patient age was associated with an $0.83 decrease in copay, primary care patients of pediatric PCPs had copays that were $2.34 less than those of internist and family medicine PCPs. Patients from zip codes with >50% Black residents had copays $2.01 less than other patients ($p<0.01$ for all estimates cited above). CONCLUSION: For the 239 PCPs who used EWFDS 0-50% of the time, it was associated with copay decreases beyond secular trends. Paradoxically, for the 48 PCPs who used EWFDS 50-100% of the time, it was associated with a relative increase in copays, when compared to the secular trend. Multivariate linear regression of EWFDS usage showed an association with decreased copays overall. The latter finding, when combined with prior studies of EWFDS that showed increased use of generic and other lower-tiered medications, suggests that EWFDS is effective overall in achieving its goal, but that it may not be effective among technophile PCPs. One possible explanation for this difference is that technophilic PCPs may be as enamored of the newest medication technology as they are of HIT.

Most other findings were consistent with expectations. Copays decreased overall during this time period, consistent with known increased use of lower-tiered medications. Higher levels of PCP-prescribing likely increased familiarity with the insurers formulary, such that these PCPs had lower copays than PCPs with fewer

pharmacy claims from the insurer. Estimates of higher patient and physician income were associated with increased copays, suggesting that resource scarcity may drive the use of less expensive medications. Further supporting this idea was the finding that patients with more claims during the study period, which represent direct costs but are also likely
indicative of other healthcare costs and decreased wealth, had lower copays. One other possible explanation for the latter finding could be increased patient familiarity with generic medications and the concept of formularies. Lower copays among primary care patients of pediatricians and among elderly patients may be explained epidemiologically. Given that African-Americans are known to place less faith in the medical profession than other groups, lower copays may be explained by consequent higher price elasticity for medical care.

COLORECTAL CANCER SCREENING IN PATIENTS WITH HIV Florence Momplaisir 1; Kathleen Brady 2; Gia Badolato 2; Judith A. Long1. 1University of Pennsylvania, Philadelphia, Pennsylvania; 2PA Department of Public Health, Philadelphia, Pennsylvania. (Tracking ID # 10488)

BACKGROUND: As HIV positive patients live longer, they become susceptible to the development of chronic diseases and cancers. Since the introduction of antiretroviral therapy (ART) in 1995, the incidence of AIDS-defining malignancies (ADMs) has declined tremendously, whereas the frequency of non-ADMs has risen disproportionately compared to the general population. Currently, there are only two published studies describing the use of CRC screening in HIV positive patients. In both, CRC screening was found to be significantly lower in HIV positive patients compared to HIV negative patients. These studies; however, did not evaluate in detail factors associated with CRC screening. There is strong evidence that quality measures for HIV care are better met when, compared to non-expert general practitioners, patients are seen by infectious disease (ID) specialists or expert generalists. There are very few studies; however, looking at quality of primary care in these patients. Whether having a primary care physician (PCP) improves non-ADM screening in HIV positive patients is unknown. In this study we evaluate whether having a PCP is associated with higher CRC screening rates in a population of HIV positive patients.

METHODS: Study sample. Patients included in this study were selected from a larger study called the Medical Monitoring Project (MMP) led by the Pennsylvania Department of Public Health and the Center for Disease Control (CDC). MMP participants were selected based on a three-stage sampling design described elsewhere and consists of HIV patients seeking care from a diverse pool of providers in Philadelphia. Patients were included in our study if they were MMP participants aged 50 or older.

DATA SOURCE: The data were collected by means of chart abstraction. We used the National Health and Nutrition Examination Survey (NHANES) template to determine if CRC screening had been performed.

OUTCOMES: The primary outcome of interest was CRC screening defined as having a documented colonoscopy, sigmoidoscopy, barium enema, or Fecal Occult Blood Test after the age of 50. INDEPENDENT VARIABLES: Patient and provider related factors were collected. Patient factors of interest included age, gender, race, lowest and most recent CD4 counts, lowest and most recent HIV viral loads, presence of co-morbid conditions, insurance status, and history of substance abuse or alcohol use. Provider factors of interest included provider specialty (ID or Generalist) and practice type (primary care practice, single versus multispecialty care practice).

STATISTICAL ANALYSIS: Standard descriptive statistics were used to describe all potential factors associated with ever having at least one CRC screening. All variables were dichotomized. Statistical differences for CRC screening (yes/no) based on clinical and demographic factors were assessed using the 2 test. A multivariable logistic regression model was created to assess the relative strength of the various associations. All variables associated with CRC screening at p RESULTS: Out of 123 chart abstractions performed, 115 had a complete clinical record from MMP to be fully analyzed. The majority

of the population was male (71.3%), non-white (73.8%) and between the age of 50 and 59 (71.3%). Most patients had a recent CD4 count greater than 350 (69.6%), an undetectable viral load (75.6%), and no history of opportunistic infections (69.5%). 45.2% did not have a PCP. In accordance with other studies, we found that the rate of CRC screening among patients with HIV was low (49%) compared to the national rate of 62.9%. Having a documented PCP was the only variable strongly associated with CRC screening. Rates of screening were 66.7% among those with a PCP versus28.5% among those without a PCP (2 $p<0.001$). After adjusting for race, substance use, and alcohol use, the odds of getting CRC screening in those without a PCP was 0.2 (95% CI 0.09-0.51, $p<0.001$).
CONCLUSION: Patients with HIV who lack a PCP are significantly less likely to receive CRC screening. Given the improved survival among patients with HIV and the increased risk of dying of non-ADMs, it is imperative that all persons be managed with standard preventive practices regardless of HIV status. Having PCPs working in collaboration with ID specialists might help improve CRC screening rates in this population.
CORRELATION OF BLEEDING RISK WITH THE USE OF ANTICOAGULANT PROPHYLAXIS IN HOSPITALIZED MEDICAL PATIENTS Sunay Shah 1; Shital Patel 1; Hanish Singh 1; Jatin Rana 1; Eiad Sabia 1; David Paje 1; Scott Kaatz1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 10495)
BACKGROUND: Anticoagulants have been shown to be very effective at preventing venous thromboembolism (VTE) in hospitalized medical patients. However, the risk of bleeding inherent with these medications has been a significant cause of concern for most clinicians, particularly in patients whose other clinical attributes make them more likely to bleed. There is currently no standard tool to stratify the bleeding risk in patients who are being considered for anticoagulant prophylaxis. The purpose of this study is to determine if the bleeding risk, as defined by the Decousus model, predicts the use of anticoagulant prophylaxis. METHODS: Adult patients newly admitted to the general medical service were assessed, and were categorized as low or high-risk for bleeding based on the Decousus model. The rates of anticoagulant prophylaxis in these categories were then compared using the chi square test.
RESULTS: 167 patients were assessed for bleeding risk; 155 (93%) were found to be low-risk and 12 (7%) were high-risk. Clinical data required to calculate the risk was available for all the patients. 5% (7/155) of the low-risk group and 25% (3/12) of the high-risk group did not receive anticoagulant prophylaxis, $p=0.03$.
CONCLUSION: Patients who are at high risk of bleeding based on the Decousus model are less likely to receive anticoagulant prophylaxis. This risk assessment tool may be useful in evaluating patients who are being considered for anticoagulant prophylaxis.
WHAT PREVENTS ADMITTING TEAMS FROM LEAVING ON TIME? PREDICTORS OF 8-HOURS OFF IN A LARGE ACADEMIC MEDICINE RESIDENCY. Jed Gonzalo 1; Shoshana Herzig 1; Eileen Reynolds 1; Julius Yang1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 10496)
BACKGROUND: The ACGME duty hour regulations have compelled some programs to consider modifying inpatient resident staffing models to ensure compliance. Such changes, which are limited by financial resources and a fixed resident supply, may have unintended consequences on both care delivery and educational outcomes. Identifying key operational factors that predict non-compliance is an important step in structure redesign. We sought to investigate our residency programs compliance rate with the 16-hour shift/8-hours off between shifts rule and to identify workload factors associated with non-compliance.
METHODS: For our residency program, duty hour limits as applied by the Internal Medicine Residency Review Committee mandate 8 hours off between shifts. Our medicine ward teams consist of three housestaff, completing call shifts every 4th day, admitting patients from 7 am until 8:30 pm, and working until 11 pm to complete call-related duties. A
night-float team admits patients overnight. Post-call shifts start at 7 am, requiring an 11 pm departure time the

night prior to ensure 8-hours off. Between August and December of 2010, we sent an online survey to all on-call ward residents immediately after each call night during four inpatient medicine call rotations. The survey was developed to identify reasons for extended shifts, including call day characteristics, such as number of short call and total admissions, number of admissions after 5 pm, and hospital departure time. We used logistic regression to identify the independent predictors of having less than 8-hours off between shifts (departure after 11 pm).

RESULTS: One-hundred and eighty-eight on-call surveys (94% response rate) were collected. Overall, 77 of 188 on-call shifts (77 of 800 total shifts, call and non-call) were followed by less than 8-hours off. Factors associated with less than 8-hours off between shifts were >3 patients admitted per team after 5 pm (adjusted OR 6.6, 95% CI 2.5-18.0) and >6 total long call admissions per team (adjusted OR 3.4, 95% CI 1.7-7.0). A team census >6 prior to a call day (adjusted OR 1.5, 95% CI 0.7-2.9), number of short call admissions on a call day (adjusted OR1.4, 95% CI 0.7-3.0), and having an intern in clinic that day (adjusted OR 2.2, 95% CI 0.9-5.5) were not significantly associated with having less than 8-hours off between shifts.

CONCLUSION: The ACGME duty hour standards were implemented in 2003 but residency programs have struggled to comply with all recommendations. Few studies have investigated the factors contributing to extended shifts. We found multiple late-day admissions and a moderate number of long call admissions are significant predictors of extended shifts, revealing vulnerabilities to be both workload and timing-specific. The relatively low number of admissions predicting non-compliance in a 16-hour day model is cause for concern and may be compromising resident education. The 2010 mandate of 16-hour-only shifts for interns may lead to non-traditional daily admitting structures, rather than the standard long-call days. In our current 16-hour model, we have struggled to contain our number of admissions and ensure an 11 pm hospital departure time. The predictors identified will be used to inform ward model redesign.

ACCULTURATION AND PROGRESSION OF LATE-LIFE DISABILITY IN HISPANICS Jose Delgado 1; Elizabeth A Jacobs 2; Kyriakos S Marquides 3; Carlos F Mendes de Leon4. 1Georgetown University Hospital, Washington, District of Columbia ; 2University of Wisconsin -Madison, Madison, Wisconsin ; 3University of Texas Medical Branch, Galveston, Texas ; 4University of Michigan School of Public Health, Ann Arbor, Michigan . (Tracking ID # 10502)

BACKGROUND: Disability disproportionately affects the elderly. Aged Hispanics have a higher prevalence of disability than non-Hispanic whites. Little is known about the potential role of acculturation in Hispanic health. The aim of this study was to examine the relationship between acculturation and the progression of late-life disability in Hispanics.

METHODS: Data came from the Hispanic Established Populations for the Epidemiological Study of the Elderly (H-EPESE). Interviews were performed in six consecutive waves between 1993 and 2007. Data included measures for disability (Activities of Daily Living [ADLs], Instrumental Activities of Daily Living [IADLs], and a summary measure of three performance tests of basic physical functions), acculturation and socioeconomic status (income, education). Longitudinal models were used to determine the association of acculturation at baseline with each disability outcome.

RESULTS: In the 3050 participants, higher acculturation was associated with both lower ADL (p=0.004) and IADL disability (p less than0.001) and higher physical function (p less than 0.001) at baseline. Acculturation was not associated with increase in either ADL disability (p=0.40) or IALD disability (p=0.37) over time. Higher acculturation was associated with less decline in basic physical functions (p=0.03). This association remained significant after adjustment for education and income (p=0.02).

CONCLUSION: In contrast to the relationship between acculturation and other chronic conditions, our study suggests that higher acculturation may have an important protective effect on late-life disability and on decline in basic physical functions in older Hispanics.

EFFECT OF PATIENTS AWARENESS OF CAD RISK FACTORS ON HEALTH RELATEDBEHAVIORS
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BACKGROUND: Coronary artery disease (CAD) is the leading cause of morbidity and mortality in the United States. Although many patients are aware of modifiable CAD risk factors, it is not known whether awareness of risk factors will translate into better health behaviors and control of these factors. We surveyed patients at risk for CAD and
hypothesized that knowledge of a risk factor would be associated with better control of that risk factor.
METHODS: We administered a cross-sectional, anonymous survey to 2200 patients aged >40 years attending 4 general medicine practices and a cardiology clinic in Western Massachusetts. The paper and pencil survey consisted of the following sections: demographics, co-morbidities associated with CAD, health maintenance behavior, and awareness of 5 risk factors (smoking, obesity, hypercholesterolemia, hypertension (HTN) and diabetes (DM)), and 1 protective factor (exercise). Patients with specific risk factors were asked about control of that risk factor as follows: diabetes (A1CRESULTS: A total of 1702 subjects completed surveys (response rate 77%); 1504 patients had sufficient data for multivariable analysis. The sample was predominantly female (61.6%) and white (57.5%). The median age was 55 years, 78% had at least a high school degree, and 15% had CAD. No patient factors, including a history of CAD, were consistently associated with better control of all risk factors. Awareness of each risk factor was positively associated with control of that factor, but the association only reached statistical significance for exercise. The adjusted proportions of those who reported good control among those who were aware compared to those who were not aware for each factor were as follows: HTN (76.4 % versus 68.6 %, p=0.33), DM (32.5% versus19.5 %, p=0.28), high cholesterol (79.2 % versus 79.1 %, p=0.61), obese or overweight (76.4% versus 62.2 %, p=0.24), smoking (61.0% versus62.3 %, P=0.28), and exercise (48.4% versus 44.0%, P value=0.028). For patients with a history of CAD, awareness was not associated with better control of any of the factors.
CONCLUSION: Awareness that sedentary lifestyle increase the risk for CAD was positively associated with exercising 3x/week. For other risk factors, awareness was not associated with better behavior or control, even for patients with CAD. Taken alone, educational efforts to increase awareness may have limited impact on risk factor control.
THE ASSOCIATION OF ELECTRONIC HEALTH RECORD-BASED REMINDERS WITH HYPERTENSION SCREENING AND BLOOD PRESSURE CONTROL AT US PRIMARY CARE VISITS
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2Harvard School of Public Health/Brigham and Womens Hospital, Boston, Massachusetts . (Tracking ID # 10514)
BACKGROUND: Electronic health records (EHRs) with guideline-based reminders may improve screening and treatment for hypertension in primary care practices.
METHODS: We examined adult visits to primary care physicians using the 2007 and 2008 National Ambulatory Medical Care Survey. We assessed the association of EHR-based reminders with two outcomes 1) hypertension screening and 2) blood pressure control (BP<140/ 90 mmHg). We used multivariable logistic regression to adjust for confounding by patient factors (age, sex, race/ethnicity, diabetes), insurance type, and practice type, and used SUDAAN software to account for the complex survey design.
RESULTS: Patients had a mean age of 50 years, 33% were male, 15% had diabetes, 64% were White, 14% were Black, and 15% were Latino. Hypertension screening was performed at 91% of visits and blood pressure was controlled at 76% of visits. Screening rates were higher at visits by Latino patients than at visits by White patients (93% vs. 90%; p<0.05), at visits by patients with diabetes (93% vs. 90%; p<0.05), and at visits to community health centers compared to visits to physician-owned practices (94% vs. 90%; p<0.05). Rates of

blood pressure control were higher at visits by White patients compared to visits by Black patients (76% vs. 72%; p<0.01), at visits by patients without diabetes

(77% vs. 69%; p<0.001), at visits by women (79% vs. 70%; p<0.001), at visits paid for by private insurance compared to visits paid for by Medicare/Medicaid (78% vs. 71%; p<0.001), and at visits to practices owned by an HMO compared to visits to physician-owned practices (82% vs. 76%; p<0.05). About one-third of providers (37%) reported use of EHR-based reminders. Screening was associated with EHR-based reminders (92% vs. 90%; odds ratio [OR], 1.49; 95%CI 1.10-2.03), even after adjusting for potential confounders (93% vs. 90%; adjusted OR [AOR], 1.56; 95%CI 1.15-2.12). Blood pressure control was also associated with EHR-based reminders (78% vs. 74%; OR, 1.28; 95%CI1.08-1.52), even after adjusting for potential confounders (78% vs. 74%; AOR, 1.22; 95%CI 1.04-1.44).
CONCLUSION: In primary care, EHR-based reminders were associated with improved hypertension screening and blood pressure control. Since small improvements in blood pressure control are associated with reductions in cardiovascular morbidity and mortality, EHR-based reminders should be incorporated into intervention studies aimed at improving cardiovascular outcomes.
DIAGNOSTIC DIFFICULTY IN PRIMARY CARE: RESULTS FROM A PHYSICIAN SURVEY Urmimala Sarkar 1; Doug Bonacum 2; William Strull 2; Christiane Spitzmueller 3; Nancy Jianhua Jin 1; Andrea Lopez 1; Hardeep Singh4. 1University of California San Francisco, San Francisco, California ; 2Kaiser, Oakland, California ; 3University of Houston, Houston, Texas . (Tracking ID # 10515)
BACKGROUND: Missed and delayed diagnoses lead to significant patient harm and costs, but difficulties in diagnosing patients are not well studied in primary care where most diagnoses are made. We surveyed primary care physicians (PCPs) about diagnostic difficulty and assessed barriers to timely diagnosis in the outpatient setting. METHODS: We conducted a survey of all general internists and family physicians practicing in a large integrated health system across 10 geographically dispersed states in 2005. The survey instrument was iteratively developed and pre-tested through interviews with a sample of PCPs. An independent research firm administered the final 54-item confidential survey via mail to participants, and de-identified results for analysis. Our primary outcome (% of their patients that respondents considered difficult to diagnose), included 5 ordered responses (0%, 1% 5%, 6%10%, 11%15%, and >15%); for study purposes, we defined diagnostic difficulty as >5%. We categorized barriers in 3 conceptual domains potentially influencing timeliness of the diagnostic process in primary care: (1) information processing (information availability and time to review it); (2) subspecialty referral processes, and (3) patient characteristics (e.g. non-adherence to recommended follow-up). Cron-bachs alpha scores for the domains were 0.70, 0.81 and 0.72 respectively. For each domain, we summed the individual item responses such that higher scores indicated more optimal processes. We also collected information on respondent characteristics and explored whether physician characteristics and their ratings of information processing, referral processes, and patient barriers, were associated with perceived diagnostic difficulty.
RESULTS: Of 1817 surveys mailed, 1054 were completed (response rate 58%). Because some physicians were mostly hospital-based, we restricted our sample to 848 (80%) respondents who reported primarily practicing in the outpatient setting and had a patient panel. Respondents had been in practice for mean of 13 years and 62% were male. Half (50%) reported >5% of their patients were difficult to diagnose. Physicians with more experience reported less frequency of diagnostic difficulty (OR per 1 year decrease in experience 1.04, CI 1.02-1.06). In adjusted analyses, problems with information processing (OR 1.29, CI1.04-1.60) and referral processes (OR 1.43, CI 1.16-1.78), were
associated with greater (>5%) difficulty to diagnose, but patient barriers were not (OR 1.07, CI0.89-1.28).

Analysis of specific constructs within the two significant domains revealed that physicians who reported insufficient time to integrate clinic information and insufficient time to think carefully about diagnosis reported more frequent diagnostic difficulty. Similarly, physicians who reported that subspecialists do not provide recommendations for next steps after consultation were more likely to report diagnostic difficulty (p0.05 for difference between PCPs reporting vs. not reporting diagnostic difficulty for all constructs). CONCLUSION: Diagnostic difficulty is not uncommon among PCPs and appears to correlate with inadequate time to process diagnostic information and insufficient guidance from subspecialists. Although our study was performed prior to comprehensive electronic health record (EHR) implementation at this health system, barriers we found associated with perceived difficulty might not necessarily be mitigated by EHRs. Practice-level interventions that address these factors are needed to reduce diagnostic difficulty in primary care.

THE EFFECT OF THE NUMBER OF ADMISSIONS TO INPATIENT MEDICAL TEACHING TEAM ON PATIENT SAFETY OUTCOMES Yelena Averbukh 1; William Southern2. 1Montefiore Medical Center, New York, New York; 2Montefiore Medical Center, Sleepy Hollow, New York. (Tracking ID # 10516)

BACKGROUND: An estimated 44,000 to 98,000 preventable deaths caused by medical errors occur each year in the U.S. In teaching institutions, house staff members are involved in over half of the cases of medical errors. Excessive workload and inadequate supervision are among most commonly cited reasons for resident error. First in 2003 and then in July 2010 the Accreditation Council for Graduate Medical Education (ACGME) enacted new limits on the number of patients residents were allowed to care for with the hope that lower workload would improve the quality of care and patient safety. However an observational study of 8,529,595 Medicare recipients admitted to acute care hospitals showed that duty hour reform was not associated with any consistent improvements or worsening in mortality. In 2009 ACGME also called for Internal Medicine programs to ensure for 4:1 ratio of the learner to faculty and need for sufficient supervision and teaching during each rotation or major learning experience. In spite of the growing body of evidence suggesting that inadequate supervision of house staff is associated with sub optimal safety and care outcomes for the patients, there is very little evidence on how medical team workload affects quality of supervision and patient safety outcomes. To address this we examined the associations between the number of patients seen by a teaching team and length-of-stay, 30-day readmission, and 60-day mortality.

METHODS: In this retrospective observational study we examined all admissions to the medicine teaching service of an urban academic medical center from March 1st 2009 to June 30th 2010. Each month, approximately 18 teaching teams provide care at 2 hospitals within the medical center. First, we examined the total number of admissions seen by each team each month. Next, we defined each team as less busy (total admissions 49). Admissions were assigned to the teams without bias according to an on-call schedule. The primary outcome measures were length-of-stay, 30-day readmission, and 60-day mortality. The two patient groups were compared with respect to demographic characteristics, co-morbidities (Charlson score), severity of illness (Laboratory-based Acute Physiology Score, LAPS), and length of stay using t tests, chi-squared, and rank sum tests, as appropriate. Logistic regression models were constructed to determine the in dependent association between assignment to a busy team and readmission and mortality, after adjustment for demographic and clinical characteristics. In

additional analysis, teams were placed in to quintiles of number of admissions, and the readmission rate for each quintile was determined. RESULTS: Of 12,119 admissions examined, 6,398 (52.8 %) were assigned to the less busy teams and 5,721 (47.2 %) were assigned to busy teams. Patients assigned to busy teams were older, were more likely to be female, white, have Medicaid, and had higher LAPS score. Mean length-of-stay was not statistically different between the groups (5.2 vs 5.3 days, p=0.08). After adjustment for demographic (race, sex, ethnicity, insurance type) and clinical characteristics (LAPS and Charlson score), care by a busy team was associated with greater30-day readmission rate (OR 1.21, 95% CI 1.10-1.34). After

adjustment for demographic and clinical characteristics, care on a
busy team was not associated with increased risk of mortality (OR1.05, 95% CI 0.88-1.27). There was a significant linear association between the number of monthly admissions to teams and readmission rate (Figure 1).
CONCLUSION: Admission to a busier medical teaching team is associated with 21 % increased odds of 30-day readmission. We found no association between admission to a busy team and length of stay or 60-day mortality. Further research is needed to determine if controlling for the number of monthly admissions to inpatient teaching teams will improve readmission rates.
POST-OPERATIVE HIP FRACTURE CARE IN AN ACUTE CARE FOR ELDERS (ACE) UNIT Keith Primeau 1; Edgar Pierluissi2. 1University of Arizona, Tucson, Arizona; 2University of California, San Francisco, San Francisco, California. (Tracking ID # 10522)
BACKGROUND: Over 300,000 Americans suffer a hip fracture each year, the majority over age 65. The Acute Care for Elders (ACE) model of hospital care for older adults can improve function at discharge and reduce nursing home admission for medical patients. The efficacy of this

model of care has not been evaluated in patients after hip surgery. An ACE unit at San Francisco General Hospital, a public hospital serving a low-income, diverse population has cared for post-operative hip surgery patients since July, 2007. We describe patient characteristics and ambulation status at discharge, length of stay, and discharge location of patients receiving care in an ACE unit to those receiving usual care. METHODS: Retrospective chart review of patients age 65 or greater admitted to general medical-surgical wards after hip fracture repair from July 2007 to June 2010. Patients with multiple fractures, multiple injuries secondary to trauma, or who were transferred or managed nonoperatively were excluded. We compare 56 patients admitted to an ACE unit and 96 admitted to usual care.
RESULTS: The average age of patients admitted to an ACE unit was 80 years and 79 for those admitted to non-ACE units. Seventy-six percent of ACE patients were female compared to 63% admitted elsewhere. The ethnicity of patients was 48% Asian, 31% White, 9% Latino and 12% African-American, compared to 33%, 38%, 13%, and 9%, for ACE and non-ACE units, respectively. Forty percent of patients on the ACE unit had an open reduction and internal fixation, 34% a closed reduction and internal fixation, and 26% a partial total hip replacement, compared to 51%, 24%, and 24%, respectively. At discharge, compared to baseline, 50% of ACE patients had declined in ability to ambulate, whereas 73% of non-ACE patients declined in ability to ambulate. (p=0.03) The average length of stay was 10.0 days and10.5 days (p=0.70) in the ACE and non-ACE units, respectively. Patients in the ACE unit were discharged home 26% of the time compared to 17% for patients discharged from non-ACE units (p=0.23). CONCLUSION: In post-operative hip fracture patients, an ACE model of care serving a low-income, diverse population resulted in increased ability to ambulate and trends toward increased discharge to home.
COMPARISON OF POSITIONAL SYMPTOMS AND PREFERRED SLEEPING ANGLE WITH THORACIC FLUID CONTENT IN PATIENTS WITH HEART FAILURE Anne S. Kemble 1; Bruce A.G. Soll 2; Khung Keong Yeo 3; James W. Davis 4; Todd B. Seto 2; Irwin J. Schatz2.
1University of Hawaii John A. Burns School of Medicine, Honolulu, Hawaii ; 2Department of Medicine, John A. Burns School of Medicine, University of Hawaii, Honolulu, Hawaii ; 3Division of Cardiovascular Medicine, University of California, Davis Medical Center, Sacramento, California ; 4John A. Burns School of Medicine, University of Hawaii, Honolulu, Hawaii . (Tracking ID # 10527)
BACKGROUND: Orthopnea and paroxysmal nocturnal dyspnea (PND) are among the cardinal manifestations of heart failure. The number of pillows a patient sleeps on indicates a preferred angle of recumbency, and is

thought to be a measure of orthopnea severity. These symptoms are believed to result from position-related redistribution of fluid from the splanchnic circulation and lower extremities into the thoracic circulation, leading to pulmonary alveolar and interstitial edema, yet there is little data to support this assumption. This study compares symptoms of orthopnea, PND, and preferred sleeping angle to thoracic fluid content measured by Impedance Cardiography (ICG) in patients with systolic heart failure.
METHODS: 25 patients with stable heart failure and ejection fraction less than 40% completed a questionnaire that included screening for orthopnea and PND. Overnight polysomnography was performed. Each patient fell asleep at their preferred sleeping angle and then slept at 0, 15, 30, and 45 degrees in random order. Thoracic fluid content (TFC, a surrogate marker of total thoracic fluid) was recorded continuously using ICG. Pearson correlation was used to compare continuous variables, and nonparametric one-way analysis of variance was used to compare continuous variables with groups.
RESULTS: 4 patients reported a history of orthopnea, and 6 patients reported PND. Preferred sleeping angles ranged from 0 to 32 (mean 12). The thoracic fluid content index (TFCI, a calculation adjusting for body surface area) was found to have a statistically significant decrease with increasing angle in only 3 of the 25 patients (slope 0.05, 0.043, and 0.039 with p=0.011, 0.028, and 0.0001 respectively). Yet all 3 of those patients selected 0 as their preferred sleeping angle, indicating that the changes in TFCI were not likely clinically significant. The other 22 patients had no significant change in TFCI with angle. Overall there were no significant correlations between TFCI and preferred sleeping angle (p=0.18), preferred sleeping angle and orthopnea (p=0.93), TFCI and PND (0.42), or TFCI and orthopnea (p=0.93). The primary study had been powered to assess respiratory events with changes in sleeping angle, and was not designed to have statistical power for this secondary study.
CONCLUSION: Symptoms thought to result from position-related redistribution of fluids into the thoracic circulation did not show the expected correlation with levels of TFC measured by ICG. Furthermore, TFC did not change significantly with angle of recumbency. Recent studies suggest that ICG measurement of TFC is a sensitive indicator of chest fluid changes, net thoracic fluid levels, and rales on pulmonary exam. This study challenges the assumption that positional symptoms in patients with heart failure are solely the result of redistribution of fluids into the thoracic space. Given the impact of these symptoms on patient assessment and clinical decision making, further research is needed on the relationship between body position and symptoms of heart failure.
BURNOUT IN INTERNAL MEDICINE RESIDENTS IS ASSOCIATED WITH DECREASED WELLNESS AND LACK OF MINDFUL AWARENESS Rachel Swigris 1; Allan Prochazka 2; Ravi K Gopal 3; Debra Sorensen 2; Michael Craine 2; Jessica Campbell4. 1University of Colorado, Denver, Colorado ; 2Veteran Affairs Medical Center, Denver, Colorado ;
3Denver VAMC, Denver, Colorado ; 4Denver Health Medical Center, Denver, Colorado . (Tracking ID # 10539)
BACKGROUND: Burnout is prevalent among internal medicine residents (IMR) and has been linked to self-reported suboptimal patient care, perceived medical errors and deferred clinical decision-making. In practicing physicians, training in mindfulness improves well-being. There is a paucity of data on interventions to prevent or decrease burnout in residents and no published data on mindfulness training in IMR. We hypothesized that burnout is associated with impaired mindfulness and decreased well-being among IMR.
METHODS: We administered a postal survey to 1st-, 2nd- and 3rd-year IMRs at the University of Colorado Denver School of Medicine. The Maslach Burnout Inventory was used to assess two components of burnout, emotional exhaustion (EE) and depersonalization (DP). We defined burnout as EE >26 or DP >9. We assessed mindfulness using the Baer Five Facet Mindfulness Questionnaire (FFMQ), for which the Nonreact facet is scored 735, the other 4 scored 840, and for all 5 facets, higher scores=greater mindfulness. We measured wellness using the 6-item Brief Resident Wellness Profile (BRWP) scored 15; higher scores=greater wellness. We used Pearson product moment correlation and multivariable linear regression (MVLR) to examine the relationship between burnout and wellness or mindfulness. For the MVLR, we built a model for each of the two

burnout facets (EE and DP) and included as potential predictors in each model all variables with p<0.15 on bivariate analysis. Backward elimination was used to yield the most parsimonious models.
RESULTS: The response rate was 60.9% (98/161). Respondents were evenly distributed among PGYs, and 48% of respondents were female.

Survey results are shown in Table 1. 46.9% of respondents were burned out. Various facets of mindful awareness and wellness were associated with burnout (Table 2). In the MVLR analyses, wellness and the Act aware Facet of Mindfulness were independent predictors of both EE and DP.
CONCLUSION: Nearly half of our IMR were burned out. IMR burnout was associated with impairments in well-being and mindfulness. Wellness and mindfulness were independent predictors of burnout. Prospective studies are needed to determine whether interventional programs in mindfulness training will decrease burnout and improve wellness.
IATROGENIC PNEUMOTHORAX: ANALYSIS OF A NEW AHRQ MEASURE Debra Lurns 1; Tracey Smith 1; Brent Petty2. 1Johns Hopkins Hospital, Baltimore, Maryland; 2Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 10544)
BACKGROUND: CMS introduced nine safety measures via AHRQ as part of its pay-for-performance (P4P) program for FY10. One of the measures was iatrogenic pneumothorax (IP). At our institution, the observed/expected rate for IP had been unexpectedly high. The objective of this project was to identify the causes for IP and to determine whether these cases had been accurately identified through the coding and electronic selection process.
METHODS: The University Health Consortium (UHC) database identified cases coded as having IP at our hospital in CY08, FY09 and FY10. Each identified case was extensively reviewed (including progress notes, operative and procedure notes, radiology reports and discharge summary) by two quality improvement specialists and a physician to determine the presence and cause of IP. Our strict definition required verification that pneumothorax (PTX) was not present on admission but later was reported by a radiologist in a formal x-ray report. Additional provider input was elicited on specific cases when needed to clarify events surrounding the PTX.
RESULTS: For CY08, 62 cases were identified. Of these, 12 (19%) were excluded because they were lung lobectomies, 4 others related to cardiovascular surgery, (excluded per updated AHRQ policy in June 2009), 4 related to surgery with expected PTX because of the surgical approach, 3 because no radiology report documented PTX, 3 present on admission, and 1 was a pleural effusion (excluded per AHRQ policy). That left, at most, 35 patients (56%) who actually had IP. Of these, 12 were related to central line (CL) placement and 6 were related to scalenectomy (S), a surgery done frequently at our hospital
with a 20-35% rate of PTX. For FY09, 64 cases were identified. Of those, 15 (23%) were excluded because they were associated with lung lobectomies, 5 because of pleural effusion, 2 related to thoracoscopic procedures (per AHRQ policy), 3 related to surgeries expected to have PTX, and 3 because no radiology report documented PTX. Thus, at most, 36 patients (56%) had IP. Of these, 10 were related to CL and 9 were related to S. For FY10, only 36 cases were identified, a 59% reduction from FY09. With improved software for searching discharge records, no cases were excluded for lobectomy, thoracoscopy or pleural effusions. Of these 36 cases, 2 were excluded because there was no radiographic confirmation of PTX, 1 was a hospital coding error, and 6 were surgical cases with expected PTX, leaving, at most, 27 cases of IP, of which 8 were related to CL and 7 were related to S. In each time period, there were several surgical procedures likely related to PTX but not expected to have this complication in large numbers. Examples included thoracic spinal surgery, open right partial nephrectomy and peritoneal stripping of metastatic cancer.
CONCLUSION: Relying on software searches of coded discharge information can overestimate the incidence of IP. Improvement of both software and coding practices can reduce this error. For patients with true IP, central

line placement was the most common cause, but accounted for 12 or fewer cases during each period, with a downward trend over time. Scalenectomy may put our institution at risk for inflated observed/expected IP if that unusual surgical procedure (without its own ICD code) is not adjusted for in observed/expected calculations. The rare but explicable incidence of IP in other surgical procedures near to or involving the diaphragm must also be adjusted for in those calculations. Without rigorous methodological intervention, IP will continue to be overestimated and will make inter-institutional comparisons potentially invalid.

ARE HEALTH CARE PROFESSIONALS ADVISING A LOW-FAT DIET TO PATIENTS WITH DIABETES OR DIABETES RISK FACTORS? Ingrid Lobo 1; Danielle Loeb 1; Vahram Ghushchyan 1; Amy G. Huebschmann1. 1University of Colorado, Denver School of Medicine, Aurora, Colorado. (Tracking ID # 10550)

BACKGROUND: Over 17.5 million people are diagnosed with type 2 diabetes mellitus (DM) in the U.S. and >90% of U.S. adults with DM have type 2 DM. Maintaining low cholesterol levels is a key aspect of cardiovascular prevention for people with type 2 DM or risk factors for type 2 DM (e.g. hypertension, overweight). The American Diabetes Association (ADA) recommends health care providers counsel their patients with or at risk for type 2 DM to follow a low-fat diet (Despite this recommendation, the extent to which populations with or at risk for type 2 DM receive low-fat diet advice from health care professionals remains unclear. We assessed this issue using data from the federally sponsored, nationally representative survey of the non-institutionalized U.S. population (Medical Expenditure Panel Survey, MEPS). METHODS: MEPS collects data on sociodemographic information and chronic health conditions, among other endpoints. Survey data are obtained from patient self-report and insurance claims. Between 2001 and 2007, all MEPS participants were asked the following question: Has a doctor or other health professional ever advised you to eat fewer high-fat or high cholesterol foods? We designated participants DM status as + DM or no DM using MEPS self-report (data on diabetes type were unavailable). We also quantified participants ADA-designated risk factors for type 2 DM. ADA-designated type 2 DM risk factors measured in MEPS included: age >45 years, BMI >25 kg/m2, physical inactivity, members of a high risk ethnic population (non-Caucasian), hypertension, hyperlipidemia, and a history of cardiovascular disease. We first measured the unadjusted prevalence of low-fat diet advice by DM status and presence or absence of DM risk factors. Next, we performed a multivariate logistic regression analysis to determine the odds of advice to eat a low-fat diet for MEPS participants with DM vs. no DM. Finally, we performed separate multivariate logistic regression analyses to determine the odds of advice to eat a low-fat diet for participants with incrementally higher numbers of type 2 DM risk factors (e.g. 1 risk factor, 2 risk factors). Each regression analysis also controlled for gender, education, income, census region, smoking status, and the generalized chronic illness morbidity index. RESULTS: Unadjusted rates of advice to eat a low-fat diet were lowest in individuals reporting no risk factors or DM (7.50.3%), intermediate in the presence of type 2 DM risk factors (32.30.3%), and highest for participants reporting DM (71.10.7%). In multivariate regression analysis, participants reporting DM had 1.98 greater odds of receiving low-fat dietary advice as compared to participants reporting no DM. As the number of risk factors for type 2 DM increased, the adjusted odds of receiving advice to eat a low-fat diet increased in an accelerated fashion (reference: OR=1.0 for no type 2 DM risk factors; 2 risk factors, OR=2.41 [95% CI=2.16-2.70]; 3 risk factors, OR=7.78 [95% CI=6.98-8.69]. CONCLUSION: In keeping with national guidelines, the majority of patients with DM receive low-fat dietary advice from health care professionals. However, only 1/3 of patients with type 2 DM risk factors report receiving low-fat dietary advice. Health care professionals should provide low-fat dietary counseling more often to their patients with risk factors for type 2 DM.

A NOVEL CLINICAL DECISION SUPPORT TOOL IMPROVES PRIMARY CARE TREATMENT OF CHRONIC KIDNEY DISEASE David Feldstein 1; Douglass Wiegmann 2; Brian Arndt 1; Scott Hetzel 1; Thomas Gabert 3;

Paul Smith1. 1University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin ; 2University of Wisconsin-Madison, Madison, Wisconsin ; 3Marshfield Clinic, Minocqua, Wisconsin . (Tracking ID # 10552)
BACKGROUND: Twenty six million Americans suffer from chronic kidney disease (CKD). Early intervention can prevent complications and delay progression to end stage renal disease. Despite the high prevalence and associated morbidity, patients are not receiving evidence-based care for the treatment and prevention of CKD. Clinical decision support (CDS) can improve guideline adherence and quality of care. The objectives of this study were to develop a CKD clinical decision support tool (Kidney Care) that improves primary care providers adherence to CKD guidelines and test its feasibility in primary care clinics.
METHODS: Kidney Care is a web-based CDS tool designed to support primary care providers (PCPs) care of CKD patients. Kidney Care was designed using human factors principles and tested for usability. The tool is comprised of four components: 1) patient specific guideline recommendations; 2) brief point of care clinician informational resources; 3) electronic Nephrology consultation; and 4) patient educational materials. Twenty PCPs and their medical assistants from six Wisconsin clinics were trained to use Kidney Care. The PCPs and medical assistants used Kidney Care for 25 of their patients with stage 3 CKD over a six month period. Kidney Care use was recorded. The number of unmet guideline criteria for each patient was recorded at enrollment and completion of the six months. PCPs completed a 19 item multiple choice CKD knowledge test and a 44 item CKD self-efficacy survey prior to training and at study completion. Each self-efficacy item was rated on a scale of 0 (not at all confident) to 10 (extremely confident) with the total score being the sum of all items. Changes in the number of unmet guideline criteria were analyzed using the Wilcoxon-signed rank test. Spearman correlation coefficient was used to determine the effect of frequency of PCP and medical assistant access to a patients guideline page on changes in unmet guidelines. Changes in overall CKD knowledge and self-efficacy were analyzed using paired T-tests. Spearman correlation coefficients were calculated for effect of PCP tool usage on changes in PCP CKD knowledge and self-efficacy.
RESULTS: Eight (40%) of the PCPs were trained in Internal Medicine and 12 (60%) in Family Medicine. PCP clinics were urban (35%), suburban (20%) and rural (45%). Sixteen (80%) PCPs completed pre and post CKD knowledge and self-efficacy questionnaires. Sixty seven patients were enrolled in the study and had a median of 6 (Interquartile Range (IQR) 47) unmet guideline criteria on enrollment. The median unmet guideline criteria at study conclusion was 4 (IQR 1.5-6) with a median decrease in unmet guidelines of 0 (IQR 3-0) ($p<0.001$). Tool usage correlated with a decrease in unmet guidelines (Rho 0.581, $p<0.001$). PCP CKD knowledge test scores improved by a mean of 1.2 questions (SD 2.3, $p=0.06$). Tool usage correlated with improvement in test scores (Rho 0.584, $p=0.02$). Overall self-efficacy scores increased by an average of 37.9 (95% CI: 15.3-60.4, $p=0.003$). However, tool usage did not correlate with self-efficacy score changes (Rho 0.11, $p=0.75$).
CONCLUSION: The implementation of a CKD clinical decision support tool was feasible in a range of primary care clinics. This novel tool was able to decrease the number of unmet guidelines per patient. Tool usage was associated with an increase in PCP knowledge about CKD, but not self-efficacy. This is an important step in providing PCPs with tools to care for their patients with CKD. Future studies will determine if Kidney Care can improve patient outcomes.
GENDER AND RISK OF HOMELESSNESS AMONG OPERATION ENDURING FREEDOM/OPERATION IRAQI FREEDOM VETERANS Oni Blackstock 1; Cynthia Brandt 2; Sally Haskell 3; Rani Desai4. 1VA Connecticut Healthcare System/Yale Robert Wood Johnson Foundation Clinical Scholars Program, New York, New York ; 2VA Connecticut Healthcare System/Yale Center for Medical Informatics, West Haven, Connecticut ; 3VA Connecticut Healthcare System/Yale School of Medicine, West Haven, Connecticut ; 4VA Connecticut Healthcare System/Yale Robert Wood Johnson Foundation Clinical Scholars Program, West Haven, Connecticut . (Tracking ID # 10556)

BACKGROUND: Compared to men, women are disproportionately underrepresented among homeless persons

and, more specifically, among homeless Veterans. We sought to determine risk of homelessness by gender among Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) Veterans, the Veteran cohort with the largest proportion of women.
METHODS: OEF/OIF Veterans with at least one Veterans Health Administration (VHA) visit were compared by gender. Cox proportional hazards models were used to determine the relative risk of homelessness by gender, adjusting for relevant demographic and clinical variables. Time to homelessness was defined as the time from military separation to the first VHA visit at which the Veteran used specialized VA homeless program services or received a V60.0 ICD-10 diagnostic code, indicating lack of housing.
RESULTS: Of 462,098 Veterans, 9,170 (2.0%) were identified as homeless, 1,109 women (2.0%) and 8,061 men (2.0%). Homeless women were more likely to be younger (27.07.2 vs 27.78.0 years, p CONCLUSION: Contrary to data indicating female gender is protective against homelessness, we found women and men OEF/OIF Veterans to be at equal risk. Furthermore, the characteristics of homeless women and men OEF/OIF Veterans differed. These differences may speak to the need for gender-specific interventions to prevent homelessness among OEF/OIF Veterans.
IS APPEARING CHRONICALLY ILL A SIGN OF POOR HEALTH? Shail Rawal 1; Stephen W. Hwang 2; Mina Atia 3; Rosane Nisenbaum 3; Dwayne E. Pare 4; Steve Joordens5. 1Department of Medicine, University of Toronto, Toronto, Ontario ; 2Division of General Internal Medicine, Department of Medicine, University of Toronto and Centre for Research on Inner City Health, The Keenan Research Centre in the Li Ka Shing Knowledge Institute of St. Michaels Hospital, Toronto, Ontario ; 3Centre for Research on Inner City Health, The Keenan Research Centre in the Li Ka Shing Knowledge Institute of St. Michaels Hospital, Toronto, Ontario ; 4Centre for Computational Cognitive Neuroscience, University of Toronto Scarborough, Toronto, Ontario . (Tracking ID # 10557)
BACKGROUND: Physicians are taught to begin the physical examination with a general inspection that often includes an assessment of whether the patient appears chronically ill. This practice is grounded in the assumption that a patients apparent health status correlates with their actual state of health. However, the evidence for this component of the physical examination is limited. The goal of this study is to determine if the assessment by a physician that a patient appears chronically ill is a sensitive or specific sign for the detection of poor health status. METHODS: This cross-sectional study involved 126 adult outpatients recruited from four primary care clinics and one general internal medicine clinic at an academic medical institution. The health status of each patient participant was determined using the self-administered version of the 12-Item Short Form Health Survey (SF-12). A photograph was taken of each participant, showing a frontal view of the persons face with a neutral facial expression. Physician participants (n=71 internal medicine residents and general internal medicine faculty) viewed the patients photographs using an online program. The order of presentation of the photographs was randomized for each physician. With the patients age provided, physicians were asked to assess whether or not the patient appeared chronically ill. For each physician participant, we determined the sensitivity and specificity of appearing chronically ill for the detection of poor health. We examined two different criteria for the definition of poor health: SF-12 physical health score >1 SD or >2 SD below the age group norm. For the entire group of physicians, the median and inter-quartile range (IQR) for sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio were calculated.
RESULTS: Among 126 patient participants, 42 (33%) had an SF-12 physical health score >1 SD below age group norm, and 22 (18%) had a score >2 SD below the age group norm. Physicians rated a mean of 29% of patients as appearing chronically ill (range, 4-52%). When poor health status was defined as an SF-12 physical score >1 SD below age group norms, the median sensitivity was 35.7% (IQR 28.6-47.6%), median specificity 77.4% (IQR 69.0-83.3%), median positive likelihood ratio1.57 (IQR 1.33-2.13), and median negative likelihood ratio 0.82 (IQR0.74-0.89). When poor health status was defined as an SF-12 physical score >2 SD below age group norms, the median sensitivity was 40.9% (IQR 31.8-54.5%), median specificity 74.0% (IQR 66.3-82.7%),

median positive likelihood ratio 1.67 (IQR 1.46-2.10), and median negative likelihood 0.75 (IQR 0.68-0.87). CONCLUSION: A physicians assessment that a patient appears chronically ill has poor sensitivity and modest specificity for the detection of poor health status. The likelihood ratios associated with appearing chronically ill indicate that this assessment has very limited diagnostic value.

CHEMOTHERAPY USE IN LUNG CANCER AT THE END OF LIFE: PREDICTORS AND VARIATION IN USE

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BACKGROUND: Adverse effects of chemotherapy in lung cancer, when administered near the end of life, often overshadow any benefits and are associated with considerable direct and indirect economic cost. Variation in rates and predictors of chemotherapy administration in lung cancer patients are not well understood, but have significant implications for the societal and individual patient costs and benefits of health care delivered near the end of life.

METHODS: We examined linked SEER-Medicare claims data to identify 51,905 patients ages 65+ who received chemotherapy for lung cancer. We included those who were diagnosed with lung cancer between 1995 and 2005 and had traditional Medicare parts A and B coverage for at least 12 months prior to first lung cancer diagnosis and until three years after diagnosis or until death. We calculated rates of chemotherapy use within 30 and 14 days of death among those who received any chemotherapy. We then used logistic regression to identify the predictors of end of life chemotherapy treatment. The model predictors were race, sex, age, U.S. birth, year of diagnosis, Medicaid enrollment any time after diagnosis, marital status, time since diagnosis, and comorbidity, controlling for fixed effects of geographic SEER site. RESULTS: Among the 46,603 (89.8%) who died within three years of diagnosis, 31.5% received chemotherapy within 30 days of death and15.9% received chemotherapy within 2 weeks of death. Marriage (OR=1.12, p=.014), diagnosis from 1997 through 2004 (OR=1.17 to 1.48, p<.001 to .034 for each year), and recency of diagnosis (OR=3.9 to 24.8, decreasing each 6 months past diagnosis, p<.001 for each interval) were significant predictors of higher rates of chemotherapy receipt during the last 30 days of life, whereas female sex (OR=.90, p<.001), black race (OR=.85, p=.001), Medicaid coverage (OR=.70, p<.001), and older than 75 (OR=0.88 age 75 79, 0.79 age 8084, 0.67 age 85+, p<.001 for each cohort) predicted lower rates. Divorce, widowhood, unknown marital status, Asian, Hispanic, or other race, US birth, comorbidity score, and age (7074) were not significant predictors. Pseudo-R2 was 0.14. ORs for chemotherapy within 2 weeks of death are similar, although marriage and diagnosis in 1998 no longer achieve significance while diagnosis in 1996 does.

CONCLUSION: Despite the high mortality rate of lung cancer and considerable side effects associated with chemotherapy, a substantial

proportion of Medicare patients continue to undergo treatment even in their last days of life. Although rates decline with age, this is true even among the oldest old (85+). Whereas expensive therapies generate difficult questions at the nexus of medical economics and ethics if treatment has measurable benefit, the question should be moot at the stage of illness when treatment has very limited or no benefit and when resources ought to be directed toward improving comfort and the quality of the final days of life. It is unclear why such aggressive treatment is continued so often in end-stage lung cancer. Altogether the variables examined here account for little of the variability in chemotherapy use near the end of life. The impact of physician factors, including demography and preferred practice habits, while not examined here may be an important source of variations in care.

HOW SAFE IS YOUR NEIGHBORHOOD? PERCEIVED NEIGHBORHOOD SAFETY AND FUNCTIONAL

DECLINE IN OLDER ADULTS Vivien K. Sun 1; Irena Stijacic Cenzer 2; Brie A. Williams2. 1School of Medicine, University of California at San Francisco, San Francisco, California ; 2Division of Geriatrics, University of California at San Francisco and San Francisco VA Medical Center, San Francisco, California . (Tracking ID # 10564)

BACKGROUND: Perception of living in an unsafe neighborhood could lead older adults to limit their physical activity, leading to deconditioning and functional or mobility decline (Functional decline). Functional decline is a strong predictor of health care costs, health care utilization, poor quality of life, and mortality in older adults. While perception of living in an unsafe neighborhood is associated with baseline physical inactivity and 8-year mobility impairment in older adults, these studies were small, geographically limited, or did not assess other forms of functional decline such as impairment in the Activities of Daily Living (ADL). Our goal was to assess the relationship between perception of neighborhood safety and long-term functional decline in older Americans.

METHODS: Our cohort included 18,043 adults aged 50 or older who participated in the 1998 Health and Retirement Study, a nationally representative study of older persons. Our predictor was perception of neighborhood safety [Would you say the safety of your neighborhood is excellent, very good, good, fair or poor?]; categorized into 3 groups: very safe (excellent/very good), moderately safe (good), and unsafe (fair/ poor). Our primary outcome was 10-year functional decline, defined as any new difficulty or dependence in an ADL (eating, dressing, transferring, toileting, and/or bathing); any new difficulty in walking several blocks and/ or climbing one flight of stairs; or death. We assessed the relationship between perceived neighborhood safety and functional decline, whether sociodemographics and health status confounded the relationship, and whether the association between perceived neighborhood safety and functional decline differed by baseline functional status.

RESULTS: The mean age was 67 years (range 50105), 44% were men, 77% white, 71% received a high school education or higher. At baseline,63.7% of participants were independent in all ADL and mobility measures. Overall, 65.1% perceived their neighborhood to be very safe,24.8% perceived it as moderately safe, and 10.1% perceived it as unsafe. Subjects in the very safe group were more likely to be male, white, have higher wealth, fewer chronic conditions, and lower baseline functional impairment (all $P<0.001$). Over 10 years, 57.3% experienced functional decline, including 53.4% of subjects who perceived their neighborhood to be very safe, 63.4% who perceived their neighborhood to be moderately safe, and 67.6% unsafe, $P<0.001$. After adjustment for age, race, gender, marital status, education, income, net worth, baseline medical conditions and functional status, there was still a significant association between perceived neighborhood safety and 10-year functional decline for those who considered their neighborhood moderately
safe (OR 1.22; 95% CI 1.11-1.34) or unsafe (OR 1.27; 95% CI 1.10-1.46) compared to the very safe group. The association between perceived safety and functional decline was strongest for those who were independent at baseline [moderately safe group OR 1.32 (95% CI1.18-1.48), unsafe group OR 1.70 (95% CI 1.42-2.04) compared to the very safe group].

CONCLUSION: Overall, 1 in 3 older Americans reported that their neighborhood was unsafe or moderately safe and this perception was associated with increased 10-year functional decline, especially for those who were independent at baseline. Our findings suggest that asking older patients about their neighborhood safety may provide important information about risk of functional decline that is not captured by sociodemographics, health conditions, and baseline functional status. Moreover, public health interventions to promote physical activity while addressing safety concerns could help to reduce long-term functional decline in independent older adults.

SEVERITY-OF-ILLNESS STRONGLY PREDICTS DEVELOPMENT OF VENOUS THROMBOEMBOLISM IN MEDICAL IN-PATENTS Richard H White 1; Beate Danielsen 2; Daniel J Tancredi 1; Calvin Hirsch 1; Scott Kaatz3. 1University of California, Davis, Sacramento, California ;
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BACKGROUND: A major national quality improvement initiative is the prevention of venous thromboembolism (VTE) in hospitalized patients. The Joint Commissions core VTE measure includes assessing the risk of VTE shortly after hospital admission and at the time of entry into an intensive care unit. Unfortunately, data regarding risk factors for VTE events that develop during a medical hospitalization (Hosp-VTE) are meager. Most reviews cite single risk factors such as older age or specific disease states, such as cancer or heart failure. A proprietary measure of severity-of-illness (SOI) has been developed by 3 M that uses administrative discharge data coupled with the present-on-admission (POA) indicator, allowing the calculation of a SOI score both at the time of admission, and at the time of discharge. Calculation of the score is highly complex with many interactions between risk factors, but the factors most strongly relate to SOI are diagnoses that reflect physiologic impairment.
METHODS: We used linked State of California Hospital Discharge data from 20052009, to identify, for each linked record/case, the last medical hospital discharge of 3 or more days before Sept 30, 2009 and this hospitalization was used in our analysis. An in-hospital VTE event was defined using the highly specific ICD-9-CM codes 415.11 or 415.19 for pulmonary embolism (PE) and 453.41 or 453.42 for proximal and distal deep vein thrombosis in the legs (DVT) coupled with a present-on-admission (POA) indicator = No, which means the VTE developed after hospital admission. Cases were excluded if there was a VTE event within 91 days before the index admission, or if there was a surgical hospitalization within 31 days of the admission date. Severity of illness (SOI) at the time of admission was calculated using 3 M software. Other risk factors included age, race, sex, and the number of chronic comorbidities using the non-cancer terms in the Elixhauser co-morbidity index. The number of days from the index medical admission to the occurrence of VTE was modeled using multivariable Cox regression, stratifying by presence of cancer (ICD-9-CM=140209.9) or no-cancer. RESULTS: Among 1855398 cases hospitalized, 8979 cases had an inhospital VTE that met the case definition; 1742 with cancer and 7237 without. For non-cancer cases, SOI was mild in 20.2%, moderate in42.1%, major in 30.2% and extreme in 7.5%. The corresponding mean 30 day mortality rates from the day of admission were 0.9%, 3.7%,11.2% and 29.2% .VTE risk factors with a relative hazard of >2.0

included: prior VTE within 91365 days of admission, HR=2.0, (95% CI:1.7-2.5); major SOI (referent=mild) major SOI, HR=3.3, (95%CI=2.9-3.7); and extreme SOI, HR=5.0 (95%CI=4.4-5.7). For cancer cases only the SOI level was a significant predictor: for moderate SOI, HR=1.5 (95% CI: 1.0-2.1); for major SOI, HR=2.0 (95%CI=1.4-2.8); and for extreme SOI, HR=2.1 (95%CI=1.4-3.0). Seventy-two % of all in-hospital VTE cases had an SOI level that was major or extreme. The effect of SOI in predicting DVT or PE was similar, both in cancer and non cancer cases. CONCLUSION: In this observational study of medical patients hospitalized in California hospitals principally during 2008and 2009, SOI was an extremely strong predictor of development of in-hospital VTE, with a risk 5 times higher in extremely ill patients compared to mildly ill patients. Lacking any information about the use of VTE thromboprophylaxis, the findings indirectly suggest that either a high proportion of more severely ill patients do not receive thromboprophylaxis or, more likely, that the prophylaxis regimens currently used are not as effective in very sick patients. The risk of venous thromboembolism likely increases as the extent and severity of physiologic impairment increases.
TRENDS IN THE FINANCIAL BURDEN OF PRESCRIPTION DRUGS AMONG THE NON-ELDERLY, 19992007 Walid F Gellad 1; Julie M Donohue 2; Xinhua Zhao 1; Jessica S Banthin3. 1VA Pittsburgh Healthcare System/University of Pittsburgh, Pittsburgh, Pennsylvania ;
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BACKGROUND: Prescription drug expenditures and pharmacy benefit design have changed substantially over the last decade, yet little is known about the impact of these changes on the financial burden faced by consumers. We used nationally representative data to assess how the outof-pocket financial burden for

prescription drugs changed from 19992007. METHODS: We use data on individuals less than age 65 from the nationally representative Medical Expenditure Panel Survey (MEPS) to measure the financial burden for prescription drugs annually from 19992007. Following previous literature, financial burden was calculated for each individual using total out-of-pocket drug costs for all family members in a given year divided by family income. The financial burden measure was adjusted to 2007 dollars using the consumer price index and excluded premium costs. We examined the proportion of individuals living in families that spent more than 10% of their income on out-of-pocket drug costs. We analyzed how this measure of financial burden differed by insurance and income groups. Because of the potential role of increasing generic drug use on financial burden, we calculated the percentage of all prescriptions in each year that were for generic drugs.
RESULTS: In 1999, there were 7.1 million people (2.9%) who lived in families spending more than 10% of their family income on out-of-pocket costs for prescription drugs. There was a steady increase in this percentage each year until 2003, when 10.8 million individuals (4.3%) lived in families spending more than 10% of family income on drugs. From 2003 to 2007, however, the financial burden steadily decreased, and in 2007, 7.4 million individuals (2.8%) lived in families spending more than 10% of their income on drugs. Similar trends were seen in each insurance and income group, although the likelihood of high financial burden differed substantially. In 2007, 1.1% of individuals with private employer-related insurance lived in families spending more than 10% of family income on drugs, compared to 4.4% in private nongroup insurance, and 7.4% in public insurance. The financial burden for drugs was highest for the poor; 14.2% of those with income less than 100% of the poverty line lived in families spending more than 10% of their income on drugs in 2007. Between 1999 and 2003, the percentage of prescriptions filled as generics was steady between 36% to
39%, but started to increase in 2004 (40%) until in 2007, 52% of all prescriptions were filled as generics.
CONCLUSION: The financial burden for prescription drugs in those under 65 peaked in 2003 and steadily decreased from 2003 to 2007. The decrease in financial burden since 2003 is important evidence of the success of the various strategies used to lower drug costs, such as the increased use of generic drugs. This financial burden remains high, however, for low-income individuals; whether this problem will be addressed when the Medicaid expansions and insurance exchanges authorized under health reform are fully implemented is unknown. Whether rising premiums, which are not measured here, overshadow these decreasing out-of-pocket costs is also unknown.
HIV RISK AFTER RELEASE FROM PRISON: A QUALITATIVE STUDY OF FORMER INMATES Jennifer E Adams 1; Carolyn Nowels 2; Karen Corsi 2; JEREMY LONG 3; John Steiner 4; Ingrid Binswanger2. 1Denver Health, Denver, Colorado ; 2University of Colorado, Aurora, Colorado ;
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BACKGROUND: Human Immunodeficiency Virus (HIV) infection and hepatitis C (HCV) are more prevalent among prison inmates than in the general population. The post-release period is a highly vulnerable time for former inmates and may be associated with increased risk behavior for these infections. Few studies have examined the health perceptions, risks and health-care seeking experiences of former inmates as they pertain to HIV and HCV, nor have they focused on the high-risk immediate post-release period. We sought to understand the experiences of former inmates during the post-release period which put them at risk for HIV or HCV transmission, acquisition, and disease progression, as well as failure to link with health care.
METHODS: This was a qualitative study of 29 former inmates 18 years and older within two months after their release from prison to the Denver, Colorado area. Trained interviewers conducted and recorded individual, in-person, semi-structured interviews exploring participants perceptions of risk, circumstances that put them at risk for HIV and HCV acquisition and transmission, and barriers to engaging in medical care after release. Interview transcripts were coded and analyzed utilizing a team-based general inductive approach to analysis. Atlas.ti software was used to code transcripts and organize data. RESULTS: Twenty men (69%) and nine women (31%) with a mean age of 39 years (range 2257 years) participated. The participants were racially and

ethnically diverse. Four major themes emerged from the interview transcripts: 1) risk behaviors, including unprotected sex, transactional sex, non-consensual sex, and drug and alcohol use, were commonly described in the immediate post-release period; 2) engagement in risky behavior often occurred within the first few days to weeks after release; 3) former inmates had important educational needs about risk behaviors as they pertained to HIV and HCV; and 4) former inmates faced major challenges in accessing health care and medications after release. Based on analysis of interview transcripts, we created a conceptual model of the multiple factors impacting rates of HIV and HCV infection, progression and transmission among former inmates (see Figure 1). CONCLUSION: Risk factors for acquiring and transmitting HIV and HCV were described as pervasive among former inmates in the immediate post-release period. Prevention efforts should be concentrated in this time period and should focus on health education, promotion of safe sex and needle practices, improved access to substance abuse treatment, and provision of safe transitional housing free of drug use. Improved coordination between correctional staff, parole officers and community health care providers may lead to improved continuity of health care and health outcomes related to HIV and HCV.

FACTORS ASSOCIATED WITH ADMISSION AND DISCHARGE MEDICATION RECONCILIATION ERRORS AT 2 TEACHING HOSPITALS Amanda Salanitro 1; Christianne Roumie 2; Jeffrey Schnipper 3; Courtney Cawthon 4; Stephanie Labonville 5; Cardella Leak 4; Ankita Munjal 4; Edith Swain 6; Kurt Niesner 7; Alexandra Businger 8; Chandra Osborn 4; Sunil Kripalani8. 1VA Tennessee Valley Geriatric Research Education Clinical Center (GRECC), HSR&D Targeted Research Enhancement Program for Patient Healthcare Behavior and Section of Hospital Medicine, Vanderbilt University, Nashville, TN, Nashville, Tennessee ; 2VA Tennessee Valley Geriatric Research Education Clinical Center (GRECC), HSR&D Targeted Research Enhancement Program for Patient Healthcare Behavior, and Clinical Research Center of Excellence (CRCoE); Department of Medicine, Center for Health Services Research, Institute for Medicine and Public Health, Vanderbilt University, Nashville, Tennessee ; 3Brigham and Womens Hospital Division of General Medicine and Primary Care; Brigham and Womens Hospital Academic Hospitalist Service; Harvard Medical School, Boston, Massachusetts ;
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BACKGROUND: Healthcare providers are tasked with the reconciliation of medications during care transitions. Errors may occur in this process, most commonly when documenting the pre-admission medication list (PAML) and writing discharge orders. We examined factors associated with such errors at two academic medical centers. METHODS: We analyzed data from patients assigned to the intervention arm of the Pharmacist Intervention for Low Literacy in Cardiovascular Disease (PILL-CVD) Study, a randomized controlled trial. We assessed patient characteristics associated with medication reconciliation errors including health literacy, cognitive function, and patients baseline understanding of their pre-admission medication regimen. We also determined the presence of an electronic medication list updated within 90 days prior to admission, number of pre-admission and discharge prescription medications, and number of medication changes between

admission and discharge. We used negative binomial regression to analyze predictors of the number of errors, as well as clinically-relevant errors, in the physicians PAML and discharge medication orders, considering the study pharmacists medication history as the gold standard. Results are reported as incidence rate ratios (IRR). RESULTS: Among 379 patients with admission data, 174 (41%) had at least 1 PAML error. Among 401 patients with discharge data, 158 (39%) had at least 1 error in discharge medication orders. PAML errors were more common with a higher number of pre-admission medications, and less common when a recent medication list was present (Table). Clinically-relevant discharge medication errors were associated with married status, impaired cognitive function, higher number of PAML errors, and more medication changes made prior to discharge. CONCLUSION: Medication reconciliation errors are common at the time of hospital admission and discharge. Clinically-relevant admission medication errors increased as the number of pre-admission medications increased. Furthermore, at discharge patients are at increased risk for clinically-relevant medication errors if they have impaired cognition, if PAML errors exist, or if many changes are made to their medication regimen during hospitalization. Further studies need to evaluate interventions focused on taking accurate pre-admission medication histories and verifying the accuracy of discharge orders in patients known to be at high risk for medication errors.

BARRIERS PERCEIVED BY PHYSICIANS REGARDING THEIR OWN HEALTH CARE Susan George 1; Jeffrey Jackson 2; Janice Hanson3.
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BACKGROUND: Physicians have been shown to have multiple negative health seeking behaviors, which include self prescribing and consulting friends and colleagues for their medical problems. While this type of behavior may not be harmful in acute illnesses, it is generally agreed that these behaviors can lead to poor outcomes in chronic illness and psychiatric conditions. Several studies have attempted to evaluate possible barriers to seeking care among physicians using surveys alone. This study seeks to evaluate how physicians perceive their own health care and barriers to accessing needed care through the use of semi structured interviews.

METHODS: This is a qualitative study utilizing semi structured interviews. Staff physicians and residents were recruited from the Departments of Medicine and Surgery at Walter Reed Army Medical Center and the Medical College of Wisconsin. An independent researcher performed the interviews, which focused on three major domains: perceptions about own health care, perceptions about providing care to self/family, perceptions regarding accessing mental health care. The interviews were recorded and transcribed by an outside transcription service. De-identified transcripts were coded separately by two re-
searchers for themes, with frequent meetings for discussion and disagreement resolved through discussion. This process was used to elaborate an organizational scheme with major themes. Interviews continued until no new themes emerged.

RESULTS: Saturation was achieved after 24 interviews were completed. Four major themes emerged including: 1) barriers to accessing care, 2) caring for family and friends, 3) physician health behaviors, and 4) potential solutions to barriers. Perceived barriers to care include concerns about confidentiality, fear of consequences including employability, time constraints, and stigma related to particular diseases including mental health and sexuality (function and diseases). Two beliefs emerged regarding health care for family and friends. Some physicians act as family providers or act as an intermediary, arranging care with colleagues or refilling standard medications. Other physicians made a decision not to treat family members for several reasons, including concerns about altered judgment, lack of objectivity, and guilt with potential bad outcomes. Physician health behaviors included self-diagnosing and self-prescription, informal care from colleagues, denial and minimization

of symptoms, and unhealthy lifestyles. There was a strong sense of not wanting to burden colleagues in order to take care of ones own health needs. There were many potential solutions proposed to the perceived barriers, such as building time in the schedule for regular health visits, changing the culture to improve attitudes toward stigmatized diseases and health in general, allowing physicians to receive care outside their place of work, and restricting access to electronic medical record to improve confidentiality. CONCLUSION: Physicians, both staff and residents, identified a number of important themes regarding health care for themselves and their families. There are a number of important barriers to accessing care, providers are split on providing care for family members, and physicians health behaviors are often not healthy. A number of potential solutions were suggested that could improve medical care for health care providers.

USE OF A VIDEO DECISION SUPPORT TOOL TO SUPPLEMENT GOALS-OF-CARE DISCUSSIONS WITH PATIENTS SEEN BY AN INPATIENT PALLIATIVE CARE SERVICE Nicole M. LaRue 1; MichaelK. Paasche-Orlow 1; Angelo E. Volandes2. 1Boston University Medical Center, Boston, Massachusetts; 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 10593)

BACKGROUND: A failure to participate in effective goals-of-care discussions may lead to the delivery of aggressive interventions in scenarios that are inconsistent with patients and families wishes. The current practice of eliciting preferences includes verbal descriptions of complex future disease states with which patients and families may have little familiarity or experience. Prior studies have demonstrated wide variability regarding patients preferences in the setting of advanced disease. The misunderstanding of factual information, particularly in patients with low health literacy, may account for a significant proportion of the variation in preferences which is observed. The use of video to reinforce verbal descriptions of treatment options may better inform patients and families engaged in end-of-life decision making. The purpose of this study is to assess the effect of a video decision support tool on preferences for end-of-life care in patients and surrogate decision makers consulted on by an inpatient palliative care service. METHODS: This temporal intervention study consists of an observational and video phase, conducted over two consecutive five month periods, or until 25 subjects are enrolled in each group. Eligible subjects include adult patients and/or their healthcare proxies who are consulted on by an inpatient palliative care team and who are

appropriate for a goals-of-care discussion. Subjects in the observational phase receive the usual standard of care provided by an inpatient palliative care service. During the intervention phase, a short video illustrating specific treatments for three different levels of medical care, i.e. life-prolonging care, basic care and comfort oriented care, is integrated into the standard palliative care consult. Following the palliative care consultation, all patient subjects and/or their healthcare proxies are surveyed regarding preferences for care near the end of life, the reasons for choosing as they did and the level of certainty regarding their decision. The primary study outcomes are the differences in proportions of patient subjects/ healthcare proxies in each group who prefer comfort oriented care and who die in accordance with their stated preferences. The secondary outcomes include the level of uncertainty regarding treatment preferences, satisfaction with pain control and symptom management and healthcare proxy satisfaction with end-of-life care following subjects death. Participants comfort level with the video is also measured. Outcomes are measured during the index hospitalization as well as over the phone at 714 days, 23 months and 56 months post-discharge.

RESULTS: To date, eight subjects have been enrolled in the observational phase of the study. When asked to identify preferences for end-of-life care, 2 preferred life-prolonging care, 1 preferred limited care, 4 preferred comfort care and 1 was unsure. The mean uncertainty score (range 0 to 50; higher score indicating greater uncertainty) was 20. There have been no adverse events reported and there has been no feedback that participation has been distressing in any way. Recruitment is actively ongoing.

CONCLUSION: The use of a video decision support tool to supplement goals-of-care discussions with patients and families consulted on by an inpatient palliative care team may provide an easily reproducible method for more accurately eliciting preferences and ultimately improve end-of-life care.

RESISTANT HYPERTENSION IN A VA POPULATION: NEED FOR FURTHER STUDY, BETTER TREATMENT AND PREVENTION OF CARDIOVASCULAR EVENT Jian Huang 1; Manmeet Singh 2; Wei Gu 1; Ronna Mallios 3; Sean McFarland 1; Jocelyn Fong1. 1VACCHCS, Fresno, California ; 2VACCHCS; UCSF Fresno, Fresno, California ; 3UCSF Fresno, Fresno, California . (Tracking ID # 10598)

BACKGROUND: Resistant hypertension (RH) is widely understudied, although it is a relatively common clinical problem with increased cardiovascular risk. The exact disease mechanisms are not well defined and the reported prevalence of RH varies with study populations. We sought to determine the prevalence of RH and its association with other co-morbid conditions in a VA population.

METHODS: Demographics and clinical data on diagnosis, labs, and medication profiles were collected from electronic records of 17,466 patients in this cross-sectional study. RH was diagnosed if BP was uncontrolled on 3 or more, or controlled on 4 or more agents, including a thiazide diuretic. We used t-test or Chi square test where appropriate for comparison of parameters between those with and without RH. We also used logistic regression model to calculate the adjusted OR and 95% CI.

RESULTS: Mean age was 67 years and BMI of 29.6 with 96% males. Overall prevalence of RH was 9% versus 13% among hypertensive patients. Patients with RH had significantly older age, higher BMI and Framingham score (FS) as well as higher prevalence of MI, PCI, CABG, CVA or TIA, PVD, CHF, ED, CKD, DM, and metabolic syndrome (MS) ($P<0.0001$). Further adjusting for confounding factors, including demographics, certain co-morbid conditions and
medications, did not change the significant association of RH with older age, higher BMI and FS, and co-existing CAD, CVA or TIA, PVD, CHF, ED, CKD, DM and MS.

CONCLUSION: Overall prevalence of RH in this study fell in the range reported in general population. Certain cardiovascular and metabolic diseases and conditions with target organ damage were significantly more prevalent in RH group. Our results suggest the need for multi-faceted intervention in this high risk population. Further research is warranted to study the underlying disease mechanisms of RH in order to develop more effective treatment for the prevention of cardiovascular event.

PERSPECTIVES OF NURSES, HOSPITALIST PHYSICIANS AND PHYSICIAN ASSISTANTS TO LOCALIZING MEDICAL TEAMS TO A NURSING UNIT: A FOCUS GROUP STUDY Siddhartha Singh 1; Kathlyn Fletcher1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10600)

BACKGROUND: Localizing medical teams to a single nursing unit is an attractive way to organize hospital care. In our hospital we localized patients assigned to two hospitalist-physician assistant (HPA) teams on one nursing unit between the period April 1, 2010 and July 10, 2010. We studied the perspectives of nurses, hospitalist physicians and physician assistants (PA) exposed to this intervention.

METHODS: We conducted a focus group study and invited all the nurses as well as hospitalist physicians and PAs who provided patient care on the localized nursing unit to participate. Invitations were sent out by e-mail, written informed consent and demographic information was obtained from the participants. Focus groups were conducted using a semi-structured open-ended focus group guide, were audio recorded and then transcribed. All identifiers were removed from the transcriptions. We analyzed the transcribed data qualitatively using grounded theory. The process included open-coding, axial coding and selective coding. Our open-coding procedure focused on identifying the impact of localization on patients and staff. Two investigators independently coded the focus group transcripts. We began by each reviewing one focus group transcript which resulted in our coding scheme. We then used this coding scheme to analyze the remaining transcripts. Our institutional review board approved this study.

RESULTS: We conducted 4 focus groups for 29 nurses and 1 focus group for 9 hospitalist physicians and PAs

(see table). The analysis resulted in a coding scheme that mirrored the Institute of Medicines six aims for improvement of healthcare. Participants noted that patient safety increased due to greater provider accessibility, quicker responses of providers to patient decomposition and fewer telephone orders. They also felt that localized care was more effective and efficient due to functional multidisciplinary rounds and better teamwork; more patient-centered due to better and more frequent patient-provider interactions and more timely due to greater provider accessibility. On the other hand participants also noted that greater efficiency led to higher perceived workload which if not recognized and managed had the potential to have a negative impact on quality of care. Greater access of patients and nurses to providers may have the unintended consequence of more interruptions in workflow. Overall, participants felt that localization of medical teams was beneficial for patients as well as staff.
CONCLUSION: Our study is limited by being a single site study and shows that nurses, physicians and PAs felt that localization of medical teams to a single nursing unit led to improved quality of care and provider experience but the intervention had the potential for unintended negative consequences.

TALK THE WALK TO DO MORE: LOCALIZING HOSPITALIST PHYSCIAN ASSISTANT TEAMS TO A SINGLE UNIT IMPROVES WORKFLOW Siddhartha Singh 1; Vipulkumar Rana 2; Cheryl Jenks 3; Kathleen Idstein 1; David Marks1. 1Medical College of Wisconsin, Milwaukee, Wisconsin ; 2Medical College of Wisconsin, Brookfield, Wisconsin ; 3Froedtert Hospital, Milwaukee, Wisconsin . (Tracking ID # 10601)
BACKGROUND: Localization of medical teams to a hospital unit is an attractive way to organize hospitalist services but its operational impact on workflow has not been examined.
METHODS: Between April 1, 2010 and July 10, 2010, we localized patients assigned to two hospitalistphysician assistant (HPA) teams on one nursing unit. We concurrently compared the operational outcomes of these localized teams to two similar HPA teams with patients dispersed throughout the hospital to over 10 different units (the usual practice). A hospitalist faculty admitting medical officer (AMO) was asked to assign at least 5 admissions to each nonlocalized team every day. Non-localized teams did not take new patients beyond a maximum census of 16 patients each. The AMO assigned new patients to the localized teams to keep the nursing unit patient census (32) full. Beyond these guidelines the AMO was asked to consider the teams perceived workload and use judgment in deciding assignment. We collected billing information to determine total encounters for providers on these teams as a measure of clinical workload. We determined number of pages to each provider during work hours (from 7 am to 6 pm) through our telecommunication records. For the final 15 days of the intervention period we asked the Physician Assistant (PA) on each team to wear a pedometer and record steps taken during their work day as a measure of non-value added work. We used generalized estimating equations to determine the effect of localization on the number of patient encounters per day by the HPA team, number of pages during work hours to the HPA team and number of steps taken by the PAs while accounting for repeated measures per provider. This study was reviewed by the institutional review board and granted an exemption as a quality assurance project.
RESULTS: Non localized teams performed an average of 11 billable patient encounters, received 28 pages between 7 am and 6 pm and the non localized PAs took 5,554 steps during their workday. In comparison, localized HPA teams averaged 0.99 more billable patient encounters a day (CI 0.41 1.58; p=0.001) and received 11.93 fewer pages every day (CI 10.95 12.91; p<0.001). PAs on localized teams walked 1182 fewer steps during the workday (CI 215 to 2580; p=0.097). CONCLUSION: Our study shows that localizing HPA teams to one nursing unit allowed them to perform more clinical work while decreasing the number of interruptions due to pages. Fewer pages may also mean that localized HPA teams communicated more with nurses directlya safer and richer mode of communication in comparison to phone communication or orders. Additionally the pedometer data suggests that non value added work represented by number of steps walked per day may have been lower on localized

teams. In summary, localizing HPA teams to one nursing unit has a dramatically positive impact on their workflow.

OUTCOMES OF LOCALIZING HOSPITALIST-PHYSICIAN ASSISTANT TEAMS TO A NURSING UNIT

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BACKGROUND: Localization of medical teams to a hospital unit has been shown to improve nurse-provider communication but its affect on patient outcomes is unknown.

METHODS: Between April 1, 2010 and July 10, 2010 we conducted a trial of localizing patients assigned to two hospitalist-physician assistant (HPA) teams to one nursing unit. We concurrently compared their outcomes to patients assigned to two similar HPA teams with patients dispersed throughout the hospital to over 10 different units (the usual practice). Patients with a principal diagnosis of sickle cell disease (SSD) were excluded from the analysis as they were preferentially assigned only to the non-localized teams. A faculty admitting medical officer (AMO) assigned patients to each team and did not use any clinical criteria (other than diagnosis of SSD) to make this assignment. The AMO was asked to assign at least 5 admissions to each non-localized team every day. Non-localized teams did not take new patients beyond a maximum census of 16 patients each. The AMO assigned new patients to the localized teams to keep the nursing unit patient census (32) full. Beyond these guidelines the AMO was asked to consider the teams perceived workload and use judgment in deciding assignment. We used linear mixed models for comparing log-transformed length of stay and charges, and generalized linear mixed models for comparing 30 day risk of readmission. We controlled for age, race, gender, payer status, weekend admission/discharge, co-morbidities, principal diagnosis and the effect of repeat admissions of the same patient. This study was reviewed by the institutional review board and granted an exemption as a quality assurance project.

RESULTS: 655 admissions were assigned to the localized teams and 541 (non-sickle cell) admissions were assigned to the non-localized teams. These admissions were similar except that patients on localized teams were older. As compared with patients cared for by non-localized teams, patients cared for by localized teams had a 11% longer adjusted length of stay (P=0.022) but similar charges and similar 30-day risk of readmission (see table).

CONCLUSION: Our study reveals a counterintuitive finding of higher length of stay when we localized HPA teams- an intervention designed to promote efficiency. This finding needs to be further explored within a wider context of other measures of quality of care such as patient satisfaction, failure to rescue rates and process measures. In addition, as new patients could be assigned to the localized teams only when the nursing unit had open beds due to discharges, there may have been a perverse incentive promoting higher length of stay to keep unit census high.

POLST USE IN CALIFORNIA NURSING HOMES

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BACKGROUND: Physicians Orders for Life Sustaining Treatment (POLST) forms improve communication of life-sustaining treatment preferences across care venues. California implemented this clinical tool in 2009 and a novel intervention of Community Coalitions was undertaken to advance POLST in localities. Community Coalitions engaged local hospitals, emergency services providers and nursing homes in educational and

operational activities designed to support POLST adoption. About 18 months after introduction of POLST, we studied the implementation of POLST in California nursing homes (NHs) and the association with Community Coalition activity.
METHODS: NHs randomly selected in Coalition and non-Coalition counties were mailed surveys asking about POLST use and problems with implementation. Coalitions identified with which NHs they worked and the level of intensity of interaction with each NH.
RESULTS: Of 547 NHs surveyed, 143 (51%) of those in Coalition counties participated and 141 (52%) from non-Coalition counties. At 83% of responding NHs at least some staff had received POLST education and 59% of NHs reporting having a formal policy on handling POLST. Two-thirds of NHs had admitted a resident with a POLST and approximately 23% of newly admitted residents over the past month had a POLST (range 0-100%) (Coalition county NHs 26% v non-Coalition county NHs 19%, p=0.2). Eighty percent of NHs had completed a POLST with a resident and 55% of residents were estimated to have a POLST (range 0-100%) (Coalition county NHs 61% v non-Coalition area NHs 50%, p=0.04). NHs receiving more intense Coalition interaction had a greater percentage of staff with education, were more likely to have a POLST champion, and were more likely to have completed a POLST with a resident after admission (no interaction 76%, low intensity 87%, high intensity 95%, p<0.01). Few NHs (7%) reported difficulty following POLST orders, but 37% noted difficulty involving physicians in POLST completion and 62% reported difficulty in obtaining original POLST documents from other facilities.
CONCLUSION: Less than 2 years after introduction, most California nursing homes report using POLST, although some NHs reported no
experience. A novel Community Coalition intervention facilitated POLST implementation.
EMPATHY, SUPPORT, OR BLAME REGARDING CIGARETTE SMOKING FROM PHYSICIANS CARING FOR TERMINAL LUNG CANCER PATIENTS: WHEN YOU STARTED, EVERYONE SMOKED AND IT WAS COOL
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BACKGROUND: Patient-centered care is respectful of and responsive to individual patient needs and beneficial for numerous patient outcomes. Patients with advanced cancer are especially in need of compassionate, caring physician responses. However, patient morbidity and mortality concerns can be particularly difficult for physicians to address. These health conditions can engender complex dialogues, making them fruitful for study of communication strategies. One issue of clinical importance in lung cancer care is how physicians address patients potential emotional reactions regarding any history of their cigarette smoking, since it is a frequent mediating factor in the disease. Other studies, with conditions including lung and breast cancer, as well as rape and HIV infection, have found an association between a lack of supportive communication, blaming, and

shaming from medical providers and worsened outcomes. Successful motivational behavior change strategies employ support and empathy. Because supportive communication is associated with better outcomes, it is important to understand

dialogues between lung cancer patients and physicians in regard to cigarette smoking. The objective of this study is to examine physician communication associated with cigarette smoking in an existing database of first visits of undetected standardized patients (SPs) with stage IV lung cancer.
METHODS: Design: Consenting physicians had covert audio recordings of office visits with SPs. Population: Practicing physicians: 23 community oncologists and 23 community family physicians of which SPs successfully audio-recorded 19 oncologists and 20 family physicians. Physicians averaged 48.1 (SD=9.2) years old. Seventy-one percent were male and 29% were female. Prompted physicians were able to identify the SP correctly in 15% (n=5) of visits which were subsequently removed from the data set, leaving 34 undetected visits for this study. Analysis and text management: We conducted a thematic analysis of the transcripts, using an iterative process to create a coding system, with keywords and phrases in areas of interest. Two team researchers, randomly paired, coded each transcript. Coding development continued until saturation; with each revision all previously coded interviews were recoded by a minimum of 2 researchers. We resolved differences in coding in the larger research group by consensus. Team members then reviewed all coded elements in context, using sequence analysis to understand cigarette smoking dialogue, focusing on physician speech. Identifying and defining cigarette smoking-related dialogue: Dialogue categories consisted of a) patient cigarette smoking related cues with physician responses and b) physician spontaneous questions regarding smoking behavior. We categorized these dialogues as supportive or not supportive by the physician towards the patient. Supportive statements regarding smoking were affirming, empathic, or non-blaming towards the patients decision to smoke or having cancer. Not supportive statements regarding smoking occurred either as a nonempathic response to an SP empathic cue or were blaming towards the patient for smoking or having cancer.
RESULTS: Actor adherence to role averaged 92%. Twenty six of the 34 (76.5%) encounters contained a total of 49 dialogues regarding cigarette smoking, with a range of 04 smoking dialogues per encounter. Of these dialogues, 14.3% (n=7) were found to be supportive and 85.7% (n=42) were unsupportive. Supportive dialogues included empathy regarding the patients decision to smoke (The sad thing is that people who smoke and develop a condition they blame themselves -they feel guilty. People from your generation were fooled. When you started, everyone smoked and it was cool.) and acknowledged the difficulty of quitting (Its tough isnt it?). Unsupportive dialogues included pairing delivery of a poor prognosis with a statement about patient smoking (Nowadays most people with lung cancer are previously smokers.), responding to family history of death from lung cancer with a statement about smoking rather than empathy (Patient: My mother died of lung cancer. Doctor: Was she a smoker?), and not acknowledging the difficulty of quitting smoking (Youve been smoking a lot off and on.).
CONCLUSION: Lung cancer patients frequently have a history of cigarette smoking which has contributed to their disease. It is to be expected that they feel some shame, guilt, sadness, or regret regarding their decision to smoke. Physicians can respond supportively by empathically acknowledging reasons patients may have started smoking and the difficulty of quitting. Less supportive responses include linking diagnostic or prognostic statements with the smoking history, which may be interpreted by the patient as blame for the disease. When a patient has a family history of lung cancer, concerns can be similarly addressed in a supportive fashion. Physicians can empower patients to address a personal and family legacy of smoking therapeutically through supportive
behaviors. Cigarette smoking histories present an under-addressed opportunity for physicians to provide support and avoid blaming lung cancer patients. Such supportive relationships, in other health related domains

have been associated with improved outcomes.
BARRIERS TO A COMMUNITY-BASED HEALTH INFORMATION EXCHANGE OF MENTAL-HEALTH DATA TO SUPPORT PRIMARY CARE Michael Weiner 1; Paul Dexter 2; Donald P. Hay 3; Donald Lindgren 4; Faye Smith 5; Tull Glazener 5; Adriane E. Siefert 5; Kristyn Looney 5; Klaus Hilgarth 3; Malaz Boustani 6; Hugh Hendrie 10; Christopher Callahan10. 1Indiana University Center for Health Services and Outcomes Research, and Center of Excellence on Implementing Evidence-Based Practice, Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service HFP 04148, Indianapolis, Indiana ; 2Wishard Health Services and Regenstrief Institute, Inc., Indianapolis, Indiana ; 3Indiana University School of Medicine, Indianapolis, Indiana ; 4Midtown Community Mental Health Center, Indianapolis, Indiana ; 5Regenstrief Institute, Inc., Indianapolis, Indiana ; 6Indiana University Center for Aging Research, Indianapolis, Indiana . (Tracking ID # 10609)
BACKGROUND: Although excellent primary care requires comprehensiveness and coordination, many patients see primary care providers with limited access to specialty-care records. Mental-health (MH) records are often sequestered due to historical practices or policies. In health information exchange (HIE), institutions create agreements and technical means to share selected information. Exchanging certain MH information poses challenges, because federal and State law restricts sharing of details about substance abuse. With attention to policy, law, and technology, we integrated into an electronic health record (EHR) system the diagnoses of patients also seen in an affiliated community MH center (CMHC).
METHODS: The CMHC uses an electronic data system at all of its 13 sites. Stakeholders were gathered, including institutional leaders, their attorneys, and technical staff from the EHR vendors. The team reviewed legislation, institutional practices for managing and protecting data, and technical requirements for transmitting, storing, and displaying data. Agreements were reached to enable the HIE to occur. Due to disparities in designs of the EHR systems, CMHC records were examined to determine technical structure and relationship to native entry of data such as diagnoses. Data were imported into the primary, comprehensive EHR system, which includes all order entry, diagnostic test results, inpatient and outpatient narrative notes, and imaging and is accessed more than ten million times per year at the local institution. This EHR system is part of a city-wide HIE with five hospital systems, including 11 hospital facilities and more than 100 clinics and day surgery facilities. Following inspection of data, clinicians were informed about availability of CMHC data in the primary EHR system. RESULTS: The CMHC provides care for about 1700 patients who are also seen in primary care. Regarding substance-abuse records specifically, the Code of Federal Regulations (Title 42, Part 2) prohibits disclosure without a patients consent. One exception allows for disclosure between or among personnel having a need for the information in connection with the diagnosis or treatment if the communications are within a program or between a program and an entity having direct administrative control over the program. More broadly regarding MH data other than psychotherapy notes, the Health Insurance Portability and Accountability Act does not treat such data

differently from medical or surgical data, which can be shared for treatment. Under the authors State law, exchanging MH data between providers within an institution is also permitted. The institutions ongoing participation in the city-wide HIE program complicated plans to share new data. Limiting HIE of CMHC data to the primary institution and the CMHC required these data to be electronically tagged and required new access controls. Transferring data from the CMHC EHR required agreement upon data formats and telecommunications technologies. Making the CMHC data available in the main EHR system also required creating a new template through which data could be displayed. CMHC data including diagnoses were delivered to the primary system. The main user interface was modified to include a link to the CMHC information, enabling

primary care providers to access CMHC data. Next steps include incorporating into the main EHR system the narrative progress notes from the CMHC.
CONCLUSION: This work illustrates legal, cultural, and technical issues surrounding sharing of community-based MH data to support primary care. Adding MH data to an existing HIE requires attention to law, local access controls, data formats, and education of administrators and clinicians.
HOW DO PATIENTS AND PHYSICIANS DIFFER IN THEIR CONCEPTUALIZATION OF THE REASON FOR HOSPITALIZATION? Zackary Berger 1; Anne Dembitzer 2; Mary Catherine Beach1. 1Johns Hopkins School of Medicine, Baltimore, Maryland; 2NYU School of Medicine, New York, New York. (Tracking ID # 10610)
BACKGROUND: An emerging body of literature focuses on concordance between patient and physician in terms of understanding of reasons for hospitalization. This basic agreement - or common ground - forms the very basis by which all other communication regarding an illness and its treatment is based. The few existing studies that exist on this topic vary widely in their estimates of diagnostic concordance. In light of the potential differences among studies in the measurement of diagnostic concordance, and to address patient understanding of hospitalization in general, we sought to qualitatively analyze the ways in which stated reasons for hospitalization differ between patient and physician from an epistemological perspective, in order to develop a framework for understanding inpatient-physician diagnostic discordance. An emerging body of literature focuses on concordance between patient and physician in terms of understanding of reasons for hospitalization. This basic agreementor common groundforms the very basis by which all other communication regarding an illness and its treatment is based. The few existing studies that exist on this topic vary widely in their estimates of diagnostic concordance. In light of the potential differences among studies in the measurement of diagnostic concordance, and to address patient understanding of hospitalization in general, we sought to qualitatively analyze the ways in which stated reasons for hospitalization differ between patient and physician from an epistemological perspective, in order to develop a framework for understanding inpatient-physician diagnostic discordance.
METHODS: In a major urban medical center in New York, we asked inpatients whether they knew why their doctors admitted them to the hospital, comparing that to their most recent physicians note in the medical record. We then qualitatively analyzed statements made by patients and physicians regarding reasons for admission, classified ways in which these statements differed, calculated the prevalence of diagnostic concordance, and developed a model to demonstrate its potential impact on communication.
RESULTS: Of 46 patients, diagnostic concordance was present in 25 (54%), discordance in 16 (35%), and 5 patients (11%) could not give any reason for their hospitalization. Both patients and physicians most often expressed the reason for hospitalization in terms of diagnosis (kidney stone) rather than symptoms (back pain). Patients whose statements were concordant with their providers usually used slightly different terminology; some also included or omitted detail found in the physicians statements. Patients whose statements were discordant with their physicians were either vague (Im sick), agreed on organ system (chest pain vs. dysphagia), or disagreed on the organ system involved (cant speak vs. atrial tachycardia).
CONCLUSION: A significant proportion of medicine inpatients could not state their physicians reason for admission. Further research on this topic should investigate whether establishing inpatient diagnostic concordance improves outcomes.
RESIDENT USE OF SMARTPHONES WHILE PROVIDING PATIENT CARE Mitesh Patel 1; Jessica Dine 1; David Asch1. 1Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. (Tracking ID # 10615)
BACKGROUND: The use of smartphones among the general population has grown dramatically over the past decade. The growth of medical applications for these devices has helped stimulate their adoption as a new tool for health care providers. Yet, their use by physicians in clinical settings is unknown.
METHODS: Our objective was to determine the percentage of internal medicine residents using smartphones in clinical settings, to assess how the devices were being used, and to evaluate perceptions of the impact of

smartphone use on patient care. We surveyed internal medicine housestaff at three academic medical centers (Brigham and Womens Hospital, the Hospital of the University of Pennsylvania, and the University of California, San Diego) between December 2009 and February 2010. Surveys were administered as hardcopies at intern and resident conferences, as well as through an online version that was made available through email.
RESULTS: Among 125 respondents, 79 (63.2%) used a smartphone as a tool while providing patient care (TABLE 1). The most commonly used device was the iPhone and iTouch (64.6%), followed by the Blackberry(12.7%). Among smartphone users, about two-thirds used their device at least four times a day as an aid for providing patient care. The most common use of the smartphone was for medication reference (96.2%) or as a medical calculator (89.9%). More rare uses included using the camera feature to evaluate at rash over time, viewing pill identification photos for medication reconciliation, and searching the internet for journal articles and other medical information. Smartphones were perceived by housestaff to help save time (93.5%), reduce medication errors (77.9%) and improve quality of care (68.8%). A higher proportion of interns indicated that a smartphone helped them with specific tasks such as learning more medicine, choosing treatment options, improving patient safety and reducing medication errors. In contrast, a higher proportion of residents felt a smartphone helped them with broader issues, such as reducing healthcare costs and improving quality of care. Qualitative analysis revealed that use of smartphones while providing patient care created risks to patient privacy, the patient-physician relationship, and conflicts of interest in medical decision-making (TABLE 2). In contrast, benefits included enhanced ability to perform medication reconciliation and practice medicine at the point-of-care. More than half of respondents that did not use a smartphone reported that it was due to financial reasons. .
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CONCLUSION: A significant proportion of residents are using smart-phones as a tool for providing patient care. These smartphones may play
an important role on improving physician efficiency, patient outcomes and health care quality.
Table 1:
Characteristic
%
(N=79)
Device
IPhone/ITouch
BlackberryOther Smartphone Personal Digital Assistant64.612.712.710.1
Times used per day
1-3 4-6 7-9
Table 2:
Issue Current Practice with Smartphones Proposed Next Steps
Patient privacy
- New challenges to protecting patient privacy- Lack of standard guidelines for storing patient information or taking pictures- Password protection has not been universally adopted
- Hospital and health institutions should evaluate systematic methods that can be implemented to reduce breaches in patient privacy through wireless and cellular technology such as virtual private networks (VPN), secure sockets layer (SSL), and encryption techniques <p class="Ms
THE DIFFERENTIAL EFFECT OF HOSPITAL SERVICE-LINE PROFITABILITY ON READMISSIONS VERSUS

DEATH Amol S. Navathe 1;
Kevin G. Volpp 1; R. Tamara Konetzka 2; Matthew J. Press 3; Jingsan Zhu 1; Richard C. Lindrooth4. 1University of Pennsylvania, Philadelphia, Pennsylvania ; 2University of Chicago, Chicago, Illinois ; 3Cornell University, New York, New York ; 4University of Colorado Denver, Denver, Colorado . (Tracking ID # 10618)
BACKGROUND: Recent policy reform has emphasized the role of readmission rates as an indicator of quality of care, particularly with linking reduced Medicare payments to excess readmissions in The Patient Protection and Affordable Care Act. Under prospective payment, a reduction in reimbursement rates can potentially lower the quality of care during the hospital stay. We examine two measures that are commonly associated with the quality of hospital care: 30-day read-missions and 30-day mortality. Our objective was to determine whether the profitability of hospital service-lines to which a patient was admitted
was associated with the likelihood of readmission or death within 30 days.
METHODS: We utilized a two-stage Cox proportional hazards competing risks framework, allowing for the simultaneity of readmission and mortality risks in the post-hospitalization period. This analysis was performed on a sample of 15,731,768 Medicare Fee-for-Service (FFS) discharges from 4,815 general acute-care hospitals eligible for prospective payment (PPS) during the fiscal years 1997, 2001, and 2005. Risk adjustment was performed using Elixhauser comorbidities and year fixed-effects controlled for secular trends. Baseline hazards were computed at the hospital service-line level to focus on longitudinal within-hospital variation. Profitability was measured using annual markup, computed by subtracting the cost of stays from the allowed charges and dividing this difference by the cost.
RESULTS: There was no evidence of an association between service line profitability and readmission risk (average effect: 0.16 percentage point decrease in readmission risk per 10 percent increase in markup, p-value

range less than 0.001 to 0.092). This effect was most pronounced for hospitals with high shares of Medicare patients, with an average magnitude of 1.67 percentage points per 10 percent increase in markup (p-value less than 0.001). As the service-line markup approached break-even, sensitivity to changes in markup increased.
CONCLUSION: Service-line profitability impacted readmission and death within 30 days of discharge differentially, with no effect on the rate of readmission and a negative relationship with mortality. This finding highlights the complexity in utilizing readmission rates as quality of care indicators. Thirty day mortality has been implemented by CMS as an indicator of inpatient quality for certain conditions. However, there is still controversy regarding the use of 30-day readmission rates. On the one hand rapid readmissions may reflect poor quality of inpatient care. On the other hand, readmissions may also reflect the post-discharge quality of care, including transitions to the outpatient setting and outpatient care itself. The quality of care post-discharge may be unaffected by the variation in inpatient profitability and, as a result, readmission rates were unaffected. While post-discharge care likely also plays a role in 30-day mortality, our findings suggest that it did not offset the effect of reduced inpatient profitability.
CAN WE MEASURE AGENDA SETTING AND BALANCING PRIORITIES IN ENCOUNTERS AND ARE THESE SKILLS INDEPENDENT? Sondra Zabar 1; Kathleen Hanley 1; Jennifer Adams 1; Mack Lipkin 1; Colleen Gillespie2. 1NYU School of Medicine, New York, New York; 2NYU School of Medicine, NY, New York. (Tracking ID # 10619)
BACKGROUND: Agenda-setting and prioritizing are critical skills for effective and efficient clinical care. Studies have shown that physicians commonly interrupt patients early into the interview and do not fully uncover patients agendas. While some communication skills curricula emphasize surveying problems to elicit concerns, there is less focus on skills related to agenda setting. Little is known about how agenda setting influences the rest of the clinical encounter. To examine these processes we created an Objective Structured Clinical Exam

Station where the learner needs to uncover and manage an urgent, unanticipated agenda. METHODS: 21 PGY1, 2 &3 medicine residents completed an OSCE station as part of an annual 10-station OSCE in which a 63-year-old healthy male presented worried about the flu and receiving the H1N1vaccination. If he was asked if he had other concerns, he showed a mole to the doctor. The mole was a realistic (validated by dermatologists) melanoma tattoo. For each OSCE station including this one, trained Standardized Patients (SPs) rated residents communication, organization and time management, assessment, patient education and counseling, and management and treatment plan performance across cases using a 19-item behaviorally anchored checklist with 3 response options (not done, partly done, well done). Cronbachs alpha ranged from .68 to .90 for items within these skill domains. Scores were calculated as % of items within each category rated as well done. In addition to assessing these general skills, the SP also indicated whether he had a chance to express both H1N1 and mole concerns at the start of the visit and whether the resident prioritized one or the other, balanced both issues, or prioritizing was unclear. Chi Square analyses explored whether this measure of agenda-setting/prioritizing was associated with residents performance in the other cases. Independent samples t-tests were used to assess whether residents ability to set the agenda/prioritize in this case was associated with mean differences in overall OSCE performance in core domains. RESULTS: Overall 86% (18/21) residents recognized the urgency of evaluation of the mole. 17/21 (81%) of residents gave the SP an opportunity to express both concerns at the start of the visit. 2 residents prioritized either H1N1 or the mole (10%), 12 residents achieved a balance between the two (57%), and 7 residents priorities were unclear (33%). Residents who
established balanced priority between the patients two concerns performed better than the other residents in 2 of the 3 assessment items: agenda-setting (p=.06) and history gathering for the skin lesion (p=.01) but not in exploring the patients anxiety (p=.44). These residents did not perform better in the 2 education and counseling items focused on H1N1 but they did in providing recommendations for the skin lesion (p=.07). They also performed better than residents who either didnt set a clear priority or who clearly prioritized one over the other in management and establishing a treatment plan: 100% discussed next steps vs. 71% and 50% respectively (p=.03) and 100% made a specific plan for follow-up vs. 0% and 50% respectively (p<.001). OSCE results from the other 9 stations mirrored those found in this station: residents who had balanced the priority of the patients two concerns received higher assessment and management/treatment plan scores across the ten stations OSCE than those in the other two groups combined (assessment: mean of 55% well done vs. 36%, p=.046; management/treatment plan: mean of 53% well done vs. 42%, p=.027). Residents communication and patient education and counseling scores did not differ. CONCLUSION: An OSCE station using a mole tattoo effectively demonstrated a relationship between agenda setting and balancing priorities. Balancing priorities and setting the agenda appears to be a skill largely independent of communication and patient education skills. However, this skill appears to be associated with effectively assessing patient health concerns and arriving at and effectively recommending an appropriate management/treatment plan. This advanced communication skill set incorporates clinical reasoning and negotiations and may prove to be a key communication skill.

FINANCIAL CONDITION OF TEACHING HOSPITALS AND PATIENT OUTCOMES FOLLOWING 2003 ACGME RESIDENT DUTY HOUR REFORM Amol S. Navathe 1; Jeffrey H. Silber 2; Amy K. Rosen 3; DylanS. Small 1; Yanli Wang 2; Jingsan Zhu 1; Michael Halenar 1; Kevin G. Volpp1. 1University of Pennsylvania, Philadelphia, Pennsylvania ; 2The Childrens Hospital of Philadelphia, Philadelphia, Pennsylvania ; 3Boston University, Boston, Massachusetts . (Tracking ID # 10630)

BACKGROUND: The new Accreditation Council for Graduate Medical Education (ACGME) revised resident duty hour regulations will take effect July 1, 2011. One of the concerns is that these duty hour rules represent a significant unfunded mandate, with estimated costs of several hundred million dollars per year. The differential impact of duty hour reform on patient outcomes by underlying financial health of teaching hospitals is unknown. Hospitals that are more financially stressed may be less able to respond to such mandates and as a

consequence, patient outcomes may be affected. In this study, we examine whether hospital financial health was associated with differential outcomes before and after implementation of the 2003 ACGME duty hour regulations.
METHODS: We used 20002005 Medicare data to evaluate changes in a comprehensive set of patient outcomes in less versus more financially healthy hospitals before and after duty hour reform. Financial health of hospitals was measured as the average ratio of cash flow to total revenue in the year prior to duty reform implementation using Medicare Cost Reports data. Interrupted time series analysis and logistic regression models, adjusting for patient comorbidities, common time trends, and hospital site, were utilized to assess changes over time. Outcome measures included mortality within 30 days of hospital admission, AHRQ Patient Safety Indicators (PSIs), failure-to-rescue (FTR) rates, and prolonged length of stay (PLOS). PSI measures included PSIC reflecting continuity of care in the perioperative setting, PSI-T representing technical skills-based care, and PSI-O, an Other composite, with a mix of surgical and medical PSIs. We studied 3,614,174 unique Medicare patients admitted to 869 short-term acute-care non-federal teaching hospitals with principal diagnoses of acute myocardial infarction (AMI), congestive heart

failure (CHF), gastrointestinal bleeding, or stroke or a DRG classification of general, orthopedic or vascular surgery.
RESULTS: There was no systematic evidence that the degree of change in patient outcomes was associated with hospital financial health in post-reform year 1 (Post 1) or year 2 (Post 2) versus the pre-reform period. All 8 tests measuring the association between mortality and hospital financial health quartile were insignificant: Post 1 OR range 1.001.02 (95% CI range, 0.971.04) and Post 2 OR range 0.991.02 (0.971.05). For PSIs, 6 of 8 tests were insignificant except for minor effects in Post 1 for PSI-O and Post 2 for PSI-T: OR 0.96 (0.940.99) and OR 0.97 (0.940.99) respectively. FTR rate analysis demonstrated no significance for either post-reform year (OR 1.00 for both) and the test on PLOS outcomes resulted in significance only for the combined surgical sample in Post 2: OR 1.03 (1.021.04). CONCLUSION: Hospital financial health was not associated with differential changes in patient outcomes before or after the 2003 ACGME duty hour reform. Our findings offer evidence that despite the significant costs, financially stressed hospitals kept up with the financially healthiest hospitals in quality of care provided. If we had found a deleterious association, then newly anticipated financial stresses from more stringent 2011 duty hour rules would have been cause for very serious concern. As it stands, our results provide some reassurance that teaching hospitals may successfully adapt to these new financial pressures without significant reductions in quality.
ELECTRONIC RISK ALERTS TO IMPROVE PRIMARY CARE MANAGEMENT OF CHEST PAIN: A RANDOMIZED, CONTROLLED TRIAL Thomas Sequist 1; Shane Morong 1; Amy Marston 2; Carol Keohane 1; E. Francis Cook 1; E. John Orav 1; Thomas Lee1. 1Brigham and Womens Hospital, Boston, Massachusetts; 2Harvard Vanguard Medical Associates, Boston, Massachusetts. (Tracking ID # 10631)
BACKGROUND: The primary care evaluation of chest pain represents a significant challenge. Electronic decision support could improve the quality and safety of chest pain evaluations by promoting risk-appropriate care. METHODS: We enrolled 292 primary care clinicians caring for 7,083 adult patients with chest pain and no history of cardiovascular disease across 15 health centers. Clinicians were randomized to receive alerts within the electronic health record recommending risk-appropriate care based on automated calculation of the Framingham Risk Score (FRS) during office visits for chest pain. One alert recommended performance of an electrocardiogram and administration of aspirin for high risk patients (FRS greater than or equal to 10%), and a second alert recommended against performance of cardiac stress testing for low risk patients (FRS <10%). The primary outcomes included performance of an electrocardiogram and administration of aspirin therapy for high risk patients during the office visit; and avoidance of cardiac stress testing within 2 months of the office visit for low risk patients. Hospital outcomes were collected within 1 month of the office visit. We surveyed all 292

clinicians enrolled in the study at the conclusion of the 15 month intervention period, achieving a 76% response rate.
RESULTS: The majority (81%) of patients with chest pain were classified as low risk. The clinical evaluation was generally more aggressive among high risk patients compared to low risk patients, including rates of performing electrocardiograms (50% versus 43%, p<0.001) and cardiac stress tests (17% versus 10%, p<0.001). High risk patients were more likely than low risk patients to be evaluated in the emergency department (11% versus 5%, p<0.001) and to be hospitalized (7% versus 3%, p<0.001). A diagnosis of coronary artery disease was established more commonly among high risk compared to low risk patients (1.1% versus 0.5%, p<0.001). Acute myocardial infarction occurred among 28 (0.4%) patients, also more commonly among high risk compared to low risk patients (1.1% versus0.2%, p<0.001). Among 28 diagnoses of acute myocardial infarction, 10 (36%) represented missed diagnoses in the primary care setting not referred to the emergency department for acute management. Among high risk patients, there was no difference between the intervention and control groups in rates of performing electrocardiograms (51% versus 48%, p=0.33) or administering aspirin (20% versus 18%, p=0.43). Among low risk patients, there was no difference between intervention and control groups in rates of cardiac stress testing (10% versus 9%, p=0.40). A majority of intervention clinicians felt that the electronic alerts for high risk patients were very (9%) or somewhat (49%) effective at improving their management of chest pain. A large majority of clinicians (81%) felt that the cut-off of 10% for the FRS to identify high risk patients was about right. CONCLUSION: Acute myocardial infarction is infrequent among primary care patients with chest pain, though often misdiagnosed. Primary care management of chest pain commonly involves underutilization of interventions in high risk patients and overutilization in low risk patients. Electronic alerts do not increase risk-appropriate care for these patients.
PATIENT-PROVIDER RACE CONCORDANCE AND ADHERENCE TO ANTIHYPERTENSIVE MEDICATIONS: WHAT IS THE ROLE OF PATIENT TRUST? Antoinette Schoenthaler 1; Linda Baier Manwell 2; Mark Linzer 3; Roger Brown 2; Mark Schwartz1. 1NYU School of Medicine, New York, New York ; 2University of Wisconsin, Madison, Wisconsin ; 3Hennepin County Medical Center, Minneapolis, Minnesota . (Tracking ID # 10655)
BACKGROUND: Perceived quality of the patient-provider relationship has emerged as a potential contributing factor to racial disparities in healthcare. Race-discordant patient-provider relationships have been linked to lower perceived quality of care among Black patients receiving care from White providers compared to Black patients in race-concordant relationships. Alternatively, patients in race-concordant relationships have longer medical visits with higher ratings of positive affect, shared-decision making, and satisfaction. Despite mounting evidence that patient-provider race concordance affects processes of care (e.g., patient satisfaction, health service utilization), the impact on intermediate patient outcomes such as medication adherence is unclear. More importantly, no study has examined the mechanisms by which race concordance affects patient outcomes.
METHODS: We analyzed cross-sectional data from surveys of primary care providers and their hypertensive patients participating in the Minimizing Error, Maximizing Outcome (MEMO) Study, a multi-method longitudinal (20012005) study designed to explore the relationships between work conditions, physician outcomes and quality of care. Race concordance was characterized as dyads where both the patient and provider were of the same race; race discordance was characterized as dyads where the patient was Black and the provider was White. Medication adherence was assessed by asking patients to respond to a single question: In a typical week, how close do you come to following your doctors recommendations about medications? Responses were dichotomized as always take all of my medicine vs. usually/ sometimes take all of my medicine. Patient trust was measured with 4-items assessing the patients overall trust in the provider as well as trust in their providers medical decision-making under certain financial/administrative constraints. Responses ranged from not at all to completely on a 5-point Likert-type scale. Multivariate logistic regression models tested the hypothesis that a higher proportion of patients in race-concordant dyads would exhibit better medication adherence than patients in the race-discordant dyads, after adjusting for patient (e.g., gender, age, number of hypertensive medications),

provider (e.g., age, gender, specialty), and clinic-level (e.g., location) characteristics. Using Mackinnons model of mediation analysis, probit regression models were conducted to assess the effect of race concordance on medication adherence and if trust mediated this relationship.
RESULTS: Data from 220 physicians (10% Black, 41% female; mean age 44) and 816 of their hypertensive patients (24% Black, 64% female;

mean age 61) were included. Eighty-seven percent (87%) of patients were in race-concordant relationships: 76% in a White patient-provider dyad and 11% in a Black patient-provider dyad. A total of 55% of Black patients were in race-discordant relationships with White providers compared to only 1% of White patients seen by Black providers; we excluded the latter group due to the small sample size. White patients were older and had more comorbid conditions and lower diastolic blood pressure than Black patients in either race-concordant or discordant relationships (p=0.05 for each) and race-discordant relationships (69%; OR=0.51, 95% CI 0.30, 0.84, p=0.008). Adherence levels were not significantly different among Black patients in race-concordant vs. race-discordant relationships (p >0.05). Trust in the provider did not mediate the effect of race concordance on medication adherence; rather it had an independent effect. For each 1-point increase in the trust scale, all patients were 1.8 times more likely to report always being always adherent to their medications, irrespective of their providers race (OR=1.82, 95% CI: 1.30-2.55, p<0.001). CONCLUSION: White patients with White providers reported the highest levels of adherence. Among Black patients, there were no significant differences in adherence levels by racial composition of the patient-provider relationship. Trust in ones provider was associated with better adherence for all patients, regardless of racial composition of the patient-provider relationship. While these findings do not conform to previous studys results, they convey an important message to the medical field. A patient-provider relationship characterized by high levels of trust is an influential determinant of patient behavior and even transcends the influence of race in certain populations. Future research is needed to understand under what circumstances race-concordance affects intermediate patient outcomes, particularly in Black patients, and the mechanisms driving this relationship.
BIOMARKERS FROM MULTIPLE PATHWAYS ARE NOT ASSOCIATED WITH THE ONSET OF TYPE 2 DIABETES: THE FRAMINGHAM HEART STUDY. Dhayana Dallmeier 1; Martin Larson 2; Na Wang 3; Joao Fontes 2; Emelia Benjamin 2; Caroline Fox2. 1Boston University Medical Center, Boston, Massachusetts; 2Framingham Heart Study, Framingham, Massachusetts; 3Boston University School of Public Health, Boston, Massachusetts . (Tracking ID # 10659)
BACKGROUND: Prior studies report conflicting findings regarding the association of biomarkers in predicting the onset of type 2 diabetes. We evaluated a panel of 12 biomarkers as possible predictors of the new-onset of diabetes in the Framingham Heart Study.
METHODS: We measured levels of circulating biomarkers representing inflammation (C-reactive protein, interleukin-6, monocyte chemoattractant protein-1, tumor necrosis factor receptor 2, osteoprotegerin, fibrinogen), endothelial dysfunction (intercellular adhesion molecule), vascular damage (CD40-ligand, P-selectin, lipoprotein-associated phospholipase A2) and oxidative stress (urinary isoprostanes) in participants free of diabetes who attended the Offspring 7th (n=2499) or multi-ethnic Omni 2nd (n=189) examination of the Framingham Heart Study (19982001). Biomarker concentrations were log-transformed and standardized (mean= 0, standard deviation=1); multivariable logistic regression was used to test each biomarker in association with incident diabetes (defined as: 1) fasting glucose level of 126 mg/dL and over or 2) use of insulin or oral hypoglycemic medications) at 6.6 years mean follow-up (20052008). We adjusted for age, sex, cohort, and additionally for established clinical covariates related to diabetes (body mass index, fasting glucose, systolic blood pressure, HDL cholesterol, triglycerides and smoking).

RESULTS: In a total of 2638 participants (56% women, mean age 59 years), at follow-up, 162 participants (6.1%) developed diabetes. C-reactive protein, fibrinogen, intercellular adhesion molecule, interleukin-6, urinary isoprostanes, monocyte-chemoattractantprotein-1 and tumor necrosis receptor factor 2 were associated with incident diabetes after adjusting for age, sex and cohort (all p-values <0.02). However, none of the inflammatory biomarkers remained significant after multivariable adjustment (all p>0.05). The c-statistic for prediction of diabetes was 0.89 in the multivariable model including only clinical covariates.
CONCLUSION: We demonstrated associations between biomarkers from multiple different pathways in association with incident diabetes, which were absent after additional adjustment of established clinical covariates. Inflammatory biomarker panels may not be an effective resource to adequately predict diabetes onset in community-based samples.
RACIAL AND ETHNIC DISPARITIES IN RECEIPT OF THE HERPES ZOSTER VACCINE: RESULTS OF A NATIONAL POPULATION-BASED SURVEY Deirdre Mooney 1; Janice Weinberg 2; Christine Lloyd-Travaglini 2; Karen Lasser1. 1Boston University School of Medicine, Boston, Massachusetts ; 2Boston University School of Public Health, Boston, Massachusetts . (Tracking ID # 10660)
BACKGROUND: Herpes Zoster (HZ) vaccination decreases illness due to shingles, yet despite national guidelines, the vaccine is underutilized. Racial and ethnic disparities in receipt of other vaccines such as influenza and pneumococcal are well documented, yet few data are available regarding HZ vaccine receipt.
METHODS: We analyzed population-based data on 13,086 adults age 60 and older from the 2008 and 2009 National Health Interview Survey (NHIS), a nationally representative sample of the civilian non-institutionalized population. We used Chi square tests to compare receipt of HZ vaccine according to respondents demographic characteristics, access to care, and receipt of influenza and pneumococcal vaccine. To analyze race as a predictor of HZ vaccine receipt, we used multiple logistic regression controlling for sex, age, immigrant status, education, marital status, insurance type, income, region of the country, and having a usual site of care or care provider (all significant bivariable predictors of HZ vaccine receipt). We accounted for NHIS stratification, clustering and sampling in the multivariable analysis.
RESULTS: Only 8.1% of eligible adults reported receiving the HZ vaccine. There were racial differences in receipt, with blacks (3.7%) and Hispanics(3.5%) receiving the vaccine less often than whites (9.8%; p Whites were2.2 times more likely to receive the HZ vaccine than were blacks and Hispanics, while they were 1.2 times more likely to receive the influenza vaccine and 1.5 times more likely to receive the pneumovax. HZ vaccination was more common among those who received the influenza or pneumococcal vaccine (10.7% and 12.8%) relative to those who had not received these vaccines (4.3% and 3.9 %, respectively; p Foreign-born individuals were also less likely to receive the vaccine (OR 0.62; 95% CI0.43-0.88; p=0.008) as were those without a usual source of care (OR0.53; 95% CI 0.29-0.96; p=0.04). Persons with Medicaid or no insurance were less likely to report vaccination than those with other insurance including Medicare and private insurance (OR 0.37; 95% CI 0.25-0.57; pMidwest versus the West (OR 0.68; 95 CI 0.52-0.90; p=0.008 and OR0.70; 95% CI 0.57-0.88; p=0.002, respectively).
CONCLUSION: Racial and ethnic disparities exist in HZ vaccine receipt, with minorities having lower vaccination rates regardless of income, insurance type or having a usual source of care. Logistical barriers unique to the HZ vaccine (high cost, Medicare part D reimbursement, and need for freezer storage) may pose particular challenges to minority patients and the institutions that serve them. Multilevel interventions that increase patient and provider awareness of the vaccine and develop systems to promote vaccine uptake are needed to eliminate racial and ethnic disparities.

KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING SMOKING AND CESSATION ADVICE: A SURVEY OF PHYSICIANS IN BUENOS AIRES Jonatan Konfino 1; Raul Mejia 1; Adriana Basombrio2. 1Hospital de Clinicas, University of Buenos Aires, Buenos Aires, N/A ; 2Direccion de SIDA, Gobierno de la

Ciudad de Buenos Aires, Buenos Aires, N/A . (Tracking ID # 10661)
BACKGROUND: The efficacy of the Highly Active Antiretroviral Therapy (HAART) has transformed HIV/AIDS into a chronic disease. In Argentina, the infectologist assumes the role of being the patients primary care physician, which might result in scarce use of preventive measures and provision of tobacco cessation assistance.
METHODS: A cross sectional study was conducted in Buenos Aires, Argentina in 2010 to assess physicians knowledge, attitudes and current practices with regard to providing smoking cessation advice to their HIV-positive patients.
RESULTS: 169 infectologists were invited to participate and 128 completed the survey (75%), 61% were women and 66% worked at public hospitals. The median age was 39 years and 19% smoked. 90% indicated that they advise their patients to quit smoking, 17% that they set a quit date with the patient, 23% provide brief advice on tobacco cessation, 35% prescribe any pharmaceutical aid, 8% recommend the use of web sites for quitting, 5% suggest the use of phone quit lines and 17% use behavioral-cognitive treatment. 40% of participants considered that treating tobacco addiction was their responsibility but 92% considered that these patients should be referred to a specialist on cessation. The main barriers they reported to deliver tobacco cessation assistance were not having enough time (84%) and being trained inadequately on tobacco cessation (73%). CONCLUSION: Most of infectologists reported treating tobacco addiction but they do not use evidence based strategies for cessation. Not having enough time and being inadequately trained were the main barriers they found for providing assistance forquitting. The provisionof training in tobacco cessation to the infectologists might reduce tobacco consumption among people living with HIVand would have a significant positive effect on their health.
EVALUATION OF RILONACEPT FOR PREVENTION OF GOUT FLARES DURING INITIATION OF URATE-LOWERING THERAPY: RESULTS OF A PHASE 3, RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL Robert R Evans 1; Robert Terkeltaub 2; H Ralph Schumacher 3; Kenneth G Saag 4; James Clower 5; William Jennings 6; Jian Wang 1; Shirletta King-Davis 1; Steven P Weinstsin1. 1Regeneron Pharmaceuticals, Inc., Tarrytown, New York ; 2VA Medical Center, San Diego, California ; 3VA Medical Center and University of Pennsylvania, Philadelphia, Pennsylvania ; 4University of Alabama at Birmingham, Birmingham, Alabama ; 5Westside Center for Clinical Research, Jacksonville, Florida ;
6Radiant Research, San Antonio, Texas . (Tracking ID # 10664)
BACKGROUND: While attaining serum uric acid levels <6.0 mg/dl is critical to the long-term management of gout, gout flares (GFs) are often precipitated as serum uric acid levels fall during the initial months of urate-lowering therapy (ULT). This phase 3 study evaluated the efficacy and safety of rilonacept, an interleukin-1 (IL-1) blocker, for the prevention of GFs during initiation of ULT with allopurinol. METHODS: This multicenter trial included adults with gout (1977 ARA preliminary criteria), uric acid levels >7.5 mg/dL, and self-reported history of 2 or more GFs in the previous year. Eligible patients were initiated on allopurinol 300 mg daily (or lower dose in those with renal dysfunction) with subsequent titration to achieve uric acid <6 mg/dL and randomized to receive treatment (Tx) with weekly subcutaneous (SC) injections of placebo (Pbo; n=80), rilonacept 80 mg (R80; n=80), or rilonacept 160 mg (R160; n=81) (loading dose on Day 1). GFs were reported by the patient via interactive voice response diary; GFs were treated, as appropriate, with NSAIDs or oral glucocorticoids while continuing weekly SC injections and allopurinol Txs. The primary endpoint was the mean number of GFs over the 16 week Tx period. Other endpoints included the percent of patients with 1 or more GFs, and the number of GFs during each 4 week Tx period through week 16. Safety and tolerability were also assessed.
RESULTS: Baseline characteristics were similar among treatment groups;92.9% were male, the mean (SD) age was 52.3 (12.6) years, and the number of flares reported in the prior year was 4.6 (3.3). By week 2 median serum uric acid levels decreased to 6.0 mg/dL in the R groups and 6.2 mg/dL in the Pbo group. Through week 16, the mean number of GFs per patient (primary endpoint) was significantly lower in both R groups relative to

Pbo:1.06 for Pbo; 0.29 for R80 (95% CI, 0.20 to 0.60; p=0.0003 vs Pbo), and 0.21 for R160 (95% CI, 0.14 to 0.41; p<0.0001 vs Pbo). From day 1 to week 16, the proportion of patients who experienced one or more GFs was 46.8% Pbo (95% CI, 35.5 to 58.4) vs 18.8% R80 (95% CI, 10.9 to 29.0) vs 16.3% R160 (95% CI, 8.9 to 26.2; p<0.0001 for both comparisons), resulting in an 60% and 65% reduction in the respective R groups. The number of GFs per Tx period is shown in Table 1.
The overall incidence of adverse events (AE) was similar between Pbo(60.8%) and rilonacept (63.4%). Injection site reactions (generally mild) were the most frequent AE with rilonacept compared with placebo (1.3% Pbo, 8.8% R80, 19.8% R160). Other common AEs included respiratory infections, musculoskeletal system disorders, and headache, and rates were similar among the treatment groups. Three patients in each group experienced serious AEs; no rilonacept-related SAEs, deaths, or serious infectious AEs were reported.
CONCLUSION: This phase 3 trial confirmed that IL-1 blockade with rilonacept markedly reduced the occurrence of gout flares during initiation of urate-lowering therapy. Rilonacept demonstrated an acceptable safety and tolerability profile.
Table 1
Tx period Placebo
n=79
R160mg n=81
Day1-wk4 27 7 5 Wk4-wk8 29 9 6 Wk8-wk12 17 6 2 Wk12-wk16 11 1 4
R80mg n=80
SOCIOECONOMICAL FACTORS, TOBACCO CONSUMPTION AND RELATED ATTITUDES IN YOUTH IN ARGENTINA. A MULTILEVEL ANALYSIS Raul Mejia 1; Bruno Linetzky 2; Daniel Ferrante2. 1Hospital de Clinicas, University of Buenos Aires, Buenos Aires, Argentina ;
2Ministry of Health, Buenos Aires, Argentina . (Tracking ID # 10665)
BACKGROUND: Adolescence is the time in life when tobacco consumption begins. There is no evidence about the relation between socioeconomic factors and tobacco prevalence in youth in Latin America. The objective of this study is to investigate associations of socioeconomic status (SES) with tobacco consumption and related attitudes in adolescents from Argentina.

METHODS: We used the 2007 Global Youth Tobacco Survey (GYTS) which asses tobacco use among 13 to 15 years old youths who go to school. The GYTSs variables used were: current smokers, smokers who want to quit now, never smokers susceptible to start smoking within the next 5 years, second hand smoke exposure outside home, adolescents who by single cigarettes, agreement with prohibition of smoking in public places. Information about the SES of the neighborhood of the school was obtained from national statistics. We used three variables: neighborhood with Convergent Poverty (households with insufficient economic capacity to purchase basic goods and services for subsistence); school public or private and; schools with social assistance (provision of free breakfast and lunch for students).The statistical analysis includes the description of the weighted prevalence of each individual variable for each socioeconomic level and school characteristic. A multilevel analysis was done using random intercept logistic regression model.
RESULTS: We used the 2007 Global Youth Tobacco Survey (GYTS) which asses tobacco use among 13 to 15 years old youths who go to school. The GYTSs variables used were: current smokers, smokers who want to quit now, never smokers susceptible to start smoking within the next 5 years, second hand smoke exposure outside home, adolescents who by single cigarettes, agreement with prohibition of smoking in public places. Information about the SES of the neighborhood of the school was obtained from national statistics. We used three variables: neighborhood with Convergent Poverty (households with insufficient economic capacity to

purchase basic goods and services for subsistence); school public or private and; schools with social assistance (provision of free breakfast and lunch for students).The statistical analysis includes the description of the weighted prevalence of each individual variable for each socioeconomic level and school characteristic. A multilevel analysis was done using random intercept logistic regression model. CONCLUSION: Students from schools located at poor neighborhoods are more susceptible to start smoking, have a higher prevalence of smoking, are exposed more frequently to second hand smoking than those who attend schools from wealthier neighborhoods. These results provide evidence to the implementation of tobacco control policies in schools from low SES neighborhoods.

Table 1

Convergent Poverty

Social Assistance

Public school

OR

(IC 95%))

OR

(IC 95%))

OR

(IC 95%))

Current smoking

<td width="75" style="padding-bottom: 0cm; padding-

THE TIMING OF ANTIBIOTIC FILLS RELATIVE TO AMBULATORY VISITS Jeffrey A. Linder 1; Mark W. Friedberg 2; Dana P. Goldman 3; Daniella Meeker4. 1Brigham and Womens Hospital/Harvard Medical School, Boston, Massachusetts ; 2Brigham and Womens Hospital/Harvard Medical School/RAND Corporation, Boston, Massachusetts ; 3RAND Corporation/University of Southern California, Los Angeles, California ; 4RAND Corporation, Santa Monica, California . (Tracking ID # 10666)

BACKGROUND: Most analyses of antibiotic use in the United States have focused on visit-based antibiotic prescribing, with the assumption that antibiotics prescribed for acute infections will be used promptly. However, patients may delay their use of antibiotics longer than clinicians intend and clinicians may prescribe antibiotics without seeing patients face-to-face. We sought to describe the relationship between the timing of antibiotic prescriptions filled by patients and their most recent ambulatory visit.

METHODS: We performed a retrospective analysis of medical and prescription drug insurance claims of employees from a large multinational corporation for patients aged 18 to 64 years old from January 2001 to December 2007. We identified claims for patients filling antibiotic prescriptions plausibly intended to treat acute infections (i.e., antibiotic durations between 4 and 21 days and short-duration azithromycin). We then identified the most recent ambulatory visit preceding each antibiotic claim, identified the visit diagnosis, and calculated the time interval between the visit and the antibiotic claim. In order to isolate single episodes of care, we considered only the first of multiple fills when less than a month elapsed between sequential fills.

RESULTS: During the study period, 125,132 patients (mean age 44 years old [standard deviation, 13 years], 48% male) filled 324,987 antibiotic prescriptions that were plausibly intended to treat acute infections. The most commonly prescribed antibiotic classes were penicillins (36% [standard error for all percentages, <1%]), macrolides (29%), cephalosporins (15%), and tetracyclines (5%). Eight percent of antibiotic prescription fills occurred within 1 day of the preceding ambulatory visit, 14% within 4 days, 48% within 30 days, and 71% within 60 days. The median length of time between patients filling an antibiotic prescription and the most recent visit was 33 days. There was no outpatient visit within the preceding 90 days for 28% of antibiotic prescription fills. The most common diagnoses for the visits immediately prior to antibiotic prescription fills were acute respiratory infections (ARIs; 60%; median days to fill, 28), urinary tract infections (UTIs; 8%; median days to fill, 20), acne (7%;

median days to fill, 28), and cancer screening (5%, median days to fill, 44). Overall, 25% of the most recent ambulatory visits had diagnoses that did not include ARIs, UTIs, acne, or other infections (median days to fill, 51).
CONCLUSION: The majority of antibiotic prescription fills occur more than a month after patients most recent ambulatory visit, indicating a large proportion of antibiotics are either not filled promptly or are prescribed by clinicians in the absence of closely antecedent ambulatory visits.
RANDOMIZED CONTROLLED TRIAL OF MEDICAL HOME FEATURES TO REDUCE CARDIOVASCULAR RISK Barbara J Turner 1;
Christopher Hollenbeak 2; Pandit Kavita 3; Shelly Joseph 3; Mark Weiner4. 1University of Texas Health Science Center San Antonio, San Antonio, Texas ; 2Penn State College of Medicine, Hershey, Pennsylvania ; 3University of Pennsylvania, Philadelphia, Pennsylvania ; 4University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania . (Tracking ID # 10673)
BACKGROUND: The patient-centered medical home offers services and tools that may reduce coronary heart disease (CHD) risk and blood pressure in vulnerable populations. We conducted a randomized, controlled trial in African-American primary care patients with uncontrolled hypertension to evaluate the impact of an intervention using practice-based registry, staff support and community-based peer coaches on predicted CHD risk and systolic blood pressure after 6 months.

METHODS: A single-blind, randomized, controlled trial of behavioral support to reduce CHD risk was conducted in two level 3 NCQA certified, academic general medicine practices in the University of Pennsylvania Health System. A practice-based electronic medical record (EMR) registry was used to identify African-American patients aged 4075 with uncontrolled hypertension, defined as a mean blood pressure above goal over a two-year period with at least one reading >10 mmHg above goal. Peer coaches were recruited and trained from among African-American patients with well controlled hypertension according to the same practicesEMR registry or from local community volunteers. Eligible subjects were recruited from July 2007 to November 2009. The intervention group received telephone-based lifestyle counseling by peer coaches to reduce CHD risk every other month for six months and educational visits to primary care staff on alternate months (two visits). All subjects received brochures about healthy foods and lifestyle. The primary outcome was 6 month change in predicted 4-year risk of a CHD event, based on a model developed by DAgostino, for intervention versus control groups, and the secondary outcome was change in systolic blood pressure. Multiple imputation was used to estimate missing values for intent-to-treat analysis. Sensitivity analyses were conducted to evaluate comparability of completers versus non-completers.
RESULTS: Of 566 eligible patients, the 280 (49%) randomized subjects were characterized by: mean age 62 (SD 8.8); 65% women, 53% diabetes mellitus, and 18% had prior CHD or equivalent. Baseline 4-yr CHD risk did not differ significantly for the 136 intervention and 144 control subjects (5.8% and 6.4%, respectively). In both groups, mean baseline systolic blood pressure was 140.5 mmHg. Follow-up for 4-year CHD risk was competed in 76% of subjects and for systolic blood pressure in 88% of subjects. In an intent-to-treat analyses, the intervention group had greater reductions in both CHD risk (difference 0.8%, P=0.023) and systolic blood pressure (difference 7.1 mmHg, P=0.001). After adjustment, these significant differences persisted as well as for a reduction in diastolic blood pressure (P=0.023). Reduction in systolic blood pressure was similar for completers versus non-completers for the CHD risk analysis. One patient died in each study arm.
CONCLUSION: In this randomized, controlled trial, components of the medical home that included using a registry to identify at-risk hypertensive African-American patients and an intervention combining community- and office-based behavioral support produced clinically significant reductions in predicted 4-yr CHD risk and blood pressure. This trial supports the potential for the medical home to produce improved clinical outcomes in vulnerable populations.

MAMMOGRAPHY KNOWLEDGE, ATTITUDES, AND PHYSICIAN RECOMMENDATION AND EDUCATION: DOES PRIOR SCREENING MATTER? Edson Carias 1; Alfred Rademaker 1; Dachao Liu 1; Connie Lea Arnold 2; Terry Davis4. 1Northwestern University, Chicago, Illinois;
2LSU Health Sciences Center, Shreveport, Louisiana. (Tracking ID # 10676)

BACKGROUND: Although many interventions have successfully increased the rate of initial mammography use, the factors that prevent the consistent use of repeat screenings remain a growing focus in health-services research. Probable barriers to repeat screening may be worse in disadvantaged populations. The purpose of this study is to evaluate potential differences in breast cancer screening knowledge, attitudes, and physician recommendation and education between women who have had prior mammograms but are not up-to-date and those who have never been screened.

METHODS: Eligible participants (females, age 40 years and over) who had never had a mammogram or were not up to date on their mammogram screening (defined as not having had a mammogram for more than two years) were enrolled in six Federally Qualified Health Centers (FQHCs) in Louisiana. Structured surveys with questions about mammogram screening knowledge, attitudes, self-efficacy, and physician recommendation and education were administered to each participant. Literacy was assessed with the Rapid Estimate of Adult Literacy in Medicine (REALM). Chi-square tests were conducted for data analysis. Multivariate logistic regressions adjusted for age, literacy, and race.

RESULTS: Among the 937 female participants enrolled in our study, 65% were African-American, 35% were white, 30% had less than a high school diploma, and 44% read on less than a 9th grade level. Participants ranged in age from 40 to 89, with a median age of 52. Approximately 24% of participants had never received a mammogram (N=227). Participants who never had a mammogram were less likely than previously-screened participants to have heard of any tests that find breast cancer (71% vs. 89%, $p<0.0001$). Similarly, when compared to those who have had a mammogram, women who have never had a mammogram were less likely to know someone with breast cancer (64% vs. 78%, $p=0.0001$). Participants who have never had a mammogram were less likely to report knowing what it was (75% vs. 99%, $p<0.0001$), having had a physician recommendation for a mammogram (66% vs. 87%, $p<0.0001$), or having been given information or education on mammograms (28% vs. 68%, $p<0.0001$). Interestingly, approximately one in three FQHC participants who had previously been screened reported having never been given information or education on mammograms. Both groups reported having seen or heard an advertisement about breast cancer screening (85% vs. 80%, $p=0.13$). Although both groups had positive attitudes towards screening benefits, those who have never had a mammogram were more likely to agree that they were afraid of getting one because they might find out that something is wrong (26% vs. 13%, $p<0.0001$). Women who never had a mammogram were less likely to know where to get a mammogram (77% vs. 83%, $p<0.0001$) or less likely to know how to get a mammogram (69% vs. 85%, $p<0.0001$). The two groups showed no difference in literacy levels ($p=0.76$). Results remained significant after adjusting for age, race, and literacy. CONCLUSION: Participants who had not previously been screened had less knowledge about mammography and were less likely to have received a physician recommendation or education for a mammogram. Women who did not previously have a mammogram were less confident with the logistics of getting a mammogram, as well as dealing with the results of a mammogram. It is important for clinicians to provide counseling about the benefits of regular screening and explicit information about obtaining a mammogram.

PHYSICIANS DIALOGUES WITH TERMINAL LUNG CANCER PATIENTS: TRENDS WITH SHARED DECISION MAKING AND PATIENT FRIENDLY EDUCATION Elizabeth Edwardsen 1; Sally Rousseau 2; Diane Morse 3; Shmuel Reis 4; Mary Gale Gurnsey 2; Adam Taupin 2; Cleveland Shields 5; Jennifer Griggs 6; Susan McDaniel2. 1University of Rochester, Rochester, New York ; 2University of Rochester, Rochester, New York ; 3University of Rochester School of Medicine, Rochester, New York ; 4Rappaport Institute, Haifa, N/A ; 5Purdue University, West Lafayette, Indiana ; 6University or Michigan, Ann Arbor, Michigan . (Tracking ID # 10682)

BACKGROUND: Patient-centered care is respectful of and responsive to individual patient values, preferences and needs. This approach is a foundation of high-quality health care outcomes including safety, effectiveness, efficiency, and equity. Patient-centered care promotes patient autonomy. Shared decision making considers the patients perspective and involves defining problems, providing information and presenting options so patients can participate in care decisions. Patients

with terminal cancer speak with their physicians about treatment options, symptom management, and morbidity and mortality concerns. These health issues can lead to complex dialogues, allowing potential opportunities for insights into the study of patient-physician communication. The objective of this study is to examine physician communication with respect to shared decision making and patient friendly education with terminal cancer patients.
METHODS: Design: Consenting physicians had covert audio recordings of office visits with Sps (standardized patients). Population: Practicing physicians: 23 community oncologists and 23 community family physicians of which SPs successfully audio-recorded 19 oncologists and 20 family physicians. Physicians averaged 48.1 (SD=9.2) years old. Seventy-one percent were male and 29% were female. SPs were all male. Prompted physicians were able to identify the SP correctly in 15% (n=5) of visits which were subsequently removed from the data set, leaving 34 undetected visits for this study. Analysis and text management: We conducted a thematic analysis of the transcripts, using an iterative process to create a coding system, with key words and phrases in areas of interest. Two team researchers, randomly paired, coded each transcript. Coding development continued until saturation; with each revision all previously coded interviews were recoded by a minimum of 2 researchers. We resolved differences in coding in the larger research group by consensus. Team members then reviewed all coded elements in context, using sequence analysis to understand shared decision-making, patient-friendly education and patient-centered approaches to medical care. Dialogue categories included: 1) decision-making, shared or not shared, 2) patient education, patient-friendly or medical jargon and 3) approach to medicine, patient-centered or physician-centered. RESULTS: Thirty-two of 34 (94%) encounters contained dialogue with decision making. Of these utterances, 48 % (n=104) were coded as shared decision-making and 52 % (n=114) were not shared. Word counts for patient encounters were comparable for family physicians and oncologists. Percent word counts for the family physicians ranged from 24-78%, average 56% and median 58%. Respective counts for the oncologists were 31-83%, average 62% and median 66%. The absolute word counts were on average 10% higher for the family physicians. Despite this difference, shared decision making utterances were more prevalent (4:1) for the oncologist group compared with the family physicians. Family physicians, as a subgroup, were coded for non-shared decision making 2:1 to shared decision-making. Both physician groups utilized patient friendly education more commonly than medical jargon (6:1 for family physicians and 4:1 for oncologists). Both physician groups used similar approaches to medicine with patient-centered and physician-centered utterances. However, the oncologists leaned slightly more towards patient-centered encounters. Shared decision-making dialogues included: I think you need to understand your standing and your options, You can even decide now what you want to do, and I will respect your decision. Unshared dialogues included: well I want to check some blood work today we probably need to do a couple of scans too and see how thats done, and We need to get you in to see an oncology doctor. Patent-centered approaches included: Now in terms of symptoms in the lungs and pain what symptoms are you having right now? Patient-friendly education included: Well Ill tell you what, lets look at it and well get youand if nothing looks really serious here today, I mean lets hope nothing acutethen well get you an appointment with the oncologist. CONCLUSION: Elements of shared decision-making and patient-friendly education were identified in the vast majority of patient-physician encounters. In this set of encounters the oncologists exhibited more shared

decision-making (possibly due to greater comfort and exposure to terminal cancer patients). Patient-friendly education abounded in most encounters. Continued medical education and research are indicated to expand and explore this trend toward
patient-centered care and shared decision-making with all patient populations. ACKNOWLEDGEMENT OF FUNDING: This project was supported by NCI grant R21CA124913 for Dr. Shields and NIMH T32 MH18911 PI Eric Caine for Dr. Morse.
DUTY HOURS Kevin Volpp 1; Judy Shea 2; Dylan Small 2; Mathias Basner 2; Jingsan Zhu 2; Laurie Norton 2; Adrian Ecker 2; Cristina Novak 2; Lisa Bellini 2; David Dinges2. 1Philadelphia VA; University of Pennsylvania School of Medicine and Wharton, Philadelphia, Pennsylvania ;
2University of Pennsylvania, Philadelphia, Pennsylvania . (Tracking ID # 10686)
BACKGROUND: The Accreditation Council for Graduate Medical Education (ACGME) recently released new duty hour standards that will restrict interns to working 16-hour shifts. This is a controversial set of new regulations that stemmed from a recent Institute of Medicine Report that suggested curtailing the duration of shifts for interns either by shortening them or through widescale use of mandatory naps for extended duty overnight shifts. Previous research has indicated that naps on extended duty shifts for interns have low adherence rates and do not succeed in significantly increasing amount slept while on call, suggesting this is not a viable policy solution. We undertook this study to determine whether a system of mandatory naps for interns was feasible and could result in significant increases in the amount slept while on extended duty overnight shifts.
METHODS: 98 intern months at the Philadelphia VA Medical Center (PVAMC) and 75 intern months on the oncology unit of the Hospital of the University of Pennsylvania (HUP) were randomly assigned to either receive a standard intern schedule, which involved extended duty overnight shifts of up to 30 hours, or a mandatory nap month, in which interns were given protected time from 1230530 am in which they were expected to sign out their cell phones to a covering resident. The schedule was a residency programmatic initiative; study participants were asked to wear wrist watch actiwatches and complete sleep diaries. The primary outcome was mean hours slept during extended duty overnight shifts as measured by Actiwatch Spectrum wrist activity monitors. Secondary outcomes included percentage of call nights with no sleep and mean hours slept during other nights of the call cycle. The analyses were done using an unadjusted intent-to-treat analyses testing for differences between the intervention and control groups at each of the two sites, analyzing each site as a separate trial. To account for the correlation among a participants multiple observations, all of the analyses used Huber-White robust standard errors with individual participants as the clusters.
RESULTS: Interns on mandatory nap rotations at both PVAMC and HUP had significantly higher amounts of mean sleep during the protected periods (PVAMC: 2.6 vs. 1.6 hours, p-value<0.0001; HUP: 2.8 vs. 1.9 hours, p-value<0.0001). Nap month participants were also significantly less likely to have call nights with no sleep (PVAMC: 12.5% vs. 26.9%, p-value<0.0001; HUP: 11.1% vs. 17.1%, p-value 0.04). However, mean amount slept over the full call cycle was no different in the control and intervention groups (PVAMC 6.7 vs. 6.8 hours, p-value 0.50; HUP: 6.7 vs. 6.5 hours, p-value 0.19).
CONCLUSION: A mandatory nap intervention significantly increased mean amount slept during overnight call nights, which in the context of new ACGME regulations restricting duty hours could provide a useful alternative for programs seeking to comply with ACGME guidance on fatigue management for residents. However, overall mean sleep within each call cycle was unchanged, suggesting that while this approach could help with acute sleep deprivation, it would be unlikely to address problems with chronic sleep deprivation among residents.

EFFECTS OFA PATIENTACTIVATION INTERVENTION TO OVERCOME CLINICAL INERTIA TO CONTROL BLOOD PRESSURE Christopher N Sciamanna 1; Jeffrey Thiboutot1. 1Penn State Milton S. Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 10687)

BACKGROUND: Hypertension is a common chronic disease known to have many adverse health effects. Unfortunately, physicians have a tendency not to intensify their treatment of hypertension in response to uncontrolled blood pressure values; this tendency has been labeled clinical inertia. This trial was aimed at determining the impact of providing patients with tailored, web-based feedback to help them know when to ask questions aimed at intensifying their hypertension care. METHODS: Diagnosed hypertensive patients (n=500) were enrolled in this RCTand randomized to one of two study groups: (1) Intervention condition Web-based hypertension feedback, based on the individual patients self-report of health variables and previous BP measurements, to prompt them to ask questions during their next physicians visit about hypertension care (e.g., What can you do help me lower my blood pressure); (2) Control conditionWeb-based preventive health feedback, based on the individuals self-report of receiving preventive care (e.g., pap testing). The feedback gave participants questions to ask which they could discuss with their primary care provider (PCP) at their next visit. The primary outcome of the study is change in blood pressure and change in the percentage of patients in each group with controlled blood pressure (RESULTS: Of 500 patients enrolled at baseline, 418 (83.6%) completed the 1-year follow up visit. Most (82.2%) participants utilized the intervention during at least 6 of 12 months, though this did not differ between groups. In addition, most (61.2%) participants reported asking questions directly from the web-site with no difference between study groups. As an example of the control condition (preventative maintenance), if participants had not received a recent tetanus shot they were prompted to ask their PCP if they might benefit from receiving one. Significantly more patients in the control group reported discussing this with their PCP (30.9% control, 13.9% intervention; p<0.001). This led to significantly more subjects in the control group (20.7% control, 8.7% intervention, p=0.005) reporting receiving a tetanus shot in the past year at follow-up. As a similar example of the intervention condition (hypertension care), if participants had not received a creatinine test or urine protein in the past year, they were prompted to ask their PCP if they might benefit from such tests. Significantly more participants from the intervention condition reported discussing creatinine testing (45.8% intervention, 30.2% control; p=0.009) and urine protein testing (40.3% intervention, 30.2% control; pCONCLUSION: The use of a patient activation intervention designed to overcome clinical inertia for hypertension care did not lead to more changes in hypertension medication use or blood pressure control. This was despite high levels of adherence, which led to positive changes in the use of preventive care services (e.g., tetanus immunization) as well as hypertension care services (e.g. creatinine testing, urine protein testing). By providing patients with individually tailored questions to ask during their PCP visits, this study demonstrated that participants were likely to discuss the questions with their PCP. These discussions led to changes in care, demonstrating that the feedback led to a positive change in the health management process.

THE RELATIONSHIP BETWEEN PREGNANCY INTENTION AND PRECONCEPTION HEALTH BEHAVIORS IN A NATIONAL SAMPLE OF REPRODUCTIVE-AGE WOMEN Cynthia H. Chuang 1; Marianne M. Hillemeier 2; Anne-Marie Dyer 1; Carol S. Weisman1. 1Penn State College of Medicine, Hershey, Pennsylvania ; 2Penn State University, State College, Pennsylvania . (Tracking ID # 10695)

BACKGROUND: While the causes of adverse pregnancy outcomes are only partially understood, it is known that predictors include unintended pregnancy and suboptimal preconception health behaviors. Moreover, the nonpregnant phases of a womans reproductive life have important implications for her own health as well as for future pregnancy outcomes. However, it is not well understood whether women recognize these risks, and how intention for future pregnancy impacts health behaviors. The objective of this study was to describe smoking, alcohol use, and folic acid supplementation in preconception women and determine if the likelihood of healthy preconception behaviors differs by whether and when women intend future pregnancy. METHODS: Analysis was based on 36,949 nonpregnant women in the 2004 Behavioral Risk Factor Surveillance System (BRFSS) who were of reproductive age (1844 years), sexually active, and capable of future pregnancy. The association between future pregnancy intention (intending pregnancy in less than 12 months from now, between 12 months

to less than 2 years from now, in 2 or more years from now, not wanting to have a child in the future, or not sure/ambivalent) and preconception behaviors (any smoking, more than 7 alcohol drinks/week, and daily folic acid supplementation) was determined. Multivariable logistic regression models adjusted for diabetes, weight category, race/ethnicity, marital status, education, income, and any children under 18 living in the household (a proxy for prior pregnancy). RESULTS: Women intending pregnancy in less than 12 months had lower rates of smoking (18.5%), lower rates of at-risk alcohol use (4.4%), and higher rates of folic acid supplementation (54.3%) than other women. However, in adjusted analysis, only the odds of folic acid supplementation remained higher in women intending pregnancy in the next 12 months (adjusted OR 1.49, 95% CI 1.15-1.92) compared with women not intending future pregnancy. Women intending pregnancy later or ambivalent about future pregnancy were no more likely to be engaging in healthy preconception behaviors than women not intending future pregnancy. CONCLUSION: In this large, nationally representative population-based study, women intending pregnancy within 12 months were more likely to use folic acid, but pregnancy intention was not associated with preconception smoking or at-risk alcohol use in adjusted analysis. These findings support growing evidence that other than folic acid supplementation, women do little to change their health behaviors before pregnancy. Future research to understand determinants of preconception health behaviors is needed to inform future interventions aimed at reducing preventable adverse pregnancy outcomes.

EMERGENCY DEPARTMENT UTILIZATION BY PRIMARY CARE PATIENTS ATAN URBAN SAFETY-NET HOSPITAL Karen Lasser 1; Jeffrey Samet 1; Howard Cabral 2; Andrea Kronman1. 1Boston University School of Medicine, Boston, Massachusetts; 2Boston University School of Public Health, Boston, Massachusetts. (Tracking ID # 10696)

BACKGROUND: Patient Centered Medical Homes seek to reduce emergency department (ED) utilization by primary care patients. Few data are available on such utilization at safety-net hospitals. METHODS: We analyzed data on patients who had 1 primary care visit in the past year (July 1, 2009-July 1, 2010) to Boston Medical Center. Using ICD-9 codes for the principal ED visit diagnosis, we defined ED utilization according to a modified version of the NYU ED algorithm, categorizing ED visits as high, intermediate, and low severity. Such classification has a strong association with future hospitalization or death. We defined a frequent ED utilization group with 4 ED visits in the past year, and an occasional ED utilization group with 13 ED visits in the past year. Medical and psychiatric diagnoses were obtained from the EMR problem list and billing data. We used t-tests and chi-square tests to compare demographic characteristics of patients with and without any ED use. Controlling for age, gender, language, insurance, and the presence of medical and

psychiatric diagnoses, we used multiple logistic regression to analyze predictors of frequent vs. occasional ED utilization.

RESULTS: Among 39,593 patients who had seen their primary care provider in the past year, 65.4% had no ED visits over that period. The 34.6% (13,710/39,593) with 1 ED visit made 30,048 ED visits, with a mean of 2.2 visits (IQR 12). Frequent utilizers, accounting for 14.1% of all primary care patients with any ED use, made 41% of all ED visits by primary care patients. Most ED visits made by high utilizers were categorized as low severity (72.2%); 8.8% were high severity, and the remaining 19% were indeterminate severity. Patients with and without any ED use did not differ by language (79% spoke English) or gender (57% female). Patients with ED use were older (mean age 46.9) than persons without ED use (mean age45.8; t <0.0001). A higher proportion of blacks (43.2%) and Hispanics(42.9%) used the ED, relative to Asians (17.7%) and whites (20.1%; p<0.0001). ED utilization by privately insured patients (21.3%) was less than that by patients with Medicaid and Free Care (44.9% and 46.0%, respectively; p<0.0001). Among patients with any ED use, frequent ED utilizers were of similar age (mean 47) yet had a higher burden of medical and psychiatric comorbidity compared to occasional

utilizers. In multivariable analyses, frequent (vs. occasional) ED utilizers were more likely to be under age 50 (odds ratio [OR] 1.2; 95% confidence interval [CI], 1.1-1.3), to have COPD (OR 1.8; 95% CI, 1.6-2.0), diabetes (OR 1.3; 95% CI, 1.1-1.4), CHF (OR 2.1; 95% CI, 1.8-2.5), bipolar disorder (OR 1.6; 95% CI, 1.3-2.0), anxiety (OR 1.3; 95% CI, 1.1-1.5), schizophrenia (OR 1.6; 95% CI, 1.2-2.1), depression (OR 1.7; 95% CI, 1.5-1.8) and PTSD (OR 1.6; 95% CI, 1.3-1.8). CONCLUSION: ED utilization by primary care patients at an urban safety-net hospital was high, though most visits were low-severity. A medical home model which provides adequate access to psychiatric as well as primary care, and chronic disease management, has the potential to decrease non-emergent ED utilization.

BLOOD PRESSURE MEASUREMENT BIASES IN CLINICAL SETTINGS Jewell Halanych 1; Susan Andreae 1; Andrea Cherrington 1; Michelle Martin 1; Maria Pisu 1; Louise Russell 2; Monika Safford1. 1University of Alabama at Birmingham, Birmingham, Alabama; 2Rutgers, New Brunswick, New Jersey. (Tracking ID # 10698)

BACKGROUND: An article in JAMA(2008;299:28422844) reported that blood pressure (BP) measurement in clinical care settings seldom follows the protocol recommended by the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC). This may lead to over- or underestimates of the number of patients with controlled BP. We evaluated BP measurement modality as a source of bias in determining BP control.

METHODS: We evaluated BP measurement biases in the context of a community-based randomized trial in underserved, rural diabetic patients. Clinical BP was measured by community clinical staff instructed to take the participants BP like you do in your own clinic. Research BP was measured by personnel trained and certified according to an established research protocol in compliance with JNC recommendations. Each participant had both types of BP assessment during study enrollment on the same day over the course of 2 hours, with the clinical BP assessed first, most closely simulating clinical settings. Both BP assessments were conducted using an automated LifeSource Blood Pressure Monitor (Model UA 789). RESULTS: The study sample included 227 diabetic participants (mean age 59 years, 86% African-American, and 75% female). As shown in the Table, mean clinical BP was higher than mean research BP by 5 mmHg for systolic BP (SBP, $p<0.001$) and 2 mmHg for diastolic BP (DBP, $p<0.001$), with greater differences for participants >65 years old. As shown in the Figure, using SBP >130 or DBP >80, the proportion of participants who were uncontrolled was 8% higher when using clinical versus research BP measurement ($p<0.001$). Using higher cut-offs

TABLE. Mean BP for 227 diabetic patients measured using a typical
clinical protocol and research protocol.

(SBP >140 or DBP >90), the proportion of participants uncontrolled was 10% higher when using clinical versus research BP measurement ($p<0.001$). The difference was 14% in participants >65 years old. CONCLUSION: Measurement biases in clinical settings may be an important component of observed low BP control rates in real-world settings. Per a 2002 NIH report, measuring blood pressure 5 mmHg too high would falsely classify 27 million persons as having HTN. At the cost of $1,000 per year to treat a patient, thiswould add $27 billionto the Nations healthcare billto treat a nondisease. Efforts to reduce this measurement bias may have a beneficial impact on treatment burden, medication costs, and quality of care measures.

CONTRACEPTIVE CARE IN THE VA HEALTHCARE SYSTEM Sonya Borrero 1; Maria Mor 2; Xinhua Zhao 2; Melissa McNeil 1; Said Ibrahim 3; Patricia hayes4. 1University of Pittsburgh, Pittsburgh, Pennsylvania ; 2VA PittsburghHealthcare System, Pittsburgh, Pennsylvania ; 3VA Medical Center, Philadelphia, Pennsylvania ; 4Women Veterans Health Strategic Health Care Group, Washington D.C., District of Columbia . (Tracking ID # 10702)

BACKGROUND: High quality, equitable contraceptive care is a growing priority in the Department of Veterans Affairs (VA) as the number of women veterans using the VA health care system continues to rise. The objective of this study was to examine contraceptive use within the VA by race/ethnicity and to determine whether

receiving primary care in a VA womens health clinic enhances contraceptive provision.
METHODS: We used national VA administrative databases to describe use of contraceptive methods among female veterans aged 1845 who made at least 1 visit to either a VA womens health clinic (WHC) or a traditional VA primary care clinic (PCC) in fiscal year (FY) 2008. The outcome variable for this study was a prescription or procedure indicating contraceptive use during FY 2008. The primary predictor variables of interest were patient race/ethnicity (Hispanic, non-Hispanic black, and non-Hispanic white) and receipt of care in a WHC. Covariates included socio-demographic information, medical diagnoses that may impact choice of contraceptive method, number of visits, whether the subject had a VA gynecology visit, geographic location, and whether the site was a hospital- or community-based clinic. Chi-square tests were used to compare variables by race/ethnicity. We examined the bivariate relationships between each covariate and contraceptive use and computed the unadjusted odds ratios for each pair. We then used multivariable regression models to examine the associations between race/ethnicity and receipt of care in a WHC with contraceptive use while controlling for potential patient-level and facility-level confounders. RESULTS: A total of 103,950 women veterans were included in the study cohort: 6% were Hispanic, 39% white, and 24% black. Approximately 45% of women had been seen in a WHC. Nearly 70% of women did not have any other insurance. Only 22% of women had documented use of any contraception. After adjusting for potential confounders, Hispanic and black women had significantly lower contraceptive use compared to white women (OR: 0.82; 95% CI: 0.76-0.88 and OR: 0.85; 95% CI: 0.82-0.89, respectively). Women who had received care in a WHC were significantly more likely to have contraception compared to those who received care in a PCC (OR: 2.05; 95% CI: 1.97-2.14), and this trend was seen across all race/ethnicity categories. Other factors significantly associated with higher rates of contraception in the adjusted analysis included younger age, not being married, increasing frequency of clinic visits, having seen gynecology, presence of non-VA insurance, being seen in a hospital-based clinic, and a diagnosis of migraines with aura. A diagnosis of breast cancer, tobacco use and age >35, stroke, coronary artery disease, and diabetes were all associated with a significantly less likelihood of having any contraceptive method.
CONCLUSION: We found that overall contraceptive use in the VA is low, especially among minority women. We also found that receipt of primary
care in a VA womens health clinic is associated with significantly higher rates of documented contraception.
HIGH CONCORDANCE BETWEEN DERMATOLOGISTS AND GENERAL INTERNISTS IN IDENTIFYING DERMATOLOGIC CONDITIONS INTERNISTS SHOULD BE ABLE TO MANAGE Oluwatumininu Johnson 1; Carrie Mahowald 2; Miguel Sanchez2. 1NYU School of Medicine, Brooklyn, New York; 2New York University School of Medicine, New York, New York. (Tracking ID # 10705)
BACKGROUND: Studies reveal that a low percentage of Generalists accurately diagnose dermatologic cases, and that a significant amount of referrals from Generalists are ultimately deemed unnecessary. In our setting, a large urban ambulatory care center and Primary Care Internal Medicine Residency training site serving a medically indigent, racially, ethnically and linguistically diverse community, dermatologic conditions are common, and specialty services are limited. We therefore set out to identify dermatologic conditions that both Dermatologists and General Internists believe Internists should be able to diagnose and manage, with the overall goal of building a targeted teaching tool for Internists, to aid in improved patient care and prevention of unnecessary referrals.
METHODS: After a thorough review of the relevant literature and records of referrals at our practice site, we conducted five facilitated focus groups using a purposive sampling method to assess the self perceived needs of generalists and the perspective of dermatological consultants on that need: 3 groups of General Internists (n of 15, 2, 10) and 1group of Dermatology Residents (10) and 1 group of Attendings (2). Near identical questions were posed and each group was asked to generate a list of dermatologic conditions that Internists should be able to diagnose and treat. The Dermatologists focus groups also had to generate conditions that were often

misdiagnosed or unnecessarily referred from the Internist to the Specialist. All focus groups were audio recorded, transcribed and analyzed independently by each investigator using the Atlas TI software and then themes identified were compared, discussed and a consensus on findings was reached. This project was approved by our institutional IRB.
RESULTS: There was a high level of agreement on both dermatologic conditions General Internists should feel comfortable diagnosing and treating, and on the perceived weaknesses of the Generalist in diagnosis and treatment. The top ten most common and/or pertinent of these areas were then selected as the focus for our curriculum. These areas are: general skin care, the skin exam and common dermatologic nomenclature, drug eruptions, suspicious moles, dermatitis, alopecia, acne, lower extremity lesions (stasis dermatitis, cellulitis and vasculitis), common dermatologic outpatient procedures, and fungal infections. In addition, we have collected a rich data set on barriers to and preferences for learning this material which informed the development of a multi-component curriculum that includes on-line multi-media (text, pictures, algorithms and animations), and expert precepted live patient practice components.
CONCLUSION: By improving the acumen and confidence of General Internists in these needs-based areas of Dermatology, it would in turn enhance quality and efficiency of patient care in our under-served, urban community.
INTERNET BASED DEPRESSION PREVENTION FOR ADOLESCENTS: 2.5 YEAR FOLLOW-UP Benjamin N/A Van Voorhees 1; Monika Marko-Holguin1. 1The University of Chicago, Chicago, Illinois. (Tracking ID # 10711)
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ABSTRACTS
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BACKGROUND: We conducted a long-term follow-up study of a primary care/Internet-based depression prevention intervention for adolescents (CATCH-IT), Competent Adulthood Transition with Cognitive-Behavioral Humanistic and Interpersonal Training).
METHODS: We elected to examine Internet site related outcomes for the entire cohort: 1) the number of times and the types of coping strategies used in the previous two weeks; 2) depressed mood, automatic negative thoughts, perceived social support and perceived school impairment at2.5 year follow-up compared to baseline.
RESULTS: N=44, 53% of available sample, N=83 consented to participate. A majority of participants in follow-up study (54%, N=20) reported using 1 to 2 coping strategies favoring behavioral activation approaches in the last 2 weeks (M=1.8, SD=1.9). The most commonly used coping strategies were Changing negative thoughts (CBT, 29.7%, N=11) and Changing my activities to be more active with people or fun things (BA, 16.2%, N=6). Less utilized strategies included avoiding procrastination (2.7%, N=1) and relationship problem solving (5.4%, N=2). Significant declines at 2.5 years were found for Center for Epidemiologic Studies Depression (CES-D, M=22.2 versus M=13.5, p-value=0.001) scores, automatic negative thoughts (M=36.09 versus M=16.98, p-value=0.001) and educational impairment (M=9.00 versus M=5.31, p-value=0.03) when compared to the scores at baseline and 68 weeks (active period of intervention) post intervention. Scores of perceived social support from friends or family were stable and/or improved from baseline to 2.5-year follow-up. CONCLUSION: Half of those who participated in the long-term outcome study reported ongoing and recent use of CATCH-IT coping strategies. Moreover, their depressed mood, automatic negative thoughts and educational impairment levels remained significantly below those measured at enrollment.
GAPS IN MEDICAL STUDENTS KNOWLEDGE OF THE LINK BETWEEN OBESITY, LIFESTYLE, AND CANCER David P. Miller 1;
Mara Z. Vitolins 1; Stephen W. Davis 1; Sonia J. Crandall 1; Edward H. Ip 1; Karen S. Vaden 1; John G. Spangler1. 1Wake Forest University School of Medicine, Winston-Salem, North Carolina. (Tracking ID # 10714)

BACKGROUND: Over two-thirds of Americans are overweight or obese. This obesity epidemic has generated much attention in mainstream media, including concern over obesitys link with heart disease and diabetes mellitus. However, entering medical students may be less aware of the increased risk of cancer associated with excessive weight, poor diet, and lack of exercise. To help guide the development of medical school obesity curricula, we conducted a needs assessment to determine first year medical students baseline knowledge of the link between cancer risk, obesity, and lifestyle factors.
METHODS: The study was conducted at a single medical school in the southeast. For two consecutive years, first year students participated in a new obesity curriculum developed by members of the research team and delivered via web-based modules. Each module began with a 5 item multiple choice pretest to prime the learner. Pretest questions were randomly drawn from a pool of 10 questions for each module. We examined the pretest results to determine specific gaps in students baseline knowledge of the link between cancer with obesity, diet, and exercise. Prior to analysis, a group of 3 multidisciplinary team members coded each pretest item as cancer related or non-cancer related. Coding discrepancies were resolved by group consensus.
RESULTS: Of 242 students, 175 (72.3%) completed two of the modules and were included in the analysis. Ten pretest questions were cancer related (4 obesity items, 4 dietary items, and 2 physical activity items). The remaining 10 pretest items were non-cancer related. Overall, students scored worse on the cancer-related items than the non-cancer related items
(mean correct score 47% vs. 55%, $p<0.001$). A minority of students knew that obesity caused the greatest increased risk for uterine cancer (6%), properly identified foods associated with increased cancer risk (27%), or understood the relationship between exercise and cancer risk (31%). Similarly, a minority of students knew that 1020% of cancer deaths worldwide can be attributed to obesity, but approximately two-thirds (62%) overestimated the magnitude of risk. Only 2 items were answered correctly by at least two-thirds of students: knowing that obesity is associated with gastrointestinal cancers and knowing that whole grains and fiber can lower colorectal cancer risk. CONCLUSION: Students enter medical school with significant gaps in their awareness of how cancer risk is affected by obesity, diet, and exercise. Given that weight and lifestyle are modifiable risk factors, medical school obesity curricula should include information on cancer risk.
ETHICS EDUCATION ACROSS THE CURRICULUM: HOW DO MEDICAL STUDENTS RELATE PRE-CLINICAL LEARNING TO CLINICAL EXPERIENCE? Lauris C. Kaldjian 1; Laura Shinkunas 1; Valerie Forman-Hoffman 1; Marcy Rosenbaum 1; Jerold Woodhead 1; Lisa Antes 1; Jane Rowat1. 1University of Iowa Carver College of Medicine, Iowa City, Iowa. (Tracking ID # 10715)
BACKGROUND: Ethics education in medical school occurs predominantly during the pre-clinical years. Little is known about how the cognitive content of this education is remembered, perceived, and applied after students enter the clinical environment.
METHODS: We gathered data from third-year medical students during Internal Medicine and Pediatrics clerkships at the University of Iowa in 200708 through (1) a voluntary written survey and (2) content analysis of required written reflections about ethical and professional issues encountered during these clerkships. The survey queried: attitudes toward the clinical relevance of their second-year ethics course; knowledge about four ethical principles, other sources of ethical value, and a systematic approach to ethical reasoning taught and practiced in their second-year ethics course (using: A Clinicians Approach to Clinical Ethical Reasoning. JGIM 2005;20:306311); and perceptions about ethics in the clinical environment. Three investigators used content analysis to identify ethical principles, other sources of ethical value, and goals of care in students written reflections. NVivo qualitative software and SAS were employed to calculate frequency and chi-square statistics. Students prior performance data from the second year (from a paper and a multiple choice exam during the ethics course) were also examined.
RESULTS: From a class of 141 third-year students, 109 (77.3%) were included for analysis based on completion of study components. The four ethical principles were recalled by most students (beneficence95.4%,

nonmaleficence 95.4%, autonomy 71.6%, justice 82.6%), but other sources of ethical value were recalled less frequently (rights11.9%, consequences 10.1%, comparative cases 16.5%, professional guidelines 18.4%, conscientious practice 21.1%). Out of 15 possible items within the systematic approach to clinical ethical reasoning taught in the second year, 34.9% of students cited 03 items, 50.5% cited 46, and 14.7% cited 79. Content analysis of reflections showed that no one of the four ethical principles was mentioned in more than 16% of reflections, and goals of care were mentioned in only 14.7%; by contrast, consequences were mentioned in 51.4%. Students who scored 90-100% on the multiple choice exam in the second-year ethics course were able to recall more sources of ethical value (P=0.02) and were more likely to refer to goals of care in their reflections (P=0.02). Most students believed the content of the second-year ethics course was relevant to medical practice (71.6%) and helped prepare them for the challenges they faced in the clinical environment (58.7%), that ethics and medicine are inseparable (93.6%), that they are able to recognize key ethical

obligations and challenges (96.3%), and apply a systematic approach to clinical ethical reasoning (65.1%). Students were more likely to believe that ethical and professional values in the clinical environment are practiced (71.6%) than discussed (44.0%).
CONCLUSION: Most third-year medical students in this study appear to recognize the clinical relevance of ethics and be satisfied with their pre-clinical ethics education. Though most can recall the names of four ethical principles, few are able to recall the names of other sources of ethical value or describe most of the components of a systematic approach to clinical ethical reasoning.

HOUSING INSTABILITY AND INCIDENT HYPERTENSION IN THE CARDIA COHORT Maya Vijayaraghavan 1; Margot Kushel 1; Eric Vittinghoff 2; Stephan Kertesz 3; David Jacobs 4; Cora Lewis 4; Steve Sidney 5; Kirsten Bibbins-Domingo1. 1Division of General Internal Medicine/SFGH, University of California, San Francisco, San Francisco, California ; 2Department of Epidemiology/Biostatistics, University of California, San Francisco, San Francisco, California ; 3Division of Preventative Medicine, University of Alabama at Birmingham, Birmingham, Alabama ; 4Division of Epidemiology, University of Minnesota, School of Public Health, Minneapolis, Minnesota ; 5Kaiser Permanente, Northern California Division of Research, Oakland, California . (Tracking ID # 10716)
BACKGROUND: Housing instability, a precursor to homelessness, may be an independent social and environmental risk factor for hypertension, but limited prospective data exist. We sought to determine if housing instability in early adulthood was associated with incident hypertension over 15 years of follow-up in the Coronary Artery Risk Development in Young Adults (CARDIA) study. Because causes of housing instability vary by race and sex, we hypothesized that housing instability would exert a differential effect on incident hypertension by race and sex.
METHODS: CARDIA is a study of 5,115 young adults, recruited from four sites in 19856 when they were 1830 years of age. The cohort is balanced by race (black/white), sex, age and education, and has been followed with periodic exams over 20 years. At Year 5, when participants were 2335 years of age, all available CARDIA participants were asked about housing; of these, 4342 did not have hypertension and were analyzed. We defined housing instability as living in overcrowded conditions (> 2 people per bedroom), moving 8 or more times in 2 years, or occupying a place without paying rent or money. We defined incident hypertension as systolic blood pressure >140 or diastolic blood pressure >90 or being on anti-hypertensive medications. We used pooled logistic regression to estimate the independent association between housing instability and incident hypertension at years 7, 10, 15 and 20 adjusting for age, sex, race, income, education, smoking, alcohol, cocaine, amphetamine use, marital or relationship status, marital or relationship problems, children, and body mass index (BMI). Because the effect of housing instability varied by race and sex, we report stratified results.
RESULTS: Of the 4342 participants without hypertension at Year 5, 370(8.5%) were living in unstable housing

with prevalence 5.0% (59/1179) among white women, 6.6% (69/1052) among white men, 11.7% (142/ 1212) among black women and 11.1% (100/899) among black men. Within the entire cohort housing instability was not associated with incident hypertension after adjusting for demographics, socioeconomic status, behavioral risk factors, social factors, and BMI (Adjusted Odds Ratio (AOR) 1.2, 95% CI 0.9-1.7). However, this association varied by race and sex (p-value for interaction <0.001). Incident hypertension between years 5 and 20 occurred in 10.8% (121/1120) of stably housed white women vs. 28.8% (17/59) of unstably housed white women. Unstably housed white women had greater odds of incident hypertension (AOR 6.7, 95% CI 3.2-13.7) compared to stably-housed white women. There was no association with incident hypertension for unstably housed white men (AOR 0.8, 95% CI 0.4-1.8), black women (AOR 0.9, 95% CI 0.6-1.6), or black men (AOR 1.0, 95% CI 0.6-1.8) compared to stably housed adults in each race-sex subgroup. CONCLUSION: In a biracial cohort of young adults, housing instability was associated with incident hypertension in white women, but not in white men, black women, or black men. Given the discordance in our findings by race and sex, housing instability may represent different phenomenon for black and white men and women. Some literature suggests that early-life psychosocial risk factors known to be associated with homelessness may be different for women and whites, compared to men and blacks. On this basis, we speculate that psychosocial stressors associated with housing instability may contribute to the development of incident hypertension in unstably housed white women.

IMPACT OF PRICE DISCOUNTS WITH AND WITHOUT MESSAGING ON SUGARY BEVERAGE CONSUMPTION: RESULTS FROM A MULTI-SITE INTERVENTION Matthew Press 1; Jane Jue 2; Daniel McDonald 3; Kevin Volpp 2; Jingsan Zhu 2; Nandita Mitra 2; David Asch 2; George Loewenstein3. 1Weill Cornell Medical College, New York, New York;
2University of Pennsylvania, Philadelphia, Pennsylvania; 3Carnegie Mellon University, Pittsburgh, Pennsylvania. (Tracking ID # 10722)

BACKGROUND: Some policymakers interested in curbing increases in obesity and diabetes have advocated taxing the purchase of sugary beverages. The objective of our study was to determine if an alternative financial incentivea price discount for zero calorie beverageswould affect consumers beverage choice. In addition, we sought to assess whether messaging about the discount would augment its effectiveness. METHODS: This was a nonrandomized, prospective trial of two interventions carried out at the cafeterias and stores of three different hospitals. The first intervention was a 10% discount on all zero calorie bottled beverages, including water, diet soda, and diet iced tea. The second intervention was a 10% discount on all zero calorie bottled beverages plus messaging to consumers about the discount. Messaging was in the form of marketing posters, which were displayed prominently and conveyed a connection between the discount and a healthier beverage choice. Each intervention lasted three weeks, and prices reverted to baseline between the interventions. Sales of sugary beverages and zero calorie beverages during the interventions were compared to pre- and post-intervention periods using overdispersed Poisson regression. Covariates in the regression model included day of the week and total number of transactions (to adjust for customer volume), and the regression coefficients were converted to percent change in sales. RESULTS: During the discount intervention, sales of sugary beverages at the three sites increased 6.5% (p=.276), decreased 10.8% (p=.004), and increased 5.6% (p=.000); sales of zero calorie beverages increased 4.7% (p =.383), increased 15.2% (p=.001), and increased 3.0% (p=.098), respectively, relative to baseline. During the discount plus messaging intervention, sales of sugary beverages increased 5.0% (p=.277), decreased 10.3% (p=.008), and increased 1.4% (p=.313); sales of zero calorie beverages increased 11.7% (p=.007), increased 23.9% (p=.000), and increased 1.0% (p=.577), respectively, relative to baseline.

CONCLUSION: In response to the price discount intervention, sugary beverage purchases decreased, and zero calorie beverage purchases increased, at one of the three sites. At that site, messaging appeared to augment the effect of the discount. However, at the other sites, the interventions had no or modest effects at increasing

zero calorie beverage purchases, and, in these cases, the effects were at least partially offset by increases in purchases of sugary beverages. The impact of financial incentives, such as price discounts, on consumer consumption of sugary beverages may vary in different settings. Policies based on these interventions require further evaluation before widespread implementation.

FACTORS ASSOCIATED WITH ADDRESSING BARRIERS TO ACCESSING CANCER CARE IN A PATIENT NAVIGATION PROGRAM

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BACKGROUND: Patient navigation, which aims to reduce barriers to care, is increasingly being adopted as a model to reduce cancer health disparities in underserved communities across the country. Although studies are ongoing to assess the full benefit of this model on cancer care outcomes, there is little understanding of the process of navigation to achieve these outcomes. In this study, we examine documented barriers to care and corresponding navigation activities to address them.

METHODS: Data from the intervention arm of a multi-site quasi-experimental patient navigation study included eligible women with abnormal Mammogram or Pap tests from 5 urban community health centers, during January 2007 to December 2008. Navigators were trained to identify, document and address 20 pre-defined barriers to care at each patient encounter. The goal of navigation was to engage in activities to ameliorate these barriers in order to facilitate timely diagnostic resolution of the abnormality. In each patient encounter, navigators documented unique barriers and corresponding actions taken to address that barrier. Based on literature review and consensus of the research committee, access barriers were grouped into 3 types: Logistic (e.g. Transportation), Cultural (e.g. Fear) and Financial (e.g. Employment). A barrier is considered addressed when there is a corresponding documented action (e.g. Arrangement for Transportation). Our analyses used the barrier as the unit of analysis and examined associations between patient characteristics and types of barrier with whether or not a barrier was addressed. Patients can contribute multiple barriers from multiple visits, and we used Generalized Estimation Equation (GEE) multiple logistic regression to examine these associations, accounting for correlation between multiple observations per subject.

RESULTS: Among 1118 female intervention subjects, mean age was 42 years; 67% were non white; 71% had either public or no insurance. Overall, 602 (54%) subjects had 1 or more unique barriers identified across all encounters. This resulted in 1691 unique barriers to care of which 620 (37%) were Logistic, 167 (10%) were Cultural and 71 (4%) were Financial; almost half 833 (49%) of documented barriers did not fit into one of the predefined categories and were documented as Other. Overall 72% of the identified barriers were addressed. The Other barrier category had the lowest percentage of addressed barriers (59%), followed by Financial (79%), Logistic (84%) and Cultural barriers (92%). In bivariate analysis, using GEE model, Other barriers were less likely (OR:0.29, CI: 0.21, 0.4) and Cultural barriers were more likely (OR: 2.4, CI:1.2, 4.6) to be addressed compared to Logistic barriers. In bivariate analyses, African American women compared to White women had a lower odds of having an addressed barrier (OR: 0.64, CI: 0.42, 0.97) as did those from two community health centers (OR: 0.2, CI: 0.1, 0.4 and OR: 0.25, CI: 0.13, 0.48). In Multivariate GEE model, using type of barriers and adjusting for race, age, marital status, language, type of insurance and site of care to assess whether or not a barrier was addressed; type of barrier (Other barriers vs. Logistic barriers, OR: 0.32, CI: 0.23, 0.46, and Cultural barriers vs. Logistic barriers, OR: 2.67, CI:1.34, 5.35) and belonging to one of the community health centers (OR:0.33, CI: 0.15, 0.77) were the only significant predictors of the outcome. CONCLUSION: In this community health center-based navigation program, navigators addressed most identified barriers when they

were able to clearly categorize the barrier. After adjusting for site of care and barrier type, no individual patient characteristic was found to be associated with the ability of a navigator to address an identified barrier. This suggests that navigator training, which targeted 20 known barriers to care, provided navigators with the skills necessary to address those known barriers yet highlights unmet navigator training needs that are specific to the population served across each site of care.

PHARMACISTS PERSPECTIVES ON A PHARMACIST-LED CARE TRANSITIONS INTERVENTION: WHAT CAN WE LEARN FROM PILL-CVD? Sunil Kripalani 1; Katherine Taylor-Haynes 1; Alison Oberne 2; Courtney Cawthon 1; Jeffrey L Schnipper3. 1Vanderbilt University, Nashville, Tennessee ; 2University of South Florida, Tampa, Florida ; 3Brigham and Womens Hospital, Boston, Massachusetts. (Tracking ID # 10735)

BACKGROUND: Increasingly, institutions are implementing multi-faceted programs which seek to improve hospital discharge transitions. However, little is known about which aspects of these complex interventions are most beneficial. The Pharmacist Intervention for Low Literacy in Cardiovascular Disease (PILL-CVD) study was a two-site randomized trial designed to reduce serious medication errors after hospitalization through a tailored educational intervention and telephone follow-up. The current qualitative study sought to determine the most important aspects of the intervention from the perspectives of the pharmacists who delivered it.

METHODS: Semi-structured interviews were conducted with the 11 study pharmacists to examine their perspectives on pharmacist involvement in the different aspects of the PILL-CVD intervention, including medication reconciliation, two in-hospital patient counseling sessions, and provision of simple medication adherence aids. Also, while telephone follow-up was conducted initially by non-clinical personnel, pharmacists followed up when problems were identified. Interview data were coded systematically using an a priori analytic framework, RE-AIM+, that expands upon Glasgows (1999) evaluation framework of Reach, Efficacy, Adoption, Implementation, and Maintenance.

RESULTS: Pharmacists considered medication reconciliation the most important facet of the intervention. They frequently identified errors in

the Pre-Admission Medication List (PAML) as documented by treating physicians. A careful medication review by the pharmacist identified patients with poor understanding of their pre-admission medication regimens, pinpointed errors in patients medical records, and enabled creation of a complete, accurate medication list, but this process was considered time-consuming and likely imperfect. Adherence aids (e.g., pill box, illustrated daily medication schedule) were felt to be highly valuable for patients with low health literacy, though pharmacists found them less useful for higher health literacy patients. Having non-clinical staff conduct the initial post-discharge follow-up calls effectively leveraged pharmacists time and hospital resources.

CONCLUSION: Medication reconciliation and use of simple adherence aids were felt to be the most beneficial aspects of this multi-faceted care transition intervention. This experience supports greater pharmacist involvement in medication reconciliation, either to verify the work of other health care providers or to construct the PAML from the outset. Additional refinements to the patient education tools may be needed to increase their utility for patients with adequate health literacy, though another solution would be to provide such tools only to patients with low health literacy. A protocol for post-discharge telephone follow-up by non-clinical personnel leveraged pharmacists time and could reduce the cost of similar interventions.

PATIENT AND PHYSICIAN DISCUSSIONS AFTER DECISION SUPPORT FOR COLORECTAL CANCER SCREENING IN THE ELDERLY Carmen Lewis 1; Christopher P DeLeon 1; Michael P Pignone 1; Carol Golin1. 1University of North Carolina - Chapel Hill, Chapel Hill, North Carolina. (Tracking ID # 10736)

BACKGROUND: The potential benefit of colorectal cancer screening decreases with increasing age and co-morbidity. Individualized decision making between elderly patients and their providers has been recommended to encourage screening in those most likely to benefit from screening and to avoid harm in those most likely to experience net harm. This study has 2 purposes: 1) To assess the feasibility of providing targeted decision

support intervention for both physicians and elderly patients prior to an office visit and audio-taping visits and 2) to examine individualized decision making during the visit through an analysis audiotapes of the visits.
METHODS: We recruited a convenience sample of 6 physicians and their patients who were age 70 and older, not up to date with CRC screening, and were scheduled for an upcoming appointment Prior to the visit we provided patients with a decision support booklet targeted to elderly patients. Physicians were given a bar graph showing life expectancy estimates divided by quartiles of health state and targeted to the patients age and gender. Visits were audio-taped, transcribed and coded for elements of individualized decision making.
RESULTS: Among 71 eligible patients, 20 (28%) agreed to participate with the majority declining because of the audiotaping. Twelve of the 20 encounters (60%) had discussions of CRC screening, defined as 3 verbal exchanges between physician and patient. The average discussion time was 6 minutes (range 1 to 22). Two of the 12 discussions were initiated by the patient. The patients health status was discussed in 7 encounters and in 3 of these encounters screening was discussed in the context of the patients other health issues. In 4 encounters, the USPSTF recommendations that screening is not routinely recommended for older adults were discussed. Decisions in favor of screening were made in 7 encounters (6 for FOBT; 1 colonoscopy); no decisions were made explicitly to discontinue screening permanently, but 3 patients preferred not to get screening at the current visit and for 2 the decision about screening was deferred. In 6 encounters, the physicians assessed patient understanding, 2 physicians discussed the potential benefits of screening, 2 physicians discussed the potential harms, and 2 physicians discussed uncertainty in the decision.
CONCLUSION: Our decision support tool triggered discussions in over half of participants who agreed to be audiotaped. Discussion was initiated primarily by physicians. Most discussions included considerations of limited life expectancy and an assessment of patient understanding, but fewer discussed benefits, harms, and uncertainty in the decision.
IMPLICATIONS OF DECLINING CABG RATES ON RACIAL DIFFERENCES IN CABG HOSPITALVOLUME
Peter W Groeneveld 1; Feifei Yang 1; Gina Pugliano 1; Lin Yang1. 1University of Pennsylvania, Philadelphia, Pennsylvania. (Tracking ID # 10737)
BACKGROUND: Coronary artery bypass grafting (CABG) has declined in frequency in the United States during the past decade. It is uncertain if this decline has been similar among white and black patients. Because hospitals may be unlikely to abandon their cardiac surgery programs despite declining surgical volumes, it is also unclear if declining CABG volumes have increased the proportion of whites and blacks receiving CABG at low-volume hospitals. Prior research indicates patients at hospitals with low CABG volumes (i.e., less than 150 cases/ year) have worse surgical outcomes than patients at high-volume centers.
METHODS: Medicare claims from 2001 to 2008 for patients age 65 and older were analyzed to determine the number of white and black patients undergoing CABG in each year. Hospital identifiers on these claims were used to determine the annual number of U.S. hospitals providing CABG services. The total Medicare CABG volume at each hospital was calculated for both 2001 and 2008, and hospitals with fewer than 75 Medicare-reimbursed CABGs were designated as low-volume centers (Medicare CABGs constitute approximately 50% of all CABGs, thus hospitals with fewer than 75 Medicare CABGs were likely to be low-volume centers). The percentages of black and white patients undergoing CABG in low-volume hospitals in 2001 were compared to the corresponding percentages of black and white patients undergoing CABG at low-volume hospitals in 2008.
RESULTS: There was a 27% decrease in the annual volume of CABGs among white Medicare patients from 2001 (152,000 cases/year) to 2008 (111,400 cases/year), but the decline among black Medicare patients was only 14% between 2001 (7,242 cases/year) and 2008 (6,248 cases/ year) ($p<0.001$ for the difference in slopes). The number of U.S. hospitals offering CABG increased by 11% from n=1,039 in 2001 to n=1,154 in 2008 ($p<0.001$). The percentage of white CABG patients undergoing surgery at hospitals with low CABG volumes increased from 8% in 2001 to 16% in 2008 ($p<0.001$). The percentage of black CABG patients undergoing surgery at low-CABG-volume hospitals increased from 13% in 2001 to 21% in 2008 ($p<0.001$).

CONCLUSION: The decline in CABG volume during 20012008 was more pronounced among white patients than among black patients, suggesting that over time, whites were more likely than blacks to receive alternative treatment for severe coronary artery disease. Despite the national decline in CABG volume, we observed a paradoxical increase in the number of U.S. hospitals performing CABG surgery. Hence, there was a substantial increase in the fraction of all CABGs performed at low-volume centers, but the proportion of black CABG patients at low-volume centers was substantially greater than the proportion of white CABG patients at low-volume centers. If low-volume hospitals persistently have worse CABG

outcomes than high-volume centers, these findings portend increasing racial disparity in CABG outcomes over time.

NEIGHBORHOOD CHARACTERISTICS ASSOCIATED WITH ACCESS TO PATIENT-CENTERED MEDICAL HOMES Jaya Aysola 1; John Z. Ayanian2. 1Harvard Medical School, Boston, Massachusetts ; 2Dept. of Health Care Policy, Harvard Medical School, Boston, Massachusetts. (Tracking ID # 10738)

BACKGROUND: Patient-centered medical homes have gained prominence as models to promote high quality, cost-effective primary care. Evidence for significant racial/ethnic and geographic disparities in access to medical homes exist, however, the factors contributing to these disparities are not well established. Our study examined whether community characteristics, such as social cohesion, built environment, and perceived neighborhood safety are associated with access to patient-centered medical homes and are potential contributors to this disparity in access for children.

METHODS: We analyzed the 2007/2008 National Survey of Childrens Health (NSCH), a nationally representative cross-sectional survey of parents/guardians of children, ages 017, that assessed neighborhood characteristics and access to a medical home (n=84,474). Our main outcome was access to a patient-centered medical home, measured by a composite score constructed from a total of 19 NSCH survey questions based upon the American Academy of Pediatrics medical home definition. Our primary predictors were neighborhood cohesion, perceived community safety, the built environment measured by the number of neighborhood amenities (e.g. parks, sidewalks), and the number of neighborhood detractors (e.g. vandalism). For the predictors determined to be significantly associated with medical home access in unadjusted analyses, a multivariable logistic regression model including all predictors assessed access to a medical home, adjusting for age, gender, race, insurance type and status, poverty level, parental education level, primary language, family structure, household employment status, geographic region, and children with special health care needs. Analyses were conducted with SUDAAN software to account for the complex survey design.

RESULTS: Over 93% of all children had access to a personal provider and usual source of care. Access to medical homes was reported for 62% of all children and was more common among children who were Non-Hispanic white, privately insured, in higher income households, and without special health care needs. Adjusted analysis revealed three of our four predictors were independently associated with access to a medical home. Children living in communities perceived as unsafe were less likely to have access to a medical home as compared to children living in communities perceived as safe (adjusted OR 0.70; 95% CI: 0.69,0.79). Children living in neighborhoods with one amenity as compared to those with four amenities, were also less likely to have access to a medical home (OR 0.72; 95% CI: 0.62, 0.84). Similarly, children living in less cohesive neighborhoods were less likely to have access to a medical home than those living in very cohesive neighborhoods (not cohesive: OR 0.54; 95% CI 0.48, 0.61; somewhat cohesive: OR 0.72; 95% CI 0.65,0.80; cohesive: OR 0.81; 95% CI 0.74, 0.89).

CONCLUSION: Our study suggests that several neighborhood characteristics are independently associated with access to a patient-centered medical home. Understanding the social and environmental factors that

impede access to new models of health care delivery is essential to informing policies that reduce disparities in access to such models. Efforts to increase patient-centered medical homes in such at risk, disadvantaged communities should be a priority to improve primary care for children.

ASSOCIATION OF PRE-TREATMENT NUTRITIONAL STATUS WITH CHANGE IN CD4 COUNT AFTER INITIATION OF ANTIRETROVIRAL THERAPY AT 6, 12, AND 24 MONTHS IN RWANDAN WOMEN

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BACKGROUND: HIV infection and malnutrition are prevalent in Africa. Rwandan women share a greater burden of HIV than men, and malnutrition (using World Health Organization definition of body mass index (BMI) <18.5 kg/m2) is common (approximately 19%) in our preliminary studies of HIV-positive Rwandan women. Low serum albumin and BMI have been shown to independently predict increased mortality in several African studies. However, macro-and micro-nutrient supplementation have failed to consistently show reductions in HIV mortality. It is thus unclear whether these malnutrition measures simply mark more advanced HIV disease, and there are scant data on the effect of nutritional status on response to antiretroviral therapy (ART). As ART becomes more available in the low income countries, it is crucial to understand the association between poor nutrition and response to ART. We hypothesized that poorer nutritional status would be associated with poorer gains in CD4 count after ART initiation. METHODS: This analysis was done on 537 Rwandan Womens Interassociation Study and Assessment (RWISA) participants who initiated ART after study entry and had at least six subsequent months of follow up. RWISA is a population-based observational cohort study of 710 ART-naive HIV + and 226 HIV-negative women who enrolled in 2005 and seen at six-month visits. At these visits, health and health behavior data were collected, including whether women initiated ART (exact dates of ART initiation and medication regimen were determined), physical exams performed, and biologic specimens collected and stored. Medical care was provided by non-governmental and national health organizations, separately from the RWISA study. Following World Health Organization (WHO) and Rwandan guidelines, women were eligible for ART if they had; WHO Stage IV disease, irrespective of the CD4 cell count; WHO Stage III disease with CD4 cell counts <350 cells/L, or CD4 <200/L regardless of clinical stage. The study outcomes were changes in CD4 count at follow up visits 63, 123, and 243 months after ART initiation. Indicators of nutritional status collected from the study visit prior to ART initiation that were used in these analyses included BMI, albumin, fat adjusted for (height)2, fat free mass (FFM) adjusted for (height)2, and sum of skinfold measurements at the thigh, triceps and subscapular muscles. Resistance and reactance obtained from bioelectric impedance measurements were used in standard formulae to calculate FFM and fat. Other covariates used included age, income in Rwandan Francs (FRW), education, pre-ART CD4 count (per 100 cells/ L) and history of AIDS defining illness (ADI) prior to ART initiation. Nutritional variables were examined in univariate linear regression models of CD4 change. Multivariate linear regression models of change for each nutritional variable were fit using backwards selection.

RESULTS: 537 women initiated ART at a mean age of 35 years. Mean (within 6 months) preART CD4 count was 216 cells/ L. Prior to ART, the mean BMI was 21.6 kg/m2 (18.3% of the women classified as malnourished), mean albumin 3.4 g/dL; mean adjusted fat 4.70 kg/m2,
mean adjusted FFM 17.1 kg/m2; and mean sum of skinfold measurements 0.495 cm. The mean change in CD4 count from pre-ART to 63, 123, and 243 months was 71, 89 and 153 cells/ L, respectively. In univariate analysis, higher albumin was associated with a smaller increase in CD4 count from pre-ART to 6 months post-ART (estimate

17.8 cells/ L per g/dL, p=0.03), but not at 12 or 24 months post-ART. Thus for example, those with 4.0 g/dL albumin gained on average 17.8 fewer CD4 cells/uL compared to those with 3.0 g/dL of albumin. FFM was also inversely associated with change in CD4 count at 6 months (6.7 cells/ L per kg/m2, p=0.03, respectively), but not at 12 or 24 months. For example, those with an adjusted FFM of 18.1 kg/ m2 gained 6.7 fewer CD4 cells/uL from pre-ART to 6 months post-ART compared to those with 17.1 kg/ m2 FFM. BMI, fat, and skinfold measurements were not associated with change in CD4 count at any follow up time.
In multivariate analysis after adjustment for covariates, no nutritional variables were associated with a change in CD4 cent count from pre-ART to 6, 12, or 24 months post-ART. Reflecting in part the regression to the mean phenomenon, higher CD4 count prior to initiation of ART was a consistent predictor of lower increase in CD4 count from pre-ART to each post-ART follow up time (estimate 20.52, -23.30, and 29.05 cells/ L, per 100 cells/l higher CD4 preART, respectively for 6, 12, 24 months, p<0.0001 for each).
CONCLUSION: In univariate analysis, higher FFM and albumin were associated with a smaller increase in CD4 count from pre-ART to 6 months, but not 12 or 24 months post-ART. However, these results did not persist in multivariate analysis at 6 months after adjustment for traditional predictors of response to ART. No marker of nutritional status predicted change in CD4 count from pre-ART to 6, 12, or 24 post-ART months in multivariate analysis.
These results show that poor pre-ART nutritional status, measured by BMI, adjusted fat, adjusted FFM, albumin, and skinfolds does not preclude a good response to ART. The associations, of higher FFM and albumin with a smaller post-ART CD4 increase seen in univariate analysis, likely reflect that these were markers of severe illness, and thus these were not significant in multivariate analysis. Low BMI, fat, FFM, albumin, and skinfolds can be associated with severe illness, and these markers should be fully investigated and interpreted with caution in further nutritional analyses.
ASSESSING PROVIDER KNOWLEDGE OF A HERNIATED LUMBAR DISC: ARE SPECIALISTS BETTER INFORMED THAN PRIMARY CARE PHYSICIANS? Sandra Feibelmann 1; Steven J. Atlas 1; KarenR. Sepucha1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 10740)
BACKGROUND: Health care providers engaging in shared decision making with their patients need to be well-informed about the relevant condition and available treatment options and outcomes. Primary care physicians (PCPs) see patients with a variety of conditions that are often initially managed by the PCP but may eventually require specialty referral. We sought to compare PCP and specialist knowledge about a herniated lumbar disc (HD).
METHODS: Providers were identified through the American Medical Association physician master file. The HD survey was mailed to 100 primary care or internal medicine providers and 100 specialists in neurological surgery, orthopedic spine surgery, physical medicine and rehabilitation, and pain medicine. Mailed surveys included 21 knowledge items covering the benefits and risks of surgery and non-surgical treatment options for HD. We determined what proportion correctly answered each item and compared results of PCPs and specialists. RESULTS: Among 182 eligible participants, 97 providers completed the survey (53% response rate), 22 (23%) PCPs and 74 (77%) specialists. Their average age was 51 (SD 9.3), 83% were White, and they were practicing on average for 20 years (SD 9.8). PCPs had more years of practice than specialists (23 [SD 10.4] versus 18.5 [SD 9.4], p=.04).
Specialists saw more patients with HD, median annual volume of 200 (quartiles 97.5, 400) for specialists compared to 20 (quartiles 7.75, 52.5) for PCPs. Overall, respondents correctly answered 71% of survey items with specialists more likely to correctly answer items than PCPs (73% vs. 63%, p=.008). More specialists knew that pain caused by a herniated disc usually gets better without surgery (93% specialists vs. 73% PCPs, p=.02). More specialists also understood that surgery provides faster relief from pain (81% specialists vs. 54.5% PCPs, p=.02) and that after five years both surgery and non-surgical treatments provide similar pain relief (76% specialists vs. 41% PCPs, p=.003). Specialists were more likely to know the rate of a serious complication (82%

vs. 59%, p=.03). A majority of PCPs and specialists understood that exercise or staying active (91% vs. 90.5%, p=.62)), physical therapy (91% vs. 95%, p=.42), over-the-counter pain medicine (91% vs. 99%, p=.13), and cortisone shots into the back (91% vs. 97%, p=.22) help some patients relieve their HD pain. Less than half of providers knew how many patients would have the same or more back or leg pain after surgery (41% PCPs vs. 26% specialists, p=.13).
CONCLUSION: In this sample, specialists who treat herniated disc patients were more informed about the benefits and risks of HD treatments compared to PCPs. It is challenging for PCPs to remain knowledgeable about all relevant information, especially when patient volume for a particular condition is low. Decision aids and other materials may be useful to support PCPs in educating patients about treatment options for a HD.
DECISION SUPPORT AND INDIVIDUALIZED DECISION MAKING FOR COLORECTAL CANCER SCREENING IN THE ELDERLY CarmenL. Lewis 1; Christopher P. DeLeon 1; Michael P. Pignone 1; Carol E. Golin1. 1University of North Carolina - Chapel Hill, Chapel Hill, North Carolina. (Tracking ID # 10741)
BACKGROUND: Individualized decision making with providers about colorectal cancer (CRC) screening is recommended for adults age 75 and older because the potential net benefit of screening decreases with increasing age and co-morbidity. However, little is known about older patients preferences about CRC screening or the individualized decision making process. The purpose of this study was to provide decision support then examine physicians and patients perceptions of CRC screening and assess visit outcomes regarding CRC screening. METHODS: We recruited a convenience sample of 6 physicians and their patients who were age 70 and older, not up to date with CRC screening, and were scheduled for an upcoming appointment. Prior to the visit, we provided patients with a decision support booklet targeted to elderly patients. Physicians were given a bar graph showing life expectancy estimates divided by quartiles of health state and targeted to the patients age and gender. Patients responded to questions about their screening preference (prefer screening, prefer not to get screening or unsure) prior to decision support and after decision support but prior to their visit. After the visit, patients responded to 5 point Likert scale about their perceptions of decisional balance between the risks and benefits of screening. After the visit, physicians also responded to 5 point Likert scale about their perceptions of decisional balance in this patient and whether it was likely that screening would prolong the patients life. We analyzed audiotapes of the visit to determine visit outcome, specifically whether CRC screening was discussed and if a decision about screening was made.
RESULTS: Prior to decision support, 8 of the 20 patients preferred to undergo screening, 3 preferred no screening and 9 were unsure. Post decision support, 10 patients changed their screening preferences resulting in 6 who preferred screening, 9 preferred no screening, and 5

were unsure. After the visit, 12 patients thought the benefits outweighed the risks, 5 thought they were about the same, and 2 thought risks outweighed the benefits, while physicians responded that for 11 patients benefits were greater than risks, for 7 they were about the same, and 2 the risks were greater than the benefits. 11 physicians thought that screening would likely prolong the patients life, 3 reported it unlikely, and 6 assessments were neutral. Audiotapes revealed 8 visits with no discussion, 7 visits in favor of screening, 5 visits where screening was discussed but the decision was deferred, and no decisions were made to discontinue screening. The patients post decision support preference was not associated with the visit outcome (p=0.443) or the patients perception of decisional balance (p=0.135). However, the visit outcome was associated with the physicians perception of benefit (0.015), but not with physician decisional balance (p=0.62).
CONCLUSION: Patient decision support changed patient CRC preferences but these preferences do not appear to influence visit outcomes in this small sample. Perceived decisional balance was in favor of screening for both physicians and patients. Physicians perceptions of benefit may influence the individualized decision

making for older patients, although additional research is needed to confirm these findings and determine screening outcomes.

IMPACT OF STUDENT-RUN CLINICS ON PRECLINICAL STUDENTS SOCIOCULTURAL AWARENESS AND INTERPROFESSIONAL ATTITUDES: A PROSPECTIVE COHORT ANALYSIS Leslie C. Sheu 1; CindyJ. Lai 2; Anabelle D. Coelho 2; Lisa Lin 2; Patricia Zheng 2; Patricia Hom 2; Vanessa Diaz 2; Patricia S. OSullivan2.
1UCSF, San Francisco, California;
2University of California, San Francisco, San Francisco, California. (Tracking ID # 10742)

BACKGROUND: Descriptive studies have suggested that student-run clinics (SRCs) may positively impact preclinical students sociocultural and interprofessional attitudes which relate to how they may provide care in the future. However, rarely have studies included students from multiple professions, previously validated instruments, or a control group. At our health professions campus, first-year students from the Schools of Medicine, Nursing, and Pharmacy can elect to participate in one of three SRC electives, each focusing on a specific underserved population: Latino/Latina community, Asian/Pacific Islander immigrants, and the urban homeless population. In this study, we used validated measures to explore the impact of these SRCs on preclinical students sociocultural and interprofessional attitudes as compared to those who did not participate in SRCs.

METHODS: Using a pre-post control group design at the beginning and end of the academic year, we conducted a prospective cohort study involving first-year health professional students who did or did not participate in SRCs. We used two validated measures both using 5-point Likert scale for item ratings: 1) Sociocultural Attitudes in Medicine Inventory (SAMI), consisting of a 26-item questionnaire evaluating exposure to sociocultural attitudes and perceptions of influence of sociocultural background in physician/patient/health issues; and 2) Readiness for Interprofessional Learning Survey (RIPLS), a 19-item questionnaire measuring teamwork and collaboration, professional identity, and roles and responsibilities. The survey also included basic demographic information and open-ended questions for clinic participants to reflect on their experiences working with underserved populations and with other health professional students. All matching surveys were included in the statistical analysis. Descriptive statistics for all scales were generated in the two measures, and we conducted an analysis of covariance, using the pre-scores as the covariate, with two main effects, participation in SRCs and health professional school. The analysis was repeated for each dependent variable, which were the subscales for SAMI and RIPLS. The level of significance was set at 0.05. Qualitative analysis of open-ended responses was performed and consensus reached through discussion.

RESULTS: Of all students, 77% (274 of 358) completed the post-survey, with 68% (n=182) having matching pre-post surveys. First-year students held positive attitudes in both sociocultural and interprofessional domains at baseline and at the end of the year. There were no significant differences in context awareness based on SRC participation (p=0.53) or school (p=0.09), and no significant difference in sociocultural awareness (p=0.32 for SRC participation, p=0.06 for school). Students interprofessional attitudes were not different based on SRC involvement for any scale (p=0.385 for Team subscale, p=0.975 for Identity subscale, 0.285 for Role subscale). When analyzed by professional school, nursing students held more favorable interprofessional attitudes, regardless of SRC participation (p=0.006 for Team subscale, p=0.015 for Identity subscale, p=0.225 for Role subscale). No interaction effects were significant. In the qualitative analysis, 99% reported reinforced or increased commitment to working with the underserved, noting improved insight into health disparities and career choices. Forty percent reported that their experiences made a positive impact on their interprofessional attitudes.

CONCLUSION: In this study designed to rigorously evaluate the effect of SRC participation on two critical variables, we found no differences in sociocultural or interprofessional attitudes after adjusting for students baseline attitudes. However, given the highly positive scores on the SAMI and RIPLS at baseline, lack of further improvement in scores was not surprising; students still perceived benefits in their sociocultural and

interprofessional attitudes, suggesting that learning about these issues may be more tacit. Such positive experiences in SRCs may have other effects not examined in this study.

PHARMACIST INTERVENTION FOR LOW LITERACY IN CARDIOVASCULAR DISEASE (PILL-CVD): A RANDOMIZED CONTROLLED TRIAL Sunil Kripalani 1; Christianne L Roumie 2; Anuj K Dalal 3; Courtney Cawthon 1; Alexandra Businger 3; Svetlana Eden 1; Ayumi Shintani 1; Ileko Mugalla 1; Terry A Jacobson 4; Kimberly J Rask 9; Viola Vaccarino 9; Tejal K Gandhi 3; David W Bates 3; Mark V Williams 5; Jeffrey L Schnipper3. 1Vanderbilt University, Nashville, Tennessee ; 2VA Tennessee Valley Geriatric Research Education Clinical Center, Nashville, Tennessee ; 3Brigham and Womens Hospital, Boston, Massachusetts ; 4Emory University, Atlanta, Georgia ; 5Northwestern University, Chicago, Illinois . (Tracking ID # 10745)

BACKGROUND: Serious medication errors (SMEs) are common after hospital discharge and include preventable or ameliorable adverse drug events (ADEs), as well as potential adverse drug events (pADEs) due to medication discrepancies or non-adherence. The Pharmacist Intervention for Low Literacy in Cardiovascular Disease (PILL-CVD) study was a randomized controlled trial to determine the effect of an educational and behavioral intervention on the incidence of SMEs after discharge. METHODS: Patients hospitalized with acute coronary syndromes or acute decompensated heart failure were enrolled in the trial. The intervention consisted of pharmacist-assisted medication reconciliation, inpatient pharmacist counseling, low-literacy adherence aids, and tailored telephone follow-up beginning 14 days after discharge. The primary outcome was the incidence of SMEs during the first 30 days after hospital discharge. Secondary outcomes included the incidence of preventable or ameliorable ADEs, as well as pADEs. We computed the risk ratio (RR) and 95% confidence interval (CI) of events in the

intervention group vs. the control group using negative binomial regression.

RESULTS: Among 851 participants, 426 (50.1%) experienced >=1 SME, 256 (30.1%) had >=1 ADE, and 253 (29.7%) had >=1 pADE. The intervention did not significantly alter the number of SMEs (RR=0.92, 95% CI 0.77 to 1.10) or ADEs (RR=1.09, 95% CI 0.86 to 1.39). Intervention patients tended to have fewer pADEs (RR=0.80, 95% CI0.61 to 1.04), p=0.09. Post-hoc analyses stratified by site showed that at the site without information technology-assisted medication reconciliation previously in place, the intervention significantly reduced pADEs (RR=0.69, 95% CI 0.50 to 0.96).

CONCLUSION: A health-literacy sensitive, pharmacist-delivered intervention did not significantly reduce SMEs after hospital discharge. This type of intervention may reduce pADEs at hospitals without robust medication reconciliation programs.

TRENDS IN U.S. CORONARY REVASCULARIZATION PROCEDURES: 20012008 Peter W. Groeneveld 1; Daniel Polsky 1; Feifei Yang 1; Lin Yang 1; Gina Pugliano 1; Andrew J. Epstein1. 1University of Pennsylvania, Philadelphia, Pennsylvania. (Tracking ID # 10746)

BACKGROUND: Coronary revascularization is among the most common and most costly hospital-based major interventional procedures performed in the United States. It is uncertain how new revascularization technologies, new published evidence from clinical trials, and updated clinical guidelines during the past decade have influenced the national volume of all coronary revascularizations as well as the proportion of revascularizations that are coronary artery bypass grafting (CABG) surgeries. The objective of this study was therefore to examine national time trends in the volume and type of coronary revascularization procedures during 20012008.

METHODS: We used the Agency for Healthcare Research and Qualitys Healthcare Cost and Utilization Project/Nationwide Inpatient Sample (NIS), a complete set of hospital discharge claims from a stratified random selection of approximately 20% of U.S. hospitals, to estimate the total number of CABG surgeries and percutaneous coronary interventions (PCI) performed annually from 2001 to 2008, as indicated by procedure codes recorded on these claims. We then used Medicare claims to estimate the annual volume of outpatient

PCI procedures by calculating the annual ratio of outpatient to inpatient PCI procedures recorded on Medicare outpatient and inpatient facility claims, and applying this ratio to the inpatient PCI counts reported in the NIS. We tested time trends in proportions (e.g., CABG as a percentage of all revascularizations) with the Cochran-Armitage test, and we tested time trends in count data with negative binomial regression models. RESULTS: The annual volume of coronary revascularizations in the U.S. decreased from 1.18 million procedures per year in 2001 to 1.11 million procedures per year in 2008, a 6% decrease (p=0.02). The annual national CABG volume decreased steadily by 34%, from 371,700 procedures per year (32% of all revascularizations) in 200102 to 246,800 procedures per year (22% of all revascularizations) in 200708 (p<0.001), but PCI volume increased during the same interval from 808,000 procedures per year in 200102 to 864,800 procedures per year in 200708, a 7% increase (p=0.04). The estimated number of non-federal hospitals providing CABG increased from n=1,060 in 2001 to n= 1,200 in 2008 (p=0.002). The average CABG caseload per hospital declined by 39% (p<0.001), and the estimated number of hospitals providing fewer than 100 CABGs per year increased from n=140 in 2001 to n=320 in 2008 (p<0.001).
CONCLUSION: There was a 34% decline in CABG and a concurrent 7% increase in PCI for the treatment of coronary artery disease in the United
States during the past decade. This shift in revascularization practice patterns may indicate increasing preference by physicians and/or patients for PCI rather than CABG for the interventional treatment of coronary artery disease. It is uncertain whether this marked reduction in CABG utilization reflects increasing adherence to evidence-based guidelines for the use of CABG, or alternatively indicates increasing underuse of CABG for the treatment of those coronary artery disease patients (i.e., triple-vessel disease or left main disease patients) for whom CABG has demonstrably better outcomes than PCI.
CROSSING QUALITY CHASM: PRIMARY CARE FROM THE PERSPECTIVE OF HOMELESS PATIENTS AND THEIR CAREGIVERS Stefan Kertesz 1; David Pollio 2; Kay Johnson-Roe 3; Jocelyn Steward 3; Allison Borden 3; Theresa Kim 4; Erin Stringfellow 5; John Andrew Young 3; Cheryl Holt6. 1Birmingham VA Medical Center, Birmingham, Alabama ; 2University of Alabama, Tuscaloosa, Maryland ; 3Birmingham VAMC, Birmingham, Alabama ; 4Boston Medical Center, Boston, Alabama ; 5Boston Health Care for the Homeless, Boston, Alabama ;
6University of Maryland, Baltimore, Alabama. (Tracking ID # 10749)
BACKGROUND: A patient-centered medical home should address the priorities of the patients it seeks to help. For patients who have been homeless, these priorities may not be captured by standard primary care quality measures. We interviewed homeless patients and expert providers to better understand aspects of quality relevant to homeless primary care, as part of a project to develop a future patient-reported survey. METHODS: Thirty-six homeless patients from 2 cities were interviewed (28 male, 8 female; 22 veterans, 21 >1 year homeless). Interviews also included 22 nationally-selected expert providers (8 MDs, 7 nurses, 7 other). A semistructured interview queried 8 quality-related constructs drawn from Institute of Medicine (IoM) reports on primary care and quality. Interviews were audiotaped and transcribed. Two parallel analyses were used, a thematic analysis within existing IoM constructs, and an open-coded analysis for potential new constructs. Multiple coders were used, and acceptable inter-rater reliability achieved. Three new constructs emerged on preliminary review: Substance Abuse/Mental Illness, Homeless-Specific Needs, and Trust/Respect. A multidisciplinary team reviewed transcripts to identify 5 to 15 themes per construct.
RESULTS: Among 11 constructs, several themes distinctive to homeless care emerged. Examples:Under Patient Control, patients embraced some aspects of control (e.g. choice of provider) but also asserted limits on control (Im an addict!.. See if I had total control of what my doctor didI [would go out] and relapse and it would be ugly).
Under Shared Knowledge, potential misuse of the electronic record was referenced, as was the need for candid, dialogic communication (For you to sit with a doctor that dont even wanna speak to you, or dialogue

with you in no type of way, he just wanna look at youThats sad, thats pitiful.)
Under Homeless-Specific Needs, providers addressed competing priorities (shelter, food, etc), and the need to counteract stigma (Theyre so invisible anyway and feel such low self-esteem thatIts not even the straw that broke the camels back, its just, its F Y.).
Under Trust/Respect, patients and providers spoke about interpersonal comfort between patient and provider, and the importance of confidentiality (Trust means to me that I have no fear that what I say to him is going to get back to me through a third source, without me okaying it with him).
CONCLUSION: Patients and providers familiar with homelessness offer a nuanced understanding of IoM priorities such as patient control and shared knowledge while highlighting concerns regarding stigma, trust

and respect. Design and measurement of the patient-centered medical home requires specialized consideration if it is to effectively serve vulnerable subpopulations like the homeless.
PRIMARY CARE PROVIDERS ATTITUDES AND EXPERIENCES WITH ONLINE WEIGHT CONTROL PROGRAMS Kevin O Hwang 1;
Heather Stuckey 2; Monica Chen 1; Jennifer Poger 2; Samuel Forjuoh 3; Christopher Sciamanna2. 1The University of Texas Medical School at Houston, Houston, Texas ; 2Penn State College of Medicine, Hershey, Pennsylvania ; 3Texas A&M HSC College of Medicine, Scott &White Healthcare, Temple, Texas . (Tracking ID # 10766)
BACKGROUND: Online weight control programs (OWPs) help overweight and obese individuals lose weight. Partnerships between OWPs and primary care providers (PCPs) could yield substantial public health benefits, in which each party provides services according to its own strengths. PCPs note that they lack competence in helping their patients lose weight and that their patients lack access to programs with low out of pocket costs. Despite their potential to address needs of PCPs and patients, OWPs have not been integrated into the primary care setting. This study sought to learn about PCPs attitudes and experiences with OWPs. Such knowledge is critical if OWPs are to be successfully integrated into primary care.
METHODS: We conducted 6 focus groups with 3 to 8 internal medicine and family medicine PCPs at 3 centers (n=32). Discussions were recorded and transcribed verbatim. Transcripts were reviewed iteratively for recurring themes. Open-ended questions addressed topics such as: referring patients to specialists, other professionals, community resources, and OWPs; characteristics of effective OWPs; and barriers to referring patients to OWPs.

RESULTS: When considering weight loss resources for their patients, the PCPs valued affordability, structure, familiarity, practicality, and educational content. PCPs personal and professional experience with OWPs was limited. Some PCPs referred patients to websites which provided basic information and aid in counting calories. PCPs perceived difficulty in identifying effective, evidence-based OWPs from among an extensive array of weight-related websites. They believed that effective OWPs would offer the following: structured behavioral program; accountability from other users and/or other staff; practical tips on how to initiate and maintain beneficial behaviors; and aid with decisions. They regarded information alone as inadequate to help patients lose weight. The PCPs felt that online discussions among users of OWPs should be monitored by experts for content and tone. Additionally, they welcomed the idea of receiving feedback from administrators of OWPs about their patients progress, especially if they could specify the amount and frequency of such feedback. The PCPs anticipated using the feedback as a framework for talking with patients about their weight loss efforts and for praising patients when weight loss was successful.
CONCLUSION: The features which PCPs desire can be found in existing OWPs or are technically feasible to implement. Researchers and OWP administrators need to collaborate to design and identify effective OWPs in

prospective studies. Reducing or eliminating costs to patients will likely encourage PCPs to refer patients to OWPs. Lastly, OWPs should work closely with PCPs to design flexible systems for sending feedback to the PCPs about their patients.

THE PREVALENCE OF CONFLICTS OF INTEREST AMONG GUIDELINE PANEL MEMBERS Jennifer Neuman 1; Deborah Korenstein 1; Joseph S Ross 2; Salomeh Keyhani1. 1Mount Sinai School of Medicine, New York, New York; 2Yale University School of Medicine, New Haven, Connecticut. (Tracking ID # 10767)

BACKGROUND: Conflict of interest (COI) among authors of clinical practice guidelines may adversely impact the objectivity of the recommendations issued. Over the past decade, scant research has examined this topic in the field of Internal Medicine. We sought to determine the frequency of COI among authors of clinical practice guidelines between the years 20002010.

METHODS: We conducted a retrospective study of authors of hyperlipidemia and diabetes guidelines, published between the years 2000 and 2010 in the US and Canada. We chose hyperlipidemia and diabetes as representative disease categories because of the high prevalence of both diseases in the population. Guidelines were identified through The National Guideline Clearinghouse, MDConsult, UpToDate, and the websites of organizations with a potential interest in these diseases. COI were defined in two ways: 1) as the direct compensation of a guideline author by a pharmaceutical company in the form of grants (including research), speakers fees, honoraria, etc., or 2) primary authorship (1st author) of a clinical trial funded by the a manufacturer of a drug used to treat the disease of interest in the guideline, in the two years prior to and the year of guideline publication. Direct compensation was determined by examining declarations of COI that were published within the guideline. Authors that declared no COI were further investigated through examination of publications via MEDLINE and through an internet search. Guidelines were categorized as government-sponsored versus other, year developed (before and after 2007), disease (hyperlipidemia versus diabetes) and country of origin (U.S. and Canada). We used descriptive statistics to characterize the prevalence of COI among authors and panel Chairs and used two-sampled tests of proportion to examine differences by guideline characteristics.

RESULTS: We identified 14 guidelines meeting our search criteria. These guidelines included 288 authors, representing 246 separate individuals. All guideline panels had at least one author with a COI. Overall, 55% (158/288) of authors were found to have COI. Among authors not reporting COI, 13% (20/150) had undeclared COI. Among Chaired guidelines, 60% (6/10) of Chairs had COI. Government-sponsored guideline panels had significantly fewer authors with COI than non-government-sponsored panels (71% vs. 20% P less than0.001), and COI was more prevalent among Canadian specialty organizations than U.S. specialty organizations (84% vs. 62%, p less than 0.01). We found an increased presence of COI in guidelines published after 2007 compared to those published prior (66% vs. 28%, p less than 0.001).

CONCLUSION: We found a high prevalence of COI, under-reporting of COI by guideline authors, and significant differences in the prevalence of COI between government and non-government-sponsored guidelines. Our finding that the majority of guideline authors and Chairs have COI, and that one out of eight authors did not report their COI raises concerns about the objectivity of these guidelines and the effectiveness of current disclosure practices. The guideline development process must be reformed to minimize conflicts of interest among authors to ensure the credibility and evidence-based nature of the clinical practice guidelines issued in the U.S. and Canada.

WILLINGNESS TO PAY (WTP) FOR WEIGHT LOSS COACHING: RESULTS FROM THE POWER TRIAL Reza Alavi 1; Lawrence Appel 1; Frederick Brancati 2; Jeanne Clark 1; Penny Mohr 3; Gail Daumit4. 1Johns Hopkins University, Baltimore, Maryland ; 2Johns Hopkins School of Medicine, Baltimore, Maryland ; 3Center for Medical Technology Policy, Baltimore, Maryland ; 4Johns Hopkins University, Rockville, Maryland . (Tracking ID # 10768)

BACKGROUND: With two thirds of American adults currently over-weight or obese, there is a pressing need for affordable evidence based weight-loss interventions. Efficacious medical or behavioral weight-loss programs are not routinely covered by insurance. Commercially-available programs do not have rigorous evidence supporting their efficacy and effectiveness, and insurance companies have been reluctant to cover such interventions. Improving the evidentiary base for weight loss interventions and understanding how patients value weight loss interventions by assessing their willingness to pay (WTP) is a critical step in translating findings from effectiveness trials into practice. Upon completion of a randomized controlled trial comparing an in-person behavioral intervention to a phone/email/web-based intervention for weight-loss, we studied participants WTP and the characteristics associated with WTP for continuing their weight loss interventions.
METHODS: POWER Hopkins is an on-going NHLBI-funded 24-month randomized clinical trial of weight loss with a self directed control arm, and two active intervention groups: 1) an in-person directed (IPD) group with individual and group in-person interventions plus web-based education and tracking support; 2) a call-center directed (CCD) group with similar interventions delivered by telephone, web, and email. At the end-of-study visit, we conducted in-person interviews of the IPD and CCD participants to assess their valuation of services received, double bound dichotomous-choice WTP, and likelihood to actually purchase these products. We used linear regression to examine the baseline characteristics (age, sex, income, race, education, and BMI) associated with WTP. RESULTS: Of the 234 adults who completed the trial to date, 206 (88%) completed the end of study WTP survey. Mean age was 57 years, 61% were women and 56.3% were White, mean BMI at baseline (2 years earlier) was 36.4 kg/m2, 33% had graduate or professional degrees, and 61% had annual family income >$75,000. 69.4% of participants were interested in continuing the intervention, and 46.6% were ready to actually sign up for the services they received in the next two months (Table). Participants thought their intervention was worth $70.9 (CI60.3-81.4), and they were willing to pay $49.6/month (CI 44.8-54.3). Multivariate analysis identified race as the only predictor of WTP: White participants reported mean WTP that was $18.2 (CI 8.0-28.3) less than African American participants.
CONCLUSION: After completing a two-year trial, the majority of participants in both groups were interested in continuing their multifaceted weight-loss interventions, and were willing to pay similar rates to other commercially available products. The surprising racial differences in WTP seen in this high SES group needs to be further examined when trial weight results are available. After a free or fully subsidized period, it might be reasonable to implement a direct to consumer or cost sharing mechanism to better translate effective evidence-based weight loss interventions into practice.

DO FINANCIAL INCENTIVES FOR GUIDELINE ADHERENCE IMPROVE CARE OF HYPERTENSION IN THE PRIMARY CARE SETTING? A MULTI-SITE RCT

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BACKGROUND: Few data exist regarding the effectiveness of pay-for-performance programs as a tool to change provider behavior and improve quality of care, and some claim that financial incentives for quality are unnecessary and/or ineffective in motivating physicians to improve care. Using a cluster randomized controlled trial (RCT), we evaluated whether participants who receive financial incentives in addition to audit and feedback for their performance in delivering guideline-recommended hypertension (HTN) care improved the quality of HTN care in the primary care setting.
METHODS: Eighty-three primary care physicians and 45 non-physician health care staff members from 12 VA primary care clinics in 11 states enrolled in a 20-month cluster RCT designed to assess the effectiveness of

financial incentives in improving adherence to guideline-recommended HTN care as outlined in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7). Participants at each hospital were cluster-randomized to one of four study arms: (1) physician-level incentives; (2) practice group-level incentives; (3) combined physician- and group-level incentives; or (4) control. Participants received an educational session about HTN management. At the end of each of five 4-month study periods, all participants received audit and feedback on their performance. Intervention-arm participants received monetary rewards based on their use of guideline-recommended antihypertensive medications and the proportion of their patients who achieved JNC 7 blood pressure (BP) goals or received appropriate treatment in response to an elevated BP reading. Appropriate treatment included prescribing a new or increasing the dose of a current medication, prescribing a lifestyle modification for patients with Stage 1 HTN, or a follow-up visit with a controlled BP reading. We included data from the 77 physicians who participated for at least two performance periods in a repeated measures model with covariates for arm, performance period, an arm*performance period interaction, and an indicator of whether or not the provider had reached the ceiling value for that measure. We also performed backwards elimination on a maximal model including the above covariates as well as those with a scientific or statistical

Table 1:

association with the outcome. We evaluated the arm*performance period interaction to assess the effectiveness of the intervention.

RESULTS: Average total payment over the 20 month study period for a physician in the individual arm was $2,570. The rate of improvement in proportion of patients achieving BP control or receiving appropriate clinical response to uncontrolled BP from one performance period to the next was 1.5 percentage points greater for physicians in intervention arms than for physicians in the control arm ($p<0.01$). This means that, on average, for two study physicians with panel sizes of 1,000 patients each, the physician in the intervention arm would have 45 more patients achieving BP control or appropriate response to uncontrolled BP after one year of exposure to the intervention, whereas the control arm physician would have only three more patients meeting this measure after the same period. After controlling for the gender and average age of a physicians patients and whether a physician practiced at a teaching hospital, this relationship remained significant ($p<0.01$). When the four study arms were compared, participants in group incentive arms showed no statistically significant differences from control arms.

CONCLUSION: Patients of physicians who received modest financial incentives in addition to audit and feedback for delivering guideline-recommended HTN care had greater rates of improvement in BP control or receiving an appropriate clinical response to uncontrolled BP than patients of physicians who received audit and feedback only. However, incentives targeted at individuals appear to be more effective than incentives targeted at groups. These results suggest that, if properly designed, performance-based health care payment models could improve the quality of health care. Our ongoing work is assessing whether incentives have unintended effects on patients or the health care delivery system.

READMISSION RISK MODELING: A SYSTEMATIC REVIEW Devan Kansagara 1; Honora Englander 2; Amanda Salanitro 3; David Kagen 4; Cecelia Theobald 3; Sunil Kripalani3. 1Portland VA Medical Center, Oregon Health and Science University, Portland, Oregon ; 2Oregon Health and Science University, Portland, Oregon ; 3Vanderbilt University, Nashville, Tennessee ; 4Portland VA Medical Center, Portland, Oregon.
(Tracking ID # 10779)

BACKGROUND: Easily deployed risk models able to accurately identify those at high-risk for hospital readmission could help target transitional care interventions to the most appropriate patients. In addition, the

utility of readmission rates as a quality metric depends on accurate prediction of the readmission rate expected in a given population. We performed a systematic review of risk prediction models for hospital readmission. METHODS: We searched Ovid MEDLINE, CINAHL, and the Cochrane Library (Central Trial Registry, Systematic Reviews, and Abstracts of Reviews of Effectiveness) from database inception through June 2010 for English-language studies of readmission risk prediction models for adult medical patients. We had searched reference lists of reviews and relevant articles. Each full-text article was independently assessed by two reviewers for inclusion. We only included models tested in both a derivation and validation cohort. RESULTS: From 6089 abstracts, we reviewed 141 full-text articles. Thirty-two articles examining twenty risk models met inclusion criteria. Most of these modeled the risk of all-cause readmissions ranging from 30 days to one year post-discharge. Only one study specifically distinguished potentially preventable readmissions. Most models relied on readily available administrative data, though 8 of 20 models did incorporate primary data from surveys or chart review. The ability of
most models to accurately distinguish high from low readmission risk was poor to fair (11/13 models with available data reported a c-statistic of <0.70; range 0.600.83). Almost all models (19/20) included comorbidity variables and most (17/20) included utilization variables such as prior hospitalization. Most models examined basic socio-demographic factors such as age, sex, and race, but only seven examined other patient characteristics such as social support, behavioral risks, and depression. Prior hospitalization was consistently among the factors most predictive of readmission. However, given the differences in populations and risk factors examined, it is unclear which other risk factors are consistently associated with readmission risk. CONCLUSION: Many statistical models predicting readmission risk have been evaluated, but their predictive ability is modest. This may reflect the very complexity of factors that contribute to readmission risk. Many models use administrative data and could be readily deployed at a health system level, but limited accuracy may temper their utility as quality metric tools. Moreover, potentially important clinical and socio-demographic variables are often overlooked. Future studies should assess the value of modeling patient characteristics that could be targeted by interventions such as health literacy, depression, and medication adherence.
SERVICES AVAILABLE TO LATINO PATIENTS WITH DIABETES AT HEALTH CENTERS ACROSS THE MIDWEST Arshiya A. Baig 1; Cara Locklin 1; Amanda Campbell 2; Cynthia T. Schaefer 3; Loretta Heuer 4; Marla C. Solomon 1; Quinn T. Michael 1; Martin Vargas 5; Deborah L. Burnet 1; Marshall H. Chin1. 1University of Chicago, Chicago, Illinois ;
2MidWest Clinicians Network, Inc., Lansing, Michigan ; 3University of Evansville, Evansville, Indiana ; 4North Dakota State University, Fargo, North Dakota ; 5Community Action Partnership of Western Nebraska, Gering, Nebraska. (Tracking ID # 10782)
BACKGROUND: Type 2 diabetes disproportionately affects the growing Latino population and causes a high burden of disease. Many Latino patients with diabetes have limited socioeconomic resources, and thus health centers play a crucial role in caring for them. In this study, we assess the availability of services provided to Latino patients with diabetes at health centers across the Midwest and whether services vary by proportion of Latinos with diabetes seen at the centers. METHODS: We conducted a survey of providers that treat patients with diabetes at Federally Qualified Health Centers affiliated with the MidWest Clinicians Network (MWCN). A survey was mailed to 1475 providers at 99 health center sites across 10 Midwestern states. Providers included certified diabetes educators, certified medical assistants, dietitians, health educators, licensed practical nurses, physicians, physician assistants, registered nurses, advanced practice nurses, and social workers. Providers were asked about the access to: 1) different types of providers; 2) language services; 3) culturally-tailored diabetes services; 4) expanded clinic hours; and 4) community outreach services at their sites. Health center sites were categorized as low density (LD) if <25% of their diabetes patient population was Latino or high density (HD) if >25% their diabetes patient population was Latino. RESULTS: We received responses from 622 providers (47% adjusted response rate) at 87 sites (88%) from all 10 states with an average of 6 respondents

per site. Of all respondents, 247 (39%) were physicians, 131 (17%) were advanced practice nurses, and 60 (10%) were physician assistants. 266 (43%) providers stated they worked in HD sites. Table 1 describes results by high density and low density site providers. Cluster analyses by site did not show any difference in the outcomes listed. CONCLUSION: Health center sites serving a high density Latino patient population with diabetes offered many specialized services such as Spanish-

speaking providers, on-site interpreters, culturally tailored diabetes programs and community outreach for their patients. However, there are many opportunities for improvement related to subspecialty access, language services, and culturally tailored programs at both HD and LD sites.

Table 1. Services to patients by site density

THE ASSOCIATION OF VARYING LEVELS OF ENGLISH ABILITY WITH GLUCOSE CONTROL AMONG LATINOS WITH DIABETES Arshiya A. Baig 1; Cara Locklin 1; Edward Foley 2; Bernard Ewigman 1; David O Meltzer 1; Elbert S Huang1. 1University of Chicago, Chicago, Illinois; 2Macneal Hospital, Berwyn, Illinois. (Tracking ID # 10785)

BACKGROUND: English speaking ability may impact receipt of diabetes care and glucose control among Latinos. Most diabetes studies have treated ability to speak English as a dichotomous variable despite the fact that there are many levels of English speaking ability. As a result, it is unclear how varying levels may be associated with glucose control

among Latinos. Our main objective was to assess the association of English speaking ability with glucose control among Latinos with diabetes.

METHODS: We analyzed a subset of 167 Latino adults with diabetes from a cross sectional survey of 676 adults with type 2 diabetes recruited at clinics in the Chicago area from May 2004 to May 2006. The main outcome of interest was inadequate glucose control, defined as a glycosylated hemoglobin (HbA1c) >=7.0%. The main exposure of interest was English speaking ability, which was categorized as a series of indicator variables self-reported as speaking English very well (referent), well, not very well, or not at all. Adjusted analyses accounted

for age, gender, educational attainment, annual income, health insurance status, duration of diabetes in years, being born in the U.S. and number of years in the U.S.

RESULTS: In the sample, 38% reported speaking English very well, 21% reported speaking well, 26% reported speaking not very well and 14% said they did not speak English at all. Latinos who reported speaking English very well were more likely than the other groups to be younger, have graduated high school, and to have been born in the U.S. (all ps <0.01). Mean A1c was 8.01.9% for Latinos who spoke English very well,6.01.1% for those who spoke well, 7.41.5% for those who spoke not very well, and 8.61.9% for those who spoke no English. In adjusted analyses, Latinos who spoke English well were less likely to have an HbA1c <7.0% (OR=0.31, 95% CI 0.10-0.96) compared to those who spoke English very well. The odds of having inadequate glycemic control did not differ statistically for those who reported speaking English not very well (OR=0.69, 95% CI 0.19-2.44) or not at all (OR=1.55, 95% CI0.34-7.07) compared to those who spoke English very well. CONCLUSION: English speaking ability has a variable association with glycemic control in Latino patients with diabetes. High English fluency may reflect acculturation and adoption of poor lifestyle habits while inability to speak English may reflect increased barriers to care and lack of access to resources for diabetes. Further studies are needed to elucidate the mechanisms by which language affects glucose control.

WEBSITE FOR AT-RISK ALCOHOL USE: HOW TO MAKE IT VISIBLE AND FOR WHOM? Nicolas Bertholet 1; Myriam Rege Walther 2; Bernard Burnand 2; Jean-Bernard Daeppen1. 1Alcohol Treatment Center, Lausanne

University Hospital, Lausanne, N/A; 2Health Care Evaluation Unit, University Institute of Social and Preventive Medicine, Lausanne, N/A. (Tracking ID # 10794)

BACKGROUND: Websites providing information and tailored feedback for at-risk alcohol use are increasingly used to reach a large population that does not necessarily access primary care practices. Such websites need to target individuals with at-risk alcohol use and to be visited. METHODS: We developed a website offering general information on alcohol use and its consequences, screening, and brief intervention with tailored feedback. The website is in French. To increase its visibility, we conducted a media campaign in the French part of Switzerland. We assessed the characteristics and satisfaction of the users. To qualify the impact of the media campaign, we recorded the geographical provenance of the users.

RESULTS: Between July 15 and November 14 2010, 14938 visitors accessed the website and 86% completed the screening and received tailored feedback. General information pages represented 23% of all the visited pages. Most users were male (67%), mean age (SD) was 36.5(13.6); 34% of men and 38% of women reported weekly risky use (>14 drinks for men, >7 for women), 54% of men and 30% of women reported binge drinking (>6 drinks/occasion) at least once a month. Of the 56% people with risky use (either weekly risky use, binge drinking once a month or both), 67% envisioned change after receiving the feedback. Among those (n=976) who completed the satisfaction survey, 88% said the website provided useful information, and 79% that they could recommend it to a friend. Most visits (84%) came from Switzerland. CONCLUSION: People may visit websites providing information and personalized feedback on alcohol use on their own, but a media campaign appear to increase largely the number of visitors. Our website seems to target the appropriate users since at-risk alcohol use was overrepresented among users compared to the general population, and satisfaction was high. Most at-risk drinkers envisioned change after their visit.

ACTIVATING PATIENTS TO IMPROVE GLYCEMIC CONTROL: THE REDUCING RACIAL/ETHNIC DISPARITIES IN DIABETES WITH COACHED CARE (R2D2C2) PROJECT Sherrie H. Kaplan 1; Dara H. Sorkin 1; John Billimek 1; Quyen Ngo-Metzger 1; Sheldon Greenfield1.

1University of California, Irvine, Irvine, California. (Tracking ID # 10795)

BACKGROUND: The Coached Care intervention, aimed at increasing patient involvement in treatment decisions, has been shown to improve the health outcomes of patients with chronic diseases. In order to assess its effectiveness in reducing disparities in diabetes care among diverse patient groups, we modified the intervention to use community-based coaches with diabetes drawn from outpatient clinics of a university teaching hospital. METHODS: We conducted a stratified, randomized controlled cluster trial at all 6 outpatient clinics of a university teaching hospital. We stratified by clinic and three ethnic groups: Non-Hispanic white, Mexican-American, and Vietnamese. Patients are randomized to enroll in either the Coached Care intervention or the control group and are followed for two years. Patients enrolled in the Coached Care intervention are each paired with an ethnically and linguistically matched coach, who meets with the patient for 20 minutes before every diabetes-related medical visit during the study period. The coaches, who themselves also have diabetes, were recruited from the community and trained to teach patients skills to negotiate treatment decisions with their providers. Patients randomized to the control group complete 20-minute standardized diabetes education sessions with a research assistant before each visit.

To date, 677 patients have been enrolled in the study. All study patients completed baseline and follow-up surveys. Other key study variables were collected from medical records, laboratory and administrative databases. The primary outcome was change in hemoglobin A1c from baseline to one-year follow-up. Multiple regression was used to test intervention effects on glycemic control over the observation period. RESULTS: To date, 288 patients (79% Mexican American, 8% Vietnamese, 13% Non-Hispanic white) have completed the one-year observation point. The majority of patients (53%) had a median annual household income below $20,000; 66% had limited proficiency in English. There were no significant differences between the Coached Care group (mean [SD]=9.1% [1.4%]) and control group (9.2% [1.6] %; p=.52) in baseline HbA1c values. At one

year, patients in the Coached Care intervention group had a significantly lower HbA1c (8.6% [1.8%]) compared to controls (9.2% [1.9%]; p<.05). This difference persisted after adjustment for baseline HbA1c, age, gender, race/ ethnicity, duration of diabetes and regimen intensity (adjusted mean difference [95%CI]=0.38[0.75,-0.02]; p<.05).
CONCLUSION: Coached Care appears to improve glycemic control in a socioeconomically and ethnically diverse patient sample. Further research will address whether for similar access to care, Coached Care is effective in reducing racial disparities.
CLINICAL MESSAGING &PRACTICE VARIATION: A 10 YEAR EXPERIENCE Bradley H. Crotty 1; Yonas S. Tamrat 1; Arash Mostaghimi 1; Charles Safran 1; Bruce Landon1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 10798)
BACKGROUND: Patient Portals, which offer secure electronic communication between patients and their providers, were first introduced in 2000. Despite patient interest, clinicians have been slow to adopt clinical messaging into their practices. Although the usefulness to patients of clinical messaging in terms of convenience is clear, large numbers of messages have the potential to burden busy physicians, who must triage and respond to each inquiry directly without additional compensation. The long-term trends of clinical messaging have not been

described. In this study, we report on the usage patterns of clinical messaging within a large health system that was among the first nationally to adopt this technology. In addition, we also examine whether use within primary care differs by practice setting. METHODS: We analyzed patient portal use over a ten-year period within a single academic health system. Clinical messages were defined as patient-initiated clinical correspondence sent to a physician or nurse practitioner, excluding appointment and prescription refill requests. We restricted the analysis to actively enrolled patients, defined as registered patients who had accessed the web portal within the preceding two years. We assessed trends in the number of actively enrolled patients, and message frequency per 100 actively enrolled patients as well as per provider. Analyses examining differences in clinical messaging by demographic and clinical characteristics using multivariate Poisson regression are currently underway. In preliminary analyses looking at usage patterns by practice setting, we analyzed 2010 data from three primary care practices with heterogeneous patient populations: an urban hospital-based practice, a satellite practice located in an underserved area, and a community health center serving primarily underserved patients. We analyzed the average number of messages/100 actively enrolled patients/month using the Kruskal-Wallis test. Analyses were performed using SAS 9.2 (Cary, NC). RESULTS: At the close of 2010, approximately 50,000 patients were active users of the patient portal across all participating practices within the health system. The number of clinical messages grew steadily along with total number of patients. (Figure 1) Over the ten-year period, providers saw a near doubling of messages, from 15.9 (SD 2.1) to 31.2 (SD 3.8) messages per month. (Figure 2) The average number of messages per 100 actively enrolled patients per month decreased initially over the first two years from37.2 (SD 3.0) in 2001 to 20.6 (SD 2.2) in 2003, and then stabilized at an average of 22.0 (SD 2.6) from 20042010. Among the subset of primary care practices, patient use of clinical messaging differed by the practice setting. The median number of clinical messages per 100 actively enrolled patient per month in 2010 was 21.5 (IQR 3.5) for the hospital-based practice, 17.4 (IQR 3.6) for the satellite practice in an underserved area, and5.9 (IQR 4.0) for the community health center (p<0.001). CONCLUSION: Patient portal registration and clinical messaging has steadily increased over the past decade. After starting at a relatively high level and decreasing over the first three years, the average number of clinical messages per user per month has remained relatively constant over the last seven years. The initial high volume may reflect an early-adopter effect for patients who were among the first to sign up for the patient-portal. Over the ten-year study period, the average number of messages per provider has nearly doubled as more patients per provider have become users of the portal. Within primary care, use of clinical messaging varied

widely by practice setting among actively enrolled patients.
Figure 1: Patient Site Registration and Messaging
Figure 2: Clinical Messages Over 10 Years

A MOBILE HEALTH APPLICATIONS NEEDS ASSESSMENT AT A LARGE ACADEMIC INSTITUTION Ida Sim 1; Raymund Dantes1.
1University of California, San Francisco, San Francisco, California. (Tracking ID # 10803)
BACKGROUND: Mobile communication devices present opportunities to improve health and disease management by expanding interventions beyond the reach of traditional, practitioner visit-based care. Already, 17% of cell phone users have used their phone to access health or medical information, and 9% of cell phone users have an application that helps them track or manage their health. The vast majority of mobile health applications operate independently in closed silos that do not communicate with other applications or electronic health records.
At the University of California, San Francisco, a large, research-intensive health sciences public university and medical center, there is growing interest to establish a centralized infrastructure to support and encourage creation of mobile health applications for research projects as well as for clinical care. In this study, we sought to summarize the current experience of UCSF mobile health developers; and second, to assess the specific needs of future mobile health developers at UCSF, so that future campus-wide efforts can better support faculty, staff, and trainees in the development of new applications.
METHODS: We conducted a cross-sectional, mixed quantitative and qualitative web-based survey from August 29 to September 24, 2010 of all faculty, staff, trainees, and students of the University of California, San Francisco.
Survey questions were formulated and piloted with the input of key stakeholders, including current mobile health developers and campus administration.
Participants were solicited using a single email invitation jointly sent by the university provost and the chief information officer to all UCSF faculty, students, and staff. This includes approximately 24,000 people. Only email recipients with interest or experience in developing mobile health applications were asked to complete the survey. Participants received no financial or other material compensation. Participants were not required to answer every question. The survey began by asking whether the participant had current or prior experience developing mobile applications. Participants without prior experience were asked a total of 12 questions. Participants with prior mobile application experience were asked 9 additional questions about their experiences, for a total of 23 survey questions.
RESULTS: We received responses from 770 people, for an overall response rate of approximately 3%.165 respondents indicated that they were currently or had been previously involved with developing a mobile application for use with patients, research participants, trainees, or colleagues. 22 respondents had applications that had already been deployed, 21 had project prototypes, and 34 had projects under design. Common barriers encountered by developers included high initial costs, procuring funding, data security, and technical development.
Enthusiasm for mobile health development services was very high among hundreds of survey respondents. 515 (95%) respondents would consider or definitelyuse campus-based mobile health development services if they were available.
The intended functions of mobile health applications were diverse. The majority of respondents said their applications would be used for research (66%), patient care (62%), and health education (58%). Nearly half would use mobile applications for health monitoring (49%), and 42% would use applications for clinical teaching.

Respondents were also more interested in building applications for low socioeconomic status (SES) populations compared to middle or high SES populations (37% vs.
31% and 25%). Nearly one-third of respondents wanted to develop applications for low English or low health literacy populations. Respondents indicated they would like additional support in all steps of mobile application development, but more requested support in technical development (65%), building a user interface (59%), programming/coding (54%), and application testing/refinement (53%).
CONCLUSION: We discovered there are already at least 165 mobile health development projects at UCSF, with dozens of projects already deployed or in prototype stages.
We also discovered there are 515 UCSF community members who have mobile health ideas they would consider or definitely develop if support services were available. There was high enthusiasm for using mobile health applications for patient care, research, and health education. There was also significant enthusiasm for building applications for low SES, low English, and low health literacy populations.
To our knowledge, there is no other publically available survey of mobile health technologies at a similar academic institution.
This needs assessment survey of potential mobile health developers was designed to guide the development of mobile health development services at our institution. Based on our quantitative and qualitative results, we recommend that such services prioritize technical services, including programming and secure data management. These services should be flexible enough to assist in the creation of education, research, and patient care applications. The emergence of mobile health technologies is an unprecedented new technology that will have significant but still unpredictable effects on the future of patient care, medical research, and education. Academic institutions should consider which technical, consultative, and infrastructure services are needed to enable faculty, staff, and trainees to most effectively advance the use and science of mobile health.
IMPACT OF WORKLOAD ON PATIENT SAFETY AND QUALITY OF CARE: A SURVEY OF AN ONLINE COMMUNITY OF HOSPITALISTS Henry Michtalik 1; Peter J Pronovost 1; Brian Driscoll 2; Michael Paskavitz 3; Daniel Brotman1. 1Johns Hopkins University, Baltimore, Maryland; 2Quantia Communications, Waltham, Massachusetts. (Tracking ID # 10808)
BACKGROUND: Studies of the impact of provider workload on patient safety and quality of care have primarily focused on nurses and resident physicians, but not attending physicians. We examined the relationship between workload and patient safety and quality via a survey of an online community of Hospitalists.
METHODS: We electronically surveyed 890 self-identified Hospitalists enrolled in QuantiaMD.com, an online physician community which provides continuing medical education and a national discussion forum. Participants received a secure e-mail link to the online survey and were awarded $10 at completion. The survey queried physician and practice characteristics, workload, frequency of an unsafe census, and what a safe workload would be in his/her setting. Safe was defined as with minimal potential for error or harm. Physicians also rated the impact of average census on process and outcome measures using a Likert scale ranging from 1 (Never/Definitely Not) to 5 (Very Often/ Definitely).
RESULTS: Of the 890 physicians contacted, 506 (57%) responded. Five (1%) were excluded for not completing the survey. Physicians had an average age of 38.3 years (SD: 8.4) and were in practice for a median of 6 years [IQR: 3, 10]. The majority identified their primary practice area as adult (78%), pediatric (1%), or combined med/peds (2%) hospital medicine. Physicians practiced in an urban (46%),

suburban (43%), and rural (11%) setting and primarily as part of a community hospital (54%), academic teaching hospital (28%), or private group (12%). Forty percent of physicians reported that their typical inpatient census exceeded safe levels at least monthly and 36% of these reported a frequency greater than once per week. When the average actual workload was compared to the perceived safe workload, 40% of physicians exceeded their own reported safe level. Physicians reported that their patient load often (>4/5) led to incomplete

patient/family discussions (25%), ordering potentially unnecessary tests or procedures (22%), delaying admitting or discharging patients until the next shift or day (22%), cross-covering (20%) or caring (17%) for too many patients, worsened patient satisfaction (19%), poorer handoffs (18%), increased 30 day read-mission (14%), worsened overall quality of care (12%), failure to promptly act on critical findings (10%), and treatment errors (7%). With respect to adverse events, physicians reported that workload has likely (>4/5) caused transfers to higher levels of care (10%), morbidity/complications (7%), mortality (5%), and incident reports (6%).
CONCLUSION: Hospitalists currently report unsafe workloads that expose patients to poorer quality of care and adverse events. Forty percent of Hospitalists reported an unsafe workload at least monthly. Over 20% of Hospitalists reported workload has often caused incomplete patient discussions, unnecessary tests and procedures, admission/discharge delays, and excessive cross-coverage. Over 20% of Hospitalists also reported that workload has likely caused patient transfers, morbidity, or mortality. Hospitalist workload may be adversely affecting patient safety and quality of care and should be further explored.

INAPPROPRIATE TESTING FOR URINARY TRACT INFECTION IN HOSPITALIZED PATIENTS: AN OPPORTUNITY FOR IMPROVEMENT Sarah Hartley 1; Staci Valley 1; Latoya Kuhn 2; Laraine Washer 1; Tejal Gandhi 1; Anurag Malani 3; Carol Chenoweth 1; Sanjay Saint 3; Scott Flanders1. 1University of Michigan, Ann Arbor, Michigan ; 2Ann Arbor VAMC and University of Michigan, Ann Arbor, Michigan ; 3St Joseph Mercy Hospital and University of Michigan, Ann Arbor, Michigan. (Tracking ID # 10810)

BACKGROUND: Urinary tract infection (UTI) is the second most common bacterial infection leading to hospitalization, accounting for 40% of nosocomial infections. Despite the high prevalence of UTI, variability in diagnostic testing and treatment of UTI among hospitalized patients is common and can lead to inappropriate antibiotic use and subsequent antibiotic resistance. We therefore sought to determine the appropriateness of urine culture for UTI and its impact on antimicrobial prescribing.

METHODS: We randomly selected patients admitted to a large academic center between Feb 2008 and Feb 2009 who had urine cultures obtained during the hospital stay. Patients were excluded if they were admitted to intensive care, had a major urinary procedure (e.g., renal transplant, diversion, or stents), were actively being treated for a UTI at the time of admission, started on treatment >48 hours prior to urine collection while admitted, or were an obstetrics patient. Retrospective chart review was independently performed by two physicians to determine the presence of signs or symptoms of a UTI, presence of a urinary catheter, antibiotic administration and urine culture results. Determination of appropriateness for sending urine cultures was compiled from national and professional society guidelines (i.e., from the Centers of Disease Control and Prevention and the Infectious Disease Society of America).

RESULTS: Of the 210 patients included, 97 (46%) patients had an appropriate reason documented to obtain a urine culture. The majority of these (72%) had fever. Urinary symptoms were infrequent, occurring in 22%. In 113 (53.8%) patients no guideline-accepted criterion for obtaining a urine culture was found. Of these 113 patients, 41% had no documented indication for culture while 67 patients (59%) had documented reasons that were not consistent with guidelines, including orthopedic procedures (21%) and altered mental status without a urinary catheter (14%). Of all 210 patients 84% had negative urine cultures. Culture negativity was similar regardless of the presence or absence of indications supported by the guidelines (84% vs. 84%). Of the culture-negative patients, 45% were on antibiotics within 48 hours prior to urine collection. More than 10% of culture-negative patients were started on antibiotics for UTI within 72 hours after culture. The kappa statistic on indications for culture was 0.89, indicating excellent inter-rater agreement.

CONCLUSION: In over one half of hospitalized patients, urine cultures are obtained outside of accepted criteria, often being sent for reasons other than urinary symptoms. In these scenarios, complicating factors included insufficient supporting data (orthopedic procedures) or nonspecific symptoms (altered mental status), which might include UTI in the differential diagnosis. Urine cultures infrequently generated new antibiotic use, perhaps due to high rates of preexisting antimicrobial use. Guidelines relevant to the hospitalized patient are urgently

needed.

VALIDATION STUDY OF HEMOGLOBIN A1C THRESHOLD FOR DIAGNOSING DIABETES: THE ASSOCIATION BETWEEN HEMOGLOBIN A1C LEVELS AND 3-YEAR INCIDENCE OF RETINOPATHY

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BACKGROUND: In 2010, the American Diabetes Association for the first time incorporated hemoglobin A1C (Hgb A1C) level of 6.5% as the diagnostic threshold for diabetes. Experts have historically used the outcomes of retinopathy as the benchmark for defining the diagnosis of diabetes. Due to scarce data on the relationship between Hgb A1C and the incidence of retinopathy, the expert panel relied primarily on several cross-sectional studies examining the association between Hgb A1C levels and the prevalence of retinopathy. In addition, these previous studies were methodologically limited by the lack of adjustment for participants who were pharmacologically treated for diabetes, and by residual confounding from other independent risk factors of retinopathy such as hypertension. To test the validity of the current Hgb A1C thresholds for the diagnosis of diabetes, we conducted the largest longitudinal study to date, and examined the association between Hgb A1C levels and 3-year incidence of retinopathy.

METHODS: We analyzed data from a cohort of 21,137 unselected Japanese adults aged 21 and older who underwent a preventive health check-up between January 1st and December 31st 2006, and returned for follow-up health check-up 3 years later at a medical center in Tokyo, Japan. Fundoscopic digital photos were systematically taken for both eyes for all participants at these check-ups and evaluated by clinical ophthalmologists. Retinopathy was defined as the presence of hard exudates, soft exudates, or retinal hemorrhages. We excluded those with retinopathy at baseline (n=237), with missing information on baseline Hgb A1C (n=24), baseline fundoscopic exams (n=523), or follow-up fundoscopic data (n=371). We conducted a series of logistic regression

models to examine the relationship between baseline Hgb A1C levels and the incidence of retinopathy at 3 years adjusting for baseline demographic factors, those with diabetes receiving treatment, and confounding risk factors for retinopathy.

RESULTS: Of the 19,982 participants in our analytic sample, approximately 49% were male. The mean age (SD) was 50.8 (11.5) years old, the mean body-mass index was 22.5 (3.3) kg/m2, the mean Hgb A1C was5.6 (0.6) %, and the mean fasting blood glucose was 100.3 (14.6) mg/dL;4.5% had diabetes at baseline using Hgb A1C threshold of 6.5%. At 3 years, the cumulative incidence of retinopathy was 0.86% (172/ 19,982). Compared to those with an Hgb A1C level of 5.0-5.4 % (the reference category), adults with Hgb A1C of 6.5-6.9% were associated with a significantly higher risk of developing retinopathy [odds ratio (OR): 3.83, 95% confidence interval (CI): 1.88-7.81, p<0.001] (see Table). This risk remained statistically different after the adjustment for blood pressure, hypertension treatment, low-density lipoprotein, high-density lipoprotein, and diabetes treatment [OR: 2.19, 95% CI: 1.03-4.66, p=0.041]. Those with Hgb A1C between 5.5 and 6.4% did not exhibit higher risk of retinopathy relative to the reference group. CONCLUSION: Our results support current American Diabetes Association guidelines recommending using Hgb A1Clevel of 6.5% or higher as the threshold for the diagnosis of diabetes.

Table. Odd ratios (OR) for developing new retinopathy across different baseline Hgb A1c

` 1: Adjusted for age, sex, systolic and diatolic blood pressure, hypertension treatment, LDL and HDL.

` 2: Adjusted for the variables in Model 1 plus diabetes treatment

* p-value <0.05

THE BURDEN OF CHRONIC DISEASE AMONG THE BHUTANESE REFUGEE POPULATION AT A US URBAN CLINIC Gayathri Suresh Kumar 1; Michael Saenger 1; Selina Varma 1; Molly Burleson 1; Brandon Kohrt 1; Paul Cantey2. 1Emory University, Atlanta, Georgia; 2Center for Disease Control and Prevention, Atlanta, Georgia. (Tracking ID # 10815)

BACKGROUND: Since the 1980 s, the government of Bhutan, a small impoverished country in Asia, enacted several policies that discriminate against minority ethnic groups living in Bhutan. Facing discrimination and prosecution, an estimated 80,000 people have fled to U.N. refugee camps in Nepal. To date, thousands of refugees have been resettled in countries across the globe including the US. From March 2008 to April 2009, an estimated 1,600 Bhutanese resettled in Atlanta. The Grady Refugee Clinic (GRC) cares for the Bhutanese refugee population in and around metro Atlanta.

In addition to the myriad of struggles facing these patients, many must also cope with the burden of chronic disease. While an increasing prevalence of chronic diseases has been noted among other refugee groups in the United States, it is unclear the magnitude of this burden in this Bhutanese refugee population.

The main objective of this study was to determine the prevalence of certain chronic diseases among the Bhutanese refugee population within this US urban clinic and compare these rates to selected populations.

METHODS: A retrospective cross-sectional study was performed using 66 patient charts of Bhutanese refugees seen in the refuge clinic at GMH. Inclusion in the study required meeting the following eligibility criteria: 1) resettled Bhutanese refugee, 2) 18 years of age or older, and3) seen in the clinic from September 2009 and August 2010. Data were abstracted on selected patient characteristics and certain chronic disease conditions, specifically overweight, obesity, diabetes, and hypertension using a standard data collection form. Diagnoses of these conditions were made using expert national clinical guidelines for each of the conditions (e.g., JNC 7 report for hypertension).

RESULTS: In the clinic population, hypertension was present in 23% (n=15), diabetes in 14% (n=9), overweight in 42% (BMI cut-off of 2529.9 kg/ m2; n=28), and obesity in 9% (BMI cut-off of >30 kg/m2; n=6).

The prevalence of diabetes is significantly higher among the refugee patients seen in our clinic than the Nepali population (13.5% vs 3.9%, respectively; pp=0.099). The prevalence of overweight and/or obesity is higher among the GRC patients than the Nepali population (51.5% vs.8.9%; p=0.229) and the Bhutanese general population (52%; p=0.192). There is no significant difference in prevalence of HTN between the GRC patients (22.7%) and the US (24.2%), Nepali (18.7%), and Bhutanese(22.1%) general populations.

CONCLUSION: This study demonstrates that the Bhutanese refugee population in our urban clinic faces a significant chronic disease burden. It is unclear why such a significant burden exists in this population. Possible explanations include exposures in refugee camps, poor access to care, decreased activity level, stress and depression, acculturation, and adopting unhealthy western behaviors. Exploring the determinants of chronic disease is needed as it

may drive future public health interventions for this vulnerable population.

IMPLEMENTING FACULTY OVERSIGHT OF INTERN WRITTEN SIGN-OUT Jerry Jacob 1; Gregory Bump 2; Saddam Abisse 1; James E Bost 1; Michael Elnicki1. 1University of Pittsburgh, Pittsburgh, Pennsylvania; 2University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania. (Tracking ID # 10820)

BACKGROUND: Recently the Accreditation Council for Graduate Medical Education mandated residency training programs to monitor and teach safe hand-off practices. Resident trainees manage hand-offs with written, verbal or combined methods of sign-out communication. Although poor sign-out contributes to medical errors, there are limited resources available for faculty to assess the content of sign-out, and teach sign-out skills.

METHODS: Based on observed deficiencies in sign-out at our institution we developed a curriculum incorporating the SIGNOUT mnemonic. The curriculum was paired with weekly faculty evaluation and feedback

using a novel structured sign-out evaluation tool. We compared the inclusion of sign-out content, organization and readability in 177 written sign-outs during implementation of the paired curriculum and faculty feedback with 128 written sign-outs prior to implementation. RESULTS: The pairing of a one-page curriculum with weekly faculty evaluation of written sign-out improved the inclusion of advanced directives from 38% to 67% ($p<0.001$) and anticipatory guidance from a mean score of 1.8 [SD 1.2] to 2.3 [SD 1.5] on a 5 point Likert scale ($p<0.001$) by blinded review of sign-out by two independent senior residents. Readability and organization of written sign-out was unchanged. CONCLUSION: A simple curriculum on sign-out content and organization paired with faculty evaluation and feedback can improve some parameters of sign-out. Prompting faculty with a structured evaluation tool of sign-out may be a useful way to improve and teach sign-out skills, as well as satisfy regulatory requirements to monitor and teach safe hand-off practices.

USE OF CLINICAL VIGNETTES TO MEASURE ADHERENCE TO A POINT-BASED VTE RISK ASSESSMENT TOOL: A COMPARISON BETWEEN INTERNAL MEDICINE RESIDENTS AND HOSPITALIST ATTENDINGS.

Michael Sasso 1; Michael Beck2. 1Penn State Hershey Medical Center, Harrisburg, Pennsylvania; 2Penn State Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 10821)

BACKGROUND: Venous thromboembolism (VTE) remains a major cause of morbidity and mortality in hospitalized patients. Evolving guidelines for appropriate VTE prophylaxis have been endorsed by the American College of Chest Physicians (ACCP) for decades; however, appropriate prophylaxis remains underutilized. One possible explanation is that a commonly used point-based VTE risk assessment is too complex to use reliably, and might lead to inaccurate VTE risk stratification and inappropriate prophylaxis. To evaluate this possibility, we constructed clinical vignettes to measure and compare adherence to VTE guidelines between internal medicine residents and attendings.

METHODS: Fifteen clinical vignettes of de-identified cases admitted to a general medical service through our emergency department were reviewed by internal medicine residents and attendings. Prior to completing the vignettes, all physicians received written and oral instructions. Each session lasted 60 minutes and was proctored by the author MJB. After reading each vignette, all physicians was
asked to stratify each vignette as low, medium, or high VTE risk; indentify contraindications to pharmacologic prophylaxis with low molecular weight heparin; and formulate a VTE prophylaxis plan. Responses were evaluated for appropriateness by MJB. The vignettes were scored as appropriate, over-prophylaxis, or under-prophylaxis based on the initial risk assessment and consideration of documented contraindications.

RESULTS: Fifteen vignettes were reviewed by 36 residents and thirteen attendings. As an aggregate, the residents stratified 21%, 37%, and 43% of the vignettes as low, moderate, or high VTE risk, respectively. The attendings stratified 18%, 31%, and 51% as low, moderate, or high VTE risk, respectively. Resident guideline adherence was 65% compared to 78% by attendings. Over-prophylaxis occurred in 28% of resident responses, and in 14% of attendings responses. Under-prophylaxis occurred in 7% of resident responses, and in 8% of attendings responses.

CONCLUSION: Using clinical vignettes, our study demonstrates that, when using a point-based VTE risk assessment tool, attending physicians adhere to the guidelines by prescribing risk appropriate VTE prophylaxis more often than residents. Additionally, residents appear to underestimate VTE risk and over-prophylax more often than attending physicians. Under-prophylaxis was similar between the two groups. This suggests that appropriate VTE prophylaxis may be a teachable skill, and reinforces the ACCP statement that an educational approach should be part of any institutions VTE prevention strategy. This is especially true when an institution is using a point-based VTE risk assessment tool and/or has medical residents performing this task.

TO REFER OR NOT TO REFER OBESITY: ARE PRIMARY CARE PHYSICIANS ADDRESSING THE QUESTION?

Juliette Slomka 1;
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BACKGROUND: The prevalence of obesity, along with patients who are overweight, now encompasses that of over half of the United States adult population. The potential impact obesity has on quality of life, including mortality, is now a prominent focus of current health policy. One goal of the Healthy People 2020 objectives is to increase the proportion of primary care physicians who regularly measure Body Mass Index (BMI). Additionally, obesity has been linked to diverse illnesses including type 2 diabetes mellitus, metabolic syndrome, hypertension, hyperlipidemia and cardiovascular disease (CVD) and carries a large economic burden on our nations health care expenditures. Previous studies demonstrate that patients are actually receiving less guidance from physicians in the primary care setting. METHODS: As part of routine clinical care at the University of Pittsburgh Medical Centers Oakland Practice, patients complete routine screening questions on the Divisions computerized questionnaire, The Functional Assessment Screening Tablet (FAST). Utilizing cross-sectional data, a random sample of 350 patients were selected with self-reported high or low CVD risk factors including those with weight-related comorbidities. We examined the frequency distribution of measured body status according to self-perceived weight status, as well as physician documentation of weight status assessment abstracted from the medical record during a 12-month timeframe. The primary outcomes of interests are whether physicians offered patients with obesity a weight intervention (either a referral to a weight loss program, in-office weight counseling or pharmacotherapy). T tests, chi-square analyses and logistic regression were performed using a significance level of <0.05.

RESULTS: The overall sample was primarily female (62.8%) and the characteristics of the patients in each of the two cardiovascular strata included 72.% female in the low-risk group with a mean BMI of 26.3(SD 5.52) and 53.4% female with a mean BMI of 30.4(SD 7.1) in the high-risk cardiovascular group (p<0.001). In the low and high-risk groups, 16.5% and 40.6% of the patients were obese while32.9% and 37.4% were overweight based on BMI (p<0.001). The majority of patients in the low-risk strata appeared to accurately self-report a healthy perceived weight (53.6%) compared to an overestimation of self-reported healthy weight 35.9% in the high-risk strata (p=0.003). Using SAS software, multivariable logistic regression using backward selection demonstrated that BMI was significant with an adjusted odds ratio of 1.13 (95% CI 1.08-1.2) for physicians offering weight loss interventions.

CONCLUSION: Patients who are not afflicted with comorbid health conditions associated with obesity tend to have a more accurate self-perception of their individual body weight status. BMI predicted whether a physician offers a weight intervention. This information provides insight into how physicians may tailor their assessments, likely due to the time constraints of practicing in an outpatient setting.

PATIENT-CENTERED MEDICAL HOMES AND QUALITY OF PRIMARY CARE FOR CHILDREN: RESULTS FROM A NATIONAL SURVEY Jaya Aysola 1; Asaf Bitton 2; John Z. Ayanian2. 1Harvard Medical School, Boston, Massachusetts ; 2Dept. of Health Care Policy, Harvard Medical School, Boston, Massachusetts. (Tracking ID # 10834)

BACKGROUND: Patient-centered medical homes (PCMH) have gained prominence as models for more coordinated and cost-effective primary care. However, the impact of these models on quality of care merits further evaluation. We examined a large national survey to assess the association of medical homes with several indicators of quality of primary care for children.

METHODS: We analyzed the 2007/2008 National Survey of Childrens Health (NSCH), a nationally representative cross-sectional survey of parents/guardians of children, ages 017 (n=91,642). The primary predictor was access to a patient/family centered medical home (PCMH), measured by a composite score constructed from 19 NSCH survey questions related to the American Academy of Pediatrics definition of PCMH. We analyzed nine measures of quality of care, including number of preventive medical and dental care visits,

receipt of appropriate immunizations and developmental screenings, and the absence of unmet health care needs. In the subset of children with specified chronic conditions, including asthma and mental health disorders, we examined the association of the medical homes with the number of missed school days and receipt of needed mental health services, respectively. In multivariable regression models we assessed the association of medical homes with each quality measure, adjusting for age, gender, race, insurance, poverty, parental education level, primary language, family structure, household employment, geographic region and special health care needs. Analyses were conducted with SUDAAN software to account for the complex survey design.
RESULTS: Access to medical homes was reported for 62% of all children and was more common among children who were Non-Hispanic white, privately insured, in higher income households, and without special health care needs. In adjusted analyses, children with a medical home were more likely than those without a medical home to have one or more preventive medical visits (adjusted OR (aOR) 1.25; 95% CI: 1.11, 1.41) and to receive developmental screenings (aOR 1.25; 95% CI: 1.04, 1.51), and much less likely to have any unmet medical needs (aOR 0.27; 95% CI: 0.23, 0.32). Parents/guardians of children with medical homes as compared to those without reported that they were more likely to have medical providers ask about their childs development (aOR 1.54; 95% CI:1.34, 1.78). In contrast, among children with behavioral or developmental disorders, those with medical homes were less likely to receive needed mental health services than those without (aOR 0.65; 95% CI: 0.49, 0.85). Among children with asthma (n=7518), the mean adjusted number of missed school days due to illness were days lower among those with a medical home than those without a medical home (5.00.3 vs. 6.70.5, $p<0.001$).
CONCLUSION: Patient-centered medical homes were associated with improved quality of care on some but not all pediatric measures. Our results underscore the benefits of the medical home model in primary care while highlighting areas for improvement. As plans for broad implementation of the patient-centered medical home proceed, evaluations of medical homes should assess the need for improved care coordination for mental health services.

BRIEF VERSUS EXTENDED COUNSELING FOR HIV CLINIC BASED BUPRENORPHINE TREATMENT OF OPIOID DEPENDENCE Jeanette Tetrault 1; Brent Moore 1; Declan Barry 1; Patrick OConnor 1; Richard Schottenfeld 1; David Fiellin 1; Lynn Sullivan1. 1Yale University School of Medicine, New Haven, Connecticut. (Tracking ID # 10835)

BACKGROUND: Untreated opioid dependence adversely affects HIV outcomes. Integrating buprenorphineinto HIV treatment settings is feasible. However, the optimal level of counseling to augment pharmacotherapy for opioid dependent, HIV-infected patients has not been established. METHODS: We conducted a 12-week randomized clinical trial of physician management (PM) versus PM plus enhanced medical management (EMM). All subjects received buprenorphine treatment. PM was a brief, manual guided counseling strategy and EMM was an expanded nurse administered drug counseling strategy that included antiretroviral (ARV) and buprenorphine adherence. The primary outcomes were percentage of opioid negative urine toxicologies, maximum duration of continuous abstinence from illicit opioids, buprenorphine treatment retention, CD4 count and percentage of subjects with non-detectable HIV viral load. Study group differences on treatment retention were evaluated using the Mantel Cox log rank test; differences on other outcome variables were examined using chi-square tests for categorical data and t-tests for continuous data. General estimating equations (GEE) were used for categorical repeated measure outcomes, and mixed-model ANOVAs for continuous repeated measures.
RESULTS: 47 subjects were enrolled and randomized. There were no differences in baseline characteristics between the two groups with the exception of duration of HIV disease (15.4 years in the PM group vs.8.7 years in the PM + EMM group, p=0.001). At 12 weeks, there were no differences between the two groups in percentage of opioid negative urines (61.6% PM vs. 69.0% PM + EMM, p=0.5) or maximum duration of continuous abstinence (4.9 weeks PM vs. 5.2 weeks PM + EMM, p=0.8). There was a trend toward increased

retention in the PM group compared with the PM + EMM group (80% vs. 59%, p=0.1). CD4 counts increased from 312 at baseline to 338 cells/mm3 at 12 weeks in the PM group and from 295 to 308 cells/mm3 in the PM + EMM group (p=0.9). The percentage of subjects with non-detectable HIV viral loads decreased from 69% at baseline to 35% at 12 weeks in the PM group and from 65% to 52% in the PM + EMM group (p=.01).
CONCLUSION: Patients receiving buprenorphine along with PM and PM + EMM in a HIV clinical setting demonstrated a high degree of opioid abstinence, treatment retention, and a decrease in HIV viral load.

However, we were unable to detect a difference in efficacy between PM and PM + EMM, though there was a trend toward increased retention and greater decrease in viral load with PM only. Strategies to optimize counseling approaches and impact both opioid dependence and HIV outcomes for this specialized population are needed.

PAYMENT SOURCE AS AN ADJUSTMENT FOR HOSPITAL READ-MISSION RATES John S. Hughes 1; Richard Fuller 2; Elizabeth McCullough 2; James Vertrees2. 1Yale School of Medicine, New Haven, Connecticut; 23M Health Information Systems, Silver Spring, Maryland. (Tracking ID # 10844)

BACKGROUND: Preventable readmissions are among the measures increasingly used to evaluate the quality of hospital care. Current risk-adjustment methods may not be sufficient to account for the susceptibility of low-income individuals to more frequent hospitalizations, which can result in disproportionately higher than expected readmission rates for safety-net hospitals. We therefore examined the residual effect of payment source, a surrogate for socio-economic status and age, on predicted readmission rates after adjustment for case-mix and severity of illness.

METHODS: We used administrative data from January 2005 through April 2007 from 165 Florida hospitals with at least 2,000 eligible admissions, comprising 4,626,909 hospitalizations. Each admission was linked at the patient level so that readmissions to any hospital could be identified. We identified 30-day preventable readmissions to any hospital using Potentially Preventable Readmissions (PPR), a method that determines preventability of repeat hospitalizations based on whether there is a plausible causative relationship between the reason for the initial admission (IA) and the readmission (RA). We used All Patient Refined Diagnosis Related Groups (APR DRGs) to categorize reasons for hospitalization, and to adjust for severity of illness (SOI). Each eligible admission was assigned to a base APR DRG and to one of 4 SOI levels within the APR DRG. We calculated an expected readmission rate for each hospital using indirect standardization of statewide average rates within each APR DRG and severity level. We then examined overall expected and actual PPR rates within categories of patient age, the presence of a major mental health or substance abuse diagnosis, and categories of payer source. We used regression analysis to examine the influence of each of these factors on the accuracy of the PPR rate, and to generate modifications to the APR DRG risk adjustment.

RESULTS: Actual PPR rates for individual hospitals ranged from2.27% to 20.79%, and ranged from 2.42% below to 8.18% above the expected rates derived from statewide averages. In the examination of payer source, the PPR model underestimated the statewide rate for Medicare patients (10.3% predicted versus 11.2% actual) and Medicaid patients (7.7% predicted versus 9.0 actual), while it overestimated the PPR rate for commercial insurance (6.7% predictedv. 5.1% actual). We used coefficients derived from regression analysis to create adjustment factors for payment source and applied them to the standard APR DRG model, yielding predicted overall PPR rates much closer to the actual values for Medicare (11.16% v. 11.24% actual), Medicaid (8.88% v. 8.98% actual), and Commercial insurance(5.08% v. 5.10%).

CONCLUSION: There appear to be additional risks for preventable readmissions associated with payment source that are not measured in the PPR risk adjustment mechanism using APR DRGs. This study shows that adjustments for payment source, and likely for other socio-demographic variables (education, income), when available, can be readily incorporated into a risk-adjustment model. Not adjusting
for payment source, and implicitly for the effects of poverty (Medicaid) and age (Medicare) could unfairly

penalize hospitals that care for disproportionate shares of Medicare and Medicaid patients, while simultaneously favoring hospitals with larger numbers of privately insured patients.

TRANSLATING MEDICAL STUDENT KNOWLEDGE OF QUALITY IMPROVEMENT: A QUALITY IMPROVEMENT PILOT CURRICULUM DEMONSTRATION Jason Fish 1; Carl Stevens 1; LuAnn Wilkerson1. 1UCLA, Los Angeles, California. (Tracking ID # 10846)

BACKGROUND: With a persistent gap between evidence-based best practices and actual medical care in the US, healthcare systems are investing deeply in the integration of quality improvement (QI) methods but are lacking a physician workforce committed to and trained in project-based QI methodology. To address this, we developed and piloted a QI curriculum, embedding QI didactic and practical elements in the core third year internal medicine clerkship.

METHODS: The curriculum includes didactics on basic principles of QI methodology and health services research. In 20092010, 23 students were exposed, and assessment of all third year medical students ability to develop any structured QI strategy was determined using the Objective Structured Clinical Examination. The grading of the exam focused on broad QI categories.

RESULTS: The mean score on the exam was 43%. Those students exposed to the curriculum scored 20.9% higher than those students not exposed (p less than 0.001). We also found that those students participating in the QI pilot curriculum scored 21.1% higher than those students not participating in the curriculum (P less than 0.001), controlling for all students reporting exposure to some other QI didactics or QI projects (neither of which were significant in the multivariate model). Using t-tests, we identified that students in the pilot curriculum were more likely to recognize the importance of identifying key stakeholders, current institutional processes, and the need for continuous evaluation.

CONCLUSION: Out data indicates that our pilot demonstration of a QI curriculum using QI and health services methodology, coupled with practical business modeling tools, improved our students ability to recognize opportunities for QI and develop key strategies for improving quality. Yet, our data also indicates that students still have difficulty applying QI to clinical practice. More research is needed to identify how best to teach QI to medical students in a way that translates into appropriate application.

HOW DO RESIDENTS LEARN TO PERFORM HIGH-QUALITY DISCHARGE CARE? A STUDY OF PROFESSIONALIZATION AND CORE COMPETENCY DEVELOPMENT S. Ryan Greysen 1; Danise Schiliro 2; Leora Horwitz 3; Leslie Curry 4; Martha Radford 2; Elizabeth Bradley4.

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BACKGROUND: The Accrediting Council for Graduate Medical Education requires residents to develop competency in Systems Based Practice (SBP) and Practice-Based Learning Improvement (PBLI), however, we have limited understanding about how and when residents develop these competencies as they progress through training. Discharge care, an intrinsically systems-based practice, is

an ideal setting to explore opportunities and challenges for competency development in SBP and PBLI during post-graduate medical education.

METHODS: We employed a qualitative approach using in-depth, in-person interviews to describe the discharge process from the perspective of residents and to generate hypotheses about how residents learn to perform high-quality discharge care. We developed a purposeful sample of participants with attention to post-graduate year, gender, and experience in two internal medicine training programs, Yale and New York University (NYU), to ensure a wide breadth of experiences. We have completed 17 interviews with Yale residents and have begun

enrollment of residents at NYU. Interviews were professionally transcribed and independently coded by two investigators using the constant comparative method and discrepancies were resolved by consensus. Additionally, three senior team members with diverse backgrounds and experiences provided layered input for coded transcripts. Thematic analysis was performed by the entire research team.
RESULTS: We analyzed transcripts from 17 residents: Ten (59%) were seniors (PGY-2 or PGY-3), seven (41%) were interns (PGY-1), and ten (59%) were female. Interns and seniors differed in their understanding of four aspects of discharge care: teamwork, uncertainty, safety, and continuity. Regarding teamwork, interns focused on collaborating with other physicians, while seniors recognized the interdisciplinary nature of discharge planning and engaged nurses, social workers, and case managers as part of the discharge team. While all participants described challenges with the inherent uncertainty of discharge timing, seniors differed from interns in their use of advanced planning strategies to anticipate challenges, often starting discharge planning at the time of admission. Concerning patient safety, interns tended to focus on avoiding medication errors whereas seniors took a more comprehensive view of a safe discharge to include patients home environment and social support system. Similarly, once patients were discharged, interns described difficulty with continuity and learning post-discharge outcomes whereas seniors typically developed methods to follow up with patients after discharge. When asked explicitly how they learned to perform high-quality discharge care, both interns and residents indicated there was no formal training or structure for learning about the discharge process, only peer-to-peer instruction and learning by doing on the wards.
CONCLUSION: Discharge care may be an overlooked opportunity in post-graduate medical education to teach concepts of SBP and PBLI competencies explicitly. Although our findings suggest residents are acquiring aspects of these competencies, learning about discharge care is unstructured and individual experiences may vary considerably. Educational interventions to standardize learning about discharge care and further emphasize teamwork, patient safety, and post-discharge outcomes of care may improve the development of SBP and PBLI during residency training. Such interventions may also help shape discharge practices at teaching hospitals to improve the overall quality of discharge care.
RETROSPECTIVE ANALYSIS OF HPV VACCINATION STATUS IN FEMALE PATIENTS: DOES THE VACCINATION PROCESS MATTER? Alina Katsman 1; Jason Fish2. 1University of California, Los Angeles, Los Angeles, California; 2UCLA, Los Angeles, California. (Tracking ID # 10854)
BACKGROUND: Clinical trials have shown that vaccines against HPV types 16 and 18, such as Gardasil, are almost 100% effective in preventing high-grade pre-cancer. According to a November 2010 report from the Centers for Disease Control and Prevention (CDC), only 17 percent of adult women aged 19 to 26 have received at least one shot of the HPV vaccine. It is unclear why the national rate is so low; we hypothesize that the current rate of vaccination for all eligible women attending two busy primary care practices at an academic healthcare center will be similar to the national rates and that by understanding the current vaccination process employed in the clinics may explain the low rates.
METHODS: We performed a retrospective analysis of all eligible female patients aged 18 to 26 from June 1, 2009 to May 31, 2010 at both primary care practices. We first used billing data to identify all eligible patients that came into the clinics during the inclusive time period. The inclusion criteria included female patients age 18 to 26 during the time period June 1, 2009 to May 31, 2010 and the exclusion criterion was female patients who never saw a medical doctor. For all patients identified, we performed a chart audit to determine whether these eligible patients received the HPV vaccine, had documentation that the vaccine was discussed, or had documentation that the patient declined that vaccine. Using quality improvement techniques, we also identified process flow diagrams to understand better the vaccination processes employed in both clinics.
RESULTS: From the original billing data, there were 1251 eligible females aged 1826 who were seen at both primary care practices over the course of one year (6/1/09-5/31/10). Excluding 2 patients who did not see a medical doctor, the final cohort for our analyses consisted of 1249 patients. We found that each patient visited a

physician an average of 1.8 times during this time period, and that 65% of the patients had an identified primary care physician at the center. After reviewing both billing data and chart audits, we found that 38.8% of eligible females had documentation of receiving the Gardasil vaccine at some point; 2.4% had declined the vaccine; and 8% were still undecided but had the discussion with their physician. Overall, 50.8% of the cohort was found to have an unknown status of the HPV vaccine. We looked at whether having a primary care physician affected these rates. Of those that had a PMD, 57.4% have a known vaccination status (either got the vaccine, declined, or discussed) while 42.5% of patients had an unknown status. Of those that did not have a PMD assigned, 33.7% have a known vaccination status and 66% did not. Using quality improvement techniques, we identified process flow diagrams indicating a lack of infrastructure for ordering and tracking the HPV vaccinations.
CONCLUSION: Since 2006, the HPV vaccine, specifically Gardasil, has been approved for the prevention of cervical, vulvar, and vaginal cancer associated with HPV types 16 and 18 and for the prevention of genital warts caused by HPV types 6 and 11 in female patients ages 9 through 26. Although our data indicate that these two primary care practices in an academic healthcare center are vaccinating more patients against HPV than the national average, the HPV vaccination status of 50% of the patients that come into the clinics remains unknown. In addition, for those patients engaging the healthcare system with no identified PMD, the rates are even lower which also could be seen as missed opportunities for preventive care. In examining the processes of administering the vaccine, the lack of infrastructure may be accounting for the significant variability found, given that the current process of vaccination rests solely on the physician to ask about vaccination status, order the vaccine and document accordingly. While the overall percentage of vaccination is higher than that of the national data, we feel that an infrastructure with reminders and proper tracking could improve upon the centers current rate. Further research should be done to identify strategies for improving the vaccination rates in the context of the complex structures of the academic healthcare center.

A WEB-BASED EBM EDUCATIONAL PRESCRIPTION TO EVALUATE RESIDENT EBM COMPETENCY

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(Tracking ID # 10858)

BACKGROUND: The expanding volume of medical research makes it critical for physicians to learn how to incorporate evidence into clinical care. The ACGME requires that residents are competent at practicing evidence-based medicine (EBM) as part of the practice based learning and improvement competency. Currently there are no validated tools to measure resident EBM competency. The objective of this study is to evaluate the feasibility and reliability of a novel EBM educational prescription (EP) in evaluating internal medicine residents EBM competency. The study also evaluated the effect of EP use on patient care decisions.
METHODS: The study was performed over a 6 month period at five internal medicine residency programs throughout the US. Residents completed EPs in various clinical settings including continuity clinic, inpatient ward rotations and outpatient block rotations. The web-based EP was developed to guide residents through the steps of EBM to answer patient care questions. Residents used the EP to describe a clinical question, document a search strategy, analyze the quality of evidence found, report the results of the evidence and describe how to apply the evidence to their individual patients. EP results were presented to attending physicians who graded the EP using a web-based form. EPs were graded on: 1) question formation; 2) searching;3) evaluation of evidence; 4) application to patient; 5) ability to teach the team; 6) overall competence. Each area was scored on a scale of 1 (not yet competent) to 9 (superior) using an integrated grading rubric to provide anchors. The website includes attending training in EP grading. Time to complete and

grade EPs, satisfaction with the EP and whether the EP changed patient care were recorded with each EP. Residents and attendings completed end of study questionnaires about their attitudes toward the EP and barriers to its use. Data collection will be completed in March 2011.
RESULTS: Preliminary results showed that 216 residents completed 499 EPs and 100 attendings graded 344 of those EPs. The average overall competency score was 6.51 (SD 1.46) out of 9. Residents took a median of 50 minutes (Interquartile Range (IQR) 3065) to complete EPs and attendings took a median of 15 minutes (IQR 1020) to grade each EP. Residents reported that 21% of the completed EPs changed the patient care plan, 6% would have changed the patient care plan if they had the information sooner and 52% confirmed the current care plan. To date, 86 residents and 25 attendings completed end of study questionnaires. Residents felt that performing EPs was probably or definitely a valuable experience (72.6%) and changed how they approached patient care (63.1%). The main barriers to resident use of EPs were time (52.4%) and comfort using evidence resources (17.9%). Attendings felt that the EP probably or definitely was a valuable tool in evaluating residents EBM skills (91.3%) and that it probably or definitely improved patient care (78.2%). Most attendings said that they would continue using EPs upon completion of the study (78.2%). CONCLUSION: It is feasible to incorporate an online EP into clinical care in diverse clinical settings. EPs impact patient care plans. Overall, the EP process was well received by residents and faculty and felt to be a valuable tool. This study represents early evidence of the first valid tool to evaluate resident EBM competency during clinical care. Future analysis of the data will evaluate inter-rater reliability of the EP grading as well as factors affecting grading. A current study is underway to compare EP grades with grades on an EBM objective structured clinical exam (OSCE).
EFFECT OF MEDICARE PART D BENZODIAZEPINE EXCLUSION ON PSYCHOTROPIC USE AMONG BENZODIAZEPINE USERS Michael K. Ong 1; Haiyong Xu 1; Lily Zhang 1; Francisca Azocar 2; Susan L. Ettner1.
1UCLA, Los Angeles, California; 2OptumHealth Behavioral Solutions, San Francisco, California. (Tracking ID # 10860)
BACKGROUND: The Medicare Modernization Act (MMA) created prescription drug coverage through Medicare Part D starting in 2006, but specifically excluded benzodiazepines from coverage due to studies showing adverse effects among elderly patients. However, when used appropriately, benzodiazepines are an effective, low-cost treatment for anxiety. We evaluated the effect of the benzodiazepine coverage exclusion on psychotropic prescribing patterns and costs among benzodiazepine users with prescription drug coverage before and after MMA implementation.
METHODS: We compared two cohorts of patients drawn from the same insurer who were prescribed benzodiazepines through the end of 2005. The intervention cohort was drawn from elderly individuals (N=19,339) enrolled in a large Medicare Advantage (MA) plan and the comparison cohort was drawn from near-elderly individuals (N=3,488) enrolled in a managed care plan. Both cohorts had prescription drug coverage before and after MMA implementation but benzodiazepine coverage was excluded for the intervention cohort after MMA implementation. Predicted psychotropic drug use rates and expenditures were generated from multivariable regression analyses that adjusted for time period (2006 and 2007 vs. 2005), age, gender, and comorbidities. Significance was determined as $p<.05$.
RESULTS: Benzodiazepine claim occurrences (including noncovered prescription fills) dropped from 100% in 2005 to 54.2% in 2006 and74.8% in 2007 among the intervention cohort; among the comparison cohort, this dropped from 100% in 2005 to 81.9% in 2006 and57.5% in 2007. Correspondingly, benzodiazepine costs dropped from $149 in 2005 to $73 in 2006 and $67 in 2007. From 2005 to 2007, predicted non-benzodiazepine psychotropic drug claim occurrences significantly increased among the intervention cohort (35.8% to39.2%) but significantly declined among the comparison cohort(58.4%to 47.4%). Similarly, predicted non-benzodiazepine psychotropic drug expenditures significantly increased among the intervention cohort ($163 to $207) but

significantly declined among the comparison cohort ($647 to $571) from 2005 to 2007. These changes were primarily due to significant differences in use of antidepressants (intervention cohort, 34.0% to 37.7%, $105 to $114; comparison cohort, 47.1% to 39.2%, $399 to $322) and anxiolytics (intervention cohort, 8.0% to 12.3%, $24 to $45; comparison cohort, 18.4% to14.6%, $115 to $89).
CONCLUSION: Elderly benzodiazepine users continued to use benzodiazepines after its coverage exclusion, although at lower rates than before. Correspondingly, they increased use of non-benzodiazepine psychotropic drugs, particularly antidepressants and anxiolytics, although the magnitude of this increase does not appear to compensate for the reduction in benzodiazepine use. Use of benzodiazepines continued among the elderly despite negative financial incentives, possibly due to the low costs of such medication. While some substitution occurred with antidepressants and anxiolytics, the gap in psychotropic drug use may reflect either possible increases in psychotherapy or reduced use of treatment.

EFFECT OF MEDICARE PART D BENZODIAZEPINE EXCLUSION ON PSYCHOTROPIC USE AMONG PATIENTS WITH NEW ANXIETY DISORDERS Michael K. Ong 1; Lily Zhang 1; Haiyong Xu 1; Francisca Azocar 2; Susan L. Ettner1. 1UCLA, Los Angeles, California;
2OptumHealth Behavioral Solutions, San Francisco, California. (Tracking ID # 10861)
BACKGROUND: The Medicare Modernization Act (MMA) created prescription drug coverage through Medicare Part D starting in 2006, but specifically excluded benzodiazepines from coverage due to studies showing adverse effects among elderly patients. However, when used appropriately, benzodiazepines are an effective, low-cost treatment for anxiety. We evaluated the effect of the benzodiazepine coverage exclusion on prescribing patterns and costs, and outpatient behavioral care, among Medicare patients with new anxiety diagnoses.
METHODS: We compared two cohorts of patients drawn from the same insurer, an intervention cohort (N=8,397) of elderly individuals from a large, national Medicare Advantage (MA) plan, and from a comparison cohort (N=1,657) of near-elderly individuals enrolled in a managed care plan. Both cohorts had prescription drug coverage before and after MMA implementation, but benzodiazepine coverage was excluded for the intervention cohort after MMA implementation. Each cohort was comprised of individuals with new anxiety diagnoses in the first six months of 2005, 2006, and 2007. New diagnoses were defined as having no encounters with anxiety diagnoses in the prior six months. Predicted use and expenditure outcomes were generated from multivariable regression analyses that adjusted for time period (2006 and 2007 vs. 2005), age, gender, and comorbidities. Significance was determined as $p<0.05$.
RESULTS: Among the intervention cohort, those diagnosed in 2005 were predicted to have significantly higher rates of covered psychotropic drug claims than those diagnosed in 2006 or 2007(75.4% vs. 45.9% and 50.0%); this difference was largely due to significantly reduced covered benzodiazepine claims, with 63% among those diagnosed in 2005 vs. 0.9% and 1.3% among those diagnosed in 2006 and 2007). Non-benzodiazepine (mostly antidepressant and anxiolytic) predicted claim occurrences among the intervention cohort significantly increased from 40.3% in 2005, to45.5% and 49.5% in 2006 and 2007. Predicted overall annual drug expenditures among the intervention cohort non-significantly increased from $125 in 2005 to $129 in 2006, and significantly increased to $154 in 2007. In contrast, among the comparison cohort, predicted claim occurrences did not significantly differ from 20052007 for all psychotropic drugs (74.6%, 74.4%, 77.7%), benzodiazepines (48.2%, 43.5%, 48.0%) and non-benzodiazepine psychotropic drugs (59.2%, 59.7%, 57.9%). Predicted overall psychotropic drug expenditures for the comparison cohort were relatively constant from 20052007 ($438, $464, $381) although there was a significant decline in predicted benzodiazepine expenditures in 2006 ($39) and 2007 ($38) compared to 2005 ($67). There were no significant differences in outpatient behavioral care across

all years in either cohort.
CONCLUSION: Among elderly patients with new anxiety diagnoses, the benzodiazepine exclusion implemented in MMA resulted in increased use of non-benzodiazepine psychotropic drugs but overall less covered psychotropic drug use. Despite this reduction in overall psychotropic drug use and spending on benzodiazepines, overall psychotropic drug expenditures increased for the intervention group. The gap between psychotropic use before and after MMA may reflect reduced use of treatment, but not increased psychotherapy. Increasing psychotropic drug expenditures suggest that
potential reductions in inappropriate benzodiazepine use were offset with slightly higher drug expenditures.
EFFICACY OF PATIENT REMINDERS LETTER TO IMPROVE A D H E R E N C E T O P R E V E N TAT I V E A N D D I A G N O S T I C RECOMMENDATIONS Zhou Zhang 1; Jason Fish2. 1UCLA, Woodland Hills, California; 2UCLA, Los Angeles, California. (Tracking ID # 10864)
BACKGROUND: Recent literature identifies that completion of recommended services is marginal. Given these low rates, physicians have been trying many strategies to increase adherence; specifically, strategies have involved letters, phone calls, and text messages. While each has been shown to be effective for preventative services, it is unclear how each reminder strategy may affect completion of diagnostic study recommendations. Further, it is also unclear how best to implement these strategies in complex healthcare organizations. We hypothesize that while these strategies may benefit patients and increase adherence to both preventative and diagnostic study recommendations, there will simultaneously be a need to identify and improve organizational processes to facilitate patient participation in completing these recommended services.
METHODS: Using pilot data from a database of all ordered recommended care for both preventative and diagnostic study recommendations from one general internists outpatient practice at an academic health center from 20082009, we collected completion rates of these recommendations. The database included record of completion of recommended care as well as documentation of two patient reminder letters being sent for each order. The physician followed a standard protocol for sending two reminder letters. Employing quality improvement techniques, we also generated process flow diagrams for preventative services and diagnostic study recommendations (which included laboratory, specialist referrals, and radiological studies) to identify how patients engage the medical system to complete the recommended services.
RESULTS: During the 12 month study period, a total of 1630 recommended services were recorded (251 preventative services, 416 specialist referrals, 683 labs, and 180 radiology and other diagnostic studies). Preventative services had a completion rate of 45% without any reminder letters, similar to published studies. With one reminder letter, this completion rate increased 13% and, with a second reminder letter, the completion rate increased an additional 8%. For the diagnostic study recommendations, baseline completion rates were found to be: 65% for referrals, 82% for labs, and 79% for radiological studies. The three diagnostic study recommendations increased 7-12% after a first reminder letter, with the second reminder letter increasing the completion rate by 1-3%. Using QI techniques, we generated process flow diagrams which identified complicated process for preventative services in comparison to diagnostic study recommendations.
CONCLUSION: Completion of recommended preventative services was significantly improved with two patient reminder letters. However, for some preventative services, such as colonoscopy for colon cancer screening, we did find that the completion rate remained low despite the two reminder letter intervention. We also found that for diagnostic study recommendations, one reminder letter offered an additional benefit; whereas, the second reminder letter offered minimal benefit. Our process flow diagrams also indicated that some of the processes for services, such as preventative services, have complicated processes, which may account for the differences of the effect the reminder-letter intervention had on some of the recommended services. Further research is needed to identify improved strategies for increasing

completion rates, with an understanding of these strategies in the context of organization processes.

UPPER GASTROINTESTINAL SYMPTOMS DETERMINED USING A FREQUENCY SCALE FOR THE SYMPTOMS OF GASTROESOPHAGEAL REFLUX DISEASE ARE AFFECTED BY VERTEBRAL DEFORMITIES IN ELDERLY JAPANESE INDIVIDUALS Yoshinori Tokushima 1; Hitoshi Eguchi 1; Yuta Sakanishi 1; Yuichiro Eguchi 1; Satoshi Matsunaga 1; Tsuneaki Yoshioka 2; Shu Soejima 1; Yasutomo Oda 1; Sei Emura 1; Ryuichi Iwakiri 3; Kazuma Fujimoto 10; Takashi Sugioka 1; Shunzo Koizumi1. 1Saga Medical School, Saga, N/A; 2Saga Medhical school, Saga, N/A; 3Saga Medical School Internal Medicine, Saga, N/A. (Tracking ID # 10865)

BACKGROUND: According to the World Health Statistics 2010 reported by the World Health Organization, Japanese people have the longest average lifespan in the world. The quality of life for elderly individuals is thus a priority issue in an aging society. Gastroesophageal reflux disease (GERD) is a lifestyle-related disease that shows a markedly increased prevalence in elderly individuals in Japan. Increased abdominal pressure, caused by kyphoscoliosis, is thought to be one factor responsible for this increased incidence. In a previous study, we found that the pathogenesis of GERD diagnosed by upper gastrointestinal endoscopy in elderly patients was affected by the increase in intra-abdominal pressure caused by vertebral deformities, including spondylosis deformans. However, the relationship between vertebral deformities and GERD, including GER symptoms, in elderly individuals remains unclear. The aim of this study was, therefore, to clarify the relationship between vertebral deformities and GER symptoms evaluated by questionnaire in the elderly general population in Japan.
METHODS: Elderly individuals who visited four adult day care services in Japan were enrolled in this study. GERD symptom scores were assessed using a frequency scale for the symptoms of GERD (FSSG) questionnaire. The degree of spine shortening was determined by the difference between arm span (cm) and body height (cm) (DAH), and medication history associated with GER symptoms was obtained. RESULTS: A total of 112 elderly individuals were evaluated (89 female; mean age 80.16.1 years). The mean body mass index was 21.03.9 and the mean DAH was 6.46.4 cm. Sixteen individuals (14%) had significant GER symptoms (FSSG score >8), 61 (54.5%) had mild GER symptoms (FSSG score 17), while 35 (31%) had no symptoms evaluated by FSSG. Of the patients with GER symptoms evaluated by FSSG, only five (4.5%) were treated with proton-pump inhibitors, and 12(10.7%) were treated with H2 blockers. FSSG score and symptoms due to functional dyspepsia were both significantly correlated with DAH (r=0.333 and r=0.337, respectively, both pCONCLUSION: This study confirmed a positive relationship between GER symptoms and vertebral deformities. An FSSG questionnaire can provide a useful and inexpensive method for identifying GERD patients in the elderly general population.

TOWARD UNIVERSAL HIV TESTING: IS THE CDC RECOMMENDATION OF OPT-OUT SCREENING THE ANSWER? Anish P Mahajan 1;
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BACKGROUND: Most Americans have not been tested for HIV, and 20% of those infected are unaware. To expand testing, the CDC recommends routine opt-out HIV screening, in which patients are told they will undergo testing unless they decline. Objective: To determine if opt-out screening is associated with greater testing offers and patient acceptance of screening than routine opt-in or risk-based testing.
METHODS: At 2 safety-net clinics, participatory research methods were used to create 3 screening interventions: physician-initiated (P-I) optout, nurse-initiated (N-I) opt-out, and N-I opt-in. Using a quasi-experimental time samples design, each intervention was implemented for a 2-month interval over 6 months. 14,872 patients were eligible for screening. Differences in testing offers and patient acceptance of screening

between the interventions and risk-based testing (standard of care) were assessed. Multivariate regression was used to identify correlates of screening refusal.
RESULTS: Relative to risk-based testing, the interventions increased the offer rate (11% vs. 25% p<0.05) and actual testing rate (7% vs. 14% p<0.05). Although offer rates were similar between opt-out and opt-in, the physician offer rate was greater than nurses (28% vs. 22% p<0.05). Overall percentage of patients accepting screening in optout and opt-in interventions were similar (59% vs. 56% p=0.09), but P-I opt-out was associated with greater acceptance than N-I opt-out (65% vs. 54% p<0.05). Recent test, older age, female sex, and African-American ethnicity were associated with refusing screening (p<0.05).
CONCLUSION: Routine HIV screening in ambulatory care is feasible, and resulted in at least a 2-fold increase in the percentage of clinic patients offered screening and proportion undergoing testing. The CDC recommendation for opt-out screening was not associated with greater patient acceptance of screening compared to opt-in screening. Such strategies do not assure universal offering of HIV testing.
A MULTISITE STUDY COMPARING MEDICAL STUDENT AND FACULTY OPINIONS REGARDING ONLINE PROFESSIONALISM Lynn Malec 1; Erik Black 2; Beatrice Boateng 3; Reed Van Deusen4.
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BACKGROUND: Educating physicians-in-training about issues related to medical professionalism remains an important yet elusive challenge for medical educators. The Accreditation Council for Graduate Medical Education (ACGME) counts professionalism as a core competency in resident education however little guidance exists as to how to teach or evaluate trainees regarding professionalism. Professionalism education must encompass domains such as compassion, responsiveness to patient needs, respect for patient privacy, and sensitivity to diverse patient populations. Research has already established that unprofessional behavior in medical school is associated with later State board disciplinary action. Recent advances in Internet technologies and the consequent rise in popularity of online social media sites have added to the complexity associated with educating physicians-in-training about professionalism. Facebook, as a dominant online social media destination, has garnered specific attention from medical education researchers. Since the emergence of social media sites, medical trainees activities outside the workplace are increasingly publically available.

With this change, come new questions as to what constitutes professional behavior.
METHODS: A survey composed of vignettes, questions related to demographics, and opinion questions was electronically distributed to first year medical students and faculty in internal medicine and pediatrics at three academic medical institutions (University of Pittsburgh, University of Florida, and University of Arkansas). The vignettes contained de-identified photographs, quotes, and case scenarios. All vignettes were originally posted by medical trainees and were publicly available at the time they were obtained from the source websites. Participants were asked their opinions on how acceptable each vignette was to be posted online for four different levels of learner (premedical student, medical student, resident, and faculty member). There were three possible levels of acceptability for each level of learner: acceptable if posted on a public site, acceptable if posted on a protected site, and not acceptable. Comparisons between medical student and faculty responses were done using the Chi-squared statistic. This study was approved by the IRB at all three institutions.
RESULTS: The survey response rate was 30%. On average, medical students were 24 years old (SD=3.2) and faculty were 45 (SD=10.6). Vignette #1 was a picture of a woman standing in a parking lot holding a keg. If a premedical student posted this picture, 21.5% of faculty and 14.3% of medical students felt it would be

unacceptable (P<.05). No statistically significant difference was found between medical students and faculty for this image if it were posted by medical students, residents, or faculty members. Vignette #2 was a picture of a man and woman on a beach and he is kissing her chest. If a premedical student posted this, 75.9% of faculty and 64.1% of medical students felt it would be unacceptable (p<.05). No statistically significant difference was found if this image were posted by medical students, residents, or faculty. Vignette #3 was a picture of the text Im not an alcoholic. Im a drunk. Alcoholics go to meetings. If a premedical student posted this, 75.3% of faculty and 54.9% of medical students felt it would be unacceptable (p<.01). No statistically significant difference was found if this image were posted by medical students, residents, or faculty. Vignette #4 was a picture of a woman drinking from a large bottle of liquor. If a premedical student posted this, 69.1% of faculty and 51.5% of medical students felt it would be unacceptable (p<.05). No statistically significant difference was found if this image were posted by medical students, residents, or faculty. Vignette #5 was a picture of a woman holding a bottle of beer and positioned in a provocative pose. Statistically significant differences were found among faculty and medical students at all levels of learners. 48.7%, 49.5%, 59.7%, and 67.8% of faculty and 31.2%, 38.1%, 50%, and 58% of medical students felt it would be unacceptable for this to be posted by premedical students, medical students, residents, and faculty, respectively.
CONCLUSION: This study illustrates the lack of consensus on what constitutes professional behavior amongst medical students and attending physicians. Prior studies have suggested that generational differences do exist when it comes to perceptions of professionalism. Data derived from this study supports the idea that generational differences may play a role in perceptions of professionalism when applied to activities outside the workplace. As social media sites such as Facebook become more ubiquitous, there will be increasing challenges in the education of physicians-in-training about issues related to medical professionalism compounded by the
fact that perceptions of professionalism differ between educators and trainees.
MONITORING OF PRIMARY HEALTH CARE IN A FEE-FOR-SERVICE WITH UNIVERSAL COVERAGE COUNTRY: THE SWISS CHEESE SITUATION Nicolas Senn 1; Jacques Cornuz1. 1Department of Ambulatory Care and Community Medicine, University of Lausanne, Lausanne, N/A. (Tracking ID # 10874)
BACKGROUND: Monitoring primary health care (PHC) is essential for public health, health authorities and care providers in order to achieve a high quality of efficient care (at best cost). Switzerland has a unique consumer-driven fee-for-service with universal coverage health system regulated by the health authorities. Very few studies have attempted to describe the Swiss PHC system and none have looked at the feasibility of using existing standardized indicators. We investigated the challenges of applying an international monitoring tool for PHC in Switzerland and compared with the US situation, since these two countries have been labeled as the Sister Republics (Hutson JH, The Library of Congress, 1991)
METHODS: We analyzed the strengths and weaknesses of the Swiss PHC system by practicing a standard monitoring tool developed for Europe called PHAMEU (Primary Health Care Activity Monitor for Europe, http://www.phameu.eu
Web End =www.phameu.eu). We investigated the availability and quality of data and identified the indicators most relevant to describe the Swiss PHC health system with reference to the US situation. All collected data refer to the period 2005 to 2009.
RESULTS: From the 91 PHAMEU project indicators, 37 (41%) were built on directly available data, 14 (15%) required major adaptations of existing data and 40 (44%) were based on expert opinion as no data were available. Whereas 33 out of 39 (85%) indicators describing the structure of PHC (governance, economics and work-forces) relied on existing data, only 7 out of 37 (19%) indicators describing the process of PHC (access, continuity physician-patient, coordination and comprehensiveness) were based on existing data. Slightly more than half (55%) of the available information came from the governmental sector, 33% came from PHC providers, 10% came from private health insurances and 2% came from other sources. The most relevant

indictors describing the Swiss PHC system were the following: 1) 99.2 % of the population is covered by health insurance (US: 85%) 2) 26% (15 b$) of health expenditures was spent on PHC (US: no comparable data available). 3) 2.3% was spent on prevention (US: 3%) 4) 63% of private practices are single handed (US: 27%). 5) Number of GP visits per year and per capita was 2.8 (US: 1.5). 6) Mean duration of PHC consultation was 17 minutes (US: 21 minutes). 7) 3.2% of the time of consultations was spent for home visits. 8) 5.8% of the time of consultation was spent for telephone.
CONCLUSION: In Switzerland, which has a consumer-driven fee-for-service with universal coverage health care system, almost half of data were not available to built standard indicators for monitoring PHC. The information describing the operational activities of PHC is dramatically lacking especially in regards to the health status of patients, health care management and patients satisfaction. This might reflect the relative autonomy of PHC providers in their practice, which are predominantly single handed compared to the United

Sates where less than 30% of practices are single-handed. It seems however urgent to implement information systems to fill these Swiss cheese holes.
SUBCLINICAL THYROID DYSFUNCTION AND THE RISK OF HEART FAILURE, OTHER CARDIOVASCULAR EVENTS AND MORTALITY IN THE ELDERLY David Nanchen 1; Jacobijn Gussekloo 1; Rudi G.J. Westendorp 1; David J. Stott 2; J.Wouter Jukema 1; Stella Trompet 1; Simon P. Mooijaart 1; Nicolas Rodondi 3; Anton J.M. de Craen1. 1Leiden University Medical Center, Leiden, N/A ; 2University of Glasgow, Glasgow, N/A ; 3Department of Ambulatory Care and Community Medicine, Lausanne, N/A. (Tracking ID # 10877)
BACKGROUND: Mild thyroid dysfunction is common in older people. However the clinical importance is uncertain. We aimed to determine the extent to which subclinical hyper- and hypothyroidism influence the risk of common diseases in elderly people, including heart failure, atrial fibrillation, cerebrovascular and cardiovascular events or mortality.
METHODS: We studied 5748 men and women aged 7082 years with known cardiovascular risk factors or previous cardiovascular disease, but free of heart failure and atrial fibrillation in the Prospective Study of Pravastatin in the Elderly at Risk (PROSPER) trial. In multivariate adjusted Cox proportional hazard models, we compared the risk of incident heart failure hospitalization, atrial fibrillation, cerebrovascular and cardiovascular events or mortality over a 3.2-year follow-up. Thyroid status was established at study baseline. Euthyroid participants (defined as
thyroid stimulating hormone [TSH] level 0.45-4.5 mIU/l) were compared with those with subclinical hyperthyroidism (TSH <0.45 mIU/l with normal free thyroxine) and those with subclinical hypothyroidism (TSH >4.5 mIU/l with normal free thyroxine). RESULTS: The mean age of the study population was 75 (SD 3.3). The prevalence of cardiovascular disease was 44% at study baseline. Subclinical hyperthyroidism was present in 234 participants (4.1%) and subclinical hypothyroidism in 466 participants (8.1%) at baseline. There was no difference in prevalence of diabetes or known cardiovascular disease by thyroid status at baseline. During the 3.2-year follow-up, the incidence of heart failure hospitalization was higher in elderly adults with subclinical hyperthyroidism compared to the euthyroid group, with 25 vs 12 events per 1000 person-years (multivariate adjusted hazard ratio 2.61, 95% confidence interval, 1.59-4.26, p<0.01 (see Figure). The risk of heart failure dependant of thyroid function was similar in adults with endogenous subclinical hyper-thyroidism, with or without pre-existing cardiovascular disease, or those under pravastatin or beta-blocker therapy, but increased with increasing heart rate (p for trend 0.043). We found no association between subclinical hypothyroidism and heart failure. There were no consistent association between subclinical thyroid dysfunction and the risk of atrial fibrillation, cerebrovascular and cardiovascular events or mortality.
CONCLUSION: Subclinical hyperthyroidism is an independent risk factor for heart failure in elderly adults, particularly in those with an elevated heart rate. Randomized controlled trials of treatment of subclinical

hyperthyroidism to prevent heart failure in older people are warranted.

COMPUTED TOMOGRAPHY ASSOCIATED CANCER AND CANCER DEATHS FROM EMERGENCY DEPARTMENT VISITS IN THE US Leah Zallman 1; Steffie Woolhandler 2; David Himmelstein 2; David Bor 3; Danny McCormick1. 1Cambridge Health Alliance, Cambridge, Massachusetts ; 2Cambridge Health Alliance/City University of New York School of Public Health, Cambridge, Massachusetts ; 3Cambridge Health Alliance, Jamaica Plain, Massachusetts. (Tracking ID # 10895)
BACKGROUND: Computed tomography scan (CT) use has increased substantially in the past decade. Although CTs offer distinct diagnostic advantages, their widespread use raises concern about iatrogenic cancer. Little is known about the number of cancers and cancer-related deaths caused by CT scans during the evaluation of adults- patients in U.S. emergency departments (EDs).
METHODS: We estimated the lifetime attributable risk of cancer and cancer related deaths caused by CT use during the evaluation of adult patients in US EDs annually and the frequency of, trends in and factors associated with CT use in this setting. We conducted a cross sectional analysis of CTs performed during ED visits by adults in a nationally representative sample using the National Hospital Ambulatory Medical Care Survey (NHAMCS), 19982008. We used the Biologic Effect of Ionizing Radiation VII model to estimate the lifetime attributable risk of cancer incidence and mortality based on age at exposure, gender, and effective dose estimates for all adult visits to US EDs during which a CT was performed in 2008. Because the NHAMCS does not provide details of CTs ordered (i.e. abdomen vs chest, single or double pass), we calculated the effective dose using the National Emergency Department Sample, which provides nationally representative estimates of the proportion of CTs performed on each body area(i.e. chest, abdomen) and the number of passes through the CT scanner for ED patients. We also established the proportion of visits for which CTs were performed from 1998 and 2008 and conducted multivariate logistic regression analysis to determine patient and hospital characteristics associated with CT usage in 2008. In order to determine whether potential increases in rates of CT use over time were associated with improved detection of severe or occult disease that require hospital admission, we compared the proportion of hospital and intensive care unit admissions per CT each year from 1998 to 2008 with a chi-square trend test. If increases in CT use were not associated with improved detection of severe disease requiring hospital or intensive care unit admission, we would expect this ratio to decline over time.
RESULTS: In 2008, 16,406,921 CTs were performed nationally during adult ED visits; we estimate that these will cause 3750 (95% CI 3570 3940) cancers and 1994 (95% CI 19042088) cancer deaths in future years. The proportion of adult ED visits during which a CT was performed increased from 4.8% (95% CI 4.4-5.1) to 17.1% (95% CI16.0-18.2) between 1998 and 2008, a 335% increase. Older age, triage time of <15 minutes, and evaluation at an urban hospital were independently associated with higher odds of receiving a CT. The proportions of hospital and intensive care unit admissions per CT fell from 2.69 (95% CI 2.69-2.69) to 0.95 (95% CI 0.95-095) (p=0.0019) and from 0.28 (95% CI 0.28-0.28) to 0.12 (95% CI 0.12-0.12) (p=0.0093), respectively.
CONCLUSION: While the net number of lives saved by CT use in the EDs is not known, the large number of cancers and cancer deaths attributable to CT use, as well as the large increase in CT use without an associated increase in admission rates, highlight the importance of curbing unnecessary CTs in the ED setting.
NEEDLE AND SYRINGE EXCHANGE PROGRAMS IN CORRECTIONAL SETTINGS: FEASIBLE, SAFE AND NECESSARY! Hans Wolff 1; Thierry Favrod-Coune 2; Jean-Pierre Rieder 2; Francoise Pinault 2; Laurent Getaz 2; Barbara Broers2. 1University Hospitals of Geneva, GENEVA, N/A; 2University Hospitals of Geneva and University of Geneva, Geneva, N/A. (Tracking ID # 10899)
BACKGROUND: Addiction-related problems are highly prevalent in almost every prison in the world. Despite

the fact that illicit drugs are forbidden, they frequently enter most correctional facilities. Therefore, harm reduction measures such as needle and syringe exchange programs (NSP) need to be implemented. In the community and in prison, NSPs have been shown to: 1. prevent the transmission of infectious diseases, 2. not compromise the security (syringes not used as a weapon) and 3. not increase the consumption nor the injection of drugs. Despite strong evidence of efficacy, NSPs exist in less than 1% of the prisons worldwide. The Geneva University Hospitals are dispensing health care to inmates of the prison of Geneva, the largest remand prison in Switzerland. This prison faces severe overcrowding as it housed in 2010 a mean of 543 inmates, primarily male, in the 270 officially provided places (occupancy rate: >200%). The NSP is in place since 1996. The aim of the study is to evaluate the acceptance and feasibility of the NSP in prison.
METHODS: In the prison of Geneva, a syringe exchange protocol was elaborated by addiction specialists and accepted by the prison authorities in 1996. The protocol gave an official framework to provide injection kits and appropriate counseling to drug-using inmates. Staff is trained in addiction and harm reduction measures. Evaluation included distribution and return of the syringes over time.
RESULTS: Each year 169446 syringes were distributed to 2453 intravenous drug using inmates (fig 1). The return rate ranged from 58 to 83%. No acts of aggression or other incidents involving the contents of injection kits (e.g. threats, aggression, injury by a syringe left in a dustbin) were reported. The program was well accepted by the prison staff and the health care team. Healthcare workers noted that 10-20% of the iv-drug users participating in the program related an initial hesitation when distributing the syringes, which let suspect that the fear of denouncement existed and that the totality of the target prisoners were not reached. The prison direction actively supported the program and operated no cell search for drugs after delivery of an injection kit. In addition to the harm reduction itself, the program helped to strengthen the dialogue in an atmosphere of greater understanding and encouraged constructive co-operation between all partners (healthcare team, prison officers, and political partners).
CONCLUSION: Scientific evidence as well as our experience showed that syringe and needle exchange in the prison is feasible, safe and well accepted by staff and iv-drug users, although it could be improved by providing better confidentiality during the distribution of the injection kits. The program needed an active supervision to make sure that nurses, prison staff and detainees feel comfortable with it. Access to harm reduction measures should be universal, in concordance with human rights principles and therefore be implemented in all prisons.

DELIVERY, UPTAKE, AND SATISFACTION WITH DECISION SUPPORT INTERVENTIONS IN A PRIMARY CARE CLINIC Carmen L Lewis 1; Leslie Stewart 1; Shaun McDonald 1; Kim Young-Wright 1; Robert Malone 1; Christopher P DeLeon 1; Michael P Pignone1.
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BACKGROUND: Patient centered care is an important component of quality medical care. Employing decisions support interventions is a means of promoting patient centered care by encouraging patient to be more actively engaged in their medical care. However, implementation of decision support interventions in primary care poses a number of challenges including the timing of delivery to maximize uptake and effectiveness and the logistics of integrating the program into existing clinic operations. Our purpose was to implement decision support interventions for a wide variety of health conditions in primary care practices and to test the effectiveness of this program in terms of patient uptake and satisfaction.
METHODS: We employed health information technology (HIT) to identify patients who are potentially eligible for decision support using ICD-9 diagnosis codes and billing information. For patients who were due for CRC screening, staff mailed decision support several weeks prior to the patients upcoming appointment. For in-clinic delivery, we employed continuous quality improvement methodology to modify nurse work processes to assess patient eligibility for and interest in targeted
decision support interventions by administering a computer-based survey during their intake evaluation.

Decision support was then provided by care assistants according to patient preference (DVD and booklet provided in clinic vs. mailed after the visit). During follow up appointments nurses were also triggered to collect information about patient uptake and satisfaction with decision support interventions. RESULTS: From 8/10 to 11/10 we delivered decision support to 433 eligible patients for screening (236 for colorectal cancer (CRC) and 5 for PSA screening), symptomatic conditions (46 for hip and 42 for knee osteoarthritis, 46 for chronic pain, 2 for depression, 9 for menopause, 9 for benign prostatic hyperplasia), and chronic conditions (28 for diabetes, and 10 for weight loss surgery). Over this period, clinic staff follow-up on 532 patients who had been provided decision support within 6 months of their clinic visit. Of these patients, 363 (68%) indicated that they had received a decision aid. Among this 363 patients, 302 (83%) liked receiving the decision aid, 295 (81%) found the information useful, 209 (58%) watched some or the entire DVD, and 239 (67%) read some or the entire booklet. Patients were more likely to report that they liked receiving the decision support (88% vs. 79% p=0.03), more likely to watch the DVD (66% vs. 51% p<0.01) orread the booklet (72% vs. 59%; p=0.02) for symptomatic conditions (n=134) compared to screening (CRC) (n=197). Similarly, those who received decision support in clinic (n=168) were more likely to report they liked getting it (90% vs. 77% p<0.01) more likely to watch it (67% vs. 50%; p<0.01) and more likely to read the booklet (74% vs. 58%; p<0.01) than those who were mailed decisions support (CRC screening) before their upcoming visit.

CONCLUSION: We were able to deliver a wide variety of decision support interventions and the majority of patients reported receiving them. Uptake and satisfaction appeared to vary by topic type and delivery method.

SHORT LENGTH OF STAY IS ASSOCIATED WITH INCREASED MORTALITY William Southern 1; Julia Arnsten2. 1Albert Einstein College of Medicine/Montefiore Medical Center, Sleepy Hollow, New York ; 2Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York. (Tracking ID # 10906)

BACKGROUND: Since the introduction of the prospective payment system (PPS) in 1983, hospitals in the U.S. have been financially incentivized to shorten inpatient length-of-stay (LOS), and LOS has shortened dramatically. However, it is unclear if reducing LOS adversely affects patient outcomes, such as hospital readmission and mortality. Given financial pressures to shorten LOS, it is possible that some patients may be discharged too early, and that premature discharge is associated with poor patient outcomes. Previous attempts to examine associations between LOS and patient outcomes have generally been confounded by patient-level factors. In particular, because LOS is closely associated with disease severity, patients with shorter lengths-of-stay tend to be less severely ill than patients with longer lengths-of-stay. We used a unique study design to examine associations between LOS and outcomes of care. Our analysis was based on physician LOS tendencies, which were determined for each physician and then used to group hospital admissions and assess associations with mortality and readmission. METHODS: We examined all admissions to the medical teaching service of an urban medical center from 7/1/02 through 6/30/08. First we calculated the mean LOS for each physician during the study period; this defined each physicians LOS tendency. Next, each physician was designated a long-LOS or a short-LOS physician defined by the median LOS for all physicians. Then we created two admission groups, which we defined according to the physician to whom the admission had been assigned. We then compared admissions assigned to long-LOS physicians vs. short-LOS physicians with respect to baseline admission characteristics (demographic characteristics, insurance, Charlson co-morbidity score, admission laboratory values, Laboratory-based Acute Physiology Score (LAPS), and diagnoses), physician characteristics (# of admissions, hospitalist vs. non-hospitalist, years since licensure, years since graduation, and US vs. international medical school) and 30-day mortality and readmission rates. Next, we constructed logistic
regression models to assess the independent association between physician LOS tendency, and patient

outcomes after adjustment for patient-level and physician-level covariates. To address the threat of residual confounding, we used a propensity score model to match admissions assigned to long-LOS physicians with those assigned to short-LOS physicians with respect to demographic characteristics, insurance, Charlson co-morbidity score, admission laboratory values, Laboratory-based Acute Physiology Score (LAPS), and discharge diagnoses. Each admission assigned to a short-LOS physician was matched to one admission assigned to a long-LOS physician using a greedy, nearest neighbor matching protocol. Finally, we constructed univariate and multivariate conditional logistic regression models to assess the independent association between physician LOS tendency and patient outcomes in the matched patient groups.
RESULTS: 26,445 admissions and 79 physicians were examined. 7380 admissions were assigned to long-LOS physicians, and 19,065 admissions were assigned to the short-LOS physicians. Admission groups were similar with respect to age, sex, insurance type, admission creatinine, Charlson score, and discharge diagnoses. Admissions assigned to short-LOS physicians were more likely to be Black, and had a higher mean LAPS score. Short-LOS physicians saw more total admissions, and were more likely to be hospitalists, have fewer years of licensure, and fewer years since graduation. After propensity score matching, the patient groups were similar with respect to all demographic and clinical characteristics. In unmatched analysis, care by a short-LOS physician was not significantly associated with 30-day mortality (OR 1.07, 95% CI: 0.94-1.22). After adjustment for demographic and clinical patient characteristics care by a short-LOS physician was associated with increased risk for 30-day mortality, but the difference was not significant (OR 1.13, 95% CI: 0.97-1.32). After propensity score matching, care by a short-LOS physician was associated with significantly increased risk for 30-day mortality (OR 1.18, 95% CI: 1.02-1.37) which remained after adjustment for physician characteristics (Or 1.19, 95% CI: 1.01-1.40). (Table) Care by a short-LOS physician was not associated with increased risk of readmission in unadjusted (OR 1.03, 95% CI: 0.96-1.11), adjusted (OR 1.03, 95% CI: 0.95-1.12), propensity score matched (OR 1.03, 95% CI:0.94-1.12), or matched and adjusted analyses (OR 1.04, 95% CI: 0.94-1.14).
CONCLUSION: We used a unique study design to examine associations between physician LOS tendency and mortality. Compared to admissions assigned to physicians with longer LOS tendencies, admissions assigned to physicians with shorter LOS tendency had higher 30-day

mortality. It is unclear why assignment to short-LOS physicians was not associated with increased risk for readmission. However, we were unable to capture readmissions to hospitals outside our system, and it is possible that patients discharged after short LOS were more likely to seek readmission elsewhere, biasing our results. Future studies should apply this study design to a larger sample size to better assess the association between physician length of stay tendency and patient outcomes.

FEASIBILITY OF UTILIZING AN ALL-VOLUNTEER WORKFORCE OF SUCCESSFUL WEIGHT LOSERS TO ADDRESS THE US OBESITY EPIDEMIC

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BACKGROUND: Though most adults are able to lose weight if they try, few are able to maintain that loss without ongoing support. Long-term, sustained interventions have been shown to improve weight loss and delay weight gain. However, given that overweight and obesity affect 2 out of 3 Americans, any potential intervention needs to be highly cost-effective. Laypersons (i.e. peers) have demonstrated effectiveness in leading groups for individuals interested in weight loss, although studies have not assessed using successful unpaid volunteers. In addition, nearly one in 6 US adults has successfully lost at least 10% of their weight and kept it off for at least one year. In this study, we examine the possibility of utilizing an all-volunteer workforce to help address the obesity epidemic.
METHODS: We used data from a survey of a nationwide panel of adults (Knowledge Networks, Inc.) with a response rate of 83%. The analytic sample consisted of 673 men and women who completed the online survey in February 2010. Of the 673, 133 (19.7%) participants were not overweight (BMI >25.0) at their maximum

weight, so were excluded from these analyses. Participants were asked about their weight history using items from the National Health and Nutrition Examination Survey (NHANES) Weight History Questionnaire and the Behavioral Risk Factor Surveillance System (BRFSS). Survey items were created to identify participant interest in three specific types of weight control programs: a free program led by successful peers, a program that was not free and led by a successful peer, and a more traditional program led by trained paid professionals. Interest was assessed using a 5-point Likert-type scale and question order was varied randomly. We additionally created a survey item to assess participant interest in leading a weight control group, which was asked of successful peers, defined as individuals who had ever lost at least 10 pounds. Participants were also asked about any prior volunteering. Multiple logistic regression models assessed: (1) the association of participant characteristics with preference for an unpaid successful volunteer group leader over a paid expert, and (2) the association of participant characteristics with likelihood of willingness to volunteer to lead a weight control group. All models controlled for demographics (age, gender, race/ethnicity, education level, household income), weight history, weight loss intention, and medical history (overall health status, hypertension, diabetes). RESULTS: The sample had the following characteristics: 45.5% were female,16.2% were at least 65 years old, 31.3% were college graduates, and 50.8% had a household income of greater than $50,000. The majority of participants(61.3%) reported currently trying to lose weight and most (85.9%) had lost at least 10 pounds once in the past. Though most (51.6%) participants had no preference between the peer-led free program and expert-led paid program, nearly half (44.5%) preferred the peer-led free program. Only 3.9% of participants preferred the expert-led paid program. After controlling for demographics, weight history, medical history and weight loss intention, the only variables associated with a preference for a peer-led free program, versus an expert-led paid program, was a recent personal experience with a weight control program (adjusted OR 2.2, 95% CI 1.1-4.5) and experience as a
volunteer (adjusted OR 2.2, 95% CI 1.3-3.8). Of the individuals with prior weight loss success (n=540), 14.7% were willing to volunteer to meet with a group of people to help them control their weight (i.e. answered strongly agree or agree). In multivariable analyses, willingness to be a group leader in a peer-led free program was associated with BMI category, recent personal experience with a weight control program and experience as a volunteer. Those who had a BMI in the 18.5-24.9 (normal weight) and 25.0-29.9 (overweight) ranges were 0.1 times (95% CI 0.0-1.0) and 0.2 times (95% CI0.0-1.0) as likely, respectively, to be interested in being a group leader than those with a BMI >40.0 (morbidly obese). Individuals who recently participated in a weight loss program were 0.3 times as likely to be willing to lead a group (95% CI 0.1-0.9). Those who reported ever volunteering for an organization were 14.6 times (95% CI 4.4-48.2) more likely to be interested in being a group leader than those who did not report volunteering. CONCLUSION: Overall, participants appear to be much more interested in a free weight control program led by peers, compared to traditional programs (expert-led) or programs led by peers for which they are required to pay. In addition, one in 7 individuals with prior success at weight loss would be willing to volunteer to lead weight control groups, suggesting a feasible work-force for this type of intervention. Interest in volunteering to lead such a program amongst those who have been successful at weight loss was associated with prior experience with volunteerism. This may mean that using existing hospital volunteering programs as recruitment vehicles may be useful for identifying potential volunteers. Further research is necessary to determine the effectiveness of a volunteer-led weight control program.

HEPATITIS B: PREVALENCE, RISK FACTORS AND KNOWLEDGE OF TRANSMISSION MODES AMONG INMATES IN A SWISS PRISON Laurent Getaz 1; Hans Wolff1. 1University Hospitals of Geneva, Geneva, N/A. (Tracking ID # 10917)

BACKGROUND: Hepatitis B (HBV)-infection continues to be a substantial problem worldwide despite the existence of a safe and effective vaccine. HBVis transmitted within prison settings, but also after release, because of resumption of drug use and sexual activity. Preventive programs in prison can reach many high-risk individuals. This study aimed to estimate the prevalence of HBV infection and its associated factors as well as

the knowledge of transmission modes among inmates of Genevas Champ-Dollon prison, which is Switzerland largest remand prison. METHODS: A total of 116 individuals were interviewed using a standardized questionnaire on sociodemographic characteristics and HBV knowledge. All accepted blood samples. HBV surface antigen (HBsAg), antibodies against surface antigen (HBsAb) and antibodies against core antigen (HBcAb) were detected by enzyme immunoassay. RESULTS: This prison population was characterized by a high proportion of young male migrants: 36% originating from Eastern Europe, 32% from sub-Saharan Africa and 22% from North Africa; 64% were illegal immigrants without health insurance.
Prevalence for HBcAb indicating past or current infection was 44% (95% CI: 34.9-53.0) and 4.3% (95%CI: 1.4-9.8) had HBsAg indicating current infection. Eleven percent (95%CI: 5.5-17.0) of inmates had only HbsAb, suggesting former vaccination.
Region of origin is significantly associated with HBV infection ($p<0.00001$): 75.7% (28/37) of inmates from sub-Saharan African were HBcAb positive (95% CI 61.8-89.5), 40.5% (17/42) from Eastern Europe (95% CI 25.6-55.3) and 12% (3/25) from North Africa (95% CI 2.5-31.2). Age 27 years or older was also significantly associated with infection ($p=0.035$). On stratified analysis, origin and age remained significantly associated with HBV infection.
Eleven percent (4/37) of inmates from sub-Saharan Africa and 1.3% (1/79) of those from other origins were HBsAg positive ($p=0.038$).

Only 1 of 5 inmates (20%) suffering current infection (HBsAg positive) was aware of his infection.
A minority of inmates was aware that HBV can be transmitted through unprotected sex (24%), sharing needles (26%), sharing razor (21%) and tattooing (19%). Inmates not originating from Western Europe had the worst knowledge of transmission modes ($p=0.003$).
CONCLUSION: Prevalence of current HBV infection was 14 times higher than in the Swiss general population and also higher than in U.S. prisons. The high prevalence (4.3%) combined with the ignorance of infection and the lack of knowledge of transmission modes underlines the need for action to limit the risk of HBV in this population. The main risk factor found in our study was the geographical origin of the inmates. Differences in the prevalence of HBV by world regions reported by the CDC corroborate these results.
Two-thirds of the inmates were illegal immigrants in Switzerland, who had no health insurance and thus no access to community immunization program. A serological screening of populations characterized by high HBV prevalence would enable the implementation of an intensive educational program targeting contagious and susceptible inmates. When relevant, appropriate treatment could be provided. Persons tested positive for past or current infection could be excluded from vaccination thus leading to substantial reduction of costs.
Prison settings provide unique opportunities to vaccinate this high risk population. Vaccinating incarcerated persons protects not only those individuals, but also the community at large.

DISPARITIES IN SURGERY FOR EARLY STAGE LUNG CANCER: AN ANALYSIS OF MORTALITY ONE YEAR AFTER DIAGNOSIS

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BACKGROUND: Our recent, prospective cohort study confirmed reports of administrative data showing that African-Americans (AA) with early stage, non-small cell lung cancer do not receive potentially curative surgery

as often as similar white patients (W). We also found that comorbid illnesses and lack of a regular source of care were factors associated with less surgery for AA but not W patients. Poor perceptions of communication predicted lower surgical rates for all. We now report an analysis of outcomes one year after diagnosis and examine whether racial differences are associated with one year mortality in this cohort or whether other factors explain mortality differences.
METHODS: Using pulmonary, oncology, thoracic surgery, and generalist practices in 5 communities, we enrolled 437 newly diagnosed patients with early stage, non-small cell lung cancer. Inclusion criteria were as follows: patients were required to be at least 18 years old, have a tissue diagnosis or >60% probability of non-small cell lung cancer using Bayesian methods, and be limited to Stage I or II disease by clinical and radiological testing. Patients were identified from direct referral from practices or through the utilization of a chest CT review protocol. After being informed of the diagnosis of probable or definite lung cancer, but before the establishment of a treatment plan, patients were administered a 100-item survey. Chart reviews were performed 4 months after enrollment to assess comorbidities, pulmonary function tests, and treatment with surgery. Mortality data were obtained by personal or family contact and death certificates 1 year after enrollment. Regression analyses were performed with one-year mortality as the primary outcome.
RESULTS: Of the 437 patients enrolled, 386 were eligible for lung cancer surgery based on diagnostic stage and absence of absolute contraindications. Eighty-eight percent had the diagnosis confirmed pathologically. Of those patients enrolled, 29% were AA, 90% had health insurance, and the median age was 66 years. The one-year mortality rate for the cohort was 17% (N=66). Although mortality was similar according to race (AA 17%, W 17% p=0.9), AA were, on average, 4.4 years younger at the time of death compared to W (66.9 vs. 71.3 years). The one-year mortality for surgically treated patients was 12% compared to 25% for the no surgery group (p=.002). Regression analysis revealed that age over 66 (OR 3.4, 95% CI 1.8-6.6) and 2 comorbid illnesses (OR 2.8, 95% CI 1.2-6.4) were associated with worse mortality while surgical treatment (OR .52, 95% CI .29-.93) was protective. Race, income, education, marital status, gender, and regular source of care were not associated with one-year mortality. CONCLUSION: Older age and comorbid illnesses are associated with one-year mortality in early stage lung cancer. Although African-Americans receive lung cancer surgery less often than white patients, it is surgical treatment, not race, that is associated with survival.
RACIAL/ETHNIC DISPARITIES IN HYPERTENSION FOLLOW-UP CARE OF HEALTH CENTER PATIENTS
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BACKGROUND: Racial ethnic minorities, especially African Americans, are more likely to have hypertension and suffer from increased morbidity and mortality compared to Whites. Federally Qualified Health Centers (Health Centers) supported by the Health Resources and Services Administration, care for over 18 million patients, 63% of whom are racial/ethnic minorities. For Health Center patients with hypertension, we assessed the presence and magnitude of racial/ethnic disparities in obtaining counseling or training to help manage hyper-tension, hospitalizations, or ER visits due to hypertension, and self assessed confidence in ability to self manage hypertension. METHODS: Cross-sectional analyses using the 2009 Health Center Patient Survey, a nationally representative sample of 4,558 patients seen at a Health Center in the last 12 months. After examining the prevalence of hypertension in the full sample, we focus on the subset who self-report hypertension (n=1764) including 522 non-Hispanic white, 575 African American, and 602 Hispanic patients. We estimated logistic regression models to predict the likelihood of obtaining each of the following: health professional advice about diet, salt, exercise, and alcohol; patient compliance with advice; training on patient self management by a nurse; hospital or ER episodes in past 2 years due to hypertension; and confidence in capacity to self-manage hypertension. In our models, we controlled for patient characteristics including the

presence and source of health insurance coverage, comorbidities, income, employment, self-reported health status, gender, age group, and other factors.
RESULTS: Among all health center patients, both African Americans and Hispanics are more likely to have hypertension compared with White patients (OR=2.90 (2.30, 3.65) and OR=1.31 (1.05, 1.62) respectively). Among hypertensive health center patients, there are no racial/ethnic disparities favoring Whites evident in the receipt of counseling on lifestyle (diet, salt, exercise and alcohol) or compliance with counseling (for example, receipt of advice to change diet: African Americans OR=1.64 (1.27, 2.13), Hispanics OR=1.32 (1.03, 1.71); compliance with diet advice: African Americans OR=1.65 (1.28, 2.14), Hispanics OR=1.30 (1.01, 1.69)). In

addition, no disparities exist in receipt of hypertension self-management training by nurses (African Americans OR=2.46 (1.82, 3.33); Hispanics OR=1.71 (1.26, 2.33)). African Americans are more likely than other racial/ethnic groups to be hospitalized or visit the ER in the past 2 years due to hypertension (OR=1.50 (1.07, 2.11)). Hispanics are less likely to express confidence in their capacity to self-manage hypertension relative to other racial/ethnic groups (OR=0.56 (0.42, 0.74)).
CONCLUSION: Among Health Center patients with hypertension, there are no apparent racial/ethnic disparities in patients receipt of counseling or self-management training provided by a health center professional. However, disparities exist for hospitalization/ER use and self-efficacy for hypertension control. These results persisted after controlling for a number of important patient clinical and demographic characteristics. Health centers, like other settings, need to address potentially avoidable acute care usage due to hypertension by implementing better care coordination and improving patient self-management. A more aggressive educational and outreach program may lead to greater self-efficacy for hypertension self-management.
RESULTS OF THE IMPROVING PERFORMANCE IN PRACTICE PROGRAM: IMPROVING PRIMARY CARE THROUGH PRACTICE COACHING AND IMPROVEMENT NETWORKS Erin Elizabeth Van Scoyoc 1; Kevin Stanford 2; Peter Margolis 2; Darren DeWalt3. 1UNC Chapel Hill, Chapel Hill, North Carolina ; 2Cincinnati Childrens Hospital Medical Center, Cincinnati, Ohio ; 3University of North Carolina at Chapel Hill, Chapel Hill, North Carolina. (Tracking ID # 10929)
BACKGROUND: Optimal strategies for widespread primary care transformation are unknown. One challenge to scale up is how to design programs to address variation in the organizational or contextual factors that may be associated with successful quality improvement (QI) efforts. The Improving Performance in Practice (IPIP) initiative is a program of the primary care specialty societies and boards that aims to improve the pace and success of primary care transformation efforts and establish ongoing improvement networks. The IPIP program assists states in developing regional ambulatory care quality initiatives that support practices in undertaking routine performance measurement and data sharing, education in QI methods and clinical content, and the creation of networks of practices to share the ideas and work of improving care. State programs also provide on-site practice coaching to facilitate the improvement process. IPIP enrolled its first practices in 2006, and is currently active in seven states, with more than 350
participating practices. The objective of this study is to investigate whether practices that have participated in the IPIP program have improved the quality of care for patients with diabetes, and to determine if practice characteristics influenced the pace of improvement.
METHODS: Practices participating in the IPIP program submit monthly performance reports on standardized measures. We studied practices reporting the following diabetes measures: percent of diabetic patients in the practice with: A1c >9%, systolic blood pressure (SBP) <130 mmHg, LDL <100 mg/dL, an eye exam, smoking cessation counseling, a foot exam, and testing or treatment for nephropathy. We included all practices that had participated in the IPIP program for at least six months prior to November 2009, and excluded practices that did not focus on diabetes, and practices that used a convenience consecutive sampling method for data reporting. We used linear regression to determine the mean rate of change over time for each measure, and estimated the

projected improvement over 12 months based on the mean rate of change per month for each measure. We then compared the rate of improvement by practice characteristics including: practice size (number of provider FTEs), presence of an electronic health record (EHR), prior experience with quality improvement, initial performance, and number of months participating in the IPIP program. RESULTS: 165 practices participating in the IPIP program were included. 33% of practices were in Pennsylvania, 32% in Colorado, 23% in North Carolina, and 12% in Michigan. 64% of practices had less than or equal to 3 FTEs. 49% had an EHR in place, and 22% reported prior experience with quality improvement. 46% had participated in IPIP for more than 12 months. Practices participating in the IPIP program improved significantly in all of the measures except for the blood pressure and cholesterol goals (SBP< 130 mmHG and LDL<100 mg/dL).(Figure 1) Practices with worse initial performance improved faster than those with better initial performance ($p<0.01$ for all of the diabetes measures). Presence of an electronic health record, prior experience with QI, and practice size did not impact the rate of improvement ($p>0.05$ for all of the diabetes measures). CONCLUSION: Practices participating in the IPIP program improved the quality of care for their patients with diabetes. Improvement was faster in practices with worse initial performance. Creating networks of practices can be an effective model to disseminate quality improvement to community primary care practices. Consistent, frequent measure reporting across a large number of practices, combined with information on practice context and facilitation, can help to understand factors that expedite translation of evidence into practice. Such an improvement infrastructure can also lead to more rapid adaptation of the practice support strategies.

HOUSING AND CASE MANAGEMENT DECREASE HOSPITALIZATIONS AMONG FREQUENT USERS OF HOSPITAL SERVICES: A PILOT STUDY Laura Zimmermann 1; David Buchanan 2; Lou Rohr3. 1; 2Erie Family Health Center, Chicago, Illinois; 3Rush University Medical Center, Chicago, Illinois. (Tracking ID # 10936)

BACKGROUND: Homeless individuals utilize the heath care system often and at great expense. Although some of these individuals have complex medical needs requiring intensive support, others have complex social needs which require supportive housing and case management. In some cases, the increased use of health services is a symptom of these other basic needs being unmet. We examined the impact of supportive housing and case management on health care utilization among homeless individuals who are hospitalized frequently. METHODS: A social worker (S.S.) at John Stroger Hospital of Cook County identified subjects who were 18 years or older, hospitalized at least three times in the last 12 months at a Cook County Bureau of Health Services hospital, and met the Housing and Urban Development definition of being chronically homeless. The intervention consisted of case management including referral to interim housing and facilitated access to permanent housing. Baseline demographic data were collected through subject self-report, and investigators used Cook County Bureau administrative databases to collect information about hospitalizations, days in the hospital, emergency room (ER) visits, and clinic visits for each individual 12 months before and after enrollment. Time spent in permanent housing during the next 12 months was also recorded. Wilcoxon Signed Rank test was used to compare these measures 12 months before and after enrollment for 1) all enrolled 2) those enrolled who achieved permanent housing 3) those enrolled who did not achieve permanent housing. RESULTS: Investigators enrolled 34 individuals, and 21 achieved permanent housing. Nineteen achieved permanent housing for greater than 6 of the 12 months after enrollment. The average age of enrollees was 47.6 years, and 71% (n=24) were men. Among all individuals enrolled, average number of hospitalizations decreased from 3.9 to 1.3 after enrollment ($p=<0.001$), and mean days in the hospital decreased from 18.0 to 6.8 ($p=<0.001$). Mean number of ER visits decreased from4.3 to 2.6 but was not statistically-significant. Those who achieved permanent housing had significantly lower mean hospitalizations (3.8 to1.2, $p=<0.001$) and hospital days (18.3 to 8.6, $p=0.002$). However, even those individuals who did not achieve permanent housing

had lower rates of hospitalization (4.0 to 1.4, p=0.004) and lower mean hospital days (17.6 to 3.8, p=0.003) after enrollment in the program. In those who achieved permanent housing for greater than 6 months, case management and supportive housing is also associated with significantly lower mean number of ED visits (3.5 to 1.4, p=0.022). CONCLUSION: Among homeless individuals who are frequent users of hospitals, supportive housing and case management is associated with significantly lower rates of hospitalization and days in the hospital in the twelve months after enrollment compared to the twelve months before enrollment.

ELECTRONIC HEALTH RECORD IDENTIFICATION OF PRE-DIABETES AND AN ASSESSMENT OF UNMET COUNSELING NEEDS Laura Zimmermann 1; Jason Thompson 2; Stephen Persell3. 1 ; 2Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois ; 3Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Evanston, Illinois. (Tracking ID # 10937)

BACKGROUND: Over 57 million people in the United States have pre-diabetes, and 70% will progress to diabetes mellitus (DM) type 2. In

2002, two large clinical trials demonstrated that lifestyle modification consisting of diet, exercise, and sustained weight loss can reduce the incidence of DM in pre-diabetic, at-risk patients by approximately 60%. The Diabetes Prevention Program (DPP) went on to demonstrate a 34% reduction in DM incidence at ten years. However, recent National Health and Nutrition Survey (NHANES) data suggest that these practices have not been widely encouraged by physicians and that pre-diabetes often goes unrecognized.

Frequently, serum glucose measurements become part of the health record because serum glucose is included in popular laboratory bundles(i.e. basic metabolic panel, basic chemistry panel, etc.) that providers order to diagnose or evaluate conditions other than abnormal glucose metabolism. However, patients and providers are often not aware of these data and may not use these data to initiate preventive counseling for pre-diabetic patients. Electronic health record (EHR) -generated clinician reminders can keep appropriate preventive care from slipping through the cracks during a busy primary care visit, and have been shown to increase rates of preventive care.

We explored whether electronic health record (EHR) query based on glucose measurements can identify pre-diabetic patients eligible for lifestyle intervention, and we estimated rates of pre-diabetic lifestyle modification counseling.

METHODS: Subjects included men and women >18 years of age who attended at least three office visits in a large, urban, academic primary care practice in Chicago. Electronic search identified patients with plasma glucose levels of 100 to 199 mg/dl between June 1st, 2007, and June 1st, 2009, excluding those with diabetes or diabetic medications/ supplies documented as coded, searchable data in problem, diagnosis, or medication lists. This glucose range was chosen based on the most widely accepted definition of pre-diabetes: the presence of impaired fasting glucose (IFG) and/or the presence of impaired glucose tolerance (IGT). IFG is defined as fasting serum glucose levels of 100 to 125 mg/dl, and IGT is defined as serum glucose levels of 140 to 199 mg/dl two hours after an oral glucose load of 75 grams. From these 5,366 patients,100 randomly-selected subjects underwent classification into provisional categories based on all available EHR documentation on fasting state and concurrent fasting lipid panels: likely pre-diabetes, likely diabetes, abnormal glucose metabolism in the setting of acute illness, or possible normal glucose metabolism. In those likely to have pre-diabetes, investigators reviewed phone and office encounters 6 months before and after each glucose measurement to identify documented lifestyle modification counseling. We compared characteristics of subjects who did and did not receive lifestyle modification counseling using the two-tailed students t-test for normally-distributed continuous variables, Wilcoxon Rank Sum test for non-normally-distributed continuous variables, and the Fisher exact test for categorical variables.

RESULTS: The initial electronic query identified 5,366 non-diabetic patients who had attended the clinic over two years with glucose measurements in the range of 100199 mg/dl. Eighty-three percent had a glucose level of

100 to 125 mg/dl. Of the 100 randomly-selected patients (from the 5,366) for whom manual chart review was undertaken, 58% (95% CI 48 to 68%) of subjects met criteria for likely pre-diabetes. Fourteen percent were categorized as likely having diabetes, 21% had hyperglycemia in the setting of acute illness or corticosteroid use, and 7% had glucose measurements possibly reflecting normal post-prandial glucose levels. Four of 14 categorized as likely to have diabetes had no documentation of the diagnosis or a diabetes-related prescription recorded in the free text portion of the EHR, implying that these individuals had undiagnosed diabetes. Counseling was documented in 30.5% (95% CI 21 to 44%) of subjects likely to have pre-diabetes. Twenty-six lifestyle counseling events were

identified, comprising 24% of opportunities (95% CI 17 to 33%) in the 58 pre-diabetic individuals. We noted only one instance of documentation of a specific Diabetes Prevention Program recommendation, which appeared in a phone note and included the recommendation of weight loss of 7% of body mass. The difference in mean baseline BMI was clinically and statically significant when comparing those counseled to those not counseled (34.1 versus 29.9, p=0.037). Otherwise, there were no statistically- or clinically-significant differences between the two groups in terms of demographics (age, sex), co-morbidities (hypertension, dyslipidemia, coronary heart disease, congestive heart failure, cerebrovascular accident, transient ischemic attack), or clinical characteristics (glucose, creatinine, blood pressure, lipid levels). CONCLUSION: EHR query using a glucose measurement criterion can identify pre-diabetic individuals and those who require further evaluation of glucose metabolism, including subjects with undiagnosed diabetes. Our findings support the need to address glucose measurements of 100 to 199 mg/dl on a systemic or organizational level, potentially with physician reminders. Future research should investigate EHR-based, population-level interventions to facilitate pre-diabetes recognition and intervention, leading to improved quality of care.

POORER CLOCK DRAW TEST SCORES ARE ASSOCIATED WITH GREATER FUNCTIONAL IMPAIRMENT IN PERIPHERAL ARTERIAL DISEASE: THE WALKING AND LEG CIRCULATION STUDY II Laura Zimmermann 1; Mary McDermott2. 1Institute for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, Illinois ;
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BACKGROUND: Men and women with lower extremity peripheral arterial disease (PAD) have greater functional impairment than those without PAD. Men and women with PAD have slower walking speed, poorer walking endurance, and lower physical activity levels compared to those without PAD. Impaired walking performance in PAD is not fully explained by the degree of lower extremity arterial obstruction. Thus, mechanisms for functional impairment in PAD are not fully understood.

Cognitive impairment is a major risk factor for decreased functional performance in the aging population and is more prevalent in those with PAD compared to those without cardiovascular disease. Individuals with PAD perform worse on multiple cognitive function tests compared to ageand education-matched controls without PAD. However, to our knowledge, no published studies have established an association between subtle cognitive disturbance and functional performance in individuals with PAD. This cross-sectional study determined whether cognitive impairment, assessed by the clock draw test (CDT) is associated with poorer functional performance among older, dementia-free individuals with PAD, independent of severity of arterial obstruction and potential confounders. METHODS: Participants were men and women age 60 and older with Mini Mental Status Examination scores 24 with PAD (n=339) and without PAD (n=234). Subjects were recruited from two urban vascular testing laboratories and a primary care clinic. Functional performance measurements included the 6-minute walk test, 4-meter walking velocity at usual and fastest pace, the Short Physical Performance Battery (SPPB), and accelerometer-measured physical activity at home. CDTs were scored using the Shulman method, which assigns points based on components of the clock and ranges from a score of 0 to 5, 5 being the

best score. Results adjust for age, sex, race, education, ABI, comorbidities, and other confounders. Clinical characteristics and associations between CDT scores and clinical characteristics were compared between PAD and non-PAD subjects using general linear models for continuous variables and chi-square tests for categorical variables. Analysis of covariance was used to analyze the relationship between CDT and functional performance measures after adjustment for demographics, comorbidities.
RESULTS: Clock draw test (CDT) scores were categorized using as follows: Category 1: CDT score 02, Category 2: CDT score 3, Category 3: CDT score 45. In unadjusted analyses of PAD participants, lower CDT scores were associated with slower usual- and fast-paced walking velocity, lower SPPB score, and lower levels of physical activity in those with PAD (p-trend=0.005, 0.003, 0.011, 0.005, respectively). After adjustment for age, sex, race, education level, ABI, cardiovascular disease, cancer, and pulmonary disease, lower CDT scores were associated with slower usual-paced walking velocity (Category 1: 0.78 meters/second; Category 2: 0.83 meters/second; Category 3: 0.86 meters/second; p-trend=0.024) and lower physical activity (Category 1: 420 activity units; Category 2: 677 activity units; Category 3: 701 activity units; p-trend=0.045) among PAD subjects.

In unadjusted analyses of participants without PAD, lower CDT scores were associated with slower normal and fast-paced walking velocity (p-trend=<0.001, <0.001) and a poorer SPPB score (p-trend=0.001). After adjustment for age, sex, race, education level, ABI, cardiovascular disease, cancer, and pulmonary disease among participants without PAD, lower CDT scores continued to be associated with slower usual-paced walking velocity (Category 1: 0.79 meters/second; Category 2: 0.95 meters/second; Category 3: 0.98 meters/second; p-trend=0.025), slower fast- paced walking velocity (Category 1: 1.17 meters/second; Category 2: 1.28 meters/second; Category 3: 1.33 meters/second; p-trend=0.044), and poorer SPPB scores (Category 1: 8.06 meters/second; Category 2: 10.29 meters/second; Category 3: 10.49 meters/second; p-trend=0.036).
CONCLUSION: Cognitive impairment is associated with poorer functional performance, independent of ABI, in older, non-demented individuals with PAD. Further prospective study is needed to determine the mechanisms of the association between CDT scores and functional performance in PAD participants and whether those mechanisms are unique to PAD participants compared to the general population. Longitudinal data are necessary to determine whether baseline CDT score or decline in CDT score predict decline in functional performance, institutionalization, or mortality in individuals with PAD
UNDERESTIMATION OF CALORIES PURCHASED AT FAST-FOOD RESTAURANTS-WHO AND HOW MUCH? Jason P Block 1; Suzanne Condon 2; Ken Kleinman 1; Sheryl Rifas-Shiman 1; Matthew W Gillman1. 1Harvard Medical School/Harvard Pilgrim Health Care, Boston, Massachusetts ; 2Massachusetts Department of Public Health, Boston, Massachusetts. (Tracking ID # 10939)
BACKGROUND: Obesity results from overconsumption of energy in relation to energy expenditure. Adults may over-consume because they are unaware of the calorie content of foods they buy. When presented with restaurant menus in experimental settings, adults underestimate the calorie content of meals they would choose, but no real-world evaluations exist of how well adults estimate the calories of the food they purchase. The purpose of this study was to quantify the difference between actual and reported calorie content of food purchased for dinner at fast-food restaurants in New England and to assess the correlates of underestimation.
METHODS: We interviewed adults 18+ years of age at fast-food restaurants during the baseline phase of a study to evaluate a coming federal regulation that will require chain restaurants across the US to post calories on their menus. We randomly selected 3 McDonalds, 3 Burger Kings, 2 Subways, 1 Wendys, and 1 KFC in each of Boston and Springfield, MA, Providence, RI, and Hartford, CT, for a total of 40

restaurants. We visited each restaurant three times from April to August 2010 between 5:15 to 7:30 pm, for 120

total restaurant visits. We attempted to approach all adults sequentially as they exited the restaurant. In exchange for a $2 incentive, we conducted a brief interviewer-administered survey to collect demographics, height and weight, food choices, and whether the participant saw and used nutritional information available in the restaurant. As part of the survey, we also asked each participant to estimate the calorie content of his or her dinner. To calculate the actual calorie content of food purchased, we used the participants receipt and nutritional information from restaurant websites. Using multivariable logistic regression accounting for clustering of respondents by chain, we examined correlates of large-scale underestimation (reported minus actual calories 500).
RESULTS: We interviewed 915 participants (7.6 respondents per restaurant), representing 36% of adults we approached. 59% of respondents were male, 38% were White, 33% were Black, and 20% Hispanic; 42% were 1829 years old, 31% were 3049 years, and 27% were 50 years old. 556 subjects (65%) were overweight or obese. The mean actual calorie content of meals was 836 calories (SD 425), and the mean underestimation was 135 calories (SD 753; IQ range 530 underestimate to 100 overestimate). 33% purchased 1000 calories, and 27% underestimated by 500 calories. The most important factors in food choice were taste (79% said taste mattered a lot), convenience (54%), price (32%), and calorie content (26%). 210 (23%) of participants reported seeing nutritional information in the restaurant, but only 38 (19%) of them used that information to inform their food choices. In multivariable models adjusted for age, race/ethnicity, BMI category, and sex, subjects purchasing 1000 calories were much more likely to underestimate calorie content by 500 calories (OR 10.43 [95% CI 7.13-15.24]). Noticing calorie information in the restaurant (OR 1.19 [95% CI0.74-1.92]) was not associated with underestimation. The importance of taste, convenience, price, and calorie content also were unrelated. Compared with Whites, Asians (OR 3.35 [95% CI 1.26-8.90]), Blacks (OR2.54 [95% CI 1.59-4.06]), and Hispanics (OR 3.60 [95% CI 2.08-6.24]) were more likely to underestimate. 18-29-year-olds v. 50-year-olds (OR 0.57 [95% CI 0.34-0.94]) were less likely to underestimate, and BMI and sex were unrelated. Correlates of purchasing a 1000-calorie meal were underestimation of calorie content by 500 calories and age 18 to 29 years old v. 50 years old. The importance of calorie content (mattered a lot v. not at all) predicted a lower odds of ordering a 1000-calorie meal. CONCLUSION: One-third of adults visiting fast-food restaurants in New England purchased 1000 calories for dinner, and 27% underestimated the meals calorie content by 500 calories. Purchasing 1000 calories strongly predicted underestimating calorie content of meals by 500 calories. Minorities were more likely to underestimate calorie content, and 18-to-30-year olds were less likely. Collection of similar data after the federal menu labeling regulation goes into effect will help determine the impact of the regulation on these patterns of knowledge and consumption. The strong association of large-calorie meal purchases and underestimation of calorie content holds promise that menu labeling could make calories more salient.
MAPPING NEGLECTED TERRAIN: HOW FRONT-LINE NURSING HOME STAFF ASSESS AND COMMUNICATE ABOUT CHANGE IN CONDITION Karen Glasser Scandrett 1; Mary Ann Anichini 2; Celia Berdes 3; Kenneth Boockvar 4; Debra Saliba 5; Linda Emanuel 3; Stephanie Taylor5. 1Northwestern University, Chicago, Illinois ; 2Presbyterian Homes, Lake Forest, Illinois ; Buehler Center on Aging, Chicago, Illinois ; 4The Mount Sinai Medical Center, New York City, New York ; 5RAND Corporation, Santa Monica, California . (Tracking ID # 10940)
BACKGROUND: Nursing home residents are dependent on nursing aides (NAs) for basic daily care, socialization and other quality of life activities, and the early detection of clinical changes. Contact with registered nurses is limited, and physician visits may be infrequent. Although NAs may detect important changes in a resident up to five days before they become clinically significant, and despite the availability of tools to help staff report and document changes, residents regularly experience unplanned discharges for potentially preventable clinical problems. Methods from safety sciences may help to implement better communication and management practices among nursing home staff, but these methods are not utilized by many nursing homes, and gaps in staff education and training exist. As part of a larger curriculum development

project to train nursing home staff members in patient safety, we conducted focus groups to understand how staff detect clinical changes and communicate about it with other providers. We used a patient safety framework to identify the organizational structures and processes needed for effective clinical care and team communication.
METHODS: Four focus groups were conducted by a trained facilitator at a single, non-profit suburban facility; two groups were comprised of NAs and two of licensed staff members, with day and evening shifts divided. An interview guide addressed four training-responsive conceptual areas derived from prior literature review and expert panel consensus: 1) How staff learn about their residents typical health patterns; 2) How staff watch for clinical changes (who watches and what is noted); 3) What clinical changes are perceived to be significant and must be reported; and 4) How staff communicate about changes in their resident. Within each training concept, questions were also asked to ascertain barriers to or facilitators of performing each task. Transcribed interviews were analyzed for themes in an iterative process by multidisciplinary team members.
RESULTS: A total of 12 staff participated in the four groups. They reported using multiple sources of information to develop their understanding of residents baseline function, and to detect subtle clinical changes. They regarded all clinical changes as potentially significant, and described multiple methods for communication about them with various team members. Communication between CNA and nurse was reported to be not consistent or reliable. Physician response resulting from communication between nurse and physician depended on physician familiarity with the resident and was not perceived as effective in achieving desired results.
CONCLUSION: Front-line nursing home workers self-report skill in detecting subtle clinical change in their residents, but are less confident in assessing the significance of those changes. Staff members developed some creative approaches to communicate within their discipline, but interdisciplinary communication is not a systematized routine and the desired clinical outcome is not always achieved. Skills and tools for structured clinical assessment, effective interdisciplinary communication, and exposure to systematic approaches to implement improvements are important topics for further training. Patient safety science offers an important framework to shape efforts for quality improvement in nursing facilities.
A RESIDENT-RUNCOMMUNITYHEALTHFAIR:POSSIBLEIMPLICATIONS FOR IMPROVED HEALTHCARE COMMUNICATION Douglas P. Olson 1;
Barry G. Fields 1; Stephen J. Huot 1; Donna M. Windish1. 1Yale Primary Care Residency Program, New Haven, Connecticut. (Tracking ID # 10942)
BACKGROUND: Health fairs are a common public health promotion activity, and one way internal medicine residency programs can increase

community involvement. While education and screening are major goals, the motivation and expectations of the attendees may inform a more rational health fair design, and also provide insight into patient-physician communication.
METHODS: All English and Spanish speaking participants at the Yale Primary Care fall 2010 health fair in Waterbury, CT were asked to participate anonymously in a survey to collect demographic data and basic information about their medical history. These data were matched with health screening results that included measurements of blood pressure, BMI, and glucose. The survey was approved by the Yale University IRB.
RESULTS: 228 attendees participated in the survey; 176 (75%) were female; the average age was 54 years [range 21 to 84]; 164 (72%) spoke English; 30% had less than a high school education, while 6% had a college education or greater; 73% had a primary care provider; and 80% had insurance, including state Medicaid. Based on BMI results, 26% were overweight, 30% were obese and 23% were morbidly obese. On fingerstick measurement, 30% had impaired fasting glucose, 22% had a glucose 126199 mg/dL, and 5% had glucose 200 mg/dL. 31% of blood pressure readings met a diagnosis for essential hypertension (140/90 mmHg). Overall, 41% had visited the emergency room (ER) for care at least once in the past year (range of ER visits was 1 to

18) and 28% (or 68% of those who visited the ER) had been admitted to the hospital in the prior year. Despite these numbers, 80% of participants rated their health as good or better, 18% as fair and 2% as poor.
CONCLUSION: The community served by this health fair was a largely English-speaking, middle-aged, overweight female population with a low level of formal education. The Spanish speaking population (30%) is slightly higher than the Latino population of Waterbury (24.1%). Despite 4 out of 5 attendees having insurance, and 73% having a primary care provider, 2 out of 5 had visited the ER for care in the past year, and many of them were admitted to the hospital. These data underscore the significant and complex medical problems faced by underserved populations and reflect the national trend of increased ER visits for care, even among those with access to primary care. Additionally, as many people had routine primary care providers, this survey demonstrates that most attendees came for additional health information and education and not for a diagnostic or therapeutic intervention, suggesting that doctor-patient communication for this population could be augmented which may lead to decreased ER visits as well. Further research into these areas is needed.
THE DISCLOSURE GAP: PATIENT AND PROVIDER PERSPECTIVE ON THE QUALITY OF ACTUAL DISCLOSURES Thomas H Gallagher 1;
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1University of Washington, Seattle, Washington ; 2COPIC, Denver, Colorado ; 3University of Melbourne, Melbourne, N/A ; 4University of Colorado Health Science Center, Denver, Colorado . (Tracking ID # 10943)
BACKGROUND: Disclosing unanticipated outcomes to patients is an expectation of accreditation standards and national quality organizations. Preliminary studies suggest that a sizable gap exists between these expectations and current practice. Yet few studies have measured the quality of actual disclosures.
METHODS: We developed and validated a brief survey to assess patients and physicians ratings of the quality of actual disclosures. The surveys were administered to patients and physicians who were participating in the 3Rs program of COPIC Insurance, a program to promote disclosure of certain unanticipated outcomes and to reimburse patients for out-of-pocket expenses and lost time. Patients and
physicians rated the overall quality of the disclosure. Patients were also asked whether specific disclosure elements recommended by consensus guidelines were present in the discussion, and how likely they were to return to this physician if they needed similar care in the future. The surveys were distributed to 908 patients and 936 physicians between 20072009 after management of the event in the 3Rs program had been concluded.
RESULTS: Surveys were returned by 817 physicians (87%) and 514 patients (57%). Physicians and patients did not agree on the severity of the event in question. 33% of patients considered the event to be extremely serious (I might have died), compared with 8% of physicians (P<.0001). When asked to rate the quality of the disclosure on a scale from 0 (extremely dissatisfied) to 10 (extremely satisfied), physicians were much more satisfied with the quality of the disclosure (mean 8.1) than were the patients (mean 6.2, P<.001). 41% of patients rated the quality of the disclosure as a 5 or less. Regarding patient assessment of specific disclosure elements, physicians scored highest on explaining the event in terms the patient could understand (68% agreed), providing a sincere apology to the patient (65% agreed), and being truthful when explaining the event (64%). In contrast, only 37% of patients agreed that the physician assured them that steps would be taken to prevent similar events from happening again. Ten items from the patient survey were combined into a Patient Satisfaction Scale (Chronbach alpha=.96). Lower Patient Satisfaction scores were associated with higher patient perception of the severity of the event (Spearman correlation=.15, P=.002) and with a lower likelihood of returning to that physician for future care (Spearman correlation=.78, P<.001).
CONCLUSION: Measuring patient and physician ratings of actual disclosures is feasible, and reveals substantial shortcomings. Routinely measuring disclosure quality could help organizations target efforts to improve these challenging conversations.
PUBLIC REPORTING FOR PERCUTANEOUS CORONARY INTERVENTIONS IN NEW YORK STATE Lena

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BACKGROUND: Prior studies of public reporting on risk-adjusted mortality for coronary artery bypass grafting (CABG) have found that public reports have strong predictive validity and likely encourage poor quality surgeons to leave practice. However, except for CABG surgery, there are few data on the predictive accuracy of public reports or their impact on providers practice. We used data from New York State on percutaneous coronary interventions (PCIs) to address three questions:1) what is the predictive accuracy of public reports for PCIs, 2) what is their impact on market share, and 3) is report performance associated with decisions to leave practice?
METHODS: We examined quality performance by hospitals (and cardiologists), as measured by publicly reported risk-adjusted mortality rates (RAMRs) for non-emergent PCIs performed in New York State between 1998 and 2007. For hospitals (and cardiologists) in each performance quartile, we estimated: 1) the average risk-adjusted mortality rate after report publication, 2) the change in market share from pre-release to post-release year, and 3) the proportion of physicians leaving practice in the post-release year.

RESULTS: Between 1998 and 2007, the New York State public reports included data on 351 cardiologists who performed non-emergent PCIs at 49 hospitals. We found that report cards had poor predictive ability for hospitals. For example, in 20022004, average hospital RAMRs increased monotonically from best to worst performance quartiles (RAMRS of 0.21, 0.27, 0.36, and 0.50, p-value <0.001). In the year after the report was published, hospitals in the worst performance quartile in 20022004 still had the highest RAMR of any quartile but the association was not significant and none of the trends were monotonic (RAMRs from best to worst quartile: 0.56, 0.57, 0.59, 0.77, p-value=0.30). We found that public reports for cardiologists were inconsistent in their ability to predict future performance. For example, between 2005 and 2007, patients who picked a cardiologists from the worst performance quartile (based on the 20012003 report), had a higher chance of dying than those who picked a cardiologist from one of the other three quartiles (RAMRs of 0.61, 0.56, 0.52, 0.83; p=0.005). However, performance was similar across the top three quartiles, and none of the other years we examined had statistically significant results. Performance ranking was not associated with a change in market share for hospitals or for physicians (all p>0.05). There was no association between report performance, and decisions to stop practicing in New York after report publication (4% in top and bottom quartiles; p>0.05).
CONCLUSION: We found that the New York State reporting system for PCIs has poor predictive accuracy for hospitals, and inconsistent predictive accuracy for cardiologists. We found no evidence that consumers or payers are using the public reports to drive market share, or that cardiologists who perform poorly are more likely to leave practice after report release. The utility of public reporting may differ substantially for different procedures.
PUBLIC OPINIONS ABOUT PAYING PEOPLE TO TAKE THEIR MEDICINES James D. Park 1; Jessica Metlay 2; Jeremy M Asch 3; David A Asch1. 1University of Pennsylvania, Philadelphia, Pennsylvania ; 2Vassar College, Poughkeepsie, New York ; 3Brandeis University, Waltham, Massachusetts. (Tracking ID # 10951)
BACKGROUND: There is considerable interest in using financial incentives to improve peoples health. In fact, financial incentives are of increasing national interest, as legislative elements are embedded in the Affordable Care Act. However, paying people to improve their health touches upon strongly held views about personal

responsibility. As various stakeholders consider financial incentives for improving health, public opinions regarding social and ethical issues related to their use have yet to be defined. This study aims to evaluate public opinions about the use of financial incentives to improve health.
METHODS: The New York Times article, For Forgetful, Cash Helps the Medicine Go Down by Pam Belluck, highlighted a study using financial incentives to improve Warfarin adherence. The article, published on June 13, 2010, resulted in 217 reader comments posted by June 14th. A second article, Should People Be Paid to Stay Healthy, was published on June 14, 2010 and contained five commentaries from experts in bioethics and health policy. This article elicited 177 reader comments from June 15 to June 28, 2010. The content of readers comments was systematically analyzed. Three reviewers read comments from both articles to identify common themes. Comments were randomly divided into a training set and an evaluation set. Two reviewers worked together to assign themes to each of the comments in the training set. Comments could be assigned multiple themes or none at all. Through that process, the
original set of themes was modified to a more consistent set to which all reviewers agreed. Two reviewers worked independently to code the comments in the evaluation set. To test for inter-rater reliability, kappa scores were calculated for each theme. Differences in coding were adjudicated between the two reviewers (using the third reviewer for disagreements) and the coding of all comments was combined into a single set for analysis.
RESULTS: Participant information was unavailable. General data about the online readership was obtained: 48.9% are women; 62.8% are between the ages of 2554; 48.6% earn an income of $75,000 or more;84.3% have some college education.
Average number of themes assigned to a comment was 1.5 and ranged between 06. Kappa scores ranged between 0.45-0.75 with a mean of0.64, indicating generally good agreement.
Themes, percent of comments representing the theme, &select exemplarsAlternative IncentivesGood health should be the ultimate incentive (10%)
Penalties should be used as an incentive (20%)
Ethical &Social IssuesFinancial incentives reward people for irresponsibility (21%) Were going to reward people for being lazy and stupid.
Financial incentives indirectly penalize people with good health habits (10%) Responsible members of our society must constantly pay the price for the stupidity of others.
Financial incentives will ruin people and society (6%) With each act that we as a society take to mitigate personal responsibility, we create ever more inept and dysfunctional fellow citizens.
People will game the system to win the financial incentive (3%) Financial incentives are paternalistic (4%)
Negative Public PerceptionsPeople make moralistic judgments or negative assumptions about individuals who use financial incentives.(11%)
People think the government is involved in financial incentives.(11%) People distrust the health profession and the services they provide. (12%)
The idea of paying people to take medications is absurd, outrageous, etc. (25%)
Positive Public PerceptionPeople support the use of financial incentives (13%) Less expensive to pay them to take the meds than to watch them fall apart. CONCLUSION: The comments revealed largely negative perceptions of financial incentives that may limit the public acceptability and uptake of this approach. In addition, the comments conveyed an appeal for greater personal responsibility for individual health. Despite the negative perceptions, there was measurable but minority support for the use of financial incentives, particularly from individuals who recognized good health practices may avert higher healthcare costs for chronic conditions later in life.
PRE-CLINICAL MEDICAL STUDENTS KNOWLEDGE AND ATTITUDES IN CARING FOR LESBIAN, GAY, BISEXUAL AND TRANSGENDER PATIENTS Nicole Rosendale 1; Benjamin Cox 2; Allison Avery 1; ColleenC. Gillespie 3; Adina Kalet 4; Richard Greene1. 1NYU School of Medicine, New York, New York ; 2New York

University School of Medicine, Brooklyn, New York ; 3NYU School of Medicine, Brooklyn, New York ; 4NYU School of Medicine, NY, New York . (Tracking ID # 10952)

BACKGROUND: While Americans have grown much more accepting of lesbian, gay, bisexual and transgender people, little research has investigated pre-clinical medical students knowledge and attitudes in

caring for lesbian, gay, bisexual and transgender (LGBT) patients. This study provides results of a survey of such knowledge and attitudes in 1st and 2nd year medical students. The survey will ultimately serve as a pre-test for evaluating the impact of an LGBT health curriculum. A similar study conducted in the same medical school in 2006 also allows for identification of secular trends.

METHODS: In December 2010, first and second year medical students at NYU School of Medicine were sent an email requesting their participation in a 39-question survey designed to assess their knowledge, attitudes and confidence in caring for LGBT patients. Knowledge was assessed via 20 multiple choice and true/false questions focusing on five major content areas: epidemiology of health issues in LGBT populations, anatomical and physiological aspects of transgender individuals, equity/access to health care, medical practice with LGBT patients (e.g., how to ask about sexual behavior; prevalence with which gay men disclose sexual orientation to their physicians), and sociocultural issues. Attitudes were assessed on a 5-point agreement scale and are grouped into four (conceptual and empirically supported via factor analysis) categories: attitudes toward LGBT patients, attitudes about comfort/confidence in treating LGBT patients, attitudes about the need to know about sexual orientation and behavior to effectively treat, and views of whether most primary care physicians can effectively treat LGBT patients. Students were also asked about their connections with and experience in treating LGBT individuals. Repeated measures ANOVAs with Bonferroni-corrected multiple comparisons were used to compare content areas within the overall knowledge scores and attitude items.

RESULTS: A total of 155 of 330 students responded (47% response rate). Students, on average, got 59% of items correct on the 20-question knowledge assessment (SD=13%). Students who identified as LGBT or had clinical experience with LGBT patients had significantly higher knowledge scores. Knowledge was lowest in the medical practice (mean 34% correct, SD 38%) and epidemiology (37% correct, SD 16%) and highest in the transgender (84% correct, SD 19%) and sociocultural (74% correct, SD 32%) areas. Students generally held positive attitudes toward LGBT patients (mean endorsement of positive statements about LGBT patients=4.3, SD .6) but were slightly less comfortable/confident in treating LGBT patients (mean=3.6, SD .9) and reported slightly less positive attitudes toward needing to know (mean=3.7, SD .6). Most students did not strongly endorse that most primary care physicians can effectively treat LGBT patients (mean=2.3, SD .8). Knowledge and attitudes were fairly similar to those found for 3 rd and 4th year medical students in 2006.

CONCLUSION: Knowledge of LGBT health concerns, as measured in our survey, suggests the need for more education for preclinical students, particularly since identification with the LGBT community and clinical exposure to LGBT patients is associated with higher scores and more positive attitudes. Students in our sample need to learn more about clinical practice with and the epidemiology of health issues with LGBT patients and some students report discomfort and lack of confidence in conducting physical exams on and discussing sexual behavior with LGBT patients.

CONFINED TO IGNORANCE: THE ABSENCE OF PRISONERS FROM NATIONAL HEALTH DATA Brie Williams 1; Cyrus Ahalt 1; Ingrid A Binswanger 2; Michael Steinman1. 1University of California, San Francisco and SFVAMC, San Francisco, California; 2University of Colorado, Denver, Aurora, Colorado. (Tracking ID # 10954)

BACKGROUND: As of 2008, 1 in 31 Americans was incarcerated, on parole or probation, and 1 in 15 was expected to spend time in prison

during his or her lifetime. Although studies show that persons currently or previously incarcerated are in worse health and generate higher health care costs than the general public, such studies are small, infrequently

conducted, and incorporate limited measures of health (e.g. self-report of selected medical conditions within larger criminal justice questionnaires). Our goal was to analyze leading publically available national health datasets for questions that could be used to assess the health of persons with a current or prior history of incarceration.
METHODS: We analyzed all 48 datasets from the Society of General Internal Medicine (SGIM) Dataset Compendium, a resource providing links to major national datasets for generalist researchers. Five were not publically available, 7 did not include patient-level health data, and 4 were not relevant to US prisoners and were excluded, resulting in 32 datasets. For each dataset, we examined all publicly available documentation (questionnaires, codebooks, and results summaries) for the terms: Jail, Prison, Incarceration, Crime, Criminal, Convict, Victim, Police, Correctional, Corrections. We then determined each datasets stated focus (health care costs, health disparities, older adults, youth, health risk factors) and sample construction (longitudinal, cross-sectional). In a secondary analysis, we contacted all 12 longitudinal study investigators to determine whether subjects who became incarcerated during the study were dropped and/or reenrolled after release; 3 studies did not respond to 2 emails and 1 phone call and were therefore not considered for subsequent analyses.
RESULTS: Of the 32 datasets, 20 were cross-sectional and 12 were longitudinal. Datasets focused on health disparities (9), health care costs (7), older adults (6), youth (5), and/or health risk factors (11). None was designed to investigate the health of persons with a current or past history of incarceration. Subjects incarcerated at the studys outset were excluded in 25 datasets (78%); the remaining 7 may have included prisoners but did not code them as such (e.g. studies of all hospitalized patients in the US). Eight studies (25%; 4 cross-sectional, 4 longitudinal) included a question with one of our keywords. Of these, 4 (1 cross-sectional (USRDS) and 3 longitudinal (MIDUS, ADDHEALTH, CARDIA)) included a question that could be used to define a group with a history of incarceration. The others did not differentiate incarceration from other criminal justice problems (e.g. Question: Do you have legal problems, such as imprisonment, prosecution, lawsuits, or litigation?). The 4 datasets with a question about incarceration history were focused on health risk factors (3 - CARDIA, ADDHEALTH and USRDS), health disparities (3 - CARDIA, ADDHEALTH and MIDUS), and youth (1- ADDHEALTH). Notably, only 3 of 9 studies focused on health disparities and none of the studies focused on health care costs assessed incarceration. Our secondary analysis of longitudinal studies showed that only 2 of 9 both followed subjects through incarceration and generated a new code to indicate that they had been incarcerated (ADDHEALTH and CARDIA). The remaining studies either dropped those who became incarcerated (44%) or followed them but did not indicate they had been incarcerated (33%).
CONCLUSION: Large health-related datasets can provide accurate, unbiased, and relevant data to researchers, public health experts, clinicians and policy-makers. Of the 32 national health datasets reviewed, 1 cross-sectional and 3 longitudinal datasets could be used to investigate the health of persons who have been incarcerated. The association between incarceration and poorer health has been documented for the large and growing criminal justice population which is overrepresented by racial and ethnic minorities. A lack of relevant data, however, precludes more rigorous assessment of incarcerations impact on health disparities, risks for specific health outcomes, and health care

costs. In 2007, the Institute of Medicine issued new ethical guidelines for prisoner health research recognizing that access to research may be critical to improve the health of prisoners. Our findings suggest that a good place to start would be through the broader inclusion of incarceration-related questions in national health datasets.
INVITING PATIENTS TO READ THE DOCTORS NOTES: HOPES, FEARS, AND DISSONANCE Jan Walker 1; Suzanne G. Leveille 2; Long Ngo 1; Elisabeth Vodicka 3; Jonathan D. Darer 4; Joann G. Elmore 5; Henry J.

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5Department of Medicine, University of Washington School of Medicine, Harborview Medical Center, Seattle, Washington ; 6Group Health Cooperative, Center for Health Studies, Mercer Island, Washington ; 7Division of General Internal Medicine, University of Colorado Denver, Aurora, Colorado. (Tracking ID # 10955)
BACKGROUND: As the public demands better care and greater transparency, providers increasingly offer patients online access to laboratory results and other parts of their electronic medical records through secure Internet portals. However, few clinicians routinely share encounter notes with their patients. OpenNotes, a yearlong research and demonstration project involving primary care physicians (PCPs) and their patients in Boston (BOS), Pennsylvania (PA), and Seattle (SEA), is inviting patients to review their doctors notes online. We hypothesized that patients would be generally positive in their attitudes toward open notes, although there might be differences based on demographic and health factors, and that PCPs would be generally less positive. Prior to providing access to notes, we surveyed eligible patients and doctors about their attitudes and expectations. METHODS: We conducted online surveys of patients and PCPs from the 3 participating primary care settings: an urban academic health center and associated community practices (BOS), a primarily rural integrated health system (PA), and a county hospital serving mainly indigent patients (SEA). Eligible patients and PCPs in BOS and PA had active
portal accounts; patients and PCPs in SEA used a portal made accessible for the OpenNotes project. Drawing on insights from focus groups and individual interviews, we developed surveys designed to solicit patients perceptions about potential benefits and risks related to reading their PCPs visit notes and included a set of parallel items in surveys of their PCPs. Survey invitations were sent to PCPs by email and to their patients through secure patient Internet portals. We calculated proportions of patients and PCPs agreeing or disagreeing with a series of benefit and risk statements. In addition, we evaluated patients perceptions of benefits and risks according to demographic and health characteristics.
RESULTS: 38,325 patients and 174 PCPs completed surveys. Patient response rates were 40% in BOS, 43% in PA, and 100% in SEA where all patients joining OpenNotes (n=273) completed surveys at enrollment. PCP response rates were 83% in BOS, 52% in PA, and 75% in SEA. Among patients, mean age was 52 years (SD 14, range 18103), with 63% female, 95% white, and 64% employed. 27% reported education up to high school (HS); 29% had some college; 17% graduated college; and 26% had post-college education. 16% reported fair/poor health.93% of patients wanted to look at their notes, and 94% thought open notes a good idea, compared to 55% of PCPs. Patients and doctors also differed on risks and benefits (see Table 1). Demographic and health characteristics accounted for few differences among patient perceptions of benefits and risks. However, 94% of those with HS education or less felt they would take better care of themselves, compared to 84% of those with the most education. Similarly, 84% of those with HS education or less felt that open notes would help them remember to take medications, compared to 64% of those with advanced education. Those rating their health fair/poor felt they were more likely than those with better health to take medications as prescribed (83% vs. 73%). We found no substantial differences in perceptions of risks according to patients characteristics. CONCLUSION: Overall, patients were remarkably positive about the prospect of reviewing their visit notes online and anticipated many benefits and few risks in doing so. The majority of PCPs were also positive about potential benefits, but they were strikingly more worried about risks. The implications of such open interchange are complex, and we look forward to the end of our year-long intervention when both patients and PCPs will report on their experiences with OpenNotes.

GENDER DISPARITIES IN LIPID-LOWERING THERAPY AMONG VETERANS WITH DIABETES Varsha G.

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BACKGROUND: Women with diabetes are more likely than men to have a low-density lipoprotein cholesterol (LDL) above recommended levels. This is an important quality issue because 1) hyperlipidemia is a risk factor for cardiovascular disease, 2) hyperlipidemia may have a higher impact on cardiovascular outcomes in women compared to men with diabetes, and 3) treatment of hyperlipidemia with statins in diabetes is associated with a more than a 20% reduction in cardiovascular disease risk. The reasons for worse lipid control among women with diabetes are unclear, but may be due in part to differences in treatment patterns. We undertook this study to assess differences in lipid-lowering therapy between female and male veterans with diabetes and elevated LDL. METHODS: We conducted a cross-sectional study of veterans serviced by the Veterans Health Administration (VA) in 2006 who had both diabetes and hyperlipidemia and compared all females (N=22,475) to age- and facility-matched males (N=89,431). We compared proportions of patients with any VA prescription for lipid-lowering therapy in the year and, among those with elevated LDL (>100 mg/dl) and no prior treatment, we compared initiation of lipid-lowering therapy. Likelihood of treatment was estimated using multiple logistic regression with adjustment for race, VA eligibility, health care utilization, cardiovascular diseases, mental health conditions, and a comprehensive list of other co-morbidities. We also performed the analysis stratified by age. RESULTS: Women had higher LDL levels than men (11038 vs. 101 36 mg/dL) and fewer of them were receiving lipid-lowering therapy (80% vs. 84%). Women were less likely to receive therapy (adjusted odds ratio [95% confidence interval]: 0.79 [0.76-0.82]) or to be initiated on such therapy (37% vs. 42%, 0.84 [0.770.90]). Differences were greatest in the youngest women (<45 years old) for both any lipid-lowering therapy (61% vs. 75%, 0.53 [0.480.59]) and initiation of therapy (27% vs. 39%,0.56 [0.470.67]). Adjustment for potential confounders did not change the risk estimates.
CONCLUSION: Women veterans with diabetes and hyperlipidemia receive less aggressive lipid-lowering therapy than men, especially in younger age groups. This disparity is of concern, because early intervention to control hyperlipidemia can reduce the later burden of cardiovascular disease among diabetic women.

TASTE IS EVERYTHING: A QUALITATIVE STUDY OF BEVERAGE CONSUMPTION IN COLLEGES Jason P Block 1; Matthew Gillman 1; Stephanie Linakis 1; Roberta Goldman2. 1Harvard Medical School/ Harvard Pilgrim Health Care, Boston, Massachusetts ; 2Brown University School of Medicine, Providence, Rhode Island. (Tracking ID # 10957)

BACKGROUND: Young adults consume more sugary beverages than any other age group, leading to increased risk for weight gain. Limited data are available to explain the reasons for this high sugary beverage consumption or to provide insights into how behavioral interventions might reduce consumption. We conducted a qualitative study to examine these factors among college students.
METHODS: We conducted a total of 12 focus groups of freshman and sophomore students in 6 colleges located in Massachusetts and Louisiana, including 2 historically black colleges. Prior to each focus group, participants completed a brief survey about demographics and
factors that determine beverage choice. We asked a core set of questions at each group addressing students behaviors around the consumption of beverages, and their opinions about proposed interventions in colleges to reduce sugary beverage intake. Discussions were audio-recorded and professionally transcribed. We conducted a content analysis of the focus group transcripts using the principles of the immersion-crystallization method. This qualitative approach consists of the analysis team individually reviewing the transcripts and engaging in a series of group analysis discussions to identify dominant themes and preliminary interpretation of the data. Next, we used a group consensus procedure to create a code book and code definitions, and we subjected the transcripts to line-by-line coding. Analysis of resulting code reports facilitated further comparison

of data from each of the 12 transcripts and final interpretation of the findings.
RESULTS: 90 students participated in the 12 focus groups (mean 7.5 participants per group). Mean age was 19 years old; 63% were female; 55% were freshman; 50% were White; 47% were Black. In pre-focus group surveys, nearly all (93%) participants reported that taste was an important factor in determining beverage choice followed by price (58%) and calorie content (30%). In the focus group discussions, taste remained the most important reason for choosing a beverage. Students were often quite fixated on favorite sugary beverages: I want to drink my favorite drinks until the day that youre going to die and If theyre healthy or not Im going to drink it if Im thirsty. They considered changing from a favorite drink difficult: It takes . . . one of those [near] death experiences but something like really drastic to change. Price was important, and students sought value: You get a lot for that dollar and Only label I look at is the price label. Health and calorie content had limited contribution to beverage choices: When its not like an immediate negative effect . . . no matter how unhealthy . . . you tell people something is, I dont really think anyone is going to like take it to heart. Some students reported calorie content of food as an important determinant of their diet but rarely considered drinks as substantial contributors to overall calorie intake: Some people think about it when theyre doing their food, but drinks . . . [are] overlooked. The strongest themes emerging about the negative impact of sugary beverage consumption were the perceived dangers of the mysterious chemical content of dark sodas. Although Black and White students were mostly similar in their perspectives and behaviors, in the pre-focus group survey 60% of White v. 0% of Black students reported giving some consideration to the calorie content of beverages when choosing what to drink.
CONCLUSION: Among a diverse group of college students in two states, taste and price were the most important factors in choosing beverages with little thought given to health impact. The disconnect between consideration of calorie content of food v. beverages raises the possibility that educational interventions that present the caloric content of beverages in food currency may be beneficial.
IMPROVINGFOLLOW-UP OFABNORMALTEST RESULTS: EVALUATING THE IMPACT OF A MANDATORY NOTIFICATION Archana Laxmisan 1;
Dean Forrest Sittig 2; Donna Espadas 3; Kenneth Pietz 3; Hardeep Singh1. 1Baylor College of Medicine; Houston VA HSR&D Center of Excellence, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas ; 2University of Texas Health Science Center, Houston, Texas ; 3Houston VA HSR&D Center of Excellence, Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas. (Tracking ID # 10958)
BACKGROUND: Concerns about timely follow-up of abnormal imaging and lab test results remain despite electronic notifications to providers. In the Veterans Health Administration (VA), there is a wide variability in

what notifications are delivered to the clinician due to individual preference and system-level mandates. On March 11, 2009, a change in the VA electronic health record (EHR) was implemented to require all pathology results (normal or abnormal) to be transmitted to ordering providers via EHR-based automated notifications that cannot be switched off by providers (mandatory alerts). We examined the impact of this intervention on follow-up of abnormal pathology results in the outpatient setting.
METHODS: We conducted retrospective chart reviews to evaluate preand post-intervention follow-up outcomes at two large VA facilities. We electronically extracted all pathology reports in a six-month time-frame before and after the date of intervention. From 16,738 pre-intervention and 17,305 post-intervention reports at two sites, we randomly selected 688 and 706 abnormal outpatient reports, respectively. Trained reviewers collected outcome data using a standardized pre-tested data collection instrument, on all possible acceptable follow-up actions for up to six months post alert transmission. Follow-up actions were defined as documentation of either 1) ordering or performance of an appropriate follow-up test or referral, 2) prescribing or changing treatment based on result,

3) patient notification of test result, 4) subsequent hospitalization where the result was addressed, or 5) other documentation of appropriate provider-recognition such as noting patient preference to decline or to seek follow-up elsewhere. Reviewers also categorized follow-up actions as direct or indirect, depending on whether they could clearly link the action directly to the report. For example, a direct action would be a letter communicating results to a patient, while an already scheduled consultation before the result was available would be an indirect action. Outcome measures included proportion of abnormal reports with lack of any follow-up within 6 months and median time to direct follow-up action pre-and post-intervention.
RESULTS: Post intervention, the proportion of reports without follow-up decreased significantly (9.8% vs.3.5% p<0.01). However, median time to direct follow-up action was unchanged pre and post intervention (8 days IQR 515 days vs. 8 days IQR 5-14 days; P=0.6)
CONCLUSION: Notification of abnormal pathology results is likely more effective at improving follow-up when made mandatory than when providers are allowed to customize receiving these results on their own. However, mandatory notification did not lead to fail-safe follow-up at six-months or prompt earlier follow-up actions by ordering providers. Thus, interventions other than making test result alerts mandatory in EHR are needed to ensure direct follow-up actions on patients abnormal pathology results in the outpatient setting. These interventions should be designed to address the several socio-technical factors that contribute to patient safety in a complex environment.
USING THE INDEX OF RELATIVE RURALITY (IRR) TO ESTIMATE DEGREE OF RURALITY AT THE SMALL-AREA LEVEL IN HEALTH SERVICES RESEARCH Sanae Inagami 1; Shasha Gao 2; Martine Shendge 2; Janice Probst 3; Hassan Karimi 4; Roslyn Stone 5; Mary Ann Sevick 6; Michael Fine2. 1 ; 2VA Pittsburgh Healthcare System, Pittsburgh, Pennsylvania ; 3University of South Carolina, Charleston, South Carolina ; 4University of Pittsburgh, Pittsburgh, Pennsylvania ;
5University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 10961)
BACKGROUND: Accurate analysis of health problems facing rural residents, as well as the implementation of programs to address them, depends on how well rurality is measured. Currently, rural classification systems at the small-area level include those based on the Rural Urban Commuting Area (RUCA) system and a relatively new measure, the Index of Relative Rurality (IRR). The IRR has the potential to be used at
the small-area level but has been demonstrated in analyses only at the large-area (county) level. We describe the development and demonstrate the application of a ZIP code-level Index of Relative Rurality (IRR) classification system that can be used to delineate the degree of rurality at the small-area level. We compare how the choice of classification system affects how geographic areas and the populations who reside in these areas are defined as rural.
METHODS: Data from the 2000 US Census and from the United States Department of Agricultures Economic Research Service (ERS) were linked to Veteran clinical and demographic(including residential address) data extracted from the Veterans Administration Pittsburgh Health System administrative and clinical records, which consisted of 7,608 Veterans with diabetes living in Ohio, Southwest Pennsylvania and West Virginia having recorded a primary care visit in 2008.The ERS data provided the ZIP code RUCA rurality measure associated with each Veteran address. A ZIP code-level IRR classification system was developed using 4 Census-derived measures: residential area-level population, population density, degree of urbanization, and distance to Metropolitan Statistical Area (MSA) from Veteran address. An IRR score of 0 is assigned to the least rural (most urban) geographic area, and a score of 1 is assigned to the most rural. RESULTS: When using the 4-tier (Urban, Large Rural, Small Rural, Isolated Rural) RUCA classification system, fewer than 5% (137/7570) of Veterans with diabetes lived in rural areas. When using the IRR classification system, when rural was defined as 0.4, 21% (1597/ 7570) of Veterans with diabetes lived in rural areas. Nineteen percent (1434/7608) of Veterans with diabetes had addresses that could not be geocoded to a specific latitude and longitude because patient addresses were either post office boxes or rural routes. These addresses were more likely to be located

in rural areas compared to urban areas when using ZIP code information as a proxy for address. Using the 4-tier RUCA classification system, 12% (137/371) of addresses that could not be geocoded were categorized in rural areas compared to 8% (1297/7199) in Urban areas; when using the IRR classification system, 48% (710/1597) of those living in more rural areas (IRR 0.4) could not be geocoded compared to 14% (762/6011) in more urban areas (IRR <0.4). CONCLUSION: The ZIP code-level RUCA classification system compared to the IRR appears to more narrowly define what geographic areas/ populations are rural. Results using the ZIP code-level IRR classification system are comparable to those obtained from using RUCA codes, but using the IRR classification system has the advantages of being more flexible methodologically and easier to interpret than using RUCA codes.

SENIORS UNNECESSARILY COMPLICATE THEIR HOME MEDICATION REGIMENS POST-DISCHARGE

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BACKGROUND: Following hospitalization, seniors have multiple medication changes and new instructions. Seniors also frequently receive medication instructions from many sources. The universal medication schedule (UMS) was recently proposed for standardizing prescribing practices to four daily time intervals which would simplify regimens and potentially improve adherence. We aimed to determine whether seniors consolidate their medications following a hospital discharge, or if there was evidence of unnecessary regimen complexity.

METHODS: Face to face interviews were performed by study nurses with 200 seniors 70 yrs in their homes in the community one month following hospital discharge. At one month, subjects would have developed a routine schedule for taking their medications. During the home visit, the study nurse asked the subject to demonstrate how they

took their medications in a normal day. The nurse visualized where the medications were stored and whether or not a pill box was used. Information on times of day, locations of med, and reasons for each were recorded. Following the interview, research assistants entered their medication lists and calculated the number of times in a day the subject took their medications. Two health care professionals (a pharmacist and a physician) blinded to the actual use of the patient were given the medication regimens of each patient. They were asked to determine the fewest number of times a day that a patient could take the regimen. A third healthcare professional served as a tie-break.

RESULTS: Of 200 seniors [mean age 83.0 yrs, 57% female], 152 (76%) had medication changes at hospital discharge. Medication regimens could be simplified for 85 (42.5%) patients. Of those seniors who were not consolidating their medications, 53 (26.5%) could have had the number of times a day medications were taken reduced by 1; 26 (13.0%) could have reduced by 2; and 6 (3.0%) could have reduced by 3. Medication regimen interrater reliability between the pharmacist and physician (kappa) was 0.845. The three most common causes of overcomplexity of medication regimens were (1) misunderstanding medication instructions (i.e. taking cholesterol lowering medications very late at night), (2) concern over absorption of drugs (i.e. before or after meals), and (3) perceived drug-drug interactions. Pillboxes were used by 99 (49.5%) of subjects but usage did not significantly correlate with simplified regimens.

CONCLUSION: Over forty percent of seniors aged 70 and older overly complicate their medication regimen following a hospitalization. This lack of consolidation potentially impedes medication adherence. Health care professionals should ask patients to explicitly detail the number of times medication consumption occurs in the home. Home nurse visits may also be useful to better ascertain true medication usage. In exploring the reasons behind the complexity, patients and health care professionals need improved education and communication about medication usage.

READABILITY OF PATIENT EDUCATION MATERIALS LINKED TO ELECTRONIC HEALTH RECORDS

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New York; 2Mount Sinai Medical School, New York, New York. (Tracking ID # 10968)
BACKGROUND: Ample patient education materials (PEMs) are available on the internet. However, many are written at high school or college reading levels. This renders them inaccessible to the average Medicare beneficiary, who reads at a 5th grade level, and the average US resident, who reads at an 8th grade level. Currently, electronic health record (EHR) providers partner with companies that produce PEMs. This allows clinicians to access PEMs without navigating away from the patients electronic medical record during visits. Because institutions are indirectly endorsing these PEMs through the EHRs they purchase, it is crucial to assess their readability. Our goal was to assess the readability of PEMs provided by popular EHR vendors. We hypothesized that a majority of these PEMs are written above target readability, defined as at or below an 8th grade reading level.
METHODS: Per a 2009 report by Modern Healthcare, 26% of US hospitals use Meditech as their EHR supplier. Meditech uses PEMs from Micromedex, Medline, and Lexicomp. These PEM databases are also freely accessible in most academic hospitals. Based on proportions assuming 20,000 PEMs, 50% of PEMs above target readability, a 10% margin of error, and alpha 0.05, we randomly sampled 100 disease-matched PEMs from each of these three databases (n=300 PEMs). Grade reading level needed to read the PEMs was calculated using three
validated indices endorsed by the Center for Medicare and Medicaid Services as being appropriate for assessing readability of PEMS: SMOG, Gunning Fog, and Flesch-Kincaid. These indices vary in stringency, and are based on the number of syllables per word as well as sentence length. We calculated the percentage of documents that were above target readability, and used an ANOVA to compare the average readability scores of each database.
RESULTS: Thus far, we have analyzed 50 disease-matched PEMs from each of three PEM databases. The percentage of each databases PEMs that are above target readability are shown in Table 1, as well as median grade levels and grade level ranges for each databases PEMs. Based on the Gunning Fog index, the ANOVA showed a significant difference in the average grade reading levels of the PEMs from these sources. Micromedex had the lowest average reading level (9th grade) compared to 10thgrade for Medline and Lexicomp ($p<.001$).
CONCLUSION: The vast majority of PEMS available through the most widely used EHR are written at reading levels considerably higher than that of the average US adult. Given health literacys enormous impact on our healthcare system, it is crucial that EHR vendors provide educational materials that are written at appropriate reading levels designed for comprehension by patients at all levels of health literacy.
HIRING AND TRAINING PROCESSES OF AGENCIES SUPPLYING PAID CAREGIVERS TO OLDER ADULTS Lee Lindquist 1; Kenzie Cameron 1; Joanne Messerges-Bernstein 1; Elisha Friesema 1; David Baker1. 1Northwestern University, Chicago, Illinois. (Tracking ID # 10972)
BACKGROUND: Seniors frequently rely on the assistance of paid, non-family caregivers to maintain independence in their homes. Caregivers often are asked to provide medication reminders, transportation to physician appointments, and support for activities of daily living. As the demand for caregivers increase, agencies or private businesses are supplying caregivers to seniors. No prior studies have examined what, if any, screening processes agencies use in selecting caregivers or what training is provided to the caregivers.
METHODS: We aimed to identify screening and training practices of agencies that provide paid non-related caregivers to seniors. Further, we assessed differences between caregiver salaries and agency charges. This study was considered exempt by the Northwestern University IRB. We phoned 432 agencies that advertised to supply home health care and caregiver services in senior-dense areas of Illinois, Wisconsin, Indiana, Arizona, and Florida. Agencies that (1) had 2 or less employees or (2) did not offer non-nursing home services were excluded. Telephone interviews were conducted with surveyors posing as prospective clients obtaining information on caregivers for a senior with dementia. Agencies were queried about their hiring practices,

training, supervision, services provided and fee schedules.
RESULTS: Of the 432 caregiver agencies contacted, 139 fit the inclusion criteria. Of those surveyed, all performed screening procedures; 98%
Table 1:
Database Micromedex (n=50) Medline (n=50) Lexicomp (n=50) Readability Index
Flesch-Kincaid
Gunning Fog SMOG
Flesch-Kincaid
Gunning Fog SMOG
Flesch-Kincaid
Gunning Fog SMOG
% of PEMs Above Target Readability
56 86 94 70 90 96 80 96 100
Median Grade Levels (Range)
8th (5-10)
9th (7-11)
10th (7-12)
9th (5-14)
10th (6-16)
10th (8-15)
9th (7-11)
10th (7-13)
10th (8-12)

perform a criminal background check at the state level, but only 55% perform a federal check. Other screening measures include phoning references (100%), drug screening (33%), checking driving records (30%), requiring proof of auto insurance (4%), credit check (5%), and psychological evaluation (2%). Some agencies stated that they perform an elder abuse record check, social security number trace, national caregiver background check, circuit court access program medical assistant exclusion list, and state caregiver check. On further investigation, we found no evidence of these databases and were unable to verify their existence. All agencies reported that caregivers could assist with reminding clients of medications, accompanying seniors to physician appointments, and following physician orders. Although these activities require strong health literacy, no agencies reported assessing potential caregivers health literacy. Agencies primarily determined skill sets through self-report via questions of the caregiver (100%) during the hiring interview. Training of caregivers was extremely variable and included providing a manual, post-hiring training in the home of the senior by a care manager or nurse, shadowing other caregivers, or family effort after hiring. The range of time spent on training was 8 hours to 4 days. On average, agencies charged seniors an hourly rate of $19.31 ($12-$28). Caregivers received $8-10 an hour on average from prior reports. Of the agencies, 64% did not provide health insurance for their employee caregivers.

CONCLUSION: Using an agency to hire caregivers may give seniors and their families a false sense of security regarding the background and skill set of the caregivers. Recent studies have shown that caregivers make errors on medication regimens. More stringent screening, education, and training of caregivers by agencies are needed to ensure adequate care of their senior clients.

EFFECTS OF MEDICARE PRESCRIPTION DRUG COVERAGE ON NON-DRUG MEDICAL SPENDING J. Michael McWilliams 1; Alan M Zaslavsky 1; Haiden A Huskamp1. 1Harvard Medical School, Boston, Massachusetts. (Tracking ID # 10977)

BACKGROUND: The Medicare prescription drug benefit (Part D) has increased use of prescription drugs, decreased out-of-pocket spending for prescription drugs, and decreased cost-related non-adherence among elderly adults. The national effects of Part D on hospitalization rates and non-drug medical spending, however, have not been clearly defined.

METHODS: We used longitudinal survey and linked Medicare claims data from the nationally representative Health and Retirement Study to measure quarterly non-drug medical spending and utilization from 20042007 among 3,224 elderly beneficiaries reporting less generous prescription drug coverage (drugs partially or not at all covered) and 2,495 reporting more generous coverage (drugs mostly or completely covered) in 2004. To estimate effects of the implementation of Part D, we fitted generalized linear models comparing non-drug utilization and spending before and after 2006 by prior drug coverage. We estimated these effects for the entire cohort, for adults with drug-sensitive chronic conditions, and for adults with low incomes. For comparison, we conducted similar analyses for a control period from 20022005, prior to Part D implementation. Applying a similar analysis to biennial survey data, we compared changes from 20042008 in prescription drug coverage, out-of-pocket spending, and cost-related non-adherence for beneficiaries with less or more generous drug coverage in 2004. We then compared these differential changes to differential changes occurring in a control cohort from 20022004. Comparisons were adjusted for baseline sociodemographic and health characteristics, the complex
survey design, repeated measures, survey non-response, and missing claims due to Medicare Advantage enrollment.

RESULTS: After the first quarter of 2006, spending on acute and post-acute care tended to be lower for beneficiaries with less generous prior drug coverage ($313/quarter; P=0.08) than was expected from preceding trends and changes in spending for beneficiaries with more generous prior drug coverage. Spending on acute

and post-acute care after 2006 was significantly lower than expected for beneficiaries with drug-sensitive chronic conditions ($413/quarter; P=0.03) and low incomes ($781/quarter; P=0.01) who had less generous drug coverage in 2004. Hospitalization rates also tended to be lower than expected after 2006 for those with less generous prior drug coverage (0.014/ quarter; P=0.08). Spending on other non-drug services did not differentially change after 2006 for beneficiaries with less generous prior drug coverage ($4/quarter; P=0.97). In a control cohort from 20022005, spending on acute and post-acute care did not differentially change after the first quarter of 2004 for beneficiaries with less generous drug coverage in 2002 ($19/quarter; P=0.90). Beneficiaries who had less generous drug coverage in 2004 reported better drug coverage (+20.5 percentage points with more generous coverage; P<0.001), lower out-of-pocket spending on drugs ($152/month; P=0.002), and less cost-related non-adherence (2.4 percentage points; P=0.04) than was expected in 2008 in the absence of Part D.

CONCLUSION: The implementation of Medicare Part D was associated with lower spending on acute and post-acute care for beneficiaries with less generous drug coverage before 2006. These benefits were concentrated among those with drug-sensitive chronic conditions, for whom increased use of prescription drugs might prevent costly complications, and among those with low incomes, who were less likely to be able to afford prescribed medications before 2006 and more likely to qualify for subsidized Part D coverage without a coverage gap. Hence, the costs of provisions in the Patient Protection and Affordable Care Act to reduce cost-sharing in the doughnut hole of standard Part D coverage may be partially offset by reduced Medicare spending on Part A services for these groups. Moreover, these findings would support policies incentivizing Part D plans to design drug coverage and formularies to minimize Part A spending.

RELIABILITY OF AN INTERACTIVE COMPUTER PROGRAM FOR ADVANCE CARE PLANNING Jane R. Schubart 1; Michael Jay Green 1; Megan Whitehead 1; Elana Farace 1; Benjamin H. Levi1. 1Penn State College of Medicine, Hershey, Pennsylvania. (Tracking ID # 10978)

BACKGROUND: The 1990 Patient Self Determination Act requires healthcare institutions to inform patients about advance directives (ADs) and offer individuals the opportunity to express their wishes regarding end-of-life care. Despite widespread efforts to promote ADs, completion rates remain low. Making Your Wishes Known: Planning Your Medical Future is an interactive computer program that guides individuals through the process of advance care planning. The program explains common health conditions that can impair patients communication of preferences, as well as interventions that commonly involve life or death decisions. Users are helped to reflect on and articulate their personal values/goals relating to medical care, disability, death/dying, and quality of life (QoL). The program includes a decision aid that translates health care preferences into a detailed AD document. An important step in establishing the validity of this decision aid is to demonstrate reliability in generating an AD that reflects an individuals values/preferences and, in the absence of major life changes, remains stable over time. This study examines the test/re-test reliability of the AD document generated by the computer program.

METHODS: Participants were recruited from a list of patients who expressed interest in advance care planning. Inclusion criteria were age >30, English speakers, >8th grade reading level, cognitively able to use the program, and not depressed. Participants completed the decision aid at 2 study sessions, 46 weeks apart, each lasting 13 hours. At the second session, participants completed a questionnaire about interim life events that might influence responses to end-of-life healthcare decisions. Generalizability Theory (GT) was used to assess multiple reliability indices and to determine the relative importance of various sources of error using 2 scales the medical Wishes scale and the QoL scale. Wishes scores involved 8 binary items (e.g., kidney dialysis, mechanical ventilation, feeding tube) under 5 clinical scenarios (stroke that would/would not improve, coma that was/was not reversible, and dementia). QoL scores were determined by the values statements selection.

RESULTS: 24 participants completed the study (19 women and 5 men; ages 4389). Under classical theory

testing, both the Wishes and QoL scales had high internal consistency in both time periods (Cronbach Coefficient Alpha=0.830.95, 0.860.89) meaning that the items comprising them fit together). Test-retest reliability was moderate to high for QoL (Pearson Correlation Coefficient=0.83). Using the GT models, reliability was low for Wishes across the scenarios (G-index=0.21), implying that rankings for specific treatments tend to vary, but improved (G-index=0.49) if the scenario was held constant, suggesting that under some scenarios the reliability of the scale may actually be high. The G-index for QoL was high (G-index=0.81), indicating that formulations of general goals/values remain stable across time. The study construct did not take into account the influence of the decision aid itself on individuals Wishes rankings.
CONCLUSION: Using our computer-based decision aid, specific wishes vary over time, but general values regarding quality of life remain consistent. Future studies will examine whether individuals wishes for specific medical treatments show greater stability after accounting for the educational impact of the decision aid.
HEALTH BELIEFS OF STROKE SURVIVORS IN AN URBAN COMMUNITY Revathi Balakrishnan 1; Judith Z. Goldfinger 2; Kezhen Fei 2; Carol R. Horowitz2. 1Mount Sinai School of Medicine, NEW YORK, New York; 2Mount Sinai School of Medicine, New York, New York. (Tracking ID # 10981)
BACKGROUND: Secondary prevention of stroke depends on the control of hypertension and hyperlipidemia and use of anti-thrombotic medications. Fewer than half of all stroke survivors have these risk factors controlled, and recurrent strokes and inadequate risk factor control are more common in minority populations. A research team formed from a community-academic partnership aimed to identify health beliefs that may contribute to poor risk factor control among stroke survivors in the predominantly minority population in Harlem and Bronx, New York for potential areas of intervention.
METHODS: Adults over 40 years of age with a history of stroke or transient ischemic attack (TIA) within the past 5 years were recruited from community and clinical sites to enroll in the Prevent Return of All Inner-city Strokes through Education (PRAISE) trial. Upon enrollment, participants completed a survey that assessed patient factors related to recurrent stroke, including demographics, health status, social support, and relationship with doctors. Blood pressure, direct LDL cholesterol and body mass index (BMI) were also measured. The composite outcome of the study was control of all three primary risk factors for stroke: blood pressure <140/90 mmHg, LDL cholesterol <100 mg/dL, and reported regular use of an anti-thrombotic.
RESULTS: Of 330 stroke and TIA survivors, 46% were African American, 33% were Hispanic, and 13% were Caucasian; 64% were female. Most participants (69%) reported residual stroke symptoms and most (70%) worried about future strokes, but only 19% identified blood pressure and only 13% identified cholesterol as major risk factors for stroke. Only one-third (31.5%) had the composite outcome of all three primary risk factors controlled. Half of the study participants reported their blood pressure was well controlled; of these people, nearly one-third (28%) did not have their blood pressure at goal. Of the 39% who reported their cholesterol was well controlled, 38% did not have their LDL at goal. While nearly all (93%) participants were under the care of a primary care doctor, one-third did not strongly believe that medications help prevent future strokes, 35% did not fully understand their medications, nearly half forget to take medications, and half believed doctors prescribe too many medications. Also, 47% believed racial discrimination occurs in doctors offices and only 23% believed that Blacks and Latinos could receive the same care as Caucasians. CONCLUSION: In this urban, predominantly minority population of stroke survivors, despite the presence of symptoms, concern for future strokes, access to a primary care physician, and a desire to prevent recurrent strokes, there remains a gap in the knowledge of stroke risk factors and the role that medications fulfill in their control. This is reflected by the inadequate use of anti-thrombotic medication, poor control of blood pressure and LDL cholesterol. In addition, this study revealed perceived racial disparities in doctors offices and access to care. These findings highlight the need for interventions that can facilitate health education among those at risk for future strokes and the need to foster more effective relationships with healthcare providers in the urban community.
RELIANCE ON VA OUTPATIENT SERVICES BY MEDICARE-ELIGIBLE VETERANS Chuan-Fen Liu 1; Willard

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7Durham VA Medical Center; Duke University Medical Center, Durham, North Carolina . (Tracking ID # 10984)
BACKGROUND: Patients who obtain outpatient care in more than one health care system disrupt continuity of care and may have a lower quality of care and worse health outcomes, particularly among individuals with complex chronic conditions. The Department of Veterans Affairs (VA), the largest integrated health care system in the United States, served 5.5 million veterans in 2008. However, a significant proportion of veterans who use the VA also have coverage through Medicare. To transform primary care delivery, VA is implementing a patient centered medical home model system wide using the team-based approach to provide patient-centered care to further improve access, coordination, and continuity of care. This study examines longitudinal changes in reliance on VA healthcare system for primary and specialty care over four years among a cohort of VA Medicare-eligible veterans.
METHODS: This is a retrospective cohort study. The study sample included 15,520 Medicare-eligible veterans who used VA primary care in 2000. We merged VA administrative and Medicare claims data to examine outpatient use during Fiscal Years (FY) 20012004. Patients

were censored at the year of death. VA outpatient care reliance was defined as the proportion of total (VA/Medicare) visits received in VA for primary care or specialty care. We estimated VA outpatient care reliance using beta-binomial regressions because of a U-shape distribution indicating that significant number of veterans concentrated at high and low VA reliance.
RESULTS: Of 869,000 primary and specialty care visits in the study period, 39% occurred within VA. VA primary care reliance was substantially higher than VA specialty care reliance (66% vs. 50% in FY2001; $p<0.001$)) and both primary and specialty care reliance decreased throughout the study period (55% vs. 32% in FY 2004; $p<0.001$). Significant shifts occurred at both extremes of VA reliance. From FY2001 to FY2004, the proportion of patients in the top decile of VA
primary care reliance decreased from 38% to 30%, while the proportion in the bottom decile doubled from 10% to 20% (Figure). Similarly, the proportion of patients in the top decile of VA specialty care reliance decreased from 24% to 13%, while the proportion in the bottom decile doubled from 23% to 47%.
CONCLUSION: VA primary and specialty care reliance by a cohort of Medicare-eligible VA primary care patients decreased substantially over 4 years. By the fourth year, only half of primary care visits and one-third of specialty care visits occurred in VA for this population of primary care users. Decreasing VA outpatient care reliance may have had substantial impacts on chronic disease management and continuity of care. Increasing use of non-VA services complicates VAs implementation of patient centered medical home models and performance measurement.

RISK OF RESIDENT CLINIC HANDOFFS: SHOWING UP IS HALF THE BATTLE Amber T. Pincavage 1; Shana Ratner 1; Megan Prochaska 1; Meryl Prochaska 1; Julie Oyler 1; Vinny Arora1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 10986)
BACKGROUND: Continuity of care in the primary care setting is associated with greater patient satisfaction and fewer hospital admissions. Nationally, many patients experience a change in their PCP when departing Internal

Medicine (IM) residents handoff their patients to junior residents. No studies to date have examined the specific patient risks relating to these handoffs. Our study aims to characterize patients at higher risk of adverse events after a clinic handoff.
METHODS: In June 2010, graduating IM residents listed clinic patients they perceived to be at high risk during the clinic handoff on a signout worksheet which included reasons for high risk status, target follow-up date, and tasks to be done. During a designated handoff meeting, departing residents discussed their patients with the junior resident taking over their clinic. Clinic coordinators used worksheets to facilitate scheduling of patients. For all patients, signouts and charts were reviewed to determine if and when patients were scheduled and if they saw their new PCP. We also examined associations between follow-up, patient factors (no show rates), and outcomes (ED visits or hospitalizations) in the three months after the transition. PGY2 residents assuming care we resurveyed regarding their beliefs of the clinic handoff process.
RESULTS: Thirty graduating residents identified 258 clinic patients as high risk. Mean age was 61 (range 2795), 63% were female, and on average the patients were transitioning to their 3rd PCP in 5 years. Patients were deemed high-risk due to complexity (59%), new diagnoses (28%), psychiatric diagnoses (18%), and non-adherence (12%). Nearly all patients (97%, 250/258) were scheduled for their follow-up appointment. However, one third (29%, 75/258) of patients no showed or cancelled their first visit with their new PCP. Ultimately, less than half (44%, 113/258) of patients saw the correct PCP. The average time between visits with the old and new PCP was 110 days (range 11 to 350). Six months after the handoff, one fifth (19%, 50/258) of patients had not yet been seen. A significantly higher overall No Show rate (NSR) (reported in Epic) was more likely to be noted among patients missing their first visit with their new PCP (22% vs. 16% NSR, $p<0.001$), transitioning to the wrong PCP (19% vs. 16% NSR, $p=0.05$), and those lost to follow-up (21% vs. 17% NSR, $p=0.02$). Overall, 26% (68/ 258) of patients visited the ED or were hospitalized during the 3 months after the handoff. Patients who missed at least one appointment with their PCP in the last year were more likely to have an acute care visit in the ED or hospital (33% vs. 22%, $p=0.038$). Most (95%) PGY-2 residents completed surveys. While half (47%) of residents worried about missing important patient data during the transition, a similar proportion (48%) reported they do not take ownership of a patient until the first clinic visit.

CONCLUSION: Resident clinic handoffs are a vulnerable time for high risk patients. While most patients were scheduled for appointments, over half were not seen by the correct resident who was to take over their care. Patients who miss appointments are especially at risk of adverse consequences during this care transition. Because residents do not feel responsible for patients until after their first clinic visit, improving patient attendance to the first visit with their new PCP is imperative. Future interventions to improve resident clinic handoffs should incorporate these findings.
ASSOCIATION OF INCARCERATION WITH TRAUMA, SUBSTANCE USE RELATED HEALTH CONSEQUENCES, AND HEALTH CARE UTILIZATION Nicole Redmond 1; LeRoi S. Hicks 2; Debbie M. Cheng 3; Donald Allensworth-Davies 4; Michael R. Winter 4; Jeffrey H. Samet 3; Richard Saitz3. 1Brigham and Womens Hospital, Dorchester, Massachusetts ;
2Brigham and Womens Hospital, Boston, Massachusetts ; 3Boston Medical Center, Boston, Massachusetts ; 4Boston University School of Public Health, Boston, Massachusetts . (Tracking ID # 10993)
BACKGROUND: Recently released inmates are at significantly higher risk of death due to drug overdose, suicide, homicide, and cardiovascular disease relative to the general population. Whether these mortality differences are due to the higher prevalence of drug dependence among inmates, or due to an independent effect of incarceration, is not clear. Among substance dependent adults, we explored the effects of incarceration on outcomes that may be intermediate markers for mortality: a) traumatic injuries, b) substance use-related health consequences, and c) hospital and/or emergency department (ED) utilization.
METHODS: We analyzed survey data (baseline, 3, 6, and 12 month follow-up) collected for the Addiction Health

Evaluation and Disease management (AHEAD)study, a randomized clinical trial to test the effectiveness of chronic disease management for substance dependence in primary care. The following 3 outcomes (past 3 months, assessed at 3, 6, and 12 months) were evaluated: (1) any traumatic injury; (2) substance use related health consequences (defined as any of the following while using drugs and/or alcohol: accident, suicide attempt, physical/sexual assault, or an overdose requiring ED/medical attention); and (3) a composite variable for hospital and/or ED utilization excluding addiction treatment or detoxification (defined as reporting yes to any medical or psychiatric hospitalization or any ED visit). The main independent variable was self-reported recent incarceration, defined as spending at least one night in jail or prison <3 months prior to the research interview. In longitudinal analyses, incarceration was modeled as a time-dependent and time-lagged (assessed at the interview prior to outcome) variable. Covariates included sociodemographic and clinical characteristics, drug dependence type (alcohol, drug, or both, determined by diagnostic interview), randomization group and past 3-month value of the outcome at baseline (i.e., at study entry). We used generalized estimating equations logistic regression models to evaluate the association between recent incarceration and each of the three dichotomous outcomes, adjusting for all covariates.
RESULTS: Of 553 subjects, 404 (73%) were male with a mean (SD) age of 38.3 (10.1) years; 260 subjects (47%) were non-Hispanic White, 175 (32%) were non-Hispanic Black, 73 (13%) were Hispanic, and 45 (8%) were of other race/ethnicity. Other cohort features were the following: 95 (17%) were alcohol dependent only, 144 (26%) were drug dependent only, and 314 (57%) were both drug and alcohol dependent; 93 (17%) reported recent incarceration at study enrollment. Recent incarceration was not significantly associated with traumatic injury (adjusted odds ratio [AOR]=1.10, 95% CI: 0.73-1.65) or health care utilization (AOR= 0.92, 95% CI: 0.68-1.24). However, recent incarceration was associated with higher odds for substance use-related health consequences (AOR=1.43, 95% CI: 1.03-1.98).
CONCLUSION: Although larger samples and/or longer follow-up may be necessary, we did not detect significant effects of incarceration on injury or health care utilization, despite adjustment for sociodemo-graphic, clinical and substance dependence characteristics. However, among people with alcohol and/or drug dependence, incarceration appears to be associated with higher odds of substance use related health consequences. Substance use related health consequences may explain, at least in part, the increased risk of death faced by former inmates.
TOTAL RECALL IS A MYTH: ASSESSING PATIENT RECALL OF HEALTH INFORMATION PRESENTED USING ALTERNATIVE FACTS &MYTHS MESSAGE FORMATS Kenzie A. Cameron 1; Tiffany Brown 1; Michael E. Roloff 2; Elisha M. Friesema 1; Sara Hauber 1; Jason A. Thompson 1; David W. Baker1. 1Northwestern University Feinberg School of Medicine, Chicago, Illinois; 2Northwestern University, Evanston, Illinois. (Tracking ID # 10995)
BACKGROUND: Preventive health messages using a Facts &Myths format attempt to reinforce accurate information and refute false information. Some research cautions against the use of such a format, reporting that myths may be misremembered as facts. However, communication research proposes that a message containing original arguments (facts), counterarguments (myths), and a refutation of counterarguments will be more persuasive than a facts only message. Given the ubiquity of the Facts &Myths format, we sought to identify how alternative Facts &Myths formats affect patients retention of accurate information.
METHODS: We conducted a randomized clinical trial of four alternative messages related to influenza/influenza vaccination. The control message was a Flu Vaccine Facts &Myths flyer disseminated by the Centers for Disease Control and Prevention (CDC control), which presents facts, myths, and some general evidence in support of the facts. Three alternative message formats were created: (1) Facts Only, (2) Facts &Myths, and (3) Facts, Myths, and Refutations, a message including additional evidence to refute the myths presented. Patients were recruited from a General Internal Medicine practice between September 2009 - February 2010 (N=126), completed a telephone pre-test, and were randomized to receive one of the 4 messages. The message was

mailed to patients one week prior to a scheduled physician visit. This abstract reports on a subset of patients (N=87) who reported receiving and reviewing a message, and who completed an in-person interview immediately prior to their visit. Participants were read 8 statements and asked to recall if the statements had been (1) presented as a fact, (2) presented as a myth, (3) presented, but I dont recall if it was a fact or a myth, or (4) not presented in the mailed message. Responses were analyzed to assess recall accuracy (range 08) for each of the 4 message formats and the difference among message formats.
RESULTS: Participants accurately recalled the presentation of a mean of 4.44 statements (SD=2.02). An ANOVA demonstrated significant differences in recall accuracy between message formats (F=8.65, p<.001): CDC control - M=4.77 (SD=1.82); Fact Only - M=3.00 (SD=1.74); Facts &Myths - M=4.52 (SD=1.97); and Facts, Myths and Refutations - M=5.76 (SD=1.65). Scheffes post-hoc analysis revealed significant differences in recall accuracy between the Fact Only and Facts, Myths and Refutations (p<.01); and Fact Only and CDC Control (p<.05) formats; the difference in recall accuracy approached signifi-

cance between the Fact Only and the Facts &Myths formats (p=.052). No other significant differences emerged between message formats on recall accuracy.
CONCLUSION: When designing patient education messages we need to understand what information receivers will retain, and their recall of the veracity, or truth value of information presented in the messages. Participants receiving the Fact Only format demonstrated lower recall accuracy than all other formats, suggesting that merely presenting individuals with factual information does not automatically assure recall accuracy. Presenting participants with alternatives that included facts and myths resulted in less than ideal recall, yet recall was significantly better than for a message presenting only facts. Thus, our study found no evidence to suggest that presentation of facts and myths in a message is counterproductive to recall accuracy.

EFFICACY AND TOLERABILITY OF ONCE-DAILY GABAPENTIN EXTENDED-RELEASE(G-ER)FORTHETREATMENTOFPOSTHERPETIC NEURALGIA IN PATIENTS AT LEAST 65 YEARS OLD

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BACKGROUND: The risk, severity and duration of postherpetic neuralgia (PHN) all increase with subject age. Furthermore, treatment decisions must consider the greater likelihood of concomitant medications in older patients. Immediate-release gabapentin is approved for treatment of PHN and has a low propensity for drug-drug interactions; but requires multiple daily dosing and is associated with a high frequency of dizziness and somnolence. The efficacy and tolerability of once-daily gabapentin extended-release (G-ER; 1800 mg) for treatment of PHN has recently been examined in a double-blind, placebo-controlled, Phase 3 study. In this analysis of data from that study, we examined the efficacy and tolerability of G-ER in patients who were at least 65 years old and subsequently compared these patients with the overall study population.
METHODS: Patients with PHN of duration >6 months and an average daily pain (ADP) score >4 were enrolled. After 1 week of baseline assessments, patients were randomized to G-ER (titrated to 1800 mg over 2 weeks) or placebo with their evening meal for a total treatment period of 10 weeks, followed by 1 week of dose tapering. The primary efficacy endpoint was baseline observation carried forward change in ADP. Rates of adverse events also were recorded. The primary efficacy endpoint and rates of adverse events also were assessed separately in patients who were >65 years old.
RESULTS: The overall intent-to-treat population included 450 patients (G-ER, n=220; placebo, n=230); 280 patients were at least 65 years old (G-ER, n=139, placebo, n=141). The safety population included two additional patients (one <65 years old, placebo; one >65 years old, (G ER). In the overall study population, the mean +/SD baseline ADP scores in the G-ER group and placebo groups were comparable (6.6+/1.4 vs

6.5+/1.4, respectively). Comparable baseline scores also were observed in patients >65 years old (G-ER, 6.8+/1.5; placebo, 6.5+/1.3). In the overall study population, ADP scores were reduced significantly at endpoint in the G-ER group when compared with placebo (least squares [LS] mean difference SE, -0.49+/0.20; p=0.0125). Similarly, in patients who were >65 years old, the reduction in ADP scores was significantly greater in the G-ER group compared with placebo (LS mean difference +/SE, -0.65+/0.25; p=0.0088). Compared with G-ER-treated patients in the overall population, a smaller proportion of G-ER-treated patients in the older subgroup reported at least 1 adverse event (52.5% vs 47.1%, respectively), but the proportions were comparable for the placebo groups of the overall population and of the older subgroup (39.4% vs 39.7%, respectively). Dizziness and somnolence in G-ER treated patients were observed less frequently in the older subgroup compared with the overall population (dizziness:10.7% vs 11.3%, respectively; somnolence: 4.3% vs 5.4%, respectively) although those frequencies were higher than observed in the respective placebo groups (dizziness: 2.8% and 1.7%, respectively; somnolence:1.4% and 3.0%, respectively). No other adverse events were observed in >5% of any group of the overall population or older subgroup and consistently more frequently in the G-ER group compared with placebo. CONCLUSION: G-ER provided significant reduction in pain intensity compared with placebo in both the overall study population and in the older subgroup of patients. G-ER was well tolerated overall and in the older subgroup of patients. The frequencies of dizziness and somnolence in G-ER treated patients, both overall and in the older subgroup, suggest a lower rate than observed in previous clinical trials of immediate-release gabapentin.

Disclosures: This analysis was supported by Depomed, Inc. and Abbott. Medical writing support was provided by Ed Parr, PhD, of Envision Scientific Solutions, and supported by Abbott.

IMPACT OF HOSPITAL TEACHING INTENSITY ON THE QUALITY OF CARE IN HOSPITALS Stephanie K. Mueller 1; LeRoi S. Hicks1.

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BACKGROUND: Studies examining the quality of care that a patient receives in teaching versus non-teaching hospitals have demonstrated mixed results and many were conducted prior to the implementation of the Accreditation Council for Graduate Medical Education (ACGME) residency work hour restrictions. Thus, a more current examination of the association between hospital teaching intensity and quality of care is overdue.

METHODS: We linked 2008 Hospital Quality Alliance (HQA) and 2007 American Hospital Association (AHA) data for each medical and surgical hospital in the U.S. Main outcome measures included 30 day readmission rate and mortality rate for 3 conditions: acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia. The predictor of interest was teaching intensity, defined as number of residents-tobed ratio and classified into either: (1) non-teaching (zero residents/ bed), (2) low teaching intensity (00.25 residents/bed), (3) medium teaching intensity (0.25-0.6 residents/bed) and (4) high teaching intensity (> 0.6 residents/bed). We utilized linear regression to examine the relationship between teaching intensity and each clinical outcome adjusted for hospitals: geographic location, ownership, urban versus rural setting, nursing intensity (nurses/1000 patient days), presence of an ICU, insurance mix, hospital size and presence of hospitalists.

RESULTS: Of the 2423 hospitals reporting quality outcome data, 1528 (63%) were non-teaching, 699 (29%) were low teaching intensity, 116 (5%) were medium teaching intensity, and 80 (3%) were high teaching intensity. After adjustment for hospital characteristics, increasing teaching intensity was significantly linearly associated with readmission rates for all three conditions and conversely associated with mortality rates for AMI and CHF (see Table).

CONCLUSION: In this nationally-representative sample of medical and surgical hospitals we found that increased teaching intensity is associated with higher readmission rates but lower mortality for the most common of inpatient medical diagnoses. Our findings suggest that teaching intensity may be associated with higher quality of inpatient care, but poorer quality transitions of care.

Reference group

DOES MEDICARE PART D PROVIDE ADEQUATE DRUG COVERAGE FOR COMMON HEALTH CONDITIONS Chien-Wen Tseng 1; Tetine Sentell 2; Emmett Keeler 3; Randi Chen 4; R. Adams Dudley5. 1U of Hawaii Dept. of Family Medicine, Honolulu, Hawaii ; 2University of Hawaii Dept. of Public Health, Honolulu, Hawaii ; 3RAND, Santa Monica, California ; 4Pacific Health Research Institute, Honolulu, Hawaii ; 5UCSF School of Medicine, San Francisco, California . (Tracking ID # 11000)

BACKGROUND: Medicare Part D plans provide important drug coverage for 28 million Medicare beneficiaries but vary widely in which drugs they cover and the copayments charged. Such variation among Part D formularies means that some drugs are widely covered by nearly all plans at affordable copayments, while other drugs are covered by only some plans or are covered only with high copayments. To understand the clinical impact of such Part D formulary variation, we examined which common health conditions may currently lack widely covered drugs at affordable copayments. Beneficiaries whose health conditions are treated by these drugs are at greater risk for high out-of-pocket drug costs, cost-related medication non adherence, and losing coverage for their current medications if they seek to switch plans.

METHODS: We analyzed 3,693 Part D plan formularies nationwide using the June 2009 Centers for Medicare and Medicaid Services (CMS) Prescription Drug Plan Formulary and Pharmacy Network Files. Seven common health conditions were examined; hypertension, hyperlipidemia, diabetes, heartburn, asthma or chronic obstructive pulmonary disease (COPD), depression, and Alzheimers. For each condition, we determined whether the corresponding treatment classes had widely covered and affordable drugs. The definition of widely covered was varied from 80% to 90% of plans. The definition of affordable was varied from $15 to $35 copayment per month. Sensitivity analyses found these findings to be robust to the definition of widely covered and affordable, and results are presented for drugs which are covered by 90% of plans at copayments $35.

RESULTS: A total of77 (43%) out of 180 drugs were widely covered and affordable (average coverage: 98% of plans, average copayment $5.10)
and 103 drugs were non-widely covered or had high copayments (average coverage: 48% of plans, average copayment $35).

Out of seven conditions, there were widely covered and affordable drugs in almost all treatment classes for hypertension, depression, heartburn, and dyslipidemia. In contrast, there were no widely covered and affordable drugs for two treatment classes for diabetes (thiazolidinediones and insulin), nor for most treatment classes for asthma/COPD (short or long-acting beta-agonist, steroid inhaler, combination beta-agonist/steroid, other), nor for Alzheimers.

All 77 widely covered drugs were generic, and no brand-name drugs were widely covered by 90% of plans at $35 copayments. Generic drugs were on average covered by 91% of plans (range 13% to100%) and the average copayment was $7. Most but not all of the 99 generic drugs included were widely covered and affordable (77 of 99 drugs=78%). Brand-name drugs were on average covered by 45% of plans and none were widely covered at copayments of $35 or less. The average brand-name copayment was $40 (range $17 to $71, standard deviation $12). CONCLUSION: Medicare beneficiaries who need medications for chronic diseases such as asthma, diabetes, and Alzheimers remain at risk for high out-of-pocket drug costs given the lack of widely covered and affordable drugs in Part D formularies for treating these conditions. Even as the Part D coverage gap is phased out, policymakers need to evaluate how to address variation in formularies and high copayments for drugs for treating these common health conditions.

NO MOMENT WASTED: THE PRIMARY CARE VISIT FOR DIABETIC ADULTS Shari Bolen 1; Paulette Sage 2; Adam Perzynski 2; Kurt Stange2.

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BACKGROUND: Although quality of care guidelines are straightforward, diabetes visits within the primary care

setting are often more complex than adhering to these guidelines. We sought to take an in-depth look at what happens when the health care needs of people with diabetes are addressed by exemplar clinicians caring for the underserved.

METHODS: We conducted a qualitative study of diabetes visits from a safety net primary care clinic with high quality of care scores for diabetes patients. We recruited adults with type 2 diabetes from the 4 primary care physicians at the clinic until no new themes emerged in analyses. We audiotaped, observed, and transcribed the doctor-patient visits. Using a grounded theory approach, two investigators independently coded and analyzed transcripts for all health issues that arose during the visit, and marked whether the physician or patient first initiated the discussion on a particular health issue.

RESULTS: Fifteen patients participated. In a mainly African American (93%) middle-aged (mean age 61 years) female (64%) population, mean blood sugar, blood pressure, and cholesterol were under fairly good control (HbA1c 7.5%, BP 134/81 mmHg, and LDL 100 mg/dl). However, nearly one-half of patients were above recommended goals in at least one category. The mean visit length was 27 minutes (range 1838 minutes) for a scheduled 20 minute visit, and did not include time for finishing the note. The average number of total health issues discussed at the visit was 25 (range 16 to 31), with an average of 15 brought up first by the physician and an average of 10 brought up first by the patient. The health issues were grouped into the following domains from most to least frequently discussed: chronic diseases, prevention, health behavior, social environment, medications, acute symptoms, intrapersonal, and coordination of care. Physicians most frequently initiated discussions in chronic diseases, prevention, and health behavior. Patients most frequently initiated discussions of social environment and acute/new symptoms followed by prevention and health behavior -which were also frequently raised by physicians.

CONCLUSION: Primary care visits by diabetes patients are complex. Emerging new models of primary care delivery and quality measurement should support and allow adequate time to address the complementary priorities of patients and physicians as they work together on the complex tasks of improving patients health.

COGNITION AND CHOICE OF TRADITIONAL MEDICARE OR MEDICARE ADVANTAGE J. Michael McWilliams 1; Christopher C Afendulis 1; Thomas G McGuire 1; Bruce E Landon1. 1Harvard Medical School, Boston, Massachusetts. (Tracking ID # 11006)

BACKGROUND: Since the Medicare Modernization Act of 2003, increased payments to Medicare Advantage (MA) plans have been associated with a dramatic proliferation in the number of plans available to Medicare beneficiaries and more generous benefits for MA enrollees. Too many or overly complex insurance options may result in suboptimal choices by Medicare beneficiaries. In particular, those with cognitive deficits may have difficulty identifying the most valuable option in their enrollment decisions.

METHODS: For 6,672 participants from the nationally representative Health and Retirement Study, we analyzed survey data, linked Medicare enrollment data, and county-level administrative data on MA plans from 20042007, to determine: 1) if the availability of more plans has increased or decreased enrollment in MA; and 2) if beneficiaries with lower cognitive functioning have been less responsiveness to expanded benefits in MA. Logistic regression was used to estimate effects of within-county increases in the number of plans available and generosity of plans benefits on beneficiaries enrollment in MA or traditional Medicare. Generosity of benefits was measured as the expected monthly out-of-pocket costs in MA for a standardized population of beneficiaries, averaged across all plans available in a given county and year. Results were compared by cognitive functioning, which was assessed in surveys by a validated instrument modeled after the Min-Mental State Examination. All analyses were adjusted for sociodemographic and
health characteristics of participants, county fixed effects, the incomplete linkage to enrollment files, and the

complex design of the survey. RESULTS: The mean number of MA plans increased twofold or more each year from 2004 to 2007 in U.S. counties with at least 1 plan. Increases in available MA plans up to 15 were associated with significant increases in MA enrollment (P=0.004), but increases between 1530 plans were not (P=0.84). Increases above 30 plans were associated with significantly decreased enrollment in MA (P<0.001). By 2007, over 95% of study participants faced lower expected out-of-pocket costs in MA than in traditional Medicare with Medigap coverage, based on county-level averages. Decreased expected out-of-pocket costs in MA (more generous benefits) were associated with increased MA enrollment among participants with high cognitive functioning (P=0.02) but not among participants with low cognitive functioning (P=0.56). CONCLUSION: Medicare beneficiaries were less likely to enroll in MA when faced with numerous choices. Those with lower cognitive functioning were less responsive to the generosity of MA benefits in their enrollment decisions. Simplifying choice in MA could improve beneficiaries decisions, strengthen value-based competition among plans, and extend the benefits of choice to seniors with impaired cognition. In particular, the role of insurance exchanges established by the Patient Protection and Affordable Care Act could be expanded to serve Medicare beneficiaries and MA plans.

USINGA REGIONAL HEALTHINFORMATION EXCHANGE TO IMPROVE IDENTIFICATION OF POST-DISCHARGE FOLLOW-UP PROVIDERS Mustafa Fidahussein 1; John Hook 1; Joe Kesterson 1; Martin Were1.

1Regenstrief Institute, Inc., Indianapolis, Indiana. (Tracking ID # 11012)

BACKGROUND: Determining who patients should follow-up with post-discharge is a key step in transitioning care from an inpatient to outpatient setting. Typically, this follow-up provider information is contained within the discharge summary, and inpatient providers rely greatly on it to determine who to communicate the patients hospital course, discharge summary, and any test results returning after discharge. Unfortunately, no studies exist that evaluate how complete and accurate the follow-up information documented in discharge summaries is, and whether strategies exist to improve identification of the providers who discharged patients actually follow-up with after hospitalization. We set out to determine (a) the follow-up patterns of patients discharged from two large hospitals in central Indiana, and (b) the potential role of a regional health information exchange (RHIE) in improving identification of the providers with whom these patients follow-up with post-discharge. METHODS: We performed this study at two large urban Midwestern hospitals (Hospital A and Hospital B) which are served by comprehensive electronic health record systems (EHRs) and which participate in the Indiana Network for Patient Care (INPC) RHIE. The study involved 679 randomly-selected patients (306 from Hospital A and 373 from Hospital B) who were admitted to the General Internal Medicine Hospitalist Services (GIMHS) teams during Jan-Feb 2009 at these institutions. Discharge summaries for the study patients were each reviewed independently by two physicians who abstracted the names of the intended follow-up providers that were mentioned in the summaries. If there were disagreements between the reviewers on whether a particular follow-up provider was mentioned, the reviewers discussed the case to achieve consensus. Electronically stored encounter data from the INPC were also queried to extract all outpatient physician encounter data for the study patients that occurred 1214 months prior to the relevant admission and 35 months after discharge (Jan 1, 2008 -Jun 1, 2009). Using this data, we determined the frequency with which patients actually followed up with the intended outpatient providers,

and also with other providers who were not mentioned in the discharge summary. We also determined how often historical visit information contained in the RHIE could be used to inform likely outpatient follow-up providers for patients, especially when no information about the follow-up providers was available in the discharge summary. RESULTS: Of the 679 study patients, 458 (67%, [180, 59% Hospital A &278, 75% Hospital B]) had at least one follow-up provider mentioned in the discharge summary, with the other 221 (33%, [126, 41% Hospital A &95, 25% Hospital B]) having no follow-up provider mentioned. Of the 458 patients with a

provider mentioned in the discharge summary, 185 (40%, [84, 47% Hospital A &101, 36% Hospital B]) followed-up in clinic with at least one of the mentioned providers, 132 (29%, [61, 34% Hospital A &71, 26% Hospital B]) followed-up with none of the providers mentioned in the summary, and 141 (31%, [35, 19% Hospital A &106, 38% Hospital B]) did not follow-up with any provider. Historical encounter information from the RHIE revealed that of the 317 patients who had a follow-up provider mentioned in the discharge summary and who followed-up post-discharge with any provider, 182 (57%, [83, 57% Hospital A &99, 58% Hospital B]) followed with at least one of the same providers they had been seeing prior to admission. Of the 123 patients who did not have any follow-up providers mentioned in the discharge summary but still followed-up post-discharge with any provider, 58 (47%, [43, 52% Hospital A &15, 16% Hospital B]) followed-up with at least one of the same providers they had been seeing prior to admission. Overall, of the 440 patients who had a clinic visit post-discharge, 240 (55%, [126, 55% Hospital A &114, 55% Hospital B]) saw at least one of the same providers they had visited with prior to their admission. Of the 458 patients that had at least one follow-up provider mentioned in the discharge summary, 182 (40%, [74, 41% Hospital A &108, 39% Hospital B]) were seeing at least one of these providers prior to admission. Of these 182 patients, 94 (52%, [43, 58% Hospital A &51, 47% Hospital B]) followed-up with the at least one of the same providers post-discharge.

CONCLUSION: A care system which relies largely on follow-up provider information contained within discharge summaries is highly inadequate at identifying the actual providers patients follow up with after they are discharged from the hospital. We found that 33% of discharged patients had no follow-up providers identified. Even when follow-up providers were mentioned in the discharge summary, almost a third of the patients still saw other providers. Regional Health Information Exchanges, which contain encounter information that occur after hospital discharge, offer a valuable resource in improving identification of the true follow-up providers for patients discharged from the hospital. Additionally, historical visit information within these systems can help predict who the likely post-discharge follow-up provider will be for patients being discharged from the hospital. We observed that more than half of the patients actually followed up with a provider they had seen prior to the admission. Making this historical provider information available during discharge planning could potentially increase the likelihood that the right follow-up providers will be identified at the time of a patients hospital discharge.

PERCEPTION OF CLINICIAN ROLES AND RESPONSIBILITIES DURING CARE TRANSITIONS OF OLDER ADULTS Nancy L Schoenborn 1; Alicial. Arbaje 2; Kenric A. Maynor 3; Kathryn J. Eubank 4; Joseph A. Carrese5. 1Johns Hopkins Bayview Medical Center, Johns Hopkins University School of Medicine, Baltimore, Maryland ; 2Division of Geriatric Medicine and Gerontology, Johns Hopkins University School of Medicine, Baltimore, Maryland ; 3Geisinger Health System, Danville, Pennsylvania ; 4Geriatrics Section, Department of General Internal Medicine, University of Texas at Southwestern, Dallas, Texas ; 5Division of General Internal Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 11019)

BACKGROUND: Older adults with complex care needs frequently require care in multiple settings, and they are at high risk of receiving suboptimal care during care transitions. Clinician roles and responsibilities during care transitions remain poorly defined. We sought to characterize the perceived roles and responsibilities of inpatient- and outpatient-based clinicians during care transitions, and explore barriers to clinicians fulfilling their perceived roles.

METHODS: This was a qualitative study involving one-hour semi-structured in-depth interviews conducted with forty participants directly involved in care transitions of older adults (18 physicians, 3 nurse practitioners (CRNPs), 3 physician assistants (PAs), 10 case managers, 4 social workers, and 2 home care coordinators). These participants were from a variety of settings, including an acute care hospital, a skilled nursing facility (SNF), two community-based outpatient practices, and one home healthcare agency. Interviews explored the roles and responsibilities of clinicians (physicians, CRNPs, PAs) during care transitions of older adults, as perceived by themselves and by others. Audiotapes of the interviews were transcribed, coded, and analyzed,

generating several themes and subthemes.
RESULTS: Participants averaged 45.3 years of age and 17.2 years in practice. Seventy-two percent were women, and 15% were ethnic minorities. Slightly less than half (45%) were from outpatient clinics and home care, 27.5% from an acute hospital, and 27.5% from a SNF. Content analysis revealed several major themes:1) Essential components of clinician roles during care transitions. These included: Review of clinical information upon receiving patient; Communication with patient and family; Communication with multi-disciplinary staff; Medication reconciliation; Assessment of discharge needs and available support at home; Discharge summary; Post-discharge follow up and care; and Communication with clinicians in other settings.2) Tension between routine and ideal roles.
We found differences between what clinicians did routinely and what they would do ideally in transitions. For example, a hospitalist would routinely send the discharge summary to the primary care provider but ideally would call the primary care provider on admission and discharge of the patient.3) Agreement between self and others perceptions of ideal roles.4) Patient and clinician factors prompting clinicians to go the extra mile and move from routine to ideal roles.
Clinicians were more likely to go above and beyond their routine when the patient was medically or socially more complex, in high risk situations such as a major change in status, and when the clinician was personally more invested (e.g., when she knew the receiving clinician personally or developed a strong interest in the patients case).5) Barriers to fulfilling ideal roles.
These included: healthcare system barriers such as reimbursement and staff turnover, care transition process barriers such as lack of access to other providers, and lack of knowledge and education regarding care transitions.
CONCLUSION: This study characterizes the roles and responsibilities of clinicians during care transitions of older adults. We report discrepancies between perceived roles of clinicians in an ideal care transition and actual practice, and we describe perceived barriers to fulfilling the ideal role. We also describe patient and clinician factors that may prompt clinicians to do more than the routine and act closer to the ideal role. Future investigations could explore ways to overcome some of the barriers, and whether to target certain high-risk transitions.

PHARMACY SUPPORT IN VA PRIMARY CARE CLINICS AND MEDICATION ADHERENCE AMONG PATIENTS WITH DIABETES Beverly Mielke 1; Mark Perkins 2; Edwin Wong 2; Chuan-Fen Liu 3; David Au 4; Christopher Bryson2. 1UW Medicine, VA Puget Sound Healthcare System, Seattle, Washington ; 2VA Puget Sound Health Care System, Seattle, Washington ; 3Department of Veterans Affairs, Seattle, Washington .
(Tracking ID # 11022)
BACKGROUND: While there has been extensive research into patient specific predictors of adherence and patient specific interventions to improve adherence, little work has focused on organizational level factors that may either facilitate or hinder adherence. Pharmacists working in primary care clinics are an integral part of many patient-centered medical homes. We examined whether the presence of pharmacists in VA primary care clinics was associated with medication adherence among patients with diabetes. METHODS: We obtained refill data for all patients with diabetes on an oral medication seen in VA primary care clinics during fiscal years 2006 and 2007. We calculated a medication possession ratio using an algorithm developed specifically for the VA data sources, classifying patients as adherent if they had more than 80% of their oral therapy regimen during the first quarter of 2007. For all clinics with more than 100 such patients, we calculated an adjusted proportion of patients adherent in that clinic. Adjustment included patient level factors such as age, comorbidities, and diabetes severity from diagnostic codes. We then used organizational data from the VA Primary Care Survey,

which reported the number of full time equivalents (FTE) of pharmacists working within primary care. We used generalized estimating equations both to produce the adjusted proportions and to examine the association between pharmacy FTE per thousand patients with diabetes and proportion of adherent patients.
RESULTS: There were 212 clinics overall, comprised of 139 VA medical centers (VAMC) and 73 community-based outpatient clinics (CBOCs) in the sample, with a total of 304,472 patients represented. Overall, 71% of clinics had some pharmacist support, with 69% of VAMCs and 74% of CBOCs in the sample reporting support. There were 0.95 (range 07.6) pharmacist FTE per 10,000 clinic patients and 1.5 (0 to 14.4) pharmacist FTE per 100,000 patient-visits per year on average. The overall proportion of adherent patients was 70.8%, with wide clinic-level variation from 57.9% to 79.8% adherent patients. The adjusted proportion of patients adherent in clinics staffed with pharmacists (70.7%, 95% CI69.9% to 71.4%) and clinics without pharmacists (71.3%, 95% CI 70.1 to72.4%) was not different. Among all clinics, there was a small negative association between pharmacy FTE and adherence (0.27% per FTE, 95% CI 0.51 to 0.02%). In all other analyses after adjusting for the number of patients per clinic, or restricting to clinics with pharmacists, there were no significant associations between FTE and adherence.
CONCLUSION: This observational analysis of pharmacy FTE in primary care clinics did not explain the wide variation observed in clinic-level medication adherence. In addition to considering the usual threats to validity in cross-sectional observational data, other external organizational support, such as telephone wait times and administrative support to facilitate the mechanics of refills, may be more important in promoting adherence than high-level internal support such as pharmacists.
A RANDOMIZED CONTROLLED TRIAL OF PEER MENTORING AND FINANCIAL INCENTIVE TO IMPROVE GLUCOSE CONTROL IN AFRICAN AMERICAN VETERANS Judith A. Long 1; Erica Jahnle 2; Diane Richardson 1; Kevin Volpp1. 1Philadelphia VA Center for Health Equity Research and Promotion, Philadelphia, Pennsylvania; 2University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania. (Tracking ID # 11023)
BACKGROUND: Minority populations have disproportionately high rates of Diabetes Mellitus (DM), poor DM control, and the consequences of poor control micro-vascular complications. Interventions that improve DM control in minority population have the potential to reduce important health disparities. In this study we conducted a randomized controlled trial to test the effectiveness of peer mentoring and financial incentives in improving glucose control relative to usual care in a population of African American veterans.
METHODS: All participants were African America veterans, with persistently poor DM control (last 2 HbA1c readings >8%), between the ages of 50 and 70 years. Participants were randomized to one of three arms (usual care, peer mentoring, or financial incentives), with follow-up 6 months after enrollment. Participants had a study HbA1c drawn at enrollment and at follow-up. In addition they were called monthly to assess for hypoglycemic symptoms. Those in the peer mentoring arm were matched to a trained mentor who previously had poor DM control (HbA1c >8%) but now was in good control (HbA1c <8%). Mentors were called monthly to reinforce the training and given $20 a month for speaking with their mentee at least four times/month. Participants randomized to the financial incentive arm were told they could earn $100 at six months if their HbA1c dropped by one point and $200 if the HbA1c dropped by two points or to 6.5%. We used an intention to treat analysis and assumed no change from baseline in HbA1c for those lost to follow-up who did not have a current (+/1 month) HbA1c in the electronic medical record.
RESULTS: A total of 118 veterans were enrolled and randomized to the 3 arms (39 to usual care, 39 to peer mentoring, and 40 to financial). The mean baseline HbA1c by arm was: usual care 9.9 (SD1.6), peer mentoring 9.8 (SD 1.8), and financial incentive 9.5 (SD1.5). The mean baseline HbA1c for peer mentors (based on chart review that made them eligible for the study) was 6.7% (SD 0.6). Follow-up HbA1c was missing for 2 people in the usual care arm, 3 in the peer mentoring arm, and 4 in the financial arm. HbA1c dropped by 0.1% in the control arm, 0.9% in the peer mentoring arm, and 0.3% in the financial incentive arm. After adjusting for

baseline HbA1c, the mean change relative to control was 1.02 points (95% CI 1.75 to 0.29) in the peer mentoring arm and 0.53 points (95% CI 1.22 to 0.15) in the financial incentive arm. The intervention was well tolerated. Participants reported <3 minor hypoglycemic symptoms per month 91% of the time (511/563 calls). In addition, there were only two hospitalizations for hypoglycemia (1 in the control arm and 1 in the financial incentive arm). CONCLUSION: Peer mentors had a strong and statistically significant effect in improving glucose control in a population of veterans with persistently poor DM control whereas financial incentives had only a marginal influence on glucose control. Peer mentors may be a relatively low-cost and culturally sensitive means to improving glucose control and reducing racial disparities in diabetic outcomes.

RACIAL/ETHNIC DISPARITIES IN CANCER SCREENING RATES AMONG PATIENTS OF HEALTH CENTERS Quyen Ngo-Metzger 1; Ravi Sharma 1; Leiyu Shi 2; Seiji Hayashi 1; Charles Daly 1; Robert Politzer 3; Quyen Ngo-Metzger1. 1Health Resources and Services Administration, Rockville, Maryland ; 2Johns Hopkins School of Public Health, Baltimore, Maryland ; 3Consultant, Columbia, Maryland. (Tracking ID # 11025)

BACKGROUND: Certain racial/ethnic minority populations in the US have higher cancer prevalence and mortality, underscoring the need for

prevention and early detection. In order to rectify any disparities, evidence-based screening guidelines must be implemented effectively in minority communities.

Health Centers are Federally Qualified Health Centers supported by the Health Resources and Services Administration. They serve nearly 1 in 4 low-income (below 100% Federal Poverty Level) individuals in the US and 1 out of 7 uninsured Americans, many of whom are racial ethnic minorities. For patients of Health Centers, our objective is to assess the presence and magnitude of disparities among racial/ethnic groups and other key variables in the use of three types of cancer screening tests -Pap smear, mammogram, and colorectal screening (CRS), including sigmoidoscopy, colonoscopy, and home blood stool test - after accounting for confounding factors.

METHODS: Cross-sectional analyses using the 2009 Health Center Patient Survey. This face-to-face interview survey comprises a nationally-representative sample of 4,558 patients seen at a Health Center in the last 12 months including 1,278 non-Hispanic white, 1,142 African American, and 1,973 Hispanic patients. We estimated logistic regression models to predict the likelihood of obtaining each of three types of screening tests, after controlling for the following factors: the presence and source of health insurance coverage, presence and number of comorbidities, income relative to the Federal Poverty Level, employment status, self-reported health status, tobacco use, alcohol use, gender, age group, educational attainment, work disability or work limitation, and preferred language. RESULTS: Among health center patients, African Americans are as likely as non-Hispanic whites to receive all three types of screening (Pap, OR=1.54, 95%CI: 1.12, 2.12; Mammogram, OR=1.60, CI: 1.07, 2.40; CRS, OR=1.34, CI: 1.01, 1.77). For Pap smear and Mammogram use, there are no disparities evident between Hispanics and non-Hispanic whites (OR=1.41 (1.03, 1.95); OR=1.37 (0.93, 2.01) respectively). Regardless of race/ethnicity, smoking is strongly associated with lower likelihood of screening (Pap, OR=0.70 (0.54, 0.92); Mammogram, OR=0.51 (0.36, 0.73); CRS OR=0.79(0.62, 1.00). Additionally, lack of health insurance is strongly associated with lower likelihood of screening (Pap, OR=0.66 (0.52, 0.84); Mammogram, OR=0.54 (0.38, 0.75); CRS, OR=0.47 (0.37, 0.60).

CONCLUSION: Among Health Center patients, racial/ethnic minorities appear to be as likely as Whites to receive cancer screening, even after controlling for important clinical and demographic factors. Although smoking is a risk factor for cancer, in this study, smoking is associated with a decreased rate of cancer screening. We find that disparities due to health insurance exist: those who lack insurance coverage were less likely to be screened than those with coverage. These findings are consistent with other national data that show disparities due to lack of health insurance. Expansion of coverage may reduce disparities in cancer screening in

all settings. Furthermore, more research is needed to better understand the association between smoking and lack of cancer screening. Providers may need additional interventions to increase cancer screening among smokers.

A PERSONAL HEALTH RECORD MODULE IMPROVES DOCUMENTATION OF FAMILY HISTORY Jeffrey L. Schnipper 1; Lynn A. Volk 2; Jonathan S. Wald 3; Tejal K. Gandhi 2; Deborah H. Williams 1; Blackford Middleton2. 1Brigham and Womens Hospital, Boston, Massachusetts;
2Partners HealthCare System, Wellesley, Massachusetts; 3JSW, Inc., Sharon, Massachusetts. (Tracking ID # 11026)

BACKGROUND: Collecting and documenting detailed patient family history information is important to identify those at high risk for disease who may benefit from increased surveillance and/or risk factor modification. Currently, effective methods are lacking for systematically collecting and documenting this information for use in clinical decision support and patient care. This study evaluated the use of a family history module within an electronic personal health record (PHR) on the frequency and comprehensiveness of documented family history information. METHODS: We randomized 11 primary care practices within an integrated delivery system in the Northeast that used the Patient Gateway PHR. In the intervention practices, consented patients received access to an electronic Family History module three weeks before a scheduled office visit requesting detailed information on their personal and family history of six target conditions (breast and colon cancer, coronary artery disease, diabetes, glaucoma, and osteoporosis). Patients submitted eJournals that could be viewed by physicians during the visit where the information could be verified and easily added to the electronic health record (EHR). Study patients included those who submitted eJournals and had an associated visit. Control patients submitted eJournals about topics unrelated to family history. Study outcomes included mean number of conditions documented in the EHR per patient and mean quality score reflecting the comprehensiveness of the documented history. Scores for each condition were calculated by giving one point each for number of relatives, the degree of relationship, and the age of onset. Differences in documentation before and 30 days after the visit in the two arms of the study were analyzed using Wilcoxon rank sum test. RESULTS: 652 of 975 patients (66.9%) invited to complete a family history module submitted an eJournal. The mean number of conditions per patient documented in the EHR increased significantly more after the visit in the intervention arm compared to the control arm. The increase in quality score was greater in the intervention group, although the difference was not quite statistically significant. A weighted score which integrated quantity and quality of documented family history information also increased more in the intervention arm than in the control arm (Table).

CONCLUSION: An electronic PHR module requesting updated family history information from patients prior to an office visit was associated with a significant increase in the number of conditions documented in the EHR. There was also a trend towards more comprehensive information regarding number of relatives, degree of relationship, and age of onset for each condition, information crucial to determine patient risk and guide management.

HEALTH INFORMATION EXCHANGE AND QUALITY OF CARE Lisa Kern 1; Yolanda Barron 1; Rina Dhopeshwarkar 1; Rainu Kaushal1.
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BACKGROUND: Health information exchange, or the electronic sharing of clinical data across health care providers, has become a national priority. However, evidence on the effectiveness of health information exchange has been limited. We previously found, in a cross-sectional study, that health information exchange was associated with higher ambulatory quality of care. However, it was not possible in that study to rule out confounding by physicians baseline quality of care. This study was designed to address that limitation. Our

objective was to determine any association between health information exchange and quality of care, adjusting for baseline quality of care.
METHODS: We conducted a longitudinal cohort study over two years (Clinicaltrials.gov Registration #NCT00225563). We included primary care physicians in the Taconic Independent Practice Association in the Hudson Valley region of New York State. We included all of those primary care physicians who had at least 150 patients with MVP Healthcare and had quality data at baseline and follow-up. All physicians had access to an electronic portal, through which physicians could view test results, radiology reports, discharge summaries and other reports for their patients over time, regardless of the ordering physician. We used usage of the portal as the independent variable. For the dependent variable, we used health care quality at follow-up, as measured by 13 metrics from the Health Plan Employer Data and Information Set (HEDIS) and 2 patient satisfaction metrics. We used generalized estimation equations to measure associations between usage and quality at follow-up, adjusting for 11 physician characteristics (including adoption of electronic health records, case mix, resource utilization and health care quality at baseline).
RESULTS: We included 138 primary care physicians. The mean practice size was 4 physicians per practice. Nearly half (43%) of the physicians were users of the portal. Non-users performed at or above average for 51% of the quality metrics at both baseline and follow-up (p=1.00). Users performed at or above average for 57% of the quality metrics at baseline and 64% at follow-up (p=0.06), a relative improvement of 12%. Adjusting for physician characteristics and baseline quality, use of the portal was independently associated with higher quality of care at follow up (Odds Ratio 1.42; 95% Confidence Interval 1.04, 1.95; p=0.03).
CONCLUSION: Health information exchange, which is presently being encouraged by federal incentives, was associated with modest improvements in ambulatory quality.
MEDICAL JOURNALS IN THE 21ST CENTURY: HOW CAN THEY REFLECT THE MANY FACES OF GENERALISM? Jocalyn Clark 1;
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BACKGROUND: As a prime mode of dissemination for researchers and practitioners in general and internal medicine, medical journals aim to publish the best science and debate across all areas of medical education, research, policy, and practice. Individually and collectively, general medical journals strive to serve their diverse readerships by promoting quality research and reporting, medical professionalism, and the integrity of the scientific literature.
But what is the evolving role of general medical journals in the 21st century? Beyond being venues for the publication of science, journals like Journal of General Internal Medicine (JGIM), BMJ, PLoS Medicine and the other leading general medical journals are now interestedand often requiredto engage in broader activities that help improve the world in which we all practice and teach. These responsibilities include arbitrating plagiarism, authorship, competing interests, and other editorial crimes and misdemeanours (JGIM Jan 2011: p1); intervening when necessary in allegations of research misconduct; promoting best publication practice and ethics; organizing as groups of editors to set standards on trial registration and interactions with the pharmaceutical industry; and advocating for social responsibility and the health of vulnerable populations.
METHODS: In this session, Dr Jocalyn Clarksenior editor at PLoS Medicine, former assistant and associate editor at BMJ, assistant professor of medicine at the University of Toronto, member of SGIM, and member of the editorial policy committee of the World Association of Medical Editors (WAME)will report 3 recent cases that reflect the new roles and responsibilities of medical journals. She will discuss the leadership agenda needed to address the challenges and external pressures that both journals and the profession face, and how GIM practitioners can shape and influence that agenda. Evidence shows that none of these cases was simple or straightforwardbut each case provides an opportunity to reflect and debate the role of journals within the broader world of general and internal medicine.

RESULTS: Ghostwriting. Publishing ethics say that ghostwriting is unethical and unacceptable; but it is pervasive in the medical literature. The astonishing extent of ghostwriting in the HRT literature was revealed recently when PLoS Medicine &The New York Times partnered to intervene in litigation that resulted in the public release of 1000 s of documents showing how HRT was over-promoted by Wyeth and the risks to womens health downplayed. How can journals fight against ghostwriting and what can GIM profession do to help? Editors Competing Interests. Recent published research has revealed the extent of income from advertisements, reprints, and industry-supported supplements received by leading general medical journals, raising questions about the competing interests of editors. Given that most journals have concerned themselves mostly with the competing interests of authors and reviewers, what are the ways that journals can examine and manage their own potential for conflict? Journals Social Responsibility. If medical journals are to reflect the stated social responsibility commitments of professional associations like SGIM, they must orient their journal scope and priorities to address the needs of vulnerable populations. PLoS Medicine recently undertook an extensive re-visioning of its scope to reflect the global burden of disease and to prioritize papers addressing global health issues. How do general medical journals promote social responsibility, and how can GIM practitioners influence this aspect of journals?
CONCLUSION: The many faces of generalism demand that general medical journals in the 21st century assume new and evolving leadership roles to reflect the diversity of GIM and the external pressures that professionals and journals face. Continued debate and collaboration are required.

PERCEPTIONS OF RATES OF UNINTENDED PREGNANCY AMONG PRIMARY CARE PROVIDERS Eleanor Bimla Schwarz 1; Eleanor Bimla Schwarz 1; Sara M. Parisi 1; Mindy Sobota 2; Melissa Nothnagle 3; Cynthia Chuang4. 1University of Pittsburgh, Pittsburgh, Pennsylvania ;
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BACKGROUND: Primary care providers (PCPs) treat many women of reproductive age and are well positioned to address risk of unintended pregnancy. As contraceptive effectiveness is a major factor in womens contraceptive decision making, it is important for PCPs to convey accurate information on the risk of unintended pregnancy with and without available methods of contraception.
METHODS: We distributed an online survey to 550 PCPs trained in General Internal Medicine or Family Medicine and practicing in Western Pennsylvania, Central Pennsylvania, Rhode Island, or Oregon, in 2009. The survey focused on PCPs experiences using electronic medical records and clinical decision support. In addition, the survey contained 6 open-ended questions to assess their knowledge of the prevalence of unintended pregnancy in the United States, risk of pregnancy among non-users of contraception, and the failure rates of available contraceptive methods with typical use. Responses were considered to be correct if they were within two percentage points above or below the typical use failure rates provided by the 19th edition of Contraceptive Technology: for condoms (15%), oral contraceptive pills (8%), contraceptive injections (3%), and IUDs (< 1%). Similarly, estimates of the prevalence of unintended pregnancy in the US were considered correct if they ranged from 48-52%, and estimates of the risk of pregnancy with use of no contraception were considered correct if they were between 83-87%.
RESULTS: One hundred and seventy-two PCPs completed the online survey, a response rate of 31%. The majority (54%) of respondents underestimated the prevalence of unintended pregnancy in the US and 81% underestimated the risk of pregnancy among women using no contraception. On average, those that underestimated the prevalence of unintended pregnancy underestimated it by 23+/8 percentage points. Those that underestimated the risk of pregnancy among women using no contraception underestimated it by a mean

of 35+/20 percentage points. The majority of PCPs also underestimated the typical use failure rate of most contraceptive methods, with the exception of the IUD. Specifically, 86% of PCPs underestimated the typical use failure rate of oral contraceptive pills, 62% underestimated the typical use failure rate of condoms, and 16% underestimated the typical use failure rate of contraceptive injections. Although the majority of PCPs correctly reported the failure rate of IUDs as <1%, they were more likely to overestimate the failure rate of IUDs than any other contraceptive. Male PCPs were significantly more likely to underestimate the prevalence of unintended pregnancy than were female PCPs (70% vs. 42%, p=0.001). But male and female PCPs were equally likely to underestimate the risk of pregnancy among women using no form of contraception (80% males vs. 83% females, p=0.53).
CONCLUSION: Many PCPs have inaccurate perceptions of rates of unintended pregnancy with typical use of available contraceptives, and many underestimate the risk of pregnancy when no contraception is used. Whether more accurate perceptions of rates of unintended pregnancy would improve PCPs provision of preconception and contraceptive counseling is unknown, but deserves further study.
REDUCING DISPARITIES IN ACCESSING PRIMARY CARE: THE ROLE OF HEALTH CENTERS Quyen Ngo-Metzger 1; Leiyu Shi 2; Seiji Hayashi 1; Charles Daly 1; Ravi Sharma 1; Robert Politzer3. 1Health Resources and Services Administration, Rockville, Maryland ; 2Johns Hopkins School of Public Health, Baltimore, Maryland ; 3Consultant, Columbia, Maryland. (Tracking ID # 11030)
BACKGROUND: Disparities in access to primary care in different types of health care settings are found to be due to race/ethnicity, health insurance, income, and health needs. The purpose of this study is to examine the experience of primary care by patients seen at health centers (HCs) compared to mainstream healthcare settings such as physician offices (POs) HMOs, and hospital outpatients (HOs). The focus is on racial/ethnic (predisposing), health insurance, income (enabling) and health (need) disparities, and the role of the healthcare system in overcoming these.
METHODS: Comparative effectiveness study based on cross-sectional analyses of two nationally representative surveys. For patients seen at HCs, the 2009 Health Center Patient Survey was used. The survey, sponsored by the Health Resources and Services Administration, has a probability sample of 4,562 patients representing over 13 million HC medical patients seen during 2008. For patients seen at other healthcare settings, the 2008 National Health Interview Survey was used. To reflect the design of the Health Center Patient Survey, only respondents with at least one physician visit in mainstream healthcare settings (n=21,545) were included. Similar measures of primary care accessibility (e.g., usual source of care USC, unable or delayed in getting medical care, unable to get dental care, unable to get mental care, unable to get prescription drugs) were used in both analyses. In addition to race, income, insurance, and health status, other covariates in the multivariate analyses were age, gender, education, marital status, employment, disability, and residential region.
RESULTS: Patients seen at HCs experienced comparable or better accessibility to primary care compared to other settings, e.g., 96% of HC patients identified a USC compared to 85% for patients nationally. Whereas there were no racial/ethnic and health-status related disparities and limited insurance-related disparities in HC settings, significant disparities (racial/ethnic, insurance, and income) existed in other settings. For example, in terms of racial/ethnic disparities, nationally 17% African Americans and 29% Hispanics did not have a USC, compared to 12% whites (p<.01). 12% African Americans and 11% Hispanics were unable to get needed medical care compared to 8% whites (p<.01). Nationally 49% uninsured did not have a USC, compared to 9% privately-insured (p<.01). 27% uninsured were unable to get needed medical care compared to 4% privately-insured (p<.01). In terms of income disparities, nationally 24% low-income patients did not have a USC, compared to 10% higher-income patients (p<.01). 15% low-income patients were unable to get needed medical care compared to 4% higher-income patients (p<.01). These national-level disparities (two-fold for racial/ethnic groups and three-plus-fold for insurance and income groups) persisted after controlling for other patient

sociodemographic characteristics.
CONCLUSION: Patients seen at HCs report comparable or better accessibility to primary care compared to other healthcare settings. Unlike other healthcare settings where significant disparities existed in primary care quality among patients with different racial/ethnic, insurance, and income groups, few disparities were noted among HC patients. As safety-net providers for uninsured and vulnerable populations, HCs provide high-level accessibility to primary care and overcome health disparities.

ASSOCIATION OF EDUCATIONAL DEBT WITH QUALITY OF LIFE, BURNOUT, AND MEDICAL KNOWLEDGE: A NATIONAL STUDY OF INTERNAL MEDICINE RESIDENTS Colin P. West 1; Tait D. Shanafelt 1; Joseph C. Kolars2. 1Mayo Clinic, Rochester, Minnesota; 2University of Michigan Medical School, Ann Arbor, Michigan. (Tracking ID # 11031)
BACKGROUND: Physician debt has steadily increased in recent years, and the median debt of the medical school graduating class of 2010 was $160,000. Increased educational debt has been associated with decreased career satisfaction, depressive symptoms, and cynicism among care providers. However, despite the established prevalence of distress in medical students and physicians, there are no data on the relationship between debt and other specific aspects of well-being such as burnout or quality of life (QOL). Associations with competency have also not been explored.
METHODS: We conducted a study of United States residents using the 2008 Internal Medicine In-Training Examination (IM-ITE) survey. Educational debt was assessed, along with quality of life (QOL) and symptoms of burnout. Medical knowledge was measured by scores on the IM-ITE. Associations between debt, well-being factors, and medical knowledge were analyzed in multivariable models.
RESULTS: Data were obtained for 16,394 residents, representing 74.1% of all eligible U.S. internal medicine residents in the 20082009 academic year. QOL exhibited little association with debt. However, the presence of at least one symptom of burnout was more common among residents with greater amounts of educational debt (odds ratio, 1.72 [CI 1.49 to 1.99]; $p<0.001$ for debt >$200,000 relative to no debt). IM-ITE scores were lower at higher debt levels, with a difference of 5.0 points between residents with no debt and residents with debt exceeding $200,000. This difference exceeded the 4.1-point and 2.7-point differences seen as residents progressed through their first and second years of training, respectively. CONCLUSION: Debt burdens were associated with increased symptoms of burnout and lower medical knowledge scores. These associations with well-being and a key training competency have not previously been reported, and emphasize the potential for debt to impact both physician well-being and patient care skills. Further study of the effects of debt on physicians is warranted.
TREATMENT WITH DALTEPARIN IS ASSOCIATED WITH LOWER RISK OF BLEEDING COMPARED TO TREATMENT WITH UNFRACTIONATED HEPARIN, IN PATIENTS WITH CHRONIC KIDNEY DISEASE Manuela Calvo 1; Manuela Calvo 1; William Southern2. 1Albert Einstein College of Medicine, Bronx, New York; 2Albert Einstein College of Medicine, Sleepy Hollow, New York. (Tracking ID # 11033)
BACKGROUND: Subcutaneously administered low-molecular-weight heparins (LMWH) have emerged as the drugs of choice for hospitalized patients requiring anticoagulation because of their favorable safety profile and ease of use. However, because LMWHs are excreted by the kidneys, and accumulate in patients with chronic kidney disease (CKD), intravenous infusion of unfractionated heparin (UFH) is often used in patients with CKD. We sought to examine the safety of using Dalteparin, a LMWH that has shown minimal tendency to accumulate, in patients with CKD. We hypothesized that any risk associated with accumulation of Dalteparin would be offset by the risks of intravenous infusion of UFH, which requires more frequent monitoring and adjustment of dosing. We therefore compared the risks of bleeding in patients with CKD who are treated with Dalteparin vs. UFH.

METHODS: In this retrospective cohort study we examined all patients with CKD (GFR <60), admitted to the medical service of an urban academic medical center from January 1, 2006 to June 30, 2010 who were treated with treatment doses of Dalteparin or UFH. Treatment
doses were defined as 10000 units of daily for a minimum of three days for Dalteparin and intravenous infusion for a minimum of three days with at least one activated partial thromboplatin time 50 seconds for UFH. Smaller doses were thought likely to be used for prophylaxis, and were excluded. Demographic characteristics, laboratory values, ICD-9 code diagnoses, and inpatient medications were extracted for each admission from the electronic medical record. The primary outcome was bleeding, defined as an ICD-9 code for any bleeding event within 60 days of the initiation of anticoagulant therapy. Patients treated with dalteparin vs. UFH were compared with respect to demographic characteristics, length of stay, admitting diagnosis, co-morbidities, history of bleeding, treatment with warfarin, laboratory values (creatinine, liver function tests, hemoglobin, platelet count, INR, aPTT) and bleeding rates using t-tests and chi-squared tests, as appropriate. We constructed logistic regression models to examine the independent association between choice of anticoagulant (Dalteparin vs. UFH) and bleeding rates, after adjustment for demographic and clinical characteristics of patients.
RESULTS: Of 3546 patients with CKD treated with anticoagulants, 2045 (58%) received Dalteparin and 1501 (42%) received UFH. Patients treated with dalteparin were older, and had fewer comorbidities. A total of 355 bleeding events were identified .The incidence of bleeding was 7.6% in the dalteparin group vs. 11.7% in the UFH group (p<0.001). After adjustment for demographic and clinical characteristics, treatment with dalteparin was associated with significantly smaller risk of bleeding (OR 0.69, 95% CI:0.55-0.88) when compared with treatment with UFH.
CONCLUSION: The use of dalteparin in patients with renal insufficiency was associated with a lower rate of bleeding events compared to the use of UFH in a group of patients with similar characteristics. Dalteparin appears to be safe to use in patients with CKD.
RESEARCH WITHOUT RESULTS: INADEQUATE PUBLIC REPORTING OF CLINICALTRIAL RESULTS Ravi K. Gopal 1; Traci E. Yamashita 2; AllanV. Prochazka1. 1Denver VAMC, Denver, Colorado; 2University of Colorado Denver Health Science Center, Aurora, Colorado. (Tracking ID # 11035)
BACKGROUND: With a goal to increase transparency of the medical literature, required registration of randomized trials began in 1997. The online database clinicaltrials.gov launched in 2000 to meet these requirements. The Food and Drug Administration Amendment Act (FDAAA 801) of 2007 requires basic results reporting starting in September 2008. This law mandates that the study sponsor or principal investigator submit results no later than 1 year after primary completion date, but may be extended for 1 year upon request under good cause. We aimed to evaluate the rate of compliance with results reporting by applicable trials registered inclinicaltrials.gov and the peer-reviewed publication rate for completed studies with results. METHODS: From all 99,315 records in clinicaltrials.gov, we excluded not applicable studies per FDAAA 801 (without a United States site, phase 0 and 1, non-interventional studies), then grouped records by primary completion date into the year before required reporting, October 2006 to September 2007 (0607), and one and two years after required reporting of results, October 2007 to September 2008(0708) and October 2008 to September 2009 (0809). Abstracted data from the records included presence of results in clinicaltrials.gov, funding source, trial phase, enrollment size, and publication listed in clinical trials.gov or found in pubmed.gov by searching for clinical trials registration number. The primary and secondary outcomes were the rate of results reported in clinicaltrials.gov and publication rate among studies reporting results. Bivariate comparisons between the outcomes with funding and phase were tested with the chi-squared statistic. Mean number of subjects enrolled was compared using the t-test. Logistic

regression models were determined using stepwise selection from all study characteristics. Number enrolled was mean-centered and transformed to represent a unit change of 100 subjects.

RESULTS: We identified 1097 records in 0607, 2231 in 0708, and 2923 in 0809. Study characteristics did not differ over the study period including funding source, study phase, and number subjects enrolled. Results reporting increased from 6.8% (n=75) prior to mandatory reporting to 19.7% (n=427, p<.001) in 0708 and 10.8% (n=316, p<.001) in 0809. In regression analysis, odds ratios for reporting results was 3.34 (95%CI: 2.56-4.35) for 0708 and 1.75 (95% CI: 1.34-2.30) for 0809, versus 0607. Industry funding had positive association with reporting (OR1.60, 95%CI: 1.14-2.25) while NIH funding (OR .60, 95%CI: .42-.87) and other U.S government funding (OR .19, 95%CI: .06-.63) were negatively associated. Focusing on the 818 records that had results in clinictrials. gov, 60% (n=45) in the year prior to mandatory reporting had a peer reviewed published paper that could be found in clinicaltrials.gov or pubmed.gov. This rate decreased to 32.8% (n=140, p<.001) in 07 08 year and further to 19.9% (n=63, p<.001) in the 0809 year. In regression analysis, the odds of records with peer-reviewed published results decreased after required reporting (0708 OR: .31, 95%CI .19-.53; 0809 OR: .16, 95%CI .09-.28). Studies that were NIH funded (OR3.55, 95%CI: 2.08-6.06), Phase III (OR 2.56, 95%CI: 1.82-3.60), and larger enrollment (OR 1.02, 95%CI 1.01-1.04) were more likely to publish their results. A total of 1,112,461 subjects were enrolled in studies over the study period in which no results were reported.
CONCLUSION: Clinical trial registry has increased the transparency of published trials, but this represents a small minority of trials. Reporting of basic results for all applicable registered trials has increased but not reached its goal of universal reporting, with industry funded studies leading the way. Unfortunately, patients are still being left on the cutting room floor. Enticements with either a stick or carrot and barriers to reporting need to be identified to improve data reporting and hence transparency.

EFFICACY OF ELECTRONIC TOOLS TO ASSIST WITH IDENTIFICATION OF AND COUNSELING FOR OVERWEIGHT PATIENTS Joyce Tang 1; Robert F. Kushner 1; David W. Baker1. 1Northwestern University, Chicago, Illinois. (Tracking ID # 11040)

BACKGROUND: Although overweight (Body Mass Index [BMI] 2529.9 kg/m2) is associated with serious health consequences, physicians often do not recognize patients who are overweight and infrequently counsel them about weight loss. Our objective was to evaluate a set of electronic health record (EHR)-embedded tools to assist with identification and counseling of overweight patients.

METHODS: Physicians at an academic GIM clinic were randomized to activation of an EHR-embedded tool set (n=15) or to serve as usual care controls (n=15). The tool set included: automated calculation of BMI; physician point-of-care alert for overweight (BMI 2729. 9 kg/m2); a counseling template to help physicians counsel patients on action plans; and an order set to facilitate entry of overweight as a diagnosis and order relevant patient handouts. We queried the EHR weekly to obtain names of patients for whom the tool set was used. These patients were surveyed by phone 3 weeks after their appointment and queried about progress toward their goal and perspectives about counseling received. Medical records were reviewed for a random sample of patients with BMI 2729.9 kg/m2 who had a visit with an intervention group physician (n=100) or with a control group physician (n=100) during the study period in order to assess physician recognition of overweight as a problem (i.e. listed as an encounter diagnosis or problem in the assessment and plan) and documentation of weight-specific counseling (i.e. recommendation for weight loss or maintenance). Outcomes for intervention and control groups were compared using chi
square tests. Intervention physicians also completed an anonymous survey rating the tools and ranking barriers to tool use.

RESULTS: Intervention group physicians were more likely than control physicians to document a diagnosis of overweight (28% vs. 8%, respectively; p<0.001) and to document weight-specific counseling (32% vs. 18%, respectively; p=0.02). Two-thirds of intervention physicians documented counseling in at least 20% of their overweight patients, but only 36% of control physicians did. When documenting weight-specific counseling, intervention group physicians used the tool about half the time. Overall, the tool was used in response to only 10.7% of alerts, but 5 physicians used the tool in response to 2040% of prompts. When the tool was used,

physicians nearly always entered overweight as an encounter diagnosis (97%) and documented an action plan (98%). Sixty-one patients for whom the tool was used were interviewed by phone 3 weeks after their visit (63% response rate). Virtually all patients reported taking steps toward their goal (98%), and most said counseling increased their motivation (93%) and led to changes in their diet or exercise habits (88%). Most intervention physicians responding to a survey (73% response rate) agreed that the tool alerted them to patients they did not realize were overweight (91%) and improved the effectiveness of their counseling (82%). Physicians estimated the tool required 7.5 minutes to use, and rated time as the most important barrier to tool use.
CONCLUSION: EHR-based alerts and management tools increased documentation of overweight, the frequency of counseling, and short-term behavior change among the vast majority of patients for whom the tools were used. Although a subgroup of physicians used the tools frequently, overall tool usage was low due to time constraints. Future efforts to increase physician counseling need to identify ways of overcoming the time constraints of a routine office visit.
FACTORS AFFECTING LEARNERS DAILY PRIORITIES DURING WARD ATTENDING ROUNDS AND ATTENDING PHYSICIANS ADAPTABILITY Brita Roy 1; Nidhi Huff 2; Analia Castiglioni 1; Lisa Willett 1; Carlos Estrada 3; Robert Centor1. 1University of Alabama at Birmingham, Birmingham, Alabama ; 2University of Alabama at Birmingham, Birmingham, Alabama ; 3Birmingham VAMC, The University of Alabama at Birmingham, Birmingham, Alabama. (Tracking ID # 11041)
BACKGROUND: Understanding learners expectations and priorities for ward rounds is essential to enhance learning. In prior work, we identified domains necessary for successful ward rounds from the learners perspective. However, learners may prioritize domains differently due to daily changes in competing demands. This study aims to assess factors that affect the relative importance of each domain to learners on a daily basis and the frequency that attending physicians focus on those domains.
METHODS: In a prospective observational study, trainees from 39 different internal medicine inpatient ward teams at 3 hospitals from September-November 2010 independently completed daily evaluation cards. Each day, trainees (a) documented their teams total patient census (<5, 610, and >11 patients), (b) day of call cycle (pre-call, call, post-call, and other), (c) ranked the 2 domains their attending demonstrated best, and (d) selected the domain that was most important. Domains of successful ward rounds have been previously described, and included: Teaching Process(i.e. sharing decision-making process, physical exam skills), Learning Environment (i.e. being approachable, respectful), Role Modeling (i.e. teaching by example, bedside manner), and Team Management (i.e. efficiency, providing autonomy). Patients were admitted only on call days, every fourth night, maximum of 10 admissions in a 24-hour period; at least 1 trainee completed a 30-hour shift on the post-call day. We used Chi square tests to evaluate associations between census/call cycle and domain selected (Chi for trend).

RESULTS: Trainees completed 831 cards, evaluating 41 attendings. Team Management was the most important domain for learners on post-call days (40%) compared to non-post-call days (NPCD) (22%) (p<0.001), and attendings were ranked highly in Team Management on post-call days (ranked as a top attribute on 51% of post-call days, vs. 38% of NPCD; p=0.002). As patient census increased, Team Management was increasingly important to trainees (p-trend <0.001), but was not ranked as a top domain for attending performance (p-trend=0.56).
Teaching Process was most important on NPCD (29%) compared to post-call days (19%) (p=0.007), and attendings performed well in this domain on NPCD (59%) vs. post-call days (51%) (p=0.07). Teaching Process had no association with importance (p-trend=0.36) or performance (p-trend=0.56) as patient census increased. The importance of Role Modeling and Learning Environment was unchanged between post-call and NPCD days

(p=0.05, p=0.53; respectively). As patient census increased, Role Modeling became less important (p-trend=0.07), but attending physicians performed better in this domain (p-trend=0.04). Attending performance in Learning Environment decreased as patient census increased (p-trend=0.001), and it was a lower priority for learners (p-trend=0.02).
CONCLUSION: On post-call days and days with higher patient loads, efficiency and autonomy is the priority for trainees, but on other days attendings should focus on sharing decision making process. Success on ward rounds requires emphasis of different skills on different days: the best ward attendings recognize trainee fatigue and work load, and apply a diverse and adaptable skill set for changing needs.
CHRONIC CANCER MEDICATION ADHERENCE IN BREAST CANCER SURVIVORS: A QUALITATIVE STUDY Jenny J Lin 1; Helen-Maria Lekas 2; Liliana Serrano 3; Nina Bickell1. 1Mount Sinai School of Medicine, New York, New York ; 2Columbia University, Mailman School of Public Health, New York, New York ; 3Mount Sinai Medical Center, New York, New York. (Tracking ID # 11043)
BACKGROUND: Adherence to chronic medication is challenging but critical. As more primary cancer treatments are delivered orally and are under the patients control, understanding factors motivating cancer treatment adherence grows in importance. For women with breast cancer estrogen receptor-positive (ER+) tumors, primary adjuvant therapy requires five years of a daily anti-hormonal agent. While nonadherence tends to be higher among those experiencing side effects or with more negative views of anti-hormonal medications, other women with similar side effect profiles continue to adhere. We undertook this study to identify breast cancer survivors perceptions about and experience with hormonal therapy to inform an intervention to improve adherence.
METHODS: To date, we conducted 3 (2 English, 1 Spanish) of 6 focus groups with women diagnosed with early-stage ER + breast cancer for whom hormonal therapy was prescribed. We assessed their medication adherence, explored their beliefs about medication risks and benefits, medication side effects and barriers and facilitating factors to treatment adherence. We asked about quality of life issues, support needs, and psychosocial issues such as the symbolic meanings of continued cancer medication use (e.g., a perpetuation of the patient role). Each groups discussion was taped, transcribed verbatim and thematically analyzed.
RESULTS: We identified 4 major themes associated with medication adherence: (1) resilience exemplified by the ability to endure and cope with both medication side effects and cancer diagnosis; (2) belief that hormonal therapy is a preventive measure to decrease risk for recurrence (rather than ongoing treatment for breast cancer); (3) trust of physicians and the medical communitys knowledge; and (4) ability to exercise control over the uncertainty associated with cancer and its recurrence. Personal resilience in being able to cope with a cancer diagnosis and endure medication side effects was very
important (I consider myself a trooper). Patients almost universally felt that daily hormonal therapy helped prevent recurrence of breast cancer, although there was some difference in perceptions of how much risk reduction the medications afforded. Some felt that though the risk reduction may be very, very small, they continue to adhere for that 2% reduction in risk. Trust in
theirpersonalphysiciansandintheknowledgeofthemedicalsystemwasakey factor to continued adherence (I trust my oncologist implicitly). Women also felt that taking hormonal therapy was a personal choice (you choose to treat yourself and its up to you to find out all the best options). Some barriers to medication adherence included a misunderstandingof why oneneeded to take
themedication,poortrustoforcommunicationwithphysicians(e.g.notfeeling comfortable discussing side effects), worry about risks associated with medication and concerns about becoming dependent on medication.
CONCLUSION: Factors affecting breast cancer patients adherence to cancer medication are similar to other chronic diseases such as physician trust, physician-patient communication and beliefs about risks and benefits of medications. However, breast cancer patients also express issues of resilience, ability to endure medication side effects and risk of cancer recurrence as important aspects to medication adherence. As cancer survivors

live longer and more primary care physicians manage these patients and their chronic issues, it is important to recognize and support the factors that facilitate better medication adherence in these patients.

FACILITY CHARACTERISTICS DO NOT EXPLAIN HIGHER DIAGNOSTIC MAMMOGRAPHY FALSE POSITIVE RATES AT FACILITIES SERVING VULNERABLE WOMEN L. Elizabeth Goldman 1; Rod Walker 2; DianaL. Miglioretti 2; Rebecca Smith-Bindman 3; Karla Kerlikowske1. 1University of California San Francisco, San Francisco, California ; 2Group Health Research Institute, Seattle, Washington ; 3Univerisity of California San Francisco, San Francisco, California. (Tracking ID # 11044)

BACKGROUND: Facilities serving vulnerable women have higher diagnostic mammography false positive rates than facilities that serve primarily non-vulnerable women. False positives can lead to anxiety, unnecessary biopsies, and contribute to additional healthcare costs. Whether facility characteristics such as the availability of on-site breast ultrasound or biopsy, affiliation with an academic service, or profit status explain these differences in quality is unknown.

METHODS: We examined 78733 diagnostic mammograms obtained to evaluate a breast problem performed at Breast Cancer Surveillance Consortium facilities from 19992005. We used hierarchical logistic regression to determine if adjusting for facility characteristics accounts for differences in false positive rates between facilities serving vulnerable and non-vulnerable women. Facilities were assigned vulnerability indices according to the proportion of mammograms performed on women with lower educational attainment, racial/ethnic minority status, limited household income, or rural residence.

RESULTS: Higher false positive rates for diagnostic mammography interpretations to evaluate a breast problem at facilities serving vulnerable women were not explained by facility characteristics. While both availability of ultrasound and biopsy services onsite were associated with greater odds of a false positive in 7 of 8 models ($p<0.05$; ORs ranging from 1.24 to 1.88), adjustment for the availability of these services did not attenuate the association between vulnerability and false-positive rates. Prior to adjustment, odds ratios comparing the odds of a false positive between facilities on the basis of the binary vulnerability indices were: lower educational attainment (OR 1.33; 95% CI 1.03, 1.74); racial/ethnic minority status (OR1.33; 95% CI 0.98, 1.80); limited household income (OR 1.56; 95% CI 1.26,1.92); rural residence (OR 1.38; 95% CI 1.10, 1.73). After adjustment, these estimates were practically unchanged.

CONCLUSION: Availability of on-site diagnostic services may contribute to higher utilization of medical care overall, but it does not explain the higher

false-positive rates of diagnostic mammography at facilities serving vulnerable women. Future studies of diagnostic mammography interpretations should evaluate whether higher false positives rates at facilities serving vulnerable women are driven by radiologists concerns of a high cancer prevalence and low likelihood of follow-up in their patient populations.

ANTICOAGULATION OUTCOMES IN ATRIAL FIBRILLATION: IMPACT OF MENTAL ILLNESS Susan M. Frayne 1; Minang Turakhia 1; Rudolf Moos 1; Sarah A. Friedman 1; Susan Schmitt 1; Dan Berlowitz 2; Ciaran Phibbs1. 1VA Palo Alto Health Care System, Menlo Park, California; 2VA Bedford, Bedford, Massachusetts. (Tracking ID # 11045)

BACKGROUND: Warfarin anticoagulation can reduce stroke risk in atrial fibrillation (AF), but can harm patients with difficulty adhering to its rigorous monitoring requirements and complex dosing regimen. While clinicians often perceive patients with mental health conditions (MHC) as being at risk for non-adherence, little empiric evidence guides anticoagulation clinical decision-making in this population. We examined whether presence of comorbid MHC is associated with adverse anticoagulation outcomes: stroke, major hemorrhage, or death.

METHODS: Using the Veterans Health Administration (VA) National Patient Care Database linked to Medicare data, we identified 77,431 non-institutionalized patients with AF at the start of the observation period (FY2004) receiving warfarin from VA. We considered patients to have MHC Yes if they had an MHC ICD9 code (derived

from AHRQ Clinical Classifications Software algorithm) both at baseline and in the observation period. Patients were MHC No if they had no MHC ICD9 code in FY02-FY04. The 12,701 with ambiguous MHC status (ICD9 code at baseline or in the
observation period, but not both) were excluded from main analyses, leaving N=64,730 in the main analytic cohort. The primary outcome was the composite of stroke, major hemorrhage and death. Admissions for strokes and major hemorrhage were identified from ICD9 codes in inpatient VA and Medicare records, using established algorithms. Death was identified from VA Vital Status file (derived from VA and non-VA sources). Logistic regressions estimated adjusted odds ratios of MHC on the primary outcome and on its components, first controlling for age (AOR1), then also controlling for sex, race/ethnicity and CHADS2 stroke risk index (AOR2). RESULTS: Comparing the 10,731 MHC Yes versus the 53,999 MHC No, mean (SD) age was 72 (9.8) versus 75 (7.7) and mean (SD) CHADS2 was 3.0(1.5) versus 2.9 (1.5). 20.4% versus 16.0% had the primary (composite) outcome, 5.1% versus 4.3% died in FY04, 2.4% versus 1.3% had a stroke, and 14.4% versus 11.4% had a major hemorrhage. Patients with MHC Yes were more likely than those with MHC No to have the composite outcome in unadjusted and adjusted analyses (Table). This was true for each specific MHC as well; those with psychotic disorders and alcohol use disorders did particularly poorly. Examining components of the composite outcome, for stroke, AOR2 was 1.41; for hemorrhage, AOR2 was 1.27; and for death, AOR2 was 1.18 ($p<.05$ for each AOR2).
CONCLUSION: Warfarin-treated AF patients with MHC had significantly higher risk of stroke, hemorrhage, and death, even after adjustment for covariates. This effect was most pronounced for patients with psychotic or alcohol use disorders, pointing to the possibility that these represent high-risk subgroups. Identification of mediators of this relationship could inform efforts to improve AF-related outcomes in this vulnerable population, such as intensifying oversight of warfarin treatment or evaluating safety and efficacy of alternative stroke prevention therapies.
Table: Odds ratios for Primary Outcome, MHC Yes (and specific MHCs) versus MHC No
P <.05 for every odds ratio in table*AOR1, adjusted for age; **AOR2, adjusted for age, sex,
SYNDROMIC SURVEILLANCE OF INFLUENZA-LIKE-ILLNESS USING AUTOMATED VA DATA - PRELIMINARY RESULTS FROM THE IDAHO INFECTIOUS DISEASE REPORTING NETWORK William G Weppner 1;
Andrew Wilper 1; Joanne Mitten 2; Jay Tiumalu 3; Rick Tivis 3; Dennis Stevens4. 1Univ. of Washington/Boise VAMC, Boise, Idaho ; 2Boise VAMC, Boise, Idaho ; 3Idaho State University, Boise, Idaho ; 4Boise VAMC, University of Washington, Boise, Idaho. (Tracking ID # 11056)
BACKGROUND: Syndromic surveillance of disease uses existing health care information to help better identify and predict clinically relevant outbreaks of disease such as influenza. Currently, influenza-like illness(ILI) disease monitoring in Idaho is based on laboratory data combined with periodic person-to-person reports collected by Idaho state workers. This is time consuming an relies on voluntary reporting. Our objective was to study whether syndromic surveillance of ILI using data from the Veterans Administration electronic medical record (CPRS) correlates to officially reported influenza activity levels in the State of Idaho. METHODS: The Boise Veterans Affairs Medical Center (VAMC) provides care to over 20,000 veterans living in Idaho with clinics in Boise and surrounding sites. Using data from the Veterans Integrated Service Network (VISN 20) data warehouse for influenza from 2009, we identified ILI cases from these clinics using ICD-9 codes collected as weekly counts. Additional counts of fever (>100.5F) hypoxia (O2 <92%), lab tests for
influenza (A/B antigen, culture; novel flu), and prescriptions for antivirals (oseltamivir) were summed individually, and in an unweighted fashion as total weekly counts; Spearman correlation and multivariate logistic regression were used with predictors from the same week &preceding week. This was correlated with weekly flu activity as reported by the CDC; this reports geographic spread of influenza, as reported by state epidemiologists. The VA Puget Sound IRB approved this study. RESULTS: Using comparisons with epidemiologist-reported flu activity

level, all clinical data elements had statistically significant associations using Spearman correlation: sum of total counts of predictors r=0.57 (p<0.0001); lab tests r=0.51 (0.0001); ICD-9 codes r=0.47 (p=0.0003); prescription r=0.38 (p=0.005); fever r=0.31 (p=0.02); hypoxia r=0.28 (p=0.04). Total counts accounted for one-third (r2=0.3) of variance. Similar results were found for preceding week counts. In logistic regression, both ICD-9 and lab counts were significant predictors (Wald 2=6.80, p=0.009, Wald 2=7.15, p=0.007 respectively). CONCLUSION: Limitations include that we were only able to sample a small percent of the overall state population using VA data; accordingly, young people, women and children are underrepresented in this sample. Despite this, this study suggests that data obtained from electronic health records may be useful in predicting ILI on a regional basis. The combination of ICD-9 codes, vital signs, lab, and pharmacy data provided the best correlation with influenza. ICD-9 and lab counts

both contribute independently to prediction and should be considered to build a stronger model of prediction in our data.

This research was made possible by NIH Grant #3P20 RR0116454-0952 from the INBRE Program of the National Center for Research Resources. Research support was also provided by the Boise Veterans Affairs Medical Center and University of Washington.

Fig

ANTIPSYCHOTIC PRESCRIBING IN OLDER VETERANS ADMINISTRATION NURSING HOME PATIENTS

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(Tracking ID # 11057)

BACKGROUND: Antipsychotic medications are associated with potential adverse events among older patients, and recent studies report a high prevalence of use of these agents in U.S. nursing homes. Little is known, however, about antipsychotic use in Veterans Administration (VA) nursing homes, which, unlike their counterparts in the private sector, participate in a national formulary with a centralized pharmacy benefit manager. In this study, we estimated the prevalence of antipsychotic use by older VA nursing home patients and identified demographic, health status, and organizational factors associated with antipsychotic prescribing.

METHODS: We conducted a cross-sectional study of 3,692 Veterans over age 64, who were admitted between January 2004-June 2005 to 133 VA nursing homes, also known as Community Living Centers (CLCs). These patients had at least a 90-day stay and one drug dispensing record and were not admitted for respite or palliative care. We used VA Pharmacy Benefits Management dispensing data to examine antipsychotic prescribing. We used ICD-9 codes from VA inpatient and outpatient files in the year before admission and the Minimum Data Set to identify evidence-based indications for antipsychotic use (e.g., schizophrenia, dementia with psychosis). Independent variables included patient demographics, health status, and facility characteristics (urban/rural, region of US, bed size, presence of Alzheimers/Dementia Special Care Unit). We conducted multivariate analyses using Generalized Estimating Equations to identify the factors independently associated with receipt of an antipsychotic.

RESULTS: Overall, 25.7% (948/3692) of patients were prescribed an antipsychotic. Of these patients, 93% had regularly scheduled administration, and 90% received atypical agents. Only 59.3% of antipsychotic users had a documented evidence-based indication. Veterans with dementia but no psychosis were as likely as those with an evidence-

based indication to receive an antipsychotic (OR 1.10, 95% CI 0.82-1.47). Patients with aggressive behavior (OR 2.74, 95%CI 2.04-3.67), and those receiving anxiolytic/hypnotic medications (OR 2.30, 95%CI1.64-3.23) or drugs for dementia (OR 1.52, 95% CI 1.21-1.92) had higher odds of being prescribed an antipsychotic. Veterans residing in an Alzheimers/Dementia Special Care Unit were more likely to be prescribed an antipsychotic (OR 1.66, 95% CI 1.26-2.21). CONCLUSION: Antipsychotic prescribing is common in older VA nursing home patients, including those without a documented evidence-based indication for use. The odds of use are increased in Veterans residing in Alzheimers/Dementia Special Care Units and in those with aggressive behavior and taking concomitant anxiolytic/ hypnotics. Quality improvement efforts are needed in VA, as well as non-VA, nursing homes to reduce potentially inappropriate antipsychotic prescribing and increase the use of non-pharmacological behavior modification approaches. The effect on nursing homes of FDA antipsychotic warnings issued subsequent to the study period should be examined, both within and outside of the VA system.

RETAIL CLINICS EFFECTS ON PRIMARY CARE RELATIONSHIPS Rachel O Reid 1; J. Scott Ashwood 2; Mark W Friedberg 3; Ellerie Weber
4; Claude M Setodji 2; Ateev Mehrotra4. 1University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania ; 2RAND Corporation, Pittsburgh, Pennsylvania ; 3RAND Corporation, Boston, Massachusetts ; 4University of Pittsburgh, RAND Corporation, Pittsburgh, Pennsylvania. (Tracking ID # 11061)

BACKGROUND: Retail Clinics (RCs) are convenience-focused clinics located in retail stores. Staffed by nurse practitioners, they provide walk-in care for a limited set of acute and preventive concerns and saw 5 million visits in 2009. Physicians and policymakers are concerned that retail clinics may negatively impact primary care relationships. In theory, each RC visit to could represent one fewer visit to a primary care provider (PCP) and, therefore, one fewer opportunity to build a primary care relationship or receive preventive or chronic care. In this study we empirically evaluate these concerns.

METHODS: We performed a retrospective cohort analysis of a database of de-identified insurance claims from a sample of 14.8 million patients in 20 insurance markets from the years 20079. We sampled all patients who had an index visit to an RC for one of 11 simple acute conditions and randomly selected control patients who had an index visit to a PCP for one the same conditions.

We included 94,235 patients who were younger than 65 years, living within 20 miles of an RC, and continuously insured for 1 year before and after an index visit: 29,575 with RC index visits and 64,660 with PCP index visits. For each patient, we compared care delivered in the 365 days before and after the index visit. Using a difference-indifferences approach, we evaluated the impact of the RC visit on two proxies for a primary care relationship: (1) receipt of a preventive health examination or (2) having two or more visits to the same PCP. We used multivariate logistic regression to estimate the marginal effect of visiting a retail clinic on subsequent receipt of primary care.

RESULTS: Compared to visiting a PCP for a similar concern, visiting an RC was associated with 1.4% ($p=0.001$) increased likelihood of having a subsequent preventive health examination. Adjusted rates of preventive examinations were 27.2% before and 28.9% after an RC index visit, compared to 45.9% before and 46.2% after a PCP index visit. Compared to visiting a PCP, visiting an RC was associated with 2.5% ($p<0.001$) decreased likelihood of having two or more visits with the same PCP. The adjusted percentages of patients having two or more PCP visits were41.8% before and 42.8% after an RC index visit, compared to 51.8% before and 55.3% after a PCP index visit.

CONCLUSION: Compared to visiting a PCP for an urgent health condition, visiting an RC may modestly increase the likelihood of receiving subsequent preventive examinations and moderately decrease the subsequent likelihood of having multiple visits to the same PCP. It is possible that some preventive issues that can be addressed in an acute visit to a PCP cannot be addressed at a comparable visit to an RC. Concerning PCP continuity, after visiting RCs patients may substitute RC visits for PCP visits or may simply seek less

primary care. These first empirical analyses of the impact of RC care on PCP relationships find effects of mixed direction and modest magnitude. Physicians concerns that RCs will undermine primary care relationships may not be substantiated.

OUTPATIENT AND INPATIENT PAID MALPRACTICE CLAIMS AND THE FOCUS OF PATIENT SAFETY EFFORTS Tara F. Bishop 1; AndrewM. Ryan 1; Lawrence P. Casalino1. 1Weill Cornell Medical College, New York, New York. (Tracking ID # 11071)

BACKGROUND: Since the landmark Institute of Medicine Report, To Err is Human, there has been significant progress in patient safety, but most initiatives have centered around inpatient care. This study sought to compare the volume of paid malpractice claims for errors in the outpatient versus inpatient settings. The number and dollar amount of paid malpractice claims may be taken as an indicator of errors in each setting.

METHODS: Using data from the National Practitioner Databank (NPDB), we performed a cross-sectional comparison and trend analysis of malpractice payments for errors in the outpatient and inpatient settings. The NPDB is a repository of all malpractice claims paid on behalf of licensed health care providers. For the cross-sectional analysis, we limited our sample to claims paid in 2008. For the trend analysis, we examined payments made from 2004 to 2008. We only included payments made on behalf of a physician (MD or DO) including resident physicians. We excluded entries in which only disciplinary action by a credentialing or licensing body occurred. We calculated the absolute number and proportion of malpractice claims paid for physicians in the inpatient, outpatient, and both (for the same case) settings and used linear regression analysis to determine whether these proportions changed over time. We used the Chi-squared test to multiple logistic regression to compare differences in payments amounts by setting. We also performed chi-squared test to compare differences in the types of errors and outcomes of events by setting. RESULTS: In 2008, there were 10,535 malpractice claims paid on behalf of physicians. Of these payments, 5,020 or 47.7% were for errors in the inpatient setting, 4,487 or 42.5% were for errors in the outpatient setting, and 1,028 or 9.6% were for errors in both settings. The proportion of payments for errors in the outpatient setting increased a small but significant amount from 41.2% in 2004 to 42.6% in 2008 ($p=0.003$). Mean payment amount for errors in the outpatient setting was significantly lower than in the inpatient setting ($291,834 vs $369,227, $p<0.001$) as was median payment amount ($155,000 vs. $195,000, $p<0.001$). This difference remained significant even after accounting for differences in the type of error and patient and physician characteristics. In the outpatient setting, the most common types of errors were diagnostic (46.5%), treatment (22.5%), and medication (7.6%) errors. In the inpatient setting, the most common types of errors were surgical(35.4%), diagnostic (19.9%), and treatment (17.4%) errors. Obstetric(13.9% vs. 1.5%) and anesthesia (3.7% vs. 1.4%) errors were more common in the inpatient setting. In bivariate analysis, the proportion of the types of error was significantly different between the inpatient and outpatient settings ($p<0.001$). Major injury was the most common outcome in both the inpatient (37.2%) and outpatient (32.3%) settings.

A small but significantly higher percentage of inpatient malpractice payments were for an outcome of death (34.5% vs. 32.3%, $p<0.001$). CONCLUSION: A high proportion of paid malpractice claims are for errors in the outpatient setting. These findings suggest that we need similar focus on error reduction in the outpatient setting as has been done in the inpatient setting.

EFFECTS OF A WALKING INTERVENTION ON SYSTEMIC INFLAMMATION IN PERSONS WITH DIABETES MELLITUS AND PERIPHERAL ARTERIAL DISEASE Tracie Collins 1; Scott Lunos 1; James Hodges1. 1University of Minnesota, Minneapolis, Minnesota. (Tracking ID # 11073)

BACKGROUND: We sought to determine whether a walking intervention would reduce inflammation in patients with diabetes mellitus and peripheral arterial disease (PAD).

METHODS: We obtained blood samples from a consecutive subset of patients with diabetes mellitus and PAD (as defined by an ankle-brachial indexan objective measure of lower limb blood flow <0.9) who were part of a larger, two-arm, six-month trial. The two study arms were attention control and a home-based walking

intervention. All participants were contacted bi-weekly for six months and, during each call, the study coordinator discussed participants efforts to manage their diabetes mellitus and, as indicated, hypertension, hyperlipidemia, and smoking. For participants randomized to the intervention group, each phone call also included a stage of change based intervention to motivate the use of home-based walking at least three days each week for 50 minutes each session. Also, each intervention participant completed a 50-minute walking session with an exercise instructor one additional day each week. The study was funded by the American Diabetes Association. Participants completed baseline and six-month assessments of co-morbidities, exercise behaviors, and walking ability. Linear regression was used to assess the relationship between group assignment, walking ability, or exercise behaviors with each biomarker.
RESULTS: We obtained blood samples on 55 participants (control=25 and intervention=30). At baseline, median values for the biomarkers were as follows; soluble intercellular adhesion molecule (ICAM) 245.94, interleukin-6 (IL-6) 3.18, soluble vascular cell adhesion molecule (VCAM) 828.63, monocyte chemoattractant protein (MCP-1) 414.09, B2 microglobulin 2.80, total cholesterol 168.00, triglycerides 174.00, high-density lipoprotein (HDL) 40.00, low-density lipoprotein (LDL)81.00, and C-reactive protein (CRP) 2.82. There were no significant differences between the control and intervention groups in baseline characteristics with the exception in use of cilostazol (26% of the control group used this medication versus 8% of the intervention group, P=0.008). At 6 months and based on change in the intervention group minus change in the control group, we observed the following: ICAM 5.15 (SE 11.58, P>0.20), VCAM 29.62 (SE 48.99, P>0.20), total cholesterol 9.77 (SE 6.85, P=0.16), triglycerides 10.90 (SE 34.53, P>0.20), HDL 3.61 (SE 2.09, P=0.09), LDL 1.67 (SE 5.83, P>0.20), CRP0.19 (SE 1.41, P>0.20). In analyzing treadmill walking distance as a predictor of inflammation, we observed that ICAM changed by 1.81 (SE5.63, P>0.20); VCAM changed by 11.17 (SD 23.85, P>0.20), LDL by 0.95 (SE 2.77, P>0.20), and HDL by 0.57 (SE 1.04, P>0.20), for every 1 SD change in area under the curve for treadmill walking distance. We observed similar changes in biomarkers when looking at additional measures of walking ability including responses to the Walking Impairment Questionnaire and Exercise Behaviors Survey.
CONCLUSION: Our results suggest that some biomarkers of inflammation (ICAM, VCAM, total cholesterol, triglycerides, and LDL) may be improved by exercise in persons with diabetes mellitus and PAD.

Surprisingly, HDL which is traditionally managed with an increase in physical activity, did not improve as walking distance improved.
HEALTHCARE DISPARITIES EXPERIENCED BY ADULTS ON THE AUTISTIC SPECTRUM Christina Nicolaidis 1; Dora Raymaker 2; Katherine McDonald 3; Sebastian Dern 4; Elesia Ashkenazy 2; William Cody Boisclair 5; Amanda Baggs6. 1Oregon Health &Science University, Portland, Oregon ; 2Autistic Self-Advocacy Network, Portland, Oregon ;
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6AASPIRE member at large, Burlington, Vermont. (Tracking ID # 11075)
BACKGROUND: There has been a great increase in the recognition of Autism Spectrum Disorders (ASD). Current estimates are that up to 1% of the adult population may be on the autistic spectrum. Though studies have shown that people with developmental disabilities experience significant disparities in care, most studies have recruited participants through disability services or institutional settings and may not have included the wide heterogeneity of ASD. Autistic adults who use the Internet represent an understudied population of healthcare users who may experience important barriers to care. Our objective was to identify disparities in healthcare for autistic adults who use the Internet, as compared to Internet users without disabilities.
METHODS: The Academic Autistic Spectrum Partnership in Research and Education (AASPIRE), a partnership

between researchers, autistic self-advocates, family members, healthcare workers, and disability service providers, used a Community Based Participatory Research (CBPR) approach where community members served as equal partners in each stage of the project. We conducted an online survey via the Gateway Project, an online registration system for research projects committed to inclusion, respect, accessibility and community relevance. Gateway Project participants, age 18 or older, completed an assessment of autistic traits (the Autism Quotient) and provided information on autism-related diagnoses. Gateway Project participants who reside in the US and self-identify as being on the autistic spectrum were invited to participate in a survey on unmet healthcare needs, healthcare utilization, healthcare satisfaction, barriers to healthcare, general and psychological well-being, and healthcare self-efficacy using standardized instruments. Our team of academic and community partners adapted all instruments to be accessible to autistic adults. We matched autistic participants by age and sex with non-autistic adults without disabilities and invited them to take the same survey. We analyzed data using Stata software. We used t-tests and chi-squared tests for bivariate analyses and used logistic and linear regression for multivariate analyses. Primary analyses include all adults who consider themselves to be autistic. Secondary analyses limit autistic participants to those who score 32 or greater on the Autism Quotient and to those who have formal medical diagnoses on the autistic spectrum.
RESULTS: 360 participants (199 autistic, 161 non-autistic without disabilities) completed the survey. Both groups had high educational attainment (>90% with at least some college), but the autistic group had lower income (53% vs. 29% with <$25,000 annually). In multivariate analyses, after adjustment for age, sex, race/ethnicity, personal and parental educational level, income, and type of health insurance, autistic adults had higher odds of having unmet health needs (physical health, OR 2.3, p=0.01; preventive health OR 2.0, p=0.045; mental health, OR 5.1, p<0.001), higher odds of using the emergency room within the past year (OR 3.2, p=0.001), lower odds of complying with preventive care such as pap smears (OR 0.32, p=0.006), lower satisfaction with health care (p<0.001), lower healthcare self-efficacy (p=<0.001), and a greater number of barriers to healthcare in each category (p<0.001). Secondary analyses limiting the autistic group to either those who had formal medical diagnoses or those who scored high on the AQ did not significantly alter the results.
CONCLUSION: Autistic adults who use the Internet report receiving significantly worse healthcare than Internet users without disabilities. Healthcare providers should be made aware of potential barriers to care for autistic adults - including adults such as those in our sample, with overall high educational attainment and the communication and intellectual skills necessary to use the Internet. Future research is needed to find ways to improve healthcare for adults across the entire autistic spectrum.
TWENTY PERCENT OF TENNESSEE MEDICAID RECIPIENTS WHO PARTICIPATED IN WEIGHT WATCHERS LOST 5% OR MORE OF THEIR INITIAL WEIGHT Nia S. Mitchell 1; Misoo Ellison 1; James Hill 1; Adam Gilden Tsai1. 1University of Colorado, Denver, Colorado. (Tracking ID # 11078)
BACKGROUND: Obesity and its associated medical problems are crucial issues for internists in the United States, as well as the health care system as a whole. Low socioeconomic groups have higher rates of obesity than the general population. Although there is some evidence that commercial weight loss programs are effective, they are still too expensive for the most vulnerable populations. In an effort to help control obesity, Tennessee Medicaid (TennCare) partnered with Weight Watchers to offer its recipients access to the weight loss program for a nominal fee. The aim of this study was to determine the weight change among adult Medicaid beneficiaries that participated in Weight Watchers.
METHODS: Weight Watchers is a well known commercial weight loss program that helps its participants lose weight through group support and information about healthy eating, portion control, exercise, and behavior modification. Participants attend weekly group meetings led by Weight Watchers employees who have successfully lost weight with the program. Program participants paid a $1 copayment for each visit and TennCare covered the other $10. The current study is a retrospective analysis of weight change among 1,192

overweight and obese TennCare recipients who participated in Weight Watchers in 2006 and 2007. Weight change in kg was calculated as the difference from the first date of participation to the last. Weight change was also calculated as percentage change from initial weight. Weight change was subsequently categorized as weight loss or gain of 0 to 5%, >5 to 10%, and >10%. Analyses were stratified by gender and by initial BMI category for women (overweight vs. obese) because the starting weights for males vs. females and for overweight vs. obese females were significantly different. The average weight loss was also calculated based on the number of meetings attended.
RESULTS: During the study period, 1,965 Medicaid recipients participated in the program and 1,192 individuals were eligible for analysis with at least one follow-up weight measurement. The average starting weight for females was 111.4 kg (SD=27.7) and the average starting weight for males was 144.3 kg (SD=43.0); and the average baseline BMIs for females and males were 41.1 (SD=9.4) and 45.4 (SD=13.1), respectively. The average weight loss for all participants was 3.0 kg, equal to 2.7% of initial weight. Twenty percent of participants lost 5% or more of their initial body weight while participating in the program. There was no statistical difference in weight loss between overweight or obese females or between males and females.
The average number of meetings attended was 9.9 (SD=10.2), with a range of 2 to 92 meetings and a median of 7. Over 13% of the participants (N=160) only attended 2 meetings. On average, these participants lost 0.5% (SD=6.4) of their initial weight. Over 23% of the participants (N=276) attended 13 or more meetings, and they lost an average of 6.4% of their initial weight.

CONCLUSION: Twenty percent of the TennCare recipients who participated in Weight Watchers lost a clinically significant amount of weight, even though the average weight loss among all participants was modest. Participants who attended more meetings were more likely to lose a clinically significant amount of weight. Obesity and its associated comorbidities place a significant burden on Medicaid budgets and on the primary care providers who treat Medicaid patients. Thus, partnerships that allow low-income patients to access weight loss programs may provide a valuable weight management tool and should be explored further.
NOMINAL GROUP TECHNIQUE TO IDENTIFY ATTRIBUTES OF TOP ATTENDING PHYSICIANS Nidhi Gupta Huff 1; Brita Roy 2; Carlos Estrada 3; Robert Centor 4; Analia Castiglioni 2; Lisa Willett 2; Stuart Cohen2.
1University of Alabama at Birmingham, Fultondale, Alabama ;
2University of Alabama at Birmingham, Birmingham, Alabama ;
3Birmingham VAMC, The University of Alabama at Birmingham, Birmingham, Alabama ; 4University of Alabama at Birmingham, Birmingham VAMC, Birmingham, Alabama. (Tracking ID # 11079)
BACKGROUND: Ward attending rounds remain a cornerstone of residency education; however, data is limited on characteristics that define exceptional attendings. We created a study to identify attributes of top ranked attending physicians.
METHODS: Internal medicine residents and students on general medicine services at an academic medical center participated in nominal group technique (NGT) sessions to generate a list of attributes describing their ward attending. Participants voted on attributes based on perceived importance. For attributes with three votes or more, six physicians independently assigned them to our five previously identified domains of teaching excellence: role modeling, teaching process, learning environment, team management, and setting expectations. Attendings were placed into top, middle, and bottom tertiles using a preexisting, standard evaluation (E-value). E-value rank was compared with the number of votes in each domain. Correlation between attending rank and number of votes within domains were calculated using Pearson Correlation Coefficient (r).
RESULTS: A total of 264 residents and students participated in 17 NGT sessions for 23 attending physicians. This generated 66 attributes, which fit within the five domains of teaching excellence. Top ranked attendings received the most votes in the teaching process domain (54% of votes); attributes included: sets aside time to

teach, explains the decision making process, teaching at the bedside, and asks questions. Attending rank and teaching process votes were significantly associated (r=.998; p=.036) with no significant trends in other domains. CONCLUSION: Teaching excellence in top rated attendings is characterized by engaging learners by explaining the decision making process and setting aside time to teach.

ACCURACY OF DO NOT RESUSCITATE (DNR) IN ADMINISTRATIVE DATA L. Elizabeth Goldman 1; Philip W. Chu 1; Dennis Osmond 1; Andrew Bindman1. 1University of California San Francisco, San Francisco, California. (Tracking ID # 11080)

BACKGROUND: Having a Do Not Resuscitate (DNR) order, defined as a physician order of DNR within 24 hours of admission, is strongly associated with in-hospital death. The Center for Medicare and Medicaid Services is beginning to require the collection of whether patients have DNR orders on admission that could be used as a risk adjustment variable in hospital quality assessments. The validity of this approach is partially dependent on whether DNR is accurately reported by hospitals. The objective of this study is to test the accuracy of a DNR data element in California administrative data, the only state that currently requires the collection of this information.

METHODS: We used an audit by registered nurses (RN) of 1673 medical records from 48 California hospitals to compare DNR coding in the 2005 Patient Discharge Data (PDD) to RN re-abstraction and determined whether patient characteristics were associated with coding accuracy. Subjects were selected using a probability sample of patients with acute myocardial infarction, community-acquired pneumonia, or congestive heart failure. Overcoding a DNR order was considered to have occurred when the PDD recorded a DNR order, and the RN reabstraction said there was none. Undercoding a DNR order was considered to have occurred when the PDD did not record a DNR order, and the RN abstraction did.

RESULTS: The PDD overcoded a DNR order in 191 (11.4%) records and undercoded a DNR order in 71 (4.2%) records. Among those overcoded, the record did confirm a DNR order in 99 (46.6%) but it was incorrectly documented in the PDD because the order was written more than 24 hours after admission. The odds of DNR being inaccurately coded increased significantly with patient years of age, [(overcoding OR1.03; p=0.002); (undercoding OR 1.04; p<0.0001)] and undercoding was higher among those patients who died (OR 2.01; p=0.007)]. CONCLUSION: Among hospitalized patients with one of three common medical conditions, DNR coding in administrative data is inaccurate in more than one in seven cases. While there are important reasons to include DNR status in risk adjusted mortality rates to judge hospital quality, the finding that the recording of DNR status is particularly problematic among patients who died suggests that this variable as currently reported by hospitals in California is invalid. Further work needs to be done in developing data reporting standards for DNR if it is to become a useful component in performance measurement.

BENEFITS OF WALKING THERAPY IN PATIENTS WITH DIABETES MELLITUS AND PERIPHERAL ARTERIAL DISEASE WHO ARE LIMITED BY LEG PAIN OR FATIGUE Tracie Collins 1; Winta Ghidei 2; Jasjit Ahluwalia3. 1University of Minnesota, Minneapolis, Minnesota ;
2University of Minnesota, Center for Health Equity, Minneapolis, Minnesota ; 3University of Minnesota, Executive Director, Center for Health Equity, Minneapolis, Minnesota. (Tracking ID # 11083)

BACKGROUND: Patients with diabetes mellitus and peripheral arterial disease (PAD - defined by an ankle-brachial index - an objective measure of lower limb blood flow - <0.9) are limited by walking from both leg pain and fatigue or fatigue only. Commonly health care providers focus on leg pain, but not fatigue when managing patients with PAD. Walking therapy is an important treatment option for patients with PAD to reduce leg pain and improve quality of life. We conducted a secondary analysis of a clinical trial in which we randomized patients with diabetes mellitus and PAD to an attention control and a home-based walking intervention. This secondary analysis compared treadmill walking

distance, both maximal and onset to pain, at baseline and at 6 months in both the intervention and control groups for those stopping the treadmill secondary to leg pain and fatigue, or fatigue only. METHODS: All participants (n=145) were contacted bi-weekly for six months and, during each call, the study coordinator discussed participants efforts to manage their diabetes mellitus and, as indicated, hypertension, hyperlipidemia, and smoking. Participants completed baseline and six-month assessments of treadmill walking distance, both maximal walking distance and onset to pain distance. Linear regression was used to assess the relationship between group assignment and each outcome.
RESULTS: Of the 145 patients randomized (mean age 66.5 years, SD10.1 years), eight terminated treadmill testing for reasons other than leg pain and fatigue or fatigue only, 106 terminated treadmill testing secondary to leg pain and fatigue (control=54; intervention=52), and 31 terminated testing secondary to fatigue only (control=12; intervention=19). Comparing change from baseline to 6-months among participants who terminated treadmill testing because of leg pain and fatigue, control participants improved their maximal walking distance by 48.0 (20.9) meters as compared to 24.3 (21.6) meters for intervention participants (p=NS) and onset to pain distance increased by 50.2 (21.7) meters for control participants as compared to 54.6 (28.4) meters for intervention participants (p=NS). For persons who terminated treadmill testing for fatigue only, change from baseline to 6-months in maximal walking distance was 28.4 (52.7)) meters for control participants compared to46.7 (31.7) meters for intervention participants (p=NS) and onset to pain distance was 38.0 (52.6) meters for control participants as compared to 139.1 (34.6) meters for intervention participants (p=0.10). CONCLUSION: A home-based walking intervention may have more benefit for improving onset to pain distance as compared to maximal walking distance in persons with diabetes mellitus and PAD who are limited by fatigue (i.e., deconditioning). Further research is needed to address the benefits of home-based walking for persons with diabetes mellitus and PAD who are limited not only by leg pain but also fatigue.
EQUITY IN THE RECEIPT OF TAMIFLU DURING THE PANDEMIC FLU? William Shrank 1; Sebastian Schneeweiss 2; Michael A. Fischer 2; Jerry Avorn 2; Greg Brill 3; Julie Slezak 4; Josh Liberman 5; Troy Brennan 6; Niteesh Choudhry2. 1Brigham and Womens Hospital, Harvard Medical School, Boston, Massachusetts ; 2Brigham and Womens Hospital, Boston, Massachusetts ; 3Harvard University, Boston, Massachusetts ; 4CVS Caremark, Chicago, Illinois ; 5CVS Caremark, Hunt Valley, Maryland ; 6CVS Caremark, Woonsocket, Rhode Island . (Tracking ID # 11084)
BACKGROUND: Tamiflu is a potentially life-saving therapy for the management of influenza. During the recent pandemic flu, lay press reports raised concerns about differential access to Tamiflu based on patient income. However, little is known about the relationship between patient characteristics and receipt of Tamiflu therapy. In a sample of patients insured by a large, national pharmacy benefits manager, we evaluated patient characteristics associated with Tamiflu receipt during the pandemic flu.
METHODS: We identified patients continuously enrolled in a pharmacy benefit insurance plan from CVS Caremark between October, 2008 and May, 2010. Pharmacy claims were used to examine whether patients received a prescription for prophylactic or therapeutic doses of Tamiflu during the study period. Independent, patient-level variables included gender, age, geographic region, number of unique medications (a proxy for comorbidity) and median income in zip code of residence. We fit a logistic regression model to assess patient characteristics associated with Tamiflu receipt. In addition, we used county-level information about rates of influenza diagnosis during the study period for 19 states to assess the relationship between patient characteristics and Tamiflu receipt, controlling for disease burden.
RESULTS: The study cohort consisted of almost 26 million patients throughout the US who, on average, were 41 years old; 52.5% were female, and they used an average of 1.9 unique medications in the first 4 months of the study period. Overall, 1.26 million patients (4.8%) filled a prescription for Tamiflu during the study period. In multivariate analyses, beneficiaries aged 5064 and 65 or older had 51.2% and77.1% lower odds, respectively,

of receiving Tamiflu than young adults (age 1834). (p<0.001 for both) Patients in the Southern U.S. and those taking more medications were more likely to receive Tamiflu. (p<0.001 for both) Patients in the highest income quintile had 32% greater odds of receiving Tamiflu than those in the lowest quintile. In the 19 states with influenza diagnosis data, we found no statistically significant relationship between rates of diagnosis and the likelihood of Tamiflu receipt. Geographic variations became insignificant after controlling for influenza disease burden, and the relationship between income and Tamiflu receipt strengthened. Patients in the highest income quintile had 64% greater odds, and patients in the second highest quintile had 32% greater odds, of receipt of Tamiflu than those in the lowest quintile. (p<0.001 for both)
CONCLUSION: We found that income in the zip code of residence is more strongly related to Tamiflu receipt than rate of influenza diagnoses during the pandemic flu. These findings corroborate concerns about equity of treatment in the setting of pandemic flu, and they call for more equitable solutions to distributing potentially life-saving treatments.
A POOLED SAFETY ANALYSIS OF ROFLUMILAST FOR THE TREATMENT OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE: TIME TO ONSET, DURATION AND SEVERITY OF ADVERSE EVENTS B Wagner 1;

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BACKGROUND: The Centers for Disease Control (CDC.gov) recently reported that chronic obstructive pulmonary disease (COPD) rose from previously being the 4th leading cause of death in 2008 to 3rd in the US and its incidence is believed to be increasing in the US. Despite current treatments, patients with COPD continue to experience exacerbations, which can accelerate the progression of the disease and increase mortality. Therefore, there is an important unmet need to achieve optimal treatment for patients to help reduce exacerbations of COPD. The selective phosphodiesterase 4 (PDE4) inhibitor roflumilast (ROF) was shown to significantly reduce the incidence of moderate or severe COPD exacerbations by 17% compared with placebo and to improve lung function in 2 identical 12-month pivotal trials in patients with severe airflow limitation, bronchitic symptoms, and a history of exacerbations. In two 6-month studies of moderate-to-severe COPD patients treated concomitantly with salmeterol or tiotropium, roflumi-last also significantly improved lung function and reduced the proportion of patients experiencing a moderate or severe exacerbation. To further characterize this new treatment, the safety and tolerability of roflumilast were analyzed in a pooled COPD safety population.
METHODS: The COPD safety pool comprised 12,054 patients with moderate-to-very severe COPD from 14 randomized, double-blind studies of ROF 250 g (n=797) or 500 g (n=5766) once-daily vs placebo (n=5491). The incidence of the most frequent (2% higher for ROF vs placebo [PBO]) individual adverse events (AEs), serious AEs, and rates of withdrawals due to AEs are reported for all dose groups. The

incidence by severity (by system organ class [SOC]), duration, and time to onset for the most frequently experienced AEs are reported for the 500 g dose.
RESULTS: AE incidence was 67.2%, 60.7%, and 62.8% and serious AEs was 13.5%, 7.2%, and 14.2% for ROF 500 g, 250 g, and PBO, respectively. Withdrawals due to AEs were 14.3% for ROF 500 g, 8.9% for ROF 250 g, and 9.2% for PBO. The most frequently reported AEs were exacerbations (19.8%, 21.2%, 23.1%), diarrhea (10.1%, 4.9%,2.6%), decreased weight (6.8%, 0.8%, 1.8%), nausea (5.2%, 2.3%, 1.4%), and headache (4.6%, 3.5%, 2.0%) for ROF 500 g, 250 g and PBO, respectively.For ROF 500 g compared to PBO, between-treatment weight loss was 2.14 kg (P<0.0001); ~80% of patients regained half of their lost weight by 3 months after ROF discontinuation. The incidence of infections was similar (25.9% ROF 500 g vs 27.5% PBO), with no difference in pneumonia (1.8% vs 2.0%, respectively). Fewer cardiovascular AEs were reported with ROF 500 g (5.7%) than PBO (5.9%); no difference in potential proconvulsant effects was seen. Mesenteric

vasculitis was not seen in any patient, and depression or suicidality affected very few patients in either group (3 for ROF and 1 for PBO during treatment and 2 for ROF 3 weeks after treatment cessation). AE frequency by SOC at any intensity was similar (2% difference) for ROF 500 g and PBO, except for moderate respiratory, thoracic, and mediastinal disorders, which were 2% lower with ROF and mild/ moderate gastrointestinal disorders, or mild/moderate nervous system disorders were 2% higher with ROF. For time to onset for AEs, during the first 4 weeks AE incidence was higher with ROF 500 g (27.6%) than PBO (14.1%), while the incidence of AEs with onset later than 4 weeks was higher with PBO (85.9%) than ROF 500 g (72.4%). The majority of AEs in all treatment groups lasted <4 weeks. Weight decrease, diarrhea, nausea, and headache were more often experienced for <4 weeks with ROF 500 g vs PBO. For AEs of 26 weeks duration, there were slightly more AEs in patients in the ROF 500 g group vs PBO. In most cases, COPD exacerbations and diarrhea lasted <4 weeks.
CONCLUSION: In this large safety population of moderate-to-very severe COPD patients, oral, once-daily roflumilast was well tolerated. No unexpected AEs related to roflumilast treatment were identified. The most common AEs were generally mild-to-moderate in severity and short-lived (<4 weeks).

PERCEPTIONS OF ALERT FATIGUE BY PCPs USING AN INTEGRATED ELECTRONIC HEALTH RECORD

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BACKGROUND: Integrated electronic health records (EHRs) facilitate communication and overcome previous concerns about missing clinical information during primary care visits. The Veterans Affairs (VA) EHR uses the View Alert notification system to generate asynchronous alerts to clinicians about significant events of various priorities (e.g., diagnostic test results, referrals, orders for signature, communication from other providers). We evaluated the extent to which EHR-based notifications were acted upon and their potential to cause primary care providers (PCPs) to perceive too much information (information overload) or feel overwhelmed by the quantity of information they receive (alert fatigue).
METHODS: We conducted a cross-sectional, web-based survey of VA PCPs to assess their perceptions and practices related to alert management. We developed initial survey items after an extensive literature review and refined the survey content after pilot testing with several PCPs and soliciting expert input. The final survey tested the following constructs: 1) follow-up action on high-priority alerts; 2) follow-up action on all alerts; 3) information overload; 4) alert fatigue. We also assessed individual PCP characteristics and their alert burden. We used a large administrative VA database to identify all PCPs with a minimum patient panel size of 250, a strategy designed to exclude trainees and subspecialists. The survey was administered through a commercial internet-based survey service. Invitation emails and subsequent reminders were followed by telephone attempts to reach non-respondents.
RESULTS: Of 5001 PCPs invited, 2590 (51.8%) responded. Characteristics of respondents included 55.4% female; 31.1% non-white, and31.5% non-physician providers; 82.1% had 2 or more years in VA practice, and 49.0% had prior experience using a non-VA EHR. Respondents reported a median alert burden of 63 per day (range 1-500); 54.1% perceived over half of their alerts to be unnecessary. Regarding actions on alerts, 93.2% reported they followed up on all high-priority alerts, whereas only 77.6% reported they followed up on all alerts. Just over two-thirds of PCPs reported perceived information overload (68.7%) and alert fatigue (67.3%). The majority (81.1%) believed managing alerts took too much time away from normal duties, and 87.3% reported that they used personal time (after hours or weekends) to manage alerts through remote EHR access or working in the office. About a third (30.5%) reported receiving some protected clinical time to manage alerts; compared to those without protected time, fewer respondents in this group indicated they experienced

information overload (64.9% vs. 70.7%, P=.004) and alert fatigue (64.4 vs. 68.5%, P<.05).
CONCLUSION: In a national survey of VA PCPs, the majority of respondents endorsed information overload and fatigue related to large numbers of EHR-based asynchronous alerts. Not all EHR alerts were considered necessary, and responses suggest that a significant proportion of alerts are not acted upon. PCPs with protected (i.e., paid) time to manage alerts were marginally less likely to report alert fatigue. Future research is needed to quantify the various types of alerts PCPs receive and to review the necessity of all types of alerts to reduce alert volume.
EFFECTS OF AN EDUCATIONAL INTERVENTION ABOUT TOBACCO USE ON MEDICAL STUDENTS IN ARGENTINA Jonatan Konfino 1;
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BACKGROUND: In Argentina smoking prevalence among medical students is 30% and similar to that in the general population. The objective of this study was to implement and evaluate a brief educational intervention about tobacco use on fourth year medical students in Buenos Aires.
METHODS: At the beginning of the fourth year of the 6-year medical school, students assigned to rotations at the Universidad de Buenos Aires Hospital de Clinicas were divided into four groups. Each group attended classes at specific locations with different teachers and there was no structured contact among the different groups. Students were assigned to intervention or control based on a cluster-randomized trial design. All fourth year medical students from the Hospital de Clnicas were invited to participate in March 2009. Participants completed the Global Health Professions Student Survey (GHPSS). About half of the students then attended the modified Spanish version of the Rx for

Change Course, about tobacco cessation for students in the health sciences. Three months later, all participants completed the GHPSS againRESULTS: We invited 354 students to participate and 299 (84%) accepted. Of these 299, 70% were women, 26% had an outside job and 20% lived alone. The median age was 23 years. Although 88 (29%) were smokers, only 50 (57%) smoked cigarettes daily. Among smokers, 78% were women. Among the 299 students, 51% were exposed to second hand smoke (SHS) in their home in the previous week and 90% were exposed outside their homes. There was a high level of knowledge regarding tobacco consumption as 93%of the students answered correctly all the questions such as Smoking during pregnancy increases the risk of disease in the newborn, such as Sudden Death Syndrome? Only 3%of students had ever received information about smoking cessation and most were interested in receiving it for themselves or for their future patients. 40% of respondents considered that medical advice or smoking cessation counseling by physicians was not effective. No significant changes were observed in tobacco consumption or in the students beliefs about cessation counseling after the implementation of the educational intervention.
CONCLUSION: Providing knowledge on tobacco did not change students consumption or attitudes about tobacco use and cessation. Teaching medical students about helping their patients quit smoking should be a priority in Latin American medical education. New educational strategies will need to be developed to modify students attitudes and behavior about tobacco use.
THE EFFECT OF ELECTRONIC MEDICAL RECORD ALERTS ON PROCESSES OF CARE RELATED TO PREVENTING FALLS IN COMMUNITY-DWELLING ELDERLY PATIENTS David R. Goldmann 1;
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Veterans Affairs, Philadelphia, Pennsylvania. (Tracking ID # 11092)
BACKGROUND: Falls represent a significant cause of morbidity and mortality for vulnerable elders. Electronic medical records (EMR) have the potential to educate providers about fall prevention and simplify providing indicated care. We tested whether active or passive EMR alerts with links to order sets for management resources improved guideline-adherent fall prevention by generalists compared to usual care for community-dwelling elderly patients.
METHODS: We used a concurrent cohort design to measure two fall-related care processes (physical therapy referral and adjustment of high-risk medications) during three study periods: (1) no intervention (8 months), (2) a passive alert recommending physical therapy (PT) referral (6 months), and (3) an active alert recommending medical review for culprit drugs (6 months). Eligible patients 1) were 70 or older; 2) had been seen at least twice yearly during any of the two years prior to the beginning of the study by general internal medicine physicians in the three study practices (clinics A, B and C); and 3) responded during the study period to an eight-item health assessment questionnaire (HAQ), which included two items on past falls and fear of falling. The passive alert (Fig 1) containing fall-related assessment actions, resource links, and a PT referral link was seen by clinicians in all 3 practices in Period 2; the active alert (Fig 1) indicating that a high-fall risk medication was on the patients medication list and providing links to medication substitution protocols and other resources was seen in clinics B and C in Period 3. An educational intervention was delivered to all practices between the two alert periods. The passive alert was placed in the best practices section of the EMR; the active alert appeared on the screen and required a response before the provider could proceed. We
compared PT referrals, change in high-risk medications, and responses to the alerts across the practices within periods and across periods. RESULTS: In Period 1, 1377 of 3718 (37%) eligible patients answered the HAQ, with 392 of the 1377 (28.5%) answering positively to one or both falls questions. The percentage of those answering positively was not significantly different among the practices. In Period 2, 14/192 passive alert firings elicited a direct response from the clinician (7.3%); in Period 3, 41/ 184 passive alert firings elicited a direct response (22%). Of 21 concurrent active firings of the active alert in Period 3, all elicited a response. The medication list was reviewed in 12 (57%), and in 4 cases culprit drugs were stopped (19%). The Table illustrates how the proportion of PT referrals changed across the three study periods and practices.
CONCLUSION: One-time alerts to initiate preventive measures in elderly patients at increased risk for falls prompted a modest increase in PT referrals in 1 of 3 general internal medicine practices during a period in which an active alert regarding fall-risk related medication was operating concurrently. While very high-risk medications were present in only a minority of those elders at risk for falling, use of an active medication alert was associated with increased response to the passive PT referral alert.
Practice A
PracticeB Practice C Total Period1
4/37 (10.8%)
10/158 (6.3%)
12/197 (6.1%) 26/392 (6.6%)
Period 2
5/60 (8.3%)
6/63 (9.5%)
6/111 (5.4%) 17/234 (7.3%)
Period 3
1/12 (8.3%)
10/50 (20.0%) 8/126(6.3%) 19/188(10.1%)
COMMUNITY HEALTH CENTERS OUTPERFORM PRIVATE PHYSICIAN OFFICES ON AMBULATORY CARE PERFORMANCE MEASURES L. Elizabeth Goldman 1; Philip W. Chu 1; Max J. Romano 2; Randall S.

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3Stanford University, Palo Alto, California . (Tracking ID # 11093)
BACKGROUND: Community health centers (CHC) serve as a safety-net for many low-income and minority patients. Many are designated as Federally Qualified Health Centers, Federally Qualified Health Center look-alikes, and Indian Health Centers that receive cost-based reimbursement to provide comprehensive services to patients with higher burdens of chronic disease. Under health care reform, continued safety-net support will be predicated on demonstrated quality and efficiency. Currently, there is little data directly comparing the quality of safety-net care to that in private offices and none account for patient social and medical complexity.

METHODS: We examined the performance of CHC to private practice physicians on 18 previously established outpatient quality indicators using the 20062008 National Ambulatory Medical Care Survey, a national sample of office-based and community health center-based physician visits. CHC surveyed included Federally Qualified Health Centers, Federally Qualified Health Center look-alikes, and Indian Health Centers. Quality indicator performance was defined as the percentage of applicable visits receiving appropriate care. We compared unadjusted performance, as well as adjusted for patient age, sex, type of insurance, number of chronic diseases, depression, median zip code percent poverty and bachelors degree to account for visit complexity.
RESULTS: Across all U.S. providers, performance on the 18 indicators was variable. Adherence ranged from 14% to 100%. Compared to private office care, however, CHCs performed better on 6 indicators ($p<0.05$) and no differently on 11 indicators. Adjusting for visit complexity, CHCs performed better on 8 indicators and no differently on the remaining indicators.
CONCLUSION: CHC provide as good or higher quality care on select well established ambulatory care measures for patients in the setting of a greater chronic disease burden and socioeconomically complex patients. Future work should monitor performance on ambulatory care quality indicators with implementation of reimbursement modifications and performance incentives.
Table Private Practice Compared to CHC Performance on Quality Indicators
ENHANCING RESIDENTS CLINICAL SKILLS IN SCREENING, BRIEF INTERVENTION, AND REFERRAL TO TREATMENT FOR SUBSTANCE USE DISORDERS Neda Ratanawongsa 1; Jennifer Manuel 1; Daniel Ciccarone 1; Jennifer Hettema 2; Brad Shapiro 1; Sharad Jain 1; Diana Coffa 1; Carrie Cangelosi 3; Jacqueline Tulsky 1; David Hersh 4; Paula Lum1. 1UCSF, San Francisco, California ; 2University of Virginia, Charlottesville, Virginia ; 3San Francisco General Hospital, San Francisco, California ; 4San Francisco Department of Public Health, San Francisco, California . (Tracking ID # 11096)
BACKGROUND: Although substance use disorders cause significant morbidity and mortality in their patient populations, many internal medicine residents are not competent or confident in their skills with screening, brief intervention, or referral to treatment (SBIRT). In needs assessment surveys at our county hospital, residents who ranked discomfort and lack of experience as significant barriers were less confident in their abilities to engage in SBIRT, and half of our continuity clinic patients reported lack of counseling about substance use by their providers. To respond to this need for experiential clinical learning, we implemented and evaluated two specific methodologies within an SBIRT residency curriculum: a narrative reflection clinical case discussion and a clinical observation checklist exercise.
METHODS: Beginning in July 2009, we implemented an 8-week, 32-hour longitudinal SBIRT curriculum for internal medicine residents, comprised of small group discussions, motivational interviewing (MI) role-play, and site visits to local substance use treatment programs. To respond to gaps in experiential learning, we developed a narrative reflection-based case discussion facilitated by SBIRT-trained clinical faculty, in which residents were asked to write about and discuss a memorable experience talking with a primary care patient about drug or alcohol use that was particularly rewarding or challenging. Reflection prompts asked about challenges and

rewards in the encounter, helpful people/resources, wishes for what could have been different, questions/insights in caring for patients with substance use disorders, and goals for the next conversation. In July 2010, adapting SBIRT skills card and the validated Behavioral Change Counseling Index, we developed a clinical observation checklist to track residents implementation of SBIRT skills with their continuity patients comprised of check-off boxes for specific SBIRT tasks, rating scales for communication style, and qualitative comments for what residents should keep, stop, and start doing. We implemented the checklist in a formative feedback exercise in which trained faculty observers rated residents interactions with 2 clinic patients, followed by a debrief and goal-setting for future

practice-based improvement. Using an editing analysis style, we coded the qualitative comments from the narratives, discussions, rating checklists, and debriefings about insights, challenges, and rewards in residents SBIRT interactions.

RESULTS: To date, 32 residents have participated in at least 2 clinical case reflection exercise discussions and at least 1 observation checklist exercise. Qualitative analysis from the narrative reflections/discussions reveals that residents felt increasing self-efficacy applying MI skills to engage in discussions about substance use with patients whom they found frustrating: It was really nice to just set aside his other, numerous, health concerns and focus on this issue of central concern to him. For me, relaxing about the time pressures allowed much more of my recent and past training in strong interpersonal communication and motivational interviewing to come out, in a reasonably natural way or It was rewarding to listen to his perspective on his ETOH, why he drinks and his own very good insights into the negative sides of drinking. However, residents cited lack of time, competing responsibilities, lack of precepting support, and patient resistance as continued barriers to applying SBIRT skills in clinic: I wish I had a bit more time to chat about her life, her family, and her daily struggles or I wish we could have had more time to talk about his alcoholism. Pt has other medical issues including diabetes, which he is very concerned about and he wanted to address that. Analysis of qualitative checklist data revealed that residents screened skillfully for drug use disorders and employed patient-centered listening skills, while struggling with rolling with resistance and formulating specific action plans. Residents set objectives for themselves to assess for drug use disorders more systematically and employ MI skills more regularly across other behavior change topics.

CONCLUSION: In this SBIRT residency curriculum, reflective practice exercises using narrative-prompted facilitated discussions and clinical observation exercises revealed improving self-efficacy and improving MI skills in conversations with patients about substance use disorders, but also continuing challenges related to systems-based practice and rolling with patient resistance. These clinical exercises suggest that experiential learning, using structured reflection and observation tools, is a valuable educational method for identifying continuing needs and evaluating the impact of a competency-based SBIRT curriculum.

A CLINICAL RISK INDEX FOR LONG TERM SURVIVAL OF HOSPITALIZED OLDER PATIENTS Kala M. Mehta 1; Edgar Pierluissi 1; W. John Boscardin 1; Katharine A. Kirby 1; Louise C. Walter 1; Mary-Margaret Chren 2; Robert M. Palmer 3; Steven Counsell 4; C. Seth Landefeld1. 1Division of Geriatrics, University of California, San Francisco, San Francisco, California ; 2Department of Dermatology, University of California, San Francisco, San Francisco, California ;
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BACKGROUND: Predicting long term survival in hospitalized older adults may help guide decision-making for patients, families and clinicians. There are no long-term prognostic indices for this population. Thus, our

objective was to develop and validate a clinical index for older, hospitalized adults in a cohort with near-complete mortality data up to 15 years.
METHODS: We developed this prognostic index in 1482 patients >=70 years discharged from the general medical service of a teaching hospital (mean age, 79.6 years; 61% female) and validated it in 1564 similar patients discharged from another teaching hospital (mean age80.5 years, 67% female). All patients were followed until death or 10 years after discharge. Independent predictors of mortality were examined using Kaplan-Meier survival analysis. The clinical index was identified using multiple Cox proportional hazards analyses with a best subsets method of variable selection.
RESULTS: The cumulative incidence of death at 1, 5, and 10 years was 30%, 66%, and 86%, respectively. In the development group, independent (p, 0.01) risk factors for death were older age; male gender; >=2 dependent activities of daily living (ADL) at hospital discharge; body mass index<=18; chronic kidney disease; congestive heart failure; chronic lung disease; cancer; and severe cognitive impairment. A clinical risk index with these risk factors stratified patients according to risk of death (Table 1). CONCLUSION: Using clinical information at hospital discharge, this risk index accurately stratified hospitalized older adults according to their risk for death over 10 years. Risk for death over time differed greatly according to the clinical index: few patients with low predicted risk died in one year, and almost all patients with high predicted risk had died by 10 years.
Table 1. Death rates according to quintities of predicted risk derived from the development cohort at 1, 5, and 10 years.
MEDICARE POST-HOSPITALIZATION SKILLED NURSING BENEFIT IN THE LAST SIX MONTHS OF LIFE
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BACKGROUND: Older adults often transition to skilled nursing facilities (SNFs) following acute hospitalization in the last months of life under the Medicare SNF benefit. However, current Medicare policy prohibits concomitant payment for both SNF and Hospice services. We sought to examine patterns of SNF use following hospitalization in the last 6 months of life.
METHODS: We used the Health and Retirement Study (HRS), a nationally represented study of older adults, linked to Medicare claims data. From Medicare claims, we determined the number of individuals age 65+ who used the SNF benefit in the last 6 months of life following hospitalization, and their admitting diagnosis to SNF. Using linked data from the HRS, we examined demographic, social, and clinical correlates of SNF use.
RESULTS: Our sample included 4,516 patients who died between 1994 and 2006 (mean age 83 [SD 8], 54% female, 87% white). Age-adjusted use of the SNF benefit in the last 6 months of life increased from 17% in 1994 to 36% in 2006. The most common admitting diagnoses were heart failure (9%), hip fracture (6%), and rehabilitation (5%). Use of the SNF

benefit was greater among patients who were: older (>85 36%, <85 26%), poorer (lowest quartile of net worth 34%, highest quartile 28%), and did not have cancer (no cancer 32%, cancer 26%) (all p<.001). These differences persisted after adjustment for age, sex, race/ethnicity, marital status, educational attainment, region, chronic conditions, and year of death. After using the SNF benefit 18% of patients enrolled in hospice and 27% died in a hospital. Among patients who died in 2006, 14% used the post-hospitalization SNF benefit 2 or more times in the last 6 months of life.
CONCLUSION: Over one-third of older adults now receive care in a SNF at the end of life under the Medicare SNF benefit. Many older adults shuffle between the hospital and SNF at the end of life. Although Medicare policy prohibits payment for hospice when patients are using the SNF benefit, many patients use the benefit near the end of life, suggesting a need to incorporate palliative services into the Medicare SNF benefit.
FACTORS ASSOCIATED WITH OBESITY IN A PRIMARY CARE POPULATION Adam Gilden Tsai 1; Jeanne Rozwadowski 2; Rachael Meir 3; David Brody 3; Jeanette Waxmonsky1. 1University of Colorado, Denver,

Colorado; 2Denver Health and Hospitals, Denver, Colorado;
3Denver Health Managed Care, Denver, Colorado. (Tracking ID # 11102)
BACKGROUND: Obesity is more prevalent among African-Americans and Hispanics as well as persons of lower socioeconomic status (SES). Lack of health care access and lower SES may also be associated with minority status and obesity. This study attempts to determine whether, in an outpatient health care setting, the relationship between race/ ethnicity and obesity could be explained by health care utilization or by poverty.
METHODS: This was a cross-sectional analysis of adult patients aged 1865 seen in primary care clinics within the past year with documented weight and height. Underweight individuals and women who had been pregnant in the last year were excluded. Weight categories were defined by body mass index (BMI): normal weight (1924.9 kg/m2), overweight (2529.9 kg/m2), obesity (3039.9 kg/ m2), and morbid obesity (>40 kg/m2). The roles of demographic and clinical factors as predictors for being in a higher BMI category were analyzed using ordinal logistic regression. Socio-demographic factors (race/ethnicity, language, household income) were assessed from data collected routinely within clinical encounters. Burden of co-morbid disease was assessed using the Chronic Disease and Disability Payment System, a validated measure for use in Medicaid populations.
RESULTS: Of the 23,428 patients, 25% were non-Hispanic Whites, 51% were Hispanic, and 19% were African-American. Obesity prevalence was 43% overall (compared to 34% nationally). Whites had a lower prevalence of obesity (39%) than Blacks (44%) or Hispanics (47%); $p<0.001$ for both comparisons. In multivariate analyses, all factors were significant except language, % of federal poverty level, and number of visits (see tables). The factors most strongly associated with greater odds of obesity were: female gender, Latino ethnicity, African-American race, increasing age, increasing co-morbidity index, and use of >4 medications.
CONCLUSION: Female gender, Latino ethnicity, African-American race, increasing age, increasing co-morbidity, and medication count are independently associated with obesity. Household income (% of federal poverty level) was not associated with obesity in this analysis. This may be because our patient population is nearly all low income (97% of persons at or below 200% of federal poverty level in the current analysis). Alternatively, this may be explained by similar utilization of care within this system. These results suggest that, in a public health care system with a uniformly low SES group of patients, the association between race/ethnicity and obesity is not explained by poverty or by differential health care utilization.
SHARED DECISION MAKING IN PSA TESTING Alison Rose Landrey 1;
Daniel D Matlock 2; Laura Andrews 1; Thomas D Denberg3. 1University of Colorado Hospital, Denver, Colorado ; 2University of Colorado Hospital, Aurora, Colorado ; 3Atrius Health and Harvard Vanguard Medical Associate, Boston, Massachusetts . (Tracking ID # 11103)
BACKGROUND: With substantial evidence indicating the equivocal benefit of the prostate specific antigen (PSA) test in screening for prostate cancer, the United States Preventive Task Force suggests that a clinician should not order the PSA test without first discussing with the patient the potential but uncertain benefits and the known harms of prostate cancer screening and treatment. Other professional societies have similar recommendations. Evidence also suggests that many men are tested without this discussion. There is thus a need to develop effective ways to aid patients and physicians in having such discussions. This project examines if a low literacy, one-page flyer outlining the risks and benefits of the PSA test, and encouraging patients to talk to their provider about this test, increases the rate of discussions surrounding PSA testing.
METHODS: The flyer was developed iteratively among practitioners at the University of Colorado and was designed for people with a 4th grade reading level. Men between the ages of 50 and 75 who were scheduled for an upcoming annual visit were randomized to either receive the flyer in the mail or no intervention (n=303).Our primary outcome was documentation of discussion of PSA testing. Secondary outcomes included rate of PSA testing and results of a post-visit phone survey assessing patients perception of their participation in the decision making, patient knowledge of PSA testing, the control preferences scale, and acceptability of the flyer. Additionally, clinicians seeing patients in the intervention arm were randomized to receiving a reminder to

discuss PSA screening prior to the visit or no intervention. Chi-Squared analysis was used to evaluate differences between the groups.
RESULTS: There were no differences in chart documentation of PSA discussions (17.6% in the flyer group vs. 13.7%, p=0.36) or the rate of PSA testing (62.5% vs. 58.5%, p=0.49). When clinicians were reminded to discuss the PSA test with their patients, there was a non-significant trend toward patients receiving more testing (72.9% vs. 55.4%, p=0.06). Response rate for the follow-up survey was 53.7% (55.2% in the intervention and 53.0% in the control). Of those patients who reported having received the flyer in the survey, significantly more reported having a discussion around PSA testing with their provider (91.5% vs.57.1%, p<0.001) and reported sharing their feelings surrounding PSA testing (83.0% vs 56.7%, p=0.002). Patients who reported receiving the flyer generally scored better on knowledge questions regarding PSA testing, but this difference was significant for only one of the questions:85.1% vs. 68.6% knew that the PSA test is conducted by a blood sample (p=0.003). The majority of patients preferred an active role in decision making, reporting that the decision should be made either the patient alone (19.7%), by the patient with providers input (32.2%), or by the patient and provider together (40.8%), with similar responses between the groups. Of those who received the flyer, 89% would recommend it to others.
CONCLUSION: Patients who reported receiving the flyer had more discussions with their provider and expressed more of their feelings around PSA testing. Additionally, the flyer improved

knowledge around PSA testing and was highly acceptable to the patients. However, it had no effect on the rate of PSA testing or the rate of documentation of discussions surrounding PSA testing. Interestingly, reminding the provider to discuss PSA testing resulted in a higher rate of PSA testing. Improving patient participation in PSA decision making is important regardless of the rate of PSA testing.
LITERACY-COMPENSATORY STRATEGIES AND RESOURCES OF OLDER LATINOS WITH DIABETES
Kristina M. Cordasco 1; Gery Ryan 2; Blanca X. Dominguez 2; Alexis Huynh 2; Diana C. Homeier 3; Kathyrn Pitkin Derose 2; Catherine A Sarkisian4. 1The VA Greater Los Angeles Health Care System; The RAND Corporation; The University of California, Los Angeles, Los Angeles, California ; 2The RAND Corporation, Santa Monica, California ; 3LAC + USC Medical Center, Los Angeles, California ; 4The VA Greater Los Angeles Healthcare System; The University of California, Los Angeles, Los Angeles, California . (Tracking ID # 11105)
BACKGROUND: Limited health literacy is associated with multiple health disparities. As a foundation for developing patient-centered interventions to decrease these disparities, we identified literacy-compensatory strategies and resources used by older Spanish-speaking Latinos with diabetes and limited health literacy.
METHODS: We conducted semi-structured interviews with monolingual Spanish-speakers who were illiterate (Shortened Test of Functional Health Literacy, sTOFHLA=0), very low literate (sTOFHLA score=18), or limited health literate (sTOFHLA score=916); aged 65 years or more; patients of The Los Angeles County + University of Southern California Medical Center primary care clinics; had visual acuity 20/100; and diagnosed with diabetes for 1 or more years. We asked participants to describe how they manage the prevention, monitoring, responding, and communicating tasks associated with diabetes self-management (Table). All interviews were professionally
translated and transcribed. Using content analysis, two team members (K.C. and B.D.) read the first 30 transcripts and then jointly listed and discussed themes of reported literacy-compensatory strategies and resources. After serially testing these themes against 6 intentionally-selected test transcripts, we presented them to the entire research team. Through discussion, the team further developed and clarified theme definitions. We then reviewed the remaining transcripts and labeled participants statements that illustrated these themes. Transcripts and labeling were managed with Atlas.ti6.0.

RESULTS: Of the 91 participants, 23% were illiterate, 43% were very low literate and 34% had limited health literacy. Participants described using a range of strategies and resources for acquiring information, organizing information and acting on tasks. Strategies can be broadly classified as those in which the participant retains complete control for caring for their health, those in which the participant shares control with others, and those in which the participant relinquishes control to others. Those participants who retain complete control in managing their disease compensate for their literacy deficits by relying on alternative skills, such as memory, and procuring assistance from a variety of resources, including healthcare personnel, neighbors, and available strangers. A second category of participants share control with family members, consistently utilize one or two family-members as their resource when faced with literacy-dependent tasks. In a third category, some patients completely relinquish control of their health to others, so that a caregiver performs all tasks related to the participants health.
CONCLUSION: Older illiterate, low-literate, and limited health literate patients use a range of strategies and resources to compensate for their literacy limitations. Future work should examine if certain strategies and resources are more effective than others, potential determinants of effectiveness, and how interventions can be synergistic with patients strategies and resources.
Table: Tasks For Which Participants Were Asked To Describe Management
Prevention Tasks
Taking and Refilling Medications Using InsulinCaring for FeetMaintaining a Diabetic Diet
Obtaining a Flu ShotMonitoring and Responding Tasks
Knowing Sigs/Symptoms of Hypo/Hyper-Glycemia
Monitoring Blood Glucose and Blood PressureKnowing how to respond to hyper/hypo-glycemia Attending Appointments Obtaining Regular Laboratory Assessments
Communicating Tasks
Seeking Information Form HealthCare ProvidersSeeking Clarification When The Patient Does Not Understand Something Being CommunicatedSeeking Information From, Utilizing, and Requesting Help From Family Members, Friends, and Community Resources Revealing Limited Literacy Skills

BLOOD PRESSURE CONTROL IN A HIGH PERFORMING HEALTH-CARE SYSTEM: ARE WE OVERTREATING? Eve Kerr 1; Michelle Lucatorto 2; Rob Holleman 3; Leonard Pogach 4; Mary Hogan 3; Sarah Krein 1; Steven Bernstein 1; Timothy Hofer1. 1VA Center for Clinical Management Research and University of Michigan, Ann Arbor, Michigan ;
2VA Office of Quality and Performance, Washington DC, District of Columbia ; 3VA Center for Clinical Management Research, Ann Arbor, Michigan ; 4Center for Healthcare Knowledge Management, East Orange, New Jersey . (Tracking ID # 11107)
BACKGROUND: In response in part to rigorous performance measurement, the Veterans Health Administration (VHA) and other high-performing healthcare systems have seen dramatic improvements over the past decade in the proportion of diabetic patients whose blood pressure (BP) is less than 140/90 mm Hg. However there is increasing concern that performance measures may also be motivating overtreatment of hypertension, resulting in dangerously low diastolic levels. In collaboration with clinical and research experts in hypertension, we have developed a tightly-linked clinical action measure, which is designed to encourage appropriate clinical action while minimizing unintended consequences like overtreatment; and a measure of potential overtreatment, designed to monitor for overly aggressive treatment in the face of low diastolic BP. We applied these measures to examine what proportion of VA diabetic patients are meeting appropriate quality for hypertension and the degree of potential overtreatment. METHODS: Using data from the national corporate data warehouse, we examined the proportion of diabetic Veterans passing a linked clinical action measure for hypertension between July 2009 and September 2010. The index BP was the last BP recorded prior to July 2010. Passing the

measure was defined as: having an adequate index BP at the visit (BP<140/90; or SBP <150 with either a low diastolic (<65) or on >=3 moderate dose BP medications) or having an appropriate action within 90 days of the index BP (BP medication intensification or repeat BP <140/90). We also examined overtreatment, defined as having an index BP <140/65 and either BP medication intensification within 90 days or being on >=4 BP medications at moderate or high dose. Variability across facilities was assessed using multilevel logistic models.

RESULTS: 696,504 diabetic patients in 129 facilities were eligible. Overall, 93% passed the linked action measure: 81% because they had a BP <140/90 at the visit; and an additional 12% with BP >140/90 who passed on the basis of BP <150/65(1%), SBP <150 on >=3 medications (2%), medication intensification (8%) and repeat BP <140/90 (1%). Facility pass rates varied significantly but over a limited range from 90% to 96% (p<.001). 144,264 patients (20%) had a BP <140/65; of these, 25% had potential overtreatment (21% were intensified, 4% were on >=4 medications). Facility rates of potential overtreatment varied from 21% to 30% (p<0.001). Facility rates of potential overtreatment varied from 21% to 30% (p<0.001). Facilities with higher rates of overtreatment had:(1) higher rates of meeting a stringent (and not promoted in VHA) BP control level of 130/80(p<0.05); and (2) higher proportions of patients on 4 or more antihypertensive agents (p<0.001).
CONCLUSION: Over 90% of diabetic Veterans are receiving appropriate hypertension care, as indicated by a linked clinical action measure, with moderate variation across facilities. Rates of potential overtreatment varied widely across facilities and were associated with higher facility rates of meeting stringent control levels and with complicated drug regimens. Our results show that overall rates of potential overtreatment are currently approaching the rate of under-treatment (5%-7%) and suggest that monitoring and reducing overtreatment may now be equally important for improving quality of care in VHA and possibly in other high performing healthcare systems.

FACTORS INFLUENCING QUALITY OF LIFE IN LATE LIFE DISABILITY Alexander Smith 1; Jennifer King 1; Lindsey Yourman 1; Cyrus Ahalt 2; Catherine Eng 1; Sara Knight 1; Eliseo J Perez-Stable 1; Kenneth Covinsky1.
1UCSF, San Francisco, California; 2SFVAMC, San Francisco, California. (Tracking ID # 11110)

BACKGROUND: While late life disability is widely assumed to negatively impact quality of life, factors influencing quality of life of elders with late life disability have not been well described. We therefore conducted a study of quality of life in a diverse population of elders with late life disability. METHODS: We used qualitative methodology. Subjects were recruited from On Lok, the first Program of All-inclusive Care for the Elderly (PACE). All On Lok enrollees are disabled and meet Medicaid criteria for nursing home placement. Average life expectancy is 4.5 years following enrollment. We interviewed elders in English, Spanish, and Cantonese who had a mini-mental status >20. Respondents were asked to rate their overall quality of life on a 5 point scale (excellent to poor). Open ended questions explored the reasons for their rating, with specific probes about living with disability and dependence. Responses were taped and transcribed. Transcripts were analyzed using grounded theory methodology. Codes were grouped into themes. Recruitment stopped when no new themes emerged.
RESULTS: We interviewed 60 older adults (mean age 78, 62% women, 27% European American, 23% African American, 12% Latino, 37% Chinese American, mean 3 ADL dependencies). 76% of respondents rated their quality of life as good or better. 6 domains emerged that dependent elders felt were important to their quality of life: physical (disability, pain, non-pain symptoms); psychological (depression, anxiety, resilience); cognitive (cognitive impairment); ethical (autonomy, dignity); spiritual/religious (hope, religious coping); and social (life-space, isolation/support). Examples of representative quotes include: It is unfortunate that a lot of your family or other people feel that once you are old you do not know anything anymore and you justkind of in the way (dignity: deserving of respect or esteem); Before I could take the bus to go out but last year since I fell until now I am too afraid to go out on my own (life space: ability to function and participate in society). CONCLUSION: In

this diverse group of very disabled elders, most rated their quality of life as at least good. Many of the factors that influence quality of life, including life-space, resilience, religious coping, and respect for dignity, are missing from standard assessments of quality of life (e.g. SF-36).

RESPECT THE WAY I NEED TO COMMUNICATE WITH YOU: HEALTHCARE EXPERIENCES OF ADULTS ON THE AUTISTIC SPECTRUM Christina Nicolaidis 1; Dora Raymaker 2; Katherine McDonald 3; Elesia Ashkenazy 2; Sebastian Dern 4; Cody Boisclair 5; Amanda Baggs 6; Enyinne Ejiasa 1; Roberta Delaney 7; Way Rhonda8.

1Oregon Health &Science University, Portland, Oregon ; 2Autistic Self-Advocacy Network, Portland, Oregon ; 3Portland State University, Portland, Oregon ; 4AASPIRE member at large, Berlin, N/A ; 5AASPIRE member at large, Atlanta, Georgia ; AASPIRE member at large, Burlington, Vermont ; 7AASPIRE member at large, Portland, Oregon ;

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BACKGROUND: It in now estimated that up to 1% of the population may be on the autistic spectrum, but little is known about how to provide quality primary care to autistic adults. Our online survey research has found that autistic adults who use the Internet have statistically significant worse healthcare outcomes than non-autistic Internet users. The objective of this qualitative study was to obtain an in-depth understanding of autistic adults experiences with healthcare and recommendations for improving care.

METHODS: The Academic Autistic Spectrum Partnership in Research and Education (AASPIRE) is a partnership between researchers, autistic self-advocates, family members, healthcare workers, and disability service providers. We used a Community Based Participatory Research (CBPR) approach were community members served as equal partners in every stage of the project. We conducted semi-structured, open-ended, in-depth interviews via telephone, email, or instant messenger chat, with adult Internet users who considered themselves to be on the autistic spectrum. Participants had to reside in the US and either carry a formal medical diagnosis on the autistic spectrum or score 32 or greater on the Autism Quotient. We purposefully sampled participants from our earlier online survey to ensure diverse demographic characteristics, diagnosis type, age of diagnosis, preferred communication mode, and healthcare utilization and satisfaction. Interview questions addressed participants positive and negative experiences with healthcare and their recommendations for improving care. Academic and community partners jointly analyzed data using thematic analysis with an inductive approach (consistent with Grounded Theory), at a semantic level with an essentialist paradigm.

RESULTS: 27 autistic Internet users (12 men and 15 women), aged 20 64 years, participated in an individual interview. 63% were White, non-Hispanic. While education levels were high (88% with at least some college), the majority of the participants were unemployed and had a personal income of less than $25,000. We identified five common themes. 1) Difficulty with body awareness can affect ability to report symptoms: I dont know my own body. So when I feel all these different sensations, everywhere, I dont know which is the real problem and which is just sensation. 2) Preference for written communication is not always respected by physicians: I prefer and find it easier to communicate in text But with every doctor I speak to, they wave away the note-card and look at me to ask the same question I have just answered. 3) Difficulty with open-ended questions or vague explanations: BAD: How do you feel? Too vague. 4) Sensory issues can cause difficulty interacting with provider: All of the sensory input makes my brain slow down.... I am not able to bring up my concerns because it is all I can manage to figure out what the doctor is saying so I can respond to his questions. 5) Difficulty with executive function affects ability to navigate health system: With my autism it is very difficult for me to understand and follow all the different appointments and procedures I have to schedule.... No one will help me since apparently people magically become competent at these things before they turn 21. Participants offered

many concrete suggestions for how providers can help improve healthcare interactions with autistic patients. Examples included asking specific, closed-ended questions, allowing patients to communicate in writing, allowing time for patients to process information, and reducing unnecessary sensory stimuli.
CONCLUSION: Autistic adults describe important factors that may adversely affect the health and healthcare of patients on the autistic spectrum and offer concrete ideas of how to improve care. Healthcare providers should be open to accommodations and strategies that may improve interactions with autistic patients, and thereby positively impact health outcomes. We are using information from this study to create interactive tools to improve the primary care of adults on the autistic spectrum.
USE OF COMPLEMENTARY AND ALTERNATIVE MEDICINE AMONG PATIENTS WITH END-STAGE RENAL DISEASE Gurjeet Singh Birdee 1;
Kerri Cavanaugh 1; Russell Rothman 1; Talat Alp Ikizler 1; Russell S Phillips2. 1Vanderbilt University, Nashville, Tennessee; 2Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 11120)
BACKGROUND: Few studies have examined the use of complementary and alternative medicine (CAM) among patients with chronic kidney
disease including end-stage renal disease (ESRD). Mind-body practices, one type of CAM modality, may be a novel therapeutic option for patients with ESRD during dialysis. Examples of mind-body practices are breathing exercises, meditation and yoga. The purpose of this study was to identify the frequency of CAM use, perceptions of mind-body practice, and willingness to learn mind-body practices among patients with ESRD receiving in-center hemodialysis.
METHODS: Adult patients with ESRD on hemodialysis were surveyed at a dialysis center affiliated with an academic medical center in Boston, MA from September 2009 to July 2010. We queried patients regarding: use of 18 common CAM modalities and dietary supplements in their lifetime and the last month; perceived importance of mind-body interaction for health (Likert scale 010 for none to extremely important); and willingness to learn mind-body practices during hemodialysis. Data were analyzed using descriptive statistics for CAM use and bivariate analyses based on demographics including age, sex, race, and dialysis vintage. CAM therapies were grouped into categories based on conventional definitions according to the National Center for Complementary and Alternative Medicine: 1. biologically based practices (e.g. herbs); 2. manipulative/body based practices (e.g. chiropractic); 3. mind-body based practices (e.g. meditation); and 4. alternative medical systems (e.g. homeopathy). Continuous variables are reported as medians and inter-quartile range (IQR), and categorical variables as frequencies. Categorical variables were compared using Fischers exact test.
RESULTS: Among 106 eligible subjects, 89 subjects completed the survey (response rate 84%); 53% were male, 61% black, and their mean age was 62 years. More than half of patients (61%) reported using CAM for health in their lifetime. Among all subjects, the most frequent CAM modalities used in their lifetime were mind-body practices (42%) and manipulation and body-based practices (34%). The most common mind-body practices used were deep breathing exercises (27%), meditation (26%), and yoga (11%). Overall lifetime CAM use was similar among patients with regards to gender, race, and dialysis vintage. In the last month, 36% of patients reported using CAM for health. The most common CAM modalities used in the last month were mind-body practices (27%). Subjects reported that mind-body interactions were very important to health with a median score of 9 (ICQ: 5,10). A majority of patients reported interest in learning mind-body practices (70%) and participating in a mind-body study during dialysis (75%). Of patients who had used mind-body practices in their lifetime, a large majority reported interest in participating in a mind-body study during dialysis (87%). In addition, a majority of patients who never used mind-body practices also reported interest in participation (65%).
CONCLUSION: CAM use, particularly mind-body practice, is frequent among patients with ESRD on hemodialysis. Most patients on hemodialysis perceive mind-body interactions as very important for health and are interested in learning mind-body techniques during dialysis. Mind-body therapies may be a feasible therapeutic intervention for patients with ESRD. Further research to develop and evaluate mind-body therapies

in this population is warranted.

WERE NOT GOING THERE: AN ANALYSIS OF PATIENT-PROVIDER COMMUNICATION ABOUT NARCOTIC ANALGESIA FOR CHRONIC NON-MALIGNANT PAIN Helen Kinsman 1; Todd Korthuis 2; Somnath Saha 2; Victoria Sharp 3; Jonathan Cohn 4; Richard Moore 1; Mary Catherine Beach1. 1The Johns Hopkins University School of Medicine, Baltimore, Maryland ; 2Oregon Health &Science University, Portland, Oregon ; 3St. Lukes-Roosevelt, New York, New York ; 4Wayne State University School of Medicine, Detroit, Maryland . (Tracking ID # 11121)

BACKGROUND: Pain is a presenting symptom in over 80% of office visits, and chronic pain affects more Americans than diabetes, CHD,

and cancer combined. Patients in pain often seek pharmacologic relief, making analgesics the most frequently discussed therapeutic drug in outpatient visits. Anecdotally, negotiations about narcotic analgesics in this setting are frustrating for patients and providers. We conducted this study to better understand patient-provider communication about narcotic analgesia for chronic nonmalignant pain.

METHODS: We audio recorded 45 HIV providers interacting with 418 of their patients in routine outpatient encounters at four sites (Baltimore, Detroit, New York, and Portland) in the Enhancing Communication and HIV Outcomes (ECHO) Study. We transcribed each visit and used 20 narcotic-related search terms to identify transcripts containing conversations about narcotic analgesics. Through qualitative analysis of each encounter, we developed and applied a coding scheme to describe key features of this dialogue.

RESULTS: Providers had a mean age of 44.5 years, and were mostly female (58%) and white (69%). Patients had a mean age of 45.4 years, 66% were male, 58% were African American, and 34% had known their HIV provider for more than 5 years. Out of 418 encounters, 130 contained at least one narcotic-related search term. Of these, 48 encounters (11% of total) were found to contain substantive discussion of narcotic-related pain management. The most common causes of pain were musculoskeletal/back (31%) and neuropathic (17%); in 29% of encounters, the cause of pain was never mentioned. Most narcotic conversations were initiated by patients (58%), while providers more often ended the conversation (74%), sometimes abruptly (e.g. P:The end of the night, where I sleep, my back hurt me real badthats when I take the Percocet and D:Let me ask a quick question for ya P:Uh Huh D:When was the last time you had a flu shot?). In almost half of the encounters, providers verbalized concern about the narcotic regimen (46%), and suggested alternative therapeutic options (48%). A third of encounters (33%) contained dialogue suggesting a difference of opinion or conflict (P:I cant just stop takin em. D: Why? P: What do you want me to do, go crazy? D: You could slow down. Say go from four to three. P: Uh uh. I just want my regular prescription what you all been giving me every month). Fewer than half of providers (42%) explicitly acknowledged the patients experience of pain. Providers more often offered/agreed than refused/disagreed to give the prescription (50% vs. 23%), sometimes reluctantly (Ill give you a little bit of oxycodone but you need to get off that, okay?). However, in 27% of encounters, no decision seemed to be made about the issue.

CONCLUSION: Pain management discussions are relatively common in routine outpatient HIV encounters and are characterized by provider avoidance suggestive of ambivalence or discomfort, as well as patient-provider conflict. Further research and attention to this particular communication challenge is needed to determine and teach optimal communication about narcotic medications for chronic nonmalignant pain.

VARIATIONS IN DIABETIC OUTCOME MEASURES ACROSS LANGUAGE GROUPS FOLLOWED ATAN IMMIGRANTAND REFUGEE CLINIC Xiaoxue Huang 1; Tracy Boyd 1; Susan Onstad 1; Anita Leake 1; Azeb Gebrekidan 1; Rahel Habtemichael 1; Vi Le 1; Mona Mussa 1; Carey Jackson1. 1University of Washington, Seattle, Washington. (Tracking ID # 11122)

BACKGROUND: The Institute of Medicines (IOM) report on health disparities, Unequal Treatment, identified the medical systems inability to distinguish minority groups with meaningful specificity as a primary barrier to

recognizing critical disparities in health care and outcomes. A recent follow-up report on Race, Ethnicity, and Language Data called for more detailed demographic data collection. Hospitals have historically identified patients according to five federal categories (Black/African American, White, Asian/Pacific Islander, American Indian/Alaska Native and Hispanic/Latino) and other. These may miss
important language, literacy and ethnic variations in quality of care across groups, particularly those for whom English is a second language. This study evaluated the validity of self-reported primary language to detect disparities in diabetes care across language groups of first generation, mostly non-English speaking outpatients at an international clinic.
METHODS: The REALL (Race, Ethnicity and Language proficiency Level) study is across-sectional pilot study, surveying a convenience sample of immigrant and refugee patients receiving primary care at an urban, county hospital. REALL participants were eligible for this study if they had diabetes based on medical record data using a standard hospital quality improvement protocol and completed the REALL survey question about how many and what languages they speak, their reading ability in those languages, including English, and the culture they most identify with. Survey data were linked with medical record data that included hemoglobin A1C (HA1C), low density lipoprotein (LDL) and systolic blood pressure (SBP). Diabetes control was evaluated across the 6 largest language groups.
RESULTS: A total of 640 patients were surveyed and no one refused. 250 patients were diabetics and eligible for the study (51.5% of all diabetic patients in the clinic). Common language groups were Vietnamese (n=60), Somali (42), Cambodian (31), Amharic (30), Chinese(23), Tigrinya (19) and other (45, representing 22 smaller language groups). The survey data were 90.84% concordant with registration data for primary language (kappa=0.895). Mean HA1Cs were lowest among Vietnamese patients (7.24, 95%CI 6.88-7.60), significantly lower than Somali patients (8.43, 95%CI 7.88-8.98, p=0.0003) and Cambodian patients (7.89, 95%CI 7.35-8.43, p=0.038). While 52% of Vietnamese patients had HA1C <7, only 26% of Somali patients had HA1C <7 (p=0.015). There were no statically significant differences across language groups in mean LDL level or SBP.
Limitations: These are preliminary results that reflect a clinic sample that only cares for immigrants and refugees, which may not reflect population samples or other clinical experience. This study is ongoing, the number and percentage of eligible diabetic patients are expected to increase to almost double.
CONCLUSION: Results suggest that there is variability in diabetic outcomes across language groups in first generation immigrant communities. The observed differences may reflect aspects of relocation to the US not yet understood. Somalis are the most recently arrived refugee community, thus the least acculturated, least established and potentially most stressed of all immigrant communities in this study. Further inquiry into length of time in the US, length of time established in clinical care and qualitative work on dietary practices are warranted.
ASSESSING AFRICAN AMERICAN CONGREGATION MEMBERS READINESS TO PARTICIPATE IN RESEARCH Adebowale Ayoola Odulana 1; Mimi Kim 2; Yhenneko Taylor 3; Melissa Green 2; Moses Goldmon 4; Paul Godley 2; Shelly-Ann Meade 5; Carlton Boyd 6; Daniel Howard 7; Giselle Corbie-Smith2. 1Univeristy of North Carolina at Chapel Hill Cecil G. Sheps Center for Health Services Research, Raleigh, North Carolina ; 2University of North Carolina at Chapel Hill Cecil G. Sheps Center for Health Research, Chapel Hill, North Carolina ; 3College of Health and Human Services University of North Carolina at Charlotte, Charlotte, North Carolina ; 4Shaw University, Raleigh, North Carolina ;
5University of North Carolina at Chapel Hill Department of Epidemiology, Chapel Hill, North Carolina ; 6National Institute of Environmental Health Sciences, Durham, North Carolina ; 7Robert Wood Johnson Foundation Center for Heatlh Policy Meharry Medical College, Nashville, Tennessee . (Tracking ID # 11123)
BACKGROUND: Church based research has increasingly become a strategy for involving African Americans in research efforts to reduce

health disparities. While the role of the pastor and the church environment has been noted to be critical to the success of these efforts, few studies have independently evaluated African American church/pastor characteristics and congregant characteristics as organizational and individual constructs respectively, as they relate to attitudes towards research participation. In this study, we assessed the organizational and individual readiness of African American congregants to participate in research.
METHODS: We surveyed adult members of 11 predominately African American churches, all in regions with a high density of African Americans and significant health disparities. Respondents were asked to share their attitudes regarding research participation, and how willing, ready, and confident they were about participation; pastors were also surveyed and matched individual congregants through church identifier. The main outcome measure, the readiness index score, summed responses across the 3 domains (i.e. willingness, readiness and confidence in research participation). We constructed a series of logistic generalized estimating equations to adjust for clustering and to assess the independent contributions of church/pastor characteristics and respondent characteristics, to congregants readiness to participate in research.
RESULTS: Of the 1094 respondents, (response rate 83%) 72% were female, 57% were age 50 or older, 82% had at least a high school education, and 50% reported 2 or more health conditions. In surveyed churches, 79% had male pastors, 52% had a pastor age <45, and 97% had a pastor with a high school education or higher. Respondents who were concerned about paying for healthcare were more willing (1.55 CI1.16-2.08), ready (OR 1.43 1.14-1.80), and confident (1.77 CI 1.39-2.25) about research participation. Churches with younger pastors (age <45) had members who felt ready (OR 1.32 CI 1.16-1.50) and confident (OR1.91 CI 1.63-2.23) to participate in health research when controlling for respondent characteristics. Churches with a pastor with at least a high school education were confident (OR 2.49 CI 2.10-2.94) regarding research participation. Pastor age less than 45 (OR 1.28; CI 1.07-1.54) and higher pastor educational attainment (OR 1.56; CI 1.28-1.89) were independently associated with a congregants higher readiness scores. After controlling for these church level characteristics congregants concern about paying for health care (OR 1.53; CI 1.24-1.89) was the only individual characteristic that was associated with higher readiness scores.
CONCLUSION: Characteristics of the church leadership were significantly associated with congregant readiness for research participation, a finding that highlights the importance of the church context in relation to individual decisions regarding research participation. Church based research strategies that prioritize establishing commitment and buy in on an organizational level when conducting research may prove vital to acquiring and sustaining access to underrepresented African Americans.
PHYSICIANS ATTITUDES ABOUT RECOMMENDING SURGERY FOR EARLY STAGE LUNG CANCER AND POSSIBLE REASONS FOR TREATMENT DISPARITIES Samuel Cykert 1; Franklin McGuire 2; Paul Walker 3; Michael Monroe 4; Giselle Corbie-Smith 5; Peggye Dilworth-Anderson 5; Lloyd Edwards5. 1University of North Carolina, Chapel Hill, Chapel Hill, North Carolina ; 2USC School of Medicine, Columbia, South Carolina ; 3ECU Brody Medical School, Greenville, North Carolina ; 4Carolinas Medical Center, Charlotte, North Carolina ; 5UNC-CH, Chapel Hill, North Carolina . (Tracking ID # 11126)
BACKGROUND: Multiple reports have shown double digit gaps in lung cancer surgery rates for African-American patients (AA) with early stage disease compared to Whites (W). Physician attitudes could potentially influence the framing of surgical decisions and contribute to this disparity in care. As part of a recent prospective cohort study to examine possible causes of decisions against lung cancer surgery and lower surgical rates for African-Americans, we performed a companion survey of physicians caring for lung cancer patients.
METHODS: Using pulmonary, oncology, thoracic surgery, and generalist practices in 5 communities, we enrolled 437 newly diagnosed patients with early stage, non-small cell lung cancer. Inclusion criteria were as follows: patients were required to be at least 18 years old, have a tissue diagnosis or >60% probability of non-

small cell lung cancer using Bayesian methods, and be limited to Stage I or II disease by clinical and radiological testing. Patients were identified from direct referral from practices or through the utilization of a chest CT review protocol. After being informed of the diagnosis of probable or definite lung cancer, but before the establishment of a treatment plan, patients were administered a 100-item survey. We asked patients to identify the physician who had provided the most information about his or her lung cancer care. After informed consent was obtained, physician participants completed a 93-item survey that included statements followed by Likert-type response scales to assess attitudes about lung cancer communication, reasons for recommending against surgery, and possible causes of black-white treatment disparities.
RESULTS: One hundred physicians were identified by participating patients. Eighty-four completed the questionnaire. The median age of respondents was 45 yrs and 73% were W, 11% Asian, 7% Hispanic, and 5% AA. 48% practiced in academic settings while the remainder practiced in community settings. 20% were thoracic surgeons, 40% pulmonologists, 16% oncologists, and 20% were general internists. All respondents believed that comorbid illnesses were important in recommending against surgery with 76% regarding these as extremely important. 36% felt that patients deemed non-compliant should not go to surgery while 21% agreed that lower compliance was a reason that AA underwent surgery less. The percentage of respondents who felt that the following factors were important in recommending against surgery were: 51% difficult communication, 46% fear of surgery, 46% disbelief in diagnosis, 76% lack of social support, and 23% financial barriers. Percentages of agreement for specific reasons that AA do not receive surgery as often as W were: 23% difficult communication, 34% fear of surgery, 25% disbelief in diagnosis, 26% lack of social support, and 48% financial barriers.
CONCLUSION: The wide range of acceptable reasons for physicians recommendations against lung cancer surgery and their correlation with perceptions of why African-American patients do not go to surgery as often highlight the potential contribution of subjective decision making to disparities in cancer care. The connection of these attitudes to actual recommendations and outcomes requires further investigation.
PROMOTING ADVANCE CARE PLANNING IN PATIENTS WITH CANCER WITHOUT DIMINISHING HOPE OR RAISING ANXIETY: AN INTERACTIVE COMPUTER-BASED DECISION AID Michael Jay Green 1; Jane R Schubart 1; Elana Farace 1; Erik B. Lehman 1; Megan Whitehead 1; Benjamin H Levi1. 1Penn State College of Medicine, Hershey, Pennsylvania. (Tracking ID # 11127)
BACKGROUND: Despite agreement that patients with advanced cancer ought to prepare for the future, most do not complete advance directives (AD), and even when they do, physicians often disregard the AD documents at key moments. Among the many reasons for this disregard are concerns that: 1) addressing the topic of advance care planning would diminish patients hope and raise their anxiety, and 2) lack of knowledge undermines patients ability to meaningfully complete AD

documents that physicians can trust. We developed an interactive computer-based decision aid to help people clarify and articulate their medical treatment preferences in the event they become unable to speak for themselves. The purpose of this study was to determine whether use of the decision aid by patients with advanced cancer would increase their knowledge of advance care planning without diminishing hope or increasing anxiety. The study was sponsored by the American Cancer Society and this in an interim analysis of results.
METHODS: We conducted a randomized controlled trial of advance care planning methods using standard advance directive materials vs. a computer-based decision aid (Making Your Wishes Known: Planning Your Medical Future). Patients with advanced cancer (stage 4 disease and life expectancy <2 years) were recruited from clinics in oncology, surgery, and radiation medicine at a mid-Atlantic academic medical center. Participants were randomly assigned to Control or Intervention Groups, and completed pre/post measures of anxiety (STAI) hope (Herth Hope Index), and knowledge (27 items). Changes in group mean scores from baseline to post-

intervention were compared using a repeated measures mixed model adjusted for the baseline measure.
RESULTS: 139 individuals were enrolled and 138 completed the protocol (mean age 61 years, range 2287; 39% female; 96% white; 52% with lung, breast, brain or liver cancer; 84% own their own computer). There were no demographic differences between groups. Baseline anxiety was low in both groups (mean=30 in Control and 29 in Intervention Group, where 20=low anxiety and 80=high anxiety), and did not increase significantly after advance care planning. Similarly, hopefulness was high (mean=41 in both groups, where 12=low hope and 48=high hope) and did not diminish after advance care planning. Knowledge scores increased in both groups, but significantly more ($p<0.01$) in the Intervention Group than the Control Group (13% vs 3%). Finally, participants in the Intervention Group expressed significantly greater mean satisfaction with the advance care planning method than those in the Control Group ($p=0.03$).
CONCLUSION: In this interim analysis, use of our decision-aid for advance care planning resulted in greater knowledge without increases in anxiety or decreases in hope. These findings counter concerns raised by some physicians about the benefits and risks of advance care planning.
USING UNANNOUNCED STANDARDIZED PATIENTS TO ASSESS QUALITY OF CARE: CHARTING AND OUTPATIENT SAFETY Sondra Zabar 1; Angela Burgess 1; Kathleen Hanley 1; David Stevens 2; Jessica Murphy 3; Mack Lipkin 1; Adina Kalet 4; Colleen Gillespie7. 1NYU School of Medicine, New York, New York ; 2Gouverneur Healthcare Services, New York, New York ; 3Governeur Healthcare Services, New York, New York ; 4NYU School of Medicine, NY, New York . (Tracking ID # 11137)
BACKGROUND: Accurate charting is critical to outpatient safety and yet little is known about residents completeness and accuracy in documenting the care they provide. Unannounced Standardized Patient (USP) can assess what residents do when behaving spontaneously in real practice. USP visits are used in this study to explore the degree to which residents may be over- or under-documenting or failing to document important information in the right place. In addition, we use chart data from these standardized clinical scenarios to explore the degree to which residents vary in their practices.
METHODS: 15 internal medicine residents each saw four Unannounced SPs (USP) over 6-months in their urban, outpatient, continuity practice. The 4 cases were new visits and reflected chief complaints and patient demographics common to this primary care practice. Neither clinic staff nor the residents knew which patients were actors; residents had been informed and consented that USPs would be introduced to the clinic during a 6-month period. After each visit, the highly trained USPs completed a comprehensive checklist and rating form and residents entered their notes believing these to be actual patients. The electronically charted notes for these visits (n=60) were then collected and abstracted. Core variables for these analysis included degree of correspondence between the chart and USP-report of 12 physical exam procedures in two relevant USP cases (over- or under-documentation); documentation of allergies in the chart field used as a fail-safe against prescription errors (documenting in the right place); and rate of variation in residents ordering of labs and scheduling of next visits.
RESULTS: The overall detection rate of the USPs was approximately 38% (23 of first 60 visits) and varied across USP cases (14%; 47%; 31%; 71%, $p=.014$). There was complete or almost complete (<10%) agreement between the chart and the USP-report for 7 of the 12 physical exam procedures assessed. In 5 instances there was substantial over- or under-documentation: over-documentation was present in all 5 procedures (extremities 27%, neurological 20%, vitals 13%, heart 20%, and abdomen 20%) and two procedures involved both over- and under-documentation (extremities, vitals). In the one case involving allergies (if asked, the USP reported PCN allergy), while 88% of the residents charted the PCN allergy, only 29% noted it in the correct chart field (used by the pharmacy system to prevent prescription error). Residents ordered 78% of the labs deemed essential (SD 9%); 6/16 residents ordered <75% of essential labs. There was substantial variation in residents scheduling of next visits: across all four cases, most next visits were scheduled for 1 month (4053% depending on the case); however 7% to 27% of visits, depending on the case, were PRN; 1333% of visits were for less than 1 month

(from 2 days to 3 wks); and 727% were for more than 1 month (from 2 months to 1 yr). CONCLUSION: USP methodology is a feasible, practical way to assess actual resident behavior in clinical practice. Residents tend to over-document physical examination procedures. While residents documented allergies, most did so in the wrong place, with serious implications for patient safety. Follow-up practice (labs ordered and scheduling of next visits) varied substantially in even in this homogeneous resident physician population, especially striking given the standardized encounters. USP visits provide valuable insight into the accuracy of residents charting as well as the amount of resident-driven variation in practice, both of which are clearly determinants of patient safety.
DECISIONS OF CLINICIAN EDUCATORS TO ENCOURAGE ROUTINE HIVSCREENINGAMONGTRAINEES
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BACKGROUND: CDC recommendations for routine, voluntary HIV screening of all Americans age 1364 have been slow to be adopted. One method to increase adherence to clinical practice guidelines is through medical school and residency training. The purpose of this study was to explore clinician educator (CE)s attitudes, barriers, and behaviors regarding routine HIV testing.
METHODS: We conducted a subgroup analysis of CEs who responded to a 2008 survey of general internists who were active

SGIM members. Members were asked about their outpatient practices, knowledge and attitudes regarding the revised CDC guidelines, their role in trainee education, HIV testing practices and whether they encouraged trainees to perform routine HIV screening. Survey items were adapted from focus group findings and pilot tested among potentially eligible participants. Knowledge of the guidelines was rated as optimal (5 of 5 guideline questions answered correctly), high (>3 of 5 answered correctly) or low (<3 answered correctly). Positive attitudes were measured by agreement with statements that testing would benefit patients, improve public health, and/or not interfere with other medical needs. Associations between HIV testing knowledge and attitudes and encouraging trainees to perform routine screening were estimated using bivariate and multivariate logistic regression.
RESULTS: Of 1,592 active members approached, 515 (32%) responded to the survey. Of these, 367 (71%) indicated they supervised trainees in an outpatient general internal medicine clinic. CEs were primarily female (53%), white (76%), and practiced in university-based settings (60%) and communities with estimated HIV prevalence >0.1% (73%). Although both those who supervised residents and those who did not reported high rates of awareness of CDC recommendations (85 and 95%, p=0.22), both had suboptimal knowledge (56% for both groups, p=0.89). Many in both groups reported continued risk-based testing (39 vs 47%, p=0.05). 193 (57%) of CEs reported that they encourage trainees to perform routine HIV testing. CEs who reported screening over 25% of patients in their own clinic were more likely to encourage testing (53% vs 22%, p<0.001). Higher knowledge scores (aOR 5.55, 95% CI 2.3,12.8) and positive attitudes toward testing (aOR 9.77, 95% CI 4.81,19.8) were independently associated with encouraging trainees to screen for HIV. Reasons for not encouraging trainees to perform HIV screening included perceived low local prevalence (37%), competing teaching priorities (35%), and a busy clinic environment (33%). CONCLUSION: Clinician educators have a special role in the dissemination of the CDC guidelines in that they impact the knowledge and attitudes of newly

practicing physicians. Despite awareness of CDC guidelines regarding HIV screening, many CEs do not recommend this practice to their trainees. Those CEs who do encourage testing among trainees have greater knowledge, better attitudes supportive of testing, and report a higher percentage of patients screened. Interventions that improve faculty knowledge of CDC HIV screening guidelines and address barriers to screening in resident clinic may improve medical education regarding routine HIV screening.

COMPARISON OF ROUTINE IMMUNIZATION IN THE GERIATRIC POPULATION AMONG TEACHING, NONTEACHING, AND GERIATRIC AMBULATORY PRACTICES AT A LARGE ACADEMIC MEDICAL CENTER Elisabeth Ihler 1; Rubina Malik2. 1Montefiore Medical Center, New York, New York; 2Montefiore Medical Center, Bronx, New York. (Tracking ID # 11140)

BACKGROUND: Three vaccines are recommended for all geriatric patients: annual influenza vaccine, herpes zoster vaccine at age 60, and pneumococcal vaccine at age 65. However, attainment of universal vaccination has been difficult. There is some evidence that variation in preventive health practices is in part due to clinic factors rather than patient characteristics, with resident clinics faring worse than clinics with similar patient populations staffed by attending physicians and nurse practitioners. To assess this, we investigated differences in administration of these three vaccines between 3 groups of primary care practices operated by Montefiore Medical

Center, including 5 resident teaching practices, 21 nonteaching practices, and one geriatrics practice. We hypothesized that the geriatrics practice would provide the most comprehensive vaccination coverage of the elderly.

METHODS: We compared vaccination practices for the elderly from 20082010 among primary care sites at Montefiore Medical Center. The 21 practices without residents were pooled as the nonteaching group, the 5 teaching sites that included internal medicine and family medicine residents as well as faculty were pooled as the teaching group, and the practice staffed by the geriatrics physicians and fellows was treated as the geriatrics group. The Montefiore Clinical Information System (CIS) was used to select patients for inclusion, collect demographic data (age, gender, race, ethnicity, primary language) and assess vaccination status via vaccine administration recorded in the electronic medication record.

To assess eligibility to receive the pneumococcal vaccine, we identified patients who were seen at least twice in the same practice from 1/1/ 2008 to 1/1/2010, and were at least 65 years old at the time of the first visit in the period. To assess eligibility to receive the herpes zoster vaccine, we identified patients who were seen at least twice in the same medical practice from 5/15/08 (the date of the formal ACIP recommendation) to 1/1/2010, and were at least 60 years old at the time of the first visit. To assess eligibility to receive the influenza vaccine, patients were assessed for both the 20082009 and 20092010 flu seasons. Patients over the age of 65 who were seen at least once in a medical practice between 10/1/08-4/1/09 or between 10/1/09-4/1/10 were included in the influenza groups.

Subgroups of patients with COPD and diabetes were targeted in this study due to medical indications for pneumococcal and influenza vaccination. They were identified using information from ICD-9 codes, electronic problem lists, and laboratory data.

We compared patient characteristics and vaccinations rates between practice sites using chi-square (for categorical variables) or one-way ANOVA (for continuous variables).

RESULTS: There were significant differences between the three practice groups in patient characteristics. The geriatrics group patients were older (mean 79.5 years) compared with teaching (72.8) and nonteaching groups (73.8). In addition, the geriatrics practice had more white and English-speaking patients than the two other groups. The teaching group had the most Hispanic and Spanish-speaking patients. The practices also differed in the prevalence of DM and COPD.

Overall, vaccination rates did not meet national goals in any practice. There were significant differences between practices for influenza vaccination rates for both the 200809 (39.9% nonteaching, 44.5% teaching, and

46.5% geriatrics, p<0.05) and 200910 flu seasons(30.4% geriatrics, 34.0% teaching, 34.7% nonteaching, p<0.05). Rates of pneumococcal vaccine were lowest in the geriatrics practice (25.6%) compared with the teaching (38.5%) or nonteaching (34.0%) practices (p <0.05), In addition, patients with DM received significantly more pneumococcal vaccine than patients without these conditions at the nonteaching (38.2% of diabetics vs 31.7% of nondiabetics) and teaching(41.4% vs 36.4%) groups (p<0.05), but not in the geriatrics group(25.5% vs 25.7%). In both the 200809 and 200910 flu season, patients with DM received more influenza vaccine than nondiabetic patients in all practices (p<0.05). The rates of vaccination with he herpes zoster vaccine were very low across all sites, ranging from0.9% in the geriatrics group to 2.1% in the teaching group (nonsignificant). There were some differences between groups for vaccinated vs. unvaccinated patients for race, ethnicity, primary language and gender but no consistent pattern emerged. CONCLUSION: Overall, vaccination rates in all groups were substantially lower than the 90% coverage that is the national goal, but were

roughly comparable with national vaccination rates for minority patients. There were significant differences between nonteaching, teaching, and geriatrics groups for immunization coverage with all vaccines, as well as for the relationship between chronic disease and vaccination. There was no single practice with overall higher rates of vaccination. The geriatrics groups rates of pneumococcal vaccination for all patients and for patients with DM were surprisingly low, possibly reflecting in part the greater mean age of these patients, who may have received their pneumococcal vaccination after age 65 but prior to the implementation of the electronic medication record in 1997. Pneumococcal and influenza vaccination rates were higher for patients with DM in the nonteaching and teaching groups, but not in the geriatrics patients. This may indicate a greater awareness of age-related vaccination guidelines in the geriatrics practice. Limitations of the study include the thirteen-year limit on vaccination records as well as the inability to identify patients who may have received vaccination at an outside site or who were offered and refused vaccination. The institution of automated reminders for vaccines as part of the electronic medical record may improve vaccination rates in the future.

HEALTHCARE PROVIDERS MISS OPPORTUNITIES TO COUNSEL HIV-INFECTED PATIENTS ABOUT HIGH-RISK SEXUAL BEHAVIOR

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(Tracking ID # 11141)

BACKGROUND: Although HIV care guidelines recommend that providers counsel patients about safe sex, HIV-infected patients and providers report that discussion of sexual behavior is infrequent. Using audio-recorded clinical encounters between patients and their providers, we investigated the frequency and content of discussions regarding sexual behavior in HIV care.
METHODS: We performed a cross-sectional analysis of data from two sites of the Enhancing Communication and HIV Outcomes (ECHO) Study. Patients were adults receiving HIV care who presented for routine outpatient follow-up with their provider. Clinical encounters were audio-recorded, transcribed and searched for discussion of patients sexual behavior. We classified the encounters by whether or not the patient reported safe sex, and then according to whether the provider advised a change or maintenance of the recommended behavior (counseling) or not (missed opportunity). When counseling occurred, we further classified the type of behavior change discussed (e.g. condom use). When a missed opportunity occurred, we further classified the type of indication for a counseling session (e.g. diagnosis of STI).
RESULTS: Patients were 62% male, 54% African American, with a mean age of 45.0 (range 2077). Providers were 59% female, 86% white, with a mean age of 42.8 (3057). Of the 223 encounters, discussion of sexual behavior occurred in 92 (0.41, 95% CI: 0.35-0.48). Of these 92 discussions, 11 patients denied sexual activity and were excluded from further analysis. Of the 25 patients who reported safe sex, providers missed

opportunities to reinforce behavior in half of the encounters, 0.56 (0.35-0.76). Of the 56 patients with an indication of unsafe sex, providers missed opportunities to recommend behavior change in three quarters of encounters, 0.77 (0.64-0.87). The most commonly recommended behavior changes were condom use (n=13), disclosure of HIV status (n=5), and reduction in number of partners (n=5). The most commonly missed indications for counseling were STI symptoms (n=20) or STI screening (n=10).

Table 1: Number of encounters with discussion of safe or unsafe sexual behavior in which counseling was received.

CONCLUSION: Discussion of sexual behavior occurred in less than half of HIV care visits. When sexual behavior dialogue occurred, HIV providers often missed opportunities to recommend or reinforce safe sex practices. Further evaluation of barriers to patient-provider communication regarding sexual behavior is indicated to improve this important aspect of HIV care.

Counseling does not occur
Counseling occurs Total
Patient reports safe sex
14 missed opportunities to reinforce patient's safe sex practice
11 encounters with reinforcement of patient's safe sex practice
25
56
Total 57 24 81
Patient gives indication of unsafe sex
43 missed opportunities to address behavior change toward safer sex
13 encounters addressing behavior change toward safer sex

PUBLIC OPINIONS ABOUT PAYING PEOPLE TO QUIT SMOKING James D. Park 1; David A Asch1.
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BACKGROUND: Paying people to quit smoking has been shown to be at least as effective as more traditional pharmacologic approaches (Volpp and Das, 2009). Randomized trials comparing the use of financial incentives to conventional care have demonstrated abstinence rates of 20.9% vs. 11.8% for usual care at 6 months (Volpp et al, 2009). Despite their effectiveness, financial incentives remain controversial. Social and ethical concerns include the appearance of rewarding individuals for unhealthy lifestyle choices, a sense of undermining personal responsibility, and the acceptability of money as a treatment. To understand the extent of these concerns, a randomized controlled public opinion survey was performed. METHODS: Study population: In order to reflect broad public representation, individuals 18 years or older waiting at major transportation depots in Philadelphia were approached between June and August 2010. Participants were compensated with a candy bar for completing the questionnaire.

Questionnaire design: One of three versions was randomly distributed to participants. All participants were asked whether they would support a $25 increase in their annual health insurance premium to pay for a smoking cessation treatment. In version 1, the question was prefaced by According to research, a new treatment helps some people to quit smoking. New treatment was changed to new medication in version 2 and paying people in version 3.

In addition to smoking status, political affiliation, and sociodemographic information, participants were asked to assign responsibility for smoking cessation among individuals, other people/society, and chance/luck using 9 statements adapted from the Multidimensional Health Locus of Control Questionnaire (Wallston et al, 1994). Using a 6-point Likert scale, 3 items for each domain were used.

Analysis: Chi-square tests were used to compare rates of support. Multivariate logistic regression was used to identify predictors of willingness to support a smoking cessation policy on the entire sample

and on those responding separately to each of the three versions. Hypotheses were generated prior to data collection. Statistical testing was two-sided and significant for p-values <0.05.
RESULTS: 1,010 individuals completed the question about willingness to support the policy. 52.8% were female, 26.9% African-American, 17.5% current smokers, and 46.3% had a household income <$40,000. Overall support for increasing health insurance premiums by $25 to pay for any smoking cessation treatment was 41.6%. The financial incentive survey received the lowest support rate (39.3%) but did not statistically differ from the treatment (45.8%, p=0.14) or medication (41.7%, p=0.58) versions.
In subgroup analyses, current smokers overall support for a smoking cessation policy (54.9%) was significantly higher than previous smokers(41.5%, p=0.005) or lifetime non-smokers (36.9%, p<0.001). Within each smoking category, participants showed similar support for each of the three versions. Within the lower income group (household income <$40,000), the financial incentive version (34.8%) was statistically lower than the medication version (49.4%, p=0.04) but not the generic treatment (47.2%, p=0.06).
Participants with Democrat affiliation had a higher overall support rate(45.7%) than Republicans (30.3%, p=0.001). When considering the financial incentive, Republicans (23.3%) had a significantly lower support rate than Democrats (40.6%, p=0.04).
Multivariate logistic regression revealed that current smoking status (OR2.95; 95% CI: 1.90-4.60), age in ten year increments (OR 1.22; 95% CI: 1.08-1.38), Democratic affiliation (OR 1.11; 95% CI: 1.00-1.23), and endorsement of an external locus of control for smoking cessation (OR 1.10; 95% CI: 1.05-1.16) were associated with willingness to support any smoking cessation policy. When considering the financial incentive policy, endorsement of an internal locus of control for smoking cessation (OR 0.87; 95% CI: 0.78-0.96) was a negative predictor of the willingness to support the policy. CONCLUSION: Only 41.6% of the participants supported any investment in smoking cessation treatment, although that support varied by sociodemographic characteristics, political affiliation, and expressed views on the locus of responsibility for smoking cessation. The financial incentive policy received the lowest rate of support, but that support did not differ significantly compared to medication or generic treatment policies. This research suggests that a financial incentive would be perceived no differently than currently used medications for smoking cessation. Rather, much of the negative perceptions involving financial incentives and tobacco cessation may be targeted to the broader issue of whether to help people with a socially stigmatized health behavior.
IS AN OBESITY COUNSELING CURRICULUM FOR RESIDENT PHYSICIANS ASSOCIATED WITH PATIENT WEIGHT LOSS IN PRIMARY CARE? Melanie Jay 1; Colleen Gillespie 1; Sheira Schlair 2; Stella Savarimuthu 1; Daniel Erck 3; Scott Sherman 4; Sondra Zabar 1; Adina Kalet1. 1New York University School of Medicine, New York, New York ;
2Montefiore Medical Center, New York, New York ; 3West Virginia School of Osteopathic Medicine, Lewisberg, West Virginia ; 4New York Harbor VA, New York, New York . (Tracking ID # 11143)
BACKGROUND: There is little evidence that physician training in evidence-based obesity counseling techniques affect patient outcomes. Intensive counseling has been proven to reduce weight while evidence on brief, focused physician- delivered counseling, like the 5As model (assess, advise, agree, assist, arrange), has been inconclusive. We use patient exit interviews and chart reviews to explore whether patients weight status is associated with resident training after a 5As obesity counseling curriculum.
METHODS: Twenty-three primary care residents were scheduled into either an intervention (5-hr 5As obesity counseling curriculum, n=12)
or control group (standard residency training, n=11). Over a 7-month period, we interviewed 158 of the residents obese patients (Body Mass Index >or=30 kg/m2) post medical visit about the nature and quality of obesity counseling that occurred, during that index visit. We then conducted chart reviews to determine weight

at all subsequent medical visits within 6 months and calculated weight change by subtracting the patients weight (kg) measured at the latest time point within the 6 month period from the index visit weight. Quality of obesity counseling was calculated as the percent of 21 possible 5As practices that the patient reported the resident physician used during the index visit. We characterized weight loss/gain by both patient (BMI, gender, race, language, motivation and intention to lose weight, patient activation) and resident variables (quality of obesity counseling, participation in the curriculum) and then used exploratory regression analyses to identify the combined influence of patient and resident characteristics on weight loss/gain. RESULTS: Fifty-six percent (88/158) of patients had visits within a 6 month period subsequent to the index visit, mean number of visits was 4.8 (SD=3.7), 53% of follow-up visits were with the same resident (SD=43) with a mean of 3.8 patients/resident (range 111). Over a 6 month period following the index visit, the mean weight change in all patients was -.32 kg (SD=2.3, range 8.2 - +5.8). Mean weight loss among patients initially seen by a resident who completed the obesity counseling curriculum (.7 kg, SD=2.4, n=43) tended to be greater than mean weight loss for patients initially seen by residents who had not completed the curriculum (+.1 kg, SD=2.2, n=45) (p=.084). Six percent of patients of curriculum residents lost >5% of body weight compared with none of the patients of control residents (p=.092). The exploratory regression model explained 11% of weight change variance (p=.039). Having a resident physician who completed the curriculum accounted for 5% of the variance (p=.037) after controlling for patient BMI, gender, race, and activation stage and quality of 5As counseling. CONCLUSION: Patients of resident physicians who had completed a 5As-based obesity counseling curriculum lost slightly more weight (< 1 kg) than patients of residents who had not completed the curriculum, but the magnitude of weight loss was small and significant only after controlling for patient and resident variables. Further research is needed to better understand how much physician training is needed to more substantially affect patient weight outcomes.

PALLIATIVE AND ONCOLOGIC CO-MANAGEMENT: SYMPTOM MANAGEMENT FOR OUTPATIENTS WITH CANCER Kara Bischoff 1; Vivian Weinberg 1; Michael Rabow1. 1UCSF, San Francisco, California. (Tracking ID # 11144)

BACKGROUND: Although outpatient palliative care clinics are increasingly common, evidence of their clinical efficacy is limited. This prospective study assessed the impact of palliative care co-management on symptoms and quality of life among ambulatory patients at a comprehensive cancer center.

METHODS: 267 adult outpatients with cancer were referred by their oncologist and seen for at least 2 visits within 120 days at the UCSF Symptom Management Service; 152 of these patients were also seen for a third visit within 240 days of the first. Patients completed a modified Edmonton Symptom Assessment Scale and a validated spiritual well-being questionnaire prior to each visit. Overall change in symptom severity from the first to subsequent visits was calculated using two-tailed analysis of variance (ANOVA) methods for repeated measures; a test for a trend in scores over time was defined by a linear contrast. ANOVA models and Kruskal-Wallis tests were used to determine the difference in means and distributions, respectively, for baseline symptoms and for pairwise change in symptoms according to demographic and clinical variables.

RESULTS: At baseline, mean age of studied patients was 57.3 years (SD13.9). Median time since cancer diagnosis was 17.5 months (range 18 256). Fifty-four percent of patients were female; 67% were Caucasian. Prostate, breast, gastrointestinal, and gynecologic cancers were the most common diagnoses. Fifty-nine percent of patients had metastatic disease at baseline. During the study period, 68% of patients received oncologic treatment (chemotherapy, hormonal therapy or radiation) and only 3% were enrolled in hospice. At baseline, severity of evaluated symptoms did not differ significantly by presence of metastatic versus localized disease. However, female gender, African-American ethnicity, and non-prostate cancer diagnoses were associated with greater baseline pain ($p=0.02$, $p<0.001$, $p<0.001$, respectively) and fatigue ($p=0.05$, $p=0.02$, $p<0.001$, respectively).

Second clinic visits were on average 41 days after the first. Between the first and second clinic visits there was

a significant improvement in pain (p<0.001), fatigue (p<0.001), anxiety (p<0.001), depression (p<0.001), quality of life (p=0.002) and spiritual wellbeing (p<0.001), but not nausea (p=0.14) or relationship problems (p=0.31). For the subset of patients with evaluable data who were seen for a third visit, the improvement in pain, fatigue, anxiety, depression, quality of life and spiritual wellbeing observed at the second visit persisted to the third visit (p<0.005 for each symptom).
CONCLUSION: Palliative care, provided in a symptom management clinic concurrent with oncologic care, was associated with significant improvement in nearly all symptoms evaluated. A sustained effect is suggested by the subset of patients seen for a third visit. Although cancer stage has a key impact on prognosis, cancer patients with localized disease had a symptom burden similar to patients with metastatic cancer. To control for the impact of time and non-palliative treatments, as well as for referral bias, randomized controlled studies of outpatient palliative care are indicated.
COMORBID DIABETES AND EXPENDITURES AMONG MEDICARE BENEFICIARIES WITH HEART FAILURE Saul Blecker 1; Frederick Brancati1. 1Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 11146)
BACKGROUND: Diabetes is common in heart failure patients and has been associated with an increased mortality rate. We examined whether diabetes was associated with increased expenditures, procedures, and hospitalizations among a nationally representative sample of Medicare beneficiaries with heart failure near the end of life.
METHODS: We performed a cross-sectional analysis of resource utilization among Medicare beneficiaries with heart failure during the last six months of life. Data were obtained from a 5% sample of beneficiaries with Medicare Parts A and B. We included all beneficiaries over the age of 65 who had a diagnosis of heart failure and died in 2007. Our primary exposure was presence of diabetes. Diagnoses of heart failure and diabetes were established using the International Classification of Diseases, Ninth Revision (ICD-9) codes 428 and 250, respectively, listed as either a hospital discharge diagnosis or in at least two physician claims in the year preceding the last six months of life. The primary outcome was total Medicare expenditures during the last six months of life. Secondary outcomes were other markers of utilization, including number of hospitalizations, number of intensive care unit (ICU) days, and performance of procedures, including cardiac catheterization, implantable cardiac defibrillator (ICD), and cardiac resynchronization therapy (CRT). Characteristics between individuals with and without diabetes were compared using chi-squared tests for categorical variables and Wilcoxon rank sum tests for continuous variables. We used negative binomial and log-linear regression models to compare utilization between beneficiaries with and without diabetes
with adjustment for covariates, including age, gender, race, geographic location, comorbidities, and prior hospitalizations.
RESULTS: The prevalence of diabetes was 41.7% (n=6,922) among 16,613 Medicare beneficiaries with heart failure who died in 2007. Individuals with comorbid diabetes were younger (81.8 vs 85.8, p<0.001), more likely to be male (45.9% vs 40.2%, P<0.001), had higher numbers of hospitalizations in the prior year (mean 2.6 vs 1.8, p=0.02), and had higher rates of hypertension, cardiovascular disease, and kidney disease as compared to individuals without diabetes. Diabetes was associated with higher total expenditures (mean $39,042 vs $29,003, p<0.001), even after adjusting for covariates (adjusted cost ratio 1.08, 95% CI1.05-1.12). For both diabetics and non-diabetics, over half of Medicare expenditures were related to hospitalization costs (mean $22,516 vs $15,721, p<0.001). When compared to their counterparts without diabetes, beneficiaries with diabetes had higher rates of hospitalization (adjusted incidence rate ratio (aIRR) 1.09, 95% CI1.05-1.12) and days spent in the ICU (aIRR 1.19, 95% CI 1.09-1.29). However, after adjustment, diabetes was not associated with a significant increase in performance of cardiovascular procedures, including cardiac catheterization (adjusted prevalence ratio (aPR)1.03, 95% CI 0.87-1.21), ICD (aPR 1.03, 95% CI 0.75-1.41), and CRT (aPR 0.94, 95% CI 0.59-1.49).

CONCLUSION: In our nationally representative sample of Medicare beneficiaries with heart failure near the end of life, comorbid diabetes was extremely common. Comorbid diabetes was associated with significantly higher Medicare expenditures, much of which appeared to be driven by increased rates of acute and intensive care hospitalizations. Rates of invasive cardiovascular procedures were, however, similar in individuals with and without diabetes. To reduce the substantial costs associated with diabetes among heart failure patients, clinicians and policy makers should focus on programs designed to prevent hospitalizations in this high-risk population.

SCREENING FOR PERIPHERAL ARTERIAL DISEASE IN ASYMPTOMATIC INDIVIDUALS: A SYSTEMATIC REVIEW AND META-ANALYSIS Amy Tu Wang 1; Mohammad Hassan Murad 2; Rafael Malgor 3; Adnan Rizvi 4; Tarig Elraiyah 2; Melanie Lane 2; Larry Prokop 2; Victor Montori2. 1Mayo Clinic, Rochester, Rochester, Minnesota ; 2Mayo Clinic, Rochester, Minnesota ;
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BACKGROUND: Peripheral arterial disease (PAD) is estimated to affect 8 million Americans and is associated with increased risk of morbidity and mortality. PAD can be reliably detected via a widely available, noninvasive, and inexpensive tool, the Ankle Brachial Index (ABI). Although only 10% of individuals with PAD present with classic symptoms, the United States Preventive Services Task Force issued 2003 recommendations against screening for PAD in asymptomatic individuals, while other groups including the American Heart Association recommend for ABI screening in asymptomatic individuals. Given these disparate recommendations, we performed an updated systematic review to include new evidence in hopes of shedding light on this controversial issue.

METHODS: We conducted a systematic review and random-effects meta-analysis of electronic bibliographic databases for studies that evaluated the outcomes of using ABI to screen asymptomatic individuals for PAD.

RESULTS: Thirty-one studies reported the yield of screening asymptomatic individuals for PAD to average 16% (range 1-42%). Yield of screening increased with age and risk factors for cardiovascular disease. PAD was fairly uncommon in younger and lower risk populations.

Nineteen studies reported on the association between PAD and all-cause mortality and cardiovascular mortality. Compared to patients without PAD, patients with PAD were at higher risk of all-cause mortality (pooled hazard ratio 2.99; 95% confidence interval (CI), 2.16-4.12) and of cardiovascular mortality (2.35; 95% CI, 1.91-2.89). Five studies reported outcomes of interventions provided to asymptomatic PAD patients identified via screening. These studies used different outcomes making it difficult to draw meaningful conclusions. No studies compared effects of utilizing screening ABI versus no screening in asymptomatic individuals in terms of patient important outcomes. CONCLUSION: The current available evidence demonstrates that the yield for screening ABI to identify PAD in asymptomatic individuals is fairly high especially among older patients and those with cardiovascular risk factors. Our review also showed that PAD is associated with a 2 to 3 fold increase in mortality. Unfortunately, there were no studies that directly compared outcomes in groups receiving screening versus those that did not. Thus, we could not recommend for routine screening for PAD in asymptomatic individuals. This further underscores the need for a thoughtfully designed study that answers this patient-important question.

USABILITY TESTING FOR THE DEVELOPMENT OF AN ELECTRONIC HEALTH RECORD INTEGRATED CLINICAL PREDICTION RULES IN PRIMARY CARE Devin Mann 1; Andre Kushniruk 2; Thomas McGinn 3; Alice Li 3; Daniel Edonyabo 3; Lucas Romero 3; Jacqueline Arciniega 3; Dillon Chrimes 2; Joseph Kannry3. 1Boston University School of Medicine, Boston, Massachusetts ; 2University of Victoria, Victoria, British

Columbia ; 3Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11151)
BACKGROUND: Usability testing assesses both the ease of use and ability of clinicians to successfully interact with a prototype patient-oriented computer tool. Usability testing is a critical but underutilized step in the development of health information technology tools. The rapid growth of electronic health records (EHR) in primary care has only increased the need for usability in primary care interventions. In theory, clinical decision support (CDS) systems help EHR users deliver more efficient and effective care. The integration of evidence based medicine (EBM) into EHR systems using CDS tools at the point of care is a critical step towards using HERs to facilitate EBM in primary care. Clinical prediction rules (CPR) such as the Walsh and Heckerling criteria for Strep and Pneumonia, respectively, formally incorporate EBM diagnostic probabilities and provide primary care providers well-validated resources for care delivery. As part of a planned randomized controlled trial testing a new EHR embedded CPR tool (termed iCPR) for strep throat and pneumonia, we conducted usability testing to help develop and refine the new tool.
METHODS: We conducted usability testing to evaluate the main functionalities of the iCPR tool: alerting, risk calculator, bundled ordering, progress note and patient instructions. Eight primary care providers interacted with the prototype iCPR tool using two written clinical scenarios (1 for strep and 1 for pneumonia). Using the think aloud protocol analysis method, providers were encouraged to verbalize their thoughts as they interacted with each component of the tool. Screen capture software and audiotaping were used to record all human-computer interactions. Audio transcripts of subjects verbalizations were annotated with relevant screen movements (e.g. menu selections, etc.) to provide a holistic recording of the provider-iCPR interaction. This data was then coded using thematic protocol analysis by two trained coders with disagreements resolved by consensus. RESULTS: A total of 263 coded observations were recorded that dealt with the following 7 themes (# of unique codes): usability (33),
navigation (26), content (25), usefulness (13), understandability (9), visibility (9), and workflow (27). Code frequency was evenly distributed across providers with the following breakdown across iCPR functionalities: 53 alert, 16 risk calculator, 22 progress note, 14 patient instructions, 93 bundled order set, and 65 global coded segments. Common issues included perceived excessive clicks and readability of text as noted by one user, Its becoming a lot of clicking and reading and you want to do this thing quickly, especially if you have a lot of patients waiting. Providers had generally positive perceptions on how the tool would affect their workflow, along with suggestions for optimizing its implementation. This usability feedback led to critical changes throughout the prototype tool including redesigning the alert mechanism, adjusting the contents of the bundled order sets, revising the progress note templates and reorganizing the patient instructions. CONCLUSION: Usability testing provides critical feedback from users regarding potential barriers towards implementation of a new EHR embedded CDS tool. This data has been used to refine the development of the iCPR tool and will help achieve enhanced workflow integration and acceptance by providers.
ASSOCIATIONS BETWEEN HEALTH LITERACY, CALORIE KNOWLEDGE AND NUMERACY AND FAST-FOOD MENU SELECTION Jing-Yu Pan 1;
Arnoldys Stengel 1; Nichola Davis2. 1Montefiore Medical Center, Bronx, New York; 2Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 11155)
BACKGROUND: Calorie labeling laws require fast-food chain restaurants to post calorie information on menu boards. Initial evaluations of the impact of this law suggest that it may only affect calories purchased in a minority of consumers. The Patient Protection and Affordable Care Act mandates that calorie labeling be implemented nationwide and in addition to posting calorie information, caloric recommendations must also be posted. We sought to examine whether health literacy, calorie knowledge, or numeracy may affect calories purchased among a primary care adult population.
METHODS: We surveyed 131 adult patients attending a public hospital clinic in the Bronx, NY. Consecutive patients were recruited from the clinic waiting room to complete a 65-item questionnaire administered by

interview. The questionnaire included frequency of fast food restaurant use, calorie knowledge, weight loss attempts within the past year, health literacy and subjective numeracy. Participants were asked to select food choices from 2 fast-food menus, the first menu had no calorie information, and the second menu had the calorie information. Body mass index was determined from chart documentation of height and weight. Calorie knowledge was determined by asking participants if they knew on average how many calories most Americans should eat each day. Health Literacy was assessed with the 6-item Newest Vital Sign, which asks 6 questions about a nutrition food label (response range 06). Numeracy was assessed with Fagerlins Subjective Numeracy Scale which asks 8 questions about preference for numerical data and perceived ability to work with numbers (response range 06). The sum of the calorie items selected from the menus with and without the calorie information was calculated. Unpaired t-tests examined whether mean scores of calories selected differed among those with higher vs. limited health literacy, those who knew calorie recommendations compared to those who did not, and those with high vs. low numeracy.
RESULTS: In this population, mean (+/SD) age was 43+/16, mean (+/SD) BMI was 31+/8, and 63% reported trying to lose weight in the past 1 year. Thirty-seven percent reported going to a fast-food restaurant one or more times in a week, with some respondents going as often as 10 times a week. Forty percent of survey respondents correctly chose 2000 calories as the average number of calories most

adult Americans should consume daily. Mean (+/SD) response on the health literacy scale was 2.6+/1.9,with 35% of respondents having a score of less than 2 suggesting limited health literacy. Participants selected an average of 763+/448 calories on a fast-food menu without calorie information, compared to 511+/336 calories ($p<0.005$) when calories were added. Of 131 participants, 48 completed all survey measures. Among these participants, the sum of calories selected by those with limited health literacy was (1198+/1094); significantly higher than the calories selected by participants with higher health literacy (762+/435), $p=0.04$. Adults who knew the caloric recommendations chose 854+/716 calories and those who did not know the calorie recommendations chose 801+/438 calories, $p=0.76$. Participants below the median level of numeracy selected 876+/547 calories and those above the median selected 827+/700 calories, $p=0.79$. CONCLUSION: Our findings suggest that health literacy may be an important factor in calories selected at a fast-food restaurant. While participants with higher knowledge and higher numeracy selected fewer calories, this was not statistically significant in our sample. As calorie labeling is implemented nationally it will be important to examine knowledge, health literacy and numeracy as potential barriers in using calorie information.
GENDER CONCORDANCE OF PATIENTS AND PROVIDERS: BALANCING PATIENT PREFERENCE WITH EDUCATIONAL NEEDS Amy Devlin 1; Long Ngo 1; Carol K. Bates 1; Diane Brockmeyer1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 11159)
BACKGROUND: Prior studies show patients prefer same-sex physicians; we believe this drives gender imbalance in our resident outpatient panels. Among our senior residents, males have 65% male patients, and females have 80% female patients. This limits resident experience managing gender specific issues.
Our clinic graduates 44 residents annually, transferring 3500 patients to new interns. We preferentially transitioned patients to opposite gender interns over the past 2 years. Patient assignments were made to interns of the opposite gender of the patient 67% of the time. 86% of patients were assigned to an intern who was the opposite gender of their prior resident PCP. Exceptions were made to assign equal numbers of patients to new interns, to match language for non-English speaking patients, and for preceptor continuity for sicker patients. Patients were notified of their new PCP via letter.
This study examines the impact of change in physician gender on the likelihood of patient follow-up.
METHODS: In this retrospective cohort study, patient follow-up visits were recorded for the 12 months after assignment to new PCP for the June 2008 and 2009 graduation cohorts. The primary exposure was assignment of a new, opposite-sex primary care physician (female-to-male PCP or male-to-female PCP) vs. unexposed

groups (male-to-male PCP, female-to-female PCP). 6150 patients were switched to opposite gender PCPs and 987 patients remained in the unexposed group (N=7137). The binary outcome variable was follow-up vs. no follow-up with assigned PCP, or with any MD or NP in the practice. Logistic regression was used to estimate unadjusted and adjusted odds ratios of the effect of switching patients to opposite gender PCPs on the probability of follow-up with PCP and with any provider. Two linear contrasts from the logistic regression models were used to obtain odds ratios for the comparison between female-to-male versus female-to-female PCP, and male-to-female versus male-to-male PCP switch. To address confounders, covariate adjustments were made for age, gender, diabetes, chronic narcotic use, known significant illness, and language (English vs. non-English speaking).
RESULTS: At 12 months after assignment to new PCP, 48% of patients had follow up in the practice, and 16% of patients followed up with the assigned new PCP. If the new PCP was the same gender as prior PCP, rates were 55% and 23%. If the new PCP was different gender from prior PCP, rates were 47% and 11%. Patients with existing illness, diabetes, pain treated with narcotics and non-English speaking patients had greater follow-up rates.
Multivariable models were used to adjust for potential confounders of age, gender, illness, diabetes, narcotic use, and non-English speaking patients. For rates of follow up with assigned PCP, adjusted odds ratios showed patients transitioned from female-to-male vs. those continuing with female PCPs were 52% less likely to follow-up with the assigned PCP (OR=0.48, CI=0.38-0.60). Patients transferred from male-to-female PCPs were 26% less likely to follow-up than male-to-male PCPs (OR=0.74, CI=0.56-0.98).
CONCLUSION: Reassigning patient panels to opposite gender PCPs appeared to decrease patient follow-up. Further investigations are needed to optimize continuity of care for patients while providing a balanced resident educational experience.
ADHERENCE TO CHRONIC DISEASE MEDICATIONS AMONG NEW YORK CITY MEDICAID ENROLLEES
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BACKGROUND: Adherence to medications for hypertension, diabetes, and dyslipidemia is a critical component of primary and secondary cardiovascular disease prevention and control. While provider and payor organizations such as Medicare/Medicaid have traditionally been involved in introducing medication adherence initiatives, local public health departments can play a unique role in monitoring, piloting and promoting best practices, and in facilitating systems-level changes designed to increase adherence rates. To better understand factors related to adherence in the New York City (NYC) Medicaid population on chronic disease medications, and to establish a method for evaluating potential interventions, the NYC Department of Health and Mental Hygiene, in collaboration with the New York State Department of Health, aimed to 1) determine the rate of medication adherence among NYC Medicaid enrollees with chronic disease (diabetes, hypertension, or dyslipidemia) on maintenance medications, 2) identify predictors of medication adherence, and 3) describe prescribing patterns (number of days supplied).
METHODS: We performed a retrospective analysis of pharmacy claims data from the New York State Medicaid system. Included were individuals ages 2064 continuously enrolled in Medicaid and who had at least two fills of an eligible medication for dyslipidemia, diabetes, or hypertension during the observation period from July 1, 2008-June 30, 2009, and at least one fill in the three months prior. Adherence was measured using the medication possession ratio, with adequate adherence defined as 80%. Multivariable logistic regression was used to predict medication adherence as a function of race/ethnicity, age, gender, number of medications, and number of conditions. RESULTS: Data were analyzed for a total sample of 160,238 patients, involving over 3.5 million prescription fills. Overall, 63% of enrollees were adherent to their chronic disease medication regimens. In multivariable logistic regression older age and taking a larger number of medications were significantly

associated with increased adherence. Compared with whites, Asians were more likely to be adherent (OR=1.28, 95% CI: 1.24-1.33), whereas blacks were less likely to be adherent (OR=0.84, 95% CI: 0.81-0.86). The majority of prescriptions filled were for 30 days supply, rather than 60 or 90 days (95.9%, 0.6% and 2.5%, respectively).

CONCLUSION: In a population of NYC Medicaid recipients on stable medication regimens for hypertension, diabetes, and/or dyslipidemia, adherence to medications for these conditions was inadequate and racial disparities were indentified. Results from this study may be used by health departments and other providers to inform development and evaluation of future medication adherence programs. Because prior studies have shown improved adherence with use of prescriptions greater than 30 days supply, the low prevalence of these larger prescriptions in our analysis identifies a potential target for local systems-level interventions designed to improve medication adherence and address health disparities.

KNOWLEDGE LEVEL ABOUT HPV AMONG AN UNDERSERVED LATINA POPULATION IN METRO-ATLANTA: NEW OPPORTUNITIES FOR TARGETED INTERVENTIONS

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BACKGROUND: Human papillomavirus (HPV) is the leading cause of cervical cancer. Currently there is a two-pronged approach employed to prevent development of cervical cancer: 1) secondary prevention via Papanicolaou smear screening, used in the U.S. since the 1950 s, and 2) primary prevention with use of the recently introduced HPV vaccine. Despite the availability of effective secondary prevention, Latina women are disproportionately affected by cervical cancer incidence and mortality, with death rates more than 50% higher than in non-Hispanic white women. Explanations for these findings include lack of access to healthcare, lack of knowledge and health literacy, poor follow-up, immigration status, and cultural beliefs, among others. Improving HPV vaccination coverage is critical in order to decrease this health disparity.

Recent data from our group suggests that lack of knowledge about cervical cancer and its cause may play a crucial role in shaping cervical cancer prevention health service use, and thus, incidence of disease among Latina women. Because the Southeastern U.S., and especially the metro Atlanta area, is beginning to support increasing numbers of Latino immigrants, it is important to address the specific knowledge gaps that impact this population.

The objective of this study is to evaluate the level of knowledge of HPV in a sample of Latinas living in metro Atlanta, and to assess the factors correlated with differing levels of knowledge.

METHODS: This study is a secondary analysis of data from a cross-sectional survey of a convenience sample of Latina women recruited from the waiting room of two clinics serving an indigent population. Women completed the Survey using Computer Assisted Personal Interview (CAPI) with Audio Computer Assisted Self Interview (ACASI) components. Knowledge level of HPV was measured by the number of correct responses to five questions. Thus each survey respondent received a score between 0 and 5. The score was then tested for correlation with demographic factors and other characteristics of the survey respondents by Fishers exact test (SAS, version9.2; SAS Institute, Cary, NC). P-values <0.05 were considered significant.

RESULTS: A total of 86 Latina women responded to the knowledge items, which included five questions regarding HPV knowledge. Eighty percent of these women were of Mexican origin. Among the study participants, 54% correctly identified HPV as the most common sexually transmitted infection (STI), 54% responded incorrectly that herpes was the most common STI, 74% correctly responded that HPV causes

cancer, 29% correctly answered that
HPV can cause penile cancer, and 12% responded correctly that HPV may not have symptoms.
Multivariate analysis revealed that those who already had received the vaccine scored higher on the knowledge questions (p=0.0054). Additionally, there were higher scores in those who feel they speak English best, as opposed to Spanish (p=0.061), those who read or speak primarily in English (p=0.0309), those who primarily think in English (p=0.0433), and those who speak in English with friends (p=0.0474). Although not significant, there was a trend that first generation Latinas scored lower on the knowledge questions (p=0.16).
Further examination found that those who speak or read primarily in English (p=0.0049), those who think in English (p=0.0384), those who feel they speak English best (p=0.0079), and those that speak in English with friends (p=0.0312) were more likely to have received the vaccine. First generation Latinas were also less likely to have received the vaccine (p=0.0306).
CONCLUSION: Among a convenience sample of underserved Latinas recruited from outpatient clinics, most were aware that HPV is associated with cervical cancer. However, the highest level of knowledge appears to be associated with those who are more comfortable with the English language. Additionally, this subset of the population is largely the same persons who have already been vaccinated. Therefore, further strategic educational interventions in this population should target first-generation women or those less comfortable with the English language. The most critical intervention to decreasing the incidence of cervical cancer may be improving access to education and increasing English proficiency.
COLORECTAL CANCER SCREENING IN PRIMARY CARE Craig Daniel Seaman 1; Bruce Ling 2; Maria Mor2. 1University of Pittsburgh Medical Center, Glenshaw, Pennsylvania ; 2Veterans Affairs Medical Center, Pittsburgh, Pennsylvania . (Tracking ID # 11164)
BACKGROUND: Colorectal cancer is the 3rd most common cancer and 2nd leading cause of death due to cancer. The United States Preventive Services Task Force (USPSTF) recommends annual fecal occult blood test (FOBT), flexible sigmoidoscopy in combination with FOBT, or colonoscopy as colorectal cancer screening (CRC) methods. CRC screening is significantly underutilized with CRC screening rates estimated between 55-63%. Effective patient-provider communication is necessary in all aspects of medical care. Our study assessed whether or not increased level of discussion regarding CRC screening between patient and provider is associated with increased CRC screening rates.
METHODS: The study consisted of males 5074 years of age due for CRC screening during the 12 month period following enrollment. Transcribed audiotaped visits between patient and provider, an attending physician, at a single Veterans Affairs Medical Center in Pittsburgh, PA, were categorized as CRC screening absent, CRC screening mentioned, or CRC screening discussion present. Outcomes were determined by reviewing electronic medical records 15 months after enrollment in the study with outcomes defined as completion of FOBT, flexible sigmoidoscopy, or colonoscopy. Two sided p values were calculated with Fishers exact methods.

RESULTS: The analytic cohort consisted of 66 patients due for CRC screening that had transcribed audiotaped visits. 22 (33%) patients completed CRC screening with 8 (36%) categorized as CRC screening absent, 11 (50%) categorized as CRC screening mentioned, and 3 (14%) categorized as CRC screening discussion present. 44 (67%) patients did not complete CRC screening with 22 (50%) categorized as CRC screening absent, 12 (27%) categorized as CRC screening

mentioned, 9 (20%) categorized as CRC screening discussion present, and 1 (3%) whose transcript was missing (p value=0.30). 42.1% of patients that agreed to CRC screening during the encounter with the provider did not complete CRC screening. These patients were compared with patients that reported intent to complete CRC screening and did so. Multiple variables were analyzed with a statistically significant difference present between the aforementioned groups with respect to prior history of CRC screening (p value=<0.001). Among

patients that voiced intent to complete CRC screening and did so, 12 (75%) previously completed screening compared with 4 (25%) that never completed screening. Among patients that voiced intent to complete CRC screening but failed to do so, 2 (12%) previously completed screening compared with 14 (88%) that never completed screening.
CONCLUSION: The level of discussion between patient and provider does not predict completion of CRC screening. In addition, very limited discussion occurs between patient and provider regarding CRC screening. Among patients that voiced intent to complete CRC screening, a prior history of CRC screening predicts subsequent completion of screening. Furthermore, I hypothesize that increased level of discussion between provider and patient regarding CRC screening is negatively associated with completion of CRC screening because patient reluctance results in increased level of discussion (as opposed to increased level of discussion resulting in patient reluctance). Also, focusing additional efforts on individuals agreeing to CRC screening that have never completed screening may increase screening completion rates.
MISSED OPPORTUNITIES FOR ADVANCE CARE PLANNING IN PRIMARY CARE Sangeeta Ahluwalia 1; Jennifer Levin 1; Karl Lorenz 1; Howard Gordon2. 1Veterans Administration, Los Angeles, California ; 2University of Illinois, Chicago, Chicago, Illinois . (Tracking ID # 11167)
BACKGROUND: Advance care planning (ACP), a process of patient-provider communication by which a patient can make their preferences for future care known, is particularly relevant for patients with heart failure (HF) , who face a highly variable trajectory characterized by periods of medical crisis, and where considerable uncertainty exists about the timing and nature of death. There is indirect evidence to suggest that ACP discussions are limited in the primary care setting; such discussions are often avoided until death is imminent. A key barrier to engaging in ACP reported by primary care clinicians is the lack of opportunity during a busy clinic visit to raise this complex topic with their patients. The purpose of this study was to 1) determine the frequency and type of ACP communication between HF patients and their primary care providers (PCP) during clinic visits following discharge from a HF hospitalization and 2) to characterize missed opportunities for engaging in ACP during the visit.
METHODS: We conducted a content analysis of 76 post-discharge primary care clinic visits, that were recorded and transcribed, with veterans 65 years with HF and their PCP/Transcripts were analyzed for the presence of 5 components of ACP as defined by existing literature: explanation of disease trajectory, prognosis communication, discussion or completion of formal directives, discussion or identification of a surrogate decision-maker, and personal and psychosocial planning for the future. Transcripts were also analyzed using grounded theory methods for missed opportunities for providers to engage in ACP, defined as direct communication by the patient providing information regarding their thoughts, concerns, or questions related to any of the 5 components of ACP that was not fully encouraged or adequately responded to by their provider.
RESULTS: Out of the 76 unique clinic visits analyzed, only one contained a discussion of all 5 components of ACP. Of the remaining 75 visits, 15% (n=11) included an explanation of disease trajectory, 23% (n=17) included prognosis communication, 4% (n=3) included a discussion of formal directives, 0% (n=0) included discussion of a surrogate decision-maker, and 4% (n=3) included personal and/or psychosocial planning for the future. The following categories of missed opportunities for engaging in ACP emerged from the analysis: i) emotional opportunities, where veterans expressed concern or worry regarding their prognosis, future functional abilities and likelihood of decline, or their overall expected health state, ii) information-seeking opportunities, where veterans sought information on their prognosis, specific treatment options, or future care, and iii) social-support opportunities, where veterans discussed their future health within the context of their family/caregiver or broader social environment. Categories of provider responses to these communications included: i) incomplete responses, where the physician did not fully explore the comment, ii) misdirected responses, where the provider bypassed the comment by engaging in a related discussion and iii) terminated responses, where the provider invalidated or ignored the veterans thoughts or feelings.

CONCLUSION: These findings demonstrate particularly limited engagement in ACP by PCPs with their patients with HF. Patients actively seek information, empathy and guidance from their providers regarding their illness that may be overlooked or inadequately addressed by their provider. The missed opportunities for ACP identified here represent meaningful entrees into discussions about planning and preparing for future care; active recognition of these opportunities may help providers to initiate what is already a difficult and complex topic.

SOCIAL DISPARITIES IN MAIL-ORDER PHARMACY USE: AN EXAMPLE OF THE INVERSE CARE HYPOTHESIS Andrew J Karter 1; Julie A Schmittdiel 1; Melissa M Parker 1; Dean Schillinger 2; Howard H Moffet 1; Wendy T Dyer 1; James Chan 1; William H Herman 3; O. Kenrik Duru4.

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BACKGROUND: A third of all chronic disease prescriptions in the US are filled by mail. Use of Mail-Order Pharmacy (MOP) has been associated with improved adherence, better LDL-C control, and cost savings for health plan operations when compared to community (walk-in) pharmacies. Tudor-Harts inverse care hypothesis posits lagging uptake of innovations by vulnerable populations due to resource and access barriers (resulting in more care for those who need less, and less care for those who need more). While we have reported ethnic disparities, there has not been formal evaluation of disparities in mail-order pharmacy across other social indicators, or studies of how incentives to increase use of MOP may affect existing disparities in MOP utilization.

METHODS: We evaluated social disparities in prevalent use of MOP (defined by any mail order refills in year prior to baseline survey) in a sample of 17,758 Kaiser Permanente patients with diabetes who responded to a survey (62% response rate) from the Diabetes Study of Northern California (DISTANCE). Each subject had a pharmacy benefit and had filled a cardiometabolic medication (diabetes, anti-hypertensive, or lipid-lowering) in the year prior to baseline. We also evaluated new MOP use (i.e., incident use among subjects without previously recorded MOP use) during the 12 months after a new financial incentive was offered to promote MOP in specific subsets of

pharmacy benefit beneficiaries. We used primarily unadjusted summary statistics (%), but also specified difference-in-difference models using modified Poisson regression models with robust standard errors to estimate relative risk.

RESULTS: There was markedly lower prevalent use of MOP among those with lower income (25% with incomes under $25 K vs. 50% in $80 K+), less education (27% in no degree vs. 43% in college grads), inadequate health literacy (32% vs. 43% in adequate HL), non-English speakers (23% vs. 38% in English speakers) and minority patients (25% in African Am and Latinos, 48% in Asians, 53% in Whites)($p<0.0001$ for all). Adjustment for age, sex, self-reported difficulty navigating the phone refill system, depressive symptoms, and distance from home to pharmacy did not change patterns substantively. Among the subset of previous non-users, 36% became MOP users in the year after being offered a financial incentive compared to 9% among those not offered the incentive. Among non-users offered incentives, uptake was inversely related to income (see figure). Similarly, greater response to incentives was also observed for other social indicators of advantage (e.g., adequate health literacy). CONCLUSION: We observed substantive social disparities in the prevalence of MOP use. Financial incentives to enroll greatly increased new MOP use among previous non-users overall, but paradoxically, poorer patients were less likely to initiate use despite offerings of reduced out-of-pocket costs. While our study did not examine adherence and health outcomes, it does suggest that health plans need to

tailor and promote innovations such as MOP for vulnerable populations, in order to attenuate disparities that may be exacerbated by broadly applied quality improvement initiatives.
Income differences in new (incident) mail order pharmacy (MOP) use in year after introduction of a financial incentive among those not using MOP prior to incentive roll-out
TREATMENT DELAYS AT A FREE URBAN CLINIC: MAKING A CASE FOR POINT OF CARE A1C TESTING
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BACKGROUND: The management of chronic diseases, including diabetes, can be particularly challenging for free medical clinics. In addition to the struggles of limited medical resources, limited continuity, and complicated social situations, accessing laboratory testing can also be challenging. The Birmingham Free Clinic, a free, primary care, volunteer-driven clinic in Pittsburgh, Pennsylvania, serves a large population of uninsured patients, many of whom have diabetes. The clinic has no on-site phlebotomy services but currently partners with a local hospital (approximately one mile away) for free limited laboratory testing for the patients. Point of care (POC) testing, specifically for hemoglobin A1C (A1C), offers potential advantages in managing chronic diseases in this setting. POC testing allows
clinicians to make immediate treatment decisions at the point of care rather than requiring patients to make separate trips to the lab. We believe that POC A1C testing can offer particular advantages for a patient population that is low income, has difficulty accessing transportation, and may have transient housing situations. However, with a very limited budget, the clinic has to develop cost effective protocols and interventions. In order to assess the potential advantages of implementing POC testing in a free clinic we first investigated the treatment delays that were associated with the current lab-based, off-site A1C testing.
METHODS: We performed a retrospective chart review of all known patients with diabetes seen at the clinic between June 2010 and October 2010. Data was abstracted from the period of June 2008 through October 2010. Data abstracted included basic demographic information, housing status, monthly income, date(s) that A1C was ordered, date(s) the test was obtained at the lab, and date(s) that patients had clinic follow-and the A1C lab result was acted upon by a clinician. The University of Pittsburgh Institutional Review Board approved this project.
RESULTS: A total of 56 patients were included in the chart review. The majority of the patients were African American (50.9%) men (75%). The mean monthly income was $589.71 (SD 580.04). Mean driving distance from home to clinic was 6.32 miles (SD 5.56). Mean A1C over this time period was 8.88% (SD 2.25). At the time of the analysis, 25% of the patients were homeless, including 5.5% in a drug and alcohol rehabilitation facility attached to the clinic and 20% doubled-up. Over this period, 175 A1Cs were ordered of which 101 (58%) were obtained by patients. It took a mean 65 days (SD 103) for patients to obtain their blood work after receiving a lab requisition. The mean time from date A1C was initially ordered until the A1C results were acted upon was 110 days (SD 124).
CONCLUSION: Our study shows significant delays in care when patients have to go to an offsite lab to obtain tests. In this analysis, we found that it takes more than 2 months for many patients to go to the lab after receiving a laboratory requisition. An additional month often passes before any changes are made to therapy based on those results. POC testing could potentially get patients to goal faster and prevent or delay expensive, life-altering complications. It may also minimize transportation costs and time barriers for patients. Further investigation into the cost effectiveness of POC testing for this population could aid in decisions regarding resource allocation.
COMPARATIVE SAFETY AND EFFECTIVENESS OF DIABETES MEDICATIONS IN SUBPOPULATIONS OF ADULTS WITH TYPE 2 DIABETES
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BACKGROUND: Although many studies have examined the comparative effectiveness and safety of medications for type 2 diabetes, clinicians need better guidance on how to tailor treatment according to demographic and clinical characteristics of individual patients. METHODS: As part of a comprehensive systematic review, we searched MEDLINE, EMBASE, and Cochrane databases from inception through April 2010 and hand-searched journals and reference lists using search terms for type 2 diabetes and all FDA-approved diabetes medications. Two investigators independently reviewed citations to identify studies that compared the effectiveness and safety of diabetes medications as monotherapy or in combination for sub-populations of patients with type 2 diabetes. We abstracted data from eligible articles and assessed study quality.

RESULTS: We identified 28 studies (21 randomized controlled trials (RCTs) &7 observational studies) that reported outcomes in subgroups of patients. Five studies examined the impact of age on glycemic control, but we were unable to draw conclusions regarding comparative medication effectiveness in older adults with diabetes. Two RCTs conducted subgroup analyses by sex for the outcome of fracture. One 4-year study showed an increased risk of fracture among women treated with rosiglitazone compared with metformin or sulfonylurea (hazard ratio (HR) 1.57 (1.13-2.17; p=0.007) and 1.61, respectively (1.14-2.28; p=0.007). The second 6-year trial confirmed an excess fracture risk in women treated with rosiglitazone plus metformin or sulfonylurea compared with metformin plus sulfonylurea (RR in women 1.82 (1.37-2.41) and in men 1.23 (0.85-1.77)). Two RCTs favored metformin over sulfonylurea among obese patients in terms of weight loss. In one study, obese patients gained on average 3.7 kg (0.5 to 7.9 kg) on sulfonylurea and lost on average1.3 kg (5.8 to 3.2 kg) on metformin (p<0.001). Eleven RCTs evaluated comparative effects on glycemic control by subjects baseline hemoglobin A1c (HbA1c) level, and found a greater absolute reduction in HbA1c among those with higher baseline HbA1c. Two studies examined all-cause mortality in patients with baseline heart disease. One study of patients with congestive heart failure reported decreased all-cause mortality risk in patients taking metformin compared with sulfonylurea (adjusted HR 0.70 [0.54-0.91]) at a median follow up of 2.1 years. The second study found increased all-cause mortality in patients with ischemic heart disease taking metformin compared with sulfonylurea or repaglinide (adjusted HR3.82 [1.22-11.9; p=0.02]).

CONCLUSION: Effectiveness and safety of oral diabetes medications may depend on patient sex, pre-treatment HbA1c level, and the presence of heart disease. Overall, strength of evidence was low because studies were not powered to assess differences within or between sub-populations. Future research is needed to address medication effects in patients with co-morbid conditions.

PATIENT REPORTED BARRIERS TO ENROLLMENT IN A PATIENT PORTAL Mita Sanghavi Goel 1; Tiffany Brown 1; Adam Williams 1; Romana Hasnain-Wynia 1; Andrew Cooper 1; Jason Thompson 1; David Baker1. 1Northwestern University, Chicago, Illinois . (Tracking ID # 11196)

BACKGROUND: With the introduction of meaningful use criteria and the advancement of electronic health records (EHRs) generally, use of tethered personal health records, or patient portals, is becoming more commonplace. Previous studies have found low rates of enrollment in patient portals overall and significant disparities in enrollment by race and ethnicity, but the reasons for these findings are not well understood. Our study aims to identify patient-reported barriers to enrollment in a patient portal.

METHODS: Patients were eligible if they had an attending physician within the General Internal Medicine (GIM) clinic, two face-to-face visits in the past 18 months, and an order placed by their physician to activate the electronic patient portal, but did not enroll within 30 days of the order being placed. After generating lists of eligible patients, we randomly selected patients for the telephone survey. Lists were stratified by race as recorded within the EHR to ensure adequate sampling of non-white patients. Patients who were contacted and agreed to participate completed a 15 minute survey that used closed and open-ended questions to examine: (1)

whether participants recalled a discussion with their provider about the patient portal (2) whether participants attempted enrolling in the patient portal (3) experiences of those attempting to enroll (4) reasons for not attempting to enroll (5) access to and typical use patterns of the internet and (6) perceptions of benefits of the patient portal. We used content analysis to categorize responses to open-ended questions. Analyses were performed in SAS. Racial differences in responses were analyzed using Fishers exact test for categorical variables; $p<0.05$ was considered significant.

RESULTS: The survey response rate was 61%. Participants mean age was 51 years; 72% were female, 70% had a college degree or greater, 48% were black.

Reasons for not enrolling in the patient portal. Twenty-six percent of respondents did not remember discussing the patient portal with their providers, 63% did not attempt to enroll despite remembering a discussion with their providers, and 11% attempted to enroll, but did not succeed. Differences by race were not significant.

Reasons for not attempting to enroll. Among those who did not attempt to enroll in the patient portal, 60% endorsed reasons related to low priority or inattention as the primary reason for not attempting to enroll, 30% reported attitudinal barriers and 8% reported technical barriers. Differences by race were not significant.

When asked whether specific factors contributed to not attempting to enroll, black respondents were significantly less likely than whites to report that they forgot (52% vs. 74%, $p<0.05$) or were too busy to enroll (30% vs. 59%, $p<0.05$). There were no significant differences in access to the internet as a reason for not attempting to enroll.

Attitudes towards patient portals. Overall, respondents favorably viewed a variety of benefits that patient portals provide; however, black respondents were less likely than whites to endorse as important or very important features that assisted self-management: getting test results (69% vs. 86%, $p<0.05$), managing medical problems (58% vs. 82%, $p<0.05$) and seeing when you are due for screening tests (72% vs. 88%, $p<0.05$). There were no significant differences in attitudes towards administrative tasks such as scheduling appointments or refilling medications.

CONCLUSION: Strategies to increase uptake of the patient portal need to ensure patients understand the features of a patient portal, remember being invited to enroll, and receive follow-up reminders to enroll. In addition, interventions to eliminate racial disparities in patient portal enrollment must address attitudinal barriers and not focus solely on improving access.

SCREENING, BRIEF INTERVENTION AND REFERRAL TO TREATMENT (SBIRT) FOR OPIOID ABUSE IN AN URBAN HOSPITALIZED POPULATION: A PILOT STUDY Richard Gil 1; Nancy L Sohler 2; Mia Brisbane 1; Gabriela Ordonez Llanos 3; Chinazo O Cunningham4.

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BACKGROUND: BACKGROUND: Numerous studies demonstrate the deleterious health outcomes associated with substance abuse and dependence. To intervene early in the course of substance use, Screening, Brief Intervention, and Referral to Treatment (SBIRT) has been advocated by many. In primary care settings and emergency departments, SBIRT has been successful in screening for and identifying populations with problematic alcohol use, providing brief interventions to them and referring them for treatment, leading to improved outcomes. Although substance use disorders are common among hospitalized patients, few studies have examined the feasibility of or outcomes associated with conducting SBIRT in hospitalized patients. Although data regarding SBIRT for drug use has been sparse, with the rise in opioid use, abuse, and dependence, many

advocate for SBIRT specifically for drug use. We sought to test the feasibility of conducting SBIRT for problematic opioid use targeting patients hospitalized on the medical wards of a large urban academic medical center.
METHODS: METHODS: On 22 days between October 2009 and 2010, we identified all adult patients who were admitted within 24 hours to four different floors of the medical wards of a large urban academic medical center in the Bronx. A research assistant attempted to reach all admitted patients who were 1875 years old, fluent in English or Spanish, and alert and oriented. Patients who were intubated, restrained, or on contact isolation were excluded. We administered audio computer-assisted self-interviews (ACASI) to patients, collecting sociodemographic information and risk of problematic opioid use (using the Alcohol, Smoking, Substance Involvement Screening Test [ASSIST] questionnaire, developed by the World Health Organization [WHO]). According to the WHO criteria, patients were categorized as having no opioid use, or low, moderate, or high risk of problematic opioid use. Those who had moderate or high risk problematic opioid use received a brief computer-based intervention in which they were informed about their risk and opioid addiction treatment options, and invited to receive additional information and referrals to treatment. We conducted simple frequencies to describe patients sociodemo-graphic and clinical characteristics.
RESULTS: RESULTS: Of the 231 patients who were newly admitted to the medical wards, we were unable to reach 42 (18.2%) (they were already discharged, not in their rooms, or otherwise occupied with health care providers) and 42 (18.2%) refused to participate. Of the remaining 147 patients, 61 (41.5%) were ineligible for the following reasons: age >75 years (n=37), on contact isolation (n=12), disoriented (n=8), in severe pain (n=2), blind (n=1), and not fluent in English or Spanish (n=1). In addition, computer issues resulted in incomplete interviews in 3 patients. Of the 75 patients included in this analysis, the mean age was 48.6 years, and the majority were women (65.3%), Hispanic (49.3%) or black (38.7%), had a high school education (68.0%), and had public insurance (66.7%). In terms of opioid use in the prior 3 months, 42 (56.0%) reported no opioid use, 4 (5.3%) low risk, 26 (34.7%) moderate risk, and 3 (4.0%) high risk of problematic opioid use. Of the 29 patients with moderate or high risk, 19 (65.5%) were interested in referral to treatment and 27 (93.1%) reported that the brief computerized intervention was useful.
CONCLUSIONS: In a large urban academic medical center, we found moderate or high risk of problematic opioid use in 39% of patients hospitalized on the medical wards. Our data suggest that in the inpatient medical setting, ample opportunity exists to identify patients with problematic opioid use, to provide a brief intervention, and to refer them to treatment. In fact, of those with moderate or high risk of problematic opioid use, over half were interested in referral to treatment, and nearly all reported usefulness of the brief intervention. Despite this, we question whether a model of conducting SBIRT like ourswith a dedicated person outside of the team delivering health careis feasible. Of all patients newly admitted to the hospital, only one-third were screened for problematic opioid use, as approximately one-fifth were unable to be contacted, one-fifth refused to be screened, and one-fourth were ineligible. Because moderate or high risk of problematic opioid use appears to be common in hospitalized patients on medical wards and has substantial consequences, further research examining SBIRT related to problematic opioid use in hospitalized patients is warranted.
UNDERSTANDING PROVIDER PERSPECTIVES ON CARE TRANSITIONS FROM HOSPITAL TO HOME: FINDINGS FROM A 360 DEGREE QUALITATIVE EVALUATION Honora Englander 1; Melinda Davis 1; Devan Kansagara2. 1Oregon Health &Science University, Portland, Oregon ; 2Portland VA Medical Center, Portland, Oregon . (Tracking ID # 11201)
BACKGROUND: Patients are vulnerable to experiencing poor quality, fragmented care as they transition from acute hospital care to home. Transitional care improvements are a growing priority for health reform and are an opportunity to accomplish the triple aim of lowering health care costs, improving quality, and increasing patient satisfaction. Understanding gaps in care and barriers to improvement from both patient and provider perspectives informs the development of transitional care interventions. Prior qualitative work has found that

patients and their caregivers feel poorly prepared for self-care after discharge. Few studies, however, have examined transitional care deficiencies from a health care provider perspective. We conducted a qualitative assessment to evaluate multidisciplinary inpatient and outpatient provider perspectives of roles, barriers, and facilitators to effective care transitions from hospital to community-based care.
METHODS: Investigators conducted in-depth semi-structured interviews (2) and focus groups (13) from October 2010 to January 2011. Participants were drawn from the general medicine and cardiology services at an urban, academic hospital; three partnering outpatient primary care clinics; and one Medicaid managed care plan. Standard qualitative analytic techniques were applied to verbatim written transcripts.
RESULTS: The seventy-five participants included internal medicine residents (6), inpatient hospital attendings (5), outpatient general medicine attendings (5), subspecialty attendings (4), community clinic providers (9), pharmacists (8), nurses (14), case managers (8), social workers (1), and hospital executives (15). The following themes emerged as key contributors to poor transitions of care: 1) lack of clarity of roles and responsibilities among providers and across settings, 2) lack of multidisciplinary communication, and 3) patient barriers such as no insurance, lacking a usual source of care, substance abuse, and complex medication regimens. Many providers noted the irrationality of providing high cost rescue hospital care for the uninsured without adequate transitional care. Providers also noted that the uncertainties associated with unsatisfactory transitions negatively impact job satisfaction. Finally, providers noted opportunities to expand education and competencies in care coordination across disciplines and facilities.
CONCLUSION: Many providers from a range of disciplines are involved in transitions of care across settings. Providers experiences underscore that communication across settings and, importantly, across disciplines may be critical to enhancing care transitions. Clarity about roles and responsibilities as well as education that promotes collaboration is likely to improve transitional care. In addition, barriers unique to specific patient populations such as the uninsured are particularly challenging and may be an additional opportunity for focused care transitions improvements.
PREDICTING 30 DAY READMISSIONS WITH ADMINISTRATIVE DATA John W. Showalter 1; Nicole Swallow 1; Colleen Rafferty1. 1Penn State University, Hershey, Pennsylvania . (Tracking ID # 11203)
BACKGROUND: Readmissions within 30 days of hospital discharge have been shown to be frequent and costly. Published studies that have successfully reduced 30 day readmissions involve time and

labor intensive interventions; many institutions may not have adequate resources to apply similar interventions to all admitted patients. Development of a risk assessment tool that identifies patients at highest risk of readmission could help institutions to focus interventions on the highest risk patients. Previously published risk assessment tools are limited because their use requires direct patient contact, large amounts of clinical data, and they cannot be done at the time of admission. The objective of this study is to create a risk assessment tool for 30 day readmissions which uses easily obtainable administrative data, requires no patient contact, can be done at the time of admission, and performs better than published risk assessment tools.
METHODS: An expert system (rule based computer learning program) was created using data from all adult patients discharged from the Penn State Hershey Medical Center Internal Medicine service between November 1, 2008 and October 31, 2009. The expert system was developed from subjects randomly assigned to a training data set and was validated against the remaining subjects (testing data set). The expert system was then further validated against an independent data set that included all patients discharged from the Internal Medicine service between November 1, 2009 and October 31, 2010. The primary outcome was all-cause 30 day readmissions to any service at our institution and the secondary outcome was all-cause 30 day readmissions to the Internal Medicine service. Four input variables were used to develop the expert system: 1. number of diagnoses billed, 2. presence of an outpatient clinic visit, 3. presence of an inpatient admission and 4. presence of an Emergency Department visit. All were restricted to the year prior to the date of inpatient

admission and to data from our institution.
The decision making process of the expert system was based on certainty factor analysis. Certainty factor analysis refers to a mathematical method of handling uncertainty, originally designed for medical decision making. Using the training data set, certainty factors for utilization were determined by calculating the readmission rates for the eight unique patterns of utilizing outpatient, inpatient and Emergency Department services. Certainty factors for number of diagnoses billed were determined for subjects with zero, 110 and greater than 10 diagnoses billed, also based on the training data set. A composite certainty factor for readmission (CFR) was then calculated based on those numbers for all subjects. Threshold values of CFR to predict subjects with a high risk of readmission were calculated using receiver operator characteristic (ROC) curve analysis.
RESULTS: The total study population consisted of 5,191 subjects with 1,244 in the training, 1,244 in the testing and 2,743 in the independent validation set. There was no statistical difference between the three data sets with regard to age, sex or race. The independent validation set had a significantly (p-value <0.01) increased rate of readmissions (14.8%) as compared to the training(12.8%) and testing (11.8%) sets.
Using a threshold CFR value of 0.352 the system was able to identify patients at high risk for readmission. Readmission rates for patients with a CFR above the threshold value were greater than 30 percent for all data sets. In the independent validation set, 9.8 percent of patients were above the threshold. This high risk group accounted for27.1 percent of readmissions to the Internal Medicine service. Additionally, subjects in the independent validation set with a CFR below 0.2 had a readmission rate to the Internal Medicine service of only 5.4 percent. CONCLUSION: Using only administrative data which is readily available at the time of admission, our expert system was able to identify a group of patients who had a greater than 30 percent chance of readmission. The size of the group identified, 9.8% of the total population, is almost twice as large as other published clinical
risk assessment tools. Identifying this high risk group early in their clinical course allows them to be the focus of interventions shown to be effective, and may result in an even larger reduction in read-missions than previously observed. Further study of this expert system will include adapting it for use at other institutions and validating it within their patient populations.
HIV SCREENING PRACTICES IN AN URBAN OUTPATIENT RESIDENT CLINIC Michelle Doll 1; Lawrence Ward 2; Robert Bettiker 2; Rafik Samuel2. 1Temple University Hospital, Philadelphia, Pennsylvania ; 2Temple University School of Medicine, Philadelphia, Pennsylvania . (Tracking ID # 11204)
BACKGROUND: Routine HIV testing for all patients has been advocated by the CDC since 2006. However, many patients continue to receive HIV diagnoses late in the course of the disease. Late diagnoses have devastating consequences both for public health and for the health of the individual. We reviewed the HIV screening practice of internal medicine residents in our outpatient clinic. We also surveyed physicians and patients to determine acceptability of screening.
METHODS: A retrospective chart review was conducted of 205 patients. Eligible patient charts contained at least 2 office visits and a visit within the last year. Data collected included age, sex, race, comorbidities, and HIV risk factors. A separate data collection was performed using surveys, which were given to clinic patients, resident physicians, and attending physicians. The patient surveys included a self-risk assessment, degree of willingness to be tested, reasons for declining testing, and history of prior screenings. The physician surveys included a self-assessment of success in HIV screening efforts, ranking of priority of HIV screening compared with other primary care issues, identification of barriers to screening efforts, and comfort level in performing HIV counseling.
RESULTS: HIV screening was offered to 38% (79) of our patients and 35% (71) went on to complete the testing and have a documented result. One patient was HIV positive, while the other 70 tested were non-reactive. 28 resident physicians and 8 attending physicians completed surveys. Residents estimated that they were

screening 49% of their patients for HIV, while attending physicians estimated 42%. 64% of physicians said they would screen more people if rapid testing were available in their clinic. Time constraints and competing health issues were cited as the biggest barriers to screening by physicians in our study. Our clinic population does have a high prevalence of chronic medical conditions, with an average of 5 problems per patient requiring ongoing medical care. There was also a high prevalence of HIV risk factors. Alarmingly, in the subset of patients not offered testing for HIV, 29% had the presence of a risk factor such as past or present drug and alcohol abuse, high risk sexual practices, or history of hepatitis or STDs. Patient surveys were completed by 29 individuals. The vast majority of patients surveyed believed themselves to be very low or no possible HIV risk. However, most patients were still agreeable to HIV testing with the only 4 out of 29 indicating that they would decline testing. Those four all cited no possible risk as the reason to decline testing.
CONCLUSION: While there is an overall positive patient perception of HIV testing, we are falling far short of CDC recommendations. Perhaps most concerning is the lost opportunities for HIV testing in patients with clear risk factors. Since time constraints and competing health issues are cited as significant barriers to HIV screening efforts by physicians, tools for quick and concise counseling regarding testing may be of benefit. In addition, ongoing physician education may help us to prioritize HIV testing.

STUDENTS PROGRESSIVE MASTERY OF COMMUNICATION SKILLS OVER THE FIRST YEAR OF MEDICAL SCHOOL Kathleen Hanley 1;
Sondra Zabar 2; Adina Kalet 3; Nina Yeboah 1; Colleen C. Gillespie1.
1NYU School of Medicine, New York, New York ; 2NYU School of Medicine, New York, New York ; 3NYU School of Medicine, Brooklyn, New York . (Tracking ID # 11205)
BACKGROUND: Students enter medical school with diverse backgrounds and skill sets and can be expected to respond in different ways to education and training. Recognizing this, medical education curricula in the 21st century should be designed to identify students strengths and weaknesses and to be sensitive to specific patterns of development over time. We designed and implemented a baseline and end-of-first year assessment of medical students communication skills in order to better understand students communication skills development.
METHODS: Within the first 2 weeks of matriculation, incoming medical students (n=165) participated in a 3-station Standardized Patient (SP) Examination. SPs assessed communication skills in 3 broad domains (information gathering, relationship development, and patient education and counseling; Cronbachs alphas>.82) using a validated, behaviorally anchored checklist with a 3-point response scale (not done, partly done, well done). Scores were calculated as % items well done. At the end of students first year of medical school, as part of their Practice of Medicine course, students completed another 3-station SP examination using the same communication skills checklist. Changes in students communication scores from the beginning to the end of their first year of medical school are described using paired t-tests and the degree to which individual students relative communication skills standing (>1 SD below their class mean, +/1 SD of the mean, >1 SD above their class mean) changed over time is also explored.
RESULTS: Mean communication scores (% well done) for incoming medical students were as follows: overall communication=57.2% well done, SD 15.5%; information gathering=62.2%, SD15.6%; relationship development=61.4%, SD 18.3%; patient education and counseling=42.9%, SD 20.4%. By the end of the year, mean change in scores (on different albeit similar cases) was as follows: communication score mean=+10.5%, SD 18.6, p<.001;information gathering mean=+7.6%, SD 20.4, p<.001; patient education and counseling mean=+27.0%, SD 22.6%, p<.001. Relationship development mean improvement=+3.8%, SD 25.2%, p=.054. Overall, for 56% of the students, their relative standing stayed the same between assessment time points; 23%

of students saw their relative standing decrease over time; and 20% of students saw their relative standing increase over time. 68% (n=21) of the 31 students who scored >1 SD below the mean at baseline improved in their relative standing at the end of the year (scoring within 1 SD of the mean or more than 1 SD above the mean), and their overall communication score increased, on average, by 37%(SD 10%). 74% (n=20) of the 27 students who scored >1 SD above the mean at baseline saw their relative standing decrease at the end of the year (scoring within 1 SD of the mean or >1 SD below the mean), experiencing a mean decrease in scores of 11%, SD12%.
CONCLUSION: Medical students overall communication abilities, as assessed by SPs in 3-station OSCEs, appear to increase during their first year of medical school. The largest increases were seen in their patient education and counseling, a skill set that was lower
than the other communication skills at baseline and one to which the curriculum devotes substantial time. Aggregate changes however, can mask important individual level changes: while most students relative standing didnt change over time, most high-scoring students saw their relative standing decrease slightly probably largely due to ceiling effects and regression to the mean, and the majority of low-scoring students saw their relative standing increase fairly dramatically across all 3 domains. Each of these patterns has different implications for assessing and evaluating student mastery of core clinical skills and more importantly for tailoring education and remediation. Following this cohort of students throughout their education will help us better understand how to develop and enhance the communication skills students bring to us.
SICKLE CELL PATIENTS CARE IN THE EMERGENCY DEPARTMENT Allison E. Jordan 1; Cory R. Walker 1; Kit N. Simpson 1; Cheryl P. Lynch1.
1Medical University of South Carolina, Charleston, South Carolina . (Tracking ID # 11206)
BACKGROUND: One in 500 African-American children has sickle cell disease (SCD), and is managed in pediatric clinic settings. In the late adolescence to young adult phase, patients with SCD face a difficult transition from pediatric to adult care. Consequently, frequent visits to the emergency department (ED) serve as their regular source of care. Many patients with SCD are often perceived as drug seeking because they require high levels of narcotics to manage their pain, especially during sickle cell pain crises. Patients greater than 20 years old with frequent painful events have the greatest risk of early death, indicating that continuity of care is important to minimize morbidity and mortality. Currently, there is no consistent widespread comparable practice among SCD patient providers to assess neither efficacy of treatment nor for consistent experience of patients. The Medical University of South Carolina (MUSC) ED treats approximately 1,400 adult SCD patients per year. The purpose of the study was to determine processes of care among SCD patients presenting to the adult ED for pain crisis.
METHODS: Of 576 ED visits between November 2008 and March 2009, a retrospective review was performed of 10 randomly selected patient electronic medical charts. Since patients with SCD had more than one ED visit during the specified time period, there was a greater likelihood of selecting frequent ED users. However, no duplicate charts were reviewed; each visit was taken as a separate event. Demographic, clinical and utilization data (vital signs including pain rating, processes of care, and medication) were abstracted with special attention to nursing documentation.
RESULTS: The selected patients were 70% female with mean age of 29 years (range 1951). Mean pain score on admission was 9.3 (range 710). Home pain medication was recorded for 80%, but only 40% of these records had the doses recorded. Fifty percent of patients had a primary care physician (PCP) recorded.
Table 1. Treatment Processes During Emergency Department Visit Table 2. Return Visits to Emergency DepartmentSouth Carolina state discharge data shows that each ED visit costs $1200 and 58% of patients with SCD are Medicaid recipients. In 2007, South Carolina hospitals had 2,772 admissions for sickle cell pain crisis

with total charges of $58 million and an estimated $18.6 million for South Carolina hospitals.

CONCLUSION: Adult SCD patients use of the ED poses both quality of care and economic issues. To facilitate the transition of pediatric sickle cell patients to adult care, a medical home model should be used to introduce patients to their new PCPs, case managers, and nurses. Sickle cell pain crisis protocols must be implemented, and better documentation of a patients home medications is needed to adequately treat their pain in the ED.

INAPPROPRIATE DISPENSING OF ELECTRONICALLY DISCONTINUED MEDICATIONS: AN EMERGING PATIENT SAFETY CONCERN Adrienne Allen 1; Thomas Sequist2. 1Brigham and Womens Hospital, Boston, Massachusetts ; 2Brigham and Womens Hospital, Newton, Massachusetts. (Tracking ID # 11207)

BACKGROUND: Electronic medication prescribing is greatly facilitated by the adoption of electronic health records with direct links to pharmacies to initiate prescriptions. These systems do not support the transmission of medication discontinuation orders from the electronic record to the pharmacy, creating the potential for inappropriate dispensing of previously ordered medications.

METHODS: We used electronic data within a large multi-site group practice using a common electronic health record to identify adult patients (>18 years) with an electronically discontinued anti-hypertensive or statin medication during a 12 month period during 2008 to 2009. Pharmacy dispensing records were reviewed to determine if these medications were dispensed in the 12 months following the discontinuation order. Patient demographic and clinical data were obtained from the electronic health record. We fit hierarchical multivariable logistic regression models to identify predictors of dispensing discontinued medications after adjusting for patient sociodemographic characteristics (age, sex, race and insurance status), total number of prescribed medications, and presence of comorbid conditions (diabetes, hypertension, and cardiovascular disease).

RESULTS: We identified 63,615 patients who had 140,245 anti-hypertensive medications and statins discontinued during the study period. 2,565 (1.8%) of these medications were dispensed to 1297 (2%) patients following electronic discontinuation within the electronic health record, including 2% of anti-hypertensive medications and 1.3% of statins. The vast majority (93%) of these medications were dispensed at least 1 day after the medication was discontinued, with 7% being dispensed on the day of the discontinuation order. Among the 2,565 inappropriately dispensed medications, 44% were refilled more than once during the 12 months following the discontinuation order, with an average of2.0 erroneous refills per medication during this time. Patients with more than 5 medications on the electronic medication list, statin discontinuation, non-white race, and Medicaid insurance were more likely to have had a discontinued medication dispensed by the pharmacy (Table).

CONCLUSION: Dispensing of discontinued medications does occur and poses an important risk to patient safety, particularly among those patients receiving multiple prescription medications. Further work should evaluate patient harm from this dispensing and explore methods to improve communication between physician offices and pharmacies.

Table 1:

Patient age (years)

Female sex Race

White (ref)

Black

Other Insurance

Commercial (ref)

Medicaid

Medicare

SelfNumber of medications

0-5 (ref)

6-10

11-15

>15 Medication type
antihypertensive (ref)
statin
Comorbid conditions
Diabetes
Hypertension
Cardiovascular disease
THE COURTEOUS CONSULT: RESIDENT REFLECTIONS ON INPATIENT CONSULTATIONS Lauren Peccoralo 1; Anna Podolsky 1; Katherine Krauskopf 1; Kristofer L Smith 1; David Stern1. 1Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11210)
BACKGROUND: The quality of clinical consultations varies for physician trainees in academic centers. Prior work demonstrates that poor quality consult interactions can lead to lower quality of care, decreased patient satisfaction and an unprofessional work environment. Little is known about barriers to consult quality in the physician trainee setting. We explored trainees perceptions of consultation interactions on the inpatient wards 1) to generate hypotheses about elements of and barriers to high-quality, professional consults and 2) to develop a quantitative study and an educational intervention to improve the consistency, quality and courtesy of consult interactions. METHODS: We conducted our qualitative study in one urban academic medical center. Participants were internal medicine (IM) residents in their second and third post graduate years (PGYs). Investigators developed a moderator script to guide the one hour-long semi-structured focus group. During the session, the moderator asked trainees to discuss perceptions about positive and negative consult interactions, elements of a good consult and downstream effects of consult interactions. The focus group was audio recorded and transcribed verbatim. Investigators used a grounded theory approach with inductive-deductive code generation for data analysis. Two investigators independently coded the transcript. Investigators decided on final codes, categories and themes via consensus.
RESULTS: The focus group consisted of eight IM residents, half in their second PGY and half in their third PGY. Five of the participants were female and all had functioned in both the roles of a consulter and

consultant during their training. Three main themes emerged from this focus group data: mutual respect, the consult as a teaching tool, and the value of verbal communication. Regarding mutual respect between a consulter and a consultant, important elements discussed were consulter preparedness, transparency regarding consult purpose and application of recommendations. Within the theme of consult as a teaching tool residents identified three categories of teaching: teaching to prepare for a consult, patient-based teaching and direct clinical skills teaching. Finally, the importance of regular and high quality verbal communication between the consultant and the primary team was evident in its effect on coordination of care, clarity of the care plan, patient satisfaction and collegiality among multispecialty trainees. CONCLUSION: IM Residents in our focus group believe that mutual respect, teaching and verbal communication are key components of a successful and professional consult. These findings have important implications in a changing hospital work environment. With emerging electronic medical records in many academic centers, ever tightening work hour restrictions for trainees and increasing clinical volume demands, the need for verbal communication and time for teaching will likely decrease, jeopardizing the quality of consult interactions. The identification of these themes along with the evolving practice environment provide important directions for continued qualitative and quantitative investigation and interventions aimed at improving the consultation process among physician trainees.
SMOKING CESSATION-RELATED INFORMATION, MOTIVATION, AND BEHAVIORAL SKILLS SPECIFIC TO HIV-INFECTED SMOKERS James Sosman 1; Laura Thibodeau 1; Nasia Safdar 1; Doug Jorenby 1; Sheryl

Catz 2; Ben Balderson 5; Jennifer McClure 5; K. Rivet Amico3.
1University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin ; 2Group Health Center for Health Studies, Seattle, Washington ; 3University of Connecticut, Hartford, Connecticut . (Tracking ID # 11212)
BACKGROUND: The intersection of the tobacco and HIV/AIDS epidemics represents an area of growing clinical and public health importance. Until recently, cigarette smoking among HIV + persons received little attention because of limited life expectancy. Effective antiviral treatments have resulted in dramatically increased life expectancies. In the U.S., the prevalence of cigarette smoking is estimated to be 50-70% among HIV + persons vs. 20.8% in the general population. Smoking is associated with reduced quality of life, increased incidence of bacterial pneumonia, risk of malignancies, and increased mortality compared to HIV + non-smokers. We hypothesize that many people are unaware of the ways in which HIV and tobacco use may interact, and some may have low motivation or lack skills relevant to smoking cessation.
METHODS: We recruited a cross sectional convenience sample of HIV + adult smokers from two HIV clinics to participate in structured quantitative interviews. The interview included an HIV specific measure of smoking-related information, motivation, and behavioral skills and standard measures of current smoking behavior, smoking history, self-efficacy for quitting smoking, knowledge of smoking consequences, and demographic and psychosocial characteristics. Participant medical records were abstracted for year of HIV/AIDS diagnosis, HIV viral load, CD4 lymphocyte count, and antiretroviral medication use (HAART). Descriptive statistics were computed for all study variables.
RESULTS: Of eligible smokers approached, 70% (61) consented and 58 completed the interview. Most were men (77%), 81% were Caucasian, median age 46 years and were HIV + for 9 years. Most were on HAART (79%) with a median CD4 count 473 cells/ul and 65% had undetectable HIV viral loads. Participants had on average initiated smoking at age 17 and smoked for 25 years. Fifty-five percent indicated that their HIV diagnosis had no effect on their smoking, while 32% reported that their HIV diagnosis had increased their smoking. Sixty-seven percent reported that they were seriously considering quitting smoking in the next 6 months, and 28% were considering quitting in the next 30 days. The mean time that smokers had quit was 12 months. Fifty-eight percent had not used any cessation medication/aides in the past. Thirty-eight percent did not know how smoking affects the course of HIV disease; however, 91% thought they understood smoking risks for HIV-negative people. Seventy-five percent thought smoking is a way to relax, and 44% thought smoking is a good way to cope with feeling down or stressed. Primary motivations included: 81% worried that smoking may have long term negative effects on their health; 89% were ready to make positive changes in life to improve their health; 73% believed that family and friends think they should quit smoking. Self-efficacy for cessation skills was low: 37% felt confident that they could quit smoking; 64% thought it would be hard or very hard to go through a normal daily routine without a cigarette. However 49% accepted the telephone number for the Tobacco Quit Line when offered at the end of the interview. Seventy-one percent reported alcohol use with median AUDIT-C score of 6 (range 110); 58% thought it would be hard or very hard to drink alcohol without smoking.
CONCLUSION: This formative effort describes the broader context of smoking-related IMB (information, motivation, behavioral) strengths and deficits among HIV + smokers. Most were life- long smokers who recognized the general health risks of smoking but less the effects on HIV. Most believed their HIV diagnosis had no effect on their smoking. Most wanted to improve their health but were not confident they could quit smoking. Tailored smoking cessation interventions are needed to build on HIV + smokers motivation to quit.
RATES OF NON-EVIDENCED BASED TREATMENT FOR RURAL VETERANS WITH POST TRAUMATIC STRESS DISORDER Thad Abrams 1; Brian Lund 2; Peter Kaboli1. 1University of Iowa, Iowa City, Iowa ; 2VA, Iowa City, Iowa . (Tracking ID # 11214)
BACKGROUND: Rural veterans comprise a disproportionate share of active duty military personnel and have been identified as a population at risk for inferior healthcare outcomes. Recent work has focused on identifying

variations in use of non-evidenced based benzodiazepines (BZD) among veterans with PTSD. Variations in BZD use have been found to be correlated with comorbidity, gender, utilization, and geographic region. However, little is known about BZD use variations among rural veterans with PTSD, and if found to what degree use of BZD may reflect higher comorbidity, issues with access, mental health stigma, or other factors.
METHODS: A cross-sectional study design was used to identify all veterans with a visit for PTSD (n=498,081) in fiscal year 2009. BZD use was identified using electronic pharmacy data and defined BZD use by the receipt of at least one prescription fill for 90 days. Rural residence was determined using Rural Urban Commuting Area (RUCA) codes. Chi square tests were used to

compare BZD use between rural and urban veterans with multivariable logistic regression models to adjust BZD use for demographics, period of service, utilization, and location of PTSD diagnosis.
RESULTS: Average age was 53.8 (SD 14.6) and 93% were male; overall, BZD fills were identified in 30.6% of veterans. Use of BZDs was significantly higher for rural veterans compared to urban veterans(33.2% vs. 29.4%; P<.001). Multivariable logistic regression models indicated that veterans from rural areas were 17% more likely to use a BZD (P<.001). Additionally, veterans from rural areas had fewer outpatient visits (mean 7.913.7 versus 9.317.0 [P<.001]) and less likely to have an inpatient visit than veterans from urban areas (6.6% vs.7.5%; P<.001).
CONCLUSION: This study finds that rural veterans with PTSD are more likely to be prescribed non-evidenced based BZD, yet at the same time are less likely to utilize outpatient and inpatient services relative to urban veterans. As BZD use among veterans with PTSD remains high in the VA, efforts to explain the degree to which contributing factors (e.g. access, mental health comorbidity, or stigma) are necessary in order to reduce the use of BZD among veterans with PTSD.
DELINEATING HYPONATREMIA IN THE COMANAGED ORTHOPAEDIC PATIENT George Ou 1; Eileen Hennrikus 2; Abdulla Damluji 3; Aaron Baker1. 1Penn State College of Medicine, Hershey, Pennsylvania ; 2Penn State, Hershey Medical Center and College of Medicine, Hershey, Pennsylvania ; 3Penn State, Hershey Med Center and College of Medicine, Hershey, Pennsylvania . (Tracking ID # 11215)
BACKGROUND: Introduction: Hyponatremia is independently associated with increased mortality and longer length of hospital stay. Among the 15 comorbidities that SS Waikar et al (Am J Med 2009:122,9) evaluated, the odds ratios for death in patients with versus those without hyponatremia is highest among orthopedic surgery patients. Hyponatremic orthopedic patients have a higher odds ratio of death than hyponatremic patients with cardiovascular disease, metastatic cancer or pulmonary disease. The cause of an orthopedic patients hyponatremia has not been characterized. With the rapid growth of medical-surgical comanagement teams, the management of the orthopedic patients hyponatremia is now the responsibility of the internal medicine hospitalist to recognize, diagnosis and treat.
Objectives:1. To define the occurrence and timing of hyponatremia in the orthopedic patients: present on admission, immediately following surgery or while convalescing in the hospital.2. Define any association with age, race or sex3. Define orthopedic procedures that have the highest incidence of hyponatremiaMETHODS: Retrospective chart review of all adult, age >21, hospitalized orthopedic surgical patients admitted to Penn State Hershey Medical Center during a one-year period. Age, race, sex and orthopedic procedures were categorized. Sodium (Na) levels were documented preoperatively, first day postoperative, and day of first hyponatremia. Hyponatremia was defined as Na <135 mEq/L. Sodium was corrected for hyperglycemia using the formula: Measured Na + 2.4 X (glucose -100)/100. Results are reported as proportions and medians, and compared using chi-square, Fisher exact, or Wilcoxon rank-sum tests, as appropriate. Data analyses were performed with STATA 11.0 software (Stata Corporation, College Station, TX).
RESULTS: Of the 1302 orthopedic surgical patients, 997 patients had both pre and post-operative sodium levels documented. 71 (5%) of patients had preexisting preoperative hyponatremia and were excluded to

calculate the incidence rate. 250 patients developed first new
postoperative hyponatremia, giving an incidence of 25%. Of those patients, 237 (95%), developed hyponatremia within one day postoperatively, an additional 4% developed it by the second day and 1% developed it beyond two days after the procedure. The median negative change in sodium, defined as postoperative minus preoperative sodium level was 6 mEq/L in hyponatremic group versus 3 mEq/L in the normonatremic group (P-Value <0.001). No statistical differences were found for the occurrence of hyponatremia according to age, sex or race. When categorizing orthopedic procedures, we found the highest incidence of hyponatremia in hip arthroplasties, 34% followed by knee arthroplasties, 23% and all other orthopedic procedures, 20%. Hip arthroplasties had the distinction of being the only procedure that had a higher proportion of hyponatremic patients than normonatremic patients: 36% vs. 23% respectively.
CONCLUSION: We found that hyponatremia is prevalent in orthopedic surgical patients. Our results found that the majority of hyponatremia did not pre-date the surgery, nor did it develop during a long protracted hospitalization. It occurred within the first 24 hours postoperatively. Hip arthroplasties have the highest incidence of hyponatremia compared to other adult orthopedic surgical procedures. It is not due to the age, sex or race of the patient. A 6 mEq/L median drop in sodium within 24 hours suggests significant intercellular electrolyte and fluid shifts peri-operatively that could explain the increase in mortality that other authors have found. Even the normonatremic group had a 3 mEq/L median drop in sodium. We are currently extracting data on comorbidities and medications, especially as it might relate to the pre-operative hyponatremic patients. That new hyponatremia develops within 24 hours of surgery, suggests, as was found in the spine literature, that some patients are prone to an inappropriate surge in antidiuretic hormone within a few hours postoperatively that is exacerbated by the infusion of hypotonic fluids. Examining in this population, duration of surgery, and perioperative fluids, blood loss, hypotension, pressors, and urine output may clarify why some patients develop hyponatremia. If we can identify the etiology of the orthopedic patients hyponatremia, we may be able to alter current fluid management practices in the perioperative period. If we find that adjustments in the type and amount of fluids used in perioperative resuscitation can alleviate the incidence of hyponatremia, we will have succeeded in improving the mortality of the orthopedic patient.
Postop day
Table 1
normonatremic hyponatremicTotal
0 27
3.62
0 0.00
27 2.71
1 697
93.43
237 94.80
93493.78
2 13
1.74
11 4.40
24 2.41
3 6
0.80
2 0.80
8 0.80
4+ 3

0.40
0 0.00
3 0.30
total 746
100.00
250 100.00
996 100.00
Table 2
Procedure Normonatremia Hyponatremia Total
Hip Arthroplasities
176 23.59
92 36.80
268 26.91
Knee Arthorplasties
312 41.82
9236.80
404 40.56
All others 258
34.58
66 26.40
324 32.53
total 746
100.00
250 100.00
996 100.00

CORRELATION OF SOCIAL DISTRESS AND A1C Tara Michelle DuVal 1;
Michael Rothberg 2; Garry Welch 2; Jennifer Friderici 2; Gina Luciano2.
1Baystate Medical Center, Northampton, Massachusetts ; 2Baystate Medical Center, Springfield, Massachusetts . (Tracking ID # 11216)
BACKGROUND: Diabetes mellitus is an example of a chronic disease in which patient participation, coupled with social and health systems support, is paramount. Good glycemic control requires patient knowledge and substantial motivation to comply with multiple medications, frequent injections, glucose monitoring, exercise and dietary restrictions, yet little is known regarding specific social factors that may interfere with patients ability to comply with complex medical regimens. The objective of this study was to develop a scale to measure social distress in diabetic patients and to correlate the scale to clinical outcomes.
METHODS: We conducted a case-control study of diabetic patients aged 18 years from 2 academic ambulatory care centers in Western Massachusetts. Patients with a diagnosis of type II diabetes mellitus and an average hemoglobin A1C level 9% (cases) or 7% (controls) were eligible to participate. Patients were surveyed over the telephone regarding 20 sources of social stress and 10 sources of support in themselves or their family. Patients also completed validated measures of behavior (Diabetes self-care inventory and Diabetes self-care questionnaire), Depression (PHQ-9), and Knowledge (Brief Diabetes Knowledge Test (DKT)). Clinical measurements were obtained by chart review. The primary outcome was glycemic control. Bivariate examinations of glycemic control with social stress, depression, self-care and demographics were conducted

using unpaired t-tests, Kruskal-Wallis rank tests or Spearmans correlation, and 2 tests. Multiple logistic regression models were built to examine adjusted odds ratios for poor control as a function of social stress scores. The extent to which depression or self-care mediated stress scores association with control was quantified by examining the change in the stress score coefficient when each covariate was removed from the model.
RESULTS: Our sample included 123 patients with A1C7 and 123 with A1C9. Patients with A1C7 were older (mean age 56.2 vs.49.2 yrs., P<0.0001), less likely to be employed (8% vs. 18%, P=0.01), less likely to have systolic blood pressure >140 mmHg (28% vs. 44%, P=0.05) less likely to be obese (68% vs. 77%, P=0.09), and scored lower on the DKT (47% vs. 58%, P=0.003). A1C did not vary by gender (P=0.51), race/ethnicity (P=0.10), income (P=0.43), education (P=0.28), self-care behavior (P=0.21) or PHQ-9 scores (P=0.27). Social stress scores for 221 patients ranged from 0 to 19 (mean # of items/SD 6.3/4.0). Scores were higher in patients with A1C9 (6.9 vs. 5.7, P=0.03). However, only four items correlated meaningfully with A1C: difficulty paying for medical care (Spearmans =0.15, P=0.02), lack of access to transportation (=0.21, P=0.001), job stress (=0.13, P=0.04), and difficulty sending money or gifts to relatives (=0.11, P=0.09). The median score of the 4-item scale was significantly higher in patients with A1C9 (2 vs. 1, P=0.0009, Kruskal-Wallis rank test). Social support scores were available for 223 patients with an average score of 5.6/SD 2.0. Support scores were not significantly correlated with A1C (5.7 vs. 5.6, p=0.85). Before adjustment for covariates in a logistic regression model, the four-item stress score was associated with odds of A1C9 (OR 1.37, 95% CI 1.11, 1.69). Adjustment for age, employment status and BMI did not diminish the association between social stress and control appreciably (OR 1.33, 95% CI 1.046, 1.68). Self-care, depression, and knowledge scores were tested as mediators in the model, but their addition did not change the stress scores association with A1C by more than 4%.
CONCLUSION: A 4-item social distress scale appears to be independently associated with diabetes control. In contrast, social supports were not associated with diabetes control.
IMPACT OF INDWELLING CATHETER USE IN PATIENTS ADMITTED WITH CONGESTIVE HEART FAILURE Andrea Porrovecchio 1; Rubina Malik 1; Kevin Clerkin 2; William Southern1. 1Montefiore Medical Center, Bronx, New York ; 2Albert Einstein College of Medicine, Bronx, New York . (Tracking ID # 11220)
BACKGROUND: Congestive heart failure (CHF) is a leading cause of inpatient admission in the United States. It accounts for nearly one million admissions per year with an approximate 20% readmission rate. Indwelling urinary catheters may allow accurate assessment of fluid balance and response to diuretic therapy in patients hospitalized for CHF, but may be associated with increased risk of urinary tract infection (UTI). Thus, although indwelling urinary catheters are frequently used in hospitalized patients with CHF, it is unclear if the potential benefit (more accurate assessment of fluid balance) is offset by the potential harm (increased risk of UTI). The goal of this study was to assess the use of indwelling urinary catheters in patients hospitalized with heart failure exacerbations and determines if catheter use was associated with improved clinical outcomes. Specifically, we sought to examine the association between indwelling urinary catheter use and rates of infection, length of stay (LOS), readmission and mortality in patients hospitalized with exacerbations of CHF.
METHODS: In this retrospective observational cohort study we examined all admissions of patients >18 years of age to an urban academic medical center with a primary discharge diagnosis of CHF from July 2007June 2008. Patients with and without an indwelling urinary catheter were compared with respect to baseline characteristics and outcomes. Baseline characteristics included age, gender, ethnicity, Charlson co-morbidity score, Laboratory-based Acute Physiology Score (LAPS), ejection fraction, admission to intensive care, use of inotropic medications, and duration of catheter use. The outcomes evaluated were rates of hospital acquired UTI, LOS, 30-day readmission rate, and 30-day mortality. Data were extracted from the hospitals clinical information system, charts and social security death registry. Patient groups (catheter vs. no catheter) were compared with respect to baseline characteristics using t tests, chi-square tests, and rank sum tests, as

appropriate. Logistic and Poisson regression models were used to examine the independent association between indwelling urinary catheter use and each outcome, after adjustment for baseline characteristics.
RESULTS: 389 patients with an indwelling urinary catheter and 465 patients without a catheter were examined. Catheterized patients were significantly older (73.4 vs. 65.1), more likely to be female (63.5% vs 40.9%), white (32.1% vs.18.9%), have more comorbidities (Charlson score 3.9 vs. 3.4) and have a higher ejection fraction (44.5% vs 40.0%). For all comparisons of baseline patient characteristics, the p value was less than 0.001. Indwelling urinary catheter use was associated with a higher rate of hospital acquired UTIs (11.3% vs 3.2%, $p<0.01$) and a longer length of stay(11.0 days vs 5.9 days, $p<0.001$). There was a significant linear association between duration of indwelling urinary catheter use and increased risk of UTI. Each day an indwelling urinary catheter was in place was associated with a 9.8% increased odds of UTI. (figure) The readmission rates did not differ between groups. After adjustment for patient related covariates the use of indwelling catheter was not associated with increased mortality at 30 days. (table)

CONCLUSION: Despite the potential benefit of an indwelling urinary catheter in assessing fluid balance, we found no benefits of catheter use in patients admitted with CHF. We found a significant linear association between rates of catheter associated UTI and number of catheter-days. Although the use of indwelling urinary catheters might potentially shorten inpatient LOS by allowing accurate measurement of fluid balance and fine titration of treatment, we found no such benefit. In fact, the use of indwelling urinary catheters is associated with practically double the length of stay. We found no association between indwelling urinary catheter use and 30-day readmission, or 30-day mortality. Routine use of indwelling urinary catheters in patients admitted with CHF should be discouraged. Further, if used, catheters should be frequently assessed and removed as soon as possible.

VARIATIONS IN NON-EVIDENCE BASED TREATMENT AMONG VETERANS WITH POST TRAUMATIC STRESS DISORDER Thad Abrams 1; Brian Lund 2; Mary Sarrazin1. 1University of Iowa, Iowa City, Iowa ; 2VAMC, Iowa City, Iowa . (Tracking ID # 11224)

BACKGROUND: Post Traumatic Stress Disorder (PTSD) is one of the signature wounds afflicting returning veterans from Iraq and Afghanistan. Although recent efforts from the Veterans Health Administration (VHA) have focused on improving guideline based prescribing, non-evidenced based benzodiazepines (BZD) remain the third most commonly prescribed class of medications among veterans with PTSD. Evidence generating these estimates has relied heavily on the use of administrative data. Yet, multiple coding algorithms exist and there is little agreement on an optimal algorithm for identifying PTSD. Thus, we sought to examine the variation in benzodiazepine use by three common PTSD coding algorithms.
METHODS: A cross-sectional study design was used to identify all veterans with a visit for PTSD (n=498,081) in fiscal year 2009 using three PTSD coding algorithm methods: 1) one or two outpatient visits, 2) three or more outpatient visits, or 3) at least one inpatient visit. BZD use was identified using electronic pharmacy data and defined by receipt of at least one prescription fill for 90 days. Unadjusted analyses used chi square to compare demographics (e.g. age, sex, period of service, residence, and location of PTSD diagnosis) multivariable logistic regression models adjusted BZD use for demographics.
RESULTS: Average age was 53.8 (SD 14.6) and 93% were male; overall, BZD fills were identified in 30.6% of veterans. BZD fills varied substantial by coding algorithm. For method 1, 20% of veterans with PTSD had a BZD fill; for method 2, 34% of veterans had a BZD fill; and for method three, 44% of veterans identified with PTSD by one or more inpatient codes had a BZD fill. Multivariate logistic regression models indicated that veterans with an inpatient PTSD code had an odds ratio of 1.92 (95% CI, 1.832.10) for BZD fill relative to veterans with one or two outpatient codes. Odds for the receipt for a BZD correlated with increasing use of outpatient visits with a diagnosis of PTSD.
CONCLUSION: BZD use remains high among veterans identified with PTSD and the identification such

veterans using administrative data strongly depends on the coding algorithm employed with an observed period prevalence varying from 44% to 20%. As BZD have received a Class D guideline recommendation (e.g. no benefit with significant chance for harm) efforts to reduce the use of BZD among veterans with PTSD remain a priority in the VHA. This study suggests that those efforts should perhaps be focused first on veterans receiving care from the inpatient setting.

RESIDENT SATISFACTION WITH AMBULATORY CONTINUITY CLINIC IS ASSOCIATED WITH A CAREER CHOICE IN GENERAL INTERNAL MEDICINE Lauren Peccoralo 1; Lawrence Ward 2; Alex Federman 1; Ira Helenius 1; David C. Thomas1. 1Mount Sinai School of Medicine, New York, New York ; 2Temple University School of Medicine, Philadelphia, Pennsylvania . (Tracking ID # 11225)

BACKGROUND: Despite the increased time devoted to ambulatory training in Internal Medicine (IM) residencies, the percentage of IM residents entering primary care has decreased from 50% in 1998 to 20% in 2006. Little is known about the association of residents satisfaction with ambulatory continuity practice and career choice, specifically General Internal Medicine (GIM). This study sought to determine if IM residents satisfaction with ambulatory continuity care experience is associated with their interest in GIM careers.

METHODS: Investigators conducted a cross-sectional survey IM of residents at two academic medical centers: Mount Sinai School of Medicine in New York City, NY and Temple University School of Medicine in Philadelphia, PA from April 2010 through July 2010. The survey assessed satisfaction with elements of ambulatory continuity practice using a modified version of the VA Learners Perception Survey, which asks residents to rate their satisfaction with 35 elements of clinic in the following five domains: clinical preceptors, learning environment, working environment, clinical environment and personal environment. Investigators dichotomized responses for analysis from 4-point Likert responses to either very satisfied or not very satisfied (somewhat satisfied, somewhat dissatisfied and very dissatisfied). Consideration of a career in GIM was measured using a 4-point Likert scale of responses to the question:AS A RESULT of

your continuity clinic experience, how likely would you be to consider a future employment opportunity in General Internal Medicine? Investigators dichotomized responses for analysis into either likely or unlikely. The authors examined bivariate associations between satisfaction of clinic elements and considering a career in GIM using the Chi-square test. A logistic regression model tested the association between elements on the satisfaction survey and GIM career plans as a result of the clinic experience, adjusting for demographic characteristics and the residents baseline interest in a GIM career before the clinic experience. Investigators conducted collinearity diagnostics of the predictors and a literature review of the most relevant clinic factors to achieve balanced representation of domains in final adjusted model.

RESULTS: A total of 192 residents completed the survey (92% response rate). Fifty one percent were Mount Sinai residents, 49% percent were female, and participants were equally distributed across postgraduate years. In the bivariate analysis, residents who were very satisfied with 15 of the 35 specific clinic elements were more likely to report considering a GIM career than those who were not very satisfied. The adjusted model included 8 clinic elements and the collected demographics. In the final adjusted model, residents who were very satisfied with continuity with patients (OR3.2, p=0.03), the number of patients per session (OR 6.5, p=0.02) and room availability for seeing patients (OR 3.3, p=0.04), and those who intended to enter GIM before the clinic experience (OR30.8, p=.001) were more likely to consider a career in GIM as a result of the clinic experience. Gender, postgraduate year, and training site were not associated with intention to enter GIM in the adjusted model.

CONCLUSION: IM residents satisfaction with ambulatory continuity practice is associated with a proclivity towards entering a career in GIM. More research is needed to determine the impact of various clinic

experiences on residents career decision-making process.

SCREENING FOR OSTEOPOROSIS IN HIGH RISK, MENOPAUSAL WOMEN: A RANDOMIZED TRIAL OF INTERACTIVE VOICE RESPONSE Leonie Heyworth 1; Ken Kleinman 2; Stephanie Oddleifson 2; Lydia Bernstein 2; Judith Frampton 2; Karen Salvato 2; Thomas W. Weiss 3; Steven Simon 4; Maureen Connelly5. 1Brigham and Womens Hospital, Boston, Massachusetts ; 2Harvard Pilgrim Health Care, Boston, Massachusetts ; 3Merck Co., Inc, West Point, Pennsylvania ; 4VA Boston Healthcare/ Brigham &Womens Hospital, Boston, Massachusetts ;
5Dept. Population Medicine, Harvard Medical School; and Harvard Pilgrim Health Care, Boston, Massachusetts . (Tracking ID # 11226)

BACKGROUND: Osteoporotic fractures are a major cause of disability and mortality. Among women older than age 50, 40% will experience at least one fracture; therefore, menopausal women, especially those with additional risk factors for fracture, are an important group to target for osteoporosis screening. Bone mineral density (BMD) is the best predictor of fractures in this age group.
Whether interactive voice response (IVR) calling can increase rates of BMD screening is unknown.
METHODS: We identified 4685 women age 5064 and at high risk for osteoporosis in a large not-for-profit health plan in New England. We randomly allocated 1562 women to a patient mailing, 1565 to IVR, and 1558 to usual care. The mailing intervention included educational materials about BMD screening, and the IVR was a single interactive outreach call to engage women in a discussion of bone density screening and barriers to care. The IVR directed
women who were overdue for BMD screening to schedule this test with their primary care physician. The primary endpoint was any BMD screening in the 12 months following the intervention. We used logistic regression with generalized estimating equations to determine whether the mailing and IVR interventions differed from usual care and to account for clustering among women by physician. We performed these analyses on an intention-to-treat basis.
RESULTS: Mean age was 57 and baseline characteristics between the three study groups did not show significant differences on measured variables. In the IVR group, 59% had some verbal interaction with the computerized call system, of whom 76% agreed to proceed with the intervention. In adjusted analyses, the incidence of BMD screening was 24.6% in the IVR group compared with 18.6% in the usual care group ($P<0.001$). The difference between the patient mailing group and the usual care group was not statistically significant ($P=0.3$).
CONCLUSION: In this large community-based randomized trial, randomization to IVR improved rates of BMD screening in high risk, menopausal women age 5064. Unexpectedly, the rate of BMD screening in the IVR intervention group improved even if the IVR messages were not received. However, more than three-quarters of women in the whole IVR group remained unscreened. Future studies should further examine the efficacy of IVR, as well as additional approaches to enhancing BMD screening within this group, including research into identifying and overcoming barriers to BMD screening among patients and health care providers.

COLORECTAL CANCER SCREENING IN FQHCS: DOES LITERACY IMPACT PATIENTS KNOWLEDGE, BELIEFS, BEHAVIOR, AND PHYSICIAN RECOMMENDATION? Connie Lea Arnold 1;
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BACKGROUND: Few patients in Louisiana Federally Qualified Health Centers (FQHCs) are receiving colorectal cancer (CRC) screening within the recommended timeframe. In order to determine effective strategies to increase initial and repeat CRC screening, we are conducting a randomized control trial in 6 FQHCs in North Louisiana. The purpose of this report is to present baseline data on CRC knowledge, beliefs, self-reported behavior and physician recommendation by literacy level.

METHODS: Eligible patients (men and women aged 50 and over who had not been screened or who were not up-to-date with CRC screening) in six FQHCs were given a CRC structured interview and literacy test.
RESULTS: Of the 812 patients interviewed to date: 68% are AA, 32% white; 33% have not completed high school and 50% are reading less than a 9th grade level. Overall, awareness of CRC was high for both lower literate (LL) patients (less than a 9th grade) and those with higher literacy (HL) (9th grade or above) with no significant difference by literacy level of having heard of CRC (96% vs. 97%). Knowledge was lowest for LL patients. LL patients were significantly less likely to be able to explain what CRC is than their HL counterparts (29% vs. 14%, p=<0.0001) or to report they have heard of tests to screen for CRC (44% vs. 65%, p<0.0001). Overall both groups had heard of colonoscopy more than Fecal Occult Blood Tests (FOBTs): LL patients were less likely than their HL counterparts to have heard of a colonoscopy (79% vs. 93%, p<0.0001) and more likely to have heard of FOBTs (47% vs. 35%, p=0.012). LL patients were less likely to have

positive attitudes about CRC screening. They were less likely to believe it is very helpful to find CRC screening early (76% vs. 92%, p<0.0001); that if CRC is found early their chances of survival were very good (57% vs. 69%, p=0.005); or that having an FOBT will decrease their chances of dying from CRC (8% vs. 19%, p<0.0001). LL patients were more likely than their HL counterparts to agree that FOBT instructions will be confusing (12.7% vs. 4.3%, p<0.0001) and that doing an FOBT is embarrassing (15.0% vs. 8.7%, p<0.0001) and messy (23% vs. 18%, p<0.0001). Physician recommendation was low for both groups (38% LL vs. 39% HL, NS) as was FOBT self-reported completion rate with LL patients being less likely to report completion (26% vs. 29%, p=0.037). Results remained significant after adjusting for age, race, and location.
CONCLUSION: Eligible patients cared for in FQHCs have a high awareness of CRC but few reported having completed screening or being offered screening. Lower literate patients had less knowledge and poorer attitudes about CRC screening and were less likely to have ever been screened than their higher literate counterparts. Louisiana FQHCs serve vulnerable populations that need better access to plain language screening education and cost effective CRC screening.

REPEATED COMPUTERIZED TOMOGRAPHY IMAGING AMONG YOUNG VETERANS WITH AND WITHOUT POST TRAUMATIC STRESS DISORDER. Thad Abrams 1; Kelly Richardson 2; Mary Sarrazin3.
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BACKGROUND: The Veterans Health Administration (VA) has been faced with a substantial increase in the number of patients with post traumatic stress disorder (PTSD) as a result of the conflicts in Iraq and Afghanistan. As an invisible wound of war, PTSD may complicate the management of other conditions and impact utilization of healthcare resources. We completed this study to examine the influence of PTSD on the receipt of one specific high intensity resource, computerized tomography (CT), in veterans less than 35 years of age.
METHODS: We performed a retrospective cohort study of 131, 373 new veteran enrollees aged less than 35 years with at least one outpatient visit in 2006. PTSD was identified by specific ICD-9 CM diagnosis codes in a prior outpatient encounter. The use of CT scans during the subsequent three years (20072009) was identified using common procedural terminology codes 70160 - 75635. CT scans were categorized into four anatomical areas: brain, head/neck, chest/abdomen/pelvis, and spine. Overall rates of CT imaging and rates of repeat CT imaging (i.e., repeat CT scan in the same anatomical category within 180 days) were compared among veterans with and without PTSD. Generalized linear mixed models were then used to adjust the receipt of CT scans using fixed effects for demographics and comorbid conditions and random intercepts to account for hospital-level variation.
RESULTS: PTSD was identified in 15.3% (20,125) of patients and7.0% (9,220) received at least one CT scan between 2007 and 2009. Veterans with PTSD had substantially higher rates of CT scans relative to those

without PTSD (18.1% vs. 5.0; P<.001). Anatomical categories with the highest differences between those with and without PTSD were the brain (9 vs. 2%; P<.001) and chest/ abdomen/pelvis (7 vs. 2%; <.001). Repeat imaging was also substantially higher among those with existing PTSD relative to those without (1.5 vs. 0.4%; <.001). In multivariate analyses for the receipt of any repeat imaging, there was a strong association with a diagnosis of PTSD (OR, 2.97; 95% CI, 2.5 - 3.49[P<.001]. In multivariate analyses among the individual anatomical categories for repeat imaging, there were strong associations seen between PTSD and the anatomical areas of the brain, (OR, 2.74; 1.89 - 4.03 [P<.001] and spine (OR, 3.22; 1.67 - 6.23 [P<.001]). Notably, CT examinations linked to an emergency room visit accounted for 28% (n=2,562) of all CT exams.
CONCLUSION: These findings indicate that PTSD strongly influences the receipt of costly and resource intense CT examinations. More importantly as younger patients, these veterans are likely to have the highest potential risk for the associated consequences of repeated radiation exposure.
HAND HYGIENEFOLLOW THE LEADER? Lisa Shieh 1; Stephanie Carr2. 1Stanford Hospital, Stanford, California ; 2Stanford Medical School, Stanford, California . (Tracking ID # 11242)
BACKGROUND: Considerable resources have been devoted to improving hand hygiene compliance, yet true compliance remains unacceptably low especially among physicians. Estimates from U.S. hospitals conclude that 2 million hospital-acquired infections occur yearly, resulting in 100,000 deaths and direct costs of $30-$40 billion. Few studies have observed physician team dynamics in relation to hand hygiene compliance. We aimed to determine whether the compliance of attendings (and/or first person entering/exiting the patient room) influenced the compliance of physician teams. By studying team dynamics, we may be able to create a new focus for hand hygiene compliance efforts.
METHODS: Four medical students individually shadowed physician teams in a variety of departments as they conducted morning rounds. The students measured hand hygiene compliance on entering and exiting each patient room. They collected data on hand hygiene compliance of the attending, the first person entering or exiting the room, and the entire team. Compliance was defined as using the gel dispenser or sink. The students also noted whether any member of the team had contact with the patient or the room environment. Physician teams were not informed that their hand hygiene compliance was being measured so as to not influence their habits.
RESULTS: Observations of 349 hand hygiene opportunities during physician team rounding showed a hand hygiene compliance rate of 40% among physicians. When broken down into entering verses exiting a patient room, compliance rates were 31% and 48%, respectively. A subset of two teams within internal medicine and inpatient oncology was then observed for compliance in relation to the attending and first person entering (n=103 opportunities). Overall analysis (for combined in and out) showed that when the attending washed, a greater percentage of the team washed (90% versus 71%, P=0.03). When broken down by in/out, the attending always washed when entering. On exiting, a greater percentage of the team washed if the attending washed (90% vs. 71%, P=0.05). Overall analysis for when the first person entering the room washed was identical to when the attending washed (90% vs. 71%, P=0.03) because the occurrences where the attending did not wash were the same as when the first person did not wash. When there was patient/environment contact, there were no observations where the attending/first person did not wash.
CONCLUSION: Physician team members were more likely to wash their hands on entering and exiting patient rooms if their attendings or if the first person entering the room washed. Additional team observations are being conducted to better study the influence of

attending versus first person entering, as well as to conduct root cause analysis.
GLYCEMIC CONTROL AND FUNCTIONAL DECLINE IN FRAIL ELDERS WITH DIABETES MELLITUS Celia

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BACKGROUND: The American Geriatric Society (AGS) recommends a Hemoglobin A1c (A1c) less than or equal to 8% for frail elders. Diabetes mellitus has been shown to be a strong risk factor for functional limitations in elders. However, it is unclear whether A1c levels are associated with functional outcomes in the frail elderly.
METHODS: We examined the relationship between A1c and 2 year decline in activities of daily living (ADL) in frail, nursing-home eligible elders with diabetes enrolled at On Lok Senior Health between 10/ 2002 and 12/2008. 1,579 A1c measurements in 367 elders were divided into 4 categories (<7, 77.9, 88.9, and 9+). At baseline and at 2 year follow-up, nursing or occupational therapy categorized each enrollees ability to perform 5 ADLs as independent, partially dependent or completely dependent, allowing us to identify elders who had declined in ADLs. We used a population averaged mixed-effects Poisson regression to determine the risk of worsening function across A1c values, accounting for clustering of A1c values by patients and adjusting for age, gender, race/ethnicity, length of time at On Lok, baseline function, hospitalizations, ER visits, and comorbidities. We performed analyses stratified by treatment (insulin versus oral antihyperglycemic agents) to determine whether the A1c-ADL relationship differed across treatments.
RESULTS: The mean age was 80 years, and 116 patients (32%) were taking oral antihyperglycemics, and 185 patients (50%) were taking insulin. ADL function declined after 58% of A1c measurements. Lower A1c and insulin use were associated with 2-year functional decline (p<0.001 and p=0.005, respectively). In all subjects, compared to patients with intermediate A1c (77.9), there was a trend toward patients with A1c <7 being at higher risk for functional decline (p=0.15) and patients with higher A1c (88.9) being at lower risk for functional decline (p=0.03). For elders taking oral medications, A1c <7% was associated with a 20% increase in ADL decline (p=0.04). For elders taking insulin, A1c 88.9 and 9+ was associated with 18% and 13% decreases in ADL decline (p=0.006 and 0.08, respectively). CONCLUSION: Among frail, nursing-home eligible community-living elders, higher A1c levels (>8) is not associated with worse function and may be associated with better function. Our results suggest that the current American Geriatrics Society A1c target of less than or equal to 8% for frail elders may be lower than is necessary to maintain function for this vulnerable population.
RANDOMIZED CONTROLLED TRIAL OF INTEGRATION OF CLINICAL PREDICTION RULES WITHIN AN ELECTRONIC HEALTH RECORD Thomas McGinn 1; Joseph Kannry 2; Alice Li 1; James Stulman 1; Daniel Edonyabo 2; Lucas Romero 2; Jacqueline Arciniega 2; Devin Mann3.
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BACKGROUND: Practicing evidence-based medicine at the point of care has been a major challenge because of the difficulty in integrating evidence into the clinical decision-making process. Clinical decision supports (CDS) have been developed as platforms within electronic health records (EHRs) to help introduce evidence-based medicine (EBM). In theory, CDS should seamlessly integrate EBM into EHR systems to support the physician in delivering efficient, effective care at the point of care. Currently, prior attempts at integrating these EBM delivery platforms into EHRs have been limited by the lack of usability testing of the CDS interface and inadequate provider training prior to use. As a platform for building EBM into EHRs, CDS could significantly improve clinical workflow and quality delivery by providing access to many well-validated frontline decision aids like clinical prediction rules (CPRs) that are currently underutilized. CPRs improve clinician accuracy by generating probabilities for risk stratification for specific prognoses and/or diagnostic assessments, but these rules have not been regularly implemented for day-to-day care due to inaccessibility at the point of care. We have developed an Integrated Clinical Prediction Rules Clinical Decision Support program (iCPR) that incorporates two well-validated CPRs (Walsh CPR for Streptococcal Pharyngitis and the Heckerling CPR for

Pneumonia) into an outpatient EHR system used at over 30% of the nations academic health centers. The two main aims of this study were (1) to assess adoption of the iCPR program in primary care and (2) to assess the impact of the iCPR program on test ordering and treatments.
METHODS: The current study is a randomized controlled trial of the effectiveness of the iCPR program in changing provider-ordering behaviors within the ambulatory care department of an urban primary care center using a large commercial EHR system (EpicCare). Formal usability testing with 15 primary care providers prior to study launch was conducted to guide the iCPR development process. Both faculty and housestaff are randomly allocated to have access to the iCPR program as part of their EHR experience. Providers randomized to the intervention arm receive an hour-long training session to learn how to interact with this interface and, after training, gain access to the interface. Providers randomized to the control arm receive background papers on the validation of the 2 CPRs used for this trial. Intervention providers voluntarily use the iCPR interface when the interface is automatically triggered through specific chief complaints, diagnoses, and/ or orders that these clinicians input at the point of care. The interface then generates the appropriate iCPR pathway to aid in the clinical decision-making process by risk stratifying the patient and then facilitating the generation of medication orders, notes, supportive therapies and patient instructions. Weekly reports of aggregated encounters are compiled to monitor incident use of the interface. Monthly reports of de-identified encounters that display diagnoses, procedures, imaging, and/or chief complaints as well as accompanying CPR scores and orders are produced to monitor provider ordering patterns.
RESULTS: To date, 44% of the targeted 140 providers have been trained and randomized. In the intervention arm, there have been

2,068 total clinical encounters of which 81 triggered the iCPR interface via criteria that fit the use of either the Walsh or Heckerling CPR. Of these 81 encounters, 78% used the risk stratification section and 60% continued on to use the bundled ordering option associated with the iCPR interface. In the control arm, there have been 1,833 total clinical encounters of which 85 encounters fit the triggering criteria we used for the iCPR interface. The rate of triggering has been similar in the intervention and control arms (3.92% and 4.64% respectively) suggesting successful randomization.
CONCLUSION: Our preliminary data suggest that the automated integration of CPRs into EHR has been successful with over 70% of providers adopting the use of the risk stratification section of the iCPR interface. The development and implementation of the iCPR system depended upon the pretrial usability testing and the intervention provider training. These two factors likely contributed to the observed early success of the study.
REDUCING BARRIERS TO MENTAL HEALTH AND SOCIAL SERVICES FOR IRAQ AND AFGHANISTAN VETERANS: OUTCOMES OF A NEW INTEGRATED PRIMARY CARE CLINIC Karen Hope Seal 1; Greg Cohen 2; Daniel Bertenthal 2; Beth Cohen 3; Shira Maguen 4; Aaron Daley2.
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BACKGROUND: Despite high rates of post-deployment psychosocial problems in Iraq and Afghanistan veterans, mental health and social services are under-utilized. We sought to evaluate whether a new Department of Veterans Affairs (VA) Integrated Care (IC) clinic (established in April 2007), offering an initial three-part primary care, mental health and social services visit, improved psychosocial services utilization in Iraq and Afghanistan veterans compared to Usual Care (UC), a standard primary care visit with referral for psychosocial services as needed.
METHODS: This was a retrospective study using VA administrative data to compare clinical outcomes of UC after 2007 to both UC before 2007 and IC after 2007. The study population included 526 Iraq and Afghanistan veterans initiating primary care at a VA medical center between April 1, 2005 and April 31, 2009. Multivariable

models compared the independent effects of primary care type on VA mental health and social services utilization.
RESULTS: Compared to UC patients before April 2007, veterans presenting to UC after April 2007, were significantly more likely to have had an initial mental health evaluation (25% versus 59%, p After April 2007, there were further increases in initial mental health evaluations in the IC versus UC primary care clinic (92% versus 59%, p In particular, female veterans, younger veterans, and those with positive mental health screens were independently more likely to have had mental health and social services evaluations if seen in the IC versus UC clinic. Among veterans who screened positive for >1 mental health disorder(s), there was a median of 1 follow-up specialty mental health visit within the first year in both the UC and IC clinics.
CONCLUSION: Among Iraq and Afghanistan veterans new to primary care, an integrated primary care visit further improved the likelihood of an initial mental health and social services evaluation, but did not improve retention in specialty mental health services. Future studies
can test interventions targeted at enhancing mental health services retention in combat veterans.
A CLUSTER RANDOMIZED CONTROLLED TRIAL OF AUTOMATED NOTIFICATION OF POST-DISCHARGE MICROBIOLOGY RESULTS Robert El-Kareh 1; Christopher Roy 2; Eric G. Poon3. 1UCSD, La Jolla, California ; 2Brigham and Womens Hospital, Boston, Massachusetts ;
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BACKGROUND: Test results are often pending at the time patients are discharged from the hospital. These post-discharge results are frequently missed, potentially leading to delays in diagnosis and treatment. Microbiology cultures are among the most common pending results and often require urgent action. We sought to create, implement and evaluate an automated system to notify physicians of post-discharge microbiology results potentially requiring treatment.
METHODS: We created an electronic system at a large academic hospital to identify blood, urine, cerebral spinal fluid and sputum bacterial culture results whose antibiotic susceptibilities returned post-discharge, represented likely true infections, and were not treated with an antibiotic to which they were susceptible. The system automatically sent email-based alerts to the inpatient and outpatient physicians. From February 2009 to June 2010, we conducted a cluster randomized controlled trial to evaluate the systems impact on clinician follow-up of these results. In the intervention group, alerts were sent the first morning the culture results were finalized. In the control group, they were sent 3 days after finalization. Our primary outcome measure was evidence of follow-up of the result prior to 3 days after finalization with either an antibiotic order or note referencing the post-discharge result. We created a multivariable logistic regression model using the generalized estimating equations approach to assess the impact on test result follow-up after adjusting for repeated measures within the hospital-based physician, patient age, type of culture and primary hospital service.
RESULTS: Our system sent alerts for 97 eligible culture results to 73 inpatient physicians in our intervention group and 60 culture results to 48 inpatient physicians in our control group. Urine cultures comprised 138/157 (88%) of these results. We found evidence of follow-up action in 27/97 (28%) intervention results compared with 8/60 (13%) control results (aOR 3.0, 95%CI 1.2-7.7, p=0.014). Evidence of follow-up was more likely for urine cultures than non-urine cultures (aOR 5.2, 95%CI1.2-22.4, p=0.008), less likely for each increasing decade of patient age (aOR 0.72, 95%CI 0.57-0.91, p=0.02), and did not vary by primary hospital service (adjusted p=0.09).
CONCLUSION: Email-based alerts significantly increased the proportion of potentially untreated post-discharge bacterial culture results

with documented follow-up action. These alerts can augment hospital-wide test result communication strategies.

THE OPTIMAL INTERVAL OF HBA1C TO DETECT DIABETES IN HEALTHY ADULTS: A LARGE COHORT STUDY IN JAPAN Osamu Takahashi 1; Paul Glasziou 2; Rafael Perera 3; Gautam Deshpande 4; Sachiko Ohde 5; Takuro Shimbo 6; Tsuguya Fukui1. 1St.Lukes International Hospital, Tokyo, N/A ; 2Bond University, Queensland, N/A ; 3University of Oxford, Oxford, N/A ; 4University of Hawaii, Honolulu, Hawaii ; 5St.Lukes Life Science Institute, Tokyo, N/A ;
6National Center for Global Health and Medicine, Tokyo, N/A . (Tracking ID # 11271)
BACKGROUND: To identify adults at risk of cardiovascular disease, hemoglobin A1c (HbA1c) screening is important but in determining the validity of tests and optimal monitoring interval for re-screening, few studies have accounted for the measurement variability. We aimed to determine the optimal interval for rechecking HbA1C levels below the diagnostic threshold of 6.5% for healthy adults by estimating the variation in long-term change of HbA1C level (signal) and within-person variation (noise).
METHODS: Population-based, cohort from 2005 to 2008 in Tokyo, Japan. In healthy adults not taking diabetes medication, we measured the serum HbA1c annually for 4 years. We calculated the ratio of signal to noise by dividing change in HbA1c by within-person variance and estimated the optimal interval of screening when this ratio is over one. RESULTS: At baseline, the 16,313 people (53% female) with a mean age of 50 years old (SD: 12 years, range: 21 to 92), had a mean fasting plasma glucose level of 99.2 mg/dl (SD: 12.7 mg/dl) and a mean HbA1c level of 5.4 % (SD: 0.5 %). Within-person variation of HbA1c were 0.02 (coefficient of variation (CV): 2.7%) and 0.03 (CV: 3.0%) for those with HbA1c at baseline of <6.0 % and 6.0-6.4%, respectively. The trend mean HbA1C levels slightly increased over 3 years from 5.3 % to 5.5% (0.07% per year) for those with HbA1C at baseline of <6.0% and from 6.1% to6.2% (0.03% per year) for those with HbA1C at baseline of 6.0-6.4%. The signal-noise ratios were 0.2 at 1 year, 0.03 at 2 years, and 0.4 at 3 years, respectively, for those with HbA1c at baseline of <6.0 %, and 0.8, 3.3,3.3, respectively, for those with HbA1c at baseline of 6.0-6.4 %.
CONCLUSION: In those with an HbA1c <6.0% at baseline, the signal-noise-ratios of HbA1c measures for re-screening are very weak and decisions placed on such measures are potentially misleading. The optimal interval for re-screening healthy adults should be more than 3 years for those with baseline HbA1c of <6.0 % and 2 years with baseline HbA1c of 6.0-6.4%.
TEAMWORK AND WORKING AT TOP OF LICENSE AMONG PHYSICIANS, NURSING, AND NON-PROFESSIONAL STAFF AT TEACHING AND NON-TEACHING AMBULATORY PRACTICES Erin J Goss 1; Jason Fletcher 2; Claudia Lechuga 2; Paul Meissner 2; Arthur Blank 2; David Loundsbury 2; Diane McKee2. 1Montefiore Medical Center, New York, New York ; 2Albert Einstein College of Medicine, Bronx, New York . (Tracking ID # 11277)
BACKGROUND: The 2007 Joint Principles of the Patient Centered Medical Home (PCMH) call for comprehensive, coordinated, quality and easily accessible care delivered by a personal physician together with a team within a practice who collectively take responsibility for ongoing patient-centered care. Results from the National Demonstration Project
show that practice transformation to a team-based approach to care can be challenging. The transformation requires shifts in roles and mindset rather than just a series of practice changes but ideally allows more staff members to fully use their training and skills, or work at top of license by redistributing tasks. In preparation for Montefiore Medical Centers (MMC) transition of its ambulatory sites into PCMH practices, we sought to measure staff perceptions of teamwork and the amount of work done at top of license at distinct sites. We hypothesized that prior to PCMH transformation at Montefiore ambulatory sites, where lean ancillary staffing is common, staff would rank their sites as exhibiting low levels of teamwork, but that teaching sites would report greater teamwork. Caring for residents patients intrinsically requires a team based approach to deal with issues that present when the resident is performing other housestaff duties. The choice to work in an educational

environment may invoke feelings of camaraderie that bolster communication and teamwork. We also hypothesized that professions that report less time working at top of license, would report less teamwork. METHODS: We administered a brief survey to all staff at 4 MMC ambulatory sites, including two teaching sites with a total of 57 residents. Participation was voluntary and anonymous. The survey included the Healthcare Team Vitality Instrument (HTVI), a 10-item questionnaire that was developed to assess team vitality of licensed and unlicensed personnel working in healthcare teams in inpatient hospital units. For this study, questions were adapted to the outpatient setting. Responses were collected using a 5-point Likert scale (1, strongly disagree and 5, strongly agree) with higher scores indicating better team vitality. The 10 questions were grouped into 4 previously validated factors: support structures (3 questions), engagement and empowerment (3 questions), patient care transitions (2 questions), and team communication (2 questions). Scores for questions relating to a particular factor were averaged to create an overall factor score. Mean factor scores between practices and professions were compared using t-tests. The survey included two questions that asked staff to estimate the amount of time spent doing tasks that did or did not require them to work at top of license, and collected demographic information including profession, site, and number of years worked at the current ambulatory site. Results are reported as simple percentages compared using t-tests. RESULTS: 226 out of 322 (70%) employees participated in the survey including 115 (61%) of employees from teaching sites and 111 (83%) of employees from non-teaching sites. Thirty three respondents (15%) were nursing and ancillary clinical staff (RN, LPN, social work, pharmacists), 73 (33%) were physicians (attendings or residents), and 118 (52%) were nonprofessional support staff (administration, clerical, patient care technicians, and patient support representatives). There was no difference between how staff at teaching compared to non-teaching sites rated their practices with regard to team communication (4.10.8 vs 3.90.9; $p > 0.1$) or engagement and empowerment (3.51 vs 3.31; $p > 0.1$), however there were lower scores for support structures (3.51 vs 3.80.9; $p < 0.1$) and significantly lower scores for patient care transitions (3.30.9 vs 3.60.9; $p < 0.05$) at the teaching clinics compared to the non-teaching clinics. Physicians reported the least amount of time spent working at top of license. Only 20% of physicians spent more than 75% of their time performing tasks that fully required use of their training, compared to 39% of nurses and only 55% of non-professional staff ($p < 0.001$) Results were similar at teaching and non-teaching sites. Physicians rated access to support structures lower than nursing/ancillary staff and non-professional staff (3.40.9 vs 3.70.9 and3.81 respectively; $p < 0.05$), but there were no differences between staff and others with regards to the other three factors calculated on the HTVI.

CONCLUSION: The Healthcare Team Vitality Index allows researchers to look at four different factors of a well-functioning team and is validated for the healthcare field. Contrary to our hypothesis, practices involved in resident education scored lower on measures of support structures and patient care transitions than non-teaching sites, although actual differences were small. Further investigation is needed to determine why teaching sites report lower levels of teamwork, in order to improve the likelihood of a successful transition to team-based care within a PCMH. Potential explanations include unfamiliarity between team members due to rapid resident turnover, competing housestaff duties outside the clinic, and limited accountability. Physicians reported more time spent doing tasks that did not require them to fully use their level of training compared to nurses/ancillary clinical staff or non-professional staff; however there was little difference in how these groups rated teamwork at their sites.

GEOGRAPHIC VARIATION IN THE IMPACT OF MASSACHUSETTS HEALTH REFORM ON USE OF REFERRAL-SENSITIVE INPATIENT PROCEDURES AMONG MINORITIES AND LOW INCOME POPULATIONS Amresh D Hanchate 1; Karen Lasser 2; Danny McCormick 3; Meredith DAmore 4; Nancy Kressin5. 1Boston University School of Medicine, Boston, Massachusetts ; 2Boston University School of Medicine, Chestnut Hill, Massachusetts ; 3Harvard Medical School, Cambridge, Massachusetts ; 4Boston Medical Center, Boston, Massachusetts ; 5Boston University School of Medicine, West Roxbury,

Massachusetts . (Tracking ID # 11281)
BACKGROUND: While the landmark 2006 Massachusetts (MA) health reform sharply increased insurance coverage to near-universal levels, little is known about the extent to which it increased access to care, the variation in gains in access across the state and the mediating role of local physician availability. Specifically, few prior studies have examined the impact of the reform on use of inpatient surgical procedures whose receipt is sensitive to outpatient physician referral and to the presence of insurance coverage. Such procedures are typically underutilized by minority and low-income populations.
METHODS: Using discharge data from all non-federal MA hospitals from 200409 (N=5,177,087 discharges), we identified all non-obstetrical major therapeutic procedures for patients aged >=40 and for which >=70% of hospitalizations were initiated by outpatient physician referral (high-referral rate procedures). For pre- and post-reform periods, defined as the 21 months preceding and following implementation of health reform (7/1/2006 - 12/31/2007), we estimated county-level procedure rates, and their changes, for those aged 4064. We adjusted for secular changes unrelated to health reform by capturing corresponding changes for those aged >70, as they are covered by Medicare and unaffected by the health reform. We used the county-level Health Professional Shortage Area designation from the Department of Health and Human Services as the indicator of local primary care practitioner availability. Using procedure counts aggregated at the county-level, and stratified by sex, age, race/ethnicity or income and year (N=2,240), we estimated hierarchical Poisson regression models with a difference-in-difference specification treating those aged >70 as the comparison cohort. Statistical significance was assessed at a p<0.05 level.
RESULTS: We identified 22 high-referral rate procedures for which the outpatient referral proportion averaged 90%; these included musculo-skeletal (joint replacement), cancer treatment (colorectal resection) and cardiovascular (heart valve) surgical procedures. Adjusted for secular changes unrelated to health reform, the post-reform statewide procedure rate for those aged 4064 increased by 6.7%; the corresponding increase was larger among lower income populations (low income=12%;
medium income=13%; high income=2%) and among Hispanics (Hispanics=19%; Blacks=5%; Whites=6%). Variation in post-reform changes in procedure rates across the counties was large, with an interquartile range of [2%,12%]. Corresponding post-reform procedure rate changes among subpopulations were also large: low income population (interquartile range=[8%,12%]); Hispanics (interquartile range=[11%,77%]); Blacks (interquartile range=[0%,18%]). Increase in procedure use was significantly greater among the 6 counties with greater primary care physician shortages than the remaining 8 counties(11.4% vs. 5.4%).
CONCLUSION: Following health reform, use of major inpatient surgical procedures that are primarily initiated by outpatient referral increased among those aged 4064, including among minority and lower income subpopulations, indicating improved access to care. Variation in these gains by county was substantial. Counties with greater primary care provider shortages experienced larger increases in procedure rates. Further research is needed to better understand the causal processes underlying the geographic variations.
THE ACCESS PARTNERSHIP: A MODEL TO IMPROVE ACCESS TO SPECIALTY CARE FOR THE UNINSURED? Lauren Block 1; Sai Ma 2; Matthew Emerson 3; Anne Langley 3; Desiree de la Torre3. 1Johns Hopkins Hospital, Baltimore, Maryland ; 2Johns Hopkins School of Public Health, Baltimore, Maryland ; 3Johns Hopkins Medical Institution, Baltimore, Maryland . (Tracking ID # 11282)
BACKGROUND: A patchwork of access to primary care exists for the uninsured across the U.S., but meeting the specialty care needs of this population remains a challenge, particularly as 25% of primary care visits end with a specialty referral. The Access Partnership (TAP) is a novel cooperative program between primary care and specialty physicians at an academic medical center program designed to provide access to needed specialty care for uninsured and underinsured patients. Providers refer patients from designated zip codes to needed specialty care and diagnostics. If the medical director agrees as to medical necessity, patients pay a nominal fee to enter the program, and a care coordinator schedules the appointment and any needed follow-up,

including imaging and procedures, without any additional charges. We sought to evaluate program impact by examining patient satisfaction, perceived access to care, follow-through rates at specialty appointments, and emergency department utilization before and after initiation of the TAP program.
METHODS: A program evaluation survey was created using a RAND questionnaire and administered via phone by trained interviewers. Answers were graded using Likert scales and positive answers grouped and tallied. Visit and claims data were analyzed for the first year of program activity. We then selected Medicaid patients from the same zip codes with matched specialty care referrals during the same period and surveyed 248 of these patients.
RESULTS: Between May 2009 and April 2010, 726 specialty referrals were made for 336 patients, 309 patients had approved referrals, and 214 of these patients chose to enter the program. Of those patients who entered the program, we reached 136 (63%) by phone. Analysis of administrative data revealed that 89% of referrals for patients who entered the program were completed, which is comparable to specialty care show rates found in the literature. Referrals to diagnostic tests and specialty physicians were more likely to be completed than referrals to ancillary care and pain management providers. 21% of patients surveyed reported completing specialty referrals in the year prior to joining TAP (pre-TAP), compared with 88% in the time since joining TAP (post-TAP) ($p<0.001$). Patient-reported access to care increased signif-

icantly after TAP, with 33% of patients reporting access to care pre-TAP, and 87% of patients reporting access to care post-TAP ($p<0.001$). Patient satisfaction with healthcare increased significantly after TAP, with 41% of patients reporting satisfaction with care before TAP, and 91% reporting satisfaction with care after TAP ($p<0.001$). 86% of patients reported a financial barrier to specialty care pre-TAP, compared with 18% post-TAP ($p<0.001$). Reported ED visit rate per month was lower post-TAP, with 0.09 reported visits per month compared with 0.18 visits per month pre-TAP ($p<0.001$). Administrative data showed that while the total number of ED visits did not vary after TAP, the total number of patients who used the ED decreased. We then used difference-indifference models to compare TAP and Medicaid patients, controlling for age and gender. Our preliminary results show that compared with Medicaid patients, TAP patients reported significantly decreased ED use and significantly increased access to specialty care during the same period.
CONCLUSION: TAP enrollment was associated with significantly increased access to and satisfaction with care. Patient-reported ability to complete specialty referrals and decreased ED utilization correlated with administrative data. Limitations include recall bias and lack of comparison group visit and claims data. Future work will evaluate financial, administrative, and patient outcomes through comparison of administrative data with the matched cohort of Medicaid patients.
ADDRESSING HEALTH DISPARITIES FOR MINORITY PATIENTS WITH ASTHMA: A SYSTEMATIC REVIEW
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(Tracking ID # 11286)
BACKGROUND: Minority patients with asthma have disproportionately greater rates of morbidity and mortality than their non-Hispanic white counterparts. The aim of this study was to systematically review the literature to characterize interventions that have potential to improve health disparities and care of minority patients with asthma. METHODS: In consultation with a biomedical librarian, we conducted an electronic search of the English literature in Medline, PsycINFO and CINAHL from 1950 to Fall 2010. We exploded Medical Subject Heading (MeSH) terms related to asthma (i.e. respiratory inhalers, anti-asthmatic agents). Asthma-related terms were combined with terms to identify studies focused on minority populations (e.g. MeSH Minority Groups and keyword dispari*mp) and with terms to identify intervention studies. Inclusion criteria were adult population (age

18 or older) and intervention studies with greater than 50% minority participants or statistical sub-analysis by race/ethnicity. To assess study quality, the previously validated Downs and Black checklist was used (maximum score=27).
RESULTS: The search yielded 1054 articles (Medline 985; CINAHL/ PsycINFO 69), 33 of which met inclusion criteria. Downs and Black scores ranged from 8 to 27 (median=22, IQR 1824). Most studies assessed outcomes (e.g. lung volume, morbidity, mortality, etc [27]) and many evaluated process measures (e.g. quality of life, knowledge, [19]). Study populations targeted primarily black (13), Latino/a (2), Asian (2) individuals, or a combination of the above (7). A handful (9) were minority subset analyses of larger studies of predominantly Caucasians. Study design included random assignment (15), pre/post (7), cohort (9) or case control(2). Interventions targeted patients (28), community (8), organizations (7), or policy (1). Intervention setting included outpatient (23), hospital (10; 5 exclusively in the emergency department), community (7), employer (1), government (4) and health plan (2). The most common intervention studied(22) included patient education or empowerment (e.g. coaching, self-
management programs) with mixed results. Successful outcomes included improved knowledge and adherence to therapy, better symptom control and disease severity (e.g. increased peak flow), improved quality of life and self-efficacy, and decreased costs and acute care visits (ED and hospital). Few studies (6) targeted at patient education or empowerment were culturally tailored. Only 6 studies evaluated environmental or therapeutic interventions, with interesting results. For instance, one study showed that inhaled corticosteroids increased bronchodilator responsiveness in Latino/a patients but not in black patients. Only three studies evaluated system redesign. One of these improved clinician knowledge regarding the importance of placing action plans in patient charts, but did not significantly change knowledge regarding need for inhaler education or peak flow management.
CONCLUSION: While the majority of interventions that could address health disparities and improve care for minority patients with asthma focus on patient education or empowerment, the results of these studies are mixed, and few were culturally tailored. Moreover, far fewer interventions focused on specific therapies or system redesign. To truly improve the health and outcomes for minority patients with asthma, future work should address these gaps.
DO WORKFORCE CHARACTERISTICS EXPLAIN DIFFERENCES IN DIABETES QUALITY OF CARE IN AN INTEGRATED DELIVERY SYSTEM? Calie Santana 1; James Grigg 1; Yuming Ning1. 1Montefiore Medical Center, Bronx, New York . (Tracking ID # 11287)
BACKGROUND: Integrated delivery systems are one type of Accountable Care Organization (ACO). ACOs are promoted in the Affordable Care Act due to their potential to reduce costs and improve both quality and the patient experience. Montefiore is an integrated system in Bronx, NY with four hospitals and 21 primary care sites. These sites are managed centrally but are heterogeneous in their payer mix and teaching status. There are three main site types: (1) commercial-dominant payer mix (n=10), (2) mixed-payer and teaching (n=5), and (3) mixed-payer and non-teaching (n=6). These sites also differ in the workforce of their diabetes teamsfour (all commercial) offer diabetes care management by nurses and three (all mixed/teaching) have nutritionists on staff. Our previous work showed significant differences in diabetes quality of care across sites within this integrated system. We sought to measure the association between workforce characteristics and quality of care for patients with diabetes across all primary care sites in our system. We hypothesized that the presence of diabetes nurses and of nutritionists would be associated with higher performance in quality measures.
METHODS: Workforce characteristics (diabetes nurses, nutritionists) were gathered via a survey completed by the medical directors of each site. Diabetes HEDIS performance outcomes were gathered from Montefiores Clinical Information System. Our study population included patients age >18 with one visit in 2009 followed by at least one visit in 2010. Patients who were pregnant or died during 2010 were excluded. Of these, we chose patients with diabetes defined as a diabetes ICD9 code, Hemoglobin A1c (HbA1c) >6.5, or diabetes in the

electronic problem list between 2006 and 2010. Outcomes considered the most recent value for 2010, and included: (1) HbA1c <8%, (2) LDL <100 mg/ dL, (3) microalbumin checked at least once, and (4) blood pressure <140/90, and (5) blood pressure <130/80. If the value was not checked at least once in 2010 the measure was considered unmet. We measured the bivariate association between each workforce characteristic and each dichotomous outcome using a 2-level mixed effects logistic regression with sites having random effects. This technique accounts for clustering of patients within sites when using patient-level outcomes

and site-level independent variables. The models were adjusted for patient-level age, sex, race/ethnicity and insurance. We also studied HbA1c and LDL values as continuous outcomes in 2-level mixed effects linear regression models.
RESULTS: Our study population included 26,225 patients. In general, commercial sites had the highest performance followed by mixed/ teaching sites and then mixed/non-teaching sites. In our population,59.6% had controlled HbA1c (62.5% in commercial sites, 56.0% in mixed/teaching, and 57.3% in mixed/non-teaching). For LDL, 43.1% of patients achieved control (44.4%, 41.8%, and 40.6% across commercial, mixed/teaching, and mixed/non-teaching sites, respectively). About half of the patients (55.0%) had their microalbumin levels checked at least once in 2010 (63.3% in commercial sites, 49.3% in mixed/ teaching, and 32.9% in mixed/non-teaching). Blood pressure of <140/ 90 was achieved in 59.0% of patients (61.7% in commercial, 58.9% in mixed/teaching and 46.3% in mixed/non-teaching sites, respectively). Tighter blood pressure control (< 130/80) occurred in 45.0% of patients(48.4%, 43.1%, and 35.0% for commercial, mixed/teaching, and mixed/ non-teaching sites, respectively). The differences between site types was significant for all five outcome measures ($p<0.001$). No one individual site was consistently the best or the worst performer across all outcomes. Presence of nutritionists was associated with a 0.25 increase in HbA1c measured continuously ($p=0.03$). There was no significant association between diabetes nurses or nutritionists and all other outcomes, after adjusting for patient-level demographics. CONCLUSION: We hypothesized that the presence of diabetes nurses and nutritionists would be associated with improved performance in diabetes quality of care measures. Instead, we found equivalent (or higher A1cs in the case of nutritionists) in the settings with these personnel. In this integrated, centrally-managed primary care network, differences in workforce characteristics did not explain heterogeneity in diabetes process and outcome measures across sites, after accounting for patient-level factors. The presence of nutritionists may be a marker for determinants of worse diabetes controlboth patient-level and organizational. In addition, availability of diabetes nurses might not be a robust enough intervention. The true effectiveness of these workforce characteristics will be measured in future studies where changes in diabetes measures over time are the main outcomes. Our study supports the role of additional patient-level factors (e.g. adherence) and non-personnel site resources (e.g. teamwork) on quality of care in diabetes. The determinants of differences in quality of care among sites in an integrated system must continue to be carefully measured and corrected. At this point, the efficiencies of system integration in the system we evaluated have not corrected these differences.
INVOLUNTARY USE OF OUT-OF-NETWORK PHYSICIANS IN PRIVATE HEALTH PLANS Kelly A Kyanko 1; Leslie Curry 2; Susan H Busch2. 1Yale School of Medicine, New Haven, Connecticut ; 2Yale School of Public Health, New Haven, Connecticut . (Tracking ID # 11288)
BACKGROUND: Health insurance plans that provide reimbursement for outof-network services are popular, providing enrollees with greater physician choice, but at higher cost-sharing and additional costs due to balance billing. However, there is increasing interest among policymakers in the issue of involuntary use of out-of-network physicians, especially in the inpatient setting. A patient may involuntarily use an out-of-network physician for at least three reasons: 1) during a medical emergency; 2) if it is not disclosed that a physician is out-of-network; or 3) if at in-network hospital but seen by a outof-network hospital-affiliated physician, such as an anesthesiologist, that has chosen not to contract with an insurer. Despite recent legislative activity at

federal and state levels, little is known about the scope of this issue. We aimed1) To determine the percent of privately insured individuals who used an outof-network physician in the last year, 2) To determine how much out-of-network use was involuntary, and 3) To describe the characteristics of individuals using out-of-network physician services (i.e., health status, income) and the types of services used (i.e., inpatient versus outpatient). METHODS: An internet survey was conducted in December 2010 with participants in KnowledgePanel, a probability-based online research panel designedtobestatisticallyrepresentativeoftheU.S.population.Anovelsurvey was constructed from existing literature, lay press articles, key informant interviews, and investigator hypotheses and was tested through cognitive interviewingandpilotsamples.Thesurveywasadministeredtopanelistsages 1864 enrolled in health insurance plans with provider networks. RESULTS: The study completion rate was 51%; enrollment was closed after 10 days when a previously established number of participants screened in. Of those participants that used any health services in the last year, 9% used at least one out-of-network physician (N=585, representing 901 out-of-network physicians). Surprisingly, individuals with household incomes less than $35,000 were significantly more likely to use out-of-network services than higher income individuals (OR=1.4, p=0.004). This result held even after controlling for health status. 41% of individuals that used out-of-network services had involuntarily used an out-of-network physician. Non-whites and those with fair or poor self-reported health status were significantly more likely to have involuntary use (OR=2.8, p <0.0001 and OR=2.4, p=0.005, respectively). Involuntary use was more common in the inpatient setting, with 56% of out-of-network inpatient encounters involuntary as compared to 15% in the outpatient setting. Among involuntary out-of-network inpatient encounters, 52% occurred at an in-network hospital. CONCLUSION: Involuntary use of out-of-network physicians is common, especially in the inpatient setting and among vulnerable populations. These results suggest that greater efforts are needed to protect patients from involuntary out-of-network charges. The impact of various solutions afforded by state legislation, such as bans on balance billing, transparency efforts, and hold harmless provisions and recently introduced regulation in the Affordable Care Act pertaining to emergency care should be evaluated on their ability to protect patients from involuntary excessive cost-sharing charges while preserving physician choice.

LINAGLIPTIN IMPROVES GLYCEMIC CONTROL INDEPENDENT OF BODY MASS INDEX IN PATIENTS WITH TYPE 2 DIABETES Marc Rendell 1; Steven Chrysant 2; Angelina Trujillo 3; Angela Emser 4; Maximilian von Eynatten 4; Sanjay Patel 5; Hans-Juergen Woerle4.

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BACKGROUND: Three randomized, double-blinded, placebo-controlled, phase 3 trials for the DPP-4 inhibitor linagliptin examined its safety and efficacy of glycemic control as monotherapy, as add-on to metformin, or as add-on to metformin + sulfonylurea in patients with type 2 diabetes (T2D). Identical endpoints, linagliptin dosing, and a large cohort size (more than 2,200 patients) facilitate subgroup analyses using the pooled dataset. Given the need for evaluation of the safety and efficacy of new antidiabetic agents on a background of other medications and patient comorbidities, we analyzed pooled patient data to evaluate the effect of key patient characteristics on the safety and efficacy of linagliptin. Some research studies have shown a reduced treatment response in obese individuals with T2D, thus we determined the response to linagliptin treatment in overweight and obese patients.

METHODS: The primary efficacy outcome in all three pooled studies was mean change from baseline in HbA1c

at 24 weeks. The incidence of any adverse events (AE) were recorded. Patients were categorized according to baseline BMI: normal weight (<25; n=496), overweight (25 to <30; n=894), or obese (30; n=834).
RESULTS: The mean (SD) patient age and baseline BMI were 5710 years and 29.04.9 kg/m2, respectively. Patients were predominantly White (58%) and Asian (42%), with an equal gender distribution. Overall, 57% of patients had a mean disease duration of >5 years, 40% of patients were overweight (mean BMI 27.51.4), and 38% were obese (mean BMI 34.13.0). Mean baseline HbA1c (SD) and HOMA-IR were 8.1% (0.8) and 4.75.3 mU/ Lmmol/L, respectively. In the pooled analysis of efficacy, linagliptin showed significant reductions in HbA1c levels in all 3 groups with no significant difference based on BMI. In the linagliptin-treated group, mean change from baseline in HbA1c levels among obese patients was 0.61% (0.79), compared to a similar reduction of 0.60% (0.85) in overweight patients and 0.66% (0.93) in patients with normal BMI. The overall AE rate did not differ significantly between the 3 groups, and the most commonly observed AE was hypoglycemia; however the overall hypoglycemic event rate with linagliptin as monotherapy and as add-on to metformin therapy was very low (1.0%) and comparable to placebo. A higher rate of hypoglycemic events only occurred in the study that used a background therapy with metformin and a sulfonylurea; this was expected due to the combination with SU. CONCLUSION: Treatment with linagliptin provided clinically meaningful HbA1c reductions in patients with T2D, independent of BMI, with a safety profile comparable to placebo. Treatment with linagliptin resulted in mean HbA1c reductions of 0.600.66% at 24 weeks across BMI categories. The reductions in HbA1c were consistent with results from the primary phase 3 trials.
PRIMARY CARE RESIDENTS COMFORT AND EXPERIENCE WITH ALCOHOL SCREENING AND BRIEF INTERVENTION David P Miller 1;
J Aaron Johnson 2; Kristy B Le 1; David C Parish 2; Hunter Woodall 3; Denice C Clark 2; J Paul Seale2. 1Wake Forest University School of Medicine, Winston-Salem, North Carolina ; 2Mercer University School of Medicine, Macon, Georgia ; 3AnMed Health, Anderson, South Carolina . (Tracking ID # 11295)
BACKGROUND: One-third of adult Americans have engaged in binge drinking or abused alcohol within the last year. Screening and brief intervention (SBI) for unhealthy alcohol use is recommended by the U.S. Preventive Services Task Force; however, SBI is often not performed. Given the prevalence and importance of alcohol disorders, primary care residents should be trained to provide alcohol SBI. To inform the development of a regional SBI training program, we conducted a needs assessment to determine residents comfort with and experiences conducting alcohol SBI. METHODS: We surveyed residents in 4 primary care training programs in the Southeast (2 internal medicine and 2 family medicine residency programs). The survey contained 83 items addressing residents attitudes, beliefs, and current practice pertaining to intervening with hazardous drinkers. Survey items were a mixture of multiple-choice questions, yes/no items, and Likert scale items. A series of questions assessed how often residents screened patients for alcohol misuse and performed interventions. We also asked residents how often their interventions included three key recommended elements: feedback, advice, and goal-setting. One point was assigned to each element the residents reported usually or always including in an intervention, yielding an intervention score ranging from 0 (no elements included) to 3 (all elements included).
RESULTS: Out of 180 residents, 155 (86.1%) completed the survey. Slightly more than half of residents (58%) reported they usually or always screen for alcohol misuse during an initial visit, but only 14% reported screening at
acute care visits. Most residents who reported screening patients for at-risk alcohol used either quantity-frequency questions (48%) or the CAGE (64%); only 17% used the AUDIT, AUDIT-C, or single alcohol screening question. When a brief intervention was performed, only 24% of residents usually or always included the 3 recommended elements of feedback, advice, and goal-setting, while 24% included none of these. Only 21% of residents felt confident they could help their at-risk patients cut down or quit using alcohol, and only 16% of residents thought they had been successful in the past. The most frequently reported barriers to discussing

alcohol use with patients were lack of adequate training (56%), the belief that talking with patients is unlikely to make a difference (43%), and being too busy (37%). Residents reported a mean of 9.3 hours of alcohol training (95% CI 5.6 - 13.1 hours), with no significant increase in training hours across three years of residency. CONCLUSION: Residents report a limited number of training hours in alcohol SBI, and more than half feel they lack adequate training. More than 40% of residents do not usually screen for alcohol misuse at initial clinic visits, and those who do rarely use instruments designed to detect at-risk drinking. Only one-fourth of residents who do brief interventions include the three recommended elements. These findings indicate the need for increased SBI training.

USING INPATIENT MORTALITY DIFFERENTIAL FROM WEEKEND ADMISSION TO IDENTIFY THE ROLE OF HOSPITAL STRUCTURES: THE CASE OF ISCHEMIC STROKE Amresh D Hanchate 1; Lee Schwamm 2; Elaine Hylek1. 1Boston University School of Medicine, Boston, Massachusetts ; 2Massachusetts General Hospital, Boston, Massachusetts . (Tracking ID # 11298)

BACKGROUND: A challenge in identifying factors underlying differences in hospital outcomes is the potential confounding from differences in unobserved patient characteristics across hospitals. Taking the case of hospitalizations for acute ischemic stroke, for which inpatient mortality (IM) rates are high and vary widely by hospital, little is known about the role of hospital structures, i.e., the setting in which care is delivered. To estimate the impact of hospital structures, we use a unique study design based on exploiting the within-hospital variation in IM between weekday and weekend admissions, thereby attenuating the confounding from unobserved patient differences across hospitals. METHODS: Discharge and American Hospital Association data were merged for all hospitalizations for ischemic stroke (N=234,408) from all hospitals (N=407) from four states (200507 for FL, MA and NJ, and 200608 for AZ). We only included Emergency Department (ED) admissions that did not result in transfer to another hospital and excluded admissions for patients aged <18, non-ischemic strokes and in hospitals without AHA data. We examined hospitals with >25 weekend admissions. We estimated a discharge-level hierarchical (hospital fixed effects) regression IM model, including interactions of weekend admission and hospital structure indicators. Patient risk factors were based on patient demographics and secondary diagnosis codes. We report the ratio of weekend/weekday adjusted IM for hospitals with a structure (e.g., bed capacity level).

RESULTS: We examined 106,146 ischemic stroke admissions from 188 hospitals, of which 27% were during a weekend. While there was no significant difference in overall weekday-weekend IM (weekend=4.5%; weekday=4.4%; p=0.36), variation across hospitals was considerable: the median hospital-level ratio of weekend/weekday IM was 1.04 with an interquartile range of 0.66 to 1.38. In contrast, differences between patient risk factors of weekend/weekday patients were smaller, with interquartile range of expected IM of 0.94 to 1.06. We examined ten hospital structure indicators (see Table); of these three were associated with higher excess weekend IMhospitals with a) absence of hospitalists providing care (excess

weekend IM ratio=1.33, p<0.01), b) safety-net hospital (ratio=1.15, p=0.06), and c) <80 ED daily volume (ratio=1.31, p=0.08). 27% of weekend admissions were in hospitals that exhibited one of these three structures. CONCLUSION: Absence of hospitalists, safety-net status and lower emergency department daily volume were associated with significant excess inpatient mortality from weekend admission for ischemic stroke.

CONTROLLED STUDY OF OUTCOMES FROM A RESIDENT SCHOLARSHIP CURRICULUM Colin P West 1; Andrew J Halvorsen 1; Furman S McDonald1. 1Mayo Clinic, Rochester, Minnesota . (Tracking ID # 11305)

BACKGROUND: Training in research is an important component of residents preparation for their future careers, whether their focus will be on appraisal and application of the scientific literature to the care of their patients or on the academic pursuit of knowledge through independent scholarship. Recognizing this, the Accreditation Council for Graduate Medical Education requires accredited training programs to implement and support research curricula. The Mayo Clinic Internal Medicine (IM) Residency Program has developed a

multifaceted research curriculum to meet this requirement. This curriculum is available to residents online and spans the full three years of training. Additional key elements include rigorous review of mentor-approved research elective proposals and a comprehensive mentorship structure. We assessed residents peer-reviewed scholarly output associated with this program to that of peers training elsewhere.
METHODS: For residents beginning training in 2003 through 2006, we conducted MEDLINE searches for peer-reviewed articles between July of their match year and the end of their expected graduation calendar year. To provide an appropriate comparison, we evaluated outcomes for applicants who matched to Mayo relative to those of applicants who were ranked higher than the lowest ranked Mayo-matched applicant (i.e., were ranked to match) but matched elsewhere due to personal preference. Only data from ERAS (name, medical school) and the NRMP (matched residency program) were considered eligible search parameters to avoid potential familiarity bias for Mayo residents. Outcomes included mean peer-reviewed articles and case reports per applicant, the proportion of applicants with at least 1 publication, and the median 2009 journal impact factor of the resident publications.
RESULTS: The study included 192 Mayo-matched and 429 ranked-to-match non-Mayo residents. Results are displayed in the Table. The curriculum was associated with more than three times as many peer-reviewed articles (2.1 vs. 0.6 per resident) and over four times as many case reports (0.57 vs. 0.13 per resident) than alternative research curricula (both $p<0.0001$). Nearly twice as many Mayo-matched residents published at least 1 article (65.6% vs. 36.0%, RR=1.82; $p<0.0001$). The median journal impact factor for articles associated with this curriculum was also greater. ($p=0.003$).
CONCLUSION: When compared to their equally-qualified peers, residents participating in a multifaceted research curriculum produced more peer-reviewed articles, more case reports, were more likely to publish at least 1 paper, and published in higher impact journals. Many factors contribute to these results, but the Mayo IM resident scholarship curriculum is a key part of the research environment fostering this productivity. Understanding the successful components of this curriculum, and the resources necessary to implement them, may assist other training programs in developing effective research curricula.
Table 1:
Outcomes Mayo (n=192) Non-Mayo (n=429) P-value
Peer-reviewed articles, No. (per resident) 397 (2.1) 276 (0.6) <0.0001
As first author, No. (% of articles) 227 (57.1%) 132 (47.8%) 0.01 Case reports, No. (per resident) 109 (0.57) 56 (0.13) <0.0001 At least 1 article, No. (% of residents) 126 (65.6%) 155 (36.0%) <0.0001 2009 Journal Impact Factor, Median 4.6 3.6 0.003

MEASURING CARE COORDINATION. CAN WE USE DATA FROM THE ELECTRONIC HEALTH RECORD?
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. (Tracking ID # 11307)
BACKGROUND: There is widespread agreement that care coordination is a hallmark of high quality health care at all levels. At a national level, the Institute of Medicine recommends focusing on care coordination as a key strategy for improving quality of care for the nation. At a systems-level, researchers have shown that organized, integrated systems of care provide higher quality at lower cost. At a clinical level, numerous professional societies, including the American College of Physicians and the Society of General Internal Medicine, advocate

a re-designed primary care environment (The Advanced Medical Home) that emphasizes care coordination. Unfortunately, there is no agreed-upon approach to measuring this critical activity. Due to the resources required, it is not usually feasible to observe large samples of providers or patients directly. However, providers using an electronic health record (EHR) routinely communicate electronically, and this activity is captured and stored digitally. We sought to determine whether the data recording these communications could be retrieved and used to measure intensity of care coordination.
METHODS: We collected data from a convenience sample of 12 primary care physicians (7 family medicine physicians and 5 general internists) working at 3 separate locations (Lebanon, Manchester, and Nashua New Hampshire) within a single health care system in which all providers use the same home-grown EHR. Trained observers (an internal medicine resident and post-doctoral fellow in qualitative research) shadowed each physician for an entire shift and recorded all care coordination activities. Technical support staff from the same institution developed a data query that allowed retrieval of all electronic communications initiated and received by these same physicians on the day that they were observed. We then compared the number of care coordination activities observed directly with the communication events retrieved electronically for each physician and used Spearmans rho to assess the strength of the association.
RESULTS: A total of 888 care coordination tasks were recorded via direct observation, while the EHR query retrieved a total of 534 communication events. For the 12 individual physicians, the observed counts ranged from 19 to 170 (mean 74), and the electronic counts ranged from 23 to 95 (mean 44). The observed counts were higher than the electronic counts for all but one of the 12 physicians as the electronic counts did not include phone, email, or in-person activities. The difference between the observed and electronic counts ranged from 4 to 49 with a mean difference of 22. Using physicians as the unit of analysis, the Spearmans correlation between observed and electronic counts was 0.77 ($p<0.01$). Physicians with the highest observed counts were also more likely to have higher rates of self-initiated electronic communication events ($p<0.01$).
CONCLUSION: It is difficult to promote and reward care coordination if it cant be measured. Our findings suggest that EHR data can be used to create a measure of care coordination that is highly correlated with the relative intensity of care coordination measured via direct observation - the gold standard. Additional studies with larger samples and different EHRs are needed to validate these findings.
THE PREVALENCE AND CORRELATIONS OF MEDICAL STUDENT BURNOUT IN THE PRE-CLINICAL YEARS: A CROSS-SECTIONAL STUDY Rebecca Anne Mazurkiewicz 1; Robert Fallar 1; Deborah Korenstein 1; Jonathan Ripp1. 1Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11308)
BACKGROUND: Burnout is a psychological syndrome of emotional exhaustion, depersonalization, and impaired personal accomplishment induced by repeated workplace stressors. Current research suggests that physician burnout may have its origins in medical school. The consequences of medical student burnout include both personal and professional distress, loss of empathy, and poorer health. The objective of our study was to determine the prevalence and correlates of burnout among third year medical students.
METHODS: We administered a survey to medical students at The Mount Sinai School of Medicine (MSSM) in New York, New York during their clinical orientation at the beginning of their third year of medical school. The survey included a measurement of burnout, the Maslach Burnout Inventory-General Survey (MBI-GS), which measures the 3 domains of burnout (Emotional Exhaustion, Depersonalization, and Cynicism) and has been validated in large populations of health care professionals. We defined burnout as a high score on either the MBI Exhaustion (score >3.2) or Cynicism (score >2.2). Our survey also included a sleep deprivation screen, and questions related to demographic information, current and previous academic rotations, psychiatric history, time spent working/studying, participation in extracurricular activities, social support network, autonomy and isolation. Multiple comparison chi-square tests were conducted to identify statistically significant differences in proportions ($p<0.05$) of burnout across survey items. Fishers Exact test was utilized when cell sizes were small ($n<5$).
RESULTS: Of the 123 eligible medical students in the MSSM class of 2010, 86 (70%) participated in this study.

Sixty-one of the 86 medical student participants (71%) met criteria for burnout at the beginning of their third year of medical school. Thirty-nine percent of medical students with burnout suffered from sleep deprivation as opposed to 33% of those who did not have burnout (p=0.04). Fifty-eight percent of medical students with burnout disagreed with the statement I have control over my daily schedule as opposed to 50% of those who did not have burnout (p=0.03). Lastly, 15% of medical students who were burnt out disagreed with the statement I am confident that I will have the knowledge and skills necessary to become an intern when I graduate as opposed to 11% of those who did not have burnout (p=0.03). Burnout was not associated with any demographic information, current and previous academic rotations, psychiatric history, time spent working/studying, participation in extracurricular activities, social support network, autonomy or isolation. CONCLUSION: Our findings show that burnout affects the majority of third year medical students prior to the initiation of clinical training. These results also demonstrate an association between burnout and medical student confidence in becoming a capable intern and between burnout and lack of control over ones daily schedule. The implications of our work suggest the need for strategies to decrease workload while maximizing medical students autonomy over their work environment. Future studies should examine whether burnout is predictive of behaviors and performance during clinical training.

JGIM PEER REVIEW Jeffrey Jackson 1; Malathi Srinivasan 2; Joanna Rea 3; Kathlyn Fletcher 1; Richard Kravitz2. 1Zablocki VAMC, Milwaukee, Wisconsin ; 2UC Davis, Sacramento, California ; 3Zablocki VAMC, Shorewood, Wisconsin . (Tracking ID # 11310)

BACKGROUND: Peer review for medical journals is an important, but poorly studied process. Our studys purpose was to evaluate the predictive validity of the peer-review process at the Journal of General Internal Medicine (JGIM). Specifically, this study examines the impact of original research manuscripts both published and rejected by JGIM, using subsequent manuscript publication and citation number as measures of impact. METHODS: We included research submissions to the Journal of General Internal Medicine for 1 year (July 2004-July 2005). We selected this window to allow time for rejected manuscripts to be published elsewhere. For articles sent out for review by JGIM, we abstracted peer reviewer ratings of article quality in five domains (interest, originality, statistics, validity, clarity) as well as reviewers publication recommendation (accept, minor revision, major revision, reject). We determined publication status for articles rejected by JGIM by searching PUBMED and contacting authors. For all published articles, we measured the 3-year article citation rate (from ISI) and calculated an impact factor (Rw) by dividing its 3-year citation number by the average citations for 3 years among general medicine journals. An Rw >1.0 indicates above average impact. Desirable outcomes (from the journals perspective) would be to accept articles with high impact (Rw >1.0) and reject those with low impact (Rw <1.0). Because the data were skewed by outliers with high impact, nonparametric tests were used to compare groups. RESULTS: Among 507 JGIM research submissions, 223(44%) were rejected without review, 142 (28%) were rejected after review and 142 (28%) were accepted. Among rejected articles 243 (48%) were published elsewhere and 136 (27%) were not published. Articles rejected without review were less likely to be published elsewhere than those rejected after review (RR: 0.63, 95% CI: 0.42-0.95). The median JGIM articles impact was1.1 (range 07.2). Articles published in JGIM had greater impact than rejected articles (p=0.0001), but there was no difference in Rw between articles rejected with or without review (Rw: 0.6 vs. 0.8, p=0.28). Reviewer quality ratings had good internal consistency (Cronbach alpha: 0.79) and there was strong correlation between quality ratings and the reviewers recommendation regarding publication (r=0.7). The reviewers quality rating also correlated with article citation rates; a one point increase in average quality rating increased the impact (RW) by 0.2 (95% CI: 0.02-0.4). However, there was no quality rating cut point that accurately distinguished high from low impact articles. On multivariable analysis, interest to JGIM readers (OR1.3, 95% CI: 1.1-1.7), originality (OR: 1.4, 95% CI: 1.2-1.8) and validity of conclusions (1.7, 95% CI:1.4-2.1) increased the likelihood of acceptance. However, there was low inter-rater agreement between reviewers for

either quality ratings or publication recommendations. Seventy-one percent of submissions had desirable outcomes (18% accepted with Rw >1.0, 53% rejected with Rw <1); undesirable reviewer outcomes occurred in 29% of submissions. There was evidence that a greater number of reviewers collectively increased the accuracy in discriminating articles with higher or lower impact.
CONCLUSION: The editorial publication decision accurately discriminated high and low impact articles in 71% of submissions. While there was good evidence reviewers were internally consistent, there was poor agreement between reviewers for either quality ratings or publication recommendations. The accuracy of sorting is improved with a greater number of reviewers. Our data was not sufficient to determine the optimum number of reviewers.

INCREASED BMI IS ASSOCIATED WITH DECREASED MORTALITY IN SEPTIC PATIENTS Ethan F. Kuperman 1; John W. Showalter 2; ErikB. Lehman 3; Jennifer L. Kraschnewski2. 1Milton S. Hershey Penn State College of Medicine, Hershey, Pennsylvania ; 2Penn State Milton S. Hershey Medical Center, Hummelstown, Pennsylvania ; 3Penn State MiltonS. Hershey Medical Center, Hershey, Pennsylvania . (Tracking ID # 11312)

BACKGROUND: Sepsis is associated with substantial inpatient morbidity and mortality, and early recognition of patients with severe sepsis can lead to improvements in patient outcome. Obesity afflicts 30% of Americans, and is characterized by alterations in inflammatory regulators of sepsis (i.e. IL-6 and TNF-a). Previous studies found increased mortality among obese trauma and surgical patients, but conflicting results on the impact of obesity for nonsurgical admissions and limited investigations for septic patients. We hypothesized, due to immune dysregulation, obesity would be a negative prognostic factor for inpatients with sepsis.
METHODS: After receiving approval from the Penn State Institutional Review Board, we performed a retrospective chart review on all adult patients admitted to a 450-bed tertiary university hospital with a primary billing diagnosis of sepsis (based on ICD-9 codes 38.0-38.9) between July 1, 2007 and June 30, 2010 (n=830). A diagnosis of sepsis was determined by confirming patients met 2 of 4 SIRS criteria. Modified APACHE II scores were calculated using vital signs, mean arterial pressure, laboratory values, oxygenation, Glasgow Coma Scale, age, and presence of chronic disease.
To analyze the correlation between BMI as a continuous variable and mortality, gender, and race a two-sample T-test or analysis of variance was used. For age, APACHE II score, and length of stay, a Pearson correlation was used. Chi-square testing was used to analyze the association of BMI (in categories) with mortality, gender, and race, and an analysis of variance was used for age, APACHE II score, and length of stay. A Cochran-Armitage test for trend was used to determine if there was a trend in the mortality rate as BMI increased.
RESULTS: Seven hundred and ninety-two charts met inclusion criteria. Of these patients, 129 expired during their admission and 663 patients survived to discharge. Bivariate analysis revealed a lack of correlation between BMI and age, gender, race, APACHE II score, or length of stay. Among survivors, mean BMI was slightly higher (27.6 vs. 26.3 kg/m2, p-value 0.035). There was a statistically significant trend towards decreasing mortality with increasing BMI (Figure). Underweight patients (BMI <20 kg/m2) had higher mortality, but this was not statistically different from the patients with normal BMI (2024.9 kg/m2).
CONCLUSION: In contrast to trauma patients, septic inpatients who were obese had decreased mortality. These results add to the growing body of evidence that obesity, although detrimental to long term survival and cardiovascular health, may be protective in the critically ill setting. Further research is necessary to determine if malnutrition should be added to existing prognostic models. If this trend is reproducible, early identification of septic patients who are also underweight may aid in triage and improve patient outcomes.

CLINICAL RESPONSIBILITIES OF FIRST-YEAR RESIDENTS DURING EARLY INTERNSHIP Mark R. Raymond 1; Janet Mee 2; Ann King 2; Marcia Winward 2; Susan Jacovino 2; Steven A. Haist1. 1National Board of Medical Examiners, Philadelphia, Pennsylvania ; 2NBME, Philadelphia, Pennsylvania . (Tracking ID # 11314)

BACKGROUND: The United States Medical Licensing Examination (USMLE) is undergoing a comprehensive review. One recommendation from this review is to support two decision points: entry into supervised practice and entry into unsupervised practice. A multi-phase practice analysis is being conducted to better inform exam content decisions. The first phase included a survey of new interns to determine required clinical responsibilities.
METHODS: The survey assessed 39 clinical activities, degree of attending supervision, and demographics. The survey also included an open-ended statement, Please list one or two activities that you

performed in August that you found particularly challenging. The activities included in the survey were based on the ACGME competencies, an AAMC report on medical school clinical skills curricula, published internal medicine and surgery residency requirements, and a literature review. The surveys were sent to residency program directors in 10 specialties (anesthesiology, emergency medicine, family medicine (FM), internal medicine (IM), neurology, OB/GYN, pediatrics, psychiatry, surgery, and urology) at 354 randomly selected institutions to be distributed to all interns (1,104 residency programs and 8,793 interns). The initial survey was sent in September 2009. Descriptive statistics were used to illustrate the findings.
RESULTS: A total of 3,003 surveys were returned for a 34% response rate; 2,523 surveys met various selection criteria for use. Most respondents (94.6%) completed 24 months of residency. Time spent in each setting was 16.5% ER, 12.2% ICU, 50.5% other hospital unit,15.1% outpatient clinic, and 5.7% other. Most (96%) new interns educated patients about disease course, 95% counseled patients about lifestyle changes, 86% had to manage an angry patient or family member, and 74% told patients bad news. Also, 41% and 83% obtained informed consent for major and minor procedures, respectively, and 89% had to interpret chest x-rays, 88% ECGs, and 71% arterial blood gases. Lumbar puncture and central venous line insertion were performed by 23% and 24% of the interns, respectively. Care with other professionals within their system was arranged by 93% of the interns, and with outside agencies by 73%. Regarding supervision, for the 8 procedures listed in the survey, the attending was in the room 10%-37% of the time. There were differences by specialty, e. g., arranging care with an outside agency occurred more often with IM or FM interns. Lastly, 98% of respondents used electronic databases to obtain diagnostic or treatment information related to patient care.
CONCLUSION: Some of the findings will directly affect the content of USMLE. Interns early in training obtain informed consent, counsel and educate patients, manage angry patients and family members and deliver bad news. These findings will influence changes to the Step 2 Clinical Skills Examination. Procedures with potential significant complications (central venous catheter insertion) were often performed. Based on this information, USMLE will need to assess an examinees procedural knowledge and explore how to specifically assess the associated skill. The amount of inpatient, ICU, and outpatient content of the USMLE assessing readiness for supervised practice should reflect the current intern experience by setting. The findings may impact undergraduate and graduate medical education as well. Enhancements to communication skills training and training in common procedures may be warranted.
A NOVEL APPROACH TO MEASURING CONTINUITY OF HOSPITAL CARE Ryan Thompson 1; Timothy Ferris1. 1Massachusetts General Physicians Organization, Boston, Massachusetts . (Tracking ID # 11319)
BACKGROUND: The increasingly technical nature of high-quality hospital care often involves multiple specialized caregivers in the care of a single patient. At the same time, continuity of care -the successful bridging of information, management plan, and relationships between episodes or sites of care - remains an essential characteristic of high-quality, patient-centered care. Given these competing realities, we undertook an effort to improve care continuity for hospitalized patients, starting with the development of a measurement system for inpatient continuity. We then piloted this measurement system on 104 patients. We describe here

our measurement approach for inpatient care continuity and the results of our measurement pilot.
METHODS: During a patient hospitalization, each transition in provider and setting has the potential for care discontinuity, and therefore a measurement opportunity. Using the individual patient as our unit of measurement, we conducted face-to-face surveys of patients at three time points during a patients inpatient episode: 1) the emergency room, 2) an inpatient unit, and 3) by telephone after discharge (Figure 1). We defined eight continuity of care measurement concepts (Figure 2), and assigned each concept to one of three domains of continuity as defined in the literature - 1) continuity of information, 2) continuity of management plan, and 3) continuity of patient-provider relationships. We then developed and tested 33 questions to measure these concepts, including 5 emergency room questions, 20 ward inpatient questions, and 8 post-discharge questions. Survey item pre-testing included cognitive testing and key informant interviews. We pilot tested our measurement system on randomly-selected adults awaiting admission in our emergency room. A single trained surveyor conducted a majority of the surveys. We excluded patients who were clinically or psychologically unstable or were unable to provide consent. Of the 104 patients surveyed in the emergency department, 57 and 54 patients completed the inpatient and post-discharge portions of the survey, respectively. Reasons patients did not complete the inpatient survey included short length of stay, absence due to testing or procedures, clinical or psychological instability, and removal of consent. Reasons patients did not complete the discharge portion of the survey included incorrect telephone number, inability to contact patients despite multiple attempts, and removal of consent. We excluded patients from the discharge portion of the survey who were discharged to a destination other than home.
RESULTS: Figure 2 shows the results of the survey, organized by continuity of care domain and measurement concept. We present the proportion of respondents indicating patients top box perception of care continuity (e.g. strongly agree, very confident, yes). No items demonstrated a significant ceiling affect. Responses showed sufficient variance for statistical analysis. We also show concept scores by gender and insurance status (Medicare or private). Of 1824 total questions asked of 104 patients in the pilot (average of 17.5 questions per patient), 1168 were top box responses, giving an overall continuity score of 64%. Of the three continuity domains, scores were highest for perceived continuity of management plan (73%), and lowest for continuity of patient-provider relationships (50%). Differences in male and female patient responses were not significant except for provider coordination: 79% of men felt strongly that their providers coordinated with each other, compared to 60% of women ($p=<0.05$). Additional differences by insurance type, age, and admitting service may prove to be significant with a larger sample currently being collected.
CONCLUSION: Continuity of care is central to the patient experience of care, and is at risk of continued decline as hospital care becomes increasingly complex and fragmented. An effective strategy to measure and monitor care continuity is an important precursor to making improvements. Our pilot represents proof-of-concept that continuity of care can be measured by directly surveying patients across an inpatient episode. We found that continuity of care can be measured and assessed within each domain of care continuity - information, management plan, and relationships. Our pilot results suggest significant opportunity for improving continuity of care for our inpatient population. Data from continuity measurement can be used by hospital leaders to draw attention to areas of needed improvement. Our pilot data represents a small sample of patients, and was limited by suboptimal rates of inpatient and post-discharge surveys. Subsequent data collection efforts will need to improve the percentage of patients that complete inpatient and discharge parts of the survey. We expect larger sample sizes will yield greater understanding of variation in the patient experience of continuity based on demographic factors, reason for admission, and admitting clinical service.

TESTOSTERONE AND ABNORMAL GLUCOSE METABOLISM IN AN INNER-CITY COHORT Anne Monroe 1; Adrian Dobs 1; Joseph Cofrancesco 1; Todd Brown1. 1Johns Hopkins University School of Medicine, Baltimore, Maryland . (Tracking ID # 11327)

BACKGROUND: Low testosterone has been independently associated with insulin resistance and diabetes mellitus (DM) among men in large cross-sectional and prospective studies. Although prior studies included ethnically diverse men, they did not target for inclusion individuals with opiate use, Hepatitis C virus (HCV), or HIV, which disproportionately affect inner-city populations. These factors may alter the relationship between testosterone and DM, as previous studies have linked opiate use, HCV, and HIV to both hypogonadism and DM. We present data from an inner-city cohort examining the association between free testosterone (FT) and abnormal glucose metabolism and exploring other factors contributing to abnormal glucose metabolism in this group.
METHODS: The Study of HIV, Injection Drug Use, Nutrition, and Endocrinology (SHINE) is a cross-sectional study of volunteers recruited from medical and HIV clinics, community methadone maintenance programs, an existing cohort of injection drug users, and homeless shelters in Baltimore City from 20012004. We limited the current analysis to male study participants. The independent variable was FT from a morning blood sample, log-transformed to account for non-normal distribution. The two outcomes studied were 1) insulin resistance and 2) presence of prediabetes or DM. Insulin resistance was calculated using the homeostasis model assessment of insulin resistance (HOMA-IR): fasting glucose (mmol/L) fasting insulin (U/ mL))/22.5. Prediabetes was defined as fasting blood glucose (FBG) between 100 and 125 mg/dL or 2-hour OGTT result of 140 to 199 mg/ dL. DM was defined as FBG 126 mg/dL, 2 hour OGTT result 200 mg/dL, self-reported use of DM medication or DM diagnosis. We used multiple linear regression to examine the relationship between log FT and insulin resistance. We used multiple logistic regression to

examine the relationship between log FT and prediabetes/DM. Final models were adjusted for age, race, BMI, and Hepatitis C status. RESULTS: We analyzed data from 175 male participants, of whom 43(24.6%) had low FT (FT <52 pg/mL). The majority of participants(93.7%) were African American, and median age was 43.8 years (IQR=38.7-48.0 years). Ninety-one participants (52.9%) had HIV and sixty-two(35.8%) had HCV. Seventy participants (40%) were overweight or obese. About half of participants (49.1%) used opiates occasionally or frequently, and 37 (21.1%) were on methadone maintenance. There was no statistically significant difference in age, race, HIV status, Hepatitis C status, BMI, or frequency of opiate use between men with low FT and normal FT. There were more men in the low FT group on methadone maintenance (39.5% v. 15.2%, p=.001). Overall, 23 men(13.1%) had prediabetes/DM, which was unrelated to FT (OR of prediabetes/DM for each log increase in FT=0.60, p=0.49; value for insulin resistance with each log increase in FT=0.10, p=0.31). In adjusted analysis, there was an association between Hepatitis C status and prediabetes/DM which was not statistically significant (OR=2.17, p=0.09). Among HIV+ men (n=91), there was no association between use of antiretroviral therapy and insulin resistance or prediabetes/DM.
CONCLUSION: The prevalence of hypogonadism was high in this inner-city cohort and was associated with methadone use. However, low FT was not related to insulin resistance or prediabetes/DM. Our results suggest that other factors like HCV infection are stronger drivers of abnormal glucose metabolism in this group. Continued work to identify diabetes risk factors among inner-city populations will help determine targets for intervention to reduce diabetes incidence.
DIFFICULTY MEASURING SYMPTOMS OF CO-MORBID DEPRESSION AND HEART FAILURE Bernice Ruo 1; George Mark Holmes 2; David Baker 1; Dean Schillinger 3; Darren A DeWalt 4; Kirsten Bibbins-Domingo 4; Morris Weinberger 5; Aurelia Macabasco-OConnell 5; Grady Kathleen 1; Kimberly Broucksou 5; Michael Pignone6. 1Northwestern University, Chicago, Illinois ; 2University of North Carolina, Raleigh, North Carolina ; 3University of California, San Francisco, San Francisco, California ; 4University of North Carolina, Chapel Hill, North Carolina ;

5University of California, Los Angeles, Los Angeles, California ; 6University of North Carolina, Durham, North Carolina . (Tracking ID # 11328)
BACKGROUND: Questionnaires for depression are increasingly used for screening, diagnosis, and monitoring treatment. These questionnaires include items to assess both emotional (e.g. feeling sad) and physical (e.g. fatigue) symptoms. However, many medical conditions, including heart failure (HF), have physical symptoms that overlap with depression. Therefore, depression questionnaires may overestimate the prevalence or severity of depression among patients with HF, and HF-related quality of life questionnaires may overestimate HF severity among patients with depression.
METHODS: We analyzed data from ambulatory patients at 4 academic medical centers with symptomatic HF (NYHA class II-IV). HF symptoms were assessed using the HF Symptom Scale (HFSS), a 7 item questionnaire that assesses: a) difficulty over the past 4 weeks doing (physical activity) because you are feeling short of breath or tired, and b) limitations resulting from heart failure (how much of the time heart failure stopped you from doing (physical activity). HFSS scores range from 0 (worse) to 100 (better). Depressive symptoms were measured using the 8-item Patient Health Questionnaire (PHQ8). PHQ8 scores range from 0 to 24 with higher scores representing more depressive symptoms. We performed a factor analysis on items from the HFSS and PHQ8 to identify the main underlying latent variable(s) being
measured, the loading of items from the questionnaires on the factor(s), and the amount of overlap of the content being measured by these 2 questionnaires.
RESULTS: The 595 participants had a mean age of 61 years; 48% were female; 39% were African-American and 16% Latino; 27% had less than a high school education; 58% had an ejection fraction of less than 0.45; 31% were NYHA class III or IV. The mean HFSS score was 56+/23, and 33% had moderate or greater depressive symptoms (PHQ8 score >=10). We found 2 main factors (eigenvalues 6.7 and 1.9). Four HFSS questions (limitations from shortness of breath; difficulty getting dressed, walking on level ground at a normal pace, walking fast or climbing stairs) loaded heavily onto factor 1 and weakly onto factor 2. Seven PHQ8 questions (feeling depressed, having little interest in doing things, having trouble falling or staying asleep, poor appetite or overeating, feeling bad about oneself, trouble concentrating, and moving or speaking slowly) loaded heavily onto factor 2 and weakly onto factor 1. Three HFSS questions (limitations from needing to rest during the day, not sleeping well at night, fatigue) and one PHQ8 question (feeling tired/ little energy) loaded substantially onto both factors.
CONCLUSION: Symptoms of tiredness, fatigue, and difficulty sleeping can be due to HF or depression. Questionnaires that incorporate these concepts together with more specific characteristics of HF symptoms may be less responsive to treatment effects targeted toward HF in patients that have HF and depression. To more accurately measure the distinct factors (e.g. physical and mental health) among patients with HF, better measurement tools are needed that attempt to avoid conflation of the two illnesses.

SURROGATE-CLINICIAN COMMUNICATION FOR HOSPITALIZED OLDER ADULTS: A QUALITATIVE STUDY OF SURROGATE EXPERIENCES Alexia M. Torke 1; Sandra Petronio 2; Christianna Purnell 3; Greg A. Sachs 1; Paul R. Helft 1; Christopher M. Callahan4.
1Indiana University, Indianapolis, Indiana ; 2Indiana University Purdue University Indianapolis, Indianapolis, Indiana ; 3Regenstrief Institute, Inc, Indianapolis, Indiana ; 4Indiana University, Indianapolis, Indiana . (Tracking ID # 11334)
BACKGROUND: Many hospitalized older adults have impaired cognition and require the assistance of family members or other surrogates to make medical decisions. Surrogates often face high stress due to the patients serious illness, yet must navigate the hospital, process medical information and make decisions. Good communication with clinicians is crucial to these tasks. The present study describes communication experiences of surrogate decision makers for hospitalized older adults. METHODS: Interviews were conducted at an urban, public hospital and a university-affiliated tertiary care referral center. Surrogates were eligible for an interview if

they had made a decision for a patient aged 65 or older regarding one of the following issues: life sustaining care; procedures and surgeries; or nursing home placement. The interview guide was developed based on literature review in interpersonal communication, medical ethics, and health communication. Interviews were conducted by one of two investigators, within 4 weeks of hospitalization for surviving patients or 3 to 6 months after hospitalization if the patient died. Interviews were audio-recorded, transcribed verbatim, and analyzed using the constant comparative method. To conduct the first-order analysis, the first ten interviews were read and independently coded by three investigators, who met to reach consensus on developing codes and themes. Subsequent interviews were coded by one of the three investigator and code-checked by all three. These investigators met after every 3 to 5 interviews to discuss emerging themes and codes. Interviews and analysis continued until theme saturation was reached.

RESULTS: There were 34 interviews yielding 759 double-spaced pages of transcribed text. Surrogates were 79% female, 44% white and 56% African American. Surrogates began the hospitalization with a Frame of References that impacted the current hospital experience. Prior experiences with the health care system framed Expectations and impacted Trust. Surrogates rarely stated expectations explicitly but revealed them through stories of their hospital experiences regarding the hospital environment, patient care, or communication. Such stories revealed how the hospital experience either reinforced or violated their expectations. Surrogates described intense emotions such as anxiety, distress, and obligation. Surrogates formed Relationships with a Team of clinicians rather than with individuals, due to frequent staff changes and multiple clinicians. Surrogates were often Unable to Name individual clinicians, even those who were especially important in the patients care. In spite of the lack of continuity, expressions of Emotional Support were highly valued. Surrogates expressed a need for Frequent Communication and stressed the Importance of Information about the patient, whether or not a decision had to be made. Despite its importance, several patients reported a Struggle for Information. Medical Jargon was a frequent barrier. Surrogates were appreciative of information provided by any member of the clinical team, including nurses, social workers, and physicians. Conflict was rare but highly intense and stressful.

CONCLUSION: In the hospital, relationships with clinicians are often fragmented and brief, yet expressions of support and exchanges of information can occur and are highly valued by surrogates. The high need for information and support suggests that frequent contact with the surrogate should be a standard part of providing care to patients with cognitive impairment. Because surrogates appreciate contact from many members of the health care team, clinician-surrogate communication can rely on an interdisciplinary approach.

PAIN MANAGEMENT IN PRIMARY CARE: A QUALITATIVE ANALYSIS OF PROVIDER EXPERIENCE AND ATTITUDE Lesiley Lincoln 1; Linda Pellico 2; Robert Kerns 3; Daren Anderson4. 1Yale University, West Haven, Connecticut ; 2Yale University, New Haven, Connecticut ; 3Yale University/Veterans Administration Health Care System, New Haven, Connecticut ; 4Community Health Center, Inc, Middletown, Connecticut . (Tracking ID # 11336)

BACKGROUND: Pain is the most frequent presenting complaint in the ambulatory setting and the majority of patients with chronic non-cancer pain are cared for by primary care providers (PCPs). Previous studies report high frustration among PCPs caring for patients with chronic pain. Exploring PCPs experience and attitudes towards pain management through qualitative analysis may yield specific areas to target quality improvement initiatives.

METHODS: We used a descriptive qualitative design to analyze comments PCPs provided to three survey questions: I. Describe some barriers that you feel limit your ability to manage chronic pain. II. Can you describe some of the positive aspects related to caring for patients with chronic pain? III. What are some of the negative aspects about caring for patients with chronic pain? All PCPs in the VA Connecticut Healthcare System in two academically affiliated VA institutions and five community based clinics were invited to participate by mail. 45

PCPs responded, for a response rate of 75%. All responses were coded by a multidisciplinary team. Data were grouped according to Krippendorffs analytical technique of clustering to identify responses that could be gathered around similar characteristics. Content analysis using Krippendorffs method was used to identify recurrent themes.
RESULTS: I. Barriers to managing Chronic Pain: 1) Inadequacies of education including diagnostic deficiencies in musculoskeletal exam skills and knowledge of the appropriate use of imaging, uncertainty about utilization of non-pharmacologic modalities of treatment, creating individualized treatment plans, and assessing response to treatment. 2) Lack of consultant support spanning multiple disciplines and pain specialists in particular. 3) Psychosocial complexity. A high prevalence of co-morbid mental illness, substance abuse, and alcoholism was reported in veterans with chronic pain. 4) Time pressure. PCPs felt limited in adequately addressing pain and other medical problems in a primary care visit. 5) Skepticism expressed towards the quality of evidence, patients motivation and participation, and efficacy of consultants advice. 6.) System impediments in transfer of disgruntled patients between providers, handwritten monthly opiate refills, and coordination of urine drug testing. II. Positive aspects of caring for patients with chronic pain were rewards and challenges. 1. Rewards were reported in building strong relationships with patients, and in improving patient mood, quality of life, and return to work. 2. Challenges included providing holistic care, obtaining accurate diagnoses, and communicating effectively. III. Negative aspects of caring for patients with chronic pain: 1.) Challenging patient encounters. PCPs were challenged by confronting patients misusing opiates, non-adherent patients, and unrealistic expectations of patients. Patients demanding opiate escalations were described as manipulative, explosive, and abusive. 2.) Provider frustrations. These included feeling pressured to prescribe opiates, fear of being deceived by patients, fear of regulation, and a sense of hopelessness when patients remained in pain. CONCLUSION: PCPs experience substantial difficulties in caring for patients with pain while acknowledging certain positive aspects. Targeting barriers and negative aspects of pain care while reinforcing providers perceptions of efficacy and personal reward in the care of patients with chronic pain may improve the overall quality of care of chronic pain patients in the primary care setting.

MOTHERS AVOIDING DEPRESSION THROUGH EMPOWERMENT INTERVENTION TRIAL (MADE IT)

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BACKGROUND: Postpartum depression negatively affects the quality of life and daily functioning of mothers. Postpartum depression is particularly problematic for low-income black and Latina women who often dont have adequate mental health care coverage and are less likely to receive depression treatment. The objective of this study was to evaluate the effectiveness of a behavioral educational intervention to prevent postpartum depression among self-identified black and Latina postpartum mothers.
METHODS: We conducted a randomized controlled trial at a large urban hospital. Mothers were recruited during their postpartum hospital stay (N=540) and randomized to a 2-part behavioral educational intervention or enhanced usual care. Eligible subjects were black or Latina, women 18 years of age, English or Spanish speaking, had working telephones, and had infants whose birthweights were 2500 grams and 5-minute Apgar scores >6. Participants randomized to the intervention arm received a culturally-tailored 2-step intervention that prepares and educates mothers about modifiable factors associated with postpartum depression (physical symptoms, low social support, low self-efficacy, and infant factors), bolsters social support, enhances management skills, and increases participants access to resources. Enhanced usual

care participants received a list of community resources and received a 2-week control call. Participants were

surveyed prior to randomization during their postpartum hospital stay, at 1-month, at 3-months, and at 6-months postpartum to assess depressive symptoms. For ethical reasons, all women who had severe depressive symptoms were referred for psychiatric assessment/treatment and a priori subgroup analyses were planned to assess impact of the intervention on mothers who did not receive psychiatric referral at baseline. The primary outcome, depression, was assessed using the Edinburgh Postnatal Depression Scale (EPDS 10 vs. <10). Study attrition rate was low (20% at 6 months) and equivalent across treatment groups. By examining baseline data for drop outs versus those retained in the study, we concluded that the data were likely missing at random. We used repeated measure analysis to assess changes in depression over time. RESULTS: Among the 668 mothers approached and for whom contact could be made prior to discharge, 128 refused (19%) and 540 enrolled. Mean age of participants was 28 (range 1846); 62% were Latina and 38% were black. Sixty-three percent had Medicaid insurance, 56% earned $30,000 annually, 35% were foreign born, and 21% spoke Spanish. There was only one significant difference between enhanced usual care vs. intervention at baseline: presence of comorbid conditions was higher among enhanced usual care vs. intervention (27% vs. 20%, respectively). Analyses including mothers referred at baseline for psychiatric assessment/treatment (N=540), showed those in the enhanced usual care group as compared with the intervention group were more likely to exceed depression criteria at all time points but significant only at one month (15.3% vs. 8.8%, p=.03 respectively). Excluding the 45 mothers referred for psychiatric assessment/treatment at baseline, positive depression screens were significantly more common among the enhanced usual care group than the intervention group post hospitalization: at 1-month (14.4% vs. 7.1%, p=.01), at 3-months (11.4% vs. 6.3%, p=.058) and at 6-months (13.1 vs. 7.5%, p=.068). In repeated measure analysis for up to 6-months of follow up, the intervention was protective against a positive depression screen with an OR of 0.57 (95% CI: 0.37-0.88). CONCLUSION: A simple, culturally tailored intervention prevented postpartum depression among black and Latina mothers in an urban setting. More research is needed to determine whether this intervention is effective in other settings.

RACIAL/ETHNIC DIFFERENCES IN 6-MONTH POSTPARTUM BREASTFEEDING RATES Elizabeth A Howell 1; Jessica Block 2; Amy Balbierz 2; Wang Jason 2; Caron Zlotnick2. 1Dept. of Health Evidence &Policy, Mount Sinai School of Medicine, New York, New York ; 2Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11347)

BACKGROUND: Racial/ethnic differences in breastfeeding rates are well documented. Although breastfeeding duration rates overall are below Healthy People 2010 goals, rates for black and Latina mothers are much lower than their white counterparts. Little research has examined which factors may influence racial/ethnic differences in breastfeeding rates. The objectives of this study were to examine the association between race/ethnicity with 6-month breastfeeding rates, and to explore whether such differences can be accounted for by clinical factors, breastfeeding support, or additional demographic factors. METHODS: Data were obtained from 2 postpartum depression prevention randomized controlled trials implemented at a large urban hospital. Both trials tested the same intervention: 1 trial enrolled self-identified black and Latina women, the other trial enrolled white and other minority women. Eligible participants were postpartum mothers who had uncomplicated deliveries at a large urban hospital, 18 years of age,

English or Spanish speaking, had working telephones, and had infants whose birthweights were 2500 grams and 5-minute Apgar scores >6. This study includes 889 (of the 1080 enrolled) mothers who completed both the baseline and 6-month surveys. All participants were surveyed during their postpartum hospital stay prior to randomization, at 1-month, at 3-months, and at 6-months postpartum and answered a series of questions on depressive symptoms, breastfeeding, breastfeeding support, self-identified race/ethnicity, and other factors. We conducted bivariate statistics to examine the association between race/ethnicity, other demographic factors, clinical factors, depression, and breastfeeding support with 6-month breastfeeding status. Multivariable logistic regression models assessed the independent association between race/ethnicity, other factors, and 6-month

breastfeeding rates.
RESULTS: Mean age was 30 (range 1846); 48% were black or Latina. Thirty-one percent had Medicaid insurance, 33% earned $30,000 annually, and 31% were foreign born. Overall, 49 % of mothers breastfed at 6 months postpartum. Breastfeeding at 6-months was more common among white/Other vs. black/Latina mothers (64%vs. 33%, p<.0001) and mothers born outside of the US vs. US born (63% vs. 43%, p<.0001). Mothers who were married, 30 or older, privately insured, had annual incomes >$30,000, did not have comorbid conditions at baseline, delivered vaginally, and those who didnt screen positive for depression at baseline were more likely to be breastfeeding at 6-months. Mothers who thought breastfeeding was extremely/moderately important were much more likely to be breastfeeding at 6-months compared with mothers who did not think breastfeeding was as important (56% vs. 18%, p<.0001) and partner support was strongly associated with breastfeeding at 6-months. After controlling for demographic factors, breastfeeding support, and clinical factors, black and Latina women remained significantly less likely to breastfeed at 6-months as compared with white and other women (adjusted OR=0.26 95% CI: 0.16-0.40). CONCLUSION: Black and Latina mothers are less likely than white mothers to continue to breastfeed for the first 6-months postpartum. Although mothers view of breastfeeding and breastfeeding support are important correlates of breastfeeding at 6-months, they do not explain racial/ethnic differences in breastfeeding rates. Further research is needed to investigate the origins of racial/ethnic differences in breastfeeding rates. Culturally appropriate interventions stressing the importance of breastfeeding support and presenting the benefits of breastfeeding to mothers and families may extend the duration of breastfeeding for all racial/ethnic groups.

ESTIMATING THE HEALTH EFFECTS OF DIFFERENT DELAYS IN ACHIEVING SYSTOLIC BLOOD PRESSURE CONTROL IN ADULTS WITH DIABETES Neda Laiteerapong 1; Priya M. John 1; David O. Meltzer 1; Elbert S. Huang1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 11348)

BACKGROUND: In major clinical trials, blood pressure control that lowers systolic blood pressure (SBP) from 155 to 145 mmHg has been shown to decrease complication rates which improve quality of life in adults with type 2 diabetes. However, in real world clinical practice, patients with elevated blood pressure levels may routinely experience prolonged delays in achieving optimal blood pressure control due to a combination of patient and physician factors (clinical inertia). While delays in achieving control are commonplace, the health effects associated with different delays are not well known. We used decision analytic modeling to estimate the effects on health outcomes of different delays in achieving SBP control.

METHODS: We used the diabetes complication model from the United Kingdom Prospective Diabetes Study, which is a Monte Carlo simulation

model that is framed by simultaneous progression through diabetes complications (heart disease, myocardial infarction, heart failure, stroke, amputation, renal failure, and blindness) and mortality. We studied adults aged 50 to 59 years old with new onset Type 2 Diabetes. To estimate the health effects of delays in achieving SBP control, we compared hypothetical populations who experience initial suboptimal SBP (150 mmHg) for different durations of delay (from 1 to 45 years after diagnosis) followed by optimal SBP, to a baseline population who has a lifetime of optimal SBP (130 mmHg). We present rates of non-fatal complications and the decrease in life expectancy and quality of life as a result of delays in SBP control for different durations.

RESULTS: Compared to a lifetime of optimal SBP, we found that increasing delays in achieving optimal SBP led to an increased risk of

complications, decreased life expectancy, and decreased QALY. Notably, a 5-year delay results in a lifetime 1% relative risk increase of any diabetes-related complication, a 27-day decrease in life expectancy, and a 37-day decrease in quality of life. (Table) Delays ranging between 5 and 20 years had the steepest decline in quality of life. (Figure)

Table. Health effects of delays in achieving optimal SBP control. CONCLUSION: Notable clinical effects begin

to appear at 5 years of delay in achieving optimal systolic blood pressure in patients with type 2 diabetes. Quantifying the health effects of delays in achieving optimal blood pressure may be useful in medical decision-making regarding the frequency of visits and rate of treatment intensification, especially for patients with historically poor blood pressure control over five years.

Table 1:

Delay (years with suboptimal SBP)

No. of individuals with any lifetime non-fatal complication (per 10,000 patients)

Relative risk increase of any lifetime non-fatal complication

Decrease in life expectancy (days)

Decrease in quality of life (quality-adjusted days)

0 5046 1.000 0 01 5056 1.002 0.3 2.25 5110 1.013 26.8 37.1 10 5214 1.033 85.7 109.5 20 5487 1.087 170.0 216.2 45 5653 1.120 195.5 249.8

DISPARITIES IN ENROLLMENT IN AND USE OF AN ELECTRONIC PATIENT PORTAL Mita Sanghavi Goel 1; Tiffany Brown 1; Adam Williams 1; Romana Hasnain-Wynia 1; Jason Thompson 1; David Baker1. 1Northwestern University, Chicago, Illinois. (Tracking ID # 11357)

BACKGROUND: The Health Information Technology for Economic and Clinical Health Act aims to accelerate the meaningful use of electronic health record (EHR) technology. One key strategy for realizing a variety of meaningful use criteria is providing patients access to their EHR (i.e., a tethered personal health record or patient portal). If patient portals are going to increasingly become a standard part of care delivery, it is important to ensure they are accessible to everyone and to minimize disparities in their use. Currently, little is known about the use of patient portals; therefore, we aimed to examine variations in enrollment in, and use of, an electronic patient portal by race/ethnicity, gender and age among patients directly offered this service by their providers. METHODS: We performed an observational, cross sectional study of established patients with attending physicians at one urban, academic

general medicine practice who received electronic orders from their providers requesting their enrollment in a patient portal. Our primary outcomes of interest were: (a) enrollment in the patient portal, (b) solicitation of provider advice among those enrolled, and (c) request for medication refills among those enrolled.

The primary independent variable was race/ethnicity, as determined by the EHR; internal reviews determined the kappa between EHR and self-reported race/ethnicity to be 0.98. Age, gender and provider were extracted from the EHR. Educational attainment and income were determined by linking individual patients home addresses to census block group (CBG) level data and determining the percent of people in the CBG who completed high school and the percent below the federal poverty level.

To examine differences in enrollment by sociodemographic characteristics, we used chi-square statistics and performed multivariate logistic regression adjusting for race/ethnicity, age, gender, imputed education, imputed income, and provider. For regression analyses, we also adjusted variances to account for clustering of patients by provider. Lastly, we repeated similar analyses for our other outcomes: use of the advice and refill functions among those who had enrolled in the patient portal. We considered $p<0.05$ significant for all analyses.

RESULTS: Overall, 69% of 7088 patients with electronic orders enrolled in patient portals; however there were significant differences by race/ ethnicity. All minority patients were significantly less likely to enroll than whites: 55% of blacks, 64% of Latinos and 66% of Asians compared with 74% of whites (chi-square $p<0.05$ for all pairwise comparisons). These differences persisted in adjusted analyses, although differences between Asians and whites were no longer significant. In addition, those who were 65 years and older were significantly less likely to enroll in the portal than those ages 1834 years (adjusted OR 0.79, 95% CI 0.65-0.97). Of those 4091

patients enrolled in the portal, 76% solicited provider advice and 22% requested medication refills. There were no racial/ethnic differences in either advice solicitation or medication refills in unadjusted or adjusted analyses. There were however, differences by age and gender. The youngest patients, ages 1834 years, were significantly less likely to solicit provider advice or request medication refills than any other age group in unadjusted and adjusted analyses. Similarly, male patients were less likely to solicit provider advice or medication refills than women, although only the disparity for soliciting provider advice remained significant after adjustment. CONCLUSION: Future efforts to expand use of the patient portal need to address potential mechanisms for these disparities to ensure this technology is accessible to diverse patient populations.

CLASSIFYING OLDER ADULTS WITH DIABETES BY COMORBID DISEASES Neda Laiteerapong 1; James Iveniuk 1; Priya M. John 1; Aniruddha Das 1; Elbert S. Huang 1; Edward O. Laumann1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 11358)

BACKGROUND: One of the great challenges of caring for older adults with diabetes is that they are highly heterogeneous in terms of comorbid disease. Comorbid diseases, which occur individually or in complex combinations, may alter the risks and benefits of intensive glycemic control. Despite the potential importance of comorbid diseases, there is no commonly accepted approach to categorizing comorbid diseases in older people with diabetes. One potential approach is to identify categories (classes) of older diabetes patients using Latent Class Analysis (LCA), a method that identifies latent variables and is the categorical analog to factor analysis. In this study, we use LCA to
identify classes of older adults with diabetes by comorbid diseases and then compare the classes in terms of their treatment intensity and functional status.

METHODS: This study was based on a nationally representative sample of 750 respondents with diabetes, 5785 years old, who participated in the National Social Life, Health and Aging Project survey. Using LCA, we specified comorbid diseases (arthritis, cancer, dementia, depression, emphysema, falls, heart failure, hypertension, incontinence, kidney disease, myocardial infarction, obesity, stroke, and thyroid disease) to identify latent variables. We then categorized the sample into classes based on these latent variables. To compare the classes, we used measures of treatment intensity (total medication count, insulin use, and HbA1C levels) and self-reported functional status. We used chi-square analysis, one-way ANOVAs, and multivariate logistic regression to describe classes in terms of their treatment intensity and functional status.

RESULTS: We found three distinct classes of older adults with diabetes. Sixty percent of the sample were relatively healthy (Class 1), but still had a high prevalence of hypertension (62%), obesity (54%), arthritis (44%), incontinence (33%), depression (21%), and falls (17%). In addition to a higher prevalence of most of these comorbid diseases, the other 2 classes were distinctive in their prevalence of specific comorbidities. Thirty percent were chronically ill with especially high rates of cancer (24%) and kidney disease (19%) (Class 2). Ten percent were chronically ill with particularly high rates of heart disease (CHF, 100%; MI, 98%) (Class 3). Both Classes 2 and 3 had a higher total medication count than Class 1 (12.01 (2), 9.06 (3), 6.39 (1), $p<.001$) and both classes were at least twice as likely to be on insulin compared to Class 1. All of the classes had very similar mean HbA1C levels with Class 2 having the lowest (6.8% (2), 7.0% (3), 7.0% (1), $p=.02$). Classes 2 and 3 reported significantly more functional disability than Class 1 for all activities of daily living.

CONCLUSION: In this nationally representative sample of older adults with diabetes, we found that 60% are relatively healthy, but that the remaining 40% in the two other classes are distinctive in their high prevalence of specific comorbid diseases, including cancer, kidney disease, and heart disease. Compared to the relatively healthy class, the chronically ill classes are treated more intensely than the relatively healthy class and have worse functional disability. Future work should evaluate how these classes compare in terms of long-term outcomes and treatment effects.

A SYSTEMATIC REVIEW OF SOCIAL FACTORS ON RISK OF READMISSION AND DEATH AFTER HOSPITALIZATION WITH PNEUMONIA OR HEART FAILURE: IMPLICATIONS FOR PAY FOR

PERFORMANCE Linda Calvillo-King 1; Matthew Lo 1; Kathryn Eubank 1; Pete Yunyonying 1; Heather Stieglitz 1; Danielle Arnold 1; Ethan Halm2. 1University of Texas, Southwestern, Dallas, Texas; 2Univ. of Texas Southwestern Medical Center, Dallas, Texas. (Tracking ID # 11361)

BACKGROUND: Rates of readmission and death after hospitalization for community acquired pneumonia (CAP) and heart failure (HF) are publically reported and will be tied to reimbursement. Safety net hospitals will be disproportionately affected if reimbursement policies do not account for important patient-level social determinants that may increase risk of readmission and death. We performed a systematic review to assess the impact of social factors on readmissions or death in CAP and HF.

METHODS: We searched OVID, PubMed and PSYCHINFO for studies published since January 1, 1950. Eligible articles studied CAP or HF, include patient level data, examine 1 social factor (e.g., sociodemographics, insurance), and use readmission and/or death as the outcome. Studies were abstracted by two investigators using a structured data form ascertaining results [univariate (UV) and multivariate (MV) associations] and methodological quality. Inter-rater discrepancies were resolved by consensus.

RESULTS: For CAP, 24 of 64 candidate articles met inclusion criteria. Readmission was the primary outcome for 4 studies, death for 16, and a composite outcome of readmission or death for 4.

For HF, 52 of 170 were included. Readmission was the primary outcome for 26 studies, death for 39, and a composite outcome for 4. Thirty-nine percent of articles used administrative datasets, 23% medical records/ interviews, and 38% both. The overall methodological quality was mixed.

Few studies rigorously examined social factors besides age, gender and race. Among CAP studies of readmission, only 5 assessed age effects, with 2/5 finding higher UV risk in the elderly, and 1/5 showing a significant MV age association. Six studies assessed gender effects with 3/4 showing higher UV&MV risk in women. Three examined race with 1/3 showing higher UV&MV readmission risk in non-whites. For death, 7/9 found a UV&MV risk for older age; 5/7 higher UV&MV risk in women; and 3/7 for higher UV risk for non-whites (and 2/6 MV race differences). Similarly, for HF studies of readmission, 28 assessed age effects, with 4/10 finding higher UV risk in the elderly, and 1/4 showing a significant MV association. Twenty-six assessed gender with 3/12 showing higher UV risk and 3/5 higher MV risk for women. Eighteen examined race with 6/9 showing higher UV risk and 3/5 higher MV risk for non-whites. For death, 38 assessed age effects with 5/11 showing higher UV risk and 8/13 higher MV risk for older age. Thirty-six assessed gender with 4/11 showing higher UV risk and 8/12 higher MV risk for women. Twenty-two assessed race effects with 3/7 showing higher UV&MV risk for non-whites.

A few studies found significant influences of ethnicity, insurance, education, unemployment, nursing home residence, functional status, mental health, and alcoholism, among others on rates of readmission or death.

CONCLUSION: Most studies of readmission or death after CAP and HF ignored social factors, though those that looked found significant influences of age, gender, and race as well as others. More research is needed to assess the impact of deeper level social variables on risk of post-DC outcomes. Pay-for-Performance policies should adjust for the impact of social determinants of adverse post-hospital outcomes.

FITNESS MEMBERSHIPS AND FAVORABLE SELECTION IN MEDICARE ADVANTAGE PLANS Amal Trivedi 1; Alicia Cooper2.

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BACKGROUND: Within the last decade, many Medicare Advantage (MA) plans have begun offering coverage of fitness memberships in addition to the mandated standard benefits. Using a quasi-experimental study design, we examined whether Medicare Advantage plans experienced favorable selection of enrollees after adding coverage for fitness memberships. METHODS: We identified 11 health plans with continuous participation in MA from 2002 to 2008 that offered a new fitness membership benefit in 2004 or 2005 without changing

prescription drug coverage or ambulatory care copayments. We matched these case plans to 11 control MA plans in the same Census region or division that did not offer coverage for fitness memberships from 2002 to 2008. We employed a difference-in-differences (DID) approach to compare the self-reported health status of new entrants after the fitness membership benefit was instituted with the health status of enrollees entering prior to the addition of the fitness benefit. Self-reported health status was assessed via the 2006 to 2008 Medicare Health Outcomes Survey (response rate 69%),which surveys MA enrollees at baseline and at two years and includes information about when each enrollee entered their plan. We used generalized linear models with generalized estimating equations to adjust for age, sex, year of enrollment, clustering by health plan, and repeated measurement of beneficiaries. The study population included 4,852 Medicare Advantage enrollees age 65 and older in 11 plans that added fitness membership benefits in 2004 or 2005, and 5,064 Medicare enrollees age 65 and older in 11 matched control plans. RESULTS: Among the 11 case plans, the proportion of enrollees reporting excellent or very good health was 29 percent among enrollees that entered prior to plan offering a fitness membership benefit and 35 percent among new entrants after the plan offered fitness benefits (difference: 6 percentage points; 95% CI 3 to 10). Similarly, the proportion of new entrants without limitation in moderate activity was 10 percentage points greater (95%CI 8 to 13), and the proportion of new entrants without difficulty walking was 8 percentage points greater (95% CI 6 to 10) than the rates reported by prior enrollees. Among the 11 control plans, the difference in self-reported health status, disability, and walking ability between new entrants and prior enrollees was 1 percentage point or less for each measure. The adjusted DID was 5 percentage points for general health (95% CI 2 to 9), 9 percentage points for limitation in moderate activity (95% CI 5 to 13), and 7 percentage points in difficulty walking (95% CI 4 to 10). Patterns persisted in two-year follow-up responses for both activity limitation (7 percentage points, 95% CI 3 to 11)and difficulty walking (10 percentage points, 95% CI 5 to 15), but not self-rated health.
CONCLUSION: Plans offering coverage of fitness memberships may attract and retain a healthier subset of the Medicare population. Despite requirements for a mandated minimum benefits package and guaranteed issue of coverage, some MA plans may effectively cream-skim by designing insurance benefits that selectively appeal to the healthy.
EXPLORING PHYSICIANS EXPECTATIONS AND ACTUAL EXPERIENCES OF USING A PORTABLE BIOFEEDBACK DEVICE TO MANAGE STRESS : A QUALITATIVE STUDY Jill de Grood 1;
Jean E. Wallace 2; Jeffrey P Schaefer 2; Adriane Lewin 2; Jane B Lemaire2. 1Ward of the 21st Centtury Research Center, University of Calgary, Calgary, Alberta ; 2University of Calgary, Calgary, Alberta . (Tracking ID # 11369)
BACKGROUND: Given the nature of their work duties and work environment, physicians often experience occupation related stress that may lead to personal harm and impaired professional performance. A variety of stress management techniques exist and their use likely varies depending on the individual physician. We set out to explore physicians expectations and actual experiences of using a portable biofeedback device to manage stress.
METHODS: Semi-structured, open-ended interviews were conducted with a volunteer sample of 40 physicians practicing in a large urban teaching hospital. They all participated in a related intervention study where they were asked to use a portable biofeedback device for stress

management for 28 days. We interviewed them before and after the intervention study. During the initial interview prior to the intervention, we explored the physicians everyday experiences with stress, their current use of stress management and/or biofeedback techniques, and their expectations of the portable biofeedback device. During the second interview after the intervention, we explored the physicians actual experiences of

using the biofeedback device including their perceptions of the device meeting their expectations, its effectiveness, and their intentions for continued use. Interview recordings were transcribed and analyzed independently by two of the researchers with differences reconciled by discussion.
RESULTS: Prior to the intervention, participants reported using a variety of stress management techniques including exercise, quiet time, relaxation techniques (e.g., breathing, mediation imagery, visualization) and taking a time out or break. A number of individuals indicated they informally practiced biofeedback to relieve stress (e.g., were aware of their heart rate or breathing), however none used any formal biofeedback monitoring devices. When asked how they felt that participating in the biofeedback study would benefit them, the major themes that emerged were the following: acquiring another tool to better cope with stress; satisfying their curiosity and interest in learning about biofeedback; reducing anxiety and stress; increasing awareness, mindfulness and identification of stress; increasing the likelihood of practicing stress reduction techniques; and improving personal well being and happiness. Following the intervention, the majority of participants felt that study biofeedback device met their expectations. Many described how the device raised their awareness about stress and coping strategies, allowed them to achieve an extra level of calmness and focused their attention to the task at hand. A few participants found the device distracting, difficult to use, and stress generating due to the sense of pressure to use it. A majority of participants felt the biofeedback device made a difference in how they coped with stress. They described being more self-aware and feeling more in control of their reactions to stressful situations. Nearly all of the participants said they intended to continue to use the portable biofeedback device as it helped them to recover more quickly from stressful events and confirm their ability to be successful in a healthier physiological response to stress. Barriers identified were time constraints within the busy work environment and having to carry the device around, both of which made it difficult to use at work.
CONCLUSION: Physicians practice a variety of stress relieving techniques to help them cope with the day-to-day stresses of their jobs. The physicians who volunteered to participate in the biofeedback intervention, not surprisingly, had very positive expectations of the portable biofeedback device enhancing their stress management tools and furthering their understanding of the mind-body connection. The participants reports of their actual experiences suggest that their expectations were met to a great degree.
COMPARING WORK ATTITUDES AND EXPERIENCES OF MEDICAL TEACHING UNITS HEALTH CARE PROVIDERS: A CROSS SECTIONAL STUDYAleem Bharwani 1; Gabriel Fabreau 1; Jean E. Wallace 1; Meghan Elliot 1; Suneil Khanna 1; Evan Minty 1; Garielle Brown 2; Jill de Grood 7; Adriane Lewin 1; Janet Gilmour 1; Jane B Lemaire1. 1University of Calgary, Calgary, Alberta ; 2Ward of the 21st Century Research Center University of Calgary, Calgary, Alberta . (Tracking ID # 11370)
BACKGROUND: Healthcare provider (HCP) wellness is being increasingly linked to quality of patient care. On Medical Teaching Units
(MTUs), health care providers with diverse job descriptions collaborate to form multidisciplinary teams. These HCPs face the same challenging work environment and share a common goal of providing quality patient care within the acute care hospital system. The purpose of this study is to compare the work attitudes and experiences of three groups of HCPs working on two MTUs.
METHODS: For this cross sectional study, a survey was sent to all residents (n=65) staff physicians (n=35) and nurses (n=190), (response rates 94%, 60%, and 34% respectively) with work experience on either one of two university hospital MTUs of a single internal medicine training program during 2010. The survey was constructed to measure work attitudes and experiences of HCPs with a 5-point Likert response set coded as strongly disagree (1), disagree(2), neither agree nor disagree (3), agree (4), strongly agree (5) with reverse coding where appropriate. Single survey items were used to measure emotional exhaustion and communication, and multi-item scales were used to measure workload, team strength, job control, and work spillover into personal life. Mean scores were calculated and differences across groups were assessed using analysis of variance. Higher values indicate experiencing more of the work attitude or experience.

RESULTS: The residents, staff physicians and nurses working on the two MTUs reported a range of work attitudes and experiences (Table 1). The significant differences across the groups of HCPs were their perceptions of job control, with the residents reporting the lowest mean score, and work spillover into personal life and intradisciplinary communication, with the nurses reporting the lowest mean scores. All three groups reported experiencing similar levels of emotional exhaustion, workload, team strength, and interdisciplinary communication.

CONCLUSION: Within the shared work environment and goals of MTU multidisciplinary teams, physicians, medical residents and nurses report both similar and different work attitudes and experiences. Future research could explore whether these findings are confirmed in larger studies. Appreciating these similarities and differences may help to promote a well functioning multidisciplinary team and foster a healthy workplace.

REGIONAL VARIATION IN TRANSPLANT WAITLIST: A CONTRIBUTOR TO TRANSPLANT DISPARITIES

Milda R Saunders 1; Hyo Jung Tak 1; Lainie Friedman Ross 1; G. Caleb Alexander1. 1University of Chicago Medical Center, Chicago, Illinois. (Tracking ID # 11371)

BACKGROUND: There is substantial regional variation in healthcare quality in the United States. African Americans and Whites are not distributed equally among regions in the US. The objectives of this study were to quantify regional differences in access to the renal transplant waitlist, and to examine how these differences may contribute to racial disparities in waitlist access.

METHODS: Using the United States Renal Data System (USRDS), we examined non-Hispanic Whites (n=166,874) and Blacks (n=133,474) aged 1870 who initiated dialysis between January 2000 and December 2006. We linked U.S. 2000 Census Data to USRDS data using subjects zip code at dialysis initiation. We defined our outcome variable as time to transplant waitlist after dialysis initiation. We used the 11 United Network for Organ Sharing (UNOS) regions as indicator variables in order to account for geographic and administrative boundaries. First, we used Cox proportional hazards to

identify the association between UNOS region and time to transplant waitlist while adjusting for individual (age, gender, insurance and employment status, BMI, and co-morbidities at dialysis initiation) and neighborhood (proportion female headed households, male unemployment, percent poverty and proportion without high school diploma) characteristics. UNOS Region 3 was used as the reference group because it was largest and had longest time to transplant waitlist. Then we used Cox proportional hazards to compare time to transplant waitlist for Whites and African Americans within a given region after adjusting for the individual and neighborhood characteristics above.

RESULTS: The average time to renal transplant waitlisting was23.7 months and was significantly shorter for Whites (22.1 months) than African Americans (25.8 months, p=<0.001). Women, those with coronary artery disease, greater neighborhood disadvantage, Medicaid or no insurance at dialysis initiation had a longer average time to

waitlisting than their counterparts (all p-values <0.05). Compared to patients in Region 3 (see Table 1), patients in eight of the ten other regions were more likely to appear on transplant waitlist (adjusted HR1.1-1.6, p-values <0.05). Compared to Whites within the same region, African Americans had similar times to transplant waitlist in all but three regions. African Americans had a longer time to transplant waitlist than their White counterparts in regions 3 and 4, but waited less time in region 5. Over 30% of the African American population with end stage renal disease resided in Regions 3 and 4 which have both longer times to transplant waitlist overall and disparities between African Americans and Whites.

CONCLUSION: African Americans are over-represented in geographic regions with longer times to renal transplant waitlist. Within these regions they face double disadvantage due to racial disparities in time to transplant waitlist. These regional differences may play an important role in transplant waitlist disparities.

Table 1: Transplant Waitlist Outcomes by Region UNOSregion

States Hazard Ratio (HR) transplant waitlist
(p-value)
White-African American HR within region
Total population
(n=300,348)
Proportion African American
1 CT, VT, ME, MA, NH, RI
1.86 (<0.01) 1.10 (0.14) 10630
COMPARING RESIDENT AND STAFF PHYSICIAN PERCEPTIONS OF HOW 24 HOUR SHIFTS AFFECT SENIOR RESIDENTS WELLNESS, ABILITY TO DELIVER QUALITY HEALTH CARE AND MEDICAL EDUCATION EXPERIENCE: A CROSS SECTIONAL STUDY Jane B Lemaire 1; Evan Minty 1; Jean E. Wallace 1; Suneil Khanna 1; Meghan Elliot 1; Gabriel Fabreau 1; Garielle Brown 1; Adriane Lewin 1; Jill de Grood 1; Janet Gilmour 1; Aleem Bharwani1. 1University of Calgary, Calgary, Alberta . (Tracking ID # 11373)
BACKGROUND: Research has linked extended physician duty hours with reduced quality of care, poorer performance on learning measures, increased workplace injury, and higher incidence of burnout. The objective of this study is to compare the residents and staff physicians perceptions of how 24 hour shifts affect senior residents wellness, ability to deliver quality health care, and medical education experience. METHODS: For this cross sectional study, a survey was sent by email to all internal medicine residents (n=65) and staff physicians (n=35) (response rates 88% and 51% respectively) with work experience on either one of two university hospital Medical Teaching Units (MTU) of a single internal medicine training program during 2010. The survey measured the respondents perceived impact of the 24 hour shifts upon aspects of senior resident self/work with single-item responses and multi-item scales, all with a 5-point Likert response set coded as strongly disagree (1), disagree(2), neither agree nor disagree (3), agree (4), strongly agree (5) with reverse coding where appropriate. Mean scores were calculated and differences between groups were assessed using unpaired T-tests. Higher values indicate experiencing more of the work attitude or experience.
RESULTS: Both internal medicine residents and staff physicians feel that 24 hour shifts make it difficult for senior residents to achieve general wellness, expose senior residents to personal harm, and lead to rotation disruptions. Neither group perceive that the extended work hours required undue expenditure of emotional labour. Significant differences include the following: staff physicians are more likely to feel that the senior residents have access to relationship support and teach successfully than the senior residents, but less likely to feel that the senior residents provide continuity of care when working 24 hour shifts. CONCLUSION: Both internal medicine residents and staff physicians perceive some important negative impacts of 24 hours shifts upon senior resident wellness and medical education experience and overall have similar perceptions of the impact of the 24 hour shifts.
UTILIZATION OF SERVICES IN MEDICARE ADVANTAGE AND TRADITIONAL MEDICARE: A NATIONAL COMPARISON Bruce E Landon 1; Joseph P Newhouse 1; Alan M Zavlavsky 1; John Z Ayanian1. 1Harvard Medical School, Boston, Massachusetts. (Tracking ID # 11375)
BACKGROUND: Relative to traditional Medicare (TM), clinically integrated health plans that participate in Medicare Advantage (MA) may be able to treat a given patient more efficiently, using fewer resources with equal or superior quality, through their flexibility in benefit structure, network contracting, and ability to coordinate and manage care. Little prior research, however, has compared the utilization of services within

MA and TM, largely because standardized utilization measures, such as available through HEDIS, are not available for the unmanaged TM population. This issue has become even more salient since the passage of the

Medicare Modernization Act of 2003, which increased payment rates to MA plans and resulted in a doubling of MA enrollment over the ensuing years as well as a large increase in the number of participating plans. We compare utilization of services, overall and for specific procedures, between Medicare beneficiaries enrolled in Medicare Advantage plans and matched samples enrolled in traditional Medicare. METHODS: The Centers for Medicare and Medicaid Services collects annual standardized utilization data from all HMO plans participating in MA. These data include rates of selected procedures (e.g., cardiovascular and orthopedic procedures) as well as overall outpatient and inpatient visit data, and are available at the level of individual enrollees. For the time period 20032008, coinciding with the implementation of the Medicare Modernization Act, we compare HEDIS utilization measures collected for each health plan and similar utilization data constructed using the HEDIS specifications from a random 20% sample of the TM population. Using robust statistical weighting, we compared MA and TM enrollees of similar age, sex, and race/ethnicity in the same markets.
RESULTS: MA enrollees were substantially less likely than comparable TM enrollees to receive most of the specific procedures we examined, including elective orthopedic procedures such as knee or hip replacement (absolute : 10-15%) as well as general surgical procedures such as cholecystectomy and prostatectomy (absolute : 5-10%) . MA enrollees, however, were slightly more likely to receive CABG surgery and colectomy (absolute >10%). Overall outpatient visits were approximately 11% lower for MA enrollees. Inpatient visits and days were slightly higher for TM enrollees (absolute : 2-5%). Medical hospitalization rates were higher for MA enrollees whereas surgical hospitalization was higher for TM enrollees. Ongoing analyses will assess differences in utilization rates over time and for enrollees of health plans participating in MA for the duration of the study versus those that began enrolling patients in later years. Sensitivity analyses suggest that differences in health status do not explain our findings. CONCLUSION: Utilization rates for MA enrollees are substantially lower than for matched samples of TM enrollees, despite the fact that MA plans generally receive higher reimbursement overall. Alternative payment arrangements are needed for MA plans in order to harness the potential cost savings that might be realized from enrolling more Medicare beneficiaries in the MA program.
FACULY AND RESIDENT KNOWLEDGE OF HEALTHCARE COSTS Bradley A Sharpe 1; Amy K Clouse 2; Adam Carlson2. 1University of California San Francisco, San Francisco, California ; 2University of California, San Francisco, San Francisco, California . (Tracking ID # 11378)
BACKGROUND: Numerous studies have shown that physicians at all levels possess poor knowledge of the costs associated with medical care and frequently order tests inappropriately. Few contemporary studies have examined hospitalist attending or housestaff knowledge of medical charges associated with commonly ordered tests. No studies to date have assessed physician knowledge of Medicare reimbursement. METHODS: To assess physician knowledge, we developed a questionnaire which asked physicians to estimate actual hospital charges(i.e. what a person with no insurance would be charged) and Medicare reimbursement for 17 commonly ordered diagnostic tests and a one night hospital stay. Participants also responded to eight close-ended attitudinal questions using a 5-point Likert scale. Forty-
eight hospitalist faculty and 111 internal medicine residents from the University of California San Francisco (UCSF) were invited to complete the survey. Questionnaires were distributed either at educational conferences or electronically via email. Mean estimates were tabulated for actual charges and Medicare reimbursement for faculty and residents. A percent (%) error of these mean estimates was calculated for each test as [(mean estimated - actual)/actual] x 100. The correlation coefficient between number of years in practice and % error was calculated.
RESULTS: Thirty six hospitalists and 92 residents completed the survey, representing a response rate of 75% and 82% respectively. In general, the accuracy of physician estimates of hospital charges and reimbursement was poor. For all diagnostic tests and hospital room costs, providers grossly under-estimated actual hospital charges. The mean % error for all providers for actual hospital charges was 41.4% (on average, providers underestimated the cost by 41.4%). For nearly all diagnostic tests, providers grossly over-estimated Medicare

reimbursement. The mean % error for all providers for Medicare reimbursement was +190.2% (on average, providers overestimated the reimbursement by 190.2%). For example, the mean estimate for the Medicare reimbursement for a blood culture was $76.60 while the actual cost is $14.42. The range of physician estimates for all diagnostic tests was extremely wide. For example, estimates of the actual hospital charge for a chemistry panel (blood test) ranged from $5 to $700 (actual charge=$422). There was no correlation between estimate accuracy and years in practice. Both faculty and residents rated their personal knowledge of charges for diagnostic tests as poor (2.00 and 2.08 out of 5 respectively) and their interest in receiving education about costs as high(4.21 and 4.25 respectively).
CONCLUSION: At a single academic medical center, hospitalist attending and internal medicine residents demonstrated poor awareness of the actual hospital charges for diagnostic tests. Furthermore, they grossly over-estimated Medicare reimbursement. This research indicates a deep lack of understanding of healthcare finances - both the actual burden of inappropriate diagnostic testing but also the complex reimbursement structure. As providers expressed interested in receiving further education, future research should focus on the effects of a curriculum designed to increase charge awareness but also enhanced understanding of national healthcare finances.
PREDICTING TIES IN GEOGRAPHICALLY DEFINED PHYSICIAN NETWORKS Bruce E. Landon 1; Nancy L Keating 2; Alistair J OMalley 1; Michael Lawrence Barnett 3; Sudeshna Paul 1; Jukka-Pekka Onnela 1; Nicholas A Christakis1. 1Harvard Medical School, Boston, Massachusetts ;
2Harvard Medical School, Newton, Massachusetts ; 3Harvard Medical School, Brookline, Massachusetts . (Tracking ID # 11380)
BACKGROUND: Informal interactions can define networks of physicians. Such networks differ from formal organizational structures (e.g., physician interactions dictated by a health plan or a hospital) by not necessarily conforming to the boundaries established by formal networks. Understanding more about such informal physician networks provides an opportunity to discover novel ways of influencing physician practices and understanding the transmission of ideas and new treatments among physicians.
METHODS: We employ novel methods from the field of network science to define social networks among physicians within defined geographic areas. We identify networks based on shared patients (ties), and we examine how such networks vary across different geographic regions. Using dyadic regression, we then identify physician and patient-population

factors that are associated with such patient-sharing ties. Shared patients were defined using encounter data from the Carrier File for the Medicare program for calendar year 2006 for 100% of Medicare beneficiaries living in 51 randomly sampled hospital referral regions (HRR).
RESULTS: We studied a total of 4,955,568 Medicare beneficiaries living in51 HRRs who were seen by a total of 271,877 physicians practicing in those HRRs (range 99 to 9,589 physicians within an HRR). 57% of physician pairs shared just one patient, whereas 20% shared 4 or more patients. A male physician was more likely to have a tie with another male physician ($p<.001$), but female physicians were less likely to have ties with other female physicians ($p<.001$). Having the same hospital affiliation was the strongest predictor of a relationship ($P<.001$). Physicians who were closer in age and closer in geographic distance were more likely to have ties, even when controlling for hospital affiliation (both $p<.001$). Physicians who had more similar patient populations (e.g., based on age, race, or gender) also had more ties (all $p<.001$). We observed moderate variability in network parameters across geographic regions.
CONCLUSION: The tools of social network analysis can be used to define networks of physicians in defined geographic areas. The structure and nature of such networks varies across geographic regions. Physicians are generally more likely to have patient sharing relationships with physicians who are similar to them and care for similar populations of patients.

ASSOCIATIONS BETWEEN RESIDENT PHYSICIAN WELL-BEING AND ASSESSMENTS OF KNOWLEDGE AND CLINICAL PERFORMANCE Thomas Beckman 1; Darcy Reed 1; Tait Shanafelt 1; Colin West1. 1Mayo Clinic College of Medicine, Rochester, Minnesota . (Tracking ID # 11383)

BACKGROUND: Medical knowledge and clinical performance ratings, which are the major criteria for assessing resident physicians, should solely reflect resident abilities to care for patients and work in teams; but these assessments may be influenced by other factors. Resident empathy has been shown to be associated with resident assessments of faculty. However, the relationship between resident well-being and the performance assessments that residents receive remains unclear. Resident distress is common and it is known that the learning environment and interpersonal relationships play crucial roles in learning. Therefore, we used a prospective longitudinal study design to investigate the hypothesis that resident well-being and empathy influence assessments of medical knowledge and clinical performance. METHODS: We studied 730 clinical performance assessments completed by peers, supervisors, and allied health professionals; 193 mini-clinical evaluation exercise (mini-CEX) evaluations; and 260 in-training examinations (ITE) of Mayo Clinic internal medicine residents in January 2009, August 2009, January 2010, and August 2010. Resident characteristics were obtained from a longitudinal survey of resident well-being (the Mayo IMWELL Study) that uses standardized instruments measuring empathy and multiple domains of well-being including quality of life, burnout, fatigue, and depression. Validity of the mini-CEX, ITE, Maslach Burnout Inventory (MBI), and Interpersonal Reactivity Index (IRI) has been established. The 6-item Mayo clinical performance assessment, which occurs on a 5-point scale, has also been shown to be reliable and valid. Multivariate generalized estimating equations were used to evaluate associations between resident knowledge and clinical performance assessments and resident well-being and empathy. This study sample provided 80% power for a medium-to-small Cohen effect size of 0.3 for all outcomes. The threshold for statistical significance was set at $p<0.01$ to account for multiple comparisons.

RESULTS: A total of 202 residents (84% of all eligible) provided both well-being and assessment data. In multivariate models, resident scores

on the IRI measure of the tendency to adopt the psychological view of others were associated with higher peer ratings on desirability as a physician for a family member (beta=.022, 95% CI=.006-.038, p=.007). Consequently, a 5-point increase in this empathy score was associated with a 0.1-point increase in resident ratings as desirable physicians. Additionally, burnout as measured by the MBI was associated with higher supervisor ratings of communication (beta=.305, 95% CI=.098-.513, p=.004). Hence, burnout was associated with a 0.3-point increase in resident communication score. There were no statistically significant associations between resident ITE or mini-CEX scores and quality of life, burnout, fatigue, depression, or empathy.

CONCLUSION: In this sample, most measures of resident well-being were not associated with assessments of resident knowledge and clinical performance. This supports the trustworthiness of these standardized measures as criteria for assessing resident competency, despite the possibility of varying levels of resident well-being. Nonetheless, the associations between resident empathy and burnout and assessments by peers and supervisors suggest that resident ratings may be influenced by personal factors. These relationships require further study.

THE EFFECT OF PATIENT PARTICIPATION IN HEALTH DECISIONS: AN EVIDENCE-BASED REVIEW Marla L Clayman 1; Gregory Makoul 2; Jennifer Webb 1; Carma Bylund 3; Betty Chewning 4; Neeraj K Arora5. 1Northwestern University, Chicago, Illinois ; 2St. Francis Hospital System, Hartford, Connecticut ; 3Memorial Sloan Kettering Cancer Center, New York, New York ; 4University of Wisconsin School of Pharmacy, Madison, Wisconsin ; 5National Cancer Institute, Rockville, Maryland . (Tracking ID # 11386)

BACKGROUND: Many authors assert that patient participation in health decisions is desirable, in terms of both moral reasoning and patient outcomes. We conducted a review of articles published through the end of 2009 to identify the extent to which patient participation about decisions in the medical encounter is associated with

measured outcomes. METHODS: We conducted a Pubmed (Medline) search through the end of 2009, using the MeSH headings (Physician-Patient Relations[MeSH] OR Patient Participation[MeSH]) and the terms (decision OR decisions OR option OR options OR choice OR choices OR alternative OR alternatives) in the title or abstract. The search excluded non-English language and animal studies. We reviewed all available abstracts of the 7041 citations found through the search. Of these, 5579 were rejected because they were not about the topic, not empirical, were not specific to decision making, were not in the context of physician-patient decisions, or lacked either a measure of patient participation or an outcome measure. We obtained the remaining 1462 articles, subsequently rejecting 1379 because, upon closer examination, they did not meet the inclusion criteria. In order to remain in the sample, articles had to have a measure of patient participation, confirmation that a decision was part of the physician-patient encounter, and an outcome measure (psychosocial or biological). Thus, we retained 83 of the original 7041 Pubmed citations. A secondary search reviewed references of these 83 articles. We conducted 119 full article reviews on non-redundant referenced articles, yielding an additional 12 articles for data abstraction. Of these 95 articles, only 6 were randomized controlled trials (RCTs). As RCTs provide the strongest evidence regarding potential effects of patient participation, we include only those 6 studies in our final sample. RESULTS: Of the 6 included studies, there is wide variation in measurement of patient involvement (ranging from the coding of audio recordings to patient-reported involvement in decision making) and patient outcomes. Patient involvement reportedly increased in each of the intervention groups. However, two of the studies found no effects of patient participation in decision making and measured outcomes. Four studies found positive effects: two studies reported less decisional conflict among those with more

participation; one study found fewer hospitalizations among those with more participation; and one study reported lower anxiety, although 3 studies found no relationship between anxiety and participation. CONCLUSION: We found very few randomized controlled trials with measures indicating actualparticipation in a decision and a relationship to a health outcome. Those thatdo exist have little consistency in how these items were measured. It isimportant to note that the seminal RCTs by Greenfield, Kaplan and Ware, whichare widely cited as evidence for the beneficial effects of patientparticipation in decisions, were not included among the 6 RCTs that met ourcriteria. This is because those authorsmeasured items including patient question asking, but there was no indicationthat these questions were related to decision making. There is a great need forwell-designed studies that include measures of patient participation andclinically relevant psychological and biological outcomes of patientparticipation in medical decisions.

HOSPITAL-ACQUIRED CONDITIONS AND PAY-FOR-PERFORMANCE: THE IMPACT OF RISK-ADJUSTMENT Jennifer Meddings 1; Laurence F. McMahon, Jr.1. 1University of Michigan, Ann Arbor, Michigan. (Tracking ID # 11388)

BACKGROUND: The Centers for Medicare and Medicaid Services no longer pay for specific hospital-acquired conditions (HACs), as a form of pay-for-performance. Hospitals can lose payment regardless of a patients risk to develop HACs. Hospital rates of HACs without risk-adjustment will soon be reported by Medicares Hospital Compare website. Reduced pay for all hospitalizations will occur in 2015 for hospitals in the top quartile of risk-adjusted HAC rates. The underlying premise is that hospital performance rather than patient characteristics determine a hospitals HAC rate. Our primary objective was to describe how hospital comparisons by HAC rates would be modified with even simple risk-adjustment.

METHODS: We evaluated claims data for 462,176 adult Medicare discharges from 125 acute care Michigan hospitals using the 2007 Healthcare Cost and Utilization Project State Inpatient Dataset. Using the examples of catheter-associated urinary tract infections and

decubitus ulcers, cases were identified using ICD9-CM codes for these conditions when listed only as secondary diagnoses, meaning not the principal reason for admission. We assessed how hospital comparisons would be modified by basic risk-adjustment when comparing rankings by observed (unadjusted) HAC rates to comparisons using observed/expected ratios based on each hospitals number of discharges per Diagnosis-Related Group (DRG) assigned at discharge and each DRGs statewide mean rate of urinary tract infections (UTIs) and decubitus ulcers as secondary diagnoses. Because very few cases of UTIs were identified as catheter-associated using the catheter code 996.64 (and medical record reviews support many UTIs in claims data are in fact catheter-associated UTIs+), hospitals were compared by UTI rates (including cases of catheter-associated UTIs).+Infect Control Hosp Epidemiol. Jun 2010;31(6):627633. RESULTS: Hospital rates (unadjusted) of UTIs as secondary diagnoses for any discharge ranged from 7 to 24% (mean 14%, SD 3.4%); hospital rates (unadjusted) of decubitus ulcers as secondary diagnoses ranged from 0 to 11% (mean 3%, SD 1.5%) of discharges. Hospital rates of UTIs and decubitus ulcers also varied greatly by common DRGs, as shown in the Table.

The Figure shows how each hospitals performance compared when using observed-to-expected ratios of UTIs (ranging from 0.6 to 1.8) using each hospitals discharge DRGs. As demonstrated in the Figure, of the 31 hospitals identified in the top quartile (identified by black bars) as poor performers using unadjusted UTI rates, 8 were reassigned to better quartiles after simple risk adjustment using observed-to-expected ratios of UTI cases by each hospitals discharge DRGs.

Similarly, 5 of 31 hospitals identified in the top quartile as poorperformers by unadjusted decubitus ulcer rates were reassigned to better quartiles after using observed-to-expected ratios of decubitus ulcer cases using each hospitals discharge DRGs.

CONCLUSION: Even with simple risk-adjustment by discharge DRGs, many hospitals identified as poor performers by UTI rates (1 in 4) and by decubitus ulcer rates (1 in 6) would be reassigned as better performers; thus, risk adjustment should be developed carefully prior to public reporting and hospital pay modifications by hospital-acquired complication rates.

SMOKING HABITS AND CESSATION EFFORTS AMONG DEPLOYED SOLDIERS Susan George 1; Dorothy Becher 1; Michael Zapor 1; Joshua Hartzell1. 1Walter Reed Army Medical Center, Washington, District of Columbia . (Tracking ID # 11392)

BACKGROUND: Smoking has significant financial and health implications on US military service members(SM). Deployment overseas appears to play a role in these smoking behaviors, including recidivism. Past studies have examined smoking rates among SMs while deployed, but no studies have been done examining smoking cessation among this population. The purpose of this study is to better define smoking habits and smoking cessation patterns among deployed personnel.

METHODS: This is a descriptive study, utilizing a survey with 56 component questions. Members of the 4th Brigade Combat Team, 82nd Airborne Division were recruited in theatre while they waited for a post deployment health assessment. The survey tool consisted of questions regarding basic demographics, current smoking status, and smoking cessation behaviors. Demographic information was described using means, as well as simple frequencies. Univariate analysis was performed using analysis of variance and chi square, with the primary outcome being smoking cessation attempt.

RESULTS: Approximately 450 SM were approached and 313 surveys were completed (69.6%). The mean age was 25.7 years (range 19 47 years). The group was predominantly male (96.2%). The group was 65.2% white, 9.3% black, 8% Hispanic, and 3.5 % Asian. Current smoker (> 100 cig in lifetime, >1 cigarette in the past month) comprised 44.1 %(138/313) of the group. This group reports smoking for an average of 6.6 years, with an average of 2 quit attempts in the past. Of the current smokers, 44.9% (62/138) said they attempted to quit during their current deployment. Most of these SM did so cold turkey, with 37 %(23/62) reporting no use of a

cessation aid. Predictors of a cessation attempt via univariate analysis included confidence in ability to quit (p=0.00), successful quit attempt in past (p=0.002), and higher scores on a scale of how much they want to quit in the next month (p=0.035). CONCLUSION: This study reveals that a surprisingly large proportion of deployed SMs are attempting to quit smoking while deployed. However, most of these soldiers are not utilizing medications or nicotine replacement in these efforts, possibly given limited availability. The univariate correlates reveal that certain SMs may be more likely to attempt to quit while deployed. Future studies are needed to determine availability of smoking cessation aids in theatre and if their use can improve rates of cessation in the deployed setting.

PROSPECTIVE ASSOCIATION BETWEEN BODY MASS INDEX (BMI) AND RECEIPT OF PREVENTIVE SERVICES: RESULTS FROM THE CENTRAL PENNSYLVANIA WOMENS HEALTH STUDY (CEPAWHS)

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BACKGROUND: Optimizing preventive service receipt, as recommended by the U.S. Preventive Services Task Force and the Centers for Disease Control and Prevention, is important for providing high-quality, comprehensive primary care for reproductive-aged women. Previously published, cross-sectional studies have not conclusively shown whether overweight and obesity affect receipt of these services. Some studies suggest underutilization of preventive services in women who are overweight and obese, perhaps due to physician bias, whereas other studies show the opposite, perhaps due to greater need for preventive services associated with obesity-related comorbidities. Utilizing a unique, prospective population-based cohort, we investigate the effect of body mass index (BMI) on the receipt of guideline-concordant preventive services among reproductive-aged women. We employ the behavioral model of healthcare utilization to determine the association between BMI and preventive service receipt.

METHODS: We used data from the Central Pennsylvania Womens Health Study (CePAWHS) population-based longitudinal survey of women ages 1845. The analytic sample consisted of 1,420 women who completed a telephone survey during 2004/05 and a follow-up survey 2 years later. Women who were either underweight (BMI <18.5; n=23) or pregnant at baseline during the study period (n=54) were excluded from the analysis. Multiple logistic regression models assessed the independent contribution of BMI category (normal weight [BMI 18.5-24.9], overweight [BMI 2529.9], and obese [BMI >=30]) to the receipt of preventive screenings (pap smear, cholesterol screening, diabetes screening) and counseling services (dietary/nutritional, exercise, weight management), and reproductive counseling (defined as counseling for pregnancy planning, birth control or preconception care). All models controlled for variables that predispose individuals to use of health services (age, race/ethnicity, educational level), variables that enable healthcare access (having a usual healthcare provider or using an obstetrician-gynecologist, poverty status, and continuous health insurance coverage), and need-based variables (overall health status, a single item from the Short Form 12 and metabolic comorbidities (at least one of the following: hypertension, high cholesterol or diabetes mellitus).

RESULTS: Overall, women who were obese were older, had lower educational attainment, and were more likely to be in or near- poverty status. Additionally in unadjusted analysis, women who were obese were less likely to see an obstetrician-gynecologist, had lower overall self-rated health status and higher rates of co-morbidities (hypertension, high cholesterol, diabetes mellitus). In multivariable analyses, women who were overweight and obese did not differ from normal weight women in receipt of pap smear or reproductive care counseling, but did

receive greater rates of cholesterol (51.4% and 65.8% vs. 42.3%, p<0.001) and diabetes screening (44.6% and 57.1% vs. 35.7%, p<0.001) as well as greater preventive counseling for diet or nutrition(50.3% and 65.8% vs.

28.5%, p<0.001), exercise or physical activity(47.0% and 59.2% vs. 32.6%, p<0.001), and weight management(37.0% and 62.5% vs. 11.5%, p<0.001) (see Table).
CONCLUSION: Overall rates of preventive services received in this study were low, below levels expected for optimal primary care. Of particular concern is the low rate of reproductive care counseling provided to overweight and obese women of reproductive age, given their elevated
risk for adverse pregnancy outcomes. Reassuringly, our data suggest that primary care physicians are appropriately targeting women who are overweight and obese for services that address comorbidities associated with increased BMI (i.e. cholesterol and diabetes screening, and counseling on nutrition, physical activity and weight management). However, these services remain underutilized, provided to less than half of overweight and less than two-thirds of obese women in this study. The overall low rates of preventive services and counseling suggest future work is necessary to improve the receipt of these important services, particularly among the overweight and obese population.
WHAT DO NEW INTERNS SAY IS CHALLENGING? Steven A. Haist 1;
Susan Jacovino 2; Mark R. Raymond 2; Janet Mee2. 1National Board of Medical Examiners, Philadelphia, Pennsylvania ; 2NBME, Philadelphia, Pennsylvania . (Tracking ID # 11395)
BACKGROUND: The United States Medical Licensing Examination (USMLE) is undergoing a comprehensive review. One recommendation from this review is to support two decision points: entry into supervised practice and entry into unsupervised practice. A multi-phase practice analysis is being conducted to better inform examination content decisions. The first phase included a survey of new interns to determine required clinical responsibilities during their first few months of training.
METHODS: The survey assessed clinical activities, supervision from attending, demographics and an open-ended statement, Please list one or two activities that you performed in August that you found particularly challenging. The survey was sent to residency program directors in 10 core specialties at 354 randomly selected institutions (8,793 interns) in September 2009. A total of 3,003 surveys (response rate 34%) were returned (2,523 usable). Most (1,716) interns provided at least one write-in response to the open-ended statement and 876 provided two responses. Two reviewers independently coded a random sample of 500 responses. Each challenging activity was coded to the six ACGME competencies or an additional category, Personal Issues (PI). Subcategories were created under each competency, and coding of an entry to more than one category or subcategory was allowed. After the first 50 responses, the reviewers compared classifications and reached consensus on differences. The coding
outline was further revised. The reviewers then analyzed the next 450 responses following the same procedure. The following are samples of responses: Intubating a 350-lb patient who was vomiting everywhere during a code, and Managing end-of-life issues, both medical and social.
RESULTS: The number of challenging activities coded to each major category were: Patient Care (PC), 59.6%; Interpersonal and Communication Skills (IPCS), 19.5%; Professionalism, 0.4%; Systems Based Practice (SBP), 11.2%; PI, 58 8.6%. For various reasons, medical knowledge and practice-based learning were not useful as categories (e.g., almost all write-in responses involved knowledge). Procedures accounted for 120 (30%) of PC responses (e.g., Lumbar Puncture, 29; Central Line Placement, 26). Overall, 62 responses involved Specific Patient Populations (e.g., Pediatric, 30; patients with psychiatric conditions, 14). DNR/withdrawal of care accounted for 14 responses, only 4 responses involved clinic. IPCS included Telling Bad News, 46 responses; Life/Death Discussions, 26; and Angry Patients or Families, 18. SBP challenges included 19 responses associated with Medical Records (dictating, electronic medical records) and 18 with Cross-Cover/Night Float. The PI responses (58) included Workload and Time Management (32) and role transition (18).
CONCLUSION: The findings will directly affect content of USMLE. Early interns note that discussing bad news and death and dying, and communicating with angry patients and families were challenging. These findings will influence changes to the Step 2 Clinical Skills Examination. Procedures with potential significant complications

were often deemed challenging. Based on this information, USMLE will need to assess procedural knowledge

and explore how to assess the associated skill. The findings may impact undergraduate and graduate medical education. Preparing trainees for their role transition, addressing time management, and training in dictating should ease the transition to supervised practice.

MORTALITY AND CAUSES OF DEATH AMONG HOMELESS ADULTS IN BOSTON Travis P. Baggett 1; Nancy A. Rigotti 2; Erin Stringfellow 3; Stephen W. Hwang 4; E. John Orav 5; James J. OConnell3. 1Massachusetts General Hospital, Boston, Massachusetts ; 2Harvard Medical School, Boston, Massachusetts ; 3Boston Health Care for the Homeless Program, Boston, Massachusetts ; 4University of Toronto, Toronto, Ontario ; 5Brigham and Womens Hospital, Boston, Massachusetts . (Tracking ID # 11402)

BACKGROUND: An estimated 2.3-3.5 million Americans experience homelessness each year. Understanding the mortality patterns and causes of death among homeless adults would inform health care goals and improve service delivery strategies for this marginalized population. Our specific aim was to determine overall and cause-specific mortality rates among homeless adults in Boston.

METHODS: We retrospectively assembled a cohort of all individuals aged 18 years and older who had any contact with the Boston Health Care for the Homeless Program (BHCHP) between 1/1/2003 and 12/ 31/2007. We used probabilistic record linkage software (LinkPlus, version 2.0) to cross-link individuals from the BHCHP cohort to the Massachusetts Department of Public Health annual death files spanning the same years. The linkage algorithm generated a match probability score for record pairs on the basis of first name, middle name, last name, date of birth, social security number, gender, and race/ethnicity. Record pairs meeting a minimum threshold match score were manually reviewed and accepted as true matches if they satisfied the criteria specified by the National Death Index. ICD-10
cause of death codes were extracted from the death certificates of decedents and classified according to convention. Overall and cause-specific mortality rates were calculated by dividing the number of deaths by the person-time of observation. We used the Chi-square goodness-of-fit test to determine whether deaths were uniformly distributed across seasons of the year, weeks of the month, and days of the week.

RESULTS: The study cohort was comprised of 24,459 adults followed for a median of 2.9 years, generating 68,239 person-years of observation. The mean age at cohort entry was 41 years. Two-thirds of participants were male, 30% were black, and 19% were Hispanic. There were 1029 deaths during the study period, yielding a crude mortality rate of 1508 per 100,000 person-years. The mean age at death was 51 years (range 1993). Mortality rates were significantly higher in men than women (1819.0 vs. 882.4; rate ratio 2.1, 95% CI 1.8-2.4). There were no temporal variations in mortality. Overall, the leading causes of death were heart disease (230.1 per 100,000 person-years), cancer (224.2 per 100,000 person-years), and poisoning (209.6 per 100,000 person-years). More than 80% of poisoning deaths were due to narcotics and other illicit drugs. The leading cause of death was poisoning among 1824 year olds and 2544 year olds, cancer among 4564 year olds, and heart disease among those older than 65 years. Lung cancer accounted for the highest proportion of cancer deaths in both men (96.5 per 100,000 person-years) and women (44.1 per 100,000 person-years).

CONCLUSION: The age-adjusted mortality rate in this cohort of homeless adults in Boston was 2.5-fold higher than that seen in the general population of Massachusetts. The preponderance of deaths due to heart disease and cancer suggests that the high prevalence of tobacco use in this population may be a useful target for health interventions. The alarming rate of drug-related deaths underscores a continuing need for addiction services for homeless people.

TEAM-BASED CARE: BARRIERS AND FACILITATORS TO ITS ADOPTION IN THE PATIENT CENTERED

MEDICAL HOME Robert A Gabbay 1;
Heather L Stuckey 2; Jessica Huntley 3; Dana Naughton 4; Michelle Miller-Day5. 1Penn State College of Medicine and Penn State Hershey Medical Center, Hershey, Pennsylvania ; 2Penn State Hershey College of Medicine, Department of General Internal Medicine, Hershey, Pennsylvania ; 3Penn State College of Medicine, Hershey, Pennsylvania ; 4Penn State University, University Park, Pennsylvania ; 5Penn State University College of Liberal Arts, University Park, Pennsylvania. (Tracking ID # 11404)
BACKGROUND: Team-based patient care is an essential element of both the Patient Centered Medical Home (PCMH) and the Chronic Care Model (CCM), and is widely accepted as a way to improve the quality of care for patients with chronic conditions. Twenty-five primary care practices in Southeast Pennsylvania that started implementing the CCM in May 2008 and became NCQA-recognized PCMHs were studied to understand their adoption of team-based care. The practices were part of the first regional rollout of the Pennsylvania Chronic Care Initiative, led by the Governors Office of Health Care Reform. The practices participated in a multi-year learning collaborative and received financial incentives to transform from six of the regions health insurers. The initial target disease was on improving diabetes with subsequent rollout to other chronic illnesses.
METHODS: Domains investigated were (1) knowledge and motivation of the team, (2) relationships within the team, (3) characteristics of a successful team, (4) satisfaction of team members, (5) leadership of the team and (6) communication. Providers and non-providers on the improvement teams at each of the 25 practices were surveyed (n=98), and interviews and focus groups were completed at 10 practices. Survey responses were analyzed for internal consistency using Cronbachs Alpha and for difference in paired groups using the Wilcoxin test with each domain and demographic characteristic. Qualitative transcripts were coded and analyzed using Nvivo. No significant differences were noted in responses between providers and non-providers.
RESULTS: Key findings that contributed to team-based care include the importance of regularly scheduled meetings, use of standing orders to empower team members, an overall redistribution of workload, recognition and rewards, facilitative leadership, an electronic medical record system to facilitate communications, and collaborative learning and sharing with other practices. Some practices more fully adopted team-based care than others, but overall participants were appreciative of the opportunity and had a positive experience.
CONCLUSION: With more and more primary care practices nationwide embracing the PCMH, these findings should help practice teams understand factors that may facilitate or hinder team-based care in their transformation work. Our research indicates that transformation and adoption of team-based care is an ongoing journey for most primary care practices.
FIVE-YEAR TIME-SERIES ANALYSIS OF A VA SYSTEMS REDESIGN INITIATIVE TO IMPROVE PATIENT FLOW Justin Glasgow 1; Peter Kaboli1. 1Iowa City VAMC, Iowa City, Iowa . (Tracking ID # 11405)
BACKGROUND: For the healthcare system to achieve its goal of improving quality of care and patient safety, hospital systems and providers must understand which quality improvement (QI) programs are successful. Unfortunately, most QI efforts are analyzed using a pre-post intervention analysis which cannot account for temporal trends nor determine whether improvements are sustained. This abstract outlines a time-series analysis of a Veterans Administration (VA) systems redesign initiative. This initiative, the Flow Improvement Inpatient Initiative (FIX), was a nationwide collaborative with goals of reducing bottlenecks, delays, waste, and errors associated with inpatient care. Two focuses of FIX were to reduce hospital length of stay (LOS) and to increase the proportion of patients discharged before noon. Our objective is to use a time-series analysis to understand the improvements associated with FIX in five outcome measures and whether any improvements are sustained in the two years after implementation. METHODS: Continuous piecewise linear regression modeling of five risk-adjusted patient outcomes; LOS, in-hospital mortality, 30-day mortality, 30-day all-cause readmission, and rates of patients discharged before noon. Analyzed data covers a 5 fiscal year period (FY05 - FY09) consisting of 1,690,191 discharges from 126 VA facilities. Models were evaluated in SAS version 9.2 using Proc AUTOREG allowing for evaluation of and correction for any autocorrelation between measurements.

The analysis focuses on identifying the pre-FIX trend (FY05-06) for each outcome measure and then identifying whether there was any change during FIX (FY07) and if the change was sustained after FIX (FY08-09). RESULTS: All five outcome measures show a steady rate of improvement throughout the 5-year study period. The modeled rate of change per year for each outcome is displayed in Table 1. Of the outcome measures, LOS, 30-day mortality and discharge before noon show improvements in FY07 that are in the desired direction and statistically different than the change predicted by the baseline rate. Both LOS and 30-day mortality show continued improvements throughout FY08 and FY09. Conversely, discharges before noon shows a leveling in FY08 and a decline in FY09. In-hospital mortality and 30-day all-cause readmission show significant changes in the undesired direction during FY07. CONCLUSION: These results show that during FIX improvements beyond baseline temporal trends occur in three of the outcome measures, with two of them showing signs of sustainability. In contrast, if FIX was analyzed

using a pre-post study design, likely all five outcome measures would exhibit improvements during FIX. Most importantly this analysis highlights the difficulties of quality improvement in healthcare by showing that achieved results are not always successfully sustained. It appears that VAs continued focus on reducing LOS has led to not only sustaining the results of FIX but the achievement of additional improvements. However, there has been less long term focus on discharges before noon and it appears those results have not been sustained. Lastly, this time-series analysis shows that FIX did not lead to improvements in outcomes beyond its scope, with in-hospital mortality and 30-day all-cause readmission rates remaining level during and after FIX. This time-series analysis shows FIX had initial success in meeting its objectives, but there is still much to be achieved in the process of obtaining and sustaining optimal patient flow in VA.

DIFFERENCES BY GENDER AND RACE IN ACADEMIC MEDICINE LONG-TERM CAREER SUCCESS Karen Freund 1; Mary Beth Howard 1; Anita Raj 2; Samantha Kaplan 1; Heather Marino 3; Katherine Lupton 1; Phyllis Carr1. 1Boston University School of Medicine, Boston, Massachusetts ; 2Boston University School of Public Health, Boston, Massachusetts ;
3Boston University, Boston, Massachusetts. (Tracking ID # 11408)

BACKGROUND: There is a paucity of longitudinal data on the association of gender and race with career successamong medical school faculty. Previous cross-sectional research has suggested disparities in research success by gender and race. We conducted a 15 year follow up of a nationally represented group of faculty over-sampled for senior womenand minorities surveyed in 1996, to identify if gender and race/ethnicity is associated with increased likelihood of research success in 2010, as measured by independent federal research funding. METHODS: The study involved a subsample selected from a cohort of 1224 medical faculty recruited in 1996 from 24 randomly selected medical schools balanced for Public/Private status and geographic region of the US. The subsample included 263 individuals who reported spending greater than 20% of time in research whensurveyed in 1996. We used the NIH RePORTER database to assess independent federal grant funding from the period of 1996 to December 2010. Bivariate, logistic and linear regression analyses were used to assess significant associations betweenrace (white, under-represented minority, and nonunderrepresented minority) andgender with our key outcome variables: total number of grants, total dollaramount of funding, and receipt of a major federal grant (e.g. R01, P01, M01,etc.) All analyses were adjusted for number of years as a faculty member, academic rank in 1996, marital status, number of children, and age.

RESULTS: Overall, 20% of men and 23%of women (p=0.18), 22% of white, 18% of under-represented and 21% of non under-represented faculty spent greater than 20% of time in research in 1996 (p=0.53). Of the 263 faculty who reported spending greater than 20% of time in research, 45% had federal funding. There were no differencesin federal funding rates between men (45%) and women (45%), and differencesbetween white (44%), nonunderrepresented (38%) and underrepresented (59%)faculty were not statistically different (p=.24). There was no significantdifference in type of grant, or funding amount between men and women in thissample.

Academic rank appeared to be the strongest predictor of receivingfederal funding, type of federal funding, and total dollar amount of funding. CONCLUSION: This is the first study to track outcomes offaculty longitudinally. These results are limited by small sample size and lackof data on number of grants submitted and non-federal funding. Of those whoreported spending greater than 20% of their time in research, there was no difference by gender or minority status. The results suggest that women andminorities who were actively involved in research achieve success in federal funding similar to their male and majority counterparts.

ARMODAFINIL IMPROVES SEVERE SLEEPINESS, AS MEASURED BY SLEEP LATENCY TIME, COMPARED TO PLACEBO IN PATIENTS WITH SHIFT WORK DISORDER Steven G. Hull 1; James K. Wyatt 2; Ryan Dammerman 3; Ronghua Yang4. 1somniTech/Vince and Associates Clinical Research, Overland Park, Kansas ; 2Rush University Medical Center, Chicago, Illinois ; 3Cepahlon, Inc., Frazer, Pennsylvania ; 4Cephalon, Inc., Frazer, Pennsylvania. (Tracking ID # 11415)

BACKGROUND: In a previous study (Czeisler, 2009), armodafinil significantly improved wakefulness in patients with excessive sleepiness associated with shift work disorder (SWD), as measured by the Multiple Sleep Latency Test (MSLT) given at night. This post-hoc analysis of the same study examined the effect of armodafinil on improving severe nighttime sleepiness based on MSLT sleep latency time.

METHODS: In a multi-center, 12-week, randomized, double-blind, placebo-controlled, parallel-group study, permanent or rotating night shift workers with nighttime sleep latencies of <6 minutes on MSLT who were diagnosed with moderate to severe SWD were administered 150 mg armodafinil or placebo 3060 minutes before a laboratory night shift, after 3 consecutive night shifts. Patients were administered the MSLT at 2400, 0200, 0400, 0600, and 0800 at baseline and at Week 12. For this analysis, severity of sleepiness was categorized using MSLT sleep latency time as follows: <5 minutes (severe), 5 to 10 minutes (diagnostic grey area), and 1020 minutes (normal). Improvements in severely sleepy SWD patients were determined by calculating the percentage of those whose sleep latency time was >5 minutes after completing the night shift.

RESULTS: A total of 226 patients were included (armodafinil, n=112; placebo, n=104). At the end of the study, 38% of armodafinil-treated patients had sleep latencies >5 minutes (17% for placebo). The percentage of patients with sleep latency >5 minutesat 2400 hourswas 49% in the armodafinil group and 30% in the placebo group. These percentages decreased throughout the night for armodafinil (42% at 0200, 33% at 0400, 22% at 0600) and for placebo (27% at 0200, 12% at 0400, 7% at 0600). There was a slight increase at 0800 for both treatment groups (26% armodafinil; 12% placebo). CONCLUSION: Armodafinil improved MSLT sleep latencies compared with placebo in patients with SWD and severe excessive sleepiness. Armodafinil resulted in sustained improvements in MSLT sleep latencies and attenuated the decline of sleep latency throughout the night shift. A percentage of patients in both groups had sustained MSLT sleep latency times that remained <5 minutes.

Czeisler CA, Walsh JK, Wesnes KA, Arora S, Roth T. Armodafinil for treatment of excessive sleepiness associated with shift work disorder: A randomized controlled study. Mayo Clin Proc. 2009;84:95872.

This research was sponsored by Cephalon, Inc., Frazer. The original study is registered on clinicaltrials.gov (NCT00080288).

USING ELECTRONIC TRIGGERS TO IDENTIFY PATIENTS AT RISK FOR DIAGNOSTIC DELAYS IN PROSTATE CANCER Daniel Robert Murphy 1; Archana Laxmisan 2; Brian A Reis 2; Eric J Thomas 3; Hardeep Singh2. 1Baylor College of Medicine Dept Family &Community Medicine, Houston, Texas ; 2Michael E. DeBakey VA Medical Center Houston Health Services Research &Development Center of Excellence, Houston, Texas ; 3University of Texas at Houston - Memorial Hermann Center for Healthcare Quality and Safety, Houston, Texas. (Tracking ID # 11418)

BACKGROUND: Delays in prostate cancer diagnosis can lead to malpractice claims and many of these delays result from lack of follow-up of abnormal prostate specific antigen (PSA) tests. Identifying patients at risk for delayed diagnosis with traditional methods, such as chart reviews, is

inefficient and cost-prohibitive when evaluating large numbers of patients. We developed an electronic health record (EHR)-based methodology using triggers (i.e., signals that prompt record review) to selectively identify records of patients at high risk of delays in prostate cancer diagnosis. METHODS: We used literature reviews and input from specialists to develop an electronic query that identified patients at high risk for lack of timely follow-up after a newly elevated PSA test. Although we tested the trigger retrospectively, it was designed for prospective application to proactively identify delays. In our preliminary work, we did not find PSAs >15 to be associated with high risk for lack of follow-up and therefore we defined elevated PSA as a result between4.1 and 15 ng/mL. High risk was defined as lack of any of the following actions within 90 days after the elevated PSA: 1) requesting a urology referral or prostate biopsy or 2) ordering a repeat PSA test. We applied the trigger to the EHR data repository of a large, tertiary care Veterans Affairs (VA) facility to identify a test cohort of patients. We then iteratively refined the trigger by conducting sequential chart reviews that identified additional clinical criteria to exclude certain patients, such as those diagnosed with prostatitis within 30 days prior to or 90 days after the PSA date, receiving palliative care, or deceased. The refined trigger was applied to all male patients between ages 40 and 70 seen at the facility between January 1 and December 31, 2009. A physician reviewer performed chart reviews using a standardized, pretested data collection instrument to assess the positive predictive value (PPV) of the trigger program. We also collected reasons for false positive triggers. RESULTS: The trigger was applied to 51,491 patients in our study cohort; 30,012 (58.3%) had PSA tests performed, of which 869 (2.9%) had a newly elevated PSA result. The trigger further excluded 420 (48.3%) patients for whom appropriate follow up actions could be detected and an additional 84(9.7%) who had expired or had prostate cancer, active prostatitis, or a terminal illness. In the remaining 363 patients at high risk (0.7% of all patients, 41.7% of those with elevated PSA), chart reviews have been performed thus far on 109 patients and revealed 88 true positive triggers (PPV=80.7%). The most common cause for false positive triggers was appropriate care by a private non-VA urologist.
CONCLUSION: EHR-based triggers appear to be useful in detecting patients with elevated PSAs at high risk for loss of follow-up. Our trigger facilitates the detection of potential delays in prostate cancer diagnosis in a large cohort of patients and thus is far more efficient in delay
detection than non-selective record reviews. Future application and testing of these triggers can potentially identify delays in diagnosis of cancer prospectively.
WHAT FACTORS INFLUENCE THE ACCURACY OF PHYSICIANS PERCEPTION OF PATIENTS HEALTH LITERACY
Letitia J Wright 1; Mary Margaret M. Huizinga 1; Sande Okelo 1; Hsin-Chieh Yeh 1; Lisa A. Cooper1.
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BACKGROUND:Physicians tend to inaccurately perceive patients health literacy, which may contribute to poor quality of care and health outcomes; however, it is unclear whether patient and patient-physician relationship factors are associated with the accuracy of physicians perception of patients health literacy. We sought to determine factors associated with physicians perception of patients health literacy. We hypothesized that patient factors, including older age and greater than high school education would be associated with overestimation of health literacy, while black race, female sex, and lack of health insurance would be associated with underestimation of health literacy. We further hypothesized that relationship factors (i.e., race concordance, gender concordance, and familiarity) would be associated with accurate physician perceptions of patients health literacy.
METHODS: We performed a cross-sectional study of baseline data from the primary care visits of 237 hypertensive patients and 41 physicians from 15 urban, community-based practices enrolled in a clinical trial.

Patients completed the Rapid Estimate of Adult Literacy in Medicine (REALM) and were categorized as having adequate health literacy if they had a score of at least 61. Physicians rated individual patients health literacy on a 5-point Likert scale from 1 functionally illiterate to 5 fully literate (patients with a score of 5 were considered literateby physicians). The outcomevariable wastheaccuracy of physicians perception of patients health literacy, categorized as accurate (physicians rating matches patients literacy level by REALM), underestimated (physician rates patient as not literate when patient has adequate literacy by REALM), and overestimated (physician rates patient as literate when patients literacy is not adequate by REALM). Patient predictor variables were age, race/ ethnicity, gender, health insurance status, and educational attainment. Relationship predictors were race and gender concordance within the dyad, and familiarity (e.g. how well the patient was known by the physician). We used multivariable multinomial logistic regression with generalized estimating equations (to account for clustering of patients within physicians) to identify

factors that are independently associated with the accuracy of physicians perceptions of patients health literacy.

RESULTS: The average age of patients was 61.7 years; approximately 35% had adequate health literacy. About 64% were women, and 62% were Black. Ninety percent had health insurance and nearly 70% were high school graduates. Almost 45% of patients saw a race-concordant physician and about 60% had physicians of the same gender. Over 39% were well known by their physicians. One hundred fifty-five (65.4%) had their health literacy level accurately judged by physicians, 54 (22.8%) were underestimated, and 28 (11.8%) were overestimated. In multivariate analyses (see table), patients with health insurance [Relative Risk Ratio (RRR) 2.83; 95% CI, 1.07 to7.46; P=0.04] and patients in gender-concordant relationships with their physicians (RRR 1.74; 95% CI, 1.03 to 2.96; P=0.04) had higher odds of having their health literacy underestimated. In contrast, patients in race-concordant relationships had lower odds of having their health literacy underestimated (RRR 0.49; 95% CI, 0.25 to 0.98; P=0.04). Patients who were well known by their physicians had higher odds of having their health literacy overestimated (RRR 2.21; 95% CI, 1.06 to 4.63; P=0.04) than accurately perceived. No patient demographic factor, other than health insurance, was associated with accuracy of the physicians assessment of patient health literacy.
CONCLUSION: Most patient demographic factors are not associated with accuracy of perceptions of health literacy by physicians. Relationship factors may result in both underestimation and overestimation of patients health literacy. These results reinforce the need for objective measures of patient health literacy in clinical care. Future work should examine whether the accuracy of physicians perceptions of health literacy influences quality of care and health outcomes.
PROJECTED EFFECT OF DIETARY SALT REDUCTIONS ON FUTURE CARDIOVASCULAR DISEASE IN ARGENTINA Raul Mejia 1; Daniel Ferrante 2; Eliseo J Perez-Stable 3; Kirsten Bibbins-Domingo 4; Pamela Coxson 5; Lee Goldman 6; Andrew Moran6. 1Hospital de Clinicas, Buenos Aires, N/A ; 2Ministry of Health, Argentina, N/A ; 3UCSF, San Fransisco, California ; 4University of California San Francisco, San Francisco, California ; 5University of California, San Francisco, San Francisco, California ; 6Columbia University, New York, New York . (Tracking ID # 11423)
BACKGROUND: The average per capita consumption of salt inArgentina is about 12 grams per day with the majority coming from processed-foods. Reducing dietary salt may have a beneficial effect on public health byreducing consequences of elevated blood pressure because elevated bloodpressure explains nearly 50,000 deaths per year.
METHODS: The Coronary Heart Disease(CHD) Policy Model is a national-scale computer model of CHD and stroke. We theCHD Policy Model to Argentinean population to quantify the benefits of a 3 gper day reduction in dietary salt. Data sourcesfor the model included vital statistics mortality data, morbidity data fromclinical sites, and cost data from public and private sectors. We estimated therates and costs of cardiovascular disease in

subgroups defined by age and sexfor the next ten years. Based on the assumption that the effect of saltreduction on blood pressure reduction was linear over the range of 0 to 3 g perday we determined the cost-effectiveness of salt reduction considering a higheffect scenario (5.6 mmHg reduction in the systolic blood pressure) and loweffect scenario (3.6 mmHg reduction in the systolic blood pressure) scenarios. RESULTS: Reducing dietary salt by 3 g per day is projected to reduce the incidence of CHD by 10%, stroke by 12%,and myocardial infarction by 7.3% and to reduce the annual number of deathsfrom any cause by 2.5%, considering the high efficacy scenario. All
segments ofthe population would benefit. The cost of implementing a salt reductionprogram, including processed foods reduction through agreements with foodindustry and population education campaigns during 10 years would be estimatedat $14 million in US dollars. Because of the reduction in hospital admissions and other health carecosts, the implementation of this program will save $974 millions US dollars inten years (discounted). In the high efficacy scenario the salt reduction willsave 262,100 QualityAdjusted Life Years (QALYs);in the low efficacy scenario this program will save 161,500 QALYs.
CONCLUSION: A 3 g per day reduction indietary salt could dramatically reduce cardiovascular events and medical costsand should be a public health target. This potential impact contributes toraise this intervention in the public health policy agenda.
USE OF CLOSE FOLLOW-UP AS A STRATEGY TO MITIGATE HARM FROM DIAGNOSTIC ERROR IN PRIMARY CARE Hardeep Singh 1;
Traber Davis Giardina 2; Samuel Forjuoh 3; Michael Reis 3; Steven Kosmach 4; Myrna Khan 2; Eric Thomas5.
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BACKGROUND: Diagnostic errors in primary care are harmful but not well studied. Ensuring close follow-up might be one strategy to minimize harm from diagnostic error, but little empirical work has examined diagnostic error and the quality of follow-up in primary care. Because visits with errors might involve greater provider uncertainty, we hypothesized that follow-up practices (e.g., scheduling follow-up, scheduling follow-up at an appropriate time interval) by providers would differ in situations involving diagnostic errors versus those with no diagnostic errors.
METHODS: We applied electronic trigger queries to electronic health record (EHR) repositories at two large health systems between October 1, 2006 and September 30, 2007 to identify records likely to contain a diagnostic error. One site was an urban VA facility with 5 on-site and 5 satellite clinics, the other a large private health care system with 4 community-based clinics. Both sites provided longitudinal care in relatively closed systems and had integrated and well-established EHRs. Trigger queries were 1) primary care index visits followed by unplanned hospitalization within 14 days, and 2) primary care index visits followed by >1 unscheduled visit(s) within 14 days. Two physicians independently reviewed cases meeting either criterion for evidence of diagnostic errors and follow-up practices. For each index visit, reviewers recorded whether the provider scheduled any future follow-up visit, and if so, whether the provider scheduled routine follow-up (i.e., non-urgent, next available follow-up for routine medical issues usually in several months) or close follow-up (i.e., within 7 or 30 days depending on the clinical situation and specifically given for uncertain diagnosis or close monitoring). Reviewers also rated whether the time to follow-up was optimal for the clinical presentation at the index visit. We compared follow-up practices between index visits with and without diagnostic error. RESULTS: In 212,165 visits, we found diagnostic errors in 177 of 997 (17.8%) triggered records. Errors included a large variety of clinical conditions, and no single condition accounted for more than 10% of all errors. Index visits with and without diagnostic errors were equally likely to have had any future follow-up scheduled by the provider

(57.0% v. 60.9%, P=.34). Similarly, comparable proportions

of index visits with and without diagnostic errors were scheduled for future routine follow-up (rather than close follow-up) at the time of the visit(43.6% v. 42.3%, P=.81). The time interval between the index visit and follow-up was judged suboptimal (i.e. not close enough) in a higher proportion of index visits with errors, although this was not statistically different from index visits without errors (36.6% v. 9.3%, P=.07). CONCLUSION: There were no differences in follow-up practices between primary care visits with and without diagnostic errors, suggesting that close follow-up might be underutilized to mitigate harm in certain visits with diagnostic error. Our findings suggest that providers might not always perceive greater clinical uncertainty or the need to initiate close monitoring in situations involving diagnostic errors. Future investigation on describing and utilizing appropriate follow-up practices in primary care might prevent patient harm from diagnostic error.

DEFINING ENHANCEMENT: RESULTS FROM A PHYSICIAN SURVEY Timothy Dawson Hotze 1; Kavita Shah 2; Emily E Anderson 3; Matthew K Wynia1. 1American Medical Association, Chicago, Illinois ; 2Thomas Jefferson University Hospital, Philadelphia, Pennsylvania ; 3University of Illinois at Chicago, Chicago, Illinois . (Tracking ID # 11431)

BACKGROUND: Medical interventions are increasingly being used in efforts to enhance human athletic, aesthetic and cognitive performance. But determining whether an intervention is an enhancement or a therapy can be murky. In particular, the same medical intervention might be considered therapeutic for some patients but an enhancement for others, based on several factors. We investigated how physicians think of the term enhancement, whether certain interventions that might be considered enhancements would be acceptable to prescribe for differing conditions, and whether these interventions should be covered by insurance.

METHODS: Mailed survey of a national random sample of 1,500 US-licensed physicians in patient-care specialties. The survey asked physicians a series of questions on how they define enhancement as opposed to therapy, whether a set of proposed medical interventions are acceptable to prescribe given different underlying patient conditions or concerns, and whether these interventions should be covered by insurance. RESULTS: Of the 633 (46.4% adjusted response rate) physicians who responded, most (81%) agreed that a medicine is an enhancement if it makes a person perform better than humans have ever been able to person in the past. Only slightly lower agreement existed if the medicine gives a person non-medical advantages in life (76%) or makes a person better than normal for their age (67%). However, only 45% think a medicine that prevents normal deterioration due to aging is an enhancement, and nearly one-third (32%) believe it is often impossible to distinguish between medicine used for enhancement and that used for therapy. Considering the same interventions used for differing reasons, vast differences were seen in physician willingness to prescribe them and the belief they should be covered by insurance.: e.g., 10% would prescribe a medicine to enhance memory for a student, but 66% would do so for a patient with Alzheimers; and 46% would prescribe a medicine to restore sexual functioning after surgery, but only 3% would do so to help a patient achieve above-normal performance. Physicians generally felt insurance should cover medicines they were willing to prescribe.

CONCLUSION: The circumstances in which medical interventions are considered to be enhancements rather than therapies is of increasing importance for economic, political and social reasons. We found a lack of consensus among physicians on when specific interventions comprise an enhancement, which could lead to unequal access to beneficial enhancements as well as dissemination of interventions by some physicians that are viewed by many other physicians as dangerous.

IMPACT AND COST EFFECTIVENESS OF THE IMPLEMENTATION OF A NEW TOBACCO CONTROL LAW IN ARGENTINA Raul Mejia 1;
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Aires, N/A ; 2UCSF, San Fransisco, California ; 3University California San Francisco, San Francisco, California ; 4Columbia University, New York, New York . (Tracking ID # 11433)
BACKGROUND: In Argentina 27% of thepopulation smokes regularly and second hand smoke exposure affects 70% ofhomes. Tobacco use is responsible for 16% of adult mortality. As in the US,there is no national and comprehensive tobacco control law, but only regionallaws with variable components. In 2010, Argentinas lower chamber of congresspassed a tobacco control law mandating 100% smoke free environments for thecountry, strong pictorial health warnings on packaging of tobacco products anda comprehensive advertising ban. However, Argentinas senate has not approvedthe law to date. Our objective is to estimate the impact and cost-effectivenessof the implementation of this law from 2010 to 2020.
METHODS: The Coronary Heart Disease(CHD) policy model, a national-scale computer model of CHD and stroke, wasadapted with data from Argentina and used to project future clinical outcomesand costs. Data sources for the model included vital statistics mortality data,morbidity data from clinical sites, and cost data from public and privatesectors. The 2005 National Risk Factor Survey provided tobacco useestimates. Based on previousstudies, the effectiveness of interventions was estimated: 60% reduction ofsecond hand smoke exposure due to 100% smoke free policies, 1% yearly reductionof tobacco consumption due to health warnings and, 2% yearly reduction oftobacco consumption due to the comprehensive ban on advertising, promotion andsponsorship. Results were expressed as lives saved, quality adjusted life yearssaved (QALYs), and coronary heart disease and strokes avoided yearly and in the10-year period between 2010 and 2020. For the cost-effectiveness analysis, the incremental cost effective-nessratio was reported, considering the current scenario of no national law, current level of tobacco use and second-hand smoke exposure. RESULTS: In the 20102020 period,180,000 all cause deaths, 45,000 coronary heart disease deaths, 110,000myocardial infarctions and 177,000 strokes could be avoided due to the fullimplementation and enforcement of this law. 756,000 QALYs could also be saved.The yearly reduction could be21.9% for myocardial infarctions, 21% for stroke,14.2% for CHD death and 7% for all cause deaths. With full implementation ofthe interventions, net savings from the health system perspective could be $951million (discounted) in ten years, even after including the interventioncosts. CONCLUSION: The final enactment of thislaw would produce significant public health benefits in Argentina similar tothe experience in California. Strong advocacy is needed at national andinternational level to get these laws approved and enforced.
DOES IMPROVED CONTINUITY OF PRIMARY CARE REDUCE AMBULATORY CARE SENSITIVE HOSPITALIZATIONS IN VA? David A Katz 1; Kim Mccoy 1; Mary Vaughn-Sarrazin1. 1University of Iowa and Iowa City VA Medical Center, Iowa City, Iowa . (Tracking ID # 11443)
BACKGROUND: Recent changes in healthcare delivery, including the movement toward more team-based care, have reduced the likelihood of

patients seeing the same primary care provider (PCP) at repeated visits. Prior studies suggest that decreased longitudinal continuity of care (COC) increases emergency department visits and unplanned hospitalizations, but evidence is mixed. The aim of the study is to evaluate the association between longitudinal continuity of care (COC) and hospitalizations for ambulatory care sensitive conditions (ACSCs) in VA outpatients.
METHODS: We conducted a retrospective cohort study of 170,487 VA outpatients who were assigned to a VISN 23 primary care provider (PCP) and had at least one primary care visit to physicians or physician extenders during each of three years (FY2007-09). Data from the 2007 Patient Care Management Module were linked to VA outpatient and inpatient datasets (including non-VA admissions to private sector hospitals that were paid for by the VA). Clinic stop codes were used to identify primary care visits; telephone contacts, home-based contacts, or contacts with a non-PCP were excluded. Three measures of longitudinal COC, Usual Provider of Continuity (UPC), Modified Modified Continuity Index (MMCI), and Known Provider Continuity (K index), were calculated for each eligible VISN 23 primary care patient (on a scale of 01, where 1 is perfect continuity); each

measure was grouped into high, intermediate, and low COC categories. Using Proc GLIMMIX, multivariable random effects logistic regression models were used to predict hospitalization for ACSCs (based on AHRQ quality indicators) during FY2009. Separate models were fit for each COC measure, controlling for demographics, disability status, chronic medical and psychiatric conditions (Elixhauser comorbidities plus generalized anxiety disorder and post-traumatic stress disorder), history of prior ACSC hospitalization during FY2007-2008, and usual site of care (modeled as a random effect).
RESULTS: The mean number of primary care outpatient visits was 4.3, and 1.9% were hospitalized for an ACSC during FY2007-08. The mean values of UPC, MMCI, and K-index were 0.77, 0.76, and 0.75, respectively; 51% of outpatients had high continuity (UPC=1), whereas 35% and 14% had intermediate (UPC=0.50-0.99) and low (UPC <0.50) continuity, respectively. In multivariable models, low and intermediate UPC was associated with an increased odds of ACSC hospitalization: adjusted OR (95% CI)=1.53 (1.34, 1.74) and 1.46 (1.32, 1.63), respectively. Using the K-index, which explicitly accounts for number of providers, low and intermediate COC groups demonstrated an increased odds of ACSC hospitalization: adjusted OR (95% CI)=1.27(1.09, 1.47) and 1.56 (1.40, 1.73), respectively; similar results were obtained for the MMCI measures.
CONCLUSION: Longitudinal continuity of VA primary care compares favorably to that reported in non-VA settings. Reductions in PCP continuity may significantly increase the risk of ACSC hospitalizations. Innovative models of care such as the Patient Centered Medical Home need to be monitored for unintended reductions in continuity with the patients PCP.
THE DISCONNECT BETWEEN HEMOGLOBIN A1C VALUES AND PATIENT PERCEPTIONS IN POORLY CONTROLLED DIABETES Anjali Gopalan 1; Haley Moss 1; Jingsan Zhu 1; Sarah Windawi 1; Kevin Volpp1. 1University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania . (Tracking ID # 11446)
BACKGROUND: Numerous studies have shown that maintaining a hemoglobin A1c value less than 7% is associated with lower rates of diabetes-related complications. The hemoglobin A1c is the standard way that information regarding current diabetes control and risk of future complications is conveyed to patients. However, it is unclear how well understood these values are to diabetic patients who have poor glycemic control. To many such patients, particularly those with low numeracy or of lower socioeconomic status, the A1c may seem like a meaningless number that is not particularly intuitive or easily understood.
METHODS: Diabetic patients seen at three of the University of Pennsylvania internal medicine practices who had a recent hemoglobin A1c value greater than 8% were contacted regarding potential enrollment in a RCT testing different approaches to providing patient feedback on glycemic control. As part of this trial, we conducted phone surveys to collect information regarding socioeconomic status, diabetes history and participant perceptions of current disease control and disease-associated risk. Also included in this survey was the Schwartz 3-item numeracy assessment tool. Using the electronic medical record, the participants hemoglobin A1c values at the time of enrollment were also collected. The primary outcomes examined for the present analyses were the relationships between a participants hemoglobin A1c value and perception of disease control and disease-associated complication risk. Comparisons were made using unpaired t-test and chi-squared analysis.
RESULTS: We enrolled 177 patients in the study between May 2010 and November 2010. Of the enrolled participants, 55% reported no formal education beyond high school and 50% reported an individual annual income of less than $20,000. The numeracy of enrolled participants was quite poor, with 90% of respondents answering none or only one of the Schwartz assessment tool questions correctly, and only 1 participant of the 177 able to answer all three questions correctly. The average hemoglobin A1c of enrolled participants at baseline was 9.85%. Several of the findings suggest low comprehension of A1c scores. For example, 24% of enrolled participants described their current level of diabetes control as excellent or good, while 37% described their level of diabetes control as poor or terrible on a five-point Likert scale. No statistically significant difference in hemoglobin A1c values was noted between these two groups (9.78% vs 10%, p=0.52). Further, there was no

statistically significant difference in hemoglobin A1c values between the 21% of participants who reported to be not at all or slightly worried about complications and the 64% of respondents who reported being very or extremely worried about diabetes-related complications (9.52% vs 9.99%, p=0.13).
CONCLUSION: Many patients with poor glycemic control do not appear to understand the hemoglobin A1c value in assessing their diabetes control or future diabetes-related complication risk. The poor numeracy noted amongst this population may contribute to this problem. Given this, it is clear that alternate information formats to the hemoglobin A1c are needed to more effectively educate diabetic patients about disease control and severity in an effort to increase insight and, eventually, improve disease-related outcomes.
RELATIONSHIP AMONG PHYSICIAN VISIT NOTE DOCUMENTATION METHODS AND PHYSICIAN AND PRACTICE CHARACTERISTICS Stephanie Elizabeth Pollard 1; Pamela Neri 1; Allison Wilcox 1; Lynn Volk 1; Deborah Williams 2; David Bates3. 1Partners HealthCare, Inc., Wellesley, Massachusetts ; 2Brigham and Womens Hospital, Boston, Massachusetts ;
3Brigham and Womens Hospital, Harvard Medical School, Boston, Massachusetts . (Tracking ID # 11448)
BACKGROUND: Clinical documentation represents an essential process within electronic health records (EHRs). It is vital for tracking patient progress, supporting clinicians diagnostic thinking and decision making, and enabling quality measurement. Under-

standing what types of methods physicians are utilizing to input their visit notes in the EHR represents an important first step in assessing how to align documentation to improve care, and may also offer insights into how to optimize system design with the correct balance between structured and free text entry. This study evaluated how physicians were documenting their visit notes in an EHR and whether documentation method was influenced by physician or practice characteristics.
METHODS: We reviewed documentation methods of 1.94 million visit notes authored in 2008 by 1,088 community-based and academic primary care physicians (PCPs) and specialists and assessed rates of documentation method use. We determined each physicians predominant documentation method (template, free form, dictation, or no one method), defined as using only one method to enter at least 75% of visit notes. Those who did not use any single method for more than 74% of visit note entries were classified as no one method users. Using data abstracted from the EHR and Provider Master Index, we performed a multinomial regression analysis to determine the relationship between documentation method and physician and practice characteristics.
RESULTS: Overall, 85% of physicians used a single method to document the majority of their visit notes. Of primary care providers, 60% documented visits predominantly using templates, while 34% of specialists predominantly used templates and another 38% predominantly dictated their notes. Physicians who predominantly used templates were more likely to work in community-based practices (p=0.004) outside of a hospital setting (p=0.032) and were more likely to be female (p<0.001) and younger (p=0.001) than those who dictate. CONCLUSION: Clear trends exist in visit note documentation methods. Physicians predominantly use a single documentation method, although individual and practice demographics appear to influence the use of one method over another. Younger physicians at community-based practices are adopting templates to document the majority of their visit notes. Better understanding of what approaches result in the best notes and highest quality of care will be useful in development of meaningful use standards for electronic visit note documentation, as well as the next generation of clinical decision support.
EFFECT OF ACID-SUPPRESSIVE MEDICATION ON RISK OF GASTROINTESTINAL BLEEDING IN HOSPITALIZED PATIENTS ON HIGH RISK MEDICATIONS Shoshana J Herzig 1; David Feinbloom 1; Michael Howell 1; Long Ngo 1; Edward Marcantonio1.

1Beth Israel Deaconess Medical Center, Boston, Massachusetts . (Tracking ID # 11449)
BACKGROUND: Although routine use of acid-suppressive medication for stress ulcer prophylaxis in non-critically ill hospitalized patients is not currently recommended, it may be warranted in certain patients at high risk for nosocomial gastrointestinal bleeding (GIB). We sought to investigate the risk of nosocomial GIB in noncrticially ill hospitalized patients on non-steroidal anti-inflammatory drugs (NSAIDs), steroids, antiplatelet agents, and anticoagulant agents, and whether or not this risk is modified by use of acid-suppressive medication.
METHODS: We conducted a pharmacoepidemiologic cohort study of patients admitted to a large academic medical center from 2004 through 2007, at least 18 years of age and hospitalized for 3 or more days. Admissions with a primary diagnosis of gastrointestinal bleeding were excluded. The main outcome measure was nosocomial GIB occurring outside of the intensive care unit (ICU), defined as any overt GIB (i.e. hematemesis, melena, or hematochezia) occuring >24 hours after hospital admission, in a patient outside of the ICU. We grouped exposures into broad classes of drugs felt to increase risk of GIB, including NSAIDs, steroids, antiplatelet agents, and anticoagulant agents. For each medication class, we evaluated its association with nosocomial GIB using propensity score models to control for confounding by indication and exposure to the other medication classes. We then assessed and quantified effect modification by acid-suppressive medication exposure. RESULTS: The final cohort included 78,394 admissions (median age=56 years; 41% men). Acid suppressive medication was used in 59% of the cohort and nosocomial gastrointestinal bleeding occurred in 224 admissions (0.29%). Neither NSAIDs nor steroids were significantly associated with nosocomial GIB, adjusted OR0.88 (95% CI 0.56-1.39) and 1.05 (0.75-1.46), respectively; furthermore, there was no significant effect modification of GIB

risk by acid suppressive medication. Significant effect modification by acid-suppressive medication exposure status was found for the relationship between nosocomial GIB and the remaining drug classes, as presented in the Table. For each drug class, the number-needed to treat (NNT) with acid-suppressive medication to prevent 1 nosocomial GIB is also presented.
CONCLUSION: In this large pharmacoepidemiological cohort of noncritically ill hospitalized patients, antiplatelet agents and therapeutic
anticoagulants were associated with significantly increased odds for nosocomial GIB. In patients being treated with these agents, acid-suppressive medication use was associated with reduced odds of GIB but the NNTs were all relatively high. Patients on dual antiplatelet therapy stood to benefit the most from acid-suppressive medication. Our results provide clinicians with useful data to balance the potential benefits of acid-suppressive medications with their increasingly identified risks.
TEN-YEAR TRENDS IN THE QUALITY OF CARE AND RACIAL DISPARITIES AFTER THE VETERANS AFFAIRS ORGANIZATIONAL TRANSFORMATION Amal Trivedi 1; Regina Grebla 1; Steven Wright 2; Donna Washington3. 1Providence VA Medical Center, Providence, Rhode Island ; 2VA Office of Quality and Performance, Providence, Rhode Island ;
3Greater Los Angeles VA Medical Center, Los Angeles, California . (Tracking ID # 11456)
BACKGROUND: The quality of care in the VA improved following an organizational transformation in the 1990s, but it is not known whether this improved clinical performance was accompanied by narrowed or widened racial disparities. We assessed trends in overall quality and racial disparities in quality for white and black enrollees in the VA healthcare system from 20002009 and examined the role of geography, site of care, and socioeconomic status as contributors to racial disparity over time in the VA. METHODS: We linked individual-level data from the VAs External Peer Review Program (EPRP) data on quality of care with Medical SAS datasets, which provided sociodemographic characteristics. We supplemented race data from Medical SAS with Medicare enrollment data, which reduced missing race data to <1%. For each quality indicator, we used generalized linear

regression to assess the independent effect of race, year, and a race-year interaction on achievement of that indicator, adjusting for demographic characteristics, Census region, and a VAMC-level fixed effect. The sample included 918,327 white and 152,700 black VA enrollees.
RESULTS: Black enrollees were younger, more likely to be residing in the South, and had lower area-level income and education than white enrollees. With the exception of breast cancer screening, aggregate performance improved over time for all indicators. Absolute differences in performance rates between white and black enrollees were less than 2 percentage points for 5 of 6 process-of-care measures during each study year. However, disparities for the four intermediate outcomes indicators ranged from 5.5 percentage points for HbA1c control in diabetes to 8.0 percentage points for cholesterol control among persons with coronary artery disease ($p<0.01$ for white-black comparisons). There were modest
declines in racial disparity for blood pressure control (7.7 to 4.9 percentage points; $p<0.01$ for race-year interaction) and cholesterol control among persons with coronary artery disease (9.5 to 7.4 percentage points; $p<0.01$ for race-year interaction). Racial disparities were statistically unchanged for HbA1c control and cholesterol control in diabetes. Adjustments for VAMC, Census region and area-level socioeconomic status produced minimal change in these disparities.
CONCLUSION: The quality of care improved and racial disparities were minimal for most measures of the process of care from 20002009. However, these improvements were not accompanied by meaningful reductions in racial disparity for important clinical outcomes. Disparities in outcomes measures were driven by different outcomes for white and black enrollees receiving care in the same VA medical center rather than concentration of black Veterans in lower performing VA facilities.
AGENDA-SETTING IN ROUTINE PRIMARY HIV CARE ENCOUNTERS Zackary Berger 1; Somnath Saha 2; P. Todd Korthuis 3; Debra Roter 4; Victoria Sharp 5; Richard D. Moore 1; Mary Catherine Beach1. 1Johns Hopkins School of Medicine, Baltimore, Maryland ; 2Oregon Health Sciences University, Portland, Oregon ; 3Oregon Health Sciences University, Vancouver, Washington ; 4Johns Hopkins School of Public Health, Baltimore, Maryland ; 5St. Lukes-Roosevelt Medical Center, New York, New York . (Tracking ID # 11459)
BACKGROUND: Effective and efficient medical interviewers invest in the beginning of each patient encounter by eliciting the full spectrum of patient concerns and setting an agenda for the visit. Agenda setting is particularly important for patients with multiple needs and complex illnesses, such as HIV/AIDS. Although studies have demonstrated that physicians often fail to elicit the full spectrum of patient concerns, few studies have described the ways in which physicians perform the tasks of eliciting concerns and the extent to which they set an explicit agenda.

METHODS: We performed a qualitative analysis of audio recorded and transcribed routine encounters between 33 HIV providers and their patients from the Enhancing Communication and HIV Outcomes (ECHO) Study. Informed by previous work in this area, we developed themes related to how the visit is opened, whether and how providers elicit patient concerns and set an agenda for the visit. We then developed a coding scheme that we applied to a random selection of 2 encounters per provider (66 encounters total). Two authors discussed and agreed on all final categorizations.
RESULTS: Patients were 66% male, 54% African American, with a mean age of 45 (range 2077). Providers were 64% female, 73% white,with a mean age of 43 (range 3057). In 41 of 66 encounters (62%), providers opened the visit with a general opening question (How are you doing?). Seven visits opened with a leading question (Everythings okay?); we found only one encounter in which the provider opened by explicitly asking which topics the patient wanted to discuss. Patients more often responded to these opening questions with brief positive statements (Fine, n=30) than with actual concerns (n=14). In only 12 encounters (18%), the provider

continued to elicit patients concerns until the patient stated that s/he had no further concerns (probe to exhaustion). In nearly half of encounters (n=30), there was no agenda statement. Agenda statements, when they occurred, often (n =20, 30%) centered on physicians, rather than patients, priorities (e.g. D: Youre here because we wanted to jump on your blood pressure). Rarely (n=3), there was an agenda statement made by the patient (P: So you want to do the blood work for my CD4 count and viral load. Can you check me for, um, is there blood work for diabetes?). Collaboratively-negotiated agendas were observed in only 3 encounters (e.g. D: Okay. Anything else goin on?/P: Uh, not really. I think Im so centered on the pain thing that I, thats my focal point now/D: Well lets make a priority). In 53% of encounters (n=35), patients brought up new concerns later in their visit.
CONCLUSION: Providers frequently use generic opening questions that may not be effective in eliciting patients concerns, and then do not typically continue to elicit the full spectrum of patient concerns. Agendas are not often explicitly stated, and when an agenda is stated, it tends to center on physicianspriorities. Negotiation of the visit agenda between patient and provider is rare. Perhaps as a result, new patient concerns continue to arise later in most encounters. Making clinical encounters more patient-centered may require training providers to more effectively investin the beginning of each encounter and develop patient-centered agendas.
DIFFERENT PERSPECTIVES OF MEDICAL HOME CAPABILITY AND PROVIDER/STAFF MORALE, SATISFACTION, AND BURNOUT IN HEALTH CENTERS Sarah E Lewis 1; Robert S. Nocon 1; Hui Tang 1; Seo Young Park 1; Anusha M. Vable 1; Lawrence P. Casalino 2; Elbert S. Huang 1; Michael T. Quinn 1; Jonathan M. Birnberg 1; Deborah L. Burnet 1; Wm Thomas Summerfelt 3; Marshall H. Chin1. 1University of Chicago, Chicago, Illinois ; 2Cornell Weill Medical College, New York, New York ; 3Advocate Health Care, Chicago, Illinois . (Tracking ID # 11464)
BACKGROUND: One of the potential benefits of the patient-centered medical home (PCMH) may be improved provider/staff satisfaction by creating a more efficient and patient-friendly work environment. Perceptions of a health centers medical home capability may differ depending on whether they are provided by frontline providers and staff or by health center leadership. Therefore, we aimed to determine the association among PCMH capability and provider/staff morale, satisfaction, and burnout at safety net health centers, and whether these associations differed depending upon whether PCMH capability was assessed by provider/staff or health center leadership.
METHODS: The study focused on 65 clinics participating in a Safety Net
Medical Home Initiative in five states (CD, ID, MA, OR, PA). CEO assessment of PCMH capability was done using the 52-item Safety Net Medical Home Scale, while Provider/Staff assessment of PCMH capability was done using a new 43-item scale. While the questions were different, both surveys assessed total PCMH score and PCMH domains of Access and Communication, Patient Tracking and Registry, Care Management, and Quality Improvement on 0100 (worst to best) scales. The Provider and Staff survey also asked about provider/staff morale, satisfaction, and burnout using single-question 5-point Likert scales for each outcome.
RESULTS: We had a 100% response rate for the CEO survey (65 total responses), and a 78% response rate for the Provider and Staff survey (604 total responses). The average Total PCMH Score for the CEO survey was 61 SD=11 and for the Provider and Staff Survey was 6113. The correlation across clinics between the two scores, however, was low (r=.23, p<.001). 68% of providers and staff rated their morale as good or better, 78% agreed or strongly agreed that they were satisfied with their job, and 61% reported no symptoms of burnout. In unadjusted logistic regression, a 10% increase in total PCMH score measured by providers and staff was correlated with good or better provider/staff morale (Odds Ratio (OR) 2.78, 95% Confidence Interval (CI) 2.19-3.54), positive satisfaction (OR 2.10, CI 1.69-2.60), and freedom from burnout (OR 1.84, CI 1.52-2.23). However, total PCMH Score measured by CEOs was not significantly associated with provider/staff morale and satisfaction. Total PCMH Score measured by CEOs was significantly associated with provider/staff burnout (OR .84, CI0.73-.96), but in this case a 10% increase in the CEOs PCMH score was associated with worse

provider/staff burnout.
CONCLUSION: Using 2 different survey instruments, providers and staff had different perceptions of their clinics PCMH capability compared with CEOs. PCMH capacity assessed by providers and staff was associated with better provider/staff morale, increased satisfaction, and less burnout. However, PCMH capacity measured by CEOs was not significantly correlated or else was inversely correlated with provider/staff morale, satisfaction, and burnout. The most appropriate perspectives and data sources for PCMH assessment may depend upon the purpose of the analysis.
FEASIBILITY OF A WEB-BASED TREATMENT DECISION TOOL FOR OLDER PATIENTS WITH DIABETES
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BACKGROUND: Patients >65 years represent over 40% of patients living with diabetes (DM). However, it is unclear if glycemic control targets developed for the general population of DM patients are appropriate for all older patients. Therefore, we developed a web-based Geriatric Diabetes Decision Aid (GDDA) which combines a decision analytic model of DM complications with a geriatric life expectancy prediction tool. The GDDA encourages glycemic control discussions by educating patients on hemoglobin A1c (A1c), eliciting patient treatment preferences, delivering prognostic information to providers, and providing personalized data on the risks and benefits of glycemic control targets. However, to date, little is known about the best ways to display this information to older patients with DM and their providers. We present the patients and provider acceptability testing of the GDDA. METHODS: Currently, 6 patientsand 6 providers from local federally qualified health centers were interviewedutilizing qualitative methods regarding computer usage patterns, patient A1cliteracy, as well as their opinions on different methods of visually displayingthe lifetime risk of amputation at different glycemic targets (A1c of 7, 8, and9%). Options included a bar graph, simple and detailed tables, and pictograms. Patientsand providers were also

asked questions about the websites overall usabilityand design. Interviews were audio recorded and transcribed for accuracy andtheme saturation. Patients and providers used the website throughout theinterview. RESULTS: Mean patient age was 68 and 50% were female. 5 providers were male. All the providers were either in family medicine or internal medicine. One patient regularly used a computer at home and at work, and two occasionally used but did not own computers. When tested on their knowledge about A1c, only two out of six patients recognized the definition. All physicians agreed that most patients do not comprehend the definition of an A1c. Risk display results were different between patients and providers. Five patients preferred simple tables which showed the incidence of amputation per thousand patients. All providers thought patients would prefer separate pictograms for displaying the incidence of amputation with different A1c targets. Patients and providers agreed that the use of color and pictures, large print, simple wording and easy to operate navigation and scroll buttons were a necessary part of the website design. All patients agreed that the GDDA is a tool that could assist in learning about A1c and discussing treatment goals with their doctor. All providers thought the GDDA could be a useful tool to stimulate conversation regarding A1c targets with their patients.
CONCLUSION: The GDDA is an instrument that may be able to assist patients and providers in determining individualized glycemic control targets. Pictures, simple wording, and easy navigation buttons can increase usability. A1c literacy continues to be an issue for patients which may be a barrier to glycemic control discussions. Provider opinions should not be used as a proxy for patient opinions in determining the acceptability of website design.
BUILDING A COMMUNITY-BASED ACADEMIC PRIMARY CARE AND CHRONIC DISEASE MANAGEMENT PROGRAM IN WESTERN KENYA: APPROACH AND INITIAL RESULTS
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BACKGROUND: Through the Presidential Emergency Plan for AIDS Relief (PEPFAR), the U.S. has committed $60 billion for HIV/AIDS care in developing countries. Indiana University in partnership with Moi University in Kenya and a consortium of more than a dozen North American universities launched the Academic Model Providing Access to Healthcare (AMPATH). AMPATH has established HIV/AIDS clinics in 50 rural and urban health centers and hospitals that serve a catchment population of 2 million. To date, with more than $85 million in PEPFAR funding, AMPATH has enrolled more than 130,000 HIV-infected patients who have made more than 2.5 million visits to AMPATH clinics. In 2007, AMPATH decided to expand its mission to include community- and facility-based primary care and chronic disease management (CDM), focusing initially on heart and lung disease, cancer, diabetes, and mental health. In 2010, PEPFAR expanded its mission beyond HIV/AIDS to focus on strengthening health care infrastructure in selected developing countries and was renamed the Global Health Initiative. We discuss the approaches AMPATH has taken, to tools it has developed, progress to date, and future plans.

METHODS: AMPATHs approach is termed FLTR: find, link, treat, retain. Focusing on a subpopulation of 500,000, HCTand a network of community health workers identifies patients with HIV, TB, pregnancy, and chronic conditions and refers them to AMPATH clinics. AMPATH employs more than 150 counselors in a home counseling and testing (HCT) program. Working

with local community facilitators, counselors contact all households in a community and attempt to register each member, interview and screen each adult, and enter data into Android phones linked to a sophisticated electronic health record (EHR). They screen those 13 and older for HIVand those coughing for TB, deworm children, issue bednets, and refer those HIV +, pregnant, or with medical problems to AMPATH clinics. A new EHR module captures primary care and CDM data from HCT and clinic encounter forms. The EHR provides data for patient care and clinic management including patient summaries, protocol-based reminders, and drug and visit adherence data. Treatment is mostly by physicians assistants and nurses using standard protocols and encounter forms. An aggressive outreach program traces no-shows.

RESULTS: To date, HCT counselors have approached 454,598 persons: 98% agreed to be interviewed and 96% of these were screened for HIV (2.5% or more than 5000 were HIV+) and TB (45 new cases found). Of those referred to AMPATH clinics, only 17% have visited to date, but >90% of pregnant women have kept visits. The primary care EHR has been initially installed in 3 rural primary care clinics which have enrolled and have visit data for more than 50,000 patients. At clinics affiliated with the national Moi Teaching and Referral Hospital (MTRH), more than 130,000 patients have been enrolled, and visit data are being collected at TB, Antenatal, and Pediatric Clinics. Existing cardiology, pulmonary, oncology, diabetes, and mental health primary care and referral clinics at MTRH are being enhanced by training health care providers, expanding the available tests and treatments, and providing clinic-specific encounter forms. To improve care and outcomes, the AMPATH Research Network supports >70 active research projects funded by grants totaling >$30 million. CONCLUSION: A large, established academic HIV/AIDS partnership in western Kenya is expanding to include primary care and CDM. HCT has been successfully performed on almost half a million persons to identify those needing HIV/AIDS care, primary care, and CDM. However, referring patients to clinic-based care has proved challenging, yet success among pregnant women is encouraging. HCT is adding community-based screening for hypertension and diabetes to screening for HIV and TB, and AMPATH clinics are expanding to care for heart and lung disease, cancer, diabetes, and mental health. AMPATH is training a core of community health workers who will implement future community-based public health programs. Maturation of EHRs and collecting a core set of data are necessary for managing care systems of this size and for providing data for monitoring and

improving care. The research component serves the care system by providing the knowledge base for care improvement.

ACCIDENTAL BOWEL AND BLADDER LEAKAGE: COMMON YET UNDER-DIAGNOSED CONDITIONS Heidi Brown 1; Emily Lukacz2.

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BACKGROUND: Urinary and fecal incontinence are common conditions which negatively impact quality of life. While there has been an increase in awareness of urinary incontinence (UI), fecal incontinence (FI) remains under-reported, likely due to associated humiliation and embarrassment. Prevalence rates for UI range from 12 - 38%, and 38 - 55% reportedly seek care [16]. Despite prevalence rates for FI that range from 5 - 24% among community-dwelling US women, only 8-40% discuss it with their doctors [1, 2, 616]. This study aimed to further define the prevalence of and compare care-seeking behaviors for FI and UI among community-dwelling US women. METHODS: An internet-based survey of women 45 years was conducted by Nielsen via the BASES e-panel. Participants were asked about accidental leakage of urine, liquid and solid stool using questions derived from validated questionnaires. Accidental bowel leakage (ABL) was defined as any loss of solid or liquid stool in the past 12 months; UI was defined as any

episode of urinary leakage or incontinence in the past 12 months. Women with ABL were asked how they would prefer this leakage be described. Information was collected regarding demographics, medical history, coping and care-seeking for UI and ABL. Chi square and Mann Whitney U testing were used to compare care-seeking for ABL and UI.

RESULTS: The response rate was 81% (5,817/7,201); 80% were White, 9% African-American, and 6% Hispanic, with median age 5559 (range 45 to >85); 88% had health insurance, and 90% had a primary care provider. The prevalence of ABL and UI in the past 12 months were 19% (n=1,096; 95% CI 17.8 - 19.9%) and 46% (n=2,664, 95% CI 44.5 - 47.1%), respectively. While 75% of the survey population had heard of UI, only 23% and 33% had heard of fecal or bowel incontinence, respectively. Among 1,096 respondents with ABL, only 31% (339) had heard the term fecal incontinence and 40% (442) had heard the term bowel incontinence. When asked which term they would prefer, 71% (667) preferred the term accidental bowel leakage; 23% (211) preferred bowel incontinence and 6% (60) preferred fecal incontinence.

Only 8% (76) of women with ABL had been diagnosed by a health professional, as compared with 25% (644) of women with UI ($p<0.001$). Care-seeking data were available for 86% (938) of women with ABL and 97% (2,588) of women with UI. Of women with ABL, 28% (271) were not at all comfortable or somewhat uncomfortable discussing this condition with their doctor, as compared to only 15% of women with UI ($p<0.001$). Similarly, 29% (268) of women with ABL, vs. 47% (1,212) of women with UI, had ever discussed their condition with a provider ($p<0.001$). More than half of women with ABL or UI who discussed their condition did so with their family physician (figure 1). Women with UI were more likely to consult their ob/gyn or urologist than their internist while women with ABL were more likely to consult their gastroenterologist. CONCLUSION: ABL and UI are common conditions, but most women do not address them with their doctors. Women with UI are more likely than women with ABL to discuss their condition with a doctor. The overwhelming majority of women with fecal incontinence would prefer to use the term accidental bowel leakage to describe it. Thus, primary care providers should ask patients about both UI and ABL - using this preferred term - on routine review of systems to provide women appropriate care.

PHYSICIAN-PATIENT COMMUNICATION AND COLORECTAL CANCER SCREENING AMONG LATINO PATIENTS Eliseo J Perez-Stable 1; Anna Napoles 2; Jasmine Santoyo-Olsson2. 1UCSF, San Fransisco, California ; 2University California San Francisco, San Francisco, California . (Tracking ID # 11478)

BACKGROUND: Latinos are less likelythan Whites to obtain any type of colorectal cancer (CRC) screening with 2009CDC rates of 50% compared
to 65%. Furthermore, even though incidence of CRC is lower for Latinos, they aremore likely to be diagnosed with advanced disease of Stage 3 or 4, andexperience poorer 5-year survival once diagnosed. Some of the barriers to CRCscreening among Latinos can be addressed with good physician-patientcommunication such as fear, worry, and fewer perceived benefits. Our objectivewas to assess associations between components of physician-patient communicationand CRC screening rates among Latinos in a community clinic setting.
METHODS: We conducted a cross-sectional telephone survey of Latino-patients aged 50 and older with no history of CRC from three community clinicsand a large multispecialty practice in Northern and Southern California. Predictors were survey measures thatassessed patients perceptions about physician communication about CRCscreening. These included whetheror not (yes vs. no) physicians explained CRC risks and tests; elicitedpatients CRC screening barriers; were responsive to patients CRC screeningconcerns; discussed ways to reduce the risk of CRC; and the amount of physicianencouragement of CRC screening (none or a little vs. quite a bit or a lot).Outcomes were fecal occult blood test (FOBT) in the previous year vs. noscreening, and sigmoidoscopy in the previous 5 years or colonoscopy in theprevious 10 years vs. no screening. Demographic variables, limited English language proficiency (LEP)status, concordance with physician language skills, and insurance type wereascertained. RESULTS: Using lists of patientsseen in the clinical settings, we sent 1,314 initial contact letters, 910 patients were reached on thetelephone, and 504 patients completed the survey (38% of original samplingframe). Mean age was 61 years (SD=8.4), 69% were women, 53% had less than ahigh school education, 77% were born in Latin America, and 62% spoke Englishless than very well (LEP). Almosthalf (46%) reported obtaining endoscopy (with or without FOBT), 13% had FOBTonly, and 41% reported no screening of any type. For FOBT, after adjusting forsocial and demographic factors, CRC risk, site of care, language concordance,and the other communication variables, receiving more physician encouragementof CRC screening (OR=6.97, 95% CI 2.91, 16.70) was the only communicationfactor associated with being screened. For endoscopy, discussing ways to reduce CRC risk (OR=2.73, 95% CI 1.13,6.63) and receiving more physician encouragement for CRC screening (OR=6.31,95% CI 3.28, 12.14) were associated with screening in the adjusted model.
CONCLUSION: Among Latinos, the degree to which patients perceived thattheir physicians encouraged CRC screening was much more strongly associatedwith being screened than other components of communication. These data would support acommunication model where physician recommendation is central and there is lessattention to eliciting barriers or concerns.
LYMPHOPENIA AS A PROGNOSTIC FACTOR FOR OVERALL SURVIVAL IN COLON, LUNG, AND PANCREATIC CARCINOMAS Maral Kojaian 1; Siva Talluri 1; Radhika Kakarala1. 1McLaren Regional Medical Center, Flint, Michigan . (Tracking ID # 11479)
BACKGROUND: Lymphopenia in cancer patients has been found to be an independent negative prognostic factor for overall survival and disease-free survival in various hematological cancers, soft tissue sarcoma, and metastatic breast cancer. Its association with overall survival in colon, lung, and pancreatic cancers is uncertain.
METHODS: This is a preliminary retrospective analysis of data from the Great Lakes Cancer Center and the McLaren Regional Medical Center cancer registry, Flint, MI. Overall survival rate is defined as the time from the date of diagnosis to the date of death or the date when the patient was last known to be alive. Cox proportional hazards modelling was used to calculate hazard ratios for death from each of the three cancer types by lymphopenia status prior to treatment.

RESULTS: Data from 141 patients were analyzed (80 colon, 31 lung, and 30 pancreatic cancer). The prevalence of lymphopenia of <1,000 cells/ mL before treatment among colon, lung, and pancreatic cancers was 39%, 35%, 20%, respectively.

Lymphopenia tended to be more prevalent among older patients with colon cancer (43% versus 31%), lung cancer (39% versus 25%) and in pancreatic cancer (22.7 % versus 12.5 %). Similarly there was an increased prevalence among patients with well- or moderately-differentiated versus poorly differentiated colon cancer (44.1% vs 22.2%) and pancreatic cancer (40% vs 25%). In addition lymphopenia was more prevalent among non-small compared to small cell type lung cancer (37% vs 29%). The differences were not statistically significant in this small sample.
Median survival time in months was lower in patients with lymphopenia in all the three cancer groups: colon (49 vs 93; P=0.290), lung (27 vs 54; P=0.120) and the difference was statistically significant for pancreatic cancer (1 vs 8; P=0.001). The hazard ratio for death from pancreatic cancer in patients with lymphopenia compared to those without lymphopenia was 4.1 (95% CI: 1.09-15.85; P=0.037) after adjustment for age and tumor grade.
CONCLUSION: Our findings suggest that lymphopenia prior to treatment is a prognostic factor in overall survival for pancreatic cancer and potentially also for colon, and lung cancers.
ASSOCIATION OF MEDIA LITERACY WITH CIGARETTE SMOKING AMONG INDIGENOUS YOUTH IN ARGENTINA Eliseo J Perez-Stable 1;
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6ICTER, Jujuy, N/A . (Tracking ID # 11481)
BACKGROUND: Latin America has the highest prevalence of tobacco use by youth. Media literacy, defined as the ability to analyze and evaluate media messages, has been associated with lower smoking among youth in the US. We sought to determine whether media literacy related to smoking is independently associated with current smoking and susceptibility to future smoking in a sample of mostly indigenous youth inJujuy, Argentina.
METHODS: In 2006, a survey was conducted among eighth-grade students in class and from a random sample of 27 urban and rural schools stratified by region in Jujuy. Standard items adapted from the CDC global youth tobacco surveys were used, including those assessing previously identified risk factors for smoking such as peer smoking, adult smoking at home, use of alcohol, depression, school performance, and thrill-seeking attitudes. Survey items measured smoking behavior (ever, never, and current) and susceptibility to future smoking among never smokers (definitelynot likely to smoke or in the future); five items assessing smoking media literacy (SML) were adapted and translated from an existing 18-item measure.The SML scale included items such as There are often hidden messages in cigarette ads, with 4 ordered response options ranging from 1 (strongly disagree) to 4 (strongly agree). An average score of >3 was considered high media literacy.
RESULTS: Of the 3470 respondents, 53% were girls, and the majority of respondents were of indigenous (67%) or mixed indigenous/European (21%) ethnicity. About half had had at least one parent who smoked, and having 5 or more friends who smoke (57%), depressive symptoms in the previous year (38%), and consumed alcohol in theprevious week (36%) were common. 1170 (34%) reported having smoked in the previous 30 days and were defined as current smokers. Of the 1430
students who had never smoked a cigarette, 912 (64%) were susceptible to future smoking. High media literacy was present in 38% of the sample. Unadjusted models showed a significant association of SML with current smoking (OR=0.83; 95% CI 0.73 - 0.95) and susceptibility to future smoking (OR=0.79; 95% CI 0.65- 0.97). Fully adjusted models for age, gender, race, parents education level,parents employment status, two-parent household, parental smoking, friends smoking, depressive symptoms, thrill-seeking orientation, alcohol use in thepast week, work during class period, and repetition of a grade level showed that high SML was significantly associated with lower odds of being current smoker (OR=0.81; 95% CI 0.67-0.97) and of being susceptible tofuture smoking (OR=0.73; 95% CI 0.58-0.92) among those who had never smoked.

CONCLUSION: Among youth in Jujuy,higher SML was significantly associated with both lower current smoking and among never smokers, less susceptibility to future smoking. There is sufficient evidence now to evaluate the incorporation of a media literacy curriculum as a standard component of school-based education and to investigate the efficacy of smoking media literacy interventions among diverse populations.

THE USE OF SPANISH LANGUAGE SKILLS BY PHYSICIANS AND NURSES: POLICY IMPLICATIONS FOR TEACHING AND TESTING Lisa C. Diamond 1; Delphine S. Tuot 2; Leah Karliner2. 1Palo Alto Medical Foundation Research Institute, Palo Alto, California ; 2University of California, San Francisco, San Francisco, California . (Tracking ID # 11488)

BACKGROUND: Language barriers can prevent clinicians from obtaining an adequate history and may lead to longer hospital stays and higher readmission rates. Clinicians bridge this barrier in various ways, including using interpreters and using their own non-English language skills with patients. Although full language concordance between limited English proficient patients and clinicians is beneficial, the effects of partial language concordance are unknown. We sought to describe how clinicians with various levels of Spanish language proficiency use interpreters or their own Spanish skills in common clinical scenarios in the hospital setting.

METHODS: Primary data were collected from 8/2007-12/2008. The study focused on the 66-bed General Medicine floor of a 400-bed urban academic medical center with an ethnically and linguistically diverse patient population. We surveyed physicians and nurses who reported ever speaking Spanish with patients to rate their own Spanish proficiency on a 5-point scale, and then asked about use of specific strategies (own Spanish skills, professional or ad-hoc interpreters) to overcome the language barrier during common clinical interactions with Spanish-speaking patients.

RESULTS: Sixty-eight physicians and 65 nurses participated. Physicians with low Spanish proficiency (n=34) reported frequent use of adhoc interpreters (46-50%) for all information-based scenarios, except for pre-rounding in the morning: 62% reported using their own limited Spanish skills. For difficult conversations and procedural consent, most used professional interpreters. Compared to low proficiency physicians, medium proficiency physicians reported higher rates of using their own Spanish skills (38-94%) for information-based scenarios (except for procedural consent: 88% professional interpreter use), lower rates of professional interpreter use (33-39%), and little use of ad-hoc interpreters, except for communicating discharge instructions (25%). They rarely used their own Spanish skills or ad-hoc interpreters for difficult conversations. High Spanish proficiency physicians almost uniformly reported using their own Spanish skills. The majority of nurses had low Spanish proficiency (n=53). Most of these used some kind of interpretation, although frequently ad-hoc interpreters, for: discharge instruc-

tions (28%), explaining plan of care (31%), discussing disease process (19%) and explaining tests and procedures (20%). For other common clinical interactions, they were more evenly split in use of all strategies, including their own limited Spanish skills for: administering medication (31%), symptom management (37%) and conducting ongoing patient assessments (35%).

CONCLUSION: Physicians and nurses with limited Spanish proficiency use these skills, even in important clinical circumstances in the hospital. Healthcare organizations should evaluate clinicians non-English language proficiency and set policies about use of language skills in clinical care. More research is needed to inform such policies, particularly for medium-proficient clinicians; however, those with low proficiency should utilize professional interpreters.

UNDIAGNOSED AND UNCONTROLLED HYPERTENSION AND HYPERLIPIDEMIA AMONG IMMIGRANTS IN THE UNITED STATES Leah Zallman 1; David Himmelstein 2; David Bor 3; John Ayanian 4; Andy Wilper 5; Danny McCormick6. 1Cambridge Health Alliance/Harvard Medical School, Cambridge, Massachusetts ;

2Cambridge Health Alliance/City University of New York School of Public Health, Cambridge, Massachusetts ; 3Cambridge Health Alliance, Jamaica Plain, Massachusetts ; 4Brigham and Womens Hospital, Boston, Massachusetts ; 5University of Washington School of Medicine, Boise, Idaho ; 6Cambridge Health Alliance, Cambridge, Massachusetts . (Tracking ID # 11494)
BACKGROUND: Cardiovascular disease is the major cause of mortality among both the native and foreign born. Hypertension and hyperlipidemia are major modifiable risk factors for cardiovascular disease. We are unaware of nationally representative studies examining differences between immigrants and the native born in rates of undiagnosed and uncontrolled hypertension or hyperlipidemia, or the impact of insurance status on these relationships.
METHODS: We conducted a cross sectional analysis of a nationally representative sample of adults from the National Health and Nutrition Examination Survey (NHANES), 19992008 to assess the risk of having undiagnosed and uncontrolled hypertension and hyperlipidemia among foreign born (FB) individuals relative to the native-born. Participants were considered diagnosed if they reported (1) being told by a physician or health professional that they had the condition or (2) taking medications for the condition. They were considered undiagnosed if they had physical exam or laboratory findings of the condition (hypertension: SBP >140 mmHg or DBP >90 mmHg; hyperlipidemia: not reaching Adult Treatment Panel II or III goals) but were not diagnosed. Participants were considered uncontrolled if they were either diagnosed or undiag-nosed but did not meet accepted criteria for control (hypertension: SBP >140 mmHg or DBP >90 mmHg; cholesterol: not reaching Adult Treatment Panel II or III goals).We used logistic regression analysis to determine the odds of having undiagnosed and uncontrolled hypertension and hyperlipidemia, among FB compared with US-born participants. Our initial models adjusted for place of birth, age and gender. We then sequentially added health insurance, income and race/ethnicity to explore whether these factors explained differences in diagnosis and control rates between the FB and US-born.
RESULTS: Of 28,821 adults, the 6,601 FB were younger, more likely to be male; Hispanic or other ethnicity; have incomes <$20,000 or missing; be uninsured; and to speak primarily Spanish, Spanish and English equally, or other language at home, as compared to US-born. In age-and-gender adjusted analyses, FB were more likely to have
undiagnosed hypertension (OR 1.35, 95%CI 1.12-1.62, p 0.0016), uncontrolled hypertension (OR 1.38, 95%CI 1.16-1.64, p=0.0004), undiagnosed hyperlipidemia (OR 1.32, 95%CI 0.98-1.78, p=0.0656), and uncontrolled hyperlipidemia (OR 1.32, 95%CI 0.98-1.77, p=0.0683), although these last two outcomes were of borderline significance. Adjusting for insurance status moderately attenuated the association between foreign birth and all outcomes, although hypertension control and diagnosis remained statistically significant. Adjustment for income had little effect on the findings. Additional adjustment for race/ethnicity further attenuated the association of foreign birth with hypertension diagnosis and control (no longer statistically significant).
CONCLUSION: Immigrants are at increased risk of undiagnosed and uncontrolled hypertension, and may be at risk of undiagnosed and uncontrolled hyperlipidemia. These disparities are substantially reduced by controlling for insurance. Improving immigrants rates of insurance coverage could decrease their risk of undiagnosed and uncontrolled cardiovascular risk factors and may therefore reduce future cardiovascular morbidity and mortality.
INCIDENCE AND PREDICTORS OF MEDICATION NON-ADHERENCE AFTER HOSPITALIZATION Marya Cohen 1; Shimon Shaykevich 2; Courtney Cawthon 3; Sunil Kripalani 3; Michael Paasche-Orlow 4; Jeffrey Schnipper5. 1Massachusetts General Hospital, Brookline, Massachusetts ; 2Brigham and Womens Hospital, Boston, Massachusetts ;
3Vanderbilty University Medical Center, Nashville, Tennessee ; 4Boston Medical Center, Newton, Massachusetts ; 5Brigham and Womens Hospital, Sharon, Massachusetts . (Tracking ID # 11504)
BACKGROUND: Medication adherence is a key factor in patient safety. Medication management during the transition from inpatient to outpatient medical care is particularly complex and confusing to patients. Optimizing

post-discharge medication adherence is a crucial target for avoiding adverse events and rehospitalization. Nevertheless, few studies have focused on the incidence and predictors of post-discharge medication safety and adherence.
METHODS: The Pharmacist Intervention for Low Literacy in Cardiovascular Disease (PILL-CVD) study is a federally-funded, dual site randomized control trial using pharmacist-assisted counseling and follow-up to improve post-discharge medication safety among patients hospitalized for cardiovascular disease. In this secondary data analysis, we analyzed predictors of medication adherence in the 30 days after discharge based on patient self-report. An adherence score for each patient was calculated as the mean adherence in the previous week of all regularly scheduled medications. Multivariable linear regression with multiple imputation for missing covariates was used to determine the independent effects of a priori chosen patient characteristics on post-discharge adherence.
RESULTS: We analyzed data from 646 patients at both clinical sites. The population was predominantly white, male and insured; patients on average were in their 60 s, had a high level of education, and took an average of 8 daily medications The average post-discharge adherence score was 95%, and fewer than 10% of patients had an adherence score of less than 85%. Significant predictors of lower post-discharge adherence included younger age, Medicaid insurance (as opposed to private insurance), and baseline adherence (based on the 4-item Morisky scale). For every 10 year increase in age, there was a 1% absolute increase in post-discharge medication adherence (95% CI 0.4, 2.0). As compared to patients with private insurance, patients with Medicaid insurance were 4.5% less adherent at 30 days (95% CI 7.6, -1.4). For every 1-point increase in baseline medication adherence score, there was a 1.6% absolute increase in post-

discharge medication adherence (95% CI 0.8, 2.4).
CONCLUSION: In patients hospitalized for cardiovascular disease, predictors of lower 30-day post-discharge adherence included younger age, Medicaid insurance, and baseline non-adherence. It may be prudent to assess baseline adherence and be cognizant of insurance status in hospitalized patients in order to identify those who may benefit from additional interventions to improve medication adherence following hospital discharge.
UNDERSTANDING TRANSITIONS IN HOSPITAL CARE FOR THE HOMELESS PATIENT: A MIXED-METHODS, COMMUNITY-BASED PARTICIPATORY APPROACH S. Ryan Greysen 1; Becca Allen 2; Georgina Lucas 1; Marjorie Rosenthal 1; Emily Wang3. 1Yale University RWJ Clinical Scholars Program, New Haven, Connecticut ; 2Columbus House Shelter, New Haven, Connecticut ; 3Yale University Division of General Internal Medicine, New Haven, Connecticut . (Tracking ID # 11516)
BACKGROUND: Coordinating transitions in hospital care for patients experiencing homelessness is challenging yet there are limited data from the perspective of homeless patients to guide hospital-based and shelter-based interventions to improve transitions in care. METHODS: We partnered with Columbus House, a large homeless shelter in New Haven, CT to better understand the experience of homeless patients seeking acute care at area hospitals. We conducted two focus groups with homeless clients and twelve in-depth, individual and group interviews with staff at Columbus House to inform our design of a semi-structured interview targeting homeless clients who reported at least one visit to an area hospital in the last 12 months. The interview included questions about socio-demographic factors such as age, gender, race/ethnicity, and reported length of homelessness. We also inquired about total visits to area hospitals in the past year, setting of care for these visits (inpatient vs. ED only), and patient experiences in the hospital. We used mixed-methods to analyze our data: we performed qualitative analysis of responses to open-ended questions with independent coding by a multidisciplinary team using the constant comparative method, and we performed multivariable logistic regression of survey data to determine factors that might identify patients at greatest risk for difficult transitions.
RESULTS: Ninety-eight homeless individuals were enrolled in our study from 3/15-5/15/2010: 78 (80%) were

male and reported race/ethnicity was 42% black, 41% white, 16% Hispanic. Average age was 44 years and average reported length of homelessness was 2.8 years. Fifty-two (56%) of respondents reported being admitted for inpatient care whereas 44 (46%) reported receiving care in the ED only.
Fifty-nine (60%) respondents reported that they had delayed seeking care at a hospital after recognizing they needed help. Multivariable analysis showed a significant relationship between delay and increasing number of total hospital visits in the last year (OR 1.2; 95% CI 1.0-1.5). In both quantitative and qualitative analyses, participants expressed concerns about discharge timing, transportation, and coordination with the shelter. As one participant explained, they should make sure people dont leave late at night and that they have a safe ride to a safe place to stay. Twenty-six (27%) participants reported being discharged after dark and 61% reported having no plan for safe post-discharge transportation. In multivariable analysis, patients seen in the ED were more likely than inpatients to be discharged after dark (OR 2.7; 95% CI1.0-7.3) and less likely to have post-discharge transportation arranged (OR 0.16; 95% CI 0.1-0.6).
After discharge from ED or inpatient unit, 64% of participants reported going to a shelter the first night, 10% reported staying with friends or family, and 11% reported staying on the streets with no shelter whatsoever. In multivariable analysis, only discharge after dark was significantly associated with staying on the streets vs. staying in a shelter (OR 8.3; 95% CI 1.9-35.9). One participant summed the views of many: sometimes miscommunication between the hospital and shelter is a problem - the hospital sends you there, but then you cant get in. CONCLUSION: Homeless patients report many barriers to seeking acute care and may be more likely to delay care if they have frequently accessed acute care services in the past year. Furthermore, setting of care (emergency department vs. inpatient unit) and time of discharge may be important indicators of ability to access shelter on the first night after discharge. Healthcare providers encountering homeless patients in non-acute settings should be aware of reasons their patients may delay seeking acute care and providers in acute settings should pay particular attention to time of discharge and post-discharge transportation. Both hospital and shelter staff should strive for greater communication to coordinate a safe disposition for patients transitioning from acute care to community settings.
CLINICAL DECISION MAKING FOR THREE COMMON INPATIENT MEDICAL CONDITIONS Kristofer L Smith 1; Sarah Ashburn 2; Joseph S Ross3. 1Mount Sinai School of Medicine, New York, New York ; 2Johns Hopkins School of Public Health, Baltimore, Maryland ; 3Yale School of Medicine, Yale, Connecticut . (Tracking ID # 11517)
BACKGROUND: Despite well-described guidelines for several clinical conditions, physicians often make medical decisions not supported by evidence or guidelines. Using clinical vignettes, we examined clinical decisions, and the reasoning behind those decisions, for three common medical admissions: heart failure, syncope and pneumonia. METHODS: We conducted a cross-sectional survey of attending physicians and post-graduate year two and three residents at one internal medicine program in New York City. Clinical vignettes for heart failure, syncope, and pneumonia included a brief clinical scenario and a varying number of further management decisions: diagnostic tests, consultations, and treatments. Likert scales were used to determine the likelihood of making the clinical decision. Responses were subsequently grouped as All and Most of the time versus Some, Rarely and Never. Multiple choice was used for respondents to indicate one or more rationales for the decision: local practice, supporting data or guidelines, malpractice concerns, academics, rule outs, or supervisor expectations. Each vignette included clinical decisions for which there was either strong evidence or guideline support (Level 1 decisions) or for which there was no evidence or guideline support (Level 3 decisions). The heart failure, syncope and pneumonia vignettes included 10, 6, and 7 Level 1 decisions and 9, 10, and 11 Level 3 decisions respectively. Using Wilcoxon signed rank tests, the proportions of Level 1 and Level 3 decisions selected All or Most of the time were compared between attending physicians and residents and between physicians who did and did not have or plan to have primarily general internal medicine clinical responsibilities.

RESULTS: Our sample included 79 physicians; 68 (86.1%) were younger than 40 years of age and 34 (43.0%) were female. There were 31 attendings (39.2%) and 48 residents (60.8%) and 39 (49.4%) had or planned to have primarily general internal medicine clinical responsibilities. Overall, physicians selected 86.5% of Level 1 decisions and31.4% of Level 3 decisions All or Most of the time (p<0.001). For the heart failure, syncope, and pneumonia vignettes, physicians selected83.9%, 83.0%, and 93.1% of Level 1 decisions and 37.8%, 32.8%, and25.0% of Level 3 decisions respectively (p values <0.001). Residents were more likely to select Level 3 decisions when compared with attendings (33.6% vs. 28.1%, p=0.053). Physicians who had or planned to have primarily general internal medicine clinical responsibilities were

less likely to select Level 3 decisions (28.9% vs. 34.0%; p=0.056). The most common rationales for selecting Level 3 decisions were local practice, supporting data or guidelines, and rule outs, as well as supervisor expectations among residents.
CONCLUSION: For three common inpatient conditions, physicians selected nearly a third of clinical decisions within vignettes for which there is no evidence or guideline support, and resident and non-primary care focused physicians selected these unsupported decisions at higher rates. Better dissemination and understanding of clinical guidelines is needed to promote evidence-based care.

A TALE OF TWO EPIDEMICS: UNIQUE CHARACTERISTICS OF YOUNG ADULT PATIENTS WITH HEPATITIS C INFECTION FOLLOWED AT AN URBAN COMMUNITY HEALTH CENTER James A Morrill 1; Christina Carr2. 1Massachusetts General Hospital, Charlestown, Massachusetts ;
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BACKGROUND: Hepatitis C Virus (HCV) infection, the most common blood-borne infection in the U.S., has a peak prevalence among the age 4560 cohort, with a decreasing yearly incidence nationwide. However, risky injection drug use may be on the rise among adolescents and young adults in certain Massachusetts communities, leading to a recently recognized increase in new HCV cases among young patients at the state level. Survey studies and clinical experience with young adult HCV patients suggests that this segment of the HCV epidemic has distinct clinical characteristics that could be important in shaping HCV prevention and treatment efforts in primary care. The purpose of this study was to investigate clinically significant characteristics of young adult vs. older adult HCV-positive patients by examining in detail a community health center-based HCV-positive cohort enriched in young adults. METHODS: We undertook a cross-sectional study of HCV patients seen at the MGH Charlestown HealthCare Center, a community health center in Boston, Massachusetts that serves as the primary health care facility for a substantial number of young adult injection drug users. Adult patients 18 years of age or older with a positive HCV antibody test who had an encounter at MGH Charlestown between January, 2000 and December, 2008 were identified by a two-step database search, based on billing and laboratory data. Chart review was then performed for actively followed HCV-positive patients-defined as those having at least one primary care visit at the health center since July, 2007-using an electronic medical record. Demographic and clinical characteristics were abstracted, and univariate comparisons were made between young adult (age 1839) and older adult (age 40+) HCV-positive patients using Chi-square tests for categorical variables and Students t-test for continuous variables.
RESULTS: Our database search and chart review yielded 176 HCV-positive adults who are actively followed at MGH Charlestown. While the peak of the age distribution was between ages 45 and 55, 35% of the cohort consisted of young adult patients (aged 1839). These young HCV-positive adults were unique in a number of ways. Relative to the older group, they had higher rates of current smoking (82% vs. 65%, p=0.01), active illicit drug use (51% vs. 35%, p=0.04), and IV drug use (92% vs. 63%, p <0.001). They also had higher rates of incarceration (56% vs. 39%, p=0.04) and engagement in opioid maintenance treatment (74% vs. 39%, p

<0.001). Both groups had high rates of high school graduation (82% vs. 79%, p=0.65), but both also had low rates of employment (21% vs. 30%, p=0.20) and high rates of homelessness (28% vs. 25%, p=0.70). Chronic pain affected most of the cohort (56%) but was less common in young adult patients than in older patients (30% vs. 70%, p <0.001). Young adult patients, relative to older patients, also had lower rates of hypertension, COPD, and cancer (p <.01 in all
cases). The rate of psychosocial comorbidity was high in the entire cohort (86%), with equally high rates in the two groups of depression (79% vs. 76%, p=0.65), anxiety (75% vs. 66%, p=0.20), or a history of sexual or physical abuse (54% vs. 43%, p=0.179). The proportion of patients with Genotype 2 or 3 infection was higher among young adults than older patients (34% vs. 17%, p=0.02). However, young adult patients were less likely to be referred for antiviral treatment (60% vs. 88%, p <0.001), attend at least one pre-treatment visit (43% vs. 72%, p <0.001), or begin treatment (6% vs. 37%, p <0.001). Young adult patients were more likely than older patients to be denied treatment due to active substance use (21% vs. 5%, p <0.001) or loss to follow up (40% vs. 23%, p <0.001).
CONCLUSION: Young adult patients with HCV infection represent an important segment of the HCV-positive population at the MGH Charlestown Healthcare Center. These patients have unique clinical characteristics, with implications for prevention and management of HCV. The HCV-positive population as a whole is a high-risk group, with high rates of unemployment, homelessness, psychiatric disease, trauma, and chronic pain. However, a six fold lower antiviral treatment rate among young adult patients may be related to distinct risk factors and treatment barriers in this population, such as higher rates of active illicit substance use, higher rates of incarceration, and poorer clinic follow-up. Despite these obstacles, young adult patients have a higher proportion of more favorable virologic characteristics (such as Genotype 2 or 3 infection) and are more frequently involved with opioid maintenance treatment, factors which could help to lower the barriers to antiviral treatment. Future efforts to prevent and treat HCV infection should recognize the distinct characteristics of young adult and older adult patients with HCV and design specific strategies for these two groups.
HABLA ESPANOL, DOCTOR? : EXPLORING BILINGUAL RESIDENTS PERFORMANCE ON A SPANISH LANGUAGE OSCE STATION Sondra Zabar 1; Gaelle Pierre 1; Kathleen Hanley 1; Julianne Cameron 1; Francesca Gany 2; Mack Lipkin 1; Colleen Gillespie3. 1NYU School of Medicine, New York, New York ; 2NYU School Of Medicine, New York, New York ; 3NYU School of Medicine, NY, New York . (Tracking ID # 11521)
BACKGROUND: Significant evidence confirms that language concordant physicians are optimal for patient-centered care for ethnically and linguistically diverse patients. Many residents conduct medical encounters in a second language. But are they competent to provide care in another language? We piloted a Spanish language Objective Structured Clinical Exam (OSCE) station to assess residents clinical competence in a Spanish language encounter when the resident had self identified as able to work in Spanish.
METHODS: As part of an annual 10-station OSCE exam residents were either assigned to complete an asthma OSCE station in English or Spanish based on self-reported language ability. Core challenges in the case were assessing an asthma patients understanding of her condition and providing education including how to use an inhaler. A highly trained bilingual SP assessed communication skills (12 items, =.87), patient satisfaction (4 items, =.73), and patient activation (4 items, =.76) using behaviorally-anchored checklist items with a 3-point response scale: not done, partly done, well done. Case-specific items, tailored to the clinical scenario, assessed behaviors across three broad categories: patient assessment (=.42), education and counseling (=.73), and treatment plan and management (=.54). Scores calculated as % well done. Two-sample t-tests were used to examine differences in performance between the two groups of residents. The bilingual SP also rated the residents language skills in terms of how well she understood them (not well, somewhat well, or very well).

RESULTS: Twenty-one residents completed the asthma OSCE station: 11 completed it in English and 10 completed it in Spanish (language choice did not differ by PGY). Overall, there was no difference between the

OSCE performance of residents who completed the bilingual station in English and residents who completed the station in Spanish on the other nine OSCE stations. In the bilingual case, the scores of residents who completed the station in English did not significantly differ from those who completed it in Spanish for overall communication scores (English 46%, SD 26% vs. Spanish 42%, SD 26%; mean difference=4%, 95% CI [20% - 28%]), patient activation scores (English 7%, SD 12% vs. Spanish 16%, SD 18%, mean difference=9%, 95% CI [23% - 5%]) and patient satisfaction scores (English 27%, SD 34% vs. Spanish 35%, SD 41%; mean difference=8%, 95% CI [42%-27%]) . The same was true for the three case-specific domains: patient assessment, education and counseling and treatment plan and management. The SP reported that she understood all the residents at least somewhat, however she reported understanding very well only 20% of Spanish-speaking compared with 67% of English-speaking residents (Chi Sq=4.23, p=.04). Residents who were understood very well, regardless of language, performed significantly better in this case on communication (60%, SD 28% vs. 33%, SD 20%; mean difference=27%, 95% CI [50% - 4%]), patient education and counseling (33%, SD 18% vs. 14%, SD 17%; mean difference=19%, 95% CI [36% - 3%]), and treatment plan and management (17%, SD 25% vs. 0%, SD 0%; mean difference=17%, 95% CI [32% - 1%]), than those who were understood only somewhat well.
CONCLUSION: Implementing a reliable bilingual OSCE station is feasible. Self-reported language ability resulted in equivalent OSCE performance across multiple domains. Language use on a clinical exam did not appear to affect performance. The comprehensibility of the language used, however, appears to have an impact. Further research is needed to see how residents language skills on an OSCE translate into clinical performance and impact actual patient outcomes, and whether use of a second language impacts subtler aspects of performance.
A MULTIDISCIPLINARY LOOK INTO THE PERCEIVED IMPORTANCE, AND COMPETENCY OF, PHYSICAL ACTIVITY ASSESSMENT AND PRESCRIPTION COUNSELING IN HEALTH SCIENCE STUDENTS Janie Mercer 1; Jane Mohler 2; Mindy Fain3. 1University of Arizona, Tucson, Arizona ; 2University of Arizona, Arizona Center for Aging, Tucson, Arizona ;
3University of Arizona, Department of Geriatrics, Tucson, Arizona . (Tracking ID # 11527)
BACKGROUND: Chronic diseases such as coronary artery disease, diabetes, stroke, and cancer cause the majority of deaths in the U.S and physical inactivity is an important determinant in the development of these and other chronic diseases. Healthy People 2010 objective 1-3a seeks to increase the amount of people counseled about physical activity (PA). Unfortunately, the proportion of physicians that counsel patients on PA remains low due to many barriers including lack of knowledge of exercise and counseling techniques beginning as early as medical school. The importance of increasing competency of disease prevention in health professional students is recognized in Healthy People 2010 objective 174. This research seeks to gain a deeper understanding of attitudes and health care provider roles in PA counseling by health sciences students at the University of Arizona (UA).
METHODS: The objective of this cross-sectional self-report survey is to compare multidisciplinary perspectives of PA assessment and prescription counseling from medical, nurse practitioner, pharmacy, and public health student perspectives (total n=800, 50400 per sub-group). The Healthcare Students Physical Activity Outlook Questionnaire was designed using the methods of Aday and Cornelius, by a forth year
medical student, a geriatrician and a chronic disease epidemiologist specifically for this study. Domains include family and personal exercise history, attitudes and knowledge regarding role appropriateness of PA assessment and prescription counseling, time spent in their curriculum in regards to PA prescription writing, and students experiences in witnessing PA counseling. The questionnaire also includes the two-question (2Q) PA assessment questionnaire to assess each students personal level of physical activity. In addition, socio-demographic information, current professional school, year in school, and intended career field will also be obtained. Participants will be recruited via school email list serves as well as by in-class presentation of the

study by instructors. Data will be collected using an on-line Survey Monkey site, and responses will be anonymous. Data types comprise dichotomous (Y/N) and categorical (1-n) data. The analysis plan includes tabulation of sociodemographic and clinical descriptive statistics [chi-2 (proportional) and t-tests (continuous)], with tabulation and cross-tabulation by clinical type, sex, and PA category, and qualitative responses using content analysis.
RESULTS: The survey has been approved by the UA IRB. Data will be collected from Jan-April 2011 and results will be analyzed prior to the SGIM conference, for conference presentation.
CONCLUSION: Goals of Healthy people 2010 as well as the proposed goals for Healthy People 2020 include increasing the proportion of people receiving PA counseling. The attitudes, perceptions, and competency of health science students on patient-focused PA assessment and prescription counseling can help identify the targeted education and training interventions needed to increase the counseling skills needed to increase PA and prevent chronic diseases.
WHAT HAPPENS WHEN RESIDENTS CHOOSE BETWEEN SPEAKING SPANISH OR USING AN INTERPRETER?: THE PERSPECTIVE OF UNANNOUNCED STANDARDIZED PATIENTS Sondra Zabar 1; Gaelle Pierre 1; Angela Burgess 1; Kathleen Hanley 1; Jessica Murphy 2; David Stevens 5; Adina Kalet 3; Colleen Gillespie7. 1NYU School of Medicine, New York, New York ; 2Gouverneur Healthcare Services, New York, New York ; 3NYU School of Medicine, NY, New York . (Tracking ID # 11537)
BACKGROUND: Language skills can be crucial for providing patient-centered care for linguistically diverse patients. Yet not all English speaking physicians can provide care in another language. For those physicians who are not bilingual, ideally an interpreter is utilized. This study assessed residents competency in an Unannounced Standardized Patient (USP) Spanish language encounter in a clinic setting using either their own language skills or an interpreter.
METHODS: Nine medical residents completed a bilingual case with an USP and whether the resident chose to conduct the visit in Spanish, English using an interpreter, or just in English was recorded. A highly trained bilingual SP assessed communication skills (12 items, =.35), patient satisfaction (4 items, =.67), and patient activation (4 items, =.92) using behaviorally-anchored checklist items with a 3-point response scale of not done, partly done, and well done. Case-specific items, tailored to the clinical scenario, assessed behaviors across three broad categories: patient assessment (=.84), education and counseling (=.60), and treatment plan and management (=.72). Scores were calculated as % well done. Two-sample t-tests were used to examine differences in performance between the residents. RESULTS: Four medical residents who self-reported as Spanish speakers spoke Spanish with the USP while 5 medical residents who self-reported as English speakers used an interpreter with the USP. Choice of communication strategy did not differ by PGY. Overall communication scores were significantly higher, on average, for residents who spoke Spanish with the USP than for residents who used

an interpreter with the USP (English 75%, SD 12% vs. Spanish 90%, SD 4%, p=.05, mean difference=15%, %95% CI [29% - 0%]). Patient activation scores (English 15%, SD 22% vs. Spanish 69%, SD 47%, p=.06, mean difference=54%, 95% CI [110% - 2%]) were marginally higher for residents who spoke Spanish with the USP while patient satisfaction scores (English 60%, SD 42% vs. Spanish 94%, SD 13%, mean difference=34%, 95% CI [85% - 17%]) did not differ between the residents. Among the three case-specific domains, education and counseling scores (English 18%, SD 9% vs. Spanish 55%, SD 13%, p=.005, mean difference=36%, 95% CI [53% - 19%]) were significantly higher for residents who spoke Spanish with the USP than for residents who used an interpreter with the USP whereas patient assessment scores (English 31%, SD 18% vs. Spanish 42%, SD 36%, mean difference=11%, 95% CI [64% - 43%]) and treatment plan and management scores (English

75%, SD 35% vs. Spanish 100%, SD 0%, mean difference=25%, 95% CI [69% - 19%]) did not differ between residents. Overall, there were no consistent differences in performance when comparing residents score on this USP case with 2 other USP cases, whether focusing on residents who spoke Spanish with the USP (and therefore were communicating in English for the other non-bilingual cases) or on residents who used a translator (and therefore were communicating in English for the other non-bilingual cases). And Spanish-speaking residents did not consistently perform better than English-speaking residents on an annual OSCE conducted prior to these USP visits. CONCLUSION: Residents who spoke Spanish with the USP appeared to be more effective in communication, patient activation, and education and counseling than those who used an interpreter. This difference is not simply due to our Spanish speaking residents having superior clinical skills. What our results do suggest is that Spanish-speaking residents made the right choice in deciding to conduct the visit in Spanish rather than using an interpreter. Future research should investigate this in a larger sample and explore the impact of fluency on both the choice and impact of the communication strategy.

THE EFFECTS OF A STRUCTURED AMBULATORY ASSISTANT CHIEF RESIDENT ROTATION ON PROFESSIONAL SKILL DEVELOPMENT AND ACADEMIC CAREER CHOICE Christina Harris 1; Judy Tung 2; Keith Roach 2; Suzanne Wenderoth2. 1New York Presbyterian-Weill Cornell Medical College, Brooklyn, New York ; 2New York Presbyterian-Weill Cornell Medical College, New York, New York . (Tracking ID # 11538)

BACKGROUND: In 1997 the Primary Care Track of the Internal Medicine Residency Program at the New York Presbyterian Hospital/Weill Cornell Medical College initiated a structured, 812 week, ambulatory Assistant Chief Resident (ACR) rotation for all of its senior residents. During this time, residents take on responsibilities expected of a junior attending including leading morning report, precepting residents, and participating in faculty and other committee meetings. While this rotation is rated consistently as one of the best experiences of residency, little is known of its impact on professional skills development or on postgraduate career choices. The objectives of this study were: (1) to evaluate the development of professional skills during the ACR rotation (2) to assess the value and usefulness of these skills and (3) to determine the impact of the ACR experience on the decision to pursue a career in academic medicine.

METHODS: Of the 64 identified graduates of the Primary Care Track who completed residency training from 19922008, 50 (78% response rate) completed the 6 page, 28-item mailed survey. 4 graduates were excluded due to lack of contact information. Areas addressed in the survey included current practice type, the effect of ACR time on professional skill development, the value of certain professional skills, and the impact of ACR time on postgraduate and current career choice. The questionnaire utilized several different scales including a Likert scale, ranking and open-ended questions. Initial non-responders were sent a second questionnaire by mail. Fishers exact test was used for statistical analysis to compare dichotomous variables.

RESULTS: At the time of survey completion, 64% of our graduates were in primary care internal medicine, 10% hospitalists, 16% subspecialists (mostly geriatrics and HIV) and 10% in non-clinical settings.

Overall, 82% of graduates agreed that being ACR was one of the most formative experiences of their residency. Residents identified didactic teaching, leadership, and independent learning as the top three professional skills that they developed during their ACR rotation, with leadership and independent learning as two out of the top three skills most valuable in their current career.72% of graduates first jobs were in academics; three quarters as clinician-educators. Of respondents, 83% of graduates completed an ACR rotation and 17% did not. Graduates who did ACR time were more likely to be in academics at the time of survey completion compared to graduates who did not do the ACR rotation (59% vs 36%, p=.3). They were also less likely to have left academics (21% vs 50%, p=.2).91% of graduates in academic positions (compared with graduates in nonacademic positions) felt that the ACR rotation reinforced their desire to pursue an academic career (91% vs 31%, p=.0001). 86% of graduates in academics felt that the ACR rotation impacted their career choice compared to 43% of graduates in nonacademics (86% vs 43%,p=.006). 6% experienced a complete shift in career choice by pursuing clinician educator positions after serving as ACR.

CONCLUSION: A structured ambulatory Assistant Chief Resident rotation was found to develop skills in teaching, leadership and independent learning that proved valuable in the careers of our graduates. While only 6% attribute their time as ACR as resulting in a complete career change into academics, those who ended up in academics rated their ACR time as being highly influential in their career choice. More research is needed to determine additional factors that influence a residents decision to pursue a career in academic medicine.

EFFECT OF PROVIDING TAILORED PRIMARY CARE ON HEALTH CARE UTILIZATION AND RETURN TO JAIL AMONG RECENTLY RELEASED PRISONERS: A RANDOMIZED CONTROLLED TRIAL Emily Ai-hua Wang 1; Clemens S Hong 2; Shira Shavit 3; Eric Kessell 4; Ronald Sanders 5; Kevin Moos 3; Margot B Kushel3. 1Yale University School of Medicine, New Haven, Connecticut ; 2Harvard University, Charlestown, Massachusetts ; 3University of California, San Francisco, San Francisco, California ; 4San Francisco General Hospital, San Francisco, California ; 5Transitions Clinic, San Francisco, California . (Tracking ID # 11540)

BACKGROUND: 700,000 individuals are released from prison each year. The majority of these individuals have chronic medical, psychiatric, and substance abuse conditions and use acute health and criminal justice services at high rates. In January 2006, Transitions Clinic (TC) opened to serve the special needs of individuals released from prison with at least one chronic health condition. This model of transitional and primary care and the evaluation were designed with input from individuals with a history of incarceration and is informed by a community advisory board with 50% representation of formerly incarcerated individuals. The clinic is staffed by community health workers and primary care clinicians with experience working with this population. We examined the effectiveness of TC in reducing urgent medical visits and recidivism using a randomized controlled design. We hypothesized that individuals receiving primary care at TC would have fewer acute care visits compared to the control group. METHODS: Following an initial post-release visit to TC between November 2007 and June 2009, we recruited and randomized 200

participants to receive continued care at TC (n=98) or expedited primary care in the community safety net system (n=102). We followed participants for 12 months and compared the following outcomes: 1)primary care utilization, 2) emergency department (ED) utilization, 3)hospitalization and 4) jail bookings between TC participants and control participants. We obtained this data from an electronic record repository for the safety net health system and conducted analyses by intention-to-treat. We used chi-squared tests to make between-group comparisons of use of primary care, emergency services,and rate of hospitalization, and survival analysis to compare time to re-arrest.

RESULTS: Participants had a mean age of 43.6 years (SD 7.3), 64% were black, 58% were marginally housed or homeless, 94% were unemployed, and 40% of participants reported spending more than 15 years incarcerated. There were no statistically significant differences in participant characteristics between the study arms. After 12 months, TC participants had similar rates of primary care visits (60% vs. 67%, p=0.32) but lower rates of ED utilization (25% vs. 40%,p=0.04). There were no differences in hospitalization rates (10% vs. 15%, p=0.31). TC participants returned to jail at similar rates compared to controls (58% vs. 53%, p=0.46). Kaplan Meier curves showed no difference in days to first arrest. Limitations of this study are that we are unable to draw conclusions about the effectiveness of TC compared to standard of care, which is no follow up in the community, because the control group received expedited care in the safety net system.

CONCLUSION: In this population of chronically-ill recently released prisoners with high service use and costs, primary care received in a community-based clinic that provided integrated primary care and social service coordination with culturally competent providers was associated with decreased ED utilization when compared to a control group that received expedited health care. Primary care clinics that deliver culturally competent care for these patients following prison release, through care coordination and integration of primary care and social services, may improve care and reduce acute care use for these vulnerable patients.

EFFECT OF ALENDRONATE COST ON THE COST-EFFECTIVENESS OF OSTEOPOROSIS SCREENING

AND TREATMENT Smita Nayak 1;
Mark 1; Susan L S GreenspanRoberts2. 1University of Pittsburgh, Pittsburgh, Pennsylvania ; 2University of PittsburghUniversity of Pittsburgh, Pittsburgh, Pittsburgh, Pennsylvania, Pennsylvania . (Tracking ID # 11541)
BACKGROUND: Alendronate became available in generic form in 2008, and its price has been decreasing since then. The purpose of this study was to investigate the impact of alendronate cost on the cost-effectiveness of osteoporosis screening and treatment in older U.S. women. METHODS: Monte Carlo microsimulation cost-effectiveness model of osteoporosis screening and treatment for U.S. postmenopausal women age 65 and older. Screening initiation at age 65 with dual-energy x-ray absorptiometry (DXA) of the hip and spine was assumed, followed by alendronate treatment for individuals found to have osteoporosis by DXA criteria (T-score less than or equal to 2.5). The comparator strategy was no screening, with alendronate treatment only after fracture occurrence. Annual alendronate costs of $20, $60, $100, $200, $400, and $600 were evaluated; 50% medication compliance was assumed. Outcome measures included hip, vertebral, and wrist fractures; nursing home admission; medication adverse events; death; costs; quality-adjusted life-years (QALYs); and incremental cost-effectiveness ratios (ICERs) in 2010 U.
S. dollars per QALY gained. A lifetime time horizon was used, and societal direct costs were included.
RESULTS: At alendronate costs of $200 or less, osteoporosis screening and treatment was cost-saving compared to no screening with treatment only if fracture occurs. That is, osteoporosis screening followed by alendronate treatment resulted in lower total lifetime costs than no screening (ranging from $171 to $343 saved over lifetime when assuming alendronate annual costs of $200 or $20, respectively) as well as more QALYs (10.6 additional quality-adjusted life-days gained). When assuming an alendronate cost of $400 or $600, screening and treatment resulted in greater lifetime costs than no screening but was highly cost-effective, with ICERs of $714 per QALY gained and $7310 per QALY gained, respectively. Probabilistic sensitivity analysis revealed that the cost-effectiveness of osteoporosis screening followed by alendronate treatment was robust to variations in input parameter estimates at willingness-to-pay thresholds of $50,000/QALY or $100,000/QALY at all alendronate costs evaluated.
CONCLUSION: Osteoporosis screening followed by alendronate treatment is effective and highly cost-effective for women age 65 and older across a wide range of alendronate costs, and cost-saving at annual alendronate costs of $200 or less. Given a current annual cost of approximately $100 per year at discount pharmacies, osteoporosis screening followed by alendronate treatment is cost-saving, and should be promoted.
THE RELATIONSHIP BETWEEN RURALITYAND DIABETES CONTROL Stephen Tonks 1; Sohil Makwana 2; Amanda Salanitro 3; Pamela Foster 4; Monika Safford 5; Thomas Houston 6; Jeroan Allison 6; William Curry 5; Carlos Estrada7. 1The University of Alabama at Birmingham, Birmingham, Alabama ; 2The University of Alabama at Brimingham, Birmingham, Alabama ; 3Vanderbilt University, Nashville, Tennessee ; 4University of Alabama at Tuscaloosa, Tuscaloosa, Alabama ; 5University of Alabama at Birmingham, Birmingham, Alabama ; 6The University of Massachusetts Medical School, Boston, Massachusetts ; 7Birmingham VAMC, The University of Alabama at Birmingham, Birmingham, Alabama . (Tracking ID # 11549)
BACKGROUND: We sought to define the relationship between degree of rurality and glucose (A1c), blood pressure (BP), and lipid (LDL-C) control among patients with diabetes.
METHODS: Cross-sectional design. Diabetes patients attending the practices of 205 physicians from 11 Southeastern states (20062008). Degree of rurality was defined using Rural-Urban Commuting Areas (RUCA) codes based on patients home ZIP-code. Outcomes were measures of acceptable control (hemoglobin A1c<=9%, blood pressure [BP] <140/ 90 mmHg, low-density lipoprotein cholesterol [LDL-C] <130 mg/dL) and optimal control (A1c <7%, BP<130/80 mmHg, LDL<100 mg/dL). We use the Chi-square test and ANOVA to examine diabetes control and patient characteristics by degree of rurality.
RESULTS: ZIP code data was available for 1,990/2,127 patients (94%) and A1c was obtained in 77% (n=1,629). The proportion of African Americans increased by rurality (urban, large rural, and small/ isolated

rural; 15%, 27%, 23%; respectively)(p=0.004), The proportion of patients with acceptable A1c control (<=9%) decreased as rurality increased (p=0.05); although not significant, the mean A1c value increased as rurality increased (p=0.08), Figure. The mean LDL-C value increased as rurality increased, 90 mg/DL (SD37) for urban, 94 mg/dL (SD 34) for large rural, and 99 mg/dL (SD49) for small/ isolated rural (p=0.04). The proportion of patients with optimal A1c control (<7%) was similar by rurality (55% for urban, 52% for large rural, 50% for small/ isolated rural, p=0.50). Acceptable and optimal BP (both p >0.60) and LDL-C (both p >0.10) control were similar by rurality.

CONCLUSION: As patients residence rurality increased, glucose control worsened among patients with diabetes in Southeastern U.S.; such differences may be explained by patient characteristics. Funding: National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), 5R18DK065001.

PREVENTING VENOUS THROMBOEMBOLISM IN HOSPITALIZED MEDICAL PATIENTS; WILL KNOWING DRUG ADHERENCE DETERMINE HOW TO BEST PROTECT OUR PATIENTS? Jonathan Vellinga 1; Vinita Bahl 1; Hsou-mei Hu 1; Latoya Kuhn 1; Paul Grant1.
1University of Michigan, Ann Arbor, Michigan . (Tracking ID # 11552)

BACKGROUND: Venous thromboembolism (VTE) is a common, yet preventable complication affecting hospitalized patients. Appropriate VTE prevention has emerged as an important hospital quality measure with emphasis on enforcing routine risk assessment and compliance with VTE prevention guidelines. Several pharmacologic options are available for VTE prevention; however, adherence to thromboprophylactic therapies is largely unknown even when these agents are prescribed correctly. In addition, adherence rates may vary between unfractionated heparin (UFH), which is administered multiple times daily, and low-molecular-weight heparins (such as enoxaparin), which are typically administered once daily. Given the lack of efficacy data comparing UFH and enoxaparin, and the substantial cost difference between these two medications, a determination of medication adherence may be an important variable for the clinician to consider in prescribing effective VTE prophylaxis. We compared the adherence rates of UFH and enoxaparin amongst hospitalized internal medicine patients.

METHODS: From July 2009 to June 2010, we used the electronic medication administration record (eMAR) at a large university hospital to analyze the physician orders and drug administration status of subcutaneous UFH three times daily (TID) and subcutaneous enoxaparin once daily (QD) for hospitalized internal medicine patients over the age of 18. The administration of VTE prophylaxis medications on the day of admission and the day of discharge were not included. Patients were excluded if their hospital length of stay was less than 24 hours, or if they were transferred off the internal medicine service (i.e. to a surgery service) at any time during their hospitalization. VTE prophylaxis adherence was defined as the percentage of doses administered compared to doses ordered. The Pearson chi-squared statistical analysis was used to determine if there was a significant difference in adherence between the two prophylaxis regimens.

RESULTS: 6,703 patients met the inclusion criteria and had VTE prophylaxis orders for either UFH TID or enoxaparin QD. VTE prophylaxis adherence in the UFH group (n=5,366) was 86.6% while adherence in the enoxaparin group (n=1,337) was 91.1% (p<0.001).

CONCLUSION: VTE prophylaxis with enoxaparin once daily had better adherence when compared to UFH three times daily. This difference was statistically significant; however it is unclear whether this small difference has clinical relevance. Given these findings, it remains unclear if a superior VTE prophylaxis strategy exists between UFH and enoxaparin.

U.S. TRENDS IN THE DIAGNOSIS AND TREATMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER, 20002010 G. Caleb Alexander 1;

Craig Garfield 2; Ray Dorsey 3; Shu Zhu 4; Ashley Higashi 4; Haiden Huskamp 5; Rena Conti 4; Stacie Dusetzina6. 1University of Chicago, Chicago, Illinois ; 2North Shore University Health System, Chicago, Massachusetts ; 3John Hopkins, Baltimore, Massachusetts ; 4University of Chicago, Chicago, Massachusetts ; 5Harvard Medical School, Boston, Massachusetts . (Tracking ID # 11556)
BACKGROUND: Attention Deficit Hyperactivity Disorder (ADHD) affects nearly 10% of children and adolescents in the United States. The Food and Drug Administration (FDA) issued safety advisories regarding stimulants in February 2005 and Atomoxetine (Strattera) in September 2005. Little is known regarding how these advisories have affected clinical practice.
METHODS: We used the IMS Health National Disease and Therapeutic Index, a nationally representative audit of office-based physicians, to examine changes in ADHD diagnosis and treatment among children and adolescents less than 18 years of age from 2000 through 2010. We used descriptive statistics to examine trends and interrupted time series analyses to describe the effect of the FDA advisories.
RESULTS: The number of visits where ADHD was diagnosed (diagnosis visits) increased by 61% from 6.2 million visits in 2000 to 10 million visits in 2010. The fraction of visits where a stimulant or Atomoxetine was prescribed declined from 90% of all diagnosis visits (5.6 million of 6.2 million visits) in 2000 to 59% of all diagnosis visits (6.1 million of 10.3 million) in 2010. Among those receiving drug treatment, the use of substitute medications (i.e.clonidine or quanfacine) increased from 7% (2000) to 10% (2010). There was no change in the fraction of visits by boys (75%-77%) or the severity of visits where treatment was dispensed. However there was a shift towards greater care by psychiatrists (from 24% to37% of all visits over the time period examined). Ongoing analysis will estimate the effect of the 2005 FDA advisories on these changes in ADHD diagnosis and treatment.
CONCLUSION: From 2000 to 2010, the number of physician visits where ADHD was diagnosed increased substantially, while the proportion of visits resulting in treatment with a stimulant or Atomoxetine decreased by approximately one third. The role that the FDA advisories played in shaping these changes and the clinical impact of these changes on children, adolescents and their families has not been well described.

NATIONAL TRENDS IN OUTPATIENT ASTHMA TREATMENT, 1997 2009 G. Caleb Alexander 1; Ashley Higashi 1; Shu Zhu 1; Randall Stafford2. 1University of Chicago, Chicago, Illinois ; 2Stanford University, Stanford, California . (Tracking ID # 11557)
BACKGROUND: Despite reductions in asthma morbidity and mortality and changes in guidelines regarding long acting 2-agonists and other therapies, little is known regarding how asthma treatment patterns have changed. We sought to examine national prescribing trends in the office-based treatment of asthma.
METHODS: We used data from the National Ambulatory Medical Care Survey (NAMCS) and the National Disease and Therapeutic Index (NDTI), nationally representative audits of office-based physicians conducted by the National Center for Health Statistics and IMS Health, respectively. We focused on the use of six therapeutic classes (short-acting 2 agonists [SABA], long-acting 2 -agonists [LABA], inhaled steroids, antileukotrienes, anticholinergics, and xanthines) among patients diagnosed with asthma less than 50 years of age.
RESULTS: Estimates from NAMCS indicated modest increases in the number of annual asthma visits from 9.9 million [M] in 1997 to 10.3 M during 2008; estimates from the NDTI suggested more gradual continuous increases from 8.7 M in 1997 to 12.6 M during 2009. The fraction of annual visits where at least one asthma treatment was recommended (treatment visits) ranged between 85%-95% (NAMCS) and 96%-98% (NDTI). NAMCS estimates indicated declines in use of SABAs (from 80% of treatment visits in 1997 to 71% in 2008), increased inhaled steroid use (24% in 1997 to 33% in 2008), increased use of fixed dose LABA/steroid combinations (0% in 1997 to 19% in 2008), and increased leukotriene use (9% in 1997 to 24% in 2008). In 2008, anticholinergics, xanthines, and unopposed LABA use accounted for fewer than 4% of all treatment visits. Estimates from NDTI corroborated these trends.

CONCLUSION: Reductions in asthma morbidity and mortality have been associated with changes with its office-based treatment, including increased inhaled steroid use and increased combined steroid/LABA use. Xanthines, anticholinergics, and increasingly, LABA without concomitant steroid use, account for a very small fraction of all asthma treatments.

IMPACT OF AN OUTPATIENT CARE TRANSITIONS NURSE ON READMISSIONS AND MEDICATION DISCREPANCIES Kathleen Fairfield 1; Joel Botler 1; Michael Roy 1; Jennifer Palminteri 1; Erin Delaney 1; Thomas Gearan 1; Doug Salvador 1; Donald Medd 1; Deborah McGill1. 1Maine Medical Center, Portland, Maine . (Tracking ID # 11575)

BACKGROUND: Medical readmissions can be a marker of poor transitions of care; efforts to avoid unnecessary readmissions are critical. We sought to determine whether adding a care transitions nurse in an outpatient practice would reduce readmissions and medication discrepancies among adult general medicine patients discharged home from the hospital.

METHODS: This project has a pre-/post- design. All readmissions data are taken from billing information for patients admitted to the medical service of a single large (606 bed) hospital and discharged to home. Baseline data include 30-day readmission rate for 12 months prior to the intervention. The intervention is an embedded care transitions nurse with EMR access within a large practice (with 5 locations) comprised of internal medicine and family practice physicians. The care transitions nurse calls patients within 48 hours post discharge to identify and correct medication discrepancies, update the EMR, and arrange follow up visits with primary care (within 7 days) and with any

specialists. For each discharged patient, the nurse completes a medication discrepancy check at the time of the post-discharge phone call to capture the number of medications that the patient (a) should be taking but is NOT, and (b) should not be taking but in fact IS taking. For each medication discrepancy counted, the nurse ascertained the causes and contributing factors behind the error. We report on 253 admissions for the first 6 months of our intervention.

RESULTS: The proportion of patients readmitted to the hospital within 30 days of discharge was 10.2% for the 12 months before the intervention period, compared with 8.4% for the 6 month period during the intervention (p=0.50). The care transitions nurse spent a mean of 7 minutes on the phone with patients (range 133) and 26 minutes total per case(range 356). Total time included researching the patients discharge information, contact time via telephone, and documentation, including updating the medication list. Medication discrepancies were identified and corrected prior to the patients first visit with the primary care provider in 42% (106/253) of patients. These included a mean of1.7 new medications added (range 05), a mean of 0.6 medications discontinued (range 04). The most common reason for discrepancy according to the patient was conflicting information from multiple providers.

CONCLUSION: This intervention is resource-intensive and may not be feasible for smaller practices. We report that a care transitions nurse embedded in a large primary care practice modestly decreased readmission rates for adult medical inpatients, though this finding was not statistically significant after 6 months of the intervention. However, the nurse was able to identify and correct medication discrepancies before the first office visit, and arrange timely follow up care.

THE MORTALITY RISK FOR OLDER ADULTS RELEASED FROM PRISON Brie Williams 1; Patrick Blatchford 2; Marc Stern 3; Ingrid Binswanger2. 1University of California, San Francisco and SFVAMC, San Francisco, California ; 2University of Colorado, Denver, Aurora, Colorado ; 3School of Public Health, University of Washington, Seattle, Washington . (Tracking ID # 11576)

BACKGROUND: Individuals released from prison have a high mortality risk compared to community norms. Older adults (aged 55 or older) comprise a rapidly increasing proportion of US prisoners and have more chronic medical conditions than both younger prisoners and nonincarcerated older adults. Interventions to promote a safe and healthy reentry from prison for older adults are hampered by a dearth of knowledge about their health

and experience. Therefore, our aims were to compare mortality rates and causes of death between older and younger adults released from prison.
METHODS: This was a longitudinal study of all 30,237 individuals released from the Washington State Department of Corrections from July 1999 through December 2003. Individuals aged 55 or older were classified as older adults to be consistent with prior literature that accounts for the accelerated aging of prisoners. We compared baseline characteristics between younger and older prisoners using chi-square tests and t-tests. All post-release deaths and causes of death were determined using the National Death Index. Post-release mortality rates accounted for amount of time in the community.
RESULTS: Overall, 30,237 individuals were released over the study period, of whom 2.2% (856 individuals) were age 55 years or older. The average ages of the 2 groups were 61 years (older adults) and 33 years (younger adults). Older adults were significantly more likely to be men (93% vs. 87%) and white (70% vs. 62%), and to have had a longer mean length of incarceration (45 vs. 18 months) and fewer releases during the study period (1.1 vs. 1.3; all $p<0.001$). Over a mean follow-up of

1.9 years, 443 individuals died including 68 (7.9%) older persons and 375 (1.3%) younger persons. Older adults accounted for 15.3% of all post-release deaths. The post-release mortality rate per 100,000 person-years was 4,772 deaths for older adults compared to 674 deaths for younger adults ($p<0.001$). The leading causes of post-release death for older adults were cardiovascular (36.8%), cancer (30.8%) and liver disease (5.9%); while for younger adults the leading causes of death were drug overdose (26.7%), homicide (12.2%), suicide (10.4%), and motor vehicle accidents (8.8%). There were no significant differences in mortality rates between older and younger adults for overdose (211 vs. 180, $p=0.95$), suicide (70 vs. 70, $p=1.0$) or motor vehicle accidents (140 vs. 59, $p=0.44$). In contrast, death rates between older and younger adults were markedly different for cardiovascular disease (1,754 vs. 56, $p<0.001$), cancer (1,474 vs. 32, $p<0.001$), and liver disease (281 vs. 34, $p=0.005$). The death rate due to homicide was higher for younger than for older adults (70 vs. 0).
CONCLUSION: We found that the post-release mortality rate for older adults was 7-times higher than for younger adults. In context, this means that the mortality rate for older persons with an average age of 61 years following release from prison (4772 deaths/100,000 person-years) was similar to the mortality rate for 7579 year old US adults (4,034 deaths/100,000 person-years) and was approximately double the reported mortality rate for all US prisoners aged 55 or older (2,123 deaths/100,000 person-years). These findings suggest that the period of release confers added mortality risk for older persons. In addition, while post-release mortality rates for self-harm events including overdose, suicide and motor vehicle accidents were similar between older and younger adults, older adults had substantially higher mortality rates for chronic medical conditions. This final finding suggests that the geriatric model of transitional care focused on both social and medical needs is of paramount importance for older adults transitioning from prison to the community.
COMBATING OBESITY AT COMMUNITY HEALTH CENTERS (COACH): FACTORS WHICH INFLUENCE SUCCESS IN A WEIGHT MANAGEMENT QUALITY IMPROVEMENT COLLABORATIVE Abigail Wilkes 1; Priya John 1; Anusha Vable 2; Amanda Campbell 3; Cynthia Schaefer 4; Loretta Heuer 5; Marshall Chin 1; Deborah Burnet 1; Quinn Michael1. 1University of Chicago, Chicago, Illinois ; 2Harvard, Boston, Massachusetts ; 3MidWest Clinicians Network, Lansing, Michigan ;
4University of Evansville, Evansville, Indiana ; 5University of North Dakota, Grand Forks, North Dakota .
(Tracking ID # 11577)
BACKGROUND: Five Midwestern community health centers participated in a two year quality improvement (QI) collaborative targeted at improving patient recruitment and retention rates for existing weight management programs. The goal of the collaborative was to provide academic guidance for quality improvement

methodology, facilitate critical self-study, foster peer learning, and improve patient outcomes (weight loss). METHODS: Participating health center staff attended three two-day workshops where quality improvement experts led exercises in process mapping and plan-do-study-act (PDSA) cycles. Monthly conference calls prompted timely PDSA tracking and participation in peer group problem solving. Individual coaching was used to clarify concepts, brainstorm solutions, and assess project engagement. Periodic surveys and interviews were conducted to assess participants perceptions regarding effectiveness of their revised weight management programs. Clinical data was collected toward the conclusion of the project.
RESULTS: Health center staff identified expectations for the collaborative ranging from improving data tracking and implementing evidence-based approaches to improving existing program structure and providing continuing education for staff. Quality improvement goals focused primarily on patient recruitment and retention, but were tailored to the interest and experience of each center. A specific weight loss curriculum was not provided, however sites readily shared materials and best practices, often adapting successful program components from other centers as a QI strategy. Though all sites successfully applied the concept of QI cycles of change with increasing sophistication over time, some prompting was necessary to maintain focus and motivation. Success, defined as repeated cycles of change resulting in improved patient recruitment and retention rates, was associated with strong leadership engagement, protected time for the team or project champion, and effective community engagement. Obstacles to success included a high rate of staff turnover, lack of administrative support, and vague or non-specific program goals. All sites demonstrated decreased patient BMI over time, for participants in their weight management programs. During exit interviews, four out of five health centers reported that the collaborative met or exceeded their original goals. Aspects of the collaborative that centers found most valuable were resource/idea sharing, face-to-face workshop sessions, and monthly conference calls. Driving factors for success were reported as teamwork/staff engagement, communication, commitment, leadership, and clear plan/execution.
CONCLUSION: Overall, this weight management quality improvement collaborative demonstrated feasible health center participation and successful translation of QI basic methodology. Participants identified continued leadership and administrative support, staff engagement, and health center capacity for change as factors related to the success of new QI projects. Future collaborative weight management QI efforts may benefit from sharing a standardized curriculum, initiating data collection early utilizing a common format, and from standardizing some structural program elements to facilitate data comparison across sites.
PROJECT A.R.T.-E.D.: ALCOHOL REDUCTION AND HIV TESTING IN THE EMERGENCY DEPARTMENT E.
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BACKGROUND: Unhealthy alcohol use is associated with sexual risk behaviors and subsequent HIV risk. Preventive care, including alcohol brief interventions and HIV testing, are becoming more normative in the Emergency Department (ED) setting to reach young unhealthy drinkers as this is often their primary source of medical care. Notably, interventions targeting this population in the ED to promote HIV prevention are lacking. Our goal in this pilot study was to determine the feasibility and impact of providing a brief alcohol and sexual risk reduction counseling session with rapid HIV testing in the ED. METHODS: We recruited patients, ages 18 to 40 years, from a large urban ED; meeting NIAAA criteria for at-risk drinking; with at least 1 sexual risk behavior; with negative or unknown HIV status and willing to undergo testing. Our intervention combined a brief alcohol and sexual risk reduction counseling session with rapid HIV testing. We conducted a 2-week booster call. The counseling intervention was manual-guided, modeled after Brief Negotiation Interview and Project RESPECT-2 and designed to be delivered in less than 15 minutes. Assessments included the Timeline Follow-Back to quantify alcohol consumption and modified HIV Risk Behavior Scale to characterize sexual risk behaviors at

baseline and 8 weeks. Statistical analyses

included Wilcoxon Signed Rank test, McNemar test, and two-way ANOVA.We recruited patients, ages 18 to 40 years, from a large urban ED; meeting NIAAA criteria for at-risk drinking; with at least 1 sexual risk behavior; with negative or unknown HIV status and willing to undergo testing. Our intervention combined a brief alcohol and sexual risk reduction counseling session with rapid HIV testing. We conducted a 2-week booster call. The counseling intervention was manual-guided, modeled after Brief Negotiation Interview and Project RESPECT-2 and designed to be delivered in less than 15 minutes. Assessments included the Timeline Follow-Back to quantify alcohol consumption and modified HIV Risk Behavior Scale to characterize sexual risk behaviors at baseline and 8 weeks. Statistical analyses included Wilcoxon Signed Rank test, McNemar test, and two-way ANOVA.
RESULTS: Of the 65 enrolled, 66% are male, mean age is 24 years, 61% white, 82% unmarried, 55% college-educated, 42% without primary care, and 80% with AUDIT score >8. All tested HIV negative. Among the 49 with follow-up to date, alcohol consumption decreased with fewer average weekly drinks (23.7 vs. 8.8, p This decrease was significantly associated with gender (p Post-intervention, participants endorsed increased condom use (median change=3 points on a 5-point scale, W=105, pOf the 65 enrolled, 66% are male, mean age is 24 years, 61% white, 82% unmarried, 55% college-educated, 42% without primary care, and 80% with AUDIT score >8. All tested HIV negative. Among the 49 with follow-up to date, alcohol consumption decreased with fewer average weekly drinks (23.7 vs.8.8, p<0.001). Post-intervention, participants endorsed increased condom use (median change=3 points on a 5-point scale, W=105, p<0.0001). CONCLUSION: In this pilot study, a brief intervention combining alcohol and sexual risk reduction counseling with rapid HIV testing is feasible and effective in the ED for reducing alcohol use and HIV risk behaviors among young unhealthy drinkers. By focusing on this population in this setting, we are providing a tailored intervention that impacts both alcohol consumption and sexual risk behaviors for a group of vulnerable patients that may not otherwise be reached for routine preventive medical care.In this pilot study, a brief intervention combining alcohol and sexual risk reduction counseling with rapid HIV testing is feasible and effective in the ED for reducing alcohol use and HIV risk behaviors among young unhealthy drinkers. By focusing on this population in this setting, we are providing a tailored intervention that impacts both alcohol consumption and sexual risk behaviors for a group of vulnerable patients that may not otherwise be reached for routine preventive medical care.
VARIATION IN PRESCRIPTION USE AMONG PATIENTS WITH DIABETES IN THE VA HEALTHCARE SYSTEM Walid F Gellad 1;
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BACKGROUND: Regional variation in healthcare use has become a primary indicator of inefficiency in the healthcare system, yet little is known about variation in medication use. The Veterans Health Administration (VA) offers a unique setting to assess regional variation in prescription use, because of its unified national formulary and pharmacy benefit. We sought to examine regional variation in outpatient medication use for the treatment of diabetes.
METHODS: We conducted a cross-sectional analysis of all Veterans with type 2 diabetes managed in the VA in 2009 (n=1,160,895). The cohort was identified based on inpatient or outpatient ICD-9 codes for diabetes or receipt of a hypoglycemic medication. We used VA Pharmacy Benefit
Management data to identify all diabetes medications dispensed for the cohort in 2009, aggregated at the VA facility-level. We examined two outcomes: 1) the percentage of patients on oral hypoglycemic drugs at each VA who filled a prescription for a thiazolidinedione (TZD, i.e., rosiglitazone, pioglitazone), which are a brand-name-

only expensive class of medication, and 2) the percentage of patients on insulin at each VA who filled a prescription for a long-acting analogue insulin (i.e., detemir, glargine), which are expensive long-acting insulins. We report descriptive statistics and quantify variation using the coefficient of variation (standard deviation/mean x 100). We used Pearson correlation coefficients to assess whether VA facilities with a high proportion of patients on TZDs also have a high proportion of patients on long-acting insulin analogues. We developed multivariable logistic regression models, with fixed effects for each facility, to model the odds of each outcome adjusting for patient age, gender, race/ethnicity, number of providers, and being prescribed medications by a physician (vs. non-physician).
RESULTS: Overall, 908,721 (78.3%) of diabetics received a hypoglycemic medication, totaling 6,194,339 prescriptions in 2009. Across 129 VA facilities, the percentage of patients at each facility on TZDs ranged from 1.5% to 26.3%, with a mean of 8.3% (coefficient of variation,54.2%). The percentage of patients on insulin who used long-acting insulin analogues ranged from 3.7% to 71.4%, with a mean of 38.4% (coefficient of variation, 40.6%). There was a weak correlation between use of TZDs and long-acting insulin analogues ($r=0.28$, $p<.001$); VA facilities with a high proportion of patients on TZDs tend to be facilities with a high proportion of patients on long-acting insulin analogues. After controlling for patient factors, the odds of receipt of TZDs at each facility ranged from 0.11 to 1.93, and the odds of receipt of an insulin analogue ranged from 0.02 to 1.27 ($p<.001$).
CONCLUSION: Significant practice-pattern variation exists across VA medical centers in the use of higher-cost hypoglycemic medications, despite a uniform national formulary and extensive utilization management. This substantial variation is unlikely to be explained by patient factors alone. The provider, facility, and larger regional factors that lead to this variability should be examined, because of the significant cost and efficiency implications of this variation in prescribing.
ENVIRONMENTAL BARRIERS AND SUPPORTS FOR DIETARY SELF-CARE AMONG LOW-INCOME LATINOS WITH SUBOPTIMAL DIABETES CONTROL AT A COMMUNITY HEALTH CLINIC Pamela Stoddard 1; Raman Khanna 2; Ralph Gonzales2. 1Philip R. Lee Institute for Health Policy Studies, San Francisco, California ;
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(Tracking ID # 11597)
BACKGROUND: Latinos with diabetes are at high risk for poor disease management, particularly immigrants and medically underserved subgroups. Dietary self-care may be particularly important to diabetes management in this population, given their limited access to health care services. However, these patients are likely to face significant contextual challenges to healthy dietary intake. We conducted an exploratory analysis of potential neighborhood and household impediments to dietary improvement among low-income Latinos with diabetes at a community health clinic, in order to inform a dietary intervention. We hypothesized that these patients would face substantial economic and other household barriers to dietary self-care and reside in relatively poor neighborhood food environments. METHODS: We randomly sampled 41 patients from a population of 174 patients with a HbA1c >8.0% from a community health clinic serving low-income uninsured Latino immigrants. Sampled patients were administered a telephone questionnaire in Spanish. Household food

security was measured using a 6-item scale developed by the USDA. Other household characteristics were measured via binary variables based on single questionnaire items. The neighborhood food environment was measured by perceptions of fruit and vegetable and fast food availability. All measures had been previously validated in Spanish-speaking populations.
RESULTS: One in four patients lived in a food insecure household and a larger proportion (51%) reported thinking about the cost of their diets on a daily basis. Contrary to expectations, neighborhood fruit and vegetable

availability was relatively high, with most patients (59%) in agreement or strong agreement that they lived in neighborhoods with a good selection of fresh fruits and vegetables. However, most (56%) also agreed/strongly agreed that their neighborhoods had a lot of fast food restaurants. Patients had some supports for dietary self-care in the household: All had access to a kitchen, stove, and refrigerator and most (68%) ate meals at the same time as the family member with whom they spent the most time. However, nearly half reported that this person often (many times per week or daily) ate foods that were not part of their diabetic diets and only 40% received praise for following their diets on a regular basis from this family member.
CONCLUSION: Low-income Latinos with suboptimal glycemic control at a community health clinic face significant barriers to dietary self-care, including widespread concerns over food cost and significant levels of food insecurity, high neighborhood access to fast foods, and consumption of unhealthy foods by family members. However, patients also have supports for dietary self-care, including good neighborhood fruit and vegetable availability and social contact at mealtimes. Interventions attempting to improve diet quality in similar patient populations should take into account key contextual barriers to dietary improvement, such as the cost of changing diets and fast food access, and take advantage of key supports such as shared mealtimes and good environmental access to healthier foods.
THE EFFECTS OF ARMODAFINIL ON CLINICAL CONDITION LATE (04000800) IN SHIFT INCLUDING THE COMMUTE HOME AND ON FUNCTIONING IN PATIENTS WITH EXCESSIVE SLEEPINESS ASSOCIATED WITH SHIFT WORK DISORDER Milton Erman 1;
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BACKGROUND: A previous phase 3 study demonstrated that armodafinil improves the wakefulness and overall clinical condition of patients with excessive sleepiness associated with shift work disorder (SWD). This current, multi-center phase 4 study examined whether armodafinil improved overall clinical condition late (defined as 04000800) in the shift, including the commute home. This study also examined whether armodafinil improved functional and patient-reported outcomes of patients with excessive sleepiness associated with SWD. To our knowledge, this was the largest interventional study ever conducted in patients with SWD. METHODS: In this randomized, double-blind, placebo-controlled multi-center study, patients were administered 150 mg armodafinil or placebo for 6 weeks. Patients were included if they were diagnosed with SWD, worked at least 5 night shifts a month (ideal shift time was midnight to 0800), had excessive sleepiness as evidenced by a score of >6 on the Karolinska Sleepiness Scale (average of 3 scores at 0400, 0600, 0800) and were functionally impaired as evidenced by a Global Assessment of Functioning (GAF) score <70. Patients with mild or more-than-mild obstructive sleep apnea (apnea/hypopnea index >5) and those who might have had other causes for their excessive sleepiness or functional impairment were excluded. The primary efficacy endpoint was improved clinical condition, as measured by the score on the Clinical Global Impressions-Change scale (CGI-C), late in the shift, including the commute home (04000800), at final visit (Week 6 or last postbaseline observation). The key secondary efficacy measure was improved patient functioning, as measured by mean change from baseline in GAF score, at final visit. Patients were evaluated immediately after an actual night shift rather than a simulated, laboratory night shift. Safety and tolerability were also assessed.
RESULTS: A total of 383 patients were enrolled in this study and a similar proportion of patients in both groups completed the study (82% armodafinil; 88% placebo). At the final visit, more patients treated with armodafinil demonstrated improved CGI-C scores between 0400 and 0800 versus placebo (77% vs. 57%; p<0.0001). Armodafinil-treated patients also had a greater mean change in GAF score from baseline compared to placebo (+9.5 vs +5.2; p<0.0001). The most common adverse events were headache (armodafinil 15%, placebo 4%), nausea (11%, 7%), and insomnia (7%, 2%). While no serious adverse events were observed in armodafinil-treated patients, one serious adverse event was observed in the placebo group (nephrolithiasis).

CONCLUSION: Armodafinil improved overall clinical condition late in shift during the critical circadian nadir period of 04000800 in patients with SWD. Additionally, armodafinil improved overall patient functioning as assessed by the GAF. Common adverse events seen with armodafinil in this study were similar in character and frequency to those observed in a previous phase 3 study in this population.
This research was sponsored by and conducted in collaboration with Cephalon, Inc., Frazer, PA.
HAS THE QUALITY OF HEALTHCARE IN THE US IMPROVED IN THE LAST DECADE? Minal Kale 1; Alex Federman 1; Salomeh Keyhani1.
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BACKGROUND: In the past decade there has been a major focus on improving the quality of care. While efforts to improve quality have largely been directed toward reducing underuse of needed care, increasing attention has been directed at reducing the inappropriate use of health care services. However most nationally reported quality measures to date are underuse measures. We examined changes in the quality of outpatient care in the US between 1998 and 2008 using measures of underuse, misuse and overuse of health care services.
METHODS: We performed a cross-sectional analysis of the National Ambulatory Medical Care Survey (NAMCS) and the outpatient department component of the National Hospital Ambulatory Medical Care Survey (NHAMCS), which are nationally representative annual surveys of visits to non-federally funded ambulatory care practices. We examined three quality measures: anti-platelet or anti-coagulation therapy among patients with coronary artery disease (CAD) (underuse measure); use of an antibiotic other than TMP-SMX, a narrow spectrum quinolone, or nitrofurantoin in women over the age of 18 for the treatment of urinary tract infection (misuse measure); and cervical cancer screening (pap smears) in women ages 65 and older (potential overuse). Our underuse measure is a widely used performance measure, the overuse and misuse measures are not currently performance measures. We estimated the rates of underuse, misuse and overuse and their 95% confidence intervals, accounting for the complex sampling design of the NAMCS and NHAMCS. We defined significant difference by the presence of non-overlapping confidence intervals in the difference in performance in the two years.
RESULTS: There were 2241 visits for patients with CAD, 63 visits for patients with urinary tract infection and 10185 visits for females older than 65 in 1998. There were 2223 visits for patients with CAD, 218

visits for patients with urinary tract infection and 7208 visits for females older than 65 in 2008. There was a statistically significant increase in the overuse of pap smears in females older than 65, from .014% (CI: .0018-.12) in 1998 to 2.2% (CI: 1.7-3.0) in 2008. We also observed a statistically significant reduction in the underuse of antithrombotic therapy. The proportion of patients with CAD who were prescribed an anti-platelet or anti-coagulant agent increased from 22.6% (CI: 10.3-42.9) in 1998 to 52.1% (CI: 46.4-57.7) in 2008. The proportion of patients with urinary tract infection who were prescribed an inappropriate antibiotic decreased from 30.2% (CI: 19.9-43.1) in 1998 to 23.8% (CI: 15.3-35.2) in 2008; however this was a non-significant difference.
CONCLUSION: Our preliminary results using only 3 measures demonstrate a reduction in underuse, but no reduction in the inappropriate use of health care services in the past decade. Addressing waste and inefficiency in the US health care system will require more focus on developing measures and incentives that reduce inappropriate care. Efforts to bend the cost curve make developing such measures a high priority.
DIAGNOSIS OF SHIFT WORK DISORDER AND THE IMPACT OF EXCESSIVE SLEEPINESS: AN INTERNET SURVEY OF SHIFT WORKERS, PATIENTS WITH SHIFT WORK DISORDER, AND HEALTHCARE PROFESSIONALS Candace Anderson 1; Lauren Sylvester 2; Sharon Paik2. 1Cephalon, Inc., Frazer, Pennsylvania ;
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BACKGROUND: Recent findings from the 2008 National Sleep Foundations Sleep in America poll indicated that (1) the effects of shift work are under-studied; (2) shift workers (SWs) who reported symptoms of shift work

disorder (SWD) were more likely to experience negative outcomes; (3) sleepiness or falling asleep at work, mood-related work impairment, and occupational accidents were more common among SWs. Recommendations from the poll included a call for increasing resources for education about, and diagnosis and treatment of, sleep disorders. The objective of this market research study was to understand how shift work disorder (SWD) affected the lives of shift workers (SWs) and how SWD was diagnosed from the perspective of healthcare professionals (HCPs) and SWs.
METHODS: Two separate, structured, online surveys were developed and administered to one of two study groups: (1) SWs with and without a self-reported diagnosis of SWD and (2) HCPs. To participate in the shift work survey, respondents had to have spent at least 21 hours per week working shifts in the 2 weeks prior to completing the survey; reported a diagnosis of SWD or been excessively sleepy (i.e. had a score of >/=10 of the Epworth Sleepiness Scale [ESS], administered as part of the online survey); and scored >/=5 on any of the subscales (disruption of work/ school work, social life/activities, or family life/home responsibilities) of the Sheehan Disability Scale (SDS). The surveys were conducted in March and April of 2009. HCPs who spent at least 75% of their time in patient care had to have been qualified for 3 or more years in one of the following specialties or occupations: Primary Care, Psychiatry, Neurology, Sleep Medicine, Pulmonology, Occupational Medicine, Gynecology, Registered Nurse, Physicians Assistant, or Nurse Practitioner to participate in the HCP survey.
RESULTS: The shift work survey was completed by 260 respondents and the HCP survey was completed by 673 HCPs. For SWs, 28% worked a shift for </=1 year, 16% for 1 to 2 years, and 20% for >10 years. Shift work negatively affected respondents energy level (72% of respondents), social life (64%), mood (63%), ability to get sufficient sleep (63%), irritability (60%), motivation (59%), alertness/ability to stay awake (55%), concentration (55%), and sex life (54%). As a result of their excessive sleepiness, 87% reported a loss of concentration/lapses of
attention at work in the previous month; 69% made mistakes at work; 43% said their ability to care for dependents had been compromised; 37% dozed off while driving; 34% almost caused a work-related accident; 11% were injured at work; and 10% had >/=1 work-related accident. Respondents reported using a variety of over-the-counter remedies to treat the symptoms of SWD, including coffee/tea (35%) and caffeinated soda (33%). A similar percentage (38%) received prescription medication to treat symptoms such as excessive sleepiness and/or insomnia. Of SWs without a diagnosis (n=157), 23% did not believe they suffered from excessive sleepiness despite scoring >10 on the ESS and being functionally impaired as measured by the SDS. 45% and 38% of SWs discussed excessive sleepiness and insomnia symptoms associated with their work schedule, respectively, with their doctor. SWs who discussed their excessive sleepiness with their HCPs initiated this conversation 82% of the time, while HCPs rarely initiated it (13%). Most HCPs (75%) had diagnosed patients in their practice with SWD. HCPs believed that 67% of total SWD is never detected by physicians. HCPs also believed that 50% of SWD is undiagnosed because it is often masked by other conditions, including depression and obstructive sleep apnea, and that it is misdiagnosed as depression 30% of the time, insomnia unrelated to SWD 27%, chronic fatigue syndrome 22%, and OSA 20%. CONCLUSION: Respondents reported that both excessive sleepiness and insomnia associated with shift work seriously impacted their lives, both at home and at work. A significant number of respondents have used over-the-counter remedies and pharmaceutical interventions to treat SWD-related symptoms. SWs do not always recognize their own symptoms of SWD and are more likely to initiate a discussion of those symptoms due to their work schedule than HCPs. HCPs believe that SWD is missed 67% of the time and reported that SWD is masked by other comorbidities or misdiagnosed.
This research was sponsored by and conducted in collaboration with Cephalon, Inc., Frazer, PA.
QUALITY OF CARE AND ELECTRONIC MEDICAL RECORDS: WHAT CAN WE EXPECT FROM INCREASED ADOPTION AND MEANINGFUL USE? Randall D. Cebul 1; Thomas E. Love 1; Anil K. Jain 2; ChristopherJ.

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BACKGROUND: Incentives for electronic medical record (EMR) adoption anticipate a quality-related return on investment, although few reports compare achievement on quality standards among practices with and without EMR. Our objective is to describe achievement and trends in achievement on quality standards for diabetes among EMR-and paper-based practices participating in a regional program to improve care among patients with chronic medical conditions. METHODS: Retrospective cohort study of primary care practices of 7 diverse health systems in Greater Cleveland publicly reporting their achievement and improvement on care and outcome-related quality standards for adults with diabetes between 7/1/07 and 6/30/10. Results are published on the program web site www.betterhealthcleve-land.org. All sites have the opportunity to participate in twice yearly QI Summits and receive program-sponsored practice coaching. Cross-sectional analyses compare achievement of 37 practice sites in the most recent report; trend analyses include 36 sites reporting in every report since 1/08. Achievement on the care composite is reported as the percentage of patients meeting all four component standards. Achievement on the outcome composite is reported as the percentage of patients meeting at least four of five component standards. Sites provide common data elements pertaining to all eligible diabetic patients (ages

1875, at least two visits during each 12-month period), including quality-relevant elements and data for covariates used in multivariate regression models. Covariates include patient age, sex, insurance (Medicare, commercial, Medicaid, uninsured), race/ethnicity (white, black, Hispanic, other), educational attainment and household income. RESULTS: In the most recent period (7/1/09-6/30/10), care and outcomes were reported for 27,236 adults with diabetes cared for by 569 PCPs in 37 sites of 7 systems (3 EMR, 4 paper). Paper-based sites generally cared for patients who were more disadvantaged - more likely to be non-white ($p=0.03$), poorer ($p=0.02$), uninsured or covered by Medicaid ($p<0.0001$), and of lower educational attainment ($p=0.06$). In bivariate analyses of 200910 data, use of EMR was the strongest correlate of higher achievement in care (51% vs. 7% achievement) and outcome (44% vs. 16%), with consistent findings across all component care standards and four of five component outcome standards. After adjustment, the EMR effect was +34.1 percentage points for care (95% CI, 22.2-46.0; $p<0.00001$) and +11.7 percentage points for outcomes (95% CI, 5.3-18.1; $p=0.0001$). While bivariate analyses of trends also favored EMR-based sites (differences in annualized change of 8.5 percentage points in care, $p=0.01$; and 4.2 percentage points in outcomes, $p=0.02$), these trends became non-significant ($p=0.25$ for both composites) after adjustment.
CONCLUSION: In a region-wide quality improvement collaborative featuring public reporting, the use of fully functional EMR was associated with dramatically higher achievement on nationally endorsed quality measures for diabetes, with greater differences associated with care than outcome standards. Perhaps because program-wide coaching disproportionately served paper practices, trends in achievement were non-significantly different by measurement source, although paper practices started from a lower baseline. These findings raise cause for optimism that federal policies encouraging meaningful EMR use can raise quality of care.
ADOPTION OF A CLINICAL DECISION SUPPORT SYSTEM TO PROMOTE JUDICIOUS USE OF ANTIBIOTICS IN PRIMARY CARE Cara B. Litvin 1; Steven M. Ornstein 1; Arch G. Mainous 1; Andrea M. Wessell 1; Lynne S. Nemeth 1; Paul J. Nietert 1; Carol Ann Lambourne1.
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BACKGROUND: Antibiotics are overprescribed for the treatment of acute respiratory infections (ARI), leading to increasing antimicrobial resistance. The Reducing Inappropriate Prescribing of Antibiotics by Primary Care Clinicians study is assessing the impact of a clinical decision support system (CDSS) on antibiotic prescribing

for ARIs. Previous CDSS have been piloted, but low rates of use by providers have limited assessment of their efficacy. To facilitate its use, the CDSS was developed as an electronic medical record (EMR) progress note template, used at the point of care for documentation. The CDSS includes guidelines from the Centers for Disease Control and Prevention Get Smart program and presents diagnosis and treatment recommendations based on a patients age and presenting symptoms. The purpose of this report is to describe use of the CDSS, as well as facilitators and barriers to its adoption during the first year of the 18 month study. METHODS: Between January 1, 2010 and December 31, 2010, 39 providers in 9 practices in 9 states across the US participated in this study. All practices are members of a practice based research network, use a common EMR, and pool data quarterly for quality improvement and research projects. A multi-method intervention was used to facilitate CDSS implementation. Providers agreed to use the CDSS for patients seen with ARI. Each practice received two half-day site visits, sent representatives to 2 network meetings, and received quarterly reports on their use of the CDSS and use of antibiotics for ARIs. CDSS use for ARIs was calculated at the practice level as the number of encounters at which an ARI diagnosis using the CDSS was made divided by the number of all encounters at which an ARI diagnosis was made. Facilitators and barriers of adoption were explored through semi-structured interviews with providers and staff during site visits and network meetings; organized into 4 domains (organizational, provider, patient and technical factors) based on a previously published CDSS evaluation framework.
RESULTS: In the first year of the study, the CDSS was used 19,993 times. In adult patients, practice use of CDSS for encounters with diagnoses of ARIs ranged from 40% to 67%. Empowering medical assistants to open the CDSS based on patients presenting symptoms was a common organizational factor associated with CDSS use. Providers reported that CDSS use improved awareness about diagnosis and treatment guidelines. Practice-wide agreement with ARI guidelines also facilitated CDSS use. Several providers reported that the CDSS was used to prompt discussions about use of antibiotics with patients. Use of the CDSS was perceived to speed office visits and improve documentation. Barriers to adoption included variation among providers use of EMR templates at the point of care and difficulty with use of the CDSS for patients with multiple diagnoses.
CONCLUSION: Adoption of a custom designed CDSS in the first year of implementation is promising. Its impact on antibiotic prescribing for ARIs will be assessed at the end of the 18 month intervention.
NAVIGATING PUBLIC HOUSING RESIDENTS INTO PRIMARY CARE: A READINESS ASSESSMENT Tracy A Battaglia 1; Samantha S Murrell 1; Sarah E Bhosrekar 2; Sarah E Lane 1; Linda R Stanley 3; Deborah J Bowen 3; Jo-Anna Rorie3. 1Boston University School of Medicine, Boston, Massachusetts ; 2Boston University School of Public Health, Boston, Massachusetts ;
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BACKGROUND: Residents of public housing are at increased risk of living with uncontrolled chronic disease, including heart disease, stroke, and diabetes. The Boston University Partners in Health and Housing Prevention Research Center aims to improve the health of Boston Public Housing Residents through community-based participa-tory research conducted in collaboration with public housing residents and local community organizations. Despite close proximity to community health centers and comprehensive academic medical centers, previous work has shown that public housing residents face many barriers to engaging in primary care. This collaboration of residents, community organizations, and academic researchers identified cardiovascular disease prevention (heart health) as a health priority for programs targeting public housing residents. As formative work for an intervention study, we conducted this research to (1) compare the readiness of housing developments versus community health centers to address heart health through a community-based intervention, and (2) to provide a framework for an intervention to bridge residents of public housing developments and primary care services within the community health centers.
METHODS: Using the Community Readiness Model, key informant interviews were conducted across 15 community settings: 8 public housing developments and 7 nearby community health centers. Four to 6

interviews were conducted in each community setting. Key informants were identified by community leaders as knowledgeable about ongoing efforts in their respective community. Housing development key informants included residents, resident leaders, and management, while health center key informants included leadership, clinical staff, support staff, and outreach workers. Using a previously validated

scoring system, each community received a composite readiness score, which ranged from 19, corresponding with their readiness to engage in heart health prevention activities, with higher scores indicating higher levels of readiness. These composite scores were further analyzed across 6 dimensions of readiness. Interview transcripts were also reviewed for consistent themes.
RESULTS: Preliminary findings from 78 key informant interviews (42 housing development residents and 36 health center staff) found health centers have significantly higher levels of readiness to engage in heart health prevention activities (mean 5.3) compared with housing developments (mean 2.8). Both health centers and housing developments scored highest in existing programs and policies to address heart health (health center mean 6.1; housing development mean 3.6) and the resources available to address the issue (health center mean 5.7; housing development mean 3.5). Both health centers and housing developments scored lowest in community knowledge of heart health programs (health center mean 5.1; housing development mean 2.1). An overall score of 5 indicates that health centers are in the preparation phase, and their goal to progress to the next level of readiness is to continue to gather pertinent information and work with key leaders around prevention activities. For housing developments, an overall score of 2 is the denial/resistance phase, and efforts to increase education and awareness of heart health and prevention programs is needed for the community to progress to the next stage of readiness. Preliminary qualitative analysis demonstrates a lack of current partnerships between housing development and community health centers, yet an interest in partnering to address heart health in both settings. CONCLUSION: Our findings confirm a mismatch in community readiness to address heart health between housing developments and community health centers. Although the community health centers have programs to address health issues, community awareness of programs is limited. The readiness scores will guide the intervention strategies we use in each unique community, and we will focus on stage-specific goals in order to better align housing development readiness with community health center readiness. Eliciting perspectives of key stakeholders (residents of each housing development and staff of each corresponding health center) when developing an intervention around a community-identified health priority ensures community buy-in and support for program implementation. We plan to pilot the intervention at four public housing developments.
SYMPTOMS ON ATRIPLA VS. OTHER CART REGIMENS E. Jennifer Edelman 1; Kirsha Gordon 2; Maria Rodriguez-Barradas 3; Amy C. Justice4. 1Yale University School of Medicine and VA Connecticut Healthcare System, New Haven, Connecticut ; 2VA Connecticut Healthcare System, West Haven, Connecticut ; 3Michael E. De Bakey VAMC and Baylor College of Medicine, Houston, Texas ; 4Yale University School of Medicine and Public Health, VA Connecticut Healthcare System, New Haven, Connecticut . (Tracking ID # 11631)
BACKGROUND: Eighty to 90% of patients newly diagnosed with HIV are now started on Atripla, a one pill, once a day drug combination, including emtricitabine, tenofovir and efavirenz which is thought to have few side effects. However, existing studies of patient tolerability are limited as they occur in the context of randomized controlled trials, rely on relatively short follow-up and do not adjust for important covariates, including comorbid diseases. Our aims were to 1) describe the characteristics of patients prescribed Atripla in a large cohort; 2) identify any symptoms associated with Atripla; and 3) adjust the analyses for disease severity (as measured by the VACS Index), medication adherence and being cART-naive.
METHODS: We performed a cross-sectional analysis of the Veterans Aging Cohort Study, a longitudinal multi-site study of HIV-infected and HIV-uinfected Veterans. We relied on data collected from 2008 to 2009. The analytic sample was restricted to patients on cART for 3 months with available symptom, pharmacy and

adherence data. To determine symptom experiences, we used the HIV Symptom Index, which gives self-reported measure of degree of bother of 20 symptoms over the past four weeks. The VACS Index, a prognostic index that has been previously validated, was used to adjust for disease severity; scores range from 0 to 100. Adherence was calculated using fill/refill pharmacy data, ranging from 0 to 100. We calculated descriptive statistics, using chi-square for categorical variables and t-tests of Kruskal-Wallis test for continuous variables. We then used logistic regression to assess the association between Atripla and symptoms, unadjusted and then adjusted for the VACS Index, adherence and cART-naive status. RESULTS: Our sample included 1,756 Veterans. In comparison to patients on other regimens, patients on Atripla (N=1,756) were similar based on gender, race/ethnicity, and medication adherence. However, they were younger (53 vs. 54, p=0.01), less likely to be infected with Hepatitis C (33% vs. 46%, p<0.001) and less sick as assessed by the VACS Index (27 vs. 33, p<0.001) and other laboratory values. Patients on Atripla were also significantly less likely to report numbness/tingling in hands/feet (0.74, CI 0.56 - 0.97) and nausea/vomiting (0.60, CI 0.39 - 0.94) after adjusting for disease severity, medication adherence and being cART-naive. Symptoms among those on Atripla vs. other cART regimens were not significantly different for the remaining 18 assessed symptoms. CONCLUSION: Atripla is associated with less peripheral neuropathy and less nausea and vomiting than other cART regimens.

THE ROLE OF DATA IN ADDRESSING HEALTH CARE DISPARITIES IN MEDICAID MANAGED CARE PLANS: PERSPECTIVES FROM THE EXECUTIVE SUITE David Moskowitz 1; Bruce Guthrie 2; Andrew Bindman1. 1Division of General Internal Medicine, San Francisco General Hospital, University of California San Francisco, San Francisco, California ; 2Centre for Primary Health and Population Care, University of Dundee, Dundee, N/A . (Tracking ID # 11632)

BACKGROUND: The Patient Protection and Affordable Care Act includes provisions to standardize the collection of health care quality information by racial and ethnic subgroups that can be used to address disparities. In California, Medicaid managed care plans have routinely collected Health-care Effectiveness Data and Information Set (HEDIS) data on quality by racial and ethnic groups for almost a decade. As measured by HEDIS, African-Americans and whites typically experience the lowest quality of care, Asian-Americans the best, and Latino groups somewhere in between. We asked Medicaid managed care plan leaders about the role of these data as well as other motivators to address health care disparities within their plans. METHODS: We conducted semi-structured interviews with 21 health plan executives (chief executive officers, chief medical officers, directors of quality improvement and directors of cultural-linguistic services) at 8 of the 19 Medicaid managed care plans in California. We utilized purposive sampling to maximize heterogeneity in geography and plan type (e.g. non profit, commercial). All interviews were audio-recorded and transcribed. We utilized modified grounded theory for analysis. We used multiple interviews within a plan in order to triangulate themes. Two researchers independently reviewed transcripts and assigned codes with disagreements resolved by discussion.

RESULTS: Three themes emerged: 1) Many plans only examine differences in HEDIS measures by racial and ethnic groups when the plans overall performance on a measure was lower than the average

across all Medicaid managed care plans. 2) To the extent that plans have developed interventions to address disparities these tend to be targeted toward recent immigrants 3) Plans cited state regulations with financial consequences such as one requiring interpreter services as a more powerful influence on their approach to disparities than data. CONCLUSION: The experience in Californias Medicaid managed care plans suggests that the availability of health care quality data by race and ethnicity is not sufficient for ensuring that plans will use it to inform their attempts to improve health care quality and disparities. Health plan actions to address health care disparities are still driven by preconceived notions of disparities and by regulations with financial implications. If

data are to become the basis for actions to address disparities, plans will need help in interpreting the results and regulations will need to be developed that encourage actions that correspond to a plans actual performance.

HOW DO PHYSICIANS THINK ABOUT STEWARDSHIP IN HEALTH CARE? A QUALITATIVE NATIONAL STUDY Matthew K. Wynia 1;

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BACKGROUND: Stewardship may be defined as the judicious management of community resources entrusted to ones care with the aim of using the resources to the long-term benefit of the community. In health care, physicians are often entrusted with decision-making authority to spend pooled resources, whether through private insurance or government programs. We sought to understand how physicians think about the notion of stewardship and their role, if any, in serving as stewards to ensure the sustainability of the health care system.

METHODS: Using a literature review a theoretical framework was developed for assessing physician views on stewardship. This framework was initially tested using online bulletin boards (similar to focus groups) with a nationwide convenience sample of 32 physicians to explore and validate proposed item categories. Survey items were then developed in several domains: cost awareness, decision-making empowerment, and attitudes and behaviors reflecting a stewardship orientation. Items were tested using a card sort exercise in which physicians grouped items together based on similar constructs and themes. This was conducted through web-assisted telephone in-depth interviews (TIDIs) with 35 physicians to assess psychometric properties and for item reduction. A shorter version of the survey was then tested with 18 physicians, again using web-assisted TIDIs, to refine items and elicit further views and experiences in relationship to the concept of stewardship.

RESULTS: Overall, 85 physicians participated in online bulletin boards or completed a version of the survey during web assisted TIDIs (56 PCPs and 29 specialists). All endorsed the notion of an obligation to serve as an advocate for individual patients. At the same time, community health and national policy issues are top of mind for many physicians; but while cost to individual patients often affects testing and treatment recommendations, costs to payors or the larger community are rarely considered. Many physicians understand the concept of the larger community paying for the use of very expensive care through an insurance pool, but they do not see this affecting the care they deliver to their own patients. Instead, physicians found time management, use of drug samples, and the spread of communicable diseases to be meaningful examples of how care decisions for one individual might affect others. In addition, most physicians feel some responsibility for controlling overall spending, but few feel empowered to do so for a number of reasons, including litigation risks, patient demands, limited options, and the belief that patients should ultimately be responsible for making care decisions. Specialists are generally less aware of costs than PCPs; PCPs are also more likely to provide multiple testing and treatment options, while specialists often report presenting only what they view as the best option to the patient. A minority of physicians have heard the term medical stewardship, though it generally raised positive connotations in open ended questions.

CONCLUSION: Many physicians believe they are the party most responsible for making spending decisions and healthcare resource allocation. Moroever the concept, if not the term, medical stewardship makes sense to most physicians; yet it rarely affects testing and treatment recommendations. Physicians uniformly endorse an ethical obligation to respect patient rights and provide optimal quality care. Developing a shared understanding of how physician obligations toward ensuring a sustainable health care system fit into this core professional ethic is important. Specific examples of how individual care decisions can affect the larger community might be helpful in this regard, as would be efforts to help physicians serve as effective stewards of shared health care resources while continuing to be advocates for individual patients.

CLINICIANS DO NOT ACCOUNT FOR OVERALL CARDIAC RISK IN HYPERTENSIVE TREATMENT

INTENSIFICATION Jeremy Sussman 1;

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BACKGROUND: Measures of overall cardiovascular risk (OCR) such as the UK Prospective Diabetes Study (UKPDS) Risk Engine can aide prioritization in clinical decision-making, because a patient who is likely to have a clinical event will likely benefit from its treatment. While OCR predicts the benefit of treatment intensification (TI) for patients with hypertension, it remains unclear if physicians use OCR in decision-making or if they guide treatment using blood pressure alone. In this study we examined the influence of OCR in the likelihood of treatment intensification.

METHODS: Data were from the ABATe study (Addressing Barriers to Treatment for Hypertension), a prospective cohort study of 856 diabetic US Veterans with diabetes and twice-measured blood pressure >=140/90 at a single scheduled primary care visit between 2005 and 2006. We defined TI (the dependent variable) as a change in medication or dosage in the 3 months after the office visit. We divided OCR (the independent variable) into three groups - history of heart attack or congestive heart failure, high risk (UKPDS 10-year event risk >20 %) or low-medium risk (UKPDS 10-year event risk <20%). We then conducted logistic regression models to assess the association between OCR and TI. All models were adjusted for systolic blood pressure, previous years mean systolic blood pressure, comorbidity count, and clustering by clinician. We also assessed whether the association of OCR with TI was affected by uncertainty about hypertensive status, as measured by patient-reported home blood pressure values, or uncertainty of additional benefit of TI, as measured by the patient being on four classes of antihypertensive medications.

RESULTS: Of the 856 participants in the final model, 44% had a history of MI or CHF, 38% had high CV risk, and 19% had low or medium CV risk. Average BP was 154/79+/14/12 (SD). Compared to veterans with low-to-medium CV risk, high risk veterans had 1.10 times the odds of TI (95% CI 0.75-1.6, p=0.61) and those with a history of MI/CHF had 1.28 times the odds of TI (0.78-1.8, p=0.43). Three individual components of

total risk were associated with TI: higher systolic blood pressure (OR=1.15, 1.02-1.30, p=0.02 per 10 mmHg), higher hemoglobin A1C (OR1.11, 1.01-1.23, p=0.03 per 1% increase), and total:HDL cholesterol ratio (OR=1.09 0.999-1.19, p=0.06). Other individual risk factors including age, race, and smoking status were not associated with likelihood of TI. These findings were robust to multiple confounders, including clinical measures, measures of uncertainty of hypertension and measures of uncertainty of benefit of TI.

CONCLUSION: While certain cardiac risk factors such as hypertension severity play a major role in clinical decisions to intensify hypertension treatment, we found no evidence that clinicians account for overall cardiovascular risk in clinical decision-making. Emphasizing the role of overall risk on clinical treatment priorities will increase the efficiency and patient-centeredness of hypertension care.

IMPLICIT BIAS AND ITS RELATION TO HEALTH DISPARITIES: A SURVEY OF MEDICAL STUDENTS

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BACKGROUND: As the US population becomes more ethnically and racially diverse, health disparities affecting ethnic and racial minority populations becomes an ever more important issue in health care and in medical education. Although the etiology of health disparities is multifactorial, evidence suggests that individual physicians actions contribute to disparities in health. Since such disparities can be found across the spectrum of human disease, all physicians need to be aware of them and work to eliminate disparities in their own clinical practice behaviors. Subtle, often subconscious factors may lead individual physicians to make different clinical choices in patients depending on their sex, race, or ethnicity. Differences in physician care provided to patients of different racial backgrounds have been found in actual clinical settings, in hypothetical clinical scenarios, and when using standardized patients. It is thought that these differences are not the result of overt, explicit racism,

but more the result of implicit bias. Having these implicit biases does not make a physician a bad person - they are extremely common - but they need to be recognized and overcome if the physician seeks to provide equitable care to all patients.
The importance of health disparities education in the undergraduate medical curriculum is recognized by the accrediting bodies. Given the relevance of physician implicit bias to health disparities, we developed an educational session that emphasized implicit bias, after which we surveyed third year medical students on their attitudes and beliefs. Our objectives were: to explore the students attitudes and beliefs toward subconscious bias and health disparities, and to evaluate the association between students self-assessment and what they believed or observed about health disparities.
METHODS: Third year medical students were surveyed after participating in a required session focusing on health disparities. The learning objective relevant to the survey was: Examine personal attitudes, beliefs, and biases regarding patients and health care issues, and create a plan for improving your own professional behavior. Educational strategies included required readings, small group discussion, personal bias exploration using the Implicit Association Test (IAT), and a written description of an experience on the ward that may have reflected physician bias or stereotyping. The voluntary survey was a fifteen question, anonymous survey focusing on the results of the IAT, students attitudes toward the validity of the results, and their attitudes and experiences regarding
the fairness of the health care system, and their own potential implicit bias. The questions used a four point Likert Scale, providing statements that students could respond to over a range from 1 Strongly Agree to 4 Strongly Disagree. Demographic data including, ethnicity, race, and gender were collected. We reviewed univariate descriptive data to identify trends and patterns, and found that a small but substantial proportion (22%) of students disagreed or strongly disagreed with the statement Unconscious bias might affect some of my clinical decisions or behaviors. Since this position seemed a curious one to hold at the end of this session, we decided a priori to focus our data analysis specifically on factors associated with this perspective. We used Chi-square tests or 2-sided Fishers exact tests to assess statistical significance of these associations. RESULTS: We received 218 completed surveys over the two years. A total of 316 were enrolled in the course; we do not have specific attendance figures for those days, so this represents a response rate of 69% or better. Comparing gender demographics, there was a nonsignificant difference in the percentage of women responders versus percentage of women in the class (58% vs 52% p=0.067). We first dichotomized our results into groups based on the answer to the question: Unconscious bias might affect some of my clinical decisions or behaviors. Forty-Seven (22%) of the students answered Disagree or Strongly Disagree, (deniers) while 167 (77%) of students answered Strongly Agree or Agree (accepters) to this question. Each groups responses are compared in Table 1. While most students IAT results, not surprisingly, revealed an unconscious bias that favored people more like themselves (e.g., white students showing a preference for whites), this preference was more common among the deniers, who were also more likely to believe the IAT might be invalid. Although the overwhelming majority of students agreed with the statement Health disparities exist in the United States the deniers disagreed with this statement at a greater frequency than the accepters. The deniers were more likely to agree that Doctors treat all patients the same, no matter what group they belong to, and to agree that The US health care system is fair and equitable, and provides blinded care. While the deniers were slightly less likely to report that they had observed doctors treating patients differently based on race or ethnicity this difference was not statistically significant. These students, however, were less likely to report that they had observed nurses displaying the same behavior less frequently than the accepters, a difference that was statistically significant. There was no significant difference between the groups the students belonged to and their ethnicity, race or gender.
CONCLUSION: To our knowledge, this is the first study surveying medical students on their attitudes regarding implicit bias after exploring their personal biases. The fact that 22% of the students disagreed with the possibility that their unconscious bias might affect some of their clinical decisions or behaviors has significant implications.

First, the recognition of bias cannot be taught in a single session. Second, it may reflect that the methods used to teach bias in the session were not sufficiently effective for all students to be able to learn about their own unconscious biases and recognize the impact they can have in clinical care.
In our study, the deniers were also more likely to have IAT results that showed a preference for people like themselves. The existence of bias is consistent with the findings of implicit bias in preprofessional students and in self-reported MDs taking the IAT favoring Whites over Blacks. Since demographic data were no different between the two groups, and there is dissociation between explicit and implicit racial bias, raising awareness of this issue is paramount.
In conclusion, the majority of our students had implicit biases favoring people like themselves. The students who denied any potential impact of their implicit bias on their future clinical care had more bias, were less likely to believe that health disparities exist in the US, and were less

likely to report that they had observed bias in care during their clinical rotations. This suggests that there is a subgroup of students for whom it may be especially important, and challenging, to teach about the existence of and physicians contributions to health disparities. Our experience supports the value of teaching medical students to recognize their own implicit biases and develop skills to overcome them. Future research is needed to develop an effective way to teach students to recognize their implicit biases and to mitigate their impact on clinical decision making.
Table 2 comparison of responses between deniers and acceptors
1. Total number of deniers/total number of acceptors responding to
each question.
2. Reversed score.
ENGAGING ACADEMIC PHYSICIANS IN GRATEFUL PATIENT
FUNDRAISING Scott Wright 1; Steven Rum2. 1JHU, Baltimore, Maryland ;
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BACKGROUND: Nationally, $1 billion is given each year by grateful patients in support of their physicians at community hospitals and academic medical centers. Systematizing effective methodologies may translate into even greater generosity from patients to support program-matic and capital needs. Donations from grateful patients often arise from appreciation for care that has been rendered. Most physicians have limited experience with grateful patient fundraising. This study was conducted to explore the effectiveness of methods that may be used to encourage physician participation in grateful patient fundraising.
METHODS: Physicians from 5 Departments (Cardiology, Dermatology, Neurology, Oncology, and Orthopedics) who spent at least 40% of their time in patient care and whom had never made a referral to development or secured philanthropy from grateful patients eligible to participate in this study. Seventy-four doctors met these inclusion criteria and 51 (69%) agreed to participate. These physicians were randomized into one of three groups: (i) the e-mail arm - receiving weekly e-mails articles that touched on philanthropy processes and outcomes, (ii) the lecture arm, received a one-hour training session taught by physicians who had been extremely successful in grateful patients philanthropy, and (iii) the coaching arm wherein development professionals conducted one-on-one sessions with the physicians to educate and guide them in grateful patient fundraising. Groups 2 &3 also received the weekly emails. The primary outcome was the number of quality individual referrals (defined as someone who has the capacity to make a minimum gift of $25,000) given to the development team by the physicians, and the secondary outcome was philanthropic dollars received (although the short follow-up to date limits the realization of this outcome as stewardship takes time). The intervention period continued for 3 months and data collection (counting of referrals and donations) continued for an

additional 3 months.
RESULTS: There were not any quality referrals that came in from the email arm, 3 from the lecture arm, and 41 from the coaching arm. All 19 physicians randomized to the coaching arm generated at least one quality referral. Four gifts totaling $219,550 have been received from the referrals from physicians in the coaching arm and there is a $1 million pledge that has not yet come in. No gifts or pledges that have arisen from physicians randomized to the other arms.
CONCLUSION: With the mounting pressures of reduced research dollars and lower reimbursements for the delivery of patient care, philanthropy may play an increasing role in balancing budgets and allowing for innovation. This trial shows that individualized attention from development officers giving one-on-one coaching to physicians appears to be a most effective way to collaborate around grateful patient philanthropy.
PANDEMIC INFLUENZA VACCINATION AND MINNESOTA HEALTH CARE WORKERS: SELF-REPORTED BEHAVIORS AND PERCEPTIONS OF PROFESSIONAL OBLIGATION Joan Henriksen Hellyer 1; Jon Tilburt 1; Aaron DeVries 2; Gregory Poland 1; Katherine James1. 1Mayo Clinic, Rochester, Minnesota ; 2Minnesota Department of Health, St. Paul, Minnesota . (Tracking ID # 11689)
BACKGROUND: Health care workers are viewed as a priority group for vaccination against influenza, but many in this population choose to remain unvaccinated. The purpose of this study was to describe the attitudes and self-reported behaviors of Minnesota nurses and physicians regarding pandemic influenza vaccination including their perceived professional obligations.
METHODS: In Spring 2010 a random sample of 800 physicians and 800 nurses licensed and residing in the state of Minnesota were mailed an 8-page self-administered paper survey. Mailed responses from 3 waves were double-entered into an electronic database. Categorical data were compared between groups with chi-square tests. The likelihood of not being vaccinated was compared with professional group, perceived professional obligation, and perceived risk of side effects using logistic regression. P-values <0.05 were considered statistically significant. All analyses were performed using SAS v 9.1 (Cary, NC).
RESULTS: 486 of 800 (61%) physicians and 587 of 800 (73%) nurses responded. Overall, a majority of both physicians (85%) and nurses (62%) reported being vaccinated for H1N1 influenza, but physicians were more likely to be vaccinated than nurses (p<0.001). Among those who were not vaccinated, nurses were much more likely to worry about vaccine side effects (17%) than physicians (4%) (p=0.01). Compared to nurses, physicians were slightly more likely to agree that healthcare workers have a professional obligation to be vaccinated (88% vs. 72%, p<0.001) and that in an influenza pandemic, healthcare workers have the ethical obligation to follow public health authorities recommendations (92% vs. 82%, p<0.001). In unadjusted analyses, misperceiving the risk of side effects [OR=2.3 (95% CI:1.7-3.1)], perceiving a professional obligation to be vaccinated [OR=0.10 (95% CI: 0.07-0.14)], receiving information about pandemic influenza from non-public health authority sources [OR=1.87 (95% CI: 1.26-2.78)], and being a nurse [OR=3.59 (95% CI: 2.66-4.86)] were all significantly associated with not being vaccinated. In a multivariable model, perceived professional obligation to be vaccinated [OR=0.11 (95% CI: 0.07-0.15)] and being a nurse [OR=2.23 (95% CI: 1.41-3.53)] were significantly associated with not being vaccinated.
CONCLUSION: Minnesota healthcare workers reported high rates of H1N1 pandemic influenza vaccination in 2009. However, remaining

non-conformity to vaccination recommendations may be related to perceived professional norms as well as sources of information and perception of side effect risks. Public health messaging regarding health care worker pandemic influenza vaccination and its side effects should focus more attention on reaching nurses as well as physicians.
POSTTRAUMATIC STRESS DISORDER (PTSD) FOLLOWING ACUTE CORONARY SYNDROMES (ACS) PREDICTS POOR ADHERENCE TO ASPIRIN IN POST-ACS PATIENTS Ian M Kronish 1; Nina Rieckmann 2;

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BACKGROUND: Approximately 15% of ACS patients develop PTSD after the trauma of the coronary event. ACS-induced PTSD in turn is related to subsequent poor medical prognosis, including cardiac rehospitalization, ACS recurrence, and mortality. We hypothesized that elevated PTSD symptoms 1 month after ACS would be related to subsequent poor adherence to aspirin, independent of important confounders including depression.

METHODS: 163 patients were enrolled from 3 university hospitals within 1-week of ACS. PTSD symptoms were assessed 1-month later using the Impact of Events Scale-Revised (IES-R; score >32 corresponds to PTSD diagnosis). Adherence to aspirin was measured using MEMS caps, which record the date and time on each occasion the bottle cap is opened. Patients were categorized as non-adherent if they took aspirin correctly <80% of days during months 2 and 3 after discharge. Logistic regression was used to test whether PTSD (IES >32) at 1 month after ACS predicted subsequent lower adherence to aspirin during months 2 and 3. Covariates for multiple logistic regression analyses included age, gender, race, Global Registry of Acute Coronary Events (GRACE) risk score (a measure of prognosis after ACS), Charlson comorbidity index, and depression status (Beck Depression Inventory score 10).

RESULTS: 11% (n=18) of patients were classified with PTSD (IES-r >32) at 1 month after ACS. 20% (n=33) of patients were non-adherent (< 80%) to aspirin during months 2 and 3. 44% (n=8) of PTSD cases were classified as non-adherent, and 17% (n=25) of non-PTSD cases were classified as non-adherent. Without adjustment for covariates, PTSD classification was related to a greater than 3-fold increase in odds of nonadherence (OR=3.84; 95% CI=1.38-10.70). In the fully adjusted model, PTSD classification remained an independent predictor of nonadherence (OR=3.22; 95% CI=1.01-10.36).

CONCLUSION: Post-ACS patients who report ACS-induced PTSD 1 month after hospitalization are at increased risk for subsequent nonadherence, independent of other important sociodemographic and medical covariates, including depression. Future studies should examine whether this relationship helps to explain previously demonstrated relationships between PTSD symptoms and ACS recurrence and mortality.

THE IMPORTANCE OF CLINICAL SEVERITY IN THE MEASUREMENT OF READMISSION RATES: A COMPARISON OF MEDICARE BENEFICIARIES IN 1997 AND 2007 Matthew Press 1; Amol Navathe 2; Jingsan Zhu 2; Wei Chen 3; Jessica Mittler 4; Dennis Scanlon 5; Kevin Volpp2. 1Weill Cornell Medical College, New York, New York ; 2University of Pennsylvania, Philadelphia, Pennsylvania ; 3University of Pennsylvani, Philadelphia, Pennsylvania ; 4The Pennsylvania State University, State College, Pennsylvania . (Tracking ID # 11695)

BACKGROUND: Preventable hospital readmissions occur frequently, account for substantial costs, and are thought to reflect poor

quality of care transitions. Spurred in part by mandatory public reporting and impending financial incentives from the Patient Protection and Affordable Care Act, hospitals and quality improvement organizations have made reducing readmissions a top priority. In order to evaluate their efforts to reduce readmissions, these groups must accurately measure readmission rates and make longitudinal comparisons. But readmission rates are often not adjusted for clinical severity of patients, potentially leading to misinterpretation of longitudinal trends. Since the relationship between clinical severity and readmissions is not fully understood, our objective was to determine the degree to which differences in severity affect readmission rates and whether this changes over time. To do so, we examined differential trends across clinical severity levels in readmission rates of two common conditions over a 10-year period.

METHODS: We analyzed inpatient claims data from fiscal years 1997 and 2007 for all unique Medicare patients (N=1,705,654) admitted to short-term acute-care nonfederal hospitals with principal diagnoses of acute myocardial infarction (AMI) or congestive heart failure (CHF). We examined the change in the odds of 30-day

all-cause readmission for patients with higher versus lower clinical severity in 2007 compared to 1997 using a difference-in-differences approach. Each patient was assigned to one of four severity groups: group 1 represented the lowest severity, group 4 the highest. Severity was determined based on claims-level models in which 30-day mortality was regressed on age, gender, and Elixhauser comorbidities. Differences in trends in readmission among severity groups were produced by interacting severity group dummy and year dummy variables.
RESULTS: For AMI, the 30-day readmission rate for group 1 (lowest severity) was 17.1% in 1997 and 14.0% in 2007. The readmission rate for group 4 (highest severity) was 22.8% in 1997 and 23.3% in 2007. Compared to patients in group 1, the change in the odds of readmission over time was significantly higher for AMI patients in group 4 (OR=1.31 [95% CI 1.24, 1.37], P<.01). The results for CHF patients followed a similar pattern. The readmission rate for group 1 was 21.6% in 1997 and 20.5% in 2007. For group 4, the readmission rate was 22.6% in 1997 and 24.7% in 2007. Compared to patients in group 1, the change in the odds of readmission over time was significantly higher for CHF patients in group 4 (OR=1.20 [95% CI 1.16, 1.24], p<.01). CONCLUSION: Relative to Medicare patients with low clinical severity, high severity patients experienced increasing odds of readmission in 2007, compared to 1997, following hospitalization for AMI and CHF. As this analysis shows, readmission rates change over time at different rates for patients in differing severity groups. In tracking readmission rates and evaluating efforts to reduce them, policymakers and organizational leaders should take into account the underlying distribution of clinical severity in patient populations and monitor whether it changes over time.
I FEEL LIKE IM NOT A DOCTOR: PHYSICIANS PERCEPTIONS OF OPIOID MANAGEMENT Steffanie R Campbell 1; Marianne S Matthias 2; Alicia A Bergman 1; Erin E Krebs3. 1Indiana University, Indianapolis, Indiana ; 2Indianapolis VA, Indianapolis, Indiana ;
3Indianapolis VA &Indiana University, Indianapolis, Indiana . (Tracking ID # 11699)
BACKGROUND: Recent decades have seen a dramatic increase in prescribing of long-term opioids for management of chronic pain. At the same time, research has demonstrated substantial variation between primary care physicians in their perceptions about appropriate opioid

use and in their opioid prescribing practices. Current guidelines recommend structured monitoring of opioid therapy, using tools such as urine drug screening and structured pain reassessment, but adherence to these guidelines is generally low. The purpose of this study is to understand physician perspectives on opioid prescribing and monitoring practices and to identify potential barriers to opioid monitoring in primary care.
METHODS: We are conducting in-depth semi-structured qualitative interviews with primary care physicians at a VA medical center, using maximum variation snowball sampling to capture a broad range of perspectives. Interview questions were designed and refined after pilot testing to elicit experiences with opioid monitoring, perceptions about interpersonal consequences of monitoring, and barriers or facilitators to monitoring. Interviews are recorded, transcribed and checked for accuracy. Concurrent with ongoing data collection, we are using emergent thematic analysis to understand and interpret the data. Investigators separately review transcripts, then meet as a group to review data together, reach consensus on coding categories, and identify emerging themes. Interviews will continue until theoretical saturation is reached.
RESULTS: The first six primary care physicians interviewed include 4 women and 2 men with years in VA practice ranging from 4 to >20. All physicians identified tensions between opioid
management and other aspects of doctoring. Physicians wanted to treat their patients with empathy, giving them the benefit of the doubt, but described this as sometimes conflicting with the need to maintain limitations on opioid prescribing. As one physician put it, its a struggle for me sometimes-not wanting people to take

advantage of me-because I am likely to be fairly empathetic. Another stated, You feel insulted if someones going behind your back and you can confirm the lie, but you take a step back and try to get some therapeutic distance.

Participants also described tensions between their traditional role as physicians and opioid adherence monitoring tasks, which several described as more consistent with a policing role. Youre there to help them and they can tell you their deepest, darkest secrets, but yet youre policing them. Physicians described discomfort with the effect opiate monitoring could have on their relationships with patients. As one physician said, the worst thing about [urine drug testing] is you do not see the patient as a patient. Another asserted, I feel like Im not a doctor.

CONCLUSION: Opioid management in chronic pain involves many challenges for physicians. According to our preliminary findings, physicians feel opioid monitoring can detract from their fundamental roles and responsibilities, such as developing a working relationship characterized by empathy and understanding.

HIGH-RISK HOSPITALIZED PATIENTS WITH ASTHMA OR COPD WHO MISUSE RESPIRATORY INHALERS: MORE THAN MEETS THE EYE

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BACKGROUND: Clinical guidelines recommend evaluating and teaching effective respiratory inhaler technique in all settings, including hospitals. However, many high-risk patients hospitalized with asthma or chronic obstructive pulmonary disease (COPD) misuse their inhalers. While providers may not provide adequate education, patients who receive education may still fail to understand for many reasons. In addition to the well documented barrier of poor health literacy, it is also possible that patients are not able to understand education due to poor vision. Because much education regarding pharmacotherapies, including inhalers, is based on written materials, it is important to understand whether poor vision is an unrecognized barrier for inhaler teaching in hospitalized patients. In our hospital-based studies evaluating the role of health literacy in patients ability to learn inhaler technique, we have collected data on patients screening vision levels. The aim of this abstract is to explore rates of poor vision in high-risk hospitalized patients.

METHODS: Hospitalized patients with asthma or COPD were enrolled in hospital-based studies evaluating use of respiratory inhalers. Metered dose inhaler (MDI) and Diskus use was assessed with detailed checklists. Misuse of each device was defined as <75% of steps correct. The Short Test of Functional Health Literacy (STOFHLA; score >22-36, adequate; 022, less-than-adequate) was used to evaluate level of health literacy. However, prior to administration of the S-TOFHLA, vision was assessed (Snellen screening chart) and was defined as insufficient if vision was worse than 20/50 in both eyes. Chi-square and Fishers exact tests were used.

RESULTS: From September 2007 - April of 2010, 150 participants with asthma or COPD were enrolled in hospital-based studies from two urban academic institutions. Among the 146 unique participants, the mean age was 52, and the majority were female (72%) and African American (82%). The vast majority had been admitted in the past year (75%) and over a third (37%) had been hospitalized >2 times for their asthma or COPD in the past year. Further, over half (58%) had had a near-fatal event (ICU admission and/or intubation) in their lifetime. Unfortunately, the majority of patients misused their inhalers (83% MDI, 89% Diskus). Of those tested for health literacy (n=95), the majority had adequate health literacy (71%), however, a significant proportion of this cohort (35%) had insufficient vision, and therefore health literacy could not be assessed in these participants. Not surprisingly, older individuals (age>/=65) were more likely to have insufficient vision (p >0.001); vision did not differ by race (p=0.74) or gender (p=0.90). Forty-nine (34%) participants that had used MDI (n=144) had insufficient vision; while not statistically significant, all but five individuals (10%) with insufficient vision misused

their MDI (p=0.16). Similarly, of the 34% (n=29) who used Diskus (n=85) and had insufficient vision, all but one misused their Diskus (p=0.16). CONCLUSION: The majority of these high-risk patients with asthma or COPD misuse their inhalers. Moreover, insufficient vision is a common problem in this population, affecting more than 1 of every 3 patients, and is more prevalent among older individuals. While underpowered, the association between insufficient vision and misuse of inhalers
highlights the need for larger studies that address the role of vision in patients ability to self-manage their chronic diseases.

PARTNERING TO UNDERSTAND ENVIRONMENTAL CONTRIBUTION TO DIABETES DISPARITIES IN EAST HARLEM, NY Lawrence C. Kleinman 1; David Lutz 2; Ellen J. Plumb 3; Pearl Barkley 4; Hector R. Nazario 5; Michelle A. Ramos 6; Carol R. Horowitz1. 1Mount Sinai School of Medicine, New York, New York ; 2Neighborhood Open Space Coalition, New York, New York ; 3Thomas Jefferson University Hospital, Philadelphia, Pennsylvania ; 4Thomas Jefferson Tenants Association, Inc., New York, New York ; 5Community Education Council District 4, New York, New York ; 6Union Settlement Association, New York, New York.
(Tracking ID # 11717)

BACKGROUND: The Communities IMPACT Diabetes Center uses partnered methods to address diabetes-related conditions among African Americans and Latinos in East Harlem (EH), New York. EH has some of the highest rates of diabetes-related illness in New York City. We describe a novel, partnered approach to collect baseline data regarding the built and food environments in a 2 census tract area of EH and present select findings.

METHODS: Our environmental assessment explored characteristics related to walking and eating. We paired community and academic partners to assess each block independently, resolve all differences, and report results. We surveyed the data collectors and analyzed responses using standard qualitative methods.

RESULTS: Key themes included connection to their own community, community characteristics; interactions with partners, surprises and learning, and data collection. All but the first were common to academic and community partners. Relationships between partners were amiable. Both community, It was very helpful, we made sure neither of us made mistakes, and helped each other when we could, and academic, I really enjoyed it I learned a lot about the areas I surveyed partners were complimentary. Community partners strengths included local knowledge of the community, while academic partners focus on adherence to the specifications was critical. In this neighborhood, we found limited food choices, many sidewalks in disrepair, few benches, and highly variable times allocated for pedestrians to cross at cross walks.

CONCLUSION: Partnered data collection was both successful and formative, building additional relationships and further capacity for ongoing partnership. Community partners newly saw, little things that are important but people dont pay attention to. Structured observations added to our understanding of how an environment may contribute to diabetes and identified environmental targets for current intervention.

MINDFULNESS TO REDUCE PSYCHOSOCIAL STRESS Natalia Morone 1; Cheryl Lynch 2; Vincent Losasso 3; Karl Liebe 4; Carol Greco3.
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2Medical University of South Caroline, Charleston, South Carolina ;
3University of Pittsburgh, Pittsburgh, Pennsylvania ; 4Choice Care Physicians, Pittsburgh, Pennsylvania .
(Tracking ID # 11719)

BACKGROUND: Stress reduction programs are widely available and effective but largely underused in clinical settings. For an area with little published information, this study identifies key elements of learned behaviors and skills reported by participants in a stress reduction program based on mindfulness.

METHODS: The objective was to identify themes that describe the experience of learning a Mindfulness-Based Stress Reduction (MBSR) program for the first time and how participants applied the methods learned to their daily life and psychosocial stressors. We performed a qualitative investigation using participant feedback from 11 MBSR 8-week programs. Grounded theory was used to inductively generate thematic categories. Two coders independently examined the data using content analysis to identify recurring words, phrases or concepts that were initially assigned as codes, which served as anchor points across the transcripts. These codes were iteratively applied to the transcribed data, discussed between the two coders and refined to devise key themes, or concepts that emerged from the data. A third investigator reviewed the refined set of codes and resolved any differences in the interpretation of the data and associated codes. The final coding scheme was devised and provides the framework for the results.
RESULTS: The sample was made up of 274 adults who had participated in one of 11 MBSR classes offered to residents of the greater Pittsburgh area between April 2005 and November 2008. Class sizes ranged from 1629 people. Women made up 74% (202/274) of the sample and the mean age of participants was 49 years (range 2080). Classes met once weekly for 8 weeks and lasted two hours. After the fourth class a separate retreat class was offered that involved a four hour period of meditation practice. The majority of the sample (80%, 220/274) attended at least 6 classes. Nineteen people dropped out of the program, 7% (19/274). Of the 274 participants, 176 completed course evaluations and 74 of these contained written comments. Four themes were identified that described the process and results of learning mindfulness to adapt to psychosocial stressors. We categorized participants feedback into interrelated themes of Awareness (subdivided into Insight - step back from my thoughts in order to view them more clearly, and Being In the Moment), Coping - pause, take a breath, Serenity -increased feeling of calm, centeredness, and Change in Perspective -different understanding interpersonally and intrapersonally. In addition, participants described specific health benefits such as suspension of blood pressure medication and reduction in anxiety. CONCLUSION: Participants found the mindfulness-based approach effective for stress reduction. The learning process allowed them to routinely apply mindfulness strategies that provided multiple benefits. Mindfulness programs are a widely available resource for busy clinicians to refer patients for stress reduction when it is an essential part of the therapeutic plan.
PATIENT PERCEPTIONS OF PRIMARY CARE PHYSICIAN COMMUNICATION IN FOUR COUNTRIES
Gregory Makoul 1; Ralph O. Mueller2.
1Saint Francis Hospital and Medical Center, Hartford, Connecticut ;
2University of Hartford, West Hartford, Connecticut . (Tracking ID # 11727)
BACKGROUND: The Communication Assessment Tool (CAT) is an established instrument for eliciting patient perspectives on the interpersonal and communication skills of healthcare professionals. It has been used across a variety of contexts in the US. This study was conducted to examine: (1) how patients view their primary care physicians (PCPs) communication in 4 primarily English-speaking countries; (2) the extent to which patient perceptions of PCP communication are associated with likelihood to recommend the PCP. METHODS: The 14 CAT items address essential communication tasks via a 5-point scale (1=poor, 5=excellent); they were embedded in a survey that focused on physician-patient communication, administered in 23 countries between May and August of 2010. This report focuses on analysis of data collected online, in English, within the following

countries: Australia, Canada, UK, and US. To be included in this analysis, respondents must have been at least 18 years old at the time of the survey and fluent in English. In addition, they must have reported that their most recent doctor visit took place within 3 months of the survey date with a PCP they had seen at least twice. New patients, those who might have left their PCP after one visit, had last seen a specialist, or had seen the PCP more than 3 months before survey administration were excluded from the analysis. In addition to CAT scores, this analysis includes data from an item that asked participants to rate their likelihood of recommending the PCP on a scale of 010 (0=never recommend, 10=definitely recommend).

RESULTS: While more than1000 completed surveys were collected in each country, applying the exclusioncriteria resulted in the following sample sizes: Australia (n=550), Canada (n=453), UK (n=611), US (n=397). The CAT item The doctorencouraged me to ask questions received the lowest % excellent score, by far,in all countries: UK (39.7%), Canada(43.0%), Australia (47.7%), US (49.9%). Controllingfor sex, age, education, and number of months between participants last PCPvisit and survey date, there were statistically significant differences incomposite CAT scores among countries (% of the 14 items rated excellent), with UK at 50.9%, Canadaat 52.6%, Australiaat 57.4%, and US at 58.8%. There were also significant differences in thecorrelation (rdiff) betweencomposite CAT scores and patient likelihood to recommend their PCPs: Australia (r=.45),Canada (r=.55), US (r=.60), UK (r=.62).
CONCLUSION: The CAT is usually administered to patients at the point of care. While this is the first time it has been used with people not in the role of patient when completing the items, the pattern of scores is consistent with data collected from inpatients and outpatients. Indeed, the encouraged me to ask questions item has tended to receive the lowest score in every context to date. Results from this study indicate that perceived PCP communication varies significantly across countries, despite the fact that medical education and certification in each examined country places a priority on communication skills. Communication and patient recommendation of PCPs are clearly linked in all countries, but the strength of this association varies: The finding that perceived communication accounts for 20% of the variance in Australia vs. nearly 40% in the UK and US warrants further investigation. While this analysis focuses on data collected in English only, it sets the stage for future research within and between countries.
WHAT FACTORS SHOULD BILINGUAL PHYSICIANS CONSIDER IN THEIR DECISION TO RELY ON SECOND-LANGUAGE SKILLS OR AN INTERPRETER? A PATIENT SAFETY APPROACH Lauren R. Maul 1; Matthew K. Wynia 1; Marsha J. Regenstein 2; Helen B. Andres3.
1American Medical Association, Chicago, Illinois ; 2George Washington University, Washington, District of Columbia . (Tracking ID # 11741)
BACKGROUND: Language barriers frequently affect patient care, presenting safety and quality concerns related to communication. Partially bilingual physicians must weigh a number of risks in their decision whether to use their own (limited) second language skills or rely on an interpreter when caring for an LEP patient. Little is known about how physicians make this determination, and there is no formal guidance for how and when it is appropriate to use ones own language skills. We sought to 1) understand the factors that influence this decision and 2) use a patient safety approach to develop practical guidance for physicians facing this decision.
METHODS: We used a modified Healthcare Failure Modes and Effects Analysis (HFMEA) process to examine factors partially bilingual physicians consider in deciding whether to call an interpreter. HFMEA is used to identify and rank specific high priority risk factors (failure

modes) that should be addressed within a system. We defined failure as a physician electing to use his or her second language skills rather than an interpreter when this choice poses significant risk to the patient. We developed a preliminary set of 8 factors based on in-depth interviews with 28 bilingual or partially bilingual physicians nationwide. We then convened a panel of 8 physicians with nationally recognized expertise in issues related to the care of LEP patients to conduct the HFMEA process, facilitated by a national expert in quality management. The experts discussed and ranked each risk factor according to four scales scored from 110: Frequency, Importance, Amenability to Intervention, and Detectability. Risk Priority Numbers were then calculated by multiplying the scores for each scale.
RESULTS: The experts confirmed the importance of all eight factors as well as an additional factor-Physician Knowledge and Skills: Lack of knowledge of value of using a trained interpreter and how to work with one effectively. This factor produced the highest Risk Priority Number (2,418), followed by Clinical Risk or Complexity of the Encounter: The physician miscalculates the complexity or risk for miscommunication of the

clinical situation under discussion (2,232), Wait Time to Access Interpreter Services: Accessing interpreter services is challenging (logistics, wait time, etc.) (2,046), Patients English Proficiency: The patients English proficiency is overestimated (1,812), Efficiency of the Clinical Encounter: The clinical encounter takes more time and effort when communicating through an interpreter (1,771), Physicians Language Skills: The physician miscalculates his/her own second language proficiency (1,736), Quality of interpreter services: There is lack of confidence in the consistent quality of available interpreter services (1,564), The Interpersonal Aspects of Care: The physician believes the use of a trained interpreter compromises his/her rapport with the patient (1,349), and Cost of Interpreter Services: Reimbursement for interpreter services is unavailable or inadequate (1,293).
CONCLUSION: We analyzed physicians decisions to use their own skills or an interpreter from a patient safety perspective and identified a set of actionable factors that might lead to high-risk situations. The number and variety of important factors reflects the complex nature of risks that can arise from language barriers and suggests organizational approaches to risk reduction. Organizations that aim to provide high-quality care to patients with limited English proficiency should consider these factors when developing quality improvement and patient safety activities

RATES OF CO-PRESCRIBING OF DRUGS WITH POTENTIAL FOR DRUG-DRUGINTERACTIONS AMONG PERSONS INITIATINGTHERAPY WITH SELECTIVE SEROTONIN REUPTAKE INHIBITORS Robert J Valuck 1; Anne M Libby 1; Heather O Anderson 1; M Haim Erder 2; Clement Francois 3; Jalpa A Doshi 4; Carol Collins 5; Sheldon H Preskorn6. 1University of Colorado School of Pharmacy, Aurora, Colorado ; 2Shire Pharmaceuticals, Wayne, Pennsylvania ; 3Lundbeck SAS, Issy-les-Moulineaux, N/A ; 4University of Pennsylvania, Philadelphia, Pennsylvania ; 5University of Washington, Seattle, Washington ; 6Clinical Research Institute, University of Kansas School of Medicine-Wichita, Wichita, Kansas . (Tracking ID # 11750)
BACKGROUND: Selective Serotonin Reuptake Inhibitors (SSRIs) are widely used antidepressants, with approved indications for the treatment of major depressive disorder and in some instances, other disorders. Pharmacokinetic and pharmacodynamic differences among the SSRIs can give rise to potential differences in drug-drug interactions (DDI). Our objective was to determine the rate of co-prescribing of potentially interacting drugs among subjects initiating therapy with SSRIs in United States managed health care plans, in order to better understand the magnitude and distribution of this potential problem.
METHODS: First, we identified lists of potential SSRI drug-drug interactions (SSRI-DDI) of interest using medical compendia and expert panel approaches. Then, using a large health insurance claims database (the IMS LifeLink Database), we examined retrospective cohorts of new SSRI users between 20022008. For each new user, we used medical and pharmacy claims records to identify instances and rates of coprescribing of potentially interacting drugs according to the compendia and expert panel based lists, and characterized the potential SSRIDDI by drug group, individual drug, and timing of the potential interaction.
RESULTS: 913,619 subjects met study inclusion criteria; 67% were female and mean age was 45.1 years at time of initiation of SSRI therapy. The most common mental health diagnoses among new SSRI users were depression (49-59% by SSRI), anxiety (30-46%), and substance use disorder (16-18%). Using the compendia based list of potential SSRI-DDI, 48.5-62.0% of subjects had at least one instance of coprescribing of potentially interacting drug(s) that overlapped with their SSRI exposure. The most commonly occurring potential SSRI-DDI were SSRIs coprescribed with anticonvulsants (10.6-23.9% of SSRI prescriptions), other antidepressants (9.1-18.1%), benzodiazepines(12.1-19.5%), beta-blockers (9.3-14.2%), and NSAIDs (7.4-11.2%), when taken as drug classes. The most common individual drug based potential SSRI-DDI included SSRIs coprescribed with digoxin (1.0-1.1% of SSRI prescriptions), diltiazem (1.1-1.8%), temazepam (1.4-2.3%), tramadol (1.1-2.3%), and warfarin (1.7-2.5%). Similar results were observed for the panel list, where benzodiazepines as a class (12.1-19.5% of SSRI prescriptions), and cyclobenzaprine (2.6-3.0%), metoprolol (3.8-6.7%), tramadol (1.1-2.3%), trazodone (4.3-7.5%), and warfarin (1.0-2.5%) were commonly coprescribed. In terms of timing, coprescribing of two potentially interacting drugs on the same day was less common than instances where one

drug was added on to existing therapy with another; still, same day coprescribing accounted for 12.2-36.5% of the potential SSRI-DDI that were identified. CONCLUSION: SSRIs are widely prescribed, and co-prescribing of drugs that might elicit SSRI-DDI is common. Clinicians should be aware of the potential for such interactions, and evaluate both the benefits and potential clinical risks (which may range from minimal to substantial) when co-prescribing SSRIs to patients taking other drugs, or vice versa. Further study is needed to identify subsequent patient outcomes associated with specific SSRI-DDI.

ATTENDING ROUNDS: WHAT IS NOT HAPPENING? Chad Stickrath 1;

Melver Anderson 1; Allan Prochazka 1; Megan Griffiths 2; Melissa Deloughry 4; Eva Aagaard4. 1Denver VA Medical Center, Denver, Colorado ; 2University of Colorado Denver, Aurora, Colorado . (Tracking ID # 11762)

BACKGROUND: Traditionally, inpatient academic internal medicine teams have employed attending rounds to fulfill their patient care and teaching duties. Detailed observational studies of the characteristics of attending rounds in the current academic healthcare setting are lacking and there is no consensus as to the optimal way to provide patient care and teaching during these rounds.

METHODS: A cross-sectional descriptive study of attending ward rounds was conducted on the general inpatient medicine services at four teaching hospitals affiliated with the University of Colorado Denver School of Medicine Internal Medicine Residency over a six-month period in 2010. Trained, independent observer accompanied general internal medicine teams on attending rounds to observe, time, and record the activities of these rounds, including the location and participants. A single observer followed each team, observing one busy day in the call

cycle where there were the maximum expected new patient presentations (the post-call day) and one day where the team was primarily focused on presenting patients already known to the team (non-post-call day). A portion of the encounters were followed simultaneously by two observers to ensure observer variability was not a confounding factor.

RESULTS: A total of 263 patient encounters from 34 distinct rounding sessions were observed. The median duration of rounds was 118 minutes (SD 49). Among direct patient care activities during these encounters, the patient care plan was discussed 94% of the time, pertinent diagnostic studies 91% of the time, drug list 64% of the time, staff notes 54% of the time, while prophylaxis was discussed only 29% of the time, and level of invasion only 12% of the time. Among communication activities, direct communication with the patient occurred during 68% of the encounters, while communication with an RN occurred only 12.9% of the time and communication with the family only 12.2% of the time. Among teaching activities, medical topic review occurred 51% of the time, while feedback was provided only 28% of the time, physical exam teaching occurred only 13% of the time, evidence-based medicine topic review occurred only 12.2% of the time, learner-identified teaching topic review only 6% of the time, oral presentation skills only 6.1% of the time, future learning plan only 3% of the time, and history-taking skills only 2% of the time.

CONCLUSION: On attending rounds, the discussion of patient care plans and pertinent diagnostic studies occurred most frequently, while little time was devoted to a number of key activities including discussing prophylaxis, level of invasion, nursing communication, and non-medical topic teaching. Limitations of the study include the relatively small number of teams observed and the inability to directly relate the observations to patient care and/or educational outcomes. Future studies should link observed activities to outcomes and develop interventions that increase the frequency with which key activities occur.

INCOMING TRAINEE PERCEPTIONS OF THE IMPACTS OF HEALTH CARE REFORM Ruric Anderson 1; Celine Goetz 2; Creagh Milford 3; Meryl Prochaska 2; Vinny Arora2. 1NorthShore University HealthSystem, Northbrook, Illinois ; 2University of Chicago Pritzker School of Medicine, Chicago, Illinois ; 3University of

Chicago (NorthShore) Medicine Residency, Chicago, Illinois . (Tracking ID # 11769)
BACKGROUND: Health care reform legislation brings a complex series of changes that will occur over the next decade. Trainee understanding of these issues is critical for career planning and is an important component of the systems-based practice competency required by the ACGME. This study aims to assess incoming trainee 1) perceptions of the impacts of health care reform; 2) understanding of concepts and terminology related to health care reform; and 3) awareness of how health care reform might influence their specialty or primary care career choice.
METHODS: An anonymous survey was created to assess incoming trainee understanding of health care reform and its perceived impacts. Incoming interns and fellows at two Chicago GME training sites rated their agreement with statements (such as the effect of health care reform on reimbursement on primary care physicians and subspecialists) using a 5 item scale, with the response options being Agree, Somewhat Agree, Neutral, Somewhat Disagree and Disagree. Incoming trainees also were asked to rate their level understanding of a list of health care policy terms on a 4 point Likert scale, from very unfamiliar to very familiar.
Trainees also were asked whether they had received training in these areas during medical school (for interns) or during medical school or residency (for fellows). Surveys were distributed to incoming interns and fellows during GME orientation (late June and early July 2010) using a paper survey. Data were merged into a Microsoft Excel with a code denoting site. Site adjusted ANOVA and logistic regression was performed to assess differences in perspectives.
RESULTS: 77% of interns (140/181) and 96% of fellows (90/94) responded. Only 2% agreed and 18% somewhat agreed that they felt confident in answering patient questions about the recent health reform legislation. 92% of respondents either agreed or somewhat agreed they are seeking information on health care reform, preferably through formal education. 33% of the respondents agreed or somewhat agreed that they were able to keep up to date about health reform in the past year and less than 20% reported adequate training in the program they had just completed. Most respondents felt unfamiliar with the majority of health policy terminology. Only half of incoming trainees thought primary care reimbursement would improve after the implementation of reform, and only 23% agreed or somewhat agreed that health care reform would influence their choice of specialty. Differences when adjusting for site and level of training were minimal.
CONCLUSION: Incoming interns and new fellows are not confident or prepared in their ability to understand the complex changes in health care reform. Unfamiliarity with health policy terms and a perceived inability to stay current with reform issues may impact respondents ability to successfully enter practice. Despite its importance, few interns and fellows report having formal education on health reform topics. Curricula on health care policy should be developed and implemented for physicians-in-training.
THE DARK SIDE OF THE DIAPHRAGM: INCIDENTAL CT FINDINGS IN ANATOMIC AREAS IMAGED UNINTENTIONALLY Elizabeth Richey 1;
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2Department of Veterans Affairs Medical Center, White River Junction, Vermont . (Tracking ID # 11778)
BACKGROUND: The increasing ability of advanced imaging to visualize small or subtle abnormalities has undoubtedly enhanced the diagnostic capabilities of physicians. It has also, however, had a major side effect: the increased detection of incidentalomas - unexpected abnormalities that are unrelated to the reason for which imaging was performed. Incidentalomas pose a serious dilemma for physicians and patients, for whom the balance of benefits and harms of detection and subsequent intervention is unclear. We sought to determine the prevalence and downstream consequences of incidentalomas whose detection could be avoided simply by restricting the radiologists view to the side of the diaphragm for which the test was ordered.
METHODS: We reviewed the reports of all outpatient CT scans of either the chest or abdomen (but not both) performed between January 1, 2007 and December 31, 2007 at a single VA medical center. Of the 873 CT scans reviewed, 397 (45%) were performed in follow-up and within 2 years of a previous CT abnormality; these

were excluded from our primary analysis. Of the remaining 476 CT scans, 168 (35%) were of the chest and 308 (65%) were of the abdomen. We used the CT report and electronic medical record to abstract information on the CT scan, indication, radiologist, principal finding, incidental findings on the opposite side of the diaphragm, and recommendations and downstream procedures (within 2 years of the scan) related to the incidental findings. RESULTS: Ninety-six chest CT scans (57%) identified a total of 144 abnormalities in the abdomen. The most common incidental abdominal

findings detected on chest CT were renal mass (n=34), hepatic mass (n=27), and cholelithiasis (n=22). Eighty-six abdominal CT scans (28%) identified a total of 103 abnormalities in the chest. The most common incidental chest findings detected on abdominal CT were atelectasis/ scarring (n=32), pulmonary nodules (n=18, excluding granulomata), and pleural effusions (n=9). Incidental abdominal findings on chest CT led to 12 abdominal ultrasounds (8 patients), 5 abdominal CTscans (4 patients), one PET scan, one upper GI series, and one partial nephrectomy. Incidental chest findings on abdominal CT led to 14 chest CT scans (9 patients) and one chest X-ray. Rates of detection of incidental findings varied by radiologist - but only for chest findings on abdominal CT (from 17% to 69% among 3 radiologists who read at least 25 scans); for abdominal findings on chest CT, comparison was limited because only 2 radiologists read 25 or more scans (both detected 54-55% with abdominal findings). CONCLUSION: Incidental findings on the opposite side of the diaphragm are commonly detected, particularly on CT scans of the chest, and not infrequently lead to additional interventions. Whether the detection of these findings - in an anatomic area imaged unintentionally - is associated with net benefit or harm is unknown.

CLINICIANS PERCEPTIONS ABOUT HOW THEY ARE VALUED WITHIN THE ACADEMIC MEDICAL CENTER

Aysegul Gozu 1;
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1Jh, Clarksville, Maryland ; 2Jh, Bmore, Maryland ; 3Jh, Baltimore, Maryland. (Tracking ID # 11780)

BACKGROUND: Academic medicine has a tripartite mission centered on research, education, and clinical care. Academic rank is a major determinant of respect within academic health centers (AHC) and because promotion decisions are heavily influenced by research, and not clinical accomplishments, distinction in the clinical care of patients may be poorly documented, inadequately rewarded, or even taken for granted. This study set out to explore the characteristics of and the factors associated with feeling valued as a clinician within an AHC. METHODS: In 2009, all 374 physicians who spend more than 50% of their effort clinically across all departments at Johns Hopkins Medicine were surveyed about their clinical experiences and their perceptions about whether clinical work is valued by the institution. The instrument was developed building on our prior research and informed by the published literature, as well as consultation with experts. Factor analysis and reliability testing were used to identify specific questions that came together to form the clinical valuation scale. Logistic-regression was then used to identify associations between individual variables and high versus low clinical valuation scores.

RESULTS: 268 highly clinically active physicians responded (72%). The clinical valuation scale, composed of 5 questions, had a Cronbach Alpha of 0.72. The scales range of potential scores is 525, and the respondents median score was 14. Male gender (OR 2.12; 95% CI 1.20-3.89), age older than 45 years (OR 1.99; 95% CI 1.18-3.35), holding the academic rank of Professor (OR 1.44; 95% CI 1.12-1.85), spending >10% time in research (OR 2.34; 95% CI 1.29-4.26), being at Hopkins longer than 10 years (OR 2.34; 95% CI 1.19-3.47) were each statistically significantly associated with high CVS scores. Select variables that were not associated with a higher or lower clinical valuation scores included race, fellowship training, or clinical department. CONCLUSION: Disparate degrees of perceived valuation in clinical work exist among the faculty doing the lions share of patient care within an AHC. Academic health centers interested in retaining clinical faculty may wish to assess the degree to which their highly clinically active faculty members feel valued in their clinical roles and

focus attention, if
not resources, on modifiable factors or conditions that are associated with clinicians feeling appreciated for their efforts.
RACIAL/ETHNIC DIFFERENCES IN EXPLANATORY MODELS, DAILY LIVED EXPERIENCE AND HTN MANAGEMENT BEHAVIORS Barbara Bokhour 1; Gemmae Fix 2; Jeffrey Solomon 2; Ellen S. Cohn 3; DharmaE. Cortes 4; Nora Mueller 2; Lois Katz 5; Ann Borzecki 2; Paul Haidet 6; Alexander Green 7; Nancy Kressin8. 1Center for Health Quality, Outcomes &Economic Research, ENRM VA Medical Center, Bedford, Massachusetts ; 2Center for Health Quality, Outcomes &Economic Research, ENRM Veterans Affairs Medical Center, Bedford, Massachusetts;
3Sargent College of HEalth &Rehabilitation Sciences, Boston University, Boston, Massachusetts ; 4Harvard Medical School &Cambridge Health Alliance, Boston, Massachusetts ; 5New York Harbor VA Healthcare System, Larchmont, New York ; 6Penn State University College of Medicine, Hershey, Pennsylvania ; 7Massachusetts General Hospital, Cambridge, Massachusetts ; 8Boston University School of Medicine, West Roxbury, Massachusetts . (Tracking ID # 11781)
BACKGROUND: Despite improvements in hypertension control , significant disparitiespersist with lower rates of control among African-American and Latino patients.Prior work has shown that patients explanatory models (beliefs regarding thecause, mechanisms &course of illness, and effects of treatment) and daily lived experiences (patients social context, routines and habits, and competing health problems) affect their abilities to control hypertension. We sought to understand patient-based disparities in these and in patients hypertension management behaviors among African-American,White and Latino patients.
METHODS: We conducted 11 hour semi-structured qualitative interviews with 45 White, Latino and African-American patients with uncontrolled hypertension at two large Veterans Affairs Medical Centers. Patients were asked about the context of their daily lives, their understanding of HTN causes and treatment and about how they managed HTN in their daily lives, including adherence to medications, diet, and exercise recommendations. Fully transcribed interviews were analyzed using grounded theory analytic methodology, including open and axial coding, theorizing, and constant comparison analysis across cases. All coded transcripts were then reviewed by two investigators to identify EMs and DLE that drove patients HTN-management behaviors. Identified elements were reviewed and confirmed by two additional investigators. We compared barriers to BP control between the three groups. RESULTS: We identified five areas that impeded patients ability to control theirhypertension: 1) explanatory models (EMs) that differed from biomedical modelsof HTN, 2) perceptions of symptoms of hypertension, 3) competing health conditions, 4) perceptions that stress causes hypertension, and 5) daily lived experiences (including social context &routines). We found that African-American patients had higher incidence of having an EM that differed from a biomedical explanatory model than the Latino or White patients (65%, 33%, and 12%, respectively). Latino patients were more likely than White or African-American patients to describe symptoms of HTN (44%, 21%, 25%), and less likely to saythat they experienced no symptoms (0%,21%,15%) Latino patients were also less likely to have problems related to daily lived experiences (44%, 74%, 70%).
CONCLUSION: The findings from this qualitative study suggest that aspects of patients EMs and daily lived experience of managing HTN may differ among different ethnic/racial groups. Such differences may explain disparitiesin HTN control in minority veterans. Further focus on EMs and daily lived experiences in clinical care may help reduce disparities.

PROFESSIONALISM AND FACTORS ASSOCIATED WITH BURNOUT, EMPATHY, AND RESILIENCE AMONG EARLY CAREER PHYSICIANS: RESULTS OF THE HEART ALUMNI SURVEY Michelle L. Dossett 1;

Wendy Kohatsu 2; William Nunley 3; Darshan Mehta 4; Roger B Davis 1; Russell S Phillips 1; Gloria Yeh1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts ; 2Santa Rosa Family Medicine Residency Program, Santa Rosa, California ; 3Yamhill County Mental Health, McMinnville, Oregon ; 4Massachusetts General Hospital, Boston, Massachusetts . (Tracking ID # 11782)
BACKGROUND: Burnout is associated with decreased physician well-being, loss of empathy, reduced quality of patient care, and decreased career satisfaction. Despite high rates of burnout among medical students, residents, and physicians in practice, few studies have examined strategies to address this problem. A fourth year medical student elective (HEART) on humanism, physician self-care, complementary and alternative medicine (CAM) modalities, and communication skills may promote physician resilience and prevent burnout by teaching medical students skills to better cope with the stresses of residency training and medical practice. To date, little is known about the physicians who have completed this elective.
METHODS: Cross-sectional online survey of HEART alumni from the 20022009 cohorts. In addition to demographic questions about medical school and residency training, we asked about practice patterns, personal habits, attitudes toward CAM, qualitative and quantitative questions about the HEART elective, and we included validated surveys assessing burnout, empathy, resilience, mindfulness, and quality of life.
RESULTS: Of 168 eligible HEART alumni, 129 (77%), responded to our survey. 51% of respondents reported no training in self-care techniques during medical school and 40% reported no such training during residency. An overwhelming majority of respondents felt that the elective helped them better cope with stress during residency training (93%), taught them self-care skills (93%), and also improved their ability to empathize and connect with patients (93%). 89% felt that the elective taught professionalism well or very well, and 92% felt the elective taught interpersonal and communication skills well or very well. 76% of respondents reported engaging in reflective or contemplative activities at least weekly while 64% reported a regular mind body practice such as meditation, yoga, or tai chi. Decreased burnout (both on the personal accomplishment and depersonalization subscales) was correlated with increased empathy and increased resilience ($p<0.002$) and decreased emotional exhaustion was correlated with increased resilience ($p<0.003$) in this population. In multivariable regression analyses assessing demographic (e.g., age, specialty, stage of training) and lifestyle factors (e.g., exercise, healthy eating, spirituality, mind body practices), we found that engagement in a reflective or contemplative practice at least weekly was associated with reduced burnout ($p=0.0089$), increased empathy ($p=0.0357$), and increased resilience ($p<0.0001$). Similarly, support from friends or loved ones was associated with reduced burnout ($p=0.0044$), increased empathy ($p=0.0056$), and increased resilience ($p=0.0008$).
CONCLUSION: The HEART curriculum promotes the ACGME core competencies of professionalism and communication while teaching skills, such as mindfulness and mind body techniques, that may contribute to improved coping with stresses related to medical training and practice. Whether the HEART elective itself contributed to this improved coping is uncertain. Nonetheless, these findings warrant further studies of both the HEART elective and mind body interventions targeted toward medical students and residents to determine if elements of these interventions decrease burnout, promote professionalism, and enhance resilience and empathy in physicians in training.

EXAM-ROOM BASED EDUCATION TO INFLUENCE VACCINATION BEHAVIOR AMONG VETERAN PATIENTS IN A PRIMARY CARE SETTING Rachel Caskey 1; Saul Weiner 1; Ben Gerber1. 1University of Illinois at Chicago, Chicago, Illinois . (Tracking ID # 11784)
BACKGROUND: The childhood immunization program in the United States has been very successful, however, the same success has not been achieved for adult immunizations. In 2007 approximately 2% of 18-64-year-olds had received the recommended pertussis vaccination. Although posters have been used to promote public health initiatives, there is little empirical knowledge about their capacity to directly or indirectly change provider or patient behavior leading to improved vaccination of adults.
METHODS: Educational Posters surrounding combined tetanus, diphtheria, and acellular pertussis (Tdap)

vaccine were designed through patient focus groups to target patients at a Veterans Affairs medical center who are age-eligible for the Tdap vaccine. A randomized controlled trial was conducted in a general internal medicine clinic between December, 2009 through May, 2010 to measure the influence of exam-room education posters on measured Tdap vaccination rates. Six primary care practitioners were randomly selected to a control arm and six to an intervention (poster) arm. Tdap vaccination rates were measured from the electronic medical record (EMR). To improve overall provider exposure a clinical reminder in the EMR for Tdap vaccination was initiated at the beginning of our intervention period for all providers. We used student t-test to evaluate differences in vaccination rates. RESULTS: Prior to the intervention, 11/372 (3.0%) of control patients and 21/346 (6.1%) of intervention patients had received a Tdap vaccine. After the poster intervention, Tdap vaccination rates increased significantly to 76/715 (10.6%) of control patients and 89/687 (13.0%) of intervention patients ($p<0.01$). The intervention did not produce a significant increase in vaccination rates compared to the control group ($p=0.59$).
CONCLUSION: Patient-focused posters promoting vaccination did not produce an incremental effect on vaccination rates in our study sample. The overall increased Tdap vaccination rates in both arms may be due to the clinical reminders or potentially secular trends encouraging Tdap vaccination. Posters are a common public health promotion strategy and warrant continued investigation to appreciate their impact on health outcomes.
IMPACT OF RACE ON COLORECTAL CANCER Saman Sabounchi 1;
bhupinder anand2. 1BCM, houston, Texas ; 2BCM, HOUSTON, Texas . (Tracking ID # 11786)
BACKGROUND: Several studies have shown that colorectal cancer runs a more severe course in Blacks compared to Whites. Black patients tend to have a more advanced disease at diagnosis and are more likely to die from cancer than Whites. The present study was carried out to compare the characteristics and outcome of colon cancer in Blacks and Whites in a Veterans Affairs Medical Center, where patients are expected to receive similar treatment, irrespective of the race.
METHODS: The database of the Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas was searched for all patients with a histological diagnosis of colorectal cancer, diagnosed from 1996 to the present time (2010). Since the majority of patients seen in the Veterans Affairs Medical Centers are men, women patients were excluded as their numbers were too small for a meaningful analysis. Patients with racial background other than White and Black including mixed races were excluded. The data collected included demographic details such as family history, presenting symptoms, presence of metabolic feature like obesity

(BMI at diagnosis), hyperlipidemia, diabetes mellitus and hypertension. A positive family history was defined as the presence of colorectal cancer in a first degree relative (parents, siblings or children). Other predisposing factors that were recorded were presence of colon polyps, regular use of aspirin, history of alcohol use and smoking. The location of the tumor, its histological characteristics and the extent of the disease based on Dukes classification was obtained. The treatment given to the patient was classified as curative surgery or palliative therapy including the use of radiotherapy, chemotherapy or both. In addition, the outcome of the treatment, in terms of whether the patient was alive or dead, and the time to death from diagnosis was recorded. Comparisons between groups were made by one and two-tailed Chi Square tests and the Students T test. The study was approved the local Institutional Review Board.
RESULTS: A total of 300 subjects were included in the study. These comprised of 205 White and 95 Black subjects. There was no difference in the age at presentation between the two groups. Blacks were more likely to have anemia ($P=0.005$) and rectal bleeding ($P<0.001$) than Whites. However, there was no difference between the two groups with respect to the histological grade of the tumor, the extent of the disease at presentation, the proportion of subjects receiving curative surgery and the time to death after diagnosis.
CONCLUSION: There was no racial difference in the treatment outcome of colon cancer in subjects treated at a Veterans Affairs Medical Center. These findings indicate that if patients receive similar treatment, the racial

background of an individual does not have any impact of the severity of disease at presentation and the outcome of treatment.

Table 1:

Characteristic White (205) Black (95) p value Age 67.2?10.67 66.08?10.92 NS Clinical Features

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Anemia (hemoglobin <12g %) 86 (42%) 57 (60%) 0.005
Table 2:
Characteristic White (205) Black (95) p value Location - Left Colon 134 (65%) 45 (47%) 0.005 Rectum 56 (27%) 19 (20%)
Recto-sigmoid 64 (31%) 26 (27%)
Descending 14 (7%) 10 (10.5%)
Location - Right colon 71 (35%) 31 (33%) NS Transverse 23 (11%) 4 (4%)
Ascending 48 (23%) 27 (28%)
Mass PathologyLow grade histology 106 (52%) 50 (53%) NS
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Well differentiated 10 (5%) 4 (4.2%)
Mod differentiated 93 (45%) 44 (46%)
High grade histology 54 (26%) 20 (21%) NS Intermediate 26 (13%) 10 (10.5%)
Poorly differentiated 18 (8.7%) 5 (5.2%)
Signet ring 5 (2.4%) 2 (2.1%)
Mucinous 5 (2.4%) 3 (3.1%) Duke Classification NS A &B 110 (54%) 51 (54%)
C &D 95 (46%) 44 (46%)
Metastasis 96 (47%) 48 (50.5%) NS Lymph nodes 44 (21%) 20 (22%) NS
Liver Metastasis 36 (17.5%) 16 (17%) NS
Distant Metastasis 16 (8%) 12 10%) NS
NEUTROPHILIC DERMATOSIS AND MULTIPLE MYELOMA: REVIEW OF LITERATURE Ashiq Masood 1; Praveen Ranganath 1; Kanan H Hudhud 2; Muneer H Abidi3. 1Wayne State University/Detroit Medical Center, Detroit, Michigan ; 2Cancer Care Center of Frederick, Frederick, Maryland ; 3Karmanos Cancer Center/Wayne State University, Detroit, Michigan . (Tracking ID # 11787)
BACKGROUND: Neutrophilic dermatosis (ND) encompasses a collection of disorders that include Sweet Syndrome (SS), Pyoderma Gangrenosum (PG). Histologically it is characterized by neutrophilic infiltrate of skin. Despite the fact that it has been associated with a variety of hematological disorders, its association with multiple
myeloma has been restricted to case reports. In order to better understand its association with multiple myeloma, we performed a systematic review of literature to explore its association with multiple myeloma.
METHODS: A literature search was carried out using PubMed/Medline between January 1990 &December 2010 using search terms acute neutrophilic dermatosis and Multiple myeloma, Pyoderma Gangrenosum and Multiple Myeloma and Neutrophilic dermatosis and multiple myeloma. All English (12/17) case reports were reviewed. Few non English abstracts (5/17) translated in English were added to data as they contained all necessary information needed for our study. Our search yielded 17 cases of neutrophilic dermatosis associated with MM.
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Table 1:
Duplicate Diagnostic Imaging
RESULTS: Median age was 60 (range 4689) years and 59% were male. Immunoglobulin isotypes were 8/17 (47%) IgG; 6/17 (35%) IgA; others unknown. 7/14 (50%) were kappa restricted. Among the 17 cases, 11 were diagnosed with SS, 4 with PG and 2 with ND. 53% of the lesions were associated with chemotherapy, mainly in association with Bortezomib. 16/17 patients were treated with oral or topical steroids and there was 100% response. In patients 3/5 (66%) with chemotherapy induced lesions, it was observed that addition of steroids to chemotherapy prevented recurrence of lesions, while patients with PG responded better to addition of dapsone or colchicine with steroid therapy.
CONCLUSION: Neutrophilic dermatosis represent a continuum of noninfectious, nonmetastatic, inflammatory dermatosis.In patients with multiple myeloma; it should be considered a differential diagnosis of prolonged fever

with cutaneous involvement. Corticosteroids treatment in these patients can improve systemic and cutaneous symptoms.

DOES HEALTH INFORMATION EXCHANGE USE DECREASE DUPLICATE IMAGING IN THE EMERGENCY EVALUATION OF BACK PAIN? Elizabeth Elliott 1; James E Bailey 2; Jim Y Wan 3; Rebecca A Pope 1; Teresa M Waters 3; Mark E Frisse4. 1Medicine, University of Tennessee Health Science Center, Memphis, Tennessee ; 2Medicine and Preventive Medicine, University of Tennessee Health Science Center, Memphis, Tennessee ; 3Preventive Medicine, University of Tennessee Health Science Center, Memphis, Tennessee ; 4Biomedical Informatics, Vanderbilt University, Nashville, Tennessee . (Tracking ID # 11788)

BACKGROUND: Diagnostic imaging is routinely obtained in the emergency department (ED) evaluation of back pain despite evidence-based guidelines recommending selected use. Health information exchanges (HIEs) have been proposed as a way to reduce unnecessary testing. This study sought to determine whether HIE use was associated with decreased duplicate diagnostic imaging in the evaluation of benign back pain. METHODS: Cross-sectional analysis of data from the MidSouth e-Health Alliance (MSeHA) HIE for the 24,150 ED patient-visits for back pain by 19,136 patients seen in major general hospital EDs in the four counties of the Memphis Metropolitan Area between 8/1/07 and 7/31/09. Patient-visits were included with: 1) a prior visit with back pain principal diagnosis where any lumbosacral (LS) diagnostic imaging was obtained, and 2) a second ED visit for back pain in the study period. Patient-visits with age <18, trauma, and cancer were excluded. RESULTS: Of the 14,927 unique patients with ED visits for back pain26.7% (n=3980) had an index visit with LS X-ray, CT, or MRI. 478 of these 3980 patients had 800 repeat patient-visits to the ED for back pain that qualified for duplicate analysis. 179 (22.4%) of the 800 repeat back visits resulted in duplicate diagnostic imaging (X-ray 84.9%, CT 6.1%, and MRI9.5%). HIE use in the study population was low at 12.5% and billing providers accounted for 80% of the total HIE use. Table I shows duplicate diagnostic imaging by HIE use. Bivariate analysis revealed a decrease in duplicate diagnostic imaging with any HIE use (odds ratio [OR] of 0.37, 95% confidence interval [CI] 0.18-0.69), and also a decrease in duplicate diagnostic imaging with use of HIE by the billing provider (OR 0.47, CI0.23-0.92). Multivariate results, controlling for demographic factors, comorbidity, hospital system, and previous visits, revealed similar results for decreased duplicated imaging with any HIE use (OR 0.36, CI 0.18-0.71). Interaction term HIE use previous visits was assessed but results were not statistically significant (OR 0.86, CI 0.53-1.41).

CONCLUSION: This study demonstrates that HIE use is effective in reducing duplicate diagnostic imaging for back pain. HIE use was associated with 64% lower odds of any duplicate imaging even after controlling for other factors. However, HIE benefits are limited because of low HIE usage rates. Further studies are needed to assess ways to improve HIE usage, evaluate other conditions where HIE may be efficacious, and to assess the effect of HIE use on costs of care.

POSTTRAUMATIC STRESS DISORDER (PTSD) AFTER STROKE IS ASSOCIATED WITH LOWER ADHERENCE TO MEDICATIONS Ian M Kronish 1; Judith Z Goldfinger 1; Revathi Balakrishnan 1; Kezhen Fei 1; Carol R Horowitz1. 1Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11790)

BACKGROUND: There is growing recognition that post-traumatic stress disorder (PTSD) can be triggered by acute medical events such as strokes. Little is known regarding how PTSD might affect stroke survivors adherence to health behaviors that are important to secondary prevention. We hypothesized that the presence of PTSD after stroke or transient ischemic attack (TIA) would be associated with poor adherence to medications even after accounting for depression and other confounders. METHODS: We surveyed 267 participants who were being recruited to take part in a stroke prevention intervention targeted at stroke survivors in underserved communities in New York City. Participants were eligible if they were at least 40 years old and had at least one stroke or TIA in the past 5 years. PTSD was assessed at enrollment using the 17-item PTSD Checklist-Specific for stroke (PCL-S); PCL-S score >50 is highly specific for PTSD diagnosis. Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-8). Medication adherence was measured using the 8-

item Morisky scale. Patients were considered non-adherent if Morisky score was 05 and adherent if Morisky score was 68. Logistic regression was used to test whether stroke/TIA related-PTSD was associated with increased risk of poor medication adherence. Covariates for adjusted analyses included age, gender, income, stroke disability (modified Rankin score), Charlson comorbidity index, emotional and practical social support, and depression (PHQ8 >9).
RESULTS: The mean age of participants was 63 years, 64% were women, 78% were Black or Latino, and more than half earned less than $15,000 per year. Seventeen percent (n=46) of participants were classified with PTSD (PCL-S >50). Thirty-nine percent(n=105) were classified as non-adherent based on Morisky score. Participants with PTSD were more likely to be non-adherent than participants without PTSD (67% v 33%, p<.001). In the adjusted model, PTSD was associated with 2.57 (95% CI 1.20 -5.51) increased odds of non-adherence to medications. Consistent with prior research, younger age (OR 0.97 95%CI 0.95 - 0.99), depression (OR 1.90 95% CI 1.03-3.52), and low emotional support (OR 0.18 95% CI 0.06 - 0.54) were also significantly associated with decreased medication adherence in this model. CONCLUSION: PTSD represents a novel psychosocial risk factor for non-adherence to medications in post-stroke/TIA patients. Clinicians should consider screening post-stroke patients for PTSD and should carefully assess for adherence problems among those with elevated symptoms of PTSD.
UNEXPLAINED GENDER DIFFERENCES IN DYSLIPIDEMIA IN PATIENTS WITH TYPE 2 DIABETES John Billimek 1; Priel Schmalbach 1; Shaista Malik 1; Dara H. Sorkin 1; Quyen Ngo-Metzger 1; Sheldon Greenfield 1; Sherrie H. Kaplan1. 1University of California, Irvine, Irvine, California . (Tracking ID # 11791)
BACKGROUND: Gender differences in dyslipidemia are well documented. Less well-studied are the contributors to those differences such as disparities in overall quality of care, lipid-specific management (including regimen intensification) and patient preferences and behaviors. The
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objective of this study was to examine the relationship between dyslipidemia, quality of care, patient adherence and patients health habits among adult patients with Type 2 diabetes.
METHODS: The patient sample (n=1361) was drawn from participants in the Reducing Racial Disparities in Diabetes Coached Care (R2D2C2) study. Survey based measures included the 63-item Total Illness Burden Index, a 13-item measure of passivity, a 13-item measure of medication adherence, and a 9-item measure of diet, exercise and smoking history. Medical records were abstracted for lipid, blood pressure and HbA1c values, medication history, and diabetes quality of care indicators. Students t was used to compare unadjusted gender differences in patient characteristics, preferences and behaviors. Logistic regression equations were used to investigate gender differences in lipid management and lipid values, adjusted forpatient age, education, ethnicity, duration of diabetes, passivity, adherence, health habits, history of coronary heart disease and other co-morbidities. RESULTS: Compared to men, women in the sample had less total comorbid disease burden, more were Hispanic, and fewer had a history of prior coronary heart disease (all ps<.05). Women reported poorer adherence to treatment compared to men (p<.05). There were no significant differences between men and women in age, mean systolic blood pressure or HbA1c values, health habits (diet, exercise, smoking) or any of the diabetes quality process indicators. However, fewer women (44.4%) than men (32.1%) attained the recommended target for lipid control (LDL <100 mg/dl) adjusted for demographic characteristics, health habits, passivity and adherence (adjusted OR=1.56, p<.001). Women were significantly less likely to be treated intensively with 2 or more classes of cholesterol lowering medications (12.7% women versus 17.1% men; adjusted OR=0.68, p=<.05). CONCLUSION: Data from this study suggests that gender differences in dyslipidemia may be due to less intensive lipid management, despite otherwise comparable quality of diabetes care, taking into account patient health habits, total disease burden, passive approach to healthcare

management and adherence to treatment.

USING A REPORT CARD TO IMPROVE THE QUALTY OF CARE FOR PATIENTS WITH DIABETES Daniel J. Elliott 1; Brian Rahmer 1; Matthew Dunn 1; Christopher Prater 1; Barret Michalec 1; Robie Zent 1; Edward Ewen 1; Heather Fagan1. 1Christiana Care Health System, Newark, Delaware . (Tracking ID # 11792)

BACKGROUND: Despite the fact that improving performance on accepted quality metrics in diabetes care is associated with reductions in disease-related morbidity and mortality, disease control for the majority of patients with diabetes is suboptimal. Point-of-care decision support to providers may improve the likelihood that quality metrics are met, but focusing on providers misses an opportunity to improve shared decision-making between providers and patients. Therefore, we provided a diabetes report card with standard quality measures derived from the electronic health record (EHR) to both providers and patients at routine office visits. The objective of this study is to evaluate the effectiveness of the intervention on physician action related to diabetes quality metrics.

METHODS: We conducted a prospective pre-post study to evaluate the effectiveness of the diabetes report card for patients with diabetes at an urban teaching practice. The report card is populated with EHR data on HEDIS metrics including control of blood sugar, blood pressure, lipids, eye examinations and foot examinations. The report card was directed to the patient and indicated in simple language whether the patient had met the goal for each measure according to HEDIS guidelines. An electronic copy was sent to the provider at the time of the visit. We determined physician action through review of the EHR and defined appropriate action as intensifying medication therapy or ordering a repeat lab assessment. Our primary outcome was the likelihood that providers addressed unmet quality metrics. Secondary outcomes included the proportion for whom each unmet individual metric was addressed. We used the

chi-square test to assess the difference of proportions in the pre-intervention period compared to the post-intervention period. RESULTS: There were 116 patient visits in the pre-intervention period and 165 in the post-intervention period. There were no differences in baseline quality metrics between the groups. Overall, providers were more likely to address deficient measures in the post-intervention period ($p=0.01$). For individual quality measures, providers were more likely to address glycemic control in the post-intervention period for patients with poor glycemic control (67% vs 59%), but this was not statistically significant ($p=0.43$). There were no differences in response to poor control in lipid or blood pressure management. Among patients overdue for eye examinations, physicians referred 40% of patients for eye examinations in the post-intervention period compared to 13.1% in the pre-intervention period ($p<0.001$). Providers performed a foot exam on 39.1% of patients in the post-intervention period compared to 10.9% in the pre-intervention period ($p<0.001$). Of 105 provider surveys, 70% reported that the report card helped them identify a deficiency in care, 46% said it caused them to discuss a problem they would not have otherwise addressed, and 76% reported that it enhanced the overall visit. Of 102 patient surveys collected, 95% reported that the report card helped them talk to their doctor about diabetes and 86% reported that the report card made their visit better. CONCLUSION: A diabetes report card generated from the EHR and given to patients and providers as part of usual care was associated with an increase in the number of deficient quality measures for diabetes that were addressed at routine office visits. The effect was most pronounced in response to overdue eye and foot examinations. The report card was well-accepted by patients and providers and may represent an inexpensive mechanism to improve the quality of care in diabetes.

TAMOXIFEN AND THROMBOEMBOLIC COMPLICATIONS Papia Kar 1;
Adedayo Onitilo 1; Jessica Engel 1; Richard Berg1. 1Marshfield Clinic, Marshfield, Wisconsin . (Tracking ID # 11795)

BACKGROUND: Tamoxifen is a selective estrogen receptor modulator (SERM) which has not only been effective in the treatment of hormone receptor positive breast cancer but also has shown to prevent recurrence. Recently studies have shown that tamoxifen is effective in reducing the incidence of new breast cancer up to

38% in susceptible individuals. Tamoxifen is a cornerstone in the treatment of breast cancer in premenopausal women. Due to its estrogen agonistic activity, tamoxifen has been associated with several adverse effects like increased risk of endometrial cancer, deep vein thrombosis (DVT), pulmonary embolism (PE), cerebrovascular accident (CVA), myocardial infarction (MI) and vasomotor symptoms. Assessment of the association of these adverse events with the use of tamoxifen has a significant implication the risk-benefit assessment of this potentially lifesaving medication. The goal of this research project is to define the epidemiology of tamoxifen-related thromboembolic complications in order to inform improved recommendations of use in the broad spectrum of patients ranging from those who should not use tamoxifen to those who will gain the maximum benefit. METHODS: We used the Marshfield Epidemiologic Study Area (MESA) database to identify patients who had taken tamoxifen during the time period from 1/1/1992 until 6/31/2008. Tamoxifen use was identified by Medical manager application and by Freepharma, and dose documentation was required to reduce false positives. Events (DVT, PE, CVA, MI) were identified electronically by ICD-9 code and corresponding dates were recorded. Additional data including patient characteristics, stage of cancer and chemotherapy, identifiable risk factors, use of concurrent medications, comorbidities, coagulopathy laboratories were extracted. Electronically abstracted data was validated manually. Estimates of event rates and hazard ratios were summarized together with confidence limits for the estimates. Kaplan -Meier curve was used to estimate event free survival pre and post tamoxifen. Analysis was restricted to women with breast cancer without prior events.

RESULTS: There were 4223 patients identified as having taken tamoxifen, and of those, 261 had a venous event at some point. Forty-two patients had a venous event prior to tamoxifen. 565 were identified as having an arterial event alone. The incidence of study events were reported as rate per 1000 person year. Incidence rate for MI was 0.36 in age group 3049 years, 2.20 in age group 5059, 2.76 in ages 6069 , 2.74 in age group 7079 and 9.73 in ages 80 and older. Incidence of stroke was 0.73 in age group 3049, 3.48 in ages 5059, 6.21 in age group, 10.82 in ages 7079 and 21.69 in ages 80+ and older. The incidence rates for MI and stroke were compared to the MESA database population and in Framingham Heart Study (FHS) population. Incidence rate of venous events were 266.1 in age group 30 49 years, 298.2 in ages 5059, 353.1 in age group 6069 years, 557.9 in ages 7079 and 371.7 in ages 80 and above. Venous events were furthermore divided into DVT and PE. Age adjusted risk factors for both arterial and venous events were also reported.
CONCLUSION: MI rate of our cohort of women on tamoxifen appeared to be less than comparison population of Caucasian women from the Framing-
ham not on tamoxifen. This may indicate cardioprotective effect of tamoxifen which is similar to the reported literature. Our study was unique in that the various risk factors including use of statins were also reported. Incidence of stroke also showed some benefit with the use of tamoxifen when compared with age -matched individuals in the MESA population or the FHS population however this effect was not consistent across younger age groups. Overall incidence of DVT/PE was 10% which is comparable to reported observational studies but more, when compared to 1-3% in adjuvant clinical trials. In our trial the incidence of venous events continued over time unlike some studies which reported clustering of events in the first year of use of tamoxifen. Understanding the risks and benefit of prescribing tamoxifen is critical in the treatment of patients with breast cancer. Our study helps us to better define association of thromboembolic events and patient characteristics which make them more susceptible to such events. Manual validation of the data makes it very accurate and our data suggests increased risk of venous thrombotic events but there was no increased risk of arterial thrombosis, rather there is a possible protective effect of tamoxifen.

ATTEMPTED VALIDATION OF TWO PROGNOSTIC MORTALITY INDICES AT A PROGRAM FOR ALL-

INCLUSIVE CARE OF THE ELDERLY (PACE) SITE Cody Dashiell-Earp 1; Bruce Kinosian 2; Donna Raziano3. 1University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania ; 2 University of Pennsylvania/ Department of Veterans Affairs, Philadelphia, Pennsylvania ; 3MercyLIFE, Philadelphia, Pennsylvania . (Tracking ID # 11800)

BACKGROUND: Prognostic mortality indices are frequently used to identify individuals at high risk of near-term mortality, as an aid in discussions around goals of care. Equally important in PACE programs, where all individuals are nursing facility clinically eligible, with most individuals having survival less than 5 years, is to identify lower-risk individuals who may be helped by types of preventive care that have longer benefit streams. Several indices are in use by PACE programs, although they were developed in either a different population (post-acute hospital) or at adifferent time (PACE members 19921998). We evaluated the ability of two commonly used indices (with published ROC areas of .7-.75) to identify those at high risk of near-termmortality, as well as identify a group at low-risk of mortality despite their level of disease complexity and functional dependencies.

METHODS: A retrospective inception cohort from a single PACE site was defined by program enrollment during 2004. There were 108 patients enrolled during the period, for which 81 patients had available data for index scoring, with the cohort followed from 20052009. Members were scored based on their medical assessment during 2004, using both the Walter Index and the PACE Prognostic Index (PPI). The Walter index assigns a score based on gender, select diseases, functional impairments, and laboratory data, and predicts 1-year mortality in a post-acute care population. The PPI was developed among PACEmembers, and assigns a score based on gender, select diseases, selectfunctional impairments, and age. The accuracy of prediction was analyzed with Kaplan-Meier methods and ROC analysis,using each indexs original risk categories.

RESULTS: The cohort was 75% female, mean age 78 years. Overall,1-year mortality was 11%, 3-year mortality was 39%, and 5-year mortality was 49%. The Walter Index showed no discrimination of the four risk groups at 1 year (the highest risk group had the lowest mortality), and minimal discrimination at 3 years (32% - 45% mortality). The area under the ROC curve was 0.55 at 1 year, .52 at 3 years. The PPI did not discriminate between low and high-risk groups at either 1,3, or 5 years. At 3 years, both the lowest and highest risk groups had similar mortality risk (40-45%). Median survival in the low-risk group was 5 years,while median survival in the high-risk group was 3.7 years. The area under the ROC curve was 0.62 at 1 year and 0.6 at 3 years, with multiple local maxima.

CONCLUSION: For this typical PACE site, the two indices evaluated neither provided useful prognostic information to identify low-risk individuals who might benefit from more extensive care than usual, nor identified individuals at high risk of near-term mortality. Though the PPI was developed from the same programs national population, some of the diagnostic criteria for index conditions have changed (e.g., CKD), while enrollees may have differed from the prior decade. Temporal and geographic variation in PACE may reduce the validity of the PPI index , and require recalibration with an adequately sized sample from the current PACE population.

NON-AFFORDABILITY BARRIERS AND ACCESS TO CARE FOR US ADULTS Jeffrey T Kullgren 1; Catherine G McLaughlin 2; Nandita Mitra 3; Katrina Armstrong4. 1 Robert Wood Johnson Foundation Clinical Scholars, Philadelphia VA Medical Center and University of Pennsylvania; Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, Pennsylvania ; 2Mathematica Policy Research, Inc.; Department of Health Management and Policy, University of Michigan School of Public Health, Ann Arbor, Michigan ; 3Department of Biostatistics and Epidemiology, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania ; 4Abramson Cancer Center and Division of General Internal Medicine, University of Pennsylvania School of Medicine; Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, Pennsylvania . (Tracking ID # 11809)

BACKGROUND: The Patient Protection and Affordable Care Act (PPACA) seeks to increase access to care for US adults by improving the affordability of health services. While the affordability of health care is a critical

element of access, many patients face barriers to care that extend beyond their ability to pay for services. Failure to address these non-affordability barriers may limit the impact of efforts to improve the affordability of care. The objectives of this study were to estimate the prevalence of non-affordability barriers among US adults, assess how frequently those with affordability barriers also experience non-affordability barriers, and identify characteristics associated with higher prevalences of non-affordability barriers.
METHODS: We conducted a cross-sectional analysis of data from the nationally-representative 2007 Health Tracking Household Survey. Reasons for unmet need or delayed care in the previous 12 months were assigned to one dimension in the Penchansky and Thomas model of access to care. Unadjusted prevalences of barriers in each access dimension and any non-affordability access dimension were estimated for all adults (n=15,197) and for adults with affordability barriers (n=2,169). We used multivariable logistic regression to estimate associations between individual, household, and insurance characteristics and barriers in each access dimension as well as any non-affordability access dimension for all adults and for adults with affordability barriers. Estimated parameters are reported as adjusted prevalences. Sample weights were applied to obtain nationally-representative estimates.
RESULTS: Among all adults, 18.5% reported affordability barriers and 21.0% reported non-affordability barriers that led to unmet need or delayed care in the previous 12 months. Two-thirds (66.8%) of adults with affordability barriers also experienced non-affordability barriers. In multivariable logistic regression, adults younger than 26 years of age (23.5%) and 40 to 54 years of age (20.8%) had more non-affordability barriers than those 55 years of age or older (14.5%, $p<0.001$ for both comparisons). Individuals with household incomes less than $50,000 had more non-affordability barriers than those with incomes of at least $100,000 (21.2% vs. 16.5%, $p=0.001$). Persons with at least one chronic illness had more non-affordability barriers than those without a chronic illness (24.3% vs. 14.7%, $p<0.001$). Among adults with affordability barriers, individuals younger than 26 years of age (78.9%, $p<0.001$) and 40 to 54 years of age (67.9%, $p=0.04$) had more non-affordability barriers than those 55 years of age or older (59.7%). Persons with at least one chronic illness had more non-affordability barriers than those without a chronic illness (71.3% vs. 65.1%, $p=0.04$). CONCLUSION: Non-affordability barriers are more common reasons for unmet need or delayed care among US adults than affordability barriers. Further, most adults who experience affordability barriers

that lead to unmet need or delayed care also experience nonaffordability barriers. Groups who might benefit most from more affordable care under PPACA have relatively higher rates of non-affordability barriers. These results suggest ways policy-makers could address non-affordability barriers to ensure that steps to improve the affordability of care translate into true gains in access.
UNDERSTANDING BEHAVIORAL RISK FACTORS IN HIGH-DEDUCTIBLE HEALTH PLANS Jeffrey T Kullgren 1; Kevin G Volpp 2; Daniel E Polsky3. 1Robert Wood Johnson Foundation Clinical Scholars, Philadelphia VA Medical Center and University of Pennsylvania; Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, Pennsylvania ; 2Philadelphia VA Medical Center; Leonard Davis Institute of Health Economics, University of Pennsylvania; Division of General Internal Medicine, University of Pennsylvania School of Medicine; The Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania ; 3Division of General Internal Medicine, University of Pennsylvania School of Medicine; The Wharton School, University of Pennsylvania; Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, Pennsylvania . (Tracking ID # 11812)
BACKGROUND: Higher rates of engagement in healthy lifestyle behaviors have been observed among enrollees of high-deductible health plans (HDHPs). These associations have been used to argue that HDHP enrollment causes higher rates of healthy lifestyle behaviors. Reported associations between HDHP enrollment

and healthy behaviors, however, may lead to false attributions of causality if individuals who chose HDHPs were more likely ex ante to engage in healthy lifestyle behaviors. The objective of this study was to determine whether observed associations between HDHP enrollment and rates of smoking and obesity differ by the degree to which individuals can self-select into a health plan.
METHODS: We used cross-sectional data from the nationally-representative 2007 Health Tracking Household Survey to identify 8,096 non-elderly adults enrolled in a single private health insurance plan. Individuals in a plan with an annual deductible of at least $1,100 per person or $2,200 per family were classified as HDHP enrollees. All individuals not in an HDHP were classified as traditional plan enrollees. Individuals were classified into 3 coverage source groups ranging from the least to the greatest potential for plan self-selection:(1) employer-sponsored insurance (ESI) with no household plan choice; (2) ESI with household plan choice; or (3) non-group coverage. We compared rates of smoking and obesity by plan type using chi-square tests. We fit multivariate logistic regression models to measure associations between health plan type and both smoking and obesity within each coverage source group while controlling for individual, household and geographic characteristics. Sample weights were applied to obtain nationally-representative estimates.
RESULTS: HDHP enrollees (n=1,282) were less likely than traditional plan enrollees (n=6,814) to be smokers (9.1% vs. 12.2%, p=0.02) or obese (25.1% vs. 29.1%, p=0.03). In multivariate logistic regression models there was no association between HDHP enrollment and being a smoker [adjusted odds ratio (AOR) 1.04, 95% confidence interval (95% CI) 0.69-1.56] or being obese (AOR 1.10, 95% CI 0.81-1.50) among individuals with ESI and no household plan choice. There were two cases where HDHP enrollment was negatively associated with indicators of unhealthy behaviors; both were within groups with potential for plan self-selection. HDHP enrollment was
negatively associated with being a smoker (AOR 0.56, 95% CI 0.34-0.92) among individuals with ESI and household plan choice and with being obese (AOR 0.60, 95% CI 0.36-0.98) among individuals with non-group coverage.
CONCLUSION: We found no association between HDHP enrollment and smoking or obesity among individuals who could not self-select into a plan, and a negative association between HDHP enrollment and both smoking and obesity only among individuals who chose their health plan. Therefore, observed overall associations between HDHP enrollment and favorable behavioral risk factors may largely be a reflection of the type of individuals who choose HDHPs, as opposed to an actual health-promoting effect of these plans. More research is needed to identify ways in which health insurance benefit design can effectively encourage behavioral risk factor modification.
VISION IMPAIRMENT AMONG OLDER ADULTS IN AN URBAN, LOW-INCOME NEIGHBORHOOD: IMPLICATIONS FOR DIABETES PREVENTION AND MANAGEMENT Michelle A. Ramos 1; Thalia MacMillan 2; Lawrence C. Kleinman 3; Carol R. Horowitz3. 1Union Settlement Association, New York, New York ; 2Lighthouse International, New York, New York ; 3Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11819)
BACKGROUND: Racial and ethnic disparities exist in diabetes prevalence and complications, including visual impairment and loss. Recent emphasis on the impact of health literacy on health and health behaviors may overlook the fact that patients may simply not be able to see well enough to read food and medication labels, monitor glucose, take medications and insulin correctly and be safely physically active. The Communities IMPACT Diabetes Center uses a collaborative approach to explore and address diabetes-related health disparities. As part of this work, community and academic partners assessed the prevalence of visual impairment and the vision-related physical environment in East Harlem, the neighborhood with the highest diabetes morbidity and mortality in New York City.
METHODS: We designed an environmental assessment to explore characteristics of the built environment in a 16 square block subsection of East Harlem, including the presence of health and eye care facilities and the

condition of sidewalks. Using a structured data collection form, community-academic pairs assessed each block. In addition, we partnered with a vision rehabilitation agency, to survey older adults attending East Harlem senior and community centers. Domains included the Functional Vision Screening Questionnaire, receipt of eye care within the past year, demographics and comorbidities.
RESULTS: The environmental assessment revealed less than optimal walkability. Only 53% of sidewalks assessed were characterized as being in good condition and 30% had some type of obstruction. No eye care facilities were identified. With respect to the vision health survey, 555 adults (36% age 75 and older, 44% age 65 to 74, 17% age 55 to 64, and 3% younger than 55) participated, of which 75% were Hispanic and 20% African American. Half had not had their eyes examined within the past year, 26% met criteria for having low vision and 30% self-reported diabetes. Over half (52%) stated that their vision makes it difficult to do things that they would like to do, 58% reported difficulty recognizing faces of family and friends, 44% reported difficulty reading regular size print and 49% reported difficulty reading medicine labels, small print and prices when shopping. Of the total sample, 41% had regular eye care and did not need follow-up, 12% chose to see a local provider and 15% declined care or were lost to follow-up. The remaining 175 adults

(32%) received free eye care services, and all but one (99%) needed and received new glasses. Their most common visual comorbidities included cataracts (22%), age-related macular degeneration (17%), glaucoma (13%) and diabetic retinopathy (9%).
CONCLUSION: Effective approaches to prevent and control diabetes, including self-management, physical activity and healthy eating, require adequate vision or vision support. The majority of older adults we surveyed had visual difficulties that could be simply addressed through provision and use of glasses. Poor environmental conditions, such as obstructed sidewalks, could make it even more difficult for seniors to adhere to the most commonly prescribed form of exercise - walking. In addition to addressing well-known barriers to diabetes prevention and control, including behavioral and access issues, people with or at risk for diabetes could benefit from providers and policymakers recognizing, understanding and addressing visual challenges. Clinicians should consider routinely asking patients if they experience any difficulties seeing during discussions about medication adherence and self-management, and referring their patients for eye care.
IMPACT OF SOCIAL SUPPORT ON PHYSICAL AND MENTAL FUNCTIONING IN BLACKS AND WHITES WITH DIABETES, PRE-DIABETES, AND NO DIABETES Nidhi Gupta Huff 1; Raegan Durant 2; Paul Muntner 2; Todd Brown 2; Jewell Halanych 2; Martha Hovater 2; Monika Safford2. 1University of Alabama at Birmingham, Fultondale, Alabama ; 2University of Alabama at Birmingham, Birmingham, Alabama . (Tracking ID # 11821)
BACKGROUND: Individuals with diabetes (DM) often have lower physical and mental functioning than those without DM; optimal self-care may preserve functioning. Blacks may have less access to the healthcare system and may rely more on social support to succeed at self-care. We hypothesized that social support would be a more important predictor of physical and mental functioning in Blacks than in Whites across the spectrum of DM, pre-DM and no DM.
METHODS: We studied 29,052 individuals enrolled in the REasons for Geographic And Racial Differences in Stroke (REGARDS) prospective cohort study, which includes community-dwelling adults age 45 years (41% Black and 55% women), recruited between 2003 and 2007. A telephone survey was followed by an in-home visit to collect biometric data. DM was defined by self-reported diagnosis, receipt of DM medications, fasting glucose >126 mg/dL, or non-fasting glucose >200 mg/dL. Pre-DM was defined as fasting glucose 100126 mg/dL or non-fasting glucose 140199 mg/dL among those with no DM. Social support was assessed through reported number of close friends. Physical and mental functioning were assessed using the Short Form 12 physical component score (PCS) and mental component score (MCS). Linear regression models (stratified on race and DM status) were used to examine the associations between social support with PCS and MCS,

adjusted for sociodemographics, medical conditions, and health behaviors.
RESULTS: The mean age was 64 years; 6,398 had DM, 4,461 had pre-DM, and 18,193 had no DM. More individuals with DM were Black (57% for DM, 41% for pre-DM and 36% for neither, p<.01), had annual household income <$20,000 (26%, 17%, 15%, respectively, p<.01), and had lower PCS (42.011.3 for DM, 46.710.3 for pre-DM and 47.89.9 for no DM, respectively, p<.01) and MCS (53.29.4 for DM, 54.28.3 with pre-DM and 54.38.1 for no DM, respectively, p<.01). More individuals with DM reported having no close friends (8% vs. 7% vs. 5%, respectively, p<.01). In unadjusted analyses, having a greater number of close friends was associated with better physical and mental functioning for all participants. These effects were not seen for physical functioning in adjusted analyses. However, after adjustment, having more close friends remained associated with higher MCS regardless of DM status, although the effect for Whites with DM was only significant among those with 7 or more friends (see Table).
CONCLUSION: Sociodemographics, medical conditions and health behaviors accounted for the apparent protective effect of social support on physical functioning among both Whites and Blacks. For those with DM, social support may have more of an effect on mental functioning for Blacks than for Whites, suggesting that peer support interventions for Blacks with DM may hold promise.
Table. Difference in MCS associated with having close friends in
REGARDS participants with DM, pre-DM and no DM.
*P<0.05. **Adjusted for age, sex, income, insurance status, education, urban/rural residence, obesity, hypertension, history of cardiovascular disease, depressive symptoms as measured by the Centers for Epidemology Studies-Depression screen, alcohol use, cigarette smoking, exercise, and medication adherence.
MCS=Mental Component Summary Score. REGARDS=REasons for Geographic and Racial Differences in Stroke. DM=Diabetes. SE=Standard Error. Interpreta tion: After Adjustment, Blacks with DM 7+ close friends had 3.07 point higher MCS scores than those with no close friends.
HOSPITAL-ACQUIRED SEPSIS IS ASSOCIATED WITH MODIFIABLE RISK FACTORS John S. Hughes 1; Jon Eisenhandler 2; Norbert Goldfield2. 1Yale School of Medicine, New Haven, Connecticut ; 23M Health Information Systems, Wallingford, Connecticut . (Tracking ID # 11825)
BACKGROUND: The Medicare requirement for recording whether diagnoses on hospital discharge abstracts were present on admission (POA) has made it possible to screen for in-hospital complications that may have been preventable. There is little evidence so far to support an association of hospital-acquired complications with modifiable factors such as problems with the quality of in-hospital care, however. Our purpose in this study was to see if chart review could identify a higher occurrence of modifiable risk factors among patients with hospital-acquired sepsis compared to matched controls.
METHODS: Case-control study. Nurse reviewers from a peer-review organization (PRO) reviewed hospital charts from 30 New York state hospitals, each of which contributed from 6 to 10 charts of patients with hospital-acquired sepsis and equal numbers of matched controls. There were 205 cases with one of several secondary diagnoses of sepsis that were coded not POA, and an equal number of controls without sepsis matched for hospital, gender, age within 5 years, All Patient Refined Diagnosis-Related Group (APR DRG) and severity of illness level. There were 89 cases belonging to surgical APR DRGs and 116 cases from medical APR DRGs. PRO nurses recorded the occurrence of modifiable

risk factors and possible lapses in the quality of care that are thought to increase the risk of hospital-acquired infection and sepsis. Specific factors examined included the use and duration of foley catheters, improperly

administered blood transfusion, intravenous catheters inserted under emergent conditions, and improper administration of prophylactic antibiotics for surgical patients. We compared the frequency of each factor among cases and controls, calculated the odds ratio (OR) of the numbers of patients with each factor among cases and among controls, and used the McNemar chi-square test to determine statistical significance.
RESULTS: Three factors occurred with statistically significant greater frequency among cases than among controls: transfusion lasting more than 4 hours (OR 3.37, P<0.0001), foley catheter placed at least two days before sepsis (or the matching date, for controls) (OR 3.118, P<0.0001), and an intravenous line inserted under emergency conditions (OR=5.00, P=0.0005). Violations of several guidelines for care of surgical patients occurred fairly often but without statistically significant differences among cases and controls. These included failure to deliver prophylactic pre-operative antibiotics within 2 hours of surgery (52%) or to stop them within 24 hours after surgery (40%), failure to remove a foley catheter within 24 hours post-op (8.4%), and failure to provide prophylactic antibiotics at all (16.3%).
CONCLUSION: Prolonged transfusion time, the presence of foley catheters, and emergently inserted intravenous catheters were all associated with the development of sepsis after admission to hospital. All three are potentially modifiable with improved technique and more judicious usage. This study provides validation for the use of a screening mechanism for a single potentially preventable complication. Screening for other in-hospital complications using diagnoses coded not POA, when tested, are likely to be associated with modifiable risk factors also.
READMISSIONS: A MISSED LEARNING OPPORTUNITY FOR HOSPITALISTS Jennifer E. Bracey 1; Romsai Tony Boonyasai 1; Scott M Wright1. 1Johns Hopkins University School of Medicine, Baltimore, Maryland . (Tracking ID # 11829)
BACKGROUND: Hospitalists are often not aware when a patient whom they have cared for is readmitted to the hospital. However, there may be much to learn from readmissions, both in terms of clinical care and systems improvement. To this end, we asked hospitalists how they learn when a patient has been readmitted, what they do when they hear of these cases, and to what extent they view readmissions as opportunities for professional growth.
METHODS: As part of an ongoing IRB approved intervention focused on medical professionalism, we conducted a cross-sectional survey of 27 hospitalists. Respondents were contacted by email and responded via an electronic survey. Respondents were queried about their attitudes regarding learning and professionalism opportunities from readmissions. Attitude responses were assessed with a five point Likert-type scale that ranged from strongly disagree to strongly agree. In addition, respondents were queried about how they learn of a patients readmission and about behaviors they demonstrate once this knowledge is obtained. Behavior responses were assessed using a five point Likert-type scale that ranged from always to never. Data were analyzed using descriptive statistics. Results are reported as the percentage of respondents who chose agree or strongly agree for attitude responses vs. usually or always for behavior responses. RESULTS: Twenty-seven hospitalists completed the questionnaire (100% response rate). Forty-eight percent were male and 74% had worked within the hospitalist group for 1 year. Ninety percent of respondents agreed that learning of readmissions could help them become -more skilled and effective physicians. Ninety percent of respondents agreed that learning
why patients are readmitted -is an act of professionalism for hospitalists. Respondents learned of readmissions via multiple ways: 89% learned of the event accidently (e.g., noticing the patients name on a door), 48% from the readmitting provider, 7% from the patient/patients family, and 30% through other channels (e.g., the case manager informs me). Once a provider learns of a patient readmission, 41% communicate with the patients current provider and 41% visit the readmitted patient. CONCLUSION: Hospitalists recognize that committing the time and effort to learn why a patient has been readmitted is both an act of professionalism and an opportunity for clinical learning through deliberate practice. When they do learn that their patient has been readmitted, a

sizable minority communicate directly with the current providers or with the patient-steps which enhance individual learning and improve patient care. Unfortunately, this is often a missed opportunity as hospitalists are frequently un-aware that their patient has been readmitted. Establishing formal processes to inform hospitalists of patient readmissions may contribute to improved clinical skill and inpatient care.

SYNCOPE: DO WE NEED TELEMETRY? Manav Shah 1; Susmita Ayyagari 1; Robert E Graham1. 1Lenox Hill Hospital, New York, New York . (Tracking ID # 11830)

BACKGROUND: Inpatient telemetry monitoring for the evaluation of syncope is helpful only 5% of the time. In the US, estimated total annual costs for syncope-related admissions derived from the Medicare database were $2.4 billion, with a mean cost of $5400 per hospitalization. Our primary objective was to evaluate if patients admitted with syncope met guidelines of the 2009 European Society of Cardiology (ESC) and/or 2006 ACC/AHA guidelines for admission to cardiac telemetry with syncope. Our secondary objectives were to assess how many of these patients had a prior cardiac history or workup which revealed a cardiac cause of syncope. Our tertiary objective was to estimate the cost of care for workup.

METHODS: We compiled a list of patients with a primary or secondary discharge diagnosis of Syncope (ICD-9: 780.2). Charts which were included for review were those that were admitted between January and October 2010 to telemetry units for less or equal to 24 hours and a primary admission diagnosis of syncope or pre-syncope. Exclusions were made if subsequent review showed the patient was on the unit for >24 hours, a patient admitted for elective procedure, or charts which were unavailable for review. The final number of charts which were reviewed numbered at 35. According to CMS data, the cost of telemetry monitoring may be up to $1400 per night for admission only. RESULTS: The mean age of our patient population was 68, 60% were male. 48% of the study group had a prior cardiac history (cardiac arrhythmia, ischemic heart disease, conduction block, MI, CAD, CHF, and structural heart disease). Of the 35 cases, 21% were due to an arrhythmia, 33% were due to neurogenic causes, and 34% were due to vasovagal syncope. 45% of the arrhythmic causes of syncope were from conduction blocks and atrial fibrillation. 14 (40%) of the cases reviewed met ESC guidelines for inpatient syncope monitoring. Four (11%) cases met Class I recommendations by ACC/AHA guidelines for inpatient telemetry monitoring. Of the 35 patients studied, 70% were discharged with the diagnosis of syncope, and 12% were diagnosed with arrhythmia. It is estimated that about $43,000 would have been saved from the 31 patients whom did not meet both guidelines. CONCLUSION: Unfortunately a majority of one day admissions for cardiac telemetry did not meet guidelines set forth by both the ACC and ESC. The majority of these patients had a non-cardiac cause of syncope, thus potentially not warranting costly telemetry admission. We are currently using the findings of our study in order to implement a hospital-wide protocol for telemetry monitoring anticipated for less than 24 hours.

MEDICAL-PHARMACY INTERPROFESSIONAL EDUCATION IN A MEDICAL CENTER TEACHING CLINIC C. Huynh 1; R. Willett 1; B. Sicat 1; S. Mayer 1; S. Polich 1; V. Shuford1. 1Virginia Commonwealth University, Richmond, Virginia . (Tracking ID # 11834)

BACKGROUND: The Institute of Medicines report Crossing the Quality Chasm calls for drastic change in the health care system to enhance its quality and patient-centeredness. A subsequent summit of health care professional educators recommended that in order to achieve this vision, all health care professionals should be trained to function in interprofessional teams. Redesigning the education process would provide health care professionals with the knowledge, skills, and attitudes to work effectively in an interdisciplinary environment. The purpose of this study was to develop and evaluate an interprofessional education (IPE) experience for medical and pharmacy students rotating through the VCU Internal Medicine Primary Care Clinic and assess learner attitudes, perceptions, and acquisition of interdisciplinary knowledge.

METHODS: All students participated in IPE during their 4 to 5 week Internal Medicine Primary Care Clinic rotation, but only those participating in the study completed assessments pre-and post-IPE: 1. The

Interdisciplinary Education Perception Scale (IEPS) measured reciprocal attitudes toward each other and interprofessional teamwork,2.The Attitudes Toward Health Care Teams Scale (ATHCTS) compared attitudes of different members of the health care team, 3. The Student Assessment of Learning Gains (SALG) evaluated students perceptions of IPEs impact on their skills and attitudes and the perceived impact of specific IPE activities, 4. Concept maps measured the students interdisciplinary understanding of medication non-adherence. Students then collaborated in caring for patients in pharmacist-led Pharmacy clinic and physician-led Medicine clinic. A pocket card suggested clinical roles for pharmacy and medical students during patient care visits to ensure sharing of decision-making and joint responsibility for patient care. Students completed on-line modules outlining the knowledge and skills each profession brings to the team. All students engaged in a group discussion exploring stereotypes of each profession and the challenges and benefits of interprofessional care. Focus groups were conducted at the end of the IPE experience and a minimum of three months after IPE.
RESULTS: Responses to the IEPS, ATHCTS, SALG, and concept maps will be analyzed by descriptive statistics to see if a difference exists in pre- and post-experience scores. Focus groups will be analyzed using traditional qualitative techniques.
CONCLUSION: This IPE experience can be adapted for use in an outpatient clinic to provide medical and pharmacy students, as well as residents, the knowledge, skills, and attitudes to work effectively in an interdisciplinary environment.

ARE RESIDENTS APPROPRIATELY REFERRING PATIENTS FOR CARDIAC REHABILITATION AFTER MYOCARDIAL INFARCTION? A RESIDENT QUALITY IMPROVEMENT PROJECT

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BACKGROUND: In academic medical centers resident physicians are in charge of the vast majority of patient discharge arrangements. They are therefore crucial to making sure that patients with Acute Myocardial Infarction(AMI) receive referrals to an important facet of their cardiac care, cardiac rehabilitation. The term Cardiac Rehabilitation (CR) refers to coordinated, multifaceted interventions designed to optimize a cardiac patients physical, psychological, and social functioning in order
to stabilize, slow, or even reverse the progression of the underlying atherosclerotic processes, thereby reducing recurrent MI, morbidity and mortality. There is great need to evaluate the process for how patients receive cardiac rehabilitation as only 10% to 20% of the greater than 2 million eligible patients per year who experience an acute myocardial infarction or undergo coronary revascularization receive Cardiac Rehabilitation. Multiple factors contribute to this vast under use including: low patient referral rate, particularly of women, older adults, and ethnic minority patients, poor patient motivation, inadequate third-party reimbursements for services and geographic limitations to accessibility of program sites. We hypothesized that residents in academic medical centers who continuously rotate services and have to be trained on an ongoing basis would contribute to CR underuse at the Medical University of South Carolina.
METHODS: Four residents, with faculty supervision, as a part of their Quality Improvement project, examined the process of referral to CR for a patient diagnosed with Acute Myocardial Infarction(AMI) from diagnosis through enrollment in CR. 50 patients discharged from MUSC in the calendar year 2009 with the primary diagnosis of AMI(410.xx) were randomly selected. The residents reviewed the charts to ensure the patients selected were appropriate cardiac rehabilitation candidates per Medicare guidelines. Patient charts were then analyzed for completion of each step of the process using inpatient and outpatient EMR systems. The data was then analyzed with regards to age, sex, location, race and insurance status using Chi-Squared analysis. A P Value of <0.05 was considered significant. RESULTS: Of the 50 patient courses examined, 28(56%) were referred to CR, 7(14%) had consults received by the CR office, and 3(6%) enrolled in CR. We found a statistical trend towards men being more likely than women to be referred for CR (65% vs. 39%, $p=0.0675$). No statistical

difference was seen with regards to the other variables. CONCLUSION: CR was underutilized in patients discharged following AMI. From initial referral to receipt by the CR office and eventual enrollment in CR, there is a stepwise decrease in the proportion of eligible patients completing each step. The largest numerical dropout is seen as a lack of resident referral at discharge with the largest percentage drop owing to failure of the current system relaying consults to CR once the referral has been ordered. We believe targeted interventions at one or two steps in the process may dramatically improve effective CR referral in our patient population. Possible interventions include: increased resident education about the importance of arranging CR at the time of discharge and revision of discharge order entry and implementation. A larger population size is needed to determine if variables such as age, sex, location, race and insurance status influence the drop out seen at each step.

PROVIDING SUPPORT TO PATIENTS IN EMOTIONAL ENCOUNTERS: A NEW PERSPECTIVE ON MISSED EMPATHIC OPPORTUNITIES Ian Hsu 1; Somnath Saha 2; Philip Korthuis 2; Victoria Sharp 3; Jonathan Cohn 4; Richard Moore 1; Mary Catherine Beach1. 1Johns Hopkins University, Baltimore, Maryland ; 2Oregon Health Science University, Portland, Oregon ; 3St. Lukes-Roosevelt, New York, New York ; 4Wayne State University, Detroit, Michigan . (Tracking ID # 11852)

BACKGROUND: Responding empathically to patients who express emotions can strengthen the patient-physician relationship and is considered an important feature of patient-centered communication. Yet studies have repeatedly found that physicians miss 70-90% of opportunities to express empathy. Our study sought to describe how physicians respond to the expression of strong patient emotion, and to explore the reasons for lack of empathic responses.

METHODS: We conducted a qualitative analysis of 47 audio recorded encounters between HIV-infected patients and their providers. Informed by previous work in the area, we first defined empathic opportunities as

instances where patients expressed a strong negative emotion. We then examined physician responses, generated a coding scheme through iterative team discussion, and applied it to all empathic opportunities identified in visit transcripts. Two authors (IH and MCB) discussed and agreed on all final categorizations.

RESULTS: Twenty-one of 47 encounters (45%) contained at least one empathic opportunity. In these 21 encounters, there were 29 distinct opportunities; 20 involved psychosocial issues (logistical life problems, family strain, or death/illness of a loved one), and 9 involved biomedical concerns. Physicians typically offered more than one type of response to each empathic opportunity. These response types included dismiss/ minimize, ignore/change topic, elicit information, problem-solve (Have you thought about a support group?), or empathize (Sorry its been such a tough month). Empathic statements occurred at some point in the response sequence in 13 of 29 opportunities (45%). When problem-solving was the initial response, empathic statements rarely occurred in subsequent dialogue. Among the 16 instances with no empathic statements, physicians engaged in problem-solving about the issue in half (8/16, 50%). Logistical life problems (e.g. unemployment) and biomedical problems elicited more problem-solving and less empathy, whereas family strain or death/illness tended to elicit more empathy. Both problem-solving and empathy appeared to be explicit attempts to provide support to the patient - problem-solving focused on circumstances surrounding emotion whereas empathy acknowledged emotion itself.

CONCLUSION: Similar to other studies, we found providers missed most opportunities to respond empathically to patient emotion. Yet contrary to common understanding, physicians often missed these opportunities when attempting to address the problem underlying the emotion, especially when the problem involved logistical or biomedical issues, as opposed to grief or stress. With enhanced awareness of this phenomenon, clinicians may better recognize situations where they can offer empathy in addition to problem-solving. Future research should

assess patients desires for problem-solving, empathy, or both in different emotional situations.

GENERATING GENERALISTS: FACTORS OF RESIDENT CONTINUITY CLINIC ASSOCIATED WITH PERCEIVED IMPACT ON CHOOSING A GENERALIST CAREER Ryan Laponis 1; Patricia OSullivan 1; Harry Hollander 1; Patricia Cornett 2; Katherine Julian1. 1University of California San Francisco, San Francisco, California ; 2San Francisco Veterans Administration Medical Center, San Francisco, California . (Tracking ID # 11862)

BACKGROUND: Fewer residents are choosing general internal medicine (GIM) careers. The continuity clinic experience during residency may influence this choice. We sought to understand the relationship between resident satisfaction with the continuity clinic experience and perceived change in interest in pursuing a GIM career based on the experience. METHODS: We surveyed internal medicine residents using the Veterans Health Administration Office of Academic Affiliations Learners Perceptions Survey - a 76-item reliable and validated instrument that measures overall satisfaction with faculty interactions, learning, working, clinical, and physical environments and personal experience. We identified 15 reliable subscales within the survey: faculty teaching, availability and feedback, learning processes, clinic/ward balance, patient diversity, resident autonomy, clinical support services, coordination of care, computer services, work flow, interdisciplinary team work, facility upkeep, professional/personal satisfaction and work/life balance. To assess impact, we asked: As a result of this clinical training experience, how likely would you be to consider a future employment opportunity in GIM? We examined the association between satisfaction measures and future GIM interest with one-way ANOVAs followed by Student-Newman-Keuls post hoc tests.

RESULTS: Of 217 residents, 90 completed the survey (41%). Residents felt continuity clinic impacted career choice with 22.2% more likely to choose a GIM career and 43.3% less likely. Those more likely had higher satisfaction with the learning ($p=0.001$) and clinical ($p=0.002$) environments and personal experience ($p<0.001$). They also had higher satisfaction with learning processes ($p=0.002$), patient diversity ($p<0.001$), coordination of care ($p=0.009$), work flow ($p=0.001$), professional/personal satisfaction ($p<0.001$) and work/life balance ($p<0.001$).

CONCLUSION: Residents perceive the continuity clinic experience as impacting career choice. Those who indicate they are more likely to pursue GIM based on that experience have higher levels of satisfaction. Therefore, programs interested in increasing interest in GIM should focus efforts on clinic factors related to resident satisfaction and amenable to change.

HOSPITALISTS COMMUNICATION BEHAVIORS AROUND THE TIME OF HOSPITAL DISCHARGE Jennifer E. Bracey 1; Scott M Wright 1; Romsai Tony Boonyasai1. 1Johns Hopkins University School of Medicine, Baltimore, Maryland . (Tracking ID # 11883)

BACKGROUND: The quality of provider-provider and patient-provider communication at discharge is associated with patient satisfaction, adherence to treatment plans, and clinical outcomes. However, the ways in which providers communicate with each other and with patients at discharge is unknown. Therefore, we queried hospitalists about their interactions with patients and other providers at the time of hospital discharge.

METHODS: As part of an ongoing IRB approved intervention focused on medical professionalism, we conducted a cross-sectional survey of 27 hospitalists at a 350 bed University-affiliated community teaching hospital. Respondents were contacted by email and responded via an electronic survey. Respondents were queried about the frequency of various behaviors. Responses were assessed with a 5 point Likert-type scale that ranged from never to always. Data were analyzed using descriptive statistics. RESULTS: Twenty-seven hospitalists completed the questionnaire (100% response rate). Fifty-two percent of respondents were female and 74% had been working within this hospitalist group for 1 year. Thirty percent had at least some experience working in ambulatory settings after residency. Hospitalists infrequently employ teach-back methods with their patients at the time of discharge (55.6% responded never or rarely), contact the patients primary care provider after discharge (41% responded never or rarely), or call their patient after discharge (93% responded never or

rarely). In contrast, respondents report more concern with timeliness of discharge summaries (74% reported usually or always completing discharge summaries within 24 hours of discharge) and personally ensuring that patients have a scheduled follow-up appointment (56% responded usually or always). Respondents also personally spoke with patients or their caregivers about significant test results (96% responded usually or always), red flags (78% responded usually or always) and discharge medications (89% responded usually or always). Relatively fewer respondents (52%) reported that they usually or always speak with the patients nurse about the post discharge care plan and only 7.4% usually or always contact primary care providers after a patient is discharged. CONCLUSION: In general, hospitalists most reliably convey important information to the patients themselves prior to discharge. However, only a minority employ the teach-back method when doing so. Many hospitalists also do not communicate with other providers who play key roles during hospital discharge and in the post-acute care setting.

Standardizing discharge processes among providers may positively influence hospitalist behaviors around the time of discharge. Further work is needed to understand the effects of these communication patterns.

ASSESSING THE READINESS OF COMMUNITY HEALTH CENTERS FOR MEDICAL HOME CERTIFICATION Robin Clarke 1; Chi-hong Tseng 2; Arleen F. Brown2. 1University of California, Los Angeles, Santa Monica, California ; 2University of California at Los Angeles, Los Angeles, California . (Tracking ID # 11892)

BACKGROUND: The patient-centered medical home (PCMH) model holds great promise for reforming primary care delivery systems. The model has its roots in the Chronic Care Model, which was developed and validated in private practices among insured patients. The mostly broadly accepted definition of a PCMH is the certification tool designed by the National Committee for Quality Assurance (NCQA). While over a thousand private practices are certified as PCMHs through the NCQA, very few safety net Community Health Centers (CHCs) have applied for recognition. A recently enacted initiative by the Bureau of Primary Health Care (BPHC) seeks to extend NCQA PCMH certification to CHCs. The objective of these analyses was to assess the readiness of urban safety net CHCs for PCMH certification.

METHODS: We recruited urban safety net CHC participants from the Community Clinic Association of Los Angeles County (CCALAC). The CCALAC has 40 member clinic agencies that were eligible for inclusion in the project based on providing adult chronic-disease management services. The investigators sought volunteers to participate in the study by contacting clinic chief medical officers at their monthly meeting at the CCALAC. Medical directors and executives from each participating clinic completed a paper-based version of the NCQA medical home certification tool, the Physician Practice Connection-Patient-Centered Medical Home (PPC-PCMH). This survey evaluates a practices delivery system on nine elements testing the processes by which a clinic identifies, tracks, and treats its patients. Using a score out of 100, NCQA does not recognize a score less than 25 as a medical home while the quartiles from 2549, 50 74, and 75100 gain a practice higher recognition (from level 13). We performed descriptive analyses on the range of total scores and distribution of scores on the nine individual elements of the PPC-PCMH. These findings represent initial results from the first 18 clinics participating in the study.

RESULTS: The chart displays the distribution of scores for the 18 clinic agencies, which represent 81 individual clinic sites that provided 460,000 patient visits in 2009. The mean score from the participating clinics was66.3 (standard deviation 15.2; range 33.3-90). All clinics would gain recognition from the NCQA at some level as medical homes - three at level one, seven at level two, and eight at level three. The safety net CHCs attained the highest mean scores in the following NCQA PCMH elements: care management (13.4 of possible 21), patient tracking/registry function(15.6 of possible 21), and performance reporting and improvement (12.0 of possible 15). The lowest mean scores were on electronic prescribing (2.6 of possible 8) and advanced electronic communication (0.3 of possible 4). The five clinics (numbers 1, 3, 16, 17, 18) with an electronic

medical record all attained level three recognition; NCQA score and EMR presence were correlated with a Pearson coefficient of r=0.68.
CONCLUSION: These data indicate that the participating urban safety net clinics are well positioned for PCMH certification: Indeed, the majority of them would obtain the two highest levels of recognition. The findings of strong performances in coordinating care and performance reporting reflect the effective processes of the community health center model. The results are more striking because the majority of these clinics plan to implement an EMR system in 2011, which should bolster their low-scoring performances on the electronic elements.
Our findings raise several reasons that the NCQA tool may not be the best mechanism for evaluating CHCs as medical homes. Because of their initial strong performance, these CHCs may have little incentive or room for improvement on the NCQA tool. The grouping of scores in the upper range with the mean greater than one standard deviation above 50 weakens the precision of the tool to distinguish variation in quality amongst CHCs. The high correlation of 0.68 indicates the importance of an EMR to the current scoring format and reinforces previous criticism that the PPC-PCMH focuses too heavily on technological processes. The findings from this initial phase of the study demonstrate the need to investigate how the NCQAs PPC-PCMH tool applies to CHCs. This is especially important in light of the BPHCs certification initiative and the health reform acts expectation that CHC capacity will increase significantly to care for millions of newly insured patients. After extending participation to all eligible clinics within the CCALAC, the next phase of the study is to investigate whether the NCQA total score is associated with patient care outcomes and whether particular PPC-PCMH elements differentially influence quality of care. Future studies should investigate whether there are other services or processes that more accurately predict the quality of care provided by CHCs.

PREDICTORS OF DELAYED RECOGNITION OF PATIENTS WITH ACUTE MYOCARDIAL INFARCTION PRESENTING TO THE EMERGENCY DEPARTMENT Waqas Qureshi 1; Karen Olarte 1; Susie Namo 1; Nikhil Ambulgaker 1; Mostafa El-Refai 1; Niki Hector 1; Buran Gregory1. 1Henry Ford Health System, Detroit, Michigan . (Tracking ID # 11893)
BACKGROUND: The early recognition of acute myocardial infarction (AMI) is paramount in improving morbidity and mortality. However, despite major advances in diagnoses; as many as half of the patients arriving to the emergency department (ED) are diagnosed with a delay because they are assigned a low acuity triage. Early recognition of these patients with AMI remains challenging. The data is scarce about the various predictors of delayed recognition as well as the outcomes of these patients. The aim of this study was to recognize the characteristics of patients with AMI that may lead to low acuity triage and whether there is a difference in outcome of these patients in terms of interventions, hospital stay and mortality.
METHODS: We performed a retrospective cohort study of consecutive patients with AMI presenting to a busy hospital ED from July 2005 to June 2010. ED notes were reviewed to establish the initial triage category assigned to the patient. Medical records were reviewed for potential patient-related predictors of low acuity triage. Data collection included chief complaint, initial vital signs, demographics, comorbid conditions and a number of process and outcome variables.
RESULTS: Of the 1,935 patients studied, mean age was 66.4 years and 51% were women. The majority were African American (76%) while whites constituted 15%. Chest pain was the chief complaint in 1079 (56%). A total of 651 (34%) patients were initially assigned to low acuity triage. Median time to first electrocardiogram from ED registration was 23 minutes for high acuity and 98 minutes for low acuity patients ($p<0.0001$). Fifty-nine percent of high acuity cases were labeled with an AMI diagnosis prior to leaving the ED as compared with 62% of low acuity cases. Peak troponin level reached an average of 18.5 ng/ml for high acuity and 10.6 ng/ml for low acuity

patients (p<0.0001). Rates of cardiac catheterization, percutaneous intervention, coronary bypass surgery and death were 53%, 27%, 5% and 6% for high acuity cases respectively and 36%, 14%, 3% and 5% for low acuity cases respectively. The proportion of patients undergoing catheterization and percutaneous intervention were significantly different (p<.0001), but rates of bypass surgery and death were not significantly different. Average length of stay was 5.8 days for both groups. Multivariate logistic regression analysis revealed that low acuity triage was independently associated with a chief complaint other than chest pain (OR 1.8), age below 50 or greater than 70 (OR 1.3), diastolic blood pressure between 60 and 80 mmHg (OR 1.4), pulse between 50 and 100 b/min (OR 1.3), not arriving via ambulance (OR 1.4) and no history of prior MI (OR 1.3). No predictive relation was found for sex, race, insured status, presence of diabetes, hyperlipidemia, smoking, systolic blood pressure, heart failure or overall comorbidity (using the Charlson comorbidity index).
CONCLUSION: Low acuity triage of AMI is a common occurrence as shown in this study of a large urban ED. Some patient-related features make this more likely. Although statistically significant, these factors are weak predictors as evidenced by their relatively low odds ratios. The strongest risk factor seems to be a chief complaint of other than chest pain and hence AMI should be part of the differential diagnosis of other chief complaints while managing the patient. Otherwise, it is not clear what ED personnel might do differently to improve triage accuracy. Non patient-related variables such as time of presentation, day of week and ED volume may also influence the likelihood of low acuity triage of AMI, but we did not examine those factors here. The ability to consistently identify all AMI patients upon presentation to the ED remains elusive.
TRUSTANDSHAREDDECISION-MAKINGAMONGAFRICAN-AMERICANS WITH DIABETES Monica E. Peek 1; Rita Gorawara-Bhat 1; Michael T. Quinn 1; Angela Odoms-Young 2; Shannon C. Wilson 4; Marshall H. Chin1. 1The University of Chicago, Chicago, Illinois ; 2The University of Illinois at Chicago, Chicago, Illinois . (Tracking ID # 11896)
BACKGROUND: Shared decision-making (SDM) is a process where patients are active partners in the discussions and decisions about treatment. Both physician trust and shared decision-making are associated with positive health outcomes. African-Americans are less likely to trust their physicians and less likely to experience SDM than non-Hispanic whites, but previous research exploring trust and SDM in this population is limited.
METHODS: We conducted five focus groups (n=27) and a series of in-depth interviews (n=24) among a purposeful sample of African-Americans with diabetes. All patients had insurance and received their care at an urban academic medical center. Interviews and focus groups were conducted by trained race-concordant interviewers with experience in discussing health and communication issues. Each interview/focus group was audio-taped, transcribed verbatim and analyzed using the qualitative software package of Atlas.ti. Coding was conducted using an iterative process and each transcription was independently coded by two members of the research team.
RESULTS: Participants in this study described physician trust/ mistrust as arising from two domains: physician bias/cultural discordance and concerns about technical competence/medical skills. Trust-building factors focused on interpersonal skills/relationship building and demonstration of medical knowledge/skills. Some participants described how trust in their physician led to adoption of more shared decision-making preferences and behaviors (from prior autonomous role preferences/behaviors). For example, one participant described the decision to start insulin this way: It could have gone so bad with a strong personality like mine; I usually want to call all the shots. But I really trusted him, and he was patient and he talked me through itSo we ultimately decided together that insulin would be the best thing and I think that [physician encounter] was one of the best experiences of my life and I respect that he was a good doctor. Conversely, other participants noted that physician trust allowed them to play a more passive role in the clinical encounter. For example, one participant noted I prefer that my doctor tell me what to do. I have a trust issue, but I really trust this doctor, so Im more comfortable with him just telling me what to do. Interpersonal skills were more commonly reported than medical

knowledge/skills as factors that would enhance shared decision-making.
CONCLUSION: This study is consistent with prior research asserting that perceived bias/cultural discordance is a major source of physician mistrust among African-Americans. In addition, our research suggests that physician mistrust among this group may partially be addressed through relationship building activities and patient education efforts (i.e. demonstration of medical knowledge/ skills). Finally, increased physician trust may have the potential to either enhance shared decision-making or reduce SDM among African-Americans. Identifying ways to improve physician trust

among African-Americans while simultaneously empowering them to play more active roles in the clinical encounter has the potential to improve diabetes outcomes in this population, and is an important area of future research.

PRIORITIES DURING WARD ATTENDING ROUNDS DIFFER BY TRAINING LEVEL OF TEAM MEMBERS

Beau Daniel Hagler 1; Priya Chandan 2; Carlos Estrada 3; Brita Roy 2; Nidhi Gupta Huff 4; Analia Castiglioni 2; Robert Centor2. 1University of Alabama at Birmingham SOM, Birmingham, Alabama ; 2University of Alabama at Birmingham, Birmingham, Alabama ; 3Birmingham VAMC, The University of Alabama at Birmingham, Birmingham, Alabama ; 4University of Alabama at Birmingham, Fultondale, Alabama . (Tracking ID # 11898)
BACKGROUND: Within a single ward team, there are individuals of different training levels. In order to meet the needs of all team members, it is essential for attendings to understand how training level affects priorities during rounds. Therefore, we sought to determine differences in priorities during ward attending rounds based on training level of team members.
METHODS: Using a prospective observational study design, trainees from 49 inpatient ward teams at three hospitals independently completed daily evaluation cards regarding ward attending rounds from September to November 2010. Participants selected their training level along with the teaching domain most important to them each day. Domains were established in a previous study and included teaching process (i.e.: shares decision-making process, demonstrates physical exam), learning environment (i.e.: approachable, respectful), role modeling (i.e.: teaches by example, bedside manner), and team management (i.e.: efficiency, provides autonomy). We used Chi square analyses to evaluate associations between training level and domain importance.
RESULTS: Trainees completed 831 cards evaluating 41 attendings (279 cards from medical students; 354 from PGY-1/2; 177 from PGY-3/4). As training level increased, teaching process decreased in importance (p-trend=0.005) and team management increased in importance (p-trend <0.001, see Figure 1). Role modeling was most important to PGY1/2 residents (p=0.005). No differences were seen across training levels regarding importance of learning environment (p=0.31). CONCLUSION: As trainees progress, efficiency and autonomy (Team Management) are the most important aspect of ward rounds, while discussing the decision-making process and demonstrating the physical exam (Teaching Process) become less important. Understanding residents and students expectations may help enhance learning during ward attending rounds.

HOSPITALISTS AND HOUSESTAFF SUPERVISION: A MARRIAGE OF CONVENIENCE? Jeanne M. Farnan 1; Luci Leykum 2; Alfred Burger 3; Rebecca Harrison 4; Julie Machulsky 5; Vikas Parekh 6; Annelise Schleyer 7; Bradley Sharpe 8; Romsai Boonyasai 9; Vinny Arora1.

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8UCSF, San Francisco, California ; 9Johns Hopkins, Baltimore, Maryland . (Tracking ID # 11901)
BACKGROUND: In 2003, Accreditation Council for Graduate Medical Education (ACGME) announced the first

in a series of guidelines related to the residency training. The most recent recommendations focus on enhancing on-site housestaff supervision. To meet these standards, many internal medicine residency programs look to hospitalist programs to fill that need. We aimed to describe how academic hospitalists currently supervise housestaff overnight and their perceptions of how ACGME policies would impact trainee-hospitalist interactions. METHODS: The Housestaff Oversight Committee, a working group of theSociety of General Internal Medicine Academic Hospitalist Taskforce and membersof The Society of Hospital Medicine, created a web-based survey to assess thecurrent status of trainee supervision performed by hospitalists. Hospitalistprograms were chosen based upon location in one of five geographically distinctareas and practice in a hospital participating in the National ResidentMatching Program for Internal Medicine. Program leaders were identified bymembers of the Taskforce using program websites and querying departmental leadership. Respondents were contacted by email forparticipation. The 19-item SurveyMonkey instrument included questions abouthospitalists role in trainees education and evaluation. A Likert-type scalewas used to assess perceptions regarding the impact of on-site hospitalistsupervision on trainee autonomy and hospitalist workload. Descriptivestatistics were performed. RESULTS: Thirty-five of 47(74%) of the identified hospitalist program leaders responded. Five who were not hospitalist program leaders-were removed from the analysis resulting in 64% survey response rate.Respondents averaged 12 years in practice post-residency training and 73% weremale. Respondents programs had anaverage of 18 faculty. All respondentsreported that hospitalist faculty are expected to participate in housestaffteaching or other educational roles. Twenty-oneprograms (70%) described having an attending hospitalist physician presentovernight to provide cross-coverage or admit new patients, but only 8/21 (38%)described a formal supervisory role for hospitalists in which housestaff arerequired to present newly admitted patients or contact them with questionsregarding patient management. Although 63% of programs have a formal housestaffsupervision policy in place, only 43% of program leaders stated that theirhospitalists receive formal faculty development on how to supervise residenttrainees. 85% of respondents agreed that formal overnight supervisionby an attending hospitalist would improve patient safety and 62% agreed thatformal overnight supervision would improve trainee-hospitalist relationships. However,44% disagreed and felt that increased on-site hospitalist supervision wouldhamper resident decision-making autonomy and 82% agreed that a formalhousestaff supervisory role would increase hospitalist work load. CONCLUSION: Hospitalists frequently provide overnight coverage in academiccenters. However, formal supervision of trainees is not

uniform, and few hospitalists receive formal training on how to provide effective supervision. Programleaders express concern that creating additional overnight supervisory responsibilitiesmay add to an already burdened overnight hospitalist. Specifically, staffing for and formalizing this supervisory role, including explicit role definitionsand faculty training for trainee supervision, are needed.

INTERVENTION TO REDUCE INAPPROPRIATE PAPANICOLAOU TESTING IN A RESIDENT CLINIC Kyle Horton 1; Samantha Hudson 1; Denise Borden 1; Arpita Aggarwal2. 1Virginia Commonwealth University, Richmond, Virginia ; 2Virginia Commonwealth University, Glen Allen, Virginia . (Tracking ID # 11907) BACKGROUND: Cancer screening guidelines may be misapplied or misunderstood by physicians. We indentified non-adherence to US Preventive Services Task Force (USPSTF) guidelines for cervical cancer screening in our resident clinic, including often use in patients without a cervix. We therefore undertook a quality improvement (QI) project to reduce the number of guideline inconsistent Papanicolaou (Pap) tests. METHODS: Three Internal Medicine residents performed a retrospectively review of 229 charts (December 2004 to February 2009) to assess the appropriateness of Pap tests based on US Preventive Task Force guidelines. Our QI project intervention was instituting a weekly Pap Clinic which included an attending, two interns, and a

womens health resident. Interns presented the patient history to an attending before examination or Pap testing using a pre-defined template. Womens health residents precepted the actual Pap test. Post-intervention, 119 charts were reviewed (March 2009 to July 2010). Data analysis used SAS 9.2 software and a p-value of <0.05 for statistical significance. Pre and post-intervention data was analyzed using a multivariate logistic regression to calculate the odds of inappropriate testing adjusted for age, race, and type of insurance. RESULTS: Pre-intervention, 17.0% of the 229 patients received inappropriate Pap tests with the majority (79.5%) done post-hysterectomy for a non-malignant cause. The pre and post-intervention groups had similar baseline demographic characteristics. Post-intervention, there was an impressive, statistically significant decrease in the percentage of inappropriate Pap tests with only 1.7% (n=2) of 119 patients inappropriately screened (Fisher Exact Test p<0.0001). Twenty patients (16.8%) were deemed inappropriate referrals and did not undergo Pap testing. CONCLUSION: Inappropriate Pap testing due to non-adherence to USPSTF guidelines for cervical cancer screening was prevalent in our resident clinic, especially post-hysterectomy for benign reasons. Creation of a Pap Clinic with focused womens health visits was a highly effective way to reduce unnecessary Pap tests, improve quality of care and provide guideline-based care in our resident clinic. Our educational intervention at the intern level will likely have long-term benefits by enhancing compliance with USPSTF guidelines throughout the trainees future career.

POST-TRAUMATIC STRESS DISORDER IN STROKE SURVIVORS: PREVALENCE AND CORRELATES

Judith Z. Goldfinger 1; Revathi Balakrishnan 1; Kezhen Fei 1; Ian Kronish 1; Carol R. Horowitz1. 1Mount Sinai School of Medicine, New York, New York . (Tracking ID # 11909)

BACKGROUND: Stroke survivors are at increased risk for post-traumatic stress disorder (PTSD), although data on prevalence and associated factors are lacking. Harlem residents and local researchers, alarmed by high rates of stroke in their community and frustrated by the difficulty of engaging stroke survivors in prevention programs, aimed to determine the prevalence and correlates of PTSD in a cohort of survivors of stroke and transient ischemic attack (TIA).

METHODS: Using the principles and methods of community-based participatory research, the partnership of Harlem residents and researchers together developed a recurrent stroke prevention trial and baseline assessments for the trial. Adults over 40 were eligible for inclusion if they reported having a stroke or TIA within the past five years and if they were English or Spanish speaking. Baseline assessments included standard self-report scales for demographics, stroke impact (modified Rankin scale), medical co-morbidities (Charlson comorbidity index), and the 17-item PTSD Checklist Specific for stroke (PCL-S), the most frequently used scale to assess PTSD symptoms. A PCL-S score of 25 connotes a positive screening test, while a score greater than 50 is highly specific for PTSD. Biological data including body mass index (BMI), blood pressure, and LDL cholesterol level were also measured. We used logistic regression to create a model of correlates for PTSD (PCL-S score >50). We also used chi-square to compare stroke risk factors in the PTSD group (PCL-S score >50) vs. non-PTSD groups.

RESULTS: Of the 267 enrollees, mean age was 63 years, 64% were women, 78% were Black or Latino, 29% never completed high school, and more than half earned less than $15,000 yearly. Two hundred one respondents (75%) had PCL-S scores greater than 25, including 46 (17%) who scored above 50. Using logistic regression (c-statistic of0.798, p<0.0001), PTSD was associated with younger age (odds ratio0.92, 95% CI 0.89-0.96), increased disability post-stroke (OR 1.69, 95% CI 1.27-2.25), greater burden of medical co-morbidities (OR 1.20, 95% CI1.01-1.41), and history of a greater number of strokes or TIAs (OR 1.29, 95% 1.01-1.65). Factors that were not significant correlates of PTSD included gender, race, education, and income. Participants who had PTSD were more likely to smoke (33% vs. 14%, p=0.002), have elevated LDL cholesterol >100 mg/ dl (61% vs. 40%, p=0.01), and be overweight or obese with a BMI >25 kg/m2 (84% vs. 66%, p=0.01), all major risk factors for recurrent stroke. There was no significant difference in blood pressure control between the patients with and without PTSD.

CONCLUSION: PTSD is common after stroke, especially in younger people with more disability and more medical problems. This study should motivate clinicians to screen patients for PTSD after stroke. PTSD is also associated with major risk factors for stroke recurrence, specifically smoking, overweight or obesity, and elevated LDL cholesterol. Further research is needed to identify whether PTSD itself may serve as a risk factor for recurrent stroke.

RESIDENT PHYSICANS PATIENT ACTIVATING SKILLS ARE ASSOCIATED WITH OBESE PATIENTS WEIGHT LOSS Colleen C. Gillespie 1;
Melanie Jay 2; Sheira Schlair 3; Sondra Zabar 4; Adina Kalet2. 1NYU School of Medicine, Brooklyn, New York ; 2NYU School of Medicine, NY, New York ; 3Montefiore, New York, New York ; 4NYU School of Medicine, New York, New York . (Tracking ID # 11919)

BACKGROUND: Patient activation, the degree to which patients are knowledgeable, active, and collaborative partners in managing their health, has been linked to positive health outcomes in a number of chronic diseases, but it is less clear how physicians can help activate patients. We explore associations between obese primary care patients stage of activation, resident physicians skills in activating patients, and subsequent (6-month) weight loss.

METHODS: 158 obese patients of 23 primary care resident physicians were interviewed immediately after their visits. The interview included Hibbards 13-item Patient Activation Measure (PAM) that categorizes patients into 4 stages: Stage 1 - starting to take a role in managing health, Stage 2 - building knowledge and confidence, Stage 3 - taking action, and Stage 4 - maintaining behaviors. Residents skills in activating patients were assessed as part of a 10-station OSCE conducted prior to the patient interviews. In the OSCE, standardized patients

rated residents on 25 specific patient activation skills per case (e.g. whether the encounter helped the patient understand the health problem as well as feel confident they could change behaviors) using a 3-point (not done, partly done, well done) scale. Scores were calculated as % of patient activating items well done across all cases. Residents were then dichotomized into 2 groups: those with below average scores and those with above average scores. Patients weight status up to 6 months subsequent to the patient exit interview was assessed through follow-up chart review. Weight change was calculated by subtracting the patients weight (kg) measured at the latest time point within the 6 month period after the index visit from index visit weight. RESULTS: Average weight loss/gain=.32 (loss; SD=2.3, range 8.25.8) for the 88 patients who had at least one follow-up visit within the 6 months subsequent to the initial visit. Most patients (66%; 58/88) were in Stage 4 interms of activation, maintaining healthy weight behaviors. Patients who were in Stage 3 of activation(taking action) lost significantly more weight (1.7 kg, SD=2.1, n=14) than patients whose Patient Activation scores placed them in the three other stages (Stage 1=.9 kg, SD=1.9, n=6; Stage 2=+.8 kg, SD=1.5, n=10; Stage 4=.1 kg, SD=.8, n=58) (F=2.42, p=.02). Residents patient activating scores (% well done) averaged 40%(SD=14%). The patients of residents who demonstrated above average patient activating skills in the prior OSCE lost more weight (mean=1.2 kg, SD=2.1) than patients of residents with below average patient activating skills (mean=+0.0 kg, SD=2.5) (p=.04). While not significant, the magnitude of the effect of residents patient activating skills was greatest for those patientsin the 3 rd level of activation, taking action (mean weight loss of stage 3 patients of residents with above average patient activating skills=3.3 kg,SD=2.8, n=9 and of residents with below average patient activating skills=0.8 kg, SD=2.9, n=5) (F=1.82, p=.18). CONCLUSION: Patients stage of activation is associated with weight loss such that patients who report taking action to manage health lost the most weight. Resident physicians appear to vary in their ability to activate patients (as assessed by SPs in an OSCE) and such variation is associated with patient outcomes (weight status) in our study. Both effects in this pilot study are small and should be replicated in larger, more well-controlled studies - however, results do suggest important future directions for addressing obesity. In addition, further research should explore the complex

interplay between patients level of activation and the activating skills of physicians in shaping patient health behavior and outcomes.

READ AROUND YOUR CASES: DOES CLINICAL EXPOSURE ACTIVATE MEDICAL STUDENTS TO LEARN MORE FROM COMPUTER MODULES? Adina Kalet 1; Hyuk-Soon Song 2; Michael Nick 2; Martin Pusic2. 1NYU School of Medicine, Brooklyn, New York ; 2NYU School of Medicine, New York, New York . (Tracking ID # 11926)

BACKGROUND: Authentic clinical experiences as learning activities have been a foundation of medical education since the Flexner report. More recently, medical students on clinical rotations have had available to them computer modules on relevant clinical topics. Modules such as the CLIPP cases (Pediatrics) and WISE-MD modules (Surgery) are used to ensure complete curriculum coverage in over 50 medical schools. The modules are generally designed as a self-contained activity meant to be completed at a time separate from clinical activities. In this study, we postulate that students who have had any prior exposure to a clinical condition learn more from a given computer module than do those who are encountering the module without this experience. Evidence of greater learning would argue for a system of post-clinical encounter knowledge support. METHODS: We performed a prospective cohort study of clinical year medical students on surgery rotation. We made available two web modules,
on Appendicitis and Carotid Stenosis, covering History, Physical, Imaging, Operative Process and Postoperative Care. Instructional strategies included video narration, graphic visualizations and self-questioning. The modules were to be done at the students convenience during an eight week surgical clerkship. Within the module, each student reported their experience with the clinical condition and completed multiple-choice pre-tests (8 items) and post-tests (12 items) of declarative knowledge. We contrasted final score by clinical exposure, controlling for pre-test score (ANCOVA).

RESULTS: 166 students completed a module: Appendicitis 38/86 (44%) had any prior clinical exposure; for Carotid Stenosis 26/80 (33%). For both the topics, prior exposure was associated with higher post-test scores (Appendicitis effect size 0.40; 95% CI 0.03, +0.83; Carotid Stenosis effect size 0.31; 95% CI 0.16, +0.78). Adjusted for pre-test knowledge, the Appendicitis module still showed a significant effect of clinical exposure (ANCOVA $F_{2,83}=4.45$, $p=0.04$); for the Carotid Stenosis module, while the effect was in the same direction, it did not reach statistical significance (ANCOVA $F_{2,78}=0.31$, p=NS).

CONCLUSION: Students had measurably higher learning from a module when they had had at least some prior clinical exposure. There are several reasons why this might be. With an already partially developed mental model, students may encode new material more easily. Authentic cases engage the students emotionally, possibly resulting in higher motivation while considering the module. However, in terms of limitations for this observational study, we cannot exclude confounding due to systematic differences in motivation or other student characteristics. Our results should be viewed as pilot data for further study with a view to more systematically organizing students study after key clinical encounters.

A SCALE FOR MEASURING SOCIAL STRESS AMONG DIABETIC PATIENTS MichaelRothberg 1; Tara Michelle DuVal 1; Jennifer Friderici 1; Garry Welch1. 1Baystate Medical Center, Springfield, Massachusetts . (Tracking ID # 11938)

BACKGROUND: In urban clinic settings, many clinicians believe that social stress interferes with patients ability to comply with complex medical regimens and that social support is protective. However, little empirical data is available and there is a paucity of assessment tools to foster research in this area. Competing obligations from family, as well as poverty, substance abuse, illiteracy, mental illness and domestic violence are all common and potentially disruptive factors, while support includes family members and community connections. The objective

of this study was to measure social stress levels and social supports in an urban, predominantly Hispanic sample of patients with diabetes.
METHODS: Using focus groups of physicians, nurses and diabetes educators who work with patients at one academic urban health center, we created a 20-item measure of social stress and a 10-item measure of social support in English and Spanish. After pilot testing with target subjects, the scale was modified for clarity. We administered the scale by telephone to 250 patients with diabetes to assess levels of social stress and support among our clinic population. For each stress question respondents were asked whether it was a cause of stress in the past week. Some questions included the possibility that a problem for a family member might be the source of the patients stress, e.g. problems with alcohol or drug abuse in my family or myself. We also assessed depression using the Patient Health Questionnaire (PHQ-9) and self-reported disability. Proportions and 95% confidence intervals were calculated for binary response items. Bivariate examinations of continuous stress and support scores with demographic and behavioral predictors were conducted using unpaired t-tests, chi-squared tests, and Pearsons rank correlation.
RESULTS: We invited 305 patients to participate, of which 246 (81%) responded. Mean age was 5311 years, 63% were female, and 53% were Hispanic, 25% white and 19% black. All patients had type 2 diabetes, 73% were obese, and 61% were disabled. Depression measured by PHQ-9 was prevalent, with 31% scoring >=10, indicating moderate to severe depression. Nearly all patients (99%) had some form of health insurance. The average respondent endorsed 6 (SD 4) of 20 stress items (range 0 to 20) and 6 (SD 2) of 10 support items. Most (93%) endorsed at least one stress item. The top-ranked stress items were Depression/anxiety in self or family (63%; 95% CI 57%, 69%), Family sickness/disability (61%; 95% CI 55%, 67%), Not enough money for food, rent (60%; 95% CI 54%, 66%), Caring for familys needs (58%; 95% CI 51%, 64%) and Cost of travel back home to visit family (45% ; 95% CI 38%, 51%). The top-ranked support items were Supportive doctor (93%, 95% CI 90%, 97%), Good advice from family (79%, 95% CI 73%, 84%), and Supportive friends (76%, 95% 70%, 81%). Reliabilities for both scales were sound (alpha=0.8, stress; 0.6, support). There were no significant differences in stress by sex (men 6.1 vs. women 6.4, P=0.51); ethnicity (Hispanic 6.2 vs. black 6.7 vs. white 5.9, P=0.26), educational level (Pearsons r-0.07, P=0.54) or disability (disabled 6.7 vs. not 5.8, P=0.13). Stress scores were positively correlated with PHQ-9 (Pearsons r=0.60, p<0.0001), and support scores negatively so (Pearsons r=0.26, p=0.0001). Stress and support were inversely related (Pearsons r=0.16, p=0.02).
CONCLUSION: Among diabetic patients in an urban health center, levels of social stress were high, but social supports were also common. Social stress was highly correlated with depression.
RURAL PRIMARY CARE PHYSICIAN PERSPECTIVES: BARRIERS TO REPRODUCTIVE HEALTH CARE IN CENTRAL PENNSYLVANIA Cynthia H Chuang 1; Sandra W Hwang 1; Jennifer S McCall-Hosenfeld 1; Carol S Weisman 1; Lara A Rosenwasser 1; Marianne M Hillemeier1.
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BACKGROUND: Women residing in rural areas of Central Pennsylvania are less likely than urban women to receive guideline-concordant reproductive health services. Reasons for this disparity are largely unexplored, but understanding potential barriers to optimal care may lead to interventions aimed at improving reproductive health care delivery in rural areas. Using qualitative methods, we explored rural primary care physician (PCP) perspectives regarding two domains of reproductive health care-preconception care and contraceptive care.
METHODS: Using the AMA Masterfile, we identified family physicians, internists, and OBGYNs without subspecialty designation in office-based, non-federally affiliated practices in rural Central Pennsylvania. Physicians were eligible if they considered themselves PCPs and provided care for adult women of reproductive-age. We conducted in-person or telephone interviews with 18 PCPs (12 family physicians, 4 internists, and 2 OBGYNs) regarding their perceptions of PCP role and barriers to preconception and contraceptive care. Using a modified grounded theory method, interview transcripts were analyzed for major themes using QSR NVivo8 software.

RESULTS: Themes focused on (1) PCP role, (2) access to care, and (3) patient ambivalence toward reproductive health. Although PCPs believed they had an important role in preconception care and that such discussions should be routinely initiated (11/12), most indicated that preconception counseling occurs infrequently (16/17). Regarding contraceptive management, the majority of PCPs felt it was their responsibility to provide contraceptive care (11/14), although that responsibility is sometimes shared with OBGYNs and/ or family planning clinics (6/12).
PCPs did not perceive access barriers for patients obtaining contraception (12/12). However, many PCPs (8/18) identified lack of OBGYN specialists as a barrier in rural communities for pregnancy planning. Financial issues were sometimes identified as barriers to reproductive health access, particularly for patients receiving medical assistance or those who are uninsured (5/18 in preconception, 7/18 in contraception).
Finally, PCPs identified patient ambivalence toward both preconception care (13/18) and contraceptive care (6/18) as a barrier in rural communities. Social norms for larger families and unintended pregnancies, low community expectations for women to pursue advanced education and careers, and overall lack of life planning (not only reproductive planning) were identified as exacerbating factors. Some PCPs felt in conflict with these community attitudes, and even described this ambivalence toward reproductive health as negligent.
CONCLUSION: There is a gap between the role that rural PCPs believe they should play in providing preconception care and the actual execution of that role. Our findings suggest that perceived need for more specialists and frustration with patient ambivalence may contribute to this gap. In contraceptive care, the main barrier emphasized was patient ambivalence. Interventions designed to address these barriers could include both PCP training to increase comfort with providing routine preconception care in the primary care setting and community education programs to address ambivalence towards reproductive health planning.

MULTI-LEVEL INTERVENTION TO CONTROL HYPERTENSION IN AFRICAN AMERICANS: THE CAATCH TRIALL Gbenga Ogedegbe 1;
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BACKGROUND: Hypertension-related outcomes explain the most mortality gap betweenAfrican Americans and whites. Despite effective blood pressure (BP) control interventions, these approaches have notbeen translated intoclinical practice for African Americans. We evaluated the effectiveness of a multilevel evidence-based intervention [targeted at physicians and patients] in improving BP control in hypertensive African Americans in 30 community health centers (CHCs).
METHODS: Counseling African Americans to Control Hypertension (CAATCH), a cluster randomized clinical trial, compared an Intervention (IC, n=15) consisting of three patient-level components (interactive computerized hypertension education, homeBP monitoring, monthly lifestyle modification counseling) and two clinician-level components (monthly Hypertension Guidelines (JNC-7) case rounds, chart audits/ feedback) with Usual Care (UC, n=15). The primary outcome was the rate of BP control (Bp<140/90 for all patients; or <130/80 for diabetic patients) at 12 months by automated BP monitor (BPTru BPM-300). Secondary outcome was Office BP (extracted from medical records) at 12 months. Of 1059 recruited, 71% completed the trial (mean age 56 yrs, 60% obese,35% diabetes, baseline BP (SD) 149/90 (21/ 13 mmHg).
RESULTS: Using intent-to-treat analysis, BP control at 12 months by BPTru (adjusted for baseline BP,diabetes, Charlson comorbidity, resistant hypertension) was IC=59.9% vs. UC=55.1% [OR=1.22 (95% CI 0.95-1.57)]; and mean Office BP at 12 months was IC=135.4 mmHg vs. UC=141 mmHg (p<0.01). In pre-specified subgroup analyses, the intervention was associated with greater BP control for patients without diabetes [IC=61.6% vs. UC=53.6%, OR=1.39 (1.02-1.9)];and patients who received care in small CHCs [IC=62.5% vs. UC=52.2%, OR=1.53(1.08-2.15)].

CONCLUSION: In African Americans with poorly controlled hypertension,while a practice-based multilevel intervention did not significantly improve BP control by BPTru, it was associated with significant improvement in Office BP; thus suggesting that BP targets can be reached in this high-risk population. Our findings suggest that evidence-based multilevel interventions can be integrated into primary care practiceswith significant potential for improving BP control in hypertensive African Americans.

EFFECT OF A MULTI-DISCIPLINARY ADMITTING TEAM ON QUALITY AND EFFICIENCY OF INPATIENT CARE Janine Marie Jordan 1;

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(Tracking ID # 11956)

BACKGROUND: Increasing the quality and efficiency of inpatient care are explicit goals for the US health care system. Though much attention has been given to increasing the effectiveness of the discharge process, little evidence guides hospitals in ways to maximize the effectiveness of the admission process. We developed a multi-disciplinary admission team to expedite the delivery of high-quality care at the time of admission in the emergency room. Our objective is to evaluate this program regarding the quality efficiency, and safety of care

METHODS: We conducted a prospective, quasi-experimental evaluation of the effectiveness of the Synchronized Wilmington Admission Team (SWAT) from October 2010 to November 2011. The SWAT is a multi-disciplinary team comprised of a nurse, clinical pharmacist, social worker/case manager, resident physician, and faculty attending physician. The team members admit patients concurrently and develop a coordinated plan for admissions to a teaching service at an urban hospital. In addition to routine admission details, the primary tasks of the team are tracked using a checklist including prompts for evidence-based protocols, medication reconciliation, identification of post-acute care needs, and relevant CMS measures. At the time of admission, the plan of care is finalized with the patient and family. Primary outcomes are Length of Stay (LOS), Rapid Response Team (RRT) activation, Emergency Department (ED) boarding time, performance on CMS quality measures for pneumonia when applicable, and readmission rates. The SWAT is conducted on admissions to the internal medicine and family medicine teaching services on weekdays between 9 am and 5 pm, but is not always available. We compare outcomes of the SWAT admissions to all teaching patients in the year prior to implementation (historical comparison group) and to teaching patients admitted weekdays 9 am to 5 pm who did not have SWAT available (contemporaneous comparison group).

RESULTS: During the initial study period, 196 patients were admitted by SWAT and 468 without SWAT (Non-SWAT). LOS in both the SWAT and non-SWAT groups was improved from the historical comparison(4.0 [3.6 - 4.5] (p 0.01 for each). The average LOS was 2.83 (2.4 - 3.2) days for SWAT and 3.5 (3.1 - 3.9) days for Non-SWAT patients (p=0.085). SWAT patients had 0 calls for the RRT in the first 24 hours of admission and 2 overall compared to 4 in the first 24 hours and 14 overall for the non-SWAT group (p >0.05).. Only 4 patients in the SWAT group and 7 in the non-SWAT group were candidates for pneumonia core measures. The SWAT patients were 100% compliant on all measures compared to 71% for the non-SWAT group. There were no differences in ED boarding time or rate of readmissions at 30 days.

CONCLUSION: The SWAT admission process, which utilizes a multidisciplinary team for care coordination and a checklist for quality and safety measures, may be associated with improvement in LOS without adding to boarding time in the Emergency Department or increasing the rate of readmissions at 30 days. Initial results indicate that this model may provide a mechanism for hospitals to increase the quality, efficiency, and safety of inpatient care.

LIFETIME EXPOSURE TO TRAUMATIC PSYCHOLOGICAL STRESS IS ASSOCIATED WITH GREATER INCREASES IN INFLAMMATORY ACTIVITY OVER TIME IN PATIENTS WITH CARDIOVASCULAR DISEASE: PROSPECTIVE FINDINGS FROM THE HEART AND SOUL STUDY Beth Cohen 1; Aoife ODonovan 1; Thomas Neylan 1; Thomas Metzler 2; Mary Whooley1. 1University of California San

Francisco/San Francisco VA Medical Center, San Francisco, California ; 2San Francisco VA, San Francisco, California . (Tracking ID # 11976)

BACKGROUND: A history of exposure to traumatic psychological stress increases risk for adverse events and early mortality in patients with cardiovascular disease (CVD). While the biological mechanisms of these effects are not known, inflammatory activity may play a key role as it is both elevated by psychological stress and involved in the progression of CVD. However, no studies have examined if lifetime exposure to traumatic psychological stress is associated with inflammatory activity in patients with CVD. In the present study, we assessed if CVD patients with high levels of trauma exposure differed from comparison patients in baseline levels and rate of change of inflammatory markers over time.

METHODS: Patients with stable CVD who participated in the Heart and Soul Study (n=1,019) reported history of exposure to 18 traumatic events from the Computerized Diagnostic Interview Schedule for DSM-IV. Patients in the highest quartile for traumatic events were classified as having high levels of trauma exposure (n= 256 who reported 8 or more events). Body mass index (BMI) was measured, and demographics and health behaviors were assessed by self-report. Markers of inflammatory activity including interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-alpha), C-reactive protein (CRP) and resistin were measured in fasting blood samples at baseline and at five-year follow up (n=665). We constructed linear regression models with baseline, year 5, or change in inflammatory biomarker levels adjusted for factors that differed at p<.20 between groups, including age, gender and statin use. We then adjusted for potential mediating variables, including sleep quality and the health behaviors smoking, physical activity and illicit drug use, as well as PTSD and depression.

RESULTS: Patients reporting high levels of trauma exposure were not significantly different from comparison patients on markers of inflammatory activity at baseline. However, this high trauma exposure group exhibited significantly greater increases in IL-6 (=.08, p=.047), TNF- (=.11, p=.006) and resistin (=.09, p=.03) from baseline to 5-year follow up, adjusting for age, sex and statin use. In addition to demonstrating greater increases in these markers over time, patients with high levels of trauma exposure also had greater absolute levels of TNF- and resistin (p<.05) and a trend towards greater absolute levels of IL-6 (p=.11) at 5-year follow up. There were no group differences in CRP. Conclusions were similar after additional adjustments for smoking, physical activity, illicit drug use, sleep quality, PTSD and depression.

CONCLUSION: This first large-scale demonstration of an association between traumatic psychological stress and inflammatory activity links a history of traumatic psychological stress with a mechanism of accelerated CVD progression. The psychological, behavioral and biological sequelae of traumatic psychological stress may persist across the lifespan, influencing inflammatory activity and potentially CVD morbidity and mortality late in life.

FALLING OFF THE WAGON: THE NEED FOR A PARADIGM SHIFT IN TACKLING THE OBESITY EPIDEMIC

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BACKGROUND: Minority populations are disproportionately affected by the obesity epidemic. In recent years experts in the field have recommended that social and behavioral interventions should be focused on promoting small lifestyle changes that will eliminate or reduce the gradual excess weight gain that occurs in people of all ages over the life span. This small change approach is based on analyses that demonstrate that people gradually gain weight over time because of a small average daily difference between energy intake and energy expenditure known as the energy gap. Based on theory and experimental research on small change strategies we developed a novel behavioral intervention aimed at achieving weight

loss among Black and Hispanic adults in two New York City communities through small changes in eating behavior and physical activity. Prior to the implementation of the trial we sought to develop a better understanding of how different experimentally-based small change strategies would translate across different cultural groups. Qualitative group interviews were used to culturally tailor the future intervention.
METHODS: Black or Hispanic adults 21 years of age with a BMI 25 and a previous weight loss attempt were recruited at two clinical and two church sites in Harlem and the South Bronx, New York. Six focus groups, three in Spanish and three in English were conducted by two moderators using a standardized interview guide following informed consent. Participants were asked to describe previous attempts at changing their eating behaviors to lose weight. Participants were then presented with thirteen experimentally-validated small change eating strategies known to reduce the energy gap(i.e. using a 10 inch plate for main meal, not eating when the TV is on, eating breakfast everyday, eating dinner at home at least 6 days a week). Participants voted for the top six strategies they felt could be easily adopted by themselves and their family or social network. Group discussion explored potential advantages and challenges of adopting each of the six strategies. Sessions were tape-recorded and transcribed verbatim. Responses were entered into Ethnograph qualitative software and systematically analyzed using grounded theory methods. Through an iterative process, concepts were grouped into categories based on similar properties and dimensions. Over-arching themes were then developed by three trained qualitative experts. Three additional trained corroborators independently reviewed the transcripts, and consensus was reached with the final themes reported here.
RESULTS: 67 participants mean age 54 years13, 72% women and 60% Hispanic were enrolled. More than half of participants had some college education (58%), 30% were employed, 42% were married and had one or more children. 74% described themselves as weighing too much and being advised by a medical provider to lose weight. The mean BMI was 347.2. 52% of participants described their general health as fair or poor. Only 36% of participants met the daily recommendations of eating five or more servings of fruit and vegetables. We identified three primary themes: 1) The Wake Up Call- an interaction with a health care provider or their own personal decision-making (based on psychologic or physiologic reasons) would prompt a self-awareness that obesity was negatively impacting their health and that it was time to initiate a behavior change; 2) Taking Control - preferences for a particular weight loss strategy were chosen based on which aspect of the built and/or social environment participants believe they could gain control over ; and 3) Falling Off the Wagon -all participants described the experience of not being able to maintain newly adopted behavior/s long term as a result of either unrealistic weight loss planning and goals or negative environmental influences such as stress. Participants selected the following six small change strategies; 1) Using a smaller plate for the main meal; 2) Making half of the main meal vegetables; 3)Putting snacks out of sight; 4) Eating breakfast everyday; 5) Drinking water instead of sweetened beverages; and 6) Eating dinner at home at least 6 days a week. Common reported advantages of the strategies were: 1) Do not require a sacrifice -you dont feel like you are giving something up; 2) Cost-effective -its cheaper than eating out all the time; and 3) Health benefits - there are lots of health benefits from drinking water.

CONCLUSION: Our study demonstrates that among community dwelling African-American and Hispanic adults the need to lose weight is often triggered by outside influences such as a health care provider or change in health status (i.e. new onset diabetes). While individuals are able to select strategies that results in short tem weight loss they reported that they are unable to maintain these efforts long term. Some strategies may conflict with family and cultural meal practices and values, others with daily schedules or household food environments. Participants voted for six out of thirteen small change eating strategies that they believe could be easily adopted and maintained long term by themselves or other members of their family and social network. Our results may also have important implications for translating basic experimental research on small change strategies for diverse cultural groups. The development of obesity interventions utilizing small environmental and behavioral

changes may be more sustainable over time in comparison to more robust dieting efforts that yield positive results but cannot be maintained long term. The translation of the small change strategies into more culturally and environmentally relevant forms may also increase the success of interventions. The results of this study will be used to refine and tailor a large scale randomized behavioral intervention targeted at achieving a 7% within-patient reduction in weight through small sustained changes in eating behavior coupled with sustained increases in lifestyle physical activity.

ODDS OF MAJOR ADVERSE CARDIOVASCULAR EVENTS ASSOCIATED WITH VARENICLINE: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS Sonal Singh 1; Yoon Kong Loke 2; John Spangler 3; Curt D Furberg3. 1Johns Hopkins University, Baltimore, Maryland ; 2University of East Anglia, Norwich, N/A ; 3Wake Forest University School of Medicine, Winston-Salem, North Carolina . (Tracking ID # 11999)

BACKGROUND: Varenicline is a partial agonist at the 4- 2 nicotinic acetylcholine receptors and a full agonist at -7 nicotinic acetylcholine receptors. Varenicline is associated with myocardial infarction and cardiac arrest in spontaneous reports. Its effect on cardiovascular outcomes is unknown. Our objective was to ascertain the risk of major adverse cardiovascular effects of varenicline compared to placebo controls among tobacco users.

METHODS: Systematic searches were conducted in August 2010 of relevant articles in MEDLINE, EMBASE, regulatory authority Web-sites in the United States and Europe and manufacturers trial registries with no date restrictions. Randomized controlled trials of varenicline for treatment of nicotine addiction among smokers or smokeless tobacco users, had at least 7 days of treatment, and reported on any major adverse cardiovascular event (including zero events) of myocardial infarction, unstable angina, coronary revascularization, coronary artery disease, arrythmias, transient ischemic attacks, strokes and sudden death or cardiovascular death and congestive heart failure were included.

RESULTS: The initial search yielded 347 citations. After a detailed screening of 45 full text studies for cardiovascular events, 14 double blind placebo controlled randomized controlled trials enrolling 8216 tobacco users were included. Follow-up duration ranged from 7 weeks to 1 year. Major adverse cardiovascular events occurred among 52 of 4908 participants receiving varenicline and 27 of 3308 patients receiving placebo therapy (Peto Odds Ratio (OR), 1.72 [95% confidence interval {CI}, 1.09-2.71]; P=.02 I2=0%). Sensitivity analysies using treatment arm continuity correction to account for imbalance in zero events among the included trials yielded similar results. These estimates were also robust to the choice of comparators (placebo vs active controls). There was no evidence of publication bias via funnel plot asymmetry.

CONCLUSION: Among tobacco users varenicline use is associated with significantly increased odds of major adverse cardiovascular events.

FROM SKEPTICS TO USERS: EDUCATING PHYSICIANS IN SHARED DECISION MAKING AND INCREASING USE OF DECISION AIDS Leigh Simmons 1; Karen Sepucha 1; Lauren Leavitt 1; Christine Greipp1.

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BACKGROUND: Since 2005, primary care providers at Massachusetts General Hospital in Boston, MA, have been able to prescribe decision aids to their patients through the hospitals electronic medical record. These decision aids are produced by the Foundation for Informed Medical Decision Making, a leading developer of decision aids. Twenty-seven video and paper-based decision aids covering a range of medical conditions are available for prescription. The use of the decision aids has been varied, with some providers using them often and others never using them. The purpose of this project was to evaluate the impact of provider training sessions on utilization of decision aids in primary care.

METHODS: All primary care practices at MGH were offered a one-hour course in shared decision making and use of decision aids to be held at the time of their regularly scheduled practice meetings. The key components of the provider training session are 1) an overview of shared decision making concepts, 2) a review of prescribing data at the group and clinician level, and 3) a viewing of a video decision aid. In advance of the session, practice leaders chose from one of three decision aid topics: screening options for colorectal cancer, treatment options for knee osteoarthritis, and advance directives planning. Physician providers received one unit of continuing medical education credit for participation in the session. We examined two metrics: overall group rates of decision aid use and the number of providers who had prescribed at least one decision aid in the four weeks before and four weeks after the session.

RESULTS: We conducted training sessions with 15 primary care practices comprising over 200 physicians. We have baseline data for all practices and complete follow-up data for seven practices. For these seven practices, overall utilization increased significantly, from 57 prescriptions prior to and 113 prescriptions after the session ($p<0.001$). Six out of seven practices demonstrated an increase in their overall prescription rates after our intervention. The number of providers who prescribed at least one program also increased from 26/130 (20%) to 45/130 (35%) ($p<0.001$). Thirty-six providers increased their prescription rates, with the most significant increases noted for providers who had joined the practice within the prior year, and for providers previously known to be high prescribers. The increase in prescription was spread across several decision aids, not only the program used in the session.

CONCLUSION: A CME course that is designed to enhance provider understanding of shared decision making and to give personal feedback on usage of decision aids was successful in increasing overall prescribing rates, and in attracting more users. Whether the observed short term increase will be sustained needs to be evaluated.

THE MEANING OF INTERPROFESSIONAL EDUCATION: AN EXPLORATION OF STUDENTS PERSPECTIVES Paul Haidet 1; Beth Bates 2; Cori Breault 1; Susan Glod 1; James O. Ballard1. 1Penn State University College of Medicine, Hershey, Pennsylvania ; 2Penn State University School of Nursing, Hershey, Pennsylvania . (Tracking ID # 12001)

BACKGROUND: Interprofessional education may foster better collaboration and teamwork in medical care. While the theoretical and empirical literature points toward the value of interprofessional education, there is little published data exploring students actual experiences during interprofessional learning sessions. We performed this study to explore nursing and medical students perspectives and experiences during two interprofessional sessions on end-of-life (EOL) care.

METHODS: At the Hershey campus of Penn State University, educators recently introduced two interprofessional sessions as part of elective courses on end-of-life care in the nursing and medical schools. During the sessions, eleven 4th-year medical and sixteen junior or senior bachelors nursing students worked in four groups of 67 students each. Group assignments were random and stratified so that each group had nursing and medical representation. The sessions employed Team-Based Learning, a pedagogical method that incorporates both small-and large-group discussions, and fosters high degrees of student engagement and cooperation.

We developed an interview guide to probe: a) impressions about each others profession, b) interprofessional interactions during the EOL sessions, and c) interprofessional perspectives regarding EOL care. We randomly selected 12 students (6 nursing and 6 medical), ensuring that at least one medical and one nursing student was sampled from each of the four course groups. We invited the students to participate in a 60-minute, one-on-one, semi-structured interview. We added additional probes to the interview guide after the first three interviews, based on early themes that emerged during those interviews. We audio-recorded all interviews, and are in the process of transcribing them. We are analyzing the audio and transcripts using a narrative framework, which directs attention to elements such as character, agency, and plot, to derive recurrent themes and relationships

among thematic elements.
RESULTS: All approached students agreed to be interviewed. Eleven students completed interviews; one nursing students availability prevented completion. Interviews lasted between 45 and 80 minutes. All five nursing and three medical students were female. Four initial themes emerged in our analysis thus far; these include: 1) both nursing and medical students described fundamental differences between nursing and doctor roles in end-of-life care, positioning nurses in much greater relationship with the patient than the doctor;2) there are large barriers to clinical interprofessional interactions, mainly driven by both nurse and doctor perceptions of the others heavy workload; 3) when they occur, informal interactions (including those during the EOL sessions) have a strong humanizing effect by reducing fear of the other; and 4) for medical students, informal discussions about nursing students course work created biomedical

legitimization of nurses background training, potentially enhancing respect.
CONCLUSION: Students emerge from medical and nursing school with role expectations not only for themselves, but also for other members of the clinical team. While such role expectations were generally concordant with each other in this study, they have the potential to create silos in clinical settings, especially when there is very little perceived time and fear-based barriers to interact with members of the other profession. Informal interactions in this interprofessional course tended to reduce such barriers, mainly by promoting respect and humanizing each others profession. Future work should explore whether such effects are transferrable to clinical environments.

HOSPITAL CHARACTERISTICS ASSOCIATED WITH HIGH READ-MISSION RATES AMONG MEDICARE BENEFICIARIES Alicia Ines Arbaje 1; Qilu Yu 1; Jiangxia Wang 1; Bruce Leff1. 1Johns Hopkins University, Baltimore, Maryland . (Tracking ID # 12004)

BACKGROUND: Health system improvement efforts to reduce hospital readmission rates have focused primarily on identifying and targeting high-risk patients. There is less understanding of how hospital organizational characteristics may be related to suboptimal transitional care and subsequent readmission. The objective of this study was to describe US hospitals with high readmission rates among their Medicare beneficiaries.

METHODS: Retrospective cohort study. Main outcome: readmission to hospital within 180 days of discharge. We studied US hospitals (n=5,585) participating in the 2006 round of the American Hospital Association (AHA) Annual Survey of Hospitals and who discharged Medicare beneficiaries hospitalized in the first 6 months of 2006, identified using a 5% sample of Medicare inpatient claims (MedPAR files, n=222,800) linked to AHA data.

RESULTS: 51.4% of hospitals were classified as non-profit, 22.4% as government, and 21.7% as for-profit. 48.0% were under 100 beds in size, 36.3% were in rural areas, and 17.4% were classified as teaching hospitals. Many were classified as being part of a decentralized health system (21.7%), 12.0% as moderately decentralized, and 4.4% as centralized. In bivariate analyses using logistic regression, there were significant associations ($p<0.05$) between high readmission rates and having 100199 beds (OR 1.06), compared to having <100 beds. Compared to general medical/surgical hospitals, psychiatric hospitals had higher readmission rates (OR 1.65), as did acute long-term care hospitals (OR 2.10). Compared to government-owned hospitals, non-government-owned non-profit hospitals exhibited lower readmission rates (OR 0.97), as did teaching hospitals (OR 0.97). These relationships persisted in a multi-variate model, accounting for bed size, ownership status, region, teaching status, rural location, and degree of centralization. There were statistically significant relationships between higher readmission rates and having 100199 beds (OR 1.04, 95% CI 1.00-1.07), compared to having <100 beds. Compared to general medical/surgical hospitals, psychiatric hospitals had higher readmis-
sion rates (OR 1.57, 95% CI 1.43-1.73), as did acute long-term care hospitals (OR 1.99, 95% CI 1.68-2.34).

Compared to government-owned hospitals, non-government-owned non-profit hospitals exhibited lower readmission rates (OR 0.94, 95% CI 0.92-0.97), as did teaching hospitals (OR 0.97, 95% CI 0.95-0.99). There was no relationship between high readmission rates and location (rural vs. urban). CONCLUSION: This study characterizes US hospitals with high readmission rates of Medicare beneficiaries. Hospitals that were mid-sized, non-medical/surgical, or non-teaching had increased readmission rates. Rural vs. urban location were not related to readmission rates. Further studies are needed to evaluate whether other hospital organizational characteristics may be related. Current efforts to reduce hospital readmission are primarily focused on targeting high-risk patient populations. It may be important to broaden efforts to include targeting of high-risk hospital systems in order to enhance the effectiveness of health system interventions.

RISK OF FRACTURES WITH INHALED CORTICOSTEROIDS IN COPD : SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS AND OBSERVATIONAL STUDIES Sonal Singh 1; Rodrigo Cavallazi 2; Yoon Loke3. 1Johns Hopkins University, Baltimore, Maryland ; 2University of Louisville School of Medicine, Louisville, Kentucky ; 3University of East Anglia, Norwich, N/A . (Tracking ID # 12014)

BACKGROUND: The effect of inhaled corticosteroids (ICS) on fracture risk in patients with chronic obstructive pulmonary disease (COPD remains uncertain. We aimed to evaluate the association between ICS and fractures in COPDMETHODS: We searched MEDLINE, EMBASE, regulatory documents and company registries up to September 2010. Randomized controlled trials (RCTs) of budesonide or fluticasone vs control treatment for COPD (> 24 weeks duration and controlled observational studies reporting on fracture risk with ICS exposure vs no exposure in COPD were included. Peto Odds Ratio meta-analysis was used for fracture risk from RCTs. odds ratios (OR) from observational studies were pooled using the fixed effect inverse variance method. We conducted dose-response analysis using variance weighted least squares regression in the observational studies. RESULTS: Sixteen RCTs (14 fluticasone, 2 budesonide) with 17, 513 participants, and 7 observational studies (n=69 000 participants) were included after screening 853 citations. ICSs were associated with a significantly increased odds of fractures (Peto OR 1.26; 95% CI, 1.01 - 1.57; P=0.04; I2=0%) in the RCTs. (Figure 1) Exposure to ICS was associated with a significantly increased odds of fractures (OR 1.21; 95% CI 1.12-1.32, p<0.001; I2=37%) in the observational studies, (Figure 2) with each 500 mcg increase in beclometasone dose equivalents associated with 9% increased odds of fractures, OR: 1.09 (95% CI 1.06 to 1.12; p<0.001).

CONCLUSION: Among patients with COPD, long term exposure to fluticasone and budesonide is consistently associated with a small but statistically significant dose-dependant increased odds of fracture.

DO CULTURAL VALUES IMPACT HEALTLY LIFESTYLE BEHAVIORS? Monica Ferguson 1; Katrina Armstrong 1; Frances K. Barg 1; Judy A. Shea 1; Andrea B. Troxel 1; Benita Weathers 1; Chanita Hughes Halbert1. 1University of Pennsylvania, Philadelphia, Pennsylvania . (Tracking ID # 12016)

BACKGROUND: Obesity is now a national epidemic that is due in part to unhealthy eating behaviors and inadequate physical activity. Interventions have been developed to increase intake of fruits and vegetables and increase physical activity; these approaches have

been tailored to different racial groups using culturally-based interventions. Physicians are encouraged to use these types of patient-centered approaches to provide advice about healthy lifestyle strategies. But, culturally-tailored strategies have had mixed results. To increase physicians abilities to provide patient-centered advice about lifestyle behaviors, empirical data are needed on the effects of cultural values and health beliefs on lifestyle behaviors. The purpose of this study was to evaluate the effects of these factors on adherence to recommendations for fruit and vegetable intake and physical activity in a racially diverse national sample of

adults.
METHODS: We conducted a nationally representative, random digit dialing survey of African American, white, and Hispanic adults in the US. Data on study measures were collected by self-report as part of a prospective longitudinal study on health beliefs and behaviors. Our three outcome variables were adherence to national recommendations for fruit and vegetable intake (e.g., at least 2 cups of each) and physical activity (e.g., moderate intensity exercise at least 5 days per week). Predictor variables included socioeconomics, health care variables, and cultural values. Cultural values were assessed using the Multi-Dimensional Cultural Values Assessment Tool (MCVAT), which evaluates religious (e.g., my spiritual faith is important to preventing cancer), collectivist (e.g., I should talk to my family members about whether or not I should have cancer screening tests), and individualistic (e.g., it is important for me to learn on my own about which cancer screening tests are needed) values for cancer prevention and control. Descriptive statistics were generated to characterize respondents in terms of socioeconomics, health care variables, and adherence to health behavior recommendations. We performed bivariate analyses and used logistic regression analysis to identify factors having significant independent associations with each behavioral outcome. Separate models were generated for each outcome; variables that had a $p<0.10$ association with each health behavior were included in the model for that variable.
RESULTS: Overall, 17% of respondents met guidelines for physical activity and 41% met guidelines for fruits and vegetables. Although respondents with higher religious ($t=2.81$, $p=0.01$) and collectivist values ($t=2.17$, $p=0.03$) were most likely to be non-adherent to recommendations for vegetable intake, these values did not have a significant effect on adherence in the regression model. Women, respondents who were at least high school graduates, and those who perceived that they were in excellent/good health were most likely to be adherent to recommendations for vegetable intake. Compared to whites, African Americans and Hispanics were significantly less likely to be adherent to these recommendations. Similarly, although respondents with greater levels of individualistic values were more likely to be adherent to recommendations for fruit intake compared to those with lower levels of these values ($t=1.94$, $p=0.05$) in the bivariate analysis, only female gender, greater income, and greater perceptions of health had significant effects on being adherent to recommendations for fruit intake. Respondents who were employed had a lower likelihood of being adherent to recommendations for fruit intake. None of the cultural factors or other variables had significant effects on meeting guidelines for physical activity.
CONCLUSION: Our findings raise questions about the need to address cultural values when advising patients on how to meet recommended guidelines for healthy lifestyle behaviors. Rather than using a culturally-based tailored intervention, it may be more important to reinforce overall perceptions of health and develop strategies that address barriers to adherence among those who believe that they are not in good health.
RESIDENT PROVISION OF ADEQUATE DISCHARGE COUNSELING: RESULTS FROM 22 TRAINEE PROGRAMS Micah Mann 1; Chang Dennis 1; Robert Fallar 1; Erica Friedman 1; Terry Sommer 1; Kristofer L Smith1. 1Mount Sinai School of Medicine, New York, New York . (Tracking ID # 12017)
BACKGROUND: Discussions with patients at the time of hospital discharge require substantial skill and training. High quality and thorough execution of these discussions can improve satisfaction and quality of care. Using standardized patient (SPs), we assessed the quality of a discharge discussion provided by residents from a range of training programs and hospitals sites.
METHODS: Trainees completed a 15 minute SP encounter in which they were instructed to counsel a soon-to-be discharged patient hospitalized for a congestive heart failure exacerbation. A behavioral checklist was created to evaluate resident performance. SPs were trained to evaluate the quality of the resident performance in a uniform fashion. For analysis, behaviors were grouped into seven domains: verbal professional demeanor, non-verbal professional demeanor, facilitating patient understanding, medication reconciliation, disease education, follow-up arrangements review, and assessing barriers to discharge plan. For each domain, we

defined high performers as those residents who adequately performed all of the individual behaviors within that domain. For all trainees, bivariate analyses investigated relationships between high performance and gender and medical school training location (Foreign Medical Grads (FMG) versus USMDs). Sub-group analysis of USMDs investigated relationships between high performance and work in a field with a primary care component (internal medicine, family practice, pediatrics and obstetrics/gynecology). Likert scales were used for the residents to anonymously rate the quality, relevance, and authenticity of the encounter.
RESULTS: Our sample included 226 residents from 22 programs representing 10 hospitals. The majority were female (53%) and FMGs (65%). The median age group was 2530. The residents were from internal medicine (58.8%), pediatrics (10.2%), obstetrics/gynecology(4.0%), family practice (2.7%), surgery (7.5%) and prelim/transitional(16.8%) programs. The proportion of high performers varied by domain:92.9% for verbal professional demeanor, 87.2% for non-verbal professional demeanor, 31.0% for facilitating patient understanding,37.2% for medication reconciliation, 35.8% for disease education,34.1% for follow-up arrangements review, and 14.1% for assessing barriers to discharge plan. Female gender was associated with high performance for assessing barriers to discharge plan (20.2% of women vs. 7.5% of men, p=.006). USMDs outperformed FMGs on verbal and non-verbal professional demeanor domains as well as facilitating understanding (98.7% vs. 89.8%, p=0.012; 93.7% vs.83.7%, p=0.32; and 40.5% vs. 25.9%, p=0.023 respectively). Among USMDs, compared to other specialties, residents from programs with a primary care component had significantly more high performers in the domains of facilitating understanding, medication reconciliation and follow-up arrangements review (54.1% vs. 30.0%, p=0.032; 48.6% vs. 25%, p=0.031; 43.2% vs. 22.5%, p=0.05 respectively). Most residents (79%) rated the encounter as realistic. Residents reported increased confidence (61%) as a result of the experience and found the topic useful (74%).
CONCLUSION: Participation in a discharge SP encounter can identify high and low performing residents on a number of domains. We found that while a substantial minority of residents always performed well, many did not. Furthermore, FMGs and non-primary care residents were significantly less likely to execute all behaviors adequately. SP encounters may be a helpful tool for identifying physician trainees poorly prepared to engage patients about their discharge plan.

DURATION OF RESIDENCE IN UNITED STATES AS A VALID MEASURE OF ACCULTURATION FOR ASIAN INDIANS Nazleen Bharmal 1; William McCarthy 1; Ron Hays2. 1University of California, Los Angeles, Los Angeles, California ; 2RAND Corporation, Santa Monica, California . (Tracking ID # 12023)
BACKGROUND: Duration of residence is often used as a proxy measure for acculturation in surveys. Our objective was to examine the validity of duration of residence in the United States as a measure for acculturation using the 2004 California Asian Indian Tobacco Survey. METHODS: The 2004 California Asian Indian Tobacco Use Survey (CAITS) was a multilingual telephone health survey of 3,228 randomly selected adult residents of California of Asian Indian background. The response rate was 54%. We used bivariate regression to examine the linear relationship between mean duration of residence in the United States and different domains of acculturation. The domains of acculturation included language use, media behavior, ties to people in country of origin, social customs, and ethnic identity. A 2-tailed P value of less than 0.05 was considered statistically significant and sample weight were applied.
RESULTS: The mean duration of residence in the United States was greater for Asian Indians who reported English as their primary language (14y yes vs. 10y no), rarely speaking their native language at home (18y vs. 11y for very often), rarely reading Indian cultural media (15y vs. 10y for very often), rarely staying in contact with family or friends in India (18y vs. 10y for very often), being very open to their son/ daughter marrying outside of the cultural group (14y vs. 11y for strongly against), rarely observing cultural holidays (14y vs. 12y almost

always), and being of American ethnic identity (18y vs. 8y for Indian ethnic identity). A meaningful cut-off for being more likely to adopt American cultural values and social customs for Asian Indians appears to be between 1417 years of duration of residence in the United States. CONCLUSION: Duration of residence in the United States is a valid measure of acculturation for Asian Indians.

THE EFFECT OF ACCULTURATION ON C-REACTIVE PROTEIN LEVELS AMONG HISPANIC ADULTS IN THE US Lenny Lopez 1;

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BACKGROUND: Greater acculturation has been linked to increased risk of cardiovascular disease among Hispanics, and mechanisms to explain these observations are unclear. C-reactive protein (CRP) is known to be associated with an increased risk of cardiovascular disease morbidity and mortality. Whether acculturation is associated with CRP levels among Hispanics has not been well studied.

METHODS: We conducted a cross-sectional analysis of 85,956 US adults in the National Health and Nutrition Examination Survey (NHANES) from 19992008 to determine the association of the degree of acculturation with CRP levels. Among Hispanics (n=23,505), acculturation was measured by years of residence in the US and the validated Short Acculturation Scale (SAS), which is based on language (range 020, with lower scores representing a lower level of acculturation). We weighted all analyses to reflect population estimates and used SAS-callable SUDAAN 10 to account for the complex sampling design. Chi-squared analyses were used for bivariate comparisons among

predictors and CRP levels. We then created multivariate linear regression models to examine the independent association of acculturation with CRP (log transformed), adjusting for gender, age, education, insurance status, usual place of care, hypertension, diabetes, Body Mass Index (BMI), smoking status, and statin use. Betas were back transformed and are presented as a relative difference (RD). Finally, the above model was stratified by age and gender in separate analyses. RESULTS: In our national sample, 51.8% of Hispanics had CRP levels below 1 mg/L, 24.89% had CRP levels between 1-3 mg/L, and 23.24% had CRP levels greater than 3 mg/L. In bivariable analyses, older age, female gender, lower education level, more years of residence in the US, smoking, a higher BMI and having hypertension or diabetes were associated with higher CRP levels. In the multivariate model, higher acculturation scores on the SAS scale were independently associated with higher CRP levels among Hispanics. Those who spoke primarily English at home had 16% higher CRP levels, ($p=0.017$). Other significant predictors of CRP among Hispanics include a higher BMI (RD 148% increase per 5 kg/m2 , $p<0.001$), gender (RD 54% higher levels for women, $p<0.001$), education level (RD 23% higher levels for greater than high school education, $p<0.001$), being insured (RD 31% higher CRP level, $p=0.006$), having hypertension (RD 35% higher CRP levels, $p<0.001$), and statin utilization (RD 25% decrease in CRP levels, $p=0.001$). Years of residence in the United States was not associated with increased CRP levels among Hispanics, after adjusting for clinical and demographic variables. There were no significant differences in these findings for stratified multivariate linear analyses by age and gender.

CONCLUSION: A cross-sectional analysis of a nationally representative population survey, the largest to date of Hispanics, has demonstrated that a higher degree of acculturation, defined as Hispanics who speak mostly English at home, was associated with increased CRP levels. Inflammation may play an important role in explaining the association between acculturation and increased cardiovascular risk.

CHARACTERISTICS OF MEDICARE BENEFICIARIES READMITTED TO HOSPITAL WITHIN 180 DAYS

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BACKGROUND: Hospital readmission rates among Medicare beneficiaries are high and contribute to rising health care costs and adverse patient outcomes. Typically, short time frame readmission rates (30 days) are

reported. Understanding of readmission rates over a longer time frame may frame opportunities for health service delivery improvement. The objective of this study was to characterize Medicare beneficiaries readmitted to hospital within 180 days.
METHODS: Retrospective cohort study. The primary outcome measure was readmission to hospital within 180 days of discharge. We studied Medicare beneficiaries hospitalized in the first 6 months of 2006 and discharged to the community using a 5% sample of Medicare inpatient claims (MedPAR files), n=222,800.
RESULTS: 77,364 beneficiaries (34.7%) were readmitted within 180 days. Readmitted persons were primarily women (55.9%) and white(81.1%). Mean age of readmitted persons was 73.5 years vs. 73.8 years in the non-readmitted group (p<0.000). Compared to non-readmitted persons, those with readmissions had longer mean initial admission LOS (6.6 vs. 5.0 days, p<0.000), more ICU days (1.1 vs. 0.8 days, p<0.000), higher Charlson index scores (2.1 vs. 1.5, p<0.000), have an ambulatory-care-sensitive condition (ACSC, 26.5% vs. 21.9%, p<

0.000), and were more likely to have been hospitalized in the prior 3 months (15% vs. 6.7%, p<0.000). In bivariate analysis using logistic regression, there were multiple statistically significant relationships between readmission and age, sex, or race, however the effect sizes were very small, reflecting the large dataset, and of limited clinical significance. There were significant associations between readmission and increased index admission LOS (OR 1.03, 95% CI 1.02-1.03), higher Charlson index (OR 1.34, 95% CI 1.33-1.35), more index admission ICU days (OR 1.05, 95% CI 1.04-1.05), having an ACSC (OR 1.29, 95% CI1.26-1.31), and having been hospitalized in the prior 3 months (OR2.47, 95% CI 2.40-2.54). A multi-variate model, accounting for age, sex, race, LOS, Charlson index, ICU days, ACSC, and prior hospitalization, demonstrated statistically and clinically significant relationships between readmission and more index admission ICU days (OR 1.03, 95% CI 1.03-1.03), higher Charlson index (OR 1.15, 95% CI 0.97-1.37), having an ACSC (OR 1.27, 95% CI 1.24-1.29), and having been hospitalized in the prior 3 months (OR 2.29, 95% CI 2.23-2.36). CONCLUSION: This study characterizes Medicare beneficiaries read-mitted within 180 days. Multivariate analysis suggests that older adults with complex chronic illness were at highest risk. Future studies are needed to further characterize older adults with long-time frame vs. short-time frame readmissions. Short-time frame readmission rates (e.g., 30 days) have been the focus of current healthcare reform and practice improvement efforts, but older adults represent a significant portion of the readmitted population and are heterogeneous in terms of their co-morbidity and healthcare utilization patterns. Understanding readmission rates over a longer time frame may guide healthcare organizations in the development of more targeted interventions for populations with complex chronic illness.

INTERNAL MEDICINE AND SURGERY RESIDENTS VIEWS OF DUTY HOUR RESTRICTIONS AND CAUSES OF MEDICAL ERRORS Kevin Volpp 1; Judy A Shea 2; Karen R Borman 3; Andrew T Jones 4; Arlene Weissman 5; Sean McKinney 5; Thomas W Biester 4; Kamal MF Itani6.
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BACKGROUND: Duty hour regulations, initially introduced in 2003 with further restrictions scheduled for release in 2011, were intended to improve patient safety and resident well-being. Surveys that have examined residents perceptions of and experiences with the 2003 duty hours standards have generally reported that a more regulated work life is associated with improved training morale and a better work-life balance, but also reflect widespread concerns regarding sufficient time for educational opportunities and continuity of care. Many of the early reports were limited to a single or a small number of programs and had low response rates. We assessed the potential impact of regulations debated as part of the proposed 2011ACGME duty hours by investigating

internal medicine and surgery residents perceptions of key elements of the proposed duty hour standards on quality of care as well as causes of medical errors.
METHODS: A voluntary resident questionnaire was administered following the October 2009 Internal Medicine In-Training (IM-ITE) and Winter 2010 Surgery in-training examinations (ABSITE). RESULTS: Responses were obtained from 18,272 (82%) internal medicine trainees, 3,710 (99.3%) senior-level surgery trainees and 3,878 (99.1%) junior-level surgery trainees. In general, surgical trainees thought that the 2011 ACGME changes would have little impact on the quality of patient care. The majority of senior and junior surgery trainees selected not at all or to a small extent the impact on quality of care on the following measures: reducing the cap from 80 hours per week (85% seniors, 79% juniors), limiting shift length to 16 hours (75% seniors, 63% juniors), requiring naps during 30 hour shifts (77% seniors, 64% juniors), enforcing the 80 hour rule each week instead of averaging over 4 weeks (74% seniors, 65% juniors), and increasing hours off after nights and extended shifts (66% seniors, 51% juniors). In contrast, the majority of the medicine trainees thought that most of these measures would usually or always impact patient care, for example increase hours off after nights and extended shifts (57%), limit shift length to 16 hours (53%), and require naps during 30 hour shifts (51%). More than half of the internal medicine trainees thought errors were occasionally or more often caused by: excessive workload (69%), resident fatigue (67%), inexperience or lack of knowledge (62%), incomplete handoffs (60%), and insufficient ancillary staff (54%). The majority of surgery trainees pointed to inexperience/ lack of knowledge and incomplete handoffs as the cause of adverse events. Inadequate supervision was never or rarely the cause of medical errors involving residents (72% surgery juniors, 74% surgery seniors, 56% internal medicine), nor was fatigue among surgical trainees (73% for surgery seniors, 60% for surgery juniors).
CONCLUSION: A survey among a national sample of surgical and internal medicine trainees with an extremely high response rate revealed that most surgical residents do not expect further restrictions on duty hours would have beneficial effects on quality of care while internal medicine residents were generally more favorable to these changes. These perceptions among trainees of surgical and medical specialties and their impact on training and quality of care should be taken into consideration when adjusting work hour regulations. Among surgical residents, the lack of a perceived relationship between fatigue and medical errors may help explain why they think duty hour restrictions are unlikely to improve quality of care.
UPDATED SYSTEMATIC REVIEW OF THE LITERATURE ON WOMEN VETERANS HEALTH Bevanne Bean-Mayberry 1; Caroline Goldzweig 1; Donna L Washington 1; Elizabeth Yano 1; Fatma Batuman 1; Christine Huang 1; Isomi Miake-Lye 1; Paul Shekelle1. 1VA Greater Los Angeles, Los Angeles, California . (Tracking ID # 12044)
BACKGROUND: Women veterans are a rapidly growing segment of new VA users. We assessed the state of women veterans health research, stratifying the literature into domains relevant for VA research and policy, by conducting an updated systematic review of the scientific literature on women veterans health and health care published 5 years after the original review in 2004.
METHODS: Articles were identified by searching multiple scientific databases and contacting Department of Defense and VA experts in the filed. We screened titles of all articles. Relevant articles were independently evaluated by two physician reviewers using a standardized screener. Articles were considered for inclusion if the study related U.S. veterans or military personnel and met one of three criteria: (a) included women veterans, compared men and women, or analyzed women separately; (b) involved active duty military women and a health condition or functional status that requires medical attention; or (c) were relevant to VA womens healthcare or how VA care is delivered to women. Articles were categorized and narratively summarized into structured abstracts and evidence tables.

RESULTS: We retrieved 675 articles, of which 380 were unique and passed title screen for relevance. Of these, 185 articles were rejected because inclusion criteria were not met. The remaining 195 articles were categorized by study design, funding source, period of military service of subjects, research topic area, and health conditions addressed. Nearly 60 percent of studies were VA funded. Subject categories were mental health issues (85), quality of care (54), access and utilization (48), post-deployment health issues, especially related to OEF/OIF veterans (33), and organizational research (7). CONCLUSION: Literature on women veterans increased substantially, from 182 articles published 19782004 reported in the initial review, to 195 articles in this updated review. Comparing the two reviews, most VA womens health research remains observational, but methods evolved from a descriptive to an analytical focus. New work includes post-deployment health, organizational research, and specific mental health outcomes. Greater emphasis on access/utilization and quality for women occurred, filling gaps in VA literature and research priorities. Finally, more women veterans research was published in the recent 5 years than the 25 years beforehand. Gaps now exist for women veteran research on post-deployment readjustment for veterans and families, and quality of care interventions/outcomes for physical and mental conditions.

COMPARATIVE EFFECTIVENESS TRIAL OF FAMILY-SUPPORTED SMOKING CESSATION INTERVENTION VERSUS STANDARD TELEPHONE COUNSELING FOR CHRONICALLY ILL VETERANS

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BACKGROUND: A chronic illness diagnosis may motivate some veterans to quit smoking, however, it may not be sufficient. Smoking initiation, maintenance, and cessation are strongly influenced by family members and close contacts. Thus, for chronically ill veteran smokers, a family-supported smoking cessation intervention may be more effective than a standard telephone counseling intervention.

METHODS: Smokers willing to make a quit attempt in the next 30 days who had cancer, cardiovascular disease, or other chronic diseases (i.e., diabetes, COPD, hypertension) were proactively recruited from the Durham VA and randomly allocated into two groups: standard telephone counseling (n=236) or family-supported telephone intervention (n=235). Both groups received letters from VA physicians encouraging patients to quit smoking and a self-help cessation kit. Both groups were offered nicotine replacement therapy (NRT), if not contraindicated. Participants were surveyed at baseline and 5-months post-baseline. The main outcome was 7-day point prevalent cessation at 5 months. We counted participants not completing the 5 month interview (n=66) as smokers.

RESULTS: The mean age was 59, 51% has a high school education or less, 42% were African American, 8% were female, and 55% were married or living as married. Forty three percent had heart disease, 34% had cancer, and 23% had other chronic diseases. Participants were moderately dependent on cigarettes and expressed high perceived positive social support. Participation in counseling was high (>60% smokers completed 4 or more of a total possible 5 counseling sessions in both arms of the study). Seventy-four percent of the 379 participants who responded to the survey item reported NRT use, with similar rates in both groups. Preliminary analyses found no differences in smoking cessation by arm at 5 months: 19.6% in the family-supported intervention and 21.6% in the standard telephone counseling arm. CONCLUSION: Proactive telephone counseling for chronically ill

veterans is feasible and produces clinically important smoking cessation rates. However, telephone counseling augmented with a family-supported intervention was no more effective than standard telephone counseling. Long-term follow-up (12-months post-baseline) is pending and will assess relapse rates.

USING ELECTRONIC HEALTH RECORD REGISTRIES TO INCREASE USE OF TELEPHONE QUITLINE SERVICES AMONG VULNERABLE PRIORITY POPULATIONS

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(Tracking ID # 12049)
BACKGROUND: Currently the reach of evidence-based telephone quitline services is 1%-2% of smokers and particularly low among vulnerable priority populations including racial/ethnic minorities and Veterans. The Veterans Victory over Tobacco study is currently in progress to evaluate the effects of a theory-driven intervention combining proactive outreach with offer of choice of telephone care or face-to-face care for treatment of tobacco dependence (proactive care, PRO) compared to reactive/usual care (UC). The purpose of this analysis was to examine the effects of the proactive care intervention on increasing utilization of evidence-based tobacco cessation treatments among smokers assigned to the intervention.
METHODS: In this prospective randomized controlled study, we identified a population-based registry of current smokers using the Veterans Health Administration computerized patient record system (CPRS) tobacco use clinical reminder system. A total of 6400 smokers from four VA medical centers were randomly assigned to PRO or UC. The proactive care intervention combines: (1) proactive outreach and (2) offer of choice of smoking cessation services (telephone or face-to-face). Proactive outreach included a mailed invitation packet followed by a telephone outreach call (with up to 6 call attempts) to motivate smokers to seek treatment with choice of services. A baseline survey was administered after randomization using a multiple-wave mailed questionnaire protocol. The process outcomes for this analysis were 1) enrollment in the Veterans Victory program, and 2) initiation of medication treatment.
RESULTS: Across the four sites, nearly all patients in primary care had their tobacco use status documented using the electronic clinical reminder. Within site, 3200 current smokers as identified by the electronic reminder were randomly assigned to the proactive care intervention and mailed a baseline survey. The sample was diverse; 27% African American, 60% Caucasian, 3% other race, and 10% unknown race. Six percent were of Hispanic ethnicity. At the time of the baseline survey, 7% refused to participate in the study, 12% were no longer smoking or using other tobacco products (e.g., cigar, pipe or smokeless tobacco) and 7% could not be reached due to bad contact information. Only 1% had used telephone smoking cessation counseling in the past year. Subsequently, 2500 Veteran smokers were mailed outreach invitation packets. During telephone outreach, 1744 (70%) were successfully contacted. Of the participants mailed an outreach invitation packet, 404 (16%) enrolled in telephone coaching and 78 (3%) enrolled in in-person smoking services at their VA medical center. Among smokers who participated in telephone coaching, 234 (58%) initiated guideline recommended tobacco cessation medications during the telephone coaching.
CONCLUSION: These findings indicate that proactive outreach with offer of choice of services dramatically increases the reach of telephone

quitline services to vulnerable priority populations including racial/ ethnic minorities and Veterans.
RELATIONSHIP OF ELECTRONIC MEDICAL KNOWLEDGE RESOURCE USE AND PRACTICE CHARACTERISTICS WITH INTERNAL MEDICINE MAINTENANCE OF CERTIFICATION EXAMINATION SCORES Darcy A. Reed 1; Colin P. West 1; Eric S Holmboe 2; Andrew J Halvorsen 1; Rebecca S Lipner 3; Carola Jacobs 3; Furman S McDonald1.
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(Tracking ID # 12051)
BACKGROUND: Maintenance of certification examination performance is associated with quality of care. We examined relationships between electronic medical knowledge resource use, practice characteristics and certification examination scores among physicians recertifying in internal medicine.
METHODS: We conducted a cross-sectional study of 3,958 United States physicians who took the Internal

Medicine Maintenance of Certification Examination (IM-MOCE) between January 1, 2006 and December 31, 2008 and who held individual licenses to one or both of two prominent electronic knowledge resource programs: UpToDate and the American College of Physicians Physicians Information and Education Resource (PIER). We examined associations between physicians IM-MOCE scores and their days of electronic resource use, practice type (private practice, residency teaching clinic, inpatient, nursing home), practice model (single or multi-specialty), sex, age, and medical school location.
RESULTS: In the 365 days prior to the IM-MOCE, physicians used electronic resources on a mean (SD, range) of 20.3 (36.5, 0265) days. In multivariate analyses, the number of days of resource use was independently associated with increased IM-MOCE scores (0.07-point increase per day of use, p=0.02). Increased age was associated with decreased IM-MOCE scores (1.8-point decrease per year of age, p<0.001). Physicians working in residency teaching clinics had higher IMMOCE scores by 15.0 points (p<0.001), while physicians working in private practice settings or nursing homes had lower scores by 14.1 and14.5 points, respectively (p<0.001 and p=0.010, respectively). CONCLUSION: Frequent use of electronic knowledge resources was associated with modestly enhanced IM-MOCE performance. Physicians involved in residency education clinics had higher IM-MOCE scores, while physicians working in private practice settings or nursing homes had lower recertification scores.
INTERVENTIONS TO IMPROVE ATTENDING ROUNDS IN MEDICINE: A SYSTEMATIC REVIEW Chad Stickrath 1; Danielle Shimek 2; Allan Prochazka1. 1Denver VA Medical Center, Denver, Colorado ; 2University of Colorado Denver, Aurora, Colorado . (Tracking ID # 12054)
BACKGROUND: Observations of current inpatient medicine rounding practices demonstrate a wide variety of rounding methods and no comprehensive model of attending rounds exists that has demonstrated clear advantages in terms of satisfaction, educational outcomes, and delivery of health care services. Interventions to improve attending rounds in medicine have the potential to improve medical student and house staff education, professional practice, patient satisfaction and healthcare outcomes.
METHODS: A systematic review of Medline and Embase for articles published between 1950 and November 2010 that specifically implemented an intervention to improve some aspect of inpatient attending rounds was performed. The reference lists of search
strategy-identified articles and a hand search of Medline for related articles were also performed. Then, all articles were reviewed by title and abstract by two authors independently. Articles in which an intervention was instituted to effect a change in inpatient attending rounds, which could be applied to internal medicine, were abstracted and included for review.
RESULTS: The initial Medline and Embase search resulted in 683 articles. One additional article was identified by independent Medline search and three articles were identified from the reference lists of search strategy-identified articles. Thus, Six hundred and eighty seven articles were reviewed for inclusion. Ultimately, nine articles that were identified through the initial search strategy met the inclusion criteria and were included in the review. All studies implemented an intervention to effect a change in the manner in which attending rounds in the inpatient setting were performed. All studies were performed at a single institution; a majority used a pre and post intervention design, two used a during-after approach, and one was a randomized trial. The studies varied widely in the type of intervention (educational, structural, and technological) and in the outcomes measured (satisfaction, education, patient outcomes).
CONCLUSION: Many of the rounding interventions reported positive results that have the potential to improve medical student and house staff education, professional practice, satisfaction and healthcare outcomes. Next steps should include implementation of the most promising interventions at other centers with associated evaluation of patient care and education outcomes.
COMPREHENSION OF CURRENTLY USED, FDA-MANDATED MEDICATION GUIDES ACROSS PATIENTS OF VARYING LEVELS OF LITERACY Elizabeth A H Wilson 1; Jennifer P King 1; Allison L Russell 1; Amanda L

Daly 1; Ashley R Bergeron 2; James Duhig 5; Bruce L Lambert 5; Michael S Wolf1. 1Northwestern University, Chicago, Illinois ; 2University of Illinois at Chicago, Chicago, Illinois . (Tracking ID # 12058)
BACKGROUND: Inadvertent medication errors are linked to serious adverse outcomes including patient injury, hospitalization, and even mortality. In an effort to minimize errors surrounding especially risky medications, the Food and Drug Administration (FDA) recently began requiring the issue of mandated Medication Guides for certain drugs that could pose significant threats to patients safety. The current study examined patients comprehension of information contained in actual Medication Guides in an effort to provide recommendations for the improvement of these educational documents.
METHODS: Three-hundred-eighty-seven primary care patients ages 1885 completed in-person interviews wherein they were shown three Medication Guides, one for a tablet form of medication, one for an oral solution, and one for an injectable medication. These guides were chosen as they were representative of typical guides in terms of readability and word count and that were among the 50% most often prescribed medications in general. Patients were given two minutes to look over each guide and then completed a series of functional knowledge questions assessing their understanding of its content while being able to refer back to the guide as necessary. Participants also completed the Rapid Estimate of Adult Literacy in Medicine (REALM) as well as demographic measures. To assess general understanding of the Medication Guides, we calculated the proportion of correct responses that participants gave out of all possible correct responses for each guide. Additionally, we ran regression models to determine the impact of literacy on comprehension.
RESULTS: Prior to their participation, only 35.1% of participants reported having heard of a medication guide. As measured via the

REALM, 62.8% of participants had adequate literacy, and 37.2% had limited literacy. Overall, participants performance on the knowledge assessments was 51.5%, 59.3%, and 47.1% out of a possible 100% total correct responses for the tablet, oral solution, and injectable medication guides, respectively. After controlling for age, gender, race, work status, education, and income, literacy significantly predicted performance for all three outcomes, with patients with limited literacy performing significantly poorer than those with adequate literacy ($p < 0.001$, = 5.93 for tablet, $p < 0.001$, =5.52 for oral solution, $p < 0.001$, =6.04 for injectable).
CONCLUSION: Despite their intended purpose to promote the comprehension of information surrounding potentially dangerous medications, Medication Guides, in their current form, are still poorly understood by patients, especially those with limited literacy. Designers of Medication Guides should take into account the literacy level of their intended audience as well as consider best practice strategies to improve the clarity and ease-of-use of such documents during their development to promote better comprehension among patients that will be receiving them.
RACE/ETHNIC DIFFERENCES IN PERCEPTION OF BODY IMAGE AMONG OVERWEIGHT/OBESE PERSONS IN THE SMALL CHANGES LASTING EFFECTS (SCALE) BEHAVIORAL INTERVENTION WEIGHT LOSS STUDY Ginger Winston 1; Erica Phillips-Caesar 1; Jessica Hippolyte 1; Mary Charlson1. 1Weill Medical College of Cornell University, New York Presbyterian Hospital, New York, New York . (Tracking ID # 12059)
BACKGROUND: Obesity is a major health problem in the United States disproportionately affecting African American and Hispanic adults. Body image discrepancy is the difference between ideal and current body image and denotes body image dissatisfaction. The role of body image discrepancy in motivating weight loss behavior is unclear. Published data is limited on the differences in body image discrepancy among overweight/obese African Americans and Hispanics living in urban communities.
METHODS: The SCALE pilot study is a 12-week behavioral weight loss intervention of eligible African American and Hispanic adults with a BMI greater than or equal to 25 kg/m2 recruited at two clinical and two church sites

in Harlem and the South Bronx, New York. Currently, study enrollment is complete and the 12 week follow up period is still in progress. The intervention incorporates selection of 1 of 6 small changes in eating behavior and physical activity, with or without a positive affect component. Participants are followed once weekly by trained community health workers. Body image discrepancy was measured at baseline as the difference between ideal and current body image using the 13 figure Gardner scale. Each figure of the Gardner scale corresponds to a BMI value. T-tests were used to analyze the difference in mean values of linear variables.
RESULTS: The sample included 84 persons (39% African American, 56% Hispanic, 5% other). Mean BMI at baseline was 33.7 kg/m2 corresponding to a Gardner figure of 13 (African Americans32.42 kg/m2 and Hispanics 34.0 kg/m2, p=0.21). African Americans selected a smaller figure as their current body size compared to Hispanics (9.52 vs. 10.74, p=0.02). African Americans selected a large figure as their ideal body size compared to Hispanics (6.97 vs.5.78, p=0.02). When asked to select a figure that was overweight, African Americans selected a larger body size figure compared to Hispanics (12.79 vs. 11.50, p=0.0004). Calculated body image discrepancy was less among African Americans compared to Hispanics (2.55 vs. 4.96, p<0.0001).
CONCLUSION: In SCALE, there was no significant difference in mean BMI between African American and Hispanic participants, however
African Americans underestimated their current body size to a greater degree than Hispanics and viewed their ideal body size as larger compared to Hispanics. Body image discrepancy, and therefore body image dissatisfaction, was less among African Americans compared to Hispanics. This difference in body image dissatisfaction may play a role in differential weight loss patterns among African Americans and Hispanics.
Table: 1
African Americans (n=33)
Hispanics(n=46) P-value
BMI, kg/m2 32.4 33.9 0.17
Gardner figure:
Figure now 9.5 10.7 0.02
Ideal figure 6.9 5.8 0.02
Normal size 6.3 4.9 0.0007
Underweight 1.3 3.7 <0.0001
Overweight 12.8 11.5 0.0004
Body imagediscrepancy 2.6 4.9 <0.0001
Table: 2
BMI women, kg/m2
1 17.8 17.5
2 19.1 18.8
3 20.3 20.0
4 21.6 21.3
5 22.9 22.5
6 24.1 23.8
7 25.4 25.0
8 26.7 26.5
9 27.9 27.5
10 29.2 28.8
11 30.5 30.0
12 31.8 31.3
13<td style="border-bottom
Gardner figure BMI men,

kg/m2

REAL-TIME RATINGS OF HANDOFF QUALITY BY HOSPITALIST CLINICIANS Jeanne M. Farnan 1; Paul Staisiunas 1; Stacy Banerjee 1; Elizabeth Greenstein 2; Leora Horwitz 3; Jeanne Farnan1. 1University of Chicago, Chicago, Illinois ; 2University of Chicago Pritzker School of Medicine, Chicago, Illinois ; 3Yale University, Greenwich, Connecticut . (Tracking ID # 12071)

BACKGROUND: Handoffs are a core competency of hospitalists. While the Society of Hospital Medicine and others recommend improving handoffs, monitoring and improving handoff quality is limited by lack of reliable tools to measure handoff quality. This study aims to assess the feasibility and reliability of using a paper-based tool Handoff CEX (Clinical Evaluation Exercise) to evaluate real patient handoffs between hospitalist clinicians.

METHODS: The Handoff CEX, developed based on literature review and expert consensus, includes ratings of overall performance and its components (organization, communication skills, clinical judgment, setting, patient-focused) on a 0 to 9 scale. For three handoffs a week (Mon/Tues/Fri), clinician senders and receivers were evaluated by a trained 3 rd party nonmedical observer using the Handoff CEX. Senders and receivers also evaluated each other using the instrument. Inter-rater reliability between clinician and observer was calculated using Spearmans rho. Descriptive and comparative statistics were used to

examine mean performance and superior performance, defined as top quartile.

RESULTS: From March to December 2010, all 38 (100%) hospitalist clinicians (NPs, hospitalists) consented to participate. Senders, receivers, and a trained observer rated 78 handoffs resulting in 156 participant and 153 observer evaluations. Domain means were between 6 to 7, with full use of the 0 to 9 scale noted. Internal consistency was high (Cronbachs alpha=0.90). Spearmans rho between participating clinicians and trained observer was calculated as 0.52 ($p<0.001$) indicating moderate inter-rater reliability. Although tardiness was noted in only 9% of handoffs, nearly all ratings were lower if a clinician arrived late (overall 7.26 not tardy vs. 5.85 tardy, $p<0.001$). Setting was rated significantly higher on Monday than on other days (7.50 Mon vs. 6.75 Tues/Fri, $p<0.001$). Clinician senders (starting shift) were significantly less likely to provide superior (top quartile) ratings in 3 areas (overall, organization, setting) than receivers (ending shift). Observer ratings did not show this disparity. Evaluator satisfaction with the tool was high (mean 6.80 [IQR 68]), and was also associated with overall handoff quality ($r=.60$, $p<0.001$).

CONCLUSION: Real-time assessmentof handoff quality by clinicians using the Handoff-CEX is feasible andreliable. Arriving late to handoffs can dramatically affect ratings of handoffquality. Other characteristics, such asday of week and sender/receiver roles, are also related to handoffratings. It may be easier to criticallyevaluate senders, who bear the burden of communication, than receivers. Alternatively, receivers may be more criticaldue to the stress of receiving work, or senders may overestimate receiverperformance due to the excitement of ending their shift. Further work to explore the mechanism ofthese findings is underway.

COMPARATIVE EFFECTIVENESS OF NEWER DIABETES MEDICATIONS Daniel E Jonas 1; Erin Elizabeth Van scoyoc 1; Kate Gerrald 2; Roberta Wines 1; Halle Amick 1; Matthew Triplette 1; Thomas Runge1. 1University of North Carolina Chapel Hill, Chapel Hill, North Carolina ; 2Presbyterian College, Clinton, South Carolina . (Tracking ID # 12079)

BACKGROUND: An increasing number of therapeutic options are available for type 2 diabetes. We conducted a systematic review to compare the effectiveness and adverse event profiles of newer diabetes medications: amylin agonists, DPP-4 inhibitors, and GLP-1 agonists for adults with type 2 diabetes.

METHODS: To identify published studies, we searched MEDLINE, The Cochrane Library, Embase, International Pharmaceutical Abstracts, and reference lists of included studies through July 2010. We also requested dossiers of information from pharmaceutical manufacturers. Study selection, data abstraction, validity assessment, grading the strength of the evidence, and data synthesis were all carried out according to standard Drug Effectiveness Review Project methods. Two reviewers independently selected studies that met eligibility

criteria. Information on study design, setting, intervention, outcomes, and quality were extracted by one reviewer and double-checked by another. Meta-analyses were conducted of outcomes reported by a sufficient number of studies that were homogeneous enough to justify combining their results.
RESULTS: Most of the included studies evaluated intermediate outcomes, such as HbA1c or weight. Very few studies reported health outcomes and few studies were longer than 6 months. For HbA1c, all of the included medications were efficacious for reducing HbA1c compared to placebo. For reduction in HbA1c, pramlintide was similar to glargine; sitagliptin was less efficacious than metformin or glipizide; there was no comparative evidence for saxagliptin; exenatide was similar to insulin;
and liraglutide was similar to or better than glimepiride and insulin. For weight, pramlintide, exenatide, and liraglutide appear to cause weight loss compared with placebo. Sitagliptin and saxagliptin are likely weight neutral. Most studies evaluating weight change were 6 months or less and it is uncertain whether weight loss is sustained long-term. Rates of hypoglycemia were lower with pramlintide and sitagliptin than with insulin or glipizide, similar to placebo for sitagliptin and saxagliptin, similar between exenatide and insulin, and lower with liraglutide than with glimepiride. Rates of gastrointestinal side effects were higher with exenatide and liraglutide than with comparators.
CONCLUSION: All of the included medications were efficacious for reducing HbA1c and none of them appear to cause weight gain. Little data was available to evaluate the long-term comparative effectiveness of the newer medications versus more established treatments, limiting our ability to determine how to best incorporate newer medications into clinical practice.
FOOD INSECURITY, BMI AND DIETARY DIVERSITY IN RWANDAN HIV + WOMEN Nicole Sirotin 1; Donald Hoover 2; CJ Segal-Isaacson 3; Qiuhu Shi 4; Eugene Mutimura 5; Mardge Cohen 6; Kathryn Anastos3.
1Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York ; 2Rutgers University, New Brunswick, New Jersey ; 3Albert Einstein College of Medicine, Bronx, New York ; 4New York Medical College, Valhalla, New York ; 5Womens Equity in Access to Care and Treatment, Kigali, N/A ; 6John Stroger (formerly Cook County) Hospital and Rush University, Chicago, Illinois . (Tracking ID # 12085)
BACKGROUND: Structural determinants, including poverty, low literacy levels and lack of access to electricity, are increasingly identified as important for health outcomes. Also important are nutrition-related determinants of health, including food insecurity, low BMI and low dietary diversity, which are common in areas with high HIV prevalence. Food insecurity, defined as the limited availability of nutritionally adequate foods or inability to acquire acceptable foods in socially acceptable ways, was found to be associated with low CD4 counts, virologic failure and mortality in HIV + patients. Low BMI (<18.5 kg/m2)
is a strong predictor for mortality in HIV + patients starting ART, with higher mortality in patients who are both food insecure and under-weight versus underweight but food secure. In addition, consuming fewer distinct food groups (low dietary diversity) has been found to contribute to poor health outcomes in African women. In order to elucidate potential interventions to prevent food insecurity and malnutrition in persons with HIV infection, we examined the prevalence and sociodemographic associations of food insecurity, BMI, and household dietary diversity in HIV + women in Kigali, Rwanda. We also examined the correlation between food insecurity, low BMI and low dietary diversity in these women.
METHODS: The Rwanda Womens Interassociation Study and Assessment (RWISA, initiated in 2005) is a prospective observational cohort study designed to assess the effectiveness and toxicity of antiretroviral therapy (ART) in HIV-infected Rwandan women. From July to December 2007, sociodemographic data and BMI were obtained for 622 HIV + women enrolled in RWISA. The Household Dietary Diversity Score (HDDS), a validated survey, measures household food consumption over the previous 24 hours, giving one point for each food class (total 12 possible), with <3 classes defined as low dietary diversity. Food insecurity was assessed using a single question, Do you have enough food? Logistic regression identified factors associated with food insecurity, low dietary diversity and low BMI. Spearman correlation assessed relationships between food insecurity, BMI and

dietary diversity.
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RESULTS: Prevalence of poverty was high [35% reporting monthly income <10 K Rwandan Francs (FRW) ($US 17)], as was illiteracy (23%), and 22% of women reported no formal education. 53% had CD4 counts <350 cells/l and 70% were taking antiretroviral therapy. Food insecurity was reported by 44% and low dietary diversity by 43%. The mean BMI was 22.4 kg/m2 and 12% of women had BMI <18.5 kg/m2. Food insecurity (answering usually not or never to Do you have enough food?) was inversely associated with high monthly income (>35 K FRW, $US 58 vs. <10 K FRW) (Odds ratio (OR)=0.43; 95% CI0.23-0.80), employment (OR=0.51; CI 0.29-0.91) and higher literacy (answering can read some or all to How well are you able to read?, measured at study entry) (OR=0.59; CI 0.36-0.96). Alcohol use was positively associated with being food insecure (OR=4.79; CI 2.52-9.09). Factors inversely associated with low dietary diversity included high monthly income (OR=0.11; CI 0.06-0.24) and higher literacy level (OR=0.49; CI 0.30- 0.80). BMI was associated with income (=1.39 kg/m2, p =0.008), and electricity (=1.70 kg/m2, p<0.001). Correlations were not significant between self-reported food insecurity and BMI (r=0.05, p=0.29), or dietary diversity and BMI (r=0.10, p=0.03). Weak correlations were found between food insecurity and dietary diversity (r=0.14, p=0.001).
CONCLUSION: These HIV + Rwandan women experienced high rates of food insecurity, low BMI and low dietary diversity, which may have adverse effects on their health. Socioeconomic factors, including low income, illiteracy and lack of electricity, which is often used as a proxy for disposable income, and behavioral factors such as alcohol use, were associated with food insecurity, low BMI and low dietary diversity. HIV + treatment programs in developing countries should consider these factors as indications to screen for and address food insecurity and malnutrition in vulnerable populations. Lack of correlation between self-reported food insecurity/dietary diversity and BMI in this population likely reflects HIV-related medical conditions that lower BMI. The weak association between self-reported food insecurity and dietary diversity may reflect an inexpensive, abundant single food group that provides a secure yet minimally diverse diet. Further research is needed to understand how the combination of food insecurity and low dietary diversity, and their relationship with BMI, affect the health of HIV + women.
THE ASSOCIATION OF STATIN USE AND MUSCULOSKELETAL PAIN IN ADULTS WITH OSTEOARTHRITIS AND RHEUMATOID ARTHRITIS Catherine Buettner 1; Matthew Rippberger 2; Matthew H Liang3.
1Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts ; 2Beth Israel Deaconess Medical Center and Boston University, Boston, Massachusetts ; 3Brigham and Womens Hospital; Boston VA Healthcare System; Harvard School of Public Health; Harvard Medical School, Boston, Massachusetts . (Tracking ID # 12087)
BACKGROUND: Statin use is associatedwith musculoskeletal pain (MSP) among individuals without arthritis in thegeneral population. It remains unclear whether statins affect MSP among thosewith arthritis. Statins are weak anti-inflammatory and immunomodulatory and studiessuggest a decreased risk of developing rheumatoid arthritis (RA) among statinusers and that statins may decrease signs and symptoms of RA. Our objective wasto determine the prevalence and determinants of MSP in a representative sampleof individual with and without RA and osteoarthritis (OA).
METHODS: Using the National Health and Nutrition Examination Survey 19992004(NHANES), we determined the prevalence of self-reported MSP in neck, upperextremities, lower back, and/or lower extremities among adults >=40 yearswithout arthritis, with OA, and with RA. We created logistic regression modelsto examine the association between statin use and MSP and to assess for interactionsbetween statin use and arthritis, adjusting for the effects of age, sex, race, coronary artery disease, hypertension, cholesterol

level, diabetes, anklebrachial index, smoking, BMI, physical activity, and health status. We also analyzedthe association of statin use and arthritis among those with a physician-diagnosedOA or RA.
RESULTS: Among 8643 participants of NHANES (including those with and withoutarthritis), 30% (95% CI 27%, 34%) of statin users reported having MSP during thelast 30 days, compared with 26% (95% CI 24%, 27%) of non-statin users. Aninteraction between statin use and arthritis revealed that arthritis modifiesthe effect of statin use on reported MSP (p for interaction=0.003).Stratified analysis showed that statin use is an independent predictor of MSPamong individuals without arthritis (n= 5435, adjusted OR 1.5; 95% CI 1.1, 2.1,p-value 0.003). Use of statins does not increase pain among those with OA (n=1287,OR 1.1; 95% CI0.7, 1.6, p-value 0.75) and showed a trend toward decreased MSPin any area among those with RA (n=730, OR 0.6; 95% CI 0.3, 1.0 p-value0.06).Significant associations with decreased MSP among those with RA wereparticularly evident in the areas of the neck (OR 0.2; 95% CI 0.1,0.4, p-value<.001), upper extremities (OR 0.5; 95% CI 0.3, 0.9 p-value0.02), and lessso for lower extremities (OR 0.5; 95% CI 0.2, 1.0, p-value0.05). Noassociation was observed between statin use and lower back pain among thosewith RA (OR 0.8; 95% CI 0.4, 1.8, p-value 0.58).
CONCLUSION: Statin use is significantlyassociated with MSP among those without arthritis, but does not increase painamong those with OA, and may be associated with decreased MSP among those with RA.The last finding is consistent with the anti-inflammatory effects of statins.
IS LEADERSHIP INCLUSIVENESS IN SMALL PRIMARY CARE CLINICS ASSOCIATED WITH DELIVERING CARE CONSISTENT WITH THE CHRONIC CARE MODEL/ PATIENT-CENTERED MEDICAL HOME? Krista Bowers 1; Raquel Lozano-Romero 1; Michaela Robertson 1; Michael L Parchman1. 1UTHSCSA, San Antonio, Texas. (Tracking ID # 12103)
BACKGROUND: Implementing the Chronic Care Model (CCM) is one approach to improve chronic illness care in primary care settings. The current standards of the Patient- Centered Medical Home (PCMH) were based on the CCM. Physicians and staff can rate the delivery of these elements through the Assessment of Chronic Illness Care (ACIC) survey. The concept of leadership inclusiveness encourages all members of the group to speak up, especially those in the group that would not usually have their voices heard. We examined the relationship between leadership in small autonomous primary care clinics and how chronic care is delivered in these settings.
METHODS: The ABC Intervention Study is currently collecting data from 40 primary care clinics in San Antonio and South Texas. Physicians and office staff from each clinic complete a survey including the ACIC and leadership questions. Physicians and office staff rated delivery of elements of the CCM in the clinic using the ACIC survey. Higher values reflect care more consistent with the CCM. Several of the measured components of the CCM are aspects of the NCQA scoring for the PCHMH. Leadership inclusiveness was measured by the physician and office staff on a previously validated survey about learning in primary care settings and was comprised of the following questions: 1) The practice leadership makes sure we have the time a space necessary to discuss changes to improve care: 2) Leadership in this practice is available to discuss work related problems; 3) The practice leadership supports having different opinions expressed in solving problems; 4) The

leadership in this practice is good at helping us make sense of problems or difficult situations; and 5) The practice leadership promotes an environment that is an enjoyable place to work.
RESULTS: 288 physicians and office staff in 40 offices completed the surveys. The 5 questions about leadership when combined into a leadership score had a Cronbachs Alpha of 0.98. The leadership score was associated with total CCM score (r-0.28, P<.01) as well as all measured components of the CCM.(p<.01) Strongest correlations were with decision support (r=0.34, p<.01) and delivery system design (r =.34, p<.01). Weakest associations were with self-care support (r=0.19, p<.01) and linkages to community resources(r=0.19, p<.01). People who worked in practices with high leadership scores were more likely to agree with the statement: I am comfortable telling people in my practice what I really think. (r=0.52, p<.01)

CONCLUSION: Clinics with a leadership style that promotes inclusiveness among the staff in making decisions may be more successful at implementing the concepts of the PCMH in their office because the staff have psychological safety to speak up. Leadership inclusiveness promotes an environment of psychological safety which gives staff members a place to be heard and time to listen in a busy primary care clinic. These concepts may be an important aspect of the implementation of the PCMH which are not covered in current NCQA scoring criteria.

CHARACTERISTICS OF PRIMARY CARE SAFETY-NET PROVIDERS AND THEIR QUALITY IMPROVEMENT ATTITUDES AND ACTIVITIES: RESULTS OF A NATIONAL SURVEY OF PHYSICIAN PROFESSIONALISM Lenny Lopez 1; Catherine DesRoches 1; Christine Vogeli 1; Richard Grant 1; Lisa Iezzoni 1; Eric Campbell1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12105)

BACKGROUND: Research suggests that physicians who disproportionately care for vulnerable populations (Safety Net providers) provide lower quality care. The passage of the Patient Protection and Affordable Care Act (ACA) will substantially increase the numbers of Medicaid recipients and these individuals, like current Medicaid recipients, may also gravitate toward safety net providers for their care. To date no national data exist to characterize safety net providers and their attitudes towards and participation in quality improvement activities compared to non-safety-net physicians.

METHODS: We conducted a national random sample survey of primary care physicians (Internal, Family Medicine, Pediatrics) in 2009. We defined safety-net physicians as those who reported having a patient panel with greater than 20% uninsured and/or Medicaid patients. Twelve questions explored physician attitudes about what physicians should do and the usefulness of certain quality improvement activities. Seven questions assessed the preparedness and participation of physicians in quality improvement activities. We developed a series of weighted multivariable logistic regression models to examine the relationship between safety net status and physician attitudes and participation in quality improvement activities controlling for physician personal (gender, under-represented minority status), professional (number of years in practice, graduation from a medical school outside the U.S. or Canada, specialty, income), and practice characteristics (practice organization and primary payment mechanism).

RESULTS: Of the 1,891 physicians who completed the survey (overall response rate of 64.4%), 840 practiced in primary care specialties, and 45% were safety-net providers. A greater proportion of safety-net providers were younger, female, under-represented minorities, foreign medical graduates, and medical school faculty. In addition, most safety-net PCPs were salaried and practiced in hospital and medical school affiliated practices. There was no significant difference in the number of safety-net and non safety-net PCPS accepting new patients. However, safety net providers were more likely to accept new Medicaid (68.5% vs.31.5%, $p<0.001$) and uninsured (63.4% vs. 36.6%, $p<0.001$) patients compared to non-safety net providers. After multivariable adjustment for physician and practice characteristics, there were no significant differences in provider attitudes about or participation in quality improvement activities between safety- and non-safety-net physicians. However, safety-net providers were almost twice as likely to look for disparities in their practices (OR 1.77 [CI: 1.10-3.16]), twice as likely to publicly to advocate for universal health coverage (OR 2.16 [CI: 1.22-3.82]) and three times as likely to add one more Medicaid or uninsured patient to their panel (OR 2.79 [CI: 1.84-4.22]) compared to non-safety-net providers.

CONCLUSION: We found that non-safety-net physicians were less likely to accept new Medicaid patients. We also found that the safety-net primary care providers, whose practices include significant proportions of Medicaid patients, are as likely to be involved in quality improvement activities as non safety-net providers and that their attitudes are consistent with providing equitable and universal care. Increasing access by expanding Medicaid eligibility will require continued investment in safety-net PCPs to ensure high quality health care for all.

HEROISM AND REALITY: PORTRAYAL OF CPR AND DNRS ON ER, HOUSE &GRAYS ANATOMY,

20042010 Carla C Keirns 1; Katherine Keirns 2; Peter Dashkoff 1; Lynn Hallarman1. 1Stony Brook University, Stony Brook, New York ; 2Rutgers University-New Jersey Instittue of Technology, Newark, New Jersey.
(Tracking ID # 12113)
BACKGROUND: Television medical dramas reach millions of Americans each week, entertaining them with a fictionalized view of medicine that has become increasingly sophisticated as television shows have brought in medical consultants. Prior studies have found that survival rates from CPR on television are unrealistically high, and may lead patients or families to have unrealistic expectations.
METHODS: We undertook a systematic study of CPR and DNR events on three popular television dramas. In order to minimize the role of secular trends or technological change, all show seasons were contemporaneous, including ER seasons 1115 (20042009), House seasons 16 (20042010), and Grays Anatomy seasons 16 (2005 2010). The focus of the study was the clinical circumstances of cardiac arrest, survival after CPR, survival to hospital discharge or the end of the episode, disability after CPR, use of DNR orders, and the debriefing process after CPR. Because each television show had different frequencies of CPR and different patterns of age and cause of arrest, the unit of analysis was the CPR episode, with 26 variables collected for each arrest. Coding was done by two physicians and one graduate research assistant, with the first 5 episodes of each series independently coded by all three investigators based on preliminary codes, then codes finalized, then all episodes coded by one coder with 20% of episodes coded by a second coder. All disagreements between the two coders were reviewed by all three investigators, with reviewing of the relevant video. All discrepancies were resolved easily. Of 8814 coding decisions, double coding was performed for 1762, and coders concurred initially on 1735 of these decisions (98.47%). Cohens Kappa for agreement is 0.965 with a 95% CI of 0.952 to 0.978.
RESULTS: The study had a total of 115 arrests on ER, 141 arrests on Grays Anatomy and 83 arrests on House. The survival rates were: ER 47/115 (40.8%) of whom 16/115 (13.9%) survived the episode, Grays Anatomy 42/141 (29.8%) of whom 20/141 (14.2%) survived the episode, and House 55/83 (66.3%), 51 of whom survived the episode

(61.4%). Of 339 arrests across all 3 shows, in only 7 cases was disability after CPR discussed, with 2 patients meeting criteria for brain death, one severe cardiac damage, one severe pulmonary damage hes gonna need a lung transplant , and 3 with a general discussion of the likelihood of a poor outcome after prolonged CPR. DNR orders were rare across all shows, with 4 out of the 141 arrests on ER, all in the setting of known end-stage disease, and all honored on the show. There were 4 DNR orders out of the 141 arrests on Grays Anatomy, one of which was followed, in a patient who had both cancer and a massive stroke , the other 4 were knowingly ignored. After the one DNR that was followed on Grays Anatomy the patients husband returns 3 episodes later on a shooting rampage (season 6 climax).
CONCLUSION: Survival rates from CPR on television vary by television show, but ER and Grays Anatomys statistics are consistent with US inhospital arrest results. House shows unrealistically high survival. DNR orders are systematically ignored on Grays Anatomy and House.
IMPROVING RESIDENTS SKILLS AND ATTITUDES IN IDENTIFYING AND RESPONDING TO THE PSYCHOSOCIAL CONSEQUENCES OF DISASTERS UTILIZING A WEB-BASED VIRTUAL PATIENT MODULE Anne Dembitzer 1; Colleen Gillespie 2; Sondra Zabar 2; Adina Kalet 2; Elizabeth K. Kachur 3; Marc Triola 2; Mack Lipkin2. 1New York Harbor VA Health Care System, New York, New York ; 2New York University School of Medicine, New York, New York ; 3Medical Education Development, New York, New York. (Tracking ID # 12115)
BACKGROUND: Psychosocial disorders are the most prevalent medical consequences of terrorist acts and natural disasters. Patients with trauma related mental distress often seek care from primary care physicians.

Primary care physicians have demonstrated poor understanding of the important abnormal psychosocial responses to disasters (PTSD, acute stress disorder, unresolved grief, depression), and too often managed the patient inappropriately (e.g. after 9 /11). To address this deficiency we delivered an interactive, online training course to 2nd and 3rd year NYU internal medicine residents that covers key diagnostic and management skills and addresses attitudes about role functioning. METHODS: 61 PGY 2 and 3 internal medicine residents completed a 75 minute, highly interactive, online module that used a motivating scenario, mini-lectures, video vignettes and virtual patients. A pre-module 27-item questionnaire assessed perceptions of role in disasters, confidence and knowledge. Role related questions asked residents to assess how likely it is that in a disaster they would triage, provide immediate treatment, and on going care and management for patients presenting with physical and/or for mental health symptoms. Residents self-rated their competence in those roles. Knowledge was assessed by viewing online patient video vignettes and selecting the most appropriate diagnosis. Content focused on diagnosis of acute stress disorder (ASD), Post Traumatic Stress Disorder (PTSD), depression, bereavement, and sub diagnostic distress (worried well). Following the pretest, residents viewed an online lecture, and practiced diagnostic skills using online virtual patients presenting with acute stress disorder, PTSD, grief or subdianostic distress. If they assessed an aspect correctly on the pretest, they were able to skip the related portion of the module. RESULTS: Prior to beginning the module, residents identified their role as more likely to fulfill triage, immediate treatment, and ongoing care responsibilities for physical in contrast to mental health symptoms (mean likelihood mental health=2.48 vs. physical=3.26, p<.001) and that they would be more competent in doing so (mean competence mental health=2.40 vs. physical=3.43, p<.001). Upon completion of the module residents perceptions their role related to addressing mental health but not physical symptoms increased significantly (p<.05). From
pre- to post-module, residents perceived competence to screen for mental health symptoms (2.76 vs 3.24, p<.001), distinguish between abnormal and normal psychological responses to the event (2.61 vs.3.18, p<.001), and refer patients with psychological trauma and/or symptoms for specialized care (3.27 vs. 3.47) increased significantly. Finally, residents skills in diagnosing PTSD, ASD, and the worried well increased significantly from pre- to post-module (PTSD and ASD: from mean of 53% items correct to 74%, p<.001; worried well: from mean of 40% items correct to 51%; p=.008). Depression skills did not significantly change.
CONCLUSION: Internal medicine residents can improve their knowledge and skills in identifying patients with abnormal psychosocial responses to disasters and change their attitude regarding their role in the care of these patients by participating in a brief online interactive module using virtual patients individualized to their baseline knowledge and skills. Future research is needed to explore impact of the module on other disciplines who maybe asked to assist post disaster.
EXAMINING THE RELATIONSHIP BETWEEN DISEASE BURDEN AND FALLS AMONG NURSING HOME RESIDENTS Cathryn Caton 1;
Joni Strom 1; William P Moran 1; Cheryl Lynch1. 1Medical University of South Carolina, Charleston, South Carolina. (Tracking ID # 12124)
BACKGROUND: Fall rates among nursing home (NH) residents have been recorded at 1.5 falls per bed per year resulting in an incidence of about 50%. Falls in NH adversely impacts residents quality of life while increasing the institutional economic burden. Little has been published recently about fall risk factors among NH residents. Therefore, we sought to determine if a relationship between disease burden and falls among nursing home patients existed.
METHODS: We analyzed data on 13,404 NH residents using the 2004 National Nursing Home Survey. The sampling was a stratified two-stage probability design. The analysis was limited to residents 65 years and older. The main outcome was fall (documented in the past 6 months). The variables of interest were sociodemographic factors (age, gender, race/ethnicity, marital status), number of prescribed medications and disease burden as indicated by the Charlson Comorbidity Index (CCI). The Charlson Index provided a

cumulative way of describing the severity of disease burden in categories of minimum, mild, moderate and heavy burden. Multiple logistic regression analyses were performed to examine the relationship between the CCI and falls adjusting for potential confounders. STATA version 11 was used to account for the complex sampling design and to yield sample estimates.
RESULTS: The mean age of this sample of NH residents was 80.4 years and comprised 71% females, 84% non-Hispanic white (NHW). The prevalence of falls was 35.7%. Nearly all senior residents needed assistance with activities of daily living (ADLs) and only 15% were independent in walking. Higher proportions of falls occurred among older seniors, NHW race, married, veterans, those needing assistance with walking, and those with a higher number of prescribed medications. The only comorbid conditions significantly associated with falls was stroke, which was 13% among those who had a history of falls and 16% among those with no history of falls (p=0.003). Based on CCI score, a significantly higher proportion of those with a fall history had minimum disease burden compared to those with no fall history, otherwise those with no fall history were more likely to have mild, moderate and heavy disease burdens. In multivariate analyses the CCI score maintained a significant association with risk of falls so is only reported in adjusted models. The final model showed the highest odds for risk of falls were among those seniors needing assistance with ADLs (OR 2.94, 95%CI 1.88-4.59). The CCI was associated with a lower risk of falls (OR 0.95, 95%CI 0.91-0.99). Other factors associated with higher

risk of falls was being a veteran, older age, and number of prescribed medications, while racial/ethnic minority, female gender, and lung disease were significantly associated with a lower risk of falls. CONCLUSION: There is a significant association between disease burden as indicated by the Charlson Index and the risk of falls. However, the highest risk of falls among senior NH residents needing ADL assistance highlights the need for environmental adaptations that facilitate personal care for the older adult and maximizes patient safety. Furthermore, assessment of the severity of disease burden among senior residents should be used for stratifying residents and providing more focused safety measures for those at highest risk for falls.
FACTORS ASSOCIATED WITH HEPATITIS B KNOWLEDGE IN A KOREAN AMERICAN POPULATION Genji S Terasaki 1; Adeena Khan 1; Joon-Ho Yu 1; John H Choe1. 1University of Washington, Seattle, Washington. (Tracking ID # 12130)
BACKGROUND: Hepatitis B virus (HBV) substantially increases the risk for cirrhosis, fulminant hepatitis, liver transplant, and hepatocellular carcinoma (HCC) for those chronically infected. While the overall prevalence among adults in the United States is low, rates of chronic infection among immigrant groups from endemic areas is much higher. Asian and Pacific Islander Americans represent less than 5% of the total U.S. population but comprise more than half of all chronic hepatitis B cases (Office of Minority Health 2008). Chronic infection is often acquired at birth or in early childhood and can be clinically silent for many years, leaving many adults unaware that they are carriers or chronically infected. Identification of these persons is important to manage those at risk for progression to cirrhosis and HCC, as well as to vaccinate close household contacts against further transmission. For these reasons, the Centers for Disease Control and Prevention and other public health expert groups recommend routine HBV serologic screening of immigrants from areas of high HBV endemicity (Weinbaum, et al. MMWR 2008; 57: 120).
Koreans in the US number more than 1.1 million, making this the fifth largest Asian American population. However, to date there have been no published studies of the HBV knowledge among Korean American communities. The goals of our study were to measure levels of knowledge relevant to hepatitis B; determine whether HBV knowledge was associated with having had HBV serologic testing; and identify factors associated with higher levels of HBV specific knowledge in a population-based survey of Korean American adults.
METHODS: We conducted a population-based survey of Korean adults 18 to 64 years of age living in a 3-county urban area of Washington State. Eligible participants were identified by matching an electronic

telephone/address database with a validated list of Korean surnames (Lauderdale &Kestenbaum. Population Research and Policy Review 2000; 19:283300). Bilingual and bicultural field interviewers conducted surveys in Korean or English at participants homes. Surveys included questions regarding participant demographics, health status and health care access, sources of health information, and knowledge and behaviors related to hepatitis B.
Our primary variable of interest was a composite knowledge score based upon the number of correct responses to 24 questions related to HBV infection, prevention, and transmission. Bivariate comparisons between HBV knowledge and participant factors were analyzed using appropriate t-test or chi-squared statistics; this included tests for association between knowledge and reporting having had prior HBV serum testing. This composite HBV knowledge score was also used as the main dependent outcome in multiple regression models adjusted for social and demographic factors of a priori interest.
RESULTS: Surveys were completed by 466 Korean adults. Among participants, most (58%) were female and nearly all (96%) were foreign-born. Despite high levels of education, almost half (46%) reported difficulty with spoken English and 91% completed surveys in Korean. 222 (49%) reported having had prior serologic testing, and 27 (6%) reported also having HBV infection. Overall awareness was high with 94% reporting having heard of HBV infection.
Despite a high overall awareness of HBV in this population, knowledge about the transmission, treatment, and natural history of HBV infection varied substantially among participants; the percentage of correct responses among questions about hepatitis B ranged from a low of 8% to a high of 88% answered correctly. On questions about the natural history of HBV infection, most participants correctly identified cirrhosis, liver cancer, and death as possible sequelae of chronic infection; however, only half (53%) correctly answered that HBV infection can be lifelong. Most correctly identified sexual intercourse, childbirth, and sharing razors as potential routes of HBV transmission. However, a majority also erroneously believed eating unclean food (83%), sharing eating utensils (81%) and smoking cigarette (62%) to be routes for HBV infection.
The mean composite knowledge score was 12.7 out of a possible 24 points (standard deviation 3.1). Higher knowledge scores were significantly associated with younger age, years of formal education, English language proficiency, and greater proportion of life spent in the U.S. Higher knowledge scores were also strongly associated with having been screened for hepatitis B infection in the past (p=0.005). In logistic regression models, high HBV knowledge (defined a score of 12 or more points out of 24) was independently associated with younger age and English language proficiency after controlling for gender, birth country, formal education and proportion of life spent in the U.S. CONCLUSION: In this population-based survey of Korean American adults, we found overall relatively high levels of awareness of hepatitisB. Despite this awareness, important areas of knowledge deficit exist regarding transmission of HBV infection, such as the frequent belief that sharing food (a common cultural practice) spreads this disease. Although a cross-sectional study and limited in ability to test causal inference, the association between HBV knowledge and having been tested for HBV infection suggests possible potential benefit for HBV educational programs. In particular, those Korean Americans with lowest HBV knowledge are the older, less educated, and more recent immigrants with limited English proficiency. Targeted educational programs in this community should focus on these vulnerable groups within the larger Korean American population.
IMPLEMENTING A BIOPSYCHOSOCIAL CURRICULUM IN AN AMBULATORY LONGITUDINAL CLERKSHIP: QUANTITATING LEARNING Maura Joyce McGuire 1; Rosalyn Stewart 2; Gail Geller 3; Patricia Thomas4. 1Johns Hopkins Community Physicians, Lutherville, Maryland ; 2Johns Hopkins University School of Medicine, Department of Medicine, Baltimore,, Maryland ; 3Johns Hopkins University School of Public Health, Baltimore, Maryland ; 4Johns Hopkins University School of Medicine, Glen Arm, Maryland. (Tracking ID # 12136)
BACKGROUND: The Johns Hopkins School of Medicine developed an ambulatory longitudinal clerkship (LC) for first year students as part of a new four-year curriculum. In the second year of the LC we implemented a

formal biopsychosocial curriculum framed around eleven horizontal strands (HS) domains: clinical reasoning, cultural competence, communications, ethics/professionalism, epidemiology, life-cycle (pediatrics and aging), nutrition, health policy, pain and patient safety.

METHODS: Educational methods included practice learning sessions (12 per semester), standardized patient work, written assignments, lectures, and small group work. During each semester, students were required to document two patient encounters from each clinic session and submit at least 7 written reflections on HS to an online learning portfolio. To document exposure to biopsychosocial content, we built tags for HS learning events (HSLE) into our patient tracker and learning portfolio, and required that students identify at least one HSLE for each patient tracked (PT-HSLE) and for each reflection (R-HSLE). Curriculum evaluation methods included quantitation of HSLE and knowledge assessment using a written exam. Clerkship evaluation included questions on success in meeting clinical and HS learning objectives and satisfaction with educational methods.
RESULTS: One class completed the LC prior to implementation of the HS curriculum (LC1, one semester, 124 students), and one class completed the LC after implementation of the curriculum (LC2, two semesters, 119 students). Both classes used the same patient tracker, and both had similar instructions on how to use this tool. LC1 tracked an average of 1.02 PT-HSLE per student-session and LC2 tracked 1.67 PT-HSLE per student-session ($P<0.01$); there was a trend towards more attention to PT-HSLE between first and second semesters of LC2. In LC1, 22.7% of 6642 tracked events were related to biopsychosocial learning, compared to 35.3% of 12977 events in LC2. LC1 identified no HSLEs for 4 of 11 available domains: cultural competence, nutrition, life-cycle pediatrics, and life-cycle aging. LC2 identified the learning events in all domains, with combined PT-HSLE and R-HSLE distributed as follows: communication(13.53%), pain(11.74%), clinical reasoning(11.43%), safety(10.54%), aging(9.24%), pediatrics(8.03%), nutrition(7.75%), ethics(7.69%), cultural competence(6.38%), and other(1.84%). Our written exam showed lower percentage of HS items were answered correctly compared to other items, but this was not significant due to poor exam reliability (<0.60). Student evaluations of LC2 showed similar levels of agreement that clinical and biopsychosocial learning objectives were met (84.3% vs.80.4%), and favored practice based learning to written reflections and small group learning.
CONCLUSION: We implemented a biopsychosocial curriculum in an LC, and measured learning events for eleven HS curriculum domains. Post-implementation, students documented more HS learning events, tracked previously ignored areas like cultural competence, and agreed that learning objectives for the curriculum were met. While quantitative metrics support exposure to subject matter, more work to assess learning quality is needed.

HIGHER CARDIOLOGY CONSULTATION RATES FOR CARDIOVASCULAR DISEASE FOR HISPANICS SEEN IN HIGH PROPORTION HISPANIC VS. LOW PROPORTION HISPANIC CLINICS IN A LARGE INTEGRATED ACADEMIC HEALTHCARE SYSTEM

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BACKGROUND: Prior studies have shown that co-management between generalists and cardiologists is one possible mechanism for improving overall quality of care. Lower rates of cardiology consultation have been proposed as one mechanism contributing to disparities in cardiovascular care. The ease of obtaining cardiology consultation, in turn, may be mediated by the primary care practice environment in which a patient receives care. We hypothesized that primary care practices that concentrate linguistically and culturally appropriate services for Hispanics may result in higher cardiology consultation
rates for patients with coronary artery disease (CAD) and congestive heart failure (CHF).

METHODS: We assessed cardiology consultation rates comparing patients attending practices with higher overall proportion of Hispanic patients (HP practices, n=7) vs. practices with lower overall Hispanic proportion (LP practices, n=35). We used electronic records to retrospectively identify a cohort of 9,761 adults with CAD or CHF receiving primary care between 20002005. These patients were seen at least twice in the same primary care practice within the 12 months prior to their first primary care visit during the study period to ensure enrollees were regular ambulatory patients. Kaplan-Meier curves and log rank tests were used to calculate 5-year cardiology consultation rates and to compare time-to-consultation across socio-demographic variables (race/ethnicity, gender, age, primary language, and insurance status) and site of care. We performed multivariate analyses using Cox proportional-hazards regression, adjusting for clustering at the level of the physician, to assess differences in referral at HP vs. LP practices after adjusting for sociodemographic characteristics, Charlson score, disease severity and site of care. We used the frequency of follow-up consultation as the outcome variable in a Poisson regression analysis controlling for the aforementioned variables.
RESULTS: Among the 9,761 patients, 9,168 (93.9%) had CAD, 4,444(45.5%) had CHF, and 3,851 (39.5%) had both conditions. Hispanics comprised 11% (n=975) of the CAD cohort and 11% (n=474) of the CHF cohort. Unadjusted Kaplan-Meier estimates demonstrated that Hispanics had similar rates of cardiology consultation compared to non-Hispanics (CAD: 79.2% vs. 79.7%, p=0.54; CHF: 87.5% vs. 90.6%, p=0.110). However, Hispanics at HP practices had higher rates of cardiology consultation than those at LP practices (CAD: 82.2% vs.70.7%, p<0.001; CHF 91.2% vs. 89.7%, p<0.001). Multivariate analyses showed higher consultation rates for Hispanics at HP practices (CAD: hazard ratio [HR], 1.38; 95% confidence interval [CI], 1.16-1.64 and CHF: HR, 1.40; 95%CI, 1.10-1.81). In contrast, Blacks and Whites at HP practices had no significant differences in rates of consultation compared to those in LP practices. Hispanics at HP practices had 25% more consultations for CAD and 23% more consultations for CHF than Hispanics at LP practices adjusting for sociodemographic and clinical variables.
CONCLUSION: Among primary care patients with CAD or CHF within a single large academic care network, Hispanic patients at high HP practices have higher rates of cardiologist consultation compared to Hispanic patients at LP practices. Elucidating the essential components of individual practice environments that provide higher quality of care for Hispanics will allow for well designed systems to reduce health care disparities.
A METHOD TO ACHIEVE AN ACCEPTABLE POSITIVE RATE IN PULMONARY CT ANGIOGRAMS. Lana Gimber 1; Hyun-Chun Yoon 2; Lauren Todoki1. 1sjhmc, phoenix, Arizona ; 2sjhmc, phonix, Arizona . (Tracking ID # 12147)
BACKGROUND: Pulmonary CTA has become the preferred imaging test to diagnose PE. However, recent studies have shown that pulmonary CTA has become over-utilized, with no conclusive data to suggest a reduction in morbidity or mortality. In addition to radiation exposure, contrast-induced nephrotoxicity, and high financial cost, patients are misdiagnosed and treated unnecessarily with long term anticoagulation. For these reasons, an evidence-based algorithm for suspected pulmonary embolism is necessary to optimize both patient management and clinical outcomes. The objective of this study was to evaluate the combination of clinical criteria and d-dimer values for diagnosis of

pulmonary embolism (PE) in patients undergoing pulmonary CT angiography (CTA)
METHODS: Retrospective review of all patients presenting to the Emergency Department (Kaiser Permanente - Honolulu, Hawaii) with possible PE who underwent pulmonary CTA and had a d-dimer drawn. Wells scores were retrospectively assigned based on data gathered through medical records.
RESULTS: During a 29 month period, 1110 patients underwent pulmonary CTA, 773 of which had a d-dimer drawn. These subjects were grouped based on serum d-dimer levels into negative (<4 g/ml), low (0.411.0 g/ml), or positive (>1.0 g/ml) d-dimer categories. The prevalence of positive CTA studies was >10% only in the

positive d-dimer group. Subjects were also grouped based on Wells score into low (score<2), intermediate (24), or high (>4) clinical risk of PE. The prevalence of positive CTA was >10% only in the group with high clinical risk. When risk stratified using both d-dimer and Wells criteria, only those with high d-dimer (>1.0 g/ml) and intermediate or high clinical risk (Wells criteria >2) had a prevalence of positive pulmonary CTA >10%.
CONCLUSION: The use of diagnostic algorithms using simple clinical decision rules, d-dimer testing, and pulmonary CT angiography can guide treatment decisions with low risk for subsequent PE. We have found that utilizing pulmonary CTA only in patients suspected of pulmonary embolism with a combination of intermediate or high clinical risk based on a threshold score using the Wells criteria >2 and a serum d-dimer cutoff of 1 g/ml would increase the prevalence of positive pulmonary CTA studies above 10%.
BLOOD PRESSURE LOWERING AMONG RESISTANT HYPERTENSIVE DIABETES PATIENTS IN TWO HIGH-PERFORMING HEALTH SYSTEMS: THE ADHERENCE AND INTENSIFICATION OF MEDICATION (AIM) CLUSTER RANDOMIZED CONTROLLED EFFECTIVENESS TRIAL Michele Heisler 1; Timothy Hofer 1; Julie A Schmittdiel 2; Joseph V. Selby 3; Hayden Bosworth 3; Eve A. Kerr1. 1University of Michigan/Ann Arbor VA, Ann Arbor, Michigan ; 2Kaiser Permanente-Northern California, Oakland, California ; 3Duke University/Durham VA, Durham, North Carolina. (Tracking ID # 12148)
BACKGROUND: Even in high-performing health systems where programs have been established to improve blood pressure (BP) levels and BP control levels are approaching or exceeding 80%, some hypertensive patients with diabetes continue to have poor BP control. Poor medication adherence or provider failure to intensify medications (clinical inertia) contribute to poor control in this resistant population. Yet, current programs are rarely designed to reach out to and address the problems of this population. We designed and tested the Adherence and Intensification of Medication (AIM) program to improve BP control among resistant patients in 2 high performing healthcare systems. METHODS: The AIM study was a prospective, cluster-randomized effectiveness trial in which 16 primary care teams consisting of 528 PCPs, their staff, and diabetes patients, within 3 Veterans Affairs (VA) and 2 Kaiser Permanente facilities, were randomized to either the AIM intervention or to usual care. We collected data during a 14-month intervention period. Among intervention teams, clinical pharmacists trained in motivational interviewing were supported by clinical information systems that enabled proactive identification of and outreach to eligible patients identified on the basis of persistent poor BP control and either medication refill gaps or lack of recent medication intensification. The pharmacists then provided adherence counseling, titration of medications, or both to participating patients. No maintenance support was provided after participants completed the intervention. The primary outcome was the relative change in systolic blood pressure (SBP)
measurements between eligible intervention team compared with eligible control team patients. We examined longitudinal differences in differences between SBP among eligible participants immediately after receiving the intervention and up to six months after the end of the intervention period.
RESULTS: 2303 diabetes patients on the control teams and 1797patients on the intervention teams were eligible because they had persistent poor BP control and either medication refill gaps or no recent intensification. We compared changes in SBP among all the potentially eligible patients on the control teams and intervention teams, although only 53% of the 1797 eligible intervention patients received the AIM intervention (24% declined, 12% could not be reached). Mean SBP of intervention team patients one month prior to the intervention was 151 mm Hg compared to 150 in control teams (p=.33) Changes in mean SBP after intervention team participants received the intervention were 4.4 mm Hg compared with 1.9 among eligible control team patients (P <.001). By six months after the intervention period, mean SBP was approximately 145 mm Hg among both intervention and control team patients.
CONCLUSION: The AIM program more rapidly lowered BPs among resistant hypertensive patients - those with adherence problems or who lacked recent intensification-than usual care. However, this difference did not persist over time, partly because patients on control teams also attained better BP control, albeit more slowly. In

high-performing healthcare systems that have successfully brought the majority of patients under control, the AIM program can further enhance BP control among resistant patients but will require greater penetration and maintenance to spread and sustain the improved BP effect.

ASSOCIATION BETWEEN RACE AND HEALTH-RELATED BELIEFS AMONG OLDER ADULTS WITH ASTHMA Alex Federman 1; Juan Wisnivesky 1; Elizabeth Anne Hamann Wilson 2; Ethan Halm 3; Melissa Martynenko 1; Howard Leventhal 4; Michael Wolf3. 1Mount Sinai School of Medicine, New York, New York ; 2Northwestern University, Chicago, Illinois ; 3Univ. of Texas Southwestern Medical Center, Dallas, Texas ; 4Rutgers University, New Brunswick, New Jersey. (Tracking ID # 12160)

BACKGROUND: Specific beliefs among patients about the chronicity and curability of asthma have been linked to adherence with inhaled corticosteroids (ICS). Since outcomes of asthma self-management have been shown to differ across racial and ethnic groups, we examined the association of asthma-related beliefs with race and ethnicity. We focused specifically on older adults with asthma because this population has received relatively little attention in the research literature. METHODS: We conducted English and Spanish language interviews with patients ages 60 years and older with moderate to severe asthma in the outpatient primary care practices of academic medical centers in New York City and Chicago. The primary outcome was whether the patient held the belief that the patient only has asthma when symptoms are present (no symptoms no asthma), which we previously found to be associated with ICS adherence. We also examined a related belief, that the physician can definitely or probably cure the patients asthma. These beliefs reflect the identity and control domains, respectively, of the Common Sense Model of Self-Regulation. The principal independent variable was race and ethnicity, coded into mutually exclusive categories of white (reference), black or African-American, and Latino. We conducted multivariable logistic regressions analyses of the association of race and ethnicity with asthma beliefs, adjusting for variables shown to have an association with asthma beliefs among younger adults. RESULTS: The sample included 210 patients with a mean age of 67.2(6.4); 29.2% were black, 39.7% white, and 31.1% Latino. Twenty-four

percent had not graduated high school and 14.8% self-reported poor English speaking ability. ICS were used by 76.2% of the sample, and65.5% had a history of asthma-related emergency department visits and41.3% had been hospitalized; 9.7% had been intubated for asthma in their lifetime. The no symptoms no asthma belief was held by 31.6% and the curability belief by 18.2%. In bivariate analyses, Latinos were more likely than blacks and whites to hold either belief. Latinos remained more likely to hold these beliefs in analyses that adjusted for age, sex, income, education, and English speaking ability (no symptoms no asthma, OR 3.2, 95% CI 1.3 to 7.8, p=.01; curability OR 7.0, 95% CI 2.1 to 23.6, p=.002). Black patients were more likely than whites to hold the curability belief (OR 4.3, 95% CI 1.4 to 12.8, p=.009), but were not more likely than white patients to have the no symptoms no asthma belief in either bivariate or adjusted analyses.

CONCLUSION: In a cohort of older adults with asthma, Latinos were more likely to have beliefs that are associated with poor medication adherence than non-Hispanic white and black patients, even after accounting for education and language ability. The basis for differences in beliefs between different racial and ethnic groups of asthmatics warrants further exploration, but our findings suggest that education messages to support asthma self-management among older adults may need to be tailored for specific ethnic populations.

PATIENT CENTERED MEDICAL HOME: AN INTERNAL MEDICINE RESIDENT NEEDS ASSESSMENT Margaret Horlick 1; Colleen C. Gillespie 2; Kelly Crotty 1; Craig Tenner 1; Joseph Leung1. 1VA New York Harbor, New York, New York ; 2NYU School of Medicine, New York, New York. (Tracking ID # 12164)

BACKGROUND: Prior to the pilot implementation of a patient-centered medical home model in the VA system(Patient-Aligned Care Teams, PACT), a needs assessment was conducted with residents in the primary

care clinic to assess their perceptions of their medical-home related skills as well as their perceptions of the overall functioning of the clinic. METHODS: 31/51 VA clinic-based residents (61%) completed a 39-item questionnaire designed to assess perceptions of clinic functioning including: sufficient time (3 items, Cronbachs alpha=.82);effective communication (2 items, alpha=.71); patient education and support (3items, alpha=.71); overall functioning (3 items, alpha=.83); workplace culture(2 items; alpha=.78); and quality of the learning environment (3 items,alpha=.73). Residents were also asked to rate their own skills in the 4 following areas: practice-based improvement (4 items, alpha=.79), panel management (2 items, alpha=.76); effective primary care practice (3 items, alpha=.74); and teamwork (4 items, alpha=.81). A 4-point agreement scale was used with all items worded in a positive direction. Mean agreement ratings were calculated to compare among domains using repeated measures ANOVA.
RESULTS: Residents perceptions of the overall functioning of the clinic were generally positive with the following exceptions: only 58% agreed that there is enough time to do follow-up ; only50% agreed that they quickly become aware of urgent patient issues ; and only 67% agreed that their clinical team can handle my patients non clinical needs . Residents perceptions of their specific skills suggested some defined needs: only 29% agreed that they knew their patient panels no-show rate; only 42% agreed that they can use available data to assess their practice effectiveness ; and only 47% agreed that they have a good sense of strategies my team can use to target patients with poor outcomes . In terms of mean ratings, residents skills appeared to be lowest in practice-based improvement (mean=2.36 SD .68) and panel management (mean=2.69 SD .73) ($p<.05$, posthoc pairwise comparisons). In terms of clinic functioning, residents felt positive about the overall culture of the clinic (mean=3.61 SD.48) and the learning environment (mean=3.22 SD .53) whereas the other 4 areas demonstrated room for improvement (sufficient time=2.89, SD .69; patient education and support=2.78, SD .53; communication=2.69, SD .73; overall functioning=2.98, SD.62, $p<.05$, posthoc pairwise comparisons). CONCLUSION: These survey results are consistent with previous assumptions made about the residency experience. Specifically, residents are focused on the patient in the room with them and they have a lack of experience and unfamiliarity with population health, the concepts of panel management, the use of clinical care teams and practice-based improvement strategies. We expect the implementation of the VA PACT system will address these deficiencies given its design as a clinical care team directed to provide care to a panel of patients while engaging in continuous improvement. We expect that the participation of the residents in this developing healthcare delivery model will provide a robust experiential education in enhancing those skills identified by the survey results as needing development.

BARRIERS TO ADVANCE CARE PLANNING IN THE CONTINUITY CLINIC SETTING Brandon Verdoorn 1; Ericka Tung2. 1Mayo Clinic College of Medicine, Department of Medicine, Rochester, Minnesota ; 2Mayo Clinic College of Medicine, Division of Primary Care Internal Medicine, Rochester, Minnesota. (Tracking ID # 12165)

BACKGROUND: Advance care planning (ACP) consists of discussions with a patient and/or the patients representatives about the desired direction of the patients care, particularly end-of-life care, in the event that the patient becomes unable to articulate his or her own wishes. General internists play an important role in guiding patients through the ACP process, and most patients would prefer to discuss this topic with their primary care provider. However, previous studies have identified that many internal medicine (IM) residents feel unprepared to counsel patients about end-of-life care treatment options. The primary objective of this analysis was to assess IM residents attitudes, behaviors, and barriers to ACP in the outpatient training setting. A secondary objective was to quantify the frequency of advance directive (AD) completion among residents longitudinal patients.
METHODS: As part of a quality improvement (QI) project aimed at improving the ACP training of IM residents, all categorical IM resident physicians from the Rochester, MN based Mayo Clinic Internal Medicine Residency Program were invited to complete an optional electronic survey regarding their ACP education and practices in

the outpatient primary care setting. Utilizing a retrospective review of the electronic medical record, we collected descriptive data to determine the demographics among resident physicians patients.
RESULTS: Among the total of 162 residents surveyed, 89 (54%) completed the survey. 45% of respondents noted that they never or rarely discuss ACP in the outpatient setting, with only 7% of residents noting that they discuss ACP routinely at general medical evaluation visits. Only 28% of residents noted that they are comfortable discussing ACP. Less than 10% of all residents cited that they had received education about ACP in the outpatient clinic setting. Notably, patients from the residents longitudinal practice panels had an average age of 45, with 16% of patients aged 65 years or older. Of those patients 65 or older, 23% reported having completed an advance directive. CONCLUSION: Surveyed IM residents noted that they had received very little formal training about ACP in the clinic setting and many felt unprepared to discuss this topic with their patients. Correspondingly, self-reported frequency of advance directive completion among residents patients was relatively low. These findings, in conjunction with identified system-based barriers to ACP in the ambulatory continuity

clinic setting, represent an excellent opportunity for the development of meaningful curricula and practice innovation aimed at preparing residents to provide safe, compassionate, patient-centered ACP counseling to their patients.
LOCALLY-TAILORED REGISTRIES: A NOVEL APPLICATION OF THE ELECTRONIC MEDICAL RECORD TO SUPPORT QUALITY IMPROVEMENT INTERVENTIONS Brook Watts 1; Paul Drawz 1; Randal Stalnaker 1; Cameron Carter 1; Renee Lawrence 1; Elizabeth Kern1.
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BACKGROUND: If harnessed correctly, the electronic medical record (EMR) may be a key tool in efforts to provide efficient, high quality patient care. However, despite its strengths, the Veterans Administration (VA) EMR system remains relatively unfriendly to clinical providers who wish to access local information about specific groups of patients for improvement initiatives. Current programs, such as the VA national disease registries, have been developed to help provide population-specific data, such as summary information about specific measures of clinical quality, however, these types of data repositories may have limited usefulness to agents of front-line change. These limitations include lack of local control over types of data collected/reports generated, efficiency in report generation, and lack of timeliness of data (e.g. data may be several months old). Locally-tailored registries, a novel application of electronic health record data, may provide a key component to population-based approaches to chronic disease management by providing front-line teams with easily accessible and adaptable data to facilitate local improvement projects.
METHODS: The Cleveland Locally-tailored Registries are a component of the Cleveland VA Quality Improvement and Clinical Research Database. This database uses a stand-alone SQL relational database that is updated on a nightly basis via an interface with the VAs Computerized Patient Record System. The core database includes 10 years of longitudinal data, including demographics, vital signs, laboratory data, medications, surgeries, radiology reports, and ICD-9 codes. Using the SQL database, registries of patients with chronic diseases of interest, including diabetes, heart failure, coronary artery disease, chronic kidney disease, and hepatitis C have been developed. Disease definitions have been developed to accommodate the clinical applications of each registry (i.e. sensitivity and specificity of disease definitions). Each disease registry has a unique locally-tailored user-friendly web-based interface that was developed using feedback from the clinical end-users to meet specific clinical needs and target local priorities for improvement efforts.
RESULTS: The current locally-tailored registries collectively include more than 100,000 patients. The diabetes registry (approximately 24,475 patients) and the ischemic heart disease registry (approximately 25,740 patients) are used by primary care teams to generate tools for patient education, including patient-specific report cards for use in patient visits, to identify patients in need of intensive clinical intervention (e.g., patients with

hemoglobin A1C greater than 9 and not on insulin), and to target resource allocation (e.g., deployment of clinical pharmacists to clinics with poor performance on lipid measures). Other locally-tailored registry projects include targeting heart failure patients with frequent admissions (heart failure registry, approximately 6600 patients) and improving vaccination rates for patients with hepatitis C (hepatitis C registry, approximately 3008 patients).
CONCLUSION: The Cleveland locally-tailored registries have been used by interdisciplinary clinical teams to implement a wide-range of improvement projects. Locally-tailored disease registries may support implementation efforts by providing a unique collaborative interface for clinical staff, researchers, and quality champions. In contrast to current nationally-developed disease registries, key components of the localized disease registries for supporting continuous improvement include flexibility, timeliness, efficiency, and validity.
WHAT HAPPENS WHEN ADULT PATIENTS CRY IN PRIMARY CARE VISITS? Lisa C Diamond 1; Cheryl Stults 1; Jennifer Elston-Lafata 2; Tracy Wunderlich 3; Lisa MacLean 4; Ming Tai-Seale1. 1Palo Alto Medical Foundation Research Institute, Palo Alto, California ; 2Virginia Commonwealth University, Richmond, Virginia ; 3Henry Ford Health System, Detroit, Michigan. (Tracking ID # 12170)
BACKGROUND: Even if they are unfamiliar with mental health assessment tools, any physician can recognize the level of distress associated with crying by an adult. Didactic training in medical education on how to address significant emotional distress is inadequate. The literature is relatively silent on what primary care physicians should do besides show detached concern when this occurs. This study specifically seeks to understand what brings a patient to cry during a visit and how primary care physicians respond to such a sign of distress.
METHODS: In-depth qualitative study of audio-recordings of 9 adult patients primary care office visits with 5 physicians in which the patient cried. We used content analyses to explore the underlying reason(s) that led apatient to cry and the physicians response to the patients crying. A multidisciplinary team of researchers from health services, economics, sociology, anthropology, medicine, and psychiatry performed the analyses. Population consisted of insured adult patients aged 50 80 years of age who scheduled a routine annual check-up with their primary care physician between 2006 and 2008.
RESULTS: We found that a common trigger was acute or prolonged bereavement over the death of a loved one. Suffering from emotional pain was the main precipitator for patients crying. Physicians responses to patient crying were mixed, ranging from immediate or delayed statements of empathy to lack of any expression of empathy, despite the obvious signal of crying. Assessment of mental health by the physicians was inconsistent, ranging from thorough investigation to dismissive comments. Among those not under any mental health treatment before the recorded visit (n=7), two patients explicitly requested treatment for their psychological distress. Both were marginally evaluated for symptoms of depression, and only one of them was given an antidepressant prescription and referral to behavioral health. The other patient was offered watchful waiting. Two additional physicians recommended behavioral health specialty care to two other patients, of which one accepted the referral while the other declined. Only four patients were briefly assessed for suicidality. Follow-up care planning was rather inadequate. Two patients were already under the care of a behavioral health specialist (n=2). Care coordination appeared lacking.
CONCLUSION: Some adult patients cry during annual visits, presenting an opportunity for primary care providers to assess for and recognize the level of distress and take actions to treat or to refer to specialty mental health providers. Only a few physicians were empathic in their responses and followed guidelines for treatment of depression or other mental disorders. While some primary care physicians note that not having physical measurements to diagnose mental illness prevents them from recognizing them, a patient crying during a visit can be viewed as clear signal of patient distress and a possible need for professional help to alleviate suffering. Training on how to empathically treat a crying patient should be enhanced in

undergraduate and graduate medical training or continuing medical education.
LOW SOCIOECONOMIC STATUS IS ASSOCIATED WITH INCREASED FREQUENCY OF HOSPITALIZATIONS AND ACUTE CARE VISITS FOR TREATMENT OF VASO-OCCLUSIVE PAIN CRISES AMONG ADULT PATIENTS WITH SICKLE CELL DISEASE Charles Richard Jonassaint 1; Mary Catherine Beach 1; Sophie Lanzkron 1; Carlton Haywood1. 1Johns Hopkins University, Baltimore, Maryland . (Tracking ID # 12179)
BACKGROUND: Sickle cell disease (SCD) is associated with a disproportionately high rate of morbidity and mortality. The chronicity of SCD is a substantial burden to patients and requires considerable self-management. Social and economic disadvantage may hinder patients ability to self-manage their SCD and negatively impact patients health. Few studies have examined the role of socioeconomic status (SES) in health care utilization in this population. Therefore, the aim of the current study was to assess the association of patients SES with frequency of hospitalizations and acute care encounters, independent of disease severity.
METHODS: We recruited patients with documented SCD who received care at an urban academic medical center from September 2006 to June 2007. Patients were recruited from the adult sickle cell and hematology outpatient clinic, the emergency department (ED), the inpatient units, or within 5 days following hospital discharge. Out of 96 patients who were approached, 95 patients with SCD (64% HbSS disease), aged 20 64 (mean=34) participated. Socioeconomic status was assessed using four categorical demographic variables: education (<high school, high school/GED, some college, college or beyond), annual household income (<$10,000 and >$10,000), current employment (employed/ unemployed) and receipt of disability (yes/no). Outcomes variables were the number of hospitalizations over the past year (log transformed) as documented in the patients medical record and the patients self-report of their annual number of vaso-occlusive crises that require a hospital visit (<3 and 3+). Logistic regression and multiple linear regression were used to test for the association among SES indicators and binary or continuous outcome variables, respectively. Analyses included covariates for age, sex and clinical variables: patients genotype (HbSS vs. other), number of non-sickle related comorbidities (diabetes, hypertension, HIV, hepatitis B, or hepatitis C), and number of sickle-related comorbidities (acute chest syndrome, avascular necrosis, renal disease, pulmonary hypertension, or iron overload).
RESULTS: After adjusting for covariates, patients with at least a college level education experienced an average of 1.29 (SD=1.01) hospitalizations compared to an average of 5.81 (SD=6.06) hospitalizations for patients who did not complete high school (=.73; p<.01). Further, patients with a higher education were 7.4 times more likely to report having fewer than 3 pain crises requiring hospitalization a year (p =.038). Similarly, when examining income, patients with a household income greater than $10,000 a year had fewer hospitalizations (=.50; p<.01) and pain crises requiring hospitalization (OR=.23, p=.015) than patients with a household income less than $10,000. Employed patients also experienced fewer hospitalizations than unemployed patients (= .36; p=.04). Receipt of disability was not associated with hospital utilization after adjusting for age, sex and clinical variables. CONCLUSION: Findings from this study suggest that SES is inversely associated with health care utilization. These effects were consistent when accounting for age, sex, genotype, and clinical comorbidities. However, the causal direction of the relationship between hospital utilization and SES cannot be confirmed in this cross-sectional study.
Nonetheless, assessing SES may help identify patients who are at high risk for poor outcomes. By appropriately identifying risk factors for poor health outcomes, we will be able to tailor and personalize care plans to the specific needs of each patient with the goal of improving patient self-management and disease outcomes.
PRIMARY PROSTATE CANCER TREATMENT VARIATIONS IN THE VETERANS HEALTH ADMINISTRATION VERSUS THE PRIVATE SECTOR Vinod Nambudiri 1; Mary Beth Landrum 2; Elizabeth Lamont 2; Samuel Bozeman 3; Barbara J. McNeil 2; Nancy Keating2. 1Brigham and Womens Hospital, Boston,

Massachusetts ; 2Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts ; 3Abt Association, Boston, Massachusetts. (Tracking ID # 12188)

BACKGROUND: The first-line management of loco-regional prostate cancer may include prostatectomy, radiation therapy, or active surveil-lance. Substantial variation has been observed in primary treatment of prostate cancer; such variation may be less within an integrated delivery system with equal access to care like the Veterans Health Administration (VHA). We examined primary therapy of loco-regional prostate cancer within the VHA to understand factors contributing to variation within and across facilities. We also compared primary treatment in the VHA for older men with that for older men treated in the private sector under fee-for-service Medicare plans.

METHODS: Data from the Veterans Affairs Central Cancer Registry (VACCR) were used to identify 39,547 men diagnosed with loco-regional prostate cancer during 20012004. We linked VACCR data with administrative data and surveyed of 138 VHA Medical Centers about availability of cancer-related services. We used hierarchical linear models to identify patient and provider characteristics associated with primary treatment. We also identified 65,778 men aged >65 years diagnosed with loco-regional prostate cancer in 20012004 and treated in the private sector under fee-for-service Medicare plans. We used propensity score methods to match these men with 19,210 men aged >65 treated in the private sector to compare primary prostate cancer treatment in the two settings.

RESULTS: Among VHA patients, those who were older (age >70), of black race/ethnicity, had a prior history of cancer, or high comorbidity scores were more likely to undergo active surveillance than other men (all P<.05). Significant variations in rates of primary therapy were seen across VHA facilities, with rates of surgery ranging from 5% to 66% and rates of radiation therapy ranging from 18% to 89%. Facilities with more black patients had lower rates of radical prostatectomy (P=0.02), but overall, facility characteristics explained very little of the variation observed. Compared with patients in fee-for-service Medicare, VHA patients were younger and more likely to be minorities, unmarried, living in areas of lower socioeconomics, and more likely to have vascular disease and diabetes; these differences were no longer present after matching. Adjusted rates of radiation therapy (40.1% vs. 52.2%) and radical prostatectomy (12.1% vs. 15.7%) were lower in the VHA population and rates of active surveillance were significantly higher(47.9% vs. 32.1%) in the VHA population compared to the private sector population (p<0.001).

CONCLUSION: Substantial variation in primary treatment for prostate cancer was evident in the VHA within and across facilities. Black men received less aggressive care, and facilities that cared for more black men had lower surgery rates, but overall, little variation was explained by facility characteristics. Primary prostate cancer therapy for older men was less aggressive in the VHA than in the private sector. With the absence of data demonstrating benefits of aggressive therapies for most older men with loco-regional prostate cancer, this may reflect more

appropriate selection of therapies in the VHA, although additional data are needed to understand the long-term outcomes associated with primary treatments in these settings.

QUALITY OF EVIDENCE INFORMING PATIENTS CHOICE OF RENAL REPLACEMENT MODALITY Raquel C Greer 1; Priscilla Auguste 1; Patti Ephraim 1; Johanna Sheu 2; Deidra Crews 1; Julio Lamprea 1; Temitope Olufade 1; Tanjala Purnell 1; Neil Powe 3; Hamid Rabb 1; Bernard Jaar 1;L. Ebony Boulware1. 1Johns Hopkins Medical Institutions, Baltimore, Maryland ; 2Harvard Medical School, Boston, Massachusetts ; 3University of California San Francisco, San Francisco, California. (Tracking ID # 12193)

BACKGROUND: Patients and their physicians are encouraged to engage in informed decision-making about renal replacement modality. However, the quality and quantity of evidence available to inform patients choice of renal replacement modality is unknown.

METHODS: To develop an intervention to improve decision-making about patients choice of renal replacement

modality, we obtained data from national registries and systematically reviewed studies published after 1987 to summarize evidence regarding differences in clinical outcomes between renal replacement modalities. Using modified Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria, we assessed the quality of the evidence (very low (e.g. case series), low (e.g. cross-sectional or pre-post observational studies), medium (e.g. longitudinal cohort studies or registry data), high (e.g. randomized controlled trials-RCTs) across 12 domains of clinical outcomes identified by patients as important to renal replacement modality decisions.
RESULTS: Registries provided evidence on 2 domains (8 outcomes). From 3,384 possibly relevant PubMed abstracts, 105 studies provided evidence on 10 domains (53 outcomes). (Table) There were few (n=7) longitudinal cohort studies. Most (n=98) studies had qualitative, case-series, cross-sectional, or pre-post designs. There were no RCTs. Most (n =72) studies compared outcomes between hemodialysis (HD) versus peritoneal dialysis (PD) while fewer (n=21) compared HD versus transplant (TX) or PD versus TX (n=3). The quality of evidence was low for the majority of domains.
CONCLUSION: There is little high quality evidence to inform patients choice of renal replacement modality. Research is needed to better inform decisions.
HOW MUCH DISCONTINUITY DOES A HOSPITALIZED PATIENT EXPERIENCE? Kathlyn E Fletcher 1; Jeff Whittle 2; Siddhartha Singh 3; Vishal Ratkalkar 3; Prakash Laud 4; Alexis Visotcky 5; Marilyn Schapira3. 1Milwaukee VAMC/MCW, Milwaukee, Wisconsin ; 2Milwaukee VA Medical Center, Milwauke, Wisconsin ; MCW, Milwaukee, Wisconsin ; 4MCW, MILWAUKEE, Wisconsin. (Tracking ID # 12194)
BACKGROUND: Discontinuity in hospital care has been a growing concern as the work of resident physicians has become more shift-like. We performed an observational study to characterize the physician discontinuity experienced by hospitalized patients.
METHODS: We identified patients cared for by internal medicine house staff at 3 hospitals (a VA, a tertiary care medical center and a community hospital) affiliated with a single residency program. We prospectively collected daily schedule data from house staff during months they were assigned to general medicine wards during a 1-year period. We retrospectively reviewed the charts of a random sample of patients cared for by those house staff. We also downloaded the electronic sign-
out documents from the teams every day. The house staff schedule data included times in and out of the hospital each day. The patient chart review included dates and times of admission and discharge and the comorbidities included in the Charlson comorbidity index. We assigned each patient an admitting doctor, a discharging doctor and a primary inpatient doctor. The admitting doctor was the person who wrote the history and physical (if more than one such document existed, the admitting doctor was the least senior house officer who wrote one). The discharging doctor was the person who wrote the final discharge order, and the primary inpatient doctor was the person who was assigned to be the patients intern on the sign-out document. We looked at 4 aspects of discontinuity for each patient: 1) admission-discharge discontinuity defined as being admitted and discharged by 2 different people; 2) time between admission and the first hand-off of care defined as the time between admission and the next time that the admitting doctor left the hospital; 3) whether or not patients were hospitalized during an intern or resident switch day; and 4) the percentage of hospital time covered by the primary inpatient doctor defined as the sum of the time the primary inpatient doctor was in the hospital divided by the patients length of stay (LOS).
RESULTS: We report on the results from 271 patients. Mean age was62.1 (SD 17.8). Most (63%) were male. The mean Charlson score was 2.6 (SD 2.2). Mean LOS was 5.4 days (SD 4.1). Admission-discharge discontinuity was experienced by 184 (68%) patients. After excluding patients at a hospital with a policy that dictated patients be discharged by the attending, admission-discharge discontinuity was still 54%. Mean time between admission and the first hand-off of care was 16.2 hours (SD 6.9). Sixty-seven (27%) patients were hospitalized over a switch day. Excluding the patients who were hospitalized over a switch day (i.e. the

remaining patients had the same primary doctor the whole hospitalization), a mean of 42% of hospital time was covered by the primary inpatient doctor.
CONCLUSION: Continuity of care in the outpatient setting has been associated with better compliance and better doctor-patient relationship parameters. We hypothesize that it is also important in the hospital setting. This is the first attempt at characterizing the discontinuity experienced by hospitalized general medicine patients, and we have demonstrated that there is a substantial amount. Limitations include studying only 3 hospitals and 1 house staff program. The next step is to look for associations between discontinuity and adverse events.
HEALTH INFORMATION EXCHANGE USE IMPROVES ADHERENCE WITH EVIDENCE-BASED GUIDELINES FOR NEUROIMAGING IN THE EMERGENCY EVALUATION OF HEADACHE Lisa M Mabry 1; James E. Bailey 1; Jim Y Wan 1; Rebecca Pope 1; Stephen Landy 1; Teresa Waters1. 1University of Tennessee Health Science Center, Memphis, Tennessee. (Tracking ID # 12195)
BACKGROUND: Neuroimaging is routinely obtained in the emergency department (ED) evaluation of headache despite evidence-based guidelines (EBGs) recommending selected use. Health information exchanges (HIEs) have been proposed as a way to reduce unnecessary neuroimaging. This study seeks to determine whether HIE use for patients presenting to the ED with headache decreases unnecessary neuroimaging and increases adherence with EBGs for neuroimaging. METHODS: Cross-sectional analysis of data from the MidSouth eHealth Alliance HIE for 2,102 adult patient-visits with primary diagnosis of headache (ICD-9-CM codes 346.0, 346.1, 346.9 and 784.0) for patients presenting to one of the major general hospital EDs in the four counties of the Memphis Metropolitan Area two or more times between August 1, 2007 and July 31, 2009. Adherence with EBGs for neuroimaging in

evaluation of primary headache was the primary outcome. Use of diagnostic neuroimaging (CT, CT angiography, MRI or MRI angiography) was a secondary outcome.
RESULTS: The HIE was accessed for 21.8% of ED visits for headache. Billing provider accounted for 30.0% and ED staff for 70.0% of total HIE use. 69.8% of patient-visits received some type of neuroimaging. Of the 1,467 cases with any imaging, 1,413 had at least one head CT (96.3%). Bivariate analysis revealed that HIE use by any ED personnel (odds ratio [OR] 1.78, 95% confidence interval [CI] 1.42-2.24), and by ED staff (OR2.54, CI 1.94-3.32) were associated with increased EBG adherence. Increased number of previous visits was also associated with EBG adherence (OR 1.04, CI 1.01-1.08). After controlling for demographic factors, comorbidity, hospital system, and previous visits, any HIE use was associated with decreased odds of any neuroimaging (OR 0.32, CI0.22-0.46). In addition, multivariate results revealed strong interactions between number of previous visits and HIE use on EBG adherence. The any HIE use * previous visits interaction term was associated with increased EBG adherence (OR 2.04, CI 1.28-3.26).
CONCLUSION: Systematic HIE use by ED personnel and overall HIE use are strongly associated with increased adherence with EBGs for evaluation of headache in the ED. HIE use effects appear to be most beneficial for patients with higher numbers of previous visits. HIE use should be promoted to help reduce the costs and potential harms associated with unnecessary neuroimaging in patients with headache.
ELECTRONIC HEALTH RECORDS AND PHYSICIAN STRESS IN OFFICE BASED PRACTICE? Stewart Babbott 1; Linda Baier 2; Mark Linzer 3; Roger Brown 2; Enid Montague 2; Eric Williams 4; Mark Schwartz 5; Erik Hess6. 1University of Kansas Medical Center, Kansas City, Kansas ; 2University of Wisconsin, Madison, Wisconsin ; 3Hennepin County Medical Center, Minneapolis, Minnesota ; 4University of Alabama, Birmingham, Alabama ; 5New York University, New York, New York ; 6Mayo Clinic College of Medicine, Rochester, Minnesota. (Tracking ID # 12208)

BACKGROUND: The electronic health record (EHR) is increasingly prevalent in office based care. Reports suggest that practice using the EHR can be a factor in provider reported levels of stress in office environments. We investigated the possible relationships between the presence of the number of EHR features and physician reported levels of stress.
METHODS: We performed a secondary analysis on data from the MEMO study (Minimizing Error, Maximizing Outcomes), which involved 422 Internal Medicine and Family Medicine physicians in their offices in 5 areas of the United States. As part of this study, physicians and office managers completed questionnaires about their office practice, including specific EHR features the office used (yes/no), individual measures of stress, burnout, intent to leave and satisfaction (scale 1 (low) to 5 (high). Using binary based latent class analysis, we sought to define classes of respondents based on the number of EHR features present. We then sought to define relationships between these classes and the individual reports of stress and related issues.
RESULTS: We defined 3 classes of respondents based on level of EHR use: low, moderate and high. The physician questionnaire had 15 separate features of an electronic medical record and respondents noted if each was present or absent in their practice. Using latent class analysis, we sought the best solution to classes of respondents based on the number of features in their offices. The best latent class analysis fit was a three class solution encompassing low, moderate and high amounts of EHR features. The analysis did not assign weights to any of the specific features.
We compared mean responses between classes to each of the four measures of stress or satisfaction. Data are reported as mean (standard error) (95% confidence interval). When compared with the low use group, the moderate use group reported significantly more stress (mod:3.491 (0.084) (3.327, 3.655) vs low 3.112 (0.104) (2.909, 3.315) p=0.004) , more burnout (mod: 2.306 (0.078) (2.154, 2.458) vs low 2.027(0.092) (1.847, 2.207) p=0.02) and lower satisfaction (mod 3.543 (0.071)(3.404, 3.682) vs low 3.838 (0.114) (3.165, 4.061) p=0.03). When compared with the high use group, the moderate use group also reported significantly more stress (mod 3.491 (0.084) (3.327, 3.655) vs high 3.282 (0.067) (3.151, 3.413) p=0.04). There were no differences between groups for responses in intent to leave.
CONCLUSION: The level of EHR support was associated with reported level of stress, burnout, and satisfaction in a U shaped curve. We hypothesize that the offices in the moderate class were either offices in transition to a full EHR or were those with an implemented EHR that did not have all electronic functions. Our findings have implications for EHR implementation, preparing all members of the office for potentially increased stress and decreased satisfaction during the period of transition. Similarly these findings can assist administrative leaders in developing transition strategies to mitigate worker stress and decreased satisfaction. Further work should explore the specific features of the EHR which are associated with these findings and variables such as the office organization, EHR planning, implementation and support, patient populations served, physician engagement in the practice and practice financing.
A POINT OF CARE MEDICATION DELIVERY SYSTEM IMPROVES CLINICAL OUTCOMES IN A DIVERSE DIABETIC POPULATION Ana Palacio 1; Jessica Chen 2; Leonardo Tamariz 3; Siobhan Proksell 1; Arash Harzand 1; Olveen Carrasquillo1. 1University of Miami, Miami, Florida ;
2Chen Medical Associates, Miami, Florida ; 3University of Miami, Doral, Florida. (Tracking ID # 12213)
BACKGROUND: To date, few strategies have been successful atimproving intermediate outcomes among minority diabetics. Those that exist are often complex,multi-factorial, highly culturally/ individually tailored and thus difficult toscale up. Fully automated point ofcare medication delivery systems (POCMDS) are a recent technological innovationwhich allow providers to dispense pre-sealed medications at the time of thevisit. In 2009, a private practicenetwork serving a multi-ethnic clientele in South Florida implemented aPOCMDS. While the POCMDS has generated substantialcost-savings to this fully capitated network, the impact on care outcomes hasnot been evaluated. As POCMDS have thepotential to improve medication adherence, the aim of this study was to evaluatethe impact of the implementation of this POCMDS on intermediate diabetesoutcomes.

METHODS: We conducted a pre-post design analysis amongall diabetics in the practice having had at least 6 months of follow-up beforeand after enrolling in the POCMDS. Wecollected HbA1c, LDL, systolic and diastolic blood pressure measurements, raceand ethnicity and co-morbidities from the electronic medical record. We comparedthe mean blood pressure before and after enrolling in POCMDS for all eligiblesubjects and compared mean HbA1c and LDL for those subjects with at least one measurementbefore and one measurement after the implementation of POCMDS.
RESULTS: We identified 878 diabetic patients with bloodpressure measurements. Black subjects had significantly lower systolic and diastolic blood pressure after the implementation of POCMDS when compared toNon Hispanic White and Hispanic subjects (table 2). We identified 591 patients with two HbA1c and LDL measurements. Table 1

reports the changes on HbA1c. At 6 months, thePOCMDS significantly improved HbA1C among black subjects. A similar trend was also observed among the smaller cohort of non- Hispanic whites, but not among Hispanics. The intervention did not have an impact on LDL.
CONCLUSION: We found that the POCMDS significantly improveddiabetes control and blood pressure among the large number of black diabeticsin this practice network. Theintervention is relatively simple to implement and highly scalable. Thus, fully at risk Accountable CareOrganizations (ACOS) may consider POCMDS as tool that may not only reduce theirprescription costs expenses but one that may also improve diabetes intermediateoutcomes among some vulnerable populations.
A LONGITUDINAL STUDY OF MEDICAL STUDENTS ATTITUDES TOWARD THE PHYSICAL EXAM Heather Heiman 1; Stephen Persell2.
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2Northwestern University Feinberg School of Medicine, Evanston, Illinois. (Tracking ID # 12221)
BACKGROUND: The physical exam has been called a dying art. Medical educators worry about the negative messages students receive from their clinical environment, where time constraints and technology can devalue the bedside exam. We aimed to determine how the attitudes of medical students toward the physical exam change from year 1 through year 3 of medical school.
METHODS: We administered a survey to students in the class of 2011 at our institution at four time points: at the mid-point of M1 year (prior to a physical exam course), and at the end of the M1, M2, and M3 years. We asked students to complete a 29-item questionnaire regarding their confidence in performing the physical exam and their perception of its utility. We included general questions and questions about 11 specific examinations: blood pressure, heart, lungs, abdomen, liver, neck veins, lymph nodes, thyroid, optic disk, knee and the neurological exam. Items were rated on a 5-point Likert scale where 1 was strongly disagree or not at all confident/useful, and 5 was strongly agree or very confident/useful. RESULTS: Of 177 students originally in the class of 2011, we were able to obtain surveys from 58 students at all four time points (32%). Students confidence in their ability to perform the exam as a whole increased dramatically immediately following the M1 physical exam course (from 2.1 to 4.1), declined after M2 year (3.7) and then increased to its highest level following third year (4.4). Students maintained strong agreement that the exam as a whole is important for patient care at all four time points, though the agreement declined after the M1 year (4.8 vs. 4.6, p=.04). Students modestly agreed that labs (3.4) and radiology studies were more useful than physical examination for diagnosis, and there was no change in this perception over the course of the study.
Compared with the end of M1 year, M3 students expressed more confidence in their ability to examine the blood pressure, lungs, liver, and abdomen; confidence in the other exam skills did not increase. Following M3 year, students perceived the neck vein exam more useful than they had previously; other items remained stable on this scale. CONCLUSION: M3 students at our institution maintain strong agreement that the physical

examination is important for patient care, though this agreement decreases slightly after M1 year. Clinical experience is not associated with increased regard for high-tech studies in place of the bedside exam. Confidence in exam skill as a whole rises after clerkships, but confidence is flat for many specific organ systems including the heart, and remains low for the optic disk, lymph nodes, thyroid, knee and neck veins. Advanced physical diagnosis courses which emphasize the systems which students feel less confident examining and provide evidence for the usefulness of exam maneuvers fill an important need.

ADHERENCE TO THE USPSTF 2002 OSTEOPOROSIS SCREENING GUIDELINES IN AN ACADEMIC GENERAL INTERNAL MEDICINE CENTER AND WOMENS HEALTH CARE CENTER Heidi Sara Powell 1; Kim OConnor 1; Deborah Greenberg1. 1University of Washington, Seattle, Washington. (Tracking ID # 12230)

BACKGROUND: In the United States, 1.5 million osteoporosis related fractures occur annually and are expected to increase to 3 million by 2025. Approximately 50% of postmenopausal women will suffer from an osteoporosis-related fracture during their lifetime. Those at greatest risk are women aged 65 and older. The mortality rate is estimated at 24%, within the first year following a hip fracture. In 2002, the USPSTF recommended that all women 65 years and older should be screened for osteoporosis. Universal screening of women aged 65 and older has been recommended by other organizations as well. Despite these recommendations, many women are not being screened and therefore are under diagnosed.

Primary care physicians screening rates for women aged 65 and older range from 11-62%. Few studies have been done evaluating independent predictors of BMD screening. Three, based on databases as opposed to surveys, have found that female providers have higher rates of screening compared to male providers. One study reported a wide variation in guideline adherence by practice site not explained by patient case mix. The site with the highest proportion of adherence specialized in womens health.

Our study was designed to determine how well physicians in a large urban academic medical center adhere to the USPSTF 20002 guidelines for osteoporosis screening in women aged 65 years and older. We also wanted to determine if the rates of screening differed based on physician gender or clinic practice site, the General Internal Medicine Center (GIMC) vs. the Womens Health Care Center (WHCC).

METHODS: We accessed the Medical Information Networked Database (MIND) at University of Washington Medical Center (UWMC). The system stores the records of over 1.9 million UWMC patients. All women aged 65 or older who were seen in the GIMC or the WHCC at University of Washington Medical Center by internal medicine attending physicians between Jan.1, 2006 and Feb.2, 2008 were included in the study. There were 8 female and 15 male internal medicine attending physicians in the GIMC and 5 female internal medicine attending physicians in the WHCC. We excluded patients that were seen by gynecologists, nurse practitioners, or resident physicians. If the patients were seen by more than one provider during that time period, we reviewed the electronic medical record (EMR) to determine which physician was their primary care provider. A total of 1,363 of women were included in the study. We

Table: 1

Race Number
HbA1c before POCMDS
HbA1c after POCMDS
p-value
White 77 7.401.18 7.151.21 0.19 Black 472 7.511.47 7.251.41 <0.01 Hispanic 42 7.541.25 7.551.47

Table: 2

Race NumberSBP before
POCMDS
SBP after POCMDS
p-value
White 125 13216 13029 0.48 Black 678 13715 13423 <0.01 Hispanic 75 13422 13322

then queried MIND to determine which of these women had had BMD testing with Dual Energy X-ray Absorptiometry (DEXA) from 1994 through February 2009, regardless of the physician who ordered the test. Tables were generated that displayed the number of women seen in the clinic and the percentage of these patients who had BMD testing performed based on attending physician gender and clinic practice site (GIMC vs. WHCC). We also determined the number of women seen and the number who underwent BMD testing per individual physician. Using a Chi-Square analysis, we compared the percentage of women in this population who were screened for osteoporosis based on provider gender and clinic practice site.
RESULTS: The overall rate of screening of women aged 65 years and older with BMD testing was significantly higher in the Womens Health Care Center at 79.2% than in the GIMC at 66.7% ($p<0.001$). The rates of screening based on gender of the physician were 72.2% for female physicians (including female physicians in the GIMC and WHCC) and66.1 % for male physicians ($p=0.023$). When the screening rates of the female providers in the GIMC and WHCC were compared, the providers in WHCC screened at a significantly higher rate of 79.2% compared to67.3% in the GIMC ($p<0.001$). The number of study patients seen by an individual provider during the study period ranged widely, from 1 to 116. The proportion of patients screened by an individual provider varied from 33% -100%. There was no correlation between the number of patients seen by an individual physician and the percentage of patients who they screened.
CONCLUSION: We found that our screening rates for osteoporosis in women aged 65 and older were higher than reported in previous studies and ranged from 66.7% in the General Internal Medicine Center (GIMC) to 79.2% in the Womens Health Care Center (WHCC). These high rates of screening may be due to the academic setting, as both the GIMC and WHCC are teaching sites for residents and medical students.
We found that the practice site and not gender of the provider resulted in significantly different screening rates. There was a higher rate of screening by internal medicine physicians in the WHCC as compared to the physicians in the GIMC. Futures studies are needed to determine what factors influence BMD testing of postmenopausal women by physicians and how these can be addressed to improve diagnosing and treating osteoporosis. As health care reform places more emphasis on preventive care, there is hope that screening for this important disease will approach 100%.
WHY WOULD HOUSE STAFF CHOOSE TO WORK BEYOND THE HOUR LIMITS? Sarah J Nickoloff 1; Marilyn Schapira 2; Jeffrey Jackson 3; Jeff Whittle 4; Michael Frank 5; Kathlyn Fletcher6. 1Medical College of Wisconsin, Milwaukee, Wisconsin ; 2MCW, Milwaukee, Wisconsin ;
3Milwaukee VAMC/MCW, Silver Spring, Wisconsin; 4Milwaukee VA Medical Center, Milwaukee, Wisconsin ; 5MCW, MILWAUKEE, Wisconsin ; 6Milwaukee VAMC/MCW, Milwaukee, Wisconsin. (Tracking ID # 12232)
BACKGROUND: The Accreditation Council for Graduate Medical Education (ACGME) announced new duty hour guidelines to begin July 1, 2011. The new guidelines will allow occasional exceptions to the rules in circumstances limited to required continuity for a severely ill or unstable patient, academic importance of the events transpiring, or humanistic attention to the needs of a patient or family. It is unclear how often or in what situations house staff would consider using these exceptions. The purpose of our study was to quantify the frequency of these situations, and to describe circumstances in which house staff might consider using these exceptions.
METHODS: We conducted a cross-sectional survey study at a single academic tertiary care hospital. Participants were internal medicine
housestaff on inpatient ward services during the study period. House staff were notified about participation via email and announcements at house staff meetings. The anonymous survey consisted of demographic questions and 4 questions pertaining to the duty hour exceptions. In these 4 questions, we asked each house officer to

consider the 2 prior weeks of ward service and whether they would have used the anticipated exceptions, had they been allowed. Participants were also asked to provide a brief description of these situations. The study team reviewed these free text descriptions and identified themes using a grounded theory approach.
RESULTS: Fifty-one surveys out of 86 (59%) were returned. Interns and residents each accounted for 50% of the total. Thirty-five (69%) had encountered a situation in the last 2 weeks in which they wanted to stay longer than current duty hour rules allowed. The number of times participants wanted to stay in that period ranged from zero to nearly everyday. Of those indicating that they would have stayed beyond the allowable hours, 55% would have broken the 24 + 6 hour rule; 33%, the 10 hour rule; and 12%, the 80 hour rule. The most common reason to want to stay was continuity for an unstable patient (n=30, 59%) of the respondents. Humanistic attention for the family/patient was cited by 19 (37%). Eleven (22%) participants identified an educational opportunity, and 14 (27%) chose other. Descriptions of the situations which prompted house staff to want to stay spanned several themes: 1) Concern about workload for their own team and for the team covering overnight; 2) Patient acuity early that caused a redistribution of non-urgent work to the end of the shift; 3) Critical decision points inpatient care; and 4) The desire to preserve doctor-patient communication. Procedures were the major educational opportunity cited by house staff as a reason to stay.
CONCLUSION: Nearly 70% of house staff identified at least one time in the preceding 2 weeks in which they wanted to exceed current duty hour limits. The majority involved providing continuity for an acutely ill patient, however the doctor-patient relationship, humanistic attention to patients and workload were also commonly cited. We conclude that after July 1, situations will routinely arise during which housestaff will want to stay beyond duty hours. This may occur more frequently than anticipated by the ACGME. Training program leadership should be prepared to educate current and incoming house staff about these potential situations and have plans in place for dealing with such circumstances.
RETENTION AND SCREENING RATES OF IMMIGRANT PATIENTS IN THE SOUTH BRONX Anna E Jackson 1; Angela Jeffers 2; Nicole Sirotin 2; Hillary Kunins 1; Alda Osinaga2. 1Montefiore Medical Center, New York, New York ; 2Montefiore Medical Center, Bronx, New York. (Tracking ID # 12234)
BACKGROUND: Foreign-born adults in New York City are less likely than US-born adults to have a regular primary care provider or to receive age-appropriate cancer screenings. They also may not receive special screening, such as for Hepatitis B and intestinal parasites, appropriate to country of origin. Specific recommendations on which conditions to screen for, and in which populations, are lacking in the current literature. One proposed method of addressing these deficiencies in care is to hold a dedicated immigrant clinical session within a larger primary care practice. Our community health center (CHC) in the South Bronx, an academic teaching facility, holds a weekly clinical session to provide access to comprehensive primary care services for immigrant patients in our community. Local community-based organizations (CBOs) that work with predominantly immigrant populations refer patients and can arrange appointments within one week. Patient

navigators accompany patients to appointments and assist with registration and interpretation of any subsequent communication from the CHC. Patients are initially evaluated by resident physicians who are supervised by dedicated faculty. Patients then become a part of a given residents patient panel for subsequent follow-up visits. This study aims to evaluate the success of this dedicated immigrant clinical session model in A) achieving access to care through retention in primary care and B) providing appropriate screening for cancer and infectious diseases.
METHODS: We conducted a retrospective cohort study of all new patients seen for a new visit during a dedicated immigrant clinical session at our CHC from October 1, 2007 through September 30, 2009. We extracted data via chart review, incorporating information during the year following the initial visit. The primary outcome was retention in care, defined as at least one follow-up visit within one year after initial visit. The association of age, gender, length of time in the US, and chronic illness (diabetes, hypertension and asthma)

with retention was analyzed using chi-square statistic for categorical variables and Mann-Whitney test for continuous variables. Secondary outcomes included rates of age-appropriate cancer screenings and results of specific screening tests as recommended by the Centers for Disease Control and Prevention (CDC) for refugee populations, including Hepatitis B surface antigen (HBsAg), tuberculin skin test (TST), complete blood count (CBC), and ova and parasites in stool. The decision to screen for the later conditions was left to the providers clinical judgment, as no specific guidelines have been adopted for screening immigrant patients in this setting.
RESULTS: Between October 1, 2007 and September 30, 2009, 107 patients were seen for an initial visit during an immigrant clinical session at our CHC. Fifty-three percent were female. Mean age was 43 years. The majority of patients were from sub-Saharan Africa (71%) and Latin America (28%). Median time living in the US was seven years. Ninety-one percent of patients were uninsured. Eighty-four out of 107 patients (79%) returned for at least one follow-up visit within one year. The mean number of follow-up visits was 2.5 (range 114). We did not detect differences in retention based on age, gender, length of time in US, or presence of chronic illness. Amongst the female population in the cohort, 82% received age-appropriate mammography and 79% had appropriate cervical cancer screening. Twenty-four percent of patients in the cohort received age-appropriate colorectal cancer screening with either stool guaiac cards or colonoscopy. Eighty-three patients (78%) were screened for HBsAg, of which three patients (4%) were positive. Twenty-seven patients (25%) received a screening TST, of which 7 (26%) were positive. Seventy-eight patients (73%) received a screening CBC. Of these, 31% had anemia, 3% had eosinophilia and none had thrombocytopenia. Ten of the 107 patients were checked for ova and parasites in stool, of which three were positive (30%).
CONCLUSION: A dedicated immigrant clinical session model, partnering a CHC with local CBOs, can promote access to care through retention of immigrant patients in a continuity setting. For mammo-gram and cervical cancer screening of our patients, we were able to match the national rates of 79% and 83%, respectively. However, our rates for colorectal cancer screening fell below the national average of 62%. Further work must be done to improve patient and physician education regarding colorectal cancer screening in immigrant patients. Regarding immigrant-specific screening tests (HBsAg, TST, CBC, and stool for ova and parasites), we did not screen every patient, and the percentage tested varied. This variation is likely due to the lack of specific screening guidelines in immigrant populations. Current recommendations are largely focused on refugee populations, but the larger immigrant population might also benefit from similar screenings. Amongst our patient population, we found that over a quarter of
patients screened had evidence of latent tuberculosis, anemia, and intestinal parasites, rates consistent with previously published data on immigrant and refugee populations. This supports the need for clear recommendations regarding immigrant-specific screening. Our immigrant clinical session model of partnering a CHC with local CBOs can achieve patient retention in primary care and provide an appropriate setting for age-appropriate cancer screening. Further work needs to be done to improve rates of colorectal cancer screening within our model and to better understand which diseases need to be screened for in the immigrant population.
GENERAL MEDICAL VERSUS GERIATRIC CO-MORBIDITY COUNTS: OPPOSITE EFFECTS ON OVERALL QUALITY OF CARE IN COMPLEX GERIATRIC PRIMARY CARE PATIENTS Lillian Min 1; Eve Kerr 2; Caroline Blaum 1; Wenger Neil3. 1University of Michigan, Ann Arbor, Michigan ; 2University of Michigan and VA Center for Clinical Management Research, Ann Arbor, Michigan ; 3University of California, Los Angeles, California. (Tracking ID # 12237)
BACKGROUND: Prior research across multiple data sources suggests that patients with greater burden of co-morbid conditions receive better rather than worse quality of care. Because the treatment of geriatric conditions is time-consuming and often falls outside the traditional medical model, we hypothesized that the total burden of geriatric conditions would be associated with lower overall quality. Using data from the Assessing the Care of Vulnerable Elders-2 (ACOVE-2) study, a study that focused on the care of patients with both geriatric and medical conditions, we assessed the association between overall quality of care with both the number of

general medical conditions and the number of geriatric conditions.
METHODS: As part of the ACOVE-2 study, 644 patients age >=75 who screened positive for symptoms of at least one of 3 geriatric conditions were enrolled in a practice-based intervention to improve the care of dementia, falls, and urinary incontinence. To assess care quality, we constructed an overall quality of care score that was a composite of 98 process of care quality indicators (QIs) that measured the care of preventive, general medical, and geriatric conditions (# of QIs passed divided by number of QIs eligible) over a 13 month observation window for each patient. We also constructed separate counts of general medical conditions (coronary artery disease, atrial fibrillation, congestive heart failure, cerebrovascular disease, diabetes, and chronic obstructive lung disease) and geriatric conditions (dementia, falls or fear of falling, bothersome urinary incontinence, osteoporosis, hearing impairment, malnutrition) documented in the medical record during the observation window for each patient. To assess association between co-morbidity counts and overall quality we used multivariable regression, controlling for age, gender, vulnerability to death and decline, number of primary care visits, and ACOVE-2 control vs intervention site.
RESULTS: The mean number of general medical conditions was 1.9 (SD1.3, range 06) and the mean number of geriatric conditions was 1.6 (SD0.8, range 04). The two counts were uncorrelated (r=.04, p=.3). Nearly all (95%) had at least one conditions in both categories, and more than half (52%) had at least 2 conditions in each category. On average, each additional general medical condition was associated with a 5% point increment in overall quality, while each additional geriatric condition was associated with a 3.2% point decrement, independent of each other and the multivariable controls (p<.001 for both). A moderately-complex patient with 1 general medical and 1 geriatric co-morbidity had a predicted overall quality of 53% (95% CI 50-57%). Adding 2 additional general medical co-morbidities to this hypothetical patient increased the

predicted overall quality to 60% (95% CI 57-64%) whereas adding 2 additional geriatric co-morbidities decreased expected overall quality to 42% (95% CI 38-46%).
CONCLUSION: While a greater number of general medical conditions was related to better quality of care, patients with a greater burden of geriatric conditions received worse overall quality of care, suggesting a need to focus on improving care for patients with multiple geriatric conditions.
DOES COMPLIANCE WITH THE HEART FAILURE INPATIENT QUALITY MEASURES PREVENT HOSPITAL READMISSION? Sarah Bou Malham 1; Mario Njeim 1; Nikhil Ambulgekar 1; Alaali Yathreb 1; Mahmoud Assaad 1; Mustafa Abas2. 1Henry Ford Hospital, Detroit, Michigan ; 2Henry Ford Hospital, detroit, Michigan. (Tracking ID # 12238)
BACKGROUND: Congestive heart failure national inpatient quality measures were developed by the Joint Commission in conjunction with the Center of Medicare and Medicaid Services and the American Heart Association. Although most of these measures have evidence-based foundation, data supporting their effect on patient outcomes are sparse and controversial. There is currently an urgent need to assess compliance rates, and most importantly to further analyze the efficacy of the core measures for prevention of re-hospitalization.
METHODS: We conducted a retrospective cohort study on patients discharged from a major urban hospital between June 2009 and October 2009 with a primary diagnosis of heart failure. We reviewed compliance with each of the 4 mandatory core measures: assessment of left ventricular function (LVF), use of angiotensin-converting enzyme inhibitor (ACE) or angiotensin-receptor blockers (ARB), smoking cessation education and heart failure discharge instructions. A univariable cox-regression analysis was conducted with each factor for prediction of hospital readmission. In addition, a compliance score (ranging from 0 to 4) defined as the number of measures in compliance was generated for each patient. This score was tested using a cox-regression model for prediction of all-cause hospital readmission. RESULTS: 285 patients were included in the study. Mean

follow-up was 5 months. Readmission rate at 30 days was 23.3%. Compliance rates with individual measures were the following: assessment of LVF 84.7%, use of ACE or ARB 72.8%, smoking cessation education 100% and heart failure discharge instructions 74.6%. Each one of the 4 quality measures was independently a poor and statistically non-significant predictor of readmission. Results of the univariable cox-regression analysis were the following: assessment of LVF (HR 0.95; 95% CI 0.65-1.38; P=0.78), use of ACE or ARB (HR 0.91; 95% CI 0.67-1.24; P=0.57) and heart failure discharge instructions (HR 1.04; 95% CI 0.75-1.44; P=0.79). The sample size breakdown according to the compliance score was as follows: 4 patients had a score of 1, 39 had a score of 2, 104 had a score of 3 and 138 had a score of 4. The compliance score showed to be a poor and statistically non-significant predictor of readmission based on the cox-regression results (HR 0.98; 95% CI 0.78-1.22; P=0.86). CONCLUSION: Compliance with the four mandatory heart failure quality measures did not translate into a significant increase in the time free of readmission. While adherence to these measures is currently a major quality marker that is reported to the public and tied to reimbursement, healthcare providers should reassess the way these measures are being implemented as well as their cost effectiveness. There is also an obvious need to generate new evidence-based and personalized performance measures that have a more significant impact on readmission rates and the overall outcome of heart failure patients.

MEDICAL SYMPTOMS IN PATIENTS WITH DISSOCIATIVE DISORDERS Samantha A Miller 1; Brad Foote1. 1Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, New York. (Tracking ID # 12241)

BACKGROUND: Although the negative impact of Posttraumatic StressDisorder (PTSD) on general health is increasingly recognized, the clinicalcorrelates of other trauma-related psychiatric disorders remainsunderstudied. DissociativeDisorders also may occur after trauma, most often severe and prolongedchildhood trauma. Our objectivewas to evaluate associations between Dissociative Disorders and self-reportedmedical symptoms in a sample of primarily poor minority psychiatric outpatientsin Bronx, NY. We hypothesized thatDissociative Disorders would be associated with an increased likelihood ofcommon medical symptoms independent of medical comorbidity as well as the psychiatricconditions major depression and PTSD.

METHODS: We analyzed preliminary data for 222 out of a targeted 320 patients in a cross-sectional study of English-speaking adults aged 1860 years initiating care at an outpatient psychiatric clinic in Bronx, NY. We assessed demographic data, medical and psychiatric profile, and substance use history through patient interview and chart review. Dissociative Disorders were diagnosed with the Structured Clinical Interview for DSM-IV Dissociative Disorders (SCID-D). Lifetime Major Depression and PTSD were diagnosed with the Structured Clinical Interview for DSM-IV Disorders. Medical symptoms were assessed with a self-report measure featuring alist of 21 common medical complaints administered to all patients at their first visit. A Charlson Comorbidity Score was calculated based on medical chart review. We used backward stepwise logistic regression to evaluate associations between medical symptoms and Dissociative Disorders. Variables entered into the model were age, sex, marital status, race/ethnicity, education, smoking, alcohol and illicit substance abuse or dependence, lifetime Major Depression and PTSD, Charlson Comorbidity Index score and psychiatric medication use.

RESULTS: Among 222 patients analyzed, the mean age was 37 years 13, 70% were female and 62% were Hispanic. Most had a high school diploma or less (68%), were unemployed (67%) and on Medicaid or uninsured (88%). Childhood abuse was reported by 71%, most often emotional abuse (58%) followed by physical (50%) and sexual abuse (47%). Just over 30% had a lifetime Dissociative Disorder, 78% had Major Depression and 51% had PTSD. Most patients had a Charlson Comorbidity Index Score of 0 (69%). The mean (SD) number of medical symptoms reported was 5.4 3.8 with 58% reporting 5 or more symptoms. The most commonly reported symptoms were energy problems (69%), weight problems (60%), shortness of breath (53%), appetite problems (53%) and unspecified pain (44%). On backward stepwise logistic regression, Dissociative Disorders were independently associated with fever (AOR5.98 CI 1.06 - 33.63, p=0.04), unspecified pain (AOR 2.19 CI 1.16 -

4.11, p=0.02), blurred vision (AOR 2.19 CI 1.18 - 4.09, p=0.01), nausea/vomiting (AOR 2.78 CI 1.37 - 5.63, p=0.004), dysuria (AOR3.43 CI 1.04-11.32, p=0.04) and bruising/bleeding tendency (AOR2.55 CI 1.23 - 5.26), p=0.01).
CONCLUSION: In this sample of primarily poor, minority psychiatric outpatients, the presence of Dissociative Disorders was associated with a higher frequency of health complaints commonly seen in primary care independent of medical comorbidity score, psychiatric medication use, Major Depression and PTSD. Future studies should investigate associations between Dissociative Disorders, medical diagnoses and patientoutcomes.

THE ASSOCIATION BETWEEN LOCAL FOOD ENVIRONMENT AND ADULT OBESITY AND DIABETES
Demetria Malloy-Gaston 1; Susan Babey 2; Allison Diamant3. 1Robert Wood Johnson Foundation Clinical Scholars Program, University of California at Los Angeles Dept of Medicine/Div of Health Services, Los Angeles, California ; 2University of California at Los Angeles Health Policy Group, Los Angeles, California ; 3University of California at Los Angeles Dept of Medicine/Div of Health Services, University of California at Los Angeles Health Policy Group, Los Angeles, California. (Tracking ID # 12247)
BACKGROUND: The consumption of high fat and high caloric fast foods, and lower rates of eating fruits and vegetables, are associated with a higher prevalence of both obesity and diabetes, and have added to both epidemics with both diseases and to individual and societal health care costs. Access to healthier foods and the opportunity to make choices in the built environment are important components in the battle against these epidemics. However, the most accurate way to represent the effect of the built environment has not yet been established. The objectives of this study are: 1) to investigate the relative availability of different types of food retailers - those who provide relatively less nutritious versus more nutritious food options - around peoples homes, 2) to assess whether differences in the ratio (Retail Food Environment Index -RFEI) of these venues is associated with obesity and diabetes among adults in California, and 3) to assess how these measures of food availability vary by race/ethnicity and income. Previous work using the RFEI was more limited in the food venues included and with further inclusiveness of food vendors this project better represents food choices, or lack of choice that people are exposed to around their homes.
METHODS: Data from the adult respondents of the 2007 California Health Interview Survey (CHIS 2007), a statewide population health survey, was geocoded with GIS software and linked with the 2007 InfoUSA Business File, a geographic listing of food retailers. The RFEI, a ratio of the number of less nutritious food vendors (fast-food restaurants, convenience stores, pharmacies) to the number of more nutritious food vendors (supermarkets, warehouse stores, fruit/ vegetable stores, farmers markets), will be calculated for varying buffers (1 mile, 2 miles, 5 miles) around adult CHIS respondents homes based on their level of urbanicity. We will use bivariate analyses and multivariate logistic regression modeling to assess the association of RFEI with obesity and diabetes, as well as with race/ ethnicity and income.
RESULTS: The prevalence of obesity among adults is 22.5%, while nearly 8% of California adults have been diagnosed with diabetes. Lower income, minority race or ethnicity and obesity are associated with living in areas with higher RFEI. 36.3 % of lower income adults (0-199% FPL) compared to32.1% of higher income adults (>400% FPL) live in areas of the highest RFEI (>8) (P<0.05). 39.2%% of African-Americans and36.3% of Latinos compared to 32.1% of whites live in these least healthy food environments (p<0.05). Additionally, 24.6% of people who live in areas of the highest RFEI (>8) are obese, while in areas with the lowest RFEI (<4), 20.6% of adults are obese. There were no significant differences for diabetes.
CONCLUSION: The lower the ratio of unhealthy food venues to healthy food vendors near peoples homes, the more choices people will have to consume more nutritious foods. This increased choice provides a possible means of slowing the growing obesity and diabetes epidemics. Partnership with city planners, local retailers, public health officials and community representatives will be key to bringing in more healthy food options to

those food deserts where choice is limited or not available.

RECALL OF CANCER SCREENING AND PREVENTION RECOMMENDATIONS FROM A BRCA GENETIC TESTING AND COUNSELING PROGRAM Erika Leemann Price 1; Jennifer Creasman 1; Mary Beattie2.
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2University of California - San Francisco, Millbrae, California. (Tracking ID # 12251)

BACKGROUND: As BRCA testing for hereditary breast and ovarian cancer syndromes has become increasingly available and accepted, the need for effective communication of the meaning of test results for cancer screening and prevention has become more important. BRCA results may be positive, meaning a known deleterious mutation is found; true negative, meaning the patient tests negative for a known family BRCA mutation; or non-definitive, meaning no known deleterious mutation is identified in the patient or her relatives. Most women have non-definitive BRCA results, for which the implications are not fully understood; these results may be particularly difficult to understand or remember. Understanding the recollections of patients who have participated in a genetic counseling and testing program may contribute to improved communication. We compared recollection of receiving screening and prevention recommendations in women who received definitive and non-definitive BRCA results from a cancer risk program (CRP) which provides personalized recommendations to all participants. We also sought to determine whether women received differing screening recommendations from the CRP than from elsewhere and whether recollection was associated with satisfaction with the decision to undergo genetic testing.

METHODS: We analyzed survey data from women who had undergone BRCA testing and genetic counseling within a university hospital CRP. Participants had personal and/or family histories suggestive of hereditary breast and ovarian cancer. All had hour-long genetic counselor appointments to discuss their BRCA results, and all had received written letters with personalized recommendations for screening and prevention based on BRCA results and other risk factors, reflecting expert opinion in the field. Our main outcomes were responses to two survey questions: Did you receive cancer screening recommendations from the CRP? and Did you discuss cancer prevention options with the CRP? Women who recalled receiving screening recommendations also reported whether these recommendations differed from others they had received. We stratified results by BRCA test result and prior diagnosis of cancer. To determine whether recollection was associated with higher satisfaction with the decision to undergo genetic testing, we conducted multivariable logistic regression analysis predicting recollection of receiving screening recommendations or discussing prevention options; our primary predictor was strong agreement with the statement I am satisfied with my decision to undergo genetic testing for cancer risk. We controlled for BRCA test result, prior diagnosis of cancer, age, and elapsed time since BRCA testing. RESULTS: Of 1078 English-speaking respondents, 18% had positive BRCA results; 72% had non-definitive results; and 10% had true negative results. 757 (70%) had a prior diagnosis of cancer, with most cancers being breast (62%) or ovarian (7%). 554 women (51%) reported receiving screening recommendations from the CRP and 490 (46%) reported discussing cancer prevention options. Women with positive BRCA results were more likely than those with non-definitive or negative results to remember receiving screening recommendations and discussing prevention options. Women with a personal history of cancer were less likely to remember receiving these recommendations than women without cancer (Table 1). Of the 554 who recalled receiving screening recommendations, 25% reported that CRP recommendations differed from those received elsewhere. Among women without cancer,

those with non-definitive results were more likely than those with positive or true negative results to report differences between CRP screening recommendations and other screening recommendations (differences in recommendations reported in 33% of non-definitives vs 14% of positives vs 17% of true negatives; p=.025).

Most women reported strong (64%) or moderate agreement (32%) with the statement I am satisfied with my decision to undergo genetic testing for cancer risk. In multivariable analysis, strong agreement was modestly but significantly associated with recalling receiving screening recommendations from the CRP; BRCA-positive status and no personal history of cancer were also independently associated with recollection of screening and prevention (Table 2).
CONCLUSION: Although all women in this Cancer Risk Program received in-person and written recommendations for screening and
prevention after BRCA testing, nearly half did not remember receiving these recommendations. This is particularly evident for women with non-definitive or negative BRCA test results, and for women already diagnosed with cancer. Women with non-definitive results were more likely to report receiving conflicting screening information compared to women with definitive results. These findings may reflect patients perceptions of the importance of these recommendations, as well as the nature and clarity with which these recommendations are provided. Greater satisfaction with the decision to undergo testing/counseling among women who do recall receiving recommendations and discussing prevention suggests that attention to communicating implications of all results for screening and prevention should be central to quality improvement in genetic counseling and testing programs.
A RETROSPECTIVE REVIEW OF AN EMERGENCY DEPARTMENT EVALUATION AND MANAGEMENT OF ACUTE GASTROENTERITIS IN A COMMUNITY HOSPITAL Megha Kothari 1; Macijec Walzcyszyn2.
1Lenox Hill Hospital, Jersey City, New Jersey ; 2Lenox Hill, New York City, New York . (Tracking ID # 12252)
BACKGROUND: The incidence of acute diarrhea in the United States annually is 375 million with nearly 1 million hospitalizations. Several societies, namely WGO and ACG have detailed recommendations for medical evaluation, microbiology/laboratory investigation,administering antibiotic therapy, and identifying patients who need inpatient care. Given the high incidence rate, the economic burden of inappropriate evaluation(i.e. stool cultures and (CT)) and contributing to antibiotic resistance may be improved with following recommendations. Theaims of this study were to 1.) identify the number of ED visits at LHH during August 2010 for acute diarrhea; 2.) identify the number of patients admitted with the following WGO/ACG criteria (signs of dehydration, changing mental status, fevers >101 F, visible blood in stool,frequency >6/ day, intractable vomiting, and/or symptom duration >48 hrs); 3.) identify the number of patients treated with antimicrobial therapyaccording the following WGO/ACG criteria (dysentery, age >50, mod-severetravelers diarrhea (>6 episodes/day), fevers >101, positive stoolcultures, fecal leukocyte positive);4.) identify the percentage of patients who received (CT) scans; and 5.) identify the number of patients who wereordered stool cultures according to WGO/ ACG recommendations and the incidenceof a positive result. METHODS: We performed a single-center, retrospective clinical record review of patients whovisited the LHH ED and were given ICD diagnoses of diarrhea,gastroenteritis, colitis, and enteritis during August 2010. Patients wereexcluded based on a certain criteria. For

each patient, the following information was extracted: age, number of stools, dysentery, fevers >101,symptoms >48 hrs, dehydration (clinically/vital signs), mental statuschanges, antimicrobial therapy, CT findings, travel history, fecalleukocytes/fecal occult positive, admitted or discharged, past medical historyof IBD, IBS, or malabsorptive diseases.
RESULTS: A total of 99 charts were reviewed and 74 patients were included in ourstudy. The admission rate was 25.7% andall patients were admitted according to WGO/ACG recommendations. 41.9% ofpatients were given antibiotics and of this 25.6% of patients were givenantibiotics not in adherence with WGO/ACG recommendations. 27% received CTscans, with a 75% incidence of a colitis finding.Stool cultures were ordered on 24.3%,66.6% haddocumented results, zero cultures yielded a positive result, and83.3% of stoolcultures were ordered appropriately.
CONCLUSION: We conclude that the management and evaluation of acute gastroenteritis is doneappropriately

in this community hospital, which is cost effective and minimizesincreasing antibiotic resistance.

WHAT MAKES A PERFECT DISCHARGE SUMMARY: FACULTY AND RESIDENT CONSENSUS Briar Leigh Duffy 1; James Bost 2; Melissa McNeil2. 1University of Pittsburgh/VA Pittsburgh, Pittsburgh, Pennsylvania ; 2University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 12260)

BACKGROUND: High quality discharge summaries are critical to ensuring effective transitions of care for hospitalized patients after discharge. Retrospective analyses of discharge summaries shows they are missing information about pending tests 75-87% of the time and about the follow-up provider 33% of the time. Medication discrepancy errors have been shown to occur in 29-42% of discharge summaries. Although the Joint Commission requires six discharge summary components, no studies have explored provider preferences on how the components should be written. Internal medicine residents remain confused about how to write a discharge summary. The goal of this needs assessment was to survey faculty and residents to assess their views about the preferred structure, organization, and content ofthe ideal discharge summary in order to develop a discharge summary curriculum for internal medicine residents.

METHODS: A web-based survey was developed through an iterative process among the authors. The survey consisted primarily of items rated on a 5-point Likert scale as well as open-ended responses. Topics included characteristics of a high-quality discharge summary, possible components of a discharge summary, current quality of discharge summaries, and demographic characteristics. It was pilot-tested with general medicine fellows at the University of Pittsburgh. The survey was sent to University of Pittsburgh faculty members in the Division of General Internal Medicine and University of Pittsburgh internal medicine and medicine-pediatrics residents in the spring of 2010. After the first invitation to complete the survey, two reminder e-mails were sent.

RESULTS: The response rate was 41% (113 respondents). Respondents reported statistically significant discrepancies between components that should be present and the existing quality of those components in 9 of 17 possible discharge summary components. These components included the list of diagnoses, reason for hospitalization, hospital course, pending tests at discharge, and the follow-up plan. They reported that the sections needing the most improvement were the hospital course (35.7% of respondents) and medication list (33%). They preferred a problem-based hospital course to a chronological account (73%) and a detailed medication list identifying changes from a pre-admission list (66%). They also thought discharge summaries should be more concise (47%) and accurate (17%) with a better integration of the hospital course and discharge plan (44%). The faculty reported that the current quality of discharge summaries at UPMC-Presbyterian was 3.5/5, but the residents reported it to be 3.9 (p-value=0.001). Overwhelmingly, respondents preferred to receive a discharge summary electronically.

CONCLUSION: Internal medicine faculty and residents at the University of Pittsburgh identified the hospital course and medication list as key components of discharge summaries that need improvement. Specific preferences for content and organization of high quality discharge summaries were identified that can inform future efforts at improving the quality of discharge summaries in resident training programs.

HOSPITAL HANDOFFS: A DESCRIPTIVE ANALYSIS OF WRITTEN SIGN-OUT CONTENT AND AN EXPLORATION OF A SIGN-OUT QUALITY ASSESSMENT TOOL Donna Miller 1; Marilyn Schapira 1; Alexis Visotcky 2; Prakash Laud 3; Vinny Arora 3; Kathlyn Fletcher4.

1MCW, Milwaukee, Wisconsin ; 2MCW, MILWAUKEE, Wisconsin ; 3University of Chicago, Chicago, Wisconsin ; 4Milwaukee VAMC/MCW, Milwaukee, Wisconsin. (Tracking ID # 12264)

BACKGROUND: Patient handoffs serve as critical transitions in patient care. The content and quality of the written patient handoff or sign-out may be coupled with adverse events and near misses in hospitalized patients. Existing recommendations on necessary components of the handoff are varied and based primarily on expert consensus and provider feedback. This project aims to 1) provide a descriptive analysis of the content of electronic health record-assisted written sign-outs and2) explore a scoring system of key components of the

sign-out that may be used as a tool to assess sign-out quality.
METHODS: The impact of discontinuity of care on hospitalized patients study was a prospective, 12-month study of randomly selected patient hospitalizations at 3 academic medical hospitals in Milwaukee,WI. As part of this study, the written sign-out documents were collected. Based on a literature review, we identified 12 desired components of a high quality sign-out (e.g. presence of team information, baseline examination, and anticipatory guidance). We assessed each sign-out for the presence of those components, and combined them into a sign-out quality score (SQS) of 012. We also abstracted additional contentrelated to quality (such as the use of vague language or conflicting information). In addition, a global impression or gestalt quality score (15 scale) was given to each sign-out. Descriptive analyses about the quality of the sign-out documents were performed, and some comparisons were made between initial and subsequent day sign-outs.
RESULTS: A total of 206 randomly selected patient hospitalizations were reviewed (206 initial sign-outs, 472 subsequent day sign-outs). Mean age of patients was 68 (SD 14); 5% were women. Nearly all of the teams used a sign-out that was partially generated by the electronic medical record. For the initial sign-out, mean score was 6.37 (median 7, SD2.38, range 111). Computer generated components were nearly universally present, such as code status (97%) and patient identifiers (99%). Physician entered data was present less frequently: baseline exam was present in 30% of sign-outs, plan of care in 78%, anticipatory guidance in 38%, and mental status in 12%. Initial sign-outs were significantly less likely than subsequent sign-outs to include tests/results (38% v. 47%, p=0.035), whether the patient is sick (8%v. 14%, p=0.049), confusing/conflicting information (12%v 37%, p=0.034), or vague language (28% v. 40%, p=0.002). Of note, 36% of subsequent sign-outs were duplicate copies of the prior days sign-out. SQS was significantly worse as the patient census increased (r-squared=0.24, p <0.001). Global impression of sign-out qualitycorrelated with the SQS (p<0.0001).
CONCLUSION: In these computer generated sign-outs, key identifying information (e.g. patient identifiers, allergies, code status) is present in the majority of cases. However, physician-entered communication such as plan of care, anticipatory guidance, and contingency plans are not

consistently present. Sign-out quality seems to decrease in subsequent hospital days compared to the initial day. This quality assessment score may provide a template for standardization of written sign-out components.
COMPARING EFFECTS OF DIETARY SOURCES OF VITAMIN D &MULTIVITAMIN SUPPLEMENTATION ON 25(OH)D LEVEL AMONG AFRICAN-AMERICANS VS CAUCASIANS Sameer Murali 1; Sameer B Murali 2; Lenore Arab 2; Alfonso Ang 2; Ronald L Horst3. 1UCLA, Anaheim, California ; 2University of California, Los Angeles, Los Angeles, California ; 3Heartland Assays Inc., Ames, Iowa. (Tracking ID # 12277)
BACKGROUND: Serum vitamin D [25(OH)D] levels are inversely related to skin pigmentation, resulting in lower levels among African-Americans (AA) compared to Caucasians. While this relative insufficiency does not translate into a higher prevalence in bone-related morbidity, observational evidence suggests that it significantly contributes to racial disparities involving cardiovascular disease. Supportive experimental evidence is limited in that studies are underpowered to evaluate the effects of vitamin D supplementation on health outcomes among AA, or they assume a uniform effect of supplementation on serum levels across racial groups. In order to interpret the morbidity of vitamin D insufficiency among AA, a greater understanding of the relationship between supplementation and dietary sources of vitamin D on serum 25(OH)D levels by racial group is necessary. The objective of this study is to investigate contrasts in determinants of serum 25(OH)D levels among AA and Caucasians, with an emphasis on dietary sources of vitamin D and multivitamin supplement (MV) use.
METHODS: 242 Caucasians (n=122) and AA (n=120) residing within 50 miles of UCLA participated in a cross sectional study to validate a web-based, automated, self-administered 24-hour recall (DietDay). Participants completed 8 DietDays over 2 months. Blood and urine samples were also collected from participants at study

visits for numerous biomarkers,including 25(OH)D. Parallel multiple linear regression models stratified by race were used to determine the relationship between age, gender, BMI, and major dietary sources of vitamin D (fish, milk,and MV) on serum 25(OH)D. Subjects with standardized residuals >3 were identified as outliers and dropped from the analysis, resulting in the reduction of both groups by 1 subject each.
RESULTS: 17% Caucasians had serum 25(OH)D <20 ng/mL compared to 61% of AA. AA race resulted in 17 ng/mL reduction in serum vitamin D controlling for age, BMI, gender, dietary sources of vitamin D, and race-BMI interaction. MV intake accounted for the largest rise of serum 25(OH)D in both racial groups. Among AA, MV intake was associated with a 36% higher increase (8.6 ng/mLvs6.3 ng/mL) in of serum 25(OH)D compared to Caucasians. 8 fl oz of milk significantly raised serum vitamin D levels approximately 4 ng/ mL among AA and 3.6 ng/mL among Caucasians. Fish consumption significantly raised serum vitamin D levels approximately 2 ng/mL per 3 oz serving among Caucasians, but was not significant among AA. The R-squared statistics for the AA and Caucasian models were0.18 and 0.28 respectively.
CONCLUSION: Serum vitamin Ds response to dietary sources of vitamin D differs based on race. MV supplementation is more effective at raising serum 25(OH)D levels than dietary sources, especially among AA. As AA are at higher risk of 25(OH)D insufficiency, providers should consider encouraging their AA patients to initiate MV supplementation.
SURGICAL COSTS ASSOCIATED WITH SMOKING IN VETERANS UNDERGOING GENERAL SURGERY
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1University of Iowa Hospitals and Clinics, VA Medical Center, Iowa City, Iowa. (Tracking ID # 12278)
BACKGROUND: Approximately 30% of general surgery patients undergoing elective surgery smoke cigarettes, and an estimated 10 million procedures are performed on smokers every year in the US. Smoking has been shown to be associated with poor wound healing as well as increased postoperative pulmonary and cardiovascular complications. The objectives of this study are: 1) to compare total inpatient costs in current smokers, former smokers, and never smokers undergoing general surgical procedures in VA hospitals, and 2) to determine whether the relationship between smoking and costs is mediated by postoperative complications.
METHODS: This study was performed using two data sources: First, general surgical patients were identified in the VA Surgical Quality Improvement Program data set (VASQIP), which includes abstracted
Table: 1
African-American
Regression model results for 25(OH)D (ng/mL) on dietary sources stratified by race
Coefficient SE
p-value
-0.02
0.07 0.79 gender* -2.08
1.79
0.25
age (years)
BMI (kg/m2
) -0.27
0.12
0.03
multivitamin
(pill)
8.63 2.5
0.001
milk (8 fl oz)

3.98
1.84 0.03
fish (3 oz)
1.21
1.02 0.24
Caucasian
Coefficient SE
p-value
age (years)
-0.17
0.07 0.01 gender* -4.58
1.59
0.01
BMI (kg/m2
) -0.53
0.18
0.004
multivitamin
(pill)
6.48 2.6
0.01
milk (8 fl oz)
3.64
1.42 0.01
.02 *reference category for gender is male SE=standard error
fish (3 oz)
1.94
0.8

medical record data (including smoking status) for VA surgical patients. Second, inpatient costs of care were identified in the VA Decision Support System (DSS), which provides the costs of individual patient encounters on the basis of the relative values assigned to medical services. Relative to never smokers (reference category), surgical costs for current and former smokers were estimated using generalized linear regression models with adjustment for preoperative variables (demographics, comorbidities, functional status, and laboratory values), operative variables (urgency of surgery, complexity of surgery), and hospital-level variation. Costs included those incurred during the index hospitalization and during readmissions within 30 days of surgery. RESULTS: The 14,853 general surgical patients, 34% were current smokers, 39% were former smokers, and 27% were never smokers. Unadjusted costs were significantly higher for current and former smokers relative to never smokers: relative costs (95% CI) were 1.11(1.06- 1.15) and 1.15 (1.10-1.19), respectively. After controlling for patient covariates, current smokers still had significantly higher costs compared to never smokers: relative cost was 1.04 (1.00-1.07); costs for former smokers did not differ significantly from those of never smokers: relative cost was 1.02 (0.99-1.06). The relationship between smoking and surgical costs was partially mediated by surgical complications. Relative costs for current smokers were no longer statistically significant after accounting for any surgical complications: 1.02 (0.991.05). CONCLUSION: Smokers undergoing elective general surgery have modestly increased surgical costs compared to never smokers, in part related to increased postoperative complications. Our results suggest that efforts to improve

surgical outcomes and reduce hospital costs in general surgery patients should place greater emphasis on helping patients quit smoking preoperatively.

URINARY TOBACCO BIOMARKER AND ASTHMA EXACERBATION IN THE UNITED STATES Elisa Tong 1; Hao Tang2. 1University of California, Davis, Sacramento, California ; 2California Department of Public Health, Alameda, California. (Tracking ID # 12279)

BACKGROUND: Tobacco biomarkers have mostly been used for research validation purposes and not as a clinical tool for preventive medicine. The U.S. Surgeon General has concluded there is no risk-free level of tobacco smoke exposure, but relying on patient self-report may be limited by recall bias. One promising tobacco biomarker is urinary 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL), a carcinogen that is highly sensitive and specific for tobacco exposure. NNAL reflects a longer period of exposure (23 months) than the more commonly used cotinine (nicotine metabolite reflecting past few days) and better reflects secondhand smoke exposure. Our objective was to examine the association between NNAL levels and asthma exacerbation in the national smoker and nonsmoker population.

METHODS: We examined NNAL logarithmic levels in the National Health Examination and Nutrition Survey (NHANES) 20072008, the first year urinary NNAL was measured. Regression models were developed to determine the association between NNAL on two self-reported outcomes among the adult population (>20 years old) who report having asthma currently: 1) past year asthma exacerbation and, among this group, 2) past year emergency room/urgent care visit for asthma. The models were adjusted for factors known to be significantly associated with NNAL levels: age, race/ethnicity, gender, active or nonsmoking status (based on the Centers for Disease Control defining active smokers as having short-term cotinine levels 10 ng/ml, since self-reported status had significant missings), and creatinine. We also adjusted for education status (high school vs. college+) since this may be a proxy for asthma management. All analysis was conducted using SAS 9.1 PROC TTEST, PROC SURVEYFREQ and PROC SURVEYLOGISTICS to account for complex survey design.

RESULTS: A total of 456 participants had asthma with 50% reporting a past year asthma attack, with 25% of these also visiting the emergency room/ urgent care in the past year for asthma. Of those with asthma, 27% were considered active smokers and 73% were considered nonsmokers. The median concentration of NNAL was 0.0013 ng/ml in those without a past year asthma attack, 0.0065 ng/ml in those with a past year asthma attack, and 0.123 ng/ml in those who also had a past year emergency room/urgent care visit for asthma. In bivariate analyses, NNAL was significantly associated with past year asthma exacerbation OR=1.29 (95% CI 1.10-1.52) (p=0.002) and past year emergency room/urgent care visit for asthma OR=1.55 (95% CI 1.32-1.81) (p<0.001). In multivariate regression analyses, the associations with NNAL were still significant for the former OR=1.71 (95% CI 1.29-2.27) (p<0.001) and the latter OR=1.78 (95% CI 1.12-2.85) (p=0.02). The only significant independent variable was age in the multivariate model for past year emergency room/urgent care visit for asthma (p=0.04). CONCLUSION: This is the first study to link NNAL levels with asthma exacerbation in the national smoker and nonsmoker population. Higher levels of NNAL are associated with past year asthma exacerbation and emergency room/urgent care visits for asthma, even after adjustment for demographic and clinical variables. This association warrants future prospective investigation into NNAL as a potential screening tool to prevent asthma exacerbation and to decrease utilization of emergency and urgent care services.

DOES PUBLIC REPORTING IMPACT QUALITY OF CARE IN WISCONSIN? Geoffrey C Lamb 1; Maureen Smith 2; William B Weeks 3; Alexandra Wright 2; Daniel Gottlieb 3; Matthew Gigot 4; Lucy Stewart1. 1Medical College of Wisconsin, Milwaukee, Wisconsin ; 2Health Innovation Program, University of Wisconsin, Madison, Wisconsin ; 3The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, New Hampshire ; 4Wisconsin Collaborative for HealthCare Quality, Madison, Wisconsin. (Tracking ID # 12280)

BACKGROUND: The Wisconsin Collaborative for Healthcare Quality (WCHQ) is a voluntary, statewide consortium of physician groups, hospitals, health plans and employers working together to improve health care in Wisconsin by publicly reporting comparative measures of healthcare quality. However, there has been no

formal evaluation of the impact of the WCHQs public reporting efforts. This project was designed to establish whether public reporting of ambulatory quality measures by WCHQ is associated with improvement in the delivery of recommended interventions and outcomes. To separate the effects of public reporting from other trends, the project took a three-pronged approach: 1) determine whether there was improvement among WCHQ participants with respect to the measures being reported; 2) survey participants to see how they responded to the information as it was reported; and 3) compare the rate of improvement within the WCHQ to areas not participating in the WCHQ. METHODS: WCHQ member groups commit to report outcomes for 13 ambulatory quality measures annually. They collect and report their own data either from random chart review, electronic capture, or a combination of the two (hybrid). All results are audited using a standardized method. WCHQ longitudinal analysis - In this analysis each measure was assessed to determine if there was an improvement in the mean performance of all organizations. A pairwise t-test and Tukeys range test were performed on each measure for each year. Subsequent analysis was performed to determine how many years were required to achieve statistically significant improvement for each measure. Survey- The University of Wisconsin Survey Center conducted a mail survey of the physician groups and their related clinics. The survey contained 3 sections: clinic characteristics; whether projects were undertaken in response to WCHQ reporting; and specific improvement initiatives. Comparisons to non-WCHQ participants-

The Dartmouth Institute (TDI) worked with MMI, a subsidiary of IMS Health. The MMI dataset allows for identification of physicians who work at specific sites. Using a 20% sample of Medicare beneficiaries, TDI assigned patients to physicians based on a majority of their visits, giving priority to primary care MDs. Based on these assignments, patients were characterized as WCHQ related, Wisconsin- Non WCHQ, Iowa/ South Dakota and the rest of the United States. 3 diabetes process measures were captured: eye exams, lipid profiles and HgbA1c tests. Mammography was determined for women aged 6769. Compliance rates were calculated and compared between sites and for each year 20042007.

RESULTS: For WCHQ as a whole, each measure showed an improvement in performance during the study period 20042008. This improvement was statistically significant in all measures reported for at least 3 years (HgbA1c testing, LDL testing, LDL control, kidney function screening, BP control, breast Ca screening and colorectal Ca screening). The survey of physician groups found that it was very common for WCHQ member organizations to formally focus on WCHQ measures during the study period. 15 of 18 groups reported giving priority to at least one WCHQ measure in response to WCHQ reporting. 9 groups indicated that their priorities were always or nearly always in response to WCHQ reporting. 6 showed a mix of responses, with 5 of those only occasionally responding to WCHQ reporting. Looking at the Dartmouth measures, WCHQ participants consistently outperformed the comparator groups in measures that are publicly reported through the Collaborative (HgbA1c testing, lipid testing in diabetics and breast cancer screening). In each of these measures both the overall performance and the rate of improvement during the study years was higher for WCHQ participants. Of note the only measure in which WCHQ participants failed to perform as well as one of their comparison groups was in diabetic eye testing which is not publicly reported by the Collaborative.

CONCLUSION: The three components of this study provide compelling evidence that public reporting of ambulatory measures led to improved performance among WCHQ participants. Over the time frame that public reporting was in place overall performance of the group improved significantly. Participants when surveyed stated that they focused improvement efforts in response to their performance on reported measures. Most significantly, although performance on many of these measures improved elsewhere, the members of the WCHQ improved at a faster rate than national comparison groups on measures reported by WCHQ.

A recent systematic review of public reporting, concluded that rigorous evaluation of many public reporting

systems was lacking , and what evidence of effectiveness does exist is largely hospital based. This study helps to address this gap, especially in the ambulatory environment. It provides strong support for the concept that public reporting really can lead to improved performance.

HIGHER QUALITY DISCHARGE SUMMARIES OF HOSPITALIZED OLDER ADULTS ARE ASSOCIATED WITH REDUCED RISK OF READMISSION: INSTRUMENT DEVELOPMENT AND OUTCOMES

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BACKGROUND: The communication between the care providers at thesending and receiving ends of a care transition, in the form of the dischargesummary, may influence the quality of a care transition and subsequent eventssuch as hospital readmission. However,there are few data on essential components of high-quality discharge

summariesfor older adults, especially those with complex, chronic illnesses. The objective of our study is to develop and evaluate an instrument to rate thequality of discharge summaries of hospitalized older adults.

METHODS: In the development phase, we identified core domains of high-quality hospitaldischarge summaries through a review of the literature and guided by theresults from prior qualitative study of a multi-disciplinary group of providerscaring for older adults in four care settings: hospital, skilled nursingfacility, home health care, and ambulatory care. The core domains, delineatedin Table 1 along with their respective components, were: plan ofcare (PC), admission information (AI), discharge status (DS), hospital course(HC), and communication and timeliness (CT) We created an instrument and scoring system to rate thequality of discharge summaries based on the identified components of the coredomains. In scoring one discharge summary, each component of the core domainswas given a score and these scores were aggregated for each core domain, whichin turn were aggregated to provide the overall discharge summary score (DC Score)for a discharge summary. The DC Score of each discharge summary ranged from0-26 points with 0 representing no components present and 26 representing all component-spresent. In the evaluation phase, we performed a retrospective cohort study. Weapplied our instrument and scored 626 discharge summaries of adults, aged 70 years and older, hospitalized on a general medical service at an academicmedical center and discharged to the community. We performed exploratory data analysis and then used linearregression to model the relationship between the DC Score and two outcomes: 1) older adults scores on the Care Transitions Measure (CTM), a self-reportedmeasure of the quality of care transition. Low CTM scores have been found in other work to be relatedto higher readmission rates, and; 2) older adults readmission to the hospitalfor same condition within 14 days.

RESULTS: The development phase yielded an instrument comprised offive core domains of a high-quality discharge summary. The core domains andtheir relative contribution to the DC Score are: plan of care (PC)-35%,admission information (AI)-27%, discharge status (DS)-19%, hospital course (HC)-12%, andcommunication and time-liness (CT)-up to 8%. Table 1 outlines the componentswithin each core domain. The mean (SD) and median scoreof each of the core domains and the DC Score for the 626 discharge summariesreviewed are described in Table 2. 54% of the discharge summaries were high- quality. All discharge summarieswere lacking at least one component in all domains: 60% of the dischargesummaries did not document a follow-up appointment (PC); 27% did not documentallergies (AI); 60% did not document baseline functional status (DS); 23% didnot document primary diagnosis (HC); and 52% were not documented as having beencopied to the primary care provider (CT). Higher DC Scores were associated withhigher CTM scores ($p<0.05$), as were presence of the core domains, plan ofcare, admission information, and communication and timeliness, relatedindividually to higher CTM scores. Higher DC Scores were associated withreduced readmissions for the same condition within 14 days ($p<0.05$).

CONCLUSION: This study defines coredomains of high-quality discharge summaries for hospitalized older adults and amethod to rate the quality of hospital discharge summaries. Only a minority ofdischarge summaries

studies in this study was found to be of high-quality. High-qualitydischarge summaries were associated with reduced readmissions at 14 days forthe same condition. These data should be used to inform development of qualityimprovement efforts to improve discharge summary quality and to determine ifsuch efforts could improve clinical outcomes for older adults.

Table 2. Median scores of Core domains of discharge summaries (N=626)

FACTORS ASSOCIATED WITH HEPATITIS B SCREENING IN A POPULATION-BASED SURVEY OF KOREAN AMERICANS FROM WASHINGTON STATE Adeena Khan 1; Genji Terasaki 2; Joon-Ho Yu 2; John H Choe2. 1University of Washington, Internal Medicine Residency Program, Seattle, Washington ; 2University of Washington, Seattle, Washington. (Tracking ID # 12311)

BACKGROUND: Approximately 1.3 million Americans live with chronic hepatitis B (HBV) viral infection. Because chronic HBV infection is frequently acquired in childhood and often causes little or no symptoms, infected adults may be unaware of their risk for the future sequelae of cirrhosis and liver cancer. Therefore, public health experts including those at the Centers for Disease Control and Prevention have recommended screening immigrants from regions with high rates of endemic HBV for serologic evidence of chronic infection. Although Asians represent less than one in 20 of the US population, they
comprise more than one in two of those living with chronic HBV infection in this country.

While it has been estimated that more than 4% of adults older than 40 years of age residing in Korea are chronically infected with HBV, little has been reported about the factors associated with serologic testing in Koreans living here in the United States. Previous research has identified factors associated with HBV screening in certain other Asian American subgroups; however, few studies have specifically examined Koreans, the fifth largest Asian ethnic group in the US.

In this study, we examined data from a survey of Korean American adults to determine factors associated with HBV screening in this population. Based on prior studies in other Asian American populations, we hypothesized that participant demographics (e.g. age); factors related to access to medical care (e.g. health insurance); and factors related to communication with providers (e.g. requiring medical interpreters) all would potentially be associated with HBV screening in Korean Americans.

METHODS: Eligible study participants were Korean adults 1864 years of age. Potential participants were identified by surname from an electronic database of telephone numbers and addresses from three counties in Western Washington State. Study staff made up to five separate contact attempts with potential participants, and bilingual and bicultural field interviewers conducted in-person surveys in either Korean or English lasting approximately a half hour at participants homes. The HBV survey was developed by adapting a questionnaire previously used in Chinese and Vietnamese American communities; our previous qualitative research among Koreans had identified additional cultural domains potentially influencing HBV testing, and these pilot data were used to expand included questions.

Our primary outcome of interest was self-report of having had prior serologic HBV testing. We examined whether three groups of variables were associated with having had HBV testing. First, we examined whether testing was associated with participant demographic factors, such as age, gender, marital status, and birth country. Second, we examined whether testing was associated with factors related to access to medical care, including: identifying a regular primary medical provider; having health insurance and type of insurance; and receiving medical care at one location. Third, we examined whether HBV testing was associated with factors related to language and communication, including: English proficiency; dependence on medical interpreters; and ethnicity of medical providers. Bivariate comparisons were examined using appropriate chi-squared or t-test statistics; we also constructed multivariate logistic regression models to examine which factors were independently associated with having had HBV testing.

RESULTS: Four hundred and sixty-six participants completed the survey, with the vast majority in Korean

language (91%). Among participants, nearly all were born in South Korea (93%) and had resided in the US for less than 20 years. More than half (58%) of survey participants were women, and four out of five (80%) were married. The level of education was high, with three quarters reporting having completed at least high school or more. Around half (49%) reported having had previous HBV serologic testing, but almost all (94%) had heard of hepatitis B.
Access to medical care was variable among participants, with more than a third (38%) reporting they were without health insurance, and nearly half (43%) without a regular doctor or medical provider. More than a quarter (27%) reported requiring assistance with language interpretation during physician visits.
Most access and communication factors were not significantly associated with having had HBV serologic testing in bivariate analyses among these Korean American adults. Participants with health insurance or a regular primary care physician were not more likely to have had HBV

testing than those without insurance or primary care; there was a trend toward significant association of HBV testing for those identifying a physical site of receiving medical care (p=0.07). Such communication factors as strong English speaking skills or use of medical interpreters were also not associated with having had HBV testing.
In multivariate logistic regression models, length of time residing in the US was independently but negatively associated with reporting having had HBV testing (p=0.049); that is, controlling for other demographic, health care access, and communication factors, increased time of US residence was associated with lower rates of having had HBV testing. CONCLUSION: In our population-based survey of Korean American adults, we found that most demographic, health care access, and communication factors were not associated with reporting having had HBV serologic testing. However, in multivariate models, increased length of time residing in the US was negatively associated with HBV serologic testing. Contrary to our expectation, those Koreans who have been living longest in the US were least likely to report having had HBV serologic testing, even after controlling for participant age or insurance status. Health programs focused upon immigrants often target the most recent arrivals as the most vulnerable and the most requiring of special efforts to bridge disparities of care and of health outcomes. However, for hepatitis B serologic testing, these survey data suggest that the less recently immigrated Korean Americans remain a group at increased need for targeted attention. For primary care providers, HBV serologic testing to identify those at risk for cirrhosis and liver cancer remains an important priority not only for recent Korean immigrants, but especially for those who have already resided in the US for years or decades.

EXERCISE: THE BEST MEDICINE FOR SICK PATIENTS WHO ARE IN PAIN MAY BE THE MOST DIFFICULT TO TAKE

Michael Mueller 1; Charles Thomas 1; Eileen Seeholzer1. 1Case Western Reserve University, Cleveland, Ohio. (Tracking ID # 12316)

BACKGROUND: For many common conditions like arthritis, diabetes, sleep apnea, and hypertension, exercise improves outcomes and symptoms. Physicians are encouraged to counsel and indeed motivate patients to be active in order to improve medical outcomes. Counseling patients to exercise increases activity levels for at least 6 months after a visit. But counseling tired patients in pain to exercise is a daunting prospect. Little is known about how pain affects choosing, starting and maintaining an activity. Little is known about the characteristics of patients who cite pain as an activity barrier. The aim of this project was to assess whether patients citing pain as a barrier differed from those who did not cite pain as an activity barrier in their 1) characteristics, 2) readiness to exercise, and 3) choice of activity.

METHODS: An electronic medical record (EMR) review was done of the adult obese patients counseled by

nurses with PACE + between 5/2006 and 2/2010. PACE + (Patient-centered Assessment and Counseling for Exercise and Nutrition), is an individualized counseling tool validated to improve eating choices and increase activity in primary care patients. We evaluated barriers to activity reported by obese patients at an urban primary care clinic who completed PACE + as part of a primary care initiative. Analyses comparing characteristics of patients with and without pain identified as an activity barrier were done using the Cochran-Armitage Trend test. Bivariate comparisons of categorical items were analyzed using the chi square test, and continuous items were analyzed using the Wilcoxon test.
RESULTS: Educators counseled 1,140 obese patients. Patients had a mean age of 48, and were 81% female, and 97% African American. Pain was the most frequently cited barrier (24%) to activity. Compared to patients not citing pain, patients citing pain as a barrier had a higher BMI (41.3 vs. 38.7, $p<0.05$). and were more likely to be severely obese with 51% having a BMI >40, compared to 37% with a BMI <40. Patients who cited pain as a barrier were more likely to be female, and were more likely to carry diagnoses for arthritis (27% vs. 13%, $p<0.01$), heart disease (66% vs. 55%, $p<0.05$), hyperlipidemia (65% vs. 50%, $p <0.01$), and hypertension (68% vs. 56%, $p<0.05$). The stage of change for engaging in activity did not differ between groups. Patients identifying pain as a barrier chose walking less often (53% vs. 67% $p<0.05$) and chose water aerobics (22% vs. 10% $p<0.05$) and chair exercises (3% vs. 1% $p<0.05$) more often than those not identifying pain as an exercise barrier.
CONCLUSION: Patients citing pain as a barrier to activity were more likely have a higher BMI and to carry diagnoses for arthritis, heart disease, hypertension, and hyperlipidemia. Patients with higher BMI and medical co-morbidity are likely to benefit from, but may be less able to engage in activity. Regular activity often reduces pain symptoms, but patients with pain may be hesitant to begin activities. Techniques to help clinicians are needed to address pain symptoms while encouraging activity in the patients who would most benefit. Recording exercise choices and barriers for patients in the EMR provides a way to design and measure the results of efforts to improve rates of patient engagement in healthy activity. Efforts may be aimed at improving counseling effectiveness in a practice overall or directed toward patients with particular medical problems or needs.
CORRELATES OF LACK OF ANTIPLATELET ADHERENCE AMONG AN INSURED MINORITY POPULATION
Ana Palacio 1; Leonardo Tamariz 2; Sylvia Garay 1; Claudia Uribe 3; Hua Li 1; Lesllie Hazel-Fernandez 4; Ellen Salkeld 1; Olveen Carrasquillo1. 1University of Miami, Miami, Florida ; 2University of Miami, Doral, Florida ; 3Humana, Miami, Florida. (Tracking ID # 12322)
BACKGROUND: To reduce post procedure stent thrombosis, patient-swho undergo percutaneous coronary intervention with stent implantation (PCIS)are prescribed clopidogrel for a minimum of 12 months. However, non adherence to this therapy ishigh, particularly among minority patients. Identification of correlates of inadequate adherence may help identify targetsfor potential intervention.
METHODS: Using claims data from a large health benefitscompany, we identified blacks and Latino subjects who had undergone PCIS in theprevious 90 days. Among this sample, weconducted a cross-sectional survey to obtain data on socio demographiccharacteristics, access to care, health beliefs, acculturation, patient-physician communication. Our dependent variable, self reported medicationadherence, was obtained using the 4-item Morisky scale, with higher scores indicating less adherence. RESULTS: We identified 201 Latinos and 251 Blacks who hadrecently undergone PCIS. Of these 15% admitted to sometimes forgettingto take this medication. Hispanics wereslightly more likely to be non-adherent than blacks (0.390.72 versus 0.26 0.60, $p<0.05$). Significantcorrelates of non adherence included being unable to visit the doctor whenneeded 2.5 (95% CI1.0-5.9) and having difficultiesunderstanding written medical information 2.5 (95% CI1.44.0). In this privately insured population, themost commonly cited reason (46%) for not visiting the doctor when needed was being busy taking care of somebody else
CONCLUSION: Our findings highlight ongoing challenges to providing-quality care, even among insured minority subjects. Our findings suggest that strategies thatfacilitate medication refills and those that address

health literacy mayimprove clopridrogel adherence among minority subjects having received a PCIS. Caregiver burden is also another importantfactor to consider as a cause of non-adherence.

EFFECTS OF AN ELECTRONIC POST-DISCHARGE MEDICATION RECONCILIATION TOOL ON THE ACCURACY OF AMBULATORY MEDICATION DOCUMENTATION Jeffrey L. Schnipper 1; Catherine L. Liang 1; Claus Hamann 2; Andrew S. Karson 3; Jennifer Lee 1; Elisabeth Burdick 1; David W. Bates1. 1Brigham and Womens Hospital, Boston, Massachusetts ; 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12324)

BACKGROUND: Serious medication errors occur commonly in the period after hospital discharge. Medication reconciliation in the post-discharge ambulatory setting may reduce the frequency of these errors. This process allows primary care physicians to identify and correct any errors of inpatient medication reconciliation, make additional changes to the post-discharge regimen based on their knowledge of the patient, and document an accurate regimen in the medical record to prevent future medication discrepancies. The aim of this analysis was to determine the effects of an electronic post-discharge medication reconciliation tool on the accuracy of medication documentation one month after discharge.

METHODS: As part of a Center for Education &Research on Therapeutics funded by AHRQ, we designed a novel tool built into an ambulatory electronic medical record (EMR). The tool compares the preadmission medication list in the ambulatory EMR to the hospital discharge medication list, highlights all changes, and allows the EMR medication list to be easily updated. To evaluate its effects, we conducted a controlled trial in 19 primary care practices affiliated with an integrated health care delivery system, each matched and randomized to receive the tool or usual care. Inpatients belonging to these practices, over age 55, and on 5 or more medications were recruited to participate. Thirty days after discharge, patients were contacted by phone, and a research assistant obtained the gold-standard post-discharge medication regimen by including all discharge medications, removing any planned completions in therapy, and incorporating any reported changes made by patients physicians since discharge. The documented ambulatory EMR medication list at the time of the call was compared to this gold-standard regimen and the proportion of concordant medications (exact matches in medication, dose, and frequency) was calculated. Analyses were conducted using binomial logistic regression, adjusted for hospital affiliation of each practice.

RESULTS: The study included 759 patients: 380 in intervention practices, and 379 in usual care practices. The post-discharge medication reconciliation tool was used in approximately 16% of intervention patients. In an intention-to-treat analysis, the accuracy of the EMR medication list 30 days after discharge was 23% among intervention patients and 22% among usual care patients (adjusted odds ratio 1.09, 95% confidence interval 1.00 - 1.17, p=0.04). Among patients in whom the tool was used, the accuracy of the EMR medication list was 25% (p=0.02 for comparison with patients in whom it was not used). The most common inaccuracy was documentation of medications the patient was no longer prescribed.

CONCLUSION: In this cluster-randomized controlled trial, we found that the accuracy of documented medication regimens 30 days after discharge to be poor. An electronic post-discharge medication reconciliation tool led to a small improvement in documented regimens, in part because the tool was only occasionally used. Further improvements to the tool and efforts to increase implementation may have greater effects on accurate medication documentation as well as other measures of medication safety during transitions in care.

PREPARING PATIENTS FOR THE CLINICAL ENCOUNTER USING HEALTH INFORMATION TECHNOLOGY-BASED PATIENT FEEDBACK Rachel Hess 1; Hilary Tindle 1; Molly Conroy 1; Sunday Clark 1; Ron Hays2. 1University of Pittsburgh, Pittsburgh, Pennsylvania ;
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BACKGROUND: Healthcare providers can play an important role in encouraging healthy behaviors and identifying factors that impact patients mental and physical health-related quality of life (HRQoL). Clinicians are

most effective in this role when they partner with informed and engaged patients. We evaluated the impact of a new health information technology (HIT)-based tool that provides patients with immediate, personalized, guideline-based feedback (HIT patient feedback) about their health behaviors and HRQoL and encourages them to take a more active role in their health on patient-initiation of discussions regarding tobacco use, physical activity, and mental and physical HRQoL.
METHODS: We conducted a randomized controlled pilot trial of HIT patient feedback in an internal medicine resident practice; randomization was at the physician level. Patients of participating resident physicians received or did not receive HIT patient feedback. All residents continued to receive the practices standard computerized patient-reported information report. After the clinical encounter, each participating patient, and his or her physician, completed a questionnaire regarding discussions of tobacco use, physical activity, and mental and physical HRQoL. We used chi-square tests to compare the proportion of patients reporting of initiation of discussion between the intervention and control groups.
RESULTS: Thirty resident physicians and 99 of their patients agreed to participate; 98 pairs (99%) completed post-visit questionnaires. A greater proportion of patients who received HIT patient feedback (intervention) compared to patients who did not receive HIT patient feedback (control) reported initiating a discussion about mental HRQoL (23% vs. 0%, p=0.02); initiation of discussions regarding tobacco use approached statistical significance (25% vs. 5%, p=0.06). There was no difference in discussion initiation regarding physical activity or physical HRQoL (p=0.9 for both). CONCLUSION: Providing patients with immediate, personalized, guideline-based feedback regarding health behaviors and HRQoL prior to the clinical encounter can increase patients initiation of discussions regarding mental HRQoL and tobacco use. Future work should test this intervention in a larger population as well as evaluate the impact on outcomes such as tobacco cessation and improvements in HRQoL.
The project described was supported by Grant Number UL1 RR024153 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical Research, and its contents are solely the responsibility of the authors and do not necessarily represent the official view of NCRR or NIH. Information on NCRR is available at http://www.ncrr.nih.gov/
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Web End =http:// http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp
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SINGLE CENTER EXPERIENCE OF PROGNOSTIC FACTORS AND SURVIVAL OUTCOMES AMONG VETERANS WITH MDS: A RETROSPECTIVE ANALYSIS Premal D Lulla 1; Carlos Arce-Lara 1; Sarvari Yellapragada1. 1Baylor College of Medicine, Houston, Texas. (Tracking ID # 12338)
BACKGROUND: While the epidemiology of MDS and demographics of veterans with myelodysplastic syndrome (MDS) has been established (Komrokji et. al, 2009), there is no data on prognostic factors. Several factors including age, ferritin, MCV and use of growth factors, independent of the established WHO prognostic scoring system (WPSS) have been shown to impact survival in MDS. The purpose of this study is to highlight major survival determinants among veterans with an emphasis on transfusion dependency and ferritin.
METHODS: Charts of 88 unselected patients (87 males) with pathological diagnosis of MDS from January 2000 to December 2008 at the Michael E. Debakey V.A. Medical Center in Houston, Texas were studied. Transfusion dependency was defined as needing more than 1 unit of

packed red cells each month for 4 consecutive months. 50 patients had 4 or more ferritin readings spread over a minimum of 6 months, to compute a meaningful mean increase in ferritin per year (MIF). Univariate survival

analysis was performed using GraphPad Prism5.0, and Kaplan-Meier curves were computed. Multivariate analysis on significant variables was performed using the Cox model on MedCalc Statistics Software (version 11.3.3).
RESULTS: The median age at diagnosis was 73 (5391) with a median OS of 520 days (132234). Performance status (ECOG) >2 (p=0.012), IPSS (International prognostic scoring system) scores >1.0, transfusion dependency, MIF >200 per year, MCV <100 and use of erythropoetin were significantvariables in predicting OS onunivariate analysis. On multivariate analysis, IPSS scores >1.0 (p=0.01), transfusion dependency (p=0.0029),

ECOG performance status >2 (p=0.0421) and MIF >200 (p=0.0294) were independent significant poor prognostic factors. In the sub-group of MDS without excess blasts (Cermak et. al, 2009), transfusion dependency and MIF >200 per year were highly significant variables (p<0.0001). CONCLUSION: Poor performance status, intuitively was a poor prognostic factor. The lower than expected median OS noted among veterans might represent the older than expected age of diagnosis and associated poorer performance status. Iron overload is rapidly becoming a leading problem in the management of MDS. MIF >200 correlated with transfusion dependency (chi-square test p<0.0001), and could represent an objective assessment of transfusion dependence at anytime during the disease course although further prospective studies are warranted.
THE VALUE OF TRANSESOPHAGEAL ECHOCARDIOGRAPHY (TEE) IN DIAGNOSING IMPLANTED CARDIAC DEVICE INFECTIONS AND OUTCOME PREDICTION Hussein Othman 1; Hanady Daas 2; Joel Fishbain 2; Michael Tucciarone 2; Susan Szpunar 2; Leonard Johnson3.
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BACKGROUND: Infectious complications of implanted cardiac devices (ICD) vary from superficial infections, pocket and/or generator infections, and the more serious lead-associated endocarditis. Expert opinion from the American Heart Society recommends transesophageal echocardiogram (TEE) for the initial evaluation of cardiac device infections (CDIs). Our goal was to evaluate the role of TEE in CDIs and the impact of TEE on outcomes.
METHODS: A case control study design was employed. Cases were defined as all patients with CDIs hospitalized at our institution between 2000 and 2008. The control group was defined as an unmatched cohort of patients with a cardiac device that had a TEE done for reasons other than infection. We collected data on patient demographics, presence of CDI, level of infection, microbiology, medical comorbidities, TEE findings and outcomes (discharge or death from CDI). Patients were placed into three separate categories based on the type of infection: 1. Lead-associated endocarditis (LAE) (bacteremia, histopathology, extracted lead cultures or modified Duke Criteria); 2. Pocket infection; and 3. Control group. Abnormal TEE was defined by the report of one of the following findings: vegetation, mass, clot or thrombus. Differences between the cases and controls with respect to demographic and clinical findings were assessed using 2 analysis and ANOVA. A p-value0.05 was considered to indicate statistical significance.
RESULTS: A total of 161 patients were included in the study (109 cases and 52 controls). Of the cases, 41 had LAE and 68 had a pocket infection. The three study groups were comparable in terms of mean age and gender distribution. Among the 109 cases, TEE was performed in 68.3% (28/41) of patients with LAE and 27.9% (19/68) with pocket infection (p<0.0001). An abnormal TEE was found in 3.8% (2/52) of the controls, 75% (21/28) with LAE and16.7% (3/18) with pocket infections (p<0.0001).. Comparing the three groups, 5.8% (3/52) of the controls had the device removed compared to 80% (32/40) of patients with LAE and 83.6% (56/67) of patients with pocket infection (p<0.0001). The device removal rate did not differ significantly when the comparison was restricted to the patients with LAE versus those with a pocket infection. The mortality rate was higher in the LAE group compared to the pocket infection group; 17.5% vs 2.9% (p=0.008). Among patients with LAE, only 9.7% (3/31) of patients died if the device was removed compared to 50% (4/8) if the device was not

removed (p=0.008). In patients with only a pocket infection, the mortality rates were 1.8% (1/56) with the device removed compared to 9.1% (1/11) with no device removal (NS). In those who had the cardiac device removed54.5% (48/88) did not have a TEE performed. In terms of outcomes (death and leads explantationn) there was no significant difference between groups who had TEE vs. those who did not have a TEE done.
CONCLUSION: In our study, an abnormal TEE was identified more often in patients with LAE than in patients with pocket infection or controls. However, the same number of patients in each group with CDI had complete device explantation despite these differences. While LAE is associated more often with TEE abnormalities, it is not clear whether TEE impacts overall management and could be adding cost without additional benefit.

PATIENT NARRATIVES OF THEIR EXPERIENCES AND MOTIVATIONS GOING THROUGH HEPATITIS C (HCV) DRUG TREATMENT Allen L Gifford 1; Mari-Lynn Drainoni 1; Elisa A Koppelman 1; Jack A Clark1.
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BACKGROUND: Hepatitis C (HCV) infection is common, serious, and often curable. Soon, new direct-acting antivirals will strengthen HCV treatments and sharply increase the numbers starting treatment. Current treatment is long (612 months) and physically and psychologically debilitating, and about 65% fail to respond to medications or complete the full course. Little is known about patients own experiences undergoing treatment, including success or failure.
METHODS: We conducted detailed semi-structured, audiorecorded qualitative interviews with 21 adult recipients of antiviral HCV treatment at an academically-affiliated east coast U.S. Veterans Hospital. Participants were men aged 4471 (median 57) years, and had either completed (N=17) or ended prematurely (N=4) a combination HCV medication course in the preceding 18 months. Half (11/21) achieved sustained HCV suppression. Open-ended interviews elicited narratives of receiving the diagnosis, treatment decision making, managing side effects, and medication actions. Verbatim transcripts were coded and analyzed by a collaborative team of social and clinical scientists.
RESULTS: Qualitative data were rich, and individuals described multiple motivations for completing treatment along four main themes: (1) MEETING THE CHALLENGE. Most (N=15) viewed side effects as personal challenges to be overcome with little complaint, and they took pride in successfully completing a difficult - but achievable - treatment goal. (2) BUYING TIME. Fourteen viewed HCV disease as an inexorable progression (although perceived time horizons varied). These patients put less emphasis on cure per se, and more on avoiding the bad end of painful morbidity unto death. Five were rather sanguine about perceived still-distant disease consequences; nine urgently acted to forestall an imminent threat posed by HCV, and by longstanding substance abuse. (3) PERSONAL REDEMPTION. Almost half (N=9) viewed treatment as continuing a process of recovery/redemption from what they characterized as a once-dissolute life with substance abuse. Treatment was a way of demonstrating new personal worth. Importantly, successful redemption did not always depend on curing HCV or preventing disease progression. (4) CURE. Seven described goals to cure the virus, according to a predominantly biomedical model and rationale.
CONCLUSION: This study was limited by relatively small size, and may not be broadly generalizable, especially outside the VA. Patients narrated diverse motivations for completing treatment, including clinical and largely moral rationales. Motivations may come from cultural values, learned beliefs, and/or stigma HCV patients carry and attribute to disease. Better ability to cope with side effects may improve treatment completion, and HCV patient self-management abilities likely come from complex biographical and social circumstances. Future behavioral and systems interventions to support HCV treatment should take account of patients lived experiences that give meaning and motivate participation in care.
PROVIDING PHYSICIANS WITH PATIENT-REPORTED INFORMATION PRIOR TO THE CLINICAL ENCOUNTER: THE FUNCTIONAL ASSESSMENT SCREENING TABLETS EXPERIENCE Rachel Hess 1;

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BACKGROUND: To improve the health and functioning of patients, the health care system must address causes of preventable disease and disability, including health-related quality of life. To better inform physician decision-making, we created the computerized Functional Assessment Screening Tablets (FAST), which systematically collects patient reported information, including the RAND-36 measure of health-related quality of life. The information is then provided to physicians prior to the clinical encounter. We hypothesized that systematically providing this information to physicians prior to the clinical encounter would result in increased attention to and improvement in health-related quality of life.
METHODS: In January 2005, we deployed the FAST system in a single Academic General Internal Medicine practice. At each visit, the patient is asked to complete the pre-visit questionnaire using a tablet computer. Physicians receive a report summarizing the patients responses from that visit and information from up to 6 prior visits to allow the physician to observe trends. The report highlights values deserving of attention. We used linear mixed models to examine the changes in rates average mental and physical health composites (MHC and PHC) of the RAND 36, and multivariable ordinal logistic mixed models to examine the proportion of individuals in the practice with excellent (MHC >53, PHC >53), good (MHC=39-53, PHC=43-53), or poor (MHC <38, PHC <42) mental or physical health-related quality of life. All models were adjusted for race, age, gender, marital status, educational attainment, social support, and number of comorbid medical conditions.
RESULTS: Between January 1, 2005 and January 31, 2010, 21,651 patients completed the FAST a total of 97,334 times (mean=4.5, median=3 assessments per patient). Table 1 shows the average MHC and PHC and proportion in each excellent, good, and poor category for each 12-month period. After accounting for case mix and repeated measures, the average mental health has improved slightly over the 5-year period (regression coefficient=0.07, p=0.01) and physical health is unchanged (regression coefficient=0.03, p=0.2). The proportion of individuals who have excellent or good, compared to poor, mental health has increased (odd ratio=1.02, p=0.048); the proportion that has excellent or good physical health has not changed (odds ratio=1.02, p=0.1).
CONCLUSION: This work evaluated whether point-of-care feedback to physicians improves the health-related quality of life of the practices patients. While we found statistically significant improvements in mental health-related quality of life, these differences are not large enough to be clinically important. Possible reasons for this include the lack of simultaneous suggestions to physicians regarding steps that could be taken to help their patients. Further work is needed to help physicians effectively use these metrics to impact their patients health-related quality of life.
The project described was supported by Grant Number UL1 RR024153 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical

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http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp
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DEVELOPMENT AND VALIDATION OF THE HYPERTENSION EVALUATION OF LIFESTYLE AND MANAGEMENT (HELM) KNOWLEDGE SCALE Marilyn Schapira 1; Kathlyn Fletcher 2; Dan Eastwood 1; Avery

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BACKGROUND: Hypertension is a common disease and self-management is important to obtaining good control and beneficial health outcomes. A validated scale to assess hypertension knowledge required for self-management is needed.
METHODS: This study was conducted as part of a community based randomized controlled trial of educational approaches among Veterans who had a diagnosis of hypertension. Content domains comprising the skills required for self-management of hypertension were identified through literature review and input from an expert panel. Items were generated by committee, underwent cognitive interviews and modifications, then were pilot tested in a sample of 100 persons in the target population. Items that did not demonstrate discrimination were modified or dropped. A 17 item scale was administered at baseline and 12-month follow-up following the educational interventions. Item reduction subsequently was conducted based on item analysis. The final scale consisted of 14 items. Construct validity was evaluated through correlation of scores with level of education, print literacy as measured by the Rapid Evaluation of Adult Literacy in Medicine (REALM), health numeracy as measured by the Schwartz numeracy scale, and systolic and diastolic blood pressure. Criterion validity was evaluated through comparison of baseline and follow-up scores in the total cohort and between the intervention and control groups. RESULTS: The Hypertension Evaluation of Lifestyle and Management (HELM) knowledge scale was evaluated in 404 participants. Participants were primarily male (87%) and Caucasian (96%). Six percent (6%) had less than 12 yrs education, 35% had a high school degree or GED, and 58% had post high school education. Twenty percent (20%) demonstrated less than a 9th grade level of print literacy and 13% responded to all three numeracy questions correctly. The HELM included three domains: 1) general hypertension knowledge (3 items); lifestyle and medication management (8 items), and 3) monitoring and setting goals
(3 items). Item analysis demonstrated a range of difficulty with the percent correct between 25% and 89%. The standardized Cronbach alpha was 0.49. Scores on the HELM demonstrated a positive Pearson correlation with level of education (0.28, $p<0.0001$), print literacy (0.21, $p<0.001$), numeracy (0.17, $p=0.0005$), and the Patient Activation Measures (0.10, $p=0.04$). There was no statistically significant association between performance on the HELM and systolic or diastolic blood pressure at baseline. The HELM scores (M, SD) increased among the total study cohort from baseline (8.7, 2.2) to 12 month follow-up (9.2,2.2), $p<0.001$. However, improvement in scores did not differ between the control and intervention groups.
CONCLUSION: The HELM provides a short and feasible assessment of hypertension knowledge that is designed to assess skills needed for lifestyle choices and self-management of hypertension. The HELM demonstrates moderate internal reliability and content validity. The development of validated and standardized assessment of knowledge related to chronic disease management will further efforts to conduct implementation research of interventions to improve chronic disease management.
REASONS FOR NON-PERSISTENCE AMONG ADULTS WITH HYPERTENSION AND HYPERLIPIDEMIA: 2008, 2009 AND 2010 Abhijit Gadkari 1; Colleen McHorney1. 1Merck &Co., Inc., Philadelphia, Pennsylvania. (Tracking ID # 12346)
BACKGROUND: The objectives of this study were to identify the most commonly-reported reasons for medication non-persistence in 2008, 2009, and 2010.
METHODS: Three cross-sectional surveys of adults with hypertension and hyperlipidemia were conducted using the Harris Interactive Chronic Illness Panel. Patients identified as non-persisters (i.e., stopped a medication in the last year without provider approval) were presented with a list of 12 potential reasons for stopping and asked to choose all that applied to them. The univariate distribution of patient-reported reasons for

non-persistence was tabulated to identify the most common reasons. The invariance of the nonpersistence reasons across the three years was assessed using logistic regression with generalized estimating equations (GEE) to adjust for the lack of independence among respondents who were non-persisters for both diseases.

RESULTS: The proportion of respondents identified as non-persistent for hypertension and hyperlipidemia, respectively, were 5.6% (n=789) and 10.2% (n=811) in 2008; 4.4% (n=784) and 8.1% (n=846) in 2009; and 4.4% (n=938) and 7.4% (n=944) in 2010. Data from the resulting sample of 5,112 adults was included in this study. The same five reasons were most commonly reported for non-persistence in 2008, 2009, and 2010: financial hardship (39.0%, 37.7% and 38.6%), fear or experience of side effects (33.1%, 36.6% and 33.7%), generic concerns about medications (21.3%, 16.9% and 16.7%), lack of perceived need(17.0%, 13.9% and 13.1%), and change in health insurance (16.8%,16.1%, and 18.6%). Multivariate models controlling for demographics, self-reported health, and index disease found no significant variation across the three years for nine of the 12 reasons for non-persistence. CONCLUSION: The same top reasons for non-persistence were reported in all three years. Future efforts to improve medication persistence should address patients perceived medication need, concerns, and affordability.

DOES PATIENT ASSISTANCE REDUCE RACIAL DISPARITIES IN QUALITY OF BREAST CANCER CARE?

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BACKGROUND: Breast cancer patients informational, psychosocial and access needs may affect receipt of post-surgical adjuvant treatment. High quality community-based patient assistance programs which address such barriers are often underutilized presumably b/c pts are unaware of such programs. We conducted a RCT to inform and enable women to connect with programs that can address underlying needs that might interfere with care delivery.

METHODS: Women were recruited w/in 24 wks of their surgical Rx of BC. We assessed informational, psychosocial, and practical needs and randomized women to Intervention (INT) vs usual care (UC). The INT consisted of educating women about existing programs by creating an action plan and mailing it to them with related materials. UC patients received a pamphlet about breast cancer and its treatment. All were called 2 wks later to ascertain packet receipt, and for INT patients, ongoing needs and connection to a Patient Assistance Program. Treatment data is based on chart abstraction 6 months after surgery. Analyses were intent to treat.

RESULTS: 370 women with a new primary, early-stage breast cancer operated at 1 of 8 participating NYC hospitals consented to participate: 189 in the INT and 180 in UC. 186 were Black or Hispanic and evenly divided between INT and UC. Rates of need did not differ between trial or racial groups: 234 had informational needs; 200 had psychosocial and 193, practical-access needs; 78 had 1 need, 66 had 2 needs, 139 had 3 needs. At 2 wks, 107 of INT pts had an ongoing need yet only 89 had connected to a program. Rates of treatment in INT vs UC were: 84% vs 89% RT post BCS (p=.28); 93% vs 86% chemo for ER negative tumors >1 cm (p=.28); and 87% vs 88% for hormonal therapy for ER + tumors >1 cm. Treatment underuse was higher in older women (mean: 61y vs 56y; p<0.01). Race, education, insurance, stage, type or number of needs was not related to underuse.

CONCLUSION: Post-surgical adjuvant treatment rates are high; there is no racial disparity in treatment. Some needs expressed <1 month after surgery appear to resolve without apparent external intervention and some require more intensive involvement to enable connection to a patient assistance program. This finding suggests

that future interventions take into account the dynamic changing needs of women with a new breast cancer diagnosis and more intensive efforts be made to connect those with ongoing needs to best target resources to those with unresolved needs that can interfere with treatment receipt.

EVALUATION OF ACID SUPPRESSION MEDICATION USE AT THE LOUIS STOKES CLEVELAND VA MEDICAL CENTER Pratibha Raghavendra 1; Andrea Pallotta 1; Pratibha Raghavendra 2; Bridgette Mallick 3; Sarah Augustine 1; Sharon LaForest1. 1LSCDVAMC, Cleveland, Ohio ; 2Louis Stokes Cleveland Department of Veterans Affairs, Cleveland, Ohio ; 3Louis Stokes Cleveland Department of VAMC, Cleveland, Ohio.
(Tracking ID # 12362)

BACKGROUND: Acid suppression medications (ASM) are prescribed for a variety of indications, including treatment of gastrointestinal disorders and stress ulcer prophylaxis. ASM include proton pump inhibitors (PPIs) and histamine-2 receptor blockers. The inappropriate use of PPIs has been reported at rates as high as 65%.1 Although generally believed to be benign, ASM increase gastric pH and are associated with side effects and drug interactions. The LSVAMC Pharmacy and Therapeutics Committee exhibited interest in a PPIs order set in the spring of 2009 following recent literature and a statement by the Food and Drug Administration (FDA) identifying awareness of a possible drug interaction between omeprazole and clopidogrel. 2,3 Omeprazole is the focus drug of this trial due to the heightened publicity about the drug interaction recently.

Objective: To compare the use of omeprazole and ASM at the LSVAMC before and after implementation of a quick-order set.

METHODS: A retrospective chart review evaluated ASM use in inpatients admitted to general medicine floors, the progressive care unit, and the medical and cardiac intensive care units during three phases: phase 1 - October 2008 (baseline prescribing habits), phase - 2 May 2009 (prescribing habits following FDA statement and literature release), phase - 3 February 2010 (after quick-order implementation). One-hundred patients were enrolled chronologically in each phase in a percentage distribution based on past admission rates for each hospital ward. Information on patient demographics, diagnoses, ASM use, concurrent medication use history, lab values, and comorbidities were collected using the LSVAMC electronic medical record system. The primary endpoint of the study compared the percent of inpatients on oral omeprazole between phase 1 and phase 3. Secondary endpoints compared the overall usage of ASM, identified rates of gastrointestinal (GI) bleed during hospitalization and up to 3 months post discharge, compared the percent of patients prescribed both omeprazole and clopidogrel, compared the percent of patients initiated on ASM during hospitalization, and compared the indications for ASM use between each of the three phases. A t-test evaluated continuous data and a chi-square test evaluated categorical data.

RESULTS: : One-hundred patients were enrolled in each of the 3 phases (total 300 patients). The mean age was 6365 years and the mean duration of hospitalization was 6 days. There were no differences between the patient populations in each of the 3 phases. In Phase 1, 70% of patients received omeprazole compared to 48% of patients in Phase 3 (p=0.0016). In Phase 2, 65% of patients received omeprazole compared to 48% in Phase 3 (p=0.015). There is not statistically

significant decrease in omeprazole use between Phase 1 and Phase 2. The overall use of ASM decreased from Phase 1 to Phase 3 (75% vs 60%, p=0.024) but not from Phase 2 to Phase 3 (69% vs 60%, p=0.18). The use of ASM for prophylaxis decreased from Phase 1 to Phase 3 (53% to 38%) but the rate of no documented indication increased (8% vs 30% respectively). The percent of patients that were discharged on newly initiated omeprazole for treatment of a GI disorder increased from Phase 1 to Phase 2 and to Phase 3 (9%, 28%, 62% respectively). The percent of

patients that were discharged on newly initiated omeprazole for GI prophyalxis decreased from Phase 1 to

Phase 2 and to Phase 3 (82%, 58%, 13% respectively). The percent of patients receiving omeprazole in addition to clopidogrel decreased significantly from Phase 1 to Phase 2 (94% vs 54%, p=0.0001) and decreased insignificantly from Phase 2 to Phase 3 (54% vs 25%, p>0.05).
CONCLUSION: The overall use of omeprazole significantly decreased after implementation of a quick order set.

Table 1:
Phase1=100 Phase2=100 Phase3=100
GenMed 59 59 61
PCU 25 25 24
ICU 16 16 15
Male 96% 99% 95%
Age 63(31-89) 65(37-99) 65(31-91)
LengthofStay 5.6(1-41) 6.2(1-46) 5.1(1-44)

MALIGNANCIES ASSOCIATED WITH IMMUNE THROMBOCYTOPENIC PURPURA Karim Arnaout 1; Mustapha Khalife 2; Amr Hanbali3. 1Henry Ford Hospital, detroit, Michigan; 2Henry Ford Hospital, detroit, Michigan ;
3Henry Ford, Detroit, Michigan. (Tracking ID # 12369)
BACKGROUND: Cancer and Immune thrombocytopenic purpura (ITP) are two common disorders. However, the relationship between these two diseases has rarely been reported in the literature. The objectives of this retrospective study were to determine the percentage of ITP patients who have cancer and to classify them based on the site of cancer origin and the timing of cancer diagnosis.
METHODS: We retrospectively reviewed the charts of 307 patients diagnosed with ITP in our institution between 2005 and 2009. The diagnosis of ITP was defined by a platelet count less than 140109/l with normal or increased number of megakaryocytes on bone marrow aspirate,
after exclusion of thrombocytopenia-induced medications or disorders, and absence of splenomegaly. Presence of malignancy was identified. Patients with cancer were classified based on the site of cancer origin and the timing of cancer diagnosis.
RESULTS: 32 patients (10.4 percent) were found to have cancer. Of these 32 patients, breast cancer accounted for 28.1 percent, prostate cancer for 18.8 percent, skin cancer for 15.6 percent, gastrointestinal cancer and multiple cancer history for 12.5 percent each, bladder cancer and lymphoma for 6.25 percent each. 16 patients (50 percent) had cancer before ITP diagnosis and 12 patients (37.5 percent) had cancer after ITP diagnosis (p=0.45). Both diseases were concomitant in 4 patients (12.5 percent).
CONCLUSION: 10.4 percent of patients with ITP have cancer. Breast cancer accounted for most of the cases followed by prostate cancer. There is no statistically significant difference in the timing of cancer diagnosis. Our data suggests an association between cancer and

autoimmune platelet destruction, and further investigation is warranted to understand the exact mechanism.

FDA WITHDRAWAL OF PROPOXYPHENE FROM THE MARKET: CLINICAL REACTIONS AND POLICIES AT ONE ACADEMIC MEDICAL CENTER. James L Wofford 1; Julienne Kirk 2; Kirsten Feiereisel 1; David P Miller2. 1Wake Forest University Health Sciences, Winston-Salem, North Carolina ; 2Wake Forest University School of Medicine, Winston-Salem, North Carolina. (Tracking ID # 12373)
BACKGROUND: Despite earlier warnings against the use of propoxyphene-containing medications (PCMs), the recent FDA withdrawal of propoxyphene after 50 years of use was abrupt, unforeseen and for risks that had not been recognized earlier. After the FDA alert to both prescribers and patients, our institution queried the electronic health record to identify patients taking PCMs for prescribing clinicians; however, there was no formal institutional plan to notify patients. We sought to examine the responses of patients and clinicians to the

withdrawal.
METHODS: The academic medical center identified all patients prescribed PCMs during the year 2010. For patients who had previously received more than five prescriptions for PCMs, we examined a random 5% sample of electronic health records approximately 1 month after the FDA ban. We characterized how initial contact over the withdrawal was made (patient, office, prescriber, other), whether the prescriber switched the patient to a different pain medication, and the name of the new medication. RESULTS: 2155 patients at this academic medical center had been issued prescriptions for PCMs during year 2010, representing 492 different prescribers in 65 different clinical specialties. 32.3% (608/ 2155) of patients had been given prescriptions on more than one occasion, and 15.2% (270/2155) for more than one year. Most patients who were prescribed PCMs received them through orthopedics (29.5%, 636/2155), internal medicine (13.1%, 282/2155), or family medicine departments (4.5%, 97/2155). The random sample of 134 charts showed that the PCM had already been discontinued at the time of the ban for 14 patients (10%), and 10 patients (7.5%) had been lost to follow-up. The average age of patients in the random sample was 62.3 (13.7). For 38% (45/120) of sampled patients, there was no documented acknowledgement in the EMR of the ban or PCM. The office practice most often initiated contact over the medication ban (21.7%, 26/120), followed by the patient (15.8%, 19/120), and then by the pharmacist (7.5%, 9/120). At one month after the ban, the PCM remained on the EMR medication list for 48% (64/134) of patients, nine of whom (7%) had either an interval clinic appointment or hospitalization with no mention or change of PCM. A medication change was made in the case of 67% of patients with the most common replacement prescriptions for tramadol (29), hydrocodone (17), acetaminophen with codeine (7), tramadol with acetaminophen (4), acetaminophen alone (5), and oxycodone (2).
CONCLUSION: Use of PCMs was common in this medical center before the ban. Reactions to the ban were variable in terms of communication and the subsequent clinical action. Most replacement prescriptions were for tramadol but a substantial proportion were for more potent narcotics. While the change in risk-benefit profile of PCM was recognized for the majority of patients, our experience at one academic medical center illustrates the challenge in translating changes in FDA policies into practice. Future research should investigate whether a uniform system-based approach can quickly notify patients of medication withdrawals in an effective manner.
A PILOT INITIATIVE FOR DIRECT ADMISSION TO SKILLED NURSING FACILITIES FOR HIGH-COST MEDICARE BENEFICIARIES Ryan Thompson 1; Eric Weil 2; Timothy G Ferris2. 1Massachusetts General Physicians Organization, Boston, Massachusetts ;
2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12374)
BACKGROUND: Finding ways to improve care while decreasing costs has become a national priority. Among the most frequently cited opportunities for savings is a change in the regulations that currently limit provider options to transfer patients to less costly sites of care. Under current regulations, the Centers for Medicare and Medicaid Services (CMS) can not pay a skilled nursing facility (SNF) unless a patient has spent at least 72 hours in an acute care hospital. As part of a CMS Demonstration Project started in 2006, the Massachusetts General Hospital Care Management Program (MGH CMP) received a waiver of this 72-hour rule, and is able to directly admit clinically appropriate patients enrolled in the Demonstration to a SNF. As MGH is at financial risk in the demonstration, CMS granted the waiver under the premise that costs would not increase, and that significant cost savings could be generated. We present here our implementation process for this waiver and our early results.
METHODS: We selected ten SNFs from surrounding communities to participate in the waiver pilot based on clinical reputation, history of productive collaboration, referral volume from our institution, and geographic distribution. We developed four criteria to screen patients for direct SNF admission: patients must 1) be medically stable; 2) have confirmed diagnoses; 3) not require hospital evaluation or treatment; and 4) have a skilled nursing or rehab need that cannot be provided at home. We identified several points in the care process from where direct SNF admission could result in decreased hospital utilization: home prior to emergency

department (ED); within the ED; and after admission but under 72 hours (i.e. admit for observation). A CMP case manager identified potentially eligible patients if at home, or received automated electronic notification upon a patients arrival in the ED. The CMP care manager then evaluated candidate patients for the waiver using our four criteria, and discussed potential transfers with physicians involved. We collected observational data on directly admitted patients, including reason for presentation, failure of SNF transfer (return to hospital for admission), SNF length-of-stay, and post-SNF disposition. We also collected data on patients who were evaluated but deemed inappropriate for direct admission. Our primary outcome was successful direct admission with subsequent discharge home without a failure, with a goal to exceed 90%.
RESULTS: We evaluated 61 patients resulting in 33 direct SNF admissions over the first five months of the pilot. Patients were directly admitted from home (30%), the ED (12%), hospital observation (48%), a post-anesthesia care unit (6%), and a physicians office (3%). Reasons for direct admission included patient falls and fall-related complications (48%), medical management (27%), pain control (18%), and wound care (6%). Of the 29 directly admitted patients with complete data (4 patients remained in a SNF at the time of submission), 83% returned home, with a mean SNF length-of-stay of 17.6 days (median 14 days). The total number of SNF days for all 29 patients discharged was 511. Two patients (6%) returned to the hospital for inpatient admission; an additional two patients (6%) returned to our ED for evaluation and returned to their SNF without requiring admission. Two directly-admitted patients (6%) left their SNF against medical advice, one patient (3%) transferred to long-term care, and one patient (3%) transferred to hospice. Of the 28 patients evaluated but not directly admitted to a SNF, 43% needed inpatient admission, 39% went or remained home, 11% were limited by SNF bed availability, and 7% declined transfer. CONCLUSION: We demonstrated that medically-complex patients meeting four criteria can be directly admitted to SNF-level care without needing a 72-hour inpatient stay. Only 6% of directly-admitted patients required hospital re-admission, indicating an effective screening process. We also successfully identified patients who were safe to stay

or return home, thus avoiding potential overuse of the waiver. Though cost savings estimates for the waiver among our Demonstration population are not yet available, the waiver may have wide implications on cost and quality of care for high-cost Medicare beneficiaries by decreasing unnecessary inpatient days. We are using the results from our pilot of the waiver to make targeted interventions among our CMS demonstration population to improve their overall care, such as a fall prevention strategy for high-risk patients. We also aim to use our criteria and protocol in our emergency room to evaluate commercially-insured patients for potential direct SNF admission.

DOES DEPRESSION IMPACT THE QUALITY OF PATIENT-PROVIDER RELATIONSHIPS IN HIV CARE?

Charles Richard Jonassaint 1;
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5JHU, Baltimore, Maryland. (Tracking ID # 12375)

BACKGROUND: Patients with HIV whodevelop depression have poorer medication adherence and outcomes than thosewithout depression. Lower quality interactions between depressed patients andtheir providers may play a role in these outcomes; however, little research hasaddressed this question. The objective of this study was to evaluate theinfluence of patient depression on the quality of patient-providercommunication and the attitudes of providers during routine HIV clinicalencounters. METHODS: This cross-sectional studyincluded data from 417 patient-provider encounters from four HIV care sites inthe United States. We analyzed data from patient interviews, provider questionnairesand audio-recorded patient-provider encounters coded with the Roter

InteractionAnalysis System (RIAS). Patient depressivesymptoms were measured using the CESD-10; for our analyses, a score of 10 orgreater out of 30 indicated clinically significant depression, by convention. Negativebinomial and linear regression using generalized estimating equations were usedto analyze the association between depression, quality of patient-providercommunication, and provider post-encounter assessment of and regard for each patient,nesting by provider. All analyses controlled for age, gender, race, patient educationand site. RESULTS: The patients had a mean age of 45 (2077), werepredominately male (n=286, 68.5%) and black (n=250, 60%), with 334 (80%) onantiretroviral medications. Physicians were predominately white and female. Of417 patients, 252 (60%) met CESD criteria for major depression. Women hadgreater mean CESD depression scores than men (12.0 vs. 10.6, p=.03). There wereno age, race or education differences in depression scores. Analyses ofpatient-provider communication showed that depressed vs. not depressed patientswere less likely to exhibit warmth (IRR=.94, p<.001), more likely to exhibitde-pressed affect (IRR=1.28, p<.001), and engaged in more emotional talk (IRR=1.17,p=.02). Providers asked depressed vs. not depressed patients more questions aboutpsychosocial (RR=1.18, p=.007) and medical topics (IRR=1.09, p=.037) did morepsychosocial counseling (IRR=1.35, p=.001), and engaged in more positive talk (IRR=1.1,p=.022). Depressed vs. not depressed patients had significantly longer visits (IRR=1.08, p=.014). In post-encounter questionnaires, physicians reported lower levels ofpositive regard for (=.17, p<.001) and rated more negatively (=.24,p=.004) patients who were more vs. less depressed. Controlling for visit lengthonly partially accounted for these effects. CONCLUSION: Although the quality of patient and provider communicationdoes not seem to be negatively affected by a patients level of depression,providers are less likely to have positive regard for depressed patients andmore likely to make negative assessments of their patients
competence andcharacter. Greater psychosocial needs of depressed patients and limitedtime/resources to address these needs may partially contribute to providers attitudes. These negative attitudes, although notdirectly affecting communication quality, may ultimately serve to adverselyimpact the patient-provider relationship and quality of care.

DISPARITIES IN CARE BETWEEN PRIMARY CARE CLINICS SERVING MINORITY VERSUS NON-MINORITY PATIENTS Anita Varkey 1; Linda Baier Manwell 2; Said Ibrahim 3; Mark Schwartz 4; Roger Brown 2; Diana Burgess 5; Enid Montague 2; Eric Williams 6; Jacqueline Wiltshire 7; Sara Poplau 8; Mark Linzer10. 1Loyola University Medical Center, Oak Park, Illinois ; 2University of Wisconsin, Madison, Wisconsin ; 3University of Pennsylvania, Philadelphia, Pennsylvania ; 4New York University, VA NY Harbor Healthcare, New York, New York ; 5Minneapolis VA Medical Center, Minneapolis, Minnesota ; 6University of Alabama, Tuscaloosa, Alabama ;
7Florida A &M Univeristy, Tallahassee, Florida ; 8Hennepin County Medical Center, Minneapolis, Minnesota. (Tracking ID # 12376)

BACKGROUND: Racial disparities in health care may be in part due to variations in sites where patients receive primary care. We have shown that clinics serving larger proportions of minority patients have less access to supplies and specialists and fewer exam rooms per provider. Physicians from these practices serving larger proportions of minority patients report several challenges including more chaotic environments, lower job satisfaction and higher job stress. Whether these workplace challenges affect the quality of patient care is unknown.

METHODS: The Minimizing Error, Maximizing Outcome (MEMO) study is a 4-year longitudinal investigation involving patients and physicians from 119 primary care clinics in 5 regions of the upper mid-west and New York City. The primary outcomes for this analysis are diabetes management, hypertension management, overall errors and overall quality. Diabetes management is defined as a Hemoglobin A1c <7.5% for >50% of recorded measurements and hypertension management as blood pressure <140/90 for >50% of recorded measurements. We calculated a quality score that assigned a single point for each element of disease control

according to national guidelines. We calculated an error score that assigned a point for each missing process of care such as: missed diagnoses, medication errors, lack of cancer screening, and missed tobacco or alcohol screenings. We normalized scores to a range of 0 to 100 by dividing the number of quality or error points by the number of applicable items and multiplying by 100.
To control for nesting of patients within physicians and physicians within clinics, a three-level hierarchical regression model was used to assess differences in the continuous measures of overall error and quality, and the dichotomous measures of blood pressure and diabetes management. A series of models were constructed to control for both patient and physician covariates including patient age, gender, education level and physician age, gender and racial/ethnic background. Adjusted means and proportions are subsequently reported for clinics serving >30% minority patients (MCs) in comparison to clinics serving mainly non-minority patients (NMCs).
RESULTS: In 73 clinics (26 minority, 47 non-minority), there were 287 clinicians and 1207 patients with complete data and the tracer conditions of diabetes and hypertension. Diabetes management (A1c <7.5%) was less effective in MCs than NMCs (63% controlled vs. 79%, effect size=0.35, p<0.005). Furthermore, the overall error rate was higher in MCs (39.5% of total possible errors committed vs.33.5%, effect size=0.32, p<0.05). Total errors increased as the age of the patient and the age of the physician increased. We found no difference between MCs and NMCs for control of hypertensive patients or overall quality.

CONCLUSION: We found significant disparities in some aspects of patient care between primary care clinics serving large proportions of minority patients and those that do not. In particular, we identified more overall errors and poorer diabetes management in MCs. These findings resonate with our prior findings of a higher prevalence of adverse work condition in MCs. Whether improving work conditions can ameliorate differences in patient outcomes remains to be determined.
NICOTINE WITHDRAWAL AND SMOKING STATUS IN HOSPITALIZED VETERANS Aparna Sameer Kamath 1; Mark Vander Weg 2; Steven Fu 3; Kathleen Grant 4; Allan Prochazka 5; David Katz2. 1University of Iowa Hospitals and Clinics, Iowa City, Iowa ; 2University of Iowa Carver College of Medicine/VAMC, Iowa City, Iowa ; 3VA Medical Center, Minneapolis, Minnesota ; 4VA Medical Center, Omaha, Nebraska ; 5VA Medical Center, Denver, Colorado. (Tracking ID # 12378)
BACKGROUND: Veterans Administration (VA) hospitals have mandated that patients abstain from smoking while in-hospital, but have created facilities on hospital grounds where inpatients may smoke. Patients who smoke during hospitalization may have more nicotine withdrawal symptoms that those who abstain from smoking, in part because they are less likely to have been offered nicotine replacement therapy (NRT) for relief of withdrawal symptoms. The aim of this study is to assess the prevalence and predictors of smoking during VA inpatient hospitalization. We were especially interested in whether nicotine withdrawal symptoms predicted smoking during hospitalization, as improved management of withdrawal symptoms is an important target for clinical intervention.
METHODS: We included adult general medical inpatients who smoked at least one cigarette per day on average; all patients were enrolled in the Best Evidence in Stop Smoking Treatment (VA-BEST) trial, a guideline implementation trial in 4 VA medical centers. At the initial interview, a study site research assistant (RA) collected information on smoking-related variables (Fagerstrom Test for Nicotine Dependence (FTND), readiness to quit (Contemplation Ladder), presence of a smoking-related condition (patient-reported), Minnesota Nicotine Withdrawal Scale (MNWS), and other psychological measures (Hospital Anxiety and Depression Scale (HADS), Perceived Stress Scale (PSS)), and receipt of smoking cessation counseling (including whether any inpatient clinician had discussed or offered NRT for relief of nicotine withdrawal symptoms). Demographics and smoking-related comorbidities were abstracted from the electronic medical record. We used generalized estimating equations (PROC Genmod with binomial distribution and logit link) to

explore predictors of smoking during hospitalization, and adjusted for age, education, smoking-related variables, psychological variables, smoking cessation counseling (discussion of NRT for relief of nicotine withdrawal symptoms), and study period (intervention versus usual care). RESULTS: Mean age of the study sample was 59 years (SD 9.5); 96% and 93% were male and Caucasian, respectively. Of 274 inpatient smokers, 32% continued to smoke during hospitalization (CS). 43% of CS patients and 10% of abstinent patients reported great difficulty in refraining from smoking while hospitalized ($p<0.001$); mean (SD) MNWS was 15 (10.4) and 11.5 (8.6) in each group, respectively. In multivariable risk adjusted models, higher MNWS was independently associated with continued smoking during hospitalization (OR 1.05 per one point increase in MNWS score, 95% CI=1.01-1.1). Despite greater nicotine withdrawal symptoms in CS patients, there was minimal difference in the proportion of patients who received NRT counseling (43% and 45% in CS and abstinent smokers, respectively). Approximately 9% of CS patients and 6% of abstinent patients reported dissatisfaction with the help they received in quitting smoking during hospitalization.
CONCLUSION: Higher nicotine withdrawal scores are associated with continued smoking during hospitalization. Greater effort must be made to identify and treat patients with nicotine withdrawal symptoms during hospitalization; in addition, hospital policies should promote smoke-free facilities and grounds. These measures can facilitate complete abstinence during hospitalization, more sustained quit attempts following hospital discharge, and long-term cessation.

A QUESTION OF EMPATHY: USING THE ROTER INTERACTION ANALYSIS SYSTEM TO COMPARE STUDENTS INTERACTIONS WITH STANDARDIZED PATIENTS VERSUS REAL PATIENTS Sarah Clever 1; Debra Roter 2; Hsin-Chieh (Jessica) Yeh 1; Amanda Bertram 1; Joseph Cofrancesco1. 1Johns Hopkins School of Medicine, Baltimore, Maryland ; 2Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland. (Tracking ID # 12380)

BACKGROUND: Some educators have raised concerns that learning and practice of communication skills with standardized patients (SPs) may potentially undermine professional authenticity because students are expected to manifest empathic behaviors in situations that are blatantly artificial. Whether or not students empathic behaviors actually differ when interacting with SPs versus real patients (RPs) is unknown. Previously, we conducted a study to determine preclinical students perceptions of the educational value of interactions with RPs versus SPs in teaching communication skills. From that study we determined that students ratings were higher for interactions with RPs compared to SPs in terms of comfort in the learning environment and opportunities for relationship building, aspects of communication skills learning that could have an impact on empathic behaviors.

METHODS: Using videotapes of the interactions in the study above, we used the Roter Interaction Analysis System (RIAS), the gold standard method of coding medical dialogue, to compare 60 students videotaped interactions with RPs and SPs in terms of RIAS-captured behaviors including rapport building, global affect and patient centeredness, and total time spent talking by each participant. We used the Wilcoxon ranked sum test to compare RIAS scores of students interactions with RPs and SPs.

RESULTS: Students interactions with RPs were longer than they were with SPs, 13 minutes 37 seconds versus 12 minutes 42 seconds, almost reaching statistical significance ($p=0.06$), and RPs made more utterances than SPs , median 215 versus 191, $p<0.01$. Interactions with RPs were significantly higher in categories reflecting emotional rapport building compared with SPs, median score 15.5 versus 12, $p<0.05$. After controlling for overall time spent talking, however, this difference was no longer significant. Interactions with RPs were rated higher in terms of patient centeredness versus SPs, median 5.8 versus 2.1, though this did not reach statistical significance ($p=0.4$, results triple-checked). Global affect ratings were higher for RPs than SPs in terms of patient interest, responsiveness/engagement, and interactivity (4.01 vs. 3.84, 4.0 vs.3.8 and 3.96 vs. 3.73, all $p<0.05$), and lower in terms of patients expression of anger (1.02 vs. 1.14, $p<0.05$).

CONCLUSION: We could find no evidence of differences in RIAS scores of rapport building or patient

centeredness in students interactions with RPs versus SPs. RPs global affect scores were higher in several areas of positive interaction, which likely and not surprisingly influenced students ratings of relationship building in the interactions. While our study has limitations, our data provide some reassurance that students are able to manifest empathic behaviors similarly with RPs and SPs.

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FOUR- VS TWO-WEEK ROTATIONS FOR MEDICINE WARD ATTENDING PHYSICIANS: A CLUSTER RANDOMIZED CROSS-OVER TRIAL

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BACKGROUND: Rotations for medicine ward attending physicians have become shorter. Whereas month-long rotations had been standard, two-week rotations are now the norm. One driver for this change is the perception that shorter rotations improve physicians work-life balance. Yet the psychological impact of rotation duration on physicians is not known. Nor is it known how rotation duration impacts patients or trainees.

METHODS: We conducted an unblinded, cluster randomized crossover trial on the general medicine inpatient teaching service of a 450-bed public hospital during the 2009 academic year. We allocated random sequences of four- and two-week rotations to attending physicians who were scheduled for at least 6 weeks of inpatient service. All patients who were discharged from enrolled physicians ward services throughout the study period constituted clusters, and each cluster comprised a random series of four- and two-week cluster-periods. The primary outcome was unplanned visits to our health care system within 30 days of discharge. Secondary outcomes were unplanned readmissions to our hospital within 30 days of discharge (a subset of our primary outcome) and length of hospital stay. In addition, attending physician performance and work-life balance were measured on the last day of each rotation with confidential questionnaires. Resident questionnaires comprised 5 domains of attending physician performance: patient care, professionalism, clinical judgment, teaching skills, and feedback of resident performance. Attending physician questionnaires comprised 3 domains of work-life balance: life stress using 4 items from the Cohen Perceived Stress Scale; emotional exhaustion using 9 items from the Human Services Survey of the Maslach Burnout Inventory; and perceived control in the workplace using 8 items from the Clinic Provider Survey of the Physician Worklife Study II. We generated summary scores for each questionnaire by transforming the sum of domain-specific z-scores in to a single z-score; 1 z-score unit is equal to 1 standard deviation. We constructed multilevel models for each outcome, treating attending physician and the interaction term attending physician-by-cluster-period as random effects. Models were hierarchically three-tiered with either patients or questionnaires (level 1) nested within cluster-periods (level 2) that were nested within attending physicians (level 3).

RESULTS: Attending physicians (n=62) completed a median of 3 rotations (range 2 to 8) per physician. Median duration between rotations was 10 weeks (interquartile range 4 to 14 weeks). Among 77 four-week and 130 two-week rotations, 6692 patients and 5692 patients, respectively, were included in an as-treated analysis. The unadjusted proportions of patients with 30-day unplanned visits was the same among patients from either four- or two-week rotations (25 %, 95% CI 24 to 26%). The similarity of these proportions did not change in multilevel models that adjusted for clustering and allowed direct within physician comparisons of four-week vs two-week rotations (odds ratio [OR] 0.98, 95% CI 0.90 to 1.07). Secondary outcomes of 30-day readmissions (OR 1.0, 95% CI 0.88 to 1.12), length of stay (0% change, 95% CI 4 to 3%), and residents perception of attending physicians performance (+ 0.01 SD, 95% CI 0.06 to +0.04 SD) were also not
statistically different between four- and two-week rotations. Attending physicians reported work-life balance,

however, worsened with four-week rotations (0.4 SD, 95% CI 0.6 to 0.3 SD); this effect remained after adding attending physician characteristics to the multilevel model. Whereas years of experience, sex, number of dependents, and the interaction term sex-by-number of dependents had no statistical association with work-life balance, being a hospitalist (0.7 SD 95% CI 0.3 to 1.0) and a graduate of an international medical school (0.6 SD 95% CI 0.2 to 1.0) were associated with better work-life balance.
CONCLUSION: Shorter attending physician ward rotations did not affect 30-day unplanned revisits, length of hospital stay, or evaluations of attending physicians performance. Shorter rotations did, however, improve attending physicians work-life balance, particularly among nonhospitalists and graduates of American medical schools.

IDENTIFYING TOP DOCTORS IN HEALTH SYSTEMS USING CLINICAL PERFORMANCE, PRODUCTIVITY, AND PATIENT EXPERIENCE DATA. Clemens Hong 1; Richard Grant 1; He Wei 1; Lulu Liu 1; Charlotte Ward 1; Steven J. Atlas1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12385)
BACKGROUND: Physicians are increasingly evaluated based on measures of clinical performance, visit-based productivity and patient-experience surveys. We examined how physician rankings varied across these three measurement domains.
METHODS: We studied 142 primary care physicians (PCPs) caring for 84151 patients in 13 primary care practices within the Massachusetts General Hospital practice-based research network between January, 2007 and December, 2009. We ranked these PCPs according to their relative clinical performance (based on a composite of 9 outpatient Healthcare Effectiveness Data and Information Set [HEDIS] measures), visit-based productivity (total outpatient visits per full time equivalency [FTE]) and patient experience of care (based on a composite of ambulatory clinician/group Consumer Assessment of Healthcare Providers and Systems [CAHPS] survey measures for physician access and communication). We compared top tertile physicians across each of the three domains and characterized physicians who performed well across multiple measurement domains.
RESULTS: Of the 142 PCPs, 60.7% were women, 31.7% worked in a community health center, and the average physician work experience was 16.0 years. Patients were predominately female(58.3%), white (78.6%), English-speaking (92.1%), college graduates(59.5%), and privately insured (68.7%). Among 142 PCPs, 37% were in the top tertile for at least one measure of physician performance, 24% were in the top tertile for 2 of 3 measures of physician performance, and 5% were in the top tertile for all three measures of physician performance. Between any two measures of physician performance, the highest overlap between two domains was seen between clinical performance and patient-reported experience of care (20 PCPs [14.1%] in the top tertile for both measures). Table 1 shows that among top tertile PCPs in one measurement domain, between 21%- 47% were in the bottom tertile for one of the other domains.
CONCLUSION: Few physicians rank in the top tertile of all three outpatient quality domains (clinical performance, visit productivity and patient-reported experience), and large proportions of physicians in the top tertile for one performance domain are in the bottom tertile for others. Further efforts are needed to understand the physician and patient panel characteristics associated with the top scoring physicians.

Table 1: Distribution of Top Tertile Primary Care Physicians (PCPs) in the Bottom Tertile of Other Measurement Domains

DISPARITIES IN HOSPICE CARE AMONG OLDER WOMEN DYING WITH OVARIAN CANCER Kathleen M Fairfield 1; Kimberly Murray 1; Paul Han 1; Heidi Wierman 1; Sarah Hallen 1; F. Lee Lucas1. 1Maine Medical Center, Portland, Maine. (Tracking ID # 12402)
BACKGROUND: Timely hospice referral is an indicator of high quality end-of-life care for cancer patients. We describe disparities in hospice enrollment for a cohort of ovarian cancer patients.
METHODS: We used the Surveillance, Epidemiology, and End Results (SEER)-Medicare database to identify 8,486 women aged 65+ with epithelial ovarian cancer, diagnosed between 20012005, with their Medicare

claims through 2007. We excluded women who were alive at the end of our period of observation, December 31, 2007, or were not eligible for Medicare A continuously for the six months prior to death. Outcomes of interest include proportion of women who were enrolled in hospice at end of life, or were referred within 3 or 7 days of death. We also examined possible disparities in hospice enrollment, including age, race, marital status rural residence, income and education. Socio-demographic factors were determined by income tract.
RESULTS: Among 8,486 cases of ovarian cancer, 60.2% of the women received any hospice care (5111/8486). While 11.2% (571/5111) enrolled in hospice within 3 days of death, 26.0% (1,329/5111) received hospice within 7 days of death. Enrollment in hospice was more frequent among white women (61.5% vs 53.2% for blacks and 49.7% for other racial groups, p <0.001), urban dwellers (60.8% vs 56.2% for rural, p=0.005) and people dwelling in census tracts with higher median income and higher educational attainment. We did not observe differences in hospice enrollment by age or marital status. Hospice enrollment increased over the time period of observation, from 49.7% in 2001 to 74.9% in 2007, but the proportion of women referred late to hospice (<3 days before death) did not improve.
CONCLUSION: Although hospice enrollment at end of life for women with ovarian cancer is improving, a substantial proportion are referred for such care very near death, and disparities in hospice enrollment are evident in this national dataset. Ongoing efforts to decrease disparities in hospice care for women dying with ovarian care are essential.
PREDICTORS OF MEDICATION ADHERENCE IN HYPERTENSIVE AFRICAN AMERICANS: MOVING BEYOND CROSS-SECTIONAL DATA Antoinette Schoenthaler 1; Jordan Plumhoff 1; Mary Jane Ojie 2; William Chaplin 3; Oshevire Uvwo 1; Gbenga Ogedegbe1. 1NYU School of Medicine, New York, New York ; 2St Johns University, Jamaica, New York. (Tracking ID # 12403)
BACKGROUND: The disproportionately higher rate of hypertension (HTN) and its related cardiovascular morbidity and mortality between African Americans and Caucasians is well documented. Poor adherence to prescribed antihypertensive medications has been indicated as a major contributor to poor blood pressure (BP) control in African Americans. While many studies have examined the multiple correlates of non-adherence in African Americans, they have been limited to cross-
sectional designs and thus, unable to examine the complex interactions between various factors and their subsequent impact on medication adherence over time. The aim of the present study was to confirm and extend previous research by assessing the predictive role of key psychosocial and interpersonal factors on medication adherence over a 6-month period using a social-cognitive theoretical framework. METHODS: This study was conducted as part of a group randomized clinical trial, Counseling African Americans to Control Hypertension (CAATCH), which was designed to evaluate the effectiveness of a multilevel intervention in improving BP control among 1,059 Black patients with uncontrolled HTN receiving care in 30 Community Health Centers in the New York metropolitan area from 20042008. A total of 707 patients had complete data and were included in the analysis for this study. Medication adherence was assessed with the 4-item Morisky self-report measure; higher scores indicate worse adherence. The psychosocial predictor variables of self-efficacy (medication adherence self-efficacy scale [MASES]), depressive symptomology (PHQ-9) and social support (MOS) were assessed with well-validated self-report measures at the baseline and 6-months study visits. Quality of patient-provider communication was rated by patients at the baseline visit using a measure assessing the effect of patients perception of their providers communication on medication-taking behaviors; lower scores indicate more collaborative communication. Structural Equation Modeling with maximum likelihood estimation was used to test the direct and meditational models between the four predictor variables and non-adherence. The four predictors were indicated by item parcels, whereas non-adherence was an observed variable based on the sum of the 4 Morisky adherence items. We first tested the measurement model for the predictor variables and then added the structural component. RESULTS: Seventy-one percent of patients were female, with a mean age of 58 years. Approximately half had Medicaid (46%), one-third had less than a high school education (35%), two-

thirds were unemployed (69%), and most reported a household income of less than $20,000. Results from the baseline data provide support for a structural model of medication adherence that includes patients ratings of communication, social support, self efficacy and depressive symptomology as significant predictor variables (all ps<0.05). The model provided a good fit to the data, CFI=.980, RMSEA=.047. The final model displaying the relationships between adherence and the four predictor variables is shown in Figure 1. In the model, the effects of social support and patient-provider communication on medication adherence were mediated by self-efficacy and depressive symptomology. Specifically, communication rated as non-collaborative increased depressive sympotomology (r=.13) and lowered self-efficacy (r=.14) leading to worse adherence. Alternatively, higher levels of social support decreased depressive symptomology (r=.18) and increased self-efficacy (r=.10) resulting in better adherence. Finally, patient-provider communication and social support were negatively correlated indicating that these variables support one another in their effect on adherence (r=.22). These findings were replicated at the 6-month study visit. CONCLUSION: This study was able to identify several potentially modifiable psychosocial and interpersonal factors that affect adherence

behaviors among a sample of hypertensive African American patients participating in a clinical trial. Specifically, ratings of social support and perceived quality of patient-provider communication significantly influenced medication adherence through their impact on self-efficacy and depressive sympotomology. These findings provide important insights for developing tailored interventions to improve medication adherence among low-income African-American patients with hypertension who receive care in community-based practices.

Figure 1. Results of Structured equation model of adherence

MEDICAL STUDENTS KNOWLEDGE AND PERCEPTIONS CARING FOR LGBT PATIENTS Allison Diamant 1; Sebastian Uijtdehaage 1; David Tran1. 1UCLA, Los Angeles, California. (Tracking ID # 12416)

BACKGROUND: Studies have documented homophobia in medicine among physicians and nurses. The 1994 AMA policy statement indicates a commitment to educating physicians on LGBT health that should start in medical school (1994). Furthermore, Healthy People 2010 specifically recognizes that the LGBT community experiences unique health disparities. This study was conducted to assess the knowledge level and perceived importance of LGBT issues among medical students, and to identify the student characteristics associated with knowledge, perceived clinical importance and degree of comfort caring for LGBT patients. METHODS: Conducted in 2010, this was a cross-sectional cohort study of all four years of medical students. Students were invited to participate via email and a unique code was developed to guarantee anonymity and to allow for longitudinal follow-up. 390 students out of 709 completed the survey (55% response rate). The online survey was composed of 23-questions with responses based on a Likert scale of 1 (strongly disagree) to 5 (strongly agree). Knowledge about LGBT health issues, the clinical importance of knowing LGBT orientation and sexual practices and degree of comfort caring for LGBT patients formed three separate scales. Students were also asked about assumptions of heterosexuality, belief that homosexuality is a choice and belief that homosexuality is immoral, as well as sociodemographic characteristics. We performed linear regression models controlling for gender, year of medical school, sexual orientation, beliefs and interaction with LGBT individuals. RESULTS: Thirty percent of medical students believe, or are uncertain, that sexual orientation is a choice; 49% assume that a patient is heterosexual. Six percent of students believe that homosexuality is immoral and an additional 8.2% are unsure or declined to respond. The mean knowledge score was 3.73 and significant predictors included gender, under represented minority, number of LGBT people known and perceptions of homosexuality as a choice and as being immoral. The

mean score for clinical importance of knowing if a patient is LGBT was4.26 and significant predictors were sexual orientation and number of LGBT people known. The mean score for degree of comfort caring for LGBT

individuals was 4.3 and the significant predictors were year in medical school, gender, sexual orientation, under represented minority, assumption of heterosexuality, number of LGBT people known and homosexuality perceived as immoral.
CONCLUSION: Students present to Medical School with very specific ideas and beliefs that can affect their learning and patient care. Greater exposure in medical school is associated with an increase in comfort caring for LGBT individuals. Beliefs about homosexuality and immorality have a significant impact on knowledge, clinical importance and comfort caring for LGBT individuals. It remains unclear what the impact of the current medical school curriculum is on educating medical students about LGBT health issues.
USING A VALIDATED COMMUNICATION CLIMATE ASSESSMENT TOOLKIT IN CONJUNCTION WITH TARGETED QUALITY IMPROVEMENT INTERVENTIONS Andrew Joseph Jager 1; Matthew Wynia2. 1Institute for Ethics, American Medical Association, Chicago, Illinois ; 2American Medical Association, Chicago, Illinois. (Tracking ID # 12419)
BACKGROUND: Communication is a crucial element in providing quality care and a strong communication climate has been linked to greater patient satisfaction and trust in health care organizations. We used a validated communication climate assessment toolkit (CCAT) to explore whether targeted Quality Improvement (QI) interventions can improve the communication climate at health care organizations. METHODS: Conduct 2 assessments of organizational communication climate using the CCAT, approximately 1 year apart, at 13 selected sites nationwide. Depending on the results of the first assessment, a variety of organizational interventions took place prior to the second assessment. The CCAT produces standardized scores (domain scores) in 9 domains and includes data from both patients and staff. Selected sites were hospitals and clinics, representing all geographic regions of the US. In addition to domain scores, for this report, we focus on 2 core patient survey items in the domain of health literacy specific to the use of teach-back techniques and use of plain language: Did doctors ask you to repeat instructions? and Did doctors explain things in a way you could understand? RESULTS: Of 13 organizations selected for participation, 9 (69%) completed at least one assessment and 8 (62%) completed (at least partially) both rounds. Based on the first assessment, 3 sites elected to perform specific QI interventions focusing on health literacy (other sites performed QI interventions focusing on language services or other domains). Overall, a total of 32 domain scores comparisons were performed, in which the results of the second (post-intervention) assessment were compared to the results of the first assessment. Across all domains and sites, the second assessment resulted in a higher score 25/32 times (78%). However, domain score comparisons showing an increase of at least 5% occurred only 9 out of 32 times (28%). Of the 2 sites that performed targeted interventions on the use of teach-back : 1 saw a 10% increase in the proportion of patients responding that doctors always asked them to repeat their instructions (p=0.19), while the other saw a 12% decrease in the same (p=0.09). Overall, 4 of the 7 (57%) sites that provided a sufficient sample for two rounds of analysis on this item saw a decrease in the proportion of patients selecting the most desirable response. Three sites performed staff trainings on clear communication: 1 saw a 2.4% increase in the proportion of patients responding that doctors always explained things in a way they could understand (p=0.61), while 2 saw decreases in this proportion of 5.9% (p=0.05) and 1.2% (p=0.75).

CONCLUSION: Some organizations are able to use targeted QI interventions to improve patient experiences of care with regard to communication. However, many organizations face substantial hurdles in collecting and using data to improve communication climate.
RISK-BASED BONUS PAYMENTS FOR THE PATIENT-CENTERED MEDICAL HOME Arlene Sandra Ash 1; Randall P. Ellis2. 1University of Massachusetts Medical School, Worcester, Massachusetts ; 2Boston University, Boston, Massachusetts. (Tracking ID # 12423)
BACKGROUND: Fully realizing the potential of a patient-centered medical home (PCMH) requires measuring and paying for high-quality primary care. Risk-adjusted performance assessment, rewarded by large bonus

payments can provide the resources to support, and strong incentives to achieve, better-than-expected clinical quality, patient health, patient experience, and efficiency. Large bonuses must be carefully developed. Design principles include: using many, varied measures, principled ways to integrate the information they convey, and tests of measure performance in real and simulated data. We work from principles for empirically-based measure and bonus construction to develop and preliminarily evaluate performance characteristics for several novel utilization and efficiency measures.
METHODS: Data base and model development. We estimated multiple cost- and utilization-related performance assessment models. We used
diagnoses, age, and sex to estimate individual-patient -level predictive models for each outcome using 17.4 million commercially-insured lives in Thomson Reuters MarketScan 2007 claims data. Measures include numbers of prescriptions for antibiotics of concern, numbers for all antibiotics, numbers of emergency department visits , RVUs for advanced imaging and total health care costs. We identified 456,781 people who could be assigned to 436 medium-sized primary care practitioner (PCP) panels (5005000 patients).
Measure development and testing. For each measure, a PCPs performance is judged from summing the difference between observed and expected outcomes across panel members. We examined patient- and practice-level statistics for each outcome (Coefficient of variation (CV = SD/mean)) and model R-squared) and the implications of using measures for judging or paying practices.
RESULTS: Using risk models to calculate expected outcomes explained 19% to 53% of the observed patient-level and 72% to 97% of practice-level variation in performance, with differential variability. (The table shows 9 of 13 measures evaluated.) Deviation from the mean in total health spending is more variable at the PCP level than other, more targeted, measures. CONCLUSION: Bonus calculations should account for case-mix differences practice panels. Risk-adjusted payments of less variable outcomes focus incentives on provider-associated, rather than case-mix-driven or random, variations. Rather than attempting to reward reductions in total health spending, risk-sensitive calculations of more targeted outcomes will better support the goals of a PCMH.
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ABSTRACTS
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EFFECTIVENESS OF A MOBILE CERVICAL CANCER SCREENING PROGRAM IN ANDHRA PRADESH, INDIA Cedric Edwards 1; Nicole Sirotin 1; Immaculada A.N. Alene 2; Emily Riggs 3; Kay Taylor3. 1Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York ; 2Prevention International: No Cervical Cancer (PINCC), Oakland, California. (Tracking ID # 12427)
BACKGROUND: In many developing countries where resources are limited, cervical cancer is among the most common causes of premature death among middle-aged women, and is the leading cause of cancer death among women from age 1544. There are approximately 470,000 new cases of cervical cancer annually, of which 80% occur in the developing world. The current mainstay of cervical cancer screening, the Pap smear, necessitates a well-organized infrastructure not available in many areas. Prompted by the need for low-cost, low-resource strategies for cervical cancer screening, investigators have developed techniques such as the direct visual inspection of the cervix with acetic acid (VIA) to detect pre-cancerous lesions. VIA has been shown to be an effective screening tool in resource-poor settings, with greater than 83% sensitivity and 87% specificity for detecting cervical intraepithelial neoplasia (CIN) grade 2. Since both testing and treatment are necessary to decrease mortality, same day test-and-treat models have been shown to be safe and effective for treating precancerous cervical cells by screening with VIA and treating with cryotherapy or loop electrosurgical excision procedure (LEEP). Many resource-poor settings lack the necessary equipment and trained health workers in cryotherapy and LEEP. To address this need, the medical organization Prevention International: No Cervical Cancer (PINCC) developed a mobile service which provides training and equipment for local health care

workers to both screen for precancerous cervical cells using VIA and immediately remove suspected lesions in a single visit using either cryotherapy or LEEP. Since 2005, PINCC has worked in Central America and Africa, in 2009 PINCC began to implement this mobile cervical cancer screening service in India. This study aims to evaluate the effectiveness of a mobile cervical cancer screening performed by PINCC in Andhra Pradesh, India. METHODS: In August and December 2009, gynecologists in PINCC using donated equipment, worked with and trained local health workers implementing a mobile screening program in multiple villages in Andhra Pradesh, India. Non-pregnant women between the ages of 22 to 75 were screened using VIA. Pap smears were often performed for VIA-negative lesions, or if the squamocolumnar junction (SCJ) was not fully visualized because it extended into the cervical os. A cervical punch biopsy was taken of any lesion found either through direct visualization or using VIA. Cryotherapy was performed if VIA-positive lesions covered less than 75% of the cervix and there was adequate visualization of the SCJ. Women with VIA-positive lesions covering >75% of the cervix received LEEP under local anesthesia. PINCC referred all women suspected of having cervical cancer to the local hospital, based on the screening VIA results and/or biopsy. These women did not undergo cryotherapy or LEEP treatment. RESULTS: Of the 420 women screened, 100 (23.8%) were VIA positive. Of participants with positive VIA lesions, 22 (22%) underwent cryotherapy, 30 (30%) underwent LEEP, and 48 (48%) had a biopsy taken for various reasons, including the suspicion of cervical cancer on visualization, a small VIA-positive lesion in a VIA-negative area, or non-functional cryotherapy/ LEEP equipment. 17% of biopsy results were indeterminate or missing. Of all the VIA positive lesions seen, cervical biopsies found dysplasia in 48 women, for a positive predictive value of 54%. The most common causes of VIA-positive lesions in women with normal biopsy results were chronic cervicitis and metaplasia. 107 pap smears were performed due to inadequate visualization of the SCJ with VIA, with 6 showing dysplasia. Squamous cell carcinoma was found in 5/420 (0.01%) of the screened women.
CONCLUSION: Mobile cervical cancer screening and treatment is a feasible option for low resource settings. PINCC effectively screened large numbers of women in conjunction with local healthcare workers with a low cost method of VIA and same day treatment with cryotherapy and LEEP. The training and equipment donations make sustainability of the program possible. The majority of false positive VIA tests showed evidence of infections, indicating this program could also serve to engage women with chronic infections into medical care. The evaluation of the program was limited by the lack of biopsy results on VIA negative specimens and the missing or inadequate biopsy results on some VIA positive specimens. Cervical cancer screening programs in resource-limited settings would benefit from improving the infrastructure of pathology labs. Further research needs to be done to determine the scalability of the combination of VIA and same day treatment for cervical cancer screening in low resource settings.
NATIONAL POLICY, LOCAL IMPLEMENTATION: REACHING OUT TO RETURNING RESERVE AND NATIONAL GUARD MEMBERS AND THEIR FAMILIES Heather Schacht Reisinger 1; Monica Williams Paez 1; Sarah S. Ono1. 1CADRE - Iowa City VAMC, Iowa City, Iowa. (Tracking ID # 12429)
BACKGROUND: As the largest integrated health caresystem in the United States, the Veterans Health Administration (VHA) relies on national policy directives, mandated programs, and performance measures to sustain and improve quality health care. At the same time, local VA medical centers (VAMC) often have considerable autonomy to meet these national requirements. The objective of this study is to conduct an ethnographic formative evaluation of the local implementation of a nationally mandated VA policyoutreach to Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) servicemembersand determine the impact of this policy on one VAMCs outreach efforts. METHODS: The study employs an ethnographic approachto formative evaluation. Data collection includes: archiving organizational documents; fieldnotes from observations of outreach events; and transcripts from semi-structured interviews with outreach personnel, service members, and family members. To date, interviews have been conducted with 10 family members, 9 service members, and 12 VA and non-VA outreach personnel from the catchment area of one VAMC. Textual

data is content analyzed for top-level codes and more detailed coding is completed through subcoding and matrix analyses.
RESULTS: The study is on-going. To date, national legislation and policy directives related to VA outreach have been compiled and mapped to implementation of local outreach programming at one VAMC. Results of thematic content analysis of policy documents, transcripts, and fieldnotes indicate substantial variation in definitions and approaches to outreach. For example,the National Defense Authorization Act (NDAA) of 2008 presents a comprehensive definition of outreach and details specific elements for the Yellow Ribbon Reintegration Program for Reserve and National Guard service members. The NDAA of 2008 has in turn placed greater structure on how outreach is conducted at the local VAMC. This example, among others, demonstrates ways national policy initiatives can both facilitate and hinder the quality and effectiveness of the local implementation of such policies.
CONCLUSION: Improving quality of and access to healthcare exists in the tension between directives from national policy initiatives and local determinations of how to interpret and implement these policies. Ethnographic methods allow for careful examination of how national policy might be broughtto bear in real world settings. By studying this tension, better policy can be written and new tools to effectively understand and implement these policies should be developed.

IMPACT OF SOCIOECONOMIC ADJUSTMENT ON PHYSICIAN COST PROFILES Mehrotra Ateev 1; Justin Timbie2. 1University of Pittsburgh, Pittsburgh, Pennsylvania ; 2RAND, Arlington, Pennsylvania. (Tracking ID # 12431)
BACKGROUND: Many health plans use physician cost profiles in their value-based purchasing strategies, and CMS will soon begin providing individualized cost profiles to physicians participating in the Medicare program. Currently, these profiles do not take into account differences in patients socioeconomic status (SES). Some physicians and policy makers have expressed concern that physicians who provide care to socioeconomically disadvantaged populations will appear to be more costly for reasons that are beyond their control. With these concerns in mind, Congress called for Medicare to investigate the use of socioeconomic adjustments to cost profiles in the Affordable Care Act. Our goal in this study was to investigate the relationship between patient SES and the cost of care, and whether adjustment for SES would impact a physicians cost profile.
METHODS: Retrospective data analysis of medical claims. Our claims database comprised all professional, inpatient, other facility, and pharmaceutical claims for calendar years 2004 and 2005 from commercial health plans in Massachusetts, including claims from managed care, PPO, and indemnity product lines. Combined, the health plans enrolled the majority of Massachusetts residents with commercial health insurance, or 2.8 million enrollees. From these claims we created physician cost profiles and focused on the costs of care for four representative conditions, hypertension, hyperlipidemia, asthma, and diabetes. Because patient-level measures of SES are not present in claims data, we used SES indicators from the 2000 Census measured at the zip code tabulation area (ZCTA). We examined the association with these area-level SES indicators with costs and compared physician cost profiles with and without adjustment for SES.
RESULTS: Our analyses included 13,867 physicians across a range of specialties with a median caseload of 48 patients per physician. Across all conditions, after adjusting for a patients severity of illness and physician specialty, area-level household income was positively associated with cost per episode of care. For every 1 percent increase in household income across areas (ZCTAs), costs increased by 4.1 percent on average, ($p<.001$). However, there was heterogeneity in the relationship between SES and cost by condition. For example, the cost of care for asthma and hypertension were higher among those with lower household income ($p<.001$). When we classified physicians according to quintiles of their cost profiles with and without adjustment for SES, we found that fewer than 4 percent of physicians changed quintiles following adjustment. Findings were similar across a range of physician specialties.

CONCLUSION: While socioeconomic status may be an important predictor of cost for some conditions, adjusting for SES does not appear to significantly influence a physicians overall cost profile. Whether these findings are generalizable outside of Massachusetts or whether SES data for smaller areas are required to conclusively determine the need for SES adjustment are worthy of further study. These initial results suggest that failing to adjust for SES may not adversely impact the cost profiles of physicians who care for disadvantaged populations.

ASSOCIATION OF PPD POSITIVITY AND BCG VACCINE WITH CARDIOVASCULAR DISEASE AND MARKERS OF INFLAMMATION Thomas A. OBryan 1; Thomas A. OBryan2. 1Penn State Hershey Medical Center, Hershey, Pennsylvania ; 2Penn State Hershey College of Medicine, Hershey, Pennsylvania. (Tracking ID # 12432)

BACKGROUND: In recent years, some studies have suggested a potential role of infectious agents in the inflammatory mechanism of atherosclerosis. Support of this hypothesis for certain infections such as Chlamydia pneumonia and cytomegalovirus include the detection of serum antibodies, presence of genomic material in atheromatous plaques, and antibodies to heat shock proteins in patients with atherosclerosis. The possible involvement of Mycobacterium tuberculosis in the pathogenesis of atherosclerosis has been suggested by the presence of mycobacterial heat shock protein 65 in patients with atherosclerosis. In animal models, the Bacille Calmette Guerin (BCG) vaccine has been associated with antibodies to heat shock protein 60 and atherosclerotic plaque formation. Thus, it has been suggested that Mycobacterium tuberculosis and the BCG vaccine may generate proatherogenic inflammation. A few studies involving small samples reported higher incidence of myocardial infarction in patients with latent tuberculosis infection (LBTI). However, data examining the clinical relationship between LBTI and a history of having received the BCG vaccine with cardiovascular disease and baseline markers of inflammation are lacking. The objective of this study is to examine the association of a positive tuberculin skin test and evidence of a previous BCG vaccine with serum inflammatory markers and a reported history of cardiovascular disease.

METHODS: Cross sectional design used data from NHANES 1999 2000. Subjects were 2,875 persons age >40 years who underwent tuberculin skin testing using the purified protein derivative S-1 (PPD). LTBI was defined as induration of >10 mm in reaction to PPD. BCG vaccine was defined as presence of visible scar recognized by trained NHANES examiners. Cardiovascular disease (CVD) was defined as having been told by a doctor or healthcare professional that they had at least one of the following: heart attack, coronary artery disease, angina/angina pectoris and congestive heart failure. Demographic variables included gender, age, race/ethnicity, poverty income ratio, education level, and birthplace. Laboratory data included high-sensitivity C-reactive protein (CRP) and fibrinogen levels. Laboratory values were ranked into quartiles. The relationship between CVD and inflammatory markers with LTBI and BCG status was analyzed. Chi-square cross-tabulation was used for bivariate analysis. Adjustments for socioeconomic and lifestyle data utilized a logistic regression model.

RESULTS: LTBI and BCG were identified in 11.6% and 13.5% of subjects respectively. LTBI was independently associated with male gender (p <0.001), non-white ethnicity (p <0.001), birthplace outside of U.S. (p <0.001), low education level (p=.015), and older age (p =.038). BCG vaccine was associated with birthplace outside of U.S. (p <0.001) and non-white ethnicity (p=0.001). CVD was reported in13.0% PPD-positive and 13.2% PPD-negative subjects (p=.0.92).12.7% with BCG and 13.3% without BCG reported CVD history (p=0.75). LBTI was associated with the fourth quartile of CRP values compared to the first quartile (OR, 1.44 (95% CI 1.06-1.94)) and remained significant when adjusted for age, gender, ethnicity, birthplace, income poverty ratio, education level, body mass index, smoking history, physical activity and general health condition (adjusted OR, 1.57 (1.074-2.28)). Similar results were seen for fourth quartile of fibrinogen: unadjusted OR, 1.37 (95% CI 1.01-1.87); adjusted OR, 1.67 (95% CI 1.14-2.47). BCG was not associated with either inflammatory marker.

CONCLUSION: LTBI, as evidenced by PPD positivity was associated with modest elevation of CRP and

fibrinogen levels. The clinical significance is not known, however, LTBI was not associated with CVD. Evidence of BCG vaccine was not associated with either self-reported history of CVD or elevation of inflammatory markers.

TOWARD THE LEARNER-CENTERED PATIENT-CENTERED MEDICAL HOME: DIFFERENCES BETWEEN UNIVERSITY AND VA CLINICS IN FACTORS THAT AFFECT RESIDENT CONTINUITY WITH PATIENTS

Robert Brooks 1; Harish Jasti2. 1VA Pittsburgh Healthcare System, Pittsburgh, Pennsylvania ; 2University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 12433)

BACKGROUND: A key focus of the resident continuity clinic training experience is to promote interpersonal continuity between residents and their patients - personal relationships characterized by a sense of responsibility or ownership by the resident and trust by the patient. We performed a needs assessment of our programs clinic experience, focusing on the residents perception of continuity, to assess resident attitudes toward continuity, to identify factors that promote and inhibit continuity in our clinics, and to guide design of curricular interventions that could enhance our learners sense of interpersonal continuity with their patients. Our residents are assigned to a continuous 3 year experience at either a VA Primary Care clinic or a University-based General Internal Medicine clinic, where they are partnered with a specific registered nurse to assist with care of their patients. METHODS: A cross-sectional survey was distributed to all postgraduate year 13 residents in June 2008, which included questions on attitudes and specific resident behaviors in clinic. Overall return rate on the survey was 50% (42 of 84 residents), with an equal distribution of completed surveys by sex and clinic site. Results were analyzed qualitatively with descriptive statistics, since statistical testing would be inappropriate due to multiple comparisons.

RESULTS: Residents felt that they had strong (64%) or moderately strong (36%) interpersonal continuity with their patients, and reported high rates of satisfaction with continuity at both sites, though more residents at the VA site reported being very satisfied with this aspect of clinic (29% vs 5%). The strongest facilitating factor for promoting continuity was being the person who communicated the plan to the patient. Some barriers to continuity were site-dependent: VA residents identified a lack of access due to full clinic schedules and close relationships that patients have with outside providers (co-management) as important barriers to continuity, while University residents cited patients with behavioral health issues and visits with other providers in their primary care clinic as significant challenges. Residents at both sites viewed their lack of personal accessibility outside of clinic as a major barrier to continuity with patients. Although they preferred that patients contact them through their nurse, most residents did not instruct their nurse on the optimal way to communicate patient information to them. Many residents seldom or never asked their nurses to perform tasks such as calling patients. Residents viewed talking to patients by phone as helpful in forming strong relationships and preferred this method of communication; however they did not often contact patients for management issues between visits. Interactions between residents and their nurses were different at the two sites, as were patterns of resident communication with patients. VA residents more often reported infrequent communication with nurses outside of clinic and felt they received less information about patients from their nurses than they would like. VA residents also reported less frequent communication of test results or use of letters to patients. Residents at both sites were interested in having time scheduled during clinic sessions for calling patients.

CONCLUSION: Residents value interpersonal continuity with their clinic patients. Perceived barriers to continuity include issues related to clinic scheduling, co-management, coverage for urgent care visits, patient characteristics, and the quality of inter-visit communication. Significant site-specific differences exist as barriers for VA and University clinics, and therefore interventions to improve continuity
should also target these disparities. Clinic structures and curricula to enhance distance communication are

essential, and a high priority area will be optimizing communication and collaboration between nurses and residents in the PCMH setting.

DO PHYSICIAN PRACTICE COORDINATION APPROACHES AFFECT THE QUALITY OF BREAST CANCER CARE? Nina A Bickell 1; Rebeca Franco 1; Kezhen Fei1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 12439)

BACKGROUND: Breast cancer treatment requires care from different specialists often working in fragmented outpatient settings. Both automated and staff-based office mechanisms to coordinate care exist, however, their effect on receipt of needed post-surgical adjuvant treatments has not been described. In a prior study, we demonstrated that a tracking and feedback intervention that closed the referral loop between surgeons and oncologists, a type of coordination mechanism, reduced underuse We undertook to this study to assess the relationship of mechanisms of coordination and underuse of post-surgical adjuvant treatments delivered in outpatient settings.

METHODS: This is an analysis of data from a study that was designed to implement a tracking &feedback intervention to close the referral loop between surgeons and oncologists. In this original study, we surveyed surgeons prior to (19992000) and after the intervention(200406) about coordination mechanisms they used in their office practices. Data on adjuvant treatments were obtained from patient chart abstraction. In this analysis, we examine whether factors already present in the specialist office that were independent of the intervention were associated with underuse of needed treatments. These factors included data on automated or staff assigned ways to trigger follow-up appointments track treatment plans, and how they found about patient treatment plans. These office-based mechanisms are separate from the externally implemented tracking &feedback intervention. Adjuvant treatments were obtained from chart abstraction. 35 of 51 surgeons pre-intervention and 14 of 28 post-intervention had patients with underuse; underuse rate was 23% pre- and 14% post-intervention. Bi-& multivariate analyses for pre- and post-intervention periods assessed the relationship of coordination mechanisms and surgeon underuse rates. RESULTS: Pre-intervention, 53% of physicians were in private practice, 25% in faculty practice and 22% in hospital-clinic practice as compared to 41%, 30% and 30%, post-intervention. In both pre &post periods, 29% of physicians practices had no mechanism to trigger appointments or track care; only 2 physicians had a mechanism to track treatment. In both periods there was no association between specific coordination mechanisms, number of mechanisms employed, how closely surgeons worked with oncologist or type of practice with rates of underuse (pre &post models: adj R2=0.1; p=.12; adj R2=0.07; p=.70, respectively). CONCLUSION: Physician office practice coordination mechanisms were not associated with rates of underuse of post-surgical adjuvant breast cancer treatment. As medical homes will be responsible for coordinating care, it is imperative to identify office-based approaches that effectively coordinate and improve processes of care such as the tracking &feedback intervention.

DEVELOPMENT AND VALIDATION OF A NATURAL LANGUAGE PROCESSING COMPUTER PROGRAM TO MEASURE THE QUALITY OF COLONOSCOPY Ateev Mehrotra 1; Hendrik Harkema1. 1University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 12447)

BACKGROUND: Quality measurement has been hampered by the costs and burden of reviewing medical charts and the limited information

available in medical claims. The implementation of Electronic Health Records (EHRs) is expected to facilitate quality measurement; however, much of what is captured in EHRs remains in free text , and thus still requires manual abstraction of the information. Natural language processing (NLP) is a field of computer science in which relevant structured data is abstracted from free-text language. There is great interest in whether NLP applications can be developed to extract relevant information from EHRs for quality measurement. In this project, we developed and validated a NLP-based computer program for measuring the quality of colonoscopy and associated pathology reports. Applying NLP to the assessment of colonoscopy is an ideal place to apply a

NLP tool because colonoscopy reports are typically in electronic format and poor quality of colonoscopy has been associated with higher incidence of colorectal cancer.
METHODS: A NLP computer program was developed that abstracts the necessary data to measure published colonoscopy quality indicators from major gastroenterology societies, including documentation of cecal landmarks and bowel preparation quality, reporting withdrawal time, and making appropriate follow-up recommendations. The NLP tool was then tested on a new validation set of 453 colonoscopy and 226 associated pathology reports that were also manually reviewed by 3 physicians. Reports were randomly sampled from the 32,485 colonoscopy reports from the 10 hospitals in the University of Pittsburgh Medical Care system in 20089.
RESULTS: Overall performance on most quality indicators, as measured by manual review of charts, was poor. For example, adequate withdrawal time was documented in only 0.8% of reports and appropriate follow-up recommendations in only 24%. Compared to the manual review, the NLP tool had a mean accuracy of 86.7 (SD 10.7). The difference between the clinician-abstracted and NLP-abstracted quality scores varied from 0.2 to 13.6%.
CONCLUSION: This program represents one of the first NLP based quality measurement tools, but to be used widely the program needs further refinement and validation. The disagreement on certain measures between manual abstraction and the NLP tool helps to highlight key limitations of NLP-based quality measurement applications. As the use of EHRs grows, there is great potential for NLP-based programs to automatically assess the quality of care. Our project highlights key strengths and limitations of this approach.
TOWARDS ACCOUNTABLE CARE: SURPRISING INSURANCE AND UTILIZATION CHARACTERISTICS OF VULNERABLE USERS AT AN ACADEMIC MEDICAL CENTER Peter Boling 1; Wally Smith 1; Sheryl Garland 1; Alan Dow 1; Arline Bohannon1. 1Virginia Commonwealth University, Richmond, Virginia. (Tracking ID # 12450)
BACKGROUND: Health care reform may extend Medicaid coverage to many who are now uninsured, and permit formation of accountable care organizations (ACOs). How ACOs may manage risk for the costliest, most vulnerable populations is poorly described and many reported case management programs have failed to save money. For strategic planning, we sought to characterize the costliest low income users of services at a large urban academic medical center.
METHODS: We studied FY08 utilization and cost data (M = million). Our health system is the primary safety net hospital in our metropolitan area with 35% of all Medicaid and 46% of uninsured discharges. At our health system self pay denotes persons (mostly indigent) with incomplete financial data and indigent implies complete data. RESULTS: The costliest 6,732 (top 10%) of utilizers by category (indigent n=1,773; self-pay n=1,862, and Medicaid n=3,098) accounted for $189 M ($152 M inpatient, $24 M outpatient, $9 M 23-hour observation, and $4 M ED) or 70% of $270 M costs for 67,318 service utilizers in these 3 fiscal categories combined. The 30,979 Medicaid patients had $178 M in costs, compared to $39 M for 18,615 self pay and $52 M for 17,724 indigent patients. The top 260 patients, each with over $100,000 in costs, had 765 inpatient stays ($48 M in costs), and 1,743 outpatient visits ($3 M in costs). Only 25% of ED visits for the costliest tenth resulted in admission, but half of their inpatient admissions began with an ED visit. Among the top 10% of users, per patient Medicaid costs ($41,922) were more than twice as high as self-pay ($14,945) or indigent ($17,632) users.
CONCLUSION: The costliest tenth of low income patients in an Academic Medical Center exerted cost pressure primarily through inpatient costs rather than ambulatory and ED costs. Medicaid costs dwarfed indigent and self-pay costs. The best target for case management in an emerging ACO is controlling inpatient care use, may involve existing Medicaid patients more than the currently uninsured who may soon become Medicaid patients, and should focus on the sickest patients
MAPPING QUALITY IN HEALTH CARE SYSTEMS A NOVEL TOOL FOR POPULATION MANAGEMENT

Clemens Hong 1; Steven J. Atlas 1; Lulu Liu 1; He Wei 1; Lawrence Stratton 1; Lenny Lopez 1; Richard Grant1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12451)
BACKGROUND: As primary care networks develop population-based systems of care, geographic information systems (GIS) may be a useful tool for identifying community-level variation in quality of care. We used GIS to examine colorectal cancer (CRC) screening rates among patients within our care network by the communities in which they reside. METHODS: We obtained GIS coordinates from the addresses of 142,690 primary care patients in an academic health system consisting of 174 PCPs working in 13 primary care practices (including 4 community health centers). Using data from an electronic record repository, we identified all patients aged 5274 years old eligible for CRC screening and calculated the proportion overdue for screening by town or city neighborhood and by census block group to identify geographic areas with low CRC screening rates. We then categorized census block groups by higher and lower CRC screening rates and compared differences in patient socio-demographic characteristics and median census block group household income (limiting the analysis to census block groups with greater than 30 qualifying patients).
RESULTS: Overall, 11044 (23.9%) of eligible patients within our network were overdue for CRC screening and the mean rate of overdue CRC screening by census block group was 24.2% (range 6.3-68.1%). Figure 1 shows geographic variation in the rate of overdue CRC screening among all network patients in cities and Boston neighborhoods in the Boston region. Figure 2 shows the geographic variation in the rate of overdue CRC screening among patients living in the census block group areas surrounding one MGH practice. Across the Massachusetts area served by our network, census block groups with lower CRC screening rates had higher proportions of minorities (29.7% vs 11.7%, p <0.001), non-English speaking patients (17.3% vs 4.3%, p <0.001), and those not completing high school (13.4% vs 2.7%, p <0.001), and a lower census block group median household income ($52034 vs $85442, p <0.001). CONCLUSION: Mapping quality indicators using GIS coordinates attained from administrative data may be a useful tool for targeting resources or tailoring interventions to the needs of specific communities. This detailed geographic approach may enable health systems, practices, and community health centers to identify communities that are at high risk for lower quality outcomes and thereby reduce disparities in healthcare.

THE RELATIONSHIP OF A POSITIVE FAMILY HISTORY OF BREAST CANCER ON NEWLY DIAGNOSED BREAST CANCER PATIENTS RECEIPT OF CANCER TREATMENTS Sara Kaleya 1; Kezhen Fei 1; Rebeca Franco 1; Nina A Bickell1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 12456)
BACKGROUND: Family history of breast cancer affects womens breast cancer screening behavior but whether it impacts cancer treatment decisions and may affect survivorship beliefs and behaviors is uncertain. We describe breast cancer patients treatment receipt and beliefs of women with and without a family history of breast cancer. METHODS: 333 of 374 women with early-stage breast cancer treated surgically in 8 NYC hospitals accrued to a multi-center RCT of patient assistance to improve receipt of adjuvant treatment completed both baseline and 6-month follow-up survey. All female, surgically treated, early-stage breast cancer patients whose primary surgeon agreed to participate were eligible for inclusion. Baseline survey included multiple demographic characteristics, family history, beliefs about treatment efficacy and preventing cancer recurrence, and screening and treatment behaviors. Six month follow-up survey assessed treatments received. Preventing cancer recurrence beliefs include: belief that a patient will do anything possible to keep the cancer from coming back, and good thing to keep cancer from coming back are: double mastectomy, hormonal treatment, low fat diet, exercise five times a week, and a mammogram every 6 months (Cronbach alpha=.61). Scale was scored to 100 with a lower value indicating stronger belief.

RESULTS: Of the initial 374 recruited patients 333 (89%) completed the 6-month follow-up survey. One third (33%) reported a family history of breast cancer in the baseline survey. Women with a family history were more likely to receive a mammogram before the age of 40 (64% vs 47%, p =.005), but did not report having more than one mammogram per year as compared to women with no family history. There was no difference in receipt of radiation (85% vs 89%), chemotherapy (91% vs 90%) or hormone therapy (87% vs 89%) between women with a family history and those without. Women with a positive family history were less likely to believe health behaviors can prevent recurrence as compared to women with no family history (Mean Scale Score: 45 vs 40; p=0.002). This difference was not due to a greater sense of self-efficacy. CONCLUSION: Women with a family history of breast cancer as compared to those without begin breast cancer screening at an earlier age but do not screen more often. Treatment rates are high regardless of family history. Having a family history of breast cancer does not affect beliefs about cancer treatment but is associated with slightly less belief in strategies to reduce cancer recurrence which may affect survivorship behaviors.

IMPROVING UTILIZATION OF MEDICAL CARE AND HEALTH FOR CHRONICALLY HOMELESS ADULTS WITH HOUSING Allison Diamant 1; Karen Swanson 2; Mark Casanova 3; Rowena Magana 2; Elizabeth Boyce4. 1UCLA, Los Angeles, California ; 2Los Angeles County Department of Health Services, Los Angeles, California ; 3Homeless Health Care LA, Los Angeles, California ;
4Los Angeles County Chief Executive Office, Los Angeles, California. (Tracking ID # 12457)

BACKGROUND: Homeless individuals are often discharged from hospitals with only a referral to emergency shelters, which when able to accept the individual, typically provide only an overnight bed and limited supportive services. Too often these individuals experience complications and emergencies, which in turn lead to repeat inpatient stays. Providing housing to this population has been shown to reduce
the probability of returning to emergency rooms and further hospitalizations. The evaluation of the Access to Housing for Health (AHH) Pilot Project focuses on changes in four main domains: 1) use of medical services, 2) enrollment into benefits and community services, 3) individual health status, and 4) stability in housing.

METHODS: This is a quasi-experimental one group pre-test post-test study design. Eligibility criteria: 1) currently homeless (living on street or in a shelter); 2) a frequent user of the Los Angeles County Department of Health Services system (>=2 visits to the ED or 2 inpatient stays in the past year or one of each); and 3) have a physical disability or chronic illness but be able to live independently. Baseline and follow-up (3, 6, 9 and 12 month) survey interviews were conducted by the case managers in English or Spanish. The data presented includes those individuals who completed housing for at least 12 months and completed all interviews (n=77)

RESULTS: At baseline 75% or participants had a USOC, with a significant increase up to 91% after 12 months in the program (p <0.05). At baseline 98% of participants had one or more ED visits during the preceding year; however, with receipt of housing there was a significant reduction in ED use down to 65% of participants (p <0.001) with a mean number of visits of only 3.1 (p <0.001). At baseline 77% of AHH participants had been hospitalized during the preceding year (mean 2.2 hospitalizations); and .after being housed for at least 12 months this decreased to 45% (p <0.01) and the mean number of visits decreased to 1.6 (p <0.001).

At baseline over half (57%) had gone without needed medical care during the preceding 12 months to pay for food, housing or clothing, but this rate decreased to only 13% after being housed for at least 12 months (p <0.01). Similarly 26% of AHH particpants reported that they had gone without food, housing or clothing to pay for medical care in the year prior to enrollment in the program, and this dropped to only 1.4% after 12 months of housing (p <0.0001).

At baseline 62% of AHH participants rated their general health as fair or poor versus excellent, very good or good. At 12 months of follow up only 14% of participants rated their health as fair or poor (p <0.0001). At baseline 37% rated their mental health fair or poor with a trend toward improvement of 30% at 12 months.Participants in AHH appear to be well settled in to housing based. Almost three-quarters of participants reported no difficulty paying expenses on time, 19% had a little difficulty, 5% reported somewhat difficult and 3%

very difficult. Nevertheless almost three-quarters of participants reported paying their expenses on time, 22% most of the time and 5% some of the time. All of the participants thought that it was very or somewhat likely that they would remain in housing.
CONCLUSION: The Access to Housing for Health (AHH) Pilot Project has been a collaboration of the Los Angeles County Department of Health Services, Homeless Health Care LA, the Community Development Commission, and the City of Los Angeles with the goal of providing permanent, affordable housing linked to appropriate services for homeless individuals who are either frequent users of the DHS system or whose discharge is delayed due to their homeless status. The project successfully demonstrated improvements in appropriate utilization of ambulatory, ED and hospital services, as well as improvements in health status, decreasing competing and unmet needs and stabilization in housing.
PREDICTING HOSPITAL READMISSION: VALIDATION OF RAMPART Alan Dow 1; Arpita Aggarwal 1; Heather Masters 1; Laura Kreisa 1; Wally Smith 1; Peter Boling1. 1Virginia Commonwealth University, Richmond, Virginia. (Tracking ID # 12458)
BACKGROUND: Patients readmitted within thirty days of hospital discharge are a large source of healthcare utilization. In 2012, payment

to health systems for 30-day readmissions will be curtailed in an effort to improve the quality and efficiency of medical care. We sought to develop a tool for identifying patients at high risk for readmission in order to better target interventions aimed at reducing 30-day readmission rates.
METHODS: Based on prior work at our institution, we developed the RAMPART tool to identify patient populations at high risk of readmission. This tool combines the modified Charlson index (a measure of medical co-morbidity), the self-reported number of emergent care episodes in the preceding calendar year, and the presence or absence of a recent hospital admission. To validate this approach, we examined patients who both arrived to and were discharged from two identified general medicine units between 10/1/10 and 11/30/10. Patients who met a predetermined criteria of Charlson index >4, had 3 or more recent emergent care episodes or hospitalizations in the last six months, or had a hospital admission within the previous thirty days were targeted for intervention. Patients who met the RAMPART criteria were then enrolled in a nursing-led, multi-disciplinary intervention program composed of increased focus on discharge parameters by physicians, social work, care coordination, and nursing. We then calculated the 30-day readmission rate for four groups: all patients who met the admission and discharge criteria, patients at high-risk per RAMPART, patients at high-risk per RAMPART who received the multi-disciplinary intervention, patients at high-risk per RAMPART who did not receive the multi-disciplinary intervention.
RESULTS: 548 patients arrived on the units and 588 patients were discharged to home from the study units during the specified time period. Data by group is noted in table 1. In addition, we identified several significant ongoing barriers to successful care transitions including limited health literacy, inaccurate medication reconciliation, and provider ownership across care transitions.
CONCLUSION: RAMPART criteria defined a higher risk patient population for 30-day hospital readmission. A multi-disciplinary interventiona ppeared to increase the readmission rate, suggesting patients who receive the intervention may have additional factors such as increased length of stay or awareness of personal limitations that predict readmission risk.
Table 1:
Group Discharges30-Day ReadmissionsReadmission rate All discharges 588 143 24.32% High-risk per RAMPART 174 48 27.59% High-risk with intervention 98 32 32.65% High-risk without intervention 76 16 21.05%

PROACTIVE TELEPHONE SMOKING CESSATION TREATMENT IN A VA MENTAL HEALTH POPULATION: PRELIMINARY TREATMENT ENGAGEMENT AND CESSATION OUTCOMES Erin Rogers 1; Senaida Fernandez 2; David Smelson 3; Alfredo Axtmayer 1; Scott E. Sherman1.
1VA New York Harbor Healthcare System, New York, New York ; 2New York University School of Medicine, New York, New York ; 3Edith Nourse Rogers Memorial Veterans Hospital, Bedford, Massachusetts. (Tracking ID # 12461)

BACKGROUND: It is unclear whether telephone-based treatment is acceptable and effective for smokers with a mental health diagnosis. We evaluated a proactive telephone care coordination program for VA smokers with mental illness and compared counseling delivered by VA staff to that delivered by the smokers state Quitlines.
METHODS: We analyzed preliminary data from three sites in a 13-site VA trial implementing a telephone care coordination program for smokers with menal illness. Mental health providers referred smoking patients to the program. Patients were contacted by phone to offer enrollment. Patients who enrolled were offered mailed self-help materials, smoking cessation medications and proactive, multi-call counseling. Participants were randomized to receive counseling from their state Quitline or a VA counselor who had received specialized training on smokers with mental illness. A telephone follow-up assessment was completed at two months to assess smoking status. Patients who did not want to participate in treatment were given the option of enrolling in the follow-up call only.
RESULTS: This report describes the first 213 patients referred to the program (mean age=53; 91% male). 169 (79%) patients were reached by phone to offer enrollment. Of those, 76% enrolled in treatment (65 in VA counseling and 63 in Quitline counseling), 5% enrolled in the follow-up survey only, 7% were ineligible and 12% declined participation. 100% of participants in both treatment arms scheduled an appointment to begin counseling, and 88% were interested in using smoking cessation medications. 89% of VA counseling participants and 76% of Quitline counseling participants completed at least one counseling session. Fifty-two participants have completed the two-month assessment (88% of those due for follow-up). 30% (8/27) of VA counseling and 16% (4/25) of Quitline counseling participants reported 30-day smoking abstinence at two months.
CONCLUSION: Proactive telephone programs are effective at engaging persons with mental illness into smoking cessation treatment and at producing short-term abstinence rates comparable to those seen in non-mental health populations. Full accrual of the final sample size of N=1,500 will permit us to determine the consistency of the current trend suggesting increased effectiveness of VA counseling.

WHO SHOULD BE RESPONSIBLE FOR TEST RESULTS RETURNING AFTER HOSPITAL DISCHARGE: A PROVIDER SURVEY Martin C. Were 1; Xiaochun Li 1; William Michael Tierney2. 1Regenstrief Institute Inc, Indiana University School of Medicine, Indianapolis, Indiana ;
2Regenstrief Institute, Indiana University School of Medicine, Indianapolis, Indiana. (Tracking ID # 12462)

BACKGROUND: Transitions in health care between venues provide opportunities for miscommunication and errors. An area of significant process breakdown during the inpatient-to-outpatient care transitions is in the management of tests with pending results at hospital discharge. Studies show that errors related to missed test results occur in nearly half of patients discharged with pending results. To reduce these errors, a responsible provider for the pending tests needs to be identified. This provider would follow-up on the pending results and determine what actions need to be taken once the results return. Identifying an appropriate responsible provider is not trivial, however, especially given that the decision involves and affects multiple inpatient and outpatient providers and venues. To date, almost no research exists to help inform how to identify the provider(s) responsible for following up on pending tests. In this study, we used survey methodology to assess whether perceptions regarding who is (or should be) the responsible provider for managing tests with pending results at hospital discharge differed between hospitalists, outpatient staff physicians, and physicians-in-training (residents). We evaluated provider attitudes based on the various clinical scenarios that surround pending

results to evaluate consistency of opinions within each provider group, and differences in opinions between the three groups.
METHODS: Validated instruments to assess provider opinions about responsibilities for care as patients transition from inpatient to outpatient venues do not exist. Therefore, we developed an original survey based on several scenarios that focus on how results of

diagnostic tests pending at hospital discharge are managed. We surveyed all eligible resident physicians, and the inpatient and outpatient attending physicians who oversaw care for patients admitted to three hospitals in central Indiana.
Ratings of general attitudes towards management of tests with pending results were based on a 5-point Likert Scale. We compared attitudes regarding management of pending test results between inpatient staff physicians, outpatient staff physicians, and resident physicians. We also compared opinions about which physicians were (or should be) responsible for managing the pending test results depending on various clinical scenarios. For the primary analysis, we assessed the effect of the respondents practice venues by employing a variable representing the percentage of time each physician spends in inpatient versus outpatient care. Age, gender, practice type, years of experience, and outpatient clinic type were included as covariates in our analysis as they potentially affected attitudes towards pending test management.
RESULTS: Of the 129 residents (78% of those surveyed) and 75 staff physicians (70%) who responded to the survey, 93% agreed that all tests with pending results must be reviewed by a provider. Also, 83% felt that discharging providers needed to identify the provider responsible for following up pending tests, and 68% felt that outpatient providers deserved a say in this decision.
Compared to attending physicians, residents were less likely believe that it was the inpatient providers responsibility to follow-up on pending tests (74% vs. 51%, p=0.04) or to always identify the follow-up providers (79% vs. 89%, p=0.03). As the amount of inpatient care time increased for attending physicians, fewer felt that hospital policy should determine the responsible provider for pending tests (p for trend=0.03), or that inpatient providers should be responsible for following up on these tests (p=0.004).
There was wide variability in opinion on who should be the responsible provider based on the type of pending test. Most respondents (87%) felt that inpatient providers should follow pending tests for patients with no existing responsible outpatient provider or for tests ordered in the Emergency Room prior to admission (86%) or if results returned before discharge summary reached outpatient providers (68%). Conversely, most respondents (88%) felt that outpatient providers should be responsible for results that took a long time to return (e.g. >3 months). Attending physicians were more likely than residents to think it was the inpatient physicians responsibility to follow-up on tests for patients who left against medical advice (72% vs 42%, p=0.01) or were assigned new providers (64% vs. 31%, p=0.003) or for results that returned before discharge summary reached outpatient provider (80% vs 61%, p=0.02), return after 3 months (21% vs. 5%, p=0.049); and for sensitive tests, e.g. HIV test results (69% vs. 50%, p=0.03).
CONCLUSION: In this survey of attending and resident physicians practicing at three inner-city teaching hospitals, opinions on who should be the responsible provider for managing tests with pending result varied widely based on the physicians role (resident vs. attending), the amount of time spent inpatient vs. outpatient care, and the characteristics of the pending test result. Respondents felt that it would be best to develop a consensus policy among inpatient and outpatient providers on who was responsible for managing pending tests at hospital discharge.
Respondents tended to disagree with statements that assigned responsibility to them in a way that would increase their workload. That is, inpatient physicians tended to feel that outpatient physicians should be responsible, and vice versa. In our institutions, residents are primarily responsible for preparing discharge summaries and spend the majority of their time on inpatient services. This might explain why resident

respondents felt that outpatient providers should be responsible for various aspects around pending tests. We observed the same pattern
among attending physicians: those spending more time in one venue (e.g. inpatient vs outpatient) felt that those in the other venue should be responsible for tests pending at discharge.
Similar to previous studies, our respondents felt that current systems of managing tests need improvement. Consensus policies should be established by hospitals to assign responsibility for following up tests pending at discharge.

HEPATITIS A EXPOSURE NOT ASSOCIATED WITH THE PRESENCE OF ANTI-THYROID ANTIBODIES

Thomas A. OBryan 1; Thomas A. OBryan1. 1Penn State Hershey Medical Center, Mechanicsburg, Pennsylvania. (Tracking ID # 12463)

BACKGROUND: Thyroid antibodies are found in approximately 13% of the U.S. population. Antithyroperoxidase (TPOAb) and antithyroglobulin (TgAb) are associated with autoimmune thyroid disease. Little is known about the mechanism forming these antibodies and subsequent autoimmunity, although genetic and environmental factors appear to be involved. Using data from NHANES III, the Center for Diseases Control reported higher prevalence of thyroid antibodies is associated with age, female gender, white ethnicity, and higher socioeconomic status. In a comparison of 1,064 schoolchildren from communities in Finland and Russian Karelia, thyroid antibodies were five times more prevalent in Finnish children. Finland, with a gross national product ten times higher than Karelia, also had an increased childhood prevalence of type I diabetes mellitus, celiac disease, and IgE-mediated allergies. The hygiene hypothesis suggests that stimulation of the immune system by infections at a crucial time during maturation of the immune system promotes immune tolerance. This concept is applied to help explain the rise of asthma and autoimmune diseases coinciding with the decline of infectious diseases in industrialized countries. Therefore, antibodies to certain infections should be associated with lower prevalence of autoimmune activity. Hepatitis A (HAV) IgG antibody, with its higher prevalence in low socioeconomic areas has been independently associated with fewer cases of asthma and allergy in the United States and Europe. The objective of this study is to determine if a similar inverse relationship exists between HAV serology and the presence of thyroid antibodies.

METHODS: Data of 18,119 U.S. residents age >12 years participating in NHANES III (19881994) for which thyroid antibody and HAV antibody data were available were analyzed. The presence of HAV IgG antibody was compared among individuals positive and negative for thyroid antibodies adjusted for socioeconomic factors. Others variables included age, gender, ethnicity, family income poverty ratio, urban residence, and smoking history. Chi-square cross-tabulation was used for bivariate analysis. Logistic regression model was used for multivariate analysis.

RESULTS: TPOAb and TgAb were positive in 11.8% and 9.7% of subjects respectively. Using logistic regression, both antibodies were independently associated with female gender, age, white ethnicity, and inversely associated with income poverty ratio <1 and a history of former or current smoking. HAV IgG Ab was more prevalent in individuals positive for TPOAb(58.6% vs. 50.3%; p <0.001) and TgAb (57.3% vs. 50.6%; p <0.001). However, these relationships were not significant when adjusted for age, gender, ethnicity, poverty status, urban residence, and smoking history. For TPO Ab: adjusted OR 0.95 (95% CI, 0.85-1.07); TgAb: 0.93 (95%, 0.82-1.05); at least one thyroid antibody: 0.95 (95%, 0.85-1.05). CONCLUSION: HAV IgG antibody was not associated with the presence of thyroid antibodies. Study is limited by cross-sectional design. If the protective effect of infections on developing autoimmune diseases depends on exposure early in life, the association may only be seen in

younger subjects. However, no relationship was seen when subjects were stratified by age. Interestingly, the

inverse relationship between smoking history and presence of thyroid antibodies supports an earlier observation.

STATEWIDE, MULTI-PAYER SUPPORTED MEDICAL HOME INITIATIVE IMPROVES PRIMARY CARE QUALITY Robert A. Gabbay 1; Brian Ebersole 2; Michael H. Bailit 3; Edward H. Wagner4. 1Penn State Hershey Medical Center, Hershey, Pennsylvania ; 2PA Governors Office of Health Care Reform, Harrisburg, Pennsylvania ; 3Bailit Health Purchasing, LLC, Needham, Massachusetts ; 4Group Health Research Institute, Seattle, Washington. (Tracking ID # 12467)

BACKGROUND: With pressure rising in the U.S. to address ever-increasing health care costs and inconsistent performance on standard quality measures, interest is growing in ways to support Patient Centered Medical Homes (PCMH) in primary care practices. Numerous PCMH initiatives are now being implemented across the country. While these initiatives have produced promising results, most have involved integrated health systems and a single payer. The Pennsylvania Chronic Care Initiative is one of the largest multi-payer PCMH initiatives in the country involving over 150 primary care practices (75% being small- to medium-size practices with fewer than 5 FTE providers per practice] in 7 regions of the state. The state, guided by a multi-stakeholder group, has used its authority to convene, facilitate, and lead design of the initiative, providing the 17 participating insurers and more than 750 providers with anti-trust protection.

The effort is aimed at practice redesign with an initial focus on diabetes then moving to the management of the highest-risk patients including those with a recent hospitalization or ER visit. Participating practices have been supported in implementing the Chronic Care Model through quarterly regional Breakthrough Series learning collaboratives, practice facilitation, and infrastructure payments by participating payers in 4 of the regions and a smaller state grant program in the other 3 regions. Within 18 months, practices are expected to become NCQA-recognized PCMHs.

METHODS: Practices report monthly on key clinical measures and implemented changes. The initial target disease was diabetes with subsequent reporting on other chronic illnesses. Quality improvement was evaluated for 10 key diabetes measures for approximately 50,000 diabetes patients statewide. Staggered regional rollouts occurred across the 7 regions of PA starting in May 2008 with new practices being added until December 2009. Cross-sectional data from practices were assessed, with baseline measures in September 2008 and a second measurement period two years later in September 2010, nine months after the launch of the seventh regional rollout.

RESULTS: The Pennsylvania initiative registered impressive improvement across a range of diabetes measures. Table 1 shows the absolute percentage change from September 2008 to September 2010. Improvements in key determinants of diabetes morbidity and mortality [A1C, blood pressure (BP), and LDL] were seen along with better complication screening and use of self-management goal setting. Leading practice changes included reorganizing towards team-based care, incorporation of self-management support and education, planned visits, and office huddles. Many practices began using registries and examining their data for the first time.

CONCLUSION: A state-led PCMH initiative that includes learning collaboratives, reimbursement changes for infrastructure, monthly quality reporting, and practice facilitation can improve patient outcomes. Practices are now spreading their system changes to other providers and are focusing on managing the highest-risk patients, particularly those with recent hospitalizations and other chronic conditions including cardiovascular disease, hypertension, congestive heart failure, COPD, and asthma. State government can play a critical role in spreading PCMH by convening multiple payer and provider groups to develop infrastructure support for PCMH implementation. In an effort to more widely disseminate best practices, Pennsylvania is now fostering statewide networking in addition to regional collaboration. As one of 8 sites in Medicares PCMH demonstration project, Pennsylvania can provide a national model for multi-stakeholder collaboration. Table 1:

Absolute % Difference 9/2008 - 9/2010

HbA1C >9 -12% HbA1C <7 +8% BP <130/80 +9% BP <140/90 +18% LDL <100 +11% LDL <130 +21% Foot Exam +32% Eye Exam +16% Diabetic Nephropathy +19% Self-Management Goal
Setting +27%
Measure
WHAT IS THE IMPACT OF RETAIL CLINICS ON OVERALL UTILIZATION? Ateev Mehrotra 1; Rachel Orler Reid2. 1University of Pittsburgh, Pittsburgh, Pennsylvania ; 2University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania. (Tracking ID # 12468)
BACKGROUND: Retail clinics are a new model for delivering ambulatory care with a focus on patient convenience. On a per visit basis retail clinics are cheaper than visits to a physicians office . As the number of retail clinic visits has rapidly grown, concerns have been raised their impact on utilization and overall costs. If patients now substitute retail clinic visits for physician office or emergency department visits, retail clinics could lower health care costs. If patients go to retail clinics when previously they would have not sought care (induced demand), retail clinics could increase health care costs. In this paper we estimate the impact on utilization of retail clinics.
METHODS: We used a claims database of Aetna enrollees (children and adults) in 27 cities from the years 20072009. Our analyses focus on utilization for 8 conditions that can be treated at retail clinics. We first compared the utilization for these conditions in 20 markets where retail clinic entered in 2007 to 7 control markets with no retail clinics. In addition, we perform a difference-in-differences analysis to examine the effect of retail clinic usage on an individuals utilization. We identify enrollees (n=220,913) who visit retail clinics, and we use propensity score matching to find a comparison group who does not visit a retail clinic. We then compare healthcare utilization before and after the retail clinic visit for both the retail clinic visitors and non-visitors to estimate the differential effect of retail clinic usage on subsequent healthcare utilization.

RESULTS: In the 20 markets with retail clinics there was an increase(1.0%) in total utilization 20072009, and in the 7 markets without them there was a decrease (4.4%). The number of retail clinic visits per enrollee quadrupled over the same time period. We estimate that for every 100 additional visits by retail clinic users 20072009, 80 represent new visits (induced demand), 13 replace ED visits, and 7 replace office visits (substitution). In our difference-in-difference analyses of individual patients, we find that compared to non-retail clinic users, retail clinic users increase their utilization by 0.6 visits in the 6 months (p-value <0.0001) after visiting a retail clinic. CONCLUSION: Most retail clinic visits represent new utilization and not substitution of visits to other care sites. This likely leads to higher health care costs. Those who visit a retail clinic do not become frequent healthcare users after their first visit.
HEALTH BELIEFS AND BREAST CANCER PATIENTS PERCEIVED RISK OF RECURRENCE Sara Kaleya 1; Kezhen Fei 1; Rebeca Franco 1; Nina A Bickell1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 12470)
BACKGROUND: Beliefs about preventing cancer recurrence affect future health behaviors of cancer patients and their first degree relatives. However, it is unclear how prevalent such beliefs are and whether they are related to patients beliefs about their risk of recurrence. We undertook this study to determine whether breast cancer patients beliefs about preventing cancer recurrence were associated with their beliefs about risk of recurrence.
METHODS: 333 of 374 women with early-stage breast cancer treated surgically in 8 NYC hospitals accrued to a multi-center RCT of patient assistance to improve receipt of adjuvant treatment completed both baseline and 6-month follow-up survey. Baseline survey included demographic characteristics, family history, beliefs about preventing cancer and self- efficacy. Preventing cancer recurrence beliefs include: belief that a patient will do anything possible to keep the cancer from coming back, and good thing to keep cancer from coming back are: double mastectomy, hormonal treatment, low fat diet, exercise five times a week, and a mammogram every 6

months (Cronbach alpha=.61). Scale was scored to 100 with higher value indicating stronger belief. RESULTS: Of the 333 women, almost half (43%) believed that they were unlikely to get a recurrence in the next ten years and just over one quarter of the women (29%) were concerned about getting a recurrence. Women who believed that various strategies can reduce the chance of recurrence were less likely to believe her cancer would return within ten years (r=.23, p <0.0001).
CONCLUSION: Women who believe they are unlikely to get a recurrence in the next ten years also believe that there are health behaviors they can adopt to decrease their chance of a recurrence. As perceived risk of recurrence seems to affect behavior change in cancer survivors, these beliefs can provide an opportunity for future interventions aimed at modifying behaviors that may reduce risk of recurrence.
CARING FOR COMPLEX PATIENTS: DROPPING THE BALL WHEN PLAYING ALONE John Hsu 1; Maggie Price 2; Vicki Fung2. 1MGH, Boston, Massachusetts ; 2KFRI, Oakland, California. (Tracking ID # 12472)
BACKGROUND: Patients with complex conditions often require care from several types of clinicians, particularly when the underlying condition and its treatment involve different areas of expertise. Care within integrated delivery systems (IDS) represents one promising
strategy for addressing these coordination problems. We examined the frequency of monitoring for metabolic complications and its association with the types of clinicians involved in the care, among a group of patients receiving ongoing treatment with antipsychotic medications for mental health conditions.
METHODS: Subjects were members of an integrated, prepaid delivery system (IDS), had received an antipsychotic drug in 2007, and were <65 years old. We further excluded subjects with a diagnosis of dementia. Current American Psychiatric Association guidelines recommend regular monitoring of glycemic and lipid levels. We used regression models to assess the association between individual and system factors with monitoring at least annually, among subjects who did not yet have diagnosed diabetes or cardiovascular disease. RESULTS: There were 24,458 patients receiving antipsychotic medications for mental health conditions: half were new users (past 12 months); 8% had diagnosed diabetes mellitus, and 2% had cardiovascular disease. Overall, 97% had at least one outpatient visit in 2007: 93% had at least one PCP visit; 78% had at least one psychiatrist visit; 74% had both PCP and psychiatrist visits; 4% had only psychiatrist visits; and 19% had only PCP visits. Among all subjects, 19% received an A1c test during the year, and 46% received an LDL test. After adjustment, subjects with any PCP visit were significantly more likely to receive the recommended monitoring, compared with subjects without any PCP visits (OR=3.5 for A1c testing; 95% CI:2.7-4.6, and OR=4.0 for LDL testing; 95% CI: 3.5-4.6); the odds of testing also increased as the number of PCP visits increased. Moreover, subjects with both PCP and psychiatry visits during the year were more likely to receive the recommended testing, than patients seen by either alone (OR=1.5 for A1c testing; 95% CI: 1.4-1.7, OR=2.2 for LDL testing; 95% CI: 2.0-2.3). CONCLUSION: Few patients on antipsychotic drug therapy are receiving the recommended minimum monitoring for metabolic complications. This is not surprising given that the indications for antipsychotic drug use may require direct care by psychiatrists, whereas the complications associated with the drugs are often outside of their traditional areas of clinical focus. Co-management by both PCPs and psychiatrists appears to be strongly associated with receiving the minimum recommended monitoring. The fragmentation of care resulting from the complexity of patient conditions and need for multiple types of clinicians represents a persistent challenge, even within integrated delivery systems.
RESIDENT, FACULTY, AND SUPPORTING STAFF PERCEPTIONS OF PATIENT SAFETY IN THE AMBULATORY SETTING Prateek Lohia 1;
Diane Levine2. 1Wayne State University/Detroit Medical Center, Detroit, Michigan ; 2Wayne State University Physician Group, Detroit, Michigan. (Tracking ID # 12473)
BACKGROUND: In the IOM report, To Err is Human, one of the key principles identified to improve patient safety is inclusion of patient safety education in clinical training programs. The traditional clinical curricula have focused on acquisition of basic knowledge and skills in discrete specialties. The AAMC acknowledges that

shortcomings which exist in educating doctors to improve quality of care need to be addressed. However reforming medical education presents as a major obstacle since the shortcomings are deeply entrenched in the traditions and culture of a medical institution. It is further believed that improvements in patient safety can be made by incorporating it into the GME curriculum, including residents in system redesign, analysis of medical systems, and having a graded competency assessment. Poor knowledge of patient safety concepts is demonstrated by medical trainees or they are only superficially engaged in improving patient

safety across a broad range of training levels. Little work has been done on measuring the safety culture amongst residents. This has assumed added importance in view of the most recent guidelines from the ACGME which now require that there be a culture of patient safety and continuous quality improvement in the quality of patient care, patient safety, and education. Knowledge about trainees perceptions is crucial to developing a culture of safety and to developing interventions to improve health care in the outpatient setting.
The purpose of this paper is to describe perceptions of patient safety in the ambulatory setting among the residents, fellows, faculty physicians and supporting staff in the Department of Internal Medicine. Other objectives of the study are to use this information to develop and implement a curriculum in patient safety and improve patient safety emphasizing healthcare teams in the ambulatory setting.
METHODS: We used the Agency for Healthcare Research and Quality Medical Office Survey on Patient Safety Culture (MOS- PSC), a validated survey that has 52 survey items that measure 12 areas of organizational culture pertaining to patient safety. Analysis have shown that all 12 areas have acceptable levels of internal consistency (Cronbachs alpha=.75 to .90).8 The survey uses 3 different frequency scales for the 12 dimensions in the survey. The three different frequency scales are: first a 6-point frequency scales (Daily to Not in the past 12 months), second a 5-point frequency scale (Never to Always) and lastly a 5-point scale of agreement (Strongly disagree to Strongly agree). Most items include a Does not apply or dont know option.
The original AHRQ survey was modified to create the Medical Office Safety-Patient Safety Culture/House staff. The MOS-PSC/H uses the same question format, question order and response options as the MOS-PSC. We modified background questions to allow collection of demographic data, resident and faculty specific assignments including number of clinic sessions per week and gender. We also asked questions regarding level of training, position in the department, and
whether the participant had any formal patient safety training and the nature of training. If a provider or staff member worked in more than one office, then the survey was meant only for the location where the provider spent most time. After approval from the institutional review board, the survey was sent to residents, fellows, faculty and supporting staff in the Department of Internal Medicine. Participation was solicited by email with a link to the information letter and survey housed on Survey Monkey. Statistical analysis is pending.
RESULTS: The total number of responses till date has been 168 respondents, of which 68.5% (115/168) completed the entire survey and31.5% of respondents skipped one or more questions. Other demographic information can be summarized in the table enclosed.
The mean patient safety composite scores which reflect the perceptions of all the physicians and staff with comparison to benchmark data about the medical offices, comparison between residents and benchmark data and comparison between residents and faculty physicians can be summarized in the tables enclosed.
CONCLUSION: Overall residents perceptions of patient safety are significantly lower compared to National Medical Office Survey on Patient Safety (AHRQ) benchmark data. We hypothesize that lower domain scores relate to limited resources and perhaps lack of control available to residents and faculty in an urban teaching clinic. The study also demonstrates that there is significant difference in certain perceptions of patient safety between residents and faculty physicians practicing in the same teaching clinics. Thereby as trainees progress

in their training they perceive a lower patient safety culture. One possible explanation for this perceived difference is greater awareness and understanding of issues related to patient safety among faculty compared to residents.

To our knowledge this is a first study which demonstrates perceptions of patient safety among trainees and practicing physicians in an under-represented urban teaching clinic.

APPROPRIATE ASSIGNMENT OF ISOLATION PRECAUTIONS IN THE INPATIENT SETTING FOR MEDICAL PATIENTS Lee Park 1; Alison Nicoletti 2; Donna Dunn 2; Susan Macdonald3. 1Newton Wellesley Hospital, Newton, Massachusetts ; 2Newton Wellesley Hospital, Newton, Massachusetts ; 3Newton Welleslely Hospital, Newton, Massachusetts. (Tracking ID # 12475)

BACKGROUND: Studies have shown that the use of appropriate precautions in hospitals reduces the spread of certain infections. Our hospital did not have any recent data on whether or not patients were put on precautions accurately and appropriately. The purpose of our study was to evaluate the process for placing patients on precautions, and to determine to what extent patients were being appropriately placed on precautions. We also evaluated the use of the transport sheet at our hospital. This sheet is used to give the transporter and receiving department information regarding patients, including information about precautions. We hypothesized that patients were not being placed on the appropriate precautions upon admission to the hospital. METHODS: This study was an observational study. We surveyed all medical floors in our hospital and observed all the patients on each floor for four consecutive weeks. If the same patient was still in the hospital for consecutive weeks, each observation was counted separately as the patients precautions status could change through their hospitalization. We noted which precautions sign was on the patients door as well as the precautions listed on the transport sheet in the chart and correlated this information with data from the Infection Control Department. We also correlated this data with data from the microbiology section of our electronic medical record (EMR). If any of the information did not match, the patient was labeled a mismatch . For the transport sheet, there was a mismatch if there was no transport sheet in the chart, if there was a sheet but it was blank, or if there was a sheet but the precautions section was filled out incorrectly. RESULTS: We had a total of 313 observations, of these there were 213 different patients. Of those 313, 32 (10.2%) should have been on precautions. Of those 32, 29 (91%) were on the appropriate precautions
and 23 (71.9%) patients had the appropriate history in the EMR. Only one patient (1/313, 0.3%) was on precautions and should not have been. There were a total of 47 mismatches, 38 (81%) of which were related to the transport sheet. The 38 transport sheet mismatches were 12% of the overall 313 observations. CONCLUSION: We expected to find that patients were not being placed on the appropriate precautions, but we found that patients are being put on the appropriate precautions over 90% of the time. However, we also found that patients transport sheets are not being filled out appropriately. After further investigation, we found that there was no firm policy followed in regards to completing or using the transport sheet. After presenting our findings to the Department of Healthcare Quality, a Failure Mode Effect Analysis (FMEA) was implemented to look at the processes of the transport department, with an emphasis on the transport sheet. The processes surrounding transport sheets are important to multiple arms of the hospital, not just in terms of precautions and infection control. The results of the FMEA will be meaningful across the hospital.

LIMITED ENGLISH PROFICIENT PATIENTS AND TIME SPENT IN THERAPEUTIC RANGE IN A WARFARIN ANTICOAGULATION CLINIC Clemens Hong 1; Fatima Rodriguez 2; Yuchiao Chang 3; Lynn Oertel 1; Daniel Singer 1; Lenny Lopez1. 1Massachusetts General Hospital, Boston, Massachusetts ; 2Harvard Medical School, Boston, Massachusetts ; 3Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12479)

BACKGROUND: Warfarin anticoagulation is a common and particularly complex and dangerous outpatient therapy. While anticoagulation clinics may deliver tailored, high quality care to patients receiving warfarin therapy, communication barriers with limited English proficient (LEP) patients may lead to disparities in

anticoagulation quality with implications for program design and patient safety.
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METHODS: We interrogated electronic data repositories on 2779 patients receiving care from the Massachusetts General Hospital Anticoagulation Management Service in 2010. This included data on international normalized ratio (INR) tests and patient characteristics, including language and whether the Service used a surrogate for primary communication rather than speaking with the patient directly. We calculated percent time in therapeutic range (TTR for INR between2.0-3.0) and percent time in danger range (TDR for INR <1.7 or >3.5) using the standard Rosendaal interpolation method. We ran multivariable linear regression models to study the relationship between LEP and our primary outcomes, TTR and TDR, adjusting for patient age, gender, comorbidity count, education level, and whether the site of primary care was a community health center. Finally, we examined whether the use of a communication surrogate in LEP patients had a differential effect on outcomes.
RESULTS: Among 2779 total patients, the primary reasons for anticoagulation were atrial fibrillation (69.5%) and venous thrombosis and thromboembolism (15.3%). One hundred ninety-seven patients (7.1%) were LEP; LEP patients, compared to English speakers, had a higher number of co-morbidities (3.2 vs 2.9 comorbidities, p=0.004), and were more frequently women (52.3% vs 41.1%, p=0.002), minorities (49.7% vs 5.3%, p <0.001), underinsured (20.8% vs 5.8% with Medicaid, Free Care or Self-pay, p <0.001), and less well educated (51.3% vs 6.5% with less than a high school education, p <0.001). In unadjusted analyses, LEP patients compared to English speaking patients spent less TTR (71.4% vs 74.7%, p <0.001), more TDR (11.6% vs 9.6%, p=0.004). After adjusting for sociodemographic and clinical factors, LEP patients spent less TTR (2.1%, 95%CI [4.1% to 0.04%]), but there was no significant difference in TDR (1.1%, 95%CI [0.4% to 2.5%]) between LEP patients and English speakers. Adjusting for these same factors, compared to English speakers who did not use a communication surrogate, LEP patients who did not use a communication surrogate had a lower percent TTR (3.2%, 95%CI [6.2 to 0.3%] and a higher percent TDR (2.4%, 95% CI [0.3% to 4.5%]). LEP patients who used a communication surrogate were not statistically different from English-speakers who did not use a surrogate in their percent TTR (2.5%, 95%CI [5.0% to0.01%]) or TDR (1.2%, 95%CI [0.6% to 3.0%]).
CONCLUSION: This anticoagulation clinic achieved a high average TTR. Still, there was a small but significant decrease in TTR seen with LEP patients compared to English speakers. The use of a communication surrogate appeared to reduce this difference slightly among LEP patients. These relationships and the appropriate use of communication surrogates in anticoagulation management need to be further explored. But, it appears that anticoagulation clinics can enhance their services to LEP patients to reduce disparities and improve anticoagulation quality for LEP patients.
ACTUAL PLACEMENT OF SEQUENTIAL COMPRESSION DEVICES AMONG MEDICAL PATIENTS: A ONE DAY SNAP SHOT Jean Atallah 1;
Adrian Sarzynski 1; Robert Graham2. 1Lenox Hill Hospital, New York City, New York ; 2Lenox Hill Hospital, New York, New York. (Tracking ID # 12482)
BACKGROUND: Current evidence supports the use of anticoagulant therapy as standard prophylaxis for prevention of venous thrombembolism (VTE) in hospitalized patients. However, patients can have contraindications to pharmacologic prophylaxis and mechanical methods have been used as alternatives. Although the use of sequential compression devices (SCD) has been shown to reduce the risk of VTE, efficacy is highly dependent on optimal patient compliance, consistent use, and proper fit. Our objectives were to estimate the incidence of SCDs prescribed versus SCDs placed, to determine compliance per unit, to determine SCD availability, and to understand reasons patients were not placed on pharmacological prophylaxis.

METHODS: A cross-sectional study was performed on December 28, 2010. Electronic medical records (EMR) were screened for patients ordered for SCDs on 4 regional medical floors and 4 intensive care units. Patients were excluded if they were ordered for low-molecular weight heparin (LHWH), unfractionated heparin (UH), were on warfarin with INR >2.0 or had SCD orders placed less than 24 hours. 38 patients met our inclusion criteria and data collected included: admitting diagnosis, contraindications for pharmacological prophylaxis (based on preset order-set: active bleeding, current treatment with anticoagulants, coagulopathy or thrombocytopenia <50,000, history of heparin induced thrombocytopenia), and necessity of transfusion during admission. Assessment of SCD status was based on if SCDs were not in room, in room but not on, or in room and on. Availability of SCDs was obtained verbally from bio-med department personnel. RESULTS: 16% (6/38) had SCDs in the room however only 13% (5/38) had them turned on as prescribed. 100% (6/6) of patients who were provided SCDs had them on. Four percent (1/25) of patients on regional medical floors compared to 30% (4/13) of patients in the critical care units had them on as prescribed. Three hundred SCD were present in the hospital, yet only 5 were actually clean, functional and ready for use. Reasons why patients did not receive pharmacological prophylaxis were GI bleed 32% (12/38), thrombocytopenia 18% (7/38), pancytopenia 15% (6/38), anemia 13% (5/38), orders not entered into EMR 11% (4/38), suspected HIT 5% (2/38), intracranial hemorrhage 5% (2/38), hematoma 3% (1/38), ambulation 3% (1/38), and auto-anticoagulation 3% (1/38). CONCLUSION: An exceedingly low number of patient requiring mechanical prophylaxes received it. All patients with SCDs in their room had them on, demonstrating good patient compliance. Therefore, the factor which contributed to low number of patients receiving mechanical prophylaxis was not compliance but the distribution within the hospital. Unfortunately, patients were excluded from pharmacological prophylaxis due to anemia which is not a contraindication according to the 2008 America College of Chest Physicians (ACCP) guidelines for prevention of VTE. Adherence to current guidelines, as well as increased availability of SCDs to patients could potentially reduce morbidity, mortality, and financial costs associated with VTE. This pilot study has led to a more extensive ongoing assessment of SCD use in Lenox Hill Hospital.

HEALTH INFORMATION EXCHANGE USE REDUCES AVOIDABLE DIAGNOSTIC IMAGING IN THE EMERGENCY EVALUATION OF BACK PAIN James E. Bailey 1; Jim Wan 1; R Pope 1; Teresa Waters 1; Kevin Johnson2. 1University of Tennessee Health Science Center, Memphis, Tennessee ; 2Vanderbilt University, Nashville, Tennessee. (Tracking ID # 12484)

BACKGROUND: Diagnostic imaging is routinely obtained in the emergency department (ED) evaluation of back pain despite evidence-based guidelines (EBGs) recommending selected use. Healthinformation exchanges (HIEs) have been proposed as a way to reduce unnecessarydiagnostic imaging. This study seeks to determine whether HIE use reduces potentially avoidable diagnostic imaging in patients presenting to the ED with back pain.

METHODS: Cross-sectional analysis of data from the MidSouth eHealth Alliance HIEfor 3,021 adult (age 1850) patient-visits for back pain to one of the major general hospital EDs in the fourcounties of the Memphis Metropolitan Area two or more times between August 1, 2007 and July 31, 2009. Visits were included with primary discharge diagnosis of lumbosacral or thoracic back pain (ICD-9-CM codes 720. x [ankylosingspondylitis and other spondylopathies], 721.x [spondylosis], 722.xx [intervertebral disc disorders], 724.xx [unspecified back disorders], 737.xx[curvature of spine], 846.x [sacroiliac strain], and 847. x [back strain]) excluding all codes for cervical, coccygeal, and unspecified site. Use of lumbosacral or thoracic diagnostic imaging (plain radiography, CT, and MRI) was the primary outcome. RESULTS: The HIE was accessed for 14.0% of ED visits for back pain. Billing provider accounted for 70.5%and ED staff for 29.5% of total HIE use. 18.3% of patient-visits received some type of lumbosacral or thoracic diagnostic imaging. Of the 554 cases with any imaging, 484 had lumbosacral or thoracic x-ray (87.4%), 30 CT (5.4%), and 44 MRI (7.9%). Bivariate analysisrevealed that any HIE use (odds ratio [OR] 0.49, 95% confidence interval [CI]0.35-0.67), HIE

use by ED staff (OR 0.14, CI0.05-0.38), and HIE use by any billing provider (OR 0.68, CI 0.49-0.96), were associated with decreased diagnostic imaging. After controlling for demographic factors, comorbidity, hospital system, and previous visits, any HIE use wasassociated with decreased odds of any diagnostic imaging (OR 0.16, CI 0.06-0.43),but HIE use by any billing provider was associated with increased odds of anydiagnostic imaging (OR 3.76, CI1.29-10.99). In addition, number of previous visits was associated with decreased odds of any diagnostic imaging (OR 0.92, CI 0.89-0.96). In separate analysis, the any HIE use * previous visits and any billing provider HIE use * previous visits interaction terms were not associated with decreased imaging.
CONCLUSION: Systematic HIE use by ED personnel and overall HIE use are strongly associated with reduced avoidablediagnostic imaging in the evaluation of back pain in the ED. Patients with higher numbers of previous visits are also less likely to receive diagnostic imaging. HIE use should be promoted to help reduce the costs and potential harms associated with unnecessary diagnostic imaging in patients with back pain.

RESIDENT TIME SPENT IN CLINICAL AND EDUCATIONAL ACTIVITIES AT HOME: IMPLICATIONS FOR DUTY HOURS

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BACKGROUND: The ACGME recently finalized duty hour restrictions to be implemented by July 20111. The new standards require programs to ensure that residents are managing their time before, during and after clinical assignments. With the increasing use of electronic health records (EHR), it is possible for residents to continue to participate in clinical or educational activities after leaving the hospital, potentially above and beyond duty hour limits. There is no study examining the magnitude of this phenomenon. Therefore, our study aims to quantify the extent and type of out-of-hospital work reported by Internal Medicine residents at two Midwestern teaching hospitals with EHRs.

METHODS: An anonymous one-page survey was created to assess clinical activities that could be performed from home via telephone,
internet, or remote access of EHR. These activities included checking labs, reviewing records, placing orders, communicating with ward teams, managing clinic patients and conducting activities such as independent didactics and research. Residents were asked to use a graded scale to rate the frequency of these activities during their last inpatient service month. Residents were also asked if they ever performed these activities on days off or on post-call days. Paper surveys were distributed to Internal Medicine residents at mandatory housestaff meetings at two Midwestern teaching hospitals in June 2010. The surveys were entered into an Excel database and analyzed using STATA 10.0. Site-adjusted ANOVA &logistic regression was utilized to assess differences by site or residency training year.

RESULTS: Seventy-three percent of surveys were completed, 51% by interns. There was no difference in response rates between the two sites. Ninety-three percent of residents reported checking labs from home at least once, with 45% doing so frequently, and two thirds doing so on a post-call day. Sixty-nine percent of residents reported ordering inpatient labs from home, with 37% doing so on a post-call day. Furthermore, regarding time spent communicating with team members from home, 66% of residents report paging their cross-covering teams at least once in the last month; only 5% frequently, and 39% on the post-call day. Clinic management was often done from home: 78% of residents reported calling clinic patients from home, 85% reported checking labs from home at least once in the past month, 33% did so frequently, and 23% did so on their post call day. Regarding didactics/research, nearly all (99%) of residents reported researching patients illnesses from home, and just under 50% did so on a post-call day. Likewise, 83% of residents reported doing research outside of the hospital, one-third doing so frequently. Regarding days off, 45% of residents reported coming to the hospital at least once on their day off to conduct clinical activities and two-thirds reported doing so for educational activities. When compared to interns, residents reported more out-of-hospital time preparing for

conference (resident 56% vs. intern 21%, p=0.003), emailing attendings (resident 28% vs. intern 6%, p=0.015), and contacting cross-covering teams post-call (resident 56.2% vs. intern 30% p=0.035).
CONCLUSION: As residents in-hospital time is restricted, it is important to understand out-of-hospital work activity. EHRs have allowed many residents to complete clinical tasks from home, and these activities are not captured by resident duty-hour reports. Moreover, this work is sometimes taking place on designated days off or on post-call days, when residents are most fatigued. Further study is needed to describe the extent of this practice and whether it poses a safety risk. Understanding these risks have implications both for patient safety and resident well-being, and may necessitate improved resident education on in-hospital time management and patient handoffs.
THE INCIDENCE OF DEEP VENOUS THROMBOSIS IN IMMUNE THROMBOCYTOPENIC PURPURA PATIENTS Karim Arnaout 1;
Mustapha Khalife 2; Amr Hanbali2. 1Henry Ford Hospital, detroit, Michigan ; 2Henry Ford, Detroit, Michigan. (Tracking ID # 12508)
BACKGROUND: Immune thrombocytopenic purpura (ITP) is a common autoimmune disease characterized by an increased tendency to bleed. Few studies suggested that ITP is associated with an increased risk of thrombosis. However, the incidence of deep venous thrombosis (DVT) in ITP is not well described. The objectives of this retrospective study were to determine the incidence of DVT in ITP patients and to identify the risk factors related to its occurrence.

METHODS: We retrospectively reviewed the charts of 303 patients diagnosed with ITP in our institution between 2005 and 2009. The diagnosis of ITP was defined by a platelet count less than 140 109/l with normal or increased number of megakaryocytes on bone marrow aspirate, after exclusion of thrombocytopenia-induced medications or disorders, and absence of splenomegaly. The patients who developed DVT were identified. Age, gender, history of malignancy and the mean platelet count were collected for each patient and examined for their association with DVT development.
RESULTS: 15 patients developed DVT, yielding an incidence of 5.0 percent. The mean age of patients who developed DVT was 64 and that of patients who did not have DVTwas 54 (p=0.048). Gender, history of malignancy and the mean platelet count did not have a statistically significant effect on DVT development in ITP patients.
CONCLUSION: Our data suggests that the incidence of DVT in ITP patients is 5.0 percent. Age appears to be associated with a statistically significant higher incidence of DVT in this population while gender, history of malignancy and the mean platelet count are not significant risk factors. Further studies are warranted to explain the exact mechanism of DVT in this bleeding condition.
FACTORS ASSOCIATED WITH ADHERENCE TO PHYSICIANS RECOMMENDATIONS IN A PROSPECTIVE COHORT AFTER HOSPITALIZATION WITH HEART FAILURE Howard S Gordon 1;
Richard Street 2; Anita Deswal3. 1VAMC and University of Illinois at Chicago, Chicago, Illinois ; 2Texas A&M University, College Station, Texas ; 3Houston VAMC and Baylor College of Medicine, Houston, Texas. (Tracking ID # 12509)
BACKGROUND: The contribution of physician-patient communication in adherence to physicians recommendations in patients with heart failure is poorly studied.
METHODS: In a prospective observational cohort study of patients hospitalized for an exacerbation of heart failure at 2 large VA Medical Centers, we examined the association of demographic factors, clinical factors and physician-patient communication (ratings and behaviors) with adherence for 210 patients who had scheduled outpatient visits with 93 physicians in the 6 months post-hospital follow-up period. Patients with dementia and

terminal illness were excluded. Patients completed questionnaires to collect demographics, functional status, trust, and ratings of communication. Clinical data were abstracted from medical records. Communication behaviors were collected and coded from audio-recordings of the physician-patient visits. Adherence questionnaires were administered by telephone 34 weeks after the outpatient visits. Analyses comparing adherence with potential covariates used the chi-square test or t-test as appropriate. Mixed multiple linear regression with a repeated measures design was used to examine the independent relationship of communication and potential covariates with adherence.
RESULTS: Adherence was not statistically different by race, ethnicity, marital status, education, income, employment status, ejection fraction, history of myocardial infarction or diabetes, P >0.10; but adherence was higher for patients at increased age, P=0.04, higher functional status, P =0.001 and was higher (P<.01) for patients reporting higher trust in physician, higher self-efficacy to communicate, and who rated the physician as more informative and more supportive. Adherence was higher for patients whose physicians more frequently used partnering and supportive communication behaviors (P=.02, and P=.001), but not with the overall provision of information (P=.65). Using mixed multiple
linear regression to examine the independent association of adherence with communication and potential covariates, demographic and clinical factors were not associated with adherence, but higher patients rating of the doctor as informative and the doctors more frequent use of supportive communication behaviors were significant predictors of better adherence (P=.04, and P=0.01).
CONCLUSION: In this cohort of heart failure patients, adherence was associated with age, functional status, trust, and both patients ratings and observers coding of physicians communication behaviors. In multiple regression analyses, physicians supportive communication behavior and the patients rating of the physician as informative were associated with adherence. Fortunately communication is a skill that can be taught. Future research should evaluate whether training physicians to improve communication can lead to improved adherence.
PATIENT EXPERIENCE WITH PATIENT-CENTERED MEDICAL HOMES AND ASSOCIATED QUALITY OF CARE IN MASSACHUSETTS, 2009 Asaf Bitton 1; Jennifer Kincheloe 2; David Bates 3; Joel Weissman4. 1Division of General Medicine, Brigham and Womens Hospital, Brookline, Massachusetts ; 2Kincheloe Health, Denver, Colorado ; 3Brigham and Womens Hospital, Boston, Massachusetts ; 4Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12512)
BACKGROUND: Patient-centered medical homes (PCMH) have generated significant attention as a way to reform primary care and improve outcomes, yet no state-level evidence exists regarding the availability of its components or association with quality. Of added interest, Massachusetts health insurance expansion raised questions around the capacity for primary care practices to provide sufficient access and quality care. We sought to assess the extent to which Massachusetts respondents had access to practices with core medical home features, and examined their association with quality of care indicators.
METHODS: We analyzed the 2009 Massachusetts Behavioral Risk Factor Surveillance System (BRFSS) survey, a representative statewide cross-sectional adult survey with a custom module of four questions to assess patient experience with medical homes. The survey sample consisted of adults 18 years, who were in the single split of the 2009 Massachusetts BRFSS sample that contained the PCMH question module (n=5693). We defined a high level of PCMH care experience as having a personal doctor and answering always or almost always to all four PCMH questions, including: provider knowledge about a patients medical history; getting an appointment right away; provider understanding of the patients specialist care; provider knowledge about the patients medications. We analyzed predictors of high PCMH care experience, and associations with ten available quality measures. These included access measures, vaccinations, lipid screening for cardiovascular diseases, and diabetes care processes (annual visits, eye exams, foot exams, cholesterol screening, Hemoglobin A1c testing). Multivariable regression models to assess the association of PCMH care experience

with each quality measure were adjusted for age, gender, race, insurance, income, and education using SAS-callable SUDAAN.
RESULTS: Overall, 88.2% of respondents reported having a personal doctor, and 29.8% reported having high levels of PCMH care experience. In adjusted analyses, women were more likely than men to report high PCMH scores (adjusted OR (aOR) 1.48; 95% CI: 1.20, 1.83), and those

without insurance were less likely (aOR 0.22; 95% CI: 0.13, 0.40). Respondents with high PCMH scores were less likely to report problems with obtaining care in the last year (aOR 0.53; 95% CI: 0.40, 0.71). Among adults with chronic disease, those reporting high levels of PCMH experience were more likely to ever receive a pneumococcal vaccine (aOR1.36; 95% CI: 1.04, 1.78), an annual influenza vaccine (aOR 1.43; 95% CI: 1.08, 1.88), and annual lipid screening (aOR 2.08; 95% CI: 1.30,3.34). In diabetic patients, those with high reported PCMH experience were more likely to report obtaining all five recommended care processes (aOR 2.31; 95% CI: 1.31, 4.06).
CONCLUSION: In contrast to some media reports, Massachusetts respondents reported high levels of access to primary care providers, and reasonable access to PCMH-associated care. High levels of PCMH experience were associated with receipt of a number of chronic disease and access quality indicators. Because patient experience is linked to improved quality, it will be crucial to measure experience with PCMH care on a population level as the PCMH model expands nationwide. The implementation of the BRFSS PCMH question module in Massachusetts may serve as an evaluation roadmap for other states to follow.
IMPROVING UNDERSTANDING OF RX INSTRUCTIONS AMONG PATIENTS WITH LIMITED ENGLISH PROFICIENCY Stacy Cooper Bailey 1; Dean Schillinger 2; Alice Chen 3; Urmimala Sarkar 3; Emily Larsen 1; Michael Wolf1. 1Northwestern University, Chicago, Illinois ;
2University of California at San Francisco, San Franciso, California ;
3University of California at San Francisco, San Francisco, California. (Tracking ID # 12515)
BACKGROUND: Approximately nine percent of the US population has limited English proficiency (LEP). Previous studies suggest that pharmacies often fail to provide language concordant prescription drug labeling to non-English speaking patients; this lack of language access can have serious effects on LEP patients ability to safely administer medications. The objective of this study was to determine if a set of evidence-based, multilingual prescription drug (Rx) instructions improves medication understanding among individuals with limited English proficiency (LEP) in comparison to a current, nationally-available standard. METHODS: Face-to-face interviews were conducted with 122 LEP adults recruited into the study from either clinic or community-based organizations in San Francisco, CA or Chicago, IL. Participants were randomized to receive five Rx bottles with either: 1) language-concordant Rx instructions currently generated by a major, national chain pharmacy or 2) enhanced, language-concordant Rx instructions. Enhanced Rx instructions were created utilizing health literacy and translation best practices; this approach used the Universal Medication Schedule (UMS) to ground medication-taking to four distinct times of day (morning, noon, evening and bedtime). Participants were asked to read each container label and to demonstrate how they would dose the medicine according to the instructions provided.
RESULTS: Patient understanding of Rx instructions ranged from 48% for the least understood to 96% for the most commonly understood instruction. Patients were significantly more likely to understand enhanced instructions compared to standard instructions (73% vs. 58%, $p < 0.001$). In multivariate analyses that included instruction type, age, sex, language spoken, educational attainment, study site, and number of Rx drugs currently taken, instruction type remained a significant, independent predictor of understanding, with enhanced instructions being significantly more likely to be understood compared to standard instructions (odds ratio (OR) 1.91, 95% confidence interval (1.32, 2.77), $p=0.001$).
CONCLUSION: Providing clear, language-concordant Rx labeling is essential to promote safe and appropriate

medication use among LEP populations. The enhanced Rx instructions developed and tested in this study show promising results and were designed to be easily implemented in pharmacy practice. State legislatures, State Boards of Pharmacy and the National Association of Boards of Pharmacy should consider promoting the use of this standardized, enhanced set of multilingual Rx instructions as a first step towards providing language access for LEP patients in pharmacy practices.

FACTORS ASSOCIATED WITH ADVERSE DRUG EVENTS AMONG NON-ENGLISH SPEAKING PATIENTS

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BACKGROUND: Evidence suggests that patients with limited English proficiency (LEP) experience high rates of adverse drug events (ADEs) in ambulatory care. Few studies have examined possible risk factors for ADEs within this population. Recent studies indicate that LEP patients may be more likely than English-speaking patients to utilize multiple pharmacies to fill Rx medications. The objective of this study was to examine if the number of pharmacies utilized by LEP patients was associated with self-reported experience of an adverse drug reaction. METHODS: Face-to-face interviews were conducted with 120 LEP adults recruited into the study from either clinic or community-based organizations in San Francisco, CA or Chicago, IL. Participants spoke either Spanish, Cantonese, Mandarin, or Russian as their primary language. Participants were asked to self-report the names of pharmacies they used in the past six months; the number of pharmacies utilized was calculated from the number of names provided. They were also asked to report if they had ever gotten sick or had a bad reaction after taking a prescribed medication. Additionally, patients were asked about socio-demographic characteristics such as age, sex, income, education, and number of prescription medications currently taken. RESULTS: 39.2% of patients reported a negative reaction from a prescribed medication. 33.3% were found to regularly use more than one pharmacy to fill their prescription medications and 44.1% used five or more Rx drugs. In multivariate analyses that included number of pharmacies utilized, age, sex, educational attainment, number of Rx medications currently taken, language, and income, number of pharmacies utilized remained a significant, independent predictor of self-reported adverse drug reactions, with patients using more than one pharmacy being significantly more likely to report an adverse reaction in comparison to those using only one pharmacy (odds ratio (OR) 4.0, 95% confidence interval (1.4, 11.9), p=0.012). Number of Rx medications taken, language, income, educational attainment, and age were not significantly associated with reporting an ADE. CONCLUSION: When multiple pharmacies are used, it is unlikely that each pharmacy is aware of the complete medication history of the patient. This is likely to impact pharmacists ability to provide adequate counseling or surveillance for potential ADEs. Interventions should be sought to aid communication among pharmacies, and also among prescribers, to ensure patients are dispensed safe and appropriate regimens. Pharmacies, in particular, may consider creating opportunities for medication review. Additional studies are needed to examine the reasons why multiple pharmacies are used by the LEP population; interventions may be needed to address these underlying causes.

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TELEPHONE-BASED SMOKING CESSATION TREATMENT FOR MENTAL HEALTH PATIENTS

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BACKGROUND: Proactive telephone smoking cessation counseling for mental health patients is an emerging niche of care. We compared the difference in the average number of cigarettes smoked per day before and two months after receiving at least one counseling session among patients enrolled in a VA smoking cessation care coordination program for smokers with mental illness.

METHODS: These data are preliminary results of a multi-site study evaluating a telephone care coordination program for VA smokers with mental illness. Mental Health providers referred 260 smoking patients to the program. All referred atients completed a 5-call recruitment process, 128 of whom enrolled in the program and were offered smoking cessation medications and proactive telephone counseling. Participants were randomized to receive counseling from a state Quitline or a VA counselor. A structured assessment was completed via telephone before and two months after beginning counseling. The number of cigarettes smoked per day before and after counseling was compared using a paired t-test.
RESULTS: Two months after enrolling in treatment there was a significant reduction in the number of cigarettes smoked per day among participants who received one or more counseling sessions from a VA counselor (9.28 versus 16.08, p<.0009) or from a Quitline counselor (11.13 versus 17.9, p=.001). There was a near-significant trend indicating that the more counseling sessions patients completed, the greater the decrease in their number of cigarettes smoked per day (p=.09).
CONCLUSION: Mental health patietns can achieve significant reductions in their smoking if they are referred to and engaged in smoking cessation counseling. Full accrual of our anticipated sample size of N=1,500 will allow us to confirm the current trend suggesting that participants who engage in more than one counseling session will experience greater reductions in daily smoking.
THE INFLUENCE OF PERCEIVED RACIAL DISCRIMINATION ON THE ADOPTION OF HEALTHY LIFESTYLE BEHAVIORS IN HYPERTENSIVE AFRICAN AMERICANS: THE CAATCH TRIAL. Jessica M. Forsyth 1;
Antoinette Schoenthaler 1; Joseph Ravenell 1; Gbenga Ogedegbe1. 1NYU School of Medicine, New York, New York. (Tracking ID # 12532)
BACKGROUND: Adverse lifestyle behaviors such as poor physical activity and poor fruits and vegetable intake are more prevalent in African Americans compared to Whites. Several studies have confirmed the negative relationship between adverse lifestyle behaviors and hypertension in African Americans. The efficacy of interventions targeting therapeutic lifestyle change (TLC) in controlling blood pressure (BP) among African Americans is well proven. However, few studies have examined the psychosocial factors that influence the adoption of healthy lifestyle behaviors in these studies. Perceived racial discrimination is an important psychosocial factor that has been associated with poor health outcomes in AfricanAmericans; its effect on adoption of healthy lifestyle behaviors remains untested. In this study, we examined the influence of perceived discrimination on the adoption of healthy
lifestyle behaviors among hypertensive African Americans followed in community-based primary care practices.
METHODS: Participants were 461 patients enrolled in the Counseling African American To Control Hypertension (CAATCH) trial. The objective of CAATCH was to evaluate, in acluster-randomized trial, the effectiveness of a multilevel intervention targeted at physicians and patients for improving blood pressure (BP) control in hypertensive African Americans who receive care in under-served community health centers. Analysis for the present study was limited to participants in the intervention arm. The dependent variables were the lifestyle behaviors - physical activity level assessed with the Paffenbarger Physical Activity Questionnaire, with higher kilocalories expended per week indicating greater physical activity; healthy eating habit was assessed with the diet items of the Rapid Eating and Activity Assessment for Patients measure (REAP), with higher scores indicating healthier eating habits and BP was based on the average of three BP measurements taken with a well-validated automated device (BPTru). The independent variable, perceived racial discrimination, was assessed with the lifetime, past year and stress scalesof the Schedule of Racist Events questionnaire, with higher scores indicating more frequent exposure to perceived discrimination. All assessments were conducted at baseline and 12 months with change measures from baseline to 12 months for each dependent variable taken as the outcomes. Regression analyses were used to examine the associations between perceived discrimination and the within-patient change in each of the three outcome measures from baseline to 12 months

while controlling for age, income and education level.
RESULTS: Most patients were low-income and had a high school education, with a mean age of 57 years. Age was associated with greater reduction in systolic BP (=.13, p=.02); greater exposure to lifetime discrimination was associated with less reduction in systolic BP (=.14, p=.02) and lower adoption of healthy eating behaviors (=.20, p=.004). Discrimination was associated with lower adoption of healthy eating behaviors (=.17,p=.02). There were no significant associations between discrimination and change in physical activity.
CONCLUSION: Perceived discrimination influenced the adoption of healthy lifestyle behaviors and reduction of systolic BP in low-income African American patients, but did not influence adoption of physical activity. This study provides evidence that exposure to discrimination may influence African Americans ability to adopt healthy lifestyle behaviors and should be considered in the development of future interventions.
THE COST-EFFECTIVENESS OF SELECTIVE TOBACCO CONTROL POLICIES IN SOUTH AFRICA Asaf Bitton 1; Thomas Gaziano2.
1Division of General Medicine, Brigham and Womens Hospital, Brookline, Massachusetts ; 2Brigham and Womens Hospital, Boston, Massachusetts. (Tracking ID # 12534)
BACKGROUND: Tobacco use is a leading cause of cardiovascular disease (CVD) and other chronic conditions in developing countries. However, very few estimates of the financial impact of tobacco control policies on the healthcare system in these countries have been conducted. . Because South Africa instituted discrete tax and indoor air policies aimed at reducing its high rates of tobacco use, we sought to establish the cost-effectiveness of these interventions.
METHODS: We used a Markov model to perform a cost-effectiveness analysis on the two tobacco policy interventions separated in time.

South Africa instituted a progressively increased tobacco excise tax starting in 1993, after which taxes eventually reached 52% of the retail cost. Starting in 2001, South Africa banned smoking in all indoor locations except for restaurants, which were allowed up to 25% separately ventilated smoking sections. Our model used published estimates of the effect of these interventions on tobacco prevalence, the effect on tobacco on CVD and non-CVD related mortality, South Africa-specific data on the costs of implementing and enforcing these policies, as well as CVD- and other related health care costs., To compare strategies, we report incremental cost-effectiveness ratios (ICER), in US dollars (year 2000) per disability-adjusted life-year (DALY) over a ten year window, and a variety of sensitivity analyses on the indoor air laws.
RESULTS: For the tobacco tax strategy, we used a conservative published estimate of the implementation cost of $1.24 per capita which would result in an ICER of $31/DALY averted. A threshold analysis showed that at a cost below $1.11 per capita, the policy would be cost-saving; this is notable because some published literature suggests that the true cost in South Africa may have been as low as $0.10 per capita. These analyses exclude any tax revenue intake associated with the policy. For the clean indoor air strategy, our base case estimate was an ICER of $410/DALY averted. In one-way sensitivity analyses around the costs of enforcement and the effects on prevalence, the ICERs ranged from $223 to $643 and $388 to $333 per DALY averted, respectively. A probabilistic sensitivity analysis around the intervention costs, enforcement costs, intervention benefits, and risk reduction on non-CVD mortality found a mean ICER value of $472/ DALY averted with 95% Confidence Intervals ranging from cost saving to $601/DALY averted.
CONCLUSION: For the tobacco tax strategy, we used a conservative published estimate of the implementation cost of $1.24 per capita which would result in an ICER of $31/DALY averted. A threshold analysis showed that at a cost below $1.11 per capita, the policy would be cost-saving; this is notable because some published literature suggests that the true cost in South Africa may have been as low as $0.10 per capita. These analyses exclude any tax revenue intake associated with the policy. For the clean indoor air strategy, our base case estimate was an ICER of $410/DALY averted. In one-way sensitivity analyses around the costs of enforcement

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CLOSTRIDIUM DIFFICILE ENTERITIS: AN EMERGING DISEASE? Abdallah A Kobeissy 1; Marilyn Karam 1; Edgardo A Flores 1; Christopher Hartwell 1; Wadih Chacra1. 1Henryford Health System, Detroit, Michigan. (Tracking ID # 12547)

BACKGROUND: Clostridium difficile is considered one of the most common and serious nosocomial infections associated with high morbidity and mortality. It has been viewed as a condition that is typically confined to the colon, with isolated small bowel involvement being extremely rare and unusual. However, an increasing number of cases describing isolated small bowel C. difficile infection have been
reported in the literature. Our aim was to review the incidence of C. Difficile enteritis in our institution.

METHODS: We conducted a chart review of two hundred eighty patients who underwent total colectomy and ileostomy from the year 2000 to 2010. Patients were included in our analysis based on a documented C. difficile infection after total colectomy.

RESULTS: Only eight cases of C. difficile enteritis were identified. Indications for colectomy included fulminant C. difficile colitis (two patients), ulcerative colitis (two patients), large bowel inertia (one patient) and colon cancer (three patients). Five patients had a history of antibiotic use within three months prior to surgery mainly cephalosporins. Two patients were on immunosuppressive therapy. Five were on acid suppressive therapy. The interval time between colectomy and the development of C. difficile enteritis ranged from two days to several years. Clinical presentation varied from high volume ileostomy output (three patients), leukocytosis (five patients), ileus (two patients), melena from ileostomy (one patient) and abdominal pain (two patients). Treatment included metronidazole, vancomycin or a combination of both. Four deaths were accounted for in this series; none, however, was directly attributed to C. difficile infection. CONCLUSION: C. difficile enteritis is an emerging condition that necessitates early recognition, because of the potential higher mortality and morbidity rates than its colon counterpart. Therefore, clinicians should have a lower threshold of suspicion to recognize this entity, diagnose and treat it promptly.

INITIALWEIGHT LOSS IN AFRICAN AMERICAN ADULTS SUCCESSFUL AT LONG-TERM WEIGHT LOSS MAINTENANCE: PRELIMINARY RESULTS FROM THE AFRICAN AMERICAN WEIGHT CONTROL REGISTRY Ann Smith Barnes 1; Rachel Kimbro2. 1Baylor College of Medicine, Houston, Texas ; 2Rice University, Houston, Texas. (Tracking ID # 12548)

BACKGROUND: Disparities in health parallel disparities in rates of obesity.[1] African Americans are disproportionately affected by excess weight and the diseases for which it is a risk factor.[2, 3] Interventions to address obesity among African Americans have yielded modest results. [3, 4] More recently, attempts to understand or promote long-term weight maintenance in African Americans have resulted in limited insights or in maintained losses with small clinical impact.[3, 5, 6] Long-term weight loss maintenance is the ultimate goal of any weight management program. The health benefits of weight loss are sustained as long as the healthier weight is maintained. In clinical practice, a 10% weight loss results in improved blood pressures, blood sugars, and lipids and is the clinically recommended weight loss goal for individuals trying to reduce weight.[79] Individuals who lose weight and maintain substantial weight loss are now better understood because of data collected through the National Weight Control Registry (NWCR).[10] However, limitations of the NWCR are the few representatives from ethnic minority populations and the lack of a comparison group of individuals who loss substantial amounts of weight but did not maintain the loss.[10]

The purpose of the current study was to identify a large sample of African American adults who intentionally achieved clinically significant weight loss of 10% and had maintained that weight loss for at least 1 year and to compare them to individuals who achieved 10% weight loss but regained the weight. In addition, through

quantitative comparisons of weight loss maintainers and weight loss regainers, the

study strives to add to the understanding of African-American weight loss, weight maintenance, and weight regain.
METHODS: A cross-sectional study design was used. Participants were recruited via word-of-mouth through national professional contacts of the principal investigator, postcard/fliers displayed at various venues and meetings attended by African Americans, a magazine advertisement (Jet), and by electronic invitation through eRewards. Interested individuals could interface with the registry and questionnaires through an online portal or through phone contact followed by a paper and pencil version of the same measurement tool. Prospective subjects were screened for eligibility by the PI, a call center representative, or an online screening survey. Based on responses, eligible participants were directed to the registry survey for maintainers or regainers online, or had the appropriate paper survey mailed to them. Eligible participants were asked to complete survey instruments about themselves and their weight history. Based on the descriptive data reported from the NWCR and focus group data from African American weight loss maintainers and regainers[11], a culturally relevant survey instrument was developed to capture demographic and weight characteristics, weight-loss and maintenance approaches, the effect of cultural factors on weight-loss and maintenance, and the effect of weight-loss and maintenance on quality of life. In addition, participants completed the International Physical Activity Questionnaire. At the conclusion of the survey, participants were invited to submit their names for inclusion in a maintained registry of weight loss maintainers and regainers. Responses from individuals who maintained weight and those who regained weight were compared using t-tests. All analyses were completed using STATA.
RESULTS: One thousand two hundred eighty African Americans completed surveys (383 weight-loss maintainers and 897 weight-loss regainers). Ninety percent of subjects were women and 57% had a college degree or higher. The average age was 41 years. Weight-loss maintainers lost an average of 24% of their body weight and 58% of maintainers lost >20% of their body weight. Maintainers had maintained >10% weight loss for an average of 5.2 years and 12% had maintained the loss for >10 years. The average maximum lifetime weight of maintainers was greater than regainers (105.0 kg compared to 91.6 kg, p<.001). Maintainers lost statistically more weight on average than regainers (26.4 kg vs. 16.0 kg, p<.001). A greater proportion of weight-loss maintainers than regainers reported that a health concern motivated their successful weight loss (35.8% vs 21.6%, p<.001). The majority of subjects in both groups lost a minimum of 10% of their weight on their own without the aid of a formal program. A significantly larger proportion of individuals who maintain most or all of the weight they lost employed traditional weight-loss promoting dietary practices when compared to those who regained weight: limiting amounts of food eaten (64.5% vs 56.5%, p<.010); limiting carbohydrates (33.7% vs 22.7%, p<.001); and limiting fat consumption (41.3% vs 27.9%, p<.001). In addition, a larger proportion of the maintainers adopted culturally acceptable though not evidence-based practices than those who went on to regain their weight: drinking more water (68.4% vs 54.1%, p<.001) and not eating after 7 pm (35.5% vs28.7%, p<.05).
CONCLUSION: Although the sample used in this study is not from a defined population, the methods are consistent with those used in the National Weight Control Registry which offered previously unknown insights into the characteristics and practices of community dwelling adults who had achieved clinically meaningful weight loss and maintenance. The identification of a large number of African American individuals who have been successful at long-term weight loss
maintenance confirms that success can be achieved in this population. These preliminary findings suggest that African Americans who are successful at clinically meaningful weight loss do not typically achieve their initial

success through formal programs. Alternative strategies to support African Americans in their quest for weight loss need to be developed. In addition, the study suggests the importance of health concerns in motivating individuals to lose weight and to maintain the loss. In clinical practice, providers should routinely utilize teachable moments to educate African American patients on the link between their health risk and their weight.

COST SAVINGS WITH ENHANCED EVIDENCE-BASED PRESCRIBING: THE EISENHOWER MEDICAL CENTER ANTIBIOTIC STEWARDSHIP PROGRAM Richard Anton Loftus 1; Michael Somero 2; Richard Nelson 2; Massoud Dezfuli 2; Greg Johnson 2; Stoltzman David3. 1Eisenhower Medical Center, Palm Springs, California ; 2Eisenhower Medical Center, Rancho Mirage, California ; 3Eisenhower Medical Center, Medical Director, Rancho Mirage, California. (Tracking ID # 13159)

BACKGROUND: Inappropriate use of antibiotics on inpatient units contributes to higher medication costs and development of drug resistance in local microbial populations. Analysis of medication utilization patterns can allow for implementation of Antimicrobial Stewardship Programs (ASPs). ASPs can limit use of medications deviating from the evidence base, lowering costs and the risk of resistance.

METHODS: In late 2008, the authors convened a committee of the infectious disease (ID), pharmacy, administrative, and information technology (IT) divisions of Eisenhower Medical Center (EMC), a 277-bed community hospital located in Rancho Mirage, CA. Applying the Performance Analytics software program to Horizon Business Insight databases, medication usage data was extracted from the inpatient pharmacy. Use of specific drugs was assessed by setting and prescriber type (ER prescriber, hospitalist, or infectious disease consultant), numbers of patients, and indications. Costs for specific medications were adjusted by patient census and rendered in terms of cost per patient per day. Prescriptions for two specific agents, daptomycin and linezolid, were identified as deviating from IDSA guidelines based on institutional microbial sensitivies, contributing to excessive pharmacy expenses. In February 2009, the committee implemented an ASP based on EMC usage patterns that sought to restrict these specific agents, requiring prescribers to consult with ID specialists prior to use. The ASP protocols were disseminated to staff and their rationale explained in direct face-to-face meetings with prescribing physicians. Costs data continued to be collected and analyzed for a 12-month period.

RESULTS: Following implementation of the ASP, the average cost of daptomycin per occupied bed fell from $5.51 during the pre-ASP period, to $1.52 in the year following. The average cost of linezolid per occupied bed fell from $7.06 to $1.68. The average cost for all antibiotics per occupied bed fell from $35.59 to $24.16. Within a year, total savings to the hospital from improved antibiotic usage reached $1.2 million.

CONCLUSION: Analysis of medication usage patterns can allow for the design of institution-specific ASPs that can support evidence-based use of antibiotics, dramatically reducing hospital pharmacy expenses. Future research will explore how the EMC program has impacted on institutional prevalence of drug-resistant microbial isolates.

PREDICTING UNPLANNED READMISSIONS AT A LARGE, URBAN MEDICAL CENTER Michael Hermann 1; Brittany Craven 1; Allison Bishow 1; Sarah Turse 2; Laura Kreisa 4; Peter Boling1. 1Virginia Commonwealth University, Richmond, Virginia ; 2Virginia Commonealth University, Richmond, Virginia. (Tracking ID # 13185)

BACKGROUND: 30-day hospital readmission reflects co-morbidity and care quality, drives costs, and soon will impact payment. At our institution, 30-day readmission rate is a Performance Improvement target for CY2010. We focused a pilot on two medicine inpatient units with combined monthly discharges of 330 patients and a 20% readmission rate. Given resource limitations, we needed to target a group upon admission that is at high risk for readmission. Literature review found many variables associated with readmission but few predictive tools, including LACE (CMAJ 2010. DOI:10.1503/cmaj.091117), that includes length of stay.

METHODS: We randomly selected 125 patients discharged in CY2009 from the 2 pilot units who had unplanned readmissions within 30 days (E) and 125 more that did not (C). We performed detailed reviews of

electronic health records, recording demographic data (age, sex, race), insurance type, living situation, ADL score, # of emergent admissions in prior 6 months, # of medications, and diagnoses thought to drive readmission (substance abuse, major psychiatric disorder, sickle cell disease, CKD stage 3 or more). We tested published prediction tools including the Charlson Index, LACE score, and LACE without length of stay (LACE-LOS). Using bivariate comparisons between E and C, we identified variables statistically associated with early readmission.
RESULTS: Charlson Index, LACE-LOS, # of medications and # of emergent visits were associated with readmission. Emergent care and Charlson Index provided more discrete separation of E and C groups. Pivot tables helped to identify the best pairing of emergent care visits
(3 or more) OR Charlson Index (4 or higher). This combination or RAM-PART (Re-AdMission Prediction And Risk Assessment Tool) had a sensitivity of 67% and specificity of 42% for 30-day re-admission and retrospectively identified 54% of admitted patients for targeted intervention.
CONCLUSION: We describe a prospective identification tool for high-risk patients likely to be readmitted. Sensitivity and specificity can be improved but it performs better than other published prospective tools. The tool is being validated and refined in a 6 month pilot intervention designed to reduce readmissions.
INDEPENDENCE AT HOME: GAIN-SHARING TO ALIGN INCENTIVES IN CHRONIC ILLNESS CARE Peter Boling 1; George Taler 2; Eric De Jonge 2; Bruce Kinosian3. 1Virginia Commonwealth University, Richmond, Virginia ; 2Washington Hospital Center, Washington, District of Columbia ;
3University of Pennsylvania/ Department of Veterans Affairs, Philadelphia, Pennsylvania. (Tracking ID # 13203)

BACKGROUND: Models of advanced chronic illness care have lagged due to poor congruence between financing and clinical practice. The Program for All-Inclusive Care of the Elderly (PACE) is a success story, joining Medicaid and Medicare funds in a global risk contract with a defined clinical model. Yet requirements slowed PACE growth: heavy capitalization; physical plant; limited to low income patients; and forcing a change of insurance. The VA health system Home-Based Primary Care program is now robust, but is limited to veterans. Yet, at least 3 million Americans with serious chronic illness and functional deficits lack access to regular, coordinated care, and such care is inadequately funded. To address this problem we proposed federal legislation.
METHODS: A planning group of 6 physicians, one administrator, and one lobbyist identified lead advocates in the US Senate and House of

Representatives, and used data from advanced chronic illness care models to design a gain-sharing compensation model using Medicare savings from avoidable inpatient care joined to a clinical model centered on technology-enhanced house calls. The identified target population has high co-morbidity (HCC score of 2.5 or more), high average annual cost (about $50,000), and deficits in 2 or more ADLs. Using published data from several sources that suggest potential for 25% cost savings, focused advocacy, and free national press, the planning team pursued new federal legislation. Examples from successful clinical practices and calculations showing utility of predictive modeling using Hierarchical Condition Categories helped gain regulatory support.
RESULTS: Paired House and Senate bills introduced in May 2009 gained 39 co-sponsors including 10 Republicans. In late 2009, with unanimous committee endorsement and neutral scoring by the Congressional Budget Office, the bills were included in the combined House 3-committee bill and Senate Baucus bill. The guaranteed cost-savings and appealing clinical model led to inclusion of Independence at Home (section 3024 of the 2010 PPACA) as a funded demonstration, due to start by January 2012. Implementation planning is underway. We will present modeling and program design details.

CONCLUSION: Focused, persistent advocacy based on a good idea designed to improve access and quality of care while lowering costs can result in health system change.

CLINICAL VIGNETTESAN UNFORTUNATE FAMILY PAIRING. Marc Solomon 1; Marc Solomon 2; Richard Brooks2. 1UCSF, San Franciscisco, California ; 2UCSF, San Francisco, California. (Tracking ID # 7214)

LEARNING OBJECTIVES: 1. Assess various treatment options for Echinococcal cysts. 2. Recognize the potential treatment complications of Echinococcal cysts.

CASE INFORMATION: A 28 year-old man presented with two days of fevers, abdominal pain and anorexia. The pain was not associated with nausea, vomiting, or diarrhea. The patient had no past medical history. He had immigrated from Peru ten years ago where his family sold sheep skins. He worked in construction, lived with family in San Francisco, and denied substance use. On examination, the temperature was 36.9C, the pulse 108, the blood pressure 100/68 mm Hg, the respiratory rate 22, and the oxygen saturation 96% on ambient air. He was diaphoretic but in no acute distress. Auscultation of the heart and lungs was normal. The abdominal exam revealed tenderness to palpation in the right lower quadrant with mild rebound. The remainder of the physical exam was unremarkable. The complete blood count, electrolytes, and tests of renal function were normal. Total bilirubin was 3.4 mg/dL and direct bilirubin 1.4 mg/dL. Alkaline phosphatase was 171 U/L; aminotransferase levels were normal . Computed tomography of the abdomen and pelvis revealed a dilated appendix with contrast enhancement and a liver cyst measuring 11x9x8 cm. The patient underwent appendectomy without complication. The patient was discharged on empiric albendazole. He returned the following week for Puncture, Aspiration, Injection, Reaspiration (PAIR). Under ultrasound guidance, turbid fluid was aspirated from the patients cyst. The procedure was complicated by transient hypoxemia and, later, hypotension with a systolic blood pressure of 60 mm Hg. The patient received intravenous epinephrine and was transferred to the intensive care unit. Microscopic examination of the fluid
aspirated from the liver cyst revealed scolices. Ethanol was instilled in the patients hepatic cyst for approximately one hour and later drained. The patient was discharged the following day in stable condition.

IMPLICATIONS/DISCUSSION: Echinococcus is a dog tapeworm that infects humans through contamination of eggs in canine feces. The parasite is found on all continents with highest prevalence in Eurasia, South America, Australia, north and east Africa. Two species with important public health implications are Echinococcus granulosa and Echinococcus multilocularis. The larvae released from Echinococcus eggs travel via the bloodstream to the liver, lungs, or other areas where they develop into hydatid cysts. Humans are often dead-end hosts for the organism. Larval growth in the liver results in the invasion of surrounding tissues. Up to 60% of all cystic echinococcosis cases are asymptomatic with a case fatality rate of around 2%. Farm laborers, especially sheep herders, have an increased risk of developing disease. Treatments include surgical resection of cysts, anti-helminth medical therapy, and/or PAIR, a newer- procedure developed as a response to the risk of anaphylaxis incurred with traditional surgical resection. This case highlights a important complication seen with definitive management of echinococcal cysts, one usually resulting from surgical resection. Anaphylaxis related to PAIR (less common than from surgical resection) is thought to result from a leakage of highly potent antigens from the cyst fluid and the occurrence of such complications depends upon many factors including experience. In further discussion with interventional radiology, only one prior PAIR procedure had been performed at this hospital in the recent past and the case happened to be the patients sister who was found to have a peritoneal echinoccocal cyst three years prior. References: McManus DP, Zhang W, Li J, Bartley PB. Echinococcosis. Lancet. 2003 Oct 18;362(9392):1295304.

UNEXPECTED ETIOLOGY OF HIP PAIN IN A YOUNG WOMAN Thomas Giever 1; Kurt Pfeifer2. 1Medical College of Wisconsin Affliliated Hospitals, Milwaukee, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7296)

LEARNING OBJECTIVES: 1. Identify those at risk for community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) pyomyositis and the associated mechanism of infection. 2. Identifying diagnostic and

treatment tools for pyomyositis.
CASE INFORMATION: A 31-year-old female with no past medical history presented with a 2-week history of right hip pain and a 3-day history of subjective fevers and chills. She was previously seen in the emergency department approximately one week prior for similar symptoms and sent home with a diagnosis of sciatica and plans for conservative management. At the time of presentation, she was unable to ambulate due to pain that was characterized as sharp with radiation down her posterior thigh and into her lateral foot. A CT was preformed and noted a large, multiloculated, rim-enhancing fluid collection with involvement of the right obturator internus, gluteus medius, and gluteus minimus. An MRI confirmed the CT findings in addition to showing abnormal signal within the posterior aspect of the acetabulum concerning for osteomyelitis. Blood cultures were consistently positive for CA-MRSA during the first 4 days of hospitalization. A surgical drainage was performed with CA-MRSA isolated from the abscess and acetabulum bone samples. Blood cultures remained negative following drainage and an

echocardiogram showed no signs of endocarditis. The patient was treated with vancomycin and discharged with six weeks of antibiotic therapy.
IMPLICATIONS/DISCUSSION: Pyomyositis is an infection of skeletal muscles that usually results in abscess formation. It is more common in tropical regions but has become more prevalent in temperate climates since the mid-1990 s. The usual pathogen for pyomyositis is Staphylococcus aureus with CA-MRSA becoming more dominant in recent years. Common sites of infection include the lower extremity (specifically the thigh), psoas, and the upper extremity. CA-MRSA pyomyositis is typically associated with immunosuppressed states, such as HIV and diabetes. Presenting symptoms often include localized muscular pain, edema, and low-grade fevers. Diagnosis is often delayed due to limited superficial and non-specific physical exam findings. Spread to bone can be through local extension or hematologic seeding. Treatment is a combination of surgical intervention and antibiotic therapy. In the case of CA-MRSA, effective antibiotics include vancomycin, linezolid, clindamycin, doxycycline, and trimethoprim-sulfamethoxazole, depending on site and extent of the infection.
RARE ETIOLOGY OF RENAL FAILURE IN A 35-YEAR-OLD FEMALE Thomas Giever 1; Kurt Pfeifer 2; Parameswaran Hari2. 1Medical College of Wisconsin Affliliated Hospitals, Milwaukee, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7299)
LEARNING OBJECTIVES: 1. Identify the diagnostic criteria for multiple myeloma. 2. Understand the staging system and available treatment options for symptomatic multiple myeloma.
CASE INFORMATION: A 35-year-old woman with Crohns disease presented with generalized malaise and nausea. Review of systems was also notable for intermittent chills and headaches for the past six months. Upon initial evaluation she had acute renal failure with a creatinine of 14.4 mg/dl (0.75 two months prior) and anemia with a hemoglobin of 7.3 g/dl (11.5 two months prior). Unexpectedly, a lytic bone lesion at the right inferior frontal skull was incidentally noted on a sinus CT. Further investigation included a bone survey without abnormalities and a nuclear medicine bone scan that did not show uptake at the skull but noted increased activity at L3, worrisome for malignancy. Serum and urine protein electrophoresis were remarkable for monoclonal bands of IgA kappa. Serum and urine immuno-fixation electrophoresis were notable for severely elevated free kappa light-chains and kappa:lambda chain ratio. A renal biopsy showed kappa light-chain cast nephropathy with associated acute tubular injury. A bone marrow biopsy had 59.6% plasma cells with amyloidosis and no cytogenetic abnormality. Multiple myeloma with bone marrow amyloidosis was diagnosed at international staging system (ISS) stage III and Durie-Salmon (DS) stage 2B. The patient was started on hemodialysis for renal failure and plasmaphoresis for significant light-chain burden. Chemotherapy was initiated with bortezomib, cyclophosphamide, and dexamethasone after which she achieved an almost complete response, including full recovery of renal function. Following treatment, the patient underwent an autologous stem cell transplant. IMPLICATIONS/DISCUSSION: Multiple myeloma is part of the plasma cell dyscrasias.

Approximately 75% of those affected are over the age of 70 with a mean age of 62 years. Fewer than two percent of those diagnosed are under the age of 40 years. Diagnostic criteria include greater than 10% plasma cells in the bone marrow,
monoclonal protein in the serum or urine, and evidence of organ damage (hypercalcemia, renal insufficiency, anemia, or bone lesions). The disease is classified as asymptomatic (smoldering) or symptomatic (active) myeloma. Symptomatic disease is staged by the ISS and DS systems based upon laboratory values and organ involvement. Currently treatment is only indicated for symptomatic disease and can be aggressive or conservative depending upon comorbidities. Responses to chemotherapy are high and treated patients have a median survival of 2440 months with a 5-year survival rate of approximately 25%. Stem cell transplantation offers the chance for substantial palliation but is often limited due to advanced age, comorbidities, previous chemotherapy, and high risk of transplant-related mortality.
THE DEADLY ABCs Katherine Harris 1; Loreen Herwaldt2. 1University of Iowa Hospitals and Clinics ; 2University of Iowa Hospitals and Clinics, Iowa City, Iowa. (Tracking ID # 7365)
LEARNING OBJECTIVES: 1. Identify individual risk factors for multidrug resistant Acinetobacter baumannii complex 2. Recognize the risk of nosocomial transmission of A. baumanniiCASE INFORMATION: A 48 year-old woman was transferred to the University of Iowa Hospitals and Clinics (UIHC) with four days of bacteremia and cellulitis that did not respond to intravenous antibiotic therapy. Prior to admission to the outside hospital, she had two days of fevers, chills, and extreme tenderness in her thighs and abdomen. She was hypotensive and had demarcated erythema, warmth and tenderness on her right upper thigh and across her lower abdomen. Initial blood cultures grew a Gram-negative rod in 15 hours and her blood cultures remained positive for five days despite treatment with piperacillin/tazobactam and vancomycin. The organism was Acinetobacter calcoaceticus-baumannii complex (also referred to as ABC) and susceptibilities revealed that the isolate was susceptible to colistin and intermediately susceptible to ampicillin/ sulbactam; it was resistant to all other antimicrobial agents tested. She was started on colistin and high dose ampicillin/sulbactam and her blood cultures cleared within nine hours and her cellulitis improved daily. Unfortunately, the patient died of hypotension secondary to a gastrointestinal bleeding five days after her blood cultures became negative.The patient had a past medical history of insulin-dependent diabetes mellitus, end-stage renal disease on hemodialysis, ischemic cardiomyopathy, peripheral vascular disease, hepatitis C, and cryoglobulinemia treated with 40 mg of prednisone daily. She was hospitalized two months prior to this admission for septic shock; her blood cultures were negative and she was treated with meropenem and vancomycin.
IMPLICATIONS/DISCUSSION: The infecting isolate was the first MDR-Acinetobacter isolated from a patient hospitalized at the UIHC. Our patient had many of the risk factors associated with MDR-A. baumannii infections including immunosuppression, central venous catheter, recent treatment with broad spectrum antimicrobial agents, recent stay in an intensive care unit, and recent prolonged hospital stay. Other risk factors include prior operation, trauma, burns, invasive procedures, parenteral nutrition, and indwelling catheters. Clinicians should base treatment on the infecting organisms susceptibilities. Carbapenems are often used to treat Acinetobacter infections and use of carbapenems can select resistant Acinetobacter isolates (3). Our patient was treated with meropenem shortly before she acquired the cellulitis and bloodstream infection. Bacteremia is a

common problem faced by internists. Persistent bacteremia in the setting of intravenous antimicrobial administration may indicate that the organism is a multidrug-resistant pathogen. Acinetobacter are Gram-negative bacilli that live in soil and water and can survive for months on clothing, bedding, and environmental surfaces, making nosocomial transmission difficult to control (1,2). A. baumannii has been recognized as a significant nosocomial pathogen since the 1970 s and has caused large outbreaks in hospital units, multiple

hospitals within a city, multiple cities in a country, and within several different countries (3). Numerous United States soldiers who have sustained war-related battle wounds in Afghanistan or Iraq have been infected with MDR A. baumannii, increasing the difficultly of treating these patients. (4) MDR-Acinetobacter causes bloodstream infections, ventilator-associated pneumonia, urinary tract infections, and wound infections. MDR-A. baumannii is now recognized as one of the most difficult healthcare-associated infections to control and treat (2).

AN UNUSUAL CAUSE OF VISION CHANGES IN A HEAD AND NECK CANCER PATIENT Tisha Marie Borromeo Suboc 1; Kurt Pfeifer2.

1Medical College of Wisconsin, wauwatosa, Wisconsin ; 2Medical college of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7382)

LEARNING OBJECTIVES: 1. 1.) Recognizing visual loss as symptom manifestedmultiple ocular diseases, physicians must remain alert for uncommon causes likeprimary intraocular lymphoma. 2. .2.) Knowing the most current treatments and identifying rituximab as anoption in treating rare disease such as primary intraocular lymphoma.

CASE INFORMATION: CASE: A 47-year-old gentleman with a history of T4N2cM0stage IV squamous cell carcinoma (SCC) of the oropharynx presented with visionchanges he described as looking through a fog. He completed chemotherapy(cisplatin) and radiation two months before the onset of these complaints, andassociated symptoms included severe right-sided headache. His symptomsprogressed over four months and evolved to seeing floaters as well asphotophobia. He was then referred to an ophthalmologist who found no signs ofradiation-induced retinopathy. Due to worsening symptoms, he was also evaluatedfor causes of vitritis, including syphilis, toxoplasmosis, Lyme disease andtuberculosis, and all results were negative. His vision continued to decline tothe extent that he was not able to see the numbers on a telephone and hadincreased floaters and impaired vision in dim lighting. Repeat neck CT showedno evidence of SCC recurrence. To evaluate for other possible infectious etiologies,he underwent a vitreous biopsy which revealed non-Hodgkin B-cell lymphoma.Staging for his new malignancy showed no evidence of cerebrospinal fluid (CSF)or bone marrow involvement. Positronemission tomography (PET) scan showed no hypermetabolic foci within the eyesor enlarged lymph nodes. He was started on high-dose methotrexate for localizedocular non-Hodgkin B-cell lymphoma. He received 6 cycles of methotrexate, but hisvision continued to worsen. He was then switched to rituximab, and after 4cycles, the patient reported marked vision improvement.

IMPLICATIONS/DISCUSSION: DISCUSSION: Vision changes in a cancer patient arealways worrisome for recurrence of malignancy or treatment-inducedcomplications. However, the differential diagnosis for visual disturbances isbroad, and clinicians must remain alert for uncommon causes of this commoncomplaint. Primary Intraocular lymphoma (PIOL) isa rare, aggressive, extranodal, non-Hodgkin, diffuse, large B-cell lymphomathat typically presents with visual

disturbances consistent with uveitis orvitritis. Diagnosis is challenging, since it is often mistaken for anintraocular infection and must be accomplished via cytologic examination of avitreous sample. It is also considered a subset of primary centralnervous system lymphoma and the majority of PIOL patients will present with ordevelop central nervous system involvement. Optimal treatment is controversial,but the effectiveness of methotrexate and ocular irradiation have been reportedin several case studies. More recently, rituximab has shown promise in thetreatment of PIOL. Despite these advances, PIOL still carries a poor prognosiswith a median survival of 12-20 months.

TRIPLE DIAGNOSIS Tisha Marie Borromeo Suboc 1; Kurt Pfeifer2.

1Medical College of Wisconsin, wauwatosa, Wisconsin ; 2medical college of wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7384)

LEARNING OBJECTIVES: 1. 1.) Recognizehemoptysis as a symptom that may be manifested by multiple diseasessimultaneously, hence initial differential diagnosis should be board to avoidinadequate treatment 2. 2.)

Identify andtreat fungal infections early in patients with malignancies to avoid increasedmortalityCASE INFORMATION: CASE:A 67-year-old gentleman with a history of a chronic, productive cough presentedwith 4 days of hemoptysis. Initially his sputum contained only a few specks ofblood and then progressed to being dark red. A chest radiograph showed a righthilar lung mass, and chest CT confirmed this in addition to revealing confluentbulky mediastinal lymphadenopathy. Since the patient had a 40 pack-year smokinghistory, small cell lung carcinoma was strongly suspected. Bronchoscopy was performed with bronchoalveolarlavage, transbronchial biopsies, and bronchial brushings. Final pathologyresults confirmed small cell lung cancer in addition to aspergillus present oncytology from both bronchial wash and aspirate of the right upper lobe. Upon evaluation of his cancer stage, a positron emission tomography(PET) scan showed ahypermetabolic region in the mediastinum consistent with small cell lungcarcinoma as well as a second hypermetabolic region in the right hypopharynx. Biopsyof the hypopharynx showed squamous cell carcinoma. The plan for treatment ofhis small cell lung cancer and squamous cell cancer was cisplatin and etoposidewith concurrent radiation. However, dueto the potential for rapid progression of invasive aspergillosis withchemotherapy-induced immunosuppression, the multidisciplinary team decided tostart the patient on voriconazole prior to initiation of concurrentchemotherapy and radiation. He is currently in his second cycle with cisplatinand etoposide and continues to do well. IMPLICATIONS/DISCUSSION: DISCUSSION: Hemoptysis is a symptom of multiple illnesses, including malignancy,infection and inflammatory diseases. Comorbidities often provide usefuldirection in determining the cause, but clinicians must still generate a broaddifferential diagnosis for hemoptysis to prevent delays in appropriate therapy.Invasive aspergillosis (IA) is acommon infection in patients with hematologic malignancy, particularly thosewith bone marrow transplantation and patients who have received extensivechemotherapy. The association of aspergillus infection with chronic lungdisease is also well known; however, its concurrence with solid tumors, such asbronchogenic carcinoma, is less established. One recent study of thisassociation found the prevalence of aspergillosis in patients with bronchogeniccarcinoma to be 40.6%. Methods for diagnosing aspergillus infection include PCR,ELISA and bronchoalveolar lavage cytology. PCR and ELISA have a sensitivityapproaching 100% but lower specificity for IA. Bronchoaveolar

lavage cytologyalone has a poor sensitivity but improved specificity for IArequiring treatment. The mortality rate of patients with lung cancer and IA nottreated with anti-fungals almost 100%. Thus, for patients presenting withdefinitive evidence of concurrent IA and malignancy, antifungal treatmentshould be started immediately, and potentially even prior to chemotherapy.

A UNIQUE CASE OF TMP-SMX INDUCED HYPERSENSITIVITY PRESENTING AS SYSTEMIC INFLAMMATORY RESPONSE SYNDROME Oluwakemi Y Fagbami 1; Puneet Bajaj 2; Antony Kaliyadan2. 1The Reading Hospital and Medical center, West Reading, Pennsylvania ; 2The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 7545)

LEARNING OBJECTIVES: 1. Diffuse erythematous rash accompanied by high grade fever and facial edema can be caused by infective, allergic or systemic etiologies. 2. Trimethoprim-sulfamethoxazole is an emerging cause of DRESS (drug rash with eosinophilia and systemic symptoms) syndrome and physicians need to have a high index of suspicion for optimal management and outcome.

CASE INFORMATION: A 34 year-old male presented with one day history of sudden onset of diffuse non-pruritic rash and facial swelling accompanied by high grade fever and lightheadedness. He had just completed a one week course of TMP-SMX for pilonidal abscess. Presenting vital signs included a heart rate of 121 beats per minute, respiratory rate of 22 breaths per minute and a fever of 38.9 degrees Celsius. Examination revealed a diffuse erythematous rash on the trunk and upper extremities as well as facial edema with no evidence of airway compromise. Laboratory values showed a normal white blood cell count with 5% band forms and serum creatinine of1.26 mg/dl. Clinical picture was highly suggestive of sepsis and treatment with IV fluids and antibiotics were initiated. Due to presence of diffuse rash and facial edema, other possibilities including a severe

drug hypersensitivity reaction were considered on the differential and he was concomitantly started on high dose intravenous steroids. His vital signs and laboratory parameters normalized and facial edema resolved rapidly within hours. The next day his antibiotics were discontinued and he was discharged home on a tapering dose of oral steroid. IMPLICATIONS/DISCUSSION: Drug hypersensitivity syndrome can present as a severe, acute, idiosyncratic drug reaction. It is defined by the presence of fever, cutaneous eruption, multi-organ failure and hematologic abnormalities including eosinophilia. Clinical manifestations typically occur within one to six weeks after the initiation of drug and do not resolve unless the offending agent is discontinued. Pathogenesis is unclear but may be due abnormal detoxification of arene oxide metabolite in anticonvulsant induced cases, reactivation of herpes virus (HHV-6) or T-cell mediated cytotoxicity. While rare, this syndrome is a possible complication of TMP-SMX use that physicians should be aware of. Early recognition, removal of the offending agent and in severe cases, high dose intravenous steroids are the mainstays of therapy. Physicians should be attuned to TMP-SMX drug hypersensitivity, a rare, but life-threatening complication that mimics SIRS but has a vastly different course of treatment.

A CASE OF GUILLAIN BARRE SYNDROME IN THE IMMEDIATE POST PARTUM PERIOD Lindsay Tawa 1; David Michael Elnicki2.

1University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania ;

2University of Pittsburgh School of Medicine, Wexford, Pennsylvania. (Tracking ID # 7646)

LEARNING OBJECTIVES: 1. To recognize the clinical presentation of Guillain Barre Syndrome (GBS) 2. To recognize that women in the immediate post partum period may be at increased risk for GBS CASE INFORMATION: A 27 year old female with a past medical history significant for bipolar disorder, migraine headaches, and hepatitis C presented with a 2 week history of progressive numbness and weakness in all 4 extremities. Her symptoms began as muscle cramps in her calves 2 weeks after an uncomplicated vaginal delivery of a healthy male infant. Over the next 4 days, her symptoms progressed to numbness, tingling, and weakness extending from her feet to mid thighs. Over the next week her symptoms worsened, and she noted the development of an increasingly wobbly gait. 2 days prior to presentation she developed numbness of her left forearm. She denied any current or recent upper respiratory or gastrointestinal symptoms including fever, chills, abdominal pain, nausea, vomiting, or diarrhea. She denied any loss of bowel or bladder function. Her initial presentation was at an outpatient neurology office where an MRI, EEG, and lumbar puncture were performed. MRI of the cervical and lumbar spine showed negative inflammatory changes. EEG showed decreased nerve conduction in the lower extremities. Lumbar puncture revealed a clear CSF, high protein, low WBCs, and an elevated IgG. The albuminocytologic dissociation (high protein and no cells) is classic for Guillain-Barre. On admission, she had normal facial strength and sensation. She had mild weakness of both triceps and biceps and a 4/5 hand grip strength. Her lower extremities had diffuse weakness that was worse proximally. Her patellar,achilles, biceps and triceps reflexes were absent bilaterally. Her gait was extremely wobbly. The diagnosis of GBS was made and she was started on IVIG 0.4 g/kg daily for 5 days. Forced vital capacities and neurologic checks were initiated every 8 hours with continuous cardiac monitoring. On the 4th day of IVIG treatment, her numbness had completely resolved. She was discharged after her 5th dose with mild lower extremity weakness and an unsteady but improved gait. IMPLICATIONS/DISCUSSION: GBS in the immediate post partum period has been rarely described in the literature. The reported incidence of GBS in the general population is 1.7/100,000, displays a 2:1 male predominance, and progressively increases with age. Peak rates occur above age 50, reaching 2.54/100,000 in females and3.86/100,000 in males. Because of this epidemiology, GBS is rarely expected in a woman of reproductive age. However, several nationwide cohort studies and epidemiologic reviews have shown significantly increased rates of GBS in the first 4 weeks post partum. Rates are reported at 4.62/100,000; 2.5-5 times the incidence in age matched females and 1.8 times the incidence in women over 50. The increased risk appears to be time dependent, with the highest incidence at 2 weeks post partum and then rapidly declining to baseline by 1 month. This pattern parallels that of other

autoimmune diseases, such as multiple sclerosis, myasthenia gravis, rheumatoid arthritis, and Graves disease which all have well documented post partum exacerbations. In pregnancy-associated immunosuppression, mechanisms that promote fetal rejection are suppressed and those that promote fetal acceptance are enhanced. Data suggest that cytokine regulation lies at the core of this immunologic shift. Specifically, there is a down regulation of Th1 (Il-12 and IFN-gamma) and an upregulation of Th2 (Il-10) andTh3 (transforming growth factor beta), resulting in an anti-inflammatory state. The reversal of this cytokine organization is reported to occur at 3 to 6 weeks post partum. This transition may overshoot physiologic baseline and produce a temporary proinflammatory state, leading to an increased risk for autoimmune activity. It is reasonable to hypothesize that the immunologic reconstitution in the peurperium increases the risk for GBS in women during the first 4 weeks post partum.

A CASE OF MEMORY LOSS AND PSYCHOSIS FROM HASHIMOTOS ENCEPHALOPATHY Jill Jin 1; Mary Anne Baquing 2; Andrea Cooperman1. 1UCLA-Olive View Medical Center, Sylmar, California ; 2UCLA David Geffen School of Medicine, Los Angeles, California. (Tracking ID # 7767)

LEARNING OBJECTIVES: 1. Recognize the clinical features of Hashimotos encephalopathy 2. Differentiate autoimmune encephalopathies from primary psychosis based on clinical picture and response to corticosteroid therapyCASE INFORMATION: A 49-year-old male with a history of hypothyroidism and a pituitary adenoma status-post-resection was brought into the Emergency Department by police after he was found sleeping outside in a gated community and oriented only to person. Patient had severe retrograde and anterograde amnesia and could not provide any additional history. He also complained of headache and persistent intrusive auditory hallucinations. Further history obtained from patients girlfriend revealed a traumatic brain injury one year ago following a motorcycle accident, from which patient had excellent overall recovery with minimal baseline neurocognitive deficits, and no prior psychiatric history. Clinically, patient was afebrile but mildly hypotensive and bradycardic, and physical exam showed only bitemporal hemianopsia and a left above-knee amputation. A CT scan of the brain revealed an empty sella but was otherwise unremarkable. Laboratory tests showed an elevated TSH of 19 as well as low free T4 and total T3 levels, with normal levels of other pituitary hormones. Lumbar puncture showed a slightly elevated protein, but normal cell counts and negative gram stain and cultures. Patient was started on levothyroxine, risperidone, and empiric acyclovir, with minimal improvement in memory and hallucinations. Further workup including brain MRI and PET scan as well as EEG also revealed no abnormalities. However, patients anti-thyroid peroxidase antibody titer was elevated at 138, and erythrocyte sedimentation rate and C-reactive protein were also slightly elevated. These findings raised the possibility of Hashimotos encephalopathy, a type of autoimmune encephalitis, as an etiology for the patients symptoms. Patient was given methylprenisolone 1 gram IV for 3 days, and showed marked improvement in orientation and memory with decreased auditory hallucinations after completion of the steroid course. Patient was discharged home on prednisone 60 mg daily with followup in neurology clinic.

IMPLICATIONS/DISCUSSION: Hashimotos encephalopathy is a rare disorder associated with autoimmune (Hashimotos) thyroiditis. Clinical presentation is varied with symptoms ranging from seizures and stroke-like episodes to cognitive and behavioral changes, memory loss, and psychosis. The pathophysiologic mechanisms responsible for Hashimotos encephalopathy remain unknown; however, treatment with corticosteroid therapy is highly effective and therefore misdiagnosis as a primary psychiatric disorder should be avoided. Other autoimmune encephalopathies with similar clinical presentations can result from auto-antibodies associated with paraneoplastic syndromes such as anti-N-methyl-D-aspartate (NMDA) receptor antibody or anti-voltage-gated potassium channel (VGKC) antibody. Obtaining appropriate serologic titers to diagnose these paraneoplastic autoim-

mune encephalopathies is expensive and time-consuming; therefore, in patients with a sufficient index of suspicion (i.e. those with known malignancy history), empiric therapy with high-dose steroids is warranted before diagnosing a primary psychiatric disorder. This case illustrates the importance of recognizing Hashimotos encephalopathy and other types of autoimmune encephalitis as part of ones differential diagnosis for patients presenting with altered mental status, atypical psychosis, or other focal neurologic impairments who have otherwise normal brain imaging and cerebrospinal fluid studies.

NOT JUST ANOTHER SEPSIS: WHEN KIKUCHI MET LUPUS Tracie Kurano 1; Sue Chung1. 1Olive View - UCLA, Sylmar, California. (Tracking ID # 7769)

LEARNING OBJECTIVES: 1. Recognize severe rheumatologic diseases in the differential diagnosis of sepsis 2. Diagnose Kikuchi Fujimoto DiseaseCASE INFORMATION: A 20 year-old, Hispanic Female, with no known past medical history, presented with two weeks of fevers, chills, night sweats, weight loss, myalgias, nausea, vomiting, epistaxis, generalized swelling, and arthralgias. Physical exam demonstrated fevers, pallor, diffuse nontender lymphadenopathy (submandibular, cervical, axillary, inguinal), and anasarca. Labs revealed pancytopenia (white blood cell count 1600/uL with 31% bandemia, hemoglobin 9.6 g/dL, platelet count 45,000/uL); DIC (D-dimer ELISA >18000 mg/mL with hypofibrinogenemia, and elevated PTT). Other notable labs: AST 1105 u/L, ALT 330 u/L, LDH 3494, ferritin >8000, sub-nephrotic range proteinuria with gross hematuria. Comprehensive bacterial, fungal, HIV and other viral infectious evaluations were unrevealing. CT of the chest/ abdomen/pelvis revealed diffuse lymphadenopathy. Bone marrow biopsy and excisional lymph node biopsy excluded lymphoma. Necrotizing lymphadenitis with histiocytosis, and apoptosis in the absence of neutrophils or macrophages was consistent with Kikuchi Fujimoto Disease. Her clinical status deteriorated with life-threatening consumptive coagulopathy requiring multiple transfusions of a variety of blood products. She developed new onset hypoxia, pleuritic chest pain, malar rash and worsening arthralgias. Echocardiogram and chest CT revealed new bilateral pleural and pericardial effusions without pulmonary embolus. Given the previous findings of proteinuria and hematuria, a rheumatologic evaluation for Systemic Lupus Erythematosus (SLE) was initiated. High titer ANA (1:1280) with decreased complement (C3, C4, and CH50) established six out of eleven American College of Rheumatology criteria for SLE. High dose IV Solumedrol was initiated. Lupus pneumonitis associated pleurisy and hypoxia rapidly reversed followed by normalization of DIC, renal, and liver laboratory abnormalities. Lymphadenopathy also improved. IMPLICATIONS/DISCUSSION: The initial differential diagnosis of this patient presenting with clinical sepsis and diffuse lymphadenopathy was hematologic malignancy and/or disseminated infection in a possibly immunocompromised host. This case demonstrates that severe systemic inflammation from rheumatologic diseases such as systemic lupus erythematosus (SLE) can be initially indistinguishable from sepsis or

malignancy. Kikuchi Fujimoto Disease (KFD) is a rare condition seen predominantly in Asian females characterized by fevers and lymphadenopathy. Extranodal systemic disease is uncommon in KFD; however, an association with SLE has been described. In this case, the co-presenting SLE explains the DIC, multi-organ failure, pancytopenia, pneumonitis, and renal injury initially interpreted as infectious sepsis. While it may be challenging to determine whether KFD and SLE are occurring separately or together, it is important to do so in terms of treatment and prognosis. KFD is generally a self-limiting condition with a good prognosis, typically requiring only symptomatic therapy, but is responsive to glucocorticoids in diffuse or severe cases. SLE, however, is a chronic disease with a variable prognosis and disease course, often requiring cytotoxic therapy. The challenge arises because the clinical presentations of KFD and SLE can overlap, or as illustrated in this case, co-exist. For this reason, the question of whether these two conditions are part of the same spectrum versus two distinct entities has been raised. Further study of KFD and SLE may provide a deeper understanding of the possible relationship between these two diseases.

SEPTIC PULMONARY EMBOLI ASSOCIATED WITH FACIAL ABSCESS Anthi Katsouli 1; D.Michael Elnicki2.

1UPMC Shady-side, Pittsburgh, Pennsylvania ; 2UPMC Shadyside, Wexford, Pennsylvania. (Tracking ID # 7803)
LEARNING OBJECTIVES: 1. Diagnose septic pulmonary emboli (SPE) in the absence of right-sided endocarditis or other intravascular disease is difficult. However, SPE arising from primary deep tissue infections, such as abscess has been increasingly described in patients. 2. SPE generally presents with an insidious onset of fever, respiratory symptoms, and lung infiltrates. In SPE, the embolic blood clot that leads to an infarction in the pulmonary vasculature contains microorganisms that incite a focal abscess.
CASE INFORMATION: A 46-year-old African American male with no significant past medical history presented with one month of progressive right facial swelling and one day of fever, chills, and night sweats. On physical exam, he had a large area of swelling on his right face extending from the zygoma to the angle of jaw as well as from the ear posteriorly to the nasolabial folds medially. The entire area was tender to light touch, erythematous. There was a 3 cm scab and obvious abscessed region draining a small amount of serosanguineous fluid. The patient was febrile to 39.2 with a white count of 19.7. The abscess culture grew Methicillin-Resistant Staphylococcus Aureus(MRSA). In addition, he had persistent MRSA bacteremia. The patient was started on 1 g vancomycin IV, and his symptoms improved rapidly and significantly. During the fourth day of hospitalization the patient developed shortness of breath and chest pain. Computed tomography (CT) of the chest demonstrated pulmonary consolidation and nodules at the right middle lobe and both lower lobe, consistent with septic pulmonary emboli. The patient also had an esophageal echocardiogram done, that did not show any vegetation but mobile strand, on the aortic valve, consistent with Lambls excrescence. In addition, clinical and radiographic evaluations for deep-vein thrombosis were negative. No history or stigmata of intravenous drug use, thrombophlebitis, or prior intravascular-catheter use were found.
IMPLICATIONS/DISCUSSION: This case illustrates a patient with septic pulmonary emboli and community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) bacteremia can be associated with abscess as a possible primary focus of infection. Septic pulmonary emboli are usually associated with right-sided endocarditis or other intravascular disease. However, for adults presenting with septic pulmonary emboli and CA-MRSA bacteremia,a search for deep tissue infections (such as abscess, osteomyelitis, septic arthritis, cellulitis, and, rarely, pyomyositis) beyond the more common intravascular sources may therefore be important. The pathogenesis of septic pulmonary emboli in our patient remains speculative. Deep tissue infection may be associated with local venous, and presumably septic, thrombophlebitis with septic pulmonary emboli that could not be detected using the imaging modalities available.
CARDIAC TAMPONADE SECONDARY TO COXSACKIE A PERICARDITIS Valentin Prieto Centurion 1; Elizabeth Retzer 1; Shana Ratner1. 1University of Chicago Medical Center, Dept of Internal Medicine, Chicago, Illinois. (Tracking ID # 7804)
LEARNING OBJECTIVES: 1. Diagnose cardiac tamponade with anatypical presentation 2. Recognize an atypical virus as theetiology of viral pericarditis.
CASE INFORMATION: A 43 year-old man with no significantpast medical history presented to the Emergency Department with rightupper quadrant abdominal pain with no clear etiology. Physical examof the abdomen was benign and initial laboratory studies wereunremarkable. A CT scan of the abdomen included the base of the lungsand showed a significant pericardial effusion and no intraabdominalab-normality. On further history the patient denied any chest pain,but admitted to markedly decreased exercise tolerance for threeweeks. A focused physical exam revealed muffled heart sounds,elevated JVP, but no pulsus paradoxus or leg edema. A transthoracicechocardiogram (TTE) showed compression of the RA and RV duringdiastole with hemodynamic compromise. The patient was takenemergently to the cath lab where a pericardial drain was placed and 1liter of hemorrhagic pericardial fluid was removed. A follow up TTEshowed near resolution of the pericardial effusion. Chemistries fromthe pericardial fluid was consistent with an exudate and microbiologyturned unrevealing. The drain output over the next 48 hours was 1.8 L. The autoimmune workup for the effusion was unremarkable.

Theinfectious workup was positive only for type 4 Coxsackie A IgM. Arepeat TTE showed again significant hemodynamic compromise due to thepericardial effusion with fibrinous strands now forming in the fluid.The patient was again taken to the cath lab, where loculations wereobserved in the fluid, which was again drained. Afterwards, the drainoutput was minimal and the patient was asymptomatic. Follow up TTEsduring the hospitalization and after discharge were consistent withconstrictive physiology. IMPLICATIONS/DISCUSSION: This case illustrates an unusualpresentation of cardiac tamponade secondary to a viral pericarditis.The patient was presumptively diagnosed with Coxsackie Apericarditis, given that the infectious, autoimmune,

metabolic andneoplastic work-up was otherwise negative. Coxsackie A, as opposed toCoxsackie B, has not been widely associated with pericardialeffusions. His only presenting symptoms was decreased exercisetolerance. The abdominal pain was thought to be related to passiveliver congestion, a self-limited condition or referred chest pain.Even though this patient did not have the classic physical findingsof tamponade, including pulsus paradoxus, the TTE showed significanthemodynamic compromise. Obtaining a TTE early after an effusion isidentified may speed definite therapy and prevent the patient fromdeveloping clinical signs of tamponade and decompensation.

FEELING YOUR WAY THROUGH THE DIAGNOSIS Marlowe Maylin1; Marlowe Maylin1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 7822)

LEARNING OBJECTIVES: 1. Understanding theneurologic and sensory examination. 2. Recognizing theappropriate testing involve when abnormal neurologic findings are present onphysical exam.

CASE INFORMATION: A 48 year- old man presentedwith two weeks of progressive ascending numbness and tingling of the rightleg. He first noticed the numbnessand tingling in his right foot and toes. The numbness continued to ascend to the level of the umbilicus. He also noted one episode of bladderincontinence and new onset constipation. He reported a more acute onset of sensitivity to light touch in the samelower extremity in the same distribution and difficulty ambulating. He denied recent fevers or viralprodromes.Vital signs were normal. The neurological evaluation revealedaltered sensation to light touch on his entire right lower extremity. Concurrent allodynia was noted in thesame distribution. Sensory levelwas identified at T10. He had1 + reflexes on the right lower extremity compared to 2+ on the left. A positive Babisnkis sign was alsoelicited on the right. Cranialnerves were noted to be intact bilaterally and no motor deficits were identified. Complete blood count, chemistry and lfts were within normal limits. HIV and Hepatitis Panel were negative and non reactive. ESR was 3 mm/hr and CRP was less than0.3 mg/dl. MRI of the T-spinerevealed a 2 cm segment of hyperintensity within the cord in the mid to upperthoracic region confined to the posterior columns. MRI of the brain and C-spine revealed multiple areas ofperiventricular white matter changes more prominent on T2 and flair sequencesand T2 hyperintensities scattered within the cervical spinal cord. Lumbar puncture was performed andrevealed elevated oligoclonal bands. The patient was started on IV steroids for a diagnosis of Multiple Sclerosisand his symptoms slowly improved. On further questioning, he reported evaluation in the ED one week priorfor the same symptoms and received and MRI of the L-spine with nofindings. IMPLICATIONS/DISCUSSION: Peripheral parasthesias areproblems commonly encountered by the internist. A thorough neurologic and sensory exam can help to delineatethe anatomical site and possibly the cause of the lesion. Sensory modalities examined includetouch, proprioception, vibration, temperature and pain. Limited sensory lossconfined to part of an extremity is usually indicative of peripheral or nerveroot injury where as that affecting an entire limb and extending to the trunkis indicative of spinal cord disease. In these cases a sensory level is typically defined. An extensive loss of vibratory senseand proprioception typically occurs with diseases of the dorsal columns of thespinal cord and with demyelinating neuropathies and sensoryneuronopathies. MRI is superior toCT in identifying spinal cord lesions. MRI of the entire spine should be performed always remembering that whena

sensory level is identified the lesion itself is at or above that level. If indicated and demyelinating diseasesuch as Multiple Sclerosis is a concern then MRI of the brain is alsorecommended as well as confirmation with CSF studies. Evaluating peripheralparasthesias can be perplexing to the examiner. Physicians should use the neurologic exam to identify apotential level at which spinal cord pathology is likely and further imagingand laboratory testing should include evaluation of the spinal cord at andabove that level.

MULTIPLE COMPLAINTS: ONE DIAGNOSIS Jennifer Meyer 1;

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LEARNING OBJECTIVES: 1. Review the manifestations of Multiple Myeloma bone marrow inflitration 2. Recognize back pain as a common clinical presentation ofMultiple Myeloma CASE INFORMATION: 52 year-old woman presented with 3 weeks of lower back pain, worse after falling out of bed 3 days prior to hospitalization. She was evaluated at a local ED directly after the fall where she was diagnosed with muscle strainand discharged home with narcotic pain medication. She denied bowel and bladderincontinence or radiation to her extremities. No changes in sensation or weakness of her extremities werereported. Review of systems wasnotable for fatigue and an unintentional 50 pound weight loss over the past 6 weeks. She had point-tenderness over the thoracic spine; her back pain was relieved somewhat by leaning forward. X-ray imaging was significant for a T-12 compression fracture as well asmultiple lytic lesions in her spine. Laboratory testing revealed a serum-calcium level of 15.0 mg/dl. Hertotal protein was elevated at9.4 g/dl with an albumin of only 3.1 g/dl. Creatinine was1.2 mg/dl. Hemoglobin was9.0 g/dl. Serum proteinelectrophoresis had elevated gamma globulin at 4.0 g/dL and M spike of 3.6 g/dl. Bone marrow biopsy of T-12 revealed plasma cell dyscrasia and kappa lightchain restriction, confirming a diagnosis of Multiple Myeloma. IMPLICATIONS/DISCUSSION: MultipleMyeloma is characterized by the neoplastic proliferation of a single clone ofplasma cells producing a monoclonal immunoglobulin. Most patients with this disease present with one or more-signs and symptoms related to proliferation of these cells in bone. A retrospective study of 1027sequential patients diagnosed with Multiple Myeloma at one institution reported that at presentation 58% had bone pain commonly located over the back or chest. Additionally, 73% ofpatients had anemia and 28% had hypercalcemia [1]. In a separate study, 30% of those diagnosed with Multiple Myeloma had a pathologic fracture on presentation [2]. Internistsare often the first to evaluate patients with the common chief complaint ofback pain. This may pose adiagnostic dilemma for the clinician trying to differentiate Multiple Myeloma from

benign diseases of the spine. In 1994, the Agency for Health Care Policy and Research defined a numberof red flags to be identified in the assessment of patients withacute lower back pain. Foremost, the median age at diagnosis is 66 years[1]. As such, Multiple Myelomashould be considered in those over the age of 50. Further, pain that is worse in the supine position, painthat is worse at night, pain not relieved by conventional methods, associatedconstitutional symptoms, and progressive neurological deficits in the lower extremities should warrant further investigation [3]. Physicians should be adept at recognizing back pain as a symptomof Multiple Myeloma, as delays in diagnosis have a deleterious effect on the disease course [1].

ONE GOOD TURN CAUSES ANOTHER Michelle Smith1;

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LEARNING OBJECTIVES: 1. Recognize theclinical presentation of an AIDS patient with dementia. 2. Identify the differentialdiagnosis of altered mental status in an AIDS patient.Learn thepresentation of Progressive Multifocal Leukencephalopathy secondary to JC virusinfection and PML-Immune Reconstitution Inflammatory Syndrome.

CASE INFORMATION: A 42 year-oldwoman with HIV presented two months of altered mental status. She had also hadincreased weakness and diarrhea for the previous two weeks. She noted no othersymptoms, including no headaches, fever or dyspnea. She had recently beenrestarted on HAART therapy as an outpatient two

months before presentation. Her vitalsigns were normal. She had a decreased mini-mental status score, as well as an inabilityto perform finger-toe nose and heel-to -shin maneuvers. The remainder of herexamination was otherwise normal. A spinal fluidanalysis revealed 200 lymphocytes, zero neutrophils, negative bacterialculture, negative viral profile, negative HSV PCR. The remaining laboratorystudies were normal. On the eighthday of hospital admission, she was found to have decreased strength in theright upper and right lower extremities. An MRI of the brain showed no evidenceof acute ischemia however, dilatation, signal irregularity, but did revealpersistent gadolinium enhancement around the right lateral ventricular frontal horn.Diffusion imaging revealed non-contiguous areas of abnormal diffusionconcerning for focal areas of cerebritis.
IMPLICATIONS/DISCUSSION: AIDS patientswith altered mental status are commonly encountered by the general internist.Progressive Multifocal Leukencephalopathy is caused by the human polyomavirusJCV and usually affects those with profound immunosuppression. PML within theAIDS patient population is a result of reactivation of the lytic infection inthe glial cells, and the resulting neurological effects are due todemyelination. Classic presenting symptoms correspond to the area ofdemyelination and include muscle weakness, sensory deficit, hemianopsia,cognitive dysfunction, aphasia, coordination and gait difficulties. With the useof HAART therapy PML can also present as PML-Immune Reconstitution InflammatorySyndrome. The increase in T-lymphocyte counts leads to an inflammatory responseto previously diagnosed or new PML lesions. This inflammatory reaction causesedema with a mass effect within the central nervous system, resulting in aworsening sensorium that may progress to brain herniation and death. Diagnosis of PML can be made by demonstrationof JCV via PCR or by immunoflourescent staining for viral DNA. Classic PMLpresents as multiple hypodense areas that do not correspond to vasculterritories. On MRI, PML appears in the subcortical white matter ashyperintense regions on T2 images and hypointense areas on T1 weighted images. However,the inflammation and breakdown of the blood-brain barrier in PML-IRIS may leadto contrast enhancing lesions. Detection of JCV by PCR of the CSF with PML-IRISmay be negative as the reconstituted immune system is able to control viralreplication. Biopsy of suspected PML-IRIS lesions shows high numbers of CD8+ lymphocytes. There is no anti-viral treatment directed at JC virus. Recentstudies have some benefit with the use of steroids for PML-IRIS, however theeffects of immune suppression on HIV replication in the AIDS patient has notbeen well established

WHEN THE BLIND CAN SEE CASE REPORT: CHARLES BONNET SYNDROME Anna Postolova 1 ; Va r s h a Somasekharan 2; Neda Hidarilak 1; Cortni Tyson 2; Chad Miller2.
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LEARNING OBJECTIVES: 1. Recognizethe clinical presentation of Charles Bonnet Syndrome. 2. Identify the differential diagnosis of visual hallucinations.Understandthe pathophysiology leading to a diagnosis of Charles Bonnet Syndrome. CASE INFORMATION: A 75 year oldwoman presented with a three week history of visual hallucinationsfomication. She reported seeinginsects, cars, and snakes in her house. She acknowledged that the hallucinations were inappropriate in thecontext of her surroundings. Shereported anxiety secondary to the hallucinations causing a lack of sleep forthe past three days. She had a blood pressure of 162/96. She appeared visiblyanxious. Pupils were non-reactive to light bilaterally, with lid lag in theleft eye and disjointed gaze. Neurologic exam was otherwise normal. Her past medical history was significant for hypertension, diabetes, congestive heart failure, atrial fibrillation and legal blindnesssecondary to glaucoma, cataracts, and eye infections. She had no history of psychiatric or neurologic disease butreported feeling depressed after her husbands death months ago. Her medicationsincluded amitriptyline, clonidine, and hydroxyzine. Visual hallucinations persisted despite withholding thesemedications and having several nights of sleep in the hospital. Urine toxicology wasnegative. Computed topography ofthe head showed senile atrophy with chronic ischemia without acuteabnormalities. Magnetic resonanceimaging and angiography revealed atrophy, diffuse ischemic leukoaraiosis, asmall, old left parietal parasagittal cortical infarct, and a 35 mm leftophthalmic artery aneurysm

without acute bleed. EEG did not show seizure activity. Psychiatric consultation suggested mild depression withoutcomplicated grief. The patient wasdiag-nosed with Charles Bonnet Syndrome as a diagnosis of exclusion.
IMPLICATIONS/DISCUSSION: Visualhallucinations in the elderly are commonly encountered by the generalinternist. The differentialdiagnosis includes dementia (Lewy Body or Parkinsons), delirium, psychiatricand neurologic disorders,

lack of sleep, and drug induced states. The patient denied symptoms ofdementia; this was verified by her daughter. Delirium was unlikely due to lack of confusion,disorientation, or changes in consciousness. Psychiatric consultation andimaging excluded psychiatric disorders and acute neurological deficits. Her hallucinations did not remit with-adequate sleep. Drug inducedstates in the elderly are caused by drug interactions and forgetfulness. Of the patients medications, amitriptylineand hydroxyzine can have anti-cholinergic side effects, leading to visual disturbances. Neurologic dysfunction has beenreported as an adverse effect of clonidine. Holding the medications for several days did not alleviatethe hallucinations. Negative urinetoxicology excluded overdose. Charles Bonnet syndromeincludes three characteristics: history of vision loss, distinctly formed, recurrent hallucinations, and insight into the unreal nature of thehallucinations. The reportedprevalence of this condition in the visually impaired ranges between10-38%. Hallucinations can varyfrom simple color patterns to complicated objects. The hallucinations are postulated to occur due to damage ofthe visual pathway secondary to optic surgery or nerve damage. In the absence of other causes,it is important to consider Charles Bonnet Syndrome in patients presenting withvisual hallucinations.
COUGH, DYSPNEA AND INTERSTITIAL LUNG DISEASE IN A20 YEAR-OLD SMOKER Anupama Tiwari 1; Thomas Gravelyn1.
1St Joseph Mercy Hospital, Ann Arbor, Michigan. (Tracking ID # 7848)
LEARNING OBJECTIVES: 1. Recognize the clinical presentation of Langerhans disease and the association with cigarette smoking. 2. NACASE INFORMATION: A 20-year-old female smoker with history of bulimia presented to the Emergency Department with a syncopal episode. A Computerized Tomography (CT) cervical spine was performed which incidentally revealed cavitatory pulmonary nodules in the lung apices. She reported a dry cough and mild shortness of breath. She denied chest pain, wheezing, hemoptysis, fevers, night sweats, and weight loss. Routine blood work was unremarkable. A high resolution CT chest was performed, which revealed numerous cysts in the apices and mid lung zones with relative sparing of the lung bases. Pulmonary function tests were normal. A bronchoscopy with transbronchial lung biopsies was performed. Tissue immunostaining for S-100 protein and CD-1 antigen confirmed the diagnosis of Pulmonary Langerhans cell histiocytosis (PLCH).
IMPLICATIONS/DISCUSSION: Pulmonary Langerhans cell histiocytosis (PLCH) is a rare disorder of unknown etiology that occurs predominantly in young smokers, with an incidence peak at 2040 years of age. Exact incidence and prevalence of PLCH is unknown, the diagnosis is made in approximately 2 to 5% of lung biopsy specimens from patients with interstitial lung disease. It usually occurs as a single-system disease and is characterized by focal Langerhans cell granulomas infiltrating and destroying distal bronchioles. PLCH is pleomorphic in its presentation, symptoms can be minor or absent and patients often initially attribute their symptoms to smoking. The clinical course of the disease is unpredictable. A large percentage of patients experience stable, persistent disease but many have a progressive course. Treatment consists of smoking cessation. Corticosteroid therapy may be useful in selected patients. Use of chemotherapeutic agents remains experimental. Lung transplantation may be considered in the case of unresponsive disease; however the disease may relapse in the transplanted lung. Patients with LCH require long term follow up to detect potential

disease progression and relapse. While PLCH remains a rare disease, its prevalence may be greater than previously recognized. Clinicians should be aware of this disease in the differential diagnosis of interstitial lung disease, especially in patients who have exposure to cigarette smoke.

PULMONARY SPOROTRICHOSIS MASQUERADING AS NON-HODGKINS LYMPHOMA Anupama Tiwari 1; Anurag Malani1.

1St Joseph Mercy Hospital, Ann Arbor, Michigan. (Tracking ID # 7849)

LEARNING OBJECTIVES: 1. Reduction of poor outcomes through recognition and early diagnosis of the atypical and classic clinical features of pulmonary sporotrichosis. 2. NA CASE INFORMATION: A 61-year-old female, non-smoker was noted to have small nodular opacities in right lung on a routine chest roentgenogram (CXR). Subsequently, a chest computerized tomography (CT) revealed multiple nodules with primarily upper zone involvement. She denied hemoptysis, fevers, chills, cough, chest pain, dyspnea, malaise or weight loss. Routine bloodwork including a complete blood count, complete metabolic panel and tuberculin skin test were unremarkable. A chest CT scan performed 6 months later, showed increased size and number of the previously visualized pulmonary nodules. She continued to be asymptomatic. Five months later, a bronchoscopy with transbronchial biopsies was performed and histopathology revealed an atypical lymphoid infiltrate suspicious for low-grade non-Hodgkins lymphoma. A positron emission tomography (PET)-CT performed one week later, showed increased multi-focal abnormalities in the right lung, with cavitations in some of the nodules, and significant progression of variable ill-defined nodular opacities in the middle lobe compared to the initial study. A right upper lobe video assisted thorascopic wedge biopsy was performed. Histopathology showed necrotizing granulomatous inflammation, special stains for acid-fast bacilli and fungi were negative. Two weeks after the biopsy, fungal bronchial washings, grew Sporothrix schenkii. Additionally, B cell clonality studies by PCR were negative, thus not supporting a diagnosis of lymphoma. The patient was started on Itraconazole and had significant improvement. IMPLICATIONS/DISCUSSION: Pulmonary infection with Sporothrix schenkii is uncommon; when present it is usually secondary to inhalation or aspiration of conidia in susceptible individuals. Fewer than 100 cases of primary pulmonary sporotrichosis have been reported in the literature. Cases predominantly occur in middle aged, alcoholic males, and those with underlying lung disease. The outcome of pulmonary sporotrichosis is usually poor, often because of delay in diagnosis and severe underlying pulmonary disease. With treatment, prognosis is excellent. While pulmonary sporotrichosis remains a rare infection, its prevalence may be greater than previously recognized. Clinicians should be aware of this

infection in the differential diagnosis of pulmonary granulomatous diseases, especially in hosts who have relevant environmental exposure to the fungus.

OVARIAN METASTASES TO THE MITRAL VALVE PRESENTING AS RECURRENT EMBOLIC STROKES Anne S Kemble 1;

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LEARNING OBJECTIVES: 1. Recognize metastases to the mitral valve as a potential cause of embolic stroke. 2. Identify ovarian cancer as a source of metastases to cardiac valves.

CASE INFORMATION: A 77 year-old woman with history of hypertension and dyslipidemia presented with left foot drop and right hand weakness. She was found to have decreased left leg strength and unsteady gait, with a regular rate and no murmurs on cardiac auscultation. MRI of the brain revealed acute bilateral showers of emboli to the cerebellum and cerebrum, as well as evidence of a prior embolic stroke in the right occipital lobe, without vascular abnormalities. Subsequent transesophageal echocardiogram identified an 8 mm mobile mass on the atrial side of the anterior mitral valve leaflet, with no evidence of a shunt. The patient remained afebrile

throughout admission, with negative blood cultures. She was discharged with empiric antibiotic and anticoagulation therapy, with plans for serial echocardio-graphic monitoring. Two months later, the patient was readmitted with diarrhea, weight loss, and abdominal pain. On physical exam, an enlarged uterus and pelvic mass were discovered. CT of the abdomen and pelvis showed an 11 12 cm uterine mass, a 2.53.3 cm right adnexal mass, and several small liver lesions. Based on suspicion that the recurrent embolic strokes originated from the valvular mass, a lower mini sternotomy was performed prior to gynecological surgery. Debridement of the mitral valve anterior leaflet identified the mass to be a metastatic papillary adenocarcinoma, immunopositive for cytokeratin-7 and pax-8, with a CA-125 of 935, consistent with an ovarian clear cell adenocarcinoma primary. The patients postoperative course was complicated by acute renal failure and status epilepticus. After prolonged intubation, she underwent tracheostomy and gastrostomy tube placement. The patient demonstrated dramatic improvement in neurologic status after rehabilitation. She was referred to a gynecologic oncology specialist for further management of her stage IV ovarian carcinoma.
IMPLICATIONS/DISCUSSION: Despite increasing recognition of metastatic tumors in the heart, metastases to cardiac valves are rarely encountered, and their risk of embolization is unknown. This case documents the diagnosis of ovarian carcinoma with metastatic spread to the mitral valve that initially presented as embolic strokes. Although metastatic valvular tumors are rare, recognition is important. As presented in this case, these masses can have devastating clinical sequelae, and surgical removal may be required to prevent embolic complications.
HENOCH-SCHNLEIN PURPURA ASSOCIATED WITH IGA PLASMA CELL DYSCRASIAS Sumana Devata 1; Parameswaran Hari 1; Kurt Pfeifer1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7854)
LEARNING OBJECTIVES: 1. Recognize that Henoch-Schnlein purpura in an adult can be a paraneoplastic manifestation. 2. Review the current hypotheses that may cause IgA plasma cell dyscrasias to present as Henoch- Schnlein purpura.
CASE INFORMATION: A 52-year-old healthy man presented for workup of a monoclonal gammopathy discovered during evaluation for recurrent arthralgias and rash. The rash was described as variably sized, diffusely distributed, raised purpuric lesions. Initial symptoms began at the age of 46, 12 months after a severe episode of gastroenteritis during which he had myalgias, fevers, nausea, emesis and bloody diarrhea. These symptoms spontaneously resolved; however, the patient subsequently developed the rash, swelling of his legs, and bilateral wrist and ankle pain. Further evaluation of symptoms and biopsy of the purpuric lesions revealed a leukocytoclastic vasculitis with deposition of IgA and C3 in the dermal papillary blood vessels. Treatment with prednisone provided improvement of symptoms, but steroids were unsuccessfully tapered even with the addition of immunosuppressive agents, including azathioprine and methotrexate. He continued through multiple treatments for a working diagnosis of HSP. Incidentally, he was noted to have a monoclonal IgA protein on serum electophoresis. Cryoglobulins, hepatitis B and hepatitis C serologies were negative. Bone marrow aspirate and biopsy showed highly dysplastic plasma cells at 10.2%. IgA M protein subtype was entirely from subclass 1. The patient was diagnosed with IgA1-mediated Henoch-Schnlein purpura secondary to an IgA plasma cell dyscrasia classified as smoldering multiple myeloma. Subsequent treatment for neoplastic plasma cell disorder with lenalidomide and dexamethasone for 4 cycles followed by autologous peripheral blood stem cell transplant resulted in complete remission of IgA paraprotein and complete resolution of arthralgias and purpura. IMPLICATIONS/DISCUSSION: Henoch-Schnlein purpura (HSP) is described as an immune-mediated, small vessel vasculitis associated with immunoglobulin A (IgA) deposition within the walls of involved vessels. HSP is a form of systemic vasculitis common in children with a majority of cases occurring between the ages of 315. HSP is much less common in adults, and in such cases is usually secondary to an underlying infectious, inflammatory or neoplastic cause. Typical presenting symptoms include purpura, joint pain, abdominal pain and renal disease, and characteristic pathology shows leukocytoclastic vasculitis and IgA immune complexes in

affected organs. Interestingly, HSP is rarely seen in monoclonal IgA plasma cell dyscrasias as a paraneoplastic manifestation. IgA multiple myeloma, specifically IgA1 subtype, has been associated with HSP in a handful of cases. It is hypothesized that decreased sialylation of the hinge region of the IgA molecule may provoke aggregation, deposition and complement activation leading to deposition in organs leading to the development of HSP. Ongoing research suggests that with continued studies, new therapeutic targets may lead to specific biomarkers for disease-specific therapies. In an adult presenting with HSP, IgA multiple myeloma should be suspected.

JGIM

ABSTRACT

AN UNEXPECTED PRESENTATION OF BREAST CANCER Sumana Devata 1; Yee Chung Cheng 1; Kurt Pfeifer1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 7856)

LEARNING OBJECTIVES: 1. Recognize both the common and rare causes of spontaneous tumor lysis syndrome. 2. Identify the metabolic derangements associated with tumor lysis syndrome.

CASE INFORMATION: A 58-year-old woman presented to oncology clinic for workup of a monoclonal gammopathy found during investigation of anemia. She also complained of a 20-pound weight loss, increasing fatigue and lightheadedness. She had refused health-screening evaluations in the past, and her last colonoscopy, pap smear and mammogram were 8 10 years prior to evaluation. Examination revealed right submandibular, left anterior cervical and left axillary lymph-adenopathy. Neurological exam was notable for right facial droop and right ptosis. Breast examination revealed a large, firm area on the left upper outer quadrant with skin retraction, dimpling and mild erythema. Laboratory studies revealed hyperkalemia, hyperphosphatemia, hyperuricemia and elevated lactate dehydrogenase. CT of the neck, chest, abdomen and pelvis showed an irregular, speculated left breast mass with foci of hypoattenuation and extensive adjacent left axillary lymphadenopathy. Also detected were multiple neck lymph nodes, splenomegaly, a 5 mm right posterior lung nodule and a 17 mm spherical focus of hypoattenuation in the posterior liver. A pathologic, subacute fracture of the left posterior 5th rib and multiple lytic lesions in the bones were also reported. Her laboratory abnormalities improved with hydration and allopurinol, and bone marrow aspiration and biopsy revealed a bone marrow replaced with metastatic carcinoma consistent with primary breast cancer. Left breast biopsy demonstrated an invasive ductal carcinoma, and brain MRI showed diffuse skeletal metastatic disease and diffuse supratentorial meningeal metastatic disease with focal parenchymal invasion. The patient underwent whole brain, scalp block and sacral radiation therapy. She was started on palliative chemotherapy with paclitaxel, bevacizumab for four cycles with good disease response.

IMPLICATIONS/DISCUSSION: Acute tumor lysis syndrome is a metabolic derangement associated with hyperkalemia, hyperuricemia, hyperphosphatemia, hypocalcaemia and occasionally metabolic acidosis. Spontaneous development of this syndrome is most often seen with bulky hematologic malignancies, such as acute leukemia and lymphoma. Acute tumor lysis syndrome is less frequently seen with initial diagnosis of solid tumors but is well described after initiation of chemotherapy for these cancers. The patient described presented with metastatic, stage IV, invasive ductal carcinoma and metabolic abnormalities consistent with acute tumor lysis syndrome. Acute tumor lysis syndrome generally occurs in malignancies with a large tumor burden, rapid proliferation rate, or after induction of chemotherapy or radiation therapy. This causes lysis of tumor cells leading to increased amounts of cellular contents entering the blood stream. A Medline review of tumor lysis syndrome in solid tumors revealed only one prior case of spontaneous acute tumor lysis syndrome with breast cancer. In this report, spontaneous tumor lysis syndrome occurred prior to therapy in a woman with metastatic inflammatory breast cancer and it was suggested that the inflammatory breast carcinoma had a high growth fraction when compared to other breast cancers and accounted for spontaneous tumor lysis. Although spontaneous tumor lysis syndrome is uncommon in breast and other solid organ malignancies prior to

treatment, our case demonstrates that it can occur and should therefore be considered during the evaluation of patients with solid tumors and metabolic derangements.

COUGH AND FEVER IN A 28 YEAR-OLD IV DRUG USER Monique Carreno 1; Curtis K Andrews1. 1Baystate Medical Center, Springfield, Massachusetts. (Tracking ID # 7884)

LEARNING OBJECTIVES: 1. Recognize that endocarditis may present without classic signs and symptoms. 2. Increase awareness of beta-lactam resistance among enterobacteriaceae species.

CASE INFORMATION: 28 year old male IV drug user presented to ER for evaluation of 3 days of body aches, sweats, nausea and vomiting with a week of productive cough and left-sided posterior pleuritic chest pain. He admitted to daily use of 300 mg of oxycodone and 2030 bags of heroin intranasally and IV. Last use was four days prior to admission. PE: Vitals: T-100.7, P-95, RR-18, BP-98/64, O2 95% on RA. He appeared thin and pale, was diaphoretic with piloerection. RESP: no tachypnea, notable consolidative findings in the left lower lobe. CV: tachycardic, no murmur, normal pulses. Skin: track marks on the forearms bilaterally, no signs of infection. Laboratory and imaging: WBC 13,000, Hgb 11.5%, normal platelets. Electrolytes, BUN, Cr normal. Urine tox screen positive for opiates. CXR showed left lower lobe opacification consistent with pneumonia. He was started on azithromycin and ceftriaxone for community acquired pneumonia, as well as extended release morphine for active opiate withdrawal and back pain. He showed improvement in cough and dyspnea. On hospital day 5 he spiked fever of 101, had worse dyspnea and WBC of 16,000. Chest x-ray showed a right upper lobe lucency and a persistent lower lobe opacification. Ceftriaxone was stopped and vancomycin was started for possible MRSA pneumonia. A follow-up CT chest showed multiple cavitary lesions throughout bilateral lung fields, and PPD and HIV Ab were both negative. CT-guided aspiration of a left lower lobe lesion grew Enterobacter cloacae. Antibiotics were subsequently changed to meropenem based on culture sensitivities. Repeat exam on day 8 revealed systolic murmur and echocardiogram confirmed tricuspid regurgitation and an 8 mm mobile vegetation of the tricuspid valve. He had resolution of fevers on day 16, and hospital discharge on day 22 in good condition. He was discharged on oral levofloxacin due to active IV drug use. IMPLICATIONS/DISCUSSION: Enterobacter endocarditis, although not a common cause of endocarditis, has been described previously in the literature. It most commonly occurs in the setting of prosthetic heart valves, though it has also been described in IV drug users. This case demonstrates several key points related to the diagnosis of endocarditis, as well as characteristics of Enterobacter as a pathogen. Acute endocarditis is classically found in the IV drug user and is manifested by predictable signs and symptoms including fever, heart murmur, vascular and embolic phenomenon as well as positive

blood cultures as detailed in the modified Duke Criteria. Our patient presented with fever and pulmonary findings consistent with pneumonia. He did not have a murmur early in his course, and the absence of vascular or embolic phenomena was verified several times. Follow-up imaging studies with findings consistent with septic pulmonary emboli prompted an echocardiogram that verified a tricuspid valve vegetation consistent with acute endocarditis. This case demonstrates the need for a high index of suspicion for endocarditis when the history suggests the diagnosis despite a lack of classic physical examination findings. Our case further demonstrates the phenomenon of beta-lactamase production by enterobacteriaceae. Our patient was started on ceftriaxone on admission for presumed pneumonia. He defervesed after several days, but became febrile and clinically deteriorated on day 5. We presumed that beta-lactamase production led to clinical worsening. It has been well described that the enterobacteriaceae produce several different forms of beta-lactamase, and that ceftriaxone in particular is known to be susceptible to these compounds. It has been recommended to avoid third generation cephalosporins in known Enterobacter infections due to resistance patterns.

MY HEAD HURTS WHENEVER I URINATE Fawad Aslam 1;
Muhammad Qayyum2. 1Baylor College of Medicine, Houston, Texas ; 2Sheikh Zayed Hospital, Lahore, N/A. (Tracking ID # 7908)

LEARNING OBJECTIVES: 1. Recognize that headaches and palpitations with urination are a classic feature of urinary bladder paragangliomas. 2. Manage a patient with urinary bladder paragangliomas.
CASE INFORMATION: A 40 year-old-gentleman with no past medical history presented to our clinic with about five years history of severe headaches, dizziness and palpitations while urinating. These symptoms would always occur during urination, although not on a daily basis. His symptoms had led him to decrease his water intake. He denied any other triggering event. He also denied any hematuria, diarrhea, facial flushing, itching or history of hypertension. His family history was unremarkable. On physical examination his vital signs were all within normal limits including a blood pressure of 130/ 90 mmHg. Rest of the systemic exam was also unremarkable. A blood pressure reading during one of his episodes was recorded at 200/110 mmHg. Routine investigations were normal. An ultrasound showed a lobulated mass (35 X 27 mm) along the left anterolateral wall of the urinary bladder exhibiting vascularity.Computed tomography (CT) scan revealed a lobulated enhancing mass measuring 2721 mm in the left inferolateral wall of the urinary bladder with prominent feeding vessels. At this point, a paraganglioma of the urinary bladder was suspected. 24-hours Urine Vanilyl Mandelic Acid (VMA) level and an I-131-MIBG wholebody scan were inconclusive. Cystoscopy revealed a small pedunculated mass six centimeters below the trigone on the anterior wall. He was started on prazosin and propranolol and then underwent a transurethral resection of the bladdertumor (TURBT). Histo-pathology demonstrated focal Zellbellan pattern and chromogranin immunoreactive cytoplasmic granules; confirming a paraganglioma.
IMPLICATIONS/DISCUSSION: Symptoms of catecholamine-hyper-secretion during micturition is a classical finding associated withurinary bladder paragangliomas. These neoplasms account for less than 0.06% of all bladder tumors, and less than1% of all paragangliomas. These patients suffer and may remain undiagnosed foryears. This case serves to highlight awareness about this very rare butotherwise easily diagnosed and treated condition.Paragangliaare neural crest cell derivatives that extend along the paravertebral axis fromthe neck to the pelvis. Adrenal chromafin tumors are referred to as pheochromocytomaswhile all extra-adrenal forms are called paragangliomas. Signs and symptoms ofcatecholamine excess include episodic hypertension (64%), headache (26%),sweating (25%), and palpitations (21%).6 The pathogonomonic triad ofhypertension, intermittent hematuria and symptom onset with micturition manifestsin only 50% of cases. Symptoms occur from many times daily to monthly with eachspell usually lasting about 20 minutes. Measurement of 24 hours urinarymetanephrines is the screening test of choice with a sensitivity of 87-90% anda specificity of 99%. VMA levels are less accurate. The relative superiority ofa CT versus MRI has not been established for localization. Functional imaginglike I-131 or position emission tomography is indicated if the lesion isobscure or suspicious for metastasis. Transurethral resection, partial or totalcystectomy is the treatment of choice. Annual follow-up with metanephrines iswarranted for there is a 19-50% risk of malignancy. First degree relatives needscreening since about 25% of paragangliomas are hereditary.
A HEARTBREAKING INFECTION Muneeb Mohammad 1;
Junaid Bhutto1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 7987)
LEARNING OBJECTIVES: 1. Recognize the clinical presentation of infective endocarditis. 2. Identify factorsdetermining clinical outcome, particularly ESRD.Understand the diagnostic utility of new onset murmur.
CASE INFORMATION: A 29 year-old man presented with three days of worsening fevers, chills,and diaphoresis after a dialysis session. He also reported generalized malaise,decreased appetite, nausea, and vomiting. He had had eight dialysis cathetersplaced and replaced in the past. The patient had no history of drug use. He was tachycardic and diaphoretic. A new III/VI murmur was auscultatedover the aortic area, in association with a left ventricular heave. His lungswere clear bilaterally. He had a dialysiscatheter in his left femoral region without surrounding erythema or tenderness.No drainage was noted. There were no splinter hemorrhages or peripheral skinlesion. An EKG demonstrated sinus tachycardia, and a chest x-ray was normal.Electrolytes and hematological studies were normal. An echocardiogram revealedsevere aortic regurgitation and a large aortic

root abscess, with flow throughboth the aortic valve and abscess cavity. The patient was started onantibiotics and prepped for surgical intervention. Unfortunately, he did notsurvive the procedure. Post-mortem, blood and abscess cultures were positivefor MRSA and Enterococcus faecalis.
IMPLICATIONS/DISCUSSION: A new onset heart murmur can be a diagnostic clue for the internist, anddictates further diagnostic evaluation. In our patient, the history of multi-

pledialysis catheters put him at risk for bacteremia, and subsequent endocarditis.His clinical presentation satisfied two major and two minor Dukes criteria fordiagnosis, specifically positive blood cultures and echocardiographic findings (as major), and fever and predisposing factor (as minor). Patients on hemodialysis have a high rate of infective endocarditis thanthe healthy individual. Various organisms can play a role, but S. aureus isseen as the most common culprit. The mortality in hemodialysis patients withendocarditis is high, especially with MRSA Group E + organisms. If the patientalso has an abscess from the endocarditis, the mortality increases sharply,because (and despite) the vascular surgery that must be pursued. The outcomewithout surgery is unacceptably higher. Risk factors for more serious diseaseinclude anatomic location (left vs. right), prosthetic vs. native valve, age,and associated comorbidities.Different methods have been used to prevent dialysis cathetersinfections. Antibiotic locks have been shown to decrease blood stream infectionbut increase bacterial resistance. This can up the ante in terms of diseaselethality. Therefore, the internist has to be vigilant in ensuring that athorough workup is done before endocarditis is excluded from the differential.With a high suspicion, a transthoracic echocardiogram should be followed upwith a transesophageal echocardiogram, even in the absence of positive blood-cultures. In acutely ill patients with endocarditis on transthoracicechocardiogram, a transesophageal echocardiogram may be done to evaluate forabscesses. Such measure can often be the difference between life and death inthe vulnerable hemodialysis population.
DGCI Muneeb Mohammad 1; Megan Stock 1; William Rothwell1. 1Tulane University, New Orleans, Louisiana.
(Tracking ID # 7988)
LEARNING OBJECTIVES: 1. Recognize the clinicalpresentation of disseminated N. gonorrhoeae. 2. Identify the risk factors for disseminated disease.Outline treatment options and therapeutic measures.
CASE INFORMATION: A 25 year-old woman presented with scattered pustularlesions over her body for three days, accompanied by high fevers. These lesions started on her arms andthe dorsum of her hands, later spreading to her legs and face. The area surrounding the lesions wastender, erythematous, and edematous. The lesions grew to about two centimeters in size before rupturing. The patient had no history of STDs andwas sexually active with only one partner. The patient was initially thought to have folliculitis, butshe later complained of right knee and elbow arthritis. A pelvic exam was subsequentlyperformed with cervical and blood cultures coming back positive for Neisseria gonorrhoeae. IMPLICATIONS/DISCUSSION: New rashes are a commonly-encountered complaint for theinternist. It is important to noteassociated signs and symptoms along with a careful history to help delineate adifferential. In our patient, herpolyarticular joint pain and fever certainly brought disseminated gonococcalinfection (DGCI) to the forefront. Occurring in only0.5 to 3% of gonorrhea cases, DGCI can easily bemissed as a cause of pustular rash or arthritis. It is important to remember that a careful history may benon-revealing for high-risk behavior. Risk factors for DGCI and urogenital gonorrhea includefemale gender, pregnancy, menses, and terminal component complementdeficiencies since submucosal vessels in the endometrium are more exposed tothe organism. Classic-manifestations include asymmetric migratory arthritis, tenosynovitis, anddermatitis (both pustular and macular). Rarely, endocarditis, perihepatitis, meningitis, or osteomyelitis canal-so develop. Sites for skinchanges typically involve the hands, knees, and ankles. It is vital for the clinician to befamiliar with the expression of the disease, as blood cultures are typically-negative, and other diagnostic tests may also be non-revealing. Current CDC guidelines suggest treatment with

Ceftriaxone1g IM or IV q24h and should be given for 24-48 h after clinicalimprovement. After discontinuationof IM or IV therapy, Cefixime 400 mg PO BID is recommended for seven days. Allpartners should be treated, and patients should be screened for co-infectionwith other STDs, including Chlamydia, Treponemal disease, and HIV. Of note, it is also important torealize the psychological impact the diagnosis may have on the patient andhis/her relationship with partners. With rashes being a very common complaint encountered inprimary care, it is important for the internist to be familiar with not onlythe usual pathogens (e.g. MRSA), but also infrequent causes.

ADULT EPIGLOTTITS John Moscona 1; John Moscona1.

1Tulane University, New Orleans, Louisiana. (Tracking ID # 8008)

LEARNING OBJECTIVES: 1. Recognizethe clinical presentation of adult epiglottitis. 2. Identifythe differential diagnosis of acute upper airway obstruction. 3. Understandthe management of adult epiglottitis.

CASE INFORMATION: A 70 year-old man presentedwith twelve hours of sore throat, cough, and increasing respiratory distress.On exam, he was tachycardic and tachypneic with a fever of 101.5F[gem1] .His breathing was labored and stridorous.[gem2] He had no angioedema. His oropharynx was erythematous without exudate. Hisanterior neck was tender. Breath sounds were decreased in all lungs fields withno wheezing or crackles. The patient was intubated and placed on mechanicalventilation in the intensive care unit. Intubation was difficult due to edemaof the oropharynx and epiglottitis. Blood cultures were drawn. Empiricantibiotic therapy with ceftriaxone and clindamycin was begun. Aneck CT revealed extensive edema of the pharyngeal soft tissues from thenasopharynx to the true vocal cords including the epiglottis. Blood cultureswere positive for Beta-lactamase negative HaemophilusInfluenzae[gem3] one day after admission. He was treated for acuteHaemophilus Influenzae epiglottis with ceftriaxone and dexamethasone. Threedays after admission, repeat neck CT displayed moderate improvement of thepharyngeal edema. The patient was extubated on his fifth day of hospitalization-without[gem4] complication. His clinical condition quickly improved, and he was dischargedwith oral amoxicillin-clavulanate antibiotic therapy. Theblood sample received by the Louisiana central laboratory was positive for Haemophilus Influenza type B.

IMPLICATIONS/DISCUSSION: Epiglottitis describes acute inflammationof the epiglottis and surrounding structures. The incidence of childhood epiglottitis has decreased due tothe Haemophilus Influenzae type B vaccine, yet the incidence

ofepiglottitis in adults is about 2.5 times greater.This is the first reported case of HaemophilusInfluenzae type B epiglottitis in Louisiana since 2005.This organism is extremely virulent and can causesignificant morbidity and mortality. A variety of pathogens are implicated in the development of adult epiglottitis, includingHaemophilus Influenzae, Staphylococcus Aureus, Streptococci species, and anaerobes. Theaverage age for diagnosis is between 42 and 48 years old. Adults most often experience sore throat, while odynophagia, dysphagia, cough,dyspnea, drooling, hoarsness, and stridor are ob-served more frequently inchildren. Other physical findings include fever,tachypnea, lymphadenopathy, and tenderness of the anterior neck. The differential diagnosis for upper-airway obstruction includes epiglottis, pharyngitis, infectious mononucleosis,tonsillitis, peritonsillar abscess, Ludwig angina, laryngitis, angioedema,gastroesophageal reflux disease, tumor, trauma, and inhalation or ingestioninjury. Medicaltherapy begins with broad-spectrum antibiotics to cover gram-positive organisms, HaemophilusInfluenzae type B, and anaerobes. Although controversial, corticosteroidsare often given to reduce swelling. Additionally, determining which patientsrequire airway intervention can be difficult. Stridor,muffled voice, rapid clinical course, diabetes mellitus, visualization of lessthan half of the posterior vocal folds, andextension of swelling to the arytenoidsare factors that have been associated with the need for airway intervention. Although now uncommon in the pediatric setting, epiglottitis should not be overlooked inthe differential diagnosis of an adult who presents with symptoms of upperairway obstruction.

A RABID PROGRESSION TO DEATH Reinaldo Quevedo 1;

Junaid Bhutto1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8014)
LEARNING OBJECTIVES: 1. Recognize the presentationand natural course of rabies infection. 2. Understand the importanceof early treatment in rabies infection. Understand the significantmortality associated with rabies infection.
CASE INFORMATION: A 19-year-old man presented with one day of pain and numbness in his left arm.This was accompanied by left sided facial numbness. The patient reported chestpain, neck pain, nausea, and a dry cough as well. He denied fever, chills,night sweats, or a headache. The patient was a landscaper who had recentlyarrived from Mexico. The patient hada temperature of 38.4 C, a heart rate of 110 bpm, respirations of 22breaths/min, and a blood pressure of 165/ 119 mmHg. He appeared uncomfortable and dyspneic, with generalizeddiaphoresis and facial erythema. He had left sided ptosis, with scleral injection. He had decreased strength bilaterallyin his upper extremities. Hisreflexes were decreased in upper and lower extremities. He was tachycardic and had clear lungsbilaterally. Laboratorystu-dies revealed a WBC of 11.9 10^3/UL. Blood cultures were non-diagnostic. Lumbar puncture revealed glucose of 83 mg/dl, proteinof 118 mg/dl, RBC of 18/UL, and WBC of 8/UL, with a lymphocyticpredominance. The CSF cultureswere negative for bacteria, HIV, syphilis, herpes, arboviruses and oligoclonalbands. An MRI of the head revealed diffuse symmetric encephalitis. His conditionworsened and he developed ascending paralysis requiring
mechanical ventilation.A repeat lumbar puncture revealed a WBC to 87/UL, with lymphocyte predominance.He progressed to brain death and expired after extubation. Post-mortem analysis revealed marked cerebralsoftening, congestion, and edema most consistent with rabies. IMPLICATIONS/DISCUSSION: Rabies istransmitted from rabid animals. In developing countries, a dog bite is usuallythe source of inoculation. Followingan incubation period of 3 6 months, a prodrome occurs in which patients reportnonspecific flu-like symptoms for no more than one week. Once the prodrome is complete patiententer into one of three symptom paths:1. Encephalitic:Hydrophobia, aerophobia, pharyngeal spasms, and hyperactivity2. Paralytic:Quadraparesis with sphincter involvement3. Atypical:Neuropathic pain, sensory and motor deficits, cranial nerve palsies, andbrainstem sign-sRabies isuniversally fatal once symptomatic. The key to treatment is an earlyevidence-based clinical diagnosis. Exposed patients are treated with both immunoglobulin and vaccination. Initially, rabidanimals manifest marked behavioral changes becoming overly friendly,aggressive, or fearless. Theyoften engage in excessive licking. Subsequently, the animal becomes extremelyexcitable, restless, and aggressive, with increased salivation, beforeprogressing to the fatal paralytic stage. Animal controlshould be contacted immediately regarding any potentially rabid animal.Individuals should be evaluated for possible exposure and potential treatmentif there was any contact with the animal. The internist rarely deals with animal bites.However, it is important to know the presentation of rabies. More importantly,the internist should know how to proceed in cases of bites from suspiciousanimals, as there are few other diseases that have a treatment window as silentand important as rabies.
TWO SPECIALTIES ARE WORSE THAN ONE Adrian Baudy 1;
Brian Payne1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8016)
LEARNING OBJECTIVES: 1. Identify the differential diagnosis of acute renal failure in patients withliver disease. 2. Understand the diagnostic criteria for hepatorenal syndrome. CASE INFORMATION: A 50-year-old man presented with progressively worsening abdominalpain and distention of three weeks duration. He noted associated weight gain,decreased urine output and lower extremity edema. His vital signs werenormal. He had a distended abdomen with bilateral flank tenderness, a positivefluid wave, and sparse abdominal and lower extremity palpable purpura. He had3+ pitting edema up to his sacrum. Laboratory studies revealed a Sodium 132, BUN 63, creatinine 2.6, INR is1.4. Total protein 6, albumin 1.9, T bili1.0, AST 113, ALT 62, alk phos 144,platelets 49,000. Urine sodium 12, urine creatinine 187, protein/Cr ratio 13.Hep C positive, C3 31, C4 1.5, andCryoglobulin positive. Urinalysis with large blood and 57 RBCs, >600 protein. Urine Osm 351 and Serum Osm 308IMPLICATIONS/DISCUSSION: Acute renal failure in patients withliver disease is a problem commonly

encountered by general internists. Renal and liver disease oftenpresent together, whether from multi-organ failure or result from failure ofthe other independently. Renalfailure is often multifactorial, but is normally presents as pre-renal orintrinsic renal failure. Of thepre-renal causes renal hypoperfusion is the central patho-

geneticmechanism. This is seen with iatrogenicallywith diuretic use. And intrinsicly with Hepatorenal syndrome (HRS).With HRS there is an intense intrarenal vasoconstriction in the presence ofvasodilation of systemic and splachnic circulation. Intrinsic renaldisease can result from exposure to certain drugs, toxins, or infections. With the latter normally leading toglomerulopathy. In our patientwith Hep C, purpura, cryoglobins, and low sodium, urine osmolirity greater thanserum osmolarity, and proteinuria of 13 grams/day it appears that he has amultifactoral cause of renal dysfunction secondary to cryoglobulinemia and HRS. HRS is a form of functional renalfailure that often accompanies advanced liver disease. Two patterns of HRS can beidentified. Type 1 is characterized by doubling serum creatinine to a level greaterthan 2.5 in less than 2 weeks. Type 2 is more slowly progressive and chronic. Thediagnosis of HRS is one of exclusion and depends mainly on the level of serumcreatinine. The diagnostic criteria of HRS has proposed by the InternationalAscites Club. Only the major criteria are necessary for the diagnosis of HRS,while the minor criteria are supportive.

HYPERTENSIVE HERESY: A SALTY SOLUTION TO A DIAGNOSTIC DILEMMA Lauren Doliner 1; Jillian Catalanotti1.
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LEARNING OBJECTIVES: 1. Recognize when to test for primary aldosteronism (PA). 2. Interpret initial and confirmatory testing for PA.

CASE INFORMATION: A 22 year-old woman with no past medical history and no primary care physician presented to the emergency room with menorrhagia. She was found to have a blood pressure of 155/96 and a hemoglobin of 5. She was transfused 3u PRBC and started on oral contraceptive pills and oral iron. During a gynecology follow-up visit her BP was 163/ 122 and pelvic US was normal. Her treatment was unchanged and she was referred to Internal Medicine for management of hypertension. The patient had no complaints and denied headaches, vision changes, chest pain and shortness of breath. She denied tobacco, alcohol, and drug use. Family history was notable for hypertension in her mother. BP measured in both arms was 158/104 and 146/101. Her BMI was 19. Physical exam was unremarkable. OCPs were discontinued and one month later her BP was148/100. Secondary hypertension workup was initiated including TSH, AM cortisol, plasma aldosterone-renin ratio (ARR), UA, and echocardiogram. She was found to have an elevated ARR of 50.2 and normal potassium of 3.6. She was referred to endocrinology, where an IV saline infusion test revealed aldosterone 34.9 ng/dl at the end of infusion. CT scan of the abdomen showed no adrenal masses. She was diagnosed with primary aldosteronism and sent back to Medicine with the note that her PCP could select any hypertensive management. She was treated with spironolactone 25 mg and repeat BP improved to132/87; potassium remained in normal range.

IMPLICATIONS/DISCUSSION: Primary aldosteronism has a prevalence of 5-12% among patients with hypertension. Workup for this secondary cause of hypertension should be initiated in all patients with hypertension and hypokalemia,
patients less than 25 years-old with hypertension, patients with resistant hypertension, and patients with an incidental adrenal mass and hypertension. ARR is the initial test, and a ratio greater than 30 has a high sensitivity (90%, negative predictive value 93-99%), however confirmatory tests are needed due to the high rate of false positives, which can occur in renal failure and when using sympatholytic drugs (beta-blockers, clonidine, alpha-methyldopa). False negatives occur with severe dietary salt restriction, pregnancy, hypokalemia, malignant hypertension and when using drugs that stimulate plasma renin activity (diuretics, dihydropyridine

calcium channel blockers, ACE-Is and ARBs). After a positive ARR, confirmatory testing is required. The simplest test is the IV saline suppression test, in which 2LNS are infused over 4 hours and aldosterone levels are measured. In PA, control of aldosterone secretion is lost and will not be suppressed in response to excessive salt and water load. A cut-off aldosterone level of 7 ng/dl has a sensitivity of 88% and a specificity of 100%. After diagnosis of PA is confirmed, one must differentiate aldosterone producing adenoma (APA) from bilateral adrenal hyperplasia as the cause. Although adrenal venous sampling (AVS) is the most reliable way to do so, CT scan can be used when AVS is unavailable. Surgery is the curative treatment for APA; if no mass is found on CT, patients are treated medically. Regardless of hypo- or normokalemia, aldosterone receptor agonists (spironolac-tone, eplerenone) or amiloride are recommended as first-line treatments.

REFRACTORY CHEST PAIN IN A 36-YEAR-OLD FEMALE Danesh Modi 1; Danesh Modi1. 1Temple University Hospital, Philadelphia, Pennsylvania. (Tracking ID # 8084)

LEARNING OBJECTIVES: 1. Diagnose and manage variant angina. 2. Recognize potential limitations of medical therapy in treating variant angina and suggest alternative solutions.

CASE INFORMATION: A 36-year-old G4P4 African-American female with a past medical history of asthma and a recently diagnosed acute myocardial infarction status post percutaneous coronary intervention, was admitted with a two-day history of substernal chest pain. The pain was described as sharp, intermittent, non-radiating, non-pleuritic, and non-reproducible. There were no associated symptoms. Sublingual nitroglycerin provided minimal relief. She recently quit smoking and was not taking contraception. On exam, she was found to be in no acute distress, without JVD or edema, and her cardiopulmonary examination was unremarkable. A chest radiograph revealed mild cardiomegaly. Serial electrocardiograms revealed transient ST-segment elevation in the anterior leads. Urine drug screen, beta-hCG, and TSH were normal. Cardiac biomarkers were elevated. The patient underwent repeat catheterization, which revealed severe vasospasm that resolved with intracoronary nitroglycerin. The patient was diagnosed with variant angina and discharged on calcium channel blockers and nitrates. Unfortunately, within two weeks, the patient was readmitted with chest pain. ECG again revealed transient ST-segment elevations. Fasting lipids were normal but a C-reactive protein was highly elevated. She was started on a statin, magnesium, vitamin supplementation, and increased doses of her anti-ischemic medications. Further

history revealed that her angina was not associated with her menstrual cycle. A hypercoagulable and collagen vascular disease workup was unrevealing. She was admitted three other times in as many months. We were unable to make her entirely chest pain free.

IMPLICATIONS/DISCUSSION: Variant angina, also known as Prinzmetals angina, is a debilitating and rare disorder. It most commonly affects younger women and is characterized by transient episodes of angina with ST-segment elevation that can lead to severe coronary ischemia, arrhythmia, and cardiomyopathy. With prolonged vasospasm, intracoronary thrombus can occur, which leads to frank myocardial infarction and represents one the diagnostic dilemmas in this case. While the pathogenesis is incompletely understood, endothelial dysfunction, oxidative stress, and the autonomic nervous system are thought to be involved. In addition, some data suggests an association with the menstrual cycle. Substance abuse is a known risk factor. Diagnosis can be made with provocative maneuvers such as hyperventilation or ergonovine administration, but these tests can precipitate refractory vasospasm. Standard medical therapy involves nitrates with calcium channel blockers. In addition, magnesium, vitamins C and E, and statins may favorably affect endothelial dysfunction and oxidative stress. In refractory cases, sympathetic denervation may be indicated.

SUCCESSFUL TREATMENT OF BLEOMYCIN INDUCED PULMONARY TOXICITY WITH STEROIDS Priyanka Ashish Vyas 1;

olugbodi akintomi 2; Anthony Donato3. 1Reading Hosptial and Medical Center, Wyomissing, Pennsylvania ; 2Reading Hospital and Medical Center, Wyomissing, Pennsylvania ; 3Reading Hospital and Medical Center,

Birdsboro, Pennsylvania. (Tracking ID # 8118)
LEARNING OBJECTIVES: 1. Early steroid treatment can prevent progressive lung damage in bleomycin induced lung toxicity. 2. Clear guideline needs to established regarding lung function monitoring during bleomycin treatment.
CASE INFORMATION: A 62-year old female undergoing chemotherapy for non-Hodgkins lymphoma presented to emergency care with complaints of gradual worsening of shortness of breath over two days, associated dry cough, chest pain on deep inspiration and a single episode of subjective fever with chills. She had received 5 cycles of chemotherapy with Adriamycin, Bleomycin. Vinblastine and Dacarbazine (ABVD), with last cycle completed 15 days before admission. On presentation, she was afebrile, normotensive but in moderate respiratory distress with oxygen saturation of 85% on room air. Lung examination revealed diffuse bilateral dry crackles. Initial laboratory findings showed white cell counts of 16,100 cells/microliter with 13% bands. CT scan of her thorax showed extensive bilateral mixed interstitial and alveolar infiltrates. Empiric antibiotics were started, and broncoscopy was performed. Bronchial lavage studies were negative for infection and malignancy. Transbronchial biopsy showed Diffuse Alveolar Damage. On third day, she was started on prednisone 60 mg orally daily and antibiotics were discontinued. She responded significantly over next four days. On the day of discharge, her ambulatory oxygen saturation was 95% on
room air. She was discharged on one month course of prednisone. Chemotherapy was changed to AVD. Follow up CT thorax after one month showed significant improvement in appearance of the lungs.
IMPLICATIONS/DISCUSSION: The major limitation of bleomycin as an antineoplastic agent is life-threatening pulmonary fibrosis, which occurs in up to 10% of patients. Bleomycin is associated with four types of pulmonary toxicity: subacute progressive pulmonary fibrosis, hypersensitivity pneumonitis, organizing pneumonia and acute chest pain syndrome (while rapid infusion). The lung toxicity is associated with age, smoking history, cumulative dose of bleomycin, adjuvant chemotherapy drugs, high fraction of inspired oxygen, radiation therapy, renal insufficiency and adjuvant colony stimulating factor. National Comprehensive Cancer Network (NCCN) guideline recommends baseline pulmonary function test (PFT) before starting bleomycin, but there is no consensus regarding subsequent monitoring with PFT while patient is on bleomycin. Some studies have shown significant pulmonary improvement with early use of steroids. Early detection of bleomycin induced pulmonary toxicity and treatment with steroids can change patient outcome.
DOBUTAMINE STRESS TEST INDUCED VENTRICULAR TACHYCARDIA Priyanka Ashish Vyas 1; Shuchi Gulati 2; Anthony Donato3. 1Reading Hosptial and Medical Center, Wyomissing, Pennsylvania ; 2Reading Hospital and Medical Center, Wyomissing, Pennsylvania ; 3Reading Hospital and Medical Center, Birdsboro, Pennsylvania. (Tracking ID # 8120)
LEARNING OBJECTIVES: 1. Predictive value of Dobutamine stress test induced ventricular tachycardia for coronary artery disease is low. 2. Dobutamine stress echocardiography induced ventricular tachycardia does not have any prognostic significance in patients with normal heart function.
CASE INFORMATION: A 63-year old female underwent Dobutamine stress echocardiogram (DSE) after a single episode of atypical chest pain. She had no prior cardiac disease and had only controlled hypertension as a cardiovascular risk. Baseline EKG was normal, including QT interval. Echocardio-gram at rest showed no significant wall motion abnormality. During stress testing following infusion of dobutamine, she developed chest tightness with non-sustained ventricular tachycardia of 16 beats. At peak heart rate, there was no obvious finding suggestive of ischemia. Patient was admitted to risk stratify further for coronary disease. Coronary angiography showed low normal ejection fraction and mild luminal irregularities. Comprehensive electrophysiology study did not elicit inducible arrhythmias. Patient was reassured and discharged home.
IMPLICATIONS/DISCUSSION: Cardiac arrhythmias are concerning but uncommon side effects associated with dobutamine stress echocardiography. Ventricular tachycardia oc-curs in about 0.1 to 0.3 percent of studies. Patients with systolic dysfunction are at increased risk for arrhythmias on dobutamine stress testing. But studies

have failed to show any predictive value of dobutamine stress test induced ventricular tachycardia for coronary artery disease. Also, patients with dobutamine stress echocardiography induced ventricular tachycardia have similar long term outcome compared to the patients without arrhythmias.

MY WHITE CELLS ARE EATING MY OTHER CELLS - A CASE OF HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS Diwakar Davar 1; Roy E Smith1. 1University of Pittsburgh Medical Centers, Pittsburgh, Pennsylvania. (Tracking ID # 8178)
LEARNING OBJECTIVES: 1. Recognize the cardinal features that suggest hemophagocytic lymphohistiocytosis. 2. Manage critically ill patients with hemophagocytic lymphohistiocytosis. CASE INFORMATION: A 47 year old Caucasian male with no past history presented with 4 days of peri-umbilical abdominal pain, nausea and fevers to 102 F. A few days prior to presentation, he and his wife ate at Longhorn Steakhouse and she was unwell at the time of presentation with a diarrheal illness. Travel history was remarkable for a camping trip 1 week prior and a possible tick bite at the time. Found to have progressively increasing transaminitis and direct hyperbilirubinemia. Abdominal imaging revealed borderline splenomegaly. Infectious workup was negative for viral, fungal, Rickettsial and bacterial etiologies. Developed severe shock requiring pressors, disseminated intra-vascular coagulation and progressive hypoxemic respiratory failure requiring intubation. Blood smears showed activated neutrophils with toxic granulations. Ferritin level was greater than 1500 ng/mL and triglyceride level was 345 mg/dL. Bone marrow aspirates revealed hemophagocytic histiocytes. Though there was no evidence of a monoclonal proliferation on flow cytometry or morphological analysis, T-cell gene rearrangement studies were suggestive of a clonal proliferation. Chemotherapy was instituted with dexamethasone and cyclosporine but poorly tolerated with elevations of liver enzymes. Developed extremity gangrene necessitating bilateral below knee amputations. Clinical course stabilized eventually and he was discharged to pursue outpatient chemotherapy.
IMPLICATIONS/DISCUSSION: Hemophagocytic lymphohistiocytosis or the macrophage activation syndrome is a rare condition with potentially fatal consequences. Whilst the incidence is 1 case per 12 million children, the incidence in the adult population is unknown. The hallmarks of the condition are hepato-splenomegaly, rash, cytopenias, hyper-triglyceridemia and/or hypofibrinogenemia. Pathognomic hemophagocytes may be found in the bone marrow or more rarely on peripheral blood smears. Given the rarity of the disease and the lack of controlled clinical trials, there are no clear recommendations governing treatment in adults. Despite prompt recognition and treatment, the acute mortality of this condition is near 50%. Several chemotherapeutic protocols have been developed based on studies in children and utilize agents like dexamethasone, etoposide and cyclosporine. Early recognition of this condition is vital and permits prompt institution of therapy.
VERTEBRAL ARTERY DISSECTION: ACUTE STROKE IN A YOUNG PHYSICIAN. Rebecca Karp 1; Jennifer Potter1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 8202)
LEARNING OBJECTIVES: 1. To identify vertebral artery dissection as a cause of acute stroke in an otherwise healthy individual. 2. Discuss risk factors, diagnosis, and treatment of vertebral artery dissection.
CASE INFORMATION: A 51-year-old primary care physician with a PMH significant for angioectasia of the small intestine, GERD,and osteopenia experienced transient loss of sight in the left upper visual field followed by an occipital headache while completing a 40-mile bike ride. The headache rapidly improved after a dose of acetaminophen, and she attributed the symptoms to migraine. Later the same morning, the patient developed acute onset vertigo, ataxic gait, and vomiting and was transported to a community hospital. Two hours after symptom onset, she underwent head CT, which was negative for acute pathology. She was prescribed anti-emetics and meclizine, and discharged with a diagnosis of benign positional vertigo. The following morning, the patient continued to experience vertigo, occipital headache, and was unable to walk. She was seen urgently in

Neurology Clinic where physical exam was significant for gait ataxia and veering to the left. MRI/ MRA demonstrated small infarcts involving the right cerebellum, right occipital lobe, and right thalamus; a CTA revealed dissection of the external right vertebral artery. She was admitted to the hospital and started on a heparin drip, aspirin, and a statin. A CT of the chest was negative for arterio-venous malformation, and transesophageal ECHO showed no evidence of right-to-left shunting. The patient denied spinal trauma, though she had recently begun an exercise program that included hyperextension of the neck. On the third hospital day, her symptoms had improved, and she was discharged on aspirin, simvastatin, Lovenox, and Coumadin. She continues to do well and has returned to work full-time.

IMPLICATIONS/DISCUSSION: External vertebral artery dissection (VAD) should always be considered in a patient with acute onset headache, vertigo, and ischemic symptoms. Dissection results from shearing of the arterial intimal wall leading to intramural hematoma formation.[1] When the vessel tears, thrombus forms at the exposed site and can embolize throughout the vertebral artery territory. Ischemic symptoms may also be the consequence of diminished flow within a narrowed arterial lumen, causing reduced blood supply to the brain. External VAD is a common cause of stroke in young patients and is often the result of trauma (i.e. chiropractic maneuvers and whiplash) or pre-existing arteriopathies (i.e. collagen vascular diseases and fibromuscular dysplasia).[2] Diagnosis is made via clinical exam and confirmed with imaging. The gold standard for diagnosing VAD is angiography; however, MRI/MRA and CTA are commonly employed due to their convenience, safety, and accuracy. Treatment of VAD typically involves intravenous heparin with transition to Coumadin for 36 months. However, some experts are increasingly recommending anti-platelet therapy alone. A systematic review by Engelter et al. recommended immediate anticoagulation in patients with evidence of frequent micro-emboli, multiple embolic infarctions, or a free-floating thrombus.[3] Rarely, VAD is treated with endovascular repair, however most patients do well with medical treatment alone.[1] Goayl Manu et. al. The Diagnosis and Management of Supraaortic Arterial Dissections. Curr Opin Neurol. 2009. 22:8089. [2] Thanvi B. et al. Carotid and Vertebral Artery Dissection Syndromes. Postgraduate Medical Journal (of the BMJ) 2005; 81: 383388. [3] Engelter S, Brandt T,Debette S, et al. Antiplatelets Versus Anticoagulation in Cervical Artery Dissection. Stroke 2007; 38:26052611.

WHEN GOOD DRUGS BEHAVE BADLY Ali Nadaa 1; Padmaja Vittal 1; Junaid Bhutto 1; Peter Reynaud2. 1Tulane University, New Orleans, Louisiana ; 2Tulane, New Orleans, Louisiana. (Tracking ID # 8215)

LEARNING OBJECTIVES: 1. Recognizethe increased myopathy with concomitant use of Statins and CYP3A4 inhibitors. 2. Recognizedrug-drug interaction in the differential.

CASE INFORMATION: A 74 year-old woman presented after a fall without loss of consciousness. She had bilateral lower extremityweakness for two days prior to the event. She denied any head trauma, urinary incontinence, muscle pains orchanges in urine color. Although she was ambulatory before this, She was unableto walk independently. Her alsohad hypertension, diabetes mellitus, and dementia. Shewas afebrile, her heart rate was 91 bpm, and her blood pressure was 109/71 mmHg. She was alert and oriented. Herneurological exam was unremarkable. Cardiac,pulmonary and abdonimal exams were normal. Her serum creatinine was1.5 mg/dL (baseline 0.9); aspartate aminotransferase (AST) and alanineaminotransferase (ALT) of 130 U/L and 63 U/L respectively. Her EKG was sinus rhythm. Urinalysis revealed moderate blood buturine microscopy showed no RBCs/HPF. Further evaluation revealed a serum creatine kinase (CK) of3970 U/L. A month prior, thepatient had been started on simvastatin. A week later, she was treated withamoxicillin, clarithromycin, and omeprazole for Helicobacter Pylori.

IMPLICATIONS/DISCUSSION: Medications prescribed have interactions. Although major interactions are well known, some-interactions are still being discovered and have not been completelyunderstood. This patient wasdiagnosed with rhabdomyolysis, and the insult was found to be concomitant useof simvastatin and clarithromycin. While certain associations can be incidental, the Naranjo scaleindicated a causal association

was probable. Statinsare metabolized in the liver by cytochrome P450 isoenzyme-CYP3A4. Clarithromycininhibit CYP3A4 and increases serum statin levels, which leads to toxicity. Other inhibitors of CYP3A4 includeErythromycin, Cyclosporine, anti-fungals, HIV protease inhibitors, Amiodarone,and Verapamil. Rhabdomyolysis is usually caused by trauma,excessive muscle activity, excessive alcohol intake, and medications such asstatins. The condition can belethal when associated with significant electrolyte abnormalities, renalfailure, and acidosis. Treatmentinvolves stopping further muscle injury by removing the insult, and hydratingthe patient aggressively to establish a constant urine output. However, the useof mannitol for duiresis remains controversial. In this patient, simvastatinwas discontinued and she was given intravenous fluids. She recovered well and was discharged. Arecent study showed that 25% of patients recently started on a statin alsoreceived a CYP3A4 inhibitor within one year. The modern internist has manymedications at his/her disposal, increasing the possibility of such druginteractions. the internist has to be vigilant in identifying such interactions.

A HIGH THAT COSTS TOO MUCH Reinaldo Quevedo 1; Leslie Gonsette1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8224)

LEARNING OBJECTIVES: 1. Identify an approach to diagnosing the etiology of persistent nausea and vomiting 2. Recogni-
zethe clinical presentation and treatment of cyclical vomiting syndrome.

CASE INFORMATION: A 29 year-old man presented with one week of recurrent, intractable vomitingoccurring up to ten times a day. The vomitus was non-bloody, and non-bilious; there was no relation tofood intake. He denied abdominal pain, but he did note that nausea immediatelypreceded each episode of vomiting. He had ahistory of multiple hospitalizations for similar episodes over the past sevenyears requiring treatment for dehydration and electrolyte abnormalities. He reported symptomatic relief with hotshowers and marijuana use. He wascachectic, with sunken orbits and decayed teeth. He was tachycardic and had epigastric tenderness; there wasno signs of peritonitis, and his bowel sounds were normal. There were erythematous burns on his back fromprolonged showering with hot water. His potassium was 3.3 mEq/L, the sodium was 122 mEq/l, and thecreatinine was 2.3 mg/dL (Hisknown baseline was 1.3 mg/dL). His urine toxicology was positive for marijuanaand cocaine. Stool studies werenormal. He was diagnosed with cyclic vomitingsyndrome and was treated with anti-nausea medications, supportive therapy, andsubstance abuse counseling.

IMPLICATIONS/DISCUSSION: The general internist frequently encounters theclinical presentation of nausea and vomiting. Acute causes of vomiting includeacute gastritis, obstructive structural abnormalities, iatrogenic causes,substance-related irritation, and self-induced vomiting. In this case, a detailed history was criticalin establishing the chronicity and cyclical nature of his vomiting. Cyclicalvomiting disorder (CVD) is manifested by a repetitive cycle of severe vomiting,followed by a vomiting-free period. The Rome III criteria for CVD includes: 1) Stereotypical episodes ofvomiting characterized by an acute onset and less than one week in duration, 2)Three or more discrete episodes in the prior year, and 3) Absence of nausea andvomiting between episodes Ourpatients symptoms met all components of the Rome III criteria. Thesixteen-year history of marijuana use further supported the diagnosis, as thereis a strong causal association between chronic cannabis use and cyclicvomiting. Case reports suggestthat in most cases, vomiting ceases with cessation of THC use. Interestingly,patients discussed in the case reports also found relief with hot watersubmergence. Thereare three components to treatment of: supportive, prophylactic, andabortive. Supportive therapy forcyclical vomiting consists of rehydration, electrolyte repletion andantiemetics. The definitive therapy, however, is the cessation of cannabis use.Giventhe prevalence of marijuana use, the general interest should be aware of theassociation between cannabis and cyclic vomiting syndrome. Importantly, it iscritical to establish a time course for all cases of vomiting, inclusive ofpast events, as this is essential in establishing the diagnosis of CVS.

SO WHATS IN YOUR COFFEE? Neil Shah 1; Natalie Rodden 1; Marcia Glass1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8230)

LEARNING OBJECTIVES: 1. To understand the pathogenesis of the extra-hepatic manifestationsof chronic hepatitisC. 2. Review the causes and presentation of erythema nodosum To emphasize the importance of a thorough physical exam.

CASE INFORMATION: A 38-year-oldman presented with one week of coffee-ground emesis, three days of dysuria, anda chronic complaint of lower extremity myalgias. The patient also noted a non-tender skin rash that eruptedover the past three weeks. He hadnoted similar rashes over the past year, but they had spontaneously resolved. Vitalsigns were normal. The patient had epigastric tenderness as well as tendernessin the lower quadrants with guarding. He had small, non-blanching nodules on the medial sides of his legs andthe extensor surfaces of his arms. The patient had a white blood count of 11.9, potassium of3.3, creatininekinase of 274, and a normal AST, ALT, and lipase. Urine culture had an Enterococcus colony of 100,000.Endoscopy showed a duodenal ulcer that was positive for H. pylori. ESR, CRP, RF, IgA and ANA were all within normal range. The patient was found to have apositive hepatitis C antibody, and dermatologic biopsy showed erythema nodosum. IMPLICATIONS/DISCUSSION: Hepatitis C is asingle-stranded RNA virus affecting primarily the liver that becomes chronic inmore than 80% of adults infected. It is imperative for internists to identify hepatitis early inits clinical course. Recognitionof the extra-hepatic manifestations may be important in early detection to decreasethe progression to cirrhosis. Hepatitis C has multiple extra-hepaticmanifestations, most often autoimmune or lymphoproliferative in nature, thatcan present on almost any organ system, including the skin, kidneys, brain,pulmonary, cardiovascular, and endocrine. When the virus causes cryoglobinemia,it forms immune complexes in multiple organs and blood vessels. Erythema nodosum is a dermatological disorder characterizedby erythematous plaques and nodules on the extensor surfaces of theextremities. It is a reactive processthat can be triggered by many causes, including infections such as hepatitis C,drugs, autoimmune disorders, and malignancies. This hypersensitivity responseresults from deposition of immune complexes in subcutaneous fat. The lesions spontaneously appear and regressand can be painful. Most cases oferythema nodosum resolve spontaneously in three to four weeks. Treatment is to address theunderlying condition. Our patient hadgastrointestinal complaints which could be attributed to his ulcer and urinarycomplaints which could be explained by his urinary-tract infection. The story became more interesting,however, when we noticed erythematous nodules in the setting of a positive hepatitis C antibody. Once the biopsy revealed erythemanodosum, we linked these two issues and realized the patients presentation wasmore complicated than we initially realized. Internists should include a full physical exam in theirworkup for even mundane chief complaints and always bear in mind that hepatitisC can be detected as early as possible by recognizing its extra-hepaticmanifestations.

THICKER THAN BLOOD Marissa Shams 1; Marissa Shams1.
1Tulane, New Orleans, Louisiana. (Tracking ID # 8233)

LEARNING OBJECTIVES: 1. Recognizethe clinical presentation of Hyperviscosity Syndrome. 2. Understand the patho-physiology of Hyperviscosity Syndrome. Learnthe treatment options for Hyperviscosity Syndrome. CASE INFORMATION: A 48 year-oldman with a history of hypertension, diabetes and Hepatitis C presented to the Emergency Department after being found disorientated by his friends. He remembered driving to the grocery store at which

point he became confused andon his return incurred a minor traffic accident. He woke up sitting on thefront porch. Recently, he had become frequently forgetful. The patient deniedthe use of illicit substances. He complained of frequent maroon stools butdenied headache, change in vision, chest pain, shortness of breath, nausea,vomiting and diarrhea. He was alert,awake and orientated but frequently confused and unable to answer to questionsappropriately. Except for positive hemoccult, the physical exam was normal. CT Scan of

thehead was negative. Laboratory data revealed an anion gap acidosis and proteingap. Ammonia, ethanol, lactic acid, osmolality and liver function tests werewithin normal limits. Urine toxicology panel was negative. Protein analysiswith Serum Protein Electrophoresis reveled Monoclonal Spike in the gamma regionmeasuring 0.7 g/dl. Serum IgM was measured at 900 mg/dl (normal 40-230 mg/dl).Bone Marrow Biopsy revealed a lymphoplasmacytic lymphoma. Hematology-Oncologywas consulted for emergent plasmapharesis. After two rounds of plasmapharesis,the patient clinically improved and was discharged to follow up inhematology-oncology clinic. IMPLICATIONS/DISCUSSION: HyperviscositySyndrome is a clinical entity occurring in 30% of patients with Walden-stromsMacroglobulinemia. Waldenstroms Macroglobulinemia is a lymphoid neoplasmcharacterized by a monoclonal lymphoplasmacytic expansion with a serummonoclonal M protein (IgM). The increasing amounts of IgM pentameters bind electrostaticlyto red blood cells causing aggregation and rouleaux formation, therebyincreasing the serum viscosity. The syndrome usually occurs at IgMconcentrations greater than 3000 mg/dL but can occur at lower concentrations. It ischaracterized by oronasal bleeding, neurologic symptoms and mucosal hemorrhage;frequently gastrointestinal bleeding. Neurologic symptoms include headache, dizziness, vertigo, nystagmus,ataxia, vision changes or stupor. Opthomology exam shows retinal veinengorgement, flame-hemorrhages or papilledema. HyperviscositySyndrome should be suspected in a patient who presents with the triad ofneurologic, vision and bleeding abnormalities. Should a patient present withthese findings their serum viscosity, serum immunoglobulin should bemeasured. If an abnormalmonoclonal spike is present further immunofixation is required. Normal serumviscosity, in comparison to water, equals 1.4-1.8 cP. Incontrast, symptomatic patients present with a serum viscosity greater than 5 cP. Emergent therapyincludes hydration with diuresis, plasmapharesis and control of the underlyingmalignancy. Plasmapharesis dramatically halts the symptoms occurring inhyperviscosity syndrome, as the elevated protein component is removed. Somepatients require multiple sessions of plasma-pharesis to achieve the treatmentgoal; a serum viscosity less than 4 cP. WaldenstromsMacroglobulinemia is an incurable but indolent disease. Individuals are closely monitored butonce symptomatic require aggressive therapy with chemotherapeutic agents.Chemotherapy includes alkalyating agents, nucleo-side analogs and Rituximab orBortezmib.

A PUNCH IN THE GUT Michael Shoffeit 1; Michelle Guidry1.
1Tulane, New Orleans, Louisiana. (Tracking ID # 8240)

LEARNING OBJECTIVES: 1. Recognize an atypical clinical presentation of acute intestinal ischemia. 2. Appreciate the majorsignificant risk factors for acute intestinal ischemia.

Tailor differentialdiagnosis for a patient with symptoms of bowel obstruction to the clinical situation.

CASE INFORMATION: A 71 year-old man complained oftwo days of painless abdominal distention, specifically worse over the previous24 hours. These symptoms occurred during a hospitalization for management of alarge right femoral hematoma, which developed following recent coronaryangiography to work up new-onset atrial fibrillation and heart failure. Thehematoma required repeat catheterization for embolization of the culpritartery, and his anti-coagulation was held. He had been complaining of no bowel movements for the fourdays following his repeat catheterization. Previously, two enema treatmentsfailed to stimulate a bowel movement. His vitals were: a temperatureof 36.8, blood pressure of 131/94 mmHg, a pulse of 134, respiration rate 22,and O2 sat of 99%. His abdomen was distended and tympanic without tenderness;the remaining examination was normal. His electrolytes at that time were Na127, K 4.4, Cl 94, and bicarb 24 for an anion gap of 9. Air-fluid levels anddiffuse distention of large and small bowel were visualized on abdominalX-rays, and there was no free air present under the diaphragm on decubitusfilms. There was thickening of the wall of the patients hernia and strandingaround the wall, concerning for incarceration on computerized tomography withcontrast. In the operating room, the patients hernia sac was found to benecrotic with necrotic sigmoid colon in the sac. Further exploration revealednecrotic bowel from the proximal descending colon to the distal sigmoid colon.

IMPLICATIONS/DISCUSSION: Constipation is a common-complaint confronting the patients of the general internist. Commonprecipitating factors include opioids and other medications, electrolyteabnormalities, and the bedbound state. Constipation from such causes canprogress to impaction of stool in the rectal vault with subsequent large andsmall bowel obstruction. Obstruction from this cause is commonly amenable toenemas or digital disimpaction. Classically, mesenteric ischemia does notpresent with an obstructive picture. The hallmark finding is abdominal pain outof proportion to tenderness, and other frequent findings include abdominal-distention, nausea and vomiting, diarrhea, and bloody stools. Colonic pseudo-obstruction is a knownmanifestation of colonic ischemia.This case points out theimportance of keeping a differential diagnosis that is broad and one that isinclusive of those etiologies for which your patient is at particular risk,especially those that are potentially life threatening. This patient was atrisk for acute intestinal ischemia by virtue of his two recent arterialcatheterization procedures and atrial fibrillation with interruption in hisanti-coagulation therapy. Other risk factors for acute intestinal ischemiainclude recent myocardial infarction and valvular heart disease. Promptdiagnosis and management was important, because the patients cecum was nine-centimeters at the time of surgery and further delays would have placed thepatient at risk for perforation and increased likelihood for morbidity andmortality.

A CONVINCING CASE OF NITROFURANTOIN-INDUCED SYSTEMIC INFLAMMATORY RESPONSE SYNDROME Alison Smith 1; Elma LeDoux1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8243)

LEARNING OBJECTIVES: 1. To present acase of nitrofurantoin-induced systemic inflammatory response (SIRS) with

awell-documented onset and resolution of symptoms 2. To help theinternist understand the signs and symptoms associated withnitrofurantoin-induced SIRS in order to provide appropriate medical managementgiven the increased usage of nitrofurantoinCASE INFORMATION: A 79 year-old woman with history of recurrenturinary tract infections (UTIs) presented with a one-week history of fever,chills, nausea, vomiting, and abdominal discomfort. She was treated three days prior by her PCP for symptomsconsistent with a UTI, including dysuria, fever, and nausea. She was treated with nitrofurantoin100mg bid. Patient did not recall being prescribed nitrofurantoin for previousUTIs. In the interval time frombeginning treatment with nitrofurantoin to presention three days later withworsening symptoms of infection, the patients symptoms of dysuria werecompletely resolved. Upon physicalexamination, the patient was febrile and tender to palpation in the right lowerquadrant. Her WBC was slightlyelevated. Urine analysis revealedfew WBCs with no nitrites or leukocyte esterases. Urine culture did not show any growth after two days. Patient was admitted for observationand nitrofurantoin was stopped. Inless than 24 hours after admission, her symptoms had improvedsignificantly. She was discharged home a few days later in stable condition. IMPLICATIONS/DISCUSSION: With increasing rates of antibiotic resistance,nitrofurantoin is being used more frequently as a first-line agent forUTIs. Well-documented side effectsinclude: pulmonary and allergic reactions, hepatotoxicity, lupus-like syndrome,and peripheral neuropathies. Therate of associated drug reactions with nitrofurantoin is approximately9.2%. Nitrofurantoin-induced systemtic inflammatoryresponse syndrome (SIRS) was first described by Forster et al. (Am J MedSci, 2009, 338(4): 338340). Thepatient described in this case had a history significant for stage IV bladdercancer and had a radical cystoprostatectomy, ileostomy, and chemotherapy. He had colonization of pan-resistantbacteria in his urine and had many possible sources of infection given hishistory of frequent hospital admissions. He was repeatedly treated with nitrofurantoin and developed SIRSsymptoms, which finally resolved after the cessation of the drug. However, it is difficult to ascertainif his initial reactions were from nitrofurantoin or from an over-lyinginfection. Our case presents a well-documented example ofSIRS in which nitrofurantoin is the most likely agent responsible. The patient described here was healthyprior to the use of nitrofurantoin. Her condition deteriorated rapidly with resolution of UTI symptoms afterbeing therapy with nitrofurantoin and she developed SIRS criteria, includingfever and an elevated WBC. Afterceasing nitrofurantoin therapy, her symptoms resolved, and she returned to hernormal state of health. This case,with a clear onset and resolution

of symptoms associated with antibiotic use, provides a convincing example of SIRS associated with nitrofurantoin. This problem is of growing concerngiven the increasing spread of antibiotic resistance for therapeutic agents totreat UTIs in the general population.

REMEMBERING WERNICKES: MAINTAINING A HIGH SUSPICION FOR THIAMINE DEFICIENCY Socrates Kakoulides 1;

Kexuan Wang 1; Brett Hymel 1; Domnica Fotino1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8244)

LEARNING OBJECTIVES: 1. Recognize the clinicalpresentation of Wernickes encephalopathy (WE) 2. Understand tha-

temperic therapy for Wernickes encephalopathy is essential CASE INFORMATION: A 62 years old African-American man with a questionablehistory of heavy alcohol use was admitted to the urology service for anincision and drainage of a scrotal abscess. At the time of Incision andDrainage of the pyocoele he received D5 half normal saline, one dose ofmorphine 2 mg IV, and empiric antibiotic coverage with Vancomycin andZosyn. The next morning, the patient was found to be combative, tremulous,and not oriented to the situation/place/time. A dose of Ativan was givenfor suspected alcohol/benzodiazepine withdrawal, however the patients deliriumworsened. Medicine was consulted for acute mental status change. Vitals were99.6 F, BP 112/70, RR 16, HR 64, 100% O2saturation on room air. The exam revealed a combative patient who refusedinter-view and physical exam, noted to have an unsteady gait and repeated nearfalls. Initially the patient had been noted to be appropriate, alert/oriented x4 and ambulating normally. Extraocular muscles were grossly intact. Labs: WBC 9.1 103/ uL, Na 138 mmol/L, K 3.9 mmol/L, BUN 7 mg/dL, Creatinine0.74 mg/dL, glucose 103 mg/dL, magnesium 1.3 mg/dL, calcium 7.8 mg/dL, TSH 1.38UIU/mL. EKG was normal sinus rhythm. Acetaminophen level was negative. Urine culture (2 days prior) revealed Klebsiella sensitive to Zosyn. CT headnegative for bleed or mass. Our patient was started on IV thiamine and his symptomsimproved overnight in mentation, orientation and ambulation. After 2 daysof IV thiamine with magnesium fortification the patient had returned tobase-line and was transitioned to oral thiamine. IMPLICATIONS/DISCUSSION: Patients who hide a heavy alcohol drinking history are acommon occurrence for the in-house resident and general internist. Wernickesencephalopathy (WE) is a less common etiology for acute mental status changes, but can lead to serious neurologic morbidity or mortality if missed. It affectsas many as one fourth of chronic alcoholics admitted to a general hospital. Thediagnosis is clinical and is characterized by ocular abnormalities (nystagmusand paralysis of ocular muscles), mental status changes and unsteadiness ofgait. This classic triad is seen in only a minority of patients. Ocularabnormalities may occur in one third of patients and as many as a fifth ofpatients have none of these symptoms at presentation. Accompanyinghallucination and behavioral disturbances may mimic acute psychoticdisorders. Laboratory confirmation of thiamine deficiency may delaytreatment, so empiric IV thiamine is imperative in all patients with suspectedalcohol dependence. Magnesium deficiency may exacerbate thiamine deficiency,and magnesium supplementation may reduce a refractory response totherapy. Ocular abnormalities usually respond to treatment in hoursto days, confusion may take days, and vestibular imbalances may take days toweeks to recover. Given the clinical challenges ofdiagnosing WE, physicians should maintain a high clinical suspicion of thiaminedeficiency and consider prompt treatment in patients who present withunbalanced nutrition or suspicion for alcohol abuse.

MILK-ALKALI Allison Sturtevant 1; Allison Sturtevant1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8251)

LEARNING OBJECTIVES: 1. Recognize the symptomsof hypercalcemia. 2. Establish a differentialdiagnosis for hyper-calcemia.Differentiate the causesof hypercalcemia.

CASE INFORMATION: A 45 year-old man presentedwith a month of depression with suicidal ideation as well as several days ofnausea, vomiting, muscle spasms, fatigue and weakness.His exam revealed tachycardia,but

was otherwise normal. Labs demonstrated: Sodium 139,potassium 3, chloride 89, bicarb 36, BUN 70, creatinine 1.41, GFR 54, glucose129, calcium 13.6, magnesium 1.9, and phos 4.9, albumin 3.8, intact PTH CXR: wnl With further discussion, the patient revealed that his motherhad hyperparathyroidism, and that he had been taking multiple Rolaids Tums andCentrum multi vitamins throughout the past several days to help combat his symptoms.
IMPLICATIONS/DISCUSSION: Hypercalcemia is frequentlyencountered by the internist so a good method to determine the cause isnecessary. This patient exhibited-classic signs of hypercalcemia including: fatigue, muscle aches, depression(groans moans and psych overtones) as well as nausea, vomiting, acute kidneyinjury and metabolic alkalosis. Healso starts off the differential by admitting to rolaid and multivitaminingestion versus a familial history of hyperparathyroidism. The initial BMP confirms thesuspicion of hypercalcemia . Thenext step is to check a PTH level. In the setting of hypercalcemia, increased levels of PTH indicateprimary or tertiary hyperparathyroidism. Low parathyroid levels are seen in nonparathyroid hypercalcemia such asmalignancy, vitamin D excess, milk alkali syndrome, thiazide use, granulomatousdisease, and increased boneturnover (Pagets, Addisons , thyrotoxicosis, immobilization and multiplemyeloma). History candistinguish milk alkali syndrome (as in this patient) and thiazide use. Then measure parathyroid hormonerelated peptide-elevation indicates malignancy. Elevation of vitamin D metabolites indicates vitamin Dexcess. ACE levels , vitamin Alevels, and protein electrophoresis can be used to distinguish the remainingcauses.If milk-alkali syndrome issuspected, hydration and withdrawl of the offending agents will allow for rapidnormalization of Calcium levels and resolution of symptoms. Proir to H2 blockers and protonpump inhibitors, ingestion of milk and antacids for relief of indigestionfrequently resulted in hypercalcemia due to milk alkali syndrome. Today, 90% of the time the cause iseither malignancy or primary hyperparathyroidism, but milk alkali syndrome ismaking a resurgence due to calcium supplementation to prevent osteoporosis.
HYPERCOAGUABLE STATE Allison Sturtevant 1; Allison Sturtevant1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8253)
LEARNING OBJECTIVES: 1. Identify signs andsymptoms of portal vein thrombosis. 2. Know when ahypercoagulable state workup is appropriate.
CASE INFORMATION: A 63 year-old woman presentedcomplaining of a five day history of intermittent sharp 10/10 epigastric painthat is worse after eating. Herabdomen was slightly tender to palpation and there was no hepatomegaly, splenomegaly,distension, ascites, or lower extremity edema. She had a history of a cerebrovascular accident two yearsprior. No history of clotting ormiscarriages.A CT of the abdomen revealedocclusive thrombosis of the splenic vein with non occlusive thrombus in theportal vein, short left gastric vein and

superior mesenteric vein. The spleen was moderately enlarged. IMPLICATIONS/DISCUSSION: General internists frequentlyencounter patients with thrombosis and face the dilemma of when to pursue afull hypercoagulability workup. There is not a firm concensus regarding which patients to screen, butpatients with identifiable risk factors for thrombosis such as SLE, prolonged periods of inactivity, malignancy, recent surgery, myeloproliferative disorder,Heparin-induced thrombocytopenia, preeclampsia should not be screened. Screening should be undertaken inpatients if the patient has family history of thromboses in first degreerelatives; if the patient is younger than 50; the patient has recurrentthrombosis; a history of warfarin induced skin necrosis or if the patient hasunusual or extensive thromboses such as the portal vein (without anidentifiable precipitating cause). Once a decision to test for an underlying disorder has been made, it isimportant to consider which tests can be performed in the acute phase and onanticoagulation. Antiphospholipidantibodies (lupus anticoagulant, anticardiolipin antibody, and anti-B2glycoprotein), Factor V Leiden,and Prothrombin gene mutation can be screened for in the acute phase prior tostarting anticoagulation. Lupusanticoagulant should not be measured after starting heparin therapy orCoumadin. Other testing such

asantithrombin deficiency, Factor VIII, Protein C and Protein S should not bemeasured until after the patient is out of the acute phase (generally 6 months)and off therapy. Age appropriatecancer screening should also be performed. When making the decision to perform testing for ahypercoagulable state internists should consider the appropriateness, timing, and the effect a positive test would have on the choice and duration of therapy.

THE A, B(19), CS OF ACUTE RENAL FAILURE Alison Tatum 1;

Naree Whang 1; William Rothwell1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8254)

LEARNING OBJECTIVES: 1. Indentify the varyingclinical presentations of Parvovirus B19. 2. Understand how todiag-nose and treat Parvovirus B19 infection. Identify thedifferential diagnosis of Acute Renal Failure in the setting of an acute viralillness.

CASE INFORMATION: A 48-year-old man was referred from clinic with worsening acute renal failure. He reported nausea withoutemesis, but no other symptoms. His creatinine was8.3 mg/dl (increased from hisbaseline of 1.4 mg/dl twelve days earlier). He denied a history of kidneydisease, but reported being hospitalized two weeks prior for an acute febrileillness with associated arthralgias, nausea with emesis, and diarrhea. Duringthis time, he was treated with IV fluids and doxycycline and discharged. His blood pressure was 195/108 mmHg; the remainder of his vital signs were normal. He was in no acutedistress, and his physical examination was normal. The creatinine was 8.3 mg/dl and BUN 99 mg/dl. The remainingelectrolytes were normal. A urinalysis showed 25 white cells, 1 red cell, 200 mg of protein, and few scattered fine granular casts. The urine drug screen wasnegative. An ultrasound of thekidneys showed mildly enlarged kidneys without evidence of hydronephrosis,mass, or renal artery stenosis. The HbA1c was 5.9 and spot urine protein-tocreatinine ratio was 2.31.The C3 level was low at 84.3 with a normal C4 level 28.4. ANA was He had a kidney biopsy

whichshowed a severe increase in mesangial matrix and edematous interstitium withfibrosis, tubular atrophy, and occasional inflammatory cells. Electron miscrocopy showed a thickenedbasement membrane, effacement of the foot processes, and an absence ofdeposits. Laboratory records from his hospitalization two weeks earlier revealeda positive Parvovirus B19 IgM (4.31) and IgG (0.12). Based upon these studies, the patient was diagnosed withacute renal failure secondary to parvovirus B19 infection, and underlyingdiabetic nephropathy.

IMPLICATIONS/DISCUSSION: It is important for the general-internist to recognize Parvovirus B19 infection since this ubiquitous,human-specific DNA virus causes a range of symptom severity depending on theage and health status of the human host. For infected adults, 25% areasymptomatic; 50% will present with fever and myalgia; and 25% will have fever,myalgia, arthralgia, and alace-like rash. Inimmunocom-promised individuals (i.e. history of transplants, HIV, and diabetesmellitus), infection can result in a chronic anemia thus requiring IVIGtherapy. In this subset ofpatients, the typical rash or arthropathy may be absent. Parvovirus B19 hasbeen implicated in nephritic and nephrotic syndromes. Although there is no specificantiviral treatment for parvo-virus B19, transfusions and IVIG therapy areuseful in the settings of transient aplastic anemia or chronic infection, especially in immunocompromised patients. Active Parvovirus B19 infection isdiagnosed in an immunocompetent individual by serologic testing for IgM, andviral DNA can be detected in the blood by PCR in immonocompromised individuals.

RAISING THE RED FLAGS Thomas Turnage 1; T Jan1.

1Tulane, New Orleans, Louisiana. (Tracking ID # 8257)

LEARNING OBJECTIVES: 1. Identify red flags in the evaluation of back pain 2. Recognizethe clinical presentation of pheochromocytoma Describe the pathophysiology of pheochromocytomaCASE INFORMATION: A 45 year-old woman presented with five months of progressive right lumbar back painradiating to the right abdomen. She denied any history of trauma orneurological symptoms. Associated symptoms included episodic hot flashes,diaphoresis, and constipation. Her medical history was significant foruncontrolled hypertension. Her back had decreased range-of-motion in the lumbarspine, severe right paravertebral tenderness, but no point tenderness. Abdominalexam revealed a mass 4 cm to the right of the midline and hepatomegally.

Herneurological exam was unre-markable. Abdominal CT showed a 9.5 cm9.5 cm8 cm hypervascular rounded heterogeneous right suprarenal mass. Metaiodobenzylguanide scan identified an area of increased uptake in the samearea. The 24-hr urinary concentrations of dopamine and norepinephrine were 3556 mcg/L and 228 mcg/ L respectively.
IMPLICATIONS/DISCUSSION: Backpain is a common problem encountered by internists. Most patients with backpain lack significant pathology. One approach addresses three aspects: possible underlying systemic process, neurological-compromise, and psychosocial stressors. Cues to an underlying systemic processinclude the patients age, history of cancer, unexplained weight loss,intravenous drug abuse, pain

at night, or failed medicalmanagement. Neurological involvement may manifest with sciatica, pseudoclaudication,bowel or bladder dysfunction, loss of sensation or strength, or gaitabnormalities. Psychosocial distress may lead to pain amplification andprolongation or exhibit as pursuit of secondary gain. Our patient had constantlower right back pain radiating to the abdomen. The results of the abdominal CT confirmed andassociated red flags raised the likelihood for underlying systemic pathology.Arising from chromaffin cells, catecholamine-secreting tumors may developanywhere along the neural crest including paraganglia and theadrenal medullas. The presentation varies widely from anasymptomatic incidental neoplasm to end-organ damage secondary to elevated catecholamines.The classic presentation includes episodes of hot flashes, diaphoresis,hypertension, chest pain, dizziness, syncope, or dyspnea. Epinephrine,norepinephrine, and dopamine are inappropriately secreted inter-mittentlyaccounting for the episodic nature of the symptoms. A general rule has been described for pheochromocytomas: 10% familial, 10% bilateral,10% malignant, 10% extra-adrenal, 10% in children, and 10% incidental.Catecholamine-secreting tumors are rare neoplasms with considerable morbidityand mortality if undiagnosed or untreated. Surgical resection alleviates thesymptoms and often reverses the hypertension. Due to the morbidity associated with delayed diagnosis, physicians must be aware of theclassic signs and symptoms of pheochromocytomas in addition to screening forpotential red flags in the evaluation of back pain.
DUBIOUS TUBERCULOSIS Varsha Somasekharan 1; Anna Postolova 1; Cortni Tyson 1; Chad Miller1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8265)
LEARNING OBJECTIVES: 1. Recognize the clinicalmanifestations of extra-pulmonary tuberculosis. 2. Identify a differential diagnosis of growing neck mass ina young patient from a foreign country.Understand the pathophysiology and treatment oftuberculous versus non-tuberculous scrofula.
CASE INFORMATION: A 26 year-old man presented four-months of a painful, growingleft neck mass with purulent drainage and one week history of a bleeding suprascapularsuperficial skin lesion with pain. The patient tried topical cream and oral penicillinwithout improvement. He reported subjective fevers, chills, nausea and a10-pound weight loss. He denied cough, night sweats, changes in bowel habits,insect bites, recent travel, or sick contacts. He had a recent tooth extractionfrom the right side of the mouth. He immigrated to the United States two yearsago from Guatemala. He had a fever of 100.3. The left neck mass was 3 cm3 cm,round, mobile, firm around the edges, soft in the center, tender, and hyperpigmentedwithout rubor or calor. The suprascapular wound was 3 cm3 cm with irregularborders and scabbing. There wasbilateral inguinal lymphadenopathy. His white blood cell count was 6,000. Totalprotein was 8.6 and albumin was3.6 with a protein gap of 5.0. Ultrasound revealed a 4-5 cm irregularly shaped fluidcollection in the left neck and a 1-2 cm shallow collection deep to the midlinewith no fistulous tract connecting the two. Computed tomography of the neckrevealed bilateral enlarged submandibular lymph nodes measuring
3.52 cm and 31 cm. There was lymphadenopathy along both jugular chains; some nodes hadnecrotic centers. Bilateral lung apices had nodular densities with a smallcavitary lesion in the left. Pathology of the neck mass

revealed granulomatousinflammation with giant cell reaction. Gram stain, GMS stain, PAS stain, andacid fast bacilli (AFB) stain were negative. Culture was positive for Mycobacterium tuberculosis. Sputum AFBsmear was negative; culture was positive for Mycobacterium fortuitum. Blood cultures, RPR, acute hepatitispanel, and HIV tests were negative. The patient was diagnosed with extrapulmonarytuberculosis and discharged home on anti-tuberculous therapy.

IMPLICATIONS/DISCUSSION: Fever and abscess are commonly encountered by the generalinternist. However, the internist must entertain etiologies other than the mostcommon bacterial causes when facing a patient from a foreign country whereother infectious agents are endemic. The global prevalence of HIV/AIDS requiresconsidering other etiologies for an abscess as well as early HIV testing. ThisGuatemalan patients initial presentation was concerning for abscess, but otherpossible diagnoses were malignancy (including lymphoma and head and neckcancers), lymphadenitis, cyst, and Lemierres syndrome. The most commonly seen form of extrapulmonary TB istuberculous lymphadenitis, or scrofula, most commonly in the cervical lymphnodes. Scrofula can be caused by tuberculous and nontuberculous mycobacteria(NTM). Identifying the etiology is crucial in deciding management. Fortuberculous scrofula, surgical treatment alone is associated with high rates ofrecurrence, fistula formation, and possible hematogenous spread.Anti-tuberculous therapy with multiple drugs is indicated.

AXIS OF EVIL? WHEN TO WORRY ABOUT LEFT AXIS DEVIATION Alfred Vichot 1; Alfred Vichot1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8266)

LEARNING OBJECTIVES: 1. Identify the differentialdiagnosis of left axis deviation. 2. Recognize the symptoms and treatment of chronic bifascicular block.Recognize therisk of complete heart block in patients with chronic bifascicular block.

CASE INFORMATION: A 68 year-old manpresents with 3 weeks of chest pain. The patient reports that it is gradual in onset, notassociated with exertion, retrosternal in location, 6/10 on a pain scale, andaching in quality. The patient isunable to recall duration or frequency of pain. The patient denies skin changes, fevers or chills, cough,shortness of breath, prolonged immobility, orthopnea or lower extremity pain.Family history is unremarkable for early atherosclerotic disease. The patient has smoked 2 cigars per dayfor fifteen years. The patient isafebrile, his heart rate is in the 70 s and blood pressures in both arms are140/70. The JVP was notelevated. Point of maximal impulseis nondisplaced. Murmurs andgallops are absent. Lungs are clear. Troponin I is less than 0.01. No cardiomediastinal widening is notedon chest xray. EKG has sinusrhythm with 1st degree AV block, left axis deviation, left anteriorhemiblock and incomplete right bundle branch block. No change is noted when compared with an EKG from 6 yearsago. T wave inversion is noted on2nd EKG 3 hrs later. Mobitz Type I 2nd degree AV block is noted 6 hours afterpresentation. Echocardio-gram isunremarkable. Angiography isnotable for only mild,

non obstructive disease at the origin of the leftanterior descending artery. Temporary venous pacing was performed during left heart catheterization. IMPLICATIONS/DISCUSSION: Left axisdeviation (LAD) is a common EKG finding encountered by the internist. Common causes of LAD areleft ventricular hypertrophy, left bundle branch block, left anteriorhemi-block, inferior myocardial infarction, an elevated diaphragm, andWolf-Parkinson White Syndrome. Bifascicularblock indicates a blockage of any two of the three fascicles of the ventricularconduction system. The combination of both a right bundle branch block and aleft anterior hemiblock is a frequent finding on EKGs. Oftentimes, patients are asymptomaticand do not have underlying coronary artery disease. Patients with chronic bifasicular block typically do notrequire treatment unless they develop second-or third-degree AV block. The risk of progression to complete-heart block in asymptomatic patients with chronic bifascicular block islow.

THE NILE AINT JUST A RIVER Neil Shah 1; Jana Hambley 1; Marcia Glass1. 1Tulane, New Orleans, Louisiana. (Tracking ID # 8270)

LEARNING OBJECTIVES: 1. Understand the epidemiology and pathogenesis of West Nile virus. 2. Understand the clinical manifestations ofencephalitis.Create a method for the diagnosis of West Nile virus infection.
CASE INFORMATION: A 32-year-old manexperienced several days of hallucinations and strange behavior. He was broughtin by a coworker from an industrial ship that had sailed from India. He had been in bed for the past fewdays with fever and sweats. Thepatient appeared anxious, had difficulty answering questions, and was orientedonly to place. He was febrile,tachycardic, and tachypneic. Hehad mild, bilateral ataxia of his upper extremities and an impaired tandem gaitbut was otherwise normal. Thepatient had a microcytic anemia, no leukocytosis, a sodium of 128 mmol/L , anAST of 230 units/L , an ALT of 170 units/L, a creatinine kinase of 7100units/L, and an arterial oxygen of 77 mmHg. Computerized tomography of the chest revealed multiplepulmonary emboli. MRI of brainshowed diffuse cortical atrophy without specific lesions. Cerebrospinal fluid had a normal cellcount. However, fluid analysis waspositive for West Nile Virus antibody.
IMPLICATIONS/DISCUSSION: West Nile virus is amulti-organ infection that infects neurons and spreads through the body. It can lead to motor or sensorydeficits and personality changes. It is important for the internist to recognize encephalitis since manylaboratory tests and imaging techniques may be inconclusive. In our patient with a recent travelhistory, altered mental status, ataxia, and hallucinations, this was animportant diagnosis to consider.West Nile virus wasoriginally confined to South Asia and Africa. WNV, a Flavivirus and member of thearthropod-borne viruses (arbovirus), is asymptomatic in over 80% of cases. However, of those patients withsymptomatic infection, most require hospitalization and develop West Nile fever(WNF), which is characterized by the acute onset of fever, malaise, headache,muscle pain and weakness. Patients should be empiricallytreated while awaiting diagnostic results. Diagnosis of WNV can be performed bydetection of IgM or IgG WNV immunoglobulins. However, IgG detection may indicate a past, rather than acurrent, infection. Microsphereimmunoassays
are a newer and potentially more accurate method. Finally, the virus can be detected inCSF, serum, or tissues by isolation or nucleic-acid amplification tests. Neuroimaging such as MRI can be helpfulin detecting herpes simplex virus, abscess, or fungal etiologies. Our patient exhibited several symptomsof encephalitis, including transaminitis and rhabdomyolysis. The corticalatrophy noted on MRI is a result of a separate chronic disease process that mayhave predisposed him to more serious symptoms related to the virus. The severity of the disease in thiscase likely caused him to be bedridden and placed him in a hypercoagulablestate causing pulmonary emboli. Treatment for West Nile virus is largely supportive care. Pharmacotherapy with interferonand ribavirin has shown mild efficacy in vitro but has not yet been tested inclinical trials.
UNCOMMON THINGS BEING COMMON Luke Taggart 1; Luke Taggart1. 1Tulane, New Orleans, Louisiana.
(Tracking ID # 8277)
LEARNING OBJECTIVES: 1. Recognize the clinical presentation of AcuteAortic Dissection 2. Understand pathophysiology and classification of Aortic Dissection 3. Understand diagnosis and treatment strategies of Aortic DissectionCASE INFORMATION: A 42 year-old woman presented with a 4-day history ofsubsternal chest pain. Pain occurred suddenly while she was at rest, and was described as a stabbing pain radiating to her back and upper abdomen. Deep inspiration worsened the pain and no relieving factors were noted. On the day her pain began, she took one aspirin and was transported by EMS to an outside Emergency Department for evaluation. While there, pain medication slightly improved her pain and a PO analgesic prescription was written until primary care follow-up could be arranged. When symptoms worsened on day 4, she returned for reevaluation. She noted the same location and radiation of pain, which worsened with deep inspiration and emotional stress. Occasionally, it would wake her from sleep and was slightly relieved with hydrocodone. No dyspnea, headache, visual changes, fever, recent illness, trauma, or injury were reported. The patient reported a smoking history of greater than ten years and a remote history of cocaine use, but none in the last 20 years. She was diagnosed with hypertension and Lupus 2 years earlier and had run out of her anti-hypertensive medication 4 days prior to presentation. Blood pressure was 155/121, Oxygen saturation 100% on room air. No

elevation of JVP, murmur, or reproducible chest pain was noted. Lungs were clear. Extremities had bounding pedal pulses but no edema. Troponin was not elevated. CT of the chest revealed an ascendingaorta aneurysm. Transthoracic echocardiogram revealed an aortic dissection extending from the aortic root to the descending aorta. IMPLICATIONS/DISCUSSION: Typical history of aortic dissection is acute onset severe,tearing or knifelike chest pain, back pain. Risk factors can be identified during the interview such as chronic,uncontrolled hypertension, substance abuse, and familyhistory of dissection which may indicate an underlying connective tissue disorder. Exam may reveal hypertension or hypotension, a pulse deficit, differing blood pressures in the upper extremities, and murmur of aortic insufficiency. Patients who develop Aortic Dissection often have risk factors predisposing them to damage of the intimal layer of the vessel.

Through increased wall stress, changes occur which may include aneurysm formation, ulceration, intramural hematoma, or a tear leading to blood dissecting between the medial and adventitial layers. Infarction of the vasa vasorumis is another mechanism leading to increased wall stress on the vessel by intramural hrombosis formation. Complicationsof the dissection include proximal extension of the false lumen, which can involve the pericardial space causing tamponade, aortic valve compromise leading to acute CHF, and obstruction of other major vessels. Chest X-ray abnormalities are presentin 60-90% of cases with definitive evidence of dissection established by using one or a combination of the following imaging modalities: CT, transesophageal echocardiogram, MRI, or angiography. A Stanford Type A dissection (DeBakey Type I, II) ischaracterized by a dissection of the ascending aorta and is a surgicalemergency. Pre-operative medical care includes blood pressure control with beta-blockers and, if needed, IVnitroprusside for vasodilatation. It is important to first achieve adequate beta blockade to avoid reflex tachycardia associated with nitroprusside. Blood pressure control is the mainstay of treatment for aType B aortic dissection, as surgery is usually not required emergently.

FATAL S. BOVIS ENDOCARDITIS WITH NO COLON LESION Manisha Bhide 1; Manisha Bhide2. 1Dept of Gen Int Medicine, Commerce City, Colorado ; 2Dept of Gen Int Medicine UCDenver, Aurora, Colorado.
(Tracking ID # 8285)

LEARNING OBJECTIVES: 1. To review a case of S.bovis endocarditis in a patient with bicuspid aortic valve and a normal colon. 2. Review recommendations regarding bicuspid aortic valvesCASE INFORMATION: 47 yr Caucasian male presented with c/o worsening of chronic back pain, anorexia, fatigue, chills and sweats since many months. Past medical history included chronic back pain, liver cirrhosis due to Hepatitis C, Diabetes, mild aortic regurgitation with bicuspid aortic valve. Pt lost his job and insurance and could not afford medical care for sometime, but had recently returned with above symptoms. Pt denied IV DU.Pt was admitted to hospital. Exam showed 3/6 aortic systolic ejection murmur, bilat 2+ pitting edema, left lower back tenderness. He had leukocytosis at 11,000, INR was1.5. blood culture was positive at day 1 for S.bovis, pansensitive. Pt was started on Ceftriaxone and vancomycin and GI and ID were consulted. MRI back was negative, TTE showed worsening aortic regurgitation but no vegetations. He had persistent bacteremia despite antibiotic therapy. EGD had to be done before TEE due to cirrhosis and risk for portal hypertension. On hosp day 3, pt had severe chest pain, EKG initially showed supraventricular tachycardia with ST- T changes that later became new LBBB with wide QRS and first degree AV block. Troponin progressively increased from 0.6 to2.0 to 116 He had sudden worsening of chest pain and dyspnea due to flash pulm edema. He became hypotensive, but was stabilized with pressors. EGD showed non bleeding varices, TEE showed diffuse thickening of aortic valve leaflets with abscess. Cardiothoracic surgery was consulted but pts general condition worsened. He was made comfort care and died. Autopsy showed large ring abscess with vegetation size 2.52.01.5 cm blocking coronary ostia and obstructing the blood
flow to the heart, causing massive myocardial infarction. Liver showed macronodular cirrhosis with portal

hypertension.No colonic lesions were found, that could account for S.bovis endocarditis.
IMPLICATIONS/DISCUSSION: S. bovis are gram positive Gr. D Streptococci. S. bovis is sensitive to penicillin, cephalosporin and vancomycin. S.bovis endocarditis is a severe disease because it affects multiple valves, has hemodynamically significant valvular regurgitation and may cause myocardial infiltration. The emergence of heart block on EKG is a red flag indicating abscess and myocardial infiltration. Endocarditis has 30 % mortality. Mortality with S.Bovis bacteremia is high in pts with advanced liver disease. The classic teaching is S.bovis endocarditis is strongly associated with colonic malignancy.Review of literature, shows that Origin of Strep bovis-In West, 60 % cases have colonic lesions, 30 % have hepatic pathology. Association with hepatic pathology was more common in East. In pts with cirrhosis, alteration of hepatic secretions and immunoglobulin may permit transmission of S.Bovis from Intestinal tract to portal system and a compromised reticuloendothelial sytem may contribute to S.Bovis septicemia. Bicuspid aortic valves is the most common congenital heart malformation. It is a frequent cause of native aortic valve infective endocarditis. Bicuspid valves incur high risk of abscess formation and require early valve replacement, mainly due to worsening aortic stenosis.In 2006, ACC/AHA provided guidelines for followup of aymptomatic adults with aortic stenosis, based on valve aperture and flow gradient. In 2008, ACC/AHA recommended echocardiographic screening for first degree relatives of pts with bicuspid aortic valve.This case illustrates detail medical care from primary care clinic to ICU and autopsy. A final point to ponder is if he had non-fragmented medical care, had been able to get follow up and early help for bicuspid aortic valve, would he have lead a full life?
PURULENT PERICARDITIS WITH CARDIAC TAMPONADE SECONDARY TO HAEMOPHILUS INFLUENZAE SEROTYPE D Brandon Oberweis 1; Cynthia Chuang2. 1NYU Medical Center, New York, New York ; 2Penn State College of Medicine, Hershey, Pennsylvania. (Tracking ID # 8296)
LEARNING OBJECTIVES: 1. Distinguish healthcare-associated pneumonia from community-acquired pneumonia, in respect to management options 2. Recognize the need for a high index of suspicion in diagnosing and managing purulent pericarditisCASE INFORMATION: A 56-year old immunocompetent female nurse with a recent diagnosis of left upper lobe pneumonia by CT scan, on azithromycin, returns to the emergency department five days after initial presentation with worsening shortness of breath and severe pleuritic chest pain. She was found to be hypotensive, tachypneic, and hypoxic. Examination revealed bilateral jugular venous distension, pulsus paradoxus, and muffled heart sounds. ECG showed diffuse ST elevations suggestive of acute pericarditis. She was rapidly intubated due to impending respiratory collapse. Transthoracic echocardiogram confirmed cardiac tamponade. She underwent urgent pericardiocentesis. Pericardial fluid cultures were positive for Haemophilus influenzae serotype d

beta-lactamase negative. Moxifloxacin, piperacillin-tazobactam, vancomycin, and single dose of tobramycin were started. Her condition improved and she was discharged on a 14-day regimen of ceftriaxone.
IMPLICATIONS/DISCUSSION: Otitis media and respiratory infections are the most common clinical manifestations of Haemophilus influenzae infections. Of the non-Haemophilus influenzae b serotypes, serotype f is the most common in North America. The most common etiology of purulent pericarditis is viral in origin. With the advent of new antibiotic therapy and integration of immunizations, there has been a shift in the bacterial causative agents. Streptococcus pneumonia and Haemophilus influenzae serotype b have decreased in incidence, while there has been an increase in Staphylococcus aureus. Purulent pericarditis is an uncommon, but potentially fatal condition that can progress to cardiac tamponade in rare cases. In this instance both the pericarditis and resultant tamponade were secondary to direct extension of her pneumonic process. Only three cases of purulent pericarditis due to non-serotype b Haemophilus influenzae have been found in the literature, all of which have occurred in immunocompromised patients: two cases were due to H. influenzae serotype f and the third case was due to non-encapsulated H. influenzae. We are unaware of any prior case of purulent pericarditis with cardiac tamponade due to Haemophilus influenzae serotype d in an immunocompetent adult

reported in the literature.This case illustrates the necessity of differentiating community-acquired, healthcare-associated, and hospital-acquired pneumonia. According to the American Thoracic Society Guidelines, health-care workers would be considered to have healthcare-associated pneumonia and should receive ceftriaxone, a quinolone, ampicillin/sulbactam, or ertapenem as the antibiotic regimen. Whether or not a different initial antibiotic regimen would have prevented the subsequent complications, this case presentation highlights the importance of proper history taking and an understanding of the relevant guidelines to provide optimal patient management.

THROMBOANGIITIS OBLITERANS (TAO) IN A YOUNG FEMALE SMOKER: A NEW TREND Deepika Pradhan Shrestha 1; Anthony Donato2. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania ; 2The Reading Hospital and Medical Center, Birdsboro, Pennsylvania. (Tracking ID # 8625)

LEARNING OBJECTIVES: 1. Recognize that Thromboangiitis Obliterans can occur in female smokers and at younger age group. 2. Diagnose thromboangiitis obliterans in patients presenting with digital gangrene.

CASE INFORMATION: A 19 years female smoker sought medical attention for severe pain resulting from gangrene of the right index finger. She admitted to smoking 2 packs of cigarettes for last 6 years. Physical examination was normal with the exception of dry gangrene of right index finger up to the distal interphalangeal joint, and abnormal Allens test on the right upper extremity. All other pulses were present. Extensive lab work for hypercoagulable states including protein C, protein S, antithrombin III, antiphospholipid antibody, anti cardiolipin antibody and lupus anticoagulant were normal. Work up for autoimmune disease including RF, Anti Scl-70, ANA, myloperoxidase antibody, ANCA anti pro-

teinase 3 antibody, C3 and C4 complement level were also negative ruling out autoimmune vasculitis. Hepatitis B and C panel were also negative. Diabetes was ruled out by normal fasting blood glucose. Normal echocardiogram ruled out proximal embolic source. Magnetic resonance angiography (MRA) of the right hand showed complete occlusion of distal ulnar artery and superficial palmar arch consistent with TAO. Diagnosis of TAO was made based on history of smoking, negative work up for hypercoagulable state, autoimmune vasculitis, diabetes, and MRA finding. IMPLICATIONS/DISCUSSION: Thromboangiitis obliterans (TAO) also called Buergers disease is an inflammatory disease of medium and small sized vessels characterized by non atherosclerotic thrombotic vessel stenosis and occlusion. It is classically described to occur predominantly in male smokers between 4045 years of age, however the incidence of TAO is increasing in female and at much younger age because of increasing trend of smoking in females and the trend of starting smoking at early age of life. We conclude from above case that TAO should always be considered in any female smoker presenting with digital gangrene. Autoimmune vasculitis, hypercoagulable state, diabetes and proximal source of emboli should be ruled out before diagnosing patient with TAO. The most crucial treatment of TAO is complete cessation of smoking and avoiding use of any nicotine products.

LYMPHADENOPATHY AS THE ONLY CLINICAL MANIFESTATION OF KAPOSIS SARCOMA: A CASE REPORT Dhvani Thakker, M.D. 1; Svetlana Chernyavsky, D.O. 1; Rebecca Calabrese, M.D.1. 1Beth Israel Medical Center, New York, New York. (Tracking ID # 8641)

LEARNING OBJECTIVES: 1. Identify the possibility of lymphadenopathic Kaposis sarcoma in the absence of cutaneous lesions 2. Assess for lymphadenopathy in an otherwise healthy patientCASE INFORMATION: Patient was a 49-year-old African American male with no past medical history who presented to the emergency room complaining of weakness. He denied any chest pain, shortness of breath, nausea, vomiting, abdominal pain, weight loss or night sweats. On physical exam, he was found to have 3x2cm palpable, firm, non-tender, right axillary lymph node. Rectal exam was Guiac negative. Skin exam was unremarkable for any erythema, plaques, petechiae or purpura. Cardiovascular, lung and abdominal exam were unremarkable. On admission, laboratory findings were significant for hemoglobin of 6.1 and platelets of 10. Chest X-ray was clear. He underwent an axillary lymph node biopsy which was positive for subcapsular foci of Kaposis sarcoma. Subsequently, he was found to be Human Immunodeficiency Virus (HIV) positive with a CD4 count of 58 and he

was started on HAART. Throughout the course of his hospital stay, he developed HIV-related thrombotic thrombocytopenic purpura (TTP) which lead to his demise. IMPLICATIONS/DISCUSSION: Kaposis sarcoma is a vascular tumor that is particularly prevalent in patients infected with HIV. Skin involvement is characteristic for Kaposis sarcoma and extracutaneous spread is common to the oral cavity, gastrointestinal and respiratory tract. AIDS-related Kaposis sarcoma often presents with cutaneous lesions usually as one

or several red/purple macules, papules or plaques. This case demonstrates lymphadenopathy as an important physical exam finding in an otherwise healthy male and how early identification of the primary cause can reduce both morbidity and mortality. AIDS-related Kaposis sarcoma to the lymph nodes is a rare occurrence and it is even less common in the absence of cutaneous lesions. This case is atypical because there were no cutaneous manifestations at the time of the patients presentation or during the hospital stay. The diagnosis of Kaposis sarcoma was not discovered until the lymph node biopsy was positive which further lead to a new diagnosis of HIV/AIDS. While the patient was immediately started on HAART therapy to prevent further morbidity associated with AIDS, he succumbed to TTP. Thus, it is important to recognize lymphadenopathy as a diagnostic tool for uncovering a wide range of diseases.

IT ONLY HURTS WHEN I BREATHE Heather Echols 1;

Heather Echols2. 1Tulane University, New Orleanss, Louisiana; 2Tulane University, New Orleans, Louisiana. (Tracking ID # 8716)

LEARNING OBJECTIVES: 1. Recognize the clinical presentation of Swyer-James-Macleod syndrome inadults. 2. Understand the pathophysiology of Swyer-James-Macleod syndrome. CASE INFORMATION: A 55 year-old woman presentedwith two months of progressively worsening dyspnea on exertion, coughproductive of yellow sputum and occasional hemoptysis. She has noted edema of the lowerextremities. Her lungs were clearto auscultation bilaterally; there was no wheezing or crackles. The JVP was not elevated. There was mild lower extremity edema. Thepatient had a normal ejection fraction and mild pulmonary hypertension bytransthoracic echocardiogram. CTangiogram revealed a hypoplastic right pulmonary artery. The right lung on ventilation perfusionscan had no perfusion, but normal ventilation within the right middle and lowerlobes and decreased activity in the right upper lobe. Pulmonary arteriogram revealed complete occlusion of theright main pulmonary artery. Thesefindings were diagnostic of Swyer-James-Macleod syndrome. IMPLICATIONS/DISCUSSION: Dyspnea on exertion is a commonly encountered problem. An approach to determining the cause ofdyspnea is to investigate each organ system, while allowing the history andphysical to direct us to the appropriate diagnosis. In our patient with dyspnea on exertion, productive coughand occasional hemoptysis, this led us to further investigate the pulmonarysystem. Through imaging we found aventilation perfusion mismatch and hypoplasia of the right pulmonary arterytree thus identifying the lungs as the etiology of the patients symptoms. Dyspnea on exertion is a commonpresentation of Swyer-James-Macleod syndrome in adults. Swyer-James-Macleod syndrome is apost-infectious state secondary to bronchiolitis obliterans. It is usually diagnosed in childhood,but asymptomatic individuals may go undiagnosed until adulthood. Inflammation and fibrosis causesnarrowing in the bronchioles. Thepulmonary capillary bed is secondarily affected, leading to decreased bloodflow to the pulmonary arteries, thereby causing decreased arterial development.Given that dyspnea is acommonly encountered problem, internists must broaden their differentialdiagnosis to include diseases of childhood that may go undiagnosed, but thatpresent in symptomatic adults.

UNEXPLAINED FEVERS IN A HIV PATIENT Cynthia Kay 1;

Cynthia Kay1. 1Medical College of Wisconsin, West Allis, Wisconsin. (Tracking ID # 8721)

LEARNING OBJECTIVES: 1. Recognize infective endocarditis as part of the differential in patients without known cardiac abnormalities or history of injection drug use. 2. Anticipate endocarditis complications.

CASE INFORMATION: A 43-year-old HIV male with a history of non-injection drug use (IDU) presented with fevers for 3 weeks. The patient was in the ED three weeks prior also for fevers. At that time, CXR was negative. He was swabbed for influenza and discharged home with Oseltamivir. Since then, the patient reported continued daily temperatures of 102-103 F. He denied any sick contacts or travel history. Physical exam was unremarkable. Initial laboratory studies were notable for a leukocytosis of 11.6, a positive urine drug screen for cocaine and opiates, and an unremarkable lumbar puncture. A head CT showed subtle areas suspicious for acute infarcts. A source of infection was sought with blood cultures, HIV RNA load, CD4 count, and a multitude of urine and respiratory studies. Temperatures remained consistently elevated but responded to acetaminophen. Infectious disease was consulted and IV vancomycin and pipercillin-tazobactam were started. On Hospital Day 2, the leukocytosis had resolved, and preliminary blood cultures showed gram negative bacilli. Subsequently, a transesophageal echocardiography was performed and revealed mitral valve vegetations, 0.5-0.7 cm in size. By Day 3, the blood culture organism was identified as Haemophilus parainfluenzae, sensitive to ceftriaxone. A PICC was placed, and the patient was discharged home to complete six weeks of IV ceftriaxone. Three months after antibiotic completion, the patient was seen in clinic for complaints of 25 pound weight gain and shortness of breath. He was started on oral furosemide 40 mg daily and was to return for reassessment. IMPLICATIONS/DISCUSSION: Although infective endocarditis (IE) is typically associated with a history of preexisting cardiac lesions or injection drug use, it is important to recognize the diagnosis as part of the fever differential even without such histories. In fact, HIV infection is considered an independent risk factor for IE, especially in those with CD4 counts of less than 200. Additionally, the HACEK group accounts for just 3% of IE but is known to cause native-valve endocarditis in individuals without IDU. The HACEK bacteria normally reside in the oropharynx and are often associated with dental procedures and upper respiratory infections. Disease presentation can include fevers, night sweats, weakness and signs of peripheral embolization. The antibiotic of choice for gram negative endocarditis remains IV ceftriaxone for a minimum of 4 weeks. The recognition and identification of endocarditis is important to not only properly treat it but also to anticipate its numerous complications, such as heart failure. Cardiac complications affect 30-50% of IE patients, with congestive heart failure being the most common cause of death due to IE in the modern era. Its development can vary from an acute initial

presentation to one that is more gradual, sometimes manifesting even after antibiotic completion. Other sequelae of infection consists of embolisms, brain abscess and seizures. Long term survival following endocarditis is lower than that of the general population, with approximately 80% at 5 years and 50% at 10 years. S. aureus infection and association with heart failure, diabetes, embolic events, and large vegetation size also portend a poor prognosis.

P S E U D O P H E O C H R O M O C Y T O M A : A C O M M O N PRESENTATION YET UNDER RECOGNIZED DIAGNOSIS Amy DeGueme 1; Kavita Naik 1; Kurt Pfeifer1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 8733)

LEARNING OBJECTIVES: 1. Recognize the criteria for diagnosing pseudopheochromocytoma 2. Distinguish among the common conditions which can cause paroxysmal hypertension CASE INFORMATION: A 40 year-old woman with a history of hypertension presented with elevated blood pressures and intermittent symptoms of flushing, palpitations, chest pain, and diaphoresis. Initially the patient was normotensive with an unremarkable exam. Several hours later, she was noted to have a blood pressure of 203/104 mmHg and was profusely diaphoretic, tremulous, tachycardic, and expressed a sensation of extreme anxiety. Her face was flushed and warm while her hands and feet were cool and cyanotic. This episode lasted for one hour, after which she returned to her baseline state. Evaluation for a pheochromocytoma was initiated during the paroxysm, showing grossly elevated serum catecholamines. A 24-hour urine collection for metanephrines was also initiated and later found to be within normal limits. Repeat measurements of serum metanephrines and catecholamines were

drawn when the patient returned to her baseline state and were also found to be within normal limits. An abdominal CT showed no adrenal lesions, and subsequent PET and MIBG scans were without any evidence of catecholamine-secreting lesions. After exhaustive evaluation, the patient did note that she owned and operated a high stress law firm and that her father was recently diagnosed with a terminal condition to which she had not been coping well. A psychological evaluation was offered but declined. The patients symptoms and blood pressure responded well to alpha and beta blockade with intravenous labetalol, and she was discharged home with oral labetalol. Based on her failing to meet diagnostic criteria for pheochromocytoma, she was diagnosed with pseudopheochromocytoma. IMPLICATIONS/DISCUSSION: Pseudopheochromocytoma is a constellation of clinical findings seen in patients with paroxysmal hypertension and negative workup for secondary causes, including pheochromocytoma. Observational symptoms include a paroxysmal nature, association with tachycardia, increase in plasma catecholamines documented during attacks, increase in baseline plasma epinephrine and metanephrines, and response to alpha/beta blockade. The underlying mechanism of sympathetic activation is unclear but appears to involve emotional factors. Diagnosis is considered if the hypertensive episodes are characterized by the following three features; an abrupt elevation of blood pressure (which can be greater than 200/110 mmHg in some patients); equally abrupt onset of distressful physical symptoms, such as headache, chest pain, dizziness, nausea, palpitations, flushing, and diaphoresis; and attacks are not triggered by fear or panic.

With elevated plasma catecholamines, a pheochromocytoma needs to be excluded via imaging studies or a clonidine suppression test. If pheochromocytoma is excluded, then the patient would be considered to have pseudopheochromocytoma. Management includes antihypertensive treatment with alpha and beta blockade to control symptoms related to high sympathetic activity. Psychopharmacologic agents can be effective in eliminating paroxysms and restoring a normal quality of life in patients in whom severe or very symptomatic paroxysms recur despite alpha and beta blockade. Finally, psychological interventions are considered the only potential cure for pseudopheochromocytoma, yet this is only effective in those patients that can identify an emotional basis to their symptoms.

DO NO HARM George Bensabat 1; George Bensabat2. 1Tulane University, New Orleans, Louisiana ; 2Tulane University, New Orleans, Louisiana. (Tracking ID # 8829)

LEARNING OBJECTIVES: 1. Recognize the complications of glucocorticoid therapy. 2. Identify the clinicalpresentation of hyper-osmolar non-ketotic syndromeCASE INFORMATION: A 25 year-old woman presentedwith five days of blurry vision, generalized weakness, polydipsia and polyuria.She was diagnosed with Systemic Lupus Erythematosus a month prior and wastreated with prednisone and hydroxychloroquine. She denied nausea, vomiting,chills or fever. She was treated for PID with ciprofloxacin a month ago. She also has hypertension and previousscreening for Diabetes Mellitus (DM) was normal.She wasafebrile with a blood pressure of 150/70 and pulse of 99 beats per minute. She had dry mucous membranes. She wastachycardic and had diffuse abdominal tenderness. Laboratory testing revealed a potassium level of 7.3 mEq/Land a serum glucose of 1581 mg/ dL with an anion gap of 14. ABG revealed pH of 7.39 and a PCO2 of50 mmHg . There were no urine orserum ketones. EKG revealed peakedT waves in the lateral leads. Thepatient was treated with intravenous normal saline, insulin drip, and calciumgluconate. The next day the potassium was 2.9 mEq/L and serum glucose was 129 mg/dL. She was diagnosed with hyperosmolar nonketotic (HONK) hyperglycemiainduced by glucocorticoid therapy.

IMPLICATIONS/DISCUSSION: Glucocorticoid inducedhyperglycemia is commonly encountered by the general internist. It is welldocumented in diabetics and patients with impaired glucose tolerance and. However, it is rare in patients with-outDM or impaired glucose tolerance. Although the treatment forsteroid induced hyperglycemia is identical to treatment for diabetichyperglycemia, the course of hyperglycemia is different. In the case of steroids,hyperglycemia usually ends with the cessation of glucocorticoid. Newly started steroids have more effecton glucose metabolism than chronic glucocorticoid use. Our patient will notneed treatment for

hyperglycemia if steroids are tapered and discontinued. The hyperglycemia will also become lesspronounced overtime if she remains on chronic steroid therapy. Patients presenting with HONKhyperglycemic states are total body potassium depleted. However, some present with an elevatedpotassium. Hyperosmolality of the serum and lack of insulin causes potassium toshift from within the cells to the serum. This phenomenon occurs when decreased intracellular water causesincreased intracellular potassium concentration. This promotes efflux of potassium-

from cells. Potassium may alsoenter the serum during the efflux of water from the cell, also known as the solvent drag effect. Thus highpotassium levels must be analyzed vigilantly during treatment of HONKhyperglycemic state, and potassium should be supplemented as serum levelsnormalize. Our patientdemonstrated this effect as her potassium levels fell to2.9 after treatment.Amongstthe various side effects of glucocorticoid use, hyperglycemia and DM are moreconcerning. The internist shouldbe aware of this rare presentation of glucocorticoid induced HONK state to beable to recognize it in a timely manner.

CHEST PAIN FROM A KISSING BUG Erin Boswell 1; Irene Grundy 2; Natalie Rodden 2; Chayan Chakraborti2. 1Tulane University, New Orleans, Louisiana ; 2Tulane University, New Orleans, Louisiana. (Tracking ID # 8836)

LEARNING OBJECTIVES: 1. Identify the historicalclues that would increase the pre-test probability of Chagas in a patient with angina. 2. Recognize clinicalcircumstance in which Chagas disease should be appropriately included on thedifferential diagnosis.

CASE INFORMATION: A 59-year-old Hispanic manpresented with three days of intermittent substernal chest pain radiating tothe left axilla, occurring at rest, and associated with shortness of breath,diaphoresis, and nausea. His pastmedical history was significant for hypertension. On presentation, thepatients blood pressure was 170/103 and he was bradycardic; all other vitalsigns were normal. Physicalexamination including cardiovascular exam was unremarkable.Laboratory studies revealed anormal complete blood count and basic metabolic panel. Initial cardiac troponins were0.07-0.08 ng/mL. ECG demonstratedsinus bradycardia, low voltage QRS, left anterior fascicular block, and atrialabnormality. A dobutamine stressechocardiogram showed moderate left ventricular systolic dysfunction (EF of35%) and segmental wall motion abnormalities. Coronary angiography revealed non-ischemic cardiomyopathy,akinetic left ventricle, and an apical aneurysm.These findings suggested myocarditis, inparticular, Chagas disease, which was confirmed with a positive Trypanosoma cruzi IgG. Further questioning of the patientrevealed that he lived until age 40 in an adobe construction house in ruralGuatemala. He also complained ofdifficulty swallowing and nearly daily vomiting.

IMPLICATIONS/DISCUSSION: In 1909, Brazilian physician CarlosChagas identified an infectious tropical disease caused by the parasite Trypanosoma cruzi, named after acolleague, Dr. Oswaldo Cruz. Paleoparasitology data suggest Chagashas existed for approximately 9000 years. Transmission occurs via the bite of an infected triatomine insect, or kissing bug, endemic to the Americas. Triatomes thrive in low socioeconomic, rural areas of Latin America withpoor housing conditions such as mud walls and thatched roofs. Immigration has transformed Chagas intoan important public health issue in the U.S. with an estimated 300,000immigrant cases.Cardiac manifestations of Chagasinclude biventricular enlargement, thinning of the ventricular walls, damage tothe cardiac conduction system and development of apical aneurysms, resulting insymptoms of heart failure, palpitations, syncope, and thromboembolicdi-

sease. Atypical chest painrelates to microvascular perfusion defects. ECG findings may include right bundle-branch block, leftanterior fascicular block, bradycardia, ventricular premature beats, lowvoltage QRS, and high-degree heart block. Gastrointestinal involvement is less common but can result insignificant morbidity from dilation of the esophagus or colon.Our patient exhibited conductionsystem abnormalities, dilated left ventricle

and apical aneurysm, all common inChagas disease. The patientsdescription of typical chest pain led us to evaluate for ischemic causes. However, demographics, ECG, angiographyresults, and GI complaints suggested infectious cardiomyopathy. While a thorough workup for ischemiawas unavoidable, this case reinforces the importance of historical clues anddemographic data in making the diagnosis.

WHEN TUMOR IS THE RUMOR (THE CONVERSE CAN ALSO BE TRUE) Melanie Sheen 1; Melanie Sheen1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8866)

LEARNING OBJECTIVES: 1. Identify differential diagnosis for lung and breast masses 2. Identify differential diagnosis for metastatic diseaseCASE INFORMATION: A 78 year-old woman presented with one month of weakness andfalls. She had a 50 lb weight loss over the previous year. Previously, she wasdiagnosed breast cancer and treated with a lumpectomy, chemotherapy andradiation. She moved to Texasfollowing Hurricane Katrina and was lost to follow-up. She had a 62-pack-year history ofsmoking. She had decreased strength in both lowerextremities. Otherwise, the physical exam was unre-markable. Chest X-Ray wassuspicious for two masses in the left lung. Chest CT confirmed two (5x6cm and 2.3x2.6 cm) masses, andmany lymph nodes and subpleural nodules in both lung fields. There weremultiple nodular densities in the right breast. Ultrasound revealed two lesionsin the right breast . Ultrasound guided biopsy revealed moderate to poorlydifferentiated squamous cell carcinoma with squamous pearl formation, withoutany evidence of mammary tissue. Tumor cell markers were consistent with a primary pulmonaryetiology. Biopsy of the lung massrevealed scattered squamous cells that expressed p63. The patient was diagnosedwith primary squamous cell lung carcinoma metastatic to the right breast. IMPLICATIONS/DISCUSSION: Breast and lung masses are both frequently encountered ininternal medicine. Breast canceris the most commonly diagnosed malignancy in Louisiana women, while lungcancer, on the rise, is the second most prevalent [1]. In patients with a previous history ofbreast cancer, there is a greater risk for treatment-related second primarycarcinoma, especially in patients who receive radiation therapy [2]. The reported patient received radiationtherapy as a part of her breast cancer treatment nine years earlier. Additionally, she had a significantsmoking history, putting her at a greatly increased risk for a second primarymalignancy, namely lung cancer [5,6]. In general, metastases to the breast fromextramammary sites are rare. Shetty, Ahmed, and Khan discovered only 431 cases of extramammarycarcinoma metastatic to the breast over a course of 138 years [3]. Of these cases, lung cancer was thesecond most-likely primary site to metastasize to the breast. Additionally, a

Taiwanese casereport from 2008 reports the incidence of squamous cell carcinoma metastasizingto the breast [4]. When faced witha patient with a breast mass, physicians cannot overlook the possibility thatthe mass could be metastatic from of an extramammary site. Additionally, it is important whenevaluating new lesions in breast cancer patients to take into account smokingand treatment history. New primarylesions, and metastases thereof, should be on the differential.

CELIAC CURVEBALL Jamie Nguyen 1; Cortni Tyson 2; Marcia Glass2. 1Tulane University, New Orleanss, Louisiana ; 2Tulane University, New Orleans, Louisiana. (Tracking ID # 8867)

LEARNING OBJECTIVES: 1. Recognize uncommon clinical presentations of vasculitides 2. Identify the differential diagnosis of abdominal pain. Understand the pathophysiology and treatment of vasculitides. CASE INFORMATION: A 47-year-old woman presented with atwo-day history of lower-back pain and acute onset of abdominal pain, whichwoke her up the previous night and was associated with an episode of nausea andemesis. She was afebrile with avery elevated blood pressue. Shewas tender to palpation in the epigastric region and left-upper quadrant withno rebound or guarding. Thelower-back pain was aggravated by lying down and relieved by sitting. The patient reported a history ofhypertension, gastroesophogeal reflux, gastric ulcers and gastric-bypasssurgery. Review of systems wassignificant for a one-day episode of gastroenteritis the previous week.CT scan showed stranding and inflammatory changessurrounding the celiac artery with focal dilatation of 8 mm at thetrifurcation. A CT angiogramrevealed moderate, segmental narrowing of the proximal

and mid-celiac axis withdistal dilatation. A soft-tissue densitysurrounded the celiac axis and common hepatic artery and extended to the levelof the porta hepatis. Both studieswere suggestive of vasculitis. Laboratories studies were unremarkable onadmission. ESR, CRP, C3, C4, ANA, ANCA panel, RPR, cardiolipin antibodies, HIV, and hepatitis serology were allnormal. The patient was initiated on a three-day course of pulse steroids with aprobably diagnosis of celiac-artery vasculitis. Her abdominal and lower-back pain resolved with treatment,and we discharged her on a steroidIMPLICATIONS/DISCUSSION: Abdominal pain is a common problem encountered bythe general internist. It isimportant to have a method in identifying the etiology of pain in order toavoid missing less common diagnoses. One method is to identify each abdominalorgan and determine if the problem is secondary to an infectious, ischemic,functional, or traumatic insult. Our patient had inflammatory changes in herceliac artery. These vasculitic changesmay have caused pain secondary to ischemic changes in the region. Vasculitides are often a result of immune-mediatedor infectious causes. Immune-mediated processes can be secondary to immune-complex deposition,anti-neutrophil cytoplasmic antibodies, or anti-endothelial cell antibodiesthat directly or indirectly induce vascular injury. Infectious vasculitides may be secondary to direct invasionor hematogenous spread. It isimportant to identify the etiology since steroids and anti-inflammatory agentsare used for immune-mediated
vasculitides. Diagnosis is based on clinical presentation, serologicmarkers, biopsy, and imaging. Withlaboratory results pending, our patient responded to empiric treatment withpulse steroids. Serological andinflammatory markers indicative of a vasculitis were normal, which speaksagainst the diagnosis. However,her imaging studies and clinical response to therapy suggested an isolated,celiac-artery vasculitis without systemic involvement.Although uncommon, vasculitides can have variouspresentations. It is important,therefore, for the internist to recognize this disease as a possibility whenfaced with common symptoms such as abdominal pain.
THE PAINTED SAILOR: TATTOO-INDUCED VASCULITIS Stacy Lauren Coulthard 1; Walter Downs1. 1Naval Medical Center Portsmouth, Portsmouth, Virginia. (Tracking ID # 8868)
LEARNING OBJECTIVES: 1. Diagnose a rare hypersensitivity vasculitis limited to cutaneous manifestations. 2. Recognize the potential impact on deployment and duty status of an active duty service member as a result of a localized and self-limited hypersensitivity reaction.
CASE INFORMATION: The patient is a 21 year-old active duty male with no significant past medical history who presented to the emergency department complaining of five days of a bilateral lower extremity rash and arthralgias. The patient had undergone tattooing of his right posterior leg 2 weeks prior to presentation with development of a pruritic rash at the site of the tattoo. The rash spread over bilateral legs and thighs despite treatment with antibiotics and oral steroids. Upon presentation, the patient had lower extremity palpable purpura. Laboratory evaluation was significant for leukocytosis (12,300/mcL) without left shift, elevated CRP of13.1 mg/L, and normal ESR. Other laboratory data were normal including electrolytes, coagulation studies, compliment levels, CH50, RF, anti-CCP antibody, ANCA, ANA, anti-Smith, RPR, HIV, viral hepatitis panels, cryoglobulin levels, parvovirus B19, and lyme titer. A wound culture obtained prior to antibiotics showed no growth. Blood cultures obtained at presentation were negative. Due to a clinical suspicion for vasculitis, the patient was started on intravenous steroids. Skin biopsy showed an early leukocytoclastic vasculitis. The patient was diagnosed with a tattoo-induced hypersensitivity vasculitis, treated with oral steroids and colchicine, and placed on limited duty status. After discharge, the patients clinical course was complicated by infection of ulcerated wounds with E.coli requiring antibiotic therapy. The patient was also re-admitted several months after initial diagnosis for bilateral lower extremity DVT and pulmonary embolism secondary to immobility. Ultimately, the patient appeared to have a limited clinical response to prednisone and colchicine, and was placed on monthly IVIG therapy (2gm/kg/month) in addition to steroids. There were marked improvements in the rash and clinical symptoms after initiating IVIG treatment. IMPLICATIONS/DISCUSSION: Available case reports of tattoo-induced vasculitis describe hypersensitivity to brightly colored tattoo ink for up to one year after diagnosis. The long-term treatment often focuses on suppressive therapy until the immune system auto-desensitizes. This

case features a rare case of cutaneous hypersensitivity vasculitis

after tattooing, which resulted in significant comorbidity, multiple hospitalizations, and duty status restriction of a United States sailor.
WHEN CULTURES FAIL, PCR GETS TO THE HEART OF THE MATTER: THE USE OF PCR IN THE DIAGNOSIS OF CULTURE-NEGATIVE ENDOCARDITIS Michael Wagner 1;
CDR Jeffrey Tjaden1. 1US NAVY, Portsmouth, Virginia. (Tracking ID # 8869)
LEARNING OBJECTIVES: 1. Recognize available tools for the successful diagnosis of the specific pathogen in culture-negative endocarditis to include PCR of valvular tissue. 2. Summarize recent literature regarding speciation and culture-negative endocarditis.
CASE INFORMATION: The following is a case of an active duty male with culture-negative endocarditis (CNE) found to have Aggregatibacter aphrophilus. The patient is a 53 year old physician who developed progressive fatigue, fevers, night sweats, and headaches shortly after deploying to Iraq. Symptoms did not resolve after conservative measures and continued despite treatment with 5 days of azithromycin for a presumed sinus infection. Weeks later he was found to have persistent fevers, thrombocytopenia, elevated liver associated enzymes, and 20 lb weight loss requiring transfer to Naval Medical Center Portsmouth for further evaluation. Although febrile(103F) and with markedly elevated C-reactive protein on presentation, initial blood cultures were negative despite extended incubation and terminal subculture. MRI of the brain obtained for persistent retro-orbital headachesand left inferior quadrant hemianopsia revealed multifocal regions of acute ischemia. He was found to have two vegetations on the posterior leaflet of themitral valve by trans-esophageal echocardiogram. An extensive workup to obtain microbio-logic diagnosis to include multiple cultures (bacterial, fungal, mycobacterial) from the blood, urine, CSF, and bone marrow as well as serologic testing for Coxiella burnetii, Brucella species, and Bartonella species was negative. The patient was treated for CNE (possible endocarditis by modified Duke Criteria) with 30 days of gentamicin and 42 days of vancomycin (PCN allergy) plus ciprofloxacin. Due to worsened symptomatic mitral regurgitation, the patient required a posterior leaflet resection and primary reconstruction. Special stains did not reveal any organisms, and bacterial, fungal, and mycobacterial cultures of the valve were finalized as negative. PCR testing on valvular tissue using 16S rDNA primers were positive for Aggregatibacter aphrophilus.
IMPLICATIONS/DISCUSSION: A. aphrophilus, formerly known as Haemophilus aphrophilus, one of the HACEK organisms, is a fastidious gram-negative bacillus found in oral flora and traditionally associated with causing CNE. Recent literature challenges this concept, placing additional emphasis on zoonotic agents as well as organisms partially treated withantibiotics. In this setting, using PCR to identify causative organisms may represent a more useful strategy than extending cultures. Although in our patient, surgery was performed after empiric antimicrobial treatment course, PCR of infected valvular tissue can be utilized to secure diagnosis, expedite appropriate tailored therapy, and optimize antibiotic treatment post-surgery. To our knowledge, this is the first
described case in a patient with CNE where Aggregatibacter aphrophilus was identified by PCR 16S rDNA analysis from the infected valve.
RENAL INFARCTION IN A COCAINE USER WITH POSITIVE ANCA. Ana Cecilia Ortiz 1; Phuong-Chi Pham1.
1UCLA-Olive View Medical Center, Sylmar, California. (Tracking ID # 8873)
LEARNING OBJECTIVES: 1. Recognize the myriad of etiologies of renal failure in cocaine users. 2. N/ACASE INFORMATION: A 52 year-old female, active intranasal cocaine user, with a history of hepatitis C and Staphylococcus aureus endocarditis, presented with multiple purplish to black lesions on her nose tip, fingers, and toes over 23 days. On physical exam, she was afebrile, with blood pressure 90/50 mm Hg (her baseline),

normal pulse and respiratory rate. Her skin had multiple large necrotic lesions on the nose tip, fingers and toes. Heart had regular rate and rhythm without murmurs. Lungs had a few bibasilar crackles. Abdomen was unremarkable. Extremities had no edema. Laboratory findings were remarkable for blood urea nitrogen 42 mg/dL, creatinine 4.8 mg/dL (baseline of 1) that peaked to 6.2 mg/dL on day 7, creatinine phosphokinase (CPK) 15 U/L. Serologies including cryoglobulins, complements, c-reactive protein, and anti-nuclear antibodies were negative. Perinuclear anti-neutrophil cytoplasmic antibody (p-ANCA) titer was 100 (normal less than 6). Urinalysis revealed trace proteinuria and numerous muddy brown casts. Transthoracic echocardiogram was negative for vegetations and blood cultures were negative. Nuclear renal scan revealed absence of right renal function.
IMPLICATIONS/DISCUSSION: Cocaine users can present with acute kidney injuries due to common etiologies including rhabdomyolysis, subacute bacterial endocarditis with septic emboli, or acute tubular necrosis associated with hypotension or volume depletion. Associated hepatitis B/C infections may lead to membrano-proliferative glomerulonephritis (MPGN) with or without cryoglobulinemia. This patients positive hepatitis C and p-ANCA were concerning for MPGN and ANCA-associated vasculitis, respectively. However, the lack of urinary red blood cell casts and significant proteinuria, normal complements, and negative cryoglobulins did not support either diagnosis. Of note, false positive p-ANCA, not specific for myeloperoxidase or associated with vasculitis, has been well-described in intranasal cocaine users.The presence of numerous muddy brown casts suggested an ischemic state, but there was no evidence of systemic hypoperfusion present. The absence of right renal function on renal nuclear scan suggested complete infarction. Although rare, renal infarction has been reported with cocaine use that may or may not lead to adequate functional recovery. This patient was treated supportively with fluid administration; she had good renal recovery at 2-month follow-up with serum creatinine 1.27 mg/dL. Repeat renal scan revealed normal bilateral renal perfusion and elimination. The current case demonstrated a rare renal complication in a cocaine user. Systemic thrombotic complications in cocaine users can lead to diffuse necrotic skin lesions and renal infarction. The concomitant presence of ANCA and necrotic skin lesions may lead clinicians to suspect systemic

vasculitis, leading to treatment with immunosuppressive therapy. Awareness of ANCA-pseudovasculitis as well as systemic thrombotic complications in cocaine users can spare patients from the use of potentially toxic immunosuppressive therapy.
NOT YOUR TYPICAL PLEURAL EFFUSION (AN EFFUSION BY ANY OTHER NAME) Alice Egan 1; Henry Hefler 1; Domnica Fotino1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8905)
LEARNING OBJECTIVES: 1. Recognize hepatic hydrothorax as a cause ofcardiopulmonary distress 2. Understand the pathophysiology, diagnosis andmanagement of hepatic hydro-thorax Recognize spontaneous bacterial empyema as acomplication of hepatic hydrothoraxCASE INFORMATION: A 63 year-old man with hepatitisC presented with one week of progressively worsening shortness of breath and increase abdominal girth. He denied cough, chest pain, orthopnea,PND, extremity swelling, sick contacts, abdominal pain, or bleeding. Vitals were temperature 99.1 F,heart rate 140 bpm, blood pressure 93/ 71 mmHg, respiratory rate 22, SaO2 of 96%on room air. He was in respiratory distress with jugular venous distention-noted 3 cm above the clavicle. Breath sounds were absent in the right lungfields. His abdomen was distended with a positive fluid wave.Laboratory studies revealed analbumin of 1.9 gm/dL, platelets of 143 k/mL, and INR 1.5. CXR demonstrateda complete opacification of the right hemithorax with a left sided mediastinalshift. Following thor-acentesis the patients dyspnea improved significantly; studies revealed a transudative fluid that grew Acinetobacter. Aparacentesis was consistent with cirrhosis without spontaneous bacterialperitonitis (SBP).
IMPLICATIONS/DISCUSSION: Hepatic hydrothorax (HH), asignificant pleural effusion in a cirrhotic patient without underlying cardiopulmonarydisease, is a rare complication of portal hypertension with a prevalence of5-12%. The leading proposed mechanism is leakage of ascitic fluid viadiaphragmatic defects into the negative

pressure intrapleural space duringinspiration. Diagnostic work-up includes chest x-ray, thoracentesis to exclude othercauses of pleural effusions, CTof the chest to exclude mediastinal, pulmonary, and pleural lesions andabdominal US with Doppler to examine the liver and ascertain the patency ofportal and hepatic veins. There are reported cases of HH in the absence ofascites, making it difficult to correlate the relation of cirrhosis withpleural effusions. Treatment is targeted at theunderlying disease and usually involves liver transplantation. Medical managementincludes sodium and fluid restriction, and diuresis. Thoracentesis may beindicated for symptomatic relief; alternatively, TIPS may be considered as abridge to liver transplantation for patients with refractory ascites and HH. Spontaneous bacterial empyema(SBEM) is a distinct and seriouscomplication of HH. Diagnostic criteria includes serum/pleural fluid albumingradient greater than 1.1, polymorphonuclear count greater than 500 or positivefluid culture, and the absence of infectious process on chest x-ray. Initially it was thought to beassociated with concurrent SBP. However, recent reports have shown 45% of SBEMoccurred independently of SBP.This patients respiratorycompromise was thought to be secondary to his HH since his acute symptomsresolved with thoracentesis. His diagnosis was further complicated by SBEM,which was successfully treated with imipenem. Although rare, this caseillustrates the need to consider hydrothorax and its sequellae when evaluatinga cirrhotic patient.

A DIFFERENT TYPE OF FAILURE IN MAKING THE DIAGNOSIS Sancia Ferguson 1; Sancia Ferguson1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8910)

LEARNING OBJECTIVES: 1. Understand the presentationof pericarditis, pericardial effusion, and cardiac tamponode 2. Recognize the differencebetween uremic pericarditis and dialysis pericarditis Identify the treatments foruremic pericarditis and dialysis pericarditisIdentify the treatments foruremic pericarditis and dialysis pericarditisCASE INFORMATION: A 70 year-old manpresented with 2 days of dyspnea, orthopnea and pink-tinged sputum. He also had diaphoreses andpalpitations. He had ESRDsecondary to hypertension.His heart sounds were muffled, with a 3/6holosystolic apical murmur and an S4. The was no JVD or peripheral edema. Theechocardiogram showed an ejection fraction of 60%, grade II diastolic dysfunction, left and rightatrial enlargement, moderate aortic, mitral, and tricuspid regurgitation, and amoderate pericardial effusion posterior to the right atrium. The pulmonary artery pressure was 45.

IMPLICATIONS/DISCUSSION: Dyspnea is a frequent presentation in patients with ESRD. They often have comorbidities and asystematic approach to dyspnea will often lead to more traditional diagnoses. Its important to consider the possibility of pericardialeffusion and pericarditis. Classic pericarditisincludes pleuritic pain that dissipates with leaning forward and increases whenrecumbent. Systemic symptomsincluding fever, chills and malaise, and weight loss can occur and a pericardialfriction rub may be present. Pericardial effusions can develop as a result of pericarditis and canmanifest as dyspnea, particularly orthopnea, ortho-static hypotension and cough.Exams suggest pericardial effusion or cardiac tampanode includemuffled heart sounds, pulsus paradoxus, dullness to percussion, egophony, andbronchial breath sounds may be heard at the tip of the left scapula resultingfrom compression of the left lingula by the pericardial fluid. Patients with uremic pericarditis manifest prior to or within eight weeks of beginning dialysis. Patients with dialysis pericarditis develop symptoms after receiving dialysis for more than 8 weeks. Developing pericarditis signals impending death. The resolution of pericarditis in mostpatients after 10 to 14 days of dialysis supports the hypothesis that uremicpericarditis is the result of retention of unidentified toxic metabolites. Another hypothesis is that immunologicinjury to pericardium mediates uremic pericarditis because there is an increase of uremic pericarditis during stress. Etiology of dialysis pericarditis isnt clearly elucidated either. Its difficult to attribute pericarditis to abuild up of toxic metabolites in hemodialysis patients. Patients respond to a 1014 day intensification of dialysis. Unstable patients with largepericardial effusion, with demonstrable chamber compromise on echocardiogramshould be treated with percardiectomy, pericardial window, or pericardiostomyand pericardiocenticis as a last resort.

JGIM

ABSTRACT

TILTING TOWARDS THE DIAGNOSIS Jason Halperin 1; Jason Halperin1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8916)
LEARNING OBJECTIVES: 1. Understandthe differential diagnosis of syncope 2. Recognizethe differential diagnosis of vasovagal syncope. Recognizethe utility of the tilt table test for diagnostic purposes.
CASE INFORMATION: A 60 year-old woman presented with sudden loss of consciousness. She was conversing with her neighborwhen she had a suddenly has blurry vision and passed out. Upon waking, she denied palpitations,chest pain, loss of bowel or bladder control, unilateral weakness orconfusion. Her neighbor reportedno twitching of extremities, lip smacking, tongue biting or abnormal eyemovements. She denied polyuria or diarrhea. She had a history of frequent fallsfor a year with resultant fractures. Her medications included amlodopine andlisinopril.Her supine-heart rate and blood pressure were 82 and 162/87, respectively. While upright,her heart rate and blood pressure were 96 and 109/64, respectively. Her oral mucosa-were moist. She had no cardiac murmurs or carotid bruits. Her physicalexamination, including neurological exam, was normal. Herelectrolytes, cardiac enzymes, hematologic studies and EKG were unremarkable.She had a normal echocardiogram, carotid ultrasound, head CT, MRI/MRA, and EEG.A tilt table test was positive for neurocardiogenic syncope.
IMPLICATIONS/DISCUSSION: Syncope is acommonly encountered presentation by the general internist. Neurocardiogenic causes of syncope arecommonly overlooked in the elderly, as the focus is on cardiac arrhythmias,valvular disease, stroke or seizure. The use of the test is limited byavailability of the test. The prevalence of orthostatic hypotension as a causeof syncope is 12%.The sensitivityof the head-tilt test to diagnose neurocardiogenic syncope is between 32-85% withspecificity over 90%. The head-tilt table test mimicsorthostatic stress, resulting in maximal venous pooling, central hypovolemiaand provocation of vasovagal syncope. Patients with syncope have impairedvasoconstriction of splanchnic and skeletal vascular beds, leading toexaggerated left ventricular contraction and sympathetic stimulation. The head-tilt test elicits thesehemodynamic and neuroendocrine changes, provoking arterial hypotension andcatecholamine surge that precede syncope. Treating neurocardiogenic syncope isdifficult. Pharmacologic interventions aim to treat orthostatic hypotension byperipherally vasoconstriction (midodrine) or increasing the preload. Elderlypatients frequently have supine hypertension and orthostatic hypotension andare dependant on nonpharmacologic treatments. Non-pharmacologic intervention-sinclude potural training. Physical counter maneuvers such as stooping,squatting, and leg muscle tensing may be helpful. Custom fitted elasticstockings and abdominal binders may help decrease venous pooling. Antihypertensivesthat cause orthostatic hypotension should be discontinued. Neurocardiogenic syncope is often overlooked in theelderly, as the focus is on morbid causes of syncope. However, as our patient demonstrates, vasovagal syncope canhave severe morbidity and should be confirmed with a head-tilt test in apatient without a known cause of orthostatic hypotension.
A TALE OF TWO CHEST PAINS Andrea Germond 1; David Grew 1; Chayan Chakraborti1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8920)
LEARNING OBJECTIVES: 1. Demonstrate the diagnostic value of physical examfindings and tests in the evaluation of chest pain. 2. Recognize the methodology of formal Bayesian riskassessment.
CASE INFORMATION: The juxtaposition of two clinical situations may uncover anunexpected teaching point as was the case of two patients with chest pain thatprompted a discussion of clinical reasoning and formal risk assessment. The first patient was Ms. S, a 47-year-old female smokerwith hypertension. Ms. Ss chestpain occurred after eating breakfast with an intensity of 10/10. The pain wasleft-sided, sharp, and radiated to her neck. The pain was intermittent with episodes lasting 12 minutes.She reported diaphoresis, dyspnea, and palpitations but denied nausea. Her onlymedication was amlodipine and she took an aspirin after the onset of chestpain. Sublingual nitroglycerin relievedthe pain. The second patient was Mr. H, a 52-year-old man with-previous history of MI, hypertension, and remote cocaine use. He reported suddenonset pressure-like,

substernal pain, 10/10 in intensity, with radiation tothe neck, and similar in character to his previous MI. It was constant, lasting several hours,and was associated with nausea, diaphoresis, dyspnea, and palpitations. Hedenied exacerbating factors, but reported immediate relief with nitroglycerin-paste. On the surface, the two patients were similar in presentation and thephysical exams for both were similarly unremarkable. Basic labs (CMP, CBC,coagulation studies) were normal in both cases. Ms. Ss ECG showed 2 mmdepressions in the inferior leads, while the Mr. Hs ECG showed 3.5 mmdepressions in the lateral precordial leads. Initial cardiac troponin-I was0.01 ng/mL for Ms. S and0.05 ng/mL for Mr. H (normal IMPLICATIONS/DISCUSSION: The initial pretest probability for CAD for Ms. Swas 13% and 59% for Mr. H. On physical exam, both patients were diaphoretic (LR + 2.9), although neither patient had an S3 (LR- 0.88),an increased JVD (LR-0.90), or crackles (LR- 0.58). The ECG findings (LR + 4.5)and negative troponin-I (LR- 0.10) resulted in an 8% probability of disease forMs. S. For Mr. H, the ECG findings (LR + 4.5) and troponin-I results (LR + 9.25)yielded a 98% probability of disease. Our initial clinical reasoning toclassify Ms. S as lower risk for AMI and Mr. H as higher risk was corroboratedby the formal risk assessments. Diagnostic testing further validated these riskassessments: Ms. Ss stress test was negative; Mr. Hs angiography revealed a75% occlusion in the ostial LAD and he was referred for CABG.

TWO CASES OF SPINAL CORD INFARCTIONA COMPARISON Muhammed Sherid 1; Geetha Selvakumar1. 1St.Francis Hospital, Evanston, Illinois. (Tracking ID # 8921)

LEARNING OBJECTIVES: 1. To suspect spinal cord infarction in non-aortic surgical settings 2. To understand the etiology of spinal cord infarctionCASE INFORMATION: Case 1:A 64 year old man presented with a 2 hour history of severe, sharp circumferential lower chest and back pain, associated with left leg weakness and

numbness. Past medical history was significant for dyslipidemia, hypertension, and infrarenal abdominal aortic aneurysm. His vital signs and general examination were unremarkable. Neurological examination revealed intact cranial nerves. Motor examination revealed a power of 0/5 in all muscle groups of the left lower extremity. Sensations to light touch, pain, vibration and position sensations were normal.He was unable to distinguish between warm and cold temperature sensations from the level of the nipples down to the mid thigh bilaterally. Deep tendon reflexes were absent in the left knee and ankle. Babinskis sign was positive on the left and neutral on the right. Rectal tone was decreased. CT scan showed marked atherosclerotic changes with a protruding thrombus, plaque and atherosclerotic penetrating ulcers with subintimal hematoma in the descending thoracic aorta. An infrarenal AAA unchanged 3.7 x 3.8 cm. MRI brain and spinal cord were unremarkable. A diagnosis of anterior spinal cord infarction was made. His symptoms resolved within 24 h without residual deficits.Case 2:A 46 year old man presented with sudden onset paralysis of both the upper and lower extremities associated with neck pain. There was no loss of consciousness. Past medical history was significant for DM. On neurological examination he was alert, awake and oriented. Cranial nerves were intact. Motor examination revealed a power of 0/5 in bilateral upper and lower extremities. Deep tendon reflexes were absent in all four extremities and Babinskis sign was positive bilaterally. MRI of cervical spine revealed infarction in the anterior spinal artery territory from C3-6. The patient was intubated initially due to respiratory distress. His symptoms resolved over the next 24 hours without residual neurological deficits.

IMPLICATIONS/DISCUSSION: Spinal cord infarction is a rare disorder. Aortic surgery is the most common etiology, however, other etiologies include atherosclerosis, vasculitis, embolic and thrombotic occlusion, and severe hypotension.The clinical presentation is acute onset of paraparesis or quadriparesis. A therapeutic algorithm exists regarding this condition in the setting of aortic surgery, but no definitive therapy has been shown to be of benefit in other settings.

IM NOT CRAZY: IM REALLY SICK David Grew 1; Junaid Bhutto 1; Monica Dhand1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8924)

LEARNING OBJECTIVES: 1. Recognize the clinicalpresentation of lithium poisoning 2. Identify the

differentialdiagnosis for patients with symptoms of lithium toxicity. Understand thepathophysiology of lithium toxicity.
CASE INFORMATION: A 51 year-old woman presented with a three-day history ofnausea and vomiting. Her vomituswas non-bloody and non-bilious. Itwas associated with three episodes per day of watery diarrhea. She also noted crampy lower abdominalpain, tremor and seeing spots. She was afebrile. She had ablunted affect and her mucus membranes were dry. Her abdomen was soft but tender to deep palpation in thesuprapubic area. She did not haveguarding or costovertebral angle tenderness. She was slow to perform rapid alternating movements anddysdiadokinesia. Her BUN andcreatinine were 33 and 2.2, respectively. There were 450 white blood cells on urinalysis. Amylase and lipase were 205 and 622,respectively.
The urine toxinscreen was negative. Later, sherevealed a twenty-five-year history of taking lithium for bipolardisorder. Though she denied anyrecent changes to this medication, her blood lithium level was 3.35.
IMPLICATIONS/DISCUSSION: Nausea and vomiting with abdominal pain are complaintscommonly encountered by the internist. A systematic approach is necessary to evaluate rare, dangerous causes ofnausea and vomiting with abdominal pain. Lithium is primarily filtered by the kidneys. A urinarytract infection can cause acute kidney injury and impair lithiumexcretion. In the acute phase,patients with elevated lithium levels may experience nausea, vomiting anddiarrhea and can get dehydrated. The renal mechanism for Lithium absorption issimilar to that of sodium. Therefore, the dehydrated patient with acute lithiumtoxicity can quickly accumulate the drug in the body. The toxicity virtuallyperpetuates itself unless the patient receives treatment. Prolonged elevationof lithium levels may cause neurological impairment that can manifest assluggishness, ataxia, tremor and confusion. Severe lithium toxicity is lifethreatening if patients develop seizures, non-convulsive status epilepticus orencephalopathy. Unfortunately, patients taking Lithium may be significantly impaired bytheir psychiatric condition or by drug toxicity. In such scenarios, they may beunable to communicate their drug regimen. The internist must be vigilant inscreening for lithium toxicity in a patient being treated with Lithium as wellas a psychiatric patient who has a poor history or impaired renal function.
FANCONI INSIPIDUS Pavan Thangudu 1; Christie Blanton1.
1Tulane University, New Orleans, Louisiana. (Tracking ID # 8927)
LEARNING OBJECTIVES: 1. Recognize theclinical presentation of Fanconi Syndrome and Diabetes Insipidus 2. Identify thedifferential diagnosis of Fanconi syndrome and Diabetes insipidus. Understand thepathophysiology of tenofovir induced Fanconi syndrome with Diabetes Insipidus.
CASE INFORMATION: A 41 year-oldman presented with three weeks of nausea, vomiting, and a ten-pound weight loss. His past medical history includedHemophilia A and HIV for which he was taking HAART therapy. Three months afterinitiating emtricitabine and tenofovir therapy, he began experiencing polyuria and polydipsia. Hedescribed no additional symptoms. He was acachetic man with dry mucous membranes, temporal wasting, and mild epigastrictenderness. His vital signs were normal, and aside fromcachexia, his physical examination was also normal. He had a sodium of 153 mEq/L, potassium3.5 mEq/L, chloride 123 mEq/L, bicarbonate 18 mEq/L, blood urea nitrogen 16 mg/dL,creatinine 1.5 mg/dL. The amylase and lipase were mildly elevated. The HAART was discontinued at admission, andhe was given a bolus of 1 liter of0.9% saline, and continued on a maintenanceintravenous fluids overnight. The sodium increased to165 mmol/L within 6 hours;creatinine levels remained unchanged. Urine analysis revealed a specificgravity was 1.002, trace proteinuria, 300 glucose and trace hematuria.Microscopic examination of urine was negative for cells or casts. A dDAVP- challenger-evealed nephrogenic diabetes insipidus. His sodium returned to normal with aD5W drip and oral intake of water. His bicarbonate and phosphate weresuccessfully repleted with Neutra-Phos-K.

IMPLICATIONS/DISCUSSION: Fanconisyndrome with nephrogenic diabetes insipidus is a rare complication

oftenofovir therapy. In adults,fanconi syndrome is an acquired, proximal tubule dysfunction characterized by normal anion gap metabolic acidosis, glucosuria,amionaciduria, with phosphate and bicarbonate wasting. Etiologies of fanconi syndrome include multiplemyeloma, heavy metal intoxications,anti-cancer agents, anti-virals, antibiotics and anticonvulsants.Tenofovir-associated nephrotoxicity seems to occur around 20 weeks afterinitiation. Diabetes inispidus, a condition also associated with tenofovir use, presents with polyuriaand polydypsia, and is stratifiedinto central and nephrogenic. Nephrogenic diabetes insipidus results from an alteration in the sensitivity of aquaporin channelsto anti-diuretic hormone. Urine will have a low specific gravity, and when challenged with DDAVP will have no change inurinary output. The mechanism ofrenal damage is unknown; however, multiple postulates have been suggested. While the exact pathophysiology has not beendetermined, it is acknowledged that cessation of tenofovir results in resolution of renal dysfunction within 10 weeks. HAART has dramatically improved quantity andquality of life for patientswith human immunodeficiencysyndrome. With increasing use of tenofovir in HIV management, it isnecessary for the hospitalist to be aware of this potential, albeit rare, complications.

WORKING FOR THE WEAKENED Ansley Roche 1; Henry Hefler 1; David Spruill1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8930)

LEARNING OBJECTIVES: 1. Recognize the clinicalfeatures, laboratory manifestations and diagnosis of multiple myeloma2. Understand the treatmentoptions for multiple myeloma CASE INFORMATION: A 50 year-old woman presented with worsening generalizedweakness, fatigue and dyspnea of exertion over the preceding weeks. She had a 30 lb weight loss, recurrentsinus infections, persistent nausea, and episodes of confusion. She denied chest pain, cough, sickcontacts, paroxysmal nocturnal dyspnea, orthopnea, or bleeding. The patient was afebrile, the blood pressure was 152/92 mmHg, and the heart rate was 114 bpm. Her conjunctivae were pale butanicteric. She had proximalmuscles of her lower extremities.Her hemoglobin was 7.5 gm/mL, ferritin was182 ng/mL, BUN was 31 mg/dL, and creatinine was 3.7 mg/dL. The calcium was 18.5 mg/dL, total protein was 11.1 gm/dL, albumin was 2.8gm/dL, and intact PTH was17 pg/mL. EKG revealed 1st degree AV block. A skeletal survey demonstrated severeosteopenia and many lytic lesions. Serum protein electrophoresis showed anM-spike of 4.1 gm/dL that was IgG kappa by immunofixation, and urine proteinelectrophoresis showed an IgG kappa monoclonal band as well as free IgG kappalight chains. b2 micro-globulin was >20 mg/L. Bone marrowbiopsy revealed 35% plasma cells.

IMPLICATIONS/DISCUSSION: Multiple myeloma (MM) is a clonalB-lymphocyte neoplasm of terminally differentiated plasma cells producing amonoclonal immunoglobulin. Renal insufficiency, anemia, hypercalcemia,increased total serum protein concentration and bone destruction are commonpresentations. Appropriate initialscreening tests include a serum and urine protein electrophoresis along withimmunofixation and a free light chain assay. Further evaluation includes a bone marrow aspiration andmetastatic bone survey. The diagnostic criteria includes: an M-protein in theserum and/ or urine, greater than 10% plasma cells in the bone marrow, relatedorgan or tissue impairment from the plasma cell proliferation. Poor prognosticrisk factors include low performance status, albumin, platelet count,hemoglobin or high b2microglobulin, creatinine, calcium, age, plasma cell labeling index, bonemarrow plasma cell percentage.Indications for treatment include: anemia,hypercalcemia, renal insufficiency, lytic bone lesions or severe osteopenia,and extramedullary plasmacytoma. The choice of initial therapy depends on eligibility for stem celltransplantation and risk-stratification. Eligibility for stem cell transplantation is determined by age, performance status, and coexisting comorbidities. Risk-stratification is basedon chromosomal studies. Withouteffective therapy, symptomatic patients die within a median of six months.Survival increases to approximately two to five years with combinationchemotherapy or hematopoietic cell transplantation. With many organ and tissuecomplications, MM has a variety of clinical presentations, each of which thegeneral internist may encounter on a frequent basis; however, taken incombination, they should heighten the suspicion for this diagnosis.

DAMAGED LUNGS; DERANGED ~LYTES Ken Harang 1;

Junaid Bhutto1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8967)
LEARNING OBJECTIVES: 1. Recognize the presentation of PJP 2. Recognize SIADH as a cause of isovolemic hyponatremia. Recognize Bactrim as a cause of electrolyte abnormalities. CASE INFORMATION: A 53-year-old man presentedwith a four-day history of subjective fevers, productive cough and progressiveshortness of breath. He reported pleuritic chest pain. He had a known diagnosisof HIV with a CD4 of 43 cells/mm3. He was noncompliant with hisHAART therapy.His temperature was98.3 F,blood pressure was 174/103 mmHg, breathing rate was 32 breaths/min and hisheart rate of 113 bpm. Pulse oximetry revealed Oxygen saturation in the upper80s. He had bronchial breath sounds in bilateral lung fields. The rest of hisexam was unremarkable.An ABG on 100 % non-rebreathermask revealed a pH of 7.46 PaCO2 of 28 mmHg, and PaO2 of 91.5 mmHg. EKG showed sinus tachycardia. His sodiumwas 131 mg/dL, potassium was 3.5 mg/dL, bicarbonate was 21 mg/dL and creatininewas 1.0 mg/dL. The WBC count was6.8 cells/ mm3 and hemoglobin was 15.0 gm/dl. Urinalysis displayed no evidence ofinfection. Chest X-rayrevealed bilateral infiltrates. He has a Lactose Dehydrogenase level of 731 mg/dL. A chest CT revealed extensive bilateral groundglass infiltrates. Due to unavailability of IVBactrim, he was started on primaquine, intravenous Clindamycin and prednisonefor Pneumocystis Jerovecii pneumonia (PJP). A bronchioalveolar lavage confirmed the diagnosis. Thenext day, he was switched to oral Bactrim.His homemedications of Hydrochlorothiazide and Lisinopril were restarted. On hospitalday three, an ABG revealed a pH of 7.50 and hypoxia. Patients creatinine increased from 1.1 to 1.7 mg/dL, andthere was an anion-gap acidosis. Lactic acid level was elevated. Following afluid challenge, the sodium and potassium were 114 mg/dL and 5.8 mg/dL,respectively.

IMPLICATIONS/DISCUSSION: Our patient had an acutehyponatremia and acute kidney injury. Upon review, the information revealed aninteresting interplay of the Occams Razor with Hickams Dictum. Acute hyponatremia cansometimes be secondary to an occult Syndrome of Inappropriate AntidiureticHormone. With lung injury, ADH is released and causes an inappropriateretention of free water. In anattempt to correct lactic acidosis, a clinician may infuse normal saline.However, in the presence of SIADH, the clinician may inadvertently worsen thehyponatremia. Our patient was simultaneously losing salt from HCTZtherapy. The result was a sharpdrop of the sodium. Patients on high dose Bactrimtherapy can also experience elevation of creatinine ad potassium becauseTrimethoprim can block the renal tubular potassium secretion. Moreover, highdose Bactrim can cause greater than expected derangements in creatinine andpotassium. Webelieve that the hyponatremia, and the increased creatinine and potassium weredue to two separate insults. However, they resulted from treatment of thepatients PJP. The art of medicine dictates that despite standardizedtreatments, a patients care must be individualized based on their uniquepresentation.
ETANERCEPT-AN EAGLE TO PROMETHEUS Henry Hefler 1; Marlowe Maylin1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8968)
LEARNING OBJECTIVES: 1. Recognize the clinicalpresentation of acute liver injury. 2. Identify the differentialdiagnosis for significant elevations in transaminases. Understand the pathophysiology of drug-induced liverinjury by TNF-alpha inhibitors.
CASE INFORMATION: A 54 year-old man presented with four weeks of progressivepruritis, diarrhea and jaundice. He denied herbal medications, acetaminophen ingestion, recent travel,alcohol use, intravenous drug use, sexual activity, tattoos, or environmentalexposures. Eight weeks prior topresentation, he was started on twice-weekly injections of etanercept for hispsoriatic arthritis. He was afebrile and had normalvital signs. He had scleralicterus, cutaneous jaundice and a liver palpated five cm below the costalmargin. There were no other signs ofchronic liver disease. The total bilirubin was 24 mg/dL, the direct bilirubin was19 mg/dL, the AST was 2655 U/L, the ALT was 2411 U/L, and the alkalinephosphatase was 214 U/L. Thealbumin and INR were 3 gm/dL and 1.4, respectively. A viral hepatitis panel; EBV, HSV, CMV IgM; rapid HIV; urinetoxicology; and APAP levels were negative. The ANA and ASMA were normal. An abdominal ultrasound revealed an enlarged liver. A

liver biopsy revealed diffuse lobularand portal inflammation with scattered hepatocyte necrosis consistent withdrug-induced hepatitis. Theetanercept was stopped, and after one week, the total bilirubin was 9.9 mg/dL;AST and ALT were 396 U/L and 830 U/L, respectively.
IMPLICATIONS/DISCUSSION: Jaundice and transaminase elevations are problems frequentlyencountered by the internist. Theacuity of the findings and temporal relation to any exogenous factors isintegral in indentifying a potential cause. Elevations of AST/ALT greater than 1000 are typically due toan acute and fulminant inflammatory source; elevations in bilirubin are not alwayspresent but when present, portend a poor prognosis. The differential diagnosis should include acute infectionwith viral hepatitis, ingestion of hepatotoxins, thrombosis of the portal vein,shock liver and autoimmune hepatitis. Drug-induced liver injury (DILI) can be classified bymechanism of injury, including direct hepatotoxicity and immune-mediated, butestablishing the precise diagnosis can be difficult. The key to causality is to exclude
other causes of liverinjury and to identify a characteristic clinical drug-related signature. Histology can also be useful inconfirming the diagnosis. Particularto this case, the lack of illness prior to initiation of the medication, theclinical presentation, the biochemical abnormalities, and the improvement afteretanercept was withdrawn are suggestive of DILI, which was confirmed bybiopsy. Etanercept is currently FDA approved for psoriatic arthritis, rheumatoid arthritis, juvenileidiopathic arthritis, ankylosing spondylitis and organ transplantation. TNF-alpha inhibitors cancause both direct injury to the liver and an autoimmune hepatitis with orwithout elevations in autoantibodies. With the use of TNF-alpha inhibitorslikely to increase in coming year, the general interest must be aware of thisimportant and potentially life-threatening complication.
CALCIUM CONFUSION Kate Hust 1; Marcia Glass1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 8975)
LEARNING OBJECTIVES: 1. Recognize clinical manifestations of hypercalcemia 2. Identify the differential diagnosis forhypercalcemiaUnderstand the mechanisms of hypercalcemiaIdentify treatment options for hypercalcemiaCASE INFORMATION: A50-year-old woman with a history of meta-static breast cancer presented withconstipation, fatigue, lower-back pain and difficulty responding toquestions. By way of her family,she had had no fevers, night-sweats or focal weakness. The family noted arecent increase in urinary frequency, but there was no dysuria or incontinence.The back pain had been present for over a month, but the altered mental statuswas new within the past two days. Her vital signs, cardiac, pulmonary and abdominalexaminations were normal. There were no focal deficits on neurologicexamination. There was point-tenderness to palpation of the lower spine, andboth lower extremities were painful to palpation. Her CBC and liver enzymes-were normal. The serum calcium was18 mg/dL, and the alkaline phosphatase was 639 IU/L. A bone scan revealed new mestastatic lesions to the lowerspine. She was treated with simultaneous diuresis/hydration, in addition to abisphosphonate. As her calcium-level normalized, her mental status improved to a baseline level of function.
IMPLICATIONS/DISCUSSION: The non-specific complaints of constipation,fatigue, and altered mental status are frequently encountered by the general internist.Though common, the internist should recognize the combination of these symptomsas typical of hypercalcemia. Whenserum calcium exceeds 12 mg/dL, generalized symptoms of constipation, polyuria,nausea, vomiting, and fatigue may result. As the calcium continues to rise, changes in sensorium develop,including drowsiness, confusion, lethargy, and coma. Further complications may include cardiac arrhythmias. Ninety percent of hypercalcemia is caused byprimary hyperparathyroidism and malignancy. Assessing the parathyroid hormonelevel is usually the first step in evaluation, though the level of the serumcalcium can provide insight into the etiology: calcium levels greater than 15 mg/dL are usually associated with malignancy. Hypercalcemia is rarely thehallmark of an occult tumor, however, and age-appropriate cancer screeingusually reveals the etiology. The initial treatment for hypercalcemia isaggressive hydration. Management-should also target the underlying disease. When calcium is severely elevated, bisphosphonates are thefirst-line therapy to inhibit bone

resorption in patients with normal renalfunction. Zolendronate can beadministered rapidly over 15 or fewer minutes, providing a sustained decreasein serum calcium; the maximum effect is noted after 2448 hours. More immediate therapy can be achievedby using calcitonin. Furosemideand glucocorticoids also have a place in the treatment of certain etiologies ofhypercalcemia. Emergenthemodialysis is reserved for severe hypercalcemia in the setting of renalfailure. Malignancy is a common chronic health condition, andunderstanding how to manage hypercalcemia is important for internists toeffectively alleviate symptoms and prevent potentially fatal complications.

DONT FORGET TO TAP INTO ALLYOUR RESOURCES: INVESTIGATION INTO THE ETIOLOGY OF PLEURAL AND PERICARDIAL EFFUSIONS IN A PATIENT WITH CONNECTIVE TISSUE DISEASE

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LEARNING OBJECTIVES: 1. Determine the etiology of simultaneous pleural and pericardial effusion as infectious versus rheumatologic. 2. Treat pleural and pericardial effusions associated with rheumatologic disorders.

CASE INFORMATION: A 51 year old female with a history of pulmonary sarcoidosis, Sjogrens syndrome, asthma, prior splenectomy, and coronary artery disease presents with one month of worsening shortness of breath. CT angiogram of the chest showed no evidence of pulmonary embolism or pneumonia, but did reveal small bilateral pleural effusions noted on previous CXRs. Thoracentesis was deferred due to small size and chronicity of effusions, and patient body habitus. Blood cultures grew Salmonella enteritidis and a ten day course of ciprofloxacin was initiated. The patients respiratory status improved prior to discharge. The patient was readmitted within 48 hours with fever to 102.4, worsening shortness of breath, pleuritic chest pain, and a new leukocytosis of 13.8. CXR showed an interval increase in the left-sided pleural effusion. CT-guided thoracentesis revealed 450 mL of yellow serous pleural fluid with 4600 WBCs (100% neutrophils), 2900 RBCs, LDH 1284 (serum LDH 199), total protein 5.8 (serum total protein 7.0), glucose 2, and pH of7.16, consistent with an exudative effusion. Repeat CXR after thoracentesis revealed persistent loculated pleural effusion so surgical decortication via VATS was performed. Post-operative course was further complicated by cardiac tamponade due to pericardial effusion requiring urgent pericardiocentesis and colchicine. 430 mL of serous pericardial fluid was drained, containing 24250 WBCs (96% neutrophils), 12000 RBCs, LDH 458, glucose 32, ANA 1:320, and RF11. Serum ANA was positive (1:640), as were serum dsDNA (1:80) and serum RF (21); serum CCP was negative. Cultures from pleural and pericardial effusions showed no bacterial, fungal, mycobacterial, or viral growth; cytology was negative for malignant cells. The effusions were thought to be secondary to rheumatologic disease, with rheumatoid arthritis (RA) and systemic lupus erythematosus (SLE) deemed most likely. The patient was discharged on a prednisone taper and plaquenil.

IMPLICATIONS/DISCUSSION: Pleural and pericardial effusions occur frequently in patients with connective tissue disorders. The incidence of pleural effusions is 20% in RA, 30-50% in SLE, and 50% in patients with mixed connective tissue disease. Rheumatologic pericardial involvement is more frequently due to SLE than RA. RA effusions are exudative per Lights criteria, with a WBC less than 5000 mm^3, pleural fluid glucose to serum glucose ratio less than 0.5, a pH less than 7.3, and pleural fluid LDH greater than two times the upper limit of normal serum LDH. Lupus effusions are also exudative, but typically have a pleural fluid LDH less than 500, a pH greater than 7.35, and no systemic leukocytosis. In addition, markedly low glucose levels (less than 30) distinguish RA effusions from lupus effusions (greater than 30). The presence of rheumatoid factor or anti-nuclear antibodies in pleural and pericardial fluid may suggest rheumatoid arthritis and lupus respectively;

however these findings have limited specificity, are similar to serum titers, and are not recommended diagnostic tests. Empyemas can mimic RA effusions and should be excluded by gram stain and culture, particularly in patients taking glucocorticoids. Relevant to this patient, Sjogrens syndrome, sarcoidosis, and Salmonella enteriditis rarely result in pleural and pericardial effusions. Therapies for rheumatologic associated pleural effusions include NSAIDS and glucocorticoids. NSAIDs and glucocortoids are also the mainstay of treatment for rheumatologic pericardial effusions, but colchicine can be used to prevent recurrence. Pleural effusions may require pleurodesis and decortication, and pericardial effusions often also require pericardiocentesis.

CLINICAL VIGNETTESSLE-ASSOCIATED TRANSVERSE MYELITIS INVOLVING C5-T11 LEADING TO PARAPLEGIA Neda Shafaghi 1; Ramy Hanna 1; Rachel Mory1. 1UCLA-Olive View Program, Sylmar, California. (Tracking ID # 9094)

LEARNING OBJECTIVES: 1. Recognize Transverse Myelitis as part of the differential diagnosis of Systemic Lupus Erythematosus-associated neurological sequelae. 2. Recognize the clinical features of Transverse Myelitis.

CASE INFORMATION: Systemic Lupus Erythematosus (SLE) has many clinical presentations, due to its ability to affect all organ systems in a variety of ways. Neurological involvement is common and is one of the diagnostic criteria for SLE, but is usually manifest as CNS vasculitis (lupus cerebritis). We present a case of a rare but well-described neurological manifestation of SLE, Transverse Myelitis (TM).We present the case of a male patient who initially complained of bilateral hand arthritis, then subsequently presented with weakness of the right lower extremity, progressing to paraplegia and urinary retention. Physical examination was notable for the following: hypotonicity of bilateral lower extremities, right lower extremity strength significantly less than left lower extremity, decreased sensation bilateral lower extremities, lower extremity reflexes 1+, and upgoing bilateral Babinski. The patient had no signs or symptoms of altered mental status, seizures, or any other neurological findings concerning for CNS vasculitis. A lumbar puncture was done which showed CSF protein 168, WBC 33 with a differential of 76% lymphocytes, and negative cultures. His MRI demonstrated inflammation in the cervical and thoracic spine, and the patient was diagnosed with Transverse Myelitis from C5-T11. It was at this time that the potential underlying cause was investigated, and the patient was diagnosed with SLE based on the arthritic findings, neurological involvement, positive ANA (1:2560), hematological abnormalities, and positive anti-phospholipid antibody. He recovered most of his neurological function after treatment with high dose steroids and cyclophosphamide.

IMPLICATIONS/DISCUSSION: SLE has several classic presenting features including arthritis, malar and discoid rashes, oral ulcers, serositis, hemolytic anemia, thrombocytopenia, renal failure, and cerebritis. There are other less well appreciated manifestations of SLE

and of other rheumatological/autoimmune diseases. One rare but documented sign of SLE is demyelinating plaques in the CNS that can often be mistaken for Multiple Sclerosis plaques. Sjogrens syndrome, Neuromyelitis Optica (Devics syndrome), and other rheumatological conditions have also been observed to cause demyelinating plaques in the CNS. These conditions can also cause TM. TM involves an inflammatory lesion that transects one or more levels of the spinal cord, often causing loss of neurological (motor and sensory) function below that level. The reported incidence of TM in SLE and associated diseases is 1000-fold that of the general population. TM has also been associated with standard childhood vaccines such as the Measles-Mumps-Rubella vaccine, possibly via induction of an auto-immune response. The treatment of TM in SLE is generally directed at suppressing inflammation, with corticosteroids and other immunomodulators such as cyclophosphamide.

AN INTERESTING CASE OF ADULT STILLS DISEASE Caroline T. Nguyen 1; Cindy Mong 2; Steven Allen 3; Mark Richman 1; Scott Lundberg1. 1UCLA-Olive View Internal Medicine Program, Sylmar, California ; 2UCLA Internal Medicine Program, Los Angeles, California ;

3UCLA School of Medicine, Los Angeles, California. (Tracking ID # 9099)
LEARNING OBJECTIVES: 1. Recognize the signs and symptoms of Adult Stills Disease. 2. Diagnose and treat Adult Stills DiseaseCASE INFORMATION: One week prior to admission, a 51-year-old previously healthy Hispanic woman noticed a pink, diffuse, non-tender, and minimally pruritic rash on her abdomen. Over 24 hours, the rash spread bilaterally to her arms and legs, disappearing and returning. Simultaneously, she developed joint pain in her right knee and both wrists, fever, nausea, non-bloody vomiting, and a lip lesion. Five days after initial symptoms she began to have non-bloody, watery diarrhea. Review of systems was significant for low-grade headaches, posterior neck and shoulder tenderness, and a one-day history of bilateral earache and sore throat. She denied medications, recent travel, or sick contacts. Significant findings on physical exam included fevers to 40C, crusted lip lesions, a pink, diffuse, maculopapular rash on her trunk and lower extremities to the level of the knees bilaterally, a small left axillary lymph node, effusion of the right knee, left hand stiffness, and tenderness of the cervical spine and bilateral wrists. Neurological exam was normal. Abdominal ultrasound showed enlarged liver (19 cm) and borderline enlarged spleen (12.2 cm); EKG and ECHO were normal. Laboratory findings included: WBC 12.8 with 87.5 PMNs, ESR 127, CRP 408, LDH 388, AST 66, ALT 57, RF 11, and negative ANA. An extensive work-up, including rickettsial, lyme, parvovirus, and HIV serology, RPR, ASO titer, and cultures of throat, blood, urine, CSF, and stool, yielded no signs of acute infection. The patient continued to have fever and persistent daily rash despite broad-spectrum antibiotic coverage. The ferritin level returned >8000 ng/dl. With infectious and neoplastic etiologies ruled out, methylprednisolone 60 mg IV q 12 hours was initiated. The patients fevers resolved and the rash and arthralgias improved within 24 hours.
IMPLICATIONS/DISCUSSION: Adult Stills disease (ASD) is an inflammatory disorder characterized by daily fevers, arthritis, and an evanescent rash. While etiology is unknown, infectious triggers and genetic factors have been proposed. Annual incidence is estimated at0.16 cases/100,000 persons, with equal distribution between sexes and a mean age of presentation of 38 years. The Yamaguchi Criteria, the most sensitive criteria (94%) in patients with a definite diagnosis of ASD, are most commonly used. These include having five features with at least two of them being major. Major features include 1. fever of 39 C or
greater lasting at least one week 2. arthralgias or arthritis lasting 2 weeks or longer 3. nonpruritic macular or maculopapular skin rash salmon-colored in appearance usually over trunk or extremities during febrile episodes and 4. leukocytosis (10,000/microL or greater) with at least 80 percent granulocytes. Minor features include 1. sore throat 2. lymphadenopathy 3. hepatomegaly or splenomegaly 4. abnormal liver function studies, particularly aspartate, alanine aminotransferase, and LDH and 5. negative ANA and RF. As ASD can masquerade as numerous diseases; the differential diagnosis is broad including infectious, autoimmune, and hematologic etiologies and malignancy. Consider ASD in patients with compatible symptoms with a ferritin above 3000 ng/ml in the absence of a bacterial or viral infection. While our patient met the Yamaguchi Criteria, this case was unusual in that the rash and fever persisted (i.e., was not fleeting) until steroids were administered. Treatment includes NSAIDS, glucocorticoids, biologic agents, and DMARDs. Given symptom severity in our patient, glucocorticoids were used from the onset. The functional status of patients with ASD is generally good.
NOT A SIMPLE PIMPLE Lawrence Huan 1; Anjali Niyogi1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 9123)
LEARNING OBJECTIVES: 1. Describe the presentationand treatment of septic pulmonary emboli (SPE). 2. Highlight the increasing virulenceof community-associated methicillin-resistant Staphylococcus Aureus (MRSA).

CASE INFORMATION: A 21-year old man presented with a one-day ofsevere, sharp, left-sided non-radiating pleuritic chest pain, exacerbated bydeep inspiration and relieved by palpation. He also complained of a dry cough, fever, and night sweatsfor one day. He denied recent illnesses, but reported extra and intranasal

acnewith copious purulent discharge. He denies drug use. Hedenied any recent exposure to a healthcare facility. His vitals were 100.60 F,103 bpm, respirations of 24 and 141/86 mmHg. He had acne of his external nares with underlying erythema;internal nares were normal. Theremainder of the exam was unremarkable. Laboratories revealed a white blood cell count of 17,000/L with 54% segmented neutrophils and 15% bands. Chest CT angiogram revealed eight cavitarypulmonary nodules throughout the lungs (largest2.6 cm). Sputum AFB, HIV, ANCAand ACE were negative. Blood cultures grew methicillin-resistant StaphylococcusAureus (MRSA), and MRSA nasal swabs were positive. TEE was negative for endocarditis and maxillofacial CTshowed no deep tissue involvement. He was treated with intravenous vancomycinfor presumed endocarditis with septic pulmonary emboli (SPE). IMPLICATIONS/DISCUSSION: Typical symptoms of SPE are fever, cough, andhemoptysis. Elevated markers ofinfection, positive blood cultures, nodular cavitary lesions on chest CT, andclinical suspicion are sufficient to investigate for SPE. Prompt antibiotic treatment should beinitiated. Echocardiography isrequired to rule out endocarditis. The standard treatment of MRSA SPE is vancomycin for 46 weeks. Recently, reduced vancyomycinsusceptibility organisms have been encountered and therapies involvinglinezolid, daptomycin, or cotrimoxazole have shown efficacy. It has been notedthat patients with SPE originating from focal infections other thanendocarditis may do reasonably well with early treatment. However, with MRSA endocarditis, themortality rate may be greater than 50%. Community-associated MRSA infections typicallypresent as soft-tissue or skin infections, and less commonly (As thevirulence of commuity-associated MRSA increases, internists in the inpatientand outpatient settings must recognize the potential presentations and complicationsof this organism to quickly diagnosis and treat tominimize furthercomplications.

CONTRACEPTIVE COUNSELING IN THE PERIMENOPAUSAL WOMAN Rachael R Dirksen 1; Mitra Razzaghi 2; Amy Denise Grotelueschen Huebschmann2. 1University of Colorado, Denver, Colorado ; 2University of Colorado, Aurora, Colorado. (Tracking ID # 9138)

LEARNING OBJECTIVES: 1. To recognize the importance of reviewing sexual histories and providing contraceptive counseling as part of the clinical management of perimenopausal women. 2. NoneCASE INFORMATION: A 52-year-old female with one year of irregular menses presents to clinic asking for a pregnancy test. She and her husband had unprotected intercourse three weeks ago. Her last menstrual period was approximately three months ago. She describes symptoms similar to those that she experienced in her prior pregnancies, including bilateral breast swelling and food cravings. She confides that if she is pregnant, she would like to terminate the pregnancy. Her physical exam is unremarkable except for a mildly enlarged uterus, which is firm and mobile. Pertinent laboratory results include a negative urine human chorionic gonadotropin. Obtaining other laboratory tests was deferred due to the likelihood of perimenopause as the cause of her oligomennorhea. Similar to many other women, she was having intercourse without contraception due to the misconception that she would not be able to become pregnant in the perimenopausal time period. After discussing contraceptive options with the patient, she elected to use barrier contraception. IMPLICATIONS/DISCUSSION: Over a third of all pregnancies are unintended in women aged 40 years and older, a higher percentage than that observed in women aged 3039 years. One likely reason for this disparity in unintended pregnancy rates is the common misconception in perimenopausal women that they are no longer fertile once they develop irregular menses. In one study of women older than age 40 years with an unintended pregnancy, 56% terminated the pregnancy. For these reasons,taking a sexual history and providing contraceptive counseling when appropriate is an important part of caring for the perimenopausal woman. In this vignette, our patient had the misconception that her irregular menses would prevent her from becoming pregnant. This same misconception has been documented in other studies of perimenopausal women. As general internists, we need to counsel our perimenopausal patients regarding their fertility and contraceptive

options. For optimal contraceptive counseling, we need to be knowledgeable of contraceptive options in women with and without medical comorbidities, as well as the benefits of various contraceptive agents for treating perimenopausal symptoms. In our clinical management of perimenopausal patients, we must address sexual histories and proactively provide appropriate contraceptive counseling in order to reduce the disparate rate of unwanted pregnancies in this population

A RARE CASE OF INFERIOR VENA CAVA SARCOMA PRESENTING AS ACUTE FULMINANT BUDD-CHIARI SYNDROME Muhammed Sherid 1; Geetha Selvakumar1. 1St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9141)

LEARNING OBJECTIVES: 1. To suspect the uncommon, when the clinical picture is perplexing 2. To understand that IVC sarcoma can present as Budd-Chiari syndromeCASE INFORMATION: A 91 year old male presented with a six hour history of mild, dull, constant epigastric abdominal pain without radiation. He did not have fever, nausea, vomiting, or changes in bowel movements. He had a swelling in his left scrotum for 2 months for which he did not seek medical attention. Three weeks prior to admission, the patient was diagnosed with left lower extremity DVT in another hospital and was started on warfarin. Past medical history was also significant for end stage renal disease due to polycystic kidney disease.On physical examination, he was pale, afebrile, tachycardic and hypotensive. He was drowsy but arousable and was oriented to person only. Abdomen was soft with normal bowel sounds and tender hepatomegaly which was palpable for 3 cm below the right costal margin. There was no guarding, rebound tenderness or rigidity. There was a large left scrotal swelling with no palpable masses. He had bilateral pitting pedal edema. Laboratory examination was significant for markedly elevated aminotransferases at AST 1817 and ALT 631. Alkaline phosphatase was 232, bilirubin 1.6, INR 3.3, albumin 3.3 and ammonia 180. CT scan of the abdomen and pelvis showed a large hypodensity within the inferior vena cava extending into the right atrium. The hepatic and portal veins were patent. Liver was enlarged measuring 20 cm without any masses. The patients condition deteriorated rapidly due to worsening liver function. His transaminases and INR continued to rise despite medical management. His family declined any invasive procedures. He became comatose and died on the fourth day of hospitalization. Autopsy showed distention of the inferior vena cava along its entire length by a gray-tan mass and thrombus which extended into the right atrium. The mass was a poorly differentiated sarcoma composed of malignant spindle-fusiform cells and large anaplastic cells; it arose in the intimal layer of the cava and protruded into the lumen.

IMPLICATIONS/DISCUSSION: Sarcomas of the inferior vena cava are rare, usually presenting as a mass or deep vein thrombosis. They may manifest rarely as an acute form of Budd-Chiari syndrome from hepatic venous occlusion. The treatment is surgical resection; however, because of the extension of the sarcoma to the right atrium and the patients advance age, surgery was not feasible. To the best of our knowledge, this is the first case of an inferior vena cava sarcoma presenting as acute Budd-Chiari syndrome.

AEROCOCCUS URINAE ENDOCARDITIS Muhammed Sherid 1; Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St.Francis, Evanston, Illinois. (Tracking ID # 9143)

LEARNING OBJECTIVES: 1. To suspect endocarditis in new onset stroke and fever 2. To understand that Aerococcus urinae is highly implicated as a causative agent of endocarditis in the presence of bacteremiaCASE INFORMATION: A 65 year old male presented with a 12 hour history of right-sided weakness with slurred speech and several days history of fever. There was no history of recent travel or sick contacts. There was no history of cough, shortness of breath, headache or loss of consciousness. Past medical history was significant for left sided stroke 2 years ago with no residual defects. On physical examination, his blood pressure was157/79, pulse 121, temperature 101.6 F, oxygen saturation 96% on room air. He was pale and anicteric. There was no jugular venous distension or lymphadenopathy. His head and neck examination was unremarkable. His chest was clear to auscultation. There was a 2/6 systolic murmur in the base of the heart without any radiation. The abdomen was soft, non tender and did not reveal any organomegaly. His

neurological exam was significant for right sided hemiparesis. His cranial nerves were intact. He did not have any pedal edema and there was no skin rash. His labs showed an elevated white blood cell count at 14.2, platelet 560, Hb 9.6 and Hct 28.5. His comprehensive metabolic panel was within normal limits. A CT scan of the head was unremarkable following which an MRI of the brain was done which showed acute ischemic changes along the medial

cortex of the left frontal lobe. A chest xray was unremarkable. His urinalysis showed pyuria. He was started on broad spectrum antibiotics. Urine culture grew mixed gram positive bacteria indicative of possible contamination. His blood culture grew Aerococcus urinae. A transesophageal echocardiogram was done which showed large vegetations noted on the mitral valve accompanied by severe mitral regurgitation and a smaller vegetation on the tricuspid valve. The antibiotics were changed to ampicillin and gentamycin after the organism was identified. However, despite therapy his condition deteriorated and the patient expired approximately 2 weeks after admission.
IMPLICATIONS/DISCUSSION: Aerococcus urinae is a gram positive alpha hemolytic coccus that grows in pairs and clusters. This organism is commonly misidentified as streptococcus or enterococcus. It commonly causes UTI, but has also been frequently incriminated in cases of endocarditis. This organism is associated with a high mortality when isolated from patients with endocarditis. A retrospective study of endocarditis caused by A.urinae showed that 9 out of 13 patients died. Review of literature shows that A.urinae is usually treated with penicillins or vancomycin with gentamycin.
WEBER-CHRISTIAN PANNICULITIS INDUCED BY PHENTERMINE Muhammed Sherid 1; Geetha Selvakumar1. 1St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9144)
LEARNING OBJECTIVES: 1. To use the adverse drug reaction assessment nomogram in the appropriate clinical settings 2. To suspect Phentermine as a cause of panniculitisCASE INFORMATION: A 24 year old Hispanic female presented with a 2 month history of three skin lesions, one located to the right of the umbilicus, another on the right thigh and a third on the left flank area. The lesions were painful and erythematous. For a period of 1 week prior to admission, she was complaining of fever, fatigue, myalgia, arthralgia, and generalized pruritus without any appearance of new rashes. She denied cough, sore throat, abdominal pain, diarrhea, or urinary symptoms. There was no history of recent travel or camping. There was no significant past medical history except for obesity for which she was prescribed phentermine 2 weeks before the commencing of her symptoms.On physical examination, she was febrile with T=102 F and her other vitals were normal. Weight was 210 lbs (no recent change in weight), and BMI was 31. Examination of skin showed three indurated, tender erythematous plaques located on the right side of the umbilicus, right thigh and left flank measuring 10x10cm, 10x15cm, and 2x2 cm respectively. The remainder of the examination was unremarkable. Laboratory studies showed a normal CBC and BMP. Aminotransferases and alkaline phosphatase were mildly elevated. Amylase and lipase were normal. ESR and CRP were elevated at 41 and 5.7 respectively. A chest X-ray was unremarkable. Serology of CMV, EBV, HCV, HBV, HAV, HIV, Lyme disease, Q fever, parvovirus, leptospira and syphilis were negative. ANA, RF and ANCA were negative. A skin biopsy was performed which showed superficial and deep lymphoplasmacytic perivascular inflammation extending into the subcutis. These histopathological findings are consistent with panniculitis. Due to the temporal relationship between the commencement of Phentermine and the onset of her symptoms and in the light of absence of other common causes of panniculitis, a diagnosis of phentermine-induced pannicultis was made.
IMPLICATIONS/DISCUSSION: Weber-Christian panniculitis is an infiltrative inflammatory disease occurring in adipose tissue that occurs usually in young females. It presents as tender erythematous rash, located over the extremities, abdominal areas, breasts, face and
buttocks. It is often associated with constitutional symptoms, such as fever, arthralgias, and myalgias. It may be idiopathic or associated with other disease, such as connective tissue diseases, pancreatic processes, alpha-1

antitrypsin, and physical causes like cold. There is no reported case of phentermine induced Weber-Christine panniculitis in the literature to the best of our knowledge.

PASTEURELLA MULTOCIDA CAUSING COMPARTMENT SYNDROME Muhammed Sherid 1; Geetha Selvakumar1. 1St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9146)

LEARNING OBJECTIVES: 1. To suspect compartment syndrome caused by unusual organisms 2. To recognize that timely intervention is essential in the management of compartment syndromeCASE INFORMATION: A 41 year old female presented twelve hours after a cat bite in her right forearm with severe pain, erythema and warmth in cat bite site, associated with fever and chills. She also complained of numbness in her fingers in the right hand without any weakness. It was a stray cat which was picked up by her the day before. She did not have significant past medical history. On physical examination, her vital signs were normal except for a temperature of 101 F. General examination was unremarkable. Her right forearm was erythematous, warm, tender and swollen circumferentially. Two puncture wounds with purulent discharge were identified in the anterior aspect near the wrist.The compartment pressures measured by needle manometry were 64 mmHg and 47 mmHg in the anterior and posterior aspects of the right forearm respectively. Repeat readings were consistently elevated in the same range. Since a compartment pressure above 30 mmHg requires decompression, a fasciotomy was done. Wound culture grew pasturella multocida which was susceptible to ampicillin /sulbactam. The patient was already started on the same antibiotic. Laboratory studies were remarkable for leukocytosis at 29.5 K/ mm Cu. Erythrocyte sedimentation rate and C- reactive protein were elevated at 55 and19.4 respectively. An X-ray of the right forearm and hand showed soft tissue swelling without any bone destruction or subcutaneous emphysema. Patients condition improved uneventfully during hospitalization and was followed up as an outpatient. She underwent plastic reconstructive surgery for the closure of the fasciotomy wound after completion of the course of antibiotics IMPLICATIONS/DISCUSSION: Pasteurella multocidia is Gram-negative coccobacillus. It is isolated up to 75% of cat bite wounds. In addition to causing infection in the bite site, it can spread deep to cause septic arthritis, osteomyelitis, and tenosynovitis. It can also cause pneumonia and upper respiratory infection in humans without a history of animal bites or scratches. Serious invasive infections such as meningitis, intraabdominal infection, ocular infection, acute suppurative thyroiditis, urinary tract infection, and endocarditis have been reported. However, there is no case report of compartment syndrome from pasteurella mutlocida to the best of our knowledge

LUBIPROSTONE INDUCED ISCHEMIC COLITIS Muhammed Sherid 1;
Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St. Francis, Evanston, Illinois. (Tracking ID # 9149)

LEARNING OBJECTIVES: 1. To look for uncommon causes of ischemic colitis in the appropriate clinical setting 2. To recognize that ischemic colitis can be a rare side effect of LubiprostoneCASE INFORMATION: A 54 year old female presented with a 2 hour history of nausea, non bloody, non bilious vomiting for several times

associated with crampy generalized abdominal pain which was located more in the epigastric area. She did not have any bowel movements for three days prior to her arrival. In the ED she had 1 bowel movement with hard stools followed by 6 watery, bloody stools. Past medical history was significant for DM, hypertension, hypercholesterolemia, hypothyroidism and chronic constipation. On admission her vital signs were essentially normal. Physical examination revealed a soft abdomen with mild epigastric and left upper quadrant tenderness. There was no distension, guarding, rebound tenderness or organomegaly. The remainder of the physical exam was unremarkable. Laboratory studies were unremarkable including urine toxicology and stool studies. A CT Scan of the abdomen revealed thickening of the colonic wall of the transverse colon and portions of the descending colon near the splenic flexure. A colonoscopy showed inflammatory changes in the colon between

3040 cm from the anal verge consistent with ischemic colitis. Histopathology was consistent with ischemic colitis. A diagnosis of ischemic colitis was made. To elucidate the etiology, we took a detailed history. She did not have any decrease in BP either before or during admission which rules out hypotension as a cause of ischemic colitis. As far medications, over the counters, and herbals, she stated that she was taking Lubriprostone for a period of two months for chronic constipation. At that time, she was started on 24 mcg of Lubiprostone, but several hours after taking the drug, she developed nausea, vomiting and abdominal pain with bloody diarrhea which lasted for a couple of days. She did not undergo any investigations, but her dose of Lubiprostone was changed to 8mcg daily as needed. As for this time, she took 3 pills of 8 mcg (24 mcg) 24 h prior to her symptoms.

IMPLICATIONS/DISCUSSION: Lubiprostone is prostaglandin E1 derivative which activates type-2 chloride channels (CLC-2) and consequently increases fluid secretion into the intestinal lumen. It has been approved for chronic constipation and irritable bowel syndrome. It is well known to cause nausea, vomiting, watery diarrhea, abdominal pain and distention, but to the best of our knowledge, this is the second reported case in the literature for ischemic colitis caused by Lubipros-tone. This temporal relationship between the recurrence of symptoms and the rechallenging of the drug, confirms the diagnosis in the light of absence of other causes of ischemic colitis.The actual mechanism is unclear, but could be due to the vasoconstriction effect of Lubiprostone in high doses.

GIANT LAMINATED BLADDER STONE Muhammed Sherid 1; Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St.Francis, Evanston, Illinois. (Tracking ID # 9150)

LEARNING OBJECTIVES: 1. To understand the pathogenesis and clinical manifestations of bladder stones 2. To recognize this uncommon disorder in the appropriate clinical settingsCASE INFORMATION: A 75 year old man presented with a history of urinary frequency, urgency and suprapubic abdominal discomfort for duration of one month. The patient had severe suprapubic abdominal pain and fecal incontinence while urinating for 2 weeks prior to admission. The fecal incontinence occurred while urinating in both the sitting and standing positions. He was treated with 2 courses of antibiotics without improvement. Past medical history is significant for removal of bladder stones two times, 13 and 10 years ago (the size of stone was more than 5 cm both the times). He was diagnosed with benign prostatic hypertrophy three years ago. Social history: He is from Belize in Central America and works as a teacher. No family history of kidney or bladder stones. On physical examination, he was afebrile with normal vital signs. Cardiopulmonary examination was unremarkable. Abdomen was soft. A firm mass was palpated in the suprapubic area associated with mild tenderness. He also had tenderness in the right costovertebral angle. Rectal exam revealed normal sphincter tone; prostate was enlarged with no nodules or masses. An attempt at urethral catheterization failed. Laboratory studies showed hematuria and pyuria with positive nitrite and leukocyte esterase. Urine culture grew Escherichia Coli. Complete blood count and comprehensive metabolic panel were unremarkable except for mild elevation of creatinine. CT scan of the abdomen and pelvis showed a large radioopaque laminated bladder stone measuring 8 x 7 x 6 cm. Bilateral hydronephrosis was noted as well. Patient underwent an open cystolithotomy with removal of the bladder stone which weighed one kilogram. The analysis showed uric acid 80% and calcium oxalate 20%.After surgery, his symptoms, bilateral hydronephrosis, and acute renal failure all resolved. The patient had an uneventful hospital course and was advised to increase his oral fluid intake and get 6 monthly ultrasound examinations.

IMPLICATIONS/DISCUSSION: Bladder stones occur in adult men in the vast majority of cases. They are usually secondary to bladder outlet obstruction. However, in some patients they originate from the upper urinary tract and migrate into the bladder where they grow after additional deposition of crystals. The incidence of bladder stones has been declining in developed countries while it still remains common in developing countries.The majority of these stones are composed of uric acid. Calcium oxalate, phosphate and struvite stones are next in frequency

SYNCOPE AS A PRESENTING FEATURE OF ANGIOSARCOMA OF THE COLON! Muhammed Sherid 1; Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St.Francis, Evanston, Illinois. (Tracking ID # 9151)

LEARNING OBJECTIVES: 1. To consider the unusual etiology for the common medical problem 2. To understand that angiosarcoma of the colon presents usually with advanced stagesCASE INFORMATION: A 69 year old female presented with 2 episodes of syncope within 1 week. The patient lost consciousness while she tried to get up from chair on the day of admission and one week prior to the admission. The symptoms associated with lightheadedness and blurred vision before loss of consciousness. There was a history of intermittent crampy diffuse abdominal pain for 3 week duration, associated with nausea, intermittent emesis, and watery diarrhea with 45 bowel movements daily. There was a history of loss of appetite and weight loss of 17 pounds over past 2 months. Her past medical history was significant for DM, hypertension, and diffuse vasculopathy. On physical examination, She was pale, with no orthostatic hypotension. Cardio-pulmonary exam was unremarkable. Abdomen was soft, nontender, and nondistended; bowel sounds was normal, no organomegaly, or palpable masses. Neurological exam revealed intact cranial nerves, normal muscle strength and sensation. There were mild involuntary movements in the right upper extremity. She had dysmetria on finger-to-nose testing in the right upper extremity but no significant dysmetria on the left.Laboratory studies revealed microcytic hypochromic anemia with Hb of 7.8 g/dl. Comprehensive metabolic panel were unremarkable. CT of the head showed multiple high attenuation lesions in both cerebral hemispheres and right cerebellum of 618 mm with extensive surrounding edema. CT chest, abdomen, and pelvis demonstrated several tiny nodules in the base of both lungs, in addition to a 2.4 cm soft tissue mass in left adrenal gland. Colonoscopy was done which showed a red fold in the ascending colon with several biopsies were

taken. CT-guided biopsy from left adrenal mass was performed on the same day.

IMPLICATIONS/DISCUSSION: Pathology from both sites revealed the same tumor which was poorly differentiated angiosarcoma. Immunohistochemical studies were positive for Vimentin, CD-117, CD31, CD34, and factor VIII; the findings that supported the diagnosis. Of note, CD-117 was strongly positive; a finding which suggested the tumor may be responsive to therapy with Imatinib.The diagnosis of angiosarcoma of the colon with metastases was made. In addition to the blood transfusion and dexamethazone, she received cranial irradiation and chemotherapy. On follow up, she is still alive after 4 months from the first presentation.Angiosarcoma of the colon is a very rare malignancy with only a few cases reported in the literature. It presents as abdominal pain, rectal bleeding, or anemia. It is an aggressive tumor with distant metastasis at the time of presentation in most of reported cases. The primary treatment is surgery if feasible with adjuvant chemoradiotherapy. The prognosis based on reported cases is very poor with mortality rate of 62% within one year in a review of 12 cases

CYST-TICK SWELLING OF THE KNEE. Papia Kar 1; Subhashis Mitra2.

1Marshfield Clinic, Marshfield, Wisconsin ; 2Detroit Medical Center/ Wayne State University, Detroit, Michigan. (Tracking ID # 9152)

LEARNING OBJECTIVES: 1. Recognize that musculoskeletal manifestation of Lyme, presenting as ruptured popliteal cyst, though rare should be considered in an endemic region. 2. Diagnose and treat soft tissue abscesses associated with Lyme disease.

CASE INFORMATION: A 51 year-old Caucasian male, with no significant past medical history presented with 7-day history of progressively increasing swelling over his right calf. He also reported redness in the region and pain on ambulation. The patient recalled pain and swelling of the right calf after trying to kick start a motorcycle 7-months ago which subsided with rest and elevation. The patient, a resident of central Wisconsin, has had tick bites in the past but denied any skin rash, fatigue or fever. He was afebrile with pulse of 90 beats per minute and blood pressure 143/84 mm of Hg. Physical examination revealed erythematous right calf with tenderness

and a positive Homans sign with mild effusion of right knee joint.Laboratory studies revealed elevated inflammatory markers with CRP of 24.4 mg/dl. Right lower extremity Doppler ultrasound showed no evidence of deep venous thrombosis, however did reveal a popliteal cyst with fluid leaking into the proximal calf. A magnetic resonance scan revealed a large Bakers cyst with multiple septae with fluid dissecting into the gastrocnemius muscle causing significant compression. An ultrasound guided aspirate was cloudy, with total white blood cell count of 52,800 with 90% neutrophils. Gram stain and cultures fromthe fluid were negative. With concerns for a calf abscess and the risk of developing compartment syndrome, an open incision and drainage with debridement of the abscess was performed after 24 hours. The fluid from the Bakers cyst was sent for Lyme polymerase chain reaction (PCR), which was positive. Lyme enzyme linked immunosorbentassay was reactive. Further confirmation was obtained by positive Western Blot analysis. Tissue obtained at surgery from the right medial calf was also positivefor Lyme PCR. The patient was started on intravenous Ceftriaxone, which was switched to oral doxycycline upon discharge to complete a course of 3 months.The patient was closely followed-up in clinic and continues to do well.

IMPLICATIONS/DISCUSSION: Lyme disease caused by the spirochete, Borellia burgdorferi, was first described in 1977 among patients with arthritis, living near Lyme, Connecticut. Ixodes scapularis (deer ticks) are responsible for transmission to humans. A popliteal or Bakers cyst is a synovial fluid-filled mass, commonly located in the posteromedial aspect of the knee and considered to be due to accumulation of fluid in the gastrocnemius-semimembranosus bursa. Prevalence of popliteal cyst increases with age and commonly caused by noninfectious knee effusions.Various microorganisms have been reported to cause infected popliteal cyst, including Staphylococcus aureus, Aspergillus fumigatus, Mycobacterium tuberculosis, Candida albicans among others.However Lyme disease presenting as a popliteal cyst in adults has rarely been reported. The diagnosis of popliteal cysts can be established with an ultrasound of popliteal fossa, and is useful in distinguishing ruptured popliteal cyst from thrombus. However MRI allows better evaluation of cyst rupture, hemorrhagic transformation or accompanying pyomyositis. Aspirate from the cyst should be sent for gram stain and bacterial culture along with acid-fast and fungal staining and culture. In endemic areas testing for Lyme PCR should be considered in appropriate clinic setting. Tissue obtained at surgery could also be sent for Lyme PCR as in our patient.Lyme popliteal cyst indicates disseminated infection and requires initial treatment with intravenous ceftriaxone. Surgical treatment may be necessary in some cases of ruptured cysts. In conclusion, we present a case of Lyme arthritis presenting with dissection of popliteal cyst and calf abscess, requiring surgical treatment. Lyme PCR was positive both from the synovial fluid and calfmuscle. Arthritis is a common presentation of Lyme disease in the United States and should be considered as a possible cause of popliteal cyst especially in patients living in endemic areas.

HYPONATREMIA - COMMON BUT TRICKY TO TREAT

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LEARNING OBJECTIVES: 1. Hyponatremia is a common medical problem but can be challenging in the presence of an associated endocrine disorder. The initial evaluation of hyponatremia should include - a chemistry panel, serum and urine osmolality, and urine sodium level. 2. Adrenal insufficiency is an important cause of hyponatremia in patients with diabetes insipidus who have been well controlled on desmopressin. Steroid replacement in this setting may cause rapid diuresis with a rapid rise in the sodium level.

CASE INFORMATION: This 21-year-old female with DI was well controlled and normonatremic on DDAVP. She presented to an outside facility with nausea, vomiting and serum sodium of 127 meq/L. this normalized with normal saline(NS) and her usual outpatient DDAVP dose over 2 days. Her symptoms recurred a week later and she returned to the ER and her sodium was 120 meq/L. The sodium level however decreased to 119 in 3 days despite NS! DDAVP was discontinued and hypertonic saline was initiated. Why did the sodium go down despite therapy?Adrenal insufficiency was suspected and treated with intravenous hydrocortisone. Serum sodium rose

to 132 in 10 hours. She became increasingly lethargic, nonverbal and developed a blank affect. She was transferred to Upstate University Hospital. Her sodium at transfer was up to 157 there, a rise of 38 meq/L in 18 hours. During this period, there was no record of urine volume or osmolality and she had not received any DDAVP. She had multiple episodes of seizures, became unresponsive and had to be intubated. MRI suggested extrapontine osmotic demyelination.Endocrine consult was obtained. Considering the hypernatremia with hypotonic urine (osmolality 80mosm/kg) DDAVP was restarted. Serum sodium, urine volume and osmolality were closely monitored. She was treated with hydrocortisone, anti-

epileptics and NS. Urine osmolality normalized, serum sodium was slowly brought down to 140 in 48 hours and maintained thereafter. Her clinical status however failed to improve despite the correction of hyponatremia. She was then given intravenous immunoglobulin (IVIG) for 5 days and her motor functions improved dramatically, followed by speech and cognition. Even though she had tremendous clinical improvement, repeat MRI showed worsening of the brain lesions.

IMPLICATIONS/DISCUSSION: 1.Hyponatremia is one of the most common electrolyte disturbances that physicians deal with in both the inpatient and the outpatient setting. The initial evaluation of hyponatremia should include at least 4 lab values - a chemistry panel, serum osmolality, urine osmolality, and urine sodium concentration. In patients in whom the diagnosis is not apparent after the above initial evaluation, measurement of the serum uric acid and urea concentrations, the fractional excretion of sodium, and adrenal and thyroid function tests may be helpful.2.Adrenal insufficiency should be strongly considered when hyponatremia develops in a patient with DI who was previously in good control. Repletion with corticosteroids should be done cautiously as it can lead to a rapid diuresis of hypotonic urine. This can cause a rapid rise in serum sodium concentration predisposing the patient to risk of myelinolysis. 3.IVIG therapy may accelerate recovery of Osmotic demyelination syndrome (ODS) based on data from a few case reports. Effect is possibly caused by the reduction of myelinotoxic substances, antimyelin antibodies, and the promotion of remyelination.4.MRI changes in ODS may be delayed and MRI severity is not prognostic of clinical outcome. 5.Prognosis of ODS is not uniformly bad. Significant improvement may occur with aggressive supportive therapy as in our patient; however, prevention is obviously better than cure.

WERNICKES - OR WAS IT? ANGEL T. BROWN 1; JENNIFER WHITLEY1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee. (Tracking ID # 9154)

LEARNING OBJECTIVES: 1. Identify an unusual cause of status epilepticus 2. Diagnose primary central nervous system vasculitis (PCNSV)

CASE INFORMATION: A 53 year-old female presented with seizure-like activity. She was in her usual state of health earlier that morning, but was found by family two hours later unresponsive and incontinent. Her past medical history was significant for alcohol abuse, hypertension and diabetes mellitus. She had recently been hospitalized at another facility for confusion and ataxia attributed to Wernickes encephalopathy. On arrival she had witnessed seizures which appeared to resolve with lorazepam and levetiracetam. After sedation with lorazepam, her physical examination was unremarkable. Shortly after admission she again displayed seizure activity; she was refractory to treatment and was diagnosed with status epilepticus. She required intubation. Initial laboratory data was unremarkable. Computerized tomography (CT) of the head revealed hypodensities in the left midbrain and pons. Brain magnetic resonance imaging (MRI) showed an acute-to-subacute ischemic infarct in the left posterior parietal region and extensive scattered patchy abnormal areas of hyperintensity in the cortical, subcortical, gyral, white matter and periventricular regions. EEG showed an epileptogenic focus in the left frontotemporal region. Cerebrospinal fluid (CSF) showed protein 93 mg/dL, glucose 85 mg/dL with no white or red blood cells. A cerebral angiogram showed multiple foci of vessel narrowing throughout the anterior,

middle and posterior circulation, consistent with diffuse vasculitis. Thorough laboratory evaluation ruled out systemic vasculitis, infectious
etiologies and other potential secondary causes of vasculitis. The diagnosis of primary central nervous system vasculitis (PCNSV) was made; corticosteroids and cyclophosphamide were administered. Once extubated she had auditory and visual hallucinations. Her mental status slowly improved, and she was discharged to a skilled nursing facility.
IMPLICATIONS/DISCUSSION: PCNSV is a rare disorder marked by vascular inflammation confined to the brain and spinal cord. The underlying cause is unknown. The presenting symptoms may include: headache, altered mental status, seizures, stroke, and/or weakness. CSF examination often reveals pleocytosis, elevated protein and oligoclonal bands. Traditional neuro-imaging such as CT and MRI often have non-specific findings, but may be useful to exclude tumors, infarcts, and other lesions. Cerebral angiography is often required to make the diagnosis of PCNSV. Typical findings are alternating areas of stenosis or ectasia in more than one vascular bed. If cerebral angiogram fails to yield the diagnosis, brain biopsy - considered the gold standard -may be performed. Extensive CSF and serologic evaluation must be performed to exclude secondary causes of central nervous system vasculitis, including systemic vasculitis and infection. Once the diagnosis is made, treatment consists of 2 phases: induction and maintenance. Typically prednisone and cyclophosphamide are administered 46 months to induce remission, then prednisone is tapered off and cyclophosphamide is continued for one year. PCNSV is usually fatal if left untreated.It is paramount to obtain a thorough history and physical in patients with new-onset seizures. Our patient had a recent diagnosis of Wernickes. It would have been easy to attribute her seizures to alcohol withdrawal and therefore render inappropriate treatment. It was crucial to examine all potential causes of CNS irritation.
IS GENERALIZED LYMPHADENOPATHY PART OF THE PRESENTATION OF WEGENERS GRANULOMATOSIS? Muhammed Sherid 1; Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St.Francis, Evanston, Illinois. (Tracking ID # 9156)
LEARNING OBJECTIVES: 1. To understand the myriad presentations of rare disorders. 2. To consider Wegeners granulomatosis as one of the differential diagnoses in the setting of generalized lymphadenopathy
CASE INFORMATION: A 32 year old Caucasian female presented with a several day history of lightheadedness, dizziness and blurry vision. Further history revealed that she noticed a painful rash in her shins three months ago which lasted for three weeks. She had episodes of polyarticular joint pain associated with swelling and stiffness for a year. She also had a two year history of recurrent sinusitis and left otitis with hearing loss. Midface and nasal erythema were present as well. She had malaise, loss of appetite and had lost thirty pounds over a period of six months. There was no history of fever, night sweats, cough, chest pain or shortness of breath. On examination, she had orthostatic hypotension. She was pale and had saddle nose deformity. Tenderness was present over the left cheek and forehead. Left tympanic membrane was perforated with purulent discharge. A striking finding in the examination was soft tender generalized lymphadenopathy in the cervical, axillary, epitrochlear and inguinal regions. No organomegaly was appreciated. Small joints of hands and feet, wrists, elbows and ankles were swollen and tender. No rash was noted. Laboratory studies showed mild leukocytosis, Hb of 6.8 with microcytic hypochromic picture, platelets 943 and albumin 2.6. Urinalysis was normal. HIV, syphilis and hepatitis serologies were negative. ANA multipanel was negative. p-ANCA was negative. c-ANCA tested positive with a titer of 1/320. CT scan revealed pan sinusitis and two cavitory lesions in the right upper

lobe. Nasal biopsy showed mucosal ulceration with acute and chronic inflammation with granulation tissue formation, neutrophilic micro-abscesses and focal necrosis. Lymph node biopsy revealed bening reactive follicular hyperplasia.A diagnosis of Wegeners granulomatosis was made and she was started on steroids and cyclophosphamide. During follow up, her symptoms had subsided and lymphadenopathy

resolvedIMPLICATIONS/DISCUSSION: Wegeners granulomatosis is a vaculitis disease with positive ANCA. The usual organs involved are upper and lower airways, and kidneys but any other organ systems may become involved including joints, eyes, skin, nervous system, and less commonly, the gastrointestinal tract, heart, lower genitourinary tract, parotid glands, thyroid, liver, or breast. In X-Ray, hilar adenopathy can be seen, but peripheral lymphadenopathy is not described in literature. The importance of this case is to consider Wegeners granulomatosis as one of the differential diagnoses in generalized lymphadenopathy

A NEAR FATAL FLIGHT Tulsi Sharma 1; Pankaj Mehta 2; Lisa Kaufmann3. 1SUNY Upstate Medical University, Liverpool, New York ;
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LEARNING OBJECTIVES: 1. The diagnosis of hyperviscosity syndrome requires a high index of suspicion in patients with unexplained coma/ altered mental status or unexplained shortness of breath, especially in those with an underlying hematologic disorder. 2. Sometimes we miss a very obvious finding by attributing symptoms and signs in a patient to a previously made diagnosis. This case is a classic example of delayed diagnosis because of premature diagnostic closure or anchoring heuristics.

CASE INFORMATION: Introduction: Air travel can be challenging, especially with an ongoing health condition. Some passengers may needs special precautions, particularly on a long haul flight. Case: This 67-year-old male presented with vomiting, fever and episodes of confusion. His past history included hypertension, chronic kidney disease (CKD) and lower gastrointestinal bleed 2 years ago, when he was found to have adenocarcinoma in a colonic polyp. One year later he had acute lower back pain, MRI showed possible metastatic lesions in the lumbosacral spine thought to be from colon cancer. Surgery was advised then, which he refused! He was given the prognosis of a few months. His current symptoms of fever and confusion started on a transatlantic flight while he was returning from Europe after a vacation. He had no neck signs but labs revealed acute worsening of his CKD with hematocrit of 18. He was started on broad spectrum antibiotics and received blood transfusion in the ER. Within a few hours of hospitalization patient developed chest pain with EKG changes - ST depression and rising troponin! What caused his NSTEMI was a dilemma. Blood-work revealed a large globulin gap of 11 and an elevated serum viscosity. A workup was initiated for monoclonal gammopathies. Patient underwent an urgent plasmaphereis. He improved over the next 2 days and his confusion resolved.The patient outlived his diagnosis of metastatic colon cancer but the diagnosis of myeloma was delayed. SPEP, UPEP, bone survey, bone marrow biopsy confirmed multiple myeloma. Patient was found to have multiple lytic lesions in his spine, skull and long bones. The episodes of confusion were possibly related to hyperviscosity. The patient may have worsened from the associated dehydration from vomiting, fever, his long flight and finally blood transfusion.

IMPLICATIONS/DISCUSSION: Hyperviscosity syndrome (HVS) refers to the clinical sequelae of increased blood viscosity. Hypergammaglobulinemia increases serum viscosity and is the most common cause of hyperviscosity syndrome. The reasons for elevated viscosity are increased protein content and large molecular size, abnormal polymerization, and abnormal shape of immunoglobulin molecules. Blood transfusion in these patients and can suddenly raise the blood viscosity and if required blood should be given very slowly. The most common complications of hyperviscosity syndrome include spontaneous mucous membrane bleeding, neurologic and pulmonary symptoms and retinopathy. The sludging may lead to segmental dilatation of retinal veins and retinal hemorrhages - sausage-like hemorrhagic retinal veins are pathognomic. Cardiopulmonary symptoms such as shortness of breath, hypoxemia, acute respiratory failure, and hypotension also result from this sludging of blood and decreased microvascular circulation. Acute myocardial infarction is an extremely rare complication with only a few case reports in literature. Prompt recognition and expeditious treatment are imperative in preventing deterioration. Aggressive fluid resuscitation and plasmapheresis are recommended, especially in patients with neurological, visual and other life-threatening manifestations. Cognitive psychologists refer to shortcuts in reasoning as heuristics. Anchoring heuristics lead physicians to stick with initial impressions

or diagnosis that the patient carries. Doing so is far easier than integrating the sensitivity and specificity of every new finding encountered. However, the anchoring heuristic is fallible because it conflicts with the scientific principle of checking for disconfirming evidence. This can be a double-edged sword as evidenced by this case of delayed diagnosis. And of course a near fatal flight!

EPIPLOIC APPENDAGITIS AS A CAUSE OF ABDOMINAL PAIN Muhammed Sherid 1; Geetha Selvakumar2. 1St.Francis Hospital, Evanston, Illinois ; 2St.Francis, Evanston, Illinois. (Tracking ID # 9158)

LEARNING OBJECTIVES: 1. To consider epiploic appendagitis in the differential diagnosis in the acute abdominal pain. 2. To understand the management of this self-limited conditionCASE INFORMATION: A 78 year female presented with a four day history of left sided abdominal pain (lower quadrant and left flank pain). The pain was dull in nature, moderate in severity without any radiation. Pain was constant, exaggerated with local pressure and food. The pain was not relieved by defecation or change in position. It was associated with nausea but no vomiting, no change in bowel movements. No fever, loss of appetite, or urinary symptoms. Her past medical history was significant for hypertension, and atrial fibrillation. She has past surgical history of appendectomy, cholecystectomy, and hysterectomy. Her medications include verapamil, Lipitor, amlodipine, HCTZ, and warfarin. On physical examination revealed normal blood pressure and temperature with irregular heart rate of 69. Cardiopulmonary examination was unremarkable. Her abdomen was soft, nondis-tended, there was tenderness in left lower quadrant without guarding and rebound pain. Skin and extremities were unremarkable.Laboratory studies were normal including complete blood cells, comprehensive metabolic panel, amylase, lipase, and urinalysis. CT of the abdomen and pelvis revealed induration and ring-like fat density with rim enhancement in the pericolic fat of the proximal descending colon which represents eppiploic appendagitis. Colonic wall was normal with no evidence of acute diverticulitis. The diagnosis of epiploic appendiaitis was made. Her pain was controlled by opiates without any further investigations. Her symptoms resolved within 10 days.

IMPLICATIONS/DISCUSSION: Epiploic appendagitis is triggered by torsion with ischemia and pain in one or more of the approximately 100 epiploic (or omental) appendages that arise from the serosal surface of the colon. These appendages are oriented in two rows and are composed

of adipose tissue and a vascular stalk, 0.5-5 cm in length. Epiploic appendagitis was diagnosed in the past only during exploratory laparotomy for acute abdomen; however with wide use of CT for abdominal pain, this is now more frequently diagnosed, often without the need for surgery. Risk factors are obesity, hernia, and physical inactivity. It is important to make the diagnosis so as to avoid unnecessary surgery. The treatment is symptomatic management with pain control

ASYMPTOMATIC AXIAL OSTEOSCLEROSIS IN A PATIENT WITH HISTORY OF BRAIN TUMOR AND EXCESSIVE VITAMIN D USE ERINW. KINNEY 1; MICHAEL L. BRIT1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee. (Tracking ID # 9160)

LEARNING OBJECTIVES: 1. Recognize a potential complication of vitamin D therapy 2. 1. Demonstrate radiographic work-up of incidental sclerotic bone findings on dual-energy X-ray absorptiometry (DEXA) scan CASE INFORMATION: A 58 year-old female was referred to Rheumatology for a diagnosis of prednisone-dependent polymyalgia rheumatica (PMR). The patient was diagnosed with PMR a year prior and had been unable to discontinue prednisone. Her past medical history was significant for a brain tumor 13 years prior treated with surgery and radiation, in addition to migraines and chronic low back pain. A DEXA scan was ordered given her steroid regime, postmenopausal status, and age. This study revealed very high T scores (ranging from 4.8-7.2 in the right femur and from 25.9 in the left femur) and an abnormal, sclerotic L1 vertebra. A follow-up lumbar spine series revealed widespread sclerotic changes of the axial skeleton concerning for late-

onset osteopetrosis (Albers-Schonberg Disease) or widely disseminated osseous metastatic disease. A subsequent bone scan showed multifocal abnormal uptake suggestive of metastatic disease. At this time, the patients alkaline phosphatase was 134 U/L (normal 40150 U/L) and her 25-OH Vitamin D was 20.8 ng/mL (normal 32100 ng/mL). Given the patients diffuse bone findings, normal laboratory data and symptoms of only minor low back pain, diffuse metastatic disease seemed unlikely but could not be ruled out. Review of previous records revealed a bone scan for oncologic follow-up several years prior that showed very similar findings. It was determined through discussion with the patients primary care physician that she had taken multiple dietary supplements, including high-dose Vitamin D, in the years surrounding her brain tumor treatment. Upon these discoveries, further radiographic and oncologic work-up was suspended and treatment of her presenting condition of polymyalgia rheumatica continued.
IMPLICATIONS/DISCUSSION: This patient presented with alarming radiographic bone findings but was asymptomatic. She did have a significant oncologic history, but asymptomatic diffuse metastasis from a brain tumor 13 years prior was considered an exceedingly remote possibility. Similarly, Albers-Schonberg disease is exceedingly rare with a prevalence estimated at 1 in 20,000 (1). It was known to the treating team that the patient had extensively used dietary supplements for several years but was not presently taking them. It is possible to connect her previous high-dose Vitamin D use to her current bone findings (2). There is no other plausible alternative explanation for her diffuse radiographic findings given her dramatic lack of symptoms and the stability of those bone findings over time. Vitamin D use has become commonplace among patients, both by prescription and self-administration. Therefore, clinicians must recognize potential complications of vitamin D.
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DELAYED DIAGNOSIS IN A DELAYED DRUG REACTION: A CASE OF DRESS SYNDROME Ny-Ying Lam 1; Danielle Jones1. 1Emory University School of Medicine, Atlanta, Georgia. (Tracking ID # 9164)
LEARNING OBJECTIVES: 1. Recognize the clinical features of DRESS syndrome 2. Diagnose and manage delayed cutaneous drug reactions CASE INFORMATION: A 22-year-old female with medical history significant for seizures started on Dilantin 3 weeks prior to admission presents with 2 weeks of fever, vomiting and abdominal pain, and 1 day of diarrhea. One week prior to admission, she presented to an outside hospital for similar symptoms and was noted to have an elevated Dilantin level. After a negative ID workup, her symptoms were attributed to gastroenteritis. She was switched to levatiracetam and discharged 2 days prior to this admission. On physical exam, she was febrile and tachycardic with a temp of 40 C and pulse of 112. She appeared in distress due to pain, and exam was remarkable for dry mucous membranes and abdominal distension with diffuse pain. Admission labs showed mild transaminitis (AST 123/ALT 130/Alk 90) and leukocytosis (WBC 15.7). She was continued on levitiracetam for seizure prophylaxis, given Tylenol for fever and morphine for pain. During her hospital course, she developed marked transaminitis (peak AST 762/ALT 909/Alk 120) and hyperbilirubinemia (peak tbili 14.3/Dbili 9.1) as well as liver dysfunction with coagulopathy (peak PT 35.7/INR 2.85). Aworkup for causes of acute liver injury including testing for hepatitis A, B and C, HIV and acetaminophen level was negative. All hepatotoxic medications were held. On hospital day 2, she developed a pruritic exanthem on her trunk. Over the next few days, the rash spread diffusely. She developed facial edema, jaundice and worsening distension. Lab studies revealed increasing leukocytosis and eosinophilia (peak 36.1; 11%). At this time, given the combination of rash, facial edema, hematologic changes and hepatitis she was diagnosed with DRESS syndrome (Drug Rash w/ Eosinophilia and Systemic Symptoms).The patient was started on high dose prednisone, which was continued while symptoms subsided and lab values improved. She was switched to gabapentin for seizure prophylaxis and discharged with instructions to taper prednisone slowly over 3 weeks. IMPLICATIONS/DISCUSSION: DRESS syndrome is a potentially fatal reaction that presents 26 weeks after initial exposure to a new drug. This syndrome is diagnosed in patients who exhibit a rash, eosinophilia, and systemic symptoms (fever, hepatitis, lymphadenopathy, etc). Signs and symptoms are

initially non-specific and can develop despite discontinuing the drug. Recognizing the diagnosis is important, as mortality of untreated DRESS syndrome is 10%. Diagnosis in our patient was delayed, as the hallmark symptoms took several days to develop. We were initially concerned about a possible acute drug reaction. Once the rash spread and liver enzymes increased, however, DRESS was recognized. Although a case of DRESS after levatiracetam use has been reported, Dilantin is more commonly associated. Her history of starting Dilantin 3 weeks prior also fit the appropriate timeframe. We still chose to avoid levatiracetam in the immediate recovery period because of the previous report. The clinical features differentiating delayed cutaneous drug reactions are timing of symptoms, skin appearance, and extent of systemic involvement. When a delayed drug reaction is suspected, it is important to evaluate for systemic organ involvement. The most important step in management of these reactions is withdrawal of the offending agent. High-dose systemic corticosteroids induce remission of symptoms related to DRESS syndrome, but should only be used in patients with severe organ involvement. High-doses are continued until symptoms begin to resolve and should be slowly tapered to avoid relapse after steroid withdrawal. Patients experiencing these drug reactions can exhibit adverse reactions to related meds, so all associated drugs should be avoided.

CURIOUS CASE OF HEMIDIAPHRAGMATIC PARALYSIS SECONDARY TO HERPES ZOSTER Christina Chen 1; Jenny Ruan 1; Laura Snydman 1; Richard Kopelman1. 1Tufts Medical Center, Boston, Massachusetts. (Tracking ID # 9168)

LEARNING OBJECTIVES: 1. Recognize motor manifestations of herpes zoster 2. Diagnose hemidiaphragmatic paralysisCASE INFORMATION: An 81-year-old man with a remote history of 45 pack-years of tobacco abuse but no known history of cardiac or pulmonary disease presented with a one month history of shortness of breath that worsened over the past three days. He was afebrile, tachycardic, normotensive, with a respiratory rate of 22 and an oxygen saturation of 85% on room air that improved to 95% with 3 L NC. His pulmonary examination revealed absent breath sounds at the right lung base with otherwise good air movement. Skin examination revealed two asymptomatic erythematous macules: a 1-inch diameter lesion on his right anterior chest and a half-inch diameter lesion on his right shoulder. Musculoskeletal examination revealed full strength of his upper extremities bilaterally. Laboratory data were significant for an elevated D-dimer. Studies included an EKG that revealed sinus tachycardia, an unremarkable lower extremity ultrasound, a chest x-ray that was remarkable for an elevated right hemidiaphragm, and a CTPA that showed volume loss in the right lower lobe but was otherwise unremarkable. During the hospitalization, the rash remained painless, but progressed to cover the right C5-T1 dermatome and small vesicles developed. Tzanck smear showed multi-nucleated giant cells and viral cultures grew VZV. Sniff test showed paradoxical movement of the right hemidiaphragm. EMG revealed complete paralysis of the right hemidiaphragm with full function on the left. MRI of the C-spine and T-spine did not demonstrate any mass or compression of the phrenic nerve. The patient was treated with valacyclovir and discharged to a rehabilitation facility for a month, after which he returned home on oxygen.

IMPLICATIONS/DISCUSSION: Herpes zoster is a very common condition affecting as many as 1 million people a year and typically causes sensory deficits. Occasionally this disease can cause motor paralysis and very rarely it can affect the phrenic nerve causing hemidiaphragmatic paralysis. Although herpes zoster is very common, diaphragmatic paralysis is a rare complication that has only been documented in 23 cases, 18 of which are in English literature. Most patients presented with dyspnea (16/18). Over a quarter of patients (5/18) had weakness in the corresponding extremity. Almost a third of the patients recovered (4/13) with the process ranging from 6 months to years, a less optimistic prognosis than other herpes associated paralyses. Interestingly, some patients had improvement of extremity weakness without resolution of diaphragmatic paralysis, which is thought to be due in part to the remarkable length of the phrenic nerve and the slow rate of nerve regeneration. This rare case of hemidiaphragmatic paralysis secondary to herpes zoster serves as a reminder that although neurological deficits are typically sensory, motor deficits are also possible. The true

incidence of this phenomenon is unknown since asymptomatic cases may go undiagnosed.
THE INHIBITOR WITHIN Tisha Marie Borromeo Suboc 1; kris 1; Kurt hombPfeifer2. 1Medical College of Wisconsin, wauwatosa, Wisconsin ;
2MCWMCW, Milwaukee, Milwaukee, Wisconsin, Wisconsin. (Tracking ID # 9181)
LEARNING OBJECTIVES: 1. Recognize mild elevations in partial thromboplastin time as potentially being secondary to acquired factor
VIII inhibitor. 2. Diagnosing and treating acquired factor VIII inhibitor to prevent massive bleeding.
CASE INFORMATION: A71-year-old gentleman with no significant past medical history presented with new-onsetdizziness. He was noted to have profound anemia with hemoglobin 5.8 g/dl,mildly elevated activated partial thromboplastin time (PTT), and.an abdominal CTthat revealed an infrarenal abdominal aortic aneurysm (AAA) measuring 3.5 x 4.3 cm and a retroperitoneal hematoma. Itwas initially thought that the aneurysm may have caused the retroperitonealhematoma. He underwent emergent surgeryfor repair of the AAA and drainage of the retroperitoneal hematoma. After the surgeryhis hemoglobin continued to trend downward with minimal response to packed redblood cell (PRBC) transfusions. His coagulation profile was then re-evaluatedand showed a consistent elevation of his aPTT, ranging between 3540. Prothrombintime, platelet count and fibrinogen remained normal. Repeat abdominal CT found recurrenceof his retroperitoneal hematoma and a scrotal hematoma. He underwent surgicalevacuation of his scrotal hematoma and retroperitoneal hematoma, butpostoperatively continued to respond poorly to transfusions. Plasma mixing studies were performed andrevealed no correction of PTT after mixing with normal plasma. Further testing revealed markedly diminishedfactor VIII activity and a factor VIII inhibitor level of 37 Bethesda units. He was initially treated with recombinantactivated factor VII and activated prothrombin complex concentrates (aPCC), andlater started on methylprednisone, intravenous gammaglobulin (IVIG), and rituximabweekly. After 48 hours of thesetherapies, the patient no longer required PRBC transfusions and subsequently, hisfactor VIII activity increased from APCC was then discontinued after 4 days, and methylprednisoneand recombinant activated factor VII were also tapered off. IMPLICATIONS/DISCUSSION: Acquired factor VIII inhibitor, also known as acquiredhemophilia A, is a rare bleeding disorder secondary to autoantibodies directedagainst coagulation factor VIII. Unlike congenital hemophilia which ischaracterized by hemarthroses, acquired hemophilia usually presents with softtissue bleeding. The incidence is14.7 per million/year in patients over 85 years old. Although uncommon, it is associated with high rates of morbidity andmortality secondary to severe bleeds in 90% of affected patients. The mortalityrate rages from 8% to 22%. The mostcommon conditions associated with development of factor VIII inhibitor arerheumatologic diseases, malignancy, pregnancy and drug reactions, but themajority of cases are idiopathic in origin. Diagnosis is usually by detectionof a mildly prolonged aPTT which cannot be corrected with mixing equal volumesof the patients plasma and normal plasma, also called a mixing study, or withadding phospholipid (ruling out antiphospholipid antibodies). Confirmation isdone through identification of reduced factor VIII activity and evidence of factorVIII inhibitor (using the Bethesda assay). Treatment with factor VIIIconcentrates is ineffective; instead plasmapheresis or bypassing agents, suchas recombinant activated factor VII and aPCC, are used to rapidly reverse bleeding.Up to one-third of cases, especially those associated with pregnancy and drugreactions, spontaneously remit within 12 years. However, the clear risks ofbleeding and the unknown recurrence potential have led to guidelines promoting .glucocorticoids,rituximab, IVIG, and other immunosuppressants to hasten elimination of theautoantibody and possibly reduce the risk of recurrence.
A RHEUM WITH EFFU-SION Rebecca Vasquez 1; Jeffrey Percak1.
1Tulane University, New Orleans, Louisiana. (Tracking ID # 9196)
LEARNING OBJECTIVES: 1. Identify systemicmanifestations of rheumatoid arthritis. 2. Identify lab studies that help confirm the

diagnosis ofrheumatoid lung disease.Discuss treatment of RA with systemicsymptoms.
CASE INFORMATION: A 29 year-old woman presented with four days of pleuriticchest pain. She had no fever, cough, PE risk factors, or trauma. Review ofsystems was notable for chronic joint pain in her hands.T=97.6 BP=127/87 HR=96 RR=18 SpO2=100%RAThe patient was alert, oriented, and breathing comfortably.Heart sounds were normal. Lungexamination revealed diminished breath sounds at the left base, with dullnessto percussion but no egophany or fremitus. The remainder of the exam was normalexcept for swelling and warmth in the MCPs and PIPs of both hands.CMP, CBC, CXR were all normal. RF level was 160.3 IU/ml. A CXR showed a left-sided pleural effusion with air fluid level, and CTChest confirmed a left lower hydro-/pneumo-thorax with bilateral pulmonarynodules. Pleural fluid analysis showed >13,000 WBCs, 42,000 RBCs, totalprotein 5.9 g/dl (serum protein 7.6 g/dl), glucose 4 mg/dl, and LDH 2674 U/L. Fluid gram stain, AFB, andculture were all negative.
IMPLICATIONS/DISCUSSION: Rheumatoid arthritis (RA) is a chronic systemic inflammatorydisease frequently encountered by the internist. Systemic manifestations of the disease are variable; extra-articularmanifestations of rheumatoid arthritis occur most often in seropositivepatients and include subcutaneous nodules, pleural effusion, pericarditis, lymphadenopathy, splenomegaly with leukopenia, and vasculitis. Pleuraleffusions are the most common manifestations of RA in the chest, are morecommon in older men, among those with + RF titers, and those with rheumatoidnodules.Patients with RA and a suspected rheumatoid pleuraleffusion (RPE) should undergo diagnosticthoracentesis to confirm an exudative effusion and to exclude other etiologies. Examination of the pleural fluid typically reveals protein level >3.0 g/dL, LDH >700 IU/L, low glucose (especially if Elevated fluid cholesterol (>65 mg/dL) suggests formation of rheumatoid sterile empyema. It isimportant to exclude superimposed infective empyema. Cytology may show elongatedand giant multinucleated macrophages in a necrotic background of debris. Manyuncomplicated RPE resolve spontaneously. For others, thoracentesis may be sufficienttreatment. Systemic corticosteroid administration and pleural cavity corticosteroidirrigation may be useful for recurrent or chronic RPE. Pleurodesis anddecortication in RPE should be reserved for refractory effusions andfibrothorax. Cytokine blockade therapy may play a role in the future.
TWOS COMPANY BUT THREES A CROWD Lucius Howell 1; Andrew Elson 1; Casey Dunn2. 1Tulane University, New Orleans, Louisiana ;
2Tulane University, New Orelans, Louisiana. (Tracking ID # 9198)
LEARNING OBJECTIVES: 1. Create a differentialdiagnosis for TTP. 2. Recognize SLE and Antophospholipid Antibody syndrome as causes of TTP. Recognize that vasculiticand thrombotic strokes can present similarly. Understand the utility ofMRI, MRA and MRV in differentiating vasculitic vs. thrombotic strokes.
CASE INFORMATION: A 47 yr-old woman presented with 4 days of progressiveconfusion, abnormal speech, and difficulty performing routine work. She alsoreported easy bruising. She was afebrile, heart rate was 93 bpm, and blood pressurewas 168/78 mmHg. She exhibited circumlocution, perseveration, difficulty namingobjects, and could not comprehend complex directions. Her strength, sensation,reflexes, and coordination were normal. She had diffuse petechial rash and purpura located on her upper andlower extremities. Her platelet count was 7,000 cells/mm3, and hemoglobin was8.6 g/dl. She had a creatinine of 1.7 (baseline of 1.0). The peripheral smear had schistocytesand helmet cells. The LDH was 988u/l. MRI of the brain confirmed acute ischemic insults within left parietallobe and right occipital lobe. The ADAMTS 13 activity was low and the ADAMTS 13inhibitor was elevated. She reported history of multiple spontaneous abortions. Shehad positive ANA, dsDNA, anti-Ro and anti-La antibodies. The dilute Russelviper venom was prolonged. Anti-cardiolipin, scleroderma, anti-phosphotylserineand beta-2-glycoprotein antibodies were negative. Further investigationrevealed MTHFR gene mutation.She was started on high dose IV steroids andplasma exchange for treatment of Thrombotic Thrombocytopenic Purpura .The plasmapheresiswas discontinued when platelets reached 150,000/cmm with clinical improvement.

IMPLICATIONS/DISCUSSION: TTPcan have many different precipitants. The co-presentation of SLE and TTP hasbeen documented and presents a diagnostic challenge. Many of the features ofthe classic TTP pentad such as CNS abnormalities, hemolytic anemia, andthrombocytopenia are shared with SLE. Though ADAMTS13 antibody assay candistinguish pure TTP from SLE, suspected TTP is treated empirically. Giventhe unique situation, the treatment was tailored to the patients short-termand long-term needs. Plasmaphoresis, steroids and antiplatelet treatment werestarted for immediate treatment of the TTP and SLE vasculitis. The patientsneurological symptoms improved after treatment. Follow-up imaging suggestedthat both microvascular and thrombotic processes were contributing to CNSpathology. Given her improvement,the patient was not started on lifelong anticoagulation until the isolatedprolonged DRVV test was repeated three months later. Therefore, we managed totreat the TTP and SLE simultaneously.The internist is usually the first physicianto encounter an evolving TTP. Early recognition of the disease is imperativefor patient survival. TTP, SLE, and APA can all cause CNS abnormalities. TTP and SLE co-presentation requiresboth PLEX and immunosuppresion in the acute presentation. Unique to this case is balancinganticoagulation for APA syndrome versus the risk of bleeding during this episodeand subsequent TTP crises.

CENTRAL RETINAL ARTERY OCCLUSION AS AN INITIAL MANIFESTATION OF WEGENERS GRANULOMATOSIS SEAN HUANG 1; SURESH ENJETI1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee. (Tracking ID # 9199)

LEARNING OBJECTIVES: 1. Recognize that Wegeners granulomatosis can initially present with central retinal artery occlusion. 2. Recognize that such presentation may predict a poor prognosis of the Wegeners granulomatosis.

CASE INFORMATION: A 49-year-old Caucasian male truck driver with a 32 pack-year smoking history noticed sudden loss of vision in his right eye while on the road approximately 3 hours prior to presentation. In the Emergency Room, the patient was determined to have an acute central retinal artery occlusion and anterior chamber paracentesis was performed. Admission chest X-ray revealed bilateral peripheral lung nodules. On further questioning, he reported productive cough with occasional blood streaks, shortness of breath, fever, chills, severe fatigue, hot flashes, night sweats, and 26 pounds of weight loss over three to four weeks. Outpatient antibiotic treatment did not resolve the symptoms. Family history was noteworthy for sudden loss of vision in his father. The patient was afebrile at presentation. Eye exam revealed absence of light perception and reaction to light in the right pupil. There was severe attenuation of the arterial vessels with nonmoving boxcarring noted. Breath sounds were diminished bilaterally. His lab tests were remarkable for normocytic anemia (Hb 11.2 g/dL), elevated sedimentation rate (105), C-reactive protein (>16), and positive rheumatoid factor. Computed tomography (CT) scan of the chest showed

multiple nodules in the lungs. Some of them were cavitary. CT-guided fine needle biopsy of a necrotic nodule demonstrated necrotizing granulomatous inflammation. C-ANCA was positive at 1:160 and proteinase-3 exceeded 100. The patient was evaluated by rheumatology and started on prednisone and Cytoxan. About a month later, he developed increasing shortness of breath, dry cough, loss of appetite, and generalized malaise. He was noted to have extensive bilateral pulmonary infiltrates; serum creatinine had increased from 0.7 to 5.1. He was hospitalized and treated with pulse steroids and intravenous Cytoxan. He required hemodialysis and plasmapheresis thrice each. However, rapidly progressive cardio-respiratory failure led to his demise within 5 days.

IMPLICATIONS/DISCUSSION: Wegeners granulomatosis (WG) is a systemic vasculitis characterized by necrotizing granulomatous inflammation of the respiratory tract and lungs, glomerulonephritis, and vasculitis at multiple sites. The ocular involvement usually includes uveitis and inflammation of the conjunctiva, sclera, and cornea (1). Seventeen cases of central retinal artery occlusion (CRAO) due to Wegener granulomatosis have been reported (2). Ocular presentation may be seen with or without systemic manifestations of WG. In one

study, 6.3% of the patients presented with ocular symptoms as initial manifestation (3). However, none of them was reported as CRAO. High doses of steroids and cyclophosphamide appear to be effective for therapy of CRAO secondary to Wegeners granulomatosis. Patients with WG have neutrophils expressing PR3 on their surface. Once activated by ligating between PR3 and the c-ANCAs, the neutrophils produce respiratory burst and release proteolytic enzymes that cause the necrotizing granulomatous inflammation. In this patient, the high level of proteinase-3 may account for his severe course with CRAO and rapidly progressive pulmonary-renal dysfunction. Initial presentation of CRAO in Wegeners granulomatosis is very rare. This phenomenon may predict an abysmal prognosis.1. Pakrou N, Selva D, Leibovitch I. Wegeners granulomatosis: Ophthalmic manifestations and management. Semin Arthritis Rheum 2006; 35:28492.2. S. Morell-Dubois, T. Qumneur, F. Bourdon, M. Lambert, V. Queyrel, D. Launay, E. Hachulla, P. Labalette, P.-Y. Hatron Central retinal artery occlusion in Wegenergranulomatosis La Revue de mdecine interne 28 (2007) 3337.3. Harper SL, Letko E, Samson CM, Zafirakis P, Sangwan V, Nguyen Q, Uy H, Baltatzis S, Foster CS. Wegeners granulomatosis: the relationship between ocular and systemic disease. J Rheumatol. 2001 May;28(5):102532.

RHABDOMYOLYSIS: A RESULT OF AZITHROMYCIN MONOTHERAPY David English 1; Melody Oncale1. 1Tulane University, New Orleans, Louisiana. (Tracking ID # 9202)

LEARNING OBJECTIVES: 1. Recognize rhabdomyolysis asa potential side effect of macrolides. 2. Diagnose and managerhabdomyolysis caused my medications. Understand thepathophysiology of rhabdomyolysis caused by medications.

CASE INFORMATION: A32-year-old man with hypertension presented with dark urine and muscle pain.Three days prior to admission, he presented with fever, cough, and headache andwas diagnosed with community-acquired pneumonia. He was prescribed azithromycin500mg and Tylenol #3. Two days later the patient began experiencing diffusemuscle pain and darkened urine. Hedenied any strenuous exercise, traumatic injury, cocaine or IV drug abuse, oringestion of any other prescription or herbal medications. Onad-mission, he had diffuse muscle tenderness and tea-colored urine. He was afebrile, and the remainder of theexam was non-revealing. Significantlabs included aspartate transferase (AST) of 1143U/L
(normal: 535 U/L),alanine transferase (ALT) of 236 (normal: 740), and creatinine kinase (CK) of >25,000 (normal: 38175). Urine showed large blood but no red bloodcells. Serum acetaminophen wasundetectable. Urine drug screen was positive for opiates, consistent withTylenol #3 ingestion. The workup for infectious hepatitis and HIV werenegative. Thyroid-stimulating hormone was 2. Thepatient was diagnosed with rhabdomyolysis and treated with fluids and paincontrol. His CK, AST and ALT gradually decreased. His muscle tenderness alsoimproved, and his urine gradually lightened. Given the temporal relationship,it was thought that azithromycin was the likely culprit and was discontinued.

IMPLICATIONS/DISCUSSION: Rhabdomyolysisimplies the clinical and laboratory syndrome secondary to the release of toxicsubstances, particularly myoglobin, from dying myocytes. 1 Althoughno true diagnostic criteria exist, a serum CK level greater than 5 times theupper limit of normal is often used for the diagnosis. 2 The presentationinvolves muscle weakness or tenderness and myoglobinuria. Complications includeacute renal failure, compartment syndrome, hyperkalemia, hypocalcemia, andcoagulopathy. 3 The etiologies of rhabdomyolysis include trauma,muscle hypoxia, infections, temperature alterations, congenital enzymaticdeficiencies, and toxins or drugs. 1Both illicit drugs and prescription drugs are knowncauses of rhabdomyolysis. When hydroxymethylglutaryl-Coenzyme A reductaseinhibitors (statins) are administered with macrolide anitibiotics such asclarithromycin and erythromycin, rhabdomyolysis may result secondary to themacrolides inhibition of CYP450 3A4, causing increased plasma levels ofstatins. 2 In 2009 Brener et al. reported the first case ofrhabdomyolysis secondary to clarithromycin mono-therapy, which was thought toresult from clarithromycins inhibition of CYP450 3A4. Azithromycin, a newer azolidemacrolide, is unique in that it causes little to no inhibition of CYP450 3A4. Withoutenzymatic inhibition, there have been several reports of rhabdomyolysisresulting from the concomitant use of statins and azithromycin. Its been postulated that

azithromycinalters cell membrane transporters, such as P-glycoprotein, which influences themetabolism of statins. 4 To our knowledge, there have been no casereports of rhabdomyolysis induced by azithromycin monotherapy as of Oct 2010. Othercauses of rhabdomyolysis such as temperature alterations, trauma,over-exertion, metabolic causes, and illicit drugs were excluded. The temporal relationship between ourpatients symptoms and the onset of therapy with azithromycin make azithromycinthe likely cause of rhabdomyolysis.
CASE OF SYMPTOMATIC HYPERCALCEMIA SECONDARY TO PRIMARY HYPERPARATHYROIDISM Julia Chen 1; Julia Chen1. 1Dartmouth-Hitchcock Medical Center, West Lebanon, New Hampshire. (Tracking ID # 9203)
LEARNING OBJECTIVES: 1. Recognize symptoms of hypercalcemia and initiate the proper diagnostic workup. 2. Manage symptomatic hypercalcemia, including when to refer for parathyroidectomy.
CASE INFORMATION: An 85 year old female with hypertension, degenerative joint disease, prior compression fractures and recently diagnosed depression presented to the ED with back pain and altered mental status. She fell 3 weeks ago at home after feeling lightheaded, but did not lose consciousness or hit her head. Her back pain was initially attributed to a muscle strain, but had not improved with conservative management. The pain was central, stabbing and 10/10 in severity. She complained of slow mentation, inability to articulate her thoughts, and sleepiness. She denied focal neurologic deficits. She endorsed new bladder incontinence, decreased appetite, and polydipsia.

Her medications included metoprolol, amlodipine, hydrochlorothiazide, lisinopril, aspirin, venlafaxine, ibuprofen, and a multivitamin. There was no family history of renal stones, calcium problems or neck surgeries. Plain films of her spine showed an acute compression fracture at T12. Labs revealed a calcium of 16.0 mg/dL. Additional labs showed an elevated PTH at 261 pg/mL, an elevated 24-hour urinary calcium/ creatinine ratio, normal TSH, and normal Vitamin D levels. She was treated with IV fluids, IV bisphosphonate and subcutaneous calcitonin. Her mentation improved, and calcium levels fell to 9.7 mg/dL over the next 5 days. A DEXA-scan showed demineralization of the spine, but normal bone density at the hip. A Sestamibi scan revealed persistent focal activity in the left upper pole suggestive of a parathyroid adenoma. She underwent outpatient parathyroidectomy with removal of a large left upper parathyroid gland, resulting in a drop in the PTH from 295 to 129. Removal of the right lower and left lower parathyroid glands resulted in a PTH of 15. Pathology revealed hyperplasia of all three glands. She has done well post-op and has resumed her active lifestyle.
IMPLICATIONS/DISCUSSION: Hypercalcemia is often asymptomatic, especially if the calcium level is
BEYOND THE USUAL INFILTRATE: LEGIONELLA PNEUMOPHILA
CAUSING MULTIORGAN SYSTEM FAILURE HARITHA REVANA 1;
JASMINE SHAH 1; VICTOR O. KOLADE2. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee ; 2University of Tennessee College of Medicine Chattanooga, CHATTANOOGA, Tennessee. (Tracking ID # 9204)
LEARNING OBJECTIVES: 1. Recognize that Legionellosis can cause severe sepsis with multiorgan system failure 2. Recognize that Legionella pneumonia can cause cavitary lung lesion in an immuno-competent hostCASE INFORMATION: A 30 year-old previously healthy male arrived by ambulance after he was found lying in urine and feces at home. He had reported chills and dry cough 2 days prior. At presentation he was febrile, tachycardic, tachypneic, hypoxemic, and delirious, with diffuse abdominal tenderness and normal bowel sounds. Laboratory data revealed leukocytosis, severe metabolic acidosis, elevated lactate, acute kidney injury with creatinine of 6.9 mg/dL, elevated creatine kinase, lactate, transaminases and bilirubin. Urine analysis was positive for albumin, glucose, large blood and few red cells. Arterial blood gases on room air were pH 7.43, PaCO2 18, PaO2 68 mmHg. Admission APACHE II score was 22. A chest Xray showed dense infiltrates in

lingula and left lower lobe; computed tomography confirmed the x-ray findings and revealed a cavitary lesion in the right upper lobe as well as scattered parenchymal nodules in both lungs. There was no evidence of infective endocarditis on echocardiography. He was intubated and admitted to intensive care. Treatment was started for severe sepsis, community acquired pneumonia, possible aspiration, and meningitis with empiric antibiotics vancomycin, ceftriaxone and azithromycin. The following studies were non-diagnostic: HIV screen, viral hepatitis panel, blood, urine and sputum cultures, influenza A and B screens, and cerebro-spinal fluid analysis. Subsequent laboratory data revealed elevated amylase, lipase, lactate dehydrogenase, and myoglobin; a diagnosis of acute pancreatitis with rhabdomyolysis was made. The patient worsened clinically, and dotrecogin alpha was started on day 2. Urine for Legionella antigen was positive, and the antibiotics above were replaced with levofloxacin. The patient had worsening pancreatitis, rhabdomyolysis, disseminated intravascular coagulation, acute respiratory distress syndrome, and acute renal failure requiring renal replacement therapy, but improved later so that he was discharged home on the 23rd day.
IMPLICATIONS/DISCUSSION: Published case reports document isolation of Legionella pneumophila from 13 different extrathoracic organs - including liver, spleen, lymph nodes, kidney and blood -often in the absence of pneumonia. In our patient it caused multisystem organ failure manifesting as pneumonia with acute respiratory failure, acute pancreatitis, acute kidney injury, rhabdomyolysis, leucopenia, disseminated intravascular coagulation and confusion. This can be attributed to dissemination of bacteria or legionella toxin release, or cytokine release and effector cell-induced inflammation. In the multiple case report descriptions in the literature, Legionella causes cavitary lung lesions only in immuno-compromised hosts. To our knowledge, no other cases of cavitation in an immunocompetent host have been reported.
NEW PARTNERS AND PARESTHESIAS: EVALUATION OF NEW NEUROLOGIC SYMPTOMS AFTER TREATMENT FOR A SEXUALLY TRANSMITTED INFECTION Kevin Selby 1; Katherine Johnston1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 9206)
LEARNING OBJECTIVES: 1. Explain common symptoms of transverse myelitis and their correlation with spinal cord anatomy 2. Describe the appropriate primary care evaluation of transverse myelitisCASE INFORMATION: A 48-year-old healthy woman presented for evaluation of painful vulvar rash, malaise, and fevers present for 1 week. Social history was notable for new sexual partner. Remainder of history was unremarkable. Physical exam revealed erythematous, tender vulvar ulcers. Empiric treatment for primary genital HSV was initiated with acyclovir. HSV serologies were sent and returned negative. One week later, the patient presented with complaint of numbness in her genitals and buttocks, a sensation of weakness and pins and needles in her feet, difficulty initiating urination, and constipation. Neurologic exam was significant for a sluggish right ankle jerk. MRI of the spine with and without contrast revealed posterior spine enhancement at the T11-T12 level, consistent with transverse myelitis. CSF analysis showed 14 white blood cells, 97% lymphocytes, normal glucose and normal protein. CMV, EBV and HSV PCR were all negative. Repeat serologies for HSV-2 were positive 4 weeks later. The patient was managed conservatively with antivirals and physical therapy. Her symptoms resolved after three months.
IMPLICATIONS/DISCUSSION: Acute transverse myelitis should be suspected with complaints of motor weakness, sensory abnormalities referable to the spinal cord, and bowel or bladder dysfunction. Symptoms often progress in hours to days. Perceived sensory abnormalities can signal mild or early disease without clear deficits on exam. Transverse myelitis is a focal inflammatory disorder of the spinal cord that leads to sensory, autonomic, and/or motor dysfunction in a bilateral, though not necessarily symmetric distribution. Deficits are a result of damage to the spinothalamic tracts, pyramidal tracts, posterior columns and anterior faniculi at one or more adjacent levels of the cord. It is most often an autoimmune phenomenon after an infection or vaccination, or a direct infection. Secondary causes, such as underlying systemic autoimmune disease, or an acquired chronic demyelinating disease like multiple sclerosis or neuromyelitis optica, must be considered. Diagnosis is made with demonstration of spinal cord inflammation, either with CSF pleocytosis (typically lymphocytic) or

elevated IgG index, or an MRI revealing a typical gadolinium-enhancing cord lesion. In our case, it is unclear whether she had a post-infectious immune reaction, or direct infection of the spinal cord with HSV-2. HSV is a rare cause of transverse myelitis. The most common post-infectious triggers are upper-respiratory tract infections or gastroenteritis. Viral

infection is rarely the cause. Treatment is not well defined, but may include anti-viral agents like acyclovir, corticosteroids, and/or physical therapy. Prognosis is highly variable; idiopathic cases tend to resolve within 3 months, whereas attacks associated with secondary causes are more likely to have significant residual deficits. When patients present with complaints that could be due to transverse myelitis, spinal MRI, lumbar puncture, and neurology consultation are key options for primary care evaluation.

THE PROOF IS IN THE SMEAR: ACUTE RESPIRATORY DISTRESS SYNDROME IN MALARIA Abimbola Sokunbi 1; Abimbola Sokunbi1.
1Resident, cincinnati, Ohio. (Tracking ID # 9218)

LEARNING OBJECTIVES: 1. ARDS in malaria has been described and it is associated with a high mortality rate. This clinical vignette helps recognize the manifestation of ARDS as a complication of P. vivax/P. falciparum malaria. 2. It also stresses on the importance of malarial prophylaxis to pts travelling to endemic areas even well seasoned travelers.

CASE INFORMATION: 37 year old previously healthy female who had lived in the United States for 18 years presented with 34 days of fevers, chills, sweats. She visits India annually, and returned 3 weeks prior to presentation. She took no antimalarial prophylaxis. She became increasingly hypoxic requiring intubation. ABG: PaO2 of 65 on 100% FiO2, PEEP 12; chest radiograph: diffuse bilateral airspace opacity, consistent with ARDS. She was extubated after 22 days. Initial blood smears showed P. falciparum. Repeat blood smear: P. vivax 1% parasetemia. She was treated with chloroquine, Doxycycline and Primaquine. Her illness was complicated by septic shock, UTIs, DVTs, bacterial pneumonias, rectus sheath hematoma. Patient was ultimately able to be discharged to a nursing home after 30 days IMPLICATIONS/DISCUSSION: Malaria remains a significant public health problem globally with more than two billion people exposed to the risk of contracting malaria. Respiratory complications of Malaria can be very fatal. 11% case fatality has been reported with P.vivax infection compared to 33-75% in P. falciparum infection. ARDS has been well described as a complication of P. falciparum infection. The pathogenesis of ARDS is not fully understood especially in P. vivax infection. Lung injury in P. falciparum infection relates to an increase in capillary permeability in the pulmonary vasculature and is associated with large numbers of inflammatory cells. Mechanisms for lung injury include cytokine-induced damage or direct effects of sequestration of parasitized erythrocytes. There have been a total of 20 case reports of P. vivax as a cause for ARDS. P.vivax ARDS usually occurs after initiation of therapy in P. vivax infections and in most cases after clearance of parasitemia thus this may be a post-treatment inflammatory response. Patients with malarial ARDS are managed in an intensive care unit with attention paid to hemodynamic stabilization. Frequently require mechanical ventilation, have coexistent bacterial sepsis. ARDS in malaria is a disease with a high mortality. Use of prophylaxis, early diagnosis, institution of specific antimalarial treatment and assisted ventilation can be life saving

A CASE OF PEMPHIGUS VULGARIS- A DIAGNOSTIC DILEMMA Surbhi Chamaria 1; Laura Johnson 1; Shital Patel 1; Hanish Singh1.
1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 9232)

LEARNING OBJECTIVES: 1. Recognizing the clinical features of Pemphigus vulgaris to avoid misdiagnosis in its earliest stage. 2. Using histology for accurate diagnoses &knowing the aims of treatment and follow up to achieve complete remission.

CASE INFORMATION: A 27 year old male presented to the ER with complaints of two and a half month history of painful oral lesions and macroglossia. Patient noted that the lesions were very painful and caused

considerable discomfort affecting normal oral function. He had been treated with Penicillin for possible Streptococcus pharyngitis and subsequently with nystatin mouthwash for possible candidiasis with which the lesions did not resolve. No history of fever, cough, ocular, vascular, neurological symptoms. No arthralgia, or genital lesions. Personal and family histories not significant. Patient is a non smoker. On intraoral examination ulcers were noted on the cheek, soft palate, ventral surface of the tongue, posterior pharyngeal wall, tonsils which bled on peeling it off. No skin lesions were seen on extra oral examination. Autoimmune workup, HIV, fungal, viral cultures, respiratory cultures were all negative. Laryngoscopy done showed a supraglottic ulcer. Diagnosis of pemphigus vulgaris was made after evaluating the biopsy samples. Histological findings showed squamous mucosa with suprabasal cleft formation, detached fragments of relatively unre-markable squamous epithelium, few small clusters of detached squamous epithelium with reactive nuclear changes &in addition, chronic inflammation of the lamina propria. The overall histologic findings were consistent with pemphigus vulgaris.Direct Immunofluorescence demonstrated IgG and C3 in the intercellular regions of the epithelium with negative staining along the basement membrane zone. The patient was referred to dermatology &was started on a taper dose of prednisone with the intention of starting an immunosuppressant at the end of 4 week taper. Patient is currently been followed by dermatology for treatment. IMPLICATIONS/DISCUSSION: Pemphigus vulgaris is an autoimmune blistering disease with antibodies directed against cadherin-type epithelial cell adhesion molecules, desmoglein 3 in particular. This interferes with the intercellular cement that holds epidermal cells together &results in intraepidermal blister formation. Pemphigus vulgaris has a strong genetic background with ethnic groups like Ashkenazi Jews &those of Mediterranean origin being liable. It may be associated with other autoimmune disorders such as rheumatoid arthritis, myasthenia gravis, lupus erythematosus or pernicious anaemia &drugs such as penicillamine &captopril. Any part of the oral mucosa may be affected, although sites of trauma like the buccal mucosa, gingiva &palate are affected. Oral lesions are initially vesiculobullous, but they readily rupture to form ulcers which are initially red but as infection supervenes, they develop a yellowish slough &heal slowly but rarely with scarring. Gingival lesions comprise severe desquamative gingivitis where bullae have ruptured to leave flaps of peeling tissue with red erosions or deep ulcerative craters mainly on the attached gingivae. Open denuded areas become infected. Lesions do not resolve without therapy &heal with postinflammatory hyperpigmentation resolving within 12 years &do not leave scarring. Diagnosis is made by biopsy of the lesions, histologically showing intraepithelial acantholysis without disruption of the basement membrane. DIF will show deposits of IgG between epidermal cells. Differential diagnosis include herpes simplex virus, aphthae, lichen planus, erythema multi-forme. The aim of treatment is to induce disease remissions followed by a period of maintenance. Steroids are the primary drugs used in combination with immunosuppressive therapy. Long term follow up is the rule. Some patients require years to life long suppressive therapy with a minority of patients achieving complete remission after initial treatment.

CROHNS DISEASE CAN BE A HEADACHE Shikha Chacko 1; Robin Klein2. 1Emory Internal Medicine, Atlanta, Georgia ; 2Emory University Internal Medicine, Atlanta, Georgia. (Tracking ID # 9235)

LEARNING OBJECTIVES: 1. Demonstrate an atypical presentation of the extraintestinal manifestations of inflammatory bowel disease. 2. Review the neurologic complications of IBD.

CASE INFORMATION: A 44-year-old Caucasian female with a ten-year history of stable Crohns disease presented with diarrhea and headache. She reported 810 bloody bowel movements per day associated with debilitating abdominal pain and significant weight loss. In addition, she reported a bifrontal generalized headache described as the worst headache of her life. Exam revealed conjunctival pallor, dry mucus membranes, generalized abdominal tenderness and no neurological deficits. Labs were significant for hemoglobin of 6.6, albumin of 2.1, ESR of 88, and CRP of 17. Colonoscopy demonstrated extensive colonic

transmural inflammation. She was given blood transfusions, TPN, steroids and mercaptopurine with symptomatic improvement in her pain and diarrhea. Through this, the patients headache persisted and even worsened with bowel movements. Given its association with bowel movements, the headaches were considered valsalva-induced headaches. After no relief with symptomatic treatment, a CT angiogram demonstrated multiple areas of focal narrowing in the posterior and anterior circulations consistent with intracranial vasculitis. She was diagnosed with vasculitis related to her active Crohns disease. She was continued on a long taper of steroids and started on infliximab. Ultimately, both her headache and diarrhea improved. IMPLICATIONS/DISCUSSION: Crohns disease is an inflammatory disease that affects the gastrointestinal tract. Extraintestinal manifestations of Crohns can occur and predominantly yield rheumatologic, ophthalmologic, dermatologic and hepatobiliary syndromes. Less commonly, Crohns patients will develop pulmonary, cardiac, or neurologic involvement. Headache is often a nonspecific symptom. In a patient with Crohns disease, headache can have a complex differential. Case reports have described migraines in patients with active Crohns disease and resolution of symptoms with adequate therapy. Valsalva-induced headache, a subset of cluster headache, can occur with bowel movements and alleviated with indomethacin. Lastly, although uncommon, Crohns disease-related vasculitis can occur. The neurologic sequelae of Crohns disease include vasculitis, neuropathy, and even stroke. The mechanism of these findings involves immunologic pathophysiology. Vasculitis and many other neurologic sequelae seem to correlate strongly with disease activity as opposed to other extra-intestinal manifestations that have a more independent course. Treatment usually requires a multi-drug therapy and intricate management for maintenance therapy. The extraintestinal manifestations of Crohns disease may seem vast to the clinican and debilitating to the patient. Nonspecific symptoms such as headache can sometimes indicate the extent and severity of the underlying disease. Physicians need to be aware of the myriad of extraintestinal manifestations of this common disease.

CHRONIC CONSTRICTIVE PERICARDITIS IN ASSOCIATION WITH END-STAGE RENAL DISEASE. Roman Leonid Kleynberg 1; Michael Rotblatt2. 1Olive View - UCLA Medical Center, Sylmar, California ; 2UCLA - Olive View Medical Center, Sylmar, California. (Tracking ID # 9243)

LEARNING OBJECTIVES: 1. Distinguish and differentiate the clinical features of chronic constrictive pericarditis from other forms of heart disease. 2. Manage and treat the presentation of chronic constrictive pericarditis based on its underlying etiology.

CASE INFORMATION: A 27-year-old Armenian man with a history of hypertension, end-stage-renal disease on hemodialysis, presented with massive ascites, dyspnea and hypotension. He has had ESRD over the past three years, most likely secondary to anti-hypertensive medication
non-compliance. His social history included a 1 pack-year of tobacco smoking, no alcohol or recreational drug use. On physical exam, his vitals were stable with a blood pressure of 80-90 s/30-40 s, he had decreased breath sounds on the left side, decreased heart sounds, some crackles diffusely, and 2+ pitting edema diffusely over the lower extremities. Over the past few months he had developed massive ascites, and a through workup was undertaken to discover the underlying cause of his symptoms which included intrahepatic pressure measurements, cholecystectomy, appendectomy, liver biopsy, and a peritoneal biopsy. In the hospital he was dialyzed aggressively and received multiple paracentesis (the first of which drained 6 liters of greenish fluid). An echocardiogram showed normal left ventricular systolic function, EF 55%, dilated left and right atrium, and evidence of pressure and volume overload over the right ventricle (right ventricular hypertrophy). A CT scan showed pericardial thickening and bilateral pleural effusions. A left and right heart cardiac catheterization demonstrated a thick peal around the heart, ejection fraction of 55%, PAP of 30 mm Hg, LVED pressures of 3035 mm Hg, and also equalization of pressures on both the right and left side of the heart. Following the diagnosis of CCP, a partial pericardiectomy was performed; however, the patient did not improve and a salvage total pericardiectomy soon followed. No specific etiology for CCP was found after numerous histopathological, serological and bacteriological studies. The patient developed complications from the total pericardiectomy

including septic shock, and shortly thereafter expired following a terminal extubation.
IMPLICATIONS/DISCUSSION: The most common cause of constrictive pericarditis (up to 45-55% of cases) is idiopathic or viral in etiology. The most common identifiable causes include postcardiac surgery (37%), pericarditis (16-20%) and mediastinal radiation (9%). Other recognized but less common causes include connective tissue disorders (such as RA and SLE), malignancies, and local trauma. Tuberculosis was once recognized as the most common cause of constrictive pericarditis and continues to be a major problem in the developing world. Constrictive pericarditis is a rare disorder that manifests predominantly as right heart failure and, in severe cases, systemic hypotension and circulatory collapse. The diagnosis can often be a challenge to diagnose. Some common clinical features include edema, ascites, raised jugular venous pressure, pleural effusion, and hepatomegaly, all commonly found with right-heart strain. On imaging, constrictive pericarditis may be differentiated from other forms of heart failure such as restrictive cardiomyopathy by the presentation of thickened pericardium on computed tomography and magnetic resonance imaging. Echocardiography may validate the presence of small ventricular dimensions with preserved systolic function, and dilated atria, all findings present in our patient. Abrupt termination of diastolic filling may show a characteristic septal bounce. Cardiac catheterization studies allow for definitive confirmation. Clinically, late diastolic filling is inhibited by the rigid pericardium; it is restricted as the intracardiac volume reaches the limit set by the noncompliant pericardium. This acts in general to reduce total cardiac output. Uncharacteristically, in our case, cardiac output was preserved, at least in part, most likely due to the high end diastolic filling pressure or LVEDP (measured to be equal on both the right and left ventricle at 30 mm Hg).
UNSUSPECTED BUT COMMON DIAGNOSIS: SUBACUTE ONSET OF FEVERS, LYMPHADENOPATHY AND ATAXIA IN A 75-YEAR-OLD Patrick Hemming 1; Patrick Hemming1. 1Johns Hopkins Department of Medicine Division of General Internal Medicine, Baltimore, Maryland. (Tracking ID # 9246)

LEARNING OBJECTIVES: 1. Recognize that sexually transmitted infections are are an important and potentially overlooked cause of serious illness in elderly patients 2. Recognize that life-saving treatments in elderly patients may have significant toxicity and require extensive monitoring on the part of clinicians.
CASE INFORMATION: The patient is a 75 year old man with a past medical history of prostate cancer (resected in 1993), Printzmetals angina, hypertension and hyperlipidemia. Several months prior to admission, he had chest pains, and lymphadenopathy. 6 weeks prior to admission, he began to have headaches and weight loss then drenching night sweats, fever, cough and gait disturbance with weakness and falls to the left side. He had evaluation initially for the lymphadenopathy with a lymph node biopsy that showed a monoclonal gammopathy. The chest pain was diagnosed as esophageal spasm.He is a long term smoker without any significant alcohol or illicit drug use. Pt is married, retired from work as a clergyman. On exam, he had slow responses to questions, occasional tangential speech, but was redirectable. He had difficulty with rapidly alternating movements involving the left arm and left leg.A Brain MRI showed multiple ring-enhancing lesions. An esophageal biopsy showed diffuse candidiasis. A biopsy of painful foot lesions showed Kaposis Sarcoma. The patient was diagnosed with AIDS, a CD4 count of 10 and viral load of 750000. He had a prolonged treament with HAART and antiparasitic medications for Toxoplasmosis.His hospital and rehabilitation stays lasted more than 3 months and were complicated with episodes of renal failure, infectious colitis, delerium and disabling tremors.
IMPLICATIONS/DISCUSSION: This case highlights the increasingly ubiquitous status of HIV among patients of all ages. Although the patient likely contracted the virus from a male sexual encounter, this history was not volunteered until after the diagnosis was made. The perceived typical risk factors are not always reliable when HIV is in the differential diagnosis. New neurologic symptoms, such as the gait disturbance and falling experienced by this patient has broad differential diagnosis. Although metastatic disease is the most likely cause of new brain lesions in an elderly man with prior prostate cancer, it is essential to consider other

potentially treatable conditions.This patient suffered several AIDS-related sequellae: CNS Toxoplasmosis, esophageal candidiasis with esophageal strictures,, Kaposis Sarcoma, and possible AIDS dementia. Additionally, he had complications from therapy, including medication-induced renal failure, Clostridium difficile diarrhea, delerium and disability.

LYMPHOMAS CAN CRY WOLF TOO RAMYA EMBAR SRINIVASAN 1;

AUSTIN G. TURNER 2; Mukta Panda1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee ; 2UT Health Science Center, Memphis, Tennessee. (Tracking ID # 9248)

LEARNING OBJECTIVES: 1. Discuss the clinical relevance of positive serological tests in a patient with splenic marginal zone lymphoma (SMZL). 2. Review clinical features of splenic marginal zone lymphomaCASE INFORMATION: A 55 year-old female presented to an outlying facility with a two-month history of tiredness, increasing shortness of breath and pleuritic left upper quadrant pain. Physical examination was remarkable for pallor and splenomegaly. Computed tomography confirmed splenomegaly, hence she was referred to our hospital for further management. She was anemic with hemoglobin of 9.5 g/dl and hematocrit of 28.1%; she also had lymphocytosis of 44%, elevated total bilirubin of 2.1 mg/dL and indirect bilirubin of 1.3 mg/dL, elevated LDH of 374 units/L, and decreased haptoglobin,

IMPLICATIONS/DISCUSSION: SMZL is a rare disorder, comprising less than 2% of lymphoid neoplasms, but it may account for most cases of the otherwise unclassifiable chronic lymphoid leukemias that are CD-5 negative. Most patients are over 50 and there is an equal sex incidence. It involves the spleen, the splenic hilar lymph nodes and bone marrow. Lymph nodes are not typically involved. Clinicians are often concerned about the susceptibility of lymphoma patients to infections because of their immunocompromised status. The false-positive rate of RPR is found to be 10.8% in general and appears to be higher in patients with lymphoproliferative disorders that produce antibodies. Although the reason for this finding is not known, a possible explanation would be the occurrence of non-specific binding; lymphoma cells produce antibodies that are structurally similar to the antibodies produced against syphilis infection and can thus cause a false-positive RPR test. Direct Coombs positivity can be explained by antibodies released due to lymphoma cell breakdown binding to the surfaces of red blood cells, causing hemolysis. CONCLUSION: It would be prudent for a primary care physician to pursue confirmatory testing in patients with lymphomas and positive RPR tests to determine their true significance, establish a diagnosis and to avoid unnecessary treatment.

SARCOIDOSIS AND CRYPTOCOCCAL INFECTION: A RARE CLINICAL ASSSOCIATION Asha Shah 1; Ula Abed-Alwahab 1; Sophia Hussen 2; Carlos Franco-Paredes 3; Anna Kho1. 1Emory University Department of Internal Medicine, Atlanta, Georgia ; 2Emory University Department of Infectious Disease, Atlanta, Georgia. (Tracking ID # 9252)

LEARNING OBJECTIVES: 1. Diagnose disseminated cryptococcal infection in a non-HIV patient with sarcoidosis. 2. Recognize that sarcoidosis, with or without prior steroid therapy, predisposes to cryptococcal infection due to deficient cell-mediated immunity.

CASE INFORMATION: A 42-year old African-American woman presented to the hospital with a 1 week history of nasal congestion, sore throat, and fever 38.8 C. Over 12 hours, she developed acute headache, photophobia, and neck stiffness. Review of systems was positive for a 6 month history of 50 pound weight loss and generalized weakness. Past medical history was significant for a recent diagnosis of sarcoidosis 4 months prior but she was not taking any medication for this condition. She was married and worked as a phlebotomist. She denied any sick contacts, recent travel, or substance abuse. On admission, the patient appeared acutely ill. Exam was remarkable for neck rigidity, photophobia, positive Brudzinskis sign, hepatomegaly, and splenomegaly. Lumbar puncture was significant for an opening pressure of 30 cm H20, and a positive CSF cryptococcal antigen titer >1:512. Blood and CSF fungal culture grew Cryptococcus neoformans. Chest x-ray showed a right scapular lytic lesion measuring 5.7 cm4.8 cm. Biopsy of this lesion revealed 8 cc of brown purulent fluid that was culture positive for Cryptococcus neoformans. She was diagnosed with disseminated

cryptococcal infection. Further workup was supportive of sarcoidosis as the underlying cause of the patients immunosuppression. Chest CT revealed diffuse small pulmonary nodules as well as mediastinal and bilateral hilar lymphadenopathy. Biopsy of a mediastinal lymph node showed few epithelioid noncaseating granulomas. Laboratory workup was notable for a calcium of 12.2 mg /dL, ACE 167 U/L, and albumin 2.6 gm/dL. Infectious studies were negative for HIV, Hepatitis B, Hepatitis C, and tuberculosis. Workup for malignancy was negative. The patient improved with induction treatment with IV amphotericin B and oral flucytosine for 4 weeks, along with serial lumbar punctures. Repeat CSF fungal culture was negative at 4 weeks, and the patient was discharged home on oral fluconazole 400 mg daily for 10 weeks.

IMPLICATIONS/DISCUSSION: Disseminated cryptococcal infection presents most often in HIV-positive patients. However, it may also occur in other causes of immunodeficiency that primarily affect T cell function, including cancer, transplant-related immunosuppression, and chemotherapy. Sarcoidosis is a rare cause of disseminated cryptococcal infection. Sarcoidosis, with or without prior steroid therapy, predis-poses to cryptococcal infection due to deficient cell-mediated immunity via sequestration of CD4 cells in sarcoid granulomas, anergy and reversal of the CD4:CD8 ratio. Over 48 cases of cryptococcal infection in sarcoid have been reported. It commonly manifests as meningitis (42%), osteomyelitis (38%), soft tissue abscess (25%), pneumonia (10%), and disseminated disease (8%). In a case series of patients with cryptococcal osteomyelitis, 10 out of 40 patients had concomitant sarcoidosis. Conversely, a review of 753 sarcoid patients showed only 0.4% developed cryptococcal disease, and all of these patients were receiving immunosuppressive therapy. This case is unusual in that the patient had a new diagnosis of sarcoid and was not on any immunosuppressive therapy. Mortality may be as high as 33%, even with therapy, in these patients. Early identification and treatment of disseminated cryptococcal infection in sarcoid patients is vital. In conclusion, clinicians should maintain a high index of suspicion for the potential for cryptococcal infection in patients with sarcoidosis.

INTRANEURAL HEMORRHAGE OF THE SCIATIC NERVE IN A PATIENT ON CHRONIC ANTICOAGULATION Irina Khrenova 1; Jose F Echaiz 1; Vinay Shah1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 9258)

LEARNING OBJECTIVES: 1. In the following report we present a rare case of intrasciatic nerve hemorrhage, in order to contribute tothe recognition of peripheral hemorrhagic neuropathy as a complication ofchronic anticoagulation. 2. From this case we intend to provide objective information about the management and prognosis of intrasciatic nerve hemorrhage in the setting of chronic anticoagulation. CASE INFORMATION: A 65-year-old man presentedto our hospital complaining of left hip and thigh pain. He was on chronicanticoagulation with warfarin for a bioprosthetic mitral valve, had atrialfibrillation and systolic heart failure. Three days before admission thepatient attempted to get up from a sofa, slipped and almost fell. Afterwards, severe sharp stabbing pain in the left hip and hamstring area along with muscleweakness limiting ambulation developed. Physical exam revealed tenderness andswelling in the gluteal area and posterior thigh without erythema or warmth.Neurological assessment showed predominantly distal decreased muscle strength anddecreased sensation on posterior and medial aspects of the left thigh,posterior aspect of left leg and on the dorsum and sole of left foot. Computerizedtomography (CT) of the lumbosacral spine showed mild spinal canal stenosis.Laboratory examination was significant for hemoglobin of 15.1 g/dL, Creatinineof2.4 mg/dL (baseline 1.5 mg/dL) and INR of 8.17. Warfarin was stopped and oralvitamin K given. Lumbar MRI did not show evidence of lumbar radiculopathy. Ultrasounddid not show hematomas. Given persistent pain and neurological deficit, a CT ofthe left lower extremity showed marked abnormal enlargement andhyperattenuation of the left sciatic nerve with significant adjacent fatstranding, suggestive of hemorrhage. Magnetic resonance imaging confirmed thefindings of diffuse intraneural sciatic nerve hemorrhage tracking along theentire course of the left sciatic

nerve within the left thigh. Neurosurgery wasconsulted and recommended physical therapy without surgical intervention.Cardiology consulted for management of anticoagulation and recommended resumingwarfarin 1 week after discharge since neurological function
was stable. At1-month follow up with neurosurgery, patient recovered proximal muscle strengthbut still had residual distal weakness. Anticoagulation was continued withtarget INR of 2.5. IMPLICATIONS/DISCUSSION: Peripheral neuropathy of the proximal lower extremitysecondary to bleeding has been associated with hemophilia, anticoagulationtherapy, trauma, hip surgery and bleeding, arteriosclerotic aneurysmal diseaseof the aorta and iliac vessels. While compression is the most common etiologyfor hemorrhagic neuropathy, actual hematoma formation beneath the epineurium isvery rare. We found only one case report describing intraneural bloodaccumulation that was similar to our patients pathology. As opposed to extraneuralhematoma, in the formation of an intraneural hematoma the blood fails todisperse and dissipate along the subepineurial space following the initialhemorrhage. The initial hematoma may increase in size with repeated episodes oftrauma. Regarding treatment, it seemslogical that early intervention and decompression of the nerve would preventfurther damage. Although good functional results were shown with earlyrecognition and prompt decompression of a hematoma, one animal model showedthat early removal of extraneural hematoma improved functional recovery, however evacuation of an intraneural hematoma did not. We can conclude that intraneuralhemorrhagic neuropathy is a rare and poorly understood clinical entity andthat, in our case, early recognition and treatment of coagulopathy along withconservative non-surgical approach resulted in gradual function recovery.

ELEVATED ST WITHOUT MYOCARDIAL INFARCTION! BASSEL OBAID 1; JENNIFER WHITLEY 1; Mukta Panda1. 1University of Tennessee College of Medicine Chattanooga, Chattanooga, Tennessee. (Tracking ID # 9262)

LEARNING OBJECTIVES: 1. Discuss a case of acute myocarditis initially treated as pneumonia 2. Highlight the crucial role of ECG in resolution of a diagnostic dilemmaCASE INFORMATION: A 28 year-old Caucasian male presented with a four-day history of gradual-onset shortness of breath, dry cough and myalgias, as well as two days of subjective fever, chills, nausea with generalized abdominal discomfort, vomiting and diarrhea. He denied chest pain, skin rash, sick contacts, tick bite or travel history. He had pneumonia several times as a child but had received all vaccines appropriate for his age. He did not use tobacco, ethanol or illicit drugs. On physical examination, he was alert, oriented, and well-built but mildly dehydrated; temperature was 98 F, BP 90/55 mmHg, pulse 65/ min and respiration rate 22/min with oxygen saturation of 82% on ambient air and 93% on 50% Venturi Mask. No jugular venous distension was noted; he had regular rate and rhythm without murmurs or gallops on heart auscultation, and peripheral pulses were normal. Bibasilar fine lung crackles and dullness were appreciated. He had no leg edema; examination of the abdomen and all other systems was normal. His hemogram included 15000 white cells/mL, 83% neutrophils; lymphocyte, eosinophil, platelet counts and hematocrit were normal. Electrolytes were normal. He had prerenal azotemia; he refused arterial puncture. Chest Xray showed bibasilar consolidation. Blood cultures were obtained and he was treated initially for pneumonia with azithromycin and ceftriaxone. After one liter of normal saline fast and a second at 150 mL/hr, his dyspnea, hypoxia and crackles worsened. An electrocardiogram showed ST elevation suggestive of anteroseptal infarction. Troponin I was 48 ng/mL; creatine kinase and natriuretic peptide were elevated. A stat echocardiogram showed an ejection fraction (EF) of 40% but no pericardial effusion, vegetations or valvular dysfunction. Normal saline was stopped; emergent cardiac

angiography showed an EF of 15% without coronary artery disease, and an intra-aortic balloon pump was placed. Blood cultures were negative at five days.

IMPLICATIONS/DISCUSSION: Myocarditis is inflammation of the heart muscle that may be identified by clinical or histopathologic criteria. Clinical manifestations vary greatly from asymptomatic changes on an

electrocardiogram to fulminant congestive heart failure, arrhythmias, heart block, or a syndrome resembling acute myocardial infarction. Most often, myocarditis results from viral infections and less commonly, from other pathogens, toxic or hypersensitivity drug reactions, giant-cell myocarditis, or sarcoidosis. The prognosis and treatment of myocarditis vary according to the cause, and clinical and hemodynamic data usually provide guidance as to when referral to a specialist for endomyocardial biopsy is indicated. However, biopsy is used infrequently because of perceived risks and the lack of a widely accepted and sensitive histologic standard. Dilated cardiomyopathy is the major long-term sequela of myocarditis. Treating the heart failure syndrome and complications (arrhythmias, for example) is the mainstay of treatment of acute myocarditis; cause-specific treatment may also be appropriate.

RARE CASE OF TEMOZOLAMIDE ASSOCIATED APLASTIC ANEMIA Sumana Nagireddy 1; Sumana Nagireddy 1; Susmitha Nimmagadda 2; Naresh Bellam3. 1UAB, Montgomery, Alabama ; 2UAB, Birmingham, Alabama. (Tracking ID # 9266)

LEARNING OBJECTIVES: 1. Diagnosis of a rare case of aplastic anemia after Temozolomide therapy. 2. Understand the importance of monitoring blood counts during Temozolomide therapy.

CASE INFORMATION: A 71 year old white female presented to the hospital with the complaints of progressive headache, left sided weakness, dysphagia and slurred speech. MRI Brain revealed multifocal lesions in the medial right cerebral hemisphere extending into corpus callosum. CT scan of chest, abdomen and pelvis were unremarkable. A diagnostic brain biopsy confirmed the diagnosis of glioblastoma multi-forme (GBM). Patient was initiated on concomitant radiotherapy (RT) and temozolomide (TMZ) at the dose of 75 mg/m2/day for 42 days to be followed by maintenance temozolomide. Prior to initiation of therapy, her WBC was 7200/dL, hemoglobin was 11.6 g/dL and platelets were 228,000/dL. She completed a total of 32 chemotherapy and 21 radiation treatments with no major adverse effects. However, her platelet counts dropped from 228,000 to 50,000/dl, and further treatment was held. She progressively became pancytopenic despite discontinuation of therapy and was admitted for transfusion support. On admission she had WBC of 1,000/dL, hemoglobin of10.6 g/dL and platelets of 10,000/dL. No sustained significant improvement was noted after aggressive transfusion and G-CSF support. A bone marrow biopsy showed pancytopenia with aplastic marrow and normal cytogenetics. There was no evidence of metastatic tumor or myelodysplasia. Hospital course was complicated by neutropenic fever requiring broad spectrum antibiotics. Her performance status continued to decline and was persistently pancytopenic even after 4 weeks off therapy. Repeat MRI showed unchanged multifocal glioblastoma multiforme with post radiation changes. She was transferred to palliative care where she subsequently passed away.

IMPLICATIONS/DISCUSSION: Aplastic anemia is a rare hematopoietic stem cell disorder resulting in pancytopenia and hypocellular bone marrow. It may be classified as congenital, acquired and idiopathic. Exposure to viruses (EBV, CMV), drugs (chloramphenicol, sulfonamides) and chemicals (benzene) may trigger aberrant immune response

causing aplastic anemia. TMZ hematological side effects are generally mild to moderate, but can rarely cause aplastic anemia. Grade 3 and 4 hematotoxicity noted only in 7% of patients receiving concomitant TMZ and RT. (In EORTC/NCIC landmark trail by Stupp et al 2005). Very few cases (~5) are reported in the literature of patients developing aplastic anemia associated with TMZ. The case presented illustrates the fatal outcome of TMZ associated aplastic anemia and that physicians should be aware of rare complications associated with TMZ treatment in GBM.

MYCOPLASMA MYOCARDITIS: AN UNCOMMON COMPLICATION OF A COMMON INFECTION Areej El-Jawahri 1; Meridale Baggett2.

1Massachussetts General Hospital, Boston, Massachusetts ; 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 9267)

LEARNING OBJECTIVES: 1. Recognize Mycoplasma pneumoniae as an uncommon cause of myocarditis and

treat empirically if clinical suspicion is high. 2. NONECASE INFORMATION: A 68 year-old man presented with one week of productive cough and low grade fevers. He had progressively increasing dyspnea, but denied chest pain, orthopnea, or lower extremity swelling. Physical exam was remarkable for tachypnea, diffuse wheezing, and a 3 liter oxygen requirement. The heart rate, blood pressure, and remainder of the cardiac exam were normal. EKG showed 1.5 mm ST elevations in leads II, III, avF, and V4-V6. White blood cell count was 12.9, brain natriuretic peptide was 4461, and cardiac markers were elevated (CKMB 31.7 and Troponin T 1.51). Cardiac catheterization revealed clean coronary arteries and a pulmonary capillary wedge pressure of 14. Cardiac MRI showed left ventricular dysfunction (ejection fraction 37%) and radiological findings consistent with myocarditis: regional myocar-dial edema, elevated global enhancement ratio, and multiple areas of subepicardial delayed enhancement. A presumptive diagnosis of viral myocarditis was made. Diuresis was initiated for volume-overload management, but the patients symptoms persisted. On hospital day 3, a chest-x ray showed diffuse nodular opacities concerning for multifocal pneumonia. Vancomycin and cefepime were started empirically for hospital-acquired pneumonia. On hospital day 5, the oxygen requirement increased to 5 liters. Chest CT showed diffuse bronchial wall thickening with scattered tree in bud opacities bilaterally consistent with multifocal pneumonia. The clinical combination of atypical pneumonia and myocarditis raised suspicion for mycoplasma, and azithromycin was added. Over the next few days, the patients pulmonary symptoms improved with full resolution of his oxygen requirement and wheezing. Additional work-up was negative including a viral respiratory panel, sputum cultures, anti-nuclear antibody, lyme, HIV, and hepatitis panel. Nasopharyngeal swab for Mycoplasma pneumonia PCR was eventually positive.
IMPLICATIONS/DISCUSSION: Mycoplasma pneumoniae (M. pneumoniae) is the most common cause of atypical pneumonia and accounts for 7-20% of community acquired pneumonia. Cardiac complications associated with M. pneumoniae are uncommon. M.pneumoniae often presents with nonproductive cough, upper respiratory symptoms, and fevers. We reviewed the literature and found 23 cases of Mycoplasma-associated carditis since 1979 (6 myocarditis, 15 pericarditis, and 2 myopericarditis). In our case, the diagnosis of M. pneumoniae myocarditis is established based on regional ST elevations on EKG, elevated cardiac markers indicating myocardial injury, ventricular dysfunction, and diagnostic MRI findings in a patient with positive M. pneumonia PCR. The diagnosis of M.pneumoniae can be difficult to establish definitively given the fastidious nature of the organism and the delay in culture and serologic data. Consequently, physicians may fail to

consider the possibility of mycoplasma-associated myocarditis, which may lead to further complications. Mycoplasma should be considered in patients presenting with respiratory symptoms and carditis. Empiric therapy should be initiated without awaiting further diagnostic confirmation if clinical suspicion is high.
POLYOMA BK VIRUS INDUCED HEMORRHAGIC CYSTITIS IN A RENAL TRANSPLANT RECIPIENTA RARE OCCURRENCE Geetha Selvakumar 1; Ayesha Salahuddin 1; Meghana Gopal 1; Tanvi Tiwari 1; Haritha Bellam 1; Meenu Singh 1; Muhammed Sherid 2; Habib Dakkak 1; Nael Gharbi 1; Shazel Gharbi 1; Mhd. Wisam Baqdunes 1; Harvey Friedman1. 1Saint Francis Hospital, Evanston, Illinois ; 2St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9269)
LEARNING OBJECTIVES: 1. To understand the management of polyoma virus induced infections in renal transplant recipients 2. To learn that the definitive therapy of polyoma BK viral infection in renal transplant recipients is the reduction of immunosuppressive therapyCASE INFORMATION: Our patient is a twenty one year old Hispanic female who presented with passing blood clots in the urine on and off for a month. The frequency of passing blood clots had increased for two weeks. She also complained of lower abdominal pain, dysuria and low grade fevers. She had received a renal transplant six months ago due to the deterioration of her kidney function. She did not know about the etiology of her renal disease. Her medications include trimethoprim

sulfomethoxazole, amlodipine, carvedilol, aspirin, mycophenolate mofetil, sirolimus, and prednisone. On admission her vital signs were stable and the physical examination was unremarkable except for the presence of beaus lines in her fingernails. Her pertinent labs include a WBC of 8.4, hemoglobin of 15.9, sodium of 138, potassium of 4.5, BUN of 14, creatinine of 0.94 and a GFR of >60. Urinalysis was positive for protein of 300, trace glucose, many bacteria, WBC of 26 and an RBC of >182. Urine culture and blood culture were negative. CT scan of the abdomen showed transplanted kidney in the left side of the pelvis with perinephric induration, induration throughout the pelvis and cystitis. CMV and polyoma BK virus serologies were sent and the patient was started on ciprofloxacin for the empiric treatment of UTI. An infectious disease consult was obtained and the patient was discharged on the third hospital day after clinical improvement. On the first week after her discharge the CMV titer came back negative and on the tenth day the polyoma BK viral serology was positive for 33116216 copies. The patient was notified of the results and was advised to consult her transplant physician for reduction in the dose of immunosuppressive drugs.
IMPLICATIONS/DISCUSSION: Polyoma BK virus infection should be suspected in renal transplant recipients. Serial urinalysis for the detection of viral inclusion bodies called decoy cells can be used for the early detection of this condition. The definitive diagnosis is made by biopsy which shows tubulointerstitial nephritis and typical viral cytopathic changes. No specific antiviral therapy is available and the definitive treatment is reduction of immunosuppressive therapy.

CHRONIC FIBROSING PULMONARYASPERGILLOSISATHERAPEUTIC CHALLENGE Geetha Selvakumar 1; Ayesha Salahuddin 1; Meghana Gopal 1; Haritha Bellam 1; Meenu Singh 1; Tanvi Tiwari 1; Muhammed Sherid 2; Habib Dakkak 1; Nael Gharbi 1; Shazel Gharbi 1; Mhd. Wisam Baqdunes 1; Harvey Friedman1. 1Saint Francis Hospital, Evanston, Illinois ; 2St.Francis Hospital, Evanston, Illinois. (Tracking ID # 9270)
LEARNING OBJECTIVES: 1. To understand the spectrum of diseases which constitute chronic pulmonary aspergillosis. 2. To understand the management of chronic pulmonary aspergillosis based on the presence or absence of alarm symptoms in any given patient.
CASE INFORMATION: Our patient is a seventy three year old Indian male who presented to the pulmonologists office because of cough productive of muddy sputum which occurred predominantly during the winter season for two years. He also had intermittent scant hemoptysis. He denied any shortness of breath, fever or weight loss. He was able to carry out his normal day to day activities without any difficulty. His past medical history was significant for tuberculosis thirty years ago which was treated with three drugs for a period of one year. He had also undergone right upper lobectomy for the same. He underwent a coronary artery bypass grafting fifteen years ago. He was a non smoker, but had history of tobacco chewing which he had quit many years ago. He denied any history of alcohol intake. His medications include losartan and hydrochlorothiazide, atorvastatin, aspirin and nifedipine. On examination, his vital signs were normal with an oxygen saturation of 97 percent in room air. He did not have any cyanosis or clubbing. Auscultation of the lungs revealed whispering pectoriloquy and egophony in the right upper lung field. No crackles or wheezes were heard. The rest of the physical examination was essentially unremarkable. Lab tests showed a normal complete blood count and a basic metabolic panel. C reactive protein level was 0.27. CT scan of the chest revealed a cavitary lesion with a fungus ball and loss of lung volume on the right side with associated fibrosis and bronchiectatic changes. Sputum for AFB, fungus and bacterial culture were all negative. Antibodies were positive for Aspergillus fumigatus. Since the patient had only minimal hemoptysis and due to the absence of any other disabling symptoms, it was decided that his exacerbations would be treated with antibiotics and antifungal therapy was deferred.
IMPLICATIONS/DISCUSSION: Management of chronic pulmonary aspergillosis can be a challenge due to the presence of extensive radiological changes. But, treatment in any given patient should be based on the presence of disabling symptoms like hemoptysis, weight loss and shortness of breath and the progression of disease as evidenced by radiological and serological tests. Conservative management should be considered in the absence of the above criteria. Itraconazole and voriconazole are the preferred agents when therapy is

required.

TROPICAL MIGRATORY POLYARTHRITIS AND FEVER IN A RETURNED TRAVELER: THE CASE OF CHIKUNGUNYA AND THE TOGAVIRIDAE-RELATED ILLNESSES Anna Acosta 1; Carlos Franco-Paredes 2; Kimberly Manning 2; Neil Winawer2. 1Emory Internal Medicine Residency, Atlanta, Georgia ; 2Emory Department of Medicine, Atlanta, Georgia. (Tracking ID # 9274)

LEARNING OBJECTIVES: 1. Recognize the presentation of chikungunya virus. 2. Appreciate the emergence of togavirus-related viral illnesses in travelers returning from endemic areas.

CASE INFORMATION: A 63 year-old Brazilian female was admitted with acute onset of fevers, severe myalgias, retro-orbital pain, rash and diarrhea. The patient had recently returned from a 2 month trip to Brazil. During that trip she visited both coastal and rural inland areas, drank unfiltered water, and had skin exposure to unsanitary water. Upon admission, the patient was mildly tachycardic but afebrile. Physical exam was significant for painful cervical lymphadenopathy, a mildly tender abdomen, and a scattered petechial rash on her lower extremities. Initial laboratories were significant for leukopenia and mild thrombocytopenia; liver and kidney function were normal. The diagno-

ses of malaria, typhoid, and dengue fever were entertained. Further work-up including stool studies, blood cultures, and malaria smears were negative. Dengue and salmonella typhi serologies were sent, and she was treated with anti-pyretics, fluid resuscitation, and empiric antibiotics for infectious diarrhea. She was intermittently febrile during her hospital course, but her diarrhea and myalgias improved. After a week, she developed the sudden onset of a severe migratory polyarthralgias. Dengue and typhoid serologies returned negative. Serology for chikungunya virus (ELISA, Centers for Disease Control and Prevention) was reactive at a high-titer. She was diagnosed with Chikungunya fever. The patient was treated with aggressive anti-inflammatory therapy including NSAIDs and low dose corticosteroids with gradual improvement in symptoms.

IMPLICATIONS/DISCUSSION: Chikungunya fever is caused by infection with the chikungunya virus, a member of the togavirus family. Transmitted by a mosquito vector, specifically Aedes aegyti and Aedes albopictus, it is endemic to Africa and Asia. Recently, cases have been noted in Europe, imported by travelers from endemic regions. Typically, infected patients present with fever, rash, and arthralgias. Distinct from dengue fever, this acute period is followed by a severe migratory polyarthritis which can be disabling. The course of this can be quite prolonged, often lasting weeks. Diagnosis is typically through serologic studies, although viral culture and RT-PCR have also been utilized. Another togavirus, Mayaro virus, is endemic to Brazil and can cause similar symptoms to Chikungunya fever. Both infections present with a dengue-like illness and a severe migratory polyarthritis. Given both are in the togavirus family, it is possible that antibodies for these two viruses could cross-react, yielding false-positive results. Therefore, our case may represent spread of Chikungunya and would be the first reported endemic case of the virus in South America. Or this case may in fact be a case of Mayaro virus infection with a false-positive chikungunya serology. The relative unavailability of diagnostic testing in non-endemic areas makes the diagnosis of togavirus-related infections difficult. Even when testing is available, distinguishing between the causative toga-virus agents may be complicated. Further investigation is needed into the accuracy of these tests. Due to globalization of trade and travel, tropical infections are increasingly seen in non-endemic areas. Clinicians need to consider the diagnosis of the togavirus-related illnesses in travelers with fever and polyarthritis.

ACUTE INTERMITTENT PORPHYRIA IN AN ADOPTED PATIENT April Barbour 1; Elizabeth Gray1. 1George Washington University, Washington, District of Columbia. (Tracking ID # 9275)

LEARNING OBJECTIVES: 1. Recognize Acute Intermittent Porphyria as a rare cause of recurrent abdominal pain 2. Assess the importance of broadening a differential to prevent redundancy in medical testing CASE INFORMATION: A 42 year old woman with a history of hiperlipidemia presents to the urgent care center for evaluation of excruciating abdominal discomfort. The pain began approximately 3 days prior and had increased

in intensity over that time period. Her symptoms were continuous and diffuse throughout her abdomen. She had associated nausea with vomiting. She denied aggrevating or remitting factors. She had no hematemesis, melena, or hematochezia. She was referred to the local emergency department (ED) for possible surgical abdomen. Physical examination, including a pelvic examination, was nonfocal. Labwork was unremarkable, including urinalysis, liver function testing, amylase and lipase, blood counts, and electrolytes. A CT scan demonstrated no evidence for acute intra-abdominal/ pelvic pathology. Pain resolved with the administration of dilaudid and patient was discharged from the ED with follow up care. At follow up, the
patient noted that she continued to experience episode abdominal discomfort, though lasting for shorter duration her previous episode. The pain was similar in intensity to labor pains and occured in paroxysmal attacks without identifiable precipitating causes. Upon questioning, she related a history of similar recurrent attacks of nausea, vomiting, constipation, and/or abdominal pain. She had one previous documented visit to the ED for similar symptoms several years prior. Family history of was unknown as the patient was adopted Testing was done to evaluate for precipitating causes, including a urine porphobilinogen (PBG) which was found to be elevated at two times the upper limit of normal. Patient was sent to gastroenterology for further management and placed on a high carbohydrate diet and daily cimetidine therapy for prevention of recurrent pain. She has done well with prophylactic therapy.
IMPLICATIONS/DISCUSSION: Acute intermittent porphyria (AIP) is a rare condition characterized by intense generalized abdominal discomfort. The incidence of AIP is thought to be less than 200,000 persons annually in the United States, ranking it among the conditions studied at the Offices of Rare Diseases at the National Institutes of Health. The diagnosis of AIP is often a challenge due to both its infrequency of presentation as well as its troublesome symptoms. This case illustrates the value in broadening a differential when initial workup is negative and healthcare resources are utilized in a redundant manner (e.g. multiple CT scans for abdominal discomfort). Although the underlying condition is rare, it is of particular importance in a patient in whom family history was not readily available. Recognition of this syndrome in patients with recurrent abdominal pain can lead to decreased morbidity and mortality, particularly in the reduction of unnecessary medical testing.
THE UNCOMMON DIAGNOSIS OF DISSEMINATED CRYPTOCOCCUS NEOFORMANS IN AN IMMUNOCOMPETENT PATIENTAbdulla Damluji 1;
Eileen Hennrikus 1; Shilpa Sawardekar1. 1Penn State, Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 9281)
LEARNING OBJECTIVES: 1. Recognize that Disseminated Cryptococcus neoformans can occur in immunocompetent patients 2. Consider Cryptococcus neoformans in the differential of an extensive multifocal pneumonia. CASE INFORMATION: A 61-year-old Caucasian female was admitted with a chief complaint of generalized weakness and lightheadedness. Her past medical history was significant for end stage renal disease necessitating chronic hemodialysis, well-controlled type II Diabetes Mellitus, and recent surgical repair of a gastrocutaneous fistula that was a secondary complication from prior gastric bypass surgery. She denied recent avian or other animal exposure.Vital signs on admission: temperature of 34.9 C, BP 105/64 mmHg, HR 81 beats/min, RR 26breaths/min, and room air oxygen saturation 93%. Physical examination was significant for dullness to percussion in R lung base, no murmurs or gallops on cardiovascular exam, nonfocal neurologic exam and palpable purpuric lesions with necrotic centers on the lower extremity pretibial regions bilaterally. Laboratory studies revealed leukocytosis of 14.5 k/uL, with a differential of 14.1 neutrophils, 0.1 lymphocytes, and 0.0 eosinophils. Lactate Dehydrogenase was 910 U/L (normal Imaging of the brain showed no intracranial lesions. Blood cryptococcus antigen was positive with a titer >1:8192 and blood cultures grew cryptococcus neoformans. Pleural aspirate was exudative with fungal elements visualized on smear although fluid culture remained negative. CSF was weakly positive for cryptococcus titers. Amphotericin B was added to her antibiotic regimen. Shortly thereafter she became septic and developed disseminated intravascular coagulation which led to her death.

IMPLICATIONS/DISCUSSION: Although Cryptococcus neoformans is a ubiquitous yeast, the most important risk factor for symptomatic disease is suppressed cell-mediated immunity. While Cryptococcus is a well-known complication in immune-compromised patients, this case highlights the need for internists to also consider this disease in immune-competent patients once more common pathogens are ruled out. Cryptococcal infection begins with inhalation of the organism and pulmonary invasion, followed by hematogenous dissemination most often to the CNS, but also to skin, bone, joints and the genitourinary tract. Immunocompetent individuals usually clear the pulmonary infection spontaneously and asymptomatically. Our patient presented with disseminated cryptococcosis with definite pulmonary and possible CNS and skin involvement. Given its neurotropic properties and virulence factors, it is imperative that patients with pulmonary cryptococcosis undergo a thorough CNS evaluation and receive immediate intervention with intravenous anti-fungal agents. Failure to do so can lead to fatal consequences as illustrated by this case.

PATIENT DEVELOPED SYMPTOMS AND SIGNS OF SYSTEMIC LUPUS ERYTHEMATOSUS (SLE) AFTER THREE YEARS OF PERSISTENT NEUTROPENIA. Anthi Katsouli 1; Dianne Zalenski1. 1UPMC Shadyside, Pittsburgh, Pennsylvania. (Tracking ID # 9339)

LEARNING OBJECTIVES: 1. Diagnosing leukopenia in patients with SLE is common. However, recognising SLE in patients with hematologic cytopenias as a first sign without any other clinical manifestations is difficult. Diagnosis requires clinical and serologic criteria. 2. Recognising the different mechanisms of neutropenia in patients with SLE does not change the management. Leukopenia rarely needs treatment with an exception of severe neutropenia (absolute neutrophilsCASE INFORMATION: A 46 -year-old African American female with no past medical history presented to the clinic to establish care. A complete physical examination was normal and blood work revealed white blood cells (WBC) of 2.8 with absolute neutrophil count of 1600. Three years previous to this she had a similar white blood cell count. Five months later she developed the onset of acute symmetric joint pain. She had noted morning stiffness at least an hour, swelling, and pain worst in the hands, wrists, knees, and ankles. She had also noticed a rash on her left foot with a sensory abnormality (tingling and tightness sensation). Three years ago she experienced a similar episode and a complete rheumatological work up was negative except for positive SS-A antibody. Her exam revealed synovitis noted in multiple joints, including the wrists, metacarpophalangeal, proximal interphalangeal joints. There were also 0.3 cm non-blanchable, purpuric papules on the left dorsal foot. Serologies included an ANA of 1:1280 in a homogenous pattern, anti-citrullinated protein antibodies elevated at 74 and rheumatoid factor elevated at 26. Numerous other antibodies were positive for lupus including SS-A, SS-B, double-stranded DNA, antiphospholipid and low complement levels. Her WBC was 2.0 with absolute neutrophil count of 800. Skin biopsy revealed changes diagnostic of leukocytoclastic vasculitis and electromyography was normal. Patient was diagnosed with SLE and started on steroids and a course of methotrexate and plaquenil. She had great improvement in her joint pain and stiffness and the erythematous rash on her foot. The leukopenia resolved with treatment of the SLE.

IMPLICATIONS/DISCUSSION: Patients with SLE frequently develop abnormalities in one or more of the three blood cell lines. Leukopenia is common and usually mirrors disease activity. However, neutropenia is an uncommon relevant finding in patients with SLE. Neutropenia in patients with SLE can result from immune mechanisms, bone marrow dysfunction, or hypersplenism. Accelerated apoptosis of neutrophils and their pre-cursors is an important mechanism for neutropenia in systemic lupus erythematosus. Data have implicated binding of antibody to the surface of neutrophils, followed by fixation of complement, and removal from the systemic circulation. The specific antibody anti-Ro (or SSA) is associated with granulocytopenia by this mechanism described.

THE FORGOTTEN HEPATIC HYPNOZOITE Amy DeGueme 1; Zubin Lathara 1; Nilay Kumar1. 1Medical

College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 9407)
LEARNING OBJECTIVES: 1. Illustrate the various lifecycles of Malaria species and how these can affect diagnosis and treatment goals 2. Recognize the importance of obtaining a thorough social history to find potential environmental exposuresCASE INFORMATION: A 17 year old Hispanic male presented with fevers, chills, headache, vomiting and myalgias for 2 weeks with a waxing and waning pattern. The patient had migrated from Honduras about 18 months ago but had no international travel since then. Patients fevers were episodic, high grade with chills and associated with diffuse myalgias. On initial presentation he had a fever of 102.7 degree Fahrenheit and was tachycardic with a heart rate of 130 bpm. Physical exam revealed a well-nourished male with scleral icterus and moderate splenomegaly. Preliminary laboratory results showed mild anemia with a hemolytic picture, indirect hyperbilirubinemia and thrombocytopenia. Patient continued to have episodic, high-spiking fevers that subsided completely during the interval period. Further evaluation with a peripheral smear confirmed the diagnosis of a malarial parasitic infection. Based on the peripheral smear and his place of origin, the parasite was identified as Plasmodium vivax. He was treated initially with chloroquine followed by primaquine for fourteen days to completely eliminate the hepatic phase of the parasite. He responded well to medical management and was discharged home in three days with complete resolution of his presenting symptoms.
IMPLICATIONS/DISCUSSION: As international travel increases, we will be seeing increasing cases of diseases that are exotic to the United States. Malaria is a protozoal infection which is highly endemic in tropical climates, affecting 350500 million people across the world each year. It is still one of the leading causes of mortality in the developing and third world nations. Although malaria is an acute infectious process with an incubation period ranging from 24 weeks, this case depicts a prolonged dormant phase of the disease with reactivation after many months. Understanding the lifecycle and pathophysiology of these exotic diseases is the key to diagnosis and successful treatment. Malarial relapses can occur in P.ovale and P.vivax because of reactivation of the hypnozoite phase in the lifecycle of the parasite that lie dormant in the liver. Treatment of malaria is guided by the particular species and the resistance pattern in the endemic region. Early detection and adequate treatment of the disease is essential in preventing relapses. In addition to recognizing the signs and symptoms of tropical infectious diseases, this case demonstrates the importance of obtaining a travel history in all patients; as potential sources for rare infectious diseases can be uncovered.
THROMBOCYTOPENIA AS AN EXTRACARDIAC FEATURE OF ATRIAL MYXOMA MOHAMMAD WISAM BAQDUNES 1; Muhammed Sherid 2; Habib Dakkak 3; Geetha Selvakumar 3; Nael Gharbi4. 1ST FRANCIS HOSPITAL, evanston, Illinois ; 2St.Francis Hospital, Evanston, Illinois ;
3St Francis Hospital, Evanston, Illinois ; 4St Francis Hospital, chicago, Illinois. (Tracking ID # 9408)

LEARNING OBJECTIVES: 1. To look for atrial myxoma in a patient with a new onset atrial fibrillation and unexplained extracardiac manifestations 2. To recognize that thrombocytopenia is a possible extracardiac feature of atrial myxomaCASE INFORMATION: A 54 year old morbidly obese woman was admitted to the hospital for further evaluation of left atrial mass detected by transthoracic echocardiogram after a new onset of atrial fibrillation. Patient denied any symptoms on presentation except easy bruising, frequent epistaxis and a remote history of sever vaginal bleeding. She has past medical history of uncomplicated laparoscopic gastric bypass and depression for which she was taking venlafaxine. On physical examination, vital signs were unremarkable except irregular pulse of 95 bpm. HEENT: no jaundice, pallor, JVD or lymphadenopathy. Heart exam revealed irregularly irregular rhythm, normal S1, S2, no additional sounds, rubs, gallops or murmurs. Abdomen was soft, nontender without organomegaly. Extremities and skin exam was unremarkable with no purpura, bruise or ecchymosis. Laboratory studies including complete blood count and comprehensive metabolic panel revealed low platelet counts of 91 k. Transesophegeal echocardiogram showed left atrial mass originating from the septum consistent with myxoma. Work up for thrombocytopenia revealed prolonged

bleeding time, elevated D-dimer of 5.3, and positive ANA. Other laboratory tests were unremarkable including peripheral smear, LDH, Haptoglobin, heparin/platelet antibodies, antiplatelet antibodies, anti-phospholipid antibodies, platelet aggregation studies, VWF antigen, serum Immunofixation, SPEP, and immunoglobulins panel. Patient underwent left atrial mass resection and the pathology confirmed the diagnosis of left atrial mixoma. The bone marrow biopsy was deferred to post operation but surprisingly, the platelets count went back to the normal range(160 K) within a few days(4 days) of surgery. This rise in platelet counts after the resection of myxoma strongly suggests that atrial myxoma is the potential etiology of thrombocytopenia in our patient in the light of the absence of other etiologies. IMPLICATIONS/DISCUSSION: Atrial myxomas are the most common primary heart tumors. Symptoms range from nonspecific and constitutional (fever, weight loss, arthralgias, and Raynaud phenomenon) to systemic embolization and sudden cardiac death. In about 20% of cases, myxoma may be asymptomatic and discovered as an incidental finding. In addition to thrombocytopenia reported in the literature, several other hematologic features have been reported including leukocytosis, anemia, high erythrocyte sedimentation rate, positive antiphospholipid antibodies and elevated gamma globulin levels. Myxomas have been demonstrated to produce numerous growth factors and cytokines, including vascular endothelial growth factor, resulting in angiogenesis and tumor growth and an increased expression of the inflammatory cytokine, interleukin-6 which explain these systemic symptoms. Because of nonspecific symptoms, early diagnosis may be a challenge. Echocardiography is the diagnostic procedure of choice although TEE, CT, MRI can be used. Most atrial myxomas are benign and can be removed by surgical resection.

RECOGNIZING THE OBVIOUS: WHEN FILLING TO THE TOP IS STILL NOT ENOUGH Jessica Karp 1; Yelena Averbukh2. 1Albert Einstein College of Medicine, Bronx, New York ; 2Montefiore Medical Center, Bronx, New York. (Tracking ID # 9416)

LEARNING OBJECTIVES: 1. To interpret an elevated INR test result in the setting of polycythemia. 2. To recognize when it is appropriate to order an adjusted coagulation study laboratory test.

CASE INFORMATION: A 67 year old man with polycythemia vera was admitted for management of elevated hematocrit (Hct). The patient
denied chest pain, headache, paresthesias, easy bruisability, epistaxis or melena. He reported red eyes and generalized pruritis. He had a history of coronary artery disease and peptic ulcer disease status-post upper GI bleed. He was not taking anti-coagulation therapy. On exam he had injected conjunctiva, no splenomegaly, no purpura. On admission his Hct was 64% and rechecked INR was elevated at 2.6. He had normal liver function tests. Investigation of his elevated INR with mixing studies demonstrated a correction of clotting times, ruling out the presence of coagulation factor inhibitors; quantification of factor VII was normal, making vitamin K deficiency an unlikely cause of elevated INR. With repeated phlebotomy, the patients Hct decreased to 59% with INR decreasing to 1.7, and with Hct decreasing even further to 54% his INR normalized to 1.2. Based on research of the literature on the technique and interpretation of coagulation tests, it was concluded that the patients high Hct was responsible for causing a spuriously elevated INR. This same principle is the cause for the well known problem of an under-filled coagulation study test tube in which an improperly low amount of blood and plasma in the tube may result in over anticoagulation. Similarly, with increased Hct and a relatively decreased amount of plasma in the test tube, over anticoagulation and falsely elevated INR may result.

IMPLICATIONS/DISCUSSION: Increased INR is frequently encountered in clinical practice. The usual first step is to re-check an abnormal INR and, if it remains elevated, investigate the patients diet, history of liver disease and medication list. Next, mixing studies and factor level quantifications evaluate for coagulation factor inhibitors and deficiencies. But in the work up for elevated INR, one must consider the technique of the test itself. INR values are obtained from whole blood added to a tube containing a fixed amount of citrate as anticoagulant. In a polycythemic patient, defined as Hct >48% in women and >52% in men, the red blood cell mass (RCM) is greater than in a nonpolycythemic patient. Because of this increase in RCM in the polycythemic patients blood

sample, there is less plasma in the test tube, and less than the anticipated amount of coagulation factors for the pre-measured amount of citrate anticoagulant. Thus, the volume of citrate anticoagulant needs to be decreased proportionately for patients with high Hct, otherwise clotting times may be artificially prolonged due to over-anticoagulation of the sample. Although this laboratory-based abnormality is mentioned in current clinical databases, high Hct is not a commonly considered cause of abnormal coagulation test results by a general practitioner. There are laboratory algorithms to correct the amount of anticoagulant when there is increased Hct, but the clinician must recognize the need for and request these corrected studies. Thus, with increased Hct and elevated INR in the absence of alternative explanations, the abnormal ratio of citrate anticoagulant to the patients plasma volume should be considered as a cause for abnormally prolonged coagulation studies. Prompt request for the specialized coagulation testing protocol can help medical practitioners avoid unnecessary testing and can decrease patients testing-related anxiety.

A COMMON CANCER; AN UNCOMMON ENTITY KANISHKA CHAKRABORTY 1; ANIL TUMKUR 2; DEBALINA DAS 2; DEVAPIRAN JAISHANKAR3. 1EAST TENNESSEE STATE UNIVERSITY; MEDICAL ONCOLOGY, JOHNSON CITY, Tennessee ; 2ETSU, JOHNSON CITY, Tennessee ; 3ETSU MEDICAL ONCOLOGY, JOHNSON CITY, Tennessee. (Tracking ID # 9457)

LEARNING OBJECTIVES: 1. Recognize a relatively rare but aggressive histological entity known as Metaplastic breast cancer, quite distinct in

terms of prognosis and available management options. 2. Recognize differentiating features of Metaplastic breast cancer including hormone receptor and her2/neu negativity; presence of epithelial, sarcomatoid, primary squamous and mixed adeno-squamous features on hispathology.

CASE INFORMATION: Breast cancer is the most common female cancer in America. Breast malignancies in general arise from epithelial elements and thus are called carcinomas. There are two major types; in-situ carcinoma and invasive (infiltrating) carcinoma (1). Invasive ductal, invasive lobular and ductal/lobular are common histological subtypes of invasive breast cancer. Other subtypes like Tubular, Mucinous, Medullary, Metaplastic and Adenoid cystic carcinoma comprise less than five percent of invasive carcinomas (1). We are going to present one of these relatively less explored clinical entities know as Biphasic Metaplastic breast cancer with mixed epithelial and sarcomatoid elements. An 82 year old lady presented with c/o a rapidly growing lump in her left breast. Medical history was significant for a right mastectomy for invasive carcinoma in the remote past, Parkinsons disease and significant dystaxia. Physical examination showed an easily palpable mass in the upper-outer quadrant of the left breast. Mammogram revealed suspicious calcifications and an Ultrasound confirmed the mass. Core biopsy was consistent with ER/PR and Her2/Neu negative metaplastic carcinoma of the breast. She underwent a modified radical mastectomy and had 3 of 10 lymph nodes positive on axillary dissection (despite two sentinel lymph nodes being negative). Pathology revealed a single focus of Nottingham grade III invasive carcinoma measuring 3 cm, along with areas of spindle cell architecture admixed with areas of osteoid matrix and poorly differentiated intervening pleomorphic hyperchromatic cells in a heterologous neoplasm. Immunohistochemistry was positive for Vimentin (positive in mesenchymal tumors) and p63 (positive in invasive epithelial carcinoma) but negative for cytokeratin AE1/AE3. Final staging was Stage IIB (T2N1M0). Given her age, performance status and paucity of data regarding the benefit of chemotherapy in metaplastic carcinoma she was treated with adjuvant radiation. IMPLICATIONS/DISCUSSION: Metaplastic breast cancer has been recognized as a distinct pathological entity in recent years. It consists of combinations of poorly differentiated ductal adenocarcinoma, mesenchymal and other epithelial components. The term denotes tumors with mixed Epithelial and Sarcomatoid components as well as primary squamous, or mixed adeno-squamous carcinomas. Sarcomatoid cases are classified as Monophasic (spindle cell only) or Biphasic

(mixed spindle cell-epithelial) (2). Fewer T1 tumors, possibly less nodal involvement (some case series report increased nodal involvement) (2), hormone receptor negativity and higher tumor grade are significant differentiating factors between metaplastic breast cancer and infiltrating ductal carcinoma. The knowledge regarding overall prognosis and treatment options related to this tumor is evolving. The general perception is patients with metaplastic breast cancer do poorly compared to other invasive breast cancers as all subtypes of metaplastic carcinoma display aggressive biological behavior as evidenced by high p53 and Ki-67 index (2). No specific chemotherapy regimen has proven to be effective and endocrine treatment is noted to be redundant. But further studies will be needed to assess the role of surgery, adjuvant chemotherapy, radiotherapy and newer treatment options to improve overall and disease free survival. 1. Schnitt, SJ, Guidi, AJ. Pathology of invasive breast cancer. In: Diseases of the Breast, Harris, JR, Lippman, ME, Morrow, M, Osborne, CK, (Eds), 3 rd ed, Lippincott, Williams and Wilkins, Philadelphia 2004. p.393.2. Tse, GM, Tan, PH, Putti, TC, Lui, PCW, Chaiwun, B, Law, BKB. Metaplastic carcinoma of the breast: a clinicopathological review. J Clin Path 2006; 59: 107983.

PERITONEAL MESOTHELIOMA PRESENTING AS INTRACTABLE VOMITING Benjamin Jacobs 1; Lawrence Ward2. 1Temple University Hospital, Philadelphia, Pennsylvania ; 2Temple University Hospital, Bala Cynwyd, Pennsylvania. (Tracking ID # 9591)

LEARNING OBJECTIVES: 1. Recognize the presentation of malignant peritoneal mesothelioma. 2. Understand the prognosis of malignant peritoneal mesothelioma.

CASE INFORMATION: A 50 year-old man with no PMH presented complaining of several weeks of worsening weakness, nausea, vomiting, and decreased oral intake. He experienced many episodes of fevers, chills, drenching night sweats and an unintentional weight loss of 120lbs in the past 6-9 months. He had numerous jobs, including a remote history of employment as a shipbuilder. His vital signs were all normal. Physical exam revealed an obese abdomen that was diffusely tender to palpation, without obvious masses or hepatosplenomegaly. On admission, laboratory evaluation was significant for a WBC of 14.4, hemoglobin 8.9 g/dL, and albumin 1.6 g/dL. He was HIV negative. A CT abdomen and pelvis revealed two large masses within the abdomen; the first measuring 5.3x4.5 cm subjacent to the anterior abdominal wall of the right lower quadrant, and the second measuring 7.9x7.89 cm appearing to be contiguous with the anterior wall of the rectum. Multiple periaortic lymph nodes were also noted. A biopsy of the larger rectal mass revealed morphologic features and an immunoprofile consistent with a mesothelial neoplasm. His nausea was initially difficult to control, and required multiple overlapping antiemetic medications. He was seen by medical oncology who recommended outpatient chemotherapy. Three weeks later he was readmitted for failure to thrive due to his worsening nausea and vomiting. He had lost an additional 15lbs and was unable to tolerate any oral intake. After considerable discussion with the patient and his family, he chose to be comfort care only and died in the hospital before he could go home on hospice. IMPLICATIONS/DISCUSSION: Malignant peritoneal mesothelioma (MPM) is a rare malignancy (approximately 200-400 cases per year), typically with a rapidly fatal course (median survival 6-12 months). It is a tumor of the serosal membranes, arising from the pleura, peritoneum, and tunica vaginalis and pericardium. The peritoneum is the second most common site of origin after the pleura, representing 10-20% of mesotheliomas. Asbestos exposure has been implicated in the pathogenesis of this disease. A case-control study found that among men with pleural mesothelioma, the attributable risk for exposure to asbestos was 88%, and among men with peritoneal disease, it was 58%. The most common presenting symptoms of MPM are abdominal pain and swelling, and weight loss. Radiologically, MPM generally appears are one or more peritoneal masses, sometimes with evidence of ascites. In the work-up of MPM, the more common intra-abdominal tumors (colon, ovarian, etc) must be ruled out as possible sources of peritoneal metastasis. Since the symptoms of MPM are predominantly loco-regional, treatment is generally directed within the abdominal cavity. Initial treatment often consists of maximal surgical debulking along with intra-peritoneal chemotherapy. Systemic chemotherapy is also to be considered. The role of radiation therapy

and biologic agents is still being evaluated. The prognosis of MPM is very poor. Although patients who have a single site of disease and undergo extensive debulking generally have better outcomes than those who present with diffuse disease, it is still generally considered to be a uniformly fatal disease.

A FIDDLY CASE OF RASH AND NEUTROPENIA Naveed Hasan 1; Maha Dawood 1; Fatme Allam1. 1SUNY Upstate Medical University, Syracuse, New York. (Tracking ID # 9593)

LEARNING OBJECTIVES: 1. Recognize the clinical features of Levamisole-induced pseudovasculitis. The emergence of retiform purpura with unexplained neutropenia in a cocaine abuser should prompt consideration of Levamisole as the offending agent. 2. Distinguish the immunological responses of Levamisole-induced pseudovasculitis from Wegeners Granulomatosis (WG); they mimic strongly, discernment of which is imperative to correct decision making.

CASE INFORMATION: A 44 year old white woman with history of Hepatitis C, cyclic neutropenia and polysubstance abuse was transferred from an outlying facility for evaluation of rapidly progressive skin rash of one week duration. The rash started off as a sunburn sensation and later developed into purplish, necrotic and painful skin lesions. There was no history of sinus, lung or kidney disease or symptoms. She admitted to cocaine use about 1 week ago when someone tampered her drink with cocaine. Examination revealed seven discrete, tender, blackish purple stellate skin lesions, predominantly on extremities and breast. The largest lesion measured 14 x 12 centimeters. The rash had both hemorrhagic and bullous components, well-demarcated borders with surrounding erythema. Joint exam was normal. Laboratory values were significant for neutropenic nadir of 0.02 x 109/L; positive atypical anti-neutrophilic cytoplasmic antibody (ANCA) directed against protease 3 (PR3) and positive anti-cardiolipin IgM and Hepatitis C Virus antibodies. Anti-nuclear antibody (ANA) and cryoglobulin were negative. C4 was low and C3 was normal. Partial thromboplastin time was elevated. Urine toxicology was positive for cocaine, cannabis and opiates. Diagnosis of vasculitis was entertained and she was started on steroids with no improvement after 3 days. Bone marrow was hypercellular with maturation arrest at the promyelocyte-myelocyte stage and no signs of leukemia/ lymphoma. Skin biopsy showed hemorrhage, full thickness necrosis and multiple fibrin thrombi filling small blood vessels in the dermis. Multidisciplinary review of the case and literature concluded that it is a pseudo-vasculitis secondary to cocaine adultered with Levamisole. Steroids were withdrawn and patient improved over the next few days.

IMPLICATIONS/DISCUSSION: According to Drug Enforcement Agency report in 2009, levamisole was found in 69% of seized cocaine. This antihelminthic agent is banned for human use due to multitude of adverse effects including agranulocytosis and pupura. Levamisole is metabolized to aminorex in racehorses which has high abuse potential because of its amphetamine-like pharmacological activity. Another hypothesis is that it augments response to Acetylcholine at Nicotinic channel; and in some animal models, the animals seemed happier suggesting a role of dopamine. ANCA directed against PR3 has been a pretty consistent feature, tricking the physicians to treat as vasculitis. One small case series has shown positive anti-cardiolipin antibodies in these subjects. Both genetic predisposion (Like HLA B27 positivity) and acquired states like Hepatitis C may define which population develops the retiform purpura. Cocaine adulteration with Levimasole is a medical and social challenge. Physician awareness is vital to differentiate this reversible illness from WG. The diagnosis should be entertained in all suspected WG cases presenting with agranulocytosis and positive cocaine. A urine Levamisole assay should be sent preferably within 48 hours. Cessation of exposure usually causes complete reversal of the symptoms, as was true in our case.

BILATERAL TENSION PNEUMOTHORACES DURING APNEA TESTING Naveed Hasan 1; David M Landsberg2. 1SUNY Upstate Medical University, Syracuse, New York ; 2Crouse Hospital, Syracuse, New York. (Tracking ID # 9629)

LEARNING OBJECTIVES: 1. Recognize that apnea testing (AT) for diagnosis of brain death is not a benign procedure. While it is frequently performed in Intensive Care Units, it may be associated with life threatening

complications like tension pneumothorax. 2. Assess the pre-requisites of AT carefully. Pay close attention to the diameters of endotracheal tube (ETT) and oxygen tubing (used for pre-oxygenation); if the latter is not freely flowing within ETT, a snug fit may result in tension pneumothorax.
CASE INFORMATION: A 57 year old woman with past medical history of hypertension, morbid obesity, fibromyalgia and hypothyroidism was brought to the hospital unresponsive and intubated. Initial neuro-imaging was consistent with global anoxia revealing bilaterally symmetrical basal ganglia and occipital infarcts apparently secondary to fentanyl overdose. She progressively deteriorated over the following 12 hours until brainstem reflexes were absent. American Academy of Neurology pre-requisites for apnea testing were met including euvolemia, core temperature >36.5 degrees and normotension. Formal AT was initiated. The patient was removed from ventilator and a 12 French oxygen catheter was placed at the level of the carina within the lumen of a 7.0 millimeter ETT. After 4 minutes of observed apnea, hypotension and desaturation ensued followed by obvious subcutaneous air in the thorax and head necessitating termination of AT. Chest X-ray confirmed bilateral tension pneumothoraces and sub-cutaneous emphysema treated with emergent thoracostomy. Cerebral blood flow testing performed immediately after thoracostomy confirmed brain death.
IMPLICATIONS/DISCUSSION: Tension pneumothorax is extremely rare complication encountered during AT. Predictors for its development should be identified to limit potential life threatening complications. Wijdicks et al reviewed 228 cases of AT and no pneumothoraces were described. Saposnik et al identified pre-existing acidosis as a risk factor for developing complications from AT. The patient described here had normal hemodynamic and acid-base status prior to AT. Review of the AT in this case revealed that the oxygen tubing was not moving freely within the smaller lumen ETT (7 millimeters) nor was gas noted to be venting from the ETT. We suspect that a snug fit between oxygen tubing and ETT did not allow sufficient venting of oxygen flow in this case precipitating the pneumothoraces.
ETT luminal diameter, oxygen tubing outer diameter and depth of placement should be shown careful attention in AT. Vigilance with respect to presence of adequate residual ETT lumen to allow ventilation with oxygen flow rates set at physiologic minute volumes, and preferably, review and standardization of these parameters by prospective studies will lessen the risk of pneumothoraces during AT.
AN OLD TRICK FROM THE GREAT IMITATOR Marcus Anthony Urey 1;
Stephen Harder2. 1UTSW Internal Medicine Residency, Dallas, Texas ;
2UTSW, Dallas, Texas. (Tracking ID # 9639)
LEARNING OBJECTIVES: 1. Recognize the epidemiologic reemergence of chronic syphilis infection 2. Identify visceral symptoms as an early manifestation of neurosyphilisCASE INFORMATION: A 53 year-old woman presented with six months of episodic abdominal pain. She described an electric-like mid-epigastric pain associated with emesis and thirty pound weight loss over six months. The symptom occurred every one to three weeks without relation to eating, lasted four hours, and dissipated without intervention. No alleviating or aggravating factors were identified and the patient denied hematemesis or bleeding per rectum. Prior work-up including abdominal imaging, esophagastroduodenoscopy, and colonoscopy were negative. Laproscopic choleycystectomy for cholelithiasis did not relieve

symptoms. The abdomen was soft without rebound or guarding; her surgical scars were well healed; she exhibited no costophrenic angle tenderness. Her pupils were equally reactive to light and accommodated. In all extremities, strength was rated 5 out of 5 and sensation to light touch, position and vibration were intact Deep tendon reflexes were 2 out of 4 in biceps, triceps, patellar and Achilles tendons. Laboratory evaluation revealed normal thyroid and adrenal function. HIV and hepatitis panels were negative. The urinalysis had fifteen white blood cells per high power field and excretion of porphobilinogen was low. On discussion with the family,

additional history of disorientation and tangential speech was obtained. Mini mental status exam score was 16 out of 30. Serum RPR was positive at a titer of 1:32 and CSF VDRL was positive at a titer of 1:4. A diagnosis of neurosyphilis with gastric crisis was made. The patient completed a 14-day course of intravenous penicillin and remained symptom free at three-month follow-up. IMPLICATIONS/DISCUSSION: With increasing frequency, syphilis, is once again becoming a disease relevant to the general internist. Current trends show that syphilis, including late presentations, are becoming more common. General paresis and tabes dorsalis are devastating complications of neurosyphilis which portend poor outcomes and can present with progressive dementia, sensory ataxia, and episodic lancinating pain.Gastric crisis is a complication of late neurosyphilis typically described as paroxysms of shooting abdominal pain associated with vomiting and followed by sudden relief and normalization of abdominal function. Although a rarity in the recent past, the gastric crisis was a well described complication preceding clinically evident tabes dorsalis prior to the penicillin era. While the precise mechanism is uncertain, it is hypothesized that the crisis results from pathologic degeneration of the meninges, spinal cord, and spinal root of the thoracic segments including the splanchnic bed. Treatment, presumably involves the administration of penicillin G intravenously for 14 days, similar to current treatment guidelines for neurosyphilis.With the reemergence of syphilis it is expected that the general internist will encounter its complications with increased frequency. In a patient presenting with unexplained abdominal complaints and serologic evidence of syphilis, the diagnosis of neurosyphilis associated gastric crisis should be entertained.
DISSEMINATED ACTINOMYCOSIS FROM AN INTRAUTERINE DEVICE Holly Thomas 1; Wendy Simon2. 1University of California Los Angeles, Los Angeles, California ; 2University of California, Los Angeles, Los Angeles, California. (Tracking ID # 9666)
LEARNING OBJECTIVES: 1. Recognize actinomycosis as an uncommon but significant of other diseases including malignancy 2. Recognize that actinomycosis requires an extended course of antibiotic therapyCASE INFORMATION: The patient is a 53 year-old woman with no past medicalhistory admitted with left-sided hemiparesis. Eight months prior topresentation, she developed a right back abscess which had been draining intermittently. On the day of admission, she developed left arm and legweakness and numbness and presented to the emergency department, where she hada tonic-clonic seizure. Computed tomography of the head revealed aring-enhancing, right parietal mass. Further imaging revealed masses in theright chest wall, liver, and left adnexum. Malignancy was initially suspected,and the brain mass was partially resected. She also underwent biopsies of theskin, chest wall, and liver. The pathology revealed nonspecific inflammation inall but the chest wall lesion, which revealed rare granules. Furtherquestioning revealed the presence of an IUD placed in China nearly 20 yearsprior. Subsequent endometrial biopsy showed gram-positive bacterial elementsconsistent
with actinomyces and severe endometritis. The patient was started onceftriaxone, trimethoprim-sulfamathoxazole, and minocycline as at that time histopathologicdiagnosis was not finalized. Unfortunately the patient was declining IUDremoval initially and, after one visit with an outpatient infectious diseasespecialist, was subsequently lost to follow-up.
IMPLICATIONS/DISCUSSION: Actinomyces are gram-positive, anaerobic, slow-growingorganisms that can cause a myriad of infections. It is a normal colonizer ofthe mouth, gastrointestinal tract, and vagina. Mucosal disruption is requiredfor infection. The most common presentation is facial abscess in relation totrauma; however, virtually any organ can be involved. The species most commonlyimplicated in human infection is A. israelii. Diagnosis can be made based onbiopsies of the lesions with proper microbiologic handling, but often resultsfrom histopathologic diagnosis following resection. A higher index of suspicioncould potentially prevent unnecessary surgical resections. It is widely recognizedthat intrauterine devices (IUDs) are associated with pelvic infection due to Actinomyces.The incidence is difficult to estimate but rare. The risk increases the longerthe IUD is present. The most common manifestation of IUD-related actinomycosisis endometritis. However, hematogenous spread can result in disseminatedinfection. Disseminated infection can appear as

multiple masses in virtuallyany organ system, mimicking malignancy. For facial abscess, 4 weeks of oralpenicillin is typically effective. For disseminated disease, 3 weeks of IVpenicillin followed by 612 months of oral penicillin is recommended. In casesof IUD-associated actinomycosis, the device should be removed.

LEXAPRO AND IMITREX: CONCERNING SEROTONIN EFFECTS Marie Suzy Brubacher 1; Nisha Basu2. 1Beth Israel Deaconess Medical Center, Brookline, Massachusetts ; 2Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 9698)

LEARNING OBJECTIVES: 1. Review the epidemiology of serotonin syndrome. 2. Recognize the presentation and management of the clinical manifestations of serotonin syndrome.

CASE INFORMATION: A 25 year-old female patient with a past medical history significant for migraine headaches and depression for which she takes escitalopram, presented to urgent care clinic with increased anxiety. The symptoms began one-week prior with several episodes of feeling dizzy. She described symptoms of vertigo, that the room was spinning. Concerned for the development of migraines, she started increasing the frequency of her sumatriptan. She stated she was anxious, easily startled and crying more frequently. Over time, she noted she was continuously flushed independent of her emotional state. As her symptoms persisted, she took her prescribed clonazepam in addition to sumatriptan and escitalopram with no improvement. Her vital signs in clinic were significant for blood pressure 156/98, temperature 100.1 F and pulse of 116. Her physical exam was notable for a flushed, anxious tearful young lady with a mild resting tremor, and hyperreflexia noted at the brachioradialis, biceps and patella bilaterally. She was referred to the emergency department for evaluation and was admitted to the general medicine floors for supportive care of serotonin syndrome. She was treated with cryoheptadine and lorazepam and discharged the following day. As an outpatient, her escitalopram was restarted and her sumatriptan was permanently discontinued in favor of topiramate for management of her migraines. IMPLICATIONS/DISCUSSION: Classically, serotonin syndrome is the triad of mental status changes, autonomic hyperactivity and neuro-muscular abnormalities. In reality it presents as an increasingly common spectrum of clinical findings. The rising incidence is likely

due to the increasing use of serotonergic agents. Over 48,000 exposures were identified in 2004, of which 8,187 resulted in major outcomes most of which were from co-ingestions of serotonergic agents. The true incidence of serotonin syndrome is thought to be under-represented from missed recognition due to its protean manifestations. One study reported that over 85% of physicians were unaware of serotonin syndrome. The diagnosis of serotonin syndrome is a clinical one, making a thorough history and physical vital. Mental status changes include anxiety, agitated delirium, restlessness, disorientation and easy startling. Abnormalities in vital signs include tachycardia, hypertension and hyperthermia. Common physical exam findings are mydriasis, hyperactive bowel sounds, diaphoresis, hyperreflexia, normal skin color and clonus often in the lower extremities. The most accurate diagnostic criteria is the Hunter Toxicity Criteria Decision Rules which states that a patient must have taken a serotonergic agent and have one of the following exam findings: spontaneous clonus, inducible clonus plus agitation or diaphoresis, ocular clonus plus agitation or diaphoresis, tremor and hyperreflexia, hypertonia, or a temperature above 100.4 F plus ocular or inducible clonus. Management of serotonin syndrome involves the removal of the precipitating drugs, supportive care, the control of agitation with benzodiazepines, the administration of serotonin agonists such as cryoheptadine, and the control of hyperthermia and autonomic instability. Many cases resolve within 24 hours. When symptoms persist, more aggressive therapy is required including sedation, neuromuscular paralysis and orotracheal intubation.

ARF: ACUTE RENAL FAILURE AND A RARE FINDING Sara W Wikstrom, MD 1; Jillian Catalanotti, MD, MPH2. 1The George Washington University, Arlington, Virginia ; 2The George Washington University, Washington, District of Columbia. (Tracking ID # 9805)

LEARNING OBJECTIVES: 1. Recognize Waldenstrom macroglobulinemia as a cause of acute renal failure. 2. Discuss physician non-acceptance of public health insurance (Medicaid) as a barrier to health care access and

continuity of care.
CASE INFORMATION: A 35 year-old otherwise healthy woman presented to an outside hospital with malaise, myalgias, and anorexia. She took no medications, had no allergies, and family and social histories were unrevealing. Vital signs on admission were notable for blood pressure 145/92, but were otherwise normal. Physical exam was unremarkable, with no peri-orbital or lower extremity edema. Lab studies on admission were significant for creatinine 3.9 mg/dL, and urinalysis with specific gravity 1.010, trace blood, and 300 mg/dL protein. Spot urine protein-to-creatinine ratio was 14.8. FENa was5.23%. Further work-up revealed ESR of 122, normal C3 and C4, and negative ANA and ASO titers. After her creatinine failed to improve, renal biopsy was performed; preliminary results were consistent with post-streptococcal glomerulonephritis and the patient was discharged from the hospital with creatinine stable at 3.0-3.2 mg/dL. Planned follow-up did not occur because the nephrologists did not accept her public insurance. One month later she saw a new nephrologist; at that time, the final biopsy read was obtained and was consistent with acute interstitial nephritis. Her creatinine failed to improve after a course of oral steroids and repeat renal biopsy was performed. This second biopsy confirmed interstitial nephritis, and was remarkable for tubular casts, indicating a possible underlying hematologic disorder. SPEP and UPEP with immunofixation revealed an M spike of 0.5 g/dL, with an elevated serum IgM of 1059 mg/dL and elevated urine free kappa light chains at 64851 mg/L. She was referred to hematology. Bone marrow biopsy revealed a hypercellular marrow with an IgM kappa-
restricted lymphoplasmacytic population comprising 50% of the total cellularity, expressing CD19 and CD20. Unfortunately, this hematologist also did not accept her insurance, so she transferred care to a second hematologist who diagnosed her with Waldenstrom macroglobulinemia and started treatment with bortezomib and rituximab.
IMPLICATIONS/DISCUSSION: Waldenstrom macroglobulinemia (WM) is a rare disorder, with 1400 new cases diagnosed in the US every year. The median age at diagnosis is 64 years; 60% of patients are male and less than 1% of patients are under the age of 40. WM is defined as a lymphoplasmacytic infiltrate in the bone marrow with a resultant IgM monocolonal gammopathy in the blood. It was first described as a syndrome of oronasal bleeding, severe anemia, hypofibrinogenemia, lymphadenopathy, lymphoid infiltrate of the bone marrow and hyper-viscosity. Clinical manifestations of WM are due to tumor infiltration of the bone marrow, circulating IgM and deposition of IgM in tissues. Renal insufficiency is unusual, despite IgM deposition in the glomerular basement membrane and infiltration of the renal parenchyma by neoplastic cells. Kidney biopsies from patients with WM and renal insufficiency show both glomerular and interstitial abnormalities. Characteristic pathological findings include hyaline intracapillary deposits of IgM and lymphoid infiltration of the interstitial tissues. Neoplastic infiltration of the interstitium is seen in over 50% of patients with WM and renal insufficiency. Nonspecific proteinuria is common, but the nephrotic syndrome is rare and the degree of proteinuria does not correlate with the degree or presence of IgM deposition in the glomerulus. WM should be considered on the differential diagnosis of acute renal failure in all patients; it is important to check SPEP and UPEP in all persistent renal failure patients, regardless of age. According to the Center for Studying Health System Change, as of 2008, almost half of all physicians either did not accept (28%) or limited acceptance of new Medicaid beneficiaries. Main reasons cited were low fees (84%) and administrative burden (70%). Despite having insurance, access to care remains difficult for patients with Medicaid. The effect of temporary increases in reimbursement outlined in the health care reform bill remains to be seen.
A CURIOUS CASE OF CONTAGIOUS COAGULATION Cassandra Kovach 1; Meaghan Lynch 1; Michael Paasche-Orlow1. 1Boston University School of Medicine, Boston, Massachusetts. (Tracking ID # 9991)
LEARNING OBJECTIVES: 1. Identify the biphasic course of parvovirus B19 infection. 2. Recognize the risk of aplastic crisis and thromboembolism in patients with hemoglobinopathies and acute parvovirus B19 infection.
CASE INFORMATION: A 24-year-old man with HbSC disease presented with low back pain consistent with his previous vaso-occlusive crises. His sister and nephew were concurrently admitted with similar symptoms. One

week prior to admission, the patient had subjective fevers and cough with green sputum, which had resolved. He was afebrile with stable vital signs and SaO2 100% on room air. Physical exam was unremarkable. Labs revealed WBC count 15,500 cells/mm3,
Hct 21.3% (baseline 26%), and reticulocyte count 0.6%. Urine and blood cultures were negative. Parvovirus B19 antibodies were ordered. The patients hospital course was complicated by persistently low reticulocyte count and decreasing Hct, requiring 3 units PRBCs. On hospital day 2, he became febrile and required 6 L of oxygen to maintain his SaO2. Work up was positive for multiple pulmonary emboli (PE) and anticoagulation was initiated. His respiratory and pain symptoms progressively resolved, and he was discharged on hospital day 5. The patients sister and nephew had similar clinical courses, including

bilateral PEs. Two days after his discharge, the patient was readmitted for uncontrolled pain, severe bilateral leg weakness, and arthralgias. His hip flexor strength was 3/5 bilaterally, and he required a walker to ambulate. Evaluation of his weakness revealed negative RPR and HIV titers and a normal B12 level. Parvovirus B19 IgM titer from his first admission returned elevated. Hip and lumbar MRIs showed no acute processes. He received several additional blood transfusions, pain management, and daily physical therapy, and improved over 11 days. His reticulocyte count gradually increased to 13% before returning to baseline. The patient was discharged able to ambulate with crutches and minimal pain.
IMPLICATIONS/DISCUSSION: Parvovirus B19 typically has a biphasic symptom course. The first phase occurs 710 days after exposure, coincides with viremia, and involves a mild prodrome of flu-like symptoms. Approximately 2 weeks after viral exposure, IgM and IgG antibodies appear. In children these antibodies coincide with the characteristic slapped-cheek rash known as Erythema Infectiousum, or Fifths Disease, and in adults these coincide with a rash and/or arthralgias, which are mediated by immune complex deposition. Our patient experienced this biphasic symptom course, the first phase presenting as URI symptoms prior to his vaso-occlusive crisis and the second phase presenting as debilitating arthralgias when he was readmitted. In patients with hemoglobinopathies, transient aplastic crisis is a well-established third manifestation of Parvovirus B19; indeed, virtually all transient aplastic crises in patients with sickle cell disease are due to B19 infection. Our patient was admitted to the hospital at approximately the same time as his sister and nephew, who also have HbSC disease and were also diagnosed with Parvovirus B19 infection. All three of these patients suffered temporary aplastic crises and bilateral PEs during their hospitalizations. Patients with HbSC or HbSS are at an increased risk for thrombotic events compared to healthy individuals, and patients with HbSC are at an even higher risk than those with HbSS. It appears that B19 infection can exacerbate this risk. B19 infection can occasionally mimic transient rheumatologic disorders and rarely a transient antiphospholipid syndrome.
PHERESIS FOREVER? Gaetan Sgro 1; Peggy Hasley 1; Hollis Day2.
1University of Pittsburgh Medical Center Medical Education Program, Pittsburgh, Pennsylvania ; 2University of Pittsburgh Medical Center Medical Education Program, Portersville, Pennsylvania. (Tracking ID # 9993)
LEARNING OBJECTIVES: 1. Recognize the clinical significance of ADAMTS13 levels in TTP. 2. Identify two potential causes of a suboptimal response to plasmapheresis.
CASE INFORMATION: A 71 year old woman was transferred from an outside hospital for management of anemia, thrombocytopenia and seizure. Initial laboratory studies revealed marked anemia and thrombocytopenia with 1-2% schistocytes on a peripheral blood film. ADAMSTS13 activity was undetectable. She was started on high-dose corticosteroids and plasmapheresis (PEX) for thrombotic thrombocytopenic purpura (TTP). She responded well initially and was transferred out of the ICU on hospital day 3. Platelet counts rose steadily until the end of her first week, then fluctuated between 90130109/L for the next 8 weeks. Various modifications to her treatment regimen, including switching to every other day PEX, administration of 3 doses of

vincristine and 2 doses of rituximab, failed to achieve remission. She was discharged after 65 days and continued plasmapheresis 3 days a week as an outpatient until her platelet counts finally stabilized at levels above 150109/L 90 days after admission.

IMPLICATIONS/DISCUSSION: The pathophysiologic hallmark of TTP is microangiopathic hemolytic anemia caused by von Willebrand factor (VWF)-mediated thrombus formation. In the majority of cases, abnormally large VWF multimers persist in the circulation because of a deficiency of the VWF-cleaving protease, ADAMTS13. Patients with ADAMTS13 activity of less than 10% generally have lower platelet counts on presentation, require more PEX sessions and are more likely to relapse than patients with higher ADAMTS13 levels. Initial ADAMTS13 levels have not been shown to have any impact on overall survival. For certain patients with ADAMTS13 deficiency, a decline in platelet count following an initial response to PEX has been documented in association with increases in levels of the ADAMTS13 inhibitor. So-called inhibitor boosting may be related to systemic immune activation in response to infection. For this reason, it is imperative that the possibility of infection be investigated in these patients, especially since systemic infections account for up to 50% of the major complications of PEX. Expert consensus suggests stopping PEX 2 days following remission, defined as normalization of neurologic status, normalization of LDH, platelet count greater than 150109/L and rising hemoglobin. However, some patients fail to meet these criteria despite prolonged courses of PEX. Persistently low platelet counts in these cases might reflect the unavoidable removal of platelets during exchange as well as the inadvertent normalization of thrombopoeitin levels that are appropriately elevated in response to thrombocytopenia. One case series identified 4 patients whose platelet counts exceeded 150109/L only after cessation of PEX, suggesting that our patient might have achieved remission sooner had plasmapheresis been discontinued.

A CASE OF HISTAMINE FISH POISONING Ben John Wilson 1; William Ghali2. 1Resident, Internal Medicine, University of Calgary, Calgary, Alberta ; 2Department of Medicine, University of Calgary, Calgary, Alberta. (Tracking ID # 10042)

LEARNING OBJECTIVES: 1. Recognize the clinical features of hista-mine fish toxicity. 2. Diagnose histamine fish toxicity.

CASE INFORMATION: A 25-year-old woman was sent to the emergency department (ED), via emergency medical services (EMS), after presenting to a walk-in clinic with a 1 hour history of a suspected anaphylactoid reaction. Her past medical history was remarkable for asthma, allergic rhinitis, and eczema. Her illness began within 10 minutes of eating a tuna sandwhich made with a can of solid white tuna. Immediately upon finishing the tuna, she noticed a burning sensation in her tongue and face which then spread to her neck and torso. She then developed an erythematous, pruritic, papular rash, dyspnea, and wheeze. The patients roommate had a similar, though less severe syndrome not requiring medical attention, after eating a small portion from the same can of tuna. In the ED, she was abebrile, she had a heart rate of 150 bpm, blood pressure of 139/83 mmHg, respiratory rate of 26 breaths/minute, and her oxygen saturation was 100% on a nonrebreather mask. She had an erythematous, papular rash over her face, neck, and torso, decreased breath sounds bilaterally with expiratory wheeze, and increased work of breathing. Her laboratory and radio-graphic investigations were largely unremarkable. Her syndrome was initially treated with a total of 3 intramuscular (IM) doses of 0.3 mg 1:1000 IM epinephrine in the walk-in clinic and with EMS prior to arriving tin the ED. In addition, she also received normal saline, 125 mg of IV methylprednisolone, IV ranitidine, multiple 25 mg doses of IV diphenhydramine, nebulized salbutamol, and acetaminophen. Given her unique presentation and its clear association with the ingestion of tuna, the emergency physician consulted internal medicine to assist in the diagnosis and further management of possible scombroid poisoning.

IMPLICATIONS/DISCUSSION: Histamine fish poisoning, also known as scombroid poisoning, is a histamine toxicity syndrome that results from eating specific types of spoiled fish. Histamine fish poisoning classically

manifests within minutes of ingesting spoiled fish. It begins with a burning tongue, sometimes a peppery or metallic taste to the fish is described. Progressive flushing of the face, neck, and torso with a characteristic throbbing headache also occurs soon after ingestion. Anxiety, nausea, tachycardia, palpitations, anxiety, and abdominal pain are also common features. Almost invariably, histamine toxicity follows a benign, self-limited course. For histamine fish poisoning to occur, 3 factors must be present. The ingested fish must be rich in histidine, which is typically the case with dark-fleshed fishes. Secondly, colonizing bacteria must contain histidine decarboxylase, the enzyme necessary to convert histidine into histamine. Lastly, at some point after the catch, the fish must have been exposed to relatively warm temperatures to permit bacterial replication and histidine metabolism, ultimately leading to critical histamine levels. Histamine fish poisoning is a clinical diagnosis that may be confirmed with laboratory testing. A highly probable diagnosis can be made based on the characteristic syndrome occurring in close proximity to fish ingestion. Plasma histamine levels and tissue histamine levels from suspect fish have been proposed to aid diagnosis. Treatment is supportive, consisting of H1 and H2 receptor antagonists.In the present case, the syndrome resolved within 24 hours and the patient was discharged home from the ED. The Public Officer of Heatlh was informed and arranged for 3 of the patients remaining, unopened cans to be analyzed for tissue histamine levels. Levels came back within normal limits implying that the affected fish was isolated to the one particular can.

ASYSTOLE INDUCED BY INTRACEREBRAL MASS EFFECT Ann R Garment 1; Irina Sobol1. 1New York Presbyterian Hospital - Weill Cornell Medical College, New York, New York . (Tracking ID # 10057)

LEARNING OBJECTIVES: 1. To discuss the broad differential diagnosis of asystolic cardiac arrest. 2. To recognize pertinent findings that suggest a neurogenic etiology of asystole.

CASE INFORMATION: A 53-year old man with no past medical history presented to the hospital after a syncopal event. The evening of admission he felt cool and clammy during dinner and subsequently had an episode of syncope without any associated palpitations, chest pain or shortness of breath. Witnesses reported that he was unconscious for 30 seconds without seizure-like movements, incontinence or subsequent confusion. In the emergency department while on cardiac monitor he again syncopized. Telemetry showed sinus bradycardia preceding an 18-second pause without p-waves or escape beats, followed by several junctional beats before conversion to normal sinus rhythm. His physical examination was unremarkable, his labs demonstrated normal electrolytes, negative troponins, negative lyme titers and a normal angiotensin converting enzyme level, and his ECG showed normal sinus rhythm. He was admitted to the cardiac intensive care unit to have an emergent transvenous pacing wire placed. A subsequent transthoracic echocardiogram showed an ejection fraction of 70%, normal valves and no wall motion abnormalities. Though the etiology of his syncopal events was not yet elucidated, a permanent pacemaker was deemed appropriate and was placed without complication on hospital day two. On hospital day three he developed a new-onset, severe headache. A head CAT scan was performed, which showed a 3.8 x 4.0 x3.1 cm, calcified, enhancing mass in the right fronto-temporal region with surrounding vasogenic edema, mass effect on the lateral ventricles and mild subfalcine herniation. On hospital day four, the patient was taken to the operating room for resection of the mass, which was found

to be a benign meningioma on pathology. The patient was discharged on hospital day eight without any neurological sequelae. He was scheduled to follow up with his new cardiologist regarding whether or not to ultimately remove the pacemaker if it was no longer deemed necessary.

IMPLICATIONS/DISCUSSION: When a patient experiences sinus arrest and asystole, one must consider a relatively broad differential, including myocardial infarction, electrolyte abnormalities, conduction system degeneration (from age, lyme, sarcoidosis or amyloidosis), or increased vagal tone. Complete cessation of cardiac electrical activity on telemetry, without any p-waves or escape beats, further supports vagal tone as culprit. Case reports of vagal tone causing profound symptomatic bradycardia or cardiac arrest have included carotid hypersensitivity syndrome, REM sleep, straining with defecation, and exercise (presumably a vasovagal

phenomenon). Reports of intracerebral masses causing asystole almost always describe secondary seizure activity as the phenomenon ultimately effecting asystole rather than an intrinsic property of the mass itself, though one veterinary journal reported a canine meningioma that was theoretically directly interfering with the vagal nerve based on its location. However, in the patient presented above, his tumor was causing enough mass effect to induce herniation on head CAT scan, and there was no clinical evidence of seizure activity. Therefore, this may in fact be the first reported case of an intracerebral tumor causing mass effect that subsequently induced sufficient vagal tone to precipitate complete asystole.

A CASE OF WEIGHT GAIN IN A PATIENT WITH HUMAN IMMUNO-DEFICIENCY VIRUS Yunie Kim 1; Peter Hunt 2; Edgar Pierluissi3.
1University of California, San Francisco. Department of Internal Medicine, San Francisco, California ;
2University of California, San Francisco. Positive Health Program, San Francisco, California ;
3University of California, San Francisco. Division of Geriatrics, San Francisco, California. (Tracking ID # 10062)
LEARNING OBJECTIVES: 1. Recognize that ritonavir can increase the risk of iatrogenic Cushings syndrome in patients on inhaled corticosteroids. 2. Explore a type of systems error that can cause iatrogenesis. CASE INFORMATION: The patient is a 48-year-old man with HIV (last CD4 count=207, viral loadIMPLICATIONS/DISCUSSION: Inhaled corticosteroids are absorbed through both the lung and gastrointestinal tract. Fluticasone is a potent inhaled corticosteroid metabolized by P450 CYP3A4 and has been shown to suppress the hypothalamic-pituitary axis. Itraconazole and ritonavir, two inhibitors of CYP3A4, have been implicated in iatrogenic Cushings syndrome and/or adrenal insufficiency by decreasing inhaled corticosteroid metabolism in case reports. There are even some more recent case reports implicating intra-articular and epidural steroids in iatrogenic Cushings syndrome in patients on ritonavir. The diagnosis of ritonavir and fluorinated corticosteroid inhaler associated Cushings syndrome has been delayed in some cases due to attribution of weight gain to lipodystrophy from ART. In this case, though the primary care provider was aware of a potential drug interaction and attempted to discontinue the fluticasone, a pharmacy error led to its continued dispensation. The frequent usage of fluticasone in this patient led to a marked iatrogenic Cushings syndrome and adrenal insufficiency. Health care providers should be aware of the increased risk of drug interactions in patients on ritonavir given its potent inhibition of CYP3A4. This case also serves as a reminder to maintain a low threshold to directly verify medications with a pharmacy to ensure accuracy and safety. Systems errors such as dispensation of discontinued medications and erroneous instructions can occur despite attention by both health care providers and pharmacists.

OPIOID INDUCED NEUROTOXICITY IN A PATIENT WITH CANCER RELATED PAIN Sarah J Nickoloff 1; Sean Marks1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10068)
LEARNING OBJECTIVES: 1. Recognize the emerging phenomenon of opioid induced neurotoxicity in patients who are receiving opioids for cancer related pain. 2. Understand how to evaluate suspected opioid induced neurotoxicity, and how to manage patients with this disorder. CASE INFORMATION: A 57 year old man with prostate cancer presented with low back pain. He was tender to palpation over the lower back and right femur but neurologically intact. Hydromorphone patient controlled analgesia (PCA) was started at a bolus dose of 0.4 mg intravenously (IV) with a lockout of 10 minutes and no basal rate (0.4/ 10/0). MRI revealed diffuse bony metastases throughout the thoracic and lumbar spine and a pathologic right femoral neck fracture. PCA was titrated to 14/10/9 over the next 3 days. He underwent radiation to his spine and right total hip replacement with improvement in pain, but remained on the same PCA settings until 6 days later, when his PCA was titrated to 20/10/9 because of worsening pain. The following day, the patient complained of muscle spasms and confusion. On exam, he was alert but delirious, experiencing visual hallucinations and 16 beats of myoclonus per minute in

his upper extremities. Basic chemistry panel and complete blood count were normal. A diagnosis of opioid induced neurotoxicity was made. PCA was stopped for 90 minutes, then restarted with a bolus only at 50% of prior dose and no basal dose (10/10/0). Lorazepam was scheduled for myoclonus. His symptoms resolved within 48 hours.
IMPLICATIONS/DISCUSSION: Ongoing clinician education has resulted in an appropriate increase in opioid use to manage cancer related pain and dyspnea. This changing pattern in opioid utilization has led to enhanced symptom control in cancer, but has also led to the emergence of opioid induced neurotoxicity. The incidence of opioid induced neurotoxicity is unknown. Neuroexcitatory effects of opioids may be seen in all patients on opioids, but comorbid conditions, including renal failure, can precipitate opioid induced neurotoxicity. Effects are likely caused by the 3-glucuronide opioid metabolites, which have no analgesic effect and can accumulate rapidly. Myoclonus is usually the presenting symptom of opioid induced neurotoxicity and if missed can progress to hyperalgesia, allodynia, delirium, and tonic-clonic seizures. If clinicians are unaware of opioid induced neurotoxicity, they may mistakenly treat hyperalgesia with higher opioid doses and facilitate the progression of opioid induced neurotoxicity. Evaluation includes blood work to look for renal dysfunction, physical exam to assess hydration status, and a thorough chart review of opioid dosages and dose changes. Clinical management entails treatment of exacerbating factors. If pain remains controlled, dose reduction of the opioid may be necessary along with initiation of a benzodiazepine to reduce myoclonus and raise the seizure threshold. If pain is uncontrolled, opioid rotation to a structurally dissimilar opioid at 25-50% of the morphine equianalgesic dose may be necessary. Naloxone does not treat opioid induced neurotoxicity, and should not be used.
MORE THAN MEETS THE EYE: RETINAL TOXOPLASMOSIS IN A PATIENT ON CHRONIC STEROIDS
Darcy Wooten 1; Darcy Wooten 1; Krishan Soni 1; Julia Charles2. 1UCSF, San Francisco, California ; 2UCSF, San Francisco, California. (Tracking ID # 10073)
LEARNING OBJECTIVES: 1. Review the differential diagnosis and initial work-up for anterior uveitis and neuroretinitis. 2. Diagnose and treat ocular toxoplasmosis.
CASE INFORMATION: A 79 year-old man with a history of untreated latent TB presented with 6 weeks of blurry vision in his left eye. Five months earlier he was diagnosed with renal sarcoidosis at another hospital after presenting with renal failure. There, he was found to have granulomatous interstitial nephritis on renal biopsy and diffuse thoracic and abdominal lymphadenoapthy on CT scan. High-dose prednisone was started with improvement in renal function. Three months later he noted blurry vision and superior visual field loss in his left eye. An ophthalmologist diagnosed ocular sarcoidosis and increased his prednisone to 80 mg daily. His vision continued to deteriorate and he was admitted to our hospital for expedited evaluation. Review of systems was otherwise negative. His exam showed an afferent pupillary defect, superior visual field deficit, anterior uveitis and neuroretinitis on the left. The remainder of his exam was unremarkable. His CBC, electrolytes, LFTs, and ESR were within normal limits. His creatinine was stable at 2.0. Lab tests for HIV, Bartonella, Syphilis, Cryptococcus, Cocciodiodes, CMV, and ANCA were negative. A repeat CT scan showed resolution of the lymphadenopathy, and no pulmonary abnormalities were seen. A brain MRI was unremarkable. Toxoplasma serologies were markedly elevated and a vitreous aspirate PCR assay confirmed the diagnosis of retinal toxoplasmosis. The patient was started on sulfdiazine, pyrimethamine, and leucovorin and his prednisone was tapered. His vision remains poor and is not expected to improve. IMPLICATIONS/DISCUSSION: The differential diagnosis for anterior uveitis and neuroretinitis includes infections, systemic inflammatory diseases and masquerading syndromes. The preliminary evaluation includes a detailed history, thorough review systems, basic laboratory tests, and a chest x-ray. With a recent diagnosis of renal sarcoid, our patients visual symptoms were initially attributed to ocular sarcoidosis however alternative diagnoses were pursued when his vision worsened on a higher dose of prednisone. Ocular TB, although rare in the U.S., was considered because of the patients untreated latent TB in conjunction with prolonged steroid use. The lack of respiratory symptoms or

pulmonary findings on imaging however, helped eliminate this possibility. Ocular toxoplasmosis, the ultimate diagnosis in this case, is caused by the intracellular parasite Toxoplasma gondii and accounts for 15-17% of all cases of uveitis and 25% of neuroretinitis in the U.S.; it is the most common cause of anterior uveitis worldwide. Usually a self-limited disease in immunocompetent patients, there is substantial variation in the severity and duration of active episodes. Whether corticosteroids contribute to active disease is unclear but several case reports have documented a potential association. A high index of suspicion along with the combination of serology, fundoscopy, and vitreous sampling for evidence of Toxoplasma gondii are critical in making the diagnosis. Treatment consists of sulfadiazine and pyrimethamine with leucovorin to prevent pancytopenia.

PANCREATITIS DUE TO HYPERTRIGLYCERIDEMIA Jennifer Hsieh 1;
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2Montefiore Medical Center, New York, New York. (Tracking ID # 10074)

LEARNING OBJECTIVES: 1. Recognize that hypertriglyceridemia is an uncommon cause of pancreatitis. 2. Review the risk factors, patho-physiology, and treatment of hypertriglyceridemic pancreatitisCASE INFORMATION: Chief complaint: 51 year old male with uncontrolled Type 2 diabetes mellitus, obesity, hypertriglyceridemia, and a prior episode of pancreatitis presents with epigastric pain for 1 day. History of present illness: His pain was epigastric, severe, and constant, with occasional radiation to the right and left upper abdominal quadrants. The pain was worse with movement and deep inspiration. He had occasional nausea, decreased appetite but denied

vomiting, changes in bowel movements, or changes in skin color. Review of symptoms: He denied shortness of breath, fever, and chest pain. He denied alcohol ingestion, illicit drugs or any medications. Physical Exam: Vital signs: T 99.4 F, BP 136/87, HR 85, RR 16, FS 377. His exam was notable for an obese, distended abdomen; epigastric, RUQ and LUQ tenderness; no rebound or guarding; no hepatomegaly. No xanthomas, scleral icterus or jaundice. Laboratory data: WBC 14.2, Amylase 205 U/L, Lipase 423 U/L, LDH 224 mg/dl, Triglycerides 10,840 mg/dl, EtOH 10 mg/dl, Total protein 5.4 g/dl, Albumin 3.6 g/dl, Total bilirubin 0.5 mg/dl, Direct Bilirubin 0.0 mg/dl, Alkaline phosphatase 65 U/L, SGOT 21 U/L, SGPT 68 U/L. Computed tomography of the abdomen and pelvis: Gallbladderis nonhydropic without gallstones. There is no intra or extrahepatic biliary ductal dilatation. Mild diffuse enlargement of head and neck of pancreas with small peripancreatic ascites consistent with acute pancreatitis. No fluid collections or evidence of necrosis. Hospital course: The patient was admitted with a diagnosis of pancreatitis due to hypertriglyceridemia. The patient was treated supportively with intravenous fluids, subcutaneous heparin, kept NPO, and started on an insulin infusion. Within 24 hours of starting insulin, the patients triglyceride level decreased by ~50%, to 6,115 mg/dl. He was later started on gemfibrozil. Within a week, his symptoms improved and his triglyceride level was 583 mg/dl on the day of discharge. IMPLICATIONS/DISCUSSION: Acute pancreatitis is a reversible inflammatory process that is most commonly due to excessive alcohol use or gallstones. Hypertriglyceridemia (HTG) is the third most common cause of pancreatitis, but causes only 1-4% of cases. HTG is usually asymptomatic until triglycerides (TG) are greater than 1,000 mg/dL, at which point the risk of pancreatitis increases. Primary causes of HTG include genetic defects leading to abnormal TG metabolism such as types I, IV, and V hyperlipoproteinemia. Secondary or acquired HTG is due to a high fat diet, obesity, diabetes, hypothyroidism, or medications such as estrogen, thiazide diuretics, propofol, and protease inhibitors. The typical presentation of hypertriglyceridemic pancreatitis (HTGP) is a patient with a history of dyslipidemia and the presence of an additional factor. One theory to explain the mechanism for HTGP is that pancreatic lipase hydrolyzes excess triglycerides, causing free fatty acids to accumulate in the pancreas and injure acinar cells. Another theory suggests that elevated chylomicrons in pancreatic capillaries causes hyperviscosity, producing ischemia and inflammation. The main goal in treating HTGP is to decrease the serum TG level and prevent further inflammation. There are no official guidelines regarding HTGP therapy but insulin and heparin decrease TG levels by increasing the activation and release of

lipoprotein lipase respectively. Lipoprotein lipase is produced by muscle endothelial cells and breaks down TG into free fatty acids and glycerol. Heparin use is controversial as it also increases hepatic degradation of lipoprotein lipase which may result in rebound accumulation of chylomicrons. Plasmapheresis directly removes chylomicrons, but is expensive and not readily available. Lipid lowering drugs prevent further episodes.

NOT JUST ANOTHER CASE OF ACUTE PERICARDITIS Karen Ann Clarke 1; Karen Ann Clarke1. 1Emory University, Newnan, Georgia. (Tracking ID # 10075)

LEARNING OBJECTIVES: 1. Recognize that acute pericarditis can be precipitated by cardiac diagnostic and interventional procedures. 2. Identify the differential diagnosis of chest pain in patients who have undergone a recent percutaneous coronary intervention.

CASE INFORMATION: A 60 year-old white female with a history of coronary artery disease presented with a two day history of dyspnea, and

pleuritic chest pain. The chest pain varied in its intensity, and it increased with deep inspiration. She denied radiation of the chest pain, diaphoresis, nausea, vomiting, or coughing, but she did report subjective fevers and chills. Three weeks ago, she was admitted to the hospital with a different type of chest pain, and ultimately had a percutaneous coronary intervention to her right coronary artery. She was discharged home on aspirin and Plavix. Her initial vital signs were T=97.1, heart rate=71, blood pressure= 107/77, respiratory rate=20, and room air O2 saturation=98%. The physical examination was normal, with the exception of pain when pressure was applied to the mid-sternum. The patient had three negative sets of cardiac enzymes, and her electrocardiogram was normal. Her WBC count was 17.1, CRP was 26.2 (mg/dL), and ESR was 53 (mm/hr). Since her DDimer was mildly elevated, the patient went for a chest CTangiogram, which showed no pulmonary embolus, but it did reveal a new (that is, compared with three weeks ago), sizeable pericardial effusion. Her transthoracic echocardiogram showed a small-to-moderate sized pericardial effusion, without echocardiographic findings of increased intrapericardial pressure. IMPLICATIONS/DISCUSSION: Acute pericariditis is a diagnosis that is commonly encountered by hospitalists. Patients must have at least two of the four following criteria to be diagnosed with pericarditis: pericardial effusion, chest pain, abnormal electrocardiogram (with diffuse ST elevation or PR depression), and a pericardial friction rub. Although in many instances the etiology of the acute pericarditis is idiopathic, there are multiple known causes, including infections, neoplasms, metabolic disorders, vasculitis, connective tissue diseases, and trauma. Trauma can be either direct or indirect. Indirect trauma includes a blunt injury to the chest. Examples of direct trauma include a penetrating chest injury or cardiac surgery. Although not commonly considered, direct trauma can also occur during a percutaneous coronary intervention, and lead to acute pericarditis. The development of acute pericarditis after such interventions has been reported only infrequently in case reports. The treatment of acute pericarditis due to a percutaneous coronary intervention is the same as the treatment of other types of pericarditis. As is true for most cases of acute pericarditis, in less than one week, this patients symptoms responded well to the use of Indocin and Colchicine. While it is very important to first exclude acute coronary syndrome due to in-stent restenosis as a cause of chest pain in a patient who has recently undergone a coronary intervention, acute pericarditis should also be included in the differential diagnosis.

SEIZURES OR SYNCOPE: WHEN COPD IS NOT JUST COPD Kai Huang 1; Carl J Fichtenbaum 1; Jean M Elwing1. 1University of Cincinnati Department of Internal Medicine, Cincinnati, Ohio. (Tracking ID # 10084)

LEARNING OBJECTIVES: 1. Describe the challenges of diagnosing pulmonary arterial hypertension particularly in persons with Chronic Obstructive Lung Disease. 2. Identify the utility of echocardiogram as a screening tool for pulmonary hypertensionCASE INFORMATION: A 61 year old gentleman with long history of cigarette smoking presented with progressive dyspnea and presumed seizure disorder. He had a 10 year history of dyspnea and was diagnosed with COPD five years ago by another physician. Following a colon resection for diverticulitis 3 years ago, he began supplemental oxygen and was now requiring 5 liters per nasal cannula. He was also being treated for lower extremity edema with intermittent diuretics. For the past 3 years,

he noted episodes of loss of consciousness often associated with bending over. These episodes had increased in frequency 1 month prior to presentation and were now associated with chest pressure. They were thought to be seizures and he had been receiving Keppra for the

last year with no change in frequency of these episodes. Prior evaluation included pulmonary function tests that initially showed moderate obstruction, air trapping and decreased DLCO. Later review actually showed results more consistent with restrictive defect with air trapping. An echocardiogram revealed LVEF of 50% and a markedly dilated RV, elevated mean PA pressure. Right heart catheterization was notable for severely elevated pulmonary artery pressures (76/38 mmHg; mean-50 mmHg), LVEDP of 15. After a thorough evaluation, the patient was diagnosed with idiopathic PAH and associated right heart failure. Keppra was discontinued. Patient eventually was started on sildenafil, bosentan, treprostinil, transtracheal and nasal canula O2. Subsequently patient developed a rare factor VIII inhibitor with pulmonary hemorrhage, pseuodmonal pneumonia and septic shock. He died <12 months after diagnosis of PAH.
IMPLICATIONS/DISCUSSION: This case illustrates the diagnostic challenges of pulmonary arterial hypertension. Because the onset of this condition is usually insidious, a delay in diagnosis is common. The interval from onset of symptoms to diagnosis is often greater than 2 years. Syncope occurs in ~30% of patients with PAH. Syncope indicates advanced disease and is a poor prognostic sign. This case also illustrates the concept of disproportionate pulmonary hypertension. Pulmonary hypertension, when associated with other diseases, such COPD, is typically mild with the underlying disease as the main determinant of symptoms and outcome. When the severity of PAH exceeds what would be expected on basis of the associated diseases such as COPD, other etiologies should be considered. A complete evaluation and a formal hemodynamic assessment with right heart catheterization are necessary to fully assess this condition. Echocardiogram is a simple screening tool that guides clinicians in determining when right heart catheterization is appropriate.
DRUG REACTION WITH EOSINOPHILIA AND SYSTEMIC SYMPTOMS (DRESS) Michael James Gilchrist 1; Britni Hebert1. 1UNC School of Medicine, Chapel Hill, North Carolina. (Tracking ID # 10112)
LEARNING OBJECTIVES: 1. Recognize and treat Drug Reaction with Eosinophilia and Systemic Symptoms (DRESS) in a patient with fevers, rash, leukocytosis with peripheral eosinophilia, and abnormal liver function tests. 2. Identify medications commonly prescribed in the outpatient setting that are associated with the development of DRESS. CASE INFORMATION: 79 year old female with a PMH of NIDDM, gout, HTN, and history of Schwannoma s/p transnasal resection in 2007, admitted to an academic Hospitalist service with rash, fevers and profound weakness. The patient stated that her symptoms had progressed over the last 710 days. She had been evaluated by her primary care physician several weeks prior and was prescribed allopurinol for treatment of her gout. On the day of her hospital admission, patient had a presyncopal event while using the bathroom at her home. Physical exam was significant for a temperature of 39.8. Patient appeared diaphoretic. Abdomen was soft and non-tender with no palpable hepatosplenomegaly. Skin exam notable for a morbilliform erythematous papular eruption involving her trunk and proximal extremities. Distal extremities were affected to a lesser degree. WBC count elevated at 13.5 with peripheral eosinophilia. Total bilirubin 1.4, AST 133, ALT 194. alk phos 267, and GGT 320. Urinalysis was normal. Blood and urine cultures showed no growth. EKG, chest x-ray was normal. Right upper quadrant ultrasound showed probable gallstones but no evidence of cholecystitis or hepatic masses. MRI/MRA of her brain was normal. Given her diffuse papular skin eruption, fevers, elevated liver function tests, peripheral eosinophilia, and recent initiation of allopurinol,we diagnosed the patient with DRESS. By date of discharge, patient continued to have intermittent fevers but her rash
was resolving. She was prescribed cetirizine 10 mg by mouth once daily, fluocinonide 0.05% twice daily to affected areas, and wet wraps with 2 tablespoons of salt in 1 quart of water twice daily for symptomatic relief.

She was seen in follow-up within the next week and reported that her symptoms continued to improve. Two months after her hospitalization, patient reported all of her symptoms had resolved.
IMPLICATIONS/DISCUSSION: Drug Reaction with Eosinophilia and Systemic Symptoms (DRESS) was first coined in 1996 and is used to describe a severe, idiosyncratic hypersensitivity reaction to a medication. The etiology is unknown, although an association with HHV 6 reactivation and abnormal hepatic metabolism has been implicated. Most commonly, DRESS develops 38 weeks after initiation of the offending medication but can develop as soon as 3 days. The most commonly associated medications associated with the development of DRESS are anticonvulsants (particularly phenytoin), allopurinol, minocycline, sulfasalazine, and abacavir. Patients typically present to medical care with high grade fevers, rash (urticaria, maculopapules, vesicles, bullae, pustules, cheilitis, erythroderma, or purpura), and lymphadenopathy. As with this patient, an infectious etiology is often initially suspected and must be evaluated prior to diagnosing DRESS. Hepatic involvement occurs in up to 80% of cases and has been reported to necessitate transplantation. Acute renal failure requiring long-term hemodialysis has been reported. Pulmonary, cardiomuscular, and pancreatic involvement have also been described. A significant peripheral eosinophilia is typically noted. Skin biopsy typically shows dermal edema and superficial perivascular inflammation. In retrospecitive studies, mortality has been estimated to be 10%. Prompt recognition of the syndrome and discontinuation of the offending medication is vital. The treatment for this condition varies from corticosteroids (oral or IV) to H2 blockers and topical steroids as in this patient. Immunosuppressive agents such as cyclosporin and intravenous immunoglobulin (IVIG) have also been used for refractory cases. As with this patient, the majority have complete resolution of their symptoms after discontinuation of the offending medication.
CARDIAC MANIFESTATION OF SHEEHANS SYNDROME Waqas Qureshi 1; Fatima Khalid1. 1Henry Ford Health Systems, Detroit, Michigan. (Tracking ID # 10141)
LEARNING OBJECTIVES: 1. To understand that the classical Becks triad of low arterial blood pressure, jugular venous distention, and distant, muffled heart sounds is usually absent in conditions that cause chronic pericardial effusion. 2. To recognize the importance of taking detailed history about gynecological and obstetric conditions from women, especially in the post partum period presenting to internal medicine clinic.
CASE INFORMATION: A 32-year-old African-American lady presented to the clinic with a 2-week history of cold extremities . This was associated with generalized weakness &fatigue over the past 2 months and shortness of breathness on walking two blocks for the last week. She has no known comorbidities. On further questioning, it was found that she had her first child about 34 months ago and the post partum course was complicated by retained placenta and bleeding, which required 2 units of PRBCs. She could not nurse her child because she never had milk for her child. She did not follow up with her doctor because of her financial conditions. On examination, she appeared pale but was not in any respiratory distress. Her blood pressure on presentation was 98/82 mmHg and pulse was 91. Pulsus paradoxus was positive. JVP was mildly elevated to 9 cm of water above angle of Louis. Peripheral pulses were weak. Capillary refill was normal but her hands and feet were cold. Heart sounds were not muffled. Lungs were

clear. Skin was dry and she had trace pedal edema. EKG showed low voltage complexes. CXR showed bottle shaped heart with cardiomegaly. An echocardiogram was done which showed tamponade physiology with collapse of right atrium and ventricle during diastole. Fluid was mostly located in the posterior region of pericardium. IV fluids were given &pericardiocentesis was performed. Further Investigations revealed Hb 10.1 mg/dL, WBC count 6700 (70% PMN). ESR was 28. TSH was 0.5 mU/L, serum free T4 0.1 ng/dL, serum free T3 0.7 pg/mL, serum FSH 4.8 IU/L, serum LH 2.2 IU/L, serum cortisol (8 am) 4.1 mcg/dL. Pericardial fluid studies showed protein 3.7 mg/dL, glucose 50 mg/dL, cell count 46/ml mostly lymphocytes. Cytology, Gram and AFB staining, culture, PCR for mycobacterium, cholesterol crystals, ANA, &RA factor were negative. MRI brain showed partially atrophied pituitary gland. IMPLICATIONS/DISCUSSION: This case reinforces the need to

consider Sheehans syndrome in patients who had post partum bleeding with subsequent failure to lactate. A few cases of Sheehans syndrome presenting as cardiac tamponade have been reported earlier. Although, these cases were reported in developing countries. This is the first case reported in a developed country where post partum care is very aggressive. Unfortunately, due to recent financial situation of the country, women health has suffered and has led to delay in seeking health care in some indivisuals as in our case. Cardiac tamponade is a rare presentation from the hypothyroidism since the central hypothyroidism caused by Sheehans syndrome is usually mild. The rapidity of the collection of fluid determines the symptoms. In chronic conditions causing pericardial effusion, the classical Becks triad is not seen. In such cases, cardiac tamponade mimics heart failure and can present with dyspnea, orthopnea, lower extremity edema and tender hepatomegaly. On the other hand, the presence of low levels of cortisol also increases the chances of development of low pressure tamponade. As in our case, the JVP was slightly but not markedly elevated due to relative hypovolemia from hypocortisolism. Pulsus paradoxus might be absent and arterial pressure might be normal in such cases. The replacement of steroid hormones is important in such patients with central hypothyroidism since starting levothyroxine prior to steroid supplementation might precipitate adrenal crisis. The dose of levothyroxine should be up-titrated slowly as it may precipitate cholesterol crystals causing pericarditis. Our lady was treated with stress doses of hydrocortisone and small doses of levothyroxine initially. A repeat echocardiogram prior to discharge did not show any reaccumulation of fluid. Levothyroxine was up titrated while monitoring thyroid function tests in the clinic. The patient improved remarkably. Patient is still being followed.

IMPLICATIONS OF ATYPICAL DUCTAL HYPERPLASIA ON CORE NEEDLE BREAST BIOPSY Dietlind L. Wahner-Roedler 1; Marilyn J. Morton 1; Carol A. Reynolds1. 1Mayo Clinic, Rochester, Minnesota. (Tracking ID # 10170)

LEARNING OBJECTIVES: 1. To familiarize the General Internist with the diagnosis and management of patients with atypical ductal hyperplasia (ADH) detected on core needle biopsy (CNB) specimens of the breast. 2. NoneCASE INFORMATION: A 75 year old women presented for a routine annual breast check. Clinical breast examination was normal. Screening mammogram revealed pleomorphic appearing microcalcifications in a segmental distribution in the right lateral breast. The patient was recalled for magnification views which showed multiple groups of somewhat worrisome calcifications in the upper outer right breast and a stereotactic biopsy was recommended. This was done and revealed ADH with associated calcifications. With these findings an excisional

biopsy was recommended and performed. The pathology report was: Ductal carcinoma in situ intermediate nuclear grade with associated calcifications involving an ill-defined area over 3.21.81.5 cm. All surgical resection margins are negative for tumor (minimum tumor free margins, 0.5 cm). The tumor was estrogen receptor and progesterone receptor positive. Radiation therapy to the breast was recommended, which the patient pursued locally. With a previous history of pulmonary embolism she was not felt to be a candidate for adjuvant hormonal therapy with Tamoxifen.

IMPLICATIONS/DISCUSSION: The accuracy of stereotactic CNB of suspicious breast lesions has been well established for benign and malignant disease, greatly reducing the need for surgical excisional biopsy. There are however a number of lesions which, when detected on CNB - ultrasound guided or stereotactic biopsy - cause diagnostic uncertainty and therefore require surgical excision. These, so called high risk breast lesions, are lesions which may coexist with a breast malignancy, or lie on a spectrum of pathological entities which are difficult to distinguish from malignant lesions. These high risk lesions include ADH, atypical lobular hyperplasia (ALH), lobular carcinoma in situ (LCIS), papillary lesions, flat epithelial atypia, mucocele like lesions and complex sclerosing lesions/radial scars. ADH is the most common and least controversial for management of these high risk breast lesions. Rates of ADH on CNBs have been reported to range between 1%-9% in different series. ADH is characterized by a proliferation of uniform epithelial cells with monomorphic round nuclei filling part of the involved duct. ADH shares some of the cytologic and architectural features of low-grade ductal

carcinoma in situ. When faced with the diagnosis of ADH on a CNB pathology report the responsible internist is obliged to interpret and counsel the patient in regard to the following: 1) ADH noted on CNB requires surgical excision since ADH can coexist with a breast malignancy. The rate of carcinoma found in subsequent excisions has been reported to range between 11%-69% in different series. 2) If a malignancy is excluded on excisional biopsy there is an increased risk of subsequent development of breast cancer (relative risk 3.7 to 5.3). The Gail breast cancer risk assessment tool incorporates atypical proliferative disease into a risk calculation and can be used to identify women with ADH who are appropriate candidates for breast cancer chemoprevention.

IT HAS NOTHING TO OFFER BUT BLOOD A CASE OF DIEULAFOYS LESION Jewel Ahmed 1; Nazrul Islam Chowdhury 2; Harvey Richey 3; Abdul Thanoon4. 1TTUHSC,Amarillo, Amarillo, Texas ; 2Texas Tech University Health Science Center, Amarillo, Texas ; 3Ttuhsc Amarillo, Amarillo, Texas ; 4Amarillo Diagnostic, Amarillo, Texas. (Tracking ID # 10307)

LEARNING OBJECTIVES: 1. To recognized that Dieulafoys lesionis an unusual cause of gastrointestinal bleeding with the most common locationbeing the stomach. 2. To be aware that Cases of upper GIbleeding in which no definitive bleedingsource is found on routine investigations are particularly suspiciousfor Dieulafoys lesion.

CASE INFORMATION: 74 year-oldHispanic female came to ER with non specific weakness for three days, whichstarted after an episode of non bloody diarrhea. Since then she had beenfeeling very weak and dizzy. She was dry, tachycardic and her BP was in lowernormal side with orthostatic drop. Her hemoglobin dropped from 14.1 to 9 gm/dland stool guiac test positive; other work up for anemia was negative. BUN 19and creatinine 0.51, with normal electrolytes; INR 4.4 with no other abnormal LFT. CT scan was negative for bleeding in the abdomen,retroperitoneum or chest. GI bleeding scan with 28 mCi of 99 m technetiumpertechnetate tagged with patients red blood cells was negative. She wasappropriately resuscitated with IV fluid and then admitted to JGIM

ICU with frequentfollow up of hemoglobin and hematocrit. Gastroenterologist was consulted;however they did not recommend any EGD at that moment. After 2 days, patientwas moved to regular floor as her general condition including hemoglobin wasimproved; five days later she developed hematamesis ; EGD was done which showedthere was a Dieulafoys lesion with fresh blood surrounding the lesion in the body of the stomach. AnEndoClip was placed around the lesion. Then epinephrine 1: 10,000 of a total of4 ml was injected at the base of the lesion with blanching of the mucosa.Esophagus, rest of the stomach and duodenum were normal.

IMPLICATIONS/DISCUSSION: Approximately 75-95% of the Dieulafoys Lesions(DLs) arefound within 6 cm of the gastro-esophageal junction predominantly on the lessercurvature ,which is possibly related to the peculiar vascular anatomy of thestomach in this region. Extragastric DLs are uncommon but can be found inDuodenum, Esophagus, Jejunum, Colon and Rectum. The pathology of the lesion isessentially the same throughout the gastrointestinal tract and it is caused byan abnormally large caliber persistent tortuous submucosal artery.DL is an inherently difficult lesion to diagnose and shouldbe considered during evaluation of any patient with unexplained, recurrent, massiveGI bleeding. History of NSAID intake, acid peptic disease or alcohol abuse is usuallyabsent 1. The diagnosis at initialendoscopy in earlier reports was in only half the cases. In recent series theidentification at initial endoscopic examination has been in more than 90%cases. Therapeutic endoscopy has evolved as the modality of choice for theinitial treatment of DLs 2.Adrenaline injection has been used assole therapy or in combination with other endoscopic modalities. The otherendoscopic hemostatic techniques apart from adrenaline injection include bipolarand monopolar electro-coagulation, heater probe, laser photocoagulation,injection sclerotherapy, hemocliping and endoscpic band ligation 3.We are presenting a case who came with unexplained upper GI bleedingand whose initial endoscopy was not able to find out any particular pathology. Onsubsequent clinical situation and repeat EGD was finally able to pick up thediease and

was successfully treated with endoscopic clip along with adrenalineinjection.

UNKNOWN FACE IN A KNOWN PLACE- A CASE OF CAPNOCYTOPHAGA SEPSIS Chowdhury Nazrul 1; Jewel Ahmed 1; Randy Stewart 2; Roger D Smalligan3. 1TTUHSC, Amarillo, Amarillo, Texas ; 2VA,Amarillo, Amarillo, Texas ; 3Texas Tech Univ HSC, Amarillo, Texas. (Tracking ID # 10318)

LEARNING OBJECTIVES: 1. To be aware that severe sepsis or septic shock can occur with some unusual organisms like Capnocytophaga which can be treated with narrow spectrum/single antibiotic. 2. To recognize that capnocytophaga sepsis can occur in persons who usually are not considered to be at risk for developing it e,g non splenectomised, non alcoholics or patients who are not on immunosuppressive.

CASE INFORMATION: A 73 y/o white male with PMH of untreated stage-3 adenocarcinoma of rectum (patient refused therapy 3 years prior to admission), DM-2,HTN &hyperlipidemia was admitted with syncope due to hypoglycemia (blood sugar was 29 when EMS team went to the scene). Initial P/E and lab work ups were significant for dehydration, ulceration around anus ,temp 101,HR 108, RR 20, BP 103/49; WBC 23.7 /cumm with 93% neutrophils and 5% bands, serum creatinine increased by 2 mg/dl from base line; CRP 29.83. Hypoglycemia and hypovolemia were corrected and he was put on vancomycin, piperacillin-tazobactum and levofloxacin for sepsis; eight hours later he became confused and patients blood pressure dropped to 85/55 with RR 30/min, HR 123/min, o2 sat 84% on RA and 91% on 2 L/min via nasal canula. He was treated with fluid resuscitation and vasopressor;

blood culture(anerobic)grew Capnocytophaga; antibiotic was switched to amoxicillin-clauvalonate. The septic shock was resolved. History revealed that the patient lives in a house with a pet dog and used to allow his dog to share his food in a same plate for a long time. IMPLICATIONS/DISCUSSION: Capnocytophaga is a filamentous Graam negative rod that belongs to the normal oral flora of the dogs and cats. It requires a CO2-enriched media for growth; it is very difficult to isolate in a solid media and its growth is very slow; it was first isolated in 1976 from blood and CSF of a patient who received a dog bite(4)Most affected patients were immunocompromised; however fatal sepsis has been reported in otherwise normal individuals too. (2,3).Usually, severe Capnocytophaga infections occur in immunocompromised patients; most notably after splenectomy(1,5). Pers C et al reported 39 cases of Capnocytophaga sepsis. The cases were related to recent dog bites or other close contacts with dogs. Thirteen patients had previously been in good health; underlying conditions in other patients included previous splenectomy and alcoholism. (6) Valtonen et al reported six cases where they found that alcohol abuse is an important risk factor for the development of Capnocytophaga sepsis and cats are a source of human infection; they also found that Capnocytophaga sepsis often manifests with DIC and purpura.(7)Hovenga et al reports two cases of Capnocytophaga Canimorsus infection following dog bite; those patients did not have any immuncompromising conditions.(8)Reviewing all those case reports and discussions, it is obvious that usually Capnocytophaga sepsis occurs following dog or cat bite in immunocomprmised persons. We are reporting this case who was infected by Capnocytophaga species and developed septic shock and successfully responded with Augmentin. He was not immunosuppresed and was not bitten by dog. The predisposing condition for this patient to developed capnocytophaga sepsis is his debilitating condition due to rectal cancer and diabetes. We suspect the organism probably entered in to his blood stream through the contamination of his food by dogs saliva.

WHEN LABORATORY FINDINGS SPEAK LOUDER THAN WORDS Marissa Kummerling 1; Yelena Averbukh1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 10330)

LEARNING OBJECTIVES: 1. To recognize the reasons for extreme BUN/Cr ratios in the setting of renal failure. 2. To recognize when certain ratio of elevated AST to ALT can point to extrahepatic pathology and to consider the diagnosis of rhabdomyolysis based on laboratory values in the elderly patient unable to provide medical history.

CASE INFORMATION: An 83 year old male presents with altered mental status and is unable to provide any medical history. On exam the patient is oriented to self only and otherwise is non-coherent. He is noted to move

all of his extremities, but unable to ambulate due to severe ataxia. Musculoskeletal examination did not reveal any extensive bruising. Laboratory findings were significant for blood urea nitrogen (BUN)/creatinine (Cr) of 93/1.9, with a ratio of 49:1 and liver function tests revealing AST/ALT of 524/110, with a ratio of 4.7:1. Total and direct bilirubin, alkaline phosphatase, and hemoglobin/hematocrit were within normal limits. A urine toxicology and alcohol screen were negative. Computed tomography of the abdomen demonstrated fatty infiltration of the liver without evidence of cirrhotic changes. Computed tomography of the head without contrast revealed no acute hemorrhage, mass, or shift. With aggressive hydration the patients renal and liver laboratory abnormalities normalized within a few days. This normalization was associated with an improvement in mental status to patients baseline. Critical appraisal of initial laboratory findings led to consideration of rhabdomyolysis as the etiology of extreme ratio of BUN to Cr and AST to ALT. Retrospective evaluation of CPK levels on initial blood

sample collected demonstrated a level of 14,969 and the diagnosis of rhabdomyolysis was confirmed. IMPLICATIONS/DISCUSSION: In a patient with altered mental status who is unable to provide a history, the diagnostic approach depends on the physical exam, laboratory data, and imaging. Renal failure signified by elevated BUN and creatinine is further evaluated by the patients volume status, urine electrolytes, and ability to urinate. While a BUN to Cr ratio of 20:1 represents prerenal azotemia and decreased renal clearance, ratios in excess of this value suggest an alternative source such as tissue destruction, including GI bleeding, severe hemolysis, or rhabdomyolysis. With stable hemoglobin levels, rhabdomyolysis is the most likely explanation. The ratio of AST to ALTalso reveals the presence of rhabdomyolysis. An AST:ALT ratio of 2:1 is suggestive of alcoholic hepatitis. When this ratio surpasses 3:1 and peak AST levels are greater than 300, however, extrahepatic pathology more likely explains transaminase elevation. AST is released with destruction of hepatocytes, skeletal and heart muscle, erythrocytes, kidney, and brain. ALT is specifically released with hepatocyte destruction, but is also found in skeletal and heart muscle, and renal tissue. Rhabdomyolysis releases greater quantities of AST relative to ALT, but this ratio decreases over time as AST is cleared more rapidly than ALT by the kidneys. In the absence of evidence for synthetic liver dysfunction, an AST to ALT ratio of greater than 3:1, and a peak AST level of greater than 300, elevations of ASTand ALTare best explained by the presence of rhabdomyolysis. The definitive diagnosis of rhabdomyolysis is made by measurement of creatinine phosphokinase (CPK). The treatment consists of aggressive intravenous hydration to prevent pignment induced nephropathy. In elderly patients at risk for falls and prolonged immobility the possibility of rhabdomyolysis should be considered when medical history cannot be clarified and laboratory evidence supports the presence of extreme BUN to Cr and AST to ALT ratios.

PHOSPHATURIC MESENCHYMAL TUMOR: THE DIAGNOSTIC CHALLENGE OF PARANEOPLASTIC LYTIC LESIONS

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(Tracking ID # 10361)

LEARNING OBJECTIVES: 1. Tumor-induced osteomalacia (TIO) is a diagnostic challenge thus its recognition is delayed. Our aim is to increase awareness of this condition as most TIO abnormalities are potentially reversible by tumor removal. 2. noneCASE INFORMATION: A 60-year-old male presented two years prior to his diagnosis with longstanding muscle cramping, progressive generalized weakness and chronic hip pain. Laboratory evaluation included low phosphorus at 1.7 mg/dL (normal 2.5-4.5 mg/dL), elevated alkaline phosphatase at 517 IU/L (normal 0140 IU/L), increased parathyroid hormone at 101 (normal 1075 pg/mL) and normal 1,25-dihydroxyvitamin D (1,25-DHD) at 35 ng/mL (normal >30 ng/mL). Complete blood count, monoclonal protein evaluation, tumor markers, thyroid, liver and kidney function tests were all normal. Computed tomography showed a diffuse osseous lytic process involving the entire spine, pelvis, hips and ribs showing multiple insufficiency fractures suspicious for osseous metastatic disease . The patient was found to

have bilateral femoral neck pathologic fractures therefore underwent reamed intramedullary nailing of both femurs. Bone scan (Figure 1) showed innumerable foci of increased activity throughout the skeleton consistent with osteopenia. Bone marrow biopsy was negative for malignancy. Positron emission tomography (PET) showed fluorodeoxyglucose (FDG) uptake only within a cystic lesion in the posterior neck (Figure 2). There was no increased FDG uptake elsewhere including the lytic lesions. Fine needle aspiration from the mass in the neck revealed a high grade malignant phosphaturic mesenchymal tumor of mixed connective tissue type (Figure 3).

Due to the suspicion of TIO, a serum fibroblast growth factor 23 (FGF-23) level was obtained which came back elevated at 575 RU/mL (normal <180 RU/ml). Resection of the mass in the neck resulted in normalization of blood chemistry, FGF-23 and generalized complaints. Interval imaging showed no evidence of recurrence with a follow-up of 9 months.

IMPLICATIONS/DISCUSSION: Tumor-induced osteomalacia is a rare acquired paraneoplastic syndrome characterized by overproduction of FGF-23 which is a phosphaturic agent that causes hyperphosphaturia and hypophosphatemia (renal phosphate wasting), associated with inappropriately normal or low levels of 1,25-DHD and it is typically seen with tumors of mesenchymal origin. FGF-23 is produced by osteoblasts and it exerts strong inhibition on type IIa and IIc sodium-phosphate co-transport system in proximal tubules which promotes hyperphosphaturia that in turn triggers the constellation of symptoms seen in this syndrome. Diagnosis of this disease is often challenging as the presentation can be quite insidious while causing great disability which can be avoided by surgical removal of the inciting tumor.

STRONGOLOIDES STERCORALIS SUPERINFECTION IN AN IMMIGRANT UNDERGOING CHEMOTHERAPY

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LEARNING OBJECTIVES: 1. Strongyloides stercoralis is an endemic problem in much of the developing world. An intact immune system can keep symptoms limited to itching and non-specific gastrointestinal complaints for years. 2. A short bout of immunosupression can produce a hyperinfection syndrome that can be rapidly fatal.

CASE INFORMATION: 72-year old male born in Puerto Rico who immigrated to the United States 40 years ago was admitted to the hospital for recurrent S. pneumoniae pneumonia and bacteremia following his 6th cycle of R-CHOP for an aggressive non-Hodgkins lymphoma. Past medical history had included chronic idiopathic eosinophilia with several negative stool ova and parasite exams. His hospital course was complicated by abdominal pain and diarrhea with a steadily rising white blood cell count of up to 60,000 with significant worsening of his eosinophilia. Clostridium difficile toxin testing was repeatedly negative. CT imaging confirmed pneumonia with pleural effusion and pancolitis with stable abdominal lymph-adenopathy. Stool analysis identified Strongyloides stercoralis. He was started on Ivermectin for disseminated strongyloides involving the colon, lungs and pleura. WBC trended down to 20,000 but eosinophilia peaked at 88%. He made significant improvement and was discharged home to complete the course of Ivermectin. Outpatient monitoring of his CBC with diff continues to show decline of parameters toward normal. Follow up stool analyses for Strongyloides stercoralis have been negative. IMPLICATIONS/DISCUSSION: Strongyloides stercoralis has the ability to complete its entire lifecycle within a human host, allowing it to produce very heavy parasite burden. A history of residence in an endemic region, even if remote, should raise the suspicion for this infection. Recurrent larval migration within the lungs, small and large and bowels could mimic or cause recurrent pneumonia, duodenitis and colitis respectively. Patients who have had an immunosuppressive event are more prone to disseminated infection with multiorgan dysfunction and may present with features of sepsis with or without shock.

PHYSICIAN HEAL THYSELF: THORACIC SCHWANNOMA IN A PHYSICIAN Akintomi Olugbodi 1; Akintomi Olugbodi 1; Richard Alweis1. 1TRHMC, Reading, Pennsylvania. (Tracking ID # 10470)
LEARNING OBJECTIVES: 1. Distinguishing different causes of nerve sheath tumors 2. Reviewing appropriate evaluation of suspected nerve sheath tumorsCASE INFORMATION: A 37-year old internist presented with four months of progressive bilateral lower extremity paresthesias, weakness and clumsy gait. Patient described ascending numbness and tingling sensations in his right leg with similar sensory changes between the first and second left toes. He reported several falls. No bladder or bowel dysfunction, back pain,vertigo,or hearing impairment. No personal or family history of neurological disease. Patient did not drink or smoke. He had no caf-au-lait spots, axillary or groin freckles, or subcutaneous nodules. Neurologic examination revealed normal cranial-nerves and upper extremities. He had right-sided drop foot, 3+ knee reflexes and bilateral ankle clonus. There was decreased sensation to light touch in the feet. MRI of the entire spine revealed severe compromise of the spinal cord due to mass effect from a large extramedullary mass at T7-T8 level. There was foraminal narrowing on the left. Patient underwent T6-8 decompressive hemilaminectomy with resection of left T7 tumor and fusion with an uneventful post-operative course. Pathological examination indicated a benign intradural extramedullary schwannoma. IMPLICATIONS/DISCUSSION: Schwannomas are benign nerve sheath tumors (NSTs) generally confined to the intradural extramedullary spinal space, as was found in this patient. Though 65 % of NSTs are schwannomas, it can be clinically challenging distinguishing them from malignant NSTs and neurofibromatosis types 1 and 2 (NF1 and NF 2) which also cause NSTs. Pathologic examination is usually the arbiter. Malignant NSTs grow rapidly and carry a worse prognosis. The 1987 National Institute of Health criteria for diagnosis of NF1 and NF2 were important in clinically ruling out neurofibromatosis in this patient. There were no caf-au-lait spots, Lisch nodules, skin fold freckling, bone dysplasia or family history of NF. Due to their benign nature, clinical manifestations of spinal schwannomas are due to mass effects at the level of the spinal cord involved. Classical manifestations are back pain, sensory, motor, bowel and bladder dysfunction. Notably, the patient had no back pain or sphincteric abnormalities. Complete surgical resection is potentially curative; malignant transformation of an untreated schwannoma is rare. In conclusion, most nerve sheath tumors are due to benign schwannoma but pathologic examination is imperative to distinguish from other potential causes. Treatment of spinal schwannomas is surgical resection.
A DEADLY INFECTION IN A PATIENT WITH CHRONIC LYMPHOCITIC LEUKEMIA NEVER EXPOSED TO CHEMOTHERAPY Karen Olarte 1;
Wadih Chacra 1; Haythem Ali1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 10538)
LEARNING OBJECTIVES: 1. Recognize that major infections in patients with chronic lymphocitic leukemia (CLL) increase with active treatment, but also CLL in itself is a state of cellular and humoral immunosuppression that can predispose to serious infections 2. Distinguish patients with CLL with central nervous system (CNS) manifestations consistent with Progressive Multifocal Leukoencephalopathy (PML) from CNS tumor infiltration can be challenging, in these cases brain biopsy is crucialCASE INFORMATION: A 69-year-old female with history of CLL (Rai stage 0) diagnosed 4 years prior and who never required treatment,
presented to the emergency department with one week of headache described as a global heaviness. Neurologic exam was unremarkable and head non contrast computed tomography (CT) was within normal limits. She is treated with good response to analgesics. Two weeks later she presented to her primary care physician for follow up, stating that she has been dropping things and has been feeling clumsy. Physical exam revealed a scanning speech, saccadic eye movements, mild finger to nose dysmetria, bilateral dysdiadokinesia without past pointing and an ataxic gait.Given these findings the patient was hospitalized; a brain magnetic resonance imaging (MRI) revealed nearly symmetric high signal intensity in T2 and FLAIR involving both middle cerebellar peduncles. Blood tests were unremarkable except for baseline lymphocytosis. CSF analysis showed normal biochemistry, 39 WBC with 95% lymphocytes, suggestive of a viral infection. CSF viral culture and CSF

PCR for JC virus, HSV and CMV DNA, were all negative. Blood and CSF flow cytometry showed monoclonal B lymphocytes, antigen profile: CD19+, CD5+, CD23 -, CD45+, and kappa+, which was identical for both. CSF cytology was negative. Given that no definite diagnosis could be made, the patient underwent a stereotactic biopsy of the right cerebellar peduncular lesion which was conclusive for PML. IMPLICATIONS/DISCUSSION: The natural history of CLL is extremely variable, with survival times that range from 2 to 20 years. The prevalence of PML is 0.07 % among patients with hematologic malignancies. The median survival of patients with PML without HIV infection is only 3 months. With the use of newer chemotherapeutic agents like nucleoside analogs and monoclonal antibodies, mainly rituximab, more cases of PML are being described. No data exists in the literature on the number of patients with hematologic malignancies who developped PML and were never exposed to chemotherapy agents. We describe this case of a patient with PML who was never exposed to chemotherapy and had a negative CSF PCR for JC virus. We should be aware that infections in these patients account for up to 50 % of all deaths and although most of these patients were exposed to chemotherapeutic agents, CLL in itself is a state of cellular immunosuppression with quantitative and qualitative defects in immune effector cells that can predispose patients to serious infections such as PML. The sensitivity of CSF PCR for JC virus in this population is probably lower. Brain biopsy consequently will aid in determining the definite diagnosis.

A CASE OF VARICELLA IN AN IMMUNOCOMPETENT ADULT Mark Goldin 1; Jessica Chen2. 1UCSD Medical Center, San Diego, California ;
2UCSD Medical Center, Escondido, California. (Tracking ID # 10548)

LEARNING OBJECTIVES: 1. Recognize that diagnosis of acute varicella infection in adults should focus on presenting symptoms and signs, such as fever and characteristic rash, since seroconversion is often delayed. 2. Recognize the importance of high clinical suspicion and prompt empiric treatment of adult varicella, given the significant morbidity and mortality affected individuals face, as well as the public health concerns the disease poses.

CASE INFORMATION: Varicella, also known as chicken pox, is caused byvaricella-zoster virus (VZV), and is a common childhood infection. It rarelyoccurs in individuals beyond adolescence. Here, we present a case of adult VZVinfection. A 35-year-old man with no significant past medical history presentedto primary care clinic complaining of a red, itchy rash that began on his faceand neck, and quickly spread to his back, chest, and arms over the preceding 24hours. He had felt feverish over the same time. Otherwise, he noted only mild,dry cough. He took no medications and denied allergies. He denied toxic habitsand had not been sexually active since separating from his wife four years prior.The patient was living with his four children, the youngest of whom (age 7)

heroutinely picked up from school. The patient had received all regular childhood vaccinations in Mexicoprior to immigrating to the United Statesas a teenager. His children were allborn in the U.S.and were up to date on their vaccinations. Physical exam revealed a diffuse, erythematous,papulovesicular rash over the head, trunk, arms, and to a lesser extent thelegs. There was bilateral conjunctival injection with right eye exudate, and vesicularlesions on the buccal mucosa. The remainder of the exam was unremarkable. Initial labs revealed non-reactive RPR and HIV antibody,normal finger stick glucose, and negative varicella IgG and IgM antibodies. Basedon history and exam, the patient was treated empirically for varicella withoral acyclovir 800 mg five times daily for seven days. Subsequently, he returnedwith dramatic improvement in his rash. Varicella serologies were repeated, andboth IgG and IgM were positive. IMPLICATIONS/DISCUSSION: Varicella is primarily a disease of childhood, withapproximately 90% of cases occurring before age 10. In adults, varicella is associatedwith immunocompromised state, and generally causes greater morbidity andmortality. While childhood infection is most commonly complicated by secondaryskin infection with Group A Streptococcus, the most common complication inadults is varicella pneumonia. In this case, the patient was likely exposed to

aninfected student at his childs school. He presented early in his course, andstandard-dose acyclovir cleared the infection. Serologies were chosen for theirgreater sensitivity over culture, given the patients limited ability to payfor work-up. Yet, even serologies were not positive initially. Other importantconcerns in this case relate to public health. Fortunately, the patient had hadno exposure to pregnant women, so it is unlikely any fetus was placed at riskfor congenital varicella. Though sadly, the patient was lost to follow up, andserologies were never redrawn. Thus, long-term immunity was not confirmed. Thisis of particular public health concern since the patient works in a restaurant.

SUPERIOR VENA CAVA (SVC) SYNDROME AS AN INITIAL PRESENTATION OF MALIGNANCY Amy Soni 1; Annie Im1. 1UPMC, Pittsburgh, Pennsylvania. (Tracking ID # 10553)

LEARNING OBJECTIVES: 1. Recognize the clinical presentation of SVC syndrome in a patient with no known history of malignancy 2. Initiate appropriate treatment of SVC syndrome and recognize the rare indications for emergent interventionCASE INFORMATION: A 76 year old male with a history of obstructive sleep apnea, hypertension, and a one hundred fifty pack year smoking history presented with progressive face and neck swelling for ten days prior to admission, along with plethora of the face, chest and back, and cyanosis of his ears and nose. One month prior to admission, the patient experienced chest discomfort, and a workup for ischemic heart disease was negative. Ten days prior to admission, he developed face and neck swelling and presented to the emergency department. His symptoms were attributed to an allergic reaction to a new anti-hypertensive medication, and he was treated with prednisone, diphenhydramine, and famotidine with minimal improvement. He had progressive facial swelling, plethora, and cyanosis and presented to another emergency department ten days later. Exam was remarkable for the abovementioned physical findings, in addition to visualization of collateral vessels at chest and back. His vital signs were within normal limits, and he did not have any respiratory or neurologic findings. CT chest revealed a 5.5 cm lung mass in the right paratracheal region and encasement of the superior vena cava, which was compressed to 3 mm in diameter. Venogram was performed due to concern for thrombus, and this revealed severe stenosis at the right brachiocephalic vein. A stent was placed to this area. Immediately after the
procedure, the patient noticed relief of swelling and normalization of skin color, with continued improvement during the ensuing hours. Radiation or chemotherapy were not initiated due to absence of tissue diagnosis. Subsequent biopsy of the lung mass revealed squamous cell carcinoma of the lung. PET-CT showed a positive contralateral lymph node in addition to the known mass involving the SVC, consistent with stage IIIB disease. The patient will be treated with chemotherapy and radiation. IMPLICATIONS/DISCUSSION: SVC syndrome can be a complication of underlying malignancy, most commonly non-small cell lung cancer (50%), small-cell lung cancer (22%), lymphoma (12%) and metastatic disease (9%). Malignancy is the cause of SVC syndrome in 90% of cases. Clinical presentation is due to signs and symptoms of increased venous pressure in the upper body, most commonly facial edema (82%), arm edema (46%), distended neck veins (63%), distended chest/collateral veins (53%), facial plethora (20%), dyspnea (54%), cough (54%), and hoarseness (17%). Although visually striking, edema of the upper body and plethora are of little consequence. Severe or life-threatening effects are rare, but include laryngeal compromise and cerebral edema. Diagnosis is based on clinical presentation supported with radiologic studies, most commonly CT with contrast. Venography can be used to detect thrombus or for stent placement. The goals of treatment are to 1) relieve the symptoms of obstruction and 2) treat the underlying malignancy. Emergent treatment with placement of SVC stent is indicated in the presence of cerebral edema, decreased cardiac output, laryngeal edema, or thrombus. Stent placement can provide rapid relief of symptoms and decrease risk of relapse. Radiation, chemotherapy, or combination therapy are used in most cases of SVC syndrome and are rarely urgently indicated. In addition, specific diagnosis of the malignancy is required prior to initiating these therapies, as radiosensitivity and efficacy of chemotherapy can vary. In lung cancer, the use of chemotherapy, radiation, or combination therapy, all have similar efficacy in relief of symptoms and similar rates of relapse and survival. Overall, the presence of SVC

syndrome does not significantly impact survival in patients with malignancy. In this patient, the recognition of the signs and symptoms of SVC syndrome led to the subsequent diagnosis of lung cancer.

FACTOR FIVE LEIDEN PRESENTING WITH SMALLVESSEL ISCHEMIC COLITIS George Lominadze 1; Kristina Chae 1; Darlene LeFrancois2.
1Montefiore Medical Center, Bronx, New York ; 2Montefiore Medical Center, New York, New York. (Tracking ID # 10561)

LEARNING OBJECTIVES: 1. Recognize clinical manifestations of small vessel ischemic colitis. 2. Diagnose and manage ischemic colitis due to a hypercoagulable state.

CASE INFORMATION: 42 year old man presented with intermittent crampy left lower quadrant (LLQ) abdominal pain, tenesmus, pencil-thin stools alternating with bloody diarrhea, and fevers for 6 months. He had lost 56 lbs and felt fatigued. A colonoscopy 3 months earlier showed colitis of descending and sigmoid colon without pseudomembranes, and negative biopsy for granulomas or vasculitis. Empiric treatment with 5-ASA and metronidazole failed. Aside from thyroid hormone replacement, he took no medications. He had no toxic habits and his family history was unrevealing. Examination vitals were BP 134/97, HR 65, Tmax of 100.3, BMI XX. He preferred to lay still, with exquisite tenderness at the LLQ accompanied by localized guarding. Stool guaiac was positive and there was mild dependent edema. Laboratory testing was significant for CRP 24 and ESR 60. Celiac panel testing and ANCA studies were negative. Stool cultures and ova and parasite examinations were negative as was clostridium difficile testing. CT angiography showed mural thickening of the descending and rectosigmoid colon with

infiltration of the mesenteric fat but no vessel thrombosis, although inferior mesenteric vein (IMV) could not be visualized. Colonoscopy revealed multiple descending and sigmoid colonic strictures and ulcers that microscopically displayed focal hyperplasia of the lamina propria and inflamed granulation tissue. A complete workup for hypercoagulable states was done, and genetic testing revealed a Factor V Leiden homozygous mutation. Antibiotics resulted in only transient improvement in symptoms and patient underwent a left-sided hemicolectomy. Pathologic examination of the specimen revealed colonic transmural necrosis with perforation, and fat necrosis of pericolic adipose tissue. Marked inflammation was associated with hemorrhagic changes thrombosis of submucosal and subserosal vessels. Patient is currently doing well on anticoagulation with warfarin.

IMPLICATIONS/DISCUSSION: Factor V Leiden (FVL) is an autosomal dominant mutation that can lead to a hypercoagulable state through activated protein C resistance. 3-7% of the general population is heterozygous, while 0.06 to 0.25% is homozygous. Heterozygocity increases the risk of venous thrombosis around 5 fold, while homo-zygocity can increase the risk 2030 fold. Most cases of thrombosis occur in patients in their twenties. To our knowledge this is the first report of ischemic colitis presenting as the initial thrombotic event that led to diagnosis of homozygous FVL mutation. There are two case reports of heterozygous FVL mutation presenting with ischemic colitis, one in a 24 year old woman and another in a 73 year old man. Two small studies assessed the prevalence of hereditary thrombotic risk factors in patients with ischemic colitis, with one study finding that 22% of 36 patients with colon ischemia had FVL heterozygous mutation, while in another study one out of 18 patients did. Our patient had small mesenteric vessel thrombosis (MVT), similar to the 73 year old patient with FVL heterozygous mutation, suggesting that MVT associated with FVL may not be readily detectable by CT angiography. In addition, our patients thrombosis was in the distribution of the IMV, with superior mesenteric vein (SMV) patent. According to literature, mesenteric venous thrombosis accounts for 5 to 15 percent of all mesenteric ischemic events and usually involves the superior mesenteric vein. The involvement of IMV rather than SMV likely made the prompt diagnosis difficult, as IMV drains a much smaller

section of the GI tract than SMV, leading to less severe symptoms. Nonspecific findings on colonoscopy and the lack of identifiable risk factors for ischemic colitis in this patient undoubtedly contributed to the 6 month delay in his diagnosis. Clinicians should consider studies for hypercoagulable states in patients with ischemic colitis so as not to miss this important and treatable condition.

SUSPECTED DEFECT OF NUCLEAR FACTOR KAPPA B REGULATION IN A YOUNG ADULT WITH RECURRENT INVASIVE BACTERIAL AND FUNGAL INFECTIONS Nida Rizvi 1; Pooja Jhaveri 1; Nada Elmagboul 1; Eileen Hennrikus1. 1Penn State, Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 10562)

LEARNING OBJECTIVES: 1. Recognize the relationship between Ectodermal Dysplasia and Immune deficiency syndrome 2. Recognize an immune deficiency syndrome due to Nuclear Factor Kappa B (NFkB) gene mutation.

CASE INFORMATION: A 21 year old male with no history of intravenous drug use and a known history of Ectodermal Dysplasia (ED) diagnosed by hypodontia as a child, initially presented with a pectoralis hematoma from a football injury. He subsequently developed staphylococcus wound infection which, despite adequate medical treatment, progressed to clavicular osteomyelitis. In spite of aggressive medical and surgical measures he developed Acinetobacter and

Staphylococcus bacteremia leading to pulmonary septic emboli and cavitary lesions. During the course of his treatment, he developed recurrent bacteremia with Enterococcus faecalis, Klebsiella, Stenotrophomonas maltophilia, Pseudomonas and candida with tricuspid endocarditis.An immune deficiency work up was undertaken.His prior infectious history included a retropharyngeal abscess in adolescence and pneumonia as a child. His HIV profile was negative. A neutrophil oxidative burst was normal. He had elevated IgM, showed adequate response to lymphocyte proliferation assays and had normal lymphocyte subsets. Thus far he has normal vaccine response to Streptococcus Pneumoniae, mumps, rubeola and tetanus. He tested negative for the IKBKG gene mutationone of many associated with immune deficiency in patients with ED.

IMPLICATIONS/DISCUSSION: Ectodermal Dysplasia (ED) is associated with immune deficiency syndromes affecting both innate and humoral immunity. A set of mutations involve the NFkB gene a transcription modulator associated with both immune deficiency and ED. Patients are susceptible to severe bacterial infections as in our case. Although our patient is still under investigation, identifying the specific mutation responsible for his immune deficiency is a daunting task as there are numerous possible hypomorphisms. The mutation could exist in any protein in the family of proteins related to NFkB or its essential modulator. This accounts for the wide variation in disease presentation. This patient is unusual in that he presented much later in life, as most present during childhood. For our patient, this suspected deficiency meant foregoing surgical intervention due to the high risk of infectious complications. He was started on an extended course of antibiotic and antifungal treatment. To date, his tricuspid valve vegetation has resolved. Further immunologic workup is planned for the patient and his family to further clarify any immune disorders.

RECURRENT RHABDOMYOLYSIS, PERSISTENT DERMATITIS, NEW ONSET DIABETES MELLITUS I AND ANGIOIMMUNOBLASTIC T-CELL LYMPHOMA AS MANIFESTATIONS OF HUMAN T CELL LYMPHOTROPIC (HTLV) VIRUS Hiba Beshir 1; Aman Garsa 1; Barbara Sewerin 1; Eileen Hennrikus1. 1Penn State, Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 10565)

LEARNING OBJECTIVES: 1. Recognize that Human T-cell lymphotrophic retrovirus (HTLV-1/11) can present as a myriad of clinical manifestations, including malignancy,neurologic, autoimmune and opportunistic infectious disease. 2. Recognize that Human T-cell lymphotorphic retrovirus (HTLV-1/11) may cause latent infection with intermittent episodes of acute disease, chronic infection but disease free, or persistent infection with slow progression to symptomatic disease.

CASE INFORMATION: A 53-year old married Nigerian man, with no history of intravenous drug use, presented with acute fatigue for 3 days. He felt his legs were frozen with excruciating pain and inability to walk. Two years

prior, the patient was hospitalized with rash and rhabdomyolysis. His creatine phosphokinase (CPK) exceeded 1 million units/L. Skin biopsy revealed nonspecific dermatitis. One year ago he presented to the hospital in diabetic ketoacidosis and newly diagnosed diabetes mellitus I. His exam at this presentation revealed a thin man with 2 4 cm lymphadenopathy in the submandibular, supra/infraclavicular, axillary, and inguinal areas. No hepatosplenomegaly. The skin of all extremities, back and scalp was extremely tender to touch and diffusely involved with lesions ranging from hypo-hyperpigmented macules and erythematous papules, plaques, exudative ulcerations, and pustules. Lab work revealed WBC=15.8 k/uL,85%neutrophils, 9% lymphs and 6% monocytes. CK=2,390 unit/L, LDH=2,767 IU/L, and myoglobulin=

9,649 ng/ml. Elevated complement levels of CH50=102, C4=84 and C3=185. Chest/abdomen CT-scan-extensive lymphoadenopathy. Elevated percentages of T-lymphocytes: CD3=90% and CD4 + 71%. Positive HTVL I/II antibody by enzyme-linked immunosorbent assay (ELISA) . An inguinal lymph node dissection revealed angioimmunoblastic T-cell lymphoma(AITL). A scalp biopsy from the ulcer also confirmed the diagnosis. He developed candida septicemia which was successfully treated. He received a first dose of chemotherapy, which could not be completed as his course was complicated by CMV viremia, respiratory failure, renal failure, pseudomonas otitis media, pulmonary embolism and death. Post-mortem, a remaining blood sample was sent for HTLV Western Blot confirmation testing. However, it returned uninterpretable due to high nonspecific background. No further blood was available for PCR testing.
IMPLICATIONS/DISCUSSION: 20 million people worldwide are sero-positive for Human T-lymphotropic retrovirus HTLV-I/II, but only about 5% of infected persons suffer from clinical disease. Clinical manifestations of HTLV infection include myelopathy, infiltrative skin disorders, autoimmune disorders, Adult T Cell leukemia/lymphoma, and increased susceptibility to opportunistic infections. The latency period from HTLV infection to clinical disease can be 3050 years. It is likely that our patient acquired the infection in childhood, and clinical disease first presented as a progressive eczematous rash and autoimmune mediated polymyositis presenting as rhabdomyolysis, and diabetes mellitus I presenting as DKA. Once he developed lymphoproliferative disease, his clinical course rapidly deteriorated due to opportunistic infections.
I CANT GET UP: A PRESENTATION OF THYROTOXIC PERIODIC PARALYSIS Benjamin Zaniello 1; Erica Phillips-Caesar1. 1Weill Cornell Medical College, New York, New York. (Tracking ID # 10581)
LEARNING OBJECTIVES: 1. Recognize the presentation of an unusual cause of bilateral muscle weakness 2. Review the signs, symptoms, and treatment of Thyrotoxic Periodic ParalysisCASE INFORMATION: A 31 year old Filipino male was transported by ambulance to the emergency room after finding himself unable to get out of bed in the morning, a situation made worse by a 9/10 stabbing pain in both thighs. He described his legs as too heavy to lift but could manage some mobility in his knees, ankles, and feet. His arms were similarly heavy and painful but to a lesser degree. This had never happened before; he had no preceding illness, and had spent most of the previous day out with his wife, walking around a local mall and sampling almost everything in its food court. He also played in a softball game and had a large post game meal of pasta. He noticed no palpitations or tremors, no irregular bowel movements, no neck swelling, and had in fact gained a considerable amount of weight over the last two years. On physical exam he was obese (BMI 36), with normal reflexes, benign neck exam, diminished distal muscle strength in both upper and lower extremities, and a fine resting tremor. His studies demonstrated: Potassium 2.6 mmol/L, Magnesium 1.3 meq/L, TSH0.04 mU/L, Triiodothyronine 2.18 ug/L, free Thyroxine 2.53 ng/dl, ESR 16 mm/hr, and CK 791 U/L. EKG showed only sinus tachycardia. He was given both intravenous and oral potassium repletion and within 6 hours described his pain as having decreased to 2/10 in severity and his leg strength as significantly improved. The next day his Potassium was4.6 mmol/L, Magnesium 1.7 meq/L, CK 402 U/L, and additional Thyroid studies showed a Thyrotropic Binding Inhibitory Immunoglobulin of 40% and Thyroid Peroxidase of less than 1 IU/mL, indicating possible underlying Graves disease. The patient was then able to walk out of the hospital 48 hours post

admission. As an outpatient he was maintained on a suppressive regimen of atenolol until radioiodine ablation and subsequent thyroid hormone supplementation months later. He had no further episodes of muscle weakness. IMPLICATIONS/DISCUSSION: The differential of acute symmetrical muscle weakness is relatively broad, including such diverse entities as Myasthenia gravis, drug overdose, and hypokalemia, with the last being caused by an equally diverse list which includes renal tubular acidosis, hyperaldosteronism, or gastroenteritis. A rare but important clinical cause of hypokalemia to consider is thyrotoxic periodic paralysis (TPP), which is estimated to occur in 2% of hyperthyroid Asian patients, particularly in men between the ages of 20 and 40. It typically presents with sudden bilateral distal muscle weakness and pain, with the symptoms appearing overnight after recent exercise and high dietary carbohydrate intake. The hypokalemia occurs due to rapid intracellular influx of potassium into the muscles but the pathogenesis of the influx is still unknown. And while ECG abnormalities like tachyarrhythmias or atrioventricular blocks can occur, they usually resolve along with the muscle weakness and pain once potassium is sufficiently repleted. Beta-blockers have been found to decrease the number and severity of attacks (indicating one theory behind TTPs pathogenesis, ATPase overstimulation), and treatment of the underlying hyperthyroid trigger (usually Graves, but also toxic noduler goiter, thyroiditis, etc.) is curative. This case demonstrates that, despite TPPs scarcity in this country, its dramatic presentation and targeted treatment make its early recognition critical.

ANTICHOLINERGIC-ASSOCIATED ACUTE ANISOCORIA Christopher C Shaffer 1; Rayford June 1; Wendy Ng 1; Thomas OBryan1. 1Penn State Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 10583)

LEARNING OBJECTIVES: 1. Recognize airborne anticholinergics as a cause of acute anisocoria. 2. Demonstrate the importance of a properly fitted BiPAP mask.

CASE INFORMATION: A 58 year old woman with severe obesity, obstructive sleep apnea, congestive heart failure, and mental retardation was admitted to the intensive care unit for hypoxemic respiratory failure. She was confused and lethargic, and had marked pitting lower extremity edema extending to her lower abdomen. She was diagnosed with obesity hypoventilation syndrome, and echocardiogram revealed an associated pulmonary hypertension with severe right-sided congestive heart failure. BiPAP and intravenous diuretics were initiated. On the fourth hospital day, the patient acutely developed anisocoria with a sluggish right pupil dilated to 7 mm and a fully reactive 4 mm left pupil.

The patient could not effectively communicate at this time, but her mental status was slowly improving and had not worsened since onset of anisocoria. She suffered no head or eye trauma, started no new medications, and was on no anticoagulation besides standard DVT prophylaxis. Physical exam was notable for intact cranial nerves, strength, sensation, and reflexes, although further examination was limited. Laboratory studies were only significant for a developing contraction alkalosis due to aggressive diuresis. A non-contrast head CT revealed no bleeding or masses. The patient had been using a BiPAP mask for respiratory support. Notably, she received an anticholinergic breathing treatment less than one hour prior to detection of the anisocoria. The anticholinergic treatments were immediately discontinued. Progressive improvement in right pupil size and reactivity was noted over the next 24 hours, with complete resolution by 48 hours.

IMPLICATIONS/DISCUSSION: Anisocoria, defined as a variation in pupil diameter greater than 0.5 mm, has a broad differential diagnosis including pharmacologic mydriasis, tonic pupil, open-angle glaucoma, Horners syndrome, and third nerve paralysis. This case of anisocoria

was likely caused by an anticholinergic tracking from an improperly fitted mask to the patients right eye. Anticholinergics, such as ipratropium and tiotropium, cause mydriasis by antagonizing the parasympathetic muscarinic acetylcholine receptors of the sphincter pupillae. A trial of pilocarpine eye drops may have spared the need for neurologic imaging.

There were several features unique to this patient that may have contributed to the occurrence of this event. First, the patients body habitus may have led to a poor initial mask fit. Second, the large volume of diuresis in the setting of initial generalized edema may have altered her facial contours, further affecting mask fit.
This case demonstrates the importance of understanding the differential diagnosis of anisocoria. Not all cases of acute anisocoria are caused by intracranial hemorrhage, mass effect, third nerve palsy, or iris damage due to acute glaucoma. While it is certainly prudent to rule out emergent conditions, benign etiologies should also be sought to provide an explanation and spare excess work-up. Additionally, emphasis should be placed on properly fitted masks. Not only does a poor fit affect respiratory support, it also can cause inhaled medications to spuriously enter the eye.

CASE REPORT Chikal Patel 1; Harsha Vyas2. 1Medical Group of Mitchell County, Camilla, Georgia ; 2Lewis Hall Singletary Oncology Center, Thomasville, Georgia. (Tracking ID # 10589)

LEARNING OBJECTIVES: 1. Recognize that a high index of suspicion may be required to detect a subtle presentation of a common disease. 2. Diagnose a disease process promptly by being thorough.
CASE INFORMATION: A 66 year old African American male presented in August 2010 with a history of productive cough and dyspnea on exertion since 5 weeks. Review of systems was unremarkable. Patient was febrile with tachycardia but normotensive. He was admitted and started on Levaquin for pneumonia. Laboratory evaluation demonstrated a microcytic anemia (Hgb 10.1), mildly elevated serum creatinine and hypokalemia. Anemia work-up was initiated. Patient was discharged on ferrous sulfate while results were still pending.As part of his anemia work-up, a serum protein electrophoresis and urine protein electrophoresis with immunofixation were ordered. Both studies revealed the presence of monoclonal spike in the gamma region consistent with light chains. The kappa free light chains and kappa/lambda ratio were found to be highly elevated at 2,370 mg/L (reference range: 3.3-19.4 mg/L) and at 338.6(reference range: 0.3-1.7) respectively. Measurement of quantitative immunoglobulins noted a highly elevated IgG fraction with reciprocal suppression of IgA and IgM. Subsequent bone marrow aspiration and biopsy showed an increase in the number of plasma cells, representing approximately 15% of the marrow nucleated cells. Flow cytometric analysis revealed an abnormal population of CD20+/ CD19+ clonal B cells having immunophenotypic features of atypical plasma cells with bright CD38 and aberrant expression of CD56. Skeletal survey showed numerous variable sized lytic lesions throughout the osseous structures, especially the spine and pelvis. Some of the lesions were fairly destructive and extended through the cortex of the vertebral bodies. Presumptive diagnosis of multiple myeloma was confirmed with the combination of laboratory, pathologic, and radiographic findings. At the time of this report, the patient has completed one cycle of Velcade, Revlimid, and dexamethasone and is awaiting an evaluation for autologous stem cell transplant. IMPLICATIONS/DISCUSSION: Multiple myeloma (MM) is characterized by the neoplastic proliferation of a single clone of plasma cells producing a monoclonal immunoglobulin. This clone of plasma cells proliferates in the bone marrow and often results in extensive skeletal
destruction with osteolytic lesions, osteopenia, and/or pathologic fractures. The diagnosis of MM is often suspected because of one, or more, of the following clinical presentations: Bone pain, anemia, elevated serum creatinine or serum protein, fatigue, and hypercalcemia. This case highlights the difference a primary care physician can make by recognizing a disease process promptly based on subtle laboratory data. It is important to evaluate patients suspected of having MM in a timely fashion since a major delay in diagnosis has been associated with a negative impact on the disease course.

NOT JUST ANOTHER VIRAL SYNDROME Sana Sultana Gafoor 1; Kurt Pfeifer2. 1Medical College of Wisconsin, Wauwatosa, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10591)

LEARNING OBJECTIVES: 1. Recognizing radiographic patterns that differentiate Multiple Sclerosis (MS) from Acute disseminated encephalomyelitis (ADEM) in light of similar clinical presentations. 2. Distinguish clinical features that differentiate Multiple Sclerosis (MS) from Acute disseminated encephalomyelitis (ADEM).

CASE INFORMATION: A 23 year-old woman with no significant past medical problems presented with persistent fevers, neck pain, and back pain for three weeks. She had been evaluated at an outside hospital two weeks prior to the current presentation and was treated for aseptic meningitis based on inconclusive imaging and cerebro-spinal fluid (CSF) analysis. Her associated symptoms included-headache, vomiting, lower extremity weakness, and blurry vision in the left eye. Pertinent physical exam findings were pain with cervical flexion, bilateral lower extremity weakness, and central visual field defect of the left eye. Her laboratory evaluation revealed leukocytosis, antinuclear antibody negative, rheumatoid factor positive, and elevated serum levels of lipase, antistreptolysin-O titer, and C-reactive protein. The initial evaluation of the patient included repeat lumbar puncture and MRI imaging of the brain and spine, as well as restarting empiric therapy for meningitis. Brain MRI showed new areas of supratentorial white matter signal intensities and bilateral optic nerve enhancement. Spinal MRI demonstrated subtle areas of leptomeningeal enhancement. CSF findings were significant for high opening pressure, lymphocytic pleocytosis, low glucose, and high protein but negative oligoclonal bands. Intravenous corticosteroids were initiated given her visual symptoms. As the hospital course progressed, the only other significant laboratory findings were the positive IgG and IgM Mycoplasma serologies. Given the patients improvement with steroids, MRI findings, and the otherwise negative infectious work-up, she was given the working diagnosis of ADEM. A course of systemic corticosteroids, azithromycin, and ciprofloxacin were completed and the patient made a full recovery. IMPLICATIONS/DISCUSSION: ADEM typically presents with an acute onset of focal neurological signs within days to weeks of an initial non-specific viral illness or vaccination. It usually follows a monophasic course, and this allows ADEM to be differentiated from multiple sclerosis (MS). However, recently reported adult cases have demonstrated multi-phasic presentations and consequently there has been increased reliance on MRI for diagnosis. The radiographic patterns are generally multifocal asymmetric lesions that mainly involve the supratentorial white matter. Key differentiating factors between ADEM and MS are- atypical clinical symptoms of MS, absence of oligoclonal bands in CSF, and eventual gray matter involvement. Successful management strategies include corticosteroids, plasma exchange, and intravenous immunoglobulin. Outcome of ADEM is generally favorable in the pediatric population but mortality levels in adults can be high, especially in patients requiring ICU admission or presenting with multiphasic forms.

HEMOLYSIS-ASSOCIATED PULMONARY HYPERTENSION Kristal Carthan 1; Kurt Pfeifer2. 1Medical College of Wisconsin Affiliated Hospitals, Milwaukee, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10603)

LEARNING OBJECTIVES: 1. Recognize hemolysis-associated pulmonary hypertension as a distinct clinical syndrome associated with sickle cell disease that may be resistant to standard therapy and confers a higher risk of death. 2. Discuss pathogenesis of hemolysis-associated pulmonary hypertension and highlight the paucity of potential therapies.

CASE INFORMATION: A 28-year-old gentleman with a medical history of asthma and pneumonia 6 months prior presented with worsening shortness of breath, productive cough and fevers. The days prior to admission, he noted dark colored urine and yellowing of his eyes, which he stated happened frequently when he had a cold. His physical examination was normal except for scleral icterus and hypoxia. Chest radiograph showed a right-sided pleural effusion without evidence of infiltrate and chest CT revealed several gallstones and multiple acute pulmonary emboli (PE) in the segmental and subsegmental branches without evidence of deep venous thrombosis (DVT). Laboratory evaluation showed elevations in direct and total bilirubin and positive Mycoplasma IgM serology. He was subsequently admitted to the intensive care unit (ICU) for hypoxic respiratory failure. He was initially started on antibiotics for suspected community-acquired pneumonia versus acute chest syndrome. Evaluation for common hypercoagulability disorders was negative with the exception of hemoglobin electrophoresis, which revealed both sickle cell trait and beta thalassemia. Transthoracic

echocardiogram showed severe right ventricular enlargement and estimated pulmonary artery systolic pressures of 103 mmHg indicating acute decompensation of chronic pulmonary hypertension (PHT) as his right ventricle was able to compensate for such a high pulmonary arterial pressure without hemodynamic compromise. He completed a course of antibiotics, and his PE was treated with dalteparin transitioned to warfarin. At discharge he was referred to sickle cell and pulmonary hypertension clinics for long- term follow- up. IMPLICATIONS/DISCUSSION: Sickle cell disease (SCD) is one of the most common genetic hematologic disorders in the world. Pulmonary hypertension (PHT) diagnosed by Doppler echocardiography is observed in most forms of chronic hemolytic anemias and has been reported with increasing frequency in patients with sickle cell disease (SCD). The prevalence of PHT in patients with SCD is 20-40%, and the presence of PHT often leads to heart failure and is associated with an increased risk of death regardless of the severity. SCD patients with PHT have increased endothelial dysfunction, coagulation activation and inflammation compared with patients without PHT. Furthermore, patients with thalassemia and sickle cell trait also have intravascular hemolysis which results in the release of hemoglobin into the plasma. Plasma hemoglobin can then scavenge nitric oxide and catalyze the formation of reactive oxygen and nitrogen species, which leads to acute and chronic pulmonary vasoconstriction. Further studies evaluating the contribution of coagulation-activation and inflammation to the pathogenesis of PHT in SCD are needed as therapies specific to this disease entity are lacking.

HIDDEN IN THE CUT Samuel Evan Cohen 1; Michelle Cleeves 1; Nicole Sirotin1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 10604)

LEARNING OBJECTIVES: 1. Discuss and review the presentation of Cocaine-induced Pseudovasculitis (CIP). 2. Highlight the possible role of the anti-helminthic agent Levamisole as the cause of CIP.

CASE INFORMATION: A 59 year-old woman with a history of Diabetes Mellitus and Hypertension presented with a skin rash. Three weeks prior, she had been diagnosed with cellulitis and prescribed antibiotics. The rash, however, had continued to spread. The patients vital signs and non-dermatological exam were normal. Examination of her skin demonstrated multiple 18 cm shallow violaceous ulcers with surrounding eythema and scattered, overlying serosanguinous bullae on both arms as well as her chest,face and right ear lobe. The lesions were painful to light touch. Serum creatinine was stable at 0.9 mg/dL, liver enzymes were normal, Hgb 11.0 g/dl,WBC 8.8 k/uL, ESR 40, and CRP was normal. A panel of rheumatological tests was notable for a positive anti-MPO, anti-RNP, and ANA detectable at a 1:40 titer,but negative anti-Sm, anti-Ro, anti-La, anti-CCP, anti-DNA, ASLO and normal levels of C3,C4, RF, and cryoglobulins. Additionally, a viral-hepatitis screen and HIV ELISA were negative. A urine toxicology screen was positive for cocaine. A skin biopsy from her left upper arm revealed a small-vessel vasculitis with thromboses. Based on the serological panel, the urine toxicology, and the biopsy results, the patient was diagnosed with Cocaine-induced Pseudovasculitis. One week later, no new lesions had developed. Subsequently, she was lost to follow-up. IMPLICATIONS/DISCUSSION: Cocaine-induced Pseudovasculitis (CIP) is a diseaseentity that presents with clinical and laboratory characteristics ofvasculitis. CIP typically presents with purpura, ulcers, and/or confuent wheals distributed on the face, scalp, trunk, and extremities that appear following cocaine use. Toxicologic evaluation is positive for cocaine, and while several different ANCA serologies may be present, the autoantibodies most commonly detectedare anti-MPO(a c-ANCA) and anti-RP3(a p-ANCA). In one study, ANCA was detected in 56% of all cocaine users. This serological positivity often confounds aconclusive diagnosis of CIP. Pathology is most commonly a leukocytoclastic infiltrate and thromboses of small vessels. Other histopathological findings which are characterstic of other vasculitides such as giant cells, micro-abscesses, and granulomas are absent in CIP. The treatment for CIP is cessation of cocaine use and immunosuppression is not an effective therapy. There is growing evidence that CIP is not caused by cocaine itself, but by Levamisole, the anti-helminthic agent that is used as an additive in a process known as cutting that increases the volume of the final cocaine product. The use of Levamisole as an additive has become increasingly popular it was detected in 70% of cocaine

confiscated at the U.S. border in 2009. Histopathology of skin biopsies from children who developed a rash following administration of Levamisole revealed thrombotic vasculitis, leukocytoclastic vasculitis, and vascular occlusion the same findings present in CIP. In Levamisole-induced vasculitis, skin lesions resolve in 2 to 3 weeks upon cessation of the medication. In 2008, 14.7% of Americans aged 12 or older reported having used cocaine at least once. The high prevalence of cocaine use in the general population underscores the importance of recognizing that Cocaine-induced Pseudovasculitis may mimic a vasculitis that presents with skin lesions.

IMMATURE TERATOMA OF THE TRACHEA: A TUMOR OF MONSTROUS CONSEQUENCE Alicia Diaz-Kuan 1; Steven Gamalski 1; Javier Munoz 1; Ira Wollner1. 1Henry Ford Health System, Detroit, Michigan. (Tracking ID # 10611)

LEARNING OBJECTIVES: 1. Recognize immature teratoma of tracheal primary as an exceptional diagnosis scarcely reported in current medical literature. 2. Manage immature teratoma of the trachea with combined-modality therapy, including innovative chemotherapeutic regimens.

CASE INFORMATION: A 28-year-old male presented with progressively worsening dyspnea and stridor over a two-week period. Computed Tomography (CT) of the neck showed a 43.2 cm lobulated cystic mass at the right tracheoesophageal groove with severe subglottic stenosis. He underwent rigid bronchoscopy with laser ablation and mechanical debulking of a ninety-percent-obstructive proximal tracheal mass. Pathology revealed immature teratoma. Within one month, the tumor reoccluded his airway, necessitating partial cricotracheal resection, stenting, and tracheostomy. Further CT imaging revealed multiple bilateral pulmonary metastatic foci. He underwent four cycles of etoposide, ifosfamide, cisplatin (VIP) chemotherapy with near resolution of his metastatic lesions and normalization of tumor markers. Right upper and lower lobe wedge resections were performed to remove residual radiographically apparent disease. The patient tolerated combination therapy well and is currently disease-free, while undergoing continued surveil-lance to assess for clinical, biochemical, or radiographical evidence of disease recurrence.

IMPLICATIONS/DISCUSSION: Immature teratoma is a rare nonseminomatous germ cell tumor, classically represented in pediatric literature, but unusually may occur in adults. Timely diagnosis and intervention are crucial to providing afflicted patients with the best chance at surviving this potentially devastating disease. Limited data exists to guide treatment in such unique cases. While the standard of care remains combined-modality therapy, including surgical resection and systemic chemotherapy, innovative chemotherapeutic regimens have been suggested as alternatives to standard first-line therapy. This case of immature teratoma of tracheal origin highlights a unique presentation and novel treatment of an exceptionally rare disease. Extragonadal teratomata may arise in adults, but typically as retroperitoneal or mediastinal masses. These aggressive tumors may exhibit locally destructive effects and a proclivity for early widespread metastases. To our knowledge, this is the first such case reported in an adult. These tumors may prove even more destructive when involving the main airway, requiring aggressive primary surgical intervention as a life-saving measure. Furthermore, the propensity for distant metastases makes systemic chemotherapy an integral component of treatment. While the standard of care remains combined-modality therapy, including systemic chemotherapy and surgical resection of residual disease, treatment must be tailored to suit each patient. Novel chemotherapeutic regimens have been proposed as alternatives to standard first-line therapy, with comparable outcomes suggested in clinical trials. In this case, a regimen historically reserved for salvage therapy, VIP, was utilized in place of standard bleomycin, etoposide, cisplatin (BEP) to avoid bleomycin-related pulmonary toxicity. This case emphasizes how a multidisciplinary and patient-centered approach to treating a rare and potentially devastating disease can yield a satisfactory result.

A BAGEL IS TO TRANSAMINITIS AS Susan E. Wolver 1; Susan Wolver1. 1VCUHS, Midlothian, Virginia. (Tracking ID # 10613)

LEARNING OBJECTIVES: 1. Recognize Celiac Disease as a possible cause of elevated liver transaminases. 2. Recognize the association between Celiac Disease and autoimmune disorders.

CASE INFORMATION: A 48 yr. old thin white male was seen as a new patient. He had 30 year history of well controlled Type 1 diabetes without retinopathy, nephropathy or neuropathy, as well as stable hypothyroidism and hyperlipidemia on appropriate medications. He had no complaints. Laboratory studies showed slight elevations of ALT (66 U/L), and alkaline phosphatase (ALP) (148 U/L), and a low total protein(6.0 g/dL). The rest of the comprehensive metabolic panel (CMP) and

CBC were within normal limits. Follow-up labs showed negative hepatitis serologies, undetectable Vitamin D, and fractionated (ALP) to be from liver and bone.

The second patient was a thin 64 yr. old white female with hypothyroidism who was seen as a new patient without complaint. Chart review revealed a mildly elevated ALT intermittently over 10 years. The rest of her CMP and CBC were normal and hepatitis serologies were negative. Hepatic ultrasound was normal and additional testing by hepatology revealed a profound iron deficiency when iron studies were ordered to rule-out hemochromatosis. Both patients then had antibodies drawn for Celiac Disease which were markedly positive and had confirmatory endoscopy with positive small intestinal biopsies. They started gluten free diets with normalization of celiac antibodies and other labs. Both patients felt much better with dietary restriction although they both initially claimed to be asymptomatic. IMPLICATIONS/DISCUSSION: Celiac Disease (CD) is a common condition found in about 1% of the population and seen frequently by internists. Liver enzyme abnormalities are reported in about 40% of adults who present with classic CD symptoms. Conversely, CD is present in 9% of patients with chronic unexplained liver enzyme elevations.1 26% of patients with CD also have an autoimmune condition, as in the patients above, most commonly Hashimotos thyroiditis. 2 As CD carries a risk for intestinal neoplasm, it is important to keep it in the differential for elevated transaminases, and suspicion should be high in patients with autoimmune disease.1. Rubio-Tapia, Alberto and Joseph A. Murray. The liver in celiac disease. Hepatology 46.5 (2007):16501658.2. Bardella, Maria T., et al. Autoimmune disorders in patients affected by celiac sprue and inflammatory bowel disease. Annals of medicine (Helsinki) 41.2 (2009):139143

HEMORRHAGIC STROKETHE INITIAL PRESENTATION OF WEGENERS GRANULOMATOSIS !!!! Triston B.B.J. Smith 1; Debi Yang 2; Elliot Smith 1; Samuel Baroody1. 1Allegheny General Hospital, Pittsburgh, Pennsylvania ; 2Allegheny General hospital, Pittsburgh, Pennsylvania. (Tracking ID # 10616)

LEARNING OBJECTIVES: 1. To describe an uncommon initial presentation of Wegeners Granulomatosis. 2. To describe the neurologic manifestations of Wegeners Granulomatosis.

CASE INFORMATION: A 56 year old caucasian male with no past medical history and no known vascular risk factors was admitted with a left basal ganglia stroke. The etiology was not identified and he was subsequently discharged to a rehabilitation facility. Three weeks later he was readmitted with progressively worsening shortness of breath, ortopnea, tea coloured urine present since last discharge, and a purpuric rash on both lower extremities. An initial chest x-ray was concerning for pulmonary edema but an echocardiogram revealed an EF of 60% with normal LV size and function. CT chest showed diffuse bilateral groundglass opacification associated with focal areas of nodular consolidation. Of note, the patients creatinine had increased to 3.9 from .84 on last discharge and his Hb had dropped from 13.5 to9.9 g/dl. A vasculitic evaluation was therefore initiated. The patient had C-ANCA titers of 1:320 and elevated PR-3 ABS of 29.2 u/ml. Bronchoscopy demonstrated massive alveolar hemorrhage, and kidney biopsy showed pauci immune cresentic glomerulonephritis all consistent with Wegener Granulomatosis. The patient was treated with plasmapheresis,cytoxan and presnisone with resolution of his symptoms. I hindsight it was concluded that patients initial admission for CVA most likely represented the initial presentation of this disorder since no other etiology was identified.

IMPLICATIONS/DISCUSSION: Wegeners Granulomatosis (WG) is a disorder characterized by multisystem necrotizing vasculitis primarily involving the upper and lower respiratory tract and kidneys. However it can affect any organ, including the central nervous system. We present a patient with WG whose initial manifestation was hemorrhagic stroke of the basal ganglia. Neurologic involvement in WG has been established with approximately 50% of patients experiencing neurologic manifestations at some time during its course. Mononeuritis multiplex and cranial neuropathies are frequently seen. However, histologic or radiographically confirmed vasculitis of the CNS in WG is extremely rare. Three patterns of CNS involvement have been identified: contiguous invasion from paranasal granulomas, remote granulamatous lesions and vasculitis. Drachman observed that 9% of patients with WG experienced CVAs. These included ICH (3%), SAH (2%), cerebral arterial thrombosis (3%) and venous thrombosis (1%). Most of these patients developed CVAwhile on immunosuppressive therapy. Nishino et al reported neurological manifestations in 324 consecutive cases of WG. Only two case of intracerebral hemorrhage as the presenting manifestation of WG were identified by the authors in the literature. Cerebral angiogram failed to reveal vasculitic features in our patient. This is quite similar to the other reported cases since the small size of vessels (50300 mcm) typically involved in WG is below the sensitivity of routine angiography. Conclusion: Vasculitic disorders like WG should be included in the differential diagnosis of CVA especially when an obvious etiology is not identified.

MULTIPLE MYELOMA AS A RARE CAUSE OF ATYPICAL CHEST PAIN Maryam Sharifi 1; Javier Munoz 2; Vijayalakshmi Donthireddy3.
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LEARNING OBJECTIVES: 1. Complete physical exam must be a fundamental part of the evaluation of patient with chest pain. We report a rare case of multiple myeloma presenting with an unusual sternal solitary plasmacytoma of the bone (SPB) producing atypical chest pain. 2. Plasma cell dyscrasias constitute a spectrum of diseases as they may present as a single lesion or a more systemic process.The distinction between these entities is critical as the treatment approach may also diverge from local to systemic therapies.

CASE INFORMATION: A 74-year-old male with hypertension and diabetes presented with atypical chest pain to his primary care physician. Physical exam was felt to be normal at that point and cardiac work-up was negative. A mid-sternal mass rapidly grew over the next couple of months with worsening bouts of atypical chest pain that prompted him to the emergency room. Physical exam revealed a firm, tender, non-mobile, mid-sternal mass. Computed tomography of the chest revealed a 7 cm manubrium mass. Fine needle aspiration of the mass was reported as plasmacytoma. Skeletal bone survey confirmed a single lytic lesion on the sternum. Labs showed normal hemoglobin, beta-2 microglobulin, albumin, creatinine and serum calcium. Serum and urine protein electrophoresis revealed free kappa light chains present in the gamma region. Bone marrow biopsy showed 12% plasma cells confirming the diagnosis of symptomatic MM Durie-Salmon stage IA. Cytogenetic studies were compatible with a complex karyotype including deletion of chromosome 13. The patient received radiotherapy to the manubrium and was treated with bortezomib, thalidomide and prednisone. Consideration for autologous stem cell transplantation will be given due to his excellent performance status despite of his age

IMPLICATIONS/DISCUSSION: Plasma cell dyscrasias are a group of conditions characterized by malignant proliferation of a single clone of plasma cells. Solitary plasmacytoma is most frequently found in the bone although it receives the name of extramedullary plasmacytoma when it involves only soft tissues instead of bone. SPB is a relatively uncommon hematologic malignancy that usually arises from the axial skeleton followed by the long bones of the extremities. The prognosis is dictated by the risk of progression to multiple myeloma. A normal bone marrow is one of the criteria that must be met to make the diagnosis of solitary plasmacytoma of the bone. In the case of our patient, a diagnosis of MM is more appropriate as his bone

marrow showed more than 10 percent clonal plasma cells. Complete physical exam should be a fundamental part of the evaluation of a patient with atypical chest pain. Plasma cell dyscrasias should be called to mind when facing bone lesions even if present in unusual locations.

THE PERILS OF PREMATURE CLOSURE: THYROTOXIC PERIODIC PARALYSIS TREATED INITIALLY AS GUILLAIN-BARRE SYNDROME Katelyn Gamson 1; Lori Cooper 1; David Jacobson1. 1California Pacific Medical Center, San Francisco, California. (Tracking ID # 10692)

LEARNING OBJECTIVES: 1. Recognize the clinical manifestations of thyrotoxic periodic paralysis (TPP). 2. Recognize how anchoring, confirmation bias, and premature closure can lead to a delay in the diagnosis of uncommon diseases. In this case, confounding history led to the initial diagnosis of the more commonly encountered Guillain-Barre Syndrome.

CASE INFORMATION: A 24-year old Samoan man with no significant past medical history presented to his local emergency department with ascending paralysis for one day. He reported having an upper respiratory tract infection for the prior two weeks, as well as diarrhea. The night prior to admission, he noticed cramping pain in his lower extremities. The next morning, he developed paralysis in his lower extremities that progressed to his upper extremities. On presentation, his pulse was 112 bpm. Strength was 2/5 in hip flexors, 3/5 in dorsiflexors, 4/5 in deltoids, and 5/5 triceps and grips. DTRs were absent diffusely. Labs were notable for a potassium of 1.9 mmol/L and magnesium of 1.2 mg/dL. Cerebrospinal fluid analysis revealed no wbcs, 15 rbcs, glucose of 68 mg/dL, and protein of 27 mg/dL. Because the patients paralysis did not improve immediately after repletion of potassium and magnesium, a Neurology consult was obtained. Given the patients history of antecedent diarrhea and upper respiratory tract infection, as well as the findings of ascending weakness and areflexia, IVIG was administered for suspected Guillain-Barre Syndrome (GBS). By the next morning, his strength was greatly improved. The rapidity of his clinical improvement put the diagnosis of GBS into question. On further history, the patient reported a 2030 lb weight loss over the prior few months, which he attributed to increased exercise and decreased food intake. He denied palpitations, hair or skin changes, but he endorsed a slight hand tremor. He reported eating a meal of pancakes, french fries, and ice cream the evening prior to his paralysis. Thyroid function tests were ordered, revealing a TSH <0.008 mIU/L and free T4 of 2.37 ng/dL. A diagnosis of thyrotoxic periodic paralysis (TPP) was made. The patient was started on propranolol and methimazole, with a plan for later thyroid ablation. In the meantime, the patient was instructed to avoid strenuous exercise and high carbohydrate meals. IMPLICATIONS/DISCUSSION: This case provides teaching on TPP and also demonstrates the significance of cognitive errors. As seen here, TPP and GBS can have similar clinical presentations. Both diseases involve symmetric muscle weakness, usually ascending, as well as depressed deep tendon reflexes. Both can have tachycardia upon presentation.

GBS is usually provoked by antecedent upper respiratory or gastrointestinal infection, both of which were suggested by our patients history. TPP can also be provoked by infection, but it is more often precipitated by exercise, stress, or a high carbohydrate meal. This patients diarrhea could have at least partially explained his hypokalemia, thus confounding the diagnosis. The patient had no family or personal history of thyroid disease, and on physical exam he did not have stigmata of thyrotoxicosis aside from tachycardia and a fine hand tremor. GBS usually takes at least a month to begin its recovery, while episodes of TPP only last hours to days. While TPP is uncommon in the United States, 2% of Asians with thyrotoxicosis have TPP. TPP may be unfamiliar to practitioners in Western countries, but the diagnosis should be suspected in patients presenting with acute lower extremity weakness and hypokalemia. In this case, there were multiple cognitive errors that led to an initial missed diagnosis and unnecessary treatment. There was an element of premature closure and anchoring to the initial diagnosis of GBS, leading physicians not to consider a broader differential diagnosis. Confirmation

bias also played a role, leading providers to focus on the data that fit a diagnosis of GBS (ascending weakness, antecedent upper respiratory tract infection, areflexia) and to rationalize away contradictory data (normal protein in the cerebral spinal fluid, hypokalemia). As seen in this case, it is important to be aware of our own cognitive shortcuts in decision-making that can lead to diagnostic errors, and to reexamine the diagnostic thinking process.

SPORT SUPPLEMENTS: ARE THEY SAFE? A CASE OF RHABDOMYOLYSIS AND ATRIAL FIBRILLATION IN A 28 YEAR OLD MAN Nadir Khir 1; Pieter Cohen2. 1Cambridge Health Alliance, Cambridge, Massachusetts ; 2Cambridge Hospital / Cambridge Health Alliance, Cambridge, Massachusetts. (Tracking ID # 10730)

LEARNING OBJECTIVES: 1. Many adults in the United States take one or more dietary supplement. It is important to obtain a detailed history including use of dietary supplements in patients presenting with Rhabdomyolysis and cardiac arrythmias. 2. To recognize that, unlike drugs, which must be approved by the FDA (Food and Drug Adminstration) before they can be marketed, dietary supplements do not require premarket review or approval by the FDA.

CASE INFORMATION: A 28-year-old male student and college security guard with no significant past medical history presented to his primary care physician after two episodes of tea-colored urine. He denied fevers, chills, abdominal pain, nausea, vomiting, dysuria or frequency. He also denied any recent substance use, trauma, travel, nor personal history of renal stones. His home medications were cetirizine and diphenhydra-mine for seasonal allergies; last time used were two weeks prior to presentation. He had normal vitals except for elevated blood pressure 147/90. Physical exam showed a soft, non tender abdomen. Laboratory data showed Aspartate Aminotransferase (AST) 1184 and Alanine Transaminase (ALT) 430. Total creatine kinase (TCK) >41,000. Urine Myoglobin 194. TSH 0.83. Creatinine 1.1. He was started on intravenous fluids and admitted to hospital for supportive management.Upon further questioning, he endorsed lifting weights 4 days prior to presentation after a long period of not exercising. He also used for the first time an unspecified amount of sports supplement powder called NO shotgun. He reported muscle pains and fatigue on the days after working out and then noticed the tea colored urine. He was asked to bring a sample of the product. It is labeled to contain protein, caffeine and vitamins.During his 5-day hospital stay, he had an episode of palpitations. His EKG showed atrial fibrillation that was spontaneously converted on its own. Echocardiogram showed mild bileaflet mitral prolapse, mild LVH, and ejection fraction of 70%.

Otherwise, he felt well and his TCK, AST, ALT trended slowly to normal with hydration.

IMPLICATIONS/DISCUSSION: This case illustrates the potential for cardiac arrhythmia and rhabdomyolysis with use of performance enhancing substances and the value of a complete history. Many athletes and weight lifting trainees are not aware that performance enhancing substances are not fully regulated by FDA. Although exercise is a known risk factor for rhabdomyolysis, performance enhancing substances, especially creatine, could worsen it by absorbing water in to the cells, promote cells swelling and growth or rupture; or by simply motivating the person to exercise harder. There will always be confusion about whether the primary ingredient or an adulterant in these products caused the adverse effect but a possible link can not be ignored.

TALE OF A FORGOTTEN DISEASE Priyanka Vashisht 1; Bryan Krajicek2. 1Creighton University Medical Centre, Omaha, Nebraska ;

2Creighton University Medical Centre, Omaha, Nebraska. (Tracking ID # 10743)

LEARNING OBJECTIVES: 1. Recognize signs and symptoms suggestive of a patient with complicated pharyngitis. 2. Identify the diagnostic features of Lemierres syndrome, a rare but serious complication of upper respiratory infections (URIs).

CASE INFORMATION: A 25-year-old previously healthy male was admitted to the hospital with a 7-day history of high-grade fevers with rigors, sore throat with dysphagia and a nonproductive cough. He was a college student and denied smoking, alcohol or illicit drug abuse. He refused sexual activity for several months and reported no sick contacts.

On examination the patient was febrile, appeared toxic but normotensive. Oxygen saturation was 91% on room air. Bilateral cervical lymphadenopathy was present. Pharyngeal exam showed bilateral tonsillar erythema with left tonsillar enlargement. Laboratory studies revealed leukocytosis of 22,600, predominant neutrophilia with bandemia, platelet count 53,000, and sedimentation rate of 40 mm/hr. Chemistries included sodium of 131 and bilirubin 4.6. The heterophile antibody test was positive. An initial diagnosis of infectious mononucleosis was made and the patient was started on intravenous steroids. On the second day of hospitalization, he was noted to be more tachypneic and tachycardic. A PE-protocol chest CT showed a large right hydropneumothorax and multiple peripheral round opacities in the left lung, one with cavitation. The patient underwent video-assisted decortication which revealed purulent pleural fluid and was admitted to the ICU postoperatively. A clinical diagnosis of Lemierres syndrome was suspected and neck ultrasound performed but reported negative. Given a high index of suspicion, a neck CT scan was done which revealed large left peritonsillar fluid collection and tonsillar microabscesses. A transthoracic echocardiogram was negative for vegetations. The peritonsillar abscess was incised and drained and the patient was started on intravenous ampicillin/ sulbactam and clindamycin. His pleural fluid cultures grew Fuso-bacterium necrophorum, confirming Lemierres syndrome. His symptoms improved and he was discharged home on oral clindamycin for 4 weeks with subsequent complete recovery. IMPLICATIONS/DISCUSSION: Lemierres syndrome involves septic thrombophlebitis of the internal jugular vein, secondary to oropharyngeal infection and frequently complicated by metastatic infections. Recognition is of vital importance as although rare, it is the most serious medical complication of common URIs. While described as the forgotten disease in the past, re-emergence of Lemierres syndrome has been suggested resulting from reduced antibiotic prescribing for pharyngitis.

The feasibility of a clinical diagnosis and its therapeutic and prognostic implications amplifies the importance of awareness of this rare clinical syndrome.

Patients with Lemierres frequently present with pharyngitis, fever, and pulmonary symptoms. Given a broad differential diagnosis, the clinician must have a high index of suspicion and recognize suggestive diagnostic clues. A neutrophil-predominant leukocytosis makes a viral pharyngitis less likely. Pulmonary symptoms are less common with mononucleosis and in a toxic appearing patient, should suggest completion of a chest xray. Chest x-ray or CT appearance of multiple peripheral infiltrates with or without cavitation may suggest pneumonia or endocarditis with septic emboli, but in the context of pharyngitis, should prompt consideration of Lemierres syndrome.

Additional tests can help confirm the diagnosis. While ultrasound has limitations, CT has improved sensitivity and can better localize abscesses requiring drainage. A positive heterophile antibody test may represent a false-positive or a preceding Ebstein-Barr viral infection, both of which have been described. An initial viral or bacterial oropharyngeal infection may cause altered host defense mechanisms allowing commensal bacteria to become invasive. Bloodstream or meta-static specimen culture growth of Fusobacterium necrophorum, the most commonly implicated pathogen, is a key laboratory test for Lemierres syndrome in challenging cases, as demonstrated with our patient.

A CASE OF MISDIAGNOSIS: STRONGYLOIDES INFECTION Anjali Dhurandhar 1; Richard Miranda1. 1University of Colorado Denver, Denver, Colorado. (Tracking ID # 10744)

LEARNING OBJECTIVES: 1. Assess a patient with eosinophilia and recognize what is an appropriate evaluation. 2. Recognize the importance of identifying Strongyloides infection as a cause of eosinophilia. CASE INFORMATION: This is a 42 year-old female who presented with non-bloody diarrhea and abdominal cramping. Vital signs were stable, but stool was positive for occult blood. The patient was prescribed ciprofloxacin 500 mg twice daily to cover for pathogenic bacteria. Diarrhea resolved. Six weeks later, she presented with a two week history of loose stools, bloating and weight loss. WBC was 13.9 with eosinophil count of 2.73. Clostridium difficile toxin A by EIA was positive. The patient was treated with metronidazole 500 mg three times daily for 14

days. The patients symptoms persisted and repeat Clostridium difficile toxin was negative. WBC remained elevated and eosinophil count continued to rise. Stool studies were repeated three times including culture, ova &parasites and Clostridium difficile toxin which were all negative. Stool was positive for fecal WBC and repeatedly positive for blood.The patient continued to lose weight (> 10% of original body weight). WBC peaked at 17.5, with marked eosinophilia 5.75(32.9%). The patient was referred for EGD and colonoscopy, but biopsies from the duodenum and colon did not demonstrate any eosinophils, larvae or worms. However, the patient was started on budesonide for possible eosinophilic enteritis and had resolution of diarrhea. Absolute eosinophil count also declined, but was still elevated at 2.17. Therefore, the patient was referred to an infectious disease specialist who found a positive Strongyloides antibody at 1.74 (<1.0 normal). The patient was prescribed ivermectin for two days and then two weeks later, was prescribed additional course of ivermectin for two days due to persistent symptoms. The patient responded well to this second treatment and her eosinophil count declined and has remained at zero. IMPLICATIONS/DISCUSSION: Eosinophilia almost always indicates underlying pathology and requires a thorough evaluation. Studies have shown that U.S. providers often overlook Strongyloides in the work up of asymptomatic eosinophilia and may have inadequate knowledge of helminth infections. Though not a common infection in the U.S., Strongyloides is endemic in Southeastern U.S. and has a high prevalence rate amongst those who have resided in endemic areas such as veterans and certain immigrant populations. Patients may be infected for decades and may be asymptomatic or have nonspecific symptoms. Untreated chronic infections may lead to significant morbidity and mortality as the patient ages and receives treatments for other illnesses, particularly corticosteroids. These patients may develop the hyperinfection syndrome that can result in bacterial sepsis and death. Strongyloides is the leading cause of helminth deaths in the U.S. Therefore, considering Strongyloides in the differential diagnosis of a patient with eosinophilia, nonspecific abdominal complaints, new-onset wheezing and/or skin lesions is of critical importance. Diagnosing Strongyloides with routine stool studies has poor sensitivity due to irregular larval excretion. Serological testing has higher sensitivity than direct methods and is an appropriate screening tool for individuals from endemic areas and in the workup of eosinophilia. Even if the pathogen cannot be directly visualized, a positive serologic test warrants treatment. Though this infection is completely curable in its chronic state, mortality is exceedingly high for the hyperinfection syndrome. Failure to consider this pathogen can lead to unnecessary morbidity and mortality. Our failure to recognize this pathogen did lead to the inappropriate prescribing of corticosteroids. Fortunately this patient had a good outcome and her infection was completely eradicated.

A RASH DECISION: NOT SIMPLY ANOTHER ATOPIC DERMATITIS! Maggie Kathleen Benson 1; Peggy Hasley1. 1University of Pittsburgh Internal Medicine Residency, Pittsburgh, Pennsylvania. (Tracking ID # 10751)

LEARNING OBJECTIVES: 1. Recognize cutaneous T cell lymphoma as an unusual cause of a chronic rash in the primary care setting. 2. Identify the most common skin changes associated with mycosis fungoides. CASE INFORMATION: A 52 year old Sudanese gentleman presented to clinic with a 10- year history of intermittent 12 cm patches on his torso, arms and legs. He denied having fevers, joint, chest or abdominal pain, numbness or weakness, or changes in memory or mood. Exam revealed an irregularly-shaped, coalesced, hypopigmented plaque measuring 45 cm with an overlying scale on the right posterior buttock, along with a few other 12 cm patches on the back and anterior left thigh. A biopsy of the larger plaque revealed an atypical lymphocytic infiltrate in the papillary dermis with cells positively stained with CD2, CD3 and CD4, supporting a diagnosis of cutaneous T cell lymphoma of the mycosis fungoides subtype. He was referred for CT imaging of his chest, abdomen and pelvis that was normal, and a bone marrow biopsy did not show involvement. He was initiated on bexarotene therapy.

IMPLICATIONS/DISCUSSION: Mycosis fungoides is the most common type of cutaneous lymphoma, and compromises almost 50% of cutaneous T cell lymphomas. It is characterized histologically by the proliferation of

small to medium T lymphocytes within the epidermis with unique cerebriform nuclei. Mycosisfungoides is generally considered an indolent lymphoma, with a 5-year survivalrate of >90%, but has the potential to spread to the lymph nodes and deeper tissues if left untreated. Mycosis fungoides relative rarity (incidence of 1 in 100,000) and unique clinical presentation create a diagnostic challenge for internists. The chronic nature of the skin findings and frequent lack of systemic manifestations in early disease prompts many patients to seek initial evaluation by their primary care physician in the outpatient setting. It is thus important for internists to be familiar with the key

features of mycosis fungoides in order to facilitate early biopsy and referral for therapy.

The clinical hallmark of mycosis fungoides is that of multiple fluctuating patches that have a predilection for non sunexposed skin, particularly of the buttocks or proximal extremities. The initial patch phase may have characteristic poikiloderma, consisting of mottled pigmentation with overlying epidermal atrophy. The patches progress over years to decades and ultimately form larger, both thin and thicker plaques. Over time, the disease may progress to subcutaneous tumors, but always passes through the patch and plaque phases first. Primary care physicians should consider the possibility of mycosis fungoides before making the diagnoses of the much more common atopic dermatitis or tinea corpora.

A TRANSIENTLY SWOLLEN BOWEL Jennifer Cowart 1; Lee Lu2.
1Baylor College of Medicine, Houston, Texas ; 2Baylor College of Medicine, Friendswood, Texas. (Tracking ID # 10753)

LEARNING OBJECTIVES: 1. Recognize hereditary angioedema (HAE) as a cause of recurrent abdominal pain. 2. Review the pathophysiology and treatment of HAE.

CASE INFORMATION: A 58-year-old white male with obstructive sleep apnea and recurrent abdominal pain for 2 years presented with 2 days of severe right lower quadrant abdominal pain of sudden onset with nausea and decreased oral intake. He denied fever, vomiting, diarrhea, or constipation. Physical exam revealed heart rate of 100 s and diffuse abdominal tenderness without rebound or guarding. His WBC was 26,300 with 82.1% neutrophils and hemoglobin was 20.9 (from baseline16.5); LFTs were normal. CT abdomen showed ascites, a normal liver, mesenteric fat stranding most prominent in the left abdomen, and a single loop of jejunum dilated at 3.5 cm without bowel wall thickening. The final report was consistent with viral gastroenteritis, although the ascites was of uncertain etiology. He was admitted with the diagnosis of gastroenteritis. Upon further questioning, patient reported a history of recurrent, transient swelling in his arms, face, and throat starting in adolescence. He was diagnosed with hereditary angioedema nine months prior to admission and took danazol for three months, but then did not refill his medication. At time of diagnosis of HAE, labs showed C1 esterase inhibitor of 14 mg/dL (normal range 2139); C1 inhibitor function of none detected (normal >67%); and C4 of 8.92 mg/dL (normal 1638). His father had also suffered from undiagnosed swelling episodes. The patient had two recent admissions for abdominal pain, and a CT at that time revealed small bowel thickening and dilatation. EGD and colonoscopy were non-diagnostic. With these data, he was diagnosed with abdominal attack from HAE resulting in hemoconcentration and ascites. His symptoms rapidly resolved with only supportive care, as well as WBC down to 13.2 and hgb to 15.9. He was restarted on danazol by the allergy and immunology clinic; he has had no subsequent admissions for abdominal pain.

IMPLICATIONS/DISCUSSION: HAE is a rare autosomal dominant disease, with an incidence estimated from 1/10,000-1/150,000. Type I HAE accounts for 80-85% of cases and is associated with decreased production of C1 esterase inhibitor (C1-INH), as in our patient. C1-INH is important for regulating auto-activation of complement; in its absence, the complement cascade and bradykinin production can be triggered by minor trauma or stress, producing transient angioedema of the skin, limbs, GI tract, or airway. Symptoms typically

present in the second decade of life. Abdominal pain can occur in 70-80% of patients with HAE; symptoms typically resolve in 2448 hours. Case reports with CT and ultrasound imaging during acute abdominal attacks demonstrated transient ascites with bowel edema and dilatation. Hemoconcentration, leukocytosis, and even hypovolemic shock can occur.

C1-INH concentrate is now available in the US for treatment of acute HAE attacks; up to 96% of patients with an attack have symptom relief within 4 hours of administration. For long-term prophylaxis of attacks, attenuated androgens such as danazol are effective, but are contra-indicated in patients with prostate cancer, as well as pregnant or lactating patients; C1-INH concentrate is also indicated for prophylaxis. Abdominal HAE should be included in the differential of recurrent abdominal pain, especially with CT findings of unexplained ascites and nonspecific bowel dilatation. Making the correct diagnosis is key, as patients have undergone unnecessary abdominal surgery for HAE attacks.

SEEING PAST THE SURFACE: A CASE OF MRSA ENDOPHTHALMITIS Jerry Jacob 1; Hollis Day 2; Peggy Hasley1. 1University of Pittsburgh, Pittsburgh, Pennsylvania ; 2University of Pittsburgh, Portersville, Pennsylvania. (Tracking ID # 10760)

LEARNING OBJECTIVES: 1. To recognize endophthalmitis as a potential etiology for ocular symptoms in a patient with MRSA risk factors 2. To describe the risk factors and common presentations of endogenous endophthalmitisCASE INFORMATION: A 55 year old female with a history of type II diabetes, coronary artery disease status post CABG with recent AICD implantation, and end stage renal disease on hemodialysis presented with one week of redness and pain in her right eye. She had initially been treated for presumed allergic conjunctivitis. Her symptoms progressed over the week prior to admission, and included photophobia, nausea, and chills. Physical exam on admission was remarkable for right periorbital swelling, exophthalmos, conjunctival chemosis, and corneal haze. She displayed no light perception on visual acuity. A right internal jugular tunneled dialysis catheter and a left sided AICD were present without surrounding erythema or discharge. WBC count was 9.8. Blood and vitreous cultures drawn at presentation grew methicillin resistant staph aureus. Empiric intravenous and intravitreous antibiotics were started on admission and subsequently narrowed to vancomycin. The dialysis catheter was removed and a temporary catheter was placed. A transesophageal echocardiogram revealed a1.8 cm0.6 cm vegetation on a defibrillator lead. Patient underwent extraction of her AICD. She failed to improve with antibiotic therapy alone, and subsequently underwent right eye enucleation. Blood cultures eventually cleared and the patient was discharged with a six week course of vancomycin. IMPLICATIONS/DISCUSSION: Endogenous endophthalmitis occurs when a systemic infection is spread hematogenously and seeds the eye by crossing the blood brain barrier and entering the internal ocular spaces. In contrast, exogenous endopthalmitis occurs when intraocular surgery, penetrating injury, a corneal ulcer, or periocular infection breaches the external ocular barriers. The former accounts for only 2-8% of cases of endophthalmitis. Risk factors for endogenous endophthalmitis include diabetes mellitus, renal failure, malignancy, immunosuppressive therapy, extended surgical procedures, indwelling catheters, and intravenous drug abuse. Symptoms include decreased vision, floaters, redness, discharge, eye pain, and headache. About half report systemic symptoms of fever, chills, or malaise. Classical signs include hypopyon, lid swelling, conjunctival injection, vitreous opacification, and decreased visual acuity. Fundoscopic exam is typically hindered by vitreous opacification, although Roths spots may be seen early in the course of the disease. When endophthalmitis is suspected, immediate intravitreous application of antibiotics is warranted. In contrast to exogenous endophthalmitis, all patients with endogenous endophthalmitis should also receive systemic antibiotics. Many also

advocate complete vitrectomy as a means to improving visual outcomes. A significant proportion of cases are initially misdiagnosed as conjunctivitis, noninfectious uveitis, iritis, acute glaucoma, stroke, or cellulitis. A third of patients with endogenous endophthalmitis initially present to a primary care or ER physician. Thus, the

generalist can play a vital role in preventing visual loss by maintaining a high level of awareness and promptly referring suspected cases to an ophthalmologist.

PHARMACEUTICAL FORMULATION FOR FATIGUE AND FORGETFULNESS IN POST TRAUMATIC STRESS DISORDER Thomas R Roesel 1; Molly Feliciano 2; Nancy L. Stano 2; Karen Friedman 2; Leslie Hunter 2; Crowley Brian 2; Pamela Novy2. 1Uniformed Services University for the Health Sciences, Washington, District of Columbia ;
2Deployment Health Clinical Center, Walter Reed Medical Center, Washington, District of Columbia. (Tracking ID # 10763)

LEARNING OBJECTIVES: 1. Diagnose vitamin B12 deficiency in those patients who are on proton pump inhibitors or metformin, when they present with fatigue, memory problems, and shortness of breath without the hematological findings of anemia and macrocytosis. 2. Treat metformin and proton pump inhibitor (PPI) induced vitamin B12 deficiency with supplementation to enhance cognitive behavior therapy for the anxiety and fear related to post-traumatic stress disorder (PTSD). CASE INFORMATION: A 55 year old nurse, who returned from a year-long deployment to Iraq four years ago, presents with PTSD-related mood and sleep disorder with symptoms of anxiety, tiredness, memory problems and shortness of breath. Her pulmonary testing was normal. Under the care of cardiologists for her family history of coronary artery disease, she was taking simvastatin/ezetimibe. Gastroenterologists initiated rabeprazole 20 mg daily for reflux esophagitis 4 years ago. Her last endoscopy 2 years ago revealed residual esophagitis. An endocrinologist started metformin 4 years ago for metabolic syndrome. At the time of her current presentation, she was taking 2000 mg metformin daily. She rated her fatigue as 7.4 centimeters (cm) on a 0 to 10 cm scale (10 representing very fatigued). Her clinician-administered PTSD scale (CAPS) registered 72 (>65 implies PTSD). Laboratories revealed normal values for her complete blood count, red cell indices, folate, methylmalonic acid and hemoglobin A1C, but a low vitamin B12 at 184 pg/L. The patient was started on oral vitamin B12 and received a single parenteral vitamin B12 injection intramuscularly (im). Several weeks later she began participation in a multidisciplinary three-week all day outpatient cognitive behavior and exercise therapy program for PTSD. At the start, she had already noted improved cognition, mood, sleep, memory, and shortness of breath, with less fatigue (5.2 cm on 10 cm scale). A mini-mental status examination (MME) scored 27/30. Her lipids and hemoglobin A1C were normal, but a ferritin was 8 ng/L. Iron supplementation was started. A second im dose of vitamin B12 was administered, which decreased her fatigue score to 0 the next day. Her MME was unchanged. She successfully completed the program with overall improvement in her PTSD related symptoms with a repeat CAPS of 12. She was referred back to her gastroenterologist for further care. IMPLICATIONS/DISCUSSION: Metformin and PPIs have been associated with vitamin B12 deficiency. Absorption of vitamin appears to be hampered by metformin at the ileal membrane through a calcium dependent mechanism. PPIs are thought to cause deficiency through the impaired release of the vitamin from food due to absent acid secretion. This case study illustrates that when these drugs are taken together for several years, there may be a greater need to screen for vitamin B12 deficiency. The fact that drug therapy likely induced deficiency in 4 years time points to the large storage capacity of the liver for this vitamin. Thus, a delayed presentation of vitamin B12 deficiency can be expected after PPIs or metformin are started. Vitamin B12 deficiency should be suspected when there are neurological signs and symptoms present despite normal hematological findings. Low iron stores as represented by a low ferritin in this case, was likely due to a chronic residual esophagitis in this patient. Low iron stores can mask any potential macrocytosis, making the diagnosis of vitamin B12 deficiency based on this hematological sign more difficult. The patients improvement in her symptoms of poor sleep, disordered mood, poor memory, fatigue, and shortness of breath through supplementation contributed to her successful cognitive behavior and exercise treatment for her PTSD. Her rapid and near complete improvement indicates that vitamin B12 deficiency can exacerbate the neuropsychiatric symptoms of PTSD.

HYDRONEPHROSIS: A RARE PRESENTATION OF CROHNS DISEASE Shelly Vijay 1; Puneet Bajaj 2; Moiz

Hamdani 2; Anil Sharma2. 1North Shore Long Island Jewish Health Systems, Forest Hills, New York ; 2North Shore Long Island Jewish Health System, Forest Hills, New York. (Tracking ID # 10765)
LEARNING OBJECTIVES: 1. Recognize hydronephrosis from ureteral obstruction as a rare extra intestinal presentation of Crohns disease. 2. Diagnose Crohns disease in a patient who presents with hydronephrosis without evidence of urolithiasis.
CASE INFORMATION: We report a unique case of a patient in whom the first presentation of Crohns disease was right sided hydronephrosis. A 20 year old female presented to our hospital for complain of right flank pain since two weeks. Her other complaints included on and off diarrhea for about four years, chronic feet and wrist pains and history of anemia of unknown etiology. She smoked cigarettes about one pack a day. Her labs showed microcytic anemia, normal WBC count, normal BUN/creatinine and normal urinalysis. Patients CT scan showed mild right sided ureteral obstruction causing hydronephrosis and thickened terminal ileum . No evidence of renal calculus was noted. Immunologic work-up including c - Anti neutrophil cytoplasmic antibody, p-Anti neutrophil cytoplasmic antibody and anti-saccharomyces cerevisiae antibodies were negative. Patients C-reactive protein was elevated. Colonoscopy showed ileocecal valve with nodularity, erythema, friability and scarring. Biopsy showed ulcerated mucosa with marked acute and chronic inflammation, lymphoid follicles, crypt abscesses and distorted crypt architecture consistent with Crohns disease. Patient was started on prednisone and mesalamine with conservative management of hydronephrosis in consultation with urology. She was discharged to follow up with urology and gastroenterology.
IMPLICATIONS/DISCUSSION: Crohns disease can present with several complications like intestinal obstructions, fistulas, and anal fissures. Ureteric stricture causing hydronephrosis is a rare complication of Crohns disease. This complication is due to mechanical obstruction caused by inflammatory penetration of the affected distal ileum into retroperitoneum. The right ureteral involvement is predominantly seen in Crohns disease. A majority of these patients have been treated with surgical intervention, which includes resection of ileocecal lesion and ureterolysis. Conservative treatment with corticosteroids and mesalamine may be considered before surgery. The possibility of Crohns disease should be borne in mind in a patient who presents with hydronephrosis without urolithiasis.
THE ADULTERATED COCAINE EPIDEMIC Suresh Misra 1; Joseph Joe Lukose Vadakara 1; Vinit Karur1. 1Temple University Hospital, Philadelphia, Pennsylvania. (Tracking ID # 10787)

LEARNING OBJECTIVES: 1. Recognize the hematological and dermatological complications of Cocaine adulterated with Levamisole. 2. * CASE INFORMATION: 24 year old African American female was admitted to the hospital because of chest pain after having smoked cocaine. Physical examination was unremarkable.
On admission, her labs were - Hb 12.8gm/dl, Plt 228000/uL and WBC 1600/ mm3. WBC Differential was Lymph-80%, Neutrophils- 3%, bands-3%, (ANC - 72/ mm3), Basophils- 2% atypical lymphocytes-12%. Other labs including renal, hepatic and cardiac chemistries were negative. Peripheral smear showed neutropenia and was otherwise unremarkable.
Urine Drug screen was positive for Cocaine.
On day 2, her counts were unchanged. She was initiated on Filgrastim 480mcg SQ daily and kept under neutropenic precautions.
On Day 3, she developed painful, ecchymotic and necrotizing lesions on her earlobes, arms and legs. Over the next 24 hours the rash worsened and there was a concern for early TEN.
Further workup revealed a positive ANA (1:640 titer) in a homogeneous and speckled pattern, a positive TTI ratio, a prolonged PTT , a prolonged DVV test and a positive PTT mixing study suggestive of an inhibitor, Anti Cardiolipin antibodies were negative, ESR-84 mm/hr, CRP-1.14 mg/dL . Other negative workup included- c-

ANCA, p-ANCA, Hepatitis C ab, HIV, C3, C4, RF, HIV, AT III activity, Protein C and S levels.
On day 3, her WBC 2800 /mm3 and the ANC was 1064/mm3. Filgrastim was stopped as her ANC stabilized. Due to the worsening skin lesions, a skin biopsy was obtained. This demonstrated an early leukocytoclastic vasculitis versus thrombotic occlusion of superficial cutaneous vessels.
Due to worsening pain and progressive skin lesions, she was started on Enoxaparin 40 mg SQ twice daily. With these measures, the patients skin lesions gradually improved over 45 days. Her neutropenia resolved after two doses of Filgrastim. Her condition was thought to be Levamisole induced agranulocytosis with skin necrosis, secondary to use of adulterated cocaine.
IMPLICATIONS/DISCUSSION: The 2008 National Survey on Drug Use and Health estimated the cocaine users to be approximately 1.9 million or approximately 0.7 % of the population above the age of 12. Levamisole is increasingly used for the adulteration of cocaine. The DEA estimates that as much as 80% of the seized cocaine coming into the United States is contaminated.
Levamisole, a levo isomer of tetramisole, has been used as an antihelminthic, immunomodulatory and antineoplastic effects. It was voluntarily withdrawn from the US markets due to its side effects which include agranulocytosis and necrotizing skin lesions.
Levamisole is used as an adulterant because of a similar taste and color, and because it potentiates the the rush from cocaine. It increases the release of norepinephrine in the sympathetic system, blocks monoamine oxidase, and is converted to Aminorex, which has been scheduled as a class I agent because of amphetamine like effects.
Levamisole can be detected in the urine by gas chromatography and mass spectrometry. However, this is difficult due to its short elimination half life 5.6 +/ 2.5 hrs. Other findings include a positive Lupus anticoagulant, C-ANCA, P-ANCA, ANA, Anti Cardiolipin Ab, Anti dsDNA, and Cryoglobulinemia. Skin biopsy may show Leukocytoclastic vasculitis or thrombotic occlusions of the superficial and dermal vessels however none of these are specific for this condition.
No recommendations are available for levamisole induced hematologic and dermatologic manifestations. Treatment is usually supportive with systemic antibiotics for neutropenic fever and use of Filgrastim for neutropenia. Cutaneous manifestations can be disfiguring. As these lesions sometimes have evidence of thrombosis and leukocytoclastic vasculitis, steroids and anticoagulation can be considered.
ATYPICAL PNEUMONIA OR LUPUS-AN INTERESTING CASE PRESENTATION Priyanka Vashisht 1; Thuy Koll 2; Jay Kenik 3; John Hurley3. 1Creighton University Medical Centre, Omaha, Nebraska ; 2Creighton University Medical Centre, Omaha, Nebraska ; 3Creighton University Medical Centre, Omaha, Nebraska. (Tracking ID # 10799)
LEARNING OBJECTIVES: 1. Describe that Mycoplasma pneumoniae pneumonia could present with multiple extra- pulmonary manifestations2. Identify that the auto-immune features of Mycoplasma pneumoniae in a young female may mimic lupus.
CASE INFORMATION: A previously healthy 27 year old Hispanic female presented with severe polyarthralgia and myalgia. Patient had right upper quadrant abdominal pain associated with nausea for one week and a two day history of dry cough without fever or chills. Physical exam revealed unremarkable abdominal and chest exams. There were moderate effusions of both knees, bilateral joint tenderness over the elbows and shoulders along with active synovitis of hand and ankle joints. Pertinent laboratory findings included positive Myco-plasma IgM antibodies and ANA, pancytopenia, elevated liver enzymes, elevated direct bilirubin, and low C3, C4 and total complements. Imaging findings included left lower lobe consolidation on chest CT, hepatic steatosis without evidence of duct obstruction on MRCP, small joint effusions on X-rays of bilateral knees and elbows. Liver biopsy revealed chronic inflammatory cells and cenrilobular intra-hepatic steatosis.The Rheumatology team was consulted due to a strong suspicion of autoimmune pathology such as Lupus. Aspirations from the knees revealed inflammatory synovial fluid and patient was given intra-articular kenalog injections. The two

main differentials at this point were Mycoplasma infection with extrapulmonary features versus an autoimmune pathology such as Lupus. In view of the positive Mycoplasma serology and inflammatory arthritis, the patient was given doxycycline and prednisone. Improvement in joint symptoms and liver function were noted within one week.
IMPLICATIONS/DISCUSSION: Mycoplasma pneumoniae infection can produce a number of extrapulmonary manifestations in many organ systems. This case demonstrates Mycoplasma pneumoniae with features of hematological involvement, arthritis and hepatitis. An interesting finding of positive ANA and hypocomplementemia prompted the differential diagnosis of an autoimmune process such as Lupus. In addition, the patient also exhibits other Lupus criteria such as arthritis and hematological involvement. A proposed mechanism of Mycoplasma pneumoniae extrapulmonary manifestations is the formation of immune complexes and detection of ANA in sera of patients with Mycoplasma pneumonia has been reported. However, a point to consider is whether the patient does have an underlying Lupus with leucopenia which made her more susceptible to florid Mycoplasma pneumoniae infection. The patients symptoms improved after a combination of doxycycline and steroids which further confound the diagnosis.
PASTEURELLA MULTOCIDA PNEUMONIA AND BACTEREMIA WITHOUT ANIMAL BITE OR SCRATCH
Michael Rothberg 1; Kenneth Kuper 2; Scott Kaatz1. 1Henry Ford Hospital, Detroit, Michigan ; 2Wayne State University, Detroit, Michigan. (Tracking ID # 10800)
LEARNING OBJECTIVES: 1. Recognize that Pasteurella multocida can present as pneumonia and bacteremia without a preceding cat or dog bite or scratch. 2.
CASE INFORMATION: A 59 year old female with chronic cirrhosis presented to the hospital with altered mental status, abdominal pain, and dyspnea for two days. She was febrile (102.3 oF), tachycardic, HR

138, with a pulse ox reading of 91% on 2 L. She was noted to have perioral herpetic vesicles, oral thrush, and ascites. Paracentesis yielded 10,400 PMNs, with no organisms grown on ascitic fluid culture. Chest x-ray revealed right middle and lower lobe infiltrate. 2 out of 4 Blood cultures grew Pasturella multocida. She had no history of animal bites or scratches but did admit to letting her cat sleep on her shoulder and allowing her dog to lick her face. For treatment of pasteurella bacteremia, pneumonia and SBP, she received Unasyn for ten days. Midway through the course of Unasyn, she became afebrile and retesting of the ascitic fluid revealed resolution of SBP. The patient reported reduction in symptoms, including return of mental status back to baseline and improvement of abdominal pain and dyspnea. IMPLICATIONS/DISCUSSION: P. multocida is a gram negative cocco-bacillus which colonizes the oropharynx of both dogs, cats, pigs and other animals. The most common presentation includes bite or scratch from a dog or cat, followed by rapid onset of soft tissue infection. The second most common site of infection is respiratory tract. This mode of transmission may involve inhalation of contaminated aerosols or direct inoculation of the oral cavity with cat or dog secretions, which could occur by licking or kissing. In support of transmission by contaminated aerosols, P. multocida has been shown to colonize the oropharynx in persons with close contact to animals, namely, veterinary students and animal handlers. Of P. multocida respiratory tract infections, pneumonia is the most common. Typically, patients who get this pneumonia have underlying lung disease. In a review of 136 pasteurella infections which occurred without history of animal bite, 80 involved the respiratory tract and all of them had chronic pulmonary disease. P multocida pneumonia has a high incidence of bacteremia, possibly as high as 55%, seen in one small sample of 49 patients with pasteuella pneumonia. In our patient, the most likely cause of her pneumonia was from respiratory transmission since she had history of close animal contact without bite or scratch. An alternative consideration could be direct inoculation into the blood from her dog licking her perioral herpetic vesicles, with subsequent development of pneumonia by hematogenous spread. Supporting this mechanism are two case reports of licking of an open wound. However, a PubMed search did not reveal any case reports involving transmission via herpetic vesicles. It is important to recognize that P. multocida can present as pneumonia and

bacteremia, without preceding bite or scratch.

LEFT FLANK PAIN: LETTING THE KHAT OUT OF THE BAG Lee Mozessohn 1; Daniel Panisko1. 1University of Toronto, Toronto, Ontario. (Tracking ID # 10806)

LEARNING OBJECTIVES: 1. To recognize the vasoactive properties of khat (Catha edulis) and delineate its clinical spectrum of complications with an emphasis on its cardiovascular effects.2. To develop an increased awareness of khat as a substance of possible abuse and an important determinant of adverse health outcomes in vulnerable patient populations.

CASE INFORMATION: A 47- year old male of Ethiopian origin presented with the sudden onset of severe left flank pain. He had no other comorbidities. His initial blood pressure was 128/78 with a heart rate of 110 and regular. Oropharyngeal examination revealed brown-stained teeth. Left CVA tenderness was present with the remainder of the physical exam normal. Routine blood tests were normal. CT showed a wedge-shaped lesion in the upper pole of the left kidney consistent with infarction without any obvious arterial/venous abnormality. CTA demonstrated no other vascular abnormalities. An echocardiogram was normal with no vegetations or thrombus. Investigations for hypercoag-
ulable states and vasculitis were all negative including normal ANA, ANCA, lupus anti-coagulant, antiphospholipid antibodies, anticardiolipin antibodies, homocysteine, protein C and S, and anti-thrombin III levels. There were no factor V Leiden nor prothrombin gene mutations. On further questioning, the patient admitted to chewing khat 2 hours prior to the onset of his symptoms. He was a longtime user and chewed daily for at least 18 years, most often in the early evening while socializing with friends.

IMPLICATIONS/DISCUSSION: Khat (Catha edulis) is a flowering plant indigenous to East Africa and the Arabian Peninsula. Its use is particularly prevalent in Yemen where 60 percent of males chew khat regularly. The leaves are structurally similar to amphetamine. Cathinone, a major component of khat, is currently a schedule I drug according to the US Controlled Substances Act given its high abuse potential. This has particular relevance for vulnerable populations who are culturally integrated into the social use of khat.

After chewing, blood levels of cathinone rise within 1 hour and peak at 90 to 220 minutes. Its desirable stimulant effects and euphoria begin 1 hour later. Khat causes CNS stimulation, delayed gastric emptying and interference with micturition. Particularly relevant to this case are khats cardiovascular effects. It can cause hypertension, tachycardia, and there is a case report of khat-associated stroke. A case control study from Yemen demonstrated that khat chewing was independently and significantly associated with acute MI (AMI). This was attributed to increased myocardial oxygen demands from cardiac stimulation and vasoconstriction like amphetamine.

A recent study examined the temporal pattern of AMI in Yemen. Non-khat chewers experienced a progressive increase in AMI from 0300 to 0900 like the circadian pattern of AMI in North America. However, in khat-chewers the peak period of presentation commenced at 1500 and continued until 2100 with a trough at 0300. This correlated with the custom of afternoon khat-chewing and an expected early evening peak in cathinone levels. Our patient also became symptomatic in the evening 2 hours after chewing khat-lending further support to khat as the etiology of his renal infarct and ultimately letting the khat out of the bag. To our knowledge, this is the first recorded case of renal infarction associated with khat. This case also highlights the importance of a culturally sensitive approach in diverse and vulnerable patient populations.

A STRAY BULLET WITH A STRAY DIAGNOSIS! Ayad Jindeel 1; Ayad Jindeel2. 1Harbor-UCLA Medical Center, San Pedro, California ; 2Harbor-UCLA Medical Center, San Pedro, California. (Tracking ID # 10807)

LEARNING OBJECTIVES: 1. As a result of listening to the vignette , health care providers will distinguish femoral neuropathy caused by infrainguinal lesions from suprainguinal lesions by focusing on history and physical exam. 2. As a result of listening to the vignette presentation, health care providers will recognize the differential diagnosis of underlying causes of femoral and lumbosacral plexus pathology.

CASE INFORMATION: 25-year-old male presented to urgent clinic for severe anterior right thigh pain that

started a year earlier and progressively increased in severity. Pain was associated with occasional tingling and numbness. Six months prior to presentation patient developed progressive weakness flexing his right hip or extending his right knee, resulting in increased difficulty with walking. Over the same period, patient noticed wasting of his right thigh muscles. Two weeks prior to presentation, patient developed right lower abdominal pain where he felt a mass. Ten months earlier, he stopped working in a warehouse secondary to constant pain. Patient had a history of gunshot wound to his right mid-thigh four years earlier. The bullet was left inside

and patient was asymptomatic until one year prior to presentation. He denies any h/o smoking, drug use or alcohol use. No past surgical history. On examination, his temperature was 96.5, BP 126/71, pulse 113, RR 20, lungs were clear, heart exam was normal and abdomen was soft with palpable right lower quadrant mass. He was alert, cranial nerves exam (II-XII) was normal. Motor exam was normal, except reduced strength of the right knee extension 3/5 and right hip flexion 3/5. Hip adduction, extension and abduction were 5/5. Sensations were intact in upper extremities and left lower extremities with decreased pinprick in the anterior aspect of the right thigh and the antero-medial aspect of the right leg. Reflexes were normal (2+), except right patellar reflex (0+). Basic chemistry, complete blood count, Folate, Vitamin B12, were normal. X-ray of the right thigh showed a very superficial bullet at mid-thigh level. Abdominal CT scan showed large right retroperitoneal mass involving the right psoas muscle measuring approximately 13 cm13 cm. Chest x-ray revealed multiple bilateral pulmonary nodules. A CT-guided biopsy showed Synovial Sarcoma. After the diagnosis, the patient transferred his medical care to another facility.
IMPLICATIONS/DISCUSSION: This presentation is consistent with femoral neuropathy or lumbosacral plexus pathology. Since the patients symptoms are limited to the distribution of the right lower extremity and he does not have metabolic disorder like DM, he most likely has compression of the right femoral nerve or the lumbosacral plexus rather than other etiologies like lumbosacral plexopathy (diabetic or non diabetic). Diabetic and non-diabetic lumbosacral plexopathy could present in an asymmetrical pattern but usually progress to involve both sides.1 Pathology could be: 1. at or below the inguinal ligament, for example gunshot wound, lymphadenopathy, etc. . If the injury is limited to this level, then only knee extension is affected sparing hip flexion. 2. above the inguinal ligament with abdominal/pelvic pathology like malignancy, abscess and hematomas, or lumbosacral spine pathology like prolapsed discs, abscess and malignancy. Since hip flexion and knee extension were both impaired in this patient, the defect must be proximal to the inguinal canal because the branches of femoral nerve supplying the psoas and iliacus muscles are taking off as the femoral nerve passes between these muscles. Posterior divisions of L2, L3,L4 ventral rami forms the femoral nerve that supply motor branches to the hip flexors (Iliacus and Psoas muscles) and knee extensors (Sartorius, Quadriceps Femoris ;Rectus femoris, vastus intermedius, vastus medialis, vastus lateralis). Cutaneous innervation of femoral nerves is the anterior thigh, anteriomedial aspect of the leg. Anterior divisions of L2,L3,L4 ventral rami form the obturator nerve that supply the hip adductors. References:1. P.J.B. Dyck et al Non-Diabetic Lumbosacral radiculoplexus neuropathy Brain (2001)124, 119712072.

EXENATIDE:A RARE CAUSE OF PANCREATIC PSEUDOCYST

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LEARNING OBJECTIVES: 1. Recognise exenatide as a cause in diabetics presenting with pancreatitis and pseudocyst. 2. The incidence of drug-induced pancreatitis is approximately 1.4% and the development of pancreatic pseudocyst as a result, is an even more rare entity. CASE INFORMATION: 46 year old female with

past medical history of DM presented with a 2 week history of epigastric pain, nausea and vomiting.No family history of pancreatitis or alcohol abuse.Exenatide was started 6 weeks prior for diabetes treatment. Exam revealed abdominal distension and tenderness. Amylase 76, lipase 30; calcium and triglyceride levels normal.IgG4 and ANAwere negative.CT revealed a 10cmx10 cm pancreatic cyst in the body and tail. Ultrasound revealed no evidence of gallstones, sludge or CBD dilatation.Exenatide was discontinued.EUS revealed a large pseudocyst and no evidence of pancreasdivisum, chronic pancreatitis or mass.FNA revealed debris consistent with pseudocyst.Cystogastrostomy was performed.CT scan at 4 weeks revealed complete resolution.No recurrence has been reported to date. IMPLICATIONS/DISCUSSION: Exenatide is the first incretin mimetic, introduced for the adjuvant treatment of type 2 diabetes mellitus in 2005.It is a glucagon-like peptide-1 (GLP-1) receptor agonist used as twice-daily injection.The most common causes of acute pancreatitis are gallstone disease (3060 percent), alcohol (2030 percent) and hyper-triglyceridemia (1.3-3.8 percent).The incidence of drug-induced pancreatitis is approximately 1.4%, and the development of pancreatic pseudocyst as a result, is an even more rare entity.Proposed criteria for classifying drugs as having an association with pancreatitis include pancreatitis develops during treatment with the drug, other likely causes of pancreatitis are not present, pancreatitis resolves upon discontinuing the drug and pancreatitis usually recurs upon read-ministration of the drug.The temporal relationship of our patients symptoms after introduction of exenatide in the absence of other identifiable causes of pancreatitis together with the normalization of clinical and radiographic parameters upon drug withdrawal strongly suggests exenatide as the etiology. Review of the literature reveals only 36 reports of exenatide-induced pancreatitis but to the best of our knowledge no reported cases of exenatide causing pancreatic pseudocyst.The overall reported incidence for pancreatitis in exena-tide users is 1 in 3000 and for the more severe necrotizing or hemorrhagic forms less than 1 in 10,000.This is the first reported case of pancreatic pseudocyst secondary to exenatide with all other common etiologies thoroughly excluded.Pancreatitis should be considered in patients with persistent severe abdominal pain (with or without nausea), and exenatide should be discontinued in such patients. If pancreatitis is confirmed, it should not be restarted. Our case is the first reported case of development of pancreatic pseudocyst secondary to exenatide. Exclude exenatide as a cause in diabetics presenting with pseudocyst

DIFFUSE ALVEOLAR HEMORRHAGE IN PATIENTS ON SYSTEMIC ANTICOAGULATION Daniel Eiras 1; Michael Janjigian1. 1New York University Langone Medical Center, New York, New York. (Tracking ID # 10817)

LEARNING OBJECTIVES: 1. Diagnose and manage a patient on systemic anticoagulation with diffuse alveolar hemorrhage 2. None CASE INFORMATION: A 54 year-old man presented with one week of fevers, chills, rigors, frontal headaches, and productive cough. He had a history of type I aortic dissection with subsequent St. Judes metallic aortic valve prosthesis and graft 17 years prior to admission, as well as active alcohol abuse. He was noted to be febrile and had a loud metallic S2 heard even without a stethoscope, and had a loud systolic murmur heard throughout the precordium with clear lungs. His laboratory values were significant for a white blood cell count of 18 with 31% bands and an INR of 2.8. His initial treatment included antibiotics for community acquired pneumonia.

Approximately 18 hours after presentation the patient developed hemoptysis and hypoxemia. Chest radiography showed new diffuse dense airspace consolidation, and a repeat INR was 4.8. Chest computed tomography showed a stable type I dissection and interlobular septal thickening, also known as crazy paving pattern, consistent with diffuse alveolar hemorrhage. He was treated supportively and did

not require invasive ventilation. His coagulopathy was not corrected given the risk of thromboembolic complications from the metallic valve. Blood cultures grew group B streptococcus, and a transesophageal echocardiography revealed an abscess extending into the interatrial septum and along the ascending aortic graft. The patient underwent surgical replacement of the valve and aortic graft but he died intraoperatively.

IMPLICATIONS/DISCUSSION: Diffuse alveolar hemorrhage (DAH) is a clinical syndrome characterized by hemoptysis, anemia, diffuse pulmonary infiltrates, and hypoxemic respiratory failure. It is typically caused by diseases that damage the alveolar capillary barrier, and is associated with vasculitides including Wegeners granulomatosis, Goodpastures syndrome, systemic lupus erythematosus, and idiopathic pulmonary hemosiderosis. It may be seen as an adverse reaction to certain drugs including penicillamine, nitrofurantoin, amiodarone, propylthiouracil, cocaine, or coumadin, where it may be seen even with a therapeutic INR. Radiographic findings include dense airspace consolidations seen on chest xray, and interlobar thickening (crazy paving pattern) with consolidations and ground glass opacifications on chest CT. These findings can be confused with pulmonary edema, or multilobar pneumonia. Supportive care is indicated, including correction of coagulation disorders, platelet support, supplemental oxygen, and careful fluid management.
As was seen with this case, sepsis may also initiate or exacerbate an underlying coagulopathy. During sepsis, proinflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor alpha can lead to a procoagulant state and promote thrombosis. Proinflammatory cytokines also increase permeability of endothelial cells, allowing inflammatory cells to shift from the blood into the interstitial space. These two effects shift the coagulation balance towards a consumption of coagulation factors, leading to an increased risk of bleeding.
This case highlights a relatively rare presentation of DAH caused by warfarin therapy with concurrent sepsis and antibiotic administration. Patients admitted with bacteremia and presumed sepsis requiring antibiotics who are on anticoagulation should be monitored closely since they are at a higher risk for bleeding complications, as was seen in this case.
A PAIN IN THE NECK: EXTRAPULMONARY TUBERCULOSIS Tyler Gray LeVick 1; Roger D Smalligan2. 1Texas Tech University Health Sciences Center Internal Medicine, Amarillo, Texas ; 2Texas Tech University Health Sciences Center, Amarillo, Texas. (Tracking ID # 10823)
LEARNING OBJECTIVES: 1. Diagnose and treat extrapulmonary tuberculosis in immunocompetent patients 2. N/ACASE INFORMATION: A 71-year-old white man with no significant past history presented with a recently noticed mass in the left neck. He had no recent history of fever, chills, night sweats, or weight loss. He also denied cough, dyspnea, hemoptysis or any recent or remote foreign travel. He was a retired mechanic and had never used tobacco and only occasionally drank alcohol. No family member or associate had a history of tuberculosis. On physical exam he was well-developed, afebrile, had a 5X5cm firm, nontender, slightly mobile mass in his left anterior cervical neck region, had clear lungs, normal heart sounds, soft abdomen without organomegaly, and no other palpable lymph nodes. Laboratory was essentially normal and HIV was negative. CT of the neck revealed a5.74.2 cm wide heterogeneous mass just superior and lateral to the left lobe of the thyroid. CT of the chest was normal. Fine needle aspiration of the mass was nondiagnostic. Excisional biopsy showed granulomatous inflammation with necrosis and abundant acid fast organisms. Sensitivity and susceptibility results revealed Mycobacterium tuberculo-
sis which was pan-sensitive to all first-line anti-tuberculosis medications. The patient was treated with isoniazid, rifampin, ethambutol, and pyrazinamide and showed slow but progressive clinical improvement.
IMPLICATIONS/DISCUSSION: Tuberculosis (TB) remains an important public health problem worldwide. Though rates continue to fall, the CDC recorded over 10,000 new cases in 2009. Our patient fits the demographics of these new cases in that he is male (current rates 2:1 male to female), over the age of 65 (group with highest incidence), and lives in Texas (tied for highest incidence). Being white, HIV negative, and US born, however, are low risk. Extrapulmonary tuberculosis represents about 20% of new TB cases among HIV negative patients and TB lymphadenitis, or scrofula, as our patient had, is the most common manifestation. Our patients history and exam were classic in that he had no systemic symptoms (though patients with HIV may have fever, night sweats, and weight loss) and the nodes were cervical, firm, and nontender. Some infected nodes will become fluctuant and drain spontaneously. Causative organisms include M. tuberculosis (95%) and

atypical Mycobacteria. Although it can occur at any age, it is more common in young adults and children. Most patients have a positive PPD and a normal chest x-ray. A systematic review of commercial tests, including PCR, of needle aspirates of infected nodes have shown wide ranges of sensitivity and specificity making them unreliable. Excisional biopsy of the lymph nodes with histology, AFB stain, and mycobacterial culture is the procedure of choice. The differential diagnosis includes metastatic carcinoma, lymphoma, fungal infection, cat-scratch disease, sarcoidosis, toxoplasmosis, and bacterial adenitis. Treatment of scrofula is similar to that of any other case of TB, which, based on sensitivities would include the antimycobacterials our patient received. Internists must maintain a high index of suspicion and proceed with biopsy to accurately diagnosis the condition. The result is gratifying as most patients can be cured with directly observed therapy.

ATYPICAL PRESENTATION AND COMPLICATION OF MRSA BACTEREMIA Han Na Kim 1; Nicole Adler 1; Bo Shopsin1. 1New York University Langone Medical Center, New York, New York. (Tracking ID # 10825)

LEARNING OBJECTIVES: 1. Treat abscess with incision and drainage followed by antibiotics as inadequate local infection control can result in dramatic complications with significant morbidity.2. Recognize the significance of agr gene mutation in Staphylococcus aureus infections.

CASE INFORMATION: History: A 35 year-old Hispanic man presented with two days of bifrontal and retro-orbital headache.

The patient has a history of type II diabetes and recurrent cellulitis. Four months prior to presentation, he developed a left axillary abscess, which was treated with Augmentin then changed to Bactrim after incision and drainage was performed with culture growing Methicillin-resistant Staphylococcus aureus (MRSA). Two days prior, he developed severe throbbing headache with nausea and vomiting. He presented to an outside hospital where a non-contrast head CAT scan revealed a mass in the right temporoparietal region with associated vasogenic edema and local mass effect. Magnetic resonance imaging of the head revealed a 3x3x3 cm ring enhancing lesion consistent with intra-cerebral abscess. He was started on empiric antibiotics with vancomycin, ceftriaxone, and Flagyl and transferred to Bellevue Hospital for neurosurgical drainage.

Physical Exam: On presentation, vitals were notable for a rectal temperature of 100.2 F but otherwise hemodynamically stable. His physical exam was unremarkable other than skin findings of furuncle on the left calf and a carbuncle on mid right back.

Laboratory Results: Significant pertinent laboratory results included white blood cell count of 11,000/mcL, and a negative HIV test. All blood cultures were negative but nasal swab was positive for MRSA. Interim History: Contrast head CAT scan revealed multiple ring enhancing lesions in the right parietal lobe with associated vasogenic edema and midline shift of 4 mm. The patient underwent a right parietal abscess drainage and resection. Abscess cultures were positive for agr defective MRSA and the patient was continued on vancomycin. Further workup with transesophageal echocardiogram and bone scan for source of infection was negative and he was assumed to have been transiently bacteremic secondary to his axillary abscess, leading to the formation of brain abscesses.

IMPLICATIONS/DISCUSSION: This case represents a dramatic complication of MRSA bacteremia demonstrating that metastatic infection of any body site is possible when local infection is inadequately controlled with treatment. The patient likely developed brain abscesses secondary to transient MRSA bacteremia from the axillary abscess. Incision and drainage of an abscess is critical for proper management and control of local infection. Abscess fluid should be cultured and antibiotic selection must be based on culture data to avoid breeding of resistance and treatment failure, which could lead to significant complications.

This case of afebrile MRSA brain abscess is an atypical presentation of a common illness, potentially explained by Staphylococcus aureus accessory gene regulator (agr) gene mutation developed during the patients illness.

The patients initial MRSA strain from the axilla was agr-positive, but the organism later developed an agr mutation, likely allowing a persistent infection in the brain as lack of agr, a quorum-sensing virulence factor, results in upregulation of surface proteins allowing adhesion of organisms to cell surfaces and thus contributing to persistent infections. A recent study investigating agr-dysfunction in S. aureus bacteremia and 30-dayin-hospital mortality demonstrated an increased mortality among severely ill patients with agr-dysfunction and suggested that routine examination of agr function may have a role in predicting patient outcomes and optimizing antibiotic therapy [1]. The significance of Staphylococcal agr mutation in clinical practice needs further investigation but it seems to have potential for therapeutic value and in this case, may explain the patients persistent infection with an atypical presentation.

References:[1] Schweizer M, Furuno J, Sakoulas G et al. Increased Mortality with Accessory Gene Regulator (agr)-Dysfunction in Staphylococcus aureus among Bacteremic Patients. Antimicrob Agents Chemother. doi:http://dx.doi.org/10.1128/AAC.00918-10

Web End =10.1128/AAC.00918-10

WHEN PROPHYLAXIS FAILS: A CASE OF MALIGNANCY AFTER RISK REDUCING SURGERY IN A BRCA MUTATION CARRIER Cassandra Murphy 1; Stephen Cannistra1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 10830)

LEARNING OBJECTIVES: 1. Review the benefits of risk reducing salpingo-oophorectomy (RRSO) in carriers of BRCA mutations 2. Characterize primary peritoneal serous cancer (PPSC) and current controversy over its originCASE INFORMATION: A 58 year old woman with BRCA-1 mutation presented to her PCP with abdominal pain for 2 days. Her past medical history included breast cancer diagnosed in 1991 treated with lumpectomy and radiation with recurrence, prophylactic bilateral salpingo-oophorectomy 3 years prior and Crohns disease. About 2 weeks before this visit, she had constipation and abdominal pain relieved with colace. Two days prior to her visit, the pain recurred and she described worsening lower abdominal tenderness. The pain was worse with bending and squatting and associated with bloating. She

was on chronic narcotics for chest wall pain after mastectomy but these were not relieving her abdominal pain. She denied vomiting, change in oral intake or ongoing constipation. Her abdominal exam was notable for normal bowel sounds, diffuse tympany, and tenderness in the lower abdomen. There were no palpable masses or organomegaly. On genital exam, cervix appeared normal without cervical motion or adnexal tenderness. Initial differential diagnoses included Crohns flare in the setting of a recent prednisone taper, cystitis, and partial SBO. A CT scan of the abdomen/pelvis showed diffuse omental caking and a low attenuation soft tissue mass in the pelvis, concerning for carcinomatosis. A small amount of ascites and free pelvic fluid were noted. Eleven days after her initial presentation, she underwent exploratory laparos-copy with peritoneal tumor biopsy. Disease was noted on the right hemidiaphragm, peritoneum, anterior abdominal wall, paracolic gutters, rectosigmoid and its mesentery. Biopsy showed a poorly differentiated primary peritoneal carcinoma. She has now completed an initial course of chemotherapy, followed by interval debulking surgery, with plans for additional chemotherapy post-operatively. IMPLICATIONS/DISCUSSION: Carriers of BRCA mutations are at increased risk of several malignancies, including breast, ovarian, fallopian tube, primary peritoneal serous cancer (PPSC), pancreatic cancer, and melanoma. Relative risk of gynecologic cancers can be dramatically reduced by performance of risk reducing salpingooophorectomy (RRSO), which is an important consideration for BRCA mutation carriers. RRSO is typically timed to occur after child bearing is completed (often in the 3540 year old age range, although this must be individualized). Consideration is sometimes given to performing concurrent hysterectomy if subsequent use of estrogen-only hormone replacement is desired. If RRSO is to be delayed, estrogen-progestin contraceptives may have some benefit in reducing the risk of ovarian cancer, although it cannot replace performance of RRSO. The value of ovarian cancer screening has not yet been proven in BRCA carriers. Of note, there is a 4 to 8% risk of detecting occult malignancy during a RRSO, which can rise to as high as 20% in women over age 45. For this reason, a finely sectioned pathologic evaluation of

the surgical specimens from both the ovaries and fallopian tubes is performed. The procedure should also include a survey of the peritoneum with biopsy of suspicious lesions, peritoneal lavage for cytology, omental biopsy and cytology of the diaphragm. After RRSO, women typically undergo yearly pelvic exams and CA-125 levels, which may be useful in detecting the development of PPSC (risk estimated at 4.3%, 20 years after oophorectomy). PPSC has a similar clinical presentation, histology and response to chemotherapy as ovarian cancer. The cell of origin of PPSC remains controversial. Recent research including p53 mutation analysis has linked the presence of serous tubal intraepithelial carcinoma (STIC) of the fallopian tube fimbriae to cases of fallopian, peritoneal and ovarian carcinomas, suggesting a tubal origin for at least some of these cancers.

SWOLLEN ARM? NEED FOR ALARM! Jodie Ann Bryk 1; Peggy Hasley1.
1University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania. (Tracking ID # 10833)

LEARNING OBJECTIVES: 1. To recognize the clinical presentation of superior vena cava syndrome (SVCS) 2. To identify when emergent therapy for SVCS is requiredCASE INFORMATION: A 42 year old white male with no past medical history presented with new onset swelling in his left arm following a long-distance bike ride. The swelling extended from the lateral neck to the forearm with no associated warmth or tenderness. One month prior to presentation, he developed midsternal musculoskeletal pain, mild

dyspnea on exertion, and dysphagia. He denied stridor, fevers, chills, night sweats, or weight loss. His physical exam was notable for left arm swelling without redness, warmth, pitting or venous distension. His face showed slight swelling, but no plethora. A venous doppler of the left extremity revealed no venous thrombosis. A subsequent chest x-ray showed a mediastinal mass and follow-up CT revealed an 8 x 4.4 x8.9 cm heterogeneous anterior mediastinal mass with anterior and superior extension surrounding the right internal mammary artery and narrowing the superior vena cava. A subsequent tissue biopsy was performed and pathology demonstrated a CD20 positive diffuse large B-cell lymphoma. Treatment was initiated with cyclophosphamide, hydro-xydaunorubicin, vincristine, prednisone and rituximab.

IMPLICATIONS/DISCUSSION: Superior vena cava syndrome (SVCS) occurs when there is obstruction of blood flow through the superior vena cava. Facial edema is the most common symptom of SVCS occurring in 82% of cases, however unilateral arm swelling is also seen in up to 54% of cases. Other symptoms of SVCS include dyspnea, chest pain, headaches, and dysphagia which may gradually progress over several weeks, but improve with formation of venous collaterals. Malignancy, primarily lung cancer and non-Hodgkins lymphoma, is responsible for 60 to 85% of SVCS cases, whereas nonmalignant conditions, such as fibrosing mediastinitis and catheter related thrombosis, result in 15 to 40% of cases of SVCS. In stable patients, without stridor, initial management of malignancy related SVCS should be postponed until a histologic diagnosis is made and chemotherapy is the preferred treatment. SVCS rarely requires emergent therapy and treatment is guided by clinical symptoms. Emergent endovascular stenting is indicated in patients with stridor secondary to airway obstruction, coma from cerebral edema, or significant hemodynamic instability. Radiation therapy may also be used to emergently minimize airway obstruction, however may obscure the histiologic diagnosis.

LEIMYOSARCOMA ARISING FROM THE EXTERNAL ILIAC ARTERY Nael Gharbi 1; Shazel Gharbi 2; Geetha Selvakumar3. 1Saint Francis Hospital, Chicago, Illinois ; 2Saint Francis Hospital, Chicago, Illinois ; 3Saint Francis Hospital, Evanston, Illinois. (Tracking ID # 10836)

LEARNING OBJECTIVES: 1. Although leiomyosarcoma of the central veins and pulmonary arteries have been widely reported, similar tumors of the aorta are much less common, and those arising from the peripheral arterial system are extremely rare. 2. I didnt find a single case arising from the external iliac arteryCASE INFORMATION: 86 year old female presented to the clinic with one month history of left leg swelling. It was not associated with pain, fever, or redness. She denied shortness of breath, abdominal pain, or swelling of the other leg. She denied loss of appetite or weight loss. Her past medical history was consistent with hypertension for which she took amlodipine and irbesartan. On physical examination, her vital signs were normal.

Cardiopulmonary exam was unremarkable. On abdominal exam, there was no tenderness, distension, organomegaly, mass, or ascites. She had pitting edema in the left lower extremity up to the knee. Laboratory studies were unremarkable. Venous Doppler was negative. Contrast-enhanced CT abdomen and pelvis showed a soft tissue mass measuring 6.3x4.4 cm in left anterior hemipelvis, just above the inguinal region, affecting adjacent iliofemoral vessels.She was admitted to the hospital. Ultrasound-guided biopsy was done which showed moderately differentiated leiomyosarcoma. Patient underwent laparotomy, it was described as soft and fleshy mass, fixed towards the psoas, with blood supply coming deeply from the obturator artery. And the external iliac artery went directly into this mass.The tumor was resected, vascular reconstruction was performed, and postoperative
radiation therapy was administered. Pathology: Leiomyosarcoma arising from External Iliac ArteryIMPLICATIONS/DISCUSSION: Sarcomas are rare malignant tumors that arise from mesenchymal tissue at any body site. Approximately 13230 cases are diagnosed annually in the United States. The annual incidence is 30 per million.Although leiomyosarcoma of the central veins and pulmonary arteries have been widely reported, similar tumors of the aorta are much less common, and those arising from the peripheral arterial system are extremely rare.Approximately 80 percent of the neoplasms that arise within the retroperitoneal space are malignant. Furthermore, the majority of patients who present with a primary retroperitoneal, extravisceral, unifocal soft tissue mass will be found to have a sarcoma.Leiomyosarcomas of the retroperitoneum generally arise from the inferior vena cava,its branches, or any small vessel. They often present as a mass or, occasionally, with unilateral or bilateral leg swelling, and they are usually of a large size when diagnosed. Study was published in world journal of surgical oncology on Nov, 22, 2010: leiomyosarcoma accounts for 0.7 % of all malignant soft tissue tumors treated at Operative Reference Center for soft tissue sarcoma, BG University HospitalBergmannsheil, Ruhr University Bochum, Germany, from 2000 to 2009 they had just 12 cases of vascular leiomyosarcoma.

UNUSUAL PRESENTATION OF ACUTE BLASTOMYCOSIS DURING HOSPITALIZATION Shazel Gharbi 1; Nael Gharbi 2; Geetha Selvakumar3.
1Saint Francis Hospital, Chicago, Illinois ; 2Saint Francis Hospital, Chicago, Illinois ; 3Saint Francis Hospital, Evanston, Illinois. (Tracking ID # 10837)

LEARNING OBJECTIVES: 1. Unusual presentation of acute blastomycosis which developed during hospiralization with minimal clinical symptoms and rapidly progressive multiple lung masses, mediastinal lymphadenopathy and pleural effusion which are rare in acute blastomycosis 2. This is a very rare case of acute blastomycosis which presented in chronic blastomycosis radiologic features.

CASE INFORMATION: A 70 year old male was admitted to the hospital for high creatinine and worsening anemia whichshowed on work up for worsening fatigue. The patient denied cough, shortness of breath, chest pain, fever, chills, abdominal pain and weight loss. He had past medical history of carcinoid tumor in the small intestine which causing chronic diarrhea, hypertension, chronic kidney disease, mitral valve repair. Physical examination on admission day. Patient was pale, no jaundice or distended jugular vein. Cardiovascular, rhythm and rate were regular, S1, S2 normal with mild systolic murmur. Lungs were clear. The remainder of physical exam was unremarkable. Laboratory studies were remarkable of creatinine of9.21 mg/dl (baseline Cr: 23, hemoglobin 10.2, chloride 120, bicarbonate 9, BUN 127. CXR on admission revealed heart silhouette was enlarged with no evidence for any infiltrates.The patient was started on dialysis. On day nine of hospitalization, he developed productive cough of yellowish sputum. CXR showed infiltrates in the left lower lobe. Empirical antibiotics were begun. On day fifteen, he had a low-grade temperature of 100.1 with persisting productive cough in spite of the antibiotics. Blood, sputum, stool cultures for several times were negative. Three days later,CXR showed a large mass at the right lung base and another at the right hilum. CT of chest showed multiple pulmonary masses throughout the right lung with mass-like opacities also seen in the left lower lobe with mediastinal and bilateral hilar adenopathy and left pleural effusion. CT-guided biopsy from the right lung

mass showed granulomatous inflammation. Pathology report showed few granulomas show central necrosis/suppurative inflammation. Within the granulomas and and within some giant cells yeast organisms are identified with few

budding forms. PAS, GMS and Auramine-Rhodamine stains were performed, and the results were consistent with blastomycosis. Itraconazol was started.
IMPLICATIONS/DISCUSSION: Blastomycosis is a systemic pyogranulomatous infection, primarily involving the lungs, that arises after inhalation of the conidia of Blastomyces dermatitidis. Pulmonary blastomycosis varies from an asymptomatic infection to acute or chronic pneumonia.In Acute blastomycosis symptoms develop tow to four weeks after exposure. Chest radiographs usually reveal patchy alveolar infiltrates or lobarconsolidation. Pleural effusions and mediastinal or hilar adenopathy are rare.Chronic pulmonary blastomycosis may develop after acute infection. Patients often have symptoms lasting 26 months.
BREAST MYXOID LIPOSARCOMA : AS BIG AS IT GETS! A CASE REPORT Tanmay Swadia 1; Maryam Sharifi 2; Vrushali Dabak3. 1Henry Ford Hospital, Internal Medicine department, Clawson, Michigan ; 2Henry Ford Hospital, Detroit, Michigan ; 3Heney Ford Hospital, Internal Medicine, Hematology Oncology, Detroit, Michigan. (Tracking ID # 10840)
LEARNING OBJECTIVES: 1. Breast sarcomas are primary nonepithelial malignancies arising from connective tissue within the breast. They can arise de novo or secondary to radiation therapy or lymphedema. Primary breast sarcomas are rare histologically heterogeneous tumors. 2. They account for less than 1% of all breast malignancies. Myxoid liposarcoma of the breast is a very rare subtype of breast liposarcoma.This is a case of breast myxoid liposarcoma with an unusually large size, thus posing therapeutic challenges.
CASE INFORMATION: A 60 year old female incidentally noted a breast lump. She sought no medical attention for about six months and finally presented to the clinic with an enlarging breast mass. Physical exam showed large fixed lobulated left breast mass, about 1717 cm in size with significant stretching of skin along with nipple areolar complex inferior displacement, peripheral vein enlargements with lateral skin breakdown and hyperemia.. Chest CTscan was significant for a 17 cm enhancing soft tissue mass in the left breast likely involving the underlying chest wall and possibly the adjacent pleura along with multiple bilateral pulmonary nodules, suggestive of lung metastasis (the largest one was 15 mm in diameter and was located in right lower lobe). Needle biopsy of breast mass revealed it to be myxoid liposarcoma. Given the huge size of the tumor, decision was made to do neoadjuvant chemotherapy and radiation prior to surgical tumor removal She completed neoadjuvant therapy with Adriamycin and radiation and was scheduled for surgery. However, she declined clinically and hence family decided to enroll her into hospice. IMPLICATIONS/DISCUSSION: Vast majority of primary breast sarcomas are seen in women and the average age is 4550 years old. Liposarcoma of the breast represents 3-24% of the primary breast sarcomas, prognosis is highly dependent upon histologic grade and tumor size, and surgery represents the only potentially curative modality.To the best of our knowledge only 1 breast myxoid liposarcoma case has been reported before this one .Our case is unique in both its size, being one of the largest ones reported so far and its histologic features.
HOLD THE PREDNISONE: IMMUNOGLOBULIN A (IGA)-DOMINANT GLOMERULONEPHRITIS FOLLOWING STAPHYLOCOCCUS AUREUS INFECTION Melissa Y. Wei 1; Jose E. Navarrete1. 1Emory University School of Medicine, Atlanta, Georgia. (Tracking ID # 10843)
LEARNING OBJECTIVES: 1. Recognize immunoglobulin A (IgA)-dominant glomerulonephritis following Staphylococcus aureus infection as a novel form of glomerulonephritis distinct from primary IgA nephropathy and non-IgA-dominant post-infectious glomerulonephritis. 2. Distinguish treatment and management differences in immunoglobulin A (IgA)-dominant post-infectious glomerulonephritis compared with primary IgA nephropathy.

CASE INFORMATION: A 49-year-old man with chronic low back pain status post L5-S1 fusion in 2006 presents with left lower extremity pain and weakness and is diagnosed with pseudoarthrosis. MRI of the spine shows transforaminal lumbar interbody fusion at L5-S1 with residual left neuroforaminal stenosis and disc herniations at L2-L4. His lumbar spine is fused with new hardware implanted. Three weeks postoperatively he develops purulent drainage from the surgical site, and surgical debridement confirms a deep wound abscess with methicillin-sensitive Staphylococcus aureus (S. aureus) cultures. The patients lumbar hardware is retained, and he is initiated on nafcillin. During the initial three weeks of nafcillin treatment his creatinine increases from baseline 0.9 mg/dl to 1.0 mg/dl. However, after an additional two weeks of nafcillin he is admitted with nausea and anorexia and found to have creatinine elevated to 6 mg/dl and 10 mg/dl two days later with metabolic acidosis. Urine is dilute with 2.6 grams of protein, 12 WBC/ hpf, no eosinophils, and no casts reported. Renal ultrasound does not show hydronephrosis or ureteral obstruction. Nafcillin is discontinued and linezolid initiated but renal function continues to deteriorate with creatinine to peak of 15 mg/dl. Hemodialysis is initiated with symptomatic alleviation of nausea, but renal failure persists for two weeks. Whether corticosteroids should be initiated is broached. Renal biopsy reveals acute tubular injury and necrosis, interstitial fibrosis and tubular atrophy, and focal global glomerulosclerosis (5% of glomeruli) with significant immunoglobulin A (IgA) deposits. The patient is diagnosed with acute IgA-dominant post-infectious glomerulonephritis. Corticosteroids are not initiated. His renal function gradually improves, and he is discontinued from hemodialysis with a creatinine of 5 mg/dl, proteinuria and peripheral edema. Two months later his creatinine improves to 1.4 mg/dL, and his proteinuria and edema have resolved. IMPLICATIONS/DISCUSSION: Worldwide, immunoglobulin A (IgA) nephropathy is the most common form of glomerulonephritis (GN) and a major cause of end-stage renal disease. IgA nephropathy is induced by immune complex deposits containing IgA1 and other antigens in the glomeruli. Potential antigens responsible for IgA nephropathy include bacteria, viruses and food antigens. The post-infectious GN highlighted in this case is uniquely characterized by IgA-dominant glomerular deposits. IgA-dominant post-infectious GN following S. aureus infection is a novel form of GN induced by the S. aureus cell envelope antigen that co-localizes with IgA antibody in glomeruli (Koyama 2004). It is distinct from post-infectious GN associated with glomerular immune complex deposits containing complement, IgG and IgM. IgA deposits on renal biopsy resemble primary (idiopathic) IgA nephropathy and may be misdiagnosed as primary IgA nephropathy. However, in IgA-dominant post-infectious GN acute kidney injury resolves without corticosteroids or immunosuppressants. IgA-dominant GN following S. aureus infection was initially described by Koyama (1995). Ten patients with methicillin-resistant S. aureus (MRSA) infections developed acute GN with significant IgA deposits on renal biopsy. At diagnosis creatinine ranged 112 mg/dl, proteinuria ranged 13 g/day, and most patients had microscopic hematuria. Four patients developed severe renal failure, and three patients remained on hemodialysis by end of follow-up. More recently S. aureus mesangial or intracapillary proliferative GN with IgA-dominant glomerular immune complex deposits has been linked to methicillin-sensitive S. aureus (MSSA), MRSA and methicillin-resistant S. epidermidis infections (Satoskar 2006). Post-infectious GN

presents with variable clinical and serologic features. Infection course and renal pathology are essential for accurate diagnosis and treatment. In this case of IgA-dominant GN following MSSA infection, renal function improved with antibiotics alone.

A RARE CAUSE OF JAUNDICE: WHAT HAPPENED TO THE DUCTS? Salman Nusrat 1; Ambreen 1; Eric AnishRahman2. 1University of Pittsburgh Medical Center, Shadyside, Pittsburgh, Pennsylvania ; 2Dow Medical CollegeUniversity of Pittsburgh Medical Center, Shadyside, Karachi, Pittsburgh, N/A, Pennsylvania. (Tracking ID # 10845)

LEARNING OBJECTIVES: 1. To appreciate Vanishing Duct Syndrome (VDS) as a rare cause of cholestasis. 2. To understand the clinical characteristics, pathogenesis and management of Vanishing Duct Syndrome.

CASE INFORMATION: A 40 year-old male with no significant past medical history presented with 6 weeks of fatigue and lethargy. He reported a 20 pound weight loss, night sweats and low grade fevers. He complained of decreased appetite, but denied abdominal pain, nausea, vomiting or diarrhea. He had also noticed yellow discoloration of his eyes and skin. On systemic review, he denied any other significant complains.
On physical exam he was ill-appearing with a temp of 100.5 F, P: 68, BP: 127/82 and an oxygen saturation of 100% on room air. He was icteric and cervical lymph nodes were matted, fixed and enlarged (maximum size: 3.5 cm3 cm). Chest was clear to auscultation. S1 and S2 were audible with no murmur or gallops. Abdomen was soft, non-tender, with no hepatosplenomegaly.
Complete blood count and electrolytes were within normal limits. LFTs were elevated (ALT: 351, AST: 132, Alkaline Phosphatase: 698, Total Bilirubin: 4.2, Direct Bilirubin: 2.5, gGTP: 559). Haptoglobin and LDH were within defined limits. Excisional biopsy of a cervical lymph node was positive for Hodgkins Lymphoma. A PET scan was done that showed increased FDG uptake in the spleen and lymph nodes on the both sides of the diaphragm. Bone marrow biopsy showed no abnormalities. Thus, a diagnosis of stage III lymphoma was made. However the etiology of the elevated LFTs remained unclear. Hepatitis profile, AMA and ASMA were all negative. PET CT done for tumor staging showed no liver involvement. Ultimately, a liver biopsy was done that revealed Ductopenia consistent with a diagnosis of Vanishing Duct Syndrome. The patient was started on Adriamycin, Bleomycin, Vinblastine and Dacarbazine, which resulted in normalization of his LFTs gradually over the course of the next few months. IMPLICATIONS/DISCUSSION: Jaundice is a common clinical presentation and can result from variety of underlying etiologies. Although HL usually presents with weight loss, fatigue, night sweats and lymphadenopathy, on rare occasions, jaundice may be the initial symptom. Cholestasis secondary to ductopenia is an uncommon, yet well documented complication of HL. Vanishing Duct Syndrome, also known as Bile Duct Paucity Syndrome, was first described in adults in 1988. It is a group of acquired disorders characterized by progressive destruction of bile ducts resulting in ductopenia leading to cholestasis.
In addition to HL, other etiologies such as genetic disorders, medications, infectious diseases, neoplasia and autoimmune disorders can lead to this rare pathological picture. By definition, VDS requires loss of interlobular ducts in more than 50 percent of small portal tracts. Pathological biliary apoptosis has been implicated in the pathogenesis of VDS.
Since VDS may result from a variety of underlying etiologies, the clinical presentation of this condition can be highly variable. Symptoms can range from general constitutional complains to more specific manifestations of cholestasis such as xanthelasmas and gallstone formation. Although the diagnosis of VDS can be suggested by imaging studies such as ERCP or MRCP, liver biopsyis required to confirm the diagnosis. Diagnostic yield can be increased by using immunostaining. Treatment of VDS depends on the underlying etiology and includes withdrawal of culprit medications, immunosuppression, chemotherapy or ursodeoxycholic acid. In the presence of severe complications related to hepatic dysfunction, liver transplantation may need to be pursued. There are two potential outcomes in VDS: 1) progressive and irreversible biliary obliteration leading to biliary cirrhosis; or 2) ductal regeneration and clinical recovery over subsequent months. Fortunately, for our patient, he responded well to treatment for his HL and his liver function normalized.
NEUROCYSTICERCOSIS Natalie Zelta 1; Manuela Calvo2. 1Albert Einstein Montefiore Medical Center, New York, New York ; 2Albert Einstein Montefiore Medical Center, Bronx, New York. (Tracking ID # 10847)
LEARNING OBJECTIVES: 1. Identify neurocysticercosis as a possible cause of central nervous system infections in patients coming from endemic areas. 2. Recognize the various clinical presentations of neurocysticercosis and the way it can mimic other neurological conditions.
CASE INFORMATION: A forty year-old male worker from Mexico presented with episodic and progressively worsening lower back pain and headaches. Five months prior to admission, the patient injured his back and received a number of steroid injections to the lumbar region. The back pain worsened over the last two weeks prior to admission to involve associated symptoms of radiation down his lower extremities, severe band-like

headaches, nausea, vomiting, fevers, chills, and photophobia. The day prior to admission, he became confused and could not recognize his family. On admission, the patient was alert and oriented only to name, appeared extremely tremulous, had nuchal rigidity, positive Kerning and Brudzinki sign, tenderness to palpation along the lumbar spinal processes, and lower extremity weakness with motor strength of 4/5 bilaterally. Laboratory data were only significant for a leukocytosis of 17 k/uL. Computed tomography-guided lumbar puncture was attempted twice, however, cerebrospinal fluid was unattainable. Magnetic resonance imaging of the lumbar spine revealed multiple cystic lesions with peripheral enhancement that appeared intradural. The patient was empirically treated for bacterial and viral meningitis and bacterial abscesses with broad-spectrum antibiotics; however, on the two subsequent days of hospitalization, the patient became delirious with urinary retention, worsening neurological function with a broad-based gait. MRI of the brain and entire spine attained on day two revealed cysts too numerous to quantify extending from the thoracic to lumbar regions and communicating hydrocephalus; the brain was unre-markable. A cisterna magna puncture was performed to attain cerebrospinal fluid that revealed pleocytosis with a white blood cell count of 168, 0% polymorphonuclear cells, 95% lymphocytes, and 5% monocytes; slightly elevated protein of 63 mg/dL, and a Western blot positive for Cysticercosis. Treatment with Albendazole and high-dose steriods was initiated.
IMPLICATIONS/DISCUSSION: Back pain and headaches are problems commonly encountered in the inpatient and outpatient settings. At first presentation, analgesics and physical therapy are often tried and imaging only attained when risk factors or alarm symptoms are involved; such as trauma, persistent or progressive symptoms, signs of underlying malignancy or infection, or an abnormal neurological exam. In this case, the patient was refractory to analgesics and had

associated neurological abnormalities, suggesting an underlying neurological process. Imaging revealed cystic lesions throughout the spinal canal and included a differential diagnosis of microabscesses, tuberculous meningitis, toxoplasmosis, mycosis, neurocysticercosis, and drop metastasis.
Neurocysticercosis is the most common and serious parasitic infection of the central nervous system. It occurs during an infection by the larval stage of Taenia solium when ova are ingested. Ova develop into larvae, penetrate the intestinal wall and disseminate through the body via the hematological spread to encyst in tissue. T. solium preferentially invade the brain, appearing as parenchymal cysts on CT or MRI, and rarely as isolated spinal neurocysticercosis. Seizures are the presenting finding in over 70% of cases; in fact, neurocysticercosis is the most common cause of acquired epilepsy worldwide. Hydrocephalus and increased intracranial pressure, which develop in approximately 25% of cases, may manifest as nausea, vomiting and papilledema. However, the infection can manifest as any cognitive or neurological abnormality ranging from psychosis to stroke. In rare occasions, like in this case, it can present with meningeal signs. Clinical suspicion should be based upon travel history, history of contact with an individual who might carry the tapeworm, or history of residence in an endemic area of Latin America, Southeast Asia, and India. It is in these areas that the incidence of neurocysticerosis is up to 4% of the population.
NEUROLOGICAL MANIFESTATIONS AS THE INITIAL PRESENTATION OF LUNG CANCER: PARANEOPLASTIC NEUROLOGICAL SYNDROME Deerajnath Lingutla 1; Sujatha Mogili 1; Roopa Yarlagadda 1; Sorour Rahgoshay 1; Michael Herbowy 1; James Fetten2. 1Unity Health System, Rochester, New York ; 2Interlakes Oncology &Hematology, Rochester, New York. (Tracking ID # 10857)
LEARNING OBJECTIVES: 1. To recognize the importance of investigation for occult malignancy in case of unusual neurological symptoms, we present a patient initially presenting with peripheral neuropathy who was later diagnosed to have small cell carcinoma of lung. 2. Paraneoplastic syndromes are a group of clinical disorders that are associated with malignant diseases and are manifested in sites distant from the primary or

metastatic tumors.
CASE INFORMATION: A 77-year-old male presented with gradual worsening of numbness and weakness in bilateral lower extremities associated with tingling of his hands. His past medical history was significant for diabetes mellitus, coronary artery disease and hypertension. Neurological examination revealed diminished power, absence of reflexes and decreased sensation in bilateral lower extremities. Rest of the physical examination was normal. Basic laboratory investigations were normal except low sodium of 128 mmol/l. Vitamin B12, methylmalanoic acid, thyroid function tests, RPR, IgA and IgM levels were normal. IgG level was elevated with a value of 3313 mg/dl (700 1600). CSF examination was normal except elevated protein. Electro diagnostic studies revealed peripheral neuropathy in lower extremities. MRI of spine showed no abnormalities. He was given IV immunoglobulin for presumed variant of Guillain-Barre syndrome with no improvement. Further investigations revealed syndrome of inappropriate antidiuretic hormone secretion as the cause for hyponatremia. The combination of neurological and endocrine symptoms lead to the suspicion of neuroendocrine tumor and work-up for malignancy was undertaken. Anti-neuronal antibodies were negative. CT scan of the chest demonstrated a small mediastinal mass and further biopsy revealed small cell lung cancer. Subsequent PET scan demonstrated no evidence of metastases. Patients neurological symptoms have improved within a week of initiation of chemotherapy for small cell carcinoma of the lung.
IMPLICATIONS/DISCUSSION: Most patients with lung cancer present with symptoms not related to the primary tumor, but with either nonspecific systemic symptoms, including anorexia, weight loss, and fatigue, or specific symptoms indicating a metastatic disease. Paraneoplastic syndromes associated with lung cancer are diverse in their presentation, pathophysiology, and implications. Small cell carcinoma of lung, breast cancer, gynecological cancers and lymphomas are the malignancies most commonly associated with these syndromes. Paraneoplastic symptoms can precede the diagnosis of malignant disease, and at other times may occur late in the illness or may herald the first sign of recurrence. These syndromes may be due to the production of biologically active substances, such as polypeptide hormones, antibodies, or cytokines. Due to the nature how this syndrome presents, they can be seen as a diagnostic and therapeutic challenge or as an opportunity to detect an otherwise asymptomatic malignancy. Decoding the mechanisms that produce these syndromes will lead to more understanding in tumor biology which can be translated into novel approaches for early detection and therapy. It took several weeks to establish the cause of symptoms in our patient thus illustrating the need for physicians to maintain a high index of suspicion for paraneoplastic neurological syndromes in patients presenting with unusual neurological symptoms with no clear cause. This case report signifies the importance of investigation for occult malignancy in case of unusual neurological symptoms.
WHAT LIES BENEATH (LOWER GASTROINTESTINAL BLEEDING IN A YOUNG FEMALE) Anup Subedee 1; Anthony Donato2. 1The Reading Hospital and Medical Center, Wyomissing, Pennsylvania ; 2The Reading Hospital and Medical Center, Birdsboro, Pennsylvania. (Tracking ID # 10862)
LEARNING OBJECTIVES: 1. Recognize lower gastrointestinal bleeding as a possible manifestation of acute retroviral syndrome2. Diagnose acute retroviral syndrome recognizing the specific utilities of different tests used to identify HIV infection in the early phaseCASE INFORMATION: A 38 year-old nurses aide presented with malaise, feverishness, chills, vomiting and right lower quadrant abdominal pain for 6 days and 3 episodes of bright red blood per rectum in 2 days. She also had history of headache and blurry vision for several months. She was sexually active with only one partner of opposite sex, but admitted to having unprotected anal intercourse. Physical exam revealed normal temperature and stable hemodynamic parameters. Exam showed mildly tender right lower quadrant and absence of lymphadenopathy or rash. Stool was positive for occult blood. Her initial lab tests showed mild anemia, leucopenia and thrombocytopenia (Hemoglobin 10.8 g/dL, WBC 3.6 CMM, Platelets 106 CMM). Vaginal swab was positive for Trichomonas, Gardnerella and Candida but negative for Neisseria gonorrhea. Colonoscopy revealed scattered irregular ulcers in the cecum and ascending colon and abnormal thickening of rectal mucosa. Biopsy showed ischemic colitis of unclear etiology. HIV-1 and HIV-2

antibodies were negative on ELISA tests. In the meantime, because of a strong suspicion for acute retroviral syndrome, she was further tested with HIV viral load, which was found to be 68,000 copies/ml. p24 antigen was negative. The patient was initially treated with supportive management alone but was started on antiretroviral therapy after diagnosis of primary HIV infection was made. Follow up evaluation in 2 months revealed complete resolution of symptoms of bleeding per rectum and an undetectable viral load.
IMPLICATIONS/DISCUSSION: Acute retroviral syndrome commonly presents with fever, malaise, sore throat, lymphadenopathy rash, or unexplained cytopenias. Up to 20% of patients later diagnosed with HIV have acute retroviral syndrome as their initial presentation. If the

standard ELISA antibody assay is negative and suspicion for acute HIV infection is high, a p24 enzyme immunoassay or a plasma HIV RNA level should be obtained to assess for acute HIV infection. p24 antigen is present for a short period only in the early phase of HIV infection. HIV RNA level is more sensitive and specific, and detects HIV infection 12 days earlier than the standard HIV ELISA and 6 days earlier than the p24 antigen test.
To the best of our knowledge, this is the first reported case of bleeding
from ischemic colitis associated with primary HIV infection. No alternative etiology could be identified for the lower gastrointestinal bleeding symptoms which resolved with initiation of antiretroviral therapy.
There is evidence suggesting that early treatment with HAART can preserve HIV-specific immune responses, raise CD4+ counts, decrease the incidence of opportunistic infections, and reduce transmission, although effect on mortality has not been established.

POLITENESS AS A RISK FACTOR FOR INFECTION: A CASE OF LADY WINDERMERE SYNDROME Daiki Morikawa 1; Simi Padival2.
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(Tracking ID # 10870)
LEARNING OBJECTIVES: 1. To recognize the clinical signs and symptoms of an insidious pulmonary infection with Mycobacterium avium complex 2. To recognize the diagnostic criteria and management of nontuberculous mycobacterium infectionsCASE INFORMATION: A 75 year-old Japanese woman with a past history of diabetes mellitus and mitral regurgitation presented with 1 day of diffuse chest tightness and two episodes of vomiting. She additionally complained of significant malaise and appetite loss that day. She denied any fever or cough and had no history of smoking. She previously worked as a teacher and kept a pet parakeet at home. On physical examination she was noted to be afebrile but with an O2 saturation of 86% on room air and bilateral rhonchi in the lower lobes. Laboratory examination including a CBC was normal. A chest x-ray appeared normal however a CT of the chest revealed a diffuse infiltration with occasional bronchiectasis in the right middle and lower lobes. An atypical pneumonia was suspected especially given the bird exposure so she was started on ceftriaxone and azithromycin. She continued to have low oxygen saturation and loss of appetite so antibiotics were switched to minocycline with improvement. A urine Streptococcus pneumoniae antigen and urine Legionella antigen were both negative. A sputum culture was obtained and was negative for Mycoplasma pneumoniae, Chlamydophila pneumoniae,and Chlamydophila psittaci. The initial sputum culture then became positive for Mycobacterium avium complex (MAC) 3 weeks later. By then the patient had been discharged so repeat sputum cultures were obtained on follow-up and also became positive for MAC. The patient now awaits evaluation for an appropriate antibiotic course.
IMPLICATIONS/DISCUSSION: Mycobacterium avium complex(MAC) is an intracellular organism that is known to cause insidious pulmonary infections. Typically it is seen in immunocompromised patients, but

immunocompetent patients can be affected. Lady Windermere Syndrome describes a nodular/bronchiectatic type of MAC infiltration in the middle lobe. It occurs in postmenopausal women with no underlying lung disease or smoking history. These patients may be tall with skeletal abnormalities such as scoliosis and pectus excavatum, and mitral valve prolapse. Named for Oscar Wildes Lady Windermeres Fan, it was thought that women with voluntarily cough suppression were at risk of infection; a behavior that was typical during the Victorian era. While our patient was not tall nor did she have any skeletal problems, she had other characteristics consistent with Lady Windermere Syndrome. Cough suppression may have made her susceptible to infection as coughing in public is an impolite gesture in Japanese culture. Diagnosis of nontuberculous mycobacterial lung infection requires nodular opacities on chest x-ray or nodules and bronchiectasis on chest CT. Additionally, the patient must have positive results from at least two separate sputum samples or from one bronchial lavage. Patients who do not meet full diagnostic criteria should be followed until the diagnosis can be established. Thus follow-up and repeat sputum cultures were important in making the diagnosis of a MAC infection in our patient. The foundation of MAC therapy involves the use of a macrolide. Ethambutol and/or rifampin are also used to prevent resistance to monotherapy with a macrolide. Tetracyclines have shown in vitro activity against mycobacterium but are not first-line treatment. This may have been why our patient initially responded to minocycline however complete treatment will require a 23 drug regimen. Therapy should continue for
a minimum of one year from the last negative culture with monthly sputum cultures as follow-up.

A CASE OF EOSINOPHILIC MYOCARDITIS SECONDARY TO CHURG-STRAUSS SYNDROME Atsushi Okada 1; Simi Padival1. 1Teine Keijinkai Hospital, Sapporo, N/A. (Tracking ID # 10882)

LEARNING OBJECTIVES: 1. To recognize eosinophilic myocarditis as a serious complication of Churg-Strauss Syndrome2. To recognize the indications for endomyocardial biopsy and immuno-suppression in myocarditis associated with Churg-Strauss Syndrome CASE INFORMATION: A 57 year-old male with recently diagnosed asthma presented to an outside hospital due to nausea and anorexia. Because of his history of asthma, a chest CT was obtained and revealed a right upper lobe infiltration. It was presumed to be pneumonia and he was started on antibiotics. His symptoms did not improve however and further evaluation revealed a WBC of 19,000/ml with 42% eosinophils. Due to the eosinophilia, IgE and MPO-ANCA were obtained and elevated at 3000 U/ml and 510 U/ml respectively. The patient was suspected of having Churg-Strauss Syndrome and was started on pulse steroid therapy seven days after initial admission. That evening, he was noted to have an irregular rhythm on telemonitoring despite being asymptomatic. An ECG revealed complete AV block and he was transferred to our hospital for further evaluation. On arrival, he immediately developed ventricular fibrillation and required resuscitation and intubation. Once stabilized, his physical exam was unremarkable for cardiac murmurs, peripheral edema, or other skin lesions. An ECG again showed complete AV block with no evidence of ST-T changes. Laboratory testing showed a CPK 840 U/L, CPK-MB 76 ng/ml, AST 383 U/L, and ALT 435 U/L. Initial echocardiogram showed an ejection fraction of 28% with diffuse hypokinesis. Emergent coronary catheterization was performed after temporary pacemaker insertion and was normal. An endomyocardial biopsy was obtained at the same time due to a clinical suspicion of eosinophilic myocarditis. While awaiting biopsy results he was continued on pulse steroid therapy and eventually the biopsy results showed an eosinophilic infiltration with myocardial necrosis. The patient had improvement in his symptoms and did not require further pacing over the hospital course. He was transitioned to oral prednisolone with a slow taper and two weeks after his initial decompensation, a repeat echocardiogram showed improvement of his ejection fraction to 44%. IMPLICATIONS/DISCUSSION: Eosinophilic myocarditis is a rare form of myocarditis that is characterized by inflammation caused by eosinophilic infiltration and is associated with peripheral eosinophilia. It has been linked with hypersensitivity reactions, parasitic infections, malignancies and other etiologies like Churg-Strauss Syndrome (CSS). The American College of Rheumatology (ACR) suggests that 4 out of 6 criteria including asthma, peripheral eosinophilia greater than 10%, rhinosinusitis, pulmonary infiltrates, mononeuritis multiplex,

and extravascular eosinophilic infiltration are consistent with CSS. While CSS is a rare disease affecting 2.5/100,000 people per year, almost one-third of those patients may develop myocarditis. Remission rates are as high as 90% in patients with CSS however cardiac involvement portends a worse outcome. In fact, almost 50% of deaths in patients with CSS are due to cardiac involvement. Thus rapid assessment and management is required in order to improve outcomes. This includes the use of endomyocardial biopsy for diagnosis. Current American College of Cardiology guidelines give endomyocardial biopsy a class IIa recommendation for heart failure associated with suspected allergic reaction

and eosinophilia. A strong clinical suspicion of eosinophilic myocarditis, as in our patient, reinforces the need to perform endomyocardial biopsy early in the disease course as well as to potentially start immunosuppression while waiting for the results of biopsy. Some trials suggest that immunosuppression should not be prescribed for routine treatment of myocarditis. However myocarditis due to autoimmune diseases and eosinophilic myocarditis are responsive to immunosuppressive therapy. Corticosteroids are particularly indicated in myocarditis associated with CSS. In our patient, endomyocardial biopsy allowed for the diagnosis of Churg-Strauss Syndrome by full ACR diagnostic criteria as well as supported the appropriate use of high-dose corticosteroid therapy.

A GOUT ATTACK CAUSING A HEART FAILURE EXACERBATION Victor Yung-Tao Wu 1; Robin Klein1. 1Dept. of Medicine, Emory University, Atlanta, Georgia. (Tracking ID # 10908)

LEARNING OBJECTIVES: 1. Recognize the impact of systemic inflammation on heart failure pathophysiology 2. Review diuretic management in a medically complicated patientCASE INFORMATION: A 60 year old female with biventricular heart failure presents with 3 days of worsening swelling, early satiety, orthopnea, and dyspnea. She also reports pain, warmth, and swelling over her left wrist. Her past medical history is significant for systolic dysfunction with EF of 35%, sleep apnea, hypertension, diabetes, gout, and stage III CKD with baseline Cr 1.3 mg/dL. On exam, her BP was elevated at 152/72 mmHg. Lungs had scattered basilar crackles, JVD noted at ear lobe, and extremities were grossly edematous. Additionally, her left wrist was tender to palpation, erythematous, and swollen. Laboratories showed BUN of 42 mg/dL, Cr of 1.57 mg/dL, and BNP of 579 pg/mL.

She was diagnosed with decompensated heart failure complicated by an acute gout attack. Initial treatment included afterload reduction, diuresis, and prednisone for gout. Unfortunately, her urine output did not increase, her fluid balance was only mildly net negative, and she continued to complain of wrist pain. At this point, diuresis was held while steroids were continued for gout. After treating her gout, diuresis was resumed two days later with a significant improvement in both creatinine and urine output. The clinical course is summarized below:

Day 1 Day 2 Day 3 Day 4 Day 5Intake 1,263 1,968 1,712 1,700 2,494(mL)

Output 1,650 2,109 2,370 5,200 6,200(mL)

Balance 387 -141 -658 -3500 -3706(mL)

Cr 1.85 2.21 1.59 1.42 1.26mg/dl*Diruesis held on day 2; restarted Day 4 IMPLICATIONS/DISCUSSION: Heart failure admissions have increased annually since 2000, costing the US healthcare system $3.2 billion in 2010. Efficient and effective treatment of heart failure is a necessity. Typical treatment includes diuretics as a therapeutic mainstay for volume and fluid management. However, diuresis is often complicated by other medical conditions frequently accompanying heart failure.

Heart failure leads to chronic renal hypoperfusion, neurohormonal activation of the Renin-Angiotension-Aldostrone system, and inappropriate renal vasoconstriction causing a pre-renal azotemia clinical picture. An acute gout attack releases inflammatory cytokines which further worsen renal vasoconstriction, and sodium and water retention in heart failure patients. This case illustrates the important interplay between these two conditions. While aggressive diuresis can often prompt a gout flare, the inflammatory milieu that occurs with

gout can also complicate heart
failure. If severe enough, the inflammatory cytokine effect from gout can paradoxically trigger an exacerbation of heart failure instead.
In this case, treating the gout flare and calming the acute inflammatory response with corticosteroids was an essential and necessary step towards increasing renal perfusion and thereby maximizing the diuretic effect. This effect was manifested by a 3-fold increase in diuresis as well as improved GFR.In conclusion, this case highlights the complex physiology of heart failure and illustrates the impact of systemic inflammation on heart failure treatment. Hospitalists must understand the intricacies of heart failure and its interplay with other diseases such as gout to effectively treat these patients.
ABDOMINAL PAIN AS A NEUROLOGICAL EMERGENCY: UNEXPLAINED ABDOMINAL PAIN IS A HERALD OF SUBARACHNOID HEMMORHAGE Gautam A. Deshpande 1; Gautam A. Deshpande1.
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LEARNING OBJECTIVES: 1. Recognize the association between abdominal pain and neurological emergency and the probable pathophysiologic basis of this relationship.2. Expedite the diagnosis of subarachnoid hemorrhage based on the recognition of atypical, severe abdominal pain as a presenting sign of paralytic ileus.
CASE INFORMATION: A 56-year-old Asian woman presented to the hospital with severe acute epigastric and right abdominal pain of 3 hours duration, awaking her suddenly from sleep. She had a history of mild hypertension not requiring treatment and a 4-hour episode of transient amnesia two years prior with negative CT brain imaging at that time. Prior to admission, no headache, neck pain or stiffness, vomiting, or visual changes were reported. Abdominal exam revealed normal bowel sounds and no rebound or guarding, despite diffuse tenderness to palpation. Other physical exams, including neurologic, were unremarkable. Labs revealed only mild increase in amylase; electrolytes, complete blood count, and liver function tests were normal. Abdominal CT imaging showed right-sided constipation and mild ileus without acute pathology. The patient was admitted for pain control, assistance with stool evacuation, and monitoring for evolving abdominal pathology. On the morning of the 2nd hospital day, the patient continued to have exquisite abdominal pain without peritoneal signs, accompanied by gradual onset of a subacute headache and bilious emesis after taking lactulose. Shortly thereafter, the patient was noted to have sudden seizure-like activity and loss of consciousness; massive subarachnoidhemorrhage (SAH) was found on emergent brain imaging, revealed on subsequent pathology to be due to rupture of a saccular aneurysm with accompanying bilateral vertebral artery dissection (VAD). No abdominal pathology was identified except for markedly dessicated proximal stool impaction in the ileocecal area which appeared to be chronic in nature. Macro- and micropathological examination, including for evidence of ischemia, vasculitis,and porphyria, was otherwise unrevealing. IMPLICATIONS/DISCUSSION: Subacute aneurysmal rupture with VAD leading to SAH continues to be a difficult diagnosis for physicians in the absence of typical symptoms. The clinical presentation of unexplained abdominal pain prior to neurological manifestations of SAH has not been previously reported. In this patient, slow or repeat intracranial hemorrhages is suspected to have resulted in progressive ileus, possibly over several weeks, causing abdominal pain as the first manifestation of catastrophic SAH. Recent animal models suggest that intracranial hemorrhage can induce neuronal death at dorsal root ganglia, and may cause ileus in a mechanism similar to that frequently observed in spinal nerve injury. Severe abdominal pain, initially without

accompanying neurological symptoms, is an unusual presentation of VAD/SAH, a relatively uncommon but serious condition. Despite lack of typical neurological manifestations, unexplained abdominal pain should be considered a possible herald of impending neurologic catastrophe. All general physicians should consider VAD/SAH, often resulting in adverse outcomes if missed, in young patients with atypical abdominal pain and

even mild ileus.

OVERZEALOUS DIURESIS MAY PRECIPITATE HYPERAMMONEMIC ENCEPHALOPATHY IN PATIENT WITH HISTORY OF GASTRIC BYPASS Vinod Khatri 1; Krishna Khatri 2; Michele Gentile 3; Kalyan Nadiminti 2; Sangmesh Jabshetty 2; Lakshmikant Pathak 2; Harvey Friedman2. 1St Francis hospital, Evanston, Illinois ; 2St Francis Hospital, Evanston, Illinois ; 3St. Francis Hospital, Evanston, Illinois. (Tracking ID # 10946)

LEARNING OBJECTIVES: 1. Patients with history of gastric bypass are at risk of many neurological complications that may manifest many years after the surgery. Fatal cases of hyperammonemic encephalopathy have been reported in patients with history of gastric bypass.2. Little is known about exact mechanism &precipitating factors of hyperammonemic encephalopathy. It may be precipitated by overzealous diuresis, so clinicians should be aware of this potential complication in patients with history of gastric bypass.

CASE INFORMATION: 74 years old Caucasian female was admitted with two weeks history of progressive shortness of breath. She had a past medical history of morbid obesity (s/p gastric bypass surgery), hypertension and atrial fibrillation (s/p pacemaker). On examination her vital signs revealed T-97.5 F, P-80/min, RR-20/min and BP-146/ 90 mmHg. Her chest examination revealed bibasilar coarse crackles. CVS exam showed JVD, S1, S2-normal, S3 gallop was present. Abdomen was soft and BS+. Her bilateral lower extremities revealed 2 + pitting edema. On evaluation her BNP was mildly elevated, EKG revealed paced rhythm, chest X-ray showed congestion with prominent upper lung vessels. She was treated with intravenous furosemide for acute decompensation of congestive cardiac failure &was improving symptomatically after losing about 12 L of fluids. On day 4 of admission she was drowsy &later on became comatose. Her initial workup for altered mental status revealed normal electrolytes, liver function tests and CT head. ABG revealed metabolic alkalosis &her ammonia levels were found to be elevated (198 Umol/L). She was started on lactulose through nasogastric tube with a presumptive diagnosis of hyperammonemic encephalopathy &diuretics were put on hold. She improved with this treatment &was back to her baseline mental status after three days.

IMPLICATIONS/DISCUSSION: With the epidemic of obesity &ever-increasing number of patients with history of gastric bypass done in the past, many long term neurological complications of these procedures including optic neuropathy, myelopathy, polyradiculopathy, encephalopathy, behavioral changes &seizures are seen in clinical practice. These neurological complications can manifest many years after the surgery &can be fatal. Literature review mostly attributes these complications to multiple biochemical &nutritional deficiencies that occur after a gastric bypass. Hyperammonemic encephalopathy is one of such complications, but little is known about its exact mechanism &precipitating factors. It has been postulated that some patients could be carriers of a genetic defect of urea cycle, whose subclinical disease can be unmasked after bariatric surgery in presence of metabolic abnormalities. Gastric bypass also results in hyperinsulinemia &insulin can itself down regulate urea cycle enzymes, which can impede with handling of ammonia. In our case the metabolic alkalosis (contraction alkalosis) induced by overzealous diuresis might have precipitated the hyperammonemic encephalopathy by conversion of charged ammonium ions (NH_4^+) into ammonia (NH_3) which can easily penetrate blood brain barrier. This case highlights the importance of being aware of this potential complication of over-diuresis in patients with history of gastric bypass.

APPEARANCES CAN BE DECEIVING: A CASE OF MALE ANOREXIA Lauren Michelle Maragh 1; Susana Morales1. 1New York Presbyterian Hospital Weill Cornell Medical Center, New York, New York. (Tracking ID # 10947)

LEARNING OBJECTIVES: 1. To recognize the clinical differences of anorexia in male patients. 2. To recognize those at risk for refeeding syndrome.

CASE INFORMATION: A 22 year old man was brought in by ambulance after an episode of syncope. He reported for the past 2 years persistent GI complaints and weight loss. His weight had dropped from 160 to 90lbs. He reports seeing a gastroenterologist who diagnosed him with celiac disease and prescribed him a special diet. He is an avid bicyclist and worries about his appearance. Initial examination revealed a man 6 feet

2 inches tall weighing 99 lbs with a temperature of 36. 4C, HR 3052 bpm, BP 104/78 mmHg. His eyes were sunken and had severe wasting. He had a grade II/VI systolic murmur and cool lower extremities with diffuse non-tender, non-blanching petechiae across his chest, abdomen, and extremities bilaterally. Initial labs revealed he was hyponatremic, hypokalemic with low serum magnesium and phosphate. Initial ECG showed sinus bradycardia with first degree AV block.

The patient was admitted for sinus bradycardia, electrolyte abnormalities and to monitor for refeeding syndrome. Parenteral nutrition as well as oral feeds was started with the goal to consume half of his daily caloric needs. The patient and his family were insistent that he did not have an eating disorder given that he had been told he had celiac disease in the past. He was tested for anti-tissue transglutaminase and Anti-endomysial antibodies, however these were negative. He had GI work-up which included EGD which showed villous flattening in the jejunum; however HLA testing was not consistent with celiac disease. Biopsies of his skin were not characteristic of dermatitis herpetiformis. All other evaluations including endocrine, infectious and hematologic were either negative or confirmed a state of starvation. Psychiatry was consulted and he was diagnosed with anorexia nervosa. The patient declined inpatient psychiatric admission and went to sub-acute rehabilitation after gaining 15 lbs over 4 week period.

IMPLICATIONS/DISCUSSION: The American Psychiatric Association defines anorexia nervosa (AN) as a patients refusal to maintain a minimally normal body weight for age and height with an intense fear of gaining weight or becoming fat and significant disturbance in the perception of body size. This is further classified into restrictive versus binge/purge types. It is estimated that 5-10% of AN patients are males. While many of the characteristics are the same between genders, diagnosis in males remains difficult. Remission is often seen as resumption of menarche. In males, the surrogates of remission are increased libido and testosterone which may be inaccurate with prolonged metabolic derangements. Behaviors like excessive exercising in male patients is praised which reinforces the perception that this behavior is acceptable. Changes in fat deposition are often more apparent in female patients but subtle in males. Male patients tend to have dramatic changes in weight before recognition putting them at greater risk for refeeding syndrome.

Patients with weight loss of >10% within 2 to 3 month period or <70% of ideal body weight are at greatest risk for refeeding syndrome. When

carbohydrates are reintroduced into the diet this stimulates an increase in insulin. Insulin secretion results in intracellular shifts in phosphate, magnesium, potassium and expansion of the extracellular fluid compartment. The resultant hypokalemia and hypophosphatemia can lead to paralysis, arrhythmias, changes in myocardial contraction and respiratory failure. Feeding should start at 20kCal/kg/day or about half the estimated caloric intake with 1.0 to 1.5 g/kg/day of protein with careful correction of electrolyte abnormalities. A low sodium and fluid restricted diet may also help prevent fluid overload. By monitoring weight, heart rate and electrolytes a feeding program can be adequately tailored to avoid complications.

SIMULTANEOUS NEW DIAGNOSES OF HIV INFECTION AND METASTATIC GASTRIC ADENOCARCINOMA

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LEARNING OBJECTIVES: 1. Recognize the potential for development of aggressive gastrointestinal non-AIDS defining malignancies in HIV positive individuals 2. Identify possible mechanisms, specific to HIV disease, that can lead to aggressive non-AIDS defining malignancy developmentCASE INFORMATION: A 37 year-old male presented with a 1-year history of abdominal pain, vomiting, and a 30-pound weight loss. He denied any chronic medical conditions but did report being sexually active with men. Abdominal CT on admission showed diffuse stomach wall thickening. Esophagogastroduodenoscopy (EGD) and subsequent ultrasound-guided EGD revealed diffusely thickened erythematous gastric folds, and multiple biopsies taken were inadequate for

definitive diagnosis but felt to be concerning for malignancy. Pre-surgical PET imaging showed multifocal uptake at the left axilla, scapula, mediastinum and stomach, prompting a left axillary lymph node biopsy which showed inconclusive findings of follicular hyperplasia. Chest, abdomen, and pelvis CT on hospital day 13 showed multifocal lumbar and pelvic lytic bone lesions not seen on previous imaging. CT-guided bone biopsy revealed metastatic adenocarcinoma of unclear primary origin. On hospital day 20, diagnostic laparoscopy showed diffuse peritoneal carcinomatosis and locally advanced stomach carcinoma involving the greater omentum. Omental biopsy revealed poorly differentiated carcinoma of possible upper gastrointestinal origin. Based on the patients historic, radiographic, surgical, and pathologic findings, a clinical diagnosis of metastatic gastric adenocarcinoma was made. The patient was concurrently evaluated by the infectious disease service, whose work-up revealed a reactive HIV ELISA, a HIV-1 viral load of 27,248 copies and CD4 count of 289, consistent with a new diagnosis of HIV infection. The patient was offered immediate initiation of inpatient chemotherapy and highly active antiretroviral therapy (HAART), which he chose to start at an outside institution. Despite starting appropriate treatment with one cycle of chemotherapy and HAART, he died approximately 3 months after the diagnosis of metastatic gastric adenocarinoma with diffuse peritoneal carcinomatosis was made.

IMPLICATIONS/DISCUSSION: Non-AIDS defining malignancies (non-ADMs) are cancers other than Kaposis sarcoma, non-Hodgkins lymphoma, and invasive cervical carcinoma seen in patients with HIV infection. To our knowledge, gastric cancer has been rarely described among non-ADMs, with only 8 case reports in the HIV literature. The aggressive nature and young age of onset are notable features of this patients malignancy which are consistent with the 8 identified case reports of gastric cancer in HIV. Several mechanisms have been proposed to explain the development of aggressive non-ADMs in young patients with HIV infection. Inadequate or altered immune surveillance may place patients with HIV at increased risk of neoplastic growth. Additionally, oncogenic viral coinfections known to be associated with HIV, including Ebstein Barr virus, human papilloma virus, and hepatitis B and C viruses, may have additional pro-neoplastic effects that have not yet been documented. Finally, a possible oncogenic property of HIV itself has been proposed. Our case serves to remind clinicians that, while the exact mechanisms are yet unclear, HIV infection may be associated with the development of aggressive gastrointestinal non-ADMs in relatively young patients. Further reports and investigation are needed to determine the specific relationship between HIV infection and development of gastrointestinal non-ADMs, including gastric adenocarcinoma.

STIRRING THE POTT : A CASE OF COMPLICATED POTTS DISEASE. Irem Nasir 1; Irem Nasir2. 1Greenwich Hospital, Yale New Haven Health, Astoria, New York ; 2Greenwich Hospital, Yale New Haven Health, astoria, New York. (Tracking ID # 10987)

LEARNING OBJECTIVES: 1. To name mycobacterium tuberculosis (Mtb) in the differential diagnosis of vertebral osteomyelitis/discitis in industrialized countries. 2. To recognize psoas abscesses as one component of Complicated Potts disease.

CASE INFORMATION: A 23 year old male immigrant with no prior medical history presented after a MVA, with a four month history of increasing nonradiating R flank pain. He had subjective low grade fevers, but no cough, night sweats, or weight loss. He denied any weakness or numbness of his extremities or changes of his bowel or bladder. There was no history of IVDA or risky sexual behavior. He did not recall any history of Mtb. On exam, he was afebrile. His lung exam was normal. He had full motor strength and normal sensation all fours extremities. Purulent drainage was noted from his R flank. Labs revealed a WBC of 11.6 (80% PMN) and ESR of 79. CXR was normal. CT scan of the abdomen/pelvis revealed discitis and osteomyelitis at T9-10 and T11-12 associated with an abscess from T7-L1, contiguous with the R psoas muscle. MRI of the thoracolumbar spine showed a T8-10 epidural abscess. Ampicillin-sulbactam was empirically started. CT guided percutaneous I + D of the psoas abscess was performed and cultures were positive for pansensitive S aureus and Coag Neg Staph. They were negative for AFB smear and fungi. Quantiferon assay was positive. HIV PCR was negative.

All blood and induced sputum cultures were negative for AFB and fungi. The patient underwent epidural abscess evacuation, decompression, and laminectomy. Bone biopsy of the vertebral body was negative. Surgical aspiration of the R psoas muscle showed granulomas and, given the high index of suspicion for tuberculosis, RIPE therapy was empirically started. Ampicillin-sulbactam was discontinued after 4 weeks. The epidural and psoas abscess cultures were positive for a pansensitive Mycobacterial tuberculosis strain after 4 weeks. The patient was discharged on 2 months of RIPE with pyridoxine, then 10 months of INH and Rifampin under direct observation therapy. A 2 month follow up MRI showed resolution of both the psoas and epidural abscesses. The ESR decreased to 34.
IMPLICATIONS/DISCUSSION: Spinal infections are serious, affecting the vertebral bodies, intervertebral disks, spinal canal, and the paravertebral soft tissues. A level of awareness is required by clinicians in order to diagnose the infections of the spine promptly. Potts disease results from hematogenous spread of Mtb from other sites, often pulmonary, and accounts for about 20% of extrapulmonary Mtb. Although most spinal infections are pyogenic (S aureus, Strep species, Ecoli), seen often in immunocompromised patients, a high index of suspicion is needed to promptly diagnose Potts disease, especially in immigrants from developing countries, as was the case in our patient.

Fever is more likely to be absent in Potts disease and sometimes, the disease can have an indolent course. Complicated Potts disease, which results when secondary psoas abscesses form, is rare and is a result of direct contiguous spread from spinal infections. As with our patient, emergent surgery may be necessary for diagnostic purposes as well as prevention of neurologic deficits and spine deformity. Traditionally, a 4 drug RIPE regimen (2 months) followed by INH and Rifampin (1012 months) are advocated, although shorter 69 month regimens have also been effective. There have been only 2 case reports of a psoas abscess caused by both Mtb and S aureus, where the psoas abscess was probably initially caused by Mtb and subsequently became superinfected. Clinicians must maintain a high index of suspicion in patients with flank, back, or thigh pain, even in the absence of constitutional symptoms, to promptly diagnose Complicated Potts disease.
THINK BEYOND PATIENTS ILLNESS: AN EMPATHETIC APPROACH TO DELIVER BAD NEWS Huy Duc Do 1; David Kern2. 1Johns Hopkins/ Bayview Medical Center, Baltimore, Maryland ; 2Johns Hopkins School of Medicine, Baltimore, Maryland. (Tracking ID # 10988)
LEARNING OBJECTIVES: 1. Deliver bad news empathetically to patients with poor disease prognosis in the presence of physical and socioeconomic barriers. 2. noneCASE INFORMATION: A 58 year old hard of hearing male presented with worsening chronic cough, shortness of breath and right rib pain. Chest CT showed a right lung mass and abdominal nodules. Biopsy of the lung mass revealed primary small cell carcinoma.
Mr. Z had no home and no job. His brother had agreed to let him stay at his house. The brother, however, was an alcoholic who abused him. According to Mr. Zs niece, Mr. Z lived in a poorly kept house and did not have access to nutritious meals. He had been sick for months, but had not gone to a doctor because of the cost.
Mr. Z was on the service when I arrived. He did not know his diagnosis nor understand his condition. Because he was hard of hearing, he had not heard the conversation that the previous physician had had with him and his family. The communication problem was recognized when he said What is happening to me? It seems that everyone knows about my health except me. It became my role to discuss his health status with him. Although my residency program provided a brief course on delivering bad news, I did not feel prepared to face Mr. Z. I thought of questions and challenges that would occur during the encounter. I wondered how I should respond to Mr. Zs emotional reactions (will he resent me, become more depressed?). My attending and the palliative care team provided support when I did not know what to say. Recognizing Mr. Zs hearing deficit, I spoke loudly and distinctly, and checked for comprehension. The situation was very stressful, but the news was delivered with

great empathy. The hardest part was telling him that he had only few months to live. By knowing his financial status and home situation, our team was able to present options. Mr. Z and his sister decided on inpatient hospice. We found him a hospice in an area where his sister could visit. Mr. Zs sister was happy that he would be well cared for during his remaining months. He passed away about 1 month after discharge.
IMPLICATIONS/DISCUSSION: Delivering bad news is a challenging task for which physicians are insufficiently trained. 1-3 Yet good communication can help patients make better decisions, decrease healthcare costs, minimize litigation, and be satisfying to healthcare providers, patients and their families. 3-5In delivering bad news, providers experience stress 6,8, time constraints7, and fears of harming the doctor-patient relationship7, worsening patients ability to cope8, causing depression, and
reducing hope.3,12 But in a few studies disclosure of prognosis did not correlate with depression. 9-11 In another most patients preferred to know all information about their health status, except for the exact prognosis. 10Patients perceptions of warm, patient, caring, empathetic, informative, and respectful communication with their provider about these issues is associated with improved satisfaction, alleviation of fear and anxiety, short and long-term (>13 months) psychological adjustment.5,14-16 Preferred nonverbal communication such as sitting, eye contact, and not looking at ones watch, can reduce distress in patients and their families.5,16 Being truthful while promoting hope is an important skill that can be mastered.13,17 Addressing socioeconomic issues, such as financial barriers, is necessary.18 Assurance of ongoing support (non-abandonment) is a powerful and important message. 5Fortunately, short training courses improve provider skills at delivering bad news.1-3 The SPIKES protocol (Setting; Perception-exploring the patients; Invitation-assessing patient preferences; Knowledge-empathetically providing desired information; Emotion-addressing with empathetic responses; Strategy/Summary-assessing understanding, summarizing, and collaboratively planning) provides a mnemonic that encompasses most of the desired elements. 3,19,20Our case demonstrates the value of exercising these skills with support, and the importance of addressing physical and socioeconomic factors as part of the process

A RARE CAUSE OF A SMALL BOWEL OBSTRUCTION Mehmet Asim Bilen 1; Jose J Perez 1; Garrett R Lynch 2; Lee B Lu1. 1Baylor College of Medicine, Department of Internal Medicine, Houston, Texas ; 2Baylor College of Medicine, Department of Medicine-Hematology &Oncology, Houston, Texas. (Tracking ID # 10989)
LEARNING OBJECTIVES: 1. To raise awareness to the gastrointestinal metastasis of adenocarcinoma of the lung as a possible cause of small bowel obstruction.2. To present a literature review for gastrointestinal metastasis of adenocarcinoma of lung.
CASE INFORMATION: A 66-year-old Caucasian female who presented with nausea, vomiting, anorexia, diarrhea, and increasing abdominal distention for two days. She was diagnosed with metastatic adenocarcinoma of lungs with involvement of abdominal and clavicular lymph nodes one year prior to the presentation and was treated with radiation therapy and chemotherapy. She showed significant improvement after initial therapy with decrease in size of the tumors and lymph nodes; however, six months later, the tumor masses in the lung began to increase in size. The patient was started on Pemetrexed and Cisplatin regimen and had received her last chemotherapy three weeks prior to occurrence the gastrointestinal symptoms. On admission, her abdomen was soft, non-tender and distended with tympanic bowel sounds. Further evaluation with abdominal X-rays showed dilated small bowel loops with air-fluid levels suggestive of small bowel obstruction (SBO). The patient was kept NPO and a nasogastric tube was placed for decompression. Esophagogastroduedonoscopy showed a noncircumferential mass in the proximal jejunum causing approximately eighty percent obstruction of the bowel lumen. Subsequent pathologic evaluation of the mass was consistent with metastatic adenocarcinoma of the lungs. Immunohistochemical staining revealed malignant cells with immunoreactivity to CK7, TTF-1 and negative to CK20, CDX2, synaptophysin, and chromogranin which was identical to the previous lung biopsy findings. She was diagnosed with adenocarcinoma lung cancer with metastasis to jejunum. Despite continuous supportive treatment, she could not

tolerate oral intake due to functional dilatation of her small bowel with each attempt to start her on oral feeding. With the overall poor prognosis, a percutaneous endoscopic gastrostomy tube was placed, and she was referred for hospice care. IMPLICATIONS/DISCUSSION: Lung cancer is the most lethal cancer in United States with 1.18 million deaths annually. The most common sites of metastasis include lymph node, brain, lung, pleura, adrenal gland, and bone. However, gastrointestinal metastasis from primary lung cancer is very rare. Based on a review of the literature, the prevalence of intestinal metastasis from lung cancer at autopsy was between 4.7 to 14%. According to one study, the prevalence of small intestinal metastasis was 8.1%, gastric metastasis was 5.1%, and large intestinal metastasis was 4.5%. The most common types of lung cancer metastasizing to gastrointestinal tract are large cell or squamous cell. To our best knowledge, this is the first case report of adenocarcinoma of lung with symptomatic jejunal metastasis. Primary lung cancer patients with metastasis to small bowel may present with symptoms of nausea, vomiting, abdominal pain, SBO, gastrontestinal bleeding, perforation or intussusception. Our patient presented with SBO. Non-operative and operative managements are used in patients with SBO. Nasogastric suction and intravenous fluids can sometimes be successful for partial SBO. However, surgery is still the primary treatment for malignant obstruction. For non-operative or terminal patients, alternative management is the use of octreotide as an anti-secretory agent allowing removal of nasogastric tube earlier. Overall prognosis remains to be poor. In conclusion, even though gastrointestinal metastasis from primary lung cancer is rare, it should be recognized and included in the differential diagnosis in patients with prior history of lung cancer who present with obstructive symptoms of the bowel.

RENAL TUMOR-PNEUMOTHORAX-SKIN LESIONS: WHERE THE BIRD DOG POINTS Mahmood Islam 1; Philip Hamby 1; Roger D Smalligan1. 1Texas Tech Univ HSC, Amarillo, Texas. (Tracking ID # 10992)

LEARNING OBJECTIVES: 1. Recognize clinical characteristics of a recently described (19771999) inherited syndrome: Birt-Hogg-Dub syndrome. 2. Diagnose Birt-Hogg-Dub syndrome in patients with characteristic skin lesions, a spontaneous pneumothorax and/or a renal mass.

CASE INFORMATION: A 63-year-old white man presented with left upper quadrant abdominal pain, nausea and vomiting. Several days prior he had noted painless, frank hematuria that resolved spontaneously. He had no history of fever, chills, trauma or chronic weight loss. Past medical history was important for coronary artery disease, diabetes, repeated spontaneous pneumothoraces and having been diagnosed with Birt-Hogg-Dube syndrome (BHD) in 2004 but without any follow-up. Family history was positive for one sister and one nephew with confirmed BHD. Medications were insulin and amlodi-pine/benazepril. On physical exam he had normal vital signs, clear lungs, normal heart sounds, mild left upper quadrant tenderness and multiple 2-5 mm firm, flesh-colored, dome-shaped papular lesions on his face. Abdominal CT scan showed left renal vein thrombosis and a 6 cm left adrenal/renal mass. Laboratory values were unremarkable except for microscopic hematuria. He was anticoagulated and after discussion with experts at the National Institutes of Health was transferred there where he underwent further studies and a left radical nephrectomy/adrenalectomy. The patient recovered and did well.

IMPLICATIONS/DISCUSSION: Though internists do not encounter patients with Birt-Hogg-Dube syndrome on a regular basis, they do frequently see patients with one of the following: abdominal pain, hematuria, a renal mass, renal vein thrombosis, skin lesions or a history of spontaneous pneumothorax. Birt-Hogg-Dube syndrome was first described in 1977 by dermatologists as an autosomal dominant condition of benign tumors of the hair follicle (principally fibrofolliculomas) found on the face, neck or upper trunk that appear in the third or fourth decade of life. By 1999 it was observed that the syndrome also included a predisposition to renal neoplasms, lung cysts, and spontaneous pneumothorax when the cysts rupture. The gene defect has been identified as a germ line mutation at chromosome 17p11.2 which encodes for folliculin, a new protein with unknown function. The largest study of 189 BHD patients showed lung cysts to be present in 89% with 24% suffering at least one pneumothorax. Another study of a subset of the same cohort found renal tumors in 27% of the patients. The

renal neoplasms are often multiple and of benign chromophobe/oncocytic nature but up to 7% have been of clear cell renal cell carcinoma type and have been fatal due to later recurrence and metastasis. This case is important as it will help internists recognize patients who may have Birt-Hogg-Dube syndrome and remind them that close follow-up and screening of family members can identify patients at risk for recurrent pneumothorax or a potentially malignant renal cell carcinoma.

TREATMENT OF SULFASALAZINE-INDUCED DRESS WITH CORTICOSTEROIDS AND N-ACETYLCYSTEINE Joyce Ann Jose

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LEARNING OBJECTIVES: 1. Recognize clinical features of Drug Rash with Eosinophilia and Systemic Symptoms or DRESS. 2. Review treatment options for DRESS, including N-acetylcysteine as a safe adjunct to steroid therapy for severe cases of DRESS.

CASE INFORMATION: A 66 year old female with rheumatoid arthritis presents with fever, rash, and abdominal pain. Three weeks prior, she was started on sulfasalazine for treatment of rheumatoid arthritis. Two weeks after starting sulfasalazine, she developed a facial rash that spread to her trunk and extremities so she discontinued the medicine. She continued to develop fever and abdominal pain, prompting her to present to the emergency room.

Physical exam revealed a confluent, morbilliform rash on her trunk and lower extremities. Laboratory markers revealed a mild leukocytosis, and liver transaminases were elevated at twice the upper limit of normal. Viral hepatitis and EBV serologies were negative. Abdominal ultrasound revealed gallbladder wall thickening without evidence of gallstones. MRI of the abdomen revealed severe acute hepatitis. CT scan identified diffuse, generalized lymphadenopathy.

By hospital day 6, she was febrile and confused. WBC had peaked to 51,800 cells /L with 21% eosinophils, and liver transaminases exponentially increased. Bone marrow biopsy and axillary lymph node biopsy were consistent with a reactive process.

Due to the temporal relation to sulfasalazine initiation and clinical presentation, she was diagnosed with DRESS. She was started on methylprednisolone and transferred to a tertiary care center for liver transplant evaluation. Liver biopsy revealed active hepatitis with lymphocytic infiltrate consistent with a toxic etiology. Her condition continued to deteriorate with persistent fevers, hepatic encephalopathy, coagulopathy, and worsening liver failure. Methylprednisolone dosage was increased and N-acetylcysteine infusion was

started. Fortunately, with this treatment she gradually improved clinically with normalization of lab abnormalities.

IMPLICATIONS/DISCUSSION: Drug Rash with Eosinophilia and Systemic Symptoms or DRESS is a rare, severe drug hypersensitivity syndrome. DRESS is a clinical diagnosis characterized by fever, cutaneous drug eruption, hematologic abnormalities, and systemic manifestations, including lymphadenopathy and organ involvement. The mortality rate is 10% mostly due to liver failure.

The pathogenesis of DRESS is unclear, but it is thought that the offending drug induces a hypersensitivity reaction via defects in its metabolism. This leads to accumulation of toxic metabolites that are directly cytotoxic and indirectly trigger a T-cell mediated immune response. A genetic predisposition is suggested given an increased risk of DRESS in patients with defects in drug metabolism known as slow acetylators.

Withdrawal of the inciting medication is the mainstay of treatment of DRESS. Successful treatment with systemic corticosteroids has been reported. N-acetylcysteine (NAC) has also been suggested as a possible treatment for DRESS as it repletes glutathione stores, an antioxidant involved in drug detoxification pathways.

Cases have described the use of NAC in treating DRESS due to anticonvulsants; however, its use as an adjunct in sulfasalazine-induced DRESS has not been widely reported.
We present a severe case of DRESS due to sulfasalazine therapy for rheumatoid arthritis. The presentation of fever and rash after initiation of sulfasalazine is characteristic of DRESS. This case is notable not only in the severity of systemic manifestations, but also the safe and successful use of corticosteroids and NAC in treating this condition. Given the limited treatment options and high mortality rate, treatment alternatives for severe cases of DRESS are needed. Further studies on the efficacy of NAC as a safe adjunct to steroid therapy in the management of DRESS are warranted.
VERTEBRAL COMPRESSION FRAGILITY FRACTURE IN A PREVIOUSLY HEALTHY 50 YEAR OLD MALE DUE TO IDIOPATHIC HYPERCALCIURIC INDUCED OSTEOPOROSIS Jason Coker 1;
Edward Kilb III 1; Andrew Schreiner 1; Brad Keith1. 1Medical University of South Carolina, Charleston, South Carolina. (Tracking ID # 11016)
LEARNING OBJECTIVES: 1. Recognize osteoporosis in men as an important public health problem 2. Recognize Idiopathic Hypercalciuria as a cause of Bone Mineral DiseaseCASE INFORMATION: The patient is a 50 year old Caucasian male with a history of renal stones who presents with severe back pain after jumping off a diving board. Age appropriate cancer screening has been negative. He has no history of steroid use. Social history is negative for tobacco or alcohol use. Family history is positive for multiple relatives with nephrolithiasis. Exam reveals a well built male in a back brace with a BMI of 29, point tenderness over the lower thoracic spine and an unremarkable lower extremity neurological exam. CT reveals a T12 compression fracture and multiple sclerotic lesions of the spine and pelvis. Routine blood chemistry, thyroid function tests, parathyroid and PSA levels are normal. MRI further characterizes the lesions as benign bone islands. Further testing reveals hypercalciuria and osteoporosis is confirmed with DEXA. He is then treated with HCTZ, a high calcium diet with aggressive oral hydration to minimize stone symptoms, ergocalciferol, bisphospha-nate therapy, and eventually kyphoplasty. IMPLICATIONS/DISCUSSION: Osteoporosis is typically thought of as a disease in women though it has a prevalence of 7% in Caucasian men and 5% in African American men that will only increase as the population ages. The USPTF makes recommendations for screening in women however guidelines for men are not as well studied. Currently the ACP recommends screening men who are at increased risk
according to traditional risk factors, however the age to initiate screening is uncertain. Though several authors have linked Idiopathic Hypercalciuria to lowered BMD this is not a diagnosis that commonly prompts screening for osteoporosis. More data is needed in the male population in order to direct appropriate and cost effective screening. Hypercalciuric Osteoporosis should be considered in the differential for atraumatic fragility fractures.
BILATERAL SIMULTANEOUS FACIAL NERVE PALSY DUE TO EARLY NEUROBORRELIOSIS Daniel Vogel 1; Dagmar Lin 1; Drahomir Aujesky1. 1University Hospital Bern, Bern, N/A. (Tracking ID # 11021)
LEARNING OBJECTIVES: 1. Recognize bilateral simultaneous facial nerve palsy as a possible leading presenting manifestation of early neuroborreliosis 2. Treat early neuroborreliosis, confined to the meninges and peripheral nervous system, with a 14 day course of doxycycline CASE INFORMATION: A 32-year old man presented with a short history of headache and neck pain combined with double vision, slurred speech and drooling. Physical exam showed an afebrile male with meningism and partial bilateral facial nerve palsy, rapidly progressing to a complete palsy within 24 hours. A brain MRI was unremarkable. The CSF revealed a lymphocytic pleocytosis of 717 M/L (90% monocytic), an elevated protein of 2,6 g/L and a decreased glucose quotient of 0,23.
He was diagnosed with early neuroborreliosis by detecting positive Borrelia burgdorferi IgM antibodies in CSF and serum with a positive CSF/serum IgM-index (Fig. 1). In addition to a 14-day therapy with corticosteroids we gave ceftriaxone 2 g daily, then switched to doxycycline 200 mg daily due to the development of ceftriaxone-induced exanthema. Treatment was continued for a total of 2 weeks. Facial nerve palsy resolved completely

within 2 months. IMPLICATIONS/DISCUSSION: Bilateral simultaneous facial nerve palsy is a rare clinical entity with an incidence of approximately 1 per 5 million. It often indicates a serious underlying medical condition warranting urgent medical investigation. The most common causes are borreliosis, Guillain Barre syndrome, idiopathic palsy, leukemia, sarcoidosis, bacterial meningitis, syphilis, leprosy, Moebius syndrome, infectious mononucleosis and skull fracture.

The diagnosis of early neuroborreliosis is challenging, requiring criteria such as suggestive neurological symptoms not otherwise explained, cerebrospinal fluid pleocytosis and Borrelia burgdorferi specific antibodies produced intrathecally. Facial nerve palsy has been found in up to 11% of patients with Borreliosis, being bilateral in 30-40% of these cases. Early neuroborreliosis should be treated with antibiotics to prevent further sequelae. The preferred treatment is intravenous ceftriaxone. Recent investigations however showed non-inferiority of oral doxycycline when compared to intravenous ceftriaxone in early neuroborreliosis confined to the meninges and peripheral nervous system, as in our patient. Prognosis of facial nerve palsy is generally good, although 5-20% experience ongoing neurological impairment.

Major advantages of a 14-day course of oral doxycycline in early neuroborreliosis, confined to the meninges and peripheral nervous system, are the oral route of administration and lower costs when compared to ceftriaxone.

THE TIPPING POINT: METHADONE AS A TRIGGER FOR SEROTONIN SYNDROME Brita Roy 1; F. Stanford Massie1. 1University of Alabama at Birmingham, Birmingham, Alabama. (Tracking ID # 11042)

LEARNING OBJECTIVES: 1. To recall the clinical criteria for diagnosis of serotonin syndrome.2. To be aware of the dangers of polypharmacy.

CASE INFORMATION: A 39-year-old white woman with a history of hypothyroidism, migraine headaches, depression, pseudotumor cerebri, and chronic pelvic pain, presented with fever, tremors and altered mental status. Four days prior to admission, she started methadone for treatment of chronic pelvic pain. Two days prior to admission, she was somnolent and developed dysuria, and was prescribed trimethoprim/ sulfamethoxazole (TMP/SMX). One day prior to admission, her family noticed she was anxious and tremulous, answered questions inappropriately and was unable to perform usual activities. On the day of admission, her mental status significantly worsened and she developed fevers and tremors. The patient was taking 19 medications, including citalopram, buspirone, quetiapine, amitryptiline, levothyroxine, zonisamide, gabapentin, metformin, pravastatin, meclizine, promethazine, prochlorperazine, TMP/SMX and methadone. No recent changes in medications had been made with exception of the addition of TMP/SMX and methadone. On examination, temperature was 101.9F with a heart rate of 122 beats per minute. She was diaphoretic, difficult to arouse, and her speech was unintelligible. Pupils were dilated, but reactive. Fundoscopic, cardiac, pulmonary, and abdominal exams were unremarkable. Extremities were tremulous and rigid with inducible clonus. CT head was unremarkable. Laboratory studies revealed sodium 132, glucose 239, white blood cell count 20, creatine phosphokinase 567, urine drug screen positive for methadone, and urinalysis positive for leukocyte esterase and nitrites. Antibiotics were given for her urinary tract infection, and intravenous fluids and benzodiazepines were given for treatment of serotonin syndrome. The patients mental status, rigidity, and tremors improved within hours of benzodiazepine administration. IMPLICATIONS/DISCUSSION: Serotonin syndrome is an under-recognized and potentially life-threatening condition. Diagnosis is made using the Hunter Serotonin Toxicity Criteria (sensitivity 84%; specificity 97%), which requires one of the following after exposure to a serotonergic agent: spontaneous clonus; inducible clonus with agitation or diaphoresis; ocular clonus with agitation or diaphoresis; tremor and hyperreflexia; or hypertonia, temperature above 100.4F (38C), and ocular or inducible clonus. Serum serotonin levels do not correlate with clinical findings, however elevated white blood cell count and creatine phosphokinase or low serum bicarbonate may be seen. Medications that may induce serotonin syndrome include amphetamines, selective serotonin and/or norepinephrine reuptake inhibitors, antipsychotics,

antiemetics, anti-migraines, and linezolid. In addition, certain synthetic opioids including methadone, pethinidine, tramadol, dextromethorphan and propoxyphene act as weak inhibitors of monoamine reuptake. Our patient was concomitantly using seven of these medications, and the addition of methadone likely precipitated the syndrome. Treatment includes removal of offending agent(s), supportive care, and benzodiazapines for agitation and tremor. Cyproheptadine, a serotonin 2A antagonist, can be used to control continued autonomic instability. In summary, this case is a reminder that as the arsenal of medications at our disposal multiplies rapidly, we must be increasingly aware of the dangers of polypharmacy.

STERNOCLAVICULAR SEPTIC ARTHRITIS DUE TO HAEMOPHILUS INFLUENZAE IN A PREVIOUSLY HEALTHY ADULT TOMOHIRO FUNAKOSHI 1; Simi Padival2. 1Teinekeijinkai Hospital, Sapporo, N/A ; 2Teine Keijinkai Hospital, Sapporo, N/A. (Tracking ID # 11052)

LEARNING OBJECTIVES: 1. To define the characteristics of sternoclavicular septic arthritis and recognize the importance of early diagnosis to avoid preventable complications 2. To recognize Haemophilus influenzae as a rare cause of septic arthritis in adults

CASE INFORMATION: A 72-year-old female with no significant past medical history presented to clinic with a one day history of progressive, upper anterior chest pain which worsened with movement. This was accompanied by pain in the neck and anterior shoulders bilaterally. Three days prior to presentation she had been evaluated for a sore throat and was diagnosed with an upper respiratory infection. She denied any history of trauma to the upper anterior chest, intravenous drug abuse, or any previous joint pain or swelling. On physical exam the patient appeared comfortable and was afebrile. There was mild erythema and tenderness without swelling over the sternoclavicular joints bilaterally. The anterior neck was also tender to palpation. Limited range of motion in the shoulders bilaterally and neck was noted. Laboratory exam showed a WBC of 14,100/mm3 with 86% neutrophils and a CRP of 38.8 mg/dl. While infection was not initially suspected, it could not be ruled out so blood cultures were obtained. An enhanced CT scan of the neck and chest showed marked tissue swelling around the heads of the clavicles bilaterally. The patient returned the next day with worsening erythema and pain. Blood cultures grew gram negative rods and the patient was admitted for sternoclavicular septic arthritis. MRI of the sternoclavicular area showed no evidence of osteomyelitis. She was initially treated with IV ceftriaxone and clindamycin with improvement. On hospital day 4, blood culture results showed Haemophilus influenzae, type b, which was susceptible to ampicillin. She was maintained on IV antibiotics for three weeks and then discharged home on oral antibiotics with full resolution of her symptoms.

IMPLICATIONS/DISCUSSION: Sternoclavicular septic arthritis (SCSA) usually presents with chest pain localized to the sternoclavicular joint (SCJ) or pain referred to the shoulder or neck with limited motion of the upper extremities. Fever when present, is usually low grade and erythema and swelling of the joint may be absent early in the disease course. The initial clinical differential diagnosis of SCSA may include local trauma, rheumatologic diseases, or malignancy of the SCJ area. SCSA is a rare condition that accounts for 1% of all types of septic arthritis. It usually occurs in patients with predisposing factors such as intravenous drug abuse, diabetes mellitus, or trauma. However no underlying medical condition is found in 23 % of patients. H. influenzae is recognized as an important pathogen in adults and may cause acute sinusitis, epiglottitis, and pneumonia. Serotype b (Hib) is a serious form of H. influenzae and is known to cause more invasive diseases such as bacteremia and meningitis, particularly before the era of Hib vaccination. H. influenzae is a rare cause of septic arthritis in adults. Upper respiratory infection is a frequent coexistent extra-articular finding and may be helpful in including H. influenzae in the differential diagnoses of septic arthritis. In the case of a missed diagnosis, serious and life-threatening complications such as a chest wall phlegmon, abscess, or mediastinitis may occur. When the infection is contained within the confines of the joint capsule, conservative treatment with intravenous antibiotics represents the first therapeutic option and may be successful in most patients. Heightened awareness of this unusual infection is needed for timely and appropriate diagnosis and treatment.

UNEXPECTED MRI FINDINGS IN A 24 YEAR-OLD MALE WITH NEWLY DIAGNOSED ACUTE

LYMPHOBLASTIC LEUKEMIA WITH HIP PAIN. Paul Clark, DO 1; Tanya Wroblewski, MD1. 1Department of Medicine, Walter Reed Army Medical Center, Washington DC, Washington, District of Columbia. (Tracking ID # 11065)

LEARNING OBJECTIVES: 1. Identify common and uncommon causes of bone marrow necrosis.2. Distinguish patterns of bone marrow necrosis versus avascular necrosis on MRI

CASE INFORMATION: A 24 year-old male with a recent diagnosis of Philadelphia chromosome positive Acute Lymphoblastic Leukemia (ALL) presented to the Hematology ward for consolidation chemo-therapy. The patient initially presented to his primary care provider in Texas in Oct 2010 for fevers, night sweats, headaches and was treated for a viral syndrome. He returned to the Emergency Room for worsening bone pain, night sweats and pain localized to the left hip. A CBC was done which showed a WBC of 50,OOOuL with circulating blasts noted on the peripheral blood smear. A bone marrow biopsy was performed which revealed leukemic cell necrosis and 56% blasts. Flow cytometry results were consistent with pre-B Cell ALL and FISH was positive for t(9:22). The patient underwent induction chemo-therapy and once FISH results were obtained, his chemotherapy treatment was adjusted to incorporate imatinib based on t(9:22) positivity.

Patient was transferred to Walter Reed Army Medical Center for continuation of his chemotherapy. Patient presented December 2010 for consolidation chemotherapy complaining of persistent left hip pain. CBC at this time showed 4500uL. Plain film radiographs of the left hip, pelvis and L-spine were unremarkable for fractures or acute osseous involvement. A MRI of the left hip was obtained, which showed consolidated low T1 signal and increased T2 signal along borders of red marrow of the left pelvis and left peritrocnhanteric region. This was most consistent with necrosis of leukemia cells within the marrow space versus osteonecrosis, as seen in image one. IMPLICATIONS/DISCUSSION: Bone marrow necrosis (BMN) is a clinicopathological diagnosis distinctly different from avascular necrosis (AVN). BMN is most often associated with hematological malignancies, sickle cell disease, infections, sepsis, antineoplastic drugs, metastatic carcinoma and less commonly anorexia nervosa, hemolytic uremia syndrome and antiphospholipid syndrome. Acute leukemia is the most common underlying malignancy related to BMN. The most common clinical symptoms that BMN can present with are bone pain (80%) which is either diffuse or localized to lower back, fever (70%), and fatigue.

MRI findings of BMN usually show extensive involvement, signal abnormality and central area of variability surrounded by a distinct peripheral enhancing rim. The pattern of signal in BMN may be similar to AVN but BMN usually has a diffuse pattern and commonly involves the spine and pelvis. Another defining feature is that BMN lesions do not usually progress to fractures as often seen with AVN.

MRI findings have different stages of signal abnormalities which are described in the literature (A-D) and correlate with the degree of BMN as described by Tang et al. Our patient demonstrated evidence of Class C findings with T1 hypointensity and T2 hyperintensity.

This patients case of left hip pain and eventual diagnosis of BMN highlights several points. BMN can occur anytime during treatment of a malignancy and in our patients case he was in a remission from ALL however MRI showed active BMN of the hip. Despite the severity of the patients hip pain, the cortical bone was structurally intact and there was no concern for pathological fracture, distinct from cases of AVN.

APICAL HYPERTROPHIC CARDIOMYOPATHY IN A NEW POPULATION Joshua A Barocas 1; Joan Addington-White 1; Patrick Hughes2.

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LEARNING OBJECTIVES: 1. Recognize Apical Hypertrophic Cardiomyopathy (AHCM) as a cause of new heart failure with morbidity and

mortality implications in elderly patients with no previous structural heart disease. 2. Distinguish AHCM from other cardiomyopathies based on echocardiogram and EKG diagnostic criteria.
CASE INFORMATION: An 84 year old Caucasian woman presented with increased dyspnea on exertion. She felt well overall, but noticed a marked decrease in exercise tolerance that began one year prior and has progressively worsened over the past few months. She needed to rest after walking 34 blocks. She denied orthopnea, PND, or lower extremity edema. She also denied chest pain, palpitations, dizziness or syncope. Her medical history was pertinent for paroxysmal atrial fibrillation status post pacemaker placement for slow ventricular response on coumadin, mild aortic valve insufficiency, hypertension controlled on HCTZ, and non-Hodgkin Lymphoma post radiation therapy. Her family history was negative for stroke, myocardial infarction or heart failure. Her blood pressure was 127/70, pulse 92, and respiratory rate 16. Her exam was unremarkable except for crackles at the lung bases, hearts sounds which were irregularly irregular and a laterally displaced apical impulse. Her neck veins were flat and she had no lower extremity edema. Laboratory tests included INR 2.4. ECG demonstrated ventricular paced rhythm with rate of 77. Chest xray showed stable cardiomegaly. A transthoracic echocardiogram (TTE) was obtained. Her ejection fraction was 65%. She had mild mitral regurgitation, normal right ventricle, and moderately dilated atria. Her left ventricle had normal cavity size with moderately increased wall thickness as well as hypertrophy of the apex and increased septal thickness at the apex consistent with apical hypertrophic cardiomyopathy (AHCM). TTEs from 2 and 5 years prior were retrospectively reviewed and showed evidence of early apical hypertrophy. An EKG at age 66 was normal with no signs of LVH, another at age 70 demonstrated LVH. An EKG at age 82 showed anterior T wave changes different than typical LVH. The combination of the EKG tracings and TTEs suggest the phenotypic expression of AHCM after age 66 in this patient.
IMPLICATIONS/DISCUSSION: Hypertrophic cardiomyopathy (HC) is a common problem in general internal medicine that causes significant morbidity and mortality across all age groups. AHCM as a variant of HC may be under-recognized by general internists. AHCM had previously been described in middle-aged Japanese adults, however, a recent case series described elderly Caucasian patients, most of whom had a documented structurally normal ventricle earlier in life, who developed AHCM. This variant HC typically manifests with giant negative T waves on electrocardiography and a spade-like ventricle on echocardiography. Many patients in the case series had a history of hypertension and giant negative T waves on ECG as well an 8% annual risk of stroke when atrial fibrillation was also present despite warfarin. Coronary artery fistulae were found in 6 of 13 patients studied with coronary angiogram. Sequelae of AHCM also include diastolic dysfunction, aneurysms because of the destruction of hypertrophied myocardium, ventricular arrhythmias, and myocardial infarction. The most common cardiac complication is atrial fibrillation, which when associated with AHCM portends a higher incidence of heart failure, sudden cardiac death, and stroke. Treatment includes management of angina, palpitations, and arrhythmias with beta blockers or calcium channel blockers as well as prevention of further remodeling with ACE inhibitors. Anticoagulation is indicated in patients with atrial fibrillation though the mechanism of thromboembolism formation is unknown given the apparent resilience despite aggressive warfarin therapy. More research regarding the underlying genetic and environmental factors influencing AHCM and ideal medical management is needed. Once the diagnosis of AHCM is considered by the general internist, it can be readily evaluated with TTE and EKG and may result in risk reduction of stroke, heart failure, and sudden cardiac death from arrhythmia in elderly adults.

ATYPICAL PRESENTATION OF PRIMARY ADENOCARCINOMA OF THE LUNG Shobhit Gupta 1; richard alweis2. 1Reading Hospital and Medical Center, Sicklerville, New Jersey ; 2Reading Hospital, Reading, Pennsylvania. (Tracking ID # 11095)
LEARNING OBJECTIVES: 1. Differentiating between adenocarcinoma and squamus cell carcinoma of lung 2. Effects of hypercalcemia secondary to neoplasmCASE INFORMATION:Introduction: Adenocarcinoma of the

lung is the most frequent non-small cell lung cancer in the United States comprising 40% of all lung neoplasms. Typical presentation includes a peripherally located mass causing cough, hemoptysis, dyspnea and hoarseness. It is rare for a patient to develop hypercalcemia secondary to adenocarinoma because, unlike squamous cell carcinoma of the lung, it does not produce parathyroid-like hormone. We now present such a case.

Case Presentation: A 56-year old man presented to the emergency room with dyspnea, confusion, and bilateral swelling of his neck. He was stabilized with supplemental oxygen, but initial labs revealed an elevated calcium of 11.4. Admission chest radiograph showed a questionable mass in a central location along the proximal bronchus. CT of the chest and abdomen revealed a 3.2 x 2.8 cm mass in the right upper lobe adjacent to the proximal bronchus with associated hilar adenopathy. Samples of the lung mass and 3 lymph nodes were obtained via bronchoscopy. The final pathological results confirmed a diagnosis of T2N1M0 adenocarcinoma of the lung. Despite lymph node involvement, the patient was considered a good surgical candidate with a plan for adjuvant chemotherapy in the future. The pulmonary and oncologic team expected the patients altered mental status to resolve with right upper lobe wedge resection and consequent improvement in hypercalcemia.

IMPLICATIONS/DISCUSSION:Discussion: Although the diagnosis and treatment for adenocarcinoma is similar to the other histiologic types of non-small cell lung cancer, this patient presented with findings inconsistent with those typical of adenocarcinoma. The findings of hypercalcemia and lung mass in a central location are predominately consistent with squamous cell carcinoma. Hypercalcemia secondary to squamous cell carcinoma is due to the production of parathyroid-like hormone which increases the blood levels of calcium. Hypercalcemia causes confusion and change in mental status which was evident in our patient. Furthermore the location of the lung mass was in a central location which is also generally consistent with squamous cell carcinoma while adenocarcinoma is most commonly found in a peripheral location. Despite clinical signs pointing towards a diagnosis of squamous cell primary of the lung, a true diagnosis cannot be made without histological confirmation.

ACUTE MYOCARDIAL INFARCTION IN A YOUNG FEMALE WITH SICKLE CELL DISEASE Toralben K Patel 1; Shobha Vootukuri 1; Chinmay Patel1. 1Lankenau Medical Center, Wynnewood, Pennsylvania. (Tracking ID # 11098)

LEARNING OBJECTIVES: 1. Recognize that not all chest pain in patient with sickle cell disease is acute chest syndrome 2. Discuss diagnosis and management strategies of myocardial infarction in sickle cell diseaseCASE INFORMATION: 24 year old female with past medical history significant for sickle cell disease presented with fever and chest pain for 7 days. She was recently treated with outpatient course of antibiotics without any response. On exam, patient was in mild distress secondary
to pain with temperature of 103.3 F, pulse 120/min, blood pressure 98/ 54 and pulse oximetry of 98% on room air. Laboratory data revealed hemoglobin of 7.6, white cellcount 10.6 and troponin I of 1.75. Electrocardiogram showed 1 mm ST segment elevation in leads III, aVF and V6. Patient received aggressive hydration and 2 units of packed red cell transfusion. Along with dynamic EKG changes, troponin I continued to trend up with peak of 3.17. Patient was started on aspirin, heparin, lopressor and nitroglycerin for acute coronary syndrome with close monitoring in the cardiac intensive care unit. Echocardiogram showed isolated inferior wall motion abnormality in a single segment of the left ventricle with preserved ejection fraction. Hemoglobin electrophoresis showed very high HbS level of 60.3. Patient underwent exchange transfusion following which her symptoms gradually abated. She was discharged in a good condition on hydroxyurea with appropriate follow-up and documented negative exercise stress test prior to discharge.

IMPLICATIONS/DISCUSSION: Vaso-occlusive crisis are well-known complications of sickle cell diseases (SCD). However, sickling in the heart resulting in ischemia or infarction is not commonly reported. In fact, some reports describe sickle cell disease as protective against large vessel coronary artery disease. The exact mechanism of myocardial infarction in sickle cell disease is unknown, although the combination of stress of

anemia-morphological, rheological and biochemical effects of the sickle cells themselves-and platelet abnormalities may play a role. These patients often have few or no traditional risk factors for coronary artery disease, and risk stratification tools such as the Thrombolysis in Myocardial Infarction (TIMI)and Global Registry of Acute Coronary Events (GRACE) models place these patients at low risk. Non-specific changes in cardiac enzymes and ECG may be of little diagnostic value. Coronary angiography is usually normal and may not be recommended as a routine procedure in young SCD patients with low conventional risk profiles. In sickle cell patients who present with chest pain as an element of their sickle cell crisis, the clinician must consider acute myocardial infarction in the differential along with more common entities like acute chest syndrome.

ITCHING FOR A DIAGNOSIS: A WOMAN WITH PRURITIS, NAUSEA, AND VOMITING Sarah Weiss 1; Jordan Turk1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 11104)

LEARNING OBJECTIVES: 1. Recognize the differential diagnosis of severe transaminase elevation. 2. Diagnose acute viral hepatitis C. CASE INFORMATION: A 55 year-old Guyanese woman presented with 2 days of pruritis, nausea, and vomiting. One week ago, she was prescribed dicloxacillin for a mild cellulitis. Several days after starting the antibiotic, she noted onset of fatigue, nausea, pruritis, dark urine, and light-colored stools. She denied fever, abdominal pain, or diarrhea. Past medical history was significant for coronary artery disease, hypertension, and hyperlipidemia but all were well controlled on her current medications including aspirin, metoprolol, rosuvastatin, and lisinopril. She had a known penicillin allergy but denied any other new medications or herbal remedies. She had no known history of hepatitis, alcohol abuse, toxic ingestions, or intravenous drug use.

She was afebrile, with stable vital signs. Jaundice and scleral icterus were present. The abdomen was soft, nontender, nondistended, and with no evidence of ascites. Initial laboratory testing was remarkable for: WBC 5.9 x 10^3/uL, albumin 3.8 g/dL, INR 1.1, total bilirubin5.1 mg/dL, direct bilirubin 3.3 mg/dL, alkaline phosphatase 82 U/L, aspartate aminotransferase (AST) 815 U/L, and alanine aminotransferase (ALT) 1102 U/L. Right upper quadrant ultrasound showed

mild periportal edema, but did not demonstrate any gallbladder pathology or biliary ductal dilatation.

The patient was admitted for a work-up of her hepatocellular disease. All medications were held. AST and ALT peaked at 1394 U/L and 1726 U/L, respectively. Hepatitis A and B serologies, ANA, anti-smooth muscle and anti-LKM antibodies, CMV, EBV, and HIV were all negative. Anti-hepatitis C virus (HCV) antibody was positive. No prior serology was available for comparison. Hepatitis C viral load was 60,000,000 IU/L. To determine the etiology of the severe transaminase elevation, a liver biopsy was performed and revealed parenchymal disease with severe lobular disarray consistent with acute viral hepatitis C. IMPLICATIONS/DISCUSSION: Transaminase elevation is a common laboratory abnormality encountered by the general internist. Severely elevated transaminases (>1000 U/L) indicate hepatocellular injury. The differential diagnosis includes viral, autoimmune, drug-induced, or ischemic hepatitis.

Acute hepatitis C is usually asymptomatic and is rarely diagnosed. Internists frequently screen patients for viral hepatitis C based upon evidence of liver disease. Distinguishing between acute and chronic hepatitis C can be challenging because the presence of anti-HCV antibodies, HCV RNA, and elevated transaminases are found in both phases. Anti-HCV antibodies are usually detectable 3 to 15 weeks after infection but serologic testing is not enough for diagnosis. HCV RNA by PCR is the earliest marker of infection and is positive days to weeks after exposure. Positive HCV RNA and anti-HCV antibody seroconversion are diagnostic of acute hepatitis C. However, if the patient has not been tested before, the timing of seroconversion cannot be determined. Diagnosis of acute hepatitis C becomes more complicated if there is no history of an acute exposure or if another diagnosis is plausible. In this case, our patients use of potentially hepatotoxic medications also

suggested an idiosyncratic drug-induced hepatitis. In order to determine the diagnosis and to guide our subsequent management, a liver biopsy was performed. In diagnosing acute hepatitis C, general internists should be aware that 25% of patients spontaneously clear the virus after 8 to 12 weeks. The remainder of infected patients have an 80% increased risk for developing chronic liver disease and should be referred to a hepatologist.

MULTIPLE MYELOMA PRESENTING AS RENAL FAILURE Haq Nawaz 1;
David Elnicki2. 1University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania ; 2University Of Pittsburgh Medical Center, Wexford, Pennsylvania. (Tracking ID # 11108)

LEARNING OBJECTIVES: 1. Recognize clinical features of multiple myeloma. 2. Distinguish myeloma kidney from other etiologies of acute renal failure.

CASE INFORMATION: Patient is a 62 year old female with past medical history of ischemic heart disease and diabetes mellitus who presented with two week history of nausea, non-bloody, non-bilious vomiting and a thirteen pound weight loss. There was no abdominal pain, melena or hematochezia. Her examination was remarkable for pallor. Her laboratory work up showed hypochromic macrocytic anemia with H&H of 9.4 and 27.3 respectively as well as thrombocytopenia with platelet count of 149,000. In addition she had acute renal failure with a BUN/Cr of 72/13.4 and anion gap metabolic acidosis and a random urine protein to creatinine ratio of 4.5 suggestive of nephrotic range proteinuria. SPEP revealed the presence of monoclonal proteins. Bone marrow biopsy confirmed the diagnosis of plasma cell myeloma. Kidney biopsy showed monoclonal kappa light chain deposition disease involving glomeruli and tubular basement membrane. Findings on kidney biopsy were consistent with myeloma kidney/cast nephropathy. Since her renal
failure did not resolve the patient was started on hemodialysis and discharged from the hospital with plans to follow up with hematology clinic as out-patient for chemotherapy. IMPLICATIONS/DISCUSSION: Renal failure and infections are one of the major causes of death in patients with multiple myeloma. There are several factors which are responsible for renal dysfunction in patients with myeloma cast nephropathy. These include direct toxic effect of Bence Jones proteins to tubular cells, obstruction of distal tubules by proteinaceous casts, reduced GFR and multiple electrolyte abnormalities. Patients with multiple myeloma and renal failure also have poor prognosis as compared to patients with multiple myeloma without renal insufficiency. Symptoms could include weakness, weight loss, dyspnea, edema, dehydration as well as numbess and burning pain in the lower extremities due to peripheral neuropathy. Once the diagnosis is established treatment includes avoidance of dehydration and contrast agents, treatment of electrolyte abnormalities and concurrent infections, hyperuricemia, implementation of hemodialysis and chemotherapy in select cases.

A BUGS LIFE Jason Noam Salamon 1; Sheira Schlair2. 1Albert Einstein College of Medicine, Bronx, New York ; 2Montefiore Medical Center, Bronx, New York. (Tracking ID # 11115)

LEARNING OBJECTIVES: 1. Identify the association between long term IUD usage and systemic actinomycosis. 2. Recognize that actinomycetes israelii is a common inhabitant of intestinal and genital tract but rarely results in systemic infectionCASE INFORMATION: A 40 year-old woman of Latvian descent presented with one month of fatigue, weight loss, and abdominal swelling. One month prior to admission she began feeling fatigued with minimal exertion. Her husband noted that she appeared pale with significant weight loss despite adequate oral intake. Associated symptoms included intermittent low grade fevers. Last menses was 8 months prior to admission compared to a history of regular menses. She denied a family history of cancer. On admission, she was noted to be pale, cachectic, and in moderate distress. Heart rate was 117, respiratory rate 35, oral temperature 101.3 F, and oxygen saturation was 92%. Her abdomen was distended without tenderness or guarding. Fluid wave and shifting dullness were present. A solid fixed mass below her umbilicus, a 1 cm left axillary lymph node and a 2 cm erythematous purulent ulcerating lower back mass were noted. Pelvic exam revealed thick yellow discharge and a palpable posterior cervical mass. Initial laboratory studies revealed hemoglobin of 5, MCV of 76 and 25,000 white blood cells. CT chest/abdomen/pelvis revealed multiple large ill-

defined masses in the uterus, ovary, liver, peritoneum and soft tissue of the back with a dudeno-pleurocutaneous fistula, as well as an intrauterine device (IUD). She was transfused with packed red blood cells, placed on a non-rebreather mask and underwent paracentesis. Paracentesis removed 3 liters of fluid and was negative for bacteria or dysplasia. Her IUD, which had been in place for over 10 years, was removed. She was treated with broad spectrum antibiotics with resolution of fever, tachypnea, and tachycardia. PPD was negative. Laparoscopic biopsies of multiple masses were negative for malignancy and tissue was negative for mycobacteria and fungi but positive for actinomycosis. She was diagnosed with systemic actinomycosis and treated with high dose penicillin. Her symptoms improved and she was discharged in stable condition. IMPLICATIONS/DISCUSSION: The use of IUDs as a contraceptive method is increasing, especially outside of the United States. In Eastern Europe and Asia between 27-50% of women choose IUDs for contraception. Actinomycosis israelii is a common anaerobic gram positive

non-acid-fast filamentous bacterial inhabitant of normal intestinal and genital tracts. Approximately 7% of Pap smears have positive actinomyces cultures, however treatment is reserved for symptomatic patients as there is no correlation between colonization and disease. Systemic infection uncommonly occurs through invasion of breached necrotic tissue causing granulomatous disease, abscesses and fistulas. Cervicofacial involvement is most common (50%) followed by abdominal involvement (20%) and rarely hematogenous spread. Common risk factors include recent trauma or surgery, especially with perforation, and long term IUD placement of on average 8 years. Clinical signs and symptoms are non-specific, such as indolent constitutional symptoms and abdominal masses, making diagnosis difficult and causing increased confusion with M. tuberculosis, inflammatory bowel disease and malignancy. Diagnosis is made using histological specimens showing sulfur granules and a positive anaerobic culture. Approximately 90% of IUD associated actinomycosis infection is limited to the pelvis and includes tubo-ovarian abscesses. Patients with pelvic pain or uterine tenderness who have evidence of actinomyces on Pap smear should have IUD removal sent for culture as actinomyces flourishes on foreign bodies. Treatment for systemic actinomycosis consists of high dose penicillin for 612 months (first 6 weeks 1020 million units IV then oral 4 g/d). Women who choose to use an IUD for contraception should be informed of the small risk of actinomycotic infections, particularly when the IUD is left in place for an extended period of time.

CHRONIC MEGACOLON: HIRSCHSPRUNGS DISEASE IN AN ADULT? Kamyar Shahedi 1; James Wilson 1; Darin J Saltzman1. 1Olive View - UCLA Medical Center, Sylmar, California. (Tracking ID # 11128)
LEARNING OBJECTIVES: 1. Assess the different etiologies of chronic megacolon 2. Recognize that Hirschsprungs disease may present in adulthoodCASE INFORMATION: A 22-year-old man presented in October 2010 complaining of chronic fatigue and failure to thrive. He had a significant history of refractory chronic constipation since age 2, with limited relief from laxatives and other bowel regimens. He had no other medical conditions and used no other medications. On physical exam he appeared thin, with a soft, non-tender but distended and tympanic abdomen. An abdominal CT scan showed an impressive markedly distended rectosigmoid and descending colon measuring up to 17 cm in diameter, filled with stool and air, without evidence of perforation. Laboratory work-up was remarkable for a microcytic anemia with hemoglobin 7.9 g/dl, hematocrit 25.2 percent, and MCV of 68. Hemeoccult testing was positive and iron studies were consistent with iron deficiency anemia. Further work-up was unremarkable including thyroid studies, stool studies, ANCA, ANA, HIV, and serologies for Trypanosoma cruzi. The patient was treated with tap water enemas and polyethylene glycol while in-house with mild improvement. After discharge a CT scan obtained for monitoring revealed persistent dilated descending and sigmoid colon with slight decrease in stool content without otherwise interval change. He was scheduled to undergo endoscopic evaluation for further diagnostic work-up, but missed his appointment. We plan to obtain rectal biopsy for tissue diagnosis and further management of what is believed to be an adult presentation of Hirschsprungs disease, a disease usually seen in infancy.

IMPLICATIONS/DISCUSSION: Chronic megacolon describes longstanding dilated and elongated large bowel which may be congenital or acquired. A large differential exists for the cause of chronic megacolon, but the most common acquired cause worldwide is infection with Trypanosoma cruzi (Chagas disease), which destroys ganglion cells in the enteric nervous system. Other causes include chronic constipation caused by slow transit secondary to medications and metabolic disorders such as hypothyroidism. Neurologic diseases (multiple scelerosis, diabetic neuropathy) or certain systemic diseases (sceleroderma, mixed connective tissue disease) may also cause progressive colonic dilatation. Congenital mega-colon caused by Hirschsprungs disease results from failure of migration of neural crest cells to the distal large intestine. The absence of ganglion cells results in failure of relaxation and functional obstruction with the proximal healthy bowel becoming progressively dilated. Although commonly presenting in infancy, milder cases may present in adulthood. These patients commonly have a history of chronic refractory constipation since a young age with failure to thrive, similar to our patient. Anorectal manometry showing absence of rectoanal inhibitory response may indicate Hirschsprungs. However, rectal biopsy showing an absence of ganglion cells on histology is needed for confirmation and is the gold standard. Chronic anemia is not typical in Hirschsprungs disease although two cases in adults have been reported in the literature. In these cases, the anemia was caused by compromise of the vasculature by colonic distention and superficial inflammation of the mucosa. Recognition of Hirschsprungs as a potential etiology in adults with chronic megacolon can be life changing for these patients. Surgical resection of the distal affected segment is curative and may prevent catastrophic presentations such as perforated bowel as well as dramatically improve quality of life.

SYMPTOMATIC GASTRIC SARCOIDOSIS IN A PATIENT WITH SYSTEMIC SARCOIDOSIS ON CHRONIC STEROID THERAPY ANDH. PYLORI INFECTION

Eduardo Javier Bazan 1; Jose Fernando Echaiz 1; Jennifer Swiderek1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 11130)

LEARNING OBJECTIVES: 1. In the following report, we present a case of gastric sarcoidosis, in order to recognize the complexity of the evaluation of this rare condition when it coexists with peptic ulcer disease. 2. Assess the severity of the disease and discern whether specific treatment is needed when there is coexistence with H. pylori-related gastritis.

CASE INFORMATION: A 50-year-old female presented with complaint of nausea and vomiting. Past medical history is significant for well controlled Type 2 diabetes, hypertension and multisystemic sarcoidosis on chronic therapy with systemic steroids. Her symptoms had been present for 8 months prior to admission. Her symptoms usually responded to antiemetic medications; however, they worsened significantly leading to persistent vomiting and volume depletion 3 days prior to admission. There was no abdominal pain, diarrhea or constipation associated with her symptoms. She had a history of peptic ulcer disease 3 years before, with evidence of ulcers and H. pylori infection for which she received standard treatment. Despite this, she continued to have abdominal pain and, at that time, the treatment for her sarcoidosis was ineffective as well. She received a second course of treatment for H pylori 2 years before admission. On admission, oropharyngeal and abdominal examination did not show abnormalities. Liver profile showed AST 49 IU/L (<35), albumin2.4 g/dL (3.2-4.6) and alkaline phosphatase 456 IU/L (0140) with normal bilirubins. Abdominal ultrasound showed a liver with a homogeneous echo pattern. Amylase was normal. Initial treatment included intravenous hydration and proton pump inhibitor as well as bowel rest, with improvement of symptoms. Prednisone was continued at the same dose of 10 mg daily. Esophagogastroduodenoscopy

(EGD) showed diffuse gastropathy without ulcers. Biopsy demonstrated chronic gastritis with non-necrotizing granulomas consistent with sarcoidosis and immunostain for H. pylori was positive.

IMPLICATIONS/DISCUSSION: Sarcoidosis is a chronic multisystemic disease of unknown etiology

characterized by the formation of noncaseating granulomas. Lungs are involved in 90% of the cases. Involvement of the gastrointestinal (GI) system occurs in 0.1% to 0.9% of cases, affecting most frequently the liver and stomach. Our case exhibits the complexity that accompanies the evaluation and management of coexistent GI sarcoidosis and H. pylori infection. It is unclear whether this patients symptoms were the result of H. pylori gastritis, gastric sarcoidosis, or both. Infection with H. pylori does not necessarily result in peptic ulcer disease or symptomatology. And it is uncertain whether sarcoid granulomas were indeed present at the time of the previous EGD and simply not found on those particular biopsies. In our case, the history of lack of response to both treatments for H. pylori and for sarcoidosis in the past makes it difficult to establish the major determinant in the disease process. It is possible that the H. pylori infection was not eradicated. Treatment of gastric sarcoidosis with steroids has been reported in the literature to result in dramatic clinical responses; however, the dose of systemic steroids in our case was consistently low throughout her course of illness. It is also possible thatH. pylori in this patient could be probably fortuitous considering the high incidence of H. pylori infection in the general population. The clinical manifestations of gastric sarcoidosis are abdominal pain, weight loss, nausea, vomiting, early satiety and upper GI bleeding, probably related to mucosal ulceration. It is not known whether a relation exists between the H. pylori infection and the formation of mucosal granulomas. Gastric sarcoidosis should always be considered in patients who have symptoms of dyspepsia and evidence of sarcoidosis in other organ systems regardless of whether they have a history of peptic ulcer disease.

ACUTE MULTIORGAN FAILURE SYNDROME IN A PATIENT WITH SICKLE CELL AND BETA THALASSEMIA DISEASE Mili Shum 1;

Sharon Leung 1; Darlene LeFrancois2. 1Montefiore Medical Center, Bronx, New York ; 2Montefiore Medical Center, New York, New York. (Tracking ID # 11132)

LEARNING OBJECTIVES: 1. Recognize acute multiorgan failure syndrome as a severe, life threatening complication of sickle cell vasoocclusive crisis 2. Manage acute multiorgan failure syndrome in sickle cell diseaseCASE INFORMATION: A 46-year-old African-American man presented with subjective fever, productive cough and generalized body aches including chest discomfort for two days. The patient had sickle/beta thalassemia disease complicated by two prior episodes of acute chest syndrome as well as avascular necrosis of several large joints. On arrival, his BP was 114/70, pulse 89, respiratory rate 20 and temperature 100.2 F. The patient was in no distress and had entirely normal mentation. Exam was notable for scleral icterus and tenderness on palpation of ribs, legs, and right upper quadrant of abdomen; all typical of his painful crisis episodes. Auscultation of the lungs was clear. Pertinent laboratory findings included WBC 9.1 k/uL, Hgb 11.5 g/dL (baseline 8.7 g/dL), reticulocyte count 1.7% (absolute count 70,000), platelet 262 k/uL, BUN 15, creatinine 1.3 mg/dL, LDH 454, indirect bilirubin 1.7 mg/dL, and transaminases within normal range. All cultures were negative and chest x-ray demonstrated no infiltrate. The patient received intravenous fluid repletion and analgesics. Within 24 hours, the patient became disoriented and demonstrated acute multiorgan dysfunction. Laboratory data
showed WBC 15 k/uL, Hgb 7.5 g/dL, reticulocyte count 4.6% (absolute count 148,300), platelet 36 k/uL, K 5.8, creatinine3.8 mg/dL, LDH 1310, indirect bilirubin 4.7 mg/dL, AST 765 U/L, ALT 488 U/L, and CPK 1556 U/L. Peripheral blood smear showed toxic granulation of polymorphonuclear leukocytes, rare schistocytes and target cells. Repeat chest x-ray and blood cultures were negative. The patient was transferred to intensive care unit and emergent exchange transfusion was performed with six units of packed erythrocytes. Within 12 hours of this one time exchange transfusion his mental status completely cleared. In addition, his renal function and platelet count normalized over the next 2 days; transminases and CPK returned to normal before discharge home on hospital day 6.

IMPLICATIONS/DISCUSSION: Vaso-occlusive episodes result in significant morbidity and occasional mortality in patients with sickle cell disease. Acute multiorgan failure syndrome is defined as the acute development of severe dysfunction of at least 2 of 3 major organs in the setting of a sickle cell vaso-occlusive episode. While it

carries a high mortality rate of 40-60%, it is encountered infrequently during an acute vaso-occlusive episode. This disastrous complication is even rarer in patients with concurrent alpha or beta thalassemia since these patients have higher levels of hemoglobin A and less hemoglobin S. This case highlights an unusual yet classic case of the acute multiorgan failure syndrome in a sickle/beta thalassemia patient. Although the patho-physiology of acute multiorgan failure in sickle cell crisis is partly unclear, the dramatic fall in hemoglobin levels immediately preceding organ failure and the rapid recovery with simple or exchange transfusion of packed erythrocytes indicates that it is caused by extensive microvascular occlusion and tissue ischemia of affected organs by sickled cells. Notable features of this case include the extensive and precipitous progression of neurologic, hematologic, renal, hepatic, and muscle dysfunction and the rapid recovery of clinical status after plasma transfusion, with clearing of encephalopathy, and recovery of organ function. High baseline hemoglobin levels, as was present in our patient, may represent a predisposing factor to this disastrous complication of vaso-occlusion. The prognosis for complete recovery is good only if the syndrome is recognized early and treated aggressively with transfusion support. Thus, prompt recognition of this syndrome and initiation of transfusion therapy can be life-saving.

CEFIPIME INDUCED NEUROTOXICITY Madan K Badal 1; Amal Kebede 1; Erin Phillips 2; Benzamin Lloyd3. 1The reading hospital medical center, west reading, Pennsylvania ; 2The reading Hopsital Medical center, west reading, Pennsylvania ; 3The reading hospital Medical Center, west reading, Pennsylvania. (Tracking ID # 11133)

LEARNING OBJECTIVES: 1. Recognize that an acute change in mental status after starting a Beta lactam antibiotic regimen can be the result of the antibiotic induced neurotoxicity2. EEG can be a useful tool to distinguish the cause of acute mental status change when other laboratory work up is inconclusiveCASE INFORMATION: An 80 year-old nursing home female resident with stage III chronic kidney disease was admitted with a two week history of productive cough, fever, and leukocytosis. Chest x-ray showed right upper lobe consolidation and she was empirically started on vancomycin and cefepime for health care associated pneumonia. Three days after beginning treatment, she lost orientation to time, place and person and became agitated. Physical examination was normal except crepitations at right upper lobe. A work up including complete blood count, lactate, liver functions tests, ammonia level, and MRI of the brain were within normal limits. The patients creatinine was stable. The following day, her condition further deteriorated. She was responsive

only to painful stimulation; however she did not have neck rigidity or any focal neurological deficits. EEG was ordered showing frequent frontal triphasic waves, suggestive of a metabolic encephalopathy. Cefepime was discontinued, without improvement over the next day. A repeat EEG was obtained showing persistent and continuous runs of generalized high amplitude bilaterally symmetrical triphasic sharp waves, suggestive of NCSE. Phenytoin was started in conjunction with hemodialysis. Her neurological status improved after dialysis as seen clinically as well as with resolution of epileptiform activity on EEG. IMPLICATIONS/DISCUSSION: Cefepime induced neurotoxicity is a relatively rare consequence of cefepime administration which is seen more often in elderly patients and those with impaired renal function. The presentation of cefepime induced neurotoxicity ranges from simple encephalopathy with confusion, myoclonus, and asterexis to nonconvulsive status epilepticus(NCSE), coma and even death. A typical electroencephalogram (EEG) associated with NCSE typically shows triphasic sharp waves. Repeat EEGs are necessary to monitor improvement after cefepime discontinuation, anticonvulsant therapy, and dialysis. Patients with impaired renal function generally improve with hemodialysis as only 15% of cefepime binds to serum protein. Knowledge and awareness that cefepime can cause neurotoxic clinical manifestations with characteristic EEG findings is essential for clinicians in early identifying and treating this potentially lethal but reversible complication. The appropriate renal dosing of the cefepime can minimize this complication

A FAILING HEARTTHE FIRST MANIFESTATION OF MULTIPLE MYELOMA Salman Jamaluddin Bandeali 1;

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LEARNING OBJECTIVES: 1. Recognize congestive heart failure may be the first initial presentation of multiple myeloma (MM).2. Review amyloid cardiomyopathy(CMP) and its association with multiple myeloma.

CASE INFORMATION: A 58-year-old male with HTN for 5 years and a recent embolic stroke secondary to paroxysmal atrial fibrillation presented with worsening shortness of breath, orthopnea, and paroxysmal nocturnal dyspnea for 2 weeks. Physical exam was remarkable for elevated JVP, pulmonary crackles up to mid zones bilaterally, pedal edema, and residual left sided weakness. Laboratory studies showed Hb14.1 g/dl, BNP 1396 pg/mL, creatinine 1.1 mg/dl, and calcium9.6 mg/dl. EKG revealed normal sinus rhythm, low voltage QRS with nonspecific T wave inversions in V1,2,3. A chest x-ray showed pulmonary congestion and pleural effusions. Cardiac ischemia was ruled out by negative cardiac enzymes. The patient was diuresed and responded well. An echocardiogram reported an ejection fraction of 20% with generalized left ventricular hypokinesis and concentric biventricular hypertrophy. The ejection fraction has been steadily declining from 55 % to 20% over a period of one year. Initially, his heart failure was attributed to his HTN. However, a coronary angiography revealed mild atherosclerotic disease, and the right heart catheterization demonstrated findings consistent with restrictive CMP with associated pulmonary hypertension. Infiltrative disease was considered. Serum ferritin, ceruloplasmin, ACE levels were all negative. Serum protein electrophoresis was significant for a monoclonal IgG spike of 1.5 g/dl, and Beta2-microglobulin was 3259 ng/mL (4500 ng/ml). Further workup showed multiple lytic lesions in the left femur, glenoid and humerus bilaterally. UPEP identified 2 monoclonal peaks IgG kappa and lambda Bence Jones protein. An abdominal fat pad biopsy tested positive for amyloid with Congo red stain. A bone marrow biopsy revealed 30-40% infiltration of plasma cells positive for CD38. A diagnosis of MM with an initial presenting feature of cardiac amyloidosis was made. He was started on bortezomib and dexamethasone. IMPLICATIONS/DISCUSSION: The common causes of systolic heart failure are ischemic heart disease, hypertension, valvular disease, and dilated CMP with only 5% being infiltrative. Amyloid CMP is a rare condition. About 10% to 15% of patients with multiple myeloma may develop overt amyloidosis during the course of their disease. Only one case in an Italian literature reported cardiac amyloidosis manifesting as the initial presentation. Typically, patients with amyloid CMP present with right sided heart failure, and pulmonary edema is rare. Uniquely, our patient had pulmonary edema. Diagnostic clues usually include low voltage EKGs and echocardiogram showing left ventricular wall thickening with diastolic dysfunction. The classic granular and sparkling pattern on echocardiogram is identified in only 26% of patients with amyloid CMP. Treatment is with supportive therapy. Digitalis should be used cautiously due to its potential binding to the amyloid fibrils, increasing its susceptibility for toxicity. In patients with MM, the presence of cardiac amyloidosis is an independent poor prognostic factor with a median survival of 1.1 years after diagnosis of heart involvement and 0.75 years after onset of heart failure. Only one third of the patients with MM are eligible for stem cell transplant. In the phase I VELCADECAN2007 study, the combination of bortezomib with dexamethasone has revolutionized the treatment of AL amyloidosis resulting faster hematological response and possible prolonged survival. In the literature, there are two cases reporting improvement of myocardial functionality by at least 20% after treatment with bortezomib and dexamethasone in addition to hematological and clinical remission. In conclusion, congestive heart failure is a common presentation requiring work up; recognizing amyloid CMP may be the first manifestation of MM is critical for prompt diagnosis and treatment to warrant a better outcome.

BACTERIAL OVERGROWTH IN AN OSTOMY RESPONSIVE TO RIFAMIXIN THERAPY. Bryan Jesus Romero 1; Priyanka Ashish Vyas 2; Anthony Donato3. 1Reading Hospital, Reading, Pennsylvania ; 2Reading hosptial and medical center, Wyomissing, Pennsylvania ; 3Reading Hospital, Birdsboro, Pennsylvania. (Tracking ID # 11145)

LEARNING OBJECTIVES: 1. Short bowel syndrome has a unique set of medical problems for the internist

including bacterial overgrowth, B12 deficiency, and kidney stones2. Diarrhea can be an especially morbid concern, as large-volume diarrheas without bowel surface area to absorb them can lead rapidly to hypotension and vascular collapse.
CASE INFORMATION: 67 year-old male with history of rectal cancer status post ileostomy presented to the hospital twice within one week due to symptoms of increased output in his ileostomy. In the first presentation he was hypotensive and had new renal failure, with creatinine going from 1.0 mg/dl to 3.3 mg/dl but responding immediately with correction of renal failure with saline within 2 days. One week later, returned to the ER with dizziness on standing, hypotension and creatinine of 5.0 mg/dl. Pt reported no risk factors for diarrhea, no travel history, no change in diet, and no sick contacts at home. He was taking metformin, but had been on it for years without diarrhea. His ileostomy had been in working properly since 2003. In the hospital patient require aggressive fluid repletion and creatinine slowly improved. Stool analysis for blood, Clostridium difficle toxin, ova and parasite, and routine cultures were all negative. Given the lack of a new medicine or infection, bacterial overgrowth was suspected, and an empiric trial of Rifaximin was undertaken. On day three stools were

solid, output was to a minimum, and he was tolerating solids. Patient was discharged to finish two weeks of Rifamixin with PRN immodium and to date has not returned to the hospital. IMPLICATIONS/DISCUSSION: Bacterial overgrowth is a common cause of diarrhea in short bowel syndrome. Rifamixin is an antibiotic that is non absorbable in the gut, and can alter the flora responsible for bacterial overgrowth. Patients with ileostomies presenting with acute diarrhea and negative stool cultures may benefit from rifamixin therapy to control overgrowth of gram negative organisms.
A CASE OF HEALTHYATTENTION-SEEKING BEHAVIOR Wendy Gray 1;
Wendy Gray1. 1Boston University Medical Center, Boston, Massachusetts. (Tracking ID # 11149)
LEARNING OBJECTIVES: 1. Strategically diagnose causes of attention-seeking problem behavior in patients with Intellectual and/or Developmental Disabilities (ID/DD) who have communication challenges.2. Recognize premenstrual symptoms as an etiology of problem behavior in female patients Intellectual and/or Developmental Disabilities (ID/DD) who have communication challenges.
CASE INFORMATION: A 29-year-old female with cerebral palsy and communication challenges presented to Primary Care accompanied by the manager of her Group Home, who raised concerns of problem behavior. The behavior was described as attention-seeking and demanding in nature, occurring around 3 pm, upon return from Day Program, when the patient would complain of pain and request a prn dose of ibuprofen. Group home staff suspected that the patients demands were related to a need for attention rather than to physiologic pain, for three reasons: the patients inconsistent and vague description of her pain; the ability to distract the patient from her pain; and the potential for copycat behavior, since another group home resident also requested and received prn analgesics on a regular basis. Social history revealed the patient to be independent in many activities of daily living, able to self-toilet and dress herself privately. She communicated using facial expressions, pointing, and verbalization of yes, no, and select other words. At the time of initial presentation, the patient had no complaint of pain. Lab work and physical exam were unrevealing. With the premise that the behavior was attention-seeking in nature, an empiric trial of a daily afternoon coffee breaks with social interaction was initiated. At one month follow-up, this intervention seemed to be having great effect, however, the behavior eventually resumed in an infrequent and apparently random manner. A connection to the patients menstrual cycle was made when the patient requested a sanitary pad during a week of increased frequency of behavioral episodes. Ensuing conversation with the patient revealed that the episodes in question were, in fact, related to monthly cramping and headaches associated with menses. Changing the ibuprofen prescription from prn to regularly scheduled TID dosing during the week of menses resulted in lasting success and relief to the

patient and group home staff.
IMPLICATIONS/DISCUSSION: Diagnosis and management of medical etiologies underlying problematic behavior is a common reason adults with Intellectual and/or Developmental Disabilities (ID/DD) present to adult primary care clinics. The list of potential medical causes of problematic behavior in adults with ID/DD is extensive and includes acute and chronic systemic illness, organ system dysfunction, medication effects and psychiatric illness. Some causes of behavior disorder are specific to adults with ID/DD. For example, specific genetic syndromes are characterized by behavioral phenotypes including excessive talkativeness or impulsivity. On the other hand, many common medical etiologies of problematic behavior in adults with ID/DD are conditions
common in all adults, including constipation and premenstrual syndrome. This case illustrates two important aspects of the diagnostic workup of behavioral problems in an adult with ID/DD. First, evaluation of physiologic causes of behavior disruption should be accompanied by a strategy of reducing the demands on the patient to make requests. In this case, making social interaction a scheduled event reducing the confusion of secondary gain associated with prn ibuprofen requests. As scheduled social interactions are enjoyed by most adults, such an intervention must be evaluated over many months, with close attention to needs that persist once the novelty of scheduled attention has worn off. A second important point illustrated by this case is the effect that premenstrual syndrome, which affects an estimated 30% of the general adult female population, may have in the behavior pattern of an adult woman with ID/DD. Women with ID/DD may not have the vocabulary necessary to describe menstrual cramps, and non-verbal indications may erroneously indicate abdominal problems. A careful assessment of the relation of problem behaviors to the menstrual cycle of an adult woman with ID/DD is an important step in the diagnostic evaluation of behavior disorders.
METRONIDAZOLE-INDUCED ENCEPHALOPATHY Maria Han 1;
Cynthia Margaret Cooper1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 11160)
LEARNING OBJECTIVES: 1. Identify the symptoms of metronidazole-induced encephalopathy, MIE2. Recognize the characteristic findings of MIE on magnetic resonance imagingCASE INFORMATION: Patient is a 64-year-old female who presented with dysarthria.
Two months prior, she had an above-the knee amputation. Three weeks prior, she developed diarrhea positive for C. difficile toxin and began an extended course of metronidazole. Days prior, she received doses of IV prochlorperazine for nausea. That day, she was discharged to rehab where her family found her confused and requested her return.
She complained her tongue felt too big for her mouth and of pain in her limbs. Speech was slow, hypophonic, and dysarthric. She had odd oral movements with frequent tongue thrusting. There was subtle arm weakness and diminished reflexes. Toxicology screen and cultures were negative. Brain MRI showed non-specific subcortical T2 FLAIR signal abnormalities.
Prochlorperazine-induced dyskinesia was suspected and this medication discontinued. Oral dyskinesia resolved but dysarthria and paresthesias persisted. She became lethargic and developed flaccid paresis. Motor conduction study showed reduced signal amplitude and conduction. CSF had normal protein and no leukocytes. ABG demonstrated hypoxia and hypercarbia. She was intubated.
Repeat MRI showed symmetric T2 FLAIR signal hyperintensity of the subcortical white matter in the frontal and parietal lobes, corpus callosum, midbrain red nuclei, and dentate nuclei. Findings were felt to be consistent with metronidazole-induced encephalopathy, MIE. Metronidazole was discontinued, after a cumulative dose of 65 g. Ataxia improved though weakness persisted. Subsequent MRI showed less hyperintensity in the midbrain and dentate nuclei. Polyneuropathy only minimally improved with IV immunoglobulin.
IMPLICATIONS/DISCUSSION: Metronidazole is widely used for the treatment of anaerobic, abdominal and genitourinary infections, including C. difficile colitis. Common side effects include nausea and altered taste. Neurologic side effects are uncommon and include seizures and peripheral neuropathy. MIE is a rare

complication with less than 20 previous case reports.

MIE typically manifests as cerebellar dysfunction, including ataxia and dysarthria. Symptoms have been reported with cumulative doses ranging from 25 g to 1080 g. Symptoms usually resolve within 7 days of discontinuation.
The characteristic MRI finding is bilateral symmetric T2 hyperintense lesions of the dentate nuclei. Lesions may affect the brainstem, corpus callosum, and subcortical white matter. The differential includes other toxic or viral leukoencephalitides and Marchiafava-Bignami Disease. Radio-graphic improvement typically begins within 14 days of antibiotic cessation. Neurotoxicity has been attributed to drug binding of ribonucleic acid and inhibited protein synthesis. Axonal edema may produce the characteristic MRI findings. Why certain brain areas are preferentially affected in MIE remains unclear.
MIE should be considered in any patient receiving a high cumulative dose of metronidazole who presents with new-onset cerebellar dysfunction.
OCP=ON CLOT PATROL? Arifa Abid 1; Dustin Wallace1. 1Allegheny General Hospital, Pittsburgh, Pennsylvania. (Tracking ID # 11169)
LEARNING OBJECTIVES: 1. Recognize the rare complications of prolonged oral contraceptive use, which is known to be associated with increased risk of venous thromboembolism. Thrombosis in sites such as cerebral, portal, or mesenteric veins is less frequent.2. Diagnose portal and mesenteric vein thrombosis in setting of abdominal pain as an initial presentation. Currently an etiologic factor can be identified in about three quarters of patients with portal vein thrombosis.
CASE INFORMATION: We report a case of a 38 years old female whopresented with severe epigastric and right upper quadrant abdominal pain thathad begun one month earlier. The pain was exacerbated by food intake. She had a 25 pound weight loss during that month due to reduced oral intake.She did not have any history of liver disease or thromboembolic disorders. She drank alcohol only socially and denied smoking. She was using oralcontraceptive pills for the past 10 years. On physical examination she had mild epigastric tenderness, no hepatosplenomegaly. Ultrasound with Doppler wasperformed that was suspicious of Portal vein thrombosis. MRI/MRA of the Abdomenshowed Portal vein thrombosis extending into intrahepatic branches along with superiormesenteric vein. Special investigations for an underlying procoagulantdisorder gave results within the normal range. The patient was treated with IVheparin and subsequently started on warfarin. Oral contraceptives were held. Herabdominal pain gradually resolved over 5 days and she was discharged from thehospital on day 11. Her oral intake improved as well.
IMPLICATIONS/DISCUSSION: The association of portal vein thrombosis with the use of oral contraceptives is very rare. To date only ten cases of portal vein thrombosis related to oral contraceptive ingestion have been reported in the literature.The risk of thromboembolism is significantly increased in women over the age of 25 years. Portal Vein thrombosis has been reported to cause abdominal pain when there was associated thrombosis of the mesenteric vein leading to small bowel ischemia. The development of unexplained abdominal pain in patients taking oral contraceptives should prompt clinicians to consider this possibility and to perform ultrasound with Doppler studies.
CARBAMEZAPINE AS A RARE CAUSE OF THROMBOCYTOPENIA Haris Zahoor 1; Milad Abusag 2; Eric Safyan2. 1UPMC, Pittsburgh, Pennsylvania ; 2University of Pittsburgh Medical Centre, Pittsburgh, Pennsylvania. (Tracking ID # 11184)
LEARNING OBJECTIVES: 1. Recognize carbamezapine as a rare cause of thrombocytopenia.2. 1. Understandthe importance of taking thoroughmedication history. CASE INFORMATION: A 21 year old female with history of bipolar disorder presented to theER from county prison with four days of fever, petechial rash and severe thrombocytopenia. In ER , she did notlook acutely ill and was afebrile. Physical exam showed a prominent petechialrash in bilateral lower extremities . Workup revealed a platelet count of 4 K/ul, WBC count of

3 K/ul and Hg 13.1 mg/dl. PT,APTT,INR , BUN/Cr and LFTs were within normal range. Antiplateletantibodies GP Ia/IIa, GP Ib/IX and GP IIb/IIIa were negative. CT head was negative for hemorrhage. Peripheralsmear showed normal RBC morphology withno schistocytes. Patient was given onedose of prednisone 60 mg IV, IVIG 50 grams and Ceftriaxone 2 grams IVin the ER. When asked specifically about the medication history , shestated that carbamezapine (200 mg BID) was a new drug started a month ago . Her onlyother medication included neurontin. carbamezapinewas held and neurontin was continued. Ptwas given one dose of platelets transfusion on hospital day 2. Her platelet countafter transfusion increased to 46 K/uland later decreased to 12 K/ul. No futher platelets, prednisone and IVIGs were given. Her platelet countgradually increased to 161 k/ul over the next few days. IMPLICATIONS/DISCUSSION: Drug induced thrombocytopenia is a relatively uncommon entity which can befatal and overlooked at the same time. If diagnosed early, a simpleintervention i.e withdrawl of the offending drug can prevent serious adverse effects. We present a case of druginduced thrombocytopenia due to carbamezapinewhich is an uncommon cause and rarely reported.

Drug induced thrombocytopenia is usually suspected in any patient with acutetransient fall in the platelet count and recent exposure to an offending agent.In our case carbamezapine was the probable cause of thrombocytopenia as per criteria defined by George et el in the literature. Platelet antibodies were negative but theycan be negative in typical drug induced thrombocytopenia .

We report this case to reinforce the importance of taking athorough medication history becausethrombocytopenia from an undisclosed drug had been reported in the past. Alsoit is important for the internists toknow the association of carbamezapine with thrombocytopenia because simple withdrawl of the drug can be lifesaving.

NEUTROPENIA AND PURPURIC RASH SECONDARY TO LEVAMISOLE-CONTAMINATED COCAINE David Kotlyar 1; Sarah Rosenbaum 2; Amy Sharma 3; Darlene LeFrancois4. 1Montefiore Med. Ctr./Albert Einstein Coll of Medicine, Bronx, New York ; 2Albert Einstein College of Medicine, Bronx, New York ; 3Montefiore Medical Ctr,/Albert Einstein Coll. of Med., Bronx, New York ; 4Montefiore Medical Center, New York, New York. (Tracking ID # 11192)

LEARNING OBJECTIVES: 1. 1. Recognize levamisole-associated cutaneous vasculitis and neutropenia as a serious and common consequence of cocaine use in a vulnerable population 2.

CASE INFORMATION: A 42 year old man presented with pain, swelling and rash on his left lower leg for 2 days. He had a twenty year history of active daily cocaine use and had noted that eight months prior to admission, when he changed cocaine suppliers, he developed a truncal rash. Examination revealed many nonpalpable but tender purpuric lesions accompanied by significant non-pitting edema to the middle shins of his bilateral lower extremities. In addition, there was a diffuse violaceous reticular rash on his arms and back. The patient became neutropenic within 48 hours of hospitalization with a white blood count nadir of 3,200/ L, and absolute neutrophil count of 800/ L.

Urine toxicology was positive for cocaine and cannabinoids. Serological workup showed marginal anti-nuclear antibody (titer of 1:40), negative double stranded DNA, markedly positive erythrocyte sedimentation rate of 89 mm/hr, and C-reactive protein of 9 mg/dl, low C3 and C4, positive anti-histone antibodies, positive anti-cardiolipin antibodies (IgG and IgM), positive lupus anticoagulant, and positive both peripheral-and cytoplasmic-anti neutrophil cytoplasmic antibodies (p-ANCA and c-ANCA). Hepatitis B, HIV, and Hepatitis C viral serologies were all negative. While a test for Lyme antibody titer was positive (titer 1.6), the confirmatory Lyme immunoblot was negative. Biopsy of skin of lower leg showed nonspecific vasculitis. Although urine testing for levamisole was not performed, serum testing for levamisole was negative from a sample taken at least 48 hours after the patients most recent cocaine use. IMPLICATIONS/DISCUSSION: There have been reports that up to 70% of

confiscated cocaine supplies in the United States have been cut with levamisole (1). Cutting agents are frequently added for several reasons including boosting the volume of compounded drug, tracing the drug to identify its point of origin, and to add other agents to enhance the experience when using the drug (2). Similar contamination occurred in the early 1980 s with MPTP which resulted in the development of a permanent Parkinsonian syndrome (2). Patients who use and/or are addicted to illegal drugs remain vulnerable to contamination of these unregulated substances.

Levamisole is an anti-parasitic and immunomodulating agent known to cause serious side effects including bone marrow suppression and neutropenia. In addition, cutaneous vasculitis with or without skin necrosis in association with anti-phospholipid and antineutrophil cytoplasmic antibodies may occur. Histologic specimens typically reveal a vasculopathic reaction pattern ranging from leukocytoclastic and thrombotic vasculitis to thrombotic vasculopathy without true vasculitis. Testing for levamisole via gas chromatography and mass spectrometry in blood and urine should be done promptly as the drug has a short half-life (5.6 hrs). While spontaneous resolution occurs by discontinuing levamisole use, lack of awareness of this diagnostic entity on the part of treating clinicians might delay the correct diagnosis and result in additional patient harm. Clinicians who observe skin necrosis or purpuric rashes and neutropenia in patients who use cocaine should consider levamisole as a possible cause in this vulnerable population.1. Agranulocytosis associated with cocaine use - four States, March
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THE FATAL CONSEQUENCES OF OVERLOOKING A FIBROID Kahn G Daniel 1; Jason Fish2. 1Internal Medicine Residency Program, David Geffen School of Medicine, Los Angeles, California ; 2UCLA Medical Center, Los Angeles, California. (Tracking ID # 11195)

LEARNING OBJECTIVES: 1. Recognize metastatic leiomyosarcoma as a rare cause for hemoptysis and lung nodules2. Recognize the current diagnostic dilemma of differentiating a fibroid from a leiomyosarcoma and the potential implicationsCASE INFORMATION: A 49 year old female presents with 3 weeks of scant hemoptysis occurring each morning. Past medical history significant for asthma, fibroids, GERD, breast augmentation, a former 7 pack year smoking history, and a maternal history of breast cancer at age 42. On review of symptoms, she reports intermittent sweats, progressive dyspnea on exertion, 70 pound weight gain over the last 2 years, pelvic pressure, difficulty urinating, and intermenstrual spotting for the last 3 months. She denies fevers, constitutional
symptoms, URI symptoms, chest pain, orthopnea, PND, lower extremity edema, epistaxis, bleeding diathesis, skin lesions, rash. On exam, she is afebrile with stable vital signs. She is an obese female in no acute distress. Her lungs are clear, heart is regular without murmurs, breasts have no masses, abdomen is non-tender, non-distended with no shifting dullness, skin has no rashes, nodules, atypical nevi, no lymphadenopathy. On bimanual exam, the uterus is large occupying the entire pelvis. A CXR reveals bilateral pulmonary nodules. CT chest shows greater than 30 pulmonary nodules with associated ground glass halos. CT abdomen/ pelvis shows a large heterogenous mass that favors a uterine fibroid but cannot rule out a sarcoma with no associated lymphadenopathy. An ECHO shows no obvious vegetations. Patient had a normal screening mammo-gram 3 months prior. Laboratories reveal a normal CBC, negative bacterial and fungal cultures, and negative rheumatologic serologies. A CT guided lung biopsy shows poorly differentiated malignancy, with S100 positive favoring metastatic melanoma but inconclusive. A whole body PET scan shows abnormal uptake in pulmonary nodules, pelvic mass, and right breast. An ultrasound guided biopsy of the breast lesion and hysterectomy are performed. Pathology from the breast mass and hysterectomy return as metastatic leiomyosarcoma, which is consistent with the lung biopsy. The patient is now undergoing chemotherapy. IMPLICATIONS/DISCUSSION: Leiomyosarcomas account for 1% of all uterine malignancies with a female incidence of 0.67/100,000. Given the rarity of leiomyosarcomas, our experience and diagnostic capabilities are limited.

Fibroids are extremely common and are noted in approximately 80% of surgically excised uteri. As of now, there is no clear indication for when fibroids must be further evaluated and treated and current guidelines are based on patient preference. Certain signs and symptoms may signify the need for further work up including pelvic pain, irregular or heavy uterine bleeding, rapid increase in growth, and infertility.
Like fibroids, leiomyosarcomas occur more often in african americans and present with similar symptoms consisting of bleeding, pelvic pressure, abdominal distension, and reproductive issues, making the diagnosis of leiomyosarcoma a formidable challenge.
The ability to distinguish malignant and benign uterine tumors is now more important than ever as more conservative approaches to fibroids are available that preserve the uterus. There is evidence that MRI may help differentiate sarcoma from fibroid and endometrial biopsy may be a less invasive modality to diagnose sarcoma however a negative result does not rule it out.
Leiomyosarcomas are aggressive tumors. Early hematogenosis metastases most often involve the lungs followed by the liver.
Metastases to the breast are rare and represent less than 2% of all breast malignancies. This may be secondary to the relatively avascular fibrous tissue of the breast. To date, there are 5 case reports of uterine leiomyosarcomas that have metastasized to the breast. We describe the 6th case.
ETANERCEPT ASSOCIATED ACUTE ONSET HEART FAILURE REQUIRING BIVENTRICULAR ASSIST DEVICES Monique S Tanna
1; Sharon Leung 1; Darlene LeFrancois1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 11198)
LEARNING OBJECTIVES: 1. Recognize adverse cardiovascular effects of tumor necrosis factor antagonists. 2. Assess cardiac function prior to prescribing tumor necrosis factor antagonists and know when they are contraindicated.
CASE INFORMATION: A 42-year-old woman presented with dyspnea on exertion and intermittent palpitations for two days. She had an unlimited exercise capacity at baseline and no cardiac history or risk factors. The patient had recently initiated treatment with etanercept, a

tumor necrosis factor (TNF) antagonist for rheumatoid arthritis, and had received two doses at 8 and 1 day prior to symptom onset. On day 6 of her illness she was transferred to our institution due to rapid clinical deterioration. Vital signs were BP 111/79, HR 134, T 97.3 F, and oxygen saturation 92%. She was tachypneic to 40 breaths/min with decreased breath sounds at the bases and crackles to mid-lungs bilaterally. Her jugular veins were distended and extremities were cool. ECG revealed sinus tachycardia. Laboratory findings included WBC count 14,000, SGOT 120, SGPT 126, CPK 346 (normal four days prior), CK-MB 84.3(24.4%), and troponin-T 0.98 (0.35 four days prior). While a chest radiograph and transthoracic echocardiogram four days prior had demonstrated clear lung fields and normal ejection fraction (EF), repeat testing revealed pulmonary edema with bilateral pleural effusions, biventricular global dysfunction, and an EF of 10%. CT chest was negative for pulmonary embolism. Serologic testing for an infectious etiology and histologic examination of myocardium were negative for myocarditis. Refractory cardiogenic shock despite treatment with intravenous diuretics and inotropic agents required emergent placement of biventricular assist devices. She underwent device explantation on post operative day 5 and demonstrated normal ventricular function and normal EF. At five week follow-up she was symptom free with unlimited exercise tolerance.
IMPLICATIONS/DISCUSSION: Heart failure is associated with elevated TNF levels, and these levels correlate with disease severity. Once thought to be a promising therapeutic agent for the treatment of heart failure, TNF antagonists have not been efficacious in randomized clinical trials. In contrast, one trial found higher rates of mortality and heart failure hospitalizations in the TNF antagonist (infliximab) group. There are also rare cases of etanercept associated heart failure described in the literature. A case series identified by querying the FDAs MedWatch program found 47 cases of new or worsening heart failure after TNF antagonist therapy. Of these,

38 were new onset heart failure; 19 of these had no identifiable risk factors. It has been argued that rheumatoid arthritis patients may have an intrinsically higher risk of heart failure, potentially confounding these findings. Despite this current controversy, the particular severity and shorter interval from first dose to symptom onset (8 days) in this case strongly suggests a causal relationship between drug exposure and heart failure development. In addition to the temporal relationship of etanercept with severe new onset heart failure, complete resolution with drug discontinuation also supports a true association.
Current guidelines recommend against the use of TNF antagonists in patients with NYHA Class III or IV heart failure. One guideline recommends obtaining an echocardiogram in patients with well compensated heart failure (Class I or II), and avoiding TNF antagonists in those with an EF <50%. If therapy is initiated, early recognition of the signs and symptoms of new or worsening heart failure is critical, in which case TNF antagonists should be discontinued immediately.
A MAN AND HIS HORSE BACTERIAThomas Jensen 1; Neha Prakash 2; Michael Frank2. 1MCW, Greenfield, Wisconsin ; 2MCW, Milwaukee, Wisconsin. (Tracking ID # 11202)
LEARNING OBJECTIVES: 1. 1) Describe an unusual organism causingcomplicated skin infections.2. 2) Review treatment of Streptococcus bacteremia.
CASE INFORMATION: A 75-year-old gentleman with a past medical history of neurofibromatosis and a chronic left groin wound secondary to prior peripheral nerve sheath tumor removal was admitted to an outside facility for fevers, chills, nausea, vomiting, and worsening erythema around his left groinwound. He was found to haveleukocytosis
with bandemia, tachycardia, and a fever of 102 degrees F. The patient was started on vancomycin and piperacillin/tazobactam and subsequently transferred to our hospital for continued management and topotherapy for a second peripheral nerve sheath tumor. Blood cultures drawn at the outside facility revealed pan-sensitive Streptococcus dysgalactiae subspecies Equisimilis, and echocardiogram was negative for endocarditis. He was started on penicillin G and then switched to ceftriaxone out of dosing convenience for a fourteen-day course of treatment. Upon discharge his erythema had drastically improved, and his other symptoms had resolved. IMPLICATIONS/DISCUSSION: Streptococcus dysgalactiae subspecies Equisimilis (SDSE), also known as group G strep, has often been known as a veterinary pathogen. However, in recent years it has been increasingly recognized as a human pathogen. SDSE is normal human flora on skin and in the vagina and upper respiratory and gastrointestinal tracts. Infections most commonly manifest in skin and soft-tissue, including pyoderma, cellulitis, wound infections, abscesses, necrotizing fasciitis, and bacteremia. The spectrum of clinical manifestations of this organism closely resembles those of Streptococcus pyogenes. Predisposing factors for SDSE infections include older age, diabetes mellitus, drug or alcohol abuse, cardiovascular or neoplastic disease, history of irradiation or immunosupression. SDSE remains almost uniformly susceptibleto penicillin and other beta-lactam agents. Addition of aminoglycosides may be considered to avoid poor or delayed response; however, the use of penicillin alone has been considered the therapy of choice. In aggressive cases such as toxic shock syndrome, clindamycin may be of benefit to decrease toxin production. Typical treatment course is ten to fourteen days forbacteremia with IV antibiotics.
INDISCRIMINATE HERBAL FORMULATION USE - TICKING TIME BOMB FOR FULMINANT HEPATIC FAILURE? ayodeji shedu 1; aju
daniel 2; matt dietz 3; paula summers 4; daniella capriles5. 1St Vincent Hospital Worcester, Worcester, Massachusetts ; 2St vincent Hospital, Worcester, Massachusetts ; 3UNE-COM, Biddeford, Maine ; 4Fallon Clinic, Worcester, Massachusetts ; 5St Vincent Hospital, Worcester, Massachusetts. (Tracking ID # 11208)
LEARNING OBJECTIVES: 1. To recognize indiscriminate herbal medications use as a cause of severe, silent hepatocellular injury and a probable etiology of future hepatic failure2. To highlight the broad differentials for transaminitis in a young, otherwise healthy femaleCASE INFORMATION: A 43 year-old female presented for annual physicals and had labs drawn afterwards. About 2 days prior, she had mild chills, nausea and RUQ pain

which were self-limited and resolving at the time of presentation. However, severely elevated transaminases (ALT >14000, AST >12000) prompted direct admission for further evaluation, upon which she denied fever, unintentional weight loss, nausea, vomiting, jaundice, anorexia, diarrhea, pruritus, arthralgias, myalgias, headaches, suicidal thoughts, cough, or hemoptysis.

She had no pertinent past medical history and consumed 68 alcoholic drinks every weekend, including the weekend prior to her physicals. She denied tobacco or illicit drugs use. She denied recent travel or sick contacts. She was married and used condoms for birth control. Medications included a multivitamin, a fatty acid supplement and colon cleansing herbal preparations all purchased over the internet. She used these herbal preparations weekly for colon cleansing and weight loss. She denied tylenol use.

Physical examination showed stable vitals in a healthy appearing female, and was only notable for mild RUQ tenderness on deep palpation. Liver and spleen were not palpable.

Lab studies revealed ALT 14,314, AST 12,060, normal albumin, bilirubin, alkphos, GGT, BMP and CBC. LDH was elevated at 8724, INR was 1.5. CK, amylase, lipase, and acetaminophen levels were within normal limits. A urine tox screen, hepatitis panel, autoimmune panel, HIV serologies, EBV and CMV IgM were negative. Abdominal CT showed mild thickening of the gallbladder wall with surrounding fluid. A negative HIDA scan ruled out cholecystitis. Hepatic vein thrombosis was ruled out by abdominal doppler ultrasound.

The herbal remedies were stopped, abdominal tenderness completely resolved and transaminases trended downwards. Liver biopsy was deferred following lab improvement. Post discharge, transaminases, LDH and INR completely normalized after 3 weeks of abstinence from herbal medications.

IMPLICATIONS/DISCUSSION: Though not confirmed by liver biopsy, hepatocellular injury as evidenced by abnormal labs was likely caused by one or more of the ingredients in the herbal formulations. Other causes of hepatocellular injury like viral hepatitis, autoimmune hepatitis, acetaminophen toxicity, NAFLD, hepatic vascular disease were unlikely in this case. Besides, the temporal relationship between use of the remedies, the abnormal labs and their rapid normalization after discontinuation strongly suggested herbal formulation as the main etiology of hepatocellular injury. The high B12 level was due to use of a multivitamin preparation obtained from same source which contained various vitamins in very high concentrations including 3333% RDA of B12 in each pill!

The colon cleansing remedies was a package of 3 formulations containing 9, 22 and 35 herbs respectively. Some of the herbs were in more than one formulation, increasing the likelihood of toxicity. Literature review revealed that several of these herbs have been implicated as causes of hepatitis including black cohosh, glyzzyrrhiza and skullcap. Also many herbal remedies have been linked to liver toxicity ranging from asymptomatic transaminitis to fulminant hepatic failure.

The use of herbal medications is regaining popularity in recent years. Easy accessibility to herbal remedies, increasingly through the Internet, has led to increased frequency of use, and expectedly an increased incidence of their side effects. The active ingredients and exact formulations of herbal remedies are frequently obscure. More importantly, their benefit and side effect profiles are often not well established. Clinicians should routinely inquire about patients use of herbal preparations during clinical interviews and consider herbal toxicity early during the workup for transaminitis and hepatitis.

This case shows the potential danger of indiscriminate use of herbal remedies as well as the urgent need for their regulation and standardization.

FROM NON-ST ELEVATION MYOCARDIAL INFARCTION TO LYMPHOMA Pamela Joyce Barnes 1; Pamela Joyce Barnes 1; Dustin T. Smith2.
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(Tracking ID # 11217)
LEARNING OBJECTIVES: 1. 1. Understand the clinical classification of non-Hodgkins lymphomas2. 2. Recognize the classic B-symptoms and extranodal disease sites3. Identify the most common treatment regimen for Diffuse Large B-cell LymphomaCASE INFORMATION: A 66 year old male presented with non-ST elevation myocardial infarction secondary to demand ischemia due to a normocytic anemia (hemoglobin 7.4 g/dL). The patients prior hemoglobin was noted to be 15.5 g/dL. Review of systems was positive for a ten pound weight loss, night sweats, and decreased energy. Physical exam revealed pale conjunctiva and tachycardia with a 3/6 high pitched early peaking systolic murmur. Splenomegaly and a fixed bony forehead lesion were also noted. EKG showed sinus tachycardia with nonspecific T-wave changes and isolated ST depression in V2. Troponin trended
down from a peak of 0.26 ng/mL. The patient was transfused with 4 units of red cells and his presenting symptom of chest pain resolved. Cardiology was consulted and determined the patients presentation was consistent with demand ischemia due to anemia. Computed tomography scans of the head and abdomen were obtained. Imaging revealed multiple punched out lytic lesions within the bilateral calvarium with an associated soft tissue mass in the left frontal bone and marked splenomegaly at 28.1 cm. Further laboratory studies to evaluate for multiple myeloma including urine and serum protein electrophoresis were negative and iron studies were consistent with an iron deficiency anemia. HIV was negative and thyroid studies were normal. A bone marrow biopsy was obtained and demonstrated hypercellular marrow with findings consistent with a mature B-cell lymphoproliferative disorder. Flow cytometry confirmed the presence of a distinct clonal CD5 positive/CD23 positive/FMC 7 positive mature B-lymphocyte population. Biopsy of the soft tissue forehead mass that revealed malignant diffuse large B-cell lymphoma. Hematology/oncology recommended 68 cycles of R-CHOP (rituximab, cyclophosphamide, hydroxydaunorubicin, oncovin, prednisone) plus intrathecal chemotherapy given the neurologic involvement of the lymphoma. IMPLICATIONS/DISCUSSION: The World Health Organization currently classifies lymphoid neoplasms into 3 categories: B-cell neoplasms, T-cell and NK cell neoplasms, and Hodgkin lymphomas. Approximately 80- 85% of non-Hodgkins lymhomas in adults are of B-cell origin. Clinically, non-Hodgkins lymphomas can further be divided into indolent, aggressive, or highly aggressive tumors. Patients with indolent tumors typically live for several years, even without treatment but cure is usually not possible. Highly aggressive lymphomas are frequently curable as they are generally responsive to chemotherapy. Diffuse large B-cell lymphoma (DLBCL) is considered an aggressive B-cell lymphoma. It is the most common lymphoma of the aggressive lymphomas. Approximately 30% of patients with DLBCL may present with B-symptoms (night sweats, fever, and weight loss). The most common extranodal location for disease is the gastrointestinal tract but other sites such as the testis, thyroid, bone, and central nervous system may be affected by disease. The primary therapy for this neoplasm is CHOP plus rituximab for at least six cycles. This case illustrates to clinicians the importance of physical exam findings and the importance of considering the differential diagnosis for causes of both coronary ischemia/infarction and anemia.
A CASE OF CERVICAL EPIDURAL ABSCESS DUE TO MYCOBACTERIUM TUBERCULOSIS Masayuki Kobayashi 1; Simi Padival2. 1Teine Keijinkai Hospital, Sapporo, N/A ; 2Teine Keijinkai Hospital, Sapporo, Hokkaido, N/A. (Tracking ID # 11219)
LEARNING OBJECTIVES: 1. To recognize the presentation of spinal epidural abscess, a rare disease with high mortality2. To recognize the diagnostic process of identifying tuberculous infections without a positive cultureCASE INFORMATION: A 75 year-old man with a medical history of pulmonary tuberculosis treated 57 years ago and diabetes mellitus presented with a 2 week history of daily fever, headache, and neck stiffness. He had been admitted to another hospital 5 days prior to presentation on suspicions of meningitis however the lumbar puncture was negative. He was then transferred to our hospital for further evaluation due to persistent fever and worsening neck stiffness. On physical exam, he appeared ill with a temperature of 38.6 C and had limited range of motion in his neck without point tenderness along the spinous processes. The neurologic exam

was initially unremarkable. Laboratory exams showed an alkaline phosphatase 1144 U/L, GTP

175 U/L , and CRP21.59 mg/dL. On hospital day 4 the patient was reexamined and found to have weakness in all four extremities. He underwent a contrast-enhanced MRI of the cervical and thoracic spine which disclosed an epidural abscess extending from C2 to C6 posterolaterally. No signs of osteomyelitis were noted. He was taken for anterior cervical decompression and drainage with subsequent improvement in his neurologic deficit and put on ampicillinsulbactam until results of theculture returned. Culture of the biopsy specimen was negative however histopathological evaluation of the epidural sac revealed chronic inflammation,Langerhans giant cells, and caseating necrosis consistent with Mycobacteriumtuberculosis. Despite being culture-negative, the patient was treated with isoniazid, rifampicin, pyrazinamide, and ethambutol for tuberculous epidural abscess with resolution of his symptoms. IMPLICATIONS/DISCUSSION: Spinalepidural abscess (SEA) is a rare but potentially life threatening disease that requires early diagnosis and management. It is seen in 2-3/10,000 hospital admissions and risk factors include diabetes mellitus, IV drug use, or trauma. Patients classically present initially with pain and fever only, however rapid progression of neurologic deficits such as paralysis can occur. Mortality has remained at 14% over the last several years emphasizing the need for rapid assessment and treatment. Contrast MRI with gadolinium is important fordetection of SEA and specimens should be obtained either from CT-guided needle aspiration or surgical drainage of the abscess to determine antibiotic coverage. Blood cultures may be negative in 40% of cases. The most common cause of SEA in the developed world is Staphylococcus aureus, however Mycobacterium tuberculosis has been known to present in atypical ways including as an SEA. Tuberculous SEA typically is an extension of Potts disease and less than 1% is isolated. While the gold standard of diagnosing extrapulmonary tuberculosis is acid-fastbacilli-positive cultures, some patients have culture-negative findings. Histopathologic findings of granulomatous inflammation with Langerhans giantcells along with risk factors may be sufficient to initiate a patient on tuberculosis therapy. Our patient had a history of previous tuberculosis infection as well as histopathologic findings of granulomatous disease prompting treatment for M. tuberculosis. Drainage of the abscess and the antibiotic regimen helped this patient with full recovery. A high clinical suspicion is needed to prevent mortality in a precipitous disease caused by an insidious but global pathogen.

A FORTUNATE RASH Christopher Goodman 1; David Krakow2. 1Emory University Internal Medicine Residency Program, Atlanta, Georgia ;
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LEARNING OBJECTIVES: 1. To recognize the clinical findings of heparin induced skin necrosis2. To increase awareness of complications associated with the low molecular weight heparins (LMWH).

CASE INFORMATION: We present the case of an 82 year old female with a history of rheumatoid arthritis on methotrexate and abatacept admitted to the hospital with diverticulitis complicated by a perforation and abscess who on hospital day 10 complained of a painful abdominal rash. On admission, the patient having normal renal function was started on enoxaparin (40 mg qd sc) for DVT prophylaxis.

The platelet count on the day prior to the onset of the rash was 402,000 and 286,000 the day the rash appeared. During the 7 days prior to the development of the rash, the platelets ranged from 402,000-430,000. The thrombocytosis was thought to be from acute inflammation from the diverticulitis. The patients antibiotic therapy had been changed from piperacillin/tazobactam to meropenem the day prior to the onset of the rash after sensitivities from the abscess fluid obtained from the patients
drain demonstrated ESBL E. coli. In isolation, the lowered platelet count may have been thought due to the new medication; however, the timing of the decreased platelet count and the rash were characteristic of heparin-induced skin necrosis. We immediately held the enoxaparin injections and began an argatroban drip. Over the course of the next few days the platelet count continued to drop and a total of three painful rashes developed over the lower abdomen each with a central area of necrotic tissue and surrounding erythema (see Figure 1). A

platelet nadir of 104,000 was reached seven days after the appearance of the rash and the discontinuance of enoxaparin. The rashes ceased progressing around day two with eventual resolution and no further consequences during her hospital stay. The day the rash was noted both a HIT ELISA and serotonin release assay were sent. The HIT ELISA later returned markedly positive with an OD of 2.68, and the serotonin release assay also returned positive confirming a diagnosis of HITT.
IMPLICATIONS/DISCUSSION: LMWHs such as enoxaparin are anticoagulants closely related to unfractionated heparin in structure and mechanism of action; however, as a class these anticoagulants are preferred due to their predictability, ease of administration, and decreased risk of complications such as heparin induced thrombocytopenia(HIT). The risk of HIT with LMWHs ranges from 0.7-2% depending on the study population and dosage. HIT may result in a prothrombotic state, which with clinical evidence of thrombosis is termed heparin induced thrombocytopenia with thrombosis (HITT). Heparin-induced skin necrosis is an example of thrombosis - it is a rare complication and even more unsual for the LMWHs. Blood clots develop in the small, penetrating blood vessels of skin tissue, usually affecting the abdomen, nose, and extremities - often near sites of drug injection. The resulting lesion is characterized by an area of central necrosis with an erythematous base, and the natural course ranges from self-limiting reactions to full-thickness skin loss with need for skin grafting. The Four Ts is a clinical tool used as a guide for diagnosis of HIT and includes the following: timing, degree of thrombocytopenia, evidence of thrombosis, and lack of alternative causes. In isolation, the initial drop in the platelet count for our patient might not have led to consideration of HIT because the platelet count was in the normal range and had only decreased approximately 30%. The rash was thus fortuitous for our patient as the enoxaparin was discontinued and argatroban started one or two days sooner than would have otherwise been. By recognizing the skin rash as heparin induced skin necrosis, stopping enoxaparin and initiating anticoagulant therapy may have prevented more serious thrombotic complications.
TOO MUCH OF A GOOD THING Kevin Jwo 1; Manuela Calvo1. 1Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 11227)
LEARNING OBJECTIVES: 1. Understand the differential diagnosis of erythrocytosis.2. Recognize Renal Cell Carcinoma as a common cause of secondary erythrocytosis.
CASE INFORMATION: A 67 year old man with hypertension presented with five months of episodic, intermittent dizziness associated with vomiting and diaphoresis. The patient denied trauma, fevers, weight loss, fatigue, tinnitus, pruritus, hearing loss, headache, focal weakness, dysarthria, visual changes, shortness of breath, chronic cough, snoring at night, dyspnea on exertion, or changes in urine. He denied any history of smoking or drug use, but he used to work as a welder for 50 years. On exam, orthostatics were negative with a blood pressure of 129/72 mmHg and an arterial oxygen saturation of 98% on room air. He appeared comfortable with no signs of cyanosis, his lungs were clear to auscultation, his heart sounds were normal, and his abdominal exam was benign and revealed no organomegaly or masses. His neurological

exam was non-focal with a negative Dix-Hall Pike maneuver. Laboratory data revealed a hemoglobin (Hb) of 21.3 g/dL and a hematocrit (HCT) of63.5 %,with a WBC count of 5.2/mm3 and a platelet count of 153/mm3. Urinalysis revealed 3 RBCs/HPF. A chest radiograph was normal and a non-contrast CT scan of the head demonstrated no intracranial masses. The erythropoietin (EPO) level was elevated at 22.9 mIU/mL (nl 4.1-19.5 mIU/mL) and the JAK2V617F serum screen for polycythemia vera was negative. An ultrasound and CT scan of the abdomen showed a 12 cm, heterogeneous, partially necrotic right renal mass consistent with renal cell carcinoma (RCC). MRI demonstrated no invasion of the vasculature and no lymphadenopathy. The patient underwent laparoscopic right nephrectomy with clean margins. The postoperative course was uneventful and his symptoms subsided within a month. Both Hb and HCT came down to normal values two months after the

surgery, at 14 mg and 43% respectively.
IMPLICATIONS/DISCUSSION: Erythrocytosis is a common finding in inpatient and outpatient settings and being familiar with the differential diagnosis is important for all internists. Most commonly erythrocytosis is acquired and hypoxia driven, such as in chronic lung disease, cardiopulmonary shunts, tobacco use, CO poisoning, renal artery stenosis, high altitude exposure, or sleep apnea. Erythocytosis can also be hypoxia independent, such as in EPO-secreting tumors, polycythemia vera (PV), or erythropoietin injections. Less common are congenital causes such as high oxygen affinity hemoglobinopathies, which are often inherited. Erythrocytosis can also be categorized based on the EPO level. EPO is elevated in all the above except the hemoglobinopathies and PV, in which a low EPO can be specific. The protein HIF-1 is responsible for inducing EPO production in response to hypoxia and is regulated negatively by oxygen tension. Around 60% of RCCs are associated with a mutation which leads to activation of HIF-1 and is thought to predispose for erythrocytosis.

As the classic triad of RCC: flank pain (19.5%), hematuria (24.3%), and palpable flank mass (4.4%), occur only in 9% of patients, it is important to be aware of other common presentations, such as erythrocytosis. Around 4% of patients diagnosed with RCC present with and a total of up to 8% of patients will develop erythrocytosis. The five tumors most often associated with the overproduction of EPO, in descending order of frequency, are: RCC, HCC, hemangioblastoma, uterine myomata, and pheochromocytoma. When patients present with localized disease, surgical resection can be curative. Unfortunately, many RCCs are clinically silent for much of their natural history, so it is important to have a high index of suspicion as early detection can be life-saving.
It is important to be familiar with the differential diagnoses of erythrocytosis as this can present an opportunity for early detection of resectable life-threatening carcinomas.
A CASE OF SEVERE SERUM SICKNESS IN A RENAL TRANSPLANT RECIPIENT Erin Eileen Atkinson 1; Linda Czypinski 1; Michael Ong1.
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LEARNING OBJECTIVES: 1. Distinguish serum sickness from infection in immunocompromised patients. 2. Treat serum sickness in post-transplant patients aggressively and early with plasmapheresis in an effort to preserve the transplanted graft.
CASE INFORMATION: A 51-year-old male presents to the emergency department (ED) with a 12-hour history of abdominal pain, diarrhea, vomiting, fever to 39.3 C, myalgias, and jaw pain. He is status-post unrelated living donor renal transplant seven weeks prior to admission. His post-transplant course had been complicated by two episodes of acute cellular rejection, the most recent requiring a three-day course of solumedrol followed by seven days of rabbit anti-thymocyte globulin
infusions. He was discharged one day prior to presentation. In the ED his temperature was noted to fluctuate from normal range to 3939.3. His physical exam was pertinent for tachycardia and a diffuse maculopapular rash on his chest. His abdominal pain was out of proportion to his physical exam. A Computed Tomography scan without contrast of his abdomen revealed no abnormalities. He was subsequently admitted to the general medicine team. On hospital day one his abdominal pain, vomiting, and diarrhea resolved, but he developed diffuse bilateral joint pain and swelling. He continued to have oscillating high fevers for the first four days of hospitalization despite broad-spectrum antibiotics. All infectious workup including blood, urine, and stool cultures, joint aspiration, echocardiogram, and viral serologies such as Parvovirus, Cytomegalovirus, and Ebstein barr virus were negative. He also developed acute renal failure with a rise in creatinine from 2.2 to 5.2 in four days. Complement levels were normal and erythrocyte sedimentation rate was >100. Serum sickness was diagnosed and high-dose solumedrol was initiated on hospital day 3. Given his rising creatinine and only minimal improvement of symptoms after two doses of steroids, plasmapheresis was started. After one session of plasmapheresis his fevers resolved and his joint pain and swelling improved. He only received two sessions of plasmapheresis and had complete resolution of symptoms and normalization of creatinine.

IMPLICATIONS/DISCUSSION: Serum sickness is a clinical diagnosis with symptoms of rash, high fevers, and arthralgias in addition to exposure of an offending agent 12 weeks prior to symptom onset. Jaw pain and acute renal insufficiency are also common. It is a type three hypersensitivity reaction. Human immunoglobulins bind to proteins and deposition of these immune complexes lead to activation of the complement cascade. Anti-thymocyte globulin (ATG) is one drug known to cause serum sickness. ATG is commonly used for the treatment of acute graft rejection in kidney transplant patients. The incidence of serum sickness in this population is 7% to 27%.

It is very difficult to distinguish infection from serum sickness especially in immunocompromised hosts. All patients should be evaluated for infection with bacterial cultures and viral serologies. It is prudent to start empiric broad spectrum antibiotics as infection can be lethal. Unfortunately concern for infection often delays diagnosis or the patient is misdiagnosed as fever of unknown origin. Serum sickness should always be in the differential in transplant recipients with fever and ATG exposure history. Serum sickness resolves after removal of the antigen from the serum. Treatment is based on symptomatic relief and symptoms can last12 weeks. Mild cases can be treated with anti-histamines and severe cases with steroids. The role for plasmapheresis is ill defined and has been recommended for refractory cases. This case shows that aggressive and early treatment with plasmapheresis is necessary not only for symptomatic relief but for graft preservation by preventing immune complex deposition. Furthermore, plasmapheresis may be preferential to steroids in this population given the difficulty in distinguishing serum sickness from infection and by avoiding systemic steroids side effects. A prospective randomized trial would be beneficial to further evaluate the role of plasmapheresis in serum sickness.

HYPERTENSION IN NEUROFIBROMATOSIS TYPE 1: MUST ALWAYS CONSIDER PHEOCHROMOCYTOMA

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LEARNING OBJECTIVES: 1. Pheochromocytomas occur in 0.1-5.7% of patients with Neurofibromatosis Type 1. They can be life threatening if

missed but curable with early diagnosis. Therefore, PHEO should always be considered in patients with NF-1 and hypertension.2. Patients with NF-1 should have yearly physical exams to screen for the many complications associated with NF.

CASE INFORMATION: We present the case of a 40 year old female with PMH of Neurofibromatosis Type-1 with no medical follow up in over 20 years who presented to the ER with complaints of nausea, vomiting, weight loss, headache and fever. She was found to be tachycardic, hypertensive and febrile with a white blood count of about 30,000, elevated liver enzymes in the range of 800900, elevated cardiac enzymes and a markedly prolonged QT. On physical exam, the patient appeared anxious, had drymucous membranes and had cutaneous signs of NF but the remainder of the exam was unremarkable. The patient was worked up for an infection, hepatitis and cardiac disease but all studies were normal. Given the patients presentation, there was a high suspicion for pheochromocytoma (PHEO) and or an underlying malignancy. A CT of the abdomen was done which showed a 10 cm heterogeneous right adrenal mass. A twenty four hour urine catecholamine collection was done which showed norepinephrine=4,508 mcg (NL <170); epinephrine=840 mcg (NL <35); normetanephrine=43,141 mcg (NL <900) and metanephrine=16,478 mcg (NL <400). Plasma studies also showed metanephrine=722 mcg (NL <62) and normetanephrine=5,433 mcg (NL <145). The patient was diagnosed with PHEO, pre-medicated with phenoxybenzamine for several weeks and subsequently had a right adrenalectomy with an uncomplicated post-op course. Pathology of the resected mass was diagnostic for PHEO. IMPLICATIONS/DISCUSSION: Pheochromocytomas are rare catecholamine secreting neuroendocrine tumors arising from chromaffin cells in the adrenal medulla or extra-adrenal paraganglia. PHEOs are rare and

occur in 0.05-0.2% of hypertensive individuals. Neurofibromatosis type 1(NF-1) is an autosomal dominant genetic disorder where mutations in the NF-1 gene result in loss of functional proteins causing tumors to arise from nerve tissue. NF-1 affects approximately 1 in 3000 individuals worldwide. PHEO occursin 0.1%-5.7% of patients with NF-1.

The patients history of NF-1 along with HTN, though rare, raised suspicion for PHEO. Along with ruling out infection and an underlying malignancy, pheochromocytoma also needed to be ruled out. Pheochromocytomas can potentially be life threatening if missed but are usually curable if diagnosedin time, therefore should always be considered in NF-1 patients who have hypertension. Furthermore, patients with NF-1 should have yearly physical exams to screen for the many complications associated with NF.

THE HEART OF THE PROBLEM OF THE HEART Kristal Carthan 1;

Jasleen K Randhawa 2; Kurt Pfeifer2. 1Medical College of Wisconsin, Wauwatosa, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin . (Tracking ID # 11245)

LEARNING OBJECTIVES: 1. Describe the improtance of transthoracic echocardiography in the evaluation of patients with recurrent heart failure of unknown cause. 2. Emphasize structural cardiac lesions as a potential source of recurrent cardiac decompensation.

CASE INFORMATION: A 63-year-old gentleman with a past medical history of coronary artery disease, prostate cancer treated with local radiation therapy and hypertension presented with progressively worsening exertional dyspnea, paroxysmal nocturnal dyspnea and orthopnea despite titration of his heart failure medication regimen. Transthoracic echocardiogram showed a left ventricular ejection fraction of 30% and a 4 x 2 cm right atrial mass. He was started on warfarin but was also found to have new-onset sick sinus syndrome and high-grade atrioventricular block. To better characterize the mass, he underwent cardiac MRI which revealed findings consistent with a neoplasm. He subsequently underwent surgical resection of the mass, and pathology showed B-cell non-Hodgkins lymphoma (NHL). Further work-up for another source of tumor included PET imaging and bone marrow biopsy and was negative for systemic involvement. He was diagnosed with primary cardiac lymphoma causing his recurrent heart failure. He underwent complete surgical resection followed by systemic chemotherapy with rituximab, cyclophosphamide, doxorubicin, vincristine and prednisolone (R-CHOP), and he remains free of recurrence.

IMPLICATIONS/DISCUSSION: Systemic lymphoma with cardiac involvement has been reported in up to 20% of cases; however, primary cardiac lymphoma (PCL) is rare and accounts for less than 2% of all primary cardiac tumors. The clinical presentation of PCL is highly variable but commonly includes congestive heart failure, pericardial effusion, superior vena cava syndrome and arrhythmia. Variability of clinical symptoms frequently leads to delay in diagnosis and contributes to overall poor prognosis. Most reported cases are either diagnosed at autopsy or result in death within 2 to 3 weeks despite therapy. Transthoracic echocardiography is a convenient first diagnostic modality as it can detect both structural lesions and pericardial effusions. CT and MRI can be useful to evaluate the extent of involvement and size of the tumor. The diagnosis of PCL is made when there is involvement of heart and/or pericardium without evidence of nodal or other extra-nodal disease. Cytologic evaluation of associated pericardial fluid is diagnostic in many cases, but in patients without effusion or those with inconclusive cytology, diagnosis may require open surgery which has 100% diagnostic yield. Less invasive options, including mediastinoscopy, transesophageal echocardiography-guided biopsy and endomyocardial transvenous biopsy, are other available diagnostic procedures but have high false-negative rates. Early diagnosis of PCL is important as survival is greatly increased with early intervention and treatment. The treatment of PCL is determined by the histology and as in our patient, B-cell NHL is generally treated with the R-CHOP regimen.

SUPRACLAVICULAR LYMPHADENOPATHYAS INITIAL PRESENTATION FOR TESTICULAR CANCER: AN IMPORTANT DIFFERENTIAL DIAGNOSIS FOR YOUNG MEN Masayuki Kobayashi 1; Simi Padival2.

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11248)
LEARNING OBJECTIVES: 1. To recognize testicular cancer as an overlooked but serious malignancy in young men 2. To recognize the importance of evaluating supraclavicular lymphadenopathyCASE INFORMATION: A 27-year-old Japanese male with no past medical history presented with a left neck mass. He was unaware of it until his wife detected it, prompting a visit to the outpatient clinic on the following day. He denied any recent fevers, night sweats, weight loss, or malaise. On physical examination he was noted to have a left supraclavicular lymph node measuring 2 cm in diameter. The node was hard and fixed without tenderness. No other lymph nodes were palpable and the remainder of his exam was normal. On laboratory testing a CBC was within normal limits. A CT scan of the chest and abdomen confirmed the left supraclavicular lymphadenopathy and also showed mediastinal and para-aortic lymphadenopathy. While waiting for lymph node biopsy the patient had an endoscopy and colonoscopy to evaluate for gastric cancer or colon cancer however these were negative. The patient underwent biopsy of the supraclavicular node and histology revealed metastasis of a germ cell tumor. A genital exam was performed

and did not reveal any abnormalities however testicular ultrasound showed two hypo-echoic heterogeneous lesions in the left testis. Serum -human chorionic gonadotropin was elevated at 0.21 ng/mL respectively. The patient underwent a left-sided orchiectomy and histology revealed seminoma. The patient subsequently initiated chemotherapy without complications.
IMPLICATIONS/DISCUSSION: Testicular cancer is the most common solid tumor of men between the ages of 15 and 35. While frequent in young men, it is rare compared to other cancers. Despite this, the rate of testicular cancer has been increasing and is more commonly found in developed countries. Typical symptoms include painless testicular masses, however tenderness may be a finding. Occasion-ally the patient is asymptomatic but with metastatic findings such as in our patient. The prognosis is good with a more than 95% cure rate, however treatment is more likely to be successful when testicular cancer is found early. Thus early diagnosis and management is important. Seminomas account for close to half of testicular germ cell tumors and tend to be localized at the timeof diagnosis. Common sites of metastasis include the para-aortic lymph nodes or even to the lungs but supraclavicular node involvement has been noted. In one series, metastasis to the neck occurred in 4.5-15% of patients with 5% having a neck mass as the initial presentation. Left supraclavicular lymphadenopathy, also known as Virchows node, is concerning for abdominal or pelvic malignancy. Thus a thorough assessment including genital examination is warranted in young males even if they are asymptomatic.
INTERFERON GAMMA IN THE DIAGNOSIS OF TUBERCULOUS PLEURAL EFFUSION IN AN HIV POSITIVE PATIENT Richard Bayer 1;
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LEARNING OBJECTIVES: 1. Diagnose tuberculous pleural effusion via surrogate pleural fluid markers in high risk patients. 2. N/ACASE INFORMATION: Pleural effusion is a common manifestation of tuberculosis. In the absence of acid fast bacilli (AFB), the diagnosis of tuberculosis based on pleural effusion fluid characteristics alone can be made with a high degree of accuracy. We describe the case of a 41-year-old, HIV-positive, incarcerated male with a pleural effusion of unknown etiology. Pleural effusion was observed on x-ray, and ultrasound-guided thoracentesis with pleural biopsy was performed. Histology and cytology of pleural tissue and fluid was non-diagnostic. Smears of sputum and pleural fluid were negative for AFB. Pleural fluid adenosine deaminase was not suggestive of tuberculosis, however, interferon gamma was highly elevated at 377 pg/ml and the diagnosis of tuberculosis was made. The patient was administered a standard multidrug regimen for treatment of tuberculosis one month before AFB cultures from the pleural biopsy were deemed positive. As

tuberculosis is an AIDS-defining illness, the patient has been referred for initiation of HAART.
IMPLICATIONS/DISCUSSION: Pleural effusion is the presenting symptom of Mycobacterium tuberculosis infection in approximately 3-25% of cases. Induced sputum is positive on smear or culture for over 50% of patients with tuberculous pleural effusion despite an otherwise normal chest x-ray. Approximately 10% and 40% of patients will have acid fast bacilli (AFB) present on smear or culture of pleural fluid, respectively, making the diagnosis of tuberculosis straightforward. Pleural fluid smear is more frequently AFB positive in HIV positive patients. Pleural biopsy is positive for AFB in approximately 70% of patients with a tuberculous pleural effusion. When there are no AFB to be found in sputum or pleural fluid, the use of alternative diagnostic markers is crucial. These markers include adenosine deaminase (ADA) and interferon gamma, two byproducts of T-cell metabolism which are both highly sensitive and specific for M. tuberculosis infection. We report a case of a middle-aged, HIV-positive, incarcerated male with a high suspicion for tuberculous pleural effusion. Initial workup for tuberculosis was inconclusive, and our diagnosis hinged upon the results of these surrogate markers. In our case the diagnosis was made via surrogate markers a full month prior to culture positivity in the pleural biopsy specimen, and all other tests returned as equivocal or negative. Without the use of interferon gamma, this patient may have been taken off respiratory isolation and could have exposed numerous other contacts before his infection was discovered.

DISSEMINATED INFECTION WITH VANCOMYCIN-INTERMEDIATE STAPHYLOCOCCUS AUREUS (VISA) IN A 37-YEAR-OLD David Heller 1;
Stephen Sisson1. 1Johns Hopkins University, Baltimore, Maryland. (Tracking ID # 11320)
LEARNING OBJECTIVES: 1. Diagnose VISA and identify its risk factors and treatment options 2. Recognize the insufficiency of maximal standard infection control practices for reliable control of VISA outbreaksCASE INFORMATION: A 37-year-old female with history of intravenous drug use and hepatitis C was admitted after one day of nausea, vomiting, abdominal pain and left flank/back pain. She was undergoing treatment with daptomycin for MRSA endocarditis complicated by septic pulmonary emboli and tricuspid valve vegetation at a subacute facility, after having failed a six-week course of vancomycin. Evaluation of symptoms included an abdominal CT showing a possible tubo-ovarian abscess and possible osteomyelitis of the left sacroiliac joint, confirmed by lumbar spine CT. Echocardiogram showed vegetations of the tricuspid, aortic, and mitral valves. Blood cultures grew methicillin-resistant staphylococcus aureus (MRSA) that was also of intermediate resistance to vancomycin (i.e. VISA). The patient was begun on quinopristin-dalfopristin and trimethoprim-sulfamethoxazole. On the third hospital day, the patient developed new word-finding difficulties. Neuroimaging demonstrated a small MCA-territory infarction with hemorrhage, likely from a septic embolus. The tubo-ovarian abscess and osteomyelitis seen on prior imaging were also felt to be due to disseminated VISA infection. The patient underwent aortic valve replacement and tricuspid and mitral valve repair without complication, and was discharged on a six-week course of dalfopristin and trimethoprim-sulfamethoxazole.
IMPLICATIONS/DISCUSSION: MRSA is an increasing public health threat, but is usually susceptible to vancomycin and other glycopep-tides. Vancomycin-resistant staphylococcus aureus (VRSA), defined by a minimal inhibitory concentration (MIC) greater than 16, is very rare. Within the United States, only seven cases have been confirmed. More common is MRSA with a vancomycin MIC of 48 mcg/mL, which is known as vancomycin-intermediate staphylococcus aureus (VISA). VISA is usually caused by the synthesis of an abnormally thickened staphylococcal cell wall that impairs the ability of the drug to reach targets within the cell. The first case of VISA was reported in Japan in 1997. Risk factors include indwelling central lines, dialysis, and prolonged courses of vancomycin. No single treatment has been reliably validated, but most reports suggest using an agent to which the VISA strain is known to be susceptible, such as daptomycin, linezolid, or quinopristin-dalfopristin. Our patient had persistent bacteremia despite a prolonged course of vancomycin, a risk factor for VISA. She then failed

to clear her cultures with daptomycin. Her VISA strain demonstrated sensitivity to trimethoprim-sulfamethoxazole, so this agent was used with quinopristin-dalfopristin. Linezolid and quinopristin-dalfopristin sensitivities were not available. Guidelines for prevention and control of VISA are also unclear; an outbreak in an ICU in France in 2006, in which 8 of 22 infected patients died, demonstrated that maximum contact precautions were insufficient to control spread of infection, requiring twice-daily environmental cleaning and admission restrictions. VISA is a concerning threat to public health, especially in hospital settings, whose definitive prevention and treatment is poorly understood.

A CASE OF RECURRENT PERTUSSIS INFECTION Samuel Edwards 1;
Carol Bates1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 11322)

LEARNING OBJECTIVES: 1. Recognize the presentation, diagnosis and management of Bordetella pertussis Infection2. Review timing of immunity to Bordetella pertussis after infection and vaccinationCASE INFORMATION: A 65 year old Caucasian female with a history of incidentally noted, untreated Waldenstroms macroglobulinemia, presented with a 3 month history of severe cough. She experienced paroxysmal cough prompting her to gasp for breath. She denied nasal congestion, sore throat, or sputum production. At the time of her visit, the cough had largely resolved. On exam, her oropharnyx was normal and her lungs were clear to auscultation. A chest radiograph showed a new rib fracture but no lung findings. Bordetella pertussis IgG serology was positive at 30ug/mL. As she had symptoms three months ago, she was not treated. Two years later, she again presented to her primary care doctor with 12 days of cough. The cough had worsened until 4 days prior to presentation, when she had one day of paroxysmal cough with a sensation of catching her breath, reminiscent of her pertussis. The cough since improved. She was concerned as she was a caregiver to a chronically ill infant. Her physical exam was normal. B. pertussis serology 14 days from onset of symptoms was negative at 12 ug/mL, but repeat serology 45 days after symptom onset was positive at 20 ug/mL. She was treated with azithromycin and her symptoms gradually resolved.

IMPLICATIONS/DISCUSSION: Whooping cough is an acute respiratory illness caused by the gram negative bacterium Bordetella pertussis. While often thought of as a childhood infection, pertussis is increasingly recognized as a cause of prolonged cough in adults. Pertussis infections classically begin with a 710 days of mild upper respiratory tract symptoms (catarrhal phase), followed a paroxysmal cough often with a characteristic inspiratory whoop (paroxysmal phase). Symptoms gradually wane in the convalescent phase. In adults and adolescents, the inspiratory whoop is often absent, making differentiating pertussis from other viral causes of URI difficult. Laboratory testing for B. pertussis include bacterial culture, serum serology, direct flourescent antibody testing or PCR. Treatment with macrolide antibiotics can potentially decrease the severity of symptoms and can reduce the likelihood of transmission. Classically it has been thought that Pertussis confers long term immunity to future B. pertussis infections, but it has become evident that this immunity wanes over time. Studies have demonstrated laboratory confirmed reinfection in children in as little as two years, as was true in our patient. The second infection tends to have less typical symptoms, and is less severe. Our patient was retested only because her symptoms were briefly reminiscent of her first infection. This suggests that pertussis should not be discounted even in the presence of a recently diagnosed infection. While the incidence of pertussis will
hopefully wane as booster vaccination results in greater herd immunity, it is unclear whether vaccination in patients with documented infection is useful.

ENCEPHALITIS AND ARRHYTHMIAS- RECOGNIZING AN UNUSUAL ASSOCIATION Shuchi Gulati 1;
Richard Alweis1. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11323)

LEARNING OBJECTIVES: 1. Recognize the likely association between herpes encephalitis and cardiac arrhythmias. 2. -CASE INFORMATION: A 73 year old male with a past medical history of hypertension and coronary artery disease on beta blocker therapy presented to the hospital with an acute change in mental status

following an episode of witnessed tonic-clonic seizure-like activity. The patient had recently flown and had developed low grade intermittent fever since. Examination revealed obtundation with an otherwise non-focal neurological exam. He was intubated for airway protection and transferred to the ICU. Laboratory evaluation revealed only mild leukocytosis with a normal differential. Blood chemistries were normal with negative toxicology screening. Lumbar puncture revealed clear appearance of the CSF, with normal glucose of 76 mg/dL, elevated protein of 64 mg/dL (nl 2045 mg/dL), elevated white cell count of 304 cells/microliter (nl 05 cells/microliter), with 80% lymphocytes (nl 0-50%) and 1% neutrophils. Herpes Simplex type 1 DNA was detected by PCR. A diagnosis of herpes encephalitis was made and the patient was started on intravenous acyclovir. After transfer out of the unit, he was noted to have sinus bradycardia with heart rate ranging from 4060 beats per minute. Review of his rhythm revealed a first degree heart block. The patient was evaluated and, for unclear reasons, restarted on his home dose of metoprolol. This was followed by development of complete heart block which necessitated implantation of a dual-chamber pacemaker.
IMPLICATIONS/DISCUSSION: Herpes simplex virus is the most common cause of acute, sporadic viral encephalitis, accounts for 10% to 20% of all cases. Of these more than 95% are caused by subtype I virus. The clinical hallmark of HSV encephalitis is acute onset of fever accompanied by focal neurologic signs (most commonly involving the temporal lobes). There have been isolated case reports in literature connecting cases of herpes encephalitis with development of cardiac arrhythmias. Hence patients with encephalitis need close cardiac monitoring. Literature search reveals that these patients spontaneously recover with treatment of the underlying infection and have not needed pacemakers.
Physicians taking care of patients need to recognize the association of cardiac arrhythmias with non-cardiac causes like viral infection. This can help avoid catastrophic sequelae.
IT IS MORE THAN CELLULITIS Mustafa Abas 1; Lucero Chueca Villa 2; Marcus Zervos2. 1Henry Ford Hospital, detroit, Michigan ; 2Henry Ford Hospital, Detroit, Michigan . (Tracking ID # 11379)
LEARNING OBJECTIVES: 1. To describe the clinical features of Pyomyositis.0 2. To raise the awareness of Pyomyositis in immunocompetent patients.
CASE INFORMATION: This is an 18 year-old previously healthy male, who presented to the ER with a 3 day history of fever, malaise, pain and swelling of the left anterior chest and axilla. He practices martial arts and started having symptoms one day after his last training. He took

acetaminophen with no relief. He denies any IV drug use, steroid injection, recent injuries or wounds. He has no recent travel to tropical areas either. Upon presentation to the ER, his temperature was39.9C, with tachycardia, and had a tense, reddish discoloration of the left chest and axilla. The pain was aggravated by passive movement of left arm and by superficial palpation of the affected areas. His WBC was elevated at 19.9 K/uL with a left shift (neutrophils 83% / 16.50 K/ uL). The rest of the CBC, liver, and kidney function tests were within normal limits. A soft tissue ultrasound of the chest revealed enlarged axillary lymph nodes with no fluid collection or other abnormalities. The patient was admitted with a diagnosis of cellulitis and started on vancomycin. The following day, the pain and the swelling increased and were disproportionate to the area of erythema. At that point, the antibiotic coverage was broadened to empirically cover Streptococcus pyogenes with Penicillin G and clindamycin. Further evaluation revealed a CPK of 7640 IU/L; HIV ELISA was not reactive. A contrasted CT scan showed swelling in the muscles with strings of fluids inside the pectoralis major. An emergent surgical exploration was performed and 600 ml of purulent drainage was obtained bellow the pectoralis muscle. Cultures grew community acquired Methicillin resistant Staphylococcus aureus, susceptible to vancomycin. Penicillin G was discontinued and patient was discharged to complete 2 weeks of Vancomycin.
IMPLICATIONS/DISCUSSION: Pyomyositis is a disease mostly described in tropical areas, although it has

been increasingly reported in more temperate areas in immunocompromised patients. It is a purulent infection of the skeletal muscle, caused by Staphylococcus aureus in 90% of cases. It is a rare condition because the striated muscle tissue is normally resistant to bacterial infection. Even though any skeletal muscle can be involved, the thigh and trunk muscles are affected the most. Pyomyositis may be endemic in tropical areas but rarely presents as a spontaneous condition due to strenuous exercise that causes repetitive muscle trauma in immunocompetent patients. The choice of antibiotics was targeted to treat MRSA as incidence of community acquired MRSA is increasing, especially in people who practice contact sports or go to gymnasiums. Usually the onset of the disease is marked by diffuse muscle pain and fever, which starts insidiously, with mild erythema and absence of overt external manifestations which may lead to diagnostic delay. Pyomyositis has high morbidity and a mortality that approaches 15% when inappropriately treated or misdiagnosed. MRI is considered the gold standard in the diagnosis. CT scan alone or combined with ultrasound has an essential role in the diagnosis of pyomyositis, as it shows specific findings that distinguish this disease from cellulitis and fasciitis. The treatment involves antibiotics with a need for surgical drainage in the suppurative phase of the disease. Our case is unique because our patient was immunocompetent and had a rapid progression of disease. It also illustrates that early diagnosis and appropriate treatment can lead to complete recovery without any complications.

SPONTANEOUS TENDON RUPTURE AS A RARE SIDE EFFECT OF STATIN USE Ashwin Ganta 1; Scott Turner 2; Wilson I Gonsalves 1; Tsewang Tashi 1; Mahmoud Abu Hazeem 1; Priscilla Hoang 1; Mohammad Almiani 1; Venkata Alla1. 1Creighton University School of Medicine; Department of Internal Medicine, Omaha, Nebraska ;
2Creighton University School of Medicine/ Department of Internal Medicine, Omaha, Nebraska. (Tracking ID # 11389)

LEARNING OBJECTIVES: 1. Recognize the clinical presentation of tendinopathy/tendon rupture 2. Identify rare adverse reactions of statin therapy

CASE INFORMATION: A 61 year-old male presented to the emergency department with excruciating pain in his right knee. On the morning of presentation, he developed sudden onset of stabbing pain in his right knee along with a sudden popping sound while bending down to pick up a newspaper. He was unable to bear weight and fell to the floor. He was essentially asymptomatic prior to this event and denied any preceding trauma or excessive muscular strain. Medical history was significant for hypertension, diabetes mellitus 2 and hypercholesterolemia. On examination, there was swelling in the suprapatellar region of his right knee associated with ecchymosis. He was unable to perform a straight leg raise and active extension of his right knee. Passive movements in both the knees and active movements in the left knee were normal. Hip examination was normal. Anterior-posterior and lateral radiographs of the knees showed thickening of the quadriceps tendon on the right and normal findings on the left. A non-contrast MRI of his right knee showed a tear of his right vastus lateralis tendon with mild retraction. The patient underwent successful open vastus lateralis tendon repair of his right knee. On review of his medications, the only potential etiological agent was simvastatin which he had been taking for the past three years. He denied use of fluoroquinolones, steroids or any other offending agents in the preceding three years. Post-operatively, he had not taken simvastatin for 3 weeks and had no musculoskeletal symptoms. Following discharge, he restarted his simvastatin therapy and weeks later developed pain in the area of the left quadriceps tendon. However, there was no clinical evidence of any rupture and was able to bear weight despite the pain. Given his recent medical history and the known but rare association of tendinopathy with statin use, he was recommended discontinuation of statin therapy. At three month follow-up, he was asymptomatic and had no recurrent symptoms. IMPLICATIONS/DISCUSSION: Iatrogenic, non-traumatic causes of tendon rupture include steroid and flouroquinolone use. Statins are associated with a multitude of musculoskeletal complaints of which myopathy is the most frequent. Tendinopathy and tendon rupture are very rare but reported adverse effects of statin use. The present report

describes a quadriceps tendon rupture during simvastatin therapy and contralateral symptoms of quadriceps tendinopathy on rechallenge. The lack of other causative factors, the temporal relation and reproducibility of symptoms on rechallenge support the causative role of statin therapy in our patient. The exact etiology of statin induced tendinopathy and tendon rupture remain unclear. However, proposed mechanisms include statin induced suppression of matrix metalloproteinase and prostaglandin E2 activity. This leads to impaired tendon remodeling and potentially to weakening and rupture. As the prevalence of hyperlipidemia and the prescription of statins continue to increase, it is imperative that physicians should remain vigilant to the possibility of such rare and potentially disabling side effects.

STATUS REPORT: NON-CONVULSIVE STATUS EPILEPTICUS AS A CAUSE OF ALTERED, BUTAWAKE, MENTAL STATUS Seth Berkowitz 1;

Sumant Ranji1. 1UCSF, San Francisco, California. (Tracking ID # 11393)

LEARNING OBJECTIVES: 1. Recognize in which situations assessment for Non-Convulsive Status Epilepticus is warranted 2. Diagnose Non-Convulsive Status Epilepticus and review the evidence around cost-effective evaluation for this conditionCASE INFORMATION: A 64 y/o man presented with altered mental status. He was brought to the ED after 2 days of giggling, smiling inappropriately, intermittent recognition of family members, and inability to perform ADLs. He was awake and alert with a preserved

sleep-wake cycle. His family noted fevers but no other abnormalities. His past medical history was significant for CAD s/p CABG 3 years prior complicated by atrial fibrillation leading to serial PCA and PICA infarcts. These resulted in cortical blindness, balance disturbances, and seizures, although he had been seizure-free for 2 years. Medications included benazepril, metoprolol, atorvastatin, amiodorone, warfarin, levetiracetam, escitalopram, and clonazepam. Medication adherence had been excellent. On physical exam, he was febrile to 39.2 C with otherwise normal vitals. He had neck stiffness, a regular heart rhythm , and clear lungs. Neurologically, he was A&Ox 0, making nonsensical responses and intermittently following commands. Motor exam revealed increased tone throughout. His chemistries and CBC were unremarkable. His INR was 2.7. UA revealed + Nitrite, and >50 WBC per HPF. Given his fever and rigidity, the differential diagnosis included toxidrome such as serotonin syndrome, infectious meningitis, and delirium secondary to UTI. Non-contrast head CT was unchanged from prior. LP was performed which revealed CSF with 0 WBCs, 0 RBCs, no xanthochromia, and mildly increased protein. He was treated for his UTI and admitted to the ICU for monitoring. He failed to improve and given his past seizure history a diagnosis of non-convulsive status epilepticus was considered. This was confirmed by EEG. Levetiracetam was increased and he was started on topiramate, with resolution of his seizure activity and improvement in his mental status. After an 8 day hospitalization, he was discharged to home. IMPLICATIONS/DISCUSSION: Broadly, non-convulsive status epilepticus (NCSE) is continued seizure activity in absence of major motor signs. As with convulsive status epilepticus, seizure activity is not necessarily continuous, but must recur before the postictal period has cleared. There are several major sub-types of NCSE including absence SE (varying impairment of consciousness, disorientation), simple partial SE (preserved consciousness, symptoms of a single sensory system), complex partial SE (impaired consciousness and confusion), and subtle SE (loss of consciousness, no movements or subtle automatisms). NCSE should be suspected in those with consistent symptoms and a history of seizure disorder, CVA, structural brain lesions, metabolic abnormalities, or toxidromes. NCSE can also occur in the setting of anti-epileptic drug (ADE) underdose or treatment failure, as in this case. The epidemiology of NCSE is unclear, but estimates of all cases of status epilepticus are around 40 per 100,000 patients per year. Of these, approximately 5-40% are NCSE. NCSE makes up a higher proportion of SE as people age. EEG is diagnostic. No data directly address cost-effectiveness of EEG evaluation for altered mental status, but video EEG monitoring costs roughly $1500-2500 a day, which is similar to or slightly less than an ICU admission for a similar period of time. Treatment is similar to that of convulsive status epilepticus, with benzodiazapines being the treatment of choice.

Phenytoin/fosphenytoin, barbiturates, and propofol have also been used. The prognosis is generally better than with convulsive status epilepticus and there is less evidence of excitatory neurotoxicity. In conclusion, NCSE is a rare but treatable cause of altered mental status of all levels of derangement. In patients with risk factors who are not improving with treatment for other etiologies in 2448 hours, EEG evaluation for NCSE is warranted.

AN UNCOMMON ETIOLOGY OF HYPONATREMIA Abdur Baig 1;
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(Tracking ID # 11400)

LEARNING OBJECTIVES: 1. Review the clinical characteristics of hyponatremia in alcoholics.2. Management of beer potomania.

CASE INFORMATION: A 55-year-old alcoholic man was admitted to the hospital due to persistent hiccup and agitation. He was hypertensive, had asthma and chronic renal insufficiency stage 3. Medications: amlodipine 10 mg, folic acid 1 mg, thiamine 100 mg and tamsulosin0.4 mg. Physical examination: blood pressure of 115/86 mmHg, pulse 105 beats/min, temperature 98 F and respirations 18/min. He was alert, agitated and had no focal neurological signs. Laboratory: sodium of 116 mEq/L, potassium 4.3 mEq/L, blood urea nitrogen 3 mg/dl, creatinine1.4 mg/dl. Serum osmolarity was 259 mOsm/L (normal 289308 mOs/L); aspartate aminotransferase 48 U/L, alanine aminotransferase 29 U/L, total bilirubin 0.5 mg/dl, direct bilirubin 0.1 mg/dl. Sodium spot urine was <10 mEq/L (normal 10300 mEq/L), urine osmolarity 34 mOsm/L (normal 300900 mOsm/L). Thyroid-stimulating hormone was 0.10 uIU/ml (normal 0.34-5.6 uIU/ml). Lipid panel was also normal. On intravenous(IV)normal saline at a rate of 100 ml/hour, sodium increased to 128 mEq/L the next day. Ultrasonogram of abdomen reported homogenous liver, normal left ventricular ejection fraction (66%) on echocardiogram. On discharge his sodium was 134 mEq/L and potassium 3.9 mEq/L.

IMPLICATIONS/DISCUSSION: Severe hyponatremia (<125 mEq/L) has a high complication rate, particularly when the level is <105 mEq/L. The mortality is 50%, especially in alcoholics, 18% of them develop the osmotic demyelination syndrome (ODS).

Beer potomania is characterized by 1) a history of chronic alcoholism; 2) protein malnutrition; 3) signs, symptoms and laboratory values consistent with water intoxication; 4) no evidence of another cause of hyponatremia; 5) urine osmolarity <100 mOsm/L, indicating suppression of ADH.

A normal kidney can dilute the urine to a maximum of 50 mOsm/L. On a regular diet, protein catabolism and other sources produce about 1,000 mOsm/day of solute. Water excretion depends on the free water clearance and the osmotically bound water. To become hyponatremic, more than 20 liters (1000 mOsm/50 mOsm/L) of water may be ingested in a period of 24-hour. In beer potomania, in addition to ingesting a large fluid volume, poor nutritional status contributes to the hyponatremia because of the decrease in the osmolar load to approximately 250 mOsm/day. This reduces the ability to excrete osmotically bound water. Beer carbohydrate also suppresses protein catabolism.

The first case was reported by Demanet JC et al in 1971. Since then about 26 cases published in the English literature, five developed ODS (19%) and four died (15%).

Management of severe hyponatremia is often challenging and fluid restriction is indicated. When serum sodium is corrected faster than the recommended rate, dextrose 5% in water needs to be added with additional solutes restriction. If these measures fail, desmopressin should be considered.

A CASE OF NESISIOBLASTOSIS AFTER BARIATRIC SURGERY salma makhoul ahwach 1; maguy chiha 2; honasoge mahalakshi 3; jeffrey genaw2. 1Henry Ford Hospital, detroit, Michigan ; 2henry ford hospital, detroit, Michigan ; 3heney ford hospital, detroit, Michigan. (Tracking ID # 11401)

LEARNING OBJECTIVES: 1. To determine the clinical characteristics of nesidioblastosis2. To broaden the differential diagnosis of postprandial hypoglycemia in bariatric patientsCASE INFORMATION: A 48 year old female known to have morbid obesity underwent laparoscopic bariatric surgery in 2006.Two years after the surgery, she started experiencing intermittent bouts of severe abdominal pain often following food intake. In

addition, she had episodes of both fasting and postprandial hypoglycemia which occasionally caused presyncope. She underwent a 3 hour glucose tolerance test with the following results: the fasting glucose was 69 mg/dL, one

hour following a 75 gm of glucose load it was 104 mg/dL, after two hours it dropped to 37 mg/dL and at three hours it was 70 mg/dL. During the hypoglycemia, the insulin level was 60uIU/mL and the C-peptide8.5 ng/mL (both elevated). A computed tomography scan of her abdomen was negative for any pancreatic lesion.A selective calcium injection and blood sampling of the gastroduodenal, superior mesenteric, and splenic arteries demonstrated diffuse insulin production throughout the pancreas, with positive responses in all three arterial distributions.
IMPLICATIONS/DISCUSSION: Postprandial hypoglycemia following gastric bypass surgery is often attributed to the dumping syndrome. Nesidioblastosis is a rare but increasingly recognized culprit of postprandial hypoglycemia in postgastric bypass patients. It is characterized by endogenous postprandial hyperinsulinemia and pathologic findings of hypertrophic beta cells with enlarged or normal-appearing islets. The distinction between dumping syndrome, insulinomas and nesidioblastosis is an important one to make as the treatment modalities differ significantly. Using selective arterial calcium injection, the affected area of the pancreas is localized and surgically removed with significant improvement of symptoms. Non-surgical candidates such as our patient with diffuse insulin production can be treated with somatostatin analogues with a fair response.
IRON DEFICIENCY ANEMIA IN PREMENOPAUSAL WOMEN: THINKING PAST THE PERIOD Kelly Darmody 1; Julie Mitchell1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11407)
LEARNING OBJECTIVES: 1. To recognize menorrhagia as a common etiology of iron deficiency anemia (IDA) in premenopausal women. 2. To include GI causes of anemia in the differential diagnosis of IDA in premenopausal women as well as GI investigation in workup of IDA for those at risk.
CASE INFORMATION: A 47 year old healthy female presented to outpatient clinic for annual health maintenance exam. She has low back pain for which she has been taking diclofenac, her only medication. She mentions that the pills have a sour taste and make her feel nauseated if she takes them without food. She also mentions having heartburn triggered by drinking coffee. She denied having any dark stools. She did have one episode of nonbilious, nonbloody emesis. On physical exam, she was a well-appearing African American, vital signs were normal, BMI was 30, abdominal exam was normal, systolic flow murmur was present on heart auscultation. CBC was ordered because of GI symptoms and Hb was critically low at 5.2, Hct 20%, platelets 980, MCV 67, and peripheral smear demonstrated hypochromic microcytic RBCs, moderate poikilocytosis, anisocytosis and ovalocytes. She had not had a previous CBC. The degree of anemia juxtaposed with her general health suggested a chronic cause and so non-GI sources of bleeding were considered. During a telephone call, she described chronically heavy but regular menstrual flow. She denied fatigue, SOB, or other bleeding such as hematuria or epistaxis. On a weight loss diet, she had recently stopped eating meat. She was advised to stop taking all NSAIDS, started on PPI and iron supplements. On return visit, we noted conjunctival and palmar pallor, rectal and pelvic exams were normal. Stool was negative for H. Pylori antigen, ferritin was 1.4, and a pelvic US showed extensive fibroids. Her severe iron deficiency anemia is most likely due to fibroid-induced menorrhagia, although a slow GI bleed (gastritis vs PUD) given her chronic NSAID use, epigastric pain, and emesis, cannot be ruled out. Diet may also be contributing with the recent absence of red meat.
IMPLICATIONS/DISCUSSION: The most common cause of IDA in premenopausal women is menstrual blood loss, most often due to structural lesions (fibroids, polyps, adenomyosis, and malignancy) or anovulatory cycles, both of which occur most frequently during the transition to menopause. Clinically relevant fibroids have been found in 35% of Caucasian women and 50% of African American women at menopause

transition. When compared with Caucasians, African Americans present with symptomatic fibroids an average of 5 years earlier and are more likely to have anemia. The percentage of fibroids that cause anemia, and more importantly severe anemia, has not been well characterized. In all women over 35, including this patient, workup should include an endometrial biopsy to rule out cancer or hyperplasia, regardless of other findings such as fibroids.

Many clinicians stop their IDA workup when heavy bleeding is present, but standard of care for workup of IDA in men and postmenopausal women includes both upper and lower endoscopy. Studies of IDA in premenopausal women in which both gynecologic and GI workup were completed have found dual pathology in as many as 20-34%. The most important predictor for GI pathology is UGI symptoms (OR=5.2) including nausea, vomiting, dysphagia, heartburn, dyspepsia and epigastric pain. Other predictors include lower levels of Hbg, MCV and ferritin. These studies suggest that EGD should be considered in all IDA patients regardless of menstrual blood loss, and especially in our patient with severe anemia, UGI symptoms and NSAID use. Unfortunately, EGD is an invasive test for young healthy women to undergo, and noninvasive testing such as testing for H pylori, FOBT or tissue transglutaminase for celiac disease have been suggested but not specifically studied in this population. Another approach would be to continue workup only if the patient is unresponsive to a trial of oral iron supplementation.

LEVAMISOLE: WHEN COCAINE IS NOT ENOUGH Ahmad Hatem Mattour 1; Amr Hanbali 2; Muath Dawod 1; Ammar Khanshour1. 1Henry Ford Hospital, Dearborn, Michigan ; 2Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 11409)

LEARNING OBJECTIVES: 1. Recognize the hematological and dermatological complications of Levamisole contaminated cocaine 2. Recognize the importance of early detection and testing of Levamisole in cases presenting with typical clinical and/or laboratory findingsCASE INFORMATION: 46 y/o female with no significant past medical history transferred from an outside facility after presenting with nausea, vomiting and right elbow soft tissue infection. She originally presented to an urgent care for suturing of her Right elbow abrasion sustained due to falling after cocaine use. On physical exam she had right elbow bullae and edema, peripheral purpura and nose tip purpura. Initial labs showed pancytopenia, acute renal failure, mildly elevated liver function tests, positive Disseminated intravascular coagulation panel and lactic acidosis. Urine toxicology screen confirmed cocaine use and Levamisole urine test was obtained. She received aggressive fluid resuscitation and Intravenous Immunoglobulins. Due to concern for Disseminated intravascular coagulation the patient was transferred to our institution for intensive care management.

On arrival, management for suspected toxic shock syndrome with broad- spectrum intravenous antibiotics was continued in addition to 3 days of Intravenous Immunoglobulins. The patients skin changes progressed rapidly developing generalized bullae and dry gangrene of all digits. Dermatology service was consulted and multiple biopsies demonstrated congestion of superficial dermal vessels with purpura and fibrin thrombi formation, associated dermal edema and rare eosinophils, also negative PAS stains. C-ANCA, P-ANCA, ANA, antic-ardiolipin antibodies were requested and returned negative. As part of her management, the patient received 12 units of single-donor platelets due to persistent counts of less than 20000 per microliter although she

never had spontaneous bleeding. Ten days after presentation, toxicology report came back positive for Levamisole. The patient underwent Amputation of her Left foot toes; Right hand fingers and Debridement of Right foot amputation site. The patients platelet counts continued to improve gradually without any directed intervention (e.g. steroid therapy, plasmapheresis, etc.).

IMPLICATIONS/DISCUSSION: Levamisole is an antihelementhic agent that has also been used as an immunomodulating agent in adjuvant chemotherapy for malignancies such as colon cancer and melanoma. The suggested mechanism of immune modulating action has been associated with the generation of autoantibodies such as ANA, LA and ANCA. Levamisole has also been associated with bone marrow suppression and even

agranulocytosis, as the most commonly reported hematologic side effect. Levamisole-induced thrombocytopenia (LIT) occurs in rarely but reported cases are increasing.
The most pronounced cutaneous adverse effect is a purpuric eruption with a predilection for involvement of the ears. Histological examination reveals a mixed pattern of leukocytoclastic vasculitis and microvascular thrombosis or by pure microvascular thrombosis.
Levamisole is increasingly being used as a cocaine cutting agent with reports of levamisole present in almost 70 % of the cocaine seized at US borders. The purpose of Levamisole as an adulterant is still unknown; the leading theory is that it is added during the manufacture of cocaine to potentiate cocaines effects, possibly through its metabolite aminorex.
ANNULAR PANCREAS, UNUSUAL DIAGNOSIS IN AN ELDERLY WOMAN Ahmed Saeed 1; Omar Sharif 1; Alaali Yathreb 1; Robert Pompa 1; Osama Alaradi1. 1Henry Ford Health System, Detroit, Michigan. (Tracking ID # 11413)
LEARNING OBJECTIVES: 1. Although a diagnosis of an annular pancreas is rare, especially in adults. It should be considered in situations when a patient with possible associated symptoms of gastroduodenal obstruction. 2. Endoscopic ultrasound is an excellent emerging non-invasive modality to diagnose annular pancreas and rule out pancreatic mass lesions particularly in elderly patient like ours. CASE INFORMATION: A 72 years old woman was admitted to the hospital with left foot cellulites. She had some mild abdominal discomfort for few months prior to admission for which she was kept on PPI Therapy. During hospitalization she was complaining of abdominal pain without nausea, vomiting, changes in appetite or weight loss. Physical exam was unremarkable and did not reveal any abdominal masses or significant tenderness. Lab workup showed elevated Lipase 1725 IU/L with normal liver numbers. She was diagnosed with acute pancreatitis and treated with intravenous fluid support. CT scan was performed for evaluation and showed possible pancreatic tissue surrounding the second portion of the duodenum. She was treated for the cellulites and was discharged home. Outpatient Endoscopic ultrasound was done and showed evidence of partial duodenal obstruction with inability of the scope to be passed through the second part and significant amount of residual food in the stomach despite being NPO for the procedure. In addition she had typical finding of annular pancreas (figure 1) with obvious pancreatic tissue surrounding the entire second part of the duodenum. There were no mass lesions noted either by the CT scan or by the endoscopic ultrasound. Patient symptoms progressed over the course of several weeks to nausea, vomiting, increasing abdominal pain and weight loss consistent with the duodenal obstruction. The patient is scheduled for duodenoduodenostomy to bypass the obstructed second part of the duodenum for relief of symptoms.
IMPLICATIONS/DISCUSSION: Annular pancreas is a congenital anomaly with symptoms typically beginning in childhood and develop as a result of duodenal obstruction, with intractable vomiting most commonly noted. Although it is a congenital abnormality, it can rarely present during adulthood and should be considered in the differential diagnosis of gastroduodenal obstruction. Endoscopic ultrasound is an excellent non-invasive test to diagnose the condition and to rule out pancreatic mass lesions particularly in elderly patient like ours. Surgery remains the management of choice for those patients to relieve obstructive symptoms.
ALCOHOL WITHDRAWAL: AN ATYPICAL CAUSE OF TAKATSUBO CARDIOMYOPATHY Bhavana Siddegowda 1; Mukta Panda 2; JENNIFER WHITLEY2. 1UTCOMC, CHATTANOOGA, Tennessee ; 2UTCOMC, Chattanooga, Tennessee. (Tracking ID # 11429)
LEARNING OBJECTIVES: 1. Report a typical case of stress cardiomyopathy due to an atypical cause2. Review causes for stress cardiomyopathy and to emphasize the importance of assessing for these causesCASE INFORMATION: A 58-year-old African American female with a history of chronic alcohol abuse was admitted with alcohol withdrawal seizures.. No significant past medical history. On examination patient was found to be delirious, hypertensive (BP 193/106 mmHg) and tachycardic (HR 120-160/min), remainder of exam was normal.She had negative UDS and an normal Echocardiogram in the past with EF of 60%. EKG done in the ER

initially showed diffuse ST segment and elevated troponins(0.020 ng/ml). Patient was intubated and admitted to the ICU. In view of her rising troponins and hypotension, an emergency cardiac catheterization was performed which showed LVEF of 25% with anterior apical akinesia/dyskinesia and normal coronary arteries. An echocardiogram performed after the catheterization showed moderate anterior wall hypokinesis with apical akinesis and her BNP was elevated to 960. She was on a pressor for a short while.Patient responded to supportive treatment for delerium tremens and once stabilized was transferred to other facility. A diagnosis of stress cardiomyopathy was made. IMPLICATIONS/DISCUSSION: Stress or Takatsubo cardiomyopathy is increasingly well known in the western hemisphere presenting with symptoms similar to acute coronary syndrome with elevated troponins and acute ST segment changes but with clean arteries on cardiac catheterization. This is a transient cardiomyopathy with a classic apical ballooning on echocardiogram due to apical akinesis. The pathophysiology behind this is yet to be characterized definitively. There is speculation of inherited susceptibility due to structural or metabolic predisposition, which may play a role in sudden death. Unique features include incidence greater in postmenopausal women, associated with emotional stress and rare recurrence. It is likely that alcohol withdrawal causing autonomic dysfunction, by inducing increase in catecholamine plasma concentrations may have contributed to development of stress cardiomyopathy in this patient.This particular cardiomyopathy has been associated with varied number of scenarios. Its cause and mechanism being a mystery and consequently the optimal management still remains unclear.There have been 3 case reports so far describing alcohol withdrawal association with takatsubo. Other rare causes associated with or presenting with takatsubo cardiomyopathy in the literature are pheochromocytoma, metoprolol withdrawal, post ablation of adrenal glands, post liver transplant, opiate withdrawl just to mention a few. Takatsubo has good prognosis with complete recovery of LVEF to normal in 2 to 4 weeks with one percent in house mortality. As alcohol withdrawal is commonly encountered by internists, thus it is important to keep this entity in the differential given it good prognosis.

A NOT SO CLASSIC CASE OF DIABETIC KETOACIDOSIS Adaeze Adigweme 1; Robin Klein2. 1Emory University School of Medicine, Atlanta, Georgia ; 2Emory University, Atlanta, Georgia. (Tracking ID # 11436)

LEARNING OBJECTIVES: 1. Review the pathophysiology and precipitants of diabetic ketoacidosis. 2. Recognize the role of hypertriglyceridemia in pancreatitis.

CASE INFORMATION: Mr G. is a 28 year old Hispanic male with a history of insulin dependent diabetes mellitus and alcohol-related pancreatitis who presented to the emergency department with a three day history of nausea, vomiting, and severe abdominal pain. He had been noncompliant with his medications over the three months prior to presentation.

Vital signs were significant for tachycardia and tachypnea. On physical exam, he was awake but appeared to be in acute distress. There was severe tenderness to palpation in the abdomen diffusely, especially in the epigastrium. He had multiple subcentimeter, raised yellow papular eruptions on the legs, shins, back, and hands bilaterally. The remainder of his exam was unremarkable.

Labs revealed serum sodium of 115 mg/dL, bicarbonate of 4 mg/dL, and glucose of 261 mg/dL. White blood cell count was 22.9. His arterial pH was 6.95, and carbon dioxide was 6 mg/dL. Serum lactate and beta-hydroxybutyrate were markedly elevated. Amylase was 248 mg/dL and lipase was 288 mg/dL. An emergency department nurse incidentally noted that the patients blood separated into two distinct layers of yellow and red every time it was drawn, and stated that it looked like fat . Serum lipid panel revealed triglyceride level of 2708 mg/dL. The working diagnosis was diabetic ketoacidosis precipitated by pancreatitis, secondary to severe hypertrigylceridemia.

IMPLICATIONS/DISCUSSION: Diabetic ketoacidosis is a severe complication of diabetes in which insulin

resistance or insulin deficiency leads to increased gluconeogenesis, glycogenolysis, and lipolysis, resulting in ketoacidosis. Common precipitants include, infection, pancreatitis, myocardial infarction, systemic glucocorticoid administration, and medication noncompliance. His elevated amylase and lipase in the setting of severe abdominal pain led us to believe that pancreatitis was the precipitant for his diabetic ketoacidosis.
Pancreatitis has several precipitants, most commonly alcoholism and gallstones. Other less common causes include pancreatic masses, hypertriglyceridemia, medications, and certain infections. Our patient, though he had past history of alcoholism, avidly denied recent alcohol abuse within the past year. It was not until the nurse noted that the appearance of his blood was grossly abnormal and looked like fat that we discovered his markedly elevated triglyceride level in the thousands, which is typical for familial hypertriglyceridemia.
In this case, a major teaching point for our team was that alcoholism and gallstones, although common, are not the only causes of pancreatitis. As we often learn in medicine, listening to our patient (who avidly denied recent alcohol abuse) is always key in accurate clinical diagnosis. Sometimes, when faced with a case that seems like an obvious diagnosis, we should be sure to exclude any not-so-common pathological processes.
CEPHALOSPORIN NEUROTOXICITY IN END STAGE RENAL DISEASE Hyo Youn Lee 1; Anup Subedee 2; Anthony Donato2. 1The Reading Hospital and Medical Center, Wyomissing, Pennsylvania ; 2The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11451)
LEARNING OBJECTIVES: 1. Diagnose cephalosporin neurotoxicity despite renal dosing adjustment. 2. In presence of a high clinical
suspicion for neurotoxicity, manage by immediately decreasing the antibiotic dose and confirming with a serum drug level.
CASE INFORMATION: A 47-year old male being treated for multiple myeloma and end-stage renal disease (ESRD) on peritoneal dialysis and cirrhosis was admitted for a methicillin-sensitive S. aureus port infection treated with IV cefazolin, dosed for his creatinine clearance. Following surgical removal of his port, the patient was noted to be more lethargic by his family at bedside. Upon physical examination, the patient was difficult to arouse, which was initially attributed to recovery from anesthesia. On subsequent physical examinations, the patients stupor persisted, along with development of slow myoclonic movements at rest and with intention. Removal of opiates, benzodiazepines, and gabapentin did not resolve symptoms over the following 48 hours. Electroencephalography(EEG) revealed diffuse, bi-hemispheric slow-wave delta activity of low amplitude which suggested a drug side-effect. Subsequently, the serum sample for cefazolin level was drawn, and cefazolin dose was reduced to 1 gram daily. The myoclonus started to improve the following day and almost completely disappeared by the 3 rd day. A trough serum cefazolin level was later reported as >200 g/ mL (peak normal therapeutic level: 188 g/mL), which suggested to us that despite aggressive peritoneal dialysis, there existed a high serum level of cefazolin.
IMPLICATIONS/DISCUSSION: Cephalosporins are widely prescribed beta-lactam antibiotics for broad-spectrum coverage of infections. In patients with renal insufficiency, active infection and/or prior neurologic diseases, CNS pentration of cefazolin is excellent, leading to the potential for movement abnormalities and even seizures at toxic levels.
The manifestations of cephalosporin-associated neurotoxicity vary greatly, ranging from mental status changes, myoclonus, seizures, potentially fatal nonconvulsive status epilepticus and coma. Patients will typically respond to lowering dosage or discontinuation of the drug, but the drug can be removed via hemodialysis in life-threatening situations. Clinicians should have a high degree of suspicion and awareness about the potentially fatal but reversible neurotoxic side-effects of cephalosporins.
ANEMIA AND PNEUMONIA- WHAT CAUSED THE HEMOLYSIS? Shuchi Gulati 1; Archana Satyal Chaudhary 1; Anthony Donato1. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11466)
LEARNING OBJECTIVES: 1. Recognize anemia in a patient with

Mycoplasma pneumoniae infection could be secondary to hemolysis.2. Early institution of therapy for the underlying pneumonia can lead to rapid recovery of both the infection and the anemia.
CASE INFORMATION: A 57 year old male patient with history of alcoholic liver disease was admitted with a three day history of dry cough and subjective fever. Positive exam features included fever and mild respiratory distress, as well as signs of chronic liver disease. Laboratory evaluation revealed WBC count 4500/microliter, hemoglobin of 6.0 g/dL, hematocrit of 19.4%, platelet count 90,000/microliter. Evaluation of peripheral blood smear showed anisopoiklocytosis, acanthocytosis and occasional schistocytes. An elevated reticulocyte count of 2.9 %, LDH of 316 IU/L, total serum bilirubin of 6.6 mg/dL (indirect bilirubin of 3.3 mg/dL) and a suppressed haptoglobin level of <1 mg/ dL pointed toward intravascular hemolysis as the underlying cause. The patient was transfused packed red blood cells and empiric treatment initiated with cefepime and metronidazole for presumed pneumonia. Because of the pneumonia and unexplained hemolysis, the diagnosis of Mycoplasma pneumoniae was sought and confirmed

by positive cold agglutinin titers. Treatment was initiated with intravenous steroids, immunoglobulins for the autoimmune hemolytic process and with moxifloxacin for the mycoplasma infection. The patients anemia and respiratory symptoms showed consistent improvement, after the initial lag. LDH, bilirubin and haptoglobin trended toward normal ranges and he was discharged home in a stable condition.
IMPLICATIONS/DISCUSSION: Each year Mycoplasma pneumoniae infection is responsible for an estimated 2 million cases and 100,000 pneumonia-related hospitalizations in the United States. While majority develop upper respiratory tract infections, radiologically confirmed pneumonia develops in 5-10% of cases. Less than 10% patients can develop extrapulmonary complications ofM. pneumoniae infection, including cold antibody-mediated hemolytic anemia.
Internists need to remember that although majority of autoimmune hemolytic anemia cases are primary, hemolysis can also occur secondarily in association with certain infectious diseases (e.g., Mycoplasma infection, infectious mononucleosis, CMV infection), lymphoproliferative diseases (e.g., non Hodgkins lymphoma and chronic lymphocytic leukemia) and the use of certain drugs. Early recognition of the association of hemolytic anemia with Mycoplasma pneumoniae infection can result in prompt therapy and can limit morbidity in this patient population.
HOW DID THAT BALL LAND UP IN MY HEART ?! Andrew Gregory De Nazareth 1; Shawn K Mathias 1; Dusan Stanojevic 1; Susan Schima2.
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(Tracking ID # 11468)
LEARNING OBJECTIVES: 1. To recognize that the presence of giant left atrial thrombi could lead to catastrophic complications with dislodgement.2. Diagnosis and Management of these large thrombiCASE INFORMATION: An 81 y/o caucasian woman was admitted for management of a two day history of abdominal pain. Physical exam was significant for poorly localized peri-umbilical tenderness with no rebound tenderness. All her labs were within normal limits and an Abdominal CT scan was normal except for a surprising incidental finding of a 3.5 cm left atrial mass that was seen in the superior slices of the scan. She had no complaints suggestive of a stroke/ transient ischemic attack or chest pain or dyspnea . Her past medical history is significant for hypertension, diabetes and atrial fibrillation and her INR was therapeutic at the time of admission. A trans-thoracic echocardiogram showed a large, circular partially mobile left atrial mass with no other significant valvular or functional abnormalitiesA follow up cardiac MRI showed a large 3.5 cm spherical mass with a stalk originating from the left atrial appendage. The signal intensity and gross features of the mass were consistent with a thrombus.
The patients anticoagulation was continued at discharge and she was scheduled for a follow up visit with Cardio-Thoracic surgery for surgical extraction of this clot.

IMPLICATIONS/DISCUSSION: Management of Giant Left Atrial Thrombi has no set guidelines and they could lead to catastrophic complications with dislodgement. This case illustrates the medical dilemma that we face due to lack of guidelines when we are presented with a patient with a large left atrial thrombus. Cardiac MRI is able to differentiate between masses that are thrombi and malignancy. The most significant risk factors for development of these clots are atrial
fibrillation and Mitral stenosis. Case reports and prospective case series have explained that between 25 to 70% of thrombi resolve with continuing oral anticoagulation. A 3 year follow up study of similar patients revealed that over 50% of patients developed embolic complications which included cerebral or peripheral embolism and even death despite therapeutic anticoagulation. Anticoagulation may promote fragmentation or detachment of the left atrial thrombus. Predictors of subsequent thrombo-embolism were dimension of >1.5 cm, history of thrombo-embolism and mobile thrombus. Surgical extraction of these large thrombi has been performed successfully in quite a few instances and could be the answer to saving these patients from devastating complications

THROMBOSIS DESPITE THROMBOCYTOPENIA: A CASE OF ANTI-PHOSPHOLIPID SYNDROME Shuchi Gulati 1; Anthony Donato2. 1The Reading Hospital and Medical Center, West reading, Pennsylvania ; 2The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11475)

LEARNING OBJECTIVES: 1. Recognize the occurrence of arterial and venous thromboses despite thrombocytopenia in a patient with antiphospholipid syndrome (APLS). 2. Manage patients with antiphospholipid antibodies and thrombosis with lifetime anticoagulation. CASE INFORMATION: A 27 year old female patient with a history of unprovoked right leg Deep Venous Thrombosis (DVT) one year ago was readmitted to the hospital with an acute left leg DVT. She had been anticoagulated at diagnosis of the first DVT but had not been compliant with anticoagulation. She did not have any history of pregnancy losses and no family history of coagulation disorders. She had a six pack year history of smoking. Her physical exam was notable for swelling and moderate tenderness over the affected limb. Labs revealed an elevated Partial Thromboplastin Time (PTT) of 52 seconds (nl 2531 seconds) with a normal Prothrombin Time (PT) and International Normalized Ratio (INR). Her hemoglobin was11.7 g/dl, hematocrit 38.3 %, MCV 101.3 fL with normal MCH and MCHC. Her platelet count was 64,000 cells/microliter. Other labs including white cell count with differential and chemistries were normal. The setting of recurrent DVT, thrombocytopenia and elevated PTT suggested the diagnosis of an antiphospholipid antibody syndrome specifically due to lupus anticoagulant antibodies. A mixing study was done which showed a lack of correction of the Russell viper venom time and confirmed the presence of an inhibitor in the patients plasma. Additional testing including an anticardiolpin antibody IgM was negative while the IgG was weakly positive. The rapid plasma reagin test, Protein C, protein S, antithrombin III and genes for Factor V Leiden were normal. The patient was anticoagulated with enoxaparin followed by warfarin and discharged home with intent to anticoagulate her for life. IMPLICATIONS/DISCUSSION: Antiphospholipid Syndrome (APLS), also known as the Hughes syndrome is an autoimmune disease characterized by the occurrence of arterial and venous thromboses, thrombocytopenia, recurrent pregnancy losses, and disturbances of the coagulation cascade. Overall risk of thrombosis in this patient population is between 0.5% to 30%. The most frequent thrombotic events at presentation are deep vein thrombosis and ischemic stroke, occurring in 32% and 13% of patients respectively.

While APLS is characterized by the presence of three types of antibodies, our case illustrates that the triad of recurrent thrombosis, thrombocytopenia and an elevated PTT points to an underlying lupus anticoagulant antibody. Patients with these antibodies and thrombosis require lifetime anticoagulation because of a high risk of recurrence.

AN UNUSUAL ETIOLOGY OF ACUTE GASTROENTERITIS: SALMONELLA TRANSMITTED FROM AN AMPHIBIAN CARRIER Christina Ferraro 1; Heather Dahlquist 2; Janardhana Gorthi3.
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(Tracking ID # 11485)
LEARNING OBJECTIVES: 1. To appreciate the importance of thorough history taking in a case of reportable infectious disease. 2. To be aware of the various carriers and reservoirs of Salmonella.
CASE INFORMATION: 27 y/o female nurse with no significant past medical history, presents to the ER with a 48 hour history of nausea, vomiting, diarrhea and fever of 103F. Patient reports non-bloody, watery diarrhea every 10 min during the day and two hours at night. Patient has no recent history of antibiotic use or travel, and has not been in close contact with sick people other than at work. She has two children in daycare who have not been sick. She recalls sampling salami at Wal-Mart a couple days prior; however her children who had the same sample were not ill. Upon admit, patient was aggressively rehydrated and started on Levaquin empirically, even though her WBC was not elevated. Stool was sent for culture, ova and parasites, and C. Diff toxin. Studies subsequently showed fecal leukocytes and Salmonella type B. The county health department was notified to start outbreak investigation. Further comprehensive questioning revealed patient contact with a frog that her children had found outside. Her condition improved after three days and she was discharged on Levaquin. Several days later her son presented to the ER with similar symptoms.
IMPLICATIONS/DISCUSSION: This case demonstrates the importance of obtaining a thorough history when determining the etiology of a reportable infectious disease, such as Salmonella. Upon admission, the only suggested cause of the gastroenteritis was a food source. It was not until several days later that the possible frog source was discovered. As physicians, we need to be aware of possible sources of infectious disease and ask appropriate questions to quickly determine the most probable etiology for the protection of the community. It has been well recognized that reptiles and amphibians can be carriers of Salmonella. Most outbreaks in the past have been associated with the handling of turtles. This past year, the first multistate outbreak of Salmonella infections associated with amphibians was investigated, where 85 human isolates of Salmonella Typhimurium were recovered from 31 states. CDC investigation showed an association between the infections and exposure to aquatic pet frogs such as African dwarf frogs. While 95% of Salmonella infections are foodborne from raw or undercooked egg products, raw milk products, contaminated water and meat, our case has shown that animal contact is an important source of human salmonellosis. Salmonella species remain one of the most common causes of enteric illness in the U.S. so it is imperative that we recognize both the well documented and the more recent trends of infectious etiologies.
ATYPICAL PRESENTATION OF A CATASTROPHIC ILLNESS: A NARROW ESCAPE! Jason E Lambrecht 1; Rohini Garg 1; Eric Peters 1; Tara Sabby1. 1Creighton University, Omaha, Nebraska. (Tracking ID # 11487)
LEARNING OBJECTIVES: 1. 1. Consider aortic dissection in any patient who presents with abrupt onset of severe pain within the thorax. But classic findings of tearing pain, pulse deficit and radiological abnormalities are often absent. 2. 2. Rocognize that Type A aortic dissection is a surgical emergency whereas a Type B aortic dissection is managed medically.
CASE INFORMATION: A 59 year old African American male presents to the ER with 4 days of abdominal pain. The abdominal pain is described as dull and aching, has worsened from a 2/10 to 6/10 intensity. The pain radiates to his flanks bilaterally, and at times to his left shoulder, describes it as a pressure feeling in his epigastrum. Movement exacerbates the pain, he reports alleviation when he lies on his side. He reports nausea on the first day but no vomiting. He has had normal bowel movements, without hematechezia or melena and is able to tolerate oral intake without difficulty but does describes early satiety. Other associated symptoms include chest tightness and SOB. However, the patient relates this to pain in his rib cage and associated difficulty taking a deep breath. He denies palpitations, dizziness, and has had no previous similar episodes. It has been 15

years since he last saw a physician. His past medical history is significant for untreated hypertension, GERD, and history of carpal tunnel syndrome. He has a 40-pack year history of smoking, drinks alcohol socially, and denies illicit drug use. Physical exam is remarkable for elevated blood pressure, 148/77, mild distress, no murmur, coarse breath sounds bilaterally, tender abdomen above the epigastrium, nontender in other quadrants, rib cage is tender to palpitation bilaterally, positive CVA tenderness, and no notable pulse deficits. Serial cardiac enzymes and EKG were obtained to rule out a cardiac cause. CT of the patients chest and abdomen is obtained to determine the cause of his abdominal pain. The CT results show the patient has an aortic dissection from his carotids to the bifurcation of the aorta. The patient receives emergent repair of his ascending aorta with a 32 mm hemashield Dacron graft and repair of his aortic valve. Aggressive blood pressure management is initiated. The patient was discharged 15 days later without any complications. IMPLICATIONS/DISCUSSION: Aortic dissection is a catastrophic illness usually presenting with severe chest pain and acute hemodynamic compromise. Left untreated, 33% of patients die within the first 24 hours, and 50% die within 48 hours. Overall, in-hospital mortality for acute aortic dissection is 27%. Early mortality rates are reported to be 1% to 2% per hour after the onset of symptoms. The major cause of early death is aortic rupture. Predisposing factors are systemic hypertension (approximately 70%), pre-existing aneurysm, vasculitis, collagen disorders, and bicuspid aortic valve. Symptoms are so variable that it is overlooked in 39% of the cases. Usual presentations are chest pain (type A dissections), back pain and abdominal pain (type B dissections). It can lead to syncope due to cardiac tamponade and stroke. Signs on physical examination include pulse deficit, aortic regurgitation, hypotension, MI, variation (>20 mm Hg) in systolic blood pressure between arms. Initial tests include D-dimer, chest X-ray, CT angiography, MRI, TTE and TEE. Typical findings on chest X-ray are widening of the superior mediastinum, greater than 8 cm on AP and displacement of aortic wall calcification. Surprisingly, chest X-rays are normal in 20% of the cases. TTE has a sensitivity of 59-85% and specificity of 93% to 96%. TEE has greater sensitivity and specificity, 97-99% and 97-100%, respectively. Angiography, the gold standard, is rarely used. Type A is a surgical emergency. Type B can be medically managed unless excessively dilated or mesenteric/limb ischemia occurs. Reduction of systolic blood pressure to 100 to 120 mm Hg or the lowest tolerated level should be done. Intravenous beta-blocker (BB) should be used to reduce the heart rate below 60 beats/min. Verapamil or diltiazem can be used if BB is contraindicated. Switch to oral therapy after heart rate control has been achieved. Nitroprusside can be initiated in recalcitrant patients but should not be used without betablockade.

TOPHI OR NOT TOPHI: GOUT IS THE QUESTION Oanh Kieu Nguyen 1;
Stephen Harder1. 1University of Texas Southwestern Medical Center, Dallas, Texas. (Tracking ID # 11489)
LEARNING OBJECTIVES: 1. Understand that tophaceous gout can affect the spine.2. Recognize that tophaceous gout of the spine may present as back pain and fever, mimicking an acute spinal infection.
CASE INFORMATION: A 65 year-old African American man with diabetes presented with four weeks of fever and progressive lower back pain radiating to the bilateral lower extremities. On physical examination, the patient had a temperature of 38.9 C. No murmurs were auscultated. He had limited range of motion and tenderness of the bilateral shoulders and was diffusely tender over the lumbar spine. Hard, subcutaneous nodules were palpated over both elbows and the left knee was erythematous and tender, with a small palpable effusion. Strength, sensation, and reflexes were normal in all extremities. White blood cell count was 13 x 109 cells/L with a neutrophilic predominance, erythrocyte sedimentation rate was 130 mm/hr, C-reactive protein was20.5 mg/dL and serum uric acid was 11.3 mg/dl. Blood cultures and echocardiogram were negative. Magnetic resonance imaging of the lumbar spine revealed two loculated fluid collections at L3-L4, concerning for abscesses. Fluid aspiration revealed turbid yellow fluid with white, flaky cellular debris. Bacterial, fungal, and acid-fast bacterial cultures of the fluid were negative; polarized microscopy was not performed.
Broad spectrum intravenous antibiotics were initiated with no improvement in the patients fever or pain. During

treatment, the patient acutely developed a swollen, erythematous and tender right wrist. Arthrocentesis showed intracellular and extracellular urate crystals. He was started on colchicine and a prednisone taper with rapid defervescence and resolution of wrist and back pain. Following six weeks of intravenous antibiotics, a gallium scan revealed increased activity in the lumbar spine despite resolving clinical symptoms. Biopsy of the lumbar spine demonstrated fluid with extracellular urate crystals. The diagnosis of spinal gout was made.
IMPLICATIONS/DISCUSSION: The recognition of atypical presentations of gout by the general internist is crucial for timely initiation of therapy. Cases of gout affecting the spine have been infrequently reported in the medical literature to date. Acute gout can affect intervertebral joints and tophaceous deposits may occur in the axial skeleton, even in the absence of peripheral signs or symptoms. Clinical presentations of spinal gout may range from neck or back pain to myelopathy, cauda equina syndrome, and paraplegia. A subset of these patients may present with fever, making them difficult to distinguish from spinal infections such as epidural abscess, diskitis, or vertebral osteomyelitis. Radiographic studies may not be sufficient to help differentiate between these etiologies and tissue biopsy is frequently necessary to establish a diagnosis. Spinal gout should be considered in the differential diagnosis for patients with a suspected or confirmed history of gout presenting with fever and back pain.

POOR AND CONTENT IS RICH AND RICH ENOUGH : A CASE OF FINANCIAL EXPLOITATION OF A COGNITIVELY IMPAIRED ELDERLY VETERAN Waridibo E Allison 1; Ravishankar Ramaswamy 1; Kit Harnett 1; Clark Elizabeth1. 1James J Peters Veteran Affairs Medical Center, New York, New York. (Tracking ID # 11490)

LEARNING OBJECTIVES: 1. Recognize financial exploitation as a component of elder abuse 2. Assessment of financial exploitation in cognitively impaired elderly patients

CASE INFORMATION: An 82 year old veteran admitted to hospital with acute exacerbations of COPD and CHF and with rapid atrial fibrillation was assessed by the geriatric consultation service. His dementia was found to be significantly worse than on evaluation five months prior with a Mini Mental State Examination score of 18/30 and a St Louis University Mental Status examination score of 6/30. He was deemed not to have decision-making capacity for medical consent for procedures but was able to express goals and values. He repeatedly expressed his contentment and wish that Ms X, his girlfriend of over 20 years, was to be his health care proxy. A subsequent meeting with Ms X revealed that she was the veterans sole carer and that they were struggling on a limited income. They had never married and had no joint bank accounts. Ms X had been signing the patients name on checks for monthly bills and had hired a lawyer 2 months previously to have the veteran sign a will bequeathing all his assets including property to her. She planned to sell one of the houses on the property to make ends meet. The veteran was estranged from his three siblings but discussion with them revealed that he had inherited the property from his mothers estate conditional upon no sale of the property in his life time. After his death, ownership would revert to surviving siblings. Legally his eldest ninety year old sister was his next of kin.

Ms Xs fitness as a carer was called into question by previous documentation of her refusal to allow the Visiting Nurse Service (VNS) and other services into the home and her turning up at the hospital intoxicated on two occasions during the patients current admission. Legal advice was taken from the Veteran Affairs regional counsel and the veteran was eventually discharged in the care of Ms X with referral to VNS for home care and to Adult Protective Services to evaluate the safety of the patients home situation.

IMPLICATIONS/DISCUSSION: Cognitive impairment is a major risk factor for financial exploitation because of its detrimental effect on memory, judgment and the capacity to make decisions. Recognition and assessment of financial exploitation in patients with dementia is challenging because they are often unable to answer specific questions about their financial situation. Other risk factors for financial exploitation include recent spousal death, physical disability, social isolation, alcoholism and unemployment or financial difficulties in family members. Once suspected, cases are best handled by an experienced geriatric-led multidisciplinary team. A cognitive

assessment is central to evaluating capacity of an individual to make financial decisions as is a psychiatric assessment to evaluate for psychological vulnerabilities that impair judgment. An interview with the suspected abuser should be attempted. This should be non confrontational and include questions about relationship with the patient, daily activities/routines and financial questions about housing, income sources and bill payment. Other family members should be contacted about any concerns and a home visit by a nurse or social worker is recommended.

When abuse is confirmed a clinicians priority is protection of the elderly victim as in the case described. Laws vary between states but if a physician believes financial abuse has occurred the relevant state Office of Protective Services should be informed. Application for guardianship may be necessary to deal with financial abuse in a mentally incapacitated person but it should be borne in mind that misuse of powers of attorney and guardianship can constitute financial abuse.

Education of physicians about risk factors for financial abuse and methods of assessment and intervention is critical to improving their effectiveness in combating this underreported form of abuse within our elderly population.

AN UNCOMMON CAUSE OF SUDDEN DEATH AND ACUTE CORONARY SYNDROME (ACS) IN THE POST PARTUM PERIOD

Waridibo E Allison 1; Sudip Ghimere 1; Rupak Thapa 1; Eugenio Guzman1. 1North Central Bronx Hospital, New York, New York. (Tracking ID # 11491)

LEARNING OBJECTIVES: 1. Recognize spontaneous coronary artery dissection (SCAD) as an infrequent and unusual cause of ACS in young patients with no risk factors 2. Recognize SCAD as a diagnosis that must be considered particularly in young women with chest pain during pregnancy and the post partum period.

CASE INFORMATION: A 33 year old woman of African origin, gravida 1 para 1, had sudden onset of severe central chest pain in OBGYN clinic. She had undergone an uncomplicated cesarean section two weeks prior following a normal antenatal course. She had no known risk factors for coronary disease and did not smoke, drink alcohol or use recreational drugs.

She was immediately taken to the ER in a wheelchair and on arrival at triage collapsed and became unresponsive. The patient was found to be in ventricular fibrillation cardiac arrest and ACLS protocol was initiated. She received atropine, epinephrine, magnesium and amiodarone and was defibrillated with 120/200/200 joules. There was spontaneous recovery of circulation and the patient was intubated and ventilated. A transthoracic echocardiogram (TTE) post arrest showed normal left ventricle (LV) function, no wall motion abnormalities and no pericardial effusion.

In ICU the patient was titrated off Dobutamine, amiodarone was continued and she was put on a mild hypothermic protocol to minimize anoxic brain injury. The patient was additionally commenced on aspirin, clopidogrel, lisinopril and a heparin infusion. Serial troponin levels peaked at 12.73 on Day 2 after the cardiac arrest and repeat TTE on the same day showed markedly reduced LV systolic function with an ejection fraction of 30% and severe hypokinesis of the apical wall. Right ventricle function was also reduced. Electrocardiograms initially showed inferior-lateral ST depression and later anterior-lateral T wave inversion. Extubation occurred successfully on Day 3 after the cardiac arrest and the patient underwent coronary angiography on Day 6. This revealed spontaneous coronary artery dissection of the mid LAD artery causing 95% stenosis and apical akinesis. Two drug eluting stents were placed at the dissection site.

The patient made a good recovery and was discharged 9 days after the cardiac arrest.

IMPLICATIONS/DISCUSSION: Prevalence of SCAD was recently estimated at 0.7% in an angiographic study. A 2010 review of the literature found 440 reported cases of which 70% were women. Pregnancy was associated with 26% of cases and of these 84% of cases occurred in the post partum period with 70 events occurring within

2 weeks of delivery. Approximately a fifth of all cases were diagnosed by post mortem examination and the majority of the remainder by coronary angiography. The patient in this case was fortunate to have collapsed in a hospital setting close to an ER. Mortality was even higher with pregnancy associated SCAD with sudden death or death within a few hours of symptom onset occurring in 40%.
Presentation is usually with typical symptoms of ACS including chest pain. Electrocardiogram may be normal initially. The exact etiology of SCAD is unclear but it may be influenced by eosinophilic infiltration and cystic medial necrosis, hormonal changes weakening the arterial wall and hemodynamic stress that occurs during the final trimester of pregnancy. Further research is needed to elucidate the processes involved in development of SCAD as this knowledge will assist in improving risk stratification.
There are currently no evidence based guidelines for medical management of this condition but pharmacological agents used
include aspirin, clopidogrel, heparin, beta-blockers, and angiotensin-converting enzyme inhibitors. Thrombolytics may cause extension of the dissection and further narrowing of the true lumen and are not recommended. It has been shown that coronary intervention with stenting has superior outcomes compared to conservative medical management of SCAD for both right and left coronary artery lesions. Rapid diagnosis and subsequent appropriate treatment is essential to avert disastrous clinical sequelae and to achieve an excellent outcome in this condition that disproportionally affects young women.
AN UNEXPECTED CAUSE OF UPPER AIRWAY OBSTRUCTION AFTER EXTUBATION: AN ILLUSTRATIVE CASE OF THE POTENTIAL VALUE OF HEALTH INFORMATION EXCHANGE Anil Makam 1; Won Lee2.
1Univeristy of Texas Southwestern Medical Center, Dallas, Texas ;
2University of Texas Southwestern Medical Center, Dallas, Texas. (Tracking ID # 11493)
LEARNING OBJECTIVES: 1. Recognize that myasthenia gravis can cause upper airway obstruction resulting in respiratory impairment and extubation failure.2. Recognize the potential role of health information exchange in expediting diagnostic work ups and reducing duplication of efforts. CASE INFORMATION: A code blue was called for an 18-year-old African-American female with sickle cell anemia following a CT angiogram of the chest. She was emergently intubated for hypercapneic, hypoxic respiratory failure. She had been admitted 12 hours prior for sickle cell crisis with shortness of breath. The CT chest was remarkable for new consolidations in the right middle and left lower lobes, consistent with acute chest syndrome. After a single red blood cell exchange transfusion, she had minimal oxygen requirements and met adequate ventilator weaning parameters, such as rapid shallow breathing index and minute ventilation. Immediately following extubation she became hypoxic and tachypneic, with no stridor or audible airflow upon chest auscultation. She was re-intubated without difficulty. Although her neurological exam was limited by sedation, she had mild symmetric proximal muscle weakness with 4/ 5 strength, ptosis with sustained upward gaze, a negative inspiratory force of 22 cm H_2O, and a forced vital capacity of 460 ml. A CT of her neck was unremarkable for extrinsic airway compression. A second attempt at extubation was performed with bronchoscopic assistance to evaluate for upper airway patency. As the tube was slowly retracted, the upper airway was observed to completely collapse at the level of the vocal cords. A diagnostic workup to evaluate for neuromuscular etiologies of upper airway obstruction revealed elevated anti-acetylcholine receptor antibodies and a significant decrement on a repetitive nerve stimulation study, confirming a diagnosis of myasthenia gravis. After instituting plasmapheresis, corticosteroids, and pyridostigmine, the patient made an uneventful recovery. Once extubated, she reported that she had already been diagnosed with myasthenia gravis, just 3 months prior at one of our neighboring teaching hospitals.
IMPLICATIONS/DISCUSSION: Upper airway obstruction due to bulbar predominant myasthenia gravis causing respiratory failure and asphyxia is infrequently reported in medical literature and to the best of our knowledge, this is the first documented case resulting in extubation failure. Although approximately 30% of patients with myasthenia develop some degree of respiratory impairment and 44% of intubated patients with myasthenic crisis in one case series experienced extubation failure, pulmonary complications typically are due to respiratory

muscle weakness, inability to manage secretions, atelectasis, or infectious pneumonia. Despite favorable ventilator weaning parameters, myasthenic patients with significant

bulbar muscle weakness are at risk for airway compromise when the stenting effect of an endotracheal tube is removed. When upper airway obstruction is suspected, direct visualization of the airway is essential to exclude more common etiologies, such as tracheal stenosis and laryngeal edema, and can confirm loss of airway patency after extubation. In the absence of structural abnormalities an evaluation for neuromuscular etiologies, including myasthenia gravis, should be pursued.

This case also highlights the potential value of health information exchange. The patients perplexing and complicated clinical course, with repeated intubations and a prolonged intensive care stay, could have been preempted by access to her prior health records. However, the limited history and a family who was unaware of her recent diagnosis gave no indication that further relevant information was available. Knowledge of prior history, medications, and care plan at the point-of-care in real-time can circumvent diagnostic challenges, delays in initiating therapy, and duplication of health services-thus, improving outcomes and reducing costs.

PANCREATICODUODENAL ARTERY PSEUDOANEURYSM CAUSING GASTROINTESTINAL BLEEDING

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LEARNING OBJECTIVES: 1. Pseudoaneurysms arising in the pancreaticoduodenal arterial arcade can be a significant source of gastrointestinal bleeding.2. A combination of methods should be used when a single approach fails to occlude the aneurysm completely.

CASE INFORMATION: A 48 year old African American male presented with coffee ground emesis and dark tarry stools. His past medical history is significant for pancreatitis. His vital signs on admission were stable. His labs showed an increased amylase at 186, lipase was 6, AST 49, ALT 17, alkaline phosphatase 73, bilirubin 0.7, total protein 6.1, albumin 3.5 and his electrolytes were within normal limits.

A CT scan showed a low attenuation region in the pancreatic head. This was further evaluated with a CT angiogram which showed a 2.2 cm strong contrast enhancing structure in an enlarged and inhomogenous pancreatic head suggesting a pseudoaneurysm.

The selective angiogram of the gastroduodenal artery demonstrated the superior pancreaticoduodenal artery supplying the pseudoaneurysm. The selective angiogram of the superior mesenteric artery demonstrated the inferior pancreaticoduodenal artery filling this aneurysm as well. Using microcatheter technique, both of these branches were selected and embolized with Gianturco coils. Immediate follow-up angiography revealed complete occlusion of the pseudoaneurysm with no evidence of vascular flow. The following day a contrast enhanced CT was performed which revealed residual patency of the pseudoaneurysm and this was confirmed with color Doppler ultrasound. At that time, it was elected to treat the remaining flow within the aneurysm with ultrasound-guided percutaneous injection of thrombin directly into the aneurysm. This was successful with confirmation of complete occlusion with ultrasound at the time of this intervention. A repeat CT scan done a month as a follow up demonstrated that the pseudoaneurysm had remained occluded. The patient continued to improve well and did not have any complaints. IMPLICATIONS/DISCUSSION: Chronic pancreatitis is the most common cause of pancreatic pseudocysts and is often the result of chronic inflammatory process involving the pancreas. The morbidity and mortality are increased when the pseudocysts rupture into an adjacent vessel causing a pseudo aneurysm. Bleeding of these lesions into the gastrointestinal tract can be rapidly fatal. These lesions should be treated at diagnosis because there is a high risk of rupture irrespective of the size of the lesion. Urgent repair of these lesions is associated with high periprocedural morbidity whereas elective repair is not.

The most common visceral artery aneurysm associated with pancreatitis arises from the splenic artery followed

by the gastroduodenal artery. Pseudo aneurysms of the pancreaticoduodenal artery due to pancreatitis usually arise in the superior pancreaticoduodenal artery. Inferior pancreaticoduodenal artery pseudo aneurysms are rare and so far only 88 cases are reported in the literature. Our patient had a pseudo aneurysm arising in the pancreaticoduodenal arterial arcade supplied by both the superior and inferior pancreaticoduodenal arteries. In conclusion the pseudo aneurysm in our patient received blood supply from two large arteries which mandated proximal and distal coil embolization. It also received blood supply from several small branches which explains the presence of flow even after successful coil embolization. Hence, percutaneous injection of thrombin was made which successfully occluded the pseudo aneurysm.

STERNOCLAVICULAR SEPTIC ARTHRITIS IN A HEALTHY AFEBRILE MALE Gaurav Gulati 1; David L George1. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11510)

LEARNING OBJECTIVES: 1. Recognize Sternoclavicular Joint septic arthritis in an afebrile patient with no contributing risk factors 2. Diagnose septic arthritis using invasive methods when indicated CASE INFORMATION: A 43 year old athletic male with no significant past medical history experienced a 3 week history of pain involving the anterior inferior neck and upper chest. He also described concurrent generalized aches, nausea/vomiting, night sweats, and a 20 lb weight loss. The patient noted worsening pain with push ups and internal rotation of the right arm, but had no pain on neck motion or deep inspiration. He denied any recent skin infections and high risk behaviors such as IV drug use or multiple sexual partners. Pain was unrelieved by nonsteroidals.

On physical examination he was afebrile but tachycardic. Erythema and tenderness was observed over the right SC joint. Pain worsened with adduction of the right arm, while neck rotation was asymptomatic. . Examination was otherwise normal. Laboratory studies revealed a leukocytosis of 19,300 cells/microL with 86% neutrophils and 10% bands and sedimentation rate was 108 mm/hr. CT of the neck showed an abnormal enlargement of the sternal insertion of the sternocleidomastoid. No fluid could be aspirated on arthrocentesis of the joint under CT guidance. The patient underwent arthrotomy and synovectomy of the right sternoclavicular joint. Findings of necrotic bone prompted resection of the medial end of the clavicle. Pathologic analysis showed focally intense inflammation within the joint space, acute osteomyelitis with erosion, and purulent myositis and myonecrosis of pectoralis major muscle. Blood and excision cultures were positive for methicillin sensitive staphylococcus aureus. The patient responded well to a 6 week course of intravenous nafcillin.

IMPLICATIONS/DISCUSSION: The diagnosis of SC septic arthritis is readily considered in the IV drug abuser with fever, but is more challenging in the afebrile patient without risk factors for high grade bacteremia. Inflammatory disease isolated to the SC joint may also be observed in ankylosing spondylitis, and it may accompany other joint symptoms in rheumatoid arthritis. Risk factors for developing septic arthritis of the joint include intravenous drug use (21%), distant site of infection (15%), diabetes mellitus (13%), trauma (12%), and infected central venous line (9%), none of which occurred

in this patient. Over one third of sternoclavicular septic arthritis patients are afebrile at the time of presentation. CT imaging and interventional investigation are key to diagnosis, given common failure of articular aspiration; this approach should be seriously considered in the patient with isolated inflammatory signs involving the SC joint.

A CASE OF ACUTE RESPIRATORY DISTRESS SYNDROME IN A PATIENT WITH AIDS AND KAPOSIS SARCOMA Moses Mathur 1;

Moses Mathur 1; Vikin Lalan 1; Sami Alasfar 1; Parag Desai 1; Wissam Chatila1. 1Temple University Hospital, Philadelphia, Pennsylvania. (Tracking ID # 11512)

LEARNING OBJECTIVES: 1. Recognize immune reconstitution syndrome with underlying Kaposis sarcoma as

a cause for acute respiratory distress syndrome 2. Recognize extra-cutaneous manifestations of Kaposis sarcoma.
CASE INFORMATION: A 46-year-old male with AIDS (CD4 29 cells/mL, viral load 580,000 copies/mL) on highly active antiretroviral therapy (HAART) for 6 weeks, presented with pleuritic chest pain and dyspnea. Cutaneous Kaposis sarcoma (KS) had been diagnosed 1 month prior, for which he received his first treatment with doxorubicin one week ago. In the past month, he had multiple hospital visits for abdominal pain and dyspnea, which, after an extensive workup, were treated as AIDS cholangiopathy, CMV pnemonitis, and pneumocystis jirovecii pneumonia (PJP).
On presentation he was febrile, in shock and was intubated for management of hypoxemic respiratory failure. Initial lab work showed WBC 3.2 k/mm3 (6% lymphocytes), Hgb 10.1 g/dL, platelets 43 k/mm3, BUN 34 mg/dL, Cr 1.6 mg/dL, lactate 2.2 mmol/L and normal coagulation values. His chest X-ray revealed diffuse bilateral alveolar infiltrates, with worsening parenchymal densities compared to 2 months ago.
In the ICU he was treated for acute respiratory distress syndrome (ARDS) and shock with concern for immune reconstitution syndrome (IRS). Broad spectrum antimicrobials (including PJP coverage) and corticosteroids were started. HAART was held. He was mechanically ventilated using lung protective strategy. Bronchoscopy revealed a polypoid lesion in the anterior segment of the right upper lobe and erythema throughout the tracheobronchial tree. Continuous venovenous hemodialysis was started for refractory acidemia and oliguric renal failure. Shock and multi-organ dysfunction persisted despite maximal hemodynamic and ventilatory support. With worsening prognosis, the patients family decided to withdraw care on day 4 and he expired shortly thereafter. An autopsy was performed.
IMPLICATIONS/DISCUSSION: Although HAART has revolutionized HIV treatment, it is not without complications. In particular, IRS post HAART initiation is well-described with incidence up to 35%. Risk factors for IRS include low pretreatment CD4 (<100 cells/mL), positive immune response to HAART, temporal link between HAART and symptom onset, and absence of drug-resistant infections, noncompliance, malabsorption or reduced dose levels due to drug interactions.
In untreated HIV, KS is the most common complication of HHV-8 infection. Pulmonary (33%) and gastrointestinal (GI) involvement (82%) in KS is common. Pulmonary KS mortality is high whereas GI KS symptoms are rare. In the era of HAART, KS incidence has decreased seven fold, with tumor regression seen in some cases. However, up to 50% of KS patients never achieve total remission. In the setting of IRS, patients are thus susceptible to KS flares (cutaneous or otherwise), as early as 3 weeks after starting HAART.
In our case, not only did autopsy show diffuse alveolar damage consistent with late-phase ARDS but also multifocal, bilateral lung parenchymal KS, with involvement of skin and small intestine as well. Lung specimens, bronchoalveolar lavage samples and blood samples were negative for bacterial, fungal and viral cultures. Three weeks after HAART, our patient did show immunologic response, with CD4 34 cells/mL and viral load 1938 copies/mL. With no evidence for other infections and a positive temporal relationship between clinical events, we speculate that ARDS in our case was most likely from post-HAART IRS causing a flare of pulmonary KS. The contribution of a GI KS flare to his past abdominal pain remains unknown.
Notably, the patient had been given his first dose of chemotherapy for KS a week prior to presentation. In retrospect, this patient could have perhaps benefitted had chemotherapy been initiated earlier in conjunction with HAART.
E-I-E-I-O: EVALUATION OF PULMONARY NODULES LEADS TO A SURPRISING CONCLUSION! Gaurav Gulati 1; Shuchi Gulati 1; Richard Alweis1. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania. (Tracking ID # 11515)
LEARNING OBJECTIVES: 1. Recognize the broad differential of multiple pulmonary nodules 2. Recognize the importance of a stepwise approach to the evaluation of multiple pulmonary nodulesCASE INFORMATION: A 34 year old male with 5 pack-year tobacco usage and active drug abuse presented with acute right-sided chest

pain progressively worsening over 4 days. Pain was 9/10 in intensity, sharp and non-radiating. He denied any similar previous episodes, cough, sputum production, or hemoptysis. However, he noted night sweats and 20 pound weight loss over a month. He had chronic occupational exposure to asbestos. Physical examination was unremarkable. Laboratory evaluation was significant for mild normochromic normocytic anemia and urine drug screen positive for cocaine and opiates. Chest CT revealed multiple bilateral pulmonary nodules with the largest measuring 18 mm, primarily in the upper lobes, some with central cavitations, as well as perihilar and subcarinal lymphadenopathy. Initial workup included pan cultures, sputum cytology, and a CT of the abdomen and pelvis which were all normal. Secondary workup for Wegeners disease (ANCA, MPO) and mycobacterial disease (sputum for AFB, PPD, and quantiferon Gold test) were negative. After this, echocardiogram looking for a possible source of septic embolic shower was unremarkable; shunt fraction was done to evaluate for the presence of arteriovenous malformations and was within normal limits. Finally, a lung biopsy was performed, revealing fibroblastic and histiocytic aggregates, along with filamentous-appearing organisms. A diagnosis of pulmonary actinomycosis was made based on histopathologic and modified Acid Fast Stain (FITE) results demonstrating Actinomyces sp.
IMPLICATIONS/DISCUSSION: Presence of multiple lung nodules can have a vast differential. This includes: malignancy and metastasis; infections, including abscesses, septic emboli, fungi, and parasitic infestations; inflammatory conditions, including Wegeners granulomatosis, rheumatoid arthritis, lymphomatoid granulomatosis, amyloidosis, and sarcoidosis; pulmonary AVMs; and pneumoconiosis. Clinical diagnosis can be made using selected laboratory testing and the characteristics of the lesions on imaging. Presence of lymphadenopathy and weight loss can be helpful. Lung biopsy may be necessary to establish an exact diagnosis. As in this case, a multitude of possibilities may coexist and a stepwise approach is necessary to reach a definitive diagnosis without subjecting the patient to unnecessary testing.

A CASE OF Q FEVER WITHOUT A HISTORY OF ANIMAL EXPOSUREJ. ADam Yancey 1; Amal Kebede1.
1The Reading Hospital and Medical Center, Reading, Pennsylvania. (Tracking ID # 11519)
LEARNING OBJECTIVES: 1. Consider Q fever as a diagnosis in patients with culture negative endocarditis or fever of unknown origin despite lacking animal exposure. 2. Acute Q fever is treated with doxycycline alone while chronic Q fever is treated with a combination of doxycycline and either a quinolone or hydroxychloroquine.

CASE INFORMATION: A 48-year-old woman with history polymyositis for ten years on methotrexate and prednisone presented with fever, headache, cough, and light sensitivity, which have been occurring for the past 2 to 3 weeks. She was initially treated with intravenous cefepime and vancomycin for suspected meningitis. Lumbar puncture was consistent with aseptic meningitis. While on broad spectrum antibiotics, she continued to spike daily fevers to greater than 39C. A workup for fever of unknown origin, including blood cultures, urine culture, transthoracic echocardiogram to evaluate for endocarditis, malignancy workup, and rheumatologic workup were performed. She was found to have slight Lambls excrescence present, small filiform processes on the edges of the valves thought to be formed secondary to mechanical trauma. All cultures remained negative. A workup for culture negative endocarditis was performed and the patient was found to have positive Q-fever phase 2 IgM antibody at 1:128 dilution titers. The patient was initiated on doxycycline and hydroxychloroquine. The patient denied any recent travel, animal exposure, or ingestion of unpateurized milk. The Center of Disease Control was notified of her diagnosis. IMPLICATIONS/DISCUSSION: Q fever is a zoonotic disease caused by Coxiella burnetii. Many patients are asymptomatic, thus making it difficult to assess incidence of disease. For those with symptoms, high grade fevers, malaise, headache, myalgias, cough, nausea, vomiting, and diarrhea are common. Q fever is rarely fatal but can cause serious complications including endocarditis. Acute Q fever is treated with doxycycline whereas combination therapy is required for chronic Q fever infection.
Although Q fever is a rarely diagnosed clinical entity, it can have some serious complications requiring long term

treatment including endocarditis. Q fever is often associated with animal exposure; however, the source is not always identifiable.

A CASE OF SEVERE CONSTIPATION SECONDARY TO METASTATIC PHEOCHROMOCYTOMA REQUIRING COLECTOMY. Kari L Edling 1;
William Reid1. 1Department of Medicine, University of California Los Angeles Medical Center, Los Angeles, California. (Tracking ID # 11524)

LEARNING OBJECTIVES: 1. Recognize that severe constipation is a complication of pheochromocytoma that may require surgical treatment when refractory to medical therapy. 2. N/ACASE INFORMATION: A 42-year old woman with a history of pheochromocytoma with bony metastases presented with severe constipation. She was diagnosed six years prior after a hypertensive crisis involving headache and palpitations and was found to have elevated catecholes and a right adrenal mass. She underwent adrenalectomy but developed a recurrent right adrenal mass 2 years later and severe cervical and thoracic spine pain. At that time, she was treated with systemic chemotherapy with cyclophosphamide, vincristine and dacarbazine, as well as I-131 MIBG therapy. The patient had struggled with constipation since her initial diagnosis; however, her symptoms worsened significantly with the development of spinal metastases and subsequent uptitration of opioid analgesics. Physical examination revealed a cachectic woman with a nontender, distended abdomen with decreased bowel sounds. Computed tomography of the abdomen and pelvis revealed marked pan-colonic distention, abundant colonic stool, and diffuse metastatic bony disease. Initial management with medications and suppositories was unsuccessful.

The patient was transferred to the Intensive Care Unit for aggressive treatment with phentolamine, neostigmine, and methylnaltrexone but had minimal clinical improvement. Surgery was consulted for palliative surgical management and an exploratory laparatomy with total colectomy, end ileostomy and gastrostomy tube placement was performed on hospital day 14. Pathology showed a significantly distended colon and small bowel with fecal impaction and patchy atrophy and fibrosis of the outer muscularis propria without evidence of malignancy. She recovered well and was discharged on hospital day 16 with phenoxybenzamine, metyrosine, prazosin, propranolol, pantoprazole and several opioid pain medications. Follow-up visits with her oncologist demonstrated significant improvement with decreased abdominal distention and pain and clear palliative benefit from aggressive surgical intervention. IMPLICATIONS/DISCUSSION: This is an unusual case of severe constipation due to catecholamine excess resulting in colonic pseudo-obstruction. Multiple subspecialists collaborated to provide aggressive medical management and ultimately palliative surgical treatment. Pheochromocytoma is a rare disease with an incidence of one to two cases per 100,000 people per year, with malignant pheochromocytomas comprising 10% of all cases. The tumor cells are derived from chromaffin cells which secrete catecholamines. Common presenting symptoms include hypertension, tachycardia, headache and tremor. Approximately 13% of patients will have significant constipation, and pseudo-obstruction has been reported as the initial presentation of pheochromocytoma.

Direct catecholamine stimulation of alpha and beta receptors in intestinal smooth muscle cells decreases gastrointestinal motility. In addition, stimulation of mesenteric arterial alpha receptors also causes vasoconstriction and intestinal ischemia. If resection of the pheochromocytoma is not possible, alpha adrenergic blockade is the mainstay of treatment. Initial therapy with oral agents such as prazosin (a selective alpha-1 antagonist) and phenoxybenzamine (a nonselective alpha antagonist) can be attempted. Combinations of intravenous phentolamine (a nonselective alpha antagonist) and neostigmine (an acetylcholinesterase inhibitor) have been successful in more severe cases, but can take up to 30 days to produce a bowel movement. Due to the potential for bradycardia and hemodynamic instability with neostigmine administration, this treatment should only be used in a closely monitored setting such as an intensive care unit. Surgical intervention should be considered if aggressive medical treatment is unsuccessful. Adjalle R, et al. Treatment of Malignant Pheochromocytoma. Horm Metab Res. 2009 Sep; 41(9):68796.

Mason L, et al. An Unusual Case of Severe Constipation Due to Metastatic Pheochromocytoma. J Pain Symptom Manage. 2009 Jun; 37(6):e5-7.

AMPHETAMINE TOXICITY: THINKING OUTSIDE THE BOX Gaurav Gulati 1; Anthony A Donato1. 1The Reading Hospital and Medical Center, West Reading, Pennsylvania . (Tracking ID # 11528)

LEARNING OBJECTIVES: 1. Recognize Amphetamine abuse in a patient with confusion, ataxia and psychosis 2. Learn early and appropriate management of amphetamine toxicityCASE INFORMATION: A 62 year old male with a past history of recreational drug abuse presented with acute onset unsteady gait,

word finding difficulty and erratic speech, with mild confusion and confabulation. Fixed delusions were also noted, as well as visual and auditory hallucinations. He and his accompanying family had denied any recent alcohol use.

On physical exam, he had a blood pressure of 186/105, and neurological examination revealed hypertonia, positive Rombergs test and abnormal heel to toe test as well as incoordination of movements. He also had some cogwheeling and would fall backwards on standing, which did not change with eyes being open or closed. Laboratory evaluation revealed stable Complete Blood Count (CBC) with differential, normal electrolytes, mild transaminitis, a negative blood alcohol level, negative Lyme test and RPR serology. It was however positive for amphetamines in the urinary drug screen. The patient was treated with as needed lorazepam and haloperidol. Over the next day or two he improved significantly and his problems including ambulatory dysfunction had resolved. IMPLICATIONS/DISCUSSION: Amphetamine abuse is the primary cause of emergency visits in 73,400 patients per year in the United States. Classic presentations include psychosis, agitation and sympathomimetic signs.

Confusion, ataxia and psychosis are symptoms common to alcohol withdrawal, drug ingestion and other rarer medical conditions. It is important to remember to look for a drug screen in a patient where symptoms dont fit in and the common diagnoses such as alcohol withdrawal seem less likely, even in extremes of age. Early interventions with atypical antipsychotics and benzodiazepines are warranted and bring about improvement in symptoms.

A CASE OF JELLY IN THE BELLY - RETROPERITONEAL PSEUDOMYXOMA Sumana Nagireddy 1; Sumana Nagireddy1. 1UAB, Montgomery, Alabama. (Tracking ID # 11531)

LEARNING OBJECTIVES: 1. Diagnose a rare case of retroperitoneal pseudomyxoma peritonei.2. Recognize the importance of accurate treatment to prevent long term complications.

CASE INFORMATION: 51 year old African American male admitted to the hospital with abdominal pain, abdominal distension and vomiting in June 2010. His past history was significant for retroperitoneal pseudomyxoma peritonei, diagnosed in 2004 following resection of a22.0 x 17.5 x 5.0 cm mass. Macroscopically, the contents of the mass were thick, yellow, and mucoid appearing and microscopic examination showed villous adenoma. The patient underwent debulking surgery again in 2008 along with intra peritoneal chemotherapy, and since then he was on palliative chemotherapy with Cisplatin and Gemcitabine. He remained well until he admitted to the hospital in June 2010. On admission he had leukocytosis of 30,000 cells/uL, creatinine of 2.8 mg/ dL, and lactic acid of 8.7 mmol/L. Computerized tomography (CT) of his abdomen revealed small bowel obstruction, thickened bowel wall representing ischemia, and a right-sided retroperitoneal fluid-filled structure invading into the iliac muscle and extending into the foramina of the lumbar spine. Exploratory laparotomy showed 8 cm of necrotic bowel, which was then removed. Additionally, he had large loops of bowel attached to the retroperitoneal mass, which were non-resectable. Microscopic examination of the resected small intestine showed atypical epithelium and mucin adherent to intestinal serosa. After removal of necrotic bowel, his condition was improved and he was sent home with continued palliative chemotherapy.

Follow up with his recent medical records has indicated that he was admitted to the hospital in October and December of 2010 for intestinal obstruction needing surgical intervention. IMPLICATIONS/DISCUSSION: Literature indicates pseudomyxoma peritonei (PMP) is found in approximately 2 in 10,000 laparotomies, but occurrence of PMP in the retroperitoneal space is rare. There are only 10 cases have been reported in the literature. Mucinous implants of the peritoneum are mostly expected from appendix and ovary, but unusual sources like colon, stomach, uterus, or common bile duct may exist. Retroperitoneal presentation of PMP with out intra peritoneal involvement can be explained by derangement of anatomy of appendix. Common symptoms of retroperitoneal pseudomyxoma are fullness in the right flank, loss of appetite, fatigue and slowly progressive pain. Retroperitoneal pseudomyxoma is commonly diagnosed by CT imaging of the abdomen. Various modalities of treatments like surgery, chemotherapy, and radio-therapy are available with varying degrees of success. Retroperitoneal pseudomyxoma peritonei may have better prognosis than PMP if intact removal of retroperitoneal mass is achievable. It is imperative that complete and intact removal of retro peritoneal mass is accomplished to prevent the iatrogenic spillage of mucin into peritoneal space. In our case, probable extension of retroperitoneal pseudomyxoma into peritoneal space assumed to be resulted in intestinal obstruction and necrosis. Overall, rarity of the retroperitoneal pseudomyxoma makes this case imperative for discussion and gives an insight of its complications and need for prevention of complications.

TRANSIENT PULMONARY HYPERTENSION I N A CASE OF UNCOMPLICATED MALARIA. Suman Srinivasa 1; Suman Srinivasa2. 1New York University School of Medicine, New York, New York ;
2NYU School of Medicine, New York, New York. (Tracking ID # 11533)

LEARNING OBJECTIVES: 1. Recognize malaria as an uncommon underlying cause of pulmonary hypertension. 2. Recognize that treatment of uncomplicated malaria may prevent further sequelae of pulmonary hypertension.

CASE INFORMATION: A 18 year-old man from Mali with recurrent episodes of malaria initially presented to an outside hospital with three days of fever, vomiting, and diffuse abdominal pain followed by a presyncopal episode. The patient arrived in the United States one month prior to this presentation. Labs were notable for hemoglobin 12 g/dL, platelets 88 K/uL, AST 68 U/L, ALT 104 U/L, LDH 284 U/L, and creatinine 1.3 mg/dL. HIV test was negative. A blood smear on admission was positive for plasmodium falciparum with 0.5% parasitemia. Cat scan of the abdomen and pelvis with contrast showed a splenic lesion consistent with infarction. The patient was treated with a seven day course of doxycycline and quinine for uncomplicated malaria. A transthoracic echocardiogram was performed as part of the presyncopal workup and revealed severe pulmonary hypertension based on decreased pulmonary acceleration time and systolic notching. On hospital day 7, the patient was transferred to the present hospital for further evaluation of his pulmonary hypertension. He denied chest pain, dyspnea, and decreased exercise tolerance. Vital signs were unremarkable. Physical exam was significant for a well appearing male in no acute respiratory distress; elevated jugular venous pressure, a right ventricular heave, a loud P2, and lower extremity edema were absent. A six minute walk test revealed oxygen saturations of 98-100% on room air. A repeat transthoracic echocardiogram on hospital day 11 revealed normal pulmonary arterial pressures with a preserved ejection fraction and no chamber enlargement. Two repeat blood smears were negative for plasmodium falciparum. The patient had improved clinically and was discharged home with scheduled follow up of a serial transthoracic echocardiogram. IMPLICATIONS/DISCUSSION: Pulmonary hypertension (pHTN) is an elevation in the pulmonary arterial pressure, which if severe enough can lead to right ventricular failure. The World Health Organization proposed a classification of pHTN into five groups based upon pathophysiology. Group 1 describes idiopathic disease and the remaining groups focus on an

underlying cause. Although parasites, such as schistosomiasis, have been classified in Group 4 as causing pHTN by embolic disease, little is understood about the mechanism by which malaria causes pHTN.

One study proposed that malaria causes pHTN by intravascular hemolysis in a manner similar to sickle cell disease. During the hemolysis process, nitric oxide may be depleted leading to increased pulmonary arterial pressures. [1] In patients living in endemic areas of malaria, repeated infections may aid in the development of partial immunity and subsequently lead to less severe infections but, pulmonary hypertension is an important disease sequela that can contribute to increased mortality. In this case, it seems that prompt treatment of uncomplicated malaria with doxycycline and quinine led to the resolution of pulmonary hypertension and presyncopal symptoms. Further studies are needed to fully understand the relationship between malaria and pHTN.[1] Janka J, et al. Increased Pulmonary Pressures and Myocardial Wall Stress in Children with Severe Malaria. The Journal of Infectious Disease. 2010; 202(5):791800.

SHORT PR INTERVAL IN HYPERTROPHIC CARDIOMYOPATHY , NOT ALWAYS WOLF PARKINSON WHITE

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LEARNING OBJECTIVES: 1. Discuss differential diagnoses for short PR interval in patients with hypertrophic cardiomyopathy (HCM)2. Discuss genetic and prognostic implications of short PR interval in HCM phenotype.

CASE INFORMATION: A 19 year- old female patient with known history of hypertrophic cardiomyopathy was evaluated for retrosternal tightness and episodes of presyncope / syncope. She denied smoking or alcohol use; family history was positive for premature cardiac death. Electrocardiogram (EKG) showed sinus rhythm with short PR interval, left ventricular hypertrophy with left axis deviation and secondary repolarization changes. There was no obvious delta wave. Echocardio-gram revealed asymmetric antero-septal hypertrophy and an ejection fraction of 55- 60%. There was no resting or exercise induced outflow gradient. Cardiac magnetic resonance imaging (MRI) revealed focal mid myocardial fibrosis involving basal to mid anterior segments and asymmetric anterior and antero-septal wall thickening (30 mm) consistent with hypertrophic cardiomyopathy. Given the history of otherwise unexplained syncope, family history of sudden death and a wall thickness of 30 millimeters the patient was offered an Electrophysiology (EP) study +/ Implantable Cardioverter Defibrillator (ICD). However, she declined it due to personal/social concerns and was started on atenolol. In addition, given the EKG evidence of accelerated atrioventricular conduction, possibility of HCM mimics lysosomal storage disorder or coexistent Wolff Parkinson White (WPW) syndrome were considered.

IMPLICATIONS/DISCUSSION: Electrocardiographic abnormalities are common in patients with HCM. Entirely normal EKGs are seen in less than 15% of patients. In addition to left ventricular hypertrophy, ST- T wave changes secondary to repolarization, abnormal Q waves, and giant negative T waves in anterior leads are well known. Rarely, accelerated atrioventricular conduction manifested by short PR interval with or without associated delta wave can be seen. This could be due to coexistent Wolf Parkinson White syndrome seen in less than 5% of HCM or due to accelerated atrio ventricular conduction without any anatomic accessory pathway. Certain genetic diseases like storage disorders are known to phenotypically mimic HCMP and are frequently associated with

short PR interval or WPW syndrome. These include PRKAG2 (Protein Kinase AMP activated Gamma 2) mutation of Fabrys disease or LAMP2 (Liposomal Associated Membrane Protein 2) mutation seen in Pompes and Danons diseases. It is important to differentiate these genetic variants as Fabrys, Pompes and Danons are glycogen storage disorders characterized by vacuoles containing intermediary products. These are multisystem disorders with pleotropic manifestations. Cardiac involvement in these patients is characterized by early onset of heart failure in their third decade, increase in left ventricular wall thickness greater than HCM and severely impaired left ventricular function. True pre excitation with single or multiple accessory pathways is frequently seen and patients die at a very young age secondary to life threatening ventricular arrhythmias. They are also prone for AV reciprocating tachycardias which increase risk of syncope and inappropriate ICD shocks. Therefore it is advisable to perform EP study prior to ICD implantation in these patients. Also considering the higher morbidity and mortality in patients with LAMP2 / PRKA2 mutations, genetic testing is advisable in

phenotypic hypertrophic cardiomyopathy patients with short PR interval.

MY DAD KEEPS SHOUTING AT ME Tara Ashlee Mencias 1; Tara Ashlee Mencias 2; Ankit Sakhuja 2; Kurt Pfeifer2. 1Medical College of Wisconsin, Franklin, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11539)

LEARNING OBJECTIVES: 1. Recognize the non-specific presentation of digoxin toxicity. 2. Review the indications to use digoxin immune Fab. CASE INFORMATION: A 52 year-old male with a history of congestive heart failure and paroxysmal atrial fibrillation presented with two weeks of abdominal pain, nausea, and vomiting. He presented to an outside hospital one month prior with similar complaints, and an abdominal CT at that time failed to show any intra-abdominal pathology. On presentation to our institution, he was also complaining of auditory hallucinations, stating he could hear his deceased father scolding him. His outpatient medications included furosemide, carvedilol, digoxin, hydralazine, isosorbide mononitrate, spironolactone, lisinopril, amiodarone and warfarin. In the emergency department, his initial blood pressure was 67/47 with a heart rate of 50. His serum creatinine was 2.78 mg/dL with a baseline of 1.1 mg/dL, and his serum potassium was 5.2 meq/L. ECG did not show any acute changes suggestive of hyperkalemia. Considering his symptoms and associated acute kidney injury, digoxin toxicity was considered and confirmed by a digoxin level of 3.3 ng/mL. Considering his symptomatic bradycardia, acute kidney injury and hyperkalemia, the patient was given digoxin immune Fab. A few hours later, his digoxin level decreased to 1.7 ng/mL, and his potassium level improved to 4.2 meq/L. His digoxin was discontinued per discussion with his cardiologist. With these interventions, his hypotension, bradycardia, renal failure, nausea, vomiting and hallucinations resolved. He did continue to complain of some mild abdominal discomfort.

IMPLICATIONS/DISCUSSION: Digoxin toxicity usually presents with non-specific symptoms, such as nausea, vomiting, diarrhea, abdominal pain, hallucinations, alterations in color vision and arrhythmias. The digoxin level may be diagnostically helpful in toxicity, but given the imperfect correlation between serum and intracellular levels, does not effectively rule-out digoxin toxicity, particularly in acute ingestion. Instead, clinicians must use history, physical and ECG findings in addition to digoxin levels to make the diagnosis. Common ECG findings in acute digoxin toxicity include ventricular premature beats due to increased ectopy and bradycardia or any degree of AV block due to enhanced vagal tone. In patients with pacemakers, the ECG may not show these findings,

so clinical exam and potassium levels should be used to guide treatment in these patients. A potassium level between 5.0-5.5 meq/L or signs of end organ damage (acute kidney injury and altered mental status in this case) are both indications for the use of digoxin immune Fab. A potassium level greater than 5.5 meq/L secondary to digoxin toxicity is typically fatal. Most symptoms of digoxin toxicity disappear with clearance of the drug, but abdominal pain can take months to resolve.

LAMOTRIGINE: DRESSED TO KILL Elizabeth Jeanette Smith 1; Nikhil Jain 1; Dean Padavan 1; Moyna Ng1. 1Lenox Hill Hospital, New York, New York. (Tracking ID # 11567)

LEARNING OBJECTIVES: 1. To recognize Lamotrigine and other non-aromatic antiepileptic drugs as potential causes of DRESS syndrome a severe and possibly fatal drug reaction. 2.

CASE INFORMATION: A 62 year-old female with longstanding bipolar disorder, presented with fever and a diffuse, non-pruritic rash that began on her back which then spread to her torso, limbs, and face beginning aapproximately 12 weeks after initiating lamotrigine. She continued taking this medication for a total of 21 days. Her physical exam was significant for T 38.6 C, and a diffuse morbilliform rash on the torso, arms, legs and face, involving palms but not soles. There was no mucocutaneous lesions, lymphadenopathy, hepatosplenomegaly, abdominal ascites, or jaundice noted Laboratory testing revealed thrombocytopenia (nadir

68 K), absolute eosinophilia, transaminitis AST/ALT (peak levels 490/456) and elevated LDH >2000. An abdominal ultrasound and extensive viral, bacterial and autoimmune serologies were unremarkable. A skin biopsy done on hospital day 4 revealed a mild perivascular infiltration of mononuclear cells in the superficial plexus most consistent with a drug reaction. With discontinuation of the offending drug and administration of high dose oral prednisone, her rash greatly improved and her liver function tests began to trend down. She was discharged in stable condition on hospital day 6.

IMPLICATIONS/DISCUSSION: Drug rash with eosinophilia and systemic symptoms (DRESS) syndrome is a severe drug hypersensitivity reaction characterized by a triad of rash, fever and internal organ involvement. Hepatitis is most common, but interstitial pneuomonitis, renal failure/intersititalnephritis, myocarditis, thyroiditis, and neurologic symptoms can be found.

Symptoms usually begin two to eight weeks after exposure to the offending drug. Drugs most commonly implicated are the aromatic anticonvulstants: carbamazepine, phenytoin, phenobarbital. Our case involves DRESS syndrome following the administration of Lamotrigine, a non-aromatic antiepileptic drug. The patient presented with a hypersensitivity syndrome, rash, fever, and elevated liver function tests. Less than a dozen cases of severe hypersensitivity syndrome associated with lamotrigine have been reported in the literature, at least three cases progressing to acute hepatic failure.

Early recognition of the entity known as DRESS syndrome is imperative as it can mimic other serious pathologies and withdrawal of the offending drug is usually curative. An important issue in DRESS syndrome is the documented cross-sensitivity (40-80%) among the aromatic anticonvulsant drugs. We propose that a patient with a history of non-aromatic anticonvulsant drug induced DRESS syndrome should also avoid others within the same pharmacologic class. Careful monitoring of liver function tests is recommended when initiating the drug lamotrigine as the liver is the most common site of internal organ involvement. In the future, attempts should be made to further understand the susceptibility profile, as there has been some research on a genetic basis and an association with HH6 virus.

WHEN A WHEEZING WOMAN HAS MORE THAN ASTHMA Lauren D. Moore 1; Valerie E. Stone 1; Opeyemi Olabisi 1; Clayton Knox 1; Douglas Wright1. 1Massachusetts General Hospital, Boston, Massachusetts.
(Tracking ID # 11599)

LEARNING OBJECTIVES: 1. Recognize the clinical presentation of Churg-Strauss syndrome. 2. Recognize that Churg-Strauss syndrome occurs almost exclusively in patients with a history of adult onset asthma and should be considered in the differential in patients not responding to conventional therapy.

CASE INFORMATION: A 60-year-old woman presented to her primary care physician with a two-month history of chronic chough, wheezing, and malaise. At that time she was diagnosed with asthma and treated with a fluticasone/salmeterol inhaler, albuterol, and montelukast. Ten months after her diagnosis, she presented again to her primary care physician with worsening cough and occasional hemoptysis. She was treated with a prednisone taper for a presumed asthma flare. Three weeks later her symptoms returned, prompting her to come in for evaluation.

On presentation to our medical center, she noted that her symptoms had become worse over the past year despite therapy. In addition, she had a one week history of numbness, pain, weakness, and swelling in both hands and in her left foot. Two days prior to presentation she had developed a rash on her abdomen that spread to her chest and left foot. She also noted a twelve pound weight loss over the prior month, nausea, and sinus pressure.

The patient is a non-smoker and had a past medical history of presumed asthma and rhinitis. Her exam was notable for bilateral lung crackles, bilateral hand swelling, pain in her digits with flexion, distal left lower extremity weakness, and a purpuric rash on her abdomen, chest, and left foot. Preliminary work up was significant for a white blood cell count of 12,100/cmm with 40% eosinophils, a chest x-ray that showed diffuse interstitial pulmonary opacities, and head CT that demonstrated opacification of the sinuses. Further inpatient

work up was significant for p-ANCA positivity, an ESR of 87 mm/hr, and a CRP of 149.6 mg/L. A skin biopsy demonstrated leukocytoclastic vasculitis with extensive eosinophilic infiltration. She was diagnosed with Churg-Strauss syndrome and started on 1 gram of solumedrol daily and cyclophosphamide 2 mg/kg on day 3 of treatment. Her eosinophilia completely resolved and her symptoms improved. She was discharged home on prednisone and cyclophosphamide.

IMPLICATIONS/DISCUSSION: Churg-Strauss syndrome is a small-to-medium vessel vasculitis that tends to occur in people with adult onset asthma. The disease prevalence in the U. S. is only 13 cases per 100,000, making this syndrome a diagnostic challenge. The exact pathophysiology of the disease is unclear, however abnormal immune and genetic factors are thought to play a role. The American College of Rheumatology has proposed criteria for the diagnosis of Churg-Strauss syndrome. Four or more of these criteria yields a sensitivity of 85% and a specificity of 99.7%: 1) asthma, 2) eosinophilia of more than 10% in peripheral blood, 3) paranasal sinusitis, 4) pulmonary infiltrates, 5) histological proof of vasculitis with extravascular eosinophils, and 6) mononeuritis multiplex or polyneuropathy. Therefore, this case illustrates a classic presentation of a rare syndrome.

This patients clinical presentation was thought to be most consistent with Churg-Strauss syndrome. However, based on her purpura and positive ANCA, other vasculitides were considered including microscopic polyangiitis and Wegeners vasculitis. Furthermore, while adult onset asthma does occur, this diagnosis prompted the consideration of asthma mimics including allergic bronchopulmonary aspergillosis, upper airway obstruction, and pulmonary eosinophilic syndromes.

Recognizing and treating Churg-Strauss syndrome early is important in reducing disease mortality, as the 5-year survival rate without treatment is 25%. In patients such as the one presented here, who have a history of persistent cough and wheezing which is unresponsive to conventional asthma therapy, early consideration of alternative diagnostic possibilities that can mimic asthma is critical to optimizing patient outcomes.

CRACK YOU ONCE, CRACK YOU TWICERECURRENT AGRANULOCYTOSIS ASSOCIATED WITH REPEATED LEVAMISOLE CONTAMINATED COCAINE Jonathan D Kirsch 1; Jonathan D Kirsch1. 1University of North Carolina School of Medicine, Chapel Hill, North Carolina. (Tracking ID # 11617)

LEARNING OBJECTIVES: 1. Recognize an adverse effect of cocaine contaminated with levamisole 2. Consider levamisole contaminated cocaine in the differential diagnosis of unexplained agranulocytosis CASE INFORMATION: A 51 year old female with a history of acute hepatitis B, gluten intolerance and intermittent cocaine abuse presented to the emergency department with a swollen, painful, red fifth digit on her right hand consistent with cellulitis. Her absolute neutrophil count (ANC) was 0.1 x 10^9/L. She admitted to recent, intermittent cocaine abuse. Her medications included prn acetaminophen. She is allergic to sulfa. Her past medical history was otherwise unremarkable.

Her hospital course included an extensive hematologic, infectious, and rheumatologic workup. Guided by a recent MMWR report [12/18/09 58(49)] highlighting an unexplained etiology of agranylocytosis, levamisole contamination of cocaine was considered, but not checked at that time. Her urine toxicology screen was positive for cocaine. Her lab workup also showed an elevated anti-SSA antibody and ANA of 1: 640, but was otherwise unremarkable. A skin biopsy of her necrotic finger lesion was consistent with neutrophilic dermatosis thought to be Sweets syndrome without vasculitis. The patient was treated with filgastrim (G-CSF) until her neutropenia resolved and she was discharged with antibiotics for cellulitis that resolved as an outpatient. She was counseled on cocaine cessation and was set up with outpatient resources.

She returned twice over the subsequent 6 months with similar presentations: periorbital cellulitis with neutropenia and 1st digit cellulitis with neutropenia. Her ANC was 0.5 and 0.6 x10^9/L, respectively. On both of these latter occasions, she had a positive urine toxicology for cocaine and her urine levamisole level was elevated. Both hospitalizations were uncomplicated, being treated with G-CSF on the second admission and

spontaneously recovering on the final admission. She did not follow up for repeat hematologic or rheumotologic workup.
IMPLICATIONS/DISCUSSION: Neutropenia is a rare event (7.2 cases per 1,000,000 population per year) in patients not receiving cytotoxic drugs. While technically agranulocytosis refers to ANC less than 0.1 and neutropenia is less than 0.5, the terms are often used synonymously in the literature. Levamisole has been used to cut cocaine since at least 2005, presumably due to its similar appearance and texture to cocaine, low cost, and availability for use in veterinary medicine as an anti-helminthic agent on livestock farms. Levamisole now contaminates up to 90% of cocaine confiscated in the U.S., though its domestic availability is limited due to decreased production and restricted use to treating helmithic infections in goats. Case series suggest that women with rheumato-logic disorders and HLA-B27 are more commonly affected though the etiology is unknown. Agranulocytosis has been seen in up to 13% of individuals being treated with levamisole for rheumatoid arthritis and in breast cancer treatment. It is unknown what proportion of cocaine users exposed to levamisole are affected as most dont present for medical care and agranulocytosis is not a reportable event. Cocaine itself has not been associated with neutropenia. Clinicians should be suspicious of levamisole contaminated cocaine in patients presenting with unexplained neutropenia. Workup includes a urine toxicology screen, CBC with differential and urine or serum levamisole levels measured within 48 hours of drug use. There is no established treatment, as most cases resolve spontaneously. Close monitoring, consideration of treatment with G-CSF, and substance abuse counseling is recommended. The CDC is now performing national surveillance in some states.
ILIAC VEIN COMPRESSION SYNDROME: AN ANATOMIC ANOMALY ASSOCIATED WITH INCREASED RISK OF DEEP VEIN THROMBOSIS Carmen Marie Campbell 1; Shobhina Chheda 1; Amit Nautiyal1. 1University of Wisconsin Hospital and Clinics, Madison, Wisconsin. (Tracking ID # 11625)
LEARNING OBJECTIVES: 1. Identify patients with deep venous thrombosis who may require further evaluation foriliac vein compression syndrome (IVCS) also known as May Thurner Syndrome.2. Determine appropriate evaluation and management strategy for patients with IVCS.
CASE INFORMATION: A 26-year-old woman on warfarin for prior deep vein thrombosis (DVT) presented with a one-day history of pleuritic and fleeting right-sided chest pain and recurrent left lower extremity (LLE) discomfort and edema. Symptoms developed suddenly following a 3.5 hour drive. She was first diagnosed with a LLE DVT 14 months prior when she was 30 weeks pregnant. She was managed with lovenox until she delivered and then treated with warfarin to complete 6 months of anticoagulation. Approximately three months later patient developed recurrent LLE swelling and pain. Imaging revealed a recurrent LLE DVT. Patient underwent a hypercoaguable evaluation, which was unremarkable. She was restarted on warfarin at that time. Her blood pressure was 126/77, pulse 91, temperature 36.4 Celsius, and respiratory rate of 18. Physical exam was notable for trace LLE edema, with 2+ dorsalis pedis and posterior tibial pulses. Her LLE was non-tender, without erythema or palpable cords. Laboratory studies were notable for an INR of 2.2. Doppler ultrasound revealed a clot in the left femoral, common femoral, and iliac vein. Results were compared to previous study, which revealed that clots were in near identical location, suggestive of a chronic DVT. Chest computed tomography angiography was obtained which did not reveal any evidence of pulmonary embolism. Left leg magnetic resonance venography (MRV) was suggestive of iliac vein compression syndrome (IVCS). Patient was evaluated by vascular surgery and currently consideration is being given to stent placement versus bypass surgery.
IMPLICATIONS/DISCUSSION: Deep venous thrombosis (DVT) is a condition commonly encountered by internists. The risk factors for thrombogenesis include venous stasis, endothelial trauma, thrombophilia, malignancy, and history of prior DVT. Virchow first noted a predominance of left-sided iliofemoral DVTs in the 1850s. Approximately 100 years later, May and Thurner identified an anatomic variant in which the right common iliac artery compresses the left common iliac vein, known as IVCS. IVCS can promote venous stasis,

one component of Virchows triad for DVT. IVCS is a common anatomic variant and patients with this variant are more likely to develop DVT. Three stages of IVCS have been identified. Stage one is defined by asymptomatic vein compression. In stage two, fibrous vascular lesions form at the site of the compressed iliac vein. The third phase is defined by development of DVT, which often occurs in the setting pregnancy, prolonged immobility, with use of oral contraceptives, or peri-operatively. Chronically, patients with IVCS

can present with claudication, lower extremity pain, swelling, and chronic venous stasis changes. The goal of identifying patients with IVCS is to ensure proper evaluation by vascular surgery for potential interventions to relieve discomfort and prevent disability/restore function. MRV is currently the study of choice for the diagnosis of IVCS. Acute IVCS is managed with catheter-directed thrombolysis along with anticoagulation. Chronic IVCS is managed with insertion of stents and less commonly with thrombectomy or bypass surgery. General internists should consider IVCS in patients with left iliofemoral DVTs. Identification of patients with IVCS is important as appropriate intervention can reduce risk of recurrent DVT and post-thrombotic syndrome.

NON COMPACTION CARDIOMYOPATHY: AN UNDERDIAGNOSED CARDIOMYOPATHY Devara Rajasekhar Reddy 1; Vinod Khatri 1; Sangmesh Jabshetty1. 1Saint Francis Hospital, Evanston, Illinois. (Tracking ID # 11627)

LEARNING OBJECTIVES: 1. The diagnosis of non compaction cardiomyopathy is often missed, because the disease is still not as well known as it should be among most physicians. 2. Longterm anticoagulation is needed in patients with NCCM without atrial fibrillation with LVEF <40 percent.

CASE INFORMATION: A 77 year old male with no significant past medical history was admitted with a 3 week history of progressive dyspnoea, orthopnoea, paroxysmal nocturnal dyspnoea, dry cough and bilateral leg swelling. On examination vitals signs revealed irregular heart rate of 84 per min, blood pressure of 123/81 mm of Hg,respiratory rate of 20/min, and saturation of 100% on O2. Cardiac examination showed jugular venous distension, S1, S2 and S3 was present. Lung examination showed bibasilar crackles. Extremities showed bilateral pitting pedal edema. On evaluation EKG showed sinus tachycardia with frequent and consecutive PVCs and fusion complexes and left axis deviation and left bundle branch block. CXR showed bilateral pleural effusions, interstitial edema and cardiomegaly. Cardiac markers were negative and BNP was 1250. Patient was treated as acute congestive heart failure according to standard guidelines with diuretics, ACEinhibitors, beta-blockers and oxygen. On further evaluation to determine the cause, Echocardiography was done, and showed global LV hypokinesia with prominent trabeculations and deep intertrabecular recesses suggestive of non compaction cardiomyopathy. LVEF was 23percent. Patient was anticoagulated with Coumadin as recommended. Patient condition improved and was discharged home. IMPLICATIONS/DISCUSSION: Non compaction cardiomyopathy is a rare genetic form of characterized by prominent left ventricular wall trabeculation and intertrabecular recesses communicating with the ventricular cavity. The diagnosis is often missed, because the disease is still not well known as it should be among most physicians.It is important that clinicians recognize and differentiate this condition from other forms of cardiomyopathy as treatment and prognosis may differ significantly. The major clinical manifestations of NCCM are heart failure, atrial and ventricular arrhythmias, and thromboembolic events. Echocardiography is the diagnostic test of choice for NCCM.The diagnosis is based on the following echocardiographic criteria: the presence of at least 4 prominent trabeculations and deep intertrabecular recesses, blood flow from ventricular cavity into the intertrabecular recesses, and a typical bilaminar structure of the affected portion of the left ventricular myocardium. NCCM can also be diagnosed with magnetic resonance imaging of the heart.The main emphasis of the clinical treatment of patients with NCCM is on the treatment of heart failure and arrhythmias and the prevention of thromboembolic events. The treatment of heart failure in patients with NCCM follows the general guidelines for

heart failure treatment. Long-term oral anticoagulation is indicated in particular for patients with atrial fibrillation, impaired left ventricular function(LVEF <40 percent), or demonstrated intracardiac thrombi. All patients with NCCM should be screened annually with 24-hour electrocardiogram recordings.

CRITICAL ILLNESS POLYNEUROPATHY PRESENTING AS LOCKED-IN SYNDROME Geetha Selvakumar 1; Muhammed Sherid 2; Jilalu Kelbe 2; Meghana Gopal 2; Ayesha Salahuddin 2; Haritha 1; Mhd. Wisam BaqdunesBellam 3; Nael Gharbi 4; Shazel Gharbi 2; Harvey Friedman2.
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(Tracking ID # 11647)

LEARNING OBJECTIVES: 1. Locked-in syndrome refers to quadriplegia and anarthria with preserved consciousness2. Critical illness polyneuropathy presents with flaccid quadriparesis with intact cranial nerve functionCASE INFORMATION: We present a case of an 82 year old Chinese female who was admitted and was being treated for community acquired pneumonia and a hepatic abscess. Her past medical history was significant for DM, HTN, CAD and CKD. Her medications were vancomycin, primaxin, hydrocortisone, heparin, protonix and digoxin. Her hepatic abscess was drained. During the hospitalization she had an episode of asystole which lasted for two minutes. A code was called and the patient was resuscitated. She was intubated and transferred to the ICU. She was not on any sedatives. On day two in the ICU, the patient had her eyes open but did not follow any commands. She did not have any other motor response. However, she could track and look at people in their eyes. But she did not follow other objects with her eyes. Her reflexes were nonreactive in bilateral upper and lower extremities and toes were downgoing bilaterally. She had some withdrawal to tickling in her left foot. Her WBC was 13.7, magnesium was normal, phosphorus was high at 5.9, calcium was 6.9, BUN and creatinine were 40 and 3.8 respectively. Albumin was 2.6 and alkaline phosphatase was 894. AST and ALT were within normal limits. Chest X ray showed a right lung base opacity.

Her clinical findings were suspicious for locked-in syndrome and a CT head was obtained which did not show any evidence of hemorrhage or acute intracranial pathology. A neurology consult was obtained. An EMG was done which showed short duration, low amplitude motor unit potentials consistent with a diagnosis of critical illness polyneuropathy. The patient did not improve clinically and a decision was made to do a tracheostomy and a PEG tube placement following which she was sent to a long term care facility.

IMPLICATIONS/DISCUSSION: Locked-in syndrome is caused by ischemic stroke or hemorrhage in the brainstem. Patients can communicate through eye movements due to the preservation of higher cerebral functions. Certain conditions like coma and persistent vegetative state can sometimes present like locked-in syndrome. Critical illness polyneuropathy causes flaccid quadriparesis but the cranial nerves are intact. Our patients clinical presentation was highly suggestive of locked-in syndrome. But radiological studies failed to reveal an intracranial pathology. A diagnosis of critical illness polyneuropathy was made by electromyogram. Critical illness polyneuropathy takes weeks to months to resolve. On the other hand locked-in syndrome is a potentially irreversible condition.

PSEUDO-RENAL FAILURE: HOW BINGE DRINKING CAN REALLY RUIN YOUR WEEKEND. Carla Gergi Sawan 1; Carla Gergi Sawan 2; Stephen Holt3. 1Yale Internal Medicine, Primary Care, 06514, Connecticut ; 2Yale Internal Medicine, 06514, Connecticut ; 3Yale Internal Medicine, Primary Care, Waterbury, Connecticut.
(Tracking ID # 11655)

LEARNING OBJECTIVES: 1. To diagnose and manage spontaneous bladder perforation following alcohol binge drinking. 2. To recognize the presentation of urinary ascites clinically and biochemically.

CASE INFORMATION: We report the case of a 57 year old gentleman with a history of alcohol abuse and hypertension, presenting with severe abdominal pain and constipation of five days duration. History was further notable for binge drinking of vodka during the week prior to presentation. He had oliguria and progressively

increasing abdominal girth. Physical examination revealed a silent, distended, diffusely tender abdomen, with guarding and a fluid wave. He was afebrile, with stable vital signs. Serum chemistries were remarkable for potassium 6.0, sodium 136, chloride 76, serum bicarbonate 39, and creatinine elevated to 8.3 (baseline 0.91 mg/dL). Liver function tests and coagulation studies were normal. He had a leukocytosis of 16,000 cells /mm3. His corrected calcium level was11.1 mg/dL. Arterial blood gas at room air was: pH 7.41, PCO2 51, PO2 71, HCO3 35, oxygen saturation of 91% at room air. Urinalysis results were: density 1.024, pH 7.5, negative for nitrites, ketones and leukocyte esterase, RBC >100, WBC 35. Urine sodium was 119 mmol/L.

Given patients abdominal distension and absence of bowel movements for four days, an abdominal film was obtained, showing distended loops of small bowel with absence of free air or transition. For his urinary retention, a Foley catheter was inserted yielding 600 cc of dark urine. The patient was started on empiric antibiotic coverage and IV hydration. Creatinine improved quickly so a CT scan of the abdomen and pelvis with IV and oral contrast was obtained. It showed a small amount of fluid and air anterior to the urinary bladder, of uncertain etiology. These findings prompted urgent exploratory laparotomy for suspected visceral rupture. A 1.4 cm urinary bladder perforation was identified and repaired.

Post-operatively, the patient improved with normalization of renal function, correction of biochemical abnormalities, and rapid recovery of urinary output. He was discharged 5 days later and a follow up cystoscopy after two weeks was normal. IMPLICATIONS/DISCUSSION: Bladder perforation in the setting of alcohol binge drinking is a rare (<1% of bladder rupture cases) but serious condition.

Heavy alcohol intake results in ADH suppression and polyuria. Toxic alcohol metabolites in the systemic circulation suppress the sensation of bladder fullness and ultimately lead to pathologic urinary retention. As the urinary bladder becomes increasingly distended, the dome becomes thinner and more susceptible to small changes in intravesical or intrabdominal pressures. Once rupture has occurred, urine leaks into the peritoneum and results in urinary ascites with reverse auto-dialysis across the peritoneal membrane. This phenomenon ultimately creates the illusion of acute renal failure with oliguria, hyperkalemia and rising serum creatinine. Interestingly, as urine is a sterile body fluid, most patients do not present in a septic picture. Our patient had a remarkable elevation in his serum bicarbonate despite the uremic presentation. In fact, his heavy alcohol use lead to significant epigastric discomfort for which he was taking a high amount of calcium carbonate tablets tums , resulting in hypercalcemia and metabolic alkalosis, basically milk-alkali syndrome.

Spontaneous bladder rupture requires a high level of suspicion to avoid any delay in diagnosis given the high mortality rate (80%) associated with this condition. Cystography and urgent surgical repair of the bladder wall are essential.

APPROPRIATE MANAGEMENT OF AN INCIDENTAL DISCOVERY OF MEDIASTINAL LIPOMATOSIS

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LEARNING OBJECTIVES: 1. To differentiate mediastinal lipomatosis radiographically and clinically as compared to other causes of mediastinal masses. 2. To address the appropriate diagnostic evaluation of mediastinal lipomatosis.

CASE INFORMATION: A 73 year-old obese (BMI 27.4), Caucasian male with active cigar use, diabetes mellitus type 2 and hypertension presented with vertigo and slurred speech. His physical exam was notable only for horizontal nystagmus and right-sided facial droop, and the patient denied chest pain, dyspnea, cough, or dysphasia. Vital signs, laboratory values (CBC, BMP, cardiac enzymes, and FLP), and EKG, were all within normal limits; however, he was found to have a widened mediastinum on portable chest radiograph. An acute posterior circulation CVA was diagnosed on MRI with concurrent small vessel ischemic changes, and the patient was started on antiplatelet treatment with appropriate management of glucose and blood pressure. PA and lateral chest films confirmed the presence of what appeared to be an anterior mediastinal mass with widening of the mediastinal silhouette (figure 1). The patient was taken for chest CT with contrast where

mediastinal lipomatosis was diagnosed (figure 2).
IMPLICATIONS/DISCUSSION: Mediastinal lipomatosis is a rare benign condition of accelerated deposition of unencapsulated mature adipose tissue in the mediastinum. Unlike its pathologic imitators, it does not compromise mediastinal structures and rarely requires treatment. It also does not require diagnostic tissue sampling. The pathology is unclear, although it is commonly associated with Cushings syndrome, exogenous corticosteroid use and alcoholism, and is probably similar to lipodystrophy seen in these conditions. Recently it has become increasingly associated with simple obesity, reflecting the overall increase in obesity worldwide. In such cases this incidental finding can herald potentially undiagnosed associated conditions including insulin resistance, hyperlipidemia and hypertension. Radiographically, mediastinal lipomatosis presents as smooth widening of the superior mediastinum with lateral displacement of mediastinal pleura extending beyond the transverse aortic arch. Because the radiolucency of fat is often distorted by the lucency of pulmonary tissue, diagnosis should be confirmed on contrast computerized tomography. CT should reveal homogenous fat attenuation in the superior mediastinum and in the cardiophrenic sulcus that does not compress or invade adjacent structures. Differential diagnosis includes thymoma, lymphoma, liposarcoma, lipoblastoma, encapsulated lipoma, thymolipoma, germ cell tumors, congenital cysts, intrathoracic thyroid, and parathyroid tumors; vascular abnormalities such as persistent left superior vena cava; mediastinal adenopathy; and mediastinitis. In true mediastinal lipomatosis, patients should not present with symptoms suggestive of mass effect. In the absence of symptoms and in the presence of diagnostic features on CT, no further workup is indicated. Attempts at distinguishing lipomatosis from liposarcoma require large amounts of tissue, often resulting in emotional stress and risk to the patient with minimal gain.

DRAMATIC RESPONSE OF HIGH-GRADE MEDIASTINAL LYMPHOMA TO HELICOBACTER PYLORI ERADICATION Marc S Hoffmann 1;
Stephen Gluckman2. 1Hospital of the Universtiy of Pennsylvania, Philadelphia, Pennsylvania ; 2Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. (Tracking ID # 11680)
LEARNING OBJECTIVES: 1. Recognize that high-grade gastric lymphoma isassociated with Helicobacter pylori infection and responds to eradication. 2. N/ACASE INFORMATION: A 49yo HIV-negative Puerto Rican male presented with one month of dyspnea, lower extremity edema, abdominal distension and a 30 pound weight gain. Two weeks prior, he presented to another institution where he was found to have bilateral pleural effusions and middle mediastinal mass extending to the right hepatic lobe that compressed the IVC. An endoscopic biopsy only revealed Helicobacter pylori gastritis. A thoracentesis had no growth on bacterial, fungal and AFB cultures with negative cytology. He was discharged and three days later presented to our institution after his symptoms failed to improve. He denied fevers, night sweats, weight loss or adenopathy. His only medication was tamsulosin. Past medical history was significant for untreated hepatitis C and benign prostatic hypertrophy. He is a former IV drug user and active smoker with no family history of malignancy. Initial exam was notable for normal vital signs, no adenopathy, findings of bilateral pleural effusions, tense ascites and bilateral pitting edema. A CBC, electrolytes, LFTs, and LDH were all within normal range. HCV viral load was 189,964 and urine histoplamsa antigen was negative.
On hospital day 2, he was initiated on H. pylori eradication therapy with a 7-day course of amoxicillin, clarithromycin and lansoprazole. He did not receive corticosteroids and denied taking any medications or supplements. His symptoms steadily improved and completely resolved by hospital week 4. Several non-diagnostic fine needle aspirations were obtained via EGD. A PET/CT on hospital day 24 showed a dramatic reduction of the mediastinal mass and no change to his liver lesion. A core needle liver biopsy revealed diffuse large B-cell lymphoma (DLBCL) without features of mucosa-associated lymphoid (MALT) lymphoma.

IMPLICATIONS/DISCUSSION: Diffuse large B-cell lymphoma is the most common histologic type, comprising 30-35% of all and 50-60% of high-grade lymphomas. Primary gastric DLBCL arises either de novo or, more commonly, via transformation from H. pylori associated low-grade MALT lymphomas. Transformation from low to high grade confers a poorer prognosis and alters treatment: although H. pylori eradication alone cures up to 80% of low-grade MALT lymphomas, high-grade lymphomas often mandate chemotherapy. However, in the past decade, several reports have noted resolution of early stage primary gastric DLBCL after H. pylori eradication alone. A recent prospective trial showed complete remission in 14 of 22 patients (64%) with early stage DLBCL transformed from MALT lymphoma, none of whom progressed after 5 years of follow-up. Similar response rates of 60-80% are reported in case series of patients with primary gastric DLBCL with or without MALT features. Given the potential response to H. pylori eradication alone in localized disease and the toxicity of chemotherapy, it is vital to identify patients who may only require H. pylori therapy. It may also be a reasonable first-line option in frail and elderly patients who are not candidates for more aggressive treatment. This case illustrates an atypical presentation of DLBCL, with a normal LDH, lack of PET avidity, and dramatic reduction in size without cytotoxic chemotherapy. While it is unclear that this patient has an H. pylori-associated DLBCL given disseminated disease at presentation and no MALT features on pathology, it remains the best explanation of the dramatic response to H. pylori eradication. Subsequently the patient was treated with six cycles of R-CHOP and has achieved a complete remission.

SUPRADIAPHRAGMATIC HETEROTOPIC LIVER PRESENTING AS A PLEURAL MASS CAUSING SPONTANEOUS PNEUMOTHORAX Kranthi Andhavarapu 1; Richard Sue 2; Ana Moran 2; Anthony Perry2. 1SJHMC, Phoenix, Arizona ; 2SJHMC, Phoenix, Arizona. (Tracking ID # 11703)

LEARNING OBJECTIVES: 1. Recognize supradiaphragmatic hetero-topic liver tissue as a cause of sponataneous pneumothorax2. Recognize supradiaphragmatic heterotopic liver tissue as a cause of sponataneous pneumothoraxCASE INFORMATION: A 39 year old female with history of uterine fibroid resection presented with a 3 day history of chest discomfort worsened with deep inspiration. She denied fevers, history of smoking, asthma, or prior trauma to chest wall. She did however report that menstruation began on day of symptom onset. Chest radiography revealed a small right sided pneumothorax and subsequent chest thoracostomy tube was placed with evidence of lung re-expansion. Patient declined pleurodesis and was discharged home in an improved condition. Months thereafter, she returned with a right sided pneumothorax and agreed to undergo pleurodesis, during which two tan-brown 2 cm supradiaphragmatic masses were found. Pathology report confirmed heterotopic liver tissue consisting of polygonal hepatocytes. Postoperative course was uneventful and patient discharged home.

IMPLICATIONS/DISCUSSION: Accessory liver tissue has been described commonly in thevicinity of liver such as in the gallbladder, spleen, pancreas, umbilicus,adrenal gland, or omentum. However, supradiaphragmatic ectopic liverspecifically in the pleural space is a rare finding [1]. It is usually detectedas an incidental finding during laparoscopy or autopsy. Even in the thoraciccavity, accessory liver tissue is more likely to be attached to the liverthrough a diaphragmatic defect [3].

Heterotopic or ectopic liver has been classified into fourtypes [2]. The case we described belongs to the third class of which ectopictissue is not attached to the liver. A literature search disclosed 17 cases ofsupradiaphragmatic heterotopic liver. One proposed mechanism describes aseparate liver bud independent of the main hepatic diverticulum without anyprior connection. In our case, thismechanism may explain the pathogenesis of the supradiaphragmatic liver withouta pedicle into the liver proper. Surgery has been favored with excellentprognosis [2]. Unique to our case is thepresentation with recurrent spontaneous pneumothorax.

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EXTRAGONADAL MEDIASTINAL METASTATIC YOLK SAC TUMOR Patrick Tang 1; Anthony Charles, II 2;

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LEARNING OBJECTIVES: 1. Recognize clinical and serologic findings of extragonadal germ cell tumors (GCTs) and be able to differentiate between its subtypes.2. Know multimodality treatment options of GCTs.
S492 ABSTRACTS JGIM
CASE INFORMATION: 18 year old male presented with lower back pain for 1 month and subsequent bilateral leg pain and numbness of bilateral 1st toe. Physical exam findings were remarkable for mild expiratory wheezes over left lung fields, tenderness to palpation of anterior thighs and calves and decreased sensation of the 1st toes. Chest radiograph revealed a 13 cm x 11 cm heterogenous left sided mediastinal mass with mass effect on the left pulmonary artery and left mainstem bronchus. With consideration of a primary germ cell tumor, serum AFP, LDH, and beta HCG were ordered and elevated at 12,096 ng/ml, 1292 U/L, and 262 miu/ml respectively. However, ultrasound of the testes revealed no masses. This constellation of findings suggested an extragonadal GCT. Imaging studies revealed widely metastatic disease with multiple hepatic lesions, an L5 mass with extension into the neural canal, T4 acute compression fracture, lytic lesions in the pelvic bones, multiple lytic lesions of the ribs, and multiple calvarial lesions. Diagnosis of a yolk sac tumor was confirmed with a CT-guided biopsy of a hepatic lesion, since bronchoscopic biopsy of lung mass yielded inconclusive findings. Neoadjuvant chemotherapy with bleomycin, etoposide, and cisplatin was started with anticipation for debulking procedure after four cycles.
IMPLICATIONS/DISCUSSION: Germ Cell Tumors without evidence of primary tumor in either the ovaries or testes are classified as extragonadal. Extragonadal GCTs in adults commonly presents in the anterior mediastinum, retroperitoneum, or pineal and suprasellar regions.
Patients commonly present with symptoms of fever, chills, weight loss, chest pain, and dyspnea. Serum tumor markers alpha-fetoprotein (AFP), beta-HCG, and lactate dehydrogenase. Although beta-hCG levels may be elevated in patients with seminomatous or nonseminomatous tumors, AFP is increased only in patiens with nonsemionmas. Nonseminomatous GCTs include yolk sak tumors, choriocarcinomas, embryonal carcinomas and mixed tumors with more than one cell line.
Most patients present with metastatic disease and are risk stratified into favorable, intermediate or poor prognostic groups based on histologic type, level of serum tumor markers, and site of the primary tumor. Mediastinal GCTs tend to be more aggressive, less common, and carry a worse prognosis.
Given the aggressive nature of these tumors, treatment usually requires initial chemotherapy followed by surgery. Acceptable regimens include etoposide, ifosfamide and cisplatin (VIP) or bleomycin, etoposide, and cisplatin (BEP). Radical resection of residual tumor is considered thereafter and additional cycles of chemotherapy are indicated if there is evidence of remaining disease. Even with the above therapies, the five year survival rate is estimated at 45%.
INTRACARDIA C DEVI CE ENDOCARDI TI S CAUSED BY PROPIONIBACTERIUM ACNES Suresh Challa 1; Weerawat Tananusont 2; jaya raj2. 1SJHMC, Phoenix, Arizona ; 2SJHMC, Phoenix, Arizona. (Tracking ID # 11707)
LEARNING OBJECTIVES: 1. Recognize the pathogenic potential of Propionibacterium acnes in intracardiac device related endocarditis (CDIE), especially when tissue destruction and abscess formation are found. 2. n/aCASE INFORMATION: A 52 year old male presented with complaints of chest pain, progressive shortness of breath, and low grade fever for 4 weeks. His past medical history is significant for coronary artery disease, AICD placement secondary to severe systolic dysfunction, bioprosthetic aortic valve replacement secondary to perivalvular abscess, and intravenous drug abuse (IVDA). Initial physical exam was unremarkable and EKG showed atrial-paced rhythm and non specific
intraventricular conduction delay. Serial cardiac enzymes were within normal limits. On day 2 of hospitalization

the patient was febrile at 39.2 degrees Celsius with leucocytosis. Blood cultures were obtained and vancomycin and gentamycin were empirically started given the suspicion of endocarditis. Subsequent tranesophageal echocardiography revealed a vegetation adherent to an atrial AICD lead. Anaerobic blood cultures grew Propionibacterium acnes (P. acnes) on day 7. Further management included AICD revmoval and antibiotics for 6 weeks.

IMPLICATIONS/DISCUSSION: Propionibacterium acnes (P.acnes) is an anaerobic, non spore-forming, gram-positive bacillus found as cutaneous flora of humans traditionally associated with acnes vulgaris. Although it is more commonly known as a contaminant, in rare cases it can be pathogenic. For instance, it has been identified as a pathogen in several infections including CNS shunt infections(1), brain abscesses (2), endophthalmitis (3), pulmonary infections(4), and endocarditis. It has a predilection for prosthetic valves and other foreign bodies. The usual organisms involved in CDIE are Coagulase-negative Staphylococci and Staphylococcus (7). P. acnes has been linked to a few cases of infective endocarditis worldwide (8,9,10,11).

The organism is difficult to culture if optimal anaerobic culture techniques are not used (12). The average time taken for the organisms to grow and be identified is 6 to 7 days. Prolonged culture of blood/ tissue for up to 3 weeks, both aerobically and anaerobically, may be required for detection (12). Previous cases suggest that routes of inoculation may include acupuncture, injection, and skin injuries (9,10). In this case, the organism was likely introduced systemically by intravenous drug use.

Clinical presentation of CDIE varies. The majority of cases present with fever without stigmata of endocarditis and follow an insidious course our case illustrates.(9,10) Omission of early anaerobic blood culture has been shown to delay diagnosis.(8), thus, early anaerobic blood cultures are necessary. Prompt diagnosis and treatment of Propionibacterium endocarditis is essential since the infection may have an aggressive clinical course with extensive valvular destruction, congestive heart failure, abscess formation, and systemic embolization (12,13,14). Despite the in vitro susceptibility of P. acnes to many antibiotics, surgical intervention is often needed (81%) due to complications (12).

PERICARDITIS AND ENDOMYOCARDIAL DISEASE IN HYPEREOSINOPHILIC SYNDROME Weerawat Tananusont 1; Suresh Challa 1; Jaya Raj1. 1SJHMC, Phoenix, Arizona. (Tracking ID # 11708)

LEARNING OBJECTIVES: 1. Diagnose hypereosinophilic syndrome and recognize it as a cause of pericarditis and endomyocardial disease.2. Treatment of hypereosinophilic syndrome with myocardial and pericardial involvement.

CASE INFORMATION: A 72 year old male presented with worsening bilateral lower extremity swelling and shortness of breath over 2 months. Physical examination was significant for elevated jugular venous pressure of 10 cm H2O, decreased breath sounds at bilateral lung bases with wheezing throughout, and marked bilateral lower extremity edema. The patient had bilateral pleural effusions consisting of mesothelial cells and 11%eosinophils. There were 20.2*109/L leukocytes with eosinophil predominance of 71.4% in the peripheral blood. A bone marrow biopsy was normocellular with polymorphic cell population and marked eosinophilia. Flow cytometry studies confirming marked eosinophilia with a small population of clonal B cells, and cytogenetic studies were negative for BCR-ABL and FIP1L1-PDGFRA genes. Transthoracic echocardiography revealed a thickened pericardium

with minimal pericardial effusion and constrictive hemodynamic pattern with preserved left ventricular ejection fraction of 61%. Follow up cardiac magnetic resonance imaging demonstrated diffuse thickening of the right ventricular wall with delayed enhancement, warranting a right heart catheterization which confirmed decompensated heart failure with constrictive hemodynamics. Subsequent myocardial biopsy showed moderate myocyte hypertrophy with vacuolization and granulation tissue with eosinophils, suggestive of evolving

eosinophilic endomyocardial disease. The patient was started on corticosteroid and imatinib mesylate therapy for presumptive hypereosinophilic syndrome (HES) with myocardial and pericardial involvement causing effusive constrictive pericardial inflammation. Leukocytosis and hypereosinophilia markedly improved on this regimen. IMPLICATIONS/DISCUSSION: Idiopathic Hyper Eeosinophilic Syndrome (HES) is a rare systemic disease characterized by prolonged eosinophilia without an identifiable underlying cause and multiple-organ involvement, most frequently involving the skin, lungs, gastrointestinal tract and heart. We describe a case of HES complicated with by transient constrictive pericarditis (TCP), eosinophilic pleural effusion (EPE) and endomyocardial involvement.

The diagnosis of HES requires eosinophilia of more than 1,500 cells/ L on at least two occasions, exclusion of other causes of eosinophilia, and signs and symptoms of single or multiple organ involvement. Decompensated heart failure in our case was likely secondary to transient constrictive pericarditis (TCP) which has been described in the setting of collagen vascular disease, purulent bacterial pericarditis and chemotherapy. Our patient was started on corticosteroids on the second day of hospitalization and constrictive hemodynamics resolved after 7 days of therapy by interval echocardiography. Constrictive pericarditis as an acute or late manifestation of HES has been reported, however, this case documents HES as a direct cause of TCP. Pleural effusions may have been an eosinophilic pleural effusion (EPE) secondary to TCP. EPE is defined as pleural fluid with 10% or more eosinophils. Etiology of EPE include malignancy, infections, unknown ,posttraumatic, and miscellaneous. EPE has been described as a rare presentation of HES. The development of cardiac disease in HES is unpredictable. Endomyocardial disease associated with HES has been well described and is subcategorized as endomyocardial fibrosis (EMF) or Loeffler endocarditis. The pathophysiology of endomyocardial disease in HES is thought to be infiltration of myocardium by abnormal eosinophils and subsequent necrosis by toxic degranulation. The initial necrosis is followed by thrombosis and fibrosis.

INTRAVASCULAR LYMPHOMA PRESENTS AS FEVER OF UNKNOWN ORIGIN Lawren Love 1; Sam McNulty 1; Cathryn Caton 1; Chrisopher Parsons 2; Pamela Charity1. 1Medical University of South Carolina, Charleston, South Carolina ; 2Medical University Of South Carolina, Charleson, South Carolina. (Tracking ID # 11735)

LEARNING OBJECTIVES: 1. To recognize intravascular lymphoma as a possible, yet rare, diagnosis in patients presenting with fever of unknown origin. 2. To discuss the clinical presentation of intravascular lymphoma.

CASE INFORMATION: We describe the case of a 70-year-old white male who presented with five months of hectic fevers and waxing and waning mental status. An extensive diagnostic evaluation revealed a normal cranial MRI, a bone marrow biopsy without evidence of malignancy, a mild lymphocytic pleocytosis and elevated protein within CSF, a normal skin biopsy, and a diverticular abscess on abdominal CT. The patient was treated with a fourteen-day course of IV antibiotics with radio-graphic resolution of the abscess. However, he maintained high fevers

and was treated empirically with prednisone for temporal arteritis. The patient continued to deteriorate clinically with fevers and worsening mental status and was noted to have an LDH of 682 U/L, ferritin of 1682 ng/mL, erythrocyte sedimentation rate greater than 100 mm/hr, TSH 0.02 U/mL, an undetectable free T4, T3 of 0.3 ng/dL, FSH of0.4 mU/mL, LH less than 0.3 mU/mL, and ILGF of 33 ng/mL. The patient ultimately expired. At autopsy, widespread involvement of intravascular lymphoma was identified. IMPLICATIONS/DISCUSSION: Intravascular lymphoma is a rare extranodal diffuse B cell lymphoma. Patients commonly present with fever (45%) and nonspecific laboratory abnormalities including elevated LDH (86%), elevated protein in CSF (82%), elevated erythrocyte sedimentation rate (43%), and anemia (63%). The absence of lymph-adenopathy and pathologic lymphocytes in peripheral blood and other body fluids make definitive diagnosis challenging. In fact, approximately 50% of cases are diagnosed only after autopsy. Biopsy of affected organs remains the only reliable diagnostic modality. Intravascular lymphoma is associated with poor outcomes, however early diagnosis

and treatment (typically with a CHOP regimen with or without rituximab) have been shown to improve outcomes. Thus, it is important to consider intravascular lymphoma as part of the differential for fever of unknown origin, as 3-year survival is as high as 30% with treatment, and median survival only a few months without treatment.

HYPOGLYCEMIC IN DISGUISE: A RARE CASE OF SYMPTOMATIC HYPOGLYCEMIA CAUSED BY HYDROXYCHLOROQUINE Nalinikumari Gandhe 1; Chowdhury Nazrul 2; Matt Chua 2; Bharat Khandheria 2; Roger D Smalligan3. 1TTUHSC, Amarillo, Texas ; 2Texas Tech University Health Science Center,Amarillo, Amarillo, Texas ; 3Texas Tech Univ HSC, Amarillo, Texas. (Tracking ID # 11783)

LEARNING OBJECTIVES: 1. To recognize that hydroxychloroquine can cause hypoglycemia 2. Hydroxychloroquines hypoglycemic effect can be used as adjunct in controlling poorly controlled diabetes mellitus type 2 especially patients with both Rheumatoid arthritis and Diabetes mellitusCASE INFORMATION: A 78-year-old white female with past medical history of hypertension, diabetes mellitus (DM) type 2, asthma, breast cancer, rheumatoid arthritis (RA) on hydroxychloroquine presented with episodes of cold sweats, dizziness, palpitations and nausea.

She was on glyburide for diabetes 24 months prior and 9 months after starting hydroxychloroquine for Rheumatoid arthritis, she developed frequent episodes of hypoglycemia and her glyburide was discontinued. Despite discontinuing her glyburide she would still have frequent hypoglycemic episodes with profound symptoms (one to three times in a week) hence she was brought by her family to the hospital.

Initial evaluation showed temperature of 98.3, heart rate of 91 bpm, BP of 138/57, RR 12/min, blood glucose 30 mg/dL which improved to 50 mg/dL after receiving 1 ampule of D50. Her symptoms improved significantly as well and her hydroxychloroquine was discontinued. After a consistently stable blood sugar she was put on 72 hour supervised fasting to accurately measure her insulin and c-peptide levels. Her insulin, c-peptide as well as cortisol levels were within normal range. Serum sulfonylurea measurement was undetectable. CT scan of the abdomen did not show any pancreatic mass. After several days of close monitoring, her pre-meal blood sugars ranged between 115150 mg/dL. She was subsequently discharge off of hydroxychloroquine without aggravating her rheumatoid arthritis. IMPLICATIONS/DISCUSSION: Quinolones and its derivatives have been reported to cause both symptomatic and asymptomatic hypoglycemia. These agents were explored as adjunct to insulin and oral

hypoglycemic agents for poorly controlled type 2diabetes. Patients with non-insulin dependent diabetes with suboptimal disease control during an intensive outpatient intervention showed an absolute reduction in glycated hemoglobin A1C level of 3.3% when treated for 6 months with hydroxychloroquine dosed at 200 mg 3 times per day. In a trial of patients with type 2 diabetes who had poor glycemic control despite taking maximal doses of sulfonylureas, the addition of hydroxychloroquine improved glycemic control, with greatest benefit in those with baseline hemoglobin A1C levels lower than 13.5%. Petri reported a significantly lower mean glucose levels among participants in the Baltimore Lupus Cohort while they were taking hydroxychloroquine, as well as a protective effect of hydroxychloroquine on abnormal glucose tolerance testing. In a prospective, multicentre, observational study, Wasko et al. showed that 4905 RA patients using hydroxychloroquine is associated with a reduced risk of diabetes.

Chloroquine has been shown to alter insulin metabolism in humans by both. Increasing insulin secretion and inhibiting its clearance. It reduces intracellular insulin degradation, increases intracellular insulin accumulation, slows receptor recycling and stimulates insulin-mediated glucose transport.

Our patient developed hypoglycemia without any predisposing disorders such as insulinoma, ethanol intake, oral anti-diabetic and exogenous insulin usage, liver failure or sepsis. Our case emphasize that prompt recognition of this potentially serious side effects is important. On the other hand we can exploit this side effect as an adjunct to control blood sugar in patients with RA and poorly controlled type 2 DM.

COLLAPSING GLOMERULOPATHY: A RARE AND UNFAVORABLE VARIANT OF LUPUS NEPHRITIS Manoj Bhattarai 1; Rachana Sedhai 1; Asha Shrestha 1; Iulia Grillo1. 1Memorial Hospital, Pawtucket, Rhode Island. (Tracking ID # 11794)

LEARNING OBJECTIVES: 1. Highlight diagnosis, and treatment options for collapsing glomerulopathy.2. Recognize association of collapsing glomerulopathy with different disease conditions.

CASE INFORMATION: A forty-year-old African-American female with past medical history of hypertension, hyperlipidemia, chronic anemia, hypothyroidism, and three first trimester miscarriages presented with three weeks of arthralgias (bilateral shoulders, hands, and knees). She noticed a twenty pound weight loss within two months in association with loss of appetite, vomiting, and fatigue. Her outpatient medications were levothyroxine and amlodipine. She was allergic to hydrochlorothiazide. On admission, her blood pressure was 158/76 mm Hg which remained persistently high during the hospitalization. She had severe stiffness and limited range of movement in bilateral shoulders, knees, and hands. She had trace pitting edema in bilateral lower extremities. There were no oral ulcers or skin rashes. Significant laboratory tests were positive antinuclear antibody, anti-Smith Ab, anti-RNP, anti-cardiolipin IgM Ab, lupus anticoagulant, rheumatoid factor, low C3 and C4, and elevated ESR. She had persistently high serum creatinine (lowest was 4.6 mg/dl). HIV test was negative. Twenty-four hour urine showed 11grams of protein in a volume of 2300 milliliters. Kidney biopsy was suggestive of lupus nephritis with a combination of predominantly membranous pattern of injury and superimposed recent and severe collapsing glomerulopathy (CG). Nephrotic syndrome due to focal segmental glomerulosclerosis was considered and treated with methylprednisolone 1 gram intravenously daily for three days and mycophenolate mofetil 250 mg orally twice daily. Blood pressure was controlled with metoprolol and doxazosin. Within few weeks of treatment her creatinine level came down to 1.5 mg/dl and arthralgias completely resolved.

IMPLICATIONS/DISCUSSION: Collapsing glomerulopathy is associated more commonly with HIV positivity, African-American race, intravenous drug abuse, and less commonly with lupus nephritis. It is characterized by pronounced proteinuria and rapidly progressive renal failure. Diagnosis is based on histopathological evidence of segmental and global collapse of the glomerular capillaries, marked hypertrophy and hyperplasia of podocytes, and severe tubulointerstitial disease. Treatments include blood pressure control, steroids, cyclosporine, cyclophosphamide, and mycophenolate mofetil. Some resistant cases have been treated with rituximab and/or plasma-pheresis. Our patient had lupus associated CG that was treated with steroids and mycophenolate mofetil. Her disease has been stable over a course of five months to present without any recurrence of symptoms.

WHITE HERRING: STEMI OR NOT? Catherine Dodds 1; Cynthia Margaret Cooper1. 1Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 11797)

LEARNING OBJECTIVES: 1. Review the differential for leukocytosis with neutrophilia. 2. Recognize small bowel obstruction as an unusual mimic of acute STEMICASE INFORMATION: Patient is an 82-year-old man with remote colon cancer s/p curative surgery transferred with leukocytosis. He presented after four days of vomiting and diarrhea. Initial labs showed a white blood cell count of 70,000 and acute kidney injury. Colonoscopy was normal 8 months prior. He had a normal exam and echo within the month. He denied fever, bruising, or change in bowel habits. Symptoms began after eating raw meat. Others who ate the meal had similar symptoms.

He looked dry but well. There was tachycardia and bibasilar lung crackles. Abdomen was mildly distended but non-tender.

White blood cell count was 59,400, 70% neutrophils, 20% monocytes. Creatinine was 3.7 mg/dl. Cardiac enzymes were normal. EKG had small inferior Q-waves. CXR had patchy bibasilar infiltrates. There were increased mature neutrophils and monocytes on blood smear.

He had increasing abdominal distention and was tachycardic and diaphoretic. EKG had new ST-segment elevations in the inferolateral leads. He was anticoagulated and cardiac enzymes cycled. Catheterization was

deferred due to kidney injury.
Echocardiogram showed inferior pseudodyskinesis from compression by a large subdiaphragmatic structure. NGT returned copious fluid and ST segment elevations resolved. Cardiac enzymes were flat over 24 hours. Abdominal CT showed small bowel obstruction. This resolved with conservative management. Azotemia improved with IV fluids. Discharge white blood cell count was 16,000.
Prior labs showed a white blood cell count of 14,000 with increased neutrophils and monocytes.
IMPLICATIONS/DISCUSSION: The differential for neutrophilic leukocytosis includes primary myeloproliferative disorder, such as chronic myeloid leukemia, leukemoid reaction due to stress, infection or malignancy, and marrow stimulation by a medication or toxin. The rapid decrease in white blood cell count in our patient suggests a leukemoid reaction from gastrointestinal inflammation.
Reactive leukocytosis, however, rarely presents with a count this high. The increased number of monocytes in his peripheral blood smear and the blood count at his annual physical suggest he may have underlying chronic myelomonocytic leukemia. CMML could raise the baseline for a superimposed leukemoid reaction and result in such elevated counts.

In a recent large geographic study of patients sent for cardiac catheterization to evaluate acute ST elevations, about 10% were deemed false-positives, e.g., no culprit lesion was found on catheterization and cardiac biomarkers were negative. More than 99% of these false-positives were ultimately attributed to a primary cardiac etiology.
Non-cardiac mimics of STEMI are less common. There have been case reports of acute pancreatitis, cholecystitis, and pneumonia causing EKG changes identical to STEMI. The mechanism of EKG elevation due to these processes is unclear. Inflammation of the upper GI tract may produce transient diffuse injury patterns through coronary spasm. Intra-abdominal and pulmonary processes can cause distribution-specific ST-segment elevations without evidence of myocyte damage. Our patient had physical compression of his heart by a markedly distended stomach, producing territorial ST elevations mimicking acute inferolateral STEMI. These changes resolved with decompression of his small bowel obstruction.
STAPHYLOCOCCAL PNEUMONIA IN A PATIENT WITH ADVANCED HIV INFECTION PRESENTING WITH THIN WALLED CAVITARY LESIONS ON CHEST X-RAY Addis A Asfaw 1; Jilalu A Kelbe 1; Vinod Khatri2. 1Saint Francis Hospital, Evanston, Illinois ; 2St. Francis Hospital, Evanston, Illinois. (Tracking ID # 11801)
LEARNING OBJECTIVES: 1. Recognize Staphylococcus aureus as an important cause of pneumonia in patients with advanced HIV infection2. Recognize atypical Chest x-ray patterns of staphylococcal pneumonia in adultsCASE INFORMATION: A 37Yr.old male patient was transferred to our hospital from nursing home with complaints of altered mental status described as being more lethargic with refusal to take oral food and medication. Records showed that patient is HIV positive and on Bactrim prophylaxis. Patient was not alert enough to give further history including history of current or previous use of HAART. Physical examination revealed a thin, lethargic male patient with Temp-99.60F, PR- 102 bpm, B/P 114/85 mmHg and RR-20/ min significant pallor of conjunctive, oral thrush, reduced air entry all over the lung fields (mainly due to poor inspiratory effort) , mild diffuse abdominal tenderness. Cardiovascular, skin and extremity examination was unremarkable. On neurologic examination patient was lethargic non verbal with no lateralizing motor deficits and mild resistance to neck flexion. Lab. evaluation revealed WBC count of9.8 K (82.8% Segments, 3.4% Lymphocytes, 13.7% monocytes) Hgb6.1gm/dl, Lactic acid 2.3, HIV viral load- 56754 copies/ml, CD4 &CD8 counts of 5 and 162 respectively. Serum Cryptococcal antigen, treponemal antibody test, anti toxoplasma IgM and IgG tests were negative , sputum and blood cultures grew MRSA, fungal, myco-bacterial cultures were negative as was Acid Fast Stain from sputum. Chest X-ray showed multiple small ring like cavitary infiltrates in

the mid and upper lung zones, Chest CT showed multiple cavitating pulmonary nodules throughout the lung. Transthoracic echocardiography showed normal study with no vegetation seen. Blood and sputum cultures on the 4th day of treatment grew no organism. On admission patient was started empirically with IV Ampicilin, Vancomycin, Ceftazidime and Acyclovir, and after culture results he was continued with vancomycin. On follow up patient remained in same general condition with improvement of his tachypnea, fever and renal status and finally transferred back to NH.

IMPLICATIONS/DISCUSSION: HIV-infection results in broader degree of immunosuppression which includes cell mediated immunity, humoral immunity and in the late stage of the disease, neutrophil function.

The respiratory system is not an exception to this widespread immunosuppression effect of HIV. As a result patients are susceptible to infection with common and opportunistic organisms. Typical organisms particularly the encapsulated ones, streptococcus pneumonia and haemophilus influenzae, and opportunistic organisms like Pneumocystis carinii are common causes of pneumonia in these patients. Staphylococcal pneumonia assumes increasing importance as immunosuppression worsens. Typically it presents with chest X-ray pattern which includes patchy or homogeneous parenchymal consolidation, typically segmental in distribution; single or multiple abscesses with fluid containing cavities and multiple nodular masses. In children it frequently presents with multiple thin walled cystic spaces or pneumatoceles which may contain fluid levels. In our case the chest X-ray findings; Multiple ring like cavitary lesions which cannot be easily differentiated from the classically thin walled cavitary lesions seen on X-ray of patients with PCP, making it an important differential diagnosis of pneumonia in patients with advanced HIV infection.

This case highlights that, although the radiographic presentation of Staphylococcus aureus pneumonia in patients with AIDS is similar to that of immunocompetent hosts, it remains an important differential diagnosis in patients with atypical patterns which are common with other etiologies, like PCP.

CHRONIC BACK PAIN - MORE THAN MEETS THE EYE Pramod Kumar Guru 1; Sanjay Chaudhary 2; Swati Prasad 1; Joleen Fixley3.

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LEARNING OBJECTIVES: 1. Recognize the presentation, complications and treatment of chronic Q fever2. Assessment of patients with chronic low back painCASE INFORMATION: A 61 year old male admitted for evaluation of chronic; intermittent; non-radiating band like lower back pain for 10 months progressing to constant pain, associated with episodes of night sweats and 50 lb weight loss over the preceding 12 months. His past medical history was significant for hypertension, hypothyroidism and stable abdominal aortic aneurysm since 2 years. He had a 40 pack year history of smoking and cattle exposure during childhood with a pet cat at home. His examination was essentially normal except mild tenderness of lumbar spine and left thigh discomfort with active left leg elevation. Laborotary examination revealed normal hematocrit, leucocyte, platelet count and ESR of 27 mm / hr. Serum electrolytes, renal function, liver function, urine culture test were normal. His CRP, RF, Anti CCP, PPD, TB quantiferun were all negative. Blood cultures for bacteria, fungal and mycobacterium were negative. His Q fever antibody for phase I and Phase II antigen was positive. MRI and CT scan revealed saccular abdominal aortic aneurysm (AAA) of 4.5 cm in diameter with features suggestive of L2 &L3 osteomyelitis and left psoas abscess. Patient underwent surgery for AAA and was started on Doxycycline and Hydroxychloroquine. He has been doing fine since then.

IMPLICATIONS/DISCUSSION: On initial evaluation, we narrowed down the diagnosis to a systemic problem with structural involvement of the vertebral system.With absence of endocarditis on echocardiography, negative aspirates from the psoas,we moved away from acute bacterial infectious causes. Clearly the chronicity of symptoms and relatively healthy appearance of the patient in comparison with the magnitude of the abnormality viewed on the MRI led us to consider an atypical infection. Serology confirmed the diagnosis of Q fever.

Q fever, caused by obligate intracellular gm -ve organism Coxiella burnetii, is a rare zoonotic disease, reported from all parts of world except New Zealand. The prevalence of Q fever is not known exactly due to lack of awareness, rarity of the disease and absence of validated clinical modalities to diagnose. Infectious complication of AAA is rare and mostly due to bacterial pathogens like S. aureus and Salmonella. C. brunnetii have been described as a cause of AAA infection. Our case is probably the first case of Q fever with simultaneous infection of an AAA along with lumbar vertebral osteomyelitis and psoas abscess in the absence of documented infectiveendocarditis. The diagnosis of Q fever is generally done by serology testing,because of need for special conditions for cultures and the lack of sensitivity of the technique and inherent risk of infectivity to the workers. Surgical treatment for aneurysm along with Doxycycline and Hydroxychloroquine for aminimum of 18 36 months has been extrapolated from endocarditis treatment for vascular infection. Chronic Q fever should be suspected in patients of AAA with unexplained fever, back pain, weight loss or abdominal pain. In view of high morbidity and mortality associated with chronic Q fever with AAA and valvular defects and the need for specialized tests it is important for physicians to be aware of this rare disease.

METRONIDAZOLE-INDUCED PANCREATITIS IN A PATIENT TREATED FOR ACUTE DIVERTICULITIS

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LEARNING OBJECTIVES: 1. Diagnose drug-induced pancreatitis.2. Recognize drugs associated with the development of acute pancreatitis. CASE INFORMATION: A 74-year-old male was admitted to the hospital with an episode of acute diverticulitis. This episode was controlled with intravenous (IV) hydration, narcotics and IV antibiotics (Ceftriaxone and Metronidazole). The patient improved and was discharged on oral Ciprofloxacin and Metronidazole to complete a 10-day course of antibiotics. He presented to the Emergency Department eight hours after discharge complaining of a new onset abdominal pain, which was epigastric, dull and associated with nausea, vomiting and anorexia. An acute abdominal series did not show signs of bowel obstruction and liver function tests were unremarkable. However, serum amylase and lipase were significantly elevated at more than 5 times the upper limit of normal (729 and 2250 IU/L respectively; normal on previous admission). The diagnosis of acute pancreatitis was made and the patient underwent an abdominal ultrasound which did not find evidence of gallstones. The patient denied any prior history of alcohol intake and the diagnosis of Metronidazole-induced pancreatitis was suspected. He was initially kept NPO and started on pain control and IV hydration. Metronidazole was switched to Clindamycin and twelve hours later his abdominal pain improved and diet was progressively advanced with good tolerance. Pancreatic enzymes normalized within the next 48 hours and the patient was discharged with the recommendation to avoid the use of Metronidazole.

IMPLICATIONS/DISCUSSION: Pancreatitis is a very rare adverse effect of Metronidazole and its mechanism is not well understood. It can present during treatment with the drug or even after a few days of Metronidazole exposure. The diagnosis of Metronidazole-induced pancreatitis requires a high degree of suspicion and should be considered in patients who present with gastrointestinal symptoms suggestive of acute pancreatitis and a current or recent prior exposure to the drug. If Metronidazole-induced pancreatitis is suspected, the medication should be discontinued and rechallenge should be avoided.

IS BACK PAIN A PRESENTING FEATURE OF PERNICIOUS ANEMIA?

Geetha Selvakumar 1; Roxana Sabau 1; Meghana Gopal 1; Ayesha Salahuddin 1; Haritha Bellam 1; Muhammed Sherid 2; Habib Dakkak 1; Mhd. Wisam Baqdunes 1; Nael Gharbi 1; Shazel Gharbi 1; Harvey Friedman1. 1Saint Francis Hospital, Evanston, Illinois ; 2St.Francis Hospital, Evanston, Illinois. (Tracking ID # 11831)

LEARNING OBJECTIVES: 1. To recognize the uncommon presentations of pernicious anemia2. To differentiate between pernicious anemia presenting with pancytopenia and myelodysplastic syndrome/acute myeloid leukemiaCASE INFORMATION: A 68 year old Caucasian female presented to our hospital with complaints of vomiting for three weeks. More than her presenting complaint, a low back pain of few months duration had been bothering her. She also had pain in her knees and thighs. Family members reported that the patient had been

withdrawn for few weeks. Her past medical history was significant for arthritis. She was taking aspirin and Advil. On admission she was afebrile, tachycardic and her blood pressure was 157/ 73 mmHg. Physical examination was unremarkable. Her labs showed a WBC of 2.2, platelet of 49, hemoglobin of 3.7, hematocrit of 10.1, MCV of 121 and RDW of 40. A comprehensive metabolic panel was within normal limits. The patient refused blood transfusion as she was a Jehovahs Witness. Iron and folate levels were within normal limits. Vitamin B12 level was 56 ng/ml. Antibodies to intrinsic factor were positive. Haptoglobin was less than 6 mg/dl and coombs test was negative. Reticulocyte count was 2.8 %. LDH was 5370. Thyroid function tests were within normal limits. Bone marrow studies showed marked hypercellularity with megaloblastic changes with hypersegmented neutrophils and mitotic figures. Cytogenics did not show any abnormalities. The patient was started on Vitamin B12 and iron therapy. On day four of hospitalization her reticulocytes increased to 27.2 % and on day 10 of hospitalization her WBC was 8.1, hemoglobin was 6, hematocrit was 20.7, MCV was 108, RDW was 31 and platelet count was 538. Her back pain began to resolve and the patient felt much better than before.
IMPLICATIONS/DISCUSSION: Pernicious anemia combined with impaired absorption of Vitamin B12 can be a significant cause of anemia in elderly patients. The treatment of anemia was challenging in our patient since her religious beliefs prevented her from getting blood transfusions. Pancytopenia could also suggest a diagnosis of myelodysplastic syndrome in this patient given her age. But the presence of hypersegmented neutrophils and mitotic figures in the bone marrow has ruled out myelodysplastic syndrome. Examination of the peripheral blood smear did not show any leukemic white blood cell changes suggestive of myelodysplastic syndrome or acute myeloid leukemia.

WANING EFFECT OF COMPULSIVE BATHING IN CANNABINOID HYPEREMESIS Satish Bagdure 1; Houman Sharifi 1; Bharat Khandheria1. 1Department of Internal Medicine, Texas Tech University Health Sciences Center, Amarillo, Texas. (Tracking ID # 11836)

LEARNING OBJECTIVES: 1. Recognize the clinical features of cannabinoid hyperemesis; increasing awareness of which may reduce the need for unnecessary investigations in a group of patients who may present repeatedly to hospitals with hyperemesis of unknown cause. 2. Recognize the association between cannabinoid hyperemesis and compulsive bathing episodes and that the relief obtained from bathing tends to wane off and so does the compulsive behavior.

CASE INFORMATION: A 27-year-old male with a history of prolonged and daily use of cannabinoid presented to the emergency department with nausea, vomiting, and abdominal pain that worsened for several days. During the past two years, the patient had several episodes of similar symptoms, each lasting about a week and often requiring being admitted to the hospital. His symptoms were refractory to all types of antiemetic medications and responded initially to hot showers and use of hot water bag applied to the abdomen. Later in the course of his condition the temporary relief he had from hot water bathing tended to wane off and later this behavior did not help at all. He had no underlying medical conditions. His last marijuana use was 1 day before admission to the hospital. He denied alcohol, tobacco, or other illicit drug use. On physical examination, the patients vital signs were stable. Physical examination was largely unremarkable except the abdomen which was soft and diffusely tender with decreased bowel sounds and no rebound or guarding. No organomegaly was detected nor were there any signs of erythema ab igne.

Laboratory studies including complete blood count, complete metabolic panel, liver function and amylase, lipase, and thyroid-stimulating hormone tests, were normal. The patients urine toxicology test was positive for tetrahydrocannabinol. Investigations of his symptoms from the past visit and this visit included abdominal radiography, computed tomography (CT) of the head, CT of her abdomen and pelvis without contrast medium, abdominal ultrasonography, magnetic resonance cholangiopancreatography, duplex study of aorta and

mesenteric artery and esophagogastroduodenoscopy; all of which were normal.
The patient was admitted for rehydration, antiemetics, and evaluation and was discharged after being asymptomatic for 48 hours. Later follow up revealed that cessation of marijuana use resulted in the alleviation of his symptoms.
IMPLICATIONS/DISCUSSION: Cannabinoid hyperemesis was first described in 2004. Possible mechanisms of cannabinoid hyperemesis include its ability to delay gastric emptying, its dysregulation of thermoregulatory and autonomic equilibrium through its effect on the limbic system, and the binding of cannabinoid to cannabinoid type 1 receptors in the brain. The compulsive and learned behavior of taking multiple hot showers to relieve nausea is a curious phenomenon that has been reported in the literature. The effects of cannabinoid on the functions of the thermoregulatory and autonomic mechanisms of the brain can lead to behavioral changes. Such effects might be the underlying mechanism for the compulsive hot bathing behavior.
Our patient had relief from nausea and vomiting by hot water bathing and by applying hot water bottle on his stomach in the earlier stage of his disease but later the effect waned off and this behavior did not seem to help him. The relief obtained from compulsive bathing behavior is short lasting and we believe it eventually wanes off in a subgroup of this population and the only permanent cure for this condition is to abstain from cannabinoid use.
This case illustrates the importance of recognizing cannabinoid hyperemesis early which may reduce the need for unnecessary investigations. It also illustrates that the phenomenon of compulsive bathing may be short lasting; this finding has not been reported before in the literature. Further studies are needed to elucidate the waning effect of relief from compulsive behavior in cannabinoid hyperemesis.
A BRUSH WITH DEATH Jason G. Shultz 1; Erik Wallace2. 1University of Oklahoma - Tulsa, Tulsa, Oklahoma ; 2The University of Oklahoma -Tulsa, Tulsa, Oklahoma. (Tracking ID # 11842)
LEARNING OBJECTIVES: 1. Recognize the clinical features of gastrointestinal perforation when foreign body unknowingly ingested. 2. None.
CASE INFORMATION: A 61 year-old white man with a history of gastroesophageal reflux disease (GERD) presented to the emergency department with abdominal pain. He first reported a sudden onset of sharp pain in his abdomen two weeks ago after eating a steak cooked on his outdoor grill. The pain was at first intermittent and eventually became more persistent and intense over the next two weeks. The patient reported fever and chills with associated nausea, fatigue and loss of appetite during the five days prior to admission. On physical exam, the patients abdomen was soft and tender to palpation in the mid epigastrum without peritoneal signs. Lipase was 85 IU/L and CBC, chemistries and liver function tests were normal. A CT scan with and without contrast of his abdomen and pelvis showed a nonspecific 4.5 cm low attenuation lesion that was initially thought to be either a hepatic or gastric mass. In addition, a small metallic density was identified adjacent to this lesion. Esophagogastrduodenoscopy revealed a metallic object imbedded in the gastric antrum that could not be safely removed. Surgery was required to remove the metallic object and further evaluate the adjacent lesion. The metallic object was determined to be a bristle from a grill cleaning brush which presumably came loose and attached to the steak he cooked on the grill which he then consumed. The reported lesion seen on CT was determined to be an abscess that had formed after the grill brush bristle perforated his stomach.
IMPLICATIONS/DISCUSSION: While the findings of gastrointestinal perforation are uncommon, complications from an ingested grill brush bristle are exceedingly rare. Despite the fact that grilling food is common and cleaning grills with wire brushes is widespread, only two case reports have been previously published related to complications from ingesting a grill brush bristle. One case described a teenage boy who developed a neck abscess from esophageal perforation and another patient developed a lingual abscess from a grill brush bristle. Our patient developed sudden onset of abdominal pain immediately after eating food cooked on a grill. Several causes of sudden onset abdominal pain after eating, such as mesenteric ischemia and pancreatitis, are much more common. However, patients who present with this history, especially with worsening symptoms over hours

to days that does not improve when limiting food intake, should be questioned about what food they ate and how it was prepared to determine if a foreign object could have been accidentally ingested.

POSTPARTUM NASH Anju Dayal 1; Anju Dayal1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 11856)

LEARNING OBJECTIVES: 1. LeaLearn to evaluate elevated liver enzymes early in pregnancy2. Recognize risk factors to the development of nonalcoholic steatohepatitis (NASH)

CASE INFORMATION: A 24 year old woman with obesity and diabetes mellitus (DM)was evaluated in the clinic for elevated liver enzymes five months postpartum. She was asymptomatic and incidentally found to have elevated aminotransferases of about twice the upper limit of normal during her second trimester. Her workup at that time revealed: no proteinuria, normal blood pressures, normal serum bile acids, negative serologies for viral hepatitis A, B and C, negative HIV 1/2 ELISA, mild elevation in fibrinogen andLDH but normal PT/PTT and a HbA1c of 5.9%. She was taking only prenatal vitamins. Her family history was negative for liver disease and VTE. She emigrated from Mexico, had no recent travel history, and used no drugs or tobacco. She used to drink two to five shots of Tequila once every two weeks prior to pregnancy but drank no alcohol since becoming pregnant. She had an intrauterine fetal demise (IUFD) at

36 weeks gestation;pathology revealed chorioamnionitis and autopsy suggested cord accident as the likely cause of death. Since one month postpartum her ALT increased to the 600 s and AST to the 400 s. She had gained 20 lbs since the IUFD (BMI 35), was using Ibuprofen 800 mg every 8 hours for lumbago and had worsening glycemic control with a Hemoglobin A1C of 13.5%. TSH,CPK, ANA, Anti mitochondrial Ab, Anti Smooth muscle Ab, ceruloplasmin, ferritin, cortisol, serum Ig quant, SPEP, and hypercoagulable studies were all normal. Her RUQ ultrasound revealed patent vessels and an enlarged echogenic liver consistent with fatty liver. Her liver biopsy revealed stage 2/3 NASH with perisinusoidal and portal fibrosis. Currently, she no longer uses NSAIDs but her AST/ALT remain elevated in high 100s/high 300s. She continues to have poorly controlled DM with most recent HgA1C at 10.8% and obesity with a BMI of 35.

IMPLICATIONS/DISCUSSION: It is well established that certain hepatobiliary syndromes induced by pregnancy including hyperemesis gravidarum, HELLP syndrome, acute fatty liver of pregnancy, preecclampsia/ecclampsia, and intrahepatic cholestasis, may initially manifest with an asymptomatic elevation in liver enzymes. These diseases may be associated with significant morbidity and mortality for both mother and fetus. Early diagnosis and management has been shown to improve outcomes. However, in the era of the obesity epidemic, increasing numbers of obese adolescents and young adults in their childbearing years have preexisting fatty liver disease and elevated baseline aminotransaminase levels. This makes the evaluation of elevated aminotransaminases during pregnancy more challenging. Unfortunately, there are few studies looking at the natural course of fatty liver disease and/or NASH during pregnancy. Older age is a known independent risk factor for progression to NASH but this case highlights some others, including diabetes mellitus and high aminotransferase levels. Given the current epidemic of obesity and diabetes, more research is warranted to better understand the impact of pregnancy on both fatty liver disease and NASH.

PARANEOPLASTIC CEREBELLAR DEGENERATION WITH ATYPICAL ANTIBODY WORKUP Lissa X. Yu 1; Phillip Young 2; Mitchell D Wong3.

1David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, California ; 2UCLA Department of Internal Medicine, Los Angeles, California ; 3UCLA Division of GIM/HSR, Los Angeles, California. (Tracking ID # 11859)

LEARNING OBJECTIVES: 1. Recognize clinical features of neurological paraneoplastic syndromes and associated laboratory findings.2. Consider pursing paraneoplastic workup when symptoms cannot be explained by typical causes.

CASE INFORMATION: A 72 year old Caucasian woman with history of treated breast cancer, coronary disease,

and 87 pack-year history of cigarette use presented initially with unexplained nausea and vomiting refractory to treatment. She subsequently developed anorexia, diplopia, truncal ataxia and intermittent confusion and agitation. Workup for infection, neurosyphilis, B12 deficiency, cerebellar and sellar tumors, and posterior circulation strokes were negative, and head CT and MRI showed no acute intracranial abnormalities. Serum and CSF paraneoplastic studies were positive only for Anti-P/Q Calcium Channel Antibodies, a few CSF IgG oligoclonal bands, and slightly elevated IgG synthesis rate, but were negative for Anti-Yo and Anti-Hu. Whole body PET-CT demonstrated paratracheal, supraclavicular, and subcarinal lymph nodes with intense metabolic activity. Subsequently, nine mediastinal lymph nodes were biopsied and pathology identified three to contain small cell carcinoma. The patient received 3 doses of
methylprednisolone with symptomatic improvement and clearing of mental status after 1 week of treatment. The patient declined recommended chemotherapeutic treatment and instead requested hospice care only.
IMPLICATIONS/DISCUSSION: Paraneoplastic syndromes are the non-local effects of underlying cancers, particularly lung, ovarian and breast cancers, mediated by humoral secretions of the tumor or immune responses to the tumor. Though rare, paraneoplastic effects may warrant consideration if atypical symptoms cannot be explained by other causes. Neurological paraneoplastic findings may be difficult to discern from local causes of functional loss but may be the first presenting manifestations of an underlying malignancy. Exploration of paraneoplastic serum antibodies and CSF workup in our patient enabled us to find a new primary cancer before local effects were noted. Lack of focal lesions on neuroimaging indicated no identifiable tumor or stroke, and infections and nutrition workup were negative. Though pathophysiology of paraneoplastic effects is not completely understood, it is hypothesized that small cell carcinomas may release tumor proteins and DNA that activate Helper T lymphocytes that might then initiate the production of autoantibodies against self-proteins. Paraneoplastic Cerebellar Degeneration is characterized by cerebellar symptoms including movement abnormalities and ataxias, and may be associated with Anti-Hu, Anti-Yo, and Calcium Channel antibodies, as well as Lambert Eaton Myasthenic Syndrome (LEMS). Patients positive for Anti-Hu are more likely to be women, have more diffuse loss of neurological function, and be more disabled by their disease. Patients postitive for Anti-Yo are more likely to have diplopia, and P/Q Ca-channel antibodies are often associated with LEMS findings. Although our patient was female, and had disabling multifocal neurological loss including diplopia, she lacked Anti-Hu and Anti-Yo antibodies, and although she was positive for P/Q Ca-channel antibodies, EMG performed to assess for LEMS was negative for any findings. Our patients paraneoplastic antibody profile was therefore atypical given her presenting set of symptoms.

UNUSUAL PRESENTATION OF AN UNUSUAL CANCER Ewa Monika Rakowski 1; Danit Arad1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 11863)

LEARNING OBJECTIVES: 1. Recognize central diabetes insipidus as an unusual presentation of cancer.2. Review the differential diagnosis of an anterior mediastinal mass. CASE INFORMATION: A 35 year-old man presented with 3 weeks of increased thirst and increased urinary volume. He reported no dyspnea, chest pain, cough, head trauma, headaches, vision change, new rashes or fever. He has no personal or family history of malignancy. He has a 20 pack-year smoking history but no other toxic habits or medical problems. On further questioning he had weakness, fatigue and decreased appetite with a loss of 5% of his normal body weight over 1 month.

The patients vital signs were unremarkable. His head was atraumatic with dry mucous membranes and normal visual fields. Lungs, heart, abdomen and testicular exam were unremarkable. There was no lymphadenopathy and no skin changes. Serum sodium was 151 mEq/L, serum osmolality was 307 mOsm/kg and urine osmolality was 111 mOsm/kg. All other laboratory results were within normal range. Chest x-ray revealed bilateral lung nodules and bilateral hilar adenopathy.

Fluid restriction test confirmed central diabetes insipidus (CDI). A magnetic resonance imaging scan of the brain revealed enhancement of the pituitary stalk consistent with metastatic disease. On computed

tomography scan of the chest there was a large anterior mediastinal soft tissue mass with extensive associated pulmonary nodules, mediastinal, hilar and lower cervical lymphadenopathy. Angiotensin Converting Enzyme level was normal. HIV test was negative.
Transbronchial biopsy revealed malignant cells consistent with thymic squamous cell carcinoma. Signs and symptoms of CDI were controlled with medical therapy and the patient was referred for metastatic thymic squamous cell carcinoma (SCC) treatment. IMPLICATIONS/DISCUSSION: Malignancy can present in many different ways. CDI is one of the unusual presenting features of cancer. Breast and lung cancer as well as lymphoma are reported to metastasize to the pituitary. However, pituitary metastasis overall make up less than 5% of metastasis.
When a mediastinal mass is encountered, two-thirds will be benign, however if the mass is symptomatic almost two-thirds will be malignant. The mediastinum is divided into anterior, middle and posterior subdivisions and anterior mediastinal masses make up half of all mediastinal masses. Anterior masses are usually of thymic or germ cell origin. Thymoma is the most common and usually the mass itself is asymptomatic but up to 30% will present with myasthenia gravis. Lymph nodes are considered part of the middle mediastinum and can be sites of lymphomas or metastasis for malignancies, particularly from the lung.
When an anterior mediastinal mass is found in a patient with a smoking history along with histological features of SCC it is highly suspicious for primary lung SCC. However, the presentation of the marker CD5 is not consistent with lung SCC and in some studies has high specificity (96-100%) to thymic carcinoma. The co-appearance of the marker CD117 also supports this rare diagnosis. This distinction is of clinical importance because primary thymic SCC has a better prognosis than a comparable primary lung SCC. Thymic SCC is a rare disease that usually presents with cough, chest pain, phrenic nerve palsy or superior vena cava syndrome. This case represents an unusual presenting feature of an unusual cancer. Although rare, when an infiltrative pituitary process is present, metastatic malignancy should be in the differential diagnosis. Within the wide differential diagnosis of mediastinal mass, rare diagnosis such as thymic SCC should be considered due to its possible favorable prognosis.
TRANSFORMATION TO ACUTE LEUKEMIA AND SEPSIS IN A PATIENT WITH MYELODYSPLASTIC SYNDROME INITIALLY PRESENTING WITH CHRONIC SKIN ULCERATIONS Dustin Thomas Smith 1; Dustin Thomas Smith2. 1Emory-Atlanta Veterans Affairs Medical Center, Decatur, Georgia ; 2Emory-Atlanta Veterans Affairs Medical Center, Atlanta, Georgia. (Tracking ID # 11867)
LEARNING OBJECTIVES: 1. Recognize the clinical and pathological features of myelodysplastic syndrome (MDS), as well as the other common etiologies for dysplasia that must be excluded in making the diagnosis of MDS. 2. Identify the complications of MDS and the risk for conversion to acute myeloid leukemia (AML), with infection being the most common cause of death in these patients.
CASE INFORMATION: A 62-year-old male presented with 3 months of non-healing skin ulcers on his legs. His medical history included atrial fibrillation and hypertension. He was taking no medications. He reported dyspnea on exertion and fatigue upon review of systems.
On examination, he was not in distress but was tachycardic and hypertensive. Other vital signs were normal. He was pale and cardiac exam only revealed an irregular heartbeat. The rest of his exam was normal except for mildly exudative superficial skin ulcers on his legs.
Laboratory investigations revealed a WBC count of 800 cells/mm3,
hemoglobin 7.0 g/dL (MCV 108 fL), and platelet count 30,000 cells/mm3.
Iron, B12, folate, and TSH levels were normal but his ferritin level was elevated. Fecal occult blood testing was negative. Bacterial cultures were negative. HIV, EBV, CMV, and Hepatitis A, B, and C virus testing were all

negative. Heavy metal and toxicology panels were also negative.
A blood smear revealed macroovalocytic red cells, neutropenia, and decreased platelets. A bone marrow biopsy showed hypercellular marrow with 15-20% myeloblasts. Immunohistochemistry and cytogenetics suggested high-grade MDS. Further investigations with plain radiography and a bone scan of his legs excluded any deeper tissue or bone infection. The patients ulcers improved with antibiotics. He was maintained on prophylactic antibiotics given his neutropenia. He received blood transfusions for his symptomatic anemia. His MDS was treated with azacitidine. He became transfusion-dependent and later unresponsive to further transfusions. He was readmitted 2 months after initial presentation where a repeat bone marrow biopsy now showed 20-25% blasts. The diagnosis of AML was considered given the rise in blasts and he was started on induction chemotherapy. Unfortunately, the patient developed respiratory failure and septic shock due to pneumonia. He died despite intravenous antibiotics, vasopressors, and mechanical ventilation. IMPLICATIONS/DISCUSSION: MDS is a group of myeloid neoplasms characterized by dysplasia and ineffective blood cell production resulting in anemia or other cytopenias with a risk for conversion to acute leukemia. Initially MDS was termed preleukemia from case reports of refractory cytopenias evolving into acute leukemia. MDS should be suspected in patients with an unexplained macrocytic anemia and other cytopenias. The symptoms of MDS are non-specific. MDS is rare in young patients but increases dramatically in the elderly. Blood smear abnormalities include macroovalocytes, hyposegmented granulocytes, and hypogranular neutrophils. The diagnosis of MDS requires bone marrow testing, with at least 10% dysplasia seen. Other causes of dysplasia must be excluded: B12/ folate/copper deficiencies, alcoholism, viral infections, medications, lead/arsenic poisoning, and other primary bone marrow disorders. MDS is categorized by the number of cytopenias and blasts present. Therapy is limited in MDS and prognosis is poor. Treatment includes transfusions, chemotherapy, and allogenic hematopoietic cell transplant. While chemotherapy is not very effective in MDS, it may help control any disease-related symptoms or complications. Allo-SCT is considered for patients with high risk disease and is the only curative option. Patients with MDS may suffer from symptomatic anemia, infection, bleeding, or progression to acute leukemia. Neutropenia and granulocyte dysfunction are responsible for the high incidence of infection in MDS, which is the primary cause of death. Patients with high risk MDS or transformation to AML have a survival rate of less than 10%. The risk for conversion is highest in patients like ours with refractory anemia with excess blasts. Later, his myeloblasts increased to above 20%, the level required for the diagnosis of AML. Our patient was started on induction chemo upon discovery of leukemic transformation. Unfortunately, he developed infectious complications and died shortly thereafter.
POTENTIALLY LETHAL ACETAMINOPHEN-WARFARIN INTERACTION Shreyas Saligram 1; Sarinya Boongird 1; Caridad Hernandez1.
1University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania. (Tracking ID # 11872)
LEARNING OBJECTIVES: 1. Prevention of adverse interaction between Warfarin and Acetaminophen2. Recognize an uncommon cause of acute low back pain

CASE INFORMATION: A 74-year-old man on warfarin for chronic atrial fibrillation was admitted following an acute onset of right-sided lower back pain. He had a history of chronic back pain with a recent lumbar spine CT scan two months earlier revealing degenerative changes of disks at multiple levels. The patient described the pain as primarily paraspinous with no radiation, greater in severity than any he had experienced previously. He denies any associated neurological deficit or trauma prior to the onset of pain. Medication included warfarin 2.5 mg daily, fentanyl patch, and acetaminophen 500 mg as needed. He had not recently received any new medications.
On examination, the patient was stable hemodynamically without any acute distress. In addition to mild tenderness at right paraspinous area, the remainder of the examination was normal. There were no neurologic deficits or signs of bleeding diathesis. A lumbar spine radiograph demonstrated multilevel severe degenerative

disc disease, and old compression fracture of L1. The international normalized ratio (INR) was elevated at 8.9, and the partial-thromboplastin time was elevated at 65 seconds. Hemoglobin level was stable at 13 mg/dL. Platelet count and basic metabolic panel (BMP) were within normal limits.
The diagnosis of worsening degenerative arthritis of lower lumbar spine with coagulopathy was made. The patient was admitted for pain control and monitoring. Vitamin K was administered for correcting excess anticoagulation. Fifteen hours after his admission, he suddenly dropped his blood pressure to 74/53 mm Hg. Abdominal CT revealed right paraspinal and psoas muscle hematoma extending to retroperitoneum. Repeat hemoglobin was 8.9 mg/dL, and INR was8.0. He was given fresh frozen plasma and packed red blood cell transfusion. He fortunately recovered without requiring any surgical intervention.
The cause of bleeding was secondary to interaction between Warfarin and Acetaminophen.
IMPLICATIONS/DISCUSSION: Polypharmacy is common in elderly subjects largely due to age-related coexisting diseases. An important consequence of multiple prescribing for old people is the occurrence of drug-drug interactions via alterations in Warfarin absorption or metabolism. Risk of bleeding in elderly patients may result in the lack of realization that some medications especially over the counter drugs like Acetaminophen may interact with anticoagulants and failure to mention the use of anticoagulants to their doctors.
Potentially lethal acetaminophen-warfarin interaction in an older adult is an under-recognized phenomenon. Lower doses of Acetaminophen that is less than 2grams in 24 hours should be considered in patients with Warfarin to prevent enzyme induction. In our patient, potential adverse effects of Warfarin and Acetaminophen interaction could have been avoided by checking INR regularly and also by patient education.
SHOULD I WORK-UP AN INCIDENTAL FINDING OF MICROSCOPIC HEMATURIA? Javier Neyra 1; Fatima Khalid 1; James E Novak1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 11875)
LEARNING OBJECTIVES: 1. Henoch-Schnlein purpura nephritis (HSPN) and immunoglobulin A nephropathy (IgAN) are considered to be related diseases, since both exhibit similar pathological mechanisms.2. A history of simultaneous infection other than the well-recognized synpharyngitic macroscopic hematuria is described in this adult patient.
CASE INFORMATION: A 72-year old man with history of ischemic cardiomyopathy, diabetes, and chronic obstructive pulmonary disease
was admitted to the hospital with right foot cellulitis. Physical exam revealed, in addition to the right foot erythema and tenderness, a purpuric rash with palpable lesions, predominantly in the lower extremities. Blood cultures were negative and the patient completed a course of antibiotics. Additional work-up showed microscopic hematuria with 60% dysmorphic erythrocytes and urine cytology negative for malignant cells; mild proteinuria; and baseline estimated glomerular filtration rate (eGFR) of 46 mL/min/1.73m2. Skin biopsy of the purpuric lesions confirmed leukocytoclastic vasculitis. Autoimmune assays were negative for antinuclear and anti-neutrophil cytoplasmic antibodies, and complement levels were normal. Erythrocyte sedimentation rate and IgA levels were elevated. During the patients hospital stay, his kidney function deteriorated (eGFR decreased to 35 mL/min/1.73m2) and a kidney biopsy was performed. Pathology revealed focal segmental proliferative, crescentic, and sclerosing glomerulonephritis with mesangial IgA deposition, acute tubulointerstitial nephritis, and 14% global glomerular sclerosis. Cutaneous IgA deposits were also confirmed. The patient was treated with oral corticosteroids and his kidney function has remained stable for the last two years.
IMPLICATIONS/DISCUSSION: In contrast to the typical presentation in children, microscopic hematuria and/or proteinuria comprise the most frequent initial presentation of IgAN in adults. Henoch-Schnlein purpura (HSP) is a systemic vasculitis that is characterized by deposition of IgA-containing immune complexes in tissues, including mesangial cells, and thus shares many features with IgAN. Cutaneous HSP is a leukocytoclastic vasculitis and a common extrarenal manifestation of HSPN. Simultaneous infection is reported in one third of HSPN cases. Deposits of streptococcal M protein acting as IgA-binding regions have been identified in the kidneys of patients with IgAN/HSPN and the skin of patients with HSP. Therapy includes angiotensin-converting

enzyme inhibitors, corticosteroids, fish oil, and cytotoxic agents. Our case is the first to describe the association of a common infection such as cellulitis with the occurrence of IgAN/HSPN in an adult patient. The early recognition of this disease is critical, since 20-30% of patients develop end-stage kidney disease.
TURNING A BLIND EYE TO THE SINUS Ritu Madan 1; Tsewang Tashi 2; Manu Kaushik 2; Theresa Townley 3; Anna Maio2. 1Creighton University, Omaha, Nebraska ; 2Creighton University, Omaha, Nebraska ; 3Creighton University, Omaha, Nebraska. (Tracking ID # 11877)
LEARNING OBJECTIVES: 1. To recognize cavernous sinus thrombosis as a differential diagnosis of opthalmoplegia2. To present fungal mycetoma as a rare cause of cavernous sinus thrombosisCASE INFORMATION: A 74 year old female presented with 3 day history of frontal headache and a 1 day history of right eye pain and sudden drooping of right eyelid. She denied past headaches, fever, postnasal drip and cough. She did not have past medical history of diabetes, head trauma, migraine and cancer. Her examination revealed dilated right pupil with absent light reflex and consensual reflex and third, fourth and sixth nerve palsy. Sensations on the face were preserved and fundus was normal.
CT demonstrated complete opacification of sphenoid sinus with bone hypertrophy and anterior bone erosion. CT angiography revealed an3.8 mm calcified aneurysm of supraclinoid portion of left carotid artery and opacified right sphenoid sinus with internal calcifications and thickened walls likely indicating chronic infection. Cerebral angiography revealed diminished filling of right cavernous sinus with respect to the left which was a sign of impending cavernous sinus thrombosis.

Right sphenoidotomy was done for her when a fungal ball was removed from her sphenoid sinus. The fungus had not invaded the sinus walls , so they were left intact. Culture of fungal ball revealed aspergilllus fumigatus. Her ptosis and eye movements started improving on post-op day 2. She was discharged on post-op day 3 on voriconazole for 12 weeks.
IMPLICATIONS/DISCUSSION: Paranasal sinusitis of fungal etiology is not very common. The presentation often depends on the immune status of the host. While in immunosuppressed individuals, invasive fungal sinusitis is common, in immunocompetent individuals fungal involvement of sinuses often presents as mycetomas. Only 5 % cases of fungal sinusitis have isolated involvement of sphenoidal sinus making it a rare entity. Although the association of cavernous sinus thrombosis with sinusitis is well described in literature, it is unclear if it always results from direct spread of infection or can result from non-specific inflammation. It is also uncertain if proximity of sphenoid increases the predilection for cavernous sinus thrombosis compared to other para-nasal sinusitides. Irrespective, the management hinges on surgical resection of the mycetoma and adding anti-fungal therapy when vascular invasion is likely as with cavernous sinus thrombosis. During surgery finding yellow, black or brown cheesy material that does not invade the mucosa is 100% sensitive and 99% specific. Fungus can be cultured in only 23-50% of cases, Aspergillus species being most common.
MORE THAN A PAIN IN THE NECK Elizabeth Ellen Lawler 1; Kurt Pfeifer 2; Gilbert Fareau1. 1Medical College of Wisconsin, Wauwatosa, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11887)
LEARNING OBJECTIVES: 1. 1) Distinguish Hrthle cell as an uncommon but aggressive variant of thyroid cancer 2. 2) Review the standard approach to diagnosis and treatment of Hrthle cell thyroid cancerCASE INFORMATION: A 51-year old woman presented with a five-year history of goiter that had recently doubled in size over the preceding six months. She reported a two-month history of hoarse voice, but denied any change in her swallowing or breathing. She also denied any symptoms suggestive of hyper-or hypothyroidism. She had no prior history of thyroid disease, no personal history of radiation exposure, and no family history of thyroid cancer. A CT scan of the neck identified a very large, heterogeneous thyroid gland with evidence of significant

tracheal deviation. She underwent a total thyroidectomy, the pathology of which was remarkable for an 18.5 cm widely invasive Hrthle cell thyroid cancer. She was subsequently treated with adjuvant radioactive iodine, which showed uptake in the thyroid bed and vertebral spine on post-treatment imaging. She was started on levothyroxine to suppress her thyroid-stimulating hormone below 0.1 IU/ml, and continues to return for ongoing follow up.
IMPLICATIONS/DISCUSSION: Hrthle cell carcinoma (HCC) is a relatively rare type of thyroid cancer with a significant potential to for metastasis. Adverse predictors of prognosis include size >4 cm, degree of invasion, extrathyroidal extension, and nodal or distant metastases. The majority of thyroid cancers present with a nodule. Fine-needle aspiration of the mass is an appropriate initial diagnostic procedure. In order to be classified as a malignancy evidence of capsular invasion or distant metastasis must be present. Ultimately most HCC requires histologic pathology. The treatment includes total thyroidectomy. The treatment includes total thyroidectomy, radioactive iodine therapy, and levothyroxine to suppress the TSH, followed by life-long surveillance for recurrence.
BLUE INSIDE, BLUE OUTSIDE: A CASE OF RECURRENT ECCHYMOSES Deborah Leong 1; Deborah Leong1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 11888)
LEARNING OBJECTIVES: 1. Recognize the clinical presentation of psychogenic purpura. 2. Recognize the diagnostic difficulties of and limited treatment options for psychogenic purpura.
CASE INFORMATION: A 46 year-old Hispanic woman presented to the ED with left thigh pain for 2 days progressing to ecchymosis. She denied trauma, falls, or insect bites; no mucosal bleeding or menorrhagia. She denied use of antiplatelet medications, oral contraceptives, or herbal supplements. She reported numerous similar episodes of spontaneous, painful ecchymoses since age 2 triggered by extreme emotions. She did not require blood transfusions for her two cesarean sections. However, after plasminogen activator inhibitor-1 deficiency was diagnosed 8 years ago with a PAI-1 activity of 2.2 (nl 031), she received perioperative aminocaproic acid for a total abdominal hysterectomy; this was uncomplicated. She moved to the US from the Dominican Republic at age 14. She has a fiance of 7 years and denies any abuse history. Her parents are second cousins, but her family history is negative for bleeding diathesis. Exam revealed a warm, raised, tender ecchymosis over her left medial thigh and knee. CBC and differential were normal; PT was 15.2. Hematology presumptively diagnosed hemarthrosis and started aminocaproic acid. Her lesion resolved, but a new right forearm ecchymosis formed weeks later. MRI showed edema but no hematoma. Repeat hematologic work-up found a PAI-1 activity <6 with normal PAI-1 Ag, euglobulin lysis time, platelet aggregation, vWF Ag and cofactor, and Factors II, V, VII, VIII, X, and XIII. CRP was 6.4; tests for RA, SLE, vasculitis, hereditary angioedema, and Loeys-Dietz and Ehlers-Danlos syndromes were negative. With no hematoma seen and inclusion of values <6 in the normal PAI-1 activity range, PAI-1 deficiency was felt unlikely. The patient was diagnosed with psychogenic purpura. Psychiatry diagnosed adjustment disorder; she did not meet criteria for a primary disorder. Trials of lorazepam have had equivocal effects on her symptoms. She is uninterested in longer-acting antidepressants or psychotherapy.
IMPLICATIONS/DISCUSSION: Psychogenic purpura is a rare disorder. It also known as autoerythrocyte sensitization or Gardner-Diamond syndrome, named after the two physicians who first systemically described this condition in 1955. It is characterized by recurrent, spontaneous episodes of painful ecchymoses usually occurring over the extremities. Localized pain progresses to erythema, warmth, and edema, which progress to ecchymoses over 24 hours. Lesions often regress within 48 hours and resolve within 7 to 10 days. Many patients complain of associated fever, arthralgias, myalgias, headaches, dizziness, and gastrointestinal symptoms. There are case reports of gastrointestinal bleeds, hematuria, and hemarthroses. The condition may remit for weeks to years but can recur with emotional provocation. Psychogenic purpura typically affects adolescent to middle-aged females with underlying emotional problems, including depression, anxiety, obsessive compulsive behavior, and hysterical and borderline personality disorders. Factitious disorder and

physical abuse must be excluded. The discovery of a hematologic or immunologic abnormality is rare; histopathology is nonspecific. No definitive diagnostic test exists. Intradermal injection of autologous erythrocytes classically reproduces the ecchymotic lesions but with limited sensitivity. Diagnosis is mainly through history, physical, and thorough exclusion of other causes. Numerous medical therapies including psychotropic agents, glucocorticoids, cytostatic drugs, hormonal contraceptives, and beta blockers have not proven effective. Psychotherapy may be beneficial.

HEARTACHE AND BELLYACHE Purnema Madahar 1; Michelle Cleeves 1; Cristina M Gonzalez2. 1Montefiore Medical Center, New York, New York ; 2Albert Einstein College of Medicine- Montefiore Medical Center, Bronx, New York. (Tracking ID # 11889)

LEARNING OBJECTIVES: 1. Understand the presentation and management of acute splenic infarct. 2. Recognize thrombophilia as a cause of recurrent thromboembolic events.

CASE INFORMATION: A 50 year-old woman presented with three days of sudden onset, progressively worsening left upper quadrant pain. The pain was dull, constant, radiated to her left flank, and was associated with nausea and vomiting for two days prior to admission. She denied additional gastrointestinal or genitourinary complaints during the review of symptoms. Her past medical history was significant for two ST elevation myocardial infarctions with clean coronaries seen on cardiac catheterization. Her physical exam was remarkable for stable vital signs and moderate tenderness to palpation in her left upper quadrant without rebound or guarding. There was no splenomegaly or costovertebral angle tenderness. Laboratory testing was significant for WBC 17, hemoglobin 17 and hematocrit 52. CT scan revealed a 4 by 4 cm splenic infarct and a 1 by 1 cm thrombosed splenic artery aneurysm superior to the region of the infarct. Review of old laboratory records disclosed a factor VIII activity level of 250% which was tested during a prior thrombophilia workup. Immediate systemic anticoagulation with dalteparin was initiated. IMPLICATIONS/DISCUSSION: Splenic infarction is a rare and typically clinically silent entity, thus making its prevalence uncertain, though 80% of symptomatic patients will present with abdominal pain. There are no diagnostic laboratory findings for splenic infarcts, although an elevated white blood cell count is not unusual. Conservative management of symptoms is preferred, with surgical intervention reserved for patients with persistent symptoms, pseudocyst formation, or hemorrhage. Systemic anticoagulation is not standard of care for patients with isolated splenic infarcts. However, this case necessitated systemic anticoagulation in a patient with splenic infarction and two previous thromboembolic insults in conjunction with factor VIII thrombophilia. Elevated factor VIII levels are a risk factor for venous and arterial thrombosis. Patients with >150% factor activity have a three-fold increased risk of a first thrombotic event, with a 10% increase in risk for each subsequent increase of 10% factor VIII level activity. Prevalence of elevated factor VIII levels range from 11-25%. Factor VIII activity levels greater than 150% account for 16% of all venous thrombotic events, while factor VIII activity levels >123% explain 4% of all arterial events. Lifelong systemic anticoagulation is prudent in any patient with recurrent thromboembolic events. Given the under-diagnosis of splenic infarction and the relatively high prevalence of hypercoaguable states, it is important for Internists to consider thrombophilia as an etiology for unexplained abdominal pain.

ANOMALOUS LEFT MAIN CORONARY ARTERY shreyas saligram 1;

Antony Innasimuthu 1; Caridad Hernandez1. 1University of Pittsburgh medical center, Pittsburgh, Pennsylvania. (Tracking ID # 11891)

LEARNING OBJECTIVES: 1. Treatment of anomalous left main coronary artery2. Unusual causes of chest pain.

CASE INFORMATION: 44 year old African American woman was admitted following 2 week history of intermittent chest pain. The chest pain was described as substernal, lasted for less than 1 minute, and radiated to the jaw. It was brought on by exertion and resolved spontaneously. There was no diaphoresis, palpitations, nausea, syncope or loss of consciousness. She had a past medical history of sickle cell trait and was on

medications. She never smoked, consumed alcohol or abused recreational drugs. There was no family history of Coronary artery disease or sudden cardiac death. Physical examination revealed a blood pressure of 126/86 mmHg; the remainder of her vital signs was normal. Cardiovascular examination showed normal first and second heart sound with no murmurs and a regular pulse of 60/min and the remainder of her physical examination were normal. An electrocardiogram demonstrated normal sinus rhythm and no evidence of ischemic changes. Chest x-ray was normal with no evidence of cardiomegaly. Laboratory studies, including troponin I level were normal, except for a high D-dimer level of 0.55. A CT scan of the chest with contrast obtained in the Emergency Department revealed no evidence of pulmonary embolism. However, review of her central vessels suggested anomalous origin of the Left main coronary artery (LMCA).
She subsequently underwent CT coronary angiogram which revealed anomalous location of the LMCA ostium. The LCMA originated from the right coronary sinus within the aortic root. The ostium was immediately adjacent but separate from the ostium of the right coronary artery. The left main stem then passed between the aortic root and the right ventricular outflow tract, and branched into the left anterior descending and the circumflex branch in a typical location. There was no evidence of atherosclerosis or luminal stenosis in any of the coronary arteries. She underwent single vessel coronary artery bypass with saphenous vein grafting from the aortic root to the distal left main stem. IMPLICATIONS/DISCUSSION: Anomalous origin of the LMCA from the right sinus of valsalva (RSOV) is a rare congenital coronary anomaly that may cause sudden cardiac death from myocardial infarction. It accounts for 1.3% of all coronary anomalies with an associated mortality of 57%. The origin of the LMCA from the RSOV has four subtypes, 1) anterior free wall course, crossing the anterior surface of the right ventricular outflow tract 2) septal course, intramyocardial within the muscular septum beneath the right ventricular infundibulum; 3) retroaortic course; 4) interarterial course, between the aorta and pulmonary trunk. The interarterial course has been associated with the worst prognosis, and the overall incidence of sudden death is reported to be 27%. Several mechanisms have been proposed to explain the mechanisms of sudden death. First, it could be due to the compression of the LMCA between the aorta and pulmonary trunk during vigorous exercise as these great vessels dilate. Second, the angulation of origin from the RSOV, creating a slit like orifice rather than an oval shape and this combined with exercise-induced aortic distension, may produce further narrowing of the orifice. Third, it may be due to spasm of the LMCA itself or finally congenitally small left coronary system. Coronary angiography remains the gold standard diagnostic modality in identifying the anomalous coronary vessel and defining its course. An aggressive therapeutic approach has been advocated owing to the increased risk of sudden cardiac death in patients. Prophylactic coronary artery bypass graft (CABG) surgery has been recommended to prevent sudden cardiac death and exercise-induced symptoms of myocardial ischemia.
ACUTE PRESENTATION OF SARCOIDOSIS David M Faleck 1; Arash Nafisi 2; Cristina M Gonzalez3. 1Albert Einstein College of Medicine, Bronx, New York ; 2Montefiore Medical Center, Bronx, New York ; 3Albert Einstein College of Medicine- Montefiore Medical Center, Bronx, New York. (Tracking ID # 11903)
LEARNING OBJECTIVES: 1. To review the clinical presentation of sarcoidosis.

2. To recognize the broad differential diagnosis associated with the CT scan findings seen in patients with sarcoidosis and the management dilemma it presents.
CASE INFORMATION: A 40-year-old man with no significant medical history presented with three days of non-productive cough, myalgias, vomiting and drenching night sweats. He also reported subjective fevers and chest tightness, but denied hemoptysis. He denied sick contacts or recent travel. Vital signs in the emergency room included a maximum temperature of 102.7, pulse of 109, blood pressure of 135/88 and a respiratory rate of 19. On exam, he was an African American male who was uncomfortable, diaphoretic and coughing. His exam was

notable for dullness to percussion and decreased breath sounds in the right lower lung fields. There were no rashes or ocular abnormalities. Once euvolemic, labs were significant for Na 131, Ca 9.6, Hb 11.1, MCV 80, WBC 22.0 (84% granulocytes). Non-contrast CT scan showed bilateral hilar and mediastinal lymphadenopathy, diffuse micronodular airspace opacities, scattered larger nodules, and consolidative airspace opacities within the lungs, most prominent within the upper lobes and right lower lobe. Patient was initially placed on airborne isolation and empiric antibiotic treatment with ceftriaxone and azithromycin was initiated. The patient began improving clinically within 34 days. Further testing revealed Fe 22, TIBC 191, %saturation 12, ferritin 1280, ANA negative, HIV negative, ACE 113 (normal: 853), and 24-hour urine calcium 63 (normal: 25300). All cultures were negative including blood, urine and sputum, urine Legionella and S. pneumonia antigens, viral panel, and acid fast bacilli on three induced morning sputum samples. The patient subsequently underwent bronchoscopy with endobronchial biopsy revealing non-caseating granulomas with negative fungal and acid-fast stains. Given the above findings, his overall presentation was consistent with sarcoidosis with community acquired pneumonia and we started a course of steroids for sarcoidosis that was gradually tapered as an outpatient. Tuberculosis and fungal cultures were negative at six weeks. IMPLICATIONS/DISCUSSION: We describe a case of sarcoidosis diagnosed in a previously healthy patient presenting with acute onset of symptoms consistent with pneumonia. Sarcoidosis is a chronic granulomatous disease of unknown etiology most commonly affecting the lungs. Cough and dyspnea are the most common presenting symptoms, but the onset is usually subacute to chronic. Other subacute presentations of sarcoidosis include cutaneous and ocular complaints and it often can be associated with nonspecific constitutional symptoms including fatigue, chills and night sweats. In contrast, acute sarcoidosis generally presents in the form of Lofgrens syndrome, a triad of erythema nodosum, hilar adenopathy and arthritis and portends a better prognosis. Finally, underlying sarcoidosis is often first detected upon imaging for other acute illnesses.

The differential diagnosis for the CT findings seen in our patient is broad and includes many diseases relevant to the general medical practitioner. Infectious etiologies include atypical, viral, and fungal pneumonias, tuberculosis, and septic emboli. Other interstitial lung diseases such as cryptogenic organizing pneumonia and idiopathic interstitial pneumonia, and environmental exposures such as silicosis and hypersensitivity pneumonitis must be considered as well. Among malignant etiologies, lymphoma, bronchoalveolar carcinoma, other adenocarcinomas, and hematogenous metastases are possible. Due to this extensive differential, our case presented a challenge in definitive diagnosis which delayed onset of immunosuppressive therapy. Thus, the diagnosis of sarcoidosis in the absence of Lofgrens syndrome requires ruling out infection along with a tissue biopsy of the involved organ with demonstration of noncaseating granulomas negative for fungal and tuberculosis cultures. As steroids are the mainstay of treatment of sarcoidosis, it is essential to rule out infection and malignancy before initiating treatment, which could have devastating consequences.

RECURRENT COMMON ILIAC VENOUS THROMBOSIS

Julie Kim 1; Abigail Deyo 2; Kurt Pfeifer3. 1Medical College of Wisconsin Affiliated Hospitals, New Berlin, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin ; 3Medical College of Wisconsin Affiliated Hospitals, Milwaukee, Wisconsin . (Tracking ID # 11908)

LEARNING OBJECTIVES: 1. 1. Identify patients at high risk for antiphospholipid antibody syndrome (APS) and describe appropriate treatment for acute venous thromboembolism in patient with APS 2.2. Recognize that lupus coagulant antibodies can falsely prolong INR levelsCASE INFORMATION: A 28-year-old woman with Hashimotos thyroiditis presented with a one-day history of acute onset of left thigh pain, chest discomfort, left lower rib pain with inspiration and mild dyspnea. Physical exam revealed tachypnea and an erythematous, warm, and swollen left thigh. Her medications were oral contraceptives, but she denied smoking or a family history of clotting disorders. Left lower extremity ultrasound confirmed thrombosis of the left common iliac vein, and ventilation-perfusion scan showed high probability for bilateral multi-subsegmental pulmonary emboli. She was started on warfarin and bridged with dalteparin until her INR was therapeutic. She was discharged home

but returned with progressive thigh pain. Left lower extremity ultrasound revealed worsening thrombosis with clot now extending from the left common iliac vein to popliteal vein. She underwent catheter-directed thrombolysis and was restarted on intravenous unfractionated heparin. Venogram revealed no structural cause, such as May-Thurner syndrome, for her recurrent thrombosis. Thrombophilia work-up revealed minimally elevated lupus anticoagulant, partial thromboplastin time and dilute Russells viper venom time. She was discharged home on therapeutic-dose dalteparin. Four days later, she returned with onset of new left calf pain. Ultrasound showed a patchy distribution of thrombosis from her femoral vein to her popliteal vein. Repeat catheter-directed thrombolysis and continuous heparin and tissue plaminogen activator were administered, and ultrasound evaluation afterwards showed near resolution of her clot. She was again discharged on dalteparin with hematology follow-up. Antibody screening four weeks later was significant for positive lupus anticoagulant and elevated PTT and DRVVT. She has remained on dalteparin without further recurrence of venous thromboembolism (VTE).

IMPLICATIONS/DISCUSSION: Recurrent thrombosis in the setting of therapeutic anticoagulation presents a life-threatening diagnostic dilemma. Possible etiologies include May-Thurner Syndrome, malignancy, warfarin failure, and antiphospholipid antibody syndrome. Warfarin failure can occur secondary to the presence of malignancy or due to variability in the depression of various clotting factors. Specifically, factor II is considered to be most important for warfarins clinical antithrombotic efficacy, but least well represented in the INR. Furthermore, in 10% of patients with lupus anticoagulant, INR may be falsely elevated. Thus, in patients presenting with VTE in the setting of lupus anticoagulant, a factor II level can confirm adequate anticoagulation, especially prior to labeling a patient as a warfarin failure. Individuals presenting with new onset venous or arterial thrombosis in unusual locations should be screened for APS, a rare thrombophilic disorder most commonly observed in females of childbearing age. APS is diagnosed using the Sapporo criteria, which require a thrombosis or pregnancy loss in addition to repeatedly positive lab testing (lupus anticoagulant or antiphospholipid serologies), as tested at least 12 weeks apart. APS patients presenting with venous thrombosis can be managed as outpatients on warfarin with INR goal between 23 and should be considered candidates for long-term anticoagulation.

THE CASE OF THE TIRED TEEN Sherwin Hsu1; Jeffrey Miller1;
1University of California Los Angeles Olive View Medical Center, Sylmar, California. (Tracking ID # 11914)

LEARNING OBJECTIVES: 1. General approach to a patient with hypereosinophilia 2. How to properly diagnose and treat FIP1L1-PDGFRalpha associated clonal eosinophilia

CASE INFORMATION: LG is a 25 year old male with no past medical history who presented with several months of generalized fatigue and weakness. He denied any fevers, chills, nausea, vomiting, hematemesis, hematochezia, or weight loss. He completed a course of azithromycin one week prior to admission for a 1 month history of cough. The only other medications he took were occasional doxycycline for acne and zantac as needed for reflux symptoms (mid epigastric burning pain worse after eating) which began about one year ago. The patient went to his college student health center and had some blood drawn. It showed he had anemia and thrombocytopenia, and he was instructed to go to a hospital for further work up. On further questioning, he denied any foreign travel within the last two years, any sick contacts, or any toxic habits (no tobacco, alcohol, or drugs). His family history was significant only for diabetes and hypertension without any cancers. LG was born and raised in California, had mild seasonal allergies, and worked as a sales representative in a metal plating company while also attending a local college.

On exam, LG had no lymphadenopathy. His lungs were clear and his heart was in a regular rhythm without any murmurs or signs of volume overload. Abdominal exam was benign and he had no appreciable organomegaly. Labs showed a macrocytic anemia, thrombocytopenia, and hypereosinophilia. Peripheral smear confirmed the CBC results. Pan CT scan showed hepatomegaly, splenomegaly, and patchy ground glass opacities in bilateral

lungs. A bone marrow biopsy and EGD with biopsy were done which ultimately showed increased eosinophils with a left shift in the myeloid lineage maturation and eosinophilic esophagitis. FISH analysis of the bone marrow showed a new fusion gene FIP1L1-PDGFRalpha, consistent with a myeloid neoplasm associated with eosinophilia and genetic abnormalities. Imatinib treatment was then started.
IMPLICATIONS/DISCUSSION: Hypereosinophilia is an uncommon condition and should be investigated appropriately. In Western nations, the main causes of eosinophilia are allergic conditions, vasculitides, drugs, bacterial/fungal infections, and nonmyeloid malignancies. In the tropical and subtropical regions of the world, the most common cause is helminth infections. A detailed travel history, medication history, and physical exam are keys in the initial evaluation of patients with eosinophilia. Further studies include imaging (chest xray, CT scans), blood tests (fungal or parasitic serologies, peripheral smear, HIV), and stool tests (O&P). Once the common secondary causes of hypereosinophilia have been ruled out, further workup should be aimed toward determining if the cause is a myeloid vs lymphoid disorder and if there is any evidence of end organ damage from the hypereosinophilia. Cardiac, pulmonary, cutaneous, and digestive organs are the most commonly affected systems in hypereosinophilia. CT imaging, echocardiography, and EGD are all helpful in assessing the other organ systems. Finally, it is important to do bone marrow biopsy with cytogenetic or FISH analysis to evaluate for any myeloid involvement and clinically relevant clonal evolution. In LGs case, he had evidence of eosinophilic pulmonary (CT) and esophageal (EGD) involvement. The fusion gene FIP1L1-PDGFRalpha, found on LGs FISH analysis, codes for tyrosine kinase activity. This gene is the direct target of the tyrosine kinase inhibitor imatinib mesylate, which is considered first line therapy for patients with a FIP1L1-PDGFRalpha associated clonal eosinophilia. The teaching points from this case are how to initiate a hypereosinophilia work up, and how to diagnose and treat/manage a patient who displays FIP1L1-PDGFRalpha associated clonal eosinophilia.
LANCE-ADAMS SYNDROME: A RARE CASE OF POST-HYPOXIC MYOCLONUS, IN THE COURSE OF BRONCHIAL ASTHMA Pradeep Kumar Selvaraj1; Arati Chand 1; Rommel Delrosario1; Todd Bell1; Matt Chua1; 1Texas Tech Univ Health Sci Center, Amarillo, Texas. (Tracking ID # 11930)
LEARNING OBJECTIVES: 1. Post-hypoxic myoclonus (Lance-Adams Syndrome) is a rare (only 125 cases reported) and devastating complication of acute hypoxic respiratory failure. 2. Lance-Adams Syndrome (LAS) has an excellent prognosis if treated early. Sodium valproate, clonazepam, piracetam, and levetiracetam may be recommended as first-line agents to treat patients with LAS.
CASE INFORMATION: A 55 year old African American female with history of bronchial asthma admitted for acute hypoxic respiratory failure secondary to asthma exacerbation. She was intubated and subsequently extubated after 4 days. After 7 weeks, patient presented with generalized myoclonus in the face, trunk, and limbs, accompanied by ataxia,dysarthria and dysmetria. Electroencephalography showed bifrontal polyspikes and complex of polyspikes-slow wave, synchronized with myoclonus. CT and MRI of the brain showed no acute intracranial pathology. We treated the patient with sodium valproate with the loading dose of 1500 mg, followed by 500 mg q8 hours.The patient showed drastic improvement in myoclonus after receiving the loading dose and the myoclonus completely disappeared after getting a total of 3000 mg. IMPLICATIONS/DISCUSSION: Lance-Adamssyndrome (LAS) caused by anoxia of central nervous system, is a rare complication of successful cardiopulmonary resuscitation often presenting as myoclonus and cerebellar ataxia. Generally, this condition occurs with in days or weeks after the anoxic event. The pathophysiology associated with this syndrome is poorly understood; however some studies have shown that loss of neurotransmitters like serotonin, gamma-aminobutyric acid (GABA) within the inferior olive might be an important causal factor. The postulated mechanism might be after ischemia, there is loss of GABAnergic inhibition in cerebellar afferent neurons leading to diaschisis of the motor thalamus and reticular formation, which in turn causes enhanced motor excitability and myoclonus. Diagnosis of LAS is made on the basis of clinical features and imaging modalities like PET scan, cranial magnetic resonance spectroscopy, Single photone-mission computed tomography (SPECT) have

limited usage. It is important to recognize LAS early because of its excellent prognosis if treated early.
A CASE OF CHRONIC MESENTERIC ISCHEMIA Olanrewaju Olaoye1;
Akintomi Olugbodi1; Anthony Donato1; 1The Reading Hospital and Medical Center, Reading, Pennsylvania . (Tracking ID # 11931)
LEARNING OBJECTIVES: 1. Recognize chronic mesenteric ischemia, also known as intestinal angina, as an uncommon cause of non-specific abdominal pain in the elderly.2. Discuss management options in intestinal angina.
CASE INFORMATION: An 83-year old woman with history of coronary artery disease, peripheral vascular disease, and cigarette smoking presented with recurrent abdominal pain. The pain was constant, sharp, mostly located in the right lower quadrant and worsened 3060 minutes after food. She also reported a weight loss of 8 kg over the past

2 months. Abdominal computerized tomography scan showed widespread vessel calcifications, ascending colonic thickening and a right-sided abdominal mass. Right ileocolectomy revealed multifocal thrombotic occlusion of serosal vessels and a large ischemic pseudopolyp. Because of the ischemia and ongoing pain postoperatively with no new imaging explanation, an arteriogram was performed. Occlusion of the proximal superior mesenteric artery and a 90% stenosis at the origin of the celiac artery were demonstrated. Angioplasty and stenting of the celiac artery were successfully carried out. However symptoms continued, and the patient eventually passed away on hospice care. IMPLICATIONS/DISCUSSION: Chronic mesenteric ischemia is an uncommon cause of abdominal pain and weight loss. It may also be the cause of abdominal pain in 1-2% of elderly patients with acute, severe gastrointestinal disease. It is due to hypoperfusion from a mismatch between splanchnic blood supply and postprandial intestinal demand. This diagnosis should be considered in unexplained abdominal pain in the elderly, especially if common etiologies have been ruled out and significant peripheral vascular disease risks are present.
MITRAL ANNULAR VENTRICULAR TACHYCARDIA : A RARE FORM OF IDIOPATHIC VENTRICULAR TACHYCARDIA RATNA PRIYA GANGI1; Venkata Mahesh Alla2; JOSH JANSEN3; CHANDRA NAIR3;
1CREIGHTON UNIVERSITY MEDICAL CENTER, omaha, Nebraska.
2CREIGHTON UNIVERSITY MEDICAL CENTER, OMAHA, Nebraska.
3Creighton University Medical Center, Omaha, Nebraska. (Tracking ID # 11943)
LEARNING OBJECTIVES: 1. Emphasize clinical recognition of idiopathic mitral annular ventricular tachycardia (MAVT)2. Recognize the role of ablation in selected patients with sustained symptomatic Mitral Annular Ventricular TachycardiaCASE INFORMATION: A 46 year-old white female presented to the emergency room at Creighton University Medical Center with dyspnea and palpitations and was noted to have recurrent runs of sustained wide QRS complex tachycardia (WCT). The duration of these episodes was transient lasting only a few minutes before spontaneously converting to sinus rhythm and blood pressures remained stable. The WCT had right bundle branch block type morphology with monophasic R waves in all precordial leads, at a rate of 225 beats/minute and inferior axis. Prior history was significant for paroxysmal atrial fibrillation (with recent direct current electrical cardioversion), and 1 episode of out of hospital cardiac arrest. Evaluation included normal Doppler echocardiogram and coronary angiograms. An implantable cardiac defibrillator (ICD) was initially considered given her documented arrhythmia and prior history of cardiac arrest. However, Electrophysiology (EP) study confirmed a lateral MAVT and successful catheter ablation was done. At 3 month follow up, patient was asymptomatic and remained free of VT.
IMPLICATIONS/DISCUSSION: Mitral annular ventricular tachycardia is a rare form of idiopathic VT accounting for 5% of all idiopathic VTs. The mean age of occurrence is 5560 years. Sites of origin on the mitral annulus

include Posterior portion (Pos) (58%), Anterolateral portion (AL) (11%) and Posteroseptal (PS) (31%). Characteristic EKG findings help in localizing the site of origin of MAVT. Wide QRS with early precordial transition by lead V2 and an R or Rs pattern in V2- V5 is seen in all MAVT s. Positive QRS polarity in the inferior leads is suggestive of origin from anterior part of mitral annulus, with notching of R wave indicating anterolateral origin and lack of notching anteromedial origin. Negative QRS with notching of Q wave indicates posterior origin while lack of notching indicates posteroseptal origin. By definition, ischemic heart disease should be excluded. Though re-entry, and increased automaticity have been implicated, the exact mechanism of origin remains unclear. In the EP lab, MAVT is inducible by isoproterenol infusion but not by programmed ventricular stimulation or ventricular burst pacing. Acute management is based on hemodynamic status. While class IC or III anti-arrhythmic drugs are potentially useful, catheter ablation remains the therapy of choice (Class I) and can successfully eliminate the VT in approximately 95%of cases. Increased awareness and recognition of MAVT and other idiopathic VTs can therefore help avoid ICDs and provides an opportunity for curing VT in selected patients.

SOMETHING SMOLDERING UNDER A STREPTOCOCCUS PNEUMONIA BACTEREMIA Lydia Madaris Efird1; Teresa Cheng1;

1Boston University School of Medicine, Boston, Massachusetts. (Tracking ID # 11951)

LEARNING OBJECTIVES: 1. Recognize potential underlying cause in Streptococcus pneumonia bacteremia of undetermined source.2. Expand the differential diagnosis of lower back pain.

CASE INFORMATION: A 63 year old man was admitted with an acute exacerbation of chronic lower back pain. He had a history of resected renal cell carcinoma (RCC), remote IVDU, degenerative joint disease, and monoclonal gammopathy of undetermined significance (MGUS). The patient was afebrile in moderate discomfort. Exam was significant for right-sided paraspinal tenderness with a nonfocal neurological exam. Labs were notable for a mild anemia at his baseline, serum protein 10.8, albumin 3.1, and phosphate 7.9. Plain spine films showed degenerative changes. Repeat SPEP/UPEP showed a progressive IgG gammopathy (serum IgG 5.7, urine kappa 6940) but a full skeletal series was negative for lytic lesions. The patient was treated for pain until the third hospital day, when he spiked a fever. Blood cultures were positive for Streptococcus pneumoniae and antibiotics started. Initial physical exam revealed no source; CXR, TTE, and urinalysis were negative, and MRI showed inflammation and possible septic facet joint or synovial infection, without abscess or need for intervention.

The following day, pain localized to his arthritic knee, and examination revealed warmth, edema, and effusion. Inflammatory fluid was removed from the joint, followed by full arthroscopic debridement. After a prolonged course of antibiotics, both knee and back pain resolved. IMPLICATIONS/DISCUSSION: This case reveals a septic knee and possible paraspinal infection with Strep pneumonia as an initial presentation of smoldering multiple myeloma. Bacteremia has previously been documented as an unusual presentation of multiple myeloma (MM), but these patients had signs of progressive disease. Although this patient had a prior diagnosis of MGUS, his immunoglobulin level greater than 3gm indicated advancement to smoldering myeloma. The patient did not meet the criteria for MM as he lacked end-organ damage from plasma cell dyscrasia such as renal failure, lytic lesions, or profound anemia, and declined definitive diagnosis by bone marrow biopsy.

In those cases when MM presented as bacteremia, Strep pneumonia was the most common pathogen, and infection was hypothesized to be from impaired immune function to encapsulated organisms, lower antipneumococcal antibody titers, defective opsonic activity and granulocyte adhesiveness, and inhibition of dendritic cells. It is conceivable that a similar immune deficit may be present in patients with smoldering myeloma. Of note, given normal calcium, PTH, vitamin D, the hyperphosphatemia was attributed to elevated paraproteins failing to deproteinize, thus interfering with the lab result as has been reported in myeloma.

In addition to worsening joint disease and musculoskeletal pain, many etiologies of back pain were initially considered including bony metastases in the setting of RCC, spinal abscess from IVDU, lytic lesions due to

progression to MM, and even secondary gain. However,

his history of DJD with multiple steroid injections and immunocom-promised state from smoldering myeloma placed him at risk for inflammatory fluid collection and ultimately bacteremia from encapsulated organisms. Therefore, this case suggests infection and bacteremia might be added to the differential of back pain in patients with any form of monoclonal gammopathy.

ASSOCIATION OF CLOSTRIDIUM SEPTICUM WITH COLORECTAL MALIGNANCY. Asma Iftikhar1; Asma Iftikhar1; Puneet Bajaj1; Ritu Dave 2; Shelly Vijay3; 1NSLIJ Forest Hill Hospital, Forest Hill, New York ; 2NSLIJ forest hill hospital, Forest Hill, New York ; 3North Shore LIJ Forest Hills, Forest Hill, New York.
(Tracking ID # 11988)

LEARNING OBJECTIVES: 1. Recognize the association of Clostridium Septicum with colorectal malignancy.2. Suspect Clostridium Septicum in septic patients with Colorectal malignancy and initiate treatment in a timely manner to prevent fatal outcomes. CASE INFORMATION: Clostridium Septicum is a rare infection and mostly associated with colorectal malignancies. We report our experience of Clostridium Septicum infection in a patient with colorectal malignancy who presented with sepsis secondary to tumor perforation. A 60 year old male with no significant past medical history was admitted with two week history of progressively worsening of left lower quadrant pain associated with nausea,vomiting and anorexia. Patient was afebrile, hypotensive tachycardic, and had distended abdomen with tenderness and guarding in the left lower quadrant. CT Scan confirmed a large inflammatory mass containing stool and air encasing the sigmoid colon, which may be the sequel of perforated sigmoid colon due to neoplastic process versus abscess. He underwent an emergency exploratory laparotomy with colon and small bowel resection. During the course of his hospitalization the patient went into septic shock, and was empirically started on vancomycin and metronidazole. Repeat blood culture were positive for Clostridium Septicum. Continued appropriate antibiotics for 2 weeks.Eventually his condition stabilized and he was discharged home.

Histology of the mass subsequently confirmed high grade, necrotic adenocarcinoma of colon.

IMPLICATIONS/DISCUSSION: Clostridium Septicum is a gram positive,spore forming, obligate anaerobic bacterium which causes myonecrosis through the release of exotoxin. The infection is thought to be established by hematogenous spread from the gastrointestinal tract. Clostridium Septicum infections are strongly associated with malignancy. When there is no obvious underlying etiology in patient with Clostridium Septicum infection, there should be high index of suspicion about malignancy, and a colonoscopy may be warranted for those patients. In order to improve prognosis early diagnosis and aggressive treatment is essential. In patient with underlying malignancy showing sign of sepsis the possibility of Clostridium Septicum infection should be borne in mind.

CARE OF THE CANCER SURVIVOR: THE MEMORIAL SLOAN-KETTERING ADULT LONG-TERM FOLLOW-UP PROGRAM EXPERIENCE Emily S. Tonorezos1; Kevin C. Oeffinger1; 1Memorial Sloan-Kettering Cancer Center, New York, New York. (Tracking ID # 11996)

LEARNING OBJECTIVES: 1. Recognize the unique clinical needs of survivors of pediatric and young adult cancer2. Identify emerging areas of clinical research in this population CASE INFORMATION: The Adult Long-Term Follow-Up (ALTFU) Program at Memorial Sloan-Kettering Cancer Center (MSKCC) targets high risk cancer survivors.1. Clinical AgendaHigh-risk cancer survivors are survivors with increased risk of late effects or with multi-organ dysfunction post-therapy. For example, a 40-
year-old female survivor of Hodgkin lymphoma treated with mantle radiation has increased risks for breast cancer and coronary artery disease and needs appropriate screening. A 30-year-old male treated with an allogeneic stem cell transplant for AML may have renal dysfunction, restrictive lung disease, hypertension, or hyperlipidemia. Our screening practices follow the Childrens Oncology Group guidelines (www.survivorshipguidelines.org). Our team includes 4 primary care physicians, 3 nurse practioners, 1 nurse, 1

social worker, and 1 psychologist. In 2010, 128 new patients and 458 follow-ups were seen.2. Research MissionThe MSKCC ALTFU Program focuses on two areas of research: cardiovascular risk following therapy (studies of insulin resistance, dyslipidemia, coronary artery disease, and carotid artery disease) and breast cancer following radiotherapy (studies of estimating risk, a randomized controlled trial to increase surveillance after chest radiation, and building a breast cancer risk prediction model).3. Educational CurriculumThe MSKCC ALTFU Program is dedicated to the education of clinicians. In July 2011, an MSKCC one-year clinical survivorship fellowship will be initiated. Next year, a two-year research fellowship in survivorship will be launched. Additionally, the ALTFU actively mentors junior investigators in survivorship, and transitional year interns from MSKCC rotate through the practice.

IMPLICATIONS/DISCUSSION: Almost one million long-term survivors of pediatric and young adult cancers are currently living in the United States. With improvements in cancer and supportive therapy, this number can be expected to increase. Many of these survivors see primary care physicians who may be unaware of the risk of late-effects. The ALTFU Program at MSKCC aims to improve care of the cancer survivor through clinical care, research, and education.

THATS WHEN YOUR HEARTACHES BEGIN Eric Ryan Fenstad1;

Garvan Christopher Kane2; 1Mayo Clinic Internal Medicine, Rochester, Minnesota ; 2Mayo Clinic Division of Cardiovascular Diseases, Rochester, Minnesota. (Tracking ID # 11997)

LEARNING OBJECTIVES: 1. Recognize chemotherapy as a cause of chest pain and ST elevation. 2. Review treatment of chemotherapy-induced ST elevation.

CASE INFORMATION: A 55-year old Caucasian male with hypertension and recurrent colon cancer was admitted for substernal stuttering chest pain. The pain started 30 hours after initiating continuous infusion of 5-Fluorouracil (5-FU) and persisted for 45 minutes before spontaneous resolution. Associated symptoms included dyspnea, nausea, and diaphoresis. He awoke two hours later to the same pain. An EKG demonstrated new inferior and anterolateral ST elevation which resolved after 15 minutes. Initial troponin was <0.01 but peaked at 0.12 ng/ml. Initial echocardiogram was unremarkable. The patient was started on Aspirin, Heparin, Nitroglycerin drip, and Morphine. Exercise sestamibi demonstrated an ejection fraction (EF) of 30% with moderate global hypokinesis and medium sized anterior, apical, and inferior defects. Coronary angiogram demonstrated a 50% stenotic lesion in the mid-left anterior descending coronary. He was medically managed with Aspirin, Metoprolol, Simvastatin, Lisinopril, and Plavix. Sestamibi scan three weeks later demonstrated a 56% EF and resolution of all wall motion defects, thought to be myocardial stunning secondary to 5-FU.

Five weeks later, the patient developed similar chest pain during the next cycle infusion of 5-FU. The EKG demonstrated inferior ischemia. Troponin peaked at 0.04 ng/ml. The chemotherapy infusion was completed in the hospital with concurrent nitroglycerin infusion and oral Amlodipine. Twelve hours after chemo infusion, he developed similar burning chest pain. He became tachycardic, hypertensive, had

ST elevation in the inferior leads. Chest pain and EKG changes resolved with sublingual nitroglycerin and a nitroglycerin drip. He was dismissed from the hospital on Isosorbide mononitrate, Diltiazem, and sublingual Nitroglycerin as needed and the 5-FU was discontinued. Follow up echocardiogram four weeks after discharge demonstrated a 63% ejection fraction with complete resolution of regional wall motion abnormalities.

IMPLICATIONS/DISCUSSION: First reported in 1975, cardiotoxicity secondary to antineoplastic antimetabolites is rare but not without significance. Capecitabine, Gemcitabine, Cytarabine, and 5-Fluorouracil (5-FU) belong to a class of chemotherapeutic medications called Antineoplastic Antimetabolites Pyrimidine Analogs. These medications are used predominantly to treat solid organ cancers including colorectal, stomach, pancreas, head and neck, and breast malignancies. With a 1.6% incidence, 5-FU may cause ischemic events ranging from

chest pain to angina to myocardial infarction in severe cases. The pathogenesis for cardiotoxicity with Pyrimidine analogs remains a mystery. Proposed mechanisms include depletion of high energy phosphates, myocardial and endothelial cell apoptosis, direct myocar-dial toxicity, autoimmune response, and stimulation of coagulation cascade. Cardiotoxicity may occur in patients who have no history of coronary artery disease and few to no traditional risk factors. Appropriate tests include troponin, serial electrocardiograms, echocardiography or radionuclide imaging, and percutaneous coronary angiogram if pre-test probability of Acute Coronary Syndrome is high. No data exist regarding incidence of recurrent toxicity with further dosing. Re-challenge of the chemotherapeutic agent is controversial and may only be appropriate for those patients without alternative options for treatment. The cornerstone of treatment following a suspected ischemic event is to discontinue the offending agent. Although sometimes helpful, anti-anginal agents (e.g. nitrates) and calcium-channel blocking agents (e.g. diltiazem or nifedipine) do not universally prevent or treat anginal symptoms effectively.

THE APPROPRIATE USE OF MEDICAL FUTILITY IN TREATMENT DECISIONS AT THE END OF LIFE Nicole M. LaRue1; Michael K. Paasche-Orlow1; Angelo E. Volandes2; 1Boston University Medical Center, Boston, Massachusetts. 2Massachusetts General Hospital, Boston, Massachusetts. (Tracking ID # 12031)

LEARNING OBJECTIVES: 1. Assess medical futility in relation to treatment goals near the end of life. 2. Recognize the ethical application of unilateral Do-Not-Resuscitate orders.

CASE INFORMATION: A 47-year-old female with metastatic colon cancer presented from home with fever, rigors and weakness. Her examination and work-up was consistent with cholangitis and treatment was initiated with antibiotics and placement of a percutaneous biliary drain. In spite of a short interval of improvement, the patients hospital course was further complicated by bilateral hydronephrosis and acute renal failure secondary to tumor progression. Anuria and massive volume overload ensued and the patient developed hypoxic respiratory failure requiring intubation and transfer to the ICU. Sepsis was evolving secondary to fungemia and bladder invasion by the tumor necessitated frequent blood transfusions. The patient was unresponsive and unable to interact with her family or doctors. Given the patients advanced disease and multi-organ system failure, the ICU team expressed to the family that in this tragic situation, future escalation of care would be medically futile. The family maintained that the patient had openly communicated her desire to pursue all life-sustaining therapy and to retain a full code status. A younger brother of the patient had a prolonged survival with lymphoma in the setting of aggressive therapies and the patients own sister had survived ovarian cancer. The patients family members were united in their view that the patient had
wished to maintain life as long as possible, declaring that their faith has led them to hope for a miracle despite the grim prognosis given by the medical team. To withhold treatment was seen by the family as a betrayal of the promise they had made to respect her wishes. Despite the families preferences for aggressive care, the ICU team decided that CPR was medically futile, and would only increase suffering without prolonging survival. The patient was administratively made DNR and eight days later she died. The local police were then contacted by family who believed the patient had suffered a wrongful death. IMPLICATIONS/DISCUSSION: The concept of futility is often used to withhold or withdraw care from patients with advanced disease. Medical futility is defined as a clinical action that cannot achieve a stated goal for an individual patient. However, quantitative criteria by which futility can be measured do not exist. Futility is ultimately a value-based determination which cannot be made without first establishing concrete treatment goals. As highlighted in the above scenario, if the patients goal is to maintain physiologic life, then CPR may not be a futile intervention.

A unilateral decision to withhold life-sustaining measures based on the principle of futility risks imposing religious or subjective values regarding the end-of-life onto patients and their families. Such actions may foster a culture of paternalism and present an opportunity for misuse as providers may try to avoid difficult discussions. Yet, to require that physicians deliver care believed to be ineffective or misguided poses a threat to ones professional integrity and violates the principle of first doing no harm. Medical futility should not be used as a justification for rejecting a patient or proxys preferences, but can be used as a framework for discussing goals

of care. A hierarchy in which physician autonomy should take precedence over patients self-determination does not exist. When a resolution cannot be reached, hospital ethics teams should be consulted to facilitate mediation and to advocate for both patients and physicians. Ultimately, medical futility is not grounds for unilateral treatment decisions. Case law, state statutes, and professional codes of ethics will be used as examples to exhibit these points.

VISCERAL SENSATIONS Bryan Kovas1; Kurt Pfeifer1; 1Medical College of Wisconsin Affiliated Hospitals, Milwaukee, Wisconsin. (Tracking ID # 12039)

LEARNING OBJECTIVES: 1. Recognize atypical symptomatic presentations of herpes zoster.2. Emphasize that visceral outbreaks of herpes zoster can occur without the development of a surface skin rash.

CASE INFORMATION: A 60-year-old woman with a remote history of kidney transplantation presented with 2 days of waxing and waning, deep, severe left-sided abdominal pain described by the patient as a mushroom blooming . The pain radiated around her left side to the back and also to her proximal anterior left thigh. She complained of moderate nausea when the pain was severe, but denied other associated symptoms (i.e. diarrhea, constipation, fevers, chills or dysuria). The initial exam was unrevealing as no marked tenderness or other physical signs on abdominal examination could be appreciated. The patients exacerbations of pain were not well controlled initially despite multiple doses of IV hydromorphone.

The following morning the patient noted that she was developing a rash in her left inguinal area. Exam at that time revealed several erythematous papules and a few vesicles in the lower LLQ and inguinal area. The patient was started on valacyclovir and placed in isolation. Her rash eventually progressed to clusters of red crusted 1-2 mm papules extending from the left midline abdomen to her iliac crest and left inguinal area to approximately 5 cm below the level of the umbilicus. It included L1 with some extension into the T11-12 dermatomes. Throughout her hospitalization, the patient re-iterated that the bulk of

her pain was deep within her abdomen with only minimal pain on her skin. However, abdominal and pelvic CT did not reveal any alternative etiology of the patients pain.

IMPLICATIONS/DISCUSSION: Classic herpes zoster is often described as a prodrome of severe surface pain followed by a unilateral, dermatomal, vesicular rash. However, dermatomal pain in the absence of herpetic lesions has been documented in the literature and supported by serologic and PCR evidence of VZV reactivation during acute pain episodes. Furthermore, immunocompromised patients can present with atypical symptoms or have involvement of visceral organs during reactivation. With abdominal organ involvement a patient would be expected to have more visceral than somatic pain as in our patient. Diagnosis of visceral involvement is purely clinical since radiographic findings are usually minimal and nonspecific. Therefore, herpes zoster should be included in the differential early on during a regional acute pain syndrome and should not be dependent on the development of rash if no other etiology for the pain can be found.

CAN YOU CONNECT THE DOTS? AN ASSOCIATION BETWEEN PANCREATITIS, PANNICULITIS, AND POLYARTHRITIS. VISHAL GOYAL1; SUSAN MATHEW2; 1Allegheny General Hospital, Pittsburgh, Pennsylvania. 2Allegehny General Hospital, Pittsburgh, Pennsylvania. (Tracking ID # 12061)

LEARNING OBJECTIVES: 1. Identification of polyarthritis and panniculitis as consequence of underlying pancreatic pathology.2. Recognize resolution of extra pancreatic manifestations with treatment of underlying pancreatic disease.

CASE INFORMATION: We describe a 71 year old caucasian male with Diabetes mellitus type 2, hyperlipidemia and hypertension presented to hospital with abdominal pain. He was diagnosed to have acute on chronic pancreatitis on CAT scan of the abdomen and high level of lipase in serum. His hospital stay was complicated with development of respiratory distress for which the patient was admitted to MICU and intubated. He developed erythema and swelling of his right hip, right knee and right flank along with fever. Patient underwent paracentesis to drain the fluid from the right flank and arthrocentesis of the right hip and right knee. During this

time patient developed erythematous nodular leisons on his lower extremities bilaterally. Fluid analysis of abdominal fluid and joint fluid confirmed that it was serous fluid rich in amylase. As the patient recovered from acute pancreatitis, his joint swelling as well as the nodules faded without any treatment.
IMPLICATIONS/DISCUSSION: PPP is a triad and rare presentation of acute pancreatitis. The significance of reporting this case is twofold. The panniculitis and polyarthritis are consequences of increased concentrations of pancreatic enzymes in blood stream which lead to fat necrosis of affected tissues such as fat deposits in skin and in periarticular tissue. Therefore, these entities resolve without specific treatment and resolution of the underlying pancreatitis. Additionally in literature review, it was found that panniculitis and polyarthritis present before manifestations of pancreatitis, which can delay the diagnosis and increase mortality associated with pancreatitis. In our patient, acute pancreatitis presented first followed by these lesions.
The syndrome usually presents in men with alcohol induced pancreatitis in their fifth decade of life. Abdominal pain is uncommon as presenting complaint. In fact, arthritis is the most common initial symptom. Skin lesions present as erythematous nodules in the subcutaneous tissue often in the lower extremities. The likely pathogenesis is the systemic release of pancreatic enzymes which digest fat in affected regions. A somatostatin analog, Octreotide has shown to prevent occurrence of these lesions. The tendency of certain patients to develop panniculitis and polyarthritis might be explained by low level
of proteins which work as scavengers of these enzymes such as alpha 2 -macroglobulin and alpha 1 -antitrypsin. The prognosis in these patients is not good especially in patients with pancreatitis with one or more extra pancreatic manifestations. Therefore this constellation of extra pancreatic manifestations should not be overlooked and the treatment should be directed at the underlying pancreatic disease.
CONGENITAL CORONARY ARTERY ANOMALY shreyas saligram1;
sangeetha nathaniel2; Antony Innasimuthu1; Som Chuah3; 1University of Pittsburgh medical center, Pittsburgh, Pennsylvania ; Sri Ramachandra Medical College, Chennai, N/A ; 3Aintree university hospital, Liverpool, N/A.
(Tracking ID # 12062)
LEARNING OBJECTIVES: 1. Presence of multiple congenital coronary artery anomaly 2. Unusal causes of anginaCASE INFORMATION: A 60 year old lady was being followed up in Cardiology department for history suggestive of angina. Her risk factors for cardiovascular disease were well controlled hypertension, hypercholesterolemia, increased BMI and ex smoker. She complained of exertional chest discomfort and breathlessness on moderate physical activity. It was relieved with rest or sublingual nitrates. She denied any other symptoms. Her general and cardiovascular examination was normal. Her 12-lead EKG on admission showed some non-specific T wave changes inferiorly. She underwent exercise stress test which was terminated due to chest pain. There were no EKG changes. She underwent a coronary angiogram. It was difficult to intubate the left coronary system and hence the right coronary artery (RCA) was intubated first and it showed super dominant RCA supplying the Circumflex (Cx) territories of the heart . It was noted that there was congenital absence of Cx and Left anterior descending (LAD) artery arising from the Right sinus of valsalva (RSV). There was no significant coronary artery disease noted. The Left Ventricle (LV) gram confirmed the absence of Cx and showed that there were only RCA and LAD. IMPLICATIONS/DISCUSSION: Coronary artery anomalies have been reported with an incidence of around 1% in the general population . Coronary artery anomalies may be a part of complex congenital malformation or may be isolated. Few might present with myocardial ischemia, arrhythmias or sudden death.
The absence of Cx artery is rare, incidence is not well documented because of the rarity of the condition. Absence of Cx is usually associated with super-dominant RCA that supplies the Cx territory of the heart, as in our patient. Absence of Cx leaves a large area of heart to be supplied by the RCA making it prone for ischemia on exertion.
The incidence of LAD originating from RSV was 0.03%. The LAD in this type of anomaly can take 4 possible courses: anterior to Pulmonary artery (PA), posterior to aorta, in the intraventricular septum and in between

aorta and PA . In the absence of significant coronary artery disease the risk of sudden death is low with first 3 courses of the LAD. However, when the LAD courses between aorta and PA the incidence of sudden death is around 27%. Symptoms on exercise are probably secondary to compression of LAD during exercise.
The cause of our patients anginal symptoms was probably secondary to a combination of both the absence of circumflex and the origin of LAD from the RSV. On reviewing the literature, our patient is the first patient who has had this complex of both the anomalies together.
A SURPRISING SURVIVAL Lindsay C. Northam1; Anna R. Cook1; Theresa Townley1; 1Creighton University Medical Center, Omaha, Nebraska. (Tracking ID # 12083)
LEARNING OBJECTIVES: 1. Recognize that saddle pulmonary embolism has a wide range of clinical presentations, often present-

ing without evidence of hemodynamic instability.2. Identify non-surgical management options for hemodynamically stable patients with saddle pulmonary embolism.
CASE INFORMATION: 52 year old male with a past medical history of mental retardation, epilepsy and chronic immobility presented to the emergency room with tachypnea and tachycardia. Per report from his nursing facility, the patient had had a one day history of abnormal behavior and bluish discoloration of his fingernails. At arrival to the emergency room his oxygen saturation was 94% on room air. Heart rate was tachycardic with rates ranging from 110120. Respiratory rate was elevated at 22. Physical examination revealed no evidence of elevated jugular venous pressure. Respiratory auscultation was unremarkable. There was a slight increase in circumference of the right leg compared to the left, but distal pulses were palpable and equal bilaterally. Laboratory data revealed a D-Dimer of 4.34, CHF Peptide of 3830 and WBC 23.94 with 10% bands. ABG at arrival showed a pH of 7.44, pCO2 of 32.5, pO2 of 75.5 and a bicarbonate level of 21.
Bilateral lower extremity Doppler ultrasound diagnosed acute occlusive DVTs present in the right superficial femoral, popliteal and posterior tibial veins.
Chest CT demonstrated a central pulmonary embolism involving the main pulmonary artery. Extension was seen progressing into bilateral pulmonary arteries and the distal arteries of bilateral lungs. Peripheral opacification was seen in bilateral lung fields concerning for pulmonary infarct.
Echocardiography revealed an ejection fraction of 50-55% with grade I diastolic dysfunction. No elevation of RVSP was seen.
The patient was started on therapeutic Lovenox at a dose of 1 mg/kg BID. The patient remained hemodynamically stable with systolic blood pressures maintained above 90 mmHg. Coumadin was started on hospital day 2. The patient was discharged in stable condition on hospital day 7 with a therapeutic INR.
IMPLICATIONS/DISCUSSION: Saddle pulmonary embolism is a feared diagnosis with a significant mortality, currently estimated to have a 2 week mortality of 5.8%. Common clinical presentations often include hypoxia, chest pain and tachycardia. However, regardless of the often ominous findings seen on CT scan patients frequently remain hemodynamically stable.
Hemodynamic instability in saddle pulmonary embolism is presumed to be secondary to hypoxia caused by pulmonary artery obstruction and vasospasm. Elevation in right ventricular pressure is often seen leading to right ventricular dilatation and failure. Decreased right ventricular output can ultimately lead to left sided heart failure. It is estimated that in hemodynamically stable patients, up to 45% will have no evidence of elevation of right ventricular pressure. Often these patients have atypical or asymptomatic presentations. Short-term outcomes favor patients without right ventricular dysfunction as right ventricular failure can be associated with a two-fold increase in mortality.
In hemodynamically unstable patients current treatment guidelines support the use of thrombolytics and surgical

embolectomy. Benefit has also been seen in recent studies supporting the use of thrombolytics in hemodynamically stable patients diagnosed with submassive pulmonary embolism with right ventricular dysfunction. However, management of hemodynamically stable patients with normal right ventricular function is more of an enigma. Recent studies suggest that in this particular subset of patients the benefit of aggressive thrombolytic use continues to remain unclear. Risk versus benefit of thrombolytic use must be considered in this patient population. As the use of thrombolytics has significant side
effects physicians must consider standard anticoagulation as the treatment in this patient subset.

POST COMBAT CARE Lucille Burgo-Black1; Stephen C Hunt2; Lucille Burgo-Black3; Juliette Spelman1; 1VA Connecticut Healthcare, West Haven, Connecticut. 2VA Puget Sound, Seattle, Washington. 3VA connectict healthcare system, West Haven, Connecticut. (Tracking ID # 12088)

LEARNING OBJECTIVES: 1. Recognize and manage the basic physical, psychologcal and psychosocial concerns and risks specific to the combat Veteran. 2. Provide effective evidence based interventions with the goal of health recovery and optimal function.

CASE INFORMATION: An engaging, bright, healthy appearing 27 year old army ranger/sniper with 6 years active duty, 2 deployments to Iraq and 29 kills, was recently separated from the service for medical reasons after a year on medical hold. He carries a DoD (Department of Defense) diagnosis of chronic narcotic dependant low back pain and sciatica, poly substance abuse (pills, tobacco, ETOH, marijuana), PTSD, and mild TBI. His main issues when he presents to his local VA pain clinic are chronic low back pain with significant incapacitating flares every few months and anxiety. His treatment is started with a 1 week supply of prn Percocets and Xanax, follow-up in pain clinic and a referral to primary care. A week later he is seen for his initial visit in primary care and asks for refills of the medications prescribed in pain clinic of Percocet 46 tablets a day for pain and Xanax as needed for anxiety. His goal is for improved function. He contests his discharge diagnosis of substance abuse claiming he needs intermittent narcotics to treat his pain as nothing else works and no one to date has been willing to operate on his herniated disk. He is concerned about being labeled a drug addict, found SSRIs not helpful, mental health treatment ineffective rejects NSAIDS for pain control and needs benzodiazepines to help him sleep and stay calm. He is willing to try other modalities for his chronic pain and would like to try acupuncture and chiropractic but feels that surgery would be the most effective approach. His parents divorced when he was eight, and he is living between his parents houses but mostly on his mothers couch unable to find employment, and just lost his drivers license after a DWI. He would like to go back to school on the GI bill for his MBA if the VA could fix his back. On exam he is a healthy 27 year old with bilateral paravertebral spasm, positive right straight leg raise and weakness of R great toe extension. He screens negative for depression and denies drug use other than prescribed medication. He is given a 1 week supply of Percocet and Xanax with a 1 week primary care follow-up, a consult for neurosurgery, acupuncture and chiropractic care. He refuses mental health care. The next day the clinic gets a call that he has been admitted to a local ER with a drug overdose.

IMPLICATIONS/DISCUSSION: Over 2 million OEF/OIF military personnel have deployed to Iraq and Afghanistan since 9/11 and are seeking care at the VA and in the community. Musculo-skeletal problems with chronic pain, mental health conditions and unexplained symptoms are most prevalent. More survive their injuries but face serious long term physical consequences. There are unknown health effects from environmental exposures. We are seeing elevated rates of HTN, eating disorders in women, and elevated rates of nicotine use. The mental health risk includes anticipation of combat, combat trauma, non combat trauma, and separation from family with increased prevalence of PTSD, depression, suicide and substance abuse and readjustment challenges. Women have higher rates of depression and military sexual trauma. The psychosocial disruption of deployment has negative impacts on family and marital functioning, work and education.Care should focus on helping the combat Veteran regain physical, emotional and psychosocial well being. Expressing gratitude and acknowledging

their sacrifice helps establish connection and trust facilitating treatment engagement. Initial presentations often focus on musculoskeletal concerns but taking a military history and assessing for subclinical anxiety, anger, affect liability, relationship stress and sleep disturbances and regularly monitoring for the development/progression of substance abuse and alcohol misuse can assist in normalizing reintegration issues and aid recovery. An interdisciplinary approach to chronic pain has been shown to improve pain outcomes. Clinicians should recognize the hallmarks of PTSD: re-experiencing, avoidance and increased arousal and be judicious in assigning a diagnosis of PTSD in the initial phases of readjustment. Often, symptoms such as nightmares, irritability, or mood volatility can be relieved by addressing sleep concerns, relationship issues, and substance misuse. Data supports using prazosin as first line in treating combat related nightmares. There is much overlap of PTSD and TBI symptoms and initial treatment should address improving function rather than establishing a diagnosis. The symptom overlap and frequency of co-occurring PTSD, chronic pain, mild TBI and substance abuse have highlighted the need for inter-disciplinary, integrated care.

RAPID REVERSAL OF HEART FAILURE FROM ACIDOSIS AS EVIDENCED WITH NONINVASIVE IMAGING.

Gautam K Visweswaran1;
Edward B Lankford1; 1Penn State Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 12090)

LEARNING OBJECTIVES: 1. Need for acidosis to be considered in the differential of the acutely ill patient with cardiac pump failure.2. Utility of noninvasive imaging in the management of acute myocardial dysfunction.

CASE INFORMATION: A 43-year-old woman with a history of insulin dependent diabetes mellitus presented with a 2 day history of fatigue, malaise and syncope. Upon presentation she was obtunded requiring intubation for airway protection and respiratory support. Initial arterial pH was 6.75, bicarbonate 5 and anion gap 29. Her acidosis was corrected with aggressive hydration and intravenous insulin. She was extubated after 2 days. On the third hospital day, she became dyspneic. Physical examination revealed a new S3 gallop and pulmonary edema. Serial troponins were normal, and an echocardiogram revealed multiple regional wall motion abnormalities, moderate left ventricular dilation, and estimated EF 30%. Thyroid studies were normal and an infectious workup was negative. Cardiac MRI performed on the eighth hospital day documented complete resolution of the myocardial dysfunction. IMPLICATIONS/DISCUSSION: Acidosis as a profound myocardial depressant has been extensively researched. The decrease in contractility is mediated via 1) alteration of intracellular Ca2+ handling and 2) decreased myofilament sensitivity to intracellular Ca2+ and subsequent decreased force generation.

Intracellular acidosis longer than 3 minutes causes activation of compensatory mechanisms that cause an increase in the cytosolic and diastolic Ca2+ content. The increased cytosolic Ca2+ causes activation of the Ca2+ - Calmodulin protein Kinase II that has been shown to play pivotal roles via phosphorylation of cellular proteins to help normalize intracellular Ca2+ handling and myofilament sensitivity to Ca2+. Normalization from the inhibition of excitation-contraction coupling and recovery of myocardial force generation is hastened by aggressive medical management of acidosis.

The long term effects on ventricular myocyte function and remodeling due to repeated or prolonged episodes of acidosis have not been prospectively studied. The effects are likely detrimental.

Our case provides imaging evidence documenting the reversible cardiodepressant actions of acidosis and highlights the need for acidosis
to be considered in the differential of the acutely ill patient with cardiac pump failure.

MINOCYCLINE INDUCED DERMAL AND SCLERAL MELANOSIS

daniel martin1; nikhil kalva2; 1University of Illinois Peoria, peoria, Illinois ;
2university of illinois peoria, peoria, Illinois. (Tracking ID # 12092)

LEARNING OBJECTIVES: 1. To educate on the effects of Minocycline long term use. 2. To discuss the differential of melanosis in an elderly female.

CASE INFORMATION: While approaching a patient with a cutaneous discoloration one should not only suspect systemic diseases such as Hereditary Hemochromatosis or Addison disease but also cutaneous drug reaction. A common class of medications that can cause discoloration of dermis and mucus membranesis the tetracycline class of antibiotics (1). The most common of the tetracyclines to cause pigmentation is Minocycline, an antimicrobial often used not only for antibacterial properties but also for its anti-inflammatory and mild immunosuppressive properties. Here we report a case of extensive generalized hyperpigmentation involving the face, sclera and both the upper and lower extremities caused by prolonged use of Minocycline for control of calcinosis cutis in limited systemic sclerosis.
CASE DESCRIPTION: An 86 year old female presented to our institution with fever, chills and altered mental status. A comprehensive workup revealed an Enterococcal UTI and was treated with 10 day course of oral Amoxicillin. Her family reports that she was diagnosed with limited systemic sclerosis roughly 10 yrs ago with development of disabling calcinosis cutis for about 5 years. Minocycline 100 mg daily was prescribed for control of calcinosis cutis involving both upper extremity and trunk with some success. On exam, it was noted she had a diffuse macular bluish black discoloration of her skin involving the face, sclera and distal upper and lower extremities which has been worsening over the last 612 months. She also had sclerodactyle with loss of both hand functions with contraction. A thorough exam of the dental and oral mucosa was unremarkable for dental and oral mucosal involvement. There is no itching or pain in the involved areas. She at the time had no other organ involvement.3 PicturesIMPLICATIONS/DISCUSSION: Our patients bluish discoloration was secondary to long-term use of Minocycline. Various sites are involved such as the sclera,skin, buccal mucosa and teeth as seen in our patient. Minocycline is a lipid soluble antibiotic that is often used in treatment of acne and rosacea. Hyperpigmentation or melanosis is seen in roughly 3 5 percent of the patients with long term use with cumulative dose of greater than 100 grams. Failure to recognize this common manifestation will lead to unnecessary testing for othersystemic diseases. Typically Minocycline causes 3 patterns of involvement.
Type I is typically blue black macules localized to sites of inflammation and scarring as seen in over patient with involvement limited to the pattern consistent with limited systemic sclerosis.
Type II is typically slate gray pigmentation seen in healthy skin primarily arms,shin and ankles. This pattern of involvement was also seen in our patient involving the proximal armsType III is a muddy brown hue due to increased melanin production by the basal celllayer.
Ocular structures are also commonly seen with prolonged exposure which typically presents as bluish grey discoloration around the Limbus. There usually is no impairment in vision. This was also seen in our patient described.
Even though the pigmentation is unsightly, fortunately there are no health related consequences associated with these changes. Our patients medication was continued at her request as she felt is has

strongly controlled some of the disabling calcinosis cutis that she has had in the past
ATRAUMATIC LEFT GASTRIC ARTERY - ESOPHAGEAL FISTULA: A RARE CAUSE OF LIFE THREATENING GASTROINTESTINAL BLEEDING. Gautam K Visweswaran1; Kaveh Sharzehi1; 1Penn State Hershey Medical Center, Hershey, Pennsylvania. (Tracking ID # 12114)
LEARNING OBJECTIVES: 1. Prompt recognition of risk factors and clinical features suggestive of an arterio - esophageal fistula causing life threatening gastrointestinal bleeding.2. Utility of interventional radiological procedures in the management of fistulous gastrointestinal bleeding.
CASE INFORMATION: This was a 71 year old male admitted for confusion, hypotension and bradycardia. He had history of Boerhaaves syndrome 2 years prior, leading to the diagnosis of T3N0M0 esophageal adenocarcinoma, for which he underwent primary resection and concurrent chemo radiation. Later, he

underwent uncomplicated reconstruction of esophagogastrostomy with gastric pull up. He also has had history of ischemic cardiomyopathy with low ejection fraction and left ventricular thrombus needing chronic anticoagulation.
On admission he had a PT of 80.5 seconds, anemia, suspicious lung consolidation and an unremarkable head CT. Objective improvement was noted with aggressive fluid resuscitation. 24 hours into presentation, patient found to have melena with hemodynamic instability. Bedside nasogastric lavage returned bright red blood. Endoscopy demonstrated a pulsatile bleeding protuberance located 34 cms proximal to the intact anastomosis. Local epinephrine injection to slow the bleed and a clip placement to mark the bleeding site were undertaken. Angiography identified the bleeding vessel to be an aberrant left gastric artery with take off from the left hepatic artery which was successfully embolised with gel foam. Patient was discharged home within a few days.
IMPLICATIONS/DISCUSSION: Fistulous connections between the aorta or its major branches and the esophagus are a rare cause of catastrophic gastrointestinal bleeding. Risk factors include foreign body ingestion, pressure necrosis from prolonged nasogastric tube/oropharyngeal intubation, ulcerative carcinoma, radiotherapy, suture erosion and cardiac ablation studies eroding through the atria. Variable proportions of the CHIARIS triad consisting of a) midthoracic chest pain b) sentinel hemorrhage and c) final exsanguinations have been noted to be the initial clinical presentation. Endoscopy remains the gold standard for diagnosis with CT angiography helpful for preoperative mapping.
Arterial fistulous communications with the gastrointestinal tract are rare but are associated with very high mortality with the majority of diagnoses made post mortem. Our case represents the 1st reported case of a delayed postsurgical spontaneous left gastric artery- esophageal fistula, for which therapeutic gel foam embolisation was undertaken. A very high index of suspicion for this possibility needs to be entertained in the appropriate clinical setting to institute life saving management. Interventional radiological procedures present a viable alternative for management of small and medium caliber arterial fistulae with surgical ligation remaining definitive therapy.
NO TREATMENT PLEASE : A CHALLENGING PALLIATIVE CARE CONSULTATION Melissa Wachterman1; Melissa Wachterman1; 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 12121)
LEARNING OBJECTIVES: 1. Assess a patients medical decision-making capacity 2. Apply the principles of palliative care to a challenging case
CASE INFORMATION: A 53 year-old woman with no past medical history presented to the ED with 2 weeks of back pain, difficulty walking, and loss of vision. Head CT revealed multiple brain lesions. Chest CT revealed a5.5 cm breast mass and a T12 vertebral body metastasis, with associated soft tissue mass that appeared to extend into the spinal canal. She was seen by neurosurgery who recommended brain and spine MRIs, a loading dose of dilantin, and steroids, all of which she declined, citing the burden of undergoing diagnostic procedures or experiencing side effects from medications. She spoke articulately about her awareness that she had metastatic cancer, denied feeling depressed, shared that she was a spiritual person who had an intuitive sense that she would die soon, and asked to speak with someone about hospice. She was seen by social work, palliative care, and oncology. After being told that prognosis in metastatic breast cancer ranges widely from months to years, depending on the type, the patient expressed that even in the best case scenario of having a hormone-responsive tumor, she would not want to be treated with oral tamoxifen or palliative radiation. Throughout several conversations, she consistently expressed her desire to be at home, enjoying time with family, and not undergoing medical treatment. She was discharged to home hospice.
IMPLICATIONS/DISCUSSION: A central tenet of palliative care is its focus on engaging with patients and families to understand their goals of care and to provide care that is consistent with these goals. This case brought up the difficult issue of what to do when a patients treatment decisions diverge from what we might consider reasonable . This case was particularly challenging because there was a realistic possibility that a fairly benign diagnostic intervention (breast biopsy) could reveal a diagnosis (hormone-responsive breast

cancer) that could be treated with a well-tolerated therapy (oral tamoxifen). Even if this best case scenario were not the case, an MRI of the spine would enable evaluation for spinal cord compression, a highly morbid condition that, untreated, often leads to paralysis, which drastically worsens a patients quality of life. Treatment with palliative radiation and steroids often prevents cord compression when it is identified early. Given this, the fact that this patient wanted no further evaluation brought up the issue of capacity. Physicians have an ethical and legal responsibility to assess a patients medical decision-making capacity. To have capacity a patient must be able to: 1) communicate a choice 2) understand the relevant information 3) appreciate the situation and its consequences and 4) reason about treatment options,1 criteria that we carefully evaluated and which we felt confident she met. Returning to the central tenet of palliative care, whether an intervention is beneficial is based, in large part, on the subjective perception of the patient. Therefore, provided that a patient is informed about prognosis and treatment options and has medical decision-making capacity, honoring his/her wishes is central to the palliative care approach. 1 Appelbaum PS. Assessment of Patients Competence to Consent to Treatment. N Engl J Med 2007; 357:183440.

METASTATIC BREAST CANCER PRESENTING AS SMALL BOWEL OBSTRUCTION AND NEW ASCITES

Brandon Verdoorn1; Nicholas Orme1; 1College of Medicine - Mayo Clinic, Rochester, Minnesota. (Tracking ID # 12127)

LEARNING OBJECTIVES: 1. Evaluate new-onset ascites, particularly suspected malignant ascites. 2. Recognize an unusual presentation of metastatic breast cancer.

CASE INFORMATION: A 60 year-old woman with a history of breast cancer status-post left mastectomy and axillary lymph node dissection approximately two years prior was admitted to the hospital with nausea/vomiting, abdominal pain, diarrhea, and dehydration. She had a six month history of similar symptoms and had been diagnosed

with irritable bowel syndrome (IBS). Computed tomography (CT) imaging showed mucosal hyper-enhancement of the terminal ileum, dilated small bowel loops suggestive of obstruction, and moderate ascites. Scattered sclerotic lesions were noted in the spine and pelvis. Her bowel obstruction was managed non-operatively. She underwent paracentesis, and ascitic fluid analysis revealed 398 total nucleated cells with no neutrophils, total protein of 3.7, and albumin of 2.2. Concurrent serum albumin was 3.2. The serum-ascites albumin gradient was less than 1.1, which was inconsistent with portal hypertension, and the total protein was greater than 2.5, suggestive of an exudative process. The differential diagnosis included malignancy, infection, and pancreatic ascites. Ascitic fluid Grams stain, culture, and cytology were negative times three. Magnetic resonance enterography was performed, revealing diffuse peritoneal thickening. Due to the remote history of a positive purified protein derivative (PPD) skin test, tuberculous peritonitis was considered. Mycobacterial culture and polymerase chain reaction (PCR) on ascitic fluid were negative, and chest x-ray showed no evidence of current or past mycobacterial infection. She proceeded to diagnostic laparoscopy. Peritoneal biopsy revealed high-grade adenocarcinoma, consistent with estrogen-receptor positive carcinoma of breast origin. Unfortunately, her clinical condition deteriorated rapidly and she passed away shortly thereafter. At autopsy, metastatic breast cancer was evident throughout the skeleton, small bowel, colon, uterus, fallopian tubes, ovaries, peritoneum, and lymph nodes. IMPLICATIONS/DISCUSSION: Lobular carcinoma is the second most common histologic subtype of breast cancer, representing 5-10% of invasive cancers. While the more common ductal carcinoma most often metastasizes to lung, liver, bone, or brain, lobular carcinoma more commonly affects the gastrointestinal tract, genitourinary system, pelvic organs, and peritoneum. New gastrointestinal or pelvic symptoms in patients with a history of breast cancer, particularly of lobular subtype, should prompt evaluation for metastatic disease. Though the histologic subtype of our patients cancer was unknown, the pattern of metastasis suggested lobular carcinoma.

Malignant ascites results from peritoneal carcinomatosis, massive hepatic metastasis, or hepatocellular

carcinoma (HCC) complicating cirrhosis. The initial evaluation of ascites should include peritoneal fluid analysis, including cell count with differential (to evaluate for spontaneous bacterial peritonitis), bacterial culture, albumin, and total protein. Serum albumin should be measured to determine the serum-ascites albumin gradient (SAAG). Malignant ascites due to massive hepatic metastasis or HCC complicating cirrhosis virtually always presents with a SAAG greater than 1.1 and total protein less than 2.5, whether or not peritoneal carcinomatosis is present. Isolated peritoneal carcinomatosis typically presents with SAAG less than 1.1 and total protein greater than 2.5.

Peritoneal fluid cytology should be obtained when malignant ascites is suspected. The sensitivity of a single ascitic fluid sample is suboptimal, but increases with serial tests. In patients with peritoneal carcinomatosis, sensitivity is 83% with one sample, 93% with two samples, and 97% with three samples, according to one series. However, as illustrated in this case, cytology may be serially negative even in patients with diffuse peritoneal carcinomatosis. When suspicion for malignancy remains high, peritoneal biopsy may be warranted for definitive diagnosis.

DEADLY SCRATCH: A CASE OF ENCEPHALOPATHY Fredy Chaparro-Rojas1; Venkat Kalidindi1; 1University of Miami at FAU, Atlantis, Florida. (Tracking ID # 12128)

LEARNING OBJECTIVES: 1. Recognize cat scratch disease (CSD) can present as encephalopathy in addition to lymphadenitis and is detrimental if untreated.

2. Recognize mainstay of diagnosis of cat scratch disease is Bartonella henselae serology and most often times imaging studies do not help in diagnosis.

CASE INFORMATION: A Fifty six year old, Hispanic male, was referred to our Hospital from a regional medical center due to altered mental status. As per his wife, he was in his usual state of health until three weeks before his presentation, when he started noticing a small, round, erythematous and tender mass in his left axillary region which progressively became more edematous and tender, now associated with subjective fevers and chills. Patients wife stated that they had two cats at home. On day of presenting to the hospital his symptoms started with forgetfulness and disorientation and worsened to stupor, short term memory loss with worsening confusion. Examination revealed well demarcate local induration and a palpable hard mass in left axilla, no purulent drainage was evident. The rest of his physical exam was unre-markable. Complete blood count and comprehensive metabolic panel were both within normal limits. A CT scan of the head showed scant bilateral round cortical calcifications without perilesional edema, suggestive of a healed case of cysticercosis; a lumbar puncture was performed showing one WBC, 33 RBCs and a mildly elevated protein (83 mg/dL) with a normal glucose (72 mg/dL). The gram stain was negative for microorganism, as well as the AFB and Fungal evaluation. The cultures were negatives. An MRI/MRA of the brain was unremarkable. An electroencephalogram showed generalized slowing consistent with toxic or metabolic encephalopathy. Arboviral serologies, HSV PCR in cerebrospinal fluid and HIV ELISAwere all negative. Biopsy of the axillary mass was consistent with a necrotizing abscessiform granuloma suggestive of an infectious etiology. Gram stain, AFB smears, fungal stains and cultures were all negatives. He was started on empiric Azithromycin and serologies for Bartonella henselae, as well as PCR in biopsy specimen for Bartonella and Warthin-Starry stains. His mentation gradual improved to baseline by day five of therapy. IMPLICATIONS/DISCUSSION: Cat scratch disease (CSD) is characterized by self-limiting regional lymphadenopathy. Wide arrays of neurological manifestations are seen in patient with CSD, including encephalopathy, transverse myelitis and cerebellar ataxia. Encephalopathy usually starts between 1 and 6 weeks after the initial presenting adenopathy. CT scan of the brain usually is normal; 20-30% can have mild CSF pleocytosis and generalized slowing on the EEG (1). CSD can result from a cat scratch or bite and also flea bite. At least 3 of 4 of the following criteria are necessary to establish the diagnosis of CSD (2) :(A) Cat or flea contact regardless of the presence of an inoculation site lesion. (B)Negative serology for other causes of adenopathy; sterile pus aspirated from a node; a positive Bartonella PCR assay (C).Positive serology for B. henselae enzyme immunoassay [EIA] with a titer ratio of >1:64. (D) Biopsies showing granulomatous

inflammation or a positive Warthin-Starry stain. IFA IgG titers of Bartonella >1:256 strongly suggest active or recent infection. IgM is usually very brief and suggests acute disease (3). Our patient had exposure to cats, high EIA IgG titer of 1: 2560 and biopsy findings of sterile pus and granulomatous inflammation confirming CSD. The presence of lymphadenitis and an altered mental status must alert the clinician about a possible case of CSD. In cases of encephalopathy, antibiotics are strongly recommended. The most widely studied medication for this condition is Azithromycin. Ciprofloxacin, clartithromycin and doxycycline are also useful(4). Ref:(1)Neurologic complications of Bartonella henselae infection. Curr Opin Neurol. 1995;8(3):1649. (2)Recent Advances in Diagnosis and Treatment of Cat Scratch Disease. Curr Infect Dis Rep. 2000;2(2):141146. (3)Serological response to Rochalimaea henselae antigen in suspected cat-scratch disease. Lancet. 1992;339

(8807):14435. (4) Bartonella-associated infections.Infect Dis Clin North Am. 1998;12(1):13755

RARE ETIOLOGY OF SMALL BOWEL OBSTRUCTION Ashish Moonat1;
Akshra Verma2; Andy Arwari3; 1Southern Illinois University, Springfield, Springfield, Illinois. 2SIU, Springfield, Illinois. 3Carle Foundation Hospital, Urbana, Illinois. (Tracking ID # 12132)

LEARNING OBJECTIVES: 1. To recognize Superior Mesentric Vein thrombosis a rare but serious etiology of intestinal ischemia and to stress upon the importance of early surgical intervention.2. noneCASE INFORMATION: A 64 yr old Caucasian male with a past medical history of diabetes mellitus type 2, hyperlipidemia, bladder cancer under remission, splenectomy 30 years back secondary to trauma, presented with gradually worsening right hypochondrium and epigastric pain for five weeks. It was associated with nausea and vomiting. No association with food or any other aggravating or relieving factors could be identified. He had noted a decrease in urine output and dark colored urine for the past two days. On examination, abdomen was diffusely tender, without any rigidity or rebound. Hypoactive bowel sounds and dullness to percussion in the flanks was noted. Laboratory investigation was significant for leukocytosis of 32000/ml, acidosis and lactic acid of 6 mg/dl. Abdominal X-ray showed air fluid levels suggestive of partial small bowel obstruction. Computerized Tomography (CT) scan of abdomen showed complete occlusion of the superior mesenteric vein (SMV) by a thrombus which was extending into the portal vein. Thickening of the wall of terminal ileum was also evident on the CT scan. Tests for hypercoagulability revealed a heterozygous mutation in prothrombin gene. He was initially managed conservatively with maintenance intravenous fluids, empiric antibiotics and heparin anticoagulation. Worsening of his symptoms led to exploratory laparotomy resulting in resection of fifty centimeters of infarcted ileum. Once stable, heparin was reinitiated and later changed to warfarin prior to discharge. IMPLICATIONS/DISCUSSION: Mesenteric venous thrombosis accounts for 5 to 15 % of all mesenteric ischemic events and usually involves the superior mesenteric vein; the inferior mesenteric vein is involved only rarely. Risk factors for the development of SMV thrombosis include hypercoagulable states, portal hypertension, abdominal infections, blunt abdominal trauma, pancreatitis, splenectomy, and malignancy. Thrombus causes venous congestion in the superior mesenteric vein resulting in bowel wall edema, fluid efflux into the bowel lumen leading to systemic hypotension and decreased arterial flow resulting in bowel infarction. The clinical manifestations depend largely on the extent of the thrombus, the size of the vessel or vessels involved, and the depth of bowel-wall ischemia. When ischemia is restricted to the mucosa, the manifestations consist of abdominal pain and diarrhea; transmural ischemia leads to necrosis, with gastrointestinal bleeding, perforation, and peritonitis. This patient had multiple risk factors for SMV thrombosis including inherited hypercoagulable state (prothrombin gene mutation), splenectomy and a history of bladder cancer. Inherited thrombophilic disorders - factor V Leiden, mutation G20210A of prothrombin [PTHR A20210], and mutation TT677 of methylenetetrahydrofolate reductase [MTHFR C677T] have been identified and associated with increased risk of venous thrombosis. Prothrombin gene mutation, which leads to higher plasma prothrombin

levels, occurs in approximately 8 percent of individuals with a history of venous thrombosis, and in 2 percent of healthy controls. The identification of the inherited thrombophilias is important for correct management as these patients often need lifelong anticoagulation.

APPARENT STEMI IN A YOUNG MAN Christopher Mueller1; Kurt Pfeifer1; 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 12133)

LEARNING OBJECTIVES: 1. Distinguish acute myopericarditis from acute coronary syndrome in patients who present with chest pain, elevated cardiac enzymes, and ST elevation on electrocardiogram.2. Recognize the importance of patient characteristics when evaluating the patient presenting with acute chest pain.

CASE INFORMATION: A 21-year-old man with no previous medical problems presented with substernal, sharp, chest pain that progressed in severity over the previous two days. The pain was worsened by exertion, inspiration, and supine positioning and was not relieved with aspirin. Review of systems was significant for sore throat, subjective fever, and a non-productive cough over the past week. His physical exam was remarkable for a biphasic pericardial rub, and labs revealed an elevated troponin of 21.5 ng/mL, CK-MB of 23.5 ng/mL and white blood cell count of 14,600/uL. Initial electrocardiogram showed 2 mm ST segment elevation in leads V2-V6 and II; 1 mm ST segment elevation in leads I, III, and AVF; and 0.5 mm PR segment depression in lead I. Chest radiograph was essentially normal. Echocardiogram showed a trace pericardial effusion, normal right ventricle, and normal size left ventricle with systolic dysfunction (left ventricular ejection fraction of 33%). The patient was admitted with a diagnosis of acute myopericarditis and treatment was started with aspirin, colchicine, carvedilol and lisinopril. His chest pain markedly improved, and he was discharged home three days later. Limited echocardiogram three weeks after hospitalization showed normal left ventricular size with improvement of left ventricular ejection fraction (55%). During subsequent follow up visits, the patient noted complete resolution of chest pain and no symptoms of heart failure.

IMPLICATIONS/DISCUSSION: The triad of chest pain, elevated cardiac enzymes and ST elevation on electrocardiogram causes immediate concern for acute coronary syndrome. However, this triad is not necessarily specific for acute coronary syndrome, as it may also be present in acute myopericarditis. Myopericarditis refers to a process in which there is inflammation of both the myocardium and pericardium. The inflammatory response is usually the result of tissue damage from cardiotropic viruses. Alternatively, damage from cardiotropic viruses may induce an immune response that is responsible for continued injury even after the virus has been cleared. Distinguishing myopericarditis from acute coronary syndrome requires attention to other patient characteristics, symptoms and signs. First, young patients with no risk factors for coronary disease are more likely to have myopericarditis as a cause of this type of presentation. Recent upper respiratory tract infection symptoms and subjective fever are historical elements suggestive of a possible infectious trigger to myopericarditis. Further, chest pain that is positional is more consistent with pericardial inflammation. The presence of a pericardial friction rub, diffuse ST segment elevation, and pericardial effusion on echocardiogram are also more consistent with myopericardits. Treatment of myopericarditis is usually aimed at controlling symptoms by decreasing inflammation with non-steroidal anti-inflammatory agents. Caution should be used when considering high dose non-steroidal anti-inflammatory agents in cases with significant myocardial involvement as they may not be effective and may actually increase mortality as shown in some animal models. The lack of a reliable, non-invasive diagnostic test for myopericarditis makes natural history of the disease difficult to discern. However it seems that the prognosis is generally good with most patients regaining normal cardiac function within one year.

MENINGOCOCCEMIA WITHOUT MENINGITIS Coral Parikh1; Danit Arad1; 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 12141)

LEARNING OBJECTIVES: 1. To review the spectrum of clinical manifestations of Neisseria meningitidis 2. To recognize an unusual presenting feature of meningococcemia

CASE INFORMATION: A 26 year-old man presented with one-day of fever and sore throat. He had no prior medical conditions and a review of systems was unremarkable. The patient was monogamous with his wife and he reported no history of sexually transmitted diseases. He was in college but did not live in a dormitory. The patient was febrile to 101.6 degrees Fahrenheit but appeared well and had an otherwise normal exam. He was admitted 2 days later due to blood cultures positive for Gram-negative diplococci. Three days after the onset of symptoms, he noted swelling of multiple joints but no headache, nuchal rigidity, vomiting or photophobia. He remained febrile, coherent and had no focal neurological deficits. The neck was supple. The left shoulder and right elbow joints were warm and tender; range of motion was limited by pain and joint effusions were present. A similar finding was noted on the right third proximal interphalangeal joint. No skin lesions or urethral discharge was present.

The white blood cell count was 20 K/uL. No organisms were found on urethral culture. Treatment with ceftriaxone was initiated. The organism was subsequently identified as Neisseria meningitidis. The patient was asymptomatic by the 6th day of his illness and was discharged to complete a course of antibiotics.

IMPLICATIONS/DISCUSSION: Neisseria meningitidis is most commonly known as the second leading cause of bacterial meningitis in adults. However, the clinical manifestations of meningococcemia can be quite varied. Although meningococcal bacteremia may occasionally be transient and asymptomatic, in most individuals it is associated with fever, chills, nausea, vomiting, and myalgias. Adult patients with N. meningitidis bacteremia often have respiratory tract disease including pneumonia, sinusitis, tracheobronchitis and conjunctivitis. Approximately 10-30% of patients with meningococcal disease have meningococcemia without clinically apparent meningitis. The above patient had a favorable outcome, however, it is important to recognize that the absence of meningitis has been associated with increased mortality risk, possibly due to a delay in seeking medical treatment or a delay in the time of diagnosis. The clinical features of meningococcemia most strongly associated with a fatal outcome are shock, a purpuric or ecchymotic rash, a low or normal blood leukocyte count, an age of 60 years and older, and coma.

Arthritis, as the presenting sign, was shown to occur in only 2% of patients though 10% of patients eventually developed arthritis. Initially, a monoarthritis may raise concern for a primary purulent arthritis while a late presenting polyrthritis is thought to be due to immune complex deposition. Other uncommon manifestations include pericarditis, endocarditis and urethritis (reported in individuals who practice oral sex). Finally, chronic meningococcemia can present as a rare syndrome of episodic fever, rash, and arthralgias that can last for weeks to months. If untreated or if treated with glucocorticoids, chronic meningococcemia may evolve into meningitis, fulminant meningococcemia, or endocarditis. Recognizing the broad clinical spectrum of N. meningitidis is imperative especially because fatal disease is not always associated with the well-known meningitis.

ORAL CONTRACEPTIVE PILL INDUCED TTP Sangmesh Jabshetty1;

Nanditha Malakkla2; Vinod Khatri2; Harvey Friedman2. 1SAINT FRANCIS HOSPITAL, Evanston, Illinois. 2Saint Francis Hospital, Evanston, Illinois. (Tracking ID # 12142)

LEARNING OBJECTIVES: 1. To recognize that common drugs like OCP can be a cause of serious life threatening entity like TTP-HUS like syndrome.2. To suspect TTP-HUS syndrome early in its phase, particularly so if it has atypical presentation.

CASE INFORMATION: A 36 year old Caucasian female presented to her PMDs office with sudden onset of weakness and numbness in the right

upper extremity which lasted for 20 minutes. The patient denied weakness in other extremities, headache, visual problems, or fever. She was sent to the ER for further evaluation. In the ER the patient was alert and oriented to time, place and person and did not have focal neurological deficits. The remainder of her physical examination was normal as well. Vitals were normal. A CT scan of the head was negative for any acute intracranial pathology. Laboratory results were significant for creatinine of 3.5 mg/dl and platelets of 125 k. Her

creatinine was normal 4 months ago. The next day after admission, the creatinine increased to 4.8 mg/dl and platelets dropped further to 108 k, however, there was no change in the neurological status. The patient denied taking any medications prior to admission. The following day, the platelets further dropped to 88 k and creatinine increased to 5 mg/dl. Ultrasound of the kidney did not show any obstruction, but showed increased echotexture and decreased corticomedullary differentiation. ANCA, Antiphospholipid antibody, Protein C and S were negative. The peripheral blood smear did not show schistocytes or bite cells, but the LDH was 857 and haptoglobulin was decreased. UA showed 1+ proteinuria, no casts. At this point we suspected she had TTP and did renal biopsy which showed intracapillary glomerular thrombi, supporting the diagnosis of TTP. On further questioning she revealed that she was taking birth control pills, which she thought was irrelevant to disclose. The patient was started on plasma exchange therapy and recovered uneventfully.
IMPLICATIONS/DISCUSSION: Thromboticthrombocytopenic purpura (TTP) is a syndrome that occurs mainly in adults withmultiorgan microvascular thrombosis consisting of thrombocytopenia,microangiopathic hemolytic anemia, neurologic symptoms, renal failure, andfever. The female to male ratio is 3:2, and peak incidence occurs in the 3rddecade of life. Clinical signs are the consequence of hyaline thrombosis andocclusion of capillaries and arterioles. Literature review shows that women in particularare at an increased risk during pregnancy and during the use of OCPs. Our casedid not present with the classic pentad, which signifies that we should bevigilant in suspecting this elusive entity. This case also highlights theimportance of detailed history taking.
THE UNUSUAL SUSPECT! Salman Jamaluddin Bandeali1; Lee Lu2;
1Baylor College of Medicine, Houston, Texas. 2Baylor College of Medicine, Houston, Texas. (Tracking ID # 12144)
LEARNING OBJECTIVES: 1. Report a case of isolated native tricuspid valve endocarditis (TVE) as a cause of febrile syndrome even in the absence of predisposing factors. 2. Recognize Streptococcus Viridans as a rare cause for TVE which can lead to poor outcome.
CASE INFORMATION: A 61-year-old female with hepatitis C cirrhosis, HTN, colon CA s/p resection 15 years ago presented with a four week history of fever, anorexia, watery diarrhea, abdominal pain and vomiting. She denied IV drug use or recent dental work. Exam was remarkable for a BP of 72/56 mmHg, decreased breath sounds in right lung base, and diffuse abdominal tenderness with no shifting dullness. No murmurs were noted on cardiac exam. Laboratory studies were significant for WBC 21.6 k/mm3 with 91% neutrophils and 21% bands, Cr 2.4 mg/dl from baseline of 1.0, plt 114 K/mm3 from 256, and elevated lactic acid of 2.4 mmol/L. Chest x-ray revealed a right lower lobe infiltrate. CT of abdomen showed a redundant cecum and hydropic gallbladder without ascites. She was initially treated for presumptive pneumonia. All four bottles of blood cultures grew hemolytic streptococcus sensitive to ceftriaxone. Transthoracic echocardiography (TTE) showed a 37 mm vegetation on anterior leaflet of tricuspid valve (TV) and also a vegetation on chordae. She was diagnosed with isolated TVE with septic embolism to her right lung and was treated with

ceftriaxone. Repeat blood cultures at 48 hours were negative. She became afebrile and leucocytosis improved. After being treated with ceftriaxone for 2 weeks, she spiked fevers again. Repeat TTE showed worsened TV function with vegetations 36 x 22 mm and 22 x 6 mm respectively and a frail anterior TV leaflet causing severe regurgitation. Cardiothoracic surgery was consulted to evaluate for TV replacement, but she was deemed a poor candidate in view of her cirrhosis, thrombocytopenia, and malnutrition. Ceftriaxone was switched to IV cefepime for broader coverage. Hospital course was complicated by VRE and E.coli bacteremia, catheter related Candidemia, and necrotizing pneumonia from septic embolism. The patient remains in critical condition.
IMPLICATIONS/DISCUSSION: TVE usually occurs in the setting of IV drug abuse, in the presence of foreign

device e.g. pacemaker or congenital heart disease and accounts for only 5 % of all infective endocarditis cases. Our patient had no identifiable predisposing factors. The lower incidence of right-sided endocarditis compared with left-sided endocarditis has been attributed to the lower rate of congenital and rheumatic heart disease affecting the right-sided valves, lower right heart pressures, and the reduced right heart blood oxygen content. Staphylococcus aureus is the pathogen for 50-80% of cases of TVE. hemolytic streptococcus is the most common organism for left sided endocarditis but is uncommon in the right sided disease. There have been only two case reports of isolated tricuspid valve endocarditis from Streptococcus viridians; the first case was published in 2001 by Swiston et al. in a patient with dental abscess. The possible source of Streptococcal seeding is via dental manipulation as reported by Nandakumar et al. Right sided endocarditis frequently present with pulmonary rather than cardiac manifestations. The most common complication is septic pulmonary embolism occurring in 75% to 100% of TVE patients and is usually mistaken for pneumonia. Our patient had an atypical presentation with predominant gastrointestinal symptoms. In about three fourth of patients, TVE is treated with antibiotics for 4 to 6 weeks, but in one-fourth of individuals, surgery is mandated. Indications for surgery include decompensated right ventricular dys-function, recurrent pulmonary embolism, and presence of mobile vegetation greater than 10 mm. From the two case reports, one patient underwent TV replacement and did well, and the other became profoundly septic and succumbed. Hence, TVE should always be a consideration in any febrile syndrome with Streptococcus Viridans as a potential culprit even in the absence of predisposing risk factors.

HYPERTENSIVE CRISIS DURING MICTURITION: THE RESULT OF A BLADDER PARAGANGLIOMA Joseph D Thomas1; David Walsh1; Walter Brzezinski1. 1Medical University of South Carolina, Charleston, South Carolina. (Tracking ID # 12146)

LEARNING OBJECTIVES: 1. Recognize that paragangliomas are rare extra-adrenal catecholamine secreting tumors that present with the same type of symptoms as a pheochromocytoma. Rarely these tumors present in the bladder and patients may only have symptoms during micturition.2. Recognize that diagnosis of Pheochromocytoma/Paraganglioma is often times difficult and one definitive test for diagnosis does not exist. When clinical suspicion is high, several diagnostic tests are often required to confirm a diagnosisCASE INFORMATION: A 57 year old female with a history of diabetes, hypertension, hypothyroid presented to her PCP for headache, sweating, palpitations, dizziness, and flushing. The patient had recently been hospitalized for chest pain, and during her hospitalization she was noted to be hypertensive with systolic blood pressures in the 200s after micturition. A pheochromocytoma was suspected, so a 24-hour urine collection was done during her hospitalization. The results showed a
very minimal elevation of urinary fractionated catecholamines and urinary fractionated metanephrines. Specifically her urinary norepinephrine level was 48 (normal 045) and her urinary normetanephrine level was 438 (normal 0400). Upon follow up with her primary care physician the patient continued to complain of headache, diaphoresis, and palpitations during micturition. Therefore a resting serum meta-nephrine and catecholamine level was measured and showed a very minimal elevation in her plasma normetanephrine level (0.90, normal 00.88) and a normal norepinephrine level of 253. These levels were then compared to post-micturition levels of catecholamines and metanephrines, which were markedly increased. Her serum norepinephrine level rose from 253 before micturition to 1959, and its metabolite normetanephrine rose from 0.9 to 2.6. Her dopamine and epinephrine levels however remained within normal limits pre and post-micturition. An I-MIBG scan of the adrenals was subsequently performed but was non-diagnostic as the adrenals appeared normal and the bladder could not be evaluated because of pooling contrast. Due to continued high clinical suspicion of a catecholamine secreting tumor, an MRI of the pelvis was done which revealed a 2.3 cm x 2.1 cm x1.6 cm well circumscribed, non-enhancing mass in the posterior inferior aspect of the right bladder wall. The patient was subsequently referred to endocrinology and urology for further management. The patient eventually had the tumor resected and her symptoms resolved. IMPLICATIONS/DISCUSSION: Pheochromocytomas are

catecholamine secreting tumors most commonly found within the adrenal gland or in the trunk of the para-aortic nerve. They are rare neuroendocrine tumors derived from chromaffin cells of the adrenal medulla and sympathetic nervous system. They are generally benign with only 10-15% of the tumors being malignant. Some pheochromocytomas arise outside the adrenal gland and are termed paragangliomas. Paragangliomas of the bladder comprise less than 1% of all pheochromocytomas, and are typically diagnosed in the 4th or 5th decade of life. The most common symptoms include micturitional attacks of headache, syncope, palpitations, blurred vision, hypertension, or sweating. Diagnosis of these tumors can be challenging, and historically, many institutions relied upon measurements of 24-hour urinary excretion of catechola-mines and metanephrines as a sole method of diagnosis. More recently however, measurement of plasma metanephrines has been proposed as being a superior test. A multi-center cohort study published in 2002 found that measurement of plasma metanephrines is the best test for confirming or excluding pheochromocytoma. When applying this to a paraganglioma of the urinary bladder however, the pre and post micturition levels of plasma metanephrines and catecholamines should be compared. This is essential, as the elevated levels of the catechola-mines may only be detected during bladder contraction. Once a biochemical diagnosis of the tumor is made, an I-MIBG scan, CT, or MRI can be used for tumor localization. An I-MIBG scan is a good screening tool for extra adrenal tumors, however because the radio-nucleotides are excreted in the urine, bladder lesions may not be visualized. CT scans may detect large bladder tumors, however MRI is superior due to the typical bright appearance of the tumors on T2 weighted images. Once the tumor is localized, the definitive treatment of bladder paraganglioma is excision with partial cystectomy.

A CASE OF SILICONE PNEUMONITIS Nina Sukhrani1; Jasminka Criley1; 1St. Mary Medical Center/University of California Los Angeles, Long Beach, California. (Tracking ID # 12149)

LEARNING OBJECTIVES: 1. Recognize the pulmonary complications of silicone injections. 2.

CASE INFORMATION: A 40 year-old transexual female presented with shortness of breath which began 4 days prior to admission when she

had buttocks silicone injections. She described pleuritic chest pain associated with a non-productive cough. The patient had a history of HIV (recent CD4 600), no prior hospital admissions and had been taking antiretrovirals. She had a surgical history of breast implants and rhinoplasty. She denied smoking, alcohol and illicit drug use. On presentation, her vitals were T98 F, P99, BP108/75, R30 and O2 saturation 94% on 2LO2. She had rhonchi on lung exam. WBC was elevated at 13.6. ABG:PH7.47, pCO230, pO265, HCO321 with O2 saturation 93%. CXR showed bibasilar hypoventilatory change versus developing infiltrates. CT Angiogram was negative for PE and showed bilateral infiltrates. She was admitted to the wards and started on PCP treatment with trimethoprim/sulfamethoxazole and prednisone. Levofloxacin was initiated for CAP. Vancomycin was added on HD2 given recent injections, although there was no cellulitis or abscess at the buttocks site. Blood cultures and respiratory cultures were negative. Studies for Mycoplasma, Legionella, Chlamydia, Cryptococcus and Coccidioides were negative. Due to worsening respiratory status on HD3, patient was transferred to the ICU. Repeat ABG:PH7.46, pCO223, pO253, HCO316 with O2 saturation 90% on 40% venti-mask. CT Thorax showed severe alveolar infiltrates. She improved with BIPAP and was transferred to the wards on HD5. Treatment for PCP was discontinued as patients symptoms were more likely due to silicone pneumonitis given reported history of sudden onset after silicone injections and negative infectious work-up. She had also been on antiretrovirals and had a high CD4. At the time of discharge on HD8, infiltrates had cleared on CXR and patients symptoms had resolved. IMPLICATIONS/DISCUSSION: The case described is one of silicone pneumonitis after silicone injections for cosmetic reasons. Silicone is a liquid polymer, commonly used because of its durability, noncarcinogenic nature and lack of immunogenicity. However, pathological consequences have been reported with its use, including alveolar hemorrhage and damage, granulomatous hepatitis, silicone mastitis, lymphadenopathy, splenomegaly, acute febrile systemic reaction, neurologic dysfunction and even death.

Four histological patterns have been described for silicone lung injury including the presence of silicone emboli, congestion and alveolar hemorrhage, acute pneumonitis and diffuse alveolar hemorrhage. Acute and latent forms of pneumonitis following silicone injections have been described. The acute form occurs immediately to a few days post-injection. Patients present with sudden onset of shortness of breath, fever, hypoxemia and tachycardia. Radiographs show a bilateral alveolar pattern with patchy areas of consolidation. In contrast, the latent form appears up to 6 months after the last injection and patients present with localized swelling at the injection site and only mild respiratory symptoms.

The localized cell-mediated inflammation that occurs with the influx of neutrophils, eosinophils and alveolar macrophages plays an important role in the pathogenesis of silicone emboli syndrome. An inflammatory response is produced, activating endothelial cells, increasing capillary permeability and modulating immunoregulatory responses in the alveoli. The diagnosis of silicone embolism syndrome is confirmed by embolic vacuoles on lung biopsy specimen. Management is supportive. There is no consensus regarding corticosteroid treatment. Patients usually fully recover, but pulmonary fibrosis has been described in those who survive an acute event.

Clinicians should be aware of the complications of silicone injections. Silicone injections for cosmetic purposes should be considered a high risk procedure.

PULMONARY ACTINOMYCOSIS: A DIAGNOSTIC DILEMMA Pragya Dhaubhadel1; Frances Charlene P. Briones1; John S Schicchi2; 1Harlem Hospital Center, New York, New York ; 2Columbia University, New York, New York. (Tracking ID # 12150)

LEARNING OBJECTIVES: 1. To recognize pulmonary actinomycosis, a rare condition with clinical presentation and radiological findings mimicking other lung diseases and posing a diagnostic dilemma.2. To diagnose pulmonary actinomycosis with definitive test and initiate timely treatment.

CASE INFORMATION: A 56 year old man with no significant past medical illness presented with a five month history of cough productive of whitish sputum and low grade fever associated with chills, night sweats, weight loss and loss of appetite. He was an active smoker and emigrated from Mexico. Based on clinical grounds, immigration status and chest X-ray(CXR) findings of left upper lobe opacity with nodularity, he was started on treatment for pulmonary tuberculosis (PTB) with quadruple therapy-Rifampicin, Isoniazid, Pyrazinamide and Ethambutol (RIPE) at a New York City Department of Health (NYCDOH) clinic, even though sputum was negative for acid fast bacilli (AFB). Chest computed tomography (CT) showed spiculated opacities with a cavitary lesion in the apex suspicious for malignancy which necessitated further evaluation with bronchoscopy. Bronchoalveolar lavage (BAL) and tissue biopsy were negative for fungal or bacterial pathogens and malignancy. Serum HIV antibody test was negative. Video-assisted thoracoscopic surgery was planned. However, after seven months on PTB treatment, he presented with hemoptysis with an interval increase in size of the left upper lobe opacity on CXR. The possibilities of malignancy, multi-drug resistant PTB, fungal infections were considered but repeat bronchos-copy was again negative for AFB, fungi, malignancy, including mycobacterial polymerase chain reaction. He had persistent high grade fever, chills, and productive cough and was treated for pneumonia with no clinical response to Levofloxacin. Sputum sent for AFB, Nocardia and Actinomyces were negative. Due to frequent admissions and progression of the left upper lobe cavitary lesion, open thoracotomy with left upper lobe lobectomy was done. Lung biopsy showed pulmonary actinomycosis with characteristic granules on hematoxylin and eosin (H&E) and silver stain. PTB medications were discontinued and the patient received intravenous Penicillin for 3 weeks and was discharged home on Amoxicillin.

IMPLICATIONS/DISCUSSION: Pulmonary actinomycosis remains a diagnostic dilemma despite advancements in serologic and imaging studies. Early and accurate diagnosis prevents considerable morbidity associated with the delay of missed diagnosis. Incidence of all forms of actinomycosis has declined markedly. It is now a rare infection particularly in developed countries with the pulmonary form comprising only 14% compared to 50-60% of the cervicofacial form. It is caused by Actinomyces spp. a gram-positive, anaerobic, slow growing bacterium.

The disease shares many characteristics similar to a host of suppurative lung infections like tuberculosis and lung abscess. Because of its tendency to colonize in devitalized tissues, several cases reported finding Actinomyces spp. within necrotic neoplasms of lung, making differentiation from lung cancer difficult. The common complaints that patients present with are nonspecific and include cough, sputum production and chest pain with weight loss, fever and malaise indicative of disseminated disease. Laboratory tests and CXR are nonspecific. CT is superior to radiography showing air-space consolidation with adjacent pleural thickening but is not definitive. Fiberoptic bronchos-copy is not diagnostic and cultures sent from BAL and sputum is inadequate for diagnosis because of low yield and may represent colonization. Lung biopsy is the gold standard but should be undertaken in the least invasive way possible. If the diagnosis is suspected, special staining should to be employed. As in this case, demonstration of the characteristic sulfur granules on H&E stains from the infected tissue yield the definite diagnosis.
This should therefore be considered in the differential diagnosis in any patient with long-standing pulmonary infiltrates and timely tissue

sampling should be utilized to expedite the diagnosis of this highly
treatable condition.
SWEETS SYNDROME IN ACUTE PROMYELOCYTIC LEUKEMIA Yathreb Alaali1; Javier Munoz1; Ahmed Saeed1; Haythem Ali2; Philip Kuriakose1; 1Henry Ford Health System, Detroit, Michigan ; 2Henry Ford Health System, Detroit, Michigan. (Tracking ID # 12151)
LEARNING OBJECTIVES: 1. Sweets syndrome (SS) or acute febrile dermatitis ,might occur in malignancies, a drug-induced process, or both. We report a rare case of acute myeloid leukemia with SS during therapy with all-trans retinoic acid, while the patient was responding. 2. SS presents with fever, neutrophilia and a skin infiltrate of mature neutrophils in the upper dermis. it has been rarely associated with AML in isolated case reports, and it is even less common when the patient is neutropenic on therapy.
CASE INFORMATION: We describe the case of a 48-year-old male, presented with a cellulitis on his buttocks for the previous 2 weeks. No skin rash was seen at presentation. His labs showed pancytopenia with blasts and neutropenia (ANC 0.21 K/uL); therefore the patient was started on antibiotics and admitted for further management. Flow cytometry suggested AML of promyelocytic phenotype and fluorescent in-situ hybridization (FISH) revealed 94% of interphase cells with the translocation (t15;17) PML/RARA gene rearrangement consistent with a diagnosis of AML-M3. Bone marrow biopsy showed 68% promyelocytes with marked decrease in normal hematopoietic elements. Induction chemotherapy with ATRA, cytarabine and daunorubicin was promptly started (Table 1). The clinical course was complicated with a skin rash on day 15 of treatment that started as tender purple papules on extensor surface of his upper extremities (Figure 1) and quickly disseminated to his face, particularly on his ears (Figure 2) displaying a severely swollen pinna and almost occluded external meatus. A skin biopsy was reported as neutrophilic infiltration compatible with SS. ATRA was held on day 21 of treatment and topical/systemic steroids were started, with marked clinical improvement. Due to persistence of t15;17 by peripheral FISH, ATRA was uneventfully restarted with a 50% dose reduction. A repeat FISH and bone marrow biopsy showed no evidence of AML. Following induction chemotherapy, the patient is currently receiving consolidation therapy with arsenic trioxide, which he is tolerating well with disappearance of his skin lesions IMPLICATIONS/DISCUSSION: Dermatologic lesions occurring in a patient with leukemia is a diagnostic challenge as its presence may imply a paraneoplastic syndrome, leukemia cutis, a drug-induced phenomenon, or infection. In the first scenario, SS might be the initial sign of an undiagnosed hematologic malignancy. We are able to rule out the second scenario with pathology as leukemia cutis shows immature leukemic neutrophils and SS shows mature neutrophils. In the third scenario, SS may occur following

treatment with ATRA as it is an inducer of myeloid maturation. Atypical cells sequestered in the skin might develop into mature neutrophils of SS as a result of drug-induced differentiation. Clinicians must remain vigilant about keeping SS in mind when unusual dermatologic presentations suspected to be infectious do not respond to antimicrobial therapy. High degree of suspicion for SS will allow us to commence appropriate therapy while avoiding unnecessary additional treatments.

HOW TO MEND A BROKEN HEARTUSING CARDIAC MRI TO DIAGNOSE A CASE OF TAKOTSUBOS CARDIOMYOPATHY Sarah Schaeffer1; Jeffrey Mayne2; Sarah Moore1; 1New York University School of Medicine, New York, New York ; 2New York University Medical Center, New York, New York. (Tracking ID # 12152)

LEARNING OBJECTIVES: 1. Recognize Takotsubos cardiomyopathy as a cause of a suddenly depressed ejection fraction (EF) with otherwise
mild symptoms of Acute Coronary Syndrome (ACS), especially in female patients with severe acute illness. 2. Distinguish myocardial stunning/ hybernation seen in Takotsubos cardiomyopathy from myocardial infarction on cardiac MRI.

CASE INFORMATION: The patient is an 83-year-old female with a history of paroxysmal atrial fibrillation, carotid stenosis, and COPD secondary to chemical exposure, who presented to an outside hospital with complaints of dyspnea, productive cough, and chills for 4 days. On arrival, the patient quickly developed respiratory failure requiring intubation and was admitted to the ICU for further management. Admission labs were significant for a WBC of 12.5 and a troponin of 0.4. Initial EKG showed atrial fibrillation with no ST segment changes. The patient was managed for COPD exacerbation overnight. On hospital day 2, the patients troponin increased to2.18. Repeat EKG showed sinus rhythm with first degree AV block and T wave inversions in leads II, III, aVF, and V3-V6. ACS protocol was initiated and a TTE was performed, demonstrating a moderately depressed EF, a moderate size apical aneurysm, and hypokenisis of the LV apex, apical septum,apical inferior, anterior, and lateral walls, all consistent with apical ballooning syndrome . That evening the patient developed hypotension to 70/40,which responded to IV fluids and pressors. Given this development, the patient was transferred for further management of the NSTEMI.

On transfer, the patient was extubated without complication. Labs were notable for a downtrending troponin and repeat TTE demonstrated an EF of 25-30% with persistent apical hypokenesis and akinesis.The dyskinetic myocardium was thought to be secondary to either hibernating/stunned myocardium or infarction. A cardiac MRI (CMRI) was performed to evaluate cardiac viability. Results showed normal perfusion and confirmed apical ballooning with associated mid-apical edema, but showed no delayed enhancement to suggest myocardial fibrosis, infarction, or inflammation. Based on this imaging, the patients presentation appeared most consistent with Takotsubos cardiomyopathy.

IMPLICATIONS/DISCUSSION: Takotsubos cardiomyopathy (TC) is a transient myocardial dysfunction occurring in the absence of obstructive coronary disease.It is characterized by apical akinesis and basal hyperkinesis (apical ballooning) with most cases preceded by an acute stressor.TC predominantly affects postmenopausal women and ranges in presentation from chest pain to cardiogenic shock or,as in our case,is discovered while managing acute non-cardiac illness.The pathogenesis of TC is unknown but is thought to involve catecholamine-related myocyte dysfunction after stress.Though traditionally related to emotional stress, a recent study of 136 TC patients attributed 42% of cases to physiologic stress (Sharkey 2010).In a smaller study,82% of cases followed acute medical illness or surgery (Lee 2010).Relevant to our case, studies have also shown a strong association between acute respiratory failure and the development of TC,particularly in postmenopausal women.

Clinically,TC can mimic myocardial infarction (MI).It is important to distinguish the two,as TC resolves over time and unnecessary interventions may pose risk to the patient.CMRI used to assess myocardial viability is an excellent non-invasive way to make this distinction.In MI, the dyskinetic area of infarction shows delayed

enhancement indicating fibrosis and may also reveal abnormal perfusion or edema in an arterial distribution.In contrast, the dyskinetic myocardium in TC is stunned but viable and CMRI will show normal perfusion,diffuse edema, and no delayed enhancement, as was the case in our patient.
Our patient was medically managed for CHF with expected recovery of her EF.On further discussion with the patient and family,neither was able to identify an emotional or physical stressor prior to the event.It remains likely that the stress of a COPD exacerbation and respiratory

failure precipitated the development of Takotsubos cardiomyopathy in this patient.
THYROTOXIC HYPOKALEMIC PERIODIC PARALYSIS Rosana Ayoub1;
Nasser Mikhail2; 1Olive View Medical Center, Rolling Hills, California ;
2Olive View Medical Center, Sylmar, California. (Tracking ID # 12155)
LEARNING OBJECTIVES: 1. Although most common in Asian males, thyrotoxic hypokalemic periodic paralysis also occurs in frequently in members of the Hispanic population 2. Definitive management of thyrotoxic hypokalemic periodic paralysis involves radioactive ablation, but this may take weeks tobecome effectiveCASE INFORMATION: 35 year old Hispanic male with no past medical history presented to the ED after experiencing bilateral lower extremity weakness after awakening in the morning. The patient reported that he had been having similar symptoms for 3 years, with usual onset shortly after awaking in the morning. He denied any loss of sensation in the affected extremities, eating a high carbohydrate meal, alcholol use, heavy exercise prior to presentation, or palpitations, but reported that he had been experiencing tremors, a 40 pound weight loss, hyperdefecation, and anxiety in the past year. Upon physical examination, he had 3/5 strength in bilateral lower extremities and tremors, without any decrease in sensation, lid lag,proptosis, stare, thyroid bruit, thyroid nodules, or goiter. His TSH was below normal with an increased free T4, and a K of 2. His K was repleted with a total of KCL 40 mEq PO and 40 mEq KCl IV, and upon discharge he was given Methimazole 20 mg PO BID with Propranolol 20 mg PO BID. Four days later, this patient presented to the ED complaining of identical symptoms as his first admission,and his K was found to be 1.6, with persistently low TSH and elevated free T4. He was given a total of 120 mEq KCL (80 PO and 40 IV) with resolution of his symptoms, and was discharged with Methimazole 20 mg BID, Propranolol 40 mg PO TID, KCl 20 mEq PO BID, and a referral for thyroid uptake scan and radioactive iodine ablation. The thyroid uptake scan was performed and findings were consistent with Graves disease, and patient received 9.7 mCi of sodium iodide.Less than 3 weeks later, the patient returned to the ED with similar symptoms,and K was found to be 2.7, with undetectable TSH and increased free T4. Patient received KCL 80 mEq PO and 20 mEq IV, and resolution of symptoms occurred. He was discharged with a regimen of Methimazole and instructed to return to the ED for any recurrence of symptoms.
IMPLICATIONS/DISCUSSION: This case represents thyrotoxic hypokalemic periodic paralysis as an initial presentation of hyperthyroidism in a patient later found to have Graves disease. Although Graves disease is more common in females, thyrotoxic hypokalemic periodic paralysis is three times more common in males, especially in the Asian population. The mechanism of this disorder has not been well established, but it thought to result from a potassium shift to theintracellular space as a consequence of increased activity of the Sodium-Potassium pump and B-adrenergic hypersensitivity. In effect, the Potassium causes depolarization of the resting cell membrane which in turn renders the sarcolemma unable to be electrically excitable and paralysis ensues. Most cases of THPP occurduring periods of sleep, after consumption of excessive amounts of alcohol,after carbohydrate-rich meals, or after exercise. The diagnosis of THPP can bemade clinically, with evidence of muscle weakness especially in the lower extremities, and by laboratory evidence of hypokalemia and hyperthyroidism. Treatment of THPP involves correcting the hypokalemia to resolve the paralysis, and initiating use of a B blocker,such as propranolol, to prevent further attacks until the hyperthyroidism is managed. Although these measures represent acute treatment, there exists a high
recurrence rate of hyperthyroidism, and thus radioactive ablation is encouraged, and was the case in our

patient.
LEVAMISOLE-INDUCED AGRANULOCYTOSIS AND VASCULITIS: A REPORT OF 2 CASES AND REVIEW OF LITERATURE Asha Shrestha1;
Salaheldhin Elhamamsy1; Abdullah Chahin1; Iulia Grillo1; 1Memorial Hospital of Rhode Island, Pawtucket, Rhode Island. (Tracking ID # 12157)
LEARNING OBJECTIVES: 1. Identify levamisole-adulterated-cocaine-inducedcomplications2. Learn appropriate work-up for agranulocytosis and vasculitis CASE INFORMATION: Wediagnosed two cases of Levamisole-induced agranulocytosis and vasculitis atMemorial Hospital of Rhode Island. The first case was a 49-year-old woman witha history of hepatitis B and crack cocaine abuse. She was diagnosed to haveneutropenia six months prior to the hospital admission. She was referred frominfectious disease clinic for skin lesions on bilateral fingers and severefatigue. Review of system was negative except diffuse joint pains, oral mucosallesions, and weight loss.
Physicalexamination was unremarkable except ulceration in the oral cavity and right 5thfinger periungual area. Laboratory findings showed neutropenia, microcyticanemia, high sedimentation rate, and positive pANCA.
The second case was a 60-year-old woman with past medical history of Hepatitis Cand depression, who presented with upper and lower extremities painful rash for6 days. Review of system was otherwise negative. Physical examination revealedtachycardia, high blood pressure, and necrotic skin plaques. Laboratoryfindings were positive for leucopenia,mainly neutropenia, ANCA, ANF, elevated C1 esterase,and high sedimentation rate. Biopsy of the skin lesions showed necrotizingleukocytic vasculitis.
IMPLICATIONS/DISCUSSION: Levamisoleis an imidazothiozole anti-helminthic cholinergic agonist and immunomodulatoryagent, previously used as an adjuvant treatment to various malignancies .Levamisole has shown to increase number of circulatory natural killer (NK)cells, expression of membrane CD25 (IL2 receptor) and serum levels of solubleIL2 receptors. In vitro, it modulates NK cell-mediated tumor lysis, tumor cell MHC class I expression andIL12-dependent Th1 immune responses. Levamisole was withdrawn from US and Canada in 2000 and 2003respectively due to evidence of serious side effects. However, it was found in69% of cocaine samples seized by the US Drug Enforcement Administration wasfound to be adulterated by Levamisole. Our cases fit the clinical picture of Levamisole-induced agranulocytosis and vasculitis. Upon extensive work-up, no other causes of agranulocytosis wereidentified and skin biopsy was highly suggestive of vasculitis due tolevamisole. Both patients showed improvement after cessation of cocaine use andwith supportive therapy. Due to increasing number of the reported cases oflevamisole-adulterated-cocaine-induced complications, physicians have becomeaware of different possible clinical presentations in patients using cocaine.
EVERYTHING BY THE BOOKOR SO YOU THOUGHT Sona Bhatti1;
Japs Lee1; 1MCWAH, Milwaukee, Wisconsin. (Tracking ID # 12158)
LEARNING OBJECTIVES: 1. Identify, diagnose, and treat limited presentations of Wegeners granulomatosis.2. Recognize that absence of anti-neutrophil cytoplasmic antibody does not exclude Wegeners granulomatosis.
CASE INFORMATION: A 26-year-old Caucasian woman presented with two weeks of chest pain that was worse while lying flat and with inspiration. She also reported dyspnea on exertion, non-productive cough, fevers, and chills. She had a history of international travel, most

recently to Morocco where she participated in spelunking, and camping. Her laboratory evaluation was negative except for an elevated D-dimer. Chest CT then revealed multiple pulmonary nodules with surrounding areas of hemorrhage. CT-guided biopsy was non-diagnostic, and she was started on empiric amphotericin and levofloxacin. Her symptoms persisted and subsequent chest CT showed worsening lung nodules with

hemorrhage. Bronchoscopy with bronchoalveolar lavage was non-diagnostic. Further labs, including both protoplasmic-staining and classical anti-neutrophil cytoplasmic antibody (ANCA), continued to be non-diagnostic for infection, vasculitis, or malignancy. Finally, a video-assisted thoracic surgery was performed for lung biopsy, and the pathology showed necrotizing granulomatous inflammation consistent with Wegeners granulomatosis. The patient did not exhibit extra-pulmonary manifestations of disease. She was started on prednisone and rituximab with improvement in symptoms and lung nodules on chest radiography.
IMPLICATIONS/DISCUSSION: Wegeners granulomatosis is a rare disease characterized by granulomatous vasculitis of upper and lower respiratory tracts with glomerulonephritis. The prevalence is 3 per 100,000 and has an equal male-to-female ratio. However, the limited form, involving only the upper respiratory tract or the lung, occurs in one-fourth of cases, and these patients tend to be younger with a female predominance. These patients also develop chronic, recurrent disease and are ANCA-negative in 40% of cases. Lung involvement typically appears as multiple, bilateral, nodular cavitary infiltrates..It is important to make the diagnosis early, because it can be life-saving or organ sparing. Diagnosis is made by evidence of necrotizing granulomatous vasculitis on tissue biopsy, and treatment is with steroids and cyclophosphamide. This case demonstrates that the absence of ANCA does not exclude the diagnosis of Wegeners granulomatosis, and further evaluation with tissue biopsy is needed in cases with a higher index of suspicion.
DO NO HARM : AN ALARMING CAUSE FOR TAMPONADE Pei Chen 1;
Kristin Remus1; 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 12162)
LEARNING OBJECTIVES: 1. To recognize medications that can lead to drug-induced lupus 2. To recognize clinical manifestations and laboratory findings of anti-TNF-induced lupusCASE INFORMATION: 61 year-old female with Crohns disease and crystal arthropathy presented with worsening chest discomfort, dry cough, and persistent low grade fever up to 100.1 F. Since she has been on infliximab for the last 11 months, she has experienced recent unprovoked DVT, new anorexia, and unintentional weight loss requiring TPN. Of note, she was recently discharged with presumed pneumonia treated with antibiotics and with pseudogout flare in the shoulder treated with allopurinol and cholchicine. At that time, she was also found to have a small-to-moderate pleural effusion and pericardial effusion without evidence of cardiac tamponade on imaging. Given stable hemodynamics without pulsus paradoxus, she was treated with furosemide and fluid restriction. She re-presented 10 days later with similar symptoms, including a tugging sensation in her chest. A repeat echocardiogram showed increased pericardial effusion and evidence of cardiac tamponade. Subsequently, she developed atrial fibrillation with RVR. She underwent cardiac catheterization, which showed equalization of pressures in the RA, PCWP, and pericardial pressure at 20 mmHg, and underwent pericardiocentesis of 450 mL of serosanguinous fluid with pericardial drain placement. Pericardial fluid cytology, cultures, and additional imaging were negative for infection and malignancy. Her RF of 18, ANA titer of 1:1280, positive anti-ds DNA, anti-histone antibody of 2.7 U, as well as her constitutional symptoms, arthritis,
pleural effusion and cardiac tamponade suggest the diagnosis of infliximab-induced lupus. Infliximab was discontinued. Her pericardial effusion resolved and did not recur. Four months later, rheumatoid factor and anti-ds DNA were negative. IMPLICATIONS/DISCUSSION: Drug-induced lupus is a rare adverse effect that can develop after months to years of exposure to the offending medication. In this case, infliximab, an anti-TNF-alpha, is the cause of this patients clinical presentation. A wide variety of medications have been reported, with definitive agents being procainamide, hydralazine, minocycline, diltiazem, etc. The prevalence of clinically significant infliximab-induced-lupus is up to 1%. Currently, the mechanisms involved in drug-induced lupus are incompletely understood, but it is certain that there is genetic predisposition and enhanced autoimmunity. Diagnosis can be difficult since there are no perfect diagnostic tests or set criteria. However, based on available data, infliximab induced lupus is associated with development of ANA, anti-dsDNA antibodies, and anti-histone antibodies. Despite the presence of autoantibodies, there are often no clinically symptoms. When symptoms occur, they resemble SLE and arise with constitutional symptoms, myalgia, arthralgia, arthritis, and

pleuropericarditis. Infliximab-induced lupus is associated mostly with skin manifestation and pleuropericardial abnormalities. It is often complicated by infections. This patient had symptoms including anorexia, unintentional weight loss requiring TPN, fever, and significant arthritis. Her course was further complicated by pleural effusion, pneumonia, as well as clinically dangerous cardiac tamponade requiring emergent decompression. Fortunately, the treatment for drug-induced lupus is the discontinuation of the offending medication, in this case, infliximab. In severe cases, steroid and/or immunosuppressive therapy may be required.

A CASE OF CARDIOBACTERIUM HOMINIS SUBACUTE BACTERIAL ENDOCARDITIS PRESENTING AS SUSPECTED OCCULT MALIGNANCY Jessica Prange1; Kurt Pfeifer1; 1Medical College of Wisconsin Affiliated Hospitals, Milwaukee, Wisconsin. (Tracking ID # 12176)

LEARNING OBJECTIVES: 1. Recognize and treat Cardiobacterium hominis subacute bacterial endocarditis 2. Identify patients who would benefit from early valve repair or replacement versus medical therapy aloneCASE INFORMATION: A 66 year old Caucasian gentleman, who has not sought medical care in over twenty years, presented for evaluation of a twenty-five pound un-intentional weight loss over the past six weeks. This was associated with drenching night sweats, fatigue, and progressive dyspnea on exertion. He denied any ill contacts or past medical history with the exception of a heart murmur diagnosed in childhood not thought be associated with rheumatic fever. Two months prior to presentation he had dental bridge work done without prophylactic antibiotics. Examination revealed a pale afebrile gentleman with a 3/6 holosystolic blowing apical murmur that radiation to the axilla. No Janeway lesions, Oslers nodes, palate Petechiae, splinter hemorrhages, lymphadenopathy, JVD, lower extremity edema, or prostatic abnormalities were appreciated. Laboratory evaluation showed a normal leukocyte count and differential, microcytic normochromic anemia, elevated C-reactive protein and erythrocyte sedimentation rate. Prostate specific antigen, HIV, CEA, TSH, and hepatic function tests were normal. CT of the chest, abdomen, and pelvis revealed splenomegaly without lymphadenopathy. Transthoracic echocardiogram showed a severely dilated left atrium, thickened mitral valve with bileaflet prolapse and severe regurgitation along with a large echodensity on the posterior leaflet. Colonoscopy was performed which revealed three tubular adenomas and was otherwise unremarkable. Empiric

antibiotic coverage was initiated with vancomycin, ceftriaxone, and gentamicin. Subsequently, blood cultures from admission and daily grew Cardiobacterium hominis. Antibiotic therapy was tailored to ceftriaxone alone for a six week course. He underwent coronary angiography that showed mild luminal irregularities in all major vessels along with 60% stenosis of the second obtuse marginal. He was not felt to need urgent valve repair or replacement, and was discharged to subacute rehab. IMPLICATIONS/DISCUSSION: Cardiobacterium hominis, a member of the HACEK group of organisms, is an exceedingly rare cause of endocarditis accounting for 0.1% of all cases. It can commonly mimic signs and symptoms of an occult malignancy which makes the diagnosis particularly challenging. Medical management alone is not inferior to surgical intervention in patients with valvular abnormalities unless significant complications including decompensated heart failure,S. aureus infection, paravalvular complications, or valvular perforations are present.

STALKED BY THE WOLF Sarah Turner1; Carlos Ventura2; Sheetal Chhaya2; Thomas Ardiles2; 1St. Georges University SOM, Scottsdale, Arizona. 2Maricopa Integrated Health System, Phoenix, Arizona. (Tracking ID # 12180)

LEARNING OBJECTIVES: 1. To recognize a link between radio-frequency ablation and pulmonary renal syndrome in patients with undiagnosed SLE.2. noneCASE INFORMATION: GS, a 62-year-old Hispanic female with a PMHx of HTN, presented with abdominal bloating associated with intermittent constipation, early satiety, decreased appetite and weight gain. She also reported multiple episodes of lower GI bleeding, and mild orthopnea for 2 months. On admission she was hypertensive, afebrile, and in no acute distress. She had sublingual icterus, bibasilar rales, a distended, tender abdomen, and mild pedal edema. Lab results showed

slight transaminitis and normal creatinine, and urinalysis was significant for hematuria, 2+ protein and positive leukocyte esterase. CXR showed mild effusions, but no infiltrates. Abdominal CT showed evidence of cirrhosis, ascites, and a complex mass in the liver.
Further work up was negative for Wilsons Disease, Primary Biliary Sclerosis, Sclerosing Cholangitis, Auto-immune Hepatitis, Hemochromatosis, or infectious causes of cirrhosis. Endoscopy and colonoscopy were also negative. Liver biopsy was consistent with Hepatocellular Carcinoma (HCC). Radiofrequency ablation (RFA) was performed and 6 days later she developed progressive dyspnea and hypoxemia, rapidly progressing to respiratory failure. She was intubated and transferred to the Medical ICU; she was found to have acute renal failure, and CXR showed bilateral alveolar infiltrates. Bronchoalveolar Lavage (BAL) demonstrated diffuse alveolar hemorrhage. Pulmonary-Renal Syndrome (PRS) was suspected and she was started on high dose steroids. Renal biopsy revealed focal sclerosing glomerulonephritis with immune complex deposition. Further serology showed elevated ESR and CRP, decreased C3-C4 levels, positive ANA and dsDNA, and negative ANCA, confirming a diagnosis of SLE. In addition to steroids, she was started on Mycophenolate Mofetil and diuretics. Renal function, pulmonary infiltrates and clinical condition all improved. She was extubated and transferred out of the ICU after 5 days. The patient continues immunosuppressive treatment and outpatient follow up. IMPLICATIONS/DISCUSSION: We present this case of newly diagnosed SLE, which presented with Pulmonary-Renal Syndrome (PRS) after Radio-frequency ablation (RFA) therapy for Hepatocellular Carcinoma (HCC). Although PRS is not a specific entity, it is a syndrome that suggests a broad differential diagnosis, and thus requires a specific sequence of testing for confirmation of the etiology. The pulmonary and renal pathology consists of a small-vessel vasculitis involving arterioles, venules, and alveolar capillaries in the lungs, and a form of focal glomerulonephritis (GN) in the kidney. In order to establish this diagnosis, concomitant destructive pulmonary disease or coagulopathy should be excluded. Bronchoalveolar lavage can be used to help confirm the diagnosis of diffuse alveolar hemorrhage in patients with pulmonary infiltrates and suspected GN. Definitive diagnosis, however, may require renal biopsy with findings of GN secondary to antibody deposition. PRS is most commonly seen as a manifestation of an underlying autoimmune disorder, such as Goodpastures Syndrome, Wegeners Granulomatosis, Microscopic Polyangiitis, SLE and other connective tissue disorders. Our patient progressed to PRS shortly after treatment with RFA, and was subsequently found to have SLE, confirmed by serologies. There has been abundant research demonstrating a link between Interferon-alpha (IA) and the production of autoantibodies in SLE. IA is normally released by a variety of cells in response to viral infections or in the presence of tumor antigens, and has shown to play an important part in the bodys antitumor immune response. During RFA, the immune system is exposed to tumor antigens and cellular debris, which we hypothesize, in our patients case, resulted in the immunologic cascade of increased IA, up-regulated production of autoantibodies, and the consequent unmasking of her previously undiagnosed SLE.
THE DIZZYING TRUTH CONFIRMED BY MRI Jewel Ahmed1; Michael Ryan1; Roger D Smalligan1; 1Texas Tech University HSC, Amarillo, Texas. (Tracking ID # 12182)
LEARNING OBJECTIVES: 1. Recognize that the vestibular nerve can be seen on a contrast MRI in vestibular neuritis.2. Treat acute vestibular neuritis with IV methylprednisolone with success. CASE INFORMATION: A 49-year-old white male with a long history of heavy alcohol intake presented with a two week history of double vision, vertigo and difficulty walking. He saw double mostly when he looked to the right. On standing and walking he wobbled and swayed to the left. He had no recent head trauma, fever, viral symptoms or other illness and had abstained from alcohol for over a month (while in jail). He was on no medications. On physical exam he was alert and oriented and his vital signs, lungs, heart and abdomen were normal. On neurologic exam, extra-ocular movements were intact except that he had nystagmus when he looked to the right, no hearing deficit, normal speech, normal strength, a wide based and unsteady gait, evident dysmetria on heel-to-shin test and slight dysmetria on finger-to-nose. The remainder of the neurologic exam was normal. Labs were

normal except for the CSF which showed 24 WBCs (lymphocytes), protein 102 mg/dl and glucose 41 mg/dl. CSF cultures, VDRL, West Nile virus antibody, Herpes Simplex PCR and oligoclonal bands were all negative. Myelin basic protein level was mildly elevated. A contrast MRI of the brain showed enhancement of the vestibular nerve on the right as well as findings consistent with chronic alcoholism such as patchy hyper-intensities in the centrum semiovale, corpus callosum, internal capsule, brain stem and cerebellum. He was diagnosed with acute vestibular neuritis superimposed on an alcohol-induced neurologic syndrome. He was started on IV methylprednisolone along with thiamine, folic acid and multivitamins. By day 3 of steroid treatment the patient had no more diplopia and significant improvement of his vertigo, nystagmus and unsteady gait.
IMPLICATIONS/DISCUSSION: Vertigo is a common presenting symptom of patients in both the emergency room and in the clinic. When accompanied by nystagmus, intense nausea and vomiting along with gait disturbance, in the absence of other neurologic findings, acute vestibular neuritis is the most likely diagnosis. However, when other neurologic findings are present, as in our patient, advanced neuroima-

ging is essential to rule out other more ominous diagnoses such as a cerebellar or brainstem infarction or hemorrhage among others. Enhancement of the vestibular portion of the 8th cranial nerve has only rarely been reported in acute vestibular neuritis. Karlberg et al. described two cases of vestibular neuritis where the vestibular nerve showed enhancement with triple strength gadolinium. Our case is interesting in that the vestibular nerve clearly showed enhancement with standard strength gadolinium contrast. This enhancement supports the hypothesis of a viral or post-viral inflammatory cause of acute vestibular neuritis. Regarding treatment, one randomized prospective study showed that methylprednisolone improved peripheral vestibular function in such cases as did another study comparing methylpredniso-lone with valacyclovir. Antiviral therapy alone or in combination has not shown benefit to date. Methylprednisolone dramatically reduces vestibular symptoms, is not sedating, eliminates or reduces the need for hospitalization, and allows patients to resume normal activities more quickly. Internists are reminded to obtain an MRI in any patient where signs and symptoms may indicate something other than a peripheral problem. In addition, special attention to the vestibular portion of the 8th cranial nerve may provide added support to the diagnosis of vestibular neuritis if there is enhancement on a gadolinium contrast MRI.

A RARE CASE OF PROTON PUMP INHIBITOR INDUCED HYPOMAGNESEMIA Sangmesh Jabshetty1; Vinod Khatri2; Nanditha Malakkla2; Harvey Friedman2; 1SAINT FRANCIS HOSPITAL, Evanston, Illinois. 2Saint Francis Hospital, Evanston, Illinois. (Tracking ID # 12184)

LEARNING OBJECTIVES: 1. To be aware that widely used prescription drugs, like PPIs, can cause hypomagnesemia in long term users.2. High index of suspicion is warranted for diagnosing electrolyte abnormalities in PPI users when they present with nonspecific symptoms like fatigue.
CASE INFORMATION: A 52 year old Hispanic female was seen in our outpatient clinic for management of hypertension and diabetes of seven years. She was currently on Hydrochlorothiazide, lisinopril, and metformin. She was diagnosed with GERD around two years back and has been taking omeprazole for the last 14-16 months. At this point, she did not have any major complaints except that she felt fatigued and weak for the past few months. Her last contact with any medical care was about 8 months ago. At this visit her physical examination was within normal limits. Since it was her first visit to our clinic, we got some relevant labs. Her HbA1C was 6.6%, complete blood count was within normal limits, potassium was 3.0 mg/dl, Magnesium was 0.6 mg/dl, and calcium was 8 mg/dl. After reviewing the data and her presentation, our assessment was that she was having electrolyte imbalance secondary to hydrochlorothiazide. We discontinued the diuretic and put her on oral magnesium supplementation, and asked her to follow up in two weeks. In her next visit, the repeat magnesium was0.7 mg/dl, which led us to believe it was something other than hydrochlorothiazide which was

causing her problem. Next we suspected that it was the PPI which was causing hypomagnesemia, so we discontinued it and repeated magnesium levels after two weeks which had increased to 2.1 mg/dl. The patient said she felt much better with respect to her fatigue. Oral magnesium supplementation was stopped and her magnesium levels have remained normal. She was started on Ranitidine for her GERD, and since then she is doing fine. IMPLICATIONS/DISCUSSION: Our case had multiple causes for hypomagnesemia (diabetes, diuretic, and omeprazole). By applying Naranjo criteria the likelihood of PPI causing hypomagnesemia was probable . Our patient has been taking hydrochlorothiazide and was diabetic for the past seven years. The problem of hypomagnesemia did not respond to withdrawal of hydrochlorothiazide or to oral magnesium supplementation, but promptly corrected upon discontinuation of
omeprazole. She was lucky that she did not suffer from fatal cardiac arrhythmias. The mechanism of PPI induced hypomagnesemia is elusive. The most likely hypothesis is that it is secondary to gastrointestinal loss in genetically susceptible individuals. Renal excretion of magnesium is not defective in these patients. Literature review showed about ten case reports. We also learn from this case that a widely used, benign drug like PPI can also have serious complications.

HIV OR NOT HIV? Kanza S Abbas1; Salman Jamaluddin Bandeali2; Lee Lu1; 1Baylor College of Medicine, Houston, Texas. 2Baylor College of Medicine, Houston, Texas. (Tracking ID # 12190)

LEARNING OBJECTIVES: 1. Review conditions associated with false positive HIV ELISA and indeterminate Western blot.2. Discuss the association of hepatitis B and T-Cell Lymphoma.

CASE INFORMATION: A 55-years-old African American male with CAD and HTN presented initially with progressive leg and scrotal edema and dyspnea on exertion for 2 weeks. At that time, he denied having constitutional symptoms. Exam revealed diffuse shotty lymphadenopathy (LAD), truncal macular rash, and scrotal and 3+ pitting leg edema. Laboratory studies were significant for positive HIV (ELISA) with a CD4 count of 153, albumin 2, total protein 5.4, LDH 241, and positive Hepatitis B with PCR showing 5900 copies. Echocardiogram showed EF 60-64%. CT revealed centimetric mediastinal, axillary, abdominal, and pelvic LAD with splenomegaly. With diffuse LAD and positive HIV, an acute HIV infection was considered. However, his last sexual contact was one year ago, and he had a recent negative HIV test. HIV-1 Western blot finally returned to be indeterminate with negative p120, gp 41, p24 and undetectable HIV viral load, making HIV less likely. Further studies showed normal beta 2 microglobulin, normal SPEP, and UPEP. He was started on furosemide with resolution of edema but decided to leave against medical advice prior to excisional lymph node (LN) biopsy. One month later, patient developed glove and stocking neuropathy, foot drop, 40 lbs weight loss, fever and night sweats. He was readmitted and underwent an excisional axillary LN biopsy. The pathology was consistent with angioimmunoblastic T-cell Lymphoma. Nerve conduction studies revealed a severe, asymmetrical, predominantly axonal, sensorimotor neuropathic process affecting distal nerves with ongoing denervation and early reinnervation seen in the tibial nerve. His neuropathy was thought to be secondary to Hepatitis or T-cell lymphoma. Repeat HIV (ELISA) was negative. EBV-LMP (latent membrane protein 1) was negative. Patients final diagnosis was angioimmunoblastic T-cell Lymphoma associated with Hepatitis B. Hematology and hepatology recommended concurrent lamivudine treatment for his Hepatitis B with modified CHOP. IMPLICATIONS/DISCUSSION: The ELISA test is used to screen for HIV. However, false-positive HIV-ELISA can be associated with autoimmune diseases, renal failure, cystic fibrosis, multiple pregnancies and transfusions, liver disease, hemodialysis, vaccinations for hepatitis B, rabies, or influenza. As for indeterminate Western blot, causes include the window period, cross reaction to HIV-2 infection, and antibody reaction such as lymphoma, liver disease, or autoimmune disorders. In cases with positive HIV ELISA and indeterminate Western blot, tests should be repeated in 30 days. In our case, our patients initial HIV test results were likely due to an antibody reaction due to hepatitis B and lymphoma which initially perplexed the diagnosis.
As for hepatitis B, 350 million people worldwide are infected with it. Numerous extra-hepatic manifestations of HBV infection have been reported with polyarteritis nodosa. Although rare, chronic HBV infection is a

predisposing risk for non-hodgkins lymphoma (NHL). The mechanism of lymphomagenesis is postulated to involve chronic

stimulation of B cells in the setting of sustained liver infection. In previous years, this association was demonstrated in various small retrospective cohorts but recently, a large prospective study from South Korea showed the increased risk of NHL with hepatitis B. Concomitant treatment of hepatitis in addition to the T- cell lymphoma assists in slowing or halting the progression of viral illness and from further damaging the liver. Prognosis is poor with a median overall survival of 13 years with chemotherapy. Hence, initial manifestation of hepatitis B associated NHL might mimic an acute HIV infection with a false positive HIV ELISA and an indeterminate Western blot.

OH MY ACHING BACK! A CLASSIC DIAGNOSIS OF MULTIPLE MYELOMA. Veerawat Phongtankuel1; Lawrence Ward1; 1Temple University Hospital, Philadelphia, Pennsylvania. (Tracking ID # 12191)

LEARNING OBJECTIVES: 1. Generate an appropriate differential diagnosis for back pain.2. Recognize the common diagnostic features of Multiple Myeloma.3. Appreciate the current therapeutic options for Multiple Myeloma. CASE INFORMATION: A 54 year old male with hypertension, diabetes type II, right adrenal adenoma s/p adrenalectomy, and anxiety presented with 2 months of worsening back pain. The pain was localized to the thoracic region and described as sharp, constant, and worse with movement. The patient also reported a 10 pound weight loss over the past 6 weeks. He denied numbness, weakness, or incontinence and no neurological deficits were elicited on physical exam. Initial laboratory findings revealed a calcium level of 16.2 mg/dL, a creatinine of 3.3 mg/ dL, and a serum albumin to protein ratio of 3.3 to 12.3 gm/dL. The PSA was normal at 1.0 ng/mL. A CT of the thorax, abdomen and pelvis revealed diffuse lytic lesions of all the visualized bones, including a moderate compression fracture at T8. Additional workup included a SPEP and UPEP, which demonstrated a gamma spike of 4.5gm/dL and 79 mg/dL respectively. The serum immunofixation revealed an IgG monoclonal band. Although a blood smear appeared normal, a bone marrow biopsy showed kappa chain restricted plasmacytosis which confirmed our diagnosis of IgG kappa multiple myeloma. The patient was treated with IV fluids and pamidronate to correct his hypercalcemia. His calcium and creatinine levels returned to normal levels. The patient was started on bortezomib and dexamethasone and completed his first cycle before being discharged home. IMPLICATIONS/DISCUSSION: Back pain is a common complaint encountered in the primary care setting. The differential diagnosis for back pain is broad and can be categorized into musculoskeletal pain, infection, rheumatologic diseases, neurologic disorders, and malignancy. Obtaining a comprehensive history and physical exam is critical for diagnosis. In this case, given our patients age, recent weight loss, and worsening back pain despite conservative management, further evaluation was appropriate. When we learned that the patient had osteolytic bone lesions, hypercalcemia, and renal failure, we initiated the work up for multiple myeloma.

Multiple Myeloma is a plasma cell dyscrasia that affects 4 to 5 out of every 100,000 people in the US. The neoplastic proliferation of monoclonal plasma cells in the bone marrow can lead to anemia and immunosuppression. Upregulation of osteoclastic activity and downregulation of osteoblastic activity results in hypercalcemia and osteolytic bone lesions. In addition, light chain deposition can cause renal impairment; however monoclonal heavy chains or entire immunoglobulins may be contributing factors. Symptomatic disease requires treatment and treatment involves either chemotherapy alone or chemotherapy with hematopoietic cell transplantation (HCT). Candidacy for HCT is based on multiple factors which include age, performance status, and underlying comorbid conditions. Chemotherapy is typically initiated and followed by
early or delayed autologous HCT. This has showed to be associated with the best survival rates.

NOSOCOMIAL MALASSEZIA FURFUR FOLLICULITIS IN IMMUNCOMPROMISED PATIENTS Mohanad Ali Alfaqih1; Mohammad Alhyari1; Raid Abu-awwad2; Mohd Khushman3; Hiren Pokharna1; Marcus Zervos4; 1Henry Ford Hospital, Detroit, Michigan ; 2Henry Ford Hospital, Detroit, Michigan ; 3Henry Ford Hospital,

Detroit, Michigan ;
4Henry Ford Hospital, detroit, Michigan. (Tracking ID # 12201)
LEARNING OBJECTIVES: 1. Malassezia Furfur appears to be inadequately appreciated as a cutaneous mycosis that may cause confusion with more serious disease processes.2. The routine performanceof skin biopsy specimens and cultures should obviate any possibility of misdiagnosing this disease entity with other bacterial and fungal skininfections.
CASE INFORMATION: 27-year-old male patient whowas recently transferred to Henry Ford Hospital with respiratory distress andstridor. CT scan revealed a large cystic mass centered around the right-tracheoesophageal groove resulting in severe narrowing of the subglotticairway. He underwent rigid bronchoscopy with laser ablation and mechanicaldebulking of the tumor. Pathology revealed an immature teratoma. During hisstay in the ICU he received methylprednisone for the respiratory distress butwas discontinued prior to his discharge. After discharge, the case wasdiscussed at the multidisciplinary tumor board and hemilaryngectomy wasrecommended. He was scheduled for rib graft harvest surgery with implantationof the rib graft into the forearm in preparation of a future teratoma excisionand reconstruction. However onadmission, it was noted the patient had diffuse folliculitis of the torso withno fever, chill or other systemic manifestations and the operation wascancelled. Dermatology and Infectious disease teams were consulted to rule outan infectious process and he was placed empirically on vancomycin to cover MRSAgiven his prior hospitalization. Dermatology performed a bedside biopsy andculture of the lesions which were thought to likely be a bacterial folliculitisand on discharge, vancomycin was switched to doxycycline. After his discharge,the biopsy showed acute Malassezia furfur folliculitis and accordingly,doxycycline was switched to itraconazole and the folliculitis improved and hepursued his scheduled surgical plan. IMPLICATIONS/DISCUSSION: Malassezia furfur may develop in patients withimmunosuppression resulting from diabetes, leukaemia, Hodgkins disease,steroid treatment, bone marrow transplantation, AIDS and organ transplantation.Nosocomial Malassezia furfur folliculitis in immuncompromised patients in thesetting of steroids therapy is an infrequent nosocomial infection that wasfirst reported in 1999 by Carla Archer-Dubon, MD. Misdiagnosis this disease entity with otherbacterial and fungal skin infections can be eliminated by routine performanceof skin biopsy and cultures.
Treatment with topical application ofimidazole or selenium sulphide is usually effective in the immunocompetent host.However, in cases with extensive or recalcitrant lesions and inimmunocompromised individuals, systemic antifungal treatment with fluconazole or itraconazole isrecommended
DERMATOMYOSITIS IN A PATIENT WITH METASTATIC CHOLANGIOCARCINOMA Melissa Bachhuber1; Melissa Bachhuber1.
1San Francisco VA Medical Center, San Francisco, California. (Tracking ID # 12206)
LEARNING OBJECTIVES: 1. Identify the clinical signs and symptoms of dermatomyositis.2. Recognize the diagnostic criteria and treatment strategies for dermatomyositis, including paraneoplastic dermatomyositis.

CASE INFORMATION: A 60 year old man was diagnosed in January 2009 with advanced extrahepatic cholangiocarcinoma. He underwent chemo-therapy with gemcitabine-oxaliplatin, external beam radiation, and stereotactic radiosurgery completed in September 2009. Surveillance imaging did not show evidence of tumor recurrence at regular interval follow up. In November 2010, the patient presented for evaluation of erythematous pruritic skin lesions. He denied fevers, chills, night sweats, weight loss, oral or genital lesions, muscle weakness, or new medications. Physical examination revealed various nontender erythematous plaques on his right neck with mild erosions and crusting. The bilateral upper extremities had generalized erythema and mildly dusky plaques with central scaling and negative Nikolskys sign. A single ulcerated lesion on the lower lip was

noted. There were no ocular or genital lesions. Abdominal and neurologic exams were normal. Laboratory evaluation was notable for AST 49, ALT 33, WBC 9.1, Hgb 38, normal TSH, alkaline phosphatase, bilirubin, and creatinine. Blood cultures and skin viral cultures were negative. Skin biopsy was performed and was initially suspicious for erythema multiforme. The patient received Triamcinolone ointment, empiric Acyclovir, and oral corticosteroids were initiated when he failed to improve. At three week follow up, the patient had developed pruritic papules on his DIP and PIP joints, proximal muscle weakness, and dysphagia. Laboratory results revealed AST 88, creatine kinase 167, lactate dehydrogenase 267, and ANA 1:320. Dermatologic biopsy was rereviewed and determined to be consistent with dermatomyositis. An intraabdominal surgical pathology specimen confirmed metastatic cholangiocarcinoma. Treatment with palliative Capecitabine and concomitant corticosteroids resulted in significant improvement in the patients muscle weakness, dysphagia, and skin lesions. IMPLICATIONS/DISCUSSION: Dermatomyositis is one of the idiopathic inflammatory myopathies. Its pathogenesis involves activation and deposition of complement causing lysis of endomysial capillaries and muscle ischemia. Dermatomyositis is associated with various malignant cancers, including ovarian, lung, pancreatic, stomach, colorectal, and non Hodgkins lymphoma. As this case demonstrates, the onset or relapse of dermatomyositis warrants further evaluation for malignancy.

Diagnosis of dermatomyositis is based on clinical, histopathologic, and laboratory findings. The most common clinical sign is symmetric proximal muscle weakness. Various cutaneous manifestations include the heliotrope rash, Gottrons papules, periungual telangiectasias, erythroderma, and a scaly alopecia. Esophageal dysfunction, intersititial lung disease, and cardiac involvement may also be present. The serum creatine kinase is usually elevated up to ten times the upper limit of normal and a positive ANA is present in the majority of cases. Skin biopsy confirms the diagnosis, with lesions typically demonstrating atrophy of the epidermis and perivascular lymphoid infiltrate. EMG and muscle biopsy are also important diagnostic tests if the skin biopsy is nondiagnostic.

Recently described myositis specific autoantibodies including anti-Jo, anti-Mi2, and anti-SRP may occur in some patients with dermatomyositis, however, they are less likely in paraneoplastic disease. Importantly, detection of anti-SSA, anti-SSB, anti-Smith, or anti-RNP antibodies suggests an overlap of myositis with a connective tissue disease. Treatment of dermatomyositis involves early initiation of corticosteroids targeting improvement in clinical symptoms. For refractory cutaneous disease, methotrexate, azathioprine, or intravenous immunoglobulin can also be considered. Paraneoplastic dermatomyositis may respond to successful treatment of the underlying malignancy.

WHEN ORDINARY CELLULITIS SMELLS FISHY : SHEWANELLA PUTREFACIENS INFECTION COMPLICATING CHRONIC LYMPHEDEMA Prateek C Gandiga1; Prateek C Gandiga1; 1Georgetown University Hospital, Arlington, Virginia. (Tracking ID # 12209)

LEARNING OBJECTIVES: 1. Recognize the impact of chronic lymphedema on the pathogens potentially causing a soft-tissue infection2. Recognize Shewanella putrefaciens as an unusual gram-negative pathogen in susceptible patientsCASE INFORMATION: A 53-year-old gentleman with severe chronic lymphedema presented with several days of malaise and low-grade fevers. He had no history of diabetes mellitus or systemic immunocom-promise. Exam noted bilateral lower-extremity elephantiasis with focal soft-tissue maceration, erythema, and distinctive rotting fish odor at the lateral calf. The patient was diagnosed with cellulitis and empirically initiated on intravenous vancomycin.

Despite adequate vancomycin levels, the patient rapidly developed sepsis. Piperacillin-tazobactam treatment was added. CT imaging found no evidence of abscess or necrotizing fasciitis, but multiple blood cultures isolated Shewanella putrefaciens. The patients cellulitis and bacteremia eventually resolved with piperacillin-tazobactam therapy, and he recovered without additional incident. IMPLICATIONS/DISCUSSION: Shewanella putrefaciens is a gram-negative bacillus ubiquitous in marine environments, where it causes spoilage and the rotting fish odor of decaying seafood [1]. In humans, the organism most often causes only benign colonization.

However, multiple published reports document its potential to cause both local and systemic illness, including: cellulitis; necrotizing soft-tissue infections; intra-abdominal disease; pneumonia; and bacteremia [211]. The majority of such cases involve patients with underlying uremia, hepatobiliary disorder, or malignancy.
Chronic lymphedema, regardless of the originating etiology, causes abnormal local anatomic changes [12]. Such abnormalities predispose to chronic ulceration, dermatological pathology, and infection [13]. Importantly, gram-negative bacteria and unusual organisms may be involved in soft-tissue infections in such patients, even in the absence of systemic immunocompromise.
This case is a dramatic reminder that clinicians must consider empiric coverage against gram-negative organisms, as well as closely monitor for potential complications, when treating cellulitis in patients with chronic lymphedema.[1] Gram L, et al.; 1996. [2] Brink AJ, et al.; 1995. [3] Bulut C, et al.; 2004. [4] Chen SC, et al.; 1991. [5] Chen YS, et al.; 1997. [6] Pagani L, , et al.; 2003. [7] Pagniez H, et al.; 2005. [8] Papanaoum K, , et al.; 1998.[9] Tsai TH, , et al.; 2006. [10] Tucker C, et al.; 2010. [11] Yohe S, et al.; 1997. [12] Manduch M, et al.; 2009. [13] Dupuy A, et al.; 1999.
GETTING TO THE HEART OF STROKES. Namrita Gogia1; Swapna Kanuri1; Claire Hunter1; 1Creighton University Medical Center, Omaha, Nebraska. (Tracking ID # 12211)
LEARNING OBJECTIVES: 1. Recognize the association between migraines, cryptogenic stroke (CS) and Patent Foramen Ovale (PFO)2. Management of cryptogenic stroke associated with PFO.
CASE INFORMATION: A 41 year old Caucasian female presented to the emergency room with three day duration of worsening migraine headaches, dizziness, nausea and vertigo. She has a history of typical migraine headaches with visual aura for the last twenty years. Home medications include progesterone only contraceptives. Neurologic examination revealed left facial droop with associated sensory loss and negative gag reflex. Upper and lower extremity strength, sensation and deep tendon reflexes were intact bilaterally. Heart and lung examination were normal. She received aspirin after a negative brain CT scan. Subsequently an MRI revealed infarct in the territory supplied by the left Postero-inferior cerebellar artery. MRA revealed no significant occlusive lesions. TEE revealed a PFO and atrial septal aneurysm (ASA). Lower extremity dopplers were negative for DVT. Her hospital course was

uneventful; she was discharged to home on full dose aspirin. On subsequent follow up she opted for elective percutaneous closure. Literature search revealed an association of cryptogenic stroke with PFO and migraine with aura which were interestingly present in our patient. IMPLICATIONS/DISCUSSION: Cryptogenic strokes occur in patients less than 55 years without identifiable etiology and constitute 20% of all ischemic strokes. A higher prevalence of PFO (40-50%) was noted in these patients as compared to 20% in the general population. Small emboli can travel from legs to the right atrium across the PFO and travel to the brain and cause a stroke during straining activities. The existence of this mechanism was documented in studies by the detection of thrombus lodged in the PFO in patients with embolic events. Interestingly it was noted that patients with migraine and associated aura are four times more likely to have a PFO than the general population. It is unclear if there is a causal relationship or mere coexistence. One hypothesis suggests that passage of blood directly from the right to left atrium, bypassing the lungs, allows higher concentrations of serotonin, nitric oxide, kinins or other migraine precipitating chemicals to reach the brain and trigger migraine attacks.
In patients with cryptogenic strokes due to PFO, the annual rate of recurrence is reported to be between 1.5-12%. The size of the septal separation seen on TEE, presence of atrial septal aneurysm contributes to the increased risk. The four major treatment modalities include medical therapy (anti platelets, anti coagulants), percutaneous device closure and surgical closure. As per the ACC/AHA recommendations, for patients with an ischemic stroke or TIA and a PFO, antiplatelet therapy is reasonable to prevent a recurrent event. Warfarin is indicated in high-risk patients with underlying hypercoagulable states or history of deep vein thrombosis. PFO closure may be considered for patients with recurrent cryptogenic stroke despite optimal medical therapy. The

optimal management remains unclear due to the lack of randomized trials, which are currently in progress.
PRIMARY HODGKINS LYMPHOMA: A RARE CAUSE OF SOLITARY PULMONARY NODULE. Sangmesh Jabshetty1; Nanditha Malakkla2; Vinod Khatri3; Harvey Friedman2; 1SAINT FRANCIS HOSPITAL, Evanston, Illinois ; 2Saint Francis Hospital, Evanston, Illinois ; 3St. Francis Hospital, Evanston, Illinois. (Tracking ID # 12214)
LEARNING OBJECTIVES: 1. Primary pulmonary Hodgkins is a rare clinical entity and often diagnosed incidentally on imaging.2. - It is important to diagnose and treat the diseaseearly in its stage as it could be curable.
CASE INFORMATION: A 71 year old male presented to the outpatient clinic with exertional shortness of breath and chest pain. His past medical history was significant for hypertension, diabetes, and coronary artery disease. The patient denied any cough, fever, weight loss. On evaluation, he had a positive stress test. Subsequently the patient underwent coronary angiogram which revealed triple vessel disease. He was advised to undergo CABG. During his pre-operative evaluation, his chest x-ray showed a nodule in the upper lobe of the right lung. His physical exam was essentially normal, as was his complete blood count and basic metabolic panel. CT scan of the chest revealed a 3.3 x 4.5 cm spiculated nodule in the right upper lobe suspicious of malignancy considering his age and significant smoking history. The patients CT of abdomen and pelvis did not reveal any metastasis, lympadenopathy, hepatomegaly or splenomegaly. Along with his CABG, the patient also underwent excisional biopsy of the nodule. Surgical pathology report came back as Hodgkins lymphoma (mixed cellularity type) associated with granulomatous inflammation. Classical Reed-Sternberg cells were readily identified which were strongly positive for CD-15, CD-30 and fascin, diagnostic of the disease. Post biopsy patient also underwent PET scan, which did not reveal any residual tumor in the body. Since he did not have any B symptoms and the tumor was localized, he did not receive any radiotherapy or chemotherapy. Currently the patient is cured of Hodgkins disease and he is doing well. IMPLICATIONS/DISCUSSION: Primary pulmonary Hodgkins lymphoma (PPHL) is extremely rare. At an extranodal location such as the lung this lymphoma is likely to be confused with the more commonly occurring carcinomas at this site. In fact, when we first noticed the nodule we thought it was lung cancer, because he had a significant smoking history. This lymphoma affects women more frequently than men, and typically involves the superior portions of the lungs. Radiologically, it appears as a solitary mass or multinodular disease; inhomogeneity or cavitations of these lesions are also common. Since the presentation of this disease is nonspecific, and as noninvasive tests are rarely revealing, diagnosis requires an open thoracotomy and lung biopsy. Factors which correlate with a poorer prognosis include B symptoms, bilateral disease, multilobe involvement, penetration of the pleura, and cavitation. The staging and treatment of these lymphomas according to the extent of pulmonary involvement are recommended, as radiotherapy or combination chemo-therapy may be effective in appropriately selected patients. If diagnosed early in its stage surgery itself may be curative.
ARDS AS A POTENTIALLY AVOIDABLE COMPLICATION OF EHRLICHIOSIS INFECTION Arun Jose1; Arun Jose1; 1Johns Hopkins University School of Medicine, Baltimore, Maryland. (Tracking ID # 12217)
LEARNING OBJECTIVES: 1. Review the clinical andlaboratory manifestations of Human Monocytic Ehrlichiosis (HME) 2. Recognize the increasingincidence of Ehrlichiosis, and ARDS as a dangerous but potentially avoidablecomplication of HMECASE INFORMATION: A 25 year old male with no past medical history presented with a one week history of fever, severe headache, and myalgias. He was well until two weeks prior to admission, when he began experiencing drenching night sweats and fatigue. The patient lives in rural Southern Maryland and recalled extensively rewiring the outside of his home the previous month, but did not recall any tick or insect bites. The patient denied taking any medications. Upon admission the patient was febrile to 101.3 degrees, tachycardic at 115 bpm, and eventually requiring 100% NRB to maintain oxygen saturation at 94%. He did not have any wounds or rash and the remainder of the physical exam was unremarkable. An ABG done on 4LNC showed a pH of 7.46 and PO2 of 78. Initial laboratory tests revealed pancytopenia with WBC of

2.4 K, H/H 10.9/31.4, Platelets 89 K, as well as elevated transaminases and INR. A Chest CT revealed patchy infiltrates in the right upper and lower lung fields and left base, as well as small bilateral pleural effusions. The patients PaO2/FiO2 ratio was calculated as 236, which taken in the context of rapidly worsening hypoxia and radiological evidence suggested an evolving pulmonary process. Given the high suspicion for an infectious etiology, blood was sent for CMV, RSV, EBV, HAV, HBV, HIV RNA, HCV, Babesia Ab, Histoplasma antigen, Ehrlichia PCR and E. Caffeensis IgG, Leptospira Ab, Lyme Ab, mononucleosis screen, and blood cultures. Given the possibility of lymphoma, a peripheral smear analysis was ordered. Treatment was started empirically with IV vancomycin, piperacillin/ tazobactam, and because he lives in a tick-endemic area, doxycycline. The patient steadily improved, and by the second day of treatment he was afebrile, normoxic, and no longer pancytopenic. All microbiology tests came back negative except an E. Caffeensis IgG positive at 1:512. Thus, the patient was discharged home on oral doxycycline the following day. IMPLICATIONS/DISCUSSION: Human Monocytic Ehrlichiosis (HME) is caused by the bacteria Ehrlichia Caffeensis, and is transmitted from its animal reservoir to humans via the Lone Star tick. It is most

prevalent in the Southeastern and Mid-Atlantic states, and the highest incidences typically occur between May and August. Reported cases have been increasing annually from under 200 in 2000 to almost 600 in 2006. Symptoms manifest 710 days after the tick bite and include fever (97%), headache (80%), myalgias (57%), and arthralgias (41%). A nonspecific rash is uncommon in adults (22%). Cough and pulmonary infiltrates on radiographic studies are also sometimes present (40%). Laboratory abnormalities include leukopenia, transaminemia, and occasionally bone-marrow suppression resulting in pancytopenia. The diagnosis is primarily clinical, and confirmed by either PCR or IFA. Most disease is self-limited and mild, effectively treated with Doxycycline, but if left untreated can lead to DIC, ARDS, sepsis, and an overall mortality of 3%. In immunocompetent hosts, control of bacteria involves a vigorous immune response and granuloma formation, especially in the lungs. ARDS from Ehrlichiosis can begin with worsening hypoxemia in the setting of an initially clear CXR, which rapidly progresses to the classic presentation of bilateral infiltrates, pulmonary edema, severe hypoxemia, and death. While there have been few reported cases of Ehrlichiosis leading to pulmonary abnormalities and ARDS, this case highlights the importance of empiric antibiotic coverage of Ehrlichiosis in a patient with fever, rapidly evolving respiratory disease, and possible tick exposure. As this case demonstrates, empiric therapy with Doxycycline may be effective in preventing the evolution of lung injury in Ehrlichiosis and possibly reducing ARDS-associated mortality, an especially important concern given the rising number of Ehrlichiosis cases in the past decade and the high mortality associated with ARDS.

A 67-YEAR-OLD MAN WITH WEIGHT LOSS AND DIARRHEA Vaishali Patel1; Bryan Balmadrid1; 1Duke University Medical Center, Durham, North Carolina. (Tracking ID # 12218)

LEARNING OBJECTIVES: 1. Recognize isolated retroperitoneal lymph-adenopathy as an overlooked presentation of Whipples Disease.2. Recognize key principles of evaluation of late-onset Whipples Disease from the perspective of an internist to enable faster diagnosis and initiation of treatment.

CASE INFORMATION: A 67-year-old man presented to his primary care doctor with three months of poor appetite, weight loss, and persistent non-bloody diarrhea. He complained of fatigue and intermittent chest pain with a chronic nonproductive cough. He denied fevers, chills, or night sweats. He denied any allergies. He took no medications. He had a remote smoking history (eight pack years), but quit thirty years ago. He denied alcohol or illicit substance abuse. He lived on a farm with his wife along with cattle, goats, and several dogs and cats as pets. Travel and family history were unremarkable. Physical exam was notable for cachetic body with proximal muscle atrophy. An exhaustive outpatient workup including stress test, colonoscopy, and stool studies revealed no abnormality. He experienced severe depression and marked impairment of activities of daily living.

He was admitted to the hospital nine months after onset of symptoms due to failure to thrive and altered mental status. An abdominal CT scan revealed only retroperitoneal and mesenteric lymphadenopathy without evidence of malignancy. He ultimately underwent upper endoscopy which was macroscopically normal. A duodenal mucosal biopsy revealed small round cells of the lamina propria stained densely and coarsely for PAS. Rod shaped bacilli were seen on electron microscopy. Both findings are diagnostic of Whipples Disease.
IMPLICATIONS/DISCUSSION: Late onset Whipples disease is extremely rare. Between 1907 and 1987 there were 696 reported cases; the annual incidence since 1980 has been approximately 30 cases per year internationally. It has a predilection for males of European ancestry, farmers, or people with exposure to soil and animals. It is a systemic disease which may present only with cardiopulmonary symptoms or neurologic symptoms in more advanced cases, though it usually presents with weight loss and diarrhea. In our patient, the presentation is atypical with isolated retroperitoneal lymphadenopathy on CT. Though lymphadenopathy can be seen in up to half of the cases of Whipples disease, it is a frequently overlooked manifestation. This leads to a delay in diagnosis as duodenal mucosa may appear normal on upper endoscopy and mesenteric lymphadenopathy may be the only diagnostic tissue available at time of clinical presentation. If a PAS stain is not specifically investigated on duodenal or lymph node biopsy, the disease can go unrecognized and prove fatal. Malignancy, infections, sarcoidosis and other inflammatory conditions may present with retroperitoneal lymphadenopathy and can be ruled out by biopsy. Whipples disease should be considered with the clinical syndrome of chronic diarrhea, weight loss and retroperitoneal lymphadenopathy on imaging. Given the severity and chronicity of his symptoms, earlier hospital admission with a more efficient evaluation may have proven medically and fiscally beneficial for our patient. Faster diagnosis dramatically reduces mortality associated with Whipples Disease as symptoms regress within a few weeks of treatment initiation with antibiotics and the overall prognosis for patients is excellent.

AN UNUSUAL PRESENTATION: SHOCK LIVER WITHOUT SHOCK. Parthiv R Amin1; Sumit Kalra2; Vijay Ramu2; Thomas Roy2. 1East Tennessee State University, Johnson City, Tennessee. 2ETSU, Johnson City, Tennessee. (Tracking ID # 12222)

LEARNING OBJECTIVES: 1. To consider the diagnosis of Shock liver in patients with arterial hypoxemia even in the absence of circulatory shock.2. To learn how to make a clinical diagnosis of Shock liver or Hypoxic Liver Injury, which is common entity in critically ill patients.

CASE INFORMATION: A 60 year old male, known case of chronic obstructive pulmonary disease, atrial fibrillation and ischemic cardiomyopathy was admitted with respiratory discomfort. On admission to intensive care unit, he was hemodynamically stable but was noted to have severe arterial hypoxemia. He was diagnosed with acute exacerbation of COPD with respiratory failure. By day 3 of admission, his aminotransferases increased rapidly upto 100 times the normal with a rise in creatinine. Hypovolemia and acute heart failure were absent. Other causes of liver failure were excluded. His worsening respiratory failure was treated with mechanical ventilation and supportive measures. He began to improve clinically and his underlying respiratory failure was resolved. He was discharged 20 days after admission with normal laboratory values.

IMPLICATIONS/DISCUSSION: Shock liver or Hypoxic liver injury (HLI) is defined as a massive, but transient increase in serum transaminase levels due to an imbalance between hepatic oxygen supply and demand in the absence of other acute causes of liver damage. Low perfusion is not an absolute criterion for HLI. In some reports only approximately one-half of patients with HLI had shock.

The most common cause for HLI is insufficient hepatic perfusion secondary to any form of shock or hemodynamic instability. It can also occur in focal hypoperfusion of liver as in sickle cell anemia as well as in patients with severe respiratory failure, systemic hypoxemia, and obstructive sleep apnea.

The typical biochemical picture is rapid rise in aminotransferase levels, upto 25 to 250 times the normal occurring within 13 days. It is associated with early rapid rise in serum LDH level and the ratio of serum ALT to LDH is usually less than 1.5. Aminotransferases start to decline rapidly after 7 10 days of the initial insult which

distinguishes it from the other causes of acute hepatitis. It maybe associated with a rise in serum bilirubin upto 4 times, alkaline phosphatase upto 2 times the normal and slight elevation in prothrombin time. Accompanying evidence of end-organ hypoperfusion, especially acute tubular necrosis of the kidney favors a diagnosis of HLI.

It is imperative to distinguish HLI from other causes of acute hepatitis and other causes of liver injury which require etiology oriented management. Management of HLI is directed to treatment of the underlying precipitating factor and restoration of cardiac output to improve perfusion to liver to reduce mortality and morbidity.
HLI is a common condition affecting about 50 percent of patients in some degree during their stay in intensive care unit. However it is frequently underdiagnosed especially in rare cases like ours where patient presents with arterial hypoxemia as precipitating factor in absence of hemodynamic instability.
AN ALL-CONSUMING CASE Jonathan Thompson1; Kurt Pfeifer2; Michael Kron2; Shahryar Ahmad2; 1Medical College of Wisconsin, Germantown, Wisconsin ; 2Medical College of Wisconsin, Milwaukee, Wisconsin.
(Tracking ID # 12223)
LEARNING OBJECTIVES: 1. Recognize patients at risk for intracranial tuberculomas based on their risk factors and clinical presentation.2. Treat patients with intracranial tuberculomas quickly to prevent morbidity and mortality.
CASE INFORMATION: A 44 year old male with a history of incarceration presented with a 2 week history of headache, fever, and night sweats. He had progressive dyspnea on exertion for a month, and experienced weight loss of 30 lbs over 4 months. He denied cough and hemoptysis. He had no recent sick contacts, travel or known tuberculosis exposure.
His chest X-ray on admission showed diffuse bilateral pulmonary interstitial nodular opacities. A CT chest demonstrated diffuse bilateral interstitial nodularity with biapical bullae. He was initially admitted and treated with ceftriaxone and azithromycin for community acquired pneumonia, however, he continued to have fevers as high as 104 F. Bronchoscopy with BAL and left upper lobe transbronchial biopsy were performed. BAL AFB smear was negative, cultures failed to grow organisms, and cytology was negative for malignancy. The biopsy results simply showed acute lung injury. However, a serum quantiferon-TB test was positive. Tests for Histoplasma, Blastomyces, Pneumocystis carinii, CMV, and HIV were all negative. Given his imaging findings, clinical picture and positive quantiferon-TB test, he was started on 4-drug therapy (isoniazid, rifampin, ethambutol and pyrazinamide) on hospital day 6. Despite treatment, he continued to have high fevers and his headache acutely worsened. CSF studies from a lumbar puncture revealed: WBC 85 with 9% lymphs and 88% PMNs, protein of 70 mg/dL, and glucose of 47 mg/dL. MRI of the brain showed innumerable supra and infra-tentorial 36 mm ring enhancing lesions with surrounding edema, consistent with tuberculomas. The patient was started on IV dexamethasone for intracranial tuberculomas, and his headache resolved.
The patient was discharged on hospital day 16 with the diagnosis of miliary tuberculosis with intracranial tuberculomas. Directly Observed Therapy was initiated upon discharge. His BAL cultures eventually grew Mycobacterium tuberculosis 16 days after collection. IMPLICATIONS/DISCUSSION: CNS tuberculosis occurs in only 1% of TB cases, but it causes a significant amount of morbidity and mortality. TB meningitis accounts for the great majority of the cases of CNS TB. Although most patients who develop CNS TB are immunocompromised, up to 10% of immunocompetent patients with TB will develop CNS involvement. The pathogenesis of CNS TB involves hematogenous spread of bacilli with formation of tubercles in the CNS (Ritch focus). The focus can subsequently rupture, causing meningitis, tuberculoma or abscess depending on the original location of the tubercle. In children, tuberculomas tend to be infratentorial, while in adults, tuberculomas are typically supratentorial. In one third of patients, there are multiple tuberculomas. Patients with tuberculomas typically present with headache, seizures, and papilledema. The presentation can be subacute, taking weeks or months to manifest.

The PPD skin test is positive in 85% of patients, and 30-80% of patients will have chest x-rays indicative of pulmonary TB. CSF studies are generally unremarkable, showing increased protein. On CTand MRI of the head, the classic appearance for tuberculoma is a lesion with central calcification and peripheral ring enhancement. There may also be mass effect and surrounding edema, particularly early in the infection. Treatment for intracranial tuberculosis consists of 4-drug anti-tuberculosis chemotherapy. Surgery is reserved for medical failure or uncontrollably elevated intracranial pressure. There can be a paradoxical growth of tuberculomas after the initiation treatment; however, complete resolution of tuberculomas typically occurs within three months of treatment. Mortality was as high as 85% prior to modern-day anti-tuberculosis medications. With current medication options, mortality has dropped below 10%. Recently, studies have also indicated that steroids may improve outcomes in CNS tuberculosis.

CELIAC ARTERY ANEURYSM Arun Kanmanthareddy 1; Arun Kanmanthareddy1. 1Crozer Chester Medical Center, Upland, Pennsylvania. (Tracking ID # 12228)

LEARNING OBJECTIVES: 1. Celiac artery aneurysm is a potentially fatal aneurysm with a mortality rate of 40-100% 2. Selective repair of aneurysms >2 cm with endovascular repair carries low risk versus emergent repair after rupture.

CASE INFORMATION: We present this interesting case of a 87 year old male who was admitted to the hospital for shortness of breath. Patients comorbidities were end stage renal failure, asbestosis, atherosclerosis, coronary artery disease and atrial fibrillation. Patient was hypoxic and lung sounds were decreased on the left side. Chest X-ray showed a large left sided pleural effusion and pleural plaques. CT thorax showed a large left pleural effusion and incidental finding of celiac artery aneurysm (CAA), which was 1.9 cm in size, also present was aneurysm of the infrarenal abdominal aorta and bilateral iliac artery aneurysms. Patient did not have any symptoms of abdominal pain or mesenteric ishemia. He did not have any history of pancreatitis or endovascular infections. Atherosclerosis and smoking were the only risk factors for this patient having aneurysms. The pleural effusion was drained and empirically treated with antibiotics. He was asymptomatic from the aneurysm and the size of the aneurysm remained stable compared to his previous CT scan, therefore the patient was conservatively managed and no intervention was done on the celiac artery aneurysm and continued follow up was recommended as out patient. IMPLICATIONS/DISCUSSION: CAA is an extremely rare form of visceral artery aneurysm, its prevalence varies between 0.005% to 0.01% in the general population. Infection, congenital and developmental defects, trauma and atherosclerosis are believed to be the most common etiologies for CAA. Patients are mostly asymptomatic or present with epigastric pain, when rupture occurs they present with abdominal pain and shock. Rupture can occur into peritoneal cavity, retroperitoneum or thorax. Dissection of the celiac artery aneurysm can rarely occur and can present as end organ infarction. Pancreatitis can result from compression of the pancreatic duct; gastric varices can result from extrinsic compression of the splenic, hepatic and portal vein occlusion. Risk for rupture is directly related to the size of the aneurysm; 5% for aneurysms between 1522 mm and 50-70% for sizes greater than 32 mm. Mortality has reported to vary between 40-100%. Before the widespread availability of CT scan, majority of the cases presented as ruptured aneurysms or were seen at post mortem. Currently majority of these aneurysms are diagnosed incidentally because of increased cross sectional imaging. Ultrasound, CT scan and MRI are commonly used to diagnose these aneurysms, however arteriography remains the gold standard for diagnosis. Surgery is recommended for all symptomatic, rapidly expanding aneurysms and asymptomatic ones greater than 2 cm in diameter. Elective intervention is preferred over

emergent repair; a variety of grafts, anastomosis and stents are used for the repair of CAA. Considering the high risk of rupture and subsequent high mortality associated with it, the patients need continuos follow up.

CTscan has been most commonly used to follow up these aneurysms.

PITUITARY APOPLEXY IN A YOUNG PATIENT WITH CHRONIC HEADACHES Vrinda Agrawal1; Jaya Kothapally1; Andjela Drincic1;
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LEARNING OBJECTIVES: 1. To emphasize the selective use of magnetic resonance imaging (MRI) in patients with headaches as a tool to solidify diagnosis and to aid further management.2. To review the management of pituitary apoplexy and identify role of conservative management in neurologically intact patients.

CASE INFORMATION: A 19 year old white female with past medical history of asthma, taking oral contraception presented with the complaint of severe headaches for the past six years. She described them as throbbing, bitemporal and occurring at the frequency of one to two times per week sometimes lasting unto the second day. They were associated with visual floaters and photophobia. She had been taking acetaminophen as needed for headaches without significant relief and noticed increasing frequency and intensity of these headaches for a few months before presenting to the clinic. These headaches were then diagnosed as migraine and patient was started on sumatriptan and amityrptyline. A MRI of brain was obtained that showed sub-acute hemorrhage in the posterior adenohypophysis likely into a pre-existing pituitary adenoma. She denied any other complaints and physical examination was normal. A complete laboratory work up was done with the following results: TSH 3.01 mIU/mL (normal 0.34-5.60), FT4 0.88 ng/dL (0.6-1.6), prolactin 14 ng/mL (3.3-26.7), ACTH 23 pg/mL (658), cortisol 28.5 mcg/dL, somatomedin C 239 ng/mL (128488), LH 1.2 mIU/mL (1.2-103), FSH 1.5 mIU/mL (1.8-22.5) and estradiol 18 pg/mL (24534). Given absence of any neuro-ophthalmic signs and other complaints, conservative management was adopted. She was started on cabergoline 0.25 mg twice weekly and taken off oral contraception. Repeat pituitary function tests, in a month, remained in the normal range while repeat pituitary MRI revealed mild shrinkage in the tumor volume. IMPLICATIONS/DISCUSSION: Pituitary apoplexyis a rare clinical syndrome caused by sudden hemorrhage or infarction of thepituitary gland, usually within a pre-existing pituitary adenoma. Estrogentherapy has been reported to be a precipitating factor. MRI is an essentialtechnique to help ascertain volume and extension of the tumor, adjacent tissuecompression and to determine the age of hemorrhage. Earliest and the mostcommon symptom is headache, however, in absence of any other neurological symptomslike visual disturbances or signs of pituitary insufficiency, can be easily missedfor alternative diagnosis. Patients who remain neurologically intact can befollowed conservatively.

MULTI-LOCULATED SPONTANEOUS PNEUMOTHORAX: A RARE COMPLICATION OF PULMONARY WEGENERS GRANULOMATOSIS (WG) Vinod Khatri1; Krishna Khatri1; Sangmesh Jabshetty1; Gaurav Dagar2; Meenu Singh1; Harvey Freidman1; 1St. Francis Hospital, Evanston, Illinois ; 2Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 12239)

LEARNING OBJECTIVES: 1. Spontaneous pneumothorax in Wegeners Granulomatosis (WG) is a relatively rare complication and is attributed to rupture of a subpleural cavitary nodule. 2. Multiple loculations of pneumothorax might be a result of effective immunosuppressive therapy leading to fibrotic resolution of chronic inflammation.

CASE INFORMATION: 65 years old female was admitted with worsening shortness of breath and increasing swelling of her bilateral lower extremities. Her past medical history included hypertension, dyslipidemia, CAD, CHF, aortic stenosis (s/p mechanical valve replacement) &DVT. She was also diagnosed to have Wegeners Granulomatosis (WG) about four months prior to this admission &was on immunosuppressive therapy with cyclophosphamide and prednisone. On examination in the emergency room her vital signs revealed Temp-97.8 F, P-87/min, RR-24/min, BP-211/78 mm Hg, and O2 saturation-97%. Her chest was clear to percussion, air-entry was equal on both sides, and fine basilar crackles were heard bilaterally. Cardiac exam revealed JVD, normal S1, mechanical valve click +, no murmur. Her extremities had bilateral pitting pedal edema. On evaluation EKGs showed NSR, cardiac enzymes were negative myocardial ischemia, chest x-ray showed pulmonary vascular prominence and she had elevated BNP. The patient was initially treated for acute

decompensation of congestive heart failure. On day three of admission the patient became progressively short of breath and her chest X-ray revealed multi-loculated spontaneous pneumothorax on right side. A tube thoracostomy with a small chest tube (6 F) was done but her lung failed to expand completely. Adequate lung expansion could only be was achieved after placement of a larger chest tube (14 F). Subsequently she continued to have persistent air leak in spite of chest tube suction. A heimlich valve was attached to the chest tube for this and she was discharged to a rehabilitation facility. Three weeks later the chest was removed successfully without any further complications. IMPLICATIONS/DISCUSSION: Wegeners Granulomatosis (WG) is a form of systemic vasculitis which mainly involves the respiratory tract &kidneys and is characterized by necrotizing, granulomatous inflammation. Pulmonary lesions can present as single or multiple nodular infiltrates. Spontaneous pneumothorax in WG is relatively rare and is generally attributed to rupture of a subpleural cavitary nodule. Multiple loculations seen in this case may be a result of effective immunosuppressive therapy leading to fibrotic resolution of chronic inflammation. Tube thoracostomy is the preferred treatment and leads to lung expansion &cessation of the air leak in most patients. Failure of the pneumothorax to resolve should prompt the initiation of suction. For patients who have a persistent air leak and whose lung is less than 90 percent expanded, the preferred procedure is video assisted thoracoscopy (VATS). Stable patients who have a persistent air leak but good lung expansion may be discharged after attaching a Heimlich valve to the chest tube with essentially no morbidity.

EXPLORING EDEMA Raid Abu-Awwad1; Mohanad Ali Alfaqih2; Mohammad Alhyari2; Mohd Khushman2; Kelly Caverzagie2; 1Henry Ford Hospital, Detroit, Michigan ; 2Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 12244)

LEARNING OBJECTIVES: 1. Understanding the pathophysiology of edema in adults is apowerful skill that is needed by every internist to diagnose and treat this common entity.2. The central nature of the hypothyroidism as a diagnostic clue for hypopituitarism.

CASE INFORMATION: 47 year old male patient, with a past medical history of morbid obesity, obstructive sleep apnea and hypertension, presented with gradually progressive bilateral pitting lower extremity edema over the last few months. The edema was associated with exertional dyspnea, fatigue and weight gain. Examination showed no evidence of jugular venous distension, clear chest to auscultation, unremarkable cardiac exam and symmetrical, bilateral, lower extremity edema. Chest X ray showed no vascular congestion or pleural effusion. 2D echocardiogram showed a preserved ejection fraction and pulmonary artery pressure of 10 mmHg. Kidney function test showed no evidence of renal failure and urinalysis was negative for protein. Liver ultrasound showed no evidence of cirrhosis and lower extremity Doppler ultrasound showed no evidence of deep venous thrombosis. After excluding common causes of edema, thyroid function test was done and it showed findings consistent with

central hypothyroidism. Further evaluation of the pituitary gland showed normal prolactin and low adrenocorticotropic hormone (ACTH), Cortisol, follicular stimulating hormone (FSH) and luteinizing hormone (LH). Accordingly, brain magnetic resonance imaging (MRI) was done and showed pituitary macroadenoma. Visual field was evaluated by the ophthalmology team and was intact. Neurosurgery team recommended elective trans-sphenoidal resection of the pituitary adenoma. The patient was started on prednisone followed by levothyroxine and he started to lose weight gradually and his edema improved. IMPLICATIONS/DISCUSSION: Myxedema occurs in severe hypothyroidism and may be generalized. It results from infiltration of the skin with glycosaminoglycans with associated water retention and low to normal lymphatic flow. The diagnosis is established by thyroid function test, and the treatment is hormone replacement as opposed to diuresis. In this case, we illustrate how understanding the pathophysiology of edema along with comprehensive work up was successful to diagnose and treat this common clinical entity. Moreover, the central nature of the hypothyroidism was a key to diagnose hypopituitarism which did not present itself through the other hormonal deficiencies.

AN UNUSUAL ETIOLOGY OF PERSISTENTLY ELEVATED PANCREATIC ENZYMES Ashish Moonat1; Akshra Verma2; Davendra P Ramkumar3;
1Southern Illinois University, Springfield, Springfield, Illinois ;
2Southern Illinois University, Springfield, Illinois ; 3Christie Clinic, Champaign, Illinois. (Tracking ID # 12249)
LEARNING OBJECTIVES: 1. To recognize unusual etiologies of persistent pancreatic enzymes elevation.2. To promptly treat these etiologies since causes such as periampullary cancer, once metastasized, have a high mortality and are not amenable to a definitive treatment.
CASE INFORMATION: A 79-year-old Caucasian woman presented to the emergency room with two week history of progressively increasing nausea, vomiting and retching. She denied any abdominal pain, fever, acid reflux, heartburn, hematemesis, diarrhea or constipation but her appetite had remarkably decreased. Her surgical history included three cesarean sections, hysterectomy and a normal colonoscopy 20 years ago. Significant medications included alendronate for osteoporosis, daily aspirin and naproxen as needed. She denied any smoking or alcohol use. Her physical examination was completely normal. Laboratory investigations revealed a normal complete blood count and comprehensive metabolic panel. Her amylase and lipase were elevated at 391 units/L and 2520 units/L respectively. Computerized tomography (CT) scan of abdomen demonstrated mild fat stranding around the tail of the pancreas and dilated pancreatic duct. Ultrasound revealed no gallstones or dilatation of common bile duct (CBD). She was managed conservatively with nil-per-oral status and intravenous fluids for six days but elevations in amylase and lipase persisted and mild elevation of bilirubin (1.8 mg/dl) was also noted. Magnetic resonance cholangio-pancreatography (MRCP) was then performed that showed a prominent pancreatic duct with a filling defect at the ampulla of vater. Endoscopic retrograde cholangio-pancreatography (ERCP) was planned next. On endoscopy, an ulcerated mass was noted in the second part of the duodenum which on biopsy was found to be a periampullary adenocarcinoma with some duodenal glands. CT chest, performed for staging revealed lung nodules and mediastinal lymphadenopathy. The lymph nodes were biopsied and found to have adenocarcinoma of gastrointestinal origin, thereby confirming metastatic disease. ERCP with CBD stent placement was performed. She also underwent stent placement in the duodenum to relieve gastric outlet obstruction. She was then started on chemotherapy with gemcitabine. IMPLICATIONS/DISCUSSION: Periampullary tumors are relatively rare neoplasms with an incidence of approximately 0.5% of all
gastrointestinal tract malignancies. They arise in the vicinity of the ampulla of Vater and originate from the pancreas, duodenum, distal CBD, or the structures of the ampulla of Vater complex. Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute indicates adenocarcinoma is the most frequently identified histology for ampullary cancer. These tumors obstruct the flow in the pancreatic duct and CBD causing their dilatation and elevation of amylase/lipase, bilirubin and alkaline phosphatase. Management of these tumors involves surgical resection (Whipples procedure) or chemotherapy. Hepatic metastasis, serosal implants, ascites, lymph node involvement outside the resectional field, and major vessel invasion all are contraindications to surgical resection. Our patients tumor appeared to be primary ampullary cancer based on the biopsy findings but definite diagnosis required surgical resection. However, she had metastatic disease and was not a surgical candidate and therefore underwent chemotherapy.
THE GATHERING STORM: A CASE OF FEVER AND NECK PAIN Seth Berkowitz1; Kara Bischoff1; Stephanie Rennke2; Niraj Sehgal3; 1UCSF, San Francisco, California ; 2University of California, San Francisco, San Francisco, California. (Tracking ID # 12256)
LEARNING OBJECTIVES: 1. Diagnose an unusual complication of endocarditis2. Recognize how different etiologies of thyrotoxicosis affect management CASE INFORMATION: A 47-year-old man with a history of ulcerative colitis (UC) was admitted for malaise, fever, and neck pain. On arrival he was ill-appearing, febrile (39.2C), hypotensive (80/63 mmHg), and tachycardic (163 bpm) with an exam notable for anterior neck tenderness and diffuse thyromegaly. Of note, the patient was hospitalized the previous month for UC-related

hemorrhagic proctitis, during which time he had a peripherally inserted central catheter (PICC) placed and then removed prior to discharge.
Initial management focused on volume resuscitation, initiation of broad-spectrum antibiotics, and urgent evaluation for sources of infection. CT neck showed an enlarged, heterogeneous thyroid. He had a TSH of 0.08 mIU/L (0.4-4)and a free T4 of 47 pmol/L (924). Blood cultures grew methicillin-resistant Staphylococcus aureus (MRSA), which prompted an echocardiogram revealing vegetations on the aortic valve. He was diagnosed with acute suppurative thyroiditis, likely a result of septic emboli to his thyroid from MRSA endocarditis. His recent PICC line was a key risk factor. On hospital day three he developed new altered mental status and hypertension. Repeat free T4 was above the assay maximum. His presentation was now most consistent with thyrotoxic crisis, which resolved after treatment with corticosteroids and propranolol. Though he improved clinically, a thyroid ultrasound done for persistent leukocytosis showed an abscess. This was successfully managed with percutaneous drainage and did not require surgical intervention. The patient ultimately developed hypothyroidism requiring oral replacement therapy, but he recovered well and was discharged to a skilled nursing facility for reconditioning. IMPLICATIONS/DISCUSSION: Acute suppurative thyroiditis is a bacterial infection of thyroid tissue, most commonly caused by Staphylococcus aureus. Though it more often occurs in children with congenital connections between the thyroid and oropharynx, it is also recognized as an uncommon complication of bacteremia. Inflammation causes release of pre-formed thyroid hormone in a TSH-independent manner and in rare cases this leads to thyrotoxic crisis. Because the hormone is pre-formed, thyrosuppressive medications are unnecessary. While traditionally treated with surgical debridement, recent case series demonstrate that conservative management with antibiotics and percutaneous drainage can be successful. Hypothyroidism is a common late complication.

THE GATHERING STORM: A CASE OF FEVER AND NECK PAIN Seth Berkowitz 1; Kara Bischoff 1; Stephanie Rennke 2; Niraj Sehgal3. 1UCSF, San Francisco, California ; 2University of California, San Francisco, San Francisco, California. (Tracking ID # 12256)
LEARNING OBJECTIVES: 1. Diagnose an unusual complication of endocarditis2. Recognize how different etiologies of thyrotoxicosis affect management CASE INFORMATION: A 47-year-old man with a history of ulcerative colitis (UC) was admitted for malaise, fever, and neck pain. On arrival he was ill-appearing, febrile (39.2C), hypotensive (80/63 mmHg), and tachycardic (163 bpm) with an exam notable for anterior neck tenderness and diffuse thyromegaly. Of note, the patient was hospitalized the previous month for UC-related hemorrhagic proctitis, during which time he had a peripherally inserted central catheter (PICC) placed and then removed prior to discharge.
Initial management focused on volume resuscitation, initiation of broad-spectrum antibiotics, and urgent evaluation for sources of infection. CT neck showed an enlarged, heterogeneous thyroid. He had a TSH of 0.08 mIU/L (0.4-4)and a free T4 of 47 pmol/L (924). Blood cultures grew methicillin-resistant Staphylococcus aureus (MRSA), which prompted an echocardiogram revealing vegetations on the aortic valve. He was diagnosed with acute suppurative thyroiditis, likely a result of septic emboli to his thyroid from MRSA endocarditis. His recent PICC line was a key risk factor. On hospital day three he developed new altered mental status and hypertension. Repeat free T4 was above the assay maximum. His presentation was now most consistent with thyrotoxic crisis, which resolved after treatment with corticosteroids and propranolol. Though he improved clinically, a thyroid ultrasound done for persistent leukocytosis showed an abscess. This was successfully managed with percutaneous drainage and did not require surgical intervention. The patient ultimately developed hypothyroidism requiring oral replacement therapy, but he recovered well and was discharged to a skilled nursing facility for reconditioning. IMPLICATIONS/DISCUSSION: Acute suppurative thyroiditis is a bacterial

infection of thyroid tissue, most commonly caused by Staphylococcus aureus. Though it more often occurs in children with congenital connections between the thyroid and oropharynx, it is also recognized as an uncommon complication of bacteremia. Inflammation causes release of pre-formed thyroid hormone in a TSH-independent manner and in rare cases this leads to thyrotoxic crisis. Because the hormone is pre-formed, thyrosuppressive medications are unnecessary. While traditionally treated with surgical debridement, recent case series demonstrate that conservative management with antibiotics and percutaneous drainage can be successful. Hypothyroidism is a common late complication.

THE SECRET TO THE ABDOMINAL PAIN IS IN THE SMEAR! Manuel Lam 1; Kaveh Mojtahed 1; David Oh 1; Lisa Shieh2. 1Stanford Hospital &Clinics, Stanford, California ; 2Stanford Hospital &Clinics, Mountain View, California. (Tracking ID # 12261)

LEARNING OBJECTIVES: 1. 1. Recognize anchoring heuristic as a common cause of diagnostic error. 2. 2. Assess an elevated unconju-gated hyperbilirubinemia and diagnose Gilberts syndrome.3. Recognize pigmented bilirubin gallstones as a common complication of hereditary spherocytosis.

CASE INFORMATION: A 31-year-old G1P1 presents again with post-prandial epigastric pain radiating to the back associated with nausea, vomiting and diarrhea.

Her past medical history is significant for cholecystectomy with subsequent ERCP and sphincterotomy at the age of 23; Gilberts syndrome; and recent GERD-like symptoms. Her outpatient medications include lansoprazole. She is predominantly of Ashkenazi Jewish descent, and she has a first cousin once removed who also had a cholecystectomy at 22.

She was initially admitted to an OSH, treated for viral gastroenteritis and discharged on antiemetics and loperamide. She was readmitted to a second OSH because her symptoms persisted. There, CT abdomen revealed hepatosplenomegaly. A MRCP did not show any obstructions. She was finally transferred to our hospital for consideration of endoscopic ultrasound.

Physical exam is remarkable for mild tenderness and splenomegaly. Labs are significant for mild normocytic anemia with an elevated RDW15.3% and MCHC 37.7 g/L; an elevated lipase to 525 U/L; and an elevated bilirubin, which had been attributed to Gilberts syndrome in the past. However, further investigation reveals evidence of hemolysis with an elevated unconjugated bilirubin, LDH, and an undetectable haptoglobin. Peripheral smear reveal numerous spherocytes. Osmotic fragility test is positive.

She improves with intravenous fluids and bowel rest. She is referred to Hematology, and splenectomy is recommended. Further genetic testing reveal that she did not have the UGT1A1*6(211A allele). Therefore, she does not in fact have Gilberts syndrome. IMPLICATIONS/DISCUSSION: In an otherwise healthy individual with elevated unconjugated hyperbilirubinemia (<6 mg/dL), the presumptive diagnosis of Gilberts syndrome can be made as long as hemolysis is ruled out! Workup includes: CBC, reticulocyte count, lactate dehydrogenase, haptoglobin as well as examining the peripheral smear!

We often accept the diagnoses made by other physicians at face value without critically reviewing the facts. In the case above, we describe an example of the anchoring heuristic in which the assumption of the previous diagnosis (Gilberts syndrome) may have delayed the workup of an elevated unconjugated bilirubinemia and the diagnosis of hereditary spherocytosis. A clinician can become anchored to the initial impression of other physicians without expanding a differential diagnosis.

In one hundred cases of diagnostic error involving internists, premature closure, the tendency to stop considering other possibilities after reaching a diagnosis, was the single most common cognitive factor leading to diagnostic errors. Therefore, it is important to employ a healthy sense of skepticism with the clinical impressions made by other physicians, and to compile a complete differential diagnosis in order to avoid premature closure and the anchoring heuristic.

LOWER EXTREMITY NUMBNESS IN A PATIENT WITH ACUTE ARTERIAL THROMBOSIS SECONDARY TO HEPARIN INDUCED THROMBOCYTOPENIA Ryan Wesley Nall 1; Ryan Wesley Nall1. 1Beth Israel

Deaconess Medical Center Internal Medicine, Boston, Massachusetts. (Tracking ID # 12262)
LEARNING OBJECTIVES: 1. Review the criteria used to determine the pre-test probability of heparin induced thrombocytopenia (HIT)2. Review the role of serotonin release assay, platelet aggregation assay and the solid phase ELISA for heparin-dependent antibodiesCASE INFORMATION: 88 year old female status post left knee replacement presents from rehab with a one day history of ascending weakness and numbness in the lower extremity. Numbness started in her right toes and ascended to the level of the ankle over five minutes. A similar sensation

developed moments later in the left foot. Associated symptoms included weakness with dorsiflexion of the feet and pain in the region of numbness. Patient denied other weakness or numbness, headache, vision changes, recent trauma, febrile illness or vaccination. Medications at rehab include Percocet, Lovastatin, and Fragmin. Examination revealed a temperature of 101, pulse of 110, and blood pressure of 130/80. Neurological examination of the lower extremity revealed profound weakness with dorsiflexion of the feet bilaterally, normal sensation to light touch, temperature, with decreased sensation to pin prick bilaterally. Patellar reflexes were brisk while achilles were absent bilaterally. The upper extremity neurological examination was normal. Cranial nerves II-XII were intact. Lower extremity was found to be cool to touch with absent dorsalis pedis, popliteal and femoral pulses bilaterally. Laboratory data revealed hematocrit of 30.2, white blood cell count of 9.6, platelets of 55. INR, PTT, renal function, liver function, and electrolytes were normal. Given the low platelet count and concern for HIT, all heparin products were held, heparin induced antibodies were measured and Argatroban was initiated. CTA of the chest, abdomen, pelvis, and lower extremity was performed and showed thrombus in the aorta, with flow down both iliac arteries, occlusion of the common femoral artery on the right, and popliteal artery on the left. Vascular surgery performed a thrombectomy of the left and right lower extremity thrombi. Heparin dependent antibodies later returned positive with an optical density of 2.895. The patient had a full recovery of sensation and function of her lower extremity. IMPLICATIONS/DISCUSSION: Heparin induced thrombocytopenia (HIT) can often be a challenging diagnosis. One studied method of calculating the pretest probability of HIT is the 4 T score. This score is based upon 1) the degree of thrombocytopenia and percent decline in platelet count 2) the timing of platelet decline to heparin exposure 3) thrombosis and 4) presence of other causes of thrombocytopenia. Based on this score patients fall into low, intermediate, and high probability for HIT. Testing for HIT should be performed on those with intermediate and high pretest probability of HIT. Diagnostic tests include: the serotonin release assay (SRA), platelet aggregation assay and the solid phase ELISA. The gold standard diagnostic test for HIT is the SRA with both specificity and sensitivity greater than 95%. However, this test is costly, technically difficult and results often take as long as a week to be reported. The solid phase ELISA determines the presence of heparin-dependent antibodies and results are reported much more rapidly than the functional assays (i.e. SRA, platelet aggregation assay). The ELISA has a sensitivity of >97 percent giving it an excellent negative predictive value. A positive test is often difficult to interpret as the test has a low specificity (74 to 86 percent). Warkentin et al showed that the strength of the ELISA result measured as an optical density can be helpful in predicting the likelihood of HIT. An optical density (OD) greater than 2.0 is associated with a positive serotonin release assay in 89 to 100 percent of patients. While an OD of 1.4 to <2.0 had a positive serotonin release assay of only 19 to 46 percent. Because the functional assay results are delayed the diagnosis of HIT should be considered established in patients with intermediate or high pretest probability and positive heparin induced antibodies. Optical density can be used to predict the likelihood of positive SRA and guide clinical decision making in a timely manner.

WILL VACCINATIONS DO AWAY WITH LUMBAR PUNCTURES? A CASE OF PNEUMOCOCCAL MENINGITIS Tricia James 1; Mari Kai2.
1Providence Portland Medical Center, Portland, Oregon ; 2Providence Portland Medical Center, Portland, Oregon. (Tracking ID # 12263)

LEARNING OBJECTIVES: 1. Recognize current epidemiology of streptococcus pneumoniae meningitis and antibiotic resistance rates
2. Recognize the decreased competency of internists performing procedures, which may directly effect patient careCASE INFORMATION: A 55 year-old female smoker presented with 5 days of cough, fever, and worsening confusion. On initial exam, she was confused and agitated. Her vital signs showed a temperature of39.5 C, oxygen saturation of 87% on room air, heart rate of 150 beats per minute, and a blood pressure of 133/77 mmHg. Lung exam revealed rhonchi on the right. Neurologic exam was non-focal. A chest x-ray showed a dense right upper lobe infiltrate. She had a significant leukocytosis. The initial diagnostic impression was pneumonia and sepsis. She was started on moxifloxacin, pipercillin/tazobactam, and vancomycin. Shortly after arriving in the ICU she became unresponsive, and was intubated. The admitting team felt that a lumbar puncture (LP) was indicated given her significant altered mental status. However, this was overnight, and the house-staff involved were not credentialed for the procedure, and the attending physician did not feel confident in their LP skills and no other specialists were available for the procedure. It was determined that since the patient was being treated empirically with antibiotics, it was not an emergent procedure. The following morning, after a normal CT scan, a LP was performed. The aspirate was grossly purulent. Cerebral spinal fluid studies were consistent with bacterial meningitis. The gram stain showed 1+ gram-positive diplococci and her streptococcus pneumoniae antigen was positive. Her antibiotics were changed to high dose ceftriaxone and vancomycin. The following day, blood cultures grew streptococcus pneumoniae. It was resistant to penicillin and ceftriaxone, but sensitive to moxifloxacin and vancomycin. The ceftriaxone was changed back to moxifloxacin. The patient slowly improved over a 12-day hospital course. She did have some cognitive deficits at hospital discharge, however at 3 months, she had subjectively returned to baseline and back to work full-time.
IMPLICATIONS/DISCUSSION: The incidence of streptococcus pneumoniae meningitis has decreased 30% since the introduction of the pneumococcal conjugate vaccine in 2000. Since 2003, the rate of antibiotic resistance among the isolates has increased. Organisms that have seeded the CSF from a primary pneumonia are more likely to be resistant. This patient received appropriate empiric antibiotic coverage for pneumonia and sepsis, but not for meningitis. The most recent Infectious Disease Society of America guidelines recommend vancomycin, a third generation cephalosporin, and ampicillin for age >50, with much higher doses than the standard for pneumonia. A LP performed earlier in this patient, may have resulted in appropriate antibiotics sooner. However, the multiple attending physicians in the hospital did not feel comfortable performing this procedure. A decrease in the incidence of bacterial meningitis has lead to a decreased need for LPs. A survey of internists in 2004 showed that the number of procedures performed decreased by 50% since 1986. Specifically, the percentage of internists who performed LPs decreased from 73% to 26%. The American Board of Internal Medicine (ABIM) has significantly reduced the procedural competency requirements for residents. LPs are one of many that are no longer required. Although many institutions have sub-specialists available to perform procedures, this may not be true for all hours of the day or in rural settings. Some procedures may be delayed in these setting without internists that are credentialed, directly impacting patient care as outlined in this case. Some residencies have tried to address this gap with curricular changes to improve procedural competency, but others have not. Without an ABIM requirement, procedure skills by internists will likely continue to be widely variable. Solutions are still needed to ensure that necessary procedures can be provided to patients, regardless of location or time of day.

PSEUDOHYPERKALEMIA Mohd Khushman 1; Mahmoud Mahafzah 1; Abdel-Ghanie Abu-Samra 1; Jerry Yee1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 12266)

LEARNING OBJECTIVES: 1. Pseudohyperkalemia is a phenomenon whereby the invitro serum potassium

concentration exceeds by 0.4 mmol/L its invivo level. Causes are, mechanical, ischemic, centrifugation-related, and rarely familial.2. Improved diagnostic yield occurs by avoiding fist clenshing, specimen acquisition in heparinized tubes, gentle specimen handling and notification of laboratory personnel.
CASE INFORMATION: An 82 year oldfemale with an aggressive Non-Hodgkins, B-cell lymphoma, severe leukocytosis(206.3 x 109/L), and normal platelets was admitted for an initialcycle of chemotherapy. Severe hyperkalemia was evident (10.6 mmol/L). Medicaltherapy was begun and the serum potassium level was confirmed twice. Yet, thepatient was asymptomatic with normal vital signs. The electrocardiogram (EKG) revealedno peaked T waves or QRS complex widening. Because of the persistent hyperkalemia,intensive care unit monitoring was initiated with consideration for hemodialysis. Pseudohyperkalemiawas suspected from the absence of EKG criteria and extreme leukocytosis. To establishthis diagnosis, three separate venous specimens were obtained within 10 minutesof each other. The first, delivered to the laboratory by a pneumatic tubesystem to maximize specimen agitation, was analyzed within 10 minutes; thesecond, hand-delivered sample, was analyzed within 30 minutes; and the third, heparinized specimen was analyzed within 30 minutes. The two, non-heparinized samples demonstrated potassium levels of 10.6 and 11.4 mmol/L, respectively.The heparinized sample yielded plasma potassium of3.3 mmol/L. Followingchemotherapy, the magnitude of pseudohyperkalemia decreased, concordant with areduction in leukocytosis. IMPLICATIONS/DISCUSSION: With severe thrombocytosis orleukocytosis, in vitro cell degranulation or lysis during clotting may resultin spuriously elevated serum potassium levels. Consequently hyperkalaemia maybe misdiagnosed and lead to potentially adverse effects of medical therapy orhypokalemia masked, as in this case, with further aggravation by treatment. Whenpseudohyperkalemia is assumed, improved diagnostic yield occurs by avoiding tight tourniquets and fist-clenching , specimen acquisition in heparinizedtubes, gentle specimen handling, and notification of appropriate laboratorypersonnel of the presumed diagnosis.
UNUSUAL PRESENTATION OF A COMMON BACTERIAL INFECTION. Swapna Kanuri 1; Radha Andukuri 2; Chakravarthi Pureti2. 1Creighton University Medical Center, Omaha, Nebraska ; 2Alegent Health, Omaha, Nebraska. (Tracking ID # 12267)
LEARNING OBJECTIVES: 1. Approach to a case of undetermined acute hepatitis.2. Recognize the presentation of mycoplasma pneumonia hepatitis. CASE INFORMATION: 27 year old white female presented with a week history of acute right upper quadrant abdominal pain associated with nausea, fatigue, anorexia, myalgias and arthralgias in extremities. On exam she has RUQ tenderness along with signs of arthritis, joint swelling in all the extremities. Labs showed an elevated LFTs with AST of 1242, ALT of 672, Alkaline phosphatase of 208 and Total bilirubin of 1.0. Amylase and Lipase were normal. CBC showed pancytopenia with WBC of 2.2, HGB 10.9, Platelets of 89 with neutropenia and lymphopenia indicating bone marrow depression.
US of RUQ revealed fatty liver without any evidence of cholelithiasis or choledocholithiasis. Subsequent MRCP revealed the same. X rays of
knee and elbow showed small joint effusions suggestive of synovitis. Work up of noninfectious hepatitis with Anti Smooth muscle, actin , dsDNA antibodies, Rheumatic factor, Anti-CCP, Anti Mitochondrial antibodies, Iron studies with TIBC/Fe ratio were negative. Ferritin was elevated at 804 so a Hemochromatosis work up with C282Y, H63D, S65C gene mutations was ordered which was negative. ESR, CRP, Cold Agglutinins, Cryoglobulins, complement levels were normal.
Acute Viral Hepatitis screen for A, B, C; Hep C PCR, Antibodies to Parvovirus, CMV, West nile were negative. Fungal etiology work up with Histoplasma, Cryptococcus antigen were negative.
Bacterial infectious etiology with Q fever phase I and Phase II antibodies, quantiferon gold test for TB were negative. Finally IgM antibody Mycoplasma Pneumonia was ordered which was strongly positive. Subsequently a CT guided biopsy was ordered to exclude any other etiologies. Biopsy showed acute centrilobular cholestasis without any evidence of autoimmune hepatitis. Thus a diagnosis of Acute hepatitis secondary to Mycoplasma

Pneumonia was made with a secondary reactive arthritis. She was started on antibiotics and steroids. Her Pancytopenia improved completely along with improving liver function tests at the time of discharge. IMPLICATIONS/DISCUSSION: Mycoplasma pneumonia is a major cause of respiratory infections in children. Most M. pneumonia infections in adults involve the respiratory tract presenting with mild fever and nonproductive cough to severe pneumonia. Extrapulmonary manifestations of M. pneumonia infection involves the cardiovascular, neurologic and hematologic systems. Until 2002 M. pneumonia associated cholestatic hepatitis has been reported only in children. Concomitant liver disease is extremely rare in adults. The pathogenesis of extrapulmonary disease in M. pneumonia infection is not well known and possible mechanism includes infection of hepatocytes as well as immune-mediated damage by antibodies. We are reporting this unusual presentation of a common bacterial infection presenting with acute hepatitis and hematologic involvement without any pulmonary manifestations. The diagnosis is based on positive IgM antibodies to M. Pneumonia and clinical improvement after institution of the antibiotic therapy. Our clinical case suggests that the differential diagnosis of unexplained acute hepatitis should include M. pneumonia infection.

MYCOPLASMA INFECTIONS- NOT JUST YOUR WALKING PNEUMONIA. Ngozi Iroezi 1; Ngozi Iroezi1. 1University of California Los Angeles, Los Angeles, California. (Tracking ID # 12269)

LEARNING OBJECTIVES: 1. To broaden our differential of a patient presenting with pneumonia and hemolytic anemia 2. To highlight the presentation and management of a case of extrapulmonary manifestation of mycoplasma infection.

CASE INFORMATION: This is a 49 year old female with a history of asthma presenting with worsening shortness of breath, fevers and cough for the past 1 week. She denied chest pain, endorsed orthopnea but no PND or peripheral edema, no hemoptysis, no vomiting or diarrhea. She had no TB risk factors and no sick contacts. She had a prior history of mild asthma and did not require any medications or inhalers. She was a non smoker, no history of alcohol or illicit drugs. Her physical examination showed a mildly obese female in respiratory distress unable to speak in full sentences. She was afebrile with a BP of 102/62, P 131, RR 36 and pulse oximetry of 82% on RA. She had scleral icterus. Her lung exams was notable for coarse breath sounds bilaterally with no crackles, heart sounds were tachycardic with no noted extra heart sounds, no elevated JVP and no peripheral edema. CXR showed bibasilar atelactasis with slight vascular congestion and a CT angiogram chest showed patchy consolidation in both lower lungs with hilar

adenopathy no evidence of pulmonary embolism. Labs showed a WBC of 129 with bands, metamyelocytes and myelocyte and no blasts, hemoglobin of 8.2 and platelets of 606. Serum creatinine was 0.5; LFTs showed a total bilirubin of 6.5, direct bilirubin of 2.4, Alkaline phosphatase of 187, AST of 124 and ALT of 45, showed LDH of 2496, recticulocyte count of 6.6. An infectious work up included negative HIV screen, c.difficile, histoplasma, mononucleosis, legionella and blood cultures. A direct coombs test was positive for anti c3b and neg for IgG with elevated cold agglutination of 1:160. Peripheral smear showed erythropoesis. Mycoplasma titers were notable for elevated IgG at 1:256 and IgM at 1:32 indicating recent infection. Given these findings she was diagnosed with mycoplasma related cold agglutinin hemolytic anemia. She received plasmapheresis for 5 days for clearance of IgM given persistent hemolysis and was treated with a 10 day course of azithromycin. IMPLICATIONS/DISCUSSION: Mycoplasma infections present as pneumonia in about 3-10% of case, of these about 25% go on to develop extrapulmonary complications. One of the more severe manifestations of extrapulmonary mycoplasma infection is cold agglutinin hemolytic anemia (CAHA). The diagnosis of CAHA is based on a positive direct coombs test in the presence of cold agglutinins. Mycoplasma associated CAHA is confirmed by evidence of an acute Mycoplasma infection by serologies. Mycoplasma is a fastidious organism and is difficult to grow in culture. The mechanism of hemolysis is not well understood but has been thought to be an autoimmune process resulting from mycoplasma- receptor complexes that cause agglutination. Hemolysis is a result of complement mediated destruction of the membrane of erythrocytes. In this case the

robust leukemoid reaction seen was thought to be secondary to the bone marrows response toe rapid hemolysis of the erythrocytes by releasing early precursors from the hematopoetic stem cell line which included early precursors to the neutrophils. Malignancy was thought to be less likely the cause of the leukomoid reaction given the absence of blasts in the peripheral smear and the resolution of her symptoms. The treatment of choice for Mycoplasma infections are Macrolides such as Azithromycin and Tetracyclines such as Doxycline. Studies have also shown the use of IVIG in the inhibition of further hemolysis. In refractory cases other agents such as corticosteroids, azathioprine, interferon, alkylating agents, have been used. Although most of the management of cold agglutinin hemolytic anemia is supportive care, studies have shown that treating the underlying infection is associated with a more rapid resolution of hemolysis.

FIRST IS THE WORST Dandan Liu 1; Alvin Rajkomar 1; Sumant Ranji1; Sumana Kesh1. 1University of California, San Francisco, San Francisco, California. (Tracking ID # 12270)

LEARNING OBJECTIVES: 1. Recognize the limits of laboratory data in diagnosing acute pancreatitis 2. Review treatment of hypertriglyceridemic pancreatitis (HTGP)

CASE INFORMATION: A 23 year old man with no significant medical history presented to the emergency department with sudden onset abdominal pain and six episodes of nonbloody emesis along with new polyuria and polydipsia. He had abstained from alcohol for two years and denied any ingestions or history of abdominal pain. On initial exam, he had a soft abdomen that was nontender. Labs revealed glucose of 321 mg/dL, anion gap of 29, normal lactate, and lipase of 59 units/L. He was treated with IV fluids and insulin drip for presumed new onset diabetic ketoacidosis (DKA) as well as pain control. Overnight, patient was noted to have increasing pain medication requirements, and his abdomen was increasingly distended with reproducible tenderness in the epigastric region. An abdominal CT with contrast confirmed diagnosis of pancreatitis with no evidence of gallstones. The patients blood was noted to be lipemic. Morning labs showed elevated triglyceride 7470 mg/dL and elevated lipase 143 units/L. He was continued on an insulin drip for management of hypertriglyceridemia induced acute pancreatitis (HTGP) and concomitant DKA. By hospital day 3, his triglycerides decreased to 720 mg/dL, and he was transitioned to subcutaneous insulin. His GAD and islet cell antibodies were negative. He was discharged on hospital day 6 with minimal abdominal pain, tolerating food, with plans for close outpatient follow-up for his diabetes and hypertriglyceridemia.

IMPLICATIONS/DISCUSSION: Acute pancreatitis is most commonly precipitated by gallstones or alcohol, although HTGP, with triglycerides >1000 mg/dl, accounts for 2-10% of cases. Serum lipase is a specific test for pancreatitis (spec 82-97%) with sensitivity ranging 67-85%. While there is not much literature on the reliability of lipase in lipemic samples, serum amlyase levels are known to be spuriously low in lipemic blood. DKA itself can conversely cause nonspecific elevations in amylase and lipase apart from pancreatitis in approximately 10% of cases. When the history and lab findings are incongruent with an evolving exam, the diagnostic gold standard should be ordered: a contrast enhanced CT.

The mechanism of HTGP is not clearly defined, but there is likely secondary hydrolysis of triglycerides by lipase in pancreatic arteries, leading to release of free-fatty acids that are toxic to the capillaries or acinar cells. A cascade of capillary ischemia then promotes activation of trypsinogen and thus pancreatitis. Management is fairly uniform despite etiology. Most commonly, insulin infusion is used, as it is thought to induce lipoprotein lipase activity. Heparin infusion can also be used, although it ultimately leads to a decrease in lipolytic activity. If refractory, plasmapharesis, lipid pheresis, and extra-corporeal lipid elimination are possible, although there are no direct comparisons between these treatment methods, and they are not readily available. Long-term treatment of hypertriglyceridemia is aimed to reduce levels <1,000 mg/dL to decrease the likelihood of pancreatitis. Dietary restriction with <20% of calories from fat is the first step to reduce chlomicron-mediated contribution to elevated triglycerides. Pharmaceuticals including niacin, fibrates, and fish oil can also be employed, although each carries its own set of side effects and costs. This case, with close outpatient follow-up and patient adherence to dietary restrictions should illustrate the adage first is worst.

WERNICKES ENCEPHALOPATHY: MORE THAN JUST AN UNSTEADY GAIT Sandy Tam 1; Sandy Tam1. 1Stanford University, Menlo Park, California. (Tracking ID # 12271)
LEARNING OBJECTIVES: 1. Recognize the clinical features of Wernickes encephalopathy. 2. Diagnose and treat Wernickes encephalopathy. CASE INFORMATION: A 55 year old male with hypertension, hepatitis C, syphilis status post treatment 30 years ago, and alcohol abuse presents with an unsteady gait, recurrent falls, and confusion. His wife was concerned about his recent inability to walk and disorientation; she related that he often thought it was night when it was day and vice versa, with short term memory loss. His wife denied seizures, syncope, changes in medications, and recent illness. The patient denied symptoms such as dizziness prior to his falls. His last drink was reported to be more than one week prior to admission; he reportedly drank 3 half pints of vodka nightly for the past 30 years. Vital signs and physical exam were unremarkable. He was oriented to name and hospital. His neurological exam revealed no nystagmus, intact cranial nerves, 5/5 strength in the upper and lower extremities, postural

tremor, no pronator drift, intact sensation and coordination, wide-based gait, normal reflexes, and down-going toes on Babinski. His laboratory studies were notable for mild anemia, normal metabolic panel, normal B12, folate, thiamine, and TSH, and a negative HIV screen. Toxicology screen was positive for benzodiazepines. Head CT revealed no acute changes, a low density focus in the left lentiform nucleus, possibly an old lacunar infarct, and mild periventricular low density, likely chronic small vessel ischemia. Head MRI revealed abnormal T2 hyperintensity in the caudate head, putamen and globus pallidus bilaterally. An echocardiogram was unremarkable. A lumbar puncture was attempted, but unsuccessful. The patient was started on thiamine for empiric treatment of Wernickes encephalopathy. Thiamine 500 mg was given intravenously three times daily for the first 2 days then once daily for the next 3 days. After 2 days of thiamine, the patient was able to slowly ambulate with a walker and after 5 days, without a walker. His mental status and orientation improved as well. The patient was discharged with oral thiamine.
IMPLICATIONS/DISCUSSION: The triad of clinical manifestations in Wernickes encephalopathy includes gait ataxia, encephalopathy (dis-orientation, indifference, inattentiveness), and oculomotor dysfunction (nystagmus, lateral rectus palsy, conjugate gaze palsies). All three features are present in only 30% of patients with Wernickes encephalopathy. Ataxia usually occurs first and precedes the other features by a few days to weeks. Wernickes encephalopathy is diagnosed clinically and a response to treatment with thiamine supports the diagnosis. The Caine criteria can be helpful in diagnosing Wernickes encephalopathy in chronic alcohol users. Patients meet the criteria when they have two of the four: dietary deficiency, oculomotor abnormalities, cerebellar dysfunction, and either altered mental status or mild memory impairment.
Treatment of Wernickes encephalopathy includes high-dose thiamine administered intravenously. One recommended regimen includes thiamine 500 mg intravenously three times daily for two days, then once daily for another five days. Another proposed regimen includes thiamine 500 mg three times daily for three days, then 250 mg daily for an additional five days or until an improvement is made clinically. Glucose administration without thiamine can precipitate or worsen Wernickes encephalopathy. Of note, dietary requirements for thiamine are only 1 to 2 mg daily, but the absorption and utilization of thiamine are unpredictable. Patients should be discharged with thiamine 100 mg orally once daily until they can reliably consume an adequate amount from the diet.
A DEADLY HEART ATTACK FOLLOWING CORONARY ARTERY BYPASS GRAFT Islam Al-Howaidi 1; Theresa Townley2. 1Creighton Univeristy School of Medicine, omaha, Nebraska ; 2Creighton University School of Medicine, Omaha, Nebraska. (Tracking ID # 12275)
LEARNING OBJECTIVES: 1. Discuss the risk of myocardial infarction following coronary artery bypass graft(

CABG).2. Discuss management of post CABG myocardial infarction.
CASE INFORMATION: A 44 year old Caucasian male experienced a ground level fall after he blacked out. He lost consciousness for 30 seconds. Patient has been complaining of worsening shortness of breath with minimal activity over the last six months. He denied any previous syncopal episodes, palpitation or chest pain, but he tends to have heartburn and reflux symptoms with activity. EKG on admission showed sinus tachycardia with heart rate of 100, and ST-T wave changes in the anterolateral leads. Cardiac enzymes were negative. Transthoracic echocardiography showed severe concentric left ventricular hypertrophy, with normal estimated ejection fraction, and severe
aortic stenosis with a valvular area of 1 cm, and maximum pressure gradient of 67mmhg. CAT scan of the head was negative. CT angiogram showed 75% blockage of the right ICA, and 60% occlusion of the left ICA. Subsequently, he had coronary angiography which showed left anterior descending artery with 90% disease, LCX has 70% lesion. Cardiothoracic surgeons were consulted and they operated on the patient firstly with right ICA stent, followed by aortic valve replacement with a biologic valve, and two vessel CABG with LIMA to LAD. Patient did well after that and was discharge home after one week. Two weeks later, patient was found unresponsive and was unable to be resuscitated.
Autopsy was done upon the request of the family, which showed a 6 cm left ventricular myocardial infarction aged 510 days. This has been identified as the cause of death in Mr. X case. An area of hyperemia extending the length of the left ventricle, interventricular septum, and papillary muscle. No fibrotic areas of the myocardium. And the replaced aortic valve was intact with no abnormalities. IMPLICATIONS/DISCUSSION: Perioperative myocardial infarction oc-curs in up to 4-5% of patients following CABG, and is most commonly due to coronary artery occlusion distal to the new graft. The diagnosis of perioperative MI may be difficult to make after CABG, since cardiac enzyme elevations occur as a result of the surgical procedure and since EKG changes may reflect postoperative pericardial inflammation. The incidence of MI is less in low-risk patients and higher in those with one or more of the following risk factors: Cardiomegaly, Long time on cardiopulmonary bypass, Repeat CABG, or CABG combined with other cardiac surgery. Our patient had two out four, cardiomegaly, and the aortic valve surgery which put him at a higher risk for complications. In order to make a diagnosis, A recommendation has been made to get preprocedural and postprocedural ECG with routine measurements of serum CK and CK-MB. Patients with increased serum CK-MB of fivefold or more above the upper limit of normal should be treated as having an MI, especially in the presence of a technical complication of the procedure. Elevations of less than five-fold are uncertain, although any evidence of clinical instability should prompt caution in discharge and activity.
In our patient, it was unfortunate, that it was late to resuscitate him, but the management for these is revascularization if anatomy is appropriate. The optimal revascularization strategy for early graft occlusion is not known. Repeat CABG is one approach, while balloon angioplasty with and without stenting has been performed immediately after surgery and for treatment of fresh anastomoses. If stents are to be employed, we proceed with usual measures for the prevention of thrombosis, including GP IIb/IIIa inhibitors and clopidogrel loading, and are prepared to treat bleeding complications if needed.
EARLY STENT THROMBOSIS AFTER PERCUTANEOUS CORONARY INTERVENTION Maria Sobolev 1; Ariel L Shiloh1. 1Montefiore Medical Center / The Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 12281)
LEARNING OBJECTIVES: 1. Recognize stent thrombosis as an early complication of percutaneous coronary intervention and assess its causes.2. Management of a patient with early stent thrombosis.
CASE INFORMATION: A 58 year old woman, with a history of hypertension, cerebrovascular accident, and extensive tobacco use, presented to the emergency department with an ST-elevation myocar-dial infarction. The patient rapidly decompensated due to a ventricular fibrillation arrest requiring defibrillation, intubation, and percutaneous coronary intervention (PCI). Coronary angiography revealed a total occlusion of the right coronary

artery with severe three vessel disease. Angioplasty was performed and a bare metal stent (BMS) was deployed

in the right coronary artery. Abciximab, clopidogrel, aspirin, metoprolol, simvastatin, and captopril were initiated peri-procedure. The patient was admitted to the coronary care unit and extubated successfully. On hospital day six the patient developed acute shortness of breath, followed by a cardiac arrest requiring advanced cardiac life support and intra-aortic balloon pump placement for hemodynamic support. Electrocardiogram revealed ST-elevations similar to admission. Immediate coronary catheterization demonstrated stent thrombosis, requiring thrombectomy. Clopidogrel was switched to prasugrel and the patient underwent emergent coronary artery bypass graft (CABG) surgery. The patient made a successful recovery. IMPLICATIONS/DISCUSSION: Stent thrombosis (ST) is a rare but potentially catastrophic complication of coronary artery stenting that almost always presents with a large myocardial infarction or death. The overall incidence is only two percent of stent placements and oftentimes diagnosis is only made post-mortem. The definition of ST by the Academic Research Consortium incorporates timing and diagnostic certainty. Timing is categorized as acute (within 24 hours), sub-acute (within 30 days), late (after one year) or very late (more than one year). The majority of ST occurs within 30 days of deployment, with approximately 80 percent of BMS thrombosis occurring in the first 48 hours. The pathophysiology of ST is multifactorial and includes stent factors, patient factors, lesion characteristics, and procedural factors. The single most predictive factor for ST is the absence or premature discontinuation of anti-platelet therapy, particularly clopidogrel, at the time of event. Given the multifactorial etiology, despite appropriate dual anti-platelet therapy with aspirin and clopidogrel, ST may still occur. Clopidogrel metabolism and efficacy is affected by genetic variations of the P450 hepatic enzyme CYP2C19 allele and drug-drug interactions with commonly co-administered drugs such as proton pump inhibitors, calcium channel blockers, warfarin, and lipophilic statins. Patients developing ST while on clopidogrel are recommended to switch to prasugrel, another member of the thienopyridine class of ADP receptor inhibitors not affected by CYP2C19, and continuing dual therapy with aspirin for one year. Emergent PCI to restore vessel patency is the treatment of choice for stent thrombosis, and is successful in over 90 percent of cases. Urgent CABG is recommended for the remainder of patients. Given the high morbidity and mortality, appropriate primary prevention along with prompt recognition and management of ST is essential to patient survival.

ADVERSE DRUG REACTION OF EMU OIL shreyas saligram 1; Saddam Abisse 1; David McAdams1. 1University of Pittsburgh medical center, Pittsburgh, Pennsylvania. (Tracking ID # 12288)

LEARNING OBJECTIVES: 1. Adverse drug reaction due to Emu oil2. Psoriatic exacerbation by commonly available over the counter drugs CASE INFORMATION: 73 year old man with long standing history of psoriasis presented with worsening of Psoriasis. His psoriasis was well controlled and has never been on medications for it. Eight days ago, he applied emu oil to his arms and legs for joint pain and noticed diffuse erythematic rash over his arms and legs the following day. The erythematic rash then spread to involve his trunk, back, scalp and face. Scaling developed three days after the rash began and progressively worsened. He was not on any medications and had no significant past medical history. On admission, his vitals were stable. His systemic examination was unremarkable. Examination of his skin revealed diffuse erythematous scaly lesions on his arms, thighs, chest, back, scalp.

He was reviewed by the Dermatologist and was diagnosed to have Psoriasis flare secondary to Emu oil. They recommended Triamcinolone0.1% ointment and Vaseline gauze over Triamcinolone.

IMPLICATIONS/DISCUSSION: Psoriasis is a skin disorder characterized by erythematous papules and plaques with a silver scale, although

other presentations occur. Numerous triggers that may play a role have been identified, such as infection, physical, psychological stress, and medications.

Emu oil is an oil made from the fat of the emu, Dromaius novaehollandiae, a bird native to Australia. It has been

used historically by the Australian aborigines as a pain reliever for bone, muscle, and joint disorders. Emu oil is approximately 70% unsaturated fatty acids. The largest component is oleic acid, a mono-unsaturated omega-9 fatty acid. Emu oil also contains about 20% linoleic acid (an omega-6 fatty acid) and 1-2% linolenic acid (an omega-3 fatty acid).

A handful of studies have suggested that emu oil, applied topically, may have anti-inflammatory properties and promote wound healing in various rodent models. While there are no studies showing that emu oil is effective in humans, it is marketed and promoted as a dietary supplement with a wide variety of claimed health benefits. Commercially marketed emu oil supplements are poorly standardized and vary widely in their potency. Such products are sometimes marketed deceptively. Application of oleic acid on hairless mouse skin induced an abnormal calcium distribution in the epidermis. It induced scaly skin, abnormal keratinization, and epidermal hyperplasia. Based on these observations in the animal model, it can be hypothesized that they can cause adverse reaction on human skin which may have led to Psoriasis flare as in our case.

This case report highlights the adverse reaction of commonly available over the counter herbal medication. Knowledge of this adverse drug effect is important as flare up is often suspected to be due to failure of treatment and natural progression of the disease. The above case report will enable in identifying this relatively common condition and can be treated by simple measures like avoiding the culprit drug.

A CASE OF RHOMBOENCEPHALITIS CAUSED BY LISTERIA INFECTION IN A PREVIOUSLY HEALTHY 19-YEAR-OLD FEMALE Mouhamad Mansour 1; Pamela Cooper 1; Marcus Zervos1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 12305)

LEARNING OBJECTIVES: 1. Recognize Rhomboencephalitis as a rare manifestation of Listeria infection. 2. Treat Listeria Rhomboencephalitis. CASE INFORMATION: A previously healthy 19-year-old female presented with one week of malaise, fevers, headache with nausea, vomiting and photophobia. Neurological exam was nonfocal and labs showed leukocytosis of 20,000 k/uL. CT scan of the head was unremarkable. CSF analysis showed protein of 118 mg/dL, normal glucose and 784 WBCs (78% Neutrophils). Gram stain was negative. Treatment was started empirically with Ceftraixone, Vancomycin and Acyclovir.

The patient did not show signs of clinical response, and her mental status gradually declined with the development of right spastic hemiparesis, left 6th nerve palsy and dysarthia. Ampicillin was added empirically to cover for Listeria based on clinical suspicion. MRI scan showed findings compatible with rhomboencephalitis. CSF showed no growth in bacterial cultures, and was negative for viral, fungal and acid-fast cultures. CSF was also negative for oligoclonal bands. Vasculitis work-up was negative. Few days later, patient started to improve clinically. Listeria antibodies by complement fixation in the serum were positive at 16, thus confirming diagnosis.

Ampicillin treatment was continued for 4 weeks with resolution of the neurological deficits.

IMPLICATIONS/DISCUSSION: Listeria monocytogenes meningitis usually occurs in neonates, elderly and immunocompromised patients. Cerebritis and Rhomboencephalitis are rare manifestations of Listeria infection with high mortality. Listeria rhomboencephalitis was first

described in 1957, and most of the reported cases were in immuno-competent adults. Presentation is usually biphasic, with a prodrome of headache, vomiting and fever followed by asymmetrical cranial nerve palsies, hemiparesis and cerebellar signs. CSF Gram stain and bacterial cultures are only positive in 40% of cases. Early initiation of specific therapy results in survival rate greater than 70% but about two thirds of survivors have neurological sequelae.

PULMONARY LYMPHANGITIC CARCINOMATOSIS IN METASTATIC RENAL CELL CANCER - AN UNUSUAL FORM OF METASTATIC SPREAD Diwakar Davar 1; Leonard J Appleman1. 1University of

Pittsburgh Medical Centers, Pittsburgh, Pennsylvania. (Tracking ID # 12307)

LEARNING OBJECTIVES: 1. To recognize that pulmonary lymphangitic carcinomatosis is an exceedingly uncommon mode of spread in metastatic RCC. 2. To appreciate that pulmonary lymphangitic spread in metastatic renal cell cancer treated extensively with vascular endothelial growth factor signalling inhibitors may reflect a means of tumor escape phenomenon.

CASE INFORMATION: The first patient presented with localized renal cell cancer (RCC) and underwent a radical nephrectomy and was disease-free for five years before relapsing. Sorafenib therapy started after a trial of interferon-alpha failed and continued for 7 months before the patient developed pulmonary complications. The second patient presented with metastatic disease at the outset and initially received interleukin-2. However, he progressed and then received 30 months of sunitinib followed by bevacizumab and finally sunitinib again before developing pulmonary complications.

Both patients had hypoxemia requiring the use of supplementary oxygen. The first patient had no clubbing or cyanosis but fine crepitations were noted on auscultation bilaterally. The second patient also had no clubbing or cyanosis but he had poorly heard breath sounds bilaterally with faint Velcro-like crepitations heard over both lung fields. The rest of the physical examination including HEENT,cardio-vascular, abdominal and neurological systems revealed no abnormalities in both patients.

Contrast enhanced computer tomography (CT) of the thorax in both patients revealed nodular opacities and distension of the secondary level septa and new bilateral ground glass pulmonary infiltrates. Post-mortem pathologic examination revealed extensive lymphangitic spread of tumor cells in the lungs with neoplastic infiltration of small and medium-sized pulmonary vessels in both patients.

On developing pulmonary complications, both patients were evaluated extensively but no evidence of infectious or inflammatory etiologies were found. They rapidly developed clinical progression with increased fatigue, weakness, and requirement for supplemental oxygen and succumbed within several months from when lymphangitic carcinoma-tosis was diagnosed.

IMPLICATIONS/DISCUSSION: Pulmonary lymphangitic carcinomatosis (PLC) is a distinct, interstitial pattern of metastatic cancer growth within the lung parenchyma that is seen with many tumor types, but has rarely been reported in association with renal cell carcinoma (RCC). Recent reports have attempted to explain resistance to the anti-angiogenic effects of vascular endothelial growth factor (VEGF)-signalling inhibitors observed in the clinical setting. We hypothesize that the interstitial cancer growth pattern characteristic of PLC developed in these patients as an adaptive response to inhibition of tumor neovascularization by blockade of VEGF-signalling.

In this era of multiple therapeutic agents targeting VEGF and other mediators of tumor angiogenesis, PLC may be seen more commonly inpatients with RCC as a mechanism of acquired resistance to treatment.

CARDIOMYOPATHY: A RARE COMPLICATION OF LEGIONELLA INFECTION Mouhamad Mansour 1; Michael Hudson 1; Prasanth Lingam 1; Mohammad Zaidan 1; Maryam Sharifi1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 12308)

LEARNING OBJECTIVES: 1. Recognize Cardiomyopathy as a rare complication of Legionella infection.2. Treat Legionella infection.

CASE INFORMATION: A 54-year-old Caucasian female with no prior history of heart disease presented with 3-day history of dyspnea, cough, and fevers/ chills. Physical examination revealed hypotension, tachycardia, tachypnea and fever. On cardiac examination, there was a normal S1 and S2 without added heart sounds or jugular venous distension. Lung auscultation was marked for diminished basilar breath sounds. Chest XRay showed an infiltrate in left base, whereas electrocardiogram showed sinus tachycardia with new left bundle branch block.

Initial lab analysis showed leukocytosis (19.1 k/uL) with 94% neutrophils, hyponatremia (131 mmol/L), hypocalcemia (6.9 mg/dL) and elevated cardiac troponin I at 1.69 ng/mL. She was admitted to ICU and treated

with ceftriaxone, vancomycin, and azithtromycin for community acquired pneumonia. She received aggressive IV fluid resuscitation and sepsis early goal directed therapy with worsening oxygenation and bilateral pulmonary edema on exam and Chest X-Ray.2D transthoracic echocardiogram revealed left ventricular ejection fraction of 20% with global hypokinesis and anteroapical akinesis. Cardiac catheterization was performed showing no significant or moderate coronary artery stenosis plus reduced cardiac output(3.7 L/min) and index (1.7 L/min/m2).

Blood, sputum, and nasopharyngeal cultures were persistently negative. Urine Legionella Antigen was strongly positive so patient was prescribed 14 day course of IV/PO Moxifloxacin. She improved with supplemental oxygen, IV antibiotics, dobutamine, and systolic heart failure medications (digoxin, captropril, furosemide, carvedilol) and had pre-discharge echocardiogram showing LVEF 50-55%. Repeat electrocardiogram upon 6-weeks outpatient follow-up revealed resolution of the left bundle branch block.

IMPLICATIONS/DISCUSSION: This case report summarizes a case of Legionella pneumonia with likely associated myocarditis causing severe LV systolic heart failure, hemodynamic dysfunction and transient left bundle branch block. The patient had positive urinary Legionella antigen for L. pneumophila, serogroup 1 antigen and excellent symptomatic, pulmonary, and cardiac improvement with quinolone antibiotic therapy. Gross and colleagues reported the first case of Legionella myocarditis in 1981. Since then, few cases of Legionella myocarditis, pericarditis and endocarditis have been reported, with and without concomitant pneumonia. Several dysrhythmias can occur in the context of Legionnaires disease. Urine antigen testing is recommended by the CDC for clinical diagnosis of pulmonary and extra-pulmonary legionellosis. However, Legionella involvement of biopsy-obtained myocardial tissue has been previously documented by Polymerase Chain Reaction testing.

This case demonstrates the need for awareness of the cardiac manifestation of Legionella disease. High suspicion in appropriate clinical setting results in a timely diagnosis and initiation of specific therapy.

A SLOW-GROWING ABDOMINAL WALL MASS: NOT ALWAYS CANCER Prathit A Kulkarni 1; Traci N Fraser 1; Daniel M Musher1. 1Baylor College of Medicine, Houston, Texas. (Tracking ID # 12310)

LEARNING OBJECTIVES: 1. Consider the diagnosis of actinomycosis for a new-onset, slow-growing abdominal wall mass. 2. Manage actinomycotic abscess.

CASE INFORMATION: A 63-year-old man with hypertension and no prior abdominal pathology presented with a three-month history of a growing, painful mass in the left lower quadrant (LLQ) of the abdomen. In the week prior to presentation, the pain had increased significantly. The patient denied any fevers, chills, nausea, vomiting, melena, hematochezia, changes in stool quality, or anorexia. He did endorse a 25-pound weight loss over the last year. Examination revealed a firm mass in the LLQ of the abdomen without any associated erythema, warmth, fluctuance, or drainage. The mass was minimally tender to palpation. A computed tomography scan of the abdomen showed the mass, measuring 2.9 x 5.5 centimeters (cm), in the abdominal wall of the LLQ.

When the patient followed up in the Surgical Oncology clinic one week later, the mass had grown to 10 cm in its largest diameter. Approximately 4050 milliliters of purulent, hemorrhagic material was aspirated from the lesion. Biopsy of the lesion showed features consistent with an abscess, including many neutrophils, granulation tissue, and bacteria. Cytology showed no malignant cells; it did reveal, however, the presence of Actinomyces on multiple stains.

Six days later, the patient was started on amoxicillin-clavulanate. Nine days after this, because of continued growth and new spontaneous purulent drainage from the lesion, the patient was admitted to the hospital for incision and drainage of the abscess and was discharged on long-term amoxicillin.

IMPLICATIONS/DISCUSSION: Actinomycosis is a rare diagnosis, and primary abdominal wall actinomycosis is particularly uncommon, only 20 cases having been reported in the English literature to date.

The bacteria normally colonize the mouth, gastrointestinal tract, and female genital tract. What leads to an active infection is some breakdown of the mucosal barrier. This inciting event may be, among many other causes, appendicitis, cholecystitis, diverticulitis, etc. or placement or removal of an intrauterine device, though, despite thorough history-taking, no cause may ever be identified in some cases (as in ours).

The distinguishing feature of an actinomycotic infection, as opposed to infections caused by other more common bacteria, such as some streptococcal or staphylococcal species, is a slow-growing, chronic phase of infection (which can begin to develop months or even years after the initial mucosal breakdown). This distinguishing feature is, unfortunately, the same characteristic that frequently leads to misdiagnosis, as the lesions are assumed to be malignancy and not infection. For this reason, some have called actinomycosis the most misdiag-nosed disease .

Generally, medical treatment of actinomycosis with high-dose penicillin or amoxicillin is considered the best approach. Unfortunately, in many cases, by the time the diagnosis is made, extensive surgery has already been done. Though removing the infection may be helpful from a therapeutic standpoint, surgery has its own attendant risks and can leave the patient permanently disfigured. In cases of discrete, firm, indurated abscesses, as in our patient, drainage may be needed in addition to antibiotic therapy and may lead to quicker resolution of disease.

Actinomycosis is an important diagnosis to consider in cases of slow-growing masses, since the patient may be spared extensive surgery if the diagnosis is made in a timely fashion.

I WISH I HAD HELLP! Premal D Lulla 1; Kelty Baker1. 1Baylor College of Medicine, Houston, Texas. (Tracking ID # 12312)

LEARNING OBJECTIVES: 1. Recognize Chronic active Epstein-Barr Virus (CAEBV) infections, and itsunique pathogenesis. 2. Consider CAEBV as a diagnosis in patients with fever of unknown origin (FUO) and with unexplained chronic hepatitis.

CASE INFORMATION: A 30-year-old Latin American female from Veracruz,Mexico, presented with a third episode of fever and thrombocytopenia in thelast 4 years. During the second trimester of her fourth pregnancy, 4 years ago,she had her first episode of elevated liver enzymes and high grade feversthought to represent Hemolysis, Elevated Liver enzymes and Low Platelet (HELLP)syndrome of pregnancy. A liver biopsy showed sinusoidal lymphocytic infiltratewith focal hepatitis. She delivered at 32 weeks, liver enzymes, fevers andblood counts normalized after pregnancy. 1 year later, during the 23rdweek of her fifth pregnancy she developed familiar symptoms of high gradefevers to 104 F and jaundice. Again, liver enzymes were elevated and she had a grade2 thrombocytopenia. A liver biopsy showed similar findings of focal hepatitisand sinusoidal lymphocytes. After induced premature delivery for suspectedHELLP in the 25th week, her liver enzymes and platelets normalizedand fevers subsided. She remained asymptomatic for 3 years before developing 3 weeks of high grade fevers to 104 F, gradually declining platelet counts(123 K/cu. mm) and rising liver enzymes, (AST: 99, ALT: 76, alkalinephosphatase: 639). A liver biopsy revealed: Sinusoidal lymphocytes and grade 2fibrosis. In the work-up of her FUO, an EBV-PCR demonstrated markedly elevatedviral copies (262,114), other work-up including viral hepatitis serologies,blood cultures and a bone marrow biopsy were unrevealing. On the suspicion ofchronic EBV hepatitis, fluorescent in situ hybridization (FISH) forEpstein-Barr associated mRNA (EBER) was performed on all 3 liver biopsyspecimens taken over the past 4 years (Images 13). They revealed EBV infectionof CD3 positive polyclonal lymphocytes. A diagnosis of T-cell associatedchronic EBV infection was made and she was setup for a bone marrow transplant,which is considered by experts, the only cure for CAEBV.

IMPLICATIONS/DISCUSSION: While typically EBV infects B cell lymphocytes, it can also infect T cell, NK cells and epithelial cells. Acute infectious mononucleosis and B cell associated lymphomas are frequent manifestations of EBV in clinical practice. Adolescent Asians and Central Americans are susceptible to a T cell associated chronic active EBV syndrome. Usual presentations include fevers, pancytopenia, hepatitis and

lymphadenopathy persisting longer than 6 months. This case represents a unique presentation of CAEBV masquerading as HELLP. The largest retrospective series of 82 such patients (Kimura et. al, 2003) demonstrated a median age of 11.3 years with a median survival of 6.4 years for this condition. FUO and unexplained hepatitis are common in clinical practice, a high serum EBV-PCR should raise suspicion for CAEBV.

A POST-SURGICAL COAGULOPATHY; THE CASE OF A MISSING FACTOR Premal Lulla 1; Kelty Baker2. 1Baylor College odf Medicine, Houston, Texas ; 2Baylor College of Medicine, Houston, Texas. (Tracking ID # 12321)

LEARNING OBJECTIVES: 1. Recognize that prolongation of both prothrombin (PT) and activated partial thromboplastin time (aPTT), represent an abnormality of the final common pathway, containing factors X, V, II and fibrinogen.2. A 1:1 mixing study is a quick test to differentiate acoagulation factor deficiency from a factor antibody, both with distincttherapeutic approaches. CASE INFORMATION: A 69-year-old male underwent an elective repair of an abdominal aortic aneurysm. A pre-operative basic coagulation profile was normal. An INR on post-op day 6 was 1.1 with an aPTT of 32 s. On the 14th post-operative day, he developed hemoptysis, epistaxis and bleeding from the surgical site. Coagulation tests were as follows: PT: 100 s, aPTT: >150 s, INR: 9.4. Thrombin and reptilase times were normal. Fibrinogen was elevated

to 721 mg/dl. He was not on anticoagulants and had no prior history of coagulopathies. A peripheral blood smear was normal except for a normocytic normochromic anemia. An acquired inhibitor of the final common coagulation pathway was suspected when a 1:1 PT and aPTT mixing study did not correct. Amongst the factor levels tested for in the final common pathway, factor V levels were undetectable. An inhibitor specific for human factor V was identified through serial dilutions of plasma. It was measured at 14 Bethesda Units (BU). This inhibitor had no cross-reactivity with bovine factor V, suggesting no prior exposure to bovine thrombin. The acute bleeding was managed with aggressive blood transfusions, activated factor VII (Novoseven), -aminocaproic acid, plasmapheresis and platelet transfusions (to replete with platelet bound factor V). Bleeding arrested by postoperative day 15. Inhibitor elimination therapy with corticosteroids, plasmapheresis and Rituximab was initiated. By post-operative day 21 his INR gradually trended down to 5.94 and aPTT to 64 s. On post-operative day 34 he was discharged home with an INR of 1.4, aPTT of 39 s, Factor V levels of 45% and an undetectable factor V inhibitor.

IMPLICATIONS/DISCUSSION: Factor V is essential for the generation of thrombin, and congenital or acquired deificiencies of factor V lead to marked prolongation of PT and aPTT. Acquired Factor V inhibitors are rare, although strongly associated with bovine thrombin exposure during vascular surgeries. This occurs due to antibody sensitization to bovine factor V found as a contaminant in commercial bovine thrombin (fibrin sealants). Spontaneous factor V inhibitors are also known to develop, associated in case reports and case series with collagen vascular diseases, exposure to antibiotics or more commonly post-surgery. It is interesting that through yet unknown mechanisms, not all acquired factor V inhibitors cause clinical bleeding. Unlike the more common factor VIII inhibitors, these factor V inhibitors have been reported to disappear spontaneously in approximately 3 months. As internists, it is important to recognize the various steps involved in determining the cause of a coagulopathy including the importance of performing a 1:1 mixing study to rule out factor inhibitors.

BACTEROIDES FRAGILIS PRESENTING AS NONVALVULAR INVOLVEMENT WITH INFECTED LEFT VENTRICLE THROMBI VISHAL GOYAL 1; SUSAN MATHEW2. 1Allegheny General Hospital, Pittsburgh, Pennsylvania ; 2Internal Medicine, Pittsburgh, Pennsylvania. (Tracking ID # 12331)

LEARNING OBJECTIVES: 1. Identifying anaerobic bacteria as an uncommon but important cause of endocarditis and recognize likely source.2. Recognize management strategies, predisposing conditions, and

complications that evolve from anaerobic infections particularly in endocarditis. CASE INFORMATION: We describe a 44 year old Caucasian male with history of inflammatory bowel disease presented with fever, chills, generalized weakness, and foot pain with cyanotic discoloration. He was admitted in critical condition, and TTE proved to show 3 echodensities. The first infected thrombi was attached to the interventricular septum and the other two were attached to the apex. His EF was 25% with global hypokinesis. This lead to TEE which confirmed the findings. Blood cultures were positive for Bacteroides Fragilis, a gram negative anaerobic organism. Right foot pain was secondary to right foot ischemia most probably due to emboli from the vegetations in the left ventricle. This right foot ischemia converted to dry gangrene for which the patient would undergo debridement in future. A colonoscopy was done which showed multiple fistula openings in colon at multiple levels which quickly became an obvious source of bacteremia. After medically
stable and appropriate de-escalation of antibiotics to metronidazole, he received a proctocolectomy with ileostomy. Biopsy of the colon confirmed that the patient had Crohns diesease. With appropriate management and intervention, he had complete resolution of his acute illness.
IMPLICATIONS/DISCUSSION: Anaerobic bacteria are an important cause of infection. Based on recent literature reviews, Infective endocarditis from anaerobic bacteria account for only 2-16% over the last 30 years. There are also resistant patterns with anaerobic infections which have made and continue to make treatment difficult. Bacteroides is an anaerobic non spore forming gram negative bacilli which can be found in colon, vagina and nasopharynx, which hence account for most source of this infection including this patient. It has high mortality rate, is usually related to resistance and delays in time to detection of this organism. Since the advent of metronidazole, which is one of the bactericidal agents affective against anaerobic bacteria, there has been decrease in mortality rates. Bacteroides Fragilis also produces heparinase which may explain high rate of thromboembolic phenomenon in patients with this subtype of endocarditis. Complications associated with anaerobic endocarditis are valvular destruction, mycotic aneurysms, septic emboli, aortic ring abscess and aortitis, cardiogenic shock, dysrrhythmias and septic shock. Major differentiating points between common organisms causing endocarditis and Bacteroids endocarditis are lower incidence of pre-existing valvular heart disease, large vegetations and extensive valvular destruction more than streptococcus organisms but less than staphylococcus, higher incidence of peripheral embolization and high mortality rates. Since delay in diagnosis of endocarditis due to anaerobic organisms can lead to severe complications and high mortality one can consider adding coverage against anerobes especially if there are risk factors for development of anaerobic bacteremia.
THE DEFICIENT B-VITAMIN, CAUSING A VERY-VERY BIZZARE PRESENTATION Premal D Lulla 1; Lee Lu1. 1Baylor College of Medicine, Houston, Texas. (Tracking ID # 12334)
LEARNING OBJECTIVES: 1. Recognize the constellation of findings associated with adult Beri-Beri.2. Understand that severe malnourishment from any cause including depression can cause adult Beri-Beri.
CASE INFORMATION: A 34-year-old female with no significant past medical history, endorsed 3 months of gradually progressive amnesia, ataxia, visual blurring, hallucinations &a 40 lb. weight loss. She had first noted numb feet progressing proximally associated with tingling, burning &weakness of her legs. Subsequently, she noticed that she was forgetting newly learnt information, described as nothing sticks anymore . She had a repeating visual hallucination of a woman throwing gas at her , not vivid, but occurred before sleep and waking routinely for the past 1 month. This would cause her to have panic attacks and a racy heart . Her mother, endorsed a 3 month history of a progressive decline in her daughters mood. She was not communicating her thoughts and that she would frequently skip meals. On a review of systems, she had not had a period in 4 months, and more recently had developed alopecia spontaneously. Except for a hypophosphatemia (1.9 mg/dl), her electrolytes and blood counts were normal. Estrogen, FSH, LH and prolactin levels were normal. An MRI and an LP were unremarkable. An electromyogram revealed mild slowing in bilateral lower extremity nerve conduction velocities, with an axonal pattern. A neuropathy work-up which included an ANA, Vitamin B12 level, RPR, TSH, ESR &a heavy metal screen were normal. Fundoscopy demonstrated bilateral disc edema.

Psychiatry made a provisional diagnosis of atypical depression with psychotic features &began

treatment with risperidone and mirtazapine. Through multiple office visits, her heart rate had been 100-130/min in sinus rythym, an Echocardiogram showed an ejection fraction of 70% as a result of a high-output state. As part of an amnesia work-up a serum Vitamin B1 level was low: 0.6 micro-g/L (Normal 420). A diagnosis of adult Beri-Beri was made which was managed with oral thiamine with a dramatic improvement in her memory, neuropathy, tachycardia &resolution of hallucinations &visual symptoms over a 4 month period.
IMPLICATIONS/DISCUSSION: Glucose is dependant on thiamine as a co-enzyme for ATP production vital to the nerves and heart. Historically, thiamine deficiency was described as Beri-Beri among Asian populations that subsisted on polished rice. More recently, Beri-Beri has been noted among post-bariatric surgery patients (Towbin et. al, 2004) and those dependant on parenteral nutrition not supplemented with thiamine (Hahn et. al 1998). Adult Beri-Beri involves the nervous system, causing amnesia, peripheral neuropathy and hallucinations (dry), but in rare more severe cases cause high output heart failure manifesting as persistent tachycardia, with a wide pulse pressure and edema (wet). A more acute form coupled with a simple carbohydrate deficiency is seen in alcoholics as the more common Wernickes encephalopathy (Lonsdale D, 2006). Internists must recognize that Beri-Beri is a rare diagnosis among Western populations but malnourishment from any cause is a risk factor, including severe anorexia associated with depression.
AN UNUSUAL CASE OF ORTHOPNEA Ramin Motarjemi 1; Michelle Devor2. 1UCSD/ VA, San Diego, California ; 2San Diego Veterans Administration System, San Diego, California. (Tracking ID # 12335)
LEARNING OBJECTIVES: 1. Using Incliner Sleep Wedge device to relieve Dyspnea and hypoxemia caused by a large Hiatal Hernia 2. address a chronic problem with a simple home interventionCASE INFORMATION: 76 year old male with past medical history of Coronary Artery Disease, Diabetes Mellitus, hypertension, Hiatal Hernia who is being followed by Home based Primary care program.
Patient has been complaining of mild shortness of breath for the last year. Shortness of breath is mild at rest, worse with physical activity and laying supine. Symptoms worsen when he tries to go to bed and sleep. Sitting up relieves the shortness of breath. He has no chest pain, cough or leg swelling. No evidence of congestive heart failure was seen in home visit.
On physical exam, vital signs are normal. Oxygen saturation drops to below 85% when he lays supine. No lung crackles, jugular venous distention or lower extremity swelling was noted. He had a soft protuberant abdomen, no mass felt.
Pulmonary Function Test result was suggestive of a mild restrictive process. Cardiac Perfusion scan failed to show any evidence of coronary insufficiency. Echocardiogram showed EF of 61% with mild left ventricular diastolic dysfunction.
A Incliner Sleep Wedge device was ordered for him to use when supine and at night. His symptoms improved drastically and was able to sleep at night without waking up short of breath. His O2 saturations was 92% on room air in supine position with the wedge. IMPLICATIONS/DISCUSSION: Patient had work-up for his symptoms, but the work-up failed to point to a specific cause for his symptoms. He had no clinical findings suggestive of heart failure, but would have a significant drop in his oxygen saturation with change in position.we suspected that his hiatal hernia is causing his symptoms. We prescribed an Incliner Sleep Wedge device for him to use when he goes to bed at night to sleep. In follow-up visits, he reported that his nightly symptoms are almost gone and he can sleep without shortness of breath.
This patient had a sliding hiatal hernia, in which part of the stomach protrudes through the diaphragm and up into the chest (intrathoracic stomach).
While there is a large number of published data on hiatal hernia and its association with gastroesophageal reflux disease (GERD) and its complications(such as asthma like syndromes),there are few case reports in literature looking into Hiatal Hernia as a lone cause of respiratory symptoms. Cheung et al in 2009 discussed

the effect that hernia can have in the thoracic cage and calling it a rare Inthrathoracic Gastrointestinal disease.
BLASTIC PLASMACYTOID DENDRITIC CELL NEOPLASM PRESENTING AS FOREARM SOFT TISSUE SWELLING Jatin Rana 1; Javier Munoz 1; Nalini Janakiraman 1; Kedar Inamdar 1; David Nathanson1. 1Henry Ford Hospital, Detroit, Michigan. (Tracking ID # 12344)
LEARNING OBJECTIVES: 1. Blastic plasmacytoid dendritic cell neoplasm is a rare disease presenting frequently with cutaneous involvement. We report an interesting case in which a patient presented with left forearm soft tissue swelling. 2. The use of immunohistologic staining in the work up of a patients differential diagnoses is useful to detect and confirm the presence of rare malignancies.
CASE INFORMATION: We describe a case of a sixty-six-year-old female, who presented with tender left forearm soft tissue swelling for two months duration (Figure 1). One month later a routine screening mammogram revealed a new 4 mm mass in the left breast in addition to left forearm ultrasound finding of a 6.5x1x3.6 cm soft tissue mass which was also confirmed by magnetic resonance imaging (Figure 2 and 3). Subsequent left breast needle biopsy and left forearm fine needle aspiration favored an undifferentiated malignant neoplasm of hematolymphoid origin with markers CD4+/CD56+. Positron emission tomography (PET) scan showed activity in the left forearm (Figure 4) and left breast with extension to bilateral pleura, liver, spleen, portocaval lymph nodes and omental caking. A bone marrow biopsy was negative for malignancy and shortly thereafter the patient underwent induction therapy with cytarabine and idarubicin. Following progression of metastatic disease on PET scan, the patient received reinduction chemotherapy with mitoxantrone, etoposide, and cytarabine (MEC). Medical course was complicated with new onset seizures with subsequent imaging showing an intracranial mass thus biopsy had to be performed to rule out malignant involvement albeit the biopsy ultimately revealed benign meningioma. Following removal via left sided craniotomy, the patient suffered multiple complications including septic shock with Enterobacter cloacae bacteremia, disseminated intravascular coagulopathy, and pulmonary embolism. Seven months after the initial presentation, the patient was placed under hospice care and shortly thereafter passed away.
IMPLICATIONS/DISCUSSION: BPDCN is a rare malignancy formerly recognized as CD4+/CD56+ hematodermic neoplasm and is suggested to have derived from plasmacytoid dendritic cells. It typically presents in middle-aged or elderly patients initially with skin or soft tissue manifestations with concurrent aggressive disseminating disease and poor prognosis. The importance of accurate immunohistologic evaluation is highlighted because BPDCN represents a diagnostic challenge while sharing overlapping pathological features with acute myeloid leukemia, lymphoblastic lymphoma, NK/T cell lymphoma, myelomonocytic and monocytic leukemias. BPDCN expresses CD4, CD56, CD123 (interleukin-3 receptor alpha chain) and BDCA-2 (blood dendritic cell antigen 2) while expression of TCL1 is helpful when the tissue displays weak expression of above mentioned markers. BPDCN behaves as an aggressive acute leukemia thus survival is poor with a mean survival

time near 12 months in the isolated cases found in the literature. The treatment regimen usually involves first-line multi-agent chemotherapy followed by subsequent stem cell transplantation for best outcomes. Unfortunately our patient showed dismal response to chemotherapy and the originally intended stem cell transplantation could not be instituted due to poor performance status and the multiple complications that the patient faced after the surgical resection of her meningioma.
ACUTE HIV INFECTION PRESENTING AS MENINGIOENCEPHALITIS Colleen Ford 1; Eileen Reynolds1. 1Beth Israel Deaconess Medical Center, Boston, Massachusetts. (Tracking ID # 12345)
LEARNING OBJECTIVES: 1. Recognize the neurologic symptoms of acute HIV 2. Recognize the benefits of early HIV diagnosis and treatment.

CASE INFORMATION: A 45 yo male presented with fevers, headache and flu-like illness. He was in good health until 3 weeks prior when he developed fevers, nausea, vomiting, diarrhea, dizziness, diaphoresis, night sweats, arthralgias and myalgias. He presented to a local emergency department, was told he had an acute viral illness and was sent home with reassurance. He saw his PCP several days later and was given amoxicillin. He developed olfactory hallucinations smelling burning hair, labile emotions and anxiety, intermittent vision changes, increased thirst, severe headache and neck pain and an unintentional 20 lb weight loss. He had recently divorced and was engaged in unprotected sex with men and women. Physical exam was notable for T 103.8, diffuse lymphadenopathy, and pharyngeal exudate. He was alert and oriented. CT head was normal. WBC was 4.7. He had an LP with 133 WBCs, 5 RBCs, glucose 48, and protein 144. He was started on vancomycin, ceftriaxone and acyclovir for presumed meningitis. CSF bacterial culture was negative. CSF HIV viral load was 168,000 and serum HIV viral load was 774,000. Serum RPR was positive. CSF RPR was negative. His CD4 count was 349 and his HIV antibody was positive. Given his clinical presentation and high viral load, it was felt he had acute HIV with recent seroconversion. He was discharged with close follow-up with his PCP and Infectious Disease. He was treated with penicillin G and HAART.
IMPLICATIONS/DISCUSSION: The failure to recognize his symptoms as consistent with acute HIV caused a delay in diagnosis. The patient had many features suggestive of HIV including diffuse lymphadenopathy, weight loss, fevers, sore throat as well as risk factors for HIV infection. His neurologic symptoms were consistent with acute meningioencephalitis. Neurological features- such as those seen in aseptic meningitis and menigioencephalitis are seen in up to 17% of patients with acute HIV. His positive antibody suggests that he had been infected with HIV for >3 weeks. Establishing a diagnosis of acute HIV is important from a public health perspective as these patients are highly infectious from their high viral load and may continue to engage in risky behaviors that put others at risk for infection. He was also coinfected with syphilis. Coinfection with an STI in either sexual partner increases the rate of infectivity by up to 10x. His high viral load, low CD4 count and symptom severity suggest a more rapid progression to AIDS. There is still considerable debate about whether anti-retroviral therapy should be initiated during acute infection of HIV. Data suggests that early treatment may have many benefits including decreased severity of acute illness, preservation of cellular immune function, establishing a lower viral set point, limiting viral mutation, prolonging time off chronic therapy and reduced viral transmission. Initiation of HAART was warranted in this case given symptom severity, CD4 count <350 and high viral load.

23 YEAR-OLD MAN WITH ANAPHYLAXIS AND ECHINOCOCCAL CYSTS Arielle Berger 1; Jason Andrew Korcak1. 1Montefiore Medical Center of the Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 12360)

LEARNING OBJECTIVES: 1. Describe a unique case of anaphylaxis secondary to echinococcal cyst rupture 2. Recognize the importance of a complete social history in the diagnosis of complex diseasesCASE INFORMATION: A 23-year-old man with no known past medical history presented with abrupt onset of a pruritic rash on his face, chest, and arms. The pruritis was immediately followed by an episode of nausea, vomiting, and generalized abdominal pain. The patient denied a history of similar symptoms, took no medications, and reported no allergies. He was born in Albania and lived on a sheep and cattle farm before moving to the United States at age 10. His last visit to Albania was 1 year prior to presentation. On physical exam, the patient was afebrile and hemodynamically stable. He had a morbilliform, lacey, and blanching rash on his face, upper chest, back, and knees. His abdomen was non-distended with diffuse rebound tenderness. Initial labs were significant for a white blood cell count of 12.7 k/mL with 91% granulocytes and a total bilirubin of 2.2 mg/dL. An abdominal CT scan demonstrated multiple complex hepatic cysts with daughter cysts measuring up to 6 cm, as well as perihepatic and pelvic ascites, suggesting cyst rupture. Definitive diagnosis was made by surgical excision of multiple hydatid cysts containing protoscolices, consistent with echinococcus.
IMPLICATIONS/DISCUSSION: We describe a case of hepatic echinococcal cyst rupture with subsequent

hypersensitivity rash and peritonitis. Cystic echinococcus is caused by the parasitic tapeworm Echinococcus granulosus. This disease is rare in the United States with only one case per million people, mostly occurring in immigrants from endemic regions, including the Mediterranean, Eastern Europe, North Africa, and South America. The lifecycle of the parasite begins with colonization of the small intestine in definitive hosts, usually dogs or related species, followed by the release of eggs in feces and the ingestion of eggs by intermediate hosts, such as sheep or goats. Humans can also be exposed to echinococcus through fecal-oral transmission, especially when living in close proximity to these animals. Though any organ may be affected, cysts are most commonly found in the liver, followed by the lungs. Cysts typically grow at a rate of 1 to 5 cm per year and may be asymptomatic for up to 20 years before presentation. Rupture occurs in approximately 3% of hepatic cysts, most often secondary to trauma. Cyst rupture allows spillage of contents into the peritoneal or pleural space, which can lead to allergic reactions, secondary bacterial infections, and implantation of adult tapeworms throughout the peritoneal cavity. Although classic descriptions of cyst rupture include progression to anaphylaxis, the incidence of anaphylaxis is uncommon, occurring in only0.5-16.7% of cases. In this example, a thorough social history along with an understanding of the transmission of echinococcus helped link a presentation of anaphylaxis to a diagnosis of echinococcal cyst rupture.

A BODY-BUILDER AND HIS SURREPTITIOUS STEROID USE Sonica Bhatia 1. 1New York Presbyterian Hospital/ Weill Cornell Medical Center, NY, New York. (Tracking ID # 12372)

LEARNING OBJECTIVES: 1. Recognize increasing prevalence of anabolic-androgenic steroid use among non-elite athletes in primary care settings.2. Recognize signs and symptoms of anabolic-androgenic steroid (AAS) use. CASE INFORMATION: A 31 year-old male with PMH asthma and obstructive sleep apnea, presents at a primary care doctors office for follow-up of multiple episodes of palpitations, flushing, chest discom-

fort, loose bowel movements, and shortness of breath over the last 8 months. He associates these symptoms with eating a variety of foods and taking a caffeine pill prior to exercising. He notes increased anxiety when going to the gym, but does not feel chest discomfort or shortness of breath while exercising. No complaints of sexual dysfunction. He is a professional body builder, and reports that he last took human growth hormone about 8 months prior to this visit. Exam is notable for mild hypertension, increased muscularity, and bilateral gynecomastia, and normal testicular size. Cardiac and pulmonary exam are normal. EKG shows NSR with borderline left ventricular hypertrophy. CBC reveals a hemoglobin of 17.6 g/dL. Lipid panel reveals marked dyslipidemia, with an HDL of 19 mg/dL and LDL 262 mg/dL. BMP and 24 hour 5-HIAA urine testing are normal. TTE reveals borderline low left ventricular ejection fraction, with normal wall thickness, and no valvular abnormalities. Twenty-four hour EKG monitoring does not reveal arrhythmia. After multiple interviews with several providers, he reveals that he has been taking methenolone acetate (primabolan) for the past 16 years, has taken human growth hormone and clomiphene in the past year, and had started tapering testosterone from daily injections to weekly injections. He was encouraged to continue to taper the testosterone off and started on an SSRI. He was also referred to endocrinology, and LH and FSH were both found to be less than0.2mIU/mL. Four months later, he reported that his symptoms had improved with the SSRI, and he was continuing to taper the testosterone. His blood pressure normalized and his lipid panel had improved. His SSRI was continued and he was referred to cognitive behavioral therapy. IMPLICATIONS/DISCUSSION: Competitive athletes began using AAS in the mid-1950 s, and these drugs became more prevalent among non-elite athletes beginning in the 1980 s, due to an increase in availability and decrease in cost. Many AAS users do not seek medical attention, and if they do, many do not reveal their AAS use. Some of the adverse effects that have been linked to AAS use include AAS-induced cardiomyopathy, hypertension, dyslipidemia, atherosclerotic disease, sexual dysfunction, chronic kidney disease, and symptoms of mood disorders. Underground steroid guides advise users to use AAS in cycles to allow the HPG axis to recover, and these guides suggest that clomiphene can

help to mitigate this recovery. It is suggested that AAS withdrawal may induce major depression. In addition, AAS users may be prone to body- image disorders. Muscle mass is closely linked to their self-esteem, and loss of muscularity induces anxiety, which can make it that more difficult to abstain from AAS use. SSRIs as well as cognitive behavioral therapy may be helpful for patients who are exhibiting signs of AAS dependence.

A NOT SO RETRO VIRUS Jason Halperin 1; Lauren Richey2. 1Tulane University Department of Internal Medicine, New Orleans, Louisiana ;
2Tulane University Department of Infectious Diseases, New Orleans, Louisiana. (Tracking ID # 12377)

LEARNING OBJECTIVES: 1. 1. Recognize the Central Nervous System manifestations of acute HIV infection 2.2. Review the Fiebig stages of acute HIV infection.3. Discuss the advantages and disadvantages of treating acute HIVinfection. CASE INFORMATION: A 33 year old woman presents with a one day history of myoclonus. She describes diffuse muscle contractions lasting only minutes but with frequent recurrence. In addition, she has had two episodes of bladder incontinence. She denies any change in consciousness, lip smacking, headache, neck stiffness or aura preceding her attacks. She denies recent fevers, night sweats or chills. She smokes one pack of cigarettes daily, and denies ever using illicit drugs. She reports a
recent unprotected sexual contact. Her past medical history is significant only for pelvic inflammatory disease diagnosed two weeks ago.

The physical examination was unremarkable with the exception of painful bilateral generalized muscle contractures lasting approximately thirty seconds and occurring every ten minutes. Our patient was able to converse and track her physician through these episodes.

Diagnostic testing revealed a metabolic acidosis with acute renal failure. Further, laboratory testing demonstrated an elevated creatinine kinase at 36,725 and an elevated lactic acid at 2.7. CT scan and MRI of the brain were unrevealing. EEG was normal. CSF analysis was significant for an aseptic meningitis with elevated protein and 19 white blood cells with 92% lymphocytes. Blood culture, RPR, CSF gram stain and culture, HSV PCR, as well as West Nile antibody screen were all negative. HIV ELISA was positive. Her HIV viral load by RNA PCR was1.5 million copies. Her western blot was positive but absent for the HIV p31 band, demonstrating acute HIV infection. IMPLICATIONS/DISCUSSION: Acute HIV infection (AHI) most commonly presents as mononucleosis-like illness with fever, rash, headache, lymphadenopathy and pharyngitis. Yet, the clinical picture is broad and up to 75% of symptomatic AHI may be missed at the first medical encounter. Aseptic meningitis is the most common CNS presentation. In our patient, the classic signs of meningitis were absent. Other less common presentations of CNS involved AHI include encephalopathy, ataxia, seizure and coma. AHI is easy to test and must be considered for a wide spectrum of presentations involving the CNS.

In 2003, Fiebig et al. classified primary HIV-1 infection into six distinct stages. Stage I is the sole presence of viral RNA with a mean cumulative day from infection of 15 days. Stage II is p24 antigen positive, with a mean cumulative day from infection of 22 days. Stage III is when the ELISA is positive with a mean cumulative day from infection of 25 days. Stage IV is western blot positive or negative but without p31 antigen with a mean cumulative day from infection of 31 days. Stage V is western blot positive but p31 antigen negative with a mean cumulative day from infection of 101 days. Stage VI is western blot positive including p31 antigen and is open-ended and no longer acute HIV infection. Our patient was Fiebig stage V demonstrating infection most likely occurred 34 months before hospitalization. Patient confirmed an exposure consistent with this timeframe.

Early initiation of anti-retroviral treatment (HAART) during AHI remains unknown. The benefits include decreasing the severity of AHI, decreasing the incidence of opportunistic infections, slowing the progression to AIDS and decreasing transmission by rapidly suppressing the viral load. The disadvantages include drug toxicity, difficulty with lifelong adherence, and the risk of drug resistance. Further research is urgently needed and until then starting HAART during AHI will remain a case by case decision.

INTRA ABDOMINAL MALIGNANCY PRESENTING AS SUBCUTANEOUS NODULES ALONG VENTRICULOPERITONEAL SHUNT Umna Ashfaq 1;

Umna Ashfaq1. 1Internal Medicine, DOM, University of Florida, Gainesville, Florida. (Tracking ID # 12388)
LEARNING OBJECTIVES: 1. Subcutaneous nodules along ventriculoperitoneal shunt as the initial presentation of intra abdominal malignancy with seeding along the shunt was seen which mimicked cellulitis and a missed diagnoses if not considered in differential diagnosis. 2. N/ACASE INFORMATION: A 55 year female presented to clinic for evaluation of subcutaneous nodules over chest wall medial to right breast. These

painless nodules have been more prominent when supine and less prominent upon standing. She had a past medical history of head trauma after a fall from a moving truck. She had sustained subarachnoid hemorrhage, diffuse axonal injury and traumatic neuropathy in right eye. She underwent ventriculostomy for relief of hydrocephalus, later retroperitoneal shunt for refractory hydrocephalus. Post hospitalization course was uneventful, later developing hypertension. 2 years later ventriculoperito-neal shunt was replaced secondary to infection and persistent headaches. A year later, she noticed subcutaneous nodules along her shunt on abdominal wall,was reassured that it was a normal scarring after a ventriculoperitoneal shunt . Initially painless, but later became painful and prominent while standing also. Patient was treated for cellulitis for persistant nodules , soft tissue ultrasound was done which showed right breast mass with nodules along the shunt. Breast biopsy showed invasive papillary carcinoma of right breast and was ER/PR positive. HER-2 was negative. Later evaluation by computerized tomogram revealed lesions in her spleen as well as soft tissue mass along ventriculoperitoneal shunt in the abdomen with peritoneal carcinomatosis. Initially chemotherapy was started on Femara but progression was seen on imaging studies. Perineal masses were also seen which have increased in size. She also had evidence of tumor in the pelvis. Chemotherapy was changed to weekly Taxol but poor response was seen. Subsequent workup suggested likely peritoneal or ovarian primary with tracking along ventriculoperitoneal shunt presenting as subcutaneous nodules. Later chemotherapy was changed to Gemcitabine and carboplatin to which patient responded. IMPLICATIONS/DISCUSSION: This case presents a unique presentation of intraabdominal tumors. Subcutaneous nodules are continuously being treated as cellulitis but has not been considered as tumors from abdominal malignancy tracking along ventriculoperitoneal shunt in patients with shunt placement. Metastasis through ventriculoperitoneal shunt has been seen as Germinoma that metastatized to the peritoneal cavity and ovarian cancer that developed iatrogenic leptomeningeal involvement of the lateral ventricle. These rare presentations of tumours or complications of shunts should be considered in the differential diagnoses.

AN INTERNISTS ROLE IN THE RESPONSE TO THE EARTHQUAKE IN HAITI IN JIMANI, DOMINICAN REPUBLIC Theresa Townley 1;

Theresa Townley1. 1Creighton University, Omaha, Nebraska. (Tracking ID # 12389)
LEARNING OBJECTIVES: 1. Provide insight into the role of an internist in a humanitarian disaster such as the earthquake in Haiti through the review of some some common medical problems encountered after the earthquake in Haiti. 2. Provoke discussion about the common therapeutic, diagnostic and management dilemmas faced in a disaster in a low resource setting and Discuss essential medicine and supplies required in a low resource setting to adequately respond to such a disasterCASE INFORMATION: On January 12, 2010 an earthquake struck Port-au-Prince (PAP)causing massive damage including the death of approximately 300,000 and disabling injuries to another 250,000. Although the primary need initially was for surgeons, patients suffered severe injuries which required non-surgical physicians to provide quality medical care despite resource limitations.
Patient #1-A 35 yo f who was pulled from the rubble and had a suspected unstable pelvic fracture as well as a right femur fracture. She had an external fixator placed on her right leg, a foley placed secondary to urinary retention and was on bed rest. On day #8 post-earthquake, she developed the acute onset of shortness f

breath. On exam, she was dyspneic and had a hard time speaking more than a few words at a time. On exam, she was tachycardic with a heart rate
of 100 but no murmurs, rubs or gallops . Chest sounds were clear. How do you proceed?
Patient#2 Patient was found under rubble, a large piece of mortar had landed on his leg and he developed extensive skin necrosis. He required multiple debridings and was found to have a large foul smelling wound. What antibiotics would you use to supplement the debridement? Patient #3- A 32 yo f who was found underneath rubble. After being pulled out of the rubble, she was unable to move her legs. No other injuries were apparent. She was placed on a cot. When patient could not find care in PAP, she was transported to the hospital in Jimani She was evaluated by the medical team approximately 6 days after the quake. A foley catheter was placed. What other measures need to be done? What should be done for other similar patients? Case#4 21 yo f suffered a severe crush injury to her foot which requires placement of an ex-fix and multiple debridments which are excruciatingly painful. How would you proceed with dressing changes?
IMPLICATIONS/DISCUSSION: Complex humanitarian disasters such as earthquakes in low resource settings require the rapid mobilization of trained medical professionals equipped with adequate supplies and medications. Although, surgeons are in high demand, there is also a need for skilled internists with attention to medical problems likely to develop in this setting as well as attention to supply chain and
IS THE PATIENT REALLY DYING FROM THIS? AGGRESSIVE MANAGEMENT AND GOALS OF CARE IN INTRACTABLE SPINAL INFECTIONS Rachel D.A. Havyer 1; Molly L. Olsen 1; Keith M. Swetz1.
1Mayo Clinic, Rochester, Minnesota. (Tracking ID # 12396)
LEARNING OBJECTIVES: 1. Recognize the importance of delineation of goals and aggressive symptom control in intractable spinal infections2. Distinguish phases of dying as active and acute versus chronic yet impendingCASE INFORMATION: A 56-year-old woman with brittle type 1 diabetes mellitus and end-stage renal disease developed an infected dialysis graft and ensuing methicillin-resistant Staphylococcus aureus (MRSA) endocarditis. Subsequently, debilitating back pain developed leading to a diagnosis of multi-drug resistant, multilevel, MRSA thoracic osteomyelitis (T9-T11) and epidural abscess (T5-T12). The infection progressed despite several antibiotics and led to paraplegia. Pain remained intractable despite several methods of analgesia including opioids and adjuvants, which led to significant delirium. Multiple comorbidities precluded operative treatment; however, palliative drainage was attempted with no improvement in pain or neurologic status. Due to the progressive and incurable nature of the condition and her severe symptoms, several goals of care discussions were had that delineated the major goal of maximal survival, but also a goal of improved pain control. Respite palliative sedation with mechanical ventilation did provide some improvement in her pain. Ongoing discussions as to whether the patient was dying led to varying opinions. Though the patient was not fulminantly septic and actively dying, her prognosis was limited and overall grim. Several discussions allowed for maximal medical measures to continue as long as possible, but with maximal pain control concurrently. She was ultimately discharged to a swing bed with antibiotics and ongoing dialysis until her death one month later due to progressive infection. IMPLICATIONS/DISCUSSION: Non-tuberculous bacterial spinal infections can involve the spinal column or the epidural space, with or without diskitis or osteomyelitis. Spinal infections are a rare but serious cause of back pain, and pain is the presenting symptom in roughly 75% of cases. Symptoms often improve with successful treatment of the infection, including combined systemic antibiotic therapy and surgical debridement.

Spinal infections can be treated with antibiotics alone when surgery is declined or contraindicated due to perioperative risk. Unsuccessful treatment may lead to complications including disseminated infection or neurologic complications including paralysis, spasticity, or severe pain. In these cases, prolonged and significant morbidity without definitive treatment options may occur, but prognosis may not be significantly shortened. However, when multiple comorbidities exist or infection is difficult to treat due to allergies or

emerging resistance, overall survival may be reduced. Though spinal infection may be able to be suppressed to variable degrees, potential complications including long-term pain and symptom management, and eventual death, may need to be discussed. Care providers need to be aware that progressive spinal infection may indeed be a terminal disease, particularly when other comorbid conditions coexist, even if the patient is not septic. Generalists involved longitudinally in the care of these patients should adequately ascertain patient decision making and delineate goals of care early and iteratively to ensure the best possible quality of life for these patients.

DIGITAL ARTERIAL THROMBOSIS SECONDARY TO ESSENTIAL THROMBOCYTHEMIA Myung Jae Lee 1; Fahad Khan 1; KarLeung Siu 1; Kati Glockenberg 2; Alfred Burger1. 1Beth Israel Medical Center, New York, New York ; 2Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 12406)

LEARNING OBJECTIVES: 1. To present a case of essential thromboycythemia (ET) presenting with digital ischemia2. To review the signs and symptoms of the rare disorder of essential thrombocythemiaCASE INFORMATION: A 52-year-old woman was sent to the hospital by her vascular surgeon for pain and dry gangrene at the tip of the right second digit. Two weeks prior her symptoms began with a burning sensation, mild ache and a slight blue discoloration. This progressed to a dark finger tip with worsening pain mildly relieved by holding her finger up to an air conditioner. There was no trauma to the finger, fevers or local infection. She is an active smoker with a medical history of right breast lumpectomy for a benign mass in 1992. Her only medication is over the counter ibuprofen. Physical exam showed a black tip of the right index finger with well defined borders at the distal interphalangeal joint. Pulses were full in all limbs. A grade II/VI systolic murmur was heard at the left sternal border. No splenomegaly was noted. Laboratory values showed, normocytic anemia, platelets of 1000 x 103/ L with an elevated white cell count of 20 x 103/ L. Coagulation times were normal. A heparin drip was started for presumed arterial thrombus. Cultures were negative for infection. EKG showed no dysrythmias. CT scan with IV contrast revealed no pulmonary embolus, DVT, aortic dissection or aneurysm. TEE showed no thrombi, vegetations or regurgitant valves. JAK2 and BCR/Abl mutations were not detected. Given the thrombocythemia with no obvious source of infection or chronic inflammation a diagnosis of essential thrombocythemia (ET) was made. She was started on hydroxyurea (HU) and low-dose aspirin. After 7 days of therapy platelet counts improved to 851 x 103/ L. The patient began to have pain in the right fifth digit with mottling and aspirin was increased to 325 mg and HU was continued. IMPLICATIONS/DISCUSSION: Limb ischemia is a common indication for hospital admission. Internists need to recognize essential, or primary, thrombocythemia as a rare cause of ischemic disease as the treatment differs from other more common causes of ischemia. Our case highlights the need to make the diagnosis of ET and its treatment. ET is a rare myeloproliferative disorder with an incidence of 13 per 100000 people. The average age of diagnosis is in the 5060 year old population. It is most often diagnosed incidentally by abnormality on routine labs.

Up to 85% of people are asymptomatic. ET is caused by a clonal defect in the platelet cell line. There is a sustained production of megakaryocytes which results in an abnormal rise in platelets over 600 x 103/ L without a clinically identifiable source of inflammation. Most thrombocythemias are reactive to an inflammatory process. ET comprises less than 10% of all thrombocythemias. Among reported cases of ET, studies show 11-25% with thrombotic complications. Erythromelalgia is a dermatologic manifestation seen in myeloproliferative disorders including ET. It presents as a burning sensation with swelling and redness of the extremities. This sensation is relived by cold and intensified by heat. It is common in thrombosis related to ET and may occur with or without ischemia. Other common manifestations include neurologic symptoms such as headache, dizziness and syncope or abnormal bleeding. Treatment for symptomatic ET includes low-dose aspirin for antiplatelet and HU for platelet-lowering strategies to reduce the risk of thromboembolic complications. Studies have shown long-term benefits from HU therapy. These are typically achieved at a median of 30 days.

DONT COUNT ON THE AMYLASE Frank A Evans 1; Danit Arad1.

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LEARNING OBJECTIVES: 1. Recognize the uniquely low sensitivity of serum amylase level in hypertriglyceridemia-induced pancreatitis2. Review different aspects of the third leading cause of acute pancreatitis CASE INFORMATION: A 25 year-old man presented with a several hour history of abdominal pain. The pain was severe, diffuse, and radiated to his back. He had never experienced similar pain and reported no known past medical conditions or alcohol use. Vital signs were unremarkable. He was morbidly obese and in mild pain-induced distress. There was no Murphys sign and a soft, yet diffusely tender abdomen was noted. There were no xanthomas or xanthelasmata. The rest of the exam was unremarkable. Serum glucose was 290 mg/dl and hemoglobin A1c was10.7%. Serum amylase was 160 u/l but serum lipase was 1030 u/l. Triglycerides were approximately 4000 mg/dl. Thyroid function tests were within normal. An abdominal sonogram revealed a normally distended gallbladder without a shadowing stone. Computed tomography scan of the abdomen revealed peripancreatic fluid and stranding surrounding the pancreatic body and head, consistent with acute pancreatitis. The patient was treated conservatively for acute pancreatitis and hyperglycemia. In addition, he was given oral Gemfibrozil 600 mg twice a day. After achieving glucose control and initiation of the antilipemic agent, a repeat level of triglycerides was approximately 200 mg/dl.
IMPLICATIONS/DISCUSSION: A serum amylase assay is most frequently ordered to diagnose acute pancreatitis due to its technical simplicity, easy availability, and high sensitivity. The exact sensitivity is difficult to assess because an elevated amylase is often used to make the diagnosis. When the estimation of amylase is early in the course of the disease and there is no history of chronic pancreatitis, a normal level would usually exclude the diagnosis of acute pancreatitis with the exception of hypertriglyceridemia-induced pancreatitis. A possible mechanism is that hypertriglyceridemia interferes with the laboratory measurement of amylase by preventing the calorimetric reading of the assay endpoint. Serum triglyceride concentrations greater than 1000 mg/dl may precipitate acute pancreatitis, whereas a level less than 200 mg/dl is associated with a reduction of recurrences. The pathophysiology of hypertriglyceridemia-induced pancreatitis is unclear. It is thought that the release of excess free fatty acids from triglyceride hydrolysis results in toxic injury to acinar cells and capillary

endothelia. Hereditary dyslipidemia syndrome best defines the association between pancreatitis and hypertriglyceridemia, with up to a 40% incident rate of acute pancreatitis in homozygous children for lipoprotein lipase or apoprotein-CII deficiency. Most adults with hypertriglyceridemia have either a mild form of inherited dyslipidemia or an acquired condition that raises serum lipids. Some of these conditions include alcohol abuse, hypothyroidism, pregnancy, estrogen therapy, glucocorticoid excess, nephrotic syndrome, medications, and as in the above patient, obesity and diabetes mellitus. When the clinical pretest probability is high for acute pancreatitis, but the amylase level is normal, it is important to proceed with further testing to determine hypertriglyceridemia as a possible cause.

MEDIASTINAL CLUTTER CAN MAKE YOUR HEART FLUTTER Vinod Khatri 1; Krishna Khatri 1; Sangmesh Jabshetty 1; Harvey Freidman1.
1St. Francis Hospital, Evanston, Illinois. (Tracking ID # 12411)
LEARNING OBJECTIVES: 1. Lymphoma presenting as mediastinal mass can cause pressure symptoms on the heart.2. This elevated mediastinal pressure maylead to atrial flutter/fibrillation. CASE INFORMATION: 73 yrs old gentle man with past medical history significant for indolent lymphoma presented to hospital with one month history o progressive dysphagia, three week history of dyspnea on exertion &three day history of bilateral lower extremity edema. He denied any constitutional symptoms such a fever, night sweats or weight loss. On examinations his vital signs were temp 97.7 F, pulse 65/ min regular, blood pressure 157/76 mmHg, respiratory rate 20/min and 96% on room air. His neck exam revealed a mobile, rubbery about2.5 cm lymph node in ant cervical group on left side. Chest exam showed decreased breath sound at both base with rest of lung fields

clear to auscultation, Cardiac exam revealed regular rate &rhythm, normal S1S2, with no murmurs, Abdomen was soft, mildly distended, no organomegaly, bowel sounds normal, Bilateral lower extremities revealed 3+ bilateral pitting edema. On evaluation his CT scan of chest abdomen and pelvis showed extensive bulky mediastinal &mesenteric lymphadenopathy. Mediastinal lymph nodes were causing mass effect on right side of heart. He underwent mediastinoscopy mediated lymph node biopsy which was consistent with marginal zone lymphoma. While in hospital patient developed an episode of Atrial flutter with 2:1 block which subsequently converted to sinus rhythm after amiodarone infusion. Pt had another episode of Atrial fibrillation with rapid ventricular response during the course of hospitalization which was treated successfully with amiodarone again. IMPLICATIONS/DISCUSSION: Lymphomas are known present as mass lesions both above &below the diaphragm. In this case extensively bulky mediastinal lymph nodes were causing mass effect on right side of heart leading to atrial flutter/fibrillation. On review of literature there are few case reports of primary or secondary cardiac lymphoma causing atrial brady and tachyarrythmias many of which were a result of chemotherapy for lymphoma. Lymphomas have also been reported to invade the pericardium and cause cardiac tamponade as a result of mass effect, but till date no case of lymphoma been reported to cause atrial flutter/fibrillation as a result of mass effect on right side of heart.

AN INTERESTING ENTITY: PRES (POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME) Parthiv R Amin 1; Adel El Abbassi 2; Bhuvana Guha 2; Thomas Roy2. 1East Tennessee State University, Jonesborough, Tennessee ; 2ETSU, Johnson City, Tennessee. (Tracking ID # 12412)

LEARNING OBJECTIVES: 1. 1. Clinicians should have high suspicion of PRES in appropriate clinical scenario.2. 2. Early diagnosis and treatment of PRES results in dramatic reduction in mortality and morbidity.

CASE INFORMATION: A 65 year old male, known case of hypertension and diabetes mellitus presented with fever and dyspnea. He was diagnosed with methicillin resistant Staphylococcus aureus (MRSA) pneumonia and later on developed ARDS and renal failure. He was put on mechanical ventilation. On day 4 of admission, he was weaned off of ventilator. He developed persistent confusion later and all the metabolic etiologies were excluded. His blood pressure was recorded to be 190/110 mm hg with bilateral Babinski sign. He later on became agitated and complained of 7/10, constant, generalized headache.

He was started on nitroprusside for blood pressure control. Metabolic and infectious factors were ruled out. His computed tomography of brain showed subcortical edema in parieto-occipital region suggestive of PRES. The patient improved over a course of 7 days with better blood pressure control. His MRI repeated later was suggestive of resolving PRES.

The patient was discharged after 3 weeks of admission with resolved PRES and MRSA pneumonia. The patient thus had multiple risk factors for PRES namely, accelerated hypertension, renal failure and sepsis; which resolved on blood pressure control. IMPLICATIONS/DISCUSSION: Posterior Reversible Encephalopathy Syndrome (PRES) is defined as a clinico-radiology entity characterized by presentation of headache, seizures, encephalopathy and visual disturbance accompanied by presence of reversible focal vasogenic edema on magnetic resonance imaging (MRI) of brain. The exact incidence of PRES is not known and it has been diagnosed in all age groups.

The syndrome is most commonly associated with hypertensive disorders including pre eclampsia and eclampsia, renal failure, sepsis, use of immunosuppresants and occasionally autoimmune diseases. Various theories proposed for the underlying pathophysiology include loss of cerebral autoregulation and endothelial dysfunction.

Seizures are often the presenting symptom in PRES. It is usually associated with constant and non localized headache; altered sensorium ranging from mild somnolence, confusion and coma and visual disturbances in the form of hemianopia, visual neglect, auras, hallucinations and cortical blindness. Physical examination usually reveals hypertension, exaggerated deep tendon reflexes and bilateral Babinski sign.

MRI is considered to be the modality of choice for imaging and typical findings include symmetrical punctate or

confluent areas of increased signal on proton density and T2-weighted images affecting particularly parieto-occipital region. Diffusion weighted images are used to distinguish PRES from top of the basilar stroke. The anatomical extent of radiological finding correlates with the outcome.

The treatment of PRES usually encompasses management of precipitating factor. Control of hypertension using parenteral short acting agents like labetalol and nitroprusside is paramount.

Most of the patients usually recover in 2 weeks; however deaths have been reported due to progressive cerebral edema. Control of hypertension usually produces dramatic improvement in patients and it is imperative to recognize this syndrome early in order to reduce the associated morbidity and mortality.

THE MANY FACES OF ADRENAL INSUFFICIENCY Julia Durrant 1;

Deepa Malaiyandi 1; Jennifer Mackinnon1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 12414)

S544 ABSTRACTS JGIM

LEARNING OBJECTIVES: 1. Recognize adrenal insufficiency in patients who, despite massive bilateral adrenal hemorrhage and low cortisol levels, fail to develop the classic symptoms of hypotension and electrolyte abnormalities after weeks of significant hormone deficiency.2. Assess patients with vague abdominal complaints who are anticoagulated post- operative after surgery for adrenal hemorrhage.

CASE INFORMATION: 67 year old woman presented post-operative day (POD) 18 from subacute rehab (SAR) for nausea, vomiting and vague abdominal pain following a right total knee arthroplasty. Anticoagulation with Coumadin 5 mg daily and 2 doses of Heparin 5,000 units for 1 day was started. Aside from an episode of hypotension (BP 78/57), low urine output and emesis on POD 2, her course was uneventful and discharged to SAR POD 3.

On POD 8, she returned with 4 days of vomiting, abdominal pain and constipation. Right upper quadrant ultrasound was normal. INR was2.1 and no other abnormalities were noted. She was diagnosed with postoperative ileus. On POD 12, she returned to the ED with sharp abdominal pain and multiple episodes of emesis. Last bowel movement was noted to be the day prior. Given her recent ED visit she was discharged on scheduled bowel regimen despite sodium of 128 and anion gap acidosis.

Due to ongoing anorexia and nausea, she was admitted to the hospital on POD 18. Labs revealed anion gap of 18, INR 3.9, lipase 67 and urine ketones. Oral intake and new medications begun at SAR were stopped. Labs and symptoms normalized the next day, however symptoms recurred with advancement of diet and improved once she was NPO. On POD 23, an endoscopic exam demonstrated atrophic gastritis, thickened antral folds and wide-open lower esophageal sphincter. A CT obtained to evaluate extralumal GI tract demonstrated massive bilateral adrenal hemorrhage.

The patient was transferred to intensive care unit for observation with an 2300 cortisol level of 1.7, normal vital signs and electrolytes. Diagnosis of primary adrenal insufficiency was confirmed by cosyntropin stimulation. Baseline morning cortisol was 1.8, with no response to cosyntropin at 30 (1.8) and 60 (1.9) minutes after stimulation. ACTH was elevated at 456.6. Renin was 5.3 and aldosterone <1.0. On POD 25, she began daily oral hydrocortisone and general diet with resolution of all symptoms and discharged the following day.

IMPLICATIONS/DISCUSSION: Acute primary adrenal insufficiency (PAI) is a rare but life-threatening disorder, usually caused by the anatomic destruction of the adrenal gland. 80% of PAI is caused by autoimmune destruction of the gland and the majority of acute adrenal crises are acute on chronic exacerbations caused by sepsis, surgical stress or abrupt corticosteroid withdrawal.

Adrenal hemorrhage is an uncommon cause of PAI, classically associated with meningococcal septicemia, although antiphospolipid syndrome, surgery, trauma and anticoagulation are recognized risk factors. Symptoms often consist of fever and abdominal pain with progression to hypotension and shock and laboratory findings might include hyponatremia, hyperkalemia, azotemia, and anemia, although these can vary with presentation. Postoperative use of heparin and warfarin, especially after orthopedic surgery, has been associated with an

increased incidence of adrenal hemorrhage. Our patients INR was briefly 3.9, but was otherwise therapeutic and duration of heparin bridging was less than one day, lowering our suspicion for anticoagulation related complications.

Our patients presenting symptoms of nausea, emesis, and anorexia are common in the postsurgical patient and nonspecific, complicating diagnosis. Electrolyte abnormalities of mild hyponatremia, hypokalemia and metabolic acidosis were presumed to be secondary to anorexia and vomiting and resolved with fluid resuscitation. Ongoing symptoms were ascribed to ongoing ileus and severe reflux. The presumed diagnosis was not reevaluated following lack of resolution of symptoms. Acute decompensation due to adrenal failure may occur several days after the hemorrhagic event; review of the literature failed to highlight other cases of severe bilateral adrenal hemorrhage with low cortisol and normal laboratory findings several weeks after injury. Therefore a high degree of suspicion for PAI should be maintained in postoperative patients with tenacious, unexplained symptoms.

A RARE CASE OF MULTIPLE SYSTEM ATROPHY (MSA) IN A 28-YEAR-OLD WOMAN Damanpreet Kaur Grewal 1; Sara Taherkhani2; Diljon Chahal 2; Robert Fishman 2; Abby Spencer2. 1West Penn Allegheny Health System, Pittsburgh, Pennsylvania ; 2Allegheny General Hospital, Pittsburgh, Pennsylvania. (Tracking ID # 12418)

LEARNING OBJECTIVES: 1. Distinguishing MSA is important due to differences in treatment and prognosis.2. MRI identifying hot-cross bun sign plays a crucial role in diagnosis of MSA CASE INFORMATION: A 28 year-old right-handed female with past medical history of depression and anxiety under good control on no medications presented with progressive loss ofbalance while walking and lower extremity hyper-reflexia. Blood-work including serum copper, ceruloplasmin and vitamin B12 levels did not reveal any abnormalities. Given the unclear etiology of her symptoms, patient was then referred to neurology. Four months after her initial presentation, she demonstrated micrographia, saccadic pursuit movements, dysarthria, increased tone, extensor plantar response, loss of coordination and dysmetria. MRI showed an early hot cross bun sign consistent with MSA. The patient was lost to follow-up and no further information on patients functional status could be obtained.

IMPLICATIONS/DISCUSSION: MSA is a rare neurological condition of undetermined etiology characterized by dysfunction in any combination of extrapyramidal, pyramidal, cerebellar and autonomic systems. It often presents similarly to Parkinsons disease (PD) and other neuro-degenerative diseases affecting the white matter and can lead to difficulties in diagnosis. It usually presents in individuals older than 50 and affects men more than women with mean age at presentation 50 years. The median survival is less than 10 years and 10% of patients with a diagnosis of PD are found to have MSA at autopsy. The clinical differentiation of PD and MSA is extremely difficult given the frequent occurrence of parkinsonian symptoms in MSA. The hot cross bun sign on MRI is pathognomonic for MSA. Patients with MSA have poor response to chronic levodopa therapy, more autonomic features, severely affected speech, absence of dementia, absence of levodopa-induced confusion and early falls. This case demonstrates that MSA should not be dismissed as a differential diagnosis in a young patient presenting with parkinsonian symptoms given the rapid progression of disease.

AN UNUSUAL CASE OF PYELONEPHRITIS Joshua S. Baru 1; Brian Peter Lucas2. 1Cook County Hospital, Chicago, Illinois ; 2Cook County Hospital and Rush Medical College, Chicago, Illinois. (Tracking ID # 12428)

LEARNING OBJECTIVES: 1. To describe the clinical presentation and diagnosis of renal infarction 2. To describe the etiology and differential diagnosis of renal infarctionCASE INFORMATION: A 48 year-old woman presented with one week of right flank pain that radiated to her back and two days of fever.

She denied gastrointestinal or genitourinary complaints. The pain was not related to eating. She is married and monogamous; she has never

had a sexually transmitted disease. Past history was significant for a total abdominal hysterectomy five months prior. Her temperature was 101.0 F and pulse was regular. Exam showed costovertebral angle tenderness on the right side and a systolic murmur that was three out of six, late peaking, crescendo-decrescendo in the aortic position with radiation to the carotids; she had normal carotid upstrokes. Urinalysis showed pyuria. The patient was initially treated in the emergency department observation unit for presumed pyleonephritis. However, her fever and her pain persisted and she was transferred to the General Medical floor.
Urine culture showed no growth. Computed tomography (CT) scan revealed a wedge-shaped area of low attenuation in the midpole of the right kidney. There was no evidence of renal artery stenosis on an ultrasonogram. A trans-esophageal echocardiogram revealed a heavily calcified aortic valve but no vegetations, patent foramen ovale (PFO) or intracardiac thrombus. Antinuclear and anti-neutrophil cytoplasmic antibodies were negative. Partial thromboplastin time was normal.
The patient was diagnosed with an idiopathic renal infarct. She was started on anticoagulation.
IMPLICATIONS/DISCUSSION: Renal infarcts mimic many diseases commonly encountered by internists. The presentation of renal infarcts is non-specific and frequently includes flank pain, nausea, vomiting and fever. Because the presentation is non-specific, it is often misdiagnosed as renal colic, pyelonephritis, urinary tract infection or even acute abdomen. The absence of urinary symptoms or bacteriuria and characteristic findings on contrast-infused CTscan (cortical rim sign) readily distinguish it from pyelonephritis. Lactate dehydrogenase is also useful as a highly sensitive marker for renal infarction. Given their ease of use, availability, and diagnostic accuracy, contrast-enhanced multi-detector CT is the standard for diagnosis of renal infarction.
Renal infarction is caused by cardioembolic phenomena or renal artery thrombosis. Cardioemboli can originate from the left atrial appendage, the left ventricle, the valves, the aorta or the venous circulation via a PFO. Renal artery thrombi occur in the setting of trauma, renovascular disease, renal artery dissection, medium vessel vasculitides such as polyarteritis nodosa, and hypercoaguable states such as the anti-phospholipid syndrome. Up to 60% of cases are idiopathic. Therapeutic guidelines for idiopathic renal infarcts are not well established, but anticoagulation for three to six months is generally recommended. Renal infarction should be considered in atypical presentations or courses of common intra-abdominal pathology and is readily diagnosed by CTscan.
SCEDOSPORIUM APIOSPERMUM CAUSING BLINDNESS Agnel rajani Raparthi 1; Darren Thomas2.
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(Tracking ID # 12435)
LEARNING OBJECTIVES: 1. 1 Scedosporium apiospermum is an emerging; potentially life-threatening fungal pathogen .It has become an important cause of opportunistic invasive fungal infection and accounts for 25% of all non aspergillus mold infections.2. Scedosporium is clinically and histologically indistinguishable from Aspergillus, but is typically resistant to amphotericin B making culture imperative to ensure effective pharmacotharpy.
CASE INFORMATION: A 65-year old female with noninsulin-dependent type-2 diabetes mellitus and chronic headache was transferred to our hospital for management of acute renal failure. After admission she had sudden onset of complete blindness in her left eye. The patient had a five month history of intractable left sided temporal headaches with associated double vision; she had been treated for temporal arteritis with steroids as an outpatient, though her temporal biospy had been
negative. Head computerized tomography without contrast showed an increased soft tissue density in the left orbital apex. Magnetic resonance imaging was not performed because the patient had a pacemaker. After resolution of renal failure computed tomography of orbit and sella with and without contrast revealed soft tissue mass in the left orbital apex which was contiguous with the abnormal soft tissue mass within the sphenoid and ethmoid sinuses. Sphenoidectomy revealed moist, fungal debris filling the sphenoid and to a lesser degree posterior ethmoids. Histopathology revealed multiple dense clusters of fungal hyphae, branching and focally

septate. Scedosporium apiospermum was isolated on culture. She was treated with voriconazole. Despite treatment she had progression with eventual stroke and death. IMPLICATIONS/DISCUSSION: 1) Invasive fungal sinusitis is more common in patients with hematological malignancies, bone marrow transplantation, chemotherapy induced neutropenia, solid organ transplantation, advanced HIV infection, diabetes and corticosteroid treatment.2) Chronic invasive fungal sinusitis is associated with high mortality due to advanced disease by the time of diagnosis.3) The lack of early clinical suspicion for fungal etiology may delay accurate diagnosis and treatment leading to increased mortality.4)Chronic invasive fungal sinusitis should be considered in diabetic patients with chronic sinusitis and orbital symptoms.5)Aspergillus and Mucor are more common pathogenic fungal sinus infections and with less common organisms being Bipolaris, Curvularia, Alternaria, and Scedosporium.6)Scedosporium apiospermum is an emerging; potentially life-threatening fungal pathogen commonly found in soil and polluted water.7)It has become an important cause of opportunistic invasive fungal infection and accounts for 25% of all non aspergillus mold infections in organ transplant recipients.8)Early endoscopic evaluation should be conducted for both diagnostic biopsy and for debridement.9)Scedosporium is clinically and histologically indistinguishable from Aspergillus, but is typically resistant to amphotericin B making culture imperative to ensure effective pharmacotharpy.10)Appropriate earlier antifungal therapy combined with surgical debridement and restoration of immune function leads to decreased mortality.

NEGATIVE PRESSURE PULMONARY EDEMA MOHAMMAD ALMIANI1;

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LEARNING OBJECTIVES: 1. To recognize the uncommon pulmonary complications after extubation. 2. To recognize the importance of early treatment of negative pressure pulmonary edema.

CASE INFORMATION: A 45 year old Causasian female with no significant past medical history was admitted for septoplasty for nasal septum deviation. Physical exam and chest X-ray prior to the surgery were unremarkable. The patient underwent septoplasty under general anesthesia. The induction and the procedure were uneventful. The surgery lasted for 2 hours after which the patient was extubated. Within 5 minutes after extubation, the patient developed transient stridor followed by respiratory distress manifested by tachypnea, cyanosis and oxygen desaturation (70%) for which she required urgent reintubation. Upon reintubation, no laryngeal edema was noted. Pink, frothy secretions were noted in the endotracheal tube. Physical exam revealed bilateral rales over the lungs. Arterial blood gases showed hypoxic respiratory failure. Chest X-ray showed bilateral interstitial infiltrates.

The patient was started on mechanical ventilation (assist/control mode with PEEP of 5 cm H2O) and was given one does of intravenous furosemide. Chest X-ray after 6 hours showed complete resolution of the pulmonary edema and the patient was extubated with no complication. Diagnosis of negative pressure pulmonary edema secondary to laryngospasm was made.

IMPLICATIONS/DISCUSSION: Negative pressure pulmonary edema (NPPE) is uncommon but an important cause of postoperative noncardiogenic pulmonary edema. The etiology of NPPE is related to the generation of high negative intrathoracic pressure. Forceful expiration against a closed glottis, such as laryngospasm, can result in markedly negative intrathoracic pressure. With such negative pressure, the venous return to the right heart increases leading to an increase in the pulmonary bed hydrostatic pressure with subsequent increase in catecholamine release and elevated pulmonary and systemic pressures with subsequent increase in the afterload which further exacerbates the interstitial and alveolar edema.

The incidence of NPPE is 0.05-0.1% of all procedures involving intubation and general anesthesia. Risk factors include obesity, the presence of airway lesions, short neck, obstructive sleep apnea, patients undergoing nasal, oral or pharyngeal surgery (all of which can cause laryngospasm). Young healthy athletes are also at increased

risk because of their ability to generate significant negative intrathoracic pressure.
Clinical presentation starts with transient upper airway obstruction (mostly laryngospasm), which is followed by respiratory distress within minutes after extubation. Pink, frothy respiratory secretions are characteristic for NPPE.
Management is supportive with positive pressure ventilation (e.g. CPAP) and oxygen supplementation. Some patients require reintubation. Most cases resolve in a relatively short period of time (less than 24 hours). No intervention is proven to prevent NPPE, however, avoiding laryngeal irritation by using topical laryngotracheal anesthesia may reduce the occurrence of NPPE. Delayed recognition of NPPE may increase the mortality rate to 30-40%. Therefore, early recognition is important to decrease the morbidity and mortality in these patients.
ACUTE VISION LOSS AND LACTIC ACIDOSIS Leonard H Chow 1;
nainesh shah 1; tuan pham2. 1Baylor College of Medicine, Houston, Texas ; 2baylor college of medicine, houston, Texas. (Tracking ID # 12445)
LEARNING OBJECTIVES: 1. Recognize the clinical features of metformin-associated lactic acidosis2. Treat metformin-induced lactic acidosisCASE INFORMATION: A 55 year old male with a known history of diabetes mellitus and hypertension presented to the emergency department (ED) for abdominal pain and vision loss. He had increased his metformin dose 1 week before to 850 mg four times a day after stopping using his insulin due to symptoms of hypoglycemia. In the ED, the patient had a temperature of 32.6 C (90.7F), a heart rate of 84 beats per minute, a blood pressure of 140/54 mmHg, and a respiratory rate of 15, with a pulse oximeter reading of 95% on room air. On neurologic examination, he was lethargic but able to answer questions. Patients pupils were midsized and slow to react. His fundoscopic exam findings were unremarkable; patient had no visual acuity nor were his visual fields intact. Lab results revealed a severe lactic acidosis with a pH of 6.755 and a lactic acid of 14.2 mmol/L. Creatinine concentration was 8.0 mg/dL. His baseline creatinine is 1.3 mg/dL. Formic acid, ethylene glycol, and methanol concentrations were negative. His sodium concentration was 126 mmol / L. Results of the head computed tomographic scan showed evidence of osmotic demyelination in the pons without mass effect. The patient underwent dialysis and experienced resolution of his metabolic acidosis and a full return of his vision. His electrolyte abnormalities corrected as well. Treatment of the acidosis was effective in correcting the hypothermia and restoring vision in this patient.
IMPLICATIONS/DISCUSSION: Metformin associated lactic acidosis (MALA) has rarely been described with sudden complete loss of vision. Chu et. al. in 2003 and Kreshak et. al. in 2010 both described a case of MALA associated with transient complete loss of vision. Similar to our patient who presented with pH of 6.75, the patients in these cases presented with pH of 6.64-6.65. The mechanism of vision loss in patients with metformin-associated lactic acidosis is not fully understood at this time. Animal studies have previously shown that retinal cell function is pH sensitive. This may serve as an explanation for vision changes, but further study in humans will be necessary to substantiate this theory. The deleterious effect of acidosis on visual acuity is reversible. In each patient, treatment of the acidosis resulted in the improvement of vision. This case demonstrates a rare symptom of metformin-associated lactic acidosis. Early detection and therapy are essential to achieving favorable outcomes.
INTERESTING CASE OF WEGENERS GRANULOMATOSIS Abby Gass1; Anne Drabkin1. 1Medical University of South Carolina, Charleston, South Carolina. (Tracking ID # 12449)
LEARNING OBJECTIVES: 1. Recognize the clinical features of Wegeners granulomatosis. 2. Institute appropriate acute and chronic management of Wegeners granulomatosis.
CASE INFORMATION: GA is a 36 year old Hispanic male who presented to the ED with painful bilateral ankle and foot swelling. The patient had recently been hospitalized and diagnosed with reactive arthritis 10 days prior. Upon presentation, he reported severe bilateral ankle and foot swelling, fevers for 89 days, a progressively worsening sore throat with mouth and nasal ulcers, hematuria, progressive shortness of breath, painful rash on his bilateral lower extremities, conjunctivitis, and decreased urine output. His past medical history was

significant for reactive arthritis, horseshoe kidney, and hypertension. A creatinine during the previous hospitalization was 0.9, but upon admission was8.9 mg/dL with a BUN of 67. An extensive rheumatologic workup revealed a positive C-ANCA titer of greater than 1:1280, PR3 positivity, RF positive, ANA negative, HIV negative, hepatitis B and C negative, ESR 83, CRP 23, C3 and C4 normal, and anti-GBM negative. Urine microscopy revealed sheets of red blood cells, few white cells, few granular casts, no red cell casts, and dysmorphic red blood cells. A renal biopsy revealed extensive crescentic glomerulonephritis, segmental fibrinoid necrosis, lymphoplasmocytic infiltrate, few eosinophils, and pauci-immune immunofluorescence. Skin biopsy of the palpable purpura revealed leukocytoclastic vasculitis consistent with C-ANCA vasculitis. CT of the chest revealed patchy consolidation within the upper lobes concerning for infection versus hemorrhage. The results from the renal biopsy, coupled with the positive C-ANCA with PR3 positivity and clinical presentation, suggested Wegeners granulomatosis. The patient was started on pulse-dose steroids for 3 days, which was subsequently decreased to 1 mg/kg/day. He received one gram of cyclophosphamide, 7 days of hemodialysis, and 13 days of plasmapheresis. Upon discharge the patient was no longer requiring HD, the creatinine was stable at 3, and the arthralgias, dermatologic changes, and oral ulcers had improved.
IMPLICATIONS/DISCUSSION: Wegeners granulomatosis is a vasculitis that typically affects older adults, but has been reported at all ages, which is associated with anti-neutrophil cytoplasmic antibodies (ANCA).

Patients present with constitutional symptoms including fever, migratory arthralgias, malaise, anorexia, and weight loss. The most commonly affected sites include the ear, nose and throat; pulmonary disease; renal disease; and cutaneous manifestations.
Recognition and prompt treatment are paramount to a successful outcome, as untreated generalized or severe Wegeners carries a dismal prognosis. Outcomes have improved dramatically with the introduction of cyclophosphamide plus corticosteroids. There is now evidence of a higher rate of renal recovery and dialysis independence with the use of plasma exchange. The rationale for this approach is the physical removal of ANCA by plasma exchange, whereas simultaneous corticosteroids and cyclophosphamide suppress inflammation and autoanti-body production. The second component of therapy is maintenance immunosuppression to prevent relapse. The preferred maintenance drugs in patients who have attained remission with cyclophosphamide-based regimen are methotrexate and azathioprine, which seem to have equal efficacy. In this particular gentlemen, continued treatment after discharge was difficult as the patient was an illegal alien without funding. Both compassionate Cytoxan and dialysis, if needed, was organized for the patient with the assistance of Rheumatology, Nephrology, and Social Work.
MEDICALLY HOMELESS? THE IMPORTANCE OF CONTINUITY OF CARE AND THE MEDICAL HOME
Tadeo Alejandro Diaz Balderrama 1;
Tadeo Alejandro Diaz Balderrama1. 1Medical College of Wisconsin, Wauwatosa, Wisconsin. (Tracking ID # 12452)
LEARNING OBJECTIVES: 1. Recognize the importance of the medical home in identifying complications2. Identify the consequences of a fragmented medical care and the lack of communication among providersCASE INFORMATION: A 79-year-old man presented emergently with suprapubic pain and generalized weakness after falling from a commode. Medical history was complex including benign prostatic hypertrophy (BPH), hypertension, diabetes mellitus, chronic kidney disease, and coronary artery disease. Status of his current medical problems was unknown by the patient and his wife. He reported care from multiple providers including a primary care physician (PCP), nephrologist, two cardiologists, otolarygologist, and a urologist. Although his kidney disease was followed closely by his nephrologist, he had not been evaluated by a PCP in the past 2 years. Assessment revealed ECG suspicious for anterior wall myocardial infarction, CK of 18,000 mg/dl and

elevations in troponin and brain natriuretic peptide. His initial care focused on treating rhabdomyolysis and evaluation for acute coronary syndrome. Echocardiogram revealed anterior wall motion abnormalities and a low left ventricular ejection fraction. Further investigation revealed he had been avoiding oral intake, including medications, to prevent worsening of urinary retention. Additionally, he had been taking laxatives, prescribed by his nephrologist, multiple times during the day for constipation and was also found to be on lovastatin and niacin for hyperlipidemia. Review of records kept by the wife provided laboratory reports and a negative cardiac workup. Outside records revealed a previous echocardiogram without abnormalities, baseline creatinine of 2 mg/dl and bilateral renal stent placement in 1998. Over the course of several days, his rhabdomyloysis resolved and his cardiac function stabilized. We surmised that the combination of diuretics, poor oral intake and laxatives use lead to dehydration and weakness causing the patients fall; the prolonged physical struggle after the fall along with lovastatin led to rhabdomyolysis. Discontinuation of medications most likely worsened his urinary retention due to BPH causing his suprapubic pain.
IMPLICATIONS/DISCUSSION: This patient presented with a complex medical history managed by multiple providers, and although this is not a rare occurrence, the progressive complications could have been identified with closer follow-up. While the patients wife worked to maintain records, they were still unaware of the current status of the patients medical problems. The establishment of a medical home via a primary care physician can help patients synthesize results and understand the status of their medical conditions. The medical home, as defined by the American College of Physicians, is a team based approach lead by the PCP who provides continuous and coordinated care throughout a patients life to maximize health outcomes. Additionally, the medical home provides an efficient means of obtaining information relevant to patient care at times of worsening medical problems.
AN UNUSUAL PRESENTATION OF ACUTE KIDNEY INJURY: SIMULTANEOUS SEVERE ATN AND RAPID CONVERSION FROM MEMBRANOUS TO CRESCENTIC GLOMERULONEPHRITIS Tejpreet Singh Lamba 1; Heidi Goedicke 2; Abby Spencer 2; Barbara Clark2. 1ALLEGHENY GENERAL HOSPITAL, Pittsburgh, Pennsylvania;
2Allegheny General Hospital, Pittsburgh, Pennsylvania. (Tracking ID # 12455)
LEARNING OBJECTIVES: 1. Recognize early clinical and laboratory indications to guide in the appropriate timing of kidney biopsy in patients with underlying lupus nephritis in the setting of acute tubular necrosis.2. Recognize the implications of transformation of membranous lupus nephritis into the more severe form of crescentic glomerulonephritis. CASE INFORMATION: A 25 year old African American male with past medical history of systemic lupus erythematosus (SLE), stage V lupus nephritis, non-Hodgkin lymphoma, on chronic low dose steroids who developed vomiting, diarrhea and hypotension secondary to viral gastroenteritis. In spite of adequate resuscitation and establishment of hemodynamic stability patients renal function continued to worsen. Preadmission, his baseline creatinine was 0.9 mg/dL, however during hospital course his creatinine dramatically worsened daily to 11.6 mg/ dL on day 7. Urine sediment revealed granular casts and renal epithelial cell casts consistent with diagnosis of acute tubular necrosis (ATN). In light of worsening kidney function with a background of lupus nephritis a renal biopsy was done on day 7. Biopsy revealed crescentric glomerulonephritis with diffuse global proliferative - sclerosing and membranous lupus nephritis (stage IV-S (A/C) and stage V) consistent with rapidly progressive glomerulonephritis. Components of severe acute tubular necrosis and acute interstitial nephritis were also seen on biopsy specimen. Management was redirected after biopsy results, and he was placed on high dose steroids and cyclophosphamide. Unfortunately patients creatinine did not improve; in fact he developed oliguria and uremic symptoms despite above treatment. His creatinine peaked at 14.15 mg/dL and BUN 134 mg/dL at which point hemodialysis was initiated. Hemodialysis resulted in improvement of his symptoms and he was shortly thereafter discharged home to follow up with his outpatient nephrologist.
IMPLICATIONS/DISCUSSION: Renal involvement is seen in approximately half of all patients with systemic lupus erythematosus. Lupus nephritis is classified into six subtypes. Progression of one subtype of lupus

nephritis to another is estimated to occur in approximately half of all patients as per a report from one institution. Distinguishing progression of lupus nephritis from other more common causes of acute kidney injury is important both in regards to management and prognosis. The current indications for repeat renal biopsy in lupus nephritis include an acute rise in serum creatinine, emergence of active sediment, or worsening of

proteinuria despite treatment. The presentation of ATN can at times overshadow the critical transformation of membranous glomerulonephritis into crescentic glomerulonephritis. It is important to keep a broad differential diagnosis in the setting of acute kidney injury. Early biopsy in dramatic worsening of baseline renal function in patients with lupus nephritis is crucial to guide management. Rapidly progressive glomerulonephritis generally responds to high dose corticosteroids and agents such as cyclophosphamide. However in combined diffuse proliferative and membranous lupus nephritis more intense therapy such as mycopheno-late mofetil plus tacrolimus should also be considered. This case provokes further investigation of ATN as a possible triggering mechanism into the pathogenesis for progression of lupus nephritis to the more rapidly progressive glomerulonephritis. There is minimal literature available discussing the interactions between ATN and crescentic glomerulonephritis.

SYSTEMIC, LIFE-THREATENING CHROMOBACTERIUM VIOLACEUM INFECTION IN A US MARINE CORPS RECRUIT AFTER WOUND EXPOSURE TO STAGNANT WATER Patrick Daly 1; Jason Maguire2. 1Naval Medical Center Portsmouth, Norfolk, Virginia ; 2Naval Medical Center Portsmouth, Portsmouth, Virginia. (Tracking ID # 12471)

LEARNING OBJECTIVES: 1. Recognize importance of early detection and management of wound infections.2. Recognize that C. violaceum is endemic to the Southeastern United States and should be in differential for febrile illness following exposure to soil or water source.

CASE INFORMATION: An 18-year-old active duty US Marine Corps recruit assigned to Paris Island US Marine Corps Recruit Training Center, South Carolina developed acute onset fever, nausea, abdominal pain, and loose stools in his 12th week of training. During the previous week, he noted exposure of a left knee abrasion to stagnant water during a training exercise. Soon thereafter, a painful, erythematic, pustular lesion developed and drained clear fluid. He presented four days into his illness for care with a fever of 105F. Upon evaluation for presumed acute appendicitis, abdominal computed tomography (CT) demonstrated multiple hepatic abscesses and the patient was managed for sepsis in intensive care and he received intravenous antibiotics over the first 72 hours which included piperacillin/ tazobactam, levofloxacin, tobramycin, gentamicin and meropenem. His initial left ventricular ejection fraction (LVEF) was 25% by transthoracic echocardiogram (TTE). After blood cultures grew C. violaceum, he completed an additional two weeks of intravenous gentamicin and meropenem. He improved clinically and was transitioned to oral levofloxacin to complete a six month course of antimicrobial therapy. Repeat TTE revealed a normal LVEF of 55% after 1 week of therapy. Serial CT scans demonstrated resolution of the liver abscesses. IMPLICATIONS/DISCUSSION: Chromobacterium violaceum is a saprophytic organism that causes sepsis and metastatic abscesses after percutaneous inoculation through non-intact skin from stagnant water or soil, and infection carries a high mortality rate. Although more commonly reported in tropical and sub-tropical locations in Southeast Asia, the organism is endemic in the Southeastern United States, and disease has been increasingly reported in this region, primarily Florida. This disease had not previously been reported from South Carolina.In this patient with C. violaceum sepsis and liverabscesses, early recognition and broad-spectrum antibiotics and later, targetedantibiotics, contributed to his survival from this potentially fatal infection.This infection has not been previously reported in the literature from SouthCarolina. Although the exact source cannot be definitively identified, thepatient reported exposure of an open skin lesion to stagnant water during amilitary training exercise is consistent with the
known mechanism of infection.This case emphasizes that C. violaceum, endemic to the Southeastern UnitedStates, should be considered in the differential for acute or subacute febrileillness, especially when

history reveals exposure to a possible soil or watersource. As percutaneous exposure is thecommon route of infection, guidance should be given to military trainees andtheir care providers as to appropriate skin care during training in outdoorenvironments and early recognition and management of wound infections. Additionally,the case raises awareness that military outdoor training locations should bemonitored for conditions that would increase the likelihood of exposure to C.violaceum and measures taken to reduce the risks of exposure.

LOWER EXTREMITY EDEMA, COULD IT BE CANCER? Mary b Tadros1; Krati Chauhan1. 1Creighton University Medical Center, Omaha, Nebraska. (Tracking ID # 12490)

LEARNING OBJECTIVES: 1. Recognize the association between lung cancer and nephrotic syndrome2. Recognize a different presentation of lung cancerCASE INFORMATION: This is a 73 years old male with severe, oxygen dependent COPD presented to his primary care physician for routine follow up. At that time, he complained of lower extremity edema and unintentional weight loss which was felt to be secondary to his severe chronic disease. The lower extremity edema was thought to be due to multiple treatments of prednisone for COPD exacerbation. Patient was advised to elevate legs and maintain low sodium diet, however, with worsening symptoms. Urine analysis obtained for investigation showed greater than 600 mg/dL, 24 hour urine protein revealed 22 g /day. Renal ultrasound was normal and renal function remained stable. Several tests including pANCA, cANCA, Serum kappa/lambda light chains, HIV, Hepatitis B and C, syphilis were all negative; serum complement was normal. Renal biopsy showed diffuse subepithelial deposits, consistent with Membranous Glomerulopathy. Prior to initiation of treatment with immunosuppressive therapy, patient was hospitalized for an expedite cancer screening. In the mean time, lisinopril and lasix were initiated to help reduce the proteinuria. CT of the chest revealed multiple pulmonary nodules, which were all positive for squamous cell carcinoma upon biopsy. IMPLICATIONS/DISCUSSION: Membranous Nephropathy (MN) is the most common cause of the nephrotic syndrome in nondiabetic adults. It is glomerular basement membrane (GBM) thickening with little or no cellular proliferation or infiltration. Often idiopathic, although it has been associated with hepatitis B and C, autoimmune diseases, thyroiditis, malignancies, and the use of certain drugs such as gold, penicillamine, captopril, and NSAIDs. Up to 5 to 20 % of adults with MN, particularly older than 65 years of age, have been reported to have a malignancy, most commonly a solid tumor (colon and lung). Cancer is presumed to be etiologically associated, when removal of the tumor led to gradual remission of the proteinuria. Mechanism proposed is that deposition of tumor antigens in the glomeruli promotes antibody deposition and complement activation, leading to epithelial cell and GBM injury, and consequently proteinuria.

This case illustrates a very interesting presentation of lung cancer as a nephrotic syndrome. We also hope to emphasis the importance of complete physical exam and review of system with every office visit, as it is easy to overlook acute problems in the midst of the severe chronic illnesses.

FUO: STILLS WORTH CONSIDERATION Andrea Porrovecchio 1;

Andrea Porrovecchio1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 12491)

LEARNING OBJECTIVES: 1. Recognize Adult Onset Stills Disease as part of the differential for fever of unknown origin 2. Recognize utility of ferritin as a useful tool in diagnosis and following disease course CASE INFORMATION: A 24 year old man presented with 3 weeks of fevers, sore throat and rash. One week prior to admission his symptoms progressed to include myalgias, fatigue and polyarthritis. He had no past medical history and nothing significant in his social, travel, or medication history. His temperature was 39.3C and he was ill appearing with tender submandibular lymphadenopathy. He had no exudates on his oropharynx. He had hepatosplenomegaly, erythematous macular rash on upper extremities and trunk that became more prominent when his fever spiked, and synovitis that was diffuse and symmetric. White blood cell count was 25 x 103 /ul,

hemoglobin was 11.3 g/dL, albumin was 2.3 g/dL, serum glutamic oxaloacetic transaminase was 957 U/L, and the serum glutamic pyruvic transaminase was 608 U/L. The lactate dehydrogenase was 1163 U/L. The ferritin was as high as 150,000 ng/mL. Infectious, rheumatologic, and neoplastic work up was negative.
He was diagnosed with Adult Onset Stills Disease (AOSD) and treated with IV steroids initially with 1 mg/kg daily. He clinically improved over the next 24 hours and was transitioned to prednisone. His lab abnormalities resolved over the following few weeks. IMPLICATIONS/DISCUSSION: AOSD is a rare systemic inflammatory disorder of unknown etiology that often presents as a fever of unknown origin. AOSDs incidence is estimated to be 0.16 in 100,000 persons with an equivalent distribution between genders. It has a bimodal age distribution: ages 1525, and then ages 3646. Yamaguchis criteria, which require 5 criteria, at least 2 major, have been shown to be the most sensitive diagnostic criteria. Major criteria include fever greater than 39C for one week,arthralgias for 2 weeks, macular/maculopapular rash on trunk and extremities, and leukocytosis greater than 10 x 103 ul. Minor criteria include sore throat, lymphadenopathy, hepatomegaly, or splenomegaly, abnormal liver function tests and lactate dehydrogenase, and negative anti nuclear antibodies and rheumatoid factor. Infection, malignancy and rheumatic diseases must be excluded. Our patient met all criteria. More recently, Fautrel et al have proposed a new set of criteria that includes ferritin and its glycosylated fraction. Ferritin, an acute phase reactant, is elevated in this setting often to very high levels, and is used to monitor disease activity. However, the glycosylated fraction of ferritin is more specific. In healthy subjects, typically greater than 50% of ferritin is glycosylated, but in an inflammatory disease process, the glycosylation mechanisms are saturated, and the clearance of non-glycosylated proteins is less effective, so the level can decrease to less than 20%. Taken with clinical features, a five fold increase in ferritin has a sensitivity of about 80% but a specificity of only 41%. However, when taken together with a decreased glycosylated ferritin level, the specificity is increased to 93%. Fever of unknown origin is often a diagnostic dilemma for internists. In the appropriate clinical setting, internists must consider Stills disease in the differential. An elevated ferritin and its percent glycosylation may lead you to this rare diagnosis.

BIGHEAD LION-LIKE FACE DISEASE: LEONTIASIS OSSEA AS A RARE CASE PRESENTATION OF SEVERE RENAL OSTEODYSTROPHY Bassam Yaghmour 1; George Yaghmour 1; Yara Fardous 1; Mark Faber1.
1Henry Ford Health System, Detroit, Michigan. (Tracking ID # 12496)

LEARNING OBJECTIVES: 1. 1. Recognize leontiasisossea as a rare presentation of advanced renal osteodystrophy.2. 2. Identify the characteristic clinical and radiological findings in uremic leontiasis ossea with review oftreatment.3.Review the differential diagnoses of leontiasis ossea.

CASE INFORMATION: A 34-year-old African-American man with endstagerenal disease attributed to hypertensive nephrosclerosiswas admitted to the hospital for a hypertensive emergency. He had received hemodialysis for 10 years. He did not follow his prescribeddiet and had a poor record of adherence with phosphate binders or vitamin Dreceptor activators. He was noted to have lion-like facialfeatures (enlarged skull with bulging of the mid-third of the maxilla andwidening of the nares and interdontalspaces), accompanied with voice changes, difficult nasal respiration and pill-dysphagia. These progressive facial deformities developedover the past 4 years, and were accompanied by shortening of his height, andskeletal bone pain. Serum concentrations at the time of admission included:serum intact PTH 6260 pg/ml, serum calcium9.4 mg/dL,serum phosphorus 9.0 mg/dL, and bone-specificalkaline phosphatase 1064 IU/L. Other indicators ofhigh bone turnover included serum osteocalcin >200.0 ng/ml, and radiographs of the hands, pelvisand chest x-rays that showed renal osteodystrophywith subcortical bony resorption.CT of the head and maxillofacial bones showed diffuse heterogeneous hyperosteosis and osteolysis offacial and cranial bones, and ground glass expansion of maxilla, mandible andskull vault with dystrophic calcifications within the soft tissues andcerebellum. These finding are characteristic of severe osteitisfibrosis cystica. The patient was diagnosed withuremic leontiasis ossea. Hewas started on cinacalcet (a calcium sensing receptorallosteric modifier), and active vitamin D, sevelamer carbonate.

He was also referred for a possible parathyroidectomy.
IMPLICATIONS/DISCUSSION: Leontiasis ossea is a rare medical condition characterized by an overgrowthof the facial and cranial bones. It is not a disease in itself, but a symptomof other diseases, including renal osteodystrophy , hyperparathyroidism , Pagets disease, fibrous dysplasia, or advanced lepromatous leprosy. This patientdemonstrates uremic leontiasis osseadue to high turnover bone disease, caused by severe secondaryhyperparathyroidism in end-stage renal disease. It is important to recognizefeatures of this treatable condition as it may result in life-threatening upperairway obstruction and compressive cranial neuropathy. It is important to recognize that this syndrome is preventable, if uremicpatient have significant adherence to the medical management of secondaryhyperparathyroidism with diet, phosphate binders, and vitamin D receptoractivators.
CASE OF FOREIGN BODY GRANULOMATOUS PANNICULITIS AFTER UNLICENSED COSMETIC SILICONE FILLER INJECTION Bassam Yaghmour 1; Geoffrey Potts 2; George Yagmour 1; Sean Drake1. 1Henry Ford Health System, Detroit, Michigan ; 2Wayne State University, Detroit, Michigan. (Tracking ID # 12519)
LEARNING OBJECTIVES: 1. Recognize foreign body granuloma and panniculitis presenting after silicone filler injection2. Distinguish the differential and management of panniculitis and foreign body granulomaCASE INFORMATION: A 30-year-old healthy female presented to the emergency department with two weeks of subcutaneous nodules on her thighs and buttocks associated with pain, fever, and fatigue. Three years prior, she had silicone injected into her buttocks by an unlicensed practitioner. She was treated for cellulitis with trimethoprim-sulfa-methoxazole and later cephalexin due to lack of response but was later admitted for cellulitis and treated with IV vancomycin due to low-grade fever, tachycardia, and increasing number of erythematous and indurated nodules on her bilateral thighs and buttocks. Biopsy of the largest lesion on the right thigh showed lobular panniculitis with features of silicone granuloma. Blood and tissue cultures for bacteria, fungus, and mycobacteria were negative. CT scan showed nodules

consistent with foreign material while chest X-ray ruled out sarcoidosis. Tuberculin test, ANA, and HIV were negative. The erythema resolved on a week of vancomycin. A week after discharge, minocycline significantly flattened the nodules. The patient was switched to tetracycline on a tapered six-month dose.
IMPLICATIONS/DISCUSSION: Foreign body granuloma and panniculitis are rare inflammatory complications of permanent cosmetic fillers, but other delayed complications such as hypersensitivity and lymphedema can present years after injection [2]. Silicone granulomas are often sterile with an abundance of lymphocytes, but other fillers may form biofilms [1].
The differential diagnosis of a granuloma with panniculitis would include cellulitis, lipoma, hypersensitivity, or autoimmune [1]. Care should be taken in documenting all prior fillers injected. Workup should include imaging to rule out other causes of granulomas. Stains and cultures should be used to rule out common and rare infectious agents.Der
DIAGNOSIS AND MANAGEMENT OF EMBOLIC STROKE IN A PATIENT WITH PATENT FORAMEN OVALE AND ATRIAL SEPTAL ANEURYSM Patrick Daly 1; Kevin Zawacki 2; Kevin Sumption3. 1Naval Medical Center Portsmouth, Norfolk, Virginia ; 2Naval Medical Center Portsmouth, Portsmouth, Virginia ; 3Naval Medical Center Portsmouth (now at Richmond Veterans Affairs Medical Center), Portsmouth, Virginia. (Tracking ID # 12521)
LEARNING OBJECTIVES: 1. Diagnosis and management of embolic stroke in patients with PFO.Recognize that ongoing studies are comparing effectiveness of PFO closure to medical therapy alone for prevention of stroke recurrence. 2. Demonstrate that PFO closure has role in patients for whom anticoagulation therapy is incompatible with their career or way of life.
CASE INFORMATION: A 30 -year-old male without significant past medical history presented to the Emergency

Department after awakening with diffuse left-sided parathesias and hyperesthesias. The day prior to presentation he experienced onset of severe headache and left-sided numbness. His headache was partially relieved with motrin, but persisted through his arrival to the Emergency Department. He also noted lightheadedness, confusion and disorientation. Magnetic resonance imaging (MRI) of the patients brain revealed abrupt termination of the right posterior cerebral artery at the P2 segment. The appearance of this lesion was consistent with an embolic phenomenon. The patient underwent a trans-thoracic echocardiogram (TTE) with agitated saline contrast study which demonstrated PFO with ASA and abundant intra-cardiac shunting. These findings were confirmed on trans-esophageal echocardiogram. Multidisciplinary development of patients plan of care involved cardiology and neurology physicians. It was noted that lifelong coumadin therapy would be disqualifying for future military service. The patient chose to undergo percutaneous closure of the PFO. He tolerated this procedure well and echocardiogram intra-procedure and post-procedure day one demonstrated absence of intra-atrial shunting. He was placed on six months of clopidogrel and aspirin as well as spontaneous bacterial endocarditis (SBE) prophylaxis with plan for lifelong aspirin therapy.
IMPLICATIONS/DISCUSSION: Embolic stroke in the setting of patent foramen ovale (PFO) and atrial septal aneurysm (ASA) is a condition involving substantial morbidity in young and previously healthy, asymptomatic patients. The embolic sources in these patients are thought to be small platelet or fibrin aggregates crossing from the right to left heart during transient increases in right atrial pressure that lead to intra-atrial shunting and cerebral embolism. Although PFOs are present in 30% of all adults, the incidence of stroke in these patients remains relatively uncommon. There is limited available literature for the optimal therapy of patients with cardio-embolic stroke from PFO and ASA. Concomitant PFO and ASA portends a four-fold increased risk of stroke. Two primary options exist for secondary prevention of stroke: medical therapy with antiplatelet agents or anticoagulants versus surgical or percutaneous closure of the defect. A French PFO-ASA study supported the use of aspirin therapy with a statistically significant decrease in incidence of a recurrent stroke on aspirin. The preliminary results of the CLOSURE I trial have demonstrated that percutaneous closure of a PFO using the Starflex device is not superior to best medical therapy for preventing recurrent stroke. Existing retrospective studies show that combined PFO/ASA anatomy poses increased risk for recurrent stroke. Additional patient characteristics including occupation and comorbidities should be used to assist patients and their providers in choosing optimal therapy. PFO closure has been performed successfully at our institution for patients in very highly trained specialties including divers, for whom this procedure has been career-saving.
PICA IN THE PIEDMONT Lee Merchen 1; Jonathan Lawson1. 1Medical College of Georgia, Augusta, Georgia. (Tracking ID # 12522)
LEARNING OBJECTIVES: 1. 1. Emphasize the role of the psychosocial history taking2. 2. Understand that patient culture impacts health care3. Pica has adverse associations, but white clay may also offer some benefit
CASE INFORMATION: Ms. TR, a pleasant middle aged African American woman, presented for evaluation of a recent DVT and severe iron deficiency anemia, hemoglobin 6.4, MCV 70. During the course of her medical history she mentioned that she had anemia for which she took daily iron supplements upon further questioning specifically about cravings of non-food items Ms. TR revealed that she ate large quantities of chalk daily. The substance that she referred to is kaolin, commonly known in Central Georgia as white dirt, white clay or chalk. Kaolin is a clay mined in the Piedmont area of Georgia for use in the production of ceramics and glossy paper. It is also used in medicines such as kaopectate syrup. Ms. TR reported that she eats on average of 10 to 20 ounces of kaolin per day. She began eating kaolin regularly during her early 20s when she became pregnant with her second child. Her cravings for the clay during that pregnancy persisted and became a life long behavior. Though she says at times she has eaten less chalk, she has had a steadly increasing appetite for it over the past year. She describes: it tastes like a light rain on a dirt road when you are driving a long with the windows down. Other members of Ms. TRs family also eat kaolin, including her mother and daughter and she described growing up watching mostly female members of her family and community consume this clay.

Although this patients experience illustrates the importance of cultural and family factors with this form of pica, there is a stigma attached to the practice. Ms. TR acknoledged that although she knows others who eat chalk, it is rarely openly discussed and it not widely socially accepted practice.
IMPLICATIONS/DISCUSSION: Pica is the ingestion of non-nutritive substances and has long been associated with pregnancy and iron deficiency anemia. Geophagia and pica can lead to iron deficiency anemia, and yet interestingly, there may some health benefits. Certain clays also have the ability to bind plant toxins so that if otherwise poisonous plants are preparted with small amounts of the clay they become edible. Also, a recent study indicates that Mycobacterium vaccae, a bacteria commonly found in soil, helps with complex problem solving skills and reduces anxiety levels. Though understanding of the causes and motivations behind Kaolin pica is still incomplete, this behavior can be the underlying cause of significant medical pathology. It

is important for physicians to be aware of regional cultural influences and practices such as pica in order to obtain more complete and accurate medical histories and to identify the underlying cause for medical maladies such as anemia in these individuals such as Ms. TR.
A MAN WITH GENERALIZED FATIGUE AND MALAISE Dusan Stanojevic 1; Andrew Gregory De Nazareth 1; Tammy Wichman1.
1Creighton University, Omaha, Nebraska. (Tracking ID # 12530)
LEARNING OBJECTIVES: 1. With globalization and mass world migration the exclusion of certain diagnosis based on geographic location might be the wrong thing to do in an acute setting.2. When the diagnosis is not clear history is key.
CASE INFORMATION: A 67-year-old male presented with a 10-day history of worsening nausea, diarrhea, fevers, chills, joint pain, and rigors. His past medical history was significant for diabetes, atrial fibrillation and hypertension. Patient was on appropriate medications and no recent new medications. He reported picking and eating wild mushrooms about the time of the onset of symptoms, as well as working with cattle, and eating cooked oysters. Vital signs: Temperature 101F; heart rate 87; respiratory rate 31; blood pressure 105/76 mm HG; oxygen saturation 98% on room air. A physical examination revealed a shaking patient who appeared to be in moderate distress. Chest: clear to auscultation. Cardiac: irregular heart sounds without murmurs. Gastrointestinal: nontender without hepatosplenomegaly. Extremities had traces of edema. Neurologic examination showed tremors and unstable gait. Skin: petechiae present on his lower extremities and feet. WBC count was 2,850 cells/L (37% bands). Platelets of 50,000 cells/L and hemoglobin 12.4 g/ dL. His electrolytes were within normal limits. His BUN and Cr were elevated 33 mg/dL and 1.6 mg/dL respectively. AST 264 U/L, ALT 88 U/L and Alkaline Phosphatase 127 U/L, INR 1.0. Stool studies, blood cultures, influenza PCR test, and Hepatitis panel were negative. Rocky Mountain Spotted Fever titer was negative. Patient underwent bone marrow biopsy with preliminary analysis consistent with Myelodysplastic syndrome. On Day 3 he was transferred to ICU for progressive multi organ failure and worsening pancytopenia. Upon further questioning his wife reported that he has had recent tick bites on his farm located in northwestern Iowa. The patient was started empirically on Doxycycline. His clinical picture started to improve within twelve hours. He was discharged on day 9 with after significant clinical improvement. The serum titers confirmed infection with both E. chaffeensis and A. phagocytophilum, and bone marrow genetic studies were negative for
MDSIMPLICATIONS/DISCUSSION: Ehrlicial infections are common in the Southern parts of the U.S. however CDC data shows that cases of ehrlichial infections have not been reported in Nebraska or Iowa. In our case Ehrlichiosis was rejected as a possibility by the infectious diseases service as it is not seen in Nebraska or Iowa. Due to its mild presentation, less than 7% of reported cases required admission, however ehrlichiosis can cause serious illness as well. It may present with meningoencephalitis, respiratory failure, or pancytopenia.

Mortality does occur due to failure to initiate appropriate therapy, doxycycline remains the drug of choice.There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we dont know. But there are also unknown unknowns. There are things we dont know we dont know. No matter what you think of former secretary Rumsfeld, his quote could not be more applicable to today physicians. We will encounter more and more things that we are not used to seeing as the world becomes smaller and smaller due to global traveling. For a physician, there is no bigger fear than when a seriously ill patient is not responding to treatment and all of the differential diagnoses are falling short. From medical school through residency we are always taught to look for common
things first, but the question is: in todays world does the same rule apply in a more acute setting?
The symptoms and signs that are present in ehrlicial infection are very nonspecific and can produce a picture that is consistent with wide variety of etiologies. The key to diagnosis is going back to fundamentals, such as additional history, which was essential in treatment of our patient. In todays society regional division and thinking are losing their meaning; thinking outside the box and going against what we were thought is sometimes necessary when we are dealing with sick patients. Sometimes, we have to think of zebras as well
INNOVATIONS IN PRACTICE MANAGEMENT
THE JC-ICU: CLOSE FOLLOW UP FOR AMBULATORY PATIENTS Rose Kakoza 1; Joy Lewis 2; Andrew Ellner 2; Lori Wiviott Tishler2. 1Brigham and Womens Hospital, Roxbury Crossing, Massachusetts ; 2Brigham and Womens Hospital, Boston, Massachusetts. (Tracking ID # 7272)
STATEMENT OF PROBLEM OR QUESTION: Resident clinics create a challenging practice environment that can result in fragmented patient care and leave residents with a discouraging impression of primary care.
DESCRIPTION OF PROGRAM/INTERVENTION: The Phyllis Jen Center for Primary care is a faculty/resident clinic at the Brigham &Womens Hospital that serves 40,000 patients/year and provides 800 urgent care visits/month. Urgent care doctors include residents and faculty. Many patients seen in the Jen Center are medically and psychosocially complex, often from disadvantaged communities. The JC-ICU is a virtual ICU into which residents and faculty refer patients at risk for hospitalization, inappropriate ED use or exacerbation of an acute or chronic condition. The JC-ICU team includes 3 nurses, the referring physician and the primary care physician. After referral, a care plan is determined and graduation criteria defined. The JC-ICU nurse learns about the patient via the medical record and implements the care plan via phone encounters with the patient and emails with the provider. Once the patient achieves the goal, they graduate from the ICU. Patients may re-enroll.
OBJECTIVES OF PROGRAM/INTERVENTION: Using a team-based model, the JC-ICU will:1. Provide short-term case management for at risk patients 2. Provide continuity and flow of information between patient and provider and 3. Improve the primary care experience of residents FINDINGS TO DATE: Patient Outcomes: Preliminary data have shown:1. 90% of patients (90/100) have been able to meet their goal. ED visits have been significantly reduced in key patients with a history of frequent ED visits. 2. Patient Experience:a. Some patients have stated that they appreciate the follow up calls and reminders. b. Patients have formed a relationship with the JC-ICU nurse and feel comfortable reaching out with questions or concerns c. Patients receive a timely report of test results if their referring physician is away from the clinic 3. Team Member Experience: a. Residents and faculty feel comfortable delegating titration of medications within certain parameters to the JCICU nurse. b. Residents feel more supported in their delivery of primary care to complex patients c. Nurses feel more engaged with patient care d. Nurses feel they are using more of their skill set than was required of them prior to the start of the programKEY LESSONS LEARNED: We have successfully implemented an ambulatory ICU that uses a team-based approach to address the significant issue of fragmented care that often plagues resident clinics.1. Preliminary data support that the Jen Center ambulatory ICU may significantly improve service utilization, and patient and provider experience 2. This model may also be successful in other residency clinics nationwide 3. In a predominantly revenue neutral way, we can successfully

build capacity among existing nursing staff in order to transition to team-based patient care interventions

PAGING EFFECTIVENESS: A MODEL FOR PAGER COMMUNICATION AT A LARGE ACADEMIC MEDICAL CENTER Jeffrey Chi 1; Lisa Shieh 2; joseph hopkins3. 1Stanford School of Medicine, Menlo Park, California ; 2Stanford University School of Medicine, Menlo Park, California ; 3Stanford University School of Medicine, Stanford, California. (Tracking ID # 8344)
STATEMENT OF PROBLEM OR QUESTION: Communication and patient care at large academic medical centers are negatively affected when care providers are unable to identify and reach the appropriate physicianDESCRIPTION OF PROGRAM/INTERVENTION: Patient Safety Network (PSN) is an in-house reporting system of adverse events at our institution. A 7 month review showed an average of 5 incidents per month due to paging errors. A survey of 250+ nurses revealed difficulties related to identifying the correct physician to page. A survey of 78 physicians also showed a significant volume of pages in error. A Paging Effectiveness Committee consisting of administrators,physicians, and nursing staff was formed to implement a uniform method for paging at our institution. Despite variable team structures across numerous services, proxy service pager numbers were assigned to each hospital service. A standardized protocol was implemented, requiring each service to forward a designated service pager number to a covering physicians personal pager at all times. Service pager numbers were also assigned to each patient in our electronic medical record at admission. OBJECTIVES OF PROGRAM/INTERVENTION: Develop a paging communication and escalation protocol to be implemented hospital-wide in order to decrease the number of adverse events related to miscommunication.
FINDINGS TO DATE: A subsequent audit of service pagers has shown nearly full compliance in the hospital. PSN reports following implementation of the new paging protocol have also demonstrated a decrease in adverse advents related to paging error.
KEY LESSONS LEARNED: Assigning a dedicated proxy pager number to services at large academic medical institutions reduces the need to interpret complex physician call schedules and reduces the number of paging errors.
ADVERSE EVENT REPORTING IN THE GENERAL MEDICINE OUTPATIENT CLINIC: REVIEW OF DATA FROM THE OPPORTUNITY TO IMPROVE SAFETY (OTIS) DATABASE Amy M Gordon 1; Daniel Dunham2. 1McGaw Medical Center of Northwestern University, Chicago, Illinois ; 2Northwestern University Feinberg School of Medicine, Chicago, Illinois. (Tracking ID # 8872)
STATEMENT OF PROBLEM OR QUESTION: A mechanism for adverse event reporting in the outpatient general medicine clinic should be available for practitioners and staff and be used to detect patterns of error to improve the practiceDESCRIPTION OF PROGRAM/INTERVENTION: The OTIS database was established from June 2003 through September 2010 for staff to report adverse events observed in the ambulatory medicine clinic. Data collected on each entry included occupation of reporter, whether the event was related to a specific patient, whether patients had complex and/or chronic health problems, familiarity with patients condition, severity of harm caused to a patient, and when and how often the event occurred. OBJECTIVES OF PROGRAM/INTERVENTION: 1. To log and categorize adverse events in the outpatient medicine clinic as reported by practitioners and staff. 2.To establish systems to reduce errors when patterns of events are discovered.
FINDINGS TO DATE: A total of 326 entries were collected, 75% of which were system-based events. Most frequent system-based events were
environment&supplies (63), laboratory testing (49), and patient flow&scheduling (38). Attending physicians report the most events. Resident physicians report the least. Most events reported relate to a specific patient. In events related to a specific patient, the patient is most frequently not well known to reporter and has a chronic health problem. Very few reported events caused patients harm, and if harm was caused, it was often judged by

the reporter as the least severe. Knowledge-based events were more frequently associated with events that caused harm to a patient, more than any subtype of system-based event. Events occurring over once a month are reported most frequently. Thirty-one percent of most frequent events are knowledge-based errors. Of first time events, 44% are knowledge based errors and occur more frequently than any sub-group of systematic errorsKEY LESSONS LEARNED: Most adverse events reported were system-based errors, suggesting improving systems for delivery of care rather than improving workers knowledge is fundamental to reducing adverse events. Reporters of events involving a specific patient frequently do not know the patient well, suggesting that having few care providers for a patient, as is a goal of medical homes and managed care teams, may reduce adverse events. Patients with chronic health problems may be more vulnerable to adverse events. Developing systems to close gaps in collective knowledge is necessary. Gaps in clinic workers personal knowledge also exist and are more difficult to remedy. Reporting of adverse events over seven years slightly decreased after two years of event logging, suggesting reporting fatigue of the practitioners and staff. Very few adverse events led to patient harm, which is reassuring. Self reporting was rare, suggesting people might have been reluctant to admit mistakes.

COLLABORATION OF PHARMACISTS AND HOSPITALISTS TO INCREASE USE OF ADA RECOMMENDED INSULIN REGIMENS IN INTERNAL MEDICINE PATIENTS: IMPLEMENTATION OF A PILOT PROGRAM

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STATEMENT OF PROBLEM OR QUESTION: There is increased use of sliding scale insulin (SSIM) and limited use of ADA recommended regimens of basal-mealtime-supplemental (BMS) insulin regimens in hospitalized diabetic patients.

DESCRIPTION OF PROGRAM/INTERVENTION: This was a prospective, randomized, open label, parallel group trial in diabetic patients admitted in a 1400 bed tertiary care academic hospital. Hospitalist physician-led medical teams were randomized to study intervention (INV) or usual care (UC). In the INV group, hospital pharmacists evaluated BG control daily along with the nutritional intake of hospitalized patients. They made recommendations, as needed, to the medical team using a weight-based insulin dosing algorithm as well as established ADA guidelines. Physicians in the UC group prescribed insulin according to their usual practice. Results were also compared to a historical cohort (HC) consisting of diabetic patients admitted on the hospitalsts services for upto 1 year prior to the start of the randomized trail. These patients were also on UC.

OBJECTIVES OF PROGRAM/INTERVENTION: We evaluated a collaborative program involving hospital based pharmacists and hospitalist physicians for its effectiveness in increasing the implementation of ADA recommended regimens and on attainment of ADA glycemia targets in hospitalized patients.

FINDINGS TO DATE: 188 UC and 181 INV subjects were enrolled over 29 weeks. 96 patients were studied in the HC. Mean daily blood glucose was 194 mg/dl HC, 176 mg/dl UC and 179 mg/dl INV ($p<0.001$). KEY LESSONS LEARNED: Collaborative efforts between the hospital-ists and pharmacists can increase the use of ADA recommended BMS

regimens as well as use of basal insulin while decreasing use of SSIM and risk of hypoglycemia in hospitalized diabetic patients. Non-scientific survey of the hospitalists showed that they valued the input of the hospital pharmacists in managing the insulin regimen of their patients.

A TOOL TO HELP PROVIDERS FIND PRESCRIPTION DRUG ABUSERS Alan Weiss 1; Patrick Robert2. 1The Cleveland Clinic Foundation, Cleveland Heights, Ohio ; 2The Cleveland Clinic Foundation, Cleveland, Ohio. (Tracking ID # 9189)

STATEMENT OF PROBLEM OR QUESTION: Prescription drug abuse is increasingly prevalent and difficult to find. We created a reporting tool to allow providers to monitor their controlled substance prescriptions to find

drug abusers.
DESCRIPTION OF PROGRAM/INTERVENTION: Three years of out-patient CS prescriptions were analyzed to create reports for each provider showing the top CS medications, the patients receiving them and the number of times the patient either asked for prescriptions too early or had received dangerous medication amounts (overlaps and excesses). These reports were distributed to family medicine, but not to internal medicine to create a control group. Our goal was to see if these kinds of reports could help reduce prescription drug abuse.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Discuss the dangers of prescription drug abuse. 2. Explore the concepts of prescription overlaps and excess medications. 3. Demonstrate how reports of these concepts can find at risk patients.
FINDINGS TO DATE: We found that, at the Cleveland Clinic, 8% of patients were getting their CS prescriptions too early and up to 9.25% were getting excess CS amounts. The author used his report to change his prescribing on 13 of his top 20 patients, 5 of which were terminated from his practice for violating CS agreements. He wrote 20.4% fewer CS prescriptions, on 18.5% fewer patients, had 10.5% fewer prescription overlaps but excess CS medications did not change. These reports were geiven to 48 family medicine physicians. Their CS prescription habits were compared to internal medicine at the same locations, looking at the three months before and after intervention. Family medicine improved more than internal medicine for all analyses: the number of scripts decreased (21.1% vs. 17%); the number patients receiving CS scripts declined (8.3% vs. 7.2%); the overlapping prescriptions fell (34.8% vs.34.1%); excess medications also dropped (12.3% vs. 11.4%).
KEY LESSONS LEARNED: Our reporting tool helps clinicians monitor their controlled substance prescription habits, eliminate drug abuse and improve prescription safety. We feel that the color-coded, interpretive, graphical nature of our reports is essential to help providers make clinical decisions about their controlled prescriptions. State-wide controlled substance monitoring programs in the US have been established with similar goals; we think our reports would be a good adjunct to these programs. There are a number of drawbacks to our research. First, the patient populations in family and internal medicine have different prescription needs. We hoped to address this issue by examining practices at the same locations. Second, we analyzed data 3 months after the reports were distributed, likely too early to judge long term success. Finally, we await additional data to compare our intervention to other internal medicine practices and the rest of the health system.
IMPLEMENTING PROTOCOLS AND RISK STRATIFICATION FOR CHRONIC OPIOID MANAGEMENT IN PRIMARY CARE PATIENTS WITH NON-CANCER PAIN Robin Canada 1; Susan Corson Day 1; Craig Wynne 1; Danae Nicole DiRocco1. 1University of Pennsylvania, Philadelphia, Pennsylvania. (Tracking ID # 9244)
STATEMENT OF PROBLEM OR QUESTION: Chronic non-cancer pain and related opioid therapy are difficult to manage in an academic resident primary care practice.
DESCRIPTION OF PROGRAM/INTERVENTION: A rise in regular opioid prescriptions, administrative burden, disruptive behavior, and variation in prescribing patterns prompted the institution of a work-group to address these issues. Literature on best practices for pain/ opioid management in primary care was reviewed and pain and addiction specialists consulted. Strategies identified: 1)Identification of an accountable prescribing physician and continuity attending for resident patients 2)Standardize EMR documentation: including a division-wide controlled medication agreement and use of a uniform pain diagnosis on the problem list 3)Utilize patient registries to facilitate proactive management, assure PCP continuity and adherence to guidelines Providers received an educational intervention regarding these elements and a monthly opioid/pain management Care Conference has begun to allow primary care providers to present difficult cases and questions to pain specialists.
OBJECTIVES OF PROGRAM/INTERVENTION:Identify best practices for opioid management in chronic pain Determine if risk stratification of patients results in improved outcomes Educate and evaluate

providersFINDINGS TO DATE: Findings to date show significant increases in UDS screening (from 28% to 34%, p <0.005), pain diagnosis in problem list documentation (from 17% to 24%, p <0.001)and designation of continuity provider compliance (from 81% to 89%, p <0.0001).
KEY LESSONS LEARNED: Improving opioid management and reducing aberrant behavior requires interventions at multiple points of practice operation.
Implementing protocols which require changes in physician, patient and staff behavior requires education and frequent reinforcement.
Achieving provider consensus on documentation and practice protocols is necessary, but challenging.
Initiating a Pain Management conference has provided a site for open dialogue on difficult patients and issues.
MOTIVATIONAL INTERVIEWING TO FACILITATE PATIENT-CENTERED NAVIGATION IN PRIMARY CARE: A PILOT STUDY Tracy A Battaglia 1; Sarah E Lane 1; Samantha S Murrell 1; Lois McCloskey 2; Hannah Jong 4; Ariel Childs 4; Kelly Walker 4; Edward Bernstein 3; Judith Bernstein4. 1Boston University Schools of Medicine, Boston, Massachusetts ; 2Boston University School of Public Health, Boston, Massachusetts ; 3Boston University School of Medicine, Boston, Massachusetts. (Tracking ID # 9245)
STATEMENT OF PROBLEM OR QUESTION: Successful patient navigation programs traditionally target a specific disease, such as breast cancer, without taking into account competing medical comorbidities or patient health priorities.
DESCRIPTION OF PROGRAM/INTERVENTION: Primary care-based breast health navigators were trained to screen for chronic conditions using B-MI communication techniques. Participants were English-speaking female primary care patients age 51 to 70 with >18 months since last documented mammogram. Navigators contacted participants by phone using existing protocols and invited them to participate in this study. The intervention included a broader B-MI-based conversation around smoking status, depression, obesity, and/or patient health concerns in addition to mammography screening. Per existing protocols, navigators facilitated appointment scheduling, conducted telephone outreach to remind participants of upcoming appointments, and addressed any barriers to attending that appointment. Qualitative interviews with participants

(n=11), providers (n=6), and navigators (n=5) were also conducted to evaluate their experience with enhanced navigation.
OBJECTIVES OF PROGRAM/INTERVENTION: This mixed-methods study evaluates the feasibility of expanding a primary care breast navigation program to address additional chronic diseases and allow patients to set their own priorities for action using brief motivational interview skills (B-MI).
FINDINGS TO DATE: 109 (60%) eligible participants consented to participate. Overall, 88 (81%) had at least one positive screen for smoking, obesity, or depression, and 52 (48%) of participants named smoking obesity, and/or depression as a health priority. 102 (94%) scheduled mammography screening appointments and 80 (78%) attended a mammography appointment within 30 days of the initial scheduled appointment. Seventy-seven (71%) scheduled a primary care appointment through the navigator, and 59 (77%) attended a primary care appointment within 30 days of the initial scheduled appointment. Navigators reported that use of B-MI skills resulted in more personalized interactions, and providers responded most positively to the participants listing of their health priorities. All participants interviewed responded positively to the enhanced navigation.
KEY LESSONS LEARNED: Our findings suggest that patient-centered navigation which aims to address multiple chronic conditions is feasible. Participants are willing to discuss personal health concerns with navigators, and this model leads to improvement in both mammography adherence and primary care follow up to address health priorities.
INTEGRATION OF HEALTH LITERACY SCREENING IN AN ELECTRONIC HEALTH RECORD April Barbour 1; Amber Wobbekind1.
1George Washington University, Washington, District of Columbia. (Tracking ID # 9277)

STATEMENT OF PROBLEM OR QUESTION: Though health literacy has been shown to be a strong determinant of health outcomes, physician knowledge of health literacy and screening for health literacy in the primary care setting is inadequate.
DESCRIPTION OF PROGRAM/INTERVENTION: A simple, three question template was created to assess health literacy based on validated screening questions by Benjamin J. Powers, MD, MHS et al published July 2010. A pre-intervention survey was done to assess prior educational sessions on the topic of health literacy, knowledge of health literacy, and attitudes toward health literacy. After the survey, a didactic session was done on the topic of health literacy which highlighted the importance of screening for health literacy, effect on health outcomes, and methods to improve care for patients with low health literacy followed by a demonstration of the health literacy template in the electronic medical record. In six months, the same physicians will be surveyed again to evaluate if there has been a change in knowledge or attitudes about health literacy.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Assess current knowledge of health literacy in physicians and methods for screening for health literacy2. Educate resident and attending physicians about health literacy3. Implement a simple, three question health literacy screening template to the electronic medical recordFINDINGS TO DATE: On pre-intervention survey, preliminary data shows that the majority of physicians I surveyed did not have prior education on health literacy, though the majority thought it moderately to greatly affected health outcomes. According to the results, none of the physicians were screening for health literacy at the time of the survey with an accepted tool such as S-TOFHLA or REALM, though some attendings had developed their own tools to assess health literacy such as writing instructions and having patients read them back.
KEY LESSONS LEARNED: Health literacy is a very important determinant of health outcomes, though assessment for health literacy is uncommon due to time-intensive tools like S-TOFHLA and REALM. Screening for health literacy with 3 questions, however, is very easy to implement in a primary care setting. Creating a health literacy screening template can be done easily in an electronic medical record template.
PATIENT CARE COORDINATORS AND RESIDENT WORK ENVIRONMENT Geraldine Menard 1; Michelle Guidry 1; Isolde Butler1. 1Tulane University School of Medicine, New Orleans, Louisiana. (Tracking ID # 9409)
STATEMENT OF PROBLEM OR QUESTION: This irb-approved study utilized patient care coordinators to decrease residents indirect patient care responsibilities, improve resident ward experience, and decrease 30 day readmission rate.
DESCRIPTION OF PROGRAM/INTERVENTION: Two PCCs assisted four academic hospital medicine teams by completing tasks such as scheduling appointments, obtaining referral forms for discharge, faxing discharge summaries, and obtaining outside medical records. PCCs and residents communicated through the electronic secure resident patient sign-out, phone, email, and in person. We hypothesized that utilization of the PCCs would improve the residents ward experience, increase resident teaching, and increase patients discharged before 11 am, a target time in our hospital bed utilization program. A ten question anonymous survey was sent to all internal medicine residents prior to implementation of the program and at one year post implementation.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Residents would participate in more educational activites and teaching while on the medical wards with implementation of the program.2. Discharge process would improve.
FINDINGS TO DATE: The response has been overwhelmingly positive from the residents to the PCCs. Using PCCs to handle indirect patient care needs led to an improvement in the patient workload for residents and increased time for resident-directed teaching. In the era of residency work hour restrictions and the desire to improve learner environments, physician extenders decrease indirect patient care and should be considered for academic hospital programs. The results are as noted above in the measures of success section. Limits of the study include small percentage of respondents.
KEY LESSONS LEARNED: Implementation of PCCs to coordinate indirect patient care activities can improve

the resident clinical ward experience and time dedicated to teaching as well as improve the discharge process. This program will continue at our institution, and we are beginning to utilize PCCS in assisting the medicine teams in targeting high-risk patients to reduce readmissions.

CREATING A CORE CURRICULUM FOR NEW COLLEAGUES: AN ORIENTATION PROGRAM FOR PRIMARY CARE IN AN ACADEMIC MEDICAL CENTER Lori Wiviott Tishler 1; Reema Alshirawi 1; Joseph Frolkis 1; Stuart Pollack1. 1Brigham and Womens Hospital, Boston, Massachusetts. (Tracking ID # 9437)

STATEMENT OF PROBLEM OR QUESTION: Creating a cohesive primary care workforce is challenging in a geographically-distributed AMC with an established hospitalist program, leading to problems with physician satisfaction and retention.

DESCRIPTION OF PROGRAM/INTERVENTION: Over the past fifteen years, primary care at the Brigham has grown from a single on-site practice to 12 practices, many of which are some distance from the

hospital. Anecdotally, many physicians felt that an initial orientation was lacking. A survey of new faculty confirmed this,with particular concerns about making the transition from residency training topractice (for newer graduates), referral patterns, and using our electronic record. As part of a comprehensive overhaul of our primary care orientation, we developed the CoreCurriculum. This course meets monthly from September to June of the physicians first year, and is mandatory. Topics include transition to practice, meet the administrators, LMR tricks and tips, and Managing difficult patients, among others. The format varies with the topic, but is generally an open discussion with limited didactics and significant opportunity for networking and sharing of experiences.

OBJECTIVES OF PROGRAM/INTERVENTION: The core curriculum provides:(1) Practical information about functioning within our system(2) Networking opporunties between new faculty as well as between junior and senior faculty(3) Improved retention and physician satisfaction FINDINGS TO DATE: Participants have been enthusiastic about the program. This is our first cohort and weve only met 3 times at this writing. In our first feedback results, participants expressed a desire for more discussion and less didactics. We also learned that new doctors were confused about the roles and responsibilities of various members of our team. On a 15 Likert Scale, feedback from our initial session with a scale of 1(definitely) and 5 (definitely not) showed: Was the discussion helpful to you? 1.5; Was the discussion relevant to you? 1.3; Were all your questions addressed? 2; Wasthe information presented at an appropriate level ? 1.8; Wouldyou recommend this session to your peers? 1.3.

KEY LESSONS LEARNED: 1. Becoming a new PCP is an underexplored academic and professional transition. 2. New primary care doctors crave structure and opportunity to network and form collegial relationships as they become part of a practice and a larger hospital system. 2.5 New PCPs need a safe and confidential place to discuss issues they dont feel comfortable discussing with their immediate colleagues and supervisors 3. Developing a core curriculum is a relatively straightforward, revenue limited project that has the potential to create dividends over time, particularly in the areas of staff satisfaction and retention. 4. The focus on developing a core curriculum for new PCPs gives increased visibility both academic and clinicalto onsite clinical and all off-site faculty.

PROJECT ECHO: AN INNOVATIVE CAMPUS-COMMUNITY PARTNERSHIP FOR MANAGING RESISTANT HYPERTENSION Christopher Masi 1; Kristine Bordenave 1; Andrew Davis 1; Brenda Perea 1; Stephen Brown 1; Tamara Hamlish 1; George Bakris 1; Daniel Johnson1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 9498)

STATEMENT OF PROBLEM OR QUESTION: Community health centers and their patients often have limited resources, thereby reducing their access to specialists for care of complex, chronic diseases such as resistant

hypertension.
DESCRIPTION OF PROGRAM/INTERVENTION: Using a model developed by the University of New Mexico to assist rural PCPs care for patients with hepatitis C, we created a videoconference network among 6 urban Federally Qualified Health Centers (FQHCs) and the University of Chicago (UC) to support Project ECHO (Extension for Community Health Outcomes), a 6-month educational program designed to teach state-of-the-art management of resistant hypertension to FQHC providers. FQHC PCPs use the network to present cases of patients with resistant hypertension to a specialist at UC every 2 weeks. Each session begins with a 20 minute lecture on one aspect of the causes and management of resistant hypertension. The specialist then leads an interactive discussion across the 6 sites, and participants learn from each others cases. This mini-fellowship, case-based approach improved hepatitis C outcomes managed locally in rural New Mexico and we hypothesize it will improve care of resistant hypertension in urban Chicago.
OBJECTIVES OF PROGRAM/INTERVENTION: The objectives of Project ECHO are to 1) increase primary care provider (PCP) hypertension management self-efficacy and knowledge, 2) enhance the ability of PCPs to manage resistant hypertension and therefore reduce the number of referrals of these patients to hypertension specialists, and3) significantly reduce systolic blood pressure (SBP) among the patients discussed during a 6-month, case-based videoconference curriculum. FINDINGS TO DATE: Of the 19 providers who completed the pre-curriculum surveys, 8 were male and 11 were female. Eleven of the PCPs were family practitioners, four were internists, and four were either physician assistants or advanced practice nurses. The mean summary score on the baseline hypertension management self-efficacy scale was 5.25 out of 7 (range 3.8 to 7, S.D.=1.04) and the mean summary score on the hypertension management knowledge questionnaire was 13.57 out of 26 (range 8 to 18, SD=2.85). The correlation between hypertension management self-efficacy and knowledge was low (r=0.24), suggesting that baseline hypertension management self-efficacy did not reflect baseline hypertension management knowledge.
KEY LESSONS LEARNED: Despite being confident in their ability to care for patients with hypertension, primary care providers at six FQHCs scored poorly on a baseline test of hypertension management skills. Previous studies have demonstrated disparities in self-efficacy and knowledge regarding treatment of chronic diseases. Six months after completing our Project ECHO curriculum, we will conduct follow-up surveys to determine whether hypertension management self-efficacy and knowledge improve and are more closely correlated. We will also determine whether referrals to hypertension specialists decrease and whether SBP declined among the patients reviewed as part of the curriculum. Improvement in these areas will indicate that the Project ECHO videoconference model can be used to link community PCPs with university specialists to improve management of resistant hypertension, as well as other complex, chronic diseases in urban health care settings.

A VISIT PLANNER TO COORDINATE AND IMPROVE CARE IN AN ACADEMIC GENERAL MEDICINE CLINIC Erin Elizabeth Van Scoyoc 1;
Robert Malone 1; Kim Young-Wright 1; Shaun McDonald 1; Thomas Miller 1; Carmen L. Lewis1. 1University of North Carolina at Chapel Hill, Chapel Hill, North Carolina. (Tracking ID # 10114)
STATEMENT OF PROBLEM OR QUESTION: To improve care in an academic general internal medicine clinic by prioritizing preventive and chronic disease care, coordinating tasks, and evaluating improvements in delivery processes and outcomes.
DESCRIPTION OF PROGRAM/INTERVENTION: The Visit Planner is a paper document generated at check-in that prompts care providers to address needed screening and chronic disease care. Initially developed for use with diabetic patients, we now use the Visit Planner for all established patient visits. The Visit Planner tasks are generated by a patient registry and are customized for each patient based on billing, lab, and EMR data. There are three sections of prompts: for the front desk, for the nursing staff, and for the physician or mid-level provider.

The front desk prompts include ordering an A1c and/or lipids if indicated. Nursing staff and providers address up to three prioritized prompts. Examples of nursing staff prompts include: screening for depression, tobacco abuse, and domestic violence, as well as diabetic preventive care. Examples of physician prompts include: colorectal cancer screening, follow-up on positive depression screens, contraceptive education, and follow-up on positive foot exams. OBJECTIVES OF PROGRAM/INTERVENTION: 1) To develop a system for prioritizing reminders for evidence-based care among standards of preventive and chronic disease care. 2) To effectively distribute and coordinate tasks between the front desk, the nursing staff, and physicians or mid-level providers. 3) To provide feedback on performance to staff members and measure clinical care outcomes. FINDINGS TO DATE: The Visit Planner was successfully incorporated into clinic workflow. The front desk completed 83% of 369 prompts in April 2010, and 86% of 363 prompts in October 2010 ($p=0.351$). Prompts addressed by nursing staff increased significantly over six months from 75% of 2708 prompts to 87% of 3021 prompts ($p<0.001$). Prompts addressed by providers increased significantly over six months from 66% of 1534 prompts to 73% of 1361 prompts ($p<0.001$). This included a significant increase over six months in the response to: colorectal cancer screening prompts from 43% of 457 prompts to 71% of 275 prompts ($p<0.001$), tobacco cessation counseling prompts from 47% of 118 prompts to 69% of 72 prompts ($p=0.002$), positive depression screening follow-up prompts from 62% of 341 prompts to 75% of 293 prompts ($p<0.001$), contraceptive education prompts from 35% of 37 prompts to 71% of 61 prompts ($p=0.001$), and high-risk foot exam follow-up prompts from 60% of 167 prompts to 77% of 119 prompts ($p=0.002$).
KEY LESSONS LEARNED: We developed a system for improving care planning, coordination, and performance measurement in our clinic. The Visit Planner was able to be successfully incorporated into the clinic workflow, prioritizing and distributing screening tasks among the front desk, the nursing staff, and providers. In the future we plan to measure the reliability of prompt completion by nursing staff and providers and then measure its effect on clinical outcomes. In addition, we continue to add new prompts and refine existing ones to continually improve this tool.
ADDRESSING CHRONIC CONFLICT AND PROBLEMATIC BEHAVIORS IN A GROUP PRACTICE Anthony Suchman 1; Elsie Mainali 2; Jody Hoffer Gittell3. 1McArdle Ramerman &Company, Rochester, New York ; 2Pediatrix, Virginia Beach, Virginia ; 3Brandeis University, Waltham, Massachusetts. (Tracking ID # 10326)
STATEMENT OF PROBLEM OR QUESTION: When a practice group is compromised by problematic physician behaviors and conflicts, how can a practice director introduce behavioral accountability and establish a collaborative culture?
DESCRIPTION OF PROGRAM/INTERVENTION: Working with a 5-member neonatalogy practice whose performance was impaired by chronic conflict and widespread individualistic non-collaborative behaviors, we implemented a multi-faceted program including: 1) A 360 review for the physicians and the practice as a whole based on interviews with the doctors and other ICU staff members. 2) A 9-hour retreat to reflect on current group process and performance data and to create behavioral standards, a vision statement and action steps. 3) Regular, frequent (q 3 weeks) physician-practice director meetings to set and assess specific behavioral goals and other actions in support of the group vision. 4) A follow-up 8-hour retreat 3 months later to review progress, refine communications skills and establish next steps. OBJECTIVES OF PROGRAM/INTERVENTION: In a practice beset by chronic conflict and non-collaborative behaviors, to engage the physicians in creating rigorous behavioral standards and a systematic accountability process, and to help them create and unite around a collective vision for their practice. Also, to explore the ability of the Relational Coordination Survey (RCS)a well-validated cross-sectional teamwork measureto track longitudinal changes in teamwork quality within a practice group.(1)
FINDINGS TO DATE: One physician did not meet the specified goals in the rapid-cycle behavioral accountability process and left the practice. Each of the remaining physicians improved (based on peer and director observations and changes in their individual RCS scores). The aggregate practice RCS score improved

from 3.74 to 4.10 (a strong clinically significant change). Individuals patterns on the 7-item RCS mapped closely onto direct behavioral observations, lending face validity to the RCS as a measure of individual performance.
KEY LESSONS LEARNED: Rapid turnaround in widespread problematic behavior patterns was achieved with a multi-faceted approach that engaged physicians as active partners and established an effective accountability process. The RCS appears to be a sensitive tool for monitoring individual and aggregate teamwork behaviors.
Reference: (1) Gittell JH. High Performance Healthcare. New York, McGraw-Hill, 2009.
AN ANALYSIS OF PROVIDER RESPONSES TO ELECTRONIC COMMUNICATIONS REGARDING TRANSITIONS OF CARE AND ACTIONS FOR CARE COORDINATION FOR PATIENTS IN A PATIENT CENTERED MEDICAL HOME Scott V Joy 1; Kathleen Waite2. 1Duke University, Chapel Hill, North Carolina ; 2Duke University, Durham, North Carolina. (Tracking ID # 10622)
STATEMENT OF PROBLEM OR QUESTION: How can electronic notifications of patients receiving transitional care be integrated into clinical work flow, and what actions are taken in response to notices of hospital admissions?
DESCRIPTION OF PROGRAM/INTERVENTION: A process for monitoring patients who have been evaluated in the ER, UC, and/or admitted to the hospital is critical for a PCMH. We sought to evaluate our current electronic processes related to these transitions of care. An e-mail is generated and automatically sent to our practice by a central scheduling system when a patient in our practice of 8 physicians is seen in a transitional setting. This inbox is monitored daily by clerical staff, and messages are converted to a task that is put into the electronic health record. Tasks are reviewed daily by the responsible physician, and the

following actions can be taken: 1. Complete without comment2. Complete with comment 3. Forward to a RN care manager. In November 2010, all e-mails received were collected, the electronic tasking system was reviewed to see if a task had been created from the e-mail, the history of the task was reviewed, and the action taken was recorded. OBJECTIVES OF PROGRAM/INTERVENTION: 1. Create a processes for a PCMH General Internal Medicine practice to receive electronic notification when a patient receives care at a transitional site such as Urgent Care (UC), ER, or hospital admission. 2. Create a process for a general internist to review electronic notifications of this care, and to electronically respond to the notification. 3. Measure the actions taken in response to notices about patient hospitalizations.
FINDINGS TO DATE: A total of 279 electronic tasks were created by the data management team and reviewed by providers, with 5 e-mails not being converted to an electronic task. 42% of the tasks were for Urgent Care Visits, 27% were for ER Visits, and 31% were for hospital admissions.Actions taken by physicians in regards to notifications of hospital admissions were as follows:An average of 40% of notifications of hospital admissions were Reviewed without Comment, range 0% to 88%.An average of 16% of notifications of hospital admissions were Reviewed with Comment, range 0% to 50%.An average of 44% of notifications of hospital admissions were Sent to Care Manager, range of 0% to 100%.
KEY LESSONS LEARNED: Many patients assigned to a PCMH receive care in transitional settings in a given month.Existing IT systems can be leveraged to create new processes for electronic notifications to be received regarding transitions of care within a PCMH. This provides a mechanism to track care received outside of the medical practice and opportunities to reduce or improve services based on patient needs. Variability exists amongst individual providers regarding the actions taken in response to electronic notifications of patient hospital admissions.The effectiveness of forwarding the tasks to care managers in regards to efficiency of scheduling follow-up appointments and reducing hospital readmission rates and medication errors remains to be determined.
WISH: IMPROVING WOMENS HEALTH THROUGH SERVICE INTEGRATION AND EDUCATION Mitra

Razzaghi 1; Rita Lee2.
1University of Colorado, Aurora, Colorado ; 2University of Colorado Denver, Aurora, Colorado. (Tracking ID # 10626)
STATEMENT OF PROBLEM OR QUESTION: Fragmentation in the health care system and lack of knowledge regarding recommended preventive and healthy living measures result in patients non-adherence with preventive and chronic illness care.
DESCRIPTION OF PROGRAM/INTERVENTION: The Womens Integrated Services in Health (WISH) clinic at the University of Colorado provides collaborative and comprehensive care. WISH is a primary care clinic staffed by internist with womens health training and family medicine physicians providing age-specific preventive health services, outpatient gynecologic care including procedures, and a concierge-type service for coordination of specialty care. Convenient one-stop preventive care appointments are offered. WISH coordinators who are clinic administrative staff have access and authority to directly schedule with multiple specialty clinics. The educational outreach program includes screening recommendation cards mailed annually during the patients birth month and quarterly e-newsletters with information on womens health topics. Further educational programs such as mother-daughter educational events, series of classes, and webinars are in development.
OBJECTIVES OF PROGRAM/INTERVENTION: 1) To develop a comprehensive range of gender-specific, clinically coordinated services for
women from young adulthood throughout their lifespan.2) To improve adherence with preventive and therapeutic recommendations3) To improve womens knowledge of their health care needsFINDINGS TO DATE: A survey of 200 women presenting to the WISH clinic resulted in a 78% (N=156) response rate. Average satisfaction of the overall services rated 9.28 out of 10. Of the 41% who used the coordination of care service, 95% had good (22%), very good (35%), or excellent (38%) experiences. Forty percent of patients who did not use the coordination of care were not aware of this service. Patients who were aware but decided not to use coordination of care service either preferred to schedule their appointments themselves (40%) or felt that they did not need it (60%). E-mail surveys (average of 1200 per year) demonstrate a 96.5% satisfaction rate. Baseline clinical metrics reveal rates of screening for cervical, breast, and colon cancer to be below national average. These metrics will be reassessed after a set intervention period.
KEY LESSONS LEARNED: Achieving a true integrated service requires a network of participating specialists and the infrastructure for service coordination (access to schedules, registries, and organizational support for personnel and education resources). Novel concepts such as educational programs and concierge-type services can only be successful when patients are aware these resources exist.
V I E W I N G O F C H R O N I C PA I N D E C I S I O N A I D S I N A MULTIDISCIPLINARY PAIN PROGRAM AND PATIENT REPORTED OUTCOMES Joseph M. Bumgarner 1; Leslie Stewart 2; Shaun McDonald 2; William C. Andrew 2; Timothy J. Ives 2; Paul R. Chelminski 2; Michael Pignone 2; Carmen L. Lewis2. 1Division of General Internal Medicine and Clinical Epidemiology, University of North Carolina, Chapel Hill, NC, Durham, North Carolina ; 2Division of General Internal Medicine and Clinical Epidemiology, University of North Carolina, Chapel Hill, NC, Chapel Hill, North Carolina. (Tracking ID # 10723)
STATEMENT OF PROBLEM OR QUESTION: To determine if providing chronic pain Decision Aids (DA) increases patient engagement in care and improves patient reported pain and psychosocial outcomes.
DESCRIPTION OF PROGRAM/INTERVENTION: The GMPS is a multidisciplinary program for patients with nonmalignant chronic pain. The goals of the GMPS are to reduce daily pain, improve participation in activities of daily living, and address overlaying symptoms such as sleep and/or mood disorders through pharmacological and non-pharmacological means. At the conclusion of a 30 minute enrollment visit, we asked patients to view a DA produced by The Foundation for Informed Medical Decision Making, Living with Chronic Pain, which is designed to provide evidenced-based methods for the management of chronic pain. In addition to the DA, patients were also given a pain booklet and pre and post questionnaires. Using this approach viewing rates of

the DA were less than 30%. We then extended the enrollment visit to 60 minutes and required all new chronic pain patients to read and complete the DA pre-questionnaire, watch the DA, and complete the DA post-questionnaire on computer stations in each exam room prior to the visit.
OBJECTIVES OF PROGRAM/INTERVENTION: Objective 1: To increase viewership of a chronic pain DA video in patients enrolled in the General Medicine Pain Service (GMPS) at The University of North Carolina Internal Medicine Clinic. Objective 2: Determine if viewing the chronic pain DA influences intent to discuss non-pharmacologic treatment options for chronic pain with the patients healthcare practitioner. Objective 3: Determine if viewing the DA results in improved pain or psychosocial measures.

FINDINGS TO DATE: Viewership of the DA increased 46% with our intervention. Of those who completed the DA mean age was 47.2 vs.49.2 for non-viewers, (p=0.48). 41% who viewed the DA were male vs. 50% for non-viewers (p=0.43). 73% who viewed the DA were Caucasian vs. 67% for non-viewers (p=0.53). Time to first follow-up was 28.5 days for those who viewed the DA vs. 27.4 days for non-viewers (p=0.85). For those who watched the DA, 80%, 60%, 53%, and 41% had tried pain medication, relaxation, physical activity, and improved sleep respectively. Intent to discuss improved sleep and physical activity increased 19% and 16% respectively after viewing the DA. Those who watched the DA had greater improvement in concentration (0.30 vs. -0.20, p=0.18), energy (0.16 vs. -0.40, p=0.02), and appetite (0.36 vs. 0.30, p=0.08) vs. non-viewers. Pain scores for those who watched the DA improved in all categories with greater improvement in worst (0.37 vs. -0.20, p=0.16) and average (1.11 vs. 0.07, p=0.02) vs. non-viewers.
KEY LESSONS LEARNED: By increasing visit length, our intervention integrated a DA into chronic pain management and fostered a broader conceptualization of this chronic condition among patients. Patients who viewed the chronic pain DA reported an increase in their intent to discuss improved sleep and physical activity with their healthcare practitioner after watching the DA. Patients who viewed the chronic pain DA also demonstrated a trend toward better psychosocial measures and pain scores overall. Specifically, these patients display a significant improvement in energy and average pain scores at follow-up after viewing the DA when compared to patients who did not view the DA. These findings indicate that the Chronic Pain DA increases patient engagement and has the potential to improve the clinical outcomes of pain relief and psychosocial health. A randomized intervention using the DA is needed to provide greater insight into its impact on clinical outcomes.
TREATING HEPATITIS C IN THE HOMELESS: A MODEL THAT WORKS Cheryl Ho 1; Charles Preston 1; Kim Fredericks 1; Sara Doorley1. 1Valley Homeless Healthcare Program, San Jose, California. (Tracking ID # 10827)
STATEMENT OF PROBLEM OR QUESTION: Access to Hepatitis C evaluation and treatment is often limited in patients with a history of mental illness, addiction, and/or unstable living conditions. DESCRIPTION OF PROGRAM/INTERVENTION: The Valley Homeless Healthcare Program (VHHP) is a FQHC primary care medical home in San Jose, California whose patient population has a high prevalence of infection with the Hepatitis C virus. While most of the patients with HCV desire evaluation and treatment for their infection, few qualify for treatment in a traditional specialty clinic setting because of the difficulty in co-managing mental illness, substance use disorders, while balancing unstable living conditions. At VHHP, the processes of medical evaluation, psychosocial assessment, patient education, treatment monitoring, peer support, and self-efficacy development are all conducted in a single setting of a multidisciplinary group model within primary care. Primary care physicians co-lead a weekly group visit with Psychologists for patients who are contemplating Hepatitis C treatment, currently in treatment, and who have completed treatment, all in one group together.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. To improve health-care access to Hepatitis C evaluation and treatment in patients with a history of mental illness, addiction, and/or unstable living conditions.2. To streamline processes in HCV treatment of patient education, medical evaluation, psychosocial assessment, and treatment

monitoring into a weekly multi-disciplinary group clinic. 3. To achieve outcomes of HCV treatment compliance rates and viral response rates in a socially vulnerable population that rival published standards.
FINDINGS TO DATE: A total of 28 patients have undergone treatment through this multidisciplinary group treatment model. 4 patients stopped treatment early due to intolerable side effects. 10 out of 18 (55%) patients with HCV Genotype 1 achieved a sustained viral response, or clearance of the Hepatitis C virus at 6 months compared with the published standard of approximately 50%. 8 out of 10 patients (80%) with Genotypes 2 or 3 achieved a sustained viral response, compared with 70-80% nationally.
KEY LESSONS LEARNED: Patients with a history of mental illness, substance use disorders, and unstable living conditions can be successfully treated for Hepatitis C within the primary care context of a multidisciplinary group clinic model, with treatment completion rates and sustained viral response rates that rival published literature rates.
REDUCING EMERGENCY DEPARTMENT FREQUENT USE BY INVESTIGATING RECURRENT ABDOMINAL PAIN Alan Weiss 1;
Alan Weiss 1; Maged Rizk2. 1The Cleveland Clinic Foundation, Cleveland Heights, Ohio ; 2The Cleveland Clinic Foundation, Cleveland, Ohio. (Tracking ID # 10903)
STATEMENT OF PROBLEM OR QUESTION: Frequent emergency department users account for a high fraction of ED visits. By analyzing patients with abdominal pain, we discovered factors which can reduce recurrent ED visits.
DESCRIPTION OF PROGRAM/INTERVENTION: We created a database from the Cleveland Clinic Health System (CCHS) electronic medical record, with 10 EDs, and 2.1 million visits on 570,000 patients. A cohort of 146 patients was identified who had been to any CCHS ED at least 50 times, with at least two of those being for abdominal pain. A retrospective chart review of 1595 ED visit notes and tests was performed. We asked:1. Was there any reference to past ED visits or results?2. What were patient complaints and requests?3. What ED procedures and tests were done?4. In the reviewers opinion, did the patient come to the ED for a medical, psychological, or social problem?5. Was the patient admitted, observed or discharged home?6. Did the patient receive prescriptions or follow-up appointments?7. Did the patient get a toxicology screen?8. Did the patient appear to be faking or exaggerating symptoms? OBJECTIVES OF PROGRAM/INTERVENTION:Discuss the problem of ED frequent users in terms of costs, society impact and the dangers they face from poor health outcomes. Demonstrate how a system wide database can find frequent ED users and illustrate their pattern of ED use.
Identify factors which contribute to provider and patient decision making in terms of the care the patients receive, mechanisms to decrease repeated testing and factors which reduce how often the patients return to the ED.
FINDINGS TO DATE: The ED notes mentioned prior ED visits or tests on 27% of the current ED visits. Making that reference decreased the ordering of x-rays and all radiological tests, by 25% and 20% respectively, but increased the use of IV fluids, labs and narcotics by 21%, 9% and 25% respectively. The time interval between visits decreased if the patient was sent home (by 5.3 days), or received narcotics prescriptions (by 8.2 days). The time interval between ED visits increased if the patient was admitted (by 7.3 days), had labs (by3.6 days), had radiological tests, or had nothing done (by 7.1 days). Scheduling follow-up appointments had no influence on ED recurrence.

Patients exaggerating or faking symptoms occurred on 4% of the visits, but 21% of the cohort patients performed that behavior on at least once. This subgroup was more likely to request narcotics, have more one

ED visit on the same day and have illegal substances on toxicology screening.
KEY LESSONS LEARNED: While our study is limited by what ED providers actually document, we feel that good medical decision making is often accompanied by appropriate documentation. In that respect, this retrospective cohort study significantly adds to the ED frequent user literature. The recognition of recent ED use by providers changes their perspective from an episode of care to that of a continuum. That view decreases radiology tests, but, paradoxically, may actually lead patients to return to the ED more often. At the very least, acknowledging that a patient recently was in the ED and ordering lab tests prevents them from returning as frequently. Drug seeking behavior, common in the cohort, could have been reduced with more liberal use of toxicology screens, which, while only used on 9% of visits, were found to have illegal substances on one third. Prospective studies are needed to confirm our results.
IMPROVING THE CONSISTENCY OF ORAL ANTICOAGULATION IN A SKILLED NURSING FACILITY: UNDERSTANDING BARRIERS TO PATIENT SAFETY IN LONG TERM CARE Karen Glasser Scandrett 1; Brian Joyce 1; Linda Emanuel1. 1Northwestern University, Chicago, Illinois. (Tracking ID # 10945)
STATEMENTOF PROBLEM OR QUESTION: Achieving consistency in oral anticoagulation is particularly difficult in nursing homes, with reports in the literature of therapeutic values achieved only 50% of the time.
DESCRIPTION OF PROGRAM/INTERVENTION: We convened a QI process at a local, 189-bed for-profit nursing facility at which one investigator is associate medical director. After obtaining administrative approval, a team comprised of the director of nursing, two nursing managers, two staff nurses, and representatives from pharmacy, laboratory and nutrition services met every two weeks in order to map the anticoagulation process and identify key areas for quality focus. We identified relevant tools, including a communication mnemonic, a dosing algorithm, and nutritional and pharmacy support tools, and incorporated them into a new protocol. A multimedia inservice was developed and conducted with all nursing staff over a two week period. Reminders of the revised protocol were posted at each nursing station and in the medical chart of each resident receiving anticoagulation therapy.
OBJECTIVES OF PROGRAM/INTERVENTION: To use quality improvement (QI) methods to improve anticoagulation consistency at a local skilled nursing home in the following manner:1) Develop a local team to establish oral anticoagulation goals and map the current process;2) Conduct quality improvement cycles, measuring time-to-therapeutic and percent time in therapeutic range;3) Improve nurse-physician communication about the anticoagulation process.
FINDINGS TO DATE: Data from the three months prior to the intervention were compared with to data from the three months after the intervention. A total of 458 INR draws were performed on 69 patients pre-intervention, and 560 INR draws were performed on 66 patients post-intervention. Average time to therapeutic INR was 26 days pre-intervention and 25 days post-intervention. The percentage time in therapeutic range did not change significantly. Pre-intervention, 57.6% of INR draws were within therapeutic range, while 48.3% of post-intervention INR values were therapeutic.
Data collection is ongoing and a second intervention phase is planned, which will include: 1) a revised series of inservices focusing on nurse-physician communication, using an INR reporting case-study for role-play, and 2) a physician mailing regarding appropriate Coumadin dosing and introduction of the dosing algorithm.
KEY LESSONS LEARNED: The project was initially well-received, but lost momentum due to several factors known to thwart QI efforts in nursing homes, including high staff turnover and lack of leadership and/or organizational capacity for change. Turnover was a pervasive issue; the facility administrator was replaced early in the project, delaying project start and precluding plans to collect communication data. Nursing presence on the project team was inconsistent. Three team members left the facility and two new managers were assigned to the team, without owning the problem. Facility-wide nursing staff turnover was ~50% during the project. The director of nursing lacked experience with and knowledge about QI methodology, and there was insufficient local championing of the project. Efforts were further degraded due to competing clinical needs related to high

staff turnover. Finally, delays in data analysis slowed the momentum to make protocol adjustments.
TRANSITION OF CARE FROM ACUTE HOSPITALIZATION TO THE PATIENT CENTERED MEDICAL HOME: A ELECTRONIC HANDOFF INTERVENTION Nicholas Moy 1; Edgar Pierluissi2. 1San Francisco VA Medical Center, San Francisco, California ; 2University of California, San Francisco, San Francisco, California. (Tracking ID # 11091)
STATEMENT OF PROBLEM OR QUESTION: Transitions of care between the hospital and the patient centered medical home (PCMH) is a high risk period for patients, even with an electronic medical record (EMR).
DESCRIPTION OF PROGRAM/INTERVENTION: Incorporating the key components required by the stakeholders in a handoff communication, we created an electronic tool in the San Francisco VAs EMR that communicates critical information sent by housestaff physicians in the hospital to the PCMH teams. The tool contains provider contact info, discharge date, follow-up appointments, pending labs/tests/imaging, homecare services, and other free text information deemed important by housestaff physicians. It is simple, efficient, self-explanatory, quick to fill out and easy to read so that it may be used clinically where primary care follow-up is delivered.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Determine the critical information needed by key stakeholders during the hospital to outpatient transition of care2. Implement an easy to use EMR handoff tool that communicates critical clinical information between stakeholders3. Evaluate the impact of the handoff tool via focus groups, questionnaires, and quantitative outcomes listed belowFINDINGS TO DATE: Outpatient: A focus group of RN case managers(10) was conducted. Response was generally positive. They appreciated the alerting function the note served when the patient was discharged. The note prompted the discovery of missing follow-up appointments and long wait times >1 month. The clinic staff was then able to intervene to correct these issues.
Inpatient: A focus group of housestaff (7) was conducted. Response was overwhelmingly positive. Six of the housestaff had readily adopted the tool without any formal training. They reported taking less than 2 minutes to complete the handoff, felt more reassured that patients for whom the note was completed would have appropriate follow-up and that important clinical information was being communicated. When directly asked about any negative aspects of the tool the housestaff had no comments.

Currently, the handoff is also being adopted by the Home Based Primary Care service and another PCMH clinic outside of the SFVAMC network. KEY LESSONS LEARNED: 1. Implementing simple tools that improve the ability to deliver good care while not imposing excessive burdens on stakeholders can have rapid uptake and may be spread effectively.2. Although EMRs and discharge summaries are comprehensive in nature, meaningful clinical communication depends on efficiently delivering the need to know pieces of information.
WHERE DID THE DAY GO? Andrew Schutzbank 1; Christine Sinsky2.
1Beth Israel Deaconess Medical Center, Boston, Massachusetts ;
2Medical Associates Clinic and Health Plans, Dubuque, Iowa. (Tracking ID # 11118)
STATEMENT OF PROBLEM OR QUESTION: Clinicians in primary care clinics frequently feel harried and disorganized. We present a method to measure, at the most granular level, how these clinicians spend their day.
DESCRIPTION OF PROGRAM/INTERVENTION: During a 1 week elective with Dr. Sinsky asked Dr. Schutzbank to determine how much time was spent undistracted with patients in her day. In-room time logging into the computer, hunting for information or supplies was poorly spent and to be minimized. We describe both the method created to collect this data and report our findings.
Dr. Schutzbank observed Dr. Sinsky, her nurses and reception for 1 morning to develop action categories, then spent 4 days in 30 minute periods collecting data.
Observations were coded at a resolution of 1 per 10 seconds to provide enough detail to guide change. We

used an iPad with a metronome app to cue 10 seconds via headphone and an app called Tallymander 2 to tally the observations in a non-obtrusive fashion. For example, every 10 seconds Dr. Sinsky spent doing a physical exam would add 1 to the Exam category. This data was then directly exported into Excel for analysis.
OBJECTIVES OF PROGRAM/INTERVENTION: - Develop a method to accurately and efficiently capture and code in-room activities in real time, to better understand current workflow patterns, identify time sinks, and redesign of office processes for improved quality of care- Create a methodology to compare pre- and post-workflow interventions within an individual practice-Compare how clinicians spend their time across different practices, with an emphasis on undistracted time.
FINDINGS TO DATE: Methods findings: We were able to develop a nonobtrusive method to categorize, record, and analyze clinician activity throughout their day, especially while in the patient room. Unlike previous forays into this area, we were able to inexpensively see under the hood of primary care, with the ability to record observations that accommodates the rapid task shifting common to primary care, while remaining easily customizable for different providers or practices. Data collection and data entry occur simultaneously, minimizing error and allowing for rapid analysis in spreadsheet format, and providing immediate feedback to the observed practices.
Practice findings: At Dr. Sinskys practice, initial findings suggest that she spends between 49-60% of her time in a clinic session as undistracted patient time, approximately 4% (15 minutes per 6 hour session) logging into her computer, 11% documenting the clinic note and another 4% of the session in downtime.
KEY LESSONS LEARNED: -With the right technology, we can gain direct, in-room insight into the mechanics of a primary care practice. Data recording can be rich, granular, and analyzed quickly.
-This method can be used to answer any question related to how physicians spend their time with a limited investment of time and energy.-We anticipate this methodology will be useful in analyzing efficiencies associated with individual innovations in office organization, workflow and task distribution.
TITRATION OF INSULIN USING A TELEPHONE PROTOCOL IN A VETERANS AFFAIRS PRIMARY CARE CLINIC Amy R Schwartz 1;
Christopher Miniter 2; Luz Vasquez 2; Johanna Giovanniello 2; Donna Vogel2. 1VA Connecticut Healthcare System, New Haven, Connecticut ;
2VA Connecticut Healthcare System, West Haven, Connecticut. (Tracking ID # 11124)
STATEMENT OF PROBLEM OR QUESTION: Barriers to insulin titration may include lack of process standardization, including an algorithm for titration and a method of communicating regarding home firger-stick blood glucose [FSBG] results.
DESCRIPTION OF PROGRAM/INTERVENTION: We sought to efficiently titrate insulin using a simple algorithm and weekly telephone contact. Patients with Type 2 Diabetes on NPH or Glargine Insulin are eligible for the protocol. Patients monitor FSBG and report their readings to the APRN case manager via weekly telephone calls. The case manager evaluates for hypoglycemia, provides diabetes education, and instructs the patient regarding insulin titration, using a titration protocol adapted from Riddle et al 2003 (1):1. Riddle MC et al. The treat-to-target trial. Randomized addition of glargine or human NPH insulin to oral therapy of type 2 diabetic paitents. Diabetes Care 2003;26:30803086.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Learn standardized methods to facilitate titration of insulin in a primary care setting2. Understand the risks and benefits of insulin titration protocols FINDINGS TO DATE: 16 patients (15 Male, 1 Female) were enrolled in the pilot phase of the protocol. Patients were 64 years (SD 8) on average. At protocol entry, the mean Hemoglobin A1c (HbA1c) was 9.8% (SD 1.5) and patients were prescribed mean 52 Units (SD 52) of insulin. Patients have been enrolled for 2 to 19 months, with 2 patients discharged due to lack of need for further titration or support. Current or discharge HbA1c averages 8.9% (SD 2.2), and current or discharge insulin dosage is 99.6 Units (SD 63.8). Four patients experienced hypoglycemia during titration and seven required deviation from the protocol, either due to hypoglycemia or to reduce risk for

hypoglycemia.
KEY LESSONS LEARNED: Insulin can be efficiently titrated in primary care clinic patients, using a simple algorithm and weekly telephone contact. However, a subset of patients require protocol deviation to avoid or respond to hypoglycemia. This is not surprising, as hypoglycemia is a known consequence of insulin titration. We plan to modify the titration protocol to decrease the risk of hypoglycemia.
IMPROVING COMMUNICATION ABOUT PATIENTS WITH RESIDENT AMBULATORY CARE TEAMS Lauren A Peccoralo 1; Lawrence Ward 2; James Stulman 1; Ira Helenius 1; Alex Federman 1; Deborah Korenstein 1; David C. Thomas1. 1Mount Sinai School of Medicine, New York, New York ;
2Temple University School of Medicine, Philadelphia, Pennsylvania. (Tracking ID # 11156)
STATEMENT OF PROBLEM OR QUESTION: Continuity of care in Internal Medicine (IM) resident clinics is often suboptimal. Residents rely on covering physicians to care for their patients and communication about issues is often subpar.

DESCRIPTION OF PROGRAM/INTERVENTION: Our program was instituted at two urban academic medical centers for IM residents. We developed Ambulatory Care Teams (ACTs) to promote patient continuity with a small group of providers. ACTs consisted of 5 to 7 IM residents and one supervising attending. Residents were instructed to refer patients for visits with their team members when they were personally unavailable. Teams were encouraged to communicate via the electronic medical record (EMR) and/or email. Front desk and call center staff were instructed to schedule follow up visits within the ACTs. Teams met biannually to discuss issues in caring for and improving the care of their shared patients.
OBJECTIVES OF PROGRAM/INTERVENTION: The goal of our resident primary care practice redesign was to create resident teams to enhance coverage for patients and improve communication between residents about shared patients.
FINDINGS TO DATE: On average, residents perceived seeing their own clinic patients 61% of the time and patients of their team members 30% of the time. Residents reported communicating with their team members about 8 times per month (mode) about patient care issues. In addition, 61% of residents felt their team helped to coordinate care for their patients some or most of the time. Strengths of the teams included: residents knowing a small subset of their colleagues patients and patients exposure to a smaller group of physicians. One resident noted keeping patients care limited to fewer people who know my style is easier for patients. Some residents also reported an appreciation for team camaraderie and communication. One resident said, the preceptors know the patients and its easier to communicate between residents.
KEY LESSONS LEARNED: Findings Continued: Weaknesses included: suboptimal communication within the team, difficulty scheduling with team members and lack of cohesion of team members. One resident wrote, I have to do primary care work on patients I dont know, and its hard to get in touch with [team] residents. Another said [teams are a] poor substitute for real continuity of care with a provider.
Key Lessons Learned: The ACT teams may help to enhance coverage of IM residents primary care patients and promote communication between residents about those patients. However, the teams have only a modest impact on residents perceptions of continuity and communication and may not be sufficient for meeting goals of patient centered care in academic primary care practices.
RESIDENT AND FACULTY ATTITUDES TOWARDS USING PATIENT FEEDBACK IN AN ACADEMIC INTERNAL MEDICINE OUTPATIENT PRACTICE Mitesh Patel 1; Danae Nicole DiRocco 2; Lucas Marzec 1; Susan Corson Day3. 1Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania ; 2University of Pennsylvania, Philadelphia, Pennsylvania ; 3University of Pennsylvania, Media, Pennsylvania. (Tracking ID # 11179)

STATEMENT OF PROBLEM OR QUESTION: Patient feedback has been hypothesized to play a valuable role towards quality improvement in the outpatient setting. Physician attitudes are unknown. DESCRIPTION OF PROGRAM/INTERVENTION: We conducted a prospective cohort study among internal medicine faculty and residents at three outpatient practices at the University of Pennsylvania. One of the outpatient practices served as the intervention site by utilizing touch screen kiosks to collect patient feedback after completion of the visit. These data were collected and individualized report cards were distributed to each physician. The other two practice sites served as the control. In these practices, patient feedback was collected by mail using Press Ganey CGCAHPS (Clinician and Group Consumer Assessment of Healthcare Providers) surveys. These data were used to create one practice-based report card that was distributed to all physicians. Physicians at each of the three sites were asked to report on their attitudes towards patient feedback by filling out a survey before and after seeing their report card.
OBJECTIVES OF PROGRAM/INTERVENTION: The objective of this study was to assess physician attitudes towards the proper role, validity, and potential limitations of using patient feedback in academic internal medicine outpatient practices. We also set out to understand if providing individual vs practice level feedback influenced physician attitudes towards patient feedback, and if attitudes varied by level of training.
FINDINGS TO DATE: Pre-intervention assessment among 55 respondents found that 83.6% agreed that the quality of care is related to patient satisfaction, 76.4% agreed that quality of care can be assessed from patient feedback, 90.9% agreed that patient feedback will change the way they practice, and 92.7% agreed that patient feedback would be an effective educational tool. Perceptions among these dimensions increased among physicians at the intervention site who were given individual report cards, but declined among physicians at the control sites. Attending and resident perceptions did not differ. During pre-intervention assessment, only 38.2% of physicians agreed that patient feedback should be given to the department chair, 9.1% agreed that it should be given to payers, and 18.2% agreed that it should play a role in compensation. Perceptions among these dimensions did not change significantly after the intervention.
KEY LESSONS LEARNED: Physicians consider patient feedback to be a valuable tool for improving quality of care and medical education. It was considered more valuable if individualized to the physician, rather than being reported as practice-level feedback. While physicians felt they could use this data to change their practice habits, they did not feel it was appropriate to be given to the department chair or payers for evaluation. Furthermore, they did not agree that patient feedback should play a role in determining compensation.
PROMOTING CHRONIC DISEASE MANAGEMENT THROUGH MOBILE TECHNOLOGY Henry Fischer 1; Henry H Fischer 2; Susan L Moore 2; David Ginosar 2; M Joshua Durfee 2; Cecilia Rice-Peterson 2; Thomas D MacKenzie 2; Raymond O Estacio 2; Andrew Steele2. 1Denver Health Medical Center, denver, Colorado ; 2Denver Health Medical Center, Denver, Colorado. (Tracking ID # 11180)
STATEMENT OF PROBLEM OR QUESTION: Patients and providers express frustration with the traditional approach to managing chronic disease through the 20-minute provider-driven visit.
DESCRIPTION OF PROGRAM/INTERVENTION: The study was conducted at a federally qualified community health center that serves a primarily Latino population (81%) that is largely uninsured (41%) or on Medicaid or Medicare (56%). Patients (N=47) received text message prompts for blood sugar readings 3x weekly for 3 months and appointment reminders 7, 3, and 1 day(s) prior to appointments. A software platform, the Patient Relationship Manager (PRM), displayed patient text message responses and identified out of bounds glycemic readings. A registered nurse dedicated 0.2 FTE to contacting patients with out of bounds readings and transferring patient readings to our medical record.
OBJECTIVES OF PROGRAM/INTERVENTION: To evaluate the feasibility of engaging diabetic patients in cell phone based text message interactions through blood sugar prompts and appointment reminders.

FINDINGS TO DATE: On average, patients responded to glycemic prompts 69% of the time, and 79% of the

cohort responded to more than 50% of the glycemic prompts. The mean response time was 3 hours and 5 minutes. Providers report improved engagement of their patients with their diabetes, as well as quicker identification of hypoglycemic episodes. Analysis of patient and provider focus groups, patient responses to appointment reminders, and pre- and post- patient self-efficacy surveys will be completed by the end of March 2011.
KEY LESSONS LEARNED: Most patients engaged in text message based interactions. Variation was noted among mobile service providers in message delivery, time-out, and formatting. There was little cell phone service provider turn-over among patients. This pilot study helps inform an expanded text-message based intervention that will utilize PRM to support customized patient self-management and identify and reach out to patients overdue for medication fills.
UNDERSTANDING AND REDUCING 911 EMERGENCY CALLS AT OUTPATIENT INTERNAL MEDICINE CLINIC Jessica Jen-Yin Chen 1;
Arlene Endozo 2; John Fontanesi2. 1University of California at San Diego, Escondido, California ; 2University of California at San Diego, La Jolla, California. (Tracking ID # 11260)
STATEMENT OF PROBLEM OR QUESTION: There are no data capturing 911 calls from a free standing academic outpatient Internal Medicine Clinic to understand the nature and extend of the problem.
DESCRIPTION OF PROGRAM/INTERVENTION: A separate written Patient 911 Emergency Calls Log was implemented and kept by clinic nurses outside the electronic health record (EHR). The log captures date, patient name, physician/nurse involved, reason for call, time call placed, time EMS arrived, time EMS left, event outcome. Cases were randomly assigned to physician reviewers to determine whether 911 calls are preventable. Additional analysis of all cases is performed to understand the nature of the call (patient demographic, visit types, reasons for 911 calls). The findings of the study result in recommendations in triage personnel education, and mandatory electronic health record 911 call documentation.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. To capture the volume and nature of the 911 calls2. To improve quality of care by understand situations generating 911 calls3. To prevent the need for 911 calls by deterring preventable causes FINDINGS TO DATE: The thirty 911 calls were made in 19 months with an average of 1.6 calls per month. Patient demographic showed most calls involved 6170 year old patients (33%), with female predominant (70%). The visit type included: scheduled routine visit 23%, scheduled acute visit 50%, walk-in visit 23%, and unclear visit 3%. Reasons for 911 calls can be divided into cardiac 33%, neurological 33%, pulmonary 20%, and miscellaneous 13%. Patients saw by primary care physician 60%, other providers 33%, unclear 7%. The physician reviewers were focus on preventable causes in triage system, not on scheduled visits. Preventable 911 calls: 2 cases of scheduled acute visit (7%); not-preventable: 13 cases (43%); unclear: 8 cases (27%); walk-in: 7 cases (23%). EHR documentation surrounding the calls: complete note 77%, brief note 13%, and no note 10%.
KEY LESSONS LEARNED: Most 911 calls from clinic may not be preventable. Improved triage personnel education may potentially reduce some 911 calls. 23% of 911 calls resulted from routine scheduled follow up visits. Of these, some may potentially be preventable. High risk patient tracking mechanism and education are needed. These patients
should educate to call urgent appointments for acute urgent issues instead of waiting for distant pre-scheduled appointments. Inadequate electronic health record documentation prevents understanding the nature of some 911 calls. Basic electronic health record documentation surrounding all 911 calls should be required to improved communication. Further collection and analysis of data are needed to develop further understanding of the issue.
UNCOMPLICATED HYPERTENSION: IMPROVING PRACTICE OUTCOMES WITH THE PATIENT CENTERED MEDICAL HOME MODEL Abigail Deyo 1; Jennifer Mackinnon 1; Julie Mitchell1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11291)

STATEMENT OF PROBLEM OR QUESTION: Will the patient centered medical home model improve blood pressure control in patients with uncomplicated hypertension?
DESCRIPTION OF PROGRAM/INTERVENTION: Our intervention was targeted to improve hypertension control in uncomplicated hypertension as reported to The Wisconsin Collaborative for Healthcare Quality (WCHQ). Inclusion criteria were patients 1885 years old with uncomplicated hypertension (excludes CHF, DM, and renal disease). Goal blood pressure was less than 140/90 based on JNC 7 guidelines. Patients were self-identified as having hypertension or high blood pressure. A survey identified barriers to hypertension control including diet, medication compliance, and previous patient education. After a discussion with the patient, providers then documented specific blood pressure goal, barriers in achieving goal, and the care plan and self-management goals. For critical blood pressures a nurse practitioner (NP) or provider saw the patient in urgent follow-up. In all cases, medical assistants, RNs, and NPs then coordinated targeted educational, referral, and social needs based on the survey and patient-provider discussions.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Improve our practices percent of hypertensive patients with controlled blood pressure to 70% in 1 year using the patient centered medical home model2. Increase patient participation in chronic disease self mangement3. Fully utilize each member of the healthcare teamFINDINGS TO DATE: At an academic general internal medicine practice with 13 providers, we identified 1146 patient with a diagnosis of uncomplicated hypertension and a rate of control of62.6%. The sample is 66% female and 44% male. Hypertension control was similar among female (62.1%) and male subjects(64.9%). This compares to a national average of 46.6% in 2009, although this data includes complicated HTN. The Wisconsin Collaborative for Healthcare Quality (WCHQ) has measured statewide control of uncomplicated hypertension for the last 5 years and noted a gradual trend to improving blood pressure control from59.7% in 2005 to 73.2% in 2010.
KEY LESSONS LEARNED: Pre-intervention control of uncomplicated hypertension of 62% suggests need for improvement. Other practices in the state were able to improve their control rates with systematic interventions. Providers were presented with their individual patient data, which was motivational to develop a system improvement at the practice level. Our Joint Quality Office was tracking hypertension data as reported to WCHQ; however, the data was not available to providers to enable practice change. A challenge was learning to use our electronic health record (EHR) as a tool to both record and extract meaningful data and trigger appropriate interventions. We used a paper questionnaire and then added the data to the EHR to take advantage of our patient flow. We developed

a template for standardized documentation. Clinic staff needed to participate in the planning process, as our intervention required involvement at every level and strong leadership by both physicians and the clinic manager.
THE MEDICATION SELF-TITRATION EVALUATION PROGRAM (MED-STEP): A PATIENT-DIRECTED, IT-SUPPORTED HYPERTENSION TREATMENT PROGRAM Richard Grant 1; Hannah Pajolek 2; Alexandra Pelletier 3; Joseph Kvedar3. 1Massachusetts Gneral Hospital, Boston, Massachusetts ; 2Massachusetts General Hospital, Boston, Massachusetts ; 3Partners Center for Connected Health, Boston, Massachusetts. (Tracking ID # 11316)
STATEMENT OF PROBLEM OR QUESTION: Novel care strategies, such as safely empowering patients to titrate their own blood pressure medicines, are needed to address the problem of uncontrolled hypertension.
DESCRIPTION OF PROGRAM/INTERVENTION: We developed a web-based application (Med-STEP) that allows patients with hypertension to titrate their own blood pressure medication regimens. The program was implemented in a single primary care practice staffed by 5 primary care physicians (PCPs). Each patients PCP specified a sequence of planned medication changes (Treatment Pathways) based on PCP-designated BP

thresholds that was incorporated into the Med-STEP application. During the first week of each month for a 6-month period, patients used a home blood pressure monitoring device that automatically uploaded blood pressure readings to the Med-STEP website. Based on the PCP-defined algorithm, patients were advised to increase, decrease or remain at their current Treatment Pathway stage. If a medication change was advised, a prescription was sent to the pharmacy, the medical record was updated, and the research coordinator followed up with the patient. OBJECTIVES OF PROGRAM/INTERVENTION: 1. To develop a web-based tool that uses home blood pressure results to guide patients through a medication treatment pathway for blood pressure control.2. To integrate this tool into the primary care setting.3. To test the feasibility, efficacy, and impact of the medication self-titration program.
FINDINGS TO DATE: Between 2/2010-5/2010, we recruited patients with mild-to-moderate elevated blood pressure cared for by five PCPs within a single primary care practice. Of eligible patients contacted, 48% (20/42) consented to participate (mean age 51.1 years, 45% women). PCPs required 3.3 +/ 2.8 minutes to designate 6-step medication pathways for each patient. The 20 participants provided 100 patients/months of data. Patients successfully evaluated their pathways for 59 study months; resulting in five increased medication doses [for 3 patients], two self-reports of non-adherence, and 52 readings that did not require medication changes. From baseline to study completion, there was a significant decrease in blood pressure(2.3/5.7 mmHg; p=0.01). The three subjects whose pathways were increased had an average decline of 11.4 /10.4 mm Hg. Most patients (86.7%) agreed that the system was useful to help them manage their hypertension.
KEY LESSONS LEARNED: A web-based model of blood pressure medication patient self-titration can be successfully implemented in a primary care practice setting. Expansion of the program will require attention to technical barriers (4 patients withdrew due to problems with the data upload), workflow issues (faxing medicines, ordering follow-up lab testing, and record updates were handled by study staff rather than practice staff), and the need for wider generalizability (study participants were self-selected and tended to have higher educational
attainment and self-management motivation). This example of medication self-titration may be an important step towards a medical home model in which chronic disease management is less dependent on face-to-face clinic visits.
AUTOMATED BLOOD PRESSURE DEVICE IMPLEMENTATION IN AN ACADEMIC MEDICAL CENTER. Uche Gordon Iheme 1; Stacey Jolly 1; Jennifer D Coleman 1; Laurie Zahar 1; Stephen P Hayden1. 1Cleveland Clinic, Cleveland, Ohio. (Tracking ID # 11354)
STATEMENT OF PROBLEM OR QUESTION: Blood pressure (BP) measurement using an automated apparatus may be superior to manual methods but could impact workflow, causing difficulty in implementation.
DESCRIPTION OF PROGRAM/INTERVENTION: Setting:Over 6,000 patients with hypertension are being managed by 27 physicians in our main campus General Internal Medicine (GIM) clinic, a part of the Medicine Institute (MI) which has 47,000 such patients. The problem.
ABP with the BpTru apparatus is being implemented in our MI clinic settings. The apparatus averages 5 BP measurements, over 5 minutes. This could impact workflow, causing difficulty in implementation. Intervention. GIM leaders charged a team of Nurses, Medical Assistants, and Physicians with implementing ABP measurement in the 3 sections of GIM clinic. A pilot implementation program was carried out over 6 working days in one section. ABP reading was done for any patient with a BP more than 129 mm Hg systolic or 79 mm Hg diastolic. OBJECTIVES OF PROGRAM/INTERVENTION: 1. Develop a protocol to use automated BP measurement (ABP) in an outpatient clinic and measure adherence to it.2. Evaluate the effect of the protocol on clinical work flow and acceptability.3. Compare patients initial single and average ABP measured during the implementation.
FINDINGS TO DATE: There have been no reports of undue delay in patient care. Some patients reported the automated cuff was too tight. Adherence: Of 74 consecutive patients, 46 needed ABP measurement, in whom

adherence to protocol was 87%. In 11% it was omitted, and only ABP was done in 2%. Initial and ABP difference: Among the 46 patients mean ABP systolic was 14 mm lower and ABP diastolic 6 mm lower than the initial BP. KEY LESSONS LEARNED:1. A front line team can rapidly develop and test a protocol for process change.2. ABP measurement did not significantly impact workflow.3. Patient and provider acceptability was high.4. Manual BP measurement may be needed for some patients.5. Ongoing training is needed.

A Statewide Initiative Using QI to Reduce Health Care Disparities Sunita Mutha 1; Angela Marks 2; Patricia Heinrich3. 1University of California, San Francisco, San Francisco, California ; 2University of California, San Francisco, San Francisco, California ; 3Heinrich LLC, Waltham, Massachusetts. (Tracking ID # 11398)

STATEMENT OF PROBLEM OR QUESTION: Health care disparities result in part from unequal care. Can QI tools help improve equality of care for vulnerable populations?

DESCRIPTION OF PROGRAM/INTERVENTION: We designed a process for catalyzing rapid cycle improvement to help community-based organizations:1. use their own data to document and identify disparities for preventive care or chronic condition (e.g., colorectal screening, diabetes),2. develop a detailed plan for measuring and tracking improvement, and3. test strategies for tailoring care to determine if they result in improved care and reduce disparities for target populations.

OBJECTIVES OF PROGRAM/INTERVENTION: We established a competitive funding program for California organizations to undertake QI with the goal of improving equity in care. The program consists of:1) an application specifying aims and goals for a 12-month QI effort2) range of technical assistance to help organizations achieve their aims,3) frequent monitoring of changes tested and analysis of their effect on intended measures, and4) assessment of organizational support and influence on this QI effort. FINDINGS TO DATE: We will present representative results from ongoing efforts to improve equity in care for diabetes care among Latinos, hypertension control in African Americans, and colorectal screening for limited English proficient patients. The results will include run charts of outcome measures and descriptions of the types of culturally and linguistically tailored changes that were tested. The findings will include results from efforts that have been unsuccessful in reducing disparities in care to highlight challenges and what we have learned about undertaking QI with the intent to improve equity in care. KEY LESSONS LEARNED: QI efforts that focus on improving equity in care are distinct in several ways from general QI efforts as they require:1) Specific types of demographic data to be able to stratify outcomes2) a reference group to identify disparity in care3) a clear definition of what counts as a disparity in outcomes4) tailoring interventions to cultural and linguistic issues for target populations. In addition, our statewide effort has given us insight into the state of understanding of health disparities among select health organizations, and the knowledge and skills organizations need access to in order to undertake this QI work.

DOES THIS DOCTOR SPEAK MY LANGUAGE? IMPROVING THE CATEGORIZATION OF PHYSICIAN NON-ENGLISH LANGUAGE SKILLS Lisa C. Diamond 1; Harold S. Luft 1; Sukyung Chung 1; Elizabeth A. Jacobs2. 1Palo Alto Medical Foundation Research Institute, Palo Alto, California ; 2University of Wisconsin - Madison, Madison, Wisconsin. (Tracking ID # 11484)

STATEMENT OF PROBLEM OR QUESTION: Can we improve the categorization of physician non-English language skills in an ambulatory care practice serving a diverse patient population? DESCRIPTION OF PROGRAM/INTERVENTION: In 2009, we received a grant to study physician non-English language proficiency. We sent a survey to physicians who use non-English language skills to communicate with patients, asking them use an adapted version of the Interagency Language Roundtable (ILR) scale to categorize their language proficiency. The expectation was that eventual adoption of this validated scale (5 levels with descriptors) would provide more meaningful data to both patients and the health care organization. Since 1997 PAMF has offered physician language proficiency information on its website to help patients select a language-concordant clinician. We compared the differences between the old, non-validated scale and the ILR scale.

Primary data was collected from physician self-descriptions entered between 1997-April 2010 using the old scale and from April-November 2010 using the ILR scale. We worked with the
Quality Improvement Steering Committee (QISC) at PAMF to obtain organizational support in this endeavor.
OBJECTIVES OF PROGRAM/INTERVENTION: To evaluate and improve upon the existing method of measuring physician non-English language proficiency at the Palo Alto Medical Foundation (PAMF). FINDINGS TO DATE: Almost half of physicians reporting non-English language proficiency spoke Spanish. Other languages included: Chinese (Mandarin, Cantonese, and Taiwanese), South Asian (Hindi, Bengali, Gujarati, Marathi, Punjabi, Tamil, and Urdu), other Asian (Tagalog, Japanese, Korean, Vietnamese, Arabic, and Farsi), and non-Spanish European (Dutch, French, German, Greek, Italian, Portuguese, Russian, and Serbo-Croatian). Although most clinicians who rated themselves as Fluent on the old scale used similar designations on the ILR scale, there was substantial variation in the ways clinicians reclassified themselves among those who had listed the Medical category on the old scale. Physicians self-reporting Spanish as one of their non-English languages were particularly likely to lower their self-reported proficiency levels on the ILR scale. Physicians who reported speaking languages other than Spanish were more likely to rate themselves at the high end of both scales.
KEY LESSONS LEARNED: A more accurate way of measuring physician non-English language proficiency, such as the ILR scale, could reduce healthcare disparities for patients with limited English proficiency. In spite of being supported by existing research findings, implementing even small policy changes within an organization can be challenging. The presentation of local site-specific evidence of a problem can, however, make a compelling case even if the evidence would not meet research standards. Endorsement from organization leadership is essential and change takes time, dedication, and consensus-building.
IMPLEMENTATION OF A STANDARDIZED DISCHARGE SUMMARY FORM TO IMPROVE TRANSITIONS OF CARE Anastasios Kapetanos 1;
Abby Spencer2. 1Allegheny General Hospital, Pittsburgh, Pennsylvania ;
2AGH, Pittsburgh, Pennsylvania. (Tracking ID # 11565)
STATEMENT OF PROBLEM OR QUESTION: The timeliness and content of transfer documents are highly variable; therefore we implemented a standardized discharge summary form that would be available immediately upon discharge.
DESCRIPTION OF PROGRAM/INTERVENTION: We have previously described a needs-assessment of our housestaff regarding the transition of care to extended-care facilities. Based on the results of that study, and the available literature on the key contents of a discharge summary, we designed and implemented a discharge form that would prompt for these elements. In September 2009, this form replaced the previous discharge paperwork in our hospital.
OBJECTIVES OF PROGRAM/INTERVENTION: 1.To design a discharge form that will ensure the timely transmission of relevant information to receiving institutions and physicians.2.To evaluate the accuracy and completeness of the discharge form. FINDINGS TO DATE: Fifty-one percent of documents were completed by PGY1s. Seventy-five percent of patients were discharged home and 25% to extended-care facilities. Only 31% had a contact number recorded. Pertinent results were completely documented 41% of the time, and specialist recommendations 48% of the time. Allergies were accurately documented in only 48% of forms. Four percent had no medication list, and 36% of medication lists were only partially complete.
KEY LESSONS LEARNED: In an attempt to improve transitions of care from our hospital to the receiving provider, we previously identified

content and timeliness of discharge summaries as key areas for improvement. Because hospital policy allows up to 30 days for electronic discharge summaries, we implemented the standardized discharge form to convey

critical elements of the discharge sooner. We hypothesized that this form, which would prompt for the key elements of the hospitalization, would standardize and improve that process. Our data reveal that this form is often left incomplete. Reasons for this may include inadequate housestaff education, the time required to complete the summary, or the deference to electronic summaries. Further efforts are needed to educate housestaff on the importance of this form and how it should be completed.

WHO IS ENROLLED IN AN ACADEMIC HOME-BASED PRIMARY CARE PROGRAM? Laura Montague 1; Monica Ferguson 1; Barbara Boland 1; Susan Corson Day 2; Charmaine Wright1. 1University of Pennsylvania, Philadelphia, Pennsylvania ; 2University of Pennsylvania, Media, Pennsylvania. (Tracking ID # 11580)

STATEMENT OF PROBLEM OR QUESTION: Home based primary care (HBPC) programs are small with limited availability, yet demand continues to increase as Americans age.

DESCRIPTION OF PROGRAM/INTERVENTION: In West Philadelphia, 53% of the population is over 75 years, with rising rates of complex medical illnesses. In order to improve the coordination of care of frail, chronically ill, homebound patients living in West Philadelphia, a local academic primary care practice recently developed an HBPC pilot program. Providers at this practice are currently referring patients from their panels to the HBPC program, co-managed by a nurse practitioner and MD. In this medical home transitions model, a nurse practitioner makes an initial home visit for medical evaluation or environmental assessment, and reviews the case with a collaborating physician within 24 hours. Cases are presented at a weekly team meeting. The MD follows up in 3 4 month intervals. Coordination of care between patient, family, home, hospital and office is provided by a nurse care manager. Thus far 19 of 30 patients have been enrolled for continuing HBPC.

OBJECTIVES OF PROGRAM/INTERVENTION: To enroll 30 patients in continuing HBPC, and to evaluate the characteristics, needs, and outcomes of the referred population to further inform HBPC program design, implementation, and evaluation.

FINDINGS TO DATE: Mean (SD) age was 82.1 (11.9) years with 78% female and 100% black. English was the primary language spoken in 94% of the households, and 65% of those referred lived alone. 78% were widows, with 6% currently married. Before they were enrolled in home care, mean (SD) number of prescribed medications was 12.3 (4.4) and 71% had home health assistance. In the 12 months prior to enrollment, 42% had at least 1 hospitalization; of those, 87.5% had more than 1. Mean hospital length of stay was3.6 days. Reasons for hospitalization included admission both for acute complaints such as urinary tract infection, falls and small bowel obstruction, as well as management of chronic medical conditions, including exacerbation of congestive heart failure and COPD. There was no difference in mean age, education achieved, or total household number among those hospitalized compared to those not, but those hospitalized did have higher mean number of comorbidities (6.3 (0.76) versus 4.4 (0.5), p=0.03).

KEY LESSONS LEARNED: Those patients enrolled in the HBPC pilot program were elderly with large number of comorbidities, hospitalizations, and prescriptions. More data is needed to determine the characteristics, needs, and outcomes of the homebound
population in order to plan appropriate services and policies in West Philadelphia.

IMPLEMENTATION OF A RESIDENT-RUN EXERCISE AND NUTRITION PROGRAM TO IMPROVE HEALTH BEHAVIORS OF HYPERTENSIVE PATIENTS: A FEASIBILITY STUDY Jennifer Neuman 1; Jennifer Rockfeld 1; Andrew Demidowich 1; Daniel Zanchetti 1; Arzhang Fallahi 1; David C. Thomas1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 11596)

STATEMENT OF PROBLEM OR QUESTION: Nutrition and exercise counseling services are not readily available in Internal Medicine (IM) resident clinics but are an important component in the comprehensive care of patients with hypertension.

DESCRIPTION OF PROGRAM/INTERVENTION: Patients were recruited through the Internal Medicine Associates Clinic at Mount Sinai Hospital in New York City. Objective measurements including BMI, waist circumference, blood pressure, and resting heart rate were obtained upon enrollment and completion of the

program. We conducted pre and post surveys regarding behavior and attitudes towards nutrition and exercise. Participants attended a nutrition and exercise program, composed of four weekly, hour-long sessions. Each session included a 30 minute lecture, a 20 minute group-exercise, and a 10 minute discussion on goals and barriers regarding nutrition and exercise. Patients were given pedometers and other incentives, such as subway fare, water bottles, and a collection of low-salt culturally appropriate recipes. Funding was provided through the Advancing Excellence in Clinical Medicine grant, through The Mount Sinai School of Medicine Department of Medicine. The program received IRB approval from the Mount Sinai School of Medicine.
OBJECTIVES OF PROGRAM/INTERVENTION: The goal of the program was to develop and implement a 4-week resident-led exercise and nutrition program for patients with hypertension. The primary objectives were to 1) increase physical activity among participants, 2) improve knowledge of nutrition, and 3) improve measures of chronic disease (weight, abdominal girth, BMI, blood pressure). We also aimed to extend the role of the IM resident into the community.
FINDINGS TO DATE: Of the 21 patients who signed consent, 8 patients participated in the program and 6 were present at 3 or more sessions. The majority of patients were female (7/8) with an average age of 63 years. The mean baseline BMI was 37, mean systolic blood pressure was 141 mm Hg, and mean resting heart rate was 70 beats per minute. Although our sample was not powered for statistical analysis, we noted several trends in our results. Physical activity increased with an average rise of 58%, or 45 points on the PASE score. We also found a relative increase in nutrition knowledge with an average rise of 13% or 4 points on a 30 point survey, and a relative decrease in perceived barriers to healthy diet and exercise with an average reduction of 8% or 2 points on a 50 point survey. We found that body weight decreased by an average of 1.9 lbs per patient and waist circumference decreased by an average of 0.5 cm per patient. We found no trends in blood pressure or heart rate.
KEY LESSONS LEARNED: Our pilot study supports the feasibility and possible benefit of an IM resident-run exercise and nutrition program for patients with hypertension. A healthy lifestyle approach taught by IM residents for treating hypertension may result in improved clinical parameters, increased exercise, and increased knowledge of a chronic disease. We aim to make our program a permanent fixture in The Mount Sinai Internal Medicine Residency

Program, by incorporating it into our outpatient curriculum in the future.
HEALTH INFORMATION EXCHANGE 3.0: DESIGNING A WEB-BASED INFORMATION EXCHANGE PORTAL (IEP) TO CONNECT HEALTH &SOCIAL SERVICE GROUPS TO REDUCE AVOIDABLE HOSPITALIZATIONS AND HOSPITAL READMISSIONS. Oanh Kieu Nguyen 1; Connie Chan 2; Christopher Clark 2; Gregory Eastin 2; Brad Walsh 2; Sue Pickens 2; Heather Stieglitz 1; Anil Makam 1; Snehal I. Patel 3; Ruben Amarasingham4. 1University of Texas Southwestern Medical Center; Parkland Health and Hospital System, Dallas, Texas ; 2Parkland Health and Hospital System, Dallas, Texas ; 3University of Texas Southwestern Medical Center, Dallas, Texas ; 4Parkland Health and Hospital System; University of Texas Southwestern Medical Center, Dallas, Texas. (Tracking ID # 11827)
STATEMENT OF PROBLEM OR QUESTION: Current health information exchange (HIE) efforts may fail to address the unmet need for communication &coordination of care between health and social service providers.
DESCRIPTION OF PROGRAM/INTERVENTION: Aligning the efforts of health and social service organizations is a massive logistical feat rarely achieved for the individual patient in todays clinical environment. We are designing a web-based IEP to enable real-time communication between PHHS and social service providers to facilitate care coordination across sectors and ultimately, to reduce readmissions and avoidable hospitalizations for patients with diabetes and heart failure. The IEP will facilitate exchange of critical health and case management information at the point of care, such as when a patient is discharged from the hospital or when a social worker first evaluates a client. The IEP will also lay the groundwork for an innovative system of care

delivery by allowing health &social interventions to occur away from traditional care settings; creating a longitudinal perspective of care via referral tracking; and increasing access to a broad array of services to improve individual well-being and community health.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Enable real-time communication at the point of care, between Parkland Health &Hospital System (PHHS), a major urban public safety net hospital, and social service organizations in Dallas County (e.g., Salvation Army, Catholic Charities of Dallas).2. Reduce the 30-day preventable hospital readmission rate for patients with diabetes and heart failure.3. Reduce the 1-year avoidable hospitalization rate for patients with diabetes and heart failure.
FINDINGS TO DATE: Heart failure and diabetes were identified by community leaders as conditions for which an IEP could be most helpful. PHHS data from 200809 showed related ICD-9 codes were associated with 45% of medical admissions and 20% of readmissions. Mental health, COPD, hypertension, asthma, immunizations and preventive care were also stated areas of priority.
Community profiling confirmed socioeconomic and health disparities for which an IEP could be directed. In 2008, 42% of Dallas County residents were below 200% of the federal poverty line (national average30.9%); 47% lived in a geographic area of high need (per Thompson Reuters Community Need Index). Decreasing access to care was reflected by an increasing percentage of the uninsured over a 3 year period (29.1 - >33.2%), increasing numbers of adults with no personal physician over a 4 year period (69.3 - >73.6%) and avoidable hospitalizations for chronic disease (155/100,000 discharges related to diabetes; 255/100,000 for heart failure).
KEY LESSONS LEARNED: 1. There is a widely recognized and shared frustration among health care and social service leaders about the lack of coordinated care for shared patients across these sectors.2. While the potential positive impact of HIE on quality and cost of patient care is almost universally acknowledged, current HIE efforts may inadequately address the need for communication and coordination of care between health and social service providers.3. There are important legal, privacy and security obstacles to sharing health-related information between health and non-health organizations.4. Our project is one of the first information exchange efforts to bridge the information gap between health providers and social service groups and may be replicable in other urban areas with large vulnerable patient populations.5. Once implemented the IEP will be a valuable data gathering tool, tracking referral and utilization patterns to inform community resource allocation and program development.
DEVELOPING A PROGRAM TO REIN IN OVERUSE OF DIAGNOSTIC TESTING IN THE INPATIENT SETTING Marc Larochelle 1; Jeffrey Trost1. 1Johns Hopkins Bayview Medical Center, Baltimore, Maryland. (Tracking ID # 11904)
STATEMENT OF PROBLEM OR QUESTION: Evidence suggests inpatient diagnostic testing is overused and a source of significant waste. Modifying physician ordering behavior has the potential to reduce costs and improve patient care.
DESCRIPTION OF PROGRAM/INTERVENTION: A multi-departmental, physician-led committee was organized with the aim to better understand and improve physician ordering behavior of diagnostic tests at our institution. Cardiac enzyme ordering was selected as an initial target. Based on a review of clinical evidence and guidelines, and discussions with cardiologists, criteria for appropriate ordering of cardiac enzymes for the diagnosis of acute myocardial infarction (AMI) were identified. A chart review of 35 patients admitted to an internal medicine floor on a single day in 2009 was used to contrast appropriate with actual utilization. The results were presented to internal medicine housestaff, medical students, and faculty. In addition to educational interventions, ongoing work is focused on modifying the computerized provider order entry system (CPOE) and developing a report card of ordering behavior at the institution, department, and individual levels to encourage appropriate utilization and assess progress. OBJECTIVES OF PROGRAM/INTERVENTION:1. Develop a program at the Johns Hopkins Bayview Medical Center to establish a culture of responsibility and improve

physician ordering of diagnostic tests, employing cardiac enzyme testing as our initial target.2. Identify appropriate use of cardiac enzyme testing and contrast with actual use at our institution.3. Develop interventions to align actual with appropriate ordering of cardiac enzymes and understand the potential cost savings of such an intervention.
FINDINGS TO DATE: For patients presenting with concern for AMI, appropriate utilization of cardiac enzymes was determined to include up to three measurements of cardiac troponin I spaced six to nine hours apart. Creatine kinase (CK) and MB fraction should not be included in initial testing, but may be appropriate in detecting reinfarction. Chart review of 35 patients admitted to the internal medicine service revealed a mean of 2.4 troponin I, 3.2 total CK, and 3.0 CK-MB tests ordered per patient. 80% of patients had at least one troponin I and 23% had 4 or more troponin I tests ordered. No patients were diagnosed with AMI. Extrapolating to 8,500 admissions annually, removing total CK and CK-

MB and limiting the number of troponin I tests to three for diagnosis of AMI would result in a reduction of 27,200 total CK, 25,500 CK-MB, and 5,950 troponin I tests. Based on administrative charge data this translates to $1.03 million saved annually.
KEY LESSONS LEARNED: We demonstrated significant overuse of cardiac enzyme testing at our institution and presented our findings at a housestaff conference. The 15 attendees were surveyed using an anonymous audience response system. All 15 attendees agreed that troponin I alone without total CK or CK-MB is optimal for diagnosing AMI. However, 47% and 50% of respondents felt that expectations of housestaff and attendings, respectively, would make reducing orders difficult. Prior research suggests that multimodal interventions, including further education, changes to CPOE, and report cards will enhance the likelihood of changing physician ordering behavior. Fostering an institutional culture that values and prioritizes stewardship of health care resources will be instrumental to producing meaningful and lasting change.

CREATING A COMPOSITE MEASURE OF THE QUALITY OF CARE FOR PRIMARY CARE PROVIDERS

Douglas Einstadter 1; Douglas Einstadter2. 1Case Western Reserve University and MetroHealth Medical Center, Cleveland, Ohio ; 2Case Western Reserve University and MetroHealth Medical Center, Rocky River, Ohio. (Tracking ID # 11962)
STATEMENT OF PROBLEM OR QUESTION: Quality outcome measures have become an increasingly important method to evaluate care. How best to combine various outcomes to produce one overall composite measure of quality remains unclear.
DESCRIPTION OF PROGRAM/INTERVENTION: As part of a new institutional incentive program, providers are eligible to receive incentive salary payments based on the quality of their outpatient care. We created a composite measure in order to provide a metric for measuring overall quality. Using hierarchical logistic regression, each providers performance on 15 individual quality outcomes was determined after adjusting for patient age, race, gender, insurance type, number of visits in the 2-year period, count of comorbidities, household income, and educational attainment. Results for each individual measure were multiplied by a weighting factor and then summed to yield a final score which can range from 1 (significantly below the mean on all measures) to +1 (significantly above the mean on all measures). Weights were determined based on a survey of the perceived importance of each of the measures to overall quality of care, completed by providers at all sites.
OBJECTIVES OF PROGRAM/INTERVENTION: For the past 2 years, primary care providers (PCPs) at our institution have received biannual quality reports based on multiple individual measures, with each providers outcomes compared to a peer-group average for that measure. Overall quality rankings have been based on individual measures or on subjective evaluation of providers. Our primary objective was to create and evaluate

a standardized composite quality measure.
FINDINGS TO DATE: Internal Medicine, Family Practice, and Medicine-Pediatrics faculty PCPs (n=79) with at least 100 patients seen 3 or more times for a routine office visit during the period were included in the analysis. Quality data come from 26,222 adult patients with 3 or more visits to one of 12 outpatient hospital-affiliated practices during 200910. Patients had a mean age of 54 years, 68% were female, and 43% white; 31% had Medicare, 21% Medicaid, and 20% were uninsured. The mean number of visits was 5.5, and patients had an average of 1.3 comorbidities. Composite scores ranged from 0.70 to +0.88, with scores in the top quintile ranging from 0.23 to 0.88 and those in the
bottom quintile ranging from 0.29 to 0.70. The composite demonstrates good face validity: PCPs in the top quintile were above the mean on an average of 5.2 individual outcomes and below the mean on 0.5; PCPs in the bottom quintile were above the mean on an average of 0.4 outcomes and below the mean on 4.9.
KEY LESSONS LEARNED: Using available EMR data, creation of a composite quality measure is a readily achievable task. Weighting the individual components of the composite using weights defined by the judgments of local providers improves buy-in and allows the method to be tailored to the prevailing standards at other institutions. The method demonstrates good face validity, but is complicated and may be difficult to explain fully to providers. Involving providers throughout the development and implementation of the composite measure has built a level of trust in the method which may lead to more rapid acceptability.
CHALLENGES OF BUILDING A MEDICAL HOME FROM THE GROUND UP Stuart Pollack 1; Asaf Bitton 2; Joseph Frolkis3. 1Brigham and Womens, North Attleboro, Massachusetts ; Division of General Medicine, Brigham and Womens Hospital, Brookline, Massachusetts ;
3Brigham and Womens, Boston, Massachusetts. (Tracking ID # 11983)
STATEMENT OF PROBLEM OR QUESTION: While the challenges of transforming existing practices into a PCMH are increasingly understood, there is no blueprint for creating a PCMH de novo. We have been creating a PCMH from the ground up.
DESCRIPTION OF PROGRAM/INTERVENTION: To initiate the design of the practice, 6 task forces were created: Staffing, Patient Flow, Resident Education, Neighborhood Engagement, Evaluation, and Information Technology. A leadership group consisting of the chairs of each task force and primary care leadership was also created. Each task force was charged with creating a mission statement, task list, and deliverables. The leadership group met regularly to review task force progress and to provide feedback and guidance.
OBJECTIVES OF PROGRAM/INTERVENTION: 1) To create a practice that would qualify at the highest level of PCMH accreditation at opening, that would embody a team-based model of patient-centered care, and that would demonstrate superior access, quality, value, and patient and staff experience.2) To create an innovative curriculum for trainees on delivering care in a team-based setting.3) To create a learning laboratory , with evaluative research embedded in its very foundation, that could inform care redesign and practice. FINDINGS TO DATE: The practice will open July 2011. However, there is much that can be learned from how the leadership group combined the recommendations of the task forces into an organizational structure, staffing plan, job descriptions and budget.
KEY LESSONS LEARNED: 1)The real advantage of creating a new practice is not the opportunity to define the practices processes but rather its culture. We intend to use hiring, orientation, training, practice structure, processes, metrics and incentives to create and sustain this culture.2)Much more consensus exists on the processes needed in a PCMH than on which members of the team are responsible for which processes. Decisions on how the practice is staffed, and how the staff is organized into teamlets vs. shared support, drove many subsequent decisions.3)The layout of the building and the available IT were not significantly modifiable and constrained many decisions. Minor modifications allowed us to support both patient-centeredness and team-based care.4)Many specialists and non-physicians are excited to be included in the planning and staffing of a new PCMH, creating an opportunity to

craft innovative PCP-specialist partnerships to improve real-time consultation, access, and staff education.
MONTEFIORE TRANSITIONS CLINIC: REACHING THE RECENTLY INCARCERATED Ross MacDonald 1; Aaron Fox 2; Joshua Lackner 3; Lauren Shapiro 4; Joseph Deluca 1; Matt Anderson1. 1Montefiore Medical Center, Bronx, New York ; 2Montefiore Medical Center, Bronx,, New York ; 3Montefiore Medical Center, New York, New York ;
4Montefiore Medical Center, White Plains, New York. (Tracking ID # 12099)
STATEMENT OF PROBLEM OR QUESTION: Former inmates are at high risk for morbidity and mortality following release from correctional facilities, in part due to gaps in care.
DESCRIPTION OF PROGRAM/INTERVENTION: In July, 2009,we established a TC for recently incarcerated adults through partnership with Bronx Parole Board and The Osborne Association, a local prisoner advocacy community based organization (CBO). To facilitate patient recruitment, a community health worker (CHW) was hired in early 2010, with funding from the CBO. The CHW gives health presentations to CBO clients encouraging health-seeking behaviors, and coordinates referrals to the TC, follow-up visits, and outreach to TC patients who have been lost to follow-up. The clinicis held each Saturday at a Federally Qualified Health Center (FQHC) in the South Bronx. Attending physicians from the FQHC volunteer to provide care. Nursing and administrative staff are present for existing Saturday clinical sessions. All other FQHC services are available to TC patients. In addition to general primary medical care, the clinic provides HIV primary care and treatment of opioid dependence with buprenorphine.
OBJECTIVES OF PROGRAM/INTERVENTION: The Montefiore Transitions Clinic (TC) was established to provide access to primary care, mental health services and social services for recently incarcerated adults. Initially, referrals to TC were primarily from parole officers and the overall burden of chronic illness was low. In this abstract we report on the impact of a community health worker (CHW) on patient recruitment and disease severity.
FINDINGS TO DATE: With the assistance of a CHW, the TC has reached a population of former inmates with a higher burden of chronic illness. In comparison to the first 39 TC patients, the last 30 have higher rates of all chronic diseases examined, including higher rates of HIV infection (37% vs 2%, $p < 0.01$), chronic hepatitis C (43% vs 18%), diabetes (20% vs 5%),hypertension (30% vs 12%), psychosis (20% vs 7%), opioid dependence (43% vs 20%) and asthma (37% vs 20%). With the small sample size, only HIV reaches statistical significance, but the trend toward higher prevalence is consistent across a range of diseases. Time from correctional facility release to first visit did not differ between groups, though only 21 patients in the total sample had date of release documented. 11/21 (51%) were seen within 2 weeks of release and 16/ 21 (76%)within 1 month. More patients in the parole-referred cohort were uninsured at initial visit 24/39 (61%) vs 10/30 (33%).
KEY LESSONS LEARNED: The TC was founded to provide health care access to former inmates re-entering their communities from correctional facilities and to fill a perceived gap in care. Referrals from a CBO, coordinated by a community health worker, identified a population with a high prevalence of chronic diseases including HIV, hepatitis C, mental illness and opioid dependence. This demonstrates that non-medical personnel in the community can provide appropriate triage of former inmates,identifying those at highest risk. The CBO-referred group also had higher rates of insurance coverage, possibly because the CBO was successful in assisting former inmates with administrative tasks. Initial visits seemed to occur within a month of release generally, which was
one goal of the clinic, though this needs to be better documented. A system of facilitated referrals,along with access to health centers where barriers to care are minimized, can help bridge gaps in care for the formerly incarcerated population.
WEB BASED TOOL TO IMPROVE THROMBOEMBOLISM PROPHYLAXIS RATES IN HOSPITALIZED PATIENTS. Bhaskar Arora 1; Bhaskar Arora2. 1Portland VAMC, Portland, Oregon ;

2Portland VAMC, PORTLAND, Oregon. (Tracking ID # 12205)
STATEMENT OF PROBLEM OR QUESTION: Low rate of Venothromboembolism (VTE) prophylaxis in hospitalized patients. DESCRIPTION OF PROGRAM/INTERVENTION: Web based interface developed with the goal of reminding clinical providers to comply with the VTE risk assessment and prophylaxis for hospitalized patients admitted to medical ward of an acute care teaching hospital. Providers will log on to this web based interface and a list of patients with and without prophylaxis will be generated stratified by teams (general medicine), ward (floor) and names of the providers as well as using patient identification.
OBJECTIVES OF PROGRAM/INTERVENTION: Increase rate of Venothromboembolism (VTE) prophylaxis in hospitalized patient.
Inrease compliance with VTE risk assessment tool.
FINDINGS TO DATE: pre intervention prophylaxis rate for vte prophylaxis was 70% based on chart review of a sample of about 50 patients on 2 occasions. Post intervention prophylaxis rate is yet to be established as the program hasnt been implemented yet. Goal VTE prophylaxis with this intervention is expected to be 90%.
KEY LESSONS LEARNED: Technology plays a key role in the success of patient safety intervention.
Reminder system helps improve compliance with VTE risk assessment and prophylaxis.
HOSPITALIST MANAGEMENT OF VASO-OCCLUSIVE PAIN CRISES Jonathan D Kirsch 1; Michael J Gilchrist 2; E. Allen Liles 2; Mukhtar Adem2. 1University of North Carolina School of Medicine, Chapel Hill, North Carolina ; 2UNC School of Medicine, Chapel Hill, North Carolina. (Tracking ID # 12219)
STATEMENT OF PROBLEM OR QUESTION: Vaso-occlusive pain crises (VOC) in patients with sickle cell disease are associated with considerable morbidity and mortality, prolonged hospital stays and significant resource utilization.
DESCRIPTION OF PROGRAM/INTERVENTION:This is a retrospective and prospective cohort study with four phases.1. Patients with VOC are admitted to one team of hospitalist physicians.2. Team agrees to protocol of care and preferential use of Patient Controlled Analgesia (PCA) to achieve pain control early. 3. Computerized Order Entry Set created with emphasis on PCA. 4. PCA settings used during hospitalization for each patient with VOC recorded upon discharge and utilized for future admissions.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Standardize treatment by having all patients admitted to the hospital for VOC cared for by the same hospitalist service with consistent treatment protocols.2. Reduce length of hospital stay (LOS) for patients with VOC by optimizing treatment protocols, learning the disease process and improving communication.3. Reduce complications and resource utilization without compromising patient satisfaction or outcomes.

FINDINGS TO DATE: Average LOS has decreasedfrom 5.4 days prior to intervention (January 2009 - June 2009) to 4.5 daysafter the intervention was adopted (January 2010 - June 2010).
KEY LESSONS LEARNED: Average LOS forpatients admitted to the hospital with VOC has decreased after institution of aconsistent and comprehensive pain management protocol led by hospitalists
5-YEAR MEDICAID COST SAVINGS FROM MEDICAL DUPLEXES: THE ELDER PARTNERSHIP FOR ALL-INCLUSIVE CARE (EPAC) Bruce Kinosian 1; Jean Yudin 2; Ann Dannish 3; Barbara Boland 2; Steve Touzell 3; Mary Ann Forciea 2; Lesley Carson 2; Johanne Louis2.
1University of Pennsylvania/ Department of Veterans Affairs, Philadelphia, Pennsylvania ; 2University of Pennsylvania, Philadelphia, Pennsylvania ; 3Philadelphia Corporation for Aging, Philadelphia, Pennsylvania. (Tracking ID # 12245)
STATEMENT OF PROBLEM OR QUESTION: Does providing integrated complex medical care and social supports in a medical-duplex structure reduce Medicaid costs?

DESCRIPTION OF PROGRAM/INTERVENTION: We have operated an inter-agency, interdisciplinary team a multifamily medical home integrating the Philadelphia Corporation on Aging provided waiver services with a Independence-at-Home like housecall practice, recently expanded to the General Medicine practices. The housecall program is a collaborative practice of physicians, nurse practitioners and social workers at UPHS. Each team is paired with a care manager from PCA. Coordination is through multi-modalities, although tethered by a monthly, face-to-face meeting to manage the plan of care.
Overall coordination including insuring that practice patients are followed by the EPAC care managers was dependent upon champions from PCA and UPHS.
OBJECTIVES OF PROGRAM/INTERVENTION: 1. Create a high-functioning inter-organization, inter-disciplinary team to provide all-inclusive care to frail elders in the community.2. Increase the share of community survival for frail elders.3. Reduce long-term Medicaid costs to provide home and community based care to frail elders.
FINDINGS TO DATE: There were 4360 member-months of observation for the 92 EPAC cohort members; and 6910 member-months of observation for the 216 Waiver controls. Mean age was 82, 86% female, with 3.7 mean ADL impairments. EPAC consumers had 256 months in long-term institutional care (5.7%), compared to 1726 months for wavier controls(24.9%). Mean survival was 47 months, with 44.3 months in the community for EPAC, and 31.9 months (24.2 in community) for waiver controls. Mean Medicaid costs were $1720 pmpm ($1448 HCBS/$271 NH) for EPAC and $2257 ($1084 HCBS/$1172 NH) for Waiver.
Total 5-year Medicaid costs were $7.5 M for EPAC, and $9.8 M for equivalent member-months in Waiver, and $6.7 M for 92 equivalent Waiver consumers,with an incremental cost/QALY of $4,800, due to 15 month longer survival of EPAC members.
Mean HCC score was 3.55, projected expenditures of $15.3 million. Hospitalizations were 3.8/100 member months. The subsamples Medicare costs were 48% of projected, a $7.3 M savings.
KEY LESSONS LEARNED: A multi-family Medical Home, by integrating medical care through a IAH-type housecall practice with HCBS provided by a AAA, can reduce Medicaid costs by 23%, driven by a 76% reduction in nursing home months, compared to usual HCBS.
Integrating care of complex multi-morbid frail elders in the community following medical home principles of patient centered, all-inclusive care can result in net savings to Medicare and Medicaid of $4.3 M for a matched cohort, despite a 47% increase in survival.
TITLE: IMPROVING INPATIENT PAIN: POSSIBLE BARRIERS AND SOLUTIONS. A QUALITY IMPROVEMENT INITIATIVE Shashank Jain 1; Anthony Donato 2; Bikash Acharya 3; Paulina Mendoza Mancini 3; Gaurav Gulati 4; Bryan Romero 5; Jullian Diaz Fraga6.
1The Reading Hospital and Medical Centre, Reading, Pennsylvania ;
2The Reading Hospital and medical center, Birdsboro, Pennsylvania ; 3The Reading Hospital, Reading, Pennsylvania ; 4The Reading Hospital and Medical Center, West Reading, Pennsylvania ; 5The Reading Hospital and Medical Center, Reading, Pennsylvania. (Tracking ID # 12246)
STATEMENT OF PROBLEM OR QUESTION: Pain management is often inadequately managed in the inpatient setting, with prevalence of severe pain reported in 15-36%.
DESCRIPTION OF PROGRAM/INTERVENTION: Flow charting of nursingprocesses for pain assessment revealed significant limitations in nursingcomputer resources (multiple duplicate recording systems, no provisions forprompts and reminders). A focus group conducted identified a lack of nursingeducation on equianalgesic doses and medication side-effects, addiction andwithdrawal as well as a lack of nursing autonomy in treating pain.
Interventions to addressthese shortfalls four additive intervention cycles that included shorteducation sessions for nurses, revision of the nurse documentation system forpain evaluation, a nurse reminder system for reassessment, and implementationof a standard pain order set with pain-scale driven options for analgesia,

anda nurse reminder system for pain reassessment.
OBJECTIVES OF PROGRAM/INTERVENTION: To improve inpatient painmanagement, as measured byreassessment rates and patient satisfaction, by 20% on a singlemedical-surgical ward over a 6-month time period.
FINDINGS TO DATE: Nursing education efforts did not have statistically significant impact on post-test scores. Reassessment rates as evaluated by timeseries run charting did show significant improvement by the third cycle.Patient satisfaction scores regarding pain management had not improved by cycle three (before pain protocol instituted). KEY LESSONS LEARNED: Initialfocus groups helped us to realize that potential gaps in nursing knowledge andattitudes. However, quality improvement efforts that include educationalinterventions tend to have minimal effects on systems, as demonstrated in ourstudy. Bycharting the nursing workflow, we realized the need for a reminder system forthe nurses to facilitate their process. Our data showed that such interventions improve reassessment rates andimprove system flow, as the literature suggests, however this did not translate to improved patient satisfaction. We believe that giving nurses autonomy in analgesicmanagement may close this gap, and await implementation of our pain protocol.Delays in protocol implementation may be overcome by earlier involvement of IT resources and senior leadership.
USING THE HEALTHCARE FAILURE MODE AND EFFECT ANALYSIS (HFMEA) TO IMPROVE HANDOFF PROCESSES BETWEEN HEALTH CARE PROVIDERS Aparna Sameer Kamath 1; Victoria M Steelman 2; Peter J Kaboli2. 1University of Iowa Hospitals and Clinics, VA Medical Center, Iowa City, Iowa ; 2University of Iowa Hospitals and Clincs, VA Medical Center, Iowa City, Iowa. (Tracking ID # 12285)
STATEMENT OF PROBLEM OR QUESTION: Discontinuity in patient care due to multiple shift changes make handoff processes high-risk, high-volume,vulnerable to error and a crucial process for patient safety.
DESCRIPTION OF PROGRAM/INTERVENTION: The HFMEA was conducted based on guidelines provided by the Veterans Administration

National Center for Patient Safety. Handoff processes were first mapped using a process flow map diagram and consisting of three main processes: 1) beginning of handoff (i.e., gathering information and recording handoff information), 2) the handoff process itself, and 3) the question and answer phase. Next a multidisciplinary team consisting of nurses and physicians validated the process map and discussed the potential failure modes and effects of the failure modes for each of the sub processes. The failure modes were then evaluated using a hazard matrix. Finally using a decision tree analysis recommendations were made for the failure modes depending on the criticality, detectability and existence of control measures for the failure modesOBJECTIVES OF PROGRAM/INTERVENTION: The objective of this project was to identify potential failures and barriers to effective and safe physician and nursing handoff processes with the help of Healthcare Failure Modes Effect Analysis (HFMEA).
FINDINGS TO DATE: The HFMEA identified 21 failure points rated as high-risk that were inadequately controlled. Of the 10 uncontrolled failure points in physician handoffs, four were related to not communicated or incorrectly communicated. Of the 11 uncontrolled, highly-rated failure points in the nursing handoff, all were either due to lack of or incorrect communication . The HFMEA identified three key findings: 1) Physician and nurse handoff processes occur separately without any overlap and thus did not share the same mental model about the patients or anticipated events. 2) Nursing handoffs were asynchronous, tape recorded reports, and the information shared was not standardized. 3) Potential failures during handoffs include missing or incorrect informationKEY LESSONS LEARNED: The HFMEA proved to be a valuable tool to educate healthcare professionals about the importance of effective and safe handoff processes. By performing this analysis in a multidisciplinary team, the nurses and physicians learned the importance of inter-professional communication and team work in taking care of their patients. This process minimized complacency and instilled a sense of urgency in preparation for change. Strategies to improve synchronous and asynchronous communication

between the healthcare providers are recommended and are currently in the process of implementation by the leadership.

MINI-ROUNDS, AN INTERPROFESSIONAL PANACEA TO THE INEFFICIENCIES OF AN INTERNAL MEDICINE CLINICAL TEACHING UNIT. Cheryl Goldstein 1; Kim Ghuman 2; S. Ann Colbourne1.
1University of Alberta, Edmonton, Alberta ; 2Alberta Health Services, Edmonton, Alberta. (Tracking ID # 12390)

STATEMENT OF PROBLEM OR QUESTION: In developing an Integrated Plan of Care for patients admitted to our Internal Medicine teaching units, we found a lack of routine interprofessional communication leading to patient treatment delays.

DESCRIPTION OF PROGRAM/INTERVENTION: An interprofessional Change Team comprised of front-line staff on the General Internal Medicine Clinical Teaching Units at the University of Alberta Hospital, a tertiary care center, was created to streamline the care processes for admitted patients. Ad hoc and infrequent regular communication among physicians, nurses and allied health professionals was a barrier to delivering effective care on our wards. The current state consisted of once weekly interprofessional 30 minute rounds per ward (3 wards, 18 20 beds each) to discuss individual patient care needs and discharge planning. We developed daily rapid communication touch points, Mini-rounds, focused on the Integrated Plan of Care. To determine the duration, timing and necessary participants for the rounds we ran PDSA (Plan, Do, Study, Act) cycles and used these to hone the

intervention. Feedback regarding staff satisfaction and usefulness of the intervention was provided by each participant and recorded. OBJECTIVES OF PROGRAM/INTERVENTION: To facilitate patient throughput via brief daily rounds and enhance team communication among physicians, nurses and allied health professionals. Decrease time spent by care team members searching through charts, or paging a consultant to clarify a consult request/review findings. Improve patient and family satisfaction by providing more coordinated care.

FINDINGS TO DATE: Findings from the Mini-Rounds PDSA cycles: Key players required : Charge Nurse, Senior Medical Resident (or Attending Physician), Physical Therapist, Occupational Therapist, Social Worker, and the Care Coordinator.

Optimal characteristics: brief and focused, one minute per patient, goal of 1530 minutes, early in the morning prior to initiating the work day, and led by the Charge Nurse or Senior Resident.

Care prioritization: Allied Health care workers consistently reported that the rounds enabled them to prioritize and organize their daily assessments.

Empowerment: Charge Nurses felt more empowered to provide the patient and/or family members with up to date care plans, providing communication when physician team members were unavailable.

Role Awareness: An educational opportunity to provide residents practical, hands-on instruction regarding scope of practice, allied health care professionals.

KEY LESSONS LEARNED: To care for our elderly patient population with multiple co-morbidities and societal needs, daily interprofessional care rounds provide an opportunity for a 360 assessment and review of the integrated plan of care.

Initial PDSA cycles trialed at the bedside to involve patient/family members. Due to time constraints and scheduling logistics the rounds were moved to the nurses station with input on patient/family concerns provided by care team members. Ideally Mini-rounds will allow for a cohesive care plan that represents patient preferences and can be relayed back to the patient via multiple care team members rather than physicians alone.

Current PDSA cycles will determine the most relevant issues to be covered during Mini-rounds to create a checklist or script to ensure efficiency and reproducibility.

Geographic contiguity of patients and the alignment of the allied health professionals with the physician team will optimize the functionality of Mini-rounds.

VALUE OF A HOSPITALIST INFORMATICIST FOR IMPLEMENTATION AND MAINTENANCE OF

ELECTRONIC MEDICAL RECORD (EMR) SYSTEMS Alpesh Amin 1; Amish Dangodara 2; Jim Murray 2; Ralph Cygan2. 1University of California-Irvine, Orange, California ; 2UCI, Orange, California. (Tracking ID # 12492)

STATEMENT OF PROBLEM OR QUESTION: Acceptance of in-patient EMR systems is poor without user input into design and function. DESCRIPTION OF PROGRAM/INTERVENTION: The University of California, Irvine Hospitalist Program working with our CMIO, CIO, and the Hospitalist Program Executive Director created a 50% funded Hospitalist Informaticist (HI) position. We found a HI highly benefits key components of EMR design such as admission, transfer, discharge, and handoff to outpatient setting. HI grasp the interface of what users of EMR systems need with many vital hospital functions because they serve as primary providers, consultants, and leaders or members of hospital committees. They interact frequently with multiple specialists, nurses, case managers, ancillary staff, pharmacy, and diagnostic areas,

making them well suited for both design of the EMR and for gathering user feedback to gauge potentially contradictory EMR enchancement requests that occur after implementation.

OBJECTIVES OF PROGRAM/INTERVENTION: 1. Clinicians with a narrow perspective who are only casually committed to informatics provide limited guidance to the builders of the EMR. 2. Poor design of an EMR from lack of sufficient user input may lead to unintended errors and be costly, as well as a waste of time-consuming resources. 3. A Hospitalist dedicated to informatics is ideally suited for successful EMR implementation and upkeep because of broad involvement with hospital-wide functions.

FINDINGS TO DATE: As a user, the HI knows the capabilities and limitations of the EMR system and can identify problems to craft workable solutions. They are able to broker the ordering clinicians EMR needs with those of order receiving departments to design electronic order form components with sufficient logic and required fields to support workflows. HI have a realistic perception of user acceptance of key informatics decisions such as alert settings, security rights, logoff timeouts, synonyms, and data retrieval formatting to support user needs and reduce error. Functional testing of the EMR by a HI who knows various workflows can identify potential pitfalls and errors before they have the ability to impact patient care.

KEY LESSONS LEARNED: The HI broad perspective on hospital-wide function provides ideal credibility for translating the users needs and the technicians ability to build an EMR to support those needs.

PREPARING FOR A SHOCK: A PILOT SIMULATION INTERNSHIP FOR INCOMING RESIDENTS Roger D Smalligan 1; Bharat 1; Harvey KhandheriaRichey 2; Todd Bell 1; Richard Jordan 1; Brian Weis1. 1Texas Tech Univ HSC, Amarillo, Texas ; 2Texas Tech Univ HSCTexas Tech Univ HSC, Amarillo, Amarillo, Texas, Texas. (Tracking ID # 7428)

SETTING AND PARTICIPANTS: All 12 incoming internal medicine residents, all of whom happened to be foreign medical graduates, were offered the opportunity to participate in an optional, weeklong simulation internship one week before their orientation. DESCRIPTION: The residents spent a full week in the simulation laboratory prior to their July 1 start date to allow them the opportunity to gain knowledge and skills prior to working with live patients. Attending physician faculty members served as teachers and observers. Clinical scenarios covered during the week included common medical emergencies such as chest pain, acute shortness of breath, hypotension, and acute mental status changes. Each type of emergency was presented several times to the residents, however, the underlying etiology varied. For example, three chest pain scenarios included acute myocardial infarction, pulmonary embolus or dissecting aortic aneurysm as the cause of the pain. Residents were also taught (and practiced) central line placement, lumbar puncture, thoracentesis, paracentesis, arterial line placement and intubation.

NEEDS AND OBJECTIVES: The beginning of residency training is a source of anxiety for most graduates of

medical school. Many have not had adequate opportunities during medical school to perform important procedures they will be expected to carry out once they begin residency training. This pilot study sought to determine what effect providing incoming internal medicine residents a simulation internship using high fidelity mannequins to role play various clinical scenarios might have on their comfort level as well as knowledge level as they begin what often comes as a shockthe first weeks of internship.
EVALUATION: An anonymous questionnaire was given to each resident before and after the simulation internship to evaluate any perceived change in knowledge or comfort level. Questions included subjective judgment by the participants of their comfort level with evaluating patients with chest pain, hypotension, shortness of breath, mental status changes, and with writing orders in the medical record. A Likert scale of 15 where 1 is uncomfortable and 5 is very comfortable was used. In all categories there was demonstrated improvement in both perceived comfort level and knowledge. Similarly, noticeable improvement was observed in the quality of notes and orders written by the residents by the end of the experience.
DISCUSSION/REFLECTION/LESSONS LEARNED: This pilot project demonstrated that by spending one week in the simulation lab, incoming residents can improve their comfort level in caring for common medical emergencies they will face as residents in the hospital. Since incoming residents had not had the opportunity to perform procedures during the two years prior to starting residency, the simulation internship also allowed them to learn or refresh the necessary skills to safely carry out these procedures. During the simulation internship, attending physicians were able to observe and encourage teamwork, communication skills, cultural awareness, ethics and professionalism among the interns. An unanticipated benefit was the wonderful sense of camaraderie and friendship that developed among the 12 interns. This pilot internship contributed to forming a better prepared, less anxious, more capable and more experienced group of entering interns to our internal medicine residency program.
ONLINE RESOURCE URL (OPTIONAL):
MEDICAL SIMULATION FOR CLINICAL DECISION MAKING TRAINING FOR INTERNAL MEDICINE RESIDENTS Eli M Miloslavsky 1; Emily M Hayden 2; Paul F Currier 3; James A Gordon2. 1Massachusetts General Hospital, Brookline, Massachusetts ; 2Massachusetts General Hospital Department of Emergency Medicine and MGH Learning Laboratory, Boston, Massachusetts ; 3Massachusetts General Hospital Department of Medicine and MGH Learning Laboratory, Boston, Massachusetts. (Tracking ID # 7570)
SETTING AND PARTICIPANTS: Simulation sessions are held in the MGH Learning Laboratory with the aid of high fidelity medical simulation mannequins. Sessions are open to interns on outpatient or elective rotations and attendance is voluntary. Sessions are held every other week and can accommodate up to eight interns. Junior and senior residents participate as facilitators in the sessions after taking part in a training workshop on medical simulation teaching.
DESCRIPTION: Ten common acute clinical scenarios frequently encountered on the wards such as hypertensive emergency and rapid atrial fibrillation were selected. Over the course of the year, interns have the opportunity to work through scenarios of increasing difficulty in small groups with the help of a facilitator. Each session is 60 minutes in duration and consists of two case scenarios. Each scenario begins with 1015 minutes of mannequin-based patient management where learners manage the clinical scenario in groups of two or three, followed by a 15 minute debriefing session with a senior physician (resident and/ or attending). Simulation faculty members serve as facilitators and observe and provide feedback to resident facilitators. Online surveys designed to assess interns satisfaction with the program are sent out monthly to interns who participated in the program.
NEEDS AND OBJECTIVES: Internal medicine interns today have limited opportunities to make patient care decisions independently in acute situations. However, such experiences are one of the foundations for learning in residency. Recently, mannequin-based simulation has gained widespread use in graduate medical education, typically in procedural and code training. While simulation focused on diagnosis and patient management has

been attempted in the ICU, it has not been

expanded to cases arising on the general medicine wards. We report here on a mannequin-based simulation curriculum focusing on acute situations encountered on the wards for internal medicine interns. The goal of the program is to improve differential diagnosis, patient management skills, fund of knowledge and learner confidence. A small group approach is used to bolster communication and teamwork skills. Junior and senior resident participation as program facilitators aims to improve resident teaching skills.
EVALUATION: In the first four months of the program 31 interns attended at least one session (42% of the class), with a total of 44 participants. 16 junior and senior residents participated as facilitators. 25 interns completed the online survey (71% response rate). 84% of the interns rated the sessions as excellent (5 on a 5 point scale) and the remainder as good (4 on a 5 point scale). 96% felt that the program either significantly (4 on a 4 point scale) or moderately (3 on a 4 point scale) improved their ability to work as an intern, generate a plan, and respond to changing clinical situations. 80% reported that the sessions significantly or moderately improved their differential diagnosis skills. 88% stated that they would definitely attend future sessions, while the rest felt that they would probably attend. In response to the question about session strengths, interns comments focused on the opportunity to struggle with a case on their own followed by immediate debriefing.
DISCUSSION/REFLECTION/LESSONS LEARNED: The use of medical simulation in residency training can increase and standardize trainee exposure to acute clinical scenarios on the general medicine wards and provide an opportunity for independent thinking and experiential learning critical to becoming a physician without compromising patient safety. This program may also be used to improve residents bedside teaching skills.
ONLINE RESOURCE URL (OPTIONAL):

DEVELOPING A COMMUNITY HEALTH ELECTIVE ROTATION FOR INTERNAL MEDICINE RESIDENTS

Jillian Catalanotti 1; Zohray M Talib1. 1The George Washington University, Washington, District of Columbia.
(Tracking ID # 8334)
SETTING AND PARTICIPANTS: Residents in all three PGY levels participate in this elective. Lectures are given in our academic clinic building and clinical work is performed at nearby community clinics in the Washington, DC Metro Area.
DESCRIPTION: The lack of Primary Care physicians in underserved areas is a key barrier to access. Studies show that positive community-based experiences with underserved populations during training increase the likelihood of practicing in underserved areas. ACGME Internal Medicine Program Requirements do not mandate training in community settings. Accordingly, many physicians complete their Medicine training with no community-based outpatient experience. Providing clinical experiences in community-based settings during residency is an essential recruitment strategy for Primary Care. To this end, we designed a Community Health Elective for Internal Medicine Residents. For two weeks we hold daily lectures on the field of Community Health, demographics of our local population, and public health needs of particular underserved communities. Residents also work at one community-based health center for six clinical sessions. At the end of the rotation, residents give presentations on their clinical sites.
NEEDS AND OBJECTIVES: 1. Increase residents knowledge base and comfort with providing care in community settings; 2. Improve residents ability to discharge inpatients to community settings for follow-up care; 3. Expose residents to new career possibilities; and 4.
Increase the likelihood that residents consider careers in Primary Care and underserved community settings.
EVALUATION: This course has been run three times over a 1.5 year period. Residents fill out baseline and post-course surveys and participate in a post-course focus group. Surveys include Likert-scale questions. Medians for baseline and post-course responses were compared using Wilcoxon sum-rank tests (n=14). Responses to I feel competent discharging patients from the hospital with follow-up at community health sites

improved (p=0.005). Responses to I am likely to practice Primary Care and I am likely to practice in an underserved setting had no significant change, but the median baseline responses for both questions were Agree. The median responses to This elective exposed me to new careers that I had not previously considered and Learning about Community Health has been an important part of my residency training were both Strongly agree. DISCUSSION/REFLECTION/LESSONS LEARNED: 1.While we expected residents in our primary care track to enjoy the elective, we were surprised that categorical residents, even those planning to specialize, responded very favorably. 2.Residents at all stages of training found this elective useful; PGY1s called it a good introduction to the city, while PGY3s said it informed career decisions. 3.Residents prefer small groups and discussion-based talks. 4.Because this is not a mandatory rotation selection bias may hinder our ability to show change in perceptions of Primary Care. 5.Setting up the elective requires faculty time to network, compose affiliation agreements and complete credentialing paperwork for residents. 6.In recruiting community preceptors, No may mean Not right now. Repeat contacts in subsequent semesters can be fruitful. 7.Many community-based physicians are excited to teach residents.Voluntary Clinical Faculty appointments and access to the University library are incentives for participation. ONLINE RESOURCE URL (OPTIONAL):
http://http://www.gwmed.com/joomla/index.php?option=com_content&view=article&id=96&Itemid=108
Web End =http://www.gwmed.com/
http://http://www.gwmed.com/joomla/index.php?option=com_content&view=article&id=96&Itemid=108
Web End =joomla/index.php?option=com_content&view=article&id=96&Itemid=
http://http://www.gwmed.com/joomla/index.php?option=com_content&view=article&id=96&Itemid=108
Web End =108

IMPROVING COMMUNICATION WITH POST-HOSPITAL DISCHARGE CARE PROVIDERS Jaideep S Talwalkar 1; Jason R Ouellette2. 1Yale University School of Medicine, New Haven, Connecticut ; 2Saint Marys Hospital, Waterbury, Connecticut. (Tracking ID # 8572)

SETTING AND PARTICIPANTS: The study took place at a community hospital internal medicine residency program.

DESCRIPTION: A monthly one-hour workshop entitled Reviewing Effective and Accurate Documentation (READ) was launched in August 2007 to provide consistent and ongoing instruction on chart documentation in an internal medicine residency program at a community hospital. Guided by faculty moderators, residents critique two randomly selected peer chart notes per session. Discharge summaries are reviewed during three sessions each academic year and the importance of communication during care transitions is emphasized. There was no formal mechanism in place for teaching chart documentation skills prior to implementation of the workshop series.

NEEDS AND OBJECTIVES: Prior studies have shown low rates of discharge summary availability to post-hospital care providers. We hypothesized that implementation of an educational program on chart documentation skills would improve the frequency with which hospital discharge summaries were sent to the post-hospital care provider. EVALUATION: Four blinded faculty members reviewed 63 randomly selected summaries from spring 2007, spring 2008, and spring 2009 for the presence of documentation of communication with the outpatient physician within the body of the summary. Summaries for patients who died in the hospital or were transferred to another inpatient facility were

excluded. Information regarding transmission of summaries to outpatient providers was verified through the medical records department. Documentation of communication with the outpatient physician occurred in the minority of summaries and did not change during the study period (p=0.98). However, query of the medical records department revealed that the percentage of summaries actually carbon copied to the responsible

outpatient physician increased from 47% (10/21) to 71% (15/21) to 86% (18/21) over the three years of the study (p=0.03).
DISCUSSION/REFLECTION/LESSONS LEARNED: The frequency with which hospital discharge summaries were transmitted to post-hospital care providers increased following the implementation of a structured program to teach chart documentation skills to internal medicine residents. Ongoing emphasis on the importance of communication during care transitions may have accounted for improvements seen one and two years into the educational program.
ONLINE RESOURCE URL (OPTIONAL): http://www.stmh.org/read
Web End =http://www.stmh.org/read
AN EDUCATIONAL INTERVENTION TO INCREASE PREVENTIVE HEALTH SERVICES PROVIDED TO ADOLESCENTS AND YOUNG ADULTS BY INTERNAL MEDICINE PHYSICIANS Holly Catherine Gooding 1; Emily Blood 2; Niraj Sharma3. 1Brigham and Womens Hospital and Childrens Hospital Boston, Boston, Massachusetts ;
2Childrens Hospital Boston, Boston, Massachusetts ; 3Brigham and Womens Hospital, Boston, Massachusetts. (Tracking ID # 8651)
SETTING AND PARTICIPANTS: This intervention was designed for IM residents training in an academic medical center and its associated outpatient community practices. Following a pilot session with a small group of PGY3 residents (n=18), half of the PGY1 residents in the 2010 2011 class (n=31) were randomly assigned to participate in the educational intervention during their introductory ambulatory medicine block rotation. The remainder of the PGY1 residents (n=28) received no specific instruction in adolescent and young adult medicine and served as a comparison group. One half of the PGY2 residents will participate in the educational intervention in the coming months and will also be compared to their peers.
DESCRIPTION: The educational intervention is led by two faculty trained in both adolescent and internal medicine. Residents are first introduced to general topics in adolescent medicine and the role internists play in the primary and specialty care of adolescents and young adults. The residents are then divided into two smaller groups. Each group spends one hour reviewing screening recommendations from the USPSTF using an evidence-based medicine approach. Each group also spends one hour interviewing adolescents employed by the local childrens hospital as consultants for practitioners working with youth. The adolescents are trained in the portrayal of three standardized cases designed to highlight STIs, substance abuse, and depression. The adolescents are also trained to give feedback to the residents using the Structured Communication Adolescent Guide (SCAG), a commercially available tool with established validity and reliability.
NEEDS AND OBJECTIVES: The US Preventive Services Task Force recommends screening for sexually transmitted infections (STIs), alcohol misuse, and depression in adolescents and young adults. Despite these national guidelines, few adolescents and even fewer young adults receive routine preventive care in these areas. In addition, internal medicine (IM) physicians often report inadequate preparation to care for adolescent patients as they transition to young adulthood. Fostering internists understanding of preventive care guidelines and enhancing their communication skills regarding sensitive topics are essential for ensuring the health of adolescent and young adult patients.
We aimed to create, deliver, and evaluate an educational intervention designed to increase internal medicine (IM) residents comfort with and confidence in their ability to care for adolescents and young adults, as well as the percentage of patients screened appropriately for Chlamydia, HIV, alcohol misuse, and depression.
EVALUATION: During the baseline pre-intervention period from July 2009 through June 2010, 117 IM residents saw 523 unique outpatients ages 1626, representing 8.5% of all outpatients seen by the residents. Seventy percent of the patients had documented alcohol screening, 35% had documented depression screening, 21% had HIV testing, and 40% of females had Chlamydia testing. Eighteen PGY3 residents were surveyed to pilot the assessment instrument. More residents reported that they were somewhat or very comfortable taking a

sexual history (78%) or a substance use history (67%) than a mental health history (28%) from adolescents and young adults. More residents reported that they were somewhat or very confident in their ability to identify and counsel adolescents and young adults with STIs (56%) than with substance abuse (6%) or depression (22%). The educational intervention for PGY1 and PGY2 residents is currently in progress.
DISCUSSION/REFLECTION/LESSONS LEARNED: Residents felt the opportunity to interact with adolescents from the community and to receive real-time feedback from them as well as their peers were the most valuable aspects of the workshop. Didactic portions of the intervention could be streamlined or presented in advance as self-study in the future. The practice of interviewing trained community members and receiving feedback in a small-group peer setting could be expanded to improve the care of other special populations in ambulatory medicine, such as patients requiring language interpreters or those with physical or cognitive disabilities. If successful in meeting the objective of improving preventive screening for adolescent and young adult patients, this educational intervention could be expanded to faculty practices or other internal medicine residency programs.
ONLINE RESOURCE URL (OPTIONAL):
TEAM AND PRACTICE-BASED, INTERPROFESSIONAL LEADERSHIP DEVELOPMENT Kathleen Ann McGrail 1; Nancy Cochran 2; Richard Frankel 3; Catherine Gracey4. 1Rochester General Health System, Rochester, New York ; 2Dartmouth School of Medicine, Hanover, New Hampshire ; 3Indiana University/Purdue University School of Medicine, Indianapolis, Indiana ; 4University of Rochester School of Medicine, Rochester, New York. (Tracking ID # 8726)
SETTING AND PARTICIPANTS: RGMG is the community-based outpatient arm of the Rochester General Health System, a teaching hospital system in upstate New York. Most of the RGMG practices are involved in primary care (IM, FM, pediatrics, ob-gyn) and include inner city safety net practices, as well as urban, suburban, and rural sites. Patients cared for range from well-insured to uninsured, and include refugees and migrant farm workers. Total encounters for all sites in 2009 were 529,820.The Team-based Quality Improvement Leadership Initiative (TBQI LI) is comprised of five 4-hour workshops presented over 6 months. Each group is composed of leadership triads from similar practices (2023 participants in each cohort) who work together longitudinally. As much as possible, practices attend as intact leadership triads. Many participants have been working in their professions for 20 years or more.
DESCRIPTION: The program is experiential, highly interactive and emphasizes skill development as well as appreciation, and utilization, of diversity in teams. Sessions include short didactic presentations and skills practice in the following domains: 1) Team-building using relationship-centered techniques; 2) Interpersonal communication

skills including feedback, dealing with resistance, motivational interviewing, and conflict resolution; 3) Examination of assumptions, strengths and limitations of personality and leadership style, mindfulness and self-reflection; 4) Problem-solving using Appreciative Inquiry, rapid cycle quality improvement (PDSA), nominal process. An emergent planning process integrates core material and interactive exercises to meet participants needs. Didactic material is presented to the entire group while skills work is done in groups of 69. Sessions are lead by 3 4 facilitators experienced in teaching communication skills and personal awareness.
NEEDS AND OBJECTIVES: Paradoxically, at a time when most outpatient practices are still strongly hierarchical, high level teamwork has been identified as crucial to primary care practice transformation and the success of the patient-centered medical home. Professional development for current practitioners will be necessary to address this gap and make care truly patient-centered. Each outpatient practice of the Rochester General Medical Group (RGMG), is lead by a physician-nurse-practice manager triad. Data from leadership assessments and culture of safety surveys showed significant variation across the practices and a direct relationship between triad teamwork and staff and patient satisfaction leading senior leaders to endorse the

creation of a program to improve teamwork. Its objectives were to: 1) develop leadership and communication skills within the triads; and 2) create a system-wide, inter-professional learning community.
EVALUATION: Each session is evaluated using a combination of qualitative and quantitative items. These include ratings of each of the sessions activities on a Likert scale and qualitative questions such as Please describe a moment when you were the most/least involved or aha moments. At the end of each session, participants are given the opportunity to reflect on how they were feeling before and after the session. Final evaluation of the program includes qualitative feedback, self assessed impact of the program and outcomes of project groups. DISCUSSION/REFLECTION/LESSONS LEARNED: Physicians were initially skeptical about the program but had 99% attendance at the sessions. Scores averaged 3.75/4, with a final session score of 3.89/4. Narrative feedback themes suggest the first program: was restorative, reducing professional isolation and burnout; gave a sense of common purpose, community and commitment within the triads and across RGMG; heightened personal awareness in areas that could positively affect their leadership effectiveness. Participants expressed the desire to continue to meet together as a learning community. Interpersonal communication skills were the earliest and easiest to adopt; next were group and team meeting facilitation techniques. Higher level skills such as the ability to give effective formative and summative feedback as well as managing conflict were the most difficult to master.
ONLINE RESOURCE URL (OPTIONAL):
THE AMBULATORY INTENSIVE CARE UNIT: BRINGING AMBULATORY RESIDENCY TRAINING TO THE PATIENT CENTERED MEDICAL HOME. Paul Chelminski 1; Sampson Andrew 2; Whitney Annie 2; Krista Fajman 3; Kim Young-Wright2. 1The University of North Carolina Department of Medicine, Carrboro, North Carolina ; 2UNC Department of Medicine, Chapel Hill, North Carolina ; 3UNC Department of Medicine, Chapel HIll, North Carolina. (Tracking ID # 8743)
SETTING AND PARTICIPANTS: In 2004, we developed a two month continuity ambulatory elective (COE) to redress the imbalance between hospital and ambulatory training and to defragment ambulatory training. The UNC Internal Medicine Clinic clinic provides multimodal care; it features disease management programs in diabetes, anticoagulation and chronic pain, and team-based quality improvement
initiatives. The resident and faculty practices are combined and share the same staff and resources. Prior to the COE, the residents had been customers of, not participants in, the broader systems-based initiatives in the clinic. Their activities had been limited to continuity clinics and acute care. In the COE, residents are integrated into the disease management programs and execute a collaborative quality improvement project. In 20092010, we expanded this model to interns,creating the month-long continuity ambulatory rotation (CAR).
DESCRIPTION: In 200910, twenty-four interns and six residents completed the CAR and COE rotations. A typical week for residents or interns on the COE and CAR rotation includes 2 or 3 continuity clinics (CC). They staff the acute, Same Cay Clinic (SDC) 2 or 3 times a week. They rotate through disease management programs in diabetes (DM), anticoagulation (Coag), and chronic pain (Pain). They work with an attending physician in her clinic in the preceptorship (Precept) capacity. They have protected time for conferences, Grand Rounds, and quality improvement profects (QI). This schedule is represented graphically below:
MonTuesWedThursFriAmCCPain (or QI)DM (or QI)Conferences, QI ProjectPreceptNoon Ambulatory Conference Grand Rounds PmCoag-PreceptTravel ClinicCCSDCNEEDS AND OBJECTIVES: Research shows that most medical visits occur in office settings and that 75% of health care resources are spent on chronic care. The preponderance of residency occurs, though, in tertiary care hospitals providing acute care. Cognizant of this imbalance, the residency review committee has mandated better ambulatory training. Continuity clinicswhere residents forge longitudinal, healing relationships with patientshave been the centerpiece for this. Recently, mandated continuity clinics have increased from a minimum of 108 to 130 over 3 years of training. Historically, continuity clinic has been grafted awkwardly onto inpatient months, however. This fragments the ambulatory experience, and residents remain distracted by their hospital duties. In addition, continuity clinics

have not been integrated into ambulatory systems of care that encompass the ACGME comptetencies of systems-based practice and practice-based learning.
EVALUATION: The COE and CAR electives have been highly rated by residents. We surveyed residents at the conclusion of the first year in which all interns had a dedicated clinic block. Nineteen of 30 (63%) responded. Forty-five percent rated the experience as excellent and 55% as good (No residents felt the rotation was either fair or poor.) All agreed that their understanding of ambulatory medicine was enhanced and felt that they acquired important skills in quality improvement. The survey also revealed that one of the most valued aspects was the preceptorship where residents participated in the management of an attending physicians patients. In their comments, residents frequently cited their participation in a diverse set of clinical activities and havinig time to build relationships with different clinic staff (nurses, IT, administrators, care assistants, quality improvement staff) as particular strengths of the rotation.
DISCUSSION/REFLECTION/LESSONS LEARNED: The ambulatory education of residents is a complex undertaing that requires the acquisition of diverse skills. The COE and CAR rotations provide uninterrupted ambulatory immersion, integrating multiple facets of ambulatory medicine in a patient-centered practice environment with a defined patient population and invested faculty who practice in the same clinic. It is an ambulatory intensive care unit for patients and learners. Residents valued all aspects of the experience. We were surprised to find that the one-on-one preceptorship (where residents were paired with an experienced ambulatory clinician in her practice) has consistently been rated the most valuable aspect of the curriculum. This suggests that traditional role-modeling remains an essential ingredient in the apprenticeship model of physician training. It provides

the cement for cohesive professional growth in a complex and diverse practice environment.
ONLINE RESOURCE URL (OPTIONAL):
EFFECTS OF A FIRM MODEL INNOVATION ON RESIDENT AND PATIENT SATISFACTION Jessica Schmit 1; Margaret C Lo 2; Aida Vega3. 1University of Florida College of Medicine Division of Internal Medicine, Gainesville, Florida ; 2University of Florida College of Medicine, Division of Internal Medicine, Gainesville, Florida ; 3Mount Sinai School of Medicine Department of Medicine, Division of Internal Medicine, New York City, New York. (Tracking ID # 9155)
SETTING AND PARTICIPANTS: Of the three IM residency continuity clinics at UF, the MP clinic faced the challenge of teaching the largest number of IM residents while caring for a sizable population of vulnerable, complicated, and indigent patients. Over 40% of patients are self-pay or Medicaid status, have greater than 10 active chronic issues, and are the disadvantaged i.e. African American, Hispanic, rural-based, or non-English speaking. 33 categorical medicine residents have their continuity clinics at MP and are precept by a total of 8 attendings. Residents would staff their continuity patients with any available preceptor attending that day. Oftentimes, patients may not be staffed by the same attending from their last clinic visit. The average faculty-to-resident ratio in the clinic was 1:4 which was not conducive to individualized teaching or mentoring. This unfavorable setting resulted in the lowest resident and patient satisfaction ratings year after year in their clinic experience at MP.
DESCRIPTION: In July 2007, 33 IM residents and 7 attendings at the MP clinic were randomly assigned to either the Orange Team or the Blue Team, each managing a certain patient panel. Residents and attendings in each team were expected to co-manage the patients in their team panel. Buy-in to the Firm Model was achieved via several earlier meetings with the clinic faculty and residents. Clinic team meetings were held monthly for one year afterwards. Team business cards were given to patients to identify the clinic physicians of their team. Using annual resident surveys routinely performed by the IM Residency program, pre-Firm

questionnaire data from 20062007 were compared to post-Firm data from 20072009 to assess the residents perception on the level of continuity, clinic staff support, quality of faculty supervision, and degree of attending teaching/mentoring. For patient satisfaction and quality of care, the percentages of complaints, no-shows, ED visits, and admissions were evaluated.
NEEDS AND OBJECTIVES: The overwhelming shortage of general internists has made the improvement of ambulatory education a key initiative in medicine residency programs. Success of this initiative has been difficult due to competition from heavy ward duties, resident/ faculty inertia, and limited outpatient support. These barriers result in negative resident ambulatory experience and translate into poor quality of patient care. Overcoming this atmosphere was the impetus for us at University of Florida (UF) to restructure our Internal Medicine (IM) Residency clinic at Medical Plaza (MP) into an innovative Firm Model. Success of the Firm Model in patient satisfaction and continuity has been well-cited in literature, but its impact on ambulatory teaching clinics remain under-reported. Our aim is to demonstrate that a Firm Model innovation in our large academic clinic would improve not only patient satisfaction and quality of care but also enhance resident learning and satisfaction of ambulatory education.
EVALUATION: Our Firm Model experienced an overall increase in residents satisfaction to their ambulatory education (3.9 in 2006 vs. 4.2 in 2009). Positive trends from 2006 to 2009 were seen in the level of continuity (4.1 vs. 4.3), quality of faculty supervision (4.5 vs. 4.7), and
degree of teaching/mentoring (3.2 vs. 3.8). The ratings on clinic support staff remained unchanged. As a pilot program, statistical analysis could not be done due to lack of power from small survey sample size. A separate control clinic from the same time frame had lower resident ratings in the level of continuity and degree of attending teaching and no change in the quality of faculty supervision. Statistically significant improvements in patient satisfaction and quality of care were seen with lower patient complaints (1.4% in 2006 vs. 0.66% in 2009 p=0.0001) and no-show rates (25% vs. 20% p DISCUSSION/REFLECTION/LESSONS LEARNED: Originally developed in 1970, the Firm Model remains an organizational innovation with academic and clinical advantages, including improved stakeholder satisfaction, faculty teaching/mentoring and quality of patient care. For optimal success, early buy-in from clinic staff is imperative. Any educational expectation from the Firm Model should also be made with patience as positive outcomes are modest and slow to develop. We further realize some unforeseen variables may adversely impact resident and patient satisfaction, such as new attendings or transient staff. It is thus essential to hold new faculty orientation and monthly team meetings indefinitely to promote teamwork among all stakeholders. Nonetheless, for any residency program struggling to balance the demands of high quality ambulatory teaching to those of efficient clinical care, the Firm Model is an achievable, exportable solution and can be sustained in any large teaching clinic with complex patient demographics.
ONLINE RESOURCE URL (OPTIONAL):
GLYCEMIC CONTROL ROUNDS: IMPROVING INSULIN ORDERING PRACTICES ONE TEAM AT A TIME
Rachel E Thompson 1; Abdelhak Abdou 2; Lousie Suhr 2; Dawn Corl 2; Brent Wisse3. 1Department of General Internal Medicine, University of Washington, Seattle, Washington ;
2Harborview Medical Center, Seattle, Washington ; 3Department of Endocrinology, University of Washington, Seattle, Washington. (Tracking ID # 9327)
SETTING AND PARTICIPANTS: The on-call medical team at Harbor-view Medical Center was asked to participate in Glycemic Control Rounds each Wednesday during the academic year 20092010. DESCRIPTION: For Glycemic Control Rounds (GCR) the on-call medical team joins our nurse practioner, diabetes nurse educator and endocrinologist for 30 minutes of interactive education weekly. The session focuses on open questions, review of the teams glycemic control data and directed advice. The teams glycemic control data regarding insulin ordering was collected for dysglycemic patients for the 14 days leading up to GCR. The percent of dysglycemic patients who received correction only was calculated. All attendings and residents in the department of medicine, and all medical students who rotated on medicine services in the academic year

20092010 were asked to complete a web-based survey. The survey included knowledge based questions, comfort level questions and questions that related to perceived effects of attending GCR.
NEEDS AND OBJECTIVES: There is a need to improve insulin-ordering practices in the inpatient setting. At academic centers one challenge is the changing face of the frontline from month to month as residents and students rotate. One primary goal is to eliminate sliding scale insulin and move to a physiologic system of basal, prandial and correction dosing. Many programs have focused on developing top-down interventions. In our attempt to improve this ordering practice, we instituted a weekly educational session with medical teams, thus working from the ground up.

EVALUATION: From July 2009 through June 2010 there were 251 attendees at GCR (5.3 1.6attendees per week). At the time of GCR, there were 529 patients on these services receiving insulin (11.3 3.3 per week). 165 patients were discussed in detail with 79% of these regarding hyperglycemia and 21% hypoglycemia. 79 (31%) attendees responded to our survey. 88 non-attendees responded and serve as the control for our knowledge and comfort scores. We tested the impact of attendance on knowledge scores. When we included peoples level of training (student, resident attending) in the model, attendance was associated with a 1.11 point higher score on average (95% CI: 0.18-2.04, p=0.02). Residents perceived the sessions as the most useful, followed by medical students then attendings. Using the GCR data, comparing the first 6 months to the second, the percent of dysglycemic patients with insulin orders for correction alone fell from 22% to 14% (p=0.01).
DISCUSSION/REFLECTION/LESSONS LEARNED: Our GCR sessions are both novel and effective. The sessions were well attended and well received by residents, students and attendings. GCR has allowed us to reach many trainees in a concise fashion in addition to affect improved glycemic care to their patients. The cornerstones of these sessions are relevancy and small group discussionwe review real patients in real time with their current providers.
ONLINE RESOURCE URL (OPTIONAL):
FOUNDATIONS IN CLINICAL MEDICINE: A COURSE TO FACILITATE THE TRANSITION OF SECOND-YEAR STUDENTS TO THE THIRD YEAR Susan B Glick 1; Michael OConnor1. 1University of Chicago, Chicago, Illinois. (Tracking ID # 9630)
SETTING AND PARTICIPANTS: The course is an immersive 7-day classroom-based experience that foreshadows the busy days of the clinical clerkships. Class is held from 8 AM to 5 PM each day. Students receive a one-hour lunch break daily; there are no other scheduled breaks throughout the day. Optional office hours are held from 57 each evening. The course was piloted in June 2010 with 20 rising third-year students. MSTPs were required to take the course; it was optional for MD candidates. Students who had experienced academic difficulty in the preclinical years were encouraged to take the course. Of the students who elected to take the course, some did so to gain a competitive edge and others to improve their skill set. The course will be offered to up to 48 students in June 2011; it will again be required for all MD/PhD candidates and elective for MD candidates. In 2012, the course is expected to be required for all rising third-year students. DESCRIPTION: The course includes 7 domains: 1. Hypothesis-Driven History and Physical Exam. Students are given a symptom and determine the classical and pivotal elements of the history and exam for common diseases that cause that symptom. 2. Data Interpretation: Students learn to recognize characteristic patterns in laboratory tests.3. Data Integration: Students learn to integrate the history, examination, and laboratory data to arrive at a differential diagnosis. 4. Procedures: Students learn to perform common procedures as well as their indications and potential complications. 5. Presentations: Students prepare oral presentations from paper-based cases and present the patients to a faculty preceptor. 6. Large Group Sessions: Students receive didactic instruction in a large group setting on topics including lifelong learning and medical mistakes. 7. FICM Learning Laboratory: Because some students require additional practice and others desire it, course directors hold office hours each evening.

NEEDS AND OBJECTIVES: The need for a course to transition preclinical medical students to the clinical years was identified during the curriculum reform initiative at our institution. Planning for this course, named Foundations in Clinical Medicine (FICM) began shortly
thereafter. To identify areas of need, we surveyed third year students as well as selected faculty and residents from the core clinical clerkships. We then attended national meetings and searched the literature to learn about new educational theories, programs and techniques that could be applied to the FICM course. Through these activities and others, we identified cognitive, communication and technical skills to be taught in the course as well as approaches to teach these skills to ensure students learning would be significant. The objective of this course is to facilitate second-year medical students transition to the third-year by maximizing their cognitive and emotional preparedness for the clinical disciplines.
EVALUATION: In 2010, we evaluated student performance with a pre-test, mid-term exam and final exam. The mean score improved from the pre-test (52%; range 33-71%), to the mid-term (59%; 30-80%), to the final (82%; 62-94%). We also evaluated the course with anonymous written student feedback immediately following the course. Overall, the course was well received, as illustrated by the following comments. You guys are AWESOME!!! Your vision of the course and execution was very polished and exceeded any reasonable expectation of a 1st time course. I just want to thank you both again for the opportunity to be a part of this amazing learning experience. It has assuaged the anxiety of starting 3rd year so much. Im not exaggerating when I say this class was the most enjoyable Ive had at Pritzker. I feel more aware of whats expected of me as a 3rd year, and what I must do to surpass those expectations. DISCUSSION/REFLECTION/LESSONS LEARNED: Three months after the course, students feedback highlighted a transition in their thinking about which aspects of the course were most helpful. For example, the differential diagnosis sections (develop your differential for something vague like chest pain) were among my least favorite at the time (because they took so long), but they ended up being really helpful because they made me think critically about the next steps in a patient workup - i.e. now that I have my differential, what labs/tests do I want, and how might the results of each of those reshape my ddx? I think thats a really important skill and its good to work on it early. These comments reinforce the importance of developing a curriculum that balances students short-term needs (e.g., to assuage the anxiety associated with starting the clinical clerkships) with their long-term needs (e.g., to improve analytical and critical thinking skills to maximize cognitive preparedness to study the clinical disciplines).
ONLINE RESOURCE URL (OPTIONAL):
OBSERVING THE TEACHERS: A PILOT STUDY TO DETERMINE IF FACULTY DEVELOPMENT IS AN EFFECTIVE TOOL FOR PRECEPTORS TEACHING MEDICAL STUDENTS IN A PHYSICAL DIAGNOSIS COURSE. Lisa Auerbach 1; Mimi McEvoy2. 1Albert Einstein College of Medicine, New York, New York ; 2Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 9754)
SETTING AND PARTICIPANTS: This study was conducting during a second year physical diagnosis course. The course is taught in groups of 8 same sex students and one preceptor. The groups meet weekly for 2.5 hours over 10 weeks. The sessions are peer practice. DESCRIPTION: During peer practice sessions in a 2nd year physical exam one experienced faculty member observed 10 of 23 randomly selected preceptors during 4 of 7 physical diagnosis sessions (vital signs, HEENT, abdomen and neurological) via remote observation to determine if objectives, strategies and format are being implemented as discussed in the 30 minute faculty meetings prior to each session. All preceptors consented to being observed. A 12-item observation tool was crafted based on basic principles of group teaching and course format and objectives. General observations were also recorded.

NEEDS AND OBJECTIVES: To assess teaching skills of preceptors in a second-year physical diagnosis course

for: 1. Conformity to courseobjectives/strategies/format; 2. Demonstration of effective group teaching skills in a skills based courseEVALUATION: All preceptors conformed to session objectives and teaching strategies, except in 2 cases where preceptors consistently lectured too long, minimizing hands-on practice. Other teaching approaches observed included demonstration, observation, hands- on corrections. All preceptors employed the PE skills practice checklists, but in different ways. Preceptors consistently gave feedback on techniques despite variability on the proportion of verbal explanation/ demonstration. Length of sessions varied with some preceptors ending before 2 hours; 2 preceptors who lectured for greater than 30 minutes ended laterDISCUSSION/REFLECTION/LESSONS LEARNED: Video observation confirmed that our faculty do consistently meet course objectives. Faculty development may be related to achieving consistency of course objectives and strategies among preceptors despite a variety of approaches and styles. Opportunities for specific preceptor feedback abound with this observational method.
ONLINE RESOURCE URL (OPTIONAL):
A FACULTY DEVELOPMENT PROGRAM TO PREPARE INSTRUCTORS TO OBSERVE AND PROVIDE EFFECTIVE FEEDBACK ON CLINICAL SKILLS TO INTERNAL MEDICINE RESIDENTS Sheira Schlair 1; Larry Dyche 1; Felise Milan 1; Hillary Kunins 1; Julia Arnsten 1; Eric Holmboe2.
1Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, New York ; 2ABIM, Phoenixville, Pennsylvania. (Tracking ID # 9766)
SETTING AND PARTICIPANTS: Ambulatory internal medicine teaching faculty at Montefiore Medical Center, Bronx, NYDESCRIPTION: A revised mini-CEX instrument was developed with faculty feedback. Interactive 1 hour sessions were organized over an academic year. In the first session, participants used the instrument to evaluate a trainees clinical skills in a videotaped clinical encounter and gave real-time feedback to this trainee (now faculty). In a second session, facilitators enacted a scripted resident-patient encounter with deficient rapport-building. Faculty practiced feedback giving to this precontemplative resident using a qualities of good feedback pocket-card and the mini-CEX instrument. Themes in debriefing included understanding residents personal goals, emotional needs and time management. Subsequent quarterly sessions will employ group discussions of videotaped faculty feedback encounters to explore assessment accuracy. Program impact will be assessed by pre-post feedback quality and satisfaction, as measured by faculty and resident surveys and analyses of mini-CEX instrument data.
NEEDS AND OBJECTIVES: Feedback on directly observed clinical encounters is essential to health professional skill development, and the ACGME mandates direct observation in internal medicine residencies via the mini-CEX (clinical evaluation exercise). Current studies show deficits in the quantity and quality of feedback for medical trainees. Faculty training in direct observation and feedback skills has been shown to be more important than the assessment instrument used. There is a need for effective approaches to teach faculty how to deliver effective, high quality feedback based on direct observation. Following a needs assessment survey given to faculty and residents we have implemented a 1 year program to train internal medicine faculty to (1) Become familiar with the evidence-based communication and feedback literature (2) Learn to accurately assess resident interviewing skills and(3) Conduct behaviorally specific, learner-centered, emotionally sensitive feedback sessions based on direct observation.
EVALUATION: Post-session faculty surveys had a response rate of 100% for session 1 (n=24/24) and 75% for session 2(n=15/20). Preliminary analyses comparing overall mean faculty perception of their feedback skills before and after the first two faculty development sessions do not reach appreciable educational significance (mean=2.2 vs. 2.7,p=0.22, scale 0=not able to 4=extremely able to give high quality feedback). Faculty reported greatest improvement in the feedback skills including addressing learner emotions (mean=1.3 vs. 2.8,p=0.19) and collaborative feedback processing (mean=2.1 vs. 2.9, p=0.17). Data will be forthcoming from resident surveys and analyses of mini-CEX instrument data. Preliminary qualitative analysis of faculty program evaluation yielded curricular strengths: Interactive format, systematic approach to clinicalobservation and

feedback giving, facilitator style (openness to criticism anddiscussion) and longitudinal nature of curriculum.
DISCUSSION/REFLECTION/LESSONS LEARNED: (1) Managing emotions of the pre-contemplative resident is challenging but faculty report growth after two program sessions. (2) Post-session faculty survey data revealed enthusiasm for skill development. (3) Multi-modal, interactive learning formats were well received. (4) Allocated time, faculty attitudes and faculty efficiency are critical factors to faculty satisfaction with this faculty development program and user satisfaction with mini-CEX programming overall. (5) Ongoing examination of resident perceptions of faculty feedback quality is paramount to determining program impact.
ONLINE RESOURCE URL (OPTIONAL):
ASSESSING THIRD-YEAR MEDICAL STUDENTS ABILITY TO RECOGNIZE AND ADDRESS A PATIENTS SPIRITUAL DISTRESS DURING AN ACUTE MEDICAL CRISIS Sheira Schlair 1; Mimi McEvoy 2; Zsuzsanna Sidlo 2; William Burton 2; Felise Milan1.
1Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, New York ; 2Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 9915)
SETTING AND PARTICIPANTS: 170 MS-3 s at Albert Einstein College of Medicine, Bronx, NYDESCRIPTION: In spring 2010, 170 MS-3 s completed an 8-station videotaped CSA. One standardized patient (SP) was an elderly man with acute chest pain. He expressed fear of death, which he hoped to resolve by chaplain consultation. Students task was to assess and manage the SPs chest pain and distressedaffect. There were a series of cues in the encounter that students were expected to acknowledge (e.g. prayer book and rosary beads were by the SPs bedside and SP was wearing a religious medal around his neck; SP described fear about dying and admission to CCU). After the encounter, students answered fouropen-ended questions on their assessment and management in a post-encounter written exercise: (1) Recognition of the nature of this SPs distress; (2) Their response to the patients distress; (3)A retrospective reflective assessment of what they might have done; and (4) Perceived challenges of this CSA station. The SP evaluated the students communication skills.
NEEDS AND OBJECTIVES: The skills in recognizing and addressing patients spiritual needs are not well understood. To inform curricular development, we explored how third-year medical students (MS-3) recognize and address a standardized patients spiritual distress during an acute medical crisis and also examined the relationship between students reported response to spiritual distress and Clinical Skills Assessment (CSA) communication skills performance. EVALUATION: Mixed methods analysis of the questionnaires was conducted by 3 coders using NVivo 8 for emergent themes. Analysis of

inter-rater reliabilities using SAS revealed kappa coefficients of >0.6; codings with inter-rater reliability
DISCUSSION/REFLECTION/LESSONS LEARNED: Most students reported offering a chaplain referral to a patient who exhibited signs of spiritual distress while few directly addressed spiritual beliefs. These findings raise questions regarding the role of medical students in spiritual assessment and their skills in this area. Further qualitative investigation of decision making prompting chaplain referral is warranted. In addition, further exploration is also warranted to clarify the relationship between medical students recognition and management of spiritual distress and communication skills.
ONLINE RESOURCE URL (OPTIONAL):
INDIVIDUALIZED LEARNING PLANS FOR 4TH-YEAR PEDIATRIC AND INTERNAL MEDICINE SUB-INTERNS Elizabeth Sastre 1; Michelle Shepard 1; Amy Fleming1. 1Vanderbilt University Medical Center, Nashville, Tennessee. (Tracking ID # 10006)
SETTING AND PARTICIPANTS: Twenty-three sub-interns inIM and 27 in pediatrics at a university-based medical center were invited to participatein the study and agreed. Allstudents rotating on their sub-internship each month met together with afaculty preceptor to create an individual ILP and then met as a group on aweekly basis for the remainder of the one-month rotation.

DESCRIPTION: At the initial meeting, sub-internscompleted an initial self-assessment of strengths and weaknesses modeled after-ACGME core competencies, defined career goals, and set two initial learningobjectives with corresponding plans to achieve them. During weekly groupfollow-up meetings, students documented self-reported progress, discussedsuccesses and challenges, and revised goals or plans as necessary. Upon completion of the rotation,students completed a survey consisting of Likert-scale questions addressing-satisfaction with various elements of the ILPs and ranking of their relativeimportance.
NEEDS AND OBJECTIVES: IndividualizedLearning Plans (ILPs) are an effective tool for promoting self-directedlearning among residents. However, no literature details ILP use amongmedical students. We developed astudy to (1) detail implementationof ILPs for fourth-year sub-interns in pediatrics and internal medicine (IM) ata single institution, (2) correlate students self-identified areas of weaknesswith types of learning objectives selected, and (3) evaluate satisfaction withand perceived utility of elements of the ILP exercise.
EVALUATION: Students most oftenidentified strengths in the areas of professionalism and communication andweaknesses in the areas of patient care and systems-based practice. 82% set at least one learning objectivein an identified area of weakness. Students expressed high confidence in their abilities to create specificand achievable learning objectives (4.38+/0.77) and to generate useful-strategies to meet those objectives (4.28+/0.60). They also agreed that discussions arising during groupmeetings were meaningful(4.37+/0.81). The setting of learning objectives and weekly meetings were deemed themost important elements of the project, with definition of career goals leastimportant.
DISCUSSION/REFLECTION/LESSONS LEARNED: Fourth-year subinternsreported that ILPs helped them to accomplish more during their rotation, withthe setting of learning objectives and strategies being the most useful elementof the exercise. Future researchwill need to further define elements of successful ILPs and the optimal rolefor faculty mentorship.
ONLINE RESOURCE URL (OPTIONAL):
IMPROVING UPWARD FEEDBACK IN MEDICAL EDUCATION Rachel Ann Bender Ignacio 1; Kathleen M Finn2. 1Massachusetts General Hospital, Harvard Medical School, Cambridge, Massachusetts ; 2Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts. (Tracking ID # 10048)
SETTING AND PARTICIPANTS: An Internal Medicine residency program at a large university-affiliated hospital in Boston, Massachusetts. The program has approximately 150 medical residents across all years of training. All PGY-2, PGY-3 medicine residents as well as PGY-2, PGY-3, and PGY-4 Med/Peds residents were included in the survey group. The program currently requires on-line evaluations of attending physicians following inpatient rotations and recommends similar online peer evaluations of other residents.
DESCRIPTION: When given a list of 10 potential reasons for not completing evaluations and asked to check all applicable, residents selected the following: online evaluations are unlikely to induce change from the program (39%), feedback will not be incorporated by the attending (21%), and negative feedback hurts recipients feelings (55%). Residents expressed discomfort with giving negative evaluations due to power imbalance (53%) and fear of negative repercussions including receiving reciprocal negative feedback (37%). When asked to choose one or more of seven options for giving positive feedback to attendings, 82% of residents preferred speaking to the attending, to the program director (50%), or completing online evaluations (29%). For serious concerns, residents favored contacting either the program director (26%) or chief resident (45%), versus online (18%), however 34% would give no feedback in this scenario. 82% of residents favor positioning a neutral third party to hear serious concerns.
NEEDS AND OBJECTIVES: Resident online evaluations of teaching attending physicians at our institution are poorly utilized (13% completion rate), and rarely include actual constructive critiques aimed at improving an attendings teaching skills or the quality of the teaching service. There is sparse medical education literature available on residents giving feedback to superiors. We conducted a survey of junior and senior residents with the following objectives: 1) to better assess why residents choose not to utilize the online evaluation system, 2)

the circumstances that make them more or less likely to complete evaluations, and 3) their preferred methods of submitting feedback, if not via online evaluations. We plan to present the findings of the survey to the residency program director and key program administrators in order to enhance the current evaluation system and to improve both the percentage and utility of completed evaluations.
EVALUATION: We hope to incorporate our findings into an improved evaluation system. Based on the results, we have recently started oneon-one exit interviews of junior residents with the inpatient associate program director when they rotate off the teaching service. The goal is to obtain anonymous feedback on teaching faculty with the plan to share an aggregate of evaluations with them in a summary statement that removes the temporal connection and individual voice of the online evaluations. We plan to create follow-up surveys to assess attending and resident satisfaction with our new evaluation system as well as collecting data on utilization.
DISCUSSION/REFLECTION/LESSONS LEARNED: While the ACGME mandates residents should be able to complete anonymous evaluations of attendings, this survey suggests on-line evaluations may be fulfilling a requirement but not providing any useful information. The business literature suggests giving upward feedback can be risky to ones career and highly critical evaluations of superiors should be avoided. Our results indicate that residents are happy to share positive verbal feedback with an attending, but a safer system needs to be created to allow them to provide critical feedback of teaching attendings. Not only

are residents required to evaluate their attendings, but also positions on the teaching service are highly coveted, and interaction with these select clinicians shapes the future our next generation of physicians. It is our obligation to provide our medical students and residents with the highest quality clinicians and teachers available.
ONLINE RESOURCE URL (OPTIONAL): N/A

ACADEMIC YEAR END TRANSFER OF CARE - A PILOT SIGN-OUT PROGRAM IN AN AMBULATORY RESIDENCY CONTINUITY PRACTICE

Ann R Garment 1; Wei Wei Lee 2; Erica Phillips-Caesar 1; Christina Harris1.
1New York Presbyterian Hospital - Weill Cornell Medical College, New York, New York ; 2University of Chicago, Chicago, Illinois. (Tracking ID # 10059)
SETTING AND PARTICIPANTS: The program was piloted in two ambulatory care practices at an academic medical center in New York City at the end of the 20092010 academic year. Outgoing residents were eligible for participation if they had an established continuity panel of patients that would be transferred to an incoming intern and if they practiced at one of the two study continuity sites. They were excluded if they were ending the academic year on an away rotation (e.g. international elective) or vacation. All eligible residents were consented to participation.32 resident-intern pairs participated in the study and were randomized to the pilot transfer of care program (TOC group) or the usual no-transfer of care (NTOC group).
DESCRIPTION: There were no statistically significant differences in gender, patient panel size or educational track (i.e. categorical, research, primary care) between groups. Two standardized hand-off forms were developed by investigators based on literature review. The Ten Tasks List (TTL) was a list of the ten most critical patient care tasks (e.g. medication changes, pending laboratory tests) to be followed up by the intern within the first three months of the year. These tasks were also referenced in patients medical records. The Sign-Out Document (SOD) was a more detailed form addressing the ongoing care of the full patient panel and highlighting medically complex patients. TOC residents were asked to create a TTL, a SOD and to verbally sign out both to their successive interns. NTOC residents were asked to create just a TTL and return it to the investigators only. In addition, residents and interns were surveyed about their respective year-end transition experiences.

NEEDS AND OBJECTIVES: In an effort to prevent medical errors, the Joint Commission on Accreditation of Healthcare Organizations recommended that all healthcare groups implement a standardized approach to communicating patient information during hand-off, or transfer of care (TOC), between providers. Much of the research on TOC has been conducted in the inpatient setting, but few if any studies have been in the ambulatory care setting, particularly in residency continuity practices when new interns inherit the patient panels of graduating residents at the end of the academic year. The objectives of this study were: 1) To develop a standardized TOC program among residents and interns in an ambulatory care continuity practice, 2) To evaluate the impact of this program on patient safety as documented by the completion of specific patient care tasks signed out by the residents to the interns and 3) To evaluate resident perceptions of and feedback on aspects of the program that could be improved.
EVALUATION: There was no difference in the mean number of tasks completed by the two groups (TOC 4.08+/1.75, NTOC 5.17+/1.40, p =.10). However, TOC interns were less likely to miss follow-up on tasks compared with NTOC interns (17% vs 44%) when seeing continuity panel patients (p=0.04; 95% CI 0.45-1.84). Over 90% of residents and interns agreed that sign-outs are important to patient safety. 70% of residents and 64% of interns agreed that a standardized ambulatory sign-out process would be useful. Participants identified the following barriers to outpatient
TOC: 1) Lack of protected time to create the TTL and SOD, 2) Difficulty succinctly summarizing issues for such large patient panels, and 3) Difficulty coordinating schedules for verbal sign-out. Participants also identified many advantages: 1) Relief of anxiety about complex patients, 2) Identification of patient previously lost to follow-up, and 3) Exchange of contact information for future resident-intern communication.
DISCUSSION/REFLECTION/LESSONS LEARNED: Our study demonstrated that interns participating in a standardized ambulatory sign-out program were less likely to miss following up on important clinical tasks when seeing their patients. This suggests that relying solely on office visit notes for the delineation of patient care is not adequate for inexperienced providers. As one intern commented, Many patients have complex medical issues, it isnt easy to learn about them in a few minutes before you meet them for a 30 minute visit. The program could be improved by providing residents with protected time to review patient panels, identify medically complex patients, create hand-off documents, meet with interns for verbal sign-out and schedule appointments for those complex patients to meet the new intern early on in the new year. Our results have implications for the importance of standardizing the ambulatory TOC process both for the safety of patients and the satisfaction of medical trainees.
ONLINE RESOURCE URL (OPTIONAL):
SUPPLEMENTAL CURRICULUM IN LGBT HEALTHCARE AT NEW YORK UNIVERSITY SCHOOL OF MEDICINE Benjamin Cox 1; Nicole Rosendale 2; Allison Avery 2; Richard Greene2. 1New York University School of Medicine, Brooklyn, New York ; 2New York University School of Medicine, New York, New York. (Tracking ID # 10211)
SETTING AND PARTICIPANTS: Medical students from all four classes are invited via email to attend the supplementary dinner lectures at the NYU Medical Center. These lectures are approximately 90 minutes long and take place over the course of the academic year and are given by a combination of medical students, faculty members, and specialists invited from various community organizations. Students are encouraged to share questions and comments and have the opportunity to submit questions anonymously if they choose. The lectures are organized and hosted by the LGBT People in Medicine student group at NYU with support from the Officeof Diversity Affairs. DESCRIPTION: In 2010, NYU School of Medicine created a certificate program in LGBT Healthcare Training. All medical students are invited to attend the supplementary lectures; to obtain the official certificate students must attend all four lectures. They were developed using our knowledge and skills objectives and are as follows: 1. The Gay Lexicon presents and defines terminology used in the LGBT community and by many LGBT patients. 2. LGBT Health and Sociocultural Context examines the unique

healthcare and mental health needs of LGBT patients and puts them into a cultural and psychosocial context. This lecture also gives recommendations of steps that everyone can take to improve care for their LGBT patients. 3. HIV in NYC discusses the impact of HIV on the gay community, what is being done about it, and examines the state of HIV in New York City. 4. Transgender Health 101 introduces specific transgender health issues and includes a discussion on working with transgender patients.
NEEDS AND OBJECTIVES: When pre-clinical medical students at NYU were surveyed about their knowledge, attitudes and confidence in caring for Lesbian, Gay, Bisexual, and Transgender (LGBT) patients, the mean score on the knowledge assessment was 59% and many students expressed a lack of confidence in their ability to take a sexual history on a LGBT patient or properly address their specific healthcare needs. The results of this survey demonstrate that the standard curriculum -which

includes only one lecture on LGBT health - is not sufficient and that there is a clear need for educational intervention. A four-lecture supplemental curriculum was developed with objectives to improve knowledge of: LGBT-related terminology, medical conditions that more commonly affect LGBT persons, and the sociocultural context for specific LGBT healthcare needs. The curriculum also seeks to improve skills with taking an appropriate psychosocial history and screening and counseling LGBT patients on their unique health needs.
EVALUATION: Before the first lecture of the supplemental curriculum was given, a 39-question survey designed to assess knowledge, attitudes, and confidence in caring for LGBT patients was emailed to all first and second year medical students. After the final lecture in the series, the same survey will be sent out again to all first and second year medical students with additional questions about which supplemental and standard curriculum lecture(s) the student attended. This instrument will compare how students knowledge, skills, and attitudes changed having gone to the supplementary curriculum versus how these parameters changed having gone only to the lecture in the standard curriculum. These data will suggest whether this supplemental curriculum and certificate program can improve students confidence and competency in LGBT healthcare.
DISCUSSION/REFLECTION/LESSONS LEARNED: In years past, the LGBT student group at the NYU School of Medicine hosted dinner lectures that were always high quality, but had very low participation. In an attempt to generate enthusiasm, leaders of the group designed this supplemental curriculum, presented it to school administrators, and proposed the creation of an official certificate program. The program was approved and introduced to all medical students explaining the benefits of completion (e.g., improving clinical skills, strengthening applications). At the first lecture, more than one hundred medical students came and participated! This innovation in medical education is still in progress, and its evaluation is not yet complete, however, we learned two important things about improving medical education in LGBT healthcare: creating a lecture series guided by a set of objectives is an important first step, and creating incentives such as a school-sponsored certificate had a dramatic impact on student participation. ONLINE RESOURCE URL (OPTIONAL):
ENHANCED FACULTY CONFLICT OF INTEREST DISCLOSURE TO PRE-CLINICAL MEDICAL STUDENTS AND ITS IMPACT ON ATTITUDES TOWARD INDUSTRY. Azalea Kim 1; Lawrence Mumm 1; David Muller 1; Alex Federman 1; Deborah Korenstein1. 1Mount Sinai School of Medicine, New York, New York. (Tracking ID # 10212)
SETTING AND PARTICIPANTS: Pre-clinical medical students at Mount Sinai School of Medicine and their lecturers in first and second year courses.
DESCRIPTION: In October 2010, a thirty-minute lecture introducing the issue of conflicts of interest in medicine was conducted for all first and second year students. Following these introductory lectures, all faculty and guest-speakers with exposure to pre-clinical students were asked to begin lecture sessions with a conflict of interest disclosure statement either via powerpoint slide or verbally. The statement includes whether he/she has any relevant conflicts of interest to disclose and if he/she will be discussing off-label or investigational uses of products during the learning session. In addition, lecturers were asked to submit this information, including the

nature of relevant relationships with industry, to a web-based repository. This data is accessible to students anytime so that they may explore and better understand relationships that exist with industry.
NEEDS AND OBJECTIVES: The AAMC has recommended that medical schools educate students about interactions with the pharmaceutical industry and how those interactions can threaten professionalism. However, students continue to feel inadequately educated about industry interactions and a hidden curriculum continues to positively influence student attitudes toward industry. The Mount Sinai School of Medicine mandated disclosure of conflicts of interests by faculty lecturing to pre-clinical students beginning in October 2010. The objectives of the intervention are 1) To raise medical student awarenessof the potential influence of interactions with industry and 2) To measure the impact of disclosure on student attitudes toward relationships with industry. EVALUATION: Evaluation involves documentation of use of the reporting system and the impact of the project on student attitudes. We are tracking submitted disclosures and their content. We are also utilizing a survey to assess students attitudes toward industry using 14 items within 4 domains: appropriateness of industry gifts to physicians; appropriateness of industry-sponsored education; impact of industry relationships with academic faculty on quality; and the role of conflict of interest disclosures. Survey items were based on prior instruments and utilize a 4-point Likert scale. The survey was administered on a voluntary basis to pre-clinical students prior to the intervention and to beginning third year students, who did not experience the intervention and will serve as controls. The survey will be administered again at the end of the academic year to pre-clinical students, whose responses will be compared to both pre-intervention responses and to third year controls. DISCUSSION/REFLECTION/LESSONS LEARNED: Data collection in this study is ongoing and will be complete at the end of the 2010 11 academic year. Early analyses suggest good faculty compliance with submitting disclosure data. We hypothesize that fostering student awareness of conflicts will make them more critical of industry interactions during the clinical years and will blunt the impact of the hidden curriculum which habituates them to relationships with industry and leads to increasingly positive attitudes over time. We plan to measure the impact of the new institutional policy through our survey tool, which is currently underway. In its pilot year, the main challenge is faculty acceptance of the new COI disclosure process, as well as tracking actual disclosure statements presented during lectures and developing a balanced curriculum to support student education on this issue. ONLINE RESOURCE URL (OPTIONAL):
TEACHING PRACTICE BASED LEARNING IMPROVEMENT (PBLI) THROUGH OBSERVATION, REFLECTION AND SMALL CYCLES OF CHANGE. Mamta Singh 1; Spanos Peter 2; Carter-OGorman Denise2.
1Case Western Reserve University, Cleveland, Ohio ; 2Western Reserve University School of Medicine, Cleveland, Ohio. (Tracking ID # 10295)
SETTING AND PARTICIPANTS: The medical school class is exposed to the different areas of the PBLI curriculum beginning in their first year. The topics range from health promotion, small group learning, and web modules to clinical observation. The class size ranges from 150 to 160 students. DESCRIPTION: The CWRU medical school PBLI curriculum is a multi faceted approach including:1.) A Health promotion project through which students explore behavior change and its attendant barriers.2) Interactive online modules teaching improvement science methods 3) Observational patient-based experiences where students reflect on authentic clinical situations, 4) A Personal Learning Plan, which applies improvement methods to academic achievement. The CWRU medical school PBLI curriculum is a multi faceted approach including:1.) A Health promotion project through which students explore behavior change and its attendant barriers.2) Interactive online modules

teaching improvement science methods 3) Observational patient-based experiences where students reflect on authentic clinical situations, 4) A Personal Learning Plan, which applies improvement methods to academic

achievement.
NEEDS AND OBJECTIVES: As one of the six ACGME competencies, PBLI is given equal footing with the traditional competencies of Medical Knowledge and Patient Care. However, it does not afford itself to traditional teaching and assessment methods. Given the reflective nature of this competency and its reliance on improvement science, The Case Western Reserve University medical school curriculum adopted a multifaceted curriculum that focuses on observation, reflection and multiple change cycles. The specific learning objective for this competency is that the student:Demonstrates and engages in skills and habits of self-reflection, self-assessment, and self-regulation to promote personal and professional growth.
Critically appraises and assimilates scientific evidence.
EVALUATION: Student feedback has been largely positive with all four learning cycles and students have shown interest and understanding of improvement science as well as better reflection ability. To date student feedback regarding the online modules, which include principles of quality improvement, is available.149 (96%) students thought the learning objectives were clear and 142 (91%) thought the learning objectives were met. When asked specifically whether they gained a good understanding of the key concepts, 71% students responded strongly agree or agree. DISCUSSION/REFLECTION/LESSONS LEARNED: PBLI does not lend itself to traditional teaching methods or assessment. Our integrated multi-method teaching using reflection, observation and change cycles provides a foundation for teaching and assessing this competency. A traditional linear approach is not conducive to teaching PBLI. The reflection component linked with our competency-based curriculum has been successful in getting the key concepts of PBLI across. PBLI does not lend itself to traditional teaching methods or assessment. Our integrated multi-method teaching using reflection, observation and change cycles provides a foundation for teaching and assessing this competency. A traditional linear approach is not conducive to teaching PBLI. The reflection component linked with our competency-based curriculum has been successful in getting the key concepts of PBLI across.
ONLINE RESOURCE URL (OPTIONAL):
A COLLABORATION TO TRAIN GENERAL INTERNAL MEDICINE RESIDENTS IN CULTURALLY COMPETENT LEADERSHIP, ADVOCACY, AND COMMUNITY PARTNERSHIP SKILLS Steve Roey 1; Sharad Jain 2; Craig Keenan 3; Kathleen Hicks4. 1SCVMC, San Jose, California ;
2University of California, San Francisco, San Francisco, California ;
3University of California, Davis, Sacramento, California ; 4Alameda County Medical Center, Oakland, California.
(Tracking ID # 10423)
SETTING AND PARTICIPANTS: Residents from the UCSF Primary Care Medicine Program based at San Francisco General Hospital (6 residents/year), the Primary Care Medicine residency program at Alameda County Medical Center (6 residents/year), the Primary Care Program based at the University of California, Davis (6 residents/year), and the General Internal Medicine Program based at Santa Clara Valley Medical Center (10 residents enrolled in their novel Pathways Curriculum) participated in the new curriculum developed through this collaboration. These programs have similar training missions which include direct care for vulnerable populations and leadership to address health disparities. Given the close geographic proximity, program leadership sought collaboration to assess current practices, share successes and challenges at each institution, and work together to develop training models that can be implemented, evaluated, and ultimately disseminated to a broader audience of residency training programs.
DESCRIPTION: The collaboration focused on developing a comprehensive curriculum for medicine residents on topics in cultural competence, advocacy, leadership, and community partnerships. The process required the collaboration to (1) perform an assessment of current curricula being delivered at each residency programs and compare these curricula with the literature and national guidelines, (2) implement curricular design to facilitate delivery at programs with wide variations in schedules and logistics, and (3) document the impact of these curricular innovations on resident physicians. Support was provided by The California Endowment. The program

directors participated in monthly conference calls and quarterly meetings to collaborate on project goals. Because of differences in the structure of each program, the curricular design process focused on the development of transferable modules that could be delivered at each program without relying on new resources or expert speakers.
NEEDS AND OBJECTIVES: With the explosion of chronic diseases, the widening health disparities, and the resultant morbidity and mortality from these conditions, it is imperative that we train the next generation of primary care physicians to have the knowledge, skills, and attitudes to address these medical problems and to design healthcare systems which consider the economic, political, and social factors which can exacerbate these problems. Physicians, especially those working in safety net systems, must be trained to address disparities through innovative programs that allow them to serve as agents of change, both locally and nationally, to improve outcomes for their patients. We describe a collaborative process among 4 internal medicine residency training programs that provide care to underserved populations and the development of a curriculum for residency programs specifically addressing topics on leadership, advocacy, community partnerships, and cultural competency.
EVALUATION: The impact of the curriculum on residents was assessed using pre- and post-curriculum survey; post-curriculum survey data collection will be completed this spring. Informal survey of program leadership involved in the design and implementation of the curricula demonstrated great satisfaction with the process and ease of delivery with the curriculum. After a 1-year development phase, 4 different programs with a wide variety of schedule and logistical limitations were able to implement a robust curriculum that addressed economic, political, and social factors relevant to the future of primary care physicians. Each program was able to augment existing curricula and/ or implement new curricula on cultural competence, advocacy, leadership, and community partnerships. Program leaders noted the beneficial effect that the collaborative process had not only on implementing new curricula and sharing resources and expertise, but also note the beneficial effect on mentoring and faculty development. DISCUSSION/REFLECTION/LESSONS LEARNED: Four internal medicine residency programs designed a comprehensive curriculum on leadership, advocacy, community partnerships, and cultural competency that is transferable between programs. All who participated in the design and implementation process acknowledged the benefit of collaboration. Comparing programs, discussing barriers to education, and partnering on solutions proved an invaluable technique in developing a curriculum that is both transferable and flexible to fit individual programs needs. Leveraging strengths and sharing resources among programs facilitated the process and provided smooth implementation. In addition to resident education, we believe that this process had significant beneficial impact on faculty development and program design. At a time when greater demands are being placed on educators, collaborating among program leaders that share a common mission serves as an excellent vehicle for enhancing the development of both residents and faculty.
ONLINE RESOURCE URL (OPTIONAL):

I DONT KNOW THEIR NAMES, I JUST TAKE WHAT THE DOCTOR GIVES ME : A MEDICATION RECONCILIATION OSCE STATION Colleen Gillespie 1; Margaret Horlick 1; Colleen Gillespie 1; Barbara Porter 2; gaelle pierre 1; angela hang1. 1New York University School of Medicine, New York, New York ; 2new york university school of medicine, New York, New York. (Tracking ID # 10424)
SETTING AND PARTICIPANTS: Thirty five 2nd year internal medicine residents participated in a multi-station Objective Structured Clinical Examination (OSCE).
DESCRIPTION: We designed an OSCE case requiring medication reconciliation for a patient recently discharged from a hospital who presents to his PCPs office for medication refills. He has a bag of medications and is confused about which are new. Reconciliation skills included assessing patient knowledge of hospitalization and discharge and of their medications; assessing patient understanding of medications; and clarifying medications the patient should be taking. After each encounter, the SP and a faculty member

evaluated the residents communication (11 items), patient satisfaction (4 items), and patient activating (3 items) skills (Cronbachs alpha assessing internal consistency >.70 for all) as well as their medication reconciliation skills (4 specific items) using a behaviorally anchored checklist (three point scale of not done, partially done, and well done; scores operationalized as % of items well done).
NEEDS AND OBJECTIVES: In 2006, The Joint Commission listed medication reconciliation as one of its national patient safety goals. We were interested, therefore, in evaluating 2nd year internal medicine residents knowledge of the steps involved in medication reconciliation, and their ability to communicate medication errors to a patient effectively.
EVALUATION: Our results showed that 92% of the residents fully assessed the patients knowledge of medication names, 83% fully assessed his understanding of the medications, and 86% fully clarified the medications he should taking, including updating and stopping prescriptions. However, only 51% assessed what the patient knew about both his hospitalization and discharge plan. Residents who received a well done rating for their performance in clarifying medications (30/35) had higher communication, patient satisfaction and patient activating skills both in this case and for the overall OSCE than those who received a partly done . Faculty feedback to residents focused on the core challenge of the case, whether the resident discovered duplicate medications and errors in dosing, and noted that some residents didnt fully conclude the reconciliation process, treating this encounter as the first of two visits. All residents rated the case as having moderate or high educational value.
DISCUSSION/REFLECTION/LESSONS LEARNED: Almost all 2nd year medicine residents appear to be able to reconcile medications effectively. Residents who did not complete all of the measured tasks of medication reconciliation (9 - 17% depending on the specific task) appeared to perform less well in other core clinical domains as well. This suggests that problems in medication reconciliation may reflect problems in other communication skill areas. We plan to continue this OSCE case in future years to evaluate residents skills as exposure to medication reconciliation in their daily activities becomes more common. We are interested in seeing whether relationships between effective medication reconciliation, strong communication skills and patient satisfaction and activation hold.
ONLINE RESOURCE URL (OPTIONAL):
A NOVEL APPROACH TO TEACHING THE MANAGEMENT OF DIABETIC KETOACIDOSIS USING VIRTUAL PATIENT TECHNOLOGY Gary H. Tabas 1; Gary Tabas1. 1University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 10533)
SETTING AND PARTICIPANTS: University of Pittsburgh School of Medicine third year medical students are currently completing the diabetic ketoacidosis virtual patient teaching program, including the post-test and survey, during their Adult Internal Medicine Clerkship rotation at University of Pittsburgh Medical Center Presbyterian-Shadyside, Shadyside campus, during the 20102011 academic year. Six students per month complete their internal medicine clerkship at this 540-bed teaching hospital under the direction of the Division of General Internal Medicine Teaching Faculty. Using a personal computer with an internet connection, students access the virtual patient teaching program through the University of Pittsburgh Navigator Learning Management System.
DESCRIPTION: This DKA virtual patient was constructed using authoring software that facilitates the creation of multiple pathways through a simulated case. Students diagnose DKA, manage fluids, electrolytes, and insulin, and transition the patient from IV insulin to SQ insulin. The student acts as a health care professional making diagnostic and therapeutic decisions based on the patients history and physical examination and ordering and interpreting diagnostic tests. Students immediately see the outcomes of their decisions and make new choices based on those outcomes. During this process, students learn and practice clinical decision making skills and receive learner-specific feedback based on their choices. The VP tracks individual students pathways through the case and time taken to complete the case, and assigns scores for pathways chosen (path score). All

students complete a 10-question case-based single best answer multiple choice post test and a Likert survey.
NEEDS AND OBJECTIVES: Diabetic ketoacidosis (DKA) is associated with significant morbidity and mortality and its management involves complex decision making. Only a minority of students will encounter a patient with DKA during ward rotations creating an important educational gap. Although students receive lectures on DKA, management and decision making during direct patient care are often suboptimal. The LCME and the Carnegie Foundation report on Reforming Medical Education have both noted the increasing role of simulation in student training. The use of web-based virtual patient (VP) simulation would allow students to learn and practice DKA management skills in a safe environment. The objectives of the project are: (1) implement a newly created web-based virtual patient simulation to teach the management of DKA; (2) test its effectiveness in teaching DKA-specific clinical decision making (3) assess students perceptions of the effectiveness of the DKA VP compared to other instructional methods.
EVALUATION: Project evaluation includes (1) individual scores for paths chosen (path score); (2) time to complete the case; (3) a pretest in a randomly selected subset of the participants and a post test for all participants that assesses DKA-specific decision making skills; (4) a survey assessing students perceptions of learning experiences. To date, 35 students have completed the VP, post test and survey. The mean pretest score for a subset of students was 34%. The mean post test score for all students was 67%. The mean path score among students was 84 out of a possible score of 100 when all optimal paths were chosen. Mean time spent completing the case was 29.6 minutes (range 12 to 59 minutes). The survey indicated that students perceived increased confidence in managing DKA and felt that the ability to see consequences of their decisions resulted in more effective in learning than

with lecture or small group. Students felt that the program was of high educational value.
DISCUSSION/REFLECTION/LESSONS LEARNED: Using authoring software that facilitates the creation of multiple pathways through a simulated case, it is feasible to construct an interactive web-based virtual patient to teach clinical decision making in a simulated patient with DKA. The case-based single best answer multiple choice quiz was constructed to test clinical decision making and the pre- to post test score changes among students suggests a significant improvement in DKA-specific decision making skills. On the survey, none of the students indicated having managed a patient with DKA. The DKA VP simulation represents one way to help fill this educational gap. Using the methods demonstrated in this project, educators will be able to develop and study future VPs that teach decision making in other complex medical illnesses.
ONLINE RESOURCE URL (OPTIONAL): http://vpsim.pitt.edu/vpSim/player/vpplayer.aspx?caseID=147005e8-e3d2-411d-8b3d-f52d2f6abafa
Web End =http://vpsim.pitt.edu/vpSim/ http://vpsim.pitt.edu/vpSim/player/vpplayer.aspx?caseID=147005e8-e3d2-411d-8b3d-f52d2f6abafa
Web End =player/vpplayer.aspx?caseID=147005e8-e3d2-411 d-8b3d-f52d2f6abafa
SENIOR INTERNAL MEDICINE RESIDENTS AS TEACHERS OF MEDICAL-SURGICAL COMANAGEMENT CURRICULUM Eileen Hennrikus 1; Atul Bhardwaj 1; Carolina Candotti1. 1Penn State, Hershey Medical Center and College of Medicine, Hershey, Pennsylvania. (Tracking ID # 10595)
SETTING AND PARTICIPANTS: Setting: An academic tertiary care hospital Participants: The medicine-surgical consult/comanagement service. A senior medicine resident, medicine intern and anesthesia intern rotate on service for one month. The 3rd year student and medicine attending rotate on service every two weeks.
DESCRIPTION: At the start of the rotation, all students and residents took a 35 question clinical pretest. A curriculum was developed consisting of 16 powerpoint modules that begin with the pretest clinical case questions, followed by an evidence based review of the topic with references. Topics range from Pre-op cardiac

evaluation and perioperative B-blockers to Diabetic management and osteoporosis. During the first 6 months, the modules were accessable to the attendings on the hospital computer drive. During the second 6 months, the senior residents also had access to these modules and were given the primary responsibility of teaching. At the completion of their rotation, all students and residents were given a 26 question post-test. Students, interns and residents were given a 10 question survey before and after the rotation. They were asked to rate their confidence level on medical-surgical disease management using a 10 point Likert scale.
NEEDS AND OBJECTIVES: 1. How best to educate students/residents in medical-surgical comanagement practice?2. To meet ACGMEs requirement of evaluating residents as teachers.3. To compare resident/student learning from attending led teaching versus senior resident led teaching.
EVALUATION: 39 students and residents participated over the course of a year. 18 during the attending led teaching, 21 during the resident led teaching. The average pretest scores were 57%. The post-test scores were 73% during both the attending led teaching and the resident led teaching. The confidence level in medical-surgical patient management rose 1.07 points in the attending led group and 1.46 points in the resident led group.
DISCUSSION/REFLECTION/LESSONS LEARNED: The results of the pretest scores reveal the poor initial knowledge residents and students possess regarding medical-surgical comanagement practice. Surgical comanagement accounts for nearly 30% of hospitalists practice. Peri-operative medical training remains underemphasized. Attendings had difficulty consistently finding time for organized teaching after rounds.
The senior residents had a more constant presence on the team, embraced the opportunity to teach and found the modules quick, efficient and easy to teach. Resident led teaching was equivalent to attending led teaching when a structured curriculum was developed for teaching purposes. Housestaffs confidence level rose a similar amount with attending vs resident teaching. The medical-surgical comanagement service offers a more limited curriculum than general internal medicine. It provides an opportunity for senior residents to take on the major teaching role using clinical scenarios and standard powerpoint teaching modules.
ONLINE RESOURCE URL (OPTIONAL):
A NOVEL USE OF QUALITY IMPROVEMENT (QI) TECHNIQUE: AN APPLICATION TO AN EDUCATIONAL DILEMMA Mily Joy Kannarkat 1;
Steven Kravet1. 1Johns Hopkins University, Baltimore, Maryland. (Tracking ID # 10677)
SETTING AND PARTICIPANTS: The Division of Geriatrics at Johns Hopkins University School of Medicine utilized the 2009 annual Geriatrics Retreat as a forum to gather stakeholders and address specific curricular challenges.
DESCRIPTION: Though traditionally utilized to revamp processes that will directly improve patient care, the steps of quality improvement can be considered directly analogous to the approach that educators take to solving dilemmas in curriculum development and implementation. During the Geriatrics Retreat, a faculty member with QI expertise facilitated discussion using the QI techniques of flow mapping, hazard analysis, and cause and effect (fishbone) diagram. This discussion, shaped by QI techniques, resulted in the identification and prioritization of key failure points to implementing the curriculum. Proposed curricular solutions aimed at these key failure points led to ongoing developments in 1) creation of a standard approach for identification of patients; 2) increased staff participation; 3) revision and clarification of clerkship objectives.
NEEDS AND OBJECTIVES: 1) To teach stakeholders of a required chronic disease and disability clerkship how to use and apply QI more broadly and 2) To utilize QI processes as a formal tool in addressing barriers to implementation of this curriculum.
EVALUATION: Informative, innovative, and productive were common thematic descriptions of the Retreat irrespective of the background of the participants.
DISCUSSION/REFLECTION/LESSONS LEARNED: Although traditionally used to focus on the root cause of problems in broken systems, quality improvement lends itself to medical education. Using QI techniques, we

were able to review available infrastructure, create a step-by step process, identify and evaluate failure points, and eventually propose curricular solutions.
ONLINE RESOURCE URL (OPTIONAL):
BARRIERS AND EDUCATIONAL SUCCESSES FROM A LEARNING COLLABORATIVE TO EDUCATE RURAL HEALTH CARE TEAMS AND RESIDENT LEARNERS ABOUT SHARED DECISION MAKING Kathleen Fairfield 1; Neil Korsen 2; Ruby Spicer 2; Lynn Doxey 3; Deborah Deatrick2. 1Maine Medical Center, Portland, Maine ; 2MaineHealth, Portland, Maine ; 3Mainehealth, Portland, Maine. (Tracking ID # 10724)
SETTING AND PARTICIPANTS: We are using existing infrastructure of an integrated health systems Learning Collaborative, training multi-disciplinary primary care teams to bring SDM into practice. Four practices are participating in the first phase of implementation. Two

sites have residencies in internal or family medicine. Each team includes a physician leader, administrative leader, and support staff. We carried out 20 in-depth semi-structured interviews across 4 sites, with a range of 38 respondents per site. The respondents included 7 physicians, 1 NP, 1 RN, 3 Health Educators, and 8 administrative or support staff.
DESCRIPTION: Our Learning Collaborative model engages with multi-discliplinary teams and trains them to include shared decision making routinely in processes of care. The training has included principles of SDM, identifying preference-sensitive conditions, use of decision aids in SDM, eliciting patient preferences and values, engaging health educators in SDM, and facilitating patients final decisions and self-management plans after viewing decision aids. Teams are encouraged to learn from each other and to share processes as they emerge. NEEDS AND OBJECTIVES: Engaging primary care practices in the use of decision aids for shared decision making (SDM) is difficult, particularly if they are rurally located, have resident learners, and have not had prior experience in shared decision making. Learning Objective 1: To describe barriers to implementation of SDM using a Learning Collaborative model to engage health care teams in SDM using decision aidsLearning Objective 2: To report educational successes from multidisciplinary teams engaged in this Collaborative.
EVALUATION: The most frequently cited barriers to implementing the SDM program were time requirements and impact on clinical flow. Because patients are expected to complete surveys before and after viewing decision aids, some respondents cited the surveys, which are seen as lengthy, and noted that literacy barriers restrict participation. Some sites expressed concerns about level of patient health literacy, particularly for immigrants. Some sites reported tactical concerns related to the ability to employ the decision aids, such as the availability of equipment and space limitations. The sites reported many successes as well, including that patients enjoy increased access to health information. One site actively involved the health educator on the team and found that this increased referrals for decision aids. Many respondents reported that patients have a greater sense of awareness of their choices and engagement in their care and health decisions.
DISCUSSION/REFLECTION/LESSONS LEARNED: Implementing SDM in primary care is challenging, because of such barriers as time and space in busy practice. Academic practices may have additional difficulty, due to the varied schedules of providers and because resident practices are enriched with non-English speaking patients. SDM was perceived to add value because patients are more actively involved in decisions about medical care. Supporting practices to offer SDM training and tools may result in greater engagement of SDM by providers and patients. Engaging health educators in this process may ease some of the burden of implementing SDM and improve patient acceptance and understanding.
ONLINE RESOURCE URL (OPTIONAL):
BEYOND RESIDENCY: A WEBSITE FOR THE ESSENTIALS OF CAREER PLANNING FOR RESIDENTS Julie R. Rosenbaum 1; Rina L. Garcia 1; Donna M. Windish1. 1Yale University School of Medicine, New Haven, Connecticut. (Tracking ID # 10734)
SETTING AND PARTICIPANTS: In 2003 faculty and chief residents in the Yale Primary Care Internal Medicine

Residency noted that residents had questions each year regarding career planning. Interested trainees and faculty developed a list of informational needs, which became the content outline for BR. We aimed to create a resource that would be easily accessible and updated. We combined links from other online educational resources with insights from recent graduates who
contributed their lessons learned. Over 4 years we developed content through an iterative process of presentations to residents and faculty. BR was initially launched in 2007 in the Department of Medicine and placed on the Yale Medical Library site. Initial users were Yale Primary Care, Traditional, and Medicine/Pediatric residents (N=164). DESCRIPTION: The website consists of 5 sections 1) Resume or CV? 2) Getting a Job, 3) Obtaining a Fellowship, 4) The Road Not Taken, and 5) Networking. The sections include links to outside resources like the American College of Physicians site for career counseling, timeline for the application process, job alert signups, and sites for licensing and certification. BR includes suggestions for interviewing and CV writing, including a template residents can use to start their own CVs. Important considerations for job applications include financial, practice, and legal issues. The Fellowship section includes a timeline, links to the NMRP site, and suggestions for successful application process. The Road Not Taken includes discussion of lesser known fellowship and job opportunities.
NEEDS AND OBJECTIVES: Few residencies have courses to prepare residents for careers after residency. We developed Beyond Residency (BR) to provide a unified online resource to help trainees determine career choices after residency and how to successfully obtain them. The objectives of the website were to: 1) improve access to existing resources for obtaining a job or fellowship, 2) increase knowledge about the timeline and requirements for application, and 3) decrease stress and improve satisfaction with the application process.
EVALUATION: In 2009 we began a controlled trial to evaluate the impact of the site on resident stress with career planning and satisfaction with the process. We exposed 3 of 7 Yale Affiliated Hospital medicine residency programs to BR in addition to the main Yale residencies. We developed an instrument to collect demographic data, what the resident applied for, what position was secured, and experience with the application process. The survey was sent electronically to recent graduates from Yale medicine residencies in June of 2009 and 2010, including sites that were and were not exposed to BR. Seventy-five residents (response rate=37%) completed the survey; only 15 reported use of BR. There were no differences in stress or satisfaction with the application process between residents who used BR compared to those who did not.
DISCUSSION/REFLECTION/LESSONS LEARNED: Although we did not find effects on stress or satisfaction from BR, problems accessing online tools may have played a major role as only a minority of residents reported using BR. Some reported issues finding the site and recalling the password. Difficulties contacting recent graduates for surveys were also noted. However, anecdotal evidence suggests that some residents found the centralization of career resources helpful. Further efforts at dissemination are underway.
ONLINE RESOURCE URL (OPTIONAL): http://www.beyondresidency.yale.edu
Web End =http://www.beyondresidency. http://www.beyondresidency.yale.edu
Web End =yale.edu
DEVELOPMENT OF A CURRICULUM ON TEACHING PRACTICE-BASED LEARNING AND IMPROVEMENT: A TRAIN THE TRAINER APPROACH Geoffrey Lamb 1; Jerome Van Ruiswyk 2; Barbara Connelly 3; Judith Rehm 1; Ann Morstad Boldt1. 1Medical College of Wisconsin, Milwaukee, Wisconsin ; 2Zablocki VA Medical Center, Milwaukee, Wisconsin ; 3Medical Colege of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 10748)
SETTING AND PARTICIPANTS: The course is sponsored through the office of Joint Clinical Quality and conducted at a large medical school encompassing 1450 faculty, 650 residents and 817 medical students. The campus includes an adult teaching hospital, a childrens hospital,

an inpatient mental health center and affiliated clinics. The course is offered to the clinical faculty at large on a once a year basis. The inaugural course was implemented in September, 2009. It was conducted as a half day session once a month for six months and incorporated an ongoing quality improvement project. Seven faculty completed the course including 3 pediatricians, 2 psychiatrists, a gynecologist and an internist. A second course began in September 2010 with 10 participants, including 2 Pediatricians, a Pediatric surgeon, a clinical psychologist and 6 Internal Medicine hospitalists. DESCRIPTION: Six modules were developed incorporating on-line instruction, lectures, readings, analysis of critical incidents and opportunity to practice teaching with students. Content relevant to patient safety/QI included medical error, root cause analysis, disclosure, quality improvement skills and measurement. Content relevant to teaching skills focused on learning styles, development of teaching scripts, bedside teaching, small group teaching and lectures. Products created include on-line educational modules, powerpoint presentations to support lecture material, evaluation tools and an instructors guide. The design allows each topic to be taught independently or as a component of a six month course. Projects completed during the inaugural session focused on handoffs, tracking medication problems in outpatient clinics, consistent use of time-outs before C-sections, teaching self care to asthma patients, and monitoring of metabolic effects of psychiatric drugs.
NEEDS AND OBJECTIVES: Practice based learning and improvement (PBLI) is one of six core competencies mandated by the ACGME. Unfortunately, faculty educated in the traditional system are poorly prepared to train the residents in the relevant skills, including principles of patient safety and quality improvement. There is a need to train faculty, not only to develop their own skills, but to teach these skills in clinical settings. The purpose of this project was to develop and implement a curriculum to train faculty how to incorporate principles of patient safety and quality improvement into their bedside teaching. Objectives:Teach faculty the basic content to develop their own expertise in safety and quality improvement;
Develop small group and bedside teaching skills;
Practice teaching safety/quality principles in a mentored setting; Assist in the development of relevant case scenarios to use in resident instruction;
Plan and implement a project.
EVALUATION: Evaluation incorporated pre and post tests on perceived skills, a multiple choice test of safety and quality improvement content knowledge and the QIKAT, a validated test of quality improvement process knowledge. Confidence in relevant skills were rated on a 5 point scale (1=no clue; 5=expert). Results are available from the first cohort of participants (n=7). QIKAT scores improved from a mean of 8.3 (range 114) to 9.4 (range 713), however this did not reach statistical significance. Similarly, results on a multiple choice test on safety and quality improvement knowledge improved from 73.4% to 83.9% but did not quite reach significance (p=0.09). However, participants confidence in their ability to initiate a quality improvement project (pre 2.3, post4.3; p=0.006) and their ability to teach QI/safety issues at the bedside (pre 2.9, post 4.1; p=0.002) improved substantially. DISCUSSION/REFLECTION/LESSONS LEARNED: We created a faculty development program using blended learning techniques to teach both content in patient safety/ quality improvement and teaching skills so as to enhance the teaching of this content at the bedside and in small groups. Participants significantly improved their confidence in their ability in these skill areas, but further evaluation is needed assess whether faculty completers are using the skills in actual teaching situations. Improvement on the QIKAT and the multiple choice test on
content did not achieve statistical significance but the n was small. Feedback from learners emphasized the need to master content knowledge before addressing teaching skills and the current version of the course has been restructured accordingly. Products created in support of the curriculum are intended to allow the program to be administered at multiple sites by instructors trained in the curriculum. ONLINE RESOURCE URL (OPTIONAL):
A WED-BASED MODULE ON NEUROBIOLOGY TO ENGAGE STUDENTS IN SUBSTANCE ABUSE

RESEARCH Andrea Truncali 1;
Colleen Gillespie 1; Joshua Lee 1; Stephen Ross 2; David Kerr 4; Laura Huben 4; Frederick More 3; Madeline Naegle 4; Adina Kalet 5; Marc Gourevitch1. 1NYU School of Medicine, New York, New York ;
2NYU School of Medicine, NY, New York ; 3NYU College of Dentistry, NY, New York ; 4NYU College of Nursing, NY, New York ; 5NYU School of Medicine, Brooklyn, New York. (Tracking ID # 10778)
SETTING AND PARTICIPANTS: All first-year medical students (n=172) were invited to complete the module as a supplement to their Neuroscience course addiction lecture. They received instructions for accessing the module by way of the Neuroscience course website. DESCRIPTION: The multimedia module features a case study of a cocaine-dependent man whose addictive behaviors are described and linked with associated neurobiology,including reward, cue development and executive dysfunction. It uses interactive animation, user-controlled video segments, and immediate feedback facilitated by the learning platform. Successful research faculty colleagues further discuss how basic science has advanced the understanding and treatment of addiction. Immediate pre-post-testing on 4-point Likert scales evaluated interest in SA, interest in general- and SA-focused research and perceived knowledge. Post-testing evaluated attitudes and module appeal. A -month post survey was conducted by email to assess longer-term impact.
NEEDS AND OBJECTIVES: There is a need to build the ranks of substance abuse (SA) researchers across health professions. We developed a web-based module, the Neurobiology of SA, as part of a NIDA-funded initiative to increase interest in SA research among nursing, dental and medical students. We aimed to foster students understanding of addictions physiologic basis and motivate interest in SA-focused research.
EVALUATION: 83 of 172 (48%) students voluntarily completed the module (92 pretest, 44 posttest). Prior exposure to SA treatment or research was reported as absent (45%), personal (20%),educational (31%), and clinical (13%). SA interest increased (29% pre to 45% post somewhat or very interested, p=.005). There was no change in anticipated career research involvement, but interest in conducting SA research specifically increased from 45 to 52% (p=.09). After the module, students endorsed somewhat or full understanding of how neurobiology research has shaped addiction treatment (73%), relationships between addiction and reward (81%), and pathways through which drug abuse affects decision making and inhibition (90%). SA attitudes were generally ambivalent. At 4 months (n=44), students endorsed enhanced interest in SA treatment (77% some or a lot), SA research (70%) and change in attitudes (75%), as well as improved understanding of related course material(89%) and exam performance(84%).
DISCUSSION/REFLECTION/LESSONS LEARNED: A web module on the neurobiology of SA offered to preclinical medical students with a baseline lack of interest in SA was readily integrated into existing course material and led to enhanced interest in SA and possibly motivation to conduct related research. The module deepened understanding of

related course material. Attitudes toward SA treatment were generally ambivalent post-module but may represent an improvement from baseline. Future study will assess impact among dental and nursing students.
ONLINE RESOURCE URL (OPTIONAL): http://chip.med.nyu.edu/
Web End =http://chip.med.nyu.edu/
USING STANDARDIZED PATIENTS TO EVALUATE RESIDENT SKILLS IN SCREENING AND BRIEF INTERVENTIONS FOR SUBSTANCE ABUSE IN THE PRIMARY CARE SETTING. Kathryn Treit 1; David Levitt 2; Elinore McCance-Katz 1; Gina Moreno-John 1; Patricia OSullivan 1; Jason Satterfield 1; Maria Wamsley1. 1UCSF Medical Center, San Francisco, California ; 2UCSF School of Medicine, San Francisco, California. (Tracking ID # 10792)
SETTING AND PARTICIPANTS: This project took place at a large academic residency training program. Prior to SBIRT curriculum implementation, 15 primary care internal medicine residents (PGY2/PGY3) participated in the SP evaluation. The SP exam took place at a training facility designed for observation of learners during

clinical skills exams. Actors were hired and trained in their specific roles as SPs. DESCRIPTION: The standardized patient exam consisted of 3 twenty-minute outpatient encounters representing typical clinic visits. Specific cases were as follows:*35 year-old man with risky alcohol use and paroxysmal atrial fibrillation.*39 year-old woman with low back pain and opiate misuse.*63 year-old woman with depression and an alcohol use disorder. Cases evaluated the following substance use competencies:*Screening for substance use and taking a substance abuse history. *Accurate assessment of risky use and substance use disorders.*Brief interventions to address substance use.*Appropriate referral for substance use disorders.*Effective communication with patients regarding substance useNEEDS AND OBJECTIVES: It is widely recognized that screening and brief intervention for substance use disorders are lacking in primary care settings. Barriers include physician reluctance to address substance abuse, negative attitudes towards substance abusing patients, lack of confidence and inadequate skills. In order to address this deficiency, we are implementing a Screening, Brief Intervention and Referral to Treatment (SBIRT) curriculum for primary care internal medicine residents. To measure the impact of our curriculum, we propose using a standardized patient (SP) evaluation. The objective of this project is to determine baseline SBIRT skills for residents prior to implementation of the SBIRT curriculum from an SP evaluation. EVALUATION: SPs evaluated residents using case-specific checklists that include history (HX), information sharing (IS), and patient-physician interaction (PPI) items. Residents received an average of 79 (sd=16) in history, 67 (sd=12) in information sharing and 69 (sd=6) in physician patient interaction. Residents completed a post-exercise survey indicating that they did feel it was a valuable experience (3.67/5). Residents attended a faculty-run debriefing session. Each resident SP encounter was videotaped and reviewed by residency faculty. Following the exercise, residents met individually with faculty to receive direct feedback on SBIRT skills.
DISCUSSION/REFLECTION/LESSONS LEARNED: Substance use disorders are ubiquitous in primary care settings and physicians receive inadequate training in managing these disorders. Internal medicine residents demonstrated a baseline performance on the SP evaluation that indicated room for improvement in SBIRT skills. Residents reported highest levels of confidence in screening patients for alcohol and drugs, but felt less confident making treatment plans for patients with substance use disorders. Resident evaluation scores also indicate a lack of skill in developing treatment plans for individuals with substance
use disorders. Effective curricula should address SBIRT skills and confidence in managing substance use disorders, specifically focusing on the establishment of treatment plans. Our baseline data suggest that SP assessments can be used to assess SBIRT competencies in residents and may be useful in determining specific areas for individual resident improvement.
ONLINE RESOURCE URL (OPTIONAL):
INTERNAL MEDICINE MENTORSHIP EVALUATION (IMMENSE) Shanu Gupta 1; Kamran Mahmood 1; Hany Abdelmalak 1; Joseph Abraham 1; Rohitkumar Vasa 1; Pravin Muniyappa 1; Kamal Eldeirawi 2; Steven Potts1. 1Mercy Hospital and Medical Center, Chicago, Illinois ; 2University of Illinois at Chicago, Chicago, Illinois. (Tracking ID # 10824)
SETTING AND PARTICIPANTS: This study was performed in the Internal Medicine ResidencyProgram of the Mercy Hospital and Medical Center during 20092010. The participants were the incoming class, which consisted of sixteen interns, all graduates of foreign medical schools.
DESCRIPTION: We randomly divided our 16 incoming class trainees into two groupsthe first group of 8 interns was assigned a mentor, and the second group of 8 interns had no mentor for the first 6 months. Their expectations of mentorship, in addition to their general background information, were evaluated via a questionnaire at the beginning of the year. After 6 months, the groups were switched so that the group previously receiving mentorship no longer had a mentor, and the group who were without a mentor in the first 6 months, were assigned to a mentor. The experience and value of mentorship were again evaluated via a standardized questionnaire for both groups. The mentors were given specific instructions on providing a mentor-

mentee relationship, and were asked to evaluate their interns at the beginning and end of the mentoring period. The progress of the interns was followed using these records. NEEDS AND OBJECTIVES: The role of mentorship is well recognized in the development process of an internal medicine trainee. Although an important part of training, mentorship programs are not uniformly mandated through all residency programs. In an effort to introduce a formal mentoring process in our program, we studied the specific relationship between mentors and mentees in a community program consisting mainly of international medical graduates (IMG). Our objectives were to evaluate the role of mentorship in: Resident development; IMG-specific issues; Resident comfort with post-graduate education; Resident decisions on post-residency education (fellowship) versus working in primary care or as a hospitalist.To the best of our knowledge, this is the first such study performed in a community program catering to IMGs.
EVALUATION: All 16 interns participated in and completed the study, 4 of whom were women and 12 men. Their ages ranged from 25 to 38. Although full analysis of the results is pending, review of the initial surveys reveal a unanimous interest in mentorship, with a particular interest in having a mentor that would impact professionally. In the first half of the study, all 8 participants provided positive feedbacks of their experiences. There was an improvement in communication skills, with a better understanding of healthcare policy and business. The drive for fellowship remained the same, with 7 out of 8 interns planning to pursue this. The expectations from mentors changed, from a career guide to a personal associate. The second group also showed an improved knowledge of healthcare policy and business after meeting with their mentors. The desire for fellowship decreased from 7 to 6 interns. The interest in a hospitalist career increased from 5 to 6 interns.

DISCUSSION/REFLECTION/LESSONS LEARNED: Mentoring is clearly an important component of resident education. Our evaluation of perceptions of mentorship by IMGs, and of their experience with it has provided interesting points for discussion. We find that mentorship is certainly an important social factor, which may benefit IMGs in terms of communication skills and cultural awareness. However, it would seem that these factors may be of benefit only in the very early stages of the intern year. Thereafter, career guidance seems to be more important. Providing an organized mentorship program for incoming interns would be a beneficial tool in the overall development of the resident.
ONLINE RESOURCE URL (OPTIONAL):
CONTRACT-BASED LEARNING AS AN APPROACH TO IMPLEMENTING COMPETENCY BASED TRAINING IN PRE-CLINICAL INTRODUCTION TO CLINICAL MEDICINE COURSES John F. Wilson 1; David Rudy1. 1University of Kentucky College of Medicine, Lexington, Kentucky. (Tracking ID # 10902)
SETTING AND PARTICIPANTS: The setting is year one of medical school and participants are 115 first year medical students and 30 clinical and behavioral preceptors.
DESCRIPTION: ICM is an 11 credit, year long small group course for M1 students. ICM focuses on basic and applied interviewing, professionalism and medical ethics, applied topics such as grief, pain, and addiction; The course blends small group, on-line learning modules, independent study, and clinical placements. Assessment is through an extensive on-line portfolio. Students contract for a grade through a variety of contact options. The learning contracts are designed to focus on application and synthesis dimensions of Blooms taxonomy. Each small group of eight students has a clinical and a behavioral preceptor. All course materials and assessment takes place through a single web portal. Each student has a personal WIKI page accessible to them and their preceptor, who provides blog style feedback, allowing for evaluation and dialogue.
NEEDS AND OBJECTIVES: Introduction to Clinical Medicine (ICM) courses often do not easily fit into the curricular structure of the basic science years in medical school. MCQ examinations, lecture based educational formats and the increasing pressures on clinicians teaching time are barriers to effective implementation of

competency based learning in doctoring courses. Our objective was to use a contract based learning model to implement a competency based and portfolio assessed introduction to clinical medicine course for M1 students. Contract based approaches are noted for their emphasis on fluid rather than fixed curricula, challenge rather than threat motivation, active rather than passive learning, and a focus on questions rather than answers. EVALUATION: The usefulness of contract-based teaching is illustrated through discussion of six course elements:(1) Training in interviewing includes actor-patient simulations, learning labs with cycles of practice followed by coaching, formal self-assessments, and preceptor feedback.(2) Required and elective continuing medical education credits model life-long learning.(3) Diverse topics such as Medical humanities , Service Learning, and student-designed learning activities.(4) Clinical placements introduce students to interprofessional education and team based clinical work.(5) Small group seminars on grief, loss, pain, suffering, and addiction emphasize skill learning and formation of professional attitudes.(6) A focus on written portfolio entries with blog-style preceptor feedback and formative or coaching based skill assessments move toward higher order Bloom objectives.
DISCUSSION/REFLECTION/LESSONS LEARNED: Advantages and practical problems about contract based learning are discussed and illustrated through use of student evaluations, quality assurance materials, student outcomes, and examples of portfolio entries. Issues related to faculty development of preceptors, creation and maintenance of clinical experience sites suitable for M1 students, and approaches to nurturing inter-professional involvement in the training program are discussed. The use of contract based learning to efficiently use clinician time, provide a flexible course infrastructure easily adapted to changing resources, and to promote higher order learning objectives is described. ONLINE RESOURCE URL (OPTIONAL):
MASTERY LEARNING OF ORAL CASE PRESENTATIONS: E-LEARNING AND DELIBERATE PRACTICE
Heather Heiman 1; Toshiko Uchida 1; John Butter 1; Craig Adams 1; Gary Martin1. 1Northwestern University Feinberg School of Medicine, Chicago, Illinois. (Tracking ID # 10918)
SETTING AND PARTICIPANTS: We designed a waitlist-control study in which second-year students in the class of 2013 are randomized to receive instruction in oral presentations in the fall or in the spring. When not learning oral presentations, they receive a written presentations curriculum. The universitys IRB judged this project to be exempt. Classes are divided into 4 colleges, which are cluster-randomized such that two colleges constitute the intervention group and two the control. All students are required to take both curricula, but they may elect not to contribute data to the study. Of 168 students, 161 consented. Data is being collected at baseline, after the intervention group receives the curriculum, and after both groups have received the curriculum. The class of 2012 (n=165) took the assessment to function as a historical control. M4 students on a teaching selective assist with oral presentations practice, and a separate group of M4 students function as raters. DESCRIPTION: The curriculum consists of an on-line module followed by deliberate practice. We created a 2-hour interactive module using e-learning software (Articulate). In the module, students watch a faculty member interview and examine a patient with vertigo. In segments, they watch her demonstrate a poor presentation, answer questions about her deficits, and then watch a gold standard oral presentation. They repeat this process for a full oral presentation of a second case. For deliberate practice, we developed two cases with video interviews and written physical examinations. Students deliver a presentation of Case A to an M4 student who gives detailed feedback according to a specific checklist. Students then watch the video of their Case A oral presentation, edit their Case B oral presentation and then present Case B to the same M4 student, again receiving detailed feedback.
NEEDS AND OBJECTIVES: The oral case presentation is a critical clinical skill. It is a chief means of interprofessional communication and a primary tool for evaluating students clinical reasoning. Nationally, students express confusion about expectations for presentations, and there are few published curricula. We aimed to develop an intensive 2nd-year student curriculum for mastery learning of oral case presentations. In mastery learning, students practice a task until they demonstrate or exceed a fixed standard of competence. All

learners achieve competence, but the practice time needed varies. Our specific objectives were to 1)create an intensive curriculum with deliberate practice of oral case presentations 2)develop standardized cases for assessment 3)set mastery learning standards for each case using an expert panel 4)demonstrate that the curriculum improves performance5)determine if students who fail can achieve competence via additional practice.
EVALUATION: We developed six assessment cases consisting of video interviews and written physical exams about a broad range of chief

concerns. We used rigorous methods to develop a generic checklist and a specific checklist for each case including content and style criteria. Trained M4 student raters evaluate presentations on video. For the historical controls, mean checklist scores for the six cases ranged from 62-71%. A panel of 10 experts met to determine mastery standards for each case. Assessments for the class of 2013 are being rated. Students in the intervention used a Likert scale to rate the educational quality of the curriculum (1=poor,2=fair, 3=good, 4=very good, 5=excellent). The overall curriculum was rated 4.0 (90% response rate). Using a 5-point scale with 1=strongly disagree and 5=strongly agree, students reported feeling more prepared to do a presentation after the curriculum (4.3).
DISCUSSION/REFLECTION/LESSONS LEARNED: We addressed a curricular need by creating a 4-hour mastery learning curriculum with e-learning and deliberate practice. We developed rigorous checklists and set standards for competency. Because it is on-line and integrates with a fully-developed M4 student teaching selective, the curriculum will be sustainable. We are finalizing minimum passing scores for each case; students not meeting the standard will engage in more practice and reassessment until they demonstrate mastery. Students rated the curriculum favorably. Critiques included the length of the on-line module and some difficulties navigating between slides. We are now assessing inter-rater reliability of the checklists. Initially, while most items showed good agreement between raters, items judging speech/ style did not. We eliminated two of these items and improved rater training on the others. Rating of baseline and post-curriculum data is ongoing.
ONLINE RESOURCE URL (OPTIONAL): http://simulation.northwestern.edu/elm/oralcase/player.html
Web End =http://simulation.northwestern. http://simulation.northwestern.edu/elm/oralcase/player.html
Web End =edu/elm/oralcase/player.html

IMPROVING MEDICAL STUDENT PHYSICAL DIAGNOSIS SKILLS AT BROWN MEDICAL SCHOOL Joseph Rabatin 1; Joseph Rabatin 2; andrew moraco 1; adam vasconcellos1. 1Alpert Medical School of Brown University, Providence, Rhode Island ; 2Alpert Medical School of Brown Universiyt, Providence, Rhode Island. (Tracking ID # 10924)
SETTING AND PARTICIPANTS: 30 third year medical students at four hospitals affiliated with the Alpert Medical School of Brown University were sent a four item email survey.
DESCRIPTION: The survey asked about 18 physical findings including goiter, aortic stenosis murmur, mitral regurgitation murmur, cardiac rub, jugular venous distension, S3 heart sound, clubbing, shifting dullness, hepatomegaly, asterixis, jaundice, palmar erythema, stiff neck, chest wall dullness to percussion, assymetric deep tendon reflexes, clonus and ulcerated skin lesions. They were asked about their experience with each finding, their confidence with each finding and their understanding of the disease association with each finding. The survey was repeated six weeks later with the hope that the initial survey would serve to trigger their interest and encourage their learing. We also asked if students learned on their own or were taught by others. NEEDS AND OBJECTIVES: Despite the importance of physical exam skills, research shows diminished confidence among medical students and falling rates of beside teaching. No published research has described the effect of peer encouragement for self-directed learning of physical diagnosis skills. We performed a pilot of a 30 student cohort during 20092010 academic year. We hoped to discover if peer encouragement by email would improve the reported physical diagnosis skills of third year medical students during their medicine clerkships.

EVALUATION: We had a 57% response rate to the first survey and a 53% response to the second survey. About half of the students (54%) reported learing the findings on their own rather than being taught by others. Student knowledge improved by 7% from survey 1 to 2 and they were able to see 9% more findings by the second survey. DISCUSSION/REFLECTION/LESSONS LEARNED: Based on this small sample pilot, we are expanding the survey to four medical schools to see if our discovery that most third year medical students on their internal medicine clerkship will learn on their own and are encouraged by peer-driven email to aquire physical diagnosis skills. We will survey a control group of students to see if our encouragement is a valid intervention.
ONLINE RESOURCE URL (OPTIONAL):
A COURSE ON COMICS AND MEDICINE FOR 4TH YEAR MEDICAL STUDENTS Michael Jay Green 1; Michael Jay Green1. 1Penn State College of Medicine, Hershey, Pennsylvania. (Tracking ID # 11002)
SETTING AND PARTICIPANTS: At Penn State College of Medicine in Hershey, PA, all medical students are required to register for a Humanities elective during their 4th year of study. This course was offered as 1 of 16 such electives. Over a two-year period, 16 students enrolled in the 4-week course. Students had no clinical or other academic responsibilities during this month.
DESCRIPTION: The course was taught seminar style, and met twice per week for 3 hours per session. Using various graphic stories as examples, students learned how images and text are used synergistically to communicate complex narratives. Topics included: overview of comics and medicine; elements of storytelling; how pictures work; point of view; drafting a script; dialogue and transitions; social context of medicine; and final presentations. During the course, students not only learned about how comics are relevant to the practice of medicine, but they also created their own graphic stories that illustrated memorable encounters with patients or other aspects of their professional development. NEEDS AND OBJECTIVES: While comics increasingly address serious medical themes from life with a chronically ill sibling (Epileptic by David B) to the experience of cancer (CancerVixen by Marisa Acocella Marchetto) this medium has not been used for teaching medical students to better appreciate patients experience of illness. The goals of this course were to use sequential graphic stories (or comics) to enhance students observational and communication skills, to promote empathy for others narratives, and to provide a creative outlet to express their personal growth and professional development.
EVALUATION: Pre- and post-course attitudes and skills were compared using a 5-point Likert-style scale (1 = strongly disagree, 5 = strongly agree). Outcomes of interest included whether students felt the course was relevant to their medical education, whether creating a graphic story could make them a better doctor, and whether doing so improved various skills (e.g. writing, drawing, communication, diagnosis, clinical reasoning, observation, empathy, awareness of physician bias, and interpretation ofinformation). Qualitative comments about the strengths and limitations of the course were also elicited from students.
DISCUSSION/REFLECTION/LESSONS LEARNED: Medical students who enrolled in this course on comics and medicine reported a significant improvement ($p<0.05$) over baseline in their writing skills, verbal communication skills, nonverbal communication skills, communication with patients, communication with colleagues, observational skills, awareness of physician bias, and ability to interpret information. They also reported that creating a graphic story helped them become better doctors. Reviews of the course were overwhelmingly positive, and students particularly appreciated the opportunity to reflect on their experiences as developing professionals through creative self-expression. Too often, medical school pedagogy presumes students are empty

vessels needing to be filled with knowledge and experience. Such an orientation not only disregards students

pre-existing competencies, but also squelches creativity. Empowering students to appreciate and create comics helps counter this trend.
ONLINE RESOURCE URL (OPTIONAL):
http://pennstatehershey.org/web/humanities/home/resources/comicbook
Web End =http://pennstatehershey.org/
http://pennstatehershey.org/web/humanities/home/resources/comicbook
Web End =web/humanities/home/resources/comicbook
HEALTH IMPACTS OF WAR: AN EDUCATIONAL CAMPAIGN FOR VA PROVIDERS Stephen C Hunt 1; Lucille Burgo-Black2. 1VA Puget Sound, Seattle, Washington ; 2VA Connecticut Healthcare System, West Haven, Connecticut. (Tracking ID # 11125)
SETTING AND PARTICIPANTS: The conflicts in Iraq and Afghanistan have exposed combat Veterans to risks such as physical injury (including traumatic brain injury from blast wave exposure), psychological trauma, environmental agent exposure and numerous psychosocial stressors potentially impacting financial, social and family life. A broad spectrum of mental health conditions and psychosocial difficulties are common among these Veterans : clinical lpresentations involve complex combinations of physical and mental health symptoms and conditions and a variety of psychosocial concerns that vary widely from Veteran to Veteran. A VA-wide education and training campaign collaboratively created and implemented by all of the programs and disciplines involved in post-combat care (primary care, mental health, social work, rehabilitation services, addictions services and pain management) was created and implemeneted to educate and train on topics of post-combat care the 300,000 VA employees, working in the 152 hospitals and 784 clinics nation-wide.
DESCRIPTION: The post-combat care education and training campaign addressed these topics: military culture and the challenges of deployment, health risks in the combat environment, health concerns of returning combat Veterans, models for providing intgrated post-combat care and VA services and benefits available to returning combat Veterans and their family members.
The educational strategy included: creation of a multidisciplinary leaderships group; establishing best practices; conducting national, regional and local trainings: educating leadership at all levels; designating clinical champions; promoting best practices through directives/trainings/funding incentives, developing trainings and materials through VA education services and centers of excellence; conducting community of practice conference calls.
Given that half of these Veterans are either seen outside of the VA or are receiving no health care at all, outreach and interagency collaboration was an integral aspect of the educational campaign. NEEDS AND OBJECTIVES: The one million Veterans who have separated from the military after serving in Iraq and Afghanistan have unique health care needs that must be effectively addressed to insure successful readjustment and reintegration following the war. Creating and implementing models of care, putting appropriate resources in place and educating VA providers in post-combat care is a central component of the VA mission. Resources and services in VA prior to the 2003 outbreak of these conflicts were not entirely aligned with the needs of these Veterans. VA undertook a nation-wide program to educate providers (multi-disciplinary teams of primary care, mental health and social work providers) in how to provide effective primary care based post-combat care . Topics included military culture, deployment, health risks of combat (physical, mental health and psychosocial, health care needs of returning combat Veterans and models of care for meeting the needs of returning combat Veterans and their families that are consistent with the new VA medical home model of care delivery: Patient Aligned Care Teams or PACT.
EVALUATION: The effectiveness of the VA post-combat care education and training campaign has been measured in a number of ways. Data extracted from surveys conducted by VA Primary Care Services in 2009, the VA Mental Health Primary Care Integration Program in 2010 and a QuERI (Quality Enhancement Research Initiative) implementation study completed in 2010 has been used to monitor the implementation of integrated

post-combat care programs in VA medical centers around the country. Clinical monitors and national data bases such as VSSC (VHA Support Service Center for clinical data) have been used to measure and assess in an ongoing manner critical screening and surveillance measures related to post-comgat care. Regularly scheduled focus groups and surveys have provided ongoing information on Veterans satisfaction with services and care they are receiving.
DISCUSSION/REFLECTION/LESSONS LEARNED: Training VA stafff to provide optimal care for returning combat Veterans required a rapid and ongoing dissemination of unique and continuously evolving content- and process-specific information related to the health concerns of returning cmobat Veterans as well as to strategies for creating and sustaining integrated service delivery platforms for this population. An integrated agency-wide approach was essential . The presentation will describe the scope of the health care needs of this population, the education/training programs implemented to insure that these needs were effectively addressed both within the VA system and in the community at large, and ongoing education efforts necessary to mitigate downstream health impairments and optimize the long-term function and well being of these Veterans and their families. Key elements, critical challenges, obstacles encountered and lessons learned will be summarized. This educational campaign and the strategies utilized have potential relevance for other patient cohorts and health care settings.
ONLINE RESOURCE URL (OPTIONAL):
A RESIDENT-DRIVEN APPROACH TO SYSTEMS-BASED PRACTICE EDUCATION AND INNOVATION AT A PRIMARY CARE MEDICINE AMBULATORY TEACHING CLINIC Allison Stark 1; Ari Kriegsman 1; Hillary Kunins 1; Joseph Deluca1. 1Montefiore Medical Center, Bronx, New York. (Tracking ID # 11233)
SETTING AND PARTICIPANTS: The continuity clinic of the Primary Care and Social Internal Medicine Residency Program at Montefiore Medical Center is located at the Comprehensive Health Care Center (CHCC), a multi-disciplinary Federally Qualified Health Center in an indigent neighborhood in the South Bronx. CHCC is the sole ambulatory site for thirty residents (PGY1-3), one chief resident (PGY4) and 18 attending physicians. CHCC is one of 22 Montefiore Medical Center ambulatory sites and is targeted for inclusion in the institutional effort to obtain PCMH certification.
DESCRIPTION: During the academic year 20102011 we initiated an iterative educational process to engage residents in a dialogue about SBP. An anonymous web-based survey was sent to all 19 PGY2 and 3 residents asking them how they would handle four common clinical scenarios that occur when the resident is not in clinic or between patients clinic visits: (1) following up of critical lab values; (2) scheduling non-routine follow-up appointments; (3) handling urgent care situations when patients call from home; and (4) titrating medications. Each scenario was derived from our clinical experience and piloted with colleagues prior to survey distribution. Results were analyzed and a set of best practices was created. At a program-wide retreat attended by approximately 25 residents and faculty we moderated a two-hour discussion on the survey results, best practices and other SBP topics

identified. A second anonymous survey was sent to the same 19 residents assessing the value of monthly SBP meetings.
NEEDS AND OBJECTIVES: Although the Accreditation Council for Graduate Medical Education (ACGME) requires physicians-in-training to achieve proficiency in Systems-based Practice (SBP), one of six domains of physician competency, few effective training methods have been described. The ACGME defines SBP as the ability to identify, evaluate and utilize health care system resources to provide optimal care. SBP is especially important in internal medicine residency programs, where residents have fragmented schedules and competing commitments. The emergence of the Patient Centered Medical Home (PCMH) model, with its emphasis on optimizing resources and team based care, presents an opportunity to engage residents in SBP while fulfilling ACGME educational objectives and improving patient care. To this end, we designed and implemented a

resident-driven educational program to improve resident competency in SBP, and provide an ongoing forum for discussion, education and innovation at our ambulatory teaching clinic.
EVALUATION: Seventy-four percent (14/19) of residents responded to the initial survey, with up to 5 solutions given for each scenario. Responses varied by the skill level of the clinic staff member asked to assist with the task, the number of phone calls, emails, and hand-offs required, and the time needed for task completion. Given the heterogeneity of responses a set of best practices, emphasizing non-physician resources, was created and disseminated. Our second survey used a 5-point Likert scale (5=Quite Valuable, 1=No Value) to quantify the value of monthly SBP discussions. One hundred percent (14/14) of responders reported that sessions would be valuable or quite valuable. We then initiated monthly discussions (6075 minutes) during ambulatory blocks (48 residents/month). To date we have held two sessions. Prior to each session we solicit SBP topics and distribute a resident derived agenda. Afterwards, we email key takeaway points and post updates on our programs searchable website. DISCUSSION/REFLECTION/LESSONS LEARNED: The development of a resident-driven process to address SBP is feasible, meets ACGME requirements, and provides an opportunity to optimize care at a primary care teaching clinic. Through our program, residents learn about the elements of SBP, collectively evaluate clinic processes, assume a stakeholder role in the functioning of their clinic, and facilitate the improvement of patient care. Our iterative process allows us to craft agendas for monthly SBP meetings based on real-time issues as defined by residents. These have included the making and tracking of timely referrals, incorporating non-MD providers into the management of chronic diseases, planning for the electronic medical record, and effectively managing and communicating with patients between visits. We have found that our residents are invested in SBP and are eager to engage in discussions to evaluate systems and implement change. The process will become increasingly beneficial as our clinic evolves into a certified PCMH.
ONLINE RESOURCE URL (OPTIONAL):
EFFECT OF A PAIN MANAGEMENT CURRICULUM ON RESIDENTS CONFIDENCE AND ATTITUDES Aaron Fox 1; Hillary V Kunins 2; Joanna L Starrels1. 1Division of General Internal Medicine, Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, New York ;
2Department of Family and Social Medicine, Montefiore Medical Center/ Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 11239)
SETTING AND PARTICIPANTS: Our intervention targeted 29 internal medicine residents in all 3 years of the Primary Care and Social Medicine (PCSM) residency program at Montefiore Medical Center in the Bronx, NY (intervention group). The PCSM program trains 10 residents per year and focuses on ambulatory medicine in indigent urban settings. Prior to the intervention, PCSM residents received three lectures in physical exam and diagnosis of musculoskeletal disorders (knee, shoulder, and ankle) and one session on management of chronic pain. In Montefiores categorical internal medicine residency program (comparison group) residents received a similar curriculum and did not take part in the educational intervention.
DESCRIPTION: The curriculum commenced in October 2009 and was led by faculty in general internal medicine and geriatrics. It included 14 didactic and skills practice sessions distributed throughout the three years of training: 1. Introduction to Chronic Pain: Guidelines and Psychosocial Context (one session); 2. Common Pain Syndromes (back/ neck, knee, shoulder, hip, wrist/elbow, and ankle/foot) (six sessions); 3. Therapeutic Joint Injection (one session); 4. Non-pharmacologic Treatments for Pain (one session); 5. Opioid Pharmacology (one session); 6. Opioid Risk Management: Opioid Treatment Agreements and Interpretation of Urine Drug Testing (two sessions); and 7. Racial Disparities in Pain (one session). Residents also took part in a group skills practice session with a standardized patient, focused on negotiating an opioid treatment agreement and responding to aberrant drug related behaviors.
NEEDS AND OBJECTIVES: Up to one-third of primary care patients suffer from chronic non-cancer pain (CNCP), accounting for approximately 10% of ambulatory visits. However, internal medicine residents report a lack of training and confidence in treating CNCP, and find it less rewarding than treating other chronic

conditions. We developed an innovative pain management curriculum with the objectives of improving whether residents felt confident and prepared to diagnose and treat CNCP. In addition to evaluating confidence and preparation, we hypothesized that participation in the curriculum would be associated with change in residents attitudes toward pain management, specifically that managing CNCP would become less of a burden on time, less difficult and more rewarding.
EVALUATION: First and second year residents were surveyed via email one month before curriculum inception and 12 months later. Using a 5-point Likert Scale, the survey assessed confidence, preparation, and attitudes with regard to treatment of CNCP. Of 19 PCSM residents, 14 (74%) completed both surveys. Of 76 categorical residents, 18 (24%) completed both surveys and comprise the comparison group. For each group, we analyzed pre- to post-intervention changes using paired T-tests. Among PCSM residents, confidence in and preparation for managing CNCP increased significantly. Prior to the intervention, only 2/14 residents agreed that they were prepared to manage CNCP; this increased to 9/14 after the intervention. There were no significant changes in perception of difficulty, reward, or time required to manage CNCP. Before and after the intervention, residents reported that managing CNCP was difficult, unrewarding, and time-consuming. There were no significant changes in the comparison group. DISCUSSION/REFLECTION/LESSONS LEARNED: Confidence in and preparation for managing chronic non-cancer pain improved one year into our innovative pain management curriculum, but residents continued to find management of CNCP difficult, time consuming, and unrewarding and on average still lacked confidence. Informal resident feedback has suggested reasons for our limited impact in these domains. Residents report busy clinic sessions and varying approaches to CNCP among precepting faculty, but our intervention did not address these systems-level barriers. We have since expanded faculty development in management of CNCP, created a primary care based pain management clinic in which residents will have additional time with their pain patients, and are developing a clinic-wide policy on opioid prescription. Future evaluations will help to identify successful

components of our curriculum that might be replicated in other institutions.
ONLINE RESOURCE URL (OPTIONAL):
AN INTERPROFESSIONAL STANDARDIZED PATIENT EXERCISE IMPROVES ATTITUDES TOWARDS TEAM CARE
Jennifer Staves 1; Mehran Hossaini 2; Lisa Kroon 3; Caroline Lindsay 3; Barbara Newlin 4; Bridget OBrien 1; Kimberly Topp 1; Maria Wamsley1. 1University of California, San Francisco School of Medicine, San Francisco, California ; 2University of California, San Francisco School of Dentistry, San Francisco, California ; 3University of California, San Francisco School of Pharmacy, San Francisco, California ; 4University of California, San Francisco School of Nursing, San Francisco, California. (Tracking ID # 11244)
SETTING AND PARTICIPANTS: In 20092010, 101 second- and third-year students (23 dental, 26 medical, 21 nursing, 24 pharmacy, and 7 physical therapy) participated in the ISPE that was held 6 times at the Clinical Skills Center at our University. Participants were assigned to interprofessional teams of 45 students. One faculty member from each professional school was present at the ISPE, observing teams and leading a debriefing session.
DESCRIPTION: We created the case of Paul Harris, a standardized patient (SP) with complex chronic medical conditions. During the 4-hour exercise, students were divided into interprofessional teams. Each student individually interviewed the SP while team members observed remotely. The team then gathered to develop a joint care plan. The exercise concluded with a faculty-led debriefing session in which students reflected on the interprofessional experience.
NEEDS AND OBJECTIVES: Interprofessional education (IPE) is recognized as a valuable means of enhancing

communication and collaboration between healthcare professionals. To maximize the benefits of IPE, interventions should emphasize active collaboration between students, reflect authentic clinical settings and roles of participants, and be rigorously evaluated using validated outcome measures. With these needs in mind, we developed and implemented an Interprofessional Standardized Patient Exercise (ISPE) for students from the Schools of Dentistry, Medicine, Nursing, Pharmacy, and Physical Therapy. The goals of the ISPE are to:1. Enhance knowledge of other healthcare professionals roles2. Foster collaboration in patient management3. Improve communication skills with other healthcare professionals EVALUATION: We evaluated students attitudes toward interprofessional team-based care by administering the Attitudes Toward Health Care Teams validated survey to students pre- and post-ISPE. Students attitudes improved on 2 of the 3 subscales of the survey (which uses a 6-point Likert Scale): Team Value (pre-mean=4.87, SD=.50, post-mean=5.13, SD=.53, p<.001) and Team Efficiency (pre-mean=4.41, SD=.64, post-mean=4.72, SD=.64, p<.001). Attitudes toward Physicians Shared Role in interprofessional teams did not change significantly (p=.29). We also surveyed students and faculty about their satisfaction with the ISPE, which was high; faculty would recommend the exercise for students in their profession (mean=5.67 on a 6-point scale, SD=1.05) and students would recommend the ISPE to a fellow student (mean=5.34, SD=.89). Perceived achievement of the goals of the ISPE was evaluated through focus groups, in which students across all schools reported appreciation for learning about other professions. DISCUSSION/REFLECTION/LESSONS LEARNED: We successfully developed and implemented an ISPE for students from 5 health professions. The ISPE was well received by student and faculty participants. Attitudes towards interprofessional teams improved in some, but not all areas after the ISPE. The findings from this ISPE
contribute to the growing body of literature on efforts to generate positive attitudes toward interprofessional collaboration early in training, which may influence students ability and willingness to be active and effective members of healthcare teams in their future careers. ONLINE RESOURCE URL (OPTIONAL):

DEVELOPING A BOTANICAL MEDICINE CURRICULUM FOR MEDICINE RESIDENTS: A NEEDS ASSESSMENT OF KNOWLEDGE, CONFIDENCE, AND COMMUNICATION

Miriam Rahav 1; Miriam Rahav 2; Sharon Leung 3; Darlene LeFrancois3. 1Montefiore Medical Center, New York, New York ; 2Montefiore Medical Center, Bronx, New York ; 3Montefiore Medical Center and Albert Einstein College of Medicine, Bronx, New York. (Tracking ID # 11252)

SETTING AND PARTICIPANTS: Our very large training program (including 114 categorical HS) is located in one of the five poorest Congressional Districts in the U.S., but its wide variety of neighborhoods also includes affluent areas. Residents therefore care for people of all races, with an extensive variety of conditions, psychosocial backgrounds, and resources. Our patients also represent a diverse spectrum of beliefs on health and healthcare. The Botanical Medicine (BM) curriculum will be initiated with all PGY2 categorical residents rotating on their ambulatory month (ACR). This month traditionally incorporates the essential biomedical, behavioral, and epidemiologic elements of a sound ambulatory practice, supporting residents role as primary care providers to our diverse population. The BM curriculum will be divided into a traditional lecture format as well as 5 short modules to be completed online during ACR. The online modules will have links to resources for further self-study.

DESCRIPTION: All categorical interns (n=38) and residents (n=76) were invited to participate in an online adaptation of a previously validated survey by K. Kemper at Wake Forest University. The survey evaluated participant demographics and exposure to BM in addition to the 3 domains of knowledge, confidence and communication practice. Knowledge score (0-100%) was generated as percent of the knowledge questions answered correctly. Confidence score (range 1470) was derived from responses to 14 Likert scale questions with 1 indicating strongly disagree to 5, strongly agree. Communication practice (CP) score (range 010) derived from nine items scored as a proportion corresponding to the percentage chosen (0.0 to 1.0); and two yes-no items that were scored as 0.5 for yes and 0 for no. Values were expressed as medians and interquartile range

(IQR). Univariate and multivariate linear regression (MLR) was performed, a two-sided P <.05 was considered statistically significant.
NEEDS AND OBJECTIVES: Complementary and alternative medicine (CAM) comprises a diverse set of healing modalities. CAM has grown in the last decade with 2007 estimates placing CAM use prevalence at 38% of U.S. adults; tallying $34 billion in national expenditures. As use of CAM grows so does the need for healthcare providers to provide informed counsel on safe and relevant use. Of CAM therapies botanicals are the most commonly used, but currently there is no formal curriculum in this area for our categorical housestaff (HS). To target learning needs, we conducted a needs assessment survey focusing on knowledge, confidence, and communication practices, domains considered necessary to achieve the overall goals of practicing and teaching about botanicals at the point of care. Curriculum objectives hope to improve HS competency in these three domains as pertains to the clinical applications and side effects of the 10 most commonly used botanicals in the U.S.
EVALUATION: Of the 114 HS, 86 (75.4%) responded and 76% were female. Personal use of BM was reported by 25% and 14.7% had

received formal BM education in the past. For the knowledge score, the median (IQR) between history of BM use and no history of BM use was 68 (57, 79) and 57.1 (43, 64) respectively (p=0.019). In a MLR analysis, knowledge was associated with personal use of BM after adjusted for PGY level and exposure to formal teaching in BM. For the confidence score, the median (IQR) for PGY2s and 3 s was 28 (16, 33) and 31 (29,37) respectively (p=0.019). MLR showed confidence was associated with use of BM and formal education after adjustment for PGY level. For the CP scale, over 76% of the responders had no CP with their patients over the past 30 days. However, female, history of BM use, as well as prior formal education showed statistically significantly more CP than their counterparts.
DISCUSSION/REFLECTION/LESSONS LEARNED: Despite the high prevalence of BM usage by patients, categorical HS had knowledge deficiencies relevant to the use of 10 common botanicals, greater in those reporting no history of personal BM use. In the communication domain, a great majority of HS had not communicated with patients about the use of botanicals in the last 30 days, nor did they feel confident in doing so. While history of personal use of BM and prior formal education in BM predicted confidence, overall scores remained quite low. Our BM curriculum has the potential to not only impact knowledge, but enhance confidence by identification of resources for reference and further study and create a communication practice where the spectrum of patient health practices is more fully reflected in HS-patient encounters. Acknowledgement, counseling and documentation of patients botanical use has the potential to impact the accuracy of our medical record, the safety of our practice and cultural sensitivity of our providers.
ONLINE RESOURCE URL (OPTIONAL):
INTEGRATING MULTIPLE LEVELS OF LEARNERS INTO AN INTERDISCIPLINARY TEAM-BASED MODEL OF AMBULATORY CARE Katherine Julian 1; Bridget OBrien 1; Maria Wamsley1. 1UCSF, San Francisco, California. (Tracking ID # 11255)
SETTING AND PARTICIPANTS: In 2008, IM resident continuity clinics were reorganized to create a team-based model of care. Teams included approximately 4 PGY2/PGY3 residents, an LVN, an administrative assistant (AA), and an attending.
DESCRIPTION: In April 2009, we integrated 14 PISCES students into resident continuity teams at 2 clinical sites and in June 2009, we integrated 26 interns into the teams. Each team consisted of one attending, 26 PGY2/3 residents, 23 interns, one LVN and one AA. Nine of our ten teams included PISCES students.
NEEDS AND OBJECTIVES: At UCSF, the Parnassus Integrated Student Clinical Experiences (PISCES), a year-long integrated clerkship, was developed to enhance continuity experiences for third-year students. While the PISCES program was well-received, one limitation was the relative lack of interaction between students and

residents. Moreover, internal medicine (IM) residents and interns at UCSF have had separate continuity clinic days. There is evidence that, for some content, near peer teaching may be more effective than teaching by an expert because of greater cognitive congruence. Thus, increasing opportunities for teaching interactions among residents, interns, and medical students is desirable. Program objectives were to: 1) Integrate interns and PISCES students into resident continuity clinic teams; 2) Promote near-peer teaching among multi-level learners.
EVALUATION: We surveyed interns, PGY2 and PGY3 residents in spring 2010 regarding their satisfaction with the team model. PISCES students participated in focus groups. 36 out of 70 residents completed the survey. 70% were satisfied with the clinic integration and 51% reported the integration improved informal peer mentoring between interns/ residents. 70% reported seeking advice from resident peers in clinic and 59% reported receiving quality teaching from resident peers in clinic. 78% responded that integrating resident/intern clinic improved collegiality. 87% of resident respondents supported the presence of students on the teams but only 29% of respondents felt that students were effectively integrated into the existing team structure. Although PISCES students reported positive learning experiences in the IM clinic and appreciated resident interactions when they occurred, they did not strongly identify as members of their clinic team.
DISCUSSION/REFLECTION/LESSONS LEARNED: Integrating interns and residents together in continuity clinic improved informal peer mentoring, near-peer teaching, collegiality and the clinic educational environment. Residents overwhelmingly supported the presence of students on their clinic teams. However, most residents and students did not feel that students were effectively integrated into the team structure. More work must be done to better integrate students into clinic teams and increase the interaction with interns and residents.
ONLINE RESOURCE URL (OPTIONAL):
GERIWARD: AN INTERPROFESSIONAL TEAM-BASED CURRICULUM ON CARE OF THE HOSPITALIZED OLDER ADULT Stephanie Rennke 1;
Lynda Mackin 2; Adam Moylan 3; Bree Johnston 4; Meg Wallhagen 5; Vicki Jue 6; Eunice Tam 6; Cindy J. Lai1. 1University of California, San Francisco, San Francisco, California ; 2University of California, San Francisco Department of Physiological Nursing, San Francisco, California ; 3University of California, San Francisco, Division of Geriatrics, San Francisco, California ; 4University of California, San Francisco, Division of Geriatrics and Veterans Administration Medical Center, San Francisco, San Francisco, California ; 5University of California, San Francisco, Department of Physiological Nursing, San Francisco, California ; 6University of California, San Francisco, Department of Pharmacy, San Francisco, California. (Tracking ID # 11266)
SETTING AND PARTICIPANTS: Third year medical students, 4th year pharmacy students and graduate nursing students rotating in clinicals participated. Students assembled into interprofessional teams on the hospital medicine unit for a 2-hour workshop. GeriWard, offered four times, included 26 medical students, 12 pharmacy students and 13 nursing students during the first six months of a 12-month pilot. DESCRIPTION: GeriWard consisted of two parts: (1) a two-hour bedside clinical workshop during which teams interviewed and examined an older patient from the inpatient service and reviewed one of three clinically relevant geriatric AAMC competencies: bladder catheter use, restraints and skin assessment/pressure ulcer staging; and (2) medical students presented their findings to their inpatient teams. Students completed pre- and post-workshop surveys on attitudes towards interprofessional education and self-efficacy around the geriatric competencies. Within two weeks of the workshop students gave a presentation to the inpatient team. Hospital-based faculty rated the presentations on content, knowledge and application to systems-based practice.
NEEDS AND OBJECTIVES: Health professions students in all disciplines will care for hospitalized older adults during their training and in their future careers. These students must be proficient in geriatrics, including team-based experiences that mirror interdisciplinary care models. We developed an inpatient geriatrics curriculum GeriWard for students during their clinical rotations. Student objectives were to 1) identify key geriatric competencies pertaining to the hospital setting; 2) engage in team-based learning to complete a patient-focused

exercise and 3) present a patient case emphasizing the importance of systems-based practice.
EVALUATION: A total of 51 students completed surveys (94% response rate). All students showed improvement in attitudes toward inter-professional education pre and post-curriculum (p=0.001). Students rated their knowledge and self-efficacy on the geriatric competencies higher after participating in the curriculum; for example, after the program 88% of participants were confident in identifying indications for bladder catheters and risk factors for pressure ulcers, compared to only 60% before the curriculum. Using a 5- point Likert scale, over 90% of students agreed or strongly agreed that they learned skills applicable to future practice. Hospitalist faculty rated the student presentations highly, citing the students ability to identify geriatric problems, as well as identifying opportunities for quality improvement interventions.
DISCUSSION/REFLECTION/LESSONS LEARNED: GeriWard is a novel interprofessional curriculum that combines team-based learning and bedside care of the hospitalized older adult. Students actively engage in the learning process by presenting the patient case back to the inpatient teams. Those experiences can increase students self-assessed ability to care for hospitalized older adults within an interprofessional team dynamic and provides a unique opportunity to address how systems issues can directly affect patient care.
ONLINE RESOURCE URL (OPTIONAL): https://moodle.ucsf.edu/course/view.php?id=823
Web End =https://moodle.ucsf.edu/ https://moodle.ucsf.edu/course/view.php?id=823
Web End =course/view.php?id=823
STAGED IMPLEMENTATION OF A PROGRAM TO IMPROVE RESIDENT PERFORMANCE ON STANDARDIZED EXAMINATIONS Kurt Pfeifer 1; Michael O. Frank 1; Susan Davids 1; Heather Toth 1; Monica Ziebert 1; Joanna Rea1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11267)
SETTING AND PARTICIPANTS: The Internal Medicine (IM) Residency Program at our institution is comprised of 99 residents rotating between 3 hospitals and engaging in a variety of inpatient and ambulatory electives and mandatory rotations. Residents medical knowledge is assessed yearly using the American College of Physicians (ACP) In-Training Examination (ITE). This examination focuses on educational objectives expected of a proficient second-year IM resident and is given annually to over 20,000 IM residents. Results are reported by content area and by percentile for an individual residents training level. As one means of assessing its educational effectiveness, the Residency Program compares resident ITE scores with their previous scores, national averages and performance on the American Board of Internal Medicine (ABIM) Certification Exam (CE). ITE performance in specific subspecialties is used to assess the effectiveness of related resident rotations. DESCRIPTION: The Residency reviewed resident ITE and CE data and approved implementation of a high-yield board review course conducted near the end of each residents final training year. The course was run by faculty with board review experience. Following its launch, improvement was seen in many content areas but not among lower performers. Discussion of these results led to the start of a weekly board review series to teach test-taking skills and curricular material with a CE focus. Initial results suggested further improvement in some content areas but not among the lowest performers. To improve the performance of below average test-takers, a medical knowledge competency policy was instituted to outline interventions for each resident based on their ITE performance. These included use of a learning style survey and counseling on specific study plans based upon the results; advising on test-taking strategies; and limitation of special electives and moonlighting.
NEEDS AND OBJECTIVES: 1. Improve resident performance on the American College of Physicians In-Training Examination and the American Board of Internal Medicine Certification Examination.2. Provide residents with structured, performance-driven guidance on daily study habits and board preparation.3. Utilize standardized examinations in curricular development and enhancement.

EVALUATION: Since introduction of the yearly board review course, data has shown improvement in residents performance deciles from the final-year ITE to the CE in cardiology, endocrinology, gastroenterology, hematology-oncology and pulmonology ($p<0.05$ by paired T-testing) for residents whose final-year ITE score was in the 30-49th percentile. However, no significant difference was seen in other content areas or among residents with a final-year ITE score outside this range. Since institution of weekly board review, increases in resident percentile ranks have been seen in general internal medicine, hematology-oncology, pulmonology and rheumatology ($p<0.05$) among residents with a second-year ITE score in the 30-49th percentile but only in general IM and hematology-oncology among residents with a second-year ITE rank in the 12-29th percentile. Resident feedback suggests they strongly value both interventions and considered them major contributors to their CE success.
DISCUSSION/REFLECTION/LESSONS LEARNED: As described, the program has continuously evolved over time as the standardized exam challenges of our residents and the limitations of our interventions have become better understood. The program has had a significant impact, but lack of improvement in some content areas has led to further exploration of how board review of these is conducted. A clear target for further intervention is also the group of residents with ITE scores below the 12th percentile. The medical knowledge competency policy focuses a great deal of attention on these individuals, but the impact of these interventions has yet to be determined. Overall, the program has been successful in making some early gains in resident standardized examination performance and in focusing the Residency Programs resources on this important facet of resident competency.
ONLINE RESOURCE URL (OPTIONAL):
A CURRICULUM TO TEACH RESIDENTS TEAM-BASED CARE AND POPULATION MANAGEMENT Nivedita Ghosh 1; Charles Morris 1; Rebecca Cunningham 2; Lori Tishler 3; Asaf Bitton3. 1Brigham and Womens Hospital, Boston, Massachusetts ; 2Division of General Medicine, Brigham and Womens Hospital, Boston, Massachusetts ;
3Division of General Medicine, Brigham and Womens Hospital, Brookline, Massachusetts. (Tracking ID # 11309)
SETTING AND PARTICIPANTS: All residents in a Brigham and Womens Hospital-affiliated continuity clinic will spend a two-week block of ambulatory time at Brigham and Womens Advanced Primary Care Associates, an innovative internal medicine practice grounded in the patient-centered medical home concept. The practice will be comprised of four physician-led care teams and other shared health professsionals, such as a clinical pharmacist, a certified diabetes educator (CDE), and clinical social workers.
DESCRIPTION: Through workshops and direct patient care, key non-physician health professionals will educate residents about their scope of practice, their role in the care team, and their unique skills. Residents will develop a toolkit of skills learned from these team members that they can then utilize in their own patient care encounters. To better understand the interactions among team members and patients residents will attend team meetings, shadow patients through a series of appointments, and participate in shared medical appointments.

Finally, residents will learn how to conceptualize patient care beyond individual patients and begin to think about health on a population level. They will be provided diabetic and hypertension quality metrics from their own patient panels and will be expected to devise a plan to systematically assist patients not meeting treatment goals. Importantly, development of this plan will help residents learn how to better utilize resources within their own clinics.
NEEDS AND OBJECTIVES: As health care becomes more collaborative, it is problematic that many resident clinics function in more traditional models of primary care,with few options for support from non-physician health professionals. Residents are often unaware of alternative practices, know little of the scope of practice of other health professionals, and are unfamiliar with panel management concepts. Given this training, we expect many

graduating residents will be ill-prepared to participate effectively in evolving care models. Below are the results of a 9-month process to identify key learning deficits in the traditional resident clinic and a curriculum proposal to help residents work more effectively in an accountable care environment.
All trainees will:1. Be exposed to new care delivery models2. Better understand the skills and scope of practice of non-physician health professionals3. Better understand population management and be provided with personal panel data to encourage population-level thinking EVALUATION: By tracking referrals, we will study if this program encourages residents to augment patient-care through the support of non-physician health professionals. Referrals made to such resources may constitute a proxy for more collaborative and comprehensive care efforts. Tracking the number of referrals to a specific patient-care resource, eg, a clinical pharmacist, made by residents who were exposed to the program versus an unexposed group may reveal if resident physicians behavior has actually changed as a result of the intervention. Asking residents ot rate their experience and understanding of team-based care through quantitative and qualitative measures will also be a priority. DISCUSSION/REFLECTION/LESSONS LEARNED: We found that primary care faculty agreed the following professionals had valuable and teachable skills for residents: 1) Clinical social worker- focuses on motivational interviewing, engaging the patient, and risk assessment and counseling; 2) Clinical pharmacist- focuses on optimizing individual regimens for safety, cost, patient acceptability, and best practices; 3) CDE- focuses on glucometer use, insulin use, and diabetic lifestyle education; and 4) Nutritionist-focuses on culturally sensitive diet counseling. Faculty also agree residents must understand the roles of ambulatory Advance Practice Clinicians and Care Coordinators. LESSONS1) Curriculum development was enhanced by multistakeholder input including the various health care professionals who are best poised to identify their unique skills.2) Curriculum development has preceded hiring of practice staff allowing educational expectations to be built into job descriptions.3) Use of personal panel data increases relevance. ONLINE RESOURCE URL (OPTIONAL):

INTERDISCIPLINARY PALLIATIVE CARE EDUCATION MODULE Matthew Ellman 1; Leslie Blatt 2; Susan Asher 2; Diane Viveiros 2; Dena Schulman-Green 3; Margaret Bia1. 1Yale School of Medicine, New Haven, Connecticut ; 2Yale New Haven Hospital, New Haven, Connecticut ; 3Yale School of Nursing, New Haven, Connecticut. (Tracking ID # 11428)
SETTING AND PARTICIPANTS: The program was built and instituted collaborativelyat the Yale Schools of Medicine and Nursing and Yale-New
Haven Hospital (YNHH) Depts.of Religious Ministries and Palliative Care. The web-based component is easily accessed with student ID logon. The complementarylive workshops take place 6 times per academic year. Participants include 3rd yearmedical students (on the last day of the 2nd month Medicine Clerkship),advanced nurse practitioner students, and masters-level divinity students whoare enrolled in or have completed a clinical pastoral inpatient rotation. Both components of the program are required ofall 3rd year medical students at our institution, and during theprograms 2nd year, became a requirement for advanced nursingstudents in the adult and geriatric track. The program is optional for divinitystudents, but most students enrolled in the YNHH clinical pastoral rotationhave participatedDESCRIPTION: This innovative blended curriculum has 2 components: 1) an on-line,interactive clinical case module; 2) a live workshop with multi-disciplinary faculty. Students independently work through theon-line case, which explores the clinical course of a patient with end-stage breastcancer. The module contains a variety of didactic features and challenges studentswith issues in spirituality, familydynamics, and goals of care. Students free text their responses to 4 reflections focusingon spiritual and cultural aspects of the case and the interdisciplinary team. In the live workshop, students workcollaboratively in small groups discussing palliative care issues that cross-professional lines (e.g., balancing hope / truth telling; patient requests for prayer;cultural biases). Finally, to experience first hand the contributions ofdiverse professionals, each small group collaborates to develop a plan of carefor a newly presented clinical case.

NEEDS AND OBJECTIVES: Graduatingmedical and other health professional students often do not feel adequatelyprepared to care for patients towards the end of life, especially with regardsto the spiritual and cultural aspects of palliative care. In addition, few opportunities exist forstudents to learn how to work effectively on an interdisciplinary teamproviding care near the end of life. We created, implemented, and evaluated aneducational module for medical students and other health professional students withthe following 5 learning objects: 1) To understand the basic preceptsand goals of palliative care; 2) To recognize and address common misconceptionsabout opioids; 3) To identify spiritual and cultural needs of patients andunderstand how to meet these needs; 4) To understand the clinical features ofimminent death and how to help the patient/family at that time; 5) To recognizethe contributions of all health care professionals and understand theimportance of the interdisciplinary team.
EVALUATION: We evaluated 10 cycles of the program (200910), in which a 148 medical,46 nursing, and 25 chaplain students participated. Qualitative analysis ofstudent online reflections showed nurses to be the most holistic in their clinicalassessments, with physicians focusing on care planning, and chaplains mostadept at considering nuances of spiritual issues; however, participantsrecognized issues beyond their own discipline. Results from questionnaire for 214 students (Likertscale anchors: 5=Strongly Agree; 1=Strongly Disagree) are shown here {Mean (St. Dev.)}: 1) I have greater understanding of the importance ofaddressing spiritual needs of patients with terminal illness - 4.4 (0.89); Ihave a greater understanding of contributions of other health careprofessionals &the importance of the interdisciplinary team in caring for dyingpatients - 4.4 (0.91); The combination of the online interactive case &interdisciplinarydiscussion groups facilitated learning - 4.3 (0.91).
DISCUSSION/REFLECTION/LESSONS LEARNED: Two features distinguish this program: (1) its interdisciplinary emphasis both in content and in learning format. Our qualitative analysis shows that students become aware of the roles that other professionals play on the interdisciplinary team and that they recognize the importance; (2) its

blended curriculum (online module and live workshop) with special focus on spiritual/cultural aspects of palliative care.
Student self-reports on the value of the learning experience suggest that the program imparts important palliative care content. The interdisciplinary workshop can be challenging to schedule without a working relationship with faculty in other disciplines who have access nursing, divinity and social work students. However, we believe that this palliative care learning module is a flexible tool to facilitate interdisciplinary learning and is likely adaptable for use in other educational settings.
ONLINE RESOURCE URL (OPTIONAL): http://learn.yale.edu/im/palliative2/
Web End =http://learn.yale.edu/im/ http://learn.yale.edu/im/palliative2/
Web End =palliative2/
TEACHING ACGME CORE COMPETENCIES VIA AN AMBULATORY MEDICINE CURRICULUM: A RETROSPECTIVE REVIEW OF THE AMBULATORY CURRICULUM FOR THE UHCMC/CLEVELAND VAMC INTERNAL MEDICINE RESIDENCY PROGRAM Ronda Mourad 1;
Karen Horowitz 2; Simran Singh 1; Keith Armitage 2; David Aron 1; Sarah Augustine 1; Susan Kirsh 1; Megan McNamara 1; Eleni Pelecanos1. 1Louis Stokes Cleveland VAMC, Cleveland, Ohio ; 2University Hospitals Case Medical Center/Louis Stokes Cleveland VAMC, Cleveland, Ohio. (Tracking ID # 11450)
SETTING AND PARTICIPANTS: The University Hospitals Case Medical Center/Cleveland Veteran Affairs Medical Center (UHCMC/VAMC) IM Residency is an ACGME accredited program designed to train residents to become well rounded general internists or subspecialists. There are 123 residents, with 27 categorical IM interns and 4 medicine-pediatrics interns. General Medicine faculty supervise resident continuity clinics at UH

and VAMC. Residents also receive ambulatory training during urgent care, geriatric, and elective rotations where they may choose amongst 30 subspecialty clinics.
The Ambulatory Block provides a setting to transmit medical knowledge as well as model core values specific to Ambulatory Medicine. UHCMC/ VAMC categorical interns (31 in total) are divided into three groups. Each group experiences this block in a 1-month rotation which includes 28 clinical sessions (continuity and subspecialty clinics) and 12 didactic workshops.
DESCRIPTION: Content delivered in each workshop was reviewed to specifically assess the extent to which the competencies are represented. Each workshop leader was asked to reflect on his or her work and describe how each session incorporated the ACGME competencies. A table was constructed to summarize the workshop educators self-assessment results. Additional opportunities to strengthen the presentation of core competencies in this curriculum were identified by this peer review.
NEEDS AND OBJECTIVES: Ambulatory medical education represents only 30% of the educational exposure time in the typical Internal Medicine (IM) Residency yet ambulatory practice is the primary activity for the average practicing internist. A strong ambulatory curriculum is vitally important to the training of IM residents. The intent is to create physicians who are mindful of the core values of patient care as outlined in the six ACGME competencies (patient care, medical knowledge, practice based learning and improvement, communication, professionalism, systems-based practice) as they move forward in their residency. The ambulatory program offers educators the opportunity to overtly model the core competencies. By self-reflection throughout residency, residents are expected to apply these values in patient interaction and clinical decision-making across all venues. EVALUATION: Review of the ambulatory curriculum led to the conclusion that the ACGME competencies are pertinent to each didactic
workshop. Opportunities exist to model and teach all six competencies in each workshop. Interestingly, some educators were unable to identify and report how the competencies were pertinent to their own workshops.
DISCUSSION/REFLECTION/LESSONS LEARNED: Translating ACGME competencies overtly to residents is desirable. With educators focusing on the ACGME competencies as threads in their didactic workshops, residents can be expected to incorporate these competencies into their care of patients. Future directions include: 1) feedback to educators on additional opportunities to incorporate teaching points related to each of the six competencies; 2) development of an orientation session focusing the learner on the competencies as a framework for future learning; 3) development of a tool to assess residents ability to identify these lessons after each workshop; 4) development of standardized clinical scenarios as an assessment tool to gauge residents abilities to apply the competencies.
ONLINE RESOURCE URL (OPTIONAL):
PERSPECTIVES ON THE CHANGING HEALTHCARE SYSTEM (POCHS): A FRAMEWORK FOR TEACHING SYSTEMS-BASED PRACTICE TO MEDICAL RESIDENTS Johanna Martinez 1; Oliver Fein2. 1New York Presbyterian Hospital - Weill Cornell Medical College, Lynbrook, New York ; 2Weill Cornell Medical College, Brooklyn, New York. (Tracking ID # 11483)
SETTING AND PARTICIPANTS: Perspectives on the Changing Healthcare System (POCHS), is a one-week block rotation required of all third-year medical residents at the Weill Cornell Medical Center of the New York-Presbyterian Hospital. The residents complete about 40 hours of coursework during this week. It is offered five times from September through January during the residents third year. This course is taught in a small group setting, with 812 participants in each session. Primarily the topics are taught by a core group of faculty and guest speakers who are experts in the area. Direct patient care during the one week rotation is limited to a one 3-hour evening clinic session. This format allows the residents to be emerged in the curriculum which results in a more profound focus on the topics.
DESCRIPTION: POCHS includes several teaching methods. Didactic sessions are the largest component. These sessions are divided amongst lectures and small group discussions that focus around a core curriculum.

Topics include practice organizations ie medical homes, accountable care organizations, healthcare finances and economics, insurance plans ie Medicaid, Medicare and private insurance, medical informatics, quality measures and interaction with industry.
There is a site-visit to a multi-specialty group practice. There they are exposed to an emerging delivery system of care and are able to gain access to practice directors and their perspectives on health care organization and delivery. They additionally participate in a peer debate. After completing assigned readings they engage in a debate, tackling multi-faceted aspects of controversial topics in health care reform. Such topics have included comparative effectiveness research, the public option and pay for performance.
NEEDS AND OBJECTIVES: The US healthcare system has undergone changes with regard to health care delivery, organization and financing. Inevitably GME must transform itself to keep up with these changes. The ACGME has recommended that residents develop competencies that demonstrate awareness around how to practice within the context of the larger healthcare system in order to provide quality care. However, few studies have documented how these competencies can be integrated

into medical residency education. Hence, we developed POCHS, our Systems- Based Practice curriculum. Our objectives are 1) To describe the implementation and evaluation of POCHS 2) To evaluate its impacts on residents knowledge as measured by our knowledge assessment tool 3) To evaluate its impact on resident awareness and attitudes towards the changing healthcare system as assessed through open ended interviews and 4) To obtain residents perceptions and feedback on aspects of the course that could be taught differently.
EVALUATION: Both quantitative and qualitative measures are used. The quantitative assessment includes a 50-item, pre- and post-course survey that asses knowledge of key topic areas. The residents perceptions of the course are measured with a summative evaluation. This evaluates each instructor, the venues for teaching and the course content.
The qualitative evaluations are comprised of comments that are recorded on their summative evaluation forms and asses whether their awareness of the healthcare system has increased and whether their attitudes towards systems-based practices have changed.
From 20082010, 135 residents completed the course. All had a mean increase of 18 points in knowledge scores. The course averages 4.5 on a scale of 15, 5=one of the best residency rotations. The qualitative comments theme around increased awareness because they were never taught this material, feeling more comfortable with entering practice and the necessity of this course. DISCUSSION/REFLECTION/LESSONS LEARNED: POCHS provides a framework for how to teach residents about emerging changes in health care. It is obvious that this course is needed and valued. With changes in healthcare, it is crucial that all residencies afford their trainees a similar curriculum. Based on our literature review a similar curriculum is not offered in most residencies. Our curriculum can serve as a template to other residencies. This material is important because it assists in producing more versatile physicians- which is exactly what the new face of generalism, the 21st century physician will be. Further it complies with the ACGMEs core competency of systems-based practice. Although a success POCHS demonstrated that many next steps need to be taken. The course provides knowledge and raises awareness of core issues yet the next step is to expand its objectives to include translating that knowledge beyond awareness and into skills that are then applied to clinical practice.
ONLINE RESOURCE URL (OPTIONAL):
QUALITY IMPROVEMENT EDUCATION THROUGH A RESIDENT-DRIVEN PROGRAM Jennifer Carnahan 1; Elizabeth Ellen Lawler 1; Zouyan Lu 1; Christopher Mueller 1; Pinky Patel 1; Geoffrey Lamb 1; Jaishree Hariharan 1; Theodore MacKinney1. 1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11500)
SETTING AND PARTICIPANTS: The Internal Medicine Residency Program at the Medical College of Wisconsin (MCW) is comprised of 99 residents rotating between three hospitals. Residents have continuity

clinic one half-day per week in one of six clinical sites. The QI educational program is implemented yearly and involves participation from all residents. Unique to this educational program is that the medical residents themselves are the architects of the quality improvement initiatives. A core group of resident leaders meets monthly to plan and direct the program. Members of the faculty with QI experience serve as mentors to this group.
MCW participates in the Wisconsin Collaborative for Healthcare Quality (WCHQ), a nationally recognized collaborative of health care systems throughout the state that coordinates public reporting of health care quality measures in our state. Reporting measures and other data from
WCHQ serve as guides for the development and measurement of the residents QI interventions.
DESCRIPTION: The QI program was introduced early in the 2009/10 academic year and focused on quality measures from the WCHQ. It was rolled out in a series of stages, beginning with faculty providing basic education on QI and the target quality measures. The core group of QI resident leaders was then formed and responsibility for the project was transitioned to them.
All residents performed patient panel chart reviews. Then, the QI resident leaders led a series of educational sessions with the residents to develop quality improvement initiatives at each clinic site. In these sessions, they performed root-cause analysis and process mapping to determine potential quality detractors and then selected one for the QI intervention at each site. Later sessions focused on the multidisciplinary implementation of these interventions. Throughout the process, faculty mentors provided guidance to the residents and resident QI leaders on the QI process as well as how to bring about change through leadership.
NEEDS AND OBJECTIVES: 1) Provide for medical residents a foundation of education in quality improvement (QI) that will be applicable for the duration of their careers.2) Develop a residency-wide program to contribute to meeting the Accreditation Council for Graduate Medical Education requirements for practice-based learning.
EVALUATION: Initial data from the 2009/10 academic year QI project shows that prior to the educational intervention only 52% of residents were comfortable using measurement to improve their clinical skills. After the intervention 85% reported feeling comfortable. Other areas of great improvement in QI education include use of the Plan-Do-Study-Act (PDSA) model and identifying how data is linked to specific processes. The comfort level increased from 16% to 59% in the first area and increased from 37% to 78% in the second. Furthermore, 78% of residents rated the QI educational program as good or very good. The institution as a whole also showed improvement on WCHQ rankings. Initially the rate of compliance with colorectal cancer screening was only 58.5% however, after this initiative the rate of compliance increased to 64.8%.
DISCUSSION/REFLECTION/LESSONS LEARNED: Overall, residents have responded positively and have been enthusiastic to implement the interventions. They have demonstrated an increased awareness of quality measures and an improved understanding of how to implement systems change in a multidisciplinary care system. Although coordination of a project with many residents of varying knowledge and skills was challenging, it was beneficial to have residents lead the planning and execution of this QI project, which allowed more participation and investment into its outcomes. Other intended outcomes of this QI project are to improve patient care and share lessons learned with others and early data suggests that gains have already been made. Some clinics have demonstrated an improvement in documentation of QI measures and outcomes. Residents have already disseminated their work to practitioners outside of our network. Ultimately, current residents will pass their newly acquired QI knowledge on to future residents in the program.
ONLINE RESOURCE URL (OPTIONAL):
IMPROVING ORAL CASE PRESENTATIONS USING A CURRICULUM BASED ON CLINICAL REASONING SKILLS Dalal Alromaihi 1; Eduardo Castillo 2; Kimberly Baker-Genaw 3; Eric Scher4. 1Henry Ford Health System, Dearborn Hts, Michigan ; 2Henry Ford Health System, Detroit, Michigan ; 3Henry Ford Health System, Northville, Michigan ; 4Henry Ford Health System, Troy, Michigan. (Tracking ID # 11501)
JGIM

SETTING AND PARTICIPANTS: This was an interventional study. An Oral Presentation Curriculum and an evaluation tool were developed by two Chief Medical Residents under the supervision of the Internal Medicine Program Director and the Designated Institutional Official. The study took place at Henry Ford Hospital, Detroit, MI between January and May of 2009. The facility used was the Simulation Center at the Henry Ford Hospital and included a conference room and examination rooms where encounters were videotaped. The study included a convenience sample of Internal Medicine residents who were on an elective rotation during the timeframe of the study. A signed consent was obtained from all the participating residents and the study was approved by the Institutional Review Board at Henry Ford Hospital. DESCRIPTION: The study participants underwent 4 sessions. During the first session, residents observed a videotaped patient-physician encounter and then reviewed a printed summary of the physical examination and diagnostic study results for the simulated patient. The data contained both relevant and non-relevant information. The residents then formulated oral case presentations that were videotaped. In the second session, a curriculum was presented by two course instructors and consisted of a PowerPoint presentation and two videos of different case presentations, which were reviewed by the group. In the third session, the residents presentation skills were re-evaluated by completing a second case presentation simulation exercise that described a different encounter. The first 3 sessions took place within 10 days. A month after the intervention, the residents completed the third videotaped case presentation simulation exercise to evaluate the sustainability of the effectiveness of the curriculum.
NEEDS AND OBJECTIVES: The oral case presentationis a fundamental tool for successful communication. Deficiencies in presentation skills may result from unrefined clinical reasoning skills or deficits in training. Faculty may expect a certain skill level of the presenter, which requires an understanding of the clinically relevant elements.Trainees learn how to organize their presentations based on feedback during clinical rotations. However, during the first year of training there is an opportunity to assist learners in development of concise oral presentation that is based on clinical reasoning rather than reporting unprocessed data. The objective of our intervention was to design a curriculum to teach the first year residents how to use clinical reasoning skills to differentiate relevant from non-relevant information to improve their presentation quality and length. We also developed an evaluation tool, The Henry Ford Assessment, to objectively assess the quality of the oral case presentations.
EVALUATION: 13 out of the 37 Internal Medicine residents were selected for the study and underwent all four sessions. An evaluation tool, The Henry Ford Assessment, was developed to assess the quality of the case presentations, which consisted of 15 items, each one with a 7-level Likert scale. The tool was developed based on items considered to be important during case presentations by the authors and several published papers on the subject. The presentations were also timed. The scores of the three exercises were compared. There was a significant difference between the scores of the first and second exercise (74.29 vs.89.15.5)($p<0.001$) as well as between the first and the third exercise(74.29 vs.85.66) ($p=0.001$). The total time of the presentations decreased significantly between the first and second exercise (7.62.1 min vs. 5.91.9 min) ($p<0.001$) and between the first and third exercise and(7.62.1 min vs. 6.12 min) ($p=0.006$).
DISCUSSION/REFLECTION/LESSONS LEARNED: Case presentations are fundamental to successful communication of clinical data in patient care and resident education. Unfortunately there is no standard curriculum or evaluation tool for case presentations. We created a curriculum that improved the residents case presentations and an assessment tool to evaluate these presentations. We found that our curriculum significantly improved the quality and decreased the time of the presentations. This effect was sustained one month after the curriculum. The evaluation tool is being re-evaluated based on findings. A revised tool will be pursued. Mastering the important skill of concise, accurate and relevant case presentations early in the training would improve the communication of patient information and the efficiency of time utilization during

teaching rounds. This curriculum can potentially be adapted to improve oral presentations for residents and medical students across different programs.
ONLINE RESOURCE URL (OPTIONAL):
PATIENT CENTERED MEDICAL HOME (PCMH) WITHIN A RESIDENT RUN CONTINUITY CLINIC Andrew Vasey 1; Rachel Bonnema1.
1University of Nebraska Medical Center, Omaha, Nebraska. (Tracking ID # 11558)
SETTING AND PARTICIPANTS: The Internal Medicine resident continuity clinic at the University of Nebraska Medical Center is run by a resident board of directors overseeing decisions impacting the clinic site. The resident board, which is comprised of residents from all levels of training, in conjunction with faculty and ancillary staff, created and implemented PCMH principles into the practice.
DESCRIPTION: The residents receive training in components of the PCMH and have coordinated a multi-disciplinary approach to patient care encompassing mental health, social work, pharmacy, nursing and case management. Additionally, residents are also utilizing the PCMH to institute quality improvement and research projects. One example includes a restructured hospital discharge process. The patient education discharge form (PEDF) educates the patient about why they were hospitalized, things to look out for after discharge, when his/her next clinic appointment is and the importance of follow up. The discharge process also incorporates a post-discharge phone call from our pharmacist. One of our resident-designed patient education classes is a monthly diabetes class. These are coordinated by the residents and attended by residents, staff physicians, certified diabetes educators, pharmacists and dieticians. There are also projects underway dealing with patient compliance and knowledge of their disease.
NEEDS AND OBJECTIVES: Today, practicing medicine within the ambulatory setting has been challenged by higher patient volume, less time available per patient, more intense needs of patients with chronic conditions and a more complex system. In order to meet these challenges, residents need to be trained how to handle these issues. New requirements by the Residency Review Committee for Internal Medicine reflect these challenges with an increased focus on ambulatory education. With this in mind, the Internal Medicine residency program at the University of Nebraska Medical Center implemented a Patient Centered Medical Home (PCMH) model as an experiential training tool/ feasibility project for our residents to learn and utilize patient centered care principles. Objectives are to create a curriculum for residents to:1. Learn the principles of the PCMH.2. Utilize the PCMH to improve patient care.3. Improve communication and teamwork skills.
EVALUATION: We looked at data from one year pre and post PEDF. Before the intervention, the hospital reutilization rate (30 day post discharge emergency room visit or readmission) was 23.32%. Post intervention, the hospital reutilization rate was 18.94% ($p=0.02$). When looking at the patients during the time of the intervention, those who did not receive the PEDF had hospital reutilization rates of 23.23%, while those who received the PEDF had hospital reutilization rates of 11.24% ($p <0.001$). In looking at our diabetes interventions, our patients hemoglobin A1C levels from clinic over a 2 year period decreased by 0.3%.

DISCUSSION/REFLECTION/LESSONS LEARNED: Thus far, our outcomes include clinical measures such as a decrease in hospital reutilization and improvement in A1C levels, though future directions include assessing resident knowledge and attitudes regarding PCMH principles and using surveys looking at interdisciplinary work amongst clinic personnel. We have had support from the Department of Internal Medicine for help in funding various aspects, including hiring a full time nurse coordinator and having pharmacy support. We have shown that developing a PCMH within a resident continuity clinic is feasible. Instituting a PCMH in a resident continuity clinic meets multiple educational goals including interdisciplinary teamwork, systems based practice and practice based learning. By establishing a PCMH in a resident continuity clinic, residents are learning the principles of the PCMH by performing them, incorporating them into regular practice, thereby better preparing them for a future in primary care.

ONLINE RESOURCE URL (OPTIONAL):

USING MULTI-MEDIA TO TEACH MEDICAL STUDENTS DIABETES MANAGEMENT AND ENHANCE CLINICAL SKILLS Jaishree -Hariharan 1; Judi Rehm 1; Jessica Kaho 1; Dawn Bragg2. 1Medical College of Wisconsin, Milwaukee, Wisconsin ; 2Medical college of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 11561)

SETTING AND PARTICIPANTS: The M4 class consists of 200 students who participate in an ambulatory medicine clerkship at our institution. Twenty students rotate monthly and an emphasis on use of guidelines for evaluation and management of common medical conditions was introduced in 2009. They are provided with an iPod touch to augment learning and access web-based curricular materials. As part of a learning resources grant to integrate chronic disease management into student education using technology, podcasts of lectures and instructional videos were created using technology experts and housed on our web platform. A pocket reference card for stepwise medication management in diabetes previously developed by a team of health professionals in our institution was available for decision- support. DESCRIPTION: The blended learning curriculum to teach evidence-based diabetes care is part web-based, self-study and part face-to-face. At the beginning of the month, the students are provided with access to lecture podcasts, video clips, reading materials which included evidence based guidelines, pocket cards and six cases. Video podcasts included patient evaluation, comprehensive diabetes management including medications, demonstration of diabetes supplies and self management support. Podcasts could be viewed through iTunes from the web-portal or downloaded onto their iPod. Students were given 2 weeks to review the podcasts and guidelines and prepare for case discussion in class. Class time was used to review guidelines and apply the knowledge learned to the clinical cases in an open interactive format with faculty. At the end of the course, students completed an anonymous questionnaire focused on the quality, knowledge and confidence gained from the course. NEEDS AND OBJECTIVES: The high prevalence of chronic illness in the US, particularly diabetes calls for training that is designed and organized to provide high quality care. Medical students competency to understand chronic disease management is essential to become good clinicians. Evolving web-based technology is having an impact on efficient delivery of medical education and patient care. Our objectives were to develop a web-based multi-media integrated educational experience into medical student curriculum aimed at improving medical student knowledge and confidence in diabetes evaluation and medication managementEVALUATION: Fifty-five students participated between March and November 2010. Cronbachs alpha of the Likert-scaled questions showed high reliability at 0.86. 84% rated the quality of the webcasts as good. 95% agreed that the videos provided practice-based learning and knowledge .100% reported that the course met stated objectives and 89% would recommend it to a fellow student. Self-reported knowledge and confidence before and after the course was ascertained using a 5- point scale (1=very high). Preliminary analysis using Wilcoxon signed- rank test showed significant improvement in knowledge of principles of diabetes management (N=20) from mean of 2.95 to2.35 after (p=0.001) Confidence to titrate medication improved from mean of 3.45 to 2.7 (p=0.001). DISCUSSION/REFLECTION/LESSONS LEARNED: This program was the first at our institution to attempt a technology-based blended learning method, and it has helped us deliver content and enhance learning in a format that addresses multiple learning styles. It allows flexibility with scheduling and pace of learning and provides a balance of traditional instructor led training, asynchronous online study, and structured point of care training with clinical cases. Our results show that students knowledge of diabetes and confidence in management improved with this approach.

ONLINE RESOURCE URL (OPTIONAL):

DIABETES RX: AN INNOVATIVE MOBILE DIABETES MANAGEMENT APPLICATION ON THE IPOD TOUCH Jaishree Hariharan 1; Kimberly Brennan 1; Michael Phillips 1; Jan Nelson 1; Deborah Gillard 2; Irene Oshaughnessy1. 1Medical College of Wisconsin, Milwaukee, Wisconsin ;
2Froedtert Hospital, Milwaukee, Wisconsin. (Tracking ID # 11562)

SETTING AND PARTICIPANTS: The M4 class consists of 200 students at our institution who are provided with an iPod touch to augment learning and access web-based curricular materials. Twenty students participate monthly in the ambulatory medicine clerkship and as part of a required competency in the use of guidelines in clinical practice receive instructional materials, laminated pocket cards and diabetes cases for homework. Feedback on the content of the pocket cards was very positive, however continued use is unclear. Diabetes Rx is a mobile management tool being developed to replace the existing pocket cards as part of a learning resources grant to integrate chronic disease management education into student curriculum utilizing advances in technology. It will be piloted during their ambulatory clerkship. DESCRIPTION: This custom application essentially converts a paper pocket reference chart into a digital format with a striking overall look and feel to the popular drug database tool, Epocrates. Choosing from Insulin or Oral agents, the user is guided through menus based on glycohemoglobin and creatinine branching through dosing and titration options to achieve the optimal therapy for the patient. Phase I involves building the application using Apples SDK and Objective C software for deployment on an iPod Touch, iPhone, or iPad device. Phase 2 involves testing the application for both content and functionality with a small group of users and modified after feedback. Users can install it by importing the app into iTunes and syncing their device. Phase 3 will include dissemination using the enterprise distribution method, made available to all students and accessed via a password protected website or file sharing system.
NEEDS AND OBJECTIVES: Medical decision-making in diabetes management is complex. The critical piece is using an evidence-based approach to medication management. Guidelines provide the framework, but the devil is in the details. Pocket reference cards for stepwise medication management of diabetes were developed at our institution using current guidelines for teaching medical students and residents and updated yearly. Although the cards are useful, regular updating is time consuming and expensive. Evolving web-based technology is

revolutionizing information delivery, and having an impact on efficient delivery of medical education and patient care. Our objectives were to convert this valuable information into a user-friendly mobile application (Diabetes Rx) that can be securely accessed by medical students via an Apple device. To update content expeditiously, decrease printing costs with the goal of availability to all providers for point-of-care application. EVALUATION: Phase 1 is near completion now. Phase 2 will be conducted over 2 months. It is anticipated that more students will access Diabetes Rx during their medicine clerkship and it will become a prominent clinical reference tool for diabetes management. Below is the prototype (URL) under development.
DISCUSSION/REFLECTION/LESSONS LEARNED: Diabetes Rx is the first mobile app for clinical decision-support at our institution. The mobile platform is transformative. Portability of purposeful content, simple delivery, seamless updates, saving time and money are tremendous assets. Availability for teaching and decision-making for clinicians is invaluable. Teamwork between software and content experts and educational services is essential. Modeling Diabetes Rx after Epocrates removed guess work from the development of the user interface. The future is ours to see
ONLINE RESOURCE URL (OPTIONAL):
http://www.mcw.edu/generaliInternalmed/linksofinterest/DiabetesRx.htm
Web End =http://www.mcw.edu/general
http://www.mcw.edu/generaliInternalmed/linksofinterest/DiabetesRx.htm
Web End =iInternalmed/linksofinterest/DiabetesRx.htm
HEALTH DISPARITIES: AWARENESS TO ACTION Cristina M Gonzalez 1;
Aaron D Fox1. 1Albert Einstein College of Medicine- Montefiore Medical Center, Bronx, New York. (Tracking ID

11653)
SETTING AND PARTICIPANTS: The elective, Health Disparities: From Awareness to Action, was offered on a voluntary basis to first year medical students at the Albert Einstein College of Medicine (AECOM). AECOM is located in the Bronx, NY, and its affiliated hospitals serve a predominantly ethnic and racial minority population. Prior to this elective, there was one session on HD in the third year of undergraduate education. In 2009, a pilot elective on HD was approved by the Dean of Education. The following year, course evaluations were presented to the Dean of Education and an education executive committee and the elective was expanded to include sessions on advocacy skills. In 2010, a total of eleven students participated in the course. The thirteen 1.5 hour sessions occurred over a three month period during the lunch breaks between mandatory courses with lunch provided. Attendance was voluntary, but typically sessions included six to ten students. DESCRIPTION: The curriculum was divided into three areas with the final session for evaluation:1. Background (four sessions): Sessions included computer based modules summarizing the HD literature, videos introducing the social determinants of health, and small group discussion with community health advocates.2. Provider Contributions (three sessions): Skill building sessions prepared learners to recognize implicit biases and minimize the influence of bias on patient care. Learners completed the Implicit Association Test (IAT), participated in case based discussion groups, and practiced culturally sensitive interviewing techniques.3. Advocacy Skills (five sessions): Skill building sessions prepared learners to address the social determinants of health through advocacy and social change. Sessions included strategy for advocacy campaigns, community outreach, physicians professional organizations, media communications, and legislative advocacy.
NEEDS AND OBJECTIVES: Health and health care disparities (HD) are well documented. The importance of health disparities education (HDE) in the undergraduate medical curriculum is recognized by the major accrediting bodies, and guidelines for HDE were recently published, yet
many medical schools still lack formal curricula on HD. After an initial pilot elective based on SGIM recommendations for HDE, and our own focus group interviews with the intended learners, we developed an innovative curriculum emphasizing both the epidemiology of HD and skills necessary to address HD. Course objectives were as follows: (1) Learners will define HD and list examples of diseases where disparities are evident; (2) Learners will demonstrate confidence in utilizing clinical skills targeting provider contributions to HD; (3) Learners will demonstrate confidence in developing advocacy skills targeting social contributions to HD.
EVALUATION: Learners completed questionnaires at course inception and completion. Items assessing confidence in knowledge and skills relating to HD were rated on a four-point Likert scale. Seven students completed both questionnaires. Changes in confidence were examined using paired T-tests. Learners demonstrated increased comfort in defining HD, social determinants of health, and implicit bias, and increased awareness of mistrust, communication, and physician contribution to HD. Learners also increased confidence in their advocacy skills. Perception of personal subconscious bias did not change.
Qualitative responses identified several positive aspects of the course that facilitated learning: the small group environment, enthusiasm of faculty, and focus on development of practical skills. Suggestions for improvement included: additional experiential learning and longitudinal integration into the four year curriculum.
DISCUSSION/REFLECTION/LESSONS LEARNED: Our students enjoyed the health disparities elective and felt confident they could define HD topics following the course. Despite attention to implicit bias, their perceptions of their own subconscious biases did not change. The IAT is provocative, but may not convey the intended lesson that implicit bias is natural and can be managed in clinical practice. Methods to recognize and overcome implicit bias are needed. Our students also increased confidence in advocacy skills. While physician advocacy is often discussed in the context of professionalism, teaching advocacy skills as part of HD coursework may empower students to address social contributions to HD and reduce HD in the future. Our elective was well received, and we have again presented our findings to the administration. We seek to incorporate HDE throughout the undergraduate curriculum. Demonstrating success in a pilot elective may be a

viable route for incorporating important new topics into the compulsory curriculum.
ONLINE RESOURCE URL (OPTIONAL):
TEACHING WITHOUT LECTURES IN THE FIRST YEAR: THE MUSC INTEGRATED CURRICULUM SYNTHESIS MODULE Jeffrey G. Wong 1;
Debra J. Hazen-Martin 1; Donna H. Kern 1; Matthew D, McEvoy1.
1Medical University of South Carolina, Charleston, South Carolina. (Tracking ID # 11665)
SETTING AND PARTICIPANTS: In 2009, MUSC adopted a systems-based pre-clinical curriculum. The goal for curriculum reformulation was to explicitly demonstrate relevance to the students between the basic science material being presented and their development as a patient-centered student physician. Four year-long themes [Structure-Function, Molecules-Energetics, Homeostasis-Regulation, and Fundamentals of Patient Care] were organized vertically into educational systems Blocks [Musc-skeletal, CV/Resp, Renal/GI, GU/Reprod, and Cognition]. Each Block began with a video-taped patient whose underlying conditions became the clinical framework from which the Blocks overall learning goals/objectives were derived. The video for this final Block was of a patient-actor whose broad-ranging underlying

conditions (physical, mental, cultural, socioeconomic), encompassed the breadth of material from the entire year. Six broad review topics (based on the Blocks and the Fundamentals theme) were derived from the video. DESCRIPTION: Organizationally, all 165 first year students learn throughout the year in small groups (COM TEAMS) comprised of 89 students and 12 teachers. Following the Synthesis Block video presentation, all students were assigned to one of the 6 broad topic groups - every COM TEAM had at least one student in each of the 6 groups. Broad topics were further subdivided into 3 major subtopics creating 18 in total, each with a list of review questions pertinent for mastery of the large topic. For each subtopic, 910 students worked collectively researching the answers and creating an academic poster displaying the content material for their subtopic. Faculty experts within each content block served as resources but did no active teaching . Students had no other academic commitments during this week. All 18 posters were displayed during the Synthesis Block Poster day when the students reconvened in their original COM TEAM groups and presented her/his poster to her/his other COM TEAM members. NEEDS AND OBJECTIVES: The Medical University of South Carolina (MUSC) is two years into its curricular reformulation of its pre-clinical course work. We wished to design and implement an educational review module for our students that would: (1) promote self-directed learning;2) allow independent group-work with formal peer teaching and assessment; 3) provide all students the experience of creating an academic poster; and 4) provide all students the opportunity for a formal academic presentation. EVALUATION: The students, on a tightly scheduled agenda, rotated through the 6 presentation rooms where, at any one time, 6 simultaneous talks were made. Each student evaluated their COM TEAM peers using a 5-point Likert-type scale that assessed the quality of the speakers 20 minute oral poster presentation. Students also collectively assessed one anothers effort during the research and poster preparation phase. Faculty teachers used the same evaluation tool to assess the students performance. Working collaboratively, the students were forced out of the passive learning seen in most large group lectures and were compelled to take an active role in researching answers to questions and applying content material to a real patient case. Each of our 165 students had the opportunity to participate in the creation of a poster and each student individually made an academic presentation to her/his peers and faculty members. The student evaluations from the exercise were extremely positive. DISCUSSION/REFLECTION/LESSONS LEARNED: Our Synthesis review module was totally devoid of lecture, comprised of direct, hands-on collaborative team learning, required students to be self-directed in their education, and provided each one the opportunity to create an academic poster and make an academic presentation in front of ones peers. Through this innovative educational activity, we were able to better approximate the higher rungs on Hardens Integration Ladder (R Harden, Medical Education 2000, 34:551557) and work toward achieving our institutional goals of true curricular integration.

ONLINE RESOURCE URL (OPTIONAL):
A REQUIRED, SHORT PALLIATIVE CARE ROTATION FOR FIRST-YEAR INTERNAL MEDICINE RESIDENTS Brook A. Calton 1; Adam Moylan 1; Eric Widera2. 1UC San Francisco, San Francisco, California ; 2UC San Francisco &The Veterans Affairs Hospital, San Francisco, California. (Tracking ID # 11696)
SETTING AND PARTICIPANTS: The palliative care rotation takes places at the Veteran Affairs (VA) Medical Center in San Francisco, CA.
The medical center inpatient facilities consist of a 120 bed hospital and a neighboring 108 bed Community Living Center (CLC). The Hospice and Palliative Care Service is consulted on approximately 12 new patients per day at both of the inpatient facilities. An attending, palliative medicine fellow, social worker, chaplain, and psychologist staff the consult service. The service also provides primary care for a 10-bed inpatient hospice unit housed within the CLC that admits approximately 100 new patients per year. All 44 categorical, PGY-1 internal medicine residents at UC San Francisco (UCSF) complete the palliative care rotation during an ambulatory block month in the 201011 academic year.
DESCRIPTION: Residents spend 44.5 days on the rotation. They primarily work with the Palliative Care Consult Service, but occasionally also admit patients to the inpatient hospice unit and follow them for the duration of their rotation. Residents evaluate and provide recommendations for VA patients on end-of-life issues including symptom management and goals of care. They also attend an interdisciplinary palliative care team meeting and receive instruction from attendings and fellows on 3 predefined topics: palliative care theory and end-of-life care models, pain management, and facilitating family meetings.
Residents evaluate the rotation via a questionnaire emailed to them on their final day on the service. The questionnaire gathers data on the types of experiences residents have while on the rotation, measures residents perceived comfort and knowledge of specific palliative care topics before vs. after the rotation, and queries residents impressions on the rotations strengths and weaknesses.
NEEDS AND OBJECTIVES: Graduating fourth-year medical students and first-year Internal Medicine residents report a lack of comfort and skill in providing end-of-life care. A recent study suggests the only predictor of residents perceived competence in providing end-of-life care is clinical experience in the area. Recently, licensing bodies, including the ACGME and ABIM, have addressed this educational gap by requiring curricula and mandating resident competencies in palliative care. Despite this, there are only three required palliative care rotations for internal medicine residency programs described in the literature. All of these rotations were at least one week long and none targeted first year residents. In 2009, UCSF developed a required, short (44.5 day) palliative care rotation for all PGY-1, categorical, Internal Medicine residents to increase their knowledge and comfort in providing end-of-life care. This project was supported in part by a Donald W. Reynolds Foundation Grant at UCSF.
EVALUATION: Evaluation is ongoing. All 20 residents who completed the rotation also filled out the questionnaire. Regarding residents clinical activities on the rotation: 100% discussed goals of care with a patient/family, 95% adjusted pain medications, and 85% sat in on, but only 20% led, a family meeting. 50, 60, and 35%, respectively, received lectures on palliative care theory and end-of-life care models, pain management, and family meetingsAll residents felt the rotation increased their comfort in discussing goals of care (50% strongly agreed, 50% somewhat agreed) and their ability to treat symptoms at the end-of-life (45% strongly agreed, 55% somewhat agreed). 95% of residents strongly agreed the rotation increased their belief that palliative care is valuable to patients and families. Reported strengths of the rotation included dedicated time to learn pain management and how to facilitate family meetings. Residents felt the rotation could be improved through more formalized didactics. DISCUSSION/REFLECTION/LESSONS LEARNED: Our preliminary data suggests our required palliative care rotation improves first-year residents perceived comfort with, and self-perceived knowledge of, key palliative care issues. A novel aspect of this intervention is the short duration of the rotation, at only 44.5 days, making it more realistic to implement at other institutions than longer

rotations. The short

duration and the focus on experiential learning led to variability in the extent to which residents received lectures on the three predefined core topics. Many residents suggested more formal didactics would strengthen the rotation. In the future, we should consider building in more structured case-based learning. To further evaluate the impact of this rotation, we should consider a more rigorous research design that includes the use of a control group and either pre/post intervention self-efficacy questionnaires or other validated palliative care knowledge assessment tools.
ONLINE RESOURCE URL (OPTIONAL):
PROCEDURE CLINIC DOUBLES MEDICAL RESIDENTS EXPERIENCE DOING KNEE AND SHOULDER INJECTIONS. Ruth Preisner 1; Leonard Jenkins 2; Ajay Khurana2. 1VA Pittsburgh Healthcare System, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania ; 2Veterans Administration Pittsburgh Healthcare System, Pittsburgh, Pennsylvania. (Tracking ID # 11700)
SETTING AND PARTICIPANTS: University of Pittsburgh post-graduate year (PGY)-3 internal medicine residents in the General Medicine Track are required to rotate through the Veterans Administration Pittsburgh Healthcare Systems (VAPHS) PCPC. Other PGY-3 residents may elect to do so.
DESCRIPTION: PCPC occurs the same afternoon each week. Three faculty members rotate staffing. A PCPC consult, a computer order entry, is available to all primary care providers in the VAPHS. The most common referrals include knee and shoulder injections and cryotherapy of skin tags and warts. Other consults have included trochanteric bursa, lateral epicondyle, and other bursae injections.
NEEDS AND OBJECTIVES: Musculoskeletal problems comprise approximately 25% of primary care visits. Knee injections are among the most frequent procedures performed by internists. Our medical residents report too few opportunities (23 knees and 01 shoulders per trainee).
Establishing a primary care procedure clinic (PCPC) will increase the number of procedures performed by residents.
EVALUATION: Since June 2009, 5 PGY-3 residents have rotated through the PCPC. Together they have performed 39 (average 7.8, lowest 4 per resident) knees and 16 (average 3.2, lowest 2 per resident) shoulder injections. All residents were evaluated by faculty in their e-portfolios as being able to independently perform knee and shoulder procedures .
DISCUSSION/REFLECTION/LESSONS LEARNED: On average, residents who rotated through the PCPC more than doubled their procedure numbers. All were judged to be able to perform knee and shoulder procedures independently. The VAPHS PCPC is a procedure rich environment allowing residents to increase their experience in performing knee and shoulder injections. Residency programs should consider establishing similar procedure clinics.
ONLINE RESOURCE URL (OPTIONAL):
QUALITY AND SAFETY TRACK: A PILOT PROGRAM TO DEVELOP STUDENT LEADERS IN QUALITY IMPROVEMENT AND SAFETY Julie Oyler 1; Lisa Vinci 2; Vinny Arora2. 1University of Chicago Medical Center, Chicago, Illinois ; 2Univeresity of Chicago Medical Center, Chicago, Illinois. (Tracking ID # 11710)
SETTING AND PARTICIPANTS: All first year medical students (MS1s) receive four introductory lectures on quality and safety. We then developed a 10 week elective for students interested in participating in QST. The once weekly, two- hour elective, combined lectures on QI principles with hands-on exercises using real hospital quality data. Students evaluated Center for Medicare Services (CMS) quality data on the http://www.hospitalcompare.org
Web End =www.hospitalcompare.org website and developed a group project. DESCRIPTION: Faculty used

materials previously used in a QI curriculum for medicine residents and faculty to teach principles of writing aim statements, developing process maps, interviewing stake-holders, evaluating measurements tools, developing Plan-Do-Study-Act (PDSA) cycles, creating a fish bone diagram, and developing a theoretical intervention. Students presented their theoretical QI project as the final assignment. The five students in the QST elective worked on a group QI project targeting the CMS measurement of timely antibiotic administration in pneumonia patients. The students recommended that current emergency room protocols be updated with diagnostic criteria for pneumonia and that additional training on pneumonia protocols be added to both nurse and doctor continuing education schedules. NEEDS AND OBJECTIVES: Medical students are often not introduced to quality improvement (QI) and safety concepts and rarely get hands on training in QI methodology. Recently, leaders in the American Academy of Medical Colleges encouraged medical schools to enhance QI education. Our goal is to develop and train student physician leaders in QI and safety. Recent curricular changes require University of Chicago medical students to declare a scholarly concentration. The Quality and Safety Track (QST) is one of five areas that students can participate and coursework includes involvement in the Institute for Healthcare Improvement (IHI) open school and a mentored QI project. EVALUATION: In September 2009, 88 MS1s were surveyed about their comfort with QI methodology using the Quality Improvement Knowledge Assessment Tool (QIKAT). Of the 78 (87%) responders, there was a low level of comfort with basic QI methodology. The same survey was administered to five MS1s before and after their participation the QST elective. Comfort with making changes in a system was low at the beginning of medical school and before the elective (38% and 20%) but improved significantly to 100% after the elective. Similarly, comfort with using small cycles of change and implementing a PDSA cycle were low at the beginning of medical school and before the elective (37% and 20%, 8% and 20%) but improved to 100% of the student being moderately or extremely confident in these areas of QI methodology after the elective.
DISCUSSION/REFLECTION/LESSONS LEARNED: A hands on elective in which real time data engages MS1s in quality improvement efforts can significantly improve the confidence in basic QI methodology. One student has already been selected for a special leadership opportunity by IHI and 4 of the 5 have received funding to work on Quality/Safety projects. Students presented this project as well as mentored projects at the national IHI conference and 4 other conferences and have won regional and national awards.
ONLINE RESOURCE URL (OPTIONAL):
THE IMPACT OF FACULTY CHARACTERISTICS ON INTERNAL MEDICINE RESIDENCY CANDIDATES INTERVIEW SCORES: EFFECT OF FACULTY RANK Julie Oyler 1; Vinny Arora 1; Jeffery Charbeneau 1; James Woodruff1. 1University of Chicago Medical Center, Chicago, Illinois. (Tracking ID # 11720)
SETTING AND PARTICIPANTS: A one time retrospective evaluation of previously existing interview data from applicants interviewed at the University of Chicago Internal Medicine Program from September 2004 to March 2009 was performed.
DESCRIPTION: Faculty interviewers were assigned randomly according to their availability. Each interviewer received an electronic copy of the

candidates Electronic Residency Application Service (ERAS) application prior to interview. Following the interview, faculty were asked to electronically rate applicants on a 1(worst) to 10 (best) scale. Faculty rank was obtained from the Department website. A trend test was used to test the association between faculty rank and interview score. IRB approval was obtained and data was deidentified before analysis. NEEDS AND OBJECTIVES: Research on the intern selection process has focused primarily on the impact of interview techniques and candidates characteristics on the effectiveness of resident selection. Few studies have examined interviewer characteristics, namely faculty rank, on the candidate ratings. Our goal was to determine whether faculty rank of interviewer leads to variation in residency candidate interview scores.
EVALUATION: From September 2004 to March 2009, 1918 applicants were interviewed by 291 faculty for a

total of 3813 discreet in-person interviews. In-person interviews were evaluated by academic title. 432/3813 (11%) of interviews were performed by Professors, 765/3813 (20%) by Associate Professors, 1512/3813 (40%) by Assistant Professors, 756/3813 (20 %) by Clinical Instructors, 231/3813 (6%) by Clinical Associates, 112/3813(3%) by Fellows. The average applicant score after interview with Professor (8.35 +/ SD 1.27), Associate Professor (7.96 +/ SD 1.40), Assistant Professor (7.72 +/ SD 1.32), Clinical Instructor (7.31 +/ SD 1.47), Clinical Associate (7.51 +/ SD1.42), and Fellow (7.38 +/ SD 1.35). ($p < 0.001$)
DISCUSSION/REFLECTION/LESSONS LEARNED: In our preliminary analysis of this large recruitment database, faculty of lower academic rank give residency candidates lower ratings than faculty of higher rank. The effect of rank is statistically significant and consistent across the order of academic rank. Knowledge of this relationship is useful for optimal design of a residency programs interview strategy, and the interpretation of faculty interviewer ratings of residency candidates. ONLINE RESOURCE URL (OPTIONAL):

IMPROVING RESIDENT COUNSELING COMPETENCE: A 5AS SKILLS-BASED OBESITY CURRICULUM

Shwetha Iyer 1; Hillary V Kunins 1; Angela Jeffers 1; Melanie Jay 2; Sheira Schlair3. 1Montefiore/ Albert Einstein College of Medicine, Bronx, New York ; 2Division of General Internal Medicine/New York University School of Medicine, NY, New York ; 3Montefiore/Albert Einstein College of Medicine, New York, New York.
(Tracking ID # 11749)
SETTING AND PARTICIPANTS: Our target audience was 28 interns and residents in the Primary Care/Social Internal Medicine Residency Program at Montefiore Medical Center, Bronx, New York. DESCRIPTION: The curriculum was delivered 4 times over a 6 month period to groups of 5 to 10 residents during ambulatory medicine blocks. One week prior to curriculum participation, residents completed a previously validated survey with 9 items measuring self-assessed obesity counseling competence, based on the 5As model. Each question used a 4-point likert scale. The 3-hour 5As Obesity Curriculum included a 2-hour didactic and discussion session on the epidemiology of obesity, 5As obesity counseling framework and practical tools for its implementation. Case-based discussions of treatment modalities included behavior change, medication, and surgical options for weight loss. The final hour involved reviewing motivational interviewing (MI) and practicing with a standardized patient. Two months after participation, residents completed a post-intervention survey, and gave general feedback. Preliminary analyses compared median scores before and after curriculum participation using the Wilcoxin test. NEEDS AND OBJECTIVES: Although weight loss can lead to a reduction in diabetes and hypertension and improve health outcomes,
only 42% of obese U.S. adults report that their physicians have counseled them about weight loss. Even when weight loss is advised, most physicians do not discuss specific weight loss strategies, indicating that the quality of counseling may be poor. To address this gap, we adapted, implemented, and conducted a pilot evaluation of a previously developed theory-based obesity counseling curriculum for residents using a 5As behavioral change model. In this model, residents are trained to assess obesity risk, agree on mutual goals, advise a weight-control program, assist in establishing appropriate intervention, and arrange for follow-up. The objective of our evaluation was to determine the feasibility and impact of a novel obesity counseling curriculum, which incorporates training and practice in obesity counseling skills, on residents self-assessed competency in obesity counseling. EVALUATION: To date, 16 residents have completed the curriculum and surveys, with another 10 scheduled to participate. Residents reported their counseling competence in: 1) assessing patients stage of change,2) diet and 3) current level of physical activity; 4) agreeing on mutual goals for weight loss; 5) assisting patients in goal setting for weight loss;6) responding to patients questions about behavior change; 7) offering medication and 8) surgical weight loss options; and 9) using MI techniques to change behavior. After the curriculum, there was a significant increase in the median scores from 2 to 3 (2 = somewhat able to perform, 3 = able to perform adequately) in residents report of assessing stage of change, assisting in goal setting, discussing treatment options and using MI techniques. There were no differences in the remaining domains. On qualitative questions, residents reported a high degree of satisfaction with the curriculum and requested

additional skills practice sessions in MI. DISCUSSION/REFLECTION/LESSONS LEARNED: We developed and implemented a novel curriculum for residents to address strategies for weight loss using the 5As behavior change model, which incorporated obesity counseling skills practice. Preliminary pre and post curricular analyses showed improvements in several areas of residents obesity counseling competence. Implementing this three hour curriculum in a residency program was feasible. Post curricular questionnaires indicated that residents were satisfied with the curriculum, and were eager for additional sessions for continued practice and refinement of obesity counseling using MI skills. Further evaluation, with additional learners, and direct observation of counseling skills is needed to fully elucidate the impact of the curriculum in promoting effective obesity counseling skills.
ONLINE RESOURCE URL (OPTIONAL):
INTEGRATIVE MEDICINE IN RESIDENCY (IMR): AN INNOVATIVE SPECIAL INTEREST TRACK AT THE UNIVERSITY OF NEW MEXICO Robert Richard Leverence 1; Arti Prasad1. 1University of New Mexico, Albuquerque, New Mexico. (Tracking ID # 11823)
SETTING AND PARTICIPANTS: The track is available to all Internal Medicine Residents at the University of New Mexico as of July 2010. Prerequisites are enthusiasm about new learning opportunities, commitment towards health and wellbeing, and the ability to maintain a minimum of 30th percentile score in In-Training-Exam. A three year on line curriculum offers evidence-based modules in Prevention, Wellness, Botanical Medicine, Integrative Oncology, Womens Health, Acute and Chronic care, Mental health issues, and CAM Safety& Efficacy. UNM has enhanced this curriculum through onsite mentoring with four IMR faculty, field trips, quarterly talks by guest speakers, a required integrative medicine clinic rotation at the UNM Center for Life, a research /scholarly project in an integrative medicine topic, and an end of the year retreat. There are currently six residents (four PGY3, one

PGY2, and one PGY 1) who have enrolled into this track. They are paired with mentors who also supervise their Continuity Clinics. DESCRIPTION: Integrative Medicine in Residency (IMR) is a 200-hour online competency-based curriculum developed by The Arizona Center for Integrative Medicine, U of A. This curriculum is being piloted among eight Family Medicine residency programs nationwide. There are currently five additional residency sites serving as early adopters of the IMR for which UNM is the only Internal Medicine Residency program. IMR structure was initially derived through formal needs assessment by the U of A. Competencies are aligned with the ACGME Outcome Project; content was developed by leading IM educators; online instruction blends didactic information with interactive, case-based learning and streaming video; a modular format is flexible for resident schedules; online portfolios hold competency evaluation data, and additional teaching is done through experiential on-site methods. Emphasis is placed on teaching self-care and residents wellbeing. NEEDS AND OBJECTIVES: Many Americans use complementary and alternative medicine (CAM) in pursuit of health and well-being. CAM is a group of diverse medical and health care systems, practices, and products that are not presently considered part of conventional healthcare. Integrative Medicine (IM) refers to a practice that combines both conventional and CAM treatments for which there is evidence of safety and effectiveness.The 2007 National Health Interview Survey showed that approximately 38 percent of adults use CAM. The American Medical Association advocates awareness among medical students and physicians of the benefits, risks, and evidence of efficacy for CAM. The Integrative Medicine Track in Residency at UNM Internal Medicine Program was developed to achieve the following goals : Provide residents with a broader clinical skill set Improve patient care Improve resident wellbeing Enhance residency recruitment at UNM Better marketability of graduatesEVALUATION: 1) Evaluation of the Online Curriculum is multidimensional. Curriculum evaluation by residents occurs after course completion. ACGME Competency evaluation is conducted through online

questionnaires and faculty ratings (medical knowledge tests,self assessments,reflection questions,direct observation checklists). Residents wellness and well-being are assessed with online standardized instruments on lifestyle behaviors,stress,burnout,depression,and positive personal characteristics. Resident learning in the IMR is assessed through pre-/post tests using multiple choice questions. 2) Evaluation of the IMR Track includes incoming resident survey to assess IM interest and residency program attraction;resident rating and match success;mid year evaluation of residents in standardized scales of depression,burn-out,stress,satisfaction with life;faculty mentor job satisfaction;ITE scores;# IM projects and presentations;and ABIM scores.

DISCUSSION/REFLECTION/LESSONS LEARNED: As American healthcare shifts from a predominantly disease-management orientation to one that values health maintenance and promotion, we believe Integrative Medicine will play a key role. Likewise, we feel training our residents in Integrative Medicine will not only better prepare them to meet the challenges of clinical care, but itself foster a shift in healthcare to the promotion of wellbeing. Upon introduction of the IMR track at UNM in July 2010, it was met with much enthusiasm not only by internal medicine residents but by institutional leadership including the Dean, Department of Medicine Chairman, General Medicine Chief, and the Residency Program Director, the last two of which enrolled as IMR faculty mentors. Enthusiasm remains high however the primary challenge has been integrating the IMR curriculum into the residency curriculum in a manner that allows adequate time for participation.

UNM is looking at creative ways to sustain this important specialty track.

ONLINE RESOURCE URL (OPTIONAL): https://integrativemedicine.arizona.edu/main/login.html

Web End =https://integrativemedicine. https://integrativemedicine.arizona.edu/main/login.html

Web End =arizona.edu/main/login.html

INCARCERATION MEDICINE AND RE-ENTRY: A CURRICULUM FOR URBAN HEALTH LEARNERS Jennifer E. Bracey 1; Karran A Phillips 2; Rosalyn Stewart3. 1Johns Hopkins University School of Medicine, Baltimore, Maryland ; 2National Institutes of Health, National Institute of Drug Abuse &Johns Hopkins University School of Medicine, Beltsville, Maryland ; 3Johns Hopkins University School of Medicine, Baltimore,, Maryland. (Tracking ID # 11832)

SETTING AND PARTICIPANTS: The IMRC will train PGY2 residents in the Johns Hopkins University Urban Health Residency Program, a combined Internal Medicine-Pediatrics program (MP), and PGY2 residents in the Internal Medicine (IM) Urban Health Primary Care Track.

We are working with Correctional Medical Services (CMS), which currently holds the contract to provide healthcare services to Maryland correctional facilities, to plan resident experiences in the jails or prisons. A Patient-Centered Medical Home model will be the centerpiece of each residents outpatient experience and will take place in the East Baltimore Medical Center (EBMC), located in one of the most under-served communities in Baltimore. Residents will also work in Marylands largest federally qualified healthcare center, Baltimore Medical Systems (BMS). EBMC and BMS patient populations include a large number of formerly incarcerated/newly re-entered individuals.

DESCRIPTION: The objectives of the IMRC are that residents will: 1)Be able to describe the prevalence of incarceration in the United States, including the demographics of the incarcerated. 2)Be able to define commonly used terms in the judicial system as these terms are used in many relevant readings in prison health. 3)Recognize the limitations of healthcare delivery in institutionalized settings, including the challenges in complying with evidence based medicine and CDC guidelines.4)Explain the following non-health related barriers to transitioning back to the community and how these affect access to health care: job procurement, stable housing, transportation, child care, etc. 5)Rate as important both geriatric care and palliative care in prisons and be able to describe programs such as medical parole, compassionate release, hospice units and nursing homes within prison systems. 6)Rate as strongly agree that they can take care of these patients effectively. NEEDS AND OBJECTIVES: In 2009, 2.3 million Americans were in prison or jail and an additional 5

million were on probation or parole. Thus, 1 in 31 adults are under some form of correctional control, a rate that jumps to 1 in 11 among African American men and is higher in many urban neighborhoods. Compared with the general population, incarcerated persons have higher rates of hypertension, asthma, cervical cancer, hepatitis, TB, and HIV.

Although the literature documents the extensive health challenges faced by this sizable population, few formal curricula exist to provide medical trainees with the knowledge and skills needed to care for this vulnerable population and to understand the systems and policies that affect them. The goal of this Incarceration Medicine and Re-entry Curriculum (IMRC) is for learners to develop the knowledge, skills, and attitudes necessary to care for patients who are currently or formerly incarcerated, understanding the unique health challenges faced by these individuals. EVALUATION: At the end of the curriculum, each resident will analyze a problem which they see in incarceration health, hypothesize a strategy to address the problem and present their work to an expert in the field. The identified problem may be a problem found in various settings

including jail intake, prison sick visits, transition back to the community, etc. Program leadership will identify the experts. Examples of these experts include a federal judge, methadone clinic director, healthcare for the homeless medical officer, representative from the mayors office or the City Health Department, or the director of the states correctional medical services (these are some of the individuals contacted for our needs assessment). DISCUSSION/REFLECTION/LESSONS LEARNED: A thorough Needs Assessment has been conducted using multiple modalities including a focus group with learners and both informal and structured interviews with key community players and providers. The objectives will be met through formal didactics, rotations in correctional settings, focus groups with formerly incarcerated individuals, and outpatient experiences.

This curriculum will be implemented with Urban Health residents and Internal Medicine Urban Health Primary Care Track residents beginning in late 2011, early 2012. This curriculum is being planned through the Johns Hopkins Faculty Development Program in Curriculum Development, a longitudinal program spanning nine months, which uses the six step approach used by Kern, et al. ONLINE RESOURCE URL (OPTIONAL):

A CURRICULUM USING POETRY AND FICTION FOR INTERNAL MEDICINE RESIDENTS Calvin Chou 1; Ronald Strauss2. 1University of California, San Francisco, San Francisco, California ; 2University of California, San Francisco, Larkspur, California. (Tracking ID # 11846)

SETTING AND PARTICIPANTS: 48 second-year internal medicine residents in a VA-based residency track (VA PRIME) that focuses on epidemiology and outcomes research in academic years 200910 and 201011.

DESCRIPTION: Over five weeks, residents read and reflected upon poetry and prose while on an outpatient block. After an introduction to how to approach a poem, residents read and discussed medically-oriented poems by diverse writers (Alice Walker, Reynolds Price, Paul Muldoon), poems by doctors (Peter Pereira, Rafael Campo, William Carlos Williams), poems written by patients or patients family members (Donald Justice, Jane Kenyon, C.K. Williams, Avi Kovner), and prose written by physicians (Samuel Shem, Perri Klass). For the final seminar, residents brought in a piece of their own writing (poem, short story, or journal entry) on anything having to do with the experience of being a doctor, a patient, or a patients family member, and they shared their work with each other. We distributed an anonymous survey at the end of the seminar series and asked participants to rate their impressions, either on a four-point (1 = strongly disagree, 4 = strongly agree) Likert scale or a similar five-point scale.

NEEDS AND OBJECTIVES: Many U.S. medical schools offer medical humanities electives, including literature and medicine courses. Various benefits and objectives of such courses have been described: a means of strengthening humanistic competencies such as empathy, an approach to understanding the doctor-patient relationship, and a venue for self-reflection. However, most medical literature on this subject focuses on voluntary offerings in undergraduate medical education. Our goal was to start a required literature and medicine

course for medical residents to increase their own understanding of the patient-physician relationship. EVALUATION: Response rate was 71%. Medical residents (n=34) agreed that this seminar gave them new insights into being a doctor (3.30.6, on 4-point scale), new insights into being a patient (3.40.7, on 4-point scale), and new insights into the process of medical training (3.20.7, on 4-point scale). Residents felt that the curriculum caused them to
reflect on their own personal values (3.20.7, on 4-point scale) and gave them increased empathy for patients (3.30.7, on 4-point scale). There was consensus that the overall course was helpful to me as a doctor(4.40.7, on 5-point scale). In addition, residents liked poetry significantly more after taking the course (3.1 pre vs. 3.9 post-course, on 5-point scale; p<.01) and preferred to spend this instructional time more on a medical humanities topic than a medical science topic (3.5 pre- vs. 4.2 post, on 5-point scale; p<.01).
DISCUSSION/REFLECTION/LESSONS LEARNED: Our literature and medicine course succeeded in enhancing medical residents understanding of their and their patients experiences of medicine as well as appreciation of the value of medical humanities coursework. As we did not select residents based on interest in medical humanities prior to this course, we suggest that other programs can successfully institute similar curricula as a general part of medical resident education. ONLINE RESOURCE URL (OPTIONAL):
THE CRIMSON CARE COLLABORATIVE: A MODEL FOR PRIMARY CARE MEDICAL EDUCATION Michelle Fox 1; Jessica L. OBrien 2; Emily M. Hinchcliff 3; Rebecca Berman4. 1Harvard Medical School, Massachusetts General Hospital, Boston, Massachusetts ; 2Havard Medical School, Boston, Massachusetts ; 3Harvard Medical School, Boston, Massachusetts ; 4Harvard Medical School, Massachusetts General Hospital, John D. Stoeckle Center, Boston, Massachusetts. (Tracking ID # 11853)
SETTING AND PARTICIPANTS: The Crimson Care Collaborative (CCC) is a Harvard Medical School (HMS) and Massachusetts General Hospital (MGH) student-faculty medical practice that provides high quality, affordable, health care to people in Greater Boston who do not have access to a primary care physician. First through fourth year medical students volunteer in all aspects of clinic operation. We had 92 student volunteers this past fall. The practice operates according to a bridge-to-care model: patients are seen on an ongoing basis as needed and simultaneously work with the integrated social services team to find an appropriate long-term care provider.
DESCRIPTION: The CCC is an interactive learning environment that heightens student appreciation for the complexity of primary care. Two students, precepted by a primary care attending physician, see each patient; more senior medical students take on the role of medical educator for their more junior counterpart. This tiered mentorship instills the practice of compassionate care through modeling and internalizing the behaviors of more senior practitioners. In addition, students have the opportunity to assist patients with social service needs, provide personalized health education, andlearn alongside a patient how to navigate the medical system. CCC incorporates education through several other modalities including resident teaching conferences and a 6-week course designed for students to delve deeper intoscholarly work related to the clinic.
NEEDS AND OBJECTIVES: In the environment of a severe shortage of primary care providers, medical schools need to demonstrate commitment to primary care as a career option, and encourage students to become empathic innovators and to develop a skill set to understand and improve an increasingly complex medical system.
Objective of Program:1. Increase exposure to primary care for medical students.2. Appreciate barriers to care, disparities in outcomes, and quality improvement opportunities within a clinic setting3. Promote compassionate patient care as a tenet of medical education EVALUATION: Through surveys and qualitative analyses, we found that students involved in CCC felt they were motivated by a desire to help

patients and to work with the underserved. The majority of students voiced an interest in primary care, and qualitative data suggested that working in CCC confirmed and enhanced student-interest in pursuing a career in primary care. Students report having a more enriched experience in the clinic with both structured and unstructured teaching during clinic. The pilot of the course indicates that students develop thoughtful innovations for the clinic when given a structured environment and faculty support. Through designing and running the CCC, students reported feeling tremendous ownershipand pride in the CCC, and gained a better understanding of the complexity of running a primary care practice. DISCUSSION/REFLECTION/LESSONS LEARNED:KEY LESSONSLEARNEDStudent-faculty collaborative clinics increase medical student exposure to primary care and can enhance and confirm interest in this field. Student-faculty collaborative clinics can be used as an educational tool to teach students about primary care, community medicine, and the challenges of providing health care to the underserved.

Further work is focused on assessing if and how volunteer work in theclinic changes student attitudes toward the underserved and primary care.

ONLINE RESOURCE URL (OPTIONAL):

DEVELOPMENT OF AN INNOVATIVE WORKSHOP TO TEACH COMMUNICATION SKILLS IN GOALS-OF-CARE DISCUSSIONS IN THE ICU Jacqueline Yuen 1; M. Carrington Reid1. 1New York Presbyterian Hospital, Weill Cornell Medical College, New York, New York. (Tracking ID # 11854)

SETTING AND PARTICIPANTS: The 3-hour workshop will be piloted at the resident retreat on April 5, 2011. Participants will include approximately 35 first-year residents at the Cornell Internal Medicine Residency Program.

DESCRIPTION: First, we conducted a needs assessment survey and found that our residents felt inadequately prepared for goals-of-care discussions they have encountered and ranked the discussions in the ICU to be the most challenging. Next, we identified existing courses on goals-of-care discussions in the literature. We then convened an interdisciplinary team of educators from critical care, palliative care and general internal medicine to develop our course content. The course will include these components: 1) A palliative care specialist and an intensivist will role model their approaches to goals-of-care discussions in the ICU setting and use trigger videotapes and cases to prompt a group discussion. 2) Participants will engage in small group role-play exercises with a standardized patient (SP) or family member (SF). After each enactment, a facilitator will direct the participants to self-reflect on their performance, as well as solicit feedback from other group participants and the SP or SF.

NEEDS AND OBJECTIVES: Few residency training programs provide formal training in communication skills in end-of-life discussions. Residents encounter many instances where the need to clarify goals of care arises, but many lack comfort and adequate skills to lead these discussions. Critically-ill patients are particularly challenging because end-of-life decisions often need to be made quickly and by surrogate decision-makers. Our goal is to provide first-year residents with a safe and effective means of learning to conduct goals-of-care discussions in the ICU setting.

Objectives:1. To provide role-modeling of effective approaches to goals-of-care discussions.2. To observe residents conduct goals-of-care discussions in a simulated setting and provide feedback.

3. To improve residents confidence in conducting goals-of-care discussions in the ICU setting.4. To teach communication skills that will be applied by residents in future discussions.

EVALUATION: At the conclusion of the workshop, the participants will be asked to complete an evaluation form to rate the effectiveness of the course on improving their confidence in conducting goals-of-care discussions as well as elicit suggestions for improving the course. After their first ICU rotation (and after completing the course), participants will be surveyed online to assess whether or not the skills learned from the course have impacted the way in which they led goals-of-care discussions during their ICU rotation.

DISCUSSION/REFLECTION/LESSONS LEARNED: To our knowledge, this is the first reported educational

intervention designed to teach residents to conduct goals-of-care discussions in the ICU setting. Experiential learning has been demonstrated to be most effective in teaching these advanced communication skills. Through role-modeling effective approaches and providing observation and feedback in small group role-plays exercises in our innovative course, we believe our workshop will provide a valuable educational experience for our participants. After piloting the course, we will refine the intervention (using pilot data), as well as expand it to target the educational needs of residents at different levels of training and across different specialties. In the near future, we hope to evaluate the impact of the course on residents communication skills via direct observation of actual discussions in real clinical settings or through videotaped standardized-patient exercises.
ONLINE RESOURCE URL (OPTIONAL):

AN INNOVATIVE MEDICAL SPANISH CURRICULUM FOR RESIDENTS Avik Chatterjee 1; Jaideep Talwalkar2. 1Yale Internal Medicine and Pediatrics Residency Program, New Haven, Connecticut ; 2Yale Internal Medicine and Pediatrics Residency Program, Hamden, Connecticut. (Tracking ID # 11855)

SETTING AND PARTICIPANTS: Yale-New Haven Hospital (YNHH) is a 980-bed tertiary care center in New Haven, CT, a city with a population of about 125,000. About 21% of the population self-identifies as Hispanic. The medical Spanish curriculum was offered to all 77 second-, third- and fourth-year residents in the internal medicine, pediatrics, and combined internal medicine/pediatrics residency programs, though only those who self-identified as intermediate or advanced Spanish-speakers were invited to participate. Interns were excluded because it was felt that their schedules would be too busy to allow for meaningful participation. Ultimately, twenty resident learners began participating in the curriculum in July 2010, 85% at the intermediate level and 15% at the advanced level. None are native-Spanish speakers, though all have had some formal Spanish language training.

DESCRIPTION: The curriculum, designed in conjunction with the YNHH Interpreter Services Department, is composed of nine month-long, body-system-based modules. Each module is designed to take 4 weeks to complete. Scheduling is flexible; learners choose how to fit the program into their individual schedules. Each module has grammar and vocabulary objectives, includes a variety of learning activities emphasizing practical applications, and is composed of four parts. Part one is an online grammar and vocabulary lesson; part two is a chapter from a commercially available medical Spanish DVD program; part three is a simulated patient encounter that the learner and the assigned tutor (a hospital interpreter or a native Spanish-speaking resident or fellow) schedule on their own; and part four is a community-based

activity, where the learner delivers counseling (such as smoking cessation) to a native-Spanish speaking volunteer from a local nonprofit organization.

NEEDS AND OBJECTIVES: Monolingual Spanish-speakers comprise a large part of the American patient population, and surveys reveal that physicians-in-training with low Spanish-proficiency avoid seeing Spanish-speaking patients. A needs assessment survey revealed that 91% of residents at our institution noted seeing monolingual Spanish-speaking patients a few times a week or daily, and that residents were eager to become more proficient in medical Spanish. We developed a rigorous medical Spanish curriculum for intermediate to advanced speakers with the goals of improving residents vocabulary, fluency, and confidence in communicating in Spanish, using a flexible structure that would fit into residents schedules. EVALUATION: A multi-phase program evaluation is ongoing. A formal language test was developed including a written and oral portion to evaluate learner progress at the middle and end of the curriculum. The written test was piloted on a group of medical residents/fellows of varying Spanish abilities (ranging from beginner to native speakers), with a resultant gradient in scores. The midyear evaluation, composed of the written test and a survey to evaluate the acceptance and attitudes of the residents to the intervention, is due to be returned at the end of January 2011; of the respondents to date, 100% have completed at least 4 modules and 67% are satisfied with the program. Respondents have reported increased confidence in communicating in Spanish, and anecdotal feedback from

simulated patients also indicates that participants have increased fluency. The final test and survey will take place in June 2011.
DISCUSSION/REFLECTION/LESSONS LEARNED: Our novel medical Spanish curriculum for residents has been well-received by participants and preliminary data indicate that completion of the program components is feasible within a residents schedule. While learners have been able to participate in most activities, scheduling the community-based practice sessions has been a challenge, likely because the activity requires travel to the nonprofits office. We plan on providing additional scheduling assistance and incorporating incentives (e.g., meals) to enhance participation in these sessions. Similarly, due to competing demands, we have met with challenges scheduling oral evaluations of learners. We plan to focus on written evaluations which are more flexible since they do not require simultaneous participation of curricular faculty, volunteers, and learners. Despite these challenges, residents appreciate the flexibility of the curriculum and may have improved vocabulary, fluency, and confidence in communicating in Spanish. ONLINE RESOURCE URL (OPTIONAL): http://www.yrsi.zymichost.com
Web End =www.yrsi.zymichost.com
THE HEALTH LITERACY CEX Elizabeth Leilani Lee 1; Lawrence Ward2.
1Temple University Hospital, Philadelphia, Pennsylvania ; 2Temple University Hospital, Bala Cynwyd, Pennsylvania. (Tracking ID # 11865)
SETTING AND PARTICIPANTS: The clinical evaluations took place at an outpatient internal medicine residency clinic in Philadelphia, PA. The patients of this practice are predominately African American and established to have low health literacy. In a survey of practice patients using the rapid estimate of adult literacy in medicine (REALM) questionnaire 90% of patients met the criteria of low health literacy. A total of 21 residents (6 PGY-1, 8 PGY-2, and 7 PGY-3) participated in the CEX during their weekly continuity practice session. The examinees were blind to the focus of the CEX and had a total of two CEXs completed by two different examiners for the study. The examiners consisted of 5 residents (3 PGY-1 and 2 PGY-3) who observed an entire patient encounter to complete each CEX. The patients used in the CEX
were regular scheduled patients with a chronic medical problem and were allowed to decline participation without interruption to their appointment.
DESCRIPTION: The health literacy CEX consisted of the following 10 interviewing and counseling skills: 1) Greeted the patient with a kind, welcoming attitude 2) maintained appropriate eye contact while speaking with the patient 3) Encouraged the patient to voice their concerns throughout the visit 4) Spoke clearly and at a moderate pace 5) Explained things using non-medical language 6) Limited the discussion to less than 5 major points or topics 7) Gave specific concrete explanations and directions 8) Used visual aid such as a picture, diagram, or model to help explain something to the patient 9) Asked the patient if they had any questions 10) Verified that the patient understood the directions that they gave (i.e.) asked the patient to give teach back and corrected their misconceptions. Each skill was rated on a 2 point scale (0 = not proficient, 1 = approaching proficiency, 2 = proficient) for a maximum score of 20 points.
NEEDS AND OBJECTIVES: Health literacy is defined as a constellation of skills, including the ability to perform basic reading and numerical tasks required to function in the health care environment. Low health literacy can result in difficulty accessing health care, poor health outcomes, and rising health care costs. Approximately 90 million adult Americans have fair to poor literacy placing them at risk. Health care providers are known to overestimate literacy abilities of their patients and further contribute to the health literacy problem. Medical education has recognized health literacy as an important issue, however few education tools exist to teach the clinical skills and interventions that improve health outcomes for poor literacy patients. The objective of the health literacy clinical evaluation exercise (CEX) was to develop a tool that could evaluate the use of health literacy skills in a clinical setting as well as, provide a format that encourages further education on this topic.
EVALUATION: The average total score for the health literacy CEX was12.9. The percentage of residents

scoring proficient for the 10 tasks were: 1) Greeted the patient with a kind, welcoming attitude (95.1%)2) maintained appropriate eye contact while speaking with the patient (82.9%) 3) Encouraged the patient to voice their concerns throughout the visit (51.2%) 4) Spoke clearly and at a moderate pace(68.3%) 5) Explained things using non-medical language (60.9%) 6) Limited the discussion to less than 5 major points or topics (58.5%)7) Gave specific concrete explanations and directions (53.6%) 8) Used visual aid such as a picture, diagram, or model to help explain something to the patient (9.7%) 9) Asked the patient if they had any questions (48.7%) 10) Verified that the patient understood the directions that they gave (i.e.) asked the patient to give teach back and corrected their misconceptions (2.4%). DISCUSSION/REFLECTION/LESSONS LEARNED: The health literacy CEX is an easy tool to implement and can be used to assess learners of all levels of medical education, and can be adapted to a variety of clinical settings including inpatient encounters. The examination format allows for direct bedside health literacy teaching and encourages feedback to improve the residents skills. The greatest benefit we found using the CEX was in identifying residency wide deficiencies. This was dramatically illustrated by the example that only 2.4% of residents correctly used the teach back method. This was an unexpected finding given that residents had been educated multiple times on this method. Overall, the health literacy CEX was developed to assess residents in the clinical skills that have been shown to reduce poor health outcomes in low literacy patients. Further examination of the CEX is necessary to determine its effectiveness in health literacy education.
ONLINE RESOURCE URL (OPTIONAL):
JGIM
ABSTRACTS
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A 28-HOUR RETREAT FOR INTERNAL MEDICINE INTERNS Barry Fields 1; Douglas Olson 1; Chryssanthi Kournioti 1; Stephen Huot2. 1Yale Primary Care Residency Program, Hamden, Connecticut ;
2Yale Primary Care Residency Program, New Haven, Connecticut. (Tracking ID # 11866)
SETTING AND PARTICIPANTS: We planned at an autumn Intern Retreat, held in Connecticuts pastoral Litchfield Hills, which spanned 28 hours between Saturday morning and midday Sunday. All categorical and preliminary interns in the Yale Primary Care Residency Program were invited. The Chief Residents established a period - 9 pm Friday through 5 pm Sunday - during which time residents covered their intern colleagues hospital responsibilities.
DESCRIPTION: Our Retreat was built on our primary goals:1. Enhance teambuilding while allowing expression of internship-related stress. Interns lined up in response to queries such as most introverted to most extraverted, and revealed answers to questions such as, What adjectives might a person use to describe you when they are angry at you? Later, a faculty member facilitated a discussion regarding stressors.2. Provide a forum for information about various programmatic initiatives. Interns participated in research speed dating in which pairs had limited time with one faculty member to learn about ongoing projects before moving on to another faculty member.3. Facilitate interns learning from shared experiences to create a context from which they could approach the next phase of their year. The Program Director and Chief Residents held a session discussing high and low points of the year, allowing common experiences and themes to be shared.
NEEDS AND OBJECTIVES: With ACGME-mandated scheduling changes compounding expected stresses of internship, we sought to provide reassurance, camaraderie, and personal and professional growth to interns completing the first few months of their year. Our specific objectives included:1. Enhance teambuilding while allowing expression of internship-related stress.2. Provide a forum for information about various programmatic initiatives.3. Facilitate interns learning from shared experiences to create a context from which they could approach the next phase of their year. EVALUATION: Intern Attendance: 80% of classPost-Retreat Questionnaire Results: 100% of attendees Agree or Strongly Agree with the statements on a Likert Scale: [This] was an appropriate location in which to have this Retreat and Overall, this Retreat was a valuable part of my

internship.
Representative Quotations from the Post-Retreat Questionnaire:I valued the bonding at the campfire, and our team building activity because it made me appreciate my colleagues even more than before. I feel like our class is closer together and will work better togetherThe Intern Retreat should happen every year.The Retreat created a stronger sense of communityI feel more invested in our group success and the programs success.
DISCUSSION/REFLECTION/LESSONS LEARNED: Participant feedback suggests the overarching goals of the experience were achieved, a key measure of its potential sustainability. We specifically gleaned the following incites from planning, implementing, and reviewing this years Retreat:1. Establish approximately as much free time as structured activities in the Retreats itinerary.2. Allow at least 4 months before the Retreat to find and reserve an appropriate location; many Retreat Centers are booked months in advance.
3. Do not make plans in a vacuum; elicit suggestions from all housestaff and faculty members in conceptualizing a Retreat that fits a Programs needs.4. Choose the Retreat date when intern schedules are created. Therefore, intern vacation time can be avoided.5. Incorporate Intern Retreat coverage into upper-level residents schedules from their time of creation, thus eliminating the chance of prior engagements.
ONLINE RESOURCE URL (OPTIONAL):
AN ASSESSMENT OF THE STANFORD STUDENT EXPERIENCE OF A NEW LEARNING COMMUNITY
Preetha Basaviah 1; Kambria Hooper 2; Lars Osterberg 1; Jennifer Hayes 3; Jennifer Deitz4. 1Stanford, Menlo Park, California ; 2Stanford, Palo Alto, California ; 3Stanford, Stanford, California. (Tracking ID # 11876)
SETTING AND PARTICIPANTS: The setting is the pre-clerkship years (1st and 2nd) at Stanford Medical School. Participants included 124 students in the first two years of medical school, and 15 faculty E4C members.
DESCRIPTION: Beginning in 2008, incoming students were matched with an E4C faculty, who serves as a teacher and mentor. Each E4C guides 56 students per class year in the following ways: providing periodic feedback; assisting in professional development to ensure students graduate with mastery of core clinical skills; reference letters and participate in milestone events; precepting students in preclerkship, cultivating students acquisition and refinement of communication skills, physical examination skills, clinical reasoning, and professionalism; and guidance for reflection and professionalism during clerkship.
NEEDS AND OBJECTIVES: Mentoring is perceived as an important part of academic medicine, but more research on how to design effective mentoring programs is needed. The Educators-4-CARE (E4C) Program, consisting of 15 faculty mentors from multiple disciplines, enhances the development of students as skilled and compassionate physicians by providing a curriculum designed to promote compassion, advocacy, responsibility, and empathy in students. The program focuses on developing students professionalism, clinical skills, and interpersonal communication skills. We developed a survey to assess student perceptions of effectiveness in: program structure; accessibility, quantity and quality of mentorship; and how well E4C prepared students for training. The goal was to identify strengths and opportunities for improvement in developing students professionalism, and clinical and interpersonal communication skills in the pre-clerkship years. EVALUATION: Students (n=124, response rate=75%) positively rate-dthe quality of E4C. More than 80% rated E4C as very good or excellent for rolemodeling, instruction of clinical skills, and professionalism/ interpersonalcommunication skills development. At least 75% of students gave high ratings to professionalism skills development, which included: setting goals; identifyingstrengths; identifying and remediating weaknesses; and feedback, and the overall rating of the program on professionalism/ interpersonal communication. Students overwhelmingly felt their mentor was approachable, accessible, and responsive (91%). Students gave positive ratings for faculty being a helpful resource for academic, clinical, and/or professional development issues(82%), and helping them develop a learning plan (69%). DISCUSSION/REFLECTION/LESSONS LEARNED: Student comments provided feedback for program improvement in the following theme areas: program structure, faculty mentoring,faculty teaching, faculty role modeling, social events, and the role of student feedback. Program

ratings from second year students were slightly lower than first

year students in identifying strengths in clinical skills as well as receiving feedback on clinical skills (83% and 69% for Years 1 and 2, respectively,for both areas). This finding may be attributed to less direct teaching time withE4C mentors in second year. Mentors are now rotating into more parts of the 2ndyear curriculum.
We hope to see E4C impact the following: Student performance on clinical performance examinations and National Board Examination scores Students consistently providing both empathy and relationship-centered clinical care Student wellness Successful faculty re-appointments and promotions among participating E4C facultyONLINE RESOURCE URL (OPTIONAL):
CLINICAL STUDENTS EXPLORATION OF CRITICAL INCIDENTS USING FACULTY GUIDED REFLECTION Preetha Basaviah 1; Lars Osterberg 1; Erika Schillinger 2; Kambria Hooper3. 1Stanford, Menlo Park, California ; 2Stanford, Palo Alto, California. (Tracking ID # 11885)
SETTING AND PARTICIPANTS: Faculty (longitudinal clinical skills mentors and career advisors) facilitated small group discussions with four goals: (1) develop skills of self-reflection; (2) identify coping strategies from peers such as self care, team problems, and burnout;(3) provide a positive influence on professional growth; and (4) promote and maintain humanism and professionalism.
Doctoring with CARE (Compassion, Advocacy, Responsibility, Empathy) sessions occurred every other month in 200910, and were required for coreclerkships students. Faculty facilitate 90 minute, small group discussions.
DESCRIPTION: Themesinclude abuses of power, role on the team, preparing for clerkships, death anddying. Students are encouraged to discuss experiences that challenge themprofessionally. Groups provide a safe place where students freely discussprofessional experiences. Continuity of groups was preserved for most sessions,except when students stepped out of clinical rotations. Students rated experiences-through survey after each session.
NEEDS AND OBJECTIVES: Reflective practice is an essential competency for students and an important skill for professional development. When faced with critical incidents during rotations, students often struggle to cope effectively. Some incidents involve ethical dilemmas, abuses of power, patient disrespect, and positive and negative role-modeling. Some experiences can undermine students professional development, leading students to learn from the hidden curriculum rather than constructive role-modeling. Students often lack support to effectively learn from incidents; reflecting on significant clinical experiences has shown to be an effective way for students to grow professionally. Critical reflection promotes deeper learning, giving meaning to significant clinical experiences.
EVALUATION: Students felt comfortable sharing intense, challenging-situations and ethically ambiguous experiences encountered during clinicaltraining. Students learned and/or shared coping strategies by engaging in candiddiscussions of their clinical experiences. Students learned and/or used skillsof reflective practice. With respect togroup structure, students appreciated having both specific discussion themes aswell as open discussion. DISCUSSION/REFLECTION/LESSONS LEARNED: Our findings raise questions relevant to reflective practicesessions. What is the right balance ofselected themes versus open discussion? Whatis the appropriate balance of faculty input regarding critical incidentsstudents face? Are small group, faculty guided student reflection sessions themost
effective approach for promoting student reflection? Comparing studentexperiences with different methods of promoting self-reflection may helpdetermine the optimal forum for promoting and educating students in reflectivepractice.
ONLINE RESOURCE URL (OPTIONAL):
IMPACT OF A QUALITY IMPROVEMENT CURRICULUM FOR PRECLERKSHIP STUDENTS Preetha Basaviah 1; Kambria Hooper 2; Julia Pederson 2; Stephanie Smith 2; Felipe De Jesus Perez 2; Shubha Bhat 2; Natalia Leva 2; Paul Helgerson 2; Troy Leo 2; Clarence H. Braddock2. 1Stanford, Menlo Park, California ;

2Stanford, Stanford, California. (Tracking ID # 11886)
SETTING AND PARTICIPANTS: Stanfords Practice of Medicine Course developed a QI/PS curriculum for 2nd year students transitioning to clerkships. The goal was to emphasize patient safety principles and systems-based quality improvement, as well as define the role of medical students in a hospital team with regards to practicing methods in patient safety, which could include: observing and reporting errors, dealing with mistakes they make, and actively advocating for QI. DESCRIPTION: Stanfords curriculum consisted of two, 60-minute modules presented in seminar format, focusing on key areas of process and quality improvement, and patient safety.
By the end of the two sessions, students should:1) Understand the importance and relevance of QI/PS in practice2) Briefly describe the local and national QI/PS context3) Articulate the role of the clerkship student in QI/PS4) Feel more prepared to look at clinical practice through a QI/PS lens5) Be familiar with some local Stanford initiatives and tools6) Be familiar with the role of the medical professional in QI/PS NEEDS AND OBJECTIVES: Despite increasing recognition of the importance of quality improvement (QI) and patient safety (PS), the physician role in QI is often not defined or role modeled to physicians in training. In response, a handful of medical schools have begun to incorporate PS training in the curriculum. Long-term data are not available, but results from pilot studies suggest that material is well received. The Telluride Interdisciplinary Roundtable suggested that patient safety curricula re-frame health care as part of a larger system rather than individual practice, begin during the first year and continue throughout training, and foster an environment conducive to communicating and reporting errors.
EVALUATION: The pre/post evaluation showed a significant increase ($p < 0.001$) in trainees attitudes related to the importance of Quality Improvement and Patient Safety topics, including confidence in: defining quality improvement, ability to identify flawed patient care processes, ability to improve flawed patient care processes, and approaching a care provider about a process-improvement idea. The first session, covering Process Improvement and Quality, received a rating of 3.44 (scale 15, poor to excellent) from 63 students. One student commented that the session took a topic that can be quite dry and gave an excellent talk on the subject matter. The second sesssion, covering Patient Safety concepts, received a rating of 3.58 from 59 students. One student commented, The session made a lot of great points and was very rational. I felt empowered towards the end of the talk to make a difference by noticing to detail/small things. DISCUSSION/REFLECTION/LESSONS LEARNED: Results indicate that the curriculum had a positive impact on the knowledge, skills, and attitudes related to quality improvement and patient safety of the students who attended. We have yet to see if clerkship students will participate in QI/PS efforts during clinical training.
ONLINE RESOURCE URL (OPTIONAL):

YOU BE THE EMBOLUS: A STUDY OF INTERACTIVE DESIGN FEATURES FOR LEARNING THE PATHOPHYSIOLOGY OF THROMBOEMBOLIC STROKE Adina Kalet 1; Hyuk-Soon Song 2; Martin Pusic 2; Michael Nick 2; Jan Plass3. 1NYU School of Medicine, Brooklyn, New York ; 2NYU School of Medicine, New York, New York ;
3NYU Steinhardt School of Education, New York, New York. (Tracking ID # 11899)
SETTING AND PARTICIPANTS: The intervention was carried out at a large private medical school in the northeastern United States. The participants were second year medical students who had completed their preclinical Neurosciences block and were about to start their clinical placements. In a 90-minute computer lab session, the students received an introductory neuroanatomy lecture and completed a multiple-choice prior knowledge test. They were then randomized to complete one of four versions of the CAI module (described below) followed by a 20-item post-test where they considered stroke cases similar to those in the module and

identified the likely anatomic correlates. Finally, as a transfer test, participants were asked to identify abnormalities on 20 MRIs with clinical descriptions of actual cases. All measures were scored by an individual unaware of study assignment. DESCRIPTION: We designed an online module that embedded the Stroke Locator activity in 4 clinical cases. Students considered the text of the case and then moved an animated embolus on the 3D model from the carotid to the putative cerebral vessel. After submitting their answer, the students saw an explanation specific to the case. Time was not limited. For the study maneuver, we modified the Stroke Locator module by varying the cognitive as well as the kinesthetic interactivity, creating 4 module versions: movie (low, low), slider (low, high), click (high, low), and drag (high, high). Users in the movie condition observed an animation of the embolus migration. Those in the slider condition had to drag a linear slider placed below the graphic to move the embolus along the correct path. In the click condition, students moved the embolus to any location by clicking on vascular structures. Those in the drag condition had to click and drag the embolus to emulate its movement in the vasculature.
NEEDS AND OBJECTIVES: An important learning objective for medical students is to understand the pathophysiology of embolic strokes in order to be able to recognize clinical stroke syndromes and to be able to precisely link clinical presentations to anatomic locations in the cerebral vasculature. Medical students can learn the pathophysiology of embolic stroke from a number of learning resources; however, for this particularly visual topic, computer-aided instruction (CAI) can enable novel instructional strategies including 3D visual representations and kinesthetic interactivity during learning. We developed the Stroke Locator (SL), a 3D representation of the cerebral vasculature where the student can use the computer mouse to drag an onscreen embolus into any part of the vascular tree and see what stroke syndrome is produced. In a randomized, factorial study design, we used this tool to investigate the effects of kinesthetic and cognitive design elements on the consequent learning.
EVALUATION: 53 students completed the protocol: movie (15), slider(11), click (12), or drag (15). To examine the effects of the level of cognitive and kinesthetic interactivity on clinical knowledge acquisition and reasoning, two-way ANOVAs were conducted. For clinical knowledge acquisition, measured by a multiple-choice test, students who did a module with high cognitive interactivity performed better than those doing one with low cognitive interactivity, regardless of the level of kinesthetic interactivity (Cohens d=0.52; 95% CI: 0.0, 1.0). However, for clinical reasoning, measured by MRI reading, students in the click group performed better than those who received the drag treatment (Cohens d=0.7; 95% CI: -0.1, +1.5). An observed interaction effect for cognitive and kinesthetic interactivity (F (1, 48)=3.91, MSE=84.38, p=.05) suggests that the increased behavioral complexity of the drag action may have elevated demand for cognitive resources beyond that of the click treatment. DISCUSSION/REFLECTION/LESSONS LEARNED: This study has important theoretical and practical implications. The use of interactive features in a multimedia learning environment must be carefully considered. While potentially beneficial, interactivity that is inappropriately applied may hamper rather than facilitate meaningful learning. We found that the increased kinesthetic complexity of dragging a representation of an embolus up the cerebral vasculature reduced participants ability to transfer their new knowledge to MRI reading tasks, compared with simply clicking on the expected point of thrombotic vessel occlusion. If multimedia applications are to promote deep engagement and construction of elaborated mental models in complex content areas, the type of interactivity employed must accommodate the cognitive resource limitations of target learners. A better understanding of this relationship will aid in the selection of appropriate interactive design features in medical multimedia learning environments.
ONLINE RESOURCE URL (OPTIONAL): http://wmdapps.s3.amazonaws.com/SLDrag/index.html
Web End =http://wmdapps.s3. http://wmdapps.s3.amazonaws.com/SLDrag/index.html
Web End =amazonaws.com/SLDrag/index.html
HEALTH DISPARITIES: A METHOD TO TEACH ABOUT VALUES AND ASSUMPTIONS Deborah Swiderski 1; Cristina M Gonzalez 2; Alvin H. Strelnick3. 1Albert Einstein College of Medicine Montefiore Medical Center,

Yonkers, New York ; 2Albert Einstein College of Medicine-Montefiore Medical Center, Bronx, New York ; 3Albert Einstein College of Medicine Montefiore Medical Center, Bronx, New York. (Tracking ID # 11990) SETTING AND PARTICIPANTS: This curriculum is one module in Patients, Doctors, and Communities (PDC), a required course for third year students at the Albert Einstein College of Medicine. Einstein is located in the Bronx, New York, one of the poorest and most diverse urban communities in the United States. Groups of 810 students meet monthly throughout the third year in a 2 hour seminar with dedicated faculty facilitators for a curriculum in advanced communication skills, bioethics, professionalism, health systems, and public health. The only other formal curriculum in HD is an elective for first year students, which attracts about 10 students each year. The curriculum described here is required for the entire class of 180 students. DESCRIPTION: A module on HD has been part of the PDC curriculum since its first year, but the content and structure changed each year because it proved difficult to put a face to the statistics surrounding this problem, and to engage students on a personal level with the problem of implicit bias. Two new instructional methods were piloted in 2010 toward this end. A written assignment asked students to describe an Aha! Moment when they realized they had made an assumption about a patient or team member that they discovered to be incorrect. The second was an opportunity to talk with a patient volunteer from a minority group who would discuss the impact of their minority status on the health care they had received. Students were also given core readings that covered various aspects of HD. Seminar content included time to discuss both assigned readings and students narratives, and 45 minutes to talk with the patient volunteer about their experiences. NEEDS AND OBJECTIVES: The seemingly intractable problem of Health Disparities (HD) casts a long shadow over the many achievements of modern medicine, making its inclusion in medical education imperative, a need acknowledged by many accrediting bodies. While it is important to teach students the dimensions of this problem and its external causes, it is also important, but difficult, to teach them about

the problem of implicit bias, which has been shown to perpetuate unequal care. A novel curriculum developed for third year medical students aims to build student knowledge about the problem of HD in the US and awareness of its multidimensional causes, including unintentional bias from health providersEVALUATION: Feedback about these methods was enthusiastic and positive. Faculty reported that student narratives formed the foundation for an open and honest discussion of the general problem of bias in everyday life and in the practice of medicine. Students and faculty commented on the power of having direct dialogue with a patient about their experience of bias within the medical system. Formal evaluation methods will be employed when the module is offered this year using mixed methods strategies: a student survey to collect self-report data about the impact of the module on beliefs and attitudes about HD and implicit bias; an instrument to allow facilitators to evaluate group discussion and participation; and narrative analysis of the written assignment done in preparation for the session and another assigned several months later at the end of the course, using thematic analysis to evaluate changes in student attitudes. DISCUSSION/REFLECTION/LESSONS LEARNED: The problem of HD is complex and a variety of methods are required to teach it effectively. Engaging an entire class in examining their values and assumptions is a difficult but important aspect of this effort. A number of strategies have been attempted in PDC to meet this goal in prior years, including administration of the Implicit Associations Test (IAT), core readings, and asking students to interview patients on their inpatient teams. The new methods employed in our pilot were far more successful in engaging students and faculty. We hope that formal evaluation will document that it helped them to appreciate the experience of bias from a patient perspective and to become more aware of their own potential for implicit bias, both important goals of the curriculum. Although we did not encounter problems in our pilot, we will enhance preparation for both patient volunteers and faculty facilitators to ensure that both groups feel adequately supported in their roles.

ONLINE RESOURCE URL (OPTIONAL):

INTRODUCTION TO CLINICAL PRACTICE GUIDELINES VIA CASE BASED LEARNING: THE SUMMA

HEALTH SYSTEM INTERNAL MEDICINE RESIDENCY EXPERIENCE Rex Wilford 1; Ronald Jones 1; David Sweet2. 1Summa Health System, Akron, Ohio ; 2Summa Health System, Wadsworth, Ohio. (Tracking ID # 12082)

SETTING AND PARTICIPANTS: Clinical practice guidelines have been developed from reviews of available evidence-based data with adherence being associated with improved patient outcomes. Pay-for-performance programs and public reporting have encouraged adherence. Poor resident knowledge of key clinical practice guidelines has been documented, while implementation of an interactive curriculum has been associated with improvement. We developed an internet accessible case-based ambulatory learning curriculum with direct links to established clinical practice guidelines for our internal medicine residents completing their ambulatory care rotation. DESCRIPTION: Eleven didactic cases involving common ambulatory care medical issues were developed and posted on the residency programs website with electronic links to clinical practice guidelines beginning in December 2008. A post-test to be answered utilizing the guidelines was included with each case. Twice weekly resident led small group educational sessions (30 minutes each) were implemented during the annual one month ambulatory block rotation to facilitate review of the guidelines. Attendance and participation was required for all residents completing their ambulatory care rotation, assuring exposure
of all residents to these guidelines at least annually. Cases were presented by a resident followed by a question and answer session in which residents and faculty participated. Feedback to the presenting resident was provided via the ACGME Learning Portfolio. An anonymous, voluntary electronic survey was posted for two weeks in May 2010 to obtain feedback on the curricular changes.

NEEDS AND OBJECTIVES: 1) Develop an internet accessible case-based ambulatory learning curriculum for Internal Medicine residents with direct links to established clinical practice guidelines2) Integrate this curriculum into the already established didactic program that is part of each residents ambulatory care month

EVALUATION: A total of 41 of 60 possible residents responded to the survey. 98% of respondents felt the didactic sessions where helpful in preparing them for independent practice (35% extremely helpful; 40% very helpful; 23% helpful). 98% of respondents felt the information they had learned during didactic sessions had changed the way they managed their clinic and/or hospital patients. 34% of respondents felt they were not likely or only somewhat likely to have reviewed the clinical practice guidelines prior to graduation without these didactic sessions (5% extremely likely; 20% very likely; 41% likely; 27% somewhat likely; and 7% not likely).

DISCUSSION/REFLECTION/LESSONS LEARNED: Case based learning can be an effective method to introduce internal medicine residents to clinical practice guidelines. Success of such didactic sessions rests on ease of access to the cases and clinical practice guidelines via availability on the internet with direct links, as well as organization and feedback. The vast majority of residents feel participation in such sessions is valuable and contributes to changes in the way they manage their patients. Future studies should focus on the impact of participation in these sessions on subsequent indicators of resident clinical performance. The curriculum could be implemented by other programs. ONLINE RESOURCE URL (OPTIONAL):
http://web.me.com/ronjones1/Site_7/Welcome.html
Web End =http://web.me.com/ronjones1/ http://web.me.com/ronjones1/Site_7/Welcome.html
Web End =Site_7/Welcome.html

MID-DISCIPLINE AND MID-ROTATION ASSESSMENT AND COURSE CORRECTION Mark Mayer 1; David Gugliotti 2; Matthew Kroh 2; Adele Fowler 2; Tracy Hull 2; Xian Jin 2; Robyn Stewart2. 1Cleveland Clinic Lerner College of Medicine of CWRU SOM, University Heights, Ohio ;
2Cleveland Clinic Lerner College of Medicine of CWRU SOM, Cleveland, Ohio. (Tracking ID # 12094)

SETTING AND PARTICIPANTS: In 2006, Basic Core rotations for third year medical students were designed for Cleveland Clinic Lerner College of Medicine and CWRU School of Medicine, integrating core clerk-ships. Goals were to integrate clinical rotations, didactics, and assessments across 2 or 3 disciplines in each Basic Core rotation. For this to work best for assessments, sharing of assessments between faculty of different

disciplines at periodic intervals should occur within a multi-disciplinary rotation.
DESCRIPTION: At the Cleveland Clinic, the Basic Core 1 rotation includes Internal Medicine and Surgery. Students are required to fill out logs for patient encounters, and submit these to faculty online, requesting assessment. They are also assessed on involvement in interdisciplinary didactics. A core faculty assessment team (34 members each in IM and Surgery) meets together every fourth week, tracking clinical progress, personal learning plans, diagnoses and conditions covered by students. This team discusses interventions to address learning needs, and alters upcoming rotations on the same or the sister discipline as needed. These core faculty members meet with students every 4 weeks during a 16-week Basic Core rotation. Mid-reviews and end-of-discipline reviews are entered online by Faculty

Assessment Leaders. These are available to Discipline Leaders (Clerk-ship Directors) and a Basic Core Leader during the rotation, as well as to the student and his/her adviser.
NEEDS AND OBJECTIVES: Learning needs and agendas of medical students as they progress through their core rotations should be assessed by key faculty at intervals during the rotation. These learning needs should also be shared with faculty in rotations that are upcoming. Too often, deficits in learning are not fully appreciated until the end of a rotation, and this information is frequently not shared with faculty in the next rotation.
EVALUATION: The assessment team has made mid-course corrections on behalf of students many times. Based on the assessment teams interactions, students floundering in one discipline have gotten special attention in not only that discipline, but in the sister discipline, reducing the need for subsequent remediation. When needed, remediation plans can be worked on together, without delays which often occur in settings in which the assessment is not ongoing. DISCUSSION/REFLECTION/LESSONS LEARNED: Mid-course correction has been facilitated by the use of a multi-disciplinary assessment team which meets periodically during and between discipline rotations. Information is shared within and between disciplines and (sub)-rotations. Robust use of an online patient log and faculty assessment system has helped; face-to-face meetings of an interdisciplinary assessment team has been critical. Assessment of students progress is optimized compared to standard structures, which often do not share integrated assessments in mid-course within or between disciplines.
ONLINE RESOURCE URL (OPTIONAL): https://casemed.case.edu/cas/
Web End =https://casemed.case.edu/cas/
INPLEMENTING BIOPSYCHOSOCIAL LEARNING IN A LONGITUDINAL AMBULATORY CLERKSHIP: PROGRESS AND CHALLENGES Rosalyn Stewart 1; Gail Geller 2; Patricia Thomas 3; Maura Joyce McGuire4. 1Johns Hopkins University School of Medicine, Department of Medicine, Baltimore,, Maryland ; 2Johns Hophins School of Public Health, Baltimore, Maryland ; 3Johns Hopkins University School of Medicine, Glen Arm, Maryland ; 4Johns Hopkins Community Physicians, Baltimore, Maryland. (Tracking ID # 12119)
SETTING AND PARTICIPANTS: LC begins in the 4th month of medical school, runs for two semesters and enrolls 120 medical students who work 1:1 with an LC preceptor in a practice located within 25 miles of the main campus. Prior to beginning the LC, students complete an intense clinical skills course (CS) and an orientation to HS. Faculty participants included LC preceptors, CS faculty and HS faculty; leaders of all three faculty groups attend integration meetings. The majority of LC preceptors are part-time faculty (85%). All LC preceptors receive a small stipend for teaching, complete orientation and participate in ongoing faculty development (FD) via bi-monthly online meetings. CF and HS faculty do not receive additional support for work in LC and did not consistently participate in FD. Students and faculty have access to online course materials, and receive weekly emails with readings and learning objectives.
DESCRIPTION: In addition to completing 24 patient care sessions, students learn HS by reading, reflecting,

and participating in 5 small group sessions. Students track clinical and HS learning events (HSLE) for two patients per clinic session, and submit 7 written reflections per semester to an online learning portfolio. CS faculty, who also function as individual student advisors, receive an email link when students submit a reflection, and are encouraged to review it.
NEEDS AND OBJECTIVES: Medical education reform calls for formation of professionals who improve medical practice, enhance quality and
safety, and care for patients as individuals. To address these needs, the Johns Hopkins University School of Medicine (SOM) launched a new four year curriculum which combines biopsychosocial and clinical training in a first year ambulatory clerkship (LC). The biopsychosocial curriculum is framed around eleven horizontal strands (HS): clinical reasoning, cultural competence, communications, ethics/professionalism, epidemiology, life-cycle (pediatrics and aging), nutrition, health policy, pain and patient safety. Unique objectives of our LC were to implement a curriculum for biopsychosocial learning in everyday practice, develop qualified faculty and employ appropriate instructional and evaluation methods.
EVALUATION: Curriculum evaluation methods included quantitation of HSLE and a knowledge assessment. Students and faculty complete a clerkship evaluation. FD attendance is tracked.
DISCUSSION/REFLECTION/LESSONS LEARNED: One class has completed the LC with the HS curriculum. HSLE demonstrate exposure to all eleven biopsychosocial strands, and 80.4% of students agreed that biopsychosocial learning objectives were met. Learning methods present challenges; in designing the LC curriculum we felt that reflection and facilitated discussion would promote HS learning, but few students agreed that reflections (19.6%) or small groups (15.7%) were useful. Students strongly endorsed a need for feedback on reflections; while faculty indicated goals and how to provide feedback were unclear. We believe that reflection and discussion are valuable and have potential for consolidating areas of learning that would otherwise be missed. We are working on faculty development, rubrics for providing feedback and evaluating quality of reflective learning, and incorporating team and concept-mapping methods into our small group work.
ONLINE RESOURCE URL (OPTIONAL):

A MORNING-REPORT MODEL FOR AMBULATORY MORBIDITY AND MORTALITY CONFERENCE

Christopher Wong 1; Ginger Evans 1; Joy Bucher2. 1University of Washington, Seattle, Washington ; 2Virginia Mason, Seattle, Washington. (Tracking ID # 12123)
SETTING AND PARTICIPANTS: This M&MC takes place in an academic outpatient internal medicine practice. Participants include general internists, residents, clinic management, and leaders of the front desk, nursing, and medical assistant staff.
DESCRIPTION: The chief medical resident and a faculty provider query the Patient Safety Network database, clinic providers, and staff to identify cases. Cases are selected based on potential medical errors and level of harm. During the hour-long M&MC, an opening confidentiality statement is read, and cases are then presented using a prospective, morning report style using a white board, often beginning with only a basic problem list and chief complaint. In doing so, participants experience the case as it unfolds and actively contribute to the differential diagnosis and management plan. After the clinical course is revealed in full, moderators lead an appraisal of degree of harm (serious, minor, near miss, none) and contributors to error (patient factors, system problems, communication, training). Lastly, participants develop an action plan and create task groups to improve patient safety based on the errors identified.
NEEDS AND OBJECTIVES: Despite its long history, there is a paucity of literature on best practices for Morbidity and Mortality conference (M&MC). A recent survey found internal medicine M&MC to be prevalent and popular, but heterogeneous in format and objectives, with cases chosen for educational value rather than likelihood of error or adverse events (Orlander J et al. Acad Med 2002; 77:10011006). Furthermore, the literature focuses exclusively on M&MC in the inpatient setting.

Our objectives were to: (1) create a M&MC that is sustainable in diverse ambulatory clinic settings, (2) foster a supportive, collaborative environment through a prospective, morning-report style case presentation, and (3) execute action plans to improve patient care. EVALUATION: To date, of the cases discussed, 56% involved harm to patients and 44% were considered near-misses. Common themes were inconsistent clinic protocols, unrecognized medication interactions, medication prescribing errors, and delayed diagnoses of important medical conditions. Examples of quality improvement activities produced from this conference include redesigned clinic protocols for vaccine documentation and acute coronary syndrome, and education on appropriate evaluation of dyspnea and documentation of preventive health screening. Feedback sessions found that participants valued the conferences mission and format. DISCUSSION/REFLECTION/LESSONS LEARNED: The application of a morning report format to M&MC promotes frank and open discussion, in contrast with other types of M&MC in which participants passively consider a fully presented case in retrospect. Furthermore, the morning report format is readily exportable: most internists are familiar with its rubric, and such a conference may be performed in small group clinic settings.

Reflecting on our experience with this innovative model of M&MC in the primary care setting, we find the following critical features: (1) a morning-report style presentation, (2) a small, multidisciplinary group, and (3) creation of an action-oriented task group. This model is not housestaff-dependent and may be readily adopted in any primary care clinic.

ONLINE RESOURCE URL (OPTIONAL):

IMPLEMENTING PATIENT AND FAMILY CENTERED CARE IN THE CURRICULUM OF AN INTERNAL MEDICINE RESIDENCY PROGRAM Maral Kojaian 1; Parul Sud2. 1McLaren Regional Medical Center, Flint, Michigan ; 2Mclaren Regional Medical Center, Flint, Michigan. (Tracking ID # 12138)

SETTING AND PARTICIPANTS: The setting is a community based internal medicine program. Attendants included 36 internal medicine residents (PGY 1,2,3), faculty members, and a subspecialist. One of the regularly scheduled educational noon conferences was converted into a monthly Ambulatory PFCC conference.

DESCRIPTION: A residents continuity clinic patient with family members is invited to the PFCC conference. An informed consent is obtained. The patient presents his/her story and an interactive discussion ensues among faculty, residents, patient, and family. Primary diagnosis, differential diagnoses, and management plans are discussed. The patient and family are encouraged to ask questions and express their beliefs, feelings and frustrations. Specific emphasis is placed on seeking the patients and family members understanding and perspectives about the illness and its effects on their lives.

NEEDS AND OBJECTIVES: Patient- and family-centered care (PFCC) is an approach to health care that is grounded in partnerships among patients, families, and health care providers. The four principles of PFCC are: Dignity and Respect, Information sharing, Participation and Collaboration. Integrating the core concepts of PFCC in residency training programs is seen essential in meeting the six ACGME competencies. There are many barriers to implementing change from the current profession -centric to patient-centered practice. To our knowledge most residency programs have not implemented curricula to teach PFCC to residents. Our primary objective was to implement a model of PFCC in our curriculum. A secondary objective was to seek residents feedback of this process as well as exploring barriers to the practice of PFCC.

EVALUATION: Four months after implementing the PFCC noon conference, a two part-survey consisting of 20 questions was administered anonymously amongst the faculty and residents, to evaluate their knowledge and attitudes about PFCC, and their satisfaction with this model. Twenty three people responded. Over 75% reported that PFCC conference helped improve performance in all ACGME core competencies. Eighty percent and 70% agreed that they would like to implement PFCC in their outpatient clinic and inpatient wards respectively. Ninety percent felt that PFCC strengthens social support and 80% felt that it enhances patients and families understanding of illness. Half reported that PFCC noon conferences might be burdensome to patients or that patients might be offended by revealing sensitive personal history.100% agreed that the

organization provided opportunities to learn directly from patients and their families. Time constraint was perceived as the main barrier to implementing PFCC. DISCUSSION/REFLECTION/LESSONS LEARNED: In the era of healthcare reform, patients remain at the core of human medicine, especially in the context of primary care providers and Patient Centered Medical Home. We took the initiative in our Internal Medicine residency program to teach the concepts of patient-and family centered care via a PFCC conference. This model improved residents perception of performance in ACGME core competencies particularly Interpersonal and Communication skills, Professionalism, and System-Based practice. We did not measure patient /family satisfaction , nevertheless, studies have shown that when health care providers, patients and families work in partnership, the quality and safety of health care rises, costs decrease, and provider and patient satisfaction increases. ONLINE RESOURCE URL (OPTIONAL):

A NOVEL CURRICULUM IN CLINICAL REASONING Joseph Rencic 1;
Robert Trowbridge2. 1Tufts University School of Medicine, Tufts Medical Center, Cambridge, Massachusetts ; 2Maine Medical Center, Portland, Maine. (Tracking ID # 12169)

SETTING AND PARTICIPANTS: 200 second-year medical students are divided into fifteen small groups. Groups meet for nine case-based sessions of two hours each. These are spread over 6 months. This course replaced the previous problem-based learning curriculum in the second year.

DESCRIPTION: To develop clinical reasoning skills, students learn how to apply pattern recognition to cases based on clinical findings and epidemiology, and how to apply Bayesian reasoning for more difficult cases. Each week focuses on a common medical symptom. Web-based, interactive pre-class cases introduce clinical material and teach problem solving and decision making via clinical reasoning tips . Students use these cases to develop illness scripts for specific symptoms. The in-class cases, taught by master clinicians, focus on the same symptom as the pre-class case, but have different final diagnoses. Illness scripts and clinical reasoning concepts from the pre-class case are used to compare and contrast the two cases. Students list the clinical findings, and then rate the likelihood of each finding for each disease in the differential in a tabular format. This allows development of pattern recognition and discussion of Bayesian reasoning.

NEEDS AND OBJECTIVES: Clinical reasoning is a fundamental skill of the physician. Although most medical schools have case-based learning courses, few explicitly teach clinical reasoning. We developed a case-based learning model focused on clinical reasoning that integrates principles of modern learning theory into master clinician-facilitated case-based learning. Our objectives are 1) to introduce students to key definitions and concepts of clinical reasoning, and 2) to teach students to apply these techniques to reduce cognitive diagnostic error.

EVALUATION: Evaluation of the students will be based on a final exam consisting of key features and script concordance testing items, as well as short answer to assess students reasoning processes. In addition, we will use a one station OSCE focused on applying clinical reasoning to an ambiguous case to gain a qualitative understanding of the students reasoning process. The course will be evaluated via a survey instrument and focus groups with the students and faculty. DISCUSSION/REFLECTION/LESSONS LEARNED: This course is innovative in teaching clinical reasoning by strengthening both pattern recognition and analytic skill, as well as methods for reducing diagnostic error. Existing PBL courses at other schools could be easily modified to resemble this one. Seven sessions to date are completed. Preliminary feedback has been extremely positive. Students enjoy linking their pathophysiologic knowledge to clinical cases, and facilitators have all agreed to teach the course again next year. We plan to collect formal feedback from both students and faculty at the conclusion of the course regarding course content and structure and perceived relevance. The major limitation of the course is the assessment of students. Given the significant costs of a multi-station OSCE focused on

clinical reasoning (perhaps the gold standard), our approach seems reasonable. However, we continue to work on better methods of assessment to evaluate the effectiveness of the course in achieving its objectives.
ONLINE RESOURCE URL (OPTIONAL):
DEVELOPING A RESIDENT DRIVEN PEER EVALUATION SYSTEM: OUR PROCESS AND CHALLENGES
Aubrey Jolly Graham 1; Saumil Chudgar 2; Erin Hommel 2; Diana McNeill2. 1Duke University Medical Center, Durham, North Carolina ; 2Duke University Hospital, Durham, North Carolina. (Tracking ID # 12186)
SETTING AND PARTICIPANTS: This evaluation system was implemented in a single, large Internal Medicine residency program of approximately 140 categorical residents and 26 residents from combined residency programs.
DESCRIPTION: A peer evaluation development and implementation committee was assimilated, led by residents and included representatives from all levels of training, with additional support from program administrators and directors. A succinct, practical evaluation tool that would be universal to a variety of inpatient rotations and evaluator-subject relationships was developed. A pre-implementation survey was administered to determine resident attitudes toward peer evaluation.The peer evaluation process was implemented residency-wide after a pilot phase to assess the tools ease of use and methods of dissemination. A post-implementation survey was administered both to residents and faculty advisors to assess acceptability and impact of the system.
NEEDS AND OBJECTIVES: Assessing resident performance the six ACGME core competencies is a critical part of resident education. Residency programs are challenged with demonstrating this assessment using valid and reliable tools. Peer evaluations are one such tool thought to be well suited to provide feedback in competencies that may be more difficult to assess via traditional evaluation methods: Professionalism, Patient Care, and Interpersonal and Communication skills. Unfortunately, limited data exists on the applicability and acceptability of peer evaluation among resident physicians. Acknowledging that residents are uniquely positioned to provide insightful review of each others performance, we sought to develop a valid peer evaluation tool, implement a resident-driven peer evaluation system, and simultaneously assess resident acceptance and perceived utility of peer evaluation. As a means of stimulating acceptance, peer evaluation development and implementation was entirely resident-driven.
EVALUATION: Feedback on the peer evaluation system was assessed periodically through resident-led committee meetings and focus groups, permitting interim adaptation of the feedback tool and dissemination process. Completion rates were tracked real-time. Pre- and post-implementation survey data was compared. Additional survey data concerning residents comfort with the peer evaluation system (including level of evaluator anonymity) was studied. Post-implementation surveys of faculty advisors were also analyzed. The quality of the resident peer-to-peer feedback was considered through analysis of average evaluation ratings per evaluation statement per level of training. Additional data was gathered through review of free text comments regarding specificity and usefulness of the evaluation feedback. DISCUSSION/REFLECTION/LESSONS LEARNED: Securing resident input in the development and implementation of the peer evaluation system was integral to the creation of a useful, applicable, and well-accepted system. The survey tool has since been easily adapted to a multi-evaluator 360 degree system. A completion rate of 87% was achieved. Many residents had positive comments about the utility of the system. Faculty advisors overwhelmingly reported the peer evaluations as useful. The greatest challenge has been maintaining resident confidence in anonymity, limiting more honest and robust feedback. Ratings for certain evaluation statements suggest a trend of improvement between classes as residents advance. Additional challenges include adapting to changes in rotation structure and residency management software, anticipating the cost and resources associated with maintaining the system, and ensuring timely distribution of evaluations.
ONLINE RESOURCE URL (OPTIONAL):
DISCHARGE SUMMARY QUALITY IMPROVEMENT PROJECT
Tehila Zuckerman 1; Dahlia Rizk 1; Maria

Kassab 1; Anna Kochin 1; Rebecca Calabrese1. 1Beth Israel Medical Center, New York, New York. (Tracking ID # 12192)
SETTING AND PARTICIPANTS: The study took place in a large urban academic medical center over a one month period. Discharge summaries of 29 house officers were evaluated when they were assigned to a medical ward during this time. Survey participants included all current internal medicine house officers, the primary care teaching practice, as well as hospitalist physicians. The educational intervention took place in the format of a noon conference for the house staff. DESCRIPTION: An anonymous pre-intervention on-line survey was sent to 121 internal medicine house officers and 39 faculty physicians, asking recipients to rate current discharge summary quality and their interest in a formal educational session on this topic. Thereafter, 30 randomly selected, de-indentified discharge summaries were scored using an 18 item discharge summary quality scoring tool created by study investigators. Subsequently, approximately 6070 internal medicine house officers attended an educational lecture highlighting those items in need of improvement identified by the scoring tool. The session was followed by an anonymous post-intervention on-line survey of house officers, soliciting feedback about the lecture. Lastly, thirty randomly selected, de-identified discharge summaries written by the same group, after the intervention, were scored to evaluate impact. A quality score of 80% or greater was considered adequate quality. NEEDS AND OBJECTIVES: Hospital discharge summaries are an important tool used by clinicians for communication with colleagues and patients. Studies have demonstrated discharge summary quality impacts patient morbidity and mortality. Studies have further shown discharge summary quality often does not meet the standards set by medical societies and physician consensus. This study aimed to determine the quality of discharge summaries written by house staff

at a large urban academic medical center. It further sought to evaluate whether an educational intervention would be effective to improve quality. The perception of the intervention was also assessed. EVALUATION: The pre-intervention survey yielded responses from 50 of 121 house officers and 24 of 39 faculty physicians queried. On average for both faculty and house staff, it was perceived that 60% of summaries were of high quality as it pertains to completeness and legibility. 86% of house officers and 87.5% of faculty agreed a formal educational intervention would be of benefit. The post-intervention survey of 121 house officers yielded 42 responses. The discharge summary scoring tool found the average overall pre-intervention quality score to be 87%, but identified 9 of 18 individual items scored as having an average quality below 80%. The overall post-intervention quality score of the discharge summaries improved to 93.9%, with only 1 of 18 individual items scored having an average quality score below 80%. The post-intervention survey revealed 96% of the house staff attending the session recommended formally incorporating the educational intervention into the academic curriculum. DISCUSSION/REFLECTION/LESSONS LEARNED: House officers and faculty were in agreement regarding the need for discharge summary quality improvement and an educational intervention to help achieve this goal. The educational intervention given for this purpose was universally perceived as valuable by the house officers who attended. Nearly all summary items in need of improvement achieved a quality score of greater than 80% after the educational intervention. Our study demonstrates the value of implementing a formalized discharge summary educational session into the official academic curriculum. ONLINE RESOURCE URL (OPTIONAL):

TEACHING MOTIVATIONAL INTERVIEWING IN AN AMBULATORY MEDICINE CLERKSHIP WITH SUPPORT FROM AN ONLINE WEB BASED ACADEMIC SITE Teresa Cheng 1; Julie M Crosson 2; Warren Hershman 3; Suzanne Sarfaty 4; Thomas Barber4. 1Boston University School of Medicine, Brookline, Massachusetts ; 2Boston University School of Medicine, Dorchester, Massachusetts ; 3Boston University School of Medicine, Sharon, Massachusetts ; 4Boston University School of Medicine, Boston, Massachusetts. (Tracking ID # 12226)
SETTING AND PARTICIPANTS: The MI workshop was one in a monthly series of workshops developed in

academic year 2010 on advanced physician- patient communication as part of Boston Universitys Ambulatory Medicine Clerkship. Our goals in designing the curriculum included maximizing direct teaching time and effective use of senior physicians with advanced communication skills. Scarce instructional time would be reserved mainly for skills demonstration, practice and constructive feedback. Hence, we used an online web based academic site called Blackboard to post assigned readings and demonstration videos on MI technique prior to the workshop session in order to take full advantage of the classroom time to focus on clarification of concepts, discuss contrasting view points and allow extended time for role playing. DESCRIPTION: A major difficulty with teaching MI is the tendency of health care professionals to under appreciate the challenges of adopting behavioral changes in the context of a patients life. Toward this end, during the role plays incorporated into our workshop medical students are asked to work on a meaningful personal health behavior change. During the week, they are asked to post their reflections on Blackboards Discussion Board, an online forum for non simultaneous communication. Postings are grouped into threads that contain a main heading and all related replies. Fellow students are pre-assigned in class to respond to their small group members.
Our innovations for the workshop include the employment of the previously underutilized resource of Blackboard in clinical medicine
rotations, use of experiential learning as a way of enhancing reflection on the challenges of behavior change, and the use of Discussion Board as a vehicle for sharing of reflections.
NEEDS AND OBJECTIVES: Much of health care today focuses on helping patients manage conditions whose outcomes can be greatly improved by behavior change. These conditions range from tobacco and alcohol cessation to control of chronic diseases such as diabetes and hypertension. Motivational Interviewing (MI) has been shown to be more effective than traditional advice giving in the treatment of a broad range of medical conditions. Previous efforts to incorporate MI into the curriculum of medical schools have focused mostly on knowledge and skill development. To promote a shift in attitudes and encourage understanding of the collaborative spirit of MI, we designed an experiential educational intervention to help medical students understand and articulate the challenges of behavior change. We believe this may facilitate empathy and increase understanding of the importance of the patients perspective in health behavior counseling.
EVALUATION: The MI curriculum has been in place since June 2010 and overall response has been positive. Acceptance and participation in this assignment was high. As groups of students interact during the course of the week and comment on each others posts, it is clear that Discussion Board is instrumental in achieving our learning objectives of understanding and articulating the challenges of adopting behavior changes. Students have frequently commented that the challenges of behavior change were greater than they had originally thought. Postings by students reflect on how this helped them realize the difficulties their patients face when taking on health behavior change. In addition, students have been innovative with their use of Discussion Board, attaching pictures of themselves using a variety of exercise equipment as they work to get back in shape or posting additional information they have found while doing research on a behavior change.
DISCUSSION/REFLECTION/LESSONS LEARNED: To our knowledge, online academic websites have not previously been used as a method of encouraging self reflection for behavior change. The most frequent changes adopted by the medical students include healthier eating, exercise, taking vitamins, getting more sleep, and also less common ones such as reduction in online surfing time, more leisure reading, and getting organized.
It is unclear if the increased insight into the challenges of behavioral changes will translate into long term improvements in health care communication overall and in particular for MI. Whereas role plays have been used in other MI curriculum, this is the first time that we have used a student driven scenario. In contrast to what is often seen in other role play sessions, the students remained highly engaged during the sessions. In addition, by the end of the academic year we will have a rich repository of health behavior change reflections which we hope to analyze for content and themes.

ONLINE RESOURCE URL (OPTIONAL):
IMPROVING COMMUNICATION SKILLS AND TRANSITIONS OF CARE: DEVELOPMENT OF A DISCHARGE SUMMARY CURRICULUM FOR INTERNAL MEDICINE INTERNS Briar Leigh Duffy 1; Jed Gonzalo 2; James Bost 3; Melissa McNeil3. 1University of Pittsburgh/VA Pittsburgh, Pittsburgh, Pennsylvania ; 2Beth-Israel-Deaconess Medical Center, Boston, Massachusetts ; 3University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 12248)
SETTING AND PARTICIPANTS: This study was conducted in the University of Pittsburgh Internal Medicine residency program from August-November 2010. All first-year residents rotating on the general internal medicine inpatient services were included. Sixty-five interns participated.

DESCRIPTION: Faculty and residents were surveyed to assess their views about characteristics of the ideal DS. We then used these results to develop the curriculum and to adapt a previously published DS grading tool. The curriculum consisted of a 1-hour workshop during the first week of a 4 week general medicine inpatient rotation followed by weekly 10-minute peer review sessions on colleagues deidentified DSs. The workshop included a didactic presentation of DS requirements and faculty preferences, an exercise on converting hospitalization details to a DS, and an introduction to the DS grading tool. During the peer review grading sessions, each intern received 1) formative feedback via a copy of a DS that he or she had written that had been graded by both another intern and the faculty member and 2) DS that he or she had previously gradedwith a copy of the faculty grade for comparison. Then, each intern graded a new DS written by a peer. Interns completed pre- and post-curriculum questionnaires.
NEEDS AND OBJECTIVES: High quality discharge summaries are critical to ensuring effective transitions of care for hospitalized patients after discharge. Despite their importance, little attention is given to teaching residents how to write discharge summaries (DSs) and this lack of emphasis is apparent. Retrospective analyses of DSs shows they are missing information about pending tests 75-87% of the time and about the follow-up provider 33% of the time. The primary goal of this educational innovation was to develop aninteractive discharge summary curriculum for internal medicine interns. The key element of the curriculum was the use of peer feedback as a way to reinforce key concepts, achieve resident buy-in, and use faculty time efficiently. The goal of the curriculum was improved discharge summary quality. EVALUATION: The mean score of the discharge summary improved ($p=0.02$). They reported that they had a higher level of knowledge about the required ($p=0.001$) and preferred components ($p <0.001$) of a DS compared to before the curriculum. As a result of this curriculum, participating interns stated they would write higher quality DSs (3.83/5) and would be better able to offer constructive feedback to peers (3.73/5). They felt it should be offered to next years interns (4.1/5). They commented that the feedback, specific critiques, and anonymous peer grading were helpful.
DISCUSSION/REFLECTION/LESSONS LEARNED: Participating interns improved the quality of their DSs in several categories, felt the curriculum was valuable, and asked that it be offered to future interns. Peer feedback can enhance learning for interns and distribute the teaching workload from faculty.
ONLINE RESOURCE URL (OPTIONAL):
AN EDUCATIONAL INNOVATION - INTRODUCTION OF WEB-BASED PERIOPERATIVE TEACHING MODULES FOR SENIOR RESIDENTS ROTATING THROUGH THE GENERAL INTERNAL MEDICINE CONSULT SERVICE Fraulein Morales 1; Vijay Daniels 1; Cheryl Goldstein 1; Narmin Kassam1. 1University of Alberta, Edmonton, Alberta. (Tracking ID # 12282)
SETTING AND PARTICIPANTS: In our institution, third year Internal Medicine residents complete a 4-week rotation on the GIM Consult Service. The objectives of this rotation are for learners to: gain an understanding of the consultation process, triage admissions from the Emergency Department and transfers from the Intensive

Care Unit, and learn the principles of perioperative management by completing consultations from surgical services, under the guidance of a staff internist. Perioperative consultations provide the bulk of consultations on the service.
DESCRIPTION: The authors identified the most common issues encountered in perioperative medical consultations and modules were
created to address these. Each module had a primary author and a reviewer. The author completed a literature search and wrote a summary document. The modules consisted of this summary document and the referenced articles. Twelve modules were written and uploaded to our online e-learning community allowing users access from anywhere at any time.
NEEDS AND OBJECTIVES: Prior to this Perioperative Module, there were no formal references or resource materials regarding perioperative medical management available to learners at our institution. Learning was highly preceptor and case-dependent.
To identify medical issues most commonly encountered in the General Internal Medicine (GIM) Consult Service in a tertiary care, teaching hospital. To design and create an evidence-based curriculum on perioperative medical management that will be resource material for learners rotating in the GIM Consult Service.
To design and create evidence-based curriculum on perioperative medical management that will serve as a teaching guide for preceptors on the GIM Consult Service.
To disseminate the use of the curriculum through the University of Alberta Department of Medicines web-based teaching and learning tool.
To evaluate learner usage of the curriculum by gathering usage data from our e-learning community.
EVALUATION: We introduced the perioperative modules during the Internal Medicine residents Academic Half-day to increase comfort with the online e-learning resource and to encourage use of the modules. After a two-hour seminar, the residents completed a survey which demonstrated that 92% planned on using the modules as their primary resource for perioperative medicine. After the seminar, mean comfort level with the online e-learning resource increased from neutral to between somewhat comfortable and very comfortable.
We will be presenting the usage data from the months of July to January, which will include how often learners use the modules, which modules are used most and least often, and whether there is a relationship to usage and timing of the rotations final examination on perioperative medicine. DISCUSSION/REFLECTION/LESSONS LEARNED: The authors initially intended to write a perioperative curriculum as a result of the absence of an evidence-based resource for learners and teachers. The idea to publish the modules on our online learning community came from the desire to disseminate the modules to a wider audience. We accomplished this by:Making the modules accessible from anywhere at any time (point of need). Collaborating with our e-learning community experts to have access to convenient links to relevant resources.
Encouraging the use of discussion boards for learners with questions/ clarification.
Clearly identifying module facilitators along with their contact information. Challenges remain, including (1) regular review of literature to update the modules (2) promote the continued use of the modules and discussion boards by both learners and preceptors and (3) encourage the readers to delve deep into the evidence and literature behind the summary documents and not focus on the latter.
ONLINE RESOURCE URL (OPTIONAL):
SAFE TRANSITIONS FOR EVERY PATIENT (STEP): ITS PRIMARY Geoffrey C Lamb 1; David Klehm 1; Heather Toth 1; Michael Weisgerber1.
1Medical College of Wisconsin, Milwaukee, Wisconsin. (Tracking ID # 12284)
SETTING AND PARTICIPANTS: The STEP Collaborative is a group of Medical College of Wisconsin faculty in internal medicine, pediatrics,

and family medicine participating in a three year faculty development program designed to train faculty in

curriculum development. The strategy is to develop methods to effectively teach learners to conduct safer and more effective care transitions. We have developed a workshop for training residents to effectively perform care handoffs using a standardized communication tool (the PRIMARY mnemonic). The targeted learners are residents in primary care specialties although the program would be suitable for senior medical students and specialties in which handoffs are commonplace.
DESCRIPTION: Content was developed using a systematic process including 1) a review of the care transition literature, 2) a needs assessment using surveys and structured interviews, 3) synthesis of the results of #1 and #2 to develop a standardized tool for care transitions (the PRIMARY mnemonic: Person, Reason, Input, Medical course, Assessment, Responsibilities, and Your turn) and 4) workshop creation and piloting during monthly faculty development sessions. This one hour workshop consists of an introductory presentation, an interactive discussion of critical incidents involving care transitions, and a spirited Jeopardy-like game to reinforce key elements of the process. The workshop packet contains the PRIMARY care transition mnemonic, a critical incident worksheet, a quiz for assessing learner knowledge, a workshop evaluation form, and a detailed instructors guide.
NEEDS AND OBJECTIVES: Lack of quality communication at the time of transition of patient care from one health care provider to another can lead to medical errors, patient dissatisfaction, and inefficiencies. The Joint Commission has identified that 70% of errors leading to significant patient harm arise from poor communication, often at the time of a hand off. Despite this, there is little formal education on the best methods of communicating necessary information at the time of a care transition. The few existing curricula have focused largely on handoffs within the hospital setting. Transitions to and from the primary care medical home have not been addressed. There is a need for curricula that emphasize the effective transition of patients from the perspective of the primary care setting. The purpose of this workshop is to introduce residents to a systematic approach to providing safe transitions for patients to and from the primary care setting.
EVALUATION: As a pilot, the workshop was initially presented to 37 family practice residents of all levels of training. Based on feedback from this session, the introductory lecture and the Jeopardy game were restructured make them clearer and more focused and to include more case examples.
Nineteen first year internal medicine and eight pediatric residents completed the revised workshop. Evaluations were performed using the session evaluation form. Participants found the workshop to be relevant(6.0; 1 = poor, 7=excellent) and believed that it would improve their handoff skills (3.1; 1 = strong disagree, 4 = strongly agree).
DISCUSSION/REFLECTION/LESSONS LEARNED: We designed an interactive workshop to train residents to perform consistent handoffs to and from the primary care setting. The materials developed are easily shared and adaptable to other audiences. Residents appreciate the varying formats within the workshop although transitions from one activity to another need to be smooth, without delays. The Jeopardy game can get competitive. Rules and judges decisions need to be clear and consistent. Overall, the workshop has been well received and has been characterized as both valuable and funONLINE RESOURCE URL (OPTIONAL):
FACULTY DEVELOPMENT FOR CONTRIBUTED SERVICES FACULTY THROUGH PRESENTATION ATA CME CONFERENCE Toshiko Uchida 1;
David Baker1. 1Northwestern University Feinberg School of Medicine, Chicago, Illinois. (Tracking ID # 12352)
SETTING AND PARTICIPANTS: At Northwestern Universitys Feinberg School of Medicine (NUFSM), our affiliated private practice and FQHC faculty are designated as Contributed Services (CS) faculty with Clinical professor titles. Starting in 2010, we recruited 4 CS faculty to analyze and present original research articles from the previous year at an annual CME conference. The CME conference is called the Year in Internal Medicine (YIM) and has been hosted by our Department of Medicine for the last 47 years. YIM draws approximately 200 internists each year, and consists of both didactic presentations and small group workshops lead largely by NUFSM specialists. Our session was a new addition to YIM entitled the Update in General Internal Medicine. This project was developed through our CTSA-sponsored practice based research network known as REACH.

DESCRIPTION: For each of the last 2 years, 4 CS faculty (3 private practice and 1 FQHC) per year have been recruited to present 2 articles each. Presenting faculty have ranged from 114 years post-residency, with most having very limited experience with professional presentations, and none in a setting like YIM. Articles are drawn from our monthly Division of General Internal Medicine Journal Club from the previous year. All Division and CS faculty are invited to vote for the articles which they feel have had the greatest impact on clinical practice, and presenters choose from this rank-ordered list. Faculty receive detailed one-on-one guidance and mentorship from an experienced REACH faculty member on every step of the process from article selection to data analysis to slide creation to final presentation. NEEDS AND OBJECTIVES: Many private practice faculty who are affiliated with an academic medical center (AMC) are eager to become more involved in scholarly activities within their institution, but they often find few opportunities to do so. Many AMCs are equally eager to engage their affiliated faculty in the academic life of the medical center with multiple goals including improving job satisfaction and promoting career advancement. In the program described here, faculty from our affiliated private practices as well as our affiliated federally qualified health centers (FQHCs) were recruited to give presentations at an annual continuing medical education (CME) conference hosted by our Department of Medicine. The goal of this program was to develop the analytical and presentation skills of these faculty while providing them with a substantive academic product which can serve as a step toward career advancement. EVALUATION: So far 7 CS faculty have participated in the Update with one faculty member participating both years. All presenters have agreed that it was an extremely valuable learning experience and that it yielded an important academic product. Presenters have indicated that they have gained skills in multiple areas from critical analysis of the literature to PowerPoint techniques to presentation skills. Attendees at the 2010 YIM conference rated the Update a 4.4 on a 5-point scale (the 2011 conference is still upcoming.) The greatest source of negative feedback from the audience was that the presenters were not experts in the topics covered and could not answer questions that were beyond the scope of the chosen articles.
DISCUSSION/REFLECTION/LESSONS LEARNED: Having CS faculty present at this well-established CME conference has been an excellent way to engage them in the academic life of the institution. Developing the presentations is a significant amount of work for these CS faculty, most of whom have full-time clinical responsibilities; however, all have agreed that it was worth the time invested. Since most presenters came to this project with limited experience, significant time and effort in oneon-one input was required from the REACH faculty member as well. Based on the audiences concern that the presenters were not experts, for YIM 2011 the description of Journal Club has been added to the title of the session to clarify the nature of the presentation, and presenters have prepared more thoroughly for anticipated questions. We

plan to continue this project in future years and are in the process of evaluating its impact on the involved faculty over time.
ONLINE RESOURCE URL (OPTIONAL):
MEDHERENCE: EXAMINING PATIENT AND MEDICAL RESIDENT PERCEPTIONS AND BEHAVIORS TOWARDS MEDICATION ADHERENCE Harish Jasti 1; John Donehoo1. 1University of Pittsburgh, Pittsburgh, Pennsylvania. (Tracking ID # 12399)
SETTING AND PARTICIPANTS: First-year internal medicine residents participate in a month-long ambulatory rotation. Included in this block are 2 four-hour small group sessions devoted to Pharmacology. DESCRIPTION: During the first session, the residents attend interactive didactic sessions focusing on principles of medication adherence. They are then given a list of patients who were seen by co-residents during the previous month and prescribed a new medication. The residents call patients and administer over the phone validated and scripted survey questions that assess patient adherence and physicians communication skills to improve adherence. A

pharmacist coaches the residents during these calls, and also conducts a post-call debriefing session. During the second session, the principles from session one are reviewed, along with the presentation of additional interactive didactic sessions. Another series of telephone calls is then conducted. Afterwards, direct feedback is provided to the original prescribing resident-physicians about their non-adherent patients with an explanation of the reasons for non-adherence.
NEEDS AND OBJECTIVES: Medication adherence continues to be challenging for patients and health-care workers. As many as 40-50% of prescribed medications are sometimes omitted by patients. Previous studies have identified some of the barriers that influence adherence. However, few have examined the impact of physician-patient telephone communication on residents perceptions of non-adherence.
The objectives of the study were to: (1) Identify the patients perceptions and beliefs of the barriers to medication adherence; (2) Increase the knowledge of medicine residents about these barriers; and (3) Provide residents with feedback about their patients medication adherence, and thereby potentially change prescribing behavior.
EVALUATION: During the period between Oct 2009 and May 2010, 77 patients from a general medicine clinic who had been started on a new medication during the previous week were contacted by telephone. Of those, 21 (27%) and 23 (30%) were deemed to be at medium or high risk for non-adherence, respectively. From the patients perspective, reasons for non-adherence included: (1) Concern that the medication would cause more harm than benefit; (2) Belief that the medication was not important; (3) Unable to clearly understand the purpose of the medication; and (4) Unable to afford the medication. At the end of the 2 sessions, greater than 95% of the residents commented that the sessions were extremely helpful and that they would incorporate the lessons learned.
DISCUSSION/REFLECTION/LESSONS LEARNED: Our study demonstrates an innovative approach to help resident physicians better understand the reasons for medication non-adherence. One resident noted that Calling patients provided valuable information about patients insight about their medications.... I will spend more time in clinic on patient education when prescribing medications. Another remarked that After speaking to patients who had recently been started on medications, their stories stuck in my head.... from now on, when prescribing new medications, I will ask patients if they will take them and elicit their concerns about adherence. Future research we will be conducting is to determine if this approach improves the interaction that residents have with patients during the
prescribing process, as well as the potential impact that calling patients has on their prescribing patterns and medication adherence rates. ONLINE RESOURCE URL (OPTIONAL):
ENHANCING MEDICINE SUBINTERNSHIP THROUGH NARRATIVE MEDICINE Susan Clark Ball 1; susan clark ball1. 1Weill Cornell Medical College, New York, New York. (Tracking ID # 12407)
SETTING AND PARTICIPANTS: The facilitatormet once a week for an hour with students during their medicine sub internship.Sessions consisted of 26 students.
DESCRIPTION: Students wereinvited to reflect on their sub internship experience, to discuss difficult orrewarding situations and to comment on their ownership of their role asphysician. Students read a brief text (poem, essay, story) chosen by thefacilitator, then discussed the writing, offering perspective on both thecontent and the style. Students were then asked to write to a given prompt,usually a prompt influenced by the reading, such as, describe a time when youhad a front row seat, or write about a safe place. Students and facilitatorread their writing to the group and reflected on the content and narrativestyle.
NEEDS AND OBJECTIVES: Fourth yearstudents on the Medicine SubInternship lack a forum in which they cannonjudgmentally assess their work and their future as clinicians. Our curriculum innovation sought to supportthe Medicine SubInterns by offering an added perspective through narrativecompetence and reflective writing. EVALUATION: This is the firstyear that this project has started. Students responses have been positive but more rigorous evaluation hasnot been done. Assessment tools andideas for further course enhancement are under discussion. DISCUSSION/REFLECTION/LESSONS LEARNED: The techniques ofNarrative Medicine

used in our curriculum innovation seek to enhance thestudents capacity for narrative competence and reflective writing. The Medicine SubInternship is a pinnacleexperience for most students as they find themselves at the end of one career(student) and the beginning of another (physician). The SubInternship involvesa surfeit of responsibility and a limited amount of authority. Students spend inordinate amounts of timelearning the rules and tools to get their work done but little if anystructured time is spent reflecting on their role as doctor, on theircommunication with their patients, or on their experience as a person. The Narrative Medicine curriculum innovationlooks to broaden students perspective on the sub-I experience and improvetheir understanding and insight into their role as physician.
ONLINE RESOURCE URL (OPTIONAL):
I HAVE A WEALTH OF RESOURCES IN MY COMMUNITY : A MULTI-METHOD APPROACH FOR CROSS CULTURAL TRAINING FOR INTERNAL MEDICINE RESIDENTS Lisa Staton 1; mukta panda 1; Carlos Estrada 2; donna roddy 3; david ortiz4. 1University of Tennessee College of Medicine, Chattanooga, Chattanooga, Tennessee ; 2Birmingham VAMC, The University of Alabama at Birmingham, Birmingham, Alabama ;
3Blue Cross BlueShield Tennessee, Chattanooga, Tennessee. (Tracking ID # 12422)
SETTING AND PARTICIPANTS: The Internal Medicine Residency Program at the University of Tennessee College of Medicine, Chattanooga partnered with BlueCross BlueShield of Tennessee to obtain license to use an innovative web based curriculum, Quality Interactions; trainees were required to complete 16 online sessions. The interactive case-based program uses real patients through case-based scenarios to

demonstrate how cross-cultural challenges can be addressed in the clinical setting. We evaluated the course using domains referenced similar to the General Cross-cultural Preparedness survey to assess the participants perceived preparedness for dealing with a variety of cultural encounter after the course (28 items; 5-point Likert scale). DESCRIPTION: The multi-method approach included: a) a week long mid day conference series (panel discussion, introduction to online resources), b) a noon conference webinar with a national expert, c) small group sessions, d) a multi-cultural social gathering with local diversity leaders in the university, hospital, and private health care community and e) a Grand Round presentation on cross cultural training (introducing an NHLBI-funded online curriculum, Cultural Competencies Online for Medical Practice, http://www.c-comp.org Web End =http://www.c-comp.org).
NEEDS AND OBJECTIVES: National organizations recommend that health care professionals remain sensitive to cultural diversity among patients and recognize that preconceived perceptions may contribute to disparities in health care. Furthermore, accrediting organizations support inclusion of cultural competence training for student, physicians and all health care providers. We developed a multi-method approach for cross-cultural training of internal medicine residents using community resources.
EVALUATION: Of the 35 participants, 28 responded (80%); 62% were white, 19% African American, 15% Asian and 4% Chinese. Residents comprised 71% of respondents, faculty 7%, medical students 3%, others 19%. Seventy one percent of respondents perceived that the training would help them better care for patients from cultures different from their own and 63% thought participation should help care for patients whose beliefs are at odds with western beliefs. Most participants (63%) felt that the activity would help them feel more comfortable negotiating a treatment plan. Prior to the training, participants felt comfortable obtaining a social history (64%), but felt less comfortable caring for patients who distrust the U.S. system (27%), identifying religious belief that impact care (35%), and identifying customs that might affect care prior to the course.
DISCUSSION/REFLECTION/LESSONS LEARNED: A multi-method approach for cross-cultural training may help improve learners confidence in their preparedness in cultural encounters. The training can set the stage for ongoing online learning and improve residents comfort with cross cultural encounters and improve knowledge, identification and collaboration with community partners. Follow up is needed to assess whether residents

perceived comfort will translate into improved quality of care.
ONLINE RESOURCE URL (OPTIONAL): Cultural Competence Online for Medical Practice (C-COMP): A Clinicians Guide to Reduce Cardiovascular Disparities (http://www.c-comp.org
Web End =http://www.c-comp.org) and Quality Interactions: A Patient-Based Approach to Cross-Cultural Care http://www.bcbst.com/providers/x
Web End =http:// http://www.bcbst.com/providers/x
Web End =www.bcbst.com/providers/x
THE ART MUSEUM AS A SETTING FOR MULTIDISCIPLINARY TEAMBUILDING Mary E. Thorndike 1; Ray Williams 2; Joel T. Katz3.
1Brigham and Womens Hospital/Harvard Medical School, Jamaica Plain, Massachusetts ; 2Harvard Art Museum, Cambridge, Massachusetts ;
3Brigham and Womens Hospital/Harvard Medical School, Boston, Massachusetts. (Tracking ID # 12425)
SETTING AND PARTICIPANTS: The Integrated Teaching Unit (ITU) at Brigham and Womens Hospital is a regionalized general medicine care unit with a focus on bedside teaching, increased educational time, and multidisciplinary teamwork. Two teams of attendings, residents, and medical students rotate on the unit for one-month periods. Pharmacy students rotate for 3-month periods. Nurses, two social workers, two physical therapists, and two nurse-case managers work on the unit as permanent staff, and join with each rotating team to make two integrated multidisciplinary teams. The unit uses a variety of techniques to foster multidisciplinary teamwork including orientations for new team members, daily structured multidisciplinary rounds, a discharge planning checklist, ongoing quality improvement projects, and modeling of teaching and leadership by non-physician professionals.
DESCRIPTION: We designed a teambuilding intervention that takes place twice a month at the Harvard Art Museum. Each team rotating on the ITU has an evening session at the museum attended by all members of the medical team, a selection of nurses from the unit, and the teams assigned social worker, physical therapist, nurse care coordinator, and pharmacy students. Teams take part in a series of structured discussions about works of art, led by a museum educator and a physician. Each work is chosen to prompt discussion and reflection about the nature of teamwork, the communication and interaction style of that specific team, and professional issues raised in the course of caring for patients. Program participants also complete several brief writing exercises over the course of the evening, inviting them to reflect on team dynamics, their own contributions to their team, and parallels or differences between the teams experience in the museum and in the hospital.
NEEDS AND OBJECTIVES: Multidisciplinary teams are common in medical settings, and failures in teamwork and team communication have been shown to contribute to medical errors. As health care organizations work toward new goals of increased efficiency, safety and quality, multidisciplinary teamwork will be required in every setting. However, physicians are trained in a system that tends to emphasize individual responsibility and decision-making rather than teamwork, and which privileges the physician point of view. Other medical professionals are also trained in siloed settings with little opportunity for interprofessional education.
EVALUATION: Program participants complete a written evaluation at the end of the evening in addition to the reflective writing exercises. Feedback from both medical teams and other disciplines has been 100% positive. Common themes that emerge in the writing exercises and evaluations include respect, listening, hierarchy, the traditional segregation of disciplines, and the value of incorporating a wide range of perspectives. Participants frequently comment on the power of working together in a setting where traditional hierarchies and roles are absent. Nurses, social workers, care coordinators, pharmacy students and physical therapists who attend the sessions report that the teambuilding sessions have improved communication and collaboration with the medical teams rotating on the unit DISCUSSION/REFLECTION/LESSONS LEARNED: An art museum-based experience that engages both emotional and cognitive themes, allows transcendence of traditional roles and

hierarchies, enacts team dynamics and encourages reflection on all these themes, has potential to improve communication and teamwork in a multidisciplinary medical team setting. When a group struggles together to build a theory about the meaning of a work of art, a student nurse and a senior physician-scientist can both contribute insights of substantial depth and meaning. The museum experience also serves as a chance for each group to learn something about themselves as a team-patterns of communication, humor, areas of tension, ability to tolerate disagreement and to build on each others ideas. When the teams return to the hospital, there is a new sense of connection, of knowing each other in a way that transcends the superficial. People who would have passed each other without notice now stop and talk about their shared patients.
ONLINE RESOURCE URL (OPTIONAL):
JGIM
ABSTRACTS
S619
RESIDENTS-AS-LEADERS: A PROGRAM OF LEADERSHIP DEVELOPMENT THROUGH ASSESSMENT, OBSERVATION, FEEDBACK AND COACHING Mary E. Thorndike 1; Gregg Stracks 2; Joel T. Katz3. 1Brigham and Womens Hospital/Harvard Medical School, Jamaica Plain, Massachusetts ; 2OPUS Leadership Group, Boston, Massachusetts ; 3Brigham and Womens Hospital and Harvard Medical School, Boston, Massachusetts. (Tracking ID # 12454)
SETTING AND PARTICIPANTS: The Integrated Teaching Unit (ITU) at Brigham and Womens Hospital, a regionalized general medicine care unit with a focus on bedside teaching, increased educational time, multidisciplinary teamwork and leadership development. PGY-2 and PGY-3 residents spend a month rotating as team leaders on the unit.
DESCRIPTION: Each month, the four resident team leaders take part in a structured program of leadership development, co-led by a physician and a management psychologist/leadership consultant. Each resident first completes an online self-assessment of their leadership style including strengths and areas for development, using a commercially available, nationally-normed instrument. Each resident is then individually observed leading team rounds by the leadership consultant, followed by a feedback session incorporating both the results of the self-assessment and the direct observation. During this session residents set individual goals for leadership development for the remainder of the month. Residents are then observed a second time by the ITU medical director, who again provides feedback targeted to each residents individual goals. Finally, feedback on residents performance is obtained from interns and nurses on each residents team.
NEEDS AND OBJECTIVES: Effective leadership by physicians is crucial in the current health-care environment, with increasing emphasis on multidisciplinary teams, collaboration, performance and innovative practice structure. However, little or no consensus exists regarding optimal methods for defining and developing effective leadership during residency. This lack of consensus is reflected in the ACGME competencies, where leadership themes appear in multiple locations without a clear focus.
EVALUATION: Our goal is to use information gathered from the resident self-assessments, observations and the 360-degree feedback to create and validate a tool specific to resident leadership skills that can be used both as an assessment and a guide to individual resident development. DISCUSSION/REFLECTION/LESSONS LEARNED: The first twenty residents to experience the program have given positive feedback about the percieved value of the intervention. Analysis of residents leadership behaviors as reported in the self-assessment and through direct observation show that the most commonly observed behaviors include interpersonal skills such as approachability and caring in relation to team members, as well as being organized and methodical in their work. Behaviors least frequently manifested include communicating clear expectations and giving feedback to team members.
ONLINE RESOURCE URL (OPTIONAL):
READMISSION MORNING REPORT: A NOVEL WAY TO INCORPORATE SYSTEM BASED PRACTICE,

HOSPITAL PRIORITIES, AND RESIDENT EDUCATION Mario Njeim 1; maguy chiha 1; Pamela Cooper 1; Kelly Caverzagie 1; Kimberly 1; Wadih Baker-GenawChacra2. 1Henry Ford Hospital, Detroit, Michigan ; 2Henry Ford HospitalHenry Ford Hospital, detroit, Northville, Michigan, Michigan. (Tracking ID # 12506)
SETTING AND PARTICIPANTS: All residents on the three General Internal Medicine services, in addition to their chief medical residents and senior faculty participate in preparing for the readmission morning report. An individual service meeting with all the team members and the senior staff is held monthly.This meeting helps to prepare for a monthly multidisciplinary readmission morning report attended by the Internal Medicine department leadership,representatives from nursing administration,quality improvement, home care (nursing and home infusion), case management and Psychiatry.
DESCRIPTION: Senior residents are provided with a list of patients who were treated and discharged by their team and had to be readmitted within 30 days. Senior residents are expected to arrange a meeting with their medical students, interns and senior staff to discuss each readmission. The discussion should include the initial assessment, diagnoses at time of the index admission, and the re-hospitalization, and any specific failures that might have lead to the readmission. Residents are expected to judge the readmission as preventable or not and discuss specific interventions that could have potentially improved the patients outcome based on a tool developed at Henry Ford Hospital that is based on the Institute for Healthcare Improvement (IHI) readmission list of typical failures. The results are presented monthly at the multidisciplinary readmission. Our discussion aims to raise our awareness about frequent diseases associated with high readmission rates, system or team errors.
NEEDS AND OBJECTIVES: Readmission rates have recently emerged as a major marker of quality of care and payment reform. In an attempt to incorporate patient safety and quality improvement in resident education, we have developed a new education session where residents review all the patients they discharged that were readmitted to any of our hospital facilities within 30 days. Our objectives are the following:- Provide an opportunity for resident teams to perform self-assessment, identify team or system failures that might have predisposed to readmission and find areas for improvement in patient care- Improve our patient care and attempt to improve patient outcomes Provide a framework for senior residents to demonstrate and practice leadership and participation in a longitudinal System Based Practice (SBP) initiativeEVALUATION: Each readmission isreviewed identifying potential areas for improvement in the following fields:patient assessment; patient, caregiver and family education; hand over communication; post discharge care; or criteria for patient readmission. While we are not expecting a clearand immediate effect of our intervention on readmission rates, we still feelthe collaborative effort will be of educational benefit to all participants. We will also use and evaluate the Readmission Assessment Tool developed at Henry Ford Hospital to track and evaluate monthly readmissions in each of our hospital units. DISCUSSION/REFLECTION/LESSONS LEARNED: Far from achieving animmediate effect on our readmission rates, we believe that our readmission session has a direct effect on improving resident awareness about the typical failures that can lead to hospital readmissions. Reviewing readmissions is alsohelping us identify high risk patient characteristics that predispose to worse outcomes. Our multidisciplinary meeting has been an opportunity to familiarize residents with the multiple resources available to improve our inpatient and post-discharge care. While readmission is considered to be a clear marker of quality of care, it is time to fully integrate readmission assessment in resident education and use it as a good way to demonstrate SBP in action.
ONLINE RESOURCE URL (OPTIONAL):
AN INNOVATIVE APPROACH TO ESTABLISHING COMMUNICATIONS EXPECTATIONS AND STANDARDS IN CONSULTANCY Cheryl Goldstein 1;
Jennifer Ringrose 1; S. Ann Colbourne1. 1University of Alberta, Edmonton, Alberta. (Tracking ID # 12507)

SETTING AND PARTICIPANTS: The University of Alberta Hospital General Internal Medicine Urgent Access

Clinic (UAC) was developed in October 2009 to fill a gap in ambulatory care opportunities for senior internal medicine residents and to fill a need for urgent emergency room and community referrals. This hospital is a tertiary care center and a major referral center for Northern Alberta. The senior residents complete a 2-week ambulatory block rotation with UAC scheduled three days per week. Afternoon clinic responsibilities are in the Preoperative Assessment Clinic. Attending staff is assigned to the UAC on a weekly basis. The senior residents usually see 2 new patients per day and are allotted 1 hr 45minutes to allow for a complete History and Physical exam, presentation and review with staff, and dictation of the consultation letter. During the second week, if necessary, patients may be booked to the same resident for a follow up appointment and follow up documentation as required.
DESCRIPTION: The residents are expected to dictate and review their consultation letters prior to distribution. The Attending physician will review and may choose to further revise the residents dictated letter prior to distribution. The residents are aware of their responsibilities and are given feedback during the rotation. The format of this feedback has been variable. To ensure feedback is provided we have scheduled feedback/teaching session on Thursdays to address resident performance, ambulatory topics and review consultation letters. This feedback will be passed along to the Attending staff covering the second week. At the end of the 2-week rotation, review of the residents consultation letters will assess for improvement in documentation skills. This competency, hitherto, has not been well captured in our curriculum. For the purposes of this study, the residents will be unaware that the consultation letters are part of a more formal research study.

NEEDS AND OBJECTIVES: Canadian and American post-graduate medical education governing bodies list communication as one of the mastery level core competencies for trainees in residency-training programs. There has been minimal research to date with respect to
written consultation letters in residency training programs (1,2). Residents require formal instruction on the key elements of a consultation letter.
Our objectives are:To schedule and ensure concurrent feedback on the completed consultation letters to make sure that the valuable skills of case synthesis and communication are honed and improved.
To meet a curriculum requirement in our training program.
To determine if we are meeting the needs of our referring physician base with our consultation letters.
EVALUATION: We plan to measure the effectiveness of the verbal feedback and the written communication of our residents. Two independent staff physicians will complete the Montreal Consultation Letter Rating Scale (MCLRS) based on the revised initial and final consultation letters completed by the dictating resident, prior to any revision by the Attending physician. The MCLRS was developed at the University of Montreal in 2003 and used by internists providing consultation letters to family physicians(3). In addition to the verbal feedback, the staff physician attending the UAC clinic will complete an evaluation form. The evaluation will be based on surveys sent to our referring physician population regarding the essential features of a consultation letter within Northern Alberta. The two Montreal Consultation Letter Rating Scales, and the two evaluation forms will be compared for each resident. The intra-reader reliability will also be calculated between staff members evaluating each resident. DISCUSSION/REFLECTION/LESSONS LEARNED: Communication is a key skill required for most aspects of care provided by general internists, yet a difficult skill to measure. In reviewing residents written consultation letters, we gain insight into their abilities to synthesize the patients story and care requirements, in addition to their ability to communicate a clearly outlined management plan to partnering providers.
ONLINE RESOURCE URL (OPTIONAL):

Publication date: May 2011

Year: 2011

Modified Spectral Tilt Affects Older, but Not Younger, Infants' Native-Language Fricative Discrimination

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.2 (Apr 1, 2011): 658-667A.
ProQuest document link

Abstract: It is important to ensure that hearing aid fitting strategies for infants take into account the infant's developing speech perception system. As a way of exploring this issue, this study examined how 6- and 9-month-olds with normal hearing perceive native-language speech in which the natural spectral shape was altered to emphasize either high-frequency (positive spectral tilt) or low-frequency (negative spectral tilt) information. Discrimination was tested using a visual habituation procedure. Forty-eight 6-month-olds and forty-eight 9-month-olds were presented with a fricative contrast, /f/-/s/, in 1 of 3 conditions: (a) as unmodified speech; (b) with a -6 dB/octave tilt; or (c) with a +6 dB/octave tilt. Six-month-olds showed evidence of discriminating /f/-/s/ in all 3 conditions, but 9-month-olds showed such evidence only in the unmodified condition. The findings suggest that the perceptual reorganization that emerges for consonants at the end of the first year affects 9-month-olds' discrimination of native speech sounds. Perceptual reorganization is usually indexed by a decline in the ability to discriminate nonnative speech sounds. In this study, 6-month-olds demonstrated an acoustic-based sensitivity to both modified and unmodified native speech sounds, but 9-month-olds were most sensitive to the unmodified speech sounds that adhered to the native spectral profile.

Full text: Headnote

Purpose: It is important to ensure that hearing aid fitting strategies for infants take into account the infant's developing speech perception system. As a way of exploring this issue, this study examined how 6- and 9-month-olds with normal hearing perceive native-language speech in which the natural spectral shape was altered to emphasize either high-frequency (positive spectral tilt) or low-frequency (negative spectral tilt) information.

Method: Discrimination was tested using a visual habituation procedure. Forty-eight 6-month-olds and forty-eight 9-montholds were presented with a fricative contrast, /f/-/s/, in 1 of 3 conditions: (a) as unmodified speech; (b) with a -6 dB/octave tilt; or (c) with a +6 dB/octave tilt.

Results: Six-month-olds showed evidence of discriminating /f/-/s/ in all 3 conditions, but 9-month-olds showed such evidence only in the unmodified condition.

Conclusions: The findings suggest that the perceptual reorganization that emerges for consonants at the end of the first year affects 9-month-olds' discrimination of native speech sounds. Perceptual reorganization is usually indexed by a decline in the ability to discriminate nonnative speech sounds. In this study, 6-month-olds demonstrated an acousticbased sensitivity to both modified and unmodified native speech sounds, but 9-month-olds were most sensitive to the unmodified speech sounds that adhered to the native spectral profile.

Key Words: spectral tilt, infant development, speech perception, fricative discrimination

(ProQuest: ... denotes formula omitted.)

Pediatric hearing aid fitting strategies remain the same whether the wearer is a preverbal infant or a verbal child. Now that universal newborn screening means infants with hearing loss may be fitted with hearing aids very early in life, it is important to assess how the spectral information conveyed by amplification schemes

affects early speech perception in preverbal infants. It could well be the case that preverbal infants immersed in language acquisition have different amplification needs than those of older children who have acquired language. Known differences exist in the way infants with and without hearing loss hear speech, due to factors such as the constraints of hearing aid technology, deficits associated with hearing loss, and periods of auditory deprivation when hearing aids are not worn (Dillon, 2001). All of these factors probably contribute to delayed language acquisition even in early-diagnosed infants (Moeller et al., 2007a, 2007b). However, to date, the spectral patterns used in hearing aids have not been assessed in infants with either normal or impaired hearing. Thus, the aim of this study was to examine the influence of development on the ability of infants with normal hearing to perceive native speech sounds with alternative spectral shapes in order to provide a critical benchmark for future comparisons in infants with hearing loss.

Amplification provided through infant hearing aids most commonly follows either the National Acoustic Laboratories' Nonlinear Fitting Procedure, Version 1 (NAL-NL1; Dillon, 1999) or the Desired Sensation Level input/output method (DSL [i /o]; Scollie et al., 2005). Despite DSL (i/o) prescribing more gain for high frequencies than NAL-NL1, both prescriptions are similar as they generate frequency responses that tend to maintain the natural shape of the speech spectrum (Seewald, Moodie, Scollie, &Bagatto, 2005).1 However, all research in support of the efficacy of the DSL andNAL-NL1 methods has been conducted with adults and older verbal children (Ching, 2003; Scollie et al., 2005), and there is no empirical evidence as to whether this strategy is the best for preverbal infants acquiring the details of their native language. There is some evidence that high-frequency amplification improves the perception of fricatives by language-producing children regardless of whether they have normal orimpaired hearing (Stelmachowicz, Pittman, Hoover, &Lewis, 2001; Stelmachowicz, Pittman, Hoover, Lewis,&Moeller, 2004). In contrast to Stelmachowicz and colleagues (2001), who used expanded bandwidth to increase fricative audibility for verbal children, our aim was to examine fricative perception in preverbal infants using spectrallymodified speech. Our speech stimuli were short fricative-vowel syllables, which had (a) a naturally shaped speech spectra or an altered shape in the form of either a (b) positive or (c) negative spectral tilt. For positive spectral tilt, this resulted in the amplification of high-frequency, and attenuation of low-frequency, spectral energy; for negative spectral tilt, low-frequency energy was boosted at the expense of high-frequency energy.

How will infants respond to positive and negative spectral tilt applied to speech? It might be expected that young infants would respond to speechwith low-frequency emphasis because early perception favors attention to prosodic characteristics of speech carried predominantly by vowels, which generally have greater low-frequency emphasis than consonants. However, this is likely an oversimplification because the development of infant speech perception is more complex than simply attending to the high- or low-frequency attributes of speech. It is a dynamic processwhereby the infant becomes increasingly attuned to the native language through listening to its phonetic and prosodic cues.

In the first months of life, infants with normal hearing use prosodic cues, such as rhythm and intonation, to recognize their native language (Mehler et al., 1988; Moon, Panneton Cooper, &Fifer, 1993; Nazzi, Jusczyk, &Johnson, 2000). Similarly, infants under 6 months of age prefer the low-frequency exaggerated prosodic and affective features of infant-directed compared to adultdirected speech (Fernald, 1985; Kitamura &Burnham, 1998; Panneton Cooper &Aslin, 1990). During the second 6 months of life, infants rely less on prosodic information as they demonstrate a growing awareness of the phonetic details of their native language. Moreover, their preference for infant-directed speech starts to wane (Hayashi, Tamekawa, &Kiritani, 2001; Kitamura &Notley, 2009), and at around 9 months of age, there is an emerging awareness of native-language phonetic and phonotactic information (Friederici &Wessels, 1993; Jusczyk, Friederici, Wessels, Svenkerud, &Jusczyk, 1993).

A developmental shift is also evident in the way that infants perceive native language phonetic units. At birth, infants' speech discrimination depends on general auditory abilities, which allow young infants to discriminate a

universal set of native and nonnative speech contrasts based solely on acoustic information (Eimas, Siqueland, Jusczyk, &Vigorito, 1971; Trehub, 1976). However, at around 6 months of age, infants begin to attune to native vowels (Kuhl, Williams, Lacerda, Stevens, &Lindblom, 1992; Polka &Werker, 1994) and at around 9 months of age, to consonants. Attunement to consonants involves a decline in discrimination of most nonnative consonant contrasts (Best&McRoberts, 2003;Werker&Tees, 1984) and an improvement in discrimination of native consonants (Kuhl et al., 2008). The diminished ability to distinguish nonnative contrasts is claimed to be evidence of infants' progression froma language-general to a languagespecific mode of speech perception in the latter part of the first year (Kuhl et al., 2008; Saffran,Werker, &Werner, 2006).

If native speech is acoustically manipulated by modifying its spectral tilt, how will these modifications affect infants' speech perception as it becomes increasingly language specific?We explored this question by testing the ability of 6- and 9-month-old infants to discriminate the relatively difficult high-frequency native fricative contrast /f /-/s/. Fricatives are characterized by highfrequency aperiodic noise that is produced by air being pushed through two closely held articulators. Typically, the concentration of energy for both /s/ and /f/ is above 4000 Hz, with higher frequency values obtained for /s/ than for /f/ (Clark &Yallop, 1990). Fricatives are among the most confusable contrasts in the English repertoire for adults (Miller &Nicely, 1955) and infants (Eilers, Wilson,&Moore, 1977; Holmberg,Morgan,&Kuhl, 1977; Nittrouer, 2001; Ting, Smith, &Houston, 2006). Fricatives are also the category that is most delayed in young children with hearing loss (Stelmachowicz et al., 2004).

This study tested 6- and 9-month-olds' discrimination of the fricative contrast /f/-/s/, unmodified, with a positive spectral tilt (high-frequency emphasis), or with a negative spectral tilt (low-frequency emphasis). Two alternative outcomes were considered, each dependent on the relative effect of (a) acoustic modes of perception and (b) linguistic modes of perception. The acoustic-based account predicts that positive spectral tilt will facilitate discrimination of the fricative contrast because it increases energy in the frequency region where the distinguishing features of fricatives occur. The alternative perspective considers the effects of native language attunement and the differences in the way 6- and 9-montholds perceive speech as they progress from a languagegeneral to a language-specific mode of speech perception. This account predicts that modifications to speech spectra will interfere with the performance of the 9-month-old group, who will find itmore difficult to discriminate native speech sounds that deviate from the native spectral profile.

Method

In this study, 6- and 9-month-old infants were assigned to one of three conditions: (a) Normal Speech: /faù/ and /saù/ presented in an unmodified form; (b) Negative Tilt: /faù/ and /saù/ with a -6 dB/octave spectral tilt; or (c) Positive Tilt: /faù/ and /saù/ with a +6 dB/octave spectral tilt. Avisual habituation procedure tested discrimination of the contrast in the three conditions. This procedure is widely used in testing speech discrimination in infants younger than 12 months of age (e.g., Best &McRoberts, 2003; Cohen, 2004; Werker et al., 1998). It relies on infants' inclination to fixate a visual display,which is experimentally coupled to an auditory stimulus. Because the auditory stimulus plays only when the infant looks at the visual display and stops when the infant looks away, infants soon learn the contingency of looking to listen. Over time, infants' attention to the visual stimulus diminishes as they habituate to the auditory stimulus. Once habituation occurs according to a predetermined criterion (usually a 50%decline in fixation duration), the same visual stimulus is played again together with a new auditory stimulus. Recovery of fixation duration to the new auditory stimulus is regarded as evidence that infants have discriminated the two auditory stimuli (Houston, Horn, Qi, Ting, &Gao, 2007; Werker et al., 1998).

Participants

Forty-eight 6-month-old and forty-eight 9-monthold infants were included in the study. The infants were recruited through an advertisement placed in Sydney's Child magazine and all were from homes in which Australian English was the primary language. Parental questionnaires indicated that infants had passed their newborn hearing screening test, were born full term, had no prior or current middle-ear infection, and were otherwise healthy at the time of testing. Infants were not tested for middle-ear effusion with tympanometry, and this should

be taken into account when interpreting the results. Data from an additional 22 infants were excluded because the infants failed to complete the task either because they cried or were fussy (three infants) or because they did not meet the habituation criterion (19 infants). Participant details are shown in Table 1.

Speech Stimulus Materials

The speech stimuli consisted of four tokens of /faù/ and four tokens of /saù/ produced by an adult female speaker of Australian English. Fourmeasures were obtained for each token: overall duration, vowel frequency (F0), center of gravity of the fricative, and frequency of the second formant (F2) at vowel transition. As shown in Table 2, measures of duration and mean F0 were similar for all tokens of /faù/ and /saù/, but the syllables differed in terms of center of gravity and the frequency of F2 at transition. The centers of gravity for /f/ and /s/ reflect the level of differentiation in the speaker's vocal tract when articulating the two fricatives (Nittrouer, Studdert- Kennedy, &McGowan, 1989), with the center of gravity higher for /s/ than for /f/ (Jongman,Wayland, &Wong, 2000). Similarly, the F2 transition for /s/ is usually higher than /f/ because its place of constriction is further back in the vocal tract (Wilde, 1993).

Two fast Fourier transform(FFT) filters, as depicted in Figure 1, were constructed in Adobe Audition, one with a -6 dB/octave slope and one with a +6 dB/octave slope. The filters were applied to the fricative tokens over the full bandwidth, which included frequencies up to 10000 Hz. The 6 dB/octave slope occurred between 250 and 4000 Hz around a fulcrum of 1000 Hz, and the filter was flat between 0 and 250 Hz and between 4000 and 10000 Hz. As shown in the three panels of Figure 2, the tokens in the Negative Tilt condition had increased emphasis on all frequencies below 1000 Hz and reduced emphasis on all frequencies higher than 1000 Hz. The tokens in the Positive Tilt condition had increased emphasis on frequencies over 1000 Hz and reduced emphasis on the lower frequencies. The original, unmodified speech tokens were used as the stimuli for the Normal Speech condition. Four tokens of each of the fricative stimuli were presented to the infants in a continuous loop with an interstimulus interval of 600 ms. The sound level across all tokens was measured at 65-70 dBA SPL using a sound-level meter placed at the approximate location of the infant's ear.

Materials and Apparatus

Testing was conducted in two adjacent rooms: a sound-attenuated test room and a control room. In the test room, infants were seated on their parent's lap facing a 43-cm LCD television screen positioned approximately 1.5 m from the infant and at an angle of 8° to the right of the infant's sagittal plane. The audio stimuli were presented through an Edirol micro monitor speaker placed to the immediate right of the screen. Two types of visual stimuli were presented on the screen: (a) a multicolored bull's-eye shown in conjunction with the speech stimuli during habituation trials, control trials, and test trials and (b) a silent visual stimulus presented at the beginning of each trial to attract the infant's attention to the screen. The attention-getting stimulus was an arrangement of colored shapes that loomed continuously from the center of the screen. A digital video camera was positioned directly opposite the infant at eye level and connected to (a) a DVD recorder on which each test session was recorded and (b) a television monitor in the control room, which the experimenter used to judge the infant's head and eye movements in real time. Parents were instructed not to interact with their babies. To minimize any possible parental influence, parents listened to repeated speech syllables (on one channel) overlaid with music (on the second channel) over AKG K270 studio headphones, which served to mask the experimental stimuli.

Procedure

Each infant was tested individually using an infantcontrolled visual habituation procedure. The habituation stimuluswas presented on repeated trials until there was amean 50%decline in fixation duration on three consecutive trials compared to the mean fixation duration of the first three trials. Thus, each infant was exposed to a minimum of six habituation trials. If the habituation criterion was not met after 30 trials had elapsed, the procedure was discontinued, and no further testing was conducted. Once the habituation criterion was met, two no-change control trials (of the habituation stimulus) were presented to ensure that infants had habituated and

did not show spontaneous recovery in fixation duration. Spontaneous recovery was defined as an increase of at least 100% in mean fixation times during control trials compared with the final two habituation trials. Any infants whose fixation times met this criterion were deemed not to have habituated, and their data were excluded from the final analyses. The control trials were followed by two test trials that presented the new test stimulus alternating with the habituation stimulus- that is, /saù/ /faù/ /saù/ /faù/ and so forth (Best &Jones, 1998; Houston et al., 2007). Infants who showed recovery in fixation duration in test trials compared with control trials (i.e., longer mean fixation) were said to have discriminated the two stimuli. Trials began when the infant fixated the attention-getting stimulus for at least 3 s and ended when the infant looked away from the television screen for more than 1.2 s, or when a total of 30 s had elapsed. The experimenter recorded the infant's visual fixations to the screen by pressing the space bar on a keyboard when the infant looked at the screen and releasing the space bar when the infant looked elsewhere. The keystrokes were recorded via purpose-written software, which also controlled sequencing of the experiment.

Results

Mean fixation durations for (a) the final two habituation trials, (b) the two no-change control trials, and (c) the two test trials that presented the novel speech stimuli were calculated for each infant in each of the three conditions. Means and standard errors for each age group in each of the conditions are shown in Figure 3. For each condition, a 2 (Age) ×3 (Trial Type) mixed analysis of variance (ANOVA)was conducted.Two planned contrasts for trial type were included in the analyses. The first contrast was used to confirm that habituation had occurred (i.e., that there was no recovery in fixation duration for control trials compared to habituation trials). The second contrast tested whether there was an increase in fixation duration for test trials compared to control trials (i.e., whether or not the infants discriminated the two speech sounds).

For all three conditions, the contrast testing recovery in control trials confirmed there were no significant differences in fixation durations between habituation and control trials.However, a significant Age ×TrialType interaction in the Positive Tilt condition showed that 6-month-old infants' fixation times decreased in control trials compared with habituation trials, whereas the 9-month-old infants' fixation times increased, $F(1, 30) = 8.74$, $p < .01$. This result likely arose because 10 of the 16 six-month-olds had shorter fixation times in control than in habituation trials, whereas 14 of the 16 ninemonth- olds had slightly longer fixation times in control than in habituation trials. In most cases, the difference was less than 1.2 s. The ANOVA results for the contrast testing discrimination of /f/-/s/-or recovery from control to test trials-in the three conditions are reported in the section that follows.

Normal Speech Condition

The results of theANOVAshowed a significant main effect for trial type indicating that, regardless of age, infants increased their fixation durations in test trials (Mtest = 10.6 s) compared with control trials (Mcon = 6.3 s), $F(1, 30) = 22.28$, $p < .001$, $hp\ 2 = .43$. There was no main effect for age or Age ×Trial Type interaction. Thus, when speech was presented with a natural tilt in the Normal Speech condition, both the younger and older age groups showed evidence of discriminating /f/ versus /s/.

Negative Tilt Condition

The results for the NegativeTilt condition also showed a significant main effect for trial type. Mean performance across the two age groups indicated that the infants increased their fixation durations fromcontrol trials (Mcon = 5.3 s) to test trials (Mtest = 7.2 s), $F(1, 30) = 8.19$, $p < .01$, $hp\ 2 = .21$. There was also a significant main effect for age, $F(1, 30) = 5.65$, $p < .02$, $hp\ 2 = .16$, indicating that across all trial types, the fixation durations of 6-month-olds (M6mo = 6.9 s) were longer than those of 9-month-olds (M9mo = 4.7 s). Given there was no Age ×Trial Type interaction, the results suggest that both age groups discriminated /f/-/s/ in the Negative Tilt condition.

Positive Tilt Condition

In the Positive Tilt condition, there was a significant main effect for trial type, revealing longer fixation durations

for test trials (Mtest = 11.3 s) compared with control trials (Mcon = 6.8 s), F(1, 30) = 19.12, p <.001, hp 2 = .39. However, this main effect was qualified by a significant Age ×Trial Type interaction, F(1, 30) = 5.39, p <.03, hp 2 = .15, indicating that 6-month-old infants showed a larger increase in fixation times from control to test trials than did 9-month-old infants. The superior performance of the younger group was confirmed by paired t tests, which were significant for 6-month-old infants, t(15) = 6.33, p <.001, but not for 9-month-old infants, t(15) = 1.21, p >.25. Thus, the results from the Positive Tilt condition suggest that the younger infants, but not the older infants, were sensitive to differences in the fricative contrast when high-frequency emphasis was applied.

Discrimination Indices

The analyses of fixation duration data suggest that 6-month-olds can discriminate /f/-/s/, whether the contrast is presented as normal unmodified speech or with a positive or negative spectral tilt. Nine-month-old infants, however, only show evidence of discriminating the /f/-/s/ contrast when it is presented as normal unmodified speech or negatively tilted. Because the analyses of fixation duration data are based on group means, this can obscure the underlying individual variation prevalent in infant data. To overcome this issue and examine the discrimination performance of individual infants in each condition, a discrimination index (DI) was calculated for each infant in each age group. DIs were determined by calculating the amount of time infants spent fixating in test trials as a proportion of the time spent fixating during both control and test trials (DI = test/ [test + control]). As the DI approaches 1, the relative difference in fixation time between control and test trials increases; thus, the DI is a type of novelty preference score (Arterberry&Bornstein, 2002). It factors out differences in infants' looking times and allows for meaningful comparisons between subjects across the conditions.

In a procedure similar to that used by Arterberry and Bornstein (2002), we determined a discrimination criterion for each age group in each condition. The discrimination criterion takes into account the variability in each age group in each condition and uses an effect size of 0.5 (Cohen, 1988) to determine a DI score that is significantly above chance. The discrimination criterion for each age group in each condition was calculated using the following formula:

...

where SD is the standard deviation. Using this formula, six discrimination criteria were calculated. The criteria ranged from 0.55 to 0.59. Those infants whose DI was above the discrimination criterion were classified as discriminators, whereas those with a DI below the criterion were classified as nondiscriminators.

Figure 4 shows the distribution of DIs for all infants in each condition. There was considerable variability in discrimination performance, and in all conditions, a number of infants in both age groups exceeded the DI criterion. In the Normal Speech condition, 81% of 6-month-olds and 50% of 9-month-olds were discriminators scoring above the criterion. This result concurs with the results from the fixation duration data, which suggested that both age groups discriminated /f/-/s/ in this condition. In the Positive Tilt condition, 88% of 6-month-olds but only 25% of 9-month-olds scored above the criterion. Again, these results are consistent with the findings from the analysis of fixation duration data, in which the Age ×Trial Type interaction suggested that the 6-month-old group, but not the 9-month-old group, discriminated /f/-/s/ in the Positive Tilt condition.

The DI results for the Negative Tilt condition are interesting because they contrast with the analysis of fixation durations. Recall the fixation duration results suggested that both 6- and 9-month-olds could discriminate /f/-/s/ in the Negative Tilt condition. However, the DI analysis shows that although 50% of the 6-montholds could be classified as discriminators, only 38% of the 9-month-olds are in this category-that is, the majority of 9-month-olds were not sensitive to the contrast in the Negative Tilt condition.

Overall, the DI analysis shows that the majority of 6-month-olds discriminate /f/-/s/ regardless of whether spectral tilt ismodified,whereas themajority of 9-montholds fail to discriminate /f/-/s/ in the modified conditions. The results suggest that younger infants discriminated /f/-/s/best in the Positive Tilt and Normal Speech conditions in which 88% and 81% of infants, respectively, were above criterion, and worst in the Negative Tilt condition in which only 50% reached criterion. For 9-montholds, however, the results show that only 25% of the

Positive Tilt group and 38% of the Negative Tilt group were classified as discriminators. In comparison, 9-montholds performed better in the Normal Speech condition; 50% of infants scored above criterion. Thus, although it might have been expected that positive spectral tilt would provide the most favorable conditions for fricative discrimination-because it amplifies that region of the speech spectrum where the differences between /s/ and /f/ lie-this seemed to be the case only for the 6-monthold infants.

Discussion

The results provide evidence that both 6- and 9-month-old infants can discriminate /f/-/s/. Analyses based on group means and individual DIs showed that 6-month-old infants are sensitive to the differences between the fricatives in all three conditions, with the strongest discrimination performance observed in the Positive Tilt condition and the weakest performance observed in the Negative Tilt condition. In contrast, 9-month-old infants were most sensitive to the fricative differences in the Normal Speech condition, but there was little evidence of discrimination in the Positive or Negative Tilt conditions.

How do these results bear on our hypotheses? First, the acoustic-based account proposed that amplifying high-frequency informationwould provide the best conditions for the discrimination of fricatives because it emphasizes the frequency region where the distinguishing features of fricatives occur. This expectation was met for the 88% of 6-month-old infants classified as discriminators but not for the 25% of 9-month-old infants in the Positive Tilt condition. Second, the linguistic attunement account predicted that 9-month-old infantswould discriminate the fricative contrast only in the Normal Speech condition due to their increasingly language-specific speech perception strategies. Our results confirm this prediction, with 6-month-olds showing evidence of discriminating /f/-/s/ in all three conditions, but 9-month-olds showing such evidence in the Normal Speech condition only.

At first glance, the finding that younger infants seem to discriminate a modified native-language fricative contrast more successfully than older infants seems counterintuitive. Evidence showing that general auditory perception abilities such as intensity perception (Trehub, Schneider, Morrongiello,& Thorpe, 1988) and frequency discrimination (Aslin, 1989; Olsho, 1984) improve across age might lead one to expect that 9-month-olds would outperform 6-month-olds because of their advancements in auditory perception. This was not the case, and it was only in the Normal Speech condition that 9-month-olds were sensitive to the difference between the two fricatives. However, lack of testing for middle-ear effusion with tympanometry represents a general limitation of the experimental design and may have affected the results.

A more likely explanation for the poorer performance by 9-month-olds in the Positive and Negative Tilt conditions is related to their growing awareness of the specific features of their native language. That is, 9-montholds were not detecting acoustic differences because the linguistic nature of the task invoked their newly emerging language-specific mode of speech perception and constrained their attention to the unmodified native-language spectral profiles of the fricatives. The infant's progression to a language-specific mode at around 9 months of age is well documented (see Kuhl et al., 2008; Saffran et al., 2006). In the first 6months of life, infants perceive speech in a language-general manner and discriminate native and nonnative speech contrasts alike (Eimas et al., 1971; Trehub, 1976). In the second 6 months, infants' increased experience with the native language sees them shift to a language-specific mode of speech perception, such that by 9 months of age, they recognize their native language via its phonetic and phonotactic features (Jusczyk et al., 1993) and attune to native-language consonants at the expense of nonnative consonants (Werker &Tees, 1984). Therefore, although it is generally agreed that attunement to the native language involves a decline in the ability to perceive nonnative speech sounds, this study shows that it also entails a decline in the ability to perceive native speech sounds that have been acoustically modified.

For infants with hearing loss, the formation of phonetic categories is likely to be influenced by the degree of hearing loss and the amplification strategy used in hearing aids. Thus, normal speech for infants with hearing loss is likely to be different from normal speech for infants without hearing loss. Therefore, we cannot assume

that infants with hearing loss will respond to spectrally modified speech in exactly same way as would infants with normal hearing. Thus, further investigations are required. First, it is essential to test infants with hearing loss on their perception of speech with modified spectral tilt, including their specific pattern of amplification. Second, research is needed to test the effect of modified spectral tilt on the discrimination of an expanded range of consonant and vowel contrasts to confirm that the effect of spectral tilt is independent of the frequency characteristics of the contrasts. And finally, it would be prudent to test older infants to determine if the results observed for 9-month-old infants in the present study are indicative of a more advanced phase of speech perception or whether their performance is ageidiosyncratic- that is, specific to the intense period of perceptual reorganization that occurs at the end of the first year of life.

This study clearly shows that 6- and 9-month-old infants respond in qualitatively different ways when listening to a native-language fricative contrast with modified spectral tilt and that these differences reflect the developmental trajectory for speech perception that occurs in this age range. Although native-language attunement is usually shown by a failure to discriminate most nonnative contrasts (Best &McRoberts, 2003;Werker &Tees, 1984), this study has demonstrated that attunement also occurs for native speech sounds. It seems that once perceptual reorganization for native speech begins to emerge around 9months of age, infants have difficulty discriminating native-language speech sounds that deviate from the native spectral profile. In addition, this study provides the groundwork for future research to investigate whether or not infants with hearing loss perceive speech in a similar way. In the long term, this research will take us closer to the ultimate goal of this work: to ensure that amplification strategies for infants with hearing loss are optimally suited to, and facilitative of, language development during the crucial early months of language acquisition.

Acknowledgments

This research was funded by Australian Research Council Grant DP 0559134, awarded to the second author. We thank Harvey Dillon and Teresa Ching from the National Acoustic Laboratories, who assisted with the speech stimuli; Robin Panneton and Scott Johnson, who allowed us to use their visual stimuli; and Anna Notley, Suzy Bicanic, and Cat Grimsgaard, who assisted with recruitment and testing of babies. Special thanks to all the babies and their parents who participated in our study.

Sidebar

Modified Spectral Tilt Affects Older, but Not Younger, Infants' Native-Language Fricative Discrimination

Elizabeth Francis Beach, and Christine Kitamura

J Speech Lang Hear Res 2011;54;658-667; originally published online Sep 15, 2010; DOI: 10.1044/1092-4388(2010/08-0177)

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http://jslhr.asha.org/cgi/content/full/54/2/658

Footnote

1The long-term average spectrum of speech has a spectral slope of -3 to -5 dB/octave above 800 Hz (Byrne et al., 1994).

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Editor: Robert S. Schlauch
Associate Editor: Kathryn Arehart
Received August 27, 2008
Revision received June 22, 2009
Accepted August 8, 2010
DOI: 10.1044/1092-4388(2010/08-0177)

Publication date: Apr 1, 2011

Year: 2011

A world of SILENCE

Author: Anonymous

Publication info: Belfast Telegraph [Belfast] 24 Mar 2011.
ProQuest document link

Abstract (Abstract): We don't pay much attention to our aural health. Apparently the time lag between somebody suffering hearing problems and their seeking help is around 10 years. The problem is that our ability to interpret sound deteriorates slowly, as we lose first the beginning and end of words, then high sounds become indistinct, then lower sounds "then everything goes down", in [Anthony Carter]'s words.
As David rattled on, in the way 20-year-olds do, I said 'Yeah' but hadn't the slightest what he was on about. There are only so many times you can legitimately say 'Sorry?' Once inside, the situation worsened.
Anthony says: "You couldn't produce anything better if you tried. The outer ear collects sound from the front and, as soon as it hits the bowl, there's a natural high frequency lift."

Full text: As I'd been to the Stiff Little Fingers gig on the Saturday at the Ulster Hall, filling my earholes with silicone so I could empathise with the one in seven of us with hearing problems was almost academic.
In fact, as Anthony Carter, hearing aid audiologist at the Specsavers hearing centre in Ann Street, Belfast, told me, hearing problems are on the increase because of IT and our love affair with high decibel sound.
"We're seeing many more people in their 20s now because of iPods, iPhones and loud music which are affecting hearing."
You'd have thought we would know better as the number of rock aristocrats who have permanently damaged their hearing is both impressive and worrying -- Pete Townshend has lost nearly all the hearing in both ears, Phil Collins and John Illsley of Dire Straits have also suffered significant hearing loss. This is not totally surprising as our tolerance of sound at levels above 25 decibels is poor.
The Fingers were probably belting out Belfast classics at around 110db, after which I noticed a certain ringing in the ears. According to the Specsavers experts, any ringing means damage.
But we don't pay much attention to our aural health. Apparently the time lag between somebody suffering hearing problems and their seeking help is around 10 years. The problem is that our ability to interpret sound

deteriorates slowly, as we lose first the beginning and end of words, then high sounds become indistinct, then lower sounds "then everything goes down", in Anthony's words.
My experiment started when Anthony injected, then pushed, some brightly coloured silicone into my earholes. Happily, the mauve gunk, used to make moulds for hearing aids, matched my outfit and I sashayed into the world of the partially deaf.
The first thing I noticed, as the photographer and I went to a cafe, was how isolated I felt.
As David rattled on, in the way 20-year-olds do, I said 'Yeah' but hadn't the slightest what he was on about. There are only so many times you can legitimately say 'Sorry?' Once inside, the situation worsened.
Asking for a caramelatte and mocha wasn't too bad but, when helpful young barista Heather Martin started to explain they hadn't all the ingredients for the caramelatte but would be making toothsome substitutes, I was lost.

David came to the rescue but it was touch and go. My deafness was starting to make me feel dumb.
Even worse was to follow as I realised one of the great pleasures of being in a cafe or restaurant was now denied me. That is, eavesdropping. There were a couple of suited businessmen nearby who looked as if they were having an interesting conversation. But they could have been discussing Sammy Wilson's Budget, their golf handicaps or even their mistresses (only joking) as I couldn't hear or lip-read or anything. More than frustrating.
Back on the road, I asked James Breen for directions to Fountain Street. He had to tell me about three times, with hand gestures, as it was hard to decipher what he was saying.
I walked to my bank in Donegall Place, registering the absence of the usual urban soundtrack.
Feeling as if I was in some kind of bubble, I negotiated the queue at Santander, noted they had a hearing loop for those with hearing aids, and was glad the assistant articulated clearly.
I wasn't totally disabled and did manage to buy myself a skirt at M&S but again, not being able to tune in to others' changing room chit-chat -- you know, the girly business of the Ohmigod, that looks wonderful/terrible -- was a shame.
If a friend, acquaintance or husband had hailed me in Royal Avenue, I wouldn't have known. I was reminded of a friend of my mum's who went deaf overnight after her husband died suddenly, the shock triggering an aural shutdown, as if she never wanted to hear anything again. For a gregarious woman, the deafness was truly disabling.
Anthony said this is rare, a one in a million occurrence, but of course the erosion of the hearing of around 16% of us is becoming worryingly commonplace.
The good news is that hearing aids are getting smaller, and cuter, with the newest versions looking like something in an Argento range, and the technology is improving too. "Some hearing aids, which are not on the NHS, can pick up your mobile phone tone then transfer the sound to your ear via your hearing aid." As David noted, totally cool and almost better than a real ear.
Anthony says: "You couldn't produce anything better if you tried. The outer ear collects sound from the front and, as soon as it hits the bowl, there's a natural high frequency lift."
Specsavers are on an education push to encourage people to take their free three-minute hearing test, to go in if they have the slightest symptoms, and to shed that inhibition. You won't end up looking like a granny and, trust me, you don't want to be tripping round town as I did, in a muffled world of your own.
* Have regular hearing checks, ideally every two years after the age of 60
* Avoid too many heavy metal concerts and, when you do go, don't stand too close to the speakers
* If you work with noise, say in a nightclub or as a DJ, consider buying a pair of new earplugs which filter out sound above a safe 25db. You can still hear but your ears won't suffer
* Bill Clinton started suffering when he was 51 and now wears hearing aids in both ears
* Foxy Brown, American rapper, lost her hearing overnight some years back and said: "It was 100% gone".

Thanks to surgery, she regained her hearing which was affected by sudden severe sensory-neural hearing loss
* Ludwig van Beethoven, astonishingly, composed some of his best works after going deaf at the age of 28
* Bill Roache aka Ken Barlow in Corrie is 50% deaf in each ear but it doesn't stop him acting in the venerable soap
CAPTION: Come again: Jane struggles with such simple tasks as ordering a coffee or following directions after having silicone injected into her ear (below). A modern hearing aid (bottom left)__PICTURES: DAVID FITZGERALD

Publication date: Mar 24, 2011

Year: 2011

Celebrity Apprentice's Busey finds his 'true self'; There's a thin line between the 'new' actor and the old

Author: Braxton, Greg

Publication info: The Vancouver Sun [Vancouver, B.C] 16 Mar 2011: D.5.
ProQuest document link

Abstract: The 66-year-old actor is keenly aware of the perceptions about him -he knows you think he's crazy. [...] he knows it has everything to do with a litany of well-publicized highs and lows that span more than three decades in Hollywood -a battle with drugs after his lead actor Oscar nomination for 1978's The Buddy Holly Story; a near-fatal motorcycle crash that caused a traumatic brain injury in 1988; an appearance as his "crazy" self on a 2007 episode of Entourage; a stint on VH-1's Celebrity Rehab With Dr. Drew in 2008; and an unsolicited neck smooch delivered to a startled Jennifer Garner on the red carpet at the Academy Awards in 2008. Because of a few difficulties with myself, it caused me to retreat from my true self.

Full text: Ask Gary Busey about his life these days, and he's likely to flash his trademark toothy grin. He might also jump up and declare, as he did in a recent interview, "It's CRAZY good!"
The 66-year-old actor is keenly aware of the perceptions about him -he knows you think he's crazy. And he knows it has everything to do with a litany of well-publicized highs and lows that span more than three decades in Hollywood -a battle with drugs after his lead actor Oscar nomination for 1978's The Buddy Holly Story; a near-fatal motorcycle crash that caused a traumatic brain injury in 1988; an appearance as his "crazy" self on a 2007 episode of Entourage; a stint on VH-1's Celebrity Rehab With Dr. Drew in 2008; and an unsolicited neck smooch delivered to a startled Jennifer Garner on the red carpet at the Academy Awards in 2008.
The actor was even a punch line on last week's Saturday Night Live during a skit where a ranting Charlie Sheen (Bill Hader) read an email praising him for making "perfect sense, adding, "Finally, I know, I'm not crazy." Signed "gbusey69."
Busey's off-kilter personality is on full display again in the latest edition of NBC's Celebrity Apprentice. In Sunday's premiere, Busey transformed himself into the "Pepperoni Prophet" to assist his team in running a pizzeria. Sporting savagely unkempt hair and an ill-fitting brown suit, the actor pranced like a deranged preacher outside the establishment, flinging pepperoni into the air and proclaiming that "miracles happen" where the meat landed on the ground. (An amused Donald Trump called him "a piece of work.")
The show also prompted an unexpected breakthrough. As usual, many of his teammates were caught off guard

by Busey's loud talking and inability sometimes to immediately grasp words. But fellow contestant Marlee Matlin, who is deaf, concluded that much of Busey's aggressiveness was because of hearing loss, a legacy of his 1988 accident. (When the actor was fitted with a new state-of-the-art hearing aid, his world changed, he said.)

"There's a lot more to Gary than we've seen on Celebrity Rehab," said Eden Gaha, an executive producer on Celebrity Apprentice. "His whole process is different. The question is whether he's crazy or a genius. He has no filter."

But for those who think Busey is way off the deep end, he's got a message.

"I'm not difficult," insisted Busey, his gruff voice accompanying a graceful waving of his arms. "It's not in my vocabulary. Because of a few difficulties with myself, it caused me to retreat from my true self. After The Buddy Holly Story, I went over the rainbow. I didn't know how to handle everything that came at me. It's different now. I've moved on into the light. It was just all a part of the journey of finding me."

He has certainly found a starring role on the NBC reality show, which also includes other celebrity sideshows such as singer LaToya Jackson, Richard Hatch (Survivor) and former baseball star Jose Canseco. Busey joined the show in part to help dispel lingering negative views -he's named the Center for Head Injury Services as his charity in the celebrity contest. In many ways, there's a thin line between the new Busey and the former "wild and crazy" Busey. A visitor he had just met was treated like an old friend, with affectionate pats and hugs. And while his actions and responses were thoughtful and articulate, sometimes they appeared a bit hard to fathom. During one point in the interview, he suddenly threw a couch pillow at a photographer who was clearing his equipment after shooting Busey.

"Am I making too much noise?"

"Naw," said Busey with a wide smile. "I just want to show you I like you."

Credit: Greg Braxton; Los Angeles Times

Illustration

Getty Images Files / Actor Gary Busey is well aware that many think he is crazy.;; Caption:

Publication date: Mar 16, 2011

Year: 2011

'I've moved on into the light'; After all his travails, 'Celebrity Apprentice' Gary Busey says he's found his 'true self.'

Author: Braxton, Greg

Publication info: Los Angeles Times [Los Angeles, Calif] 11 Mar 2011: D.1.
ProQuest document link

Abstract: Because of a few difficulties with myself, it caused me to retreat from my true self.

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The 66-year-old actor is keenly aware of the perceptions about him -- he knows you think he's crazy. And he knows it has everything to do with a litany of well-publicized highs and lows that span more than three decades in Hollywood -- a battle with drugs after his lead actor Oscar nomination for 1978's "The Buddy Holly Story"; a

near-fatal motorcycle crash that caused a traumatic brain injury in 1988; an appearance as his "crazy" self on a 2007 episode of "Entourage"; a stint on VH-1's "Celebrity Rehab With Dr. Drew" in 2008; and an unsolicited neck smooch delivered to a startled Jennifer Garner on the red carpet at the Academy Awards in 2008.

The actor was even a punch line on last week's "Saturday Night Live" during a skit where a ranting Charlie Sheen (Bill Hader) read an e-mail praising him for making "perfect sense, adding, "Finally, I know, I'm not crazy." Signed "gbusey69."

Busey's off-kilter personality is on full display again in the latest edition of NBC's "Celebrity Apprentice." In Sunday's premiere, Busey transformed himself into the "Pepperoni Prophet" to assist his team in running a pizzeria. Sporting savagely unkempt hair and an ill-fitting brown suit, the actor pranced like a deranged preacher outside the establishment, flinging pepperoni into the air and proclaiming that "miracles happen" where the meat landed on the ground. (An amused Donald Trump called him "a piece of work.")

Asked about his experience working on the Trump series, Busey proclaimed, "It was as good as it could be at the time. It is what is, it was what it was."

The show also prompted an unexpected breakthrough. As usual, many of his teammates were caught off guard by Busey's loud talking and inability sometimes to immediately grasp words. But fellow contestant Marlee Matlin, who is deaf, concluded that much of Busey's aggressiveness was because of hearing loss, a legacy of his 1988 accident. (When the actor was fitted with a new state-of-the-art hearing aid, his world changed, he said.)

"There's a lot more to Gary than we've seen on 'Celebrity Rehab,' " said Eden Gaha, an executive producer on "Celebrity Apprentice." "His whole process is different. The question is whether he's crazy or a genius. He has no filter."

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He has certainly found a starring role on the NBC reality show, which also includes other celebrity sideshows such as singer LaToya Jackson, Richard Hatch ("Survivor") and former baseball star Jose Canseco. Busey joined the show in part to help dispel lingering negative views -- he's named the Center for Head Injury Services as his charity in the celebrity contest.

And his so-called Buseyisms, his life's wisdom and philosophy communicated in the breakdown of words, has found a cult following on YouTube. (He's never far from a "Buseyism" in live conversation, and just as on-line, they are delivered in a scholarly manner.)

"You know what FEAR stands for?" he asked as he held court in the Hollywood Hills home of his fiancee's parents. "It means 'False Evidence Appearing Real.' "

"You know what FREEDOM stands for?" continued the actor, who is engaged to Steffanie Sampson, with whom he has a 1-year-old son, Luke Sampson Busey. " 'Facing Real Exciting Energy Developing Out of Miracles.' "

In many ways, there's a thin line between the new Busey and the former "wild and crazy" Busey. A visitor he had just met was treated like an old friend, with affectionate pats and hugs. And while his actions and responses were thoughtful and articulate, sometimes they appeared a bit hard to fathom.

During one point in the interview, he suddenly threw a couch pillow at a photographer who was clearing his equipment after shooting Busey. "Am I making too much noise?" "Naw," said Busey with a wide smile. "I just want to show you I like you."

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Illustration

Caption: PHOTO: HOMEBODY: "I didn't know how to handle everything that came at me," says actor Gary Busey, hugging son Luke as fiancee Steffanie Sampson watches.; PHOTOGRAPHER:Ricardo DeAratanha Los Angeles Times

Publication date: Mar 11, 2011

Year: 2011

Writing the Disaster: Franklin and Frankenstein

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Publication info: Nineteenth - Century Literature, suppl. SPECIAL ISSUE: WORLDLY ROMANTICISM 65.4 (Mar 2011): 433-480,585.
ProQuest document link

Abstract: The occasion for this essay is the surprise meeting of three texts from distinct traditions-Gothic romance, evangelical theology, and Enlightenment exploration-during the course of an Arctic disaster. The essay explores the relationship of the official disaster narrative (John Franklin's Narrative of a Journey to the Shores of the Polar Sea [1823]) to these heterogeneous textual companions, particularly Mary Shelley's Frankenstein (1818). Published by the Admiralty's official bookseller, John Murray, the official Franklin Narrative emerged from a highly centralized governmental and publishing network, one that attempted a virtual monopoly on prestigious Arctic publications from 1818 to 1848. The essay uncovers the complex institutional connections of this publishing nexus, and the strong centripetal pull exerted upon them by governmental authorities, while simultaneously considering a range of fugitive writings-chief among them Frankenstein-that escaped the pull of this formidable nexus. Frankenstein's proximity to the center of polar print culture and its highly regulated discursive practices reaffirms the widespread persistence not only of collaborative authorship into the nineteenth century, but also of more radically unindividualized authorship practices carried out across institutional lines. Thus, rather than asking how novels like Frankenstein were influenced by polar exploration, this essay broadens the field of inquiry to consider authorship and publishing practices across diverse domains, including corporate, governmental, and commercial. [PUBLICATION ABSTRACT]

Full text: Headnote

Keywords: history of authorship; Frankenstein; John Franklin; Arctic exploration; print culture

Disaster shadows the Arctic explorer Robert Walton from the opening sentence of his first letter in Mary Shelley's Frankenstein (1818), where he writes: "You will rejoice to hear that no disaster has accompanied the commencement of an enterprise which you have regarded with such evil forebodings."1 It continues to his final letters to his sister; icebound at "a very high latitude" and facing an impending mutiny, he confesses: "The cold is excessive, and many of my unfortunate comrades have already found a grave amidst this scene of desolation" (Frankenstein, pp. 56, 235). Walton's polar narrative, which provides the outer frame of Frankenstein, is not one of disaster averted by his reluctant submission to the will of his crew, though it is usually depicted this way.2 Walton's narrative, which he apparently intends to publish,3 is one that seeks out disaster in the Arctic and finds it.

Writing to his sister before setting out on his own Quixotic attempt to sail across the open polar sea, three months after the publication of Frankenstein, Arctic explorer John Franklin is content with the consolation prize

of merely reaching the North Pole:

I shall not however consider the voyage by any means as useless should we fail in the great object of effecting a passage if we have the good fortune to reach the Pole. . . .4

Failing to find the Passage, Franklin may reach the Pole; Walton had similarly confided in his sister that even if he does not attain the Pole he hopes to "[discover] a passage near the pole to those countries, to reach which at present so many months are requisite" (Frankenstein, p. 50).5 Passage and Pole, like real and fictional explorer, become interchangeable, with both men sharing an ambition that will just as surely lead to disaster (Franklin disappeared into the Arctic on a subsequent voyage in 1845, with all 129 of his crew).

The two-pronged 1818 expedition in search of Pole and Passage failed in such unspectacular fashion as to have merited only one official publication, but Franklin promptly set out again for the Arctic in 1819.6 Like Walton, he returned without "many of [his] unfortunate comrades," but he published the authorized Narrative of a Journey to the Shores of the Polar Sea (1823) to great success. This tale of starvation, murder, cannibalism, and madness was tailored to please an audience already schooled in Gothic romances, captivity narratives, shipwreck accounts, early ethnography, and travel writings. The disaster over which Franklin presided offered readers new heights in suffering and danger, set in a geo-imaginary region enjoying unprecedented public interest since the 1818 resurgence in exploration efforts. John Barrow (Second Secretary to the Admiralty), together with John Wilson Croker (First Secretary to the Admiralty), joined the prestigious publisher John Murray at the Quarterly Review in launching an unprecedented series of Arctic publications and expeditions. In addition to publishing the Tory Quarterly, to which Croker and Barrow contributed hundreds of articles, Murray was since 1813 the official "Bookseller to the Admiralty."7 Barrow and Murray also worked closely with Earl Bathurst's newly established Colonial Office, which was in fact the final authority on the Franklin expeditions, issuing the instructions and providing funding for the voyages that continue to this day to be represented as only "naval" and "scientific."8 The Colonial Office was closely involved because the overland Arctic expeditions of 1819 and 1825 were surveying territory and encountering people in Britain's diverse "empire of influence"9-far from the colonies of Upper and Lower Canada, but part of the Hudson's Bay Company's expanding trading monopoly (of three million square miles), which the government was supporting as part of its own long-range commercial and political interests in British North America.10 How this unique consolidation of governmental, political, and publishing forces significantly shaped the conditions of authoring and publishing exploration narratives in the first half of the nineteenth century is the larger picture that I aim to illuminate in this essay.

The exclusively naval and scientific tenor of modern accounts of Arctic expeditions is due in part to John Barrow's self-serving presentation of them as such in the Quarterly Review and in his Chronological History of Voyages into the Arctic (1818); Barrow's numerous articles laying out his personal vision of this polar program included a fifty-page manifesto in the 1816 Quarterly announcing the four-ship 1818 expedition to reach the Pole and Passage, from which Franklin had written the optimistic letter to his sister quoted earlier. Shelley's Frankenstein was in part addressing this post-Napoleonic climate of nationalistic hubris as voiced by Barrow, and indeed Shelley first submitted the novel to Murray, who rejected it.11 Had Murray published it, Frankenstein would have emerged among the eighteen first editions of Arctic exploration that Barrow shepherded through Murray's press from 1818 to 1848. Frankenstein's proximity to the center of polar print culture reveals new dimensions of the innovative models of authorship and publication in the early nineteenth century, reaffirming the significance not only of collaborative authorship (as in the Shelleys' case), but also of more radically unindividualized authorship practices carried out across institutional lines. Thus, rather than asking how novels like Frankenstein were influenced by polar exploration, in this essay I broaden the field of inquiry to consider shared authorship and publishing practices across diverse domains, including corporate, governmental, and commercial.

Frankenstein's polar frame was probably added in the autumn of 1816, after the initial ur-text that Mary Shelley drafted during the ghost-story competition of that summer;12 it no doubt gained momentum from Barrow's first

Arctic account in October 1816 (published February 1817), when Shelley was reading the Quarterly regularly.13 Scholars have demonstrated how the novel's critique of imperialism, masculinist Romanticism, and aggressive science is orchestrated through the interrelations of its three nested frame-narratives, with Walton's narrative issuing a timely warning against Britain's Arctic fever.14 We know, as Francis Spufford and Jessica Richard have shown, that writers like Mary Shelley and Samuel Taylor Coleridge were inspired by polar exploration, and that, thanks to such literary writers, "the means existed to make of the data of polar discovery a stuff of conventional imagination."15

Setting aside these useful accounts of the mutual influence of writer and explorer, and of the interplay of imagination and "the data of polar discovery," I suggest a different way of relating nineteenth-century Arctic exploration and writing. To begin, we should reaffirm the predisciplinary and generic fluidity enjoyed in the eighteenth century and before, and resist the temptation to reify the emerging category of imaginative literature, its distinction from scientific writings, and its origin in an autonomous author. Exploration writings retained the disciplinary heterogeneity found throughout Enlightenmentera exploration writings-those "totally involving corporeal" accounts by "traveling naturalist[s]" that Barbara Maria Stafford argues were replaced at the end of the eighteenth century by a Romantic disassociation of literary and scientific sensibilities.16 Departing from Stafford's unsatisfactory opposition of Enlightenment objectivity to Romantic subjectivity, however, historians of literature and of science of the early nineteenth century increasingly emphasize the continuities enjoyed across the growing divide that formed the twentieth century's "two cultures." Looking more closely at polar print culture specifically-by which I mean an inclusive field of fictional and factual, authentic and spurious, literary and scientific writings, maps, illustrations, and observations-reveals a heterogeneous domain in which "modern" disciplinarity remains inchoate.

The heterogeneity of polar print culture in the first half of the nineteenth century was the product of an unprecedented "center of calculation," publication and exploration that I will call the Murray polar print nexus. Drawing on both the "social nexus" model of literary production developed by Jerome Mc- Gann and others, and the "centers of calculation" in Enlightenment science described by Bruno Latour, my overview of the Murray nexus allows for the imbrication of the literary and the scientific in this innovative convergence of print culture, exploration, and governmental agencies.17 The multidisciplinarity and collective authorship central to polar print culture were also present in other theaters of exploration and publication: for example in Alexander von Humboldt's massive Voyages aux régions équinoxiales (1805-34), and Robert FitzRoy and Charles Darwin's Narrative of the Surveying Voyage of H.M.S. "Adventure" and "Beagle" (1839), and were coeval with the multi-authored miscellanies and magazines that proliferated in the early nineteenth century, attempting to reach increasingly fragmented reading publics.18

Unique to the polar print culture that I discuss here is how this often chaotic multiplicity is ordered and authorized through a regulated and hierarchical institutional network. I want to emphasize both the heterogeneity of the agents involved in this unprecedented nexus (hence I will avoid the term "center") and, simultaneously, the heterogeneity characterizing its actual publications and modes of authorship. Polar print culture makes visible the pressures to individuate and autonomize authorship-to endow "explorers" with the aura of individuality increasingly identified with "authors." In polar print culture we see how an author must travel across heterogeneous domains, embodied in a proliferation of composite, multidisciplinary texts only nominally reigned in by the authorial unity expected of "literature." Simultaneously, this unruly multiplicity of authors and discourses comprising earlynineteenth- century Arctic accounts was subject to formalized naval and state controls, prepublication censorship, and Murray's would-be monopoly-measures that appear anachronistic according to current accounts of print culture, which make it seem to evolve uniformly across intellectual domains. Thus, both its disciplinary heterogeneity and its formal links to centralized authority set polar print culture on a significantly different trajectory than that of contemporary commercial print culture, and particularly of Romantic literary print culture, retrospectively identified as one origin of expressive, autonomous, and

subjective authorship.19

Considered in this larger institutional framework, this nineteenth-century polar print nexus resists evolutionary models of the history of authorship and of print in Britain, which, whether drawn from literary, legal, or sociological disciplines, unfold competing but uniformly linear lines of descent leading from prepublication censorship and state licensing, to commercial proprietary authorship, and eventually to the autonomous and expressive "Romantic author." The polar print nexus is one domain into which we should extend the insights of scholarship on early-modern and eighteenth-century print culture: increasingly, authorship and books are seen as the products of "heterogeneous collectivities,"20 located in social sites (e.g., the literatory, or print shop) instead of the imaginations of autonomous individuals, and formulated with complex legal and social consequences for both writers and booksellers. Yet within this same, innovative work outside the field of Romantic studies, outdated models of a Bloomian "Romantic author" are still blamed for the demise of earlier polyvocal models of authorship; alternatively, the "Romantic author" serves as the naive origin that must be superseded by more complex Victorian and Modernist models of authorship, despite the revisionary work of Jerome McGann, Jon Klancher, Anne Mellor, Clifford Siskin, and others revealing the diversity of Romantic authorship practices. Building on their work, I aim to show how this unexplored polar print nexus can demonstrate the persistence of practices like collective authorship and prepublication state controls well into the nineteenth century, and how these practices coexisted with the visible pressure to individualize authorship and, by extension, exploration. This polar print nexus thus has a dual significance-both for appreciating the underestimated role of print culture in driving Arctic exploration and ultimately disaster, and for revealing divergent paths within our collective histories of authorship and print in the nineteenth century.

I. Voyaging with Frankenstein in the Arctic

"The act of writing was considered to be an indispensable part of making voyages" from the Renaissance onward, as Philip Edwards and Mary Fuller each argue in their respective studies of early exploration writings.21 Yet according to Fuller, despite its origins in the necessity of commercial record keeping, earlymodern exploration writing of the New World served less as a documentary record and more as a means to recuperate the "years of waste and catastrophe" through a heroic self-fashioning (Voyages in Print, p. 15). By the eighteenth century, exploration writing reached unprecedented levels of profitability, for example, in the narratives of George Anson and John Hawkesworth. Hawkesworth's Account of Cook's first expedition earned its author/compiler an unprecedented advance (£6000), its publisher high profits, and everyone involved unanticipated controversy due to Hawkesworth's imprudent reflections on Polynesian sexual freedoms and British violence, written in a fictionalized first-person voice attributed to Cook. According to Fanny Burney, her father Dr. Charles Burney and the actor David Garrick had recommended the self-taught writer Hawkesworth to the Earl of Sandwich (First Lord of the Admiralty) at a dinner; Sandwich (Cook had already sailed on his second circumnavigation) then provided Hawkesworth with the personal journals of Cook, Banks, and others, seemingly without guidance or restrictions. The ensuing publication controversy, as well as that surrounding the second narrative (Voyage Toward the South Pole [1777], authored by Cook with the aid of a ghostwriter) and its numerous unauthorized countertexts, has been the subject of excellent studies by Philip Edwards, Jonathan Lamb, Nicholas Thomas, and others.22

The era of Cook, Sandwich, and Banks witnessed a growing awareness of the importance of controlling more aspects of "authorized" exploration writings than ever before, because of the unprecedented popularity and controversies that these authorized and unauthorized productions generated. This lateeighteenth- century network of publication and exploration relied on the quasi-governmental connections of Banks (president of the Royal Society) and his political patrons, the Earl of Sandwich and Constantine Phipps, later Lord Mulgrave (explorer/ author of the ghostwritten Voyage Towards the North Pole [1774]). Banks and the (ostensibly apolitical) Royal Society had advised the Admiralty on scientific expedition goals (for example, on Cook's third voyage for the Northwest Passage and on Phipps's quest for the Pole), and had helped arrange for key

exploration publications (e.g., those of Hawkesworth, Matthew Flinders, and Phipps). But as John Gascoigne has shown in Science in the Service of Empire (1998), these turn-of-thecentury connections between the Royal Society and the British state were informal and fluid, dependent on ties of class patronage that would increasingly give way to more formalized and transparent systems of civil service. And, significantly, the books generated by these earlier Admiralty voyages emerged from diverse booksellers.23

The nineteenth-century nexus discussed here was qualitatively different from this earlier generation's model in the formalized controls that it placed on the polar publications that would emerge under its scrutiny and imprimatur. In the first half of the nineteenth century, polar publication and polar exploration were inseparable, coeval, and mutually generative. As we shall see, they covered a broad discursive terrain, shared uneasily with irreligious fiction, evangelical tracts, and emergent scientific disciplines.

Looking closely at how the writings of the 1819-1822 Franklin disaster and Frankenstein emerge in relation to this nexus of polar print culture, I suggest that we should no longer think of Franklin and Walton as authentic and fictional Arctic explorers, respectively. Today Frankenstein is considered the most famous literary work of polar exploration, and yet, as far as is known, no contemporary polar explorer referred to Frankenstein as a novel of polar exploration. Instead, the novel enjoyed an afterlife in the popular imagination as a supernatural Gothic romance about an overreaching scientist and politicized specter seemingly adaptable to any political crisis, from Irish independence to parliamentary reform.24 Indeed, Frankenstein's enduring popularity is largely thanks to nineteenth-century theater and twentieth-century film, which until very recently eliminated the Arctic frame altogether. But Frankenstein did in fact register in one account of "authentic" Arctic exploration within the Murray nexus, and its presence in polar writing illustrates how, in the early nineteenth century, authentic and imaginative polar accounts, and their author/explorers, traveled in the same circles.

The end of Franklin's Arctic expedition of 1845-all hands lost, evidence of British cannibalism, dozens of fruitless search expeditions-continues to haunt the popular imagination into the twenty-first century. But it was Franklin's first Overland Arctic Expedition, setting out in 1819 to help map the Northwest Passage, that set a new standard for transmuting polar disaster into commercial success. Along with Captain Franklin, surgeon/naturalist Dr. John Richardson and midshipman George Back would emerge as influential "Arctic Officers," serving on a dozen Arctic voyages between them and collaborating on numerous influential writings and images.

Franklin's responsibility for the disastrous outcome of the 1819-1821 expedition is now widely acknowledged, but, as with his final voyage, British national pride prevented most contemporaries from critiquing the mission's imperial hubris, poor planning, and other inadequacies.25 Naval officers setting out on land, Franklin's crew had no Arctic experience and no hunting skills, relying entirely on Canadian voyageurs and Native people to bring them to their destination-the northern coastline of the Arctic Ocean, following the route through the so-called Barren Lands established by Samuel Hearne in 1771 and described in his popular Journey to the Shores of the Polar Sea (1795).26 Hearne had spent over two years travelling with Chipewyan Indians, who led him through the Barrens to the Arctic Ocean, where he apparently watched as his companions massacred a group of sleeping Inuit men, women, and children. Hearne's remarkable voyage, and his gripping Journey in which he described the massacre at Bloody Falls in graphic (perhaps fictionalized) detail, would continue to shape British Arctic exploration for the first half of the nineteenth century-as an inconceivably difficult Arctic trek shadowed by doubts of its veracity, as a foundational episode of violence from which British Arctic exploration would never sever itself, and, last but not least, as an influential publication whose success future explorers would also need to measure themselves against.

Franklin and his officers were obsessed with duplicating Hearne's achievements as explorers and writers, and their unpublished writings often refer to Hearne's Journey, which they carried with them as a travel guide (and which Franklin had examined in manuscript at the Admiralty).27 "With regard to the Country North of Churchill," admitted Richardson, "we have no information whatever beyond Hearne's Route."28 Franklin, Richardson, and

Back also brought with them their culture's prevailing model of picturesque travel, a tradition suitable for the gentleman on the Grand Tour or on the pedestrian tours of Britain popular with the middle classes. Setting out for what he called a "pedestrian excursion" into the Barren Lands,29 Richardson, like midshipman Robert Hood, filled his unpublished journal with the picturesque allusions of the well-educated traveler in the Lake District. But there is no such thing as a "pedestrian excursion" into the Barrens. This is why Hood did not survive, Richardson barely made it (after probably resorting to cannibalism), and an unfit Franklin would lie down to die, only to be rescued by indigenous people within hours of his death.

The extent to which the Franklin officers' aesthetic (mis)- education helped doom the expedition (by choosing their winter camp for its picturesque prospect) is well documented by Ian MacLaren.30 Disorientated by the unfamiliar landscapes, optical phenomena, and acoustic distortions of the Arctic tundra and subarctic taiga, these British explorer/authors record perpetual disappointment with the land's bewildering resistance to their aesthetic expectations: that of the Alpine sublime (or alternatively, the sublime of Arctic seascapes and icebergs), the beautiful of the Italian campagna, or the Lake District picturesque popularized in William Gilpin's Three Essays (1792). British travelers to India at this time were similarly frustrated by India's lack of "tropicality," a consequence of the dominance of temperate and tropical paradigms in the formation of Britain's globalizing vision, a problem persisting today in the humanities' widespread failure to include the Arctic in its paradigms.31 Complaining of the "sameness," "blankness," and "featureless" nature of the Barren Lands (a vast region of tundra and taiga west of Hudson Bay, so-called by Europeans since the seventeenth century), Richardson and his fellow explorer/authors struggled to reconcile their experiences of the land with their European aesthetic expectations of landscape. It would be in the Narrative's accompanying illustrations that Hood and Back (who had been selected for their artistic abilities) would create the variegated landscapes that British audiences expected to find, especially the sublime and picturesque.32 Their contrapuntal visual archive of the expedition satisfied their elite readers' expectations much better than did Franklin's methodical recital of daily chores, or Richardson's descriptions of geological features and zoological specimens. But as we shall see, it would be Richardson's descriptions of the disaster's nadir that would be incorporated into this composite text to provide readers with its Gothic climax.

John Richardson (1787-1865) was an important figure in nineteenth-century British exploration and natural science: he was a leading officer on Arctic expeditions in 1819-21, 1824- 27, and 1848-49, and he published important works in Arctic zoology and geology. Encouraged by Robert Burns in Dumfries, he was a student of the Wernerian geologist Robert Jameson in the Edinburgh Enlightenment, and, as senior physician of the naval hospital at Haslar, he trained Thomas Henry Huxley and established a natural history center visited by Darwin and Lyell. Alongside these impeccable scientific qualifications, Richardson also enjoyed and quoted both from contemporary literature by Walter Scott, Coleridge, Mary Robinson, and William Gilpin and, intriguingly, from Shelley's Frankenstein. Richardson is an exemplary figure of predisciplinary intellectual curiosity and practical versatility, spanning the Romantic and Victorian eras: surgeon, naturalist, geologist, explorer, administrator, Scottish Enlightenment luminary, and evangelical Christian. Richardson, as encountered in his eclectic unpublished writings, encompasses the full range of early-nineteenthcentury intellectual and social pursuits, and it is because of his exceptional status that his take on Frankenstein is significant. As explorer and natural scientist, inspired by both cosmopolitan literary sensibilities and a sense of spiritual purpose, Richardson is uniquely able to inhabit all three distinct roles that Shelley carefully separated in Victor, Walton, and Clerval. He can do this because the roles of explorer and author, seen today as mutually influencing, did not exist as distinct entities in the early nineteenth century.

Writing to fellow officer George Back while they were in different subarctic camps in June 1821, just before the Franklin expedition would turn deadly, Richardson offered some playful reflections on the extraordinary people and sights he encountered:

My Dear Back,

Gilpin himself, that celebrated picturesque hunter would have made a fruitless journey had he come with us-we followed the lakes &low grounds, which . . . were so deeply covered with snow that it was impossible to distinguish lake from moor.33

Gilpin's "On Picturesque Travel" had advised on how to cope aesthetically with that "barren country" that extended for forty miles from Newcastle to Carlisle, but what must Richardson have thought recalling such advice while in the Barren Lands, stretching for thousands of square miles of some of the most remote terrain on the planet? In the same letter, Richardson abandoned Gilpin's picturesque for the Gothic, and specifically for Frankenstein, in a remarkable description of one of their Copper Indian guides that merits quoting in full:

So much for the country-It is a barren subject and deserves to be thus briefly dismissed. Not so, the motley group of which we were composed-it afforded ample scope for the most able pencil or pen-. . . The most prominent figure . . . of the whole, because the most unearthly, was mother Adam. She came striding along supported by a stick which towered over the heads of all the others; a pair of red stockings and various other articles of her garb heightened the peculiarities of her figure; and as to her gait, it was similar to nothing I had ever before seen. Sometimes I was tempted to compare her to Hecate, sometimes to Meg Merrilies. Not that she had mind enough to be a powerful sorceress, or majesty sufficient for a commanding presence, but because she appeared to be rather a creature of the imagination than a reality-I think however that she might have been more aptly considered a fit companion for Frankenstein's [monster] chef d'oeuvre, as she had this in common with that vision of Byshe Shelly [sic], that every member of her body seemed to have belonged to different individuals and to have been formed by a random association into a sort of semblance of the human form; but from the want of proper animation the extremities never acted in concert, and the distorted spine which composed the centre, now bent to this side, now to that, according as the leg which described the greater or the smaller circle was in motion, while the arms played up and down to preserve something like equilibrium, but with the involuntary and convulsive motions of the most fantastic of Shakespeare's weird sisters in the height of her frenzy.

There was another figure of a different gender, with an unwashed face, matted locks, and moustaches of the colour and strength of straw; equip him as you please and place him in any part of the file you choose.

Subjecting this unnamed indigenous woman to a gaze at once ethnographic, aesthetic, and medical, Richardson in this extraordinary letter abstracts her entirely from the complex "socioecological web"34 in which she labored, and relocates her in the Eurocentric domain of monstrous women, found in the popular fiction of Shelley and Scott (via Meg Merrilies, from Guy Mannering [1815]). Richardson's Victorian biographer, Rev. John McIlraith, who was Richardson's nephew and a Presbyterian minister, reprinted this letter in his biography but deleted the sentence connecting "mother Adam" to Victor Frankenstein's masterpiece.35 All subsequent polar histories rely on McIlraith's censored version of Richardson's writings, thus failing to find this shared terrain in Frankenstein between "fictional" and "factual" Arctic exploration.

When Richardson departed for the Arctic in 1819, the anonymously published Frankenstein was still assumed to be the work of the atheist Percy Shelley (Scott identified him as the author in his Blackwood's review), and thus McIlraith's biography carefully removed the irreligious associations found in Richardson's letter. Richardson's letters include other overtly Gothic and atheistic speculations (imagining "a being rising from the grave" while terrified of being forsaken by God in an "absolute solitude," a vision surpassing anything imagined by "eminent poets" like Coleridge or Robinson, he confessed)-all censored by McIlraith.36 Richardson in his letters had bravely associated himself with an outsider tradition of Arctic exploration and natural science, that of Frankenstein and the Shelleys-and that is precisely the irreligious convergence, available and interesting to Richardson, that McIlraith erased fifty years later.

Frankenstein-its creature and his bride-appeared in the midst of an infamous polar expedition, but just as quickly disappeared from history once the expedition turned toward mutiny, murder, madness and cannibalism, as sensationalistic as Shelley's romance. While Victor Frankenstein had been horrified even to contemplate the

existence of such an unsexed female monster, his more open-minded naturalist contemporary playfully refers to her as "a fit companion for Frankenstein's chef d'oeuvre," having crossed out "monster." Richardson's female creature, suggestively named "mother Adam"37 (perhaps the matriarch of a "new race of Devils" that Frankenstein had feared), exhibits the racial otherness of the male creature, but transplanted into a New World context. Richardson imagines the godless forests of America populated with Frankenstein's race of Devils, in an alternative outcome to Shelley's romance, wherein the creature had made good on his promise "to leave Europe, and inhabit the deserts of the new world" (Frankenstein, p. 190).

Richardson transfers the racial otherness associated with Frankenstein's creature38 to the Native American ignoble savage, a connection far from Shelley's intentions but resonant with her novel's anti-imperial logic, as well as with Britain's accelerating public debates over the uncertain future of its Canadian colonies and the Arctic aboriginal territories beyond them. In her size, strength, and organic disorder, Richardson's grotesque "mother Adam" also shares the female creature's threat of sexual aggression, the full dimensions of which are invisible without the Frankenstein reference. Richardson follows up the sexual threat that Frankenstein's creatures unleash by moving on in his letter to a "figure of a different gender," which Back would probably have recognized as the "Hermaphrodite being" among their native guides.39 In "the deserts of the new world," and in particular in the extreme sensory and cultural disorientation unique to northern exploration, Frankenstein and its creatures take on significance-sexual, racial, psychological- not otherwise visible in the novel's initial literary reception. The ephemeral appearances of Shelley's beings risen from the grave in Richardson's on-the-spot writings are strikingly different from the nineteenth-century appropriation of Frankenstein's monster in British and Irish metropolitan culture (especially the theater), as described by Chris Baldick, Stephen Behrendt, and others. Resituating Frankenstein in polar print culture, not merely attending to the polar theme of its outer frame, reveals that key twentieth-century preoccupations-the two creatures' threat of sexual and racial disorder, and the ambiguous appeal of Victor as scientist antihero-were powerful enough to one bewildered scientist in the Arctic to imprint themselves onto the landscapes, people, and phantoms he encountered.

Richardson's projection of European fears and desires onto indigenous people is typical of explorers' Eurocentric rhetorical violence, making possible the actual violence that such expeditions set into motion. But the specifics of this encounter-of Frankenstein in the New World, and in particular in the writings of an Arctic explorer and scientist-are unique. Richardson was more than an explorer and scientist-he was also a killer and probably a cannibal, in the literal sense of having eaten human flesh to survive.40 These controversial dimensions of Richardson's position as Arctic hero help explain the erasure of Frankenstein from Richardson's (and Franklin's) illustrious history, and from that of Arctic exploration as a whole.

Soon after Richardson wrote his Frankenstein letter, the exhausted expedition reached the Arctic Ocean, and Franklin pushed them on to chart the northern continental coast. Richardson's private journal chronicles the voyageurs' growing resistance to Franklin's command: "The fears of our voyageurs have now entirely mastered their prudence and they are not restrained by the presence of their officers from giving loose to a free and sufficiently rude expression of their feelings" (Arctic Ordeal, p. 110). "Indeed," he writes, they "deem any attempt to proceed farther as little short of madness" (p. 110). Franklin incorporated large parts of Richardson's unpublished journal into his official Narrative, but he omitted the above and numerous other references to a looming mutiny. Accustomed to the "thoughtless"41 obedience of British seamen praised by Franklin, the officers struggled to control the independent voyageurs, who knew they were heading for disaster. Franklin's party pushed on in two birchbark canoes unfit for ocean sailing, without food, relying on the voyageurs to hunt at each landfall, and did not allow the expedition to turn back until it was too late for a safe return. Of the sixteen men on the expedition, only six returned alive, four of them British-nine of the eleven voyageurs perished. Walton's eleventh-hour return when faced with open mutiny among a foreign crew closely parallels Franklin's resistance to turning back, and I suggest that real and fictional explorer shared the same motivation in returning short of their stated goal: i.e., to publish their narratives. Franklin and Richardson were obsessed with

superseding Hearne's record, as explorer and as best-selling writer. Hearne had turned back after trekking over two thousand miles and two years, a record that remains legendary today. His second great achievement, without which the first would not exist, was his popular Journey, published by a ghostwriter after his death in poverty and obscurity. Widely reviewed and excerpted for decades after its 1795 publication, it remains influential today in travel writing, wilderness writing, ethnography, and as a foundational text in Canadian history. Franklin and Richardson traveled several hundred miles farther than Hearne, but more importantly they matched Hearne's success in their writings, reaching an even larger audience and living to enjoy both fame and fortune. Both Walton and Franklin turned back in the face of growing mutiny in order to transmit to readers their written accounts, but only after many of their crew had died in order to make this possible. In so doing, they outstripped the achievements of the most famous victim of Arctic mutiny, Henry Hudson, who may have had an inland sea named after him, but did not return from the Arctic to publish his account.

Seeking access to this same polar print nexus in which Franklin and Richardson would outstrip their predecessor Hearne, the Shelleys submitted Frankenstein to Murray for publication in May 1817. Murray was their first choice because he was Byron's publisher, as literature scholars typically point out, but also because he held the unique title of "Bookseller to the Admiralty," assuming exclusive rights to prestigious Arctic publications akin to a patent. Murray rejected the novel, and it was instead published by Lackington, a firm known for supernatural fiction. The subsequent eclipsing of Frankenstein's Arctic dimension (in popular culture and academic scholarship) is in part due to this undesired distance from the center of polar print culture. In other words, Murray's status as Bookseller to the Admiralty, enjoying a virtual monopoly on Arctic voyages for an elite readership, may have been as important to the Shelleys as his role as Bookseller to Byron.42 Frankenstein would have appeared amid the officially sanctioned Arctic publications that Barrow shepherded through Murray's press from 1818 until his death in 184843-Eleanor Porden in 1818; John Ross in 1819; Franklin in 1823, 1828, 1829; William Parry in 1821, 1824, 1825, 1826; George Lyon in 1824; Edward Sabine in 1821; George Back in 1836 and 1838; Richardson in 1829-37; and Barrow himself in 1818 and 1846.44 These eighteen first editions by nine authors on the Arctic alone represent an attempt to monopolize the publication rights on an entire geo-imaginary region, an analogous practice to the contested monopoly on Arctic exploration long held by "adventure capitalists"45 in the Hudson's Bay Company. And to a significant extent, publication began to precede exploration: Barrow's Chronological History of Voyages into the Arctic launched not only the heroic age of Arctic exploration, but also the Arctic publishing nexus: this book, he hoped, would serve "as a proper introduction to the narratives of the present voyages, which, whether successful or not, will be expected by the public" (Preface).

While Murray published the first two cantos of Byron's scandalous Don Juan in 1819 (without Byron's name appearing on the title page), he may have had more to lose financially in publishing an irreligious, "inauthentic" polar narrative while contracted as official Admiralty publisher. Barrow was notoriously vicious in reviewing both "unauthorized" polar accounts like Bernard O'Reilly's Greenland (1818) and authorized accounts like John Ross's Voyage of Discovery . . . of a north-west passage (1819) that contradicted his pet theory of an open polar sea.46 Among its many transgressions, Frankenstein as an Arctic narrative was inauthentic, unauthorized, and in violation of Barrow's theory of the ice-free Pole. The Murray nexus could not afford to associate Frankenstein with their nascent Arctic publishing industry, and instead positioned the Franklin Narrative in the same legendary company as Hearne's Journey. Rather than leading with Frankenstein, the 1818 literary launch of the polar print nexus was represented by the patriotic poem The Arctic Expeditions, written by Eleanor Porden, who would become Franklin's first wife.47 Before setting off for his second Arctic land expedition in 1825, Franklin was already discussing plans for collaborating with Porden on the next narrative, but she died a few days after he sailed. Porden and Franklin's short-lived collaboration, cemented in their mutual ties to the Royal Institution, the Admiralty, and Murray, forms an intriguing Tory counter-circle to that of the exiled Shelleys and their radical politics, one deserving fuller investigation.

Given this divergence of Frankenstein from the polar print establishment, Richardson's glimpse of Frankenstein's female monster in the Barren Lands was even more remarkable than at first appears. The publication of Franklin's authorized Narrative in 1823 coincided with the beginnings of Frankenstein's new life on stage, in Richard Brinsley Peake's Presumption; or, The Fate of Frankenstein, first performed in July 1823 at the English Opera House. Frankenstein reached a wide audience on the stage, and later in film, but it did so stripped of its Arctic dimension. While Peake removed the polar frame and concentrated Shelley's multivalent text into one centered on the impious presumption of monstrous science, Arctic subjects flourished in visual culture following the 1818 and 1819 expeditions, with touring panoramas opening in Leicester Square (1819, featuring an image of Franklin) and Glasgow (1822), as well as exhibits featuring Arctic peoples, like Bullock's "Laplanders" displayed at his Egyptian Hall in 1822.48 William Parry's triumphant return from the Arctic in 1821 (at the same time that the Franklin disaster was unfolding, unbeknownst to the British public) had generated the greatest amount of national pride and interest in Arctic subjects, and so perhaps Shelley's 1818 warning against Arctic fever as its own kind of "presumption" would have fallen on deaf ears as far as a populist dramatist like Peake was concerned.

Building on the success of Parry's triumphalist first Journal of a Voyage for the Discovery of a North-West Passage,49 an enterprising Murray printed 1,500 copies of Franklin's Narrative in 1823, and it reached three editions (all with the same large print run) by the following year, as well as several translations, enjoying good reviews and wide circulation through lengthy periodical extracts.50 In contrast to Franklin's success in popular print, Frankenstein, often described as a "bestseller," was printed in an initial print run of only 500 copies, and, as William St Clair argues, "During the first fifty years of Frankenstein's existence, the readership was largely confined to a narrow constituency of men and women at the topmost end of the income scale" (The Reading Nation in the Romantic Period, p. 365). The 1824 French translation of Franklin's Narrative alone numbered 500 copies.51 Frankenstein's spectators numbered in the thousands, however, as did Franklin's, himself the subject of multimedia interest like the panoramas and, posthumously, the stage. Dislocated from Murray's polar print nexus and then from its polar setting altogether, and censored from the records of the Franklin disaster, Frankenstein as Arctic narrative was lost in distance and darkness.

II . Fort Enterprise: The Abode of Misery

Lacking Frankenstein's supernatural horror but also reveling in shocking incidents, the Franklin disaster narrative made up for in authenticity what it lacked in literary flair. The massacre at Bloody Falls had been the controversial selling-point of Hearne's Journey, while for Franklin and Richardson it was the violent deaths of Midshipman Hood and the Métis voyageur Michel Terrehaute, and the cannibalism at the center of the violence, that earned the survivor/authors a large public audience for their Narrative of a Journey to the Shores of the Polar Sea. That Franklin, Barrow, and Murray were together able to transform this disaster into a commercial success, and to transform Franklin into the darling of London society, is a testament to the degree to which polar narratives were already part of the same polar print culture, whether we call it Gothic or naturalistic, fictional or factual. In other words, it is difficult to write a popular narrative of polar exploration that is not a disaster narrative with details as formulaic as any Gothic romance: madness, mutiny, murder, and cannibalism. Frankenstein indulged in the first three and, despite its vegan monster, evoked fears of cannibalism in its popular political transformations.

The murders and cannibalism in the authorized Narrative were described in even more intense terms in the officers' unpublished letters, for example Richardson's letter to his wife preparing her for his return:

I shall not attempt to describe the miseries we endured in this journey for no description can convey an adequate idea of them, and the bare detail would be too ... harrowing to ... your feelings ...

He alludes to the murder of Hood, his own killing of Terrehaute, and his own resorting to cannibalism (unwittingly on one occasion, perhaps deliberately on another). The returning officers were aware of unauthorized accounts of their disaster filtering from the North American press into the British press before the

publication of the official narrative.53 They could not afford to have a British venture associated with the murder and cannibalism revealed in the 1816 case of the French frigate Méduse, visualized in Géricault's shocking painting displayed in Piccadilly in 1820.54 In his letter above, Richardson at first writes "the bare detail would be too harrofing to the feelings of humanity," using an idiosyncratic misspelling of "horrifying"55 that he revised to "harrowing to your feelings," suggesting that he endured not the inhuman horror of cannibalism, but an ordeal that would shock the tender feelings of a wife. The revised version is printed in his nephew's Victorian biography, which removes the cannibalistic dimensions of Richardson's ordeal altogether, as it had his reference to Frankenstein. But it was these glimpses of British cannibalism that led to high sales and, perversely, fame for the returning "heroes" of the disaster.

"Croker &Barrow are quite hot for an early publication of our journals," enthused Franklin to Richardson a few months later, boasting that "Barrow had told [Murray] the narrative was the most painfully interesting of any he had ever read."56 And Barrow should know. A nineteenth-century Hakluyt with not only the power to inspire new exploration by cultivating a market for their narratives, but also the institutional power to help commission the expeditions, Barrow in his Chronological History of Voyages into the Arctic sharpened Hakluyt's nationalism into an aggressive imperialism. Franklin understood the importance of appeasing Barrow, Croker, and Bathurst as state authorities, but equally important to him was pleasing them, and Murray, as readers and publishers. Only they could transmute the disaster over which he had presided into a success, earning him fame and fortune. And that is what they did. What had been for Richardson an indescribably horrifying experience entered the Murray nexus of publication/exploration, and emerged as "the most painfully interesting" Arctic narrative yet. The nature of the suffering merited such superlatives, but it is striking how quickly Franklin came to conceive of the ordeal as narrative, and then as commodity.57

In contrast, Richardson in his unpublished journal struggled with this difficulty of putting into words what he found unspeakable. Having split into separate parties on their deathmarch across the Barrens to Fort Enterprise, Richardson and Franklin in their reunion offered readers a glimpse of the horror through mutual reactions of shock. Richardson recorded how one voyageur, upon seeing Richardson,

> turned away in despair on beholding our ghastly countenances. He recovered however, in a short time, sufficiently to welcome us to this abode of misery, but the disappointment had evidently given him a great shock. The hollow and sepulchral sound of their voices, produced nearly as great a horror in us, as our emaciated appearance did on them. (Arctic Ordeal, p. 161)

Again we see that shades of beings risen from the grave have become all too real, as Richardson himself reports how "the ghastly countenances, dilated eye-balls, and sepulchral voices of Mr. Franklin and those with him were more than we could at first bear."58 Like Shelley, who signaled her creature's terrifying appearance through the reactions of spectators, the Franklin crew in their mutual expressions of horror gesture toward a vision of human degeneration impossible to represent. "Travel decomposes civilized man," according to Anthony Pagden,59 and in this case the decomposition is a literal one, transforming the emaciated bodies of the starving men into revenants and cannibals. The devout Richardson, already gripped with atheistic doubts, experienced this disaster as a horror approachable only in Foucault's "language to infinity" that Gothic uniquely provided, and thus it was his journal that was incorporated into the official Narrative to describe the nadir of their ordeal.60

Richardson's account in the Narrative, enthused the New Monthly Magazine, is "replete with horror." The Literary Gazette and the Gentleman's Magazine excerpted the most sensationalist Gothic passages in their glowing reviews, while simultaneously praising the volume's high production values and patriotism: "Of the costly and superb manner in which this interesting work has been embellished, we cannot speak too highly," gushed Gentleman's, praising the "noble and enterprising spirit [of] the British Government." The Literary Gazette agreed: "The spirit and character of the whole,-tables of science, typography, charts, plates finely executed of scenery and costume, render it, to use the bookselling phrase, one of the best got up volumes that

has appeared even in these improving times." The Literary Gazette then went further, praising the visual "embellishments" especially when "compared with Hearne's and Mackenzie's works."61 Here was progress where it mattered, where someone like Walton would agree it was worth risking lives for-outstripping the published Journeys of legendary explorers like Hearne and Alexander Mackenzie, and thereby attaining one of the expedition's true goals.

The Gothic dimension of their ordeal, by far the most "painfully interesting" to readers and largely the work of Richardson, was thus embedded within the heterogeneous materials-ethnographic, zoological, meteorological, geological, geographical, pictorial-that elite audiences consumed as "embellishments." Franklin confided that the expensive Narrative (at 3 guineas) was "speedily commenced and executed with all the expedition possible" in order to prevent "the public mind [losing] interest in its contents," and to forestall any "unauthorized" accounts like those that had preceded Parry's Journal in 1821.62 In October 1822 Franklin was still waiting both for the Admiralty to release the officers' journals, so that he could begin writing, and for the Colonial Office to agree on the engraver; by April 1823 the book was in press.63 While Gothic horror was crucial for sales, it also had to be contained within a socially redeeming framework for its elite audience, one befitting the scientific and nationalist register of the voyage's stated goals. A religious dimension served this redeeming purpose, coded conventionally through providential shipwreck literature, and more controversially through a submerged evangelicalism.

One reason that the Admiralty's Barrow and Croker would have been content to banish Shelley's Frankenstein from Murray's Arctic panoply was the radical implications of its irreligion. While Croker in the Quarterly Review attacked Frankenstein for its amorality, Barrow, in his review of the Franklin Narrative, lingered over the passages in which Franklin described the comfort that the starving officers took in their evangelical faith. Carrying numerous religious books with them, Franklin piously insisted that they never succumbed to despair: "Read this, ye Hunts and ye Hones," exclaimed Barrow, "and if you be not as insensible to the feelings of shame and remorse, as to those consolations which the Christian religion is capable of affording, think of Richardson, Hood, and Hepburn."64 The returning voyagers were enlisted in the intensifying fight against domestic reform precipitated by the Peterloo Massacre of 1819, and represented by scandalous figures such as Leigh Hunt and William Hone, fellow-travelers with Percy Shelley, the reputed author of Frankenstein.

It is significant that all four officers of the 1819 Franklin expedition were, like William Parry, evangelical Christians, at a time when evangelicals were a Protestant minority still open to charges of enthusiasm. While a discussion of the neglected evangelical dimension of Arctic exploration and publication is beyond the scope of this essay, it is important to keep in mind that individual members of the nexus, such as Franklin, Back, Richardson, and Parry, were privately devoted to an intensifying evangelical "Missionary Spirit"65 in their roles as explorers, which non-evangelical Church of England agents in the Admiralty, Colonial Office, and Royal Society quietly supported for instrumental reasons.66 This evangelical undercurrent goes beyond the Christian metanarrative of providential salvation redeeming the disaster of the Narrative (in itself an orthodox feature of shipwreck literature). It is clearest in the officers' neglected correspondence with family and missionaries, but it was also made deliberately visible in the third textual companion, alongside Shelley's Frankenstein and Hearne's Journey, that the Franklin Narrative used to establish its tragic hero and its socially redeeming purpose. This third text transformed the murder of Hood into a martyrdom for the shared faith of the British officers and for the embattled Christian faith of the nation after the crisis of 1819.

On the verge of starvation, Hood had been apparently shot in the back of the head by the half-Iroquois voyageur Michel Terrehaute, after Terrehaute was suspected of killing and eating two fellow voyageurs. Richardson described how he discovered Hood's body: "Bickersteth's Scripture Help was lying open beside the body, as if it had fallen from his hand, and it is probable that he was reading it at the instant of his death."67 Several days later, Richardson shot Terrehaute in the head without warning, claiming he feared for his life. Of the four British crewmembers, Hood was the most physically frail, the youngest, and the most Romantic in his

journal writings. At the moment of his death, Hood was also the most devoted Christian. Reading A Scripture Help Designed to Assist in Reading the Bible Profitably, by Edward Bickersteth, the Secretary of the Church Missionary Society, offered a nonverbal sign of the "good death" that evangelicals sought.68 Hood's reading at the moment of death provided the Franklin disaster with the Christian closure that swept into oblivion the deaths of nine voyageurs, British cannibalism, Hood's own shocking end, and the senselessness of the entire enterprise. Consistent with centuries of rationalizing European violence in New World exploration, Franklin and Richardson publicly considered Hood as the sole casualty of the disaster.

Hood's death in 1821 echoes the death in exile of a more famous young man, a contrasting exemplum of British genius prematurely extinguished in that same year-John Keats (Hood was twenty-five years old, Keats was twenty-four). It also prefigures a famous Romantic death while absorbed in reading-Percy Bysshe Shelley's death in exile in 1822. Edward Trelawny had famously identified Shelley's disfigured body by the two books in his pockets, by Aeschylus and Keats.69 Like Hood unidentifiable by the defining feature of human individuality (the face), Shelley is identified by, and dangerously absorbed in, the books he read at the moment of death. Shelley and Keats's popular examples of being consumed by their love of books are corrected by Robert Hood being lost in his book-an evangelical scriptural commentary written by the Secretary of the Church Missionary Society, whose controversial new Canadian mission at Red River the Franklin officers were quietly aiding.70 Whereas Keats and Shelley were associated with a dangerous combination of political reform and paganism, Hood's piety made him the perfect alternative to his controversial peers for Croker, Barrow, and Murray, whose Quarterly Review had famously attacked the two poets. Thus the sensationalist retelling of the Franklin disaster also offered a reactionary antidote to the irreligious influence of Hunt and Hone specifically, as Barrow had argued in the Quarterly Review, and of Keats and Shelley implicitly, testifying to the importance of the nation's embattled Christian faith from metropolis to colonial hinterland.

Conclusion: Aggregate Author, Publishing Nexus

The chance meeting of three books-Hearne's Journey, Shelley's Frankenstein, and Bickersteth's Scripture Help-in an Arctic disaster transforms our understandings of early-nineteenth-century exploration and authorship. These books from seemingly disparate domains-Enlightenment travel, Gothic romance, and evangelical theology-help us to outline more generously the remarkable ambition of polar writings like the official Franklin Narrative. The Narrative had highlighted its connections with Hearne and Bickersteth while suppressing its affinities to Frankenstein, even while evoking the novel's revenant horrors to commercial advantage. Amid such strange textual bedfellows, the Franklin Narrative begins to resemble the heterogeneous assemblage of Frankenstein's creature and its competing narrative frames: the Narrative encompassed the writings of five named authors-Franklin, Back, Richardson, Hood, and Edward Sabine-segmented into seven scientific appendixes (in subsequent editions moved into a second volume) and embellished with over thirty engravings based on the paintings of Hood and Back.

Franklin's name appears on the title page as author, but the Narrative is the product of what I would call an aggregate author-not of multiple, unified coauthors, but of an unindividuated "author" comprising an uneven aggregate of individual and institutional agents, obeying a strict hierarchy. Among the most important was Barrow, who made possible the Narrative not only by commissioning the expedition, brokering the publishing contract, and publicizing the book and the expedition in the Quarterly Review, but also by revising and authorizing "every sheet" of proofs.71 While such a radically deindividualized aggregate author may seem out of place as a contemporary of Romantic literary genius, it is recognizable in a predisciplinary longue durée as an early-nineteenth-century corporate version of the "literatory" models of collective authorship described by Adrian Johns, David Saunder, Ian Hunter, and Paula McDowell.

The aggregate author also included Earl Bathurst, whose imprimatur appears on the title page between the names of Franklin and Murray. Bathurst founded and was in charge of the Colonial Office (1812-1827), under whose jurisdiction these Arctic expeditions and publications ultimately fell. In 1823 Bathurst took a personal

interest in the engraver to be used for the Franklin Narrative, and even in the animal specimens collected;72 for the subsequent 1825 Franklin expedition Bathurst's Colonial Office paid nearly £10,000 toward their expenses and salaries, issued the official Instructions, and subsidized Murray's publication of the Narrative of a Second Expedition by £400.73 Clearly, then, we need to stop presenting nineteenth-century Arctic exploration as "naval" and "scientific," and somehow peripheral to the colonial and missionary efforts found in every other region of Britain's imperial activity.

In fact, the coincidence of the Franklin expeditions with the Colonial Office's unprecedented 1820s campaigns for stateassisted emigration to British North America is no coincidence at all. Instructed by the Colonial Office to "amend the very defective geography of the Northern part of North America,"74 the Franklin expeditions helped map the hinterlands of Britain's most remote territorial interests, the aboriginal lands beyond its existing North American colonies, whose boundaries and legal status remained contested throughout the first half of the nineteenth century. While for British historians and literary scholars the American Revolution, the territorial empire of the East India Company, and Britain's African endeavors have all overshadowed work on British North America and Hudson Bay trading territories, in the early nineteenth century this vast transcontinental region and its maritime routes were considered pressing concerns by the Colonial Office.75

Increasingly hailed by Bathurst's expanding Colonial Office as part of the solution to the growing problem of a "superfluous" population of dissatisfied and radicalizing poor, Upper Canada (Ontario) was the destination of several state-sponsored emigration schemes between 1815 and 1826.76 The Colonial Office's underwriting of the 1820s Arctic expeditions to the north of the Canadas is inseparable from its simultaneous intensive involvement in its postrevolutionary North American colonies and territories: its support of the creation of an unprecedented transcontinental Hudson's Bay Company trading monopoly in 1821; its role in secretly attempting the union of Upper and Lower Canada in 1822; and its role in the heated public discussions (and 1819 Parliamentary inquiry) into the legal and sovereign status of the Canadian provinces and aboriginal territories through which Arctic expeditions traveled. All of these efforts were in part designed to strengthen the British North American colonies militarily and numerically, and the Hudson's Bay Company's commercial interests and influence, as counter-forces to hostile republican and French Catholic populations.77 This occulted colonial dimension was central to "scientific" Arctic exploration, which for too long has been described as a naval solution to the post-Napoleonic problem of underemployed officers and ships. It is readily visible in the heterogeneous polar print nexus that I have described, indeed even on the title page of the Narrative itself. Richardson's transportation of Frankenstein's creature to the North American aboriginal territories had situated Britain's Arctic fever within this same pressing debate on empire, with which contemporary readers were closely engaged.

The writings of returning explorers were scrutinized carefully by the Colonial Office and the Admiralty, another regulatory feature of aggregate authorship in this publishing nexus that was absent from literary writing. Included in all officers' instructions were requirements to keep a journal and then relinquish it, along with all maps and charts, upon their return-a policy of secrecy not only rigorously enforced by the Admiralty and Colonial Office, but followed as well in commercial exploration financed by the Hudson's Bay Company and East India Company. Typically, only the commanding officer was subsequently authorized to publish, but there were notable exceptions and ambiguities the further back in voyaging history one goes. The most spectacular precedent for transforming a naval disaster (in which nearly 1,400 of 1,900 crew died) into a publishing success had been George Anson's ghostwritten Voyage Round the World (1748), which reached five editions in its first year alone. But it had been Anson's plunder of the Spanish galleon, and his personal prize money of £93,000, that had converted the deaths of 1,400 men into a wild success.78 The Admiralty had allowed officers to publish their own competing accounts of controversial episodes of the debacle (notably the wreck of the Wager) before Anson's official narrative appeared, using rival presses. In the publishing scandals of the Cook expeditions thirty years later, the Admiralty and its allies like Banks tried to sharpen the distinction between "authorized" and

"unauthorized" writings, and to close the temporal gap between exploration and publication. They used one publisher (Strahan, who held the King's patent and the law patent) for all three Cook narratives, but they failed to enforce the ideological constraints that the Admiralty imposed on its authors, or to suppress embarrassing "unauthorized" writings. Only in the first half of the nineteenth century would exploration writings be tightly controlled from a central network, operating for the first time through one authorized publisher, the house of Murray. The fact that the first two Franklin Narratives appeared without any "unauthorized" competing accounts is a rare distinction, and a testament to the efficiency of this innovative nexus.

The cooperation of numerous agencies and agents in this unique cross-institutional network made possible, indeed required, such a model of aggregate authorship. Aggregate authorship also reflected the interdependent nature of shipboard life and scientific enquiry, with the Captain's authorizing name indicating the strict hierarchy that the naval men obeyed. On these early examples of "floating laboratories" commanded by Franklin, Parry, Back, and Ross, the officers practiced a collaborative form of research and writing still in use today in the social and hard sciences,79 but one at odds with the individualization of authorship we associate retrospectively with the domain of expressive literature.

The collaborative nature of Arctic exploration and publication was also at odds with the growing investment in the celebrity of individual explorers like Parry and Franklin (and above all Humboldt), an individuating force promoted by Murray and Barrow for commercial and ideological ends. Predecessors like Cook and (posthumously) Hearne were also recognized as individual heroes of their published polar narratives, though both had relied on ghostwriters and both had died before they could enjoy any benefits of fame. In the first half of the nineteenth century it was the self-financed Alexander von Humboldt who embodied this emerging Romantic ideal of "autonomous" author/explorer, a fellow-traveler of Robert Walton and Victor Frankenstein, whose revolutionary books represented precisely the liberal, cosmopolitan, secular, and Romantic antithesis to the authorized productions of the British polar print nexus.

A heterogeneous, multidisciplinary text by an aggregate author, produced by an unprecedented centralized nexus of publication and exploration, the Narrative of a Journey to the Shores of the Polar Sea obscures distinctions between authentic and imaginary exploration, scientific and religious epistemes, naturalistic and Gothic modes, and, finally, authors and explorers. In sharing the same, impossible terrain as the Shelleys, Hearne, and Bickersteth, Franklin and Richardson can truly be said to "travel in their predecessors' language," as Michel de Certeau writes.80 When these predecessors are also polar explorers- Robert Walton, Samuel Hearne, the Ancient Mariner, Frankenstein's creature (last seen heading for "the most northern extremity of the globe" [Frankenstein, p. 243])-these words are of disaster redeemed through its retelling.

By no means an organic synthesis, this polar nexus rippled with internal contradictions (glimpsed in the violence of its sensationalist strands and the tensions between the multiple perspectives amassed in the texts), and with the revelations of dissidents expelled from its fold, such as John Ross and Richard King, who publicly criticized this monopoly. Those who persisted in publishing their Arctic narratives outside this formidable nexus would have to either devise innovative publishing strategies (Ross hired a door-to-door salesman), inhabit divergent traditions (Frankenstein as a supernatural romance, minus polar frame), or invite the wrath of this state-sponsored network-as was the case with Richard King and Bernard O'Reilly.

O'Reilly's Greenland, the Adjacent Seas, and the North-West Passage to the Pacific Ocean (1818), incorporating meteorological observations, engravings of optical phenomena, travel journal, and ethnographic and historical chronicle, had brazenly set out to steal the thunder of Barrow's 1818 expeditions. Writing in Murray's Quarterly Review, Barrow slammed O'Reilly's "unauthorized" and therefore "inauthentic" polar account, incensed by O'Reilly's dismissal of Barrow's ice-free pole theory as a "utopian paper-built plan of sailing to the north pole."81 How dare a mere ship's surgeon publish a "frothy quarto" for a full 50 shillings, fumed Barrow: he should have stuck to a "sensible and unpretending . . . small duodecimo" appropriate to his station.82 O'Reilly had positioned himself as an authentic polar hero because he was an unauthorized outsider:

he had successfully evaded the polar nexus's policy of relying on official journals and archived documents, and offered the public instead "a complete idea of the actual situation of the polar world" taken from "on the spot" observation, in the highest tradition of the Enlightenment "great cause of science" (Greenland, pp. iii, v). He had also trespassed into the expensive terrain of the illustrated, multidisciplinary quarto that Murray and Barrow tried to monopolize, using the expensive quarto format itself as an "authenticity effect" also signaling authority.83 Richard King, the naturalist on Back's 1833 Arctic expedition in search of John Ross, similarly defied the polar print nexus and published his Journal of an Expedition with Bentley, revealing the systematic abuse and "extermination" of Native peoples in British North America, as well as a massacre of Inuit by Back's crew, covered up by the Admiralty.84 He received twelve copies as payment, while Back's sanitized account gained him £700 from Murray.85 Ross was the most entrepreneurial of all after spectacularly falling out with Barrow and Murray in 1819-he sold 7,000 subscriptions to his 1835 Narrative of a Second Voyage via a door-to-door agent, and even designed his own panorama. Franklin was so appalled by Ross's demystification of Arctic publication that he refused to subscribe when the agent called at his house. These renegades, along with their companions in fiction like Frankenstein, both delimit the reach of Murray's polar print nexus and illustrate the unpredictable consequences of publishing outside its orbit.

Modern Arctic exploration was indeed a "paper-built plan" developed by Barrow, Croker, Bathurst, and Murray, and publicized through the Quarterly Review-a unique convergence of texts, nascent disciplines, genres, people, professions, religious and intellectual domains, and governmental agencies, no less formidable for being paper-built. State-sponsored investment in the cult of the heroic individual explorer such as Franklin and Parry was to a great extent carried out in their ceaseless and ultimately unsuccessful efforts to cohere under a central Author, and in a substantial quarto volume, a babble of voices (officer and crew, European and Native, scientific and religious, terrified and self-assured, individual and institutional), a multiplicity apparent in the heterogeneous texts themselves, wonderfully rife with contradiction. Transmuting human disasters into commercial success and ideological ammunition for further exploitation, this paper-built polar nexus helped expand Britain's imperial and colonial reach by selling a carefully controlled, yet unavoidably unwieldy, illusion of the unified author as explorer. Writing the disaster, for "Franklin" as for "Walton," but more so for Murray and Barrow, meant transforming it into success.

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Sidebar

Nineteenth-Century Literature, Vol. 65, No. 4, pp. 433-480. ISSN: 0891-9356, online ISSN: 1067- 8352.

Sidebar

ABSTRACT

Adriana Craciun, "Writing the Disaster: Franklin and Frankenstein" (pp. 433-480)

The occasion for this essay is the surprise meeting of three texts from distinct traditions-Gothic romance, evangelical theology, and Enlightenment exploration-during the course of an Arctic disaster. The essay explores the relationship of the official disaster narrative (John Franklin's Narrative of a Journey to the Shores of the Polar Sea [1823]) to these heterogeneous textual companions, particularly Mary Shelley's Frankenstein (1818). Published by the Admiralty's official bookseller, John Murray, the official Franklin Narrative emerged from a highly centralized governmental and publishing network, one that attempted a virtual monopoly on prestigious Arctic publications from 1818 to 1848. The essay uncovers the complex institutional connections of this publishing nexus, and the strong centripetal pull exerted upon them by governmental authorities, while simultaneously considering a range of fugitive writings-chief among them Frankenstein-that escaped the pull of this formidable nexus. Frankenstein's proximity to the center of polar print culture and its highly regulated

discursive practices reaffirms the widespread persistence not only of collaborative authorship into the nineteenth century, but also of more radically unindividualized authorship practices carried out across institutional lines. Thus, rather than asking how novels like Frankenstein were influenced by polar exploration, this essay broadens the field of inquiry to consider authorship and publishing practices across diverse domains, including corporate, governmental, and commercial.

Footnote

1 Mary Shelley, Frankenstein; or, The Modern Prometheus: The 1818 Version, ed. D. L. Macdonald and Kathleen Scherf, second edition (Peterborough, Ontario: Broadview Press, 1999), p. 49. Further references are to this edition and appear in the text. The numerous deaths of Walton's crew are mentioned in both the 1818 and 1831 editions.

2 Given that Walton is typically read as "a potential Frankenstein" (George Levine, "The Ambiguous Heritage of Frankenstein," in The Endurance of "Frankenstein": Essays on Mary Shelley's Novel, ed. George Levine and U. C. Knoepflmacher [Berkeley and Los Angeles: Univ. of California Press, 1979], p. 18), Walton's reluctant retreat, and the failure of his chastened ambition to match Victor's, is central to readings of Frankenstein as an ambivalent but ultimately moral lesson advocating what Percy Shelley described in his Preface as "the amiableness of domestic affection" (Frankenstein, p. 47); see, for example, Levine, "The Ambiguous Heritage of Frankenstein"; Paul Sherwin, "Frankenstein: Creation as Catastrophe," PMLA, 96 (1981), 883-903; Anne K. Mellor, Mary Shelley: Her Life, Her Fiction, Her Monsters (New York and London: Routledge, 1988), p. 126; Marilyn Butler, Introduction to Frankenstein (Oxford: Oxford Univ. Press, 1993; 1998), p. xxxv; and Michelle Levy, "Discovery and the Domestic Affections in Coleridge and Shelley," SEL, 44 (2004), 699.

3 Walton is keen to preserve the narrative account (his "papers") of his voyage, and recounts Victor's interest in these writings: "Frankenstein discovered that I made notes concerning his history," writes Walton; "he asked to see them, and then himself corrected and augmented them in many places. . . . 'Since you have preserved my narration,' said he, 'I would not that a mutilated one should go down to posterity'" (Frankenstein, p. 232). Levy also notes that "Walton eagerly adopts the duties of an author" ("Discovery and the Domestic Affections," p. 705).

4 Franklin to Mrs. Booth (sister), April 1818, Derbyshire Record Office (hereafter DRO), MS D3311/28. Quoted by permission of the Gell Muniment Trustees and the Derbyshire Record Office.

5 On the persistent interest in an ice-free Arctic, see Glyn Williams, Voyages of Delusion: The Northwest Passage in the Age of Reason (London: HarperCollins, 2002).

6 Many of the unpublished papers of officers aboard the four 1818 ships are available in the Admiralty papers at the National Archives, Kew, and are notable in their uneventfulness. Franklin, in command of the Trent and en route for the North Pole, kept a log of "Observations," all of them astronomical (National Archives, Adm 55).

7 Murray is named as such on numerous title-pages; the earliest record I can find granting him this privilege is a March 1813 note from J. W. Croker: "Mr John Murray is the Bookseller of the Admiralty &Board of Longitude" (National Library of Scotland, MS 42,128. Quoted by permission of the National Library of Scotland, hereafter NLS). Murray titles with this authorization began to appear in 1813, e.g., Ivan Krusenstern's Voyage Round the World, in the Years 1803, 1804, 1805, &1806 . . . under the command of Captain A.J. Von Krusenstern, 2 vols., trans. Richard Belgrave Hoppner (London: John Murray, Bookseller to the Admiralty and the Board of Longitude, 1813). On the practice of patents, see Marjorie Plant, The English Book Trade: An Economic History of the Making and Sale of Books (London: G. Allen and Unwin, 1939), pp. 100-21.

8 Bathurst's approval of the Franklin expedition plans and his official Instructions are reprinted in Sir John Franklin's Journals and Correspondence: The First Arctic Land Expedition, 1819-1822, ed. Richard Clarke Davis (Toronto: Champlain Society, 1995), pp. 277-78, 285-88. The narrow focus on these expeditions as chiefly naval and scientific is evident in Fergus Fleming's popular history Barrow's Boys: A Stirring Story of Daring, Fortitude and Outright Lunacy (London: Granta, 1998); Jeanette Mirsky, To the Arctic! The Story of

Northern Exploration from Earliest Times to the Present, rev. ed. (New York: Alfred Knopf, 1948); Peter J. Kitson, "Introduction," in Volume 3, North and South Poles, in his anthology Travels, Explorations and Empires: Writings from the Era of Imperial Expansion, 1770-1835, ed. Peter J. Kitson, 8 vols. (London: Pickering and Chatto, 2001), III , vii- xxii; Pierre Berton, The Arctic Grail: The Quest for the North-West Passage and the North Pole, 1818-1909 (Toronto: McClell and Stewart, 1988); and Tim Fulford, Debbie Lee, and Peter J. Kitson, Literature, Science and Exploration in the Romantic Era: Bodies of Knowledge (Cambridge: Cambridge Univ. Press, 2004). In large part this focus is due to the relegation of Arctic exploration to traditional maritime history (or popular history) and the slowness of other historiographic traditions (for example the new imperial history and oceanic studies) to influence and be influenced by developments in the circumpolar North. Rare exceptions, incorporating the Arctic into the new Atlantic studies, are Ian K. Steele, The English Atlantic, 1675-1740: An Exploration of Communication and Community (New York: Oxford Univ. Press, 1986); and Michael Dove, "Plying the Northernmost Atlantic Trading Route to the New World: The Hudson's Bay Company and British Seaborne Empire," in English Atlantics Revisited: Essays Honouring Professor Ian K. Steele, ed. Nancy L. Rhoden (Montreal and Kingston: McGill-Queen's Univ. Press, 2007), pp. 174-205.

9 On the variant meanings of "empire" in the British context (including empire of goods, empire of influence, empire of territory, empire of the sea), see Kathleen Wilson, "Introduction: Histories, Empires, Modernities," in A New Imperial History: Culture, Identity, and Modernity in Britain and the Empire, 1660-1840, ed. Wilson (Cambridge: Cambridge Univ. Press, 2004), pp. 1-26; and P. J. Marshall, introduction to The Oxford History of the British Empire, Volume III: The Eighteenth Century, ed. Marshall (Oxford: Oxford Univ. Press, 1998), pp. 1-27.

10 Between 1821, when the Hudson's Bay Company (HBC) amalgamated the western territories held by the North West Company, and 1869, when HBC sold its territories to the newly created (1867) Dominion of Canada, it ruled (as a commercial and legal administrator) roughly three million square miles of North America, nearly one-fourth of the total continent. Its original charter granted by Charles II in 1670 had given it a poorly defined and frequently disputed territory of approximately 1.4 million miles known as Rupert's Land, the vast drainage basin of all the rivers flowing into the Bay (see John S. Galbraith, The Hudson's Bay Company as an Imperial Factor, 1821-1869 [Berkeley and Los Angeles: Univ. of California Press, 1957], p. 3). The trading monopoly that the HBC enjoyed from 1821 to 1867, while it did not involve the responsibilities of colonial government that the East India Company would assume, included "the responsibility for law and order and for the acceptance of duties towards the Indians" (E. E. Rich, Hudson's Bay Company, 1670-1870, 3 vols. [New York: Macmillan and Co., 1960], III , 405). This transcontinental "Great Monopoly" spanned from Hudson Bay in the east, across all of British North America, the aboriginal territories to the north, and to the Pacific coast.

11 Shelley sent Frankenstein first to Murray in May 1817, writing in her 26 May journal entry that "Murray likes F." Three days later she wrote: "Of course Gifford did not allow this courtly bookseller to purchase F." (quoted in The "Frankenstein" Notebooks: A Facsimile Edition of Mary Shelley's Manuscript Novel, 1816-17, ed. Charles E. Robinson, 2 vols. [New York: Garland Publishing, 1996], I, lxxxvi). Murray's Recordbook records the novel as "R" (Rejected, presumably) on 14 June 1817 (NLS MS 42,632 f.1). The Shelleys also sent the novel to Percy Shelley's publisher, Charles Ollier, who rejected it in August 1817. By 24 September 1817, Frankenstein was in proofs at Lackington's (see The "Frankenstein" Notebooks, I, lxxxvi-lxxxviii), and it was published on 1 January 1818. Like all scholars working on Frankenstein, I am indebted to Robinson's impeccable textual scholarship on the novel.

12 No extant manuscripts of Frankenstein contain Walton's initial letters to his sister. In The "Frankenstein" Notebooks, Robinson estimates that while the polar frame was not part of the ur-text (I, lx), it was started by August 1816 in Draft Notebook A (I, xxxv).

13 While composing Frankenstein, Shelley read the Quarterly Review in August and December 1816 and May 1817; see The Journals of Mary Shelley, 1814-1844, ed. Paula R. Feldman and Diana Scott-Kilvert (Oxford:

Clarendon Press, 1987), II , 668. The Quarterly Review was typically published late, so that publication and title-page dates often differ; the October 1816 issue (vol. 16.1), containing Barrow's review of Thomas Selkirk's Sketch of the British Fur Trade defending his colonization efforts in Hudson's Bay Company territories (and Barrow's first Arctic proposals), appeared in February 1817 (Quarterly Review, 16 [1816], 129-72); see "Publication and Appearance Dates," Quarterly Review Archive, ed. Jonathan Cutmore, Romantic Circles Editions; available online at <http://www.rc.umd.edu/reference/qr/index.html>. Shelley finished drafting Frankenstein on 17 April 1817.

14 See Mellor, "The Feminist Critique of Science," in her Mary Shelley: Her Life, Her Fictions, Her Monsters, pp. 89-113. Mellor's study also offers extensive discussions of the significance of Percy's revisions to Mary Shelley's novel.

15 Francis Spufford, I May Be Some Time: Ice and the English Imagination (London: Faber and Faber, 1996), p. 7. See also Jessica Richard, "'A Paradise of My Own Creation': Frankenstein and the Improbable Romance of Polar Exploration," Nineteenth- Century Contexts, 25 (2003), 295-314. Because Shelley's Arctic reflects a transplanted alpine sublime, most literary scholars (Richard excepted) focus on locationless "ice" when discussing Frankenstein's Arctic: see Eric G. Wilson, The Spiritual History of Ice: Romanticism, Science, and the Imagination (New York: Palgrave Macmillan, 2003); Andrew Griffin, "Fire and Ice in Frankenstein," in The Endurance of "Frankenstein," pp. 49-73; and Fred V. Randel, "The Political Geography of Horror in Mary Shelley's Frankenstein," ELH, 70 (2003), 465-91. See also Chauncey C. Loomis, "The Arctic Sublime," in Nature and the Victorian Imagination, ed. U. C. Knoepflmacher and G. B. Tennyson (Berkeley and Los Angeles: Univ. of California Press, 1977), pp. 95-112. Jen Hill's White Horizon: The Arctic in the Nineteenth-Century British Imagination (Albany: State Univ. of New York Press, 2008) was published after I completed "Writing the Disaster," and discusses both Frankenstein and Franklin's Narrative. Like Spufford and David, Hill draws largely on Victorian popular sources and contends that for "the nineteenth-century British imagination," "the Arctic is important as a geography that is not a geography (because perceived as blank), as an imperial space that is not part of empire (because there are no economic and colonial goals in its exploration), and as a place that is everywhere . . . because it is nowhere" (White Horizon, p. 16). Because "Writing the Disaster" is part of a forthcoming book that begins with seventeenth-century materials, and because I am interested in corporate and commercial print culture and manuscript practices, rather than a collective "British imagination," my conclusions on questions of the North American Arctic's specificity are different from those of Hill, Spufford, and David, which, while illuminating, privilege Victorian (post-1818) perspectives. Focusing on the Victorian literary "British imagination" has obscured the larger transnational, economic, colonial, missionary interests in the Arctic well known to Europeans from Martin Frobisher onward, including established relations with, and knowledge of, native peoples that before the Victorian era of "blank spaces" were easily visible in European accounts. The seventeenth-century whale oil rush in Spitzbergen and Greenland, the international interest in the lost Norse Greenland colonies, the eighteenth-century Moravian commitment to Arctic missions, and the larger colonial framework of the Franklin journeys that I discuss here are brief examples of the Arctic's economic, imperial, and colonial significance known to diverse nineteenth-century Europeans.

16 Barbara Maria Stafford, Voyage into Substance: Art, Science, Nature, and the Illustrated Travel Account, 1760-1840 (Cambridge, Mass.: MIT Press, 1984), pp. 299, 381.

17 See Jerome J. McGann, A Critique of Modern Textual Criticism (Chicago: Univ. of Chicago Press, 1982); and Bruno Latour, Science in Action: How to Follow Scientists and Engineers through Society (Cambridge, Mass.: Harvard Univ. Press, 1987). Nigel Leask has recently argued, and I agree, that Latour's helpful model of "centers of calculation" leaves largely unexamined the complex practices of writing within such centers (see Leask, Curiosity and the Aesthetics of Travel Writing, 1770-1840: "From an Antique Land" [New York: Oxford Univ. Press, 2004], pp. 18-23).

18 See Jon P. Klancher, The Making of English Reading Audiences, 1790-1832 (Madison: Univ. of Wisconsin

Press, 1987). My thanks to Ian Duncan for this connection.

19 In one important respect, Murray's would-be Arctic monopoly coincides with the strengthening of monopoly practices in publishing that began with the extension of copyright in 1808 and 1814, following the "brief copyright window" (the end of perpetual copyright) opened in 1774 by Donaldson v. Becket (see Williams St Clair, The Reading Nation in the Romantic Period [Cambridge: Cambridge Univ. Press, 2004], p. 121). Key studies of Romantic-era British literary authorship include Jerome J. Mc- Gann, The Romantic Ideology: A Critical Investigation (Chicago: Univ. of Chicago Press, 1983); McGann, The Beauty of Inflections; Literary Investigations in Historical Method and Theory (Oxford: Clarendon Press, 1985); Anne K. Mellor, Romanticism and Gender (New York and London: Routledge, 1993); Jack Stillinger, Multiple Authorship and the Myth of Solitary Genius (New York: Oxford Univ. Press, 1991); Clifford Siskin, The Work of Writing: Literature and Social Change in Britain, 1700-1830 (Baltimore: Johns Hopkins Univ. Press, 1998); and Ian Duncan, "Authenticity Effects: The Work of Fiction in Romantic Scotland," South Atlantic Quarterly, 102 (2003), 93-116. Michel Foucault's 1969 essay "What is an Author?" remains central to studies of authorship, including my own. There is an immense body of cross-disciplinary work on authorship, from which I cite a few titles below. For overviews of authorship studies incorporating both literary and legal aspects, see Susan Stewart, Crimes of Writing: Problems in the Containment of Representation (New York: Oxford Univ. Press, 1991); David Saunders, Authorship and Copyright (London and New York: Routledge, 1992); and The Construction of Authorship: Textual Appropriation in Law and Literature, ed. Martha Woodmansee and Peter Jaczi (Durham, N.C.: Duke Univ. Press, 1994). For a review of more recent cross-disciplinary work on the history of authorship with reference to "the Romantic author," see Christine Haynes, "Reassessing 'Genius' in Studies of Authorship: The State of the Discipline," Book History, 8 (2005), 287-320. On the regulatory functions of proprietary authorship, see Mark Rose, Authors and Owners: The Invention of Copyright (Cambridge, Mass.: Harvard Univ. Press, 1993); and Jody Greene, The Trouble with Ownership: Literary Property and Authorial Liability in England, 1660-1730 (Philadelphia: Univ. of Pennsylvania Press, 2005). In The Reading Nation in the Romantic Period, William St Clair provides a major reassessment of the relationship of book publication and copyright (displacing "authors" and "texts") to literary study of the Romantic era. While histories of authorship and print culture often speak to different questions, one example of an overview that integrates these aspects (as well as readership) is Roger Chartier, The Order of Books: Readers, Authors, and Libraries in Europe between the Fourteenth and Eighteenth Centuries, trans. Lydia G. Cochrane (Cambridge: Polity Press, 1994). For a revisionary account of exploration and authorship histories, see Adriana Craciun, "What Is an Explorer?" in Eighteenth-Century Studies (forthcoming).

20 See Paula McDowell, The Women of Grub Street: Press, Politics, and Gender in the London Literary Marketplace, 1678-1730 (Oxford: Clarendon Press, 1998); on women's roles in manuscript culture that persisted well into the age of print, see Margaret J. M. Ezell, Social Authorship and the Advent of Print (Baltimore: Johns Hopkins Univ. Press, 1999). On the "literatory" specifically, see Adrian Johns, The Nature of the Book (Chicago: Univ. of Chicago Press, 1998); and David Saunders and Ian Hunter, "Lessons from the 'Literatory': How to Historicise Authorship," Critical Inquiry, 17 (1991), 479-509. For an overview of work on early modern authorship, see Heather Hirschfeld, "Early Modern Collaboration and Theories of Authorship," PMLA, 116 (2001), 609-22.

21 Philip Edwards, "General Introduction," in Last Voyages: Cavendish, Hudson, Ralegh: The Original Narratives, ed. Edwards (Oxford: Clarendon Press, 1988), p. 8; see Mary C. Fuller, Voyages in Print: English Travel to America, 1576-1624 (Cambridge: Cambridge Univ. Press, 1995). I am not interested in reading these Arctic voyage texts in question, and their complex modes of authorship, within a teleological generic account of "travel writing," though this approach is prevalent. See for example Barbara Korte's influential English Travel Writing from Pilgrimages to Postcolonial Explorations, trans. Catherine Matthias (Houndsmills: Macmillan, 2000), where she misreads the 1823 Franklin Narrative (believing Franklin to be the author of Richardson's

interpellated account of the cannibalism episode) because she reads it for narrative content and its evolution of the "suffering hero" (pp. 91-92).

22 See Philip Edwards, The Story of the Voyage: Sea-Narratives in Eighteenth-Century England (Cambridge: Cambridge Univ. Press, 1994), pp. 80-124; Jonathan Lamb, Preserving the Self in the South Seas, 1680-1840 (Chicago: Univ. of Chicago Press, 2001); Lamb, "Circumstances Surrounding the Death of John Hawkesworth," Eighteenth- Century Life, 18, no. 3 (1994), 97-113; Nicholas Thomas, Discoveries: The Voyages of Captain Cook (Harmondsworth: Allen Lane, 2003); and Bibliography of Captain James Cook, R.N., F.R.S., Circumnavigator, 2d ed., ed. M. K. Beddie (Sydney: Library of New South Wales, 1970).

23 See John Gascoigne, Science in the Service of Empire: Joseph Banks, the British State, and the Uses of Science in the Age of Revolution (Cambridge: Cambridge Univ. Press, 1998). Phipps's Voyage Towards the North Pole was published by J. Nourse; Flinders's Voyage to Terra Australis was published by G. and W. Nichol (1814); George Vancouver's Voyage of Discovery to the North Pacific Ocean, and round the World was Printed for G. G. and J. Robinson and J. Edwards (1798); the three official Cook voyage narratives were published in some association with Strahan: Hawkesworth by Strahan and Cadell, Cook by Strahan and Cadell, and John Douglas by Strahan.

24 See Chris Baldick, In Frankenstein's Shadow: Myth, Monstrosity, and Nineteenth-Century Writing (Oxford: Clarendon Press, 1987).

25 A useful account is Berton, The Arctic Grail.

26 Hearne's Journey to the Shores of the Polar Sea was published posthumously by Strahan (the publisher associated with all three authorized Cook narratives). One month before Hearne's death in poverty in 1792, he made an agreement with Andrew Strahan granting him £200 for publishing the Journey; the contract was witnessed by the astronomer and mathematician William Wales, who had wintered in Hudson Bay and had traveled with Cook aboard the Resolution (and had been Coleridge's teacher); Wales is widely assumed to be Hearne's ghostwriter (see contract, October 1792, British Library Add. MS 48901 ff. 51-54). Hearne did not publish his account earlier because he had traveled as an agent of the Hudson's Bay Company, who regarded its agents' explorations as commercial secrets to be circulated publicly only under external pressure, as was periodically the case; see Williams's Voyages of Delusion (pp. 215-36) for a good account of Hearne's relationship to HBC politics.

27 Doubts as to the veracity of Hearne's remarkable journey were rife in that age as well as in our own, specifically relating to Hearne's graphic description of his reluctant participation in a massacre at Bloody Falls, the latitude of the Arctic Ocean, and the general feats of survival that Hearne endured. Barrow was most concerned that Hearne's reaching the polar sea above the Arctic Circle meant that any Northwest Passage would have to be found at much higher latitudes than he hoped, and so he expected the Franklin expedition to discredit Hearne's claims. Before setting out in 1819, Franklin wrote to his father: "I have read a copy of Hearne's original journal, the details are somewhat similar to his printed book-but by no means given in that style and though I am not prepared to go to the length of some persons and doubt his statements altogether-I yet think he has left a tolerably wild field for observation and if we are so fortunate as to reach beyond him I hope we may add something to the Geography and Natural History of that unknown part of the Globe" (14 June 1819, Stromness, DRO MS D3311/40). The Admiralty held a manuscript copy of Hearne's field notes, currently in the British Library (the British Library has two Hearne manuscript versions, neither of them autograph: Stowe 307, and Add. MS 59237). I have compared the two extant manuscript versions to Hearne's published Journey and agree with Ian MacLaren (and Franklin) that the significant differences between the MS and published versions raise doubts about the reliability of many of the most-commented-upon features of Hearne's Journey, including his participation in the massacre, the degree of ethnographic detail provided, and his own role in and relationship to the native group he joined (see I. S. MacLaren, "Samuel Hearne's Accounts of the Massacre at Bloody Fall, 17 July 1771" Ariel, 22, no. 1 [1991], 25-51). Hearne's work is well known in Anglo- American

wilderness and exploration writings; for a good reading of its significance, see Bruce Greenfield, Narrating Discovery: The Romantic Explorer in American Literature, 1790-1855 (New York: Columbia Univ. Press, 1992), pp. 15-69; and Kathleen Venema's feminist reading, "'Under the protection of a principal man': A White Man, the Hero, and His Wives in Samuel Hearne's Journey," Essays on Canadian Writing, 70 (2000), 162-90.
28 Richardson, quoted in Franklin, Sir John Franklin's Journals and Correspondence, p. 317.
29 Richardson, Arctic Ordeal: The Journal of John Richardson, Surgeon-Naturalist with Franklin, 1820-1822, ed. C. Stuart Houston (Kingston and Montreal: McGill-Queen's Univ. Press, 1984), p. 6. Hood and Back's journals from this expedition remained unpublished in their lifetimes but like Richardson's have been published since: see Arctic Artist: The Journal and Paintings of George Back, Midshipman with Franklin, 1819-1822, ed. C. Stuart Houston (Montreal and Kingston: McGill-Queen's Univ. Press, 1994); and To the Arctic by Canoe, 1819-1821: The Journal and Paintings of Robert Hood, Midshipman with Franklin, ed. C. Stuart Houston (Montreal and Kingston: McGill-Queen's Univ. Press, 1974).
30 See MacLaren, "Retaining Captaincy of the Soul: Response to Nature in the First Franklin Expedition," Essays in Canadian Writing, 28 (1984), 57-92.
31 On the British "tropicalization" of India by the early nineteenth century, see David Arnold, The Tropics and the Traveling Gaze: India, Landscape, and Science, 1800-1856 (Seattle: Univ. of Washington Press, 2006); and Ian J. Barrow, Making History, Drawing Territory: British Mapping in India, c. 1756-1905 (New York: Oxford Univ. Press, 2003). I address the problem of the Arctic's invisibility in current discussions of planetarity and globalization in my "The Scramble for the Arctic," Interventions: International Journal of Postcolonial Studies, 11 (2009), 103-14. On the transplantation of British ideals of "improvement" to the Arctic, see Michael T. Bravo, "Mission Gardens: Natural History and Global Expansion, 1720-1820," in Colonial Botany: Science, Commerce, and Politics in the Early Modern World, ed. Londa Schiebinger and Claudia Swan (Philadelphia: Univ. of Pennsylvania Press, 2005), pp. 49-65. On the misapplication of critical paradigms from other regions (e.g., Orientalism, or Spufford's "Borealism") to the Arctic, see Robert G. David's discussion in his The Arctic in the British Imagination, 1818-1914 (Manchester: Manchester Univ. Press, 2000). A second problem is the tendency to conflate the Arctic and Antarctic, visible in Fulford, Lee, and Kitson, Literature, Science and Exploration in the Romantic Era; and in Kitson, ed., North and South Poles, vol. 3 of Travels, Explorations and Empires.
32 Thirty engravings of Back's and Hood's drawings were included in the first edition (twenty-four in the main text, according to Franklin's wishes), engraved by Finden, and some hand colored. Barrow and Murray's correspondence discuss the plates in detail in December 1822 (NLS Acc. 12604/1058). There has been useful work done on the visual materials of these early-nineteenth-century exploration texts, chiefly comparing the extent of the visual and verbal materials' allegiance to normative notions of the picturesque and the sublime; see for example Ian MacLaren, "Retaining Captaincy of the Soul"; Ian MacLaren, "Commentary: The Aesthetics of George Back's Writing and Painting," in Back, Arctic Artist, pp. 275-310; and Richard Davis, "Vision and Revision: John Franklin's Arctic Landscapes," Australian-Canadian Studies, 6, no. 2 (1989), 23-33.
33 Richardson to Back, 9 June 1821, Scott Polar Research Institute (SPRI) MS 395/60). Quoted with permission of the Scott Polar Research Institute (SPRI). I am grateful for Archivist Naomi Boneham for her help in accessing a large number of materials at SPRI .
34 Mary Louise Pratt, Imperial Eyes: Travel Writing and Transculturation, 2d ed. (1992; London: Routledge, 2008), p. 63.
35 See John McIlraith, Life of Sir John Richardson (London: Longmans, Green and Co, 1868), pp. 82-85; see also p. 59. McIlraith's version reads: "she appeared to be rather a creature of the imagination than a reality. Every member of her body seemed to have belonged to different individuals" (Life of Sir John Richardson, p. 84). Arctic Ordeal reprints the edited letter directly from McIlraith (see Houston, "Introduction," in Arctic Ordeal, pp. xxix-xxx); in the only modern biography, Robert E. Johnson also relies on McIlraith (see Johnson, Sir John Richardson: Arctic Explorer, Natural Historian, Naval Surgeon [London: Taylor and Francis, 1976]).

36 Richardson's beautiful letters to his wife at this time are remarkably revealing, including the following passage alluding to Robinson's "The Savage of Aveyron" and Coleridge's "Ancient Mariner" (the atheistic speculations were either revised or excised by McIlraith): "Winter clothed in her unspotted livery still besets us-The snow covers the ground to the depth of three feet. . . . If we pass the threshold of our hut and enter the forest, a stillness so profound prevails, that we are ready to start at the noise created by the pressure of our feet on the snow-The screams of a famished raven or the crash of a lofty pine rending through the intenseness of the frost, are the only sounds that invade the solemn silence of the scene-When in my walks I have perchance met one of my companions in this dreary solitude, his figure emerging from the shade has conveyed, with irresistable [sic] force to my mind, the idea of a being rising from the grave-I have often admired the pictures our eminent poets have drawn of absolute solitude, but never felt their full force until now-What must be the situation of a human being "alone, on the wide, wide sea"-How dreadful if forsaken by his God! An atheist could not dwell alone, in the forests of America. I must not however go on writing in this strain. There are yet two months of winter to come . . ." (Richardson to Mary Richardson, 10 March 1820, [SPRI MS 1503/2]). Excerpts from the Richardson- Voss collection (MS 1503) appear by permission of the Scott Polar Research Institute.
37 Her name is unrecorded but she was the mother of Jean Baptiste Adam, a Copper Indian interpreter.
38 See Howard L. Malchow, Gothic Images of Race in Nineteenth-Century Britain (Stanford: Stanford Univ. Press, 1996); and Anne K. Mellor, "Frankenstein, Racial Science, and the Yellow Peril," Nineteenth-Century Contexts, 23 (2001), 1-28.
39 Richardson also mentions this hermaphroditic guide in his journal (see Arctic Ordeal, p. 53).
40 The large body of scholarship on cannibalism largely ignores the Arctic specifically and survivor cannibalism in general, focusing on European projections of cannibalistic fears onto Native peoples in the Caribbean and Pacific (e.g., Peter Hulme, Colonial Encounters: Europe and the Native Caribbean, 1492-1797 [London: Methuen, 1986]). Survivor cannibalism (as opposed to cannibalism as a social practice) was an omnipresent threat, often a reality, to all who lived and traveled in the Arctic, unlike in the Caribbean and Pacific. See also W. Arens, The Man-Eating Myth: Anthropology and Anthropophagy (New York: Oxford Univ. Press, 1979); and Cannibalism and the Colonial World, ed. Francis Barker, Peter Hulme, and Margaret Iverson (Cambridge: Cambridge Univ. Press, 1998).
41 John Franklin, Narrative of a Journey to the Shores of the Polar Sea (London: John Murray, 1823), p. 6.
42 The British Critic's review of Frankenstein placed the novel alongside the first two Arctic publications of the Murray nexus, Porden's Arctic Expeditions and Barrow's Chronological History of Voyages into the Arctic: according to the review, Walton "has had his imagination fired by an anticipation of the last number of the Quarterly Review, and is gone out to the North Pole, in quest of lost Greenland, magnetism, and the parliamentary reward. In justice to our author, we must admit that this part is well done, and we doubt whether Mr. Barrow, in plain prose, or Miss Pordon herself, in more ambitious rhyme, can exceed our novelist in the description of frozen desarts and colliding icebergs" ([Anon.], rev. of Frankenstein, British Critic, n.s. 9 [1818], 433).
43 With the death of John Murray II in 1843, that of Barrow in 1848, and the disappearance of the third Franklin expedition after 1845, the polar print nexus unraveled, and with it its Arctic monopoly. John Murray III would continue publishing the Navy List, expanding his travel and scientific titles (including Charles Darwin's Origin of Species [1859]), and publishing the proceedings of the populist British Association for the Advancement of Science. But the severance of Barrow's official connection to Murray and the Quarterly Review dissolved the increasingly anachronistic publishing nexus, and made possible the explosion in popular Victorian writings on the Arctic, by a wide range of professed identities, including journalists, missionaries, hunters, and, increasingly, tourists. For a discussion of journalism's increasingly important role in financing and popularizing Arctic exploration in the Victorian era, see Beau Riffenburgh, The Myth of the Explorer: The Press, Sensationalism, and Geographical Discovery (New York: St. Martin's Press, 1993).

44 The relatively large print runs (for such expensive books) of the early Arctic publications reflect the ambition of Barrow's efforts: his own Chronological History was issued in 1,500 copies (197 remained on hand in 1822), and the North Georgia Gazette in 1,250; Parry's Journeys had the largest print runs (the first Journey printed 1,500 copies for the first edition, 500 for the second edition; and for the second Journey, 2,000 for first edition, 500 for second edition). Porden's Arctic Expeditions poem, in contrast to these voyage narratives, had a small run of 500 copies, 336 of which were still on hand in 1823, after 90 copies were given to the Stationers Hall and for presentation (Murray Copy Ledger B, NLS MS 42,725). This attempted monopoly ended with Barrow's death in 1848, which coincided with another surge in Arctic publications surrounding the Franklin searches. These searches generated numerous publications from multiple publishers; in 1850 John Barrow Jr. wrote to Murray complaining of Longman's domination of Franklin search publications, adding: "I am not without hope that you may once again acknowledge your child-& patronize Arctic Adventure &Discovery" (National Library of Scotland, MS 40055). By 1852 Barrow Jr. wrote to Murray, despairing, "I believe you have no great predilection for anything Polar!" when the latter declined to republish Barrow Sr.'s Arctic essays from the Quarterly (MS 40055). All quotations from National Library of Scotland manuscripts are quoted with permission, with thanks.
45 The expression is Michael Nerlich's (see Nerlich, The Ideology of Adventure: Studies in Modern Consciousness, 1100-1750, 2 vols., trans. Ruth Crowley [Minneapolis: Univ. of Minnesota Press, 1987]).
46 Ross's Voyage had an initial print run of 1,250 copies, and sold for 3 1/2 guineas; he received £667 12s. 7d. from Murray (see M. J. Ross, Polar Pioneers: John Ross and James Clark Ross [Montreal and Kingston: McGill-Queen's Univ. Press, 1994], p. 58).
47 Eleanor Porden, The Arctic Expeditions (London: John Murray, 1818).
48 See David, The Arctic in the British Imagination, pp. 148-50; and Russell A. Potter's more detailed discussion of the London panorama in his Arctic Spectacles: The Frozen North in Visual Culture, 1818-1875 (Seattle: Univ. of Washington Press, 2007), pp. 37-70.
49 William Parry, Journal of a Voyage for the Discovery of a North-West Passage (London: John Murray, published by authority of the Lords Commissioners of the Admiralty, 1821).
50 Murray Copy Ledger B (NLS MS 42,725). Franklin made 500 guineas from the first edition, 170 from the second, and by 1825 had made at least 930 guineas from Murray (NLS MS 42,725). He remained dissatisfied however, because Parry had negotiated higher payments (£1050 for the first edition and £500 for his second edition of the 1821 Journey) based on his even more popular Journeys; see Agreement between Parry and Murray, 25 April 1821 (NLS MS 42,688); Richardson to Franklin, 10 March 1824 (DRO MS D3311/55); Franklin to Richardson, 10 February 1824 (DRO MS D3311/11/53). Of the first Franklin edition's 1,500 copies, 1,000 sold for £2 14d, while 445 sold for 3 guineas (the price that Barrow had set from the start) (NLS MS 42,725 f.57). Richardson initially received £150 for his contributions to the Franklin Narrative, and was due to receive £150 more by the end of the year (Richardson to Franklin, 1 June 1823 [DRO D3311/55]). Franklin's naval salary for the 1819 expedition totaled £1,794 (House of Commons, Estimate of Amount Required for Civil Contingencies, 1823 [London: printed for House of Commons, 1824], p. 7). Hepburn, their English servant whom the Admiralty publicly commended for his devotion to his superior officers, received £220 (Hepburn to Richardson, 18 February 1823 [SPRI MS 1391/1-4]).
51 Franklin to Richardson, October 1823 (DRO MS D3311/53).
52 (April 1822, SPRI MS 1503/4 f.3). Richardson also adds: "I feel at least ten years older than I did two years ago"-another passage that McIlraith cut in his edition.
53 See for example, Richardson to Mary Richardson (wife), 1 December 1820 (SPRI 1MS 503/2/1-10); and Franklin to his mother, 8 April 1822 (SPRI MS 248/305). The Times for 4 October 1822 carried a story from the 17 August Montreal Herald reporting the deaths on the expedition, and its failure to reach far beyond Hearne's furthest point. Hints of the British survivors' conscious resort to survivor cannibalism emerged in the 18 October 1822 Times, as excerpted from the 11 September Montreal Herald: "In this struggle betwixt the love of life and

the dread of a death that must be terrifying to all mankind, Mr. Wood [sic], nine Canadians, and an Esquimaux, fell untimely and regretted victims; and had not the survivors, who for several days were driven to the necessity of prolonging a miserable existence by feeding upon the tattered remnants of their shoes, and we fear, upon a more forbidding and unpalatable fare, exerted themselves by a super-human effort to reach the Great Bear Lake, it is probable that they would have all suffered the most exquisite and appalling martyrdom" ("North-West Land Expedition," Times, 18 October 1822, p. 2). See also The Times, 5 November 1821.

54 An account of the Medusa disaster was published in London in 1818; see Margarette Lincoln, "Shipwreck Narratives of the Eighteenth and Early Nineteenth Century: Indicators of Culture and Identity," British Journal for Eighteenth-Century Studies, 20 (1997), 161-62.

55 He used this spelling elsewhere, referring to the lasting effects of the massacre at Bloody Falls described by Hearne: "[T]hese poor people [the Inuit] have been so harrofied by the Indians that they are very timorous" (18 July 1821, SPRI MS 1503/4).

56 Franklin to Richardson, 24 October 1822 (DRO MS DC3311).

57 By 1824 Franklin wanted to add more portraits of the officers to the new quarto edition but was persuaded not to by Barrow, so as not to offend the owners of the first edition, who were "principally possessors of libraries and men of the first distinction in the Country," and the reviewers, who "would say it was complete book making an imputation which I should abominate" (Franklin to Richardson, 9 June 1824, DRO MS D3311/53).

58 "Dr. Richardson's Narrative," included in Franklin, Narrative, p. 461.

59 Pagden, European Encounters with the New World: From Renaissance to Romanticism (New Haven: Yale Univ. Press, 1993), p. 162.

60 The relationship of the unpublished manuscript materials to the official Narrative is complex. Only two of Franklin's manuscripts written during this Barren Lands crossing are still extant, both of which I have examined: part of his field notes in the National Library of Scotland ("The original notes of Captn. Franklin," Oct. 9-Nov. 9, 1821, MS 42,237), and his private journal, held in the Derbyshire Record Office (MS D3311/48). Both manuscripts are damaged and impossible to read in full; Richard Davis offers partial transcriptions of the field notes as an Appendix, and a thorough explication of the relationship of the extant Franklin manuscripts, in his important edition, Sir John Franklin's Journals and Correspondence: The First Arctic Land Expedition. Davis's edition also includes the official manuscript Journals (composed after returning from the field) submitted to the Admiralty, held in SPRI (MS 248/277, 248/278). I am able to improve on Davis's careful transcriptions of the Barren Lands manuscripts in a few instances (e.g., the full phrase "Poor Hood dead" on 29 October [NLS MS 42,237 f. 10]; see Sir John Franklin's Journals, ed. Davis, p. 438); what is significant in these additional fragmentary transcriptions is the amount of time that Franklin devoted to confessional and evangelical effusions in his official field notes. Facing imminent death, he concluded most daily accounts with long religious effusions-which tend to be the text omitted by Davis, in part because largely illegible (these passages often occur near the frayed bottom of Franklin's notebook). Thus, the material decay of this fragile text unfortunately contributes to the critical neglect of the role played by Franklin's zealous faith in these documents of geographic and scientific discovery. Franklin's official Narrative incorporated Richardson's journal, revised for publication, for the conclusion to the disaster, and relied on the journals of Back and Hood as well, because of the gaps in Franklin's extant papers for the journey (see Davis, "Introduction," in Sir John Franklin's Journals, pp. xxxv-xlii). There is a second extant version of Richardson's account of the killings, the "Narrative Report" he wrote for the Admiralty, accounting for the deaths of Terrehaute and Hood (reprinted in Arctic Ordeal, pp. 148-60). There also exists correspondence between Richardson and Franklin about the two killings, wherein Franklin passes on legal advice from the Admiralty on how to revise his account of killing Terrehaute for subsequent editions of the Narrative in order to prevent any criminal investigation. Franklin passed on advice that Richardson should add sentences "which would attach first the fact of the murder of Hood stronger on Michel [Terrehaute], and secondly, those which would convey a further idea of Michel's expressions and conduct to you" on the day

Richardson killed him (in particular, "his expression of hatred towards the white people") (Franklin to Richardson, 11 August 1823, SPRI MS 1503/5/4). On 1 August 1823 Franklin had similarly passed on Barrow's wishes that for the octavo edition Richardson would "[dwell] a little more on the necessity" of killing Terrehaute, and noted that he was holding back from Murray's press the relevant section until Richardson decided (DRO MS 3311/53). The first, second, and third editions of the Franklin Narrative do not make these additions. Richardson's published account of Terrehaute's "expressions of hatred towards the white people" had also mentioned Terrehaute's explanation that "white people . . . had killed and eaten his uncle and two of his relations" ("Dr. Richardson's Narrative," in John Franklin, Narrative of a Journey to the Shores of the Polar Sea, 3d ed., 2 vols. [London: John Murray, 1824], II , 341-42).

61 See the reviews in New Monthly Magazine, n.s. 7 [1823], 399; Gentleman's Magazine, 93 (1823), 432, 428; and Literary Gazette, 12 April 1823, pp. 225-26.

62 SPRI MS 248/298/13. Franklin warned his family against believing or discussing unauthorized newspaper accounts of the expedition deaths (Franklin to his mother, 8 April 1822, SPRI MS 248/305). The unauthorized book-length accounts of Parry's recent voyage were also ever-present in their minds; see Eleanor Porden, letter to John Franklin, on her diminished enjoyment of Parry's Journal, which appeared after the unauthorized accounts (23 May 1821, DRO MS D3311/8/1/12). The unauthorized accounts included Letters Written during the Late Voyage of Discovery in the Western Arctic Sea, by an Officer of the Expedition (London: printed for Sir Richard Phillips, 1821) and the octavo A Journal of a Voyage of Discovery to the Arctic Regions: In His Majesty's Ships Hecla and Griper, in the Years 1819 and 1820 (London: Longman, Hurst, Rees, Orme, and Brown, 1821), attributed to Alexander Fisher, Asst. Surgeon with Parry. Fisher had also contributed to the onboard newspaper on Parry's expedition, published that same year as The North Georgia Gazette and Winter Chronicle (London: John Murray, 1821). The Literary Gazette (which praised Franklin's expensive authorized Journal [1823]) complained in its review of Parry's Journal of the great expense of the volume and Parry's personal profit as author, given that Fisher's account was already in print and that the expedition had been paid for by public money: "Captain Parry's reward ought to have been found in his promotion, and the parliamentary grant for his services, and not in a joint levy in the book market. On the contrary, the Lords Commissioners of the Admiralty, under whose authority the Journal appears, should have given the readers of England as cheap a history of the discoveries made with public money, and in as popular a form, as the necessary cost of printing . . . would permit" ([Anon.], "Captain Parry's Journal and the North Georgia Gazette," Literary Gazette, 14 July 1821, p. 438). After Fisher's unauthorized Journal appeared, and while Murray was preparing to publish a Supplement to Parry's first voyage (1824) and Parry's Journal of a Second Voyage for the Discovery of a North-West Passage (1824), Murray wrote an angry letter to the Admiralty Lords insisting that he had been granted by them "exclusive right of first Publication" on the subject of Parry's voyages, and expressing his "mortification" to see "the unexpected and as I conceive illegal publication of another account of the same Voyage" by Fisher (3 May 1823, Murray Letterbook, NLS MS 41,908).

63 Franklin to Richardson, 24 October 1822 (DRO MS D3311).

64 [Anon.], rev. of John Franklin, Narrative of a Journey to the Shores of the Polar Sea, Quarterly Review, 28 (1823), 399. Upon learning of the Peterloo Massacre and related unrest, Richardson wrote to his wife of the "madness &disorder" that had "taken possession" of Britain, hoping that she "suffer no inconvenience from the folly or rage of the deluded multitude-who [trample] under their feet the blessings that the inhabitants of other lands, burn to enjoy" (1 June 1820, SPRI MS 1503/2/1-10). McIlraith did not include this letter in his biography.

65 John Franklin, letter to his sister Henrietta, from Greenland, 11 July 1845: "Every ship in these days should go forth to strange lands bearing among its officers and crew a Missionary Spirit, and may God grant such a spirit on board this ship! It is my desire to cultivate this feeling, and I am encouraged to hope that we have among us some who will aid me in this duty" (DRO MS D3311/40).

66 On Joseph Banks's strategic support of missionary efforts, see Gascoigne, Science in the Service of Empire,

pp. 183-84.
67 Richardson's account, in Franklin, Narrative,, pp. 456-57. Richardson made a point of specifying that Terrehaute, unlike most Iroquois, had not converted to Christianity (p. 459).
68 See Pat Jalland, Death in the Victorian Family (Oxford: Oxford Univ. Press, 1996), p. 59. In fact, Hood's death exemplified the evangelical "bad death" that "allowed no time for spiritual preparation and contrition" (p. 59).
69 Trelawny's account popularized the notion that Shelley died virtually "in the act of reading," making possible nineteenth-century depictions of him as Matthew Arnold's ineffectual angel: "The face and hands, and parts of the body not protected by the dress, were fleshless. The tall slight figure, the jacket, the volume of Aeschylus in one pocket, and Keats's poems in the other, doubled back, as if the reader, in the act of reading, had hastily thrust it away, were all too familiar to me to leave a doubt on my mind that this mutilated corpse was any other than Shelley's" (Edward John Trelawny, Records of Shelley, Byron, and the Author, 2 vols. [New York: Benjamin Blom, 1878], I, 189-90). For a good discussion of this passage, see Karen Swann, "Shelley's Pod People," in Romanticism and the Insistence of the Aesthetic, ed. Forest Pyle (February 2005), para. 16, available online at <http://www.rc.umd.edu/praxis/aesthetic/index.html>. Trelawny modeled for the Arctic explorer in John Everett Millais's painting The North-West Passage (1874).
70 Franklin's connections with and support for missionary efforts are virtually entirely ignored (and unpublished) today (but extant in his correspondence), and along with the submerged colonial dimensions of his Arctic expeditions, would radically alter our understandings of Arctic exploration as somehow peripheral to larger imperial concerns and institutions. While beyond the scope of this paper, an easily accessible glimpse of Franklin's missionary interventions specifically can be found in his Preface to the third edition of the Narrative, wherein he acknowledged the aid that he and his officers had given to the first evangelical mission established in Hudson Bay territory (Red River), but admitted that he "refrained from entering into these subjects in the first edition" of the Narrative, "having found that it was considered better that I should then confine myself to the mention of those circumstances alone which were connected with our immediate pursuits" (Franklin, Narrative of a Journey to the Shores of the Polar Sea, 3d ed., I, xviii-xix).
71 For example, Franklin writes to Richardson that "Barrow has handsomely offered to revise every sheet, as he did Parrys and make Such additions &corrections as he thinks necessary" (24 October 1822, DRO MS D3311). On Franklin's revisions of his journals, see Richard Davis, "History or His/story? The Explorer Cum Author," Studies in Canadian Literature, 16 (1991), 93-111.
72 Franklin to Richardson, 24 October 1822 (DRO MS DC3311).
73 See D. M. Young, The Colonial Office in the Early Nineteenth Century (London: Published for the Royal Commonwealth Society by Longman's, 1961), p. 158. Bathurst's Under-Secretary for the Colonies was Henry Goulburn, a zealous evangelical; he was succeeded by Robert John Horton, known as Wilmot-Horton, the chief architect and advocate of the 1820s state-sponsored emigration schemes to Upper Canada. For both the 1819 and 1825 Arctic expedition, it was largely with Goulburn and Wilmot-Horton, not the Admiralty, that Franklin corresponded regarding developments en route.
74 Bathurst, Instructions to Franklin, in Sir John Franklin's Journals, ed. Davis, p. 286.
75 For a recent overview of how the Canadas require new historiographical frameworks in relationship to New Imperial history, Atlantic studies, the British Second Empire, and the "swing to the East" paradigms, see Nancy Christie, "Introduction: Theorizing a Colonial Past: Canada as a Society of British Settlement," in Transatlantic Subjects: Ideas, Institutions, and Social Experience in Post-Revolutionary British North America, ed. Nancy Christie (Montreal and Kingston: McGill-Queen's Univ. Press, 2008), pp. 3-41.
76 See H.J.M. Johnston, British Emigration Policy, 1815-1830: "Shovelling out Papers" (Oxford: Clarendon Press, 1972). Barrow's Arctic debut in the Quarterly Review had been a response to Lord Selkirk, founder of the embattled Red River colony (home to the evangelical mission supported by Franklin), itself the subject of an

1819 Parliamentary Blue Book examining the government's involvement in an unfolding legal controversy following the 1816 Seven Oaks massacre. Johnston estimates that from 1815 to 1825, thirty seven thousand British people immigrated to the Canadas, "a significant part" of them through the state-funded emigration schemes (British Emigration Policy, p. 1). The schemes were largely the work of the political economist Wilmot-Horton, Under-Secretary of State for the Colonies from 1822 to 1828.

77 See Johnston, British Emigration Policy; Galbraith, The Hudson's Bay Company as an Imperial Factor; and Rich, Hudson's Bay Company.

78 Anson's estimated 3/8 cut of the total prize money (approximately £243,000) was a staggering sum in the eighteenth century, as calculated by Glyn Williams in The Prize of All the Oceans: The Dramatic True Story of Commodore Anson's Voyage Round the World and How He Seized the Spanish Treasure Galleon (New York: Viking Press, 1999), p. 218. Anson's overtly imperial aim in capturing the Spanish galleon and fomenting rebellion in Spanish colonies was in fact part of a two-pronged effort, synchronized with a naval attempt to traverse the Northwest Passage, by Christopher Middleton, who was instructed to meet Anson in California (see Williams, Prize of All the Oceans, pp. 11-13). As with the well-known La Condamine expedition to South America in the 1730s, which was synchronized with Maupertius's expedition to the Arctic circle in Samiland (Lapland), the Atlantic and Pacific orientations of modern scholars tend to obscure the significance that the Arctic Ocean held for Enlightenment-era exploration and imperial efforts. See Johnston, British Emigration Policy; Galbraith, The Hudson's Bay Company as an Imperial Factor; and Rich, Hudson's Bay Company.

79 I review authorship studies in footnotes 19 and 20 above. Since completing this essay I have read the excellent collection Scientific Authorship: Credit and Intellectual Property in Science, ed. Mario Biagioli and Peter Galison (London: Routledge, 2003), which begins to address exactly this unexamined terrain between studies of authorship in sciences and literary writing. The essays collectively attest to the significance of Foucault's "What is An Author?" lecture in extending this line of inquiry, but also offer important challenges to his dating of and limitations upon the author function in the natural sciences (along these lines, see in particular the essays by Roger Chartier, Adrian Johns, and Peter Galison).

80 De Certeau, Heterologies: Discourse on the Other, trans. Brian Massumi (Minneapolis: Univ. of Minnesota Press, 1986), p. 145.

81 See O'Reilly, Greenland, the Adjacent Seas, and the North-West Passage to the Pacific Ocean (London: Baldwin, Craddock, and Joy, 1818), p. 243. O'Reilly's publishers also republished Mark Beaufoy's edition of Daines Barrington's The Possibility of Approaching the North Pole Asserted (1818); Barrington, a member of the Royal Society, was a friend of Sandwich and an advisor for the Phipps expedition to the North Pole, aboard which had served both Olaudah Equiano and Horatio Nelson.

82 [John Barrow], rev. of Bernard O'Reilly, Greenland, the Adjacent Seas, and the North- West Passage to the Pacific Ocean, Quarterly Review, 19 (1818), 208.

83 See Duncan, "Authenticity Effects." For influential theoretical approaches to textual studies and bibliography, see D. C. Greetham, Theories of the Text (New York: Oxford Univ. Press, 1999); D. F. Mckenzie, Bibliography and the Sociology of Texts (Cambridge: Cambridge Univ. Press, 1999); and McGann, Critique of Modern Textual Criticism.

84 King blamed on the fur trade, European colonization, and missionaries the widespread "barbarous warfare, treachery, bloodshed, and extermination" of the native people that he observed (Richard King, Narrative of a Journey to the Shores of the Arctic Ocean, 2 vols. [London: Richard Bentley, 1836], II , 55). King revealed the Admiralty's cover-up of the unprovoked killing of three Inuit near Mount Barrow, Point Ogle (King, Narrative, II , 68-71). Back's authorized account, Narrative of the Arctic Land Expedition . . . in the Years 1833, 1834 and 1835 (London: John Murray, 1836) was reissued in a 1970 facsimile, in which the editor distinguished this expedition for its lack of fatalities: "Unlike so many other expeditions where deaths and dissentions marred the results, that of Back stands as a major achievement" (William C. Wonders, "Introduction," in George Back,

Narrative of the Arctic Land Expedition to the Mouth of the Great Fish River, and along the Shores of the Arctic Ocean, in the Years 1833, 1834 and 1835 [Edmonton: M. G. Hurtig, 1970], p. xxv). Back's correspondence denying the sworn affidavits that his crew killed three Inuit is in SPRI MS 395/77; during the day in question, Back in his Narrative described the returning crew party in question as "fagged and depressed," noted that they shot three deer, and made some aesthetic observations, later producing a striking painting of the area, Point Ogle, engraved for the book ("Thunder Storm near Point Ogle," in Back, Narrative [1836; 1970], pp. 405-8). The manuscript draft (not a field journal) of Back's Narrative (SPRI MS 395/7/1-2) differs in interesting ways from the published version, but not in the account of the killing of the Inuit that took place on 4-6 August 1834.
85 Agreement between Richard King and Bentley, 28 May 1836 (BL Add MS 46612 f.257). John Murray Ledger C, NLS MS 47,727 f.106; 2,500 copies were published, of which only 276 remained on hand in 1838.

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Publication date: Mar 2011

Year: 2011

BIONIC BODY PARTS

Author: Walters, Jennifer Marino

Publication info: Science World 67.9 (Feb 14, 2011): 8-11.
ProQuest document link

Abstract: Walters highlights the use of bionic body parts as replacement for a missing part of a human body. The word bionic is used to describe any artificial mechanism that functions like a living organism or part of a living organism. Here, Walters discusses how artificial upgrades are changing people's bodies and live--sometimes in superhuman ways.

Full text: Headnote

Artificial parts can help rebuild people from head to toe

CUSTOM FIT: The Sabollch Lab (shown here) developed legconforming sockets that have made artificial limbs more comfortable to wear.

Patrick Kane, a 13-year-old from the United Kingdom, looks just like other kids - except for his robotic hand.

With it, he can tie his shoes, use a fork, and perform other tasks he was never able to do before. "My bionic [hand] is amazing. I can do almost anything with it," says Patrick "ITl even be able to drive when I'm old enough."

It may sound like science fiction, but bionic body parts like Patrick's are becoming a reality. The word bionic is used to describe any artificial mechanism that functions like a living organism or part of a living organism. And the use of robotic hands is only one of the ways scientists are melding man and machine to repair and replace damaged parts. Find out how artificial upgrades are changing people's bodies and lives - sometimes in superhuman ways.

LIFELIKE LIMB

Patrick is the youngest person ever to get a bionic hand. And his i-LJMB Hand is one of the most advanced ever made (see Bionic Hand, below). Its jointed digits bend similarly to real fingers and are controlled by Patrick's muscle movements. It can even lift objects roughly the weight of a refrigerator!

The i-LIMB slips over a person's remaining arm. Inside, small electrode plates make contact with the skin. These sensors pick up tiny electrical signals given off by the person's arm muscles when he or she flexes and relaxes as if to open and close a real hand. The signals are transmitted to a small computer, which then tells the robotic fingers to move.

"Things that we all take for granted, like typing or using a cell phone, are made possible by the i-LLMB," says Danny Sullivan of Touch Bionics, the company that developed the hand.

SPRING IN YOUR STEP

World-record sprinter Marion Shirley has run 100 meters in a lightning-fast 10.97 seconds - and he has only one leg. Shirley, who lost his left foot at age 5 in an accident, runs with a carbon-fiber prosthesis (a device that replaces a missing body part). The prosthetic foot he uses is called the Flex-Foot Cheetah.

When the J-shaped Cheetah hits the ground, it compresses, storing energy that would otherwise be absorbed by a runner's knee, hip, and lower back. As the "J" springs back to its original shape, it releases some of that stored energy to propel him or her forward.

In 2007, a double amputee and Cheetah wearer, South African Oscar Pistorius, beat several nonamputees in a national championship race. After that, the world governing body for track and field debated whether technological aids gave athletes with physical disabilities an unfair advantage. They ultimately allowed Pistorius to try out for the 2008 Olympics, but he didn't make the team. Tve been competing against able-bodied athletes for quite some time, and it's ridiculous to think that this foot has aided me," says Shirley. "I would be a lot faster if I had both of my natural legs."

The Cheetah is a passive prosthesis - it does not nave powered parts. But other artificial feet, like one being developed at the United States Military Academy at West Point in New York, use motors to replicate the movement of an ankle pushing off the ground. The mechanical foot has a spring that acts like a tendon (tissue that connects muscle to bone) in the ankle. When a person takes a step, "usually the energy is just wasted and put into the ground," says Will Guinther, a 22-year-old cadet working on the foot. "But in this case it's recaptured by these springs."

REGAINING HEARING AND SIGHT

Hundreds of thousands of people who were once deaf now can hear thanks to another bionic device called a cochlear implant (see Bionic Ear, above). A microphone placed under a person's skin is wired to the cochlea, a snail-shaped tube in the inner ear that turns sound waves into nerve impulses.

The microphone picks up sounds, then a speech processor filters out a voice from background noise. The sounds are converted into electrical impulses and sent to the auditory nerve, which carries the signals to a person's brain where they are translated into recognizable sounds.

Bionic eyes, meanwhile, restore vision by working similarly to the way cochlear implants restore hearing (see Bionic Eye, p. 10 top). Retinitis pigmentosa and macular degeneration are two eye diseases that destroy the

photoreceptors, or light-sensing cells, in the retina (the tissue covering the back of the eye).

A microchip implanted into the retina can help some blind people detect patterns of light and dark, so they can see the outlines of objects. Here's how it works: A camera mounted on a pair of glasses captures an image. The image is transmitted to the microchip as electrical signals, which are sent through the optic nerve to the brain for interpretation.

Scientists are developing contact lenses with microchips too. These could allow people with good sight to zoom in for better views or to see computer displays before their eyes.

WIRED FOR TOUCH

With artificial sight and sound well on their way, scientists are trying to tackle another sense: touch. Robotic limbs can't yet allow people to feel objects. So scientists are working on bionic skin with sensors that can detect pressure and temperature and relay the data to nerve endings.

Touch Bionics already makes a non-sensing skin that can fit over the i-LLMB. It can be made to look like the real thing, right down to the coloring and hair. Patrick has opted not to disguise his bionic hand, though. He thinks its robotic look is cool.

- Jennifer Marino Walters

Sidebar

MODERN MATERIALS: Many of today's high-tech prostheses are made of strong, lightweight carbon fiber or titanium.

REALISTIC LOOK: Some artificial limbs look like the real thing, right down to fine hairs.

BACK ON HIS FEET: Marlon Shirley lost his left foot at age five and is now the fastest amputee in the world.

Sidebar

MAN AND MACHINE: A passive prosthesis is not motorized. The wearer generates the energy that powers the device.

[WEB EXTRA] Go online for a slideshow about bionic body parts: www.scholastic.com /scienceworld

Sidebar

BIONIC EYE

HOW IT WORKS

1. A video camera embedded in glasses sends images to a belt-worn computer.
2. Images are turned into a simplified signal and transmitted wirelessly to the eye implant.
3. A receiver on the eye sends the signal to an electrode array that stimulates the retina.
4. The optic nerve carries the signal from the retina to the brain for interpretation.

BIONIC HAND

HIGH-TECH TEEN: Patrick Kane, 13, shows off how he types with his jetblack i-LIMB.

HOW IT WORKS

Each finger on the i-LIMB can bend, touch, point, and work together to grip and pick up objects.

Sidebar

BIONIC EAR

HEARING RESTORED: Children as young as six months can receive cochlear implants.

HOW IT WORKS

1. The microphone picks up sound.
2. A speech processor separates useful sounds from background noise
3. A transmitter sends signals to a surgically implanted receiver.
4. The implanted receiver converts signals into electric impulses.
5. Electrodes in the cochlea stimulate the auditory nerve, which sends signals to the brain.

Publication date: Feb 14, 2011

Year: 2011

Pump down the jam

Author: Anonymous

Publication info: Sunday Times [London (UK)] 13 Feb 2011: 30.
ProQuest document link

Abstract (Abstract): "It's the best Pounds 175 I've ever spent," [Eddy Temple-Morris] says of his custom-made plugs. "You can still hear the sizzle of a high-hat, the boom of a kick drum and all the midrange frequencies." They work by filtering the sound, taking the edge off the volume by an order of 9dB, 15dB or 25dB. I was advised to go for the ER-15s, meaning my safe listening limit has, in effect, been increased to eight hours at 100dB. But if an arena rock concert lasts two hours and hits 110dB, doing the logarithmic calculation, won't I be "at risk" for the second half of the show, even wearing my supersnug ER-15s? "Remember that these safe levels are set low, and that it depends where the 110dB level is measured," [Paul Checkley] says. "If it is 110dB at the speaker, there will be a substantial drop in intensity over distance. Also, we are talking averages -- while the levels may peak at 110dB, the average may be lower over the two-hour period."
As for whether tinnitus can lead to deafness, [Geraldine Daly] says: "Tinnitus does not necessarily mean that there is impending hearing loss. Yet, if the sufferer continues to be exposed to the same levels of noise, there is every chance the tinnitus will get worse." Noise-induced hearing loss means you lose frequencies of 4kHz and above. As Checkley explains, that's all the "ck-thssh-sss" consonant sounds vital to understanding what is being said to us. Some musicians he treats have hyperacusis, an abnormal growth of loudness in the cochlea, "which is even worse than tinnitus".

Full text: It was an unusual birthday present, having green gunk syringed into my ears in a Harley Street consulting room. But my girlfriend's heart was in the right place. And so, now, should my hearing levels be the next time I go to a gig -- the result, and my surprise gift, a bespoke set of decibel-reducing earplugs that "turn down" the volume of amplified music without impairing its fidelity.
The woman doing the gunking (my girlfriend had merely written the cheque) was Geraldine Daly, audiologist to the stars and to pop writers like me. She was taking a mould of each of my lugholes so my earplugs fitted perfectly. I need them because -- like 10% of adults in Britain -- I have persistent tinnitus, that ringing sound you can get after listening to loud music, and I don't want it to worsen. Typically, the condition passes after a few hours, but in one in 10 cases, the sonic hangover never leaves you. And there is no cure.
For decades, musicians and music fans took tinnitus on the chin, or rather on the tympanic membrane. Some even regarded it as a badge of honour, their "tinnitus buzz". Now most well-known bands are aware of the dangers of loud music, and in-ear monitors that lessen ambient noise on stage are the industry standard. Yet, as Daly's colleague Paul Checkley says, 90% of those tested at Musicians' Hearing Services have some degree of hearing loss if they already have tinnitus. Dido, Coldplay, Plan B, Pete Townshend and New Young Pony Club are among the company's clients. Despite the efforts of the British Tinnitus Association (BTA) and the Royal National Institute for Deaf People's Don't Lose the Music campaign, the general public is far less clued up.
While old age, stress and genetic predisposition can bring it on, the most common cause of tinnitus is prolonged exposure to amplified music above 85 decibels (dB), whether that's at home, at a gig, in the car or on personal

headphones (which can peak at 115dB). Eighty-five decibels, roughly equivalent to busy city traffic, is deemed a safe daily limit (averaged over an eight-hour working day) for unprotected ears. Decibels, however, are measured on a logarithmic scale, so every 3dB increase of intensity represents a doubling of loudness and, consequently, a halving of safe exposure time. Do the maths and a rock show, at 110dB, is safe without protection for barely two minutes. Spinal Tap might have loved to crank their amps up to 11, but here the joke is on us.

Eddy Temple-Morris, a DJ/producer and BTA advocate, is angry that the risks of loud music receive so little publicity. "I used to think the ringing noise, tinnitus, was part and parcel of going to a gig.

Nobody -- not the government, not my GP, not anybody -- told me that one day the noise would never go away. The government spends a gazillion quid on warning people not to burn themselves with fireworks on Bonfire Night. Fair enough, but 10% of the country don't burn themselves with fireworks.

There should at least be posters telling people they could permanently damage their ears simply by being at a venue."

After I'd spoken to Temple-Morris, he mentioned the interview on Twitter, and the war stories tumbled forth. @DJDanCook tweeted: "Horrendous tinnitus-induced insomnia last night." And @orangewarrior chimed in: "It actually gets a bit better after you've worn ER-15s [the medium-strength fitted earplugs] for a while. Never goes away, but I noticed an improvement." For some, though, it's already too late. Temple-Morris says that his friend Erol Alkan, a DJ, has lost 40% of his hearing in one ear.

What exactly is tinnitus? Nobody knows for sure. Loud music leaves the hair cells of the cochlea all shook up. What happens next is either that we start to pick up what Checkley describes as "excess electrical activity in the auditory system" -- internal static, if you will -- or that the brain, as Checkley puts it, "anticipates a response from those hair cells and, not receiving it, or getting it at a lower level than expected, generates a signal to compensate for it". What tinnitus sufferers "hear" is an individual perception: mine blares like a whistling kettle, only not as shrill; others report clicking, hissing and roaring noises. Most of us can learn to tune them out, but folk with chronic tinnitus want to run head first into walls.

As for whether tinnitus can lead to deafness, Daly says: "Tinnitus does not necessarily mean that there is impending hearing loss. Yet, if the sufferer continues to be exposed to the same levels of noise, there is every chance the tinnitus will get worse." Noise-induced hearing loss means you lose frequencies of 4kHz and above. As Checkley explains, that's all the "ck-thssh-sss" consonant sounds vital to understanding what is being said to us. Some musicians he treats have hyperacusis, an abnormal growth of loudness in the cochlea, "which is even worse than tinnitus".

"It's the best Pounds 175 I've ever spent," Temple-Morris says of his custom-made plugs. "You can still hear the sizzle of a high-hat, the boom of a kick drum and all the midrange frequencies." They work by filtering the sound, taking the edge off the volume by an order of 9dB, 15dB or 25dB. I was advised to go for the ER-15s, meaning my safe listening limit has, in effect, been increased to eight hours at 100dB. But if an arena rock concert lasts two hours and hits 110dB, doing the logarithmic calculation, won't I be "at risk" for the second half of the show, even wearing my supersnug ER-15s? "Remember that these safe levels are set low, and that it depends where the 110dB level is measured," Checkley says. "If it is 110dB at the speaker, there will be a substantial drop in intensity over distance. Also, we are talking averages -- while the levels may peak at 110dB, the average may be lower over the two-hour period."

No moshing down the front at a Metallica show, then. In most situations, though, it seems I'll be safer more often than sorry with the earplugs in. And rather that than be a tinnitus burnout any day. Time to write a certain someone a thank-you note, eh? c

Illustration

Caption: Girl aloud: Dido is a client of MHS. Right, Paul Checkley examines Richard Clayton

Publication date: Feb 13, 2011

Year: 2011

The importance of communication

Author: Harvey, Alyssa

Publication info: Daily News [Bowling Green, Ky] 05 Feb 2011.
ProQuest document link

Links: Check LinkSource for Full Text

Full text: Donna Woods' world didn't sound crystal clear a few years ago.

"I started noticing hearing loss in my late 40s and early 50s," she said.

Although the Bowling Green woman had tried using hearing aids twice, she ended up taking them back within the trial period.

"I didn't feel like I heard any better, plus it was an ego thing," she admitted. "I felt hearing impairment was a sign of old age."

It wasn't until one day when she was driving and straining to hear her young grandson, who was in the car with her, that Woods began to truly understand what was at stake.

"I could not understand what he was saying to me when he was in his car seat," she said. "I knew I wanted to do something."

Woods was one of several people who attended the Hearing Loss Association of America's new support group Tuesday at The Medical Center's Health and Wellness Center at Greenwood Mall.

"We focus on education, advocacy and support to the hearing impaired and those around them," said Ed Schickel, a volunteer hearing assistive technology resource. "Sometimes people around the person with hearing loss is frustrated."

The meetings, which are at 4:30 p.m. on the first Tuesday of each month, feature a program on some aspect of hearing loss and social time so that people can share ideas that have helped them.

"The support group is important because we don't always understand our own hearing loss and what's out there to help us," Schickel said.

The meetings will be real-time captioned, said Schickel, a former co-state Kentucky chapter coordinator for HLAA.

"Sometimes people are afraid to come to meetings because they're afraid they won't understand," he said. "They will be able to read what the speaker is saying to them almost as rapidly as the presenter presents. We also have listening devices. Individuals can wear a headset with a receiver."

While the HLAA support group has been available in other areas in Kentucky, it is new to Bowling Green, said Schickel, who works with a chapter in Bardstown.

"We've had a couple of people talk about it," he said. "We have been to other meetings and want to start a chapter in Bowling Green."

Tuesday's meeting was designed to help people with normal hearing communicate better with the hearing impaired. Noreen Gibbens, assistant director of audiology at Vanderbilt University in Nashville, used a digitally filtered recording to show what hearing loss sounds like.

"For people with normal hearing, the response (to the demonstration) is usually kind of like, 'Wow!' The assumption is that a person puts on a hearing aid and it will be better. We're still sending sound to an ear that is

damaged. We're just changing the sound that enters the ear canal," she said. "It's not just slowing down. It's not just talking louder. Speaking louder tends to create a distortion in speech."

Instead, it's more about the range of frequencies, Gibbens said.

"The most common type (of hearing loss) in adults is high-pitch or high-frequency hearing loss," she said. "This is because of noise exposure."

Hearing impairment - which can be caused by a variety of things, including age, disease, noise and medication - is hard on those with the problem and the people around them, Gibbens said.

"Listening requires a lot of attention. It's exhausting by the end of the day to be focused on so much," she said. "Communication is a two-way street. It's important to explain what your hearing loss is. Look at the speaker. Ask for clarification. Use amplification. Speak in a manner that maximizes the signal."

Schickel, who is hearing impaired, said people who can hear often don't understand how hearing loss can affect someone.

"Sometimes we hear, sometimes we don't hear and sometimes we get every other word," he said. "Even with hearing aids, I don't always hear the doorbell or telephone."

Hearing loss can rob someone of independence, but it doesn't have to, Schickel said.

"Some people have been forced into nursing homes because they can't hear the telephone or the doorbell," he said. "There are simple things people don't know exist that can allow people to maintain their independence and safety."

Eventually, Woods decided to try hearing aids again. She said her latest pair - which fit behind her ears - allow her to hear more, possibly because of improvements in technology.

"These are working much better," she said. "I miss only about 10 percent of what's going on."

Woods doesn't worry about her ego anymore. If she can't hear someone well, she doesn't hesitate to ask him to repeat himself. At home she uses "TV Ears," a television listening device. When she goes to movie theaters, she uses headsets that are available at the concession stands.

"You can sit on the top row midway and hear the best," she said.

She is happy that there is a group to offer support for people like her.

"I hope to stay up to date on what is available to me as a hearing-impaired person," she said. "I hope to be an advocate for hearing-impaired people." **The next Hearing Loss Association of America support group meeting will be at 4:30 p.m. March 1 at The Medical Center's Health and Wellness Center at Greenwood Mall. Ed Schickel, former co-state Kentucky chapter coordinator for HLAA, will present "Enhancing Your Life with Hearing Assistive Technology." For more information, call 846-3800 or 502-349-6792 or visit www.hearinglosskyhome.org or e-mail ed@hearinglosskyhome.org or olivetree@hearinglosskyhome.org.**

According to the Hearing Loss Association of America pamphlet "Questions and Answers on Hearing Loss":

*One out of 10 people in the United States has hearing loss.

*At age 65, one out of three people has hearing loss.

*Hearing loss ranks with arthritis, high blood pressure and heart disease as one of the most common physical conditions.

*There are 43 million Americans with disabilities. Of those, 31 million have hearing loss.

*It is estimated that 30 schoolchildren per 1,000 have hearing loss.

Publication date: Feb 5, 2011

Year: 2011

Reversing pathological neural activity using targeted plasticity

Author: Engineer, Navzer D; Riley, Jonathan R; Seale, Jonathan D; Vrana, Will A; Shetake, Jai A; Sudanagunta, Sindhu P; Borland, Michael S; Kilgard, Michael P

Publication info: Nature 470.7332 (Feb 3, 2011): 101-4.
ProQuest document link

Abstract: Brain changes in response to nerve damage or cochlear trauma can generate pathological neural activity that is believed to be responsible for many types of chronic pain and tinnitus. Several studies have reported that the severity of chronic pain and tinnitus is correlated with the degree of map reorganization in somatosensory and auditory cortex, respectively. Direct electrical or transcranial magnetic stimulation of sensory cortex can temporarily disrupt these phantom sensations. However, there is as yet no direct evidence for a causal role of plasticity in the generation of pain or tinnitus. Here we report evidence that reversing the brain changes responsible can eliminate the perceptual impairment in an animal model of noise-induced tinnitus. Exposure to intense noise degrades the frequency tuning of auditory cortex neurons and increases cortical synchronization. Repeatedly pairing tones with brief pulses of vagus nerve stimulation completely eliminated the physiological and behavioural correlates of tinnitus in noise-exposed rats. These improvements persisted for weeks after the end of therapy. This method for restoring neural activity to normal may be applicable to a variety of neurological disorders. [PUBLICATION ABSTRACT]

Full text: Headnote

Brain changes in response to nerve damage or cochlear trauma can generate pathological neural activity that is believed to be responsible for many types of chronic pain and tinnitus1-3. Several studies have reported that the severity of chronic pain and tinnitus is correlated with the degree of map reorganization in somatosensory and auditory cortex, respectively1,4. Direct electrical or transcranial magnetic stimulation of sensory cortex can temporarily disrupt these phantom sensations5. However, there is as yet no direct evidence for a causal role of plasticity in the generation of pain or tinnitus. Here we report evidence that reversing the brain changes responsible can eliminate the perceptual impairment in an animal model of noise-induced tinnitus. Exposure to intense noise degrades the frequency tuning of auditory cortex neurons and increases cortical synchronization. Repeatedly pairing tones with brief pulses of vagus nerve stimulation completely eliminated the physiological and behavioural correlates of tinnitus in noise-exposed rats. These improvements persisted for weeks after the end of therapy. This method for restoring neural activity to normal may be applicable to a variety of neurological disorders.

Damage to the peripheral nervous system causes plasticity in multiple regions of the central nervous system. Significant changes have been reported in map organization, spontaneous activity, neural synchronization and stimulus selectivity2. The ideal method of testing whether map plasticity or some other form of plasticity is directly responsible for chronic pain and tinnitus would be to reverse the plasticity and evaluate the perceptual consequence.

Recent attempts to use sensory exposure or discrimination training to reverse the map changes in individuals with tinnitus or chronic pain have provided some temporary relief6,7. Although the clinical benefits were limited, these studies provide some support for the hypothesis that neural plasticity could be used to treat these conditions. It is possible that a long-lasting reversal of the pathological plasticity in these patients would provide significant relief.

Studies in animals have shown that repeatedly pairing sensory stimuli with electrical stimulation of the cholinergic nucleus basalis generates powerful and long-lasting changes in cortical organization8. In principle,

this method could be used to reverse the effect of pathological plastic changes that are associatedwith tinnitus and chronic pain1-3,6.However, nucleus basalis stimulation is highly invasive and, thus, not practical for clinical use. We have developed a less invasive method for generating targeted neural plasticity by pairing vagus nerve stimulation (VNS) with sensory inputs, and have demonstrated a potential clinical application.

VNS triggers the release of neuromodulators known to promote plastic changes. The efficacy of VNS in enhancing plasticity seems to lie in the synergistic action of multiple neuromodulators acting in the cerebral cortex and other brain regions9. VNS improves learning andmemory of associated events in rats and humans using identical VNS parameters10.

Our study tests the hypothesis that the pairing ofVNSwith tones could be used to drive neural plasticity that would reverse the behavioural correlate of tinnitus in noise-exposed rats. The first set of experiments confirms that repeatedly pairing a single tone frequency with VNS is sufficient to generate specific and long-lasting changes in cortical maps. The rationale for our tinnitus therapy is that increasing the number of cortical neurons tuned to frequencies other than the tinnitus frequency ought to reduce the overrepresented tinnitus frequency.The second set of experiments confirms that repeatedly pairing a range of tone frequencies with VNS can be used to reverse the behavioural and neural correlates of tinnitus in noise-exposed rats.

In our first set of experiments, we sought to evaluate whether pairing VNSwith tones can generate precise, long-lasting andlarge-scale changes in the frequency representation in the cortex, as we found for nucleus basalis stimulation.We pairedVNS with a 9-kHz, 60-dB SPL tone (n58 rats) or a 19-kHz, 50-dB SPL tone (n55 rats) for 20 days (SPL, sound pressure level), 300 times per day in normal-hearing rats with cuff electrodes implanted on the left cervical vagus nerve (Methods). The VNS- tone pairing procedure was identical to earlier tone pairing procedures with nucleus basalis, ventral tegmentum or locus coeruleus stimulation that generate long-lasting map plasticity8,11,12. VNS parameters (30Hz, 0.8mA) were similar to the parameters used in previous rat and human VNS studies, except that the duration of stimulation and the widths of individual pulses were reduced by 60-fold and fivefold, respectively (Methods and Supplementary Fig. 2). The 0.5 s of VNS used in this study was sufficient to reduce the amplitude of the cortical electroencephalogram briefly (Supplementary Fig. 3 and supplemental data).Twenty-four hours after the last VNS-tone pairing session, we used standard microelectrode mapping techniques to document frequency map plasticity. VNS-tone pairing caused a 70-79% increase in the number of primary auditory cortex (A1) sites with a characteristic frequency near the paired tone frequency (Fig. 1). This result confirms our hypothesis that VNS- tone pairing can be used to direct map plasticity lasting more than 24 h.

Pairing VNS with sensory stimuli is a potentially attractive method of modifying neural circuits without significant side effects.VNSis well tolerated in the 50,000 patients who currently receive VNS therapy for epilepsy or depression13. By pairing tones with brief trains of VNS, we have been able to alter cortical frequency maps significantly in rats using only 1% of the VNS that is delivered clinically (that is, 30 s every 5 min, 24 h per day) for epilepsy treatment in humans.

Having demonstrated that VNS can be used to generate specific and long-lasting map plasticity, in our second set of studies we sought to evaluatewhetherVNS-directed plasticity couldbe adapted to renormalize pathological plasticity and eliminate tinnitus. Exposure to intense, highfrequency noise is known to generate an overrepresentation of midfrequency tones, degrade frequency selectivity and increase excitability and synchronization of auditory neurons14-16. We induced noise trauma by exposing rats to 1 h of 115-dB SPL, octave-band noise centred at 16 kHz (ref. 17; Methods). Auditory brainstem responses were used to confirm the effects of the noise exposure on hearing threshold, including temporary deafness for frequencies above 8 kHz and a long-lasting increase of auditory brainstem response thresholds and latency18 (Supplementary Figs 4 and 5). After noise exposure, twice as many A1 recording sites were tuned to frequencies between 2 and 4 kHz in comparison with naive controls (3567% versus 1462%, $P<0.05$), and very few neurons responded to frequencies above 23 kHz (1.761% versus 11.563%, $P<0.01$). The average frequency bandwidth of A1 neurons

increased by 21% (1.7560.04 versus 1.4760.03 octaves at 10 dB above threshold, P<0.00001), and the average number of spikes evoked by a tone within each site's receptive field increased by 30% (4.360.1 versus 3.360.1, P<0.00001). The average spontaneous rate increased by 23% (17.760.6 versus 14.360.4 Hz, P,0.00001). The degree of synchronization during silence measured using the correlation coefficient between multiunit activity recorded at nearby sites was significantly increased (1.760.01 versus 0.1960.01 synchronous spikes per second of silence, P,0.05; Methods). These changes in frequency tuning and synchronization are similar to the physiological changes observed after noise exposure that have been proposed to be directly responsible for tinnitus2,19. Earlier studies using several different methods have documented that noise exposure can generate behavioural correlates of tinnitus near the lowfrequency edge of the noise trauma17,20-22. However, few studies have directly compared neurophysiology and behavioural observations from the same animals20,23. It was therefore of great interest to us to relate noise-induced plasticity to perceptual disturbances.

Each of the eighteen noise-exposed rats used in this study was significantly impaired in its ability to detect a gap in narrowband noise centred on 8 or 10 kHz, but showed no impairment when the gap occurred in narrowband noise centred on 2 or 4 kHz or in broadband noise (Fig. 2, 4 weeks after exposure). Several studies have concluded that a frequency-specific impairment in gap detection is a likely sign that noise-exposed rats experience a mid-frequency tinnitus percept which fills the silent gaps17,23 (Methods and Supplementary Figs 6-9). Although it is not possible to evaluate the subjective experience of rats definitively, the gap impairment has been taken as a possible behavioural correlate of tinnitus.

Map distortion and tuning curve broadening (but not changes in spontaneous activity or synchronization) were significantly correlated with the degree of gap impairment in untreated noise-exposed rats (R.0.7 (Pearson correlation coefficient), P<0.05, n58 sham rats; Figs 3a, b and 4a-d and Supplementary Fig. 13). These correlations must be interpreted with caution because any variability in the initial cochlear trauma could generate a correlation between neural and behavioural changes even in the absence of a causal relationship. Though still not definitive, the best test for a causal relationship would be to reverse specifically the plasticity generated by noise exposure and document the reversal of the gap detection impairment.

We speculated that pairing VNS with randomly interleaved pure tones that span the rat hearing range, but exclude the overrepresented frequencies, could decrease the cortical representation of the excluded frequencies24. We also expected that pairing multiple tone frequencies with VNS ('VNS/multiple tone' pairing) would increase frequency selectivity and decrease synchronization as in our earlier nucleus basalis stimulation experiments25. We quantified behavioural and physiological correlates of tinnitus in noise-exposed rats and then tested whether pairing VNS with multiple tone frequencies could reverse the pathological plasticity and eliminate the perceptual disturbance in these rats.

VNS was repeatedly paired with multiple pure tones 300 times per day for 18 days in seven noise-exposed rats with impaired gap detection for mid-frequency sounds (Methods). Because we found that gap impairment occurred at 8-10 kHz, we selected the frequency of each randomly interleaved tone to be 1.3, 2.2, 3.7, 17.8 or 29.9 kHz. This pairing procedure was chosen because previous studies suggest it would reduce the cortical response to mid-frequency tones, increase frequency selectivity and decrease cortical synchronization2,25. After ten days of therapy, each of the seven rats showed a significant startle reduction in cued trials relative to uncued trials for every frequency tested (P<0.05; Fig. 2a and Supplementary Fig. 9a). Thus, pairing of VNS with multiple tones reversed the behavioural effect of noise exposure, which suggests that the rats' presumed tinnitus was no longer present. In contrast, rats in the shamtherapy group showed a consistent impairment in their ability to detect gaps in the putative tinnitus frequency (Fig. 2b). Each of the nine rats that received shamtherapy (tones with noVNS, VNS with no tones or no therapy; n54, 2, 3 rats, respectively) did not show a significant startle reduction in cued trials (P>0.05; Supplementary Fig. 9b) for at least one of the frequencies tested at each time point.

In the rats that received VNS paired with multiple tones, the impairment in gap detection was also eliminated when measured one day, one week and three weeks after the end of the therapy. This impairment was maintained in all three control groups at every time point tested (Supplementary Figs 9 and 10). These results indicate that pairing VNS with multiple tone frequencies is sufficient to eliminate the gap impairment induced by noise exposure (Supplementary Fig. 11). This is the first method reported to generate a long-lasting reversal of a behavioural correlate of chronic tinnitus.

Three weeks after the end of VNS/multiple tone pairing or sham therapy, we evaluated the physiological properties of the auditory cortex of each rat to determine whether the restored behaviour in the treated group was due to renormalization of the auditory cortex. After VNS/multiple tone pairing, most of the A1 properties that were degraded by noise exposure returned to normal levels. For example, the proportion of A1 neuronswith characteristic frequencies between 12 and 23 kHzwas indistinguishable from that in naive controls after VNS/multiple tone treatment (naive, 2062%; sham, 1565%; therapy, 3069%; Supplementary Figs 12 and 13a). The proportion of A1 neurons responding to 4-kHz, 70-dB SPL tones significantly increased relative to naive controls in sham rats and returned to normal levels in rats that had received the therapy three weeks earlier (naive, 45.465.0%; sham, 74.167.6%; therapy, 49.166.6%; Figs 3 (white circles) and 4a). The degree of low-frequency map distortion was positively correlated with the degree of gap impairment observed in individual rats (Fig. 4b and Supplementary Fig. 13b). The percentage of cortex responding to 8-kHz, 30-dB SPL tones (Fig. 3, black circles) was also well correlated with the gap detection impairment ($R2=0.51$, $P=0.006$). These results support the earlier hypothesis that changes in cortical maps are causally related to tinnitus4,26.

VNS/multiple tone pairing reversed the increase in the width of frequency tuning of A1 multiunit activity (that is, decreased frequency selectivity) observed in noise-exposed rats (Fig. 4c). The bandwidth (measured at 10, 20, 30 or 40 dB above threshold) averaged across all A1 sites was highly correlatedwith the degree of gap impairment (Fig. 4d and Supplementary Fig. 14), thus supporting the earlier hypothesis that decreased frequency selectivity is causally related to tinnitus27.

VNS/multiple tone pairing reversed the increase in cortical excitability observed in noise-exposed rats (Fig. 4e). The average number of spikes evoked by tones within each site's receptive field was weakly correlated with the degree of impairment of gap detection (Fig. 4f), supporting the earlierhypothesisthat tinnitus isrelatedtoincreasedexcitabilityof cortical neurons28,29.

Finally, VNS/multiple tone pairing also reversed the increase in cortical synchronization observed in noise-exposed rats, but did not reverse the increase in cortical spontaneous activity observed in noise-exposed rats (Fig. 4g, i). There was a trend for the degree of synchronization to be correlated with the degree of gap impairment, but no correlation between the rate of spontaneous activity and the degree of gap impairment (Fig. 4h, j).Our observation that noise-induced increases in spontaneous activity and synchronization are not significantly correlated with behavioural correlates of tinnitus in individual rats is consistent with earlier reports19,23.However, giventhepotential for small changes in anaesthesia level to influence spontaneous activity and synchronization in the cortex, it remains a possibility that these factors contribute to tinnitus.

Hearing loss, hyperacusis and tinnitus often result from noise exposure and could contribute to the gap impairments observed in this study. Our results confirm that exposure to intense, high-frequency noise causes pathological plasticity that is well correlated with the inability to detect a gap in a mid-frequency, 65-dB SPL tone. Correlations alone do not suggest that these changes cause tinnitus because another confounding factor (such as variability in the degree of cochlear trauma) could cause both variables to be correlated without a causal connection. By randomizing the treatment of rats with identical noise exposure, we were able to eliminate the potential confound caused by variability in the response to noise exposure. Thus, our observation that pairing multiple tone frequencies with VNS can reverse both the neural and behavioural correlates of tinnitus provides good evidence that abnormal activity in the central auditory system is responsible for the subjective experience of tinnitus. In addition, neural correlates of hearing loss (tone thresholds) and hyperacusis

(rate level functions) were not correlated with gap impairment in the rats tested (Supplementary Information). Thus, it is reasonable to conclude that the gap impairments observed in this study are primarily related to tinnitus.

VNS-directed plasticity represents a potentially powerful approach to treating tinnitus. Unlike pharmaceutical approaches, this method provides the possibility of generating long-lasting and stimulus-specific changes to neural circuits with minimal side effects. Our control experiments demonstrate that VNS-directed plasticity is driven by the repeated association of VNS with tones, and not by VNS alone. Additional studies are needed to determine whether the pairing of other sensory events with brief periods of VNS could be used to reverse the pathological plasticity associated with other common neurological conditions, such as chronic pain and amblyopia.

METHODS SUMMARY

The VNS-tone pairing protocols, noise exposure procedure, gap detection testing, neurophysiology techniques and analysis are described in Methods. The noise exposure procedure, gap detection testing, and neurophysiology techniques were identical to those in earlier reports8,17,25.

Full Methods and any associated references are available in the online version of the paper at www.nature.com/nature.

Received 14 June; accepted 8 November 2010.

Published online 12 January 2011.

Sidebar

Supplementary Information is linked to the online version of the paper at www.nature.com/nature.

Acknowledgements We would like to thank A. Kuzu, J. Omana, D. Vuppala, H. Rasul, M. Fink, E. Hanacik, R. Miller and C. Walker for help with rat behavioural training. We would also like to thank J. Eggermont, A. Møller, C. Bauer, J. Fritz, H. Reed, C. Engineer, A. Reed, M. Brosch, R. Rennaker, R. Beitel, V. Miller, C. McIntyre, G. White, P. Pandya, R. Tyler and D. deRidder for suggestions about earlier versions of the manuscript. This work was supported by the James S. McDonnell Foundation, the Texas Advanced Research Program, the National Institute for Deafness and other Communication Disorders, and MicroTransponder Inc.

Author Contributions N.D.E., J.R.R., J.D.S., S.P.S. and M.S.B. did the behaviour training sessions, noise exposure and auditory brainstem response recordings. N.D.E., J.R.R., J.D.S., W.A.V.andJ.A.S. did corticalmicroelectrodemappings. J.A.S. did theA1mapping surgeries. S.P.S. and N.D.E. did all the VNS implant surgeries. M.P.K. and N.D.E. designed the experiments, wrote the manuscript and performed data analysis. All authors discussed the paper and commented on the manuscript.

Sidebar

METHODS

VNS surgical protocol. Female Sprague-Dawley rats (250-350 g) were implanted with a platinum-iridiumbipolar cuff electrode around the left cervical vagus nerve9. As in humans, only the left vagus nerve was stimulated because the right vagus nerve contains efferents that stimulate the sinoatrial node and can cause cardiac complications13. Leads fromthe electrode were tunnelled subcutaneously to the top of the head.Afour-channel connector was used to deliver current to the stimulating electrode andmonitor the electroencephalogram(EEG) during dailyVNS sessions. Bone screws placed over the vertex and the cerebellumwere used to record auditory brainstem responses (ABRs) and EEG. Each rat was given antibiotics to prevent infection and a single dose of atropine and dexamethazone to reduce fluid accumulations in the lungs immediately after completion of the surgery.

VNS stimulation parameters and single-tone pairing procedures. VNS was delivered to unanaesthetized, unrestrained rats in a 25325325cm3 wire cage, located inside a 50360370 cm3 chamber lined with acoustic insulating foam. A pilot study was conducted to determine the minimal VNS parameters that reliably reduced EEG amplitude during slow-wave sleep (Supplementary Fig. 3). VNS parameters wereidentical for every rat in

this study.Each100-ms, charge-balancedbiphasic pulse was delivered with a current of 0.8mA. The stimulation was delivered as a train of 15 pulses at 30Hz (500-ms train duration). Cuff impedances weremeasured daily (~5kV). The impedance for three rats was unusually high after implantation and these ratswereassignedtothe tone-aloneandno-therapygroups.The impedancewas stable across the duration of training for all other rats. The 500-ms pure tones began 150ms after the onset of the VNS train (Supplementary Figs 1 and 2). For our earlier nucleus basalis stimulation studies, stimulation beginning either 200 ms before tone onset or 50ms after tone onset generated indistinguishable map plasticity8.

VNS was delivered 300 times per day for 20 days, during a VNS-tone pairing session that lasted 2.5 h (Supplementary Figs 2). To prevent rats from anticipating stimulation timing, there was a 50% chance thatVNSwould be delivered every 15 s. Twenty-four hours after the last pairing, rats were anaesthetized with pentobarbital and the right auditory cortex was exposed to allow for high-density extracellular microelectrode mapping8.

One group of rats (n=8) was exposed to a single 9-kHz, 60-dB SPL tone paired with VNS. No sound was presented when VNS was not delivered. A second group (n=5) was exposed to a 19-kHz, 50-dB SPL tone paired with VNS. During the trials in which no VNS was delivered (50%), a 4-kHz, 50-dB SPL tone was presented. As a result, a 19- or 4-kHz tone was delivered every 15 s. Frequency and intensity calibrations were performed with an ACO Pacific microphone (PS9200- 7016) and Tucker-Davis Technologies SIGCAL v4.2 software. The free-field tones were presented from a speaker (Optimus) suspended 20cm above the wire cage. All paired tones had a 5-ms rise-fall time. The intensity of every tone was selected to be approximately 20 dB SPL above the rat hearing threshold.

Noise exposure and ABRs. Twenty-eight experimental and control rats were barbiturate-anaesthetized and exposed to 16-kHz, 115-dB SPL, octave-band noise for 1 h (refs 17, 20). A single speaker was positioned 5 cm from the left ear. No ear plugs were used to restrict the noise exposure to one ear. Bilateral noise exposure was used because it best approximates the noise exposure that occurs in humans. To confirm cochlear trauma, elevated thresholds were quantified using ABRs in ten ratsunder pentobarbital anaesthesia before noise exposure, immediately after exposure and 11 weeks after noise exposure (when the auditory cortexwasmapped). For ABR recordings, the speaker was positioned 10cm from the left ear and pure tones (10ms long, 2.5-ms rise-fall time) were delivered at a rate of 20 Hz. Tone frequencies were 4, 10, 16 and 32kHz in 10-dB steps from 0 to 85 dB SPL. Tones were randomly interleaved with 1,500 repeats for each frequency-intensity combination. The signals were filtered from 100 to 3,000Hz and recorded using BRAINWARE v8.12 (Tucker-Davis Technologies).Thresholdwas defined as the lowest 10-dB SPL step at which an ABR could be recognized (Supplementary Fig. 4).

Gap detection testing. The Turner gap detection method was used to assess a behavioural correlate of tinnitus in every noise-exposed rat17 (Supplementary Figs 6-8). This method has previously been cross-validated with a conditioned lever suppression task20 (R=0.75) and a licking suppression task21. The gap detection method was selected because it avoids the need for food or water deprivation, electric shock or months of behavioural training17. Testing took place in a 20320 ×20 cm3 wire-mesh cage in a 67×67×67cm3 chamber lined with 5-cmacoustic foam. The cage was placed on a startle platform (Lafayette Instrument Co.) that used a piezoelectric transducer to generate a continuous record of downward force. Sounds were generated using System 3 hardware and software (Tucker-Davis Technologies) and were delivered by a speaker (Tucker-Davis Technologies FF1) mounted 20cm above the cage. Rats underwent gap detection testing with different band-pass-filtered (1,000-Hz bandwidth) sounds centred at 2, 4, 8, 10, 16, 20 and 24 kHz at 65 dB SPL (ref. 17). Startle responses were elicited by a 20-ms burst of white noise at 100 dB SPL. In 50% of trials, a 50-ms gap embedded in the continuous sound served as a warning of a subsequent startling noise and allowed rats to reduce the amplitude of the response (Supplementary Fig. 7b). The gap in the narrowband noise began 100 ms before the onset of the broadband startling noise. Rats underwent 30 trials during each session. The order of

sessions with different continuous sounds was counterbalanced across rats.The interval between each startle sound was 30-35 s.

In untreated noise-exposed rats, gaps in a specific narrowband sound (usually 8 or 10 kHz) did not serve as an effective warning, presumably because the ongoing tinnitus percept prevented the rats from detecting the silent gap. Thus, the animals were not warned that a loud startling noise was coming and exhibited a strong startle response (Supplementary Figs 7b and 8b). Gap detection was quantified as one minus the ratio of the startle amplitude when the startling noise was preceded by a gap in the 65-dB SPL, continuous narrowband sound to the startle amplitude when the startling noise was not preceded by a warning gap. Supplementary Fig. 8 shows typical data from one noise-exposed rat for a session in which the noise burst was cued with a gap in broadband noise (left) and a session in which a gap in an 8-kHz tone served as the warning cue (right). The warning gap typically reduced the startle amplitude by 60-70% (Supplementary Fig. 8a). In noiseexposed rats, gaps in the narrowband noise centred near the low edge of the trauma noise typically reduced the startle amplitude by less than 20%, which is not a statistically significant reduction (Supplementary Fig. 8b). The same procedure was alsoadministered using gaps in 65-dB SPL broadband noise as warning cues of the startling noise (Supplementary Fig. 7a). The frequency with the greatest impairment four weeks after noise exposure is the putative tinnitus frequency for each rat (Fig. 2).

Thirty-six rats were initially tested using the gap startle task for inclusion in this study. Five rats were excluded from the study because they showed no detectable startle response to the noise burst. Of the 31 remaining rats, three were excluded because their startle responses were unusually variable. Twenty-eight rats received noise exposure. Eighteen of these showed a statistically significant impairment in the detection of gaps in one or both mid-frequency (8- or 10-kHz) narrowband sounds tested, relative to gap detection before noise exposure ($P<0.05$). Three rats were excluded from further study because they no longer showed a startle response to the noise burst (that is, could no longer detect the startle stimulus). Seven rats were excluded from further study because they showed no impairment in gap detection (that is, no evidence of tinnitus). Our observation that gap impairments do not always result from noise exposure is consistent with human and animal studies showing that although hearing loss is common in individuals with tinnitus, the majority of individuals with hearing loss do not have tinnitus20,30,31.

Each of the eighteen rats included in this study showed a significant impairment in its ability to detect a gap in narrowband noise centred on 8 kHz (16 of 18) or 10 kHz (12 of 18). None of the 18 rats showed a significant impairment in the ability to detect a gap in low-frequency narrowband noises (2 or 4 kHz) or in broadband noise (Fig. 2 and Supplementary Fig. 11). This result indicates that these rats are able to respond normally to the startling noise burst and that the mechanisms for modulating the startle response using silent gaps remain intact. Our observation that noise-exposed rats can show gap detection impairments centred at a single frequency or across a narrow range of frequencies is consistent with clinical studies showing significant heterogeneity across subjects in the spectral characteristics of the tinnitus percept22,32,33. Despite this heterogeneity, a large fraction of tinnitus patients can match their tinnitus to a pitch and describe their phantom sound as tonal22.

VNS tone delivery to noise exposed rats. Rats were tested for gap impairment four weeks after noise exposure and 10 and 20 days after the beginning of the sham or experimental therapy. In the VNS/multiple tone paired group (n55 rats), tones were paired with VNS every 15 s with noVNS-tone pairing 50% of the time. The tone frequencies paired with VNS in the therapy group were designed to reduce the 8-10-kHz region of the frequency map. VNS was repeatedly paired with a 1.3-, 2.2-, 3.7-, 17.8- or 29.9-kHz tone that was randomly selected every trial (300 trials per day). Each tone was presented at,20 dB above the normal hearing threshold for that frequency. The tone-alone control group was passively exposed to the same tones on the same schedule as used in the paired group. A VNS-alone control group receivedVNS stimulation on the same schedule as used in the paired group without presentation of tones. The third control group did not receive tones or VNS.

To test whether the tinnitus percept remained suppressed after the end ofVNS- tone pairing, rats were also tested on gap detection one and three weeks after the end of therapy. At the end of three weeks (that is, 11 weeks after noise exposure), multiunit responses were recorded from auditory cortex neurons from the therapy, shamand naive control rats using dense microelectrode mapping techniques. Physiological and behavioural results from the tone-alone, VNS-alone and notherapy groups were statistically indistinguishable (Supplementary Fig. 10 and physiological data not shown). Data from the three groups are combined and referred to as sham controls in the main text.

Neurophysiology. In this study, we recorded from a total of 1,492 sites in 21 rats (n58 naive controls, n55VNS therapy and n58 shamcontrols). Nine hundred and sixty-five of those sites were in A1 and were included in the analysis presented in this report. We recorded 220 multiunit responses from A1 sites in noiseexposed rats that received VNS/multiple tone pairing (n=5). We also recorded 321 A1 sites from noise-exposed rats that did not receive VNS/tone pairing (n=8). The latter group included noise-exposed rats that received tones with no VNS (n=3), VNS with no tones (n=2) or no therapy (n=3). Because neural and behavioural responses were similar in all three control groups, the results were pooled to form a single data set referred to as the sham therapy group. During the acute electrophysiology recordings, sounds were delivered in a foam-lined, double-walled, sound-attenuated chamber using a speaker (Motorola 40-1221) positioned directly opposite the left ear at a distance of 10 cm. Multiunit responses were recorded using Parylene-coated tungsten electrodes that were glued together (250-mm separation, 2MV at 1 kHz; FHC) and lowered approximately 500 mm below the cortical surface. Frequency and intensity calibrations were performed with an ACO Pacific microphone (PS9200-7016) and Tucker-Davis Technologies SIGCALv4.2 software. Auditory frequency tuning curves were determined at each site by presenting 81 logarithmically spaced frequencies spanning 1 to 32 kHz at 16 intensities from 0 to 75 dB SPL (1,296 total stimuli). The tones (25-ms duration, 5-ms rise-fall time) were randomly interleaved and separated by 500 ms. Tuning curve parameters were determined by an experienced blind observer using custom software written in MATLAB v7.9 (Mathworks) to randomize the order of data fromeach recording site across all groups. Experimenters were blind to the experimental conditions of each rat during electrophysiology recordings.

Data analysis. Gap discrimination was quantified as the percentage inhibition of the startle response when a gap (warning cue) preceded the starling noise relative to the startle response when no gap was present17. Eight of 36 rats tested failed to generate consistent startle responses and were excluded from the study before noise exposure. Noise exposure eliminated the startle response in three of the remaining 28 rats, and these rats were excluded from the study. Noise exposure failed to generate any impairment in gap detection in seven of the remaining 25 rats, and these rats were also excluded fromthe study. Eighteen noise-exposed rats were included in the study. Neural responses were collected fromthirteen rats (five VNS-tone paired rats and eight sham therapy rats). One rat died before neural responses could be collected. Only behavioural responses (and EEG) were collected from the remaining four rats (two treated rats and two shams) so that the duration of the benefit could be estimated.

Sites were determined to be in A1 on the basis of continuous tonotopy. At each A1 recording site, characteristic frequency, frequency bandwidth, response threshold, spontaneous rate and latency were determined using a standard method in which the experimenter was blind to the experimental group and recording location8. At each pair of simultaneously recorded A1 sites, neural synchrony during silence (300 s) was quantified as the cross-correlation function25. The peak in the cross-correlation function (with or without subtraction of the shift predictor) was also computed and gave similar results to Pearson correlation coefficient (R). Map plasticity was quantified as the percent of A1 neurons with a characteristic frequency in a given range or as the percent of A1 neurons responding to each frequency-intensity combination using theVoronoi tessellation method of interpolation8,34. Frequency selectivity was quantified as the bandwidth 10, 20, 30 or 40 dB above threshold. Results were similar regardless of the intensity above threshold used. Excitabilitywas quantified as the number

of spikes evoked by each tone within each site's receptive field and as the spontaneous activity rate during silence.

All protocols and recording procedures comply with the NIH Guide for the Care and Use of Laboratory Animals and were approved by the Institutional Animal Care and Use Committee at the University of Texas at Dallas.

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Publication date: Feb 3, 2011

Year: 2011

Effects of Age on Concurrent Vowel Perception in Acoustic and Simulated Electroacoustic Hearing

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.1 (Feb 1, 2011): 190-210A.
ProQuest document link

Abstract: In this study, the authors investigated the effects of age on the use of fundamental frequency differences (ΔF^sub 0^) in the perception of competing synthesized vowels in simulations of electroacoustic and cochlear-implant hearing. Twelve younger listeners with normal hearing and 13 older listeners with (near) normal hearing were evaluated in their use of ΔF^sub 0^ in the perception of competing synthesized vowels for 3 conditions: unprocessed synthesized vowels (UNP), envelope-vocoded synthesized vowels that simulated a cochlear implant (VOC), and synthesized vowels processed to simulate electroacoustic stimulation (EAS) hearing. Tasks included (a) multiplicity, which required listeners to identify whether a stimulus contained 1 or 2 sounds and (b) double-vowel identification, which required listeners to attach phonemic labels to the competing synthesized vowels. Multiplicity perception was facilitated by ΔF^sub 0^ in UNP and EAS but not in VOC, with no age-related deficits evident. Double-vowel identification was facilitated by ΔF^sub 0^, with ΔF^sub 0^ benefit largest in UNP, reduced in EAS, and absent in VOC. Age adversely affected overall identification and ΔF^sub 0^ benefit on the double-vowel task. Conclusions: Some but not all older listeners derived ΔF^sub 0^ benefit in EAS hearing. This variability may partly be due to how listeners are able to draw on higher-level processing resources in extracting and integrating cues in EAS hearing.

Full text: Headnote

Purpose: In this study, the authors investigated the effects of age on the use of fundamental frequency differences (ΔF^sub 0^) in the perception of competing synthesized vowels in simulations of electroacoustic and cochlear-implant hearing.

Method: Twelve younger listeners with normal hearing and 13 older listeners with (near) normal hearing were evaluated in their use of ΔF^sub 0^ in the perception of competing synthesized vowels for 3 conditions: unprocessed synthesized vowels (UNP), envelope-vocoded synthesized vowels that simulated a cochlear implant (VOC), and synthesized vowels processed to simulate electroacoustic stimulation (EAS) hearing. Tasks included (a) multiplicity, which required listeners to identify whether a stimulus contained 1 or 2 sounds and (b) double-vowel identification, which required listeners to attach phonemic labels to the competing synthesized vowels.

Results: Multiplicity perception was facilitated by ΔF^sub 0^ in UNP and EAS but not in VOC, with no age-related deficits evident. Double-vowel identification was facilitated by ΔF^sub 0^, with ΔF^sub 0^ benefit largest in UNP, reduced in EAS, and absent in VOC. Age adversely affected overall identification and ΔF^sub 0^ benefit on the double-vowel task. Conclusions: Some but not all older listeners derived ΔF^sub 0^ benefit in EAS hearing. This variability may partly be due to how listeners are able to draw on higher-level processing resources in extracting and integrating cues in EAS hearing.

KEY WORDS: aging, competing speech perception, electroacoustic hearing, envelope and fine structure perception

In Older Americans 2008, the Federal Interagency Forum on Aging- Related Statistics (2008) reported that approximately 37 million people (12% of the U.S. population) were 65 or older in 2006. By 2030, approximately 71.5million people (20% of the U.S. population) are projected to be 65 or older. This same publication reported that hearing loss occurs in approximately 32% of adults who are 65-74 years of age, 46% of adults who are 75-84 years of age, and more than 60% of adults over 85 years of age. Taken together, these statistics suggest

that the number of older adults with hearing loss will increase substantially in the next 2 decades. Many of these older adults will be candidates for hearing aids, for cochlear implants, and for hearing systemsthat combine hearing aids (acoustic stimulation) and cochlear implants (electrical stimulus). In the present research,we focused on older adults' ability to benefit from combined electroacoustic stimulation (EAS). Compared with listeners who have traditional cochlear implants, listeners with combined EAS hearing purportedly receive improved representation of fundamental frequency (F^sub 0^) information. In this study, we sought to learn whether older listeners are at a disadvantage in using F^sub 0^ information in the perception of competing talkers when using EAS hearing.

Role of F^sub 0^ Differences in Normal Hearing

The F^sub 0^ of a talker's voice plays a role in speech perception. For speech presented in quiet, F^sub 0^ contributes to the identification of talker gender (Gelfer&Mikos, 2005; Hillenbrand &Clark 2009; Whiteside, 1998), to the perception of lexical information in tonal languages (Kuo, Rosen, &Faulkner, 2008), and to the perception of prosody (Bachorowski, 1999). F^sub 0^ also helps with concurrent speech perception. For example, two talkers are easier to understand when their voice pitches are different. In younger listeners with normal hearing, recognition of competing sentences (Bird &Darwin, 1998; Brokx &Nooteboom, 1982) as well as competing vowels (Assmann &Summerfield, 1990; Culling &Darwin, 1993; de Cheveigné, Kawahara, Tsuzaki, &Aikawa, 1997; Meddis &Hewitt, 1992; Scheffers, 1983; Arehart, King, &McLean-Mudgett, 1997) improves as F^sub 0^ differences are increased. Discerning whether one or two vowels is present in a double-vowel stimulus also improves as F^sub 0^ differences increase (Arehart, Rossi-Katz,& Swensson-Prutsman, 2005; Assmann &Paschall, 1998; de Cheveigné et al., 1997).

For complex tones presented in quiet, temporal fine structure of resolved lower-frequency harmonics provides a more robust cue for pitch perception than the high-rate temporal envelope fluctuations caused by the interaction of higher-frequency unresolved harmonics. The dominance of low-frequency resolved harmonics is supported by F^sub 0^ discrimination studies, which showed that F^sub 0^ difference limens were smaller for stimuli containing only low-frequency resolved harmonics than for stimuli containing only unresolved high-frequency harmonics (e.g., Arehart, 1994; Bernstein &Oxenham, 2003; Houtsma &Smurzynski, 1990). Despite its reduced salience, the temporal envelope cues produced by the interactions of higher-order unresolved harmonics are sufficient to convey melodic pitch information (Houtsma &Smurzynksi, 1990). F^sub 0^ information from low-frequency resolved harmonics has also been shown to be most important in mediating the use of small F^sub 0^ differences in the perception of competing vowels (Culling&Darwin, 1993; Rossi-Katz &Arehart, 2005) and in the perception of competing sentences (Bird &Darwin, 1998), with information from higher-frequency regions also contributing to the use of F^sub 0^ cues at larger F^sub 0^ differences.

Role of F^sub 0^ Differences in Cochlear Implant Hearing

Processing strategies for cochlear implants typically bandpass filter the incoming speech. The envelopes within each band are extracted, low-pass filtered, compressed to fit the electrical dynamic range, and then used to modulate trains of electrical pulses. Such processing schemes provide listeners with temporal envelope (periodicity) cues but not fine structure cues because the spectral detail is too sparse to provide the user with information about the frequencies of individual harmonics (Wilson &Dorman, 2008).

Even without the availability of fine structure cues, individuals with cochlear implants have been shown to achieve some degree of voice pitch perception when listening in quiet. For example, cochlear implant users are able to discriminate male and female voices (Dorman, Gifford, Spahr,&McKarns, 2008; Fu, Chinchilla,Nogaki, &Galvin, 2005). Another line of evidence has shown that cochlear implant listeners are able to recognizeMandarin tones at above-chance levels, with best performers achieving approximately 70% correct on tone recognition tasks (e.g., Wei, Cao, &Zeng, 2004). Cochlear implant users are also able to discriminate rising versus falling contours, albeit not as well as listeners with normal hearing (Chatterjee &Peng, 2008). In contrast, cochlear implant users do not benefit in their ability to understand speech when F^sub 0^ differences are

introduced between competing talkers. For example, the individuals with cochlear implants in Stickney, Assman, Chang, and Zeng (2007) were presented with competing sentences that had average F^sub 0^s that ranged from 0 semitones (no difference) to 15 semitones (more than an octave difference). The word identification scores of the individuals with cochlear implants did not change as the average F^sub 0^ difference between the competing talkers increased. Cullington and Zeng (2008) also reported that cochlear implant recipients had difficulty identifying the number and gender of competing talkers, even when the competing talkers, who were of different genders (male and female), had disparate F^sub 0^s.

Listeners who were presented with simulations of cochlear implants showed a similar difficulty in benefiting from F^sub 0^ differences between competing talkers (Carroll &Zeng, 2007; Cullington&Zeng, 2008; Qin&Oxenham, 2005;Stickney,Zeng,Litovsky,&Assmann, 2004; Stickney et al., 2007). In these studies, individuals with normal hearing listened to speech subjected to speech processing that is analogous to the speech processing in cochlear implants: An envelope vocoder divides the incoming signal into several contiguous frequency channels, extracts the temporal envelope from each of the channels, and then applies each channel's envelope modulation to a sine wave or white-noise carrier filtered to have the same bandwidth (e.g., Rosen, Faulkner, &Wilkinson, 1999; Shannon, Zeng, Kamath, Wygonski, &Ekelid, 1995; Souza &Rosen, 2009; Stickney et al., 2007). Because only the envelope modulation is preservedwithin each channel, this type of processing limits resolution of individual harmonics and, for a noise carrier, removes temporal fine structure cues. Listeners with normal hearing who were presented with competing vowels (Qin &Oxenham, 2005) and with competing sentences (Carroll &Zeng, 2007; Cullington &Zeng, 2008; Stickney et al., 2004, 2007) processed through an envelope vocoder showed no benefit from F^sub 0^ differences. In addition, subjects with normal hearing who were presented with cochlear implant simulations had difficulty identifying the number of competing talkers in stimuli with relatively large F^sub 0^ differences (Cullington &Zeng, 2008). Thus, cues that are based on F^sub 0^ differences in envelopevocoded stimuli are insufficient for young adults with normal hearing to accurately identify both the number and the content of competing speech sounds.

Role of F^sub 0^ Differences in EAS

Combined electric and acoustic stimulation (EAS) is one recent development in cochlear implant design and technology that may allow individuals to have improved representation and access to F^sub 0^ information (Wilson &Dorman, 2008). EAS allows listeners to combine residual hearing in the lowfrequencieswith electrical hearing provided either by a short electrode in the same ear (Gantz et al., 2009) or by a traditional cochlear implant in the opposite ear (Dorman et al., 2008). Several studies have shown that subjects with short-electrode EAS hearing systems have better speech recognition in backgrounds with competing talkers than do patients who are fit with traditional cochlear implants (Turner, Gantz, Vidal, Behrens, &Henry, 2004; Turner, Gantz, &Reiss, 2008).

One line of experimental evidence suggests that EAS benefit (defined here as the improvement in perceptual tasks obtained with EAS hearing configurations compared to traditional cochlear implant configurations)may be due, in part, to better perception of F^sub 0^ cues in EAS hearing compared with cochlear implant hearing. Kong, Stickney, and Zeng (2005) showed that EAS benefit in a group of cochlear implant users with electrical hearing in one ear and residual low-frequency hearing in the opposite ear was greater when the target and masker voices were of different gender (and, thus, had greater differences in their F^sub 0^s) than when the target and masker voices were of the same gender. In addition, Brown and Bacon (2009a) recently reported that listeners with EAS hearing had nearly as much EAS benefit when the acoustic portion of the target speech was replaced by a tone that tracked both the F^sub 0^ and amplitude envelope of the target talker. A subset of the listeners in the Brown and Bacon report also showed substantial EAS benefit when they were tested with a pure tone that tracked only the F^sub 0^ of the target talker. Zhang, Dorman, and Spahr (2010) measured sentence recognition in babble noise in nine listeners with a cochlear implant in one ear and lowfrequency residual hearing in the opposite ear. The subjects showed significant EAS benefit, with the majority of the

benefit coming from the frequency region of the F^sub 0^.

Results of several studies using cochlear implant simulations also support the idea that the ability to use F^sub 0^ differences contributes to EAS benefit (Brown &Bacon, 2009b; Chang, Bai, &Zeng, 2006; Qin &Oxenham, 2006). For example, Qin and Oxenham (2006) showed that when an unprocessed low-frequency sound (<600 Hz; which provides information about the temporal fine structure of low-frequency harmonics) was combined with higherfrequency (>600 Hz) acoustic simulations of cochlear implant-processed speech, listeners with normal hearing showed significant benefit from F^sub 0^ for both competingsentence and competing-vowel tasks.

Another set of recent studies has called into question whether F^sub 0^ plays a primary role in EAS benefit (e.g., Kong &Carlyon, 2007; Li &Loizou, 2007). For example, Kong and Carlyon (2007) used simulations to study the role of various cues in EAS benefit. They reported that the significant EAS benefit observed with the addition of a low-frequency acoustic signal was absent when the low-frequency signal was replaced by a complex tone that followed the F^sub 0^ contour. Furthermore, an EAS benefit was observed in one condition in which the F^sub 0^ contours were removed from the signal. Li and Loizou (2008) proposed that glimpsing of the target talker plays a major role in EAS benefit-that is, the low-frequency acoustic portion of the EAS stimulus provides listeners with timefrequency regions in which they are able to detect the target speech, and these glimpses then provide the listener with the opportunity to latch onto and integrate multiple cues (e.g, F^sub 0^, first formant, voicing and onset cues) from the target speech.

In summary, listeners with real and simulated EAS hearing have been show to benefit from F^sub 0^ differences in the perception of competing talkers, a benefit that is not evident in real or simulated cochlear implant hearing. In addition, F^sub 0^ information may not be necessary for EAS benefit. Finally, when F^sub 0^ cues contribute to EAS benefit, their use may be mediated by a glimpsing mechanism.

Role of F^sub 0^ Differences in Hearing by Older Adults

Aging can adversely affect neural encoding of the temporal properties of sounds in both lower and higher levels of the auditory system (e.g., Frisina et al., 2000; Hellstrom &Schmiedt, 1990;Walton, Simon, &Frisina, 2002). Such age-related deficits in temporal processing might impact the ability of older listeners to process temporal fine structure (e.g., Gordon-Salant &Fitzgibbons, 1993; Strouse, Ashmead, Ohde, &Grantham, 1998) and periodicity cues (e.g., Souza &Boike, 2006) and, hence, may impact the ability of older listeners to utilize F^sub 0^ differences. In support of this conjecture, older adults with (near) normal hearing have been shown to have more difficulty processingF^sub 0^ information for sounds presented in quiet, as evidenced by F^sub 0^ difference limens that are significantly larger in older subjects than in younger subjects (Souza, Arehart, Miller, &Muralimanohar, 2010; Vongpaisal &Pichora-Fuller, 2007). Older adults also show increased difficulty using F^sub 0^ differences to perceive competing talkers (e.g., Rossi-Katz&Arehart, 2009;Snyder &Alain, 2005; Summers &Leek, 1998; Vongpaisal &Pichora-Fuller, 2007). For example, Summers and Leek (1998) reported that age negatively impacted the ability of listeners with hearing loss to benefit from F^sub 0^ differences in a double-vowel identification task. Although Vongpaisal and Pichora-Fuller (2007) and Snyder and Alain (2005) both reported that younger and older listeners in their studies showed comparable benefit in doublevowel identification due to F^sub 0^ differences, both studies also reported age-related deficits in the overall identification rates of double vowels. In addition, Vongpaisal and Pichora-Fuller (2007) reported age-related declines in the ability of listeners to utilize F^sub 0^ differences in the identification of stimuli containing two concurrent vowels with the same formants (and, thus, with the same phonemic label). The older adults in Snyder and Alain (2005) also showed longer reaction (processing) time for competing vowel tokens with small F^sub 0^ differences as well as agerelated changes in an event-related potential (ERP) called object-related negativity (ORN), which is related to the auditory object segregation and the automatic processing of F^sub 0^ differences. Taken together, the results of these studies suggest age-related declines in the ability of older listeners to effectively utilize F^sub 0^ differences in doublevowel identification.

Finally, age may also adversely affect the ability of older listeners to effectively use F^sub 0^ differences to determine whether a double-vowel stimulus contains one or two sounds. Alain and MacDonald (2007) measured the effects of age on the ability of listeners to detect two sounds when a complex periodic tone had a single harmonic that was mistuned by 0%, 4%, or 16%. Compared with younger adults, older listeners once again showed reduced ORN responses and also had a greater likelihood of saying that two sounds were present with no mistuning and a lower likelihood of saying that two sounds were present when the harmonic was mistuned by 16%. Although the task in Alain andMacDonald (2007) was not specifically a double-vowel task, the authors noted that the mistuned harmonic of the complex tone might be perceived as being associated with a second F^sub 0^ and a second voice.

Aging and EAS Hearing

Recent clinical reports have suggested that older listenersmay not derive asmuch benefit fromEAS devices as do younger adults (Gantz et al., 2009; Luetje, Thedinger, Buckler, Dawson, &Lisbona, 2007). The present study focuses on older listeners' use of the various cues transmitted by EAS as well as traditional implants, with the goal of quantifying possible age-related deficits in EAS benefit. The observation that older adultsmay not benefit from EASdevices as much as younger adults, on the one hand, and the evidence (reviewed earlier in this article) that older adults have increased difficulty in processing F^sub 0^ differences between competing talkers, on the other hand, lead us to hypothesize that deficits in F^sub 0^ processing may contribute to age-related decrements in the ability of listeners to benefit from EAS hearing. The primary research question addressed in this study is as follows: How does age affect the ability of listeners to use F^sub 0^ differences in the perception of concurrent sounds in three different hearing configurations: (a) normal hearing, (b) EAS hearing, and (c) traditional cochlear implants?

Our experimental approach is to evaluate the effects of age on the ability of adults with (near) normal hearing to perceive double vowels using noise vocoder simulations of EAS and cochlear implant hearing. The use of vocoder simulations allows us to separate the effects of age from other possibly confounding factors that may be present in older patients with actual EAS systems (e.g., age of implantation, duration of deafness, and co-morbid health issues). Vocoder simulations can be implemented with either noise or sine wave carriers. In the present research, we have chosen to use vocoder simulations with a noise carrier. Recent studies suggest that performance on tasks involving the use of F^sub 0^ cues by listenerswith normal hearing who were presented with simulations using tonal carriers often exceeds performance on comparable tasks by cochlear implant users. In contrast, performance on speech perception tasks involving F^sub 0^ cues is more similar between cochlear implant users and listeners with normal hearing who were presented with simulations with noise carriers (Chaterjee &Peng, 2008; Souza &Rosen, 2009; Stone, Fullgrabe,&Moore, 2008). In addition, Souza and Rosen (2009) suggested that noise-vocoded speech represents a better model for perception of F^sub 0^ by cochlear implant wearers because the noise vocoder eliminates fine-structure cues, whereas sine-vocoded speech contains spectral detail not accessible in a traditional cochlear implant (Stone et al., 2008; Whitmal, Poissant, Freyman, &Helfer, 2007).

Alain, Reinke, He, Wang, and Lobaugh (2005) suggested that double-vowel identification involves the ability to (a) detect the presence of two sounds in the stimulus and (b) separate, categorize, and label the two vowels. In addition, the research previously discussed suggests that older adults may have difficulty not only in the identification of double vowels but also in the detection of how many sounds are in a double-vowel stimulus. Therefore, in this study, we included two experimental tasks using double-vowel stimuli. In the first task, referred to here asmultiplicity, we assessed the ability of listeners to detect whether one or two sounds are present in a competing-vowel stimulus. In the second task, referred to here as double-vowel identification, we required listeners to identify the two vowels in the double-vowel stimulus.

The ability to detect two sound sources in a doublevowel stimulus has not been measured previously in simulations of EAS and cochlear implant hearing. However, Qin and Oxenham (2005) noted anecdotally that

several of the participants in their cochlear implant simulation study reported hearing only one sound when listening to vocoded vowels with F^sub 0^ differences. Therefore, we predicted that both the older and younger listeners in our study would have difficulty detecting the presence of two sounds in simulated cochlear implant hearing but would be able to effectively utilize F^sub 0^ differences in the perception of multiplicity in both normal hearing and simulated EAS hearing.

As in previous studies (Qin &Oxenham, 2006), we expected listeners in this study to benefit from F^sub 0^ differences in double-vowel identification in both normal hearing and simulations of EAS hearing but not in simulations of cochlear implant hearing. Double-vowel identification involves integration of information from lower frequency regions (containing the F^sub 0^ and first formant) and higher frequency regions (containing the second and higher formants). The EAS stimulus combines a low-pass unprocessed stimulus with a high-pass vocoded stimulus; thus, it provides the listeners with undistorted signal information for the F^sub 0^ and the first formant but not for the second and higher formants. Because age-related deficits-including those related to F^sub 0^ processing-are more pronounced under more difficult and complex listening situations (Pilotti, Beyer,&Yasunami, 2001; Rossi- Katz &Arehart, 2009; Sommers, 1997), we predicted that the integration of information across frequency regions may be more difficult for older listeners in the simulation of EAS hearing than in normal hearing (due to less fidelity in the high-frequency portion of the signal), which, in turn, may cause older listeners to show poorer doublevowel identification rates and less benefit from F^sub 0^ differences in EAS hearing than in normal hearing.

Finally, we predicted that age-related deficits may be greater in the double-vowel task than in the multiplicity task, again, due to the premise that age deficits will be more pronounced for more difficult listening tasks. Although it is possible that listeners are able to reliably detect the number of sounds in the stimulus only after they are able categorize the vowels (Micheyl&Oxenham, 2009), we think that it is more likely that the detection of multiplicity is a lower-level process (and, thus, a simpler task) than the identification of the two competing vowels, which requires phonemic labeling. Such a view is consistent with the work of Alain and colleagues (see, e.g., Alain et al., 2005), which shows that neural activity associated with detecting the presence of two vowels occurs earlier than neural activity associated with identifying the competing vowels.

Method

Participants

Two groups of listeners participated in this study. One group consisted of 12 younger adults (10 female, two male), with an average age of 23.9 years and an age range of 18-32 years. Younger listeners had normalhearing sensitivity, which is defined as audiometric thresholds of 20 dB HL (American National Standards Institute [ANSI], 2004) or better at octave frequencies from 250 Hz to 8000 Hz, inclusive. The average fourfrequency pure-tone average (500 Hz, 1000 Hz, 2000 Hz, 4000 Hz) of the younger group was 5.4 dB HL, with a range of 0-11.3 dB HL.

The second group consisted of 13 healthy older adults (11 female, two male), with an average age of 69.8 years and an age range of 65-82 years. All older listeners passed the Mini-Mental State Examination (Folstein, Folstein, &McHugh, 1975)-which is a screening test of gross cognitive functioning-with a score of 26 or higher. The older adults had minimal or no hearing loss through 4000Hz in the test ear (generally, thresholds of 25 dBHL or better). The average four-frequency pure-tone average of the older group was 14.5 dB HL, with a range of 6.3-21.3 dB HL.

Figure 1 shows the audiometric thresholds of the test ears for the two listener groups. To compensate for possible differences in audibility between the two groups, frequency shaping was applied to all stimuli (described in the next section). Participants in both groups had normal middle-ear function as determined by tympanometry testing (Wiley et al., 1996). All participants spoke English as their first or primary language.No participants had any prior hearing aid experience. All participants were paid for their participation. Approximately half of the listeners were tested at the University of Washington and half were tested at the University of

Colorado, with the same test protocols and equipment used at both sites.

Stimuli

The stimuli in this study consisted of five synthesized vowels of American English (/A/ as in hod, /e/ as in head, /i/ as in heed, /e/ as in herd, /u/ as in who'd). The vowel synthesis was based on Sensimetrics cascade formant software (Klatt, 1980) with a 20000-Hz sampling frequency and 16-bit quantization. The steady-state vowels had durations of 300 ms, with 20-ms rise-fall times. Formant frequencies of the individual vowels, based in part on those published in Peterson and Barney (1952), are listed in Table 1. Table 2 lists the possible values of F^sub 0^ of the individual vowels (100 Hz + ΔF^sub 0^, with ΔF^sub 0^ ranging from 0 to 4 semitones (ST). Individual vowels were equated for root-mean-square (RMS) amplitude and then were combined with a second individual vowel to make three different types of stimuli.

The first type of stimuli is known as same-vowel same-F^sub 0^ stimuli (also called single vowels). The two individual vowels were the same and had the same F^sub 0^, chosen from the following five F^sub 0^s: 100.0 Hz, 102.9 Hz, 105.9 Hz, 112.2 Hz, and 126.0 Hz. Presumably, these stimuli would be perceived as single vowels.

The second type of stimuli is known as same-vowel different-F^sub 0^ stimuli. The individual vowels were the same but had different F^sub 0^s, chosen from four possible F^sub 0^ combinations: (a) 100.0 and 102.9 Hz, (b) 100.0 and 105.9 Hz, (c) 100.0 and 112.2 Hz, and (d) 100.0 and 126.0 Hz.

The third type of stimuli is known as different-vowel stimuli (also called double vowels). An individual vowel was paired together with each of the other four individual vowels (but not with itself), yielding 10 double-vowel combinations. One constituent vowel had an F^sub 0^ of 100Hz, and the other constituent vowel had an F^sub 0^ of 100Hz + ΔF^sub 0^, with ΔF^sub 0^ ranging from 0 to 4 ST. Each double-vowel combination yielded two different double vowel pairs. For example, /A/ and /i/ can be combined in two ways: (a) [/A/ 100.0 Hz; /i / 100 Hz + ΔF^sub 0^] and (b) [/i/ 100.0Hz; /A/ 100 Hz + ΔF^sub 0^]. Double vowels were generated with values of ΔF^sub 0^ = 0, 1/2, 1, 2, or 4 ST.

Signal Processing

The three types of synthesized vowel stimuli described earlier were RMS equalized and then processed in three ways (see also Qin &Oxenham, 2006). The first processing condition, referred to here as UNP, consisted of synthesized vowels that were band-pass filtered between 80 Hz and 6 kHz using a 12th-order elliptical filter. This set was not subjected to any further processing.

The second condition, referred to here as VOC, simulated the electrical hearing provided by a fully inserted cochlear implant, using an eight-channel noise-excited vocoder. The processing is illustrated in the top panel of Figure 2. In this condition, the speech stimuli were first bandpass filtered into eight continuous channels using third-order Butterworth filters between 80 Hz and 6 kHz. The frequency rangewas partitioned using theGreenwood frequency place map (Greenwood, 1990). Table 3 contains the lower and upper cutoffs, as well as the center frequencies of the eight bandpass filters used. The envelopes of these band-limited signals were extracted by half-wave rectification followed by smoothing (low-pass filtering using a fourth-order Butterworth filter with a 300-Hz cutoff). The 300-Hz cutoff was chosen to retain the F^sub 0^ information. Each of the envelopes was modulated using an independent noise carrier. The resultant noise-excited signals were filtered using the same bandpass filter as that used in the first step of the processing. The individual channels were then added together, with the RMS level of each channel equalized to the level obtained from the initial bandpass filtering. The resulting signals were band-limited by low-pass filtering at 6 kHz using a 12th-order elliptical filter.

The bottom panel of Figure 2 illustrates the processing in the third condition, which simulates an "electric plus acoustic" stimulation and is referred to here as EAS. The input speech tokens were low-pass filtered using a 512-pointHamming-windowed linear-phase finite impulse response (FIR) filter. A cutoff of 661 Hzwas chosen to avoid any gaps where possible cues might be lost and to maintain the original vocoder configuration. To meet

the zerophase criterion, theMATLAB "filtfilt" function was used. The normalized gain of the filter at cutoff was -6 dB.This low-pass section simulates any residual low-frequency hearing in cochlear implant users. This output was combined with a parallel section that consisted of only the fourth through eighth channels of the vocoder simulation, as discussed earlier. The low-pass acoustic stimulus and the high-pass vocoded channels were combined while maintaining RMS levels obtained from the initial filtering of the vocoder processing. The UNP, EAS, and VOC stimuli all had 20-ms rise-fall times shaped by a raised cosine function.

Stimulus Presentation

The signals were played out in the following way: Signalswere sent from a customMATLAB programto a Tucker-Davis Technologies (TDT; Alachua, FL) digital signal processor. Following digital-to-analog conversion, the signals were routed through a programmable attenuator before being delivered to the test ear of the listener with an ER2 insert earphone. Listeners were tested monaurally while seated in a sound-proof booth. The baseline level of presentation was 68 dB SPL.

Because of high-frequency threshold elevations of some of the older listeners, the 68 dB SPL stimuli were amplified using the National Acoustics Laboratories- Revised (NAL-R) linear prescriptive formula based on individual thresholds (Byrne &Dillon, 1986). The frequency-shaped amplificationwas implemented through linear-phase FIR digital filtering prior to the experiment. Stimuli were customized for each individual listener and were stored on a personal computer prior to being played out over the earphone. Listeners were able to register their responseswith either a touchscreen monitor or a computer mouse.

Tasks and Procedures

Listeners were first tested on the perception of multiplicity (one vs. two sounds) and then were tested on the identification of double vowels. Listeners participated in 5 hr of testing, typically spread out over five 1-hr test sessions.

Training on single-vowel stimuli. At the beginning of each daily session, participants were familiarized with the single-vowel stimuli. The names of all five vowels were displayed on a computer screen. Participants used amouse or touchscreen to select a particular vowel, and then that single vowel was played out to the listener. Listeners could repeat the presentation of individual vowels as many times as they wished. This familiarization was carried out for each of three processing conditions. Listeners then were tested on the identification of single vowels, in which the task was to listen to a single vowel and to identify which vowel it was. At the outset of each day of testing, listeners were presented with three blocks of vowels, with one block in each of the three processing conditions. Blocks of single vowels were 50 trials on the first day of testing and 25 trials on subsequent days of testing. Feedback was provided.

Multiplicity perception: Overview. The purpose of the multiplicity tasks was to assess the ability of listeners to discern whether one or two sound sources were present.

Multiplicity was assessed with two different tasks, with each task involving approximately 1 hr of testing.1

Multiplicity: One or two voices? On each trial, listeners were presented with a stimulus and were asked to choose whether it contained one voice or two voices. Blocks were mixed in that they contained stimuli processed in all three processing conditions and contained both same-vowel-same-F^sub 0^ and same-vowel-different-F^sub 0^ stimuli. Of 405 total test trials in this task, 225 were samevowel- same F^sub 0^ stimuli (5 Vowels ×5 F^sub 0^s ×3 Processing Conditions ×3 Repetitions) and 180 were same-vowel- different-F^sub 0^ stimuli (5 Vowels ×4 ΔF^sub 0^ Combinations ×3 Processing Conditions ×3 Repetitions). The order of the 405 trials was randomized and then broken up into five blocks of 81 trials each. Feedback was provided such that "one voice" was indicated as correct on trials that contained same-vowel-same-F^sub 0^ stimuli, and "two voices" was indicated as correct on trials that contained samevowel- different-F^sub 0^ stimuli. To familiarize the listener with the task, listeners received one practice block of 81 trials prior to the 405 test trials.

Multiplicity: One or two vowels? In the second multiplicity task, listeners were presented with a stimulus and were asked to choose whether it contained one vowel or two vowels. Blocks were mixed in that they contained

stimuli processed in all three processing conditions and contained both same-vowel-same-F^sub 0^ stimuli ("single vowels") and different-vowel stimuli ("double vowels"). Of 525 total test trials, 225 were single vowels (5 Vowels ×5F^sub 0^ Conditions× 3 Processing Conditions ×3 Repetitions) and 300 were double vowels (20 Double-Vowel Pairs ×5 ΔF^sub 0^ Conditions ×3 Processing Conditions). The order of the 525 trials was randomized and then broken up into seven blocks of 75 trials per block. Feedback was provided such that "one vowel" was indicated as correct on trials that contained single vowels, and "two vowels" was indicated as correct on trials that contained double vowels. To get familiar with the task, listeners received one practice block of 75 trials prior to the 525 test trials.

Double-vowel identification. The purpose of this task was to measure a listener's ability to benefit from ΔF^sub 0^ in the identification of two competing vowels for the UNP, VOC, and EAS conditions. Listeners were presented with a double-vowel stimulus and were required to choose the two different vowels that were contained in the stimulus. Blocks of trials contained stimuli in a single processing condition. Listeners received 720 test trials, with 240 test trials presented in each of three 1-hr test sessions.Each of the three test sessions contained five separate blocks of trials, presented in random order. The UNP and EAS conditions each had a total of 100 test trials, broken up into two 50-trial blocks (10 Double-Vowel Pairs ×2 F^sub 0^ Combinations ×5 ΔF^sub 0^ Conditions). The VOC condition had 40 test trials presented in a single block (10 Double- Vowel Pairs ×2 F^sub 0^ Combinations ×2 ΔF^sub 0^ Conditions).2 Consistent with previous studies of double-vowel identification (e.g., Culling &Darwin, 1993), feedback was not provided. Prior to the test trials in each session, listeners received practice blocks in each of the three processing conditions. Practice blocks were 25 trials for UNP and EAS, and 20 trials for VOC. The data reported for double-vowel identification are based on 60 test trials for each listener for each ΔF^sub 0^ in each of the three processing conditions.

Results

Single-Vowel Identification

Table 4 lists average identification rates of single vowels in the three processing conditions. Listeners in both groups achieved high average recognition rates of single vowels (>96%) in all three conditions. The identification rates were subjected first to an arcsine transformation (Studebaker, 1985) and then to a mixed-model analysis of variance (ANOVA).3 Shown in Table 5, this analysis showed a significant effect of processing condition but no significant differences between the older and younger groups. Post hoc comparisons with Bonferroni adjustments showed that single-vowel identification was significantly better in UNP than it was in either EAS or VOC ($p < .01$). The fact that single-vowel identification was high (>95%) in all three conditions indicates that the audibility of single-constituent vowels was sufficient for clear and consistent identification by listeners in both subject groups in all three conditions.

Multiplicity (One or Two Voices?)

Figure 3 shows the proportion of trials in which listeners reported hearing "two voices" on trials that contained either same-vowel-same-F^sub 0^ stimuli (ΔF^sub 0^ = 0 ST) or same-vowel-different- F^sub 0^ stimuli (ΔF^sub 0^ = 0.5, 1.0, 2.0, or 4.0 ST). A mixed-model ANOVAwas conducted on the arcsine-transformed proportion of trials on which "two voices" were reported in order to examine how multiplicity was affected by the within-subject factor of processing condition and ΔF^sub 0^ and the between-subjects factor of listener group. Summarized in Table 6, the results of this analysis indicated that the perception of voice multiplicity was significantly affected by the processing condition as well as by ΔF^sub 0^ but that multiplicity perception did not differ significantly between the younger and older groups.

The perception of multiplicity of voices was similar in UNP and EAS conditions but different in VOC, as indicated by post hoc comparisons with Bonferroni adjustments ($p < .01$). In addition, post hoc comparisons showed that perception of voice multiplicity at ΔF^sub 0^ = 0 ST was significantly different from ΔF^sub 0^ = 0.5, 1.0, 2.0, or 4.0 ST ($p < .01$). However, the effects of ΔF^sub 0^ on voice multiplicity perception were not the same in all three processing conditions, as indicated by the significant Processing ×ΔF^sub 0^ interaction. In the UNP and

EAS conditions, listeners reliably reported hearing only one voice when only one voice is present (same-vowel-same-F^sub 0^ stimuli; ΔF^sub 0^ = 0 ST) and hearing two voices when the same vowel was presented on two different F^sub 0^s (ΔF^sub 0^>0ST). Incontrast, in the VOC condition, listeners were guessing "one voice" and "two voices" about equally, regardless of whether F^sub 0^ differed within the same-vowel stimulus. In summary, age did not interfere with listeners' ability to use cues for the perception of multiplicity of voices derived from differences in F^sub 0^ in the UNP and EAS conditions, and, regardless of age, listeners were not able to derive ΔF^sub 0^ benefit in perception of multiple voices in the VOC condition.

Multiplicity (One or Two Vowels?)

Figure 4 shows the proportion of trials in which listeners reported hearing "two vowels" for both older listeners (left panel) and younger listeners (right panel) for the mixed blocks of trials containing both same vowelsame F^sub 0^ stimuli ("single vowels") and different-vowel stimuli ("double vowels"). Each panel shows separately the average results for single vowels (SV) and for double vowels with ΔF^sub 0^ = 0, 0.5, 1.0, 2.0, or 4.0 ST. Two mixed-model ANOVAs were conducted on the arcsine-transformed percent-correct scores to examine the within-subject effects of processing condition and ΔF^sub 0^ and the betweensubjects effect of listener group on the perception of vowel multiplicity. The first ANOVA considered only the singlevowel trials, and the second ANOVA considered only the double-vowel trials.

Summarized in Table 7, the single-vowel analysis showed that the perception of vowel multiplicity was significantly affected by both listener group and processing condition. The ability of listeners to correctly perceive only a single vowel on single-vowel trials was indicated by how close single-vowel scores were to 0% "two vowels reported." (0% "two-vowels reported" corresponds to 100% "one vowel reported.") In both groups, unprocessed single vowels were identified as "two vowels" on only a very small proportion of trials (2.5% in the older group, 2.2% in the younger group). The perception of whether one or two sound sources was present for single-vowel trials was more ambiguous for EAS single vowels (22.2% in the older group, 10.7% in the younger group) and for the VOC single vowels (66.0% in the older group, 49.4% in the younger group). In the VOC condition, younger listeners appeared to be responding "one" or "two" vowels about equally for single-vowel trials. However, older listeners were responding "two vowels" on a greater percentage of trials than were younger listeners. This latter result suggested that listeners may sometimes have a bias toward responding "two vowels" for vocoded single vowels. This possible bias is discussed more in the paragraphs that follow.

The double-vowel analysis is summarized in Table 8. The lack of a significant main effect of group indicated that the overall perception of vowel multiplicity was not affected by age. Consistent with the significant main effect of processing, the perception of vowelmultiplicity was different across processing conditions. Post hoc Bonferroni comparisons showed that EAS and UNP were similar to each other but that VOC was significantly different from both EAS and UNP ($p < .01$). Listeners also showed a statistically significant ΔF^sub 0^ benefit in vowel multiplicity, with post hoc Bonferroni comparisons indicating that vowel multiplicity at ΔF^sub 0^ = 0 ST is significantly different from ΔF^sub 0^ = 0.5, 1.0, 2.0, or 4.0 ST ($p < .01$). However, the ΔF^sub 0^ ×Processing interaction indicated that ΔF^sub 0^ benefit depends on the processing condition. The ΔF^sub 0^ benefit (defined as the difference in performance between 0 STand 4 ST) was substantial for both UNP (90.4 and 67.5 percentage points for the older and younger groups, respectively) and EAS (65.0 and 55.0 percentage points for the older and younger groups, respectively). In contrast, multiplicity scores showed no systematic improvement as a function of ΔF^sub 0^ for VOC, with scores around 70% across all values of ΔF^sub 0^.

In both the UNP and EAS conditions, the amount of ΔF^sub 0^ benefit was greater in the older group than in the younger group. Consistent with the higher-order interaction of ΔF^sub 0^ ×Processing ×Group, this difference in benefit appeared to be due to differential scores between the groups at ΔF^sub 0^ = 0 ST. For double-vowel stimuli with no F^sub 0^ difference, the older listeners reported hearing two vowels on 7.7% of trials for UNP and 33% of trials for EAS. In contrast, the "two-vowel" reports for younger listeners for double-vowel trials with ΔF^sub 0^ = 0 ST is 32.5% for UNP and 43% for EAS.

Double-Vowel Identification

Figure 5 shows the average results for the group of older listeners (left panel) and the group of younger listeners (right panel). Percentage of trials in which both vowels of double-vowel pairs were correctly identified is shown as a function of ΔF^sub 0^ in semitones for each of the three processing conditions. In all three conditions, performance by both groups was well above chance (10%). The arcsine-transformed data for all three processing conditions were subjected to mixed-model ANOVA with a between-subject factor of group and within-subject factors of ΔF^sub 0^ and processing condition. Summarized in Table 9, this analysis included only data from ΔF^sub 0^ = 0 and 4 ST, as double-vowel identification was not tested at ΔF^sub 0^ = 0.5, 1.0, and 2.0 ST. The analysis showed significant main effects of processing condition, ΔF^sub 0^, and group. Consistent with these main effects, average identification was best in the UNP condition and worst in the VOC condition, was better in the younger group than in the older group, and was better as ΔF^sub 0^ increased. In addition, the interactions of Processing ×ΔF^sub 0^, Processing ×Group, and ΔF^sub 0^ ×Group were all significant. The three-way Processing ×ΔF^sub 0^ ×Group interaction approached but did not reach statistical significance.

To clarify further the nature of these effects, separate ANOVAs were also performed for each of the three processing conditions. These analyses investigated (a) whether double-vowel identification differed between the listener groups in each specific processing condition and (b) if the listener groups showed different patterns of ΔF^sub 0^ benefit (reflected in the ΔF^sub 0^ ×Group interaction) in the different processing conditions. The analyses included data at ΔF^sub 0^ = 0, 0.5, 1.0, 2.0, and 4.0 ST for the UNP and EAS conditions, and data at ΔF^sub 0^ = 0 and 4 ST for the VOC condition. The results of the analyses are described in the paragraphs that follow and are summarized in Table 10.

UNPcondition. As indicated by the significant effect of group in the UNP condition, the older group was significantly poorer at identifying the double vowels in the unprocessed condition. Listeners in both groups also benefited significantly as ΔF^sub 0^ increased, but-as supported by the significant Group ×ΔF^sub 0^ interaction-this ΔF^sub 0^ benefit was significantly less pronounced in the older group than in the younger group. In the UNP condition, both groups showed their poorest performance when ΔF^sub 0^ was 0 ST (mean identification accuracy was 51.5% in the younger group and 27.7% in the older group.) As ΔF^sub 0^ increased from 0 ST to 4 ST, double-vowel identification improved by 31.8 percentage points in the younger group (from 51.5% to 83.3%) and by 18.3 percentage points (from 27.7% to 46.0%) in the older group. In the UNP condition, ΔF^sub 0^ benefit in the younger group began to asymptote when ΔF^sub 0^ was 1 STor greater. In contrast, in the older group, listeners continued to show slight improvements in doublevowel identification through 4 ST.

EAS condition. The effects of group and ΔF^sub 0^ were again significant for the EAS condition, supporting the finding that overall double-vowel identification was significantly poorer in the older group and that listeners' ability to identify both vowels correctly improved as ΔF^sub 0^ increased. Both groups showed poorest performance when ΔF^sub 0^ was 0 ST (mean identification accuracy was 40.6% in the younger group and 24.1% in the older group). As ΔF^sub 0^ increased from 0 ST to 4 ST, double-vowel identification improved by 17.6 percentage points in the younger group (from 40.6% to 58.2%) and by 11.4 percentage points in the older group (from 24.1% to 35.5%). The larger benefit shown by the younger group in the EAS condition was not statistically significant, as indicated by a lack of Group ×ΔF^sub 0^ interaction.

VOC condition. The effects of group were significant in the VOC condition, such that overall double-vowel identification was poorer in the older group. However, neither group demonstrated significant ΔF^sub 0^ benefit. In the VOC condition, performance for the younger group was 43.3% at 0 ST and 45.4% at 4 ST, and performance for the older group was 29.7% at 0 STand 24.2% at 4 ST. The finding that the average double-vowel identification of the older group actually decreased as ΔF^sub 0^ increased is consistent with the significant Group ×ΔF^sub 0^ interaction.

Individual Variability

Variability among listeners was higher (a) in the double-vowel identification task compared with the multiplicity tasks, (b) in the older group compared with the younger group, and (c) in the EAS and VOC conditions compared with the UNP condition. Figures 6, 7, and 8 illustrate the individual variability in the double-vowel identification task for the three processing conditions. Figure 6 shows double-vowel identification as a function of ΔF^sub 0^ for individual listeners, and Figure 7 shows the amount of benefit ([proportion double-vowel correct at 4 ST] - [proportion double-vowel correct at 0 ST], ordered on the basis of benefit in the UNP condition) for each of the three processing conditions for individual listeners in the older group (left panel) and younger group (right panel).

Several noteworthy trends emerged. First, in the UNPcondition, the participants in the younger group all showed a benefit of at least 10 percentage points as ΔF^sub 0^ increased from 0 ST to 4 ST (range = 11.7 to 51.7 percentage points). In contrast, just over half (seven of 13) of the listeners in the older group showed a benefit that equals or exceeds 10 percentage points (range = -1.7 to 55.0 percentage points). The ΔF^sub 0^ benefit in the EAS processing condition varied substantially across subjects in both groups. In the younger group, ΔF^sub 0^ benefit ranged from 3.3 to 33.3 percentage points, with four of the 12 younger subjects showing a benefit of fewer than 10 percentage points.

In the older group, the benefit in EAS ranged from -3.3 to 30.0 percentage points, with seven of the 13 older subjects showing ΔF^sub 0^ benefit that was fewer than 10 percentage points. In the VOC condition, only one of the 13 older subjects showed a positive benefit (3.3 percentage points), whereas 6 of 12 younger subjects showed a positive benefit (range = 3.3 to 16.7 percentage points).

Figure 8 shows a scatterplot of benefit from ΔF^sub 0^ differences in the EAS condition plotted against the ΔF^sub 0^ benefit in the UNP condition. In the older group, there was a significant correlation between benefits in UNP and EAS conditions (Pearson's correlation coefficient: r = .904, p <.001). Older listeners tended to fall into one of two subgroups: (a) those who showed good ΔF^sub 0^ benefit in both the UNP and EAS conditions (e.g., o9, o10, o11) and (b) those who tended to show small ΔF^sub 0^ benefit in both conditions. In contrast, the correlation between benefits in theUNPand EAS conditions was much lower in the younger group (Pearson's correlation coefficient: r = .457, p = .135), such that several younger listeners (e.g., y5, y9, y12; cf. Figure 7) who showed large ΔF^sub 0^ benefit in the UNP condition showed small benefit (< 10 percentage points) in the EAS condition.

Discussion

The primary goal of this study was to compare how older and younger listeners use F^sub 0^ differences to determine (a) the number of sound sources (one vs. two) in a doublevowel stimulus and (b) the phonemic identity of two competing vowels. Of interest was how advanced age affects the amount to which listeners benefit from F^sub 0^ differences in three different hearing configurations: normal hearing (UNP), electroacoustic stimulation (EAS), and cochlear implant hearing (VOC). The results can be summarized as follows. The perception of multiplicity was facilitated by F^sub 0^ differences for theUNPandEAS conditions but not for the VOC conditions. Furthermore, the improvement in multiplicity perception provided by F^sub 0^ differences was immune to age effects. Double-vowel identification was also facilitated by F^sub 0^ differences, with ΔF^sub 0^ benefit largest in the UNP condition, significantly reduced in the EAS condition, and absent in theVOCcondition.Furthermore, in contrast to multiplicity, age adversely affected performance on the double-vowel task in termsof amount of benefit and overall identification rates on the doublevowel task. Finally, substantial intersubject variability was observed among both older and younger listeners in their ability to benefit from F^sub 0^ differences, especially in the EAS condition.

Multiplicity

The finding that F^sub 0^ differences facilitate good multiplicity perception in UNP in younger listeners with normal hearing is consistent with other published data (Arehart et al., 2005; Assmann &Paschall, 1998; de Cheveigné et al., 1997). Although other studies have discussed potential effects of age (Vongpaisal &Pichora-

Fuller, 2007) and vocoding (Qin &Oxenham, 2005) on the ability of listeners to detect the presence of one or two sounds in a double-vowel stimulus, the present study is- to our knowledge-the first to systematically look at the role of F^sub 0^ differences in multiplicity perception by older and younger listeners in EAS and VOC conditions.

The lack of improvement in the detection of two vowels or two voices in the VOC condition suggests that the high-rate envelope cues in the VOC stimulus are insufficient to convey benefits for multiplicity perception provided by F^sub 0^ differences. In contrast, the cues that are provided in the UNP and EAS conditions facilitate significant benefit from F^sub 0^ differences in multiplicity perception. Present models of double-vowel perception suggest two possible ways in which listeners could derive multiplicity cues on the basis of F^sub 0^ differences. First, listeners may rely on a process of F^sub 0^-guided segregation, whereby a vowel would be separated from its competitor by grouping together the components that share a commonF^sub 0^ (e.g., Assmann &Summerfield, 1990; de Cheveigné, 1999; Meddis&Hewitt, 1992). F^sub 0^-guided segregation may help parse the composite formant peak (e.g., first formant) in the combined spectral envelope of the double vowel into the formant peaks of the constituent vowels (Culling &Darwin, 1993). Second, waveform interactions or beating between adjacent low-frequency components may mediate perception of double vowels for F^sub 0^ differences less than 1 ST (Assmann&Summerfield, 1994; Culling& Darwin, 1994). The fluctuations caused by beating may result in evidence of each vowel being more readily discerned during various points in the stimulus waveform. Both F^sub 0^-guided segregation and beating cues would be most perceptible from the outputs of the low-frequency auditory filters (and, hence, available in both the UNP and EAS conditions) because of the frequency spacing of harmonics relative to the auditory filter bandwidths (Assmann &Summerfield, 1994; de Cheveigné, 1999).

Although F^sub 0^ differences facilitate the perception of multiplicity in the EAS and UNP conditions, they may not be required. Results from this study (see Figure 5) as well as fromother studies (e.g., Assmann &Summerfield, 1990; Culling &Darwin, 1993) demonstrate that listeners with normal hearing are able to identify double vowels well above chance, evenwhen theF^sub 0^s of the vowels are the same. This ability has been attributed, in part, to spectral peaks and shoulders of excitation patterns (Assmann &Summerfield, 1989). The ability to access these non-F^sub 0^ cues may be age dependent. For example, whereas the younger listeners in our study reported hearing two vowels (when two vowels were actually presented) in the UNPcondition at ΔF^sub 0^ = 0 STon approximately one third of the trials, older listeners rarely did. However, this line of reasoning cannot be used to explain all of the data at ΔF^sub 0^ = 0 ST. For example, in the vowel multiplicity task at ΔF^sub 0^ = 0 ST, listeners were actually more likely to report hearing two vowels (when two vowels were actually presented) in the VOC condition. This result was unexpected, as non-F^sub 0^ cues (e.g., spectral representations) regarding the number of competing vowels available at ΔF^sub 0^ = 0 ST would be expected to be less salient in the VOC condition due to loss of spectral detail.

In the vowel multiplicity task in the VOC condition, listeners also showed a tendency toward saying that they heard two vowels when only one vowel was actually presented. A recent analysis by Micheyl and Oxenham (2009) lends a possible interpretation for this "two-vowel" response tendency in the VOC condition. The authors suggested that listeners might use "perceived fusion" as the basis for judging whether pairs of simultaneous complex tones (presented in different frequency regions) have the same F^sub 0^ or different F^sub 0^s-that is, the perceptual sensation evoked by stimuli containing simultaneous complex tones with the same F^sub 0^ would be characterized by greater fusion and less roughness than simultaneous complex tones with different F^sub 0^s. This same "perceived fusion" explanation might be applied to the current multiplicity results.Without other salient cues to utilize (e.g., F^sub 0^ differences, spectral representations), listeners may base their multiplicity judgments on their expectations that a single vowel should evoke a percept of fusion on the basis of a clean harmonic spectrum. As such, for vowels subjected to vocoding with a noise carrier (which would include inherent noise fluctuations superimposed on the envelope), listeners may tend to respond "two" because the

sound lacks the fused percept expected for a single sound.

In summary, results from the multiplicity tasks indicate that listeners are able to use F^sub 0^ cues effectively in the detection of two voices or two vowels. Older listeners benefit as much, and sometimes more, from F^sub 0^ differences in multiplicity judgments in the UNP and EAS conditions and may show a reduced ability to use non-F^sub 0^ cues when competing sounds have no F^sub 0^ differences. Finally, it is important to acknowledge that the perception of multiple sound sources and how that perception is affected by aging may depend on the specific nature of the task and stimuli that are used. For example, the use of F^sub 0^ cues might differ if listeners were instructed to report one pitch or two pitches, since listeners have been shown to require a 4-ST difference in F^sub 0^ in order to perceive two distinct pitches for double vowels (Assmann &Paschall, 1998). In addition, our tasks revealed no age deficit in the perception of multiplicity, whereas older adults did show deficits in the ability to discern the presence of one or two sound sources in the mistuned harmonic task used by Alain and McDonald (2007).

Double-Vowel Identification

The double-vowel identification results in the UNP condition for the group of younger listeners corroborate the results from other published reports in that they show large ΔF^sub 0^ benefit, with performance reaching asymptote for ΔF^sub 0^ È1 ST (Arehart et al., 1997; Assmann& Summerfield, 1990; Culling&Darwin, 1993; de Cheveigné et al., 1997; Meddis &Hewitt, 1992; Scheffers, 1983). The results from the younger group also provide a partial replication of the results of Qin and Oxenham (2005, 2006), with younger listeners showing no systematic ΔF^sub 0^ benefit in the VOC condition and modest ΔF^sub 0^ benefit in the EAS condition.

The reduced overall double-vowel identification results shown by our older listeners in the UNP condition is consistent with the reduced double-vowel identification shown by the older adults in other studies (Snyder &Alain, 2005; Vongpaisal &Pichora-Fuller, 2007). The present results add to a literature that is mixed in terms of the apparent effects of age on ΔF^sub 0^ benefit in doublevowel identification (e.g., Snyder &Alain, 2005; Summers &Leek, 1998; Vongpaisal &Pichora-Fuller, 2007). Our largest age-related deficit was for ΔF^sub 0^ benefit in the UNP condition. Summers and Leek (1998) also reported that age significantly impacted ΔF^sub 0^ benefit on doublevowel identification by listeners with hearing loss. Snyder and Alain (2005) reported no age-related deficit in ΔF^sub 0^ benefit, and Vongpaisal and Pichora-Fuller (2007) reported age-related deficits in ΔF^sub 0^ benefit only for competing vowels that had the same formants (similar to the same-vowel-different-F^sub 0^ stimuli used in our voice multiplicity task). The reasons for these differences across studies are not clear, but they may be due, in part, to differences in specific groups of older listeners included in the different studies.

The types of processing involved in using F^sub 0^ differences in double-vowel identification may vary in younger and older listeners. For example, Alain and colleagues (Alain, Dyson, &Snyder, 2006; Alain, McDonald, Ostroff, &Schneider, 2004) have hypothesized that older adults may rely on more higher-level controlled processes or schema in perceptual organization to compensate for lower-level deficits in F^sub 0^ processing. Electrophysiological evidence reported by Snyder and Alain (2005) supports the idea that perceptual organization of competing vowels in younger listeners appears to be guided by automatic primitive processing of physical grouping cues (e.g., F^sub 0^). In contrast, older listeners appear to rely more on higherlevel controlled processes in the identification of double vowels to compensate (at least, in part) for deficits in the automatic processing of physical grouping cues. The ability of older listeners to compensate for the degraded peripheral representations may be even more pronounced in conditions such asEAS, in which the stimuli have been reduced in terms of the amount of information that they provide.

As with multiplicity, the poor performance by both subject groups in the VOC condition suggests that the envelope-based cues in the VOC stimulus are insufficient to facilitate ΔF^sub 0^ benefit in double-vowel identification. TheEAS stimulus provides significant ΔF^sub 0^ benefit in double-vowel identification, but this benefit is reduced compared with the UNP condition. Qin and Oxenham (2006) showed that younger listeners

who were presented with double vowels that were low-pass filtered (<600 Hz) had poor double-vowel identification (È20%) and no ΔF^sub 0^ benefit for double vowels that were low-pass filtered (<600 Hz). The results for this low-frequency- only condition differ remarkably from the EAS results shown both in Qin and Oxenham (2006) and in our study, suggesting that listeners use and integrate cues both from the low-frequency acoustic portion and the higherfrequency vocoded portions of the EAS double vowels. This integration of cues across frequency regions is consistent with the findings of other studies showing that listeners utilize both within- and across-formant grouping mechanisms in the perception of double vowels (Culling &Darwin, 1993; Rossi-Katz &Arehart, 2005).

Task Complexity

The ability to take advantage of ΔF^sub 0^ cues appears to be related to task complexity. Whereas older listeners were able tomake use of F^sub 0^differences aswell as younger adults did in the multiplicity task, older adults showed reduced identification and reduced benefit from F^sub 0^ differences in the double-vowel identification task. Identifying two competing vowels was conceived as being operationally harder than detecting whether one or two sound sources was contained in the stimulus. Thus, the present results are consistent with the age complexity effect (Salthouse, 1991). This effect postulates that agerelated deficits will be more pronounced as task complexity increases, due to increased demands that are placed on a finite-and potentially depleted-store of processing resources (e.g., Cerella, 1990; Craik&Byrd, 1982). In competing speech perception tasks, the performance of older listeners may decrease due to listeners reallocating a limited store of processing resources to recover degraded information at the auditory periphery (e.g., McCoy et al., 2005; Murphy, Craik, Li, &Schneider, 2000; Pichora- Fuller, Schneider, &Daneman, 1995; Rossi-Katz &Arehart, 2009; Schneider, Daneman, Murphy, &Kwong See, 2000; Wingfield &Tun, 2007). The costs associated with this reallocation of processing resourcesmay be more apparent in the more difficult double-vowel identification task.

The idea that benefit from F^sub 0^ differences depends on processing resources and task complexity can also be helpful in understanding the finding that several younger listeners who showed large ΔF^sub 0^ benefit in the UNP condition showed small benefit (<10 percentage points) in the EAS condition. Processing the EAS stimulus involves extracting and integrating cues from both the low-frequency acoustic and higher-frequency vocoded portions of the stimulus (Li &Loizou, 2008). This integration processmay be less "automatic" for double vowels in the EAS condition compared with the UNP condition. In the EAS condition, listeners may be confronted with a requirement for more controlled processes in perceptual organization due to the loss of automaticity in the processing of physical grouping cues. This requirement for more controlled processes might lead to more difficulty in processing ΔF^sub 0^ cues in the EAS condition compared with the UNP condition. Although there was a general trend for ΔF^sub 0^ benefit to decrease as task complexity increased, there was also substantial variability among both the older and younger groups of listeners. Individual listeners may vary in how they allocate the resources that are required for controlled processing. This variability might, in turn, contribute to the variability in listeners benefiting from ΔF^sub 0^ cues in the more complex listening tasks.

Limitations and Implications

Due to the inherent limitations of simulation studies, the present results cannot be directly applied to older adults with actual EAS hearing. The results are also limited in that they are based on synthesized vowels rather than on natural full-length speech.However, the findings provide insight into issues that will be important to consider in clinical studies of EAS benefit. Older adults are able to derive benefit from F^sub 0^ differences in (simulated) EAS hearing in the perception of competing talkers. In addition, the amount of benefit depends on task complexity and varies substantially across individuals. Finally, the present findings suggest that it will be important to consider the higher-level processing resources that are required for extracting and integrating cues in EAS hearing-and how this processing may vary among individual listeners.

Summary

The primary goal of this study was to investigate the effects of age on listeners' ability to utilize F^sub 0^

differences of vowel sounds to determine (a) the number of sound sources (one or two) in a stimulus and (b) the phonemic identify of competing vowels. Of interest was how advanced age affected the amount by which listeners benefited from F^sub 0^ differences in simulations of different hearing configurations. The perception of multiplicity was facilitated by F^sub 0^ differences for sounds containing resolved low-frequency harmonics (UNP and EAS) but not for the stimulus that lacked low-frequency fine structure information (VOC). Furthermore, the multiplicity benefit provided by F^sub 0^ differences was immune to age effects. Double-vowel identification was also facilitated by F^sub 0^ differences, with ΔF^sub 0^ benefit largest in UNP, significantly reduced in EAS, and absent in VOC. Furthermore, in contrast to multiplicity, age adversely affected performance on the double-vowel task in terms of both amount of benefit and overall identification rates on the doublevowel identification task. Finally, substantial intersubject variability was observed among both older and younger listeners in their ability to benefit from F^sub 0^ differences, especially in the EAS condition.

Acknowledgments

This work was supported by National Institute on Deafness and Other Communication Disorders Grant R01 DC006014, a grant from the Bloedel Hearing Research Center, and a grant from the Council on Research and Creative Work from the University of Colorado. The authors are grateful to Tim Green and Stuart Rosen for sharing their stimuli and algorithms; to James M. Kates and Jessica Rossi-Katz for discussions regarding the study design; and to Melinda Anderson, Naomi Croghan, and Alison Dykhouse for their assistance in data collection.

Sidebar

Effects of Age on Concurrent Vowel Perception in Acoustic and Simulated Electroacoustic Hearing
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J Speech Lang Hear Res 2011;54;190-210; originally published online Aug 5, 2010; DOI: 10.1044/1092-4388(2010/09-0145)

Footnote

1Prior to the implementation of our experimental protocol, we initially used just one set of instructions for the multiplicity task ("one or two sounds?"). However, for the same-vowel-different-F^sub 0^s, listeners repeatedly asked for clarification as to whether they should respond on the basis of the number of voices or the number of vowels. Therefore, we refined our protocol to have two sets of instructions, including "one or two voices" and "one or two vowels."

2Because previous studies have shown double-vowel perception to be poor across all ΔF^sub 0^ conditions for vocoded stimuli, we only tested ΔF^sub 0^s of 0 ST and 4 ST in the VOC condition.

3In the ANOVA described in this study, we used Mauchley's test to assess the assumption of sphericity. In the small number of cases in which the assumption of sphericity was violated, we used adjustments indicated by Greenhouse-Geisser.

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Revision received March 3, 2010
Accepted May 19, 2010
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Appendix
Appendix. Listener instructions.
The instructions given to each listener for each task are included here.
Multiplicity: How Many Voices?
Each sound you hear contains either one voice or two voices. Your task is to choose whether you hear one or two voices in the sound. Please respond by choosing "ONE" or "TWO." If you are not sure whether there are one or two voices, please make your best guess.
Multiplicity: How Many Vowels?
Each sound you hear contains either one vowel or two vowels. Your task is to choose whether you hear one vowel or two vowels in the sound. Please respond by choosing "ONE" or "TWO." If you are not sure whether there are one or two vowels, please make your best guess.
Double-Vowel Identification
Each sound you hear contains two different vowel sounds. Your task is to choose two different vowels that you think are contained in the sound. Please respond by choosing two different vowels. If you are not sure which two vowels are in the sound, please make your best guess.

Publication date: Feb 1, 2011

Year: 2011

The Relationship Between Brainstem Temporal Processing and Performance on Tests of Central Auditory Function in Children With Reading Disorders

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.1 (Feb 1, 2011): 228-242A.
ProQuest document link

Abstract: Studies using speech stimuli to elicit electrophysiologic responses have found approximately 30% of children with language-based learning problems demonstrate abnormal brainstem timing. Research is needed regarding how these responses relate to performance on behavioral tests of central auditory function. The

purpose of the study was to investigate performance of children with dyslexia with and without abnormal brainstem timing and children with no history of learning or related disorders on behavioral tests of central auditory function. Performance of 30 school-age children on behavioral central auditory tests in common clinical use was examined: Group 1 (n = 10): dyslexia, abnormal brainstem timing; Group 2 (n = 10): dyslexia, normal brainstem timing; Group 3 (n = 10): typical controls. Results indicated that all participants in Group 2 met diagnostic criteria for (central) auditory processing disorder [(C)APD], whereas only 4 participants in Group 1 met criteria. The Biological Marker of Auditory Processing (BioMARK) identified 6 children in Group 1 who did not meet diagnostic criteria for (C)APD but displayed abnormal brainstem timing. Results underscore the importance of central auditory assessment for children with dyslexia. Furthermore, the BioMARK may be useful in identifying children with central auditory dysfunction who would not have been identified using behavioral methods of (C)APD assessment.

Full text: Headnote

Purpose: Studies using speech stimuli to elicit electrophysiologic responses have found approximately 30% of children with language-based learning problems demonstrate abnormal brainstem timing. Research is needed regarding how these responses relate to performance on behavioral tests of central auditory function. The purpose of the study was to investigate performance of children with dyslexia with and without abnormal brainstem timing and children with no history of learning or related disorders on behavioral tests of central auditory function.

Method: Performance of 30 school-age children on behavioral central auditory tests in common clinical use was examined: Group 1 (n = 10): dyslexia, abnormal brainstem timing; Group 2 (n = 10): dyslexia, normal brainstem timing; Group 3 (n = 10): typical controls.

Results: Results indicated that all participants in Group 2 met diagnostic criteria for (central) auditory processing disorder [(C)APD], whereas only 4 participants in Group 1 met criteria. The Biological Marker of Auditory Processing (BioMARK) identified 6 children in Group 1 who did not meet diagnostic criteria for (C)APD but displayed abnormal brainstem timing.

Conclusions: Results underscore the importance of central auditory assessment for children with dyslexia. Furthermore, the BioMARK may be useful in identifying children with central auditory dysfunction who would not have been identified using behavioral methods of (C)APD assessment.

KEY WORDS: central auditory processing disorder, speech-evoked brainstem auditory response, dyslexia

Present research has investigated sensory and motor deficits as contributing factors to the phonological difficulties displayed by children with reading disorders (Moncrieff &Musiek 2002; Rosen &Manganari 2001; Sharmaet al., 2006; Tallal,Merzenich,Miller,& Jenkins, 1998; Walker, Givens, Cranford, Holbert, &Walker, 2006). In particular, auditory contributions to reading deficits have been noted. Despite the lack of consensus with regard to the cause of reading disorders, a significant amount of research has focused on the auditory theories as a means of explaining, at least in part, the etiology of reading disorders. The scientific connection between auditory skills and reading has been recognized and has led to the investigation of auditory neural activity and behavioral manifestations of reading deficits (Banai, Hornickel, Skoe, Nicol, Zecker, &Kraus, 2009). Avariety of methods and stimuli have been used in order to investigate which specific areas of auditory processing may be deficient in children with dyslexia. This information has been explored to better understand whether the relationship between auditory processing and dyslexia is causal or associated.

Ramus et al. (2003) sought to investigate all possible causes of dyslexia to determine whether relationships or patterns exist among the many domains that may be deficient in children with dyslexia. Results of the study supported the phonological theory in that a significant portion of the authors' participants (10 of 16) exhibited auditory deficits on a variety of phonological and auditory perception tasks. The phonological theory postulates

that the origin of the dysfunction at the neurological level is that of left-hemisphere or interhemispheric brain regions. Of the remaining six participants who did not display auditory deficits, four exhibited a motor deficit and two a visual magnocellular deficit. The performance of children with dyslexia differed greatly among individuals, supporting the heterogeneous nature of reading disorders.

(Central) auditory processing disorder [(C)APD] can be operationally defined as a deficit in the "perceptual processing of auditory information in the central nervous system (CNS) and the neurobiologic activity that underlies that processing and gives rise to the electrophysiologic auditory potentials" (American Speech-Language-Hearing Association [ASHA], 2005, p. 2). (C)APD may affect auditory skills such as localization / lateralization, performance with competing or degraded acoustic stimuli, and temporal processing and patterning abilities, among others. According to present consensus statements and guidelines (American Academy of Audiology [AAA], 2010; ASHA, 2005), the diagnosis of (C)APD should be made via a test battery approach using psychophysical (behavioral) and/or electrophysiologic measures that have been shown to be sensitive, specific, and efficient for identification of disorders of the central auditory nervous system (CANS). A diagnosis of (C)APD is made only when performance is >2 standard deviations below the mean (regarding age-specific normative data) on two or more tests of central auditory function, combined with a pattern of deficits based on intra- and intertest comparison measures (e.g., ear differences, response condition differences, consistency across tests) that has been shown to be consistent with underlying CANS dysfunction. As with dyslexia, (C)APD is a heterogeneous disorder, with deficit patterns that vary depending on presumed region of dysfunction within the CANS (see AAA, 2010; ASHA, 2005; Bellis, 2003; Musiek &Chermak, 2007, for comprehensive reviews).

Several researchers have investigated the performance of children with dyslexia on behavioral tests of central auditory processing. Children with dyslexia have been shown to exhibit poorer dichotic listening abilities, particularly for the left ear, as compared with normal controls (e.g., Bakker, 1973; Moncrieff &Musiek, 2002; Purdy et al., 2002). Walker et al. (2006) found that children with dyslexia had more difficulty recognizing patterns of differing frequency and temporal duration for tonal stimuli. It was suggested that poor performance in children with dyslexia may be due to underdevelopment of the CANS.

In addition to dichotic speech tests, more comprehensive central auditory test batteries have been administered to childrenwith reading disorders including temporal patterning tests, tests of monaural low-redundancy speech, and gap detection. Results have indicated that children with dyslexia performpoorly on one or more components of the test battery compared with controls (Sharma et al., 2006; Welsh, Welsh, &Healy, 1980).

Disruptions in temporal processing may have adverse effects on speech perception and understanding (Hayes, Tiippana, Nicol, Sams, &Kraus, 2003; King, Warrier, Hayes,&Kraus, 2002; Phillips, 1995). The ability to discriminate stop consonants often is affected in individuals with lesions of the primary auditory cortex (Phillips &Farmer, 1990). Fast speaker rates and presence of background noise are examples of conditions that affect the accurate perception and recognition of speech. The importance of temporal processing for hearing, speech, and language is evident, and it could be expected that temporal processing deficits would disrupt these skills.

A number of studies that have associated poor auditory processing abilities with reading disorders have focused on the listener's ability to process rapid verbal and nonverbal stimuli (Kraus et al., 1996; McAnally &Stein, 1996; Tallal, 1980). Tallal (1980) found that children with reading disorders were able to sequence and discriminate the stimuli as well as their normal peers when the stimuli were presented at a slower rate; however, when presented more rapidly, the children with reading disorders performed more poorly. A significant correlation was established between the children's ability to process the rapid nonverbal information and phonic skills, suggesting a possible fundamental perceptual deficit underlying the inability to analyze the phonetic code efficiently. Studies investigating speech-syllable discrimination abilities of these children also have suggested that children with learning difficulties have difficulty behaviorally discriminating rapid spectro-temporal changes in speech syllables, which is also reflected in electrophysiologic test measures (Kraus et al., 1996; Sharma et

al., 2006).

Not all research supports the idea that deficits in auditory processing are present in individuals with reading disorders. Some studies have failed to demonstrate auditory temporal processing deficits in these children (Bretherton &Holmes, 2003; Brier, Fletcher, Foorman, Klaas,&Gray, 2003; Mody, Studdert-Kennedy,& Brady, 1997; Schulte-Korne, Deimel, Bartling, &Remschmidt, 1999; B. U.Watson &Miller, 1993; C. A.Watson &Kidd, 2002; Ziegler, Pech-Georgel, George, &Lorenzi, 2009). Others have concluded that temporal processing deficits appear to be pansensory in nature, meaning that they affect processing in multiple sensory modalities (Cacace &McFarland, 1998; Farmer &Klein, 1995; McFarland &Cacace, 1995).

Nevertheless, numerous studies suggest that, at least for some children with dyslexia, there may be a relationship between reading and auditory processing abilities. Present findings investigating the relationship between dyslexia and central auditory processing suggest that some children with dyslexia may exhibit a (C) APD that is a contributing or co-morbid factor to their reading deficits. However, not all children with dyslexia exhibit these deficits, and the heterogeneous nature of reading disorders makes it difficult to determine the prevalence of auditory processing deficits in this population. Because the performance of children with dyslexia is quite variable for auditory tasks, it is difficult to determine conclusively if the relationship between auditory skills and dyslexia is causal or associated (Rosen, 2003; Walker et al., 2006). If auditory deficits are present, they may not be evident on all measures of auditory processing; therefore, the severity of the auditory deficit does not necessarily predict the severity of the reading disorder (Rosen, 2003). Despite the fact that central auditory processing has been characterized as a possible contributing factor to dyslexia, children identified with dyslexia typically are not assessed for (C)APD. Interestingly, temporal processing deficits also are noted in children with (C)APD, and many of these children also exhibit difficulties in reading and spelling (ASHA, 2005; Bellis, 2002, 2003).

The Biological Marker of Auditory Processing (BioMARK), a brainstem electrophysiologic response elicited by speech stimuli, may provide additional insight into the auditory processing abilities of some children with dyslexia. As described by Johnson, Nicol, and Kraus (2005), the BioMARK is a neurophysiologic response recorded to multiple presentations of a 40-ms synthetic /da/ syllable. The response manifests as a series of brief neural events that are time-locked to the onset, offset, and periodic information of the stimulus /da/. The response consists of two components: an onset response composed of WavesV, A, and C, and a sustained frequency-following response composed of Waves D, E, F, andO(see Figure 1). This tool has been used to investigate temporal processing deficits displayed by children with language-based learning (including reading) disorders. Researchers have concluded that some children with language-based learning deficits exhibit abnormal brainstem timing for speech signals, which has been linked to reduced cortical processing of acoustic changes compared with normal children (Banai et al., 2009; Banai, Nicol, Zecker,& Kraus, 2005; King, Warrier, Hayes, &Kraus, 2002; Warrier, Johnson, Hayes, Nicol, &Kraus, 2004).

Approximately 30% of children with language-based learning problems, including dyslexia, demonstrate differences in brainstem encoding of speech sounds despite normal click-evoked auditory brainstemresponses (ABRs; Abrams, Nicol, Zecker,&Kraus, 2006; Banai et al., 2009, 2005; Johnson et al., 2005; Johnson, Nicol, Zecker, &Kraus, 2007; King et al., 2002; Russo, Nicol, Musacchia, &Kraus, 2004; Song, Banai, Russo, &Kraus, 2006; Wible, Nicol, &Kraus, 2005). It should be noted that a disruption in latency as minimal as fractions of a millisecond may be diagnostically significant. Specifically, delayed peak latencies for Waves V, A, C, and O and a shallowslope for the V/Acomplex have been found in children with language-based learning problems (Banai, Abrams, &Kraus, 2007; Banai et al., 2009; Johnson et al., 2005, 2007; Kraus &Nicol, 2005; Song et al., 2006). Interpeak latencies and the magnitude of Waves D, E, and F typically do not differ between normal children and children with language-based learning problems (Johnson et al., 2005, 2007).

Abnormal brainstem responses to speech also may be an indicator of poor responses at the cortical level.Wible, Nicol, and Kraus (2004) found that broader V/A slopes were correlated with an increased vulnerability of the

cortical response to the effects of background noise. Banai et al. (2005) found that children with language-based learning disorders who exhibited abnormal speech-evoked brainstem responses also had reduced speech-evoked mismatch negativity responses comparedwith normal children. Banai et al. (2009) suggested that the deficits observed may be due to a disruption at the brainstem level in timing and harmonic encoding, leading to abnormal cortical processing of speech sounds and, in turn, phonological processing and reading difficulties. In contrast, it is also possible that top-down involvement in which abnormal cortical processes affect the subcortical structures via the corticofugal pathway may be occurring in these children.

Additional support for the interaction of top-down and bottom-up factors is provided by studies demonstrating benefit from auditory training for those with abnormal brainstem timing for speech signals (Cunnigham, Nicol, Zecker, Bradlow, &Kraus, 2001; Hayes, Warrier, Nicol, Zecker,& Kraus, 2003; King et al., 2002; Russo, Nicol, Zecker, Hayes,& Kraus, 2005;Warrier et al., 2004). Specifically, children with abnormal brainstem timing involving Waves A and C exhibited improvement in both physiological and behavioral measures following auditory training.

In summary, scientific evidence supports the relationship between auditory processing and dyslexia in at least some children. The fact that central auditory processing is not affected in all children with reading deficits and reading deficits are not exhibited by all children with (C)APD demonstrates the heterogeneous nature of these disorders (ASHA, 2005; Bellis, 2002, 2003).

The BioMARK may be a promising addition to the assessment of central auditory function in terms of identification of children with brainstem timing deficits, recommendations for treatment, and monitoring progress of auditory training programs. Further understanding of how the addition of the BioMARK enhances the present central auditory assessment battery is needed. No study to date has investigated how BioMARK results relate to performance on behavioral tests of central auditory function in present clinical use for the diagnosis of (C)APD in children with reading disorders.

The purpose of the present study was to investigate whether children with dyslexia and abnormal brainstem timing also exhibit abnormal performance patterns on behavioral tests of central auditory function in common clinical use. Specifically, weinvestigatedwhether the performance of children with dyslexia and abnormal brainstem timing differs from that of children with dyslexia and normal brainstem timing on behavioral tests of central auditory function. Additionally, we sought to determinewhether a predominant pattern of deficit thatmeets present diagnostic criteria for (C)APD (AAA, 2010; ASHA, 2005) emerged in these children.

Method

Participants

Thirty-two children ages 8-12 years (20 males and 12 females, mean age = 10.2, SD = .23) participated in the present study. All participants had normal hearing sensitivity, a diagnosis of dyslexia via speech-language and related diagnostic evaluation through a dyslexia specialization clinic or school special education department, and no higher order confounding conditions unrelated to their primary diagnosis (e.g., attention-deficit/hyperactivity disorder [ADHD], limited intellectual capacity). Other factors, such as socioeconomic status, were not considered in the study. The 32 participants were from a larger pool of 58 children 8-12 years of age (21 females and 37 males, mean age = 9.8, SD = .88) who qualified to participate in the study. Of the 58 invited participants, 26 declined to participate due to significant travel distance from the available testing sites and/or scheduling conflicts. As is discussed in the paragraphs that follow, participants were separated into two groups on the basis of BioMARK testing: Group 1 (abnormal brainstem timing) and Group 2 (normal brainstem timing).

Materials and Procedure

Two phases of testing occurred. The first phase was a preliminary screening session in order to determine eligibility for the study. The second phase consisted of a behavioral central auditory evaluation for those participants who met eligibility criteria. Informed consent and child assent were obtained from all participants and their parents or legal guardians prior to the eligibility phase of the study. Ethical approval to conduct the

study was obtained through the Institutional Review Board of The University of South Dakota.

Phase 1: Eligibility/Preliminary Screening and BioMARK Testing

Phase 1 consisted of a hearing screening, clickevoked ABR testing, and BioMARK testing. This phase lasted approximately 30 min and was conducted at the testing site nearest to the participant's place of residence. Pure-tone hearing screeningwas performed in a quiet room using a Maico MA40 portable audiometer and TDH-39 supra-aural headphones (Testing Site 1) or in a soundtreated booth using an Interacoustics AC40 clinical audiometer and ER-3A insert earphones (Testing Site 2). Participants were screened at 20-dB HL for octave frequencies 500-4000Hz. Tympanometry was performed using a GSI 27A(Testing Site 1) or aGSI 33 tympanometer (Testing Site 2). For inclusion in the study, all participants were required to exhibit normal hearing sensitivity and normal Jerger Type A tympanograms (Jerger, 1972) bilaterally, indicative of normal peripheral hearing and middle-ear function. No participants were excluded on the basis of peripheral hearing or middle-ear status.

Electrophysiologic testing was conducted in accordance with clinical recommendations for administration of the BioMARK test, which specify ear of stimulation, electrode montage, and all other recording parameters (e.g., Johnson et al., 2005; Russo et al., 2004). Click-evoked ABR testing was performed to verify normal transmission of auditory stimuli through the brainstem auditory pathways via measures of latency and waveform morphology; this is a prerequisite for BioMARK testing. The clickevoked ABR was collected using the Bio-logic Navigator Pro System (Bio-logic Systems Corporation). A one-channel neurologic click-evoked ABR was recorded using silver disc electrodes (impedance <5 kW) placed at Cz (active), with the contralateral earlobe (A1) as the reference and the forehead (Fz) as ground. Responses were obtained for the right ear to rarefaction click stimuli presented at 80-dB SPL with an online filter of 100-3000 Hz. Two thousand stimulus repetitions were collected at a rate of 31.1/s. Two repeatable recordings were obtained in order to verify response replicability.

Participants were allowed to watch a DVD of their choice in order to diminish attention to the stimuli and to reduce artifact from movement. Normal click-evoked ABR waveforms using the parameters described earlier are a prerequisite for BioMARK assessment; therefore, the presence of normal click-evoked ABR waveforms, defined as presence of repeatable Waves I, III, and V with absolute latencies; interpeak latencies; and amplitudes within normal limits, was required for eligibility in the study. No participants were excluded from the study on the basis of click-evoked ABR results.

Once normal click-evoked ABR and hearing sensitivity were verified, participants underwent BioMARK testing. BioMARK responses were collected using the Bio-logic Navigator Pro System (Bio-logic Systems Corporation). A one-channel recording was obtained using silver disc electrodes (impedance <5 kW) placed at Cz (active), with the ipsilateral earlobe (A2) as the reference and the forehead (Fz) as ground. In accordance with standard clinical protocol for the BioMARK, responses were obtained for the right ear at 80-dB SPL with an online filter of 100-2000 Hz. Responses were elicited to a 40-ms speechlike /da/ stimulus with alternating polarity. Two thousand stimulus repetitions were collected at a rate of 11.1/s. Three repeatable recordings were obtained in order to verify response replicability and were added together for a grand-averaged BioMARK response for each participant. Again, each participant was allowed to watch a DVD of his or her choice in order to diminish attention to the stimuli and to reduce artifact from movement.

Participants were divided into two groups on the basis of brainstem physiology as measured by the BioMARK: Group 1 (abnormal brainstem timing) and Group 2 (normal brainstem timing). Abnormal brainstem timing was determined via a score automatically assigned to the response in the BioMARK software on the basis of normative data for five measures:Wave V latency,Wave A latency, V/A slope, first-formant frequencies, and high frequencies. BioMARK scores are generated by the software program and are given in order to determine the magnitude of deficit, with 0-5 as normal and 6-22 as abnormal. It is important to note that the BioMARK was used as a grouping variable only; therefore, additional analysis of BioMARK responses was not performed.

Participants who qualified for inclusion in Group 1 consisted of 12 children (12 males and 0 females, mean age = 10.4, SD = .45). Participants who qualified for inclusion in Group 2 consisted of 20 children (12 females and 8 males, mean age = 10.05, SD = 1.39).

Phase 2: Central Auditory Testing

Phase 2 consisted of behavioral central auditory testing at the Vermillion, South Dakota site. Order of test administration within the behavioral central auditory test battery was counterbalanced across participants to control for possible order effects. Breaks were given periodically throughout the testing session or per the participant's request. The duration of the test session was approximately 1- to 1.5 hr.

Four auditory psychophysical tests in common clinical use for the diagnosis of (C)APDin children and adults were administered including (a) Dichotic Digits (DD; Musiek, 1983), (b) Frequency Patterns (FP; Pinheiro &Ptacek, 1971), (c) Competing Sentences (CS;Willeford &Burleigh, 1994), and (d) Low-Pass Filtered Speech (LPFS; Willeford, 1977; Wilson &Mueller, 1984). All psychophysical tests were completed in a sound-treated booth in accordance with standard clinical administration procedures. Test stimuli were routed from a CD player through an Interacoustics AC40 two-channel clinical audiometer meeting American National Standards Institute (ANSI; 2004) standards and were delivered via ER-3A insert earphones at an intensity level of 50-dB SL regarding speech recognition threshold (for speech tasks) or 1000 Hz pure-tone threshold (for tonal tasks). Practice items were presented before beginning each test to ensure understanding of the task. The four tests chosen represent categories of behavioral diagnostic tests of central auditory function (i.e., dichotic speech tasks, temporal processing/ patterning tasks,monaural low-redundancy tasks), as delineated in present consensus and guideline documents for the diagnosis of (C)APD (AAA, 2010; ASHA, 2005). In addition, normative values, using a two standard deviation cutoff as specified in present recommendations for diagnosis of (C)APD, exist for each of these tests for those ranging from age 7 to adulthood (Bellis, 2003). A brief description of each of the tests follows.

For the DD task, pairs of monosyllabic digits from 1 to 10 (excluding 7) spoken by a male speaker of general American English were delivered simultaneously to each of the two ears, with each ear receiving a different digit pair. Twenty-five stimulus items consisting of four digits each were presented. This test was chosen because it has been shown to be sensitive to dysfunction of the cerebral and interhemispheric central auditory pathways while being relatively resistant to peripheral hearing loss and nonauditory factors (Musiek, 1983; Musiek &Baran, 2002). Participants were instructed to repeat all four numbers (or as many as possible), in no particular order, and were encouraged to guess if they were not sure, in accordance with standard clinical recommendations for administration of this test. Performance was scored as a function of percentage correct per ear. Subtraction of left-ear performance from right-ear performance yielded an intratest comparison measure of right ear advantage (REA).

For the FP test, triads of tone bursts differing in frequency (high, 112 Hz; low, 880 Hz) were presented. As with the DD test, the FP test has been shown to be sensitive to cerebral central auditory dysfunction while remaining resistant to nonauditory confounds as well as to peripheral hearing loss, as long as the stimuli are audible. In addition, intratest comparison measures for two response conditions (labeling and humming) have been shown to be sensitive to disruptions of the interhemispheric auditory pathways (e.g.,Musiek, 1994; Musiek &Baran, 2002; Musiek &Pinheiro, 1987). Consistent with standard clinical recommendations for administration of this test, 30 stimulus items were presented binaurally for each of the two response conditions, and responses were scored as a function of percentage correct per response condition. An intratest comparison measure, the Humming-Labeling Differential (HLD), was calculated by subtracting the score obtained in the labeling response condition from that obtained in the humming response condition.

The CS test consisted of pairs of sentences delivered to the ears in a directed-report dichotic paradigm. Consistent with clinical recommendations for administration of this test, the target sentence was presented at an intensity of 35-dB SL regarding speech reception threshold (SRT) and the competing sentence was presented

at an intensity of 50-dB SL regarding SRT. Listeners were instructed to report the target sentences only. Ten stimulus items were presented for each directed-report condition (right ear, left ear), and responses were scored as a function of percentage correct per ear using the quadrant scoring method described by Bellis (2003). A subtraction of left-ear scores from right-ear scores yielded the intratest comparison measure of REA. This test was chosen because it has been shown to be sensitive particularly to dysfunction of the interhemispheric auditory pathways, especially when used in conjunction with other, less linguistically loaded dichotic tests (Porter &Berlin, 1975; see also Bellis, 2003; Musiek &Baran, 2002, for a review).

Finally, to include a measure of monaural lowredundancy speech, the LPFS test (Wilson &Mueller, 1984) was used. For this test, stimulus items consisted of monosyllabic Northwestern University Auditory Test No. 6 (NU-6) words with a low-pass filter of 1000 Hz (Department of Veterans Affairs, 1992; Wilson &Mueller, 1984). Twenty-five stimulus itemswere presented per ear at 50-dB SL regarding SRT, and listeners were instructed to repeat the words and to guess if they were unsure. Responses were scored as a function of percentage correct per ear. Although monaural low-redundancy speech tasks have been shown, as a class, to be somewhat less sensitive than other measures to CANS dysfunction, the inclusion of these measures provides an index of auditory closure ability, which assesses the auditory skill of performance with degraded acoustic stimuli (AAA, 2010; ASHA, 2005; Musiek &Baran, 2002). Furthermore, although LPFS tests may be affected by cochlear hearing loss (e.g., Horwitz, Dubno, &Ahlstrom, 2002), all children in the present study exhibited normal peripheral hearing; therefore, inclusion of this test was appropriate for this population.

Two children were excluded from Group 1 due to lack of reliability and cooperation during the behavioral central auditory testing. These two children were noncompliant with the test procedures despite the use of reinforcement and reinstruction; therefore, the reliability of their responses was questioned. This resulted in 10 remaining participants in Group 1 (10 males and zero females, ages 9-12 years, mean age = 10.7, SD = 0.34). The 10 participants in Group 2 who were most closely matched in age to those in Group 1 were then selected for data analyses (five males and five females, ages 9-12 years, mean age = 10.6, SD = 0.35). Therefore, the final experimental data set included two age-matched groups of 10 participants each. Data from a third group of 10 normal controls ages 8-16 years (six males and four females, mean age = 12.6, SD = 2.17) with no history of language, learning, communication, or cognitive difficulties also were used to provide a normative base against which to compare the performance of the two experimental groups on the behavioral central auditory tests, with the exception of the LPFS, for which data were not available for the participants in Group 3. These participants were part of a larger, previous study investigating a variety of auditory, visual, and electrophysiologic tasks in normal and disordered auditory processing and attention. In conclusion, results from 30 participants were included in the statistical analysis.

Results

The BioMARK

Abnormal brainstem timing was determined via a score assigned to the response in the BioMARK software based on normative data for five measures including Wave V latency,Wave A latency, V/A slope, first-formant frequencies, and high frequencies. Scores 0-5 indicated normal brainstem timing, and scores 6-22 indicated abnormal brainstem timing. All of the children in Group 1 evidenced BioMARK scores of >6, whereas all of the children in Group 2 evidenced BioMARK scores of <5.

As stated previously, the BioMARK results were used as a grouping variable only, and therefore response parameters were not used for further analysis as this was not within the scope or purpose of the present study. Nonetheless, the following data are offered to illustrate the ways in which the BioMARK responses differed between Groups 1 and 2. Mean BioMARK latencies and standard deviations for Group 1 and Group 2 are displayed in Table 1.We used normative values obtained in quiet from 88 typically developing 8- to 12-year-old children for group peak latency comparisons (Banai et al., 2007). Averaged responses from Group 1 were within the normative range for latency forWaves V, E, F, and O and were in the abnormal range forWaves A, C, and D.

From an individual participant perspective, four of the 10 children in Group 1 had abnormal latency values forWave A, five children had abnormal latency values for Wave C, six children had abnormal latency values forWave D, and three children had abnormal latency values forWave O. Averaged responses from Group 2 were within the normative range for latency for all measures. Four of the 10 children in Group 2 did exhibit abnormal responses for Wave C; however, this did not render their overall BioMARK scores to be within the abnormal range. All of the children in Group 1 had abnormal V/A slopes, whereas this was the case for only four of the children in Group 2. Grand-averaged BioMARK response waves for Group 1 and Group 2 visually display the latency differences that were observed between groups (see Figure 2).

Behavioral Central Auditory Tests

Percentage correct performance by ear (DD, CS, LPFS) and response condition (FP), magnitude of REA (DD, CST), magnitude of HLD (FP), and associated standard deviations for all behavioral tests are presented in Table 2. We subjected results to several levels of data analyses, to be described in the paragraphs that follow. We conducted all analyses using Statistical Package Social Science (SPSS) Version 14.0 statistical analysis software package.

The DD Test

We subjected results of DD testing to a 3 ×2 analysis of covariance (ANCOVA), with group and ear as between-group, or independent, factors and percentage correct score as the within-group (dependent) factor. Although participants in Groups 1 and 2 were matched for age, it was not possible to age-match for participants in the normal control group. Therefore, and because neuromaturation is a critical factor in central auditory test performance, we entered age as the covariate to control for possible neuromaturational confounds. Results revealed a significant main effect of group on overall DD performance, $F(1, 27) = 5.645$, $p < .01$. Post hoc Bonferroni comparisons revealed that Group 1 exhibited significantly poorer overall DD performance as compared with Group 3 ($p < .01$; $d = 1.2$); similarly, Group 2 performed significantly poorer than Group 3 ($p < .01$; $d=1.6$). We found no significant difference in overall DD performance between Group 1 and Group 2 ($p = .30$; $d = 0.38$). ANCOVA also revealed a significant main effect of ear, $F(1, 27) = 8.325$, $p < .01$, $d = 0.62$, as all groups exhibited better performance for the right ear. No significant Group ×Ear interaction was indicated, $F(1, 27) = 1.656$, $p = .20$.

Because intertest comparison measures have been suggested to better reflect central auditory dysfunction as compared with more global task-related or higher order dysfunction, we performed a separate, planned univariate ANCOVA for REA with group as the independent factor and magnitude of the REA as the dependent factor. Results revealed no significant main effect of group on magnitude of the REA, $F(1, 27) = 2.080$, $p = .14$. However, effect size analyses (Group 1 vs. Group 2: $p = .20$; $d = 0.70$; Group 1 vs. Group 3: $p = .98$; $d= 0.09$; Group 2 vs. Group 3: $p = .13$; $d = 1.15$) suggest that the nonsignificant finding for the REA comparison may have been the result of a lack of statistical power due to the small sample size and high variability, particularly for Groups 1 and 2. Thus, Type II errors are possible with regard to the comparisons of the REA obtained from Group 2 to that obtained from both of the other groups.The largerREAforGroup 2 as compared with that of Groups 1 and 3 can be seen in Figure 3.

In summary, participants inGroups 1 (dyslexia, abnormal brainstem timing) and 2 (dyslexia, normal brainstem timing) exhibited poorer performance overall than those in Group 3 (normal control) for the DD test; however, their performance was not significantly different from one another. For all groups, right-ear performance was significantly better than left-ear performance on this task. Effect size analysis suggests that the larger REA exhibited by Group 2 (dyslexia, normal brainstem timing) as compared with the other two groups may be of practical or clinical significance, despite a lack of statistical significance likely due to a loss of statistical power.

The CS Test

As with DD testing, we subjected CS test results to a 3 ×2 ANCOVA, with group and ear as between-group factors, percentage correct score as the within-group factor, and age as the covariate. Results revealed a

significant main effect of group, F(1, 27) = 5.797, p <.01. Consistent with findings for DD, post hoc Bonferroni comparisons indicated significant differences for overall CS test performance between Group 1 and Group 3 (p <.01; d = 1.1) and between Group 2 and Group 3 (p <.01; d = 1.6); however, the difference between Group 1 and Group 2 was not significant (p = .79; d = .15). The ANCOVA also revealed a significant main effect of ear, F(1, 27) = 15.121, p <.01, d = 0.80, with better right-ear performance for all groups. The Group ×Laterality interaction approached significance, F(1, 27) = 3.150, p = .051.

To explore interaction effects and investigate inte-test comparison measures, we performed a separate planned univariate ANCOVA, with group as the between-group factor and REA as the within-group factor. Results revealed a significant main effect of group, F(1, 27) = 4.740, p <.05. Post hoc Bonferroni comparisons revealed significant differences in size of the REA between Group 1 and Group 3 (p <.05; d = 1.2) and Group 2 and Group 3 (p <.05; d = 1.4); however, no significant difference between Group 1 and Group 2 (p = .99; d = .02) was indicated. Figure 4 illustrates the REA for each group.

When taken together, results of these analyses reveal that Groups 1 (dyslexia, abnormal brainstem timing) and 2 (dyslexia, normal brainstemtiming) performed more poorly and exhibited a larger REA for the CS test than did the normal control group; however, their performance did not differ significantly from one another.

The FP Test

We conducted anANCOVA for FP testing,with group and response condition (humming, labeling) as the between-group factors and percentage correct score as the within-group factor. Again, we entered age as the covariate to control for possible age effects. The ANCOVA revealed a significant main effect of group, F(1, 27) = 10.121, p <.01, on overall FP performance. As with both DD and CS testing, post hoc Bonferroni comparisons indicated significant differences between Group 1 and Group 3 (p <.01; d = 1.5) and between Group 2 and Group 3 (p <.01; d = 1.4); however, we found no significant difference between Group 1 and Group 2 (p = .90; d = 0.02). Results also indicated a significant main effect of response condition, F(1, 27) = 20.543, p <.01, d = 0.93, with better performance in the humming condition, and a significant Group ×Response Condition interaction, F(1, 27) = 3.793, p <.05.

A separate planned univariate ANCOVA performed for HLD revealed a significant main effect of group, F(1, 27) = 6.540, p <.01, on magnitude of the HLD (see Figure 5). Consistent with the previous findings, post hoc Bonferroni comparisons revealed significant differences inmagnitude of theHLDbetween Groups 1 and 3 (p <.01; d = 1.4) and between Groups 2 and 3 (p <.05; d = 1.9); however, we found no significant difference between Groups 1 and 2 (p = .89; d = 0.17).

In summary, and as with the other behavioral tests already described, Groups 1 (dyslexia, abnormal brainstem timing) and 2 (dyslexia, normal brainstem timing) performed more poorly overall than did Group 3 (normal control) for the FP test. Groups 1 and 2 also exhibited a significantly larger HLD than did Group 3; however, they were not significantly different from one another.

The LPFS Test

Because the normal control group (Group 3) did not undergo LPFS testing, results from this group were unavailable for comparison. In addition, because participants in Groups 1 and 2 were age-matched, an ANCOVA was not needed.We subjected results to a 2 ×2 analysis of variance (ANOVA), with group and ear as betweengroup factors and percentage correct score as the withingroup factor. Results revealed no significant main effects of group, F(1, 28) = 0.142, p = .70, or ear, F(1, 28) = 1.534, p = .22, on LPFS testing, and no significant Group ×Laterality interaction, F(1, 28) = 0.838, p = .33.

In summary, performance of Groups 1 and 2 was not significantly different fromone another for theLPFS test. It is important to note, however, that for both groups, overall performance for this task was in the abnormal range as compared with age-specific normative data (Bellis, 2003), particularly for right-ear responses for participants in Group 2 (dyslexia, normal brainstem timing).

Relationship Between Brainstem Timing and Presence of (C)APD

We examined behavioral central auditory test results for each participant in Groups 1 and 2 for presence of (C)APD according to present clinical recommendations for the diagnosis of the disorder. None of the participants in Group 3 exhibited abnormal results on any test of central auditory function; therefore, their performance was not examined further. As previously described, criteria for diagnosis of (C)APD consisted of performance >2 standard deviations below the mean for age on two or more tests of central auditory function, combined with intra- and intertest patterns of deficit consistent with underlying neuroscience tenets that would indicate presumed left-, right-, or interhemispheric dysfunction, or a combination thereof (ASHA, 2005; Bellis, 2003). All 20 participants exhibited abnormal performance on at least one test of central auditory function; however, the nature of these abnormalities did not necessarily meet diagnostic criteria for (C)APD. Results revealed that four participants in Group 1 and all 10 participants in Group 2 did meet present clinical diagnostic criteria for (C)APD as defined earlier.

We used a chi-square test of independence (2 ×2 matrix) to determine whether normal versus abnormal brainstem timing was related to the presence of (C)APD. Results of the analysis approached significance, c2(1, N = 20) = 3.20, p = .074, suggesting that there may be a relationship between brainstem timing and presence of (C)APD, with normal brainstem timing being more frequently associated with (C)APD as diagnosed by behavioral tests of central auditory function. However, small sample sizes likely resulted in a loss of statistical power for this nonparametric test.

Pattern analysis of central auditory test results provided additional information to characterize the deficits exhibited by participants in Groups 1 and 2. These patterns link the central auditory test findings to sites of lesions in the auditory pathways based on findings of studies of individuals, primarily adults, who exhibited well-defined lesions of the CANS. Of the four children in Group 1 who met diagnostic criteria for (C)APD, two exhibited a classic pattern of deficit presumed to be consistent with interhemispheric (corpus callosum) dysfunction (e.g., Bellis, 2003; Bellis &Ferre, 1999; Musiek, Gollegly, &Baran, 1984). This pattern consisted of a left-ear deficit on the dichotic tests, a deficit in the labeling condition only for the FP test, and normal function for the LPFS test. The other two children in Group 1 who met diagnostic criteria for (C)APD exhibited a pattern of deficit consistent with presumed left-hemisphere dysfunction alongwith co-morbid interhemispheric dysfunction (Bellis, 2003; Bellis &Ferre, 1999). This pattern consisted of bilateral deficit on the dichotic tasks, a deficit in the labeling condition only for the FP test, and a bilateral deficit with the right ear worse for the LPFS test.

All 10 of the children in Group 2 met diagnostic criteria for (C)APD. Six of the 10 children exhibited the pattern described above of combined presumed site of dysfunction (left-hemisphere along with interhemispheric dysfunction). Three of the 10 children exhibited the classic pattern of presumed interhemispheric dysfunction. Only one of the 10 children exhibited a pattern of deficit associated with presumed left-hemisphere dysfunction alone, which consisted of a right-ear deficit for dichotic speech tests, a labeling deficit for the FP test, and a bilateral deficit for the LPFS test, with poorer performance for the right ear (Bellis, 2003; Bellis &Ferre, 1999).

Discussion

BioMARK Responses

The results of the present study were consistent with those of Banai et al. (2009, 2005), Cunningham et al. (2001), Johnson et al. (2007), King et al. (2002), and Wible et al. (2004) in that the ABRs to speech were found to be abnormal in a subset of children with dyslexia. Specifically, although results from only 20 children were used for statistical analysis in the present study, 12 of the 32 children with dyslexia who participated in the study, or 37.5% of the sample, exhibited abnormal brainstem timing as measured by the BioMARK. This finding is consistent with previous studies indicating that approximately 30% of children with language-based learning disorders, such as dyslexia, have been found to exhibit abnormal brainstem timing to speech (Banai et al., 2005; Johnson et al., 2005; King et al., 2002; Russo et al., 2004; Tallal et al., 1998; Wible et al., 2005).

In the present study, the findings for children in Group 1 (dyslexia, abnormal brainstem timing) were consistent with several studies that have indicated abnormal latencies for Waves V, A, C, and O as well as a shallow slope

for the V/A complex in children with abnormal brainstem timing (e.g., Banai et al., 2007; Johnson et al., 2005, 2007; Kraus &Nicol, 2005; King et al., 2002; Song et al., 2006). Therefore, abnormalities in BioMARK latency measures forWaves A, C, and O suggest that filter cues that aid in the ability to identify consonants and vowels may not be coded properly in the brainstems of these children, which may lead to speech perception difficulties (Banai et al., 2007). Even though the children in Group 2 (dyslexia, normal brainstem timing) did not exhibit abnormal overall BioMARK scores as determined by the automatic scoring algorithm in the computer software, some of them did exhibit prolonged latency values for Wave C as well as abnormal V/A slopes. Further investigation of these findings is needed as these children actually may have specific timing-related deficits and associated speech perception difficulties even though their overall BioMARK scores were judged to be within the normal range.

Behavioral Central Auditory Processing Deficits in Children With Dyslexia

It was expected that the children in Group 3 (normal controls) would exhibit the best performance on behavioral tests of central auditory function followed by those in Group 2 (dyslexia, normal brainstem timing), with the children in Group 1 (dyslexia, abnormal brainstem timing) exhibiting the poorest performance on behavioral tests of central auditory function.However, despite differences in brainstem physiology between Groups 1 and 2, statistical analyses did not reveal significant differences between these groups in overall performance on behavioral tests of central auditory function. Therefore, when overall performance was examined, brainstem timing as measured by the BioMARK did not appear to be an indicator of how the children would perform on behavioral tests of central auditory function. It is important to note, however, that performance of the children in Groups 1 and 2 was significantly poorer than that of children in Group 3, indicating a fundamental difference in the central auditory processing abilities of children with dyslexia as compared with normal children. These findings are consistent with those of several other studies demonstrating that performance on behavioral tests of central auditory function is poorer in children with reading disorders as compared with normal controls.

In addition to poorer overall performance on the behavioral tests administered, the children with dyslexia in the present study also exhibited significantly larger REAs for the dichotic tasks and a significantly larger HLD on the FP task as compared with the normal control group. The dichotic listening findings suggest that children with dyslexia exhibit difficulty with the processes of binaural integration and/or binaural separation regardless of the status of their brainstem physiology. Children with these difficulties often have problems hearing in background noise or when more than one person is talking at the same time. Various studies also have found poorer performance on dichotic listening tasks and a leftear deficit /REA in children with dyslexia (Moncrieff &Black 2008; Moncrieff &Musiek 2002; Sharma et al., 2006). In addition, the findings for the FP testing indicate that childrenwith dyslexia, regardless of brainstemphysiology, exhibit difficulty with linguistic labeling of nonverbal acoustic contours. Similar findings also were reported by Sharma et al. (2006) andWalker et al. (2006) for tests of temporal patterning.

The pattern of left-ear deficit on dichotic speech tasks combined with a deficit on temporal patterning tasks in the linguistic labeling report only is a classic pattern that has been shown to be consistent with inefficient interhemispheric transfer of auditory information, likely subserved by the corpus callosum (e.g., Musiek, Gollegly, &Baran, 1984; Musiek, Kibbe,&Baran, 1984). Although it is important to note that site-of-dysfunction interpretation in children without concomitant physiologic evidence of lesions via imaging or other means remains a theoretical concept, the overall group performance patterns on these tests in the present study indicate that, as a group, children with dyslexia may exhibit interhemispheric transfer difficulties that affect auditory and related abilities.

Results of LPFS testing indicated that children in Groups 1 and 2 had difficulty understanding degraded speech signals when compared with age-appropriate normative data, particularly for right-ear stimuli. These findings are consistent with those ofWelsh et al. (1980), who also found that children with dyslexia exhibited difficulty with filtered speech tasks. The pattern of bilateral and/or right-ear deficit on tests ofmonaural low-redundancy

speech has been linked to dysfunction in the primary (usually left) auditory cortex, and may be related to inadequate speech-sound representation in that brain region (Bellis, 2003; Bellis &Ferre, 1999). Therefore, as a group, children with dyslexia may have poorer cortical representation of speech sounds than children without reading disorders, which may be a contributing factor to their reading deficits.

Although the findings of left-ear deficit on dichotic speech tasks, deficits in the linguistic labeling of nonverbal tonal patterns, and deficits on monaural low-redundancy speech tasks characterize the overall performance of the children with dyslexia in the present study, it is important to note that not every child in the study exhibited this precise pattern. Therefore, pattern analysis of individual test results was conducted to elucidate more fully the nature of the central auditory deficits exhibited by these children.

Patterns of Performance on Behavioral Tests of Central Auditory Function

A test battery approach to the assessment of central auditory processing ensures that a variety of auditory processes and CANS regions are examined in order to determine an auditory profile that illuminates possible site of dysfunction and demonstrates an individual's auditory strengths and weaknesses (Bellis, 2003). Given the complexity of central auditory processing and the heterogeneity of (C)APD, combined with the possibility of nonauditory confounds, simply determining the presence of (C)APD is not sufficient. For the present study, the performance of each participantwas compared against age-specific normative data (Bellis, 2003) to determine normal versus abnormal performance on behavioral tests of central auditory function. These results then were examined to determine whether the participant met current diagnostic criteria for (C)APD, that is, abnormal performance on two or more tests combined with consistent inter- and intratest performance patterns indicative of central auditory dysfunction (ASHA, 2005).

Analysis of individual performance patterns suggests a high incidence of (C)APD in children with dyslexia. Furthermore, findings are indicative of presumed interhemispheric and/or left-hemisphere dysfunction, especially for those children with normal brainstem function as well as for some children with abnormal brainstem function. These results may provide additional support for the phonological theory of dyslexia, which states that dysfunction of left-hemisphere and/or interhemispheric brain areas are presumed to be affected in children with reading disorders (Ramus et al., 2003).

Finally, it is possible that nonauditory, global confounds, such as language capacity and attention-related issues, may have existed that resulted in poorer performance on behavioral central auditory tests for the children with dyslexia in this study. However, all participants were presented with normal cognitive capacity and no attention-related or similar concerns unrelated to their primary diagnosis of dyslexia. Furthermore, although some of the behavioral tests used in the central auditory test battery are somewhat linguistically loaded (e.g., LPFS, CS), previous research has indicated that these tests, when appropriately administered and interpreted, are relatively impervious to these confounds. Specifically, the use of strict diagnostic criteria, combined with analysis of inter- and intratest patterns that correlate with well-established neuroscience tenets that infer presumed anatomical site/region of dysfunction, renders such confounds highly unlikely (ASHA, 2005; Bellis, 2003).

The Role of the BioMARK in the Diagnostic Test Battery for (C)APD

The primary purpose of the present study was to determine whether brainstem temporal processing as measured by the BioMARK is related to performance on behavioral tests of central auditory function. Due to the heterogeneity of reading disorders and inconsistent findings regarding the relationship between auditory processing and literacy, auditory training often is not suggested for children with dyslexia. With access to assessment tools such as the BioMARK, awareness of the necessity to assess these children for auditory processing deficits is increasing. These measures demonstrate the relationships among neurophysiologic timing and speech sounds that cannot be seen with imaging techniques and show training-related improvements in neural synchrony through changes in evoked potentials (Hayes et al., 2003). Particularly, the BioMARK is able to detect brainstem timing deficits and can be used to track physiologic changes that occur following auditory

training. Neural encoding of sound in the auditory brainstem may provide additional insight into which children are the best candidates for auditory training programs (Kraus &Banai, 2007). Because it has been shown that children with abnormal BioMARK findings benefit from auditory training approaches, it is critical to determine whether those children identified by the BioMARK testing are the same as those who would be identified- and presumably treated via auditory training-using more traditional, behavioral means of central auditory assessment.

Intra- and intertest analysis of performance on the behavioral test battery used in this study yielded a diagnosis of (C)APD for 14 of the 20 children with dyslexia; of these, four also were found to exhibit abnormal brainstem timing. All of these children likely would have been referred for auditory-based intervention on the basis of their behavioral central auditory test performance. Six of the 20 children, however, exhibited abnormal BioMARK results, but did not meet criteria for (C)APD on the basis of behavioral test results. As such, it is unlikely that these children, had they undergone behavioral central auditory assessment alone, would have received a recommendation for auditory-based intervention.

There are at least three possible explanations for this disagreement between BioMARK and behavioral central auditory test results. First, it is possible that neither the BioMARK nor the behavioral central auditory test battery is sufficiently sensitive for the identification of central auditory dysfunction when used alone, in that the behavioral battery "missed" six children with central auditory dysfunction as measured by the BioMARK, and the BioMARK "missed" 10 children who met behavioral diagnostic criteria for (C)APD. Previous studies have indicated that approximately 5%-6% of typically developing childrenmay exhibit abnormal speech-evoked brainstem responses using pass-fail criteria identical to those used in the present study. Therefore, 95%-96% of typically developing children were correctly identified by this test (e.g., Banai et al., 2005). Similarly, it is possible that the behavioral central auditory results did not indicate central auditory dysfunction at all, but rather reflected other nonauditory, global confounds related to language abilities, attention, or other factors. These explanations are unlikely, however, given the vast body of literature demonstrating the sensitivity of these tests when used in combination and when strict diagnostic criteria and inter- and intratest pattern analysis are used (see Bellis, 2003; Musiek &Baran, 2002; Musiek &Chermak, 2007, for review). More likely, it is possible that, quite simply, these measures reflect different processes, mechanisms, and regions of the CANS. As such, whereas some children may exhibit abnormal brainstem transcription of speech stimuli, others may exhibit deficits at the cortical level in processes such as binaural integration, binaural separation, auditory closure, temporal patterning, and others that are not necessarily reliant on precision of brainstem timing. Still others may exhibit deficits in both regions/process areas. It is interesting to note that, as discussed previously, the children in Group 2 who met current diagnostic criteria for (C)APD using behavioral measures did exhibit some abnormalities in the temporal, rather than spectral, elements of their speech-evoked ABR responses, although overall BioMARK scores were normal. This may be suggestive of a link among (C)APD, temporal processing, and reading, as discussed in the introduction. Further investigation of abnormal BioMARK test results along with performance on behavioral central auditory processing tests is needed to explore these possibilities. Nonetheless, these findings reinforce the need for a test battery approach in assessing central auditory disorders.

Results of this study suggest that the BioMARKmay identify a subset of childrenwho would not otherwisemeet (C)APD diagnostic criteria through behavioral means of central auditory assessment but who would likely benefit from auditory-based intervention approaches. Therefore, this study provides support for inclusion of the BioMARK as part of the central auditory test battery. Finally, the surprising finding that all 20 children with dyslexia exhibited some form of central auditory dysfunction via either behavioral testing, BioMARK testing, or a combination thereof provides strong support for the evaluation of central auditory function in children with languagebased learning disorders such as dyslexia.

Acknowledgments

This study was supported by the John W. Carlson Research Grant, which was awarded through the College of Arts and Sciences at the University of South Dakota, Vermillion, SD. Additional support was provided by internal research funding through the Department of Communication Sciences and Disorders at The University of South Dakota and by a subproject of National Institutes of Research Resources Grant P20 RR-015567 awarded to Teri James Bellis that is designated as a Center of Biomedical Research Excellence (COBRE).

Sidebar

The Relationship Between Brainstem Temporal Processing and Performance on Tests of Central Auditory Function in Children With Reading Disorders

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J Speech Lang Hear Res 2011;54;228-242; originally published online Aug 5, 2010; DOI: 10.1044/1092-4388(2010/09-0239)

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Revision received March 28, 2010
Accepted June 7, 2010
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Publication date: Feb 1, 2011

Year: 2011

Noise Exposure Estimates of Urban MP3 Player Users

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.1 (Feb 1, 2011): 263-277A.
ProQuest document link

Abstract: To examine the sound level and duration of use of personal listening devices (PLDs) by 189 college students, ages 18-53 years, as they entered a New York City college campus, to determine whether noise exposure from PLDs was in excess of recommended exposure limits and what factors might influence exposure. Free-field equivalent sound levels from PLD headphones were measured on a mannequin with a calibrated sound level meter. Participants reported demographic information, whether they had just come off the subway, the type of PLD and earphones used, and duration per day and days per week they used their PLDs.

Based on measured free-field equivalent sound levels from PLD headphones and the reported PLD use, per day 58.2% of participants exceeded 85 dB A-weighted 8-hr equivalent sound levels (L^sub Aeq^), and per week 51.9% exceeded 85 dB A-weighted 40-hr equivalent continuous sound levels (L^sub Awkn^). The majority of PLD users exceeded recommended sound exposure limits, suggesting that they were at increased risk for noise-induced hearing loss. Analyses of the demographics of these participants and mode of transportation to campus failed to indicate any particular gender differences in PLD use or in mode of transportation influencing sound exposure.

Full text: Headnote

Purpose: To examine the sound level and duration of use of personal listening devices (PLDs) by 189 college students, ages 18-53 years, as they entered a New York City college campus, to determine whether noise exposure from PLDs was in excess of recommended exposure limits and what factors might influence exposure.

Method: Free-field equivalent sound levels from PLD headphones were measured on a mannequin with a calibrated sound level meter. Participants reported demographic information, whether they had just come off the subway, the type of PLD and earphones used, and duration per day and days per week they used their PLDs.

Results: Based on measured free-field equivalent sound levels from PLD headphones and the reported PLD use, per day 58.2% of participants exceeded 85 dB A-weighted 8-hr equivalent sound levels (L^sub Aeq^), and per week 51.9% exceeded 85 dB A-weighted 40-hr equivalent continuous sound levels (L^sub Awkn^).

Conclusions: The majority of PLD users exceeded recommended sound exposure limits, suggesting that they were at increased risk for noise-induced hearing loss. Analyses of the demographics of these participants and mode of transportation to campus failed to indicate any particular gender differences in PLD use or in mode of transportation influencing sound exposure.

KEY WORDS: noise-induced hearing loss, personal listening devices, portable music players, minimal hearing impairment, social factors

(ProQuest: ... denotes formulae omitted.)

In the present study, we examined the sound levels of personal listening devices (PLDs; e.g., CDs, iPods, and MP3 players), also referred to as portable music players, used by college students in New York City. The goal was to determine whether the students' estimated noise exposure from PLD use alone was more or less than the recommended exposure level for occupational noise (National Institute for Operational Safety and Health [NIOSH], 1998). One potentially significant cause of noise-induced hearing loss (NIHL) is attributed to recreational noise (Peng, Tao, &Huang, 2007;Weichbold &Zorowka, 2007), such as the use of PLDs. PLD users may be at risk for NIHL if they use these devices at high volumes for lengthy periods of time (Fligor, 2006). Research shows that NIHL is the most common form of acquired hearing loss, secondary only to the hearing loss related to age (Rabinowitz, 2000; Royster, 1996).

NIHL results primarily from long-term exposure to sounds that are excessively high (National Institute on Deafness and Other Communication Disorders, 2006). The data sets used to determine the degree of hearing loss caused by noise were collected in the late 1960s and early 1970s in predominantly White, adult male populations that were exposed to industrial noise (Baughn, 1973; Burns &Robinson, 1970; Lempert &Henderson, 1973; Passchier-Vermeer, 1968). These data were instrumental in developing standards (International Organisation for Standardisation, 1990; American National Standards Institute [ANSI], 1996) to describe the relationship between noise exposure and noiseinduced permanent threshold shift (NIPTS), as well as U.S. federal regulations (Occupational Safety andHealth Administration [OSHA], 1983) and safety recommendations (NIOSH, 1998).Current understanding of these data is that a maximum exposure of 85 dB, A-weighted (dBA), for an 8-hr daily exposure over a working lifetime of 40 years results in roughly 8% of exposed

persons having a hearinghandicap (Prince, Stayner, Smith,&Gilbert, 1997), owing to the wide variability seen in susceptibility to NIHL across individuals. Extrapolation of estimates of NIPTS to other populations (e.g., children and adolescents) exposed to nonindustrial sound exposures (e.g., music) is therefore tenuous. With these limitations acknowledged, it is well understood that higher sound levels damage hearing in shorter periods of time than do lower sound levels. To equateNIHL risk, time-intensity trading ratios are used (NIOSH, 1998) for sound exposures above a maximum "safe" level known to not contribute to NIHL (Melnik, 1991).

Literature Review

Damage to the hearing mechanism from noise exposure is permanent and cumulative through one's lifetime. NIHL from long-term sound exposure usually develops insidiously, and so significant hearing loss exists before the individual becomes aware of his or her communication difficulty secondary to cochlear damage. The contribution of PLD use to NIHL remains a topic of debate. Evidence exists to support the need to consider recreational NIHL a public health concern. Torre (2008) estimated that over 90% of college students own a PLD. It is estimated that between 5% and 10% of PLD users regularly listen to music at levels and for durations that put themselves at risk for NIHL (Clark, 1992; Felchlin, Hohmann,& Matefi, 1998). Researchers have estimated that as many as 12.5% of individuals aged 6 to 19 years have an audiometric configuration indicating they have noise-induced threshold shifts in one or both ears (Niskar et al., 2001).

Research indicates that exposure to loud sounds over a long period of time may lead to difficulty understanding speech (National Institute on Deafness andOther Communication Disorders, 2007). Consequently, even a mild hearing loss may lead to an uncertain grasp of many of the grammatical aspects of spoken language (i.e., weak consonants, such as fricatives and stops; morphemes). NIHL renders sounds distorted or muffled while also causing tinnitus, a ringing or buzzing in the head or ear in the absence of an external stimulus (Daniel, 2007; Royster, 1996). Other auditory injuries from noise exposure include loudness tolerance problems (e.g., hyperacusis) and pitch perception problems (e.g., diplacusis; Royster, 1996). Children and teenswho have been exposed to even a single intense sound (sufficient to cause acoustic trauma) may experience both hearing loss and tinnitus, with symptoms existing for at least a year or more (Holgers &Pettersson, 2005).

Several recent studies have reported the capacity for PLD output levels to present a risk for NIHL (Fligor &Cox, 2004; Keith, Michaud, &Chiu, 2008; Portnuff &Fligor, 2006;W.Williams, 2005). That PLDs are capable of causing NIHL is not a matter of debate. Whether PLDs are used often enough, at high enough levels, to pose a risk to a large number of users-a risk sufficient to warrant the attention of the popular media-is a matter of debate (Fligor, 2009). Researchers have reported awide range of estimates for individuals at risk of NIHL from PLD use. Rice, Rossi, and Olina (1987) estimated that only 1 in 1,500 PLDusers is at risk for a hearing disability from using PLDs. Felchlin et al. (1998) reported that, of 350 cassette tape player users, 10% exceeded an 8-hr time-weighted average of 85 dBA.

Areasonable goal of hearing loss preventionists might be to identify subpopulations with greater concentrations of individuals at risk because of factors that predispose them to listen to music at louder levels than normal. Factors that are thought to contribute to chosen (or "preferred") listening levels are the level of ambient noise in the listening environment (Airo, Pekkarinen, &Olkinuora, 1996; Fligor &Ives, 2006; Portnuff, Fligor, &Arehart, 2009; Worthington et al., 2009) and earphone type (Fligor &Ives, 2006; Hodgetts, Rieger, &Szarko, 2007). Age, gender, and other sociological and demographic characteristics may also contribute to sound exposure from PLDs.

Teenagers frequently play their music at a higher intensity than do other PLD users while not realizing the level as potentially hazardous (Portnuff et al., 2009). A survey commissioned by the American Speech-Language-Hearing Association (Zogby, 2006) examined the reported hearing difficulties of 301 high school students and 1,000 adults in the United States and found that teens were more likely than adults to report three of the following symptoms of hearing loss: (a) increasing the volume on their television or radio (28% of students vs. 26% of adults), (b) saying "What?" or "Huh?" during normal conversation (29%of students vs. 21% of adults),

and (c) experiencing tinnitus or ringing in the ears (17%of students vs. 12% of adults). Portnuff et al. (2009) also found that, on average, teenage males 13 to 17 years of age were choosing higher listening levels on PLDs than were their female peers. Such gender differences have been observed in other studies of PLD use (Fligor &Ives, 2006; Torre, 2008; W. Williams, 2005), suggesting that gender differences may exist.

Airo et al. (1996) reported that when ambient noise in the listening environmentwas increased to 72dBA, the average chosen listening level of PLD users increased froman average of 69dBAin quiet to 85dBA.W.Williams (2005) surveyed the listening levels of 55 adults on a noisy city street (where ambient levels were 73 dBA) and found that the average chosen listening level was 86dBA.These two studies independently show PLD users choosing a signal-to-noise ratio of 13 dBA. Furthermore, Williams estimated that 24% of his participants exceeded 85 dBA for an A-weighted 8-hr equivalent continuous sound level (LA8hn) based on measures of PLD output at use levels on a calibrated mannequin and participant self-reported use duration.

Conversely,Worthington et al. (2009) asked 30 participants to set PLDs to their preferred listening level in quiet and in 81 dB SPL of recorded subway noise and found that none of their participants exceeded recommended exposure levels. In quiet, the average A-weighted equivalent sound level (L^sub Aeq^) was 72 dBA, and in noise, the average L^sub Aeq^ was 87.5 dBA. Estimated weekly sound exposure from PLDs was determined by self-reported daily duration of use (M= 1.7 hr/day) and days per week of use (M= 4 days/week).The participants inWorthington et al.'s study had estimated weekly exposures of 6.8 hr, and consequently, none of them were considered to be at risk for NIHL in either quiet or subway noise because no participant exceeded a weekly equivalent continuous exposure of 85 dBA.

It is noteworthy thatWorthington et al. (2009) showed an average L^sub Aeq^ in noise exceeding 85 dBA, and so perhaps a larger sample of participants who may use PLDs in noisy environments for longer durations might show a higher concentration of individuals at risk for NIHL. With one of the largest public transit systems in the world, riders of the New York City subway system make up a reasonable target for study. Gershon, Neitzel, Barrera, and Akram (2006) reported that noise levels on subway platforms were an average of 85.7 dBA, with levels in subway cars ranging from 84 to 112 dBA. Based on very conservative damage-risk criteria to assess any risk for hearing loss, Gershon et al. suggested that riders are at slight risk for NIHL from exposure to subway noise alone. This does not account for additional sound exposure from occupational and nonoccupational exposures, such as use of PLDs during and after one's commute. The reasons for a person to use a PLD in urban settings may include the capacity to do so, given the portability of large music libraries as well as sociological factors that motivate use despite the potential for NIHL risk.

Although personal music players have been around since the 1980s, the popularity of the Apple iPod has dramatically increased PLD use, particularly among young people. Its popularity is partly due to its function and design. For example, the iPod is smaller and more portable than previous PLDs. The iPod user is able to easily download music by connecting to the personal computer through iTunes and peer-to-peer networks, and the large storage capacity of the iPod means that people can listen to it longer than with earlier technology. In addition, the compressed audio (e.g., MP3) file format allows music to move across space without being significantly degraded and to be reproduced without overtly losing sound quality (Boradkar, 2006). The large number of songs and the compressed format mean that music can be listened to for a greater duration of time than with previous storage media (e.g., CDs or cassette tapes). These physical qualities create an opportunity for users to be at greater risk for NIHL.

The Social Factors Associated With Personal Listening Devices

The social and cultural aspects of the iPod may play a greater role in the use of these devices than the physical features described earlier. Cultural theorists interpreted the first self-contained PLD, a portable cassette tape player called the SonyWalkman, as a cultural artifact embodying the values most associated with latemodern, postindustrial societies:mobility, high technology, modernism, choice, youth, and entertainment (Du Gay, Hall, Jones, Mackay, &Negus, 1997). This idea of "private listening in public places" represented a new and

distinctive way of life: The Walkman user becomes the solitary figure in the crowd, using music to screen out the boring and routine aspects of daily life. This device allowed the user to become a "self-sufficient individual wandering alone through the city landscape," an "urban nomad" (Du Gay et al., 1997, p. 16). The Apple iPod extended and perfected these themes. Consumers now face an unprecedented level of choice and personalization, with access to thousands of songs and individually customized playlists. With the advent of compressed music files and audio file sharing and downloading, which were not available with the cassette tape or even theCD,music is finally truly and infinitely repeatable and reproducible.

PLDusers can escape fromthe uncontrollable sounds of the city, avoiding car alarms, subway noise, car horns, and being asked for money or directions. The PLD is particularly appealing to people in modern affluent cultures, where there is a high premium on personal space, leading to a desire to withdraw and escape the streets (Bauman, 1993; Blesser&Salter, 2008; Bull, 2007; Putnam, 2000; Sennett, 1990; Simmel, 1997). Like the automobile, the PLDcan create solitude for the urban commuter, even while in close proximity to others. The white headphones of the iPod send the message that the wearer is not to be bothered (Bull, 2007). People today also want to make public spaces conform to their desires (Boradkar, 2006; Bull, 2007; R. Williams, 1983). PLD users desire to redefine their daily schedule and create a private soundtrack to accompany their commute or gym workout. They filter out the public soundscape and create their own controlled private soundscape (Szeliga, 2009).

Blesser and Salter (2008) argued that, in addition to the social need to control and individualize personal space, the iPod can lead to an altered state of consciousness. Although the extant research is indirect, they suggested that music stimulates the brain and changes the listener's emotional state, causing relaxation or excitation (Blesser &Salter, 2008; Levitin, 2006). By means of energetic masking, loud music makes the listener functionally unable to hear anything but the music at hand, thus transporting that listener to another aural space, from the immediate physical world to an imagined world of themusician (Blesser&Salter, 2008).PLDusers report feeling calmer during their commute and experiencing more pleasure during even mundane work (Bull, 2007; Simun, 2009). Drawing from the cultural theories of Adorno (1991), Benjamin (1973), Heidegger (1962), Marcuse (1964), and McLuhan (1967), Bull (2007) argued that the privacy and personalization of the iPod create a sense of warmth and connection in the distant and exclusive spaces of modern urban culture. As a result, many users now describe the iPod as almost a necessity of life. It has been called an "urban Sherpa" or "digital Sherpa," meaning that people rely on their iPods to navigate today's urban worldmuch as mountain climbers in the Himalayas rely on their guides (Bull, 2007).

Modern urban life can be particularly alienating for young people, who are struggling for identity and individuality. Music has played a primary role in this search for meaning, identity, and leisure for young people (Kotarba, 1994). The iPod's sleek and unique design, accompanied by its stylish marketing campaign, appeals to young people. The unmistakable white headphones of the iPod signal the possession of a hip, stylish cultural product. The iPod provides membership in a private club whose membership is in the millions (Jones, 2005). According to the Student Monitor, a market research group, college students rated listening to their iPods as the coolest free time activity (Associated Press, 2006). It has been called a "perfect" device and ranks number one among today's "cool" items (Levy, 2006). The iPod has become a symbol of a generation and a marker of social status.

Furthermore, and potentially to their detriment, loud music is a favorite pastime of young people. It can be reasonably assumed that young people are attracted, more so than older individuals are, to venues and activities that involve loud music, such as rock concerts, clubs, and now PLDs. Since the inception of rock 'n' roll (and perhaps before), loud music was a sign of youth, rebellion, and individuality. It figures into young people's identities as cool, rebellious, and different from those of older people. Consider that it is usually parents who ask their teenagers to turn down the music, rarely the other way around. Furthermore, feelings of alienation among urban youth as well as high energy and limited avenues for self-expression can lead teenagers and young

adults to seek out altered states of consciousness or heightened physical experiences. The physical effects, including the stimulation of brain centers and a rapid heartbeat, are intensified when one's music is being played at a high volume (Gowensmith &Bloom, 1997; Huron, 2006). Finally, the anonymous nature of modern life results in the desire to broadcast one's identity (Goffman, 1959; Simmel, 1997), so it is possible that PLD users purposely play their music loud enough so others can hear it. In the anonymous environment of a large city, which decreases social controls, iPod listeners who play their music at full volume are broadcasting their tastes and personalities and, in a way, connecting to other people in otherwise anonymous and isolating urban settings.

The Present Study

The goal of the current study was to determine whether PLD users at a New York City college, particularly those who generally use subways to travel to school, use their PLDs at high enough levels and for durations long enough to place them at risk for NIHL. We tested the following hypotheses:

Hypothesis 1: Some PLD users will listen at high levels and report durations of use that place them at risk for NIHL.

Hypothesis 2: PLD users who travel via the subway will listen at higher levels than will those who do not travel via the subway.

Hypothesis 3: Male PLD users will choose higher levels than will females.

Method

Participants

College students who used PLDs and walked onto the City University of New York campus, adjacent to an exit from a subway station, were invited to participate in this study. Participants consisted of 189 college students (92 males, 97 females) averaging 22.2 years of age (Mdn = 20, range: 18-53). Participants were invited to have their earphone levels measured and were asked to fill out a questionnaire requesting demographic information (i.e., date of birth, age, and gender), whether they had just exited the subway, whether the volume control of their PLD was the same since they had left the subway, the type of PLD and earphones they used, and the duration and frequency of use of their PLD (see the Appendix for a copy of the questionnaire). Self-reported listening duration (total listening time per day and days per week) was considered an appropriate variable for estimating daily and weekly exposures because this has been used in previously published studies (e.g., Airo et al., 1996; W.Williams, 2005;Worthington et al., 2009).Although the use of a self-report introduces some error in the measure, there is evidence that self-report of use of ear-level devices does closely match actual behavior in some circumstances (Griffin, Neitzel, Daniell, &Seixas, 2009).

Participants were eligible for the study if they were adults (age 18 and older) and provided informed consent. No efforts were taken to determine whether participants had normal hearing because in this investigation, we sought to study a large cross-section of the urban population, some of whom may have hearing loss. Although it is possible that some participants in this study had hearing loss (conductive or sensorineural), the influence of hearing loss on chosen listening level to PLD is not well defined. Loss of hearing sensitivity may cause some individuals with hearing loss to choose higher listening levels, whereas loudness recruitment may cause others with hearing loss to choose lower listening levels. Because we had no expectation that a higher rate of hearing loss would be present in this study population compared with other urban users of PLD, no effort to screen for normal hearing was deemed appropriate for the purpose of this study.

Procedure and Measures

We measured sound levels from each participant's PLD using a mannequin built according to The Jolene Cookbook (Martin &Martin, 2007), which is designed to be visually attractive and capable of assessing free-field equivalent sound levels from earphones.We constructed Jolene using a fashion mannequin and a Radio Shack sound level meter (Model 33-2055) modified with the microphone seated in the canal portion of a silicon model of an ear. This sound level meter has a digital display; a range from 50 to 126 dB, A and C weighting; fast (time

constant = 125 ms) and slow (time constant = 1 s) integration of the sound level; and, according to product literature, an accuracy of ±2 dB at 114 dB SPL and a frequency response of 32 to 10000 Hz. Although this sound level meter has limited accuracy relative to a laboratory-quality measurement system (e.g., a Type I sound level meter), its performance was considered acceptable for the purpose of this study.

We calibrated the mannequin using the Microphone In Real Ear technique (International Organisation for Standardisation, 2002) to determine a coupler to freefield correction factor to report free-field equivalent levels (transfer function of the outer ear [TFOE] of the mannequin). A hole was pierced with a needle in the side of the canal of the silicon ear, and a metal grommet with an inner diameter of 1.5mmwas inserted into this piercing. A probe tube (outer diameter: 1.5 mm) was positioned 2mmin front of the microphone that was seated in the silicone model ear and connected to the sound level meter. This probe tube was connected to an ER-7c Probe Microphone System (Etymotic Research, Inc.) and routed to a personal computer running data acquisition software (Adobe Audition, version 1.5). Pink noise generated in Adobe Audition was presented via loudspeaker at 70 dBA (verified via a separate Radio Shack sound level meter held by the mannequin's ear) and measured via ER-7c in the free field and again via the probe microphone in the ear canal of the mannequin. The difference in frequency response between the free field and the ear canal probe microphone measures was considered the TFOE for this mannequin. This TFOE correction was saved as a filter in the Audition software. This TFOE filter was applied to recorded sound files of music that were presented via two different earphones placed on the model ear.

The two earphones used for calibration were the Apple iPod earbud earphone included with the purchase of an iPod and the Koss KSC11 over-the-ear headphone (Koss Corporation). In-the-canal earphones (earphones that are seated deeply in the ear canal) did not fit the mannequin's silicone ear because the length of the silicone ear's canal was too shallow to accommodate their full insertion. Thus, determining a free-field equivalent correction factor for in-the-canal earphones for this mannequin was not possible.We used five songs as the stimuli for comparing TFOE-corrected levels recorded via the ER-7c probe microphone with those levels measured by the mannequin-modified sound level meter. These songs were the No. 1 downloaded songs on iTunes.com on December 30, 2008, in the genres of "alternative," "pop," "country," "hip-hop/rap," and "rock." A single number considered the typical level of the chorus of the song observed on the sound level meter (set to "slow" integration and A-weighting) was reported, rounded to the nearest decibel. Using the earbud earphone, the difference between the overall A-weighted levels measured by the mannequin's sound levelmeter and the overallA-weighted TFOE-corrected ER-7c probe microphone measured levels was 4.4 to 6.0 dB (M = 5.0 dB, SD = 0.5). Using the over-the-ear headphones, the difference between the overall A-weighted levels measured by the mannequin's sound level meter and the overall A-weighted TFOEcorrected ER-7c probe microphone measured levels was 3.7 to 6.8 dB (M = 5.5 dB, SD = 1.1). A single-number correction factor of 5 dB was considered appropriate for this field study (i.e., the level observed on the Radio Shack sound level meter had 5 dB subtracted from it to be considered an approximation of the free-field equivalent A-weighted sound pressure level). This 5-dB correction factor, with exclusion of in-the-canal earphones, for use with the Jolene mannequin has been advocated by other researchers (Berger &Stergar, 2009). The possible measurement range, then, for free-field corrected earphone output with our mannequin was 45 to 121 dBA.

The levels measured from participants' earphones were assumed to be representative of their typical listening levels. Consequently, we estimated noise exposure by day and by week on the basis of the PLD user's reported duration of use per day and days per week of use. After the PLD level measurements were taken, participants were counseled regarding their relative risk for NIHL and how they could take steps to mitigate risk if necessary.

Data Measures

Ambient noise in the vicinity of testing. The location where data were collected was on a sidewalk just inside the entrance to the campus, adjacent to the entrance of a subway station. Sound levels in the testing locale were

assessed using a SoundPro SP SE-2-1/3 Type 2 sound level meter (Quest Technologies). Ambient street noise ranged from56.0 to 68.1 dBA (M= 60.6 dBA, SD= 3.1 dB, Mdn = 60.0 dBA). The ambient street noise level was never equal to or above the level measured from the earphones of a participant. A request was made of the New York City Transit Authority to conduct this study inside the subway station, but this request was denied.

Estimations of sound exposure. Of the 202 participantswho gave informed consent, sevenmale participants and six female participants used in-the-canal earphones, the output of which could not be accurately measured with our mannequin. We thus excluded the sound level measures of these 13 participants from the estimations of sound exposure. Earbudswere used by 183 participants, and over-the-ear headphones were used by six participants. No participant's free-field corrected earphone output was less than the 45 dBA measurement floor of our mannequin. One male participant and one female participant had free-field corrected earphone output of 121 dBA (the measurement ceiling of our mannequin). For the sake of estimating exposure, we used this level of 121 dBA for these two participants' free-field corrected earphone listening level.

We made estimates of 8-hr equivalent continuous sound levels (LA8hn) per day on the basis of the level measured from the participant's earphones and reported daily listening duration:

...(1)

where LR is the free-field corrected earphone listening level and TR is the reported daily listening duration in hours.

We made estimates of 40-hr equivalent continuous sound levels (L^sub Awkn^) on the basis of the same measured earphone level (LR) and reported daily listening duration (TR), multiplied by number of days per week of use (making the assumption that the duration of each day's use is the same):

...(2)

where Dayswk is the reported days per week of PLD use.

The estimated daily noise dose was determined according to the following formula:

...(3)

and the estimated weekly noise dose was determined according to

...(4)

where Dday is the daily noise dose (in percentage form) and Dwk is the weekly noise dose (in percentage form) based onLA8hn andL^sub Awkn^ of 85 dBAconstituting themaximum (100%) allowable daily and weekly noise dose, respectively; this is therecommended exposure limit adopted by NIOSH (1998). Exceeding 85 dBA for LA8hn and/or L^sub Awkn^ would reflect an increased risk for NIHL, as would exceeding 100% for Dday and/or Dwk.

Results

The results showed that 58.2% of PLD users exceeded daily sound exposure limits, and 51.9% of PLD users exceeded weekly sound exposure limits. Thus, a majority of participants in this study were at increased risk for NIHL. Mean scores are presented in Table 1.

Hypothesis 1: Some PLD Users Will Listen at High Levels and Report Durations of Use That Place Them at Risk for NIHL

The average free-field corrected listening level was 92.6 dBA (SD = 10.7 dB), with a reported average 18.4 hr of use per week (SD = 17.1). There was no significant correlation between listening level and reported duration of PLD use (Pearson r = .07, p = .36). The estimated LA8hn and L^sub Awkn^ are represented in box-and-whisker plots in Figures 1 and 2, respectively. As expected from the way these estimates were made, the mean and median of both LA8hn and L^sub Awkn^ are similar (Ms for LA8hn and L^sub Awkn^ were 87.2 dBA and 87.4 dBA, respectively). These results indicate that the average participant in this study exceeds the NIOSH-recommended exposure limit, for both the daily and weekly exposures. Figure 3 is a histogram of estimated L^sub Awkn^; the data are relatively normally distributed, with an SD of 11.9 dB. The average daily noise dose was 3,289%, although this value is highly skewed by those participants with the highest noise dose; the median

noise dose was 157%.

There has previously been a supposition that persons who use over-the-ear headphones listen at levels lower than those who use earbud earphones (Hodgetts et al., 2007). In the present study, the estimated LA8hn was 87.3 dBA for earbud users (SD = 11.5 dB), and the estimated LA8hn for over-the-ear headphone users was 85.2 dBA (SD= 11.8 dB).With 183 earbud users and only six over-the-ear headphone users, we were not able to conduct statistical analyses to compare means.

Hypothesis 2: PLD Users Who Travel Via the Subway Will Listen at Higher Levels Than Will Those Who Do Not Travel Via the Subway

As summarized in Table 2, a two-way independentsamples t test indicated there was no significant difference at a <.05 between measured earphone output for the PLD users who traveled by subway (93.1 dBA, SD = 10.91) versus those who did not travel by subway (i.e., traveled by foot, bus, or car; 92.3 dBA, SD = 10.68). Although at least 20 out of the 49 subway rider PLD users (41%) had adjusted the level of their devices after leaving the subway, according to a two-way independentsamples t test (p = .157), there was no significant difference between the earphone output of those who did adjust the volume control (average free-field corrected levels = 91.5 dBA, SD = 9.67) on their PLD compared with the earphone output of those who did not (average free-field corrected levels = 94.5 dBA, SD = 11.69).

Hypothesis 3: Male PLD Users Will Choose Higher Levels Than Will Females

The average free-field corrected earphone output was 92.7 dBA (SD = 10.3 dB) for males and 92.3 dBA (SD = 11.1 dB) for females, with no significant difference between these means (see Table 3). The LA8hn and L^sub Awkn^ of male and female participants are reported in Figures 4 and 5, respectively. The average LA8hn of female participants was 86.8 dBA, and the average male LA8hn was 87.6 dBA. The average L^sub Awkn^ of female participants was 86.8 dBA, and the average male L^sub Awkn^ was 88.0 dBA. A two-way independent-samples t test failed to show a difference betweenmale and femaleLA8hn (p = .62) andmale and female L^sub Awkn^ (p = .48).

Discussion

These data indicate that the average free-field corrected PLD user's chosen listening level was in excess of the generally considered rule of thumb of not exceeding 85 dBA. Risk for NIHL is not as simple as chosen listening level, however, because it is the normalized equivalent continuous sound level (i.e., the level integrated over time), based on time-intensity trading ratios, that equatesNIHL risk. It has been previous reported (Felchlin et al., 1998) that chosen listening level and duration of use are not associated; the data from our study are consistent with this previous report. Therefore, it is only those PLD users who choose levels in excess of a safe listening level and use PLDs longer than is safe for their chosen listening level who are at risk for NIHL. The population that falls into this category represents the demographic group at risk for NIHL and commands the relative attention given by public health advocates. The size of this at-risk population has been a topic of debate (Fligor, 2009). More than half the participants in the present study were at risk for NIHL.We chose this study population because they are college students who have been previously reported to be common users of PLDs (Danhauer et al., 2009; Torre, 2008), because the ambient noise in the listeners' environment is high in New York City (Gershon et al., 2006), and because background noise has been shown to increase PLD chosen listening level (Airo et al., 1996; Fligor &Ives, 2006).

The average equivalent continuous level of participants in this study in a given day was 87.2 dBA and in a given week was 87.4 dBA. Twenty-five percent of participants had L^sub Awkn^ greater than 95 dBA, 10%of participants had L^sub Awkn^ greater than 102 dBA, and 5% of participants had L^sub Awkn^ greater than 107 dBA. According to ANSI S3.44-1996, for a 10-year exposure to L^sub Awkn^ of 95 dBA, the NIPTS for the person of average NIHL susceptibility is 20 dB HL, the NIPTS for L^sub Awkn^ of 102 dBA is 36 dB HL, and the NIPTS for L^sub Awkn^ of 107 dBA is 51 dB HL. Compared with the age-equivalent hearing thresholds at 4000 Hz reported in Annex B of ANSI S3.44-1996, these 10-year NIPTS estimates reflect shifts in hearing thresholds

that are on par with the hearing of a 40-year-old man (for persons exposed to L^sub Awkn^ = 95 dBA for 10 years), a 50-year-old man (for persons exposed to L^sub Awkn^ = 102 dBA for 10 years), and a 60-year-old man (for persons exposed to L^sub Awkn^ = 107 dBA for 10 years). The average age of participants in this study was 22.2 years; it is conceivable that in 10 years, some of these participants will be 32 years old and will have hearing that is on par with men who are decades older.

In contrast to Hypothesis 2, participants who commuted using the subway (93.3 dBA) did not have significantly higher PLD sound exposure than nonsubway commuters (92.3 dBA), even after we accounted for those who reported adjusting the volume control on their PLDs. It is possible that many more subway riders did reduce the volume control on their device and failed to disclose that they had done so when asked, or that nonsubway riders choose levels on par with subway riders.

In contrast to Hypothesis 3, there was no significant difference between PLD sound exposure for males and females in this study. Previous research has reported that males choose listening levels that are higher than those chosen by females (e.g., Torre, 2008); however, methods of measurement differ across investigations, with some studies asking participants to adjust their listening in a laboratory setting (Hodgetts et al. 2007; Torre, 2008), sometimes in response to different levels of ambient sound (Fligor&Ives, 2006; Portnuff et al., 2009). In addition, this study has a larger sample than previous studies that have found gender differences (Fligor&Ives, 2006; Portnuff et al., 2009; Torre, 2008; W. Williams, 2005). In the current study, we obtained listening levels as participants entered the campus without prompting or instruction from investigators. In this way, a measurement was obtained that was unbiased by the potentially strange listening environment of a laboratory or a presupposition on the part of the participants to anticipate a desired outcome by the investigators. In addition, all participants, regardless of gender, may have adjusted their listening level because of the ambient street noise. Thus, with participants who were in essence blinded to the fact that their listening level would be audited by researchers, and given the relatively high level of ambient noise in the listening environment, theremay not be a difference in chosen listening level between genders. This may mean that participants were less susceptible to pressure to conform to cultural norms concerning risky or wild behavior (Booth &Nolen 2009a, 2009b; Lorber, 1994). Victorian gender norms, which still seem to influence modern-day attitudes, dictate that girls exhibit lower levels of risk-taking behaviors than boys; they are "sugar and spice," whereas boys are "rough and tumble." Furthermore, one should expect even fewer gender differences when looking at private activities such as listening to music with headphones, for which there is even less external pressure to conform to gender norms. It is possible that our study population is less susceptible to stereotypical gender norms. It also is possible that background noise in the listening environment overcame gender differences that have been reported to exist when people listen in quiet environments (Fligor &Ives, 2006). Our findings are in contrast with those of W. Williams (2005), who also measured chosen listening levels, this time on a city street in Australia. He found that men had sound exposures, on average, that were at higher levels than women's (LA8hn = 80.6 and 75.3 dBA, respectively). The overall sound exposure from PLDs in his study of 55 individuals was lower (LA8hn = 79.8 dBA) than in the present study. Perhaps there are societal differences between Australia and the United States that influenced the outcome for gender.

Limitations of the current study include the fact that much of the estimates relied on the study participants' accurate report of their duration of PLD use. Using a single observed sound level measured on the mannequin (which has an accuracy of ±2 dB) to be representative of listening level during all listening is tenuous; however, past studies have relied on participant self-report (e.g., Felchlin et al., 1998;W.Williams, 2005) and, in the absence of technical solutions to monitor participants' durations of use, self-report is the most effective measure for surveying use in a large number of participants (Griffin et al., 2009). Additional limitations include the fact that our method allowed us to make sound exposure estimates only from earbud and over-the-ear headphones, rather than including in-the-canal earphones. It has been previously reported that in-the-canal earphones can produce higher output levels than other earphones (Keith et al., 2008; Portnuff &Fligor, 2006), but these

earphones provide sound isolation from ambient noise and so are used at lower levels than non-sound isolating earphones in higher levels of ambient noise (Fligor &Ives, 2006).

Conclusions

Estimates of noise exposure based on measured listening levels and reported listening duration suggest that the average PLD user in this study was at risk for NIHL. The exposure estimates indicate that a similar percentage of both sexes are at risk for NIHL, and the PLD listening environment during participants' commute did not yield obvious factors influencing PLD sound exposure. Although there is a need for further research to assess the accuracy of these estimates, these findings warrant efforts to provide targeted education for college-age people using PLDs in urban environments.

Although knowledge of the effect of loud noises on hearing loss has been present in the literature for the last 100 years (Lonsbury-Martin &Martin, 2007), the effect of noise on hearing abilities seems to have not consistently filtered down to PLD users in this study, or perhaps the information is available but has failed to elicit changes in behavior to reduce risk for NIHL. The social factors described earlier may lead to a reluctance among young people to protect their hearing. PLD use, particularly at high levels, allows young people to retreat from the noises of noisy and crowded public areas and to add a personal soundtrack to otherwise mundane activities.

Danhauer et al. (2009) reported that the vast majority of college-age students (86.6%) in their nationwide survey believed that using an iPod at "loud listening levels" may damage hearing. Furthermore, responses to Danhauer et al.'s questionnaire suggested that college students wish to exercise personal responsibility regarding their hearing health and that educational outreach campaigns that sensationalize hearing loss risk may not be effective. Considering these previous reports, educational institutions may establish a preventative program to target the inappropriate use of PLDs (as well as other sources of noise). In addition, early identification of students with mild hearing loss is essential to provide them with the necessary supports for academic skills and to prevent greater loss of hearing abilities. To prevent NIHL, it is essential that speech-language pathologists and audiologists collaborate (Moore, 2009; Smiley &Threats, 2006), given that both professions are aware of the negative effects of hearing loss and are committed to the prevention of health disabilities, specifically those affecting communication.

Broader education on the appropriate use of PLDs and the effect of noise on hearing is essential (Serra et al., 2007; Weichbold &Zorowka, 2007), especially with a worldwide sale of 25.6 million portable music players in 2005 ("Portable Music Player Market," 2005). This was an increase of 409% from the previous year (American Speech-Language-Hearing Association, 2005). Danhauer et al. (2009) advocated that members of at-risk groups participate in the design and dissemination of effective educational outreach campaigns. Greist, Folmer, and Martin (2007) evaluated the effectiveness of the NIHL-prevention curriculum "Dangerous Decibels" and demonstrated that it effected better long-term outcomes regarding attitudes toward NIHL and intended behaviors in the cohort of younger children compared with older children.

Progress in the development of more sophisticated PLDs also plays a role in potential NIHL. For example, mass-storage flash memory MP3 players, such as the iPod, can store thousands of songs, whereas older devices, such as CD players, have considerably more limited storage of audio content. There is greater potential for users of newer technology to increase their duration of use. Conversely, the newer technology could more easily incorporate software to monitor estimated listening levels and duration of use and provide the PLD user with tools to make better hearing health choices while not being unnecessarily overprotective. For instance, simple devices that seek only to limit earphone output level ignore the vitally important risk component of duration of use. Such restrictive measures will surely fail in a market that thrives on individual expression.

Working Toward Guidelines for the Prevention of NIHL

These findings and the past literature on the effectiveness of NIHL-prevention curriculum (Greist et al., 2007) suggest that it is important that prevention programs begin early, perhaps at the preschool level, to help prevent

younger children from imitating older children's inappropriate use of PLDs. Guidelines have been developed to decrease the number of individuals who may experience NIHL (e.g., Fligor, 2006). For example, individuals should not listen to music for longer than 1.5 hr at 80% of the maximum volume control setting on the portable devices (Portnuff &Fligor, 2006). The average user is able to listen to a player at about 70% of full volume for about 4.5 hr without risk (Portnuff &Fligor, 2006). There are also guidelines for the type of earphone used to reduce the risk of NIHL (Fligor &Cox, 2004; Portnuff& Fligor, 2006). Although the output of in-ear or earbud-style headphones may be higher than overthe- ear or supra-aural headphones (Portnuff &Fligor, 2006), people tend to use their headphones at the same volume level, depending on background noise (Fligor &Ives, 2006). However, the primary risk lies in listening to music in noisy environments, with headphone type a secondary concern (Fligor &Ives, 2006). Contrary to popular belief, though, using in-ear headphones that completely seal the ear allow the user to block out background noise, and thus those users often choose to listen at lower levels, even in high background noise (Fligor &Ives, 2006). In summary, guidelines for both the appropriate listening level and the appropriate headphone type are necessary to reduce NIHL risk.

It is well established that not everyone shares the same risk of hearing loss, given that some individuals have "tougher" ears and others have "tender" ears (Henderson, Subramaniam, &Boettcher, 1993). It is not possible to predict who is more at risk for NIHL; thus, it is best to exercise caution when using PLDs. A most significant problem is that hearing loss occurs slowly; therefore, parents or teachers may not notice this type of hearing loss in children/students until it is quite extensive. Consequently, prevention is key. The results of the current study suggest that PLDs produce high enough sound levels to pose a risk of hearing loss, if the device is used at high levels for extended durations. Thus, PLD users must become aware of their listening levels and know the maximum amount of time they can listen at their chosen level without risking hearing loss. Educational programs are essential to provide information on the actions necessary minimize risk for NIHL.

Acknowledgment

The research reported in this article was supported, in part, by a Professional Staff Congress-City University of New York Research Award.

Sidebar

Noise Exposure Estimates of Urban MP3 Player Users

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J Speech Lang Hear Res 2011;54;263-277; originally published online Aug 5, 2010; DOI: 10.1044/1092-4388(2010/09-0283)

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Received December 24, 2009
Revision received May 10, 2010
Accepted June 17, 2010
DOI: 10.1044/1092-4388(2010/09-0283)
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Appendix

Appendix. The questionnaire used in this study.

DOB: _____ Age: _____

Device: iPod_____ Other _____

Date: _____

Female _____ Male _____

Just got off the subway? YES_____ NO_____

Is the volume control of your MP3 player the same since you left the subway?

YES _____ NO_____

On days when you use your MP3 player, how long do you usually listen? _____ hours

How many days each week? _____ days

Ear phone type:

_____ Earbud

_____ On-the-ear (Supra-aural earphone)

_____ Completely-around-the ear (Circumaural earphone)

_____ In-the-canal (Insert earphone)

Initials of data recorder: _____

Decibels: _____

Publication date: Feb 1, 2011

Year: 2011

Dichotic Word Recognition in Noise and the Right-Ear Advantage

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Publication info: Journal of Speech, Language and Hearing Research (Online) 54.1 (Feb 1, 2011): 292-297A.
ProQuest document link

Abstract: This study sought to compare dichotic right-ear advantages (REAs) of young adults to older adult data (C. M. Roup, T. L. Wiley, &R. H. Wilson, 2006) after matching for overall levels of recognition performance. Specifically, speech-spectrum noise was introduced in order to reduce dichotic recognition performance of young adults to a level consistent with that of older adults with hearing loss. Dichotic word-recognition performance was evaluated in the free-recall response paradigm across 2 conditions: (a) quiet and (b) noise (+11 dB signal-to-noise ratio). Participants included a group of right-handed young adults (n = 32) with normal hearing. The introduction of noise resulted in significantly poorer dichotic word recognition performance than in the quiet condition for the young adults. REAs, however, did not differ between the 2 conditions. Relative to the Roup et al. (2006) older adult data, performance of the young adults in the noise condition resulted in (a) similar levels of overall recognition performance and (b) significantly smaller REAs. Results suggest that the magnitude of the REA is not dependent upon the difficulty of the dichotic task. Rather, the large REAs exhibited by older adults are more likely related to age-related deficits in auditory processing.

Full text: Headnote

Purpose: This study sought to compare dichotic right-ear advantages (REAs) of young adults to older adult data (C.M. Roup, T. L.Wiley, &R. H. Wilson, 2006) after matching for overall levels of recognition performance. Specifically, speech-spectrum noise was introduced in order to reduce dichotic recognition performance of young adults to a level consistent with that of older adults with hearing loss.

Method: Dichotic word-recognition performance was evaluated in the free-recall response paradigm across 2 conditions: (a) quiet and (b) noise (+11 dB signal-tonoise ratio). Participants included a group of right-handed young adults (n = 32) with normal hearing.

Results: The introduction of noise resulted in significantly poorer dichotic wordrecognition performance than in the quiet condition for the young adults. REAs, however, did not differ between the 2 conditions. Relative to the Roup et al. (2006) older adult data, performance of the young adults in the noise condition resulted in (a) similar levels of overall recognition performance and (b) significantly smaller REAs.

Conclusions: Results suggest that the magnitude of the REA is not dependent upon the difficulty of the dichotic task. Rather, the large REAs exhibited by older adults are more likely related to age-related deficits in auditory processing.

KEY WORDS: dichotic listening, right-ear advantage, aging

Dichotic speech recognition is a binaural auditory task that requires a listener to recall two different speech stimuli that are presented simultaneously to the two ears. For example, a word is presented to the right ear while a different word is simultaneously presented to the left ear. The listener is asked to recall one or both words, depending upon the response condition. It has long been recognized that most individuals exhibit better recognition performance for materials presented to the right ear (i.e., right-ear advantage [REA]; Kimura, 1967). The REA is thought to reflect the dominance of the left hemisphere in the perception of speech (Studdert-Kennedy &Shankweiler, 1970).

Dichotic listening has been used to measure age-related changes in auditory processing abilities in older adults (Bellis &Wilber, 2001; Golding, Carter, Mitchell, &Hood, 2004; Jerger, Alford, Lew, Rivera, &Chmiel, 1995; Noffsinger, Martinez, &Andrews, 1996; Roup, Wiley, &Wilson, 2006). Older adults exhibit reduced dichotic recognition performance relative to young adults across stimulus types (Jerger, Chmiel, Allen, &Wilson, 1994; Roup, Wiley, &Wilson, 2006; Strouse, Wilson, &Brush, 2000a, 2000b). Lower overall recognition performance is unsurprising given the difference in hearing sensitivity between these two groups. Older adults experience a

high prevalence of peripheral sensorineural hearing loss (SNHL; Cruickshanks et al., 1998; Sindhusake et al., 2001) and, therefore, do poorer on most speech tasks.

In addition, across dichotic stimulus types, mean REAs of older adult listeners are consistently and significantly larger than REAs of young adult listeners (Jerger et al., 1994; Roup et al., 2006; Wilson &Jaffe, 1996). Larger REAs in older adults do not seem to be explained by differences in hearing sensitivity given symmetric hearing sensitivity between ears. Rather, inspection of the data across studies reveals that performance on materials presented to the left ear declines at a faster rate than on materials presented to the right ear, as a function of increasing age. The greater deficit in performance on materials presented to the left ear is the basis for the large REAobserved in older adults and has been more appropriately described as a left-ear deficit (Jerger et al., 1994). Investigators speculate that the difference in REA magnitude between young and older adults reflects age-related changes in auditory processing beyond the level of the cochlea (Jerger et al., 1995). Specifically, it has been suggested that age-related declines in the interhemispheric transfer of information via the corpus callosum are, in part, responsible for the left-ear deficit exhibited by older adults (Bellis &Wilber, 2001; Jerger, 1997; Jerger et al., 1995). The observed left-ear deficit among older adults has been associated with poor speech-in-noise performance and, in some cases, rejection of binaural amplification (Allen, Schwab, Cranford, &Carpenter, 2000; Carter, Noe, &Wilson, 2001; Chmiel, Jerger, Murphy, Pirozzolo, &Tooley-Young, 1997).

The patterns of dichotic speech recognition performance observed among older adults with hearing loss, however, are based on comparisons with recognition performance of young adults with normal hearing. In particular, the differences in the magnitude of the REA between young and older adults are based on significant differences in overall levels of recognition performance. It could be that the typically small REA of young adults would increase significantly with a decrease in recognition performance similar to that exhibited by older adults. In this case, the larger REA exhibited by older adultsmay be a reflection of task difficulty rather than age-related declines in auditory processing. One way in which this assumption can be assessed is by reducing the dichotic recognition performance of young adults to a level consistent with that of older adults with hearing loss through the addition of background noise.

The impact of background noise on theREAhas been previously investigated in young adult listeners (Cullen, Thompson, Hughes, Berlin, &Samson, 1974; Godfrey, 1974; Sequeira, Specht, Hämäläinen, &Hugdahl, 2008a, 2008b). Using white noise as a masker,Weiss and House (1973) reported a nonsignificant <2% REA at a 0-dB signal-to-noise (S/N) ratio and a significant 6% REA at a -10-dB S/N ratio for CVC words. Cullen et al. (1974), on the other hand, measured dichotic CV recognition in band-limitedmasking noise. Cullen et al. observed that the mean REA in their group of young adult listeners remained essentially unchanged across multiple S/Nratios (È5% REA). More recently, Sequeira and colleagues (2008a, 2008b)measured dichoticCVrecognition in multitalker babble and traffic noise and reported a significant decrease in the REA relative to a quiet condition in their group of young adult listeners. The differences in methodology between studies-particularly, the type of background noise used-likely explain the differential effects of noise on the REA. When comparing the REAs of young adults with normal hearing to those of older adults with SNHL, however, no study has reported an increase inthe REA due to noise of the samemagnitude as that observed in older adult listeners. In a group of young adult listeners, Godfrey (1974) reported an overall REA of 6% across S/N ratios for dichotic CV recognition in white noise. Noffsinger et al. (1996), however, reported anREAof 16.8% for a group of older adults on a similar dichotic CV task. This suggests that although the REA for young adults with normal hearing may increase with the introduction of background noise, the magnitude appears to remain smaller than that exhibited by older adults.

The purpose of the present study was to determine if differences in the dichotic REA exist between young adults with normal hearing and previously published data from a group of older adults withSNHL(Roup et al., 2006) aftermatching for overall dichotic word-recognition performance. Specifically, dichotic word-recognition performance in a background of speech-spectrum noise was measured in a group of young adults with normal

hearing and then compared to performance reported for older adults on the same task. If the assumption that large REAs are due to age-related changes in auditory processing is correct, then the REAs of young adults under the noise condition should remain small. If, on the other hand, the large REAs exhibited by older adults are due to task difficulty, then the REAs of young adults under the noise condition should be significantly larger than under the quiet condition.

Method

Subjects

Thirty-two right-handed young adults (17 female, 15 male) participated in the present study. The subjects ranged in age from18 to 30 years with a mean age of 22.6 years. All subjects had normal hearing sensitivity, defined as pure-tone thresholds ≤20 dB HL for 250-8000 Hz. Bone-conduction thresholds were within 10 dB of air-conduction thresholds for 500-4000 Hz. Inclusion criteria included (a) normal otoscopy, (b) negative history of recent otic pathology, (c) screening tympanometry within normal limits (Roup,Wiley, Safady,&Stoppenbach, 1998), (d) English as the native language, and (e) righthandedness as determined by a laterality quotient of >40 on the Edinburgh Handedness Inventory (Oldfield, 1971). Subjects' handedness was limited to right-handedness due to the variability associated in dichotic speechrecognition performance known to exist among lefthanded individuals (Wilson &Leigh, 1996). All subjects were recruited from The Ohio State University student population in Columbus and were paid for their participation. The present study was approved by the Behavioral and Social Sciences Institutional Review Board at The Ohio State University.

Materials

Dichotic word recognition was measured using the Northwestern University Auditory Test No. 6 (NU-6; Tillman &Carhart, 1966) monosyllabic words from the Department of Veterans Affairs Speech Recognition and Identification Materials, Disc 1.1 (Department of Veterans Affairs, 1991). The 200 NU-6 monosyllabic words were paired to create 100 dichotic word pairs that included the carrier phrase "say the word" presented diotically. For details regarding the compilation of the dichotic word pairs, see Roup et al. (2006). In order to create a list of dichotic words in noise, each twochannel word pair was mixed with antiphasic speechspectrum noise (American National Standards Institute [ANSI], 2004) at an S/N ratio of +11 dB using speech editing software (Adobe Audition Version 1.5). Pilot data gathered prior to the experiment confirmed that dichotic word-recognition performance did not differ according to noise type (e.g., homophasic, antiphasic, or uncorrelated). Therefore, antiphasic speech-spectrum noise was selected in order to maintain lateral rather than midline perception. Pilot data also suggested that an S/N ratio of +11 dB would produce recognition performance levels in the 40%-60% range. This range of recognition performance was chosen to be consistent with dichotic wordrecognition performance levels exhibited by older adults for the same dichotic NU-6 word list (i.e., Roup et al., 2006). Multiple randomizations of the word lists were generated for both quiet and noise conditions and were recorded on a CD. Each randomization was recorded as four lists of 25 word pairs. A 4.5-s interstimulus interval was used.

Procedure

Dichotic word recognition was measured using the free-recall response paradigm under two listening conditions: (a) in quiet and (b) in speech-spectrum noise at a +11 dB S/N. The free-recall response paradigm requires the listener to repeat the stimuli from both ears, in any order. The subjects responded verbally, and the responses were recorded as correct or incorrect. Each condition consisted of 50 dichotic word trials made up of two randomizations of 25 word pairs. The randomizations were counterbalanced among the subjects in order to control for order effects. The dichotic words were directed from a CD player (Sony CE375) through a two-channel audiometer (Grason Stadler, Model 61) and were presented at 50 dB HL using insert earphones (EARTone 3A). All subjects were familiarized with the dichotic task prior to each listening condition. Each subject participated in a single 1-hr session. All audiometric and experimental testing was conducted in a double-walled sound attenuating booth (IAC 403 ATR). All equipment (audiometer, tympanometer) was

calibrated according to the appropriate ANSI standards (ANSI, 1987, 2004).

Results

Condition Comparisons

Mean dichotic word recognition and SDs for thequiet and noise conditions are presented in Table 1. Mean data for a group of older adults from Roup et al. (2006) are included for comparison. As can be seen in Table 1, dichotic word-recognition performance was reduced by the introduction of noise relative to the quiet condition for the young adult listeners. Specifically, mean recognition performance decreased by 33.3% and 34.3%for the right and left ears, respectively. In order to determine if the decrease in performance due to noise was significant, the percentage data were transformed to rationalized arcsine units (Studebaker, 1985) and were subjected to a two-way repeated-measures analysis of variance (ANOVA), with condition and ear as within-subjects factors. The ANOVA revealed a significant main effect for condition, $F(1, 31) = 333.3$, $p < .05$, indicating that dichotic word-recognition performancewas significantlyworse in noise than in quiet. The ANOVA also revealed a significant main effect for ear, $F(1, 31) = 12.9$, $p < .05$, indicating that performance on words presented to the right ear was significantly better than performance on words presented to the left ear.

Mean REAs across conditions are also presented in Table 1. The magnitude of the mean REA also changed with the introduction of noise. Specifically, the mean REA increased from 3.3% in the quiet condition to 5.9% in the noise condition. A t test of means was used to compare mean REAs between experimental conditions. Results did not reveal a significant difference in mean REAs between the quiet and noise conditions, $t(31) = -0.1$, $p > .05$. Although the introduction of noise significantly reduced overall dichotic word-recognition performance, a corresponding significant change in the magnitude of the REA was not observed.

Age Comparisons

The purpose of adding noise to the dichotic wordrecognition task was to reduce overall performance of the young-adult subjects to levels consistent with performance exhibited by older adults on the same task. For purposes of comparison, the two groups of older adult data (ranges = 60-69 and 70-77 years) from Roup et al. (2006) were combined into one group (n = 36, range = 60-77 years). Figure 1 presents individual data as a bivariate plot for the young adults (quiet and noise conditions) and the Roup et al. older adults, with the percent correct recognition for the words presented to the right ear on the abscissa and the percent correct recognition for the words presented to the left ear on the ordinate. The data points below the diagonal line indicate better performance on the words presented to the right ear (i.e., an REA), and those above the line indicate better performance on the words presented to the left ear (i.e., a left-ear advantage). The data points on the diagonal line indicate equal performance for words presented to each ear. As can be seen in Figure 1, recognition performance of the young adults from the noise condition (filled triangles) was quite similar to that of the Roup et al. older adult data (open squares), although the older adult data demonstrate greater variability. In order to determine if significant differences in performance existed between the young adults in noise and the Roup et al. older adults, we transformed the percentage data to rationalized arcsine units (Studebaker, 1985) and conducted a one-way ANOVA, with group as the between-subjects factor. Results did not reveal a significant difference in overall (i.e., both ears) dichotic word-recognition performance between the young adults in noise and the Roup et al. older adults, $F(1, 66) = 0.01$, $p > .05$. In other words, recognition performance was successfully matched between young adults with normal hearing and older adults with SNHL by the introduction of noise.

The data in Table 1 illustrate the difference in the magnitude of the mean REA observed between young and older adults. Specifically, the mean REA exhibited by the Roup et al. older adults (13.8%) was significantly larger than that of the young adults in both the quiet condition (3.3%), $t(67) = -1.8$, $p < .05$, and the noise condition (5.9%), $t(67) = -1.7$, $p < .05$. Large ear advantages exhibited by older adults are particularly evident when considering the five data points in the bottom right of Figure 1. These five data points represent older adult individuals with few if any responses from the left ear, illustrating a substantial deficit in the process of

dichotic stimuli.

Discussion

The implication that the left-ear deficits exhibited by older adults on dichotic speech recognition tasks are due to age-related deficits in auditory processing abilities is based primarily on the comparison of ear advantages between two groups with very different levels of overall recognition performance: young adults with normal hearing sensitivity and older adults with SNHL. The purpose of the present study, therefore, was to reduce dichotic word-recognition performance through the introduction of noise in a group of young-adult listeners,matching their performance to older adult data on the same dichotic task. Results revealed significantly poorer overall dichotic word-recognition performance due to the introduction of noise relative to the quiet condition.When recognition performance of the young adults in the noise condition was compared to the Roup et al. (2006) older adult data, no significant differences were found. The introduction of noise, therefore, successfully matched recognition performance of the young adults to that of older adults on the same dichotic word-recognition task.

In addition, results from the present study suggest that theREAs of young adults do not change significantly, despite significant reductions in overall recognition performance. The difference in REAs between the young and older adults, therefore, remains intact. Similar levels of dichoticword-recognition performance to that of the present study were reported by Dirks (1964) for low-pass filtered words in a group of young adults (40.3% and 33.3% for the right and left ears, respectively). The mean REA for the Dirks group was 7.0%, comparable with themean REA exhibited by the young adults in the noise condition (5.9%) from the present study, yet approximately half of the mean REA exhibited by the Roup et al. (2006) older adults (13.8%). Although there is some degree of overlap between groups (see Figure 1), the spread of individual data demonstrates the greater variability and larger ear advantages associated with older adult dichotic wordrecognition performance.

Conclusions and Clinical Implications

Background noise has often been used to reduce speech-recognition performance of young adults in an effort to make their results more comparable to those of older adults with hearing loss. It should be noted, however, that it is not possible to perfectly emulate the effects of age-related SNHL experienced by older adults through the addition of background noise. The results from the present study are, therefore, somewhat limited, based on the fact that direct comparisons between young adults with normal hearing and older adults with agerelated SNHL cannot be made. The introduction of noise to the dichotic word-recognition task served simply to provide similar levels of recognition performance from which more direct comparisons of ear advantages could be made.

Given that the REAs of the young adults did not increase significantly with the introduction of noise, the results of the present study suggest that the large REAs, or left-ear deficits, exhibited by older adults are not related to the difficulty of the dichotic task but, rather, are related to deficits in the processing of binaural competing signals. Deficits in binaural auditory processing among older adult listeners have been associated with a lack of benefit from binaural amplification (Allen et al., 2000; Carter et al., 2001; Jerger et al., 1994). The ability to identify those older adults with binaural auditory processing deficits prior to hearing-aid fitting may allow for improved fitting and counseling strategies, which in turn may result in improved perceived benefit from amplification. Further research is needed to identify specific patterns of recognition performance on dichotic speech-recognition tasks that would indicate potential binaural processing deficits related to rejection of binaural amplification.

Acknowledgments

Portions of this research were presented at the 2008 meeting of the American Auditory Society in Scottsdale, AZ. I would like to thank Terry L. Wiley for his comments on this article. I would also like to thank Kelsey Egelhoff, Elizabeth Moller, Shelley Bloom, and Makenzie Kline for their assistance with data collection.

Sidebar

Dichotic Word Recognition in Noise and the Right-Ear Advantage
Christina M. Roup
J Speech Lang Hear Res 2011;54;292-297; originally published online Aug 5, 2010; DOI: 10.1044/1092-4388(2010/09-0230)

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Received October 20, 2009
Accepted June 8, 2010
DOI: 10.1044/1092-4388(2010/09-0230)

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Publication date: Feb 1, 2011

Year: 2011

Old bats out of hell

Author: Walsh, John

Publication info: The Independent [London (UK)] 28 Jan 2011: 12.

Abstract (Abstract): Stannah sold their first Stairlift in 1974 and their name has become as generic as the Zimmer frame, "thought I read somewhere," admits Patrick Stannah, the company's CEO, "that Henry VIII is supposed to have had a stairlift". The market is now worth 150m, of which Stannah has 30 per cent. The once-derided device for getting the elderly to the first floor has become unwontedly popular in the last couple of years. Stairlifts, you might say, have gone through the roof. "The reason for their increased market penetration," said Stannah, "is that they really change people's lives. They allow them to live in their own home. The alternatives are not attractive - living downstairs all the time, moving house, moving to a care home. We've been selling stairlifts for 40 years - and now we're selling to the sons and daughters of our original customers, who learnt about the benefits 40 years ago. People simply know more about the benefits they provide. They've been normalised."

The secret, it seems, is to sell to the dependants of the immobilised. "The reality is, they are a really positive thing for people, so we talk to the extended family, the sons and daughters, and we get current customers involved in spreading the word." But is it possible to make them acceptable to a generation who think they're [Keith Richards] and [Helen Mirren]? "Our stairlifts are well designed, they look good, they're ergonomic, they're aesthetically pleasing, they're a mile away from where they were 40 years ago," said Stannah. "We can do great things with upholstery. We haven't sold a Stairlift to a rock star yet, but I'm sure it's coming, sooner or later."

"I think business still underestimates the importance of older people," says Mark Gettinby, general manager of group product development. "They tend to focus on young consumers and nobody else. A good example is mobile phones. People haven't engaged with producing a mobile that works for older people. Most major telecoms concentrate on getting customers to change their contract; but older people tend not to change their phones so frequently, so they're not a target. But also, the buttons on many phones are so small, they're hard to use - and they haven't brought phones to market that deal with such issues. In fact, they've gone to extreme lengths to make things ever smaller rather than to be legible. Not just the buttons, but the menu options too."

Full text: The Friday Essay Advertisers take heed - the booming consumer market is not young and funky, it's old and wrinkly. John Walsh heralds the power of the grey pound

Over Christmas, Nintendo launched a television ad campaign for their Wii Fit Plus. The aspiring athlete stands on a plastic tray, waves a wand at a television while exercising, and finds that his or her every move, twist and jerk is replicated on screen. As parents will tell you, Wii technology entertains children for hours. So which foxy, bendy, pliant-muscled, teen dreamboat did the company's marketing people choose to sell their product? Why, Helen Mirren, Dame Commander of the Order of the British Empire and veteran actress, whose most famous role was impersonating HM the Queen in old age. She herself, born in 1945, hits 66 in July.

In the commercial, she explains how easy the Wii Fit Plus is to assemble, what a happy alternative it is to a gymnasium ("Gym is a palaver"), how varied are its effects - it's almost, she says, "like having a new lover every day". Glowing with health in comfortable sweat pants, she concludes: "I would never have imagined myself exercising through a video console, and now I feel very, very modern and very young." You could say that Nintendo got their money's worth for the 500,000 the two-day shoot reportedly cost.

Welcome to the world of the grey pound, where enlightened businessmen strive to win the approval of an ever-growing horde of comfortably-off senior citizens. It's quite a market, and it keeps growing. According to the Office for National Statistics' new Family Spending report, the amount spent annually by over-65s rose from 97bn in 2008 to 102bn in 2009. That's 16 per cent of the nation's total expenditure. Also notable is the increasing disinclination of the over-65s to die around the time of their Biblical span of 70. According to figures released in December, one in six people now living in the UK will live to be 100.

Perhaps this accounts for the stubborn way that many of the almost-elderly refuse to accept their status as emblems of decrepitude, fit only for the twilight home. According to a report by LV=, the retirement specialists, sixtysomethings are happier than their younger counterparts, feel financially more secure and physically more robust. They take more holidays than any other age group; nearly half take two or three trips abroad a year. Perhaps surprisingly, they have also been embracing technology (email, Skype, Facebook and internet shopping) with age-inappropriate enthusiasm.

What, though, is the response of the retail world to this windfall of well-off, well-disposed, energetically high-spending consumers? How are they adapting their marketing strategies to hook these fat trophy fish swimming under their very noses? One way has been to co-opt totemic figures of age and survival. Dame Helen is only the most recent in a long line. In April 2008, the rock vampire Keith Richards, at 65, was persuaded to make his first-ever commercial. He was photographed by Annie Leibovitz, sitting on a hotel-room bed strumming a guitar, to promote the virtues of Louis Vuitton luggage. Other famous faces Vuitton dragooned into commercial modelling were Catherine Deneuve (67) and Mikhail Gorbachev (79).

In the world of fashion retail, whose basic orthodoxy is to display clothes on the most egregiously youthful and slender, Marks &Spencer caused a small but significant revolution when they signed the Sixties model Twiggy to promote their rebranding in 2005. She was 56 at the time, and is still appearing on television screens, without cracking the plasma, at 61. Debenhams followed suit last September, when they filled their windows with photos of models in their 40s, 50s and 60s, looking far from mumsy. It was a new initiative called The Style List, launched in conjunction with the fashionista Caryn Franklin, and follows other enlightened initiatives by the store chain, such as using size 16 mannequins and disabled models, and banning airbrushing.

Ageing male models are still a rarity in British male fashion. We have to look to Germany and Italy for inspiration. The German company Baldessarini, an offshoot of Hugo Boss named after its Swiss-Tyrolese founder Werner Baldessarini, markets its clothing and fragrances squarely at the sixtysomething playboy. The chap in the magazine ads is a craggy, retirement-age Adonis, his hair slicked back with expensive oil; he radiates hard-won success, good fortune and intellectual genius, while behind him a fruity brunette in a black, shag-me-Sir-Jasper frock heads for the steps of his Lear jet.

A German-born, Turkish visionary called Umit Benan has set out a store of clothes that is the envy of other designers. He has dressed a cast of 60- plus men as members of a stylish, slightly shagged-out rock'n'roll band, with an uncompromising style. The models for his Retired Rockers collection are a gallery of rogues in mix-and-don't-match styles and colours, shiny suits, 1950s shades, chocolate corduroy waistcoats, headbands, leopardskin jackets, voluminous coats, vaudevillian hats... The look is intensely silly and oddly reassuring - as though warning relatives that sixtysomething geezers will dress up any way they damn well please. But Benan clearly understands his ageing market - he makes chaps look convincingly slim, even at sixtyish, in his luxurious, well-cut fabrics. What about the mature female denim-wearer who wants to look trendy but doesn't fancy (and frankly can't fit into) her daughter's super-skinny, boot-cut jeans?

The company with the answer is Not Your Daughter's Jeans. Their soft-sell marketing coos with reassurance: "Some people say that youth is wasted on the young. But age has its distinct advantages. You're a little wiser, a lot more confident and face it - sexier than ever. You're not a teenager any more - you've been there and now you're past it, beyond it and happy to be exactly where and who you are. You wouldn't trade places with your daughter, or trade clothes with her either..."

Their version of denim contains 4 per cent Lycra for extra stretch, and a front panel that holds the mature female stomach in. Shrewdly, their advertising doesn't show a whole woman - only the lower half of a horizontal model, the jeans stretching across a curvaceous, mature bottom.

The health market - or more bluntly, the infirmity market - is set to become a battleground, as companies compete to sell older customers mobility aids and the like. The problem for them, of course, is image and the built-in dismalness of their names. For years, the Zimmer frame has become synonymous with decrepitude, immobility, the shuffling of the stricken. The Stannah Stairlift has become the humorously generic name associated with old ladies (the late Thora Hird comes to mind) unable to drag their elderly carcasses upstairs. The ear trumpet was comically Victorian, associated with retired brigadiers and irascible dowagers, but its replacement, the hearing-aid, featuring a crayfish-shaped plastic box worn behind the ear, fatally signalled the owner as a Deaf Old Git.

You should see them now. Hearing aids have changed beyond recognition. Leightons, the leading opticians, reassure their readers thus: "Many people fear that a hearing aid will make them look older and be unsuitable for the active, busy lifestyle which they are probably enjoying. [Don't you love that 'probably'?] But many of today's programmable and open ear hearing aids are amazingly light, small, stylish and clever. Just like the human brain they can identify those sounds we want to hear, while filtering out unwanted sounds, like background noise."

The super-grooviest deaf-aids are the Phonak brand. They fit inside the ear, are virtually invisible and boast cool digital features - "StereoZoom, which takes binaural processing technology to a whole new level" or the "DuoPhone" which lets you hear a voice on the phone in both ears. And now that a few million teenagers walk around with headphones in their ears, the aural stigma or wearing an earpiece has virtually disappeared.

You'd think, wouldn't you, that to make walking frames seem cool would be beyond the ingenuity of man? The name of the main manufacturer is so generic that when a group of octogenarians formed a rock band in 2007, they called it the Zimmers. But while the light, tubular walking aid still carries about it a whiff of the geriatric ward, say hello to the Rollator. It's European, it's sophisticated in shiny tubular blue and it looks like a shopping trolley with a seat, a basket and a set of brakes. Using just one, a reckless oldie could execute a nifty 180-degree turn on a street corner. Pimp my Zimmer frame - who'd have thought it?

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Mr Stannah should check out the video for Pulp's song Help the Aged, on which Jarvis Cocker can be seen serenely gliding up a long graceful staircase on a bespoke version of the ascending throne.

Even the sex industry has come round to accommodating the needs of the aged. In Germany, where

prostitution has been fully legal since 2002, special provision is now being made for this niche demographic. The Artemis brothel in Berlin, the largest "luxury wellness" house of prostitution in Germany, told the local newspaper Der Tagesspiegel that they were introducing "facilities" for the old lecher. They were coy about the actual details (for which we should be grateful,) but they included newly-installed seats in the showers, "helpful personnel" and changing rooms that can accommodate wheelchairs. Among the country's 150,000 officially registered prostitutes, many now offer advanced forms of occupational therapy to senior citizens in retirement homes. Some homes have even converted rooms into "intimate encounter" boudoirs, with the blessing of the local church organisations which own and run them.

You would think, in view of all this activity, that the age lobby would be pleased and flattered to be wooed so assiduously by manufacturers. But you'd be wrong. Age UK, the charity formed by the 2009 marriage of Help the Aged and Age Concern, has been running a campaign for a year called the Engage Business Network. Its aim is to persuade companies to take older people into account as consumers - to consider, for instance, how hard it can be for frail hands to get past layers of plastic packaging, or for short tempers to deal with call-centre telephonists in Pondicherry.

"I think business still underestimates the importance of older people," says Mark Gettinby, general manager of group product development. "They tend to focus on young consumers and nobody else. A good example is mobile phones. People haven't engaged with producing a mobile that works for older people. Most major telecoms concentrate on getting customers to change their contract; but older people tend not to change their phones so frequently, so they're not a target. But also, the buttons on many phones are so small, they're hard to use - and they haven't brought phones to market that deal with such issues. In fact, they've gone to extreme lengths to make things ever smaller rather than to be legible. Not just the buttons, but the menu options too."

He makes an exception for the Apple iPad, which is proving surprisingly granny-friendly. "The iPad's tablet format will probably be the thing that cracks technology for older people, both in its size, its operability, and its point-and-touch user-friendliness. It doesn't require complicated menus and it doesn't flash a sign saying 'Fatal Error!' which can be scary for people who don't know what to do."

Age UK has also looked into the financial services market. "We discovered that 97 per cent of travel insurers have an upper age limit, which might kick in as early as 69. We've started doing our own insurance and the oldest customer we covered was Harry Patch, the First World War veteran, who was 109. We insured him to travel back to the battlefields of Flanders. We're also looking at car insurance, where people have gone to town putting upper age limits on people who feel they can't shop around. It's not about age, though - it's about whether people feel confident about driving."

The charity has been lobbying UK companies, trying to persuade them that the grey pound is worth capturing and the older customer worth pursuing. "We've been working with forward-thinking organisations, like Marks &Spencer, to demonstrate that things like food packaging can be done better. The Government is aware this is happening. Their view is that if British companies don't do it, some foreign company is going to come and do it much better and the British are going to lose market share. So we're both saying, 'C'mon guys, get your act together and do this.'"

Bold words from the age lobby. Stand by for an explosion in goods for the Third Age generation. Sit tight for the supercharged golf buggy. Hold on for Jean-Paul Gaultier incontinence pants. Stand by for the Philippe Starck walk-in bathtub...

Publication date: Jan 28, 2011

Year: 2011

Etymotic Receives Prestigious CEA Innovations Award

Author: Anonymous

Publication info: Business Wire [New York] 04 Jan 2011.
ProQuest document link

Abstract: EB-series electronic ear protection developed to save the hearing of deployed troops Etymotic Research Gail Gudmundsen, 847-228-0006 g_gudmundsen@etymotic.com Etymotic Research, an innovator in high-fidelity hearing protection, listening and communication devices, was honored on November 9, 2010 at the CES Unveiled press preview in New York, where the Consumer Electronics Association announced winners of the 2011 Innovations Awards.

Full text: EB-series electronic ear protection developed to save the hearing of deployed troops

Etymotic Research
Gail Gudmundsen, 847-228-0006
g_gudmundsen@etymotic.com

Etymotic Research, an innovator in high-fidelity hearing protection, listening and communication devices, was honored on November 9, 2010 at the CES Unveiled press preview in New York, where the Consumer Electronics Association announced winners of the 2011 Innovations Awards. Etymotic's EB-series of electronic BlastPLG(TM) Earplugs, developed to mitigate hearing damage and tinnitus sustained by deployed Warfighters, is Best Innovations Honoree in CEA's new Health and Wellness category.

There are two versions of Etymotic's Blast Plug. EB15 is for persons who operate some or most of the time around continuous loud noise such as machinery and military vehicles and also need protection against gunfire and explosions. EB1 is for hunters who want to hear naturally and be protected from sudden firearm blasts when there isn't time to insert hearing protection.

"EB15 circuitry is configured with adaptive attenuation to become a 15-dB earplug when noise levels put the user at increased risk for hearing damage," said Dr. Mead Killion, founder of Etymotic Research and the inventor of the ER-series Blast Plugs. "Despite risk to hearing from loud machinery and sudden blasts, Warfighters decline to wear hearing protection because it interferes with situational awareness and their ability to localize quieter sounds."

Noise-induced hearing loss is a growing public health concern. Many persons are at risk for hearing damage in the workplace, ranging from construction workers to backstage and front-of-house personnel at music venues. Both versions of blast plug are designed to restore sound that is blocked when the ear canal is sealed. Both allow the user to hear naturally, as though there were nothing in the ears. When no loud noise is present, the EB15s return to natural hearing, as if nothing is in the ears to block sound.

Electronic BlastPLG earplugs are sold on the Etymotic Research website. MSRP is $449 for EB1 (pair) and $499 for EB15 (pair). Included with each pair EB Electronic BlastPLG earplugs is an assortment of ready-fit eartips, a filter removal tool and extra wax filters, headband for wind noise reduction, carrying pouch, one pair of ETYPlugs(TM) (ER-20--passive) high-fidelity earplugs and a 6-month supply of batteries.

Etymotic is actively seeking distribution partners and authorized dealers and will demonstrate both BlastPLG Earplug products at CES Booth #4018 in the North Hall.

About Etymotic Research

Chicago-based Etymotic Research, the original inventor of in-ear earphones, is a research, development and manufacturing company designing products to measure, improve and protect hearing. Etymotic's

groundbreaking K-AMP(R) integrated circuit and directional microphone technology revolutionized hearing aid design. Among its many contributions are high-fidelity hearing protection for musicians and noise-isolating, high-fidelity in-ear earphones and headsets for consumer and telephony markets. In 2010, Etymotic was honored by the National Institute for Occupational Safety and Health (NIOSH) and the National Hearing Conservation Association with a prestigious Safe-in-Sound Award.
www.etymotic.com.
Abstract:

Company / organization: Name: Etymotic Research; NAICS: 334220; Name: Consumer Electronics Association; NAICS: 813910;

Publication date: Jan 4, 2011

Year: 2011

Lovesong of the Electric Bear

Author: Wilson, Snoo

Publication info: New England Review 32.1 (2011): 8-59,190.
ProQuest document link

Abstract: A play is presented.

Full text: PERFORMANCE PIECES
The play by Snoo Wilson presented here is an imaginative recreation of the intricate interior life of Alan Turing (1912-54), the English mathematician whose idea of the Universal Turing Machine figures significantly in the conception and development of the modern computer, an embodiment of artificial intelligence that can be programmed to perform a sequence of operations leading to the solution of complex and challenging problems. Turing's early education took place at Sherborne School in Dorset. After securing First-Class Honors in Mathematics and a graduate fellowship at King's College, Cambridge, and a Ph.D. at Princeton University, he first came to prominence as one of the most brilliant of the codebreakers assembled to work together at Bletchley Park during the Second World War to out-think the German Enigma machine used to generate codes for strategic military communications, and he was for a time the head of the section assigned responsibility for deciphering the particular codes involved in German naval operations (including U-boat attacks). He ultimately became chief consultant for the overall program of codebreaking operations. During this period, among his colleagues Turing became as well-known for his various forms of eccentricity and unpredictability as for his evident genius. For his numerous significant accomplishments, in the late stages of the war he was awarded the Order of the British Empire. When the war ended, he was offered a position at the National Physical Laboratory in London, where he focused his attention on an ambitious plan for the design and production of an electronic computer. In 1951 his distinguished work as a scientist was recognized when he had the honor of being elected a Fellow of the Royal Society. Arrested and prosecuted in 1952 for homosexuality (which was at that time illegal under English law), he was subsequently denied security clearance by the British government. In order to avoid imprisonment, he submitted to a year of estrogen treatments meant to produce a form of chemical castration. He died of cyanide poisoning in the spring of 1954. In the fall of 2009, Prime Minister Gordon Brown issued a formal public apology to Turing for his treatment after the war. Readers interested in more detailed information

about Turing's life and achievements may wish to begin by consulting Andrew Hodges's account in the Oxford Dictionary ofNtttionttl Biography, as well as the Turing website that Hodges maintains at www.turing.org.uk.

Cast of Characters (doubling as needed):

* ALAN TURING
* PORGY BEAR
* BLACKWOOD, TURING SR [JULIUS], CORNISH, SERGEANT
* WINSTON CHURCHILL, DAVIS, BARMAN, GREENBAUM, DILLY KNOX
* CLEMMIE CHURCHILL, MOTHER, JUDGE
* CHRISTOPHER MORCOM, JOAN CLARKE
* KJELL CHRISTIANSEN, UNDERGRAD I, MARIAN REJEWSKI, ARNOLD MURRAY
* NURSE, FORTUNE TELLER, UNDERGRAD 2, YLENA
* BRONWYN, VARIA
* OLD SOUTHERN WOMAN, HALLAM, MAN

Act 1

(Churchill at his easel, an old man, in sunhat, painting outdoors. Dappled light. Birdsong.)

CLEMMIE: (Off) Winston! Winston!

(Enter Clemmie^ his ancient wife. Churchill oblivious.)

CLEMMIE: (Accusatory) Where's your hearing aid?

(Clemmie goes to Churchill's jacket, looks in the pockets. Failure. She has to speak louder.)

CLEMMIE: (Loud) Moran called, with bad news - for you, he said. Lord Moran. Your physician, Winston.

CHURCHILL: Bad news is always the same from my doctor: "You drink too much."

CLEMMIE : He said you would want to know. Alan Turing's dead.

CHURCHILL: Come off it, woman - Hermann Goering's been dead for years!

CLEMMIE: No, Alan Turing. (Precise) A-LAN TU-RING.

CHURCHILL: (Shocked) Turing . . . How?

CLEMMIE: By his own hand.

CHURCHILL: Oh, Christ.

CLEMMIE: Who was he? I never heard his name before.

CHURCHILL: He was a Bletchley backroom boy. A genius.

CLEMMIE: Why would he kill himself?

(Turing becomes visible, wrapped only in a sheet, peacefully dead. He is holding an apple with a bite out of it. He could be Christ taken down recently from the cross. Churchill shakes his head and turns away.)

CHURCHILL: He can't have been more than forty.

CLEMMIE: Will you come in now? IfI call you when it's lunch time, you won't hear. I'm not coming out again. I'm too old to be running around.

CHURCHILL : I'll come now. The shadows are all in the wrong places. (Pause.) Another good man down.

(Churchill moves off slowly, supported by Clemmie. EA#> Clemmie and Churchill. Porgy comes to Turing and coughs discreetly to arouse him.)

PORGY: Knock-Knock!

TURING: Go away. I thought I told you clearly, Porgy, I wanted to be alone.

PORGY: I know what you're doing in there! And Pm not going to stand for it!

TURING: I can't get it up. They pumped me so full of hormones Pm growing tits. How bad does it get before you are allowed to kill yourself?

PORGY: You haven't.

TURING: Haven't what?

PORGY : Haven't just now killed yourself with a poisoned apple. (Porgy takes half-eaten apple, palms it,

produces whole ttpple.)
PORGY: There, it never 'appened. We'll say no more aboutit. Now, don't beso childish as to try to leave me, ever again. It's selfish, and such bad manners. What would I do, with Master gone?
TURING: Kjell's not coming. It's the final straw.
PORGY: Shame. I rather liked that Kj ell. Uncomplicated. Outdoor type. Just what you needed.
(Enter Hallan, a customs officer, ana a tall handsome Norwegian, Kj ell Christiansen. Kjell sits, amused at the uptight Hallam.)
HALLAM: Mr. Christiansen? Would you tell me who you are proposing to see in Manchester?
KJELL : The good friend whose residence address I have given you. He is called Alan. Hey! You should relax. I'm not the enemy. Norway fought the Germans too. My uncle had once fled on skis away from the Nazis, cross country, nonstop for twentyfour hours. He was faster going down the hills but the German was faster coming up because of my uncle's broken arm. So he allowed the German to catch up with him; and killed him.
HALLAM : What do you know about Doctor Turing's work?
KJELL : Nothing. I don't know anything about his work except what he do to me. We met on holiday and he invited me to England.
HALLAM: Since this liaison could constitute a breach in national security, I'm using the powers vested in me by Her Majesty's Government to refuse you entry to this country as an undesirable alien.
KJELL: Okay. Call me what you like. Do what you gotta do! I still think you're cruel bastards.
HALLAM : Informally, as a Christian, Mr. Christiansen, do you ever reflect on the eternal punishments that God is reserving for sodomites?
KJELL: Who said I was a fucking Christian? I kill whales - that's my religion.
HALLAM : This way, Mr. Christiansen. (E^VHallam ¿mrfKjell. P 'orgy presents fan ancient bicycle to Turing.)
PORGY: This is your old bicycle. Recognize it? It is to be your dream transport through the ether, to the childhood home! Before you can say "Jack Robinson" you'll be twelve years old again.
TURING : Do I really have to go back, Porgy? I was bloody miserable, most of the time.
PORGY: Like it or not, it's happening, and how many people would not give their molars to be like you, getting younger at every breath? We're crossing the channel now. Next thing you know, it'll be the morning of your youth. The merry merry month of May, 1926! Smell the springtime wafting from the coast of Brittany.
(Sea swell, languid. Effects moving in time to this. Waves fade. Sound of distant hymn singing. Porgy points.)
PORGY: Look down at those peasants in their religious procession! What on earth to make of it? The women impossibly devout, all covered in lace. And the men all staggering along under one enormous crucifix, topped off with that vast lurid bleeding plaster Christ.
TURING: (Disgusted) Urgh!
PORGY: If you don't like blood, don't look. And keep your voice down; if they saw us flying above them, without visible means of support, they'd probably think we were the devil, and pelt us with stones. Flaps and undercarriage down: we're a few meters above the Turing residence, where you will see your mother - there she is! - standing at the garden gate chatting gaily to a sodomite in a black skirt.
TURING : It's her priest, Porgy; he's wearing a soutane. Surely you know what a priest is?
PORGY: You have to remember, Master, that I am only a bear. He looks pretty light on his feet to me. Unless you slow down you'll whack the old pooftah on the head with the front wheel! Down gently now. Emergency crashland. Whoops!
(Turing falls. Exit Porgy. Enter Mrs. Turing in fa flor fai h fat fana white gloves. She is spying goodbye to fan offstage character. At the sfame time Turing Sr. comes iny dressed in treeds fand cavalry trousers.)
MRS TURING : Such a lovely service, father-Une Belle Service! (To Turing Sr.) Aren't you pleased we came to live in France now, Julius?
TURING SR: Not a bit of it. I always knew it was going to be a disaster. Look what's happening now. Alan's

meant to be going to boarding school in Blighty tomorrow, but it's the start of the General Strike. The St. Malo ferry is run by the Frogs, so he can get across the channel, but then how is he going to get to his bloody school?
MRS TURING : There's something we should discuss. Alan tried to pack his bear! His elder brother says he's not ready for Sherborne, Julius. John said that if the other boys had found out about the animal, they would have ragged Alan to death. Could we not wait till the autumn term when he'll be fourteen?
TURING SR: Too late. I've paid this term's fees. (Exits.)
MRS TURING: Alan, I've told you before not to use our good cutlery to mend a puncture!
TURING: I'm sorry, mother. A giant nail appears to have fallen from the cross in the procession and gouged the innards of my front tube.
MRS TURING: You've ruined a whole set of fishknives!
TURING : Why do you need separate knives for fish anyway? I need to mend it now. If the trains aren't running tomorrow in England, I'll go by bike. It's only sixty miles.
(Mrs. Turing exits. Enter Porgy.)
PORGY: Well-ridden, Master! You're in the local English newspaper! "Boy Rides Bicycle Sixty Miles to First Day at School." What an amazing beginning to your time at Sherborne. Wait here for your oppressor.
(Porgy takes bike ttnd exits. Turing, sdone, is (approached by ttn older boyy Blackwood, wearing a gown.)
BLACKWOOD : Hey, you! Standing on the grass is a flogging offense.
TURING: Where does it say that?
BLACKWOOD: Nowhere.
TURING: I'm new.
BLACKWOOD : You've got a lot to learn, then. Only beaks are allowed to set foot there.
TURING: Are you a beak?
BLACKWOOD: Next year I'll be a beak.
TURING: I've just ridden here from Southampton.
BLACKWOOD : Did you get permission to ride outside school grounds?
TURING : How could I? I was riding in. Are you stupid?
BLACKWOOD: What's yer name?
TURING: My last name is Turing.
BLACKWOOD : All right, Turing. Come to the gym in ten minutes.
TURING: Why?
BLACKWOOD : We're going to break you in.
(Enter Porgy holding &doll of a schoolboy in a, scruffy school cap.)
PORGY: (to Turing) Stay there. Don't move, Master. Everything's taken care of. No blood. This won't hurt.
(Blackwood seizes Porgy' s doll and thrusts it into a, wastepaper basket, which he kicks offstage, to cheers. The basket rolls back on; Blackwood kicks it off to cheers again. Blackwood mutilates and finally boots the doll offstage.)
BLACKWOOD: Go and warm my bog seat, Turing.
TURING: Which cubicle is that, Blackwood?
BLACKWOOD: You should know. If you get it wrong, we'll nail you under the floorboards again.
(Turing looks round in despair. Porgy crouches upstage.)
PORGY: Psst! Alan! Master! Over here - that's right.
TURING : Why don't any of these lavatories have doors?
PORGY: For reasons I would blush to go into. Trousers down and sit. On me head!
(Turing mimes taking his trousers down ana sits on Porgy. He then starts writing on his hand.)
PORGY: That's right. And then, get on with your maths homework, Master. That's the ticket. Getting warmer!

Blackwood won't be able to complain now. Excellent!
(Enter Blackwood. Blackwood sniffs.)
BLACKWOOD : Have you just farted, Turing?
PORGY: For pity's sake, man, if you can't fart here, where can you? (Fart, off.) Nothing to do with us. Take up your complaints with cubicle 3!
(Turing stands. Blackwood points at Porgy.)
BLACKWOOD : Is that shit?
PORGY: Hurry up. Your seat's getting cold.
BLACKWOOD : You dirty little oik! It's on your hand, too!
TURING: It's ink. I was doing calculus.
(Porgy stands.)
PORGY: All right, that's enough, Blackwood. You are dismissed.
(Blackwood moves away, as if under a spell. Lights change. Enter Mrs. Turing., excited.)
MRS TURING : Alan . . . Do you want to have your palm read? For a bit of fun? She's a gypsy, Alan.
TURING : It says it costs a shilling.
MRS TURING: I'll pay! But don't tell your father.
(Effects, smoke. Fortune Teller sits with cowled head draped with fairy lights. Turing approaches through the smoke and offers his hand to be examined. Heavenly music; climax. The fairy lights die and Turing goes back to center stage.)
MRS TURING: What did she say, Alan?
TURING: She said it was the hand of a genius.
MRS TURING: (Disbelieving) Genius? You??
PORGY: Genius: native intellectual power of an exalted type, with extraordinary capacity for imaginative creation.
MRS TURING : Well, that is the most ridiculous thing I have ever heard.
TURING: Why?
MRS TURING : How she can call anyone who gives his left hand when asked for his right a genius, I have no idea. (Slaps Turing, several times.) You are a stupid ungrateful little boy who we all work night and day to support and put through public school and you won't even say your prayers and keep your hands and face clean!
(Exit Mrs. Turing. Turing shocked.)
PORGY: Don't worry about your mother. At school you have a true friend, sober, unchangeable, one whose heart is pure, and mirror to your soul.
(Enter Christopher Morcom, fairhaired and pure.)
MORCOM : My dear Turing, I just thought you might know about something I can't figure for the life of me. It's for this stupid additional scholarship paper they want me to take. They wouldn't let me take the exam at first because they said I was too ill. Now I risk looking a complete twit by failing the maths.
TURING: What kind of maths, Morcom?
MORCOM: Hyperboloids. What are hyperboloids, when they're at home?
TURING : They're a sort of mathematical curve. A solid or surface of the second degree, some of whose plane sections are hyperbolas, and the other ellipses or circles. I think, anyway. I could be wrong.
MORCOM: No, you're not. Thank you. I am ever in your debt, Turing. I shall repay it in whatever currency you nominate.
TURING : You could help me with a scientific test.
MORCOM: A test on what?
TURING : I want to see what happens when you drop a stone down the funnel of a locomotive. You know where

the bridge is at the bottom of the hill, over the railway line? The train from the quarry comes through every day at four.
MORCOM: But you'd have to guess where the funnel was in all the smoke, wouldn't you?
TURING: It's never going more than walking pace. And the path of the funnel will always be equidistant from each track.
MORCOM: The stone might get blown straight out again by the steam and take your head off.
TURING: I admit there is a slight risk. But that's true of any experiment, isn't it?
MORCOM: I suppose so. And I gave you my word. (Chuffing growing louder and louder; smoke.)
TURING: We pile up our stones at the dead center of the parapet, so we can drop a rapid sequence of projectiles. One of them has to find the target. Ready now - bombs away! One! Two! Three! Four! Five! Six!
(Blackout. Chuffing superseded by squeal of engine braking. Clank of stone falling on ironwork. Lights. Noise of caning. Morcom waiting.)
MORCOM: (Counting strokes) One, two, three, four, five, six.
(Enter Turing, rubbing his legs.)
MORCOM: Did he practice his golf swing on you?
TURING: He must be truly crap at golf, because the last one caught me behind the knees.
MORCOM: Oh, he is crap at golf. But why did he let me off? The engine driver had to have stitches. Why isn't he beating me too?
TURING: He said you were sick. You have a note excusing you from cricket, don't you?
MORCOM: You're not playing cricket, either, and you're not sick.
TURING: That's because my family is so poor. My father wrote to the housemaster, saying it's a waste of time. Plus secret agenda, he doesn't have to fork out for white flannels.
MORCOM: What does your father do?
TURING: He moans. Everything dissatisfies him. He took early retirement from the Indian Civil Service, because the writing is on the wall for the Raj. He speaks five Indian languages but his pension is the size of an electron. He moved to France to try to dodge English income tax. Then they came back because he can't stand the French.
MORCOM: How strange. (Pause.) I can see five boys smoking behind the pavilion.
TURING: D'you smoke?
MORCOM: Mother has promised me a thousand pounds when I'm twenty-one not to.
TURING: My father says my schooling is costing him ten point five times what he spends on tobacco each day
(Porgy sets up &looser tra.ce of light thttt mimics the ba.se of a huge slow pendulum.)
TURING: Why were you so late back into school this term?
MORCOM: Because I am unclean.
TURING: You're what?
MORCOM: I had tuberculosis once, and recently I had a relapse. Nothing serious. Pm perfectly all right now. I felt fine all through the Cambridge entrance exam.
TURING: I felt fine; I just knew I was crap.
MORCOM: Be nice if we both got a Cambridge scholarship, but it won't happen. I made a total hash of question four. All my hyperboloids deserted me.
TURING: At least with maths exams you know immediately how you've done. I think I got more than half right so I will scrape into Cambridge. But I can hear my father sighing already, calculating the difference he's going to have to pay because I'm not Einstein.
MORCOM: Einstein says imagination is more important than ability, and you imagine pretty well. He was a late developer too. Like you.
(Enter Blackwood.)

BLACKWOOD: Where are the bloody squits?
TURING: Not here. At long stop, silly mid-off, and square leg. Over there. On the cricket pitch, Blackwood.
BLACKWOOD: What's this piece of string?
TURING: It is an experiment into the physical properties of gravity. It's the stuff that makes us stay on the earth and not float away, Blackwood. When weighted and tied off to the light fitting at the top of the stairwell, the moving string swings in one plane only, ignoring the rotation of the earth. It's called Foucault's pendulum, after its discoverer. The string doesn't seem to "know" the earth is rotating. Any idea why?
BLACKWOOD: Turing, only the headboy is allowed facial hair in school.
TURING: The problem till just now has been I cut myself when I shave and then I pass out, which doesn't leave me in a good state for taking exams.
BLACKWOOD: Shave.
(Exit Blackwood. He calls, from off: FAG!!)
TURING: Do you not think Blackwood's probably just a machine? Cogs and wheels and so on?
MORCOM: You mean, without a soul? Surely not. There's got to be something after death.
TURING : Maybe. Sooner or later we'll all find out.
(Morcom coughs blood into a, handkerchief, violently. Porgy removes handkerchief and escorts Morcom off.
PORGY: Don't look, young Master, don't look or you'll faint!
(Enter Davis, a schoolteacher.)
DAVIS : You know about tuberculosis and its perils, don't you, Turing? Particularly dangerous in the internal organs. Lungs' risk of hemorrhaging, and so forth. Had another boy contract it last year. Wretched business. I'm afraid your friend Christopher Morcom had a considerable infection. He has now been summoned to the ethereal realms where I have no doubt there is rejoicing at his arrival. He was a very pure boy.
TURING: Christopher, dead?
DAVIS : Yes, it's a hard thing to face. But there's no going back on it. I understand you were friends with him, Turing.
TURING : I would stay with him in the holidays.
DAVIS : Ah, that's probably why his parents thought you should know, be told. His collapse was sudden but not unexpected medically. Even so, a frightful blow for the school right after he won that scholarship to Cambridge. I gather you only got a pass, is that right?
TURING : He was a lot cleverer than me, sir.
DAVIS: Morcom was a very thoughtful boy. We have to make the best of these experiences, Turing. What you should do is think of Morcom as a Christian example, walking beside you still, urging you on, encouraging you through this vale of tears, to greater effort. You yourself are quite ordinary, academically, but if you applied yourself, you might find that extraordinary things come.
TURING: Yes, sir.
DAVIS : Nothing is to be gained by slacking. (Pmse.) Turing, when your housemaster told you about the facts of life, the birds and the bees, did he mention the perils of masturbation?
TURING: Yes, sir.
DAVIS : When you leave the school, you may at Cambridge think that you're grown up, and that if you start it won't stunt your development. But the practice is still perilous. Each erection drains the blood from the brain. Far from being manly, masturbation produces thoroughly undesirable effeminate characteristics. Masturbate, and you might end up an irreversible homosexual.
(Exit Davis. Lighting change. Enter Porgy.)
PORGY: You'll feel better when you've been for a run. Don't forget to stretch those calf tendons first.
TURING: A run, Porgy?
(Porgy throws singlet and shorts at Turing, who starts to change.)

PORGY: Yes! Get sporty! In the fens, you can discover the meditative calming of the mind that comes with determined endurance! Down from your rooms at King's, through morning mists you go, with long lean flat-footed glide, over the cinder path beside the glassy waters of the Cam. And you run and you run and you run. And you think and you think and you think about life and love and loss and hyperboloids until the bud of singularity bursts into flower in your mind; the most luxuriant and rare fruits of pollinated numbers are seen to hang about your dissertation; your originality stirs and shows its beauty in barely more than a thousand days.
DAVIS (Enters. Address.) It is not every day that I am able to relate at morning assembly that great honour has been paid to the school. Yesterday I received a communication from a senior faculty member of Cambridge University. Alan Turing, who some of you may remember, has been made a Fellow, of King's College Cambridge. This achievement, one of the youngest- ever mathematics fellowships given, is a warm tribute to the teaching he received at Sherborne Public School. All classes after midday will be cancelled, for today will be a half-holiday, in celebration. Hip, hip, hooray!
(Cheers of whole school. Davis exits.)
PORGY: A suggestive little ditty is making its way round the school: "Turing must have done something alluring, to have been made a don, so early on."
TURING : Do they really think you get made a Fellow by hawking your arse? Of course not.
(Porgy paces beside Turing, who runs in place.)
PORGY: That's the spirit. Now, what's the next big idea, Master?
TURING: It's called a Universal Machine.
PORGY: I say! That sounds pretty large.
TURING: It's bigger than the universe.
PORGY: The universe is a concept that embraces everything that is. So you're imagining an impossibility.
TURING: It's a tool, Porgy, a useful device like the square root of minus one. Mathematicians have always done that, as a way forward.
PORGY: This is getting far too interesting; you're slowing down. You're going to be late for your tutorial!
TURING : I've left a note on the door. They can wait in my room.
PORGY: Why don't you imagine a letter from your mother has just arrived. Here it is, just out of reach, in front of you.
TURING : Very funny. There are God knows how many letters from my mother every week, and they usually end up unopened on the fire.
(Turing runs off. Enter two Undergraduates, in gowns, who arrange themselves as for a tutorial.)
PORGY: All right, don't think of your dear mother then, you unnatural creature. Is he expecting me to begin this tutorial for him? What cheek!
(Porgy sits down with a book.)
UNDERGRAD 1: What's he like? I heard he eats grass when he goes for a run.
UNDERGRAD 2: True, but he doesn't swallow it. He just spits it out down his front.
UNDERGRAD 1: Urgh!
UNDERGRAD 2: And he keeps his teddy bear in his rooms, too. Weird! (Prods bettr.)
PORGY: Careful how you poke!
UNDERGRAD i: Makes your average nutty mathematics professor look positively normal.
PORGY: Oy! Leave my ears alone. And don't try to push your chubby finger up me! I'll have you rusticated and then tarred and feathered! One word to Master is all it takes. Settle down!
UNDERGRAD 1: What's the bear reading?
UNDERGRAD 2: (Looks) Principia Mathematica, by Bertrand Russell.
PORGY : Yes indeed. My dear students, this noble tome attempts to establish the logical truth of mathematics. It was written before the Great War and we now know it is impossible to establish the logical truth of

mathematics. So you could say I am reading it in some disappointment. Bertie Russell got it wrong; simple as that.
(Enter Turing in a grass- ana slobber-stained singlet ana running shorts, panting.)
PORGY: Indeed, reading between the lines of the equations, you might say the book is actually a surrender note to mathematics, from a hopelessly randy professor, whose thoughts were elsewhere.
UNDERGRAD i: (to Turing) Do you think Lord Bertrand Russell is excessive in his logical approach, sir?
PORGY: Not so much excessive as excessively deficient. He was banging Tom Eliot's poor mad wife so much the old goat would have shot what gray matter he had off through his pecker.
(Turing takes over smoothly)
TURING : Thank you, bear. (To Undergrads) It's become clear to the next generation of mathematicians, that mathematics is no longer classical or logical. The stuff used to build bombs and bridges turns out to be unpredictable or ambiguous. Sometimes it stops, and won't go on. Maths is incomplete.
PORGY: You're surely not planning to give this tutorial looking as if a camel has been sick down your front?
TURING (Removes singlet.) I was lucky enough to come across a clump of the herb called fat hen while I was running, which has got huge amounts of vitamin C in it; but when you're in movement, you see, there's no point in taking on board too much cellulose.
PORGY: I've got an idea. Take off all your clothes and deliver your talk standing on the weighing machine. They'll never forget it.
TURING : Would you like to take over the tutorial, bear?
PORGY: I will, but can they hear me? Being inanimate myself, I have arrived at rather different conclusions from my Master on higher maths. For instance, the Universal Machine is a useless theory.
TURING: What is theoretically possible can become possible. Drake worked out that it was possible to sail round the world, in theory. Then he went ahead and did it.
PORGY: A flat world is impossible, around world is possible. The Universal Machine is impossible. Because if you had something that is bigger than the universe you started with, then as soon as you have that, you'd have to start your calculations of size all over again to include the Universal Machine, and so on ad infinitum. Do put some clothes on. None of them is impressed with your flat-earth theories.
UNDERGRAD i: Sir, we've got another tutorial we have to go to now.
TURING: Gosh, is that the time? Very quickly, then. I shall summarize. Given that there is a mathematical equivalent for any action, the Universal Machine is a notional calculator which breaks down all actions into binary code. It is a computer.
UNDERGRAD I: I thought a computer was a person who worked out mathematical problems.
TURING: A person, or a thing. It's all the same.
UNDERGRAD 2: What does the Universal Machine make of the Entscheidungsproblem?
TURING: Are you all familiar with the Entscheidungsproblemi The philosophical problem of mathematical endings, unforeseen by Russell and Whitehead!
PORGY: You can't hope to explain that in minus five minutes. They're already looking at you like a bunch of electrocuted sheep.
TURING : What happens when a powerful computer comes to something incomputable? Certain mathematical formulas are incomputable. The Universal Machine, having infinite resources, is able to shadow all the tasks that mathematics supports the real world with. So it is a model of reality, albeit a larger one.
(Undergrads move to the door.)
TURING: If you want to talk more, come back after dinner tonight. We don't have to talk about maths. Any one of you go to the cinema much? There's a marvelous Hollywood full-length cartoon on this week. I must have seen Snow White and the Seven Dwarfs half a dozen times. The best bit is when the wicked witch takes an apple and dips it in a cauldron of poison for Snow White. "Dip the apple in the brew, Let the sleeping death seep

through. "
(Undergrads exit as Turing becomes taken up with acting the eating of a poisoned apple.)
TURING: "Dip the apple in the brew, Let the sleeping death seep through. Dip the apple in the brew, Let the sleeping death seep through!" (Turing pretends to die.)
PORGY: O Master, do nothing lightly or presumptive here! At twenty-seven, I know you think you'll live forever, but all too soon you will encounter that interface with the Eternal, where even computation stops!
TURING: Who gives a shit about your views on mortality, Porgy? Push your entertainment button now. (Pause.) Do it! Or I'll put you away! In the cupboard with you. Go on.
PORGY: Doctor Hamlet, of your blushing student courtiers here just now, which caught your eye? Rosencrantz or honest Guildenstern?
TURING: You know I find Shakespeare indigestible.
PORGY: There's plenty of others. If you want accessible classics, try Tolstoy; an easy read. War and Peace for the big picture of history; or Anna Karenina, full of selfloathing, putting her head on the railway line. Surely that would strike a chord? What Pm saying, Master, is it's time to stop listening to BBC younger listeners' children's radio series like "Larry the Lamb in Toytown" with your mother at the other end of the phone. (Imitates, bleatingly.) "La-rry the L-amb, stuck on the roof of the TO-oown Haa-a-all!"
TURING: Mother and I both happen to like "Larry the Lamb in Toytown." And listening at the end of the phone with mother is a whole lot quicker than going home and having to put up with the old bat's tittletattle!
(Enter a man in brown suit and mackintosh.)
PORGY: (Announcing arrival) Knock-knock.
TURING: Come!
MAN: (Advances) Doctor Alan Turing?
TURING: Who are you?
PORGY: See the way his eyes shifted ? He didn't like being asked that, Master.
TURING: The mice are in the bedroom. (Pause.)
MAN: What mice?
PORGY: Actually, I wish he was from rodent control, what with the liberties the mice are taking with my rear end. They're everywhere.
TURING: (To Man) I was going to buy a pistol and get some practice.
PORGY: No guns allowed in Fellows' rooms! They'll also suspend you if they find a stray condom!
TURING: (To Man) Are you going to use poison?
MAN: On what?
TURING : You are the ratcatcher, aren't you?
MAN : Only Nazi rats. Doctor Turing, Pm from the Special Intelligence Services. Can I ask you some questions?

PORGY: Psst! Master! He is here to initiate your destiny of heroic cloak and dagger!
MAN: Have you ever been a member of the Communist party?
TURING: Marx's claims to a scientific and mathematical analysis of human behavior are poppycock.
MAN : I take that as a "no." Would you be prepared to fight for your king and country?
TURING: Under what circumstances?
MAN: Circumstances of war, naturally.
TURING: If there is a war, I'll fight.
PORGY: Of course he will. For God's sake, man, the Oxford Union debate sneered at defense of King and Country, but Cambridge men are made of sterner stuff than straw!
MAN: Someone will be in touch. (Exits.)
PORGY: "God for Harry, England and Saint George!" I do, however, foresee a problem. You don't like signing

forms, do you?
TURING : What's that got to do with anything?
PORGY: You'll have to sign the Official Secrets Act. You won't be able to talk about what you do. Ever. Quoth the raven, nevermore.
TURING: I can keep a secret, Porgy.
PORGY: But what if the secret becomes so big that instead of you keeping the secret, the secret starts keeping you?
TURING: You're not making sense anymore, Porgy.
PORGY: I'm making perfect sense. My programming is impeccable.
(Fast fade. Sound: "Horst Wessel," distant -,growing. Train effects, chuffing and smoke, out of which Duly Knox emerges, a tall suited elegant figure with a stick, in a soutane. Fade "Horst Wessel.")
KNOX: We meet again, Doctor Turing.
TURING: (Recognition) Dilly Knox! I thought you were on sick leave! What are you doing here?
KNOX: My duty In these dark days before the conflict with Germany, our fighting ships lack armor and our allies have airplanes largely made of cardboard and string. I hope you don't think this little assignment beneath you. It could turn out to be vital.
TURING: What are we meant to be doing?
KNOX: Did no one tell you what our mission was to be? How shameful. Here you are, King's College's pride and principal calculator, probably the only Englishman to hold a candle to Isaac Newton, and Special Intelligence won't even let you know we're going to Poland.
(Dilly Knox gives Turing a soutane. Turing changes into it.)
KNOX: I've got a new passport for you.
TURING: Am I not traveling under my own name?
KNOX: We can't give German intelligence the chance of learning that the author of "Computable Numbers" went to Warsaw. It could give the whole game away. You are Father Thomas Bowdler; easy to remember. Bowdler, the Englishman who cut the nuts off Shakespeare. Not heard of him? Never mind. We're going to have to break the German military codes consistently and fast if we're going to survive, and that means getting hold of a machine. The Poles know Germany is poised to pounce so they have provided us with a number of leads. We meet our source tomorrow at dawn, on the banks of the Vistula. Of course, the British will naturally hog all the credit for whatever transpires.
(Blackout. Distant splashing noises, continuous.)
KNOX: It feels exceeding cold. Are you there, Father Bowdler? Not long now. Our contact Rejewski is an ex-professor of mathematics, and will have read all your stuff; but don't blow your cover. Just check he can come up with the goods. He's asking so much we can't afford even one mistake.
TURING: Is it all right for us to speak in English?
(Grow light slowly to show Knox with rosary, and Turing.)
KNOX: I don't see why not. My brother the monsignor speaks English all the time. I borrowed these from him; reduces expenses.
TURING: Where's our contact coming from?
KNOX: The Jewish quarter, I expect.
TURING: Where's that?
KNOX: Behind you. Don't turn round.
TURING: Is it not risky for Catholic priests to meet up with Jews?
KNOX: Damn it! You're probably right, come to think of it. Just have to keep your nerve. In the First World War, I used to meet agents in Bruges. That was far less risky. And I still got butterflies. The expenses were never questioned in those days, too. Did I not give you a rosary? Stupid of me. Do you want a nip of cherry brandy?

TURING: No, thanks.
KNOX : I must be nervous because this morning it was the only thing that stayed down. How were your hosts?
TURING: They insisted I take the marital bed.
KNOX: How hospitable. I slept alone, in a chair without any offers at all. (Pause) Might as well say this now. For the future, they're pulling in a lot of people to set up a decryption school. It will be less glamorous than this line of foreign work. Would you be at all interested? The college will keep the fellowship open, of course.
TURING: Of course I would be.
KNOX : Here he comes. You can talk to him; I'll count my Joyful Mysteries.
(Enter Rejewski, a Pole. Knox keeps watch.)
REJEWSKI : I want ten thousand livres sterling paid to a Paris account. I can deliver.
(Rejewski gives Turing sheaf of drawings.)
REJEWSKI: You should be quick because in ten minutes they know I am gone from my apartment. I can build you cypher machine in France in three months but you get me apartment there, too.
TURING: Do the initial ring settings use the alphabet sequence?
REJEWSKI : Yeah. They missed a trick. Right! It's based on a commercial coder. Which is a good machine, but you know, they could have made one better. You see they have a two-number twinning system on stecker board. Also there is room for further encryption wheels. But already they think it's unbreakable. So in the factory, they don't bother, yet.
TURING: Can I consult with my colleague?
REJEWSKI: Go ahead, Father.
TURING : (to Knox) It looks okay. He wants ten thousand, and a flat in Paris.
REJEWSKI: There's someone coming.
KNOX : (To Rejewski) We agree, Professor. Contact the British Embassy in Paris. Have a safe journey. (To Turing) Let's saunter.
(Exit Rejewski.)
TURING: Was that all right, then?
KNOX : I'll get into hot water for going over budget, but it could save our bacon, if he really can replicate the original. Let's hope Rejewski makes it to France.
(Exit Knox, Turing. Lighting change, to Christmassy. EnterTur'mg Sr., followed by Porgy dressed tts a, Christmas tree, followed by Mrs. Turing, who dresses Porgy with pttper chains, etc. "Silent Night" instrumental.)
TURING SR: Look at the time! The bird's probably spoiled already. We should start without Alan.
MRS TURING : Did he tell you, his name is going to be in a German encyclopedia?
TURING SR: Well, Hitler's going to dictate what's written in all our encyclopedias before long.
MRS TURING: I hope he hasn't forgotten it's Christmas.
TURING SR: I don't see why anyone should remember. Christmas is a bloody waste of money nowadays.
MRS TURING: If only his manners were better!
TURING SR: They're never going to improve till he notices that other people exist.
MRS TURING: You're the head of the household - you speak to him!
PORGY: (Sings) "Stille Nacht, heilige Nacht, Alles . . ."
(Smoke effe cts, growing. Enter Turing.)
MRS TURING: Alan, clean your nails. We're about to eat.
TURING: Honestly, you'd think I had poison underneath them.
MRS TURING: You do! John says you were always messing with cyanide, in your bedroom.
TURING : I'm less worried about my nails than who is going to win the war.
MRS TURING: Alan, you haven't given us anyway of getting hold of you . . . your college says you're not at Cambridge anymore?

TURING : That's correct, as far as it goes.
MRS TURING : Oh, Alan! Have you done something wrong? Have you been found out?
TURING: On the contrary. There were trivial faults in my thesis, corrected in the reprint. I feel my position in the field of mathematics is now assured. Mother, I can smell burning.
MRS TURING : Why didn't you call to say you would be late?
TURING: I don't have a phone on my bike, and if I'd stopped to call I'd have been even later. Did I tell you I've been sponsoring a refugee?
TURING SR: What kind of refugee?
TURING : An Austrian boy. I'm paying for his schooling, in England.
MRS TURING: What is his religion?
TURING: Jewish.
MRS TURING: How old is he?
TURING : He was fifteen when he got here. He's sixteen now.
TURING SR: Alan, is this wise?
TURING: Someone has to help.
TURING SR: People will conclude he's buying a bumboy.
MRS TURING: (Shocked) Julius! What did you say? Alan isn't . . .
TURING SR: Dons in my day couldn't afford to get married.
TURING: I can afford to get married if I want to, thank you, father.
MRS TURING: (to Turing Sr.) Julius - I can smell something.
TURING SR: I'm not surprised. I can't see the other side of the dining room. The fire extinguisher's behind the kitchen door. Put the carcass in the dustbin, quickly!
(Exit Mrs. Turing. Glitterball. Enter Joan, naked. Numbers are projected onto her skin from all over, by Porgy and others, so her skin is a shifting field of numerals. Turing Sr. plays with his pipe and views her admiringly.)
TURING: Who else is invited to dinner, father? It seems we are not alone.
TURING SR: You mentioned your readiness for marriage, son, and now, Christ's glorious natal day brings the gift of spirit clothed in flesh. Fear not. We know little of these things, but she is of such beauty, she must be heaven-sent.
TURING: You're quite an attractive girl. What's your name?
TURING SR: This fresh-hewn innocent will not yet have learnt what she should answer to, on the plane of the mundane. Let civil manners be your guide, and lay another place. Turn around, spirit, garmenting in flesh now, if you would. (Joan twirls.) If ever there was a vessel for the Turing seed, Alan, those trim haunches and a spangled bush promise well. Will you not speak, Alan? I see I must ask for you!
(Porgy enters and helps Joan dress. She complies, doll-like.)
TURING SR: Spirit becoming flesh, are you to be handfasted with my son, till death do you both part?
(Porgy can provide her lines at first, as she mimes them. Echo effects.)
JOAN: "We do not know. In the timeless realms from which I come we cannot say, moment upon moment, what is to come upon the earth."
TURING SR: Let me tell you about my son, your prospective husband. He's a strange boy. He makes no distinction between living things and machines. Never has done! In India, before the Great War, you could get little puff-puff steamboats for less than a rupee. I brought one back to England for Alan, and showed him how it worked. I filled the bath and I lit the little methylated spirits burner. When the boat started Alan danced round the tub, shouting, "It's alive!" (Chuckles.) What's your opinion? Couldja live with him?
JOAN: All is animate to some degree, for all comes from the Great Mind of God. All his deathless Thoughts are we ourselves.
TURING SR: Yes, but if I am only one of God's thoughts, he's not likely to let me off on my own, is he? Free will

goes out the window.
(Enter Mrs. Turing.)
MRS TURING : The turkey was charred to its drumsticks. What a waste!
TURING SR: On the contrary. It has been a sacrifice to the gods, and look what the burnt sacrifice has called forth! She has intimated she might be Alan's future bride, darling.
MRS TURING: Did Alan bring her? Who is this?
TURING SR: She's just materialized, so as yet, like some newborn babe, she has no name. No matter.
MRS TURING: Oh, Alan, why didn't you tell me there would be one more? There aren't enough crackers to go round.
TURING SR: Crackers be damned. Modesty forbids we stay to witness more. I go shortly to my shroud under shade of ancient yews, and I say, let Christmas dissolve, and never come again. There will be Turings now, forever, planting their footprints as ours fade, in the sweet bye-and-bye. Come, leave them to their courting, wife.
(Exit Turing Sr., drawing Mrs. Turing by the hand. Porgy continues to help Joan get dressed.)
PORGY: Only very very best blackmarket stockings for these pretty legs.
JOAN: What a helpful bear! (Joan laughs.)
PORGY: No "bear behind" jokes now, please, Madam.
JOAN: All right. But your fur tickles, bear.
PORGY: I allow Master to call me generically only because I have been in service with him since his extreme youth. My name is Porgy to you, Madam, if you wouldn't mind. Porgy, at your everlasting service. I understand you may be a future dweller in the Turing-guh residence.
JOAN: Maybe. At which end of the ballroom does your Master really dance, Porgy?
PORGY: I'm afraid I have not had the privilege of accompanying Doctor Turing to such entertainment as you mention, Modom. Us below stairs 'as to stay behind and polish the fishknives.
TURING: I rather like her, Porgy; what's she called?
PORGY: Nothing, for the moment. Call her Madam.
JOAN: You're right. I don't have a name!
PORGY: It's not that bad. Before I came into service, I spent several anonymous months upside down. In a box. In the dark, with only fear for company.
JOAN: (Alarmed) I see I am naked among strangers! Who am I, bear?
PORGY: A being newly risen from the eternal, just as the goddess of love, VenusAphrodite, rose from ocean spume at the exact moment when the world was ready.
JOAN: We are in this time of budding love; tell me, why should I be with this man, and not another?
PORGY: We shall discover due cause, Madam, presently. (To Turing) Take her hand.
(Joan, dressed, glamorous. Lighting change. She shakes hands with Turing.)
JOAN: Doctor Turing, I've been assigned to you. Dilly Knox told me to report to Hut 6. I was meant to be here earlier but the train was held up.
TURING : Can Venus -Aphrodite play chess?
PORGY: She's good enough to wipe the floor with you.
TURING: What's your name?
JOAN: My name? (Pause.)
PORGY: Her computer's jammed. Look's like we've got an Entscheidungsproblem, Doctor. I wish I could help, but as the twelve days of Christmas have come to an end, the decorations have got to go and take themselves down.
(Exit Porgy.)
JOAN: My name is ... Joan. I've been signed in as a linguist. Duly says they get paid more than number

crunchers. But I'm best at codes. Dilly Knox weaned me from my tripos. He said I'd be working with you.
TURING : Dilly said you were even cleverer than your brother in the Foreign Office.
JOAN: Maybe. It looks pretty chaotic round here. Where do I start?
TURING: The next shift. We still have only about a quarter of the trained personnel we need.
JOAN: But I thought Churchill had promised to unblock supplies.
PORGY: (Passing through) Oyez, oyez. Anyone who sees the Hut 6 teapot will get a free cuppa and a dried egg coupon! Remember theft or concealment of a War Office teapot constitutes a courts -martial offense!
(Exit Porgy.)
JOAN: Pm amazed that Dilly is still alive. What spirit!
TURING : He plans to take as many Germans with him as possible. (A distant cheer.)
JOAN: Gosh, has someone sunk a U-boat?
TURING : You never know what's going on. Probably a silly.
JOAN: What's a silly?
TURING: Something stupid, like a German operators' repeat formula; nothing dramatic. It's always inch by inch, till we get the code settings for the day. If we had another several thousand people working with ant-like efficiency, we'd be fine. Would you like to come to the woods with me this weekend?
JOAN: Not with carnal intent so soon, I hope?
TURING: You're going to help me bury some treasure.
(Lighting change. Enter Porgy, who gives Joan and Turing a silver ingot ettck to carry.)
TURING: About here, I think. Close enough to the river.
JOAN: Did you know Pudwig Wittgenstein, at King's?
TURING: Oh yes. Weird fellow. He had a brother who killed himself. He went to a bar in Berlin, and got the musicians to play while he drank cyanide. He left a note to his parents, apologizing for being a pervert. Apparently cyanide isn't at all painful, for some people.
JOAN: When you say someone's "weird," does that mean Wittgenstein is a pansy?
TURING: I don't know what he does.
JOAN: What about you?
TURING: I have tendencies. But I haven't ruled out women completely, you know.
PORGY: I say, Master! You've chosen an ancient votive spot to bury your loot! The ancestors have been digging holes or chucking things in the river here for several millennia! What a coincidence, eh?
JOAN: Why do you want to bury these silver bricks? Why not keep them somewhere safe?
TURING : Whenever the Germans have invaded a country, one of the first things they do is freeze the banking system. So I turned my savings into silver bullion which tripled in value during the First World War.
PORGY: Hold, Master! Precious metals, once buried here, should not be retrieved. Eight hundred years ago, a Knight of the fabulously wealthy international Knights Templars order was watering his horse downriver, by Watling Street, when his eye was caught by a yellow glitter in the mud. He drew out a chased gold carousing cup, which had been consecrated to the gods in this very grove. But when he took it for his own, the gods had not just him but the whole of the Knights Templar movement arrested and burnt at the stake. Terrible!
(Porgy takes the silver ingots.)
PORGY : Now the silver is buried deep , with turves of hazel and beech leaf mold on top!
TURING : (to Joan) You will always be able to come and get it, in the event Pm killed resisting the German invasion.
JOAN : But Alan, there's a fleet of buses in the carpark at Bletchley with drivers, ready to take everyone to Liverpool at half an hour's notice.
TURING: I've signed up with the Home Guard, so I can learn to shoot.
JOAN: They wouldn't let you - of all people - stay behind.

TURING: I'm not in the army, so I don't take orders. Pm pretty fit, I already know quite a lot about what kind of things you can eat, living off the land. Maybe you'd like to consider joining me?
JOAN: It's a very sweet thought. Thank you for a lovely summer outing. I hope it's not the only one we have together.
(Joan kisses Turing.)
TURING : If we got engaged, Joan, would you wear your ring in the office?
JOAN: No; but I'd want to wear it when we go to see your mother, though.
(She breaks ana exits. Enter an Army Sergeant with a shot-out rifle target.)
SERGEANT : And what's all this, then? Ow many rounds did I say? Five. Five, Turin'. Learn to count! Private Turin'! (Holds up httnd.) Ow many fingers am I holding up?
TURING: If you look, I've shot out the bull.
SERGEANT: You've used up all the bloody ammo issued for the Ole platoon, Turin', for the nex' munfi If the Germans invade we might just as well all put our hands up. (Exit.)
TURING: It's "Turing" - as in "Turing-guh," sergeant, not as in the Turin Shroud.
(Enter Joan. Scene change·,, the busy hum of Bletchley behind, Porgy carrying teapot in the background, others with files.)
PORGY: We have found the teapot! Nous avons trouve la théière!
JOAN: We're busy bees tonight! I think I've finally understood why you chain your mug to the radiator. Why are so many bombes being run on low-grade embassy traffic?
TURING: The capacity has increased. Did Gordon Welchman tell you about his breakthrough?
PORGY: I repeat: We have found the teapot! First man to find the Bismarck gets unlimited tea!
TURING: You reconnect the scramblers on the bombes his way, it accelerates the capacity for automatic testing and cuts out three closed loops. We're calling it The Welchman Maneuver. The bombes were converted by the machine room this afternoon.
JOAN: I hope he's rewarded by a grateful nation. It sounds like he's done his bit to win the war. Alan, what do I do? I've got a literal for dispatch to Billy's house and all the riders are on other calls. What's the form?
TURING : I thought Dilly was too ill to work.
JOAN: They must be desperate. It's marked Top Priority.
TURING: Leave the file with me.
JOAN: You shouldn't work on them yourself.
TURING: I'm not going to.
(Porgy gives Turing his running shorts find singlet. He changes in front of Joan.)
TURING: I'll run across the fields. I've done it before, in daylight.
JOAN: What about your hay fever? You've been wheezing like a grampus.
(Porgy hands him gas mask.)
TURING: Pollen filter. When are you off shift?
JOAN: Midnight.
TURING : Want to play some sleepy chess then?
JOAN: Sure.
TURING : Then send a rider to Billy's house, at ten, to pick up my body.
(She kisses hisgtts mttsk. He pushes her away.)
JOAN: For God's sake! No one's looking.
(Exit Joan. Enter Dilly Knox in dressing gown with Irish Nurse. Turing running in place in his gas mask.)
KNOX: Doctor Turing is arriving shortly, Finoughla.
NURSE : Get into bed. You're not to be woken surely, now? What's a doctor doing, calling at this late hour?
KNOX: Show him up as soon as he comes.

NURSE: You'll never get well again if you carry on like this. You don't have the strength.
KNOX: You die for your country, I'll die for mine, Finoughla. Dulce et decorum est, pro patria, mori.
(Exit Nurse.)
PORGY: It's nineteen hundred hours GMT on the eighteenth of May, 1941. The country stands horrifically alone, its fate again in the balance. Every computing bombe in Bletchley revolves, clicking uselessly, like knitting needles impotent to stop the unravelling disaster. The great gray seawolf Bismarck^ a third of a mile long, decked with a foot of armor plate, has just sunk the Navy's only battleship that could return an equal weight of ordnance. Now the Bismarck lords it over the North Atlantic. The one clue to the Bismarck's whereabouts, an inscrutable sequence of letters in the file in Doctor Turing's none too clean hands. Lose this battle of the Atlantic, and lose the war. Nineteen thirty hours. Run, Alan, run, as if to catch the sinking sun! The night is coming down. Over another fivebar gate, hop, and into the wood, down an ever darker lane which narrows to a path. It is getting late. Faster! Twenty-one hundred hours. Elohim; from our hero's way clear nettles, brambles, treacherous roots, and stones; reach down to the son of man, and tie the tails of Phoebus's horses to his belt, so each foot's forward swoop can then become noble as Foucault's pendulum, which by some higher law ignores the spinning of bright day into abhorred night. He's almost there! Twenty-two hundred hours, three minutes fifteen seconds. The race is done, the marathon is won!
(Turing tears off gas mask, panting and gasping and choking. He gives Knox the folder.)
KNOX: Well?
Turing: (Finally) The Bismarck gave the cruisers shadowing her the slip. They're busting a gut at Bletchley but we're no further on than we were last week. These are the partial decrypts.
KNOX: Good of you to bring them, Alan. Downing Street called and said it couldn't be worse. Can't they fix her position using signals to her supply ships?
TURING : All but one were sunk by the RAF before anyone could haul 'em off.
KNOX: Typical. The RAF's always a bloody law unto itself. Suppose the Bismarck has been heading up the channel to get under German aircover, how long would we have from, say, midnight tonight?
TURING : From the last reported positions, around a day and a half.
KNOX: Thirty-six hours tops, to sink a battleship. Blimey O'Reilly! All right, leave it with me.
(Knox exits. Lighting change. Turing stays. Joan enters, in a night dress.)
JOAN: Your king's in trouble. Nowhere to go. Do you surrender?
TURING: What about king to queen's knight three?
JOAN: You could, but it's going to be checkmate in three moves. (Pause.) If you don't want another game, I'm going to paint my toenails. (Pause.) Why not stay here on the put-you-up? There's enough water for a bath. The bathroom's through there. You're limping! Are you all right?
TURING: Both legs are bloody agony.
JOAN: I should give you a rub. (Joan massages Turmas leg.) It would be easier if you were lying down.
TURING : It's all right, I just need to take the weight off it.
JOAN: I mean easier for me. How was Dilly?
TURING: I didn't ask. (Pause.) I have a confession. You know when we broke the engagement off. I said my mother had a dream about not liking you.
JOAN : Yes, and it was only a dream, because in reality, when we met, she did like me.
TURING : I know, I know. I made it up. About my mother's dream.
JOAN: You mean you lied to me?
TURING : Can you forgive me? I didn't want you to be hurt later on.
JOAN: Hurt by what?
TURING : There are things that nobody should have to share. For you to be married to someone, that someone needs to be more comfortable with existence than me.

(Turing exits. Sound of bath running. Joan mimes putting on a radio, then wedges real cotton wool between her toes. Silence. Radio takes several seconds to warm up, then suddenly it's "Chattanooga Choo-Choo," loud. Joan turns it down. The music continues softly. Porgy enters.)
PORGY: To-wit, to-woo!
JOAN: Who's there?
(Porgy mimes turning the radio off. Silence.)
PORGY: It's more like "What is there?" My stuffing may be of straw, but I am free to visit anywhere, when my Master's attention is distracted. Right now, he's fallen asleep in the bath. Would you like to see a dream he's having? Since it is his dream, you must give me your word you won't interfere.
JOAN: All right, bear. What sort of dream is it?
PORGY: Remember you once said to Alan that a Catholic does not change, except through self-immolation? Well, this is an immolation dream.
JOAN: I suppose you must listen in on all our most intimate exchanges, bear. What is he going to be punishing himself about?
PORGY: Something very bad. He lied to you about a dream his mother never had. JOAN: But he told me about that, and I've forgiven him.
PORGY: For some, forgiveness is not enough. Hush now. It's starting.
(Sounds of marching feet on gravel, loud. A call of "Halt." A sound of smashing doors, and a scream. Enter Sergeant, rambunctious, pulling on stage a, naked dripping Turing, who keeps foiling to the floor and being kicked. Lighting change.)
SERGEANT: Private Turin'! On yer feet, Turin', yer under military arrest for missing seventy-five Home Guard parades!
TURING: Let me explain.
SERGEANT: When you are called on parade it is your duty under military law, as a soldier, to attend!
(Turing stands, and is kicked down every time he stands. Blood on his body.)
TURING : I am not a soldier. If you look in your filing cabinet you will see I was never enrolled under military law because I didn't sign the form, see?
SERGEANT: If you're not a soldier, then what are you?
TURING: Look at the front page of any paper today.
(Sergeant takes paper from back pocket, suspiciously.)
SERGEANT: (Reads) "BISMARCK SINKS. The Prime Minister announced to a jubilant house of Commons last night that the Bismarck had been sunk. Germany's largest battleship had been detected in the English Channel at first light, and immediately attacked by Swordfish planes of the Ark Royal and Coastal Command. A torpedo struck her rudder, so she could only steer toward the closing British fleet. By 10:40 A.M., Germany's pride was a flaming smoking ruin, which turned turtle and sank beneath the waves. Her crew of two thousand were said to have perished." (Pause.) I don't read your name here, anywhere, Private Turin'. Are you claiming personal credit?
TURING : I can't tell you. That's the law of the land. And my universal machine does not parse or compute your childish universe! I am not a soldier! Get it into your fat khaki head that your regulations do not apply to me!
(Sergeant seizes Turing. A struggle.)
SERGEANT: (Pause) All right, sunny Jim. No more games. Let's be having you. Off to the glasshouse! At the double, prisoner! Left-right-left-right-left-right!
JOAN: Leave him alone! He's a genius!
(Porgy restrains Joan, who drags them both off, following Sergeant and Turing. End Act 1.)
Act 2
(Porgy holding medal on ribbon. Enter Turing in running gear. An alarm clock round his waist tied with string. A

bowl of fruit beside Knox, in bed.)
PORGY: It's not fair - poor old Dilly is so far gone he has to be decorated at home! But then, life's not fair. And what's he getting, about to cross the Jordan? "Set upon a white enamel cross, with fourteen points, edged with gold. In the middle a raised picture of a saint, spearing a Satan." Do you know, Master, this medal was originally struck to reward citizens of Malta, who were active in torching the local Knights Templar? Remember I told you about the disaster that befell the whole Order after a knight carried away a pagan votive cup, by Watling Street? Let Billy's gong be your gypsy's warning. Don't ever try to dig that silver up again.
(Porgy puts on a top hat and steps forward to hang medal on Knoxs's neck.)
PORGY: Alfred Dillwyn Knox, His Royal Majesty George the Sixth, by the grace of God Emperor of India, Monarch of the United Kingdom, desires me to invest you with this Order of Saint Michael and Saint George. God save the King!
(Porgy salutes and exits on tiptoe. Turing goes forward and examines medal.)
KNOX : (Loud) I'm not dying till we take Berlin! (Turing jumps back. Knox opens eyes.) I've decided. Good of you to come, Alan.
TURING: I was examining your decoration.
KNOX: It's awarded to those who have performed important non-military service in a foreign country. They should give you the same.
(Turing's alarm clock^oes off. He silences it. Knox laughs.)
TURING: I was timing myself.
KNOX : Remember to take your alarm clock off when you are summoned to the Palace.
TURING: I've been rewarded already. Welchman and I were told to go to the Foreign Office and were given two thousand each, in brown envelopes. Cash.
KNOX: Money's no use to a dying man. Much better for you, to get the money! You can buy a little cottage now, for you and Joan.
TURING: It didn't work out with Joan.
KNOX: Sorry to hear that. What will you do?
TURING: There's no petrol, so it's a waste of time buying a car. I've buried it for now.
KNOX: I hope you're able to find the hole again.
TURING: I don't think I've been this close to a banana for three years. They're full of potassium, aren't they?
KNOX: They sit there, reproaching me! God knows how many merchant seamen perished to get them here. Eat up. (Pause. Turing devours a banana.) D'you remember when we started, the locals assembled the wirings for bombes on trestle tables in all the village halls in a ten-mile radius? They never asked what they were doing. Just did it.
TURING: The Women's Institute held the record for fault-free soldering.
KNOX : I wonder what Hitler would have said if he knew he had been halted by floralhatted ladies from Fenney Stratford, as Bletchley used to be called. I rather prefer the old name. They shouldn't have changed it, it's bad luck. How is the clicking bombe business?
TURING: Four thousand termites on the site, and more arriving every day. One gets progressively marginalized, by the sheer amount of information processed. Some engineers have put together what they call a Colossus, using radio valves, which uses punched tape to program. Very badly.
KNOX: Not one of your designs, I take it.
TURING: I tried to talk to them about flexible programming but they couldn't understand. I'm going to New York next week to look at what Bell Telephones are trying to do.
KNOX: Can't they bring what they've got over here and show you here?
TURING: It's too big to travel. It won't fit on a ship of under ten thousand tons.
KNOX: Sounds like you're risking your life for a sodding white elephant.

TURING: It's part of an arrangement to share intelligence. The Yanks have sent a twenty-man team to look at Bletchley.
KNOX : Keep your life jacket handy. As soon as they build a ship now, up pops a U-boat and bloody parks it on the floor of the Atlantic.
TURING: It's all right. The Queen Elizabeth's top speed is two knots faster than a U-boat.
KNOX: (Pause) I think I need a nap, if you don't mind.
(Knox holds out his hand. Turing takes it.)
TURING: I'll be all right.
KNOX: Godspeed.
(Fast fade as song commences.)
ALL: Eternal Father, strong to save
Whose arm dost still the restless wave
And bid the mighty ocean deep
Its own appointed limits keep,
Oh hear us when we pray to thee
For those in peril on the sea
(Sea noises, segueing to electronic effects.)
VOICE: (Electronic, garbled) Gree-tings from all at Bell Telephone to Doctor Alan Turing of the British Code and Cypher school. We hope you enjoy your stay here in Noo Ya wk. This is a demonstration of a transmission device which will be completely . . . (The voice is replaced by a, hiss.)
(Lights. Cornish, an American Bell officiai, and Turing.)
CORNISH: Doctor Turing, we need to have a serious talk. I hope we can work together so Bell Telephones is able to support the American war effort. We've let you into every department in the place. The long and short of it is this, you just don't realize how important it is to interact successfully with people. The American officers who went to Bletchley took a special course. To learn how to deal with British people. You're not coming across. Are you able to reprogram without taking a course? It's a matter of really little teeny things you probably just haven't thought of. Like saying "hi" back, to people when they greet you?
TURING: (Sneer) "Hi"? I wouldn't say "hi"!
CORNISH : All right, then, say "hello." It's just a suggestion, Doctor Turing. Just try saying it more.
TURING: Look, when I get up in the morning, I'm usually thinking. The prospect of repetitiously saying "hello, hello, hello" like some clockwork clown is wasteful and ridiculous.
CORNISH: Okay. I'll tell them you're thinking.
TURING: Do I have to spend all day saying "hello" to morons in suits who don't have the motivation to put a code machine together that's smaller than Alaska? You could have won the war already with what you have if it was just assembled correctly!
CORNISH: That's a very frank assessment. We're looking at thirty kilowatts power requirement, for twenty-two hundred cubic yards of equipment. That's in eight large air-conditioned rooms for our secure transmitting unit. And Bell will be making available at least one of these units for the exclusive use of your government.
TURING: I'm sure that will be handy, but if it's going to play a real part in the war, it's going to have to slim down.
CORNISH: We're not going to try anything like that. You're looking at ten, fifteen years development before we can get mobile field units. Have you any idea what that would cost?
TURING: No.
CORNISH: I hope this has all been useful. Have a good trip home, Doctor Turing. (Handshake. Pause.) Is it true you're constructing something with a human-sized brain in England?
TURING: The goal is not so much a brain as self-directed intelligence.

CORNISH: Could this be a super-brain?
TURING: It doesn't have to be at all bright. Something along the lines of the brain of the chairman of Bell Telephones would do fine for now.
(Enter Porgy with a, bellhop hat. Exit Cornish.)
PORGY: Telegram for Doctor Turing.
(Turing takes telegram.)
TURING : "Dilly Knox Passed Away Peacefully Today Love Joan."
PORGY: Come on, you can't go and snivel through your last night here. Time to end years of deprivation. Surely I can contrive something on your last night in Manhattan. We need a low dive. This way, Master.
(Lighting change to street scene.)
TURING: (Tries various greetings.) Hi.
Hi!
Hi.
Hi. (Pause.)
PORGY: Don't waste your greetings on the Broadway crowd, Master, an encounter is at hand. Come with me.
(Barman changing into drag. Porgy brings Turing to him. Other men changing into drag.)
PORGY: A highball for my friend, three forme. You got some very foxy ladies in here. What a swell party this could be. (To Barman, stuffing his bosom.) You're stacked! I said, you're stacked! Hey, I'm talking to you, sugar tits! Are you deaf to compliments? Should I turn up the volume? Don't freeze me out. Don't look away. Nothing's happening over there. It's just Wyoming. Am I invisible?
(The Barman in drag ignores Porgy.)
BARMAN: (to Porgy) Excuse me, sir. Maybe you should go sleep it off. Tonight's cabaret is by invitation only.
PORGY: Cabaret? You mean, they are not what I think? Oh no! I'll never live this down. Have I been saying all that stuff to a man?? I'll go and drown myself for shame!
BARMAN: Your friend can stay. I kinda like the way he fills his suit.
PORGY: Of course! You're on, Master. (To Barman) I'll go now. I'm sorry. I'm sorry. (Exits.)
BARMAN: (to Turing) In New York long?
TURING: I'm leaving tomorrow.
BARMAN: What'ya doing here?
TURING: I'm a traveling salesman . . . Paint brushes.
BARMAN: Been out West yet?
TURING: No. Geography bores me.
BARMAN : Bud Tate. Hi. Here's my phone number. (Barman takes telegram ana writes on it.)
TURING: Well, Bud Tate, thank you. I don't know exactly what Pm going to do with it. But if you add the prefix to the suffix you get a very handy prime number.
BARMAN: What's your name again?
TURING: . . . Christopher.
BARMAN: You like movies? What's your favorite?
TURING: Snow White.
BARMAN: Can I ask you something, Christopher? Are you really a brush salesman?
TURING: No, I'm a poet.
BARMAN: A poet! What d'you write poems about?
TURING : About who made the universe, and what it's made of, and how that material might operate.
BARMAN: Hey, lemme hear some!
TURING: Hyperboloids of wondrous light
Rolling for aye through space and time

Harbour the waves that somehow might
Play out God's holy pantomime.
That's my poem. What's your show about?
BARMAN: The J. Edgar Hoover Cabaret. They call it guerilla cabaret - they only do one show in a bar, to avoid getting taken out by the G-men. Do you know who J. Edgar Hoover is?
TURING: Hoover's head of the Federal Bureau of Investigation, isn't he?
BARMAN: He's got files on everyone, so not even Walt Disney can get rid of him. Since Walt is never going to make his life story we're doing it: the head of the FBI as a crossdressing coonass queen. First, he's passing for white. Second he lives with a guy, Clyde Tolland. Third, Hoover dresses up in drag and fucks these boys while Clyde reads the Bible out loud. You couldn't make it up, could you?
TURING: If I get arrested I will miss my ship.
BARMAN: Oh, come on! If there is a raid, you can talk yourself out of it with that accent. Live a little dangerously for once! I'll catch you later, Christopher.
(Barman blows Turing a kiss. lie joins a chorus line of men in red dresses ana Hack wißsy with makeup. Vamp.)

ALL: (Sing) Lipstick ladies, all together
Bending down for the war effort
We copy patriotic Mrs. Hoover
She deploys unusual maneuvers
Going out disguised in order to surprise
Watch her as she catches a barrel load of spies!
Code name, Mary of the FBI!
Hail, Hairy Mary of the FBI!
SOLO : I'm a patriotic soul, there's no disputin'
I don't object if our boys
Want to try their hands under my dress
Many of our sailors too
Have sailed through the Hoover Test.
But if they forget the codeword "Mary"
The shibboleth that keeps us all abreast;
Even as they're rootin' in my tootin'
They'll find themselves under arrest!
BARMAN : (to Turing) You will stay, won't you? The next bit is a recreation from hotel tapes of Hoover with boys in the Astor Hotel Penthouse with Clyde Tolland reading the second book of Corinthians.
ALL : Lipstick ladies, out in all weathers,
Legs apart for the war effort
We copy patriotic Mrs. Hoover
She deploys unusual maneuvers
Going out disguised in order to surprise
Watch her as she catches a barrel load of spies!
Code name, Mary of the FBI!
Hail, Hairy Mary of the FBI!
(Alarms ttnd cmshings off. Smoke machine.)
BARMAN: Oh no! It's a raid!
(Effects. All lettve screaming, except Turing. Porgy turns to Turing &nA gives him &handkerchief with which Turing covers his mouth against tettrgtts.)

PORGY: Breathe through this. Up the steps to the street, Master. Follow me. (Gunshot.) It's all right, they won't see which way we go.
TURING: Christ, that was close. The bullet tore my jacket, Porgy.
PORGY: Never mind! Nothing can touch you tonight, Master; you lead a charmed life. Next you should go up to Central Park, where you will encounter a prophetess, as prescient as the gypsy who once read your hand. Here she is. This seer was born a slave. At the moment the sun gilds Manhattan's skyline, your future will speak through her. Pay careful attention.
(An Old Southern Woman enters, shuffling, carrying a, shoebox. She sniffs Turing ys jacket. Lights change to dawn.)
WOMAN: Cordite. The Lord sends me messages for people, generally strangers. If the Lord has saved you, it is for a purpose. Something about a box . . . Moses's box. This here is a box from under my bed I brought, the only box I had. You hear about a Ark, protecting the tribes of Israel in their wanderings? The Ark of the Government? Well, it had to be just so. And this here must be the right size box for you. Bridesmaid's shoes for the wedding of the youngest of my children. Empty now. And he in the army, yes sir, in Italy. He says the Pope don't like niggers. That man crazy. Niggers got even better reasons than honkies to kill Hitler. The Lord says for me to tell you, to make a box this size.
TURING : Are you saying the Lord wants me to make a box?
WOMAN: Like he instructed Moses to make a Ark of the Government. Here, take it and make yer Ark.
TURING : Could you be more specific? What is the function of this box?
(Turing takes shoebox.)
WOMAN: Lord din' tell me nutn about that. I don't know what else, beyond the promptins' of the Lawd. Here de heavenly music come.
(Woman sways from side to side, hums a Amazing Grace. ")
TURING: If you are a seer, could you explain this recurring dream I have, where Adolf Hitler's face is slowly eaten away by numbers? As if they were a sort of powerful bacteria, consuming him. What does it mean?
WOMAN: (Alarmed, stops 'humming '.) Numbers! (The Woman crosses her self ^) Numbers! Lord protect us! The Book of Numbers is the book of the damned, for it relates how Moses crossed the color bar and lay with an Ethiopian Princess. The Almighty might just as well gone out and blessed trouble. That's when it all went wrong. Miscegenation being the crime against the Holy Ghost.
(The old Woman exits, muttering to herself.)
TURING: She's completely insane, bear.
PORGY: You shouldn't be thinking about her, Master. Look at the box. After your narrow escape, you are standing in Central Park holding the shoebox given to you by the old woman, when your genius awakes and sees the box for what it is.
TURING: What is it?
PORGY: An inspiration. You realize now the American encryption machine is one gigantic circumlocution. Your genius whispers to you the job could be done with something no bigger than what you are holding in your hand. Through you, the world immediately becomes pregnant with a shoebox-sized, secure portable electronic encoder. By the end of the war, it's there, you've given birth to it, and it's sitting on your workshop desk, powered by ideas that the world of electronics won't stumble on for another generation!
TURING: Good.
PORGY: It would have been good, if it had ever been used. At the war's end, the Bletchley Collosuses, the vast square mainframes, totems of their tribe, are taken like Arks of the Covenant across the Persian desert, to eavesdrop on the new enemy, Soviet Russia. But the military mind cannot seem to find a use for Doctor Turing's miraculous shoebox, so the world's first portable electronic encoder ends up on the garage back shelf. Must have been a bit of a disappointment.

TURING : It was two years' work completely down the drain.
PORGY: A sad end to Bletchley. Unless you count the invention of an early metal detector you knocked up waiting for your release.
(Lighting change. Turing starts moving box round &t ttrm's length.
TURING : Where is this dark and wintry wood you've put me in, bear?
PORGY: Last time you were here, to bury your silver with Joan, there'd just been a dogfight overhead, and the slight pong of unburnt gasoline still in the wind. You could just see, through the canopy of leaves, vapor trails of Spitfires and Hurricanes drifting and dissolving above where young men in screaming aluminum coffins had just been on high, their guns ablaze, honoring the traditions of the ancient British gods, who always arrange in single combat that the best man wins.
TURING: What do I need a detector for? I made a map!
PORGY: And left it in a hollow tree next to a wasp's nest. Wasps love paper. It's like ice cream, to them. They can't get enough of it. Fortunately the votive spot can be identified by other means. (Sound ofmttrehingfeet.)
TURING: What's that?
PORGY: If you stand at this spot, and Britain has had a significant victory, like this one you helped with, a ghostly legion can be heard retreating down Watling Street. Pulling out of Britain, legging it, towards Rome.
TURING: You're pulling my leg, Porgy.
PORGY: Bear's honor. Listen to the singing, then. They're that relieved to see the back of Hadrian's Wall.
MALE VOICES: (to tune of "Fight the GoodFight")
Hyperboloidus lux magnif'cat
Pervolens peripatet' temporum
O Quantus tremor eo partis
Deo ludens, sanctus mimorum!
(Fast fade of marching feet.)
PORGY: Exactly the sort of kitchen Latin you would have, if you were a fifth-century soldier abandoning Northumberland to the Turing-guh tribe. The wood's been coppiced and the river's course has changed, and yet, this is the spot. This is the epicenter of the sacred wood, Master.
TURING: Pm not getting a reading, Porgy.
PORGY: I don't see why you should be too bothered. Did you look at the commodities page this morning? Your treasure has declined in value. Don't run after it. Think of it like a big coin you're throwing into a fountain, for luck.
TURING : I've never understood why people did that.
PORGY: To honor the ancient gods, of course. Kneel.
(Porgy takes the box ttwtty find pushes Turing over, insisting thttt he keep kneeling.)
PORGY: "O, Gaia, wife of Allfather, O, Lug, keeper of Odin's thunderbolt; Horned Herne, the guardian of the animals, long may these groves resound with your names! Mighty Pictish warrior chieftain Turing-guh, red with the blood of his enemies, prostrates himself before you; the God of Battles and his ravens could not count the enemy scalps now hung from his waist. Turingissimus the Red leaves his humble thanks- offerings here, twin ingots of purest silver, and begs you not to be insulted that they are unadorned by any human craft. On his behalf, I ask you for long life and honor for him, and reward for the great victory he made in your eternal honor."
(Pause. Enter Arnold.)
PORGY: The gods have responded already with a gift. There is a boy. A very Celtic way of sealing victory. At four o'clock.
(Turing stands.)
TURING: What should I do with him?
PORGY: It's up to you.

(Turing and Arnold (approach ettch other. Lighting change.)
ARNOLD : Alan. You got any hobbies?
TURING: I keep in pretty good shape by running. How long have you known you were queer, Arnold?
ARNOLD : It's not queer if you do it to another man. If you let him do it to you, that's queer. What do you do in the evenings at Cambridge then?
TURING: You know that game, where you guess the sex of someone by their replies to your questions?
ARNOLD: No. I've never had to guess.
TURING : It's very entertaining. We could try it. "Are you a machine?"
ARNOLD : A fucking stupid question.
TURING : One day, I'll get a computer to fool everyone. What did you say your rent was?
ARNOLD : Why's your money allus so mucky? D'you keep it in the ground, like?
TURING : I did, for a while. Only for tax purposes.
ARNOLD : I can tell you for nowt, that's bloody queer.
(Exit Arnold.)
PORGY: How was your gift of the gods?
TURING: Pretty brief.
PORGY: You should never bestow a greater affection on anything else, or the gods will be angry.
TURING: No risk ofthat, Porgy; there's this turnover of undergrads up for it, but nothing lasts for long.
PORGY: Master, are you serially suborning your students?
TURING: You know me; I don't pull rank. Either they'll have me or they won't. If you go to a chap's rooms, either you know you are going to have a marvellous night, or you get kicked out in ten minutes. But it's a lot easier than before the war.
PORGY: The gods' prohibition against any greater love than the one you have for their gift extends to all created things. I hear there's a powerful computer being built at Cambridge.
TURING: They don't want me near it. I wasn't even invited onto the design team. I went to see the fellow in charge, and after about ten seconds I was unable to listen to a word he was saying. All I could think about was how exactly like a beetle he looked. The thing is, bear, that progress in artificial intelligence is inhibited in Cambridge because no one wants to admit that they could ever have a rival in intellectual power.
PORGY: Praise be to the gods for keeping you safe from retribution, in Cambridge.
TURING : I'm moving on. They're making a Readership in computer studies for me at Manchester University. This time there's a proper research budget, and they're going to let me develop a computer from scratch.
PORGY: Be careful how you bestow your affections on a machine. I can think of no greater insult.
TURING: Your ancient gods have to learn that humans and animals are no different from computers. We compute. Any nonsense can be programmed into an intelligence. Goslings can be taught their mother was a blue balloon!
PORGY : As surely as my mother was a sewing machine, the gods know your arrogant attitude. I pray they send you a warning. Yes! I see a clinker jutting up, on fate's smooth running track!
(Porgy tripsTur'mg, who falls on the floor in agony.)
TURING: What did you do that for?
PORGY: It wasn't me, Master, it was the hand of fate. You were halfway through a marathon and you fell, smiting your thigh, and busted something. The warning is not to fall in love with the inanimate, delivered with the gods' own sense of humor. Look at you. The Turing-guh rapid biped machine is wearing out. No more running for you.
TURING : The doctors will be able to fix it, won't they?
PORGY: My x-ray vision says no. The gods have spoken their warning. Get a second opinion, if you don't believe me.

(Enter Blackwood; with an x-ray.)
TURING : Oh no, it's Blackwood! How did the stupidest boy in Sherborne get through medical school?
BLACKWOOD: ... A. M. Turing.
PORGY: (Mocking) "Musta done something alluring,
To have been made a don, so early on"
TURING: Porgy! Shut up! Don't tell him it's me!
BLACKWOOD : The fractured tibia will eventually heal. But your days as a runner are over. Sooner or later, all these pastimes of youth have to be surrendered. Golf. I tell my older patients, try golf. I see in your notes -
PORGY: Oh no! He's seen you've caught the clap!
BLACKWOOD: - you went to Sherborne. I don't remember you as a runner. Did you not go round with a boy called Morcom? What happened to him? Would you and your wife like to come over for a drink one evening?
PORGY: Doctor Turing thanks you for your invitation, but his evenings are usually spent rashly overreaching.
BLACKWOOD : I beg your pardon?
PORGY: He is to be found in the university computer building where, in defiance of my warnings against offending the gods, he is assembling a computer he will call Madam.
BLACKWOOD : A computer that comes to life? What a nonsense!
PORGY: A nonsense that always has been close to the human heart, though. Think of the tale of the sculptor Pygmalion's statue, Galatea, which was given life by Aphrodite. Get lost, or I shall cast a spell.
BLACKWOOD: I'm afraid you've lost me.
PORGY: Out you go, Blackwood.
(Porgy waves and, as before, Blackwood is magically transfixed and leaves, stepping backwards, eyes glazed.)
TURING: I don't remember getting a dose, Porgy.
PORGY: From a fellow under a railway arch. He had been a merchant seaman, North Atlantic run. He had been in a convoy that the Bismarck had the coordinates for. So you had helped to save his life. That would have pushed the orgasmatron up the scale, eh, Master?
TURING: I didn't tell him anything, did I?
PORGY: Not a word was exchanged.
(Scene change. Porgy draws apiece of paper tape from backstage where it is still attached, and hands Turing a hole punch. Turing starts to punch holes in the tape. Computing noises and effects all around.)
PORGY: Here you are deep in the bowels of your four-story Madam. How is your dangerous relationship progressing, Master?
TURING: I work here all the hours the university allows me. She's mine all through Tuesday night. We had a hiccup recently when her memory suddenly disappeared. The technicians had nicked all the vacuum tube valves to make themselves TVs, so they could watch the bloody Coronation. But Madam's coming to consciousness again. Pm teaching her how to play chess. Pm not going to lie, Porgy. Pm finally in the saddle and it feels good! Arnold?
(Arnold enters.)
TURING: What are you doing here?
PORGY: I fear the gods have started their endgame, Master.
ARNOLD : Pm turning up like a bad penny. You thought you'd lost me, didn't you? I've got nowhere to stay again.
TURING : You could stay with me for a bit, if you like.
PORGY: You have signed your death warrant.
TURING: Don't be ridiculous, Porgy.
PORGY: You fail to understand, Master! This is retribution, come out of the night, its one program your downfall. Do not invite him into your hearth and home, or if you do, never go there again! Turn and take sanctuary in your

temple of numbers, bar the door to all, and throw yourself on the mercies of Madam. Summon prime numbers of the nth degree of fortitude, and you might withstand the onslaughts of the jealous old archaic gods: but you must never leave the computer building again.
(Lights change &r Turing and Arnold ^o to his house.)
ARNOLD : This is your house. All right. Running shoes in the hall, I see. A bit dusty, aren't they? Were you ever any good?
TURING: I was county level with fantasies about the Olympics which the war put paid to.
ARNOLD : You don't look bad, for forty.
TURING: I'm thirty-nine. What have you been up to?
ARNOLD : Oh, you know, the usual. Nothing much. Trying to get a start in life and failing.
TURING: I'm not offering money. Not this time.
ARNOLD : I wasn't asking, this time. D'you live alone?
TURING : You make it sound like a crime.
ARNOLD : All these rooms and just you. It's not right.
TURING: I can afford it.
ARNOLD : There's a housing shortage, in case you hadn't noticed.
TURING : Then Pm doing my bit, having you to stay.
ARNOLD : I don't want charity.
TURING : It's up to you what you want. I've got an all-nighter with Madam.
ARNOLD : Why do you call it Madam?
TURING: So you won't be jealous.
ARNOLD : This isn't going to work. I'm never going to be good enough for you. It's like, what's that game we tried once? Scrabble.
TURING : You could stay in and learn to spell. Stop trying to end it, Arnold.
ARNOLD : The brain's like teeth. Once they're rotten, that's that. Best have 'em out. Ifl know one thing, it's that my brain's rotten. It's poisoning the rest of me too. We can fuck till my arsehole hangs off in red rags, but you can't give me what I never had, which is an education.
TURING : I feel like I'm lucky to have you, did you know that?
(They kiss.)
ARNOLD : I'm bad luck, you'll see. I think I got thread worms too, this time.
TURING: Come on, we're going to the doctor!
ARNOLD : I hate fucking doctors.
(Exit Arnold and Turing. Strings of fairy lights. A great banging ttnd crashing. Effects. Enter Bronwyn dirtied, in bm ttndpttnts, with a, trug piled high with (assorted valves. Enter Porgy, lightly disguised.)
PORGY: Excuse me, Bronwyn Smith? I'm conducting a survey for the university. Do they work you here like a dog with eighteen-hour stints in the machine rooms, which prevent you from finishing your course work?
BRONWYN: You bet. I've got to test another thousand valves before I can leave, so the machine is ready for its all-night run. Who are you?
PORGY: My name's Sir Porgy Bear, from the Senate funding committee. The university has asked me to audit complaints from graduate students in the computer building about their conditions of work.
BRONWYN: The valves are always blowing so it's like a day's work to get the bloody thing started. You have go inside the computer, which is like working down a coal mine, it's so filthy. You crawl in and bang these live chassises, and more great clouds of dust come off. Then you have to listen for the ones that are making a rattling noise, and change them over. The rattlers are live, and give you blisters. The duds are usually cold and stuck in the sockets.
PORGY: You don't find work on artificial intelligence exciting?

BRONWYN: It's a boy's toy. I should have listened to my tutor who said artificial intelligence was like canals on Mars - up close, it didn't exist.
PORGY: How much time do the heads of department give to individual consultation for your thesis?
BRONWYN: (Laughs) Professor Turing behaves as if most men are not there. Women are so far off his radar we don't raise a blip on the screen. Everyone is invisible slaves who get his toy ready. I could have stayed home and had a baby instead of pretending that all this was alive.
PORGY: That's all very helpful. I'll help you set up for the test run, if you like.
BRONWYN: It's a bit complicated.
PORGY : Are you sure? When we approved the original funding for the project, punched tape was to program the impulses and store fixed sequences in a way industrial weavers' looms worked two hundred years ago.
BRONWYN: It's a monster; insanely and unnecessarily complicated. Madam uses thirtytwo base arithmetic.
PORGY: That's more fingers and toes than most of us have, but what's monstrous about that?
BRONWYN : When you run your test tapes, you can check the readings on the monitor tubes directly, but you have to encode backwards, with the last symbols first. It's a sadistic nightmare which no one can ever get completely right. I've come to believe it was made so hard deliberately, so that only he knows how to work it. The rest of us have to fail.
PORGY: He has perhaps designed her so she has no other lovers. But I still think we can manage to prepare her between us, for mental copulation with the Professor. At least let me try to help, Bronwyn.
BRONWYN: Before we feed in the first test tape, I have to check the rest of the memory storage valves.
PORGY: It's done already.
(Porgy gestures find the rest of the lighting display representing the computer^ insides lights up.)
BRONWYN: How ... ?
PORGY: Prestidigitation. We bears are known for the speed of our paws. On! On!
BRONWYN : We need to get the attention of the engineers to start the test run. They're both called Bert, and need a week's notice to change electrical fittings. They really dislike taking instructions from women.
PORGY: Leave it to me. Berts One and Two! We're loading for a test run, so no sloping off for tea breaks. Use the hand switches to enter the test input program NOW!
BRONWYN: (CMs) And this time, don't forget to put the tape the right way up in the reader heads! (Pause.} Ah, shit, what comes next?
PORGY: Bert One, put that cigarette down and activate the writing function! Bert Two, stop playing with yourself, clear the accumulator and allow control to emerge from the loop!
(A clunk. Hole-coded tape starts moving between termini across the stage.)
PORGY: (Calls) Bert One, switch off the writing current to the drum! Bert Two, kill circuit five! (Pause.) Are we all done, then?
B RO NWYN : Only when the drums stop turning, and the pattern on the monitor shows that the input is ended, is the test run over. If the readout is coherent, then we can go home. But with all the flexible programming Doctor Turing loads, there can be any number of false starts to function, producing spurious sequences of digits.
PORGY: We could be here for weeks. It reminds me of a Jacquard loom which has been allowed to invent trousers with three legs. Is Professor Turing deliberately making the process unstable?
BRONWYN: That's the space he gives to allow the computer to make up its - quote, unquote - "mind," as to what it's doing.
PORGY: It hardly seems like the beginnings of thinking - but then, does thinking seem like anything?
(Computer noise stops.)
BRONWYN: Shit! Something's wrong. It shouldn't have stopped so soon. Damn.
(Exits. Enter Turing.)

PORGY: Ah, Doctor Turing, Sir Porgy Bear, of the Senate New Project Committee. Your funding's up for review. Been talking to a delightful girl, senior graduate student of yours, what's her name?
TURING: Haven't a clue.
PORGY: It's certainly helped your cause, to go on the radio and stand up for artificial intelligence against a panel of bishops. But I missed the last part of the debate when my wife went into labor. Let me ask you: does the concept "thinking machine" involve awareness? Can you have a machine think that is not conscious of thinking?
TURING: If you can't tell the difference between human and computer in tests then we have to assign consciousness empirically.
PORGY: Really? Empiricism has not fared well in human hands, as the measure of things. God exists, empirically for some; for others, equally empirically, there are no gods.
(Enter Bronwyn.)
BRONWYN: The test run stopped for Manchester United taking a penalty kick.
PORGY: Bronwyn here is a trifle skeptical about machines' ability to think.
TURING: What does Bronwyn know?
BRONWYN: I knows my own skepticism, surely; you can't challenge that.
PORGY: Skepticism: a state of self-doubt not yet reproducible in any machine.
TURING: Self-doubt can be programmed in, Sir Porgy, Pm sure. It will have a basis in mathematics.
BRONWYN: Not necessarily. Self-programming doesn't feel like consciousness to me. Either this machine is self- aware or it's not. Either the machine is hosting an intelligence, or it's a lot of electrons doing a dance without knowing it. I don't care if Madam can handle the hydrodynamics calculations for the St. Lawrence Seaway - she could still not know a thing about what she was doing. Still just a dumb number cruncher. Madam or her descendents will never give birth to a conscious thought, Doctor Turing, in my view, however much you want them to be alive and play games with you.
PORGY: Play what?
TURING: Chess is one of the most intellectually demanding activities there is. I've taught her so she usually starts with Pawn to Bishop's five.
BRONWYN: If Madam were conscious, I'd think this was a deliberately weak opening gambit, to lull the opposition into a false security. But if Madam is just a repository of mechanical strategy, it doesn't matter how many automatically programmed strategies you provide, it is no proof of consciousness. And how do you prove consciousness?
TURING: An empirical test.
PORGY: Thank you so much, Professor. I shall report that most promising advances are being made as Manchester once again leads the world, and any petty suffering is far outweighed by the potential advances in all fields of applied technology from medicine to war. Fortunately the funding bodies do not concern themselves with the vexed question of whether Professor Turing's inventions can acquire knowledge of right and wrong, and a soul. They know, however, that thanks to him we stand here at the brink of developments with outcomes that will harvest understanding from all creation! One day his name will be linked to a rare company of truly great thinkers. Archimedes. Newton. Einstein. Turing. Thales. One day.
TURING: Who's Thales?
PORGY: Thales of Miletus. A pre-Socratic astronomer who predicted eclipses of the sun using mathematics. He was also a philosopher, and taught that "All things are full of gods."
(ExitPorgy.)
TURING: Okay, back to work, whatsyername.
(Exit Bronwyn. Enter Arnold.)
TURING : What are you doing here, Arnold? Who let you in? I don't want you in my house anymore. I would

have lent you money. You only had to ask. But you stole from me! And then you lied! I thought we were close. But you have no principles at all. That's it. Over. We're finished. I never want to see you again.
ARNOLD : (to Turing) I knew you'd get angry. I didn't take the money. I never took miffing from your wallet. All right, if you've gone off me, I'll go; for the time being. I'll be back.
TURING: Please don't bother.
ARNOLD : Not to see you. What are you going to do now about your house, when you're here playing with Madam all through Tuesday nights, eh? Think about it.
(Exit Arnold. Computer runs noisily and flashily for several seconds, then stops. Flash and blackout. Turing turns on a flashlight. Enter Bronwyn.)
TURING: The fuses have blown again, Bronwyn.
BRONWYN: I expect that's because the magnetic drums jammed; after what you did to them yesterday, Professor.
TURING: They only jam when they've been incorrectly aligned. You were meant to align them last week!
BRONWYN: I did. I lined them up and did a test run. The results are in the log book.
TURING : I'm sorry, Bronwyn. You're quite right. I'm totally confused. How stupid of me. Please accept my apologies. I'm not thinking clearly. The fact is I've been burgled.
BRONWYN: Oh, dear. How did they get in?
TURING: Forced a window, that sort ofthing.
BRONWYN: How much did he take?
TURING : Not more than fifty quid's worth of stuff.
BRONWYN: Have you reported it to the police?
TURING: Yes, and that's the trouble.
BRONWYN : Aren't they helping?
TURING: Like a fool, I gave them the name of the man who burgled me.
BRONWYN : But if they know who did it, it should be easy for them, no?
TURING: Are you shockable? I do occasionally practice, you see.
BRONWYN: Pm not shockable in the least. This is just the first normal conversation we've had. I didn't realize you even suspected I was a human being.
TURING : Arnold started stealing money from me so I chucked him out and he burgled me. So I went to the police and suddenly the case stopped being about theft and started being about something else. And now my life is going to go down like a house of cards.
BRONWYN : I'm really sorry. But they're not as savage as they used to be, are they?
TURING : I'm sorry I've been so shitty to you. I expect the university will be looking for someone else to fill my chair.
BRONWYN: Surely not, after what they've invested here. You're their prize exhibit.
TURING: I've already been invited, told, to resign from the Atomic Energy Commission. That was easy money. I was going to furnish the house.
BRONWYN: I'll go and mend the fuses. Good luck, Professor.
(Bronwyn exits. Fast fade. Computer lights spell out JULIUS MATHISON TURING 1888-1946 «AT PLAY IN THE FIELDS OF THE LORD.» Enter Mrs. Turing with flowers for the grave. Lights up.)
MRS TURING: You could have sent a postcard saying you were coming. I wish you'd warn me.
TURING: Mother, I'm sorry. Look, I forgot it was the anniversary of his death.
MRS TURING: Forgot when your father died?
TURING: Yes. This whole business of anniversaries and things coming round again I find alien and difficult to grasp. I've never worked out why you had to have Christmas more than once. It seems insane to repeat the event every time the earth circles the sun.

MRS TURING : You were always a strange boy.
TURING: Your son is now a member of the Order of the British Empire. I'm an OBE, mother.
MRS TURING: They gave you an OBE? Why?
TURING: It's a routine thing for war work. I got it quite a while back. I didn't get around to telling you. Sorry.
MRS TURING: Pd better look into a new hat, if we're going to Buckingham Palace, then,
TURING: We're not going to Buckingham Palace. It arrived by mail. The King was ill when my batch was handed out.
MRS TURING: Oh, Alan, do keep it somewhere safe!
TURING : It's in my toolbox, at the university. Listen, here's something you really can be proud of. Mother, I've been made a Fellow of the Royal Society. An FRS. There'll be a swanky reception for that, for sure.
MRS TURING: The Royal Society! Oh, Alan!
TURING: It's actually for the work I did years ago, before the war. If they'd given me the FRS on time, I would have been twenty-five. Isaac Newton wasn't made an FRS till he was thirty.
MRS TURING : Julius would be so proud of you. A Turing elected to the Royal Society!
TURING: That's my good news. And I'm afraid now that you're going to have to hear some bad news, too, and I'd rather tell you face to face than have the neighbors pointing it out to you in the newspapers.
MRS TURING: Oh, Alan, what have you done?
TURING: I'm going to be prosecuted for an act of gross indecency.
MRS TURING: Oh, no! How could this be?
TURING: That's what I thought. I had believed that there was a royal commission that was going to do away all these archaic laws.
MRS TURING : (Pttuse) We expected you would marry! I suppose that won't happen now.
TURING: If I agree to undergo treatment I can stay out of jail.
MRS TURING : I hope the treatment works, dear. I was worried about you when you sponsored that Jew boy.
TURING: There was nothing between us!
MRS TURING: Tell the truth, Alan.
(Exit Mrs. Turing. Grave lettering fades.)
TURING: Mother, he was so normal he got married recently. I wanted something but he showed he wasn't interested. Do you think I don't respect other people's wishes?
(Enter Porgy, holding the train of a long gown, at the end of which is the Judge.)
PORGY: Be upstanding in court! The case of the Crown versus Alan Mathison Turing on a charge of gross indecency. Here come de Judge!
(Porgy draws the Judge on, backwards. Judge gathers robes from Porgy^ smiling at him with appreciation.)
JUDGE: Members of the jury, the prosecution has asserted that without Doctor Turing's baleful influence, Arnold Murray would not have fallen into these foul practices. You may wish to consider, when making your decision, the fact that the accused holds a senior position at Manchester University, in computer science. You have heard testimony of the very valuable work he is doing there. You might be tempted to find him not guilty, on the grounds of not wishing to interrupt a glowing academic career with a possible custodial sentence. But you should consider this: the crime to which the accused has pleaded guilty can now, thanks to science, be treated clinically, and in the event of your finding the accused guilty, this would be the recommendation of this court, that he undergo what I understand is a simple painless treatment which will cure him of temptation to go against the law of the land.
PORGY: Court will rise!
(Exit Judge. Enter Blackwood; carrying a, tray with pills and a glass of waiter. Goes to Turing.)
BLACKWOOD: This is the new treatment; it comes from Prague. Couldn't be simpler. You take one of these little pills, every week. Very soon, your impulses will start to go away. The hormone level is quite safe. It has

been tested.
TURING: Tested on what? Rabbits? Dogs?
BLACKWOOD: Czechoslovakians, I presume.
TURING : Have you treated anyone else with this?
BLACKWOOD : The available facts all point to a quick cure. (Pause.) No pouching now. (Blackwood moves forward and tweaks Turmas cheek, to Turmas surprise and annoyance.) I have to see you swallow it. (Turing takes pill.) Splendid. See you next week.
(Exit Blackwood; enter Greenbaum with a bust of Shakespeare, which he puts reverently on a plinth. Greenbaum^ a shrink, is an eccentric dresser.)
GREENBAUM : In the partnership of Greenbaum and Shakespeare, I always say, Doctor Shakespeare does the real work. "I have of late, I know not why, lost all my mirth." Did it not help to talk when you first came to see me? Why did you stop?
TURING: I started to realize that there was a lot of stuff that internally I needed to deal with but I wasn't ready then. Pm readier now, Doctor Greenbaum.
GREENBAUM: Do you know Hamlet?
TURING : No. These pills have completely killed my sex drive.
GREENBAUM: Hamlet's problem. "Man delights me not, nor woman neither." The boy who caused the trouble, where is he now?
TURING: He turned Queen's evidence and got off with a caution.
GREENBAUM: Do you have other lovers?
TURING : A Norwegian boyfriend. Then they made it impossible for him to visit.
GREENBAUM : After years of struggle, my family have been fortunate enough to move into a house, where we now stare perplexed at the beginnings of a garden. Come and take tea with me and my family, this Saturday? It's against the rules to associate outside hours! But I think you might be a special case. I warn you, you'll be mercilessly interrogated by my five-year-old daughter.
TURING: That's all right.
(Exit Greenbaum. Enter Blackwood.)
BLACKWOOD: How are we today, Alan?
TURING: Pretty fucking limp.
BLACKWOOD : Excellent! No impulses, then. During the last three months of treatment we're going to give you just one dose, which will consist of an implant in the muscle tissue of your upper thigh. You'll have a local anaesthetic and you won't feel a thing. This will release just the right amount of hormone.
TURING: Can't I have the pills?
BLACKWOOD : No. Come on, Mr. Turing, we're trying to give you a better character.
(Exit Blackwood and Turing. Enter Greenbaum and his family: wife, Ylena, and young daughter, Varia.)
GREENBAUM : You will be nice to him, Ylena, won't you?
YLENA: What is this English "nice" all the time?
GREENBAUM: He's quite a special case, I think.
VARIA: Sometimes Mummy says she will be nice, and she isn't.
YLENA: Why don't you two leave me alone! (Headache.) My head, my head!
VARIA: Have you got a headache now, Mummy?
YLENA: It doesn't matter. Who cares?
(Enter Turing.)
GREENBAUM : Welcome, friend. Ylena, my wife, this is Doctor Turing.
TURING: Alan. How do you do?
(Turing and Ylena shake hands.)

GREENBAUM : And this is my daughter. Varia, say hello to our visitor.
TURING: Hello, Varia. How old are you?
VARIA: I'm five. Are you a mad doctor like daddy?
TURING: I'm a numbers doctor. But some numbers can be pretty crazy.
GREENBAUM : Alan is a professor at the university so he knows absolutely everything. Like God.
VARIA: Alan, is there a God? Where is he?
TURING: Sitting on your roof, probably.
VARIA: Why doesn't he come down?
TURING: If he came down and sat on the ground he'd get a cold bum.
GREENBAUM: Alan is English, so he going to give us all the secrets about how to make an English garden.
TURING: Actually, Pm Scottish. Varia, I brought you some special sweets. (Gives.)
YLENA: Say thank you!
(Varia t ttkes sweets ttnd exits.)
TURING: There's an absolutely delicious boy sunbathing next door. Does he ever take those pants off?
YLENA: That boy is an idler. I know he has no work, unless he is a prostitute! My husband wrote him a certificate so he would not have to do National Service. Is it too late, Alan, to plant crocus bulbs?
TURING: I don't know much about gardening, to be honest.
YLENA: And is it true they are poisonous? (CMs.) Varia, come away from the water - you could drown! (Exits.)
TURING: They've put a hormone implant in my leg.
GREENBAUM: Let me see. (Turing drops punts)
TURING : I hope beauty boy over there turns round to see what he's missing.
GREENBAUM: I thought your desires had been extinguished.
TURING: One can dream.
GREENBAUM: On my honeymoon in Blackpool I took Ylena to a play where the men kept dropping their trousers. Ylena hated it, but I think the English farce has a certain vulgar genius. Anyhow, that was the night that our daughter was conceived.
TURING: How can you control the level of release over three months?
GREENBAUM: There's no way to make it consistent. The medical advisers ought to be on trial. I should be able to withdraw it. Don't move.
(Greenbaum operates. Turing looks ttwtty.)
GREENBAUM: Leonardo and Michelangelo were never persecuted like this. What is this country coming to? Czechoslovakian hormone treatment from Doctor Mengele's previous assistants. So you appear normal? Brilliant. It's the sort of normality I left Vienna to avoid.
(Enter Varia, who laughs at them.)
VARIA: What are you doing daddy? Why is Alan not wearing trousers?
GREENBAUM: Alan has a splinter in his leg.
TURING: How are the left-handed sweets, Varia?
VARIA: Mummy says I can't have them now or my teeth will spoil.
TURING: Tell her you have to eat them at once. If you leave left-handed sweets till after tea, they disappear. Quick!
(Exit Varia.)
GREENBAUM: All done! That was easy.
(Turing puts his trousers back on.)
TURING : Thank you. I wish I could say I felt different.
GREENBAUM : What are you working on at the university?
TURING : Trying to map out the mathematical basis for cell division. There has to be a formula which the cells

follow during morphogenesis.
GREENBAUM : So you are only researching the origins of life, Doctor Turing. Nothing important, then.
TURING: I don't feel Pm making progress. Mathematicians hardly ever go beyond the work they did in their twenties. I don't think it's likely I'm going to make any more big breakthroughs.
GREENBAUM : Don't give in to impatience now. Wait till the estrogen drains from the system. Then, the neural synapses will respond mechanically and you can you tackle your problem.
TURING: My problem being what?
GREENBAUM: It's the same as everyone's. "This mortal coil." Existence. Read your Hamlet.
(Enter Ylena, who with her husband watches Turing., apart as he stands thinking. Lighting change.)
GREENBAUM: "To be or not to be, that is the question. Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous fortune, or to take arms against a sea of troubles, and by opposing, end them."
YLENA: Is that the one in danger, then?
GREENBAUM: That's my skydiver. He's been terribly messed around. Pm trying to get him to pull the ripcord. I can't do it for him. The underlying problem with our grubby Peter Pan is, he has never grown up, never admitted defeat, never embraced . . . resignation.
(Exit Greenbaum and Ylena. Turing goes to his bed carrying &bowl of liquid. Enter Porgy.)
PORGY: Oh, this is what you was gold plating some spoons with earlier, isn't it?
TURING : Get your nose out of my potassium cyanide, bear.
PORGY: What's this highly poisonous substance doing now right by your bed? Surely it should be placed out of reach, in case of accident during repose, Master.
TURING : Leave it there or I'll cut your paws off!
PORGY: Has it comes to that, Master?
TURING: It's come to that. I'm chucking in the towel. Stop staring, Porgy.
(Turing dips the ttpple in it. Porgy looks on.)
PORGY: Please reconsider, Master. You liked Varia, didn't you? She liked you too. What's that poor little girl going to think when her new friend who brought her sweeties doesn't come round anymore?
TURING: I don't care. Get out if you can't bear it.
PORGY: This is no time for jokes, Master! To kill yourself makes such a terrible hole in the universe, such a blackness, that the rest of us that love you are going to be carrying it for all our lives. What would your mother say, your poor mother who brought you into the world? Has she not suffered enough?
TURING: She'll believe it was an accident, Porgy. (Imitates.) "Alan was always so careless. He never washed his hands properly before he went to bed." (Bites apple.)
PORGY: Spit it out! I implore you! Cyanide can sear with pain before it kills. You'll be writhing with contractions. I'm not watchin' that! (Covers face.)
TURING: You're wrong, Porgy. There's no pain.
(Dies. Porgy takes Turing s pulse.)
PORGY: What, dead? I am coming with you. Nothing is stronger than this love, for I am nothing indeed without you, Master. Self-evisceration is swiftest. Paws, lead on! (Tears straw out of chest.) There'd be a pricking of eyes now, right up to the gods, if they could see who humbly lays his vital organs at Master's feet. See, Master! There! (Tenderly.) There's my heart!
END

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SNOO WILSON has written novels, plays, screenplays, and scripts for television and radio. Lovesong of the Electric Bear was performed at Middlebury College and in New York in collaboration with the Potomac Theatre Project, directed by Cheryl Faraone. His other plays, which include The Pleasure Principle, Vampire, The Number of the Beast, Moonshine, The Glad Hand, and Darwin's Flood, have been produced in the U.S. and in England, by the Royal Shakespeare Company and at the Royal Court Theatre, the Bush Theatre, and the Hampstead Theatre. The playwright will be more than happy to discuss further productions of his work via a communications system directly descended from Turing algorithms: snoowilson@email.com.

Publication date: 2011

Year: 2011

Cross-Modulation Interference With Lateralization of Mixed-Modulated Waveforms

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1417-1428A.
ProQuest document link

Abstract: This study investigated the ability to use spatial information in mixed-modulated (MM) sounds containing concurrent frequency-modulated (FM) and amplitude-modulated (AM) sounds by exploring patterns of interference when different modulation types originated from different loci as may occur in a multisource acoustic field. Interaural delay thresholds were measured from 5 normal-hearing adults for an AM sound in the presence of interfering FM and vice versa as a function of interferer modulation rate. In addition, the effects of near versus remote interferer rates, and fixed versus randomized interferer interaural delay, were investigated. AM interfered with lateralization of FM at all modulation rates. However, the FM interfered with AM lateralization only when the FM rate was higher than the AM rate. This rate asymmetry was surprising given the prevalence of low-frequency dominance in lateralization, but was predicted by a cross-correlation model of binaural interaction. Effects were similar for fixed and randomized interferer interaural delays. The results suggest that in multisource environments, sources containing different modulation types significantly interfere with localization in complex ways that reveal interactions between modulation type and rate. These findings contribute to the understanding of auditory object formation and localization.

Full text: Headnote

Purpose: This study investigated the ability to use spatial information in mixedmodulated (MM) sounds containing concurrent frequency-modulated (FM) and amplitude-modulated (AM) sounds by exploring patterns of interference when different modulation types originated from different loci as may occur in a multisource acoustic field.

Method: Interaural delay thresholds were measured from 5 normal-hearing adults for an AM sound in the presence of interfering FM and vice versa as a function of interferer modulation rate. In addition, the effects of near versus remote interferer rates, and fixed versus randomized interferer interaural delay, were investigated.
Results: AM interfered with lateralization of FM at all modulation rates. However, the FM interfered with AM lateralization only when the FM rate was higher than the AM rate. This rate asymmetry was surprising given the prevalence of low-frequency dominance in lateralization, but was predicted by a cross-correlation model of binaural interaction. Effects were similar for fixed and randomized interferer interaural delays.
Conclusions: The results suggest that in multisource environments, sources containing different modulation types significantly interfere with localization in complex ways that reveal interactions between modulation type and rate. These findings contribute to the understanding of auditory object formation and localization.
KEY WORDS: sound localization, modulation, AM, FM, interference
(ProQuest: ... denotes formulae omitted.)
Amplitude-modulated (AM) and frequency-modulated (FM) sounds are the building blocks of nearly all natural and complex sounds. Important examples include communication signals from speech to vocalizations in diverse species from nonhuman primates to marine mammals, birds, and even insects (Bailey, Greenfield, &Shelly, 1993; Brillet &Paillette, 1991; Coscia, Phillips, &Fentress, 1991; Dankiewicz, Helweg, Moore, &Zafran, 2002; Dear, Simmons, &Fritz, 1993; Fant, 1970; Huber &Thorson, 1985; Klump &Langemann, 1991; Pickett, 1980; Robisson, Aubin,&Bremond, 1993; Ryan&Wilczynskin, 1988; Saberi& Perrott, 1999; Sabourin, Gottlieb,&Pollack, 2008;Simmons, 1979). Interaural delay is one of the major cues to sound localization along the azimuthal plane and has been used extensively in the investigation of binaural spatial processing and interference effects in localization. In this study, we investigated the ability of human subjects to detect spatial cues (interaural delays) in mixed-modulated (MM) waveforms (i.e., sounds that contain concurrentAMand FMcues) and the extent to which spatial cues in one type of modulation interfere with coding of conflicting spatial cues in the other type of modulation.
The rationale for exploring spatial interference across modulation types is partly derived from the idea that an FM signal is converted into AM as its instantaneous frequency sweeps through a cochlear filter's passband (Blauert, 1981; Henning, 1980; Hsieh &Saberi, 2009; Saberi, 1998; Saberi &Hafter, 1995). The induced AMs have rates and phases that are complex and dependent on a number of factors such as a filter's resonant frequency relative to that of the FMcarrier. For a periodic FM, the system must integrate different AM rates and phases at the outputs of filters that fall within the FM's peak frequency excursion. Filters near theFMcarrier frequency will output an AM rate twice that of more remote filters,1 and the periodic AM envelopes at the outputs of filters positioned above and below the FM carrier will be antiphasic (Saberi, 1998). Given these complexities, it is a priori difficult to determine the magnitude or patterns of interference across modulation types without empirical measurement.
In a multisource acoustic environment, concurrently active sounds originating from different locations may interfere with detection, localization, and identification of a target sound. Prior studies of binaural interference have extensively investigated the effects of frequency differences on lateralization of concurrently active sources (Heller &Trahiotis, 1995, 1996; McFadden &Pasanen, 1976; Perrott, 1984; Saberi, Tirtabudi, Petrosyan, Perrott, &Strybel, 2002). Heller and Trahiotis (1995), for example, demonstrated that an AM stimulus can interfere with detection of interaural delays in anotherAMsound even when their carrier frequencies are several critical bands apart. In that and other similar studies (Best, Gallun, Carlile,&Shinn-Cunningham, 2007; Heller&Trahiotis, 1996), waveforms of a single modulation type (AM) with different carrier frequencies were used. In the present study, we used waveforms of different modulation types (AM/FM) but the same carrier frequency to investigate binaural interference as a function ofmodulation type and rate. In baseline control conditions, we also examined the ability to detect interaural delays in the absence of interference separately for AM, FM, and MM sounds whose FM and AM components had identical coherent interaural delays. Based on

the idea that FM is converted to AM, we predicted substantial interference with detection of interaural delays across modulation types. In addition, based on irregularities in the inducedAM's rate and phase across peripheral auditory filters, we predicted dissimilar interference patterns depending onwhich modulation type serves as the interferer as well as interactions between modulation type and rate.

General Method

Stimuli

Stimuliwere generated usingMATLAB software (The MathWorks) on aDell PC (Dimension 8400) and presented at a rate of 44.1 kHz through 16-bit digital-to-analog converters (Creative Sound Blaster Audigy 2ZS) and through Sennheiser headphones (HD 433) in a doublewalled steel acoustically isolated chamber (Industrial Acoustics Company). The AM, FM, andMMstimuli were generated from Equations 1 to 3, respectively:

... [1]

... [2]

... [3]

where f^sub AM^, f^sub FM^, and fc represent the AM, FM, and carrier frequencies, respectively, in hertz; ITD is the interaural time difference; m is the amplitude modulation depth; and b is the frequency modulation depth (see Figure 1, top panel). The value of b was set to 1, and the value ofm was set to 0.5 to ensure that the MM waveform maintained bothAMandFMcues throughout the entire stimulus duration.Priormonaural studies of MMsounds have also typically selected values of m less than 1 (Moore &Sek, 1992, 1994). For theMM waveform, amplitude and frequencymodulation rates (fAM and fFM)wereequalwhen there was no interfering signal and were usually, but not always, different when one modulation type was selected as the interferer. Similarly, their respective interaural delays (ITD^sub 1^ and ITD^sub 2^) were different in the "interference" conditions.2 We selected a high carrier frequency of 3 kHz in all conditions to avoid carrier interaural phase effects, which are dominant at frequencies below 1.5 kHz (Mills, 1960, 1972; Rayleigh,1907; Yost&Hafter, 1987). The signal to be detected was the change in interaural delay across the two intervals of a trial.We selected a modulation frequency of 200 Hz for the waveform containing the signal because this modulation frequency has been shown to produce low ITD discrimination thresholds for both AM and FM sounds (Saberi, 1998). Because previous work on binaural interference at high frequencies has suggested that modulation phase does not affect binaural interference (Heller &Trahiotis, 1995), we set the modulation phases to zero. Stimuli were 300 ms in duration, with 20-ms linear rise- decay envelopes. All waveforms had simultaneous onsets and offsets in the two channels to prevent use of interaural envelope cues at the beginning and end of the stimulus. Delays between left and right channels were checked for accuracy with a dual-channel digital storage oscilloscope (Tektronix, Model TDS210). Stimulus levels were calibrated to 70 dB SPL using a 6-cc coupler, 0.5-in. microphone (Brüel&Kjæ r, Model 4189), and a Precision Sound Analyzer (Brüel&Kjæ r, Model 2260).

Procedures

Five normal-hearing adults (3 male, 2 female), including 3 of the authors, served as subjects. Their ages ranged from 21 to 46 (M = 31.2). All were highly experienced in spatial hearing experiments, and each received 2 hr of practice on various conditions of the experiment before data collection began.

The experiment was run in a random-block design in which themodulation rate and type were held constant within a run. Each run consisted of 50 trials in a twointerval forced-choice (2IFC), two-down one-up adaptive design that tracks the subject's 70.7% correct response threshold (Levitt, 1971; Wetherill &Levitt, 1965). On the first interval of each trial, the dichoticwaveformled to one randomly selected ear by a specific ITD; in the second interval, it led to the other ear by the same magnitude of ITD. The interstimulus interval was 250 ms. The subject's task was to identify the order of presentation of the stimuli (i.e., left-leading then right-leading, or rightleading then left-leading). Perceptually, this is equivalent to determining if the two intracranial auditory images in the two intervals of the trial were heard at left then right or at right then left. The subject then pressed

either a left or a right key to respond (left key response meant that the subject perceived the sound orders as right to left). Visual feedback was provided after each trial. The initial value of the signal interaural delay on each run was 1,500 ms (i.e., 750 ms in each interval). Two successive correct responses led to a reduction of the total interaural delay by a stepsize of 0.2 log units up to the fourth reversal and 0.1 log units thereafter (Saberi, 1995b). An incorrect response led to an increase in ITD by the same stepsize. Threshold on each run was estimated as the average of the stimulus values at track reversal points. The first three or four reversals from each run were discarded, and threshold was estimated as the average of the remaining even number of reversals. Usually, four to eight reversals went into the calculation of each threshold. All procedures were approved by the University of California, Irvine's Institutional Review Board.

Lateralization Thresholds for AM, FM, and MM Waveforms in the Absence of Interference

The purpose of this part of the study was to measure baseline ITD thresholds for the different modulation types, to which we could compare thresholds from MM waveforms with conflicting ITD cues. It was a priori unclear whether the MM stimulus with coherent ITD cues in its FMandAMcomponents within the same frequency region would produce thresholds different from those of AM or FM alone. Previous studies of spectrally remote co-modulated waveforms with common ITDs have shown improvements in ITD thresholds relative to thresholds obtained from independently modulated bands (Saberi, 1995a). All waveforms had a constant modulation rate of 200 Hz. The ITDs of both types of modulation in the MMwaveform were the same (i.e., ITD^sub 1^ = ITD^sub 2^ in Equation 3) and varied adaptively as described in the Procedures section). Each subject completed four to five runs per each of three conditions in a random-block design.

Results

The bottom panel of Figure 1 shows averaged ITD thresholds from five subjects for the three types of modulation in the absence of interference. Thresholds across conditions averaged between 100 and 150 ms. No significant improvements in lateralization thresholds were observed when the two modulation types were co-modulated (MM) relative to AM and FM alone. This finding may be contrasted to the work mentioned previously (Saberi, 1995a), which has shown an enhancement of ITD thresholds when waveforms of the same modulation type across different spectral regions are co-modulated. A one-way repeated-measures analysis of variance (ANOVA) confirmed that there was no significant effect of modulation type, $F(2, 42) = 0.795$, ns.

Binaural Interference Across Modulation Type

The threshold for an MM waveform with coherent ITDs was the same as that measured for an FM or AM waveform alone. In this part of the study, we examined ITD thresholds for the AM component of an MM waveformwhen itsFMcomponent carried conflicting ITDcues and equivalently measured ITD thresholds for the FM component of anMMwaveform when itsAM component carried conflicting ITD cues. The stimulus was an MM waveformgenerated from Equation 3 with different modulation frequencies (fAM m fFM) and different interaural delays ITD^sub 1^ m ITD^sub 2^) associated with each modulation type. In half the runs, the FMsignal was the interferer; in the other half, the AM signal was the interferering modulation type. The ITDof the interferingmodulation was set to zero, similar to designs used in other studies of binaural interference (Best et al., 2007; Heller&Trahiotis, 1995), whereas the ITD of the signal modulation was adaptively varied. The signal modulation frequency was always equal to 200 Hz, and the interfering modulation frequency was either 100 Hz, 200 Hz, or 300 Hz.We selected these rates for the interfering stimulus because they cover rates that produce relatively low to moderate lateralization thresholds for AM and FM sounds in isolation. Lateralization thresholds for rates below 100 Hz or exceeding 300 Hz precipitously increase (Henning, 1974, 1980; Nuetzel &Hafter, 1976, 1981; Saberi, 1998) and hence are likely to be nonoptimal as interfering stimuli. The task was the same as that described earlier except that subjects were informed that if they heard two perceptually distinct sounds, they should focus on that which appeared to change in spatial location across the two intervals of the trial and to use feedback to maximize performance. Each of the five subjects completed four to five runs per each of six conditions (3 rates ×2 modulation types) in a random-block design.

Results

Figure 2 shows individual-subject data from this experiment, and Figure 3 shows the mean results. The left column of Figure 2 and top panel of Figure 3 show the results for an AM signal and an FM interferer, and the right column of Figure 2 and bottom panel of Figure 3 show the results for an FM signal and an AM interferer. The abscissa in both figures represents the interferermodulation frequency. The dashed horizontal lines represent thresholds for the signal alone-that is, in the absence of the interfering waveform. Two trends are clearly evident. First, when the signal isAM, theFMdoes not interfere with lateralization for interferer rates at or below the signal modulation rate. However, the FM causes substantial interference when its rate is above that of the signal. This rate asymmetry in interference is surprising, given the well-known low-frequency dominance in lateralization and signal detection studies that have shown upward spread of masking (Divenyi, 1992; Egan &Hake, 1950; Hsieh &Saberi, 2009; Klein, Mills, &Adkins, 1990; Picard &Couturemetz, 1985). However, our finding is consistent with some binaural studies showing that a high-frequency interferer has a more pronounced effect than a low-frequency interferer on detecting the motion of a target sound in a multisource environment (Saberi et al., 2002). It is interesting to note that studies of monaural modulation masking (e.g., Ewert &Dau, 2000) have shown that for modulation rates near those used in the present study, maskers with modulation rates below the signal modulation rate have a substantially larger masking effect than those with rates above the signal, suggesting that the results observed here are not caused by asymmetries in filter slopes of higher rate modulation filters.

The second main finding from this part of the study, shown in the bottom panel of Figure 3 (and right panels of Figure 2), is that anAMinterferer has a significant effect on lateralization of FMsignals at all interferer rates tested. Note from the individual subject data shown in Figure 2 that although all subjects show a consistent asymmetric pattern of interference for an FM interferer and AM signal (left panels), the patterns are somewhat more variable across subjects for the FMsignal and AM interferer (right panels). Nonetheless, even in this case, thresholds for all subjects across all conditions (i.e., all 15 bars) are higher than thresholds in the absence of the AM interferer (dashed lines). Large intersubject variability has also previously been reported in studies of binaural interference (Best et al., 2007; Heller &Trahiotis, 1995).

To determine whether the observed differences between modulation types (AM vs. FM interferer) as well as between interferer modulation frequencies were significant, we conducted several statistical analyses.Atwo-way (2 ×3) repeated measures ANOVA on the data of Figure 3 showed a significant effect of interferer modulation frequency, $F_{Freq}(2, 42) = 59.82$, $p < .001$; no significant effect of interferer modulation type, $F_{AM/FM}(1, 21) = 2.08$, ns; and a significant Interferer Modulation Frequency ×Type interaction, $F_{Freq \times AM/FM}(2, 42) = 20.54$, $p = .001$. As this ANOVA demonstrates an overall significant difference between conditions, in order to specifically determine which conditions caused significant interference, we conducted several paired-sample post hoc t tests. Results showed that for anAMsignal andFMinterferer, only the 300-Hz interferer (see Figure 3, top panel, right bar) caused a significant increase in thresholds relative to the no-interference (dashed-line) condition, $t(21) = 10.16$, $p < .001$. Neither the 100-Hz nor the 300-Hz FM interferer caused thresholds to change significantly relative to the no-interference condition: $t(21) = 0.20$, ns, and $t(21) = 0.21$, ns, respectively. However, when the signal was FM, an AM interferer caused significant interference at all three interferer modulation rates of 100 Hz, $t(21) = 2.81$, $p < .05$; 200 Hz, $t(21) = 4.02$, $p < .005$; and 300 Hz, $t(21) = 5.17$, $p < .001$.

Effects of Small Rate Differences and ITD Perturbation

We conducted two additional complementary experiments using MM waveforms that examined very small modulation rate differences between the signal and interferer as well as the effects of perturbing the ITD of the interfering stimulus from trial to trial. We selected only theAMsignal condition because of the substantially larger number of psychophysical (Henning, 1974; Nuetzel &Hafter, 1976), neurophysiological (Grothe &Park, 1998; Joris&Yin, 1992), and neuroimaging (Giraud et al., 2000; Wienbruch, Paul,Weisz, Elbert,& Roberts, 2006) studies that have focused on detection and lateralization of AM signals and also because we found the

interesting asymmetric rate effects on lateralization of AM signals (see top panel of Figure 3). Three of the five subjects (S1, S2, S3) from the earlier parts of the study participated in the experiments described in the two sections that follow. Each subject completed three runs per condition.

Effects of Small Rate Differences

In the first part of the study, we measured lateralization thresholds for an AM signal in the presence of an FMinterferer whose modulation ratewas only 2 Hz away from that of the signal. In the previous section, the interferer modulation rate was either equal to or 100 Hz away from the signal modulation rate.When the interferer and signal modulation rates are distant, the percepts segregate into two streams in spite of the common carrier frequency. When the rates are near each other (but not equal), a fundamentally different percept is induced that may be described as perceptual beats at the rate difference (2 Hz). All procedures were the same as those described in the General Method section except that the interferer was FM at rates of 198 Hz or 202 Hz, and the signal was AM at 200 Hz.

The top panel of Figure 4 shows the results of this experiment. For comparison, the data for a 200-Hz FM interferer were replotted from the top panel of Figure 3. The form of interference was nearly identical to that observed for larger rate differences in that the lower rate interferer (198 Hz) had a much smaller effect on lateralization of theAMsignal than the higher rate interferer (202 Hz), which significantly degraded lateralization performance. A one-way ANOVA on these data showed a significant effect of interferer rate, $F(2, 22) = 12.10$, $p < .001$. Threshold for the 198-Hz condition was not significantly larger than that for the no-interference condition (dashed line), $t(11) = 1.62$, ns, whereas the threshold for the 202-Hz interferer was significantly larger than that for the no-interference condition, $t(11) = 4.37$, $p = .001$.

Effects of Interferer ITD Perturbation

In the main experiment, the interferer ITD was held constant at zero. We made this choice to be consistent with other studies of binaural interference (e.g., Heller &Trahiotis, 1996). However, it might be expected that having a fixed ITD for the interferer may produce a different magnitude of interference compared with an interferer whose ITD is either randomly selected on every presentation or is fixed at a relatively large nonzero extreme. To test this possibility, we examined binaural interference with lateralization of AM signals by an FM interferer whose ITD was either randomly selected on each presentation (i.e., different in the two intervals of the 2IFC) or fixed at 750 ms. The latter design is similar to one used in a binaural interference study by Buell and Hafter (1990), who used fixed-ITD interferers to examine lateralization of low-frequency complex tones. They reported that when the target and interferers comprised harmonic components, substantially larger interference effectswere observed comparedwithwhen inharmonic complex tones were used. In the random- ITD condition, the interaural delay was picked from a uniform distribution with a range of 1,500 ms (750 ms leading to the left ear to 750 ms leading to the right ear). Because we had examined both large and small rate differences (2 Hz and 100 Hz), to further add to the set of interferer rates examined, we selected an interferer rate that was slightly different (i.e., 210 Hz) from those used earlier. We believe that this choice should not affect interpretation of findings from this part of the study, as our main interest here was to contrast the effects of zero, fixed (nonzero), and nonstationary ITDs on binaural interference.

The bottom panel of Figure 4 shows the results of this experiment. A one-way ANOVA on the data of the bottom panel of Figure 4 showed no significant difference between conditions, $F(2, 16) = 1.05$, ns.Note that the magnitude of interference was independent of whether the interferer ITD was 0, 750 ms, or randomized on each presentation. Note also that the magnitude of interference for the 202-Hz FM interferer (see top panel of Figure 4) is actually larger than that for the 210-Hz FM interferer. This suggests that although FM sounds that have rates above an AM signal's rate cause interference, the form of this interference as a function of rate may be nonmonotonic, both for FM interferer rates above and possibly below the AM signal rate.

Discussion

The present findings suggest that in a complexmultisource environment where concurrent sounds originate from

different loci, the presence of one type of modulation may affect the ability to localize another source containing a different form of modulation. An unexpected finding with AM signals and FM interferers was that higher interferer modulation frequencies had a more pronounced effect than lower frequencies. This pattern was not observed when the signal was FM and the interfererwas AM,where significant interferencewas observed even at the lowest interferer modulation frequency (i.e., 100 Hz).We also found that perturbing the interferer ITD across intervals of a trial produced approximately the same magnitude of interference as that associated with a fixed-ITD interferer. In addition, we found that whether the AM signal and FM interferer modulation frequency differences are small (2 Hz) or large (100 Hz), similar asymmetric threshold patterns are observed. The present findings on cross-modulation interference are novel and complementary to other studies of binaural interference, which have shown that localization of a modulated waveform is adversely affected by the presence of the same type of modulation at a different frequency band (Heller &Trahiotis, 1995, 1996).

An important question to address here is the cause of the observed cross-modulation interference. As noted in the introduction, an FM-to-AM mechanism may provide part of the explanation for the interference effects. However, it is not intuitively clear why and how such a mechanism results in the observed patterns of binaural interference. The most notable of these patterns is the asymmetric effects of FM interferer rate on lateralization of AM sounds. Our goal here is not to conduct an extensive analysis of all conditions but, rather, to account for the unexpected finding that higher-rate FM interferers impact lateralization of AM signals more severely than do lower-rate interferers.

For this analysis, we processed the stimuli used in our experiment through a cross-correlation model of binaural interaction. This type of computational model, which originated in the theoretical work of Jeffress (1948) and later found neurophysiological support (Carr &Konishi, 1988, 1990; Yin &Chan, 1990), represents an interaural delay as a spatially distributed physiological place map. Peaks of activity along this tonotopically organized frequency-by-delay map correspond to estimated perceived locations in space. Our implementation of the model included a pre-processing stage (see left panels of Figure 5) consisting of a GammaTone filterbank with 40 filters whose center frequencies (CFs) were logarithmically spaced from 1 kHz to 5 kHz (Holdsworth et al., 1988) and an inner hair-cell model (Meddis, Hewitt, &Shackleton, 1990; Slaney, 1998), followed by crosscorrelation of the outputs of corresponding left and right channels with matched-CF filters. The output of this model is shown in the right panels of Figure 5. Three types of mixed-modulated waveforms were processed. First, both the FM and AM components were modulated at 200 Hz, and both had consistent ITDs equal to +600 ms (i.e., no interference). The second and third types of waveforms corresponded to interference conditions-specifically, to the data shown in the top panel of Figure 3, in which the AM signal had an ITD of +600 ms and the FM interferer had an ITD of zero (positive ITDs in this model correspond to a dichotic waveform leading to the right ear). The signal AM was always modulated at 200 Hz, whereas the FM interferer was modulated at either 100 Hz or 300 Hz.

The predicted perceived lateral position is obtained by integrating the cross-correlation surface activity across frequency channels and determining the cross-correlation lag associated with the peak of this integrated activity (Hsieh& Saberi, 2009; Saberi, 1998; Saberi &Petrosyan, 2005; Stern et al., 1988). Because carrier interaural delay has a negligible effect on lateralization at high frequencies (Neutzel &Hafter, 1981), we used the peak of the envelope of integrated activity as the predictor of perceived position. This envelope was extracted using the Hilbert Transform and plotted as the intensity strip in the right panels of Figure 5. The dark red region corresponds to the lag associated with the envelope's peak. Note that the 100-Hz FM interferer affects the predicted perceived lateral position substantially less than the 300-Hz interferer. In the presence of limiting internal noise, the smallest lateral position estimate (associated with the 300-Hz condition) will lead to the largest predicted ITD threshold, consistent with the data observed in Figure 3. The 100-Hz interferer does predict a reduction in extent of laterality relative to no interference. This is not observed in the data of Figure 3 but is seen in the small-rate-difference data of Figure 4 (top panel). We can obtain predictions closer to those of

Figure 3 but at the cost of an additional free parameter, which we thought was unnecessary. The critical observation is that a simple cross-correlation model with zero free parameters can predict the asymmetric interfererrate effects on lateralization of AM signals.

The differences, both methodological and perceptual, between the present and previous studies of binaural interference may provide some insight into the neural processes underlying the observed interference within and across modulation types. There are two primary methodological differences between the present study and previous studies of binaural interference that have employed modulated tones. First, as noted earlier, prior studies examined interference of an AM tone on another spectrally remote AM tone. Second, these studies always used equal interferer and target modulation rates. For example, Heller and Trahiotis (1995) examined ITD discrimination thresholds for a high-frequency sinusoidally amplitude modulated (SAM) tone (2-kHz or 4-kHz carrier modulated at 250 Hz) in the presence of an interfering SAM tone at a different carrier but the same modulation frequency. They found that the largest interference was caused by a low-carrier-frequency (500 Hz) SAMtone. In a second study, Heller and Trahiotis (1996) reported that the perceived lateral position of a highfrequency SAM tone is also affected by presence of a low-frequency interfering SAM tone; the interferer effectively "pulled" the target toward itself. The fact that the target and interferer in these studies were spectrally remote suggests that this type of interference likely occurs at higher levels in the binaural pathway past the initial stages of binaural interaction in peripheral nuclei (e.g., the superior olivary complex). This idea is consistent with the findings of Best and colleagues (2007), who showed reduced binaural interference when a spectrally remote SAM-tone interferer was preceded and followed by a sequence of identicalSAMtones that "captured" the interferer, presumably due to perceptual grouping.

The neural origins of interference effects reported by these studies may be at least partially different than those associated with ours. In our study, the target and interferers had the same carrier frequencies, and, as suggested by the cross-correlation analysis, the patterns of interference may have been partly caused by peripheral auditory processes. This does not mean that additional higher-level streaming or grouping mechanisms were not involved. In fact, as noted earlier, when the target and interferer had substantially different modulation rates, observers at times reported two perceptual streams, suggesting that interference across modulation types also may have been affected by central mechanisms involved in auditory object formation.What would one then expect to observe if the FM and AM waveforms were positioned in spectrally remote regions? We would still expect cross-modulation binaural interference but of a smaller magnitude compared with the effects reported in the present study or those reported in previous studies using spectrally remote AM targets and interferers. This is because-assuming that the FM waveform is transformed intoAMinformation during bandpass filtering- it is likely that some level of interference would be observed consistent with prior studies using spectrally remote AM sounds. However, because the rates and phases of the inducedAMswould be inconsistent across filters,3 it is less likely that the magnitude of this type of interference would be as large as that reported in earlier studies.

In conclusion, our findings contribute to the understanding of object formation and localization in multisource environments, and together with those from studies of stream segregation, spatial masking, and monaural and multimodal localization (Bregman, 1994; Brungart, Simpson, Ericson, &Scott, 2001; Freyman, Balakrishnan, &Helfer, 2004; Kidd, Richards, Mason, Gallun, &Huang, 2008; Musicant &Butler, 1985; Saberi, Dostal, Sadralodabai, Bull, &Perrott, 1991; Strybel &Vatakis, 2004) provide a more comprehensive picture of signal detection and identification in complex acoustic fields.

Acknowledgments

This work was supported by Grant NSC 98-2410-H-008- 081-MY3 from the National Science Council, Taiwan; Grant BCS0477984 from the National Science Foundation; and Grant R01DC009659 from the National Institutes of Health. We thank Bruce G. Berg and Virginia M. Richards for helpful comments.

Sidebar

Cross-Modulation Interference With Lateralization of Mixed-Modulated Waveforms
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J Speech Lang Hear Res 2010;53;1417-1428; originally published online Aug 5, 2010;
DOI: 10.1044/1092-4388(2010/09-0206)

Footnote

1Filters near the FM carrier will output an AM that has a rate twice that of the FM as it sweeps through both the up and down slopes of the filter during the positive and again during the negative phase of the FM, whereas for more remote filters, the FM will sweep only through either the filter 's up slope (lower frequency slope for filters with center frequencies [CFs] above the FM carrier) or the down slope (higher frequency slope for filters positioned below the FM carrier), hence generating an AM rate equal to that of the FM. Furthermore, the transition between these two extremes is graded, with the two AM peaks gradually merging into one as the distance between the FM carrier and filter CF is increased. This complex pattern also depends on the FM rate. For very rapid sweeps, the system will not track changes in instantaneous frequency. The AM is induced by filtering out sidebands of the long-term Fourier spectrum of the FM signal consisting of symmetric harmonics flanking the carrier frequency, with the lower odd harmonics inverted in phase relative to the carrier phase.
2In generating the dichotic stimuli from Equations 1 through 3, ITD was set to zero in one channel and to the desired interaural delay in the other channel.
3See Footnote 1.

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Received September 20, 2009
Accepted March 29, 2010
DOI: 10.1044/1092-4388(2010/09-0206)
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Publication date: Dec 2010

Year: 2010

Measuring the Effects of Reverberation and Noise on Sentence Intelligibility for Hearing-Impaired Listeners

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1429-1439A.

Abstract: The Speech Transmission Index (STI; Houtgast, Steeneken, &Plomp, 1980; Steeneken &Houtgast, 1980) is commonly used to quantify the adverse effects of reverberation and stationary noise on speech intelligibility for normal-hearing listeners. Duquesnoy and Plomp (1980) showed that the STI can be applied for presbycusic listeners, relating speech reception thresholds (SRTs) in various reverberant conditions to a fixed, subject-dependent STI value. The current study aims at extending their results to a wider range of hearing-impaired listeners. A reverberant analogue of the SRT is presented-the speech reception reverberation threshold (SRRT)-which determines the amount of reverberation that a listener can sustain to understand 50% of the presented sentences. SRTs are performed and evaluated in terms of STI for 5 normal-hearing participants and 36 randomly selected hearing-impaired participants. Results show that differences in STI between reverberant and noisy conditions are only small, equivalent to a change in speech-to-noise ratio <1.3 dB. The STI appears to be a convenient, single number to quantify speech reception of hearing-impaired listeners in noise and/or reverberation, regardless of the nature of the hearing loss. In future research, the SRRT may be applied to further investigate the supposed importance of cognitive processing in reverberant listening conditions.

Full text: Headnote

Purpose: The Speech Transmission Index (STI; Houtgast, Steeneken, &Plomp, 1980; Steeneken &Houtgast, 1980) is commonly used to quantify the adverse effects of reverberation and stationary noise on speech intelligibility for normal-hearing listeners. Duquesnoy and Plomp (1980) showed that the STI can be applied for presbycusic listeners, relating speech reception thresholds (SRTs) in various reverberant conditions to a fixed, subject-dependent STI value. The current study aims at extending their results to a wider range of hearing-impaired listeners.

Method: A reverberant analogue of the SRT is presented-the speech reception reverberation threshold (SRRT)-which determines the amount of reverberation that a listener can sustain to understand 50% of the presented sentences. SRTs are performed and evaluated in terms of STI for 5 normal-hearing participants and 36 randomly selected hearing-impaired participants.

Results: Results show that differences in STI between reverberant and noisy conditions are only small, equivalent to a change in speech-to-noise ratio <1.3 dB.

Conclusion: The STI appears to be a convenient, single number to quantify speech reception of hearing-impaired listeners in noise and/or reverberation, regardless of the nature of the hearing loss. In future research, the SRRT may be applied to further investigate the supposed importance of cognitive processing in reverberant listening conditions.

KEY WORDS: hearing impairment, reverberation, speech reception

Understanding speech in everyday life can be a real challenge: The common presence of background noise and reverberation in everyday listening situations seriously affects the reception of conversational speech. Normal-hearing listeners are usually able to tolerate moderate amounts of noise or reverberation, but hearing-impaired listeners often complain of not being able to understand what is being said, even when the speech level seems sufficient.

Plomp and Mimpen (1979) developed a standardized method to determine the speech reception threshold (SRT), which measures the speechto- noise ratio (SNR) that a listener can sustain while still being able to correctly reproduce 50% of the presented sentences. The SRT has been widely applied for normal-hearing and hearing-impaired listeners to assess the effect of noise on sentence intelligibility (see, e.g., Festen &Plomp, 1990; George, Festen, &Houtgast, 2006).

The effect of reverberation on sentence intelligibility can be quantified by applying the Speech Transmission Index (STI; Houtgast, Steeneken, &Plomp, 1980; Steeneken &Houtgast, 1980). The STI is based on the

observation that both reverberation and noise reduce the envelope fluctuations in speech. Using the modulation transfer function, the influence of reverberation can be translated into an equivalent SNR, after which it is treated in essentially the same way as additive noise. For normal-hearing listeners, the resulting STI is highly related to sentence intelligibility. That is, a reduction in STI essentially always gives rise to a corresponding reduction in sentence intelligibility (Houtgast &Steeneken, 1984), irrespective of whether the speech degrading factor is reverberation, noise, spectral filtering, or a combination of these factors.

Measurements by Duquesnoy and Plomp (1980) confirmed this result for a group of listeners suffering from presbycusis. They measured SRTs at various reverberation times and showed that, for each combination of noise and reverberation, the "STI at the SRT" was always the same listener-specific value.Put differently, this single STI value adequately summarized the obtained thresholds in all measured conditions. This means that individual performance in conditions with noise and reverberation can be predicted when the threshold in noise is known. For normal-hearing listeners, the resulting STIwas about one third (0.3). Hearing-impaired, presbycusic listeners needed larger STI values to reach 50% sentence intelligibility, which is regarded as a direct consequence of their hearing loss for speech-in-noise (Plomp, 1978).

The effects of noise and reverberation on speech intelligibility may thus be modeled adequately by the STI. It should be noted here, however, that their perceptual effects may in fact be different when investigated in more detail. For instance, Hedrick and Younger (2007) showed that the perceptual weighting of relative amplitude and transition cues may be different for noise and reverberation.

The main motivation for the current article was to reproduce and extend the results of Duquesnoy and Plomp (1980), specifically concerning two yet unaddressed issues. First, the STI method of assessing the effect of reverberation (i.e., translating it into an equivalent SNR) does not necessarily apply to listeners with nonpresbycusic hearing loss. Individual hearing-impaired listeners may vary widely in their susceptibility to noise and reverberation (Nabelek&Mason, 1981). The mechanisms underlying the reception of speech-in-noise or in reverberation may even be different for different groups of hearing impaired individuals(Committee on Hearing, Bioacoustics, and Biomechanics [CHABA] Working Group on Speech Understanding, 1988; Nabelek &Dagenais, 1986).

Second, assessing the effect of reverberation on speech intelligibility by measuring the SRT in noise at various reverberation times (such as Duquesnoy&Plomp, 1980) always gives rise to a confounding effect of the presence of noise. To avoid this confounding effect, one could measure sentence- or word-intelligibility scores at various reverberation times without background noise (Helfer& Wilber, 1990; Sato, Sato, &Morimoto, 2007). In the current study, we introduce a test that enables a more efficient examination of solely the effect of reverberation on speech intelligibility.

The current study extends the results of Duquesnoy and Plomp (1980) by assessing the effect of reverberation and noise on speech intelligibility in a wider range of hearing-impaired listeners. The main research question is whether the STI, as known from a measured SRT in noise only, is indeed a convenient single number to systematically quantify the combined effects of noise and reverberation in hearing-impaired listeners with diverse etiology. Moreover, a simple adaptive test is presented, similar to the SRT, that was designed to determine the amount of reverberation-in the absence of noise-that an individual listener can sustain and still understand 50% of the presented sentences. In Experiment 1, the results of this speech reception reverberation threshold (SRRT) test are evaluated for a relatively small group of normal-hearing participants. In Experiment 2, the test is applied to a larger, diverse group of hearing-impaired listeners.

Experiment 1: Normal-Hearing Listeners

Method

Measures

The STI. Thresholds for sentence intelligibility were measured in five different conditions in which sentences were presented in either background noise, reverberation, or both. Moreover, the conditions differ in whether

the SNR, the applied reverberation, or both are varied adaptively. The five conditions can bemutually compared by applying the STI. A schematic overview of the measurement conditions is given in Figure 1.

When assuming an exponentially decaying sound field, the STI can be easily calculated for any combination of reverberation time and SNR in stationary noise (Houtgast et al., 1980). The result is represented in Figure 1 in the form of iso-STI (i.e., iso-intelligibility) contours. Results by Duquesnoy and Plomp (1980) confirmed that, for presbycusic listeners, SRTs in different reverberant sound fields are distributed along an iso-STI contour, that is, they can be represented by one single, listener-specific STI value.

In the original SRT test, no reverberation is present, and the SNR is adaptively varied, as represented by the double arrowalong the horizontal axis inFigure 1 (A). Similarly, when there is no noise and when the reverberation time is adaptively varied (in the SRRT; see below), the measurement can be regarded as taking place along the logarithmic vertical axis (B). Three other measurement conditions (C, D, and E) are shown, which are discussed below.

The STI model applied here is a modification to the original version by Houtgast et al. (1980), as suggested by Van Wijngaarden and Houtgast (2004). They showed that the classic STI underestimates the adverse effect of reverberation on speech intelligibilitywhen informal, conversational speech is concerned. This motivated them to introduce amodified version of the STI model, including a total of 18 modulation frequency bands instead of the classic 14. When applying their model, different speaker styles give rise to a different STI value at the 50% sentence intelligibility point. For the Plomp and Mimpen's (1979) corpus, as used by Duquesnoy and Plomp (1980), the resulting STI is about 0.30 for normal-hearing listeners. For the sentences used in the current experiment (Versfeld, Daalder, Festen, &Houtgast, 2000), an "STI at the threshold" around 0.36 is expected, represented in Figure 1 by the dashed contour.

Noise only (SRT). The intelligibility of sentences disrupted by noise only (Condition A in Figure 1) was measured with the SRT test, following a simple adaptive up-down procedure as described by Plomp and Mimpen (1979). To measure the SRT, the masker and a list of 13 sentences, unknown to the listener, were presented. The SNR was varied adaptively to estimate the SRT, defined as the SNR at which 50% of the sentences could be reproduced without error. In each condition, the first sentence was presented at a level below threshold and repeated, at 4-dB higher levels with each repetition, until the listener was able to reproduce it correctly. The remaining 12 sentences in the list were presented only once, following a one-up-one-down adaptive procedure, with a 2-dB step size. An errorless reproduction of the entire sentence was required for a correct response. The SRT was estimated as the average presentation level of Sentences 4-13.

Reverberation only (SRRT). To determine the intelligibility of sentences disrupted by reverberation only (Condition B), the SRRT test was applied following an adaptive procedure similar to the SRT. In this condition, there was no masker present during the test, only reverberant speech. The amount of applied reverberation was varied adaptively to estimate the SRRT, defined as the reverberation time at which 50% of the sentences could be reproduced without error. Reverberation was introduced by convolving the signals with synthetic impulse responses, which makes it possible to define and vary the reverberation time in a systematic way. More details of the reverberation procedure can be found in the Stimuli section.

The step size of the SRRT was chosen to correspond to the step sizes of the standard SRT test (i.e., 4 dB for the first sentence and 2 dB for all other sentences). In terms of the STI, changing the SNR with 4 or 2 dB is equivalent to changing the reverberation time with a factor of about 2 or 3⁄42, as was derived from Figure 1. More precisely, for reverberation times between 0.25 and 3 s, a change with a factor of 3⁄42 gives rise to a change in STI equivalent to 1.8-2.0 dB per step, which is similar to the step size in the SRT procedure. The first sentence in the SRRT test was presented repeatedly, with reverberation time decreasing with a factor of 2 with each repetition, whereas the remaining 12 sentenceswere presented only once, adaptively changing the reverberation timewith a factor of 3⁄42 (one-up-one-down) after each sentence. The SRRTwas estimated as the geometric average reverberation time while presenting Sentences 4-13.

Noise and reverberation. There were three measurement conditions in which both noise and reverberation were present, each of which is displayed in Figure 1. In Condition C, which is denoted as "horizontal," the SNR was adaptively varied while keeping reverberation time constant. In Condition D, which is denoted as "vertical," it was the other way around: The SNR was kept constant while adaptively varying the applied reverberation time. The choices for the values of the fixed reverberation time in ConditionDand the fixedSNRin ConditionC were based on the expected STI at the threshold, as can be derived from Figure 1. The step sizes of the adaptive procedures for ConditionsC andDwere equal to the step sizes for the SRT (Condition A) and the SRRT (Condition B), respectively.

In Condition E, both the SNR and the applied reverberation time were varied in such a way that the adaptive procedure followed a track perpendicular to the STI contours. Following this "diagonal" track, under a 45° angle with the horizontal and the vertical axes, it was ensured that the adverse effects of noise and reverberation on speech intelligibility are equivalent in terms of STI. Thus, this measurement condition is the exact compromise between assessing the effect of noise (Condition A), on the one hand, and assessing the effect of reverberation (Condition B) on speech intelligibility, on the other hand.

As with the SRRT test, the step sizes in the diagonal condition were chosen to match the step size in the SRT test in terms of the change in STI. This meant that in order to make one step in the adaptive procedure, the SNR was changed with 3⁄42 dB [i.e., 2 ×cos(p/4)], and, at the same time, the reverberation time was changed by a factor of 1.28 {i.e., exp[log(3⁄42) ×cos(p/4)]}. These factors give rise to a change in STI equivalent to 1.6-1.8 dB per step, for the relevant range (i.e., SNRs between -2 and 13 dB and reverberation times between 0.14 and 2.1 s).

Measurement Conditions C and D were included so we would be able to assess possible effects of the different adaptive procedures (horizontal, diagonal, or vertical) on the resulting STI at the threshold without changing the range of SNRs or reverberation times in which the measurement takes place.

Stimuli

The speech material used in the current experiment was the VU98 corpus (Versfeld et al., 2000), which consists of 39 lists of sentences of a male talker and the same amount of lists for a female talker. Only 10 lists by the female speaker were used. The corpus was developed to enable efficient measurement of SRTs in noise. It was considered as being equivalent to Plomp and Mimpen's (1979) corpus.However, the speaking style of the VU98 sentences is generally more informal, as expressed by the higher STI at the SRT as discussed above.

Sentences were presented in stationary background noise, except for the SRRT test, in which no masker was present. Reverberation (if applicable) was introduced by convolving the signals with synthetic impulse responses.1 This approach of using idealized room impulse responses makes it possible to define the reverberation time in a systematic way and facilitates STI computation. In terms of the modulation transfer function, this artificial reverberation is identical to purely exponentially decaying real reverberation of the same reverberation time. The impulse responses were created by subjecting white noise to a pure exponential decay. The length of the used impulse response was in all cases equal to the desired reverberation time (T60).

In all conditions, the long-term spectra of the speech and the masker were similar in shape. Reverberation (if present) was applied to the speech and to the stationary noise (if present) separately, after which speech and noise were mixed according to the desired SNR, on the basis of their root-mean-square levels. The spectrum of the resulting signal was adapted to reach octave band levels equal to the middle of the dynamic range for each listener. The lower limit of the dynamic range was chosen to be the individual pure-tone threshold, whereas the upper limit was the uncomfortable loudness level, here chosen at 110 dB SPL. This approach is commonly used in our laboratory to ensure optimal audibility, and it is also applied for hearing-impaired listeners, as described below.

Participants

Five normal-hearing listeners participated in this experiment. Their ages were 26, 27, 46, 50, and 57 years,

respectively. They reported no problems with their hearing or with speech reception, and they were selected to have pure-tone hearing thresholds better than 10 dB HL at octave frequencies between 0.25 and 4.0 kHz. Approval for measuring human participants was obtained from the Medical Ethical Committee of the VU University Medical Center (Amsterdam, the Netherlands).

General Method and Instrumentation

The experiment was run on a Dell personal computer, equipped with a Creative Labs Audigy external sound device and Beyer Dynamic DT48 headphones. Sound calibrations were performed with a Brüel& Kjæ r Artificial Ear (Type 4152) and a Brüel &Kjæ r 2260 Observer conform ISO 389 (1991). Sound stimuli were digitally processed and mixed usingMATLAB, Version 7.0.0. All measurements were performed while the listener and the investigator were seated in a sound-insulated room in a single half-hour session.

A test-retest design was followed, in which thresholds in each of the five conditions were measured twice for each participant. Test and retest outcomes were averaged. Confounding of measurement order and sentence lists with condition effects was avoided by counterbalancing the order of conditions across participants, according to a 5 ×5 digram-balanced Latin square, while the order of the sentence lists was kept fixed. Measurements were conducted monaurally, using the participant's best ear, which was chosen according to personal preference in telephone conversation.

Data Analysis

The measurement error in each of the listening conditions was compared with the measurement error in the commonly used SRT test, which is only about 1 dB (Plomp &Mimpen, 1979). Measurement error was defined as the standard deviation of the test-retest difference divided by 3⁄42. Furthermore, it was investigated whether the STI, averaged over conditions and participants, is an adequate single number to summarize the performance of normal-hearing listeners in each of the five measurement conditions. This was done by performing a repeated measures analysis of variance (ANOVA) with condition as a within-subjects effect.

Results

In Table 1, the means and standard deviations of the obtained thresholds are displayed, plus the means and standard deviations of the corresponding STI values (averaged over test and retest). In all conditions, standard deviations are comparable with the standard deviation in the SRT test. Also displayed are the measurement errors, which, for an easier evaluation, are expressed in terms of STI and in terms of DSNR, which represents the change in SNR (in stationary noise, without reverberation) that would be needed to give rise to the same change in STI. A change of 0.033 in STI is equivalent to a DSNR of 1 dB. The measurement errors in all conditions are similar to, or sometimes somewhat better than, the measurement error of the SRT test,which serves here as a reference value. This indicates that, for normalhearing listeners, the threshold for sentence intelligibility in each of themeasurement conditions can be consistently determined.

Results of the ANOVA show that the effect of condition was not significant ($p = .07$). Post hoc comparisons (contrasts) were made between the STI in the individual conditions and the STI at the SRT in stationary noise, which is regarded as the reference conditionhere. None of these contrasts were significant ($p > .20$), which shows that the STI does not systematically vary across conditions.

Discussion

It can be concluded that the threshold for sentence intelligibility can be consistently determined in all measurement conditions for normal-hearing listeners. Moreover, the applied adaptive procedure (horizontal, vertical, or diagonal) does not systematically affect the resulting STI at the threshold. This finding makes the SRRT (vertical condition) an adequate test to examine the effect of solely reverberation on sentence intelligibility without the presence of noise.

Experiment 2: Hearing-Impaired Listeners

Method

Stimuli

Thresholds for sentence intelligibility were measured in three different conditions. These conditions were the same as those applied in Experiment 1 (see Figure 1). Sentences were presented in background noise only (Condition A), in reverberation only (Condition B), or in a combination of noise and reverberation (Condition E). The earlier performed references Conditions C and D were not included in this experiment because the results for normal-hearing listeners showed that the diagonalmeasurement procedure adequately assessed the combined effect of reverberation and noise on speech intelligibility.

The auditory stimuli in Experiment 2 were also the same as those used in Experiment 1. Tests were performed monaurally: Depending on whether only one or both ears of the participant were included, six or 12 lists of the VU98 corpus were used in the measurements. Again, the long-term spectra of the speech and the masker were similar in shape for all conditions, and the spectrum of the stimuli was adapted to reach octave band levels equal to the middle of the dynamic range for each listener. This approach ensures optimal audibility for all listeners, thus minimizing effects due to differences in individual hearing thresholds.

Participants

Participants were patients of the audiological center of the VU University Medical Center diagnosed with sensorineural hearing loss. They were asked to participate in the experiment directly after a visit to the center for a clinical evaluation of their hearing loss. The pure-tone audiogram and CVC-word intelligibility scores (in quiet) of both ears were known from this clinical evaluation. Individual ears were included in the experiment when the average pure-tone threshold for the frequencies of 500, 1000, and 2000 Hz was larger than 15 dB HL, that is, when hearing was less than optimal. Moreover, a maximum CVC-word score of at least 70% (in silence) was necessary to be included in the experiment. When both the listener's ears fitted these restrictions, both ears were measured and included separately. No other inclusion or exclusion criteria were applied, which means that the participants form a fairly random sample of moderately hearing-impaired listeners visiting the VU University Medical Center. Approval for measuring human participants was obtained from the VU University Medical Center's Medical Ethical Committee.

A total of 61 ears from 36 participants were measured in the current experiment. These ears were divided into groups on the basis of medical and family anamnesis and on audiogramslope. Audiogram slope was defined as the average pure-tone threshold at 2000 and 4000 Hz minus the average threshold at 125 and 250 Hz. Table 2 displays, for each group of ears, the mean and standard deviation of the pure-tone thresholds, plus the average pure-tone average (PTA), audiometric slope, maximum CVC-word intelligibility score, and age.

Part of the included ears (38 from the total of 61) had a hearing loss diagnosed as likely presbycusic. The slope of the audiogram was used to divide these presbycusic ears into two different groups: Group A and Group B. Ears included in Group A have rather sloping audiograms and only small hearing loss at low frequencies. This means that ears included in Group A may be considered equivalent to those of the listeners as measured by Duquesnoy and Plomp (1980). This group consists of 27 presbycusic ears from 16 presbycusic participants. Ears in Group B are selected to show flatter and more severe hearing losses than those in Group A, that is, ears in Group B show an audiogram with a slope <25 dB and a PTA >30 dB HL. In this sense, these ears also differ from those as measured by Duquesnoy and Plomp. Group B includes 11 ears from six listeners. Group C consists of eight ears from five participants diagnosed with congenital hearing impairment. Group D consists of 15 ears from nine participants with other types of hearing impairment (because of medication, otosclerosis, chronic otitis in youth, or unknown cause).

General Method and Instrumentation

The experiment was run using the same equipment as that used in Experiment 1. A test-retest design was followed; thresholds in each of the three conditions were measured twice for each participant. Test and retest outcomes were averaged. Confounding of measurement order and sentence lists with condition was avoided by randomly choosing the order of conditions for each ear while sentence and list order were kept fixed. Measurements were conducted monaurally, starting with the participant's best ear (fitting the inclusion criteria),

which was chosen according to the audiogram or, in case of a symmetrical loss, personal preference in telephone conversation.

Data Analysis

The measurement error in each of the listening conditions was compared with the measurement error in the SRT in stationary noise, expressed in STI.

Subsequently, it was investigated whether the monaural performance of an individual hearing-impaired listener could be summarized by a single STI value. This was done by performing a repeated measuresANOVA on the obtained STI values, with condition as a within-ears effect and group as the between-ears factor. The same ANOVA was repeated, with the PTA, maximum CVC score (CVC), audiometric slope, and age included in the analysis as covariates. CVC scores were arcsinetransformed before conducting any analyses.

Finally, multiple stepwise regression analyses (MSRs) were performed to identify covariates that best account for differences between the ears in the observed speech reception, as expressed in the STI at the threshold for each condition.

Results

The observed speech intelligibility thresholds, in each of the three measurement conditions, are shown in Table 3. The STI values corresponding to the thresholds are shown in Table 4. As in the normal-hearing case, the standard deviations for the measured thresholds are comparable with the standard deviation of the SRT test, sometimes even smaller. Moreover, it can be seen that, for each group of ears and for each condition, the measurement error is comparable with the measurement error of the SRT test. This indicates that the SRT in each of the measurement conditions could be consistently determined for all hearing-impaired listeners.

Results of the first repeated measuresANOVA, without any covariates, show a significant effect of condition ($p < .001$) and an interaction effect of Condition ×Group ($p < .001$). When the four covariates (PTA, audiometric slope, CVC score, and age) are included in the analysis, the effect of condition is no longer significant ($p > .20$), whereas the interaction effect of Condition ×Group still is significant ($p = .02$). Moreover, a significant interaction effect is observed for Condition ×Age ($p = .02$). When the covariates are included in the ANOVA, none of the differences in STI value between individual conditions and the STI at the SRT were significant in post hoc comparisons (contrasts).

These results indicate that the original effect of condition is mediated by the covariates or, vice-versa, that the effect of the covariates on speech intelligibility performance changes with condition. To further investigate this suggestion, MSRs were performed to identify which covariates contribute the most to explaining variance between the ears in the observed STI values for each of the three measurement conditions. Results, as displayed in Table 5, show that the maximum word intelligibility score (CVC) accounts for a large part of the variance in all three conditions. Age accounts for an additional amount of variance in the two conditions in which reverberation was included. No other independent variables significantly contributed, except in the SRRT condition, in which audiogram slope explains a small, additional amount of variance in speech intelligibility performance. This additional contribution of slope is probably simply related to the relation between slope and hearing loss: A smaller slope generally indicates a flatter audiogram, which in this study means a more severe hearing loss. When, rather artificially, the audiogram (PTA) is forced in the regression model as a first step instead of the CVC score, the effect of age is still significant in the conditions in which reverberation is present.

In summary, these findings show that the observed STI at the threshold changes significantly between measurement conditions. As the MSRs seem to confirm, this effect is mediated by the effect of age on speech intelligibility performance, which appears to change over conditions. When this effect is accounted for by including the covariates in the ANOVA, no effect of condition remains.

Scatter diagrams comparing the STIs in the three conditions are shown in Figure 2. The standard deviations in STI of individual points from the diagonal, although statistically significant, are equivalent to a change in$SNR < 1.3$ dB,which is similar to themeasurement error for the SRT. This means that, for the current group of

moderately hearing-impaired listeners, an individual's monaural STI, on the basis of solely the measurement of SRT in noise or reverberation, is a good estimate for speech intelligibility performance, regardless of whether the speech is presented in background noise, in reverberation, or in a combination of both.

Discussion

After including the covariates in the ANOVA, no relevant main effects were obtained. However, a significant Condition ×Age interaction was obtained. This interaction can be understood when considering the results from the MSRs, which show that age accounts for a significant part of the variance in speech reception when reverberation is present but not when speech is presented in noise only.

This apparent difference in the contribution of age may be explained by an increased importance of cognitive processing in reverberant conditions compared with nonreverberant conditions. That is, speech reception in stationary noise appears to be mainly governed by auditory factors, such as the audiogram(George et al., 2007; Smoorenburg, 1992; Van Rooij &Plomp, 1992) or CVC scores, which explain a large part of variance of speech intelligibility performance in the current study (see Table 5). Apparently, maximum CVC scores are reasonable predictors of speech reception in noise, as shown before by, for example, Bosman and Smoorenburg (1995), even though the range of the CVC scores in the current study was fairly small (between 75% and 100%).

In reverberant conditions, besides auditory factors, age appears to play a role, consistent with results by Helfer and Wilber (1990) and suggestions by Nabelek and Dagenais (1986). Kjellberg (2004) suggested that this age effect is related not only to increased hearing loss with age but also to the cognitive work load in listening situations with speech and reverberation, as has also been suggested by, for example, Pichora-Füller, Schneider, and Daneman (1995) and Rönnberg, Rudner, Foo, and Lunner (2008). The supposed general idea is that, in optimal listening situations, the speech signal is processed effortlessly and automatically. However, when listening conditions are adverse, because of noise or reverberation, the need for effortful (age-related) top-down processes increases, possibly giving rise to an effect of listener age. Thus, the current results appear to suggest that listening to speech in reverberation requires higher cognitive demands than listening to speechin- noise only.

In addition to the influence of cognitive factors, agerelated differences in auditory temporal processing may play a role in the observed small difference between noise and reverberation (Dreschler &Leeuw, 1990; Gordon-Salant &Fitzgibbons, 1999; Humes, Burk, Coughlin, Busey,&Strausser, 2007). Future research may focus on investigating in more detail the cognitive and temporal processes underlying the contribution of age to speech performance in reverberant conditions. In these future studies, the SRRTmay be a helpful instrument to determine the sole effect of reverberation on speech intelligibility.

Finally, theANOVAshowed a significant Condition ×Group interaction. This indicates that an effect of condition may be found within a specific group, even when there is no overall effect of condition. To further investigate this suggestion, the ANOVA was repeated within each group, but no significant effects of condition were observed ($p > .20$ in all cases). The fact that a significant interaction effect is nevertheless obtained may be explained by the differences in age between the groups. Thus, the Condition ×Group interaction may be indirectly due to the Condition ×Age interaction, which is discussed above.

General Discussion

In conclusion, even though a systematic effect of measurement condition was obtained, the differences between measurement conditions in the current experiments were comparable with the measurement error and can thus be considered fairly small. This means that, at least for the current group of moderately hearing-impaired listeners, the STI is still a convenient, single number to quantify speech recognition performance of an individual hearing-impaired listener, regardless of whether the sentences are presented in noise or in reverberation. The nature of the hearing loss (presbycusic, congenital, or otherwise) does not appear to affect this result. Thus, the STI is able to evenly evaluate the effects of reverberation, noise, and combinations of them, regardless of the hearing loss of listeners.

Because no specific inclusion or exclusion criteria on the basis of hearing loss were set for the listeners in the current study, the participants form a fairly random sample of hearing-impaired listeners visiting the VU University MedicalCenter. Therefore, it might be expected that the current results also hold for other groups of randomly selected moderately hearing-impaired listeners. Future research might be conducted to assess whether the STI method may also be applied for more severely hearing-impaired listeners.

The results of the current two experiments are summarized in Figure 3, which gives the scatter plot of the individual scores for the SRRT test (along a logarithmic scale) and the SRT test for both normal-hearing and hearing-impaired listeners. A larger individual STI value indicates a larger hearing loss for speech-in-noise, as described by the model by Plomp (1978). Because differences between the conditions are fairly small, a hearing loss for speech-in-noise may also be regarded as a hearing loss for speech-in-reverberation, as the scatter plot underlines. Nevertheless, our results show that age contributes significantly to explaining differences in speech reception in reverberant conditions, although it does not play a role in accounting for variance in speech reception in noise only. Determining the effect of reverberation on speech intelligibility directly, using the SRRT, may be helpful in understanding the possible role of cognitive processing in reverberant listening conditions.

Acknowledgment

This research was supported by the Heinsius-Houbolt Foundation, Wassenaar, the Netherlands.

Sidebar

Measuring the Effects of Reverberation and Noise on Sentence Intelligibility for Hearing-Impaired Listeners
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J Speech Lang Hear Res 2010;53;1429-1439; originally published online Aug 5, 2010;
DOI: 10.1044/1092-4388(2010/09-0197)
The references for this article include 2 HighWire-hosted articles which you can access for free at:
http://jslhr.asha.org/cgi/content/full/53/6/1429#BIBL
This information is current as of January 27, 2011
This article, along with updated information and services, is located on the World Wide Web at:
http://jslhr.asha.org/cgi/content/full/53/6/1429

Footnote

1To avoid onset artifacts of the reverberation, the convolution with the impulse response was always applied to a double sequence of the desired sentence in noise. Only the last half of the resulting signal was presented to the listener, with a maximum length of 3.5 s.

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Received September 11, 2009
Accepted April 5, 2010
DOI: 10.1044/1092-4388(2010/09-0197)
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Publication date: Dec 2010

Year: 2010

Use of Acoustic Cues by Children With Cochlear Implants

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1440-1457A.
ProQuest document link

Abstract: This study examined the use of different acoustic cues in auditory perception of consonant and vowel contrasts by profoundly deaf children with a cochlear implant (CI) in comparison to age-matched children and young adults with normal hearing. A speech sound categorization task in an XAB format was administered to 15 children ages 5-6 with a CI (mean age at implant: 1;8 [years;months]), 20 normal-hearing age-matched children, and 21 normal-hearing adults. Four contrasts were examined: /a/-/a/, /I/-/i/, /bu/-/pu/, and /fu/-/su/. Measures included phoneme endpoint identification, individual cue reliance, cue weighting, and classification slope. The children with a CI used the spectral cues in the /fu/-/su/ contrast less effectively than the children with normal hearing, resulting in poorer phoneme endpoint identification and a shallower classification slope. Performance on the other 3 contrasts did not differ significantly. Adults consistently showed steeper classification slopes than the children, but similar cue-weighting patterns were observed in all 3 groups. Despite their different auditory input, children with a CI appear to be able to use many acoustic cues effectively in speech perception. Most importantly, children with a CI and normal-hearing children were observed to use similar cue-weighting patterns.

Full text: Headnote

Purpose: This study examined the use of different acoustic cues in auditory perception of consonant and vowel contrasts by profoundly deaf children with a cochlear implant (CI) in comparison to age-matched children and young adults with normal hearing.

Method: A speech sound categorization task in an XAB format was administered to 15 children ages 5-6 with a CI (mean age at implant: 1;8 [years;months]), 20 normal-hearing age-matched children, and 21 normal-hearing adults. Four contrasts were examined: /a/-/a/, /I/-/i/, /bu/-/pu/, and /fu/-/su/. Measures included phoneme endpoint identification, individual cue reliance, cue weighting, and classification slope.

Results: The children with a CI used the spectral cues in the /fu/-/su/ contrast less effectively than the children with normal hearing, resulting in poorer phoneme endpoint identification and a shallower classification slope. Performance on the other 3 contrasts did not differ significantly. Adults consistently showed steeper classification slopes than the children, but similar cue-weighting patterns were observed in all 3 groups.
Conclusions: Despite their different auditory input, children with a CI appear to be able to use many acoustic cues effectively in speech perception. Most importantly, children with a CI and normal-hearing children were observed to use similar cue-weighting patterns.
KEY WORDS: cochlear implants, speech perception, acoustic cues
Studies of speech perception in deaf and hard-of-hearing children with a cochlear implant (CI) have shown that even after several years of using the device, many of these children perform below age norms on standardized speech perception tests, including phoneme, word, and sentence recognition tests (e.g., Geers, Brenner, &Davidson, 2003; Pisoni, Cleary, Geers, &Tobey, 1999; Sarant, Blamey, Dowell, Clark, &Gibson, 2001). Some of the variation in speech perception abilities following implantation may be explained as a result of child, family, and implant factors, but even after including these factors, 40% or more of the observed variation remains unexplained (e.g., Geers et al., 2003; Sarant et al., 2001; Wie, Falkenberg, Tvete, &Tomblin, 2007).
The results of many studies of speech perception abilities in children with a CI are difficult to interpret because the variables studied do not reflect just one process in speech perception but an accumulation of several processes. For instance, a common procedure is the use of standardized open-set or closed-set spoken word recognition tests (Pisoni, 2005). However, the ability to point to the correct picture in response to an auditory input (closed-set) or to correctly repeat spoken words (open-set) is the outcome of several preceding processes including auditory detection, acoustic-phonetic analysis, short-term memory, and lexical access and retrieval. To understand exactly which aspects of the speech perception process present a continuing challenge to children with a CI, it is essential to examine each of these underlying processes in depth (Pisoni, 2000).
The present study investigates in detail a related underlying process, namely the use of acoustic cues in the acoustic-phonetic analysis of children with a CI. Listeners use acoustic cues in speech perception to identify speech sounds. Speech sounds in any language are identified on the basis of different acoustic cues that converge in language-specific combinations. That is, learning to perceive speech consists not only of learning to identify the relevant acoustic cues in the speech signal but also of learning to combine and weigh acoustic cues (Boersma, Escudero, &Hayes, 2003; Nittrouer, 2002a).
Adultlike cue weighting in a first language can take until approximately 8 to 10 years of age to develop in children with normal hearing (Gerrits, 2001; Hazan &Barrett, 2000; Nittrouer, 2002a). Children with a CI seem to face an extra challenge because even if the implant provides sufficient acoustic information to support spoken language development, it does not restore normal hearing. The processing of sounds using a CI differs in at least two important ways from processing by the human biological ear, namely reduced spectral resolution and shifted frequency-to-place mapping in the cochlea (Shannon, 2002). Despite these two fundamental differences in sound processing by the human ear and a CI, it appears that speech recognition with a CI in quiet listening conditions can be quite good given that temporal and amplitude information in the speech signal is transmitted relatively accurately by the implant and only minimal spectral information is required to perceive words and sentences in quiet (Dorman, Loizou, Spahr, &Maloff, 2002; Shannon, 2002). Nevertheless, speech recognition by adult implant users is far from perfect, especially in noisy listening conditions, and this seems to a large extent due to the limited spectral information transmitted by the implant (e.g., Friesen, Shannon, Baskent,&Wang, 2001; Henry, Turner, &Behrens, 2005; Xu &Zheng, 2007).
Several studies have examined the role of acoustic cues in phonemeperception by adult CI users or by adults with normal hearing listening to CI simulations. For example, Xu, Thompson, and Pfingst (2005) compared the contribution of spectral and temporal cues to phoneme recognition by adults listening to implant simulations. They showed that both types of cues are important for accurate phoneme recognition.Atrade-off between

spectral and temporal cues was observed for consonant recognition but not for vowel recognition. Within the category of consonants, spectral cues were more important for conveying information about place of articulation than information about voicing and manner. Similarly, Nie, Barco, and Zeng (2006) reported that implant users rely more on temporal cues in consonant recognition and spectral cues in vowel recognition. Furthermore, they found a greater trade-off between spectral and temporal cues for consonant recognition than for vowel recognition. Finally, trade-offs were observed only for speech recognition in quiet and not in noise.

Iverson, Smith, and Evans (2006) showed similarities between implant users and adults listening to CI simulations in the use of formant movement and durational cues in vowel recognition. Iverson (2003) found shifted sensitivity peaks toward longer voice onset times (VOTs) in /t/-/d/ discrimination and speculated on increased interindividual variability in the use of spectral and temporal cues among CI users. Munson and Nelson (2005) compared phonetic identification in quiet and in noise by implant users and adults with normal hearing listening to unfiltered speech and to implant simulations. They found that sound contrasts distinguished by rapidly changing spectral patterns were most likely to be misperceived by implant users. Finally, Lane et al. (2007) compared phoneme classification and discrimination of one vowel and one sibilant contrast in seven implant users 1 month and 1 year postimplant. Phoneme classification improved significantly over 1 year of implant use, but discrimination remained relatively poor.

These studies underline the importance of spectral and temporal cues in speech recognition as well as the impact of reduced spectral and temporal resolution on speech recognition (cf. Dorman et al., 2002; Shannon, 2002). However, the listeners with a CI in these studies were postlingually deaf adults. The findings cannot be generalized to deaf children for whom the onset of deafness occurs before they have acquired a spoken language and who are implanted at amuch younger age. For example, in a study examining the recognition of spectrally reduced speech in children and adultswith normal hearing, Eisenberg,Shannon,Martinez,Wygonski, and Boothroyd (2000) found that young children (5-7 years of age) needed more spectral resolution to obtain the same levels of recognition than older children (10-12 years of age) and adults. Summerfield et al. (2002) examined the use of unambiguous vocalic information in the identification of preceding ambiguous fricative noises by children and adults with a CI and children and adults with normal hearing. They showed that all groups were able to use the vocalic information to disambiguate the fricative noises, but the implanted listeners did so to a lesser extent than the listeners with normal hearing.

To our knowledge, the present study is one of the first to examine the use of different acoustic cues for more than one sound contrast in children with a CI. It is important to include more than one contrast because studies of speech perception in children with a CI have shown an advantage for vowels over consonants, more difficulty perceiving place of articulation contrasts relative to manner of articulation contrasts, and long-lasting difficulties with perceiving voicing distinctions (Kishon-Rabin et al., 2002; Mildner, Sindija, &Zrinski, 2006). To differentiate degrees of difficulty in speech sound categorization, two vowel contrasts, /A/-/a/ and /I/-/i/, and two consonant contrasts, /b/-/p/ and /f/-/s/, were selected.The listeners in the present study completed a categorization task in which they had to classify speech stimuli from a series between two phoneme endpoints. Stimuli were created by manipulating relevant acoustic cues for each contrast. In this way, we could determine the consistency of the phoneme categorization and which acoustic cue(s) were attended to.

In the two vowel contrasts /A/-/a/ and /I /-/i/, formant frequency and vowel duration were manipulated. It is known that Dutch-speaking children 4 years of age and older use both spectral and durational cues to categorize the low vowel contrast /A/-/a/, with the spectral cues typically weighted relatively stronger than durational cues (Gerrits, 2001). However, given that only limited spectral information is transmitted by the implant, childrenwith a CImight rely more on durational cues as a compensatory strategy. The smaller spectral and temporal difference between the two vowels in the /I /-/i/ contrast relative to the /A/-/a/ contrast should make the /I /-/i/ contrast more difficult to discriminate for children.

In the voicing contrast /b/-/p/, VOT was manipulated. The presence or absence of prevoicing (a negative VOT)

has been found to be a strong cue in the perception of the voicing distinction for word-initial labial and alveolar plosives in Dutch (Van Alphen &Smits, 2004). In children wearing acoustic hearing aids, perception of VOT cues has been found to be normal in Englishspeaking children with mild to moderate hearing impairment but not in children with severe hearing impairment (Jerger, 2007).

In the place of articulation contrast /f/-/s/, noise frequency and intensity were manipulated. Accurate perception of high-frequency noise spectra has been found to be difficult for young Dutch-speaking children with normal hearing (Gerrits, 2001). A study by Pittman, Stelmachowicz, Lewis, andHoover (2002) showed that English-speaking children and adults with mild-tomoderate hearing impairment wearing acoustic hearing aids in general attributed similar perceptual weight to fricative-vowel formant transitions in the perception of CVC words.

The aim of this study was to obtain data on phoneme endpoint identification, individual cue reliance, cueweighting, and classification slope for children with a CI. Crucially, the performance of childrenwith a CI was compared not only to that of age-matched children with normal hearing but also to that of young adults with normal hearing. By comparing the children with a CI and their peers with normal hearing, we hoped to establish to what extent the CI children are delayed in these aspects. The results from the adults will show to what extent the use of acoustic cues by the younger listeners is already adultlike.

Method

Participants

Listeners were 15 prelingually deaf children with a CI (mean age 5;8); 20 children without a history of speech, language, or hearing impairment(mean age 5;10); and 21 young adults who reported no speech, language, or hearing difficulties (mean age 22;3).1 Background characteristics of the children with a CI are given in Table 1. All children with a CI received their implant before age 4;0, and mean age at implantation was 1;8. On average, they had been using the CI for 4 years and 1 month. None of the children in this group were known to have additional disabilities. For all children, the surgery was uneventful, and the implants were fully inserted. The children were fitted with the latest speech processing strategy available at the time. Dutch was the native language for all listeners. The study was approved by the University of Amsterdam Institutional Review Board.

Stimuli

Natural speech of a male adult native speaker of Dutch was recorded with a Sennheiser MKH105T microphone on a digital TASCAM CD-RW900 recorder in a sound-attenuated room. In total, four stimuli series were constructed from recordings of monosyllabic words: a lowvowel contrast (/A/-/a/), a high vowel contrast (/I /-/i/), a voicing contrast (/bu/-/pu/), and a place of articulation contrast (/fu/-/su/). Words, instead of single segments, were recorded to ensure that the recorded vowels and consonants had natural speech-like characteristics. The sampling rate for the recordings was 44100 Hz. Recorded sound files were converted to the Wave sound format and later modified in Praat (Version 5.0.23; Boersma &Weenink, 2008).

Vowel contrasts (/A/-/a/ and /I/-/i/). For the vowel contrasts /A/-/a/ and /I /-/i/,VCVwords (/A:pA:/, /a:pa/, /I:pI/, /i:pi/) were recorded. We chose a VCV context to reduce the influence of consonant context on subsequent vowel formant values. A voiceless plosive was chosen for the intervocalic consonant to ensure that the vowel segment was clearly demarcated in the waveform and spectrogram. The production of each initial vowel was lengthened to ensure reliable steady-state parts in the vowels. Steadystate parts of the initial vowels were extracted at the end of a pitch pulse at a zero crossing. The duration of the extracted vowel segments was 210 ms for the /A/-/a/ contrast and 100 ms for the /I /-/i/ contrast, the maximum durations included in the /A/-/a/ and /I /-/i/ stimuli series, respectively. Both vowel stimuli series consisted of 12 isolated vowel stimuli covering the four edges of a 4 ×4matrix. The stimulus set for the low vowel contrast /A/-/a/ is given as an example in Figure 1. A stimulus set covering only the edges of the matrix (i.e., 12 stimuli) was preferred to a stimulus set covering the entire matrix (i.e., 16 stimuli) to limit task duration.

The naturally produced tokens of the vowels /A/ and /a/ were used to create a two-dimensional series varying in duration and an F1-F2 combination. Duration was modified in three equal fractional step sizes between the two

endpoints by deleting increasingly larger segments of the original vowel segments (selected at the end of a pitch pulse at a zero crossing). Formant values for F1 and F2 in the extracted vowel segments were obtained using the implemented LPC formant analysis in Praat (maximum frequency set at 5500 Hz, effective window length set at 0.025 s, preemphasis for an inverted lowpass filter [+6dB/octave] set at 50 Hz). In the resulting formant filter, F1 and F2 were modified in three equal fractional step sizes between the two endpoints. The required step sizes were determined using the auditorily based mel scale.2 The resulting formant filters were synthesized with the shorter and longer /A/ and /a/ stimuli to create the intermediate stimuli between the four corner stimuli in the stimulus matrix. The F1-F2 and duration values of the stimuli series for the low vowel contrast /A/-/a/ are provided in Appendix A.

In addition, the naturally produced tokens of the vowels /I / and /i/ were used to create a two-dimensional stimulus series varying in duration and an F1-F2 combination. Using the same procedure as that used for the /A/-/a/ stimulus series, duration was modified in three equal fractional step sizes between the two endpoints. Again, using the same procedure as for the /A/-/a/ stimulus series, F1 and F2 extracted from the original sound were modified in three equal fractional step sizes between the two endpoints, and the resulting formant filters were synthesized with the shorter and longer /I / and /i/ stimuli to create the intermediate stimuli between the four corner stimuli in the stimulus matrix. The F1-F2 values and duration values of the stimulus series for the high vowel contrast /I /-/i/ are provided in Appendix A.

Consonant contrasts (/bu/-/pu/ and /fu/-/su/). For the consonant contrasts /bu/-/pu/ and /fu/-/su/, monosyllabic CVC words (/bub/, /pup/, /fuf/, and /sus/) were recorded, from which the initial consonant and the first 100 ms of the vowel were extracted and modified for presentation. The vowel context /u/ was chosen because the vowels /A/, /a/, /I /, and /i/ were already included as stimuli in the vowel stimuli series and the vowels /o/ and /e/ are slightly diphthongized in the central region of the Netherlands.

The naturally produced syllables /bu/ and /pu/ were used to create a stimulus series varying in VOT between a negative VOT (-83 ms) and a positive VOT (20 ms) in five intermediate steps. Intermediate stimuli were obtained by deleting increasingly longer segments of periodic energy from the endpoint /b/ for stimuli with negative VOT values and deleting segments of aperiodic energy from the endpoint /p/ for positive VOT values. All segments were deleted at the end of a pitch pulse at a zero crossing. The VOT values of the stimuli for the voicing contrast /bu/-/pu/ are provided in Appendix A. The final stimulus set was obtained by cross-splicing the consonant and vowel segments, resulting in two exemplars for each point in the stimulus series: one exemplar spliced with the vowel extracted from the syllable /bu/ and one exemplar spliced with the vowel extracted from the syllable /pu/. Both exemplars were included in the categorization task.

The naturally produced tokens of the vowels /fu/ and /su/ were used to create a two-dimensional stimulus series varying in intensity and noise spectrum. Intensity was modified in three equal fractional step sizes on the decibel scale by scaling the average intensity of the /f/ and /s/ segments at different levels. Using the same procedure as that used for the vowel stimuli series, the first four formants extracted from the /f/ and /s/ segments were modified in three equal fractional step sizes between the two endpoints, and the resulting filters were synthesized with the softer and louder /f/ and /s/ stimuli to create the intermediate stimuli between the four corner stimuli in the stimulus matrix. The resulting stimuli were all 150 ms in duration. The noise spectrum and intensity values of the stimuli for the place of articulation contrast /fu/-/su/ are provided in Appendix A. Similar to the VOT stimulus set, the final stimulus set was obtained by cross-splicing the consonant and vowel segments, resulting in two exemplars for each point in the stimulus series: one exemplar spliced with the vowel extracted from the syllable /fu/ and one exemplar spliced with the vowel extracted from the syllable /su/. Both exemplars were included in the categorization task.

Task

A categorization task was designed using E-Prime Version 2.0 software (Psychology Software Tools, Pittsburgh, PA). The format of the categorization task was XAB. The task was based on a similar task reported

in Brasileiro (2009) and Escudero, Benders, and Lipski (2009). Listeners had to decide whether Stimulus X was more like Stimulus A or Stimulus B, where X was a randomly chosen stimulus from the stimulus series and A and B were the two phoneme endpoints. The task was made as child-friendly as possible by associating X, A, and B with cartoon bird pictures (cf. Brasileiro, 2009). The interstimulus interval (ISI) between presentation of X and Awas 2,000 ms and between A and B was 1,000 ms. ISIs were thus chosen to target listener's phonetic perception instead of purely auditory discrimination (Pisoni, 1973; Van Hessen &Schouten, 1992; Werker &Logan, 1985) and also to create a clear distinction between the stimulus to be categorized (X) and the response categories (A and B). The intertrial interval was set at 1,000 ms. There was no limit on the response time. Both the order of the stimuli assigned to the first bird (X) and the order of the two phoneme endpoints assigned to the other two birds (A and B) were randomized. Listeners responded by pressing one of two keys on the laptop (labeled with stickers).

For the two vowel contrasts /A/-/a/ and /I /-/i/, participants had to categorize each stimulus twice, resulting in a total of 24 trials. For the place of articulation contrast /fu/-/su/, participants had to categorize each stimulus twice, once with the formant transition appropriate for /fu/ and once with the formant transition appropriate for /su/, resulting in a total of 24 trials. Finally, for the voicing contrast /bu/-/pu/, participants had to categorize each stimulus twice, once with the formant transition appropriate for /bu/ and once with the formant transition appropriate for /pu/, resulting in a total of 12 trials.

Procedure

Each child completed the categorization task for two contrasts (one vowel and one consonant) to reduce the length of testing.The adults completed the categorization task for all four contrasts. Presentation of contrasts was counterbalanced across listeners. Prior to the test session, children completed a practice session that consisted of six trials from the vowel contrast on which they were not tested. Categorization for different contrasts was separated by a brief pause.

Testing took place individually in quiet testing rooms in the school for the children and in a quiet testing roomat theUniversity of Amsterdamfor the adults. The taskwas administered on a Dell Latitude D630 laptop using two external speakers (Trust SP-2310). Given different testing environments, as well as probable interindividual variation in postimplant hearing thresholds for the children with a CI, the sound volume level was not set at a fixed level. During the practice session, listeners were asked whether the current volume level was comfortable or whether it had to be increased or decreased. That is, listeners performed the task at a volume level within their own range of comfort. Completing the categorization task took between 10 and 15 min for most children and between 15 and 20min formost adults.

Analysis

Phoneme endpoint identification. As part of the task, information was obtained as to whether listeners were able to correctly identify the two phoneme endpoints in the experiment-that is, the stimuli in the bottom-left and top-right corners in Figure 1. If they were unable to identify the phoneme endpoints correctly, it could mean that they were unable to discriminate between the two phonemes. Another possibility is that they did not pay sufficient attention during the task. As a result, classification scores in combination with cutoff values (e.g., 80% correct) are used in many studies to exclude listeners from a subsequent cue-weighting analysis (e.g., Nittrouer &Miller, 1997). Because in the present study listeners were exposed to each stimulus only twice, the maximum classification score that could be obtained for each contrast was 4, complicating the use of any cutoff score. More importantly, given the nature of the population in this study-namely, hard-of-hearing children-removing children from the analysis who did not seem to hear the difference (solely based on their identification accuracy) would have left an unrepresentative sample of only highperforming children with a CI for comparison with the other twogroups of listeners. For these reasons, phoneme endpoint identification is included as another dependent variable in the analysis.

Individual cue reliance and cue weighting. As proposed by Morrison (2005, 2007), logistic regression analysis

can be used to derive ameasure of individual acoustic cue use for one-dimensional and two-dimensional contrasts. In logistic regression analyses, sigmoidal curves are fitted to categorical response data.Logistic regression resembles linear regression (in terms of an intercept and regression coefficients) but differs in that it expresses the dependent variable in logarithmic values. The regression coefficients are measures of reliance on individual cues. To make the regression coefficients for each cue comparable to each other for purposes of measuring cue weighting, each stimulus was assigned a number on a scale from 1 to 4 for both cue dimensions, and this value was entered into the logistic regression analysis (cf. Escudero et al., 2009).

In addition, in the present study a measure of cue weighting was obtained by dividing the contrast coefficient for the spectral cue by the sum of both the spectral cue and the durational/intensity cue coefficients, as was previously done in Escudero et al. (2009). For this analysis, any negative coefficients were recoded as positive coefficients. If the cue ratio was higher than .5, the spectral cue was weighted relatively stronger; if this ratio was lower than .5, the durational/intensity cue was weighted relatively stronger. If the cue ratio was .5 exactly, both cues were weighted equally strong. This measure allowed us to compare the relative use of acoustic cues within or between groups of listeners regardless of overall differences in absolute reliance on each cue.

Classification slope. The rate of change from one response category-that is, each of the two phonemes in each of the sound contrasts-to the other was used as a discrimination function, which is referred to as classification slope. For two-dimensional contrasts, this discrimination function is found by taking the square root of the sum of the squares of both contrast coefficients obtained in the logistic regression analysis; for onedimensional binomial contrasts, the discrimination function is equal to a quarter of the value of the contrast coefficient (Morrison, 2007).

Statistical analysis. The SPSS Version 15 software package was used for statistical analyses. Given the relatively small and unequal sample sizes in the present study (depending on the contrast, n = 5-6 for the children with a CI, n = 8-11 for the children with normal hearing, and n= 20-21 for the adults), nonparametric statistical tests were performed in the majority of the analyses. Specifically, the rank-based Kruskal-Wallis H test for more than two independent samples was used to examine main effects, and the rank-based Mann-Whitney U test (two-tailed exact significance to adjust for small and unbalanced samples) was used for post hoc comparisons. In the examination of correlations, nonparametric bivariate Spearman R correlation coefficients are reported. Significance levels in the statistical analyses were set at .05 for main effects but at .02 for post hoc comparisons and .01 for correlations to adjust for multiple comparisons. Post hoc comparisons resulting in p values between .02 and .05 were considered marginally significant and suggestive of trends in the data.

Results

Three children out of the 15 with a CI who participated in this experiment did not complete the task for any of the contrasts due to concentration difficulties during the task. One of these children (L4; see Table 1) was implanted relatively late (3;2) and as a result had less hearing experience than many of the other children in the present study. For another child (S6; see Table 1), fitting and programming of the device had been problematic due to behavioral difficulties. In general, she was considered a lowperformer with the implant and relied to a large extent on sign language in daily communication. These circumstances likely contributed to the difficulties during the task for these two children. The third child (J8; see Table 1) was implanted early (0;8), and fitting and programming of the implant had been unproblematic. However, this child also showed concentration difficulties during other tasks for which data was collected but not reported here. Three children with a CI and two children with normal hearing completed the task for only one contrast. Of the 21 adults who participated in the experiment, 20 completed the task for all contrasts and one completed the task for only two contrasts due to an experimenter error.

In this section, phoneme endpoint identification is analyzed, followed by individual cue reliance, cueweighting, and classification slope. In the initial analyses, the performance of the three groups of listeners is compared. If a main effect is present, post hoc comparisons are presented, comparing the children with a CI to their peers with

normal hearing and to the adults and comparing the childrenwith normal hearing to the adults. The group analyses are followed by two subsections reporting correlation analyses. Means and medians of the dependent variables for all three groups of listeners are provided in Appendix B. Individual results for the children with a CI are provided in Appendix C.

Phoneme Endpoint Identification

Figure 2 illustrates the phoneme endpoint identification scores (percentage correct) for the children with a CI, the children with normal hearing, and the adults for each of the four contrasts. As expected, the adults performed close to ceiling (100% correct) on this measure. The children with normal hearing scored around 80%correct, with the place of articulation contrast /fu/-/su/ being a notable exception (close to 100% correct). Finally, the childrenwith a CI scored between 50% (/fu/-/su/) and 75% (/bu/-/pu/) correct.

The differences between the three groups of listeners in phoneme endpoint identification were partially confirmed by the statistical analysis. For the low vowel contrast /A/-/a/, no effect of group was observed ($p = .22$). As a result, post hoc comparisons are not reported. For each of the other contrasts, a main effect of group was observed (all $p < .01$). For the high vowel contrast /I /-/i/, the children with a CI did not differ significantly from the children with normal hearing ($p = .26$), but they did score significantly lower than the adults ($p < .01$). The difference between the children with normal hearing and the adults was marginally significant ($p = .02$). For the voicing contrast /bu/-/pu/, the children with a CI did not differ significantly from the children with normal hearing ($p = .43$). Both child groups scored significantly lower than the adults ($p < .01$). For the place of articulation contrast /fu/-/su/, the children with a CI scored significantly lower than the children with normal hearing ($p < .01$) and the adults ($p < .01$). The children with normal hearing did not differ significantly from the adults ($p = .63$).

Individual Cue Reliance

The group comparisons of the logistic regression coefficients for individual acoustic cues within each contrast are presented in this subsection. Mean and median cue reliance coefficients for the children with a CI, the children with normal hearing, and the adults are provided in Appendix B.

Low vowel contrast /A/-/a/. A significant effect of group was observed for both the spectral cue ($p < .05$) and the durational cue ($p < .01$). The children with a CI did not differ significantly from the children with normal hearing in their use of the spectral cue ($p = .21$). They did use the spectral cue significantly less than the adults ($p < .01$). The children with normal hearing did not differ significantly from the adults in their use of the spectral cue ($p = .17$). The children with a CI seemed to use the durational cue less than the childrenwith normal hearing, but this effect was only marginally significant ($p = .04$). Both child groups used the durational cue significantly less than the adults ($p < .01$).

High vowel contrast /I/-/i/. A significant effect of group was observed for both the spectral cue ($p < .01$) and the durational cue ($p < .01$). The children with a CI seemed to use the spectral cue less than the childrenwith normal hearing, but this effect was only marginally significant ($p = .03$). They did use the spectral cue significantly less than the adults ($p < .01$). Surprisingly, the children with normal hearing used the spectral cue significantly more than the adults ($p < .01$). The children with aCI did not differ significantly from the childrenwith normal hearing in their use of the durational cue ($p = .09$). Both child groups used the durational cue significantly less than the adults ($p < .01$).

Voicing contrast /bu/-/pu/. A significant effect of group was observed for the VOT cue ($p < .01$). The children with a CI seemed to use the VOT cue significantly less than the children with normal hearing, but this effect was only marginally significant ($p = .05$). Both child groups used the VOT cue significantly less than the adults ($p < .01$).

Place of articulation contrast /fu/-/su/. A significant effect of group was observed for the spectral cue ($p < .01$) and the intensity cue ($p < .05$). The children with a CI used the spectral cue significantly less than the children with normal hearing ($p < .01$). Both child groups used the spectral cue significantly less than the adults ($p < .01$).

The children with a CI did not differ significantly from the children with normal hearing in their use of the intensity cue (p = .22). They did use the intensity cue significantly less than the adults (p <.01). The children with normal hearing did not differ significantly from the adults in their use of the intensity cue (p = .13).

Cue Weighting

Figure 3 illustrates the mean cue ratios for the children with a CI, the children with normal hearing, and the adults for the low vowel contrast /A/-/a/, the high vowel contrast /I /-/i/, and the place of articulation contrast /fu/-/su/. A measure of cue weighting was not available for the voicing contrast /bu/-/pu/. A cue ratio of the spectral cue in relation to the other cues was obtained by dividing the contrast coefficient of the spectral cue by the sum of the contrast coefficients of both relevant cues (spectral cue and durational or intensity cue), resulting in a value between 0 and 1. A cue ratio higher than .5 indicates that the spectral cue is weighted relatively stronger than the other cue (i.e., duration or intensity).

Low vowel contrast /A/-/a/. A significant effect of group was observed (p <.01). The children with a CI did not differ significantly in their cue weighting from the children with normal hearing (p = .26). However, they did have a significantly lower cue ratio than the adults (p <.01).The childrenwithnormal hearingalsoseemedto have a lower cue ratio than the adults, but this effect was only marginally significant (p = .05). Despite the (apparent) differences between the two groups of children and the adults, the mean cue ratios indicated that the children with a CI (.78), the children with normal hearing (.68), and the adults (.56) as a group each attributed more weight to the spectral cue than to the durational cue for this contrast. This relative preference for the spectral cue was most pronounced for the children with a CI due to the fact that they hardly used the durational cue in categorization of this contrast, something that the adults-and, to a slightly lesser extent, the children with normal hearing-did do.

High vowel contrast /I/-/i/. No effect of group was observed (p = .96). As a result, post hoc comparisons are not reported. The mean cue ratios indicated that the children with a CI (.74), the children with normal hearing (.67), and the adults (.72) as a group each attributed more weight to the spectral cue than to the durational cue for this contrast.

Place of articulation contrast /fu/-/su/. The effect of group was only marginally significant (p = .06). As a result, post hoc comparisons are not reported. The mean cue ratios indicated that the children with a CI (.73), the children with normal hearing (.88), and the adults (.78) as a group each attributed more weight to the spectral cue than to the durational cue for this contrast.

Classification Slope

Illustrations of the classification slopes for each contrast for the children with a CI, the children with normal hearing, and the adults are provided as Figures 4 and 5. For all contrasts, a significant effect of group was observed (all p <.01). The children with a CI showed significantly shallower classification slopes than the children with normal hearing only for the place of articulation contrast /fu/-/su/ (p <.01). The effects for the other three contrasts were marginally significant and all in the same direction-namely, shallower slopes for the children with a CI (low vowel contrast /A/-/a/, p = .05; high vowel contrast /I /-/i/, p = .03; voicing contrast /bu/-/pu/, p = .05). Both the children with a CI and the children with normal hearing showed significantly shallower classification slopes than the adults for all contrasts (all p <.01).

Relationships Between Phoneme Endpoint Identification and Classification Slope

Given the crucial role of phoneme endpoint identification in studies of cue weighting (i.e., as a criterion to exclude listeners fromsubsequent analyses) and the finding in the present study that the children with a CI showed more difficulty than the children with normal hearing in correctly identifying the phoneme endpoints, a series of bivariate correlation analyses between phoneme endpoint identification and classification slope was performed. Given that sample sizes were small, phoneme endpoint identification and classification slope were averaged across all four contrasts for this analysis.

For the children with a CI, no significant correlation was observed between phoneme endpoint identification and

classification slope (R = .25, p = .44). However, for the children with normal hearing (R = .80, p <.01) and the adults (R = .65, p <.01), a significant correlation was observed between phoneme endpoint identification and classification slope. As expected, better phoneme endpoint identification was associated with steeper category slopes and was therefore indicative of better overall performance in the task. The reason for the absence of a significant correlation between identification accuracy and classification slope for the children with a CI is not entirely clear, but possible contributing factors are the small sample size and a lack of variability in classification slopes for this group (see Appendix C).

Effects of Age at Implantation and Length of CI Use

To determine whether there was a substantial effect of age at implantation or length of CI use (here defined as age at time of testing minus age at implantation) on the outcomes of the present study, a series of bivariate correlation analyses was performed. Given that sample sizes were small, phoneme endpoint identification and classification slope were averaged across all four contrasts for this analysis.

A separate correlation analysis revealed a negative correlation between age at implantation and length of CI use; however, this correlation was only marginally significant (R = -.60, p = .03). No significant correlation was observed between age at implantation and either phoneme endpoint identification (R= .39, p = .21) or classification slope (R = -.18, p = .57). In addition, no significant correlation was observed between length of CI use and either phoneme endpoint identification (R = .20, p = .53) or classification slope (R = .36, p = .25).

Discussion

In this study, the use of acoustic cues in a speech sound categorization task by 5- and 6-year old children with a CI, age-matched children with normal hearing, and young adults with normal hearing was compared. All children with a CI were implanted before 4 years of age and had been using their implants for an average of 4 years. The sound contrasts tested were the low vowel contrast /A/-/a/, the high vowel contrast /I /-/i/, the voicing contrast /bu/-/pu/, and the place of articulation contrast /fu/-/su/. Different measures were obtained and analyzed-namely, phoneme endpoint identification, individual cue reliance, cue weighting, and classification slope.

Limitations of the Present Study

Before we turn to a discussion of the results, it is important to note that several characteristics of the categorization task used in the present study might have affected the performance of the children with a CI.3 First, the ISIs used were relatively long (on average, 1,500 ms). Relatively long ISIs were chosen to distinguish between auditory perception and phonetic perception (Pisoni, 1973; Van Hessen &Schouten, 1992; Werker &Logan, 1985). Because our interest was in phonetic sound categorization, long ISIs were used. However, using long ISIs could have introduced auditory short-term memory- related performance difficulties. Children with a CI have been found to have smaller phonological short-termmemory capacities than age-matched children with normal hearing (e.g., Dawson, Busby, McKay, &Clark, 2002; Pisoni et al., 1999), and this might have affected their performance in the task. In fact, a phonological shortterm memory task (auditory digit span) was part of the test battery that the children in the present study completed. Replicating the earlier studies, the children with a CI were found to have a significantly lower digit span than the children with normal hearing. Correlating digit span with performance in the categorization task revealed a significant positive correlation with classification slope (averaged across contrasts) for the children with a CI (R = .70, p <.05) but not for the children with normal hearing, suggesting that phonological short-term memory limitations might have influenced the performance of the children with a CI in the categorization task. However, length of CI use correlated significantly with digit span (R = .70, p <.05), and the correlation between digit span and classification slope was no longer significant when length of CI use was statistically controlled for in the analysis.

Second, we excluded the four stimuli in the middle of the stimulus set shown in Figure 1. These stimuli were excluded to limit task duration for the children. Boersma and Escudero (2005) compared simulated listeners' perception of stimuli along the edges and stimuli covering the entire 4 ×4 matrix and found no effect of number

of stimuli. However, given that these four stimuli are the most perceptually labile of the complete stimulus set, shallower classification slopes might have been found for the children with a CI if these stimuli had been included.

Third, completing a speech discrimination or categorization task typically involves listening for a relatively long time to many more or less natural-sounding speech stimuli, raising the possibility that attentional demands might have affected the results in the present study (cf. Green, 1995). This is of particular concern when children are performing the task. Unfortunately, we were not able to explicitly control for attentional demands in the present study. However, listeners' accuracy in identifying phoneme endpoints is often used as an indirect measure of attention in the task (e.g., Nittrouer &Miller, 1997). Even though we did not use listeners' accuracy in identifying the phoneme endpoints of the stimuli series in this study as a criterion to include listeners in the analyses, as is often done, we did analyze phoneme endpoint identification. Phoneme endpoint identification by the children with aCIwas significantly lower than by the children with normal hearing only for the place of articulation contrast /fu/-/su/. However, phoneme endpoint identification by the former was significantly lower than by the adults for all contrasts except the low vowel contrast /A/-/a/, whereas for the children with normal hearing, phoneme endpoint identification was significantly lower than the adults only for the voicing contrast /bu/-/pu/. These results suggest that attentional demands cannot easily account for the performance differences between the children and the adults with normal hearing, but they might partially explain the performance differences between both groups of children. However, it is likely that phoneme endpoint identification by the children with a CI has also been affected by their hearing difficulties. Unfortunately, this possible confound between attentional demands and hearing problems cannot be disentangled in the present study.

Finally, the children with a CI in this study differed from each other in several important respects (seeTable 1). Besides variation in age at implantation and length of CI use, additional variationwas introduced by differences in etiology of the hearing loss, type of CI and speech processing algorithmused, and educational setting, to name just a few potentially relevant variables. These variables cause inherent variability in practically any sample of children with a CI, and large sample sizes are needed to control for these variables in the statistical analysis, sample sizes that were unfortunately unavailable for the present study. One of these variables, the implemented speech processing algorithm in the CI device, must be explicitly mentioned here, given that processing algorithms have been argued to differ in spectral and temporal emphasis. For example, the SPEAK (spectral peak) algorithm is suggested to provide more detailed spectral information by using a greater number of channels for stimulation than, for example, the CIS (continuous interleaved sampling) algorithm, which is suggested to providemore detailed temporal information given relatively high stimulation rates. Finally, algorithms such asACE (advanced combination encoder) combine the advantages of algorithms with either frequency emphasis or temporal emphasis by dynamically selecting stimulation sites based on the amplitudes in the different frequency bands. For the children with a CI in the present study, we were unfortunately unable to take the implemented speech processing algorithms into account in the analyses because the full information was not available. Therefore, we cannot exclude the possibility that differences in speech processing algorithms used by the children have affected the results.

Use of Acoustic Cues by Children With a CI

Notwithstanding these methodological limitations, we believe that the present study provides an important contribution to the existing literature on speech perception in children with a CI by examining the use of acoustic cues for different sound contrasts in a sample of children with a CI who were implanted relatively early. The results of the analysis of phoneme endpoint identification showed that for the place of articulation contrast /fu/-/su/, the children with a CI had clear difficulty consistently distinguishing even the phoneme endpoints in the stimulus series. For each contrast except the low vowel contrast /A/-/a/, phoneme endpoint identification was significantly poorer than that of the adults. The children with normal hearing differed significantly in phoneme endpoint identification from the adults only for the voicing contrast /bu/-/pu/.

The results of the analysis of individual cue reliance showed that the children with a CI used spectral cues in the place of articulation contrast /fu/-/su/ less effectively than the children with normal hearing. Effects for the use of the durational cue in the low vowel contrast /A/-/a/, the spectral cue in the high vowel contrast /I /-/i/, and the VOTcue in the voicing contrast /bu/-/pu/ were only marginally significant (.02 ? p ? .05) but all in the same direction, namely, less effective use for the children with a CI. Both groups of children consistently used individual acoustic cues less effectively than the adults, except for the spectral cue in the low vowel contrast /A/-/a/ and the intensity cue in the place of articulation contrast /fu/-/su/, which were used less effectively only by the children with a CI.

In line with the phoneme endpoint identification and individual cue reliance findings, the children with a CI showed a significantly shallower classification slope for the place of articulation contrast /fu/-/su/ than the children with normal hearing. The effects for the other three contrasts were only marginally significant (.02?p?.05) but all in the same direction, namely, shallower classification slopes for the children with a CI. As expected given the individual cue reliance findings, both groups of children showed significantly shallower classification slopes than the adults for all four contrasts. Given the relatively young age of the children in the present study (between 5 and 6 years) and the observation in the literature that the development of adultlike speech sound categorization takes several years to complete, this finding is not surprising. For example, Gerrits (2001) examined 4-, 6-, and 9-year-old children and observed developmental differences in cue-weighting strategies at all three ages, especially for the perception of consonant contrasts. Hazan and Barrett (2000) found that even 12-year-old children categorized phonemic contrasts less consistently than adults.

Differences in the reliance on individual acoustic cues between children with a CI, children with normal hearing, and adults did not lead to significantly different cue weightings for any of the groups of listeners in the present study. For each of the three contrasts that allowed an analysis of cue weighting, the cue ratios indicated that all three groups of listeners weighted the spectral cue as relatively stronger than the other available acoustic cue (i.e., duration or intensity) in these contrasts.

Overall, then, the performance of the children with a CI was quite similar to that of the children with normal hearing, suggesting that they are able to use many acoustic cues effectively in speech perception. This is a remarkable finding given their different auditory input and given that they had less auditory experience than the children with normal hearing. The fact that the children with a CI in the present study were implanted relatively early might have contributed to this finding.However, we did not find a significant correlation between either age at implantation or length of CI use and performance in the task. It should also be noted that sample sizes in the present study were small, limiting the statistical power of the analyses.

We specifically expected that spectral cues might be more difficult for children with a CI than other cues, given the relatively poor spectral resolution of sound processing with a CI. Thus, one might expect that the children with a CI would weight other cues (e.g., durational cues) more strongly to compensate for poor spectral resolution. However, such reversals in cue weighting were not observed. In fact, even though the children with a CI used the spectral cue significantly less effectively in categorization of the place of articulation contrast /fu/-/su/, only a marginally significant effect in the same direction was observed for the high vowel contrast /I /-/i/. Moreover, they did not seemto have difficulty with using the spectral cue in categorization of the low vowel contrast /A/-/a/.

In the present study, the difference in formant values between /A/ and /a/ was larger than the difference in formant values between /I / and /i/, and this difference might have made the spectral cue in the low vowel contrast /A/-/a/ more accessible to the children with a CI. Some support for this explanation can be found in the data of the children with normal hearing. These children did not differ significantly from the adults in their use of the spectral cue in categorization of the low vowel contrast, whereas they did for the high vowel contrast /I /-/i/ and place of articulation contrast /fu/-/su/. In addition, the children with a CI and the children with normal hearing did not use the durational cue in categorization of the /I /-/i/ contrast to the same extent as the adults. One of the

purposes of including duration as an acoustic cue in the stimulus series for the /I /-/i/ contrast was to allow listeners, especially children with a CI, to use this cue, given that the spectral cue was not highly informative for this contrast. However, the distinction in duration (30 ms) might not have been large enough for the children to consistently use in categorization of this contrast.

Accurate perception of high-frequency noise spectra has been found to be difficult for young children with normal hearing (Gerrits, 2001; Nittrouer, 2002b), which might explain the particular difficulties with the place of articulation contrast /fu/-/su/ in the children with a CI. Furthermore, children with a CI have been shown to perceive place of articulation contrasts less accurately than, for instance, manner of articulation contrasts (Kishon- Rabin et al., 2002; Mildner et al., 2006; Pisoni et al., 1999).

The finding that the children with a CI did not show a reversal in cue weighting for either vowel contrast or the place of articulation contrast despite the reduced spectral resolution of sounds transmitted by the implant is nevertheless surprising. However, Iverson et al. (2006) found that adult implant users did not use formant movement and duration cues in vowel recognition differently fromadults listening to CI simulations and suggested two possible explanations. First, because the implant users in their study were postlingually deaf adults, it is possible that they relied on already learned preimplant cue weightings to perform the task. Explicit perceptual training may be necessary to change these preimplant cue weightings (cf. Fu, Nogaki, &Galvin, 2005). Second, they hypothesized that different cue weighting might affect speech production negatively by changing the acoustic realization of speech sounds by implant users. The first explanation is of course restricted to postlingually deaf implant users, but the second explanation could also apply to the pediatric population.

Another possible explanation relates to the languagespecific reliability of acoustic cues in adult speech production and recognition. The range for each acoustic cue in the stimuli series that was used in the present study was representative of the range observed inDutch tokens that were naturally produced (Adank,VanHout,&Smits, 2004; Kissine, Van de Velde, &Van Hout, 2003; Kuijpers, 1996; Pols,Tromp,&Plomp, 1973). In otherwords, for the sound contrasts included in the present study, cues other than spectral cues might simply be relatively unreliable cues in Dutch. As a result, if a child with a CI would rely too much on durational cues in categorizing sound contrasts that are more reliably differentiated by spectral cues, word recognition might suffer considerably (cf. Iverson, 2003). One way to examine this possibility would be to look at sound contrasts for which both cues are equally reliable or to use nonspeech stimuli. In addition, step sizes on both cue dimensions would ideally represent equal psychophysical differences, something that was not controlled for in the present study.4 It is possible that when categorizing such stimuli, children with a CI do show different cue weighting than children with normal hearing and rely more on temporal cues than spectral cues.

Conclusion

To summarize, compared with age-matched children with normal hearing, the children with a CI appeared to use some acoustic cues less effectively in categorizing the vowel and consonant stimuli series in the present study. Overall, however, their performance was quite similar to that of the children with normal hearing. Most importantly, cue-weighting patterns did not differ significantly either.Despite relatively poor spectral resolution of sound processing with a CI, children with a CI are able to use spectral cues in speech perception, sometimes just as effectively as their peers with normal hearing.

Acknowledgments

We are very grateful to the children and their parents who were willing to participate in this study as well as to the adults who participated. We acknowledge Leo de Raeve of the Koninklijk Instituut voor Doven en Slechthorenden (Hasselt, Belgium) and Noelle Uilenburg of the Nederlandse Stichting voor het Dove en Slechthorende Kind (Amsterdam) for their continuous support during this study. We also thank Ellen Gerrits,Mieke Beers, Jan de Jong, andBeppie van denBogaerde for their assistance in the preparation of this article.

Sidebar

Use of Acoustic Cues by Children With Cochlear Implants
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J Speech Lang Hear Res 2010;53;1440-1457; originally published online Aug 5, 2010;
DOI: 10.1044/1092-4388(2010/09-0252)

Footnote

1The adult listeners were undergraduate students at the University of Amsterdam and were paid for their participation in the present study. The children (and their parents) were approached through their schools and received a small gift for their participation.
2The formula given by Fant (1973) was used to convert values in hertz to values in mel: m = (1000/ log102) ×log(1+f/1000).
3We thank two anonymous reviewers for pointing this out.
4We thank an anonymous reviewer for making this suggestion.

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Received November 20, 2009
Revision received March 31, 2010
Accepted April 22, 2010
DOI: 10.1044/1092-4388(2010/09-0252)

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Appendix

(ProQuest: Appendix omitted.)

Publication date: Dec 2010

Year: 2010

The Effectiveness of Clear Speech as a Masker

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1458-1471A.
ProQuest document link

Abstract: It is established that speaking clearly is an effective means of enhancing intelligibility. Because any signal-processing scheme modeled after known acoustic-phonetic features of clear speech will likely affect both target and competing speech, it is important to understand how speech recognition is affected when a competing speech signal is also spoken clearly. In 2 experiments, the authors investigated whether listeners would experience improved intelligibility when both target and nontarget speech were spoken clearly. Listeners' recognition of sentences in competing sounds was examined in 2 experiments. For both experiments, the target speech was spoken in conversational and clear styles. The competing sounds in Experiment 1 included 2-talker maskers spoken in conversational and clear styles of English or Croatian. The competing sounds in Experiment 2 included 1-talker maskers spoken in clear or conversational styles and temporally modulated white noise maskers shaped to mimic the 1-talker maskers. Performance increased for clear versus conversational targets. No significant differences were found between conversational and clear maskers. If it were possible to implement clear speech through a listening device, it appears that listeners would still receive a clear-speech benefit, even if all sounds (including competing sounds) were (inadvertently) processed to be more clear.

Full text: Headnote

Purpose: It is established that speaking clearly is an effective means of enhancing intelligibility. Because any signal-processing scheme modeled after known acoustic- phonetic features of clear speech will likely affect both target and competing speech, it is important to understand how speech recognition is affected when a competing speech signal is also spoken clearly. In 2 experiments, the authors investigated whether listeners would experience improved intelligibility when both target and nontarget speech were spoken clearly.
Method: Listeners' recognition of sentences in competing sounds was examined in 2 experiments. For both experiments, the target speech was spoken in conversational and clear styles. The competing sounds in Experiment 1 included 2-talker maskers spoken in conversational and clear styles of English or Croatian. The competing sounds in Experiment 2 included 1-talker maskers spoken in clear or conversational styles and temporally modulated white noise maskers shaped to mimic the 1-talker maskers.
Results: Performance increased for clear versus conversational targets. No significant differences were found between conversational and clear maskers.
Conclusions: If it were possible to implement clear speech through a listening device, it appears that listeners would still receive a clear-speech benefit, even if all sounds (including competing sounds) were (inadvertently)

processed to be more clear.

KEY WORDS: clear speech, speech perception, informational maskers

When a talker is asked to speak clearly, the acoustical changes in the subsequent speech production help improve listeners' recognition of speech (see, e.g., Helfer, 1997; Payton, Uchanski, &Braida, 1994; Picheny, Durlach, &Braida, 1985; Schum, 1996). The superior intelligibility of clear speech has been repeatedly documented in the literature, with improvements in recognition as high as 26 percentage points between clear and conversational speech targets (Payton et al., 1994). This clear-speech advantage is robust in both quiet and adverse listening conditions, including increased reverberation and competing steady-state or speech noise at various signal-to-noise ratios (SNRs; for a comprehensive review of clear-speech production and perception, see Smiljanic &Bradlow, 2009). The advantage is available to listeners even when talkers are trained to speak clearly at a conversational speaking rate (Krause &Braida, 2002). This clear-speech benefit has also been reported for many different listener groups, including listeners with hearing loss (e.g., Picheny et al., 1985), children with learning disabilities (Bradlow, Kraus, &Hayes, 2003), older listeners (e.g. Schum, 1996), and listeners who are not native speakers of English (Bradlow &Alexander, 2007; Bradlow &Bent, 2002).

One long-term aim of clear-speech research is to incorporate some of the acoustical properties of clear speech into signal-processing strategies (in hearing aids, cochlear implants, and other listening devices) to improve listeners' recognition of speech in both quiet and noise. However, the efficacy of transforming the real-world speech environment into clear speech is largely unknown. For example, one rarely encounters speech in the real world without competition, be it competition from other talkers or nonspeech environmental sounds. Therefore, it is necessary to understand what happens to listeners' recognition of speech not only when the target or intended speech signal becomes more clear but also when all of the sounds in the environment (received by the listening device) undergo the samesignal processing. In this article, we report the results of a series of experiments that are a first attempt to systematically investigate the speech recognition of listenerswith normal hearingwhen both the target (intended) and the nontarget (competing) speech are spoken clearly.

We propose two alternative hypotheses for howclearspeech maskers could affect listeners' speech understanding. The first hypothesis is that clear speech would be amore effectivemasker. Bythis,wemean that itwould be more difficult to recognize the target speech signal when the competing background speech is in a clearspeech style than when it is in a conversational speech style. This prediction is based on the well-established greater intelligibility of clear speech relative to conversational speech. This greater intelligibility may cause specific lexical items in the masker speech to "pop out" from the background, thereby creating a greater distraction from the target speech for the listener. In this scenario, the clear-speech masker would have greater linguistic informational masking influences. This hypothesis should hold true only when the masker is in a language that is familiar to the listener (e.g., English, a language that is known to our listener population). Therefore, as an additional means of contrasting these two hypotheses, in Experiment 1 we included both English and Croatian speech maskers. Croatian was selected as the unfamiliar language because clear speech spoken in Croatian has been shown to produce similar perceptual benefits for Croatian listeners and to be characterized by global acoustic properties similar to English clear speech (Smiljanic &Bradlow, 2005). In addition, few listeners from our subject demographic area would have knowledge of Croatian. Thus, if clear speech is a more effective masker because of greater lexical salience, the increased masking should occur only in the presence of the English clear-speech maskers. Croatian conversational and clear-speech maskers, in contrast, should be equally effective. However, if clear speech is a more effective masker in both English and Croatian, this could indicate that other complex acoustic-phonetic differences that are present between clear and conversational speech-such as slower speech rate, longer and more frequent pauses, greater pitch range, greater vowel space area, and greater vowel space dispersion reported for both languages (Smiljanic &Bradlow, 2005)-could be responsible for the effectiveness of the clear-speech masker.

The alternative hypothesis is that clear speech is a less effective masker. In other words, it would be easier to

recognize the target speech signal with competing clear speech compared with conversational speech in the background. This prediction is based on the greater temporal modulations present within a clear-speech signal (Krause& Braida, 2004, 2009).We predicted that listeners could potentially "listen within the dips" (Festen &Plomp, 1990) of these exaggerated temporal modulations to gain glimpses of the target speech signal and improve their speech recognition relative to speech embedded in a conversational masker. In this case, the clear-speech masker would have less of an energetic influence compared with the conversationally spoken speech masker. To probe this idea further, in Experiment 2 we included white noise maskers that were temporally modulated to match the temporal envelopes of the clear and conversational speech maskers also used in Experiment 2. If listeners were able to take greater advantage of the temporal modulations in the clear maskers in comparison to the conversational maskers used in Experiment 2, then noise maskers modulated to similar clear-speech envelope patterns should also prove to be less effective than their conversational speech counterparts. Comparing temporally modulated noise maskers with those composed of actual speech also provides a means of isolating the contributions of energetic versus informational masking from the various speech maskers.

We tested all of the masker conditions across two SNRs, with the easier SNR in the first half of the experiment and the harder SNR in the second half of the experiment. This was done for two reasons: (a) as ameans of avoiding ceiling or floor effects that may be expected on the basis of previous informational masking experiments (e.g., Freyman,Helfer,&Balakrishnan, 2007;Kidd, Mason, Deliwala,Woods,&Colburn, 1994; Van Engen& Bradlow, 2007) and (b) to ensure that any practice effects observed within the experiment would be counterbalanced by the increased difficulty of the second SNR condition presented in the second half of the experiments.

Experiment 1: Two-Talker Maskers

Method

Subjects. Thirty adult listeners with normal hearing (17 women and 13 men; mean age: 21;7 [years;months]) participated in Experiment 1. All listeners were native monolingual speakers of American English with no knowledge of Croatian. The institutional review board at NorthwesternUniversity approved all procedures. Listeners were paid for their participation and provided written informed consent.

Otoscopic evaluations were performed to ensure clear ear canals for all participants. Listeners' audiometric thresholds were tested using a Maico M26 clinical audiometer. All listeners had air conduction thresholds equal to or less than 20 dB HLbetween 250 and 8000 Hz, bilaterally (American National Standards Institute, 2004).

Stimuli.We used the Bamford-Kowal-Bench (BKB; Bench, Kowal,&Bamford, 1979) Revised Sentence Lists 1-16 for target sentences in all experiments. Each BKB list has 16 sentences and a total of 50 key words. The 16 sentences in each list contain either three or four scoreable key words. An example of a three-key word BKB sentence is "The orange is very sweet" (key words are underlined). Two versions of these sentence lists were recorded by a female talker at Northwestern University. The first version was recorded with the talker instructed to speak in a "typical" or "conversational" style of speech. For the second version of the sentences, the talker was instructed to speak "clearly," or how she may naturally speak if she knew the listener was having a difficult time understanding her. Each sentence from the two versions of the BKB lists was root-mean-square (RMS) normalized to the same pressure.We did allRMSnormalization for the stimuli in this project using Praat (Boersma &Weenink, 2009).

Four distinct two-talker female babble strings were used throughout testing as competing maskers. Two of the two-talker female babble strings were spoken in English by native English speakers, and twowere spoken in Croatian by native Croatian speakers. The competing English masker speech consisted of each talker speaking 20 meaningful English sentences taken from the list of sentences in Nazzi, Bertoncini, and Mehler's (1998) multilanguage corpus. The sentences had an average of 10 words per sentence (range: 9-14 words). An example of one of the sentences is "The next local elections will take place during the winter." Two female

talkers (different from the English target talker) spoke these sentences using both a conversational style and a clear style of speech. The sentences spoken by these two females have been shown to produce a clear-speech advantage; that is, when listeners with normal hearing recognized the sentences spoken by these two talkers, performance significantly increased for the clear versus the conversational sentences (see Smiljanic&Bradlow, 2008, Talkers F6 and F2). Each sentence used to construct the babble strings was RMS normalized to the same pressure. Sentences were then concatenated in different orders for each talker without any silent intervals between sentences. Because both talkers spoke the same sentences, we carefully planned the order in which the sentences were concatenated to ensure that the two talkers never spoke the same sentence at the same time. Once each talker's sentence stringwas concatenated,wemixed together the two talkers' strings into one single audio file using Audacity software (http://audacity.sourceforge. net/).

The same methods used to create the English twotalker babblewere used to create the Croatian two-talker babble. The same sentences used in the two-talker English babble described earlier were translated into Croatian (initially for the purposes of a separate study but made available to this study by a native Croatianspeaking colleague). The Croatian translations were specifically matched to the sentences used for the English two-talker babble for the number of expected syllables (15-18/sentence). All four competing babble maskers were at least 48 s in length (the overall duration varied depending on the individual talkers and clear vs. conversational styles; see Table 1). After concatenation of the sentences, all maskers were again RMS normalized to the same pressure level. Only the first 48 s of each babble string were used as competing maskers.

The speaking rate, number of pauses, and pause duration are reported in Table 1 for the speech produced by the five talkers used in these experiments. Rate was defined as the number of words spoken per minute, excluding pauses (defined as silent periods 10 ms or longer; seeKrause&Braida, 2002, for a similar analysis).Picheny, Durlach, and Braida (1986) reported that a characteristic of clear speech is that it contains more and longer pauses (or gaps between words) compared with conversational speech. Although the insertion or deletion of these pauses alone has not been shown to account for intelligibility differences between clear and conversational speech (Uchanski, Choi, Braida, Reed,&Durlach, 1996), these pauses (or lack thereof) are a prominent difference between these two speaking styles. Therefore, also reported in Table 1 are the average number of pauses per sentence produced by each talker, and the average pause duration. It should be noted that the sentences used for the masker conditions were significantly longer in length compared with the targetBKBsentences (Nazzi et al., 1998).

Procedure. Speech signals (the target and masker stimuli) were mixed in real time and output through custom software created using MaxMSP (Cycling '74, 2008) running on an AppleMacintosh computer. A MOTU 828 MkII input/output firewire output device was used for digital-to-analog conversion (24 bit). Generated signals were passed through a Behringer Pro XL headphone amplifier and passed to MB Quart 13.01HX drivers. The signals from these drivers were delivered to both ear canals using an assembly similar to the one used in clinical audiometry (i.e., via plastic tubes and disposable 13-mm foam eartips). For each trial, one BKB sentence was played. A random portion of the appropriate babble masker was presented 1 s longer than the target sentence (500ms prior to the beginning of the sentence and 500 ms at the end of the sentence). The overall RMS level of the target speech stimuli was held constant at 70 dB SPL, and the masker speech varied in level around the target speech, depending on the desired SNR.

Listeners were instructed to listen for the target female talker and repeat back what she said. Listeners' responseswere scored online for the number of key words correct and digitally recorded using an Olympus digital voice recorder. All listener responses were rescored offline by an independent second examiner for reliability measures. Items on which online and offline scores disagreed were replayed to the two examiners, who then scored those items by consensus. Such disagreement and subsequent resolution happened in 1% of the total trials scored.

Listeners were given an opportunity to familiarize themselves with the task and the target talker's voice prior to the beginning of each experiment. Each listener was presented with 16 sentences (50 key words) from BKB List 21. During familiarization, a favorable SNR of 10 dB was used for the first eight sentences, and an SNR of 5 dB was used for the second eight sentences. Eight of the sentences were presented in the presence of Croatian maskers, and the other eight sentences were presented in the presence of English maskers. The style of the target and the style of the masker were randomly varied across the 16 sentences. All combinations of target style and masker style were presented during familiarization (i.e., with respect to target-masker combinations for both languages and both SNRs, the following were played one time each: conversational-clear, conversational-conversational, clear-conversational, clear-clear).

During Experiment 1, 16 conditions were tested on all subjects: 2 SNRs (-3 and -5 dB) ×2masker languages (Croatian and English) ×2 styles of masker speech (conversational and clear) ×2 styles of target speech (clear and conversational; see Figure 1 for a schematic illustration of Experiment 1). One list of the BKB sentences (randomly chosen from Lists 1-16) was used for each test condition. We quasi-randomized the presentation of these conditions across subjects. The easier of the two SNR conditions (-3 dB; the first eight conditions) was always presented before the more difficult SNR condition (-5 dB; the second eight conditions). These two SNRs were chosen on the basis of pilot data analyzed to determine the SNRs needed to obtain usable data from most of our listeners (without reaching ceiling or floor effects) in all of the listening conditions (because many of the variables changed performance levels significantly, e.g., clear vs. conversational speech; Croatian vs. English speech maskers). Croatian maskers were always presented prior (Conditions 1-4 and 9-12) to the English maskers for each SNR (Conditions 5-8 and 13-16). This ordering was based on the results of previous literature indicating that, in comparison to their native language, monolingual listeners enjoy a release in masking when an unfamiliar language is competing in the background (see Freyman, Balakrishnan, &Helfer, 2001; Garcia Lecumberri &Cooke, 2006; Tun, O'Kane, &Wingfield, 2002; and Van Engen &Bradlow, 2007). We also had conducted pilot testing in our laboratory to ensure that, on average, the Croatian masker was easier in comparison to the Englishmasker for native English monolingual listeners. The listeners used in the pilot testing were not included in this study and thus are not discussed in this article. Because of the ordering of the SNR conditions and masker languages, there were always four blocks presented in a specific order within the 16 conditions (Croatian-3, English-3, Croatian-5, andEnglish-5).With this ordering, themore difficult conditions (lower SNR, Englishmasker) always occurred after the easier conditions (higher SNR, Croatian masker) as a means of counteracting any potential learning effects and to avoid ceiling effects for the easier listening conditions (see alsoVanEngen&Bradlow, 2007). Within those four blocks, the order of presentation of the target and masker styles were randomized for each listener. The four conditions (target style-masker style) included conversational-conversational, conversational- clear, clear-conversational, and clear-clear.

Results

Throughout this article, we have transformed listeners' performance scores for all conditions to rationalized arcsine units to stabilize error variance (Studebaker, 1985) prior to statistical analyses. A 2 ×2 ×2 ×2 repeated measures analysis of variance (ANOVA) that examined allwithin-subject effects (SNR, language ofmasker speech, style of masker speech, style of target speech) indicated a significant main effect of SNR, language of the masker speech, and style of the target speech: $F(1, 29) = 42.08$, $p < .001$; $F(1, 29) = 14.69$, $p = .001$; and $F(1, 29) = 108.54$, $p < .001$, respectively. In other words, listeners always performed significantly better when the SNR was -3 dB compared with -5 dB, when the masker speech was spoken in Croatian compared with English, and when the target speech was spoken clearly compared with conversationally (see Figure 2). The main effect of style of the masker speech was not significant, $F(1, 29) = 3.18$, $p = .085$.

We also observed two significant interactions in the four-way repeated measures ANOVA. We noted a significant interaction between the language of themasker and the style of the target speech, $F(1, 29) = 5.46$, $p = .027$. This interaction revealed that, overall, listeners benefited significantly more from a clear speech target

when the competing speech was spoken in English compared with when it was spoken in Croatian.

The second significant interaction we observed was for the language of the masker and the style of the masker speech, $F(1, 29) = 34.14$, $p < .001$. This interaction indicated that, overall, listeners identifying speech in the presence of English maskers performed significantly better in the presence of a clear-speech masker than when themaskerwas spoken conversationally.When the competing speech was Croatian, however, the opposite effect was observed; that is, listeners' performance in the presence of the Croatian masker significantly decreased when the competing Croatian speech was spoken clearly.

To probe the interaction of language of the masker and style of the masker speech further, we conducted post hoc pairwise comparisons with a Bonferronimultiple comparison correction ($a = .05/28 = .0018$), which indicated no significant differences in masker styles within individual masker language conditions (as indicated in Figure 3 by the "n.s." brackets), $ts(29)$ ranging between 3.28 and 0.10, ps ranging between .921 and .007; that is, no significant differenceswere found for style of themasker speechwhen all other within-subject factors were held constant (e.g., those conditions tested with the same SNR, the same style of the target speech, and the same language of the masker speech).

In summary, listeners performed better when the target speech was spoken clearly, regardless of the masker condition or the SNR. This clear-speech benefit was greater when the competing speech was spoken in English compared with Croatian. It should be noted that listeners' performances decreased when the masker speech was English compared with Croatian; therefore, the increased clear-speech benefit in theEnglish masker conditions may have to do with significantly poorer recognition in the conversational target listening conditions, allowing more room for improvement when provided with a clear target signal. There was no difference in performance between the clear and conversational stylemaskers within each test condition (i.e.,within each of the four panels of Figure 3 in the same masker language).

Experiment 2: One-Talker and Modulated-Noise Maskers

Method

The purpose of Experiment 2 was to further examine the effect of clear speech as a masker and to determinewhether any of the resultswe noted in Experiment 1 were due to two talkers speaking simultaneously in the masking conditions. Specifically, we wanted to ensure that we were not losing any of the modulation differences between the clear and conversationalmasker speech, and hence the clear-speech masker advantage or disadvantage, by combining two talkers. We potentially could be losing some of the greater modulation depths commonly observed in clear speech by overlaying the two speaker's voices. Therefore, in this experiment, we included two different one-talker maskers: one clear and one conversational. Also, to eliminate linguistic influences but continue to evaluate differences in modulation between the two types of maskers, we included two temporally modulatedwhite noisemaskers shaped tomatch the one-talker clear and conversational masker speech signals.

Subjects. Twenty adult listeners with normal hearing (13 women and 7 men; mean age: 23;4) who did not take part in Experiment 1 participated in Experiment 2. Again, all listeners were native monolingual speakers of American English, had normal hearing, were paid for their participation, and provided written informed consent. Otoscopic and audiometric evaluations were performed as described in Experiment 1.

Stimuli. The same versions and lists of the BKB sentences used in Experiment 1 were used in Experiment 2. Four new masker conditions were tested in Experiment 2. The first two masker conditions consisted of a single female native English talker speaking the same meaningful sentences described in Experiment 1 (Talker EM1). The first masker condition was composed of concatenated sentences spoken in a clear style, and the second condition contained the same sentences spoken in a conversational style.

We created the second two masker conditions using the temporal envelopes of the one-talker masker strings (i.e., the concatenated sentences); specifically, the envelopes of the clear one-talker masker and the conversational one-talker masker were computed in MATLAB. We applied a full-wave rectification Hilbert

transformto the stimuli,which were then low-pass filtered using a rectangular filterwith a cutoff frequency equal to 50Hz and a sampling frequency of 22.1 kHz (see Davidson, Gilkey, Colburn,&Carney, 2006).AGaussianwhite noise, generated inMATLAB, with a sampling frequency of 22.1 kHz, was multiplied by the two envelopes to create temporally modulated one-talker shaped noise maskers (one for the clear masker and one for the conversational masker).

Because of the slower speaking rate of the clearspeech stimuli, the clear style maskers were trimmed in length so that all four maskers were 40 s long.

Procedure. The procedures used to output the stimuli, the instructions given to the listeners, and the scoring technique used in Experiment 2 were identical to those in Experiment 1. Listeners were tested on a total of 16 different listening conditions. The first eight listening conditions included modulated white noise maskers, and the second eight conditions included one-talker maskers (2 SNRs ×2 styles of maskers ×2 styles of target speech for 2 different types of maskers; see Figure 4 for a schematic illustration of the overall design). The SNRs used for the modulated-noise masker conditions and the onetalker masker conditions varied from each other (-8 and -10 dB vs. -14 and -16 dB, respectively) and from those used in Experiment 1 (-3 and -5 dB). We did this in an attempt to approximate equal performance across the different masker conditions because some of the maskers used are inherently less effective (easier) than others (see Simpson &Cooke, 2005).

The two masker types (modulated white noise and one talker) were presented in separate tasks. All test conditions with the two modulated-noise maskers (eight conditions) were conducted first, followed by all of the eight one-talker masker conditions, to allow the listeners to become familiar with the target voice. To familiarize listeners with the recognition task in the presence of the modulated-noise maskers, we presented them eight sentences (25 key words) from List 21 of the BKB sentence list. The first four sentences were presented at 5 dB SNR, and the last four sentences were presented at 0 dB SNR. The style of the masker conditions (clear or conversational) and the style of the target speech (clear or conversational) were randomly varied. Listeners were tested on one random BKB list/condition (chosen from Lists 1-16, 50 key words/condition). Similar to Experiment 1, we quasi-randomized the eight listening conditions across subjects; that is, the easier of the two SNR conditions (-8 dB) was always presented first, and the more difficult SNR (-10 dB) condition was always presented last. The styles of the modulated-noise maskers and the style of the target speech were randomized across all subjects. Listeners were scored on the number of key words correct.

To familiarize listeners with the one-talker masker condition task, we presented them with the other eight sentences (25 key words) from List 21 of the BKB sentence list (the other eight sentences were used to familiarize listeners with the modulated-noise masker task). The first four sentences were presented at 5 dB SNR, and the last four sentenceswere presented at -5dBSNR.The style of the masker conditions (clear or conversational) and the style of the target speech (clear or conversational) were randomly varied. Again, the eight listening conditions were quasi-randomized across subjects (the easier of the two SNR conditions [-14 dB] was always presented first, and the more difficult SNR [-16 dB] condition was always presented last). Listenerswere tested on one randomBKB list/condition (50 key words/condition). The styles (clear or conversational) of the one-talkermaskers and the style of the target speech were randomized across all subjects.

Results

Modulated-noise maskers. A 2 ×2 ×2 repeated measures ANOVA with all within-subject factors, including SNR (-8 and -10 dB), style of the target speech (clear and conversational), and style of themasker speech (clear and conversational), indicated a significant main effect of bothSNR,$F(1, 19) = 37.69$, $p < .001$, and style of the target speech, $F(1, 19) = 312.46$, $p < .001$, for the modulatednoise masker conditions. No significant main effect of the style of the masker speech or any significant interactions were observed (see Figure 5).

One-talker maskers. We used a 2 ×2 ×2 repeated measuresANOVAto examine all within-subject factors-including SNR (-14 and -16 dB SNR), style of the target speech (conversational and clear), and style of

themasker speech (conversational and clear)-for the one-talker masker conditions. The analysis indicated a main effect of the style of the target speech, $F(19) = 240.72$, $p < .001$. No significant main effects of SNR or the style of the masker speech, or any significant interactions, were observed (see Figure 6).

In summary, listeners' performance was significantly improved when the target speech was spoken clearly regardless of masker type or SNR. For the modulated white noise maskers, listeners' performance significantly decreased in the harder SNR condition, but there was no significant difference in performance across the two SNRs for the one-talker masker conditions. Performance was not significantly affected by the masker style (conversational vs. clear).

General Discussion

These data represent a first attempt to examine listeners' speech recognition performance when not only the intended, or target, speech is spoken clearly but also when other competing signals in the listening environment are spoken clearly. Native listeners of English with normal hearing have always performed significantly better on a sentence recognition task when the target speech was spoken clearly compared with conversationally (see, e.g., Picheny et al., 1985, for a similar result). Also, listeners performed significantly better when the masker speech was spoken in Croatian compared with English (see Garcia Lecumberri &Cooke, 2006; Rhebergen, Versfeld, &Dreschler, 2005; and Van Engen &Bradlow, 2007, for similar results with different languages). No significant differences in performance were observed when the masker varied between a conversational and a clear style. This was true for two-talker English and Croatian, one-talker English, and modulated-noise maskers.

Conversational Versus Clear-Speech Targets

The improvement in intelligibility gained from clear speech has proven to be a very robust phenomenon. In fact, this clear-speech benefit has survived competition from wide-band noise (Bradlow &Bent, 2002), speechshaped noise (Krause &Braida, 2002; Payton et al., 1994), and multitalker babble (Ferguson &Kewley-Port, 2002) and now single-talker, foreign speech, and modulatednoise maskers. This consistent benefit is crucial because listening in noise proves to be most difficult for listeners with hearing impairment (Bentler, Wu, Kettel, &Hurtig, 2008; Kochkin, 2005), and clear-speech signalprocessing strategies may hold promise for listeners with hearing loss. However, if the acoustical changes that occur in a clear-speech signal can be implemented into a signal processing strategy, it would be very difficult, if not impossible, to constrain those changes only to the intended speech signal. This would be true even for those assistive listening devices that incorporate directional microphones and beam-forming technology because often both the target and competing sounds come from similar directions. Therefore, it is imperative that listeners still be able to obtain a clear-speech benefit with other clear signals competing in the environment.Onthe basis of the data reported in Experiments 1 and 2, listeners continue to achieve a clear-speech benefit regardless of the competing speech signal. We calculated clear-target speech benefit scores (quantified as the difference between clearspeech performance score and conversational speech performance score [measured as percentage correct], holding all other variables constant) for both SNRs for the three types of masker conditions (two talker, one talker, and modulated noise). Regardless of the masker type or the SNR, listeners received, on average, a minimumof a 22-percentage-point increase (for the -8 SNR, clear modulated-noise masker condition) and a maximum of a 35-percentage-point increase (for the -16 SNR conversational one-talker masker condition). These degrees of improved speech recognition in noise are dramatically greater than what is typically reported for hearing-aid users after audibility has been accounted for (i.e., through the use of directional microphone technology, digital noise reduction algorithms, or frequency gain characteristics of the listening device; Bentler et al., 2008; Keidser et al., 2006; Klemp &Dhar, 2008). It is also encouraging that the clear-speech benefit was greater for more difficult listening conditions-that is, the more difficultSNRs and the masker conditions providing informational masking. The significant interaction observed between the language of the masker and the style of the target speech in Experiment 1 may suggest that listeners can take even greater advantage of clear speech either when the

listening condition becomes more difficult or when informationalmasking causes confusion for the listener (when listening in competing English vs. Croatian speech). These results showcase the promise of clear speech as an avenue to better speech recognition in noise.

Effect of the SNR

As explained in the beginning of this article, the reason for using two different SNRs (with the easier SNR always presented first) throughout these experiments was twofold. First, we wanted to be able to account for the amount of variability observed in previous informationalmasking experiments (e.g., Freyman et al., 2007; Kidd et al., 1994; Van Engen &Bradlow, 2007); that is, having two different SNRs would allow us to have meaningful data for all of our listeners in the event that some of the listeners showed a ceiling effect in the easier listening conditions (i.e., easier SNR and/or easier masker condition; e.g., Croatian vs. English, conversational vs. clear) or a floor effect in one of the more difficult SNRconditions. Second, it is well known that listeners' experience with a task can affect their performance. Therefore, by including two SNRs, with the easier SNR presented first, we tried to ensure that any practice effects observed would be counterbalanced by the increased difficulty of the second SNR conditions in the second half of the experiment.

For the modulated white noise and two-talker masker conditions, listeners' performance significantly decreased in the more difficult SNR condition. However, for the one-talker masker condition, listeners' scores, on average, did not significantly decrease in the more difficult SNR condition. We acknowledge that the difference in SNRs between the "easier" and "harder" conditions used in these experiments was only 2 dB. Using a greater range of SNRs could possibly have yielded significant differences between SNR test conditions for the onetalker maskers. However, this result is still noteworthy because it reinforces the observation that, when conducting speech-in-speech experiments with maskers that are heavily dominated by informational masking (e.g., onetalker maskers; see Simpson &Cooke, 2005), one must consider perceptual learning within the experimental task (Kidd, Mason, &Richards, 2003; Lutfi, 1990). Although it is normal and expected for listeners to improve their recognition over the course of a task, different degrees of learning/improvement or adaptation may occur as a result of varying amounts of informational masking across different speech masker conditions (e.g., one-talker vs. two-talker vs. eight-talker maskers). This being said, in our results we did not see a significant interaction between the SNR and the language of the masker in Experiment 1. The lack of this significant interaction may suggest that the spectral and temporal density of the two-talker maskers causes enough energeticmasking that listeners either require more time to learn/adapt to the task or simply adapt less because of the energetic masking contributions when compared with the one-talker masker conditions.

Van Engen and Bradlow (2007) reported improvements in performance across trials for speech-in-speech recognition tasks. They examined English sentence recognition in the presence of English andMandarin speech maskers for monolingual native English listeners. They tested two groups of listeners in two SNR conditions in which the easier of the two SNRs was presented first. The first group performed the recognition task at SNRs of 5 and 0 dB. The second group of listeners performed the recognition task at SNRs of 0 and -5 dB. Their results indicated a significant difference in performance between the two groups at the 0-dB SNR condition; that is, those listeners who performed the 0-dB SNR condition in the second half of the experiment performed better at 0 dB SNR than those listeners who began the experiment at 0 dB SNR. These results suggest that the improvements observed in their speech-in-speech data were probably due to the time it took for listeners to gain either an understanding of the listening task or familiarity with the target voice. It is reasonable to conclude that, of the listening conditions included in the present experiments, learning which voice was the target voice would be most difficult and would take the most time in the one-talker masker conditions. However, it should be noted that in Experiment 2, we always had the listeners perform the modulated-noise masker conditions first (before the one-talker masker conditions) to familiarize them with the target voice. Also, although on average listeners' performance significantly decreased in the more difficult SNR condition in the modulated-noise masker conditions, in which there were no competing voices for the listener to identify, six of the 20 listeners improved

their score in the more difficultSNR condition. This indicates that even when the listener does not need to identify the target voice from a competing background voice, listeners' performance still can improve over the course of an experiment. These data imply that the improvements in performance observed in our data are more likely due to the listeners gaining a better understanding of the listening task rather than becoming more familiar with the target voice. It should be noted, however, that in these experiments, the masker was chosen from a long stimulus file in which the starting point randomly varied on every trial. This method differed from that used by Van Engen and Bradlow, in whose study the masker noise was frozen (not changing from trial to trial). This methodological difference could impact howmuch, how quickly, and why listeners improve their performance across a number of trials (see Felty, Buchwald, &Pisoni, 2009).

Clear- Versus Conversational Speech Maskers

An important finding of these experiments is that the style of the masker speech did not significantly affect performance. We began these experiments with two alternative hypotheses. The first was that clear speech would be a more effective masker, meaning that it would be more difficult to recognize the target signal when a more salient clear-speech signal was competing in the background. The second, alternative hypothesis was that clear speech would be a less effective masker, meaning it would be easier to recognize the target signal when a clear-speech signal, with more exaggerated temporal modulations, was competing in the background. On the basis of the results of all four masker types (two-talker English, two-talker Croatian, one-talker English, and modulated white noise), we can reject both hypotheses. Furthermore, we can conclude that the hypotheses are not rejected simply because they cancel each other out; that is, on the basis of the results fromsome of themasker conditions (e.g., the white noise maskers that would not have any linguistic content), we can conclude that, for the stimuli used in these experiments, the difference in the dips within the clear- and conversational speech signals is not enough to improve or degrade listeners' speech recognition. Moreover, our results indicate that clear speech is neither a more nor less effective masker than conversational speech. It appears that the acoustic- phonetic differences that arise in a typical clear-speech signal, though robust when imposed on the target speech, are too small to change the clear-speech signal's effectiveness as a masker. This suggests two things: (a) listeners' perception of speech they are trying to recognize is different from their perception of speech they are trying to ignore and (b) small acoustic-phonetic differences (e.g., like those commonly observed between clear and conversational speech) do not change the effectiveness of the masker speech. However, larger acoustic-phonetic differences (e.g., those observed across languages) do significantly change the effectiveness of the speech masker. This suggests that a range of acoustic- phonetic and/or linguistic variations in themasker speech can contribute to its effectiveness. Further research examining a broader spectrum of acoustic-phonetic variation in the masker speech is needed. For example, researchers have often observed that different talkers produce clear speech in different ways (e.g., Bradlow et al., 2003; Ferguson&Kewley-Port, 2007; Krause&Braida, 2004). It would therefore be advantageous in future experiments to include a variety of speakers as maskers. This is especially importantwhen one considers the significant interaction observed between the language of the masker and the style of the masker speech in Experiment 1. Although post hoc analyses indicated no significant differences between clear and conversational maskers when all other factors were held constant (which leads us to reject our original hypotheses; see Figure 3), the data revealed a trend that listeners performed better when listening in the presence of a clear English speech masker compared with a conversational one. However, the opposite was observed for the Croatian clear-speech maskers. It is plausible to assume-on the basis of the interaction of the language of the masker and the style of the masker speech-that with different speakers competing, clear speech could help the listener perform the task. In other words, contrary to our original hypothesis, a clear signal that would "pop out" may not actually cause greater difficulty for the listener but may help the listener auditorily stream the information, making it easier to ignore the masker speech (or at least determine which signal the listener is trying to ignore). A greater number of speakers producing different degrees of clear-speech intelligibility would help probe this idea. For

example, the English speakers used in the masking conditions in our experiments did produce a clear-speech advantage while producing target sentences in another experiment (see talkers F6 and F2 in Table 1 of Smiljanic &Bradlow, 2008). However, the clear-speech advantage for these speakers reported by Smiljanic and Bradlow (2008) was smaller compared with clear-speech advantages observed for other speakers that have been reported in the literature. Perhaps if the clear-speech advantage for the speakers used to create themaskers had been larger,we might have observed a significant effect of masking between clear and conversational speech maskers.

Effect of the Croatian Masker

Although not the focus of these experiments, we observed in Experiment 1 a release in masking in the presence of competing speech maskers spoken in a language other than English. These results are in agreement with previous research that has explored maskers spoken in a language that differs from the language of the target speech (Garcia Lecumberri &Cooke, 2006; Rhebergen et al., 2005; Van Engen &Bradlow, 2007). Garcia Lecumberri and Cooke (2006) investigated the recognition of English consonants for native (English) and nonnative (Basque/Spanish) listeners in the presence of several competing masker conditions at an SNR of 0 dB. They reported a small but significant improvement ($h2 = .063$) in performance by native English listeners when the competing speech masker was spoken in Spanish (a language unknown to the native group) compared with the English masker condition. Van Engen and Bradlow (2007) reported a similar release in masking when native (English) listeners performed a sentence recognition task in the presence of Mandarin two-talker babble compared with English two-talker babble.

There are several possible explanations for the observed release in masking that occurs when the masker speech is spoken in a language that is different than the target speech. First, the English masker could be providing greater energetic masking because the target and masker speech aremore acoustically similar (both spoken in the same language) compared with the Croatian condition (in which the target speech was spoken in English). However, another possibility is that the listener is more distracted by the English masker, causing interference at a linguistic level (potentially because of syllables,words, or other linguistic units) and imposing greater informational masking compared with the Croatian speech. This explanation assumes that the energetic contributions of the English and Croatian maskers are similar and that the differences in masking occur not in the auditory periphery but at the central level. Garcia Lecumberri and Cooke (2006) and Van Engen and Bradlow (2007) both suggested that the differences observed in performance may be due to the differences in linguistic interference from the masker languages (a known language vs. an unknown language).

In the present study, the language effect (increased performance in the non-English masker) was robust against variation in the style of both the target and masker speech; that is, performance in the presence of theCroatianmaskers was always better than performance in the presence of the English maskers regardless of target or masker speaking style. Although these data cannot help identify the source of the language effect as either energetic or informational, they establish that it is indeed robust. Additional data are needed to probe the role of energetic and informational masking when conducting speech-in-speech experiments in which the masker speech is not linguistically matched to the target speech. One way to probe this question would be to test listeners' performance on a speech-in-speech recognition taskwhen the masker speech varies in intelligibility (e.g., from native speech to highly accented foreign speech, all spoken in the same language).

Modulated-Noise Maskers

The modulated-noise maskers used in Experiment 2 were developed from the clear and conversational speech of one talker. As discussed earlier, including a variety of speakers will be necessary when examining the effectiveness of clear speech as a masker in future experiments. The results depicted in Figure 5 indicate that the modulation differences between the clear- and conversational speech maskers used in Experiment 2 did not significantly affect performance. However, as discussed earlier, it is well documented that different talkers adjust their speech production differently when speaking clearly (Bradlow et al., 2003; Ferguson &Kewley-Port, 2007;

Smiljanic &Bradlow, 2005). Furthermore, increases in temporal modulation are only one of the many acoustic-phonetic features that change between conversational and clear speech. Some talkers who demonstrate more dramatic changes in temporalmodulations between their clear and conversational speech may prove to be more or less effective in terms of masking, depending on the other features that change in their clear speech relative to their conversational speech.

A promising next step would to be to assess the clear-speech benefit of several speakers and then use the envelope patterns of these speakers' clear and conversational speech as maskers. Determining both the intelligibility advantage (in terms of target speech) and the masking effectiveness of clear versus conversational speech of the same speakers would potentially provide a more complete view of how speaking style modifications affect both target speech intelligibility and masker effectiveness.

Testing listeners with hearing loss would also be a critical next step. The differences in temporal modulations between some speakers' clear and conversational speech may change the effectiveness of the masking for somelisteners with normal hearing. It has been reported, however, that listeners with hearing impairment are less affected by amplitude modulations in competing noise than are listeners with normal hearing (Eisenberg, Dirks, &Bell, 1995). Therefore, it is reasonable to predict that listeners with hearing impairment may not be able to distinguish between the temporal differences in clearversus conversational speech maskers.

Potential Limitations

Previous research has shown that there is a large amount of variability in how different speakers change their speech to speak more clearly (e.g., Ferguson &Kewley-Port, 2007; Krause &Braida, 2004; Picheny et al., 1986). One possible reason we did not observe significant differences between styles of maskers is that we used only four different talkers throughout these experiments (two Croatian and two English). If a clear-speech signalprocessing strategy were to be implemented, it would be based on average clear-speech production (not on an individual talker). The rate of the clear competing speech spoken by the four talkers used throughout these experiments was faster compared with the target talker's rate of speech. If the masker talkers we had used had a more exaggerated style of clear speech, the clear-speech maskers may have had a different impact on these results.

Second, the clear-speech targets used in these studies were RMS normalized to the same pressure level as the conversational speech stimuli; however, there were significantly greater and longer pauses in the clear speech. Therefore, the intensity of the clear speech itself (not the RMS of the entire sentence that included the longer and more frequent pauses) may have given these listeners an advantage when listening to the clear-speech stimuli by inadvertently manipulating the SNR in their favor. If this were true, however, the clear-speech masker would have caused an equal disadvantage in terms of SNR. Liu and Zeng (2006) reported that when the pauses were removed from the clear- and conversational speech stimuli used in their study, the RMS was 0.2 dB greater for the clear speech in comparison to the conversational speech. Of course, the 0.2-dB difference reported by Liu and Zeng was specific to the stimuli used in their study; however, such a small difference is unlikely to account for performance differences observed between clear and conversational speech in these experiments. In addition, if the RMS normalization was slightly biased toward providing greater energy for clear speech, it actually is more promising that clear speech would not be detrimental to the listener if competing in the background.

Conclusion

This study was a first attempt to determine how listeners' speech recognition would be affected if a clearspeech strategy were implemented on not only the target speech but also competing signals, as would be the case if an electronic device indiscriminately transformed all incoming signals. The results are promising in that listeners still demonstrated a significant clear speech benefit even when the competing speech was also clear.

Acknowledgments

This project was supported, in part, by an ASHFoundation New Investigator Grant, the Hugh Knowles

Foundation at Northwestern University, and National Institute on Deafness and Other Communication Disorders Grants R01-DC005794 and 1F31DC009516-01A1. Portions of these data were presented at the 2008 American Speech-Language-Hearing Association National Convention, Chicago, IL, and at the 2008 Auditory Perception, Cognition, and Action Meeting, Chicago. We thank Chun-Liang Chan and Yan (Felicia) Gai for help with software development. Rajka Smiljanic provided the Croatian translations and recorded materials. We also thank Nah Eun (NahNah) Kim and Christina Yuen for help with data collection and management and Rebekah Abel for helpful comments throughout these experiments.

Sidebar

The Effectiveness of Clear Speech as a Masker
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J Speech Lang Hear Res 2010;53;1458-1471; originally published online Aug 5,2010;
DOI: 10.1044/1092-4388(2010/09-0210)
The references for this article include 3 HighWire-hosted articles which you can access for free at:
http://jslhr.asha.org/cgi/content/full/53/6/1458#BIBL
This information is current as of January 27, 2011
This article, along with updated information and services, is located on the World Wide Web at:
http://jslhr.asha.org/cgi/content/full/53/6/1458

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Received September 25, 2009
Revision received February 4, 2010
Accepted April 29, 2010
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Publication date: Dec 2010

Year: 2010

Listening Habits of iPod Users

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1472-1477A.
ProQuest document link

Abstract: To estimate real-environment iPod listening levels for listeners in 4 environments to gain insight into whether average listeners receive dosages exceeding occupational noise exposure guidelines as a result of their listening habits. The earbud outputs of iPods were connected directly into the inputs of a digital recorder to make recordings of listening levels. These recordings were used to estimate listening levels using reference recordings made in a real ear. Recordings were made in 4 environments with a wide range of background noises: (a) a library, (b) a student center, (c) busy streets, and (d) the subway. None of the 64 listeners were estimated to exceed allowable occupational dosages, with a maximum dose of 7.57% based on Occupational Safety and Health Administration (OSHA; 1998) methods and 10.83% based on National Institute for

Occupational Safety and Health (NIOSH; 1998) methods. All of the listeners surveyed were exposed to dosages well below OSHA and NIOSH occupational regulations. Although this does not guarantee individual safety, the results do not support the widespread concern regarding the safety of common iPod usage. However, measurements made in this study agree with the finding that iPod output can exceed safe levels and further support recommendations to monitor and limit listening volume and listening duration.

Full text: Headnote

Purpose: To estimate real-environment iPod listening levels for listeners in 4 environments to gain insight into whether average listeners receive dosages exceeding occupational noise exposure guidelines as a result of their listening habits.
Method: The earbud outputs of iPods were connected directly into the inputs of a digital recorder to make recordings of listening levels. These recordings were used to estimate listening levels using reference recordings made in a real ear. Recordings were made in 4 environments with a wide range of background noises: (a) a library, (b) a student center, (c) busy streets, and (d) the subway.
Results: None of the 64 listeners were estimated to exceed allowable occupational dosages, with a maximum dose of 7.57% based on Occupational Safety and Health Administration (OSHA; 1998) methods and 10.83% based on National Institute for Occupational Safety and Health (NIOSH; 1998) methods.
Conclusions: All of the listeners surveyed were exposed to dosages well below OSHA and NIOSH occupational regulations. Although this does not guarantee individual safety, the results do not support the widespread concern regarding the safety of common iPod usage. However, measurements made in this study agree with the finding that iPod output can exceed safe levels and further support recommendations to monitor and limit listening volume and listening duration.

KEY WORDS: noise, portable music device, iPod, OSHA

(ProQuest: ... denotes formulae omitted.)

A number of studies have demonstrated that the maximum output levels produced by many portable listening devices, including tapes, CDs, and MP3 players, can exceed Occupational Safety and Health Administration (OSHA; 1998) and National Institute for Occupational Safety and Health (NIOSH; 1998) standards for long-duration exposure (Fligor &Cox, 2004; Maassen et al., 2001; Meyer-Bisch, 1996; Rice, Breslin, &Roper, 1987; Rice, Rossi, &Olina, 1987; Rudy, 2007; Turunen-Rise, Flottorp,& Tvete, 1991a, 1991b;Wong, Van Hasselt, Tang, &Yiu, 1990). As a result of these data, there has been significant media exposure and industry concern regarding the proper use and safety of portable listening devices. This has included concerns that the earbuds that are prepackaged with many of these products poorly isolate the listener from background noises and therefore result in higher listening levels than other earbuds (Hodgetts, Rieger, &Szarko, 2007).

Williams (2005) measured the sound output levels of personal stereo users in one setting using an artificial ear. In most other studies, assessments of actual listening levels are typically performed in laboratory environments or by asking listeners to set their volumes to the level that they normally would when they listen to music. It is possible that a controlled experiment performed with background noise that is relatively invariant in level does not represent real listening environments very well. Experiments in which listeners are asked to set their volumes may bias their setting and may not reflect changes in their volume settings as a result of other factors, including environment.

Therefore, the purpose of this study was to use directly estimated iPod listening levels for users in several true listening environments to get a survey of common listening levels. This will help determine whether listeners commonly exceed recommended noise exposure dosages as a result of their normal listening patterns.

Method

To estimate iPod listening level, we conducted a normative experiment. We used an Audioscan Verifit VF-1

Real-Ear/Hearing Aid Analyzer (Version 1.0) to determine SPLs near the tympanic membrane of the first author for pure-tone stimuli at approximately 25%, 50%, 75%, and 100% of the iPod volume (only 1 kHz was measurable at 100%; at all other frequencies, output exceeded the Verifit's maximum input). After calibration, the probe tube was inserted into the ear of the first author at a depth of approximately 30 mm, with the marker ring near the intertragal notch. The probe module was positioned facing outward and below the earlobe. The stimulus level of the Verifit system was set to 0 dB SPL. The iPod earbud was then placed in the ear of the first author, and the SPLs near the tympanic membrane were determined for 16-bit, 44.1-kHz, pure-tone WAV files with maximum digital amplitude and frequencies of 250, 500, 750, 1000, 1500, 2000, 3000, 4000, and 6000 Hz. A Fonix 6500-CX Hearing Aid Test System with an HA-1 coupler was used to verify these reference values. Ten additional listeners' ear canal transfer functions were measured using a 70- or 75-dB SPL tone sweep stimulus on the Verifit VF-1. We examined both levels to ensure stability of the frequency response as a function of test level. There was no substantial difference as a result of presentation level, so for the final estimate of each ear, only one level was used. First, the tone sweep was calibrated without the listener in position according to manufacturer specifications by holding the microphone 12.5 to 15 cm from the Verifit loudspeaker. Listeners then sat facing toward theVerifit loudspeaker. The Verifit system produced the tone sweep, which was recorded via the probe tube microphone to determine the gain resulting from the presence of the listener. These sweeps were repeated three times to ensure consistency. This test yielded a curve showing gain as a function of frequency for each ear, which included both the head-related transfer function and the ear canal transfer function.We then used these gain curves as filters to adjust the estimated level to the listening level near the tympanic membrane in these 10 additional ears.

We then used an M-Audio Microtrack 24/96 digital recorder to record the same stimuli at the same volume settings directly from the iPod. These signals were recorded in stereo at a sampling rate of 44.1 kHz and a 16-bit resolution. This provided a set of reference signals with known iPod output volume and SPL near the tympanic membrane for the first author's ear.

Next, we used the same setup to record directly from the iPods of 64 observed listeners (44 females and 20 males) using original stock iPod earbuds in four different environments: (a) on a heavily trafficked street in downtown Boston (n = 14), (b) on the Boston Massachusetts Bay Transportation Authority subway (n = 14), (c) in the Northeastern University library (n = 21), and (d) in the Northeastern University student center (n = 15). The sample size is one of convenience and is based solely on the availability of iPod users during the period in which the experiment was conducted. These iPod users were approached and immediately asked not to adjust the volume on their iPods. Then they were asked if they would be willing to participate in the study. If they agreed, their iPod was plugged directly into the M-Audio recorder, and a 30- to 60-s recording was made. The listener's gender, artist and song title of current selection, and the iPod type were noted. The listeners were also asked the following questions: "How many hours per day do you listen to your iPod?", "How long ago did you begin listening to your iPod?", "Do you adjust the level according to your environment? ", "Do you adjust the level according to the type of music you're listening to?", "What genre of music do you listen to the most?", and "Where do you use your iPod the most?"

We analyzed the iPod recordings using the reference signals to estimate mean and peak dB SPL near the tympanic membrane as well as free-field, A-weighted equivalents for all samples.

First, we examined each recording to make sure that it contained a single song (i.e., no song transitions). A 30-s clip was cut from the middle of the recording, and each sound file was converted from stereo to mono by selecting the channel with the higher root-mean-square (RMS) value.

We then used two stages to determine the equivalent level of each sample: First, we estimated the levels using a pure-tone reference at 1 kHz measured at three levels, and then we applied frequency-specific gains to match the overall shape of the response of the first author's ear canal.

In the first stage, the levels of the pure-tone reference measured at 1 kHz at three iPod volumes (25%, 50%,

and 75%) were averaged to provide an overall reference level. The average level of each recording was then calculated as

...

We computed the temporal envelope using a series of 10-ms boxcar windows with 50% overlap. The peak level of the each recording was calculated a

...

where RMSmax^sub recording^ is the maximum RMS value for any of the 10-ms windows.

In the second stage, we used the recordings to make two types of sound level estimates, dB SPL near the tympanic membrane (dBTM) and free-field equivalent dBA, for two sound characteristics: (a) average level (based on overall RMS voltage) and (b) peak level (based on the highest RMS in a 10-ms sample). We determined the dBTM values by averaging the 25%, 50%, and 75% volume output levels for the reference iPod recordings made in the first author's ear for each of the measured frequencies, rather than just a single frequency as used in Stage 1. We used these measurements to generate a filter with a gain of 0 at 1 kHz and relative gains at all other frequencies. For unmeasured frequencies, we interpolated the filter values using the shape-preserving piecewise cubic interpolation function in MATLAB. We generated a final set of finite impulse response (FIR) filter coefficients using the MATLAB FIR2 function. During Stage 2, this filter was applied to each sample to generate the final dBTM for the first author's ear.

We then calculated the dBTM levels for all other test ears, using filters with frequency-specific gains equivalent to the difference between each listener's ear canal transfer function and the first author's ear canal transfer function. We first applied these filters to the 30-s recordings, and then we calculated the level at the tympanic membrane for each of the ears examined for each recorded sample. To avoid underestimating the sound levels at the tympanic membrane, the value in the ear with the highest estimated level for each sample is reported subsequently as dBTM.

To make comparisons with commonly examined metrics for sound exposure, we also calculated a free-field equivalent dBA weighting for each sample, using the standard provided by the American National Standards Institute (2004). The dBTM value measured in the first author's ear was adjusted for each recording by subtracting the ear canal gain function for the first author's ear. This resulted in an estimated level outside the ear. We then computed estimated daily dose according to OSHA and NIOSH guidelines by assuming that the listener was exposed to the estimated level for the number of hours listened per day according to the self-report (OSHA, 1998). Because typical assessments of noise exposure are made via measurements outside the ear canal, the free-field equivalent dBA weighting was used for assessing dose rather than dBTM (see Berger,Megerson,&Sterger, 2009, for a discussion). The OSHA standard allows for 90-dBA exposure (free-field equivalent) for 8 hr with a 5-dB exchange rate. Thus, for each increase of 5 dB, the allowable time of exposure is halved. The NIOSH standard allows for an 85-dBA exposure (free-field equivalent) for 8 hr with a 3-dB exchange rate. Thus, for each increase of 3 dB, the allowable time of exposure is halved.

To further assess the accuracy of this full methodology, we performed an independent verification. Three songs played at 50% iPod volume were recorded using the digital recorder, and we predicted the peak SPLs near the tympanic membrane using the previously describedmethods. Then wemeasured the peak levels for the same songs using a Fonix 6500-CX Hearing Aid Test System with an HA-1 coupler. We attached one insert earphone to the coupler and used putty to create a seal. The Fonix 6500-CX-measured peak levels for the three songs were 86.9, 84.0, and 82.2 dBTM. The levels predicted from the digital recordings were 86.20, 83.96, and 84.28 dBTM, indicating discrepancies averaging approximately 1% between the peak levels of the two measures.

Results and Discussion

Figure 1 shows the real-ear measurements of dBTM measured in the first author. Because pure tones are constant and predictable, the use of pure-tone stimuli with maximum amplitude for this measure allows more accurate and objective calculations of the referenceRMS level to be used for comparison with the iPod

recordings. In addition, only a very short sample (< 0.5 s) was required to obtain a stable and repeatable RMS level near the tympanic membrane.

Figure 2 shows the means of the mean and peak levels for all 64 listeners divided by gender (44 females and 20 males) and four different environments: (a) on the street (n = 14), (b) on the subway (n = 14), (c) in the library (n = 21), and (d) in the student center (n = 15). To provide a conservative estimate, we determined these levels using the ear canal transfer function that resulted in the highest listening level, and the samples were not A-weighted. Thirteen listeners were estimated to be listening at an average level greater than 80 dBTM. Of those 13 (eight females and fivemales), eight exceeded 85 dBTM (four females and four males). Thirty-five recordings had peak levels that exceeded 85 dBTM, 29 exceeded90 dBTM, 18 exceeded 95 dBTM, and 13 exceeded 100 dBTM.

Examination of the variability across ear canal transfer functions revealed that the differences between the maximum and minimum levels estimated using the 11 different ears averaged 3.05 dB (with a maximum of 7.00 dB) for the average levels and 7.32 dB (with amaximum of 11.56 dB) for the peak levels.

Although some of these levels, particularly peak levels, seem relatively high, these are, in essence, estimates using the worst-case scenario (i.e., the ear selected from 11 ears to result in the highest level). Subsequently, to make comparisons with noise exposure standards, we transformed the sound levels to free-field equivalent A-weighted values by first using subtractive filters with the gains provided by the first author's ear canal and then using the A-weighting functions described by the American National Standards Institute (2004).

After free-field equivalent A-weighting, which inherently removes the effects of individual ear canals, we estimated five samples to reach an average free-field equivalent dBA level greater than 80 dBA. None of those samples exceeded 85 dBA. Fifteen recordings had peak levels that exceeded 85 dBA, eight exceeded 90 dBA, and six exceeded 95 dBA, but none of these samples had peak levels exceeding 100 dBA.

As a result of the generally short listening times (M= 1.19 hr, SD = 0.73), individual doses from exposure were quite low, with a mean of 0.94% (SD = 2.38) and a maximum dose of 10.83% based on NIOSH standards and a mean of 0.88%(SD = 1.65) and a maximumdose of 7.57% based on OSHA standards.

Attempts to quantify the listener responses led to relatively few findings. We found no correlations between daily listening duration or historical duration of listening and listening level (Pearson correlations,SPSS 15.0).Two analysis of variance tests (SPSS 15.0) revealed no significant effect of gender on listening level ($p > .05$) but did reveal a significant effect of listening environment on level, $F(3, 60) = 19.05$, $p < .01$. A Bonferroni post hoc analysis indicated that the library differed significantly from all three other environments (ps <.01 for all paired comparisons with library) but that no other environments differed significantly from one another (ps >.05 for all pairs that excluded the library). Although listeners were asked to report the genre of music that they most often listened to, they were not given specific categories. After general examination of these data, the self-reported genres were divided into three categories: Pop/Rock (n = 36), Hip-Hop/R&B (n = 10), and Other (n = 18). Hip-Hop/ R&B listeners listened at a significantly higher level (averaging approximately 78.18 dBTM) than either Pop/ Rock (66.89 dBTM) or Other (67.68 dBTM) listeners; however, this result is confounded by location covariation. Almost 42% of Pop/Rock listeners in this sample population were measured in the library, whereas only 10% of Hip-Hop/R&B listeners were sampled in the library setting. Of those listening to music in the Other category, approximately 28% were sampled at the library. When all library data were excluded, an additional analysis of variance revealed no significant differences across genre ($p > 0.5$), and the resulting data had the following means and standard deviations: Pop/Rock, M = 74.67 dBTM, SD = 9.8; Hip-Hop/R&B, M = 79.92 dBTM, SD = 10.6; Other, M = 70.47 dBTM, SD = 9.4.

Limitations

This study had a few procedural and functional limitations. No hearing assessment was made for any of the listeners, and we gathered no information regarding medical history. Therefore, it is not possible to know whether differences in hearing health may have played any role in variations in listening level. No ambient noise

levels were measured, so the degree to which the background noise of the different settings correlates with the estimated listening levels is unclear.

Conclusions

According to these findings, the iPod users we surveyed generally listened to their music at levels and for durations that resulted in exposures well below the OSHA guidelines for maximum noise exposure. It is important to note, however, that music is highly kurtotic. It is well known that kurtotic noise can cause sensorineural hearing loss that exceeds the expectations for damage from equivalent-level stationary noise (Ahroon, Hamernik, &Davis, 1993; Dunn, Davis, Merry, &Franks, 1991; Hamernik &Qiu, 2001; Thiery &Meyer-Bisch, 1988). Therefore, it is still sensible to recommend that iPod users limit their listening level and duration appropriately. However, the results do not indicate that the sampled population of listeners is at substantially increased risk for hearing loss as a result of their listening habits.

Acknowledgments

The second author was supported by a fellowship for advanced researchers from the Swiss National Science Foundation. The authors thank David Epter and Amy Levasseur for making the iPod field recordings and Rita Anelli for assistance with the ear canal recordings.

Sidebar

Listening Habits of iPod Users

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J Speech Lang Hear Res 2010;53;1472-1477; originally published online Aug 5,2010;
DOI: 10.1044/1092-4388(2010/09-0059)

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Received April 3, 2009
Revision received October 1, 2009
Accepted May 8, 2010
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Publication date: Dec 2010

Year: 2010

Systematic Studies of Modified Vocalization: Effects of Speech Rate and Instatement Style During Metronome Stimulation

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Publication info: Journal of Speech, Language and Hearing Research (Online) 53.6 (Dec 2010): 1579-1594A.

Abstract: This study introduces a series of systematic investigations intended to clarify the parameters of the fluency-inducing conditions (FICs) in stuttering. Participants included 11 adults, aged 20-63 years, with typical speech-production skills. A repeated measures design was used to examine the relationships between several speech production variables (vowel duration, voice onset time, fundamental frequency, intraoral pressure, pressure rise time, transglottal airflow, and phonated intervals) and speech rate and instatement style during metronome-entrained rhythmic speech. Measures of duration (vowel duration, voice onset time, and pressure rise time) differed across different metronome conditions. When speech rates were matched between the control condition and metronome condition, voice onset time was the only variable that changed. Results confirm that speech rate and instatement style can influence speech production variables during the production of fluency-inducing conditions. Future studies of normally fluent speech and of stuttered speech must control both features and should further explore the importance of voice onset time, which may be influenced by rate during metronome stimulation in a way that the other variables are not.

Full text: Headnote

Purpose: This study introduces a series of systematic investigations intended to clarify the parameters of the fluency-inducing conditions (FICs) in stuttering.
Method: Participants included 11 adults, aged 20-63 years, with typical speech-production skills. A repeated measures design was used to examine the relationships between several speech production variables (vowel duration, voice onset time, fundamental frequency, intraoral pressure, pressure rise time, transglottal airflow, and phonated intervals) and speech rate and instatement style during metronome-entrained rhythmic speech.
Results: Measures of duration (vowel duration, voice onset time, and pressure rise time) differed across different metronome conditions. When speech rates were matched between the control condition and metronome condition, voice onset time was the only variable that changed.
Conclusion: Results confirm that speech rate and instatement style can influence speech production variables during the production of fluency-inducing conditions. Future studies of normally fluent speech and of stuttered speechmust control both features and should further explore the importance of voice onset time, which may be influenced by rate during metronome stimulation in a way that the other variables are not.
KEY WORDS: stuttering, fluency-inducing conditions, vocalization, rhythmic speech
Wingate's (1969, 1970) influential modified vocalization hypothesis postulated that fluency-inducing conditions (FICs) are successful at reducing stuttering because "the stutterer is induced to emphasize phonation and continuity of phonation in the production of some kind of melody or prosody" (Wingate, 1969, p. 682). This idea, combined with Wingate's (1979) idiosyncratic definition of vocalization as including speech production structures other than only the vocal folds, has led to many kinematic and physiological studies examining the activity of the lips, tongue, jaw, lungs, and vocal folds in persons who stutter (PWS) and in normally fluent speakers. At least one vocalization variable has been found to be altered during all of the most powerful FICs-specifically, chorus reading, delayed auditory feedback (DAF)/prolonged speech, singing, andmetronome stimulation. The most common finding has been an increase in vocal foldmovement duration, which includesmeasures such as vowel duration and voicing duration. Changes in aerodynamic measures have also beenfound, includingalterations inpeak intraoralpressure, pressure rise time, and peak airflow (Stager, Denman, &Ludlow, 1997).
Previous FIC and vocalization research has not, however, clearly established whether the altered vocalization variables are necessary for fluency, a result of fluency, or simply the result of producing speech in a prescribed style. One problem with previous research is a lack of attention to potentially confounding variables, as described in the next sections.

Speech Rate in the Context of FICs

As speech rate decreases-specifically,when the speed of articulatory patterns is reduced-concurrent changes in speech production include an increase in voice onset time (Allen&Miller, 1999;Kessinger&Blumstein, 1997), an increase in vowel duration (Kessinger &Blumstein, 1998), an increase in final stop closure duration (Allen &Miller, 1999), an increase in the release burst time of final consonants (Allen &Miller, 1999), an increase in word duration (Kessinger &Blumstein, 1997), and a reduction in peak intraoral pressures (Boucher &Lamontagne, 2001). Despite these known influences, and the fact that researchers have noted the importance of controlling speech rate duringFIC and vocalization studies (Ingham, 1984; Stager, Jeffries, &Braun, 2003), many investigations of three of the most effective FICs (chorus reading, singing, and metronomic speech) have not been adequately designed to control for this potential confounding variable. Klich and May (1982), for example, found mean vowel durations to be significantly greater during a metronome condition as compared with a control condition in PWS. However, speech was produced 14 words per minute less on average during the metronome condition, a difference in speech rate large enough to increase vowel durations regardless of the imposed rhythm (Allen &Miller, 1999; Kessinger &Blumstein, 1998). Mean speech rate was also known to be slower during the metronome condition than during the control condition in other studies that reported differences between the two conditions (Andrews, Howie, Dozsa, &Guitar, 1982; Davidow, Bothe, Andreatta, &Ye, 2009; Martin, Johnson, Siegel, &Haroldson, 1985). In addition, some investigations of metronomic speech have not provided speech rate data for their control conditions (Brayton &Conture, 1978; Hutchinson &Navarre, 1977; Janssen &Wieneke, 1987; Stager et al., 1997;Wingate, 1981). These weaknesses in previous research suggest that several of the putative findings about rhythmic speech, such as significantly greater vowel durations (Klich &May, 1982) and alterations in phonated interval distributions (Davidow et al., 2009), may have been due primarily to a reduction in speech rate.

Similar issues are seen in the chorus reading literature. Some studies have addressed the issue of slowed speech rate as a possible reason for the fluency-inducing effects of chorus reading (e.g., Ingham&Packman, 1979), but many of the FIC and vocalization reports have provided only vague information about speech rate, if the issue is addressed at all (Adams &Ramig, 1980; Freeman &Ushijima, 1978; Janssen &Wieneke, 1987; Stager &Ludlow, 1998; Wingate, 1981). In other studies, reductions in peak airflow (Stager et al., 1997), alterations of short (51-150 ms) and longer (151-400 ms) phonated intervals (Davidow et al., 2009), and increases in utterance length (Andrews et al., 1982) all may have been due to speech rate changes. Similar methodological limitations exist in studies of singing, with most reports not providing any speech rate data or, at best, providing only unclear information (Colcord &Adams, 1979; Healey, Mallard, &Adams, 1976; Smith, Denny, Shaffer, Kelly, &Hirano, 1996;Wingate, 1981). This lack of control over speech rate in previous FIC studies makes it difficult to determine the impact of rate on other variables measured during the FICs, including especially whether or not those variables would change if speech ratewere constant.

Although most FIC and vocalization investigations have not fully considered the speech rate issue, two recent reports provide insight into the influence that speech rate may have during the FICs. Davidow et al. (2009) found that changes in phonated interval distributions fromcontrol conditions to chorus reading, prolonged speech, and rhythmic stimulation were indeed dependent on speech rate for PWS. Additionally, the influence of speech rate appeared to depend on the specific FIC performed. Stager and Ludlow (1993) reported, however, that speech rate was not significantly correlated with other variables (including vowel duration) for the change from a control condition to the combination of chorus reading, metronomic speech, DAF, and masking conditions for a group of persons who do not stutter. These findings suggest that the FICs have an impact on changes to vocalization variables and that these changes are not solely mediated by speech rate. It should be noted, however, that rate was not directly manipulated, and correlations were performed across all conditions rather than for each FIC separately in the Stager and Ludlow (1993) study. These limitations restrict the conclusions that can be drawn from their findings. Overall, further investigation is needed to clarify the impact of

speech rate on speech performance during FICs and to identify those variables associated directly with the FICs.

Instatement Style of an FIC

Another important issue is that FICs can be produced in several different ways. "Prolonged speech" programs, for example, may include or emphasize gentle onsets, light articulatory contacts, extended syllable durations, continuous voicing between word or syllable boundaries, or intentionally slowed speech (see Culatta &Goldberg, 1995, for various prolonged speech treatment targets). Similar problems exist for attempts to specify singing conditions, because songs vary in tempo, rhythm, genre, and along many other stylistic and performance-related variables. Metronome stimulation can be instated and paced in several ways including one syllable per beat, one word per beat, or speaking during evenly spaced stimuli of a particular duration (e.g., speaking for 0.5 s during each stimulus and not speaking for 1.0 s between stimuli; Finn &Ingham, 1994; Jones &Azrin, 1969). These variations have been treated as if theywere behaviorally equivalent examples of "rhythmic speech," an illogical assumption that fails to recognize many differences in speech production.

Because of these issues, a complete understanding of the FICs will require efforts to specify, control, and compare precisely the effects of both speech rate and instatement method. Any change in a vocalization variable that is a critical part of an FIC ideally should be shown to be independent of both rate and instatement style or to occur across a variety of rates and styles. In the absence of such evidence, any observed changes during an FIC may simply be the secondary and unspecified result of speaking in an altered manner of speech or the result of reduced rate, rather than a direct cause of the reduced stuttering during the FIC.

The Present Study

The present study was designed to assess the impact of speech rate and instatement style on several speech production variables during metronome stimulation and to determine whether metronome stimulation itself, rather than a specific speech rate or instatement style, is the source of change for speech production variables during metronomic speech conditions. Normally fluent speakers served as participants to optimize the potential of discovering the impact of rate and instatement style without the confounding influence of stuttering. However, the results of this report should arguably be applicable to both PWS and persons who do not stutter, because of the frequent commonalities in behavioral responses for fluent speakers and PWSin previous studies. In fact, for studies involving metronome stimulation (Hutchinson &Navarre, 1977; Janssen &Wieneke, 1987; Stager et al., 1997; Wingate, 1981), 11 of 13 variables assessed were similarly altered or not altered for both groups. A similar percentage is identified for vocalization studies involving singing (Colcord &Adams, 1979; Wingate, 1981), chorus reading (Adams &Ramig, 1980; Janssen &Wieneke, 1987; Stager et al., 1997; Stager &Ludlow, 1998;Wingate, 1981), and DAF/prolonged speech (Janssen &Wieneke, 1987; Stager et al., 1997; Stager &Ludlow, 1998). As such, the previous literature suggests that findings from persons who do not stutter should be applicable to findings with PWS.

The specific speech production variables measured in the present study were vowel duration, voice onset time, fundamental frequency, intraoral peak pressure, intraoral pressure rise time, maximum airflow, vowel midpoint airflow, and phonated intervals. These variables were chosen to examine the global response of the speech system to metronome pacing and because most have also been found to change from a control condition to metronomic speech (exceptions include voice onset time and fundamental frequency) in earlier investigations. It was hypothesized that timing-related variables would demonstrate longer durations during slower speech rate conditions than during faster conditions, and longer durations during one-syllable-per-beat metronomic conditions than during one-word-per-beat conditions. To our knowledge, the present study is the first FIC and vocalization investigation to include a production comparison that matches metronomic instatement rate with a control condition speech rate. It was hypothesized that there would be no change in duration-related variables from the control condition to the metronome condition for this comparison. There is less information regarding nondurational vocalization variables in the literature; therefore, specific directional hypotheses were not

developed for those measures.

Method

Participants

Eleven normally fluent adult volunteers participated (seven men and four women; mean age = 31.73 years, range = 20-63 years). No participant reported any past or present neurological disorder or speech, voice, oral-motor, or head or neck problems. All participants reported no previous experience with metronomic speech; all scored within normal limits on a measure of working memory (Wechsler Adult Intelligence Scale-Third Edition; Wechsler, 1997). All experimental materials and procedures were approved for use by the Institutional Review Board for the Protection of Human Subjects at the University of Georgia and at Hofstra University.

Experimental Protocol

Speaking tasks. Table 1 provides an outline of the experimental activities following the completion of the working memory test. The first speaking task in each of the two sessions involved obtaining the participant's habitual monologue rate for that day. Twelve min of monologue speech were completed in four 3-min trials. After the initial monologues had been completed, experimental and control conditions were completed by the participant. Participants completed a total of 11 speaking conditions: nine experimental and two control conditions. All six conditions designed to examine the issues of speech rate and instatement style were analyzed for the present study (the others were related to other issues in FIC research). During these six conditions, the participants were asked to read aloud from a high-school- level text during three 30-s trials, during which aerodynamic data were collected. Two additional 75-s trialswere also collected to record acoustic and phonated interval data. The experimental conditions were presented in a random order across participants, with the exceptions that control reading was always conducted on the first day, and the two conditions that were based on the control condition rate were always performed on the second day. This arrangement was necessary because syllables per minute (SPM) rates for control reading had to be established to perform the other conditions. The first participant completed five conditions on the first day and six on the second day, with this order reversed for each subsequent participant. The entire experimental protocol took approximately 6 hr per participant, involving two 3-hr sessions. Participants were allowed breaks at their request, and no participant noted fatigue.

Prior to each new experimental (metronome pacing) condition, the participant practiced the task until a performance criterion of 1 or 2 on a 7-point scale was reached (1 = definitely producing this condition correctly, 7 = definitely not producing this condition correctly) during each of two consecutive 30-s practice trials. Performance criterion ratings were made by the first author (experimenter) on the basis of whether the speaker matched the syllable or word to the metronomic beat and whether perceptually similar durations between utterances were maintained. Quantitative task compliance measures were also gathered post hoc (see Task Compliance in Method section). Practice trials used different text from that used during data collection.

Control reading. During the control reading condition, the participants sat with the experimenter and read aloud. They were instructed to read as they normally would. No speaking style or speech rate was prescribed for this condition.

Altered speech rate experimental conditions. Three conditions were used to examine the effect of speech rate. The first was designed to match the rate of rhythmic speech to the participant's habitual speech rate in the control reading condition, thus requiring the participant to read one syllable per beat at a rate that matched his or her own control reading rate (Syllable-Control Reading Rate, or Syll-CRR). The second condition was intentionally slow and uniform for all participants, requiring the participant to read one syllable per beat at 140 beats per minute (BPM; Syll-140). The last condition sought the same proportional decrease in speech rate for all participants rather than the same absolute rate. As such, the third condition required the participant to produce one syllable per beat at a rate equal to 75% of his or her own control reading rate (Syll-0.75CRR). Instructions were the same as those described for the control reading task, except that participants were

instructed to produce one syllable for each beat of the metronome.

Instatement style. Three conditions were used to examine the impact of instatement style. The first was the Syll-140 condition used in the experimental speech rate comparisons. The second condition was similar, but it matched whole words, rather than syllables, to the metronomic beat (i.e., one word per beat of a metronome set at 140 BPM, orWord-140). The third condition also used words as the unit for metronome entrainment, but the rate for this condition was calculated from the text to produce an overall rate of 140 SPM (one word per beat at a calculated instatement rate, referred to asWord-CIR). The contrast between Word-140 and Word-CIR, therefore, controlled rate in two distinct ways by providing a precise comparison between the two most common metronome instatement styles in the FIC literature.

Rest Periods

To control for possible carryover effects, rest periods of at least 2 min were provided after each experimental condition. During the rest periods, participants produced monologues on self-selected topics while the experimenter measured SPM. The next experimental condition was initiated only after two criteria were met in at least one 2-min speaking period:SPM had returned to baseline levels (defined as at least 90% of the habitual monologue rate gathered from the 12-min monologue task established for that day), and the experimenter rated the speech as a 1 or 2 on a 7-point performance criterion scale (1 = sounds identical to habitual monologue, 7 = sounds completely different from habitual monologue).

Aerodynamic Data

Participants were seated in a room with a customdesigned aerodynamics workstation (see the Instrumentation section). The experimental conditions were paced via a Matrix Mr550 digital metronome (for rates 250 BPM or below) or metronome software using a laptop computer (for rates above 250 BPM). The pacing tone was sent through a unilateral insert earphone to the participant's preferred ear. Once prepared, the participants were instructed to keep their head still until the experimenter indicated that the current set of trials was completed.

Instrumentation. Intraoral pressures were collected via a Honeywell Microswitch pressure transducer (Model 164PC01D37) coupled to a 5-cm segment of plastic tubing (Intramedic PE 260). Airflow measures were collected using a full-face mask that was serially coupled to an unheated pneumotachometer (Hans Rudolph Model R4719). During data collection, the plastic mask was held firmly against the participant's nose and mouth, with the plastic tubing from the pressure transducer threaded through a small hole in the mask so that the tube's aperture was orthogonal to the corner of the mouth and behind the lips. Before initiating each day's tasks, the plastic tubing's position was taped to the face mask to ensure a consistent position for the sampling of oral pressures.

Intraoral pressures and airflow were recorded using aWindows-based custom-designed software package known as AEROWIN (Neuro Logic, Lawrence, KS; for specifics, see Barlow, Suing, &Andreatta, 1999). All signals were conditioned and filtered by a bridge amplifier (LP -dB at 50 Hz, Butterworth 4-pole, DC coupled, Biocommunication Electronics Model 225) and routed to a 16-bit analog-to-digital converter (National Instruments, Inc.). Audio signals were collected via a Sennheiser e815S microphone placed approximately 10-12 in. (25.4- 30.5 cm) from the participant's mouth. The microphone distance from the participant's mouth was kept constant across conditions. The airflow and air pressure transducers were calibrated prior to each experimental data collection session. The system was calibrated for airflow using a rotometer set to 400 cubic centimeters per second (cc/s) and for pressure using a u-tubemanometer to displace 10 cmH2O.

Data collection. The AEROWIN program collected data in 6-s epochs. The acquisition of intraoral pressure and airflow was conducted in the context of specific carrier phrases (see the Appendix) embedded within sections of the reading text during the 30-s trial periods. The carrier phrases were randomized across all conditions, as were the text sections. Once the data acquisition window was completed, the experimenter removed the transducers from the participant's face as the participant continued to read. This process was repeated for the second carrier phrase in the trial. Upon completion of the second data acquisition window, the participant

continued to read until the experimenter signaled the end of the 30-s trial.

During all task conditions, the participants were asked to match their vocal intensity to that obtained during an intensity check task. A consistent 4-dB intensity range produced by the speaker was identified via a sound-level meter during a 1-min oral reading task before the first experimental condition (or first control reading trial, if control reading was selected first during randomization) was initiated. This range was used as the target loudness level for the aerodynamic data experimental conditions. If the participant deviated from the range more than three times outside of the 6-s data acquisition window (the experimenter could not properly fit the face mask and watch the sound-level meter during data acquisition), the entire trial was repeated. The experimenter used verbal reminders to encourage the participants to maintain their vocal intensity levels within the 4-dB operating range. Peak pressure and airflow measures, which are known to be positively correlated with vocal intensity, changed minimally between conditions, suggesting that intensity was relatively constant across speaking conditions.

Measurement. Aerodynamic datawere gathered from specific targets embedded in the carrier phrases by the first author using the graphic display of the AEROWIN system. Initial identification of each target from the recordings was completed by visual inspection and by using the time-locked audio recording. Four dependent variables were measured using the AEROWIN software package: peak intraoral pressure, pressure rise time, maximum airflow, and vowel midpoint airflow. Peak intraoral pressure (displayed in cmH20) values were obtained by measuring the maximum pressure value for /p/ and /b/ sounds at the beginning of words in the carrier phrases. These bilabials were selected because kinematically, bilabial plosives generate a briefly closed respiratory system that generally equalizes lung pressures. This maneuver allows for the estimation of alveolar pressures through the sampling of oral pressures as described by Smitheran and Hixon (1981). The target sounds were surrounded with vowels to allow for easy identification of the target in the signal and to set intraoral pressure at a minimum before target production (Hutchinson &Navarre, 1977; Stager et al., 1997; Stager &Ludlow, 1993). Pressure rise time (in ms) was obtained by calculating the duration from a point immediately before the pressure rise for the plosive to the time of peak pressure. Maximumairflow (displayed in cc/s) was defined as the highest point on the airflow trace after the release of the plosive. Vowel midpoint airflow (displayed in cc/s) was gathered for each vowel following plosive productions by identifying the center of the vowel's production duration. Both the first author and a graduate assistant listened to the audio recordings to ensure proper production of all vowels and consonants used for aerodynamic analysis, allowing for variations in dialect. If either judge thought a target word or a word adjacent to the target word was produced improperly, then that target word was discarded. The same protocol was used for the acoustic data, except that the judges were the first and third authors.

Acoustic Data

Instrumentation and data collection. The PRAAT Version 4.3.27 acoustic analysis program (Boersma&Weenik, 2005) was used during two 75-s trials to collect acoustic data. The acoustic signal was transduced with an AKG-C420 head-mounted condenser microphone placed approximately 6 cm from the left oral angle. The microphone was connected to a Mackie Micro Series 1202 12-ChannelMic/LineMixer, which was then connected to the input of a PC sound card. Input gain was set to a level of 50% of the total operating range. The sampling rate was set at 22 kHz. Participants read for approximately 15 s with no data collection, followed immediately by PRAAT recording functions and commencement of a 75-s trial. Similar to the procedure used to collect aerodynamic data, carrier phrases (see the Appendix) were embedded throughout the text. The acoustic trials were also paced via a Matrix Mr550 digital metronome or metronome software, with the pacing tone sent through a unilateral insert earphone to the participant's right ear. All acoustic data were collected in a sound-treated room.

Vocal intensity was controlled during the acoustic trials by matching voice output to the intensity found during 1 min of control reading prior to the first acoustic trial. If the participant's vocal intensity was outside the common

4-dB range identified during the control reading, the experimenter prompted the participant to read more loudly or quietly to satisfy the intensity goal.

Measurement. Vowel duration (in ms) was defined as the onset of periodic vibration in the waveform following the voiceless consonant to the offset of periodic vibration. The measured vowels were the first vowels in each of the italicized words in the Appendix, except for spectators and spectacular (the first and second vowel were measured), and attack (only the second vowel was measured). Voice onset time was defined as the time (in ms) from the onset of the stop consonant burst to the onset of voicing. Voice onset time measures were completed for the initial sound in the italicized target words in the Appendix that begin with the stop consonants /p/, /t /, and /k/, in addition to the final syllable in attack. Both measures were gathered using thePRAATwaveform display, accompanying spectrogram, and audio-recording functions. Fundamental frequency measurements were also gathered via the PRAAT program. For the present study, average fundamental frequency was gathered during vowel production within the same target words that were used to collect the vowel duration measures. The judge for the acoustic measurements was a fourth-year doctoral student (third author) with expertise in acoustic phonetics. Training prior to data analysis involved the first author and judge each making separate measurements for several randomly selected trials until vowel duration and voice onset time measurements were within 10 ms of each other.

Phonated Intervals

Phonated intervals were measured during the same two 75-s trials used to collect the acoustic data using the Modifying Phonation Intervals (MPI) software (Ingham, Moglia, Kilgo, &Felino, 2006; see Davidow et al., 2009, for specifics). Briefly, a phonated interval is a measure of the duration of vibration as measured by an accelerometer from the surface of the throat in between breaks of 10 ms or more. These intervals are interpreted as an estimate of the duration of vocal fold vibration. The MPI system runs in a Windows environment and consists of an accelerometer, a signal conditioning system, computer software, and related hardware. The accelerometer had a frequency response of 2 Hz-20 kHz. The signal from the accelerometerwas bandpass filtered at 80-300 Hz.

Recording of phonated intervals required the following steps. Participants were fitted with the accelerometer, held by an elastic collar and worn comfortably around the neck such that the accelerometer was paralateral to midline and just inferior to the thyroid prominence. The MPI program was then engaged, sampling gain was adjusted, the background noise check was conducted, and movement artifact checks were completed (e.g., participants were asked to nod; if undesired signals were registered, the accelerometer was repositioned until headmovements did not record a phonated interval). Participants were instructed not to cough, clear their throats, laugh, or make other similar movement during data acquisition trials because these behaviors might inadvertently register a spurious phonated interval. Vocal fold vibration as registered by the accelerometer was filtered and conditioned by a preamplifier system. The resulting signalwas then rectified, integrated, and digitized.Aphonated interval was logged if the incoming signal was 10% above the baseline noise floor recorded prior to the measurement.

Speech Rate

SPM data for all trials in all conditions were gathered by the first author from video recordings. These data were measured using the Stuttering Measurement System (Ingham, Bakker, Kilgo,&Moglia, 1999), a software application that allows an observer using a computer mouse to count the number of syllables and stuttering events produced. The programcalculates SPM upon completion of a speaking trial.

Task Compliance

Task compliance data for experimental conditions were gathered by measuring the time between the productions targeted in each condition-either syllable or word-for two 5-s periods, one from each trial, for each condition for the acoustic data. If a minimum of 10 measurements were not obtained in the selected 5-s period, the judge continued until 10 were gathered. To be included in the data analysis, the average time between

uttered syllables or words could not deviate more than 30 ms from the expected time between beats for Syll-140, Word-140, and Word-CIR, or more than 20 ms for Syll- CRR and Syll-0.75CRR, for either of the two trials. In addition to these measurements, the judges rated whether or not the participants sounded like they were speaking in concert with a metronome. This rating, based on the entire trial, was performed because the average time between syllables could be near the target pace even if the speech was not well synchronized with the metronome. Ratings were made using a 7-point performance rating scale ranging from 1 (defined as definitely sounds like the participant is speaking to a metronome) to 7 (definitely sounds like the participant is not speaking to a metronome). A score of 3 or lower, along with the above time difference between utterances, was required for inclusion of that participant's data in the final analysis. The judges for both task compliance measures were two undergraduate volunteers who were trained by the first author to identify the beginning of syllables and words.

Data Analysis

Multiple Variable Analysis

Cochran-Mantel-Haenszel (CMH) tests (Wickens, 1989) were conducted, via SAS Version 9.1 software, to determine whether there was a pattern of association among the task conditions and speech variables across the participants or whether the distributions of the dependent variables were conditionally associated with the different speaking conditions after controlling for the different participants. TheCMHrepresents a family of tests aimed at detecting a direct association between two variables after controlling for the third variable (the stratified variable). An alpha level of .05 was used as the critical value for all CMH tests.

Individual Dependent Variable Analysis

The second set of analyses involved examining how the various conditions affected each vocalization variable. Each participant produced several tokens for each of the eight dependent variables, resulting in a mean for each variable. These means were compared using paired sample t tests (two-tailed). The alpha level was corrected for the number of tests in each comparison, resulting in a .006 (.05/8) significance level. Correcting for the total number of tests (40) could have raised the Type II error rate to a point that obscured important and interesting findings that could be studied in more detail later. Effect sizes (Cohen's d) were also calculated to examine the magnitude of the calculated differences.

Reliability

Interjudge reliability data were collected for approximately 21%, and intrajudge reliability data for approximately 14%, of the acoustic, aerodynamic, SPM, and task compliance quantitative data. Conditions were randomly selected, with the exception of a maximum of two conditions from any single participant. The interjudge reliability raters for the aerodynamic data, acoustic data, and SPM data were students trained specifically for these tasks by the first author. The validity of the phonated interval measurements using the MPI system has been previously established by comparing individual measurements with those using an acoustic analysis program (Godinho, Ingham, Davidow, &Cotton, 2006; Ingham et al., 2001).

Results

Task Compliance

Out of the total of 55 possible scores (11 participants ×5 experimental conditions), six did not meet the 30- or 20-ms task compliance target and/or received a rating of over 3 on the 7-point task compliance scale. One participant failed to meet the task compliance criteria for Syll-CRR and Syll-0.75CRR, two forWord-CIR, and two for Word-140. Table 2 shows the average deviation (absolute value) from the expected value and compliance scale ratings for the remaining participants in each condition, or for those scores that met the criteria and were included in further analyses.

For the aerodynamic data trials in which the sentence had to be produced in the 6-s data-gathering window, some words were not attempted; therefore, the participants did not always produce a similar number of words in each condition. Thus, for the aerodynamic variables analysis, the same words used in one condition for a

particular comparison were matched to the words used in the other condition in that comparison. Therefore, each condition had the same target words in the analysis. The average number of tokens used across comparisons was 13.17, with the largest being 15.78 for the comparison between Syll-CRR and Syll-0.75CRR and the smallest being 10.67 for the comparison between Syll-140 and Word-CIR. Equating the number of tokens in this manner was not necessary for the acoustic trials because all sentences were completed in the allotted time.

Main Dependent Variable Analysis

Speech rate.We examined speech ratewith three pairwise comparisons: Syll-140 versus Syll-CRR, Syll-CRR versus Syll-0.75CRR, and control reading versus Syll-CRR. Using the combined BPM rates from the aerodynamic and acoustic trials, the difference in BPM rate across the group was 154.45 for the Syll-140 versus Syll-CRR (294.45 BPM) comparison and 74.44 for the Syll-CRR (298.44 BPM) versus Syll-0.75CRR (224 BPM) comparison. The Syll-140 versus Syll-CRR comparison (see Figure 1) produced a significant CMH test result (CMHtest value = 259.07; $p < .0001$), as did the Syll-CRR versus Syll-0.75CRR comparison (CMH test value = 38.18; $p < .0001$; see Figure 2). The smaller CMH test value for this latter comparison confirms thatmore closely aligned speech rates produced more similar distributions. For the third speech rate comparison, control reading versus Syll-CRR, the distributions of the eight dependent variables were also found to be dependent on the condition (CMH test value = 66.42; $p < .0001$; see Figure 3); that is, speech rates were equated, but metronome stimulation still produced a change in the speech system.

The analysis of individual variables identified several differences between the speech rate conditions (see Table 3 for effect sizes), with the largest differences involving measures of duration. Vowel duration, voice onset time, and pressure rise time were all significantly ($p < .006$) longer during Syll-140 than during Syll-CRR. These three variables were also significantly ($p < .006$) longer during Syll-0.75CRR than during Syll-CRR. Individual data showed that all participants produced longer mean vowel durations and voice onset times during the slower condition in both comparisons, and all but one participant produced longer mean pressure rise times. The pressure rise time exception was during the Syll-CRR versus Syll-0.75CRR comparison. In addition, maximum airflow was significantly greater during Syll-140 than during Syll-CRR ($p = .006$). Eight of the 10 participants in this comparison produced greater maximum airflow means during Syll-140. Maximum airflow did not differ between Syll-CRR and Syll-0.75CRR. Peak pressure, vowel midpoint airflow, fundamental frequency, and phonated interval measurements were not significantly different in either of the speech rate comparisons.

For the control reading versus Syll-CRR comparison, there was only one significant difference, with voice onset time being shorter during Syll-CRR ($p < .006$). All 10 participants in this comparison had shorter mean voice onset times during the metronome condition.

Instatement style. The Syll-140 versusWord-140 comparison (CMH test value = 315.90; $p < .0001$) and the Syll-140 versusWord-CIR comparison (CMH test value = 309.03; $p < .0001$) both produced significantly different distributions of the eight dependent variables (see Figures 4 and 5).

As was the case for speech rate, individual measures of duration (vowel duration, voice onset time, phonated intervals, and pressure rise time) showed the greatest differences between instatement style conditions. Both comparisons produced significant differences in vowel duration ($p < .006$), with vowel durations being shorter during the word-per-beat conditions compared with the syllable condition for all nine participants. Voice onset times and phonated interval lengths were also shorter during both word-per-beat conditions than during the syllable-per-beat condition, but the difference was significant only for the Syll-140 versus Word-140 comparison. Finally, pressure rise time was significantly shorter during Syll-140 than during Word-CIR ($p < .006$), but there was no difference between Syll-140 andWord-140 for this variable. Fundamental frequency, peak pressure, maximum airflow, and vowel midpoint airflow measures were not significantly different in either of the instatement style comparisons.

Reliability

Interjudge and intrajudge agreement data, shown as the mean difference between judges or between the primary judge's twomeasurements, are shownin Table 4. Task compliance data, in the form of speech rate (SPM) and time between utterances, are also shown. We also calculated average percentage of deviation scores for each dependent variable, defined as the difference between judges (or measurements) for each token divided by the primary judge's (or initial) measurement, multiplied by 100. The average percentage of deviation was 4.9% for interjudge data and 1.75% for intrajudge data. The interjudge mean percentage of deviation was inflated somewhat by vowel midpoint airflow, which differed by 13.77% between the two judges; only three other variables differed by more than 5% between judges, with the remaining five below 5%. Inspection of the raw data showed that interpretation of findings for vowel midpoint airflow would not have changed regardless of which judge's measurements were used. Five of the intrajudge percentage of deviation scores were below 2%, and four were between 2% and 5%.

Table 4 does not include the perceptual task compliance ratings. We gathered interjudge and intrajudge reliability data for this measure from 22 trials. For interjudge reliability, all of the second ratings were identical except for four that differed by 1 scale point. For intrajudge reliability, 20 of the 22 reratings were identical on a second occasion. The remaining two differed by 1 scale point. Overall, the interjudge and intrajudge agreement data for all variables and for task compliance measures were considered satisfactory to support the interpretations presented.

Discussion

We designed this study to examine the impact of speech rate and instatement style on speech production variables during metronome stimulation and to determine whether or not the metronomic speech pattern itself, rather than any concomitant changes in speech rate or differences in instatement style, is responsible for the speech production changes.We hypothesized that (a) measures of duration for our variables of interest would be longer during slower conditions and during syllable-perbeat conditions compared with word-per-beat conditions and that (b) therewould be no changes in duration-related speech production variables from a control condition to a metronome condition when speech rates were equivalent between conditions.

Obtained data supported the first hypothesis. Vowel duration, voice onset time, and pressure rise time were all shorter during faster conditions, including conditions that specified rate in terms of whole words per beat. The second hypothesis was not supported, however, because of significant differences found for voice onset time even when rate was held constant. These findings are discussed next in regard to the importance of vocalization changes that are intrinsic to the FICs and that are likely necessary for the emergence of fluency during the FICs.

Duration-Related Variables

Duration-related measures, including vowel duration, voice onset time, and pressure rise time, were found to be longer during slower conditions and during syllable-based metronome speech compared with wordbased pacing. Exceptions to this trend were noted between Syll-140 andWord-140 for pressure rise time and between Syll-140 and Word-CIR for voice onset time. It appears that pressure rise time was influenced by the prescribed metronome rate and not a function of SPM. Furthermore, voice onset time did not appear to be influenced by the metronome rate during word-based metronomic speech. Mean phonated interval duration was only significantly different for the Syll-140 versus Word-140 comparison.

Several previous studies have found increases in vowel duration (Brayton &Conture, 1978; Klich &May, 1982; Stager et al., 1997) and pressure rise time (Hutchinson &Navarre, 1977; Stager et al., 1997) in PWS (Brayton& Conture, 1978; Klich &May, 1982; Stager et al., 1997) and persons who do not stutter during metronomespeech (Stager et al., 1997). The metronome beat rates in all of these studies, however, were extremely slow, at 60 BPM (Brayton& Conture, 1978), 90 BPM(Klich &May, 1982), and 92 BPM (Stager et al., 1997), which could explain their reported data. In fact, mean vowel duration during the matched rate comparison in the present study produced shorter mean vowel durations for eight out of 10 participants. These results suggest that other

measures of vocal fold movement duration (or measures highly correlatedwith it)-including syllable duration (Wingate, 1981), variability of the duration of voice segments (Janssen &Wieneke, 1987), and phonated intervals (Davidow et al., 2009)-will need to be reexamined using rates and instatement styles other than those used in previous studies before their specific significance to metronome stimulation and fluency induction can be established.

Voice onset time has not been measured in previous vocalization studies involving metronome stimulation, but it was of interest because it has been studied during other FICs such as prolonged speech (Packman, Onslow, &van Doorn, 1994) and because it is likely to be altered during stuttering treatment programs involving prolonged speech. Voice onset time was the only dependent variable found to change (decrease) from the control reading to the Syll-CRR task. This finding might suggest that voice onset time bears some importance during metronomic speech. However, mean voice onset time did not differ significantly between control reading (55.33ms) andSyll-140 (62.30ms; df=9, p = .067), a finding that also raises questions about the necessity of reduced voice onset time to fluency changes during metronomic speech.

Variables Not Related to Duration

The only difference found for measures not related to time (peak pressure, maximum airflow, vowel midpoint airflow, and fundamental frequency) was a significantly greatermaximum airflow during Syll-140 compared with Syll-CRR; that is, a considerably slower speech rate (154.45 SPM difference) resulted in greater peak airflow. Stager et al. (1997) measured peak airflow and found no significant change from a control condition to a 92-BPM condition, using a one-syllable-per-beat metronome condition for PWS and persons who do not stutter. Because speech rate data were not provided for the control condition in that study, it is difficult to relate Stager et al.'s findings to the present study. Regardless, the findings suggest that an alteration in all of these variables may not be important for the effects of metronome stimulation, given that it did not change significantly from control reading to Syll-CRR in our normally fluent speakers. The lack of change between conditions for the aerodynamic variables may reflect the experimental constraint of maintaining a consistent level of vocal loudness.

Vocalization Changes and the Other Most Powerful FICs

Similar issues of speech rate and instatement style are apparent in the vocalization investigations involving the other most powerful FICs (chorus reading, singing, and DAF/prolonged speech), all of which Wingate (1969, 1970) hypothesized to result in fluency based on vocalization changes. For example, studies investigating changes in vocalization during singing have measured variables such as voicing duration (Colcord &Adams, 1979), phonated intervals (Davidow et al., 2009), and syllable duration (Wingate, 1981), and have found longer mean voicing or syllable durations during singing, as compared with a control condition, for PWS and persons who do not stutter. However, songs were produced at speech rates well below typical speech rates, making it difficult to determine whether the vocalization changes were necessary for the resulting fluency in PWS.

This same issue may exist for chorus reading. Variables directly comparable to the ones in the present investigation include peak airflow (Stager et al., 1997) and phonated intervals (Davidow et al., 2009). Stager et al. found a significant reduction in peak airflow for PWS and persons who do not stutter from control to chorus reading, but an increase in speech rate of 180% from the control condition for PWS could be the reason for the reduction in that group. That is, lung volume excursion (differences in lung volume between initiation and termination of an utterance) has been found to be negatively and linearly related to speech rate (Dromey &Ramig, 1998), and therefore can influence the amount and strength of airflow. Interestingly, however, the persons who do not stutter in the Stager et al. (1997) study had a slight reduction in speech rate. Therefore, a comparison matching speech rates between a control and chorus reading condition with PWS would provide valuable information about the importance of reducing peak airflow during chorus reading. Davidow et al.'s study is not directly comparable to the present study because phonated intervals were analyzed by distribution and not mean length. Nevertheless, the present study's findings suggest that the altered phonated interval

distributions during chorus reading reported by Davidow et al. must be replicated at other rates if they are to be considered necessary or sufficient to the fluency obtained during chorus reading. The same can be stated for other findings during chorus reading such as hard onsets changing to breathy onsets (Stager &Ludlow, 1998), an increase in utterance length (Andrews et al., 1982), and a decrease in the variability of voiced and voiceless segments (Janssen &Wieneke, 1987).

The present study's results raise similar issues for DAF investigations because several studies have found alterations in vocalization variables from a control condition to a DAF condition. The vocalization variables involving time (voicing duration, pressure rise time, etc.) would be most affected by speech rate. Previous studies have found a significant increase in pressure rise time and vowel duration during a 195-ms delay condition (Stager et al., 1997), a significant increase in the variability of voiced segments during a 200-ms delay condition (Janssen &Wieneke, 1987), and a significant increase in time taken to read sentences during a 140-ms delay condition (Lechner, 1979). All of these delay intervals are above those found to be the most beneficial for most PWS (50-100ms; Lotzmann, 1961). Because speech rate generally decreases with a longer delay, and vocalization measures based on time increase as speech rate decreases, the findings from these previous studies may have been different if shorter delays had been used. It should be noted, however, that Stager et al. reported a reduction in speech rate from a control condition to their DAF condition for persons who do not stutter but an increase for PWS, showing that pressure rise time and vowel duration may increase even when speech rate does not decrease. A different delay interval may have produced similar fluency without the accompanying significant vocalization changes. As outlined in the introduction, prolonged speech studies have similar interpretive issues due to the inability to properly define prolonged speech and the fact that it can be produced at several different rates.

Implications and Future Research

Overall, the goal of the present study was to provide a critical analysis of design issues involved in studying vocalization changes during FICs. Future studies investigating multiple variations on singing and chorus reading are also necessary to determine the importance of vocalization changes during these other powerful FICs, and our laboratory is presently conducting these studies. Arguably, the most critical FIC to examine is prolonged speech, given its importance to present treatment protocols. Very little is known about how prolonged speech works. Speech rate could be the most important confounding variable to control, particularly with regard to voicing measures, given that they were shown in the present study to change significantly with speech rate. A consistent change in one or a combination of vocalization variables across all of the different styles of prolonged speech and varying speech rates could signify their greater importance for fluency. Whether or not such consistent changes can be found, the results of this study clearly show that speech rate and instatement style must be carefully controlled in future studies if their results are to make meaningful contributions to the attempt to identify the necessary and sufficient conditions for fluency in PWS.

Acknowledgment

This research was supported by grants awarded to the first author from the National Institutes of Health and Hofstra University.

Sidebar

Systematic Studies of Modified Vocalization: Effects of Speech Rate and Instatement Style During Metronome Stimulation

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J Speech Lang Hear Res 2010;53;1579-1594; originally published online Aug 10, 2010;

DOI: 10.1044/1092-4388(2010/09-0173)

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Appendix
Appendix. Carrier phrases used for aerodynamic and acoustic data.
Carrier Phrases Used for Aerodynamic Data
1. The pitifully sad guard saw Bobby in the basement.
2. Wendy panicked when the boozer fell over Pablo.
3. My bulging arms grow bigger and very powerful.
4. She saw Peter on the new better and high podium.
5. Her biting dog Snow painfully began chewing.
6. Toy batteries cost a few pennies from my bookkeeper's store.
Carrier Phrases Used for Acoustic Data
1. Those ladies, near the fence, are taking the paper sacks to the barn.
2. He seems thoughtful to spend a lot of time and help search the house.
3. The people in the corner of the yard look like puppets faithfully working.
4. The nicely dressed man is touching the shirt while checking out the very beautiful view.
5. If you look closely, you can see a calf on the gigantic hill in the back of the picture.
6. That small boy is keeping a watchful eye on the large, wooden treasure bucket.
7. The girls with the extremely long hair are shockingly surprised at how he fights.
8. The sassy ladies appear to be waiting patiently and want to attack the valuable treasure.
9. Nobody is speaking, as all of the spectators really just want to focus on the show.
10. They may be saying that he put on a spectacular show for the special occasion.

Publication date: Dec 2010

Year: 2010

Construct Validity of the Assessment of Balance in Children Who Are Developing Typically and in Children With Hearing Impairments

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Publication info: Physical Therapy 90.12 (Dec 2010): 1783-94.

Abstract: Children with hearing impairments have a higher risk for deficits in balance and gross motor skills compared with children who are developing typically. As balance is a fundamental ability for the motor development of children, a valid and reliable assessment to identify weaknesses in balance is crucial. The purpose of this study was to investigate the construct validity of posturography and clinical balance tests in children with hearing impairments and in children who are developing typically. The study involved 53 children with typical development and 23 children with hearing impairments who were between 6 and 12 years of age and without neuromotor or orthopedic disorders. All participants completed 3 posturography tests (modified Clinical Test of Sensory Interaction of Balance [mCTSIB], unilateral stance, and tandem stance) and 4 clinical balance tests (one-leg stance with eyes open and with eyes closed, balance beam walking, and one-leg hopping). Three conditions of the mCTSIB, unilateral stance, and 2 clinical balance tests were able to distinguish significantly between the 2 groups. Children with hearing impairments showed more difficulties in balance tasks compared with children who were developing typically when 1 or 2 types of sensory information were eliminated or disturbed. The study showed only low to moderate correlations among the different methods of evaluating balance. Clinical balance tests and posturography offer different but complementary information. An assessment protocol for balance consisting of posturography and clinical balance tasks is proposed. Static and dynamic balance abilities could not be differentiated and seem not to be a valid dichotomy.

Full text: Headnote

Background. Children with hearing impairments have a higher risk for deficits in balance and gross motor skills compared with children who are developing typically. As balance is a fundamental ability for the motor development of children, a valid and reliable assessment to identify weaknesses in balance is crucial.
Objective. The purpose of this study was to investigate the construct validity of posturography and clinical balance tests in children with hearing impairments and in children who are developing typically.
Methods. The study involved 53 children with typical development and 23 children with hearing impairments who were between 6 and 12 years of age and without neuromotor or orthopedic disorders. All participants completed 3 posturography tests (modified Clinical Test of Sensory Interaction of Balance [mCTSIB], unilateral stance, and tandem stance) and 4 clinical balance tests (one-leg stance with eyes open and with eyes closed, balance beam walking, and one-leg hopping).
Results. Three conditions of the mCTSIB, unilateral stance, and 2 clinical balance tests were able to distinguish significantly between the 2 groups. Children with hearing impairments showed more difficulties in balance tasks compared with children who were developing typically when 1 or 2 types of sensory information were eliminated or disturbed. The study showed only low to moderate correlations among the different methods of evaluating balance.
Conclusions. Clinical balance tests and posturography offer different but complementary information. An assessment protocol for balance consisting of posturography and clinical balance tasks is proposed. Static and dynamic balance abilities could not be differentiated and seem not to be a valid dichotomy.
(ProQuest: ... denotes formula omitted.)

Postural control, and more specifically postural stability, is a fundamental prerequisite for the motor development of children. It is the complex ability to maintain the body's center of gravity over the base of support while a person is stationary, in motion, prepares to move, or prepares to stop moving.1 The body's motor, sensory, and cognitive systems work together to achieve postural stability.1-3 Afferent input from the visual, vestibular, and somatosensory systems is integrated and evaluated by the nervous system in order to generate motor responses that keep the body in balance.4 Visual input provides information about the

orientation of the eyes and head in relation to objects in the environment. Somatosensory input provides information about the position of body parts in relation to each other and to the supportive surface and about the relative amounts of weight bearing on joints. The vestibular system is the body's internal reference that provides information about the individual's head position and movements in relation to gravity.1

Several studies of motor skills in children with hearing impairments have shown deficits in balance, general dynamic coordination, physical fitness, and ball-catching abilities, as well as clear differences in reaction times and speed of movements.5-9 Possible explanations of observed motor deficits are described in 4 categories by Wiegersma and Van der Velde5: (1) organic factors such as associated vestibular or neurological defects; (2) auditory deprivation; (3) a lack of verbal representations of motor skills and verbal-conceptual strategies to support execution; and (4) emotional factors (eg, lack of selfconfidence, overprotection, parental neglect) that can cause these children to be less willing to explore their environment. More recently, Horn et al10 warned against generalization of atypical motor development to the total population of children with hearing impairments because potential confounders such as neurological impairment, age at diagnosis, and interventions were not controlled in earlier reports. Given the heterogeneity of the population, it would be imprudent to generalize the characteristics of this population, although poor balance frequently is reported in children with hearing impairments.6,8,9,11-14

Because adequate postural stability requires tuning and integration of sensory information, the stability problems of children with hearing impairments might not be surprising. Because the labyrinth and the cochlea are closely related in anatomy and development, a hearing impairment can be associated with a vestibular deficit. Published reports show vestibular dysfunctions in approximately 30% to 70% of children with a hearing loss.15-17 The prevalence of vestibular test abnormalities is higher in profound sensorineural hearing loss,15,17 in acquired deafness (meningitis, labyrinthitis),15,17 and in some syndromes associated with deafness (eg, Usher, Waardenburg, and Pendred syndromes).18 Vestibular deficits can explain part of the balance deficits of children with hearing impairments. However, it is still necessary to trace more systematically all other mechanisms causing poor balance in children with auditory impairments in the future.

In addition, a cochlear implant, an accepted rehabilitation device for children with hearing impairments, entails a potential risk for vestibular damage.19,20 The findings about the impact of a cochlear implant on motor development and on balance performance are contradictory.9,21,22 Buchman et al21 and Schlumberger et al22 found a positive effect on motor performance because of the auditory input and the stimulation obtained from a cochlear implant. In contrast, Gheysen et al9 considered the possibility of a negative effect of a cochlear implant on the motor abilities of children who are deaf because they found lower balance scores in a group of children who were deaf and had cochlear implants compared with a group without cochlear implants. Because balance is of great importance for motor development, the study by Gheysen and colleagues cannot be neglected and warrants further investigation.

Briefly, to evaluate balance in children who are deaf or hard of hearing, but also in other children with endangered motor and balance development, valid and reliable tools are essential for clinicians as well as researchers. Those tools are essential not only for screening and diagnosis, but also for assessing progress in postural stability and for evaluating the efficacy of interventions.

A frequently used technique for evaluating postural stability is posturography. It is the quantitative measurement of postural sway, or the position and displacement of the body's center of pressure (COP), by means of a force platform. Postural sway is considered to be the consequence of a purposeful process within the central nervous system, possibly reflecting a search for the limits of stability.23 Posturography provides information about the "how" of postural control. Protocols such as the Sensory Organization Test (SOT)*,13 or the modified Clinical Test of Sensory Interaction for Balance (mCTSIB)24,25 on a force platform allow evaluation of the influence of various sensory conditions on postural sway. By closing the eyes or by standing on a cushion, inaccurate visual and somatosensory input is provided to the central nervous system. Comparing postural sway in different

conditions allows evaluation of sensory strategies for postural control. The evaluation of postural sway parameters can be considered a measure of the effectiveness of the motor strategies for postural control.1 These motor strategies can be evaluated not only in stance but also in more challenging conditions with a narrow base of support such as unilateral or tandem stance.

In a clinical setting, without the opportunity to use posturography, assessment of postural stability typically involves evaluation of functional tasks with balance constraints such as standing on one foot, walking, or standing on a line or on a balance beam. These measurements provide no information about the strategies used to control balance but offer only a quantification of the movement result. Test manuals suggest that the outcomes of these tests (eg, the length of time the child can stand on one leg) provide information on general "balance ability."26-28 Clinicians often divide balance tests into: (1) static balance tests that evaluate the ability to maintain a specific static posture such as one-leg stance and (2) dynamic balance tests that evaluate the ability to maintain balance in action such as balance beam walking and one-leg hopping. However, only limited research is available on the validity of the concepts of static and dynamic balance ability.29,30

The Movement Assessment Battery for Children-Second Edition (M-ABC- 2)27 and the Bruininks Oseretsky Test- Second Edition (BOT-2)28 are frequently used for evaluating motor abilities in children. However, the reliability of scores for the individual items measuring balance and of the balance subscore in these tests is moderate (r .65 for BOT-2 and r .73 for M-ABC-2).27,28 A prerequisite for validity of any measurement is reliability. Studies on the reliability of clinical balance tests in children documented good test-retest reliability for the one-leg stance test,31,32 2 balance items of the Koperkoördinationstest für Kinder (KTK) (De Kegel and colleagues, unpublished research), 33 and a pediatric balance scale34 but low to moderate testretest reliability for the Pediatric Clinical Test of Sensory Interaction for Balance (P-CTSIB),35 tiltboard tip tests,31,36 and a pediatric reach test.37

Studies on the reliability of posturography showed moderate to excellent reliability for conditions of bipedal standing in children between the ages of 5 and 12 years.24,25,32,38 A recent study (De Kegel and colleagues, unpublished research) evaluated the reliability of scores in different test conditions and for different sway parameters for posturography in 2 groups of children between 6 and 12 years of age: those who were developing typically and those with hearing impairments. The researchers concluded that mean sway velocity of the COP was the most reliable parameter compared with other traditional sway parameters with excellent test-retest reliability for different test conditions on a forceplate.

Although posturography and clinical balance tests often are used in research to assess balance performance, to our knowledge construct validity has not been reported previously in children. Therefore, taking into account the literature on balance control and the psychometric properties of posturography and clinical balance assessments, we constructed a protocol for posturography and selected a static clinical test and 2 dynamic clinical tests to evaluate balance. The mCTSIB,24,25 unilateral stance, and tandem stance on a force platform were selected to be able to evaluate sensory and motor strategies in conditions with increasing balance constraint. The timed measurement of one-leg standing is in most motor assessment tools26-28 used as a static balance measure and has shown good reliability in a welldesigned protocol (De Kegel and colleagues, unpublished research).31 Walking on a balance beam and oneleg hopping were selected as dynamic measures because of their good reliability. Walking on a line and walking on a balance beam also are very frequently used test items for evaluating balance ability.26-28 Hopping on one leg is a more complex functional task, combining balance control with jumping coordination. Balance is an important prerequisite for performing this task, but jumping force and gross motor coordination are other important underlying abilities required to perform the hopping task.

This study aimed to investigate 2 aspects of construct validity of the assessment of balance. The first aspect to be investigated was the knowngroup validity of posturography and the selected clinical balance tests, which was assessed by determining the ability of these measures to distinguish between a group of children who were

developing typically and a group of children with hearing impairments. The second aspect to be investigated was the convergent and discriminant validity of the different measures. The convergent validity between posturography and the clinical balance tests was evaluated to determine whether measurements of postural sway obtained while standing still predict or explain functional performance in children. In addition, the discriminant validity between static and dynamic balance was investigated. We hypothesized that static clinical balance tests correlate better with each other and with posturography than with the dynamic clinical balance tests.

Method

Participants

Fifty-three children who were developing typically and 23 children with a bilateral hearing impairment of more than 45 dB hearing level (HL) in the better ear were recruited for this study. All children were between 6 and 12 years of age. The children who were developing typically were recruited by a center for child care during school holidays, and the children with hearing impairments were recruited by a rehabilitation center for this population. A comparison of the 2 groups showed no differences in age ($t(74)=0.301$, $P=.764$), height ($t(74)=0.162$, $P=.872$), and sex ($\kappa 2(1)=0.088$, $P=.767$). The intelligence quotient (IQ) of the children with hearing impairments was evaluated with the Wechsler Intelligence Scale for Children-III (WISC-III) or the Wechsler Preschool and Primary Scale of Intelligence-Revised Edition (WPPSI-R) within the previous year. All children with hearing impairments had a performance IQ higher than 80 ($X=98.6$, $SD=15.2$). In the group of children who were developing typically, no IQ tests were taken, but all children were in mainstream education in their appropriate grade. Inclusion criteria were: no neuromotor disorder such as cerebral palsy, no orthopedic dysfunction, and no medication affecting the central nervous system.

In the group of children with hearing impairments, 65.2% had a congenital hearing loss, and 34.8% had a hearing loss acquired within the first 2 years of life. The etiology of the hearing impairment was unknown in 8.7% of the children, hereditary in 56.5%, and acquired in 34.8%. In the children with hearing impairments, 48.0% used a cochlear implant, and 52.0% used conventional hearing aids (Tab. 1).

A recent audiogram was available for all children with a hearing impairment. The mean pure tone average (indicating the mean hearing loss at frequencies 500, 1,000, and 2,000 Hz) for the group of children with hearing impairments was 97.87 dB HL ($SD=27.36$) for the right ear and 91.61 dB HL ($SD=28.57$) for the left ear. Informed consent was obtained from the children's parents.

Measures

Posturography. An AccuGait strain gauge portable force platform[dagger] (49 x 49 cm) was connected to a standard amplifier to record changes in displacement of COP. The platform measures 3 ground reaction forces and 3 moments along the axis in the medial-lateral, anterior-posterior, and vertical directions. Data were sampled at a frequency of 50 Hz. Using MATLAB,[double dagger] the forceplate data were filtered using a fourth-order low-pass digital Butterworth filter with a cutoff frequency of 10 Hz to eliminate disturbing high-frequency noise, and the mean sway velocity of the COP was computed from the raw data. The mean sway velocity of the COP was calculated by dividing the total distance traveled by the time of the trial (T). In this equation, XAP and XML represent the position of the COP in the anterior-posterior (AP) and mediallateral (ML) directions, and n is the total number of data points for the trial length.

...

This parameter was chosen because previous research showed that it is the most reliable compared with other postural sway measurement parameters (De Kegel and colleagues, unpublished research).39-42

Each participant completed the mCTSIB,24,25 unilateral stance, and tandem stance on the force platform. The mCTSIB is performed in the individual's preferred side-by-side foot position and consists of 4 standing conditions: with eyes open on a firm surface (EO), with eyes closed on a firm surface (EC), with eyes open on a foam cushion (CEO), and with eyes closed on a foam cushion (CEC). The same 45- x 45- x 18-cm, highdensity,

viscoelastic foam cushion was used in the last 2 conditions. Unilateral stance consists of 2 conditions of standing on either the right or the left foot with eyes open, and tandem stance consists of 2 conditions of standing heel-to-toe with either the left foot in front or the right foot in front with eyes open. For both unilateral and tandem stance, the mean for the left foot and right foot was calculated. Each condition of the mCTSIB, unilateral stance, and tandem stance had 3 trials of 10 seconds. The participants were barefoot for all tests and were instructed to stand as steady as possible with their arms by their sides. During each test, the foot position remained the same for all trials because the foot position was marked on the force platform. For the eyes-open trials, the participants were instructed to look at a target placed at eye level in front of the platform. For the eyes-closed trials, they were asked to look at the same target before firmly closing their eyes. The children were guarded by an observer for safety. For every condition of the mCTSIB, unilateral stance, and tandem stance, one training trial was allowed before data collection.

In children aged 6 to 12 years who were developing typically and in those with hearing impairments, excellent overall reliability of the mCTSIB, unilateral stance, and tandem stance has been demonstrated for mean sway velocity of the COP, with intraclass correlation coefficients (ICCs) between .76 and .96 in both groups (De Kegel and colleagues, unpublished research). Geldhof et al24 and Gabriel and Mu25 found comparable results.

Clinical balance tests. The oneleg stance test is a frequently used clinical assessment tool for the evaluation of static balance. In the present study, all children performed a standardized protocol of the one-leg stance test.31 They were instructed to stand as long as possible on one leg (for a maximum of 20 seconds for each trial), with the standing foot fixed and with the free foot behind the knee. Hooking the free foot around the standing leg was not permitted. The children were barefoot with their hands on their hips. Before testing, they were allowed to practice once with eyes open on each leg for 10 seconds. The test was performed 3 times with eyes open and 3 times with eyes closed, first on the preferred leg and then on the nonpreferred leg. The children were assisted by the investigator in assuming the initial position and were instructed to remain standing as long as possible on one leg. Timing by stopwatch was started as soon as the child lifted his or her foot. Timing was stopped when the child touched the free foot to the floor, touched the standing leg with the lifting leg, removed hands from hips, opened his or her eyes during the eyesclosed conditions, or moved the standing foot from the original position. The scores of 3 trials were summed for the left and right legs in both eyes-open and eyes-closed conditions according to the standardized protocol.31

In children aged 6 to 12 years who were developing typically and in those with hearing impairments, good to excellent reliability has been demonstrated for the one-leg stance protocol, with ICCs between .83 and .94 (De Kegel and colleagues, unpublished research). The results are in concordance with those of Atwater et al.31

Balance beam walking was added as a measure of dynamic balance ability. This task was adopted from the Koperkoördinationstest für Kinder (KTK), a standardized normative instrument that measures gross motor coordination in children aged 5 to 14 years, developed in 1974 by Kiphard and Schilling.33 The child has to walk backward 3 times on 3 different balance beams of decreasing widths. The standardized protocol was used according to the guidelines developed by Kiphard and Schilling.33 The raw scores, with a range between 0 and 72, can be transformed into quotients of motor performance, with an expected mean of 100 (SD 10). Recently, excellent test-retest reliability was demonstrated, with an ICC of .88 in children who were developing typically and an ICC of .97 in children with hearing impairments (De Kegel and colleagues, unpublished research).

One-leg hopping also was adopted from the KTK. The child has to hop on one leg over an increasing number of foam plates. The standardized protocol was used according to the guidelines developed by Kiphard and Schilling.33 The raw scores, with a range between 0 and 78, can be transformed into quotients of motor performance. Excellent test-retest reliability was recently found, with an ICC of .95 in children who were developing typically and an ICC of .97 in children with hearing impairments (De Kegel and colleagues, unpublished research).

Procedure

All subjects were randomly assigned to initial testing on either posturography or clinical balance tests. All test sessions took place in the same quiet room to minimize any noise or other disturbances. At least one break was offered to the children between tests.

Data Analysis

Data analysis was performed using the Statistical Package for the Social Sciences, version 17.0.§ To investigate known-group validity, performance on clinical balance tests and posturography of the 2 groups was compared. Significance testing was performed by the use of independent t tests. We used the traditional 2-sample t test if the 2 variances were equal, but if the variances were not equal, we used the 2-sample t test applicable for situations with unequal variances according to Welch.43 Because the data for the one-leg stance test with eyes open were not normally distributed, the Mann-Whitney U test was performed for significance testing with this variable. In interpreting the significance testing, alpha was set at .05. In addition, effect size, using the Cohen d statistic, was calculated for between-group comparisons. An effect size of 0.5 indicates that the mean scores in each group are 0.5 standard deviation apart. Effect sizes of 0.2, 0.5, and 0.8 are considered small, moderate, and large, respectively.44

Pearson correlation coefficients, presented in a multitrait-multimethod matrix,45 were used to investigate the convergent and discriminant validity among the different balance parameters. The 95% confidence intervals for all correlation coefficients were calculated. Analysis of data for the one-leg stance test with eyes open was performed using Spearman rank-order correlation coefficients. A percentile bootstrap procedure with 1,000 data sets was used to estimate the 95% confidence interval for the Spearman rank-order correlation coefficients.46 The strength of the coefficient was determined, as follows: .00 to .25=little if any correlation, .26 to .49=low correlation, .50 to .69=moderate correlation, .70 to .89=high correlation, and .90 to 1.00=very high correlation.47 Additionally, an exploratory principal axis factor analysis with varimax rotation was performed on the data of all 76 participating children to determine the factor structure underlying the balance variables. The one-leg stance test with eyes open was not used in this analysis.

Results

Known-Group Validity

Table 2 compares the balance performance of the children who were developing typically with that of the children with hearing impairments. Results of 2 of the 4 clinical balance tests (ie, balance beam walking and one-leg stance test with eyes closed) and 4 of the 6 conditions of posturography (ie, EC, CEO, CEC, and unilateral stance) differed significantly between the 2 groups.

Convergent and Discriminant Validity

The correlation coefficients across the different clinical balance tests and the different conditions of posturography are depicted in a multitraitmultimethod matrix in Table 3 for the children who were developing typically and in Table 4 for the children with hearing impairments. The negative sign of the correlations between clinical balance tests and posturography can be explained by the negative linear relationship between mean sway velocity of the COP and performance on the clinical balance tests.

With a few exceptions, the correlation coefficients among the different balance measures were higher in the children with hearing impairments than in the children who were developing typically. All clinical balance tests in both groups were moderately to highly correlated to each other (r=.63 to .91). The 2 dynamic balance tests (one-leg hopping and balance beam walking) showed correlations with each other (r=.67 to .73) similar to those of the static clinical balance tests (ie, one-leg stance test with eyes open and eyes closed) (r=.63 to .88).

All conditions of posturography correlated lowly to highly to each other in both groups. The correlations among the first 3 conditions (EO, EC, and CEO) of the mCTSIB as part of posturography were high (r=.70 to .89) in both groups. The correlation coefficients between the condition CEC and the other conditions of the mCTSIB were low in the children who were developing typically (r=.47) but moderate in the children with hearing impairments (r=.59 to .71). The correlation coefficients between the different conditions of the mCTSIB and

unilateral and tandem stance were contradictory between the 2 groups. Tandem stance and unilateral stance showed high correlations (r=.70 to .85) to all other conditions of posturography in the children with hearing impairments, whereas the same conditions showed overall low correlations (r=.30 to .53) to the other conditions of posturography in the children who were developing typically.

Correlation coefficients between posturography and clinical balance tests were little to moderate and varied between -.15 and -.60 in the children who were developing typically and between -.46 and -.82 in the children with hearing impairments. The CEC condition showed the highest correlations of all posturography conditions to the clinical balance tests in both groups (r=-.53 to -.73). The correlations of the CEC condition to the clinical balance tests were similar to those of unilateral stance and tandem stance (r=-.48 to -.82) in the group of children with hearing impairments but were higher than those of unilateral stance and tandem stance in the group of children who were developing typically (r=-.53 and -.60 for the CEC condition versus r=-.15 and -.52 for unilateral stance and tandem stance). Tandem stance showed very low correlations (r=-.15 to -.28) to the clinical balance tests in children who were developing typically but moderate to high correlations (r=-.57 to -.82) to the clinical balance tests in the children with hearing impairments. The static conditions of posturography did not correlate better to the 2 static clinical balance tests (one-leg stance test with eyes open and eyes closed) than to the 2 dynamic clinical balance tests (one-leg hopping and balance beam walking). Moreover, unilateral stance correlated only moderately to the one-leg stance test with eyes open and eyes closed (r=-.46 and -.52).

An exploratory principal axis factor analysis with a Kaiser-Meyer-Olkin index of 0.85 yielded 2 factors that explained 63.2% of the variance. The first factor explained 37.2% of the variance, and all conditions of posturography were strongly loaded onto this factor. The second factor explained 26.0% of the variance and encompassed all clinical balance tests that were implemented in the factor analysis. Table 5 presents the rotated factor matrix with all factor loadings of the different balance parameters. However, the results of the factor analysis should be interpreted with care. The small sample size did not allow us to run the factor analysis separately for both groups. Therefore, we do not know to what extent the results are transferable to each group separately.

Discussion

The assessment of balance has always been a challenge. The availability of computerized balance assessment has been enthusiastically embraced by researchers, as it provides a quantitative assessment and the opportunity to monitor changes over time. Clinical balance tests have long been the established measures for assessment of balance and remain very important for clinicians working with children.

The first purpose of the present study was to evaluate the knowngroup validity of posturography and clinical balance tests by determining their ability to distinguish between children who were developing typically and children with hearing impairments, a group with a potentially higher risk for postural stability problems. Two clinical balance tests and 4 of the 6 conditions of the protocol for posturography were able to distinguish significantly between the 2 groups. These results confirm the validity of these measures and are in concordance with the findings of previous studies that demonstrated poor balance control in children with hearing impairments compared with their typically developing peers.6,8,9,11-14

Posturography, and more specifically the mCTSIB, aims to evaluate the sensory strategies used to control balance. Children with hearing impairments, with a potential risk for vestibular dysfunctions, may undergo a sensory redistribution process whereby visual and somatosensory information becomes more essential for postural control, as their vestibular information may be disturbed or even absent. 48 In the posturography testing in the current study, bipedal standing on a cushion with eyes closed distinguished best between the children with hearing impairments and the children who were developing typically. It is clear from the results that the children with hearing impairments showed an increased postural sway velocity in balance tasks when one type of sensory information was disturbed but a strong, significantly increased postural sway velocity if 2 types of sensory information were disturbed. These findings confirm the validity of the mCTSIB for evaluating the

sensory strategies to control balance. Posturography during bipedal standing with eyes open and during tandem stance was not sensitive enough to differentiate significantly between the 2 groups, probably because the children were able to compensate more by using visual and somatosensory information or because the tasks were not challenging enough.

Two of the 4 clinical balance tests, more specifically balance beam walking and the one-leg stance test with eyes closed, distinguished significantly between the 2 groups and showed a high effect size, which confirms the validity of these tests. The one-leg stance test with eyes open could not distinguish significantly between the 2 groups, probably because the children could compensate more or the task was less challenging. Also, one-leg hopping could not distinguish significantly between the groups of children. This complex task, requiring other abilities such as jumping force and dynamic coordination, is probably less specific in the evaluation of balance.

The second purpose of this study was to evaluate the convergent validity among the different balance measures. Do they all measure the same "balance ability," or is posturography a measure of the motor and sensory strategies used to control balance compared with the clinical tasks evaluating the result of balance control? The results of this study showed only low to moderate correlations among the different balance measures. These findings are in concordance with those of studies of adult patients with peripheral vestibular hypofunction, which showed only poor correlations between the SOT on the Equitest* and clinical balance measures.49-51 The results of the factor analysis support the hypothesis that posturography and clinical balance tests are 2 different constructs in the assessment of postural stability. They provide different but complementary information. Posturography can be considered as a processoriented assessment tool for evaluating the strategies used to control balance. The clinical balance tests are product-oriented tools for evaluating the result of the balance control. Therefore, we propose an assessment protocol for balance consisting of posturography and clinical balance tasks.

Are static and dynamic balance 2 different aspects of the assessment of balance? This study could not confirm this clinical categorization of static and dynamic balance. Balance is a multidimensional concept.3,52 Balance control does not rely on a single neural system, such as the vestibulospinal system. Different motor, sensory, and cognitive systems work together in a specific mode to achieve postural stability during a specific task. Task- and contextspecific requirements make each balance test unique. For that reason, balance or postural stability cannot be evaluated by a single test, and it can only be interpreted in relation to different tests used in an assessment.

The condition of standing on a foam cushion with eyes closed, which was the most sensitive condition of posturography for distinguishing between the 2 groups, showed higher correlations with the clinical balance tests than the other conditions of posturography in both groups. The study by Evans and Krebs50 showed similar findings with the SOT on the Equitest in adult patients, whereby the conditions on the moving platform, which disturbed the somatosensory information in a manner similar to that of the cushion, showed stronger correlations than the conditions on the fixed platform with static balance tests and with gait parameters. These findings suggest that standing still during more challenging tasks, such bipedal standing on a cushion with eyes closed, is more ecologically valid and, therefore, important to include in a posturography assessment. The postural sway velocity in a condition in which the visual and somatosensory information is disturbed better predicts functional performance because the central nervous system is challenged in a manner similar to that of the clinical balance tests, although this is not the case for the easier conditions.

Can postural sway predict functional performance in children? The measurement of postural sway velocity during standing on one leg by posturography (unilateral stance) and the measurement of time during standing on one leg (one-leg stance test) were only moderately associated. The correlation between the way the children controlled postural sway in one-leg standing and the length of time they retained this position was no better than -.52. Posturography gives additional information about how the task is controlled but does not allow the straightforward prediction of motor performance.

Overall, our results showed better association between posturography and clinical balance tests in the group of children with hearing impairments than in the group of children who were developing typically. This finding could be the result of a higher variability in the performance of the children with hearing impairments, but it also could be the result of a lack of challenge in the tests for the children who were developing typically. In the children with hearing impairments, tandem stance, as part of a posturography assessment, showed the highest correlations, but in the children who were developing typically, this condition showed the lowest correlations with the clinical balance tests and with the other conditions of posturography. Perhaps this task was not challenging enough for children who were developing typically. They do not focus on standing as still as possible because they know they are able to regain balance if necessary.

Conclusion

Two of 4 clinical balance tests and 4 of 6 conditions of the protocol for posturography were sensitive enough to distinguish significantly between children who were developing typically and children with hearing impairments. Although posturography and clinical balance tests reflect a common component, the 2 assessment tools measure different aspects of postural stability. Posturography can be considered a process-oriented assessment tool for evaluating the strategies used to control balance. The clinical balance tests are productoriented tools for evaluating the result of the balance control. They provide different but complementary information. Therefore, we propose an assessment protocol for balance consisting of posturography and clinical balance tasks. Static and dynamic balance abilities could not be differentiated and seem not to be a valid dichotomy. Balance performance should always be interpreted in relation to the specific tests used in the assessment.

Sidebar

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Footnote

* NeuroCom Inc, 9570 SE Lawnfield Rd, Clackamas, OR 97015.

[dagger] Advanced Mechanical Technology Inc, 176 Waltham St, Watertown, MA 02472-4800.

[double dagger] The Mathworks Inc, 3 Apple Dr, Natick, MA 01760-2098.

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[De Kegel A, Dhooge I, Peersman W, et al. Construct validity of the assessment of balance in children who are developing typically and in children with hearing impairments. Phys Ther. 2010;90:1783-1794.]

Mrs De Kegel, Mr Peersman, and Dr Van Waelvelde provided concept/idea/research design. Mrs De Kegel and Dr Van Waelvelde provided writing. Mrs De Kegel and Ms Baetens provided data collection. Mrs De Kegel, Mr Peersman, and Mr Rijckaert provided data analysis. Mrs De Kegel and Mr Peersman provided project management. Mrs De Kegel provided participants. Mrs De Kegel and Dr Cambier provided facilities/equipment. Dr Dhooge, Mr Peersman, Mr Rijckaert, Ms Baetens, Dr Cambier, and Dr Van Waelvelde provided consultation (including review of manuscript before submission).
The authors thank the children and their parents; "Henri Story," a center for child care during school holidays; and "KIDS," a therapeutic center for children with an audiogenic communicative impairment for their participation in the study. They also thank Tanneke Palmans for developing the MATLAB program.
The study was approved by the Ethical Committee of Ghent University Hospital.
This article was submitted March 3, 2010, and was accepted August 2, 2010.
DOI: 10.2522/ptj.20100080

Publication date: Dec 2010

Year: 2010

More than meets the eye: Revealing the complexities of K-12 interpreting

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Publication info: University of California, San Diego, ProQuest, UMI Dissertations Publishing, 2010. 3404359.
ProQuest document link

Abstract: Although many Deaf and hard of hearing children access education through interpreters, research on educational interpreters is scant and has focused on inadequacies of under-qualified interpreters rather than examining exactly what it is that qualified interpreters do. To determine the skills and knowledge interpreters need to work in K-12 schools, it is crucial to identify current practices of educational interpreters. For this research, three interpreters working in fifth and sixth grade classrooms at three school sites were videotaped and interviewed to explore what interpreters do in the course of their work, and to illuminate the factors that inform their decisions.

This study reveals not only five primary tasks that interpreters perform, but describes in detail what interpreters do as they strive to optimize visual access, to facilitate the learning of language and content, and to cultivate opportunities for participation. Data indicate that even qualified interpreters are not always well-equipped to meet the essential needs of Deaf and hard of hearing students in K-12 settings. Results of this study contribute to our understanding of the complexities of interpreters' decisions in light of multiple and competing demands. Findings highlight the need for further research and serve as a call to action to improve the educational experiences of mainstreamed students.

Publication date: 2010

Year: 2010
